EUT: UMRR-0F0002-1D0907-050B00
FCC ID: W34UMRR0F1D

Date of issue: 2014-12-10

Test Report acc. to FCC Title 47 CFR Part 15
relating to
s.m.s., smart microwave sensors GmbH
UMRR-0F0002-1D0907-050B00

Title 47 - Telecommunication
Part 15 - Radio Frequency Devices
Subpart C – Intentional Radiators
Measurement Procedure:
ANSI C63.4-2009

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

Manufacturer's details	
Manufacturer	s.m.s smart microwave sensors GmbH
Manufacturer's grantee code	**W34**
Manufacturer's address	s.m.s. smart microwave sensors GmbH
	In den Waashainen 1
	38108 Braunschweig
	Germany
	Phone: +49 (0) 531 390 23 0
	Fax: +49 (0) 531 390 23 599
	Email: ralph.mende@smartmicro.de
Relevant standard used	47 CFR Part 15C - Intentional Radiators
	ANSI C63.4-2009

Test Report prepared by	
Technical engineer	Ralf Trepper
	m. dudde hochfrequenz-technik (laboratory)
	Rottland 5a
	51429 Bergisch Gladbach
	Germany
	Phone: +49 2207 96890
	Fax: +49 2207 968920
	Email: m.duddelabor@dudde.com

Equipment **U**nder **T**est **(EUT)**	
Equipment category	Transceiver (Field Disturbance Sensor)
Trade name	smartmicro
Type designation	**UMRR-0F0002-1D0907-050B00**
Serial no.	0X000257BB
Variants	**UMRR-0F0003-1D0907-050B00**

EUT: UMRR-0F0002-1D0907-050B00
FCC ID: W34UMRR0F1D

Date of issue: 2014-12-10

1. Test results

Clause	Requirements headline	Test result			Report page number
8.1	Antenna requirement	**Pass**	~~Fail~~	~~N.t.*~~	9
8.2	Conducted limits	**Pass**	~~Fail~~	~~N.t.*~~	10 to 13
8.3	Restricted bands of operation	**Pass**	~~Fail~~	~~N.t.*~~	14 to 16
8.4	Radiated emission limits, general requirements	**Pass**	~~Fail~~	~~N.t.*~~	17 to 21
8.5	Fundamental frequencies / Field strength limits	**Pass**	~~Fail~~	~~N.t.*~~	22 to 25
8.6	Bandwidth	**Pass**	~~Fail~~	~~N.t.*~~	26

* Not tested

The equipment passed e conducted tests	**Yes**	~~No~~

Signature: ..... (Technician)

Signature: ..... (Laboratory-Manager)

Ralf Trepper
2015.01.09
10:01:19
+01'00'

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

Table of contents

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

2. Introduction

This test report **is not an expert opinion** and consists of:

- Test result summary
- List of contents
- Introduction and further information
- Performance assessment
- Detailed test information

All pages have been numbered consecutively and bear the m. dudde hochfrequenz-technik logo, the test report number, the date, the test specification in its current version as well as the type designation of the EUT. The total numbers of pages in this report are **35**.

The tests were carried out at:

- m. dudde hochfrequenz-technik, D-51429 Bergisch Gladbach

in a representative assembly and in accordance with the test methods and/or requirements stated in:

FCC Title 47 CFR Part 15 Subpart C & ANSI C63.4-2009

The sample of the product was received on:

- 2014-07-11

The tests were carried out in the following period of time:

- 2014-09-02 – 2014-10-22

3. Testing laboratory

m. dudde hochfrequenz-technik
Rottland 5a, 51429 Bergisch Gladbach, Germany

Phone: +49 - (0) 22 07 / 96 89-0
Fax: +49 - (0) 22 07 / 96 89-20

- FCC Registration Number: **699717**

Accredited by:

DAkkS Deutsche Akkreditierungsstelle GmbH
DAkkS accreditation number: D-PL-12053-01

4. Applicant

Company name	: s.m.s. smart microwave sensors GmbH
Address	: In den Waashainen 1 38108 Braunschweig
Country	: Germany
Telephone	: +49 (0) 531 390 23 0
Fax	: +49 (0) 531 390 23 599
Email	: ralph.mende@smartmicro.de
Date of order	: 2014-04-28
References	: Dr. Ralph Mende

5. Product and product documentation

Samples of the following apparatus were submitted for testing:

Manufacturer	: s.m.s. smart microwave sensors GmbH
Trademark	: smartmicro
Type designation	: **UMRR-0F0002-1D0907-050B00**
Serial number	: 0X000257BB
Hardware versions	: UMRR-0F0002-1D0907-050B00
Variants	: **UMRR-0F0003-1D0907-050B00**
Software release	: ---
Type of equipment	: Field Disturbance Sensor / Non specific SRD
Power used	: 24 V DC
Frequency used	: 24.0810 GHz - 24.1560 GHz
Generated or used frequencies	: 16.0 MHz (crystal), 25.0 MHz (crystal), 30.00 MHz (oscillator module) 24.0810 GHz - 24.1560 GHz (carrier)
ITU emission class	: 8M40 F0N
FCC ID	**: W34UMRR0F1D**

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

For issuing this report the following product documentation was used:

Description	Date	Identifications
External photographs of the **E**quipment **U**nder **T**est (EUT)	2014-12-10	Annex no. 1
Internal photographs of the **E**quipment **U**nder **T**est (EUT)	2014-12-10	Annex no. 2
Channel occupancy / bandwidth	2014-12-10	Annex no. 3
Label sample	2014-12-10	Annex no. 4
Functional description / User Manual	2014-12-10	Annex no. 5
Test setup photos	2014-12-10	Annex no. 6
Block diagram	2014-12-10	Annex no. 7
Operational description	2014-12-10	Annex no. 8
Schematics	2014-12-10	Annex no. 9
Parts list	2014-12-10	Annex no. 10
Antenna description	2014-12-10	Annex no. 11

6. Conclusions, observations and comments

The test report will be filed at m. dudde hochfrequenz-technik for a period of 10 years following the issue of this report. It may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of m. dudde hochfrequenz-technik.

The results of the tests as stated in this report are exclusively applicable to the EUT as identified in this report. m. dudde hochfrequenz-technik cannot be held liable for properties of the EUT that have not been observed during these tests.

m. dudde hochfrequenz-technik assumes the sample to comply with the requirements of FCC Title 47 CFR Part 15 for the respective test sector, if the test results turn out positive.

Comments: ---

Date	: 2014-12-10	Date	: 2014-12-10
Name	: Ralf Trepper	Name	: Manfried Dudde
Function	: Technician	Function	: Laboratory Manager
Signature	:……	Signature	:……

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

7. Operational description

7.1 EUT details

Transceiver, Field disturbance sensor

The main task of the UMRR is the detection of any reflectors in the field of view, to measure the distance, the relative speed and the angle to the shortest reflector (and to other reflectors), to detect motion and to track (filter) the results over time.
For this **general purpose measurement application**, range and relative radial speed and the angle value of each reflector inside the antenna beam are measured and the results are reported via the communication links cycle by cycle.

7.2 EUT configuration

Operation : As soon as the equipment is powered up, TX starts operating. The channel is switched via software.
Purpose of operation : see user manual

7.3 EUT measurement description

Radiated emissions

The EUT has been tested as a standalone device. In order to establish the maximum radiation, firstly, there have been viewed all orthogonal adjustments of the test sample. Secondly the test sample (UMRR-0F0002-1D0907-050B00) has been rotated at all adjustments around the own axis between 0° and 360°, and thirdly, the antenna polarization between horizontal and vertical has been varied. All generated frequencies, the lowest and the highest frequency of the equipment have been viewed. The device was tested on a standalone basis.
The spurious emissions were measured up to 140 GHz!

