Senton GmbH
Aeussere Fruehlingstrasse 45
D-94315 Straubing

Straubing, April 5, 2005

T E S T - R E P O R T

No. 55705-050075-2 (Edition 1)

for

BMW Immobilizer

Inductive Transponder Reader for Immobilizer

Applicant:	Tyco Electronics EC NV
Test Specifications:	FCC Code of Federal Regulations, CFR 47, Part 15, Sections 15.205 and 15.209 Industry Canada Radio Standards Specification RSS-210 Issue 5, Sections 6.2.1 and 6.3 (Category I Equipment)

Table of Contents

1 Description of the Equipment Under Test (EUT)

General data of EUT	
Type designation[1]:	BMW Immobilizer
Parts[2]:	1
Serial number(s):	EZ800L38
Manufacturer:	Tyco Electronics EC NV
Type of equipment:	Inductive Transponder Reader for Immobilizer
Version:	as delivered
FCC ID:	QB4-1417121
Additional parts/accessories:	---

Technical data of EUT	
Application frequency range:	119 – 127 kHz
Frequency range:	119 – 127 kHz
Operating frequency:	125 kHz
Type of modulation:	ASK
Pulse train:	Not Applicable
Pulse width:	Not Applicable
Number of RF-channels:	1
Channel spacing:	Wideband (Not Applicable)
Designation of emissions[3]:	10K0A1D
Type of antenna:	Inductive Loop Coil
Size/length of antenna:	Ø 40 mm
Type of power supply:	Battery supply
Specifications for power supply:	nominal voltage: 13.2 V minimum voltage: 10.8 V maximum voltage: 15.6 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):	Tyco Electronics EC NV Siemenslaan 14 B-8020 Oostkamp Belgium
Contact person:	Mr. William van Loenhout
Contract identification:	Order no. 2453336427
Receipt of EUT:	February 14th, 2005
Date(s) of test:	April 5th, 2005
Note(s):	---

Report details	
Report number:	55705-050075-2
Edition:	1
Issue date:	April 5, 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 and 15.209** of the Federal Communication Commission (FCC) and the **Radio Standards Specification RSS-210 Issue 5, Sections 6.2.1 and 6.3 (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(s)
Transmitting continuously

Configuration(s) of EUT
EUT was configured as stand alone device.

List of ports and cables				
Port	*Description*	*Classification*[4]	*Cable type*	*Cable length*
1	Control Bus Connector	dc power and signal/control port	Unshielded	

List of devices connected to EUT				
Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*
1	Not Applicable			

List of support devices				
Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*
1	Not Applicable			

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

6 Measuring Methods

6.1 Radiated Emission Measurement 9 kHz to 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

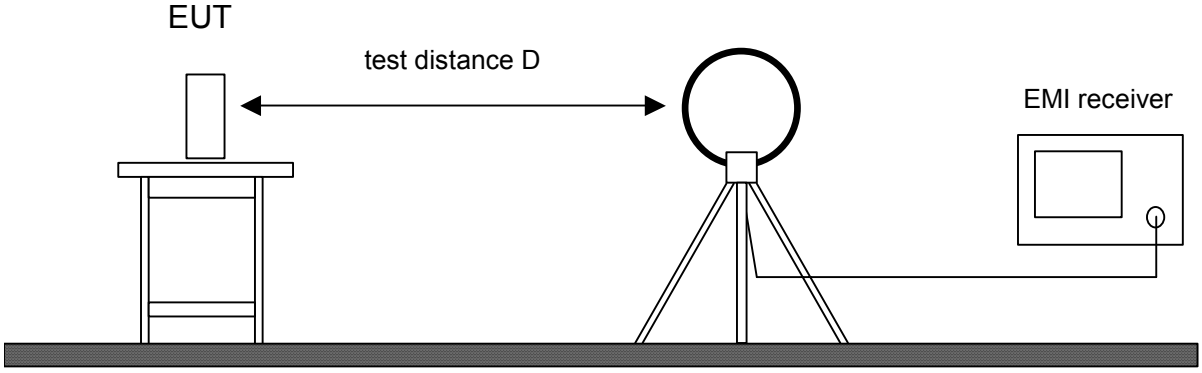
Radiated emission in the frequency range 9 kHz to 30 MHz is measured using an active loop antenna. First the whole spectrum of emission caused by the equipment is recorded at a distance of 3 meters in a fully or semi anechoic room with the detector of the spectrum analyzer or EMI receiver set to peak. This configuration is also used for recording the spectrum of intentional radiators.

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. Due to fixed polarization of the loop antenna, if possible, the EUT is put into a position that gives the maximum levels of 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 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, for non-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

6.2 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.

