FCC ID: KR5S120123007

EMI -- T E S T R E P O R T

Test Report No. :	**T30141-02-00KJ**	29. September 2005 Date of issue

Type / Model Name : S 120 123 007

Product Description : Tire guard transmitter

Applicant **:** Siemens VDO Automotive AG

Address : Siemensstrasse 12

93055 Regensburg, Germany

Manufacturer **:** Siemens VDO Automotive Ag

Address : Siemensstrasse 12

93055 Regensburg, Germany

Licence holder **:** Siemens VDO Automotive AG

Address : Siemensstrasse 12

93055 Regensburg, Germany

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.

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15 Subpart C - Intentional Radiators (October 01, 2004)

Part 15, Subpart C, Section 15.231	Periodic operation in the band 40.66-40.70 MHz and above 70 MHz §15.231(e) Radiated emissions, Fundamental & Harmonics §15.231(c) Emission Bandwidth
Part 15, Subpart C, Section 15.35(c)	Correction for Pulse Operation (Duty Cycle)
Part 15, Subpart C, Section 15.209(a)	Radiated emissions, general requirements

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2 SUMMARY

GENERAL REMARKS:

None

FINAL ASSESSMENT:

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

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

Testing commenced on : 12. August 2004

Testing concluded on : 17. August 2004

Checked by:

Thomas Weise
Ich bestätige die Richtigkeit und Integrität dieses Dokuments
2005.09.29 09:51:50 +02'00'

Thomas Weise
Dipl. Ing.(FH)
Laboratory Manager

Tested by:

Josef Knab
Ich bin der Verfasser dieses Dokuments
2005.09.29 09:23:07 +02'00'

Josef Knab

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3.3 Power supply system utilised

Power supply voltage : 3 V / DC battery

3.4 Short description of the Equipment under Test (EuT)

The EuT is a transmitter for a tire guard systems (wheel unit). It monitors a vehicle´s tire pressure whilst driving or stationary.

Number of tested samples: 2
Serial number: 83481530 / 8348142B

EuT operation mode:

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

- continuous transmission at 315 MHz (unmodulated)

- continuous transmission at 315 MHz (modulated)

- stand by

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:

- _____ Model : _____
- _____ Model : _____
- _____ Model : _____
- _____ Model : _____
- _____ Model : _____
- _____ Model : _____

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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 is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 /11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“and is documented in the mikes-testingpartners gmbh quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

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 in International Special Committee on Radio Interference (CISPR) Publication 22 (1997), 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 (1997). 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 C63.4-2003 procedures and using the CISPR 22 Limits.

4.4.1.2 Measurement Error

The data and results referenced in this document are true and accurate. The reader is cautioned that there is some measurement variability due to the tolerances of the test equipment that can contribute to a nominal product measurement uncertainty. The measurement uncertainty was calculated for all measurements listed in this test report according to NIS 81/5.1994 “The treatment of uncertainty in EMC measurements” and is documented in the mikes-testingpartners gmbh quality system according to DIN EN ISO/IEC 17025. Furthermore, component differences and manufacturing process variability of production units similar to that tested may result in additional product uncertainty. 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 device.

4.4.1.3 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 it’s characteristic impedance or left unterminated. When appropriate, the cables are manually manipulated with respect to each other to obtain maximum disturbances from the unit.

4.4.2 DETAILS OF TEST PROCEDURES

General Standard Information

The test methods used comply with CISPR Publication 22 (1997), EN 55022 (2001) and AS 3548 (1992) - "Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment" and with 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."

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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:

5.1.2 Photo documentation of the test set-up

5.1.3 Description of Measurement

The final level, expressed in dBμV, 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 dBμV and μV, the following conversions apply:

dBμV = 20(log μV)

μV = Inverse log(dBμV/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 50Ω/50 μH (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.

5.1.4 Test result

Remarks: The measurement is not applicable.

The EuT is battery powered.

5.2 Radiated power of the fundamental wave

For test instruments and accessories used see section 6 Part **CPR 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

5.2.3 Description of Measurement

The radiated power of the fundamental wave from the EUT is measured in the frequency range of 30 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 meter 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 C63.4-2003.
The 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.

