

Straubing, October 28, 2004

TEST - REPORT

No. 50602-40686-3b

for

SAVE-O-TRONIC

Electronic Locking Lock

Applicant: Schulte-Schlagbaum AG

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)

Note:

The test data of this report is related only to the individual item which has been tested. This report shall not be reproduced except in full extent without the written approval of the testing laboratory.

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1 Description of the Equipment Under Test (EUT)

General data of EUT	
Type designation ¹ :	SAVE-O-TRONIC
Parts ² :	---
Serial number(s):	01
Manufacturer:	Schulte-Schlagbaum AG
Type of equipment:	Electronic Locking Lock
Version:	As delivered
FCC ID:	Q31SOT02
Additional parts/accessories:	Tag 04FEBOH47

Technical data of EUT	
Application frequency range:	Not applicable ³
Frequency range:	125 kHz
Operating frequency:	125 kHz
Type of modulation:	ASK
Pulse train:	373 ms
Pulse width:	65.4 ms
Number of RF-channels:	1
Channel spacing:	Not applicable
Class of emission:	5k00A1D
Type of antenna:	Coil antenna
Size/length of antenna:	Dimensions of coil: 15 x 17 x 7 mm Number of loops: 280
Type of power supply:	Battery supply
Specifications for power supply:	nominal voltage: 6.0 V minimum voltage: 5.5 V maximum voltage: 6.0 V nominal frequency: --- Hz

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 General requirements according to CFR 47 Part 15 section 15.209 apply.

2 Administrative Data

Application details	
Applicant (full address):	Schulte-Schlagbaum AG Nevigeser Straße 100 D-42553 Velbert Germany
Contact person:	Mr. Helmut Guth
Contract identification:	---
Receipt of EUT:	October 4, 2004
Date(s) of test:	October 2004
Note(s):	---

Report details	
Report number:	50602-40686-3b
Edition:	1
Issue date:	October 28, 2004

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. Martin Steindl

Responsible for test report:

Mr. Martin Steindl

5 Operation Mode and Configuration of EUT

Operation Mode

Reading transponder continuously.

Configuration of EUT

EUT is configured to transmit continuously, when a transponder is found within 5 seconds after activation.

List of ports and cables

<i>Port</i>	<i>Description</i>	<i>Classification⁴</i>	<i>Cable type</i>	<i>Cable length</i>
	Not Applicable			

List of devices connected to EUT

<i>Item</i>	<i>Description</i>	<i>Type Designation</i>	<i>Serial no. or ID</i>	<i>Manufacturer</i>
	Not Applicable			

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:

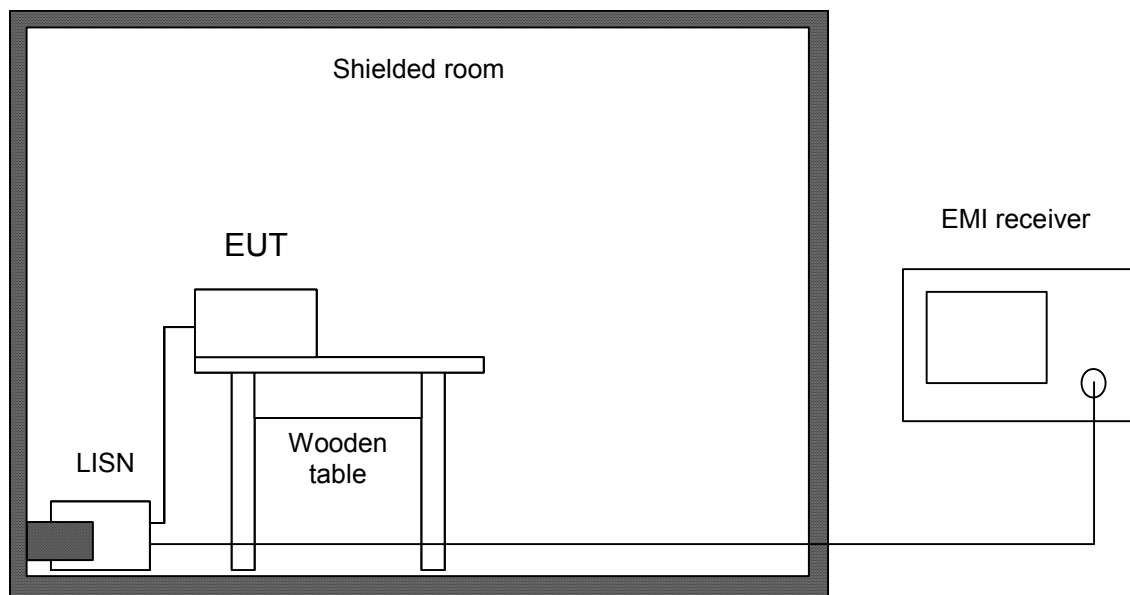
Rules and Specifications: CFR 47 Part 15, section 15.207
 IC RSS-210 Issue 5, section 6.6

Guide: ANSI C63.4 (CISPR 22)

Conducted emission tests in the frequency range 150 kHz to 30 MHz are required to be performed with quasi-peak and average detector. To simplify testing the following procedure is used:

First the whole spectrum of emission caused by 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.

