Nemko USA, Inc.
11696 Sorrento Valley Rd., Suite F
San Diego, CA 92121-1024
Phone (858) 755-5525 Fax (858) 452-1810

Certification Test Report

In Accordance With:	FCC Part 15 Subpart C, 15.231& 15.231(e)
Applicant:	Green Badge LLC dba UgMO Technologies 840 1st Ave., Ste. 300 King of Prussia, PA 19406
Equipment Under Test (EUT): Model:	Wireless Soil Sensor PH100WS
FCC ID:	YVAPH100WS
Tested By:	Nemko USA Inc. 11696 Sorrento Valley Road, Suite F San Diego, CA 92121
Test Report Number: Date: Project Number NEX Number	2010 09149167 FCC January 13, 2011 43834 149167
Total Number of Pages:	30

Section 1. Summary of Test Results

1.1 General

All measurements are traceable to national standards

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15; Subpart C. Radiated tests were conducted is accordance with ANSI C63.4-2003. Radiated emissions are made on an open area test site. A description of the test facility is on file with the FCC.

The assessment summary is as follows:

Apparatus Assessed:	Wireless Soil Sensor
Model:	PH100WS
Specification:	FCC Part 15 Subpart C, 15.231
Date Received in Laboratory:	May 13, 2010
Compliance Status:	Complies
Exclusions:	None
Non-compliances:	None

1.2 Report Release History

REVISION	DATE	COMMENTS	
-	January 13, 2010	Prepared By:	Alan Laudani
-	January 13, 2010	Initial Release:	Alan Laudani

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025.

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Alan Laudani, RF/EMC Test Engineer

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Section 2: Equipment Under Test

2.1 Theory of Operation

The PH100WS is a Wireless Soil Sensor. Its function is to control the operation of an irrigation system based on the conditions of soil moisture. The EUT was exercised by putting the transmitter into a continuous transmit mode (artificial test modes) on 434 MHz for communication. The artificial test mode allows for more than 10ms on per second.

Under normal operating mode, the sensor is in a dormant state most of the time. The sensor wakes up every ten minutes and checks the soil condition by performing a sensing operation. If conditions are not changed, the sensor will go back to sleep. However, upon condition change, an RF transmission is triggered. As such, transmissions are not periodic, and do not occur at predetermined intervals.

During installation, the Sensor may transmit when the tine cover is removed. The transmitter stops within 4 seconds when the tine cover is removed. During installation, the Sensor is activated by removal of the sleeve that covers the tine. This acts as a manual switch. Upon initial activation, the sensor will be active for 5 seconds, during which a number of control signals will be transmitted. The total duration of transmission in this interval is at most 5*7.5= 37.5 msec. As such, transmissions are not periodic, and do not occur at predetermined intervals. The sensor will then fall into an intermediate mode where the soil condition will be checked once every minute. If a condition change is detected, a packet transmission will be triggered. Otherwise the sensor will go back to sleep. After the first one hundred minutes, the sensor will fall into normal mode of operation.

The device was tested in air and in soil. It transmits at reduced power when not in soil. See set up photos. There is no receive mode for the transmitter.

Highest frequency generated or used: 434 MHz

2.2 Technical Specifications of the EUT

Manufacturer:	Green Badge LLC dba UgMO Technologies
	dba = “doing business as”
Operating Frequency:	434 MHz
Measured Power:	66.8 dBuV/m @ 3m
Modulation:	GFSK
Antenna Data:	Coil antenna
Antenna Connector:	NONE
Power Source:	3.3 V Battery

Section 3: Test Conditions

3.1 Specifications

The apparatus was assessed against the following specifications:

FCC Part 15 Subpart C, 15.231 & 15.231(e)
Periodic operation in the band 40.66–40.70 MHz and above 70 MHz.

3.2 Deviations From Laboratory Test Procedures

No deviations from Laboratory Test Procedure

3.3 Test Environment

All tests were performed under the following environmental conditions:

Temperature range	:	14 – 22 ^{o}C
Humidity range	:	32--76 %
Pressure range	:	102.0 kPa
Power supply range	:	+/- 5% of rated voltages

3.4 Test Equipment

Nemko ID	Device	Mfr.	Model	Serial Number	Cal Date	Cal Due Date
110	Antenna, LPA	Electrometrics	LPA-25	1217	1/10/2009	2/10/2011
115	Antenna, Bicon	EMCO	3110	1267	11/12/2008	11/12/2010
116	Antenna, Bicon	EMCO	3110	1267	12/2/2010	12/2/2012
827	Preamplifier	Com-Power	PA-103	161032	4/21/2010	4/21/2011
877	Antenna, DRG Horn, .7-18GHz	AH Systems	SAS-571	688	8/16/2009	8/16/2010
897	Spectrum Analyzer	Rohde & Schwarz	FSP7	837620/009	10/14/2009	10/14/2010
911	Spectrum Analyzer	Agilent	E4440A	US41421266	12/17/2009	12/17/2010
835	Spectrum Analyzer	Rohde & Schwarz	RHDFSEK	829058/005	7/12/2010	7/12/2011
898	EMI Receiver & filter set	HP	8546A	3625A00348	6/22/2010	6/22/2011
899	Filter Section	HP	85460A	3448A00288	6/22/2010	6/22/2011
919	Preamplifier	Spacek Labs MM-Wave Technology	100MHz to 40GHz	3M12 (SLK-35-3) and 3M13 (SLKa-35-4)	11/30/2009	11/30/2010

Section 4: Observations

4.1 Modifications Performed During Assessment

No modifications were performed during assessment.

4.2 Record Of Technical Judgements

No technical judgements were made during the assessment.

4.3 EUT Parameters Affecting Compliance

The user of the apparatus could not alter parameters that would affect compliance.

4.4 Tests Deleted

No Tests were deleted from this assessment.

4.5 Additional Observations

There were no additional observations made during this assessment.

Section 5: Results Summary

This section contains the following:

FCC Part 15 Subpart C: Test Results.
RSS-210 Issue 7 June 2007

The column headed “Required” indicates whether the associated clauses were invoked for the apparatus under test. The following abbreviations are used:

N No: not applicable / not relevant
Y Yes: Mandatory i.e. the apparatus shall conform to these tests.
N/T Not Tested, mandatory but not assessed. (See section 4.4 Test deleted)

The results contained in this section are representative of the operation of the apparatus as originally submitted.