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.

The resolution bandwidth during the measurement is as follows:
30 MHz – 1000 MHz: ResBW: 120 kHz

5.2.4 Test result

Frequency [MHz]	L: PK [dBµV]	Corr. Duty Cycle [dB]	L: AV [dBµV]	Band width [kHz]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	Limit AV [dBµV/m]	Delta [dB]
314.98	54.9	-16.5	-	120	16.3	71.2	54.7	67.7	-13.0

Limit according to FCC Subpart 15.231(e)

Frequency (MHz)	Fieldstrength of fundamental		Fieldstrength of spurious emissions	
	(µV/m)	dB (µV/m)	(µV/m)	dB (µV/m)
40,66 – 40,70	1000	60	100	40
70 - 130	500	54	50	34
130 - 174	500 to 1500 *	54 to 63.5	50 to 150 *	34 to 43.5
174 - 260	1500	63.5	150	43.5
260 - 470	**1500 to 5000 ***	**63.5 to 74**	150 to 500 *	43.5 to 54
Above 470	5000	74	500	54

*Linear interpolations

The requirements are **FULFILLED.**

Remarks: During the test, the Eut was set into continuous transmitting mode.

Please see page 21 of this test report, for calculation of the duty cycle for pulse operated devices.

5.3 Radiated emissions (electric field) 30 MHz – 18 GHz

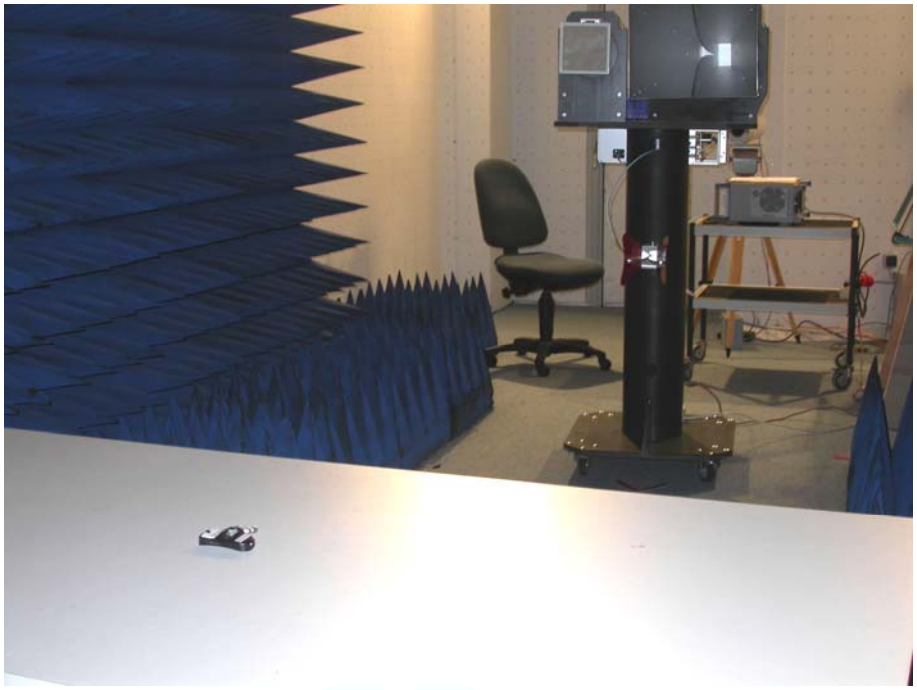
For test instruments and accessories used see section 6 Part **SER 2, SER 3**.

5.3.1 Description of the test location

Test location: OATS1 / Anechoic Chamber A2

Test distance: 3 metres

5.3.2 Photo documentation of the test set-up



5.3.3 Description of Measurement

Radiated spurious 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 meter 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 C63.4-2003. The 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.

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.

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 tuned receiver (Spectrum Analyser) and appropriate linearly polarized antennas. 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. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003.
The 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 horizontally from the EuT.

