Nemko-CCL, Inc.

1940 West Alexander Street
Salt Lake City, UT 84119
801-972-6146

Test Report

Certification

Test Of: EOSC

Test Specifications: FCC Part 15, Subpart C

FCC ID #: SZV-EOSC01

Test Report Serial No: 207585-3.2

Applicant:

EnOcean GmbH
Kolpingring 18a
Oberhaching 82041
Germany

Date of Test: June 12, 2012

Report Issue Date: June 21, 2012

Accredited Testing Laboratory By:

NVLAP Lab Code 100272-0

CERTIFICATION OF ENGINEERING REPORT

This report has been prepared by Nemko-CCL, Inc. to document compliance of the device described below with the certification requirements of FCC Part 15, Subpart C. This report may be reproduced in full. Partial reproduction of this report may only be made with the written consent of the laboratory. The results in this report apply only to the sample tested.

- Applicant: EnOcean GmbH
- Manufacturer: EnOcean GmbH
- Brand Name: EnOcean
- Model Number: EOSC
- FCC ID #: SZV-EOSC01

On this 21st day of June 2012, I, individually and for Nemko-CCL, Inc., certify that the statements made in this engineering report are true, complete, and correct to the best of my knowledge, and are made in good faith.

Although NVLAP has accredited the Nemko-CCL, Inc. EMC testing facilities, this report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

Nemko-CCL, Inc.

Norman P Hansen

Tested by: Norman P. Hansen
EMC Technician

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SECTION 1.0 CLIENT INFORMATION

1.1 Applicant:

Company Name:	EnOcean GmbH Kolpingring 18a Oberhaching 82041 Germany
Contact Name:	Armin Anders
Title:	Director Product Marketing

1.2 Manufacturer:

Company Name:	EnOcean GmbH Kolpingring 18a Oberhaching 82041 Germany
Contact Name:	Armin Anders
Title:	Director Product Marketing

SECTION 2.0 EQUIPMENT UNDER TEST (EUT)

2.1 Identification of EUT:

Brand Name:	EnOcean GmbH
Model Number:	EOSC
Serial Number:	None

2.2 Description of EUT:

The EOSC is a ceiling mounted occupancy sensor for use in homes and businesses. The EOSC is integrated into the control/security system using a 315 MHz transmitter. The EOSC is powered by solar energy with a CR2032 battery for alternate/backup power.

This report covers the transmitter circuitry of the device subject to FCC Part 15, Subpart C. The circuitry of the device, subject to FCC Part 15, Subpart B, was tested, found compliant, and is covered in Nemko-CCL, Inc. report #207585-2.1.

2.3 EUT and Support Equipment:

Brand Name Model Number	FCC ID Number or Compliance	Description	Name of Interface Ports / Interface Cables
BN: EnOcean MN: EOSC (Note 1) SN: None	SZV-EOSC01	Sensor	See Section 2.4

2.4 Interface Ports on EUT:

There are no interface ports on the EUT.

2.5 Modification Incorporated/Special Accessories on EUT:

There were no modifications or special accessories required to comply with the specification.

SECTION 3.0 TEST SPECIFICATION, METHODS & PROCEDURES

3.1 Test Specification:

Title: FCC PART 15, Subpart C (47 CFR 15)
Section 15.203
Section 15.231

Periodic operation in the band 40.66-40.70 MHz and above 70 MHz.

Purpose of Test: The tests were performed to demonstrate initial compliance.

3.2 Methods & Procedures:

3.2.1 §15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

3.2.2 §15.231

(a) The provisions of this section are restricted to periodic operation within the band 40.66-40.70 MHz and above 70 MHz. Except as Shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Radio control of toys is not permitted. Continuous transmissions, such as voice or video, and data transmissions are not permitted. The prohibition against data transmissions does not preclude the use of recognition codes. Those codes are used to identify the sensor that is activated or to identify the particular component as being part of the system. The following conditions shall be met to comply with the provisions for this periodic operation:

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

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

(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmission to determine system integrity of transmitters used in security or safety applications are allowed if the periodic rate of transmission does not exceed one transmission of not more than one second duration per hour for each transmitter.

(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

(b) In addition to the provisions of §15.205, the field strength of emission 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	1,250 to 3,750 **	125 to 375 **
174 – 260	3,750	375
260 – 470	3,750 to 12,500 **	375 to 1,250 **
Above 470	12,500	1,250

** Linear interpolations

[Where F is the frequency in MHZ, the formula for calculating the maximum permitted field strengths are as follows: for the band 130 – 174 MHz, µV/m at 3 meters = 56.81818(F) – 6136.3636; for the band 260 – 470 MHz, µV/m at 3 meters = 41.6667(F) – 7083.3333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provision in §15.35 for averaging pulsed emission and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) The limits on the field strength of the spurious emission in the above table are based on the fundamental frequency of the intentional radiator. Spurious emission shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

(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.