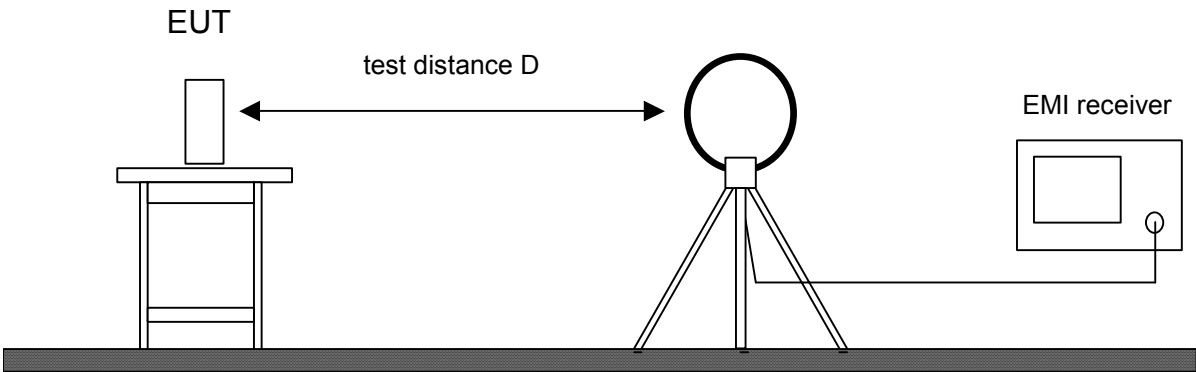


Test instruments used:

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

6.2 Radiated Emission Measurement 9 kHz – 30 MHz

Measurement Procedure:	
Rules and Specifications:	CFR 47 Part 15, sections 15.205 and 15.209 IC RSS-210 Issue 5, sections 6.2.1 and 6.3
Guide:	ANSI C63.4
Radiated emission in the frequency range 9 kHz – 30 MHz is measured initially at a distance of 3 meters in a fully or semi anechoic room with the detector of the spectrum analyzer or EMI receiver set to peak. 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. 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. Final measurement is performed at a test distance D of 30 meters using an open field test site. In case the regulation requires testing at other distances, the result is extrapolated by either making measurements at an additional distance D of 10 meters to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). In cases of very low emissions measurements are performed at shorter distances and results are extrapolated to the required distance. The provisions of CFR 47 Part 15 sections 15.31(d) and (f)(2) apply. According to section CFR 47 Part 15 section 15.209(d) final measurement is performed with detector function set to quasi-peak except for the frequency bands 9 – 90 kHz and 110 – 490 kHz where, except for pulsed operation, average detector is employed. 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.	

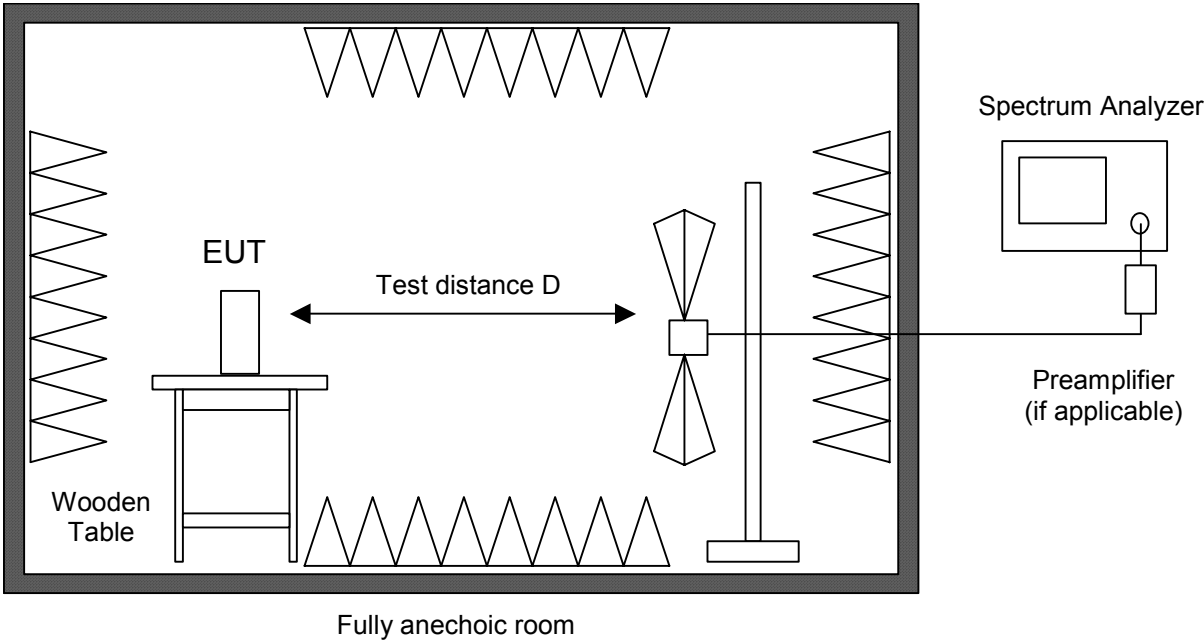


Test instruments used:

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
☒	Test receiver	ESHS 10	860043/016	Rohde & Schwarz
☐	Preamplifier	CPA9231A	3393	Schaffner
☒	Loop antenna	HFH2-Z2	882964/1	Rohde & Schwarz
☒	Fully anechoic room	No. 2	1452	Albatross Projects
☐	Semi-anechoic room	No. 3	1453	Siemens
☒	Open field test site	EG 1	1450	Senton

6.3 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). 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.	



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	FS-Z30	843389/007	Rohde & Schwarz
	Accessories			
☒	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

6.4 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

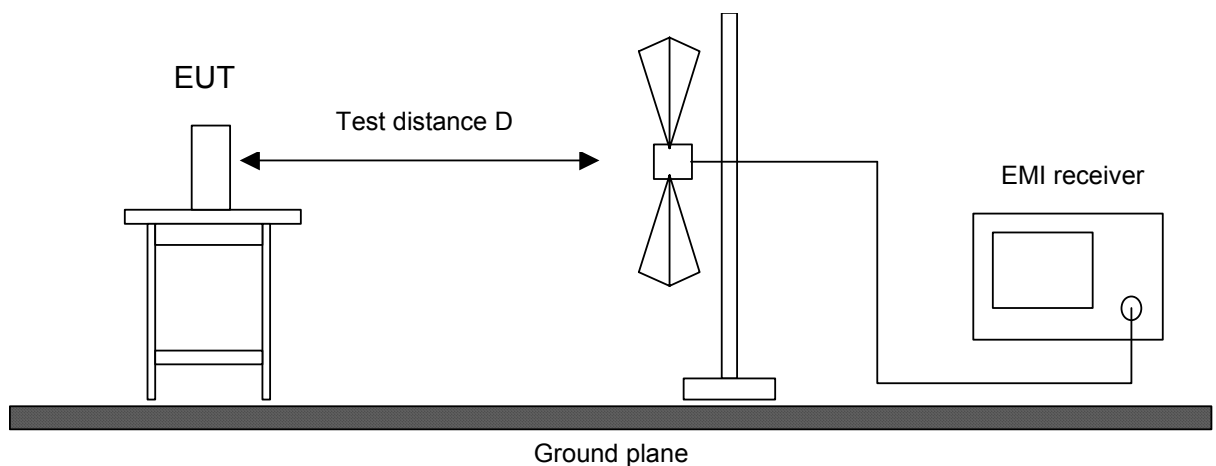
Guide: ANSI C63.4

Radiated emission at open field test site is measured in the frequency range 30 MHz to 1 GHz. 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.

In general a test distance D of 3 meters is selected. If a test distance of 10 meters is used the limits are calculated according to CFR 47 Part 15 section 15.31(d) and (f)(1).



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

7 Photographs Taken During Testing

**Test setup for radiated emission test
(fully anechoic room)**



**Test setup for radiated emission test
(open field test site)**





8 List of Measurements

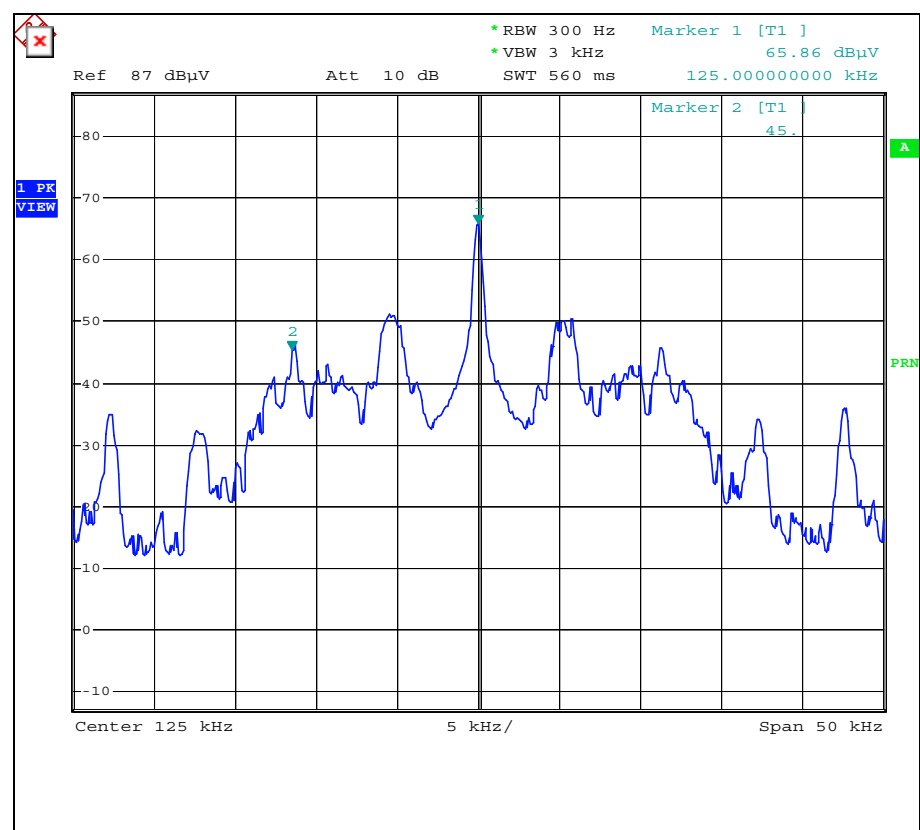
FCC CFR 47 Part 15			
<i>Section(s)</i>	<i>Test</i>	<i>Page</i>	<i>Result</i>
15.35(c)	Pulse train measurement for pulsed operation	20	Recorded
15.205(a)(b)	Restricted bands of operation	22	Test passed
15.207	Conducted AC powerline emission 150 kHz to 30 MHz	---	Not applicable
15.209	Radiated emission 9 kHz to 30 MHz	23	Test passed
15.209	Radiated emission 30 MHz to 1 GHz	24	Test passed

