Flow Metrix, Inc.

MLOG

November 15, 2004

Report No. FLWM0003

Report Prepared By

www.nwemc.com
1-888-EMI-CERT

EMC Test Report

NORTHWEST EMC

22975 NW Evergreen Parkway
Suite 400
Hillsboro, Oregon 97124

Certificate of Test

Issue Date: November 15, 2004
Flow Metrix, Inc.
Model: MLOG

Emissions			
Specification	**Test Method**	**Pass**	**Fail**
FCC 15.247(a) Occupied Bandwidth:2004	ANSI C63.4:2003	☒	☐
FCC 15.247(a)(1) Channel Spacing:2004	ANSI C63.4:2003	☒	☐
FCC 15.247(f) Dwell Time:2004	ANSI C63.4:2003	☒	☐
FCC 15.247(f) Number of Hopping Frequencies:2004	ANSI C63.4:2003	☒	☐
FCC 15.247(b) Output Power - EIRP:2004	ANSI C63.4:2003	☒	☐
FCC 15.247(d) Band Edge Compliance:2004	ANSI C63.4:2003	☒	☐
FCC 15.247(d) Spurious Radiated Emissions in the Restricted Bands:2004	ANSI C63.4:2003	☒	☐
FCC 15.247(d) Out of Band Radiated Emissions:2004	ANSI C63.4:2003	☒	☐
FCC 15.247(e) Power Spectral Density:2004	ANSI C63.4:2003	☒	☐
FCC 15.109(f) Spurious Radiated Emissions of the Receiver:2004	ANSI C63.4:2003	☒	☐

Modifications made to the product
See the Modifications section of this report

Test Facility

The measurement facility used to collect the data is located at:

Northwest EMC, Inc
22975 NW Evergreen Parkway, Suite 400; Hillsboro, OR 97124
Phone: (503) 844-4066 Fax: 844-3826

This site has been fully described in a report filed with and accepted by the FCC (Federal Communications Commission) and Industry Canada.

Approved By:

Don Facteau, IS Manager

This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government of the United States of America.

Product compliance is the responsibility of the client, therefore the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. This Report may only be duplicated in its entirety. The results of this test pertain only to the sample(s) tested, the specific description is noted in each of the individual sections of the test report supporting this certificate of test.

Revision Number	Description	Date	Page Number
00	None		

FCC: Accredited by NVLAP for performance of FCC radio, digital, and ISM device testing. Our Open Area Test Sites, certification chambers, and conducted measurement facilities, have been fully described in reports filed with the FCC and accepted by the FCC in letters maintained in our files. Northwest EMC has been accredited by ANSI to ISO / IEC Guide 65 as a product certifier. We have been designated by the FCC as a Telecommunications Certification Body (TCB). This allows Northwest EMC to certify transmitters to FCC specifications in accordance with 47 CFR 2.960 and 2.962.

NVLAP: Northwest EMC, Inc. is recognized under the United States Department of Commerce, National Institute of Standards and Technology, National Voluntary Laboratory Accreditation Program for satisfactory compliance with the requirements of ISO/IEC 17025 for Testing Laboratories. The NVLAP accreditation encompasses Electromagnetic Compatibility Testing in accordance with the European Union EMC Directive 89/336/EEC, ANSI C63.4, MIL-STD 461E, DO-160D and SAE J1113. Additionally, Northwest EMC is accredited by NVLAP to perform radio testing in accordance with the European Union R&TTE Directive 1999/5/EEC, the requirements of FCC, and the RSS radio standards for Industry Canada. Accreditation has been granted to Northwest EMC, Inc. under Certificate Numbers: 200629-0, 200630-0, and 200676-0.

Industry Canada: Accredited by NVLAP for performance of Industry Canada RSS and ICES testing. Our Open Area Test Sites and certification chambers comply with RSS 212, Issue 1 (Provisional) and have been filed with Industry Canada and accepted. Northwest EMC has been accredited by ANSI to ISO / IEC Guide 65 as a product certifier. We have been designated by NIST and recognized by Industry Canada as a Certification Body (CB) per the APEC Mutual Recognition Arrangement (MRA). This allows Northwest EMC to certify transmitters to Industry Canada technical requirements.

CAB: Designated by NIST and validated by the European Commission as a Conformity Assessment Body (CAB) to conduct tests and approve products to the EMC directive and transmitters to the R&TTE directive, as described in the U.S. - EU Mutual Recognition Agreement

TÜV Product Service: Included in TUV Product Service Group's Listing of Recognized Laboratories. It qualifies in connection with the TUV Certification after Recognition of Agent's Testing Program for the product categories and/or standards shown in TUV's current Listing of CARAT Laboratories available from TUV. A certificate was issued to represent that this laboratory continues to meet TUV's CARAT Program requirements. Certificate No. USA0401C

Accreditations and Authorizations

TÜV Rheinland: Authorized to carryout EMC tests by order and under supervision of TÜV Rheinland. This authorization is based on "Conditions for EMC-Subcontractors" of November 1992.

NEMKO: Assessed and accredited by NEMKO (Norwegian testing and certification body) for European emissions and immunity testing. As a result of NEMKO's laboratory assessment, they will accept test results from Northwest EMC, Inc. for product certification (Authorization No. ELA 119).

Technology International: Assessed in accordance with ISO Guide 25 defining the general international requirements for the competence of calibration and testing laboratories and with ITI assessment criteria LACO196. Based upon that assessment Interference Technology International, Ltd., has granted approval for specifications implementing the EU Directive on EMC (89/336/EEC and amendments). The scope of the approval was provided on a Schedule of Assessment supplied with the certificate and is available upon request.

Australia/New Zealand: The National Association of Testing Authorities (NATA), Australia has been appointed by the ACA as an accreditation body to accredit test laboratories and competent bodies for EMC standards. Accredited test reports or assessments by competent bodies must carry the NATA logo. Test reports made by an overseas laboratory that has been accredited for the relevant standards by an overseas accreditation body that has a Mutual Recognition Agreement (MRA) with NATA are also accepted as technical grounds for product conformity. The report should be endorsed with the respective logo of the accreditation body. (NVLAP)

VCCI: Accepted as an Associate Member to the VCCI, Acceptance No. 564. Conducted and radiated measurement facilities have been registered in accordance with Regulations for Voluntary Control Measures, Article 8. *(Registration Nos. - Hillsboro: C-1071 and R-1025, Irvine: C-2094 and R-1943, Newberg: C-1877 and R-1760, Sultan: R-871, C-1784 and R-1761)*

BSMI: Northwest EMC has been designated by NIST and validated by C-Taipei (BSMI) as a CAB to conduct tests as described in the APEC Mutual Recognition Agreement. License No.SL2-IN-E-1017.

GOST: Northwest EMC, Inc. has been assessed and accredited by the Russian Certification bodies Certinform VNIINMASH, CERTINFO, SAMTES, and Federal CHEC, to perform EMC and Hygienic testing for Information Technology Products. As a result of their laboratory assessment, they will accept test results from Northwest EMC, Inc. for product certification

SCOPE

For details on the Scopes of our Accreditations, please visit:
http://www.nwemc.com/scope.asp

Explanation of Northwest EMC Performance Criteria

How important is it to understand performance criteria?

It is the responsibility of the test laboratory to observe the results of the tests that are performed and to accurately report those results. As the responsible party (manufacturer, importer, etc) it is your responsibility to take those results, compare them against the specifications and standards, then, if appropriate make a declaration of conformity. As the responsible party it makes sense that you are fully aware of the requirements, how your device performs when tested to those requirements, and what information is being used to declare conformity.

To better assist you in making those conformity decisions, Northwest EMC has adopted a very simple, yet very clear performance assessment procedure. The following criteria is used when performing immunity or susceptibility tests:

Performance Criteria 1:

- The EUT exhibited no change in performance when operating as specified by the manufacturer. In this case no changes were observed during the test.
- In most cases this would be equivalent to Performance Criteria A. When operating the equipment in the modes or configurations specified by the responsible party, monitoring the parameters specified, no changes were observed. Basically nothing happened.

Performance Criteria 2:

- The EUT exhibited a change in performance when operating as specified by the manufacturer. In this case the equipment recovered without any operator intervention. The data sheets will detail the exact phenomena observed.
- In most cases this would be equivalent to Performance Criteria B. When operating the equipment in the modes or configurations specified by the responsible party, monitoring the parameters specified, changes were observed. The EUT was able to recover from those changes without any operator intervention.

Performance Criteria 3:

- The EUT exhibited a change in performance when operating as specified by the manufacturer. In this case the equipment required some operator intervention in order to recover. This intervention may be in the form of reducing the test levels, changing parameters, or even resetting the system. The data sheets will detail the exact phenomena observed.
- In most cases this would be equivalent to Performance Criteria C. When operating the equipment in the modes or configurations specified by the responsible party, monitoring the parameters specified, changes were observed. The EUT required some sort of operator intervention to recover. There was no permanent damage and the EUT appeared to function normally after completion test.

Performance Criteria 4:

- The EUT exhibited a change in performance when operating as specified by the manufacturer. In this case the equipment was damaged and would not recover. The data sheets will detail the exact phenomena observed.
- In most cases there is no specific criterion to compare this to, it typically ends the test. When operating the equipment in the modes or configurations specified by the responsible party, monitoring the parameters specified, changes were observed. There was no recovery; the equipment would no longer function as intended.

Each of the standards and specifications has unique performance criteria. In order to make an accurate assessment, one must compare the test results provided with the specific performance criteria. **To ensure that a responsible party is compliant with the specifications, one must read and understand those specifications. Provided below is a sample performance criteria, taken from EN 50082-1.**

EN 50082-1 Performance Criteria

Performance Criteria A: *The apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.*

Performance Criteria B: *The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.*

Performance Criteria C: *Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of controls.*

How should a device perform in order for a declaration of conformity to be made?

As already stated, it is the responsible party that must interpret and understand the results in such a way that a declaration of conformity is made. Having said that, we are often asked to render our opinion as to how a device should perform. Our recommendation simply follows the standards, as can be referenced below. Most of the standards and specifications offer the same performance criterion shown below as their requirements.

Test	Performance Criteria typically specified by the Standard	Equivalent Northwest EMC Performance Criteria
ESD	Performance Criteria B	Performance Criteria 1 or 2
Radiated RF	Performance Criteria A	Performance Criteria 1
EFT/Burst	Performance Criteria B	Performance Criteria 1 or 2
Surge	Performance Criteria B	Performance Criteria 1 or 2
Conducted RF	Performance Criteria A	Performance Criteria 1
Magnetic Field	Performance Criteria A	Performance Criteria 1
Voltage Dips and Variations	Performance Criteria B & C	Performance Criteria 1, 2, or 3

What is measurement uncertainty?

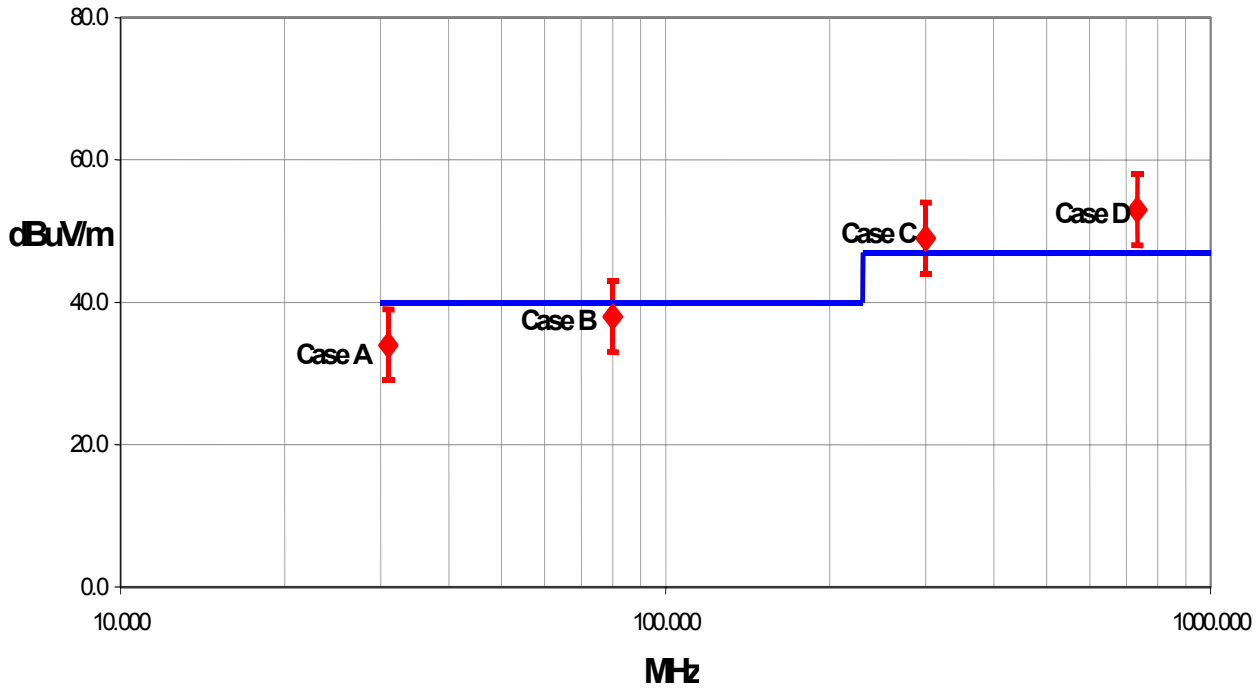
When a measurement is made, the result will be different from the true or theoretically correct value. The difference is the result of tolerances in the measurement system that cannot be completely eliminated. To the extent that technology allows us, it has been our aim to minimize this error. The following statement of measurement uncertainty is used to reflect the accuracy of the measured result as compared with its "true" value. In the case of transient tests (ESD, EFT, Surge, Voltage Dips and Interruptions), the test equipment has been demonstrated by calibration to provide at least a 95% confidence that it complies with the test specification requirements.

