

Prüfbericht - Nr.: 21139850_003

Test Report No.:

Seite 1 von 21

Page 1 of 21

Auftraggeber: Timelox
Client: Lordjursgatan 1
SE-261 44 Landskrona

Gegenstand der Prüfung: ZigBee Endnote
Test item:

Bezeichnung: 68 3081 055-1
Identification:

Serien-Nr.: ---
Serial No.:

Wareneingangs-Nr.: 81498
Receipt No.:

Eingangsdatum: 2008-12-22
Date of receipt:

Prüfart: TÜV Rheinland Product Safety GmbH, Köln, Germany
Testing location:

Prüfgrundlage: FCC 47 CFR Ch.1 Part 15 2008-Jul-10 Emission
Test specification:
Section 15.107 (a), limits same as IEC/CISPR 22:1997 (EN 55022:1998) Class B
Section 15.109 (a) Class B
Section 15.109 (g), i.e. IEC/CISPR 22:1997 (EN 55022:1998) Class B
Section 15.209 (Intentional radiator)
Section 15.247 (Intentional radiator)
Section 15.31 (e) and Section 15.215 (c)

Prüfergebnis: Der Prüfgegenstand entspricht oben genannten Prüfgrundlagen
Test Result: The test item passed the test specification(s)

Prüflaboratorium: TÜV Rheinland Product Safety GmbH, Köln, Germany
Testing Laboratory:

geprüft / tested by: O. Schaefer, SV
2009-05-10
Datum **Name / Stellung** **Unterschrift**
Date **Name / Position** **Signature**

kontrolliert / reviewed by: K. Jauernik, SV
2009-05-10
Datum **Name / Stellung** **Unterschrift**
Date **Name / Position** **Signature**

Sonstiges / Other Aspects:

FCC Registration No. 91096, 2007-Dec-05

Anhang / Annex: Messdiagramme / Measurement Diagrams
Fotodokumentation / Photo Documentation

Abkürzungen: P(ass) = entspricht Prüfgrundlage
F(ail) = entspricht nicht Prüfgrundlage
N/A = nicht anwendbar
N/T = nicht getestet

Abbreviations: P(ass) = passed
F(ail) = failed
N/A = not applicable
N/T = not tested

Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.
This test report relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any safety mark on this or similar products.

Verwendete Messgeräte sind in der linken Spalte mit einem Kreuz **x** markiert
[used instruments are marked with an **x** in the left column]

Störaussendung [emission] Test / Gerät [test / device]		Type	Hersteller [manufacturer]	Inv. – Nr. /Ser. - Nr.	kal. bis [cal. till]
Funkstörspannung / –strom [conducted disturbance]					
x	EMI Receiver 9kHz-30MHz	FMLK 1518 D	Schwarzbeck	14200382	2009-08
x	Netznachbildung [AMN]	ESH 3-Z5	Rohde & Schwarz	14200683	2010-05
x	Schirmkabine [shielded room]	B 83102 S1-X10	Siemens	---	---
Elektr. Funkstörfeldstärke 2 [radiated disturbance SAC]					
x	EMI Receiver < 26,5GHz	ESMI	Rohde & Schwarz	14200550	2010-10
x	BiConiLog-Ant 26-3000MHz	3142B	EMCO	14201363	2011-06
	Horn-Ant. 0,8-5GHz	BBHA 9120A	Schwarzbeck	30402211	2010-09
x	Horn-Ant 1-10GHz	BBHA 9120B 202	Schwarzbeck	14200694	2010-02
	Horn-Ant 1-10GHz	BBHA 9120B 204	Schwarzbeck	14200695	2009-10
	Horn-Ant 2-18GHz	BBHA 9120C 376	Schwarzbeck	30401857	2009-07
x	Horn-Ant 2-18GHz	BBHA 9120C 377	Schwarzbeck	30401858	2010-03
	Horn-Ant 15-26,5GHz	BBHA 9170 311	Schwarzbeck	30401855	2010-03
x	Horn-Ant 15-26,5GHz	BBHA 9170 312	Schwarzbeck	30401856	2010-03
x	Semi Anechoic Chamber SAC		ETS	14201372	2010-06
Weitere Messgeräte [other test equipment]		Type	Hersteller [manufacturer]	Inv. – Nr. /Ser. - Nr.	kal. bis [cal. till]
	Digital-Multimeter	Metra Hit 16	ABB	14200346	2010-06
x	Digital-Multimeter	Metra Hit 23S	Gossen	14200699	2009-09
	Oszilloskop [oscilloscope]	TDS 3052B	Tektronix	30401734	2010-02
x	Temperature / Humidity	615	testo	30401660	2009-08

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

All measurement equipment calibrations are traceable to DKD or where calibration is performed outside Germany, to equivalent nationally recognized standards organizations.

The measurement facilities for conducted and for radiated disturbances of TRPS GmbH in Cologne, Am Grauen Stein, has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules. Measurement data will be accepted in conjunction with applications for Certification under Parts 15 and 18 of the Commission's Rules.

