

FCC ID: LTQFO3AM315RX

EMI - TEST REPORT

- FCC Part 15B -

**Test Report No. :** T35421-01-02HU

11. April 2013

Date of issue

Type / Model Name : FO3-AM315RX**Product Description** : Receiver for vehicular use**Applicant** : Delphi Deutschland GmbH

Address : Delphiplatz 1

42119 Wuppertal

Manufacturer : Delphi Deutschland GmbH

Address : Wiehlpuhl 4

51766 Engelskirchen

Licence holder : Delphi Deutschland GmbH

Address : Delphiplatz 1

42119 Wuppertal

Test Result according to the
standards listed in clause 1 test
standards:**POSITIVE**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test
results without the written permission of the test laboratory.

FCC ID: LTQFO3AM315RX

Contents

1	<u>TEST STANDARDS</u>	3
2	<u>SUMMARY</u>	4
3	<u>EQUIPMENT UNDER TEST</u>	5
3.1	Photo documentation of the EUT – Detailed photos see Attachment A	5
3.2	Power supply system utilised	5
3.3	Short description of the Equipment under Test (EuT)	5
4	<u>TEST ENVIRONMENT</u>	6
4.1	Address of the test laboratory	6
4.2	Environmental conditions	6
4.3	Statement of the measurement uncertainty	6
4.4	Measurement Protocol for FCC, VCCI and AUSTEL	7
5	<u>TEST CONDITIONS AND RESULTS</u>	8
5.1	Conducted emissions	8
5.2	Radiated emissions	9
5.3	Spurious emissions radiated (electric field)	12
6	<u>USED TEST EQUIPMENT AND ACCESSORIES</u>	15

FCC ID: LTQFO3AM315RX

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15 Subpart A - General (October, 2012)

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths

FCC Rules and Regulations Part 15 Subpart B - Unintentional Radiators (October, 2012)

Part 15, Subpart B, Section 15.109	Radiated emissions, general requirements
Part 15, Subpart B, Section 15.111	Antenna power conduction

ANSI C63.4: 2003	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI C95.1:1992	IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
CISPR 16-4-2: 2003	Uncertainty in EMC measurement
CISPR 22: 2005 EN 55022: 2006	Information technology equipment

FCC ID: LTQFO3AM315RX

2 SUMMARY

GENERAL REMARKS:

Functional test of Receiver function:

- Connect receiver module to receiver harness (with LED)
- Connect receiver harness to power supply (U=12.5V; red=positive; blue=ground)
- Wait approx. 5sec until supply current drops to ~4mA, receiver module now is in polling mode
- Connect sender module to sender harness (without LED)
- Connect sender harness to power supply (U=12.5V; red=positive; blue=ground)
- After approx. 2sec sender module will continuously transmit frames
- Receiver module will indicate reception of the frames by blinking of the LED

FINAL ASSESSMENT:

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 07. January 2013

Testing concluded on : 10. January 2013

Checked by:

Tested by:

Klaus Gegenfurtner
Dipl.-Ing.(FH)
Manager: Radio Group

Markus Huber

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT – Detailed photos see Attachment A

3.2 Power supply system utilised

Power supply voltage : 12.5 V / DC

3.3 Short description of the Equipment under Test (EuT)

The EuT is a receiver for vehicular use.

Number of tested samples: 1
Serial number: Prototype

Type/Model Name: DG9T-15K619-AD
Plattform: Ford
Variant: A1 (LOW)
Project: Fo00RF

EuT operation mode:

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

- Rx mode at 315 MHz

—

—

EUT configuration:

(The CDF filled by the applicant can be viewed at the test laboratory.)

The following peripheral devices and interface cables were connected during the measurements:

- | | |
|-------------------------------|----------------------------------|
| - Test transmitter at 315 MHz | Model : Supplied by manufacturer |
| - _____ | Model : _____ |
| - _____ | Model : _____ |
| - customer specific cables | |
| - unscreened power cables | |

FCC ID: LTQFO3AM315RX

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

mikes-testingpartners gmbh
Ohmstrasse 2-4
94342 Strasskirchen
Germany

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15-35 ° C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader may notice that tolerances within the calibration of the equipment and facilities may cause additional uncertainty. The measurement uncertainty is calculated for all measurements listed in this test report acc. to CISPR 16-4-2 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurement“ and documented in the mikes-testingpartners gmbh quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, mikes-testingpartners gmbh, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component diversity and modifications in production processes may result in additional deviation. If necessary, refer to the test lab for the actual measurement uncertainty for specific tests. The manufacturer has the sole responsibility of continued compliance of the EUT.

4.4 Measurement Protocol for FCC, VCCI and AUSTEL

4.4.1 GENERAL INFORMATION

4.4.1.1 Test Methodology

Conducted and radiated disturbance testing is performed according to the procedures set out by the International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under section 1 of this report.

