TUV Rheinland of North America

Emissions Test Report

EUT Name: REX Water Module

EUT Model: REX WATER 900 MHZ

FCC Title 47, Part 15, SubpartC, RSS-210 Issue 5

Prepared for:

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Report/Issue Date: 29 September 2005
Report Number: 30561434.001

Statement of Compliance

Manufacturer:	Elster Electricity, LLC 208 South Rogers Lane Raleigh, NC 27610 919 212-4700
Requester / Applicant:	Bob Mason
Name of Equipment:	REX Water Module Model No. REX WATER 900 MHZ
Type of Equipment:	Intentional Radiator
Application of Regulations:	FCC Title 47, Part 15, SubpartC, RSS-210 Issue 5
Test Dates:	22 June 2005 to 22 July 2005

Guidance Documents:

Emissions: FCC 47 CFR Part 15, RSS-210 Issue 5

Test Methods:

Emissions: ANSI C63.4:2003

The electromagnetic compatibility test and documented data described in this report has been performed and recorded by TUV Rheinland of North America, in accordance with the standards and procedures listed herein. As the responsible authorized agent of the EMC laboratory, I hereby declare that a sample of one, of the equipment described above, has been shown to be compliant with the EMC requirements of the stated regulations and standards based on these results. If any special accessories and/or modifications were required for compliance, they are listed in the Executive Summary of this report.

This report must not be used to claim product endorsement by NVLAP or any agency of the U.S. Government. This report contains data that are not covered by NVLAP accreditation. This report shall not be reproduced except in full, without the written authorization of the laboratory.

Eugene J Marls

29 September 2005

NVLAP Signatory

Date

1 Executive Summary

1.1 Scope

This report is intended to document the status of conformance with the requirements of the FCC Title 47, Part 15, SubpartC, RSS-210 Issue 5 based on the results of testing performed on *22 June* 2005 through *22 July* 2005 on the *REX Water Module* Model No. *REX WATER 900 MHZ* manufactured by Elster Electricity, 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 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

Table 1 - Summary of Test Results

Test	Test Method(s)	Test Parameters	Measurement	Result
Channel Seperation	FCC Part 15.247(a)(1)	Greater of 25 kHz or 20 dB bandwidth	400.1 kHz	**compliant**
Pseudorandom Hopping Algorithm				**compliant**
Time of Occupancy	FCC Part 15.247(a)(1)(i)	=<0.4 sec in 10 sec.	0.396 sec in 10sec	**compliant**
Occupied Bandwidth	FCC Part 15.247(a)(1)(i)	=<500kHz	380 kHz	**compliant**
Peak Output Power	FCC Part 15.247(b)(2)	0.25 Watts	0.245 Watts	**compliant**
Spurious Emissions	FCC Part 15.247(C)	Table FCC Part 15.209	48.96 dBuV/m @ 3meters Average	**compliant**
Frequency Hopping Spread Spectrum Systems	FCC Part 15.247(g)			**compliant**
Incorporation of Intelligence	FCC Part 15.247(h)			**compliant**
Frequency Stability	FCC Part 15.215(c)	Containment of 20 dB bandwidth between 902 and 928	902.623 MHz - 915.013 MHz	**compliant**
Radiated Emissions Class B (when not transmitting)	FCC Part 15.109(a)	Table FCC Part 15.109(a)	27.27 dBuV/m @ 3meters QP	**compliant**
Conducted Emissions	N/A	Table FCC Part 15.207	EUT is battery operated.	**N/A**

1.4 Special Accessories or Equipment Modifications

No special accessories or modifications were necessary in order to achieve compliance.

2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland of North America at the 762 Park Ave. Youngsville, N.C 27596 address 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, 18, and 90. The accreditation is updated every 3 years.

2.1.2 NIST / NVLAP

TUV Rheinland of North America is accredited by the National Voluntary Laboratory Accreditation 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 Guide 25 and ISO 9002 (Lab code 200094-0). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 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 of North America 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 and C-1236).

2.1.4 Acceptance By Mutual Recognition Arrangement

The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland of North America at the 762 Park Ave. Youngsville, N.C 27596 address test results and test reports within the scope of the laboratory NIST / NVLAP accreditation will be accepted by each member country.

2.2 Test Facilities

All of the test facilities are located at 762 Park Ave., Youngsville, North Carolina 27596, USA.

2.2.1 Emission Test Facility

The Open Area Test Site and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7:1992. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4:1992, at a test distance of 3 and 10 meters. This site has been described in reports dated May 12, 1997, submitted to the FCC, and accepted by letter dated June 25, 1997 (31040/SIT 1300F2).

The site is listed with the FCC and accredited by NVLAP (code 200094-0). The 5m semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4:1992, at a test distance of 3 meters. A report detailing this site can be obtained from TUV Rheinland of North America.

2.2.2 Immunity Test Facility

ESD, EFT, Surge, PQF: These tests are performed in an environmentally controlled room with a 3.7m x 3.7m x 3.175mm thick aluminum floor connected to PE ground. For ESD testing, tabletop equipment is placed on an insulated mat with a surface resistivity of 10^9 Ohms/square on a 1.6m x 0.8m x 0.8m high non-conductive table with a 3.175mm aluminum top (Horizontal Coupling Plane). The HCP is connected to the main ground plane via a low impedance ground strap through two 470 kΩ resistors. The Vertical Coupling Plane consists of an aluminum plate 50cm x 50cm x 3.175mm thick. The VCP is connected to the main ground plane via a low impedance ground strap through two 470 kΩ resistors. For each of the other tests, the HCP is removed.

RF Field Immunity testing is performed in a 7.3m x 3.7m x 3.2m anechoic chamber.

RF Conducted and Magnetic Field Immunity testing is performed on a 4.9m x 3.7m x 3.175mm thick aluminum ground plane which is connected to one end of the anechoic chamber.

All test areas allow a minimum distance of 1 meter from the EUT to walls or conducting objects.

2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st addition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities, equal to the positive square root of a sum of terms, the terms being the variances or co-variances of these other quantities weighted according to how the measurement result varies with changes in these quantities. The term standard uncertainty is the result of a measurement expressed as a standard deviation.

The Expanded Uncertainty defines an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand. The fraction may be viewed as the coverage probability or level of confidence of the interval.

The test system for conducted emissions is defined as the LISN, spectrum analyzer, coaxial cables, and pads. The test system for radiated emissions is defined as the antenna, spectrum analyzer, pre-amplifier, coaxial cables, and pads. The conducted test system has a combined standard uncertainty of ± 1.2 dB. The radiated test system has a combined standard uncertainty of ± 1.6 dB. 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.

2.4 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 Guide 25.

3 Product Information

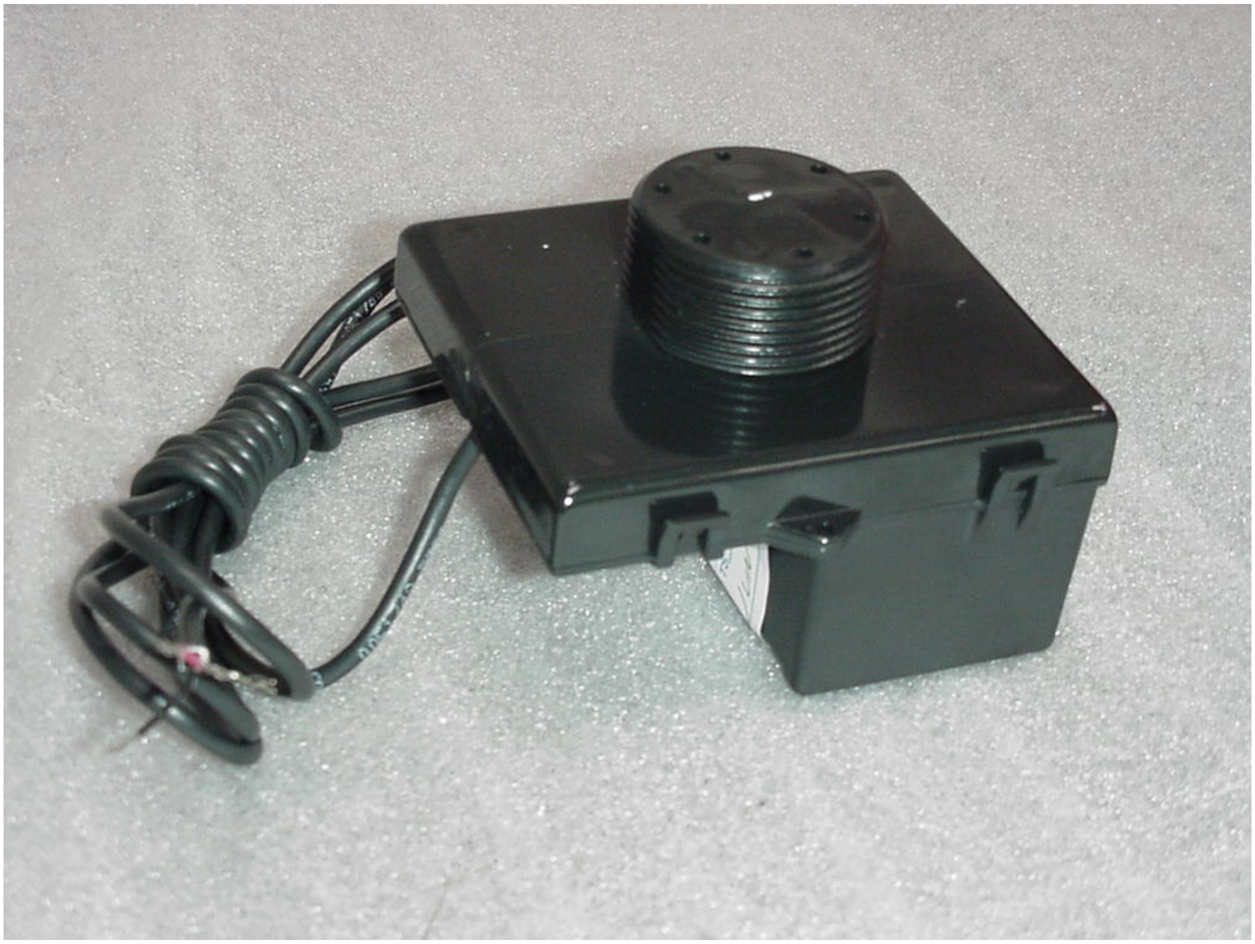


Figure 1 – Photo of EUT

3.1 Product Description

The information for all equipment used in the tested system, including: descriptions of cables, clock and microprocessor frequencies, EMI critical components, and accessory equipment has been supplied by the manufacturer and is listed in Section 6 of this report.

3.2 Equipment Configuration

A description and justification of the equipment configuration is given in the EMC Test Plan. The EUT was tested as described in the EMC Test Plan and was configured and operated in a manner consistent with its intended use. The EUT was connected to rated power and allowed to warm up to normal operating conditions. The placement of the EUT system components was guided by the test standard and selected to represent typical installation conditions.

In the case of an EUT that can operate in more than one configuration, preliminary testing was performed to determine the configuration that produced maximum radiation.

The final configuration was selected to produce worse case radiation and place the EUT in the most susceptible state. There were no deviations from the description of the Equipment Configuration given in the EMC Test Plan.

3.3 Operation Mode

A description and justification of the operation mode is given in the EMC Test Plan.

In the case of an EUT that can operate in more than one state, preliminary testing was performed to determine the operating mode that produced maximum radiation.

The final operating mode was selected to produce worse case radiation and place the EUT in the most susceptible state. There were no deviations from the description of the Operation Mode given in the EMC Test Plan.

