National
Technical
Systems

1701 E. Plano Pkwy Suite 150
Plano, TX 75074
Tel: 972-509-2566
Fax: 972-509-0073

Electromagnetic Compatibility (EMC)
For
FUELING TECHNOLOGIES, INC.
MASTER COMPUTER

FCC PART 15, SUB-PART B, CLASS A and FCC PART 15.249, SUB-PART C

Prepared For: FUELING TECHNOLOGIES, INC.
13434 177th Place
Woodinville, WA 98072

Prepared By: National Technical Systems
1701E. Plano Parkway Suit 150
Plano, TX 75074

Issued: March 2002

Service For: FUELING TECHNOLOGIES, INC.

Purchase Order No.: 20020301 & 2001121701

This is to certify that the following report is true and correct to the best of my knowledge.

Dieu Vo, EMI Operations Supervisor FCC, CE, Telecommunication	Trudy Hester Quality Assurance Manager

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1.0 GENERAL INFORMATION

1.1 Product Description

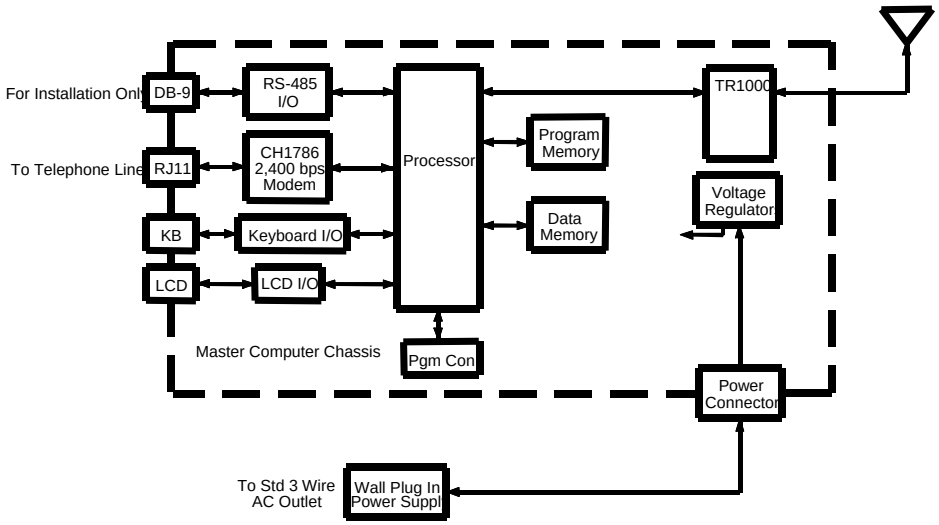
The Model 1000 LPG Tank Gauging System is composed of one or more Tank Units and a single Master Computer. One Master Computer can monitor as many as thirty tanks.

Master Computer

The Master Computer is composed of a main printed circuit board, a keyboard, and a liquid crystal display. The printed circuit board containing an ARM-7 processor, program memory (flash), non-volatile data memory, a keyboard interface, an interface to the liquid crystal display, a TR1000 RF transceiver, a serial programming link connection, a telephone line modem and its connection, an RS-485 interface for installation functions and a power supply. The Master Computer's power is furnished by a "wall plug in" power supply. The modem is a Cermetek CH 1786 2,400 bps modem. Figure 2-2 provides a diagram of the Master.

The Master Computer's function is to gather the information from the remote tanks, process and store that information together with date and time data, and pass the data for all the tanks to a host computer via the telephone line.

Figure 1.1. Master Computer Basic Block Diagram



The processor, an ARM-7, runs from external flash and data memory (non-volatile). The Master drives the Transceiver from which it receives remote data and by which it sends an acknowledgment and, occasionally, commands. The Master communicates with a

host site via the 2,400 bps modem using a standard public telephone network dial connection. It has an liquid crystal display (two lines by twenty characters) and a sixteen key keyboard by which an operator can read the stored results from each of the local tanks. The Master Computer keeps a minimum of twenty-four hours of tank readings as well as the calibration data for all the Tank Computers and load cells in its system. The unit is powered by a "wall plug in" DC output power supply that is regulated on the Master's circuit board. The RS-485 line is used for installation only.

The Tank Computer data received via the Transceiver consists of the address to which the data is sent (the Master), a preamble with a start character, the address of the sending unit, status, battery voltage, the load cell data, and temperature data along with a sixteen bit cyclic redundancy check. The data is Manchester encoded and on-off keyed. The Master acknowledges the receipt of the data and sends with it a command that may or may not change the "sleep time." Minimum sleep time is five minutes. Maximum sleep time is four hours.

A fifty ohms, permanently attached, external antenna is used.

1.2 Support Details

1.3 Instrument Calibration

All test instrumentation requiring calibration will be calibrated in accordance with ANSI Standard NCSL Z540-1. There will be a current calibration sticker attached to the item and traceability documentation will be provided at the customer's request.

