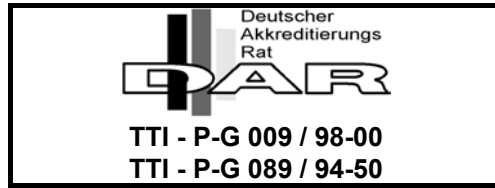


FCC ID: LTQVO315TX



EMISSION -- TEST REPORT

Test Report File No. : T 23472-00-02KJ Date : June 18, 2003
of issue

Type Designation : VO-AM 315 MHz

Kind of Product : Transmitter for Keyless Entry System

Applicant : Delphi Automotive Systems Deutschland GmbH

Manufacturer : Delphi Automotive Systems Deutschland GmbH

Licence holder : Delphi Automotive Systems Deutschland GmbH

Address : Wielpuhl 4

D – 51766 Engelskirchen, Germany

Test result accdg. to the :
regulation(s) at page 3

Positive

This test report with attachment consists of **29** pages.
The test result only corresponds to the tested sample. It is not permitted
to copy this report, in part or in full, without the permission of the test laboratory.

TEST REGULATIONS

The tests were performed according to following regulations :

- o - EN 50081-1 / 2.1991
- o - EN 50081-2 / 7.1993

-
- o - EN 55011 / 3.1991

- o - Group 1
- o - class A
- o - Group 2
- o - class B

- o - EN 55014 / 4.1993

- o - Household appliances and similar
- o - tools
- o - Semiconductor devices

- o - EN 55014 / A2:1990
- o - EN 55104 / 5.1995

Category:

- o - EN 55015 / A1:1990
- o - EN 55015 / 12.1993

- o - EN 55022 / 5.1995

- o - class A
- o - class B

- o - prEN 55103-1 / 3.1995
- o - prEN 50121-3-2 / 3.1995
- o - EN 60601-1-2 / 4.1994

- o - VCCI
- o - Part 15 Subpart C (15.209)
- - Part 15 Subpart C (15.231)

- o - class 1
- o - class 2

MEASUREMENT PROTOCOL FOR FCC, VCCI AND AUSTEL

Test Methodology

Conducted and radiated emission testing is performed according to the procedures in International Special Committee on Radio Interference (CISPR) Publication 22 (1993), European Standard EN 55022 and Australian Standard AS 3548 (which are based on CISPR 22).

The Japanese standard, "Voluntary Control Council for Interference (VCCI) by Data Processing Equipment and Electronic Office Machines, Technical Requirements" is technically equivalent to CISPR 22 (1993). For official compliance, a conformance report must be sent to and accepted by the VCCI.

In compliance with FCC Docket 92-152, "Harmonization of Rules for Digital Devices Incorporate International Standards", testing for FCC compliance may be done following the ANSI C63.4-1992 procedures and using the FCC limits or the CISPR 22 Limits.

Measurement Uncertainty

The test system for conducted emissions is defined as the LISN, tuned receiver or spectrum analyzer, and coaxial cable. The test system for radiated emissions is defined as the antenna, the pre-amplifier, the spectrum analyzer and the coaxial cable. These test systems have a measurement uncertainty of ± 4.5 dB. The equipment comprising the test systems are calibrated on an annual basis.

Justification

The Equipment Under Test (EuT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral into its characteristic impedance or left unterminated. When appropriate, the cables are manually manipulated with respect to each other to obtain maximum emissions from the unit.

General Standard Information

The test methods used comply with CISPR Publication 22 (1993), EN 55022 (1987) and AS 3548 (1992) - "Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment" and with ANSI C63.4-1992 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

For detailed description of each measurement please refer to section test results.

DISCOVERY OF WORST CASE MEASUREMENT CONDITION:

The VO-AM 315 MHz is designed for the operation on the fixed transmitter frequency range of 315 MHz. To find out the worst case conditions for the complete measurement the following tests have been performed:

- Measurement of the radiated fieldstrength of the operating frequency measured in permanent operation mode in the specified channel. This measurement have been performed in order to find out the maximum transmitted fieldstrength of the transmitter.
- Measurement of the radiated spurious emissions measured in permanent operation mode in the specified channel. This measurement have been performed in order to find out the maximum spurious emissions of the transmitter.

