Electromagnetic Compatibility Test Report

Prepared in accordance with

ANSI C63.4:2003 and RSS-GEN Issue 2

On

Real Time Mobile Interrogator

RTMI / 7S1900G001

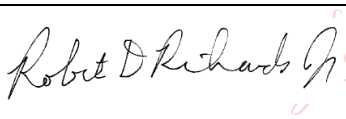
Elster Solutions
208 South Rogers Lane
Raleigh, NC 27610

Prepared by:

TUV Rheinland of North America, Inc.

Client:	Elster Solutions 208 South Rogers Lane Raleigh, NC 27610	Mark Holman 919-212-4899 / 919-250-5439 mark.holman@us.elster.com

Identification:	Real Time Mobile Interrogator	***Serial No.:***	ALPHA ONE
Test item:	RTMI / 7S1900G001	***Date tested:***	6 May 2010
Testing location:	TUV Rheinland of North America 762 Park Avenue Youngsville, NC 27596-9470 U.S.A.		Tel: (919) 554-3668 Fax: (919) 554-3542
Test specification:	Emissions: CFR 47 FCC Part 90 and RSS-119 Issue 10, FCC Part 90.203(j)(3) and RSS-119, 2, FCC Parts 90.205(h)(1), 2.985 and RSS-119, 5.4, FCC Part 90.207 and TRC-43 FCC Part 90.209(a) and RSS-119 5.5, FCC Part 90.209(b)(5) and RSS-119 5.5, FCC Part 2.997(a)(1) and RSS-GEN, FCC Parts 90.210(c), 2.991 and RSS-119, 4.2.1, FCC Part 90.210(c)(1), (2), (3), Part 2.993 and RSS-119, 5.8.2, FCC Parts 90.213, 2.995(a) and RSS-119,5.9, FCC Part 15B and RSS-GEN, 4.10		
Test Result	**The above product was found to be Compliant to the above test standard(s)**		

tested by: Mark Ryan	***reviewed by:*** Robert Richards
 25 May 2010 ***Signature***	 Digitally signed by Bob Richards Date: 2010.05.25 08:51:02 -04'00' 25 May 2010 ***Signature***
Other Aspects:	**None**

Abbreviations: OK, Pass, Compliant, Complies = passed
Fail, Not Compliant, Does Not Comply = failed
N/A = not applicable

FC	NVLAP	**Industry Canada**
90552 and 100881	**NVLAP Lab Code (200094-0)**	**IC-2932H**

TABLE OF CONTENTS

1 GENERAL INFORMATION 4

1.1 SCOPE 4
1.2 PURPOSE 4
1.3 SUMMARY OF TEST RESULTS 5

2 LABORATORY INFORMATION 6

2.1 ACCREDITATIONS AND ENDORSEMENTS 6
2.2 MEASUREMENT UNCERTAINTY EMISSIONS 7
2.3 CALIBRATION TRACEABILITY 8
2.4 MEASUREMENT EQUIPMENT USED 9

3 PRODUCT INFORMATION 10

3.1 PRODUCT DESCRIPTION 10
3.2 EQUIPMENT MODIFICATIONS 10
3.3 PURPOSE OF THIS TEST REPORT 10

4 EMISSIONS 12

4.1 CERTIFICATION REQUIRED - FCC PART 90.203(J)(3) AND RSS-119, 2 12
4.2 MODULATION REQUIREMENTS AND CHARACTERISTICS 15
4.3 RF POWER OUTPUT 18
4.4 TYPE OF EMISSIONS – EMISSION DESIGNATOR 20
4.5 BANDWIDTH LIMITATIONS 20
4.6 STANDARD CHANNEL SPACING AND BANDWIDTH 20
4.7 FREQUENCY SPECTRUM TO BE INVESTIGATED 20
4.8 SPURIOUS RADIATION 21
4.9 EMISSION MASK C: 22
4.10 FREQUENCY STABILITY FUNCTION OF THE TEMPERATURE 32
4.11 FREQUENCY STABILITY FUNCTION OF PRIMARY SUPPLY VOLTAGE 32
4.12 TRANSIENT FREQUENCY BEHAVIOR 33
4.13 RECEIVER / CABINET EMISSIONS 37

APPENDIX A 42

5 TEST PLAN 42

5.1 GENERAL INFORMATION 42
5.2 EQUIPMENT UNDER TEST (EUT) DESCRIPTION 43
5.3 EUT ELECTRICAL POWERED INFORMATION 44
5.4 EUT MODES OF OPERATION 44
5.5 TECHNICAL INFORMATION 45
5.6 EUT CONFIGURATION 46

1 General Information

1.1 Scope

This report is intended to document the status of conformance with the requirements of the ANSI C63.4:2003 and RSS-GEN Issue 2 based on the results of testing performed on 6 May 2010 on the Real Time Mobile Interrogator, Model No. RTMI / 7S1900G001, manufactured by Elster Solutions. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT (Equipment Under Test) in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report.

1.3 *Summary of Test Results*

Applicant	Elster Solutions 208 South Rogers Lane Raleigh, NC 27610	**Tel**	919-212-4899	**Contact**	Mark Holman
		Fax	919-250-5439	**e-mail**	mark.holman@us.elster.com

Description	Real Time Mobile Interrogator	**Model Number**	RTMI / 7S1900G001
Serial Number	ALPHA ONE	**Test Voltage/Freq.**	12 VDC
Test Date Completed:	6 May 2010	**Test Engineer**	Mark Ryan

Standards	Description	Severity Level or Limit	Criteria	Test Result
CFR 47 FCC Part 90 and RSS-119 Issue 10	Private Land Mobile Radio Services. FCC Scope B2 and IC TYPE I Equipment	See called out basic standards below including references to FCC Part 2 and RSS-GEN.	See Below	**Complies**
FCC Part 90.203(j)(3) and RSS-119, 2	Certification Required	Greater than 500 mW,	Limit	Complies
FCC Parts 90.215(c), 2.987 and RSS-119, 5.4	Modulation Requirements and Charactertistics	Per the standards	Limit	Complies
FCC Parts 90.205(h)(1), 2.985 and RSS-119, 5.4	RF Output power	Greater than 2 Watts	Limit	Complies
FCC Part 90.207 and TRC-43	Type of Emissions – Emission Designator	Emissions Designator	A3D	Complies
FCC Part 90.209(a) and RSS-119 5.5	Bandwidth Limitations	Desgination of Bandwidth Limitation:	6K00	Complies
FCC Part 90.209(b)(5) and RSS-119 5.5	Standard Channel Spacing and Bandwidth	Channel Spacing - 6.25 kHz, Authorized Bandwidth: 11.25 kHz	NA	Complies
FCC Part 2.997(a)(1) and RSS-GEN	Frequency Spectrum to be Investigated	150 kHz to 5 GHz	Limit	Complies
FCC Parts 90.210(c), 2.991 and RSS-119, 4.2.1	Spurious Emissions	Emissions Mask C (see below)	Limit	Complies
FCC Part 90.210(c)(1), (2), (3), Part 2.993 and RSS-119, 5.8.2	For transmitters not equipped with an audio low-pass filter	Emissions Mask C used	Limit	Complies
FCC Parts 90.213, 2.995(a) and RSS-119,5.9	Frequency Stability Function of the Temperature	For transmitters over 2 Watts	5 ppm	Complies
FCC Part 2.995(d)(2) and RSS-119, 5.4	Frequency Stability Function of Primary Supply Voltage	Battery Operated only (mobile)	Limit	Complies
FCC Part 90.214 and RSS-119, 5.9	Transient Frequency Behavior	Function of Time t_1 = t_2 = t_3 =	 ±25.0kHz ±12.5 kHz ±25.0 kHz	Complies
FCC Part 15B and RSS-GEN, 4.10	Receiver / Cabinet emissions	Class A, 30 MHz - 5 GHz (battery operated only, no conducted emisions)	Limit	Complies

2 Laboratory Information

2.1 Accreditations and Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland of North America located at 762 Park Avenue, Youngsville, NC 27596-9470 is accredited by the commission for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Registration No 90552 and 100881). The laboratory scope of accreditation includes: Title 47 CFR Part 15, and 18. The accreditation is updated every 3 years.

2.1.2 NIST / NVLAP

Program, which is administered under the auspices of the National Institute of Standards and Technology. The laboratory has been assessed and accredited in accordance with ISO Standard 17025:2005 (Lab code: 200094-0). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Industry Canada

Registration No.: IC-2932H The OATS has been accepted by Industry Canada to perform testing to 3 and to 10m, based on the test procedures described in ANSI C63.4-2009.

2.1.4 Japan – VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland at the 762 Park Ave. Youngsville, N.C 27596 address has been assessed and approved in accordance with the Regulations for Voluntary Control Measures. (Registration No. R-1174, R-1679, C-1790 and C-1791).

2.1.5 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

25 dBuV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBuV/m

2.2 Measurement Uncertainty Emissions

	U_{lab}	U_{cispr}
Radiated Disturbance @ 10m		
30 MHz – 1,000 MHz	3.3 dB	5.2 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	1.18 dB	3.6 dB
Disturbance Power		
30 MHz – 300 MHz	3.88 dB	4.5 dB

Measurement Uncertainty Immunity

The estimated combined standard uncertainty for harmonic current and flicker measurements is ± 2.5 %
The estimated combined standard uncertainty for ESD immunity measurements is 4.10 %
The estimated combined standard uncertainty for radiated immunity measurements is ± 2.05 dB
The estimated combined standard uncertainty for EFT fast transient immunity measurements is ± 2.92 %
The estimated combined standard uncertainty for surge immunity measurements is ± 2.92 %
The estimated combined standard uncertainty for conducted immunity measurements is ± 1.83
The estimated combined standard uncertainty for power frequency magnetic field immunity measurements is ± 5.8 %
The estimated combined standard uncertainty for voltage variation and interruption measurements is ± 1.74 %

The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

2.3 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005. Equipment calibration records are kept on file at the test facility.

2.4 Measurement Equipment Used

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal dd/mm/yy	Next Cal dd/mm/yy
Radiated and Conducted RF Emissions (5 Meter Chamber)					
Amplifier, preamp	Agilent Technologies	8449B	3008A01480	23-Jan-09	23-Jan-10
Antenna Horn 1-18GHz	EMCO	3115	5770	16-Jun-08	16-Jun-10
Receiver, EMI	Rohde & Schwarz	ESIB40	100043	29-Jun-09	29-Jun-10
Spectrum Analyzer	Agilent Tec.	E7405A	US39440157	04-Dec-09	04-Dec-10
Cable, Coax	Andrew	FSJ1-50A	003	14-Dec-09	14-Dec-10
Cable, Coax	Andrew	FSJ1-50A	030	14-Dec-09	14-Dec-10
Cable, Coax	Andrew	FSJ1-50A	045	14-Dec-09	14-Dec-10
Cable, Coax	Andrew	FSJ1-50A	049	14-Dec-09	14-Dec-10
1.5 GHz High Pass Filter	Bonn Electronik	BHF 1500	025155	26-Jan-09	26-Jan-10
Conducted Emissions (AC/DC and Signal I/O)					
LISN 15-18 (NSLK 8126)	Schwarzbeck Mess-Electronik	NSLK 8126	003885	02-Feb-09	02-Feb-10
Transient Limiter	Schaffner	CFL-9206	1649	09-Dec-09	09-Dec-10
Transient Limiter	Schaffner	CFL-9206	1630	10-Dec-09	10-Dec-10
Receiver, EMI	Rohde & Schwarz	ESH3	860905/005	24-Aug-09	24-Aug-10
Spectrum Analyzer	Agilent Tec.	E7405A	US39440157	04-Dec-09	04-Dec-10
Spectrum Analyzer	Agilent Tec.	E7405A	US39440161	26-May-09	26-May-10
Cable, Coax	Pasternack	RG-223	051	09-Dec-09	09-Dec-10
General Laboratory Equipment					
Meter, Temp/Humid/Barom	Fisher	02-400	01	28--Dec-09	28--Dec-10
Meter, Temp/Humidity	Dickson Company	TH550	6215304	19-Mar-09	19-Mar-11
Attenuator	Pasternack	PE7015-20	NA	22-Jan-09	22-Jan-10

3 Product Information

3.1 Product Description

3.1.1 General Characteristics

Supply Voltage 13.8V ± 20% (11.0 – 16.6 VDC)
Modulation Type AM, DSB-LC
Signal modulating the carrier 1778 Hz or 2778 Hz at 90% modulation typical sine wave
Operating Temperature –20 to +60°C
Weight ~ 65 lbs.
Antenna connector type RX: BNC; TX: N

3.1.2 Transmitter Characteristics

Frequency Range 450 - 460 MHz
Channel Spacing 25 kHz
RF Output Power 5 W @ 13.8 VDC'
Frequency Stability 2.5ppm
LO, IF, XTAL frequencies 166.4 MHz, 616.4 MHz – 626.4 MHz; 12.8 MHz TCXO
Data rate 2778 Hz

Refer to the test plan in appendix A of this test report for more details.

3.2 Equipment Modifications

A ferrite was added to the receive antenna coax near the EUT's receiver connector.