4 Emissions

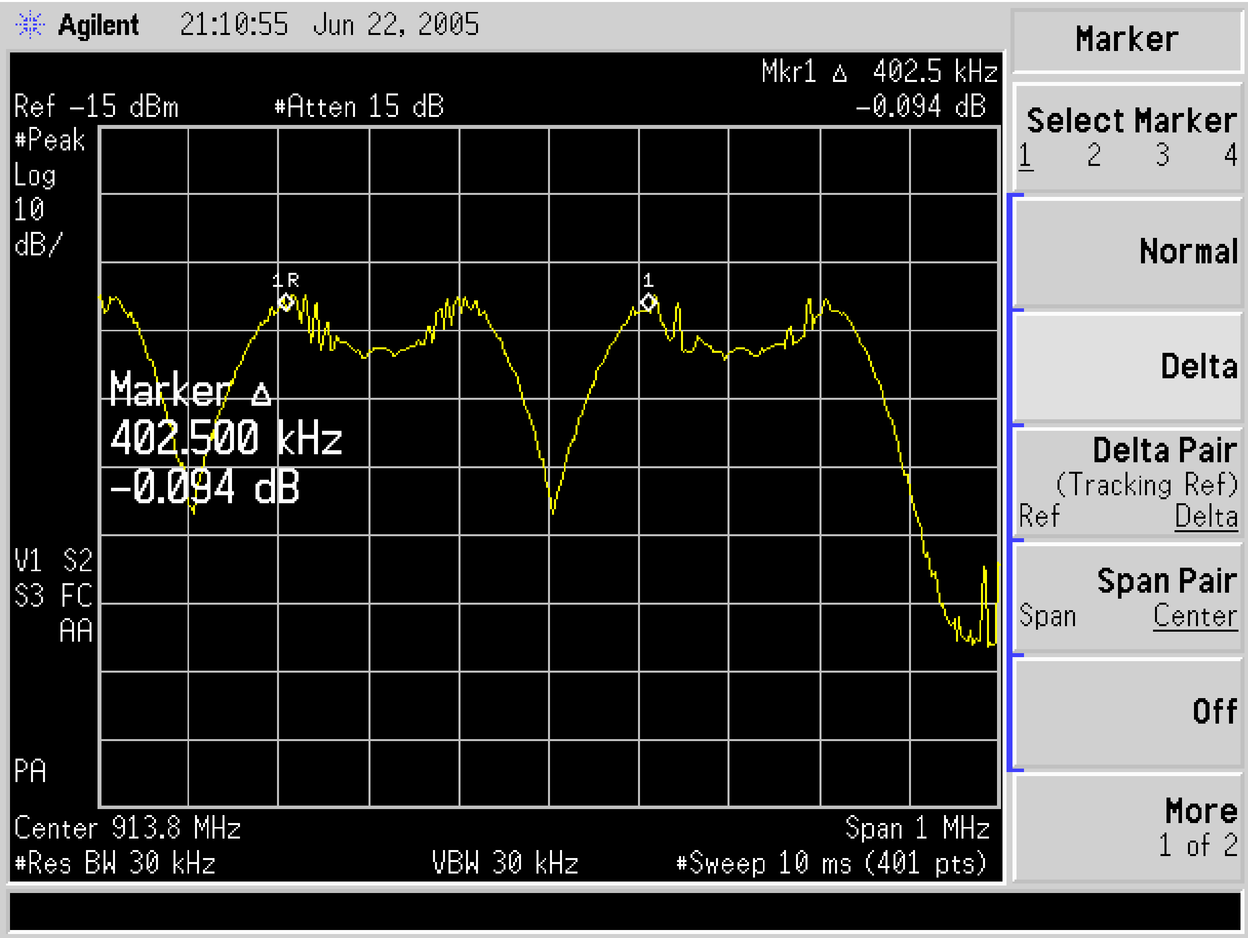
Testing was performed in accordance with 47 CFR Part 15, ANSI C63.4:1992, RSS-210 Issue 5. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

4.1 Channel Seperation Part 15.247(a)(1)

Frequency hopping Systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Bandwidth=370kHz

Channel Separation=402.5kHz



4.2 Pseudorandom Hopping Algorithm FCC Part 15.247(a)(1)

The system shall hop to channel frequencies that are selected from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their transmitters and shall shift frequencies in synchronization with the transmitted signals.

The pseudo-random hop table is used to determine the transmitter's frequency hop sequence. The transmitter is slow hopping frequency system where the entire data packet is sent on a single channel. After sending a data packet, the transmitter uses the next channel in the pseudo-random hop table. Each frequency in the hop table is used before the transmitter will hop to a frequency already used. The receiver is a single IF system whose bandwidth is 330 kHz. When not synchronized to a transmitting device, the receiver is constantly hopping across the 25 channels scanning for a valid preamble from a transmitter. Once a valid preamble is detected, the receiver is synchronized to the transmitter and receives the data packet. After the transmission, the receiver returns to the scanning mode where it can look for another packet from either the same device or a different device.

Index	Channel	Center Frequency (MHz)
1	12	907.2
2	29	914
3	5	904.4
4	19	910
5	11	906.8
6	23	911.6
7	26	912.8
8	13	907.6
9	22	911.2
10	15	908.4
11	1	902.8
12	25	912.4
13	4	904
14	21	910.8
15	14	908
16	27	913.2
17	8	905.6
18	31	914.8
19	18	909.6
20	16	908.8
21	7	905.2
22	20	910.4
23	3	903.6
24	28	913.6
25	6	904.8

Sample hop table

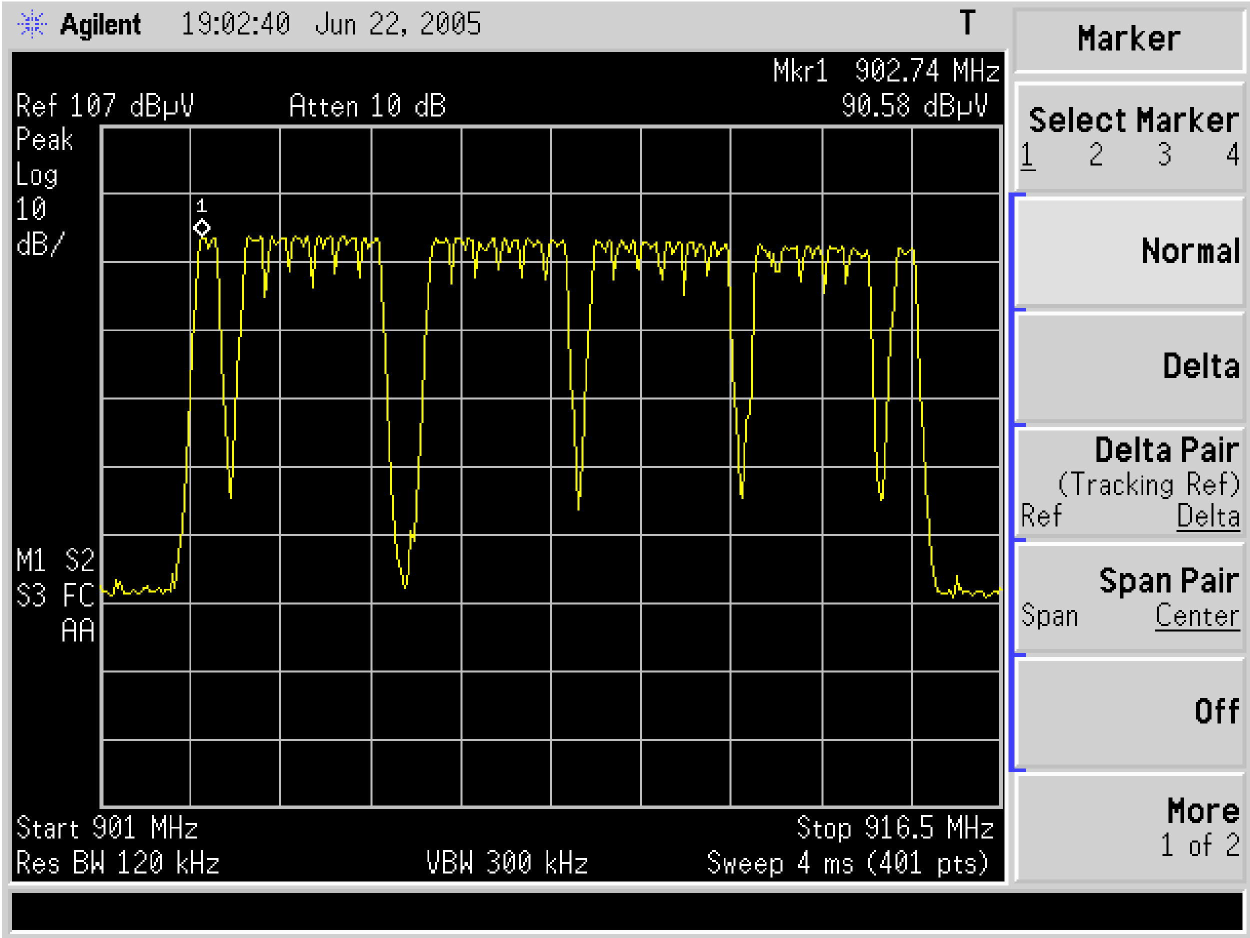


Figure 2 - Plot of hopping Channels

4.3 Time of Occupancy FCC Part 15.247(a)(1)(i)

Frequency Band (MHz)	20 dB Bandwidth	Number of Hopping Channels	Average Time of Occupancy
902-928	=>250 kHz	25	=<0.4 sec. In 10 sec.

The spectrum analyzer was set as follows:

RBW=1MHz

VBW=RBW

Span=0Hz

LOG dB/div.= 10dB

Sweep = 10 Sec.

Trigger Video

The occupancy time was measured as above. There were 4 hops at .099 seconds per hop for any 10 sec. Period. Time of occupancy equals number of hops multiplied by the duration of one hop.

Time of Occupancy = 0.396 seconds in any 10 second period.

