



**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 MMD 5.8 GHz Microwave Sensor

[FCC ID: LQN2910]

[FCC ID: LQN2911]

Model and Part Number:

902910 (Volvo Part N0: 31110097)

902911 (Volvo Part No: 31110098)

Report No.

20050616-02-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

Web Site: www.itcemc.com



Lab Code: 200172-0

EN45001 Accredited Compliance Laboratory (RES-GmbH)
Registration number: TTI-P-G 159/98-00 (RES-GmbH)

Table of Contents

PART 1 General.....	5
Test Information.....	5
Tests Performed:	5
Declaration/Disclaimer	6
Test Methodology	7
Test Facility	7
PART 2 RECEIVER MEASUREMENTS	8
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
PART 3 RF MEASUREMENTS	14
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
Administrative Details – Occupied Bandwidth Measurements	18
Test Measurement: Occupied Bandwidth Measurements (Performed in Anechoic Chamber).....	18
Occupied Bandwidth Measurement Plot	19
Spectrum Mask Measurement.....	19
Occupied Bandwidth Data:	Error! Bookmark not defined.
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
PART 4 APPENDICES.....	26
A. EUT Technical Specification.....	26
B. EUT Photographs.....	27
C. Modification Letter	31

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 Support Equipment – Radiated Emissions Tests.....	14
Table 11 Data Table Legend and Field Strength Calculation – Radiated Emissions Tests.....	15
Table 12: Field Strength of Fundamental Test Data – Peak Measurement Error! Bookmark not defined.	
Table 13 Test Data – Spurious and Restricted Bands Emissions below 1GHz.....	22
Table 14 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 (front view).....	11
Figure 2: Open Field radiated Emissions Test Setup below 1GHz (rear view).....	11
Figure 3: Radiated Emissions Test Setup, above 1 GHz (front view).....	13
Figure 4: Radiated Emissions Test setup, above 1 GHz (rear view).....	13
Figure 5: Plot of Field Strength of Fundamental Peak Measurement.....	16
Figure 6: Occupied Bandwidth Plot.....	19
Figure 7 Test Set Up Photos – Field Strength of Fundamental Measurement (Front).....	20
Figure 8 Test Set Up Photos – Field Strength of Fundamental Measurement (Rear).....	20
Figure 9: Spurious emissions below 1 GHz (front view).....	24
Figure 10: Spurious emissions below 1GHz (rear view).....	24
Figure 11: Spurious emissions above 1 GHz (front view).....	25
Figure 12: Spurious emissions above 1 GHz (rear view).....	25
Figure 13: EUT Front Unit (Part Number 902910).....	27
Figure 14: EUT Rear Unit (Part Number 902911).....	27
Figure 15: EUTs Top View (902910 & 902911).....	28
Figure 16: EUTs Front View (902910 & 902911).....	28
Figure 17: EUTs Side View (902910 & 902911).....	29
Figure 18: EUT Internal View.....	29
Figure 19: EUT Component View.....	30
Figure 20: EUT Solder View.....	30

PART 1 General

Test Information

Product:	Volvo MMD, 5.8 GHz Microwave Sensor	
Model Number:	902910	
Model Number:	902911	
Manufacturer's Name	Connaught Electronics, LTD	
Manufacturer's Address	IDA Industrial Estate Dunmore Road, Tuam Co. Galway, Ireland	
Contact	Tel: + 011 353 (93) 25128 Mr. Patrick Denny	
		Fax : +011 353 (93) 25133 Email dennypatrick@cei.ie
Test Laboratory	ITC Engineering Services, Inc. 9959 Calaveras Road, PO Box 543 Sunol, CA 94586-0543 Email: itcemc@itcemc.com Web Site: http://www.itcemc.com	Tel: +1(925) 862-2944 Fax: +1(925) 862-9013
Test Number	20050616-02	
Report Number	20050616-02-Fc15	
Test Date(s) & Issue Date	July 07 – July 08, 2005	July 13, 2005
Test Engineer(s)	Lan Vu, Bob Kershaw, Femi Ojo	
Documentation	George W Brown II	
Test Results	☒ Complies as Tested	☐ Fail
Total Number of Pages	31	

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.

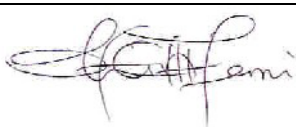
Tests Performed:

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,	Michael Gbadebo, P.E, Chief Engineer.
Compliance Engineer	(California License # 11303)

Prepared By: ITC Engineering Services, Inc.
9959 Calaveras Road, PO Box 543
Sunol, California 94586-0543
Tel: [925] 862-2944 Fax: [925] 862-9013
Email: docs@itcemc.com Web: www.itcemc.com

Product: Volvo MMD, 5.8 GHz Microwave Sensor
Model Number: 902910
Model Number: 902911
FCC ID: LQN2910
FCC ID: LQN2911

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	Volvo MMD, 5.8 GHz Microwave Sensor 902910 and 902911	
Applicant / Manufacturer Address	Connaught Electronics, Ltd. IDA Industrial Estate, Dunmore Road, Tuam, Co. Galway, Ireland	
Contact	Mr. Patrick Denny Tel: +011 353 93 25128	dennypatrick@cel.ie Fax: +011 353 93 25133
Total Number of Pages including Appendices	31 Pages	
Test Report File No.	20050616-02-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 5.8GHz microwave sensor, models; 902910 and 902911(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 902910) was tested and based on engineering judgment, the results hold for both models. The EUT was set up at 1, 3 or 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 5.8GHz Microwave 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
Preamplifier	Hewlett-Packard	8449B	3008A00101	N/A
Preselector	Hewlett-Packard	85685A	2620A00265	12-11-2005
Biconical Antenna	EMCO	3104	9111-4463	01-16-2006
I.p. Ant (200 -1000MHz)	EMCO	3146	2261	01-22-2006
Quasi Peak Adapter	Hewlett-Packard	85650A	2521A00737	12-11-2005
Spectrum Analyzer	Hewlett-Packard	8568B	2841A04315	12-11-2005
Spectrum Analyzer Display	Hewlett-Packard			12-11-2005
Horn. Ant (Below 18GHz)	EMCO	3115	8812-3050	01-19-2006
Horn. Ant (Below 40GHz)	HP	3116	4663	02-18-2006
Spectrum Analyzer	Hewlett-Packard	8569A	2128A00270	04-23-2006