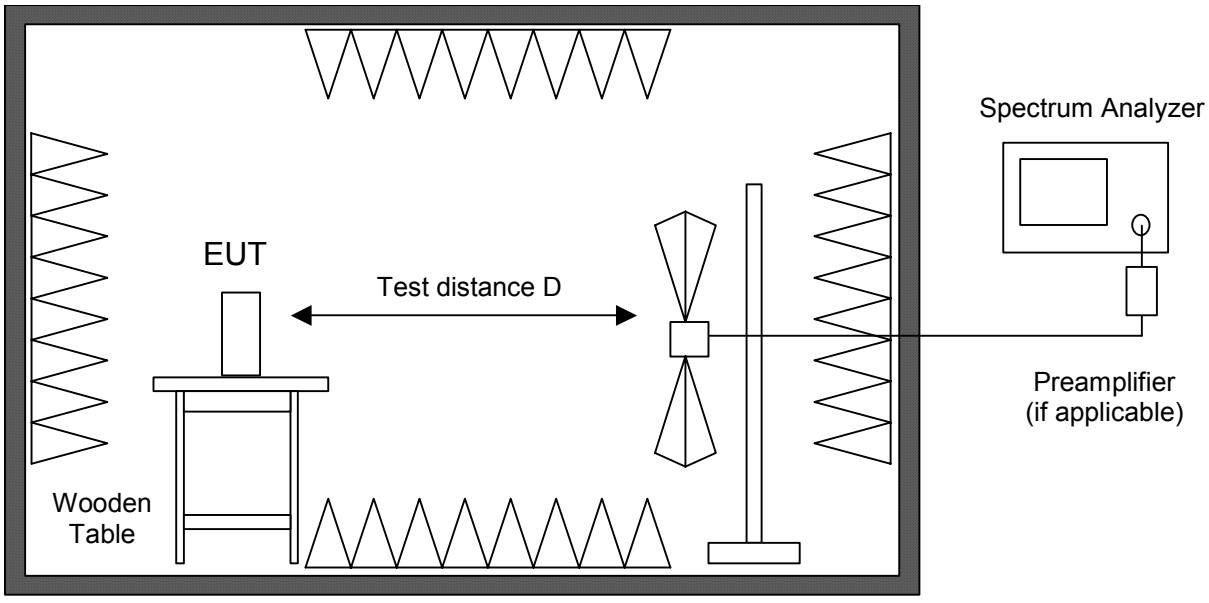
All tests below 18 GHz are performed at a test distance D of 3 meters. For higher frequencies the test distance is reduced (e.g. to 1 meter) due to the sensitivity of the measuring instrument(s) and the test results are calculated according to CFR 47 Part 15 section 15.31(f)(1) using an extrapolation 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

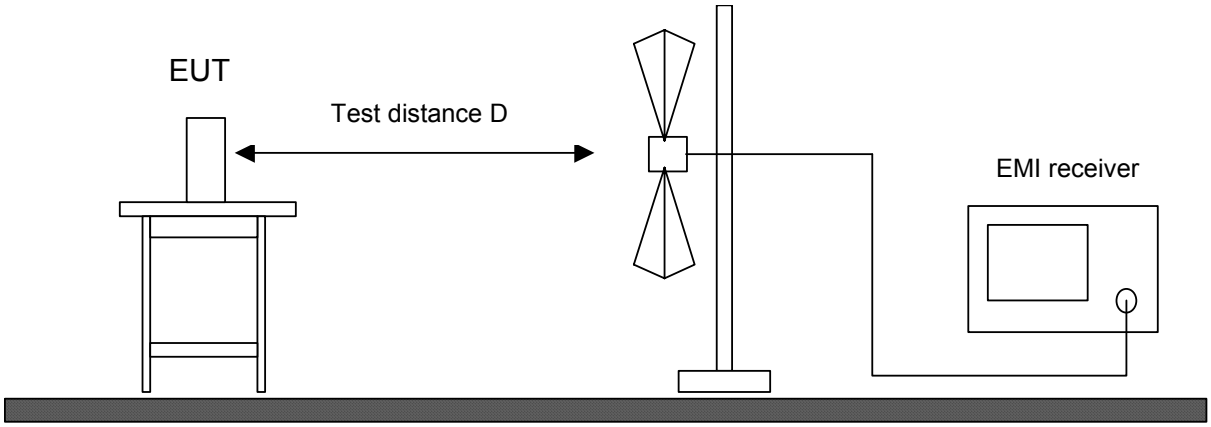
Measurement Procedure:	
Rules and Specifications:	CFR 47 Part 15, section 15.209 IC RSS-210 Issue 5, section 6.2.1
Guide:	ANSI C63.4

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.



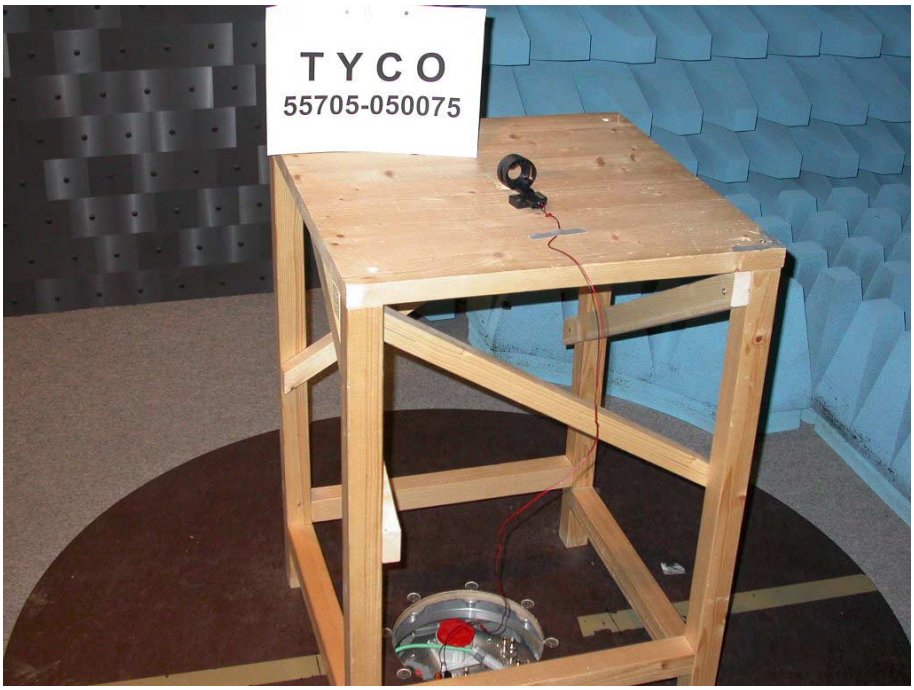
Test instruments used:

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

7 Photographs Taken During Testing

Test setup for radiated emission measurement 9 kHz – 30 MHz

Test setup for radiated emission measurement (fully anechoic room)



8 Test Results

FCC CFR 47 Parts 2 and 15			
Section(s)	*Test*	*Page*	*Result*
2.202(a)	Occupied bandwidth	17	Recorded
2.201, 2.202	Class of emission	21	Calculated
15.35(c)	Pulse train measurement for pulsed operation	---	Not applicable
15.205(a)	Restricted bands of operation	22	Test passed
15.207	Conducted AC powerline emission 150 kHz to 30 MHz	---	Not applicable
15.205(b) 15.209	Radiated emission 9 kHz to 30 MHz	23	Test passed
15.205(b) 15.209	Radiated emission 30 MHz to 1 GHz	24	Test passed

IC RSS-210 Issue 5			
Section(s)	*Test*	*Page*	*Result*
5.9.1	Emission bandwidth	20	Recorded
5.9.2	Designation of emissions	21	Calculated
6.5	Pulsed operation	---	Not applicable
6.3(a)	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 6.3(b)-(d)	Field strength of emissions 9 kHz to 30 MHz	23	Test passed
6.2.1 6.3(b)-(d)	Field strength of emissions 30 MHz to 1 GHz	24	Test passed

8.1 Occupied Bandwidth

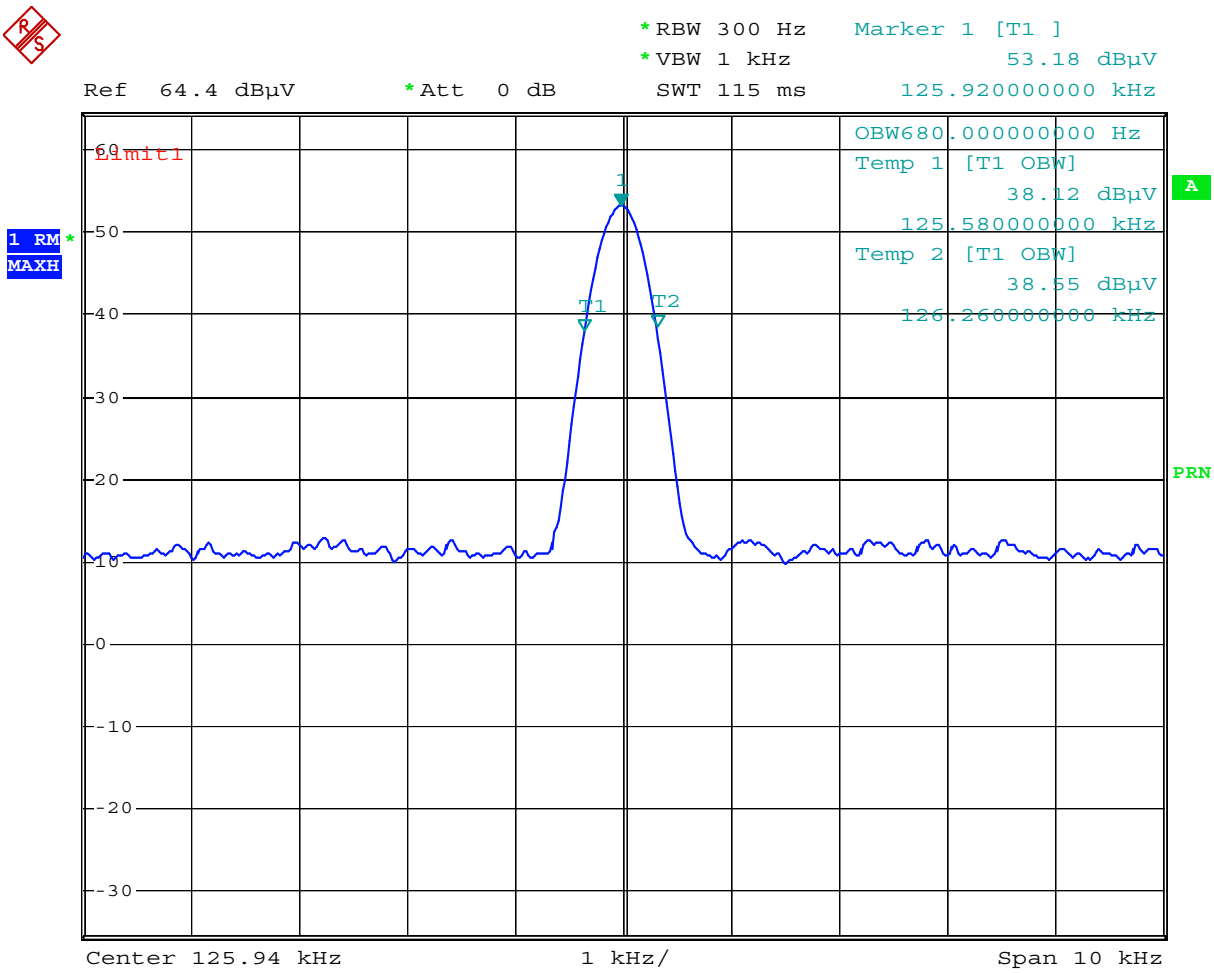
Rules and specifications:	CFR 47 Part 2, section 2.202(a) ANSI C63.4, annex H.6
Guide:	ANSI C63.4
Description:	The occupied bandwidth according to CFR 47 Part 2, section 2.202(a), is measured as the 99% emission bandwidth, i.e. below its lower and above its upper frequency limits, the mean powers radiated 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:	
Date of test:	April 5th, 2005
Test site:	Fully anechoic room, cabin no. 2