The following documents were the basis for determining the uncertainty levels of our measurements:

- "ISO Guide to the Expression of Uncertainty in Measurements", October 1993
- "NIS81: The Treatment of Uncertainty in EMC Measurements", May 1994
- "IEC CISPR 16-3 A1 f1 Ed.1: Radio-interference measurements and statistical techniques", December 2000

How might measurement uncertainty be applied to test results?

If the diamond marks the measured value for the test and the vertical bars bracket the range of + and – measurement uncertainty, then test results can be interpreted from the diagram below.



Test Result Scenarios:
Case A: Product complies.
Case B: Product conditionally complies. It is not possible to say with 95% confidence that the product complies.
Case C: Product conditionally does not comply. It is not possible to say with 95% confidence that the product does not comply.
Case D: Product does not comply.

Radiated Emissions ≤ 1 GHz		Value (dB)					
	Probability Distribution	Biconical Antenna		Log Periodic Antenna		Dipole Antenna	
Test Distance		3m	10m	3m	10m	3m	10m
Combined standard uncertainty $u_c(y)$	normal	+ 1.86 - 1.88	+ 1.82 - 1.87	+ 2.23 - 1.41	+ 1.29 - 1.26	+ 1.31 - 1.27	+ 1.25 - 1.25
Expanded uncertainty ***U*** (level of confidence ≈ 95%)	normal (k=2)	+ 3.72 - 3.77	+ 3.64 - 3.73	+ 4.46 -2.81	+ 2.59 - 2.52	+ 2.61 - 2.55	+ 2.49 - 2.49

Radiated Emissions > 1 GHz	Value (dB)		
	Probability Distribution	Without High Pass Filter	With High Pass Filter
Combined standard uncertainty $u_c(y)$	normal	+ 1.29 - 1.25	+ 1.38 - 1.35
Expanded uncertainty ***U*** (level of confidence ≈ 95%)	normal (k=2)	+ 2.57 - 2.51	+ 2.76 - -2.70

Conducted Emissions		
	Probability Distribution	Value (+/- dB)
Combined standard uncertainty ***uc(y)***	normal	1.48
Expanded uncertainty ***U*** (level of confidence ≈ 95 %)	normal (k = 2)	2.97

Radiated Immunity		
	Probability Distribution	Value (+/- dB)
Combined standard uncertainty ***uc(y)***	normal	1.05
Expanded uncertainty ***U*** (level of confidence ≈ 95 %)	normal (k = 2)	2.11

Conducted Immunity		
	Probability Distribution	Value (+/- dB)
Combined standard uncertainty ***uc(y)***	normal	1.05
Expanded uncertainty ***U*** (level of confidence ≈ 95 %)	normal (k = 2)	2.10

Legend

$u_c(y)$ = square root of the sum of squares of the individual standard uncertainties

U = combined standard uncertainty multiplied by the coverage factor: **k**. This defines an interval about the measured result that will encompass the true value with a confidence level of approximately 95%. If a higher level of confidence is required, then k=3 (CL of 99.7%) can be used. Please note that with a coverage factor of one, uc(y) yields a confidence level of only 68%.

California

Orange County Facility

41 Tesla Ave.
Irvine, CA 92618
(888) 364-2378
FAX (503) 844-3826

Oregon

Evergreen Facility

22975 NW Evergreen Pkwy.,
Suite 400
Hillsboro, OR 97124
(503) 844-4066
FAX (503) 844-3826

Oregon

Trails End Facility

30475 NE Trails End Lane
Newberg, OR 97132
(503) 844-4066
FAX (503) 537-0735

Washington

Sultan Facility

14128 339th Ave. SE
Sultan, WA 98294
(888) 364-2378
FAX (360) 793-2536

Party Requesting the Test	
Company Name:	Flow Metrix, Inc.
Address:	2 Clock Tower Place
City, State, Zip:	Maynard, MA 01754
Test Requested By:	Paul Lander
Model:	MLOG
First Date of Test:	4-26-2004
Last Date of Test:	11-09-2004
Receipt Date of Samples:	4-26-04
Equipment Design Stage:	Production
Equipment Condition:	No visual damage.

Information Provided by the Party Requesting the Test

Clocks/Oscillators:	32.768 kHz, 10.245 MHz, 455 kHz IF frequency
I/O Ports:	None

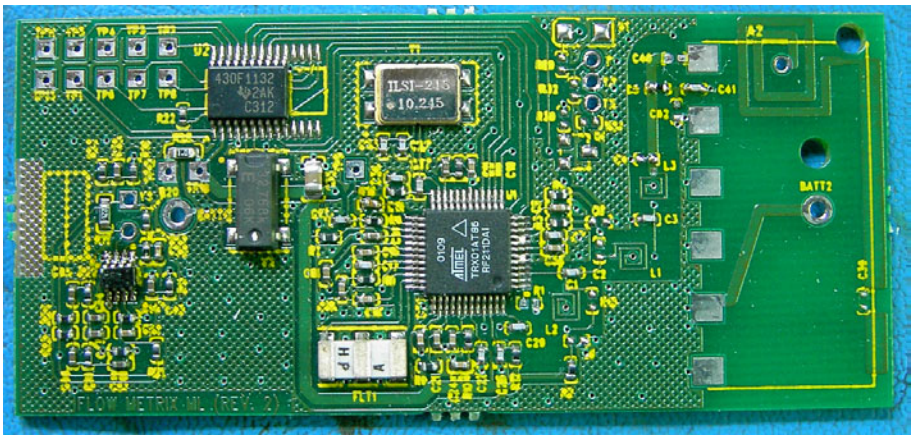
Functional Description of the EUT (Equipment Under Test):
915 MHz transceiver for installation on water piping

Client Justification for EUT Selection:
Not Provided

Client Justification for Test Selection:
Not Provided

Other Information:
Not Provided

EUT Photo



Equipment modifications					
Item	Test	Date	Modification	Note	Disposition of EUT
1	Occupied Bandwidth	04/26/2004	No EMI suppression devices were added or modified during this test.	Same configuration as delivered	EUT remained at Northwest EMC.
2	Number of hopping channels	04/26/2004	No EMI suppression devices were added or modified during this test.	Same configuration as in previous test.	EUT remained at Northwest EMC.
3	Out of Band Radiated Emissions	04/29/2004 04/30/2004	No EMI suppression devices were added or modified during this test..	Same configuration as in previous test.	EUT remained at Northwest EMC.
4	Power Spectral Density	04/30/2004	No EMI suppression devices were added or modified during this test..	Same configuration as in previous test.	EUT remained at Northwest EMC.
5	Carrier Frequency Separation	04/30/2004	No EMI suppression devices were added or modified during this test..	Same configuration as in previous test.	EUT remained at Northwest EMC.
6	Band Edge Compliance	04/30/2004	No EMI suppression devices were added or modified during this test..	Same configuration as in previous test.	EUT remained at Northwest EMC.
7	Spurious Radiated Emissions of the Receiver	04/30/2004	No EMI suppression devices were added or modifed during this test.	Same configuration as in previous test.	EUT returned to client
8	Output Power - EIRP	10/26/2004 11/05/2004	No EMI suppression devices were added or modifed during this test.	Same configuration as delivered	EUT remained at Northwest EMC.
9	Spurious Radiated Emissions in the Restricted Bands	10/26/2004 11/05/2004	No EMI suppression devices were added or modified during this test.	Same configuration as delivered.	EUT remained at Northwest EMC.
10	Dwell Time	11/09/2004	No EMI suppression devices were added or modified during this test.	Same configuration as delivered.	EUT remained at Northwest EMC.

Justification

The individuals and/or the organization requesting the test provided the modes, configurations and settings available to evaluate. While scanning the radiated emissions, all of the EUT parameters listed below were investigated. This includes, but may not be limited to, antennas, tuned transmit frequency ranges, operating modes, and data rates.

Channels in Specified Band Investigated:
Low
High

Operating Modes Investigated:
No hop

Data Rates Investigated:
Maximum

Output Power Setting(s) Investigated:
Maximum

Power Input Settings Investigated:
Battery

Frequency Range Investigated			
Start Frequency	30 MHz	**Stop Frequency**	10 GHz

Software\Firmware Applied During Test			
Exercise software	MLOG Firmware	**Version**	1.0
Description			
The system was tested using standard production firmware developed to test all functions of the device during the test.			

EUT and Peripherals			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
EUT	Flow Metrix, Inc.	MLOG	N/A

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
N/A	N/A	N/A	N/A	N/A	N/A

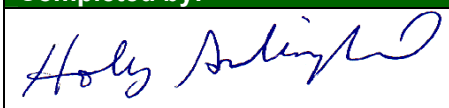
Measurement Equipment					
Description	**Manufacturer**	**Model**	**Identifier**	**Last Cal**	**Interval**
High Pass Filter	Micro-Tronics	HPM50111	HFO	04/13/2004	13 mo
High Pass Filter	Hewlett-Packard	84300-80037	HFE	02/04/2004	13 mo
Pre-Amplifier	Amplifier Research	LN1000A	APS	02/05/2004	13 mo
Pre-Amplifier	Miteq	AMF-4D-005180-24-10P	APJ	01/05/2004	13 mo
Antenna, Horn	EMCO	3115	AHC	09/18/2003	12 mo
Antenna, Biconilog	EMCO	3141	AXE	12/03/2003	24 mo
Quasi-Peak Adapter	Hewlett-Packard	85650A	AQF	12/23/2003	13 mo
Spectrum Analyzer	Hewlett-Packard	8566B	AAL	12/23/2003	13 mo

Test Description

Requirement: Per 47 CFR 15.247(d), in any 100 kHz bandwidth outside the authorized band, the maximum level of radio frequency power must be at least 20dB down from the highest emission level within the authorized band. The measurement is made with the spectrum analyzer's resolution bandwidth set to 100 kHz, and the video bandwidth set to greater than or equal to the resolution bandwidth.

Configuration: The EUT was configured for low and high transmit frequencies. For each configuration, the spectrum was scanned throughout the specified range. While scanning, emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and EUT antenna in three orthogonal axis, and adjusting the measurement antenna height and polarization (per ANSI C63.4:2003). A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.

Completed by:



NORTHWEST EMC

Field Strength of the Fundamental

REV df4.4 10/22/2004

EUT:	MLOG			Work Order:	FLWM0003
Serial Number:	none			Date:	11/05/04
Customer:	Flow Metrix, Inc.			Temperature:	72
Attendees:	none			Humidity:	32%
Cust. Ref. No.:				Barometric Pressure	30.4
Tested by:	Rod Peloquin	Power:	Battery	Job Site:	EV01

TEST SPECIFICATIONS

Specification:	FCC 15.247(d)	Year:	2004
Method:	ANSI C63.4	Year:	2003

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

REQUIREMENTS

In any 100 kHz bandwidth outside the authorized band, the maximum level of radio frequency power must be at least 20dB down from the highest emission level within the authorized band.