1.3.1 Accuracy of Measurement

The expected accuracy of measurement shall be:

Frequency Accuracy: ± 2%
Amplitude Accuracy: ± 2 dB
Distance: ± 5%
Amplitude, Measurement System (includes measurement receivers, transducers, cables, etc): ± 3 dB
Time (waveforms): ± 5%

1.4 Ambient Tests

In the event that an out-of-tolerance interference condition arises, ambient measurements shall be made in the frequency range where out-of-tolerance condition is present. Ambient measurements shall be made with power applied to all equipment, with the exception of the system under test. This level shall be at least 6 dB below the specification limits of FCC Part 15.

1.5 Failure Reporting

In the event of a test item failure or a test anomaly, the following procedure will be followed:

1. The testing will be stopped.
2. The FUELING TECHNOLOGIES, INC. Program Manager or his designate will immediately be notified.
3. A Notice of Deviation (NOD) will be prepared.
4. The test item will be retained in the setup or in storage, as applicable, pending disposition from FUELING TECHNOLOGIES, INC..
5. Testing will be resumed only on instructions (written, if practicable) of FUELING TECHNOLOGIES, INC. to the project engineer or test engineer.

1.6 Threshold of Susceptibility

When susceptibility indications are noted in test sample operation, the threshold level shall be determined where the susceptible condition is no longer present. The threshold level shall be determined as follows:

1. When a susceptibility condition is detected, reduce the signal level until the test sample recovers.
2. Gradually increase the signal level until the susceptibility condition reoccurs. The resulting level is the threshold of susceptibility, and that level shall be recorded.

1.7 Test Program Deviation

Unless otherwise directed by the responsible test witness, the tests described in the table summary page of this document may be performed in any sequence.

In the event that test plan deviations are required during the normal qualification test program, they shall be made only upon approval of the cognizant representative and that approval shall be noted in the test log with a complete description and justification for such deviations.

1.8 Inspection

All tests described herein may have been witnessed by the authorized representative(s) of FUELING TECHNOLOGIES, INC.. All testing will be performed by qualified test engineers/personnel.

1.9 Disposition of Test Items

The test sample was returned to FUELING TECHNOLOGIES, INC. upon completion of the test program.

1.10 Test Facility

Measurements for this report were taken at **National Technical Systems, EMC Test Facility**, 1701 East Plano Parkway Suit 150, Plano Texas, USA. At the time of testing, the EMC facility had the following accreditations, registrations, etc.:

- Compliance with the requirements of ISO/IEC Guide 25: 1990 (E).
- Compliance with the requirements of ISO 9000: 1997 (E).
- Compliance with the requirements NVLAP, VCCI, BSMI.
- Compliance with the radiated and AC line conducted test site criteria in ANSI C63.4-1992 as required by the Federal Communications Commission (FCC).

The EMC chamber has been qualified as one having performance characteristics suitable for testing to the requirements of IEC 1000-4-3;95, and the Open Area Test Site (OATS) has been qualified as one having performance characteristics suitable for testing as per CISPR, Part 16, and ANSI C63.4-1992.

2.0 GENERAL TEST METHODOLOGY

2.1 Emissions

Required emissions testing is performed in accordance with the respective measurement procedures listed on page 1. Specifics such as test locations will be listed in the appropriate data sections of this report.

Conducted measurements are made with power supplied to the FUELING TECHNOLOGIES, INC.' MASTER COMPUTER through a 50Ω/50µh Line Impedance Stabilization Network (LISN); support equipment not part of the FUELING TECHNOLOGIES, INC.' MASTER COMPUTER will be powered through a similar but separate LISN. Typically, each of the FUELING TECHNOLOGIES, INC.' MASTER COMPUTER's input power leads will be scanned first with a peak detector. The highest peak amplitudes relative to the appropriate limits will be identified and remeasured using a quasipeak detector. At least six of all peaks closest to the respective limits will be recorded in this report. The conducted emissions test was performed using NTS' automatic EMI test equipment. This equipment utilized HP EMI measurement software running on an HP computer that interfaced directly with HPIB (IEEE) compatible instruments with graphical displays presented on the spectrum analyzer's CRT, with hard copies of the data generated by a plotter. The program automatically selects the range of test frequencies or band, and sets the specification line limits to be used during the test. This equipment/software allows for real-time data reduction and prints tabulated data on peak value or quasi-peak value measurements.

Radiated measurements are made at an open area test site (OATS) with an antenna to FUELING TECHNOLOGIES, INC.' MASTER COMPUTER distance of 3m or 10m, as appropriate. The actual test distance will be listed in the respective test data sections. The applicable frequency spectrum is searched with a calibrated antenna system for RF emissions approaching the appropriate limits. "Maximization" of each suspect frequency is accomplished by a combination of a 360° azimuth search and varying the antenna to ground plane height from 1m to 4m, in both the vertical and horizontal polarizations. Final data was collected in the worst case configurations of the FUELING TECHNOLOGIES, INC.' MASTER COMPUTER with the highest emission levels. The six highest emission readings and the corresponding frequencies are listed in Appendix A. If necessary, radiated emissions over 1 GHz are maximized after first "aiming" the horn antennas using the "bore sight" method.

Other emissions tests will be performed in accordance with the appropriate measurement procedures listed in this report.

