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July 26, 2013

Prüfbericht / *Test Report* Nr. / *No.* 69557-03146-1 (Edition 2)

Applicant:	Brooks Automation (Germany) GmbH
Type of equipment:	RFID Reader
Type designation:	LF80_RDC
Order No.:	
Test standards:	FCC Code of Federal Regulations, CFR 47, Part 15, Sections 15.205, 15.207 and 15.209 Industry Canada Radio Standards Specifications RSS-Gen Issue 3, Sections 7.2.2, 7.2.4 and 7.2.5(Category I Equipment)

Table of Contents

1 Description of the Equipment Under Test (EUT)

General data of EUT	
Type designation[1]:	LF80_RDC
Parts[2]:	Reader, Antenna, external LED, external Sensor
Serial number(s):	02-1FF4-TS
Manufacturer:	Brooks Automation (Germany) GmbH
Type of equipment:	RFID Reader
Version:	As received
FCC ID:	N5GTSG
Additional parts/accessories:	

Technical data of EUT		
Application frequency range:	134.2 kHz	
Frequency range:	134.2 kHz	
Operating frequency:	134.2 kHz	
Type of modulation:	ASK	
Pulse train:	1.1 s	
Pulse width:	51.9 ms	
Number of RF-channels:	1	
Channel spacing:	Not Applicable	
Designation of emissions[3]:	10K0A1D	
Type of antenna:	External Ferrite antenna	
Size/length of antenna:	Ø 1 cm x 10 cm	
Connection of antenna:	☒ detachable	☐ not detachable
Type of power supply:	DC supply	
Specifications for power supply:	nominal voltage: minimum voltage: maximum voltage:	24.0 V 18.0 V 30.0 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):	Brooks Automation (Germany) GmbH Gartenstraße 19 D-95490 Mistelgau
Contact person:	Mr. Lothar Düngfelder
Order number:	
Receipt of EUT:	January 25, 2011
Date(s) of test:	January 26, 2011 – February 9, 2011
Note(s):	

Report details	
Report number:	69557-03146-1
Edition:	2
Issue date:	July 26, 2013

3 Identification of the Test Laboratory

Details of the Test Laboratory	
Company name:	TÜV SÜD SENTON GmbH
Address:	Aeussere Fruehlingstrasse 45 D-94315 Straubing Germany
Laboratory accreditation:	DAR-Registration No. DAT-PL-171/94-03
FCC test site registration number	90926
Industry Canada test site registration:	3050A-2
Contact person:	Mr. Johann Roidt Phone: +49 9421 5522-0 Fax: +49 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 Specifications** **RSS-Gen Issue 3, Sections 7.2.2, 7.2.4 and 7.2.5 (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)
The EUT was configurated to continuous transmitting.

Configuration(s) of EUT
The EUT was configured as PC controlled device.

List of ports and cables

Port	*Description*	*Classification*[4]	*Cable type*	*Cable length*
1	DC supply line	dc power	Unshielded	
2	Antenna	signal/control port	Unshielded	
3	Input	signal/control port	Unshielded	
4	Output	signal/control port	Unshielded	
5	Ethernet	signal/control port	Shielded	
6	RS-232	signal/control port	Shielded	

List of devices connected to EUT

Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*
1	Antenna			
2	External LED			
3	External Sensor			

List of support devices

Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*
1	Laptop PC	DELL dimension		DELL
2	Tag		X00131313131313131	

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

6 Measurement Procedures

6.1 Bandwidth Measurements

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 2, section 2.202(a) CFR 47 Part 15, section 15.215(c) IC RSS-Gen Issue 3, sections 4.6.1 and 4.6.2 ANSI C63.4, annex H.6
Guide:	ANSI C63.4 / IC RSS-Gen Issue 3, sections 4.6.1 and 4.6.2
Measurement setup:	☐ Conducted: See below ☒ Radiated: Radiated Emission Measurement 9 kHz to 30 MHz (6.4)

If antenna is detachable bandwidth measurements shall be performed at the antenna connector (conducted measurement) when the transmitter is adjusted in accordance with the tune-up procedure, if applicable. The RF output terminals are connected to a spectrum analyzer. If required, a resistive matching network equal to the impedance specified or employed for the antenna is used as well as dc block and appropriate attenuators (50 Ohms). The electrical characteristics of the radio frequency load attached to the output terminals shall be stated, if applicable.

If radiated measurements are performed the same test setups and instruments are used as with radiated emission measurements for the appropriate frequency range.

The analyzer settings are specified by the test description of the appropriate test record(s).

6.2 Pulse Train Measurement

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, section 15.35(c) IC RSS-Gen Issue 3, section 4.5
Guide:	ANSI C63.4
Measurement setup:	☐ Conducted: See below (direct connection or via test fixture) ☒ Radiated: Radiated Emission Measurement 9 kHz to 30 MHz (6.4)

If antenna is detachable pulse train measurements shall be performed at the antenna connector (conducted measurement). The RF output terminals are connected to a spectrum analyzer or to a diode detector in combination with an oscilloscope. If required, a resistive matching network equal to the impedance specified or employed for the antenna is used as well as dc block and appropriate attenuators (50 Ohms). The electrical characteristics of the radio frequency load attached to the output terminals shall be stated, if applicable.

If antenna is not detachable a test fixture may be used instead of direct connection to RF output terminals.

If radiated measurements are performed similar test setups and instruments are used as with radiated emission measurements for the appropriate frequency range. However, the spectrum analyzer may be replaced by a diode detector connected to an oscilloscope.

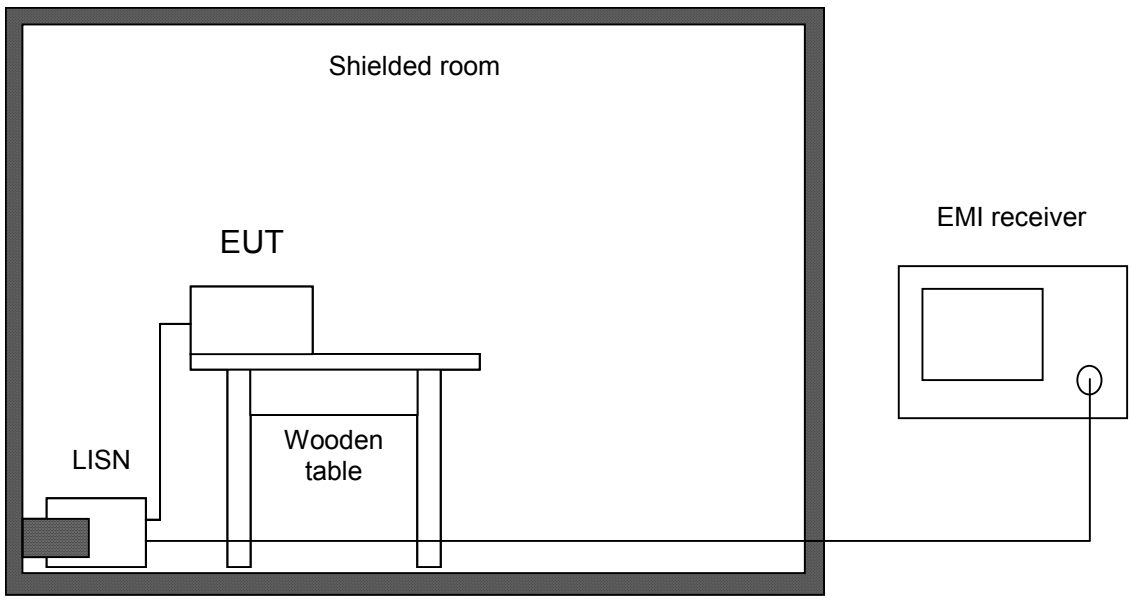
6.3 Conducted AC Powerline Emission

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, section 15.207 IC RSS-Gen Issue 3, section 7.2.4
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 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:

