Senton GmbH
Aeussere Fruehlingstrasse 45
D-94315 Straubing

Straubing, March 8, 2005

T E S T - R E P O R T

No. 50511-40907-2 (Edition 1)

for

Solid Radar FMR 25x

Level Measuring Transmitter

Applicant: Endress & Hauser GmbH & Co. KG

Test Specifications: FCC Code of Federal Regulations,
CFR 47, Part 15,
Sections 15.205, 15.207 and 15.209

Industry Canada Radio Standards
Specification RSS-210 Issue 5,
Sections 6.2.1, 6.3 and 6.6
(Category I Equipment)

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1 Description of the Equipment Under Test (EUT)

General data of EUT	
Type designation[1]:	Solid Radar FMR 25x
Parts[2]:	
Serial number(s):	71004301083
Manufacturer:	Endress & Hauser GmbH & Co. KG
Type of equipment:	Level Measuring Transmitter
Version:	
FCC ID:	
Additional parts/accessories:	

Technical data of EUT	
Application frequency range:	24.00 – 24.12 GHz
Frequency range:	24.00 – 24.12 GHz
Operating frequency:	24.12 GHz (nominal)
Type of modulation:	1G08P0NAN
Pulse train:	558.5 ns
Pulse width:	2.79 ns
Number of RF-channels:	1
Channel spacing:	Not Applicable
Designation of emissions[3]:	1G08P0NAN
Type of antenna:	Dish Antenna
Size/length of antenna:	Ø 20 cm
Type of power supply:	DC supply
Specifications for power supply:	nominal voltage: 24 V minimum voltage: 16 V maximum voltage: 36 V

[1] Type designation of the system if EUT consists of more than one part.
[2] Type designations of the parts of the system, if applicable.
[3] Also known as "Class of Emission".

2 Administrative Data

Application details	
Applicant (full address):	Endress & Hauser GmbH & Co. KG Hauptstraße 1 D 79689 Maulburg Germany
Contact person:	Mr. Peter Klöfer
Contract identification:	
Receipt of EUT:	January 2005
Date(s) of test:	February – March 2005
Note(s):	

Report details	
Report number:	50511-40907-2
Edition:	1
Issue date:	March 8, 2005

3 Identification of the Test Laboratory

Details of the Test Laboratory	
Company name:	Senton GmbH EMI/EMC Test Center
Address:	Aeussere Fruehlingstrasse 45 D-94315 Straubing Germany
Laboratory Accreditation:	DAR-Registration No. DAT-P-171/94-02
FCC Test Site registration number	90926
Industry Canada Test site registration:	IC 3050
Contact person:	Mr. Johann Roidt Phone: (+49) (0)9421 5522-0 Fax: (+49) (0)9421 5522-99

4 Summary

Summary of test results
The tested sample complies with the requirements set forth in the **Code of Federal Regulations CFR 47, Part 15, Sections 15.205, 15.207 and 15.209** of the Federal Communication Commission (FCC) and the **Radio Standards Specification RSS-210 Issue 5, Sections 6.2.1, 6.3 and 6.6 (Category I Equipment)** of Industry Canada (IC).

Personnel involved in this report	
Laboratory Manager:	 Mr. Johann Roidt
Responsible for testing:	Mr. Johann Roidt
Responsible for test report:	Mr. Johann Roidt

5 Operation Mode and Configuration of EUT

Operation Mode
Normal operation mode: Measurement with pulsed signal.

Configuration of EUT
FCC test setup. DC 24 V power supply. EUT in vertical position.

List of ports and cables

Port	*Description*	*Classification*[4]	*Cable type*	*Cable length*
1	DC supply with HART communication	dc power signal/control port	Shielded	> 3 m

List of devices connected to EUT

Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*

List of support devices

Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*
	---			

[4] Ports shall be classified as ac power, dc power or signal/control port

6 Measuring Methods

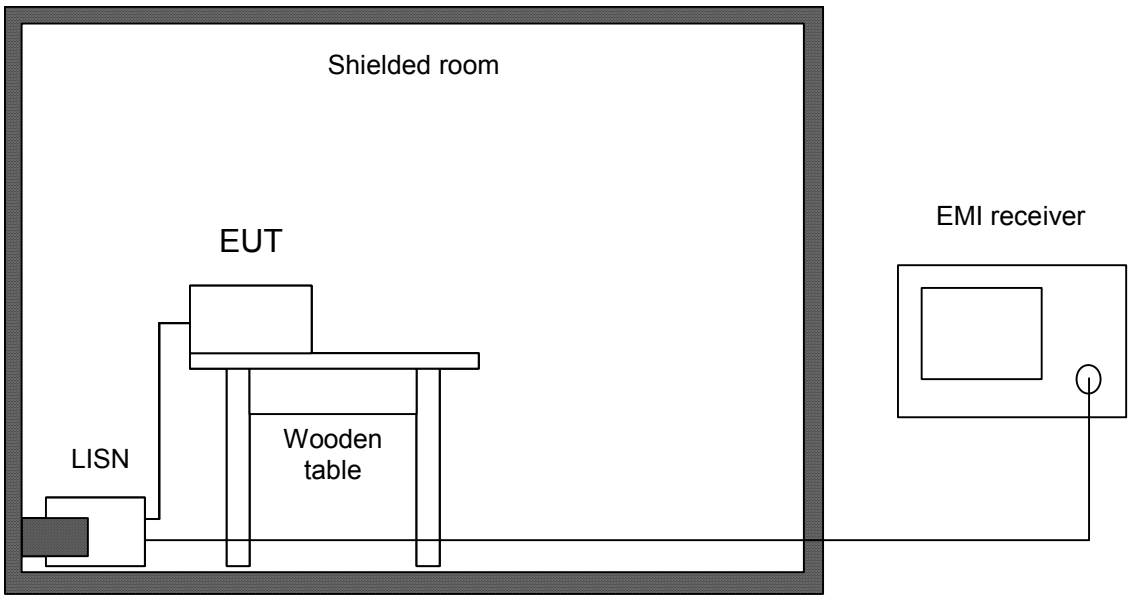
6.1 Conducted AC powerline emission

Measurement Procedure:	
Rules and Specifications:	CFR 47 Part 15, section 15.207 IC RSS-210 Issue 5, section 6.6
Guide:	ANSI C63.4 / CISPR 22

Conducted emission tests in the frequency range 150 kHz to 30 MHz are performed using Line Impedance Stabilization Networks (LISNs). To simplify testing with quasi-peak and average detector the following procedure is used:

First the whole spectrum of emission caused by the equipment under test (EUT) is recorded with detector set to peak using CISPR bandwidth of 10 kHz. After that all emission levels having less margin than 10 dB to or exceeding the average (CFR 47 Part 15) or quasi-peak (IC RSS-210) limit are retested with detector set to quasi-peak.
If average limit is kept with quasi-peak levels no additional scan with average detector is necessary. In cases of emission levels between quasi-peak and average limit an additional scan with detector set to average is performed.

According to ANSI C63.4, section 13.1.3.1, testing of intentional radiators with detachable antenna shall be performed using a suitable dummy load connected to the antenna output terminals. Otherwise, the tests shall be made with the antenna connected and, if adjustable, fully extended.
Testing with dummy load may be necessary to distinguish (unintentional) conducted emissions on the supply lines from (intentional) emissions radiated by the antenna and coupling directly to supply lines and/or LISN. Usage of dummy load has to be stated in the appropriate test record(s) and notes should be added to clarify the test setup.



Test instruments used:

Used	Type	Model	Serial No. or ID	Manufacturer
☒	EMI receiver	ESHS 10	860043/016	Rohde & Schwarz
☒	LISN	ESH3-Z5	862770/021	Rohde & Schwarz
☐	LISN	ESH3-Z5	830952/025	Rohde & Schwarz
☐	Shielded room	No. 1	1451	Albatross Projects
☒	Shielded room	No. 4	3FD-100 544	Euroshield

6.2 Radiated emission in Fully Anechoic Room

Measurement Procedure:	
Rules and Specifications:	CFR 47 Part 15, section 15.209 IC RSS-210 Issue 5, section 6.2.1
Guide:	ANSI C63.4

Radiated emission in fully anechoic room is measured in the frequency range from 30 MHz to the maximum frequency as specified in CFR 47 Part 15 section 15.33.

Measurements are made in both the horizontal and vertical planes of polarization in a fully anechoic room using a spectrum analyzer with the detector function set to peak and resolution as well as video bandwidth set to 100 kHz (below 1 GHz) or 1 MHz (above 1 GHz).

Testing up to 1 GHz is performed with a linear polarized logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna"). For testing above 1 GHz horn antennas are used.

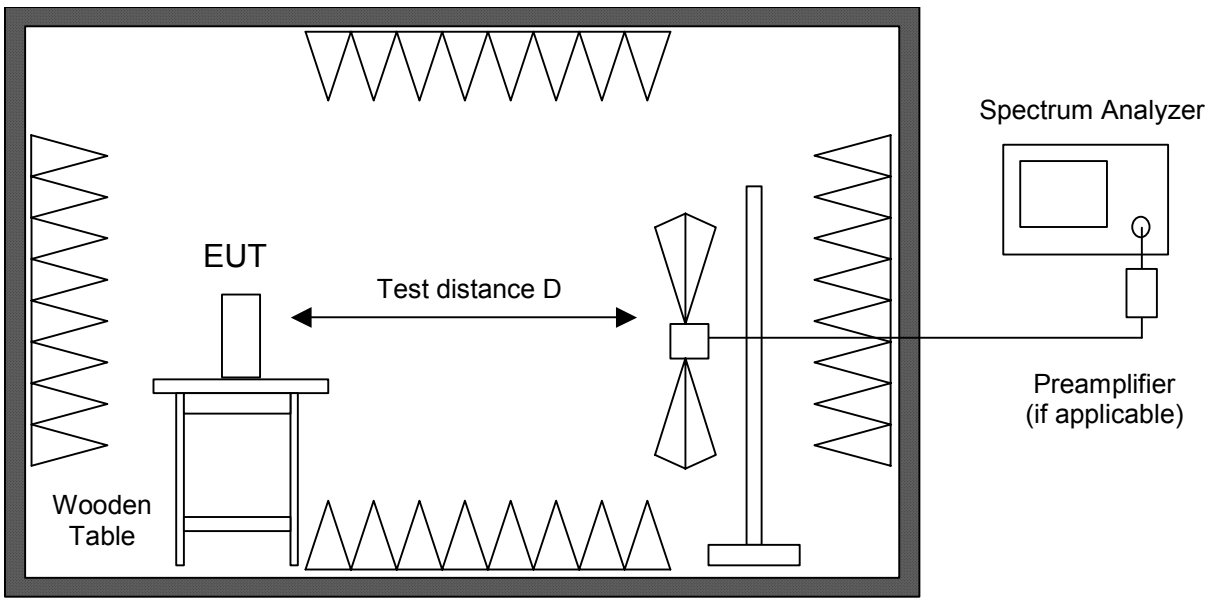
All tests below 18 GHz are performed at a test distance D of 3 meters. For higher frequencies the test distance is reduced (e.g. to 1 meter) due to the sensitivity of the measuring instrument(s) and the test results are calculated according to CFR 47 Part 15 section 15.31(f)(1) using an extrapolation factor of 20 dB/decade. If required, preamplifiers are used for the whole frequency range. Special care is taken to avoid overload, using appropriate attenuators and filters, if necessary.

If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete pulse train, including blanking intervals, as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.

Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration produces the highest emission relative to the limit and therefore shall be used for final testing.

During testing the EUT is rotated all around to find the maximum levels of emissions. Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

For final testing below 1 GHz an open field test-site is used and the plots recorded in the fully anechoic room are indicated as prescans.



Fully anechoic room

Test instruments used:

Used	Type	Model	Serial No. or ID	Manufacturer
☒	Spectrum Analyzer	FSP 30	100063	Rohde & Schwarz
☐	EMI test receiver	ESMI	839379/013 839587/006	Rohde & Schwarz
☒	Preamplifier	CPA9231A	3393	Schaffner
☒	Preamplifier 1-8 GHz	AFS3-00100800-32-LN	847743	Miteq
☐	Preamplifier 0.5-8 GHz	AMF-4D-005080-25-13P	860149	Miteq
☒	Preamplifier 8-18 GHz	ACO/180-3530	32641	CTT
☒	External Mixer	WM782A	845881/005	Tektronix
☒	Harmonic Mixer Accessories	FS-Z30	843389/007	Rohde & Schwarz
☒	Trilog broadband antenna	VULB 9163	9163-188	Schwarzbeck
☒	Horn antenna	3115	9508-4553	EMCO
☐	Horn antenna	3160-03	9112-1003	EMCO
☐	Horn antenna	3160-04	9112-1001	EMCO
☒	Horn antenna	3160-05	9112-1001	EMCO
☒	Horn antenna	3160-06	9112-1001	EMCO
☒	Horn antenna	3160-07	9112-1008	EMCO
☒	Horn antenna	3160-08	9112-1002	EMCO
☒	Horn antenna	3160-09	9403-1025	EMCO
☒	Horn antenna	3160-10	399185	EMCO
☒	Fully anechoic room	No. 2	1452	Albatross Projects

6.3 Radiated emission at Open Field Test Site

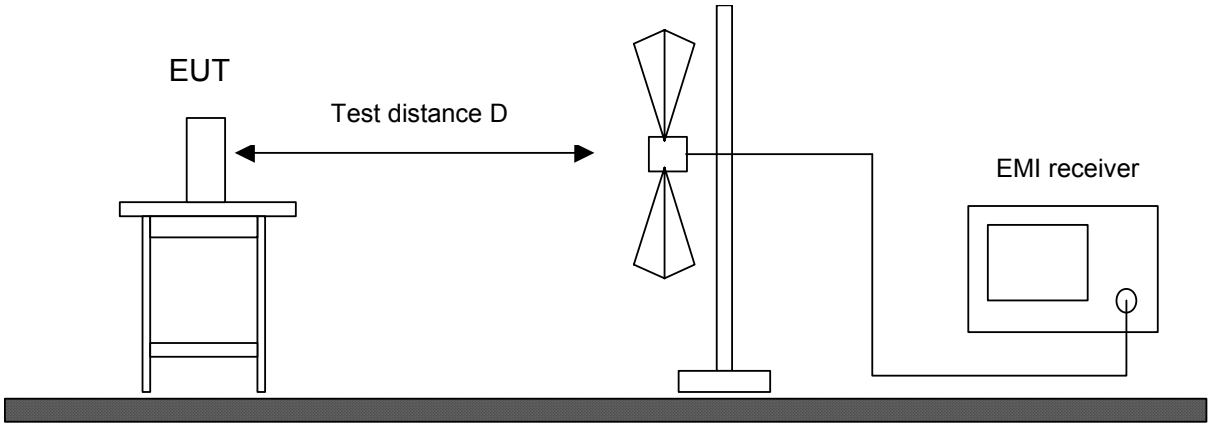
Measurement Procedure:	
Rules and Specifications:	CFR 47 Part 15, section 15.209 IC RSS-210 Issue 5, section 6.2.1
Guide:	ANSI C63.4

Radiated emission at open field test site is measured in the frequency range 30 MHz to 1 GHz using a biconical antenna up to 300 MHz and a logarithmic periodic antenna above. The measurement bandwidth of the test receiver is set to 120 kHz with quasi-peak detector selected.

If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete pulse train, including blanking intervals, as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.

Hand-held or body-worn devices are tested in the position producing the highest emission relative to the limit as verified by prescans in the fully anechoic room. EUT is rotated all around and receiving antenna is raised and lowered within 1 meter to 4 meters to find the maximum levels of emission. Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

For measuring emissions of intentional radiators and receivers a test distance D of 3 meters is selected. Testing of unintentional radiators is performed at a distance of 10 meters. If limits specified for 3 meters shall be used for measurements performed at 10 meters distance the limits are calculated according to CFR 47 Part 15 section 15.31(d) and (f)(1) using an inverse linear-distance extrapolation factor of 20 dB/decade.



Test instruments used:

Used	Type		Model	Serial No. or ID	Manufacturer
☐	EMI receiver		ESVP	881414/009	Rohde & Schwarz
☐	Biconical antenna	EG 1	HK 116	842204/001	Rohde & Schwarz
☐	Log. per. antenna	EG 1	HL 223	841516/023	Rohde & Schwarz
☐	Open field test site		EG 1	1450	Senton

6.4 Desensitization of pulsed Emissions

Since the EUT transmits pulsed energy, the desensitization factor α has been calculated and included in the calculation for the final peak value.

In the HP Application Note 150-2 the analyzer settings to measure a line spectrum are defined as follows:

a) Bandwidth B < 0.3 x PRF

b) Scan time Ts > Fs / B²

With the pulse repetition frequency (PRF) of the EUT of 3.6 MHz and the selected measuring bandwith of B =1 MHz the requirement a) was observed.

The scan width of Fs = 3 GHz and Bandwidth of B = 1 MHz leads to following values:

$Fs/B^2 = 3\ GHz / (1\ GHz)^2 = 3x\ 10^{-9}\ s$

The selected scan time of Ts= 20 ms meets requirement b). Hence, a line spectrum was measured, which could be seen, when the Pseudo-Noise-mode of the EUT was switched off (no influence on the measured amplitudes) and the frequency scale of the analyser zoomed.

The desensitization factor α_l was calculated according to HP Application note 150-2:

$$\alpha_l = 20\log(\tau eff / T) = -46\ dB$$

The calculation based on the pulse width τ eff = 2.79 ns and the pulse period T= 558.5 ns, which have been supplied by the applicant.

To avoid overloading the spectrum analyzer the internal preselector has been activated during final testing. A linearity check by adding a 3 dB attenuator to the input was used to ensure integrity of the test data.

