Electromagnetic Compatibility Test Report

Prepared in accordance with

FCC Part 90I, RSS-119 Issue 11 for NARROWBANDING - Class Two Permissive Change

On

Hand-Held Interrogator

PI900

Elster Solutions, LLC
208 South Rogers Lane
Raleigh, NC 27610

Prepared by:

TUV Rheinland of North America, Inc.

Manufacturer's statement - attestation

The manufacturer; Elster Solutions, LLC as the responsible party for the equipment tested, hereby affirms:

a) That he has reviewed and concurs that the test shown in this report are reflective of the operational characteristics of the device for which certification is sought;

b) That the device in this test report will be representative of production units;

c) That all changes (in hardware and software/firmware) to the subject device will be reviewed.

d) That any changes impacting the attributes, functionality or operational characteristics documented in this report will be communicated to the body responsible for approving (certifying) the subject equipment.

John Holt Printed name of official	John Holt Signature of official
208 South Rogers Lane Raleigh, NC 27610 Address	24 February 2010 Date
919-250-5575 Telephone number	John.Holt@Elster.com Email address of official

Client:	Elster Solutions, LLC 208 South Rogers Lane Raleigh, NC 27610	John Holt 919-250-5557 / 919-250-5486 John.Holt@us.elster.com	
Identification:	Hand-Held Interrogator	***Serial No.:***	Production Sample
Test item:	PI900	***Date tested:***	17 February 2012
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:** FCC Part 90, Subpart I, RSS-119 Issue 11 FCC Part 90.210(d) and RSS-119, Table 6, FCC Part 2.1046 and RSS-119, 5.4, FCC Parts 15.109(a) and RSS-GEN, FCC Part 2.1093 and RSS-102, Issue 4		
Test Result	**The above product was found to be Compliant to the above test standard(s)**		
tested by: Mark Ryan		***reviewed by:*** Robert Richards	
17 February 2011 ***Signature***		24 February 2012 ***Signature***	
Other Aspects:	**None**		

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

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

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1 General Information

1.1 Scope

This report is intended to document the status of conformance with the requirements of the FCC Part 90I, RSS-119 Issue 11 based on the results of testing performed on 17 February 2012 on the Hand-Held Interrogator , Model No. PI900, manufactured by Elster Solutions, LLC. 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 Revision History

Revision	Date	Description of Revision
- -	24 February 2012	Initial Release

1.4 *Summary of Test Results*

Applicant	Elster Solutions, LLC 208 South Rogers Lane Raleigh, NC 27610	**Tel**	919-250-5557	**Contact**	John Holt
		Fax	919-250-5486	**e-mail**	John.Holt@us.elster.com

Description	Hand-Held Interrogator	**Model Number**	PI900
Serial Number	Production Sample	**Test Voltage/Freq.**	7.2V DC Battery
Test Date Completed:	17 February 2012	**Test Engineer**	Mark Ryan

Standards	Description	Severity Level or Limit	Worst-Case	Test Result
FCC Part 90, Subpart I Standard	Private Land Mobile Radio Services - Subpart I: General Technical Standards	See called out basic standards below	See Below	**Complies**
RSS-119 Issue 11 Standard	Radio Transmitters and Receivers Operating in the Land Mobile and Fixed Services in the Frequency Range 27.41-960 MHz	See called out basic standards below	See Below	**Complies**
FCC Part 90.210(d) and RSS-119, Table 6	Emissions Masks	Emission Mask D	11.25 kHz	Complies
FCC Part 2.1046 and RSS-119, 5.4	Transmitter Output Power	Conducted Power Out	0.199 W	Complies
FCC Parts 15.109(a) and RSS-GEN	Spurious Emissions outside the band	Below limit of section 15.109(a) Class B	32.93 dBµV	Complies
FCC Part 2.1093 and RSS-102, Issue 4	RF Exposure	SAR or MPE Requirements	204 mW	Complies
RSS-GEN - 4.6.1	Occupied Bandwidth	99% BW ≤ 500 kHz	9.38 kHz	Complies

Note: These tests in this report are for the Class 2 Permissive Change only. Other than the 12.5 kHz Narrowbanding adjustment and the addition of an external antenna, there were no differences from the original application.

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 and C63.10:2009.

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 (dBµV/m)

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

2.2 Measurement Uncertainty Emissions

	U_{lab}	U_{cispr}
Radiated Disturbance @ 3m		
30 MHz – 1,000 MHz	4.52 dB	5.2 dB
Radiated Disturbance @ 10m		
30 MHz – 1,000 MHz	4.51 dB	5.2 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	3.33 dB	3.6 dB
Disturbance Power		
30 MHz – 300 MHz	4.00 dB	4.5 dB

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 Emissions (5 Meter Chamber and Bench top)					
Amplifier, preamp	Agilent Technologies	8449B	3008A01480	01-Feb-11	01-Feb-12
Antenna Horn 1-18GHz	EMCO	3115	5770	18-Aug-10	18-Aug-12
Ant. BiconiLog	Chase	CBL6140A	1108	24-Aug-11	24-Aug-12
Receiver, EMI	Rohde & Schwarz	ESIB40	100043	01-Aug-11	01-Aug-12
Spectrum Analyzer	Agilent Tec.	E7405A	US39440157	06-Dec-10	06-Dec-11
Cable, Coax	MicroCaox	MKR300C-0-0-1200-500500	002	16-Dec-10	16-Dec-11
Cable, Coax	Andrew	FSJ1-50A	003	16-Dec-10	16-Dec-11
Cable, Coax	Andrew	FSJ1-50A	030	16-Dec-10	16-Dec-11
Cable, Coax	Andrew	FSJ1-50A	045	16-Dec-10	16-Dec-11
High Pass Filter	Micro-tronics	BRM50702	049	20-Jan-11	20-Jan-12
General Laboratory Equipment					
Generator, Noise	York University	CNE III	Ser/98/66	CNR II	CNR II
Meter, Multi	Fluke	179	90580752	06-Dec-10	06-Dec-11
Power Supply, AC	California Instruments	3001ix	53354	07-Dec-10	07-Dec-11
Meter, Temp/Humid/Barom	Davis Instruments	7400	PB00205A13	1-Jan-11	1-Jan-12

3 Product Information

3.1 Product Description

The EUT is a PCMCIA Transceiver Card for utility meter reading.

3.2 Class 2 Permissive Change Description

The purpose for the Class 2 Permissive Change is to update the certificate with the new 12.5 kHz bandwidth requirements (narrowbanding) and to add an external antenna to the product; external antenna is terminated with a unique connector. No changes were made to the printed wire board.

There are no changes in the circuit for this Class 2 Permissive Change. The only difference is adjusting the modulation to achieve the narrow-band signal. Also an addition of an external antenna is the only physical change. The Antenna chosen is tuned to the 450 MHz band. The antenna acts as a gain antenna, typically 3.12 dBi in this frequency band. Per section 5.6.5 of this report, the gain of the antenna 3.12 dBi at 451 MHz.