5.1 Test Results

Part 15	Test Description	Required	Result
15.207 (a)	Power line Conducted Emissions	Battery Powered	NA
15.215 (c) 15.231(c)	Occupied Bandwidth/ 99% Bandwidth	Y	Pass
15.231 (a)	Types of Momentary Signals	Y	Pass
15.231 (d)	Frequency Stability	N	NA
15.231 (b)	Spurious Emissions	Y	Pass
15.107 (a)	Receiver Spurious Conducted Emissions	Battery Powered	NA
15.109 (a)	Receiver Spurious Radiated Emissions	Y	Pass

Appendix A: Test Results

Conducted Emissions

Client	Green Badge LLC dba UgMO Technologies	Temperature		°C
Pan #	43834	Relative Humidity		%
EUT Name	Wireless Soil Sensor	Barometric Pressure		kPa
EUT Model	PH100WS	Test Location	Enclosure 1	
Governing Doc	CFR 47, Part 15B	Test Engineer	Alan Laudani	
Basic Standard	Sec. 15.207 Class "**B**" Transmit	Date of test		
Test Parameters	Peak RBW: 100kHz VBW: 100kHz Quasi-Peak: RBW 9kHz, VBW 30 kHz Average: RBW 9kHz, VBW 30 kHz Quasi-Peak Limit Blue Line, Average Limit Green Line			

Not applicable as EUT is battery powered.

Occupied Bandwidth

A1.1. The 99% bandwidth shall be no wider than 0.25% of the centre frequency for devices operating between 70-900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the centre frequency.

15.231(c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

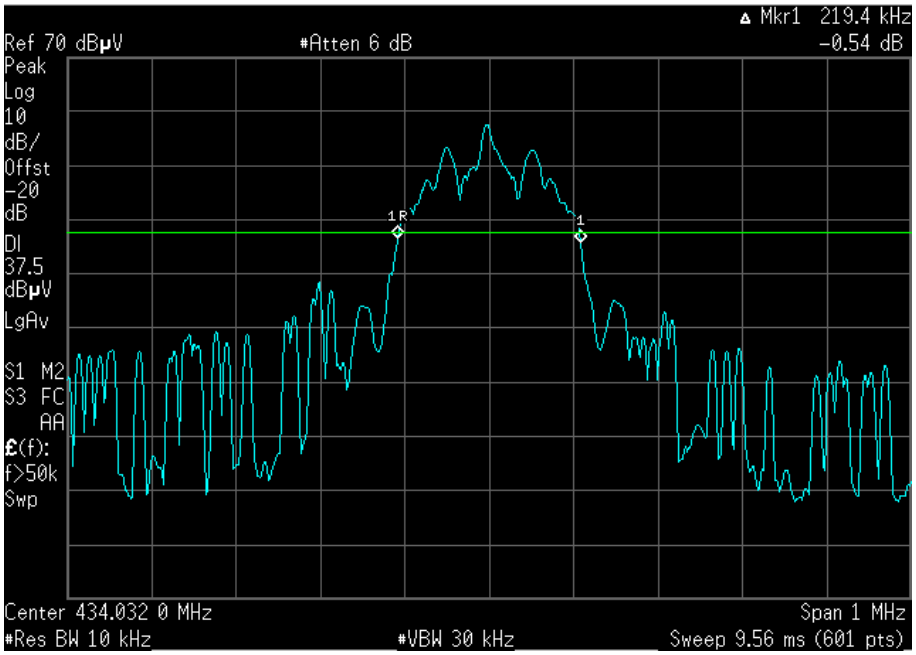
15.215(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in Sec. Sec. 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the 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. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

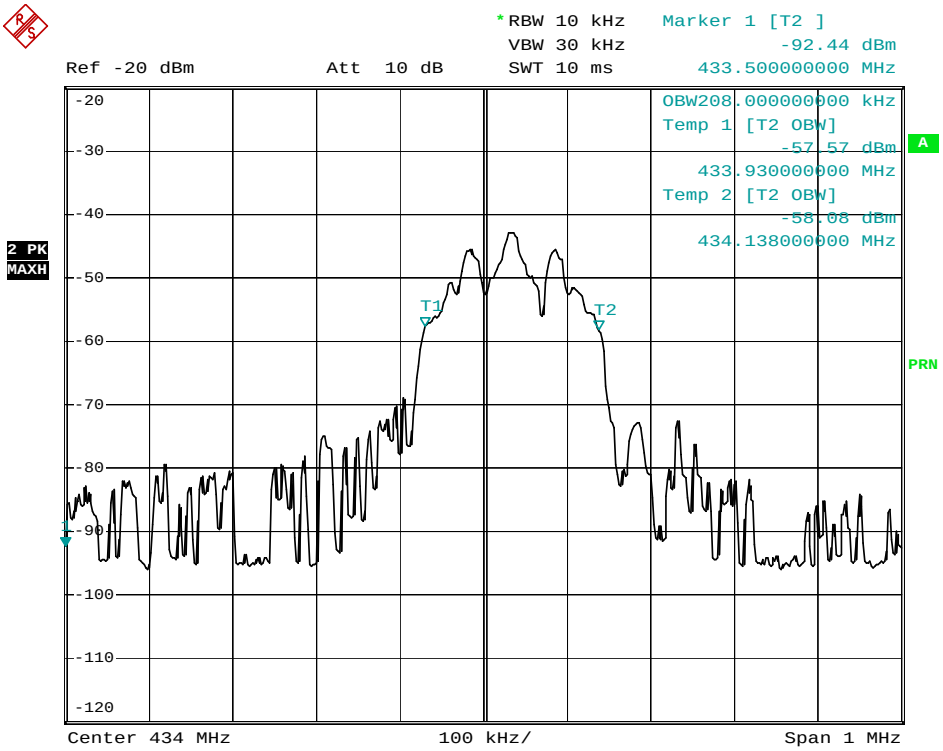
Test Conditions:

Client	Green Badge LLC dba UgMO Technologies	Temperature	24	°C
Pan #	43834	Relative Humidity	45	%
EUT Name	Wireless Soil Sensor			
EUT Model	PH100WS	Test Location	Enclosure 2	
Governing Doc	CFR 47, Part 15C	Test Engineer	Alan Laudani	
Basic Standard	Sec. 15.231 Transmit	Date of test	September 27, 2010	

Test Results:

Measured Occupied Bandwidth: 219 kHz
Measured 99% Bandwidth = 208 kHz





Date: 27.SEP.2010 10:04:31

Frequency Stability

A1.1.4 Carrier frequency stability of devices momentarily operated in the band 40.66-40.70 MHz shall be maintained to ±0.01% (±100 ppm).

15.231(d) For devices operating within the frequency band 40.66–40.70 MHz, the bandwidth of the emission shall be confined within the band edges and the frequency tolerance of the carrier shall be ±0.01%. This frequency tolerance shall be maintained for a temperature variation of −20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltages at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

Test Conditions:

Client	**Green Badge LLC dba UgMO Technologies**	Temperature		°C
Pan #	43834	Relative Humidity		%
EUT Name	**Wireless Soil Sensor**			
EUT Model	**PH100WS**	Test Location		
Governing Doc	CFR 47, Part 15C	Test Engineer	**Alan Laudani**	
Basic Standard	Sec. 15.231 Transmit	Date of test		

Test Results:

The EUT does not transmit within the 40.66—40.70 MHz band, therefore this test is not applicable.