Sample Calculation of Field Strength values for pulsed systems:

1) Measure Peak value with analyzer RBW set to 1 MHz, VBW set to 1 MHz, Ts set to 20 ms

2) Calculate Field Strength by adding antenna correction factor

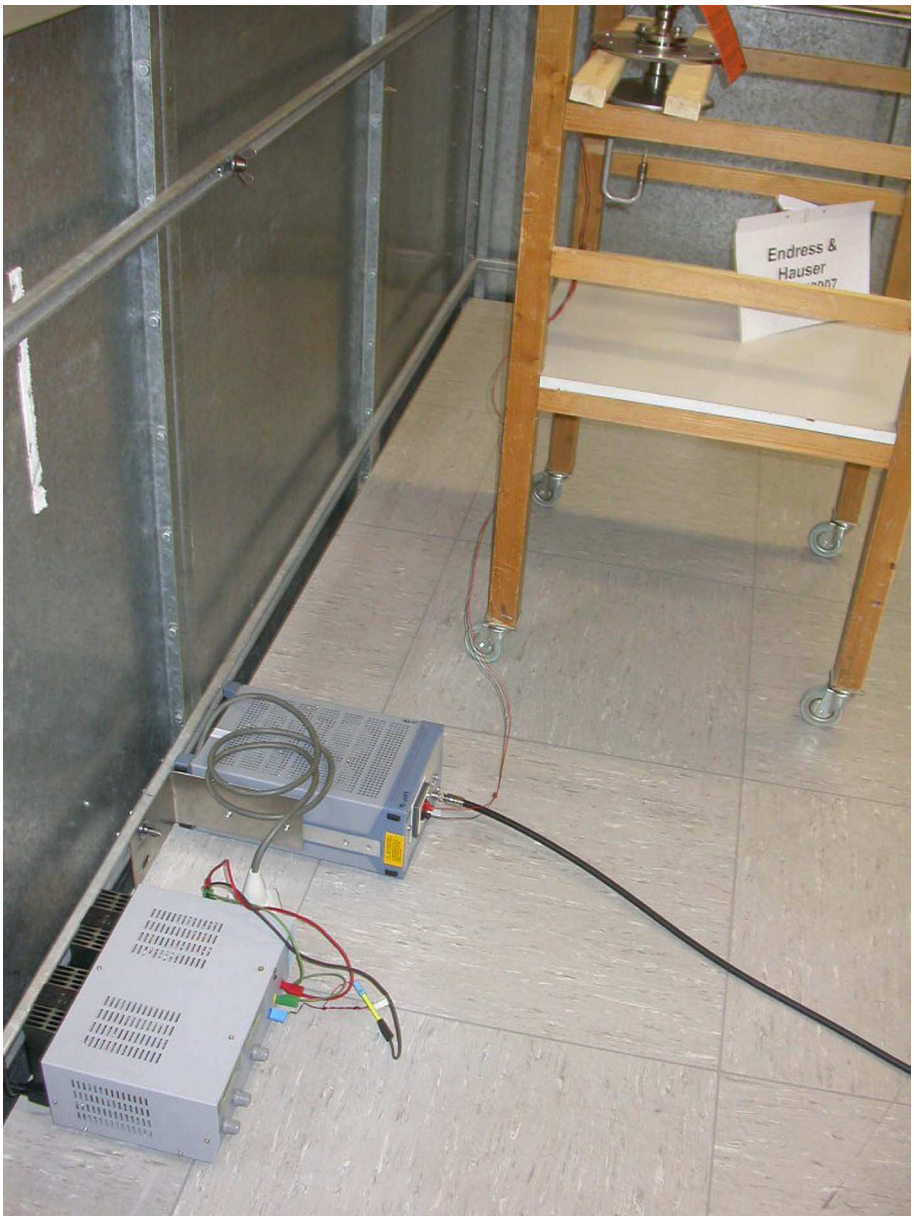
3) Calculate True Peak Field Strength by adding Desensitization Factor

4) Calculate Average value by subtracting Duty Cycle Correction Factor from True Peak Field Strength Value

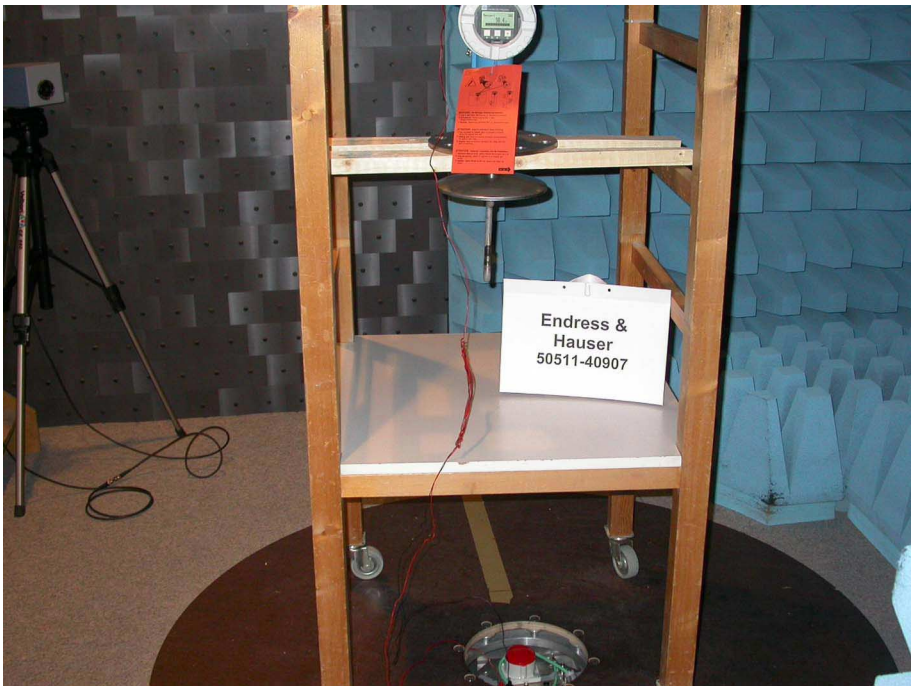
7 Photographs Taken During Testing

Test setup for conducted DC powerline emission measurement

Test setup for conducted DC powerline emission measurement
- continued -



Test setup for radiated emission measurement (fully anechoic room)



Test setup for radiated emission measurement (fully anechoic room) - continued -

8 Test Results

FCC CFR 47 Parts 2 and 15			
Section(s)	*Test*	*Page*	*Result*
2.202(a)	Occupied bandwidth	21	Recorded
2.201, 2.202	Class of emission	24	Calculated
15.35(c)	Pulse train measurement for pulsed operation	25	Recorded
15.205(a)	Restricted bands of operation	28	Test passed
15.207	Conducted AC powerline emission 150 kHz to 30 MHz	29	Test passed[5]
15.205(b) 15.209	Radiated emission 9 kHz to 30 MHz	---	Not applicable
15.205(b) 15.209	Radiated emission 30 MHz to 110 GHz	30	Test passed

IC RSS-210 Issue 5			
Section(s)	*Test*	*Page*	*Result*
5.9.1	Emission bandwidth	23	Recorded
5.9.2	Designation of emissions	24	Calculated
6.5	Pulsed operation	25	Recorded
6.3(a)	Restricted bands and unwanted emission frequencies	28	Test passed
6.6	Transmitter AC wireline conducted emissions 450 kHz to 30 MHz	29	Test passed[5]
6.2.1 6.3(b)-(d)	Field strength of emissions 9 kHz to 30 MHz	---	Not applicable
6.2.1 6.3(b)-(d)	Field strength of emissions 30 MHz to 110 GHz	30	Test passed

[5] Conducted AC powerline emission not applicable. Conducted DC powerline emission performed instead.

8.1 Occupied Bandwidth

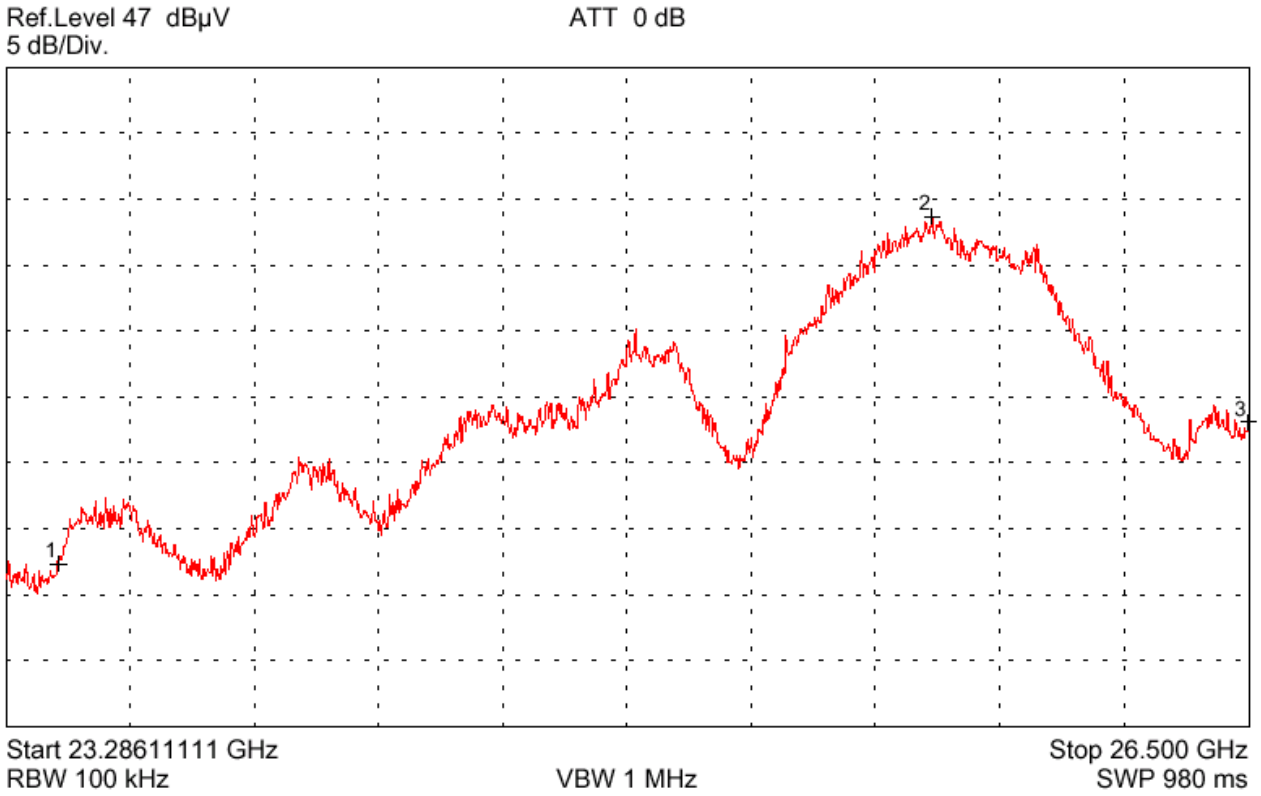
Rules and specifications:	CFR 47 Part 2, section 2.202(a) ANSI C63.4, annex H.6
Guide:	ANSI C63.4
Description:	The occupied bandwidth according to CFR 47 Part 2, section 2.202(a), is measured as the 99% emission bandwidth, i.e. below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5% of the total mean power radiated by a given emission. The occupied bandwidth according to ANSI C63.4, annex H.6; is measured as the frequency range defined by the points that are 26 dB down relative to the maximum level of the modulated carrier. The resolution bandwidth of the spectrum analyzer shall be set to a value greater than 5.0% of the allowed bandwidth. If no bandwidth specifications are given, the following guidelines are used:

Fundamental frequency	Minimum resolution bandwidth
9 kHz to 30 MHz	1 kHz
30 MHz to 1000 MHz	10 kHz
1000 MHz to 40 GHz	100 kHz

The video bandwidth shall be at least three times greater than the resolution bandwidth.

Comment:	Test performed until 26.5 GHz only
Date of test:	11 March 2005
Test site:	Fully anechoic room, cabin no. 2

Occupied Bandwidth (-26 dB):

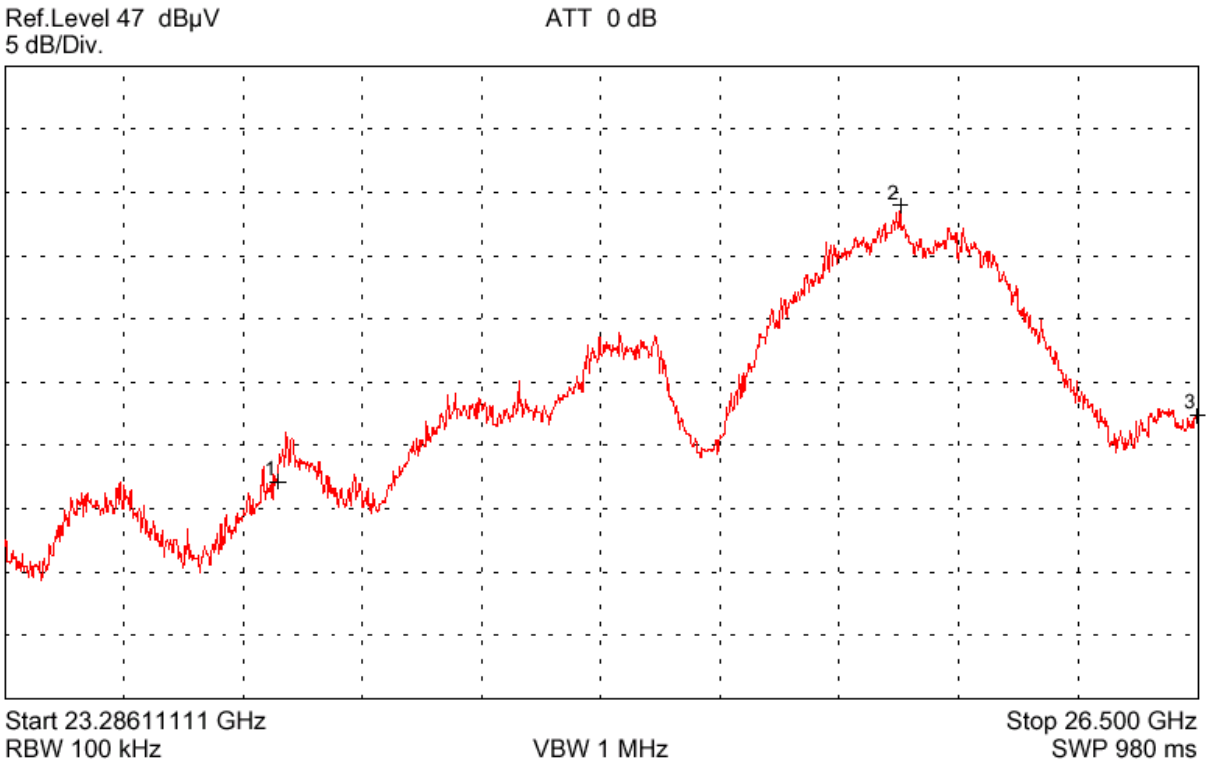


Occupied Bandwidth (-26 dB):	**> 3.0 GHz**

8.2 Emission Bandwidth

Rules and specifications:	IC RSS-210 Issue 5, section 5.9.1
Guide:	IC RSS-210 Issue 5, section 5.9.1
Description:	The 20 dB bandwidth is measured at the points when the spectral density of the signal is 20 dB down from the inband spectral density of the modulated signal, with the transmitter modulated by a representative signal. Spectral density (power per unit bandwidth) is measured with a spectrum analyzer with resolution bandwidth set to 300 Hz or alternatively equal to approximately 1.0% of the emission bandwidth. The video bandwidth shall be at least three times greater than the resolution bandwidth.