For FCC: The C2PC is to include both the narrowbanding and the addition of an external antenna.

For Industry Canada: This is report is only for the change in emissions designator for the narrow bandwidth The previous C2PC application was for the addition of the external antenna.

As such, only the radiated spurs and harmonic emissions were investigated using the limits of FCC part 15.109 and RSS-GEN just to make sure that no new radiated spurs or harmonics were generated. All other conditions have not changed from the original certification.

3.2.1 Device Type

The PI900 is an intentional radiator and is classified as a Part 15.247 / RSS-210 and a Part 90 / RSS-119 device. The Class 2 permissive change for the Part 15.249 / RSS-210 was addressed previously. This test report is only for the Part 90 / RSS-119 portion only.

Other than the narrow-band measurement, no changes were made to the device.

3.3 Equipment Modifications

No modifications were needed to bring product into compliance.

4 Antenna Port Conducted Emissions

Testing was performed in accordance with 47 CFR Part 15, ANSI C63.10:2009, RSP-100 Issue 9. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

4.1 RF Power Output

The maximum peak output power of the intentional radiator is measured as a reference for the 0dB reference of the Emission Mask.

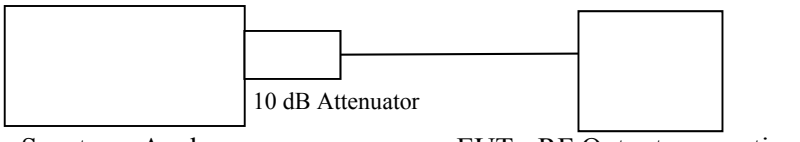
4.1.1 Test Over View

Results	**Complies** (as tested per this report)					**Date**	17 February 2012
Standard	FCC Part 2.1046 and RSS-119, 5.4						
Product Model	PI900			**Serial#**	Production Sample		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	7.2V DC Battery	**Temp**	75º F	**Humidity**	43%	**Pressure**	1005 mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

4.1.2 Test Procedure

The peak output power was measured at 451.35 MHz with no Modulation applied. The measurements were made using a direct connection between the RF output of the EUT and the spectrum analyzer. The cable loss and the attenuator was measured and added in the reference level offset in the spectrum analyzer. The spectrum analyzer's resolution bandwidth was greater than the 20dB bandwidth of the modulated carrier and the video bandwidth was equal to the resolution bandwidth.

Test Setup:



4.1.3 Deviations

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

4.1.4 Final Test

The EUT met the performance criteria requirement as specified in the test plan of this report and in the standards.

4.1.5 Final Data - Peak Power Output

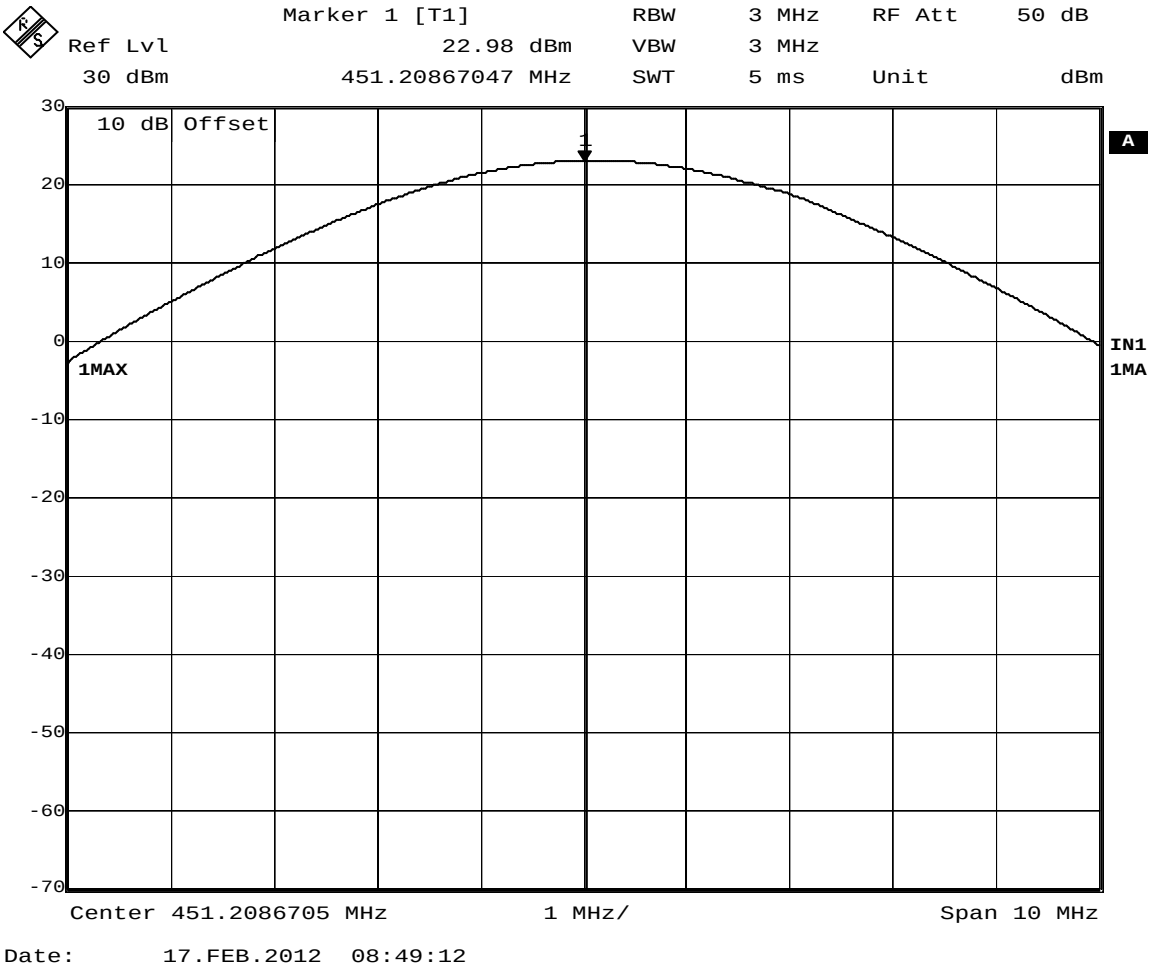


Figure 1: Peak Output Power - Worst Case Shown.

451.35 MHz = 22.98 dBm or 199 mW

Antenna Gain

The antenna gain data was measured/calculated in the lab with the following results provided:

Results; Internal Antenna

Freq. (MHz)	Peak (dBi)	Gain (Numeric)
451.5	3.12	2.05

4.2 Emission Mask D within 50kHz from edge of authorized bandwidth

The maximum allowed bandwidth using Emission Mask D.

