



**FCC Test Report for  
47CFR15, Subpart B for Unintentional Radiators, per Section 101  
Equipment authorization of unintentional radiators,  
and  
47CFR15, Subpart C per Section 209  
General Limits for Operation of Intentional Radiators**

On  
**Volvo MMS Sensor**

[MMS Sensor Front: FCC ID: LQN2960, Model No: 902960]

[MMS Sensor Rear: FCC ID: LQN2961, Model No: 902961]

[MMS Sensor Front Warranty: FCC ID: LQN2960, Model No: 902962]

Part No(s):

**MMS Sensor Front Volvo Part No: 30797734**

**MMS Sensor Rear Volvo Part No: 30797735**

**MMS Sensor Front Warranty Volvo Part No: 30797800**

Report No.

**20070402-02-Fc15**

Judgement

**Complies as Tested**

Provided for evaluation by

**Connaught Electronics, LTD**

IDA Industrial Estate

Dunmore Road, Tuam

Co. Galway, Ireland

Tests and Report by

**ITC Engineering Services, Inc.**

9959 Calaveras Road, Box 543

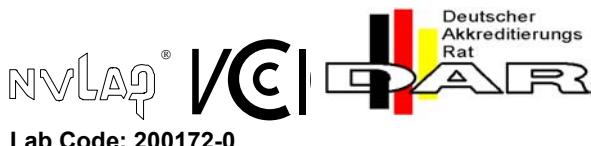
Sunol, California 94586-0543

Tel: (925) 862-2944

Fax: (925) 862-9013

Email: [itcemc@itcemc.com](mailto:itcemc@itcemc.com)

Web Site: [www.itcemc.com](http://www.itcemc.com)



Lab Code: 200172-0

**ISO 17025 Accredited Compliance Laboratory**

## Table of Contents

<b>PART 1 General.....</b>	<b>5</b>
Test Information.....	5
Tests Performed: .....	5
Declaration/Disclaimer .....	6
Test Methodology .....	7
Test Facility .....	7
<b>PART 2 RECEIVER MEASUREMENTS .....</b>	<b>8</b>
OPEN FIELD RADIATED EMISSIONS .....	8
EUT Description / Test Specification: 47 CFR PART 15, Sub-Part B .....	8
Test Procedure – Radiated Emissions Tests .....	8
Site Used – Radiated Emissions Measurement.....	10
Administrative & Environmental Details – Radiated Emissions Measurement.....	10
Radiated Emissions Test Setup Photographs.....	11
Conclusion .....	12
<b>PART 3 RF MEASUREMENTS .....</b>	<b>14</b>
Test Specification: 47 CFR PART 15, Sub-Part C .....	14
EUT Description / Test Specification.....	14
General Test Procedure – RF Tests .....	14
Spectrum Analyzer Configuration (during swept frequency scans) – Radiated Emissions .....	15
FIELD STRENGTH OF FUNDAMENTAL.....	16
Field Strength Measurement .....	16
Site Used – Field Strength of Fundamental Measurements .....	16
Administrative Details and Environmental Conditions – Field Strength of Fundamental Measurements .....	16
Test Data – Field Strength of Fundamental .....	16
Occupied Bandwidth Measurement.....	18
Site Used – Occupied Bandwidth Measurements .....	18
Test Measurement:     Occupied Bandwidth Measurements .....	18
Occupied Bandwidth Measurement Plot .....	19
Spectrum Mask Measurement.....	19
Occupied Bandwidth Data: .....	19
Measurement Photographs for Field Strength of Fundamental and Occupied Bandwidth .....	20
SPURIOUS EMISSIONS, HARMONICS, and Emissions in the RESTRICTED BANDS .....	21
Test Procedure – Spurious Emissions:.....	21
Site Used – Harmonics Emissions Measurements.....	21
Administrative Details and Environmental Conditions– Spurious and Restricted Bands Emissions .....	21
Spectrum Analyzer Configuration (during swept frequency scans) – Spurious and Restricted Emissions .....	21
Test Details – Spurious and Restricted Bands Emissions.....	22
Test Setup Photographs .....	24
<b>PART 4 APPENDICES.....</b>	<b>26</b>
A.    EUT Technical Specification .....	26
B.    EUT Photographs.....	27
C.    Modification Letter .....	30

## List of Tables

Table 1 Radio Device Measurement Information.....	7
Table 2 Measurement Uncertainty .....	7
Table 3 Test Equipment – Radiated Emissions Tests .....	8
Table 4 Support Equipment – Radiated Emissions Tests .....	8
Table 5 Data Table Legend and Field Strength Calculation – Radiated Emissions Tests.....	9
Table 6 Test Data for Radiated Emissions Measurement up to 1 GHz at 10 meters .....	10
Table 7 Test Data for Radiated Emissions Measurement above 1 GHz at 3 meters .....	12
Table 8: Support Equipment – RF Measurements .....	14
Table 9: Test Equipment – RF Measurements.....	14
Table 10 Data Table Legend and Field Strength Calculation – Radiated Emissions Tests .....	15
Table 11: Field Strength of Fundamental Test Data .....	17
Table 12 Test Data – Spurious and Restricted Bands Emissions below 1GHz.....	22
Table 13 Test Data for Radiated Emissions Measurement above 1 GHz at 3 meters .....	23

## List of Figures

Figure 1: Open Field Radiated Emissions Test Setup below 1 GHz (View 1) .....	11
Figure 2: Open Field radiated Emissions Test Setup below 1GHz (View 2).....	11
Figure 3: Radiated Emissions Test Setup, above 1 GHz (view 1) .....	13
Figure 4: Radiated Emissions Test setup, above 1 GHz (view 2).....	13
Figure 5: Plot of Field Strength of Fundamental Measurement.....	16
Figure 6: Occupied Bandwidth Plot.....	19
Figure 7 Test Set Up Photos – Field Strength of Fundamental Measurement .....	20
Figure 8: Spurious emissions below 1 GHz (view 1).....	24
Figure 9: Spurious emissions below 1GHz (view 2).....	24
Figure 10: Spurious emissions above 1 GHz (view 1).....	25
Figure 11: Spurious emissions above 1 GHz (view 2).....	25
Figure 12: EUT Front Unit (CEL Number 902960) .....	27
Figure 13: EUT Rear Unit (CEL Number 902961).....	27
Figure 14: EUT Front Warranty Unit (CEL Number 902962).....	28
Figure 15: EUTs Front View (902960 902961 & 902962) .....	28
Figure 16: EUT Internal View 1 .....	29
Figure 17: EUT Internal View 2.....	29

**PART 1 General****Test Information**

<b>Product:</b> <b>Model Number(s):</b>	Volvo MMS Sensor 902960, 902961 & 902962	
<b>Manufacturer's Name</b> <b>Manufacturer's Address</b>	Connaught Electronics, LTD IDA Industrial Estate Dunmore Road, Tuam Co. Galway, Ireland	
<b>Contact</b>	Tel: + 011 353 (93) 25128 Mr. Patrick Denny	Fax : +011 353 (93) 25133 Email <a href="mailto:dennypatrick@cei.ie">dennypatrick@cei.ie</a>
<b>Test Laboratory</b>	ITC Engineering Services, Inc. 9959 Calaveras Road, PO Box 543 Sunol, CA 94586-0543 Email: <a href="mailto:itcemc@itcemc.com">itcemc@itcemc.com</a> Web Site: <a href="http://www.itcemc.com">http://www.itcemc.com</a>	Tel: +1(925) 862-2944 Fax: +1(925) 862-9013
<b>Test Number</b> <b>Report Number</b>	20070402-02 20070402-02-Fc15	
<b>Test Date(s) &amp; Issue Date</b>	April 9 – April 13, 2007	June 4, 2007
<b>Test Engineer(s)</b>	Femi Ojo	
<b>Documentation</b>	Femi Ojo	
<b>Test Results</b>	<input checked="" type="checkbox"/> Complies as Tested	<input type="checkbox"/> Fail
<b>Total Number of Pages</b>	30	

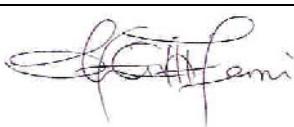
The electromagnetic interference and RF tests, which this report describes, were performed by an independent engineering consultancy firm, ITC Engineering Services, Inc. (ITC), in accordance with the requirements specified in the FCC rules, 47CFR Part 15, Subparts B and C. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical characteristics. Any modifications specified in this report for compliance must be implemented in all production units for compliance to be maintained.