In all measurement distances the 3 dB beam width of the measuring antenna, for measurements above 1 GHz, is greater than the EUT's dimensions.

Conducted emissions

The device was connected via LAN cable to the LAN port from a notebook and this to the artificial mains network. First it has been tested in with inactive *(UMRR-0F0002-1D0907-050B00)* and secondly with active *(UMRR-0F0002-1D0907-050B00)*. L1 and N have been viewed.

8. Compliance assessment

8.1 Antenna requirement

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 this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, 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.

8.1.2 Result

The equipment meets the requirements	**Yes**	~~No~~	~~N.t.~~

Further test results are attached	**Yes**	~~No~~	Annex no. 11

Linear polarized planar antennas:

- one transmitting antenna
- two receiving antennas

N.t.* See page no. 29

8.2 Conducted limits

8.2.1 Regulation

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional 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, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

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

(b) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

1) For carrier current system containing their fundamental emission within the frequency band 535–1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 µV within the frequency band 535–1705 kHz, as measured using a 50 µH/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in §15.205, §15.209, §15.221, §15.223, or §15.227, as appropriate.

(c) 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 provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtainig their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

8.2.2 Test procedures

The EUT and the additional equipment (if required) are connected to the main power through a line impedance stabilization network (LISN). The LISN must be appropriate to ANSI C63.4-2009 Section 7. Additional equipment must also be connected to a second LISN with the same specifications described in the above sentence (if required).

8.2.3 Result

Tested with external AC power supply

Conducted emissions (Section 15.107)						
Tested line	f MHz	Bandwidth kHz	Noted receiver level dBµV	Spec. limit (average) dBµV	Margin dBµV	Remarks
L1		9		> 50.0		*[2]
N		9		> 50.0		*[2]
L1		9		> 50.0		*[2]
N		9		> 50.0		*[2]
L1		9		> 46.0		*[2]
N		9		> 46.0		*[2]
L1		9		> 46.0		*[2]
N		9		> 46.0		*[2]
L1		9		50.0		*[2]
N		9		50.0		*[2]
L1		9		50.0		*[2]
N		9		50.0		*[2]
L1		9		50.0		*[2]
N		9		50.0		*[2]
L1		9		50.0		*[2]
N		9		50.0		*[2]
Measurement uncertainty	< ± 2 dB					

Remark: *[1] Noise level of the measuring instrument ≤ -2dBµV (0.009 – 30MHz)
Remark: *[2] Quasi peak measurements lower than "Specified Average Limit"

The equipment passed the conducted tests	~~Yes~~	~~No~~	**N.t.[2]**

Further test results are attached	~~Yes~~	**No**	Page no.

Test equipment used:

N.t.* See page no. 29

EUT: UMRR-0F0002-1D0907-050B00
FCC ID: W34UMRR0F1D

Date of issue: 2014-12-10

Tested only Laptop via LAN port (Laptop: HP proBook 6475b, S/N CNU2509011)

Conducted emissions (Section 15.107)									
Tested line	f	Bandwidth	Noted receiver level		Spec. limit		Margin		Remarks
			QP	**AV**	QP	**AV**	QP	**AV**	
L / N	MHz	kHz	dBµV	**dBµV**	dBµV	**dBµV**	dBµV	**dBµV**	
L1	0.1566	9	65	**52**	65	**55.6**	0	**3.6**	---
N	0.1566	9	65	**52**	65	**55.6**	0	**3.6**	---
L1	0.2334	9	53	**41**	62	**52.3**	9	**11.3**	---
N	0.2334	9	53	**41**	62	**52.3**	9	**11.3**	---
L1	0.3075	9	43	---	60	**50**	17	---	*[2]
N	0.3075	9	43	---	60	**50**	17	---	*[2]
L1	1.1529	9	35	---	56	**46**	21	---	*[2]
N	1.1529	9	35	---	56	**46**	21	---	*[2]
L1	1.3854	9	35	---	56	**46**	21	---	*[2]
N	1.3854	9	35	---	56	**46**	21	---	*[2]
L1	1.7712	9	35	---	56	**46**	21	---	*[2]
N	1.7712	9	35	---	56	**46**	21	---	*[2]
L1	11.7997	9	35	---	60	**50**	25	---	*[2]
N	11.7997	9	35	---	60	**50**	25	---	*[2]
Measurement uncertainty			< ± 2 dB						

Remark: *[1] Noise level of the measuring instrument ≤ -2dBµV (0.009 – 30MHz)
Remark: *[2] Noted Quasi peak receiver level measurements are lower than the"Specified Average Limit"

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~

Further test results are attached	~~Yes~~	**No**	Page no.

Test equipment used: K30, 28, 72, 272, 428, 429

N.t.* See page no. 29

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

EUT: UMRR-0F0002-1D0907-050B00
FCC ID: W34UMRR0F1D

Date of issue: 2014-12-10

Tested EUT+ Laptop via LAN port (Laptop: HP proBook 6475b, S/N CNU2509011)

Conducted emissions (Section 15.107)									
Tested line	f	Bandwidth	Noted receiver level		Spec. limit		Margin		Remarks
			QP	**AV**	QP	**AV**	QP	**AV**	
L / N	MHz	kHz	dBµV	**dBµV**	dBµV	**dBµV**	dBµV	**dBµV**	
L1	0.1566	9	65	**46**	65	**55.6**	0	**9.6**	---
N	0.1566	9	65	**46**	65	**55.6**	0	**9.6**	---
L1	0.2334	9	49	**42**	62	**52.3**	13	**10.3**	---
N	0.2334	9	49	**42**	62	**52.3**	13	**10.3**	---
L1	0.3075	9	41	---	60	**50**	19	---	*[2]
N	0.3075	9	41	---	60	**50**	19	---	*[2]
L1	1.1529	9	35	---	56	**46**	21	---	*[2]
N	1.1529	9	35	---	56	**46**	21	---	*[2]
L1	1.3854	9	35	---	56	**46**	21	---	*[2]
N	1.3854	9	35	---	56	**46**	21	---	*[2]
L1	1.7712	9	35	---	56	**46**	21	---	*[2]
N	1.7712	9	35	---	56	**46**	21	---	*[2]
L1	11.7997	9	38	---	60	**50**	22	---	*[2]
N	11.7997	9	38	---	60	**50**	22	---	*[2]
Measurement uncertainty			< ± 2 dB						

Remark: *[1] Noise level of the measuring instrument ≤ -2dBµV (0.009 – 30MHz)
Remark: *[2] Noted Quasi peak receiver level measurements are lower than the"Specified Average Limit"

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~

Further test results are attached	~~Yes~~	**No**	Page no.

Test equipment used: K30, 28, 72, 272, 428, 429

N.t.* See page no. 29

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

8.3 Restricted bands of operation

8.3.1 Regulation

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]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	([2])
13.36 - 13.41			

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.
[2] Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

(c) Except as provided in paragraphs (d) and (e), regardless of the field strength limits specified elsewhere in this Subpart, the provisions of this Section apply to emissions from any intentional radiator.

(d) The following devices are exempt from the requirements of this Section:

(1) Swept frequency field disturbance sensors operating between 1.705 and 37 MHz provided their emissions only sweep through the bands listed in paragraph (a), the sweep is never stopped with the fundamental emission within the bands listed in paragraph (a), and the fundamental emission is outside of the bands listed in paragraph (a) more than 99% of the time the device is actively transmitting, without compensation for duty cycle.