Table 4 Support Equipment – Radiated Emissions Tests

Description	Manufacturer	Model No.	Serial No.	Calibration Due
DC Power Supply	BK Precision	1688		n/a
Digital Multimeter	Fluke	16	79510141	December 14, 2005

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 5.8 GHz Microwave Sensor (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, on the 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 18GHz, the EUT was set up at a 1 meter from the receiving 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)
 Ouasi-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 3104/sn. 4463 Biconical	30 – 200
VL	Vertical	EMCO 3146/sn. 2261 Log Periodic	200 – 1000
HL	Horizontal	EMCO 3146/sn. 2261 Log Periodic	200 – 1000
VH1	Vertical	EMCO 3115/sn. 8812-3050 Horn	Below 18000
HH1	Horizontal	EMCO 3115/sn. 8812-3050 Horn	Below 18000
VH2	Vertical	HP 3116/sn. 4663 Horn	Below 26500
HH2	Horizontal	HP 3116/sn. 4663 Horn	Below 26500
VH4	Vertical	S&D DBD-520 Horn	Below 75000
HH4	Horizontal	S&D DBD-520 Horn	Below 75000

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 & Environmental Details – Radiated Emissions Measurement

Test Date:	July 08, 2005
Test Engineer:	Bob Kershaw & Femi Ojo
Temperature	75.4°F
Humidity	37%

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
30.76	6.9	10.8	2.0	19.8	90	1.0	VB	-	-	30.0	-10.2	P	
33.48	7.5	10.9	1.8	20.2	90	1.0	VB	-	-	30.0	-9.8	P	
48.05	6.5	11.4	2.4	20.2	0	1.0	VB	-	-	30.0	-9.8	P	
58.89	5.2	10.3	2.6	18.2	90	2.0	HB	-	-	30.0	-11.8	P	
65.79	6.8	7.9	2.6	17.3	120	1.0	VB	-	-	30.0	-12.7	P	
118.14	4.4	12.9	3.2	20.5	90	2.0	HB	-	-	33.0	-12.5	P	
120.06	4.5	13.0	3.2	20.7	90	1.0	VB	-	-	33.0	-12.3	P	
132.76	5.7	12.5	3.4	21.6	90	1.0	VB	-	-	33.0	-11.4	P	
200.07	5.4	11.7	3.9	21.0	90	3.0	HL	-	-	33.0	-12.0	P	
200.08	3.5	12.1	3.9	19.5	90	1.0	VL	-	-	33.0	-13.5	P	
220.61	7.2	11.1	3.8	22.1	0	1.0	VL	-	-	36.0	-13.9	P	
233.21	4.3	11.0	4.2	19.5	0	1.0	VL	-	-	36.0	-16.5	P	
271.85	4.5	12.7	6.5	23.7	90	2.0	HL	-	-	36.0	-12.3	P	
331.35	3.2	14.4	6.3	23.9	90	1.0	VL	-	-	36.0	-12.1	P	
408.39	5.7	15.7	6.2	27.6	90	1.0	VL	-	-	36.0	-8.4	P	
460.61	3.9	17.2	7.7	28.8	120	1.0	VL	-	-	36.0	-7.2	P	
530.12	3.3	16.8	8.2	28.3	0	2.0	HL	-	-	36.0	-7.7	P	
530.87	4.1	18.2	8.2	30.5	0	1.0	VL	-	-	36.0	-5.5	P	
573.29	4.9	17.5	8.5	30.9	0	1.0	VL	-	-	36.0	-5.1	P	
585.29	3.5	18.2	8.5	30.2	0	1.0	VL	-	-	36.0	-5.8	P	

No emission of significant level was observed above 585.29MHz Thru 1GHz

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 (front view)