2.1.1 Radiated Emissions Field Strength Calculations

FS = RA + AF + CF - AG where: FS = field strength CF = cable attenuation factor
RA = receiver amplitude AG = amplifier gain

The receiver used for radiated emissions measurements performed the field strength calculations automatically. The program has resident AF and CF figures for individual antennas and cables.

2.2 Order of Testing

Testing normally proceeds from the least volatile to the most. As an example for "global" requirements the sequence typically would begin with conducted emissions, then radiated prescans in the semi-anechoic chamber, then OATS radiated emissions measurements. The actual order may vary due to tests conducted, scheduling and facility availability.

2.3 Special Test Justification

None

3.0 TEST CONFIGURATION

3.1 Selection of FUELING TECHNOLOGIES, INC.' MASTER COMPUTER Configuration and Modes of Operation

As per measurement procedures, **the worst-case test configuration and mode of operation was used for all testing**. Unless otherwise noted elsewhere in this report, this selection will apply to all testing. The selection process was based on previous investigative testing of the FUELING TECHNOLOGIES, INC.' MASTER COMPUTER system.
Worst case operating mode is described as "Operate." Other modes used will be listed in the respective data measurement sections when appropriate. Operating modes considered were all those available to the operator, including Standby.

3.2 Equipment Modifications

None

4.0 TEST INSTRUMENTATION

Instrument	Mfr.	Model	NTS Control No.	Cal Due
RADIATED EMISSIONS				
HP Spectrum Analyzer	HP	8566B	E1128P	05/21/02
Quasi Peak Detector	HP	85650A	E1004P	08/15/02
Pre-Amp	HP	8447F	E1120P	12/03/02
Pre-Amp	HP	8449B	E1009P	04/07/02
Biconilog Antenna	Chase	CBL 6140	E1021P	10/10/02
Horn Antenna	Emco	3115	E1023P	03/07/02
LISN	Solar Electronics	8028-50TS 24 BNC	E1110P	01/20/02
LISN	Solar Electronics	8028-50TS 24 BNC	E1111P	01/20/02

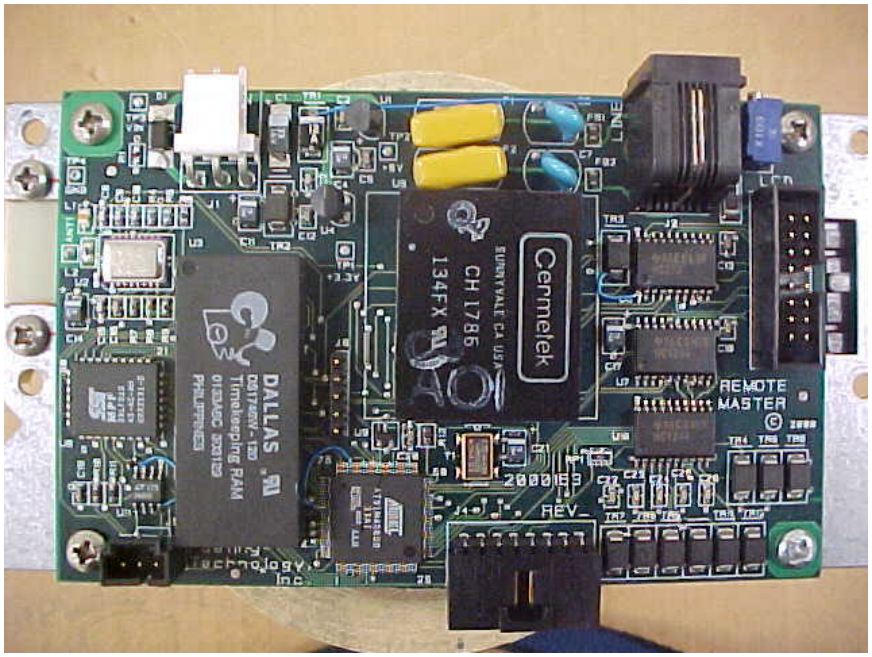
5.0 EMISSIONS

The test procedures of Paragraph 2.1 were followed for these measurements. Conducted measurements were made in shielded enclosures. Radiated final measurements were made at the OATS facility described in Paragraph 2.0. All readings are quasi-peak unless otherwise stated and are listed in order of ascending delta. The original test data is contained in Master Job Folder B2819, located at the National Technical Systems EMC Facility. Mode of operation is that listed under Paragraph 3.1, unless otherwise stated.