(2) Transmitters used to detect buried electronic markers at 101.4 kHz which are employed by telephone companies.

(3) Cable locating equipment operated pursuant to Section 15.213.

(4) Any equipment operated under the provisions of § 15.253, § 15.255 or § 15.257 of this part.

(5) Biomedical telemetry devices operating under the provisions of Section 15.242 of this part are not subject to the restricted band 608-614 MHz but are subject to compliance within the other restricted bands.

(6) Transmitters operating under the provisions of Subpart D or F of this part.

(7) Devices operated pursuant to § 15.225 are exempt from complying with this section for the 13.36-13.41 MHz band only.

(8) Devices operated in the 24.075-24.175 GHz band under § 15.245 are exempt from complying with the requirements of this section for the 48.15-48.35 GHz and 72.225-72.525 GHz bands only, and shall not exceed the limits specified in § 15.245(b).

(9) Devices operated in the 24.0-24.25 GHz band under § 15.249 are exempt from complying with the requirements of this section for the 48.0-48.5 GHz and 72.0-72.75 GHz bands only, and shall not exceed the limits specified in § 15.249(a).

(e) Harmonic emissions appearing in the restricted bands above 17.7 GHz from field disturbance sensors operating under the provisions of Section 15.245 shall not exceed the limits specified in Section 15.245(b).

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

(c) Except as provided in paragraphs (d) and (e), regardless of the field strength limits specified elsewhere in this Subpart, the provisions of this Section apply to emissions from any intentional radiator. (d) The following devices are exempt from the requirements of this Section:

(1) Swept frequency field disturbance sensors operating between 1.705 and 37 MHz provided their emissions only sweep through the bands listed in paragraph (a), the sweep is never stopped with the fundamental emission within the bands listed in paragraph (a), and the fundamental emission is outside of the bands listed in paragraph (a) more than 99% of the time the device is actively transmitting, without compensation for duty cycle.

(2) Transmitters used to detect buried electronic markers at 101.4 kHz which are employed by telephone companies.

(3) Cable locating equipment operated pursuant to Section 15.213.

(4) Any equipment operated under the provisions of § 15.253, § 15.255 or § 15.257 of this part.

(5) Biomedical telemetry devices operating under the provisions of Section 15.242 of this part are not subject to the restricted band 608-614 MHz but are subject to compliance within the other restricted bands.

(6) Transmitters operating under the provisions of Subpart D or F of this part.

(7) Devices operated pursuant to § 15.225 are exempt from complying with this section for the 13.36-13.41 MHz band only.

(8) Devices operated in the 24.075-24.175 GHz band under § 15.245 are exempt from complying with the requirements of this section for the 48.15-48.35 GHz and 72.225-72.525 GHz bands only, and shall not exceed the limits specified in § 15.245(b).

(9) Devices operated in the 24.0-24.25 GHz band under § 15.249 are exempt from 83 complying with the requirements of this section for the 48.0-48.5 GHz and 72.0-72.75 GHz bands only, and shall not exceed the limits specified in § 15.249(a).

(e) Harmonic emissions appearing in the restricted bands above 17.7 GHz from field disturbance sensors operating under the provisions of Section 15.245 shall not exceed the limits specified in Section 15.245(b).

8.3.2 Result

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~

Further test results are attached	~~Yes~~	**No**	Page no.

Test equipment used: K40, K46, K50, K56, K84, K144, K147, K148, K501, 103, 166a, 171a, 223a, 280, 345, 359a, 406, 443, 445, 502, 515, 518, 545, 547, 549

N.t.* See page no. 29

8.4 Radiated emission limits, general requirements

8.4.1 Regulation

(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.

(f) In accordance with Section 15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. lf measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in Section 15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in Section 15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in Section 15.109 that are applicable to the incorporated digital device.

8.4.2 Test procedure

The EUT and this peripheral (when additional equipment exists) are placed on a turn table which is 0.8 m above the ground. The turn table would be allowed to rotate 360 degrees to determine the position of the maximum emission level. The test distance between the EUT and the receiving antenna are 3m. To find the maximum emission, the polarization of the receiving antenna is changed in horizontal and vertical polarization; the position of the EUT was changed in different orthogonal determinations.

ANSI C63.4: 2009 Section 8 “Radiated Emissions Testing”

Measurement procedures for electric field radiated emissions above 1 GHz are covered in Clause 8 of ANSI C63.4-2009. The C63.4-2009 measurement procedure consists of both an exploratory test and a final measurement. The exploratory test is critical to determine the frequency of all significant emissions. For each mode of operation required to be tested, the frequency spectrum is monitored. Variations in antenna height, antenna orientation, antenna polarization, EUT azimuth, and cable or wire placement is explored to produce the emission that has the highest amplitude relative to the limit.

The final measurements are made based on the findings in the exploratory testing. When making exploratory and final measurements it is necessary to maximize the measured radiated emission. Subclause 8.3.1.2 of C63.4-2009 states that the measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” We consider the “cone of radiation” to be the 3 dB beamwidth of the measurement antenna.

While the “bore-sighting” technique is not explicitly mentioned in C63.4-2009, it is a useful technique for measurements using a directional antenna, such as a double-ridged waveguide antenna. Several precautions must be observed, including: knowledge of the beamwidth of the antenna and the resulting illumination area relative to the size of the EUT, estimation for source of the emission and general location within larger EUTS, measuring system sensitivity, etc.

C63.4-2009 requires that the measurement antenna is kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. That means that if the directional radiation pattern of the EUT results in a maximum emission at an upwards angle from the EUT, when a directional antenna is used to make the measurement it will be necessary for it to be pointed towards the source of the emission within the EUT. This can be done by either pointing the antenna at an angle towards the source of the emission, or by rotating the EUT, in both height and polarization, to maximize the measured emission. The emission must be kept within the illumination area of the 3 dB beamwidth of the antenna so that the maximum emission from the EUT is measured.

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

Radiated emissions test characteristics	
Frequency range	30 MHz - 4,000 MHz
Test distance	3 m*
Test instrumentation resolution bandwidth	120 kHz (30 MHz - 1,000 MHz)
	1 MHz (1000 MHz - 4,000 MHz)
Receive antenna scan height	1 m - 4 m
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 20dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

8.4.3 Calculation of the field strength

The field strength is calculated by the following calculation:

Corrected Level = Receiver Level + Correction Factor (without the use of a pre-amplifier)

Corrected Level = Receiver Level + Correction Factor – Pre-amplifier (with the use of a pre-amplifier)

Receiver Level : Receiver reading without correction factors
Correction Factor : Antenna factor + cable loss

For example:
The receiver reading is 32.7 dBµV. The antenna factor for the measured frequency is +2.5 dB (1/m) and the cable factor for the measured frequency is 0.71 dB, giving a field strength of 35.91dBµV/m.
The 35.91dBµV/m value can be mathematically converted to its corresponding level in µV/m.

Level in µV/m = Common Antilogarithm (35.91/20) = 39.8

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).

8.4.4 Result

UMRR-0F0002-1D0907-050B00 - / FB6 / FB9 / FB12

TRANSMITTER SPURIOUS RADIATION BELOW 30 MHz (Section 15.205, 15.209)										
Frequency MHz	Bandwidth Type of detector kHz	Noted receiver level dBµV	Test distance m	Correction factor dB	Distance extrapol. factor dB	Level corrected dBµV/m	Limit dBµV/m	Margin dB	Polaris. EUT / antenna H xx° / H	Antenna height cm
---	**120 / QPK**	---	**3**	---	**0**	---	---	---	**H, V/H, V**	**100-400**
---	**120 / QPK**	---	**3**	---	**0**	---	---	---	**H, V/H, V**	**100-400**
---	**120 / QPK**	---	**3**	---	**0**	---	---	---	**H, V/H, V**	**100-400**
---	**120 / QPK**	---	**3**	---	**0**	---	---	---	**H, V/H, V**	**100-400**
---	**120 / QPK**	---	**3**	---	**0**	---	---	---	**H, V/H, V**	**100-400**
***No emissions detected**										
Measurement uncertainty: 4 dB										

Remark: *[1] Noise level of the measuring instrument ≤ 4.0dBµV@10m distance (0.009 MHz –30 MHz)
Remark: * Peak Limit according to Section 15.35 (b).