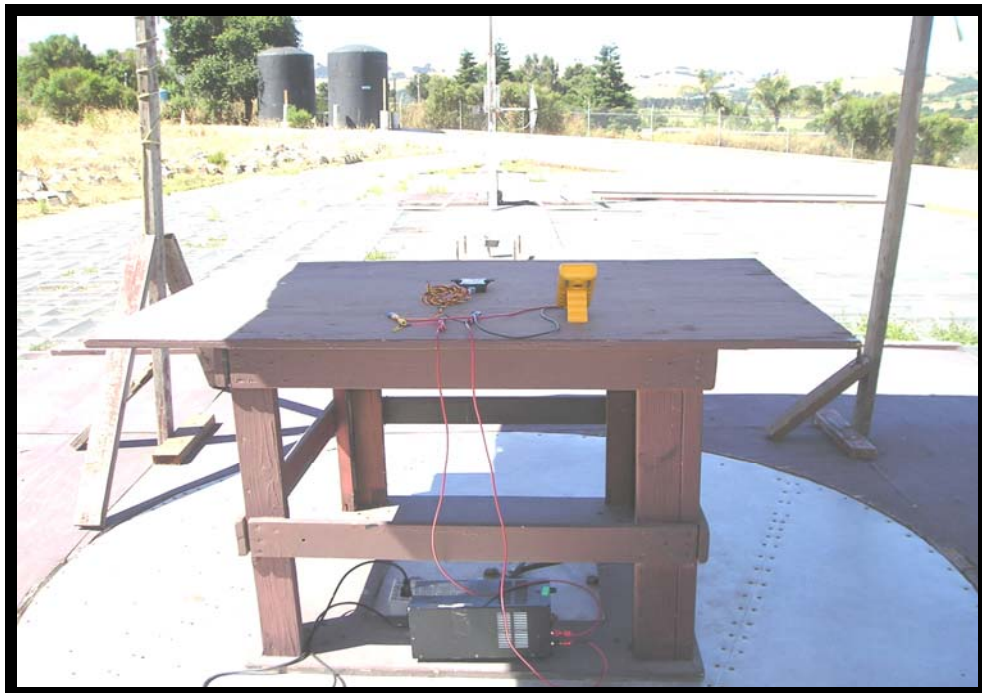


Figure 2: Open Field radiated Emissions Test Setup below 1GHz (rear view)

OPEN FIELD RADIATED EMISSIONS Results (cont.)

Administrative and Environmental Details– Radiated Emissions Measurement

Test Date:	July 08, 2005
Test Engineer:	Bob Kershaw & Femi Ojo
Temperature	75.4°F
Humidity	37%

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		CORRECTION		CORR	TURNABLE ANT			CLASS A		CLASS B		FILTER	
FREQ	AMPL	ANT	CAB	AMPL	ANG	HT	POL	AMPL	MARG	AMPL	MARG	MODE	NOTES
MHz	dBuV/m	dB	dB	dBuV/m	DEG	m	-	dBuV/m	dB	dBuV/m	db		
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	56.2	34.4	-29.2	61.4	90	1.2	HH	-	-	141.0	-79.6	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 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 MMD, 5.8 GHz Microwave 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 (front view)

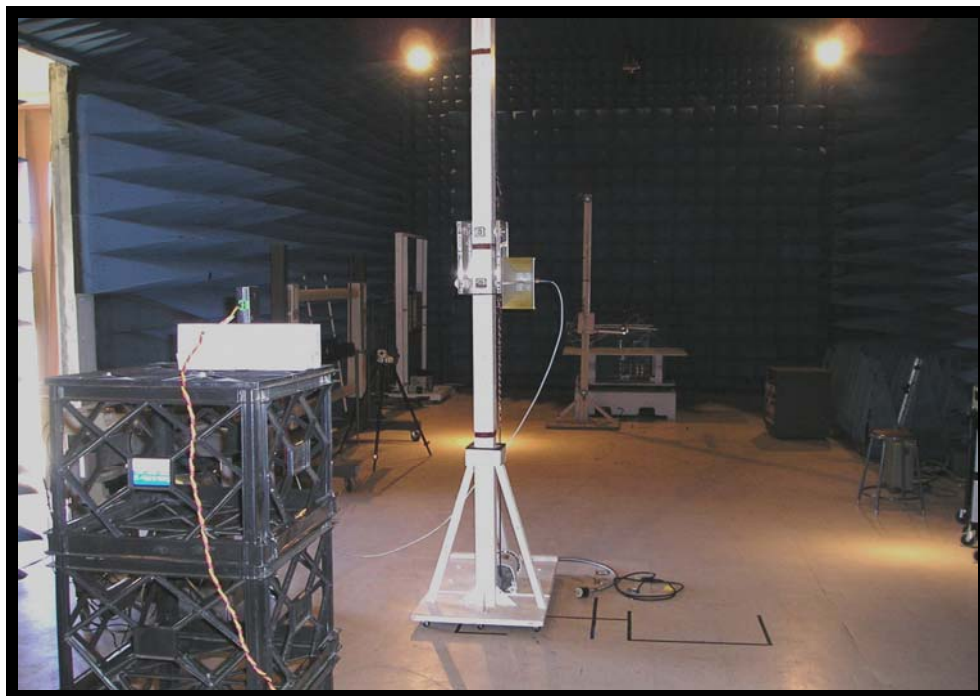


Figure 4: Radiated Emissions Test setup, above 1 GHz (rear view)

PART 3 RF MEASUREMENTS

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

EUT Description / Test Specification.

Connaught's product 5.8GHz microwave sensor, models; 902910 and 902911(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 902910) was tested and based on engineering judgment, the results hold for both 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 and or on an open field. 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		n/a
Digital Multimeter	Fluke	16	79510141	December 14, 2005

Table 9: Test Equipment – RF Measurements

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due
Preamplifier	Hewlett-Packard	8449B	3008A00101	N/A
Preselector	Hewlett-Packard	85685A	2620A00265	12-11-2005
Biconical Antenna	EMCO	3104	9111-4463	01-16-2006
I.p. Ant (200 -1000MHz)	EMCO	3146	2261	01-22-2006
Quasi Peak Adapter	Hewlett-Packard	85650A	2521A00737	12-11-2005
Spectrum Analyzer	Hewlett-Packard	8568B	2841A04315	12-11-2005
Spectrum Analyzer Display	Hewlett-Packard	-	-	12-11-2005
Horn. Ant (Below 18GHz)	EMCO	3115	8812-3050	01-19-2006
Horn. Ant (Below 40GHz)	HP	3116	4663	02-18-2006
Spectrum Analyzer	Hewlett-Packard	8569A	2128A00270	04-23-2006

Table 10 Support Equipment – Radiated Emissions Tests

Description	Manufacturer	Model No.	Serial No.	Calibration Due
DC Power Supply	BK Precision	1688		n/a
Digital Multimeter	Fluke	16	79510141	December 14, 2005

General Test Procedure – RF Tests

For the spurious and harmonics measurements, below 18GHz, the 5.8 GHz Microwave Sensor (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 18GHz, the EUT was set up at a 1 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.