3.3 Purpose of this Test Report

This test report is intended to be used for a Class II Permissive Change for an already approved device having the FCC ID number: G8JMMIO1. The change is replacing the original multi-board controller system (which is now obsolete) with a new single board computer. Including the two previous Class 2 Permissive changes, no other modifications were made from the original application.

The original apparatus was comprised of the following computational modules: SCSI, VM30, VSBC4, VMOD-2, PB-ADC3 and PB-DIO. These modules are now obsolete and have been replaced in the RTMI with the Hercules II SBC (single board computer).

This test report is also intended to be used for a new application with Industry Canada. Therefore this test report will include some of the original test data found in the original FCC application for sections where the computer update will not have any effect of the intentional RF emissions.

The EUT product information, test configuration, mode of operation, test types, test procedures, test levels, pass/failure criteria, in this report were carried out per the product test plan located in appendix A of this report

3.3.1 RELATED SUBMITTAL(S)/GRANT(S)

This apparatus was originally certified by the FCC, on 03/26/1999. Reference FCCID: G8JMMIO1

On 04/03/2002, this device was granted a Class 2 Permissive Change by the FCC to correct the emission designator from 85K6A1D as originally granted, to 6K00A3D.

On 07/26/2004, this device was granted a Class 2 Permissive Change by the FCC:
The original device's enclosure (PN-52860PO08) had become obsolete by the supplier. A new enclosure (PN-52860P200) had to be selected to house the original circuitry and PCB's (printed circuit board assemblies). The original device's schematics have not changed, the new enclosure necessitated length and routing changes to the device's wiring. The original device's operational description, block diagrams, antenna information, tune-up / alignment procedures, and user manual remain unchanged. The parts list has changed to reflect the new enclosure and the necessary revisions of the wiring diagram.

4 Emissions

4.1 Certification Required - FCC Part 90.203(j)(3) and RSS-119, 2

Applications for part 90 certification of transmitters designed to operate on frequencies in the 421–512 MHz band, received on or after February 14, 1997 must include a certification that the equipment meets a spectrum efficiency standard of one voice channel per 12.5 kHz of channel bandwidth. Additionally, if the equipment is capable of transmitting data, has transmitter output power greater than 500 mW, and has a channel bandwidth of more than 6.25 kHz, the equipment must be capable of supporting a minimum data rate of 4800 bits per second per 6.25 kHz of channel bandwidth.

4.1.1 Method of Measurement

The transmitter antenna output port is connected to an EMI receiver/Spectrum analyzer featuring a demodulation output port. This port is then connected to a digital oscilloscope. The transmitter was set to the High Data Rate mode.

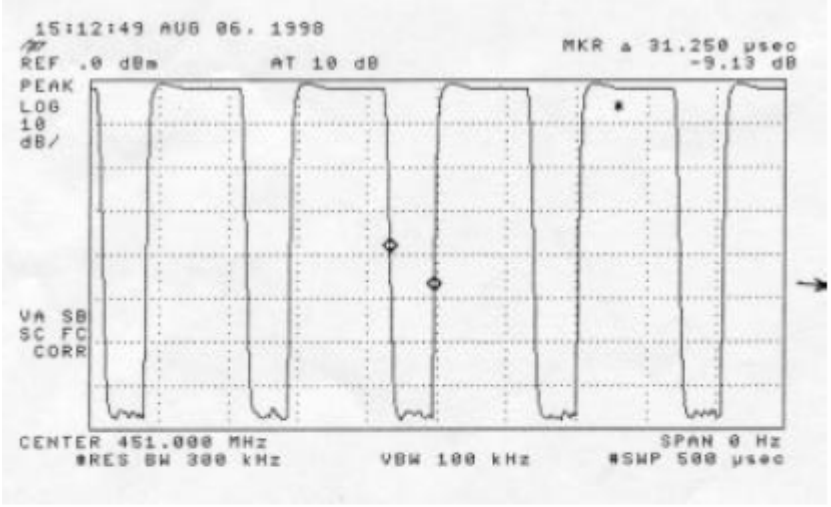
Note: It was determined that the modifications will not effect this measurement. Therefore, this test data was taken from the original test report as submitted to the FCC.

4.1.2 Test Results

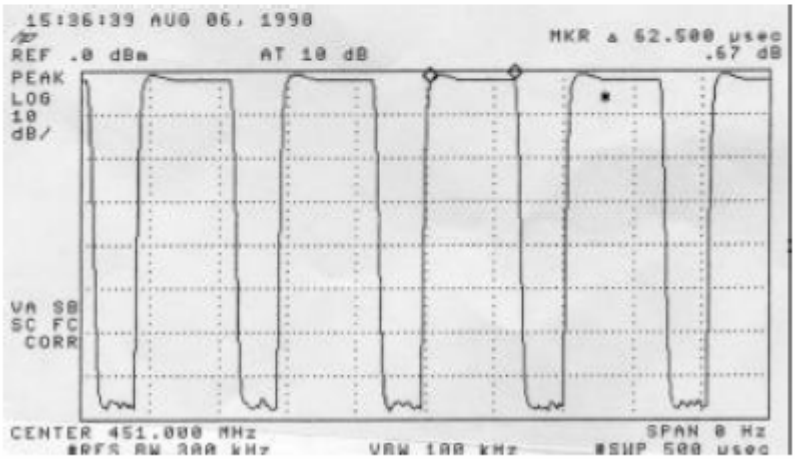
The equipment, Mini-Mobile Interrogator from Elster Integrated, meets a spectrum efficiency standard of 12.5 kHz of channel bandwidth. The equipment was capable of supporting a minimum data rate of 4800 bits per second per 6.25kHz of bandwidth, that is 19.2 Kbits/s. See measurement plots, below.

4.1.3 Test Data

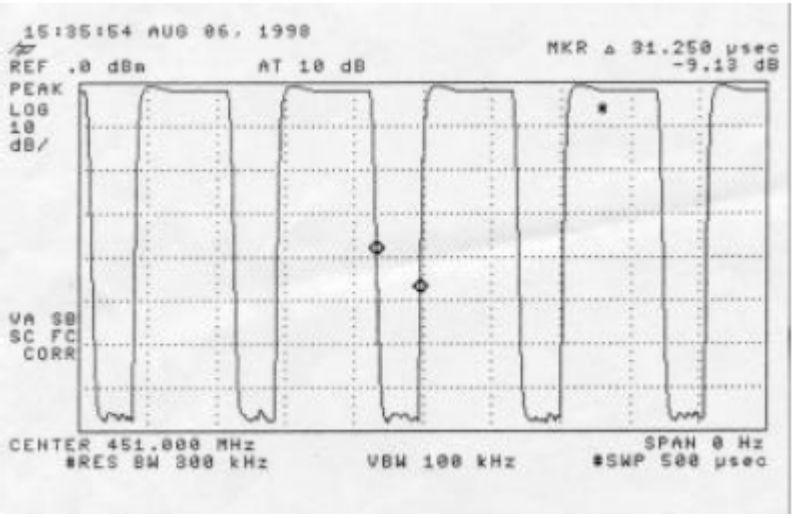
MEASUREMENT PLOTS; FCC PART 90.203(j)(3)



31 µ sec BIT period = 32.2 kHz data rate



62.5 µ sec BIT period = 16.0 kHz data rate



Avg. data rate = 2 / [(31 + 62.5) µ sec] = 21.4 kHz

MEASUREMENT PLOTS; FCC PART 90.203(j)(3)

4.2 Modulation Requirements and Characteristics

Per FCC Parts 90.215(c), 2.987 and RSS-119, 5.4

The Mini-Mobile Interrogator maximum output power is more than 2 watts.
The transmitter utilizes digital emissions without and audio-low pass filter. Therefore, it was tested using the modulating signal as specified by Part 2.

4.2.1 Test Procedure

The transmitter antenna output port is connected to an Hewlett Packard EMI/spectrum receiver analyzer Incorporating a demodulation output port.

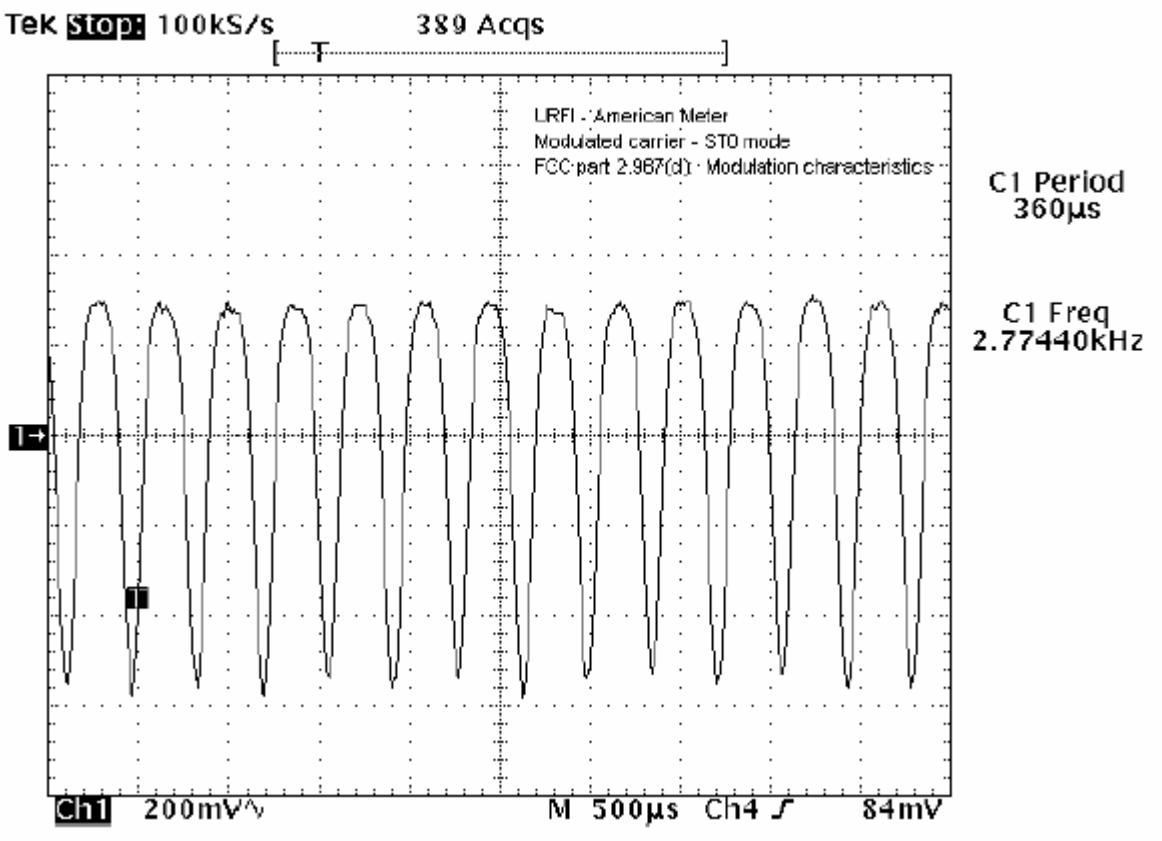
Note: It was determined that the modifications will not effect this measurement. Therefore, this test data was taken from the original test report submitted to the FCC.

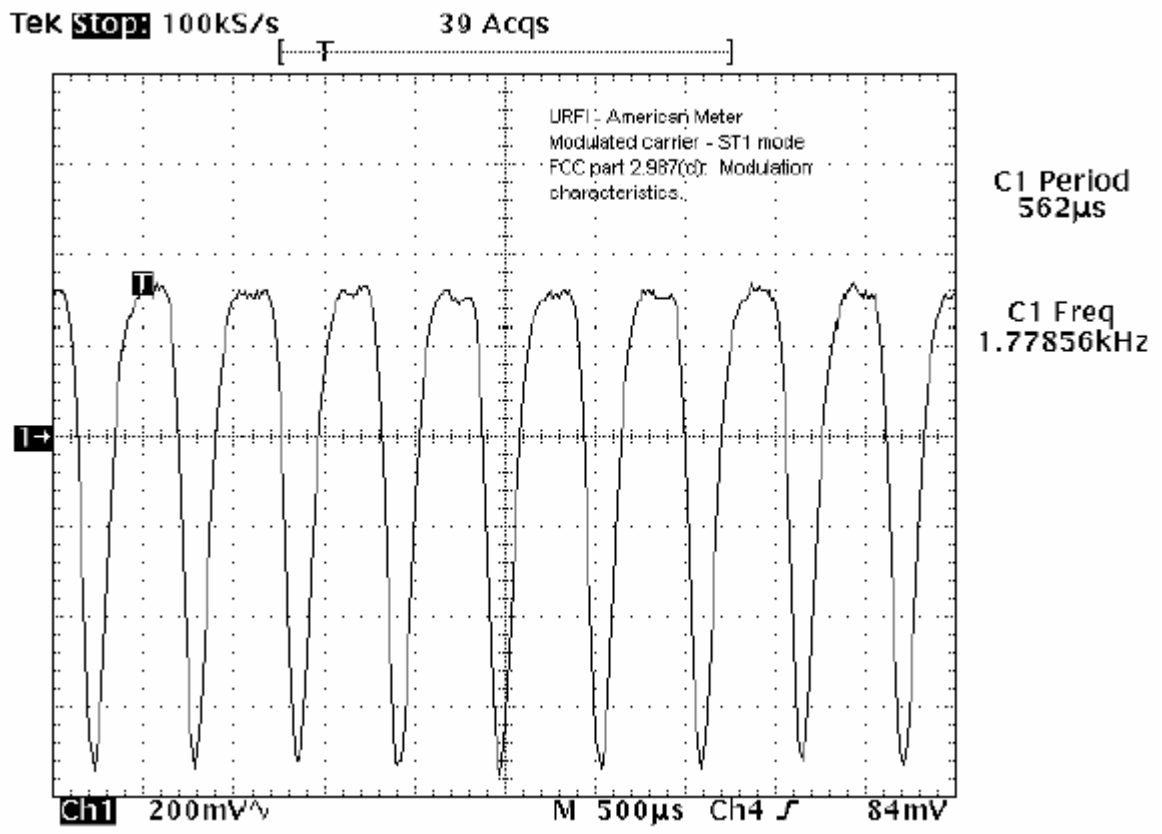
4.2.2 Test Results

The measurement plots show that the equipment meets the modulation requirements of the rules under which the equipment is to be licensed. TXALL1's (1778Hz modulating tone), TXALL0's (2778Hz modulating tone), and default (containing both highs and lows). The following transmission modes are representative of the transmitter intended use. These transmissions feature a continuous stream of data.