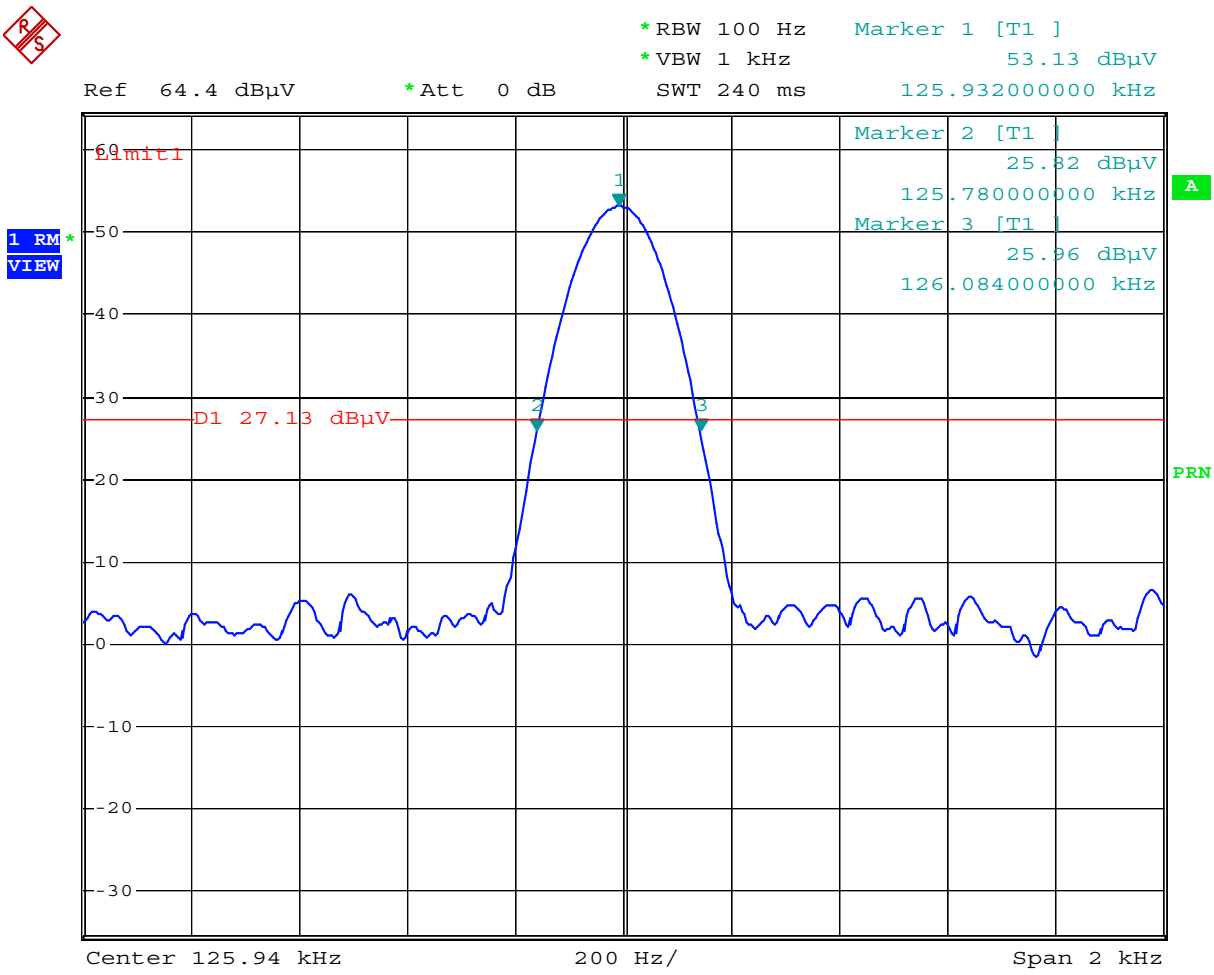
Occupied Bandwidth (99 %):



Comment: Tyco 050075: Occupied Bandwidth
Date: 5.APR.2005 11:23:59

Occupied Bandwidth (99 %):	**0.68 kHz**

Occupied Bandwidth (-26 dB):