Registration-Number: 91096

Date of Listing: 2007-Dec-05

Messunsicherheit [measurement uncertainty]

Where relevant, following measurement uncertainty levels have been estimated for tests performed on the apparatus.

	Expanded Uncertainty	
	U_{Lab}	U_{CISPR}
Conducted Emission 0,15 to 30 MHz, Power Line	2,70 dB	3,6 dB
Radiated Emission 9kHz to 30MHz, Magnetic Field 3m	4,16 dB	5,2 dB
Radiated Emission 30 to 300MHz, OATS 3m or 10m	5,11 dB	5,2 dB
Radiated Emission 300 to 1000MHz, OATS 3m	4,71 dB	5,2 dB
Radiated Emission 30 to 1000MHz, Semi Anechoic Chamber 3m	4,91 dB	5,2 dB
Radiated Emission 1000 to 2750MHz, Semi Anechoic Chamber 3m	4,89 dB	under consid.

Calculated in accordance with UKAS LAB 34
Uncertainty figures are valid to a confidence level of 95%

1. Vereinbarungen [requirements and agreements]

Auftragsgemäß wurde an dem vorgestellten Prüfling eine EMV-Prüfung durchgeführt. Die Prüfung erfolgte nach den folgenden Grundlagen.

[The tested device got investigated by the following requirements and standards]

Störaussendung [Emission] FCC 47 CFR Ch.1 Part 15

Section 15.107 (a) limits same as IEC/CISPR 22:1997 Class B (EN 55022:1998 Kl. B)	Störspannung, AC-Eingang [conducted noise, AC power input]
Section 15.109 (a) Class B	El. Störfeldstärke [radiated el. noise]
Section 15.209	El. Störfeldstärke [radiated el. noise]
Section 15.247	
Section 15.31 (e) and Section 15.215 (c)	Voltage Variation Bandedge Compliance
ANSI C63.4:2003	Test Procedures

1.1. Übersicht der Prüfergebnisse [Summary of test results]

Elektromagnetische Aussendung [Emission tests]	Ergebnis [result]
Funkstörspannung am Netzanschluss [Mains terminal disturbance voltage]	Pass
Funkstörspannung, Knackstörungen [Disturbance voltage, clicks]	N/A
Funkstörspannung/-strom [conducted cont. disturbance]	N/A
Funkstörleistung [Disturbance power]	N/A
Funkstörfeldstärke [Radiated disturbance] „Unintentional“	N/A
Funkstörfeldstärke [Radiated disturbance] „Intentional“	Pass
Oberschwingungsströme [Harmonic current emissions]	N/A
Spannungsschwankungen [Voltage fluctuations]	N/A

Elektromagnetische Beeinflussbarkeit [Immunity tests]	Ergebnis [result]
Leitungsgeführte Störgrößen, induziert durch HF-Felder [Conducted disturbances, induced by radio frequency fields]	N/A
Hochfrequente elektromagnetische Felder [Radiated, radio-frequency electromagnetic fields]	N/A
Schnelle transiente elektrische Störgrößen/Burst [Electrical fast transient/burst]	N/A
Spannungseinbrüche, Kurzzeitunterbrechungen und Spannungsschwankungen [Voltage dips, short interruptions and voltage variations]	N/A
Stoßspannungen [Surge]	N/A
Entladung statischer Elektrizität [Electrostatic discharge]	N/A
Magnetfelder mit energietechn. Freq. [Power frequent magnetic fields]	N/A

Abkürzungen [abbreviations]:

Pass	Anforderungen erfüllt	[requirements fulfilled or test passed]
Fail	Anforderungen nicht erfüllt	[requirements not fulfilled or test failed]
N/A	Nicht anwendbar/gefordert	[not applicable/requested]
A/nT	Anwendbar, nicht getestet	[applicable, not tested]

Begründung für anwendbare, jedoch nicht durchgeführte Prüfungen

[Reason for applicable but not executed tests]

Nr. [No.]	Begründung [Reason]
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1.2. Einteilung des Prüflings [classification of EUT]

Der Prüfling wird klassifiziert in Kategorie
[The EUT is classified into category]

FCC 47CFR Part 15 Subpart C Section 15.201
Intentional Radiator

Certification

2. Informationen zum Prüfling [information about EUT]

Geräteart [kind of device]: Siehe Seite 1 dieses Berichtes [refer to page 1 of this report]
Type: Siehe Seite 1 dieses Berichtes [refer to page 1 of this report]
Ser. Nr.: Siehe Seite 1 dieses Berichtes [refer to page 1 of this report]

Gerätevarianten [EUT variants]: Keine [none]

Andere Bezeichnung
[brandname]: NN

Nennspannung [rated voltage]: 9V DC
Netzfrequenz [frequency]: ---
Nennstrom [rated current]: ---
Nennleistung [rated power]: Keine spezif. Daten vorhanden [no specific data available]
Schutzklasse [protection class]: ---