The equipment passed the conducted tests	**Yes***	~~No~~	~~N.t.~~

Further test results are attached	~~Yes~~	**No**	Page no.

Test equipment used: K74, 23, 103, 430

N.t.* See page no. 29

EUT: UMRR-0F0002-1D0907-050B00
FCC ID: W34UMRR0F1D

Date of issue: 2014-12-10

UMRR-0F0002-1D0907-050B00- / FB6 / FB9 / FB12

TRANSMITTER SPURIOUS RADIATION ABOVE 30 MHz (Section 15.205, 15.209)											
Frequency MHz	Bandwidth Type of detector kHz	Noted receiver level dBµV	Test distance m	Correction factor dB	Distance extrapol. factor dB	AV Correction factor dB	Level corrected dBµV/m	Limit dBµV/m	Margin dB	Polaris. EUT / antenna H xx° / H	Antenna height cm
30.0000	100, PK	≤ 3.5	3	-2.60*[5]	0	0	0.9	40.0	39.1	H,V/H,V	100-400
88.0000	100, PK	≤ 3.5	3	-10.80*[5]	0	0	-7.3	40.0	47.3	H,V/H,V	100-400
216.0000	100, PK	≤ 3.5	3	-10.30*[5]	0	0	-6.8	43.5	50.3	H,V/H,V	100-400
960.0000	100, PK	≤ 3.5	3	8.50*[5]	0	0	12.0	43.5	31.5	H,V/H,V	100-400
1700.000	1000, PK	≤ 4.5	3	3.80*[6]	0	0	8.3	54.0	45.7	H,V/H,V	100-400
1805.500	1000/PK	≤ 10	3	9.5*[6]	0	0	19.5	54.0	34.5	H,V/H,V	100-400
2250.000	1000, PK	≤ 10	3	8.00*[6]	0	0	18.0	54.0	36.0	H,V/H,V	100-400
4000.000	1000, PK	≤ 10	3	8.40*[6]	0	0	18.4	54.0	35.6	H,V/H,V	100-400
5000.000	1000, PK	≤ 10	3	9.10*[6]	0	0	19.4	54.0	34.6	H,V/H,V	100-400
7500.000	1000, PK	≤ 14	3	12.9*[6]	0	0	26.9	54.0	27.1	H,V/H,V	100-400
8300.000	1000, PK	≤ 14	3	14.80*[6]	0	0	28.8	54.0	25.2	H,V/H,V	100-400
*** All other emissions lower than the noise level of the measuring equipment!**											
Measurement uncertainty	4 dB										

Bandwidth = the measuring receiver bandwidth
Remark: *[1] noise floor noise level of the measuring instrument ≤ 3.5dBµV @ 3m distance (30 – 1,000 MHz)
Remark: *[2] noise floor noise level of the measuring instrument ≤ 4.5dBµV @ 3m distance (1,000 – 2,000 MHz)
Remark: *[3] noise floor noise level of the measuring instrument ≤ 10dBµV @ 3m distance (2,000 – 5,500 MHz)
Remark: *[4] noise floor noise level of the measuring instrument ≤ 14dBµV @ 3m distance (5,500 – 14,500 MHz)
Remark: *[5] for using a pre-amplifier in the range between 100 kHz and 1,000 MHz
Remark: *[6] for using a pre-amplifier in the range between 1.0 GHz and 18.0 GHz

The equipment passed the conducted tests	**Yes***	~~No~~	~~N.t.~~

Further test results are attached	**Yes**	~~No~~	Page no.34

Test equipment used: K40, K46, K50, K56, K84, K144, K147, K148, K501, 103, 166a, 171a, 223a, 280, 345, 359a, 406, 443, 445, 502, 515, 518, 545, 547, 549

*** 30 MHz - 18 GHz: All spurious emissions are lower than the noise level of the measuring equipment.**

*** 18 GHz - 40 GHz: All spurious emissions are lower than the noise level of the measuring equipment.**

*** 40 - 60 GHz: All spurious emissions other than harmonics are lower than the noise level of the measuring equipment.**

*** 60 GHz - 90 GHz: All spurious emissions are lower than the noise level of the measuring equipment.**

*** 90 GHz - 140 GHz: All spurious emissions are lower than the noise level of the measuring equipment.**

N.t.* See page no. 29

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

8.5 Fundamental frequencies / Field strength limits

8.5.1 Regulation

Test requirement: FCC CFR47, Part 15C Section 15.245 Test procedure: ANSI C63.4:2009
(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:

Frequency (MHz)	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (millivolts/meter)
902-928	500	1.6
2400-2483.5	500	1.6
5725-5875	500	1.6
10.5-10.55	2500	25.0
24.075-24.175	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 the second and third harmonics of field disturbance sensors operating in the 24075–24175 MHz band and for other 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.
  (iii) Field disturbance sensors designed to be used in motor vehicles or aircraft must include features to prevent continuous operation unless their emissions in the restricted bands, other than the second and third harmonics from devices operating in the 24075– 24175 MHz band, fully comply with the limits given in § 15.209. Continuous operation of field disturbance sensors designed to be used in farm equipment, vehicles such as fork lifts that are intended primarily for use indoors or for very specialized operations, or railroad locomotives, railroad cars and other equipment which travels on fixed tracks is permitted. A field disturbance sensor will be considered not to be operating in a continuous mode if its operation is limited to specific activities of limited duration (e.g., putting a vehicle into reverse gear, activating a turn signal, etc.).
(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.

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

8.5.2 Test procedure

The EUT and this peripheral (when additional equipment exists) are placed on a turn table which is 0.8m above the ground. The turn table would be allowed to rotate 360 degrees to determine the position of the maximum emission level. The test distance between the EUT and the receiving antenna are 3m. To find the maximum emission, the polarization of the receiving antenna are changed in horizontal and vertical polarization, the position of the EUT was changed in different orthogonal determinations.

ANSI C63.4: 2009 Section 8 “Radiated emission measurements”

Measurement procedures for electric field radiated emissions above 1 GHz are covered in Clause 8 of ANSI C63.4-2009. The C63.4-2009 measurement procedure consists of both an exploratory test and a final measurement. The exploratory test is critical to determine the frequency of all significant emissions. For each mode of operation required to be tested, the frequency spectrum is monitored. Variations in antenna height, antenna orientation, antenna polarization, EUT azimuth, and cable or wire placement is explored to produce the emission that has the highest amplitude relative to the limit.

The final measurements are made based on the findings in the exploratory testing. When making exploratory and final measurements it is necessary to maximize the measured radiated emission. Subclause 8.3.1.2 of C63.4-2009 states that the measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” We consider the “cone of radiation” to be the 3 dB beamwidth of the measurement antenna.

While the “bore-sighting” technique is not explicitly mentioned in C63.4-2009, it is a useful technique for measurements using a directional antenna, such as a double-ridged waveguide antenna. Several precautions must be observed, including: knowledge of the beamwidth of the antenna and the resulting illumination area relative to the size of the EUT, estimation for source of the emission and general location within larger EUTS, measuring system sensitivity, etc.