Prepared By: ITC Engineering Services, Inc.
9959 Calaveras Road, PO Box 543
Sunol, California 94586-0543
Tel: [925] 862-2944 Fax: [925] 862-9013
Email: docs@itcenc.com Web: www.itcenc.com

Product: Volvo MMD, 5.8 GHz Microwave Sensor
Model Number:902910
Model Number:902911
FCC ID:LQN2910
FCC ID:LQN2911

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 11 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 3104/sn 4463 Biconical	30 – 200
VL	Vertical	EMCO 3146/sn. 2261 Log Periodic	200 – 1000
HL	Horizontal	EMCO 3146/sn. 2261 Log Periodic	200 – 1000
VH1	Vertical	EMCO 3115/sn. 8812-3050 Horn	Below 18000
HH1	Horizontal	EMCO 3115/sn. 8812-3050 Horn	Below 18000
VH2	Vertical	HP 3116/sn. 4663 Horn	Below 26500
HH2	Horizontal	HP 3116/sn. 4663 Horn	Below 26500
VH4	Vertical	S&D DBD-520 Horn	Below 75000
HH4	Horizontal	S&D DBD-520 Horn	Below 75000

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):	July 07 , 2005
Test Engineer(s):	Bob Kershaw & Femi Ojo
Temperature	71°F
Humidity	42%

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.

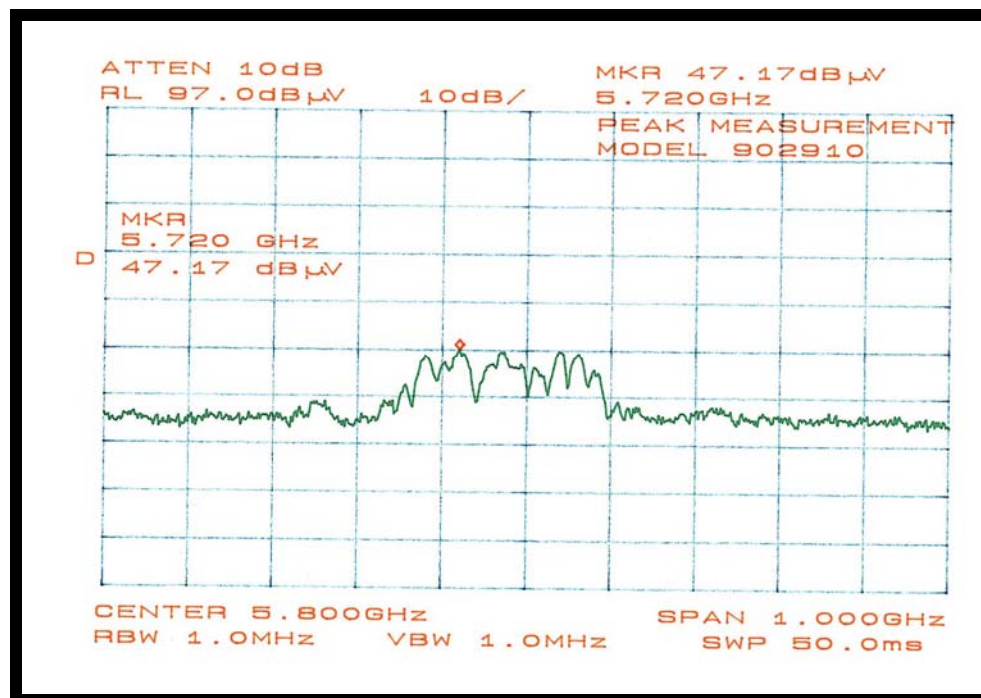


Figure 5: Plot of Field Strength of Fundamental Peak Measurement.

FIELD STRENGTH OF FUNDAMENTAL (cont.)

INDICATED		CORRECTION		CORR	TURNTABLE ANT			CLASS A		CLASS B		
FREQ	AMPL	ANT	CAB / AMP	AMPL	ANG	HT	POL	AMPL	MARG	AMPL	MARG	DET
GHz	dBuV/m	dB	dB	dBuV/m	DEG	m	-	dBuV/m	dB	dBuV/m	dB	MODE
5.720	47.2	34.3	-29.3	52.2	90	1.0	VH	-	-	74	-21.8	p
5.723	45.7	34.3	-29.3	50.7	0	1.0	HH	-	-	74	-23.3	p

Table 12: Field Strength of Fundamental Test Data – Peak Measurement

The margin in Table 12 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: = 52.2dBμV/m
Peak Limit (15.209) = 74.00dBμV/m (54dBμV/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.

dB (in μV) Duty Cycle Correction	= 0.0083 secs	= 20log(0.0083)	= -41.62dBμV
Pulse Desensitization Factor (PDF)	= -40dB		
Peak Level with PDF	= 52.2 dBμV/m + 40dB		= 92.2dBμV/m
Peak Level with Duty Cycle Correction	= 92.2dBμV/m – 41.62dB		= 50.58dBμV/m

Test-Data Summary – Average Measurement:

Center Frequency = 5800 MHz
Average Level: = 50.58dBμV/m (Calculated).
Average Limit (15.209) = 54.00dBμV/m

Conclusion

The 5.8 GHz Microwave Sensor meets the requirements of the test reference for Fundamental Frequency Field Strength.