4.2.3 Test Data

MEASUREMENT PLOTS PART 2.987





. PART 90.211(C) AND PART 2.987: MODULATION REQUIREMENTS AND CHARACTERISTICS

4.3 RF Power Output

RF Power Output (ERP) and antenna height limits: 450-460 MHz band

4.3.1 Test Over View

Results	**Complies** (as tested per this report)					**Date**	4 May 2010
Standard	FCC Parts 90.205(h)(1), 2.985 and RSS-119, 5.4						
Product Model	RTMI / 7S1900G001			**Serial#**	ALPHA ONE		
EUT Powered By	12 VDC	**Temp**	73ºF	**Humidity**	34%	**Pressure**	1005 mbar
Mod to EUT	None		**Test Performed By**		Mark Ryan		

4.3.2 Test Procedure

The maximum allowable effective radiated power (ERP) is dependent upon the station's antenna HAAT and required service area and is authorized with the following table:

Service area radius (km)	8
Maximum ERP (w) (1)	100
Up to reference HAAT (m) (2)	15

(1) Maximum ERP indicated provides for a 39dBu signal strength at the edge of the service area per FCC Report R-6602, Fig. 29 (See 73.699, Fig. 10 b).
(2) When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation: ERPallow=ERPmax x (HAATref/HAATactual)2.

4.3.3 Method of Measurement

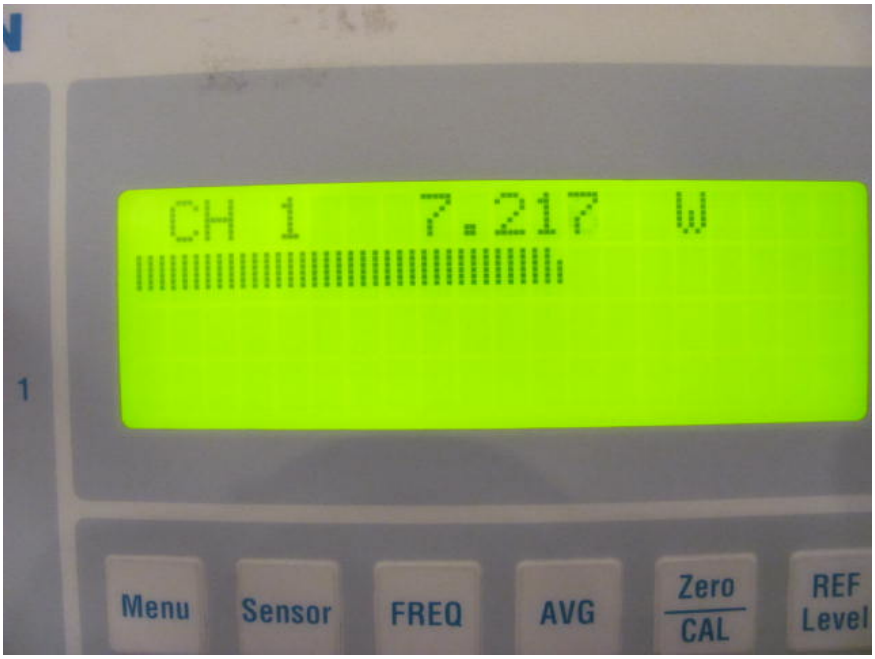
The EUT could not be commanded to CW mode, therefore the peak measurements was made using a Boonton power meter and a Bird Thru-line watt meter was used to measure the rms power output.

4.3.4 Test results

Termination	Level (dBuV)	Output Power (W) (modulated)	
50 ohm	140.5	7.22 (peak)	5.00 (rms)

Note: This Power level will allow an antenna with up to 11 dB gain to be employed.

4.3.5 Test Data



Peak power measurement using a Boonton Power Meter

Power (rms) reading on a Bird Watt Meter

4.4 Type of Emissions – Emission Designator

Per FCC Part 90.207 and TRC-43

The first symbol indicates the type of modulation on the transmitter carrier. The second symbol indicates the type of signal modulating the transmitter carrier. The third symbol indicates the type of transmitted information.

Designator for the Mini-Mobile Interrogator: **A3D**, as noted in the Class 2 Permissive Change as certified by the FCC on 04/03/2002.

4.5 Bandwidth Limitations

Per FCC Part 90.209(a) and RSS-119 5.5
The Bandwidth of this apparatus is 6 kHz or 6K00, as noted in the Class 2 Permissive Change as certified on 04/03/2002.

4.6 Standard Channel Spacing and Bandwidth

Per FCC Part 90.209(b)(5) and RSS-119 5.5 as originally certified.

Frequency (MHz)	Channel spacing (kHz)	Authorized bandwidth (kHz)
451.350 (2)	6.25 (1)	20 (1) (3)

(1) For stations authorized on or after August 18, 1995.
(2) Bandwidths for radiolocation stations in the 420-450MHz band and for stations operating in bands subject to this footnote will be reviewed and authorized on a case-by case basis.
(3) Operations using equipment designed to operate with a 25kHz channel bandwidth will be authorized a 20kHz bandwidth. Operations using equipment designed to operate with a 12.5 kHz channel bandwidth will be authorized a 11.25kHz bandwidth. Operations using equipment designed to operate with a 6.25kHz channel bandwidth will be authorized a 6kHz bandwidth.

4.7 Frequency Spectrum to be investigated

Per FCC Part 2.997(a)(1) and RSS-GEN

(a) In all of the measurements set forth in 2.991 and 2.993, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:

(1) If the equipment operates below 10GHz: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

The device under test was investigated from 150 kHz to 5 GHz.

4.8 Spurious Radiation

Per FCC Parts 90.210(c), 2.991 and RSS-119, 4.2.1

Emission masks and spurious emissions at antenna terminal used to verify occupied bandwidth.

4.8.1 Test Procedure

The transmitter was properly loaded with a 50 Ohm termination and operated under normal condition in its intended use. That is the maximum rated conditions under which the equipment will be operated.

For measuring emissions up to and including 50kHz from the edge of the authorized bandwidth, the resolution bandwidth was adjusted to 100Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps was measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must no be less than the instrument resolution bandwidth. For frequencies more that 50kHz removed from the edge of the authorized bandwidth a resolution of at least 10 kHz was used for frequencies below 1000 MHz. Above 1000 MHz the resolution bandwidth of the instrumentation was at least 1 MHz.

Applicable emission mask for equipment designed to operate with a 25 kHz channel bandwidth:

Frequency (MHz)	Mask for equipment without audio low pass filter
450.0 – 460.0	C

4.9 Emission Mask C:

Per FCC Part 90.210(c)(1), (2), (3), Part 2.993 and RSS-119, 5.8.2
This Emissions Mask is for use with transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P)

Frequency range (kHz) Displacement frequency	Reference unmodulated output level (dBuV/W)	Formula	Attenuation (dB) from reference level
Fo + 5 < Fd < Fo + 10 Fo - 10 < Fd < Fo – 5	130.3/0.2138	83 Log (Fd/5)	0 < Att. < 25
Fo + 10 < Fd < Fo + 24.1* Fo - 24.1*< Fd < Fo – 10	130.3/0.2138	29 Log (Fd^2/11)	27.8 < Att. < 50
Fo + 24.1 < Fd < Fo + 62.5** Fo - 62.5 < Fd < Fo - 24.1	130.3/0.2138	50	50
Fo + 62.5 < Fd < 5GHz 9 < Fd < Fo - 62.5	130.3/0.2138	43 + 10 Log P	51.7

Notes:
Measurements of emission power are expressed with the same parameters used to specify the un-modulated transmitter carrier power.

*: The condition 29 Log (Fd^2/11) or 50 dB whichever is the lesser attenuation give the common frequency point of 24.1 kHz
**: 250% of 25 kHz (authorized Bandwidth) = 62.5 kHz
Fo: Carrier fundamental frequency (MHz)
Fd: Displacement frequency
P: Output Power in Watt (Un-modulated)
Figure 9 to figure 17, section 5.3, demonstrate compliance with the emission mask C.

4.9.1 Test Over View

Results	**Complies** (as tested per this report)			**Date**	05 MAY 2010		
Standard	FCC Part 90.210(c)(1), (2), (3), Part 2.993 and RSS-119, 5.8.2						
Product Model	RTMI / 7S1900G001			**Serial#**	ALPHA ONE		
EUT Powered By	12 VDC	**Temp**	72°F	**Humidity**	32%	**Pressure**	1001 mbar

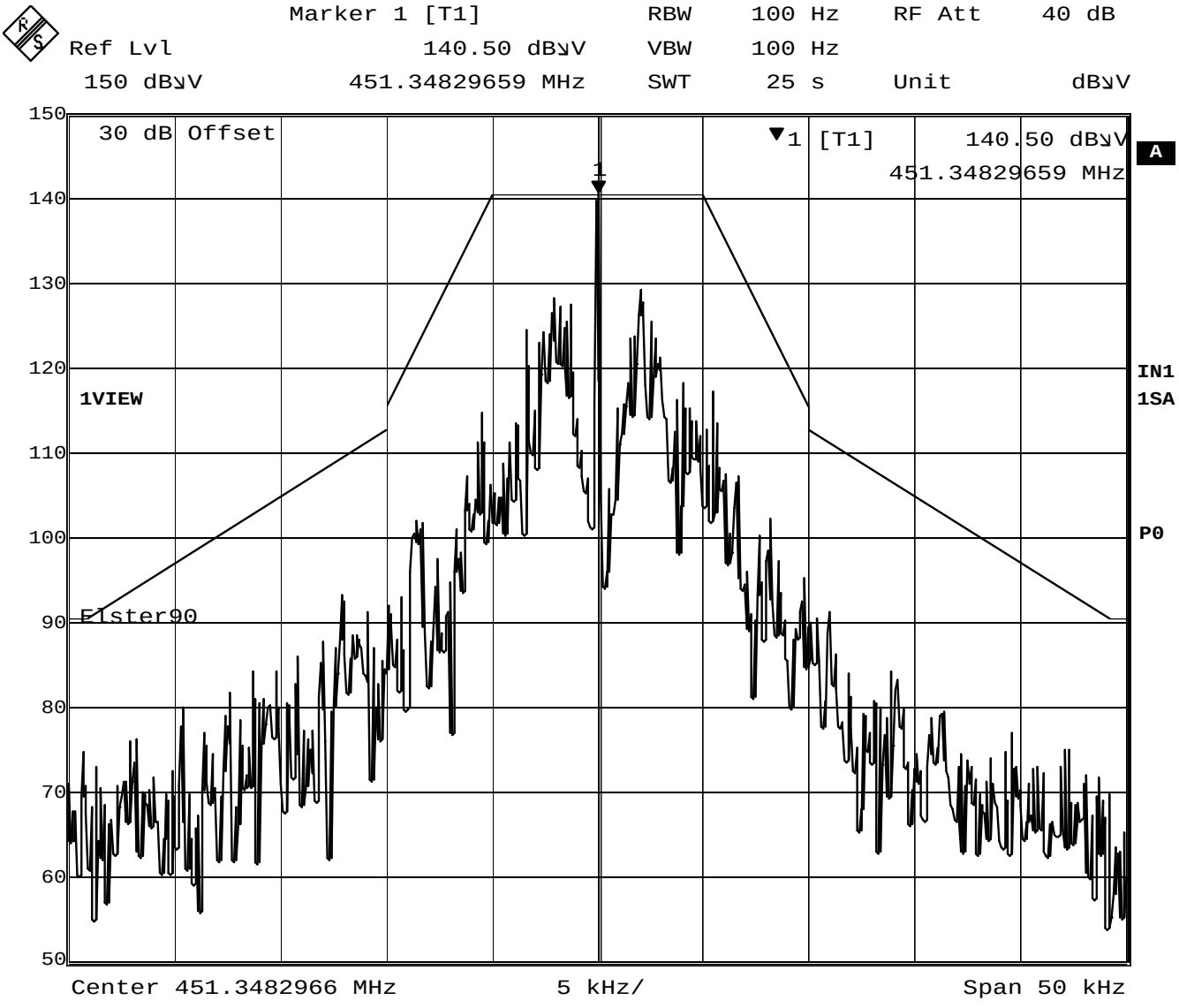
4.9.2 Test Procedure

A 50 Ohm dummy load is used to terminate the transmitter antenna output port.
A procedure can be found in the following document: ANSI/TIA/EIA-603: 1992 Land Mobile for PM Communications Equipment Measurement and Procedure Standards

