TEST REPORT # EMCC-930251C, 2000-10-25

EQUIPMENT UNDER TEST:

Type:	KALESTO
Article Number:	63.100.002.9.2
Serial Number:	161339
Equipment Category:	Transmitter
Manufacturer:	OTT MESSTECHNIK GmbH & Co. KG
Address:	Ludwigstrasse 16 87411 Kempten Germany
Phone:	+49-831-5617-313
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RELEVANT STANDARD: 47 CFR Part 15C - Intentional Radiators, §15.245

MEASUREMENT PROCEDURE USED:

☒ ANSI C63.4-1992 ☐ FCC/OET MP-4 (1987) ☐ Other

TEST REPORT PREPARED BY:

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TEST PERSONNEL:

Reinhard Sauerschell

SIGNATURE OF THE COMPANY OFFICIAL:

Dr. Werner G. Rašek
- President-

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1 GENERAL INFORMATION

1.1 Purpose

The purpose of this report is to show compliance to the FCC regulations for devices operating under section 15.245 of the Code of Federal Regulations title 47.

1.2 Limits and Reservations

The test results in this report apply only to the particular Equipment Under Test (EUT) as declared in this report.
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1.3 Test Location

Company Name:	EMCC DR. RAŠEK
Street:	Moggast 72-74
City:	91320 Ebermannstadt
Country:	Germany
Laboratory:	Test Laboratory of EMCC DR. RAŠEK FCC Registration Number: 90566 This site has been fully described in a report submitted to the FCC, and accepted in the letter dated February 09, 2000 Registration Number 90566.
Phone:	+49-9194-9016
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1.4 Manufacturer

Company Name:	OTT MESSTECHNIK GmbH & Co. KG
Street:	Ludwigstrasse 16
City:	87411 Kempten
Country:	Germany

Name for contact purposes:	Mr Zircher
Phone:	+49-831-5617-313
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E-mail:	k.zircher@ott-hydrometry.de

1.5 Dates

Date of receipt of EUT:	CW 42/2000
Test date:	CW 42/2000

2 PRODUCT DESCRIPTION

2.1 Equipment Under Test (EUT)

Description:	Low power motion detector
Device designation:	Microwave Radar Sensor
Type:	KALESTO
Article number:	63.100.002.9.2
Serial number:	161339
FCC ID:	OA6KALESTO

Transmit Frequency:	24.075 to 24.175 GHz (sweep operation mode: distance measurement) 24.125 GHz (CW operation mode: velocity measurement)
Type of modulation:	A0N (CW operation mode: velocity measurement) 100M0F1N (sweep operation mode: distance measurement)
Measurement distance:	1.5 to 30 m
Power:	12.0 VDC (9 to 15 VDC range)
Interface:	RS 458 (twisted pair)
Microwave module:	M/A-COM 87729-M01, D/C 9917
RF power:	5 dBm nominal
Horn antenna:	M/A-COM 86552, D/C 0027

2.2 EUT Peripherals

The EUT was tested connected with
- data logger, manufacturer OTT MESSTECHNIK GmbH & Co. KG, type OTT-LOG, article number 55.505.100.3.2, installed in MIDI housing, SN 161712 for start up and initializing purposes,
- DC power supply EA 3050, SN 001 (standard power supply with transformer, bridge rectifier and capacitor, no further electronical regulator).

2.3 Mode of Operation During Testing

The equipment under test (EUT) was operated during the tests under the two possible conditions:
- sweep mode (FMCW, distance measurement),
- CW mode (velocity measurement).

These modes were set by connecting the data cable of the EUT to the appropriate plug at the data logger. After switching power ON the system started up automtically into the selected mode and remained there, also when the data logger was switched OFF.