4.2.1 Test Over View

Results	**Complies** (as tested per this report)				**Date**	17 February 2012	
Standard	FCC Part 90.210(d) and RSS-119, Table 6 – Emission Mask D						
Product Model	PI900			**Serial#**	Production Sample		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	7.2V DC Battery	**Temp**	75º F	**Humidity**	43%	**Pressure**	1001 mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

4.2.2 Test Procedure

The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two to three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emissions mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, refer to paragraph (m) of FCC 90.210, or RSS-119 section 4.2.2

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

4.2.3 Final Test

The Band width emissions are below the level of emission mask D.

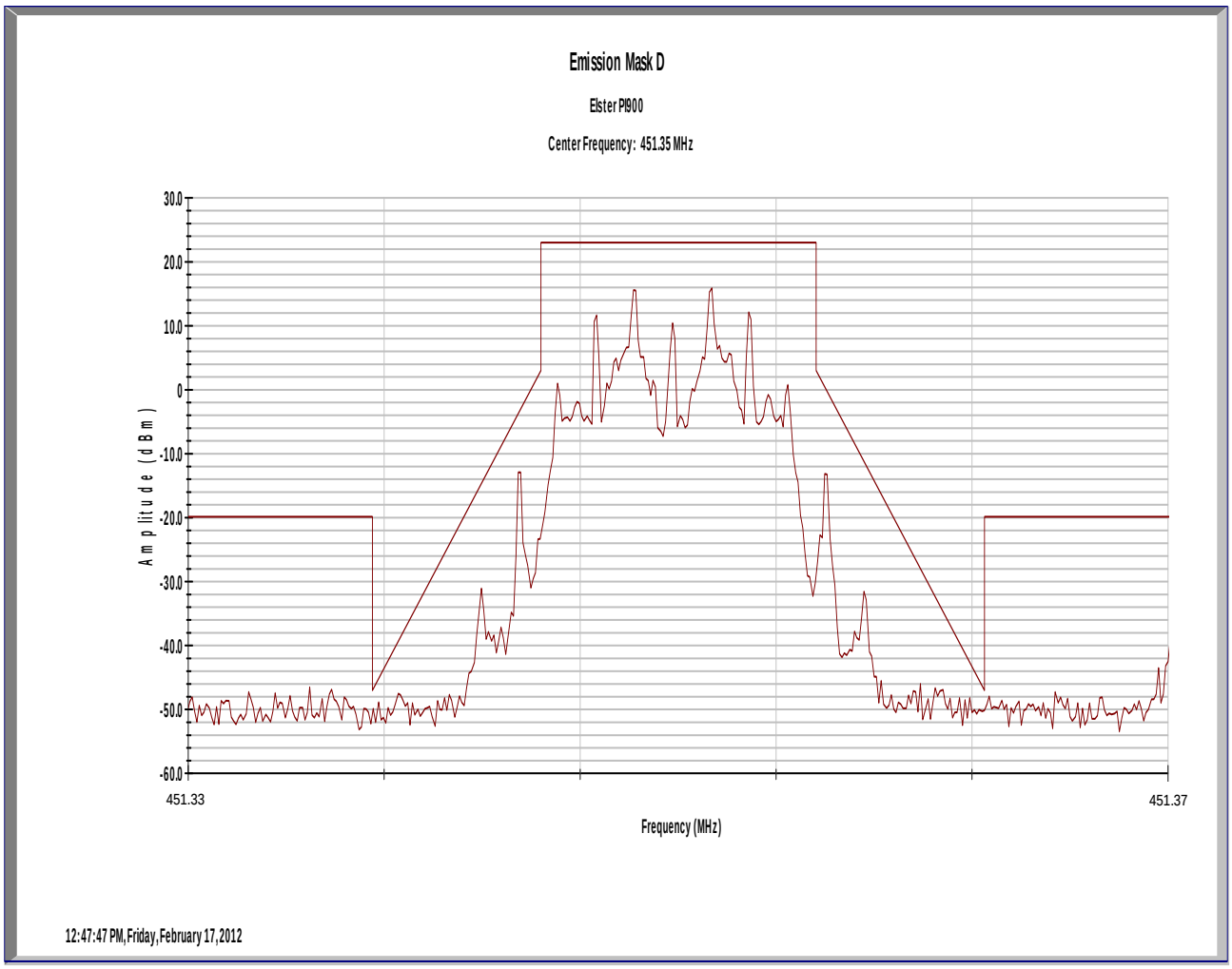


Figure 2: Emissions Mask D

Note: The Reference of the Mask is set to the Max Power output of the EUT at 22.98 dBm