EUT OPERATING MODES

No hop, Low channel 913.294 kHz

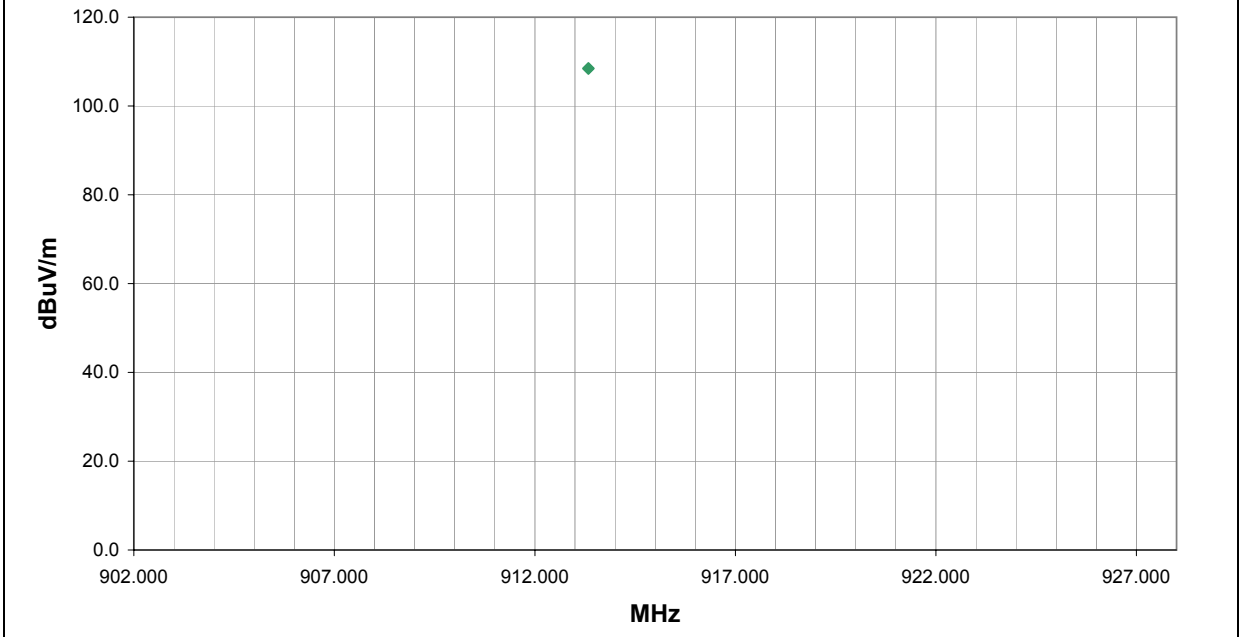
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Run #
Pass	14

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Azimuth (degrees)	Height (meters)	Distance (meters)	External Attenuation (dB)	Polarity	Detector	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
913.335	75.0	33.5	253.0	1.0	3.0	0.0	H-Bilog	PK	0.0	108.5		
913.336	74.9	33.5	134.0	1.3	3.0	0.0	V-Bilog	PK	0.0	108.4		

NORTHWEST EMC

Field Strength of the Fundamental

REV df4.4 10/22/2004

EUT:	MLOG			Work Order:	FLWM0003
Serial Number:	none			Date:	10/26/04
Customer:	Flow Metrix, Inc.			Temperature:	66
Attendees:	none			Humidity:	45%
Cust. Ref. No.:				Barometric Pressure	29.5
Tested by:	Greg Kiemel	Power:	Battery	Job Site:	EV01

TEST SPECIFICATIONS

Specification:	FCC 15.247(d)	Year:	2004
Method:	ANSI C63.4	Year:	2003

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

REQUIREMENTS

In any 100 kHz bandwidth outside the authorized band, the maximum level of radio frequency power must be at least 20dB down from the highest emission level within the authorized band.

EUT OPERATING MODES

Transmitting at 917.3 MHz

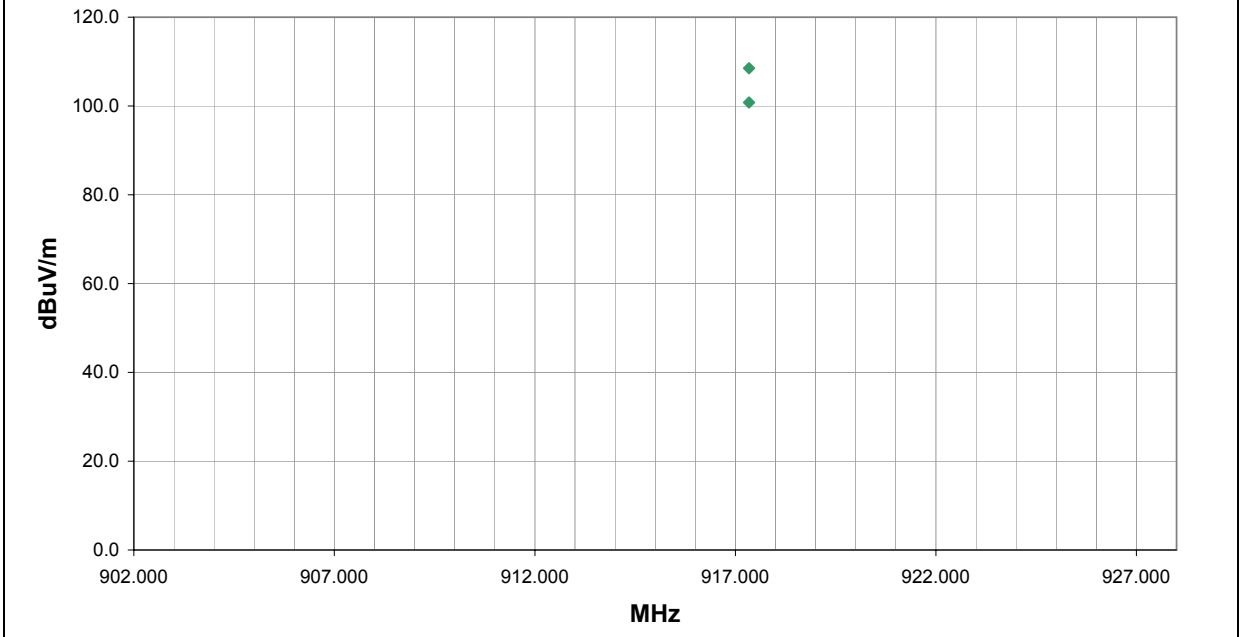
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Run #
Pass	10

Other

Tested By:



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Azimuth (degrees)	Height (meters)	Distance (meters)	External Attenuation (dB)	Polarity	Detector	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)
917.340	75.0	33.5	18.0	1.0	3.0	0.0	H-Bilog	PK	0.0	108.5		
917.341	67.3	33.5	146.0	1.2	3.0	0.0	V-Bilog	PK	0.0	100.8		

NORTHWEST EMC

Out of Band Radiated Emissions

REV df4.12 04/08/2004

EUT:	MLOG	Work Order:	FLWM0001
Serial Number:	none	Date:	04/29/04
Customer:	Flow Metrix, Inc.	Temperature:	75
Attendees:	none	Humidity:	31%
Cust. Ref. No.:		Barometric Pressure	30.12
Tested by:	Holly Ashkannejhad	Power: Battery	Job Site: EV01

TEST SPECIFICATIONS

Specification:	FCC 15.247(d)	Year:	2004
Method:	ANSI C63.4	Year:	2003

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

REQUIREMENTS

In any 100 kHz bandwidth outside the authorized band, the maximum level of radio frequency power must be at least 20dB down from the highest emission level within the authorized band.

EUT OPERATING MODES

Transmitting low or high channel

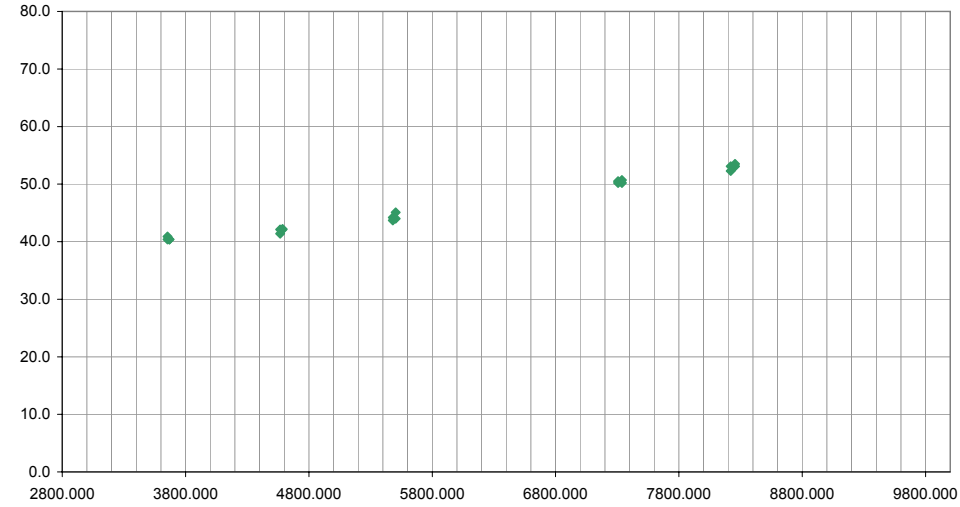
DEVIATIONS FROM TEST STANDARD

No deviations.

RESULTS	Run #
Pass	4

Other

Tested By: Holly Ashkannejhad



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Azimuth (degrees)	Height (meters)	Distance (meters)	External Attenuation (dB)	Polarity	Detector	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)	Comments
8255.700	39.6	13.9	48.0	1.3	3.0	0.0	H-Horn	PK	0.0	53.5			High channel, EUT Horizontal
8219.700	39.3	13.8	44.0	2.7	3.0	0.0	H-Horn	PK	0.0	53.1			Low channel, EUT Horizontal
8255.700	39.2	13.9	61.0	1.9	3.0	0.0	V-Horn	PK	0.0	53.1			High channel, EUT vertical
8219.700	38.5	13.8	38.0	1.2	3.0	0.0	V-Horn	PK	0.0	52.3			Low channel, EUT Vertical
7338.400	40.1	10.6	90.0	2.7	3.0	0.0	V-Horn	PK	0.0	50.7			High channel, EUT vertical
7306.400	39.9	10.6	93.0	1.3	3.0	0.0	H-Horn	PK	0.0	50.5			Low channel, EUT Horizontal
7306.400	39.6	10.6	328.0	2.7	3.0	0.0	V-Horn	PK	0.0	50.2			Low channel, EUT Vertical
7338.400	39.6	10.6	170.0	1.3	3.0	0.0	H-Horn	PK	0.0	50.2			High channel, EUT Horizontal

NORTHWEST EMC

Out of Band Radiated Emissions

REV df4.12 04/08/2004

EUT:	MLOG			Work Order:	FLWM0001
Serial Number:	none			Date:	04/30/04
Customer:	Flow Metrix, Inc.			Temperature:	77
Attendees:	none			Humidity:	32%
Cust. Ref. No.:				Barometric Pressure	30.16
Tested by:	Holly Ashkannejhad	Power:	Battery	Job Site:	EV01

TEST SPECIFICATIONS

Specification:	FCC 15.247(d)	Year:	2004
Method:	ANSI C63.4	Year:	2003

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

Conducted Emissions: Adjusted Level = Measured Level + Transducer Factor + Cable Attenuation Factor + External Attenuator

REQUIREMENTS

In any 100 kHz bandwidth outside the authorized band, the maximum level of radio frequency power must be at least 20dB down from the highest emission level within the authorized band.

EUT OPERATING MODES

Transmitting low or high channel

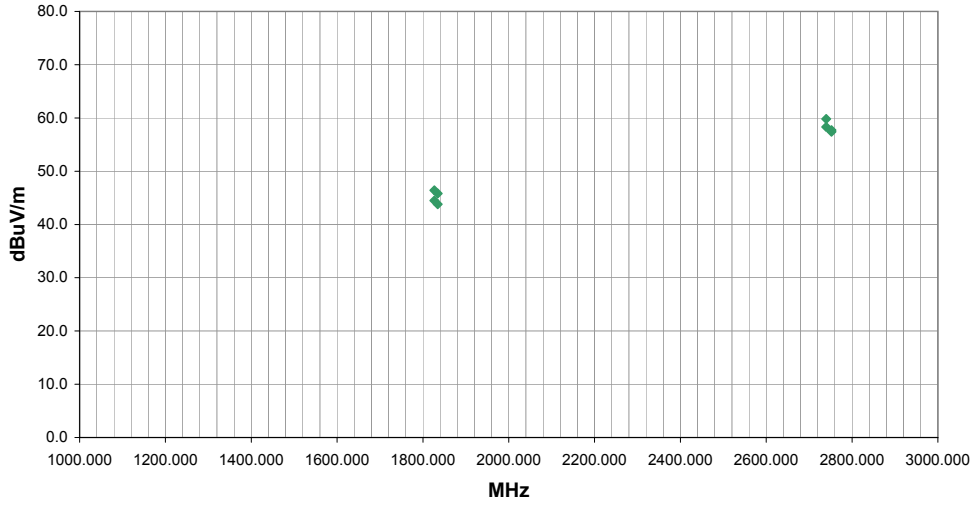
DEVIATIONS FROM TEST STANDARD

No deviations.