2.4 Modifications Required for Compliance

None

3 TEST RESULTS SUMMARY

Summary of Test Results

Requirement	CFR Section	Report Section	Test Result
Antenna Requirement	15.203	4	Pass
Conducted Emissions	15.207	5	Pass
Radiated Spurious Emissions	15.209, 15.205(b), 15.245(b)(3)	6	Pass
Field Strength Limits (Fundamental)	15.245(b)	6	Pass
Field Strength Limits (Harmonics)	15.245(b)(1)(ii)	6	Pass

The client has made the determination that EUT Condition, Characterization, and Mode of Operation are representative of production units, and meet the requirements of the specifications referenced herein.

Consistent with Industry practice, measurement and test equipment not directly involved in obtaining measurement results but having an impact on measurements (such as cable loss, antenna factors, etc.) are factored into the "Correction Factor" documented in certain test results. Instrumentation employed for testing meets tolerances consistent with known Industry Standards and Regulations.

The measurements contained in this report were made in accordance with the procedure ANSI C63.4 - 1992 and all applicable Public Notices received prior to the date of testing. All emissions from the device were found to be within the limits outlined in this report.
The test results in this report apply only to the particular Equipment Under Test (EUT) as declared in this report.

Test Personnel: Reinhard Sauerschell
Issuance Date: 2000-10-25

4 ANTENNA REQUIREMENT

Test Requirement: FCC CFR47, Part 15C

4.1 Regulation

15.203 An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of Part 15C. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

4.2 Result

Device:	Microwave Radar Sensor
Type:	KALESTO
Article number:	63.100.002.9.2

Antenna is a horn antenna and dielectric lens antenna tight installed inside the housing.

The EUT meets the requirements of this section.

5 CONDUCTED EMISSIONS

Test Requirement: FCC CFR47, Part 15C

Test Procedure: ANSI C63.4:1992

5.1 Regulation

Section 15.207 (a) For an intentional radiator which 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 450 kHz to 30 MHz shall not exceed 250 microvolts. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

Section 15.207 (d) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provision for, the use of battery chargers which permit operating while charging, AC adaptors or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

5.2 Test Equipment

Type	Manufacturer/ Model No.	Serial No.	Last Calibration	Next Calibration
Receiver (30 MHz - 1 GHz)	Rohde & Schwarz ESS	825132/015	March 2000	March 2001
V-LISN 50 ohms//(50 uH + 5 ohms)	Schwarzbeck NNLA8119(mod) (NSLK8127)	253	May 2000	May 2002

5.3 Test Procedures

For tabletop equipment, the EUT is placed on a 1 meter by 1.5 meters wide and 0.8 meter high nonconductive table that is placed above the groundplane. Floor standing equipment is placed directly on the groundplane. Any supplemental grounding mechanisms are connected, if appropriate. The EUT is connected to its associated peripherals, with any excess I/O cabling bundled to approximately 1 meter. The EUT is connected to a dedicated LISN and all peripherals are connected to a second separate LISN circuit. The LISNs are bonded to the groundplane.
Conducted measurements are made on each current carrying conductor with respect to ground.

The EUT was tested as a tabletop equipment, connected with the data logger and the power supply to provide the 12 VDC operation power. During the test the data logger was switched off. The tests were performed both in sweep mode and in CW mode. The initial step in collecting conducted data is a peak scan of the measurement range with an EMI test receiver. The significant peaks are then measured with quasi-peak detector.
Worst case conducted emissions are listed under chapter: test results.

Conducted Emissions Test Characteristics	
Frequency range	0.45 MHz - 30.0 MHz
Test instrumentation resolution bandwidth	9 kHz
Lines Tested	Line 1 (L) / Line 2 (N)

5.4 Test Results

Device: Microwave Radar Sensor
Type: KALESTO
Article number: 63.100.002.9.2

PRODUCT EMISSIONS QUASI PEAK DATA							
No	Tested Line	Emission Frequency [MHz]	Receiver Mode and Bandwidth [kHz]	Result [dBµV]	Spec Limit [dBµV]	Margin [dB]	Remarks
1	L	0.46	9 / QP	26.2	48.0	21.8	power supply
2	N	0.525	9 / QP	32.1	48.0	15.9	power supply
3	N	0.56	9 / QP	31.5	48.0	16.5	power supply
4	N	0.63	9 / QP	29.5	48.0	18.5	power supply
5	N	0.765	9 / QP	25.1	48.0	22.9	power supply
6	N	12.285	9 / QP	24.5	48.0	23.5	
all other emissions more than 25 dB below the limit							

Same results in sweep mode and in CW mode.