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: _____

Administrative Details – Occupied Bandwidth Measurements

Test Date(s):	July 07 , 2005
Test Engineer(s):	Bob Kershaw & Femi Ojo
Temperature	71°F
Humidity	42%

Test Measurement: Occupied Bandwidth Measurements (Performed in Anechoic Chamber)

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

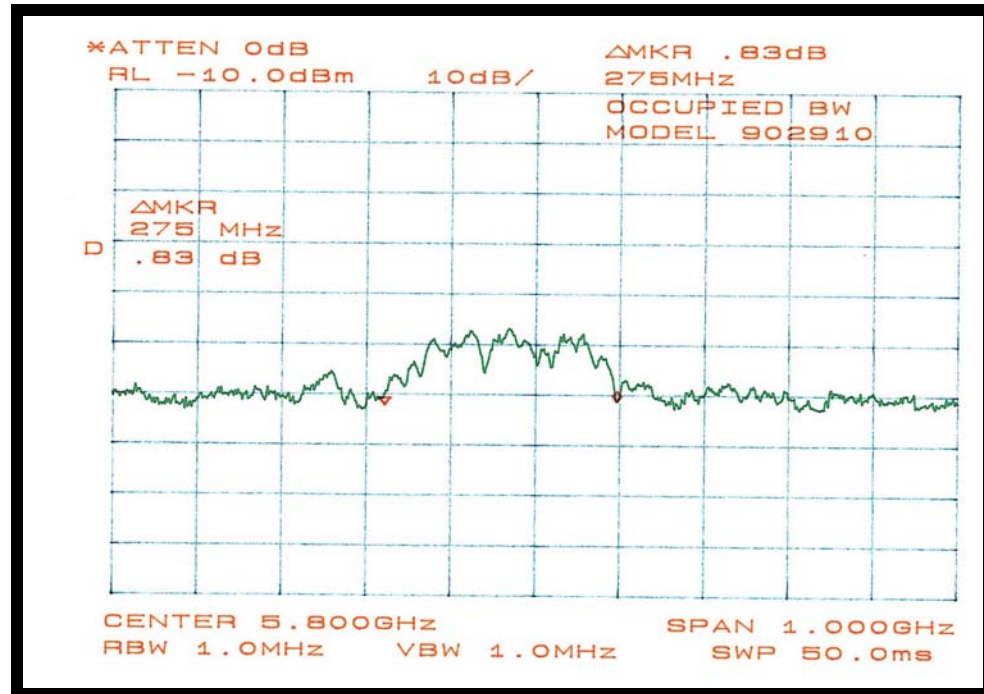


Figure 6: Occupied Bandwidth Plot

Test-Data Summary – Occupied Bandwidth:

Center frequency: 5800 MHz
Mask Bandwidth: 275 MHz

Occupied Bandwidth Data:

Upper Frequency (F_u)	$=f_0 + 275/2$	$=5800 \text{ MHz} + 137.5$	$=5937.5 \text{ MHz}$
Lower Frequency (f_L)	$=f_0 - 275/2$	$=5800 \text{ MHz} - 137.5$	$=5662.5 \text{ MHz}$

FIELD STRENGTH OF FUNDAMENTAL (cont.)

Measurement Photographs for Field Strength of Fundamental and Occupied Bandwidth

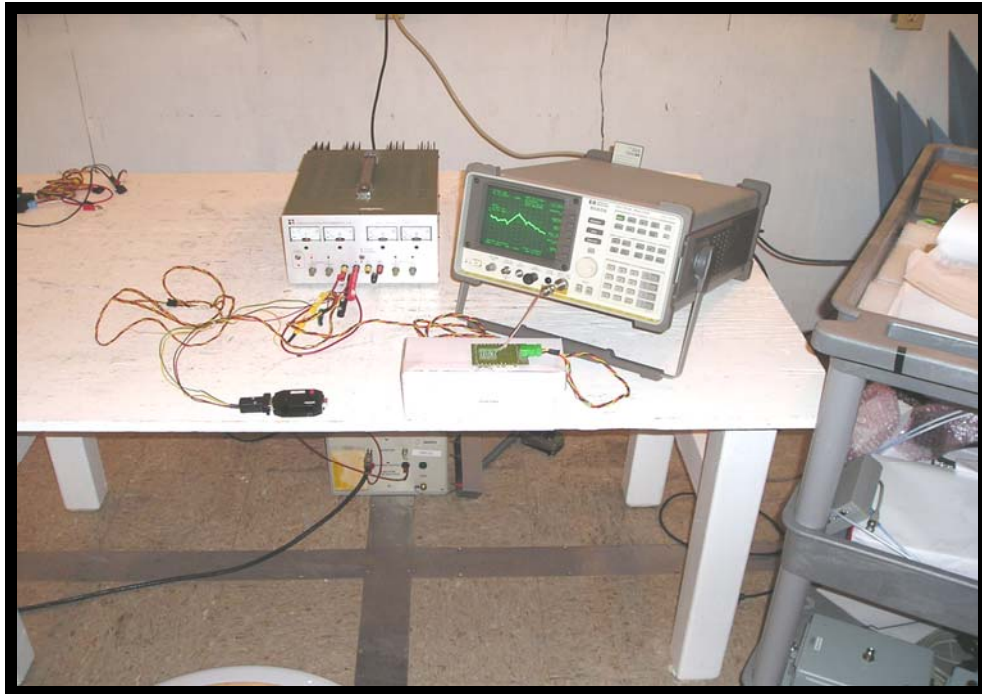


Figure 7 Test Set Up Photos – Field Strength of Fundamental Measurement (Front)



Figure 8 Test Set Up Photos – Field Strength of Fundamental Measurement (Rear)

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

Test Date:	July 08, 2005
Test Engineer:	Bob Kershaw & Femi Ojo
Temperature	75.4°F
Humidity	37%