RBW: 100 Hz

VBW: 300 Hz,

Sweep: 100 S

Span: 40 kHz

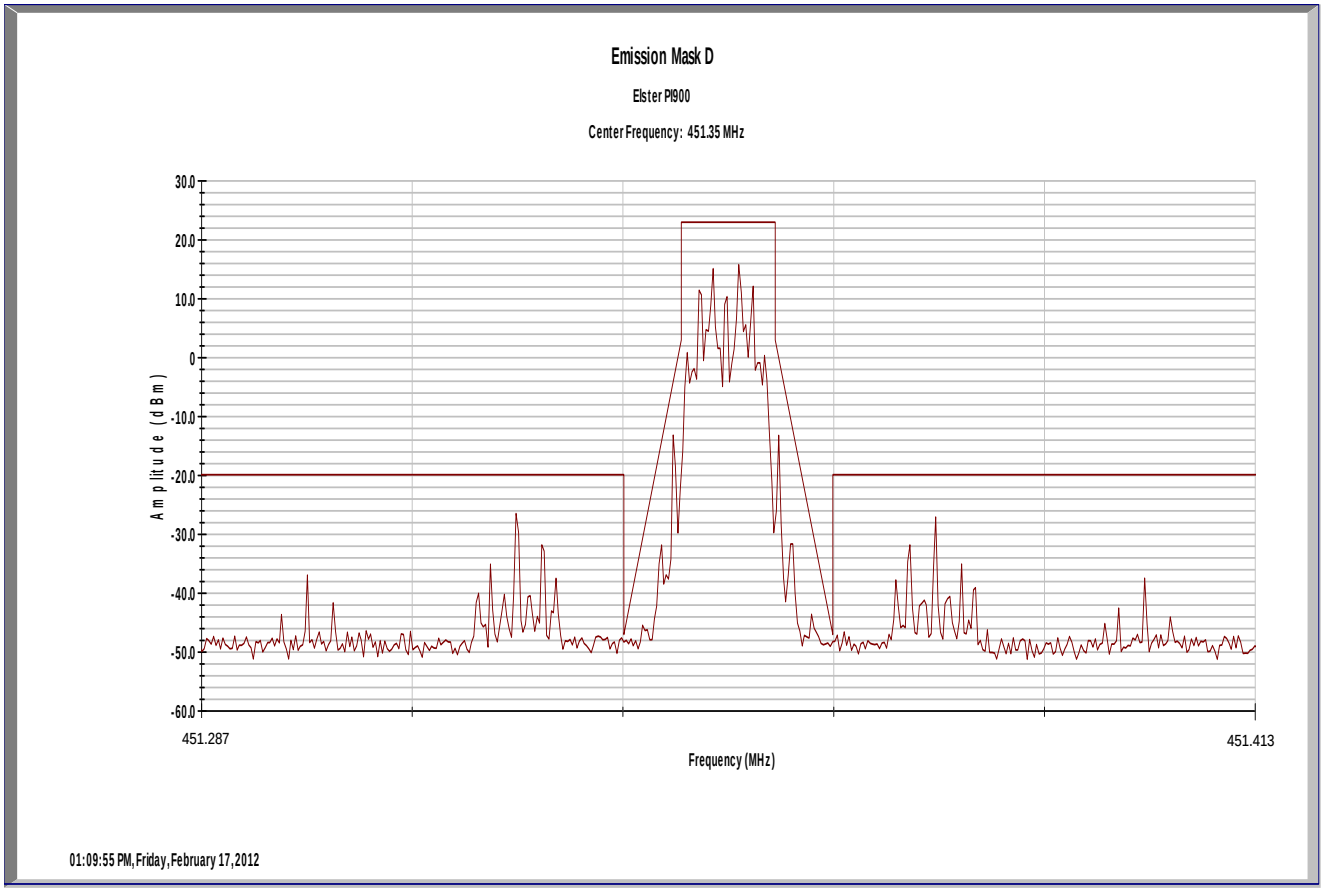


Figure 3: Peak

RBW: 100 Hz

VBW: 300 Hz,

Sweep: 100 S

Span: 126 kHz (50 kHz beyond either side of the Allowed bandwidth)

4.4 Emission Mask D beyond 50kHz from edge of authorized bandwidth

The maximum allowed bandwidth using Emission Mask D.

4.4.1 Test Over View

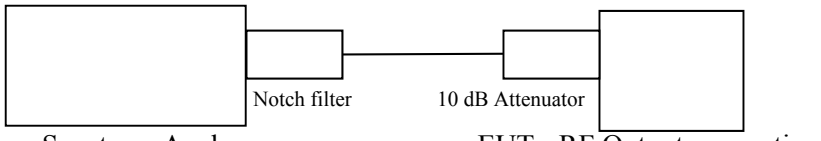
Results	**Complies** (as tested per this report)				**Date**	17 February 2012	
Standard	FCC Part 90.210(d) and RSS-119, Table 6 – Emission Mask D						
Product Model	PI900			**Serial#**	Production Sample		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	7.2V DC Battery	**Temp**	75º F	**Humidity**	43%	**Pressure**	1001 mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

4.4.2 Test Procedure

Emissions must be 50 + 10log(Po) dB below the mean power output of the transmitter. Method of measurements: The tabulated data shows the results of the Conducted field strength emissions test.

The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental. This test was conducted per TIA/EIA STANDARD 603 Section 2.2 "Methods of Measurement for Transmitters, using conducted power measurement method.

Test Setup:



4.4.3 Final Test

The Band width emissions are below the level of emission mask D. A tunable notch-filter was placed in line to keep from overloading the spectrum analyzer.

Freq (MHz)	Pk	Qp	Av	RBW	VBW
542.00	-85.32	-89.59	-93.10	100 kHz	300 kHz
902.72	-42.17	-42.49	-42.85	100 kHz	300 kHz
1354.00	-58.90	-59.72	-61.01	1 MHz	3 MHz
4513.60	-67.23	-72.77	-79.26	1 MHz	3 MHz