	Type	*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☒	Test receiver	ESHS 10	1028	860043/016	Rohde & Schwarz
☒	V-network	ESH 3-Z5	1059	894785/005	Rohde & Schwarz
☐	V-network	ESH 3-Z5	1218	830952/025	Rohde & Schwarz
☐	Artificial mains network	ESH 2-Z5	1536	842966/004	Rohde & Schwarz
☐	Shielded room	No. 1	1451	---	Albatross
☒	Shielded room	No. 4	1454	3FD 100 544	Euroshield

6.4 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-Gen Issue 3, sections 7.2.2 and 7.2.5
Guide:	ANSI C63.4

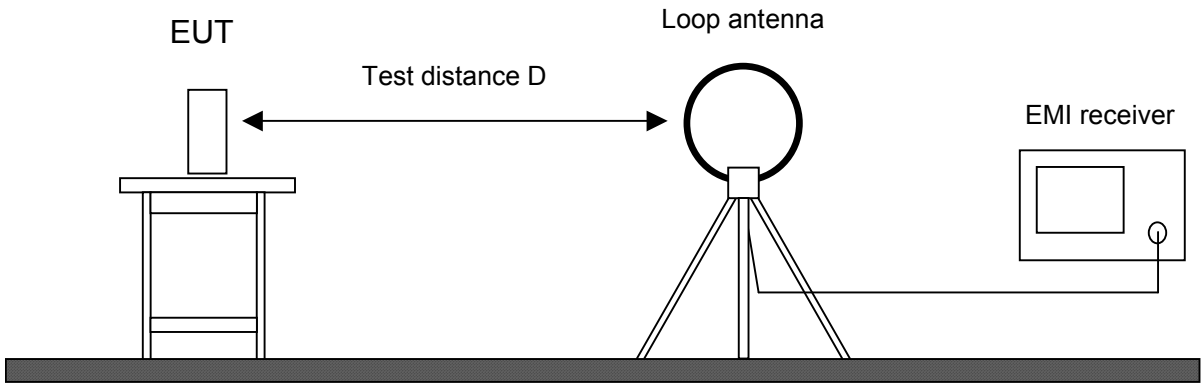
Radiated emission in the frequency range 9 kHz to 30 MHz is measured using an active loop antenna. First the whole spectrum of emission caused by the equipment is recorded at a distance of 3 meters in a fully or semi anechoic room with the detector of the spectrum analyzer or EMI receiver set to peak. 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.
If worst case emission of the EUT cannot be recorded with EUT in standard position and loop antenna in vertical polarization the EUT (or the radiating part of the EUT) is rotated by 90 degrees instead of changing the loop antenna to horizontal polarization. This procedure is selected to minimize the influence of the environment (e.g. effects caused by the floor especially with longer distances).

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 to 90 kHz and 110 to 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:

	Type		*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☒	Spectrum analyzer		FSP30	1666	100036	Rohde & Schwarz
☐	EMI test receiver		ESMI	1569	839379/013 839587/006	Rohde & Schwarz
☒	EMI test receiver		ESU8	2044	100232	Rohde & Schwarz
☐	Test receiver		ESHS 10	1028	860043/016	Rohde & Schwarz
☐	Preamplifier	Cabin no. 2	CPA9231A	1651	3393	Schaffner
☒	Loop antenna		HFH2-Z2	1016	882964/1	Rohde & Schwarz
☒	Fully anechoic room		No. 2	1452	---	Albatross
☐	Semi anechoic room		No. 3	1453	---	Siemens
☒	Semi anechoic room		No. 8	2057	---	Albatross

6.5 Radiated Emission at Alternative Test Site

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, section 15.209 IC RSS-Gen Issue 3, section 7.2.5
Guide:	ANSI C63.4

Radiated emission in the frequency range 30 MHz to 1 GHz is measured within a semi-anechoic room with groundplane complying with the NSA requirements of ANSI C63.4 for alternative test sites. A linear polarized logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna") is used. The measurement bandwidth of the test receiver is set to 120 kHz with quasi-peak detector selected.

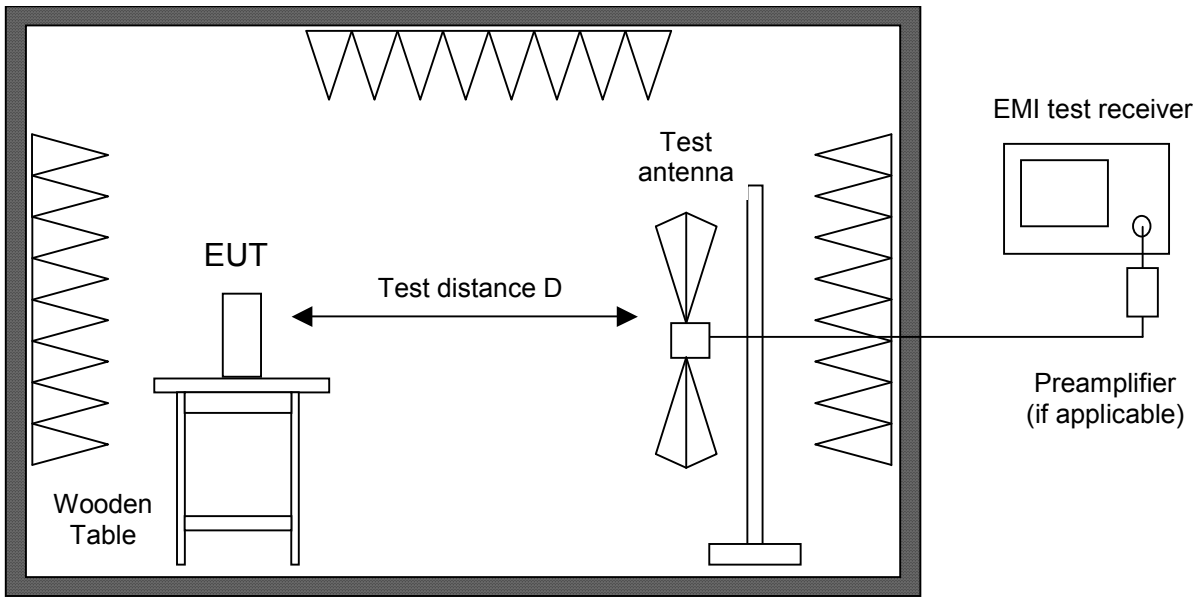
If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete 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 fully anechoic room.

If no prescan in a fully anechoic room is used first a peak scan is performed in four positions to get the whole spectrum of emission caused by EUT with the measuring antenna raised and lowered from 1 to 4 m to find table position, antenna height and antenna polarization for the maximum emission levels.
Data reduction is applied to these results to select those levels having less margin than 10 dB to or exceeding the limit using subranges and limited number of maximums. Further maximization is following.
With detector of the test receiver set to quasi-peak final measurements are performed immediately after frequency zoom (for drifting disturbances) and maximum adjustment.
Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

In cases where prescans in a fully anechoic room are taken (e. g. if EUT is operating for a short time only or battery is dircharged quickly) final measurements with quasi-peak detector are performed manually at frequencies indicated by prescan with EUT rotating all around and receiving antenna raising and lowering 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.