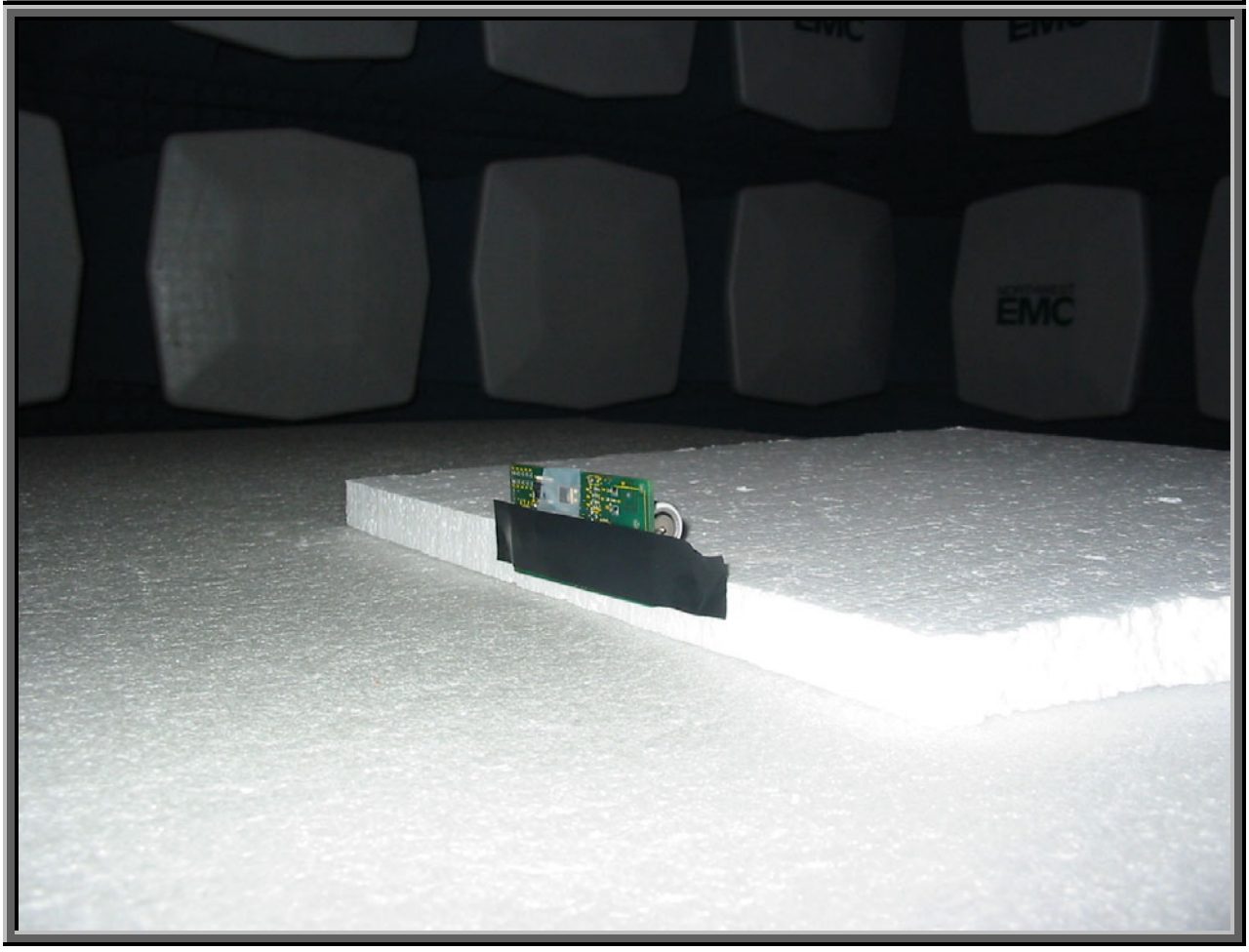
RESULTS	Run #
Pass	5

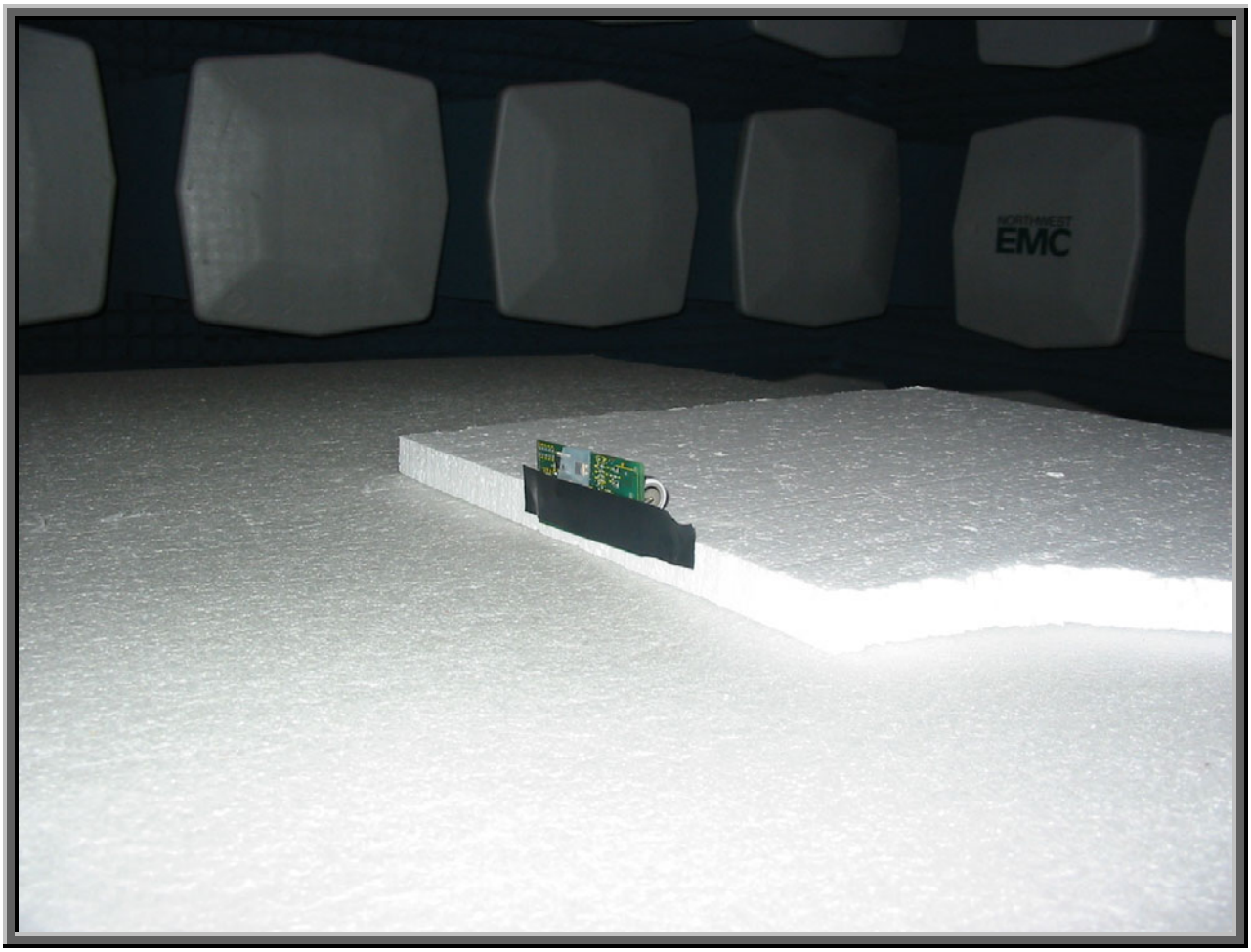
Other

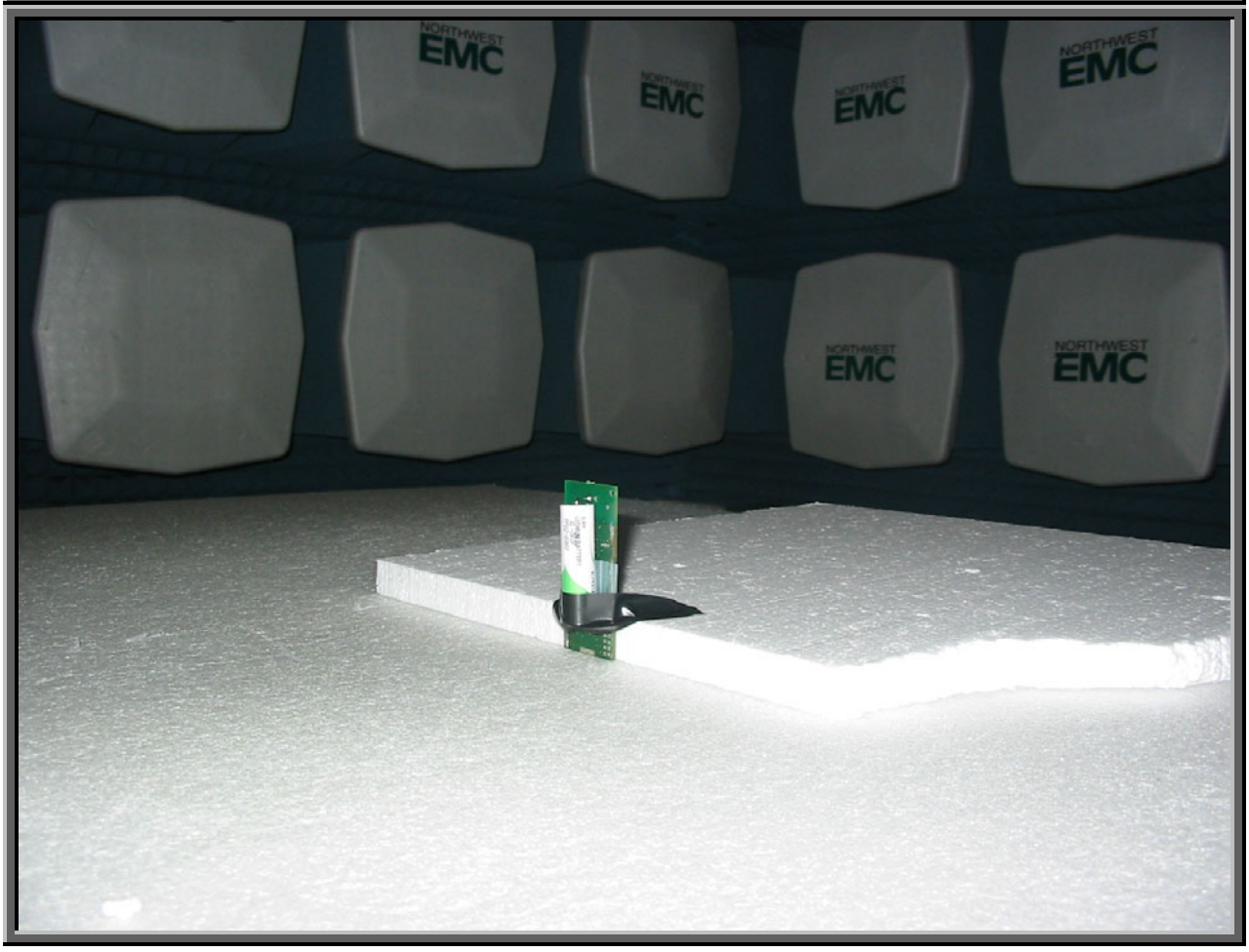
Tested By: Holly Ashkannejhad



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Azimuth (degrees)	Height (meters)	Distance (meters)	External Attenuation (dB)	Polarity	Detector	Distance Adjustment (dB)	Adjusted dBuV/m	Spec. Limit dBuV/m	Compared to Spec. (dB)	Comments
2739.900	61.0	-1.2	335.0	1.4	3.0	0.0	V-Horn	PK	0.0	59.8			Low channel, EUT Vertical
2739.900	59.5	-1.2	184.0	1.3	3.0	0.0	H-Horn	PK	0.0	58.3			Low channel, EUT horizontal
2751.900	58.8	-1.1	30.0	1.3	3.0	0.0	H-Horn	PK	0.0	57.7			High channel, EUT Horizontal
2751.900	58.5	-1.1	315.0	1.4	3.0	0.0	V-Horn	PK	0.0	57.4			High channel, EUT Vertical
1826.600	51.3	-4.9	270.0	1.1	3.0	0.0	V-Horn	PK	0.0	46.4			Low channel, EUT Vertical
1834.600	50.6	-4.8	267.0	1.1	3.0	0.0	V-Horn	PK	0.0	45.8			High channel, EUT Vertical
1826.600	49.4	-4.9	171.0	1.5	3.0	0.0	H-Horn	PK	0.0	44.5			Low channel, EUT horizontal
1834.600	48.6	-4.8	10.0	1.6	3.0	0.0	H-Horn	PK	0.0	43.8			High channel, EUT Horizontal


EMC


NORTHWEST
EMC


NORTHWEST
EMC

Justification

The individuals and/or the organization requesting the test provided the modes, configurations and settings available to evaluate. While scanning the radiated emissions, all of the EUT parameters listed below were investigated. This includes, but may not be limited to, antennas, tuned transmit frequency ranges, operating modes, and data rates.