4.4 Occupied Bandwidth FCC Part 15.247(a)(1)(i)

The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

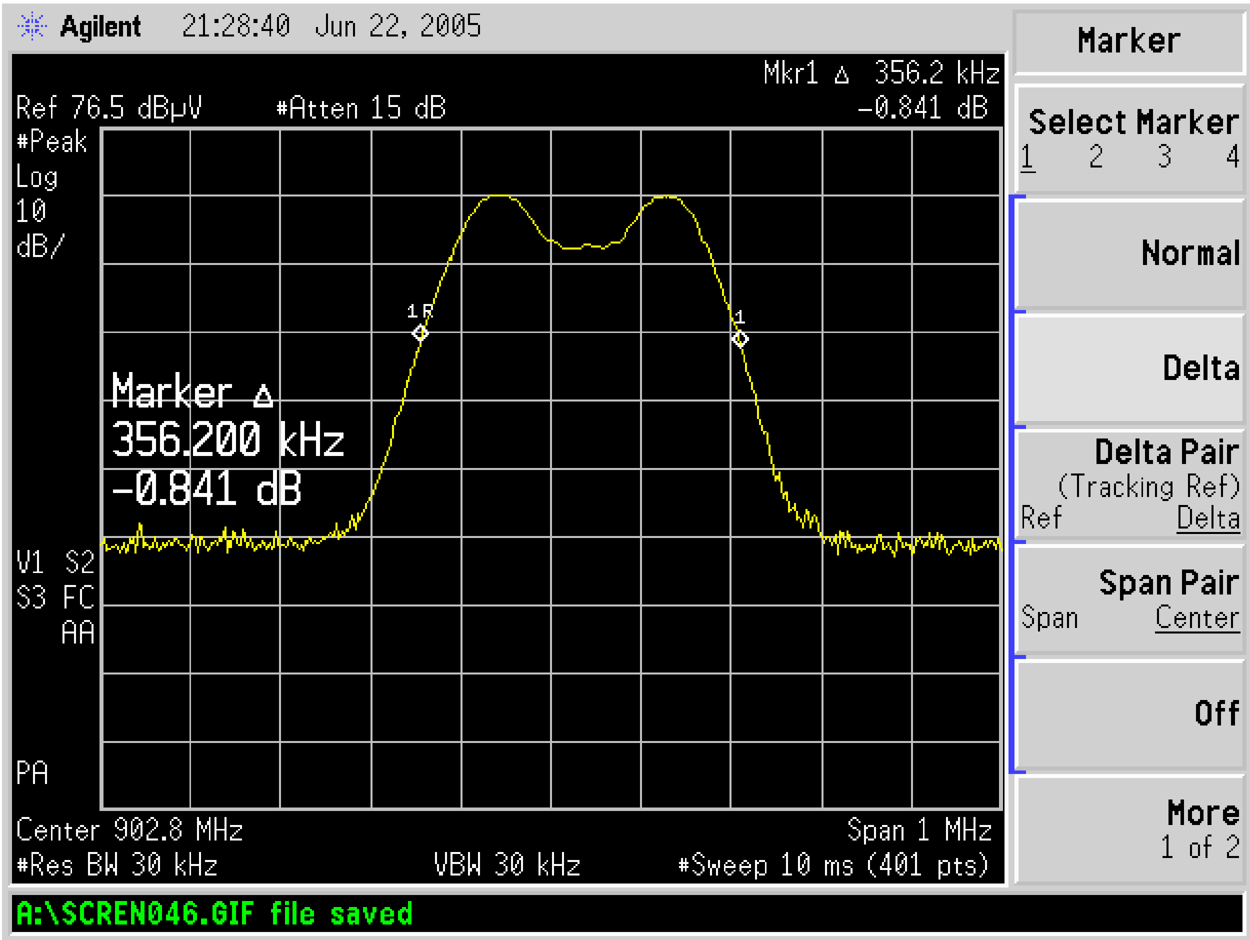


Figure 3 – CH1 Occupied Bandwidth

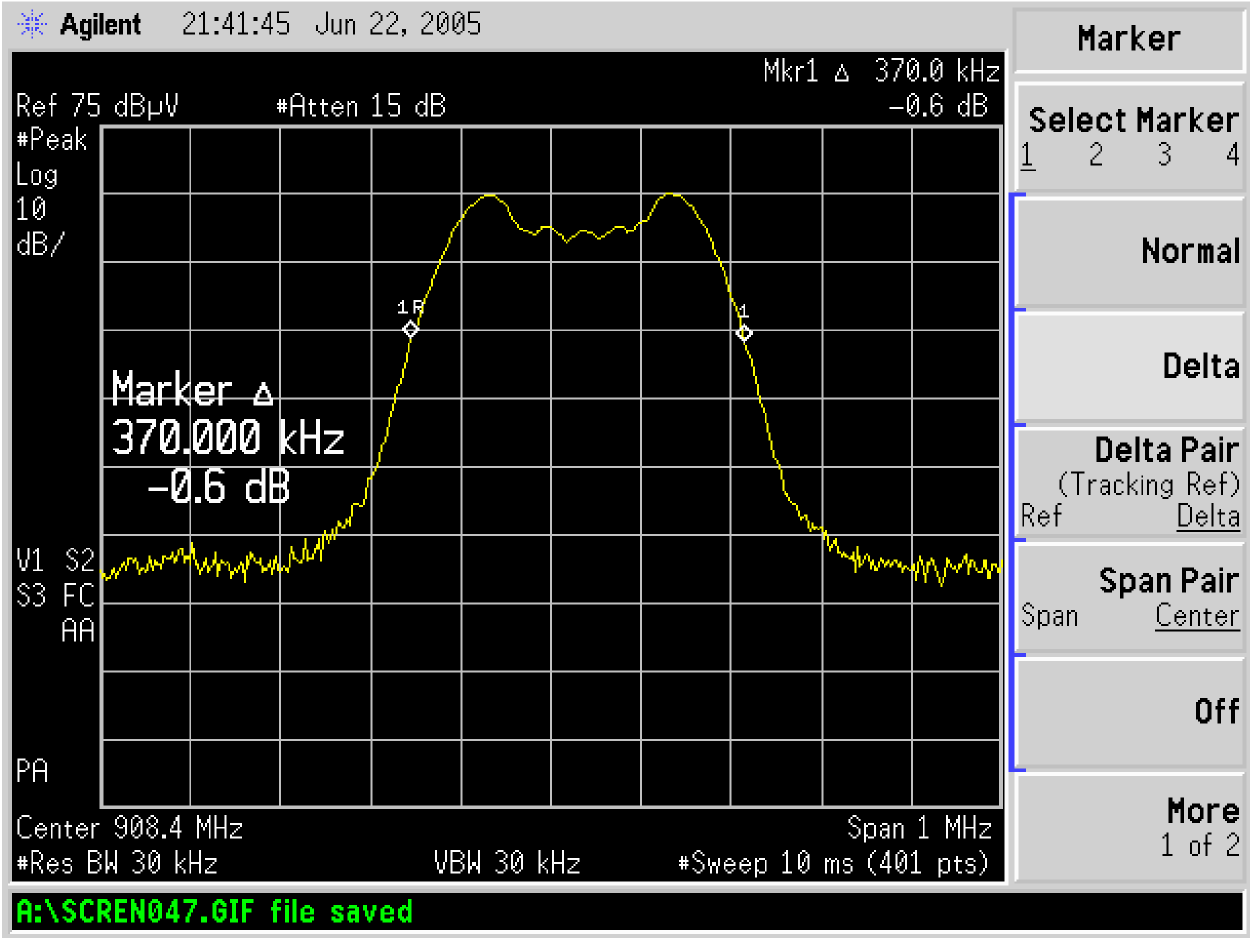


Figure 4 – CH15 Occupied Bandwidth

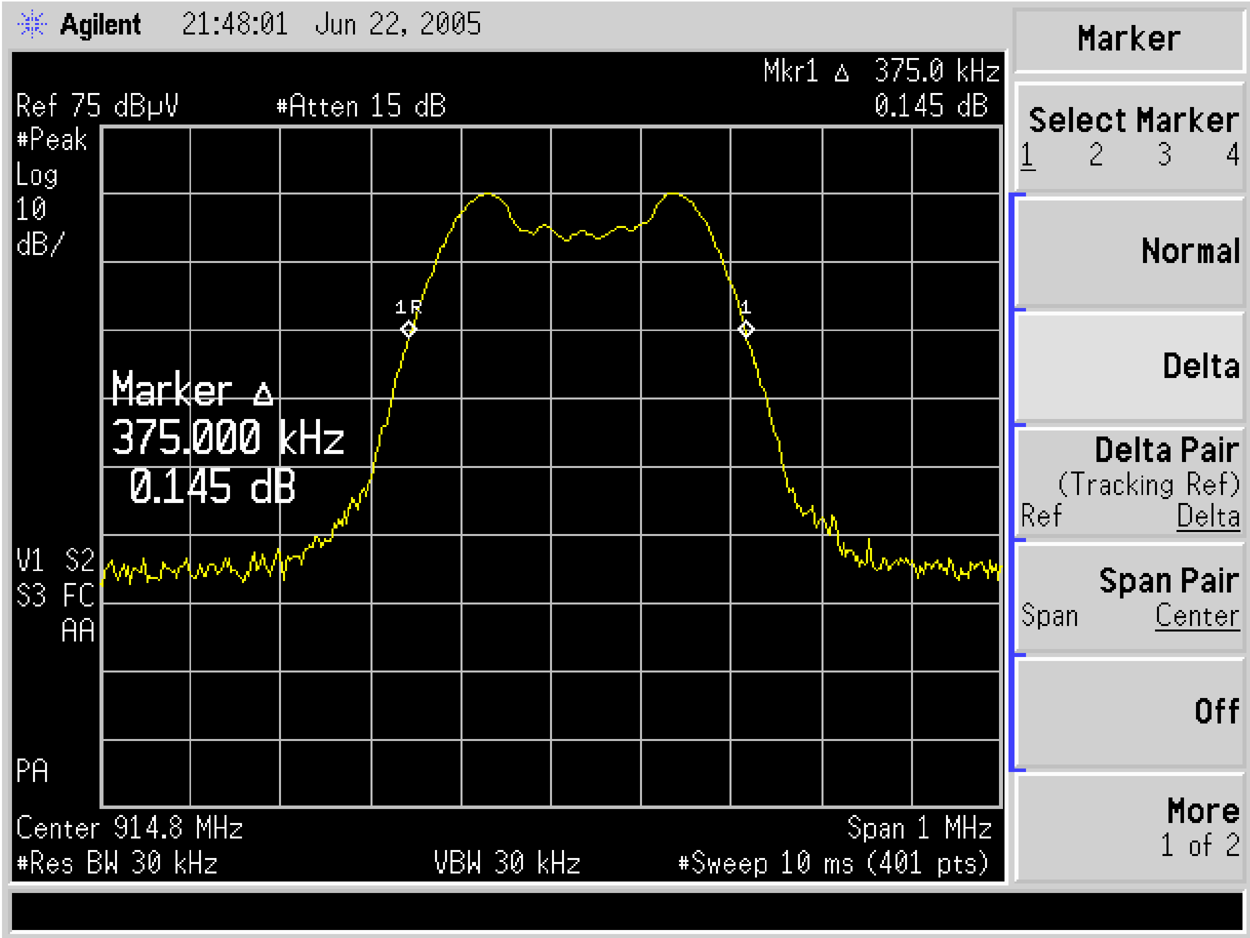


Figure 5 – CH31 Occupied Bandwidth

4.5 Peak Output Power FCC Part 15.247(b)(2)

The maximum peak output power of the intentional radiator shall not exceed 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels. (Conducted Measurement)

The peak output power was measured at CH1, CH15, and at CH31. The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. After the measurement was made the cable loss and the attenuator was added to the measurement. 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:

Peak Power Output CH1 = 0.153 Watts

CH15 = 0.160 Watts

CH31 = 0.168 Watts

4.5.1 Antenna Gain

If peak power output was performed using the conducted method then the antenna gain will be stated.

The Substitution method was used.

The measurement was performed with out modulation. The transmitter under test was placed on a non-conductive table 80cm above the ground plane. The spectrum analyzer was tuned to the transmitter carrier frequency and the turntable was rotated 360 degrees about the vertical axis until the highest maximum signal was received. Then the receive antenna was raised and lowered 1 to 4 meters until the maximum signal was detected. Then the substitution dipole antenna and signal generator replaced the transmitter under test. Both the receive and substitution dipole antennas were placed in the vertical polarization. The input signal to the substitution antenna was adjusted to the maximum signal received from the transmitter. The receive antenna was then raised and lowered to ensure the maximum signal was still received. The cable to the dipole was then removed and attached to a calibrated power meter to record the power level and added to the substitution dipole gain to obtain the EIRP level. Then the steps above were repeated for the horizontal polarization. The gain of the EUT antenna is the difference between the measured RF power at the RF port and the measured EIRP.

4.5.1.1 Results

Frequency	Polarization	Conducted Power Measurement	Measured EIRP	Antenna Gain
902.8 MHz	Vertical	21.85 dBm	25.17 dBm	3.32 dBi
902.8 MHz	Horizontal	21.85 dBm	14.87 dBm	-6.98 dBi
908.4 MHz	Vertical	22.04 dBm	24.87 dBm	2.83 dBi
908.4 MHz	Horizontal	22.04 dBm	14.17 dBm	-7.87 dBi
914.8MHz	Vertical	22.25 dBm	25.07 dBm	2.82 dBi
914.8 MHz	Horizontal	22.25 dBm	14.37 dBm	-7.88 dBi

4.6 Spurious Emissions FCC Part 15.247(c)

4.6.1 Test Methodology

4.6.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 300 kHz and provide a reading at each frequency for each 6° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

4.6.1.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

4.6.1.3 Deviations

There were no deviations from this test methodology.

4.6.2 Test Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

4.6.2.1 Radiated Emissions Outside the Frequency 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 radiated measurements.