C63.4-2009 requires that the measurement antenna is kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. That means that if the directional radiation pattern of the EUT results in a maximum emission at an upwards angle from the EUT, when a directional antenna is used to make the measurement it will be necessary for it to be pointed towards the source of the emission within the EUT. This can be done by either pointing the antenna at an angle towards the source of the emission, or by rotating the EUT, in both height and polarization, to maximize the measured emission. The emission must be kept within the illumination area of the 3 dB beamwidth of the antenna so that the maximum emission from the EUT is measured.

Radiated emissions test characteristics	
Frequency range	9 kHz - 100,000 MHz
Test distance	10m, 3 m*
Test instrumentation resolution bandwidth	9 kHz (20 kHz – 30 MHz)
	120 kHz (30 MHz - 1,000 MHz)
	1 MHz (1000 MHz - 100,000 MHz)
Receive antenna height	1 m (20 kHz – 30 MHz)
Receive antenna polarization	0° - 90° (20 kHz – 30 MHz)
Receive antenna scan height	1 m - 4 m (30 MHz - 15,000 MHz) 1 m – 2.5 m (18,000 MHz - 40,000 MHz)
Receive antenna polarization	vertical/horizontal (30 MHz - 100,000 MHz)

*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 20dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

8.5.3 Calculation of the average correction factor

The average correction factor is computed by analyzing the "worst case" on time in any 100msec time period and using the formula: Corrections Factor + 20*log (worst case on time/100msec). Analysis of the remote transmitter worst case on time in any 100msec time period is an on time of 50msec, therefore the correction factor is 20*log (50/100) = - 6 dB. The maximum correction factor to be applied is 20 dB per section 15.35 of the FCC rules.

8.5.4 Calculation of the field strengths

The field strength is calculated by the following calculation:

Corrected Level = Receiver Level + Correction Factor (without the use of a pre-amplifier)

Corrected Level = Receiver Level + Correction Factor – Pre-Amplifier (with the use of a pre-amplifier)

Receiver Level : Receiver reading without correction factors
Correction Factor : Antenna factor + cable loss

For example:
The receiver reading is 32.7 dBµV. The antenna factor for the measured frequency is +2.5 dB (1/m) and the cable factor for the measured frequency is 0.71 dB, giving a field strength of 35.91dBµV/m.
The 35.91dBµV/m value can be mathematically converted to its corresponding level in µV/m.

Level in µV/m = Common Antilogarithm (35.91/20) = 39.8

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).

8.5.5 Result

UMRR-0F0002-1D0907-050B00 - Measured peak / FB6

FUNDAMENTAL EMISSIONS (Section 15.245)										
f (GHz)	Bandwidth (kHz), Type of detector	Noted receiver level **dBµV**	Test distance **m**	Correction factor **dB**	Distance extrapol. factor **dB**	Level corrected **dBµV/m**	**Peak Limit dBµV/m @ 3 meter**	Margin **dBµV/m**	Polarisation antenna orientation	height/cm
24.0768	PK/1MHz	**93.9**	3	18.6	0	**112.5**	147.9	**35.4**	V 5°/V	169
24.0852	PK/1MHz	**94.1**	3	18.6	0	**112.7**	147.9	**35.2**	V 5°/V	169
Measurement uncertainty		± 6 dB								

Bandwidth = the measuring receiver bandwidth

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~

Further test results are attached	~~Yes~~	**No**	Page no.

UMRR-0F0002-1D0907-050B00 -Measured average / FB6

FUNDAMENTAL EMISSIONS (Section 15.245)										
f (GHz)	Bandwidth (kHz), Type of detector	Noted receiver level **dBµV**	Test distance **m**	Correction factor **dB**	Distance extrapol. factor **dB**	Level corrected **dBµV/m**	**Average Limit dBµV/m @ meter**	Margin **dBµV/m**	Polaris antenna orientation	height/cm
24.0768	AV/1MHz	**73.1**	3	18.6	0	**91.7**	127.9	**36.2**	V 5°/V	169
24.0852	AV/1MHz	**73.9**	3	18.6	0	**92.5**	127.9	**35.4**	V 5°/V	169
Measurement uncertainty		± 6 dB								

Bandwidth = the measuring receiver bandwidth

UMRR-0F0002-1D0907-050B00 -Measured average / FB6

HARMONIC EMISSIONS (Section 15.245)										
f (GHz)	Bandwidth (kHz), Type of detector	Noted receiver level **dBµV**	Test distance **m**	Correction factor **dB**	Distance extrapol. factor **dB**	Level corrected **dBµV/m**	**Average Limit dBµV/m @ meter**	Margin **dBµV/m**	Polaris antenna orientation	height/cm
48.16318	AV/1MHz	**55.4**	0.5	32.7	-15.5	**72.6**	87.9	**15.3**	V 5°/V	110
48.16362	AV/1MHz	**54.7**	0.5	32.7	-15.5	**71.9**	87.9	**16.0**	H 10°/V	110
Measurement uncertainty		± 6 dB								

Bandwidth = the measuring receiver bandwidth

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~

Further test results are attached	**Yes**	~~No~~	Page no. 33

UMRR-0F0002-1D0907-050B00 - Measured peak / FB9

FUNDAMENTAL EMISSIONS (Section 15.245)										
f (GHz)	Bandwidth (kHz), Type of detector	Noted receiver level **dBµV**	Test distance **m**	Correction factor **dB**	Distance extrapol. factor **dB**	Level corrected **dBµV/m**	**Peak Limit dBµV/m @ 3 meter**	Margin **dBµV/m**	Polarisation antenna orientation	height/cm
24.1143	PK/1MHz	**93.9**	3	18.6	0	**112.5**	147.9	**35.4**	V 5°/V	169
24.1227	PK/1MHz	**94.1**	3	18.6	0	**112.7**	147.9	**35.2**	V 5°/V	169
Measurement uncertainty	± 6 dB									

Bandwidth = the measuring receiver bandwidth

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~

Further test results are attached	~~Yes~~	**No**	Page no.

UMRR-0F0002-1D0907-050B00 -Measured average / FB9

FUNDAMENTAL EMISSIONS (Section 15.245)										
f (GHz)	Bandwidth (kHz), Type of detector	Noted receiver level **dBµV**	Test distance **m**	Correction factor **dB**	Distance extrapol. factor **dB**	Level corrected **dBµV/m**	**Average Limit dBµV/m @ meter**	Margin **dBµV/m**	Polaris antenna orientation	height/cm
24.1143	AV/1MHz	**73.0**	3	18.6	0	**91.6**	127.9	**36.3**	V 5°/V	169
24.1227	AV/1MHz	**73.7**	3	18.6	0	**92.3**	127.9	**35.6**	V 5°/V	169
Measurement uncertainty	± 6 dB									

Bandwidth = the measuring receiver bandwidth

UMRR-0F0002-1D0907-050B00 -Measured average / FB9

HARMONIC EMISSIONS (Section 15.245)										
f (GHz)	Bandwidth (kHz), Type of detector	Noted receiver level **dBµV**	Test distance **m**	Correction factor **dB**	Distance extrapol. factor **dB**	Level corrected **dBµV/m**	**Average Limit dBµV/m @ meter**	Margin **dBµV/m**	Polaris antenna orientation	height/cm
48.23700	AV/1MHz	**53.0**	0.5	32.7	-15.5	**70.2**	87.9	**17.7**	V 5°/V	110
48.23700	AV/1MHz	**52.3**	0.5	32.7	-15.5	**69.5**	87.9	**18.4**	H 10°/V	110
Measurement uncertainty	± 6 dB									

Bandwidth = the measuring receiver bandwidth

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~

Further test results are attached	~~Yes~~	**No**	Page no.