**Tests Performed:****Emissions Requirements:**

- OPEN FIELD RADIATED EMISSIONS in accordance with the FCC PART 15 Sub-Part B.

**RF Requirements:**

- FIELD STRENGTH OF FUNDAMENTAL in accordance with the FCC 47 CFR 15.209.
- HARMONIC EMISSIONS in accordance with the FCC 47 CFR 15.209.
- SPURIOUS EMISSIONS in accordance with the FCC 47 CFR 15.209.

Report generated by	Report reviewed by
	
Femi Ojo, Compliance Engineer	Michael Gbadebo, P.E, Chief Engineer. (California License # 11303)

**Declaration/Disclaimer**

ITC Engineering Services, Inc. (ITC) reports apply only to the specific samples tested under stated test conditions. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. ITC Engineering Services, Inc. shall have no liability for any deductions, inferences or generalizations drawn by the client or others from ITC Engineering Services, Inc. issued reports.

This report is the confidential property of the client. As a mutual protection to our clients, the public and ourselves, extracts from the test report shall not be reproduced except in full with our written approval. The applicant/manufacturer shall not use this report to claim product endorsement by NIST, NVLAP or any US Government agency.

**ITC Engineering Services, Inc. (ITC) is:**

Accepted by the Federal Communications Commission (FCC) for FCC Methods, CISPR Methods and AUSTEL Technical Standards (Ref: NVLAP Lab Code 200172-0)

Approved by the Industry Canada for Telecom Testing

Certified by Rockford Engineering Services GmbH for EMC Testing according to the European EMC Directive 89/336/EEC per EN45001

Certified by Reg. TP for EMC Testing according to the European EMC Directive 89/336/EEC per EN45001 for RES GmbH (DAR-Registration number: TTI-P-G 159/98-00)

Certified by the Voluntary Control Council for Interference by Information Technology Equipment (VCCI) for EMC testing, in accordance with the Regulations for Voluntary Control Measures, Article 8, Registration Numbers - Site 1: C-1582 and R-1497.

## PART 1 General (Cont)

### Test Methodology

The electromagnetic interference and RF tests, which this report describes, were performed by an independent engineering consultancy firm, ITC Engineering Services, Inc. (ITC), in accordance with the FCC test procedure ANSI C63.4-2003

### Test Facility

The open area test site, the conducted measurement facility, the semi anechoic chamber and the test equipment used to collect the emissions and RF data is located in Sunol, California, and is fully described in site attenuation report. The approved site attenuation description is on file at the Federal Communications Commission.

**Table 1 Radio Device Measurement Information**

Product Type Model Number(s)	Volvo MMS Sensor 902960, 902961 & 902962	
Applicant / Manufacturer Address	Connaught Electronics, Ltd. IDA Industrial Estate, Dunmore Road, Tuam, Co. Galway, Ireland	
Contact	Mr. Patrick Denny Tel: +011 353 93 25128	<a href="mailto:dennypatrick@cel.ie">dennypatrick@cel.ie</a> Fax: +011 353 93 25133
Total Number of Pages including Appendices	30 Pages	
Test Report File No.	20070402-02-Fc15	

**Table 2 Measurement Uncertainty**

150kHz to 30MHz:		
Combined standard uncertainty uc(y)	± 1.68 dB	Normal
Expanded uncertainty U	± 3.36 dB	Normal (k = 2)
30MHz to 1GHz:		
Combined standard uncertainty uc(y)	± 3.24 dB	Normal
Expanded uncertainty U	± 6.48 dB	Normal (k = 2)
1GHz to 18GHz:		
Combined standard uncertainty uc(y)	± 2.48 dB	Normal
Expanded uncertainty U	± 4.96 dB	Normal (k = 2)
Above 18GHz:		
Radiated emission up to 26 GHz	± 3 dB	
Radiated emission up to 40 GHz	± 3 dB	
Radiated emission up to 75 GHz	± 3 dB	

## PART 2 RECEIVER MEASUREMENTS

### OPEN FIELD RADIATED EMISSIONS

#### EUT Description / Test Specification: 47 CFR PART 15, Sub-Part B

Connaught's product Volvo MMS sensor, models; 902960, 902961 and 902962 (or the EUTs) as referred to in this report are intentional radiators. The units are similar both in design and functionality. One of the EUTs (model 902960) was tested and based on engineering judgment, the results hold for all models. The EUT was set up at 3 and 10 meters in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-2003. The measurement instrumentation used was a receiver with bandwidth parameters as stipulated in ANSI C63.4-2003. The MMS Sensor was set up on a wooden non-conductive tabletop, 80 cm above the ground reference plane, in an open field. The transmit function was not activated for the tests.

**Table 3 Test Equipment – Radiated Emissions Tests**

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
Preamplifier	Hewlett-Packard	83051A	0000009025	1/29/08
Preselector	Hewlett-Packard	85685A	2620A00265	3/28/08
Biconical Antenna	EMCO	3104C	9111-4463	1/24/08
I.p. Ant (200 -1000MHz)	EMCO	3146	1596/1001	1/25/08
Quasi Peak Adapter	Hewlett-Packard	85650	2521A00871	3/28/08
Spectrum Analyzer	Hewlett-Packard	8568B	2841A04315	3/28/08
Spectrum Analyzer Display	Hewlett-Packard	85662A	2848A17028	3/28/08
Horn. Ant (≤18GHz)	AH System	SAS-571	887	12/12/07
Spectrum Analyzer	Hewlett-Packard	8565E	3943A01328	08-16-07

**Table 4 Support Equipment – Radiated Emissions Tests**

Description	Manufacturer	Model No.	Serial No.	Calibration Due
DC Power Supply	BK Precision	1688	2250558	N/A
Digital Multimeter	Extech	EX330	06140748	11/29/07

#### Test Procedure – Radiated Emissions Tests

The measurement range investigated was from 30 MHz to 18 GHz due to lack of emissions activity above 5.8GHz. For measurements below 1GHz, the EUT was set up at 10 meters from the receiving antenna, on an Open Area Test Site (OATS) with the EUT running in a continuous mode. The EUT was rotated 360 degrees azimuth and the search antenna height varied 1 to 4m in order to maximize the emissions. Significant peaks from the EUT were then recorded to determine margin to the limits. For measurements above 1GHz, the EUT was set up at 3 meters from the antenna in a semi-anechoic chamber with the EUT running in a continuous mode. The EUT was rotated 360 degrees azimuth and the search antenna height varied 1 to 4m in order to maximize the emissions. Significant peaks from the EUT were then recorded to determine margin to the limits.