Based on this test results, the measurements have been performed completely on the specified channel. This test results are documented in the following sections of the testreport.

TEST RESULT

CONDUCTED EMISSIONS - 10/150 kHz - 30 MHz

<p>■ - Test not applicable</p>

Test location :

- o - Shielded room no. 1
- o - Shielded room no. 2
- o - Shielded room no. 3
- o - Shielded room no. 4
- o - Shielded room no. 5
- o - Shielded room no. 6
- o - Shielded room no. 7
- o - Anechoic chamber
- o - Full compact chamber

For test instruments and test accessories used please see attachment B A4

Description of Measurement

The final level, expressed in dB μ V, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC Limit or to the CISPR limit, which is equivalent to the Australian AS 3548 limit.

To convert between dB μ V and μ V, the following conversions apply:

$$\text{dB}\mu\text{V} = 20(\log \mu\text{V})$$

$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EuT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection, and a Line Impedance Stabilization Network (LISN), with 50 Ω /50 μ H (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimeter's above the floor and is positioned 40 centimeter's from the vertical ground plane (wall) of the screen room. If the minimum passing margin appears to be less than 20 dB with a peak mode measurement, the emissions are remeasured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

Test result:

The requirements are

o - MET

o - NOT MET

Min. limit margin

_____ dB at _____ MHz

Max. limit exceeding

_____ dB at _____ MHz

Remarks: Test not applicable

SPURIOUS EMISSION

Spurious emissions from the EuT are measured in the frequency range of 9 kHz to 30 MHz using a tuned receiver and a shielded loop antenna. The antenna was positioned 3, 10 or 30 meters horizontally from the EuT. Measurements have been made in all three orthogonal axes and the shielded loop antenna was rotated to locate the maximum of the emissions.

Spurious emissions from the EuT are measured in the frequency range of 30 MHz to 10 times the highest used frequency using a tuned receiver and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection and measurements above 1000 MHz are made with a 1 MHz/6 dB bandwidth and peak detection, remeasurement of results which may be critical will be repeated in average mode. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna was positioned 3, 10 or 30 meters horizontally from the EuT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarization's and the EuT are rotated 360 degrees.

SPURIOUS EMISSION (MAGNETIC FIELD) 9 kHz - 30 MHz

■ - Test not applicable

- o - in a shielded room
- o - at a non - reflecting open-site and
- o - in a test distance of 3 meters.
- o - in a test distance of 30 meters.

For test instruments and test accessories used please see attachment B SER1

Description of Measurement

The final level, expressed in dBµV/m, is arrived at by taking the reading from the EMI receiver (Level dBµV) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has to be compared with the relevant FCC limit.

The resolution bandwidth during the measurement is as follows:

- 9 kHz – 150 kHz: ResBW: 200 Hz
- 150 kHz – 30 MHz: ResBW: 10 kHz

Example:

Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level (dBµV/m)	Limit (dBµV/m)	=	Delta (dB)
1.705	5	+	20	=	25	30	=	5

Testresult in detail:

Frequency [MHz]	L: PK [dBµV]	L: AV [dBµV]	L: QP [dBµV]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	L: QP [dBµV/m]	Limit [dBµV/m]

The requirements are

- MET

- NOT MET

Min. limit margin

_____ dB at _____ MHz

Max. limit exceeding

_____ dB at _____ MHz

Remarks: Test not applicable

SPURIOUS EMISSIONS (electric field) 30 MHz - 1000 MHz

- Test not applicable

Test location :

- - Open-site 1 (Landshuter Str. 211a / Straubing)
- - Open-site 2
- - 3 meters
- - 10 meters
- - 30 meters

For test instruments and test accessories used please see attachment B SER2

Description of Measurement

The final level, expressed in dBµV/m, is arrived by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (Factor dB) to it. This is done automatically in the EMI receiver, where the correction factors are stored. This result then has the FCC or CISPR limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets at page 24 - 25. The CISPR 22 limit is equivalent to the Australian AS 3548 limit.