Measurement are made in both the horizontal and vertical planes of polarization in a fully anechoic room using a spectrum analyzer with the detector function set to peak and resolution as well as video bandwith set to 1 MHz. All tests are performed at a test-distance of 3 meters. Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration procedure the highest emission relative the limit and therefore shall be used for final testing. During the tests the EUT is rotated all around to find the maximum levels of emissions. The cables and equipment were placed and moved within the range of position likely to find their maximum emissions. When the EuT is larger than the beamwidth of the measuring antenna, the measurement antenna will be moved over the surfaces for the four sides or the test distance will be reduced to demonstrate that emissions were at maximum at the limit distance.

The resolution bandwidth during the measurement is as follows:
30 MHz – 1000 MHz: ResBW: 120 kHz
1000 MHz – 18000 MHz ResBW: 1 MHz

5.3.4 Test result

Testresult in detail:(<1GHz)

Frequency [MHz]	L: PK [dBµV]	Corr. Duty Cycle [dB]	L: AV [dBµV]	Band width [kHz]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	Limit AV [dBµV/m]	Delta [dB]
629.96	20.6	-16.5	-	120	23.4	44.0	27.5	47.7	-20.2
944.95	23.8	-16.5	-	120	27.8	51.6	35.1	47.7	-12.6

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Testresult in detail:(>1GHz)

Frequency [MHz]	L: PK [dBµV]	Corr. Duty Cycle [dB]	L: AV [dBµV]	Band width [kHz]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	Limit AV [dBµV/m]	Delta [dB]
1260	69.3	-16.5	-	1000	-14.5	54.8	38.3	47.7	-9.4
1576	67.5	-16.5	-	1000	-14.1	53.4	36.9	54.0	-17.1
1888	58.1	-16.5	-	1000	-12.2	45.9	29.4	47.7	-18.3
2208	61.1	-16.5	-	1000	-10.5	50.6	34.1	54.0	-19.9
2524	63.9	-16.5	-	1000	-10.1	53.8	37.3	47.7	-10.4
2836	57.6	-16.5	-	1000	-9.1	48.5	32.0	54.0	-22.0

Limit according to FCC Subpart 15.231(b) Subpart 15.209(a) / Subpart 15.205(a)

Frequency (MHz)	Fieldstrength of fundamental		Fieldstrength of spurious emissions	
	(µV/m)	dB (µV/m)	(µV/m)	dB (µV/m)
40,66 – 40,70	1000	60	100	40
70 - 130	500	54	50	34
130 - 174	500 to 1500 *	54 to 63.5	50 to 150 *	34 to 43.5
174 - 260	1500	63.5	150	43.5
260 - 470	**1500 to 5000 ***	**63.5 to 74**	150 to 500 *	43.5 to 54
Above 470	5000	74	500	54

*Linear interpolations

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 [dBµV/m]
30-88	100	40
88-216	150	43,5
216-960	**200**	**46**
Above 960	**500**	**54**

Besides 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.

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Restricted bands of operation:

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

MHz	MHz	GHz
25.5 – 25.67	960 – 1240	4.5 – 5.15
37.5 – 38.25	1300 – 1427	5.35 – 5.46
73 – 74.6	1435 – 1626.5	7.25 – 7.75
74.8 – 75.2	1645.5 – 1646.5	8.025 – 8.5
108 – 121.94	1660 – 1710	9.0 – 9.2
123 – 138	1718.8 – 1722.2	9.3 – 9.5
149.9 – 150.05	2200 – 2300	10.6 – 12.7
156.52475 – 156.52525	2310 – 2390	13.25 – 13.4
156.7 – 156.9	2483.5 – 2500	14.47 – 14.5
162.0125 – 167.17	2655 – 2900	15.35 – 16.2
167.72 – 173.2	3260 – 3267	17.7 – 21.4
240 – 285	3332 – 3339	22.01 – 23.12
322 – 335.4	3345.8 – 3358	23.6 – 24.0
399.9 – 410	3600 – 4400	31.2 – 31.8
608 – 614		36.43 – 36.5

The requirements are **FULFILLED.**

Remarks: During the test, the Eut was set into continuous transmitting mode.

The measurement was performed up to the 10th harmonic (3150MHz).