## OPEN FIELD RADIATED EMISSIONS (cont)

### Spectrum Analyzer Configuration (swept frequency scans)—Radiated Emissions

IF Bandwidth..... 120 kHz

Measurements below 1000 MHz (unless stated otherwise)

Analyzer Mode (for Peak Measurements) ..... Peak/Log

Resolution Bandwidth ..... 100 kHz

Video Bandwidth ..... 100 kHz

Analyzer Mode (for Quasi-Peak Measurements)

Quasi-Peak/Linear Resolution Bandwidth ..... 1000 kHz

Video Bandwidth ..... 1000 kHz

Measurements above 1000 MHz (unless stated otherwise)

Quasi-Peak Adapter Mode ..... Disabled

Analyzer Mode (for Peak Measurements) ..... Peak

Resolution Bandwidth ..... 1000 kHz

Video Bandwidth ..... 1000 kHz

Analyzer Mode (for Average Measurements) ..... Video Filter

Resolution Bandwidth ..... 1000 kHz

Video Bandwidth ..... 10 Hz

**Table 5 Data Table Legend and Field Strength Calculation – Radiated Emissions Tests**

Detector mode: Peak (P) or Quasi-Peak (QP) or Average (A)

	Polarization	Antenna	Freq Range (MHz)
VB	Vertical	EMCO 3104/sn 4463 Biconical	30 – 200
HB	Horizontal	EMCO 310c4/sn 4463 Biconical	30 – 200
VL	Vertical	EMCO 3146/sn. 1001 Log Periodic	200 – 1000
HL	Horizontal	EMCO 3146/sn. 1001 Log Periodic	200 – 1000
VH	Vertical	SAS-571/sn. 887 Horn	≤18000
HH	Horizontal	SAS-571/sn. 887 Horn	≤18000

**The margin in the Table 6 is calculated as follows:**

Margin = Corrected Amplitude – Limit, where Corrected Amplitude = Spectrum Analyzer Amplitude + Cable Loss + Antenna Factor – Pre-Amp Gain.

## OPEN FIELD RADIATED EMISSIONS Results

## Site Used – Radiated Emissions Measurement

Test Site 1 - 3m Open Field Radiated Site  
 Test Site 1 - 10m Open Field Radiated Site  
 EMC Lab 1 - Test Laboratory  
 Semi-Anechoic Absorber Lined Shielded Room

## Administrative &amp; Environmental Details – Radiated Emissions Measurement

Test Date:	April 11, 2007
Test Engineer:	Femi Ojo
Temperature	24.4°C
Humidity	42%

## Table 6 Test Data for Radiated Emissions Measurement up to 1 GHz at 10 meters

The table below shows a summary of the highest amplitudes of the radiated emissions from the equipment under test at various antenna heights, antenna polarization, and EUT orientations.

INDICATED		CORRECTION		CORR	TURNTABLE ANT			CLASS A		CLASS B			
FREQ	AMPL	ANT	CAB	AMPL	ANG	HT	POL	AMPL	MARG	AMPL	MARG	FILTER	
MHz	dBuV/m	dB	dB	dBuV/m	DEG	m	-	dBuV/m	dB	dBuV/m	db	MODE	NOTES
32.94	5.9	11.1	1.9	18.9	90	2.5	HB	-	-	30.0	-11.1	P	
40.04	6.1	11.3	2.2	19.6	0	1.0	VB	-	-	30.0	-10.4	P	
50.13	8.8	11.7	2.2	22.7	180	2.0	HB	-	-	30.0	-7.3	P	
65.84	5.8	7.9	2.6	16.3	90	1.0	VB	-	-	30.0	-13.7	P	
110.57	5.6	12.0	3.2	20.9	90	1.0	VB	-	-	33.0	-12.1	P	
117.49	5.2	12.9	3.2	21.4	120	1.0	VB	-	-	33.0	-11.6	P	
132.77	5.6	12.5	3.4	21.5	90	1.0	VB	-	-	33.0	-11.5	P	
149.38	5.8	12.2	3.8	21.8	0	2.0	HB	-	-	33.0	-11.2	P	
203.86	8.9	11.8	3.9	24.5	90	1.0	VL	-	-	33.0	-8.5	P	
204.68	2.5	11.4	3.9	17.8	0	2.0	HL	-	-	33.0	-15.2	P	
220.57	7.9	11.1	3.8	22.8	0	1.0	VL	-	-	36.0	-13.2	P	
408.60	4.0	15.7	6.2	25.9	90	1.0	VL	-	-	36.0	-10.1	P	
440.81	3.6	15.9	6.6	26.1	90	2.0	HL	-	-	36.0	-9.9	P	
444.86	4.3	16.2	6.8	27.3	90	1.0	VL	-	-	36.0	-8.7	P	
558.44	1.5	18.0	8.1	27.6	90	1.0	VL	-	-	36.0	-8.4	P	
573.30	3.1	17.5	8.5	29.1	0	1.0	VL	-	-	36.0	-6.9	P	

No emission of significant level was observed above 573.30MHz

## Test Data Legend

P = Peak

QP = Quasi Peak

The margin is calculated as follows:

Margin = Corrected Amplitude - Limit; where Corrected Amplitude = Amplitude + Cable Loss + Antenna Factor.

## OPEN FIELD RADIATED EMISSIONS Results (cont.)

### Radiated Emissions Test Setup Photographs



Figure 1: Open Field Radiated Emissions Test Setup below 1 GHz (View 1)

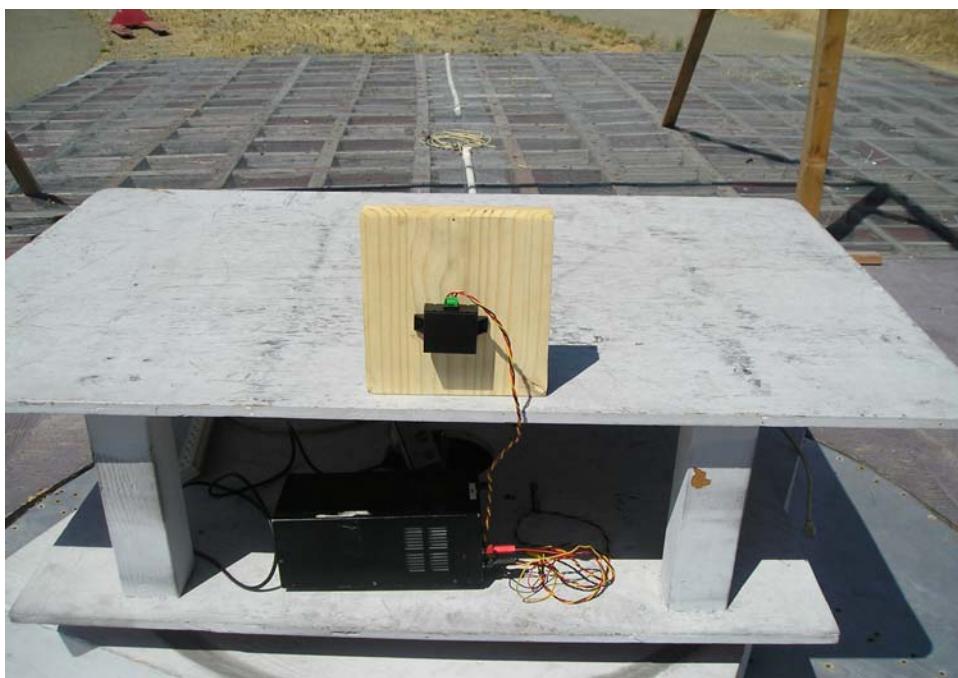


Figure 2: Open Field radiated Emissions Test Setup below 1GHz (View 2)

## OPEN FIELD RADIATED EMISSIONS Results (cont.)

### Administrative and Environmental Details – Radiated Emissions Measurement

<b>Test Date:</b>	April 11, 2007
<b>Test Engineer:</b>	Femi Ojo
<b>Temperature</b>	26.7°F
<b>Humidity</b>	45%

**Table 7 Test Data for Radiated Emissions Measurement above 1 GHz at 3 meters**

The table below shows a summary of the highest amplitudes of the radiated emissions from the equipment under test at various antenna heights, antenna polarization, and EUT orientations.