The EUT meets the requirements of this section.

Test Personnel: Reinhard Sauerschell

Test Date: 2000-10-19

6 RADIATED EMISSIONS

Test Requirement: FCC CFR47, Part 15C
Test Procedure: ANSI C63.4:1992

6.1 Regulation

Section 15.245 Operation within the bands 902–928 MHz, 2435–2465 MHz, 5785–5815 MHz, 10500–10550 MHz, and 24075–24175 MHz.
(a) Operation under the provisions of this section is limited to intentional radiators used as field disturbance sensors, excluding perimeter protection systems.
(b) The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental (millivolts/meter)	Field Strength of Harmonics (millivolts/meter)
902–928	500	1.6
2435–2465	500	1.6
5785–5815	500	1.6
10500–10550	2500	25.0
24075–24175	2500	25.0

(1) Regardless of the limits shown in the above table, harmonic emissions in the restricted bands below 17.7 GHz, as specified in § 15.205, shall not exceed the field strength limits shown in § 15.209. Harmonic emissions in the restricted bands at and above 17.7 GHz shall not exceed the following field strength limits:

(i) For field disturbance sensors designed for use only within a building or to open building doors, 25.0 mV/m.

(ii) For all other field disturbance sensors, 7.5 mV/m.

(2) Field strength limits are specified at a distance of 3 meters.

(3) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.

(4) The emission limits shown above are based on measurement instrumentation employing an average detector. The provisions in § 15.35 for limiting peak emissions apply.

Section 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. For battery operated equipment, the equipment tests shall be performed using a new battery.

Section 15.33 (a) (2) If the intentional radiator operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

Section 15.35 Measurement detector functions and bandwidths.
(b) On any frequency of frequencies above 1000 MHz, the radiated limits shown are based upon the use of measurement instrumentation employing an average detector function. When average radiated emission measurements are specified in the regulations, including emission measurements below 1000 MHz, there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules in this part, e.g., see § 15.255. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. Measurement of AC power line conducted emissions are performed using a CISPR quasipeak detector, even for devices for which average radiated emission measurements are specified.

Section 15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement distance (meters)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30
30–88	100	3
88–216	150	3
216–960	200	3
Above 960	500	3

(b) In the emission table above, the tighter limit applies at the band edges.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

6.2 Radiated Emissions Test, 9 kHz to 30 MHz (Magnetic Field Test)

6.2.1 Test Equipment

Type	Manufacturer/ Model No.	Serial No.	Last Calibration	Next Calibration
Receiver (9 kHz - 1 GHz)	Rohde & Schwarz ESS	825132/015	March 2000	March 2001
Loop Antenna	R&S HFH 2-Z2	892665/004	June 2000	June 2002

6.2.2 Test Procedures

For tabletop equipment, the EUT is placed on a 1 meter by 1.5 meters wide and 0.8 meter high nonconductive table that sits on a flush mounted metal turntable. Floor standing equipment is placed directly on the flush mounted metal turntable. The EUT is connected to its associated peripherals with any excess I/O cabling bundled to approximately 1 meter.

Emissions from the unit are maximized by adjusting the orientation of the receive loop antenna and rotating the EUT on the turntable. Manipulating the system cables also maximizes EUT emissions. All tests performed with the EUT placed in two polarizations on the nonconductive table: horizontal and vertical. Refer to the photographs' section.