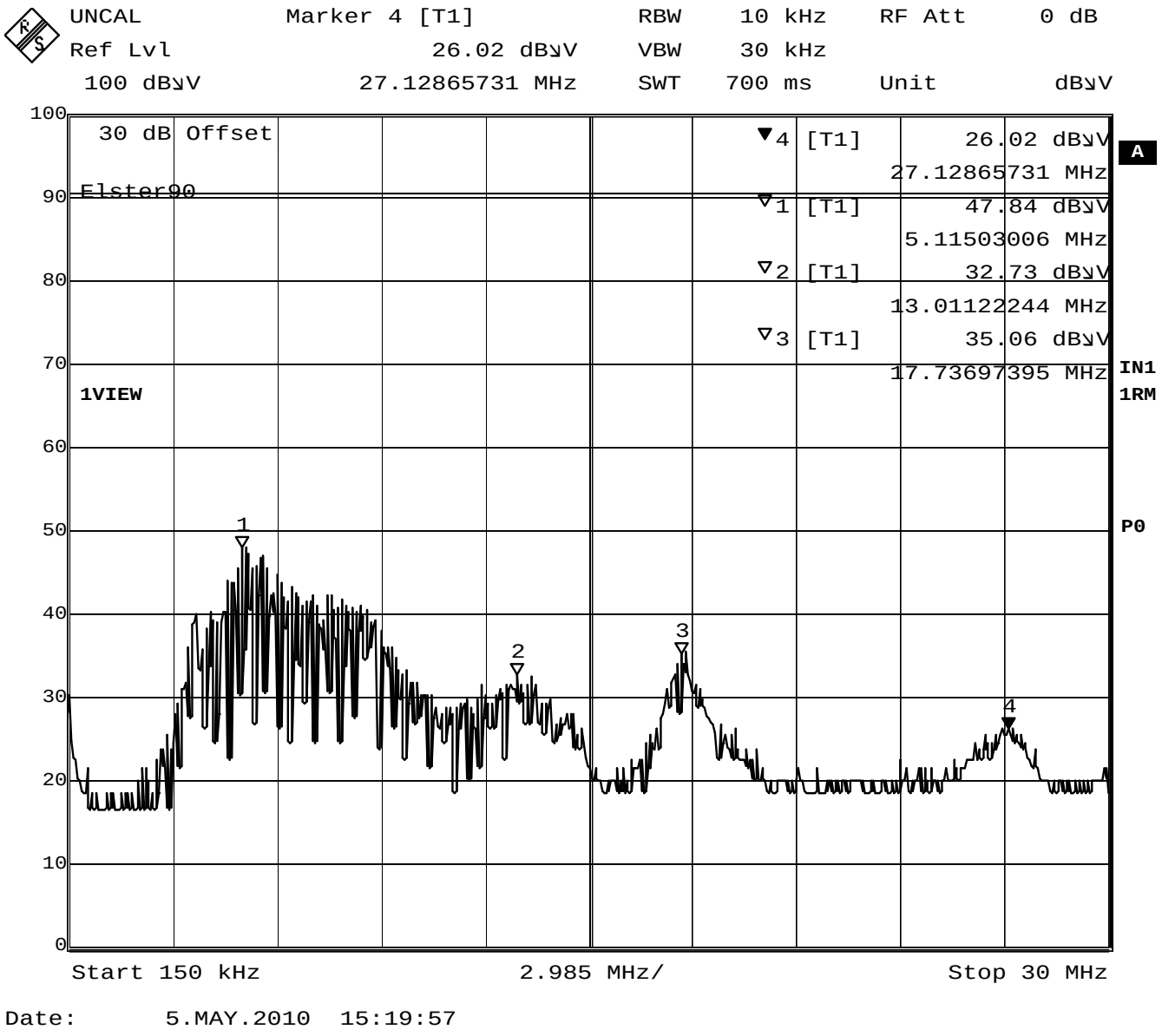
4.9.3 Test Results

All emissions are below the limits ad defined by emission Mask C in

4.9.4 Test Data

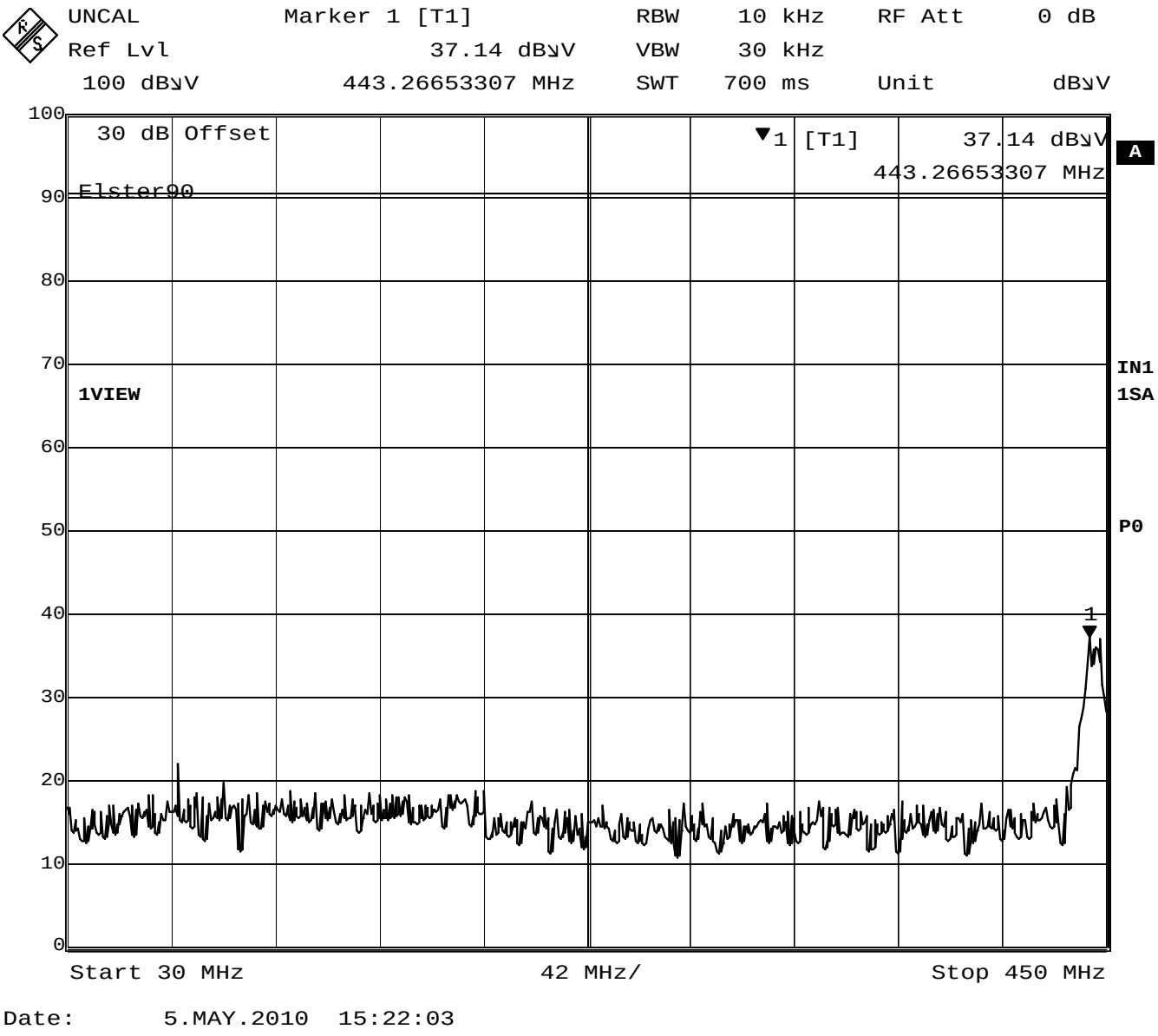


Plot of in-band Emissions Mask - FCC 90.210(c)(1), (2) and (3)