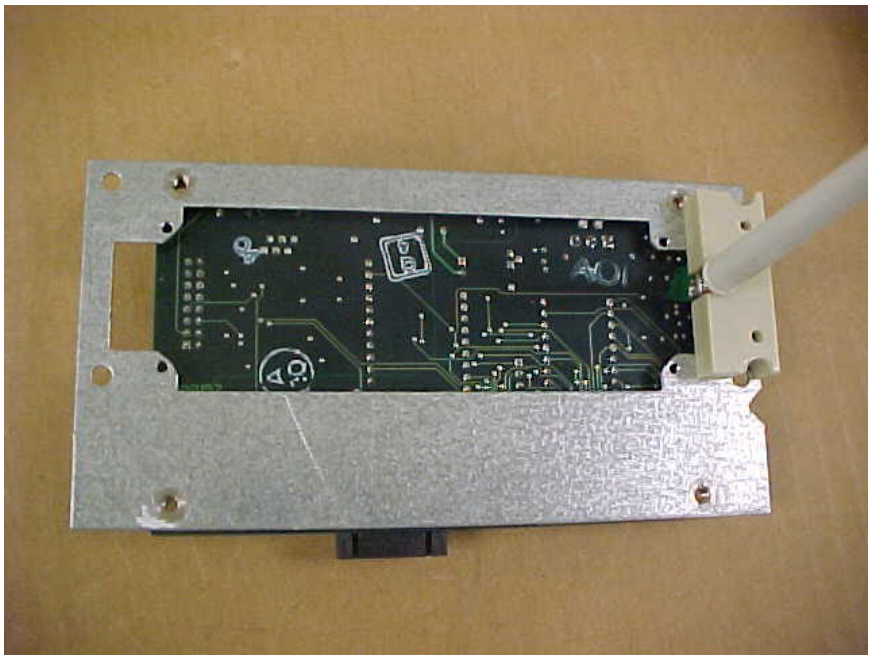
5.1 Radiated Emissions

5.1.1 Radiated Emissions Test Setup

Front View of Equipment Under Test

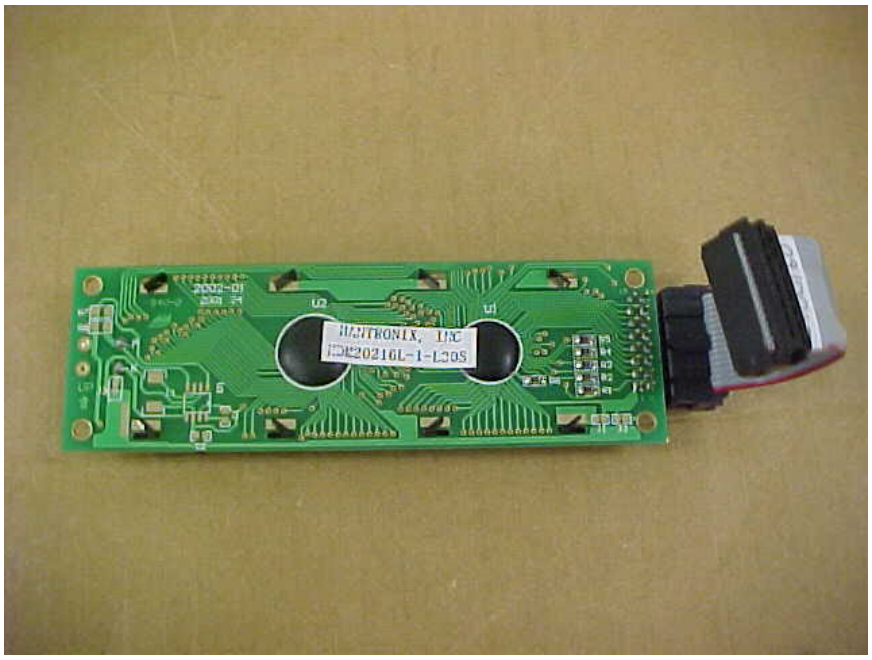


Close Look at the front EUT Model 1000152 Rev. A

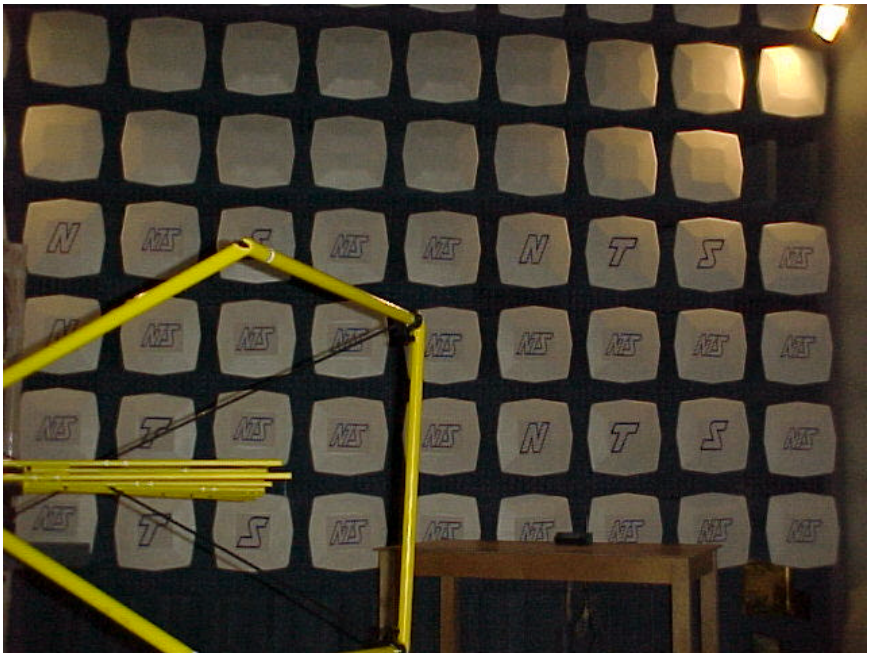


Close Look at the rear EUT Model 1000152 Rev. A

Close look at the Front Liquid Crystal Display Model NDM20216L-1-L30S