INDICATED FREQ MHz	CORRECTION AMPL dB	ANT CAB	CORR AMPL dBuV/m	TURNTABLE ANT			CLASS A		CLASS B		FILTER MODE	NOTES
				ANG DEG	HT m	POL	AMPL dBuV/m	MARG	AMPL dBuV/m	MARG		
1038.0	46.8	24.3	-34.6	36.5	0	1.0	VH	-	-	54.0	-17.5	P
1040.0	45.6	24.3	-34.6	35.3	90	1.2	HH	-	-	54.0	-18.7	P
1138.0	49.2	24.4	-34.5	39.1	0	1.0	VH	-	-	54.0	-14.9	P
1173.0	49.7	24.5	-34.4	39.7	0	1.0	VH	-	-	54.0	-14.3	P
1184.0	48.7	24.5	-34.4	38.8	90	1.2	HH	-	-	54.0	-15.2	P
1215.0	46.2	24.6	-34.4	36.4	0	1.0	HH	-	-	54.0	-17.6	P
1243.0	51.5	24.6	-34.3	41.8	0	1.0	VH	-	-	54.0	-12.2	P
1244.0	45.5	24.6	-34.3	35.8	90	1.2	HH	-	-	54.0	-18.2	P
2181.0	44.7	28.0	-32.8	39.9	0	1.0	VH	-	-	54.0	-14.1	P
2215.0	43.3	28.2	-32.7	38.7	90	1.2	HH	-	-	54.0	-15.3	P
3642.0	44.2	31.6	-31.2	44.6	0	1.0	VH	-	-	54.0	-9.4	P
4750.0	45.3	32.8	-29.8	48.3	0	1.0	VH	-	-	54.0	-5.7	P
5371.0	45.8	34.0	-29.5	50.3	0	1.0	VH	-	-	54.0	-3.7	P
5765.0	36.3	34.4	-29.2	41.4	0	1.0	VH	-	-	54.0	-12.6	P
5799.0	36.2	34.4	-29.2	41.3	90	1.2	HH	-	-	54.0	-12.7	P
6857.0	44.0	35.0	-29.1	50.0	90	1.2	HH	-	-	54.0	-4.0	P
11531.	37.7	39.1	-27.4	49.4	0	1.0	VH	-	-	54.0	-4.6	P
11531.	36.0	39.2	-27.4	47.8	90	1.2	HH	-	-	54.0	-6.2	P
17296.	30.5	42.9	-23.9	49.6	0	1.0	VH	-	-	54.0	-4.4	P

No emission of significant level was observed above 17.3GHz

### Test Data Legend

P = Peak

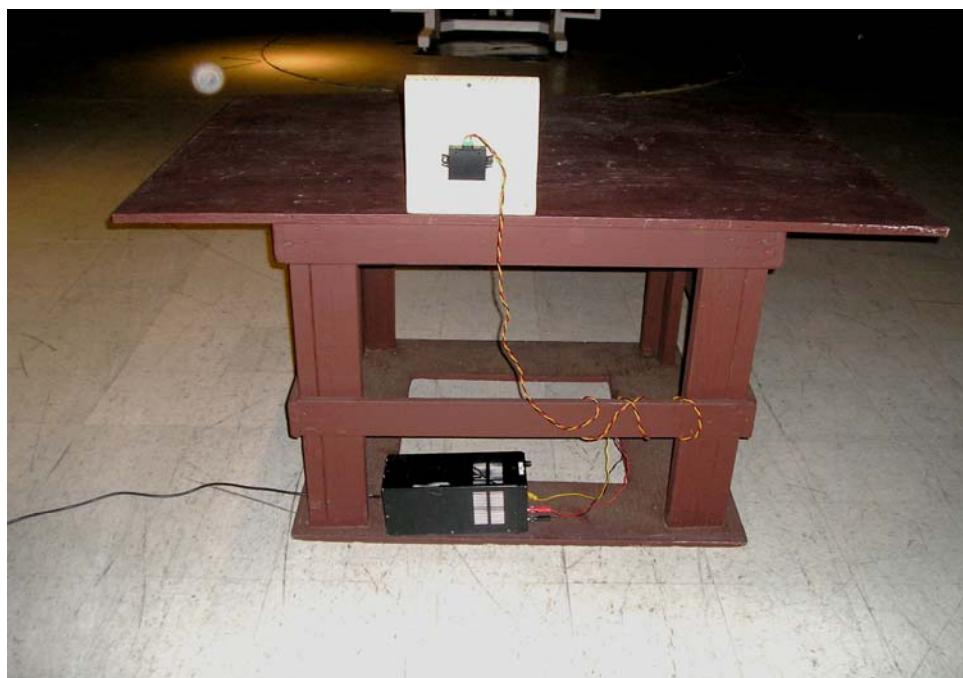
QP = Quasi Peak

The margin is calculated as follows:

Margin = Corrected Amplitude - Limit; where Corrected Amplitude = Amplitude + Cable Loss + Antenna Factor.

### Conclusion

The Volvo MMS Sensor meets the requirements of FCC Part 15, Class B for Radiated Emissions.

**OPEN FIELD RADIATED EMISSIONS Results (cont.)****Radiated Emissions Test Setup Photographs****Figure 3: Radiated Emissions Test Setup, above 1 GHz (view 1)****Figure 4: Radiated Emissions Test setup, above 1 GHz (view 2)**

## PART 3 RF MEASUREMENTS

### Test Specification: 47 CFR PART 15, Sub-Part C

#### EUT Description / Test Specification.

Connaught's product Volvo MMS sensor, models; 902960, 902961 and 902962 (or the EUTs) as referred to in this report are intentional radiators. The units are similar both in design and functionality. One of the EUTs (model 902960) was tested and based on engineering judgment, the results hold for all models. The EUT comes with an antenna permanently attached. The EUT, was set up on a wooden table, 80cm above the ground reference plane in an anechoic chamber. It was powered and tested in normal continuous mode.

**Supply Voltage Tested: 13.5VDC**

**Table 8: Support Equipment – RF Measurements**

Description	Manufacturer	Model No.	Serial No.	Calibration Due
DC Power Supply	BK Precision	1688	2250558	N/A
Digital Multimeter	Extech	EX330	06140748	11/29/07

**Table 9: Test Equipment – RF Measurements**

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
Preamplifier	Hewlett-Packard	83051A	0000009025	1/29/08
Preselector	Hewlett-Packard	85685A	2620A00265	3/28/08
Biconical Antenna	EMCO	3104C	9111-4463	1/24/08
I.p. Ant (200 -1000MHz)	EMCO	3146	1596/1001	1/25/08
Quasi Peak Adapter	Hewlett-Packard	85650	2521A00871	3/28/08
Spectrum Analyzer	Hewlett-Packard	8568B	2841A04315	3/28/08
Spectrum Analyzer Display	Hewlett-Packard	85662A	2848A17028	3/28/08
Horn. Ant ( $\leq$ 18GHz)	AH System	SAS-571	887	12/12/07
Spectrum Analyzer	Hewlett-Packard	8565E	3943A01328	08-16-07

#### General Test Procedure – RF Tests

For the spurious and harmonics measurements, below 1GHz, the EUT was set up at a 3 meter distance from the receiving antenna, on an Open Area Test Site (OATS), with the EUT running in a continuous mode. The EUT was rotated 360 degrees azimuth and the search antenna height varied 1 to 4m in order to maximize the emissions. Significant peaks from the EUT were then recorded to determine margin to the limits. For measurements above 1GHz, the EUT was set up at a 3 meter distance from the antenna, in a semi-anechoic chamber, with the EUT running in a continuous mode. The EUT was rotated 360 degrees azimuth and the search antenna height varied 1 to 4m in order to maximize the emissions. Significant peaks from the EUT were then recorded to determine margin to the limits.