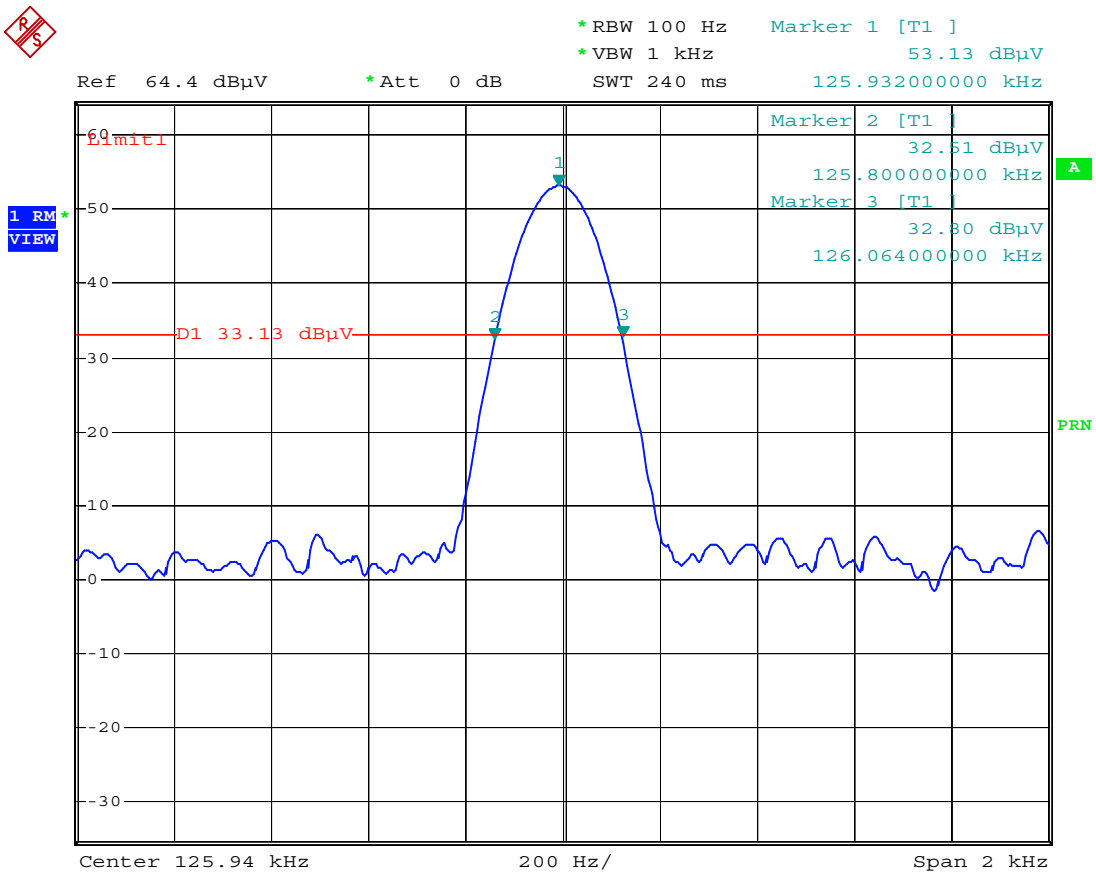
Comment: Tyco 050075: Occupied Bandwidth
Date: 5.APR.2005 11:25:54

Occupied Bandwidth (-26 dB):	**0.30 kHz**

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:	
Date of test:	April 5th, 2005
Test site:	Fully anechoic room, cabin no. 2



Comment: Tyco 050075: Emission Bandwidth
Date: 5.APR.2005 11:27:17

Emission bandwidth (-20 dB):	**0.26 kHz**

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:	Amplitude Modulation

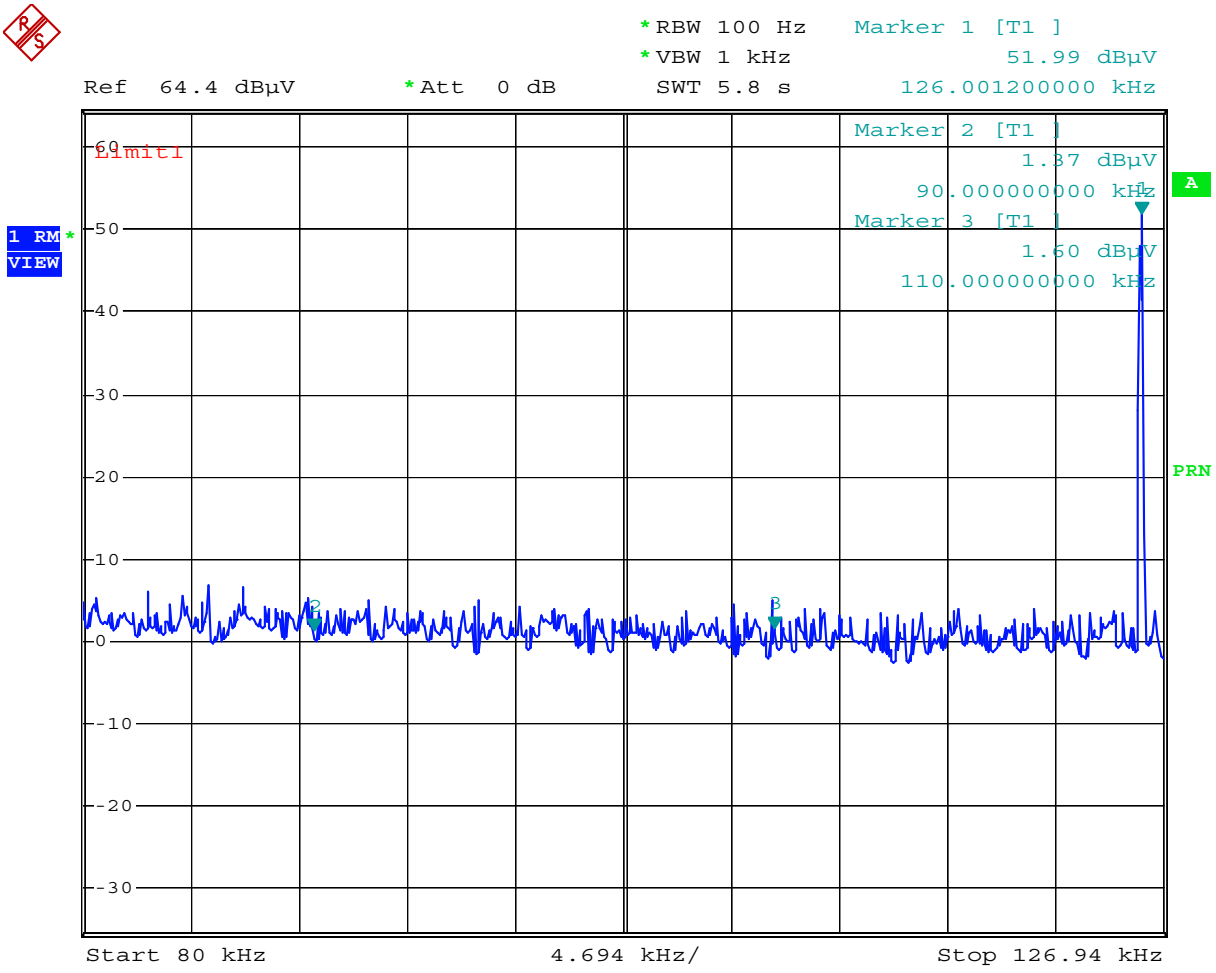
B_n = Necessary Bandwidth	B_n = 2BK
B = Modulation rate	B = 5 kHz
K = Overall numerical factor	K = 1
Calculation:	$B_n = 2 \cdot (5\ kHz) \cdot 1 = 10\ kHz$