Alternate test site (semi anechoic room)

Test instruments used:

	Type		*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☒	EMI test receiver		ESU8	2044	100232	Rohde & Schwarz
☒	Trilog antenna	Cabin no. 8	VULB 9163	1802	9163-214	Schwarzbeck
☒	Semi anechoic room		No. 8	2057	---	Albatross

7 Photographs Taken During Testing

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Product Service

Test setup for conducted DC powerline emission measurement

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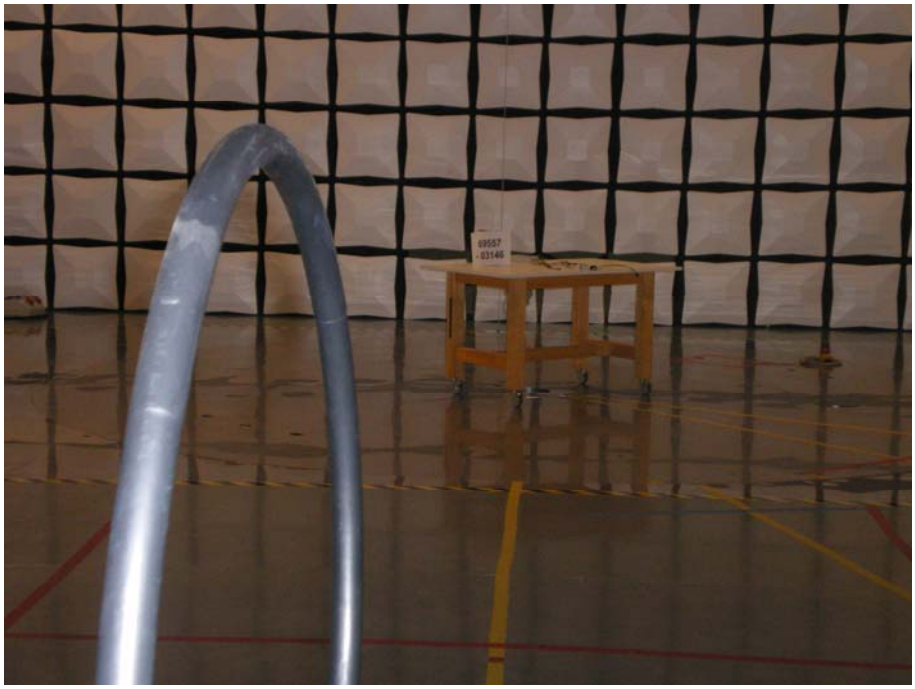
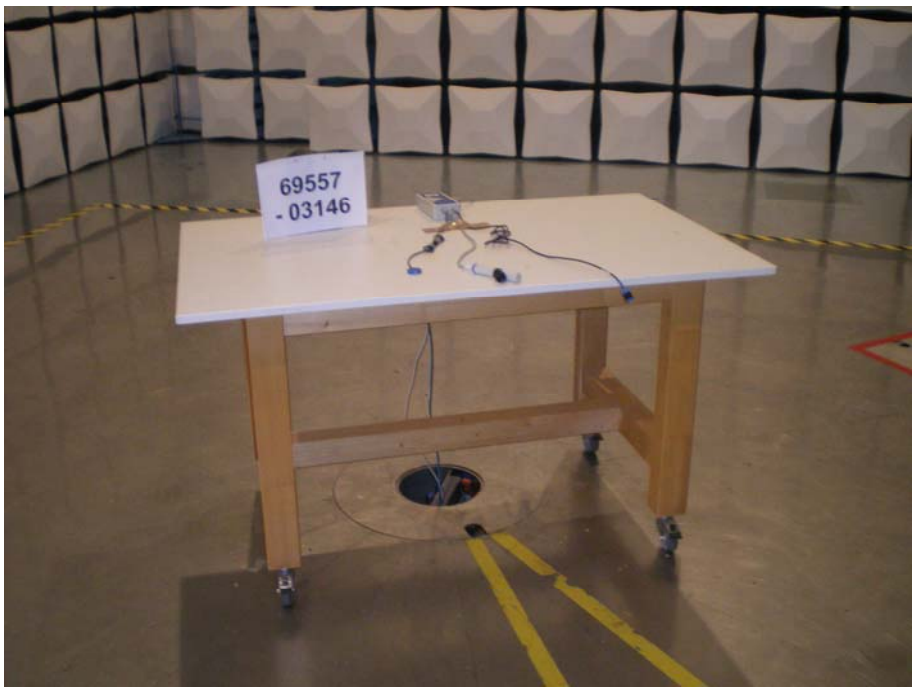
Fax: +49 9421 5522-99
Web: www.tuev-sued.de

Product Service

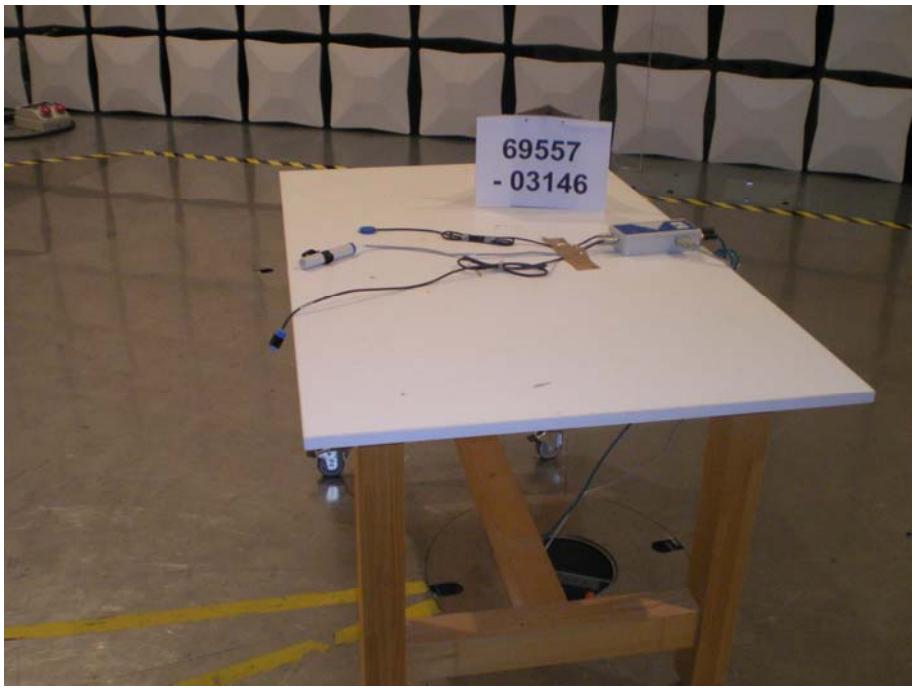
Test setup for radiated emission measurement 9 kHz – 30 MHz



Test setup for radiated emission measurement (alternate test site)



Test setup for radiated emission measurement (alternate test site) - continued -



8 Test Results

FCC CFR 47 Parts 2 and 15			
Section(s)	*Test*	*Page*	*Result*
2.1046(a)	Conducted output power	---	Not applicable
2.202(a)	Occupied bandwidth	23	Recorded
2.201, 2.202	Class of emission	29	Calculated
15.35(c)	Pulse train measurement for pulsed operation	30	Recorded
15.205(a)	Restricted bands of operation	32	Test passed
15.207	Conducted AC powerline emission 150 kHz to 30 MHz	---	Not applicable
15.207	Conducted DC powerline emission 150 kHz to 30 MHz	34	Test passed
15.205(b) 15.209	Radiated emission 9 kHz to 30 MHz	37	Test passed
15.205(b) 15.209	Radiated emission 30 MHz to 1 GHz	38	Test passed