The EUT was tested as a tabletop equipment, connected with the data logger and the power supply to provide the 12 VDC operation power. The test distance was reduced to 3 m by extrapolating the limit by using the square of an inverse linear distance extrapolation factor (40 dB/decade) according to section 15.31 (f) (2).
During the test the data logger was switched off. The tests were performed both in sweep mode and in CW mode. The initial step in collecting radiated data is a peak scan of the measurement range with an EMI test receiver. The significant peaks within a margin of 25 dB to the limit are then measured with quasi-peak detector.
Worst case radiated emissions are listed under chapter: test results.

Radiated Emissions Test Characteristics (magnetic field test)	
Frequency range	9 kHz - 30 MHz
Test distance	3 m*
Test instrumentation resolution bandwidth	200 Hz (9 kHz - 150 kHz)
	9 kHz (150 kHz - 30 MHz)
Test instrumentation detector	QP
Receive antenna height	1 m
Receive antenna orientation	0 - 360°

* Section 15.31 (f) (2) At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a

minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade).

6.2.3 Calculation of Field Strength Limits

Calculation: microvolts/meter to dBµV/m

Specified parameters			
Frequency	Field Strength		Measurement distance
(MHz)	(µV/m)	(dBµV/m)	(meters)
0.009–0.490	266.7-4.9	48.5-13.8	300
0.490–1.705	49.0-14.1	33.8-23.0	30
1.705–30.0	30	29.5	30

6.2.4 Field Strength Calculation

No special calculation for obtaining the field strength in dBµV/m is necessary, because the EMI receiver and the active loop antenna operate as a system, where the reading gives directly the field strength result (dBµV/m). The gain, antenna factors and cable losses are already taken into consideration.

For test distance other than what is specified, but fulfilling the requirements of Section 15.31 (f) (2) the field strength is calculated by adding additionally an extrapolation factor of 40 dB/decade (inverse linear-distance for field strength measurements). The basic equation with a sample calculation is as follows:

FS = RA + DF
where
FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV/m
DF = Distance Extrapolation Factor in dB,
where DF = 20 log (Dtest/Dspec) where Dtest = Test Distance and Dspec = Specified Distance

Assume the tests performed at a reduced Test Distance of 3 m instead of the Specified Distance of 30 m giving a Distance Extrapolation Factor of DF = 40 log(3m/30m) = -40 dB.
Assuming a receiver amplitude of 40.7 dBµV/m is obtained. The distance factor of -40 dB are added, giving a field strength of 0.7 dBµV/m. The 0.7 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 40.7 - 40 = 0.7 [dBµV/m]

Level in µV/m = Common Antilogarithm (0.7/20) = 1.1

6.2.5 Test Results

Device: Microwave Radar Sensor
Type: KALESTO
Article number: 63.100.002.9.2

PRODUCT EMISSIONS QUASI PEAK DATA									
No	Emission Frequency [MHz]	Receiver Mode and Bandwidth [kHz]	Test Distance [m]	Receiver Reading RA [dBµV/m]	Distance Extrapola-tion Factor DF [dB]	Result = Corrected Reading FS [dBµV/m]	Spec Limit [dBµV/m]	Margin [dB]	Remarks
1	0.61	10kHz/PK	3	39.5	-40	-0.5	31.9	32.4	
2	0.66	10kHz/PK	3	40.7	-40	0.7	31.2	30.5	

The EUT meets the requirements of this section.

Test Personnel: Reinhard Sauerschell

Test Date: 2000-10-19

6.3 Radiated Emissions Test, 30 MHz to 26.5 GHz

6.3.1 Test Equipment

Type	Manufacturer/ Model No.	Serial No.	Last Calibration	Next Calibration
Receiver (30 MHz - 1 GHz)	Rohde & Schwarz ESS	825132/015	March 2000	March 2001
Antenna (30 MHz - 1 GHz)	EMCO 3143	9608-1316	Feb. 2000	Feb. 2001
Receiver (1 GHz - 26.5 GHz)	Rohde & Schwarz ESAI-D ESMI-RF ESMI-B1	833771/008 833827/002 832504/005	June 2000	Dec. 2001
Antenna (1 GHz - 18 GHz)	Schwarzbeck BBHA 9120 D	137	Oct. 1999	Oct. 2001
Standard Gain Horn Antenna (18 GHz - 26.5 GHz)	Mid Century MC 20/31B	1362/86	May 2000	May 2002

