FCC Certification Test Report

FCC Certification Test Report
for
Johnson Controls Automotive Electronics
FCC ID: QI8MW1014

August 30, 2002

Prepared for:

JOHNSON CONTROLS Automotive Electronics
18 Chaussée Jules César 95520 OSNY
FRANCE

Prepared By:

Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879

FCC Certification Test Program

FCC Certification Test Report
for the
Johnson Controls Automotive
Immobilizer
FCC ID: QI8MW1014

WLL JOB# 7170

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Abstract

This report has been prepared on behalf of Johnson Controls Automotive to support the attached Application for Equipment Authorization. The test report and application are submitted for an Intentional Radiator under Part 15.209 of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for a Johnson Controls Automotive Immobilizer.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The Johnson Controls Automotive Immobilizer complies with the limits for an Intentional Radiator device under Part 15.209 of the FCC Rules and Regulations.

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1 Introduction

1.1 Compliance Statement

The Johnson Controls Automotive Immobilizer complies with the limits for an Intentional Radiator device under Part 15.209 of the FCC Rules and Regulations.

1.2 Test Scope

Tests for radiated emissions were performed. All measurements were performed according to the 1992 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Johnson Controls Automotive 18 Chaussée Jules César 95520 OSNY FRANCE
Quotation Number:	59840

1.4 Test Dates

Testing was performed on July 15, 2002.

1.5 Test and Support Personnel

Washington Laboratories, LTD	Ken Gemmel, Ta Thuan

Abbreviations

A	Ampere
Ac	alternating current
AM	Amplitude Modulation
Amps	Amperes
b/s	bits per second
BW	Bandwidth
CE	Conducted Emission
cm	centimeter
CW	Continuous Wave
dB	decibel
dc	direct current
EMI	Electromagnetic Interference
EUT	Equipment Under Test
FM	Frequency Modulation
G	giga - prefix for 10^9 multiplier
Hz	Hertz
IF	Intermediate Frequency
k	kilo - prefix for 10^3 multiplier
M	Mega - prefix for 10^6 multiplier
m	Meter
μ	micro - prefix for 10^{-6} multiplier
NB	Narrowband
LISN	Line Impedance Stabilization Network
RE	Radiated Emissions
RF	Radio Frequency
rms	root-mean-square
SN	Serial Number
S/A	Spectrum Analyzer
V	Volt

2 Equipment Under Test

2.1 EUT Identification & Description

The EUT is an inductive immobilizer theft protection device for automotive applications. The EUT emits a 125 kHz signal that is picked up by the ignition key for the automobile. The RF signal provides an excitation signal to the key, which responds with a coded response. If the response is correct, the vehicle's computer allows the ignition to operate.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Johnson Controls Automotive
FCC ID Number	QI8MW1014
EUT Name:	Immobilizer
Model:	MW1014
FCC Rule Parts:	§15.209
Frequency Range:	125.27 kHz
Occupied Bandwidth:	18.08 kHz
Keying:	Manual
Type of Information:	Control
Number of Channels:	1
Power Output Level	Fixed
Antenna Type	Imbedded
Interface Cables:	None
Power Source & Voltage:	12Vdc from vehicle battery

2.2 Test Configuration

The EUT was setup as shown in the following diagram and installed on the test site. The following figure shows the Test Setup diagram.