For the field strength measurements of the fundamental frequency, the EUT was setup in an anechoic chamber at a 3 meter distance from the receiving antenna. The EUT was rotated 360 degrees azimuth and the search antenna height varied 1 to 4m in order to maximize the field strength emission of the fundamental. The maximum level of the fundamental emission from the EUT was measured and recorded at optimum antenna and table orientation to determine margin to the limits.

## PART 3 RF MEASUREMENTS (cont.)

### Spectrum Analyzer Configuration (during swept frequency scans) – Radiated Emissions

IF Bandwidth..... 120 kHz

Measurements below 1000 MHz (unless stated otherwise)

Analyzer Mode (for Peak Measurements) ..... Peak/Log

Resolution Bandwidth..... 100 kHz

Video Bandwidth..... 100 kHz

Analyzer Mode (for Quasi-Peak Measurements)

Quasi-Peak/Linear Resolution Bandwidth..... 1000 kHz

Video Bandwidth..... 1000 kHz

Measurements above 1000 MHz (unless stated otherwise)

Quasi-Peak Adapter Mode ..... Disabled

Analyzer Mode (for Peak Measurements) ..... Peak

Resolution Bandwidth..... 1000 kHz

Video Bandwidth..... 1000 kHz

Analyzer Mode (for Average Measurements) ..... Video Filter

Resolution Bandwidth..... 1000 kHz

Video Bandwidth..... 10 Hz

**Table 10 Data Table Legend and Field Strength Calculation – Radiated Emissions Tests**

Detector mode: Peak (P) or Quasi-Peak (QP) or Average (A)

	Polarization	Antenna	Freq Range (MHz)
VB	Vertical	EMCO 3104/sn 4463 Biconical	30 – 200
HB	Horizontal	EMCO 310c4/sn 4463 Biconical	30 – 200
VL	Vertical	EMCO 3146/sn. 1001 Log Periodic	200 – 1000
HL	Horizontal	EMCO 3146/sn. 1001 Log Periodic	200 – 1000
VH	Vertical	SAS-571/sn. 887 Horn	≤18000
HH	Horizontal	SAS-571/sn. 887 Horn	≤18000

## FIELD STRENGTH OF FUNDAMENTAL

### Field Strength Measurement

The EUT was set up as described above. The measurement instrumentation used was an Analyzer with bandwidth parameters as stipulated in ANSI C63.4-2003.

#### Site Used – Field Strength of Fundamental Measurements

- Test Site 1 - Shielded Room: 16' x 12' x 9'
- Test Site 1 - 3m Open Field Radiated Site
- Test Site 1 - 10m Open Field Radiated Site
- Test Site 2 - Environmental Lab
- EMC Lab 1 - Test Laboratory
- Semi-Anechoic Absorber Lined Shielded Room
- Other:

#### Administrative Details and Environmental Conditions – Field Strength of Fundamental Measurements

Test Date(s):	April 9, 2007
Test Engineer(s):	Femi Ojo
Temperature	23.9°C
Humidity	38%

#### Test Data – Field Strength of Fundamental

The measurement plot below represents the maximum worst-case result from the measurement performed in accordance to the requirements of this section.

#### Field Strength of Fundamental Plot.

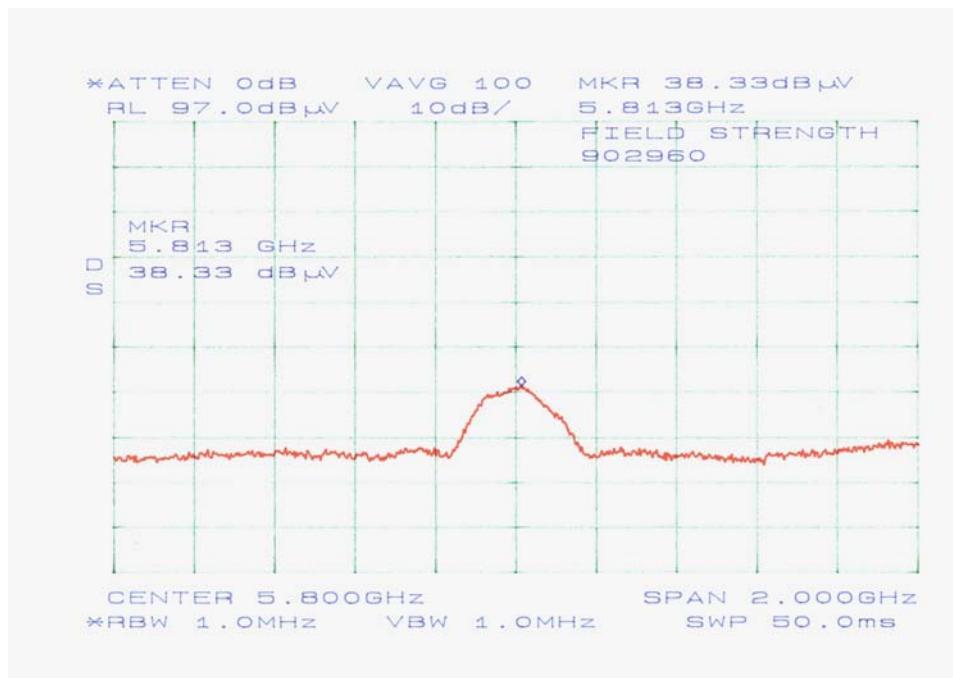


Figure 5: Plot of Field Strength of Fundamental Measurement.

## FIELD STRENGTH OF FUNDAMENTAL (cont.)

INDICATED		CORRECTION		CORR	TURNTABLE ANT			CLASS A		CLASS B		DET
FREQ	AMPL	ANT	CAB / AMP	AMPL	ANG	HT	POL	AMPL	MARG	AMPL	MARG	
GHz	dBuV/m	dB	dB	dBuV/m	DEG	m	-	dBuV/m	dB	dBuV/m	dB	MODE
5.813	38.3	33.3	-29.3	42.3	0	1.0	VH	-	-	74	-31.7	p
5.727	38.1	33.3	-29.3	42.1	0	1.0	HH	-	-	74	-31.9	p

Table 11: Field Strength of Fundamental Test Data

**The margin in Table 11 is calculated as follows:**

Margin = Corrected Amplitude – Limit, where Corrected Amplitude = Spectrum Analyzer Amplitude + Cable Loss + Antenna Factor – Pre-Amp Gain.

**Test-Data Summary – Peak Measurement:**

Center Frequency = 5800 MHz  
 Peak Level: = 42.3dB $\mu$ V/m  
 Peak Limit (15.209) = 74.00dB $\mu$ V/m (54dB $\mu$ V/m + 20dB)

**Average Level Calculation of Field Strength of Fundamental with Duty Cycle correction.**

The duty cycle rating as provided by the manufacturer is 0.83% (or 0.0083) over a 100mSec interval = 0.0083 seconds.