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EUT Name	REX Water Module	**Date**	22 June 2005
EUT Model	REX WATER 900 MHZ	**Temp / Hum in**	70°F / 44%rh
EUT Serial	Not Serialized	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15, RSS-210 Issue 5	**Line DC**	3.6VDC
Deg/sweep	N/a	**RBW / VBW**	100kHz / 100kHz
Dist/Ant Used	3m / 3115_5770	**Performed by**	Mark Ryan

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)	20dB Below Fundamental (dBuV/m)	Spec Margin (dB)
Fundamental CH 1:										
902.80	H	1	133	86.00	0.00	3.36	23.40	112.76	N/a	N/a
1805.00	H	1.11	185	70.62	35.49	6.23	27.69	69.05	92.76	-23.71
902.80	V	1.3	79	91.88	0.00	3.36	22.26	117.50	N/a	N/a
1805.00	V	1.91	99	70.05	35.49	6.23	27.74	68.53	97.50	-28.97
Fundamental CH 15:										
908.40	H	1	131	84.57	0.00	3.38	23.40	111.35	N/a	N/a
1817.00	H	1.15	230	68.20	35.46	6.24	27.72	66.70	91.35	-24.65
908.40	V	1.32	91	87.85	0.00	3.38	22.37	117.4	N/a	N/a
1817.00	V	1	113	70.79	35.46	6.24	27.78	69.35	97.40	-28.05
Fundamental CH 31:										
914.80	H	1	132	82.55	0.00	3.38	23.50	109.43	N/a	N/a
1830.00	H	1.07	188	68.44	35.43	6.26	27.76	67.03	89.43	-22.40
914.80	V	1.32	90	87.72	0.00	3.38	22.59	117.50	N/a	N/a
1830.00	V	1.08	82	70.40	35.43	6.26	27.82	69.05	97.50	-28.45

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

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

RBW and VBW = 100kHz

Peak Measurements.

The fundamental of the EUT was tested in all three planes and the X plane was worst case.

4.6.2.2 Restricted band measurements

Radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a) (see 15.205(c)).

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EUT Name	REX Water Module	**Date**	23 June 2005
EUT Model	REX WATER 900 MHZ	**Temp / Hum in**	75°F / 38%rh
EUT Serial	Not Serialized	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15, RSS-210 Issue 5	**Line DC**	3.6VDC
Deg/sweep	N/a	**RBW / VBW**	See Note Below
Dist/Ant Used	3m / 3115_5770	**Performed by**	Mark Ryan

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)
Fundamental CH 1:										
Spurious Emissions, Peak Measurements;										
2708.00	H	1.31	249	54.08	35.34	7.78	29.52	56.04	74.00	-17.96
2708.00	V	1.11	105	56.39	35.34	7.78	29.44	58.26	74.00	-15.74
3611.00	H	1.31	143	50.43	34.99	9.13	31.63	56.20	74.00	-17.80
3611.00	V	1.00	118	50.46	34.99	9.13	31.59	56.19	74.00	-17.81
4514.00	H	1.44	117	51.73	35.11	10.57	32.85	60.04	74.00	-13.96
4514.00	V	2.44	113	46.32	35.11	10.57	32.84	54.62	74.00	-9.38
5417.00	H	1.44	100	42.79	34.74	11.51	34.63	54.19	74.00	-19.81
5417.00	V	1.49	113	43.43	34.75	11.59	34.53	54.81	74.00	-19.19
Spurious Emissions, Average Measurements;										
2708.00	H	1.31	249	44.56	35.34	7.78	29.52	46.52	54.00	-7.48
2708.00	V	1.11	105	46.66	35.34	7.78	29.44	48.53	54.00	-5.47
3611.00	H	1.31	143	41.28	34.99	9.13	31.63	47.05	54.00	-6.95
3611.00	V	1.00	118	41.27	34.99	9.13	31.59	47.00	54.00	-7.00
4514.00	H	1.44	117	42.21	35.11	10.57	32.85	50.52	54.00	-3.48
4514.00	V	2.44	113	36.26	35.11	10.57	32.84	44.56	54.00	-9.44
5417.00	H	1.44	100	32.33	34.74	11.51	34.63	43.73	54.00	-10.27
5417.00	V	1.49	113	31.18	34.75	11.59	34.53	42.56	54.00	-11.44

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

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Frequencies above fall within the restricted bands specified in part 15.205(a)

RBW/VBW=1MHz/1MHz for frequencies between 1 GHz to 10GHz for peak measurements.
RBW/VBW=1MHz/100Hz for frequencies between 1 GHz to 10GHz for average measurements.

The fundamental of the EUT was tested in all three planes and the X plane was worst case.

SOP 1 Radiated Emissions

Tracking # 30561434.001 Page 2 of 3

EUT Name	REX Water Module	**Date**	23 June 2005
EUT Model	REX WATER 900 MHZ	**Temp / Hum in**	75°F / 38%rh
EUT Serial	Not Serialized	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15, RSS-210 Issue 5	**Line DC**	3.6VDC
Deg/sweep	N/a	**RBW / VBW**	See Note Below
Dist/Ant Used	3m / 3115_5770	**Performed by**	Mark Ryan

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)
Fundamental CH 15:										
Spurious Emissions, Peak Measurements;										
2725.00	H	1.38	112	59.23	35.35	7.83	29.57	61.29	74.00	-12.71
2725.00	V	1.01	87	59.57	35.35	7.83	29.49	61.54	74.00	-12.46
3633.00	H	1.73	148	50.57	34.96	9.19	31.70	56.50	74.00	-17.50
3633.00	V	1.14	78	52.65	34.96	9.19	31.65	58.53	74.00	-15.62
4542.00	H	1.33	68	49.77	35.13	10.68	32.95	58.27	74.00	-15.73
4542.00	V	1.08	111	50.72	35.13	10.68	32.92	59.18	74.00	-14.82
5450.00	H	1.36	120	48.17	34.76	11.63	34.69	59.73	74.00	-14.27
5450.00	V	1.37	123	47.22	34.76	11.63	34.56	58.65	74.00	-15.35
7267.00	H	1.11	53	46.50	35.01	13.62	36.53	61.65	74.00	-12.35
7267.00	V	1.34	113	48.02	35.01	13.62	36.24	62.87	74.00	-11.13
Spurious Emissions, Average Measurements;										
2725.00	H	1.38	112	49.14	35.35	7.83	29.57	51.20	54.00	-2.80
2725.00	V	1.01	87	49.46	35.35	7.83	29.49	51.43	54.00	-2.57
3633.00	H	1.73	148	41.17	34.96	9.19	31.70	47.10	54.00	-6.90
3633.00	V	1.14	78	43.18	34.96	9.19	31.65	49.06	54.00	-4.94
4542.00	H	1.33	68	40.05	35.13	10.68	32.95	48.55	54.00	-5.45
4542.00	V	1.08	111	41.15	35.13	10.68	32.92	49.61	54.00	-4.39
5450.00	H	1.36	120	38.21	34.76	11.63	34.69	49.77	54.00	-4.23
5450.00	V	1.37	123	37.25	34.76	11.63	34.56	48.68	54.00	-5.32
7267.00	H	1.11	53	33.02	35.01	13.62	36.53	48.17	54.00	-5.83
7267.00	V	1.34	113	30.77	35.01	13.62	36.24	45.62	54.00	-8.38

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

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Frequencies above fall within the restricted bands specified in part 15.205(a)
RBW/VBW=1MHz/1MHz for frequencies between 1 GHz to 10GHz for peak measurements.
RBW/VBW=1MHz/100Hz for frequencies between 1 GHz to 10GHz for average measurements.

The fundamental of the EUT was tested in all three planes and the X plane was worst case.

SOP 1 Radiated Emissions Tracking # 30561434.001 Page 3 of 3

EUT Name	REX Water Module	**Date**	23 June 2005
EUT Model	REX WATER 900 MHZ	**Temp / Hum in**	75°F / 38%rh
EUT Serial	Not Serialized	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15, RSS-210 Issue 5	**Line DC**	3.6VDC
Deg/sweep	N/a	**RBW / VBW**	See Note Below
Dist/Ant Used	3m / 3115_5770	**Performed by**	Mark Ryan

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)
Fundamental CH 31:										
Spurious Emissions, Peak Measurements;										
2744.00	H	1.95	131	61.03	35.34	7.88	29.63	63.20	74.00	-10.80
2744.00	V	1.05	287	60.62	35.34	7.88	29.53	62.69	74.00	-11.31
3659.00	H	1.34	58	48.54	34.90	9.22	31.78	54.64	74.00	-19.36
3659.00	V	1.12	107	47.96	34.90	9.22	31.71	54.00	74.00	-20.00
7318.00	H	1.21	48	40.73	35.01	13.67	36.48	55.87	74.00	-18.13
7318.00	V	1.43	310	43.28	35.01	13.67	36.21	58.15	74.00	-15.85
9148.00	H	1.33	261	43.00	35.54	15.78	38.39	61.63	74.00	-12.37
9148.00	V	1.18	34	43.34	35.54	15.78	38.38	61.96	74.00	-12.04
Spurious Emissions, Average Measurements;										
2744.00	H	1.95	131	41.55	35.34	7.88	29.63	43.72	54.00	-10.28
2744.00	V	1.05	287	49.34	35.34	7.88	29.53	51.41	54.00	-2.59
3659.00	H	1.34	58	38.26	34.90	9.22	31.78	44.36	54.00	-9.64
3659.00	V	1.12	107	38.13	34.90	9.22	31.71	44.17	54.00	-9.83
7318.00	H	1.21	48	29.04	35.01	13.67	36.48	44.18	54.00	-9.82
7318.00	V	1.43	310	31.37	35.01	13.67	36.21	46.24	54.00	-7.76
9148.00	H	1.33	261	31.35	35.54	15.78	38.39	49.98	54.00	-4.02
9148.00	V	1.18	34	31.28	35.54	15.78	38.38	49.90	54.00	-4.10

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

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Frequencies above fall within the restricted bands specified in part 15.205(a)
RBW/VBW=1MHz/1MHz for frequencies between 1 GHz to 10GHz for peak measurements.
RBW/VBW=1MHz/100Hz for frequencies between 1 GHz to 10GHz for average measurements.

The fundamental of the EUT was tested in all three planes and the X plane was worst case.

4.7 Frequency Hopping Spread Spectrum Systems FCC Part 15.247(g)

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bur4sts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

When the REX Meter is presented with a continuous data stream, each 97.3 msec packet transmitted by the meter will be sent on the next channel in the 25-channel pseudo random list. When presented with a continuous data stream, the REX meter adheres to the 0.4 second dwell time for each 10 second window requirement. The REX Meter always distributes its transmissions across all 25 channels, and does not re-use a channel again until a transmission has occurred on each of the other 24 channels.

4.8 Incorporation of Intelligence FCC Part 15.247(h)

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop-sets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

The REX meter does not attempt to recognize other users or interferers within the spectrum band and then attempt to select which channels to use. The REX Meter always distributes its transmissions across the same 25 channels. A channel is not re-used until a transmission has occurred on each of the other 24 channels.

4.9 Frequency Stability FCC Part 15.215(c)

The requirement to contain the 20 dB bandwidth of the emission within the specified frequency band includes effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

4.9.1 Containment of the Emission during Variations in Temperature

The EUT was placed in an environmental temperature test chamber, supplied with the normal AC voltage, and with an antenna attached to the output port. If the antenna is an adjustable length antenna, it will be fully extended. The monitoring device (ie. Spectrum analyzer) was then attached to a receive antenna placed 15 cm away from the EUT via coaxial cable.

The temperature inside the chamber is then raised to the highest temperature specified and allowed sufficient time for the temperature of the chamber to stabilize. While maintaining a constant temperature inside the environmental chamber, the carrier signal was then measured 40 min after temperature stabilization. Then the above process is repeated for the lowest temperature specified and 10 degree Centigrade increments between the extremes thereafter.

Results

Channel 1 (Modulated)

Temperature	Frequency in MHz measured 20dB below peak		Permitted Band Edge in MHz	Results
-30° C	902.630	903.003	902 - 928	**Pass**
-20° C	902.633	903.008	902 - 928	**Pass**
-10° C	902.633	903.010	902 - 928	**Pass**
0° C	902.630	903.010	902 - 928	**Pass**
10° C	902.640	903.003	902 - 928	**Pass**
20° C	902.630	903.003	902 - 928	**Pass**
30° C	902.625	902.998	902 - 928	**Pass**
40° C	902.625	902.995	902 - 928	**Pass**
50° C	902.623	902.998	902 - 928	**Pass**

Channel 31 (Modulated)

Temperature	Frequency in MHz measured 20dB below peak		Permitted Band Edge in MHz	Results
-30° C	914.625	915.008	902 - 928	**Pass**
-20° C	914.645	915.000	902 - 928	**Pass**
-10° C	914.630	915.010	902 - 928	**Pass**
0° C	914.635	915.005	902 - 928	**Pass**
10° C	914.628	915.013	902 - 928	**Pass**
20° C	914.630	915.000	902 - 928	**Pass**
30° C	914.627	914.998	902 - 928	**Pass**
40° C	914.615	915.003	902 - 928	**Pass**
50° C	914.623	914.995	902 - 928	**Pass**

Spectrum Analyzer Parameters:

RBW=30kHz
VBW=30kHz
Span=1MHz
LOG dB/div.= 10dB
Sweep = 9.093 mS
Trigger Video

4.9.2 Containment of the Emission during Variations in Voltage

The setup was identical section 4.9.1 except the temperature inside of the chamber was set to 17 deg. C. The DC voltage was varied from 85% to 115% of the nominal voltage (3.6V).