(d) For devices operation 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 on the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

(e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided that intentional radiator complies with the provisions of paragraphs (b) through (d) of this section except the field strength table in paragraph (b) of this section is replaced by the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66 - 40.70	1,000	100
70 –130	500	50
130 – 174	500 to 1,500 **	50 to 150 **
174 – 260	1,500	150
260 – 470	1,500 to 5,000 **	150 to 500 **
Above 470	5,000	500

** Linear interpolations

[Where F is the frequency in MHZ, the formula for calculating the maximum permitted field strengths are as follows: for the band 130 – 174 MHz, µV/m at 3 meters = 22.72727(F) – 2454.545; for the band 260 – 470 MHz, µV/m at 3 meters = 16.6667(F) – 2833.3333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent periods between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

3.2.3 Test Procedure

The testing was performed according to the procedures in ANSI C63.4: 2003 and 47 CFR Part 15. Testing was performed at the Nemko-CCL, Inc. Wanship open area test site #2, located at 29145 Old Lincoln Highway, Wanship, UT. This site has been fully described in a report submitted to the FCC, and was accepted in a letter dated February 15, 2012 (90504).

Nemko-CCL, Inc. is accredited by National Voluntary Laboratory Accreditation Program (NVLAP); NVLAP Lab Code: 100272-0, which is effective until September 30, 2012.

SECTION 4.0 OPERATION OF EUT DURING TESTING

4.1 Operating Environment:

Power Supply: Solar panel with backup power from 3 VDC from CR2032 battery

4.2 Operating Modes:

The EUT was tested on two axes while constantly transmitting. New batteries were used for testing.

4.3 EUT Exercise Software:

No software was required.

SECTION 5.0 SUMMARY OF TEST RESULTS

5.1 FCC Part 15, Subpart C

5.1.1 Summary of Tests:

Part 15, Subpart C Reference	Test Performed	Frequency Range (MHz)	Result
15.203	Antenna Requirement	N/A	Complied
15.231 (a)	Periodic Operation	315.0	Complied
15.231 (b)	Radiated Emissions	0.15 to 3150	Complied
15.231 (c)	Bandwidth	315	Complied
15.231 (d)	Frequency Stability	40.66 to 40.70	Not Applicable
15.231 (e)	Radiated Emissions	30 to 3150	Not Applicable

5.2 Result

In the configuration tested, the EUT complied with the requirements of the specification.

SECTION 6.0 MEASUREMENTS, EXAMINATIONS AND DERIVED RESULTS

6.1 General Comments:

This section contains the test results only. Details of the test methods used and a list of the test equipment used during the measurements can be found in Appendix 1 of this report.

6.2 Test Results:

6.2.1 §15.203

The antenna is a wire soldered to the PCB and cannot be replaced by the user. See Photograph 8 of Appendix 2 of this report.

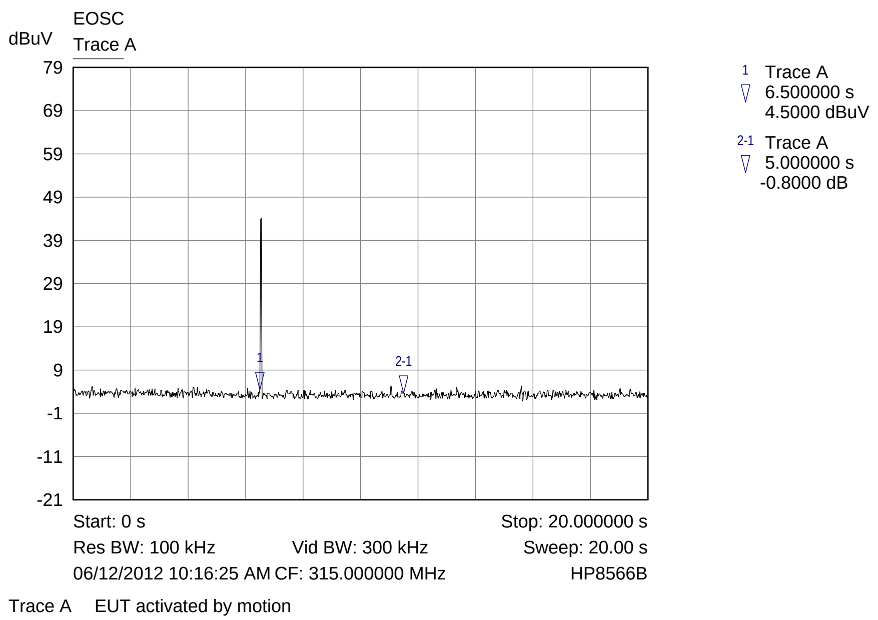
RESULT

The EUT complied with the requirements of this section.

6.2.2 §15.231 (a)

1. The EUT is not manually activated.

2. The EOSC is automatically activated when motion or temperature change is seen. The EUT stops transmitting within 5 seconds of being activated. See the plot below.