<b>dB (in <math>\mu</math>V) Duty Cycle Correction</b>	=0.0083 secs	=20log(0.0083)	= -41.62dB $\mu$ V
<b>Pulse Desensitization Factor (PDF)</b>	= -40dB		
<b>Peak Level with PDF</b>	= 42.3 dB $\mu$ V/m + 40dB		= 82.3dB $\mu$ V/m
<b>Peak Level with Duty Cycle Correction</b>	=82.3dB $\mu$ V/m – 41.62dB		= 40.68dB $\mu$ V/m

**Test-Data Summary – Average Measurement:**

Center Frequency = 5800 MHz  
 Average Level: = 40.68dB $\mu$ V/m (Calculated).  
 Average Limit (15.209) = 54.00dB $\mu$ V/m

**Conclusion**

Volvo MMS Sensor meets the requirements of the test reference for Fundamental Frequency Field Strength per FCC Part 15C

## FIELD STRENGTH OF FUNDAMENTAL (cont.)

### Occupied Bandwidth Measurement

For the measurements, a spectrum analyzer was used. The EUT was measured according to the method specified in ANSI C63.4-2003.

#### Site Used – Occupied Bandwidth Measurements

- Test Site 1 - Shielded Room: 16' x 12' x 9'
- Test Site 1 - 3m Open Field Radiated Site
- Test Site 1 - 10m Open Field Radiated Site
- Test Site 2 - Environmental Lab
- EMC Lab 1 - Test Laboratory
- Semi-Anechoic Absorber Lined Shielded Room
- Other:

Test Date(s):	April 9, 2007
Test Engineer(s):	Femi Ojo
Temperature	23.9°C
Humidity	38%

#### Test Measurement: Occupied Bandwidth Measurements

The EUT was set up on a wooden non-conductive tabletop, 80 cm above the ground plane of the test location. Pre-scan measurements were first performed with a spectrum analyzer at 3 meter from a receiving antenna, in a Semi-Anechoic Chamber at the pre-determined worst-case height at 1 meter and in vertical polarity. The EUT running in continuous mode and was rotated 360 degrees azimuth in its x-y-z axis positions. It was also measured in the horizontal polarity. The analyzer was then placed in 'max-hold' mode to record signal level.

#### Spectrum Analyzer Configuration (during swept frequency scans) – Occupied Bandwidth

Start Frequency ..... 5.300 GHz  
Stop Frequency ..... 6.300 GHz  
Sweep Speed ..... 50mSecs  
RES Bandwidth..... 1000 kHz  
Video Bandwidth..... 1000 kHz  
Quasi Peak Adapter Mode ..... Bypass  
Quasi peak Adapter Bandwidth..... Disabled

## FIELD STRENGTH OF FUNDAMENTAL (cont.)

### Occupied Bandwidth Measurement Plot

The plot and test data below represents the maximum worst-case results from the measurements performed in accordance to the requirements of the standard and extreme test conditions specified at the beginning of this Part.

### Spectrum Mask Measurement

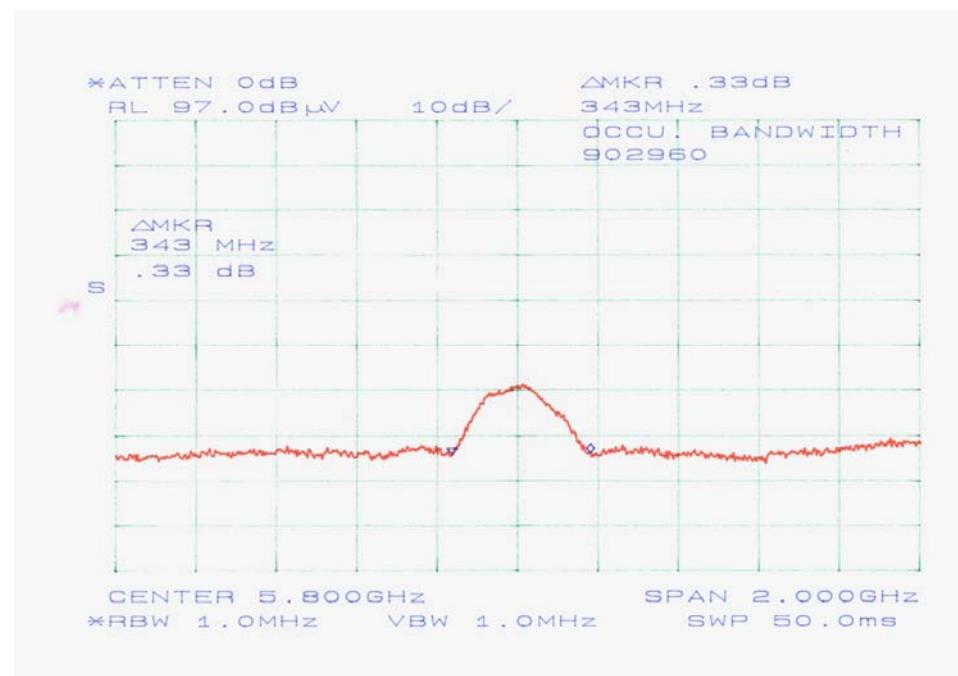


Figure 6: Occupied Bandwidth Plot

### Test-Data Summary – Occupied Bandwidth:

Center frequency: 5800 MHz  
Mask Bandwidth: 343 MHz

### Occupied Bandwidth Data:

Upper Frequency ( $F_u$ )	$=f_0 + 343/2$	$=5800 \text{ MHz} + 171.5$	$=5971.5 \text{ MHz}$
Lower Frequency ( $f_L$ )	$=f_0 - 343/2$	$=5800 \text{ MHz} - 171.5$	$=5628.5 \text{ MHz}$

**FIELD STRENGTH OF FUNDAMENTAL (cont.)****Measurement Photographs for Field Strength of Fundamental and Occupied Bandwidth****Figure 7 Test Set Up Photos – Field Strength of Fundamental Measurement**

**SPURIOUS EMISSIONS, HARMONICS, and Emissions in the RESTRICTED BANDS**

**Test Specification:** FCC PART 15, SECTION 47 CFR 15.205  
FCC PART 15, SECTION 47 CFR 15.209

**Test Procedure – Spurious Emissions:**

The measurement range investigated was from 30 MHz to 18 GHz due to lack of emissions activity above 5.8GHz. The measurement instrumentation used was an Analyzer with bandwidth parameters as stipulated in ANSI C63.4-2003

**Site Used – Harmonics Emissions Measurements**

- Test Site 1 - Shielded Room: 16' x 12' x 9'
- Test Site 1 - 3m Open Field Radiated Site
- Test Site 1 - 10m Open Field Radiated Site
- Test Site 2 - Environmental Lab
- EMC Lab 1 - Test Laboratory
- Semi-Anechoic Absorber Lined Shielded Room

**Administrative Details and Environmental Conditions– Spurious and Restricted Bands Emissions**

<b>Test Date:</b>	April 11, 2007
<b>Test Engineer:</b>	Femi Ojo
<b>Temperature</b>	24.4°C
<b>Humidity</b>	42%

**Spectrum Analyzer Configuration (during swept frequency scans) – Spurious and Restricted Emissions**

IF Bandwidth.....120 kHz

Measurements below 1000 MHz (unless stated otherwise)

- Analyzer Mode (for Peak Measurements) ..... Peak/Log
- Resolution Bandwidth..... 100 kHz
- Video Bandwidth..... 100 kHz
- Analyzer Mode (for Quasi-Peak Measurements)
- Quasi-Peak/Linear Resolution Bandwidth..... 1000 kHz
- Video Bandwidth..... 1000 kHz

Measurements above 1000 MHz (unless stated otherwise)

- Quasi-Peak Adapter Mode ..... Disabled (if available)
- Analyzer Mode (for Peak Measurements) ..... Peak
- Resolution Bandwidth..... 1000 kHz
- Video Bandwidth..... 1000 kHz
- Analyzer Mode (for Average Measurements) ..... Video Filter
- Resolution Bandwidth..... 1000 kHz
- Video Bandwidth..... 10 Hz

**SPURIOUS, HARMONICS, and RESTRICTED BANDS Emissions (cont.)****Test Details – Spurious and Restricted Bands Emissions**

Transmitter	Operating Mode
Limit	47CFR 15.209

The tables below shows the summary of the highest amplitudes of the spurious RF radiated emissions from the equipment under test.