Types of Momentary Signals

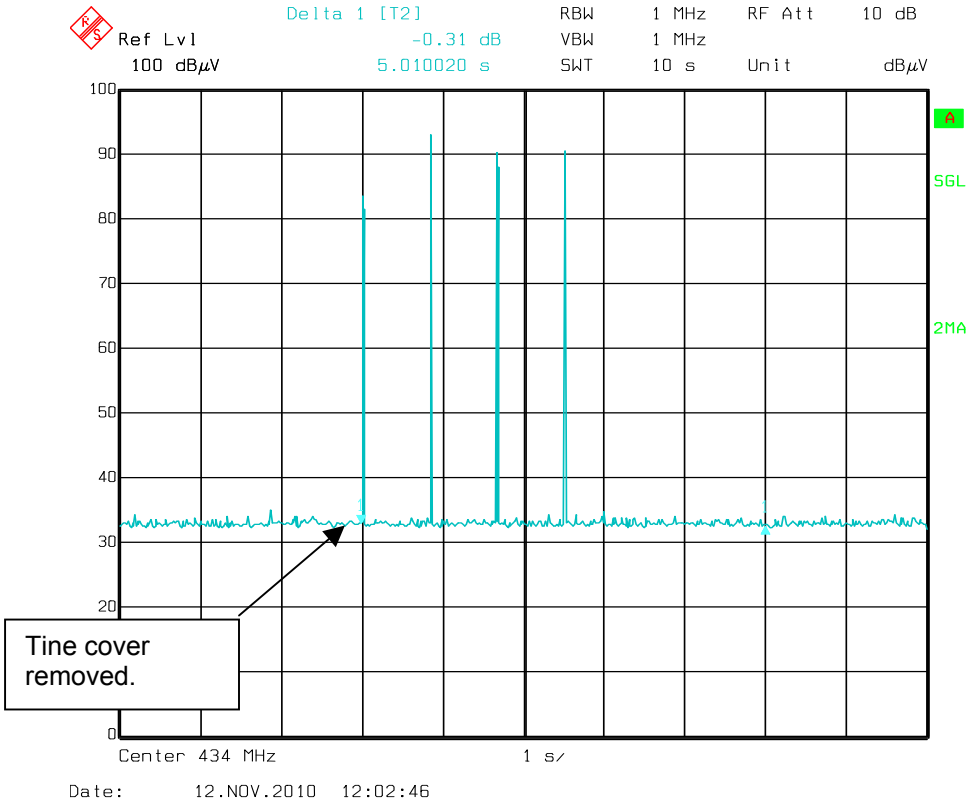
RSS A1.1.1(c) Periodic transmissions at regular predetermined intervals are not permitted, except as provided in A.1.1.5. However, polling or supervision transmissions, to determine system integrity of transmitters used in security or safety **applications are allowed if the total duration of transmission does not exceed 2 seconds per hour for each transmitter**.

15.231(a)(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation

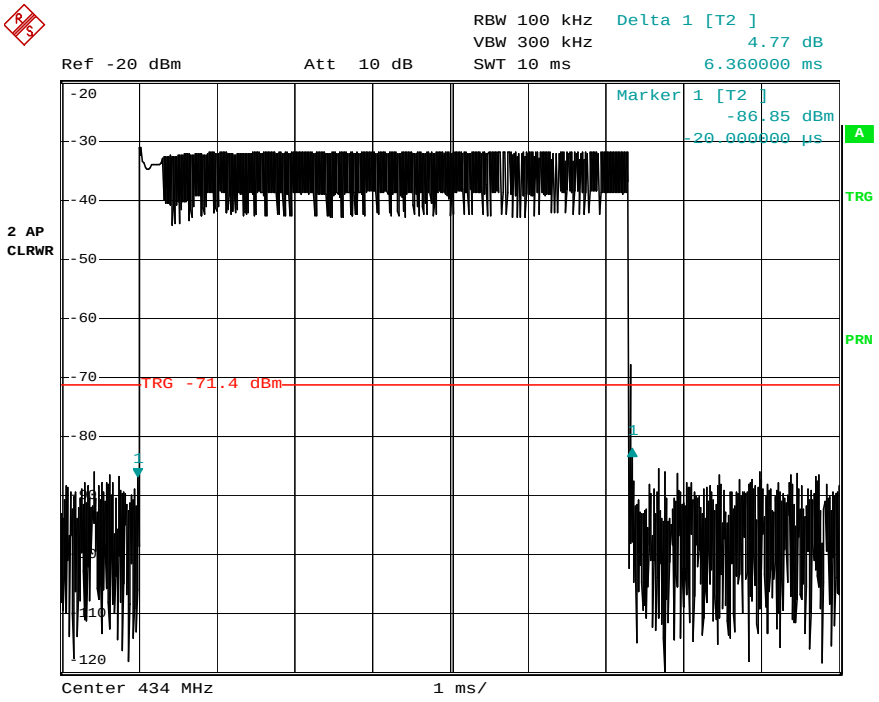
Client	Green Badge LLC dba UgMO Technologies	Temperature	24	°C
Pan #	43834	Relative Humidity	45	%
EUT Name	Wireless Soil Sensor			
EUT Model	PH100WS	Test Location	SOATS	
Governing Doc	CFR 47, Part 15C	Test Engineer	Alan Laudani	
Basic Standard	Sec. 15.231 Transmit	Date of test	September 27, 2010	

The Sensor is 'turned on' by removing the Tine Sleeve. From that moment, the Sensor will transmit once per second, not to exceed 5 seconds, then about once per minute for the next 100 minutes (Interim Mode), then about once per 10 minutes (Normal Mode).

This plot shows the transmitter stops within 5 seconds of pulling off the tine sleeve.