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 (a)

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

Table 13 Test Data – Spurious and Restricted Bands Emissions below 1GHz

INDICATED		CORRECTION		CORR	TURNTABLE ANT			CLASS A		CLASS B		FILTER	
FREQ	AMPL	ANT	CAB	AMPL	ANG	HT	POL	AMPL	MARG	AMPL	MARG	MODE	NOTES
MHz	dBuV/m	dB	dB	dBuV/m	DEG	m	-	dBuV/m	dB	dBuV/m	db		
30.76	6.9	10.8	2.0	19.8	90	1.0	VB	-	-	30.0	-10.2	P	
33.48	7.5	10.9	1.8	20.2	90	1.0	VB	-	-	30.0	-9.8	P	
48.05	6.5	11.4	2.4	20.2	0	1.0	VB	-	-	30.0	-9.8	P	
58.89	5.2	10.3	2.6	18.2	90	2.0	HB	-	-	30.0	-11.8	P	
65.79	6.8	7.9	2.6	17.3	120	1.0	VB	-	-	30.0	-12.7	P	
118.14	4.4	12.9	3.2	20.5	90	2.0	HB	-	-	33.0	-12.5	P	
120.06	4.5	13.0	3.2	20.7	90	1.0	VB	-	-	33.0	-12.3	P	
132.76	5.7	12.5	3.4	21.6	90	1.0	VB	-	-	33.0	-11.4	P	
200.07	5.4	11.7	3.9	21.0	90	3.0	HL	-	-	33.0	-12.0	P	
200.08	3.5	12.1	3.9	19.5	90	1.0	VL	-	-	33.0	-13.5	P	
220.61	7.2	11.1	3.8	22.1	0	1.0	VL	-	-	36.0	-13.9	P	
233.21	4.3	11.0	4.2	19.5	0	1.0	VL	-	-	36.0	-16.5	P	
271.85	4.5	12.7	6.5	23.7	90	2.0	HL	-	-	36.0	-12.3	P	
331.35	3.2	14.4	6.3	23.9	90	1.0	VL	-	-	36.0	-12.1	P	
408.39	5.7	15.7	6.2	27.6	90	1.0	VL	-	-	36.0	-8.4	P	
460.61	3.9	17.2	7.7	28.8	120	1.0	VL	-	-	36.0	-7.2	P	
530.12	3.3	16.8	8.2	28.3	0	2.0	HL	-	-	36.0	-7.7	P	
530.87	4.1	18.2	8.2	30.5	0	1.0	VL	-	-	36.0	-5.5	P	
573.29	4.9	17.5	8.5	30.9	0	1.0	VL	-	-	36.0	-5.1	P	
585.29	3.5	18.2	8.5	30.2	0	1.0	VL	-	-	36.0	-5.8	P	

No emission of significant level was observed above 585.29MHz Thru 1GHz

Table 14 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	
5799.0	56.2	34.4	-29.2	61.4	90	1.2	HH	-	-	141.0	-79.6	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 14 is calculated as follows:

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

Conclusion

The Volvo MMD 5.8 GHz Microwave 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

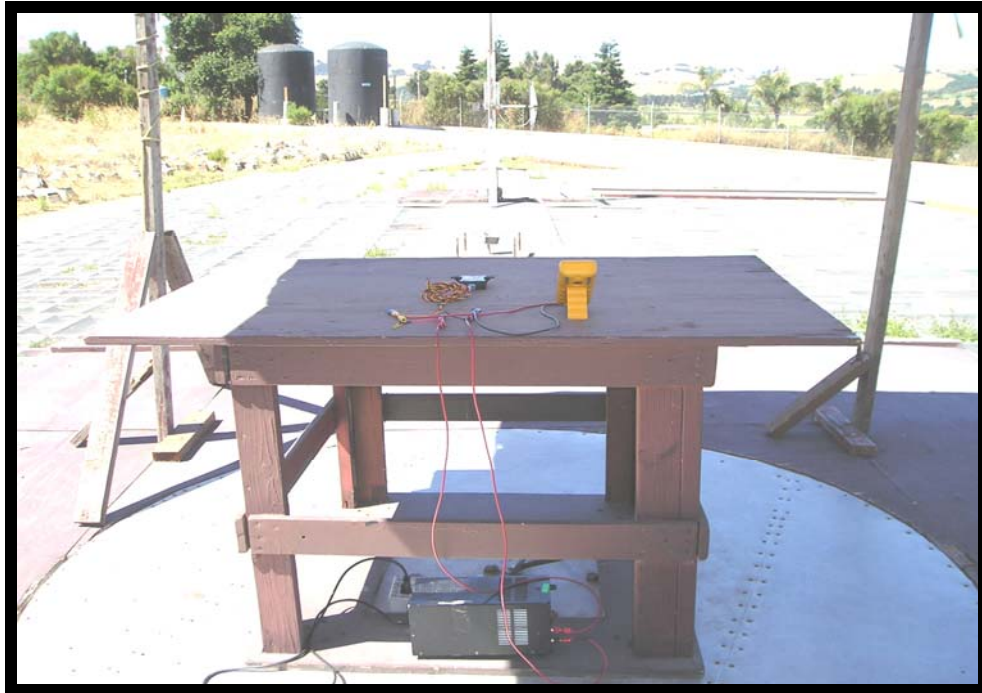


Figure 9: Spurious emissions below 1 GHz (front view)