**Table 12 Test Data – Spurious and Restricted Bands Emissions below 1GHz**

INDICATED		CORRECTION		CORR	TURNTABLE ANT			CLASS A		CLASS B			
FREQ	AMPL	ANT	CAB	AMPL	ANG	HT	POL	AMPL	MARG	AMPL	MARG	FILTER	
MHz	dBuV/m	dB	dB	dBuV/m	DEG	m	-	dBuV/m	dB	dBuV/m	db	MODE	NOTES
32.94	5.9	11.1	1.9	18.9	90	2.5	HB	-	-	30.0	-11.1	P	
40.04	6.1	11.3	2.2	19.6	0	1.0	VB	-	-	30.0	-10.4	P	
50.13	8.8	11.7	2.2	22.7	180	2.0	HB	-	-	30.0	-7.3	P	
65.84	5.8	7.9	2.6	16.3	90	1.0	VB	-	-	30.0	-13.7	P	
110.57	5.6	12.0	3.2	20.9	90	1.0	VB	-	-	33.0	-12.1	P	
117.49	5.2	12.9	3.2	21.4	120	1.0	VB	-	-	33.0	-11.6	P	
132.77	5.6	12.5	3.4	21.5	90	1.0	VB	-	-	33.0	-11.5	P	
149.38	5.8	12.2	3.8	21.8	0	2.0	HB	-	-	33.0	-11.2	P	
203.86	8.9	11.8	3.9	24.5	90	1.0	VL	-	-	33.0	-8.5	P	
204.68	2.5	11.4	3.9	17.8	0	2.0	HL	-	-	33.0	-15.2	P	
220.57	7.9	11.1	3.8	22.8	0	1.0	VL	-	-	36.0	-13.2	P	
408.60	4.0	15.7	6.2	25.9	90	1.0	VL	-	-	36.0	-10.1	P	
440.81	3.6	15.9	6.6	26.1	90	2.0	HL	-	-	36.0	-9.9	P	
444.86	4.3	16.2	6.8	27.3	90	1.0	VL	-	-	36.0	-8.7	P	
558.44	1.5	18.0	8.1	27.6	90	1.0	VL	-	-	36.0	-8.4	P	
573.30	3.1	17.5	8.5	29.1	0	1.0	VL	-	-	36.0	-6.9	P	

No emission of significant level was observed above 573.3MHz Thru 1GHz

**Table 13 Test Data for Radiated Emissions Measurement above 1 GHz at 3 meters**

INDICATED		CORRECTION		CORR	TURNTABLE ANT			CLASS A		CLASS B			
FREQ	AMPL	ANT	CAB	AMPL	ANG	HT	POL	AMPL	MARG	AMPL	MARG	FILTER	
MHz	dBuV/m	dB	dB	dBuV/m	DEG	m	-	dBuV/m	dB	dBuV/m	db	MODE	NOTES
1038.0	46.8	24.3	-34.6	36.5	0	1.0	VH	-	-	54.0	-17.5	P	
1040.0	45.6	24.3	-34.6	35.3	90	1.2	HH	-	-	54.0	-18.7	P	
1138.0	49.2	24.4	-34.5	39.1	0	1.0	VH	-	-	54.0	-14.9	P	
1173.0	49.7	24.5	-34.4	39.7	0	1.0	VH	-	-	54.0	-14.3	P	
1184.0	48.7	24.5	-34.4	38.8	90	1.2	HH	-	-	54.0	-15.2	P	
1215.0	46.2	24.6	-34.4	36.4	0	1.0	HH	-	-	54.0	-17.6	P	
1243.0	51.5	24.6	-34.3	41.8	0	1.0	VH	-	-	54.0	-12.2	P	
1244.0	45.5	24.6	-34.3	35.8	90	1.2	HH	-	-	54.0	-18.2	P	
2181.0	44.7	28.0	-32.8	39.9	0	1.0	VH	-	-	54.0	-14.1	P	
2215.0	43.3	28.2	-32.7	38.7	90	1.2	HH	-	-	54.0	-15.3	P	
3642.0	44.2	31.6	-31.2	44.6	0	1.0	VH	-	-	54.0	-9.4	P	
4750.0	45.3	32.8	-29.8	48.3	0	1.0	VH	-	-	54.0	-5.7	P	
5371.0	45.8	34.0	-29.5	50.3	0	1.0	VH	-	-	54.0	-3.7	P	
5765.0	36.3	34.4	-29.2	41.4	0	1.0	VH	-	-	54.0	-12.6	P	Fund
5799.0	36.2	34.4	-29.2	41.3	90	1.2	HH	-	-	54.0	-12.7	P	Fund
6857.0	44.0	35.0	-29.1	50.0	90	1.2	HH	-	-	54.0	-4.0	P	
11531.	37.7	39.1	-27.4	49.4	0	1.0	VH	-	-	54.0	-4.6	P	
11531.	36.0	39.2	-27.4	47.8	90	1.2	HH	-	-	54.0	-6.2	P	
17296.	30.5	42.9	-23.9	49.6	0	1.0	VH	-	-	54.0	-4.4	P	

No emission of significant level was observed above 17.3GHz thru 10GHz

### Test-Data Summary – Spurious, Harmonics, and Restricted Bands Measurements

#### The margin in Table 13 is calculated as follows:

Margin = Corrected Amplitude – Limit, where Corrected Amplitude = Spectrum Analyzer Amplitude + Cable Loss + Antenna Factor – Pre-Amp Gain.

### Conclusion

Volvo MMS Sensor meets the requirements of the test reference for Spurious and Restricted Bands emissions levels specified in the 47CFR15.209

## SPURIOUS and RESTRICTED BANDS Emissions (cont)

### Test Setup Photographs



Figure 8: Spurious emissions below 1 GHz (view 1)