Channels in Specified Band Investigated:
Low
High

Operating Modes Investigated:
No Hop

Data Rates Investigated:
Maximum

Output Power Setting(s) Investigated:
Maximum

Power Input Settings Investigated:
Battery

Software\Firmware Applied During Test			
Exercise software	MLOG Firmware	**Version**	1.0
Description			
The system was tested using standard production firmware developed to test all functions of the device during the test.			

EUT and Peripherals			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
EUT	Flow Metrix, Inc.	MLOG	N/A

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
N/A	N/A	N/A	N/A	N/A	N/A

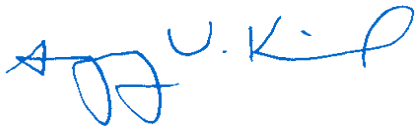
Measurement Equipment					
Description	**Manufacturer**	**Model**	**Identifier**	**Last Cal**	**Interval**
Spectrum Analyzer	Tektronix	2784	AAO	02/26/2003	24 mo
Near Field Probe	EMCO	7405	IPD	NCR	NA

Test Description

Requirement: Per 47 CFR 15.247(a)(1)(i), the 20 dB bandwidth of a hopping channel must be less than 500 kHz. The measurement is made with the spectrum analyzer's resolution bandwidth set to ≥1% of the 20dB bandwidth, and the video bandwidth set to greater than or equal to the resolution bandwidth.

Configuration: The occupied bandwidth was measured with the EUT set to low and high transmit frequencies. The measurements were made using a near field probe and spectrum analyzer to measure the RF output of the EUT. The EUT was transmitting at its maximum data rate in a no hop mode.

Completed by:



NORTHWEST
EMC

Occupied Bandwidth

Rev BETA
01/30/01

EUT:	MLOG			Work Order:	FLWM0001
Serial Number:	N/A			Date:	04/26/04
Customer:	FlowMetrix			Temperature:	23 °C
Attendees:	None			Humidity:	34%
Customer Ref. No.:	N/A			Bar. Pressure:	30.19
Tested by:	Rod Peloquin	Power:	Battery	Job Site:	EV06
Specification:	47 CFR 15.247(a)(1)(i)	Year: 2004	Method: DA 00-705, ANSI C63.4	Year:	2003

SAMPLE CALCULATIONS

COMMENTS

None

EUT OPERATING MODES

No hop mode

DEVIATIONS FROM TEST STANDARD

REQUIREMENTS

The 20 dB bandwidth of the hopping channel is less than 500 kHz

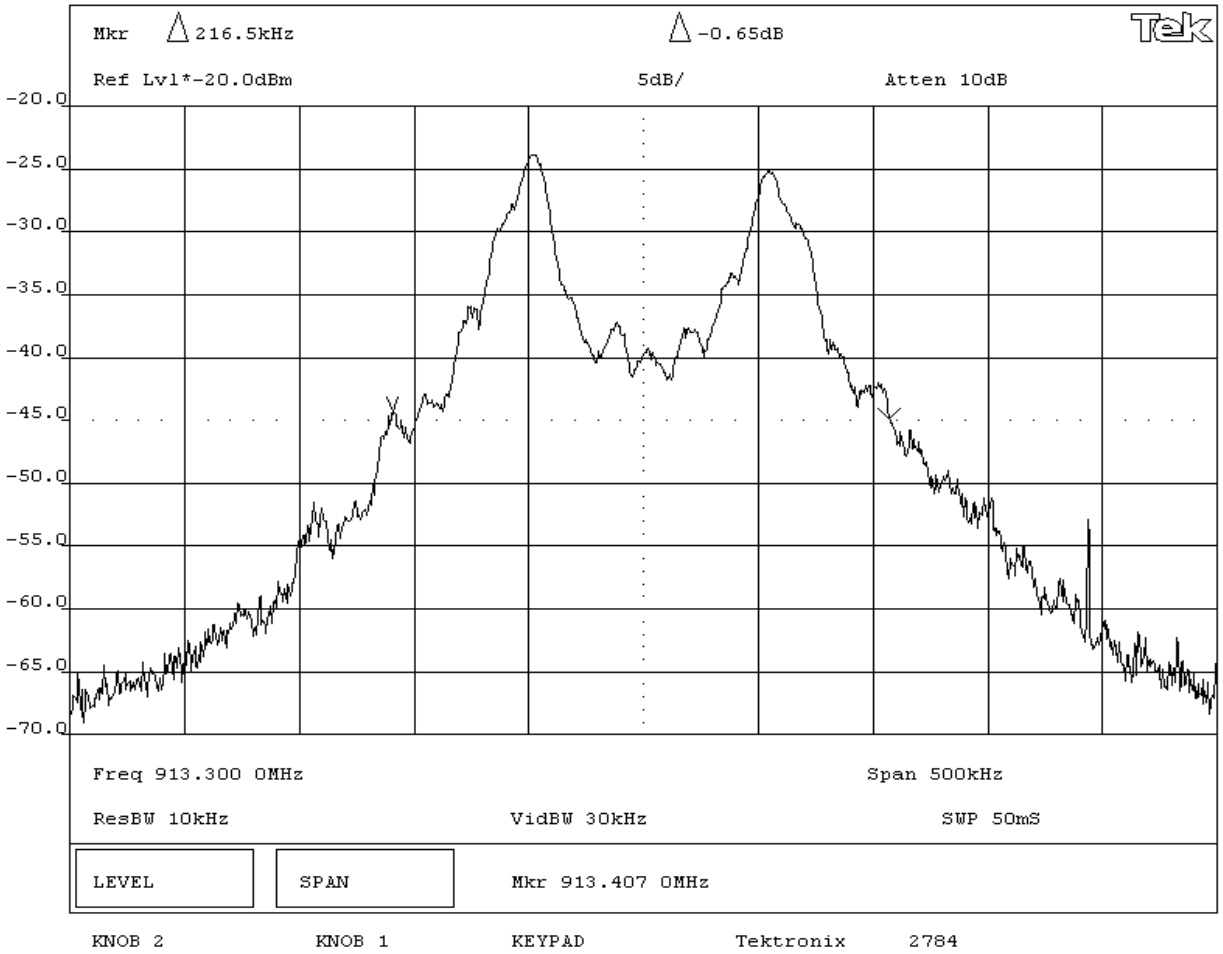
RESULTS	BANDWIDTH
Pass	217 kHz

SIGNATURE

Tested By: _____

DESCRIPTION OF TEST

Low Channel



NORTHWEST
EMC

Occupied Bandwidth

Rev BETA
01/30/01

EUT:	MLOG			Work Order:	FLWM0001
Serial Number:	N/A			Date:	04/26/04
Customer:	FlowMetrix			Temperature:	23 °C
Attendees:	None			Humidity:	34%
Customer Ref. No.:	N/A			Bar. Pressure:	30.19
Tested by:	Rod Peloquin	Power:	Battery	Job Site:	EV06
Specification:	47 CFR 15.247(a)(1)(i)	Year: 2004	Method: DA 00-705, ANSI C63.4	Year:	2003