Comment:	Test performed until 26.5 GHz only
Date of test:	11 March 2005
Test site:	Fully anechoic room, cabin no. 2



Emission bandwidth (-20 dB):	**> 2.5 GHz**

8.3 Designation of Emissions

Rules and specifications:	CFR 47 Part 2, sections 2.201 and 2.202 IC RSS-210 Issue 5, section 5.9.2
Guide:	ANSI C63.4 / TRC-43

Type of modulation:	Unmodulated Pulse Emission

B_n = Necessary Bandwidth	$B_n = 2 K / t$
K = Overall numerical factor	K = 1.5
t = Pulse duration in seconds at half-amplitude	t = 2.79ns
Calculation:	$B_n = 2 \cdot 1.5 / 2.79ns = 1.075$ GHz

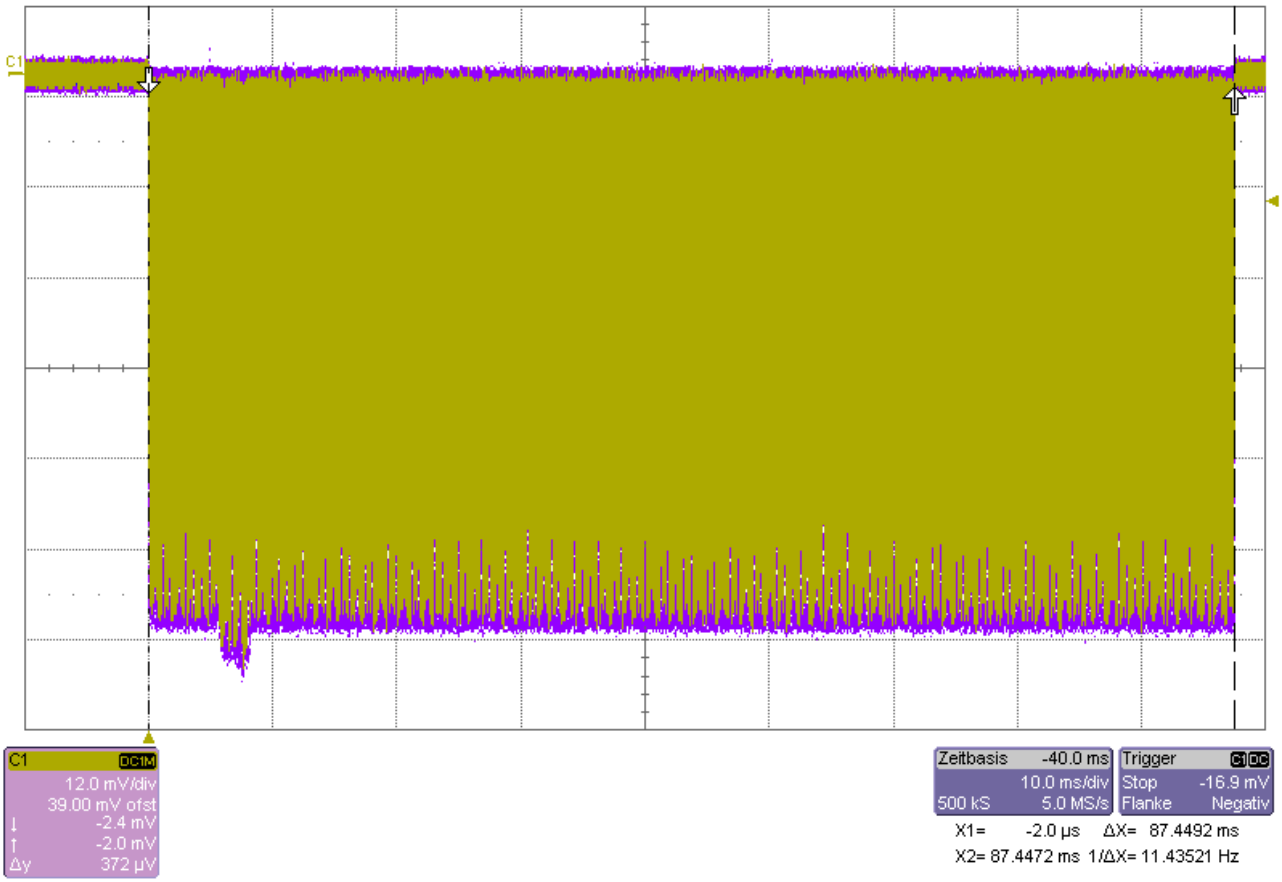
Designation of Emissions:	**1G08P0NAN**

8.4 Duty Cycle Measurement

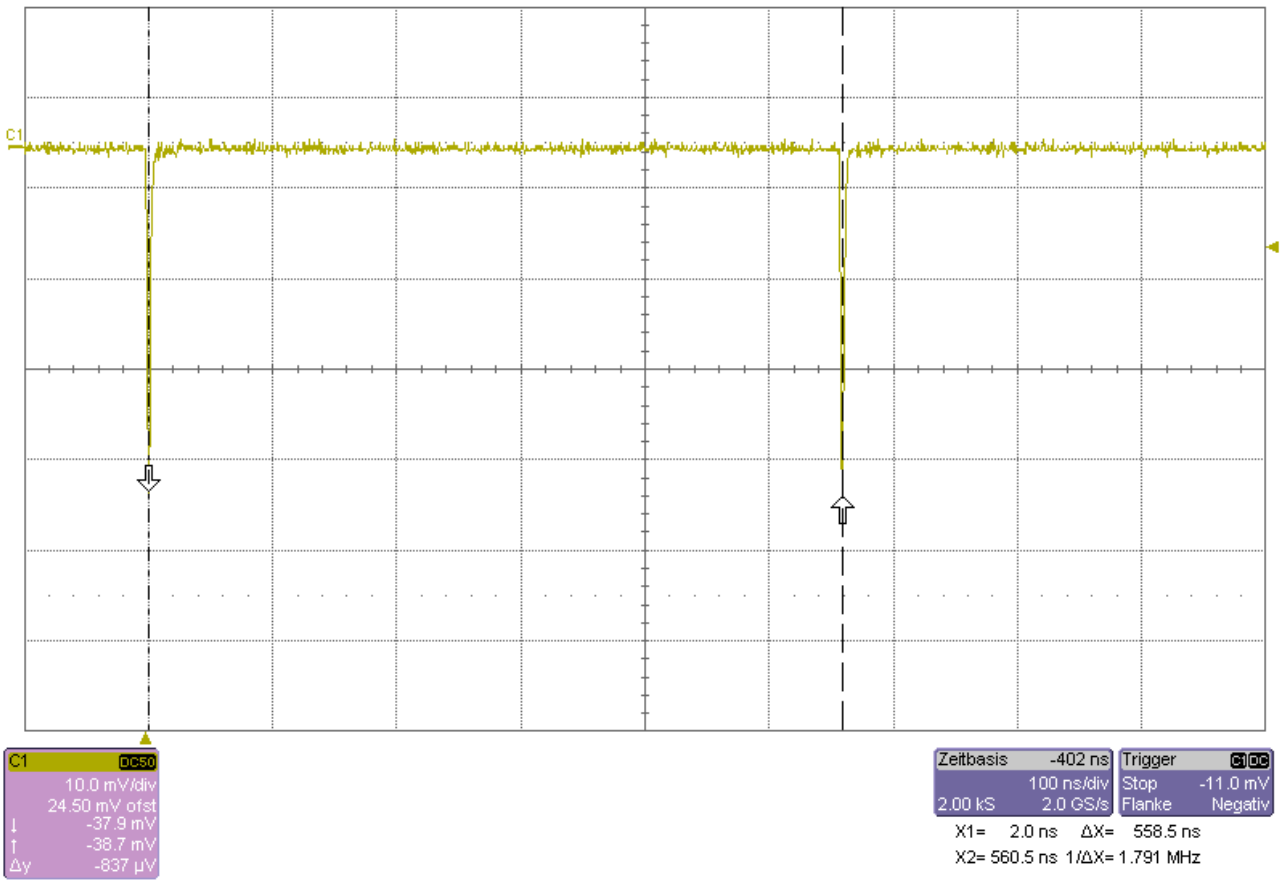
Rules and specifications:	CFR 47 Part 15, section 15.35(c) IC RSS-210 Issue 5, section 6.5
Guide:	ANSI C63.4

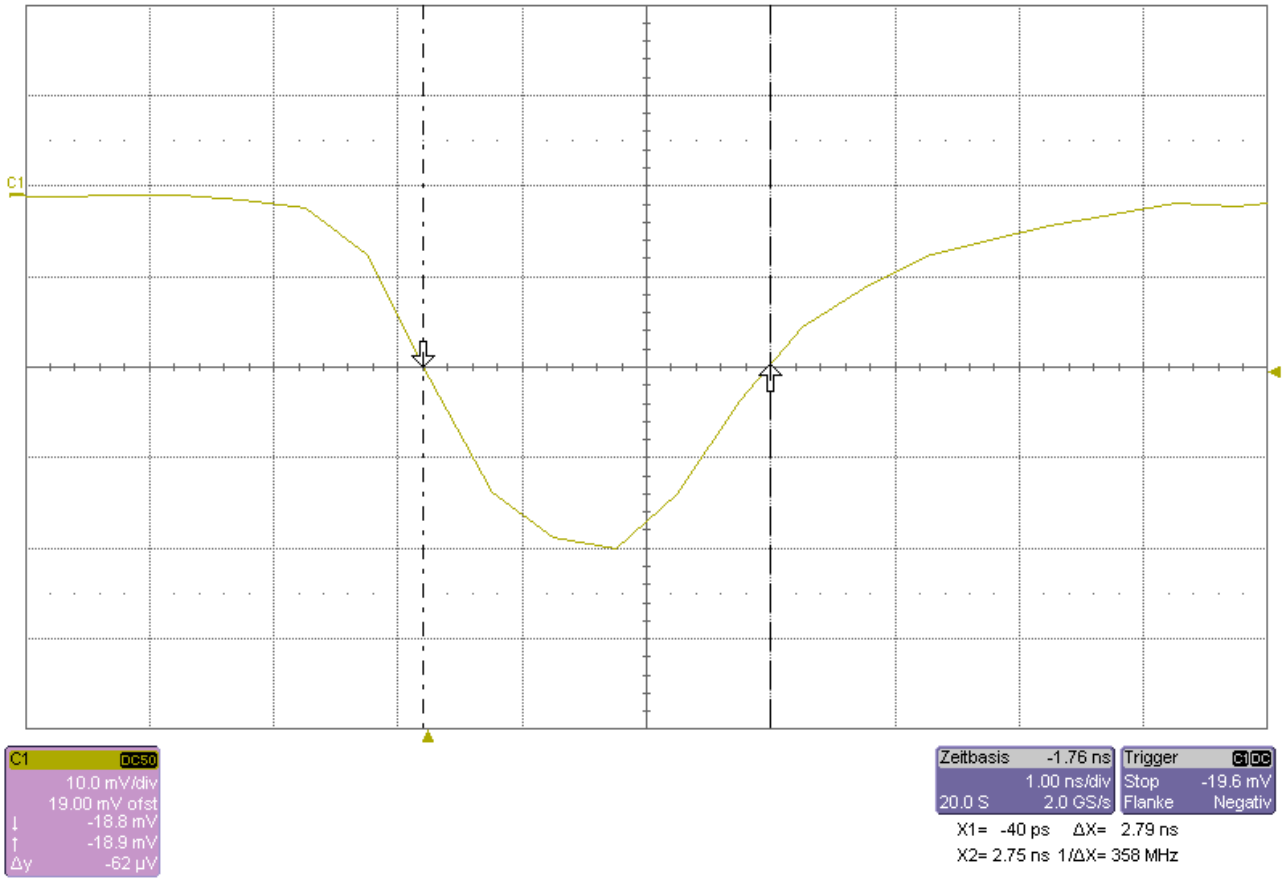
Comment:	Measurement with negative diode detector.
Date of test:	8 March 2005
Test site:	Fully anechoic room, cabin no. 2

Total Pulse Train:



Worst case:


C1
C1 DC50
10.0 mV/div
24.50 mV ofst
-37.9 mV
-38.7 mV
Δy -837 µV
Zeitbasis -402 ns
100 ns/div
2.00 kS 2.0 GS/s
Trigger C1 DC
Stop -11.0 mV
Flanke Negativ
X1= 2.0 ns ΔX= 558.5 ns
X2= 560.5 ns 1/ΔX= 1.791 MHz



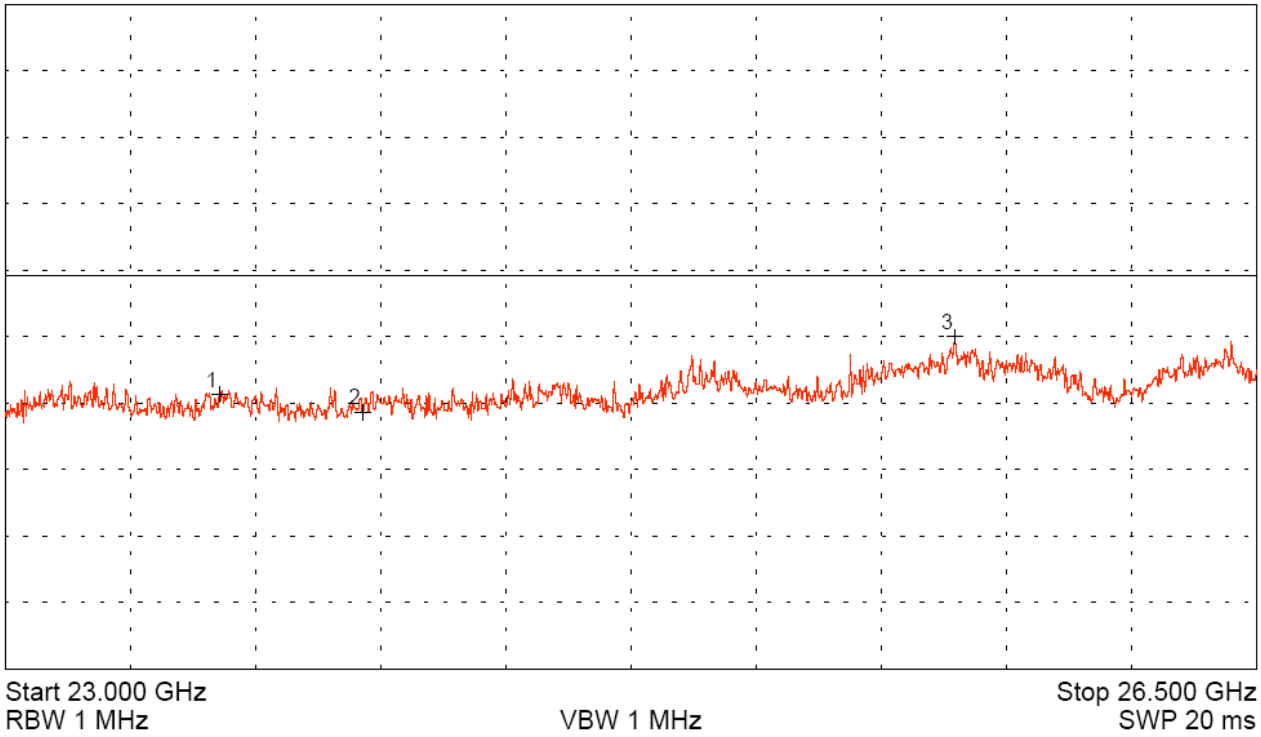
Calculation of Duty cycle correction:

TX-On-Time (worst case):	T_{on}	=	2.79 ns
Pulse Train Time:	T_{pt}	=	558.5 ns
Period Time:	T_{period}	=	558.5 ns
Pulse Train Correction:	C_{pt}	=	$20 \cdot \mathrm{Log}(T_{on} / T_{period})$ dB
		=	**-46.0 dB**

8.5 Restricted bands of operation

Rules and specifications:	CFR 47 Part 15, section 15.205(a) IC RSS-210 Issue 5, section 6.3(a)
Guide:	ANSI C63.4
Limit:	Only spurious emissions are permitted in any of the frequency bands listed in CFR 47 Part 15, section 15.205(a) or IC RSS-210 Issue 5, section 6.3(a).

Comment:	
Date of test:	
Test site:	Fully anechoic room, cabin no. 2
Test distance:	3 meters



Test Result:	Test passed

8.6 Conducted Powerline Emission Measurement 150 kHz to 30 MHz

Rules and specifications:	CFR 47 Part 15, section 15.207 IC RSS-210 Issue 5, section 6.6				
Guide:	ANSI C63.4 / CISPR 22				
Limit:	CFR 47 Part 15			IC RSS-210	
	Frequency of Emission (MHz)	Conducted Limit (dBµV)		Frequency of Emission (MHz)	Conducted Limit (dBµV)
		Quasi-peak	Average		Quasi-peak
	0.15 - 0.5 0.5 - 5 5 - 30	66 to 56 56 60	56 to 46 46 50	0.45 - 30	48

Comment:	EUT has no AC mains supply. Test performed on DC supply instead.
Date of test:	21 February 2005
Test site:	Shielded room, cabin no. 4

Test Result:	Test passed

Tested on:	DC supply: PLUS

Frequency (MHz)	Detector	Reading Value (dBµV)	Correction Factor (dB)	Final Value (dBµV)	CFR 47 Part 15 Limit (dBµV)	CFR 47 Part 15 Margin (dB)	RSS-210 Limit (dBµV)	RSS-210 Margin (dB)
0.150 - 30	Quasi-Peak	0.0	0.0	***				

*** No measurements above noise level detected.

Tested on:	DC supply: MINUS

Frequency (MHz)	Detector	Reading Value (dBµV)	Correction Factor (dB)	Final Value (dBµV)	CFR 47 Part 15 Limit (dBµV)	CFR 47 Part 15 Margin (dB)	RSS-210 Limit (dBµV)	RSS-210 Margin (dB)
0.150 - 30	Quasi-Peak	0.0	0.0	***				

*** No measurements above noise level detected.

Sample calculation of final values:

Final Value (dBµV) = Reading Value (dBµV) + Correction Factor (dB)

8.7 Radiated Emission Measurement 30 MHz to 110 GHz

Rules and specifications:	CFR 47 Part 15, section 15.209 IC RSS-210 Issue 5, section 6.2.1		
Guide:	ANSI C63.4		
Limit:	Frequency of Emission (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)
	30 - 88	100	40.0
	88 - 216	150	43.5
	216 - 960	200	46.0
	Above 960	500	54.0

Comment:	
Date of test:	
Test site:	Frequencies ≤ 1 GHz: Open field test site Frequencies > 1 GHz: Fully anechoic room, cabin no. 2
Test distance:	3 meters

Test Result:	Test passed

Frequency (MHz)	Polarization	Detector	Reading (dBµV)	Correction (dB/m)	Pulse Train Corr. (dB)	Final Value (dBµV(m)	Limit (dBµV/m)	Margin (dB)
25900,000	horizontal	Peak	5,4	43,0	0,0	48,4	54,0	**5,6**

9 Referenced Regulations

All tests were performed with reference to the following regulations and standards:

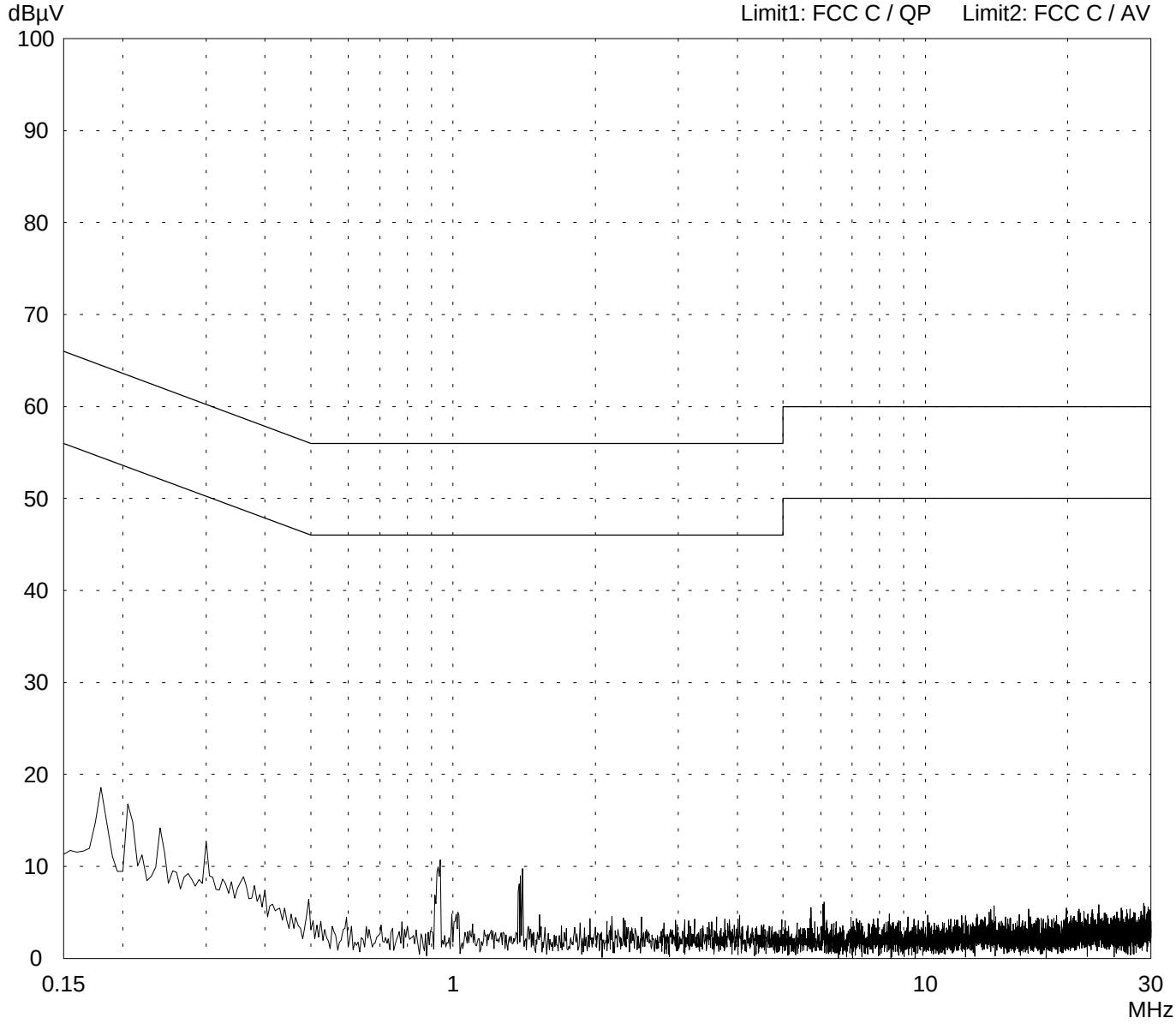
☒	CFR 47 Part 2	Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC)	October 10, 2004
☒	CFR 47 Part 15	Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)	April 5, 2005
☒	ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz	December 11, 2003 (published on January 30, 2004)
☒	RSS-210	Radio Standards Specification RSS-210 Issue 5 for Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands), published by Industry Canada	November 2001
☐	ICES-003	Interference-Causing Equipment Standard ICES-003 Issue 4 for Digital Apparatus, published by Industry Canada	February 2004
☒	CISPR 22	Third Edition of the International Special Committee on Radio Interference (CISPR), Pub. 22, “Information Technology Equipment – Radio Disturbance Characteristics – Limits and Methods of Measurement”	1997
☐	CAN/CSA-CEI/IEC CISPR 22	Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment	2002
☒	TRC-43	Notes Regarding Designation of Emission (Including Necessary Bandwidth and Classification), Class of Station and Nature of Service, published by Industry Canada	October 9, 1982

10 Charts taken during testing

Conducted Emission Test 150 kHz - 30 MHz
according to FCC Part 15 Subpart C

Model: Solid Radar FMR 25x	Mode: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment
Serial no.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	
Test site: Shielded room, cabin no. 4	
Tested on: Linecord DC-supply plus	
Date of test: 02/21/2005 / Operator: M. Steindl	
Test performed: semi automatically / File name:	

Detector: Peak / Final Results: QP	Final results: 20 dB Margin 25 Subranges

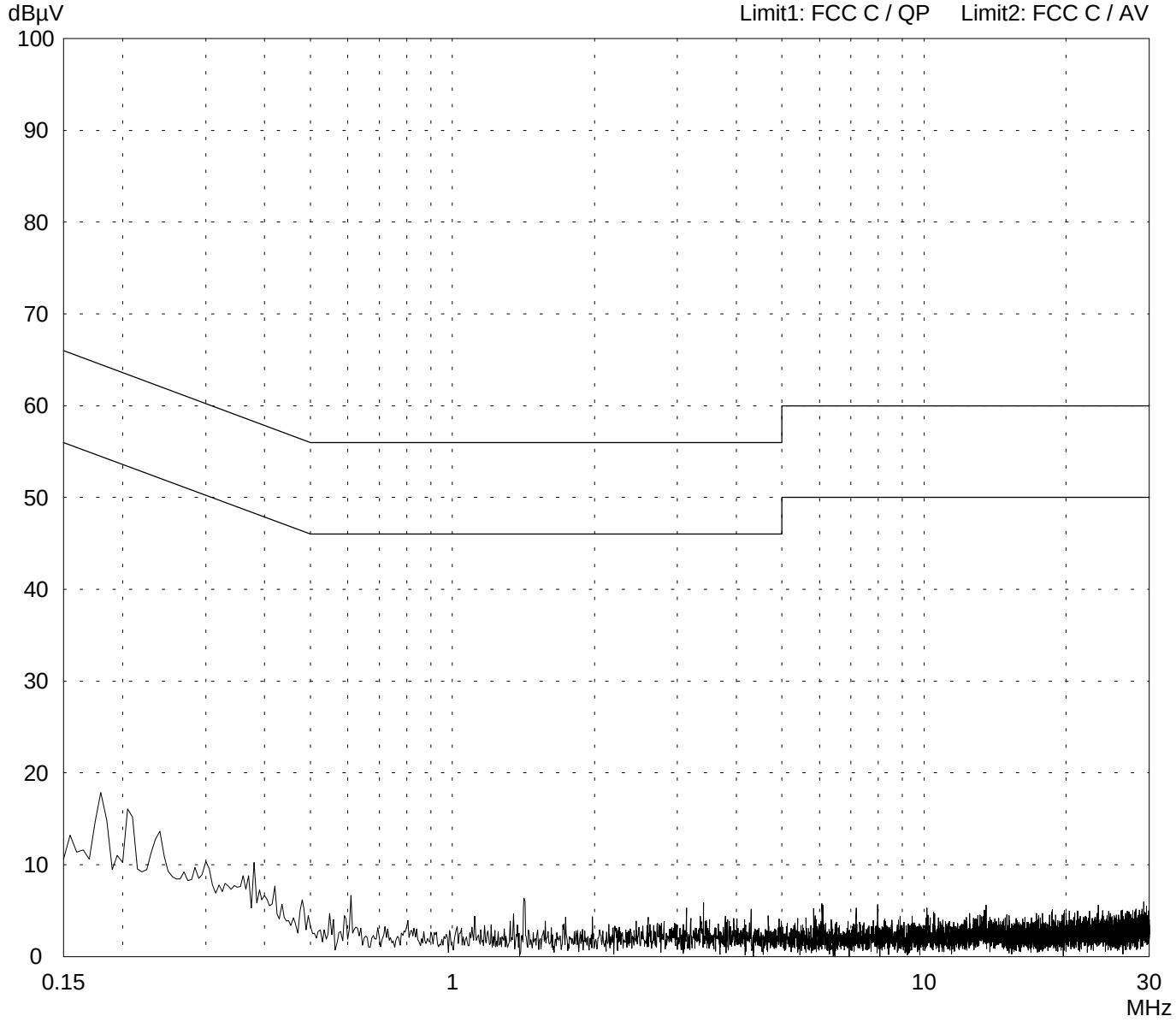


Result: Limit kept	Project file: 50511-40907 Page 33 of 54 Pages

Conducted Emission Test 150 kHz - 30 MHz
according to FCC Part 15 Subpart C

Model: Solid Radar FMR 25x	Mode: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment
Serial no.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	
Test site: Shielded room, cabin no. 4	
Tested on: Linecord DC-supply minus	
Date of test: 02/21/2005 / Operator: M. Steindl	
Test performed: semi automatically / File name:	

Detector: Peak / Final Results: QP	Final results: 20 dB Margin 25 Subranges

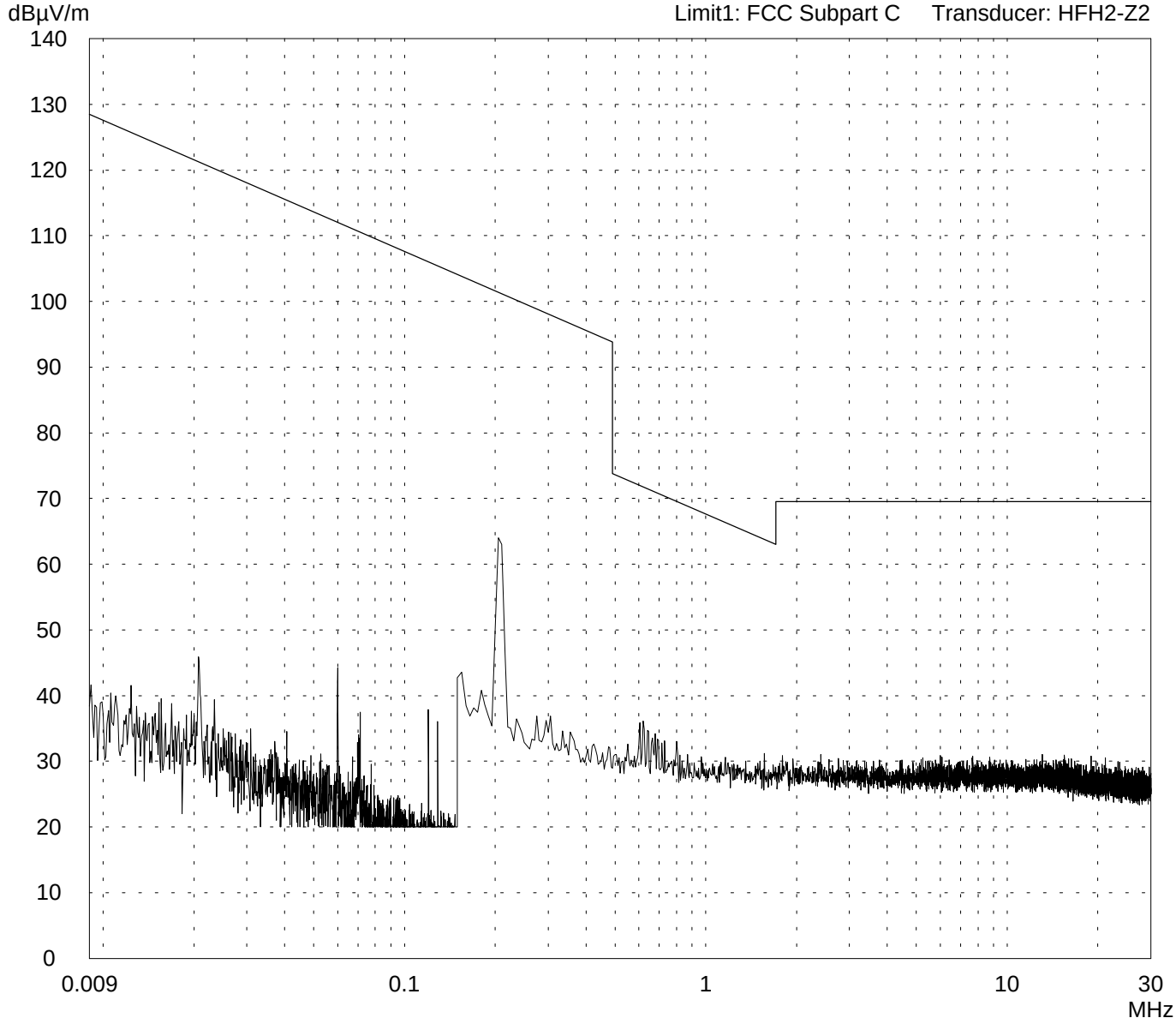


Result: Limit kept	Project file: 50511-40907 Page 34 of 54 Pages

Radiated Emission Test 9 kHz - 30 MHz
according to FCC Part 15 Subpart C

Model: FMR 25x	Mode: Normal operation, EUT vertical
Serial no.: Prototype	
Applicant: Endress + Hauser	
Test site: Shielded room, cabin no. 1	
Tested on: Test distance 3 metres	
Date of test: 07/26/2005 / Operator: J. Roidt	
Test performed: automatically / File name:	

Detector: Peak / Final Results: QP	Final results: 20 dB Margin 25 Subranges

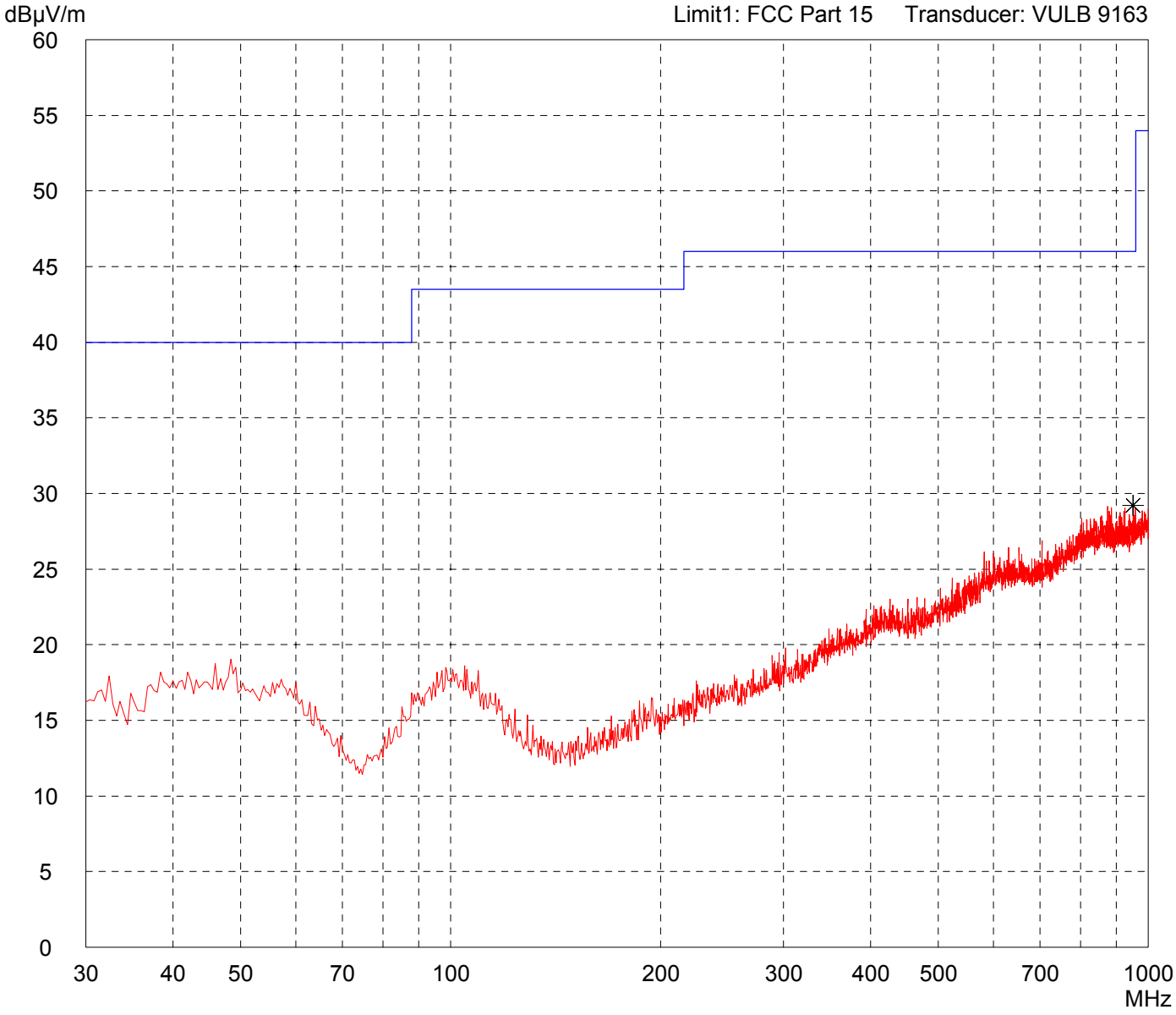


Result: Limit kept	Project file: 50511-40907 Page 35 of 54 Pages

Radiated Emission Test 30 MHz - 1 GHz
acc. to FCC Part 15 (Fully Anechoic Chamber)

Model: Solid Radar FMR 25x	Comment: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment
Serial no.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	
Test site: Fully anechoic room, cabin no. 2	
Tested on: Test distance 3 metres Horizontal Polarization	
Date of test: 02/18/2005 / Operator: M. Steindl	
Test performed: automatically / File name: default.emi	