IC RSS-GEN Issue 3			
Section(s)	*Test*	*Page*	*Result*
4.8	Transmitter output power (conducted)	---	Not applicable
4.6.1	Occupied Bandwidth	23	Recorded
8	Designation of emissions	29	Calculated
4.5	Pulsed operation	30	Recorded
7.2.4	Transmitter AC power lines conducted emissions 150 kHz to 30 MHz	---	Not applicable
7.2.4	Transmitter DC power lines conducted emissions 150 kHz to 30 MHz	34	Test passed
7.2.2	Restricted bands and unwanted emission frequencies	32	Test passed
7.2.2(b)(c) 7.2.5	Unwanted emissions 9 kHz to 30 MHz	37	Test passed
7.2.2(b)(c) 7.2.5	Unwanted emissions 30 MHz to 1 GHz	38	Test passed
5.6	Exposure of Humans to RF Fields	40	Exempted from SAR and RF evaluation

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:

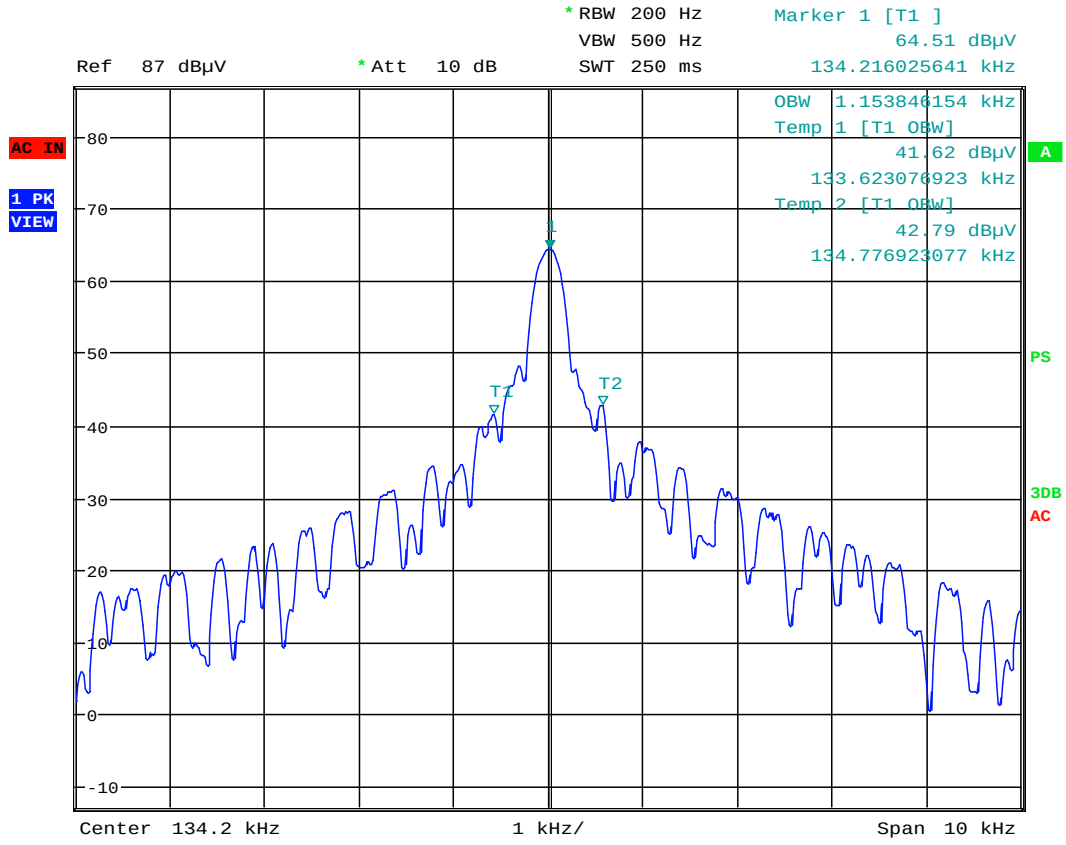
Fundamental frequency	Minimum resolution bandwidth
9 kHz to 30 MHz	1 kHz
30 MHz to 1000 MHz	10 kHz
1000 MHz to 40 GHz	100 kHz

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

Measurement procedure:	Bandwidth Measurements (6.1)

Comment:	
Date of test:	January 26, 2011
Test site:	Fully anechoic room, cabin no. 2

Occupied Bandwidth (99 %):



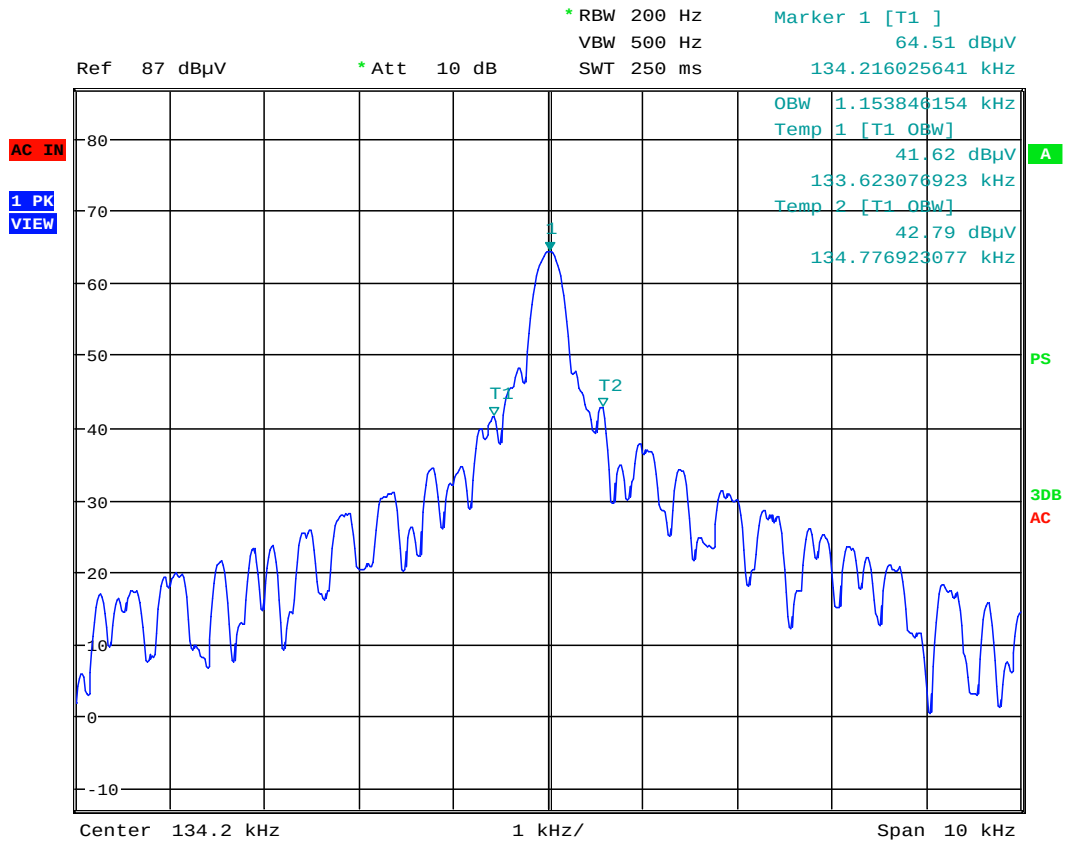
Occupied Bandwidth (99 %):	**1.154 kHz**