SAMPLE CALCULATIONS

COMMENTS

None

EUT OPERATING MODES

No hop mode

DEVIATIONS FROM TEST STANDARD

REQUIREMENTS

The 20 dB bandwidth of the hopping channel is less than 500 kHz

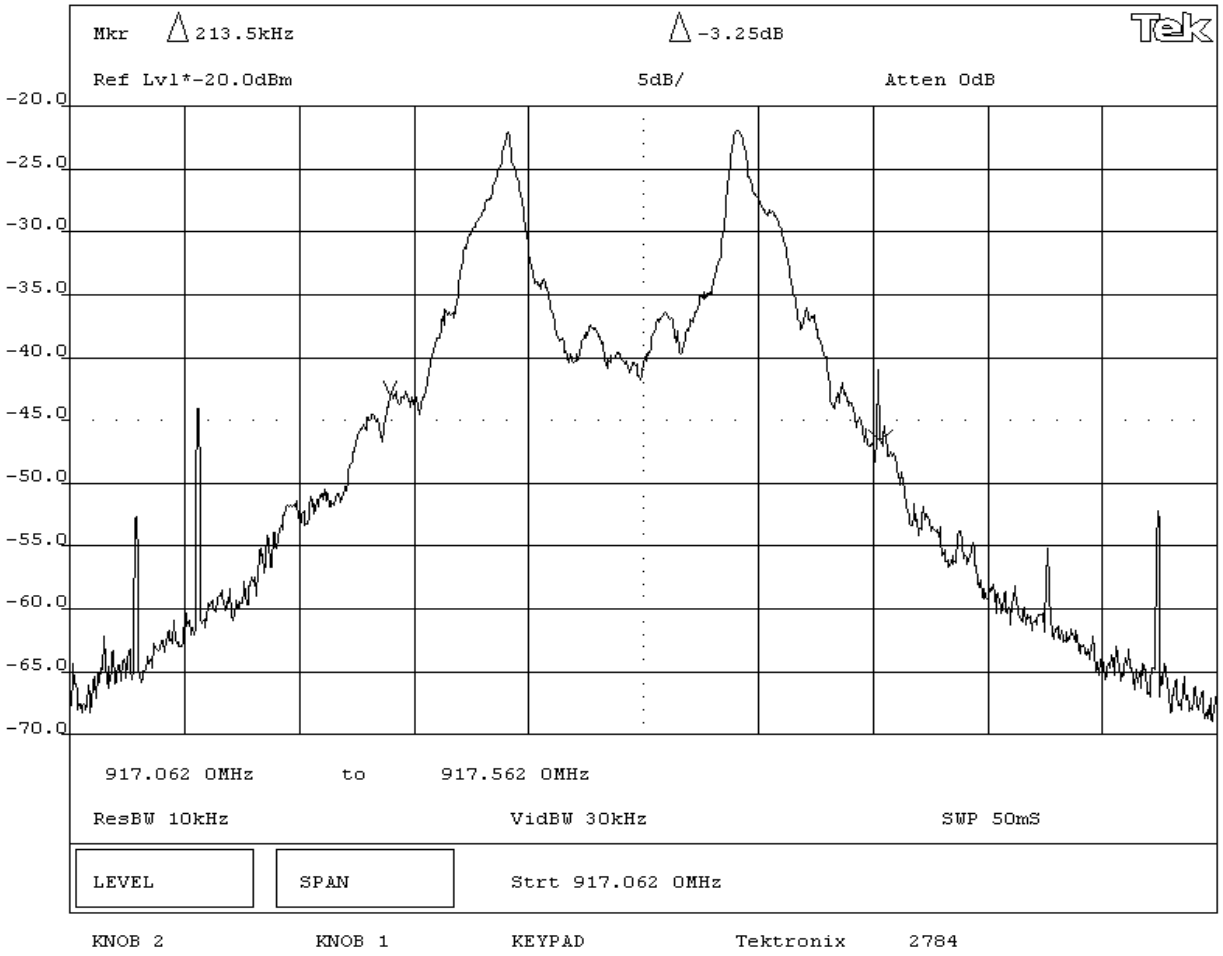
RESULTS	BANDWIDTH
Pass	214 kHz

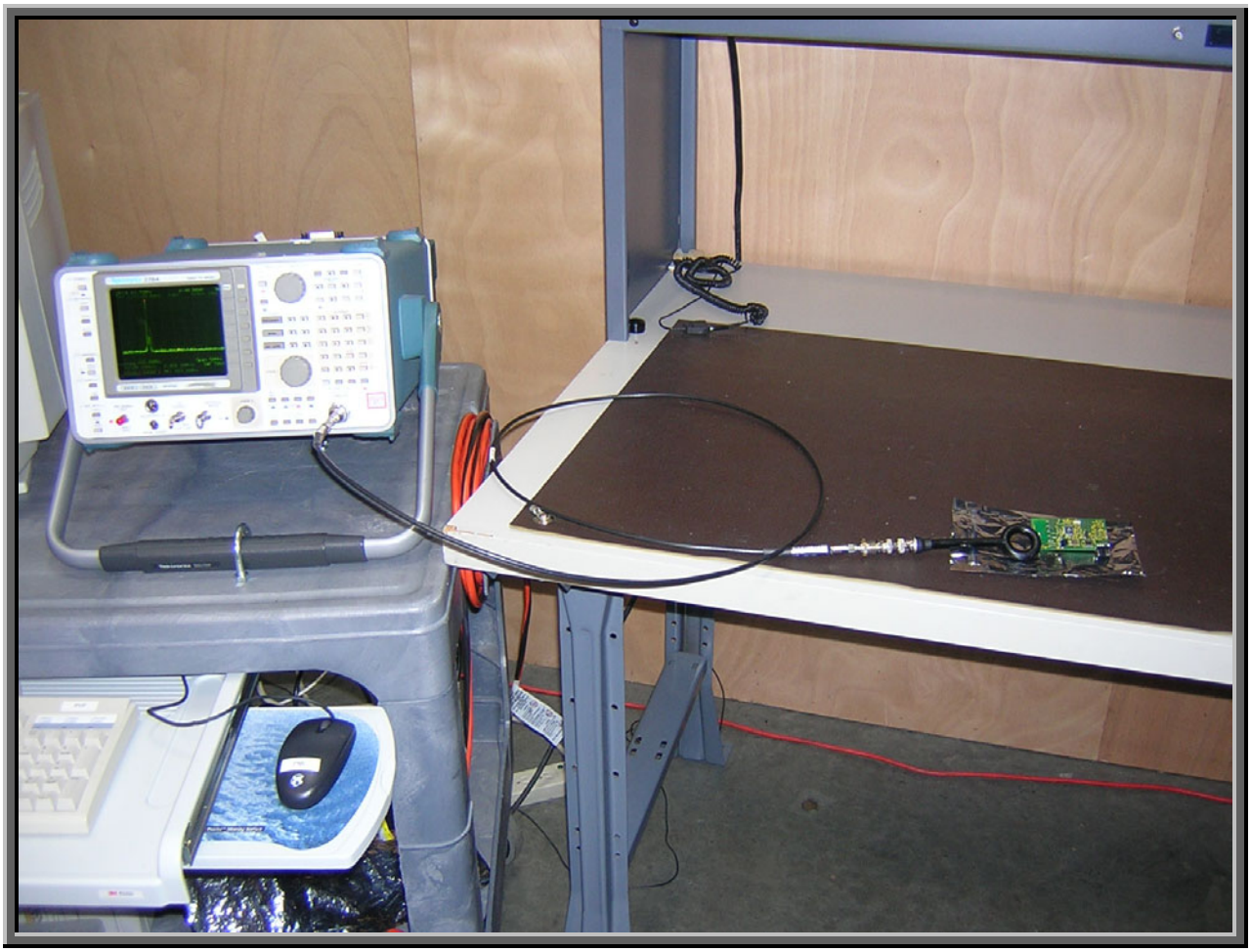
SIGNATURE

Tested By: _____

DESCRIPTION OF TEST

High Channel





Number of Hopping Frequencies

Justification

The individuals and/or the organization requesting the test provided the modes, configurations and settings available to evaluate. While scanning the radiated emissions, all of the EUT parameters listed below were investigated. This includes, but may not be limited to, antennas, tuned transmit frequency ranges, operating modes, and data rates.

Channels in Specified Band Investigated:
all

Operating Modes Investigated:
Hopping

Data Rates Investigated:
Maximum

Output Power Setting(s) Investigated:
Maximum

Power Input Settings Investigated:
Battery

Software\Firmware Applied During Test			
Exercise software	MLOG Firmware	**Version**	1.0
Description			
The system was tested using special firmware developed to test all functions of the device during the test.			

EUT and Peripherals			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
EUT	FlowMetrix	MLOG	N/A

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
N/A	N/A	N/A	N/A	N/A	N/A

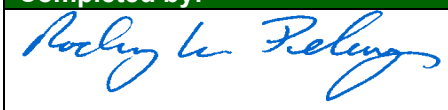
Measurement Equipment					
Description	**Manufacturer**	**Model**	**Identifier**	**Last Cal**	**Interval**
Spectrum Analyzer	Tektronix	2784	AAO	02/26/2003	24 mo
Near Field Probe	EMCO	7405	IPD	NCR	NA

Test Description

Requirement: The number of hopping channels is required to be measured to allow calculation of total dwell time per 47 CFR 15.247(f). The measurement is made with the spectrum analyzer's resolution bandwidth set to 100 kHz, and the video bandwidth set to greater than or equal to the resolution bandwidth.

Configuration: The number of hopping frequencies was measured across the authorized band. The measurements were made using a near field probe and spectrum analyzer to measure the RF output of the EUT. The hopping function of the EUT was enabled.

Completed by:



NORTHWEST EMC

EMISSIONS DATA SHEET

Rev BETA 01/30/01

EUT:	MLOG			Work Order:	FLWM0001
Serial Number:	N/A			Date:	04/26/04
Customer:	FlowMetrix			Temperature:	23 °C
Attendees:	None			Humidity:	34%
Customer Ref. No.:	N/A			Bar. Pressure:	30.19
Tested by:	Rod Peloquin		Power: Battery	Job Site:	EV06
Specification:	47 CFR 15.247(f)	Year: 2004	Method: DA 00-705, ANSI C63.4	Year:	2003

SAMPLE CALCULATIONS

COMMENTS

EUT OPERATING MODES

Modulated by PRBS at maximum data rate. Hopping carrier.

DEVIATIONS FROM TEST STANDARD

None

REQUIREMENTS

To determine dwell time per 15.247(f) the total number of hopping frequencies must be determined

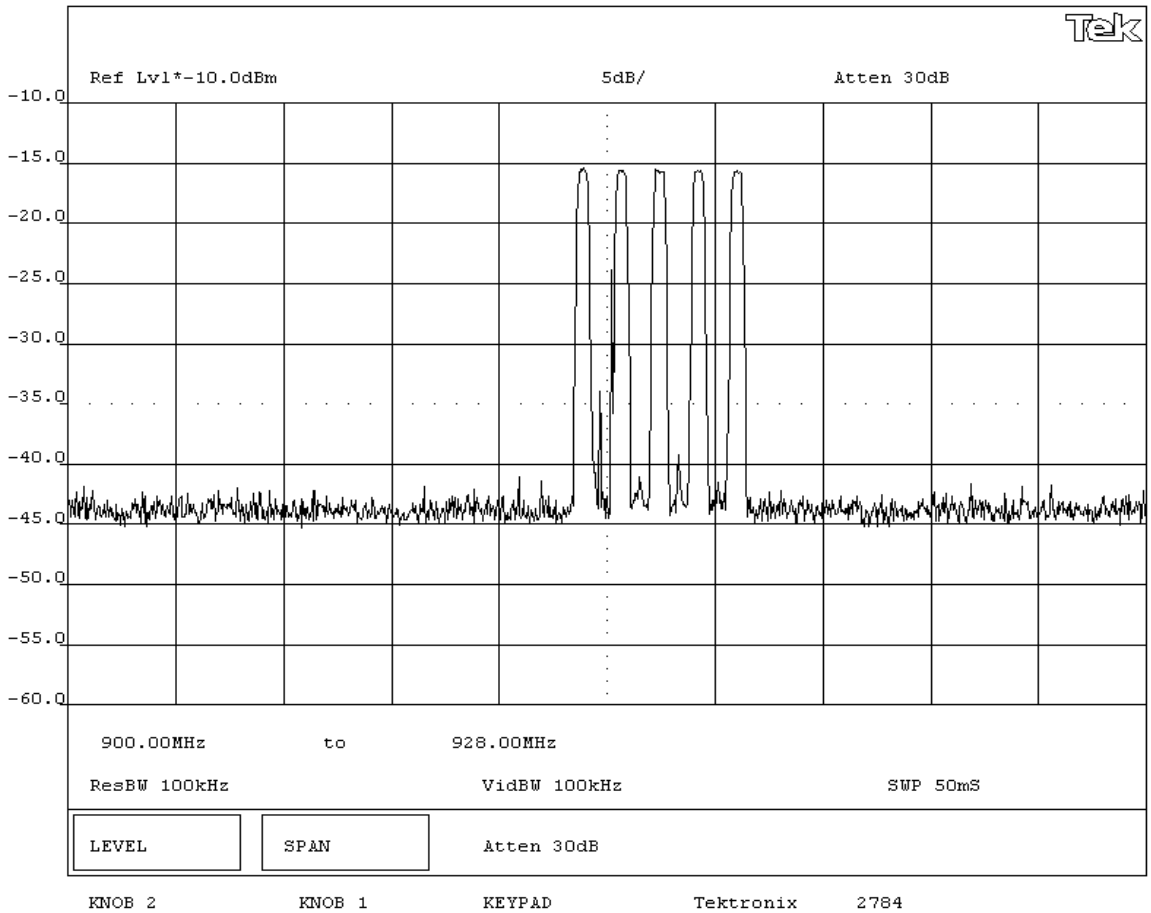
RESULTS	NUMBER OF HOPPING FREQUENCIES
Pass	5

SIGNATURE

Tested By: Rodney La Peloquin

DESCRIPTION OF TEST

HOPPING CHANNELS



Justification

The individuals and/or the organization requesting the test provided the modes, configurations and settings available to evaluate. While scanning the radiated emissions, all of the EUT parameters listed below were investigated. This includes, but may not be limited to, antennas, tuned transmit frequency ranges, operating modes, and data rates.

Channels in Specified Band Investigated:
Low
High

Operating Modes Investigated:
No hop

Data Rates Investigated:
Maximum

Output Power Setting(s) Investigated:
Maximum

Power Input Settings Investigated:
Battery

Software\Firmware Applied During Test			
Exercise software	MLOG Firmware	**Version**	1.0
Description			
The system was tested using standard production firmware developed to test all functions of the device during the test.			

EUT and Peripherals			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
EUT	Flow Metrix, Inc.	MLOG	N/A

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
N/A	N/A	N/A	N/A	N/A	N/A

Measurement Equipment					
Description	**Manufacturer**	**Model**	**Identifier**	**Last Cal**	**Interval**
Spectrum Analyzer	Tektronix	2784	AAO	02/26/2003	24 mo
Antenna, Biconilog	EMCO	3141	AXE	12/03/2003	24 mo

Test Description

Requirement: Per 47 CFR 15.247(f), the peak power spectral density conducted from the antenna port of a hybrid transmitter must not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission.

Configuration: The peak power spectral density measurements were measured with the EUT set to low and high transmit frequencies. The EUT was transmitting at its maximum data rate in a no hop mode.

The measurement was made using the alternative test procedure described in FCC 97-114. The maximum field strength of the fundamental was measured at a 3 meter distance. The field strength was maximized by rotating the EUT on a turntable, adjusting the position of the EUT and EUT antenna in three orthogonal axis, and adjusting the measurement antenna height and polarization (per ANSI C63.4:2003). Then the analyzer was tuned to the highest point of the maximized fundamental emission and reset per the procedure outlined in FCC 97-114:

> The emission peak(s) were located and zoom in on within the passband. The resolution bandwidth was set to 3 kHz, the video bandwidth was set to greater than or equal to the resolution bandwidth. The sweep speed was set equal to the span divided by 3 kHz (sweep = (SPAN/3 kHz)). For example, given a span of 1.5 MHz, the sweep should be 1.5 x 106 ÷ 3 x 103 = 500 seconds. External attenuation was used and added to the reading. The following FCC procedure was used for modifying the power spectral density measurements:

"If the spectrum line spacing cannot be resolved on the available spectrum analyzer, the noise density function on most modern conventional spectrum analyzers will directly measure the noise power density normalized to a 1 Hz noise power bandwidth. Add 34.8 dB for correction to 3 kHz."