The EUT is normally battery operated, but due to long transmits times required for testing, a DC power supply was used in place of the battery. Therefore the tables below will simulate a fresh battery and a discharged battery.

Channel 1 (Modulated);

Voltage	Frequency in MHz measured 20dB below peak		Permitted Band Edge in MHz	Results
3.06 VDC	902.630	903.005	902 - 928	**Pass**
3.60 VDC	902.640	902.998	902 - 928	**Pass**
4.14 VDC	902.638	903.000	902 - 928	**Pass**

Channel 31 (Modulated);

Temperature	Frequency in MHz measured 20dB below peak		Permitted Band Edge in MHz	Results
3.06 VDC	914.635	915.000	902 - 928	**Pass**
3.60 VDC	914.633	915.003	902 - 928	**Pass**
4.14 VDC	914.630	915.005	902 - 928	**Pass**

Spectrum Analyzer Parameters:

RBW=30kHz
VBW=30kHz
Span=1MHz
LOG dB/div.= 10dB
Sweep = 9.093 mS
Trigger Video

4.10 Radiated Emissions when not transmitting FCC Part 15.109(a)

Testing was performed in accordance with FCC part 15.109(a). 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.

4.10.1 Test Methodology

4.10.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 300 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarizations.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

4.10.1.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, than the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

4.10.1.3 Deviations

There were no deviations from this test methodology.

4.10.2 Test Results

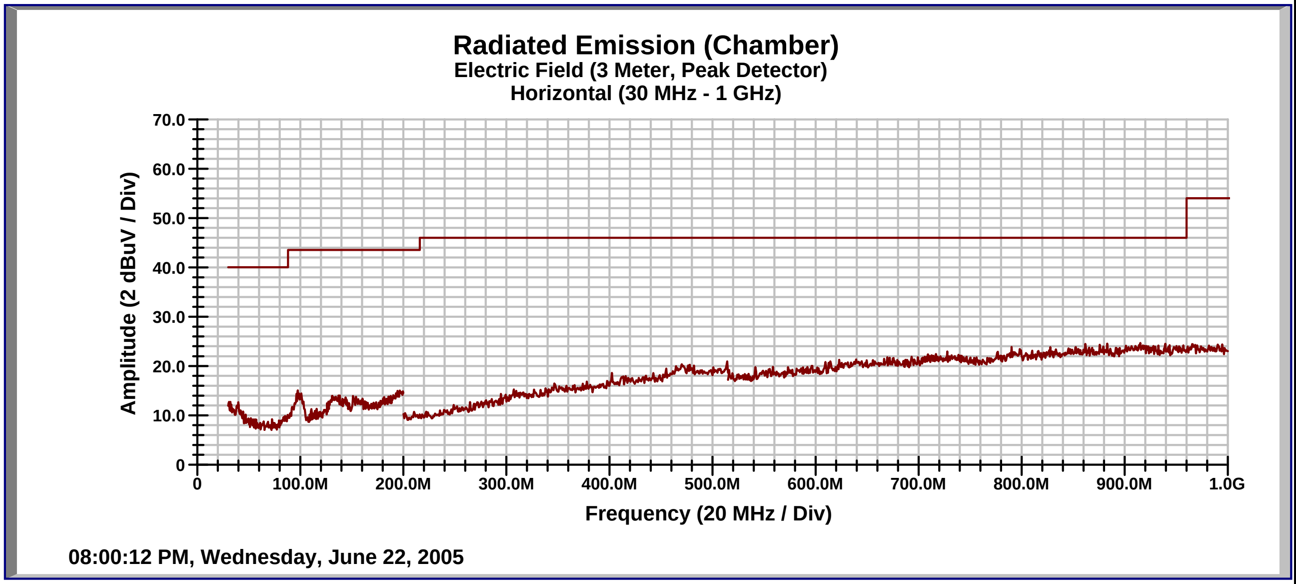
Section 4.10.2.1 lists the final measurement data under the worst case operating modes, configurations, and/or cable positions. As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

4.10.2.1 Final Data

The data recorded in this section contains the final results under the worst-case conditions and with any modifications or special accessories implemented as the manufacturer intends.

SOP 1 Radiated Emissions — Tracking # 30561434.001 Page 1 of 2

EUT Name	REX Water Module	**Date**	22 June 2005
EUT Model	REX WATER 900 MHZ	**Temp / Hum in**	71°F / 43%rh
EUT Serial	Not Serialized	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15, RSS-210 Issue 5	**Line DC**	3.6VDC
Deg/sweep	12°/Sec	**RBW / VBW**	120kHz / 300kHz
Dist/Ant Used	3m / 3110B-SAS516	**Performed by**	Mark Ryan
Configuration	Standby mode - not transmitting		



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)
98.67	H	3	100	5.51	0.00	1.05	10.05	16.61	54.00	-37.39

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

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

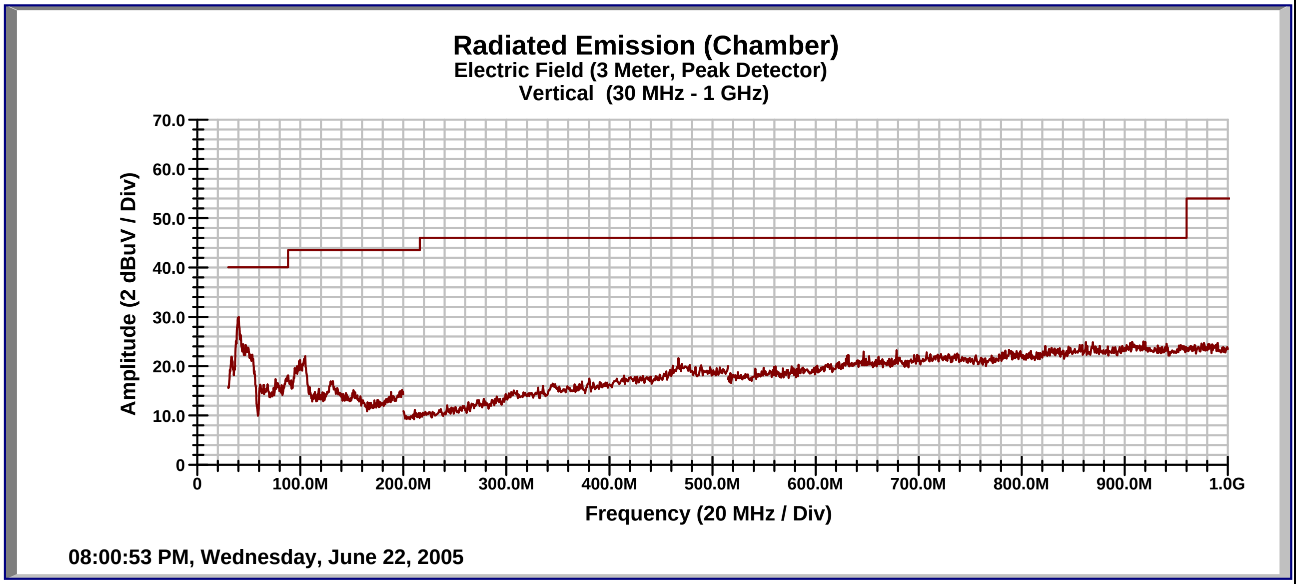
Notes: Using QP Detector.

Limits shown are for a Class B digital device - FCC Part 15.109(a), for when the EUT is not transmitting.

There is no active clock or oscillator above 108MHz when the EUT is not in transmit mode.

SOP 1 Radiated Emissions   Tracking # 30561434.001 Page 2 of 2

EUT Name	REX Water Module	**Date**	22 June 2005
EUT Model	REX WATER 900 MHZ	**Temp / Hum in**	71°F / 43%rh
EUT Serial	Not Serialized	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15, RSS-210 Issue 5	**Line DC**	3.6VDC
Deg/sweep	12°/Sec	**RBW / VBW**	120kHz / 300kHz
Dist/Ant Used	3m / 3110B-SAS516	**Performed by**	Mark Ryan
Configuration	Standby mode - not transmitting		



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)
39.96	V	1	350	16.60	0.00	0.66	10.01	27.27	49.60	-22.33
103.94	V	1	328	9.63	0.00	1.08	10.98	21.69	54.00	-32.31

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

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Using QP Detector.

Limits shown are for a Class B digital device - FCC Part 15.109(a), for when the EUT is not transmitting.

Signal shown in blue is worst case emission.

There is no active clock or oscillator above 108MHz when the EUT is not in transmit mode.

4.10.3 Photos

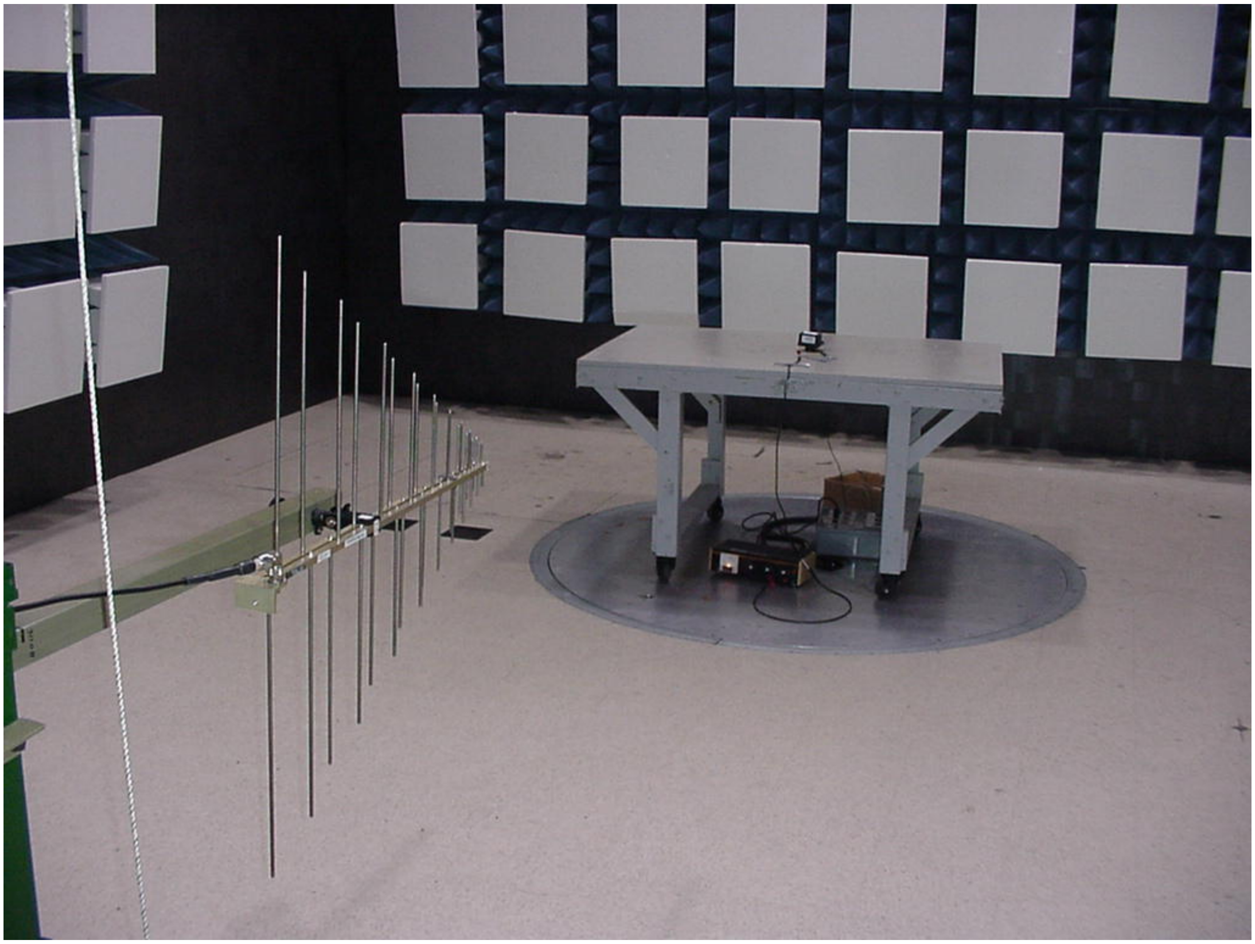


Figure 6 - Radiated Emissions Test Setup (Chamber – Front, X orientation)