Occupied Bandwidth (continued)

Rules and specifications:	IC RSS-Gen Issue 3, section 4.6.1
Guide:	IC RSS-Gen Issue 3, section 4.6.1
Description:	If not specified in the applicable RSS the occupied bandwidth is measured as the 99% emission bandwidth. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is also recorded. The span between the two recorded frequencies is the occupied bandwidth.
Measurement procedure:	Bandwidth Measurements (6.1)

Comment:	
Date of test:	January 26, 2011
Test site:	Fully anechoic room, cabin no. 2

Occupied Bandwidth (99 %):



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Occupied Bandwidth (99 %):	**1.154 kHz**

8.2 Bandwidth of the Emission

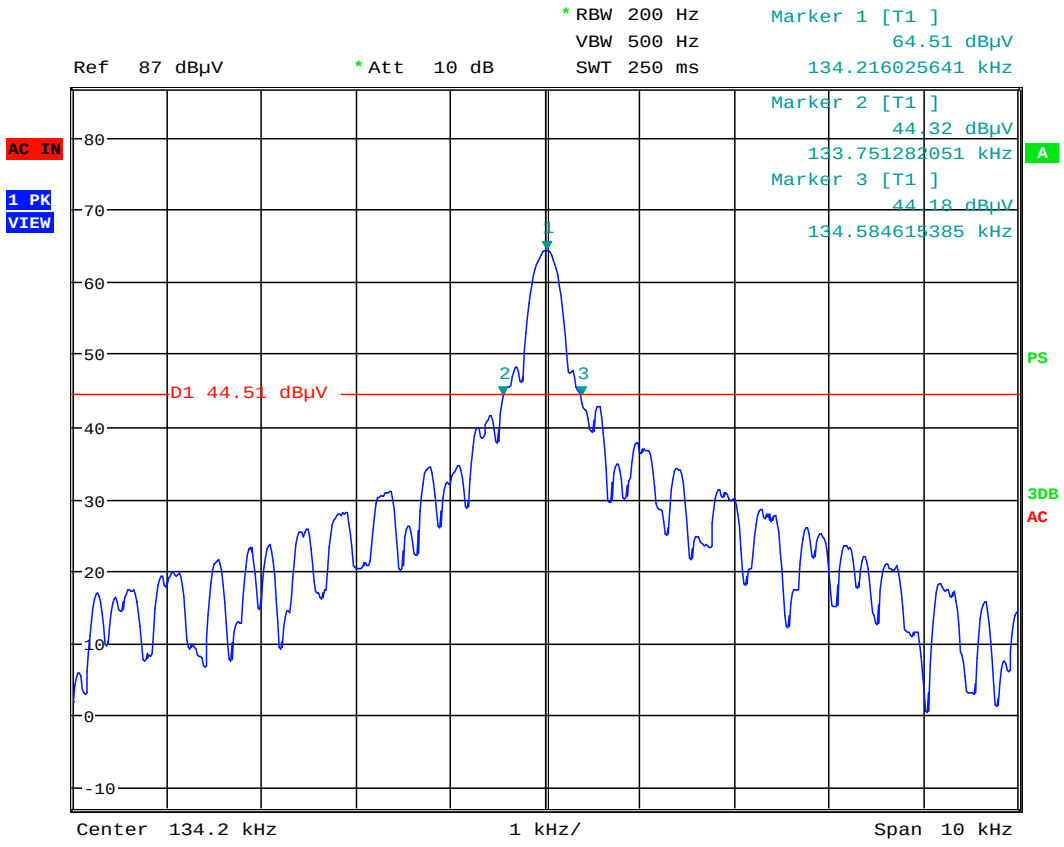
Rules and specifications:	CFR 47 Part 15, section 15.209 IC RSS-GEN Issue 3, section 7.2.5
Guide:	ANSI C63.4
Description:	The 20 dB bandwidth of the emission is measured as the frequency range defined by the points that are 20 dB down relative to the maximum level of the modulated carrier. For intentional radiators operating under the alternative provisions to the general emission limits the requirement to contain the 20 dB bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation. 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.

Measurement procedure:	Bandwidth Measurements (6.1)

Comment:	
Date of test:	January 26, 2011
Test site:	Fully anechoic room, cabin no. 2



Date: 26.JAN.2011 17:25:32

Bandwidth of the emission:	**0.83 kHz**

8.3 Designation of Emissions

Rules and specifications:	CFR 47 Part 2, sections 2.201 and 2.202 IC RSS-Gen Issue 3, sections 8
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:	$B_n = 2 \cdot (5\ kHz) \cdot 1 = 10\ kHz$

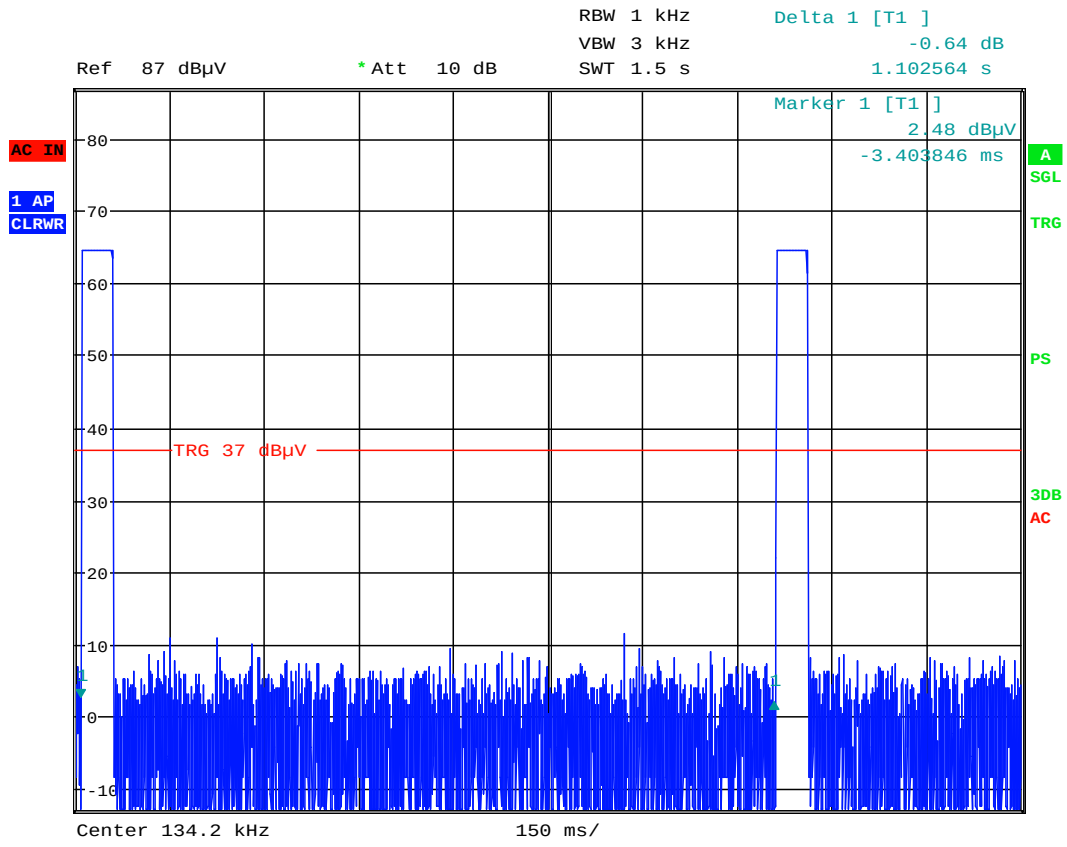
Designation of Emissions:	**10K0A1D**

8.4 Pulse Train Measurement

Rules and specifications:	CFR 47 Part 15, section 15.35(c) IC RSS-Gen Issue 3, section 4.5
Guide:	ANSI C63.4
Measurement procedure:	Pulse Train Measurement (6.2)