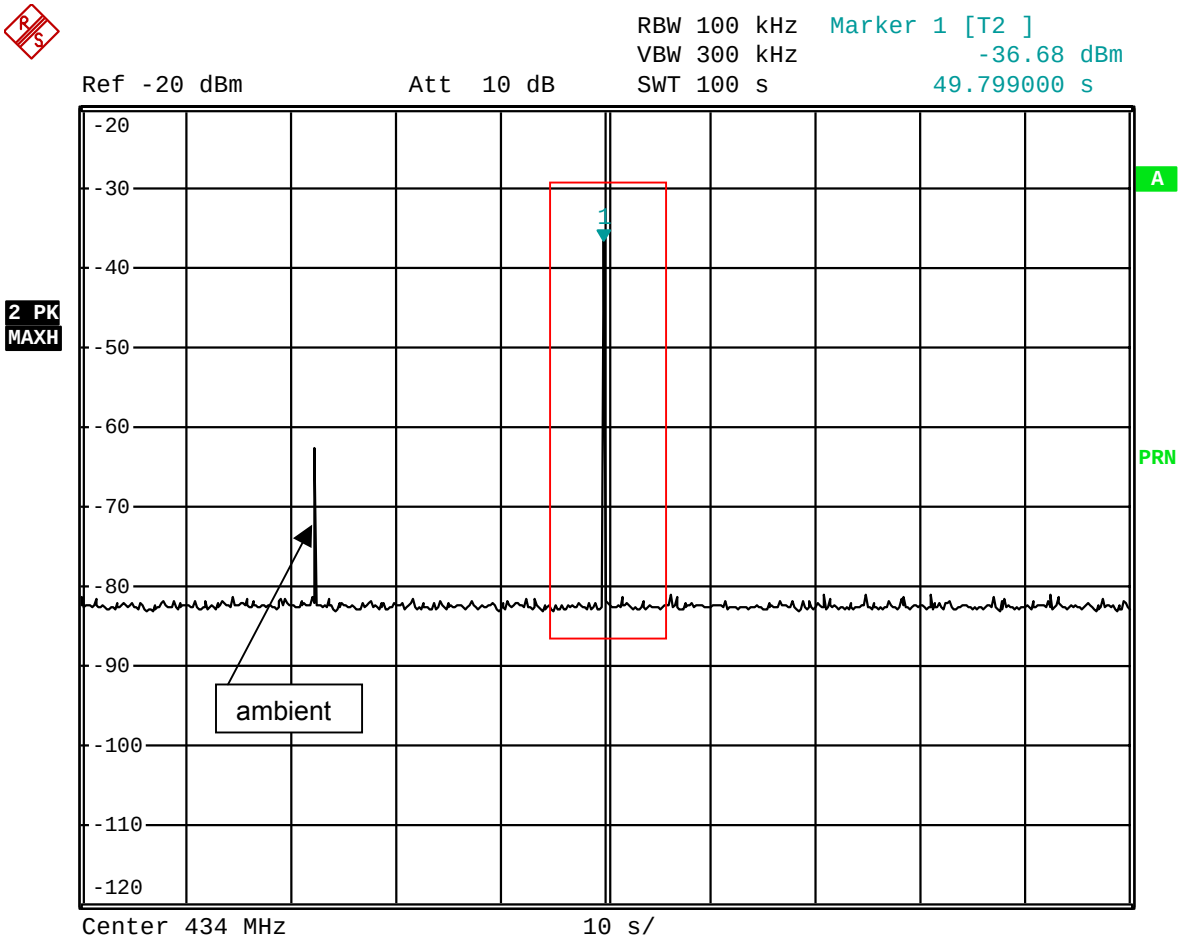
This plot shows power on in 10 ms
6.4 ms in 100 ms and the emission does not repeat in 5 seconds.



Date: 27.SEP.2010 09:36:47

This plot sweeps 100 s, shows one emission at 49.7 seconds
This was the 5th sweep of 100 seconds on max peak hold, the time of emission occurrence was 459.7 seconds.

Observance of the test sample showed repetition of 1 emission every 10 minutes used for test mode only.



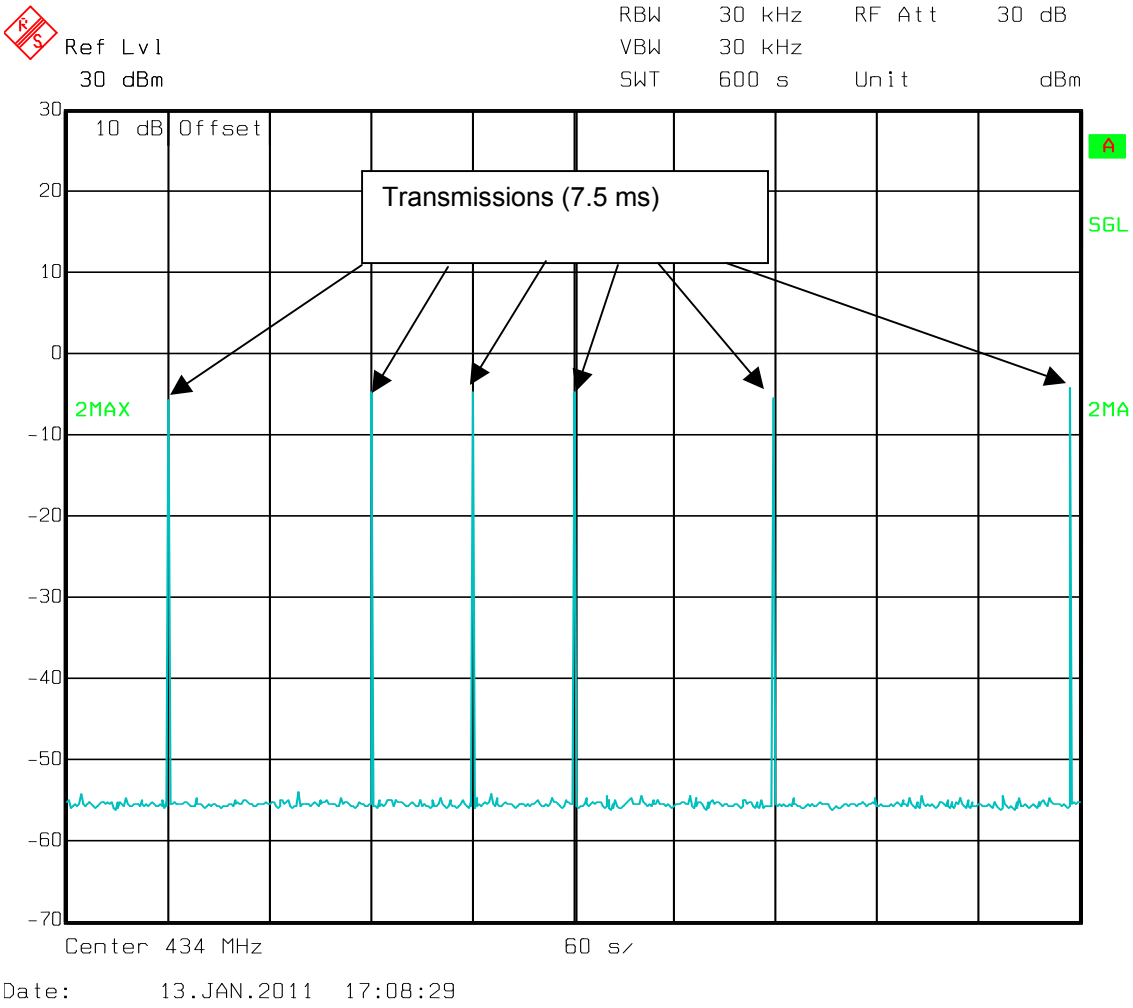
Date: 27.SEP.2010 09:55:39

Duty cycle factor = 20 x log(on /100 ms) = 20 x log(6.4ms/100ms)
= -23.8 dB, which is limited to –20 dB for Average definition of pulsed emissions.