3. The EOSC does not transmit at regular predetermined intervals.

4. The EUT is not used during an emergency that involves fire and safety of life.

5. The EUT does not require set up information transmissions by a professional installer.

RESULT

In the configuration tested, the EUT complied with the requirements of this section.

6.2.3 §15.231 (b) Radiated Emissions

The EOSC operates at 315 MHz, therefore; the field strength of the fundamental must be less than 6041.68 µV/m (75.6 dBµV/m) at 3 meters. The maximum permitted field strength of any unwanted emission must be 20 dB below the maximum allowable fundamental field strength (55.6 dBµV/m).

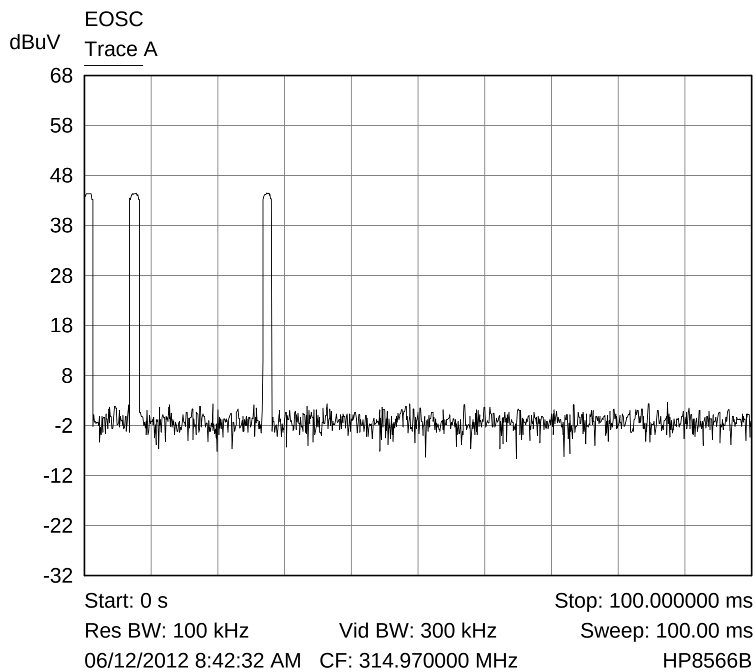
Emissions in the restricted bands of §15.205 must meet the limits specified in §15.209.

Measurement Data Fundamental and Harmonic Emissions:

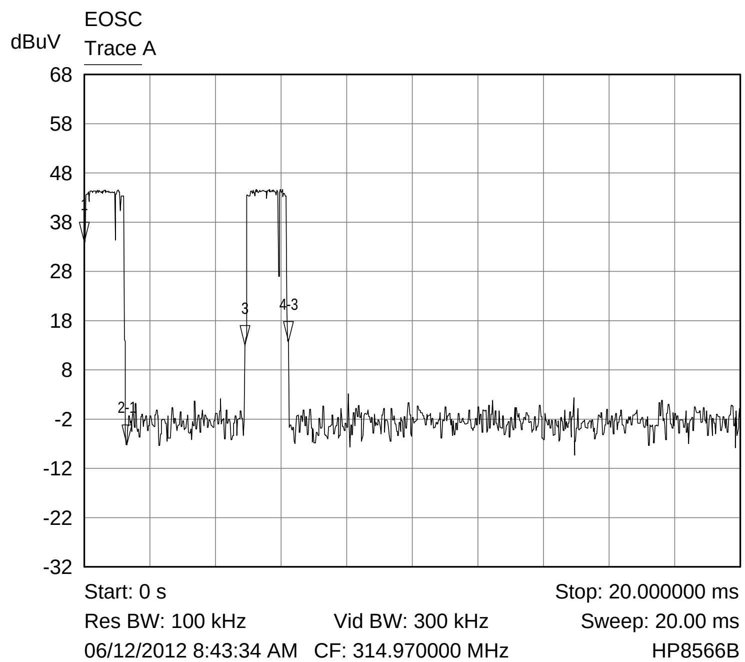
The frequency range from 150 kHz to the tenth harmonic of the highest fundamental frequency was investigated to measure any radiated emissions.

Pulsed Emission Averaging Factor

The EOSC transmitter is a pulsed emission; therefore, the method of §15.35 for averaging a pulsed emission may be used. A timing diagram of the pulsed transmission, plots of the pulse train, and the average factor calculations are shown below:



Trace A 100 ms Pulse train



Mkr	X-Axis	Value	Notes
1 ▽	0 s	34.0000 dBuV	
2-1 ▽	1.300000 ms	-41.2000 dB	
3 ▽	4.900000 ms	13.0000 dBuV	
4-3 ▽	1.320000 ms	0.9000 dB	

Average factor calculation

From the plots, there are 3 pulses transmitted in 30 seconds. The maximum time for averaging the emission using FCC §15.35(c) is 100 ms. The Average Factor will be calculated using 100 ms as specified in FCC §15.35(c).