Detector: Peak	List of values: Selected by hand



Result: Prescan	Project file: 50511-40907

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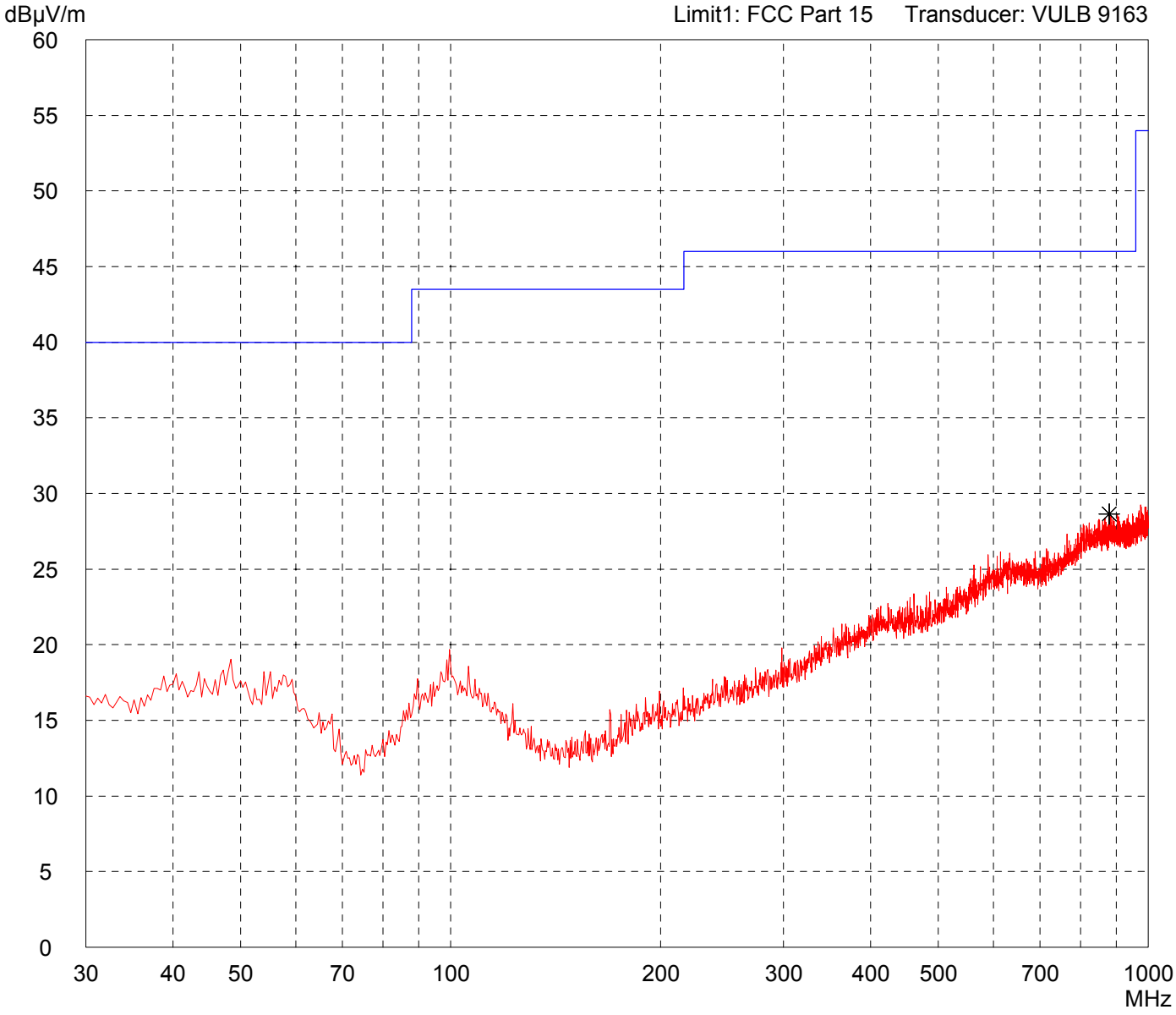
Radiated Emission Test 30 MHz - 1 GHz
acc. to FCC Part 15 (Fully Anechoic Chamber)

Model: Solid Radar FMR 25x	Comment: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment
Serial no.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	
Test site: Fully anechoic room, cabin no. 2	
Tested on: Test distance 3 metres Vertical Polarization	
Date of test: 02/18/2005 / Operator: M. Steindl	
Test performed: automatically / File name: default.emi	

Detector: Peak	List of values: Selected by hand



Result: Prescan	Project file: 50511-40907

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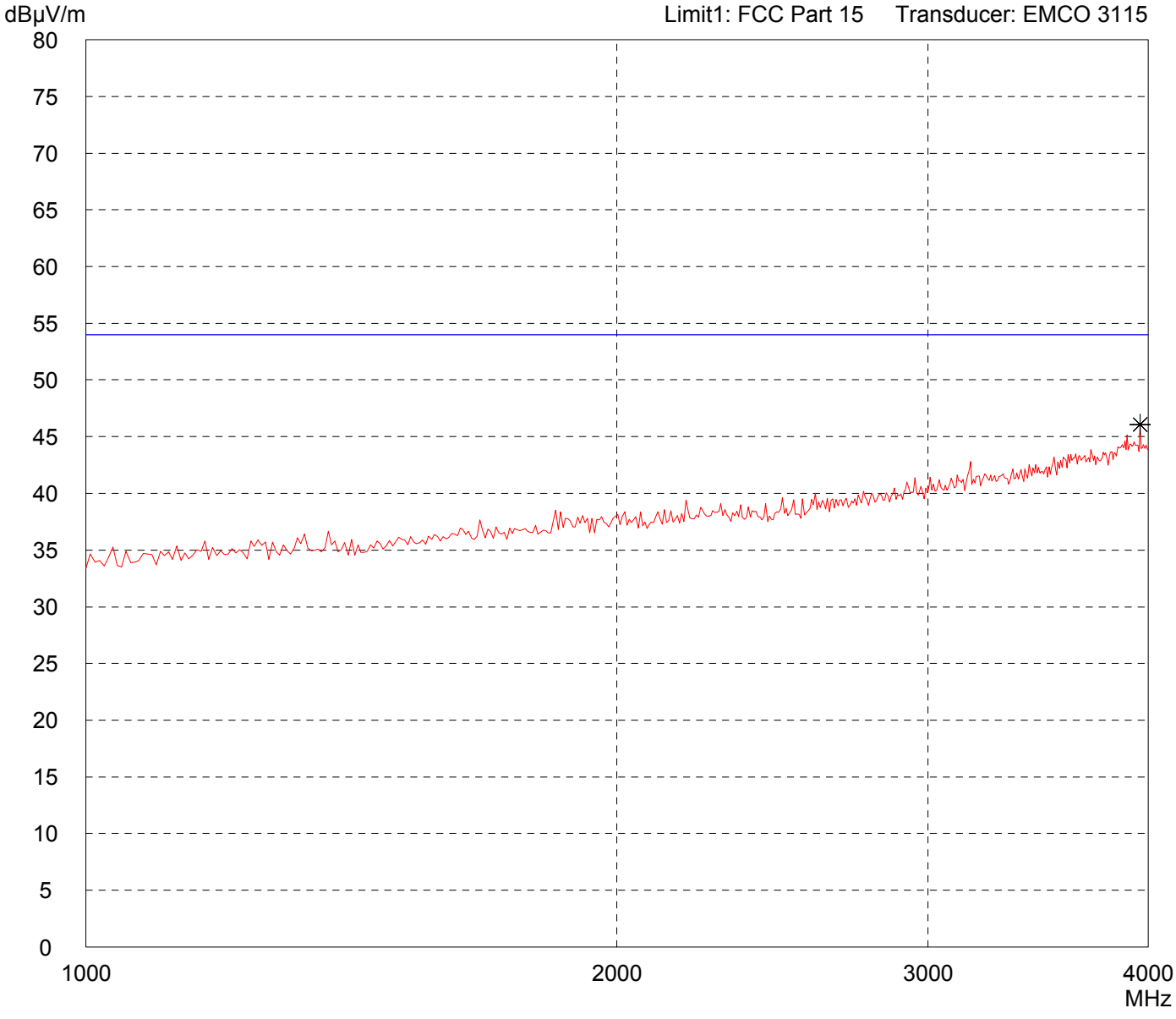
Radiated Emission Test 1 GHz - 4 GHz
acc. to FCC Part 15 (EMCO 3115)

Model: Solid Radar FMR 25x	Comment: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment
Serial no.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	
Test site: Fully anechoic room, cabin no. 2	
Tested on: Test distance 3 metres Horizontal Polarization	
Date of test: 02/18/2005 / Operator: M. Steindl	
Test performed: automatically / File name: default.emi	

Detector: Peak	List of values: Selected by hand



Result: Prescan	Project file: 50511-40907

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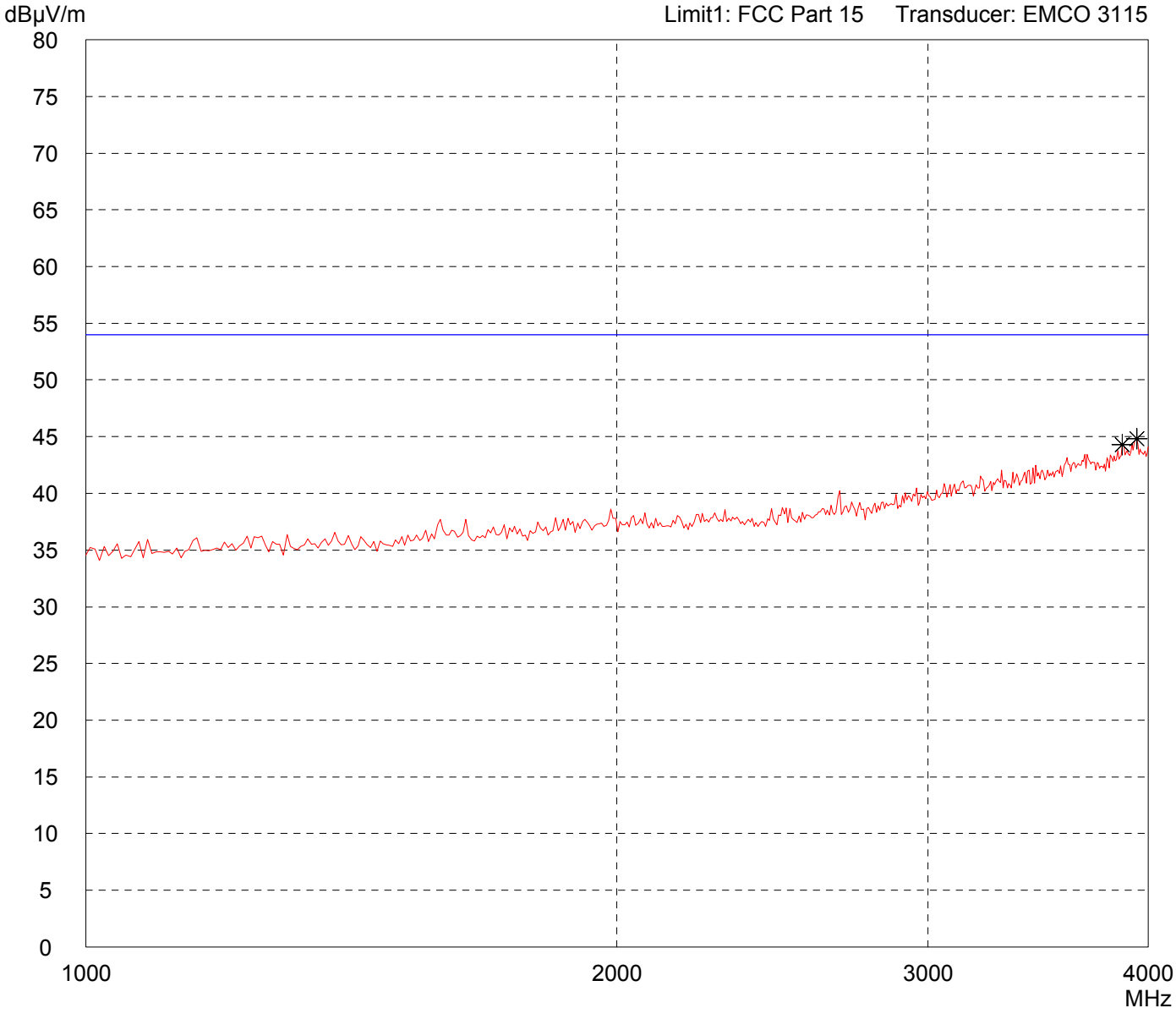
Radiated Emission Test 1 GHz - 4 GHz
acc. to FCC Part 15 (EMCO 3115)

Model: Solid Radar FMR 25x	Comment: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment
Serial no.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	
Test site: Fully anechoic room, cabin no. 2	
Tested on: Test distance 3 metres Vertical Polarization	
Date of test: 02/18/2005 / Operator: M. Steindl	
Test performed: automatically / File name: default.emi	

Detector: Peak	List of values: 10 dB Margin / 50 Subranges

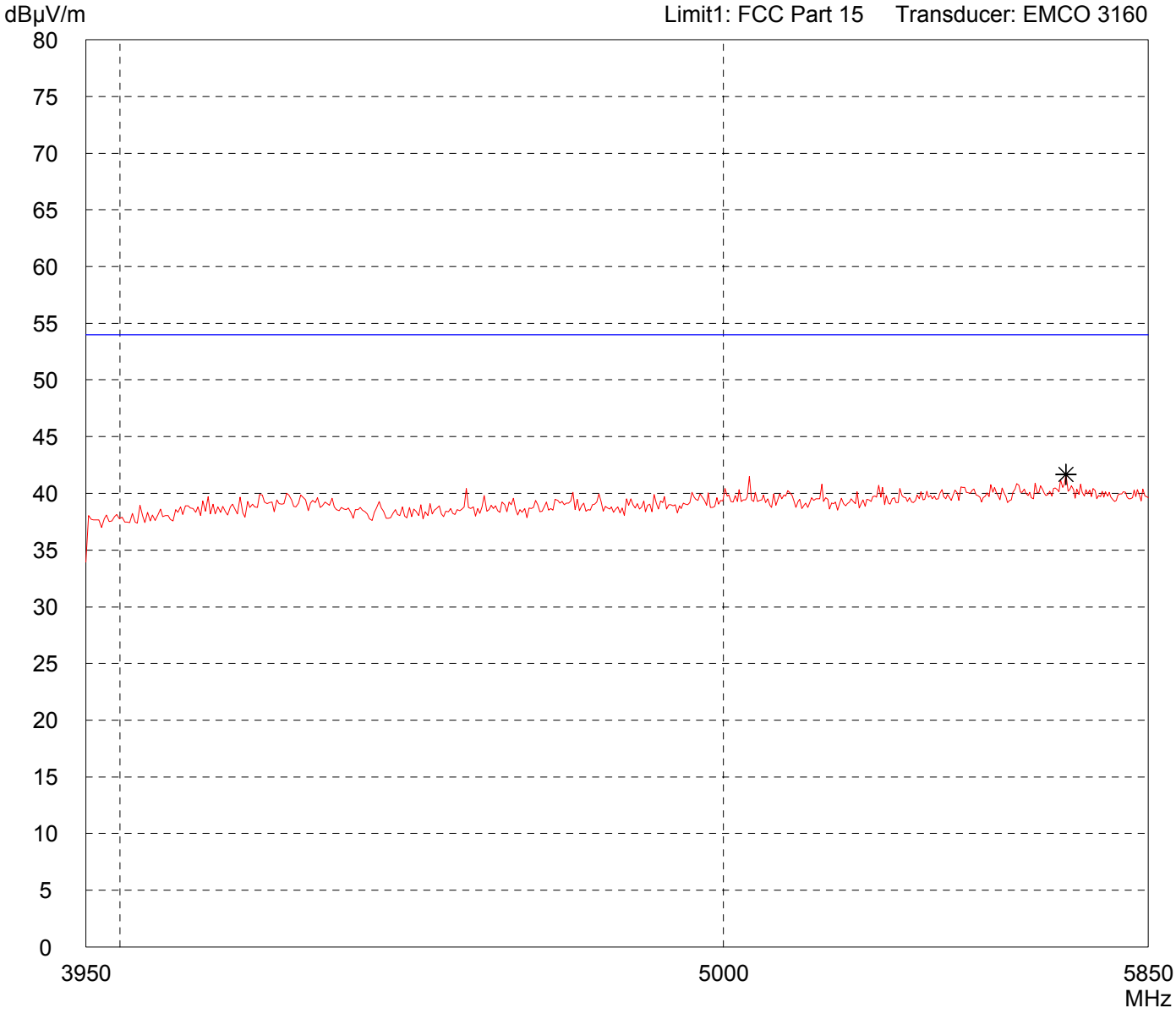


Result: Prescan	Project file: 50511-40907 / Page 39 of 54 Pages

Radiated Emission Test 3.95 GHz - 5.85 GHz
acc. to FCC Part 15 (EMCO 3160)

Model: Solid Radar FMR 25x	Comment: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment
Serial no.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	
Test site: Fully anechoic room, cabin no. 2	
Tested on: Test distance 3 metres Horizontal Polarization	
Date of test: 02/18/2005 / Operator: M. Steindl	
Test performed: automatically / File name: default.emi	