Designation of Emissions:	**10K0A1D**

8.4 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:	 April 5th, 2005 Fully anechoic room, cabin no. 2
Test distance:	3 meters



Comment: Tyco 050075: Restricted Frequency Bands
Date: 5.APR.2005 11:29:54

Test Result:	Test passed

8.5 Radiated Emission Measurement 9 kHz to 30 MHz

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			
Limit:	Frequency of Emission (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)	Measurement Distance d (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 - 30.000	30	29.5	30

Comment:	
Date of test:	April 5th, 2005
Test site:	Open field test site

Test Result:	Test passed

Frequency (MHz)	Detector	Distance d_1 (m)	Distance d_2 (m)	Reading Value d_1 (dBµV)	Reading Value d_2 (dBµV)	Correction Factor (dB/m)	Extrapolation Factor (dB/dec)	Extrapolation Factor (dB)	Pulse Train Correction (dB)	Final Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
0,12598	QP	3	10	55,4	28,2	20,0	-51,9	-76,7		-28,5	25,6	**54,1**

Sample calculation of final values:

$$\text{Extrapolation Factor (dB/decade)} = \begin{cases} -40 \text{ (dB/decade)} & \text{if } d_1 = d_2 \\ \dfrac{\text{Reading Value } d_2 \text{ (dBµV)} - \text{Reading Value } d_1 \text{ (dBµV)}}{\text{Log}(d_2) - \text{Log}(d_1)} & \text{if } d_1 \neq d_2 \end{cases}$$

$$\text{Extrapolation Factor (dB)} = (\text{Log}(d) - \text{Log}(d_2)) \cdot \text{Extrapolation Factor (dB/decade)}$$

$$\text{Final Value (dBµV/m)} = \text{Reading Value } d_2 \text{ (dBµV)} + \text{Correction Factor (dB/m)} + \text{Extrapolation Factor (dB)} + \text{Pulse Train Correction (dB)}$$

8.6 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:	
Date of test:	April 5th, 2005
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

No measuments above noise level detected.

Sample calculation of final values:

Final Value (dBµV/m) = Reading Value (dBµV) + Correction Factor (dB/m) + Pulse Train Correction (dB)

9 Referenced Regulations

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

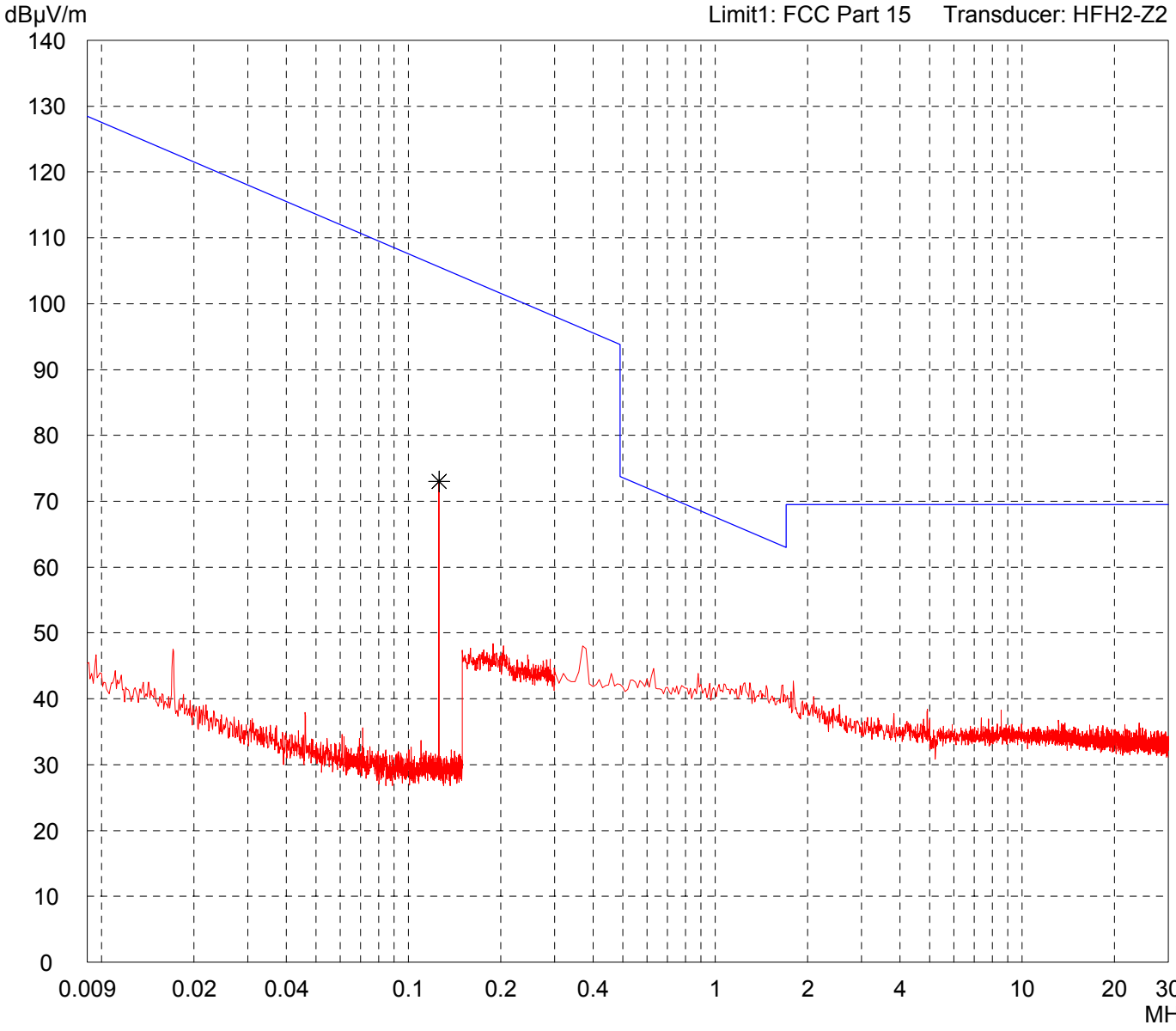
☒	CFR 47 Part 2	Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC)	October 10, 2004
☒	CFR 47 Part 15	Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)	September 19, 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-Gen	Radio Standards Specification RSS-Gen Issue 1 containing General Requirements and Information for the Certification of Radiocommunication Equimpment, published by Industry Canada	September 2005
☒	RSS-210	Radio Standards Specification RSS-210 Issue 6 for Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, published by Industry Canada	September 2005
☐	RSS-310	Radio Standards Specification RSS-310 Issue 1 for Low Power Licence-Ecempt Radiocommunicaton Devices (All Frequency Bands): Category II Equipment, published by Industry Canada	September 2005
☒	RSS-102	Radio Standards Specification RSS-102 Issue 1: Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields, published by Industry Canada	September 25, 1999
☐	ICES-003	Interference-Causing Equipment Standard ICES-003 Issue 4 for Digital Apparatus, published by Industry Canada	February 7, 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