Example:

Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level (dBµV/m)	Limit (dBµV/m)	=	Delta (dB)
719	75	+	32.6	=	107.6	110	=	-2.4

Testresult in detail:

Frequency [MHz]	L: PK [dBµV]	L: AV [dBµV]	L: QP [dBµV]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	L: QP [dBµV/m]	Limit [dBµV/m]
630.018	15.6	5.6	12.1	24.5	40.1	30.1	36.6	55.6
945.027	14.6	3.7	10.4	28.6	43.2	32.3	39.0	55.6

Test result:

The requirements are

■ - MET

○ - NOT MET

Min. limit margin 16.6 dB at 945.027 MHz

Max. limit exceeding _____ dB at _____ MHz

Remarks: The limits are met.

SPURIOUS EMISSION 1 GHz - 18 GHz

o - Test not applicable

Testlocation :

- o - Open-site 1
- - Anechoic chamber (Landshuter Str. 211a / Straubing)
- - 3 meters
- o - 10 meters

For test instruments and test accessories used please see attachment B SER3

Description of Measurement

The final level, expressed in dBµV/m, is arrived by taking the reading from the Spectrumalyzer in dBµV and adding the correction factors of the test setup incl. cables.

Example of the correction value at 1.8 GHz

Level reading at 1.8 GHz	Correction EMCO 3115	correction Amplifier AWT 4534 + cable	Correction factor (summarized)	corrected level
56 dBµV	+27.3 dB	-41.2 dB	-15.8 dB	42.1 dBµV/m

Testresult in detail:

Frequency [MHz]	L: PK [dBµV]	L: AV [dBµV]	L: QP [dBµV]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	L: QP [dBµV/m]	Limit [dBµV/m]
1258.52	51.7	-	-	-10.0	41.6	-	-	55.6
1577.15	51.5	-	-	-8.5	43.0	-	-	54.0
1889.78	62.9	62.0	-	-6.7	56.2	55.3	-	55.6
2208.41	58.4	57.5	-	-5.5	52.9	52.0	-	54.0
2521.04	52.7	-	-	-4.8	47.9	-	-	55.6
2833.67	48.7	-	-	-3.5	45.2	-	-	54.0
3152.30	48.6	-	-	-2.4	46.2	-	-	55.6

Testresult

The requirements are

■ - MET

o - NOT MET

Min. limit margin

0.3 dB at 1889.78 MHz

Max. limit exceeding

 dB at MHz

FCC ID: LTQVO315TX

Remarks: The limits are met. The measurement has been performed in Peak-mode. For critical
results, the measurement would be repeated in average mode. The measurement has
been performed up to the frequency range described under FCC Part 15.33 for
unintentional radiators: 3150 MHz

FIELD STRENGTH OF THE FUNDAMENTAL WAVE

- Test not applicable

- - Open-site 1 (Landshuter Strasse 211a, Straubing)
- - 3 meters
- o - 10 meters
- o - 30 meters

For test instruments and test accessories used please see attachment B CPR1

Description of Measurement

The final level, expressed in dBµV/m, is arrived by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (Factor dB) to it. This is done automatically in the EMI receiver, where the correction factors are stored. This result then has the FCC or CISPR limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets at page 24 - 25. The CISPR 22 limit is equivalent to the Australian AS 3548 limit.

Example:

Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level (dBµV/m)	-	Limit (dBµV/m)	=	Delta (dB)
315	45	+	22.5	=	67.5	-	74.3	=	-6.8

Testresult in detail:

Frequency [MHz]	L: PK [dBµV]	L: AV [dBµV]	L: QP [dBµV]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	L: QP [dBµV/m]	Limit [dBµV/m]
315.009	49.4	41.9	48.1	17.4	66.8	59.3	65.5	75.6

Test result:

The requirements are

■ - MET

o - NOT MET

Min. limit margin

10.1 dB at 315.009 MHz

Max. limit exceeding

_____ dB at _____ MHz

Remarks:

The limits are kept.