Konstruktion/Aufbau:
[constructional details] Siehe Foto- bzw. System-Dokumentation
[refer to photo and system documentation]
Abmessungen [dimensions]

Schnittstellen [interfaces, ports]
Eingang [input]: ---

Intern [internal]: ---

Ausgang [output]: ---

Ein/Ausgang [bidir. I/O] ---

EMV relevante Daten
[EMC relevant data] Weitere Daten siehe System-Dokumentation in Anhang 3
[for further information refer to appendix 3]
Systemfreq. [system freq.]: 2405 – 2480 MHz

Filter [filter]: ---

Erdung [grounding]: ---

Schirmung [shielding]: Keine [None]

Besondere EMV-Massnahmen
[special EMC measures]: ---

Sonstiges [other aspects]: ---

Betriebsart während der
Prüfungen [EUT mode]: 1 Standby
Transmit

3. Prüfaufbau [EUT configuration]

Der Prüfaufbau erfolgte entsprechend den Angaben der genannten EMV-Normen.

Die Messungen und Tests wurden unter "worst case"-Bedingungen durchgeführt, d.h., es wurden typische Anordnungen und Betriebszustände gewählt bzw. angenommen und für maximale Störaussendung optimiert (sogenannte "Ungünstigste Konfiguration").

Die maximalen Störaussendungswerte wurden dokumentiert.

Einzelheiten sind (auch) der Fotodokumentation zu entnehmen, in der die Konfigurationen maximaler Störaussendung dargestellt sind.

Soweit nicht anders angegeben, gelten diese Angaben für alle nachfolgenden Messungen.

[The test setup was made in accordance with mentioned EMC standards.

Measurements and tests were executed under "worst case" conditions. Typical EUT arrangements or operating modes were chosen or assumed and for maximum emission optimized (a so called "unfavourable configuration").

Maximum emissions are reported.

Details of test setup or adjustments are (also) shown inside the photo documentation, in which configurations of maximum emission are displayed.

As far as not mentioned otherwise these statements are valid for all following tests.]

Testkonfiguration [tested configuration]

Prüfling EUT: ---

[Equipment Under Test EUT]

Verwendete Zusatzgeräte AE: Compag Laptop with customer software
[Auxiliary Equipment AE]

Versorgung [supply]: Wie in Kap. 2 [same as in chapter 2]

Überwachung während Prüfung: ---
[supervision during test]

Abkürzungen [abbreviations]	N/A	Nicht anwendbar [not applicable]
	NN	Nicht bekannt [not named]
	NC	Nicht bestückt [not connected]

4. Prüfungen [EMC tests]

4.1. Funkstörspannung an Netzanschlüssen 0,15 – 30 MHz [conducted cont. disturbance at mains terminals]

Prüfgrundlage [test bases]: FCC Part 15 Class B Section 15.107 (a)
IEC/CISPR 22 Class B
EN 55022 Klasse B

Grenzwerte [limits]		Quasi-Peak QP	Mittelwert Av
FCC Part 15.107 (a) Class B	0,15 - 0,5 MHz	66 - 56 dB μ V	56 - 46 dB μ V
FCC Part 15.207	0,5 - 5 MHz	56 dB μ V	46 dB μ V
IEC/CISPR 22 Class B	5 - 30 MHz	60 dB μ V	50 dB μ V
EN 55022 Klasse B			

Detektor [detector]	QP, 9 kHz	Av, 9kHz
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Messung auf [tested port]: AC_In

Länge der Versorg.-leitung [length]: ca. 2m

Betriebsart [EUT mode]: siehe Kap. 2 [refer to chapter 2]

Prüfaufbau [test setup]: siehe Kap. 3 [refer to chapter 3]

Messergebnis [test data]: siehe Anhang 1 [refer to appendix 1]

Anmerkungen [comments]: ---

Prüfergebnis [test result]:
X Anforderungen erfüllt [Req. fulfilled, Passed]
--- Anforderungen nicht erfüllt [Req. not fulfilled, Failed]
--- Nicht anwendbar/gefordert [Not Applicable/Requested]
--- Nicht getestet [Not tested]

Datum [date]: siehe Messwertediagramme [refer to test result diagrams]

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4:2003. The resolution bandwidth is set to 9 kHz for both peak detection and quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak. Line conducted data is recorded for both NEUTRAL and HOT lines. A 50 μ H/50 ohms line impedance stabilization network (LISN) was used.

4.2. EI. Funkstörfeldstärke,

[radiated disturbance, intentional radiator]

Prüfgrundlage [test bases]: FCC Part 15.209
FCC Part 15.247

Grenzwerte [limits]		L2	L3
FCC Part 15.209	0.009 – 0.490 MHz		2400/F(kHz) 300m !
	0.490 – 1.705 MHz		2400/F(kHz)
	1.705 - 30 MHz	71,6 dBµV/m = 300 µV/m	31,6 dBµV/m = 30 µV/m
Detektor [detector]		QP, 120 kHz	QP, 120 kHz
Messentfernung [distance]:		d2 = 3m	d3 = 30m
Entf.-Formel [distance formula] by FCC Part 15.31 (f) (2)	L2 = L3 + 40 dB/dec.		