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

EUT: UMRR-0F0002-1D0907-050B00
FCC ID: W34UMRR0F1D

Date of issue: 2014-12-10

UMRR-0F0002-1D0907-050B00 - Measured peak / FB12

FUNDAMENTAL EMISSIONS (Section 15.245)										
f (GHz)	Bandwidth (kHz), Type of detector	Noted receiver level **dBµV**	Test distance **m**	Correction factor **dB**	Distance extrapol. factor **dB**	Level corrected **dBµV/m**	**Peak Limit dBµV/m @ 3 meter**	Margin **dBµV/m**	Polarisation antenna orientation height/cm	
24.1518	PK/1MHz	**93.9**	3	18.6	0	**112.5**	147.9	**35.4**	H 5°/V	169
24.1602	PK/1MHz	**94.1**	3	18.6	0	**112.7**	147.9	**35.2**	H 5°/V	169
Measurement uncertainty	± 6 dB									

Bandwidth = the measuring receiver bandwidth

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~

Further test results are attached	~~Yes~~	**No**	Page no.

UMRR-0F0002-1D0907-050B00 -Measured average / FB12

FUNDAMENTAL EMISSIONS (Section 15.245)										
f (GHz)	Bandwidth (kHz), Type of detector	Noted receiver level **dBµV**	Test distance **m**	Correction factor **dB**	Distance extrapol. factor **dB**	Level corrected **dBµV/m**	**Average Limit dBµV/m @ meter**	Margin **dBµV/m**	Polaris antenna orientation height/cm	
24.1518	AV/1MHz	**73.3**	3	18.6	0	**91.9**	127.9	**36.0**	H 5°/V	169
24.1602	AV/1MHz	**74.0**	3	18.6	0	**92.6**	127.9	**35.3**	H 5°/V	169
Measurement uncertainty	± 6 dB									

Bandwidth = the measuring receiver bandwidth

UMRR-0F0002-1D0907-050B00 -Measured average / FB12

HARMONIC EMISSIONS (Section 15.245)										
f (GHz)	Bandwidth (kHz), Type of detector	Noted receiver level **dBµV**	Test distance **m**	Correction factor **dB**	Distance extrapol. factor **dB**	Level corrected **dBµV/m**	**Average Limit dBµV/m @ meter**	Margin **dBµV/m**	Polaris antenna orientation height/cm	
48.31138	AV/1MHz	**52.8**	0.5	32.7	-15.5	**70.0**	87.9	**17.9**	V 5°/V	110
48.31138	AV/1MHz	**51.9**	0.5	32.7	-15.5	**69.1**	87.9	**18.8**	H 10°/V	110
Measurement uncertainty	± 6 dB									

Bandwidth = the measuring receiver bandwidth

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~

Further test results are attached	~~Yes~~	**No**	Page no.

Test equipment used: K147, K148, 103, 280, 359a, 443, 502, 515, 518, 545, 547, 549

N.t.* See page no. 29

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

8.6 Bandwidth (20 dB)

8.6.1 Regulation

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

8.6.2 Test procedure

ANSI C63.4-2009 Section 13.1.7 Occupied bandwidth measurements. The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical. Once the reference level is established, the equipment is conditioned with typical modulating signals to produce worst-case (i.e., the widest) bandwidth. In order to measure the modulated signal properly, a resolution bandwidth that is small compared to the bandwidth required by the procuring or regulatory agency shall be used on the measuring instrument. However, the 6 dB resolution bandwidth of the measuring instrument shall be set to a value greater than 5 % of the bandwidth requirements.

8.6.3 20 dB bandwidth limit

8.6.4 Result

The maximum measured 20 dB bandwidth is:

FB6: 8.37 MHz
FB9: 8.42 MHz
FB12: 8.43 MHz

The equipment passed e conducted tests	**Yes**	~~No~~	~~N.t.~~

Further test results are attached	**Yes**	~~No~~	Annex No. 3

Test equipment used: K76, 431, 433, 502, 626

N.t.* See page no. 29

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

9. Additional information to the test report

Remarks

N.t.[1]	Not tested, because the antenna is part of the PCB
N.t.[2]	Not tested, because the EUT is directly battery powered
N.t.[3]	Not tested, because not applicable to the EUT
N.t.[4]	Not tested, because not ordered

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

10. List of test equipment

Type	Manufacturer/ Model no.	Serial no.	Last calibration	Next calibration	Calibration executed by
Test fixture	Dudde	---	04/2014	04/2015	Dudde
Magnetic loop antenna (9 kHz - 30 MHz)	Schwarzbeck FMZB 1516 (23)	---	05/2013	05/2016	Dudde
OATS (CISPR 16) to 1.0 GHz)	Dudde (103)	---	09/2013	09/2015	Dudde
OATS	Dudde (104)	---	06/2014	06/2016	Dudde
Pre-amplifier (100kHz - 1.3GHz)	Hewlett Packard 8447 E (166a)	1726A00705	07/2014	07/2016	Dudde
Horn antenna (2.0-14.0 GHz)	Schwarzbeck BBHA 9120 C (169)	305	09/2012	*	Dudde
Spektrumanalyzer 9 kHz - 18 GHz	Rohde & Schwarz (171a)	---	06/2014	06/2016	Rhode & Schwarz
Mixer WR22 Q-Band (33-50 GHz)	OM Labs MA2742A (269a)	Q40512-1	03/2013	03/2016	Dudde
Mixer WR15 V-Band (50-75 GHz)	OM Labs MA2744A (295a)	V41027-1	08/2014	08/2017	Dudde
Mixer WR10 W-Band (75-110 GHz)	OM Labs MA2746A (296a)	W40706-2	03/2013	03/2016	Dudde
Pre-amplifier (1GHz - 18GHz)	Narda (345)	---	02/2014	02/2016	Dudde
Receiver (9 kHz –40.0 GHz) (40.0 GHz -110 GHz)	Anritsu Spectrum Analyzer MS2668 (359a)	6200163244	06/2014	06/2017	Rohde & Schwarz
Gain Horn antenna (33-50 GHz)	Dorado GH-22-25 (383)	040810	04/2012	*	Dorado
Gain Horn antenna (50-75 GHz)	Dorado GH-15-25 (384)	031003	04/2012	*	Dudde
Gain Horn antenna (75-110 GHz)	Dorado GH-10-25 (385)	040808	04/2012	*	Dudde
Bilog antenna (30- 1000 MHz)	Schwarzbeck VULP 9168 (406)	---	04/2011	04/2015	Schwarzbeck
Logt. Per, Antenne (1- 18 GHz)	Schwarzbeck STLP 9148 (445)	---	09/2012	09/2015	Schwarzbeck
Horn antenna (15.0-40.0 GHz)	Schwarzbeck BBHA 9170 (280)	BBHA9170378	08/2014	08/2017	Schwarzbeck
Microwave Amplifier	Schwarzbeck BBV 9719 (443)	----	01/2013	01/2015	Schwarzbeck
Harmonic Mixer U-Band (40-60 GHz)	Farran FSZ-60 (515)	100037	08/2010	08/2016	Farran
Harmonic Mixer E-Band 60-90 GHz	Rohde & Schwarz FSZ-90 (501)	100062	08/2010	03/2016	Rohde & Schwarz
Harmonic Mixer F-Band 90-140 GHz	Radiometer Physics SAM-140 (545)	20006	05/2013	05/2017	Rohde & Schwarz
Harmonic Mixer F-Band 140-220 GHz	Radiometer Physics SAM-140 (546)	20002	02/2013	02/2017	Rohde & Schwarz