6.3.2 Test Procedures

For tabletop equipment, the EUT is placed on a 1 meter by 1.5 meters wide and 0.8 meter high nonconductive table that sits on a flush mounted metal turntable. Floor standing equipment is placed directly on the flush mounted metal turntable. The EUT is connected to its associated peripherals with any excess I/O cabling bundled to approximately 1 meter.

Preview tests are performed to determine the "worst case" mode of operation. With the EUT operating in "worst case" mode, emissions from the unit are maximized by adjusting the polarization and height of the receive antenna and rotating the EUT on the turntable. Manipulating the system cables also maximizes EUT emissions. All tests performed with the EUT placed in two polarizations on the nonconductive table: horizontal and vertical. Refer to the photographs' section.

The EUT was tested as a tabletop equipment, connected with the data logger and the power supply to provide the 12 VDC operation power.
During the test the data logger was switched off. The tests were performed both in sweep mode and in CW mode. The initial step in collecting radiated data is a peak scan of the measurement range with an EMI test receiver under closer distances as given in the rule. The significant peaks are then measured with the appropriate detectors (AV and PK).
Worst case radiated emissions are listed under chapter: test results.

Radiated Emissions Test Characteristics	
Frequency range	30 MHz - 26,500 MHz
Test distance	3 m
Test instrumentation resolution bandwidth	120 kHz (30 MHz - 1,000 MHz)
	1 MHz (1,000 MHz - 26,500 MHz)
Test instrumentation detector	QP (30 MHz - 1,000 MHz)
	AV (1,000 MHz - 26,500 MHz)
Receive antenna scan height	1 m - 4 m
Receive antenna polarization	Vertical/Horizontal

6.3.3 Calculation of Field Strength Limits

Calculation: microvolts/meter to dBµV/m

Frequency	Field Strength		Measurement distance	Remarks
(MHz)	(microvolts/meter)	(dBµV/m)	(meters)	
30–88	100	40	3	
88–216	150	43.5	3	
216–960	200	46	3	
960-26,500	500	54	3	
24,075-24,175	2,500,000	128	3	Carrier

6.3.4 Average Correction Factor

NOTE: All measurement performed using the test receiver's average detector and the max. hold facility; the average value measured directly without the necessity of additional correction factor.

6.3.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF
where
FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB

Assume a receiver reading of 23.5 dBµV is obtained. The Antenna Factor of 7.4 dB(1/m) and a Cable Factor of 1.1 dB are added, giving a field strength of 32 dBµV/m. The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 23.5 + 7.4 + 1.1 = 32 [dBµV/m]

Level in µV/m = Common Antilogarithm (32/20) = 39.8

6.3.6 Test Results

Device: Microwave Radar Sensor
Type: KALESTO
Article number: 63.100.002.9.2

PRODUCT EMISSIONS DATA 15.245 BANDS											
No	Emission Frequency [MHz]	Receiver Mode and Bandwidth [kHz]	Test Distance [m]	Receiver Reading RA [dBµV]	Correction Factor AF+CF [dB(1/m)]	Distance Extrapolation Factor DF [dB]	Result = Corrected Reading FS [dBµV/m]	Spec Limit [dBµV/m]	Polarization Eut/Ant	Margin [dB]	Remark
1	200.03	120, QP	3	18	12	0	30	66.2	v / h	36.2	
2	366.7	120, QP	3	23	17.7	0	40.7	66.2	h / v	25.5	
3	2,038	1000, AV + PK	3	22.5	26.5	0	49	66.2	h / v	17.2	
4	24,075	1000, AV	3	7	41.8	0	48.8	66.2	on axis, co polarized	17.4	noise
		1000, PK	3	19	41.8	0	60.8	66.2+20 = 86.2		25.4	noise
5	24,105	1000, AV	3	74.4	41.8	0	116.2	128		11.8	CW mode
		1000, PK	3	74.4	41.8	0	116.2	128+20 =148		31.8	
6	24,105	1000, AV	3	72.4	41.8	0	114.2	128		13.8	sweep mode
		1000, PK	3	74.4	41.8	0	116.2	128+20 =148		31.8	
7	24,175	1000, AV	3	7	41.8	0	48.8	66.2		17.4	noise
		1000, PK	3	19	41.8	0	60.8	66.2+20 = 86.2		25.4	noise