Grenzwerte [limits]		L2	L1
FCC Part 15.209	30 - 88 MHz	40 dBµV/m = 100 µV/m	29,5 dBµV/m
	88 – 216 MHz	43,5 dBµV/m = 150 µV/m	33 dBµV/m
	216 – 960 MHz	46 dBµV/m = 200 µV/m	35,5 dBµV/m
	> 960 MHz	54 dBµV/m = 500 µV/m	43,5 dBµV/m
Detektor [detector]	< 1000 MHz	QP, 120 kHz	
	> 1000 MHz	Av, 1 MHz	
Messentfernung [distance]:		d2 = 3m	d1 = 10m
Entf.-Formel [distance formula] by FCC Part 15.31 (f) (1) by EN 55022 10.6	$L2 = L1 + 20 \text{ dB/dec.}$ $L2 = L1 * (d1/d2) = L1 + 20 * \lg d1/d2 = L1 + 10,46 \text{ dB}$		

Grenzwerte [limits]

FCC Part 15.247 (b) (1)	902 – 928 MHz	N/A	
	2400 - 2483,5 MHz	1W = 30 dBm ERP	
	5725 – 5875 MHz	N/A	
	outside these bands	Limits as	FCC Part 15.209
Detektor [detector]		Pk	
Messentfernung [distance]:		d2 = 3m	

Grenzwerte [limits]

Grenzwerte [limits]		Carrier	Harmonics
FCC Part 15.249	902 – 928 MHz	50 mV/m	0,50 mV/m
	2400 - 2483,5 MHz	= 94 dBµV/m	= 54 dBµV/m
	5725 – 5875 MHz	= -13 dBm	= -53 dBm
	24,0 – 24,25 GHz	250 mV/m = 108 dBµV/m = 1 dBm	2,50 mV/m = 68 dBµV/m = -39 dBm
	outside these bands	Limits as	FCC Part 15.209
Detektor [detector]		Pk	
Messentfernung [distance]:		d2 = 3m	

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Obere Messfrequenz [upper freq. of measurement] FCC Part 15 Section 15.33 (a)	From 30 MHz To 26.5 GHz
---	----------------------------

Messort [location]:	Absorberkammer [semi anechoic chamber SAC]
Prüftisch [turn table] Dimension Material	1,5m, Höhe [height] 0,8m Holz, nichtleitend [wood, non-conductive]
Messentfernung [distance]:	3 m
Messmethode [method]	Substitution
Betriebsart [EUT mode]:	siehe Kap. 2 und Anhang 1 [refer to chapter 2 and appendix 1]
Prüfaufbau [test setup]:	siehe Kap. 3 [refer to chapter 3]
Messergebnis [test data]:	Max. radiated power on Channel 11 = 3,2 dBm Max. radiated power on Channel 17 = 3,1 dBm Max. radiated power on Channel 26 = 2,8 dBm
Anmerkungen [comments]:	The transmitter was modulated. The center frequency for each channel can be calculated as, $F_c = (2405 + (5 * ch)) \text{ MHz}$, where ch = 11, 12, ..., 26.
Prüfergebnis [test result]:	X Anforderungen erfüllt [Req. fulfilled, Passed] --- Anforderungen nicht erfüllt [Req. not fulfilled, Failed] --- Informativ getestet [Informatively tested] --- Nicht anwendbar/gefordert [Not Applicable/Requested] --- Nicht getestet [Not tested]

X, Y and Z positions were tested and "X" position was found to be worst case.

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4:2003.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions. The Analyser was set to max. hold. All test was performed with Peak and Average detector. All values are the same. The Res.Bw and Vid.Bw for the above table is 1 MHz. The report shows the max. value.

Frequency error or frequency drift					
Measurement uncertainty: $\pm 1 \times 10^{-7}$ Limit: $\pm 60 \text{ ppm}$					
Tx Freq. (GHz)	Temp. (°C)	Voltage (V)	Error (kHz)	Verdict	Remark
Channel 11	23	9	0	Pass	---
	-20	9	0,950	Pass	
	50	9	1,620	Pass	

Frequency error or frequency drift					
Measurement uncertainty: $\pm 1 \times 10^{-7}$ Limit: $\pm 60 \text{ ppm}$					
Tx Freq. (GHz)	Temp. (°C)	Voltage (V)	Error (kHz)	Verdict	Remark
Channel 26	23	9	0	Pass	---
	-20	9	0,950	Pass	
	50	9	1,620	Pass	

(2) The frequency tolerance of the carrier signal shall be maintained within + 0.001% of the operating frequency over a temperature variation of –20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. **For battery operated equipment, the equipment tests shall be performed using a new battery.**

Bandedge	
Measurement uncertainty: $\pm 1 \times 10^{-7}$	
Low frequency at 20 db bandwidth (GHz)	High frequency at 20 db bandwidth (GHz)
2,40260	2,48239

All other emission at least 20 dB below the limit as defined in section 15.209(a)

See also plot's in Appendix 1.