Figure 4: Table showing conducted emissions, see plots below

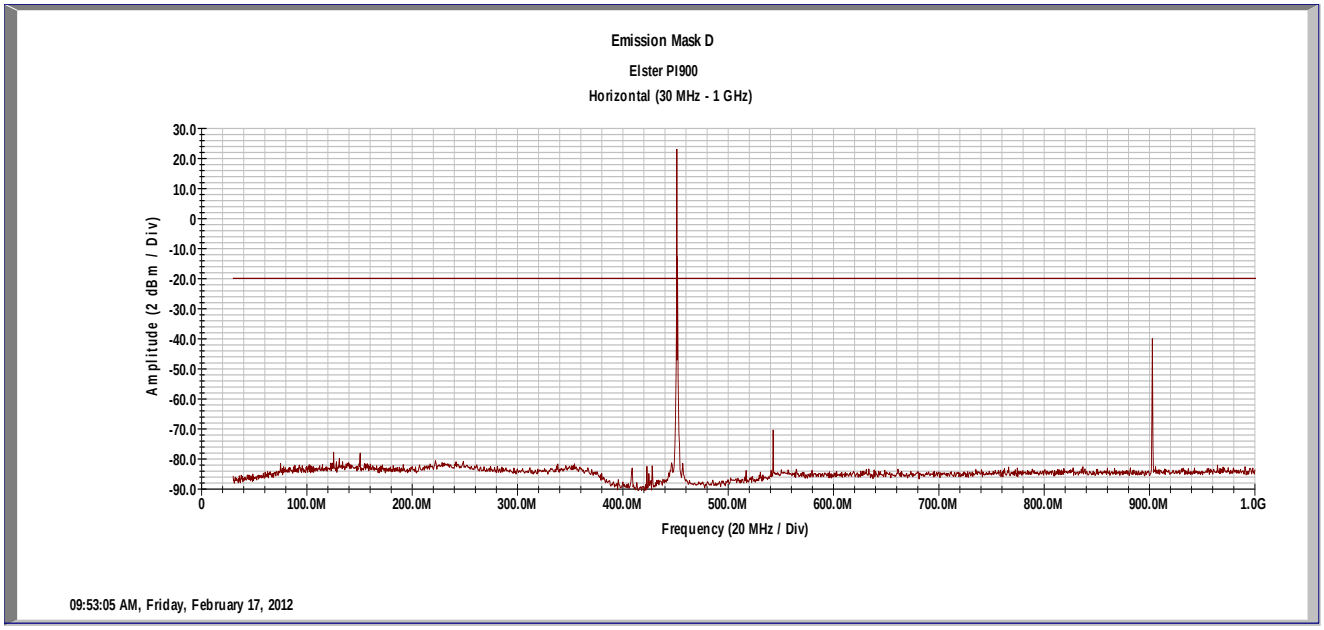


Figure 5: Emission Mask D – 20 MHz to 1 GHz - Emissions beyond the

RBW: 100 kHz, VBW: 300 kHz

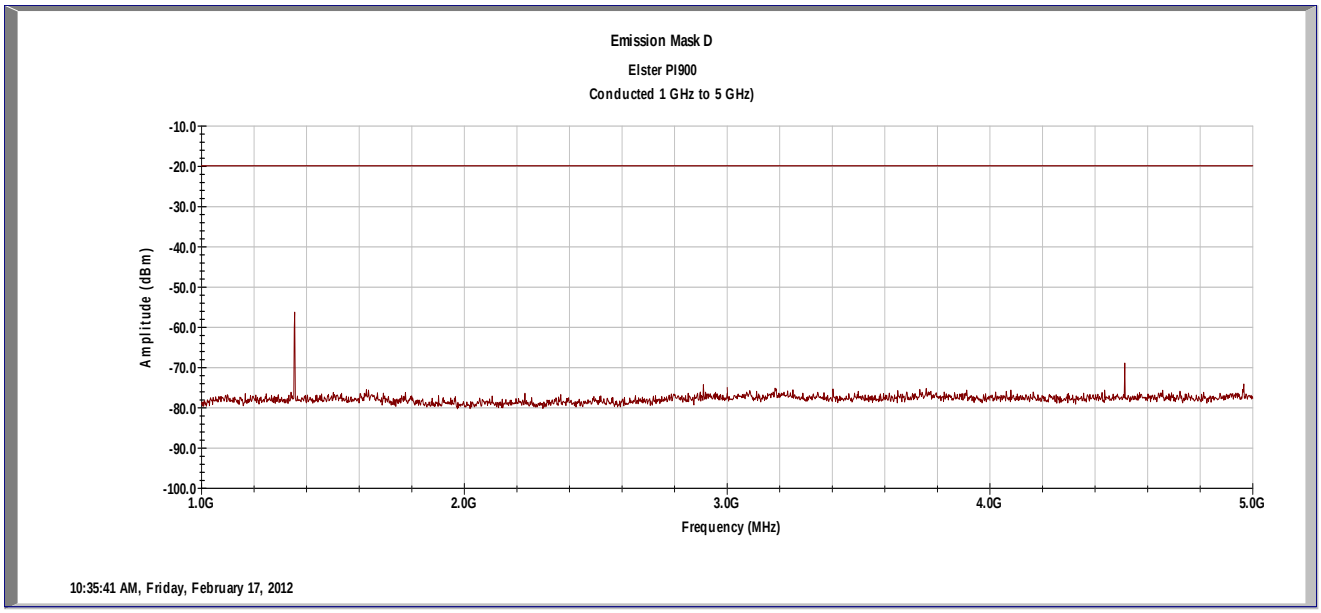


Figure 6: Emission Mask D – 1 GHz to 5 GHz

RBW: 1 MHz, VBW: 3 MHz

4.5 99% Power Bandwidth

For the purpose of RSS-GEN Section 4.6.1; When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

4.5.1 Test Over View

Results	**Complies** (as tested per this report)				**Date**	17 February 2012	
Standard	RSS-GEN section 4.6.1						
Product Model	PI900			**Serial#**	Production Sample		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	7.2V DC Battery	**Temp**	75º F	**Humidity**	43%	**Pressure**	1001 mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

4.5.2 Test Procedure

Using the procedures of RSS-GEN section 4.6.1, the 100 Hz resolution bandwidth is close to the 1% of the 40 kHz span. The Video bandwidth is 3 times that of the resolution bandwidth.

The limit of the bandwidth shall be within emission Mask D.

4.5.3 Deviations

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

4.5.4 Final Test

The EUT met the performance criteria requirement as specified in the test plan of this report and in the standards.

4.5.5 Final Data

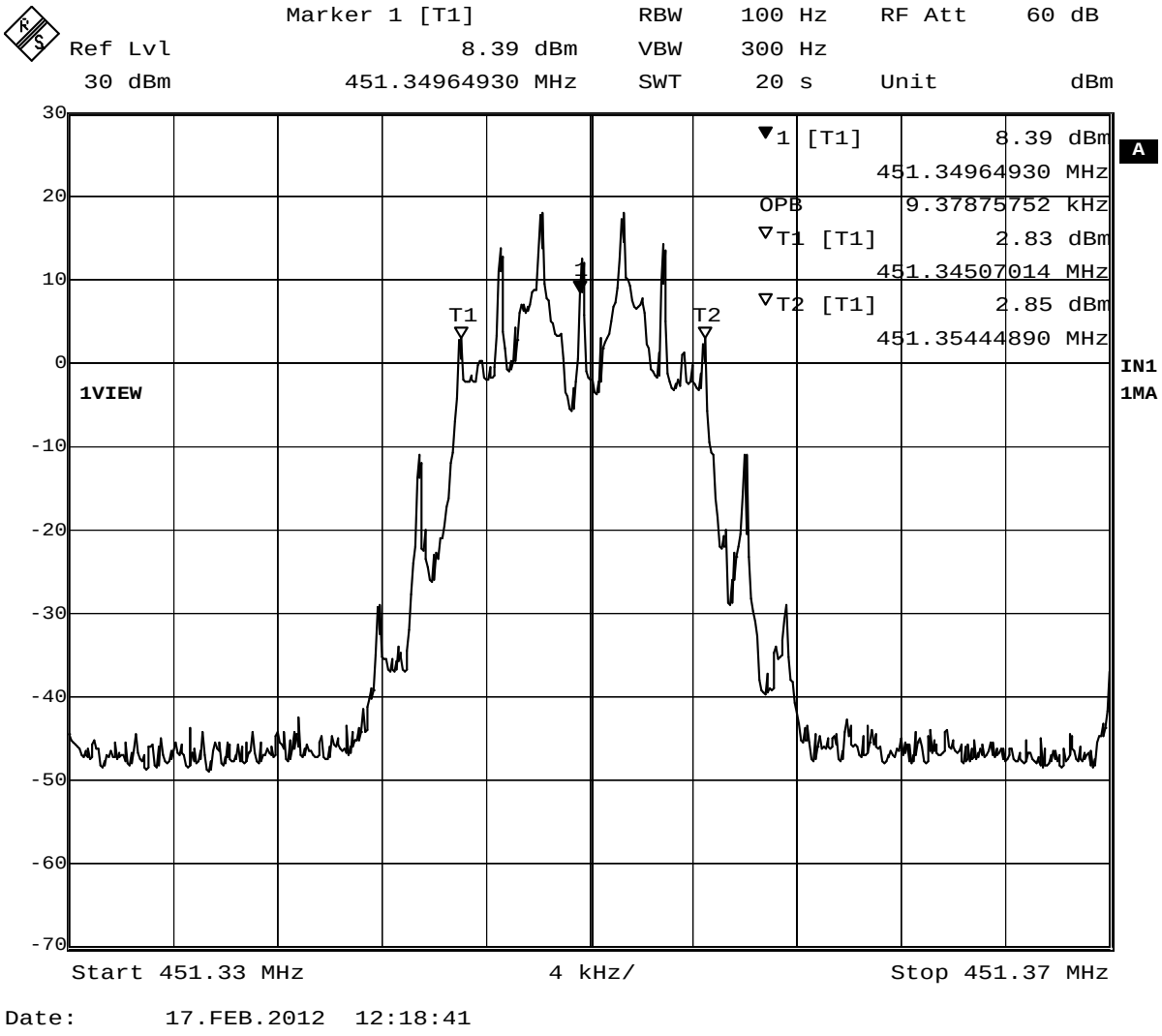


Figure 7 – 99% Power Bandwidth = 9.38 kHz

Spectrum Analyzer Parameters:
RBW=100 Hz
Span=40 kHz
VBW= 300Hz
LOG dB/div.= 10dB
Sweep = Auto
Detector = Peak detector, max hold