IC RSS-210 Issue 5			
<i>Section(s)</i>	<i>Test</i>	<i>Page</i>	<i>Result</i>
5.9.1	Emission Bandwidth	19	Recorded
6.5	Pulsed Operation	20	Recorded
6.3	Restricted Bands and Unwanted Emission Frequencies	22	Test passed
6.6	Transmitter AC Wireline Conducted Emissions 450 kHz to 30 MHz	---	Not applicable
6.2.1	Field Strength of Emissions 9 kHz to 30 MHz	23	Test passed
6.2.1	Field Strength of Emissions 30 MHz to 1 GHz	24	Test passed

Emission Bandwidth

Rules and specifications:	IC RSS-210 Issue 5, section 5.9.1
Guide:	Where indicated, 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 to be measured with a meter of 300 Hz resolution bandwidth or alternatively equal to approximately 1.0% of the emission bandwidth.

Comment:	Reading transponder continuously Test distance: 1m
Date of test:	October 29, 2004
Test site:	Fully anechoic room



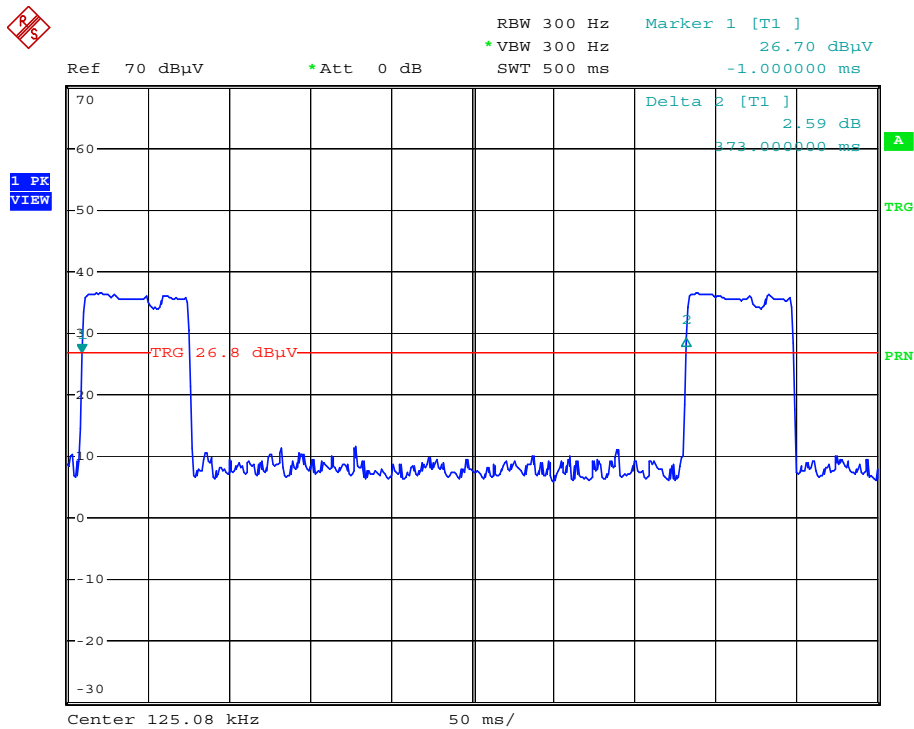
Emission bandwidth (20 dB points):	17.7 kHz
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Pulse Train Measurement

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

Comment:	reading tag continuously
Date of test:	October 4, 2004
Test site:	Fully anechoic room

Total Pulse Train:



Comment A: Feig 40686
Date: 6.OCT.2004 10:10:36

RBW 1 kHz Delta 2 [T1] 0.99 dB
 *VBW 300 Hz
 *Att 0 dB SWT 100 ms 65.400000 ms

Ref 70 dBuV

Marker 1 [T1] 26.78 dBuV
 -200.000000 ms

1 PR VIEW

TRG 26.8 dBuV

Center 125.08 kHz 10 ms/

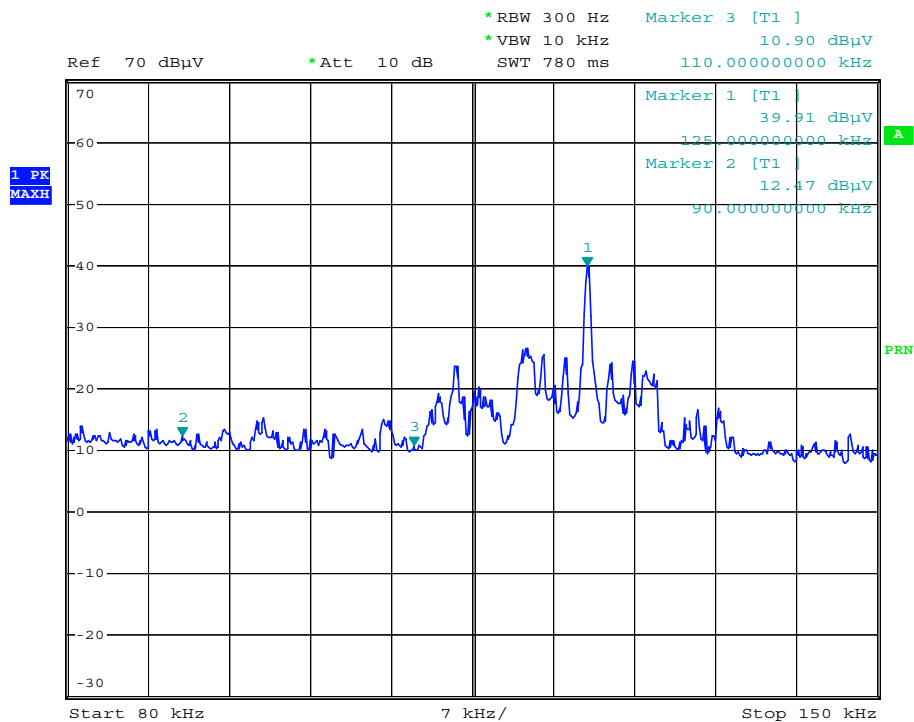
TX-On-Time (worst case):	T_{on}	=	65.4 ms
Pulse Train Time:	T_{pt}	=	373 ms
Period Time:	T_{period}	=	100.0 ms
Pulse Train Correction:	C_{pt}	=	$20 \cdot \log(T_{on} / T_{period})$ dB
		=	- 3.69 dB

Restricted Bands of Operation

Rules and specifications:	CFR 47 Part 15, section 15.205
Guide:	ANSI C63.4

Comment:	Reading transponder continuously
Date of test:	October 29, 2004
Test site:	Fully anechoic room

Test Result:	Test passed
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Comment A: Feig 40686: Restricted Bands Requirement
Date: 29.OCT.2004 11:20:02

Radiated Emission Measurement 9 kHz to 30 MHz

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 ($\mu\text{V/m}$)	Field Strength ($\text{dB}\mu\text{V/m}$)	Measurement Distance (meters)
	0.009 - 0.490	2400/F(kHz)	67.6 - 20 · log(F(kHz))	300
	0.490 - 1.705	24000/F(kHz)	87.6 - 20 · log(F(kHz))	30
	1.705 - 30	30	29.5	30

Comment:	reading tag continuously
Date of test:	October 11, 2004
Test site:	Open field test site

Test Result:	Test passed
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Test distance:		6 meters		Extrapolation factor:		40 dB/decade		
Frequency (MHz)	Detector	Reading Value ($\text{dB}\mu\text{V}$)	Pulse Train Correction (dB)	Correction Factor (dB/m)	Extrapolation Factor (dB)	Field Strength ($\text{dB}\mu\text{V/m}$)	Limit ($\text{dB}\mu\text{V/m}$)	Margin (dB)
0.1250	Peak	23.7	-3.7	20.0	-68.0	-27.9	25.7	53.6

Sample calculation of field strength values:

$$\begin{aligned} \text{Field Strength (dB}\mu\text{V/m)} &= \text{Reading Value (dB}\mu\text{V)} + \text{Pulse Train Correction (dB)} \\ &\quad + \text{Correction Factor (dB/m)} + \text{Extrapolation Factor (dB)} \end{aligned}$$

Radiated Emission Measurement 30 MHz to 1 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:	reading tag continuously
Date of test:	October 6, 2004
Test site:	Open field test site
Test distance:	3 meters

Test Result:	Test passed
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Frequency (MHz)	Detector	Antenna Polarization	Reading Value (dBµV)	Correction Factor (dB/m)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30 - 1000	Peak				***		

***: All measurements showed more than 20 dB margin to the limit

Sample calculation of field strength values:

$$\text{Field Strength (dBµV/m)} = \text{Reading Value (dBµV)} + \text{Correction Factor (dB/m)}$$