6 dB Bandwith				
Systems using digital modulation techniques may operate in 2400-2483.5 MHz Band. The minimum 6dB bandwith shall at least 500 kHz				
Tx Freq. (GHz)	Bandwith (MHz)	Limit (kHz)	Verdict	Remark
Channel 11	1,50	>500	Pass	---
Channel 17	1,50	>500	Pass	---
Channel 26	1,51	>500	Pass	---

Peak power spectral density				
Systems using digital modulation techniques, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmisson.				
Tx Freq. (GHz)	PSD (dBm/3kHz)	Limit (kHz)	Verdict	Remark
Channel 11	-12,8	8	Pass	---
Channel 17	-12,6	8	Pass	---
Channel 26	-13,2	8	Pass	---

Radiated Emissions, restricted Bands					
Radiated Emissions which fall in the restricted bands, as defined in section 15.205(a), must comply with the radiated emission limits specified in section 15.209(a).					
Tx Freq. (GHz)	Emission Frequency	Detector Type	Pol. V/H	Emission Level (dBμV/m)	Remark
Channel 11	---	---	---	---	No signals found 30 dB below the limit
Channel 17	---	---	---	---	No signals found 30 dB below the limit
Channel 26	---	---	---	---	No signals found 30 dB below the limit

The results show the worst case.

Spurious Emission (dBμV/m) = measured (dbμV) + Antenna-factor (dB (1/m)) + Cable Loss

Antenna Connector Requirements	
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 provisions of this section.	
The antenna is printed to the PCB.	Result
	Pass

Maximum Permissible Exposure (MPE)			
According to 1.1307 (b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the commissions's guideline.			
Calculation Result	MPE distance	Limit (mW/cm²)	Result
Max. MPE on Channel 11 = 0.000415 mW/cm²	20 cm	1	Pass
The SAR measurement is not required.			

Equation (3) given in OET Bulletin 65 is used to estimate the MPE distance.

$$S = (PG) / (4\pi R^2)$$

S= power density, in mW/cm²

P= power input to the antenna, in mW

G= numeric gain of the antenna,

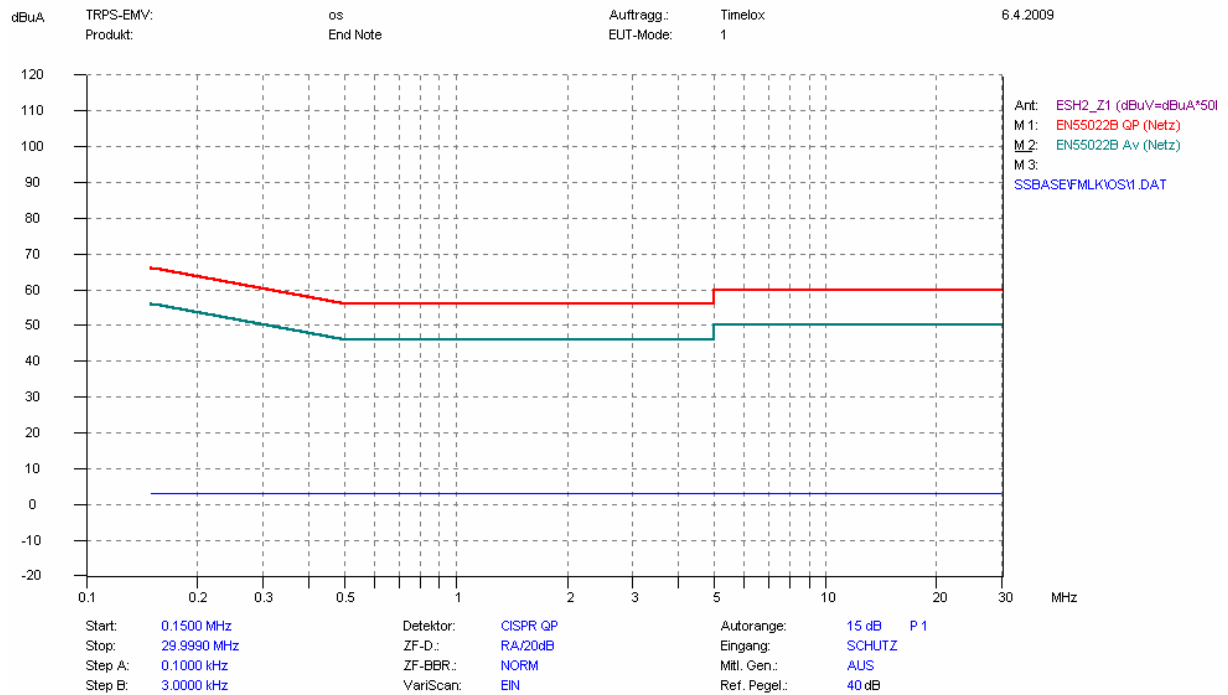
R= distance of the center of the antenna, in cm