Interim Mode:

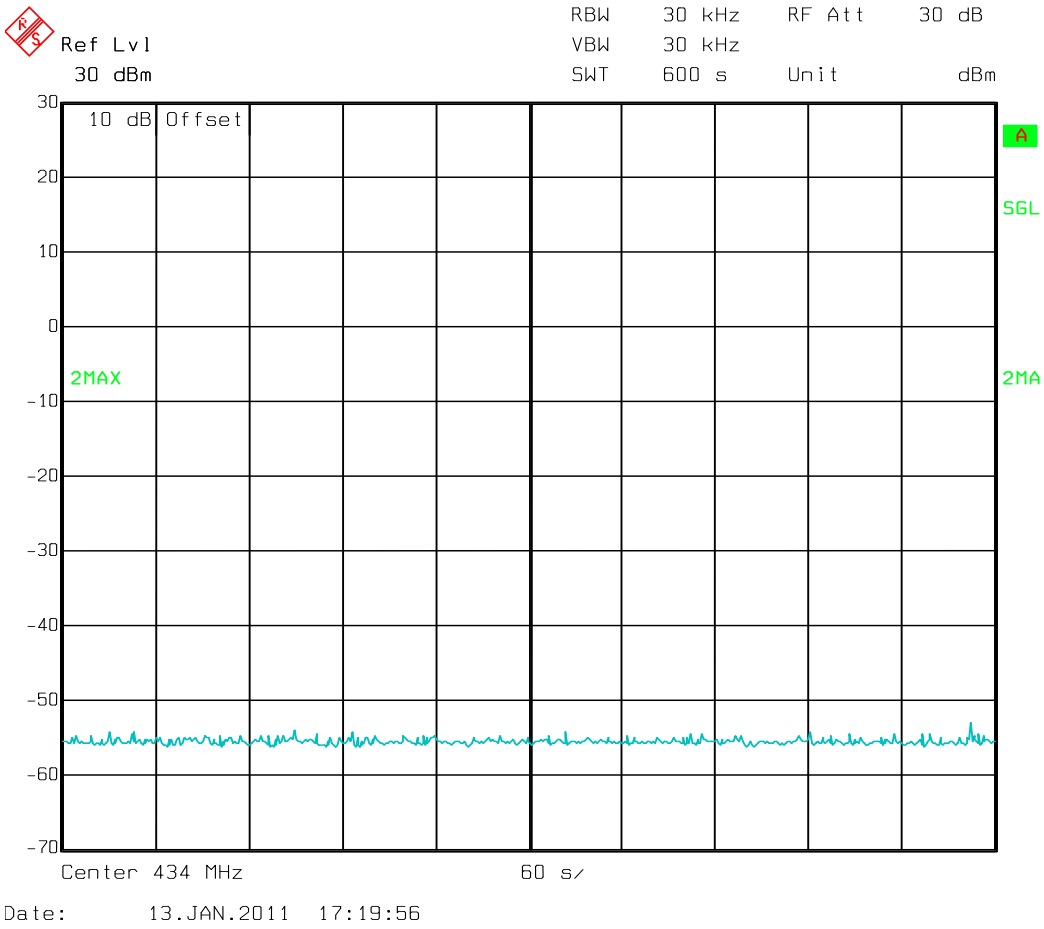
Transmitting once every minute for 100 Minutes when in soil.

(10 minute sample shown)



Interim Mode:

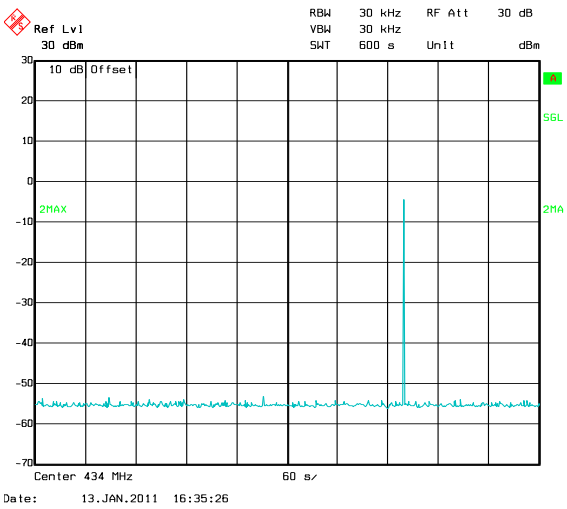
When in air (transmission is suppressed)

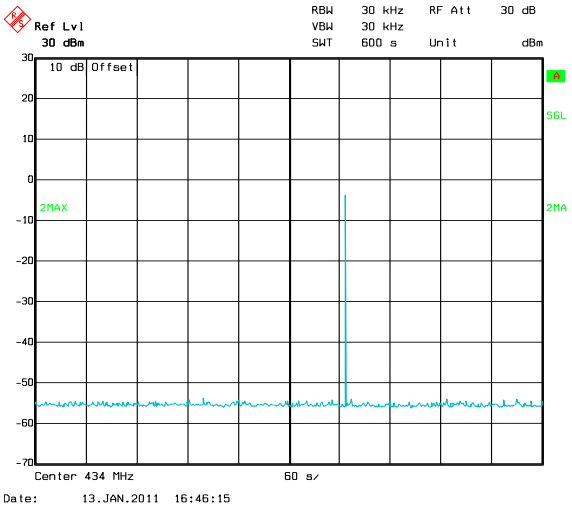


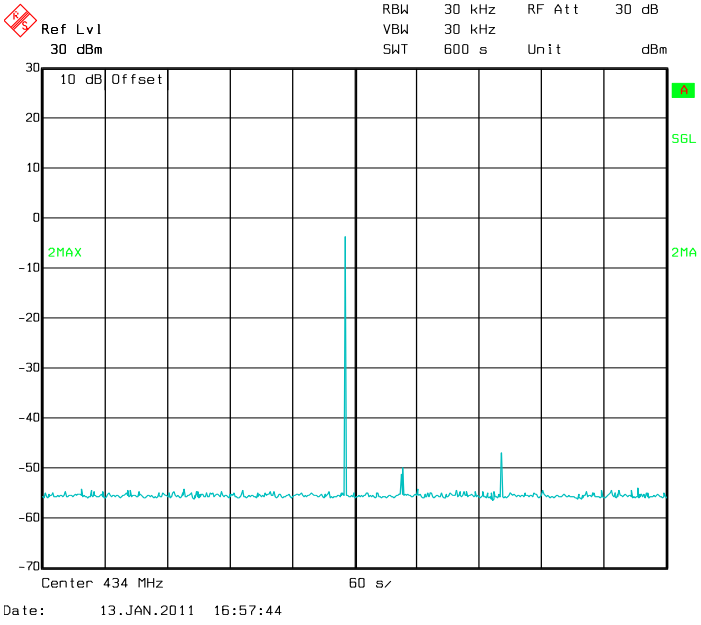
Normal Mode

Transmissions in Soil:

Three 10 minute samples:







Radiated Emissions

Spurious Emissions

RSS210 Annex 1
A1.1.2 (1) The field strength of emissions from momentarily operated intentional radiators shall not exceed the limits in Table 4.