The Average Factor is calculated by the equation:

Average Factor = 20 log (on time/pulse train time)

Pulse train time = 100 ms per FCC §15.35(c)

On time = 1.32ms x 3 = 3.96 ms

Average Factor = 20 log (3.96 / 100)
= -28.04 dB

§15.35(b) specifies a 20 dB maximum between the peak and average measurements; therefore, a –20.0 dB averaging factor will be used. The power level of the EUT transmitter was set to +4.

The data in the tables shown below are the worst-case emissions seen at the listed frequency and antenna polarity using the test configurations shown in Appendix 2 Photographs 1 and 2. Emissions were measured from 9 kHz or the lowest frequency used in the device to 3150 MHz, the 10th harmonic of the fundamental frequency. An active loop antenna was used below 30 MHz, a biconilog antenna was used from 30 to 1000 MHZ, and a double ridged guide antenna was used above 1000 MHz.

<u>Radiated Interference Measurements – (Vertical Polarity)</u>

Frequency (MHz)	Detector	Receiver Reading (dBμV)	Average Factor (dB)	Correction Factor (dB/m)	Field Strength (dBμV/m)	Limit (dBμV/m)	Delta (dB)
315.0	Peak	62.5	-20.0	18.5	61.0	75.6	-14.6
630.0	Peak	15.7	-20.0	26.2	21.9	55.6	-33.7
945.0	Peak	5.3	-20.0	31.0	16.3	55.6	-39.3
1260.0	Peak	5.9	-20.0	26.9	12.8	55.6	-42.8
1575.0*	Peak	6.1	-20.0	28.1	14.2	54.0	-39.8
1890.0	Peak	3.9	-20.0	29.7	13.6	55.6	-42.0
2205.0*	Peak	3.1	-20.0	30.9	14.0	54.0	-40.0

Frequency (MHz)	Detector	Receiver Reading (dBμV)	Average Factor (dB)	Correction Factor (dB/m)	Field Strength (dBμV/m)	Limit (dBμV/m)	Delta (dB)
2520.0	Peak	6.4	-20.0	32.0	18.4	55.6	-37.2
2835.0*	Peak	2.9	-20.0	33.1	16.0	54.0	-38.0
3150.0	Peak	2.9	-20.0	34.1	17.0	55.6	-38.6
* Emissions within restricted bands							

Radiated Interference Measurements - (Horizontal Polarity)

Frequency (MHz)	Detector	Receiver Reading (dBμV)	Average Factor (dB)	Correction Factor (dB/m)	Field Strength (dBμV/m)	Limit (dBμV/m)	Delta (dB)
315.0	Peak	75.4	-20.0	18.5	73.9	75.6	-1.7
630.0	Peak	23.3	-20.0	26.2	29.5	55.6	-26.1
945.0	Peak	13.8	-20.0	31.0	24.8	55.6	-30.8
1260.0	Peak	3.3	-20.0	26.9	10.2	55.6	-45.4
1575.0*	Peak	5.1	-20.0	28.1	13.2	54.0	-40.8
1890.0	Peak	2.2	-20.0	29.7	11.9	55.6	-43.7
2205.0*	Peak	2.2	-20.0	30.9	13.1	54.0	-40.9
2520.0	Peak	3.7	-20.0	32.0	15.7	55.6	-39.9
2835.0*	Peak	3.2	-20.0	33.1	16.3	54.0	-37.7
3150.0	Peak	1.3	-20.0	34.1	15.4	55.6	-40.2
* Emissions within restricted bands							

Sample Field Strength Calculation:

The field strength is calculated by adding the Correction Factor (Antenna Factor + Cable Factor) and the Average Factor to the measured level of the receiver. The receiver amplitude reading is compensated for any amplifier gain.

The basic equation with a sample calculation is shown below:

FS = RA + CF + AV

FS = Field Strength
RA = Receiver Amplitude Reading
CF = Correction Factor (Antenna Factor + Cable Factor)
AV = Averaging Factor

Assume a receiver reading of 44.2 dBμV is obtained from the receiver, with an average factor of –8.6 dB and a correction factor of 17.5 dB. The field strength is calculated by adding the correction factor and the average factor, giving a field strength of 53.1 dBμV/m, FS = 44.2 + 17.5 + (-8.6) = 53.1 dBμV/m