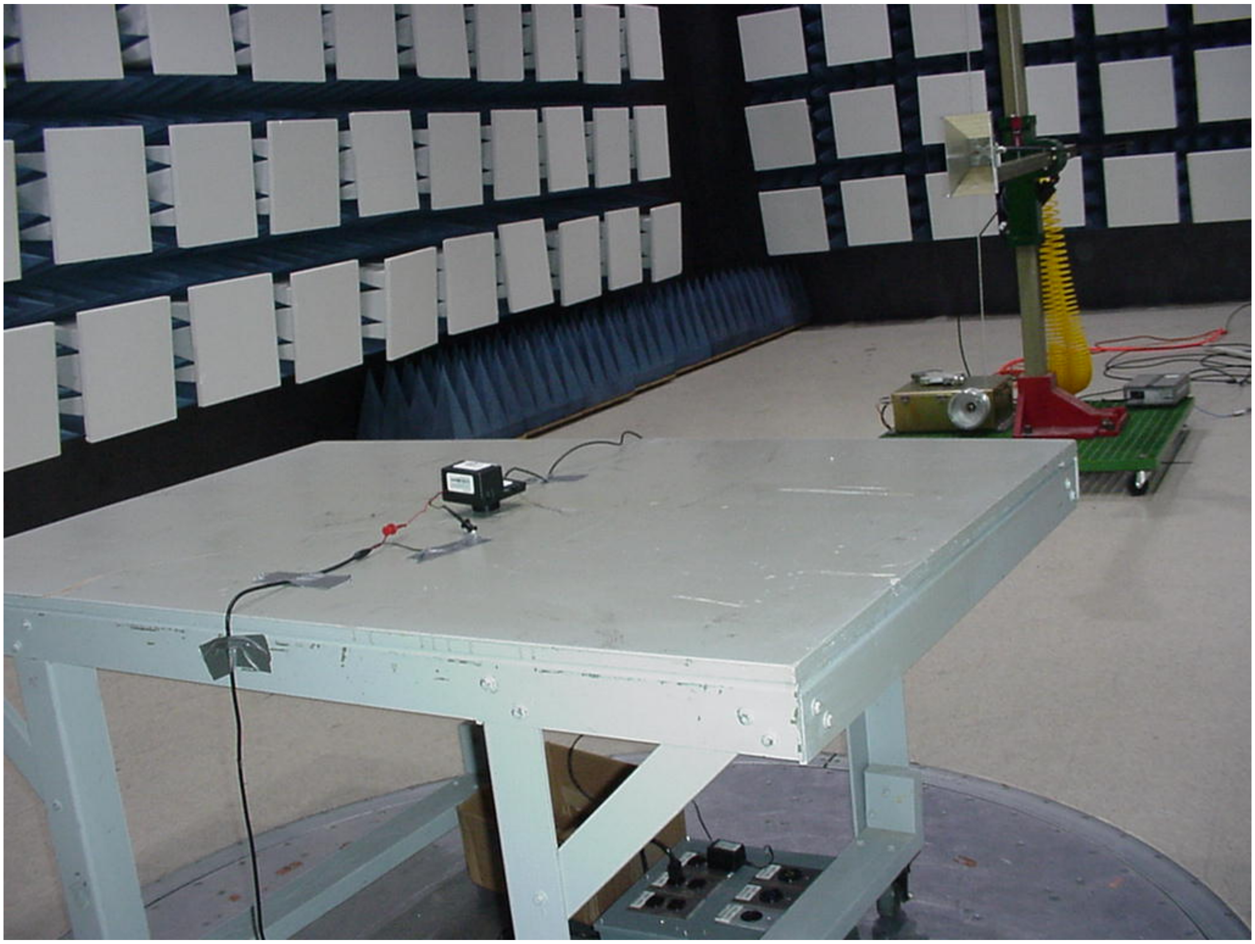


Figure 7 - Radiated Emissions Test Setup (Chamber – Back, X orientation)

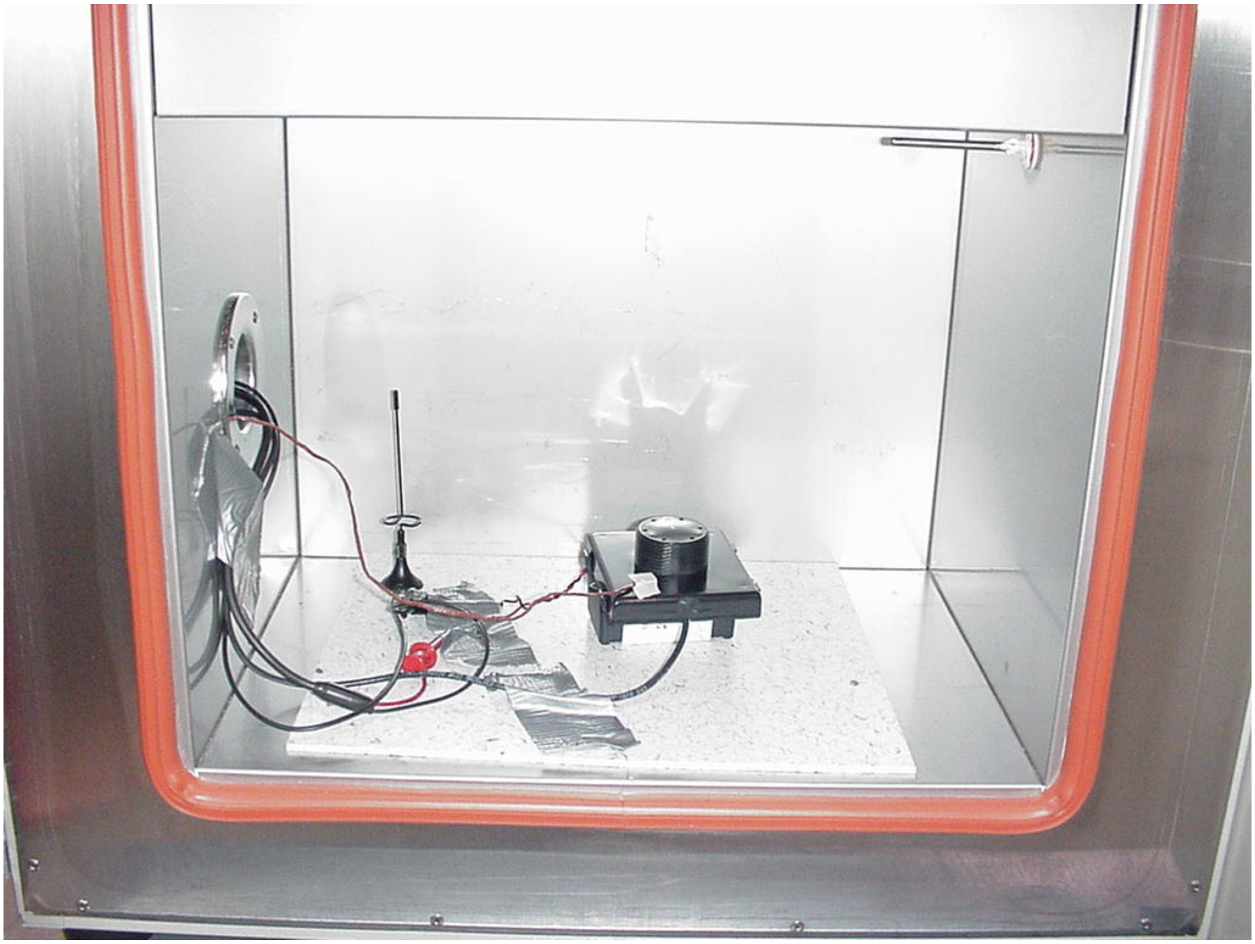


Figure 8 – Internal view of Temperature Chamber Setup

Figure 9 – External view of Temperature Chamber Setup

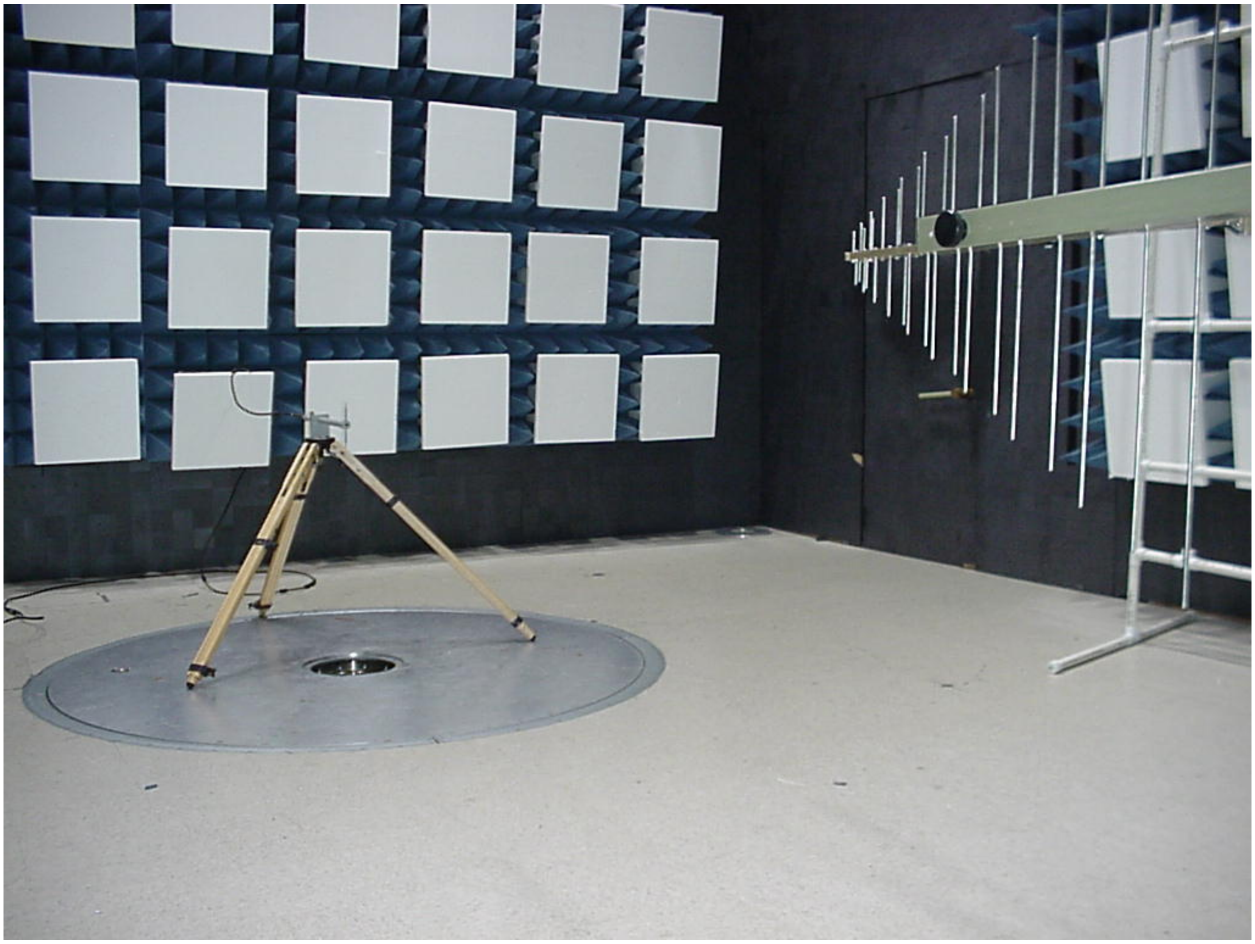


Figure 10 – Setup for Substitution Method

4.10.4 Sample Calculation

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:

$$\text{Field Strength } (dB\mu V/m) = FIM - AMP + CBL + ACF$$

Where: FIM = Field Intensity Meter (dBμV)
AMP = Amplifier Gain (dB)
CBL = Cable Loss (dB)
ACF = Antenna Correction Factor (dB/m)

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

4.11 Conducted Emissions

The EUT is battery operated and has no provision for operation from the AC mains and therefore no conducted emissions tests were performed. However, since the battery life is very short due to the transmitter having been placed in a constant transmit mode that is required for testing, the battery was removed and replaced with a lab DC power supply per section 3.3 of the test plan.