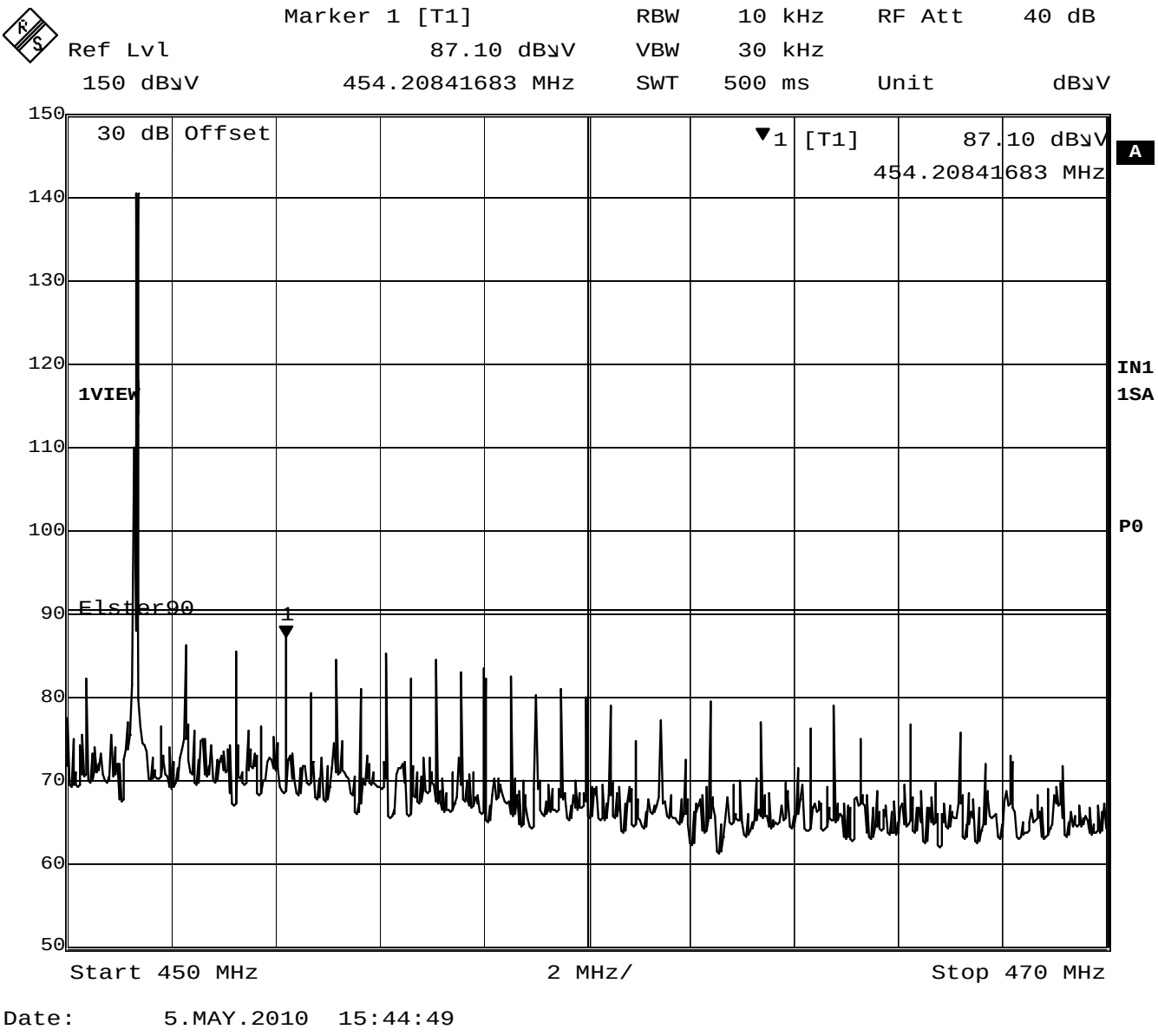


Date: 5.MAY.2010 15:19:57

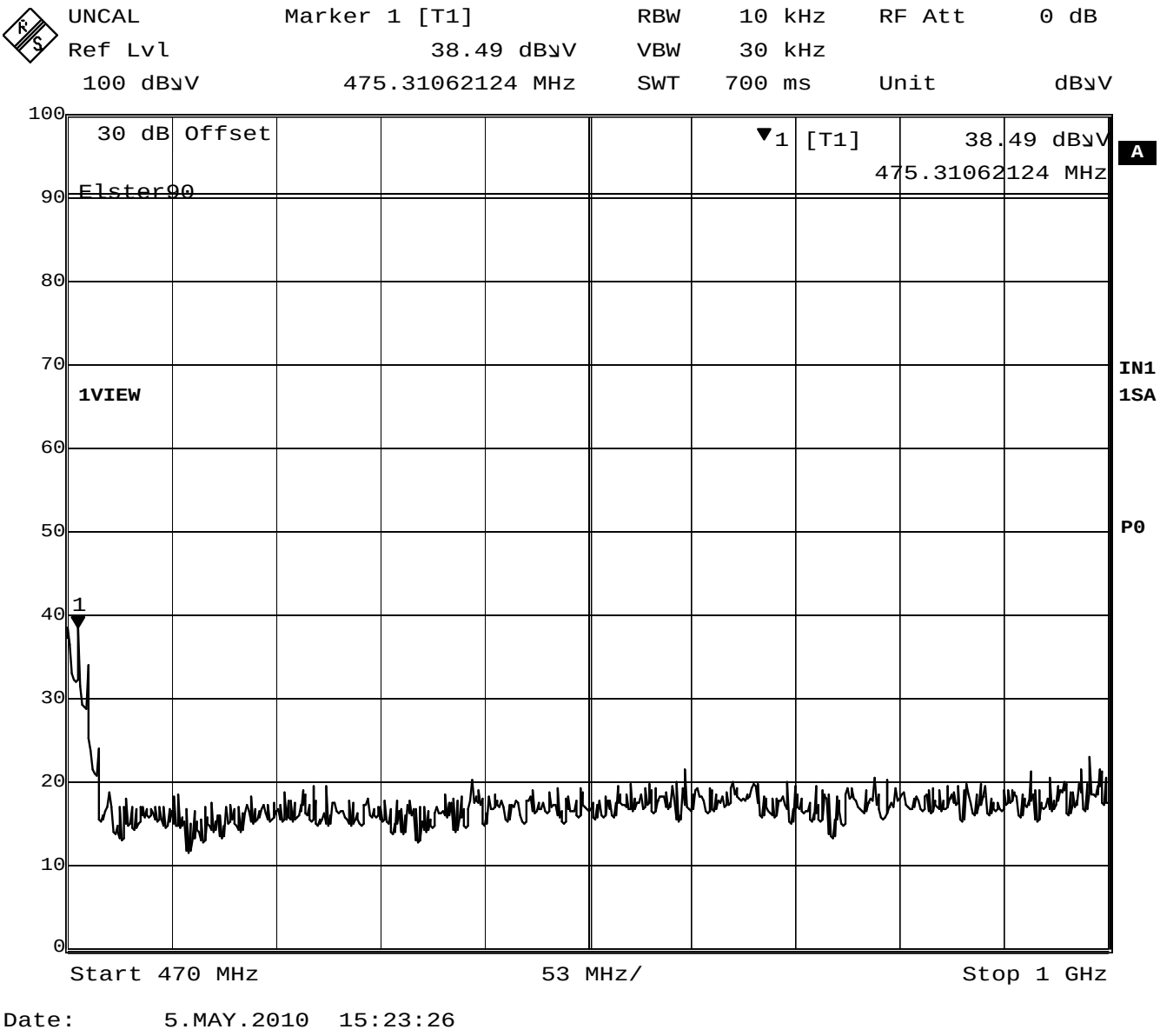
Plot of Emissions Mask - FCC 90.210(c) - 150 kHz to 30 MHz



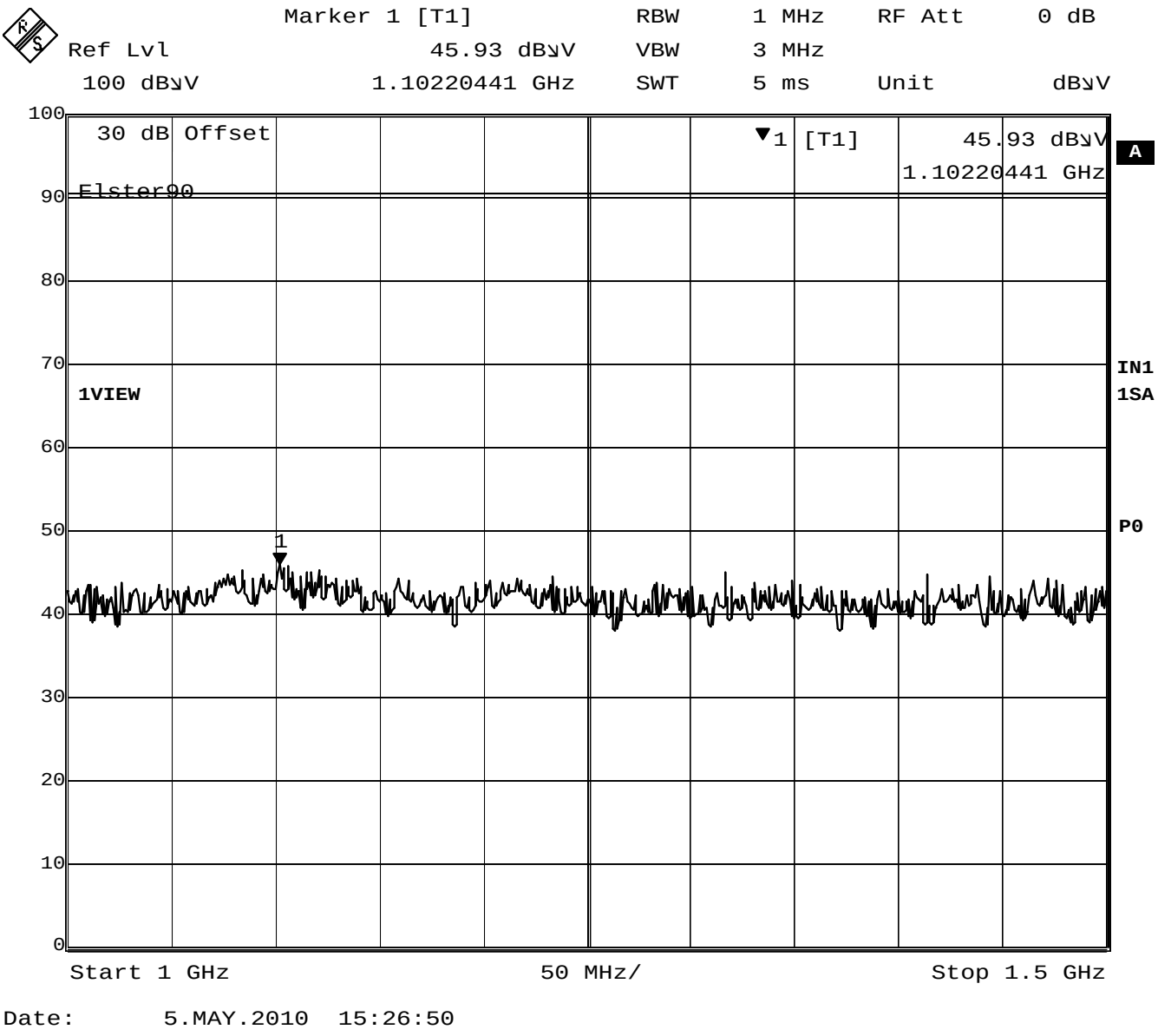
Plot of Emissions Mask - FCC 90.210(c) – 30 MHz to 450 MHz



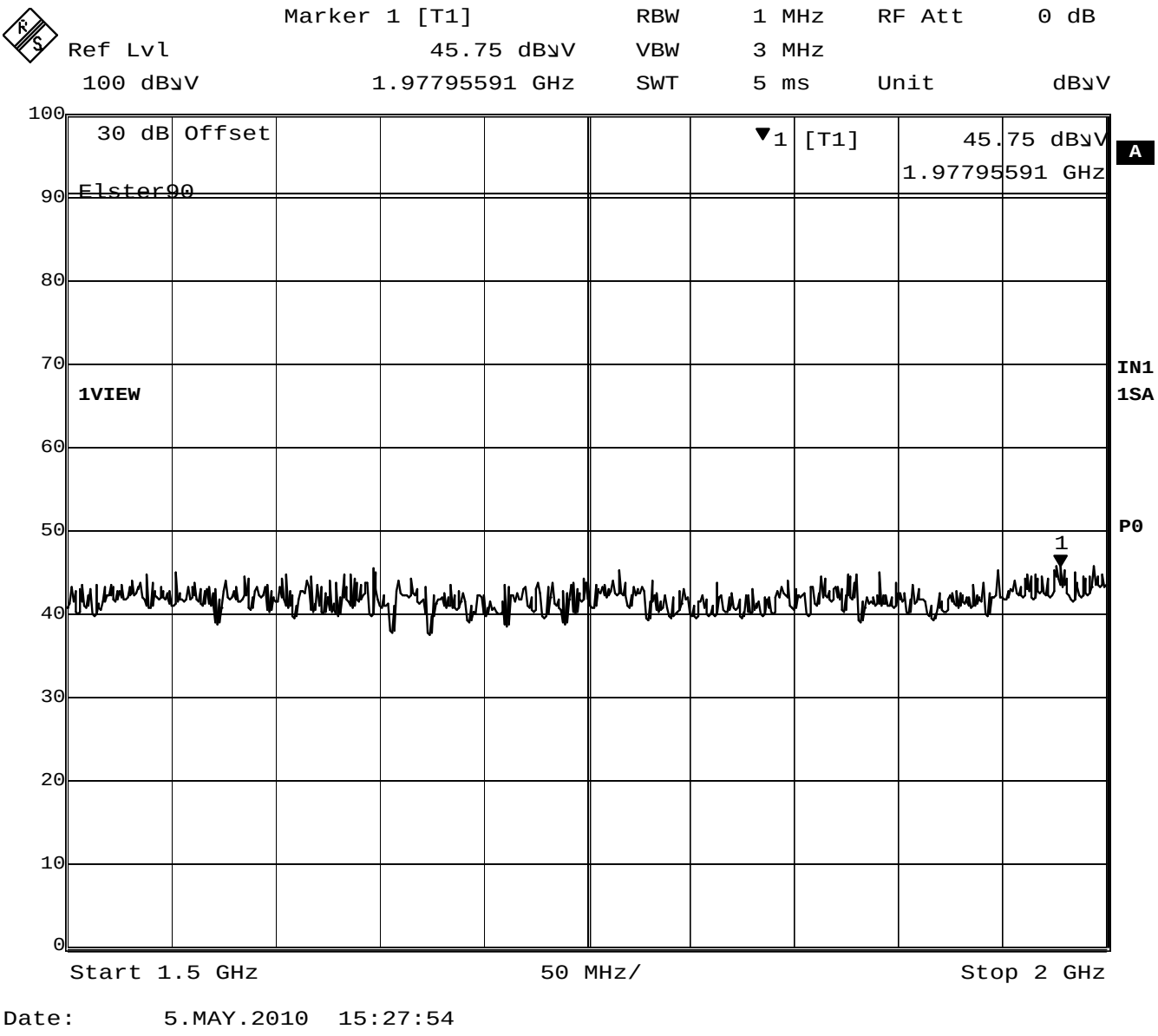
Plot of Emissions Mask - FCC 90.210(c) – 450 MHz to 470 MHz (In-band)



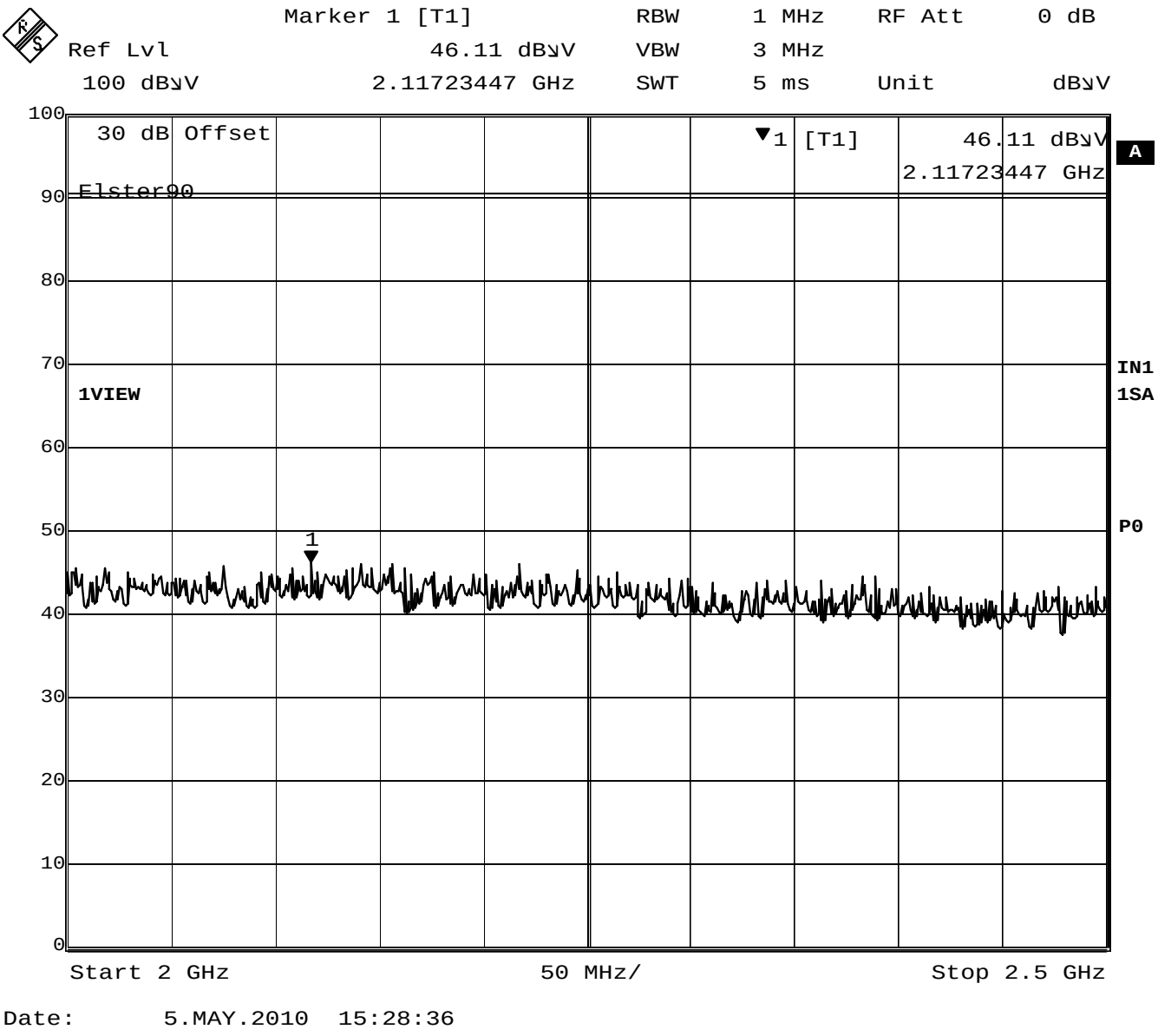
Plot of Emissions Mask - FCC 90.210(c) – 470 MHz to 1 GHz