9 Referenced Regulations

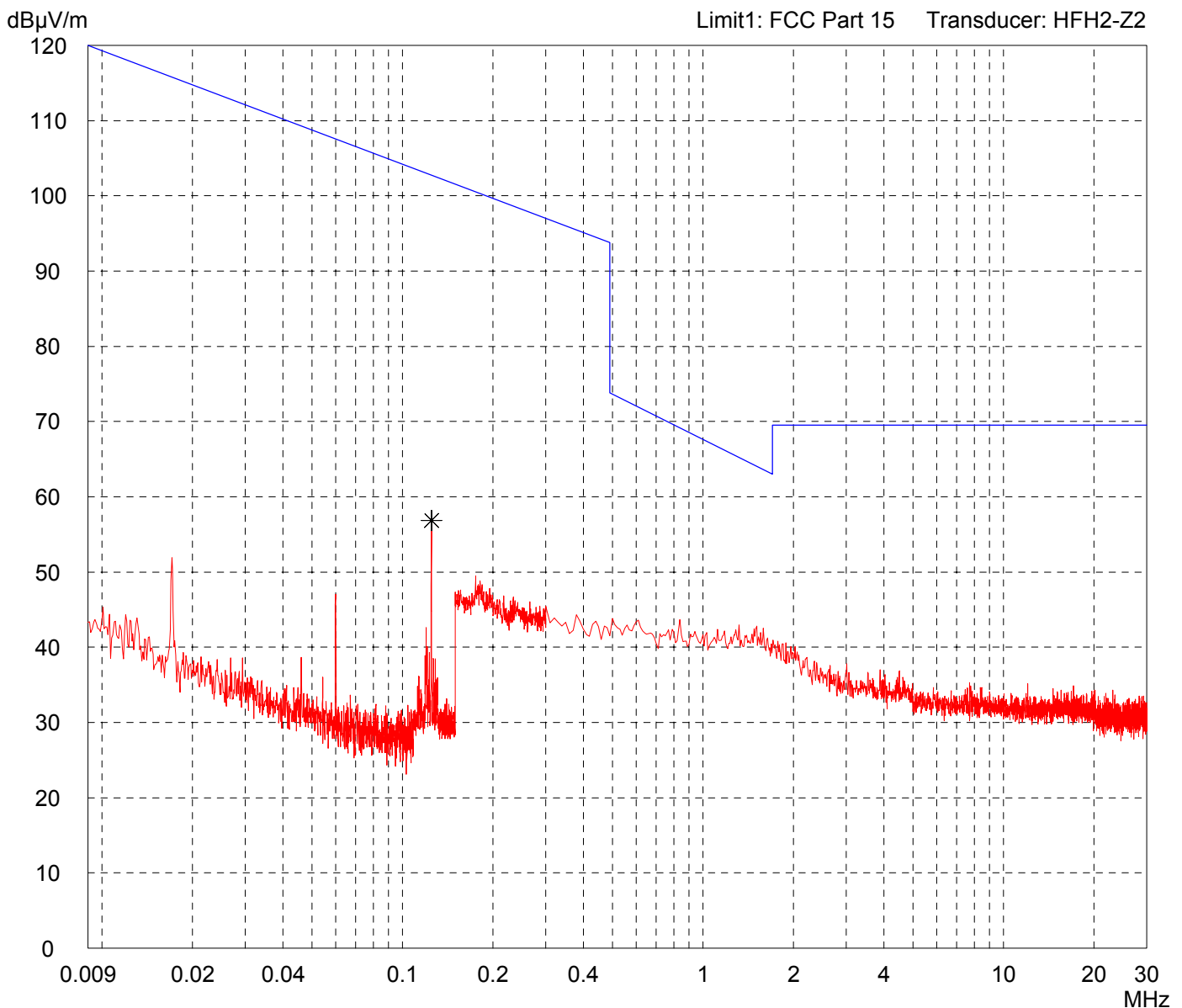
All tests were performed with reference to the following regulations and standards:

☒	FCC Part 2	Code of Federal Regulations Part 2 Frequency allocation and radio treaty matters; General rules and regulations	October 01, 2001
☐	FCC Part 15 Subpart A	Code of Regulations Part 15 (Radio Frequency Devices), Subpart A (General) of the Federal Communication Commission (FCC)	July 12, 2004
☐	FCC Part 15 Subpart B	Code of Regulations Part 15 (Radio Frequency Devices), Subpart B (Unintentional Radiators) of the Federal Communication Commission (FCC)	July 12, 2004
☒	FCC Part 15 Subpart C	Code of Regulations Part 15 (Radio Frequency Devices), Subpart C (Intentional Radiators) of the Federal Communication Commission (FCC)	July 12, 2004
☐	FCC Part 74 Subpart H	Code of Regulations Part 15 (Radio Frequency Devices), Subpart H (Low Power Auxiliary Stations) of the Federal Communication Commission (FCC)	July 12, 2004
☐	CFR 47 Part 95 Subpart C/E	Code of Federal Regulations Part 95 (Personal Radio Services), Subpart C/E (Radio Control(R/C) Radio Service) of the Federal Communication Commission (FCC)	October 1, 1998
☒	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) of Industry Canada	November 2001
☐	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
☐	TIA/EIA-603	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards	February 1993
☐	TIA/EIA-603-1	Addendum to TIA/EIA-603	March 4, 1998