The EUT is compliant to the requirements of RSS-GEN

5 Radiated Spurious Emissions

5.1 Spurious Emissions Outside the band – 450 MHz Band

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power, based on either RF conducted or radiated measurements. Conducted antenna port measurements are provided in Section 5.1 of this report to show that the EUT meets these requirements at the band edges.

5.1.1 Over View of Test

Results	**Complies** (as tested per this report)					**Date**	14 November 2011
Standard	FCC Parts 15.109(a) and RSS-GEN						
Product Model	PI900			**Serial#**		Production Sample	
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	7.2V DC Battery	**Temp**	75º F	**Humidity**	43%	**Pressure**	1020 mbar
Perf. Criteria	(Below Limit)			**Perf. Verification**		Readings Under Limit	
Mod. to EUT	None			**Test Performed By**		Mark Ryan	

5.1.2 Test Procedure

Testing was performed in accordance with 47 CFR Part 15, ANSI C63.10:2009, RSS-GEN Issue 2. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

5.1.3 Deviations

Although this test isn't required, it was made just to make sure no un-foreseen signals were emitted over the air using the narrow bandwidth and / or the external antenna.

5.1.4 Final Test

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

The worst –case emissions are shown below. All other emissions are on file at TUV Rheinland.

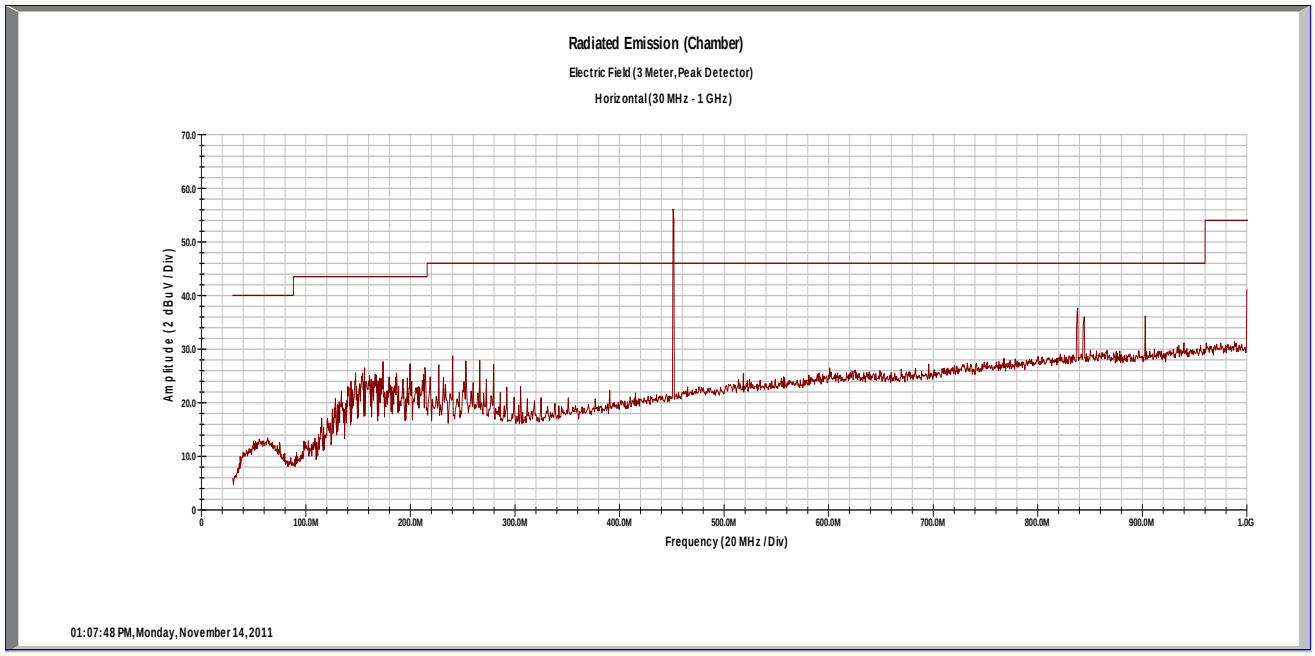
Radiated Emissions
451 MHz Wake Up Tone Fundamental

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)
451.35	V	1.2	315	102.78	0.00	2.29	16.20	121.27	NA	NA
451.35	H	1	290	84.12	0.00	2.29	16.20	102.61	NA	NA

Notes: Wakeup tone at 451 MHz, Measured at 3m

Worst Case orientation

Radiated Emissions - 451 MHz Wake Up Tone
Vertical



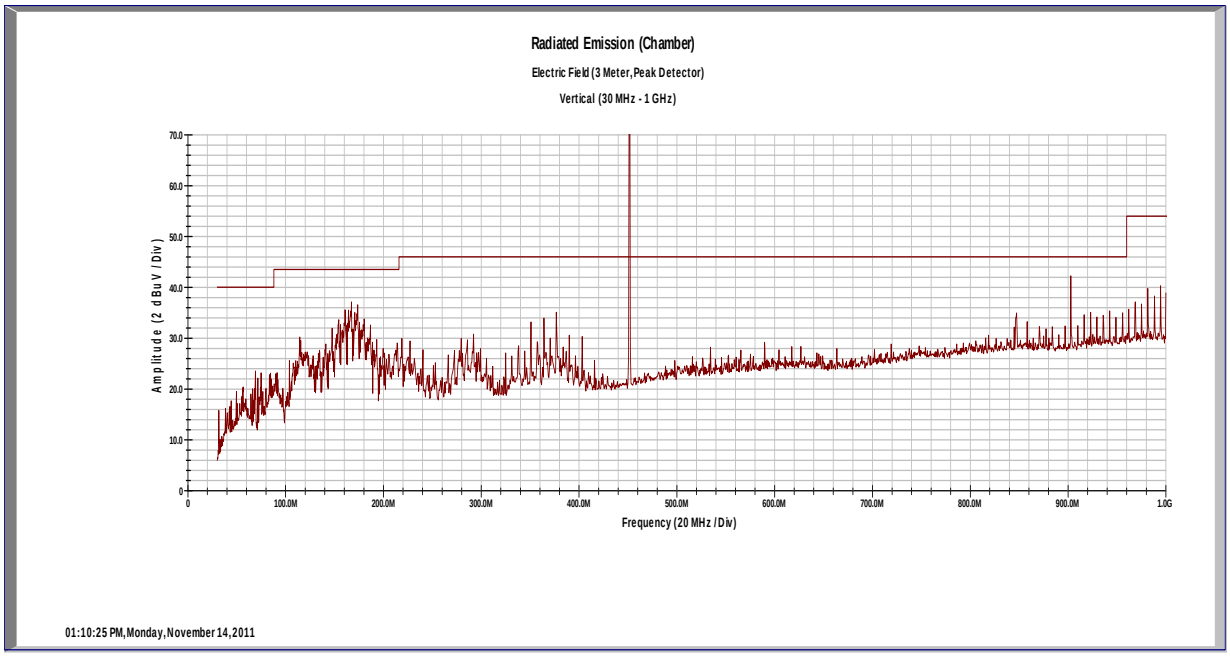
Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
1000.00	H	1	4	14.77	0.00	3.49	23.90	42.16	54.00	-11.84