CONDUCTED POWER OF THE FUNDAMENTAL WAVE MEASURED ON THE ANTENNA TERMINALS

- Test not applicable

Testlocation :

- Shielded room no. 1
- Shielded room no. 2
- Shielded room no. 3
- Shielded room no. 4
- Shielded room no. 5
- Shielded room no. 6
- Shielded room no. 7
- Anechoic chamber
- Full compact chamber
- Climatic test chamber VLK

For test instruments and test accessories used please see attachment B CPC2

Description of Measurement

The conducted power of the fundamental wave measured on the antenna terminals in a climatic test chamber. The antenna jack was connected to the input of a communication test receiver. The internal batteries have been removed also and a variable DC power supply was used instead. The measurements have been made with the EuT unmodulated. During the test the supply voltage and the temperature were varied and applied simultaneously. The lower supply voltage was given by the manufacturer. In case the equipment was switching off before, the switch off voltage was used instead.

Testresult

The requirements are

o - MET

o - NOT MET

Frequency range of equipment								
Temperature °C	DC supply voltage V	Power dBm	Power dBm	Power dBm	Power dBm	Power dBm	Power dBm	Power dBm
-30								
-20								
-10								
0								
+10								
+20								
+30								
+40								
+50								

Remarks: Test not applicable

EQUIPMENT UNDER TEST

Operation - mode of the EuT.:

The equipment under test was operated during the measurement under following conditions:

- - Standby
 - o - Test program (H - Pattern)
 - o - Test program (colour bar)
 - o - Test program (customer specific)
 - - continuous transmitting mode at 315 MHz
-
-
-
-

Configuration of the equipment under test: see attachment D
Following periphery devices and interface cables were connected during the measurement:

- o - _____ Type : _____
- o - _____ Type : _____
- o - _____ Type : _____
- o - _____ Type : _____
- o - _____ Type : _____
- o - _____ Type : _____

- o - unshielded power cable
- o - unshielded cables
- o - shielded cables MBPS.No.:
- o - customer specific cables
- o - _____
- o - _____

SUMMARY

GENERAL REMARKS:

The product VO-AM 315 MHz has been tested on the following frequency:
TX-Mode: 315 MHz

The unit measurements met also the bandwidth requirements.

The EuT complies with the requirements described under 15.231(a) regarding the activation/deactivation of the transmitter. The transmitter on time is smaller than 5 seconds after activation.

FINAL JUDGEMENT:

The requirements according to the technical regulations and tested operation modes are

- - met.
- o - **not** met.

The Equipment Under Test

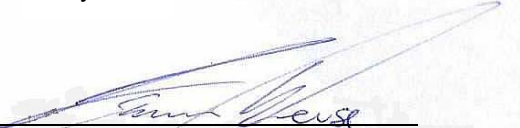
- - **Fulfils** the general approval requirements according to page 3.
- o - **Does not** fulfil the general approval requirements according to page 3.

Date of receipt of test sample : accdg. to storage record of MBPS

Testing Start Date : May 30, 2003

Testing End Date : June 10, 2003

Checked by:

i. A. 
Günter Mikes
Dipl.Ing.(FH)

Tested by:


Josef Knab

Attachment A: Test data

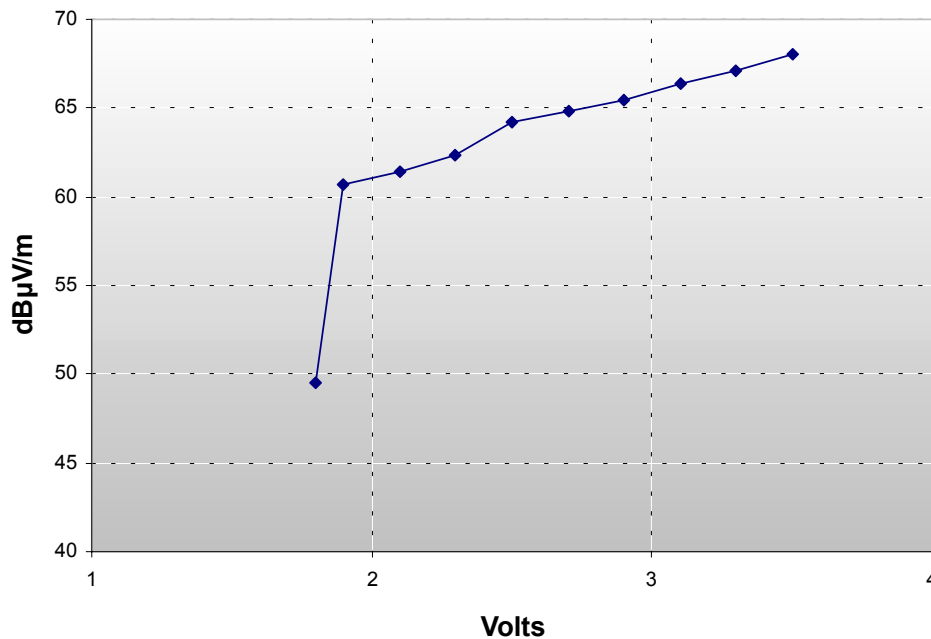
Relative Emission Level vs. Supply Voltage

FCC Part 15.31 (e)

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage.

TX OUTPUT vs. Voltage LEVEL		
Volt in	Frequency [MHz]	TX OutPut Pk [dB μ V/m]
1,7	n.op.	n.op.
1,8	314,9949	49,50
1,9	314,9949	60,72
2,1	314,9949	61,42
2,3	314,9951	62,35
2,5	314,9951	64,22
2,7	314,9951	64,84
2,9	314,9953	65,50
3,1	314,9953	66,43
3,3	314,9953	67,11
3,5	314,9953	68,01