Detector: Peak	List of values: Selected by hand



Result: Limit kept	Project file: 50511-40907

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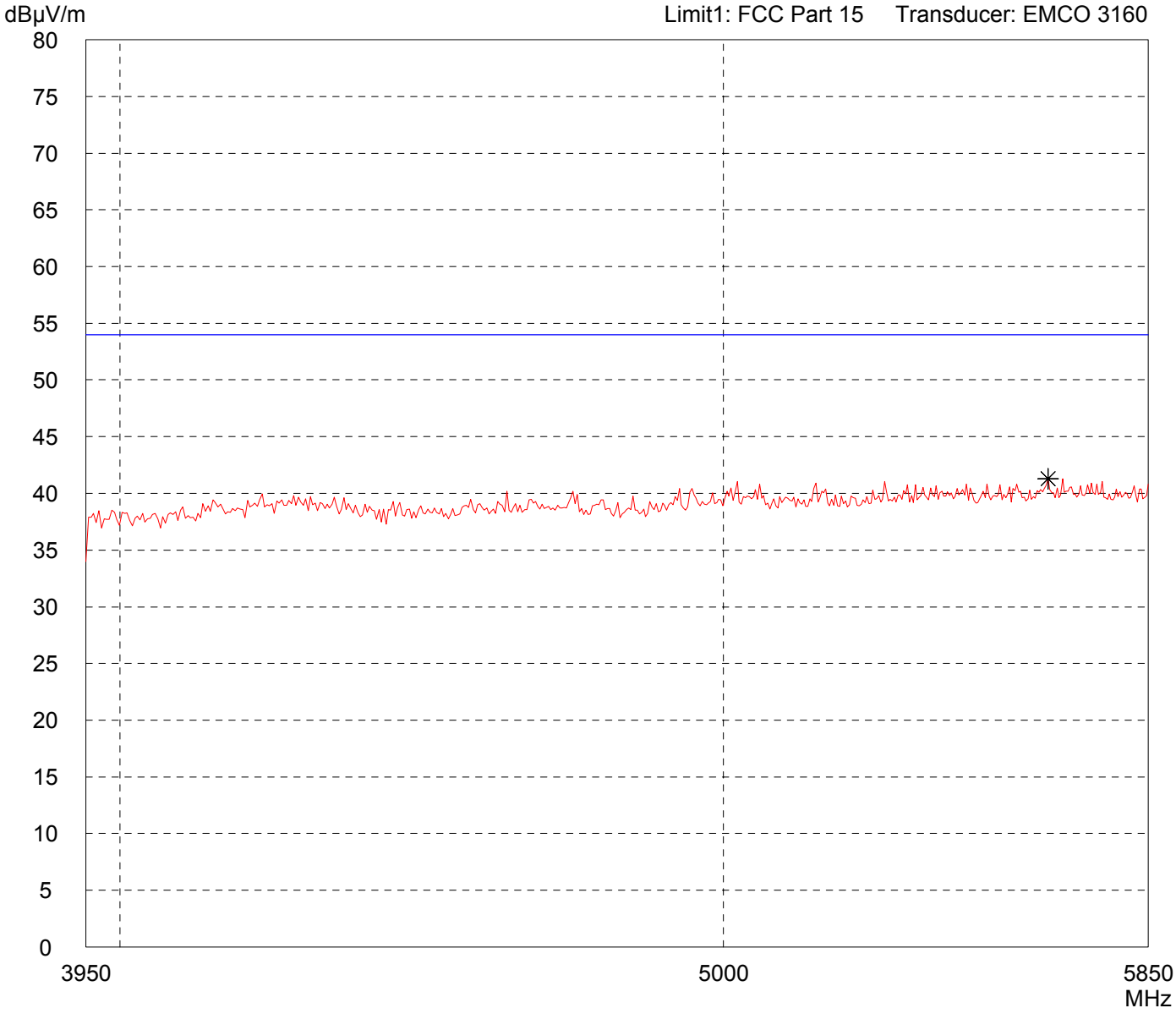
Radiated Emission Test 3.95 GHz - 5.85 GHz
acc. to FCC Part 15 (EMCO 3160)

Model: Solid Radar FMR 25x	Comment: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment
Serial no.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	
Test site: Fully anechoic room, cabin no. 2	
Tested on: Test distance 3 metres Vertical Polarization	
Date of test: 02/18/2005 / Operator: M. Steindl	
Test performed: automatically / File name: default.emi	

Detector: Peak	List of values: Selected by hand



Result: Prescan	Project file: 50511-40907

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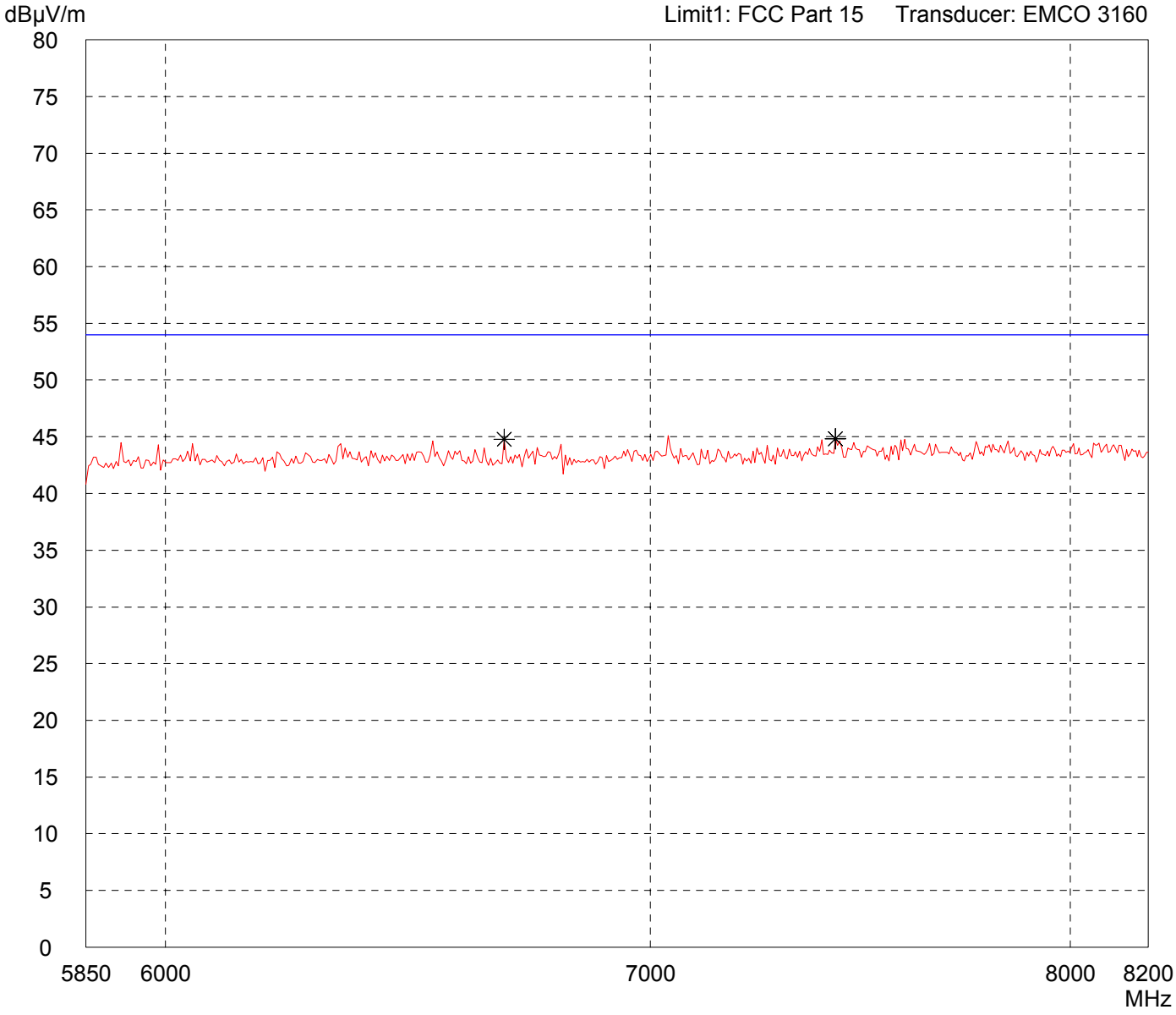
Radiated Emission Test 5.85 GHz - 8.2 GHz
acc. to FCC Part 15 (EMCO 3160)

Model: Solid Radar FMR 25x	Comment: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment
Serial no.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	
Test site: Fully anechoic room, cabin no. 2	
Tested on: Test distance 3 metres Horizontal Polarization	
Date of test: 02/18/2005 / Operator: M. Steindl	
Test performed: automatically / File name: default.emi	

Detector: Peak	List of values: Selected by hand



Result: Prescan	Project file: 50511-40907

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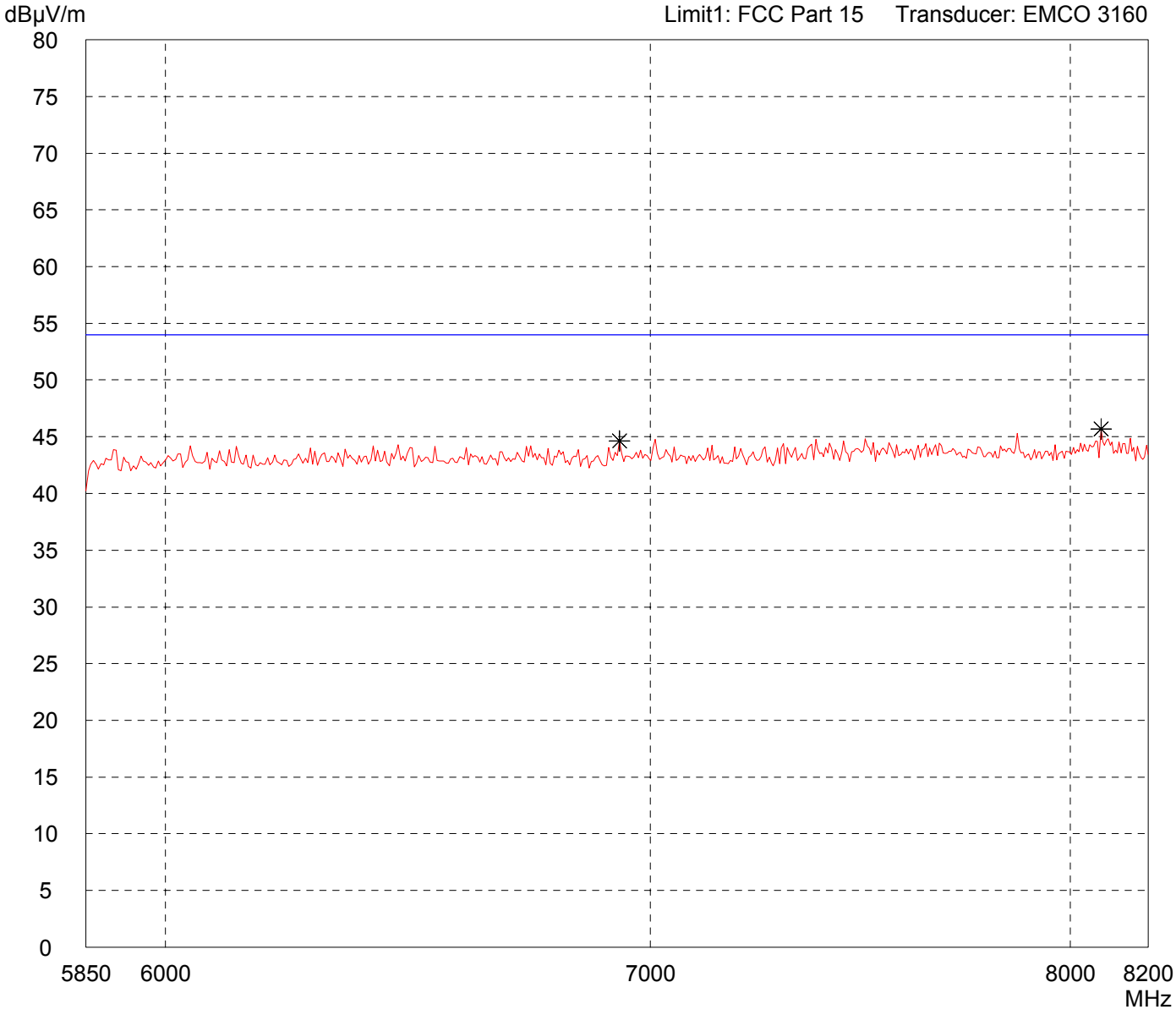
Radiated Emission Test 5.85 GHz - 8.2 GHz
acc. to FCC Part 15 (EMCO 3160)

Model: Solid Radar FMR 25x	Comment: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment
Serial no.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	
Test site: Fully anechoic room, cabin no. 2	
Tested on: Test distance 3 metres Vertical Polarization	
Date of test: 02/18/2005 / Operator: M. Steindl	
Test performed: automatically / File name: default.emi	

Detector: Peak	List of values: Selected by hand



Result: Prescan	Project file: 50511-40907

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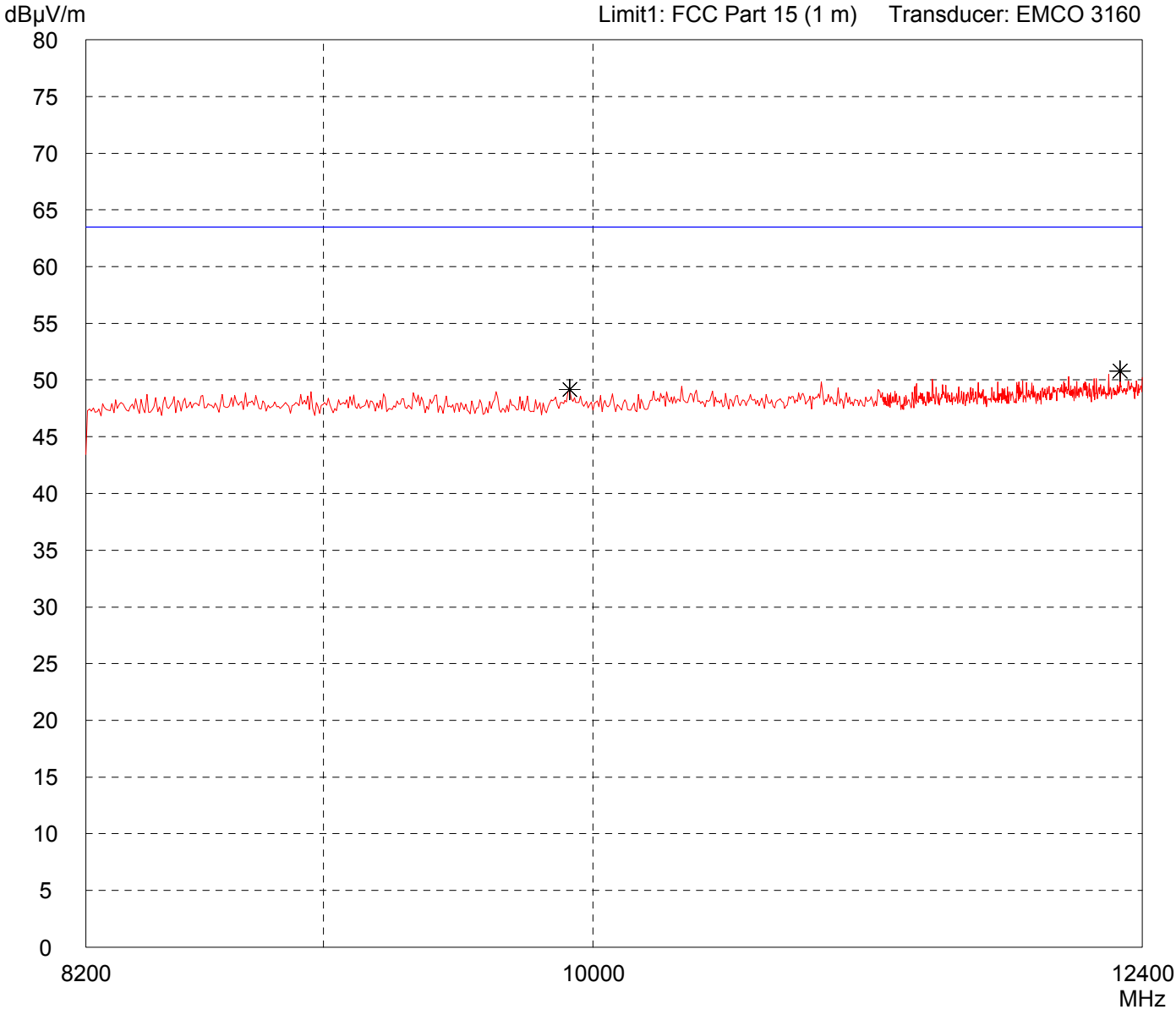
Radiated Emission Test 8.2 GHz - 12.4 GHz
acc. to FCC Part 15 (EMCO 3160)

Model: Solid Radar FMR 25x	Comment: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment
Serial no.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	
Test site: Fully anechoic room, cabin no. 2	
Tested on: Test distance 1 meter Horizontal Polarization	
Date of test: 02/18/2005 / Operator: M. Steindl	
Test performed: automatically / File name: default.emi	