Comment:	
Date of test:	January 26, 2011
Test site:	Fully anechoic room, cabin no. 2

Total Pulse Train:



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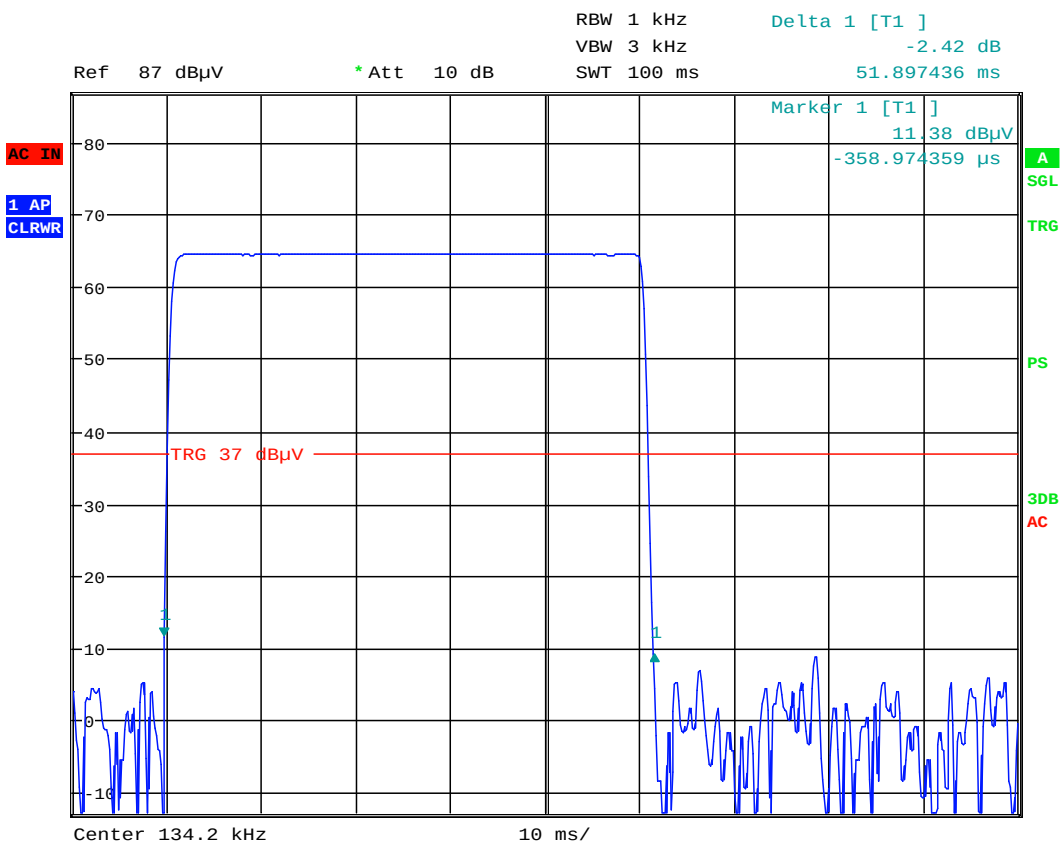
Worst case 0.1 second interval:



Date: 26.JAN.2011 17:22:56

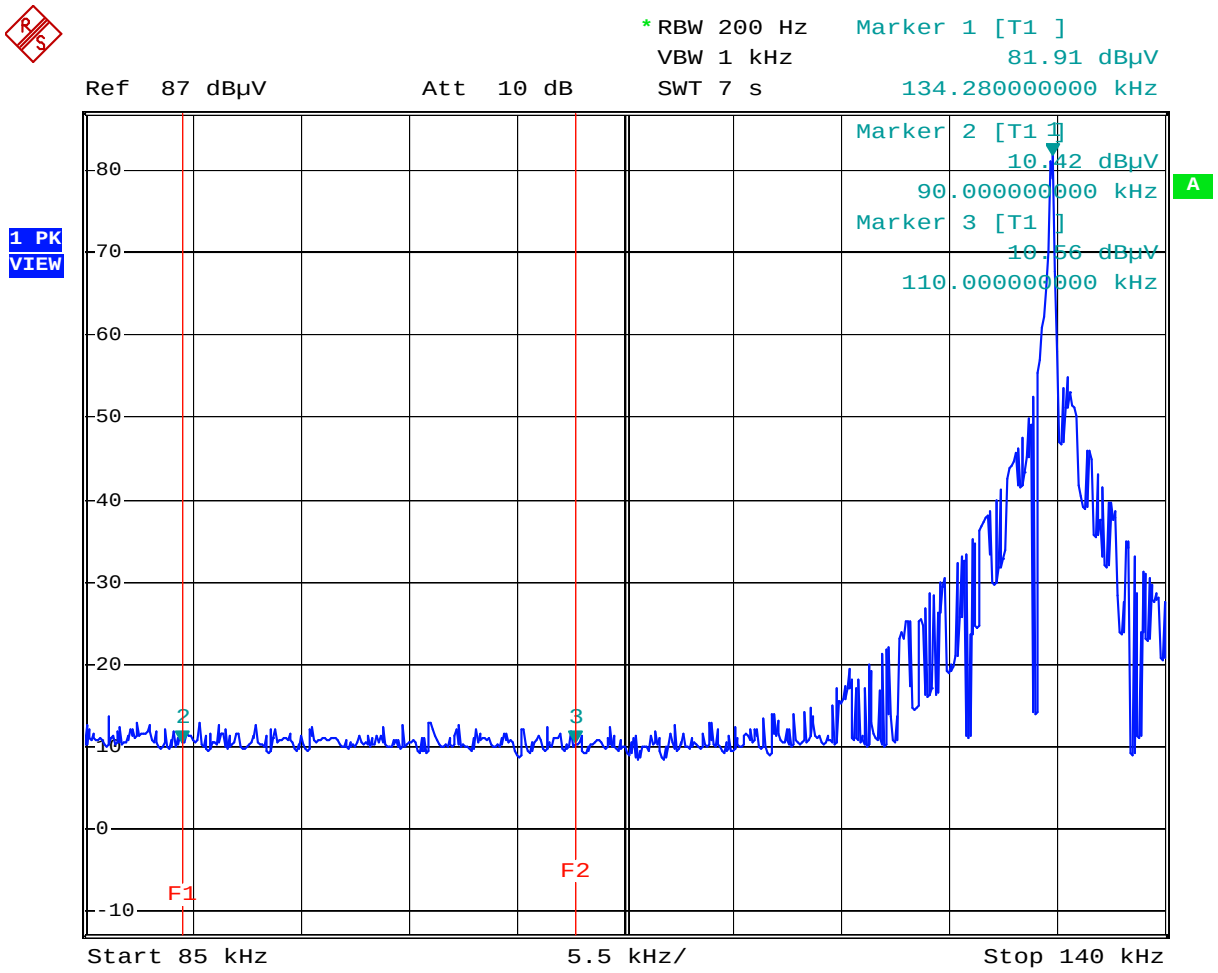
Calculation of pulse train correction:

TX-On-Time (worst case):	T_{on}	=	51.897 ms
Pulse Train Time:	T_{pt}	=	1.1 s
Period Time:	T_{period}	=	100 ms
Pulse Train Correction:	C_{pt}	=	$20 \cdot \text{Log}(T_{on} / T_{period})$ dB
		=	**-5.697 dB**

8.5 Restricted Bands of Operation

Rules and specifications:	CFR 47 Part 15, section 15.205(a) IC RSS-Gen Issue 3 section 7.2.2(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-Gen Issue 3 section 7.2.2(a)
Measurement procedure:	Radiated Emission Measurement 9 kHz to 30 MHz (6.4)

Comment:	
Date of test:	February 9, 2011
Test site:	Fully anechoic room, cabin no. 2
Test distance:	3 meters



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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-Gen Issue 3, section 7.2.4		
Guide:	ANSI C63.4 / CISPR 22		
Limit:	Frequency of Emission (MHz)	Conducted Limit (dBµV)	
		Quasi-peak	Average
	0.15 - 0.5 0.5 - 5 5 - 30	66 to 56 56 60	56 to 46 46 50
Measurement procedure:	Conducted AC Powerline Emission (6.3)		

Comment:	Test performed on DC port of EUT
Date of test:	January 27, 2011
Test site:	Shielded room, cabin no. 4

Test Result:	Test passed

Tested on:	PLUS

Frequency (MHz)	Detector	Reading Value (dBµV)	Correction Factor (dB)	Final Value (dBµV)	Limit (dBµV)	Margin (dB)
0.225	Quasi-Peak	42.4	0.0	42.4	62.6	20.2
0.270	Quasi-Peak	46.6	0.0	46.6	61.1	14.5
0.280	Average	31.6	0.0	31.6	50.8	19.2
0.295	Average	35.7	0.0	35.7	50.4	14.7
0.403	Quasi-Peak	51.9	0.0	51.9	57.8	5.9
0.403	Average	29.6	0.0	29.6	47.8	18.2
0.460	Quasi-Peak	38.1	0.0	38.1	56.7	18.6
0.498	Average	22.8	0.0	22.8	46.0	23.2
0.527	Average	29.1	0.0	29.1	46.0	16.9
0.545	Quasi-Peak	38.3	0.0	38.3	56.0	17.7
0.592	Average	29.6	0.0	29.6	46.0	16.4
0.670	Average	29.3	0.0	29.3	46.0	16.7
0.671	Quasi-Peak	48.0	0.0	48.0	56.0	8.0
0.845	Average	28.5	0.0	28.5	46.0	17.5
0.940	Quasi-Peak	40.2	0.0	40.2	56.0	15.8
1.080	Quasi-Peak	38.0	0.0	38.0	56.0	18.0
1.185	Average	34.8	0.0	34.8	46.0	11.2
1.345	Quasi-Peak	39.7	0.0	39.7	56.0	16.3
1.420	Average	29.0	0.0	29.0	46.0	17.0
1.775	Average	36.0	0.0	36.0	46.0	10.0
1.780	Quasi-Peak	39.2	0.0	39.2	56.0	16.8
1.930	Quasi-Peak	36.5	0.0	36.5	56.0	19.5
2.070	Average	32.9	0.0	32.9	46.0	13.1
2.415	Average	23.7	0.0	23.7	46.0	22.3
2.670	Quasi-Peak	37.2	0.0	37.2	56.0	18.8
3.255	Average	35.5	0.0	35.5	46.0	10.5
3.560	Quasi-Peak	38.8	0.0	38.8	56.0	17.2
3.675	Quasi-Peak	36.1	0.0	36.1	56.0	19.9
4.145	Average	34.5	0.0	34.5	46.0	11.5
4.735	Average	36.1	0.0	36.1	46.0	9.9
4.745	Quasi-Peak	37.4	0.0	37.4	56.0	18.6
6.230	Quasi-Peak	32.3	0.0	32.3	60.0	27.7
6.510	Average	38.4	0.0	38.4	50.0	11.6
7.710	Quasi-Peak	41.1	0.0	41.1	60.0	18.9
7.990	Average	40.9	0.0	40.9	50.0	9.1
10.060	Average	44.4	0.0	44.4	50.0	**5.6**
10.085	Quasi-Peak	39.0	0.0	39.0	60.0	21.0
10.940	Average	42.0	0.0	42.0	50.0	8.0
10.975	Quasi-Peak	33.7	0.0	33.7	60.0	26.3
13.050	Quasi-Peak	26.4	0.0	26.4	60.0	33.6
13.897	Average	33.7	0.0	33.7	50.0	16.3

Tested on:	MINUS

Frequency (MHz)	Detector	Reading Value (dBµV)	Correction Factor (dB)	Final Value (dBµV)	Limit (dBµV)	Margin (dB)
0,295	Quasi-Peak	41,4	0,0	41,4	60,4	19,0
0,295	Average	35,8	0,0	35,8	50,4	14,6
0,355	Quasi-Peak	44,9	0,0	44,9	58,9	14,0
0,403	Average	28,9	0,0	28,9	47,8	18,9
0,425	Average	27,4	0,0	27,4	47,3	19,9
0,436	Average	25,9	0,0	25,9	47,1	21,2
0,488	Quasi-Peak	46,0	0,0	46,0	56,2	10,2
0,545	Average	21,3	0,0	21,3	46,0	24,7
0,624	Quasi-Peak	44,3	0,0	44,3	56,0	11,7
0,808	Average	32,2	0,0	32,2	46,0	13,8
0,815	Quasi-Peak	39,7	0,0	39,7	56,0	16,3
0,890	Quasi-Peak	39,9	0,0	39,9	56,0	16,1
0,895	Average	24,7	0,0	24,7	46,0	21,3
1,135	Quasi-Peak	40,4	0,0	40,4	56,0	15,6
1,180	Average	35,3	0,0	35,3	46,0	10,7
1,380	Average	29,2	0,0	29,2	46,0	16,8
1,410	Quasi-Peak	38,0	0,0	38,0	56,0	18,0
1,770	Average	36,2	0,0	36,2	46,0	9,8
1,775	Quasi-Peak	40,3	0,0	40,3	56,0	15,7
2,000	Quasi-Peak	38,1	0,0	38,1	56,0	17,9
2,070	Average	33,1	0,0	33,1	46,0	12,9
2,660	Quasi-Peak	38,4	0,0	38,4	56,0	17,6
2,660	Average	36,3	0,0	36,3	46,0	9,7
3,385	Quasi-Peak	37,6	0,0	37,6	56,0	18,4
3,545	Average	34,1	0,0	34,1	46,0	11,9
3,630	Quasi-Peak	37,9	0,0	37,9	56,0	18,1
4,135	Average	37,9	0,0	37,9	46,0	8,1
4,725	Average	37,3	0,0	37,3	46,0	8,7
4,730	Quasi-Peak	38,3	0,0	38,3	56,0	17,7
5,615	Quasi-Peak	40,9	0,0	40,9	60,0	19,1
6,500	Average	39,5	0,0	39,5	50,0	10,5
7,090	Average	43,0	0,0	43,0	50,0	7,0
7,980	Quasi-Peak	44,4	0,0	44,4	60,0	15,6
8,570	Average	44,7	0,0	44,7	50,0	**5,3**
9,460	Quasi-Peak	47,2	0,0	47,2	60,0	12,8
10,640	Quasi-Peak	43,7	0,0	43,7	60,0	16,3
10,930	Average	41,6	0,0	41,6	50,0	8,4
13,000	Average	35,3	0,0	35,3	50,0	14,7