RESULT

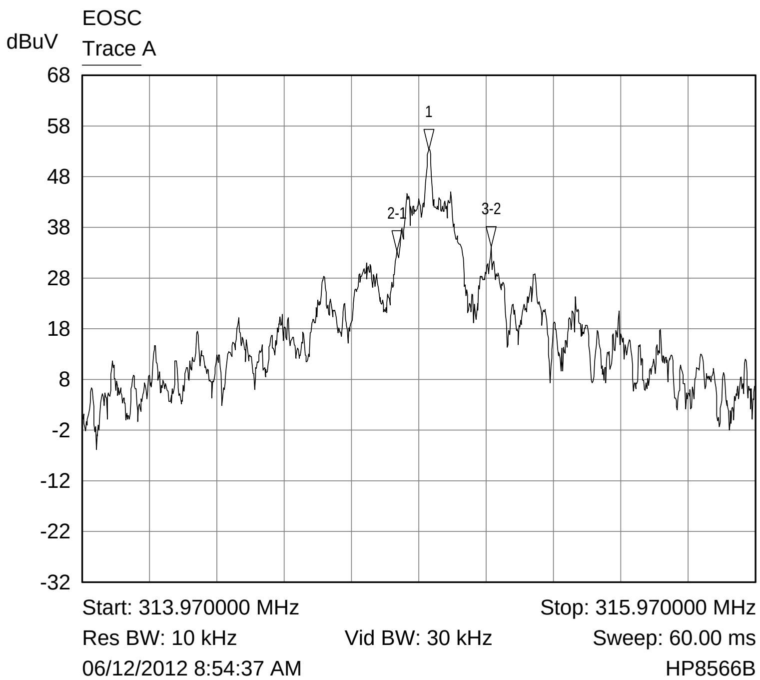
In the configuration tested, the EUT complied with the requirements of this section.

6.2.4 §15.231 (c) Bandwidth

Demonstration of Compliance:

The bandwidth of the emission must not be wider than 0.25% of the center frequency. The center frequency is 315 MHz, therefore the bandwidth must not be wider than 787.5 kHz. The EOSC bandwidth was 282.0 kHz. See spectrum analyzer plot below.

<u>Bandwidth Plot</u>



Mkr	X-Axis	Value	Notes
1 ▽	315.000000 MHz	53.4000 dBuV	
2-1 ▽	-96.000000 kHz	-20.0000 dB	
3-2 ▽	282.000000 kHz	0.8000 dB	

RESULT

In the configuration tested, the EUT complied with the requirements of this section.

APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT

A1.1 Radiated Disturbance:

The radiated disturbance from the EUT was measured using a spectrum analyzer with a quasi-peak adapter for peak and quasi-peak readings.

A loop antenna was used to measure emissions below 30 MHz. Emission readings more than 20 dB below the limit at any frequency may not be listed in the reported data. For frequencies between 9 kHz and 30 MHz, or the lowest frequency generated or used in the device greater than 9 kHz, and less than 30 MHz, the spectrum analyzer resolution bandwidth was set to 9 kHz and the video bandwidth was set to 30 kHz. For average measurements, the spectrum analyzer average detector was used.

A preamplifier with a fixed gain of 26 dB was used to increase the sensitivity of the measuring instrumentation. The quasi-peak adapter uses a bandwidth of 120 kHz, with the spectrum analyzer's resolution bandwidth set at 1 MHz, for readings in the 30 to 1000 MHz frequency ranges. A 31 dB preamp was used for measurements above 1000 MHz with the spectrum analyzer RBW set to 1 MHz and VBW at 3 MHz..

A biconilog antenna was used to measure the frequency range of 30 to 1000 MHz, at a distance of 3 meters from the EUT. The readings obtained by these antennas are correlated to the levels obtained with a tuned dipole antenna by adding antenna factors. A double-ridged guide antenna was used to measure the emissions at frequencies above 1000 MHz at a distance of 3 meters from the EUT.

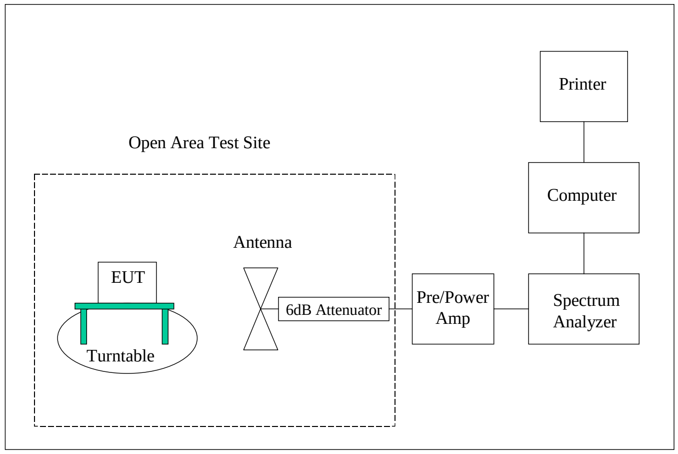
The configuration of the EUT was varied to find the maximum radiated emission. The EUT was connected to the peripherals listed in Section 2.3 via the interconnecting cables listed in Section 2.4. A technician manually manipulated these interconnecting cables to obtain worst-case radiated disturbance. The EUT was rotated 360 degrees, and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Where there were multiple interface ports all of the same type, cables are either placed on all of the ports or cables added to these ports until the emissions do not increase by more than 2 dB.