5 Test Equipment Use List

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal dd/mm/yy	Next Cal dd/mm/yy
SOP 1 - Radiated Emissions (5 Meter Chamber)					
Ant. Biconical	EMCO	3110B	3367	24-Feb-05	24-Feb-06
Ant. Log Periodic	AH Systems	SAS-516	133	7- Feb-05	7- Feb-06
Cable, Coax	Andrew	FSJ1-50A	041	15-Jan-05	15-Jan-06
Cable, Coax	Andrew	FSJ1-50A	042	15-Jan-05	15-Jan-06
Chamber, Semi-Anechoic	Braden Shielding	5 meter	A67631	27-Jan-04	27-Jan-05
Data Table, EMCWin	TUV Rheinland	EMCWin.dll	002	6-Jan-02	6-Jan-06
Spectrum Analyzer	Agilent Tec.	E7405A	US39440157	6-Aug-05	6-Aug-06
Spectrum Analyzer	Agilent Tec.	E7405A	US39440161	6-Aug-04	6-Aug-05

General Laboratory Equipment					
Meter, Multi	Fluke	79-3	69200606	6-Aug-04	6-Aug-05
Meter, Temp/Humid/Barom	Fisher	02-400	01	13-Aug-04	13-Aug-05
Power Supply, AC	B+K Precision	1650	91-08975	CNR II	CNR II

* Calibration of equipment past due for re-calibration will be performed expeditiously. If any equipment is found to be out of tolerance at that time, affected customers will be notified accordingly.

6 EMC Test Plan

TEST PLAN TABLE OF CONTENTS

1.0 Introduction

This manufacturer-supplied document provides a description of the Equipment Under Test (EUT), configuration(s), operating condition(s), and performance acceptance criteria. It is intended to provide the test laboratory with the essential information needed to perform the requested testing.

2.0 Customer

The information in the following tables is required, as it should appear in the final test report.

Table 2 – Manufacturer Information

Company Name:	ELSTER
Street Address:	208 South Rogers Lane
City, State, Zip Code:	Raleigh, NC 27610
Tel:	919-212-4700
Fax:	919-212-5108

Table 3 – Technical Contact Information

Contact Name	Telephone	Fax	Email address
Andy Borleske	919-212-5060	919-250-5486	Andrew.borleske@us.elster.com

3.0 Equipment Under Test (EUT)

The information provided in the following table is listed as it should appear in the final report.

Table 4 – EUT Designation

EUT	Model Name	Model Number
Rex Water Module	REX Water Module	WM900

3.1 Technical Description

3.1.1 Device Type

The REX Water Module is an intentional radiator and is classified as a Part 15.247 device. The critical specifications of the REX Water Module are listed in the following table:

Frequency Band	902 – 915 MHz
Classification	Frequency Hopping Spread Spectrum
Maximum Output Power	0.25W (+24 dBm)
Channel Spacing	400 kHz
Channel 20 dB Bandwidth	325 kHz
Number of Channels	25
Max channel dwell time within a 10 second period	< 0.4 seconds

Note: When the EUT is shipped to end users it is a potted, sealed, and a battery-operated, self-contained unit. There are no user adjustments available.

3.1.2 Electronic Assembly Description

3.1.2.1 Description of Circuit Function

The REX Water Module electronic assembly implements a transmit only 900MHz frequency hopping, spread spectrum radio for transmitting water meter readings to other REX 2-way devices. The block diagram in Figure 11 shows the major sections of the electronic assembly:

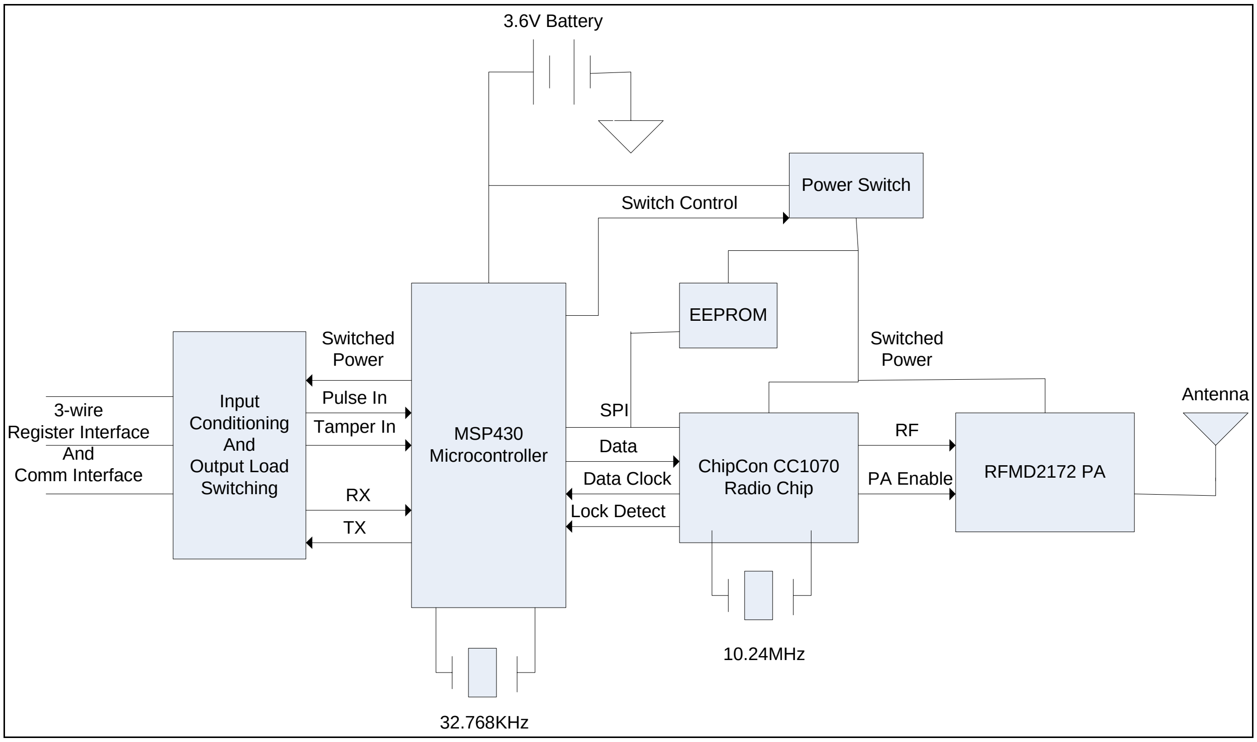


Figure 11: REX Water Module Block Diagram

3-Wire Register Interface	Interface to the various different water meter register styles, as well as the communications interface for configuration and test. The module auto detects when it should be in communications mode. In an assembled module, this is the only cable protruding from the plastic housing.
Battery	3.6V Lithium Thionyl Chloride Battery
Microcontroller	A 28-pin, 0.65 mm pitch microcontroller.
Radio Chip	A transmit-only 900 MHz FSK radio chip
PA	An RF power amplifier
Power Switch	A MOSFET for switching the supply power to all the peripherals that are not needed during sleep operation.
EEPROM	The serial EEPROM provides storage for configuration information and metering data.
Antenna	A board mounted short monopole antenna. There is no provision for an external antenna on an assembled unit.
Input conditioning	Protection circuitry and interface logic to interface with different water meter types, and the configuration communications interface.

3.1.3 Rf Channel Plan

The REX Water Module is a frequency-hopping spread spectrum device using 25 hopping frequencies between 902.8 MHz and 914.8 MHz. The 20 dB bandwidth of the hopping channel is approximately 325 kHz and the average time of occupancy on any frequency is less than 0.4 seconds within a 10 second period. In a constant transmit mode, the REX Water Module would send a packet every 97.3 msec with a delay of 250 to 500 msec between packets. Each packet is sent on the next channel in the pseudo-random channel list. In 10 seconds, the REX Water Module would send no more than 20 packets, with four packets sent on each of 20 channels and three packets sent on each of 5 channels. For the channels sending four packets, the total on time is 0.389 seconds, which is less than the 0.4 second occupancy requirement.

The REX Water Module uses the following 25 channels in the following pseudo-random order:

Index	Channel	Center Frequency (MHz)
1	12	907.2
2	29	914
3	5	904.4
4	19	910
5	11	906.8
6	23	911.6
7	26	912.8
8	13	907.6
9	22	911.2
10	15	908.4
11	1	902.8
12	25	912.4
13	4	904
14	21	910.8
15	14	908
16	27	913.2
17	8	905.6
18	31	914.8
19	18	909.6
20	16	908.8
21	7	905.2
22	20	910.4
23	3	903.6
24	28	913.6
25	6	904.8

3.2 Configuration(s)

There is currently only one hardware configuration for the Rex Water Module, the water pit module.

Figure 12 – Picture of a REX Water Module (show with water meter)

3.3 Operating Conditions

The water module operates from it's own self-contained 3.6 volt battery. If an external power supply is to be used, the battery leads can be severed, powered externally. The power supply needs to be able to supply at least 250mA at 3.6V.

3.3.1 Firmware and Software

There is a 16-bit TI MSP430 microprocessor that controls the behavior of the REX Water Module. The firmware revision to be tested is expected to be labeled 255.5. A software program titled "Meter Explorer" will be used to exercise the REX Water Module and place the module in various modes of operation required to test that the modules adhere to the FCC guidelines. Elster Electricity will provide the test lab with a laptop pc with the software and the interface hardware required to communicate to the REX Water Module.

3.3.2 Mode(s)

Refer to Section 3.3.6.

3.3.3 Testing the REX Water Module

3.3.3.1 Required Equipment

The following equipment is required to communicate to the REX Water Module to change the operating mode for test purposes:

1. A pc with a Windows NT or Windows 2000 operating system.

2. An Elster Electricity software program titled "MeterExplorer". This software tool can be used to place the REX Water Module into the various test modes. The software on a CD or a laptop computer with the software loaded will be provided to the test lab. Version 3.0.9 or higher of MeterExplorer is required.

3. A water module comm. interface (supplied by Elster).

Elster Electricity will provide the test lab with a laptop pc with the comm interface and power supply. The description of the test setup has already been done on this laptop, and the reader of this document can skip to Section 3.3.5.

3.3.4 Test Setup

To communicate to the REX Water Module, the comm. interface must be plugged into a serial port on the pc and must also be plugged into the power supply. The comm. interface connects to the Rex Water Module through the register interface (the only cable protruding from the unit), with the supplied clipleads. The clip leads are to be connected as follows: red to red, bloack to black, and white to bare. Also, if the unit is to be powered externally, the battery leads must be clipped, and attached to a power supply at 3.6V.

MeterExplorer Setup

By default, MeterExplorer is installed to the following directory:

C:\Program Files\ABB\MeterTools\

Assuming the default directory is not changed, the following step must be followed to allow MeterExplorer access to the REX Water Module definition file:

- Copy the files titled "REX_WATER_METER_255_5.MD" to the following folder: C:\Program Files\ABB\MeterTools\MD\REX\

Note that the 255_100 suffixes on the end of the file names indicate the firmware release. The firmware release and the file names may change accordingly.