Fundamental Frequency (MHz), excluding restricted band frequencies of Table 1	Field Strength of Fundamental (Note 1) microvolts/m at 3 metres, (watts, e.i.r.p.)	Field Strength of Unwanted Emissions (Note 1) microvolts/m at 3 metres
40.66-40.70	See Section A2.7	
70-130	1,250 (470 nW)	125
130-174	1,250 to 3,750*	125 to 375
174-260 (Note 2)	3,750 (4.2 μW)	375
260-470 (Note 2)	3,750 to 12,500*	375 to 1,250
Above 470	12,500 (47 μW)	1,250

15.231(b) In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66–40.70	2,250	225
70–130	1,250	125
130–174	[1]1,250 to 3,750	[1]125 to 375
174–260	3,750	375
260–470	[1]3,750 to 12,500	[1]375 to 1,250
Above 470	12,500	1,250

[1]Linear interpolations.

At 434 MHz this interpolates to 11000 microVolts/m or 80.8 dBuV/m at 3m
Unwanted emissions 60.8 or FCC15.209/RSS Table 2, whatever is higher.

Client	Green Badge LLC dba UgMO Technologies	Temperature	16	°C
Pan #	43834	Relative Humidity	74	%
EUT Name	Wireless Soil Sensor			
EUT Model	PH100WS	Test Location	SOATS	
Governing Doc	CFR 47, Part 15C	Test Engineer	Alan Laudani	
Basic Standard	Sec. 15.231 Transmit	Date of test	July 2, 2010	

Test Results:

See Table. EUT complies for fundamental power and spurious emissions.

Additional Observations:

The Spectrum was searched from 30MHz to the 10th Harmonic (4350 MHz).

These results apply to emissions that may be found in the restricted bands defined in FCC Part 15 Subpart C, 15.205.

The EUT was investigated with a fresh battery. The emissions were measured with a test mode to repeat the emission so measurements could be maximized for the rotation of the sample and height and polarity of the measurement antenna.

All Measurements below 1GHz were performed at 3m employing a CISPR quasi-peak detector, except for the radio's fundamental. Peak measurements above 1GHz were done utilizing RBW of 1MHz and VBW of 3MHz. Average measurements above 1GHz were done utilizing RBW of 1MHz and VBW of 10Hz as the duty cycle was 100%.

Measurements made at the 3 meter Outside Area Test Site, all measurements max hold after peaking for EUT rotation and antenna height from 1 to 4 meters.

Fundamental power was measured at 1 MHz RBW, 3 MHz VBW to ensure capture of entire emissions envelope. Average reading of Fundamental power therefore was peak + duty cycle factor.

No other emissions found within 20 dB of the limits.

Emissions were measured on a 80cm (height) table and in a bucket of dirt on top of the 80cm table.

Since the EUT is to be orientated horizontally when installed, it was not defined as a hand held device.

Mode: in air, meeting Limits of 15.231(a), table in (b)
Special test mode to broadcast once per second. Normal operation stops transmitting within 5 seconds.

Radiated Emissions Data

Job # :	43834	Date :	7-2-2010	Page	1 of 1
NEX #:	149167	Time :	0830		
		Staff :	aal		
Client Name :	Green Badge LLC dba UgMO Technologies			EUT Voltage :	bat
EUT Name :	Sensor			EUT Frequency :	-
EUT Model # :	Sensor			Phase:	-
EUT Serial # :				NOATS	
EUT Config. :	Transmitter on table			SOATS	X
	Horizontal			Distance < 1000 MHz:	3 m
	CFR47 Part 15.231			Distance > 1000 MHz:	3 m
Specification :	CFR47 Part 15, Subpart B, Class B				
Loop Ant. #:	NA				
Bicon Ant.#:	115_3m	Temp. (°C) :	16		
Log Ant.#:	110_3m	Humidity (%) :	74		
DRG Ant. #	877	Spec Analyzer #:	911		
Cable LF#:	SOATS	Analyzer Display #:	911		
Cable HF#:	SOATS	Quasi-Peak Detector #:	911		
Preamp LF#:	827	Preselector #:	NA		
Preamp HF#	919				

Quasi-Peak	RBW:	120 kHz
	Video Bandwidth	300 kHz
Peak	RBW:	1 MHz
	Video Bandwidth	3 MHz
Average	RBW:	1 MHz
	Video Bandwidth	10 Hz

dcf -20 dbB

Measurements below 1 GHz are Quasi-Peak values, unless otherwise stated.
Measurements above 1 GHz are Average values, unless otherwise stated.

Meas. Freq. (MHz)	Meter Reading **Vertical**	Meter Reading **Horizontal**	Det.	EUT Side F/L/R/B	Ant. Height m	Max. Reading (dBµV)	Corrected Reading (dBµV/m)	Spec. limit (dBµV/m)	CR/SL Diff. (dB)	Pass Fail	Comment
107.9	49.1	43.7	Q	-	1.0	49.1	29.0	43.5	-14.6	Pass	In air
434.0	80.0	69.1	P	-	1.0	80.0	99.4	100.8	-1.4	Pass	
434.0	60.0	49.1	A	-	1.0	60.0	79.4	80.8	-1.4	Pass	
868.0	40.9	35.8	P	-	1.0	40.9	68.0	80.8	-12.8	Pass	
868.0	20.9	15.8	A	-	1.0	20.9	48.0	60.8	-12.8	Pass	
1302.0	55.7	54.3	P	-	1.0	55.7	51.1	80.8	-29.7	Pass	
1302.0	35.7	34.3	A	-	1.0	35.7	31.1	60.8	-29.7	Pass	
1736.0	81.2	69.6	P	-	1.0	81.2	79.7	80.8	-1.1	Pass	
1736.0	61.2	49.6	A	-	1.0	61.2	59.7	60.8	-1.1	Pass	

Note: Corrected Reading Computations
Average = Peak Maximum Meter Reading + Antenna Factor + Path Loss + DUTY CYCLE FACTOR
66.8 = 71.0 + 16.6 + 3.0 –23.8

EUT passes
Limit paragraph 231(e) = 4400 uV/m
Corrected Average Reading = 66.8 dBuV/m
$10^{(66.8/20)}$ = 2188 uV/m
"Sensor" was the model number when the datasheet was secured. UGMO has changed it to PH100WS
Peak limit = 20 dB above the average limit.
The emissions at 107.9 MHz are from energizing the tine to sense soil moisture and meet the limit of 15.209(a).