Please see page 21 of this test report, for calculation of the duty cycle for pulse operated devices.

5.4 Correction for Pulse Operation (Duty Cycle)

For test instruments and accessories used see section 6 Part **DC**.

5.4.1 Description of the test location

Test location:

5.4.2 Photo documentation of the test set-up

5.4.3 Description of Measurement

The Duty cycle factor, expressed in dB, is arrived by taking the following formula:

$$K_E = 20 \log [(t_{iB} * p)/T_w]$$

K_E: pulse operation correction factor [dB]
t_{iw} pulse duration for one complete pulse track [msec]
t_{iB} pulse duration for one pulse [µsec]
T_w a period of the pulse track [msec]
p number of pulses in one train

5.4.4 Test result

Remarks: The pulse train [Tw] exceeds 100 ms, therefore the duty cycle have been calculated by averaging the sum of the pulsewidths over the 100 ms width with the highest average value.

For detailed results, please see the test protocol (customer declaration) below.

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5.4.5 Test protocol

Customer declaration

Correction for Pulse Operation (Duty Cycle)
FCC Part 15 Subpart 15.35(c)

Averaging Factor in nominal condition:

According the customer specification (see extract in Annex), the averaging factor of TG1B ND has been calculated as following:

Averaging factor = $20 \times \log\left(\frac{Ton}{Tperiod}\right) = 20 \times \log\left(\frac{14.3ms}{100ms}\right) = -16.9dB$

with:
- Ton (Nominal) = 14.3ms due to the fact that Ton is 28.57ms but it operates in ASK modulation => Ton is divided by 2.

- Tperiod = 100ms because the shortest inter frame time (Nominal) is
85.6+28.53= 114ms (>100ms)

This calculation should also be done in worst case condition by taking in account the inter frame timing tolerance of +/-10% and the Wu baud rate tolerance of +/-5% (see customer specification in annex).

Averaging Factor in worst case condition:

Averaging factor (Worst case) = $20 \times \log\left(\frac{Ton}{Tperiod}\right) = 20 \times \log\left(\frac{15.02ms}{100ms}\right) = -16.45dB$

with:
- Ton (+5% Baud rate tolerance) = 14.3 + 0.72 = 15.02ms (considering ASK)

- Tperiod = 77.04 + 30 = 107.04ms (>100ms)

because
Shortest inter frame timing (considering its -10% tolerances)= 85.6 – 8.6 = 77.04ms.
Ton (+5%) (without considering ASK) = 28.57 + 1.43 = 30ms

Conclusion

The averaging factor that should hence be considered for TG1B EP (S120123 07A0) is -16.45dB.

Annex: Extract of TG1B EP customer specification

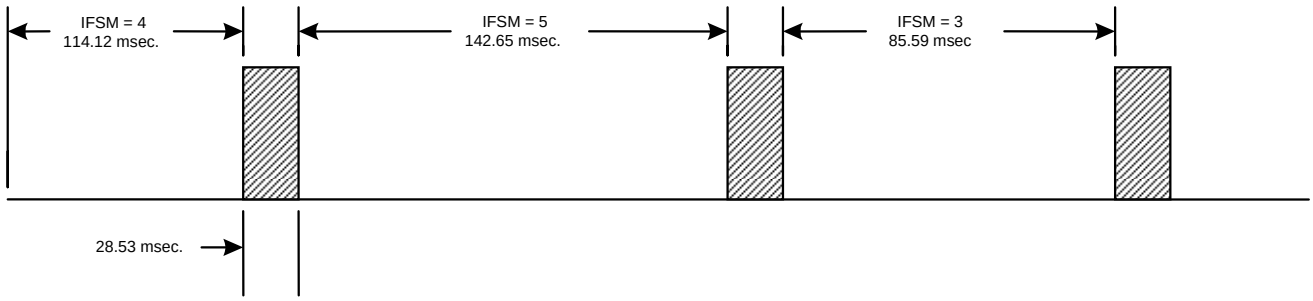
RF Link
TPS transmissions shall meet the following RF requirements, depending on intended target market:

	Domestic Market	European Market
Carrier Center Frequency	315MHz	433.92MHz
Carrier Frequency Tolerance	± 75kHz	± 75kHz
Modulation	Amplitude Shift Keying (ASK)	
Modulation Depth	90% - 100% (Min = 0.10Max @ 90%)	
Data Encoding	Manchester Encoding with 50% Duty Cycle	
Baud Rate	4.2 kbps ±5%	

TPS Frame Structure
All TPS RF frames shall have the following structure:

		@4.2kbps
Frame Length	15 Bytes	28.57 msecs
Wakeup Tone	5 Bytes	9.50 msecs
Data Bytes	10 Bytes	19.03 msecs

Inter-Frame Spacing
Each transmission (one “packet”) consists of a number of identical frames (calibratable from 1 to 8; default value is 6) that are spaced in a pseudo-random fashion. The pseudo-random spacing is achieved using an Inter-Frame Spacing Multiplier (IFSM) comprised of a randomly selected value of 3, 4 or 5 (repetition of spacing values is allowed). The IFSM is multiplied with the frame length to get the inter-frame spacing. This is done in order to avoid frame collisions between data from multiple sensors. In addition to inter-frame spacing, the IFSM is also used to generate an initial quiet time prior to each transmission to further reduce the chance of synchronous transmission from more than one sensor.
The following is an example of inter-frame spacing:



The accuracy of the IFSM timing is +/- 10%.

5.5 Emission Bandwidth

For test instruments and accessories used see section 6 Part **MB**.

5.5.1 Description of the test location

Test location: Shielded Room S4

5.5.2 Photo documentation of the test set-up

5.5.3 Test result

Fundamental	20dB Bandwidth F1	20dB Bandwidth F2	Measured Bandwidth	LIMIT Fundamental f*0,0025
315.00 MHz	314.9864 MHz	315.0300 MHz	43.6 kHz	787.5 kHz

Limit according to FCC Part 15 Subpart 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.

The requirements are **FULFILLED.**

Remarks: For detailed results, please see the test protocol below.

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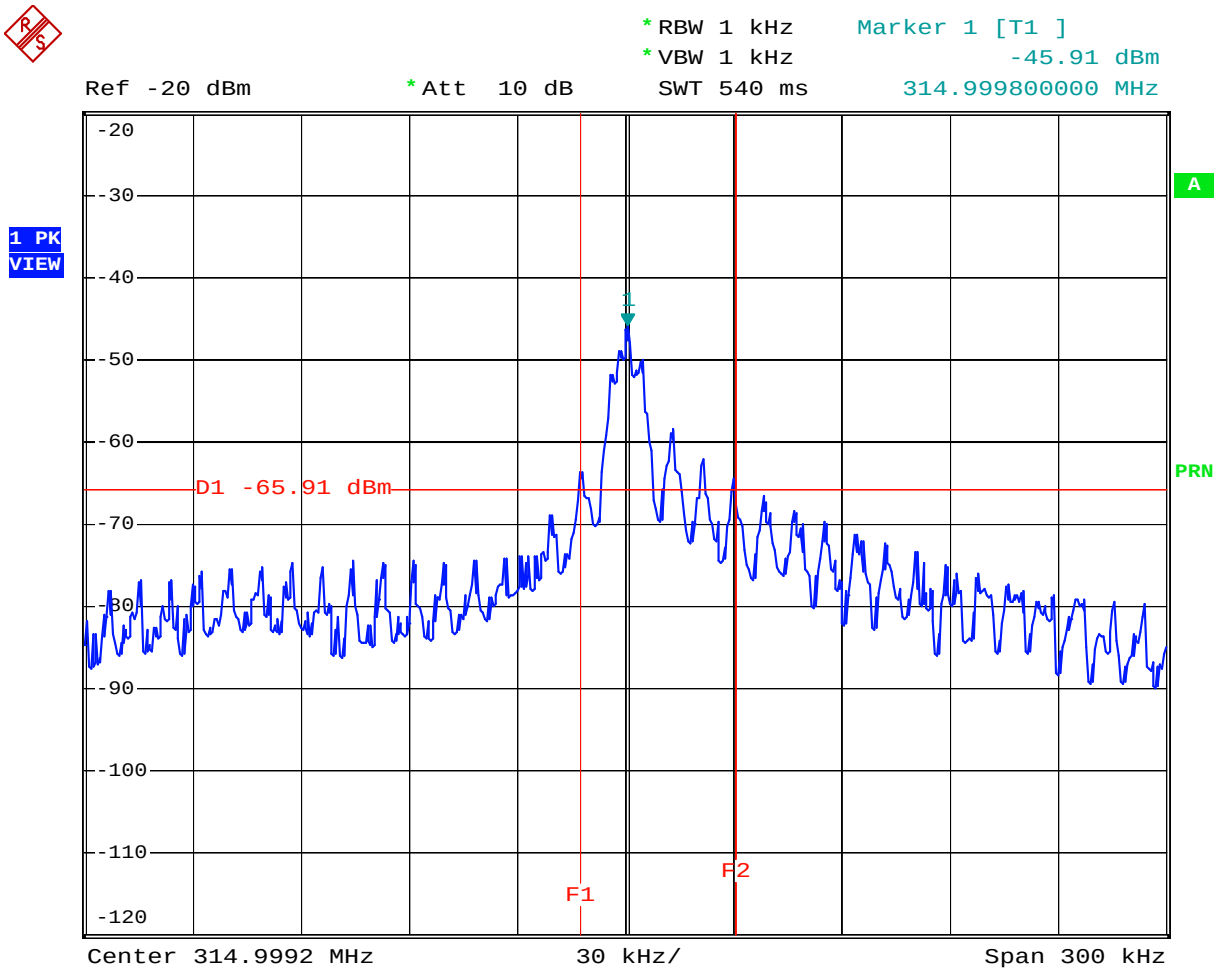
5.5.4 Test protocol