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

Model: BMW Immobilizer	Comment: - DC 12 V power supply
Serial no.: EZ800L38	
Applicant: Tyco Electronics EC NV	
Test site: Fully anechoic room, cabin no. 2	
Tested on: Test distance 3 metres	
Date of test: 04/05/2005 / Operator: M. Steindl	
Test performed: by hand / File name: default.emi	

Detector: Peak	List of values: Selected by hand

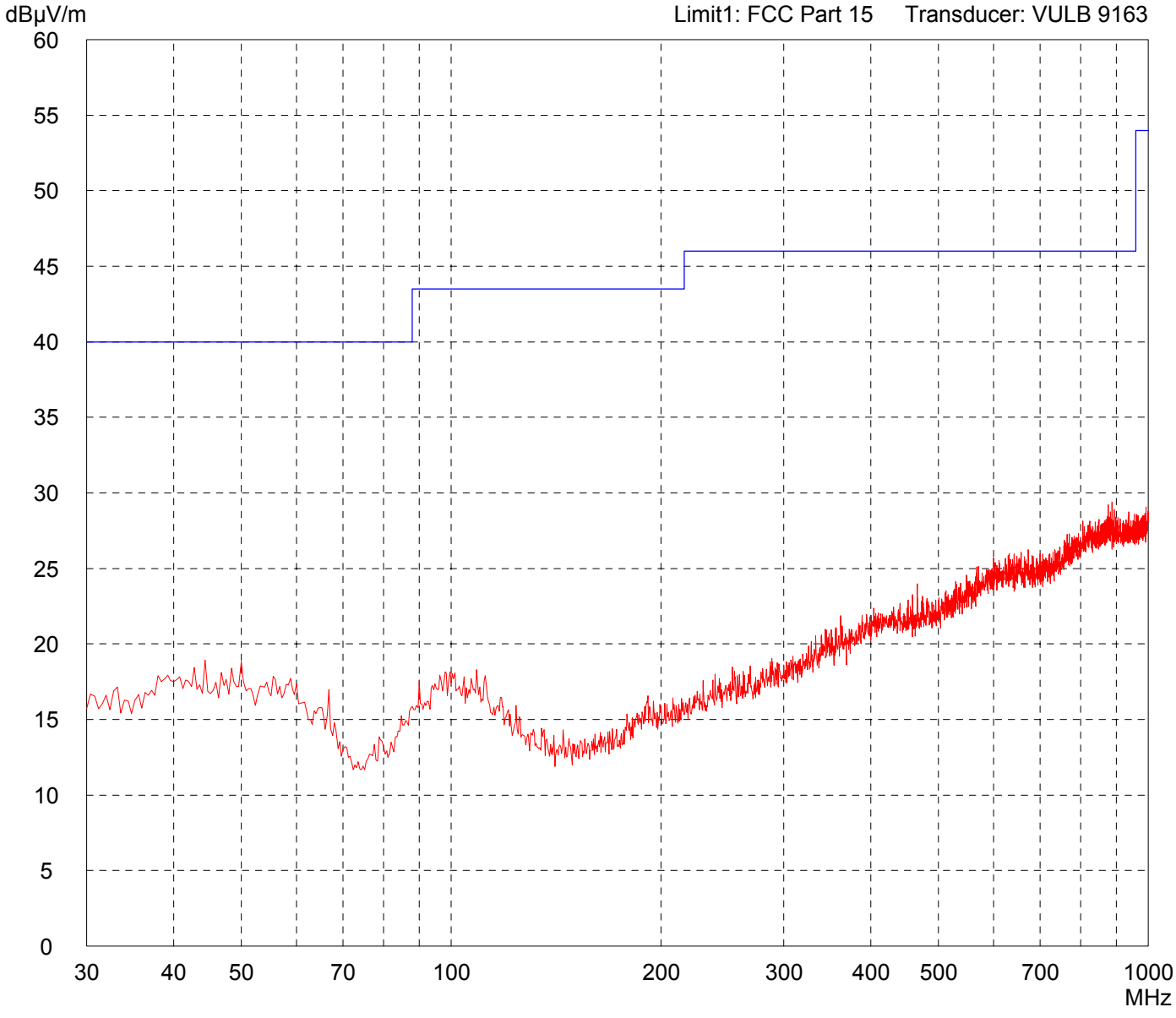


Result: Prescan	Project file: 55705-50075 Page of Pages

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

Model: BMW Immobilizer	Comment: - DC 12 V power supply
Serial no.: EZ800L38	
Applicant: Tyco Electronics EC NV	
Test site: Fully anechoic room, cabin no. 2	
Tested on: Test distance 3 metres Horizontal Polarization	