The test methods used comply with CISPR Publication 22, EN 55022 - "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.4 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

4.4.1.2 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 using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each in order to obtain maximum disturbances from the unit.

4.4.2 DETAILS OF TEST PROCEDURES

4.4.2.1 General Standard Information

The test methods used comply with CISPR Publication 22, EN 55022 - "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.4 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

FCC ID: LTQFO3AM315RX

5 TEST CONDITIONS AND RESULTS

5.1 Conducted emissions

For test instruments and accessories used see section 6 Part A 4.

5.1.1 Description of the test location

Test location: None

5.1.2 Photo documentation of the test set-up

5.1.3 Applicable standard

According to FCC Part 15B, Section 15.107(a):

Except as shown in paragraphs (b) and (c) of this Section, for an unintentional radiator that is designed to be connected to the public utility AC power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

5.1.4 Description of Measurement

The correction factors for cable loss and antenna gain are stored in the memory of the EMI receiver therefore the final level (dBμV) appears directly in the reading of the EMI receiver. This level is compared to the FCC limit.

To convert between dBμV and μV, the following conversions apply:

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

$$\mu\text{V} = 10^{(\text{dB}\mu\text{V}/20)}$$

The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a line impedance stabilization network (LISN) with 50Ω/50 μH (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit 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.

5.1.5 Test result

Remarks: The measurement is not applicable.

The EuT has no AC mains connections.

FCC ID: LTQFO3AM315RX

5.2 Radiated emissions

For test instruments and accessories used see section 6 Part SER 1, SER 2.

5.2.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

5.2.2 Photo documentation of the test set-up

SER1:



SER2:



FCC ID: LTQFO3AM315RX

5.2.3 Applicable standard

According to FCC Part 15B, Section 15.109 (a):

Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 m shall not exceed the given limit.

5.2.4 Description of Measurement

Radiated emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz 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. Table top equipment is placed on a 1.0 X 1.5 dB(μ V/m) non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the equipment under test will be in accordance to ANSI C63.4. The interface cables that are closer than 40 cm to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 cm 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 m horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres, measurement scans are made with horizontal and vertical antenna polarization and the EUT is rotated 360 degrees. The radiated emissions from the EUT are measured in the frequency range of 1 GHz to maximum frequency as specified in section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 metre non-conducting table 80 centimetres above the ground plane. The set up of the equipment under test will be in accordance to ANSI C63.4. The Interface cables that are closer than 40 cm to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 cm 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 m horizontally from the EUT.

Measurements are made in horizontal and vertical polarization in a fully anechoic chamber. All tests are performed at a test distance of 3 m. Hand-held or body-worn devices are rotated through three orthogonal axes to determine the attitude of the highest emission shall be used for final testing. During the tests the EUT is rotated 360° and the cables and equipment are placed and moved in position in such a way to find the maximum emission level. For testing above 1 GHz, the emission level of the EUT in peak mode complies to the average limit is 20 dB lower, then testing will be stopped and peak values of the EUT will be reported, otherwise, the emission will be measured in average mode again and reported.

The resolution bandwidth during the measurement is as following:

30 MHz – 1000 MHz: RBW: 120 kHz

Above 1000 MHz: RBW: 1 MHz

FCC ID: LTQFO3AM315RX
5.2.5 Test result
Measurement distance: 3 m

Frequency [kHz]	L: QP [dBµV]	L: AV [dBµV]	Bandwidth [kHz]	Correct. [dB]	L: QP [dBµV/m]	L: AV [dBµV/m]	Limit [dBµV/m]	Delta [dB]
536.8	24.1	19.7	9.0	20	44.1	39.7	73.0	-33.3
1073.6	23.4	18.0	9.0	20	43.4	38.0	67.0	-29.0
1342.0	21.6	15.9	9.0	20	41.6	35.9	65.0	-29.1

Frequency [MHz]	L: QP [dBµV]	Correct. [dB]	L: QP [dBµV/m]	Limit [dBµV/m]	Delta [dB]
33.78	3.7	13.4	17.1	40.0	-22.9
118.54	9.3	12.9	22.2	43.5	-21.3
517.43	4.8	21.9	26.7	46.0	-19.3

Limit according to FCC Part 15 Subpart 15.209(a)

Frequency (MHz)	Field strength of spurious emissions		Measurement distance (meters)
	(µV/m)	dB (µV/m)	
0.009-0.490	2400/F(kHz)	--	300
0.490-1.705	24000/F (kHz)	--	30
1.705-30.0	30	29.5	30

Limit according to FCC part , Section 15.109(a):

Frequency (MHz)	Limit (µV/m)	Limit dB(µV/m)
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

The requirements are **FULFILLED**.

Remarks:

FCC ID: LTQFO3AM315RX

5.3 Spurious emissions radiated (electric field)

For test instruments and accessories used see section 6 Part SER 3.