10 Charts taken during testing

Radiated Emission Test 9 kHz - 30 MHz acc. to FCC Part 15 (Fully Anechoic Chamber)

Model: SAFE-O-TRONIC		Comment: - 6 V battery supply - reading transponder continuously
Serial no.: 01		
Applicant: Schulte-Schlagbaum AG		
Test site: Fully anechoic room, cabin no. 2		
Tested on: Test distance 3 metres		
Date of test: 10/11/2004	Operator: M. Steindl	
Test performed: by hand	File name: default.emi	
Detector: Peak		List of values: Selected by hand

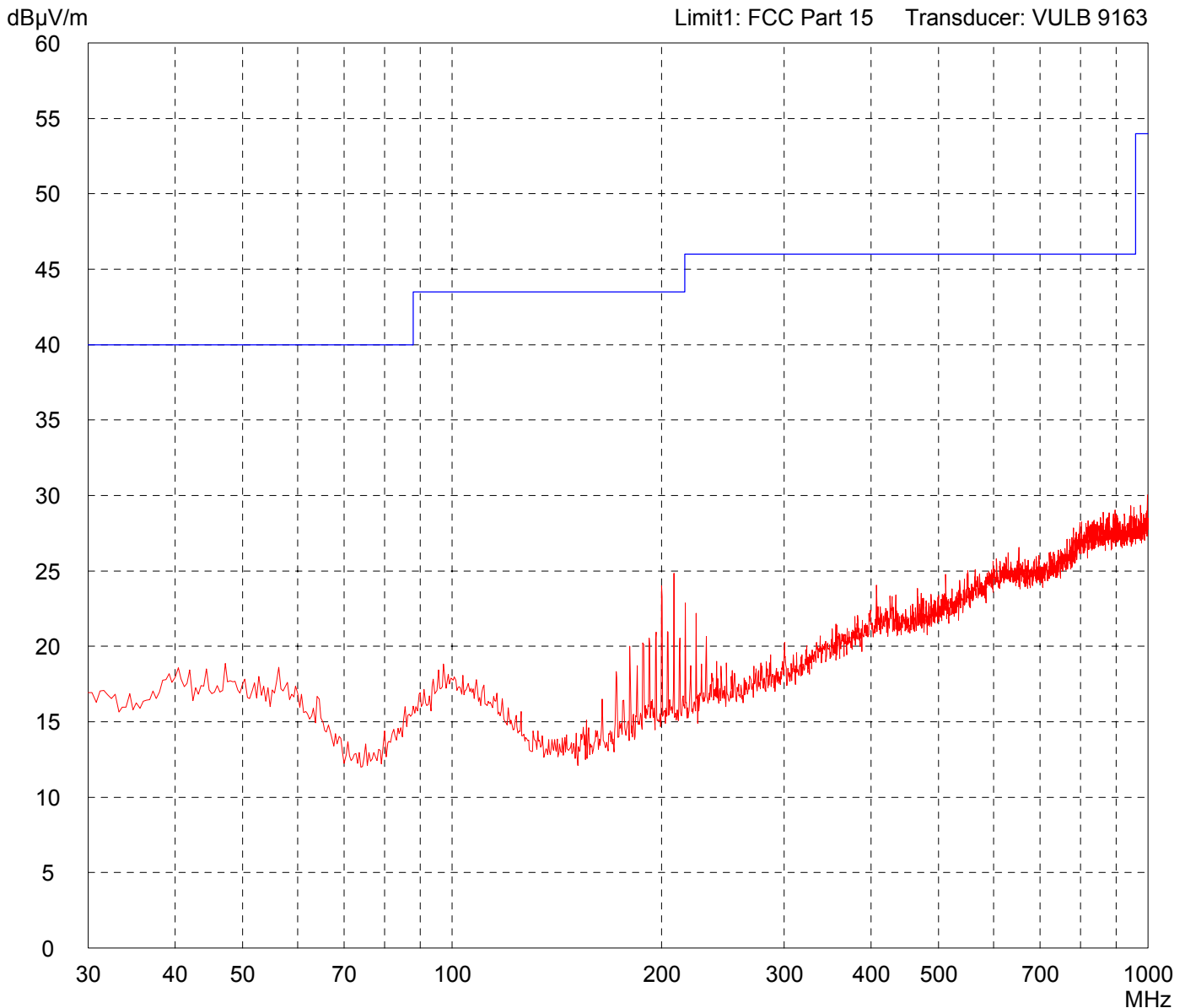


Result: Prescan	Project file: 50602-40686	Page of Pages
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Radiated Emission Test 30 MHz - 1 GHz acc. to FCC Part 15 (Fully Anechoic Chamber)