Date of test: 04/05/2005 — Operator: M. Steindl	
Test performed: automatically — File name: default.emi	

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

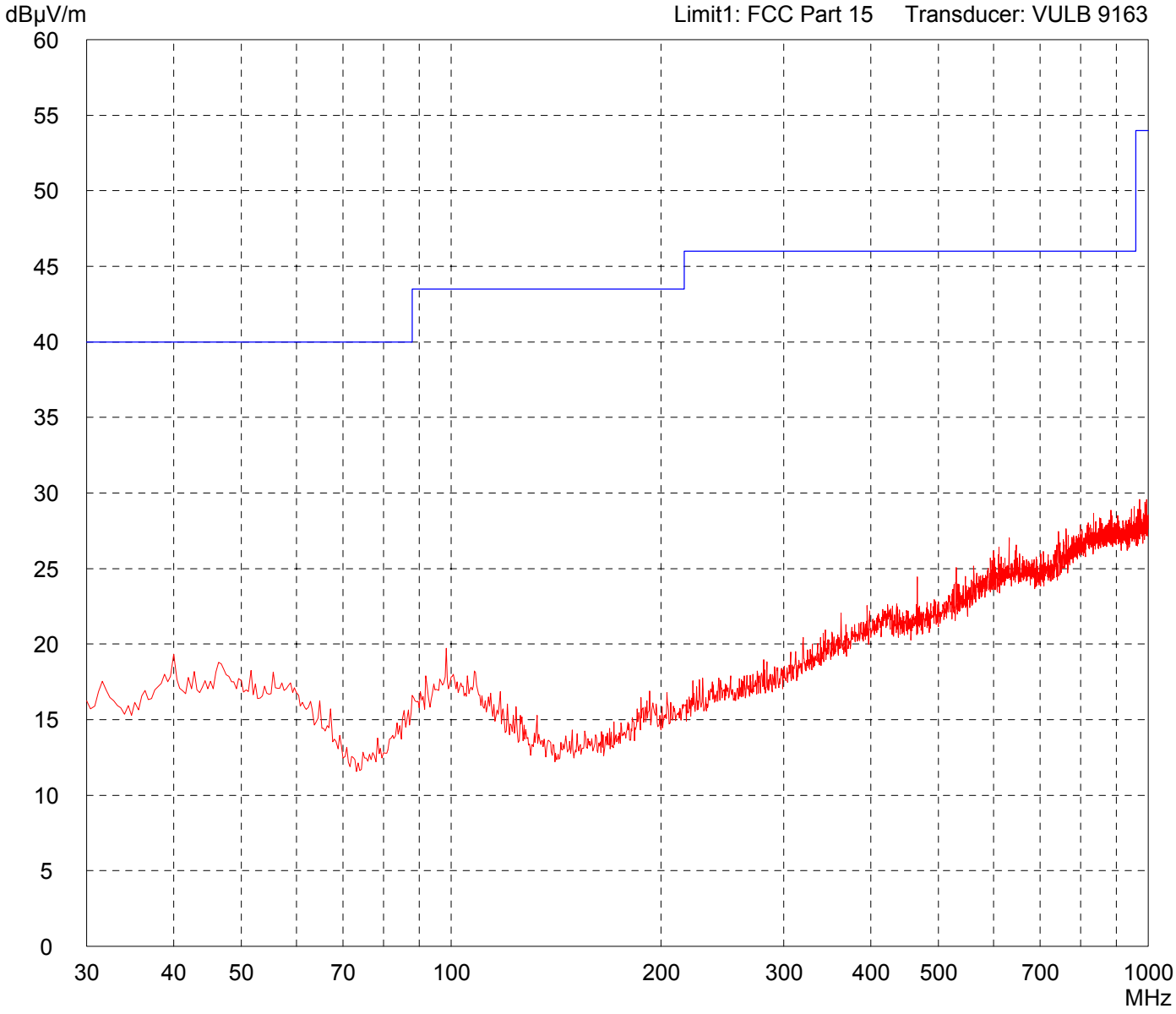


Result: Prescan	Project file: 55705-50075 — Page of Pages

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

Model: BMW Immobilizer	Comment: - DC 12 V power supply
Serial no.: EZ800L38	
Applicant: Tyco Electronics EC NV	
Test site: Fully anechoic room, cabin no. 2	
Tested on: Test distance 3 metres Vertical Polarization	
Date of test: 04/05/2005 / Operator: M. Steindl	
Test performed: automatically / File name: default.emi	

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



Result: Limit kept	Project file: 55705-50075 Page of Pages