5.3.1 Description of the test location

Test location: Anechoic Chamber A2

Test distance: 3 metres

5.3.2 Photo documentation of the test set-up

SER3:



5.3.1 Applicable standard

According to FCC Part 15C, Section 15.231(b), Section 15.209(a) and Section 15.205(a):
The emissions from intentional radiators shall not exceed the effective field strength limits.

5.3.2 Description of Measurement

The radiated power of the spurious emission from the EUT is measured in the frequency range above 1 GHz using a spectrum analyser and appropriate linear polarised antennas. Measurements are made in the horizontal and vertical polarization of the antenna. The set up of the EUT will be in accordance to ANSI C63.4. The interface cables closer than 40 cm to the ground plane are bundled in the centre in a serpentine fashion so they are at least 40 cm away from the ground plane. Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration results in the highest emission and therefore shall be used for final testing. During the tests the EUT is turned 360 degrees to find the maximum level of emission. For testing above 1 GHz, if the emission level of the EUT in peak mode complies with the average limit is 20 dB lower, then testing will be stopped and peak values of the EUT will be reported, otherwise the emission will be measured in average mode again and reported.

FCC ID: LTQFO3AM315RX

The resolution bandwidth during the measurement is as follows:

1000 MHz – 18000 MHz RBW: 1 MHz

Example:

$$\begin{array}{rclclclclcl}
 \text{Frequency} & & \text{Level} & + & \text{Factor} & = & \text{Level} & - & \text{Limit} & = & \text{Delta} \\
 (\text{MHz}) & & (\text{dB}\mu\text{V}) & & (\text{dB}) & & \text{dB}(\mu\text{V}/\text{m}) & & \text{dB}(\mu\text{V}/\text{m}) & & (\text{dB}) \\
 170.5 & & 5 & + & 20 & = & 25 & - & 30 & = & -5
 \end{array}$$

5.3.3 Test result f > 1 GHz

Frequency (MHz)	L: PK (dBμV)	L: AV (dBμV)	Bandwidth (kHz)	Correct. (dB)	Duty Cycle Correct. factor (dB)	Corrected PK level dB(μV/m)	Effective limit dB(μV/m)	Delta (dB)
1452.69	44.8	--	1000	-11.6	--	33.2	54.0	-20.8
2578.38	41.3	--	1000	-10.0	--	31.3	54.0	-22.7

Limit according to FCC Section 15.231(b), Section 15.209(a) and Section 15.205(a):

Frequency (MHz)	Field strength of spurious emissions @ 3m		Effective limit for 315 MHz	
	(μV/m)	dB(μV/m)	(μV/m)	dB(μV/m)
40.66 – 40.70	225	47		
70 - 130	125	42		
130 - 174	125 to 375*	42 to 51.4*		
174 - 260	375	51.4		
260 - 470	375 to 1250*	51.4 to 61.9*		
Above 470	1250	61.9		

*Linear interpolation

FCC ID: LTQFO3AM315RX

Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in the table above or to the general limits shown in the table below according to § 15.209, whichever limit permits a higher field strength.

Frequency (MHz)	15.209 Limits (µV/m)	15.209 Limits dB(µV/m)
30 - 88	100	40
88 - 216	150	43,5
216 - 960	200	46
Above 960	500	54

Additionally there is a limit according to §15.35(b) on the radio frequency emissions, as measured with a peak detector, corresponding to 20 dB above the maximum permitted average limits.

Restricted bands of operation according to FCC Part 15C, Section 15.205(a):

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	608 – 614	5.35 – 5.46
2.1735 – 2.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2483.5 – 2500	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	2690 – 2900	22.01 – 23.12
8.41425 – 8.41475	162.0125 – 167.17	3260 – 3267	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3332 – 3339	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3345.8 – 3358	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4	3600 – 4400	Above 38.6

The requirements are **FULFILLED**.

Remarks:

FCC ID: LTQFO3AM315RX

6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
SER 1	FMZB 1516	01-02/24-01-018			16/02/2013	16/02/2012
	ESCI	02-02/03-05-004	10/10/2013	10/10/2012		
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
SER 2	ESVS 30	02-02/03-05-006	26/06/2013	26/06/2012		
	VULB 9168	02-02/24-05-005	16/03/2013	16/03/2012	08/04/2013	08/10/2012
	S10162-B	02-02/50-05-031				
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N_20m	02-02/50-12-018				
SER 3	FSP 30	02-02/11-05-001	18/10/2013	18/10/2012		
	AFS4-01000400-10-10P-4	02-02/17-05-003				
	AMF-4F-04001200-15-10P	02-02/17-05-004				
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	3117	02-02/24-05-009	18/12/2013	18/12/2012		
	Sucoflex N-1600-SMA	02-02/50-05-073				
	Sucoflex N-2000-SMA	02-02/50-05-075				