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Anhang 1 [Appendix 1]

Messdiagramme [Test Data]

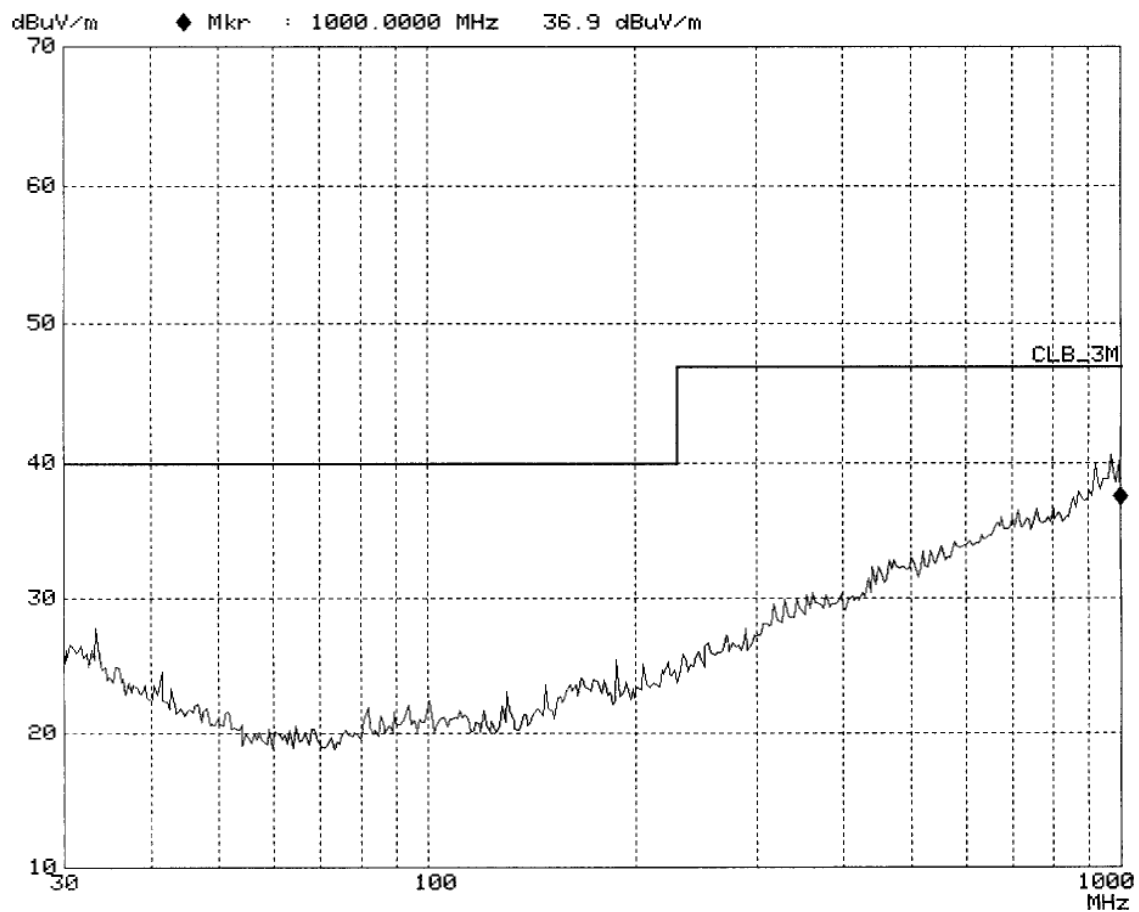
Conducted emission - DC mains input/output port



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El. Funkstörfeldstärke,
[radiated disturbance, intentional radiator]