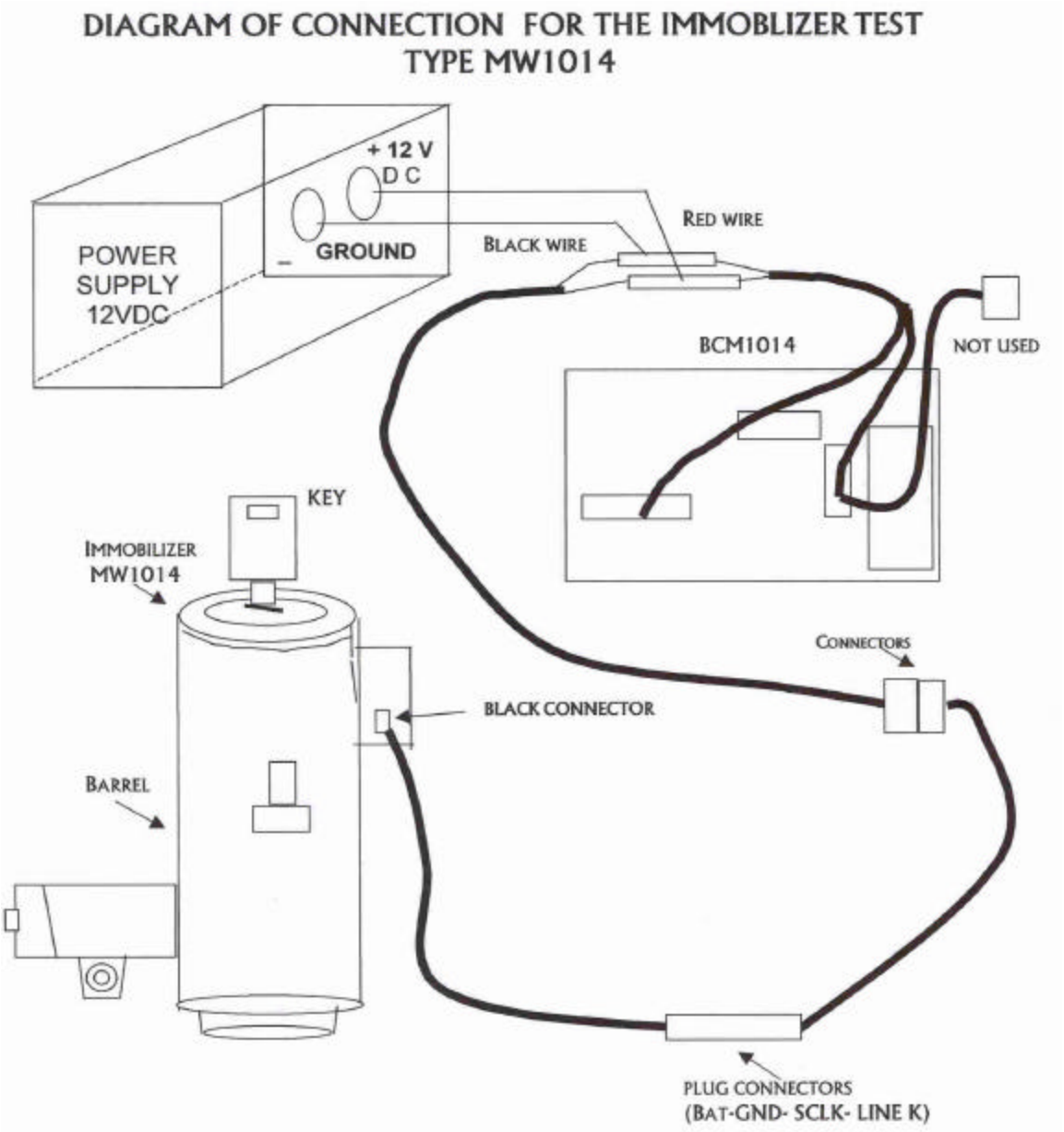

Figure 1. Test Setup Diagram

2.3 Testing Algorithm

The EUT was provided with the 12 Vdc and powered on for continuous transmission and modulated by the transponder in the key.

Worst-case emission levels are provided in the test results data.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file

with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

Land Mobile FM or PM Communications Equipment Measurement and Performance Standards (ANSI/TIA/EIA-603-93)

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.

3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

Table 2: Test Equipment List

Equipment	Serial Number	Date Calibrated	Calibration Due
EMCO 6502 Active Loop Antenna	8903-2333	8/21/01	8/21/02
ARA LPB-2520A Biconilog Antenna	1118	6/19/02	6/19/03
Hewlett-Packard Spectrum Analyzer: HP 8568B (Site 1)	2928A04750	7/02/02	7/02/03
Hewlett-Packard Quasi-Peak Adapter: HP 85650A (Site 1)	3303A01786	7/05/02	7/05/03
Hewlett-Packard RF Preselector: HP 85685A (Site 1)	3146A01296	7/02/02	7/02/03

4 Test Results

4.1 Occupied Bandwidth:

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer.