Close look at the Rear Liquid Crystal Display Model NDM20216L-1-L30S



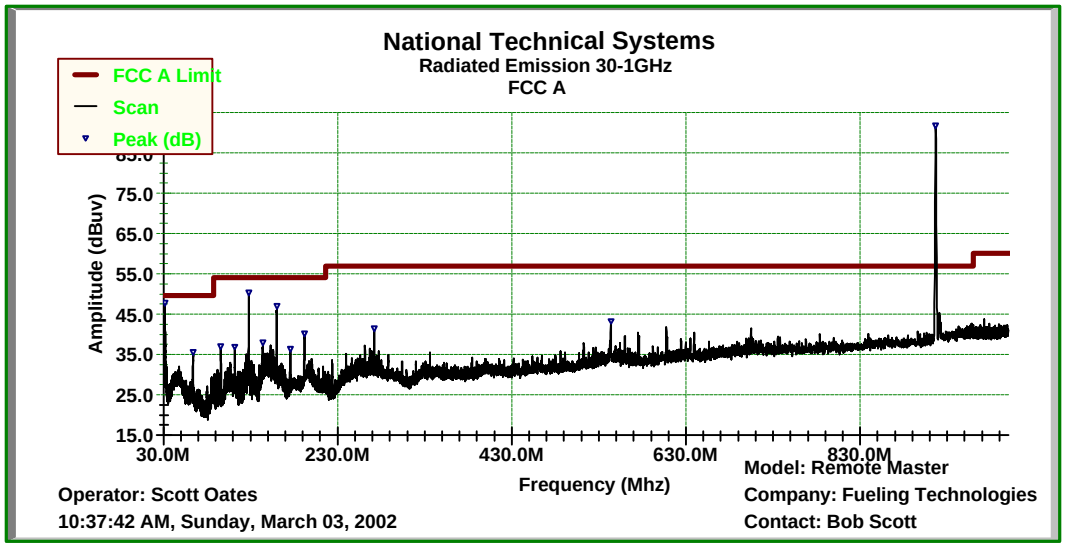
Radiated Emissions (FCC Chamber), Front of EUT 30-1000MHz

Radiated Emissions (FCC Chamber), Front of EUT 1-10GHz

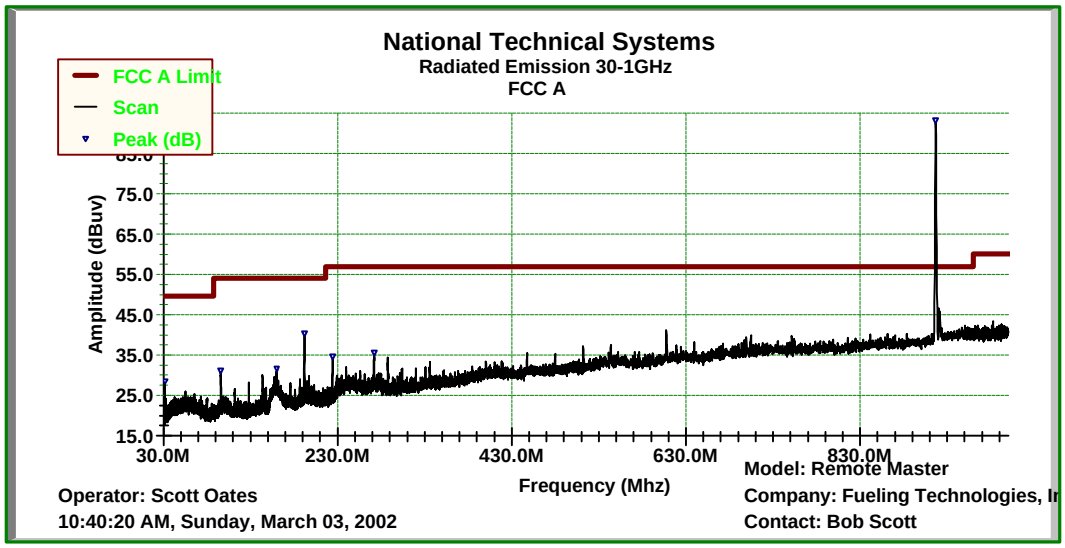
5.1.2 Radiated Measurement Data

Date of measurement: 03/03/02. Test Personnel: Scott Oates, EMC Technician
Radiated Emissions (FCC Class A prorate to 3m distance from antenna)