PRODUCT EMISSIONS DATA 15.205 BANDS											
No	Emission Frequency [MHz]	Receiver Mode and Bandwidth [kHz]	Test Distance [m]	Receiver Reading RA [dBµV]	Correction Factor AF+CF [dB(1/m)]	Distance Extrapola-tion Factor DF [dB]	Result = Corrected Reading FS [dBµV/m]	Spec Limit [dBµV/m]	Polari-zation Eut/Ant	Margin [dB]	Remark
1	133.35	120, QP	3	12	10.1	0	22.1	43.5	v / v	21.4	
2	166.68	120, QP	3	21	10.8	0	31.8	43.5	v / v	11.7	
3	400.05	120, QP	3	22	18.7	0	40.7	46	v / v	5.3	
4	1,169	1000, AV	3	20.5	26.5	0	47.0	54	h / v	7	
		1000, PK	3	20.5	26.5	0	47.0	74	h / v	27	
5	1,509	1000, AV	3	24.5	26.5	0	51.0	54	h / v	3	
		1000, PK	3	24.5	26.5	0	51.0	74	h / v	23	

NOTE: Same results both in CW and in sweep mode, if not otherwise indicated.
Same results for the carrier with voltage variation of the power supply.

The EUT meets the requirements of this section.

Test Personnel: Reinhard Sauerschell

Test Date: 2000-10-20

6.4 Radiated Emissions Test, 26.5 GHz to 100 GHz

6.4.1 Test Equipment

Type	Manufacturer/ Model No.	Serial No.	Last Calibration	Next Calibration
Antenna (30 MHz - 1 GHz)	EMCO 3143	9608-1316	Feb. 2000	Feb. 2001
Receiver (26.5 GHz - 100 GHz) Waveguide Mixer LO Amplifier	Rohde & Schwarz ESAI-D ESMI-RF ESMI-B1 R&S/Tektronix FS-Z40/WM782A FS-Z60/WM782U FS-Z75/WM782V FS-Z110/WM782W R&S, FS-Z30	 833771/008 833827/002 832504/005 840448/007 840449/001 840450/005 840451/005 775850/002	June 2000	Dec. 2001
Standard Gain Horn Antenna	FMI/Pro N 2624-25	21	May 2000	May 2002
Standard Gain Horn Antenna	FMI/ProN 2424-25	30	May 2000	May 2002
Standard Gain Horn Antenna	FMI 2824-25	24	May 2000	May 2002

6.4.2 Test Procedures

The basic test setups and procedures are the same as for the tests 30 MHz to 26.5 GHz. Above 26.5 GHz additional external mixers have to be used, which means additional correction factors.

Radiated Emissions Test Characteristics	
Frequency range	26,500 MHz - 100,00 MHz
Test distance	0.5 - 3 * m
Test instrumentation resolution bandwidth	1 MHz
Test instrumentation detector	PK (no AV available)
Receive antenna scan height	no height scan performed due to high gain antenna
Receive antenna polarization	Vertical/Horizontal

* According to Section 15.31 (f) (1): At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. (...) When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

6.4.3 Calculation of Field Strength Limits

Calculation: microvolts/meter to dBµV/m

Frequency	Field Strength		Measurement distance	Remarks
(MHz)	(microvolts/meter)	(dBµV/m)	(meters)	
26,500 - 100,000	500	54	3	
Harmonics	7,500	77,5	3	

6.4.4 Calculation of Average Correction Factor

The tests were performed with PK detector, because the spectrum analyzer provides no AV detector in EXT MIXER measuring mode.