OUTPUT FIELD STRENGTH vs INPUT VOLTAGE



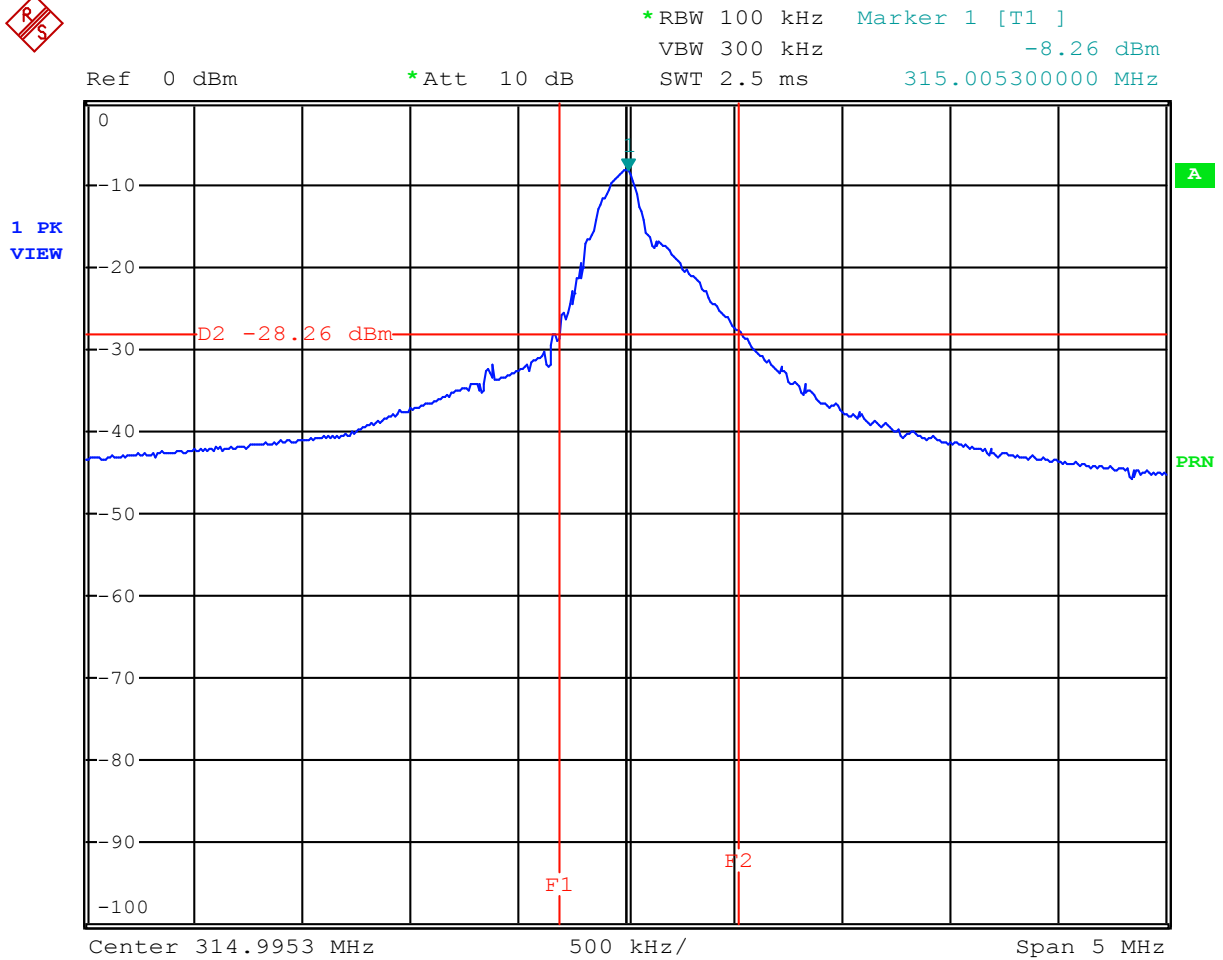
Attachment A: Test data

Occupied Bandwidth

FCC Part 15.231 (c)

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

Fundamental [MHz]	Duty Cycle	20 dB Bandwidth F1	20 dB Bandwidth F2	Measured Bandwidth	LIMIT Fundamental f * 0.0025
315		314,6878 MHz	315,5100 MHz	100 kHz	787,5 kHz



Date: 3.JUN.2003 15:37:08

Attachment B: List of test equipment

All test instruments used, in addition to the test accessories, are calibrated and verified regularly.

Test Report No: T23472-00-01KJ
 Beginning of Testing: 30 Mai 2003
 End of Testing: 10 Juni 2003

Test ID	Model Type	Kind of Equipment	Manufacturer	Equipment No.
CPR2	RG 217	RF-Cable Rosenberger	HF-Technik	99-07/60-03-016
	RG 214	RF-Cable Rosenberger	HF-Technik	99-07/60-03-017
	VULP 9163	Antenna	Schwarzbeck Mess-Elektronik	99-07/62-03-002
	ESVP	Test Receiver	Rohde & Schwarz München	99-07/63-03-002
MB	Metra Hit 29 S	Multimeter	GOSSSEN-METRAWATT	99-07/34-03-001
	HP 6264 B	DC Power Supply	HP Hewelett-Packard	99-07/49-03-001
	model 7405	Near Field Probe	EMCO Elektronik GmbH	99-07/67-03-001
SER2	RG 217	RF-Cable	Rosenberger HF-Technik	99-07/60-03-016
	RG 214	RF-Cable	Rosenberger HF-Technik	99-07/60-03-017
	VULP 9163	Antenna	Schwarzbeck Mess-Elektronik	99-07/62-03-002
	ESVP	Test Receiver	Rohde & Schwarz München	99-07/63-03-002
SER3	FA210A0050M0000	GHz-Cable	Rosenberger HF-Technik	99-07/60-03-018
	3115	Horn Antenna	EMCO Elektronik GmbH	99-07/62-03-003
	AMF 40-005-180-24-10 P	18 GHz Amplifier	PARZICH GMBH	99-07/66-03-004
	FSP 30	Spectrum Analyzer	Rohde & Schwarz München	99-07/74-03-003
	Nr. 2	Full Compact Chamber	emitel AG	99-07/91-03-001

CONSTRUCTIONAL DATAFORM FOR TESTING OF RADIO EQUIPMENT

Licence holder:	Delphi Deutschland GmbH		
Address:	Wiehlpuhl 4, D-51766 Engelskirchen		
Manufacturer:	Delphi Deutschland GmbH		
Address:	Wiehlpuhl 4, D-51766 Engelskirchen		
Type:	Transmitter for Keyless Entry System		
Model:	VO-AM 315 MHz		
Serial-No.:		Protection class:	