Desktop EUT are measured on a non-conducting table 0.8 meters above the ground plane. The table is placed on a turntable, which is level with the ground plane. For equipment normally placed on floors, the equipment shall be placed directly on the turntable.

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Wanship Open Area Test Site #2	Nemko-CCL, Inc.	N/A	N/A	11/16/2011
Test Software	Nemko-CCL, Inc.	Radiated Emissions	Revision 1.3	N/A
Spectrum Analyzer/Receiver	Rohde & Schwarz	1302.6005.40	100064	07/28/2011
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711	01/17/2012
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137	01/18/2012
Biconilog Antenna	EMCO	3142	9601-1008	10/15/2010
Double Ridged Guide Antenna	EMCO	3115	9604-4779	03/10/2011
High Frequency Amplifier	Miteq	AFS4-01001800-43-10P-4	1096455	06/22/2011
6’ High Frequency Cable	Microcoax	UFB197C-0-0720-000000	1296	05/10/2011
20’ High Frequency Cable	Microcoax	UFB197C-1-3120-000000	1297	05/10//2011
3 Meter Radiated Emissions Cable Wanship Site #2	Microcoax	UFB205A-0-4700-000000	1295	05/10/2011
Pre/Power-Amplifier	Hewlett Packard	8447F	3113A05161	08/25/2011
6 dB Attenuator	Hewlett Packard	8491A	32835	12/14/2011

An independent calibration laboratory or Nemko-CCL, Inc. personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