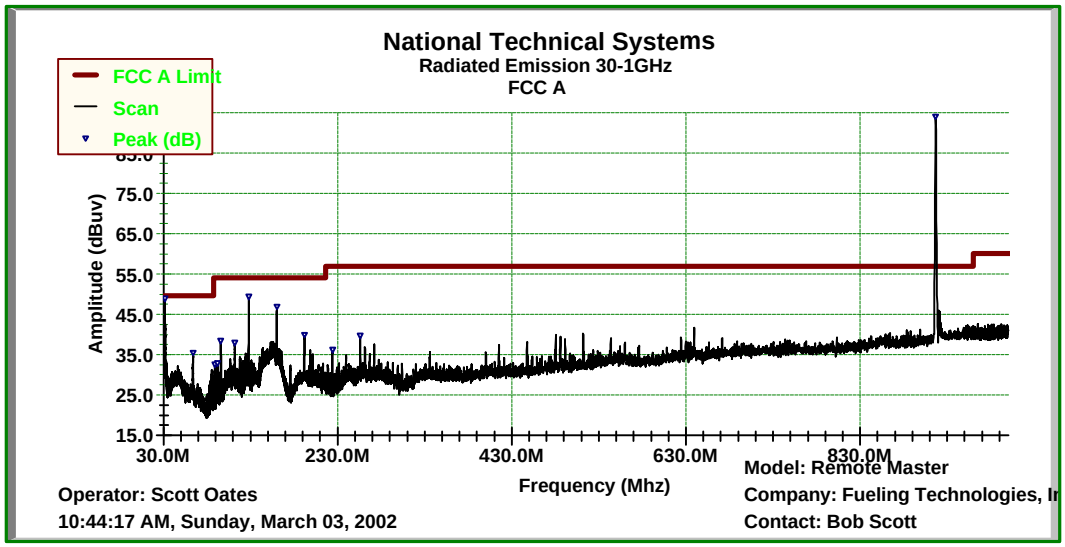
Frequency MHz	FCC-A 3M	Polarity	Peaks	QP	QP Margin	Turn Table	Tower Height
31.93 MHz	49.540	V	43.695	43.385	-6.155	170.000	1.000
31.942 MHz	49.540	H	27.499	27.209	-22.331	190.000	1.800
63.969 MHz	49.540	V	32.784	32.024	-17.516	110.000	1.000
95.965 MHz	53.980	H	31.449	31.012	-22.968	120.000	2.500
95.977 MHz	53.980	V	37.052	36.842	-17.138	125.000	2.000
127.97 MHz	53.980	V	45.239	44.959	-9.021	330.000	1.000
127.99 MHz	53.980	H	35.640	35.879	-18.101	110.000	2.000
159.97 MHz	53.980	H	34.950	34.370	-19.610	270.000	2.100
159.98 MHz	53.980	V	42.254	41.894	-12.086	0.000	1.000
271.97 MHz	56.900	H	36.548	35.768	-21.132	80.000	1.000
271.98 MHz	56.900	V	37.648	37.348	-19.552	30.000	1.000
916.58 MHz	56.900	H	90.996	91.097	34.197	225.000	1.000
916.59 MHz	56.900	V	95.597	95.206	38.306	140.000	1.000



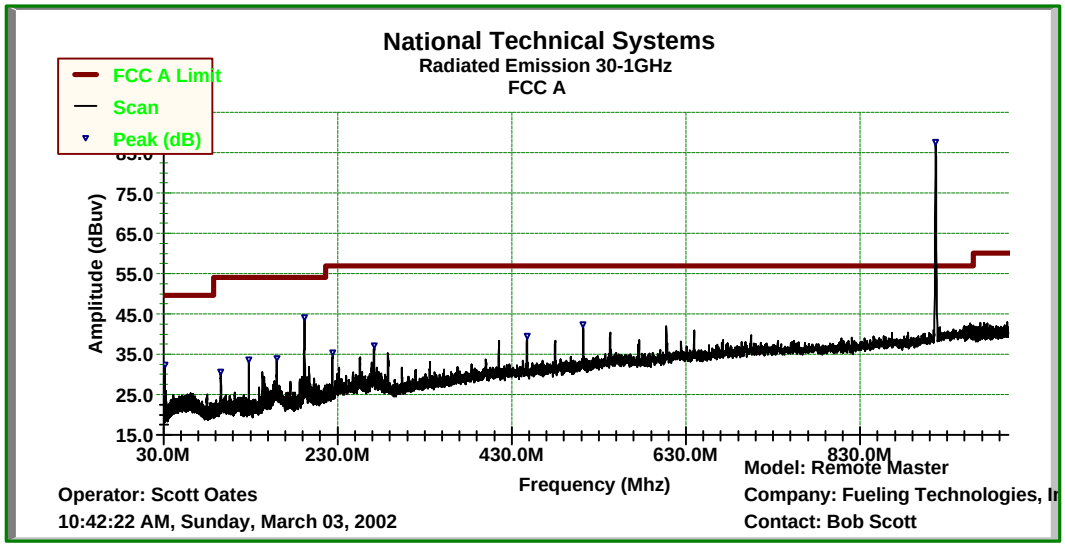
Radiated Emissions Pre-scan on FCC Chamber 30-1000MHz, Vertical Front



Radiated Emissions Pre-scan on FCC Chamber 30-1000MHz, Horizontal Front



Radiated Emissions Pre-scan on FCC Chamber 30-1000MHz, Vertical Rear



Radiated Emissions Pre-scan on FCC Chamber 30-1000MHz, Horizontal Rear

5.2 Radiated Measurement CFR 47 FCC part 15.249 Subpart C

Mode of Operation during emissions test:

Mode of operations during emissions test: The diagnostic mode of the MASTER COMPUTER was set to continuously transmit random data. Note that this mode represents the worst case where data transmissions can last for periods greater than 100mS. This diagnostic mode was added specifically to simplify FCC Subpart C compliance testing.