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

Harmonic Mixer F-Band 220-325 GHz	Radiometer Physics SAM-325 (591)	20029	02/2013	02/2017	Rohde & Schwarz
Signal Analyzer (9 kHz –30.0 GHz)	Rohde & Schwarz FSV 30 (502)	100932	02/2013	02/2016	Rohde & Schwarz
Gain Horn antenna (40-60 GHz)	Dorado GH-19-20 (518)	070106	08/2010	*	Dudde
Dual Mode Potter Horn Antenna 60 - 90 GHz	Radiometer Physics FH-PP-90-WR12 (549)	---	09/2011	*	Dudde
Dual Mode Potter Horn Antenna 90 - 140 GHz	Radiometer Physics FH-PP-140 WR8 (547)	---	02/2013	*	Dudde
Dual Mode Potter Horn Antenna 140 - 220 GHz	Radiometer Physics FH-PP-220 WR5.1 (548)	---	02/2013	*	Dudde
Dual Mode Potter Horn Antenna 220 - 325 GHz	Radiometer Physics FH-PP-140 WR8 (592)	---	02/2013	*	Dudde

*Standard-gain horn antennas have gain characteristics that are established by the physical dimensions and dimensional tolerances
Consequently, standard-gain horn antennas need not be calibrated beyond the dimensional characteristics that are provided by the manufacturer, unless damaged or deterioration is suspected, or if used at distances closer than (2D2)/λ. This is also described in NRL Report 4433!

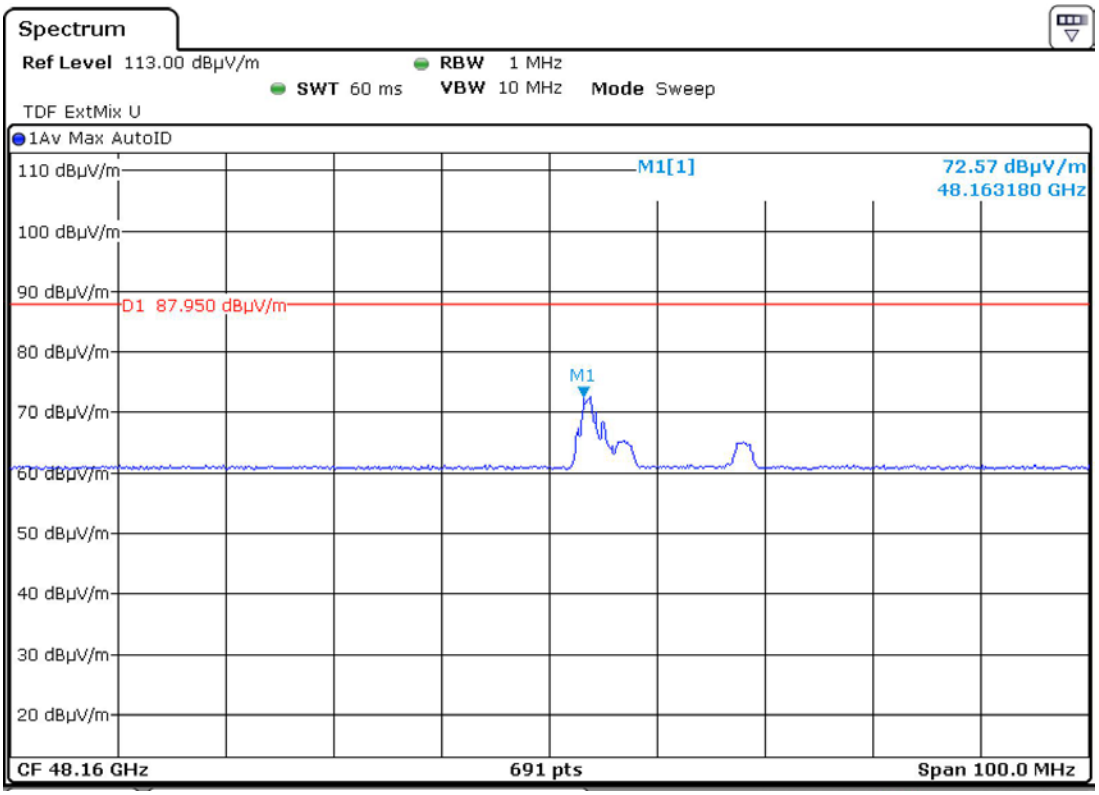
m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

11. Cable list

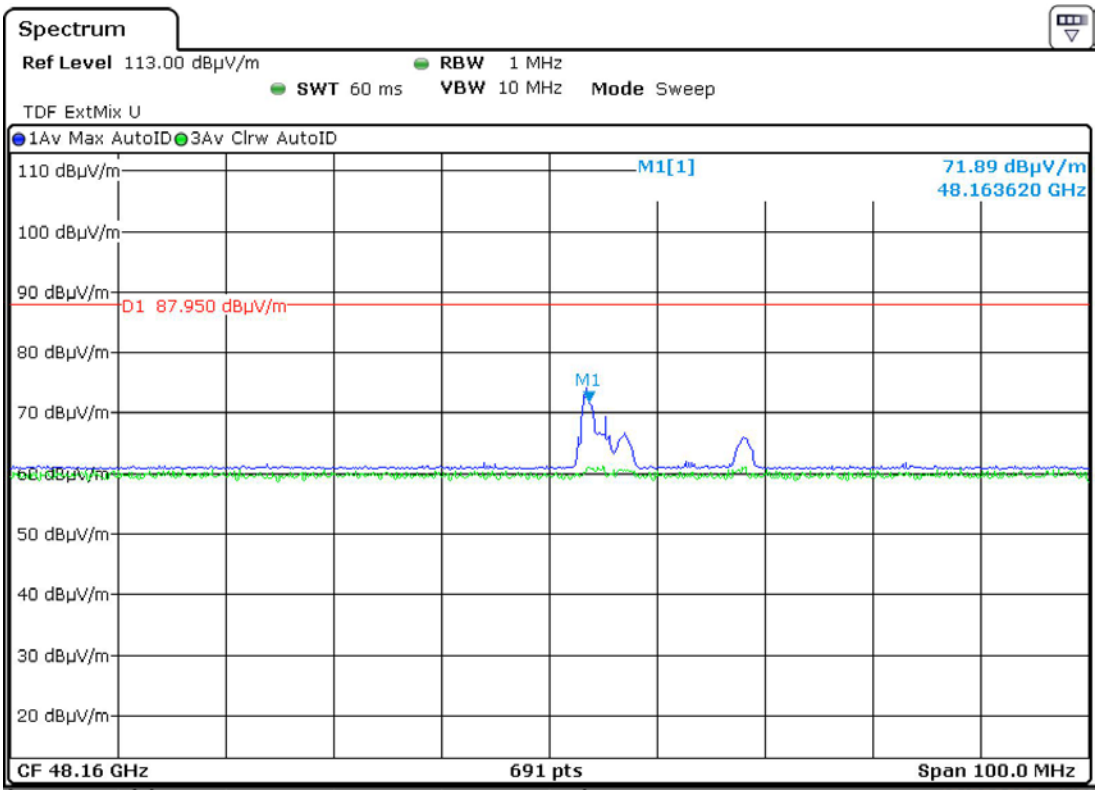
Type	Manufacturer/ Model no.	Cable no.	Last calibration	Next calibration	Calibration executed by
RF- cable	Kabelmetal 14.5m [N]	K1	04/2014	04/2015	Dudde
RF- cable	Kabelmetal 18m [N]	K1a	04/2014	04/2015	Dudde
RF- cable	Sucoflex 104 2m [APC]	K17a	04/2014	04/2015	Dudde
RF- cable	Sucoflex 104 2m [APC]	K18a	04/2014	04/2015	Dudde
RF- cable	Aircell 0.5m [BNC]	K40	04/2014	04/2015	Dudde
RF- cable	Sucoflex 104 Suhner [N] 1 m	K52	04/2014	04/2015	Dudde
RF- cable	Aircell 1m [BNC/N]	K56	04/2014	04/2015	Dudde
RF- cable	Sucoflex 100 Suhner [N] 1 m	K61	04/2014	04/2015	Dudde
RF- cable	Sucoflex 100 Suhner [SMA] 0.5 m	K62	04/2014	04/2015	Dudde
RF- cable	Sucoflex 106 Suhner 6,4m [N]	K74	04/2014	04/2015	Dudde
RF- cable	Sucoflex 106 Suhner 6,4m [N]	K75	04/2014	04/2015	Dudde
RF- cable	Sucoflex Suhner 13 m [N]	K144	04/2014	04/2015	Dudde
RF- cable	Sucoflex Suhner 8m [SMA]	K145	04/2014	04/2015	Dudde
RF- cable	Sucoflex Suhner 8m [SMA]	K146	04/2014	04/2015	Dudde
RF- cable	Jyebao 1.5 m [APC]	K147	04/2014	04/2015	Dudde
RF- cable	Jyebao 3 m [APC]	K148	04/2014	04/2015	Dudde