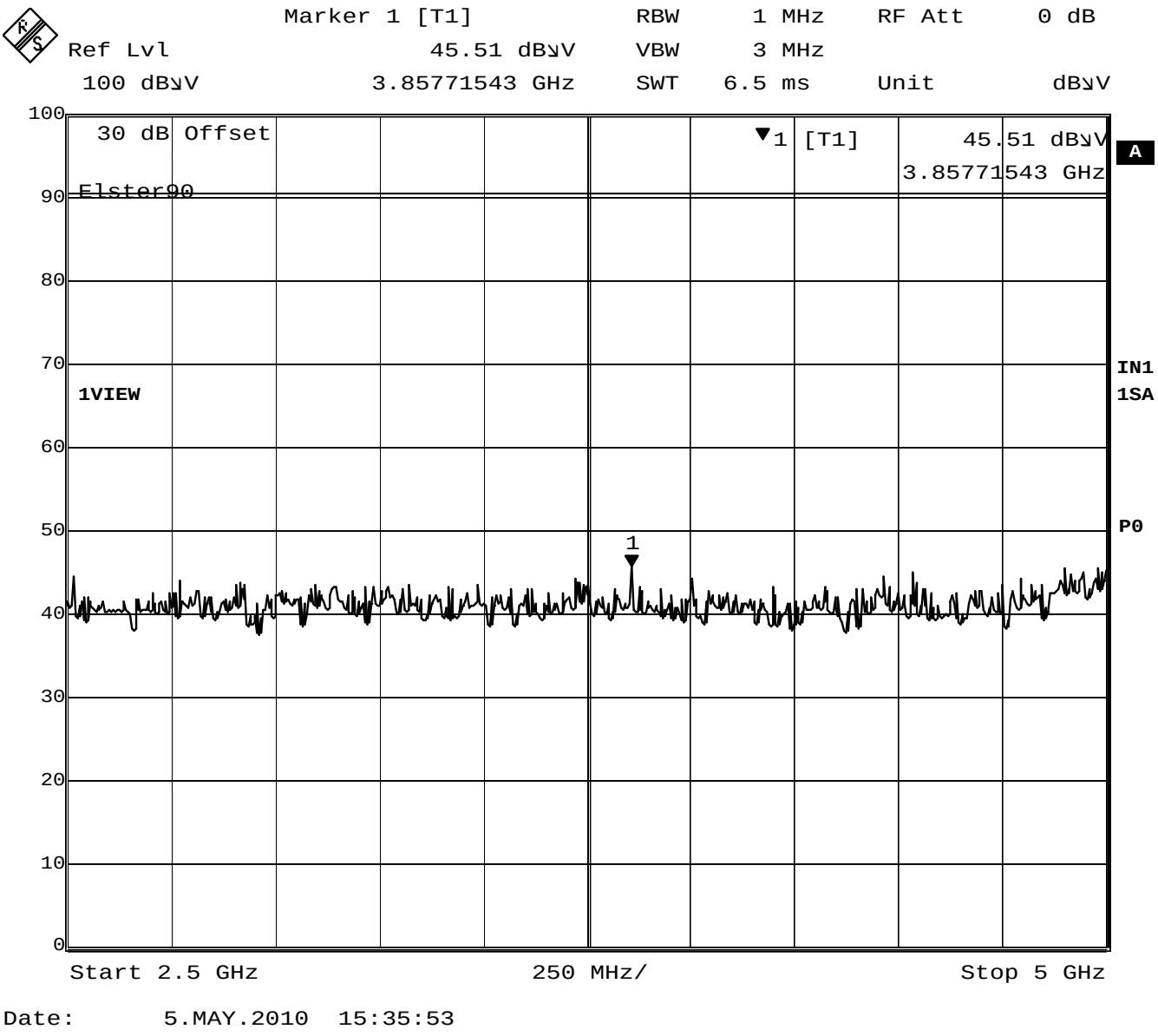
Plot of Emissions Mask - FCC 90.210(c) – 1 GHz to 1.5 GHz



Plot of Emissions Mask - FCC 90.210(c) – 1.5 GHz to 2 GHz



Plot of Emissions Mask - FCC 90.210(c) – 2 GHz to 2.5 GHz



Plot of Emissions Mask - FCC 90.210(c) – 2.5 GHz to 5 GHz

4.9.5 Test Results

All emissions are below the limits ad defined by emission Mask C in

4.10 Frequency Stability Function of the Temperature

Per FCC Parts 90.213, 2.995(a) and RSS-119,5.9

Minimum frequency stability in the Frequency range of 421 – 512 MHz is 5 ppm, for Mobile stations with output power over 2 Watts.

4.10.1 Method of Measurement

The transmitter is set in operation with the maximum rated output power specified by the manufacturer. A Thermotron temperature chamber is used to perform the test. The transmitter is exercised with a transmission mode providing a continuous stream of data.
The ambient temperature is varied from -30° to +50°C. The device under test is operated for 15 minutes prior to testing. A sufficient period of time (about 30 minutes) before any measurements was observed to stabilize all the transmitter components for each temperature level.

Note: It was determined that the modifications will not effect this measurement.
Therefore, this test data was taken from the original test report submitted to the FCC.

4.10.2 Test Data

Frequency stability function of temperature		
Temperature (°C)	MCF(MHz)	PPM error [(MCF/ACF)-1]10^6
-30	459.99828	3.74
-20	459.9988	2.61
-10	459.99912	1.91
0	459.9994	1.30
10	459.99966	0.74
20	460.00001	0.02
30	460.00022	0.48
40	460.0005	1.09
50	460.00061	1.33

FCC PART 90.213 AND PART 2.995(A): FREQUENCY STABILITY FUNCTION OF TEMPERATURE

4.11 *Frequency Stability Function of Primary Supply Voltage*

Per FCC Part 2.995(d)(2) and RSS-119, 5.4

The device under test is powered up and set to a continuous transmission mode. The device is mobile and battery operated therefore the primary supply voltage was reduced to reach the battery operating end point at 11.0V. Below this point the transmitter ceases to transmit.

4.12 *Transient Frequency Behavior*

Per FCC Part 90.214 and RSS-119, 5.9

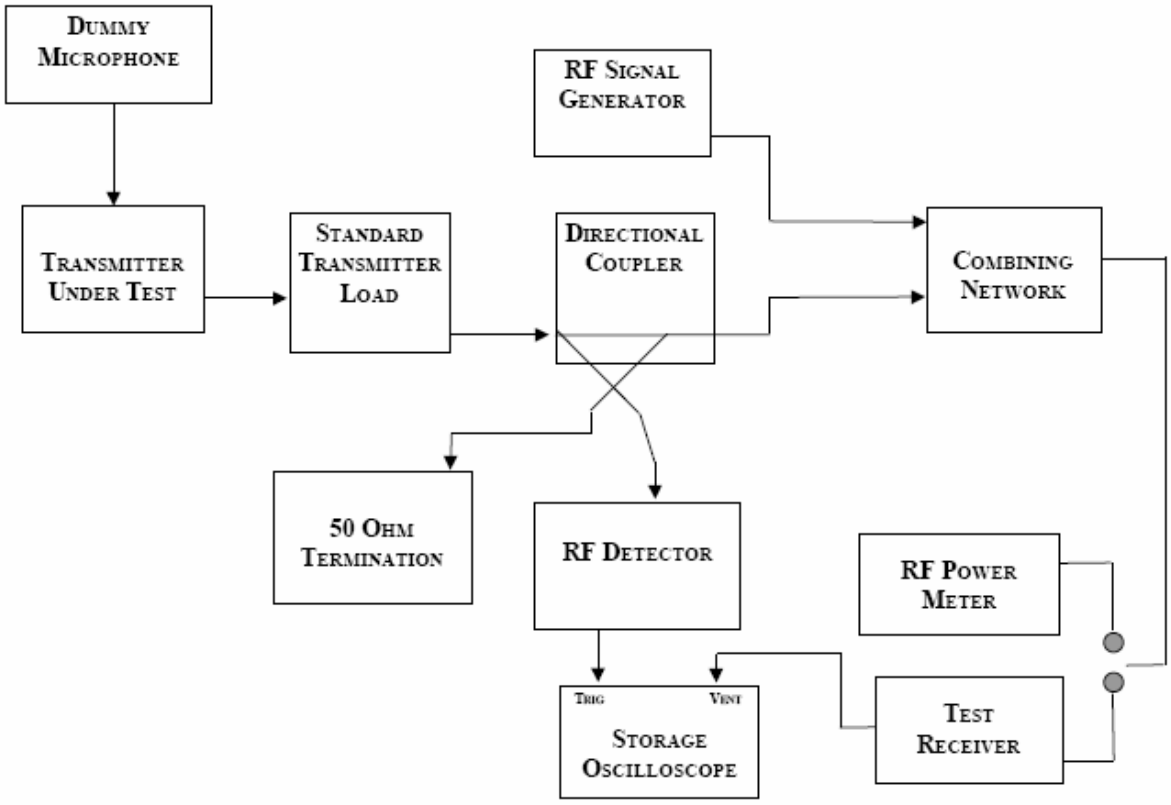
Transient frequency behavior is a measure of the difference, as a function in time, of the actual transmitter frequency to the assigned transmitter frequency when the transmitter RF output power is switch off or on.

4.12.1 Method of Measurement

Please refer to the following publication ANSI/TIA/EIA-603: 1992 Land Mobile for PM Communications Equipment Measurement and Procedure Standards

Note: It was determined that the modifications will not effect this measurement. Therefore, this test data was taken from the original test report submitted to the FCC.

TEST SET UP METHOD OF MEASUREMENT PART 90.214



a) The equipment is connected as illustrated in the above figure.

b) The test receiver's Demodulator Output Port (DOP) is connected to the vertical input channel of the storage oscilloscope. Connect the output of the RF peak detector is connected to the external trigger on the storage oscilloscope. The output of the RF combiner is connected to the RF power meter.

c) The test receiver is set to measure FM deviation with the audio bandwidth set at <50Hz to >15,000Hz and the RF frequency is tuned to the transmitter assigned frequency.

d) The signal generator is set to the assigned transmitter frequency and is modulated with a 1kHz tone at +25kHz deviation and its output level is set to -100dBm.

e) The transmitter is turned on.

f) Sufficient attenuation via the RF attenuator is supplied to provide an input level to the test receiver which is approximately 40dB below the test receiver's maximum allowed input power when the transmitter is operation at its rated power level. Note this power level on the RF power meter.

g) The transmitter is turned off.

h) The RF level of the signal generator is adjusted to provide RF power into the RF power meter 20dB below the level noted in step f). This signal generator RF level is maintained throughout the rest of the measurement.

i) The RF power meter is disconnected and connect the output of the RF combiner network is connected to the input of the test receiver.

j) The horizontal sweep rate on the storage oscilloscope is set to 10 milliseconds per division and the display is adjusted to continuously view the 1000Hz tone from the DOP. The vertical amplitude control of the oscilloscope is adjusted to display the 1000Hz at +4 divisions vertically centered on the display.

k) The oscilloscope is adjusted so it will trigger on an increasing magnitude from the RF peak detector at 1 division from the left side of the display when the transmitter is turned on. The controls are set to store the display.

l) The attenuation of the RF attenuator is reduced so the input to the RF peak detector and the RF combiner is increased by 30dB when the transmitter is turned on. The controls are set to store the display.

m) The transmitter is turned on and the stored display is observed. The output at the DOP, due to the change in ratio of power between the signal generator input power and the transmitter output power will, because of the capture effect of the test receiver, produce a change in display: For the first part of the sweep it shows the 1kHz test signal. Then once the receiver's demodulator has been captured by the transmitter power, the display shows the frequency difference from the assigned frequency to the actual transmitter frequency versus time. The instant when the 1kHz test signal is completely suppressed (including any capture time due to phasing) is considered to be $t_{on.}$ The trace should be maintained within the allowed divisions during the period t_1 and t_2. During the time from the end of t_2 to the beginning of t_3 the frequency difference should not exceed the limit set by the FCC in Part 90.213. That is 2.3 kHz for the 'Mini Mobile Interrogator' device.

o) To test the transient frequency behavior during the period t_3 the transmitter is switched on.