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

Combined Standard Uncertainty $u_c(y)$ = ± 2.26dB Expanded Uncertainty $U = 4.52\ ku_c(y)$ k = 2 for 95% confidence

Notes: The spike at 450 MHz is the fundamental frequency.
A tuned notch filter at the fundamental frequency was used in these measurements.

Radiated Emissions - 451 MHz Wake Up Tone
Horizontal



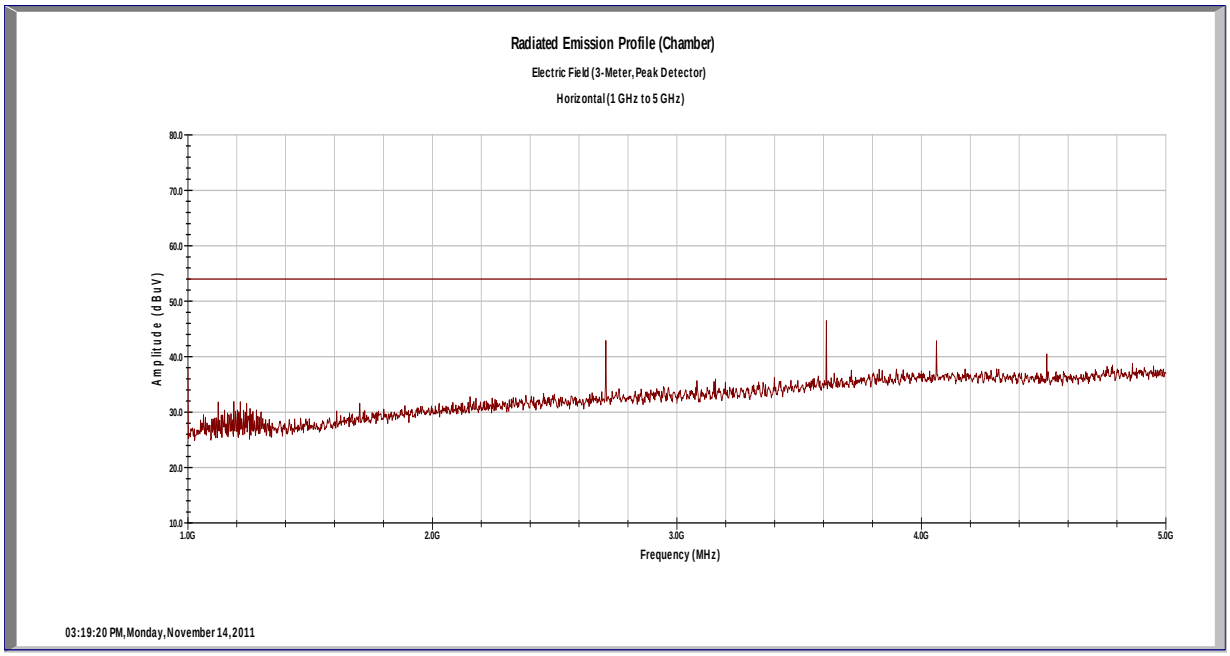
Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
154.12	V	1	237	18.04	0.00	1.36	8.15	27.54	43.50	-15.96
363.96	V	1	0	15.17	0.00	2.10	14.80	32.07	46.00	-13.93
902.68	V	1.1	206	18.10	0.00	3.32	22.50	43.92	46.00	-2.08
994.48	V	1.2	355	9.91	0.00	3.48	23.90	37.29	54.00	-16.71

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

Combined Standard Uncertainty $u_c(y)$ = ± 2.26dB Expanded Uncertainty $U = 4.52\ ku_c(y)$ k = 2 for 95% confidence

Notes: The spike at 450 MHz is the fundamental frequency.
A tuned notch filter at the fundamental frequency was used in these measurements.

Radiated Emissions - 451 MHz Wake Up Tone
Vertical



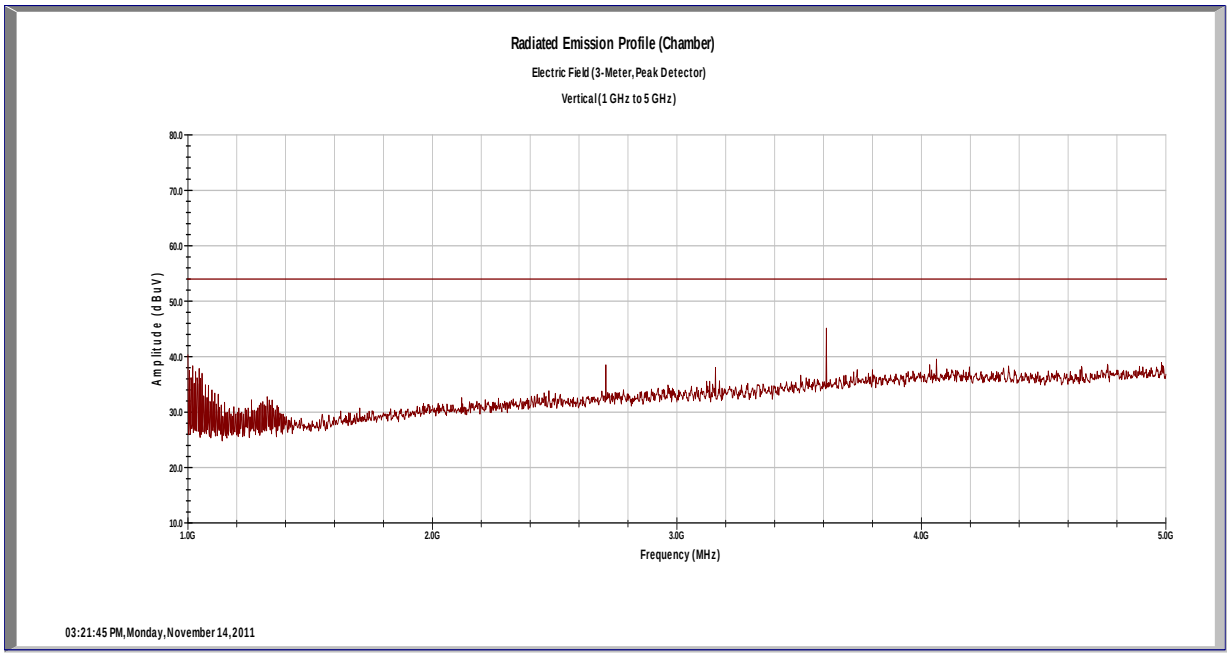
Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
2708.40	H	1	223	44.36	34.65	7.54	28.94	46.19	74.00	-27.81
2708.40	H	1	223	37.22	34.65	7.54	28.94	39.05	54.00	-14.95
3610.80	H	1	262	44.50	34.59	8.85	31.63	50.40	74.00	-23.60
3610.80	H	1	262	39.56	34.59	8.85	31.63	45.46	54.00	-8.54
4062.00	H	1.1	222	41.20	34.22	9.76	32.30	49.04	74.00	-24.96
4062.00	H	1.1	222	32.40	34.22	9.76	32.30	40.24	54.00	-13.76