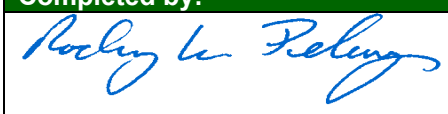
The spectrum analyzer display was internally offset by a correction factor equal to the antenna factor (dB/m) plus the cable loss (dB) plus a field strength (dBm/m) to EIRP (dBm) conversion factor of 11.77dB. The conversion factor of 11.77 dB was derived from the equation:

$$EIRP = (Ed)^2 / 30$$

Where: E is the measured maximum field strength in V/m
d is the distance in meters from which the field strength was measured (3 meters)
EIRP is in W

The bandwidth correction factor of 34.8 dB was added to the marker noise value (dBm/Hz) on the spectrum analyzer display to convert it to dBm/3kHz for comparison with the limit.

Completed by:



NORTHWEST
EMC

EMISSIONS DATA SHEET

Rev BETA
01/30/01

EUT:	MLOG			Work Order:	FLWM0001
Serial Number:	N/A			Date:	04/30/04
Customer:	Flow Metrix, Inc.			Temperature:	23° C
Attendees:	None			Humidity:	34%
Customer Ref. No.:	N/A			Bar. Pressure:	29.89
Tested by:	Rod Peloquin	Power:	Battery	Job Site:	EV06
Specification:	CFR 47 Part 15.247(f) Year: 2004	Method:	FCC 97-114, ANSI C63.4	Year:	2003

SAMPLE CALCULATIONS

Meter reading on spectrum analyzer is internally compensated for cable loss, antenna factor, and field strength (dBm/m) to EIRP (dBm) conversion factor.
Power Spectral Density per 3kHz bandwidth = Power Spectral Density per 1 Hz bandwidth + Bandwidth Correction Factor.
Bandwidth Correction Factor = 10*log(3kHz/1Hz)

COMMENTS

EUT OPERATING MODES

Modulated by PRBS at maximum data rate

DEVIATIONS FROM TEST STANDARD

None

REQUIREMENTS

Maximum peak power spectral density conducted from a hybrid transmitter does not exceed 8 dBm in any 3 kHz band

RESULTS | **AMPLITUDE**

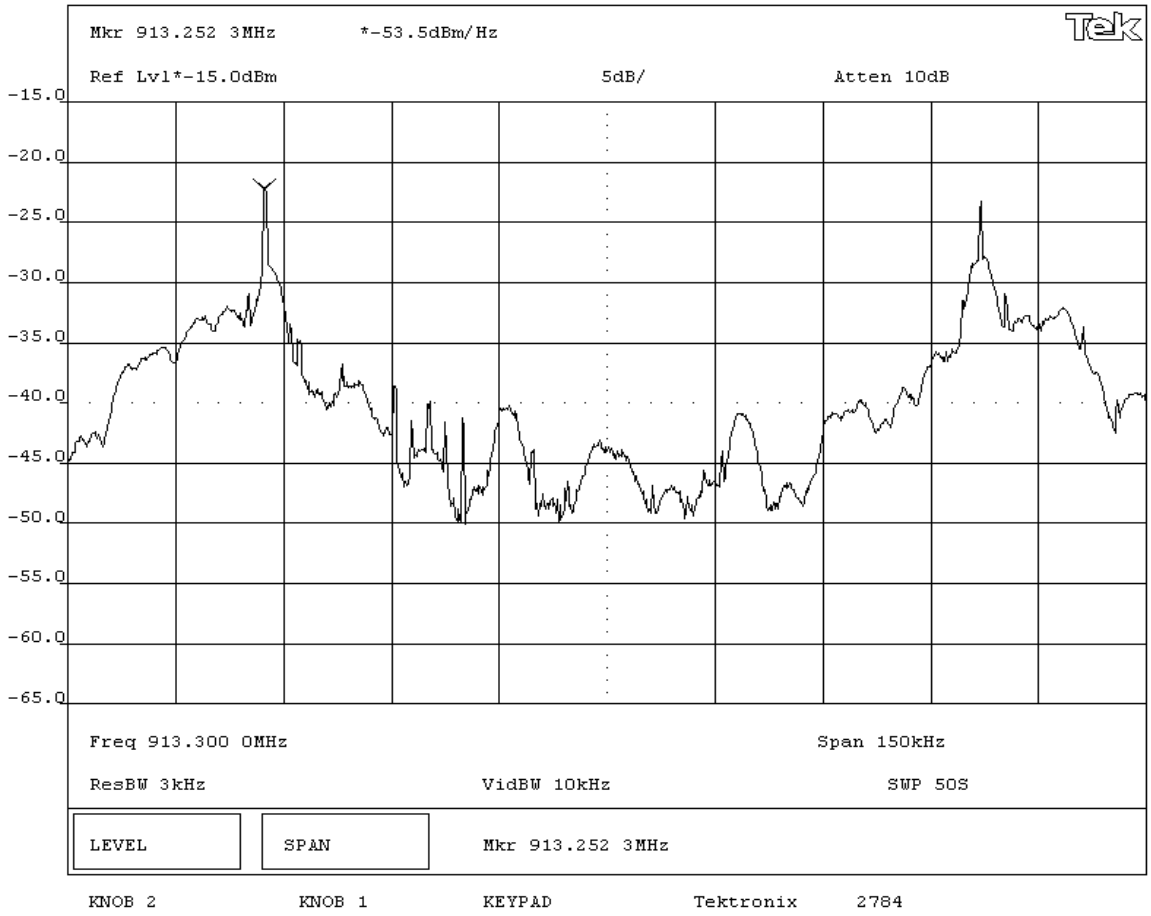
Pass | Power Spectral Density = -18.7 dBm / 3kHz

SIGNATURE

Tested By: _____

DESCRIPTION OF TEST

Power Spectral Density - Low Channel



NORTHWEST EMC

EMISSIONS DATA SHEET

Rev BETA 01/30/01

EUT:	MLOG					Work Order:	FLWM0001
Serial Number:	N/A					Date:	04/30/04
Customer:	Flow Metrix, Inc.					Temperature:	23° C
Attendees:	None					Humidity:	34%
Customer Ref. No.:	N/A					Bar. Pressure:	29.89
Tested by:	Rod Peloquin			Power:	Battery	Job Site:	EV06
Specification:	CFR 47 Part 15.247(f)	Year:	2004	Method:	FCC 97-114, ANSI C63.4	Year:	2003

SAMPLE CALCULATIONS

Meter reading on spectrum analyzer is internally compensated for cable loss, antenna factor, and field strength (dBm/m) to EIRP (dBm) conversion factor.
Power Spectral Density per 3kHz bandwidth = Power Spectral Density per 1 Hz bandwidth + Bandwidth Correction Factor.
Bandwidth Correction Factor = 10*log(3kHz/1Hz)

COMMENTS

EUT OPERATING MODES

Modulated by PRBS at maximum data rate

DEVIATIONS FROM TEST STANDARD

None

REQUIREMENTS

Maximum peak power spectral density conducted from a hybrid transmitter does not exceed 8 dBm in any 3 kHz band

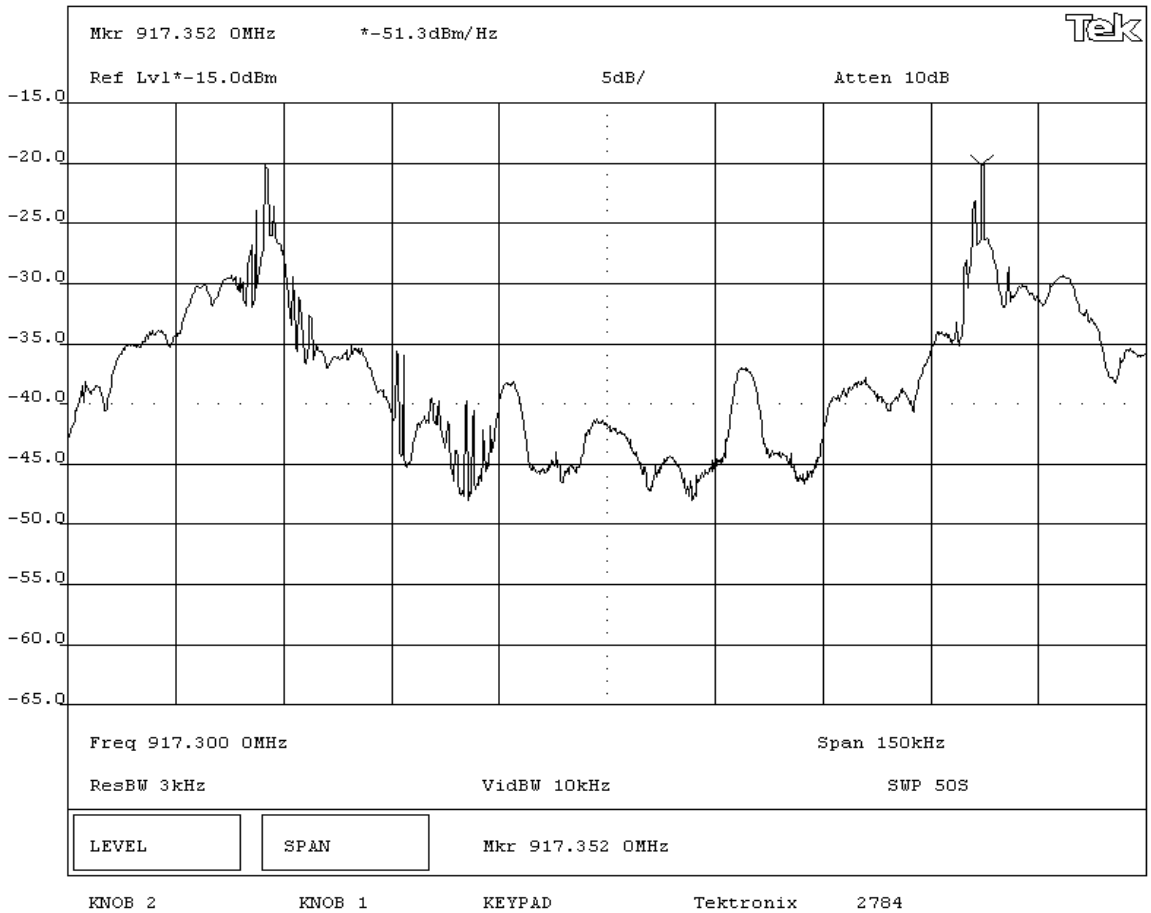
RESULTS	AMPLITUDE
Pass	Power Spectral Density = -16.5 dBm / 3kHz