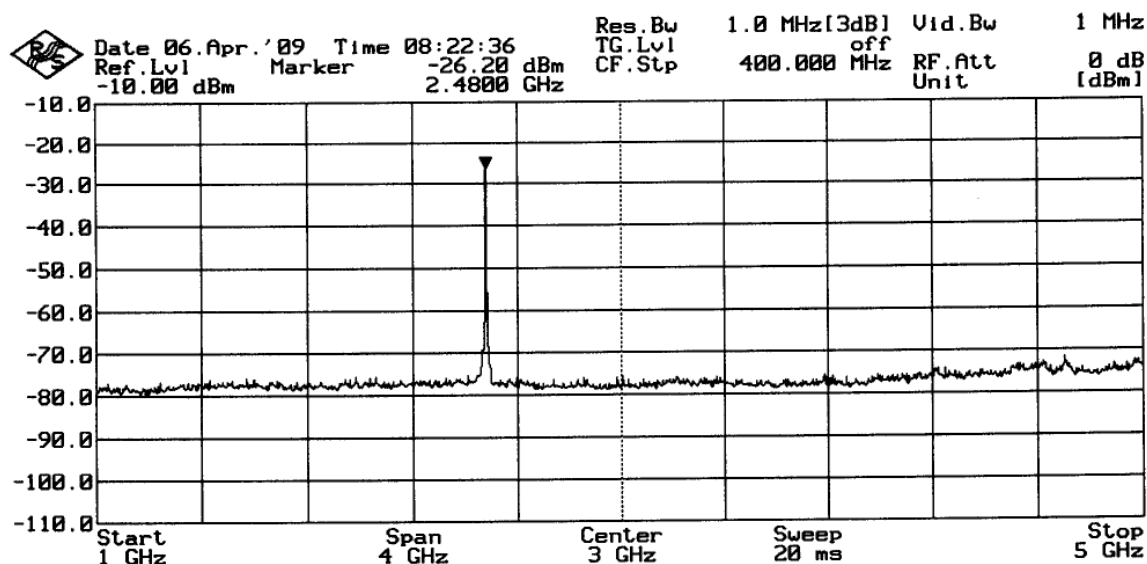
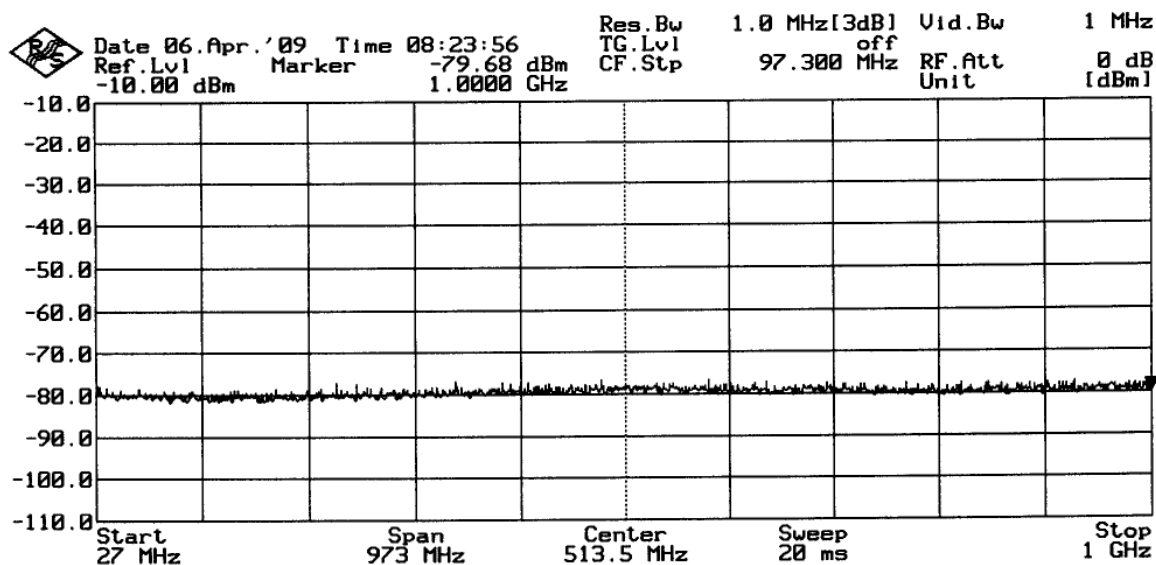
Including Antenna factor and cable lost



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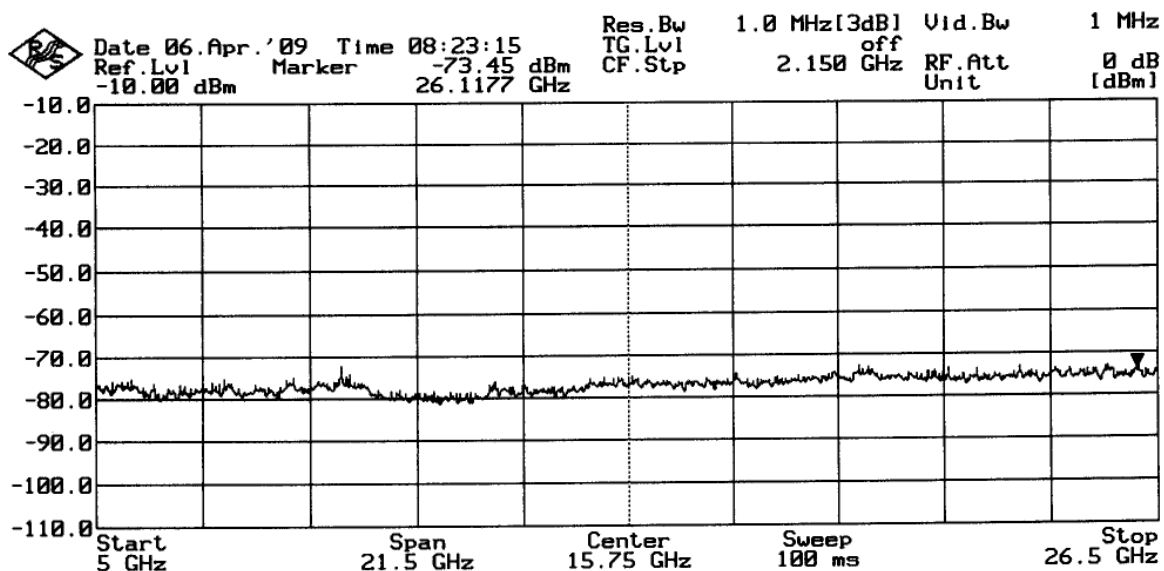
El. Funkstörfeldstärke,
[radiated disturbance, intentional radiator]

Relative measurement in a distance from 10 cm with small testantenna.



