FCC CERTIFICATION TEST REPORT

for

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Stratford Road
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FCC ID: KHH35AS

January 12, 1999

WLL PROJECT #: 4907X

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1.0 Introduction

This report has been prepared on behalf of Lucas Automotive Electronics to support the attached Application for Equipment Authorization. The test and application are submitted for an Intentional Radiator under Part 15.209 of the FCC Rules and Regulations. The Equipment Under Test was the Lucas Automotive Electronics Low Power Transceiver.

All measurements herein 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. Calibration checks are made periodically to verify proper performance of the measuring instrumentation.

All measurements are 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.

All results reported herein relate only to the equipment tested. The measurement uncertainty of the data contained herein is ±2.3 dB. Refer to Appendix A for Statement of Measurement Uncertainty. This report shall not be used to claim product endorsement by NVLAP or any agency of the US Government.

1.1 Summary

The Lucas Automotive Electronics Transceiver complies with the limits for an Intentional Radiator under Section 15.209.

2.0 Description of Equipment Under Test (EUT)

The Lucas Automotive Electronics 35AS Immobilizer System is a 125 kHz low power transceiver that is used as a theft deterrent ignition system switch used in automobiles. The 35AS consists of an energizer coil and an immobilizer unit. The energizer coil is fitted to the end of the ignition lock key barrel of the vehicle and the immobilizer unit is mounted in the vehicle fascia. The energizer coil is connected to the immobilizer unit via twisted pair wiring. The immobilizer communicates with the transponder which is mounted in the handle of the vehicle ignition key. With the ignition turned on, the oscillator in the immobilizer unit drives the energizer coil to produce a 125 kHz electromagnetic field which activates the transponder. The transponder and immobilizer exchange data and if the transponder identity is recognized by the immobilizer and the immobilizer identity is recognized be the engine management unit the engine is allowed to run, otherwise the engine is stopped.

2.1 On-board Oscillators

The Lucas Automotive Electronics 35AS Immobilizer System contains a 4 MHz oscillator and a single chip transceiver which uses an inductor and capacitor to provide a 125 kHz resonant circuit.

3.0 Test Configuration

To complete the test configuration required by the FCC, the 35AS Immobilizer transceiver was mounted on a vehicle ignition key barrel and a key was placed in the ignition tom modulate the carrier. The ignition barrel was placed in the horizontal plane in order to simulate "normal" installation in a vehicle. Unshielded wires were connected to the unit to simulate connection to the vehicle wiring. During emissions testing, 14.4 VDC was applied via a bench power supply to simulate a car vehicle battery with a key installed into the switch.

3.1 Testing Algorithm

The transceiver was turned on and modulated by the transponder in the key. Worst case emissions are recorded in the data tables.

3.2 Conducted Emissions Testing

Conducted emissions testing was not performed as the EUT is battery powered.

3.3 Radiated Emissions Testing

The EUT was placed on an 80 cm high 1 x 1.5 meters non-conductive 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. Biconical, log periodic and rod 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. The peripherals were placed on the table in accordance with ANSI C63.4-1992. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The output from the antenna was connected, via a preamplifier, to the input of the spectrum analyzer. The detector function was set to quasi-peak or peak, as appropriate. For emissions above 30 MHz, the measurement bandwidth on the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth. For emissions below 30 MHz, the measurement bandwidth on the spectrum analyzer system was set to at least 9 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth.

3.3.1 Radiated Data Reduction and Reporting

To convert the raw spectrum analyzer radiated data into a form that can be compared with the FCC limits, it is necessary to account for various calibration factors that are supplied with the antennas and other measurement accessories. These factors are grouped into a composite antenna factor (AFc) and are supplied in the AFc column of Table 1. The AFc in dB/m is algebraically added to the Spectrum Analyzer Voltage in dbμV to obtain the Radiated Electric Field in dBμV/m. This level is then compared with the FCC limit.

Example:

Spectrum Analyzer Voltage:	VdBμV
Composite Antenna Factor:	AFcdB/m
Electric Field:	EdBμV/m = VdBμV + AFcdB/m
To convert to linear units:	EμV/m = antilog (EdBμV/m/20)

Data is recorded in Table 1.

Table 1

FCC 15.209 3M Radiated Emissions Data – Site 2

CLIENT: Lucas Automotive Electronics
FCC ID: KHH35AS
DATE: 23 December 98
BY: Chad M. Beattie
JOB #: 4907X

FREQ kHz	POL H/V	Azimuth Degree	Ant Height m	SA LEVEL (QP) dBuV	AFc dB/m	E-FIELD dBuV/m	E-FIELD uV/m	LIMIT uV/m	MARGIN dB
121.56	V	180.00	1.0	81.0	3.8	84.8	17378.0	197433.4	-21.1
244.64	V	180.00	1.0	46.5	3.7	50.2	323.6	98103.3	-49.6
366.88	V	180.00	1.0	57.9	3.7	61.6	1202.3	65416.5	-34.7
489.18	V	180.00	1.0	43.7	3.7	47.4	234.4	49061.7	-46.4
610.94	V	180.00	1.0	46.8	3.7	50.5	335.0	3928.4	-21.4
733.78	V	180.00	1.0	43.8	3.7	47.5	237.1	3271.0	-22.8
856.76	V	180.00	1.0	42.3	3.7	46.0	199.5	2801.0	-22.9

Table 2

System Under Test

FCC ID: KHH35AS

EUT:	Lucas Automotive Electronics Immobilizer; M/N: 35AS; S/N: N/A; FCC ID: KHH35AS
DC Power Supply:	BK Precision DC Power Supply; M/N: 1711; S/N: 98070161

Table 3

Measurement Equipment Used

The following equipment is used to perform measurements:

Hewlett-Packard Spectrum Analyzer: HP 8568B

Hewlett-Packard Quasi-Peak Adapter: HP 85650A

Hewlett-Packard Preselector: HP 85685A

Antenna Research Associates, Inc. Biconical Log Periodic Antenna: LPB-2520A (Site 2)

Electromechanics Company Active Rod Antenna: 3301B

Solar 50 Ω/50 µH Line Impedance Stabilization Network: 8012-50-R-24-BNC

Solar 50 Ω/50 µH Line Impedance Stabilization Network: 8028-50-TS-24-BNC

AH Systems, Inc. Portable Antenna Mast: AMS-4 (Site 2)

AH Systems, Inc. Motorized Turntable (Site 2)

RG-214 semi-rigid coaxial cable

RG-223 double-shielded coaxial cable

Appendix A

Statement of Measurement Uncertainty

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