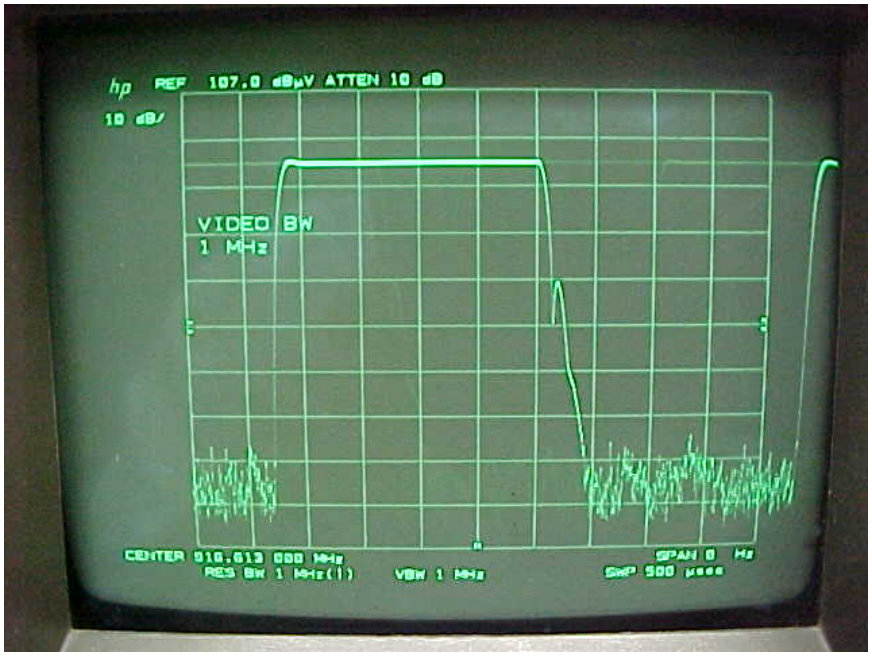
This transmission method employs Manchester data encoding with an On/Off Keying (OOK) modulation method at the frequency 916.5 MHz. Due to the nature of this method, the duty cycle of the transmission waveform is by definition 50%, corresponding to a peak correction factor of -6 dB. The frequency tolerance of the transmitter is +- 200 KHz. The nominal power output of the transmitter is 0.25 mW.

Test Result for FCC 15.249

The field strength was measured at 3 meters distance between Equipment under test and measurement antenna.

Radiated outside specific frequency band were met FCC part 15 subpart B class B and Spurious frequency per FCC part 15 subpart C requirement.

The maximum Radiated emission was scan from 30 Mhz to 9.2Ghz.



Intentional Radiator at 916.6MHz

Test requirement Field Strength of Emissions from Intentional Radiator

EUT name: FUELING TECHNOLOGIES, INC. MASTER COMPUTER.
Reference to FCC part 15 subpart C, 15.249.
The fundamental frequency tuned at 916.58.

Duty Cycle: 50 % (due to modulation method per manufacture information)

The table lists the fundamental and harmonic emissions frequencies. The site correction factor includes: cable loss, antenna factor, and pre-amplifier. All measurements were taken with 1 MHz RBW and 1 MHz VBW. All readings are peak with the specific bandwidth. The duty-cycle correction factor is not required, as all peak measurements are below the FCC limits.

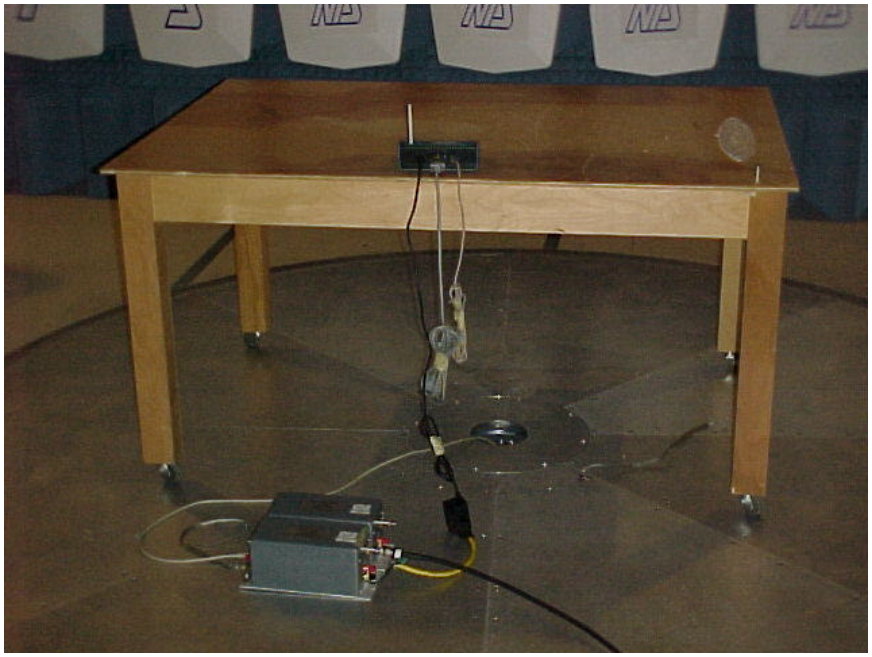
11:47:27 AM, Sunday, March 03, 2002 Company: FUELING TECHNOLOGIES, INC.
RE 1-10GHz Intentional Radiator in FCC Chamber