In Soil Mode: Limits of 15.231(e). Special test mode TX once per second.

Radiated Emissions Data

Job # :	43834	Date :	1/12/2011	Page	1 of 1
NEX #:	164705	Time :	8:00 AM		
		Staff :	JO		
Client Name :	Green Badge LLC dba UgMO Technologies			EUT Voltage :	bat
EUT Name :	Sensor			EUT Frequency :	N/A
EUT Model # :	Sensor			Phase:	N/A
EUT Serial # :				NOATS	X
EUT Config. :	Transmitter on table			SOATS	
	Horizontal			Distance < 1000 MHz:	3 m
	CFR47 Part 15.231			Distance > 1000 MHz:	3 m
Specification :	CFR47 Part 15, Subpart B, Class B				
Loop Ant. #:	NA				
Bicon Ant.#:	116_3m	Temp. (°C) :	16		
Log Ant.#:	110_3m	Humidity (%) :	38		
DRG Ant. #	877	Spec Analyzer #:	898		
Cable LF#:	NOATS	Analyzer Display #:	898		
Cable HF#:	NOATS	Quasi-Peak Detector #:	898		
Preamp LF#:	NA	Duty Cycle (%):	100		
Preamp HF#	317				

Quasi-Peak	RBW: 120 kHz
	Video Bandwidth 300 kHz
Peak	RBW: 1 MHz
	Video Bandwidth 3 MHz
Average = Peak + Duty Cycle Factor	
DCF = 20 x log(duty cyle)	

Measurements below 1 GHz are Quasi-Peak values, unless otherwise stated.
Measurements above 1 GHz are Average values, unless otherwise stated.

Meas. Freq. (MHz)	Meter Reading **Vertical**	Meter Reading **Horizontal**	Det.	EUT Side F/L/R/B	Ant. Height m	Max. Reading (dBµV)	Corrected Reading (dBµV/m)	Spec. limit (dBµV/m)	CR/SL Diff. (dB)	Pass Fail	Comment
107.9	42.8	44.4	A		2.5	44.4	33.4	43.5	-10.2	Pass	
215.3	15.9		A		1.5	15.9	5.6	52.8	-47.2	Pass	
323.8	34.9	35.0	A	L	2.5	35.0	29.0	46.0	-17.0	Pass	
539.5	7.6	9.0	A	L	2.5	9.0	7.8	46.0	-38.2	Pass	
434.0	69.3	71.0	P	L	1.3	71.0	90.6	92.9	-2.3	Pass	
434.0	69.3	71.0	A	L	1.3	71.0	66.8	72.9	-6.1	Pass	
868.0	19.7	20.0	P		1.5	20.0	47.5	72.9	-25.4	Pass	ambient
1302.0	24.8	21.5	P	L	1.4	24.8	55.7	72.9	-17.2	Pass	
1302.0	24.8	21.5	A	L	1.4	24.8	31.9	52.8	-20.9	Pass	
1736.0	30.1	24.1	P	L	1.4	30.1	64.7	72.9	-8.2	Pass	
1736.0	30.1	24.1	A	L	1.4	30.1	40.9	52.8	-11.9	Pass	
2170.0	41.0	41.9	P	L	2.5	41.9	47.7	74.0	-26.3	Pass	ambient
2604.0	41.0	43.2	P	L	2.5	43.2	52.1	74.0	-21.9	Pass	ambient
3038.0	18.0	17.0	P	L	1.5	18.0	30.3	74.0	-43.7	Pass	ambient
3472.0	19.0	22.3	P	L	1.5	22.3	33.9	74.0	-40.1	Pass	ambient
3906.0	21.0	21.3	P	L	1.5	21.3	36.2	74.0	-37.8	Pass	ambient
4340.0	19.0	20.4	P	L	1.5	20.4	35.2	74.0	-38.8	Pass	ambient

Conducted Emissions Test Data—Receive Mode

Part 15.207(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

7.2.2 The purpose of this test is to measure unwanted radio frequency currents induced in any AC conductor external to the equipment which could conduct interference to other equipment via the AC electrical network. Except when the requirements applicable to a given device state otherwise, for any license-exempt radiocommunication device equipped to operate from the public utility AC power supply, either directly or indirectly, the radio frequency voltage that is conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown below. The tighter limit applies at the frequency range boundaries. The conducted emissions shall be measured with a 50 ohm/50 microhenry line impedance stabilization network Frequency Range

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

Client	Green Badge LLC dba UgMO Technologies	Temperature	16	°C
Pan #	43834	Relative Humidity	74	%
EUT Name	Wireless Soil Sensor			
EUT Model	Sensor	Test Location	Enclosure 1	
Governing Doc	CFR 47, Part 15B	Test Engineer	**Alan Laudani**	
Basic Standard	Sec. 15.107 Class "**B**"	Date of test	7-2-2010	
Test Parameters	Peak RBW: 100kHz VBW: 100kHz Quasi-Peak: RBW 9kHz, VBW 30 kHz Average: RBW 9kHz, VBW 30 kHz Quasi-Peak Limit Blue Line, Average Limit Green Line			
EUT does not have need for AC power as it is battery powered.				

Radiated Emissions Test Data—Receive Mode

The following receiver spurious emission limits shall be complied with:

(a) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 1.

Table 1 - Spurious Emission Limits for Receivers

Spurious Frequency (MHz)	Field Strength (microvolt/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960	500

Client	**Green Badge LLC dba UgMO Technologies**	Temperature	16	°C
Pan #	43834	Relative Humidity	74	%
EUT Name	**Wireless Soil Sensor**			
EUT Model	Sensor	Test Location	Enclosure 1	
Governing Doc	CFR 47, Part 15B	Test Engineer	**Alan Laudani**	
Basic Standard	Sec. 15.207 Class "**B**"	Date of test	7-2-2010	
EUT does not have a receive mode. No emissions evident while in standby mode				

APPENDIX B

B. Radiated Emissions Measurement Uncertainties

1. Introduction

ISO/IEC 17025:2005 and ANSI/NCSL Z540.3: 2006 require that all measurements contained in a test report be "traceable". "Traceability" is defined in the *International Vocabulary of Basic and General Terms in Metrology* (ISO: 1993) as: "the property of the result of a measurement... whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons, *all having stated uncertainties*".

The purposes of this Appendix are to "state the *Measurement Uncertainties*" of the conducted emissions and radiated emissions measurements contained in Section 5 of this Test Report, and to provide a practical explanation of the meaning of these measurement uncertainties.