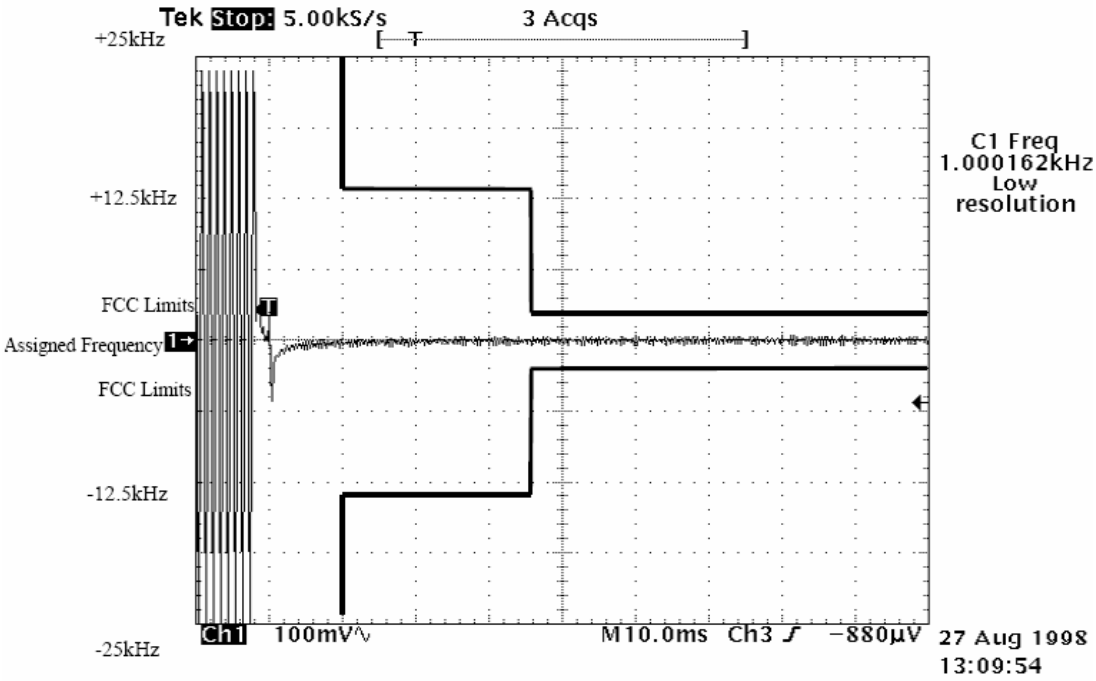
p) The oscilloscope is adjusted so it will trigger at 1 division from the right side of the display, when the TX is turned off. The moment when the 1kHz test signal stars to rise is considered to provide t off.

TRANSIENT FREQUENCY BEHAVIOR FOR EQUIPMENT DESIGNED TO OPERATE ON 25KHZ CHANNELS TABLE

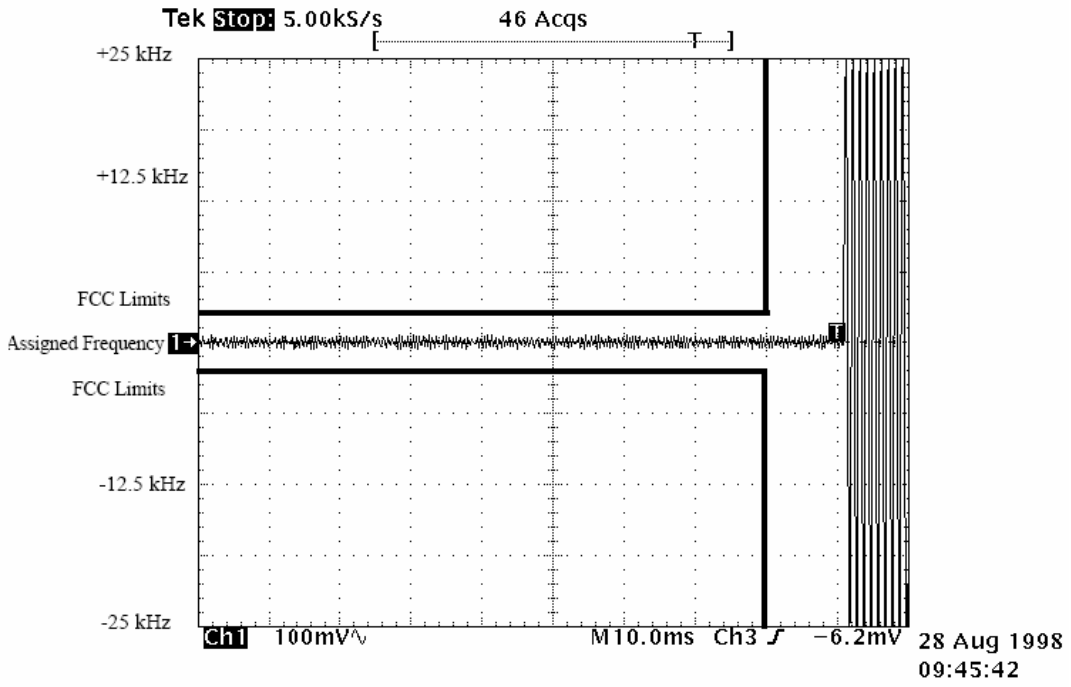
Time Intervals [1, 2]	Maximum Frequency difference[3] (kHz)	Frequency Ranges (MHz)					
		Base stations And Portable Radios			Mobile Radios		
		150-174 (ms)	450-500 (ms)	500-512 (ms)	150-174 (ms)	450-500 (ms)	500-512 (ms)
t_1[4]	±25.0	5.0	10.0	20.0	5.0	10.0	5.0
t_2	±12.5	20.0	25.0	50.0	20.0	25.0	20.0
t_3[4]	±25.0	5.0	10.0	10.0	5.0	10.0	5.0

1. ton is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
t1 is the time period immediately following ton.
t2 is the time period immediately following t1.
t3 is the time period from the instant when the transmitter is turned off until toff.
toff is the instant when the 1 kHz test signal starts to rise.
2. During the time from the end of t2 to the beginning of t3, the frequency difference must not exceed the limits specified in paragraph 90.213.
3. Difference between the actual transmitter frequency and the assigned transmitter frequency.
4. If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

4.12.2 Test Data:



PART 90.214, TRANSIENT FREQUENCY BEHAVIOR



PART 90.214, TRANSIENT FREQUENCY BEHAVIOR

4.13 *Receiver / Cabinet Emissions*

This test measures the electromagnetic levels of spurious signals generated by the EUT that radiated from the EUT and may affect the performance of other nearby electronic equipment.

4.13.1 Over View of Test

Results	**Complies** (as tested per this report)					**Date**	04 May 2010
Standard	FCC Part 15B and RSS-GEN, 4.10						
Product Model	RTMI / 7S1900G001			**Serial#**	ALPHA ONE		
Configuration	See test plan for details						
Test Set-up	Tested in a 5m Semi Anechoic chamber, placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane on a turn-table. See test plans for details						
EUT Powered By	12 VDC	**Temp**	72ºF	**Humidity**	42%	**Pressure**	1002 mbar
Frequency Range	30 MHz - 5 GHz @ 3m						
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

4.13.2 Test Procedure

Radiated and FCC emissions tests were performed using the procedures of ANSI C63.4 including methods for signal maximizations and EUT configuration. The photos included with the report show the EUT in its maximized configuration.

The frequency range from 30 MHz - 5 GHz was investigated for radiated emissions.

Radiated emission testing was performed at a distance of 3 meters in a 5 meter semi-anechoic chamber.

4.13.3 Deviations

There were no deviations from the test methodology listed in the test plan for the radiated emission test.

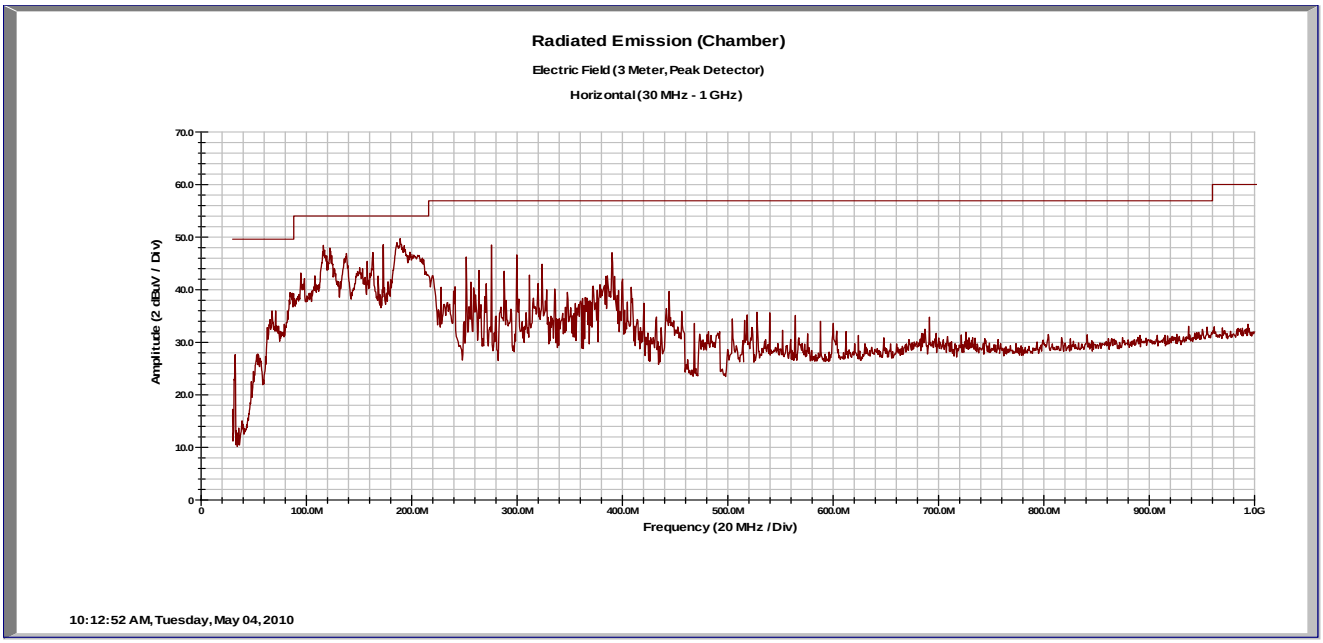
The EUT is intended to be a mobile device powered by a 12 VDC Battery, as such conducted emissions on the power line are not required per FCC Part 15.107(d).

4.13.4 Final Test

All final radiated emissions measurements were below (in compliance) the limits.

4.13.5 Final Graphs and Tabulated Data

Radiated Emissions 30 MHz – 1000 MHz
Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
189.20	H	1.7	0	33.66	0.00	1.48	10.25	45.39	54.00	-8.61
276.00	H	1	59	33.29	0.00	1.79	12.26	47.34	56.90	-9.56
389.80	H	1	12	21.38	0.00	2.14	14.99	38.51	56.90	-18.39

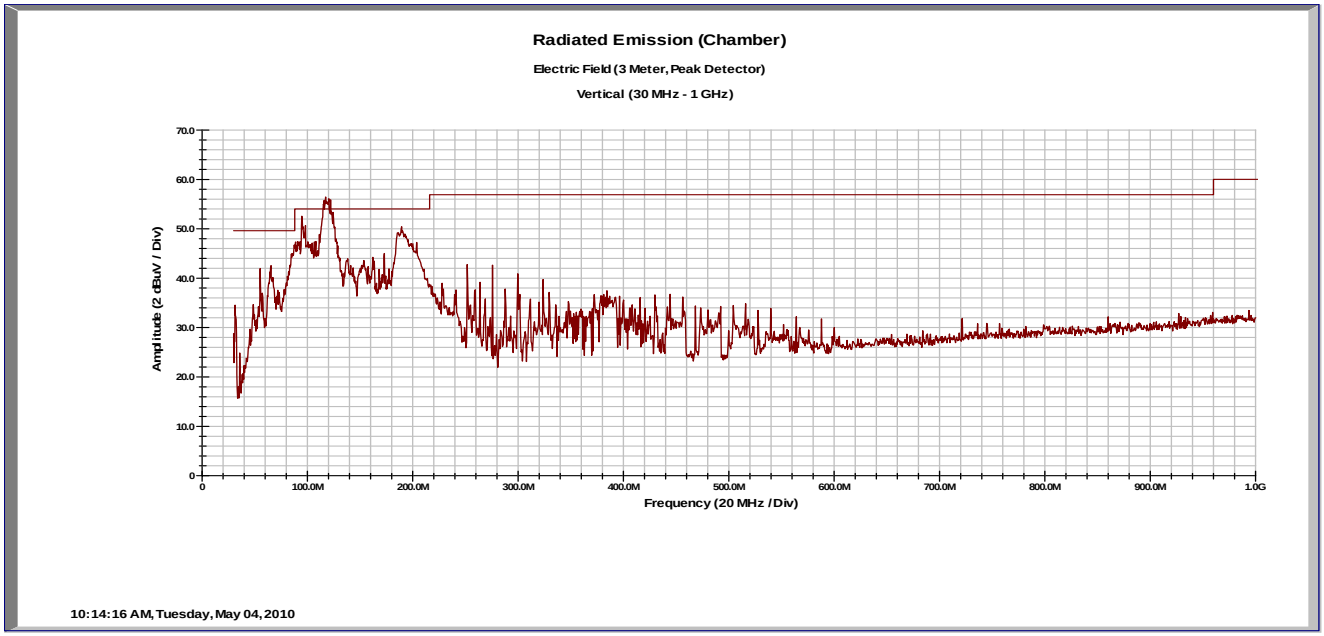
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