Frequency MHz	Bellcore A 3M	Polarity	Peaks	AVG	AVG Margin	Turn Table	Tower Height
1.8332 GHz	60.000	V	55.499	38.899	-21.101	210.000	1.300
1.8333 GHz	60.000	H	46.900	38.399	-21.601	125.000	1.300
2.7498 GHz	60.000	H	45.749	35.249	-24.751	120.000	1.300
2.7499 GHz	60.000	V	42.149	36.149	-23.851	0.000	1.200
3.6664 GHz	60.000	V	44.966	33.866	-26.134	210.000	1.200
3.6665 GHz	60.000	H	42.466	34.366	-25.634	0.000	1.200

No Signal was see after 4GHz

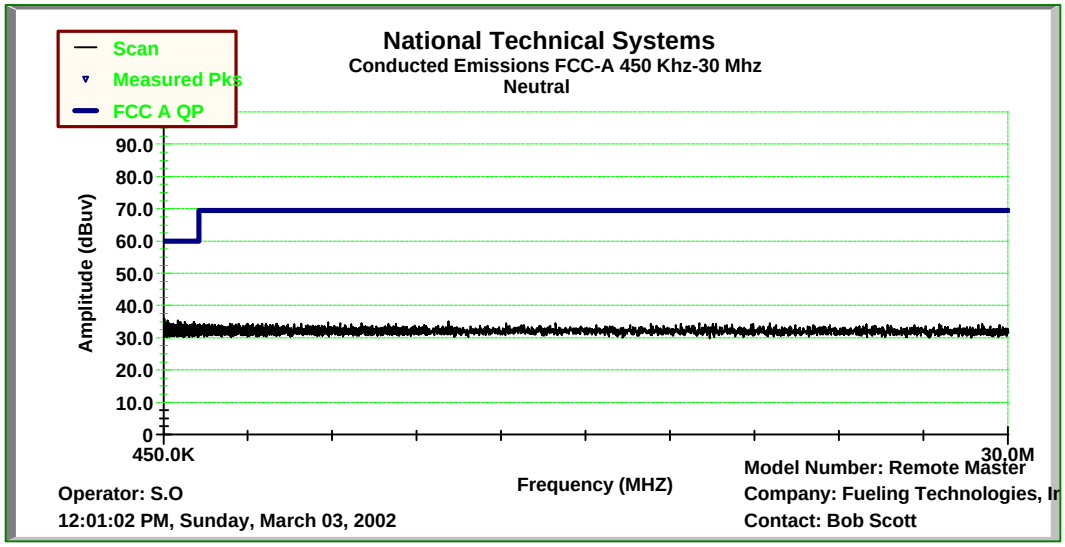
5.3 Conducted Emissions

5.3.1 Conducted Emissions Test Setup

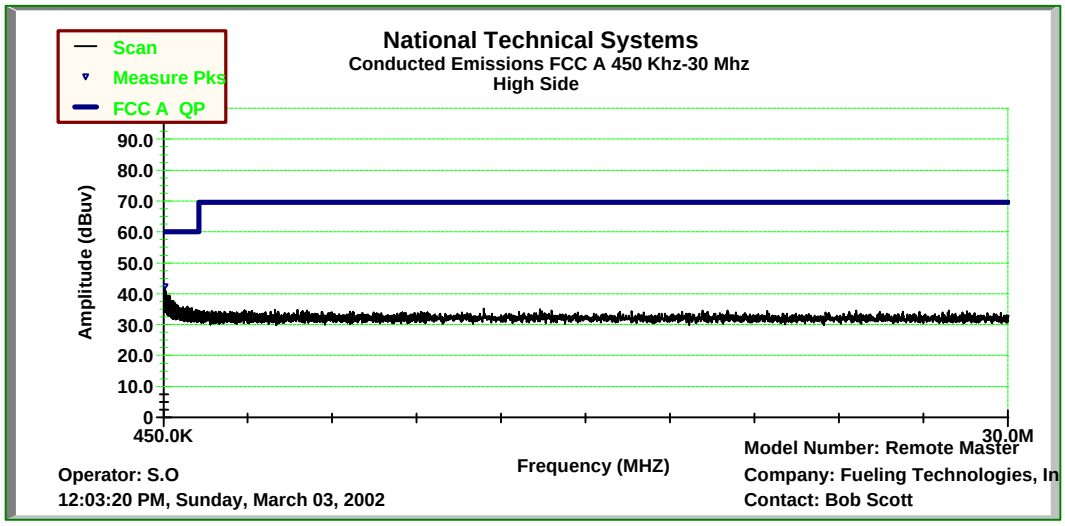


Conducted Test Setup for AC Power line

5.3.2 Conducted Emissions Test Results



Conducted Emission .45-30MHz on Neutral Line



Conducted Emission .45-30MHz on High Line

Note:

- The worst case configuration was selected to perform the emissions test.