2. Statement of the Worst-Case Measurement Uncertainties for the Conducted and Radiated Emissions Measurements Contained in This Test Report

Table 1: Worst-Case Expanded Uncertainty "U" of Measurement for a k=2 Coverage Factor

Radiated Emissions Measurement Detection Systems	Applicable Frequency Range	"U" for a k=2 Coverage Factor
Spectrum Analyzer with QPA & Preamplifier	30 MHz - 200 MHz	+3.9 dB, -4.0 dB
Spectrum Analyzer with QPA & Preamplifier	200 MHz-1000 MHz	+/- 3.5 dB
Spectrum Analyzer with Preamplifier	1 GHz - 18 GHz	+2.5 dB, -2.6 dB
Spectrum Analyzer with Preamplifier	18 GHz - 40 GHz	+/- 3.4 dB

NOTES:
1. Applies to 3 and 10 meter measurement distances
2. Applies to all valid combinations of Transducers (i.e. LISNs, Line Voltage Probes, and Antennas, as appropriate)
3. Excludes the Repeatability of the EUT

3. Practical Explanation of the Meaning of Radiated Emissions Measurement Uncertainties

In general, a "Statement of Measurement Uncertainty" means that with a certain (specified) confidence level, the "true" value of a measurand will be between a (stated) upper bound and a (stated) lower bound.

In the specific case of EMC Measurements in this test report, the measurement uncertainties of the conducted emissions measurements and the radiated emissions measurements have been calculated in accordance with the method detailed in the following documents:

- *ANSI Z540.2 (2002) Guide to the Expression of Uncertainty in Measurement*
- NIS 81:1994, *The Treatment of Uncertainty in EMC Measurements* (NAMAS, 1994)
- NIST Technical Note 1297(1994), *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results* (NIST, 1994)

The calculation method used in these documents requires that the stated uncertainty of the measurements be expressed as *an "expanded uncertainty", U, with a k=2 coverage factor*. The practical interpretation of this method of expressing measurement uncertainty is shown in the following example:

EXAMPLE: Assume that at 39.51 MHz, the (measured) radiated emissions level was equal to +26.5 dBuV/m, and that the +/- 2 standard deviations (i.e. 95% confidence level) measurement uncertainty was +/- 3.4 dB.

APPENDIX C

C. Nemko USA, Inc. Test Equipment & Facilities Calibration Program

Nemko USA, Inc. operates a comprehensive Periodic Calibration Program in order to ensure the validity of all test data. Nemko USA's Periodic Calibration Program is fully compliant to the requirements of NVLAP Policy Guide PG-1-1988, ANSI/NCSL Z540.3: 2006, ISO 10012:2003, ISO/IEC 17025:2005, and ISO-9000: 2000. Nemko USA, Inc.'s calibrations program therefore meets or exceeds the US national commercial and military requirements [N.B. ANSI/NCSL Z540.1-1994 replaced MIL-STD-45662A].

Specifically, all of Nemko USA's *primary reference standard devices* (e.g. vector voltmeters, multimeters, attenuators and terminations, RF power meters and their detector heads, oscilloscope mainframes and plug-ins, spectrum analyzers, RF preselectors, quasi-peak adapters, interference analyzers, impulse generators, signal generators and pulse/function generators, field-strength meters and their detector heads, etc.) and certain *secondary standard devices* (e.g. RF Preamplifiers used in CISPR 11/22 and FCC Part 15/18 tests) are periodically recalibrated by:

- A Nemko USA-approved independent (third party) metrology laboratory that uses NIST-traceable standards and that is ISO Guide 25-accredited as a calibration laboratories by NIST; or,
- A Nemko USA-approved independent (third party) metrology laboratory that uses NIST-traceable standards and that is ISO Guide 25-accredited as a calibration laboratory by another accreditation body (such as A2LA) that is mutually recognized by NIST; or,
- A manufacturer of Measurement and Test Equipment (M&TE), if the manufacturer uses NIST-traceable standards and is ISO Guide 25-accredited as calibration laboratory either by NIST or by another accreditation body (such as A2LA) that is mutually recognized by NIST; or
- A manufacturer of M&TE (or by a Nemko USA-approved independent third party metrology laboratory) that is not ISO Guide 25-accredited. (In these cases, Nemko USA conducts an annual audit of the manufacturer or metrology laboratory for the purposes of proving traceabilty to NIST, ensuring that adequate and repeatable calibration procedures are being applied, and verifying conformity with the other requirements of ISO Guide 25).

In all cases, the entity performing the Calibration is required to furnish Nemko USA with a calibration test report and/or certificate of calibration, and a "calibration sticker" on each item of M&TE that is successfully calibrated.

Calibration intervals are normally one year, except when the manufacture advises a shorter interval or if US Government directives or client requirements demand a shorter interval. Items of instrumentation/related equipment which fail during routine use, or which suffer visible mechanical damage (during use or while in transit), are sidelined pending repair and recalibration. (Repairs are carried out either in-house [if minor] or by a Nemko USA-approved independent [third party] metrology laboratory, or by the manufacturer of the item of M&TE).

Each antenna used for CISPR 11 and CISPR 22 and FCC Part 15 and Part 18 radiated emissions testing (and for testing to the equivalent European Norms) is calibrated annually by either a NIST (or A2LA) ISO Standard 17025-Accredited third-party Antenna Calibration Laboratory or by the antenna's OEM if the OEM is NIST or A2LA ISO Standard 17025-accredited as an antenna calibration laboratory. The antenna calibrations are performed using the methods specified in Annex G.5 of CISPR 16-1(2003) or ANSI C63.5-2004, including the "Three-Antenna Method". Certain other kinds of antennas (e.g. magnetic-shielded loop antennas) are calibrated annually by either a NIST (or A2LA) ISO Standard 17025-accredited third-party antenna calibration laboratory, or by the antenna's OEM if the OEM is NIST or A2LA ISO Standard 17025-accredited as an antenna calibration laboratory using the procedures specified in the latest version of SAE ARP-958.

In accordance with FCC and other regulations, Nemko USA recalibrates its suite of antennas used for radiated emissions tests on an annual basis. These calibrations are performed as a precursor to the FCC-required annual revalidation of the Normalized Site Attenuation properties of Nemko USA's Open Area Test Site. Nemko USA, Inc. uses the procedures given in both Sub clause 16.6 and Annex G.2 of CISPR 16-1 (2003), and, ANSI C63.4-2003 when performing the normalized site attenuation measurements.

APPENDIX D

D. NVLAP Accreditation

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 200116-0

Nemko USA, Inc. - San Diego EMC Division
San Diego, CA

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2010-01-01 through 2010-12-31
Effective dates

Sally S. Bruce
For the National Institute of Standards and Technology

NVLAP-01C (REV. 2009-01-28)