Emission Bandwidth
FCC Part 15 Subpart 15.231(c)



F1 = 314.9864 MHz F2 = 315.0300 MHz

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6 USED TEST EQUIPMENT AND ACCESSORIES

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

The calibration intervals and the calibration history will be given out on request.

Test ID	Model / Type	Kind of Equipment	Manufacturer	Equipment No.
CPR 2	ESVS 30	Test Receiver	Rohde & Schwarz München	02-02/03-05-006
	VULB 9168	Trilog-Broadband Antenna	Schwarzbeck Mess-Elektronik	02-02/24-05-005
	S10162-B / +11N-50-10-5 / +	RF Cable 33m	Huber + Suhner	02-02/50-05-031
	KK-EF393-21N-16	RF Cable 20m	Huber + Suhner	02-02/50-05-033
	NW-2000-NB	RF Cable	Huber + Suhner	02-02/50-05-113
MB	FSP 30	Spectrum Analyzer	Rohde & Schwarz München	02-02/11-05-001
	RF Antenna	Broadband Antenna	mikes-testingpartners gmbh	02-02/24-05-032
SER 2	ESVS 30	Test Receiver	Rohde & Schwarz München	02-02/03-05-006
	VULB 9168	Trilog-Broadband Antenna	Schwarzbeck Mess-Elektronik	02-02/24-05-005
	S10162-B / +11N-50-10-5 / +	RF Cable 33m	Huber + Suhner	02-02/50-05-031
	KK-EF393-21N-16	RF Cable 20m	Huber + Suhner	02-02/50-05-033
	NW-2000-NB	RF Cable	Huber + Suhner	02-02/50-05-113
SER 3	FSP 30	Spectrum Analyzer	Rohde & Schwarz München	02-02/11-05-001
	AFS4-01000400-10-10P-4	RF Amplifier 1-4 GHz	PARZICH GMBH	02-02/17-05-003
	3117	Horn Antenna 1-18 GHz	EMCO Elektronik GmbH	02-02/24-05-009
	Sucoflex N-1600-SMA	RF Cable	novotronik Signalverarbeitung	02-02/50-05-073
	Sucoflex N-2000-SMA	RF Cable	novotronik Signalverarbeitung	02-02/50-05-075