These readings were used for calculating the results, because the tests at lower frequencies, particularly at the carrier, showed no significant differences between AV and PK (in CW mode: 0 dB, in sweep mode: 2 dB).

6.4.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Mixer Loss. The basic equation with a sample calculation is as follows:

FS = RA + AF + ML
where
FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB(1/m)
ML = Mixer Loss in dB

Assume a receiver reading of 10.2 dBµV is obtained. The Antenna Factor of 38.8 dB(1/m) and a Mixer Loss of 22 dB are added, giving a field strength of 71 dBµV/m. The 71 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 10.2 + 38.8 + 22 = 71 [dBµV/m]

Level in µV/m = Common Antilogarithm (71/20) = 3,548

For test distance other than what is specified, but fulfilling the requirements of Section 15.31 (f)(1) the field strength is calculated by adding additionally an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements). The basic equation with a sample calculation is as follows:

FS = RA + AF + ML + DF
where
FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB(1/m)
ML = Mixer Loss in dB
DF = Distance Extrapolation Factor in dB,
where DF = 20 log (Dtest/Dspec) where Dtest = Test Distance and Dspec = Specified Distance

Assume the tests performed at a reduced Test Distance of 1 m instead of the Specified Distance of 3 m giving a Distance Extrapolation Factor of DF = 20 log(1m/3m) = -9.5 dB.
Assuming a receiver reading of 10.2 dBµV is obtained. The Antenna Factor of 38.3 dB(1/m), the Mixer Loss of 22 dB and the Distance Factor of -9.5 dB are added, giving a field strength of 61.5 dBµV/m. The 61.5 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 10.2 + 38.8 + 22 - 9.5 = 61.5 [dBµV/m]

Level in µV/m = Common Antilogarithm (61.5/20) = 1,188

6.4.6 Test Results

Device: Microwave Radar Sensor
Type: KALESTO
Article number: 63.100.002.9.2

PRODUCT EMISSIONS DATA 15.245 BANDS											
No	Emission Frequency [MHz]	Receiver Mode and Bandwidth [kHz]	Test Distance [m]	Receiver Reading RA [dBµV]	Antenna Factor AF [dB(1/m)]	Mixer Loss ML [dB]	Distance Extrapolation Factor DF [dB]	Result = Corrected Reading FS [dBµV/m]	Spec Limit [dBµV/m]	Polarization Eut/Ant	Margin [dB]
1	48,213	1000, PK	3	11	38.8	22	0	71.8	77.5	on axis, co polarized	5.7
2	72,315	1000, PK	1	11.1	42.3	30	-9.5	73.9	77.5	on axis, co polarized	3.6
3	96,420	1000, PK	0.5	2	44.8	34	-15.6	65.2 *	77.5	all	12.3

* Receiver noise

PRODUCT EMISSIONS DATA 15.205 BANDS											
No	Emission Frequency [MHz]	Receiver Mode and Bandwidth [kHz]	Test Distance [m]	Receiver Reading RA [dBµV]	Antenna Factor AF [dB(1/m)]	Mixer Loss ML [dB]	Distance Extrapolation Factor DF [dB]	Result = Corrected Reading FS [dBµV/m]	Spec Limit [dBµV/m]	Polarization Eut/Ant	Margin [dB]
No emissions detected											

NOTE: Same results both in CW and in sweep mode.

The EUT meets the requirements of this section.

Test Personnel: Reinhard Sauerschell

Test Date: 2000-10-20

7 MISCELLANEOUS COMMENTS AND NOTES

None.

8 LIST OF ANNEXES

Following annexes are separated parts to this test report.

Description	Pages
Annex 1: Photographs of test setups	4
Annex 2: Photographs of equipment under test (EUT)	12