Model: SAFE-O-TRONIC	Comment: - 6 V battery supply - reading transponder continuously
Serial no.: 01	
Applicant: Schulte-Schlagbaum AG	
Test site: Fully anechoic room, cabin no. 2	
Tested on: Test distance 3 metres Horizontal Polarization	
Date of test: 10/06/2004	Operator: M. Steindl
Test performed: automatically	File name: default.emi

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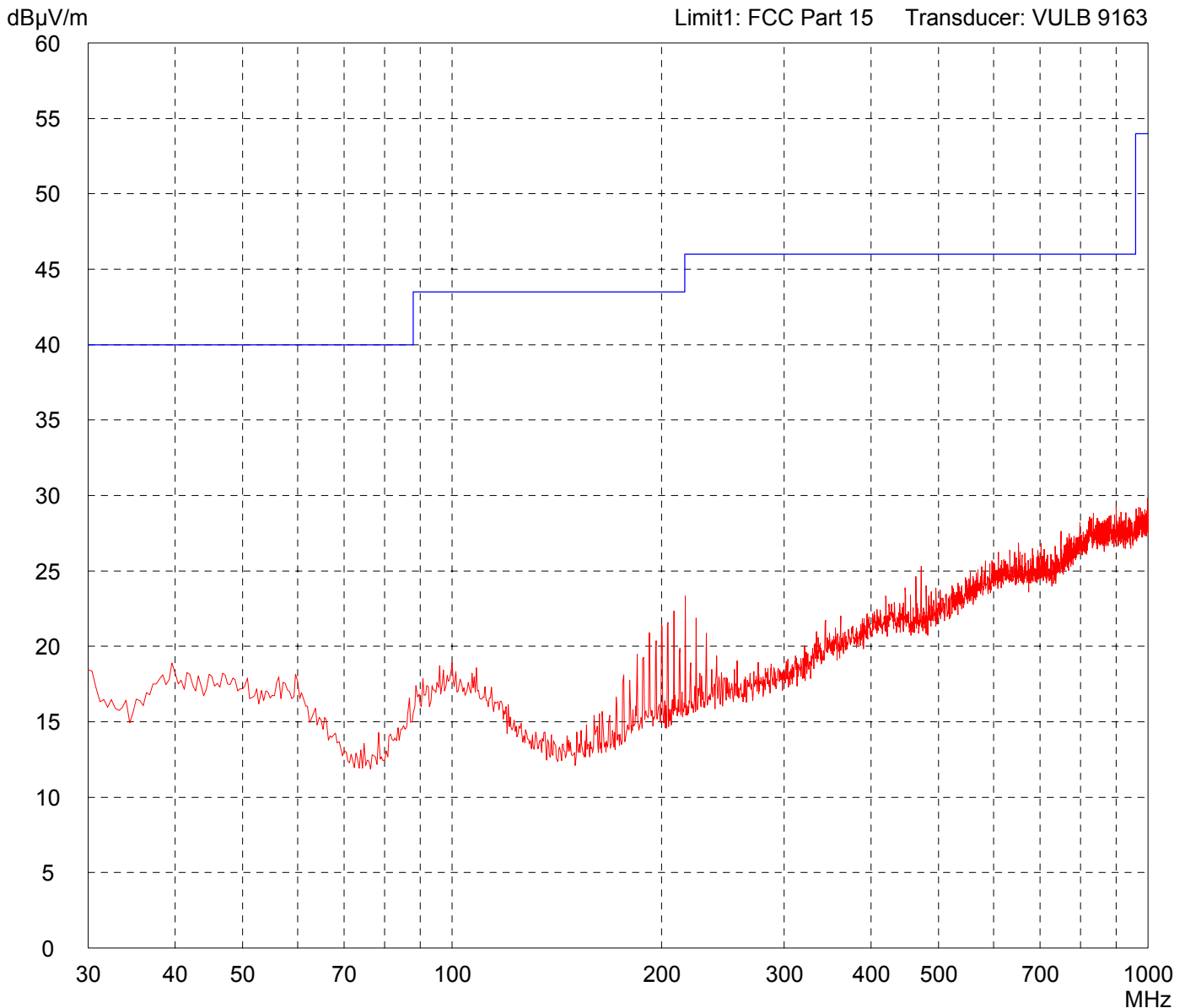


Result: Prescan	Project file: 50602-40686
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Radiated Emission Test 30 MHz - 1 GHz acc. to FCC Part 15 (Fully Anechoic Chamber)

Model: SAFE-O-TRONIC	Comment: - 6 V battery supply - reading transponder continuously
Serial no.: 01	
Applicant: Schulte-Schlagbaum AG	
Test site: Fully anechoic room, cabin no. 2	
Tested on: Test distance 3 metres Vertical Polarization	
Date of test: 10/06/2004	Operator: M. Steindl
Test performed: automatically	File name: default.emi

Detector: Peak	List of values: 10 dB Margin 50 Subranges
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Result: Prescan	Project file: 50602-40686
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