Combined Standard Uncertainty $u_c(y)$ = ± 1.65dB Expanded Uncertainty $U = 3.3\ ku_c(y)$ k = 2 for 95% confidence

Notes:

Radiated Emissions 30 MHz – 1000 MHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
31.60	V	1	259	25.86	0.00	0.60	5.12	31.58	49.60	-18.02
95.96	V	1	244	37.79	0.00	1.05	6.80	45.63	54.00	-8.37
119.00	V	1	268	41.10	0.00	1.16	7.74	50.01	54.00	-3.99
185.88	V	1	108	35.48	0.00	1.46	9.37	46.31	54.00	-7.69

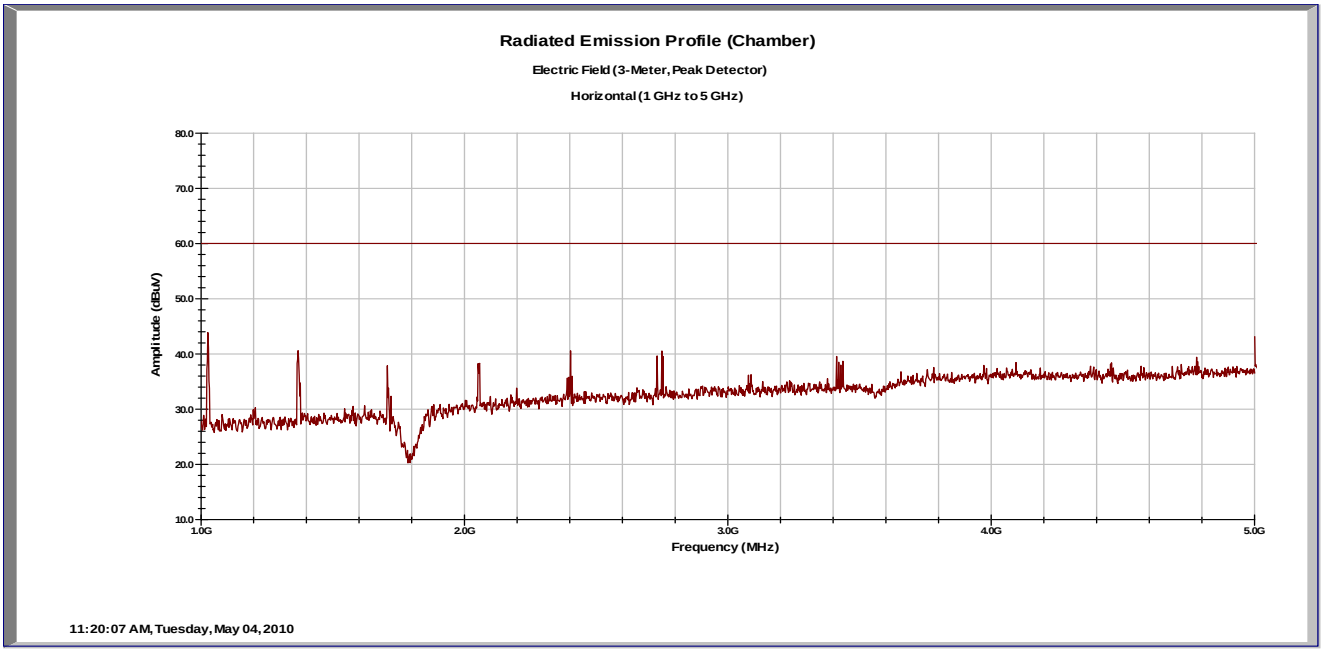
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

Combined Standard Uncertainty $u_c(y)$ = ± 1.65dB Expanded Uncertainty $U = 3.3\ ku_c(y)$ k = 2 for 95% confidence

Notes:

Radiated Emissions 1 GHz – 5 GHz

Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
1027.60	H	1.2	337	54.21	36.91	4.71	24.12	46.13	60.00	-13.87
1027.60	H	1.2	337	56.59	36.91	4.71	24.12	48.51	80.00	-31.49
2749.60	H	1.9	5	37.63	35.56	8.03	28.75	38.85	60.00	-21.15
2749.60	H	1.9	5	43.89	35.56	8.03	28.75	45.11	80.00	-34.89

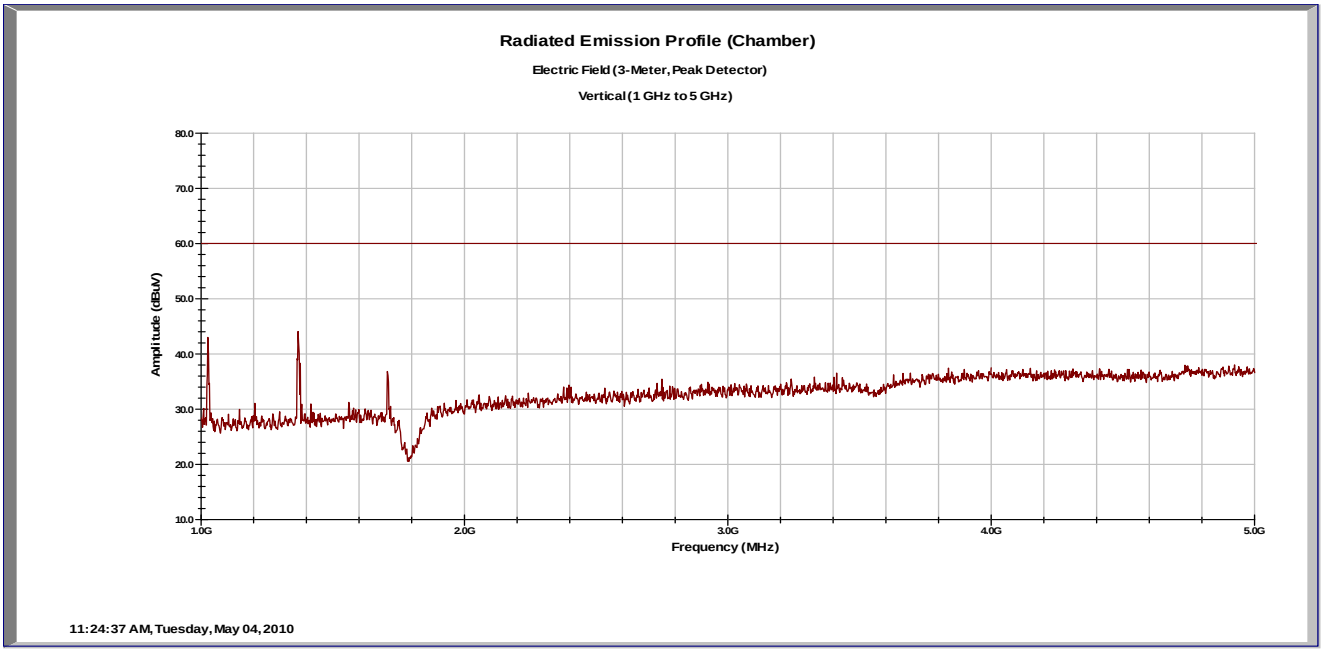
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

Combined Standard Uncertainty $u_c(y)$ = ± 1.65dB Expanded Uncertainty $U = 3.3\ ku_c(y)$ k = 2 for 95% confidence

Notes:

Radiated Emissions 1 GHz – 5 GHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
1368.40	V	1	226	48.20	36.04	5.43	25.36	42.95	60.00	-17.05
1368.40	V	1	226	51.80	36.04	5.43	25.36	46.55	70.00	-33.45

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

Combined Standard Uncertainty $u_c(y)$ = ± 1.65dB Expanded Uncertainty $U = 3.3\ ku_c(y)$ k = 2 for 95% confidence

Notes:

Appendix A

5 Test Plan

This test report is intended to follow this test plan outlined below unless otherwise stated in this report or quote agreement. The following test plan will give details on product information, test set ups, and product configurations. The product information below came via client, product manual, product itself and or the internet.

5.1 General Information

Client	Elster Solutions
Address	208 South Rogers Lane
Address	Raleigh, NC 27610
Contact Person	Mark Holman
Telephone	919-212-4899
Fax	919-250-5439
e-mail	mark.holman@us.elster.com

Product Name

RTMI

Model(s) Name

7S1900G001

5.2 Equipment Under Test (EUT) Description

The Real Time Mobile Interrogator (RTMI) is a portable data retrieval and storage system designed to provide remote meter reading of mechanical indexes via TRACE meter transponders.

The RTMI is designed for use in vehicles for fast, accurate automated meter reading at maximum range and at normal residential driving speeds.

The CMMI consists of several required components. Those components are:

- Interrogator unit
- GPS receiver
- Transmitting antenna
- Receiving antenna
- LCD VGA Touch Screen designed for in car computing
- Power supply cable

Interrogator unit: The interrogator unit is the heart of the RTMI, containing within its rugged case these core components:

- Transmitter
- Eight receivers
- Power supply (backup)
- Computer CPU (microprocessor)
- Connection receptacles, controls and indicators

Modifications

A ferrite was added to the Receive antenna coax to be compliant in receive mode.

Countries

☒	**USA**	☐	**Europe**
☐	**Taiwan**	☒	**Other: Canada**
☐	**Japan**		

*Check all that apply

General Product Information

Size	**H**	18cm	**W**	46cm	**L**	32cm	
Weight	~30kg		**Fork-Lift Needed**		No		
Notes							

5.3 EUT Electrical Powered Information

5.3.1 Electrical Power Type

☐	**AC**	☒	**DC**	☒	**Batteries**	☐	**Host -**

5.3.2 Electrical Power Information

Name	**Type**	**Voltage**		**Frequency**	**Current**	**Notes**
		min	**max**			
Power	DC	11	16.6	N/A	~6.5 ADC	TX Mode
Notes						

5.4 EUT Modes of Operation

The EUT (RTMI) will be powered with a 12 VDC deep cycle automotive battery to simulate actual use in a meter reading vehicle. TX/RX antennas as supplied will be attached to the transmit and receive ports respectively. The Xenarc VGA display will be connected and powered by the 12 VDC battery.

For the Radiated Emissions Limits, TX function will be disabled. Ref 1.16.2.

For Land Mobile Radio testing, TX can be enabled and a typical transponder data can be transmitted.

5.5 Technical information

EUT Clock/Oscillator Frequencies

☐	**Less than 108MHz**	**FCC – scan up to 1GHz**
☐	**Less than 500MHz**	**FCC – scan up to 2GHz**
☒	**Less than 1000MHz**	**FCC – scan up to 5GHz**
☐	**Greater then 1000MHz**	**FCC – scan up to 5th Harmonic or 40GHz**

Electrical Support Equipment

Type	Manufacture	Model	Connected To
Battery	Optima	3478DT	Elster Power Cable
Power Cable	Elster	N/A	EUT Power
TX Antenna	MaxRad	MUF4505	EUT Transmitter
RX Antenna	MaxRad	MUF4065	EUT Receiver
VGA Monitor	Xenarc	705TSV	EUT VGA and USB
VGA Monitor Power	Xenarc	705TSV	Battery
GPS	Garmin	16x-HVS	EUT GPS

EUT Equipment / Cabling Information

EUT Port	Connected To	Location	Cable Type		
			Length	Shielded	Bead
EUT/Monitor Power	12 VDC Battery	Under Test Table	12 AWG 8 ft.	N	Y
GPS	GPS Receiver	On Test Table	28 AWG 16 ft.	Y	N
Transmitter, N Female	TX Antenna	On Test Table	12 ft. N Type, Male	Y	N
Receiver, BNC Female	RX Antenna	On Test Table	12 ft. BNC Type, Male	Y	N
VGA	Xenarc VGA Monitor	On Test Table	6 ft.	Y	Y
USB 1	Xenarc VGA Monitor	On Test Table	6 ft.	Y	Y

EUT Test Program(s)

For FCC and IC:

For Radiated Emissions, TX will be disabled for detection of unintentional radiation from the EUT.

For Land Mobile testing, the transmitter will be enabled for RF power and spurious emission testing. Typical transponder data will be transmitted.

Monitoring of EUT during Testing

The EUT will be installed, monitored, and evaluated by test agency personnel for compliance with requested FCC and IC standards.

EUT representatives will be present to operate and troubleshoot equipment as necessary.

5.6 EUT Configuration

5.6.1 Description

Configuration	Description
Reference Block Diagram 1.16.2	
Notes	All configurations are the same except as noted above

5.6.2 Block Diagram