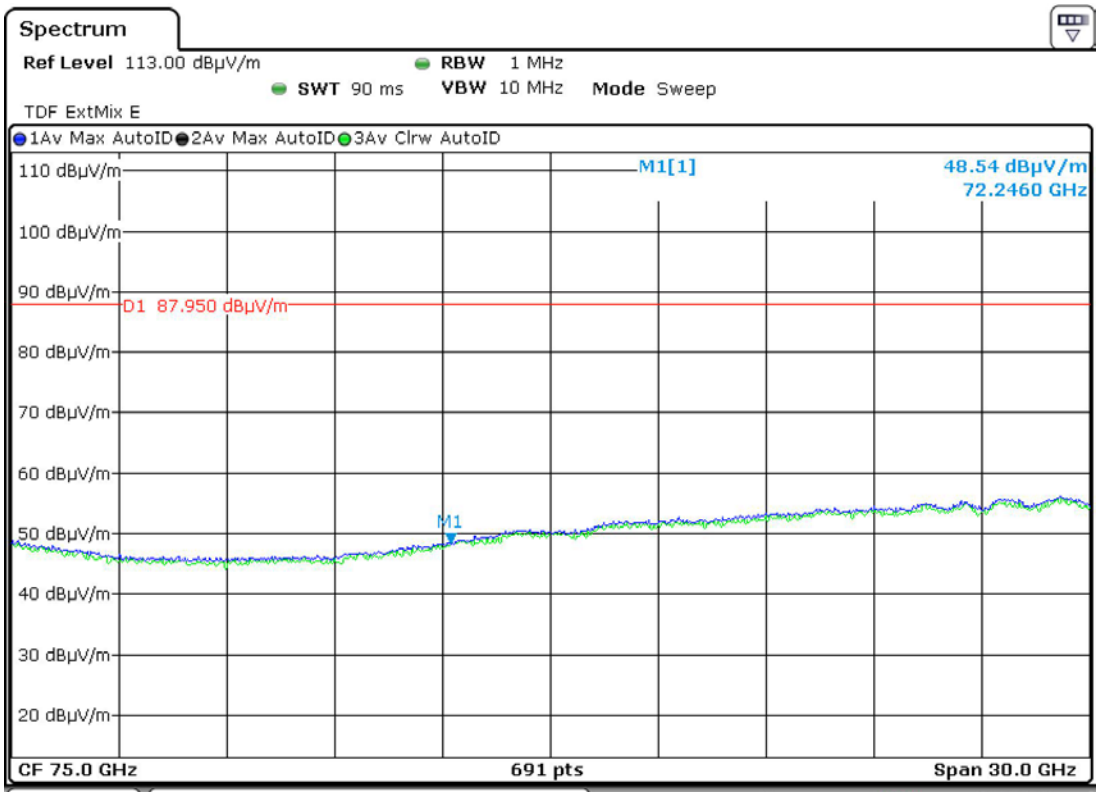
m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

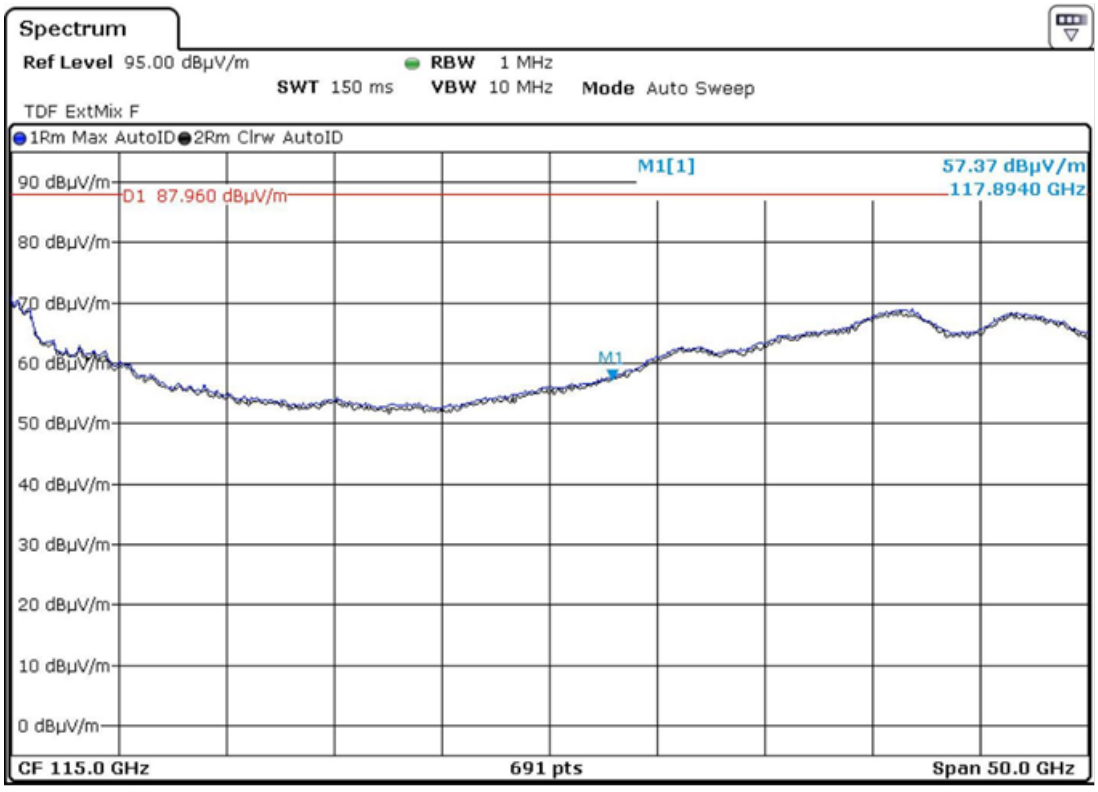
Spurious Emissions: vertical



Spurious Emissions: horizontal







m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920

End of test report

m. dudde hochfrequenz-technik Rottland 5a D-51429 Bergisch Gladbach/ Germany Tel: +49 2207-96890 Fax +49 2207-968920