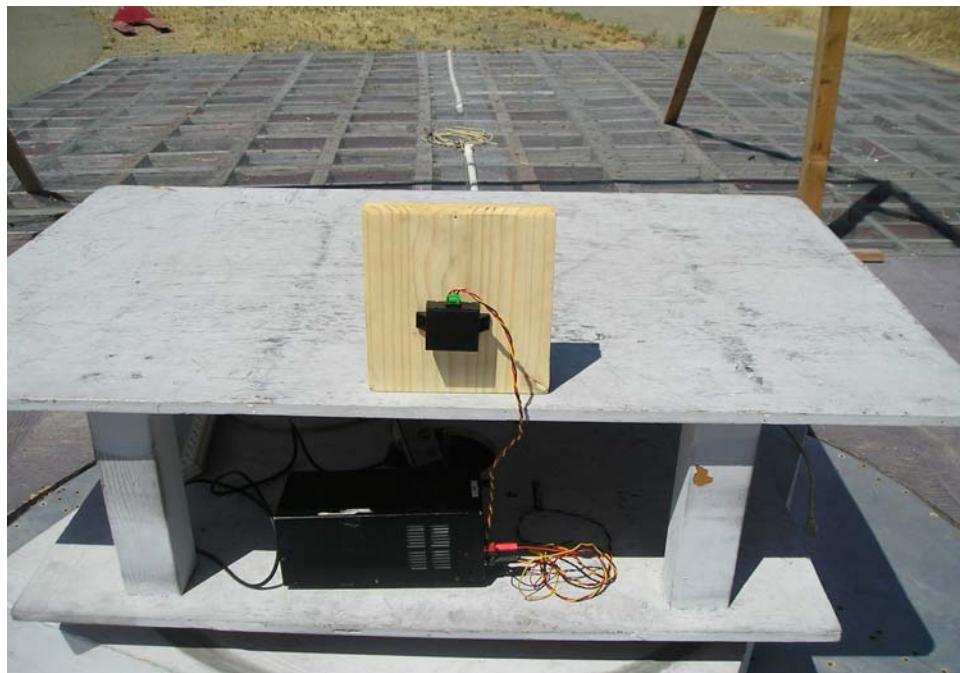
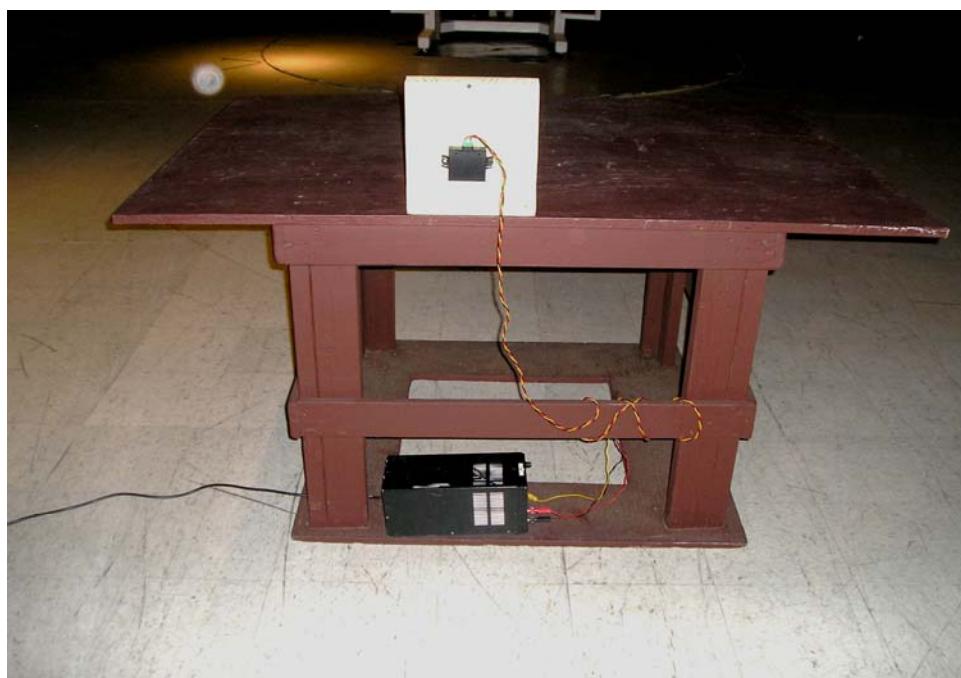


Figure 9: Spurious emissions below 1GHz (view 2)

**Spurious emissions (cont.)****Test Setup Photographs (cont.)****Figure 10: Spurious emissions above 1 GHz (view 1)****Figure 11: Spurious emissions above 1 GHz (view 2)**

**PART 4 APPENDICES****A. EUT Technical Specification**

Applicant	Connaught Electronics, Ltd.		
Product Specifications			
Description	Volvo MMS Sensor		
Frequency Range	5725MHz to 5875MHz		
Part Number(s)	CEL	902960 902961 902962	
Serial Number(s)	08010000eeddaadd Df000000eeddaadd 62010000eeddaadd		
Cable(s)	n/a		
Peak Output Power	42.3dB $\mu$ V		
Mainboard	Manufacturer	CEL	
	Part Number	171726 Rev 0005	
	Dimension	Approx. 65mm x 59mm	
	Connector(s)	One (1) 5-pin	
Power Supply(s)	DC Cell		
	Input	13.5Vdc/50mA	
	Output	n/a	

## B. EUT Photographs



Figure 12: EUT Front Unit (CEL Number 902960)



Figure 13: EUT Rear Unit (CEL Number 902961)



Figure 14: EUT Front Warranty Unit (CEL Number 902962)



Figure 15: EUTs Front View (902960 902961 & 902962)



Figure 16: EUT Internal View 1

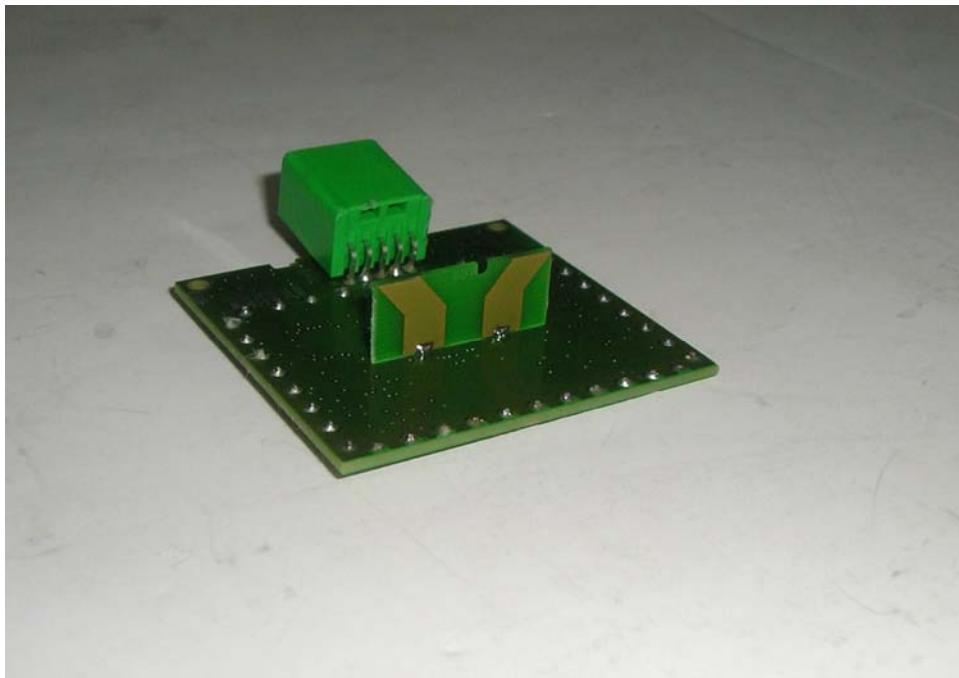


Figure 17: EUT Internal View 2

## C. Modification Letter

To Whom It May Concern:

This is to certify that no modifications were necessary for Volvo MMS Sensor, models 902960, 902961 and 902962 to comply with the required Requirements of:

FCC Rules and Regulations per 47 CFR 15.209

It is the manufacturer's responsibility to ensure that additional production units of Volvo MMS Sensor, models 902960, 902961 and 902962 are manufactured with identical electrical and mechanical characteristics. For further information, please contact the manufacturer at:

Connaught Electronics, Ltd.  
IDA Industrial Estate, Dunmore Road,  
Tuam, Co. Galway, Ireland

Tel: +353 932-5128  
Attention: Mr. Patrick Denny