El. Funkstörfeldstärke,
[radiated disturbance, intentional radiator]

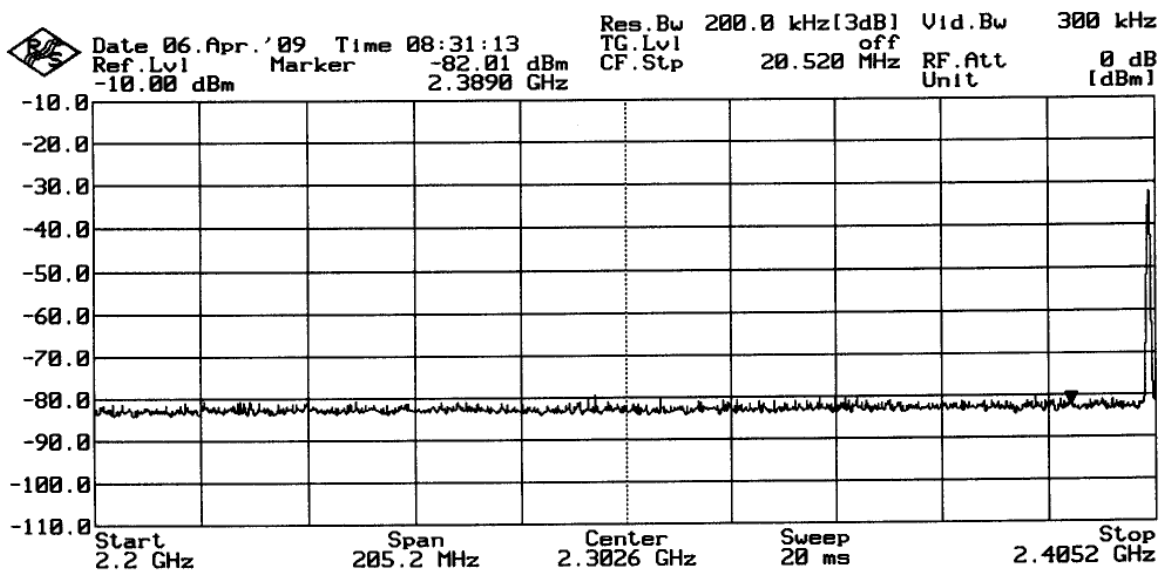
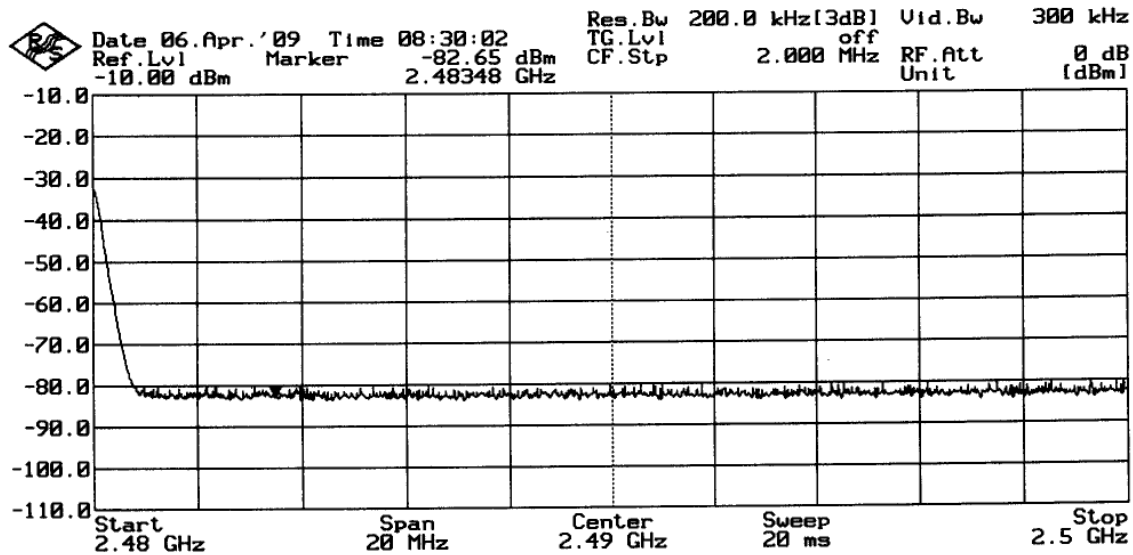
Relative measurement in a distance from 10 cm with small testantenna.



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Section 15.205 Band-edge compliance of RF emission, restricted bands



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Ende des Prüfberichtes / *End of Testreport*