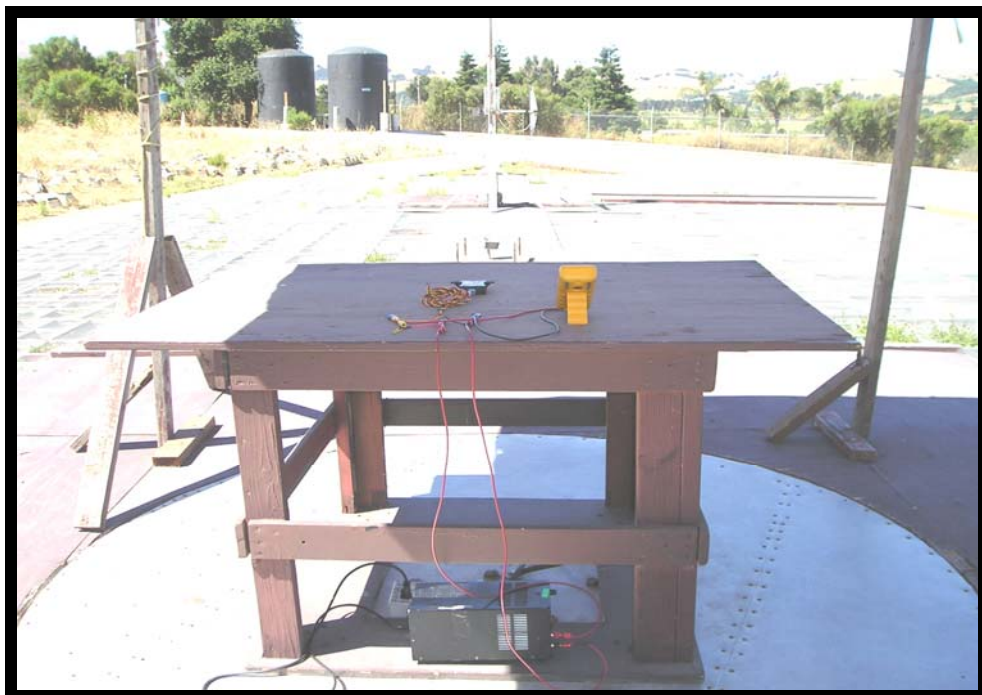


Figure 10: Spurious emissions below 1GHz (rear view)

Prepared By: ITC Engineering Services, Inc.
 9959 Calaveras Road, PO Box 543
 Sunol, California 94586-0543
 Tel: [925] 862-2944 Fax: [925] 862-9013
 Email: docs@itcenc.com Web: www.itcenc.com

Product: Volvo MMD, 5.8 GHz Microwave Sensor
 Model Number:902910
 Model Number:902911
 FCC ID:LQN2910
 FCC ID:LQN2911

Spurious emissions (cont.)

Test Setup Photographs (cont.)



Figure 11: Spurious emissions above 1 GHz (front view)

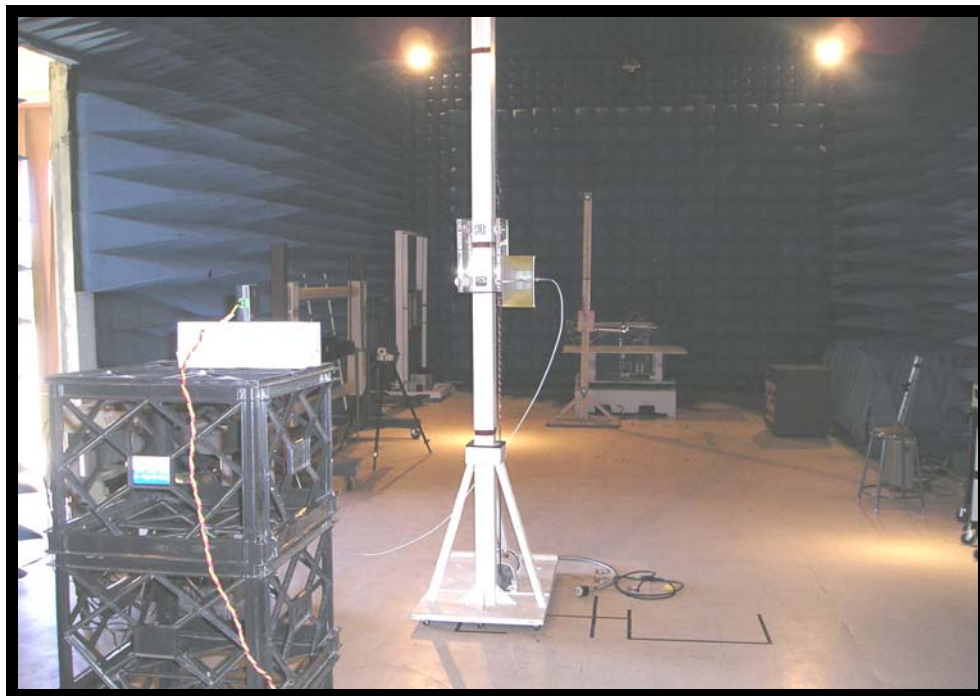


Figure 12: Spurious emissions above 1 GHz (rear view)

PART 4 APPENDICES

A. EUT Technical Specification

Applicant	Connaught Electronics, Ltd.			
Product Specifications				
Description	Volvo MMD 5.8GHz Microwave Sensor			
	Frequency Range	5631.5 MHz to 5968.5 MHz		
	Part Number(s)	CEL	902910 902911	
	Serial Number(s)	84100000000000ee 42100000000000ee		
	Central Processor	16LF876A – 1/SS.		
	Cable(s)	n/a		
	Peak Output Power	-37.27dBm		
	Mainboard	Manufacturer	CEL	
		Part Number	17174 Rev 1.4	
		Dimension	Approx. 65mm x 59mm	
		Connector(s)	One (1) 5-pin, p/n. 4-1393472-9	
	Antenna Board	Manufacturer	CEL	
		Model	CTX/R 0509	
		Part Number	516299	
		Dimension	Approx. 23mm x 10mm	
		Layers	2-sided	
		Antenna	Two (2) 10mm Dual loop, 1mm traces	
	Ports	One (1) 4-pin		
Power Supply(s)	DC Cell			
	Input	13.5Vdc/50mA		
	Output	n/a		