3.3.5 Running MeterExplorer

From the Start menu, open MeterExplorer as follows:

Start ▶ Programs ▶ MeterTools ▶ MeterExplorer

3.3.5.1 MeterExplorer Properties

At the top of the MeterExplorer window, there are 3 drop down menus that allow selection of the meter type, communication medium, and the communication protocol. For the REX Water Module, these drop downs must be set to the following:

- REX.REX_WATER_METER_255_5
- DIRECT_SERIAL
- REX_OPTICAL

This MeterExplorer GUI configured for the REX Water Module is shown in Figure 13.

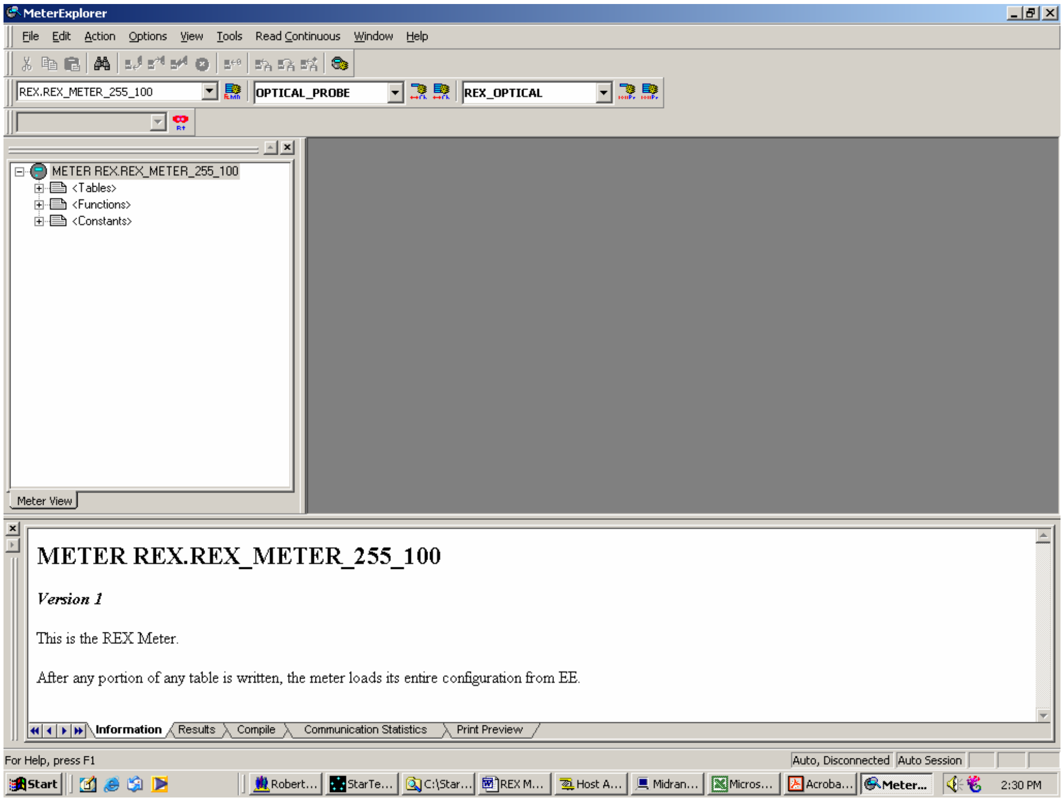


Figure 13: MeterExplorer GUI

To the immediate right of the communication medium (i.e. DIRECT_SERIAL) drop down menu is a tool button that allows the communication port and medium to be configured. By default, MeterExplorer uses Com Port 1 for communications. If you are using a different serial port on the pc, click the button and change the serial port to the port to which the optical probe is connected. The baud rate also needs to be set in this dialog box. The Rex Water Module communicates at 4800 BPS.

To the immediate right of the communication protocol (i.e. REX_OPTICAL) drop down menu is a tool button that allows the communication protocol to be configured. Click on this tool button to check that the following properties are set correctly:

- Password = blank or \x00\x00\x00\x00.
- The check box for Manufacturing Access must be checked.

The configuration is also shown in Figure 14.

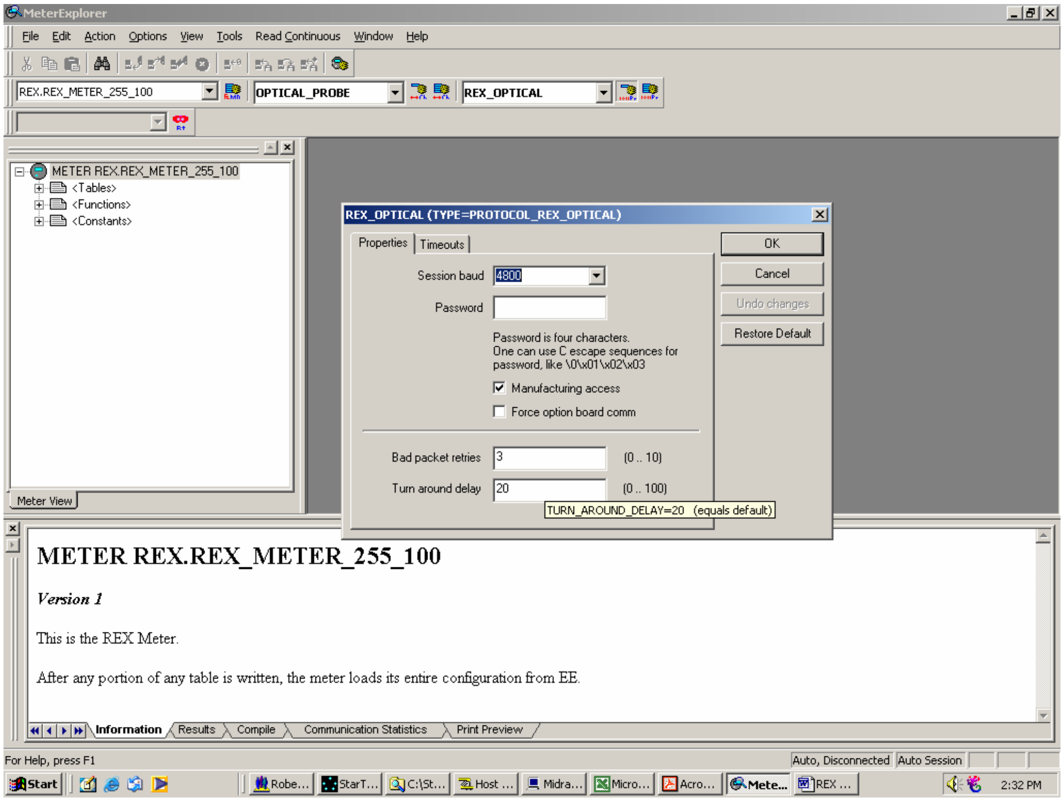


Figure 14: MeterExplorer - REX_OPTICAL Protocol Properties

3.3.5.2 Using MeterExplorer

MeterExplorer can be used to read or write tables to the module and to force the module to execute functions or commands. To read or write tables, expand the <Tables> item by clicking on the + box and then select the desired table by highlighting the table in the table list in the left-hand window. The table then can be accessed one of two ways:

1. From the main menu: **Action**▶**Read** or **Action**▶**Write**

   OR

2. Right click the mouse while it is over the highlighted table and click the right mouse button. From the pop-up menu, select **Read** or **Write**

3.3.6 Description of Test Modes in the REX Water Module

The REX Water Module supports the following test modes of operation to facilitate FCC and manufacturing tests:

1. Test mode - Constant transmit, unmodulated data on a single channel
2. Test mode - Constant transmit – modulated data on a single channel
3. Test mode - Constant transmit hopping – normal hopping, hopping between the 25 channels in the pseudo-random list of channels

The following sections describe the MeterExplorer software can be used to place the module in the various modes.

For all the tests, the radio channel is specified as a number from 0 to 31, with the center frequency of the channel calculated from the following formula:

Center Frequency = 902.4 + Channel * 0.4 (MHz)

For example, channel 0 is:

Center Frequency = 902.4 + 0 * 0.4 (MHz) = 902.4 MHz

and channel 31 is:

Center Frequency = 902.4 + 31 * 0.4 (MHz) = 914.8 MHz

3.3.6.1 Constant Transmit Modes Using MT_105_RADIO_TEST_TABLE

The radio test table allows the test engineer to place the water module into various constant transmit modes. Any configuration written to this table is only valid while the comm. interface is connected to the register cable. The device will revert to normal operating state if the comm. interface is disconnected. For any of the constant transmit modes, an external power supply must be used. The battery can only support individual packet transmission, and cannot supply enough current for a constant transmit mode. Any actions in the table take place as soon as the table is written.

3.3.6.1.1 Constant Transmit – Unmodulated Data

MT_105_RADIO_TEST_TABLE.TRASMIT_CONTINUOUSLY= 2 {Continuous, Unmodulated}

MT_105_RADIO_TEST_TABLE.CHANNEL = 0 – 31 (selects the channel) (note: the value of this field corresponds to a channel index into an internal list. Use the enumerated value to select the channel)

MT_105_RADIO_TEST_TABLE.POWER = 200

3.3.6.1.2 Constant Transmit – Modulated Data

MT_105_RADIO_TEST_TABLE.TRASMIT_CONTINUOUSLY= 1 {Continuous, Modulated}

MT_105_RADIO_TEST_TABLE.CHANNEL = 0 – 31 (selects the channel) (note: the value of this field corresponds to a channel index into an internal list. Use the enumerated value to select the channel)

MT_105_RADIO_TEST_TABLE.POWER = 200

3.3.6.1.3 Constant Transmit – Channel Hopping

When placed in this mode, the module will continually transmit packets, with each packet being approximately 97.3 msec in duration and a 400 msec off time between packets. Each packet is sent on the next channel in the pseudo-random list of channels (refer to Section 3.1.3).

To place the REX Water Module in this mode, the following MT-105 parameters must be set:

MT_105_RADIO_TEST_TABLE.TRASMIT_CONTINUOUSLY = 0 (off)

MT_105_RADIO_TEST_TABLE.SEND_TEST_PACKETS = number of packets to send (max 255)

MT_105_RADIO_TEST_TABLE.CHANNEL = 255 (hop)

MT_105_RADIO_TEST_TABLE.POWER = 200

WARNING: Once MT105 is set as shown above, the module will be unresponsive over the comm. interface until it is finished transmitting packets. It will not stop transmitting, even if the comm. interface is removed. It will stop if power is removed, and will return to normal operating mode when power is re-applied.

3.3.6.2 Normal Operation

In normal operating mode, the REX Water Module transmits once every 4 hours. This time period is configurable and can be decreased to aid in testing. The transmit period is set in:

MT_101_CUSTOMER_CONFIG_TABLE.TRANSMIT_PERIOD

It can be set from 1 to 65535 seconds.

To restore the REX Water Module to the normal operating condition, use MeterExplorer to write the base configuration to the module. This is done as follows:

1. Highlight <Tables> under REX_WATER_METER.
2. With the table selected, right click on the mouse to bring up a menu and select **Read**
3. With the table selected, right click on the mouse to bring up a menu and select:
   Load All From File
4. At the prompt, select and open the file named: “RexWaterModuleBaseConfig.mtd”
5. Right click any of the highlighted tables, and select write

The read followed by the write verifies that the information unique to a particular module is maintained.

3.4 Power Requirements

The Rex Water Module is powered by an internal 3.6V battery. If an external power supply is to be used, it should provide 3.6V, and be able to supply at least 250mA.

3.5 Oscillator / Microprocessor Frequencies

This section lists all oscillator frequencies used in the EUT. This is required for immunity testing (each frequency is dwelled upon during Radiated Immunity) and extremely helpful for mitigation during Radiated Emissions.

The 900 MHz radio in the REX Water Module is a frequency-hopping spread spectrum radio. The receiver is a single conversion, super-heterodyne receiver, with a 10.7 MHz IF. The receiver local oscillator is 10.7 MHz below the channel frequency.

Table 5 - Oscillator Frequency List

Frequency (MHz)	Description of Use
32kHz	Processor Clock
10.24MHz	Synthesizer reference
~4 MHz	Internal oscillator in the processor

4.0 Equivalent Models

This is the first product of its kind for Elster Electricity, so we will not be providing any equivalent models.