The occupied bandwidth was measured as shown in Figure 2:

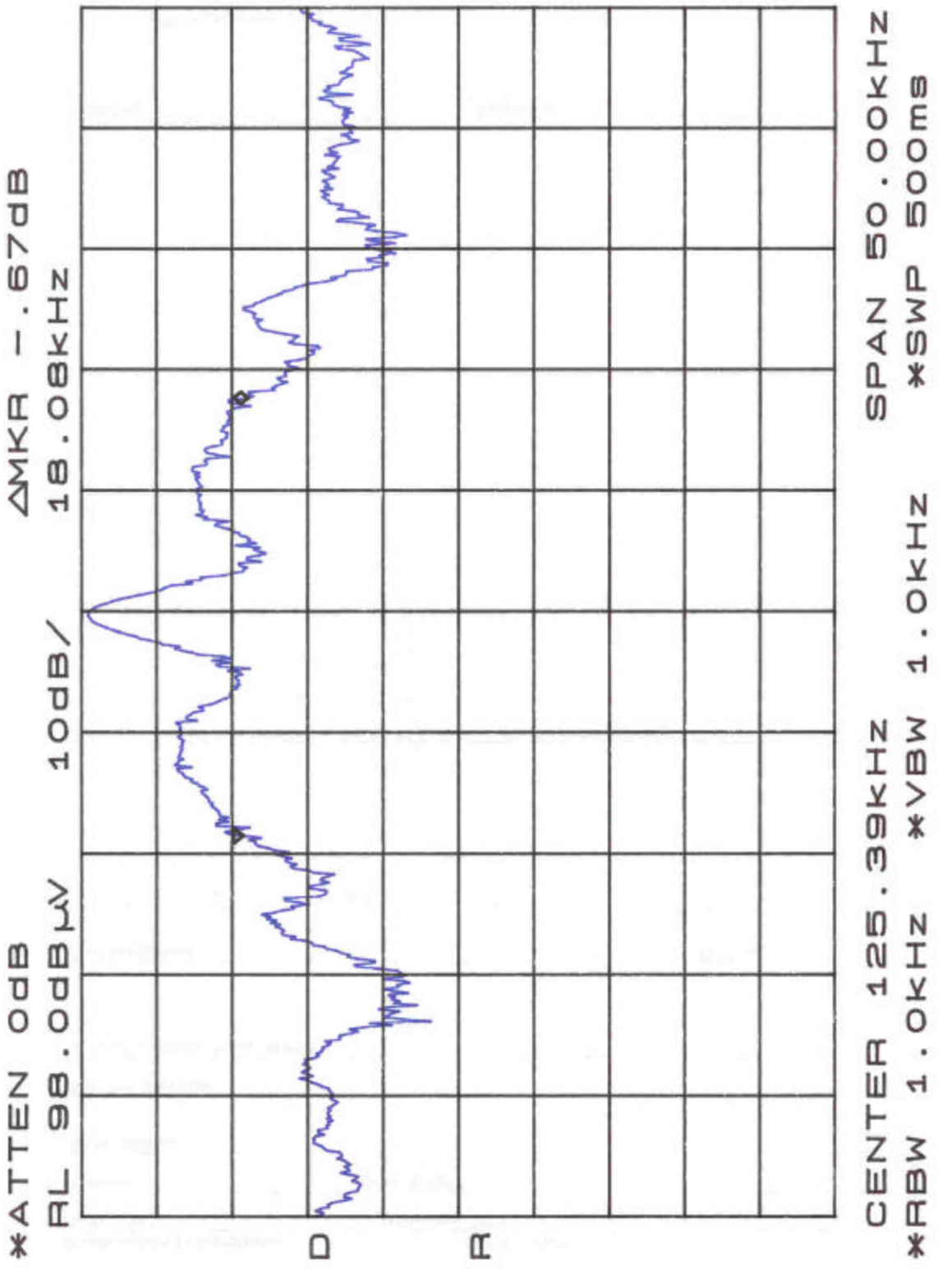

Figure 2. Occupied Bandwidth

4.2 Radiated Spurious Emissions:

The EUT must comply with requirements for radiated spurious emissions. The limits are as shown in the following table.

Table 3. Radiated Spurious Emissions Limits

Compliance Standard: FCC Part 15.209

Compliance Limits		
Frequency (MHz)	Limit (uV/m)	Test Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 - 30	30	30
30 - 88	100	3
88 – 216	150	3
216 – 960	200	3
> 960	500	3

4.2.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters.