Detector: Peak	List of values: Selected by hand



Result: Prescan	Project file: 50511-40907

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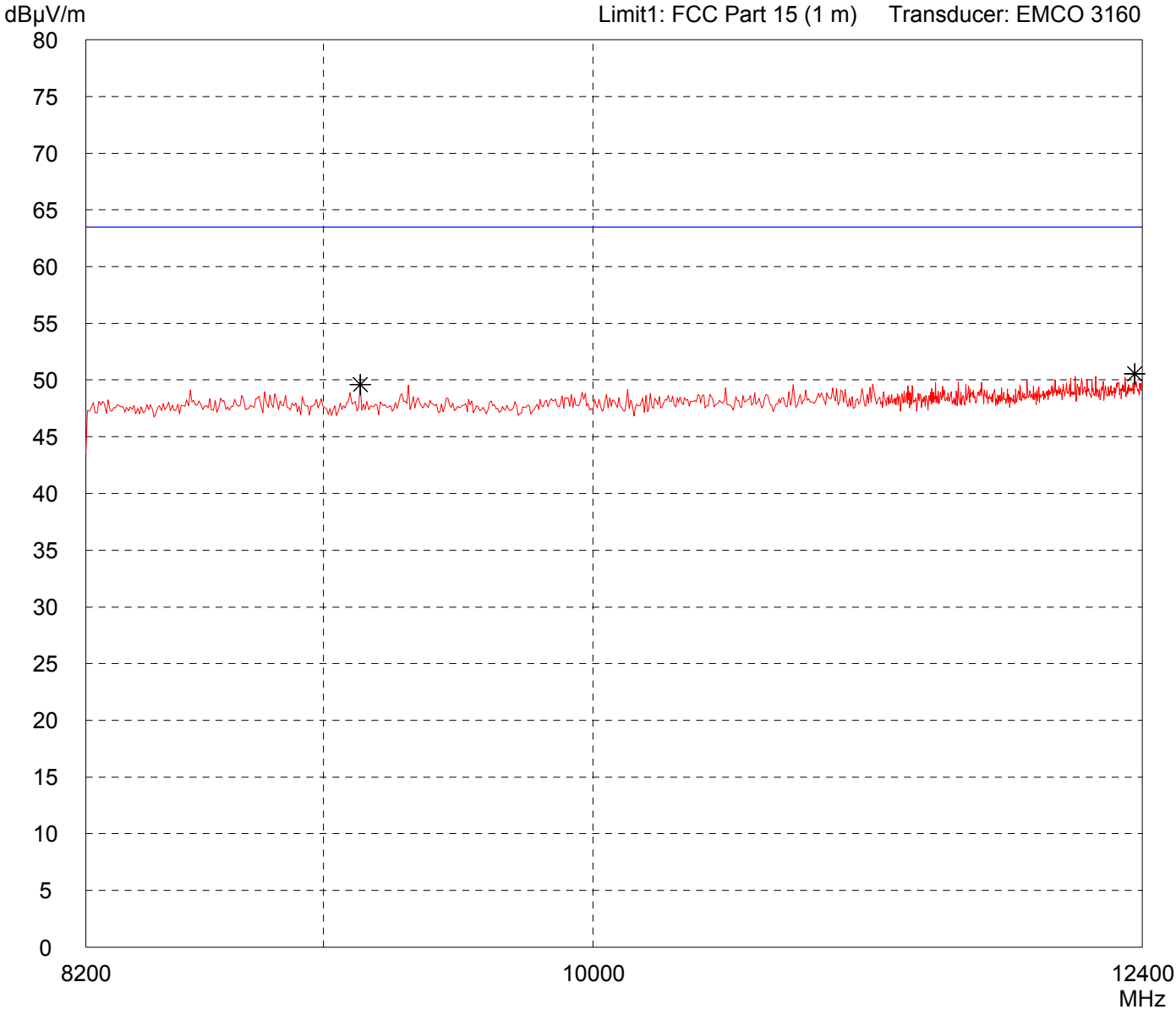
Radiated Emission Test 8.2 GHz - 12.4 GHz
acc. to FCC Part 15 (EMCO 3160)

Model: Solid Radar FMR 25x	Comment: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment
Serial no.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	
Test site: Fully anechoic room, cabin no. 2	
Tested on: Test distance 1 meter Vertical Polarization	
Date of test: 02/18/2005 / Operator: M. Steindl	
Test performed: automatically / File name: default.emi	

Detector: Peak	List of values: Selected by hand



Result: Prescan	Project file: 50511-40907

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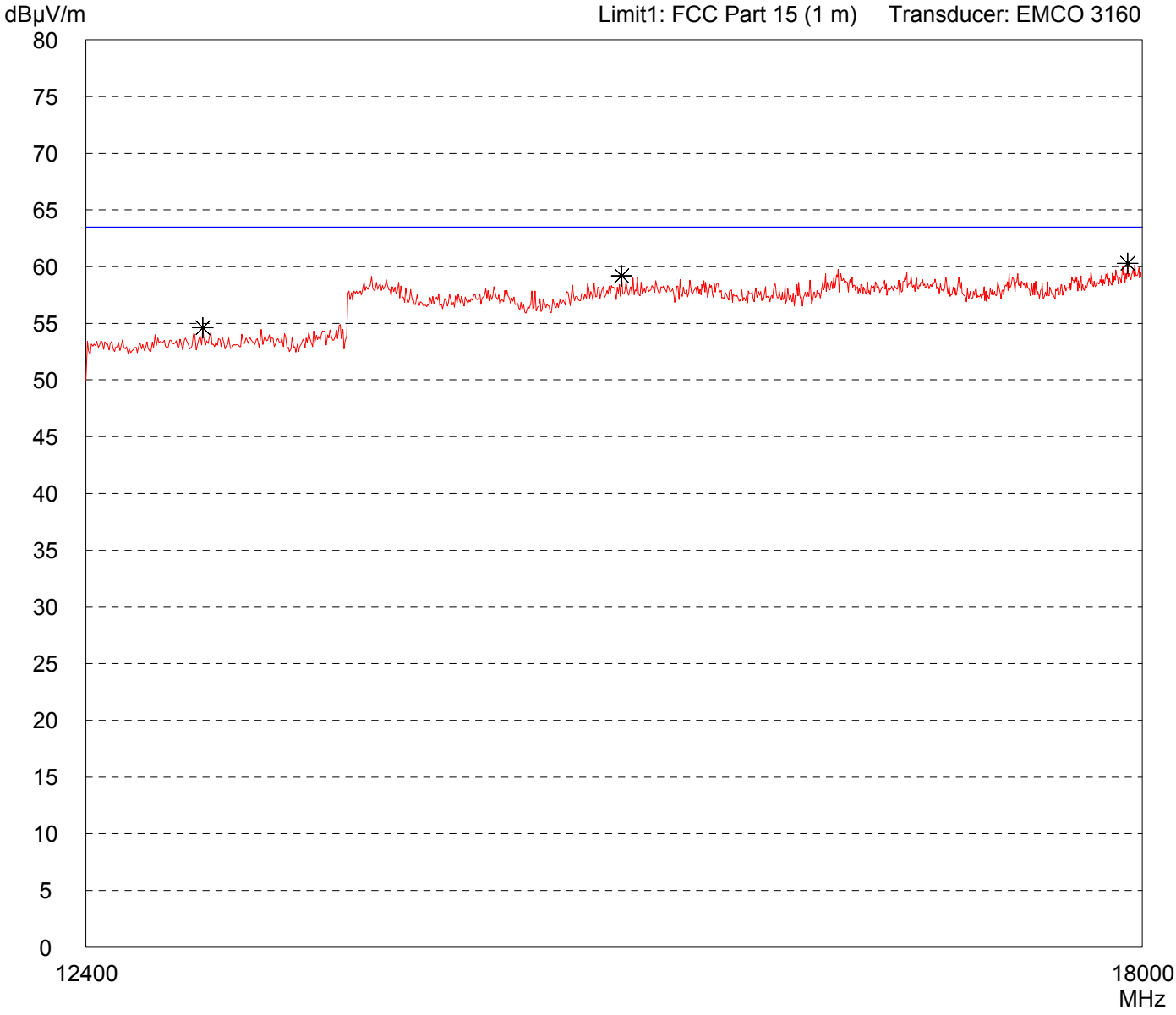
Radiated Emission Test 12.4 GHz - 18 GHz
acc. to FCC Part 15 (EMCO 3160)

Model: Solid Radar FMR 25x	Comment: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment
Serial no.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	
Test site: Fully anechoic room, cabin no. 2	
Tested on: Test distance 1 meter Horizontal Polarization	
Date of test: 02/18/2005 / Operator: M. Steindl	
Test performed: automatically / File name: default.emi	
Detector: Peak	List of values: Selected by hand



Result: Prescan	Project file: 50511-40907

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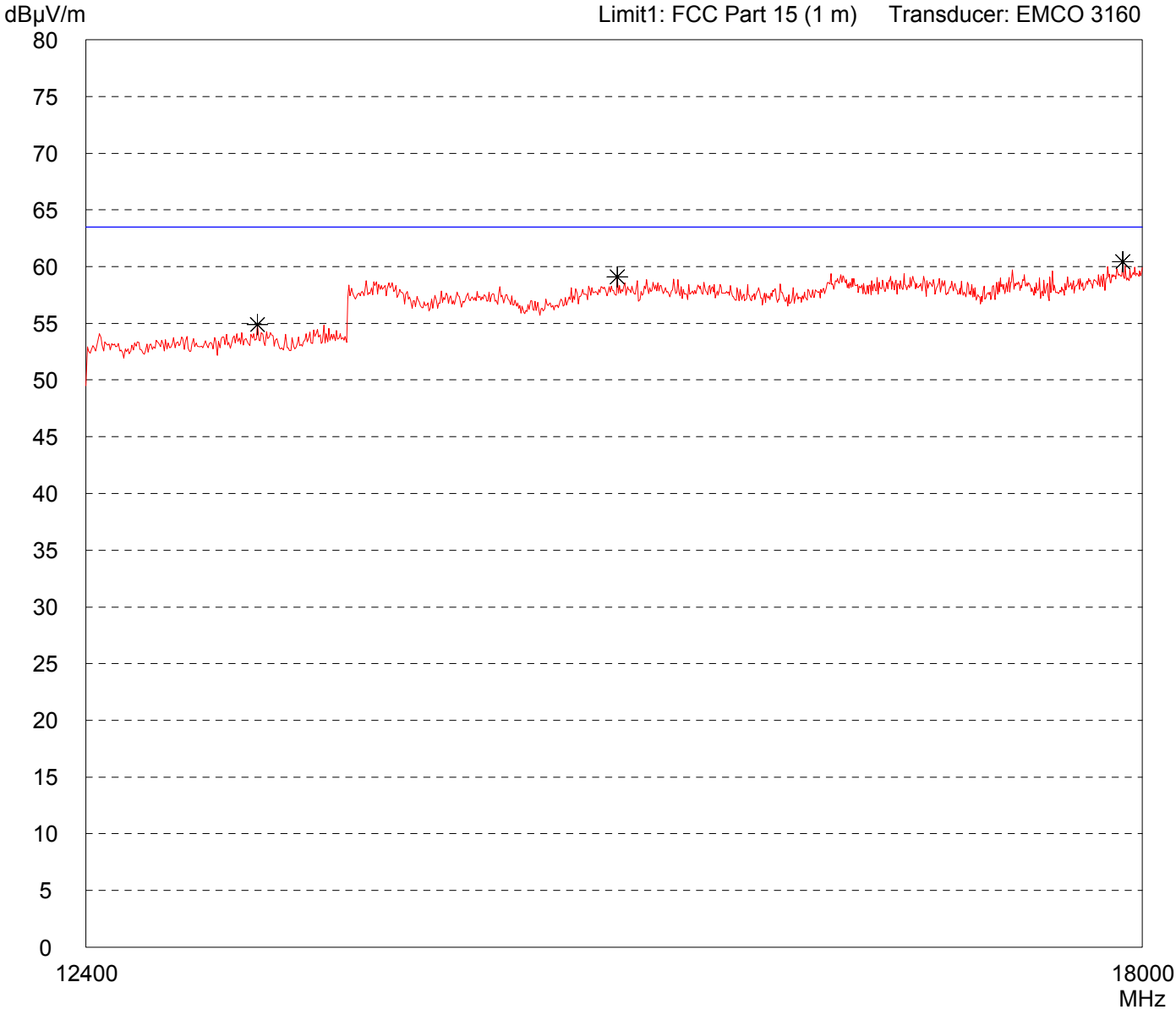
Radiated Emission Test 12.4 GHz - 18 GHz
acc. to FCC Part 15 (EMCO 3160)

Model: Solid Radar FMR 25x	Comment: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment
Serial no.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	
Test site: Fully anechoic room, cabin no. 2	
Tested on: Test distance 1 meter Vertical Polarization	
Date of test: 02/18/2005 / Operator: M. Steindl	
Test performed: automatically / File name: default.emi	

Detector: Peak	List of values: Selected by hand



Result: Prescan	Project file: 50511-40907

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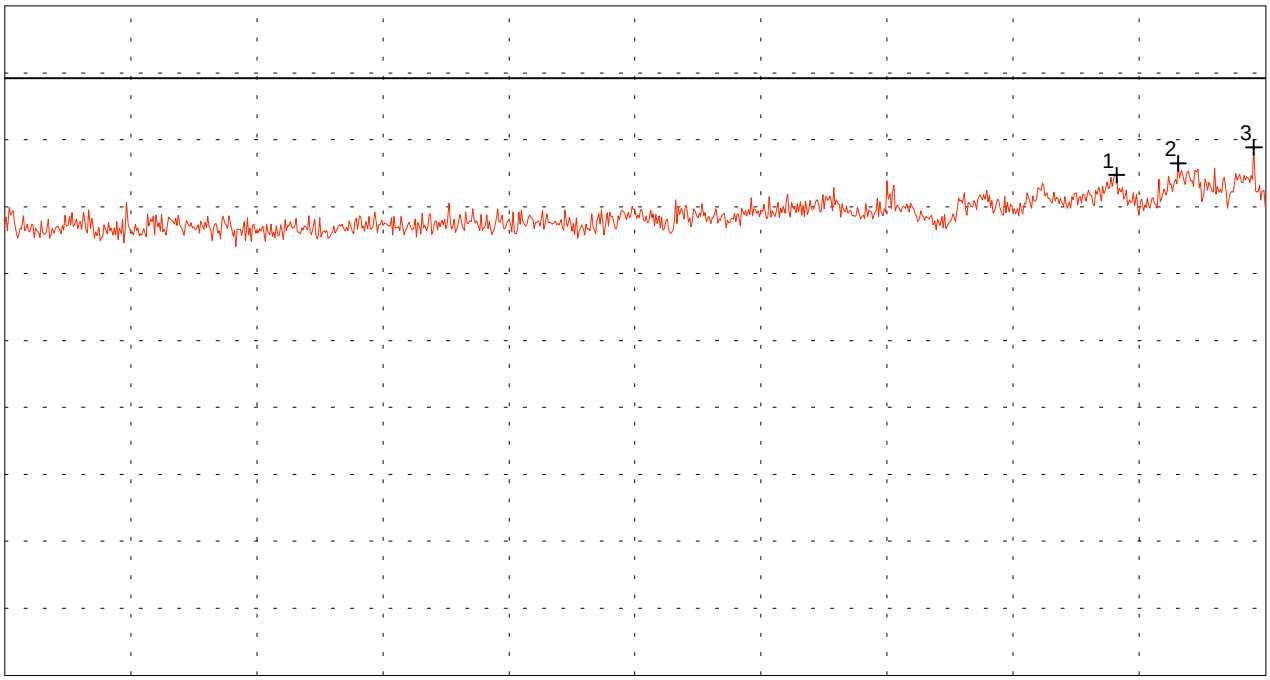
Spurious emissions according to FCC 15 C

Model: Solid Radar 25x	Mode: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment - Measurment Distance: 0.50 m - Polarisation: horizontal
Serial No.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	

Ref.Level 75 dBµV ATT 0 dB Ref. Offset 43 dB
5 dB/Div.



Start 18.000 GHz Stop 26.000 GHz
RBW 1 MHz VBW 1 MHz SWP 40 ms

Multi Marker List

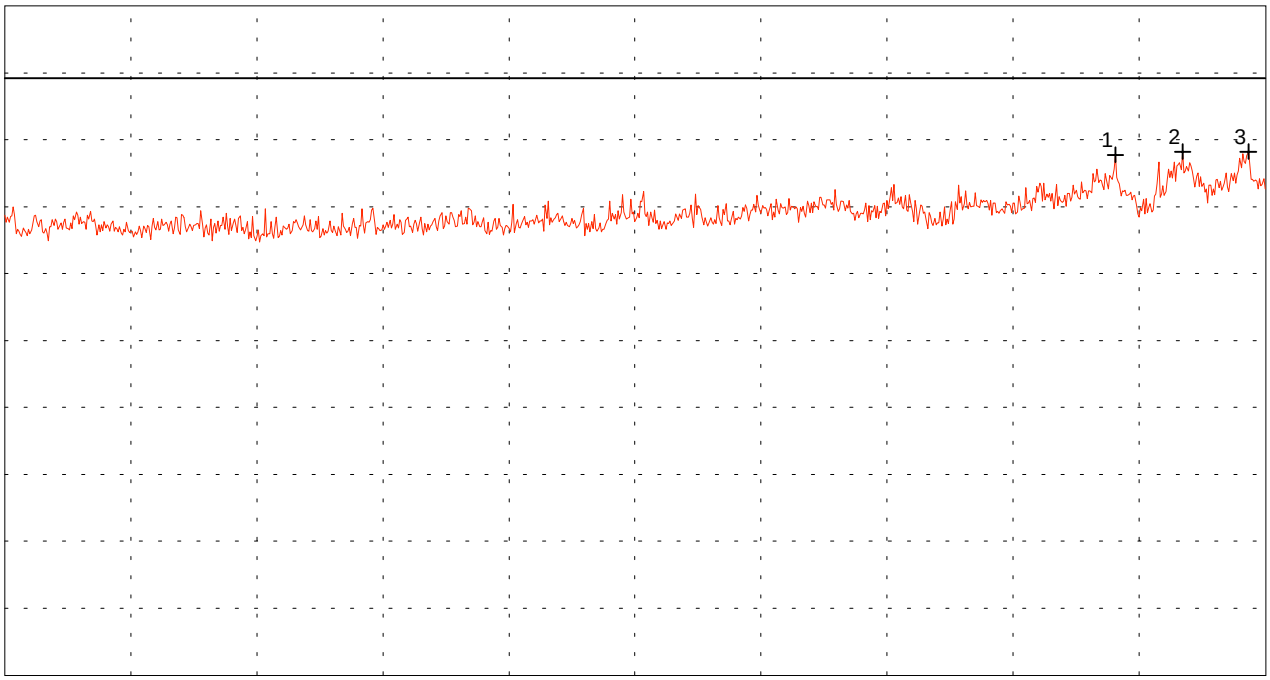
No. 1	25.057778 GHz	62.36 dBµV
No. 2	25.448889 GHz	63.24 dBµV
No. 3	25.928889 GHz	64.43 dBµV

Tested by: M. Steindl	Project-No.: 50511-40907
Date: 02/22/2005	Page 48 of 54 Pages

Spurious emissions according to FCC 15 C

Model: Solid Radar 25x	Mode: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment - Measurment Distance: 0.50 m - Polarisation: vertical
Serial No.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	

Ref.Level 75 dBµV ATT 0 dB Ref. Offset 43 dB
5 dB/Div.