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

Combined Standard Uncertainty $u_c(y)$ = ± 2.26dB Expanded Uncertainty $U = 4.52\ ku_c(y)$ k = 2 for 95% confidence

Notes: A tuned notch filter at the fundamental frequency was used in these measurements.

Radiated Emissions - 451 MHz Wake Up Tone
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)
1078.40	V	1.3	0	50.75	35.82	4.69	24.71	44.33	74.00	-29.67
1078.40	V	1.3	0	42.86	35.82	4.69	24.71	36.44	54.00	-17.56
3610.80	V	1.2	218	43.57	34.59	8.85	31.63	49.47	74.00	-24.53
3610.80	V	1.2	218	28.09	34.59	8.85	31.63	33.99	54.00	-20.01

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

Combined Standard Uncertainty $u_c(y)$ = ± 2.26dB Expanded Uncertainty $U = 4.52\ ku_c(y)$ k = 2 for 95% confidence

Notes: Notes: A tuned notch filter at the fundamental frequency was used in these measurements.

6 RF Exposure

6.1 Exposure Requirements – FCC Part 2.1093 and RSS-102 Issue 4

FCC KDB # 447498 DO1 - Mobile and Portable Device RF Exposure and Procedures and Equipment Authorization Policies section 5) b) states the following:

Section 5)a): RF exposure is evaluated with a duty factor of 50% when the actual operation duty factor is ≤ 50%.
Section 5) b) i): The power thresholds and operating conditions in Table 1 are used to determine SAR test requirements for PTT radios required to comply with the general population exposure limit. When the occupational exposure limit applies, these power thresholds are increased by a factor of five (5) to determine the test requirements.

Table 1 - SAR Evaluation Power Thresholds for PTT devices, $f \leq 0.5$ GHz

Exposure Conditions	mW
Held to face ≥ 2.5 cm	250
Body-worn ≥ 1.5 cm	200
Body-worn ≥ 1.0 cm	150

Notes:
1. The time-averaged output power, corresponding to the required PTT duty factor, is compared with these thresholds.
2. The closest distance between the user and the device or its antenna is used to determine the power thresholds.

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RSS-102 section 2.5.1 states:
SAR evaluation is required if the separation distance between the user and the device is less than or equal to 20 cm, except when the device operates:

- from 3 kHz up to 1 GHz inclusively and its output power (i.e. the higher of the conducted or effective isotropic radiated power (e.i.r.p.) source-based time-averaged output power) is less than, or equal to 200 mW for General Public Use and 1000 mW for Controlled Use;

Per section 3.1 of RSS-102:
In addition to the above mentioned SAR standards, the following information shall apply when performing SAR evaluation:

- If a device has push-to-talk capability, a minimum duty cycle of 50% (on-time) shall be used in the evaluation. A lower duty cycle is only permitted if the transmission duty cycle is an inherent property of the technology or in the design of the equipment and not under user-control. Proof of the various on-off durations and a detailed method of calculation of the average power shall be included in the SAR evaluation. In general, maximum average power levels shall be used to determine compliance.

6.1.1 Test Procedure

If the antenna is located > 20cm from the user, then an MPE calculation is acceptable.

If the antenna is located < 20cm (portable / mobile / hand-held device) from the user, then SAR evaluation is required.

6.1.2 Evaluation

The EUT is considered a PTT hand-held device that is not body worn or held to the head during operation.

The EUT is a hand-held portable device where the antenna can be located less than 20cm from the user, therefore SAR evaluation is required.

The EUT is not sold to the general public and is used in a controlled occupational environment.

6.1.2.1 Evaluation for FCC for 451 MHz Band

The EUT is an occupational, hand-held, portable Push To Talk (PTT) device that will be held from the face ≥2.5 cm at $f \leq 0.5$ GHz, therefore SAR evaluation to table 1 of FCC KDB # 447498 DO1 is required.

SAR testing will not be required if the level is below 250 mW eirp for the general population exposure limit or 5 x 250 mW = 1250 mW eirp for occupational exposure limit.

At 451 MHz, the antenna has a gain of 3.12 dBi, which is a numeric gain of 2.05.

The maximum power output plus maximum antenna gain of the EUT is:

198.7 mW * 2.05 (numerical antenna gain) * 0.5 (50% duty cycle* for PTT) = 203.66 mW.

The EUT is below the 250.0 mW reference power level for general population exposure.

*Note: Refer to note 28 of FCC KDB # 447498 DO1 for duty factor on PTT devices.

6.1.2.2 Evaluation for Industry Canada for 451 MHz Band.

The EUT is an occupational, hand-held, portable Push To Talk (PTT) device. According to the manufacturer, the operation in this band is considered to be a PPT device.

SAR testing will not be required if the level is below 200 mW eirp for the General Public Use exposure limit or 1000 mW eirp for Controlled Use exposure limit .

At 451 MHz, the antenna has a gain of 3.12 dBi, which is a numeric gain of 2.05.

The maximum power output plus maximum antenna gain of the EUT is:

198.7 mW * 2.05 (numerical antenna gain) * 0.5 (50% duty cycle for PTT) = 203.66 mW.

The EUT is well below the 1000 mW reference power level for Controlled Use exposure.

6.1.3 Conclusion

SAR test data is not required for either FCC or Industry Canada.