Emissions measurements were performed at 3 meters. The correction factor from 300m was determined to be 40 dB decade after a measurement was performed at 3 and 10 meters with the following results:

Frequency	**Test Distance (m)**	**Emission Level (dBuV) Spectrum Analyzer**
0.125	3	68.4
0.125	10	41.9

The difference in the readings is 26.5 dB. This justifies the distance correction factor of 40 dB/decade, which is applied in the data table as “Distance Correction Factor”.

The peak emissions data are presented in Table 3.

Table 3. Radiated Emission Test Data

CLIENT: Johnson Controls
MODEL NO: MW1014
TYPE/PART: 15.209
DATE: July 15, 2002
BY: Ken Gemmel
JOB #: 7170

Tx Frequency: 125 kHz

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level Peak (dBuV)	AF (dB/m)	Distance Correction (dB)	E-Field (dBuV/m)	E-Field (uV/m)	Limit (uV/m)	Margin dB	Notes
0.125	Y	180.0	1.0	68.4	10.6	-80.0	-1.00	0.8913	19.2	-26.7	
0.250	Y	0.0	1.0	31.3	10.3	-80.0	-38.36	0.0121	9.6	-58.0	AMB
0.375	Y	180.0	1.0	32.3	10.4	-80.0	-37.32	0.0136	6.4	-53.4	
0.500	Y	0.0	1.0	25.4	10.4	-40.0	-4.20	0.6166	48.0	-37.8	AMB
0.625	Y	0.0	1.0	27.6	10.4	-40.0	-2.00	0.7943	38.4	-29.7	AMB
0.750	Y	0.0	1.0	37.1	10.4	-40.0	7.50	2.3714	32.0	-22.6	AMB
0.875	Y	0.0	1.0	17.1	10.4	-40.0	-12.50	0.2371	27.4	-41.3	AMB
1.000	Y	0.0	1.0	27.1	10.4	-40.0	-2.50	0.7499	24.0	-30.1	AMB
1.125	Y	0.0	1.0	45.7	10.4	-40.0	16.08	6.3701	21.3	-10.5	AMB
10 Meter											
0.125	Y	180.0	1.0	41.9	10.6	-60.0	-7.50	0.4216	19.2	-33.2	Reference
0.125	X	180.0	1.0	62.1	10.6	-80.0	-7.30	0.4315	19.2	-33.0	
0.250	X	0.0	1.0	29.9	10.3	-80.0	-39.76	0.0103	9.6	-59.4	AMB
0.375	X	0.0	1.0	28.4	10.4	-80.0	-41.22	0.0087	6.4	-57.3	AMB
0.500	X	0.0	1.0	26.0	10.4	-40.0	-3.60	0.6607	48.0	-37.2	AMB
0.625	X	0.0	1.0	24.1	10.4	-40.0	-5.50	0.5309	38.4	-37.2	AMB
0.750	X	0.0	1.0	24.5	10.4	-40.0	-5.10	0.5559	32.0	-35.2	AMB
0.875	X	0.0	1.0	24.2	10.4	-40.0	-5.40	0.5370	27.4	-34.2	AMB
1.000	X	0.0	1.0	20.4	10.4	-40.0	-9.20	0.3467	24.0	-36.8	AMB
1.125	X	0.0	1.0	31.3	10.4	-40.0	1.68	1.2138	21.3	-24.9	AMB
0.125	Z	225.0	1.0	63.2	10.6	-80.0	-6.20	0.4897	19.2	-31.9	
0.250	Z	0.0	1.0	32.8	10.3	-80.0	-36.86	0.0144	9.6	-56.5	AMB
0.375	Z	0.0	1.0	30.3	10.4	-80.0	-39.32	0.0108	6.4	-55.4	AMB
0.500	Z	0.0	1.0	25.6	10.4	-40.0	-4.00	0.6310	48.0	-37.6	AMB
0.625	Z	0.0	1.0	39.7	10.4	-40.0	10.10	3.1989	38.4	-21.6	AMB
0.750	Z	0.0	1.0	40.1	10.4	-40.0	10.50	3.3497	32.0	-19.6	AMB
0.875	Z	0.0	1.0	20.1	10.4	-40.0	-9.50	0.3350	27.4	-38.3	AMB
1.000	Z	0.0	1.0	18.9	10.4	-40.0	-10.70	0.2917	24.0	-38.3	AMB
1.125	Z	0.0	1.0	22.6	10.4	-40.0	-7.02	0.4458	21.3	-33.6	AMB