Start 18.000 GHz Stop 26.000 GHz
RBW 1 MHz VBW 1 MHz SWP 40 ms

Multi Marker List

No. 1	25.048889 GHz	63.88 dBµV
No. 2	25.475556 GHz	64.11 dBµV
No. 3	25.893333 GHz	64.11 dBµV

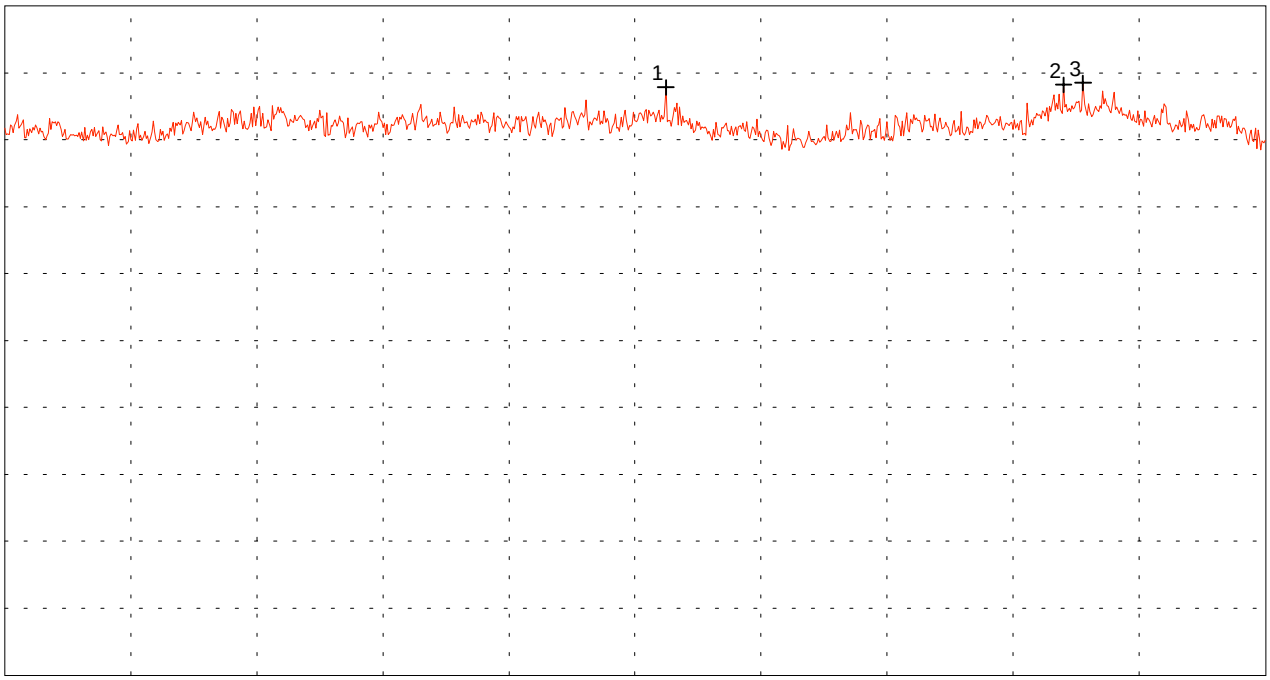
Tested by: M. Steindl	Project-No.: 50511-40907
Date: 02/22/2005	Page 49 of 54 Pages

Spurious emissions according to FCC 15 C

Model: Solid Radar 25x	Mode: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment - Measurment Distance: 0.50 m - Polarisation: horizontal
Serial No.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	

Ref.Level 22 dBµV
5 dB/Div.

ATT 0 dB



Start 26.000 GHz
RBW 1 MHz

VBW 1 MHz

Stop 40.000 GHz
SWP 60 ms

Multi Marker List

No. 1	33.342222 GHz	15.91 dBµV
No. 2	37.760000 GHz	16.11 dBµV
No. 3	37.977778 GHz	16.25 dBµV

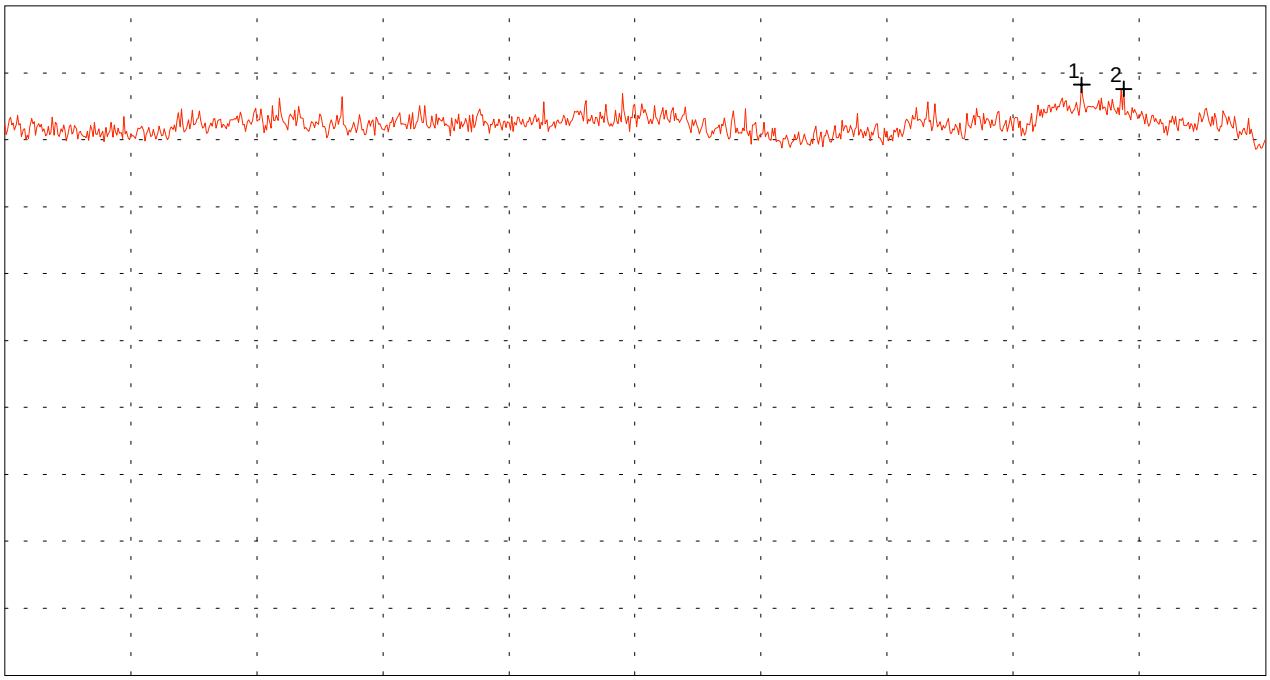
Tested by: M. Steindl	Project-No.: 50511-40907
Date: 02/22/2005	Page 50 of 54 Pages

Spurious emissions according to FCC 15 C

Model: Solid Radar 25x	Mode: - DC 24 V power supply with 330 Ohms communication resistor - EUT in vertical position - continious measurment - Measurment Distance: 0.50 m - Polarisation: vertical
Serial No.: 71004301083	
Applicant: Endres + Hauser GmbH & Co. KG	

Ref.Level 22 dBµV
5 dB/Div.

ATT 0 dB



Start 26.000 GHz
RBW 1 MHz

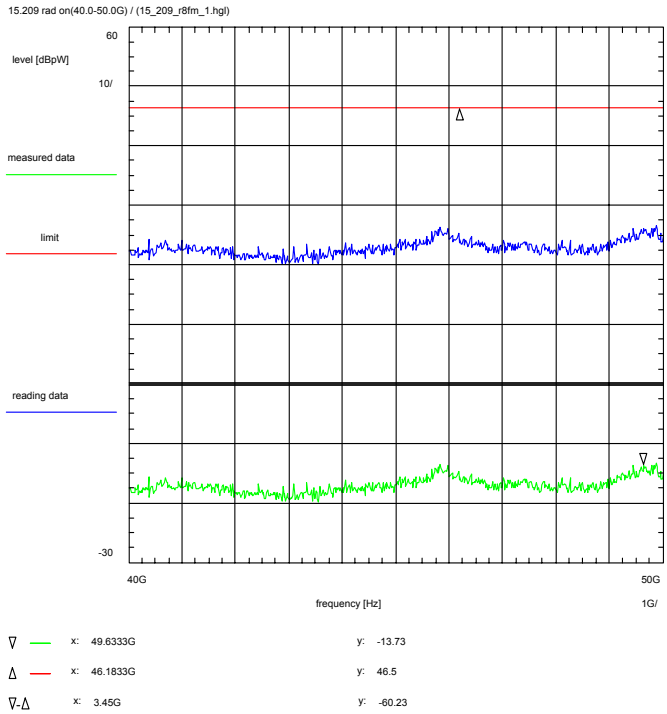
VBW 1 MHz

Stop 40.000 GHz
SWP 60 ms

Multi Marker List

No. 1	37.962222 GHz	16.11 dBµV
No. 2	38.428889 GHz	15.80 dBµV

Tested by: M. Steindl	Project-No.: 50511-40907
Date: 02/22/2005	Page 51 of 54 Pages



Subclause: 15.209) Emission limitations
DUT normal operation mode
Radiation comming out of DUT-cabinet(s) and antenna: 40.0 GHz - 50.0 GHz

Test results:
see plot (an explicit table was not generated)

Operating condition of DUT:
operating condition 1, see section 1.5.2

Test setup:
see annex 1: 2.3

Test equipment:
see annex 2: A_50, C217, R001

Data of correction:
see annex 4

Remark:

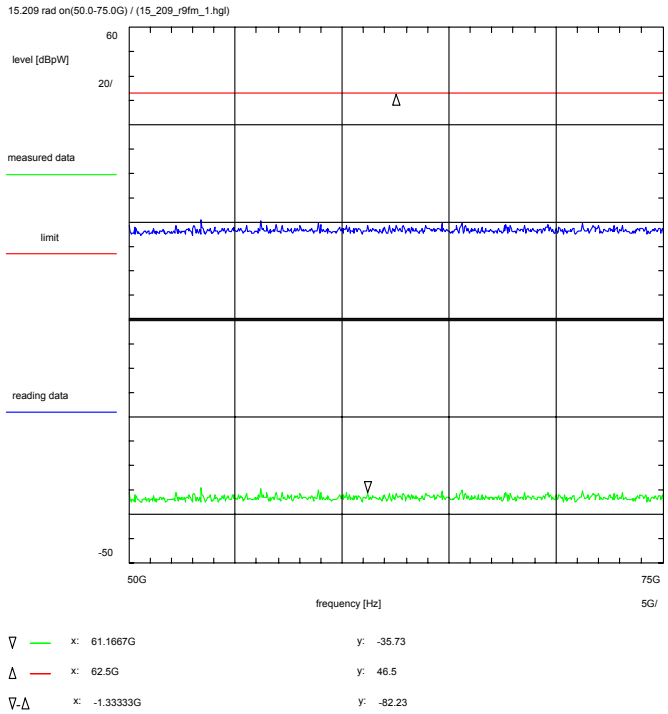
Test result: **Test passed**

Information on the measurement:

Environment condition:			
Date & Time:	Wed 15/Jun/2005 11:40:00		
Location:	CETECOM ICT Services GmbH, Laboratory RSC-Sat		
Temperature:	22	°C	
Humidity:	55	%	
Voltage:	24	Vdc	
Setup of measurement equipment:			
Start frequency:	40	GHz	
Stop frequency:	50	GHz	
Center frequency:	45	GHz	
Frequency span:	10	GHz	
Input attenuation:	0	dB	
Resolution-BW:	1	MHz	
Video-BW:	1	MHz	
Video-Average:	1	sweep(s) (>1)	
Detector-Mode:	2	Pos Peak (Maximum-Hold)	
Correction (average):			
Directional coupler	+	0.0	dB
Coaxial cable (C217)	+	4.3	dB
DUT-Antenna	+	0.0	dBi
Test antenna (A_50)	-	24.2	dB
BW correction factor	+	0.0	dB
Atten. between HPA and feedhorn	-	0.0	dB
Distance corection factor (3->0.3m)	-	20.0	dB
TOTAL CORRECTION:	-	-39.9	dB
Limit:			
Limit acc. to 15.209):	54.0	dBuV/m (at 3m)	
this corresponds to	46.5	dBpW (at 3m)	

calculation: p = e - 17 + 20 * log(d) with:
d = Distance (m)
e = Field Strength level (dBuV/m)
p = Radiated Power level (dBpW)

Remarks:
Measurement with a measuring antenna
close to the DUT-cabinets (about 0.3m distance).
If any critical spurious radiations are detected a measurement
in an exactly defined distance will be carried out.



Subclause: 15.209) Emission limitations
DUT normal operation mode
Radiation comming out of DUT-cabinet(s) and antenna: 50.0 GHz - 75.0 GHz

Test results:
see plot (an explicit table was not generated)

Operating condition of DUT:
operating condition 1, see section 1.5.2

Test setup:
see annex 1: 2.4

Test equipment:
see annex 2: A_75, R001; R025

Data of correction:
see annex 4

Remark:

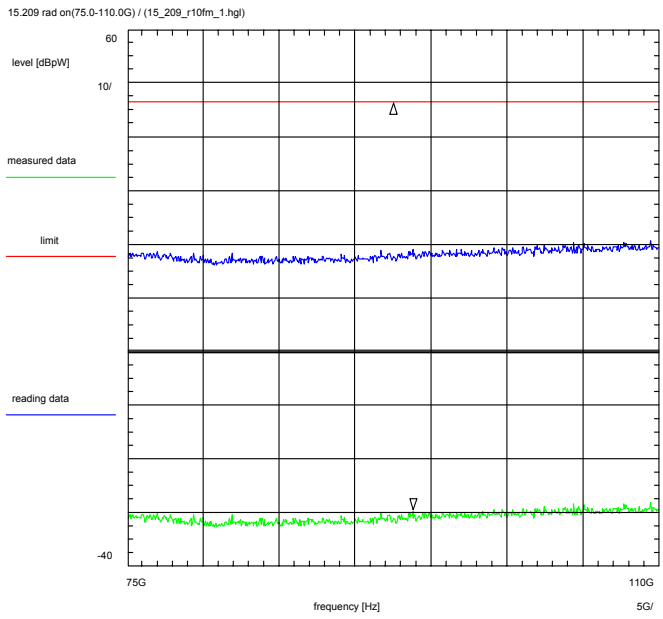
Test result: **Test passed**

Information on the measurement:

Environment condition:			
Date & Time:	Wed 15/Jun/2005 11:49:57		
Location:	CETECOM ICT Services GmbH, Laboratory RSC-Sat		
Temperature:	22	°C	
Humidity:	55	%	
Voltage:	24	Vdc	
Setup of measurement equipment:			
Start frequency:	50	GHz	
Stop frequency:	75	GHz	
Center frequency:	62.5	GHz	
Frequency span:	25	GHz	
Input attenuation:	0	dB	
Resolution-BW:	1	MHz	
Video-BW:	1	MHz	
Video-Average:	1	sweep(s) (>1)	
Detector-Mode:	2	Pos Peak (Maximum-Hold)	
Correction (average):			
Directional coupler	+	0.0	dB
Coaxial cable	+	0.0	dB
DUT-Antenna	+	0.0	dBi
Test antenna (A_75)	-	25.4	dB
BW correction factor	+	0.0	dB
Atten. between HPA and feedhorn	-	0.0	dB
Distance corection factor (3->0.1m)	-	29.5	dB
TOTAL CORRECTION:	-	-54.9	dB
Limit:			
Limit acc. to 15.209):	54.0	dBuV/m (at 3m)	
this corresponds to	46.5	dBpW (at 3m)	

calculation: p = e - 17 + 20 * log(d) with:
d = Distance (m)
e = Field Strength level (dBuV/m)
p = Radiated Power level (dBpW)

Remarks:
Measurement with a measuring antenna
close to the DUT-cabinets (about .1m distance).
If any critical spurious radiations are detected a measurement
in an exactly defined distance will be carried out.



Subclause: 15.209) Emission limitations
DUT normal operation mode
Radiation comming out of DUT-cabinet(s) and antenna: 75.0 GHz - 100.0 GHz

Test results:
see plot (an explicit table was not generated)

Operating condition of DUT:
operating condition 1, see section 1.5.2

Test setup:
see annex 1: 2.4

Test equipment:
see annex 2: A028, R001, R029

Data of correction:
see annex 4

Remark:

Test result: **Test passed**

Information on the measurement:

Environment condition:			
Date & Time:	Wed 15/Jun/2005 11:58:50		
Location:	CETECOM ICT Services GmbH, Laboratory RSC-Sat		
Temperature:	22	°C	
Humidity:	55	%	
Voltage:	24	Vdc	
Setup of measurement equipment:			
Start frequency:	75	GHz	
Stop frequency:	110	GHz	
Center frequency:	92.5	GHz	
Frequency span:	35	GHz	
Input attenuation:	0	dB	
Resolution-BW:	1	MHz	
Video-BW:	1	MHz	
Video-Average:	1	sweep(s) (>1)	
Detector-Mode:	2	Pos Peak (Maximum-Hold)	
Correction (average):			
Directional coupler	+	0.0	dB
Coaxial cable	+	0.0	dB
DUT-Antenna	+	0.0	dBi
Test antenna (A028)	-	19.4	dB
BW correction factor	+	0.0	dB
Atten. between HPA and feedhorn	-	0.0	dB
Distance corection factor (3->0.1m)	-	29.5	dB
TOTAL CORRECTION:	-	-48.9	dB
Limit:			
Limit acc. to 15.209):	54.0	dBuV/m (at 3m)	
this corresponds to	46.5	dBpW (at 3m)	

calculation: p = e - 17 + 20 * log(d) with:
d = Distance (m)
e = Field Strength level (dBuV/m)
p = Radiated Power level (dBpW)

Remarks:
Measurement with a measuring antenna
close to the DUT-cabinets (about .1m distance).
If any critical spurious radiations are detected a measurement
in an exactly defined distance will be carried out.