Radiated Emissions Test Setup

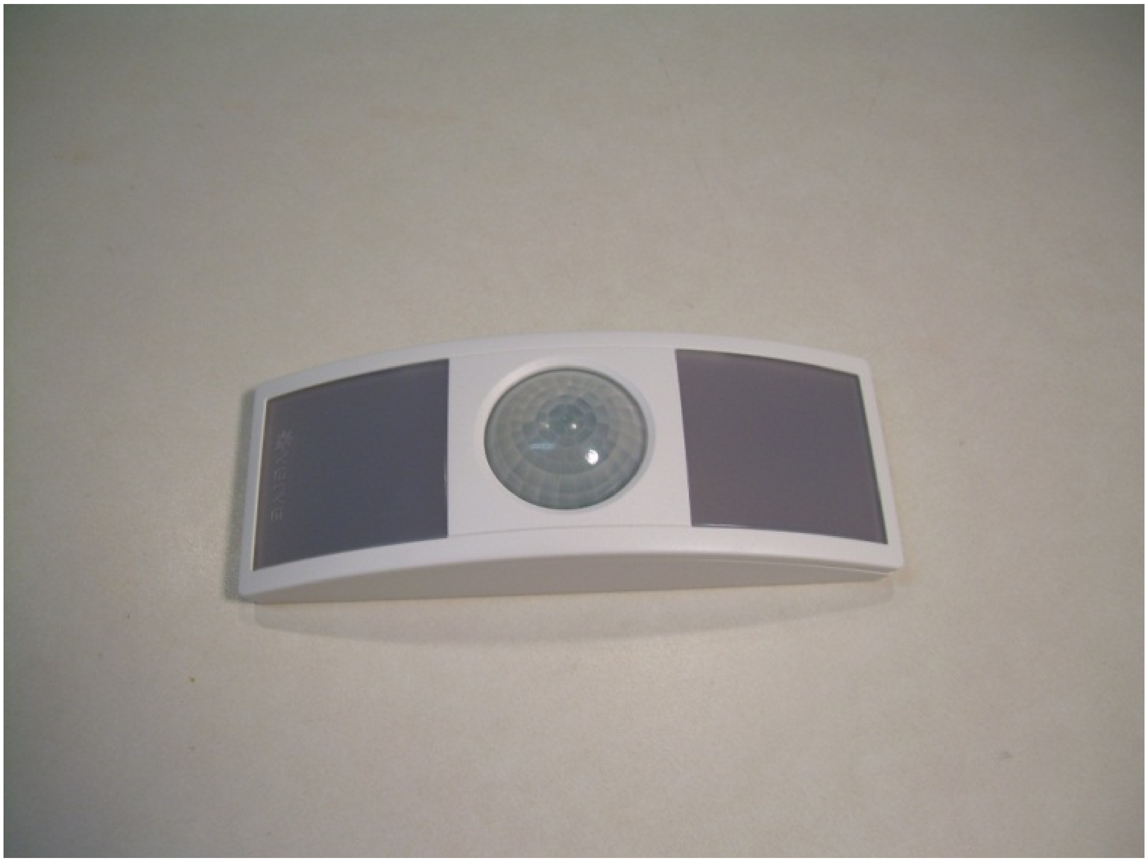


APPENDIX 2 PHOTOGRAPHS

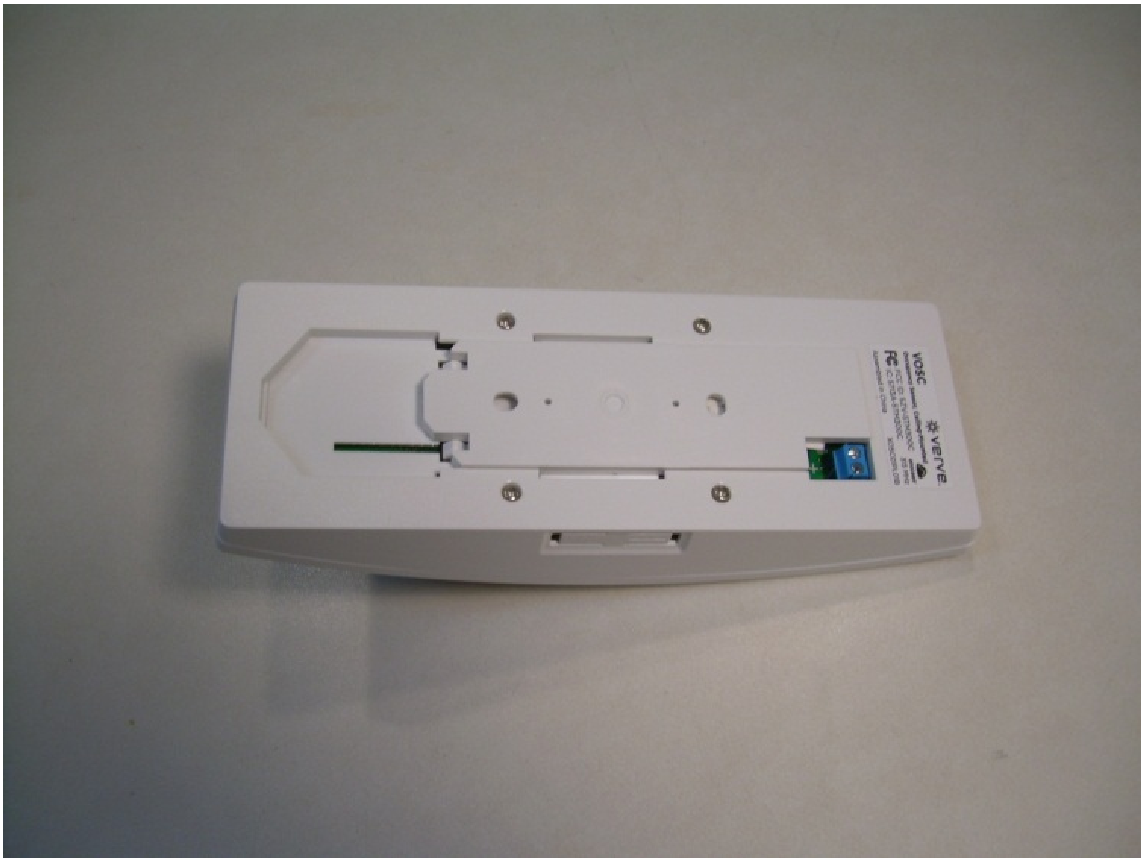
Photograph 1 – Front View Radiated Disturbance Worst Case Configuration