B. EUT Photographs



Figure 13: EUT Front Unit (Part Number 902910)



Figure 14: EUT Rear Unit (Part Number 902911)



Figure 15: EUTs Top View (902910 & 902911)



Figure 16: EUTs Front View (902910 & 902911)



Figure 17: EUTs Side View (902910 & 902911)



Figure 18: EUT Internal View

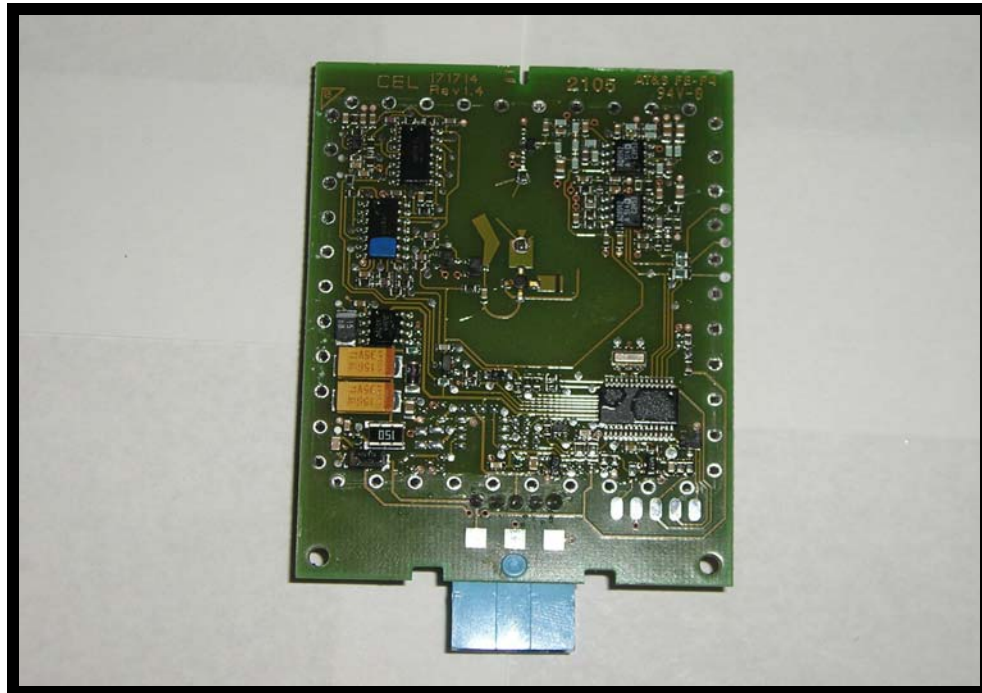


Figure 19: EUT Component View

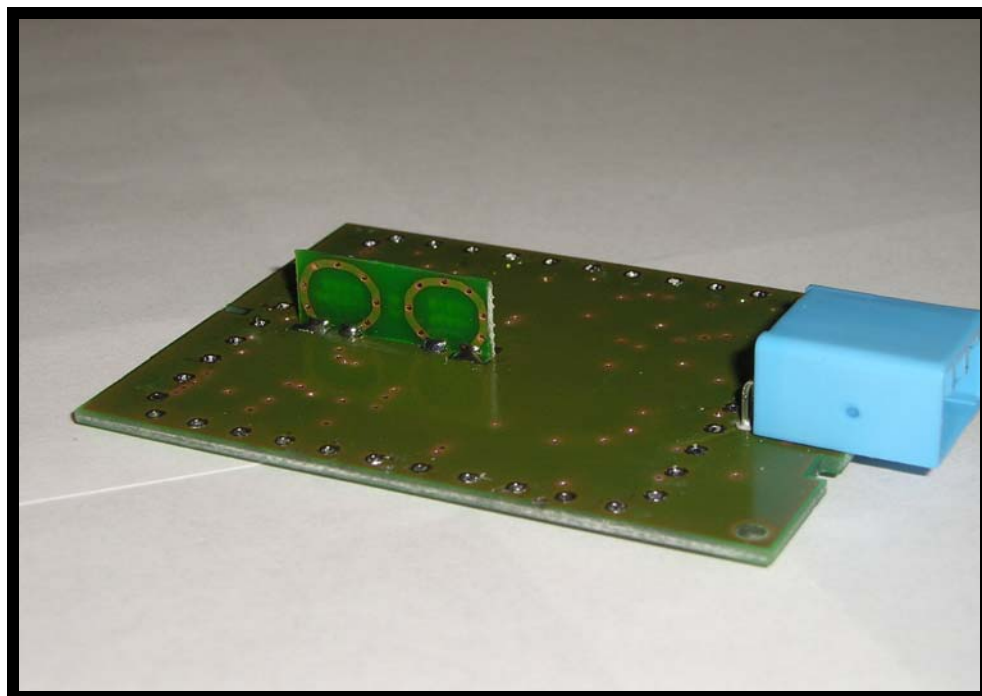


Figure 20: EUT Solder View.

C. Modification Letter

To Whom It May Concern:

This is to certify that no modifications were necessary for Volvo MMD 5.8GHz Microwave Sensor, models 902910 and 902911 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 the 5.8GHz Microwave Sensor, models 902910 and 902911 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. Joe Danaher