5 Appendix 1 – Test Configuration Photographs

Figure 3. Radiated Emissions Test Setup, Front

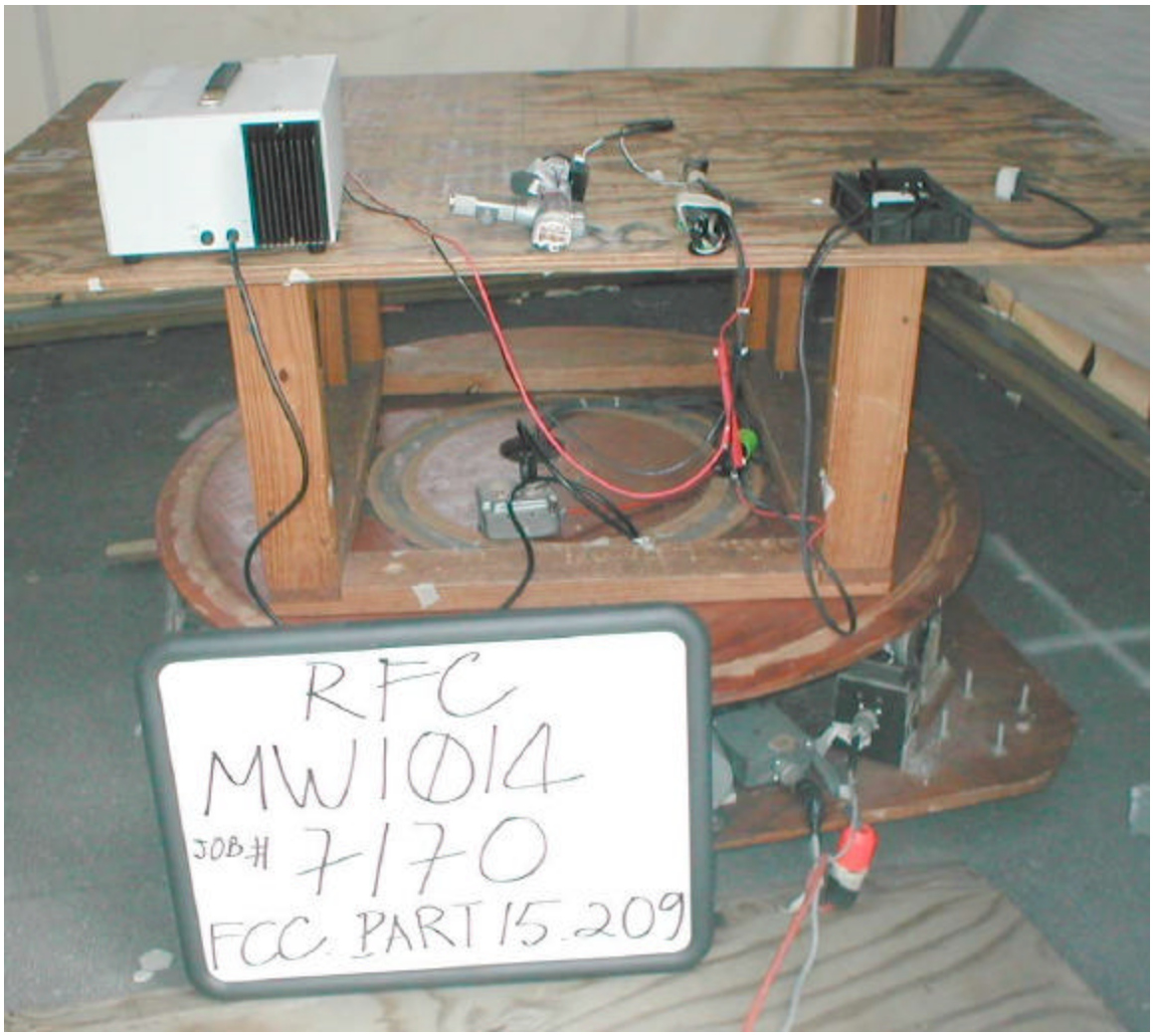

Figure 4. Radiated Emissions Test Setup, Rear