Photograph 2 – Back View Radiated Disturbance Worst Case Configuration

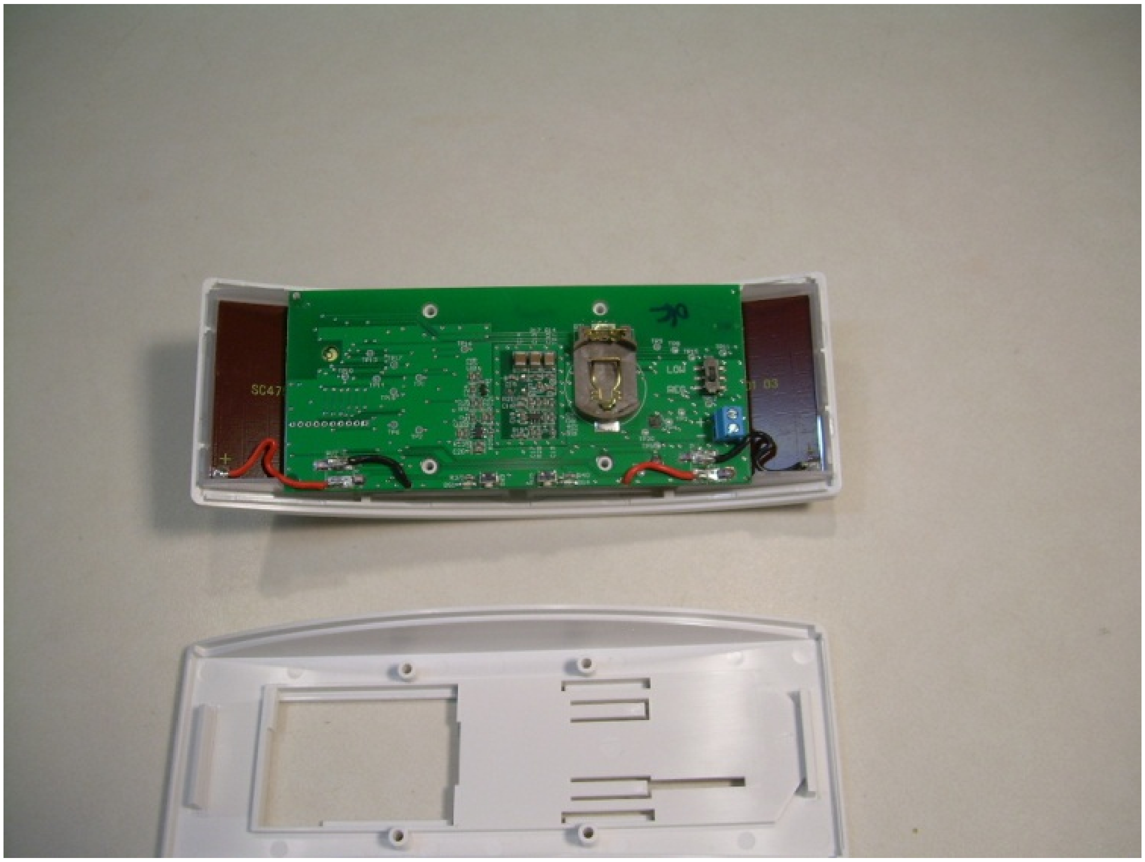
Photograph 3 – Front View of the EUT



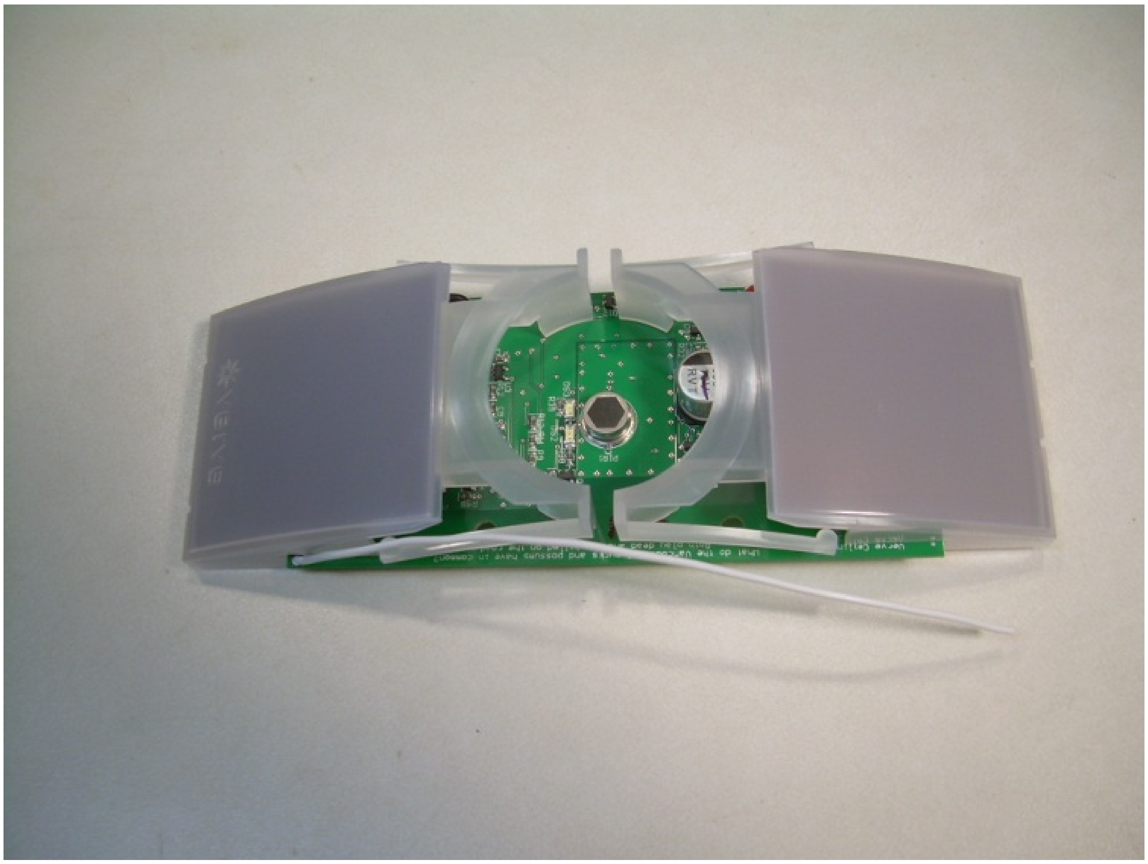
Photograph 4 – Back View of the EUT



Photograph 5 – View of the EUT and back of PCB with Back Cover Removed



Photograph 6 – View of the EUT with Front Cover Removed



Photograph 7 – View of the Front Side of the PCB