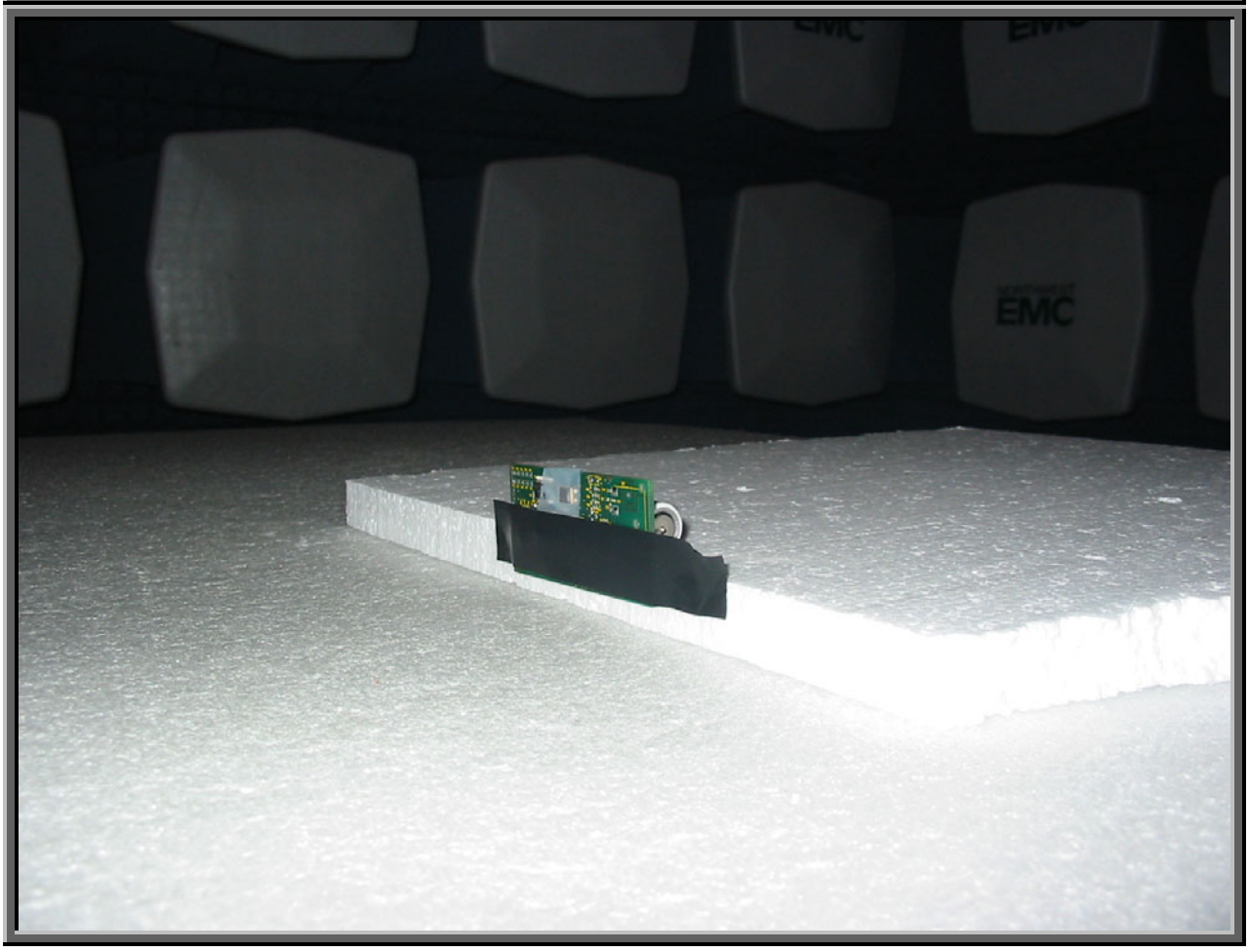
SIGNATURE

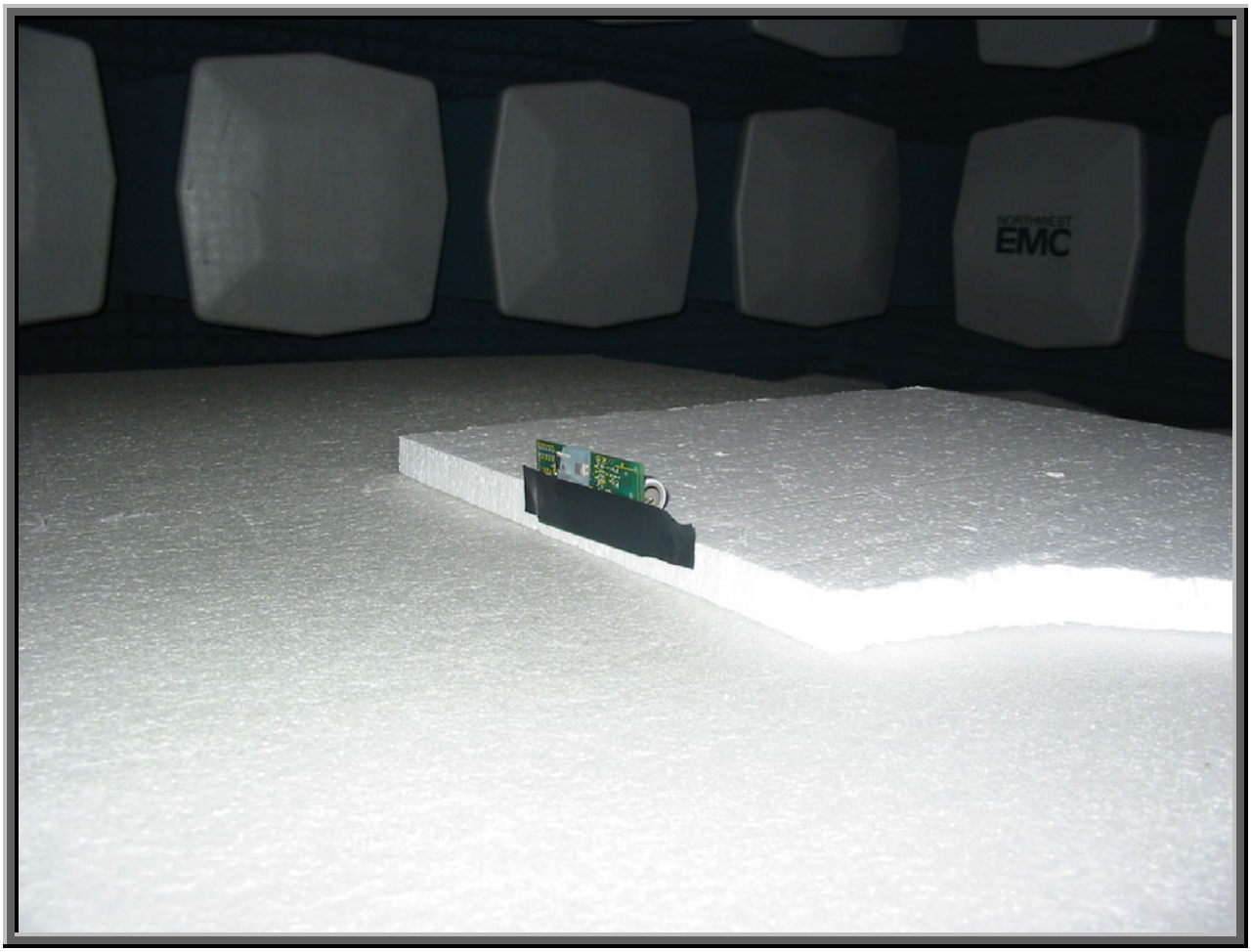
Tested By: _____

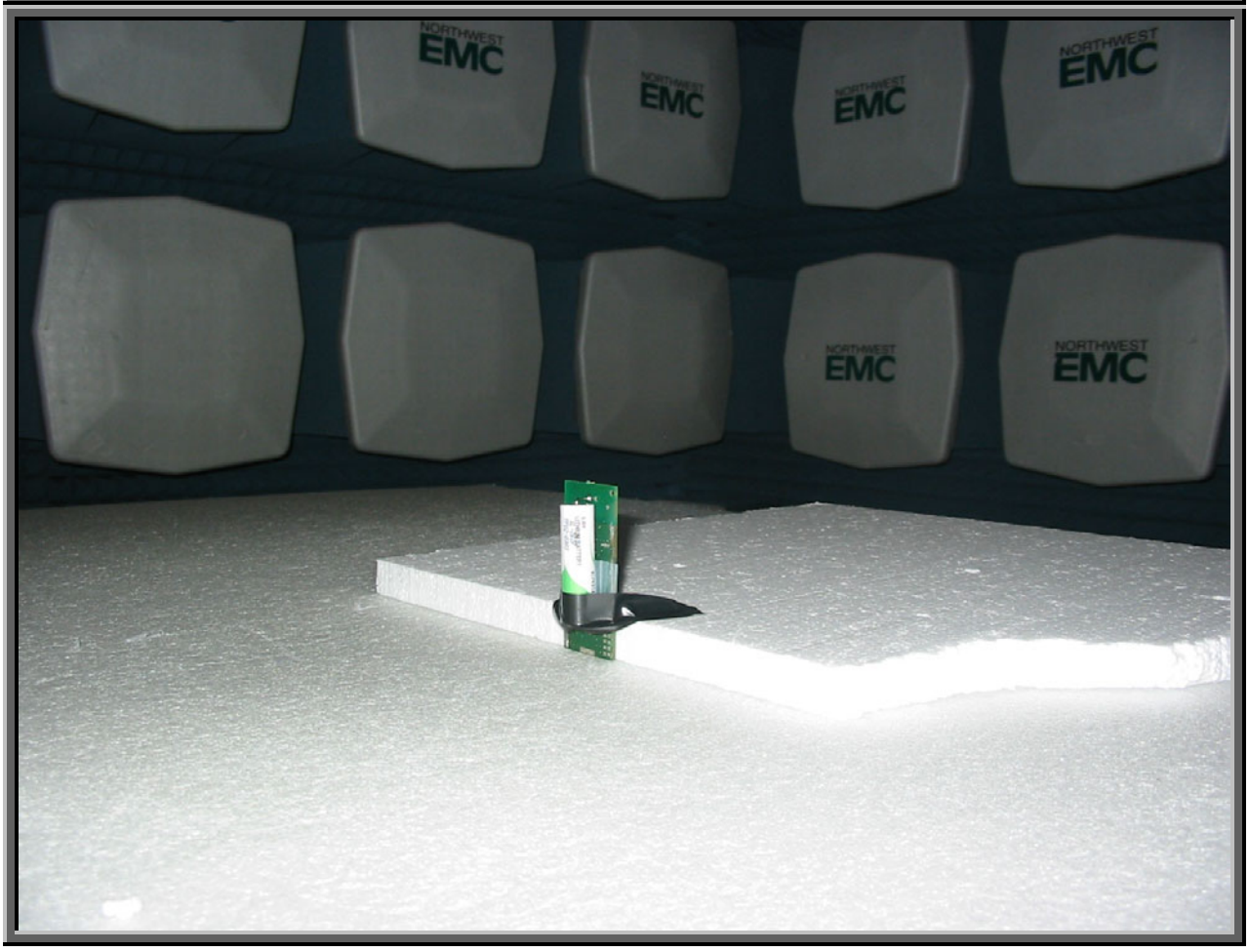
DESCRIPTION OF TEST

Power Spectral Density - High Channel




EMC


NORTHWEST
EMC


NORTHWEST
EMC

Justification

The individuals and/or the organization requesting the test provided the modes, configurations and settings available to evaluate. While scanning the radiated emissions, all of the EUT parameters listed below were investigated. This includes, but may not be limited to, antennas, tuned transmit frequency ranges, operating modes, and data rates.

Channels in Specified Band Investigated:
All

Operating Modes Investigated:
Hopping

Data Rates Investigated:
Maximum

Output Power Setting(s) Investigated:
Maximum

Power Input Settings Investigated:
Battery

Software\Firmware Applied During Test			
Exercise software	MLOG Firmware	**Version**	1.0
Description			
The system was tested using standard production firmware developed to test all functions of the device during the test.			

EUT and Peripherals			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
EUT	Flow Metrix, Inc.	MLOG	N/A

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
N/A	N/A	N/A	N/A	N/A	N/A

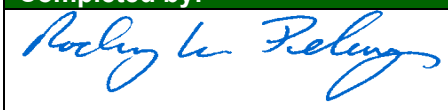
Measurement Equipment					
Description	**Manufacturer**	**Model**	**Identifier**	**Last Cal**	**Interval**
Spectrum Analyzer	Tektronix	2784	AAO	02/26/2003	24 mo
Near Field Probe	EMCO	7405	IPD	NCR	NA

Test Description

Requirement: Per 47 CFR 15.247(a)(1), the hopping channel carrier frequencies must be separated by a minimum of 25 kHz or the 20dB bandwidth of the hopping channel. The measurement is made with the spectrum analyzer's resolution bandwidth set to greater than or equal to 1% of the span, and the video bandwidth set to greater than or equal to the resolution bandwidth.

Configuration: The carrier frequency separation was measured between each of 5 hopping channels in the middle of the authorized band. The measurements were made using a spectrum analyzer and near field probe. The hopping function of the EUT was enabled.

Completed by:



NORTHWEST EMC

EMISSIONS DATA SHEET

Rev BETA 01/30/01

EUT:	MLOG			Work Order:	FLWM0001
Serial Number:	N/A			Date:	04/30/04
Customer:	Flow Metrix, Inc.			Temperature:	23 °C
Attendees:	N/A	Tested by:	Rod Peloquin	Humidity:	38% RH
Customer Ref. No.:	N/A	Power:	Battery	Job Site:	EV06

TEST SPECIFICATIONS

Specification:	47 CFR 15.247(a)(1)	Year:	2004	Method:	DA 00-705, ANSI C63.4	Year:	2003

SAMPLE CALCULATIONS

COMMENTS

EUT OPERATING MODES

Modulated by PRBS at maximum data rate. Hopping carrier.

DEVIATIONS FROM TEST STANDARD

None

REQUIREMENTS

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

RESULTS	CHANNEL SPACING
Pass	1 MHz

SIGNATURE

Tested By: _____

DESCRIPTION OF TEST

Carrier Frequency Separation