Additional informations to the above named model:

Antenna: transmitter:	Type: Loop		
	Length/size => ϕ 25,5 mm		
receiver:	Type:		
	Length/size:		
Power supply of the transmitter: Type:	Lithium	nominal voltage:	3 V
		lowest voltage:	2,1 V
		highest voltage:	3,2 V
		current consumption	A
Power supply of the receiver: Type:	Car Battery	nominal voltage:	12 V
		cuurrent consumption	A

Ancillary equipment:

Description: _____	Type: _____	Serial-no.: _____
Description: _____	Type: _____	Serial-no.: _____
Description: _____	Type: _____	Serial-no.: _____

Extreme temperature range in which the approval test should be performed:

- Category I: General (-20°C to +55°C)
- Category II: Portable (-10°C to +55°C)
- Category III: Equipment for normal indoor use (0°C to +55°C)

Connectable cables:

Name of the cable	Digital	Length/m	shielded
	O yes O no		O yes O no
	O yes O no		O yes O no
	O yes O no		O yes O no
	O yes O no		O yes O no
	O yes O no		O yes O no

O If applicable, if necessary complete overleaf

Page D1

Type designation: Transmitter VO-AM 315 MHz			
Name and type designation of individual units comprising the radio equipment:			
Type of equipment:			
<input type="checkbox"/> Radiotelephone equipment	<input checked="" type="checkbox"/> Remote-control equipment	<input type="checkbox"/> Radiomaritime equipment	<input checked="" type="checkbox"/> LPD
<input type="checkbox"/> One-way radiotelephone equipment	<input type="checkbox"/> Inductive loop system	<input type="checkbox"/> Inland waterways equipment	<input type="checkbox"/> RLAN
<input type="checkbox"/> Personal paging system	<input type="checkbox"/> Radio-relay system	<input type="checkbox"/> Radionavigation equipm.	<input type="checkbox"/>
<input type="checkbox"/> Satellite earth station	<input type="checkbox"/> CB radiotelephone equipment	<input type="checkbox"/> Antenna	<input type="checkbox"/>
<input type="checkbox"/> Data transmission equipment	<input type="checkbox"/> Movement detector	<input type="checkbox"/> Aeronautical equipment	<input type="checkbox"/>
Technical characteristics:			
	Transmitter-receiver	Transmitter	Receiver
Frequency range		315 MHz	
Maximum no. of channels		1 Channel	
Channel spacing			
Class of emission (type of modulation)		A1D	
Maximum RF output power			
Maximum effective radiated power (ERP)		< 10 mW	
Output power variable			
Channel switching frequency range		N/A	
Method of frequency generation	<input type="checkbox"/> Synthesizer	<input checked="" type="checkbox"/> Crystal	<input type="checkbox"/> Other
Frequency generation TX			
Frequency generation RX			
IF	1st IF	2nd IF	3rd IF
Integral selective calling	N/A		
Audio-frequency interface level at external data socket			
Modes of operation	<input type="checkbox"/> Duplex mode	<input type="checkbox"/> Semi-duplex mode	<input checked="" type="checkbox"/> Simplex mode
Power source	<input type="checkbox"/> Mains	<input type="checkbox"/> Vehicle-regulated	<input checked="" type="checkbox"/> Integral
Antenna socket	<input type="checkbox"/> BNC <input type="checkbox"/> M <input checked="" type="checkbox"/> None	<input type="checkbox"/> TNC <input type="checkbox"/> UHF <input type="checkbox"/>	<input type="checkbox"/> N <input type="checkbox"/> Adapter <input type="checkbox"/>
Test specifications: FCC 15.231			

O If applicable, if necessary complete overleaf

Page D 2

Declarations:

- We declare that the above information are correct and the named model was supplied with the maximum configuration to the accredited test laboratory.

Wiehl-Bomig _____, date 05.06.2003 _____



place of issue

Joachim Krebs (Projektleiter)