Sample calculation of final values:

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

8.7 Radiated Emission Measurement 9 kHz to 30 MHz

Rules and specifications:	CFR 47 Part 15, sections 15.205 and 15.209 IC RSS-GEN Issue 3, sections 7.2.2 and 7.2.5			
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
	Additionally, the level of any unwanted emissions shall not exceed the level of the fundamental emission.			
Measurement procedure:	Radiated Emission Measurement 9 kHz to 30 MHz (6.4)			

Comment:	
Date of test:	January 26, 2011
Test site:	Open field test site

Test Result:	Test passed

Extrapolation factor: -40 dB/decade

Frequency (MHz)	Detector	Distance d1 (m)	Distance d (m)	Reading Value (dBµV)	Correction Factor (dB/m)	Extrapolation Factor (dB)	Pulse Train Correction (dB)	Final Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
0.13420	Peak	10	300	64.5	20.0	-59.1	-5.7	19.7	25.0	**5.3**

Sample calculation of final values:

Extrapolation Factor (dB) = (Log(d) - Log(d_1)) · Extrapolation Factor (dB/decade)

Final Value (dBµV/m) = Reading Value d_1 (dBµV) + Correction Factor (dB/m) + Extrapolation Factor (dB) + Pulse Train Correction (dB)

Note: Extrapolation factor (dB) and final value (dBµV/m) are relating to distance d.

8.8 Radiated Emission Measurement 30 MHz to 1 GHz

Rules and specifications:	CFR 47 Part 15, section 15.209 IC RSS-GEN Issue 3, section 7.2.5		
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
	Additionally, the level of any unwanted emissions shall not exceed the level of the fundamental emission.		
Measurement procedures:	Radiated Emission at Alternative Test Site (6.5)		

Comment:	
Date of test:	January 26, 2011
Test site:	Frequencies ≤ 1 GHz: Semi-anechoic room, cabin no. 8
Test distance:	3 meters

Test Result:	Test passed

Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dBµV)	Correction Factor (dB/m)	Pulse Train Correction (dB)	Final Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30.840	vertical	Quasi-Peak	15.9	14.6		30.5	40.0	9.5
34.100	vertical	Quasi-Peak	18.5	14.5		33.0	40.0	7.0
77.220	horizontal	Quasi-Peak	22.9	10.2		33.1	40.0	6.9
81.500	vertical	Quasi-Peak	24.0	10.4		34.4	40.0	5.6
88.050	horizontal	Quasi-Peak	27.0	11.3		38.3	43.5	5.2
107.430	horizontal	Quasi-Peak	16.4	13.0		29.4	43.5	14.1
231.920	horizontal	Quasi-Peak	27.5	13.4		40.9	46.0	5.1
250.040	horizontal	Quasi-Peak	30.6	13.8		44.4	46.0	**1.6**
275.030	horizontal	Quasi-Peak	28.5	14.2		42.7	46.0	3.3
300.010	horizontal	Quasi-Peak	24.6	14.8		39.4	46.0	6.6
326.700	horizontal	Quasi-Peak	18.4	15.4		33.8	46.0	12.2
386.840	horizontal	Quasi-Peak	23.0	16.7		39.7	46.0	6.3
458.020	horizontal	Quasi-Peak	9.9	17.8		27.7	46.0	18.3
625.070	horizontal	Quasi-Peak	17.5	21.1		38.6	46.0	7.4

Sample calculation of final values:

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

8.9 Exposure of Humans to RF Fields

Rules and specifications:	IC RSS-Gen Issue 3, section 5.5
Guide:	IC RSS-102 Issue 4, section 2.5

Exposure of Humans to RF Fields	Applicable	Declared by applicant	Measured	Exemption
The antenna is				
☐ detachable				
The conducted output power (CP in watts) is measured at the antenna connector: CP = **..... W**			☐	
The effective isotropic radiated power (EIRP in watts) is calculated using				
☐ the numerical antenna gain: G = **.....** $EIRP = G \cdot CP \Rightarrow EIRP$ = **..... W**		☐		
☐ the field strength[5] in V/m: FS = **..... V/m**			☐	
$EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP$ = **..... W**				
with: Distance between the antennas in m: D = **..... m**			☐	
☒ not detachable				
A field strength measurement is used to determine the effective isotropic radiated power (EIRP in watts) given by[5]: $EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP$ = **939.5 µW**				
with: Field strength in V/m: FS = **16.79 µV/m** Distance between the two antennas in m: D = **10 m**			☒ ☒	
Selection of output power				
The output power TP is the higher of the conducted or effective isotropic radiated power (e.i.r.p.): TP = **939.5 µW**				

[5] The conversion formula is valid only for properly matched antennas. In other cases the transmitter output power may have to be measured by a terminated measurement when applying the exemption clauses.
If an open area test site is used for field strength measurement, the effect due to the metal ground reflecting plane should be subtracted from the maximum field strength value in order to reference it to free space, before calculating TP.

Exposure of Humans to RF Fields (continued)	Applicable	Declared by applicant	Measured	Exemption
Separation distance between the user and the transmitting device is				
☐ less than or equal to 20 cm ☒ greater than 20 cm		☒		
Transmitting device is				
☐ in the vicinity of the human head ☐ body-worn		☒		
SAR evaluation				
SAR evaluation is required if the separation distance between the user and the device is less than or equal to 20 cm.				
☐ The device operates from 3 kHz up to 1 GHz inclusively and with output power (i.e. the higher of the conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 200 mW for general public use and 1000 mW for controlled use.				☐
□;				
☐ The device operates above 1 GHz and up to 2.2 GHz inclusively and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 100 W for general public use and 500 W for controlled use.				☐
☐ The device operates above 2.2 GHz and up to 3 GHz inclusively and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 20 mW for general public use and 100 mW for controlled use.				☐
☐ The device operates above 3 GHz and up to 6 GHz inclusively and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 10 mW for general public use and 50 mW for controlled use.				☐
☐ SAR evaluation is documented in test report no.				
RF exposure evaluation				
RF exposure evaluation is required if the separation distance between the user and the device is greater than 20 cm.				
☒ The device operates below 1.5 GHz and the maximum e.i.r.p. of the device is equal to or less than 2.5 W.				☒
☐ The device operates at or above 1.5 GHz and the maximum e.i.r.p. of the device is equal to or less than 5 W.				☐
☐ RF exposure evaluation is documented in test report no.				

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 1, 2010
☒	CFR 47 Part 15	Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)	October 1, 2010
☒	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 3 containing General Requirements and Information for the Certification of Radiocommunication Equimpment, published by Industry Canada	December 2010
☒	RSS-210	Radio Standards Specification RSS-210 Issue 8 for Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, published by Industry Canada	December 2010
☐	RSS-310	Radio Standards Specification RSS-310 Issue 3 for Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category II Equipment, published by Industry Canada	December 2010
☒	RSS-102	Radio Standards Specification RSS-102 Issue 4: Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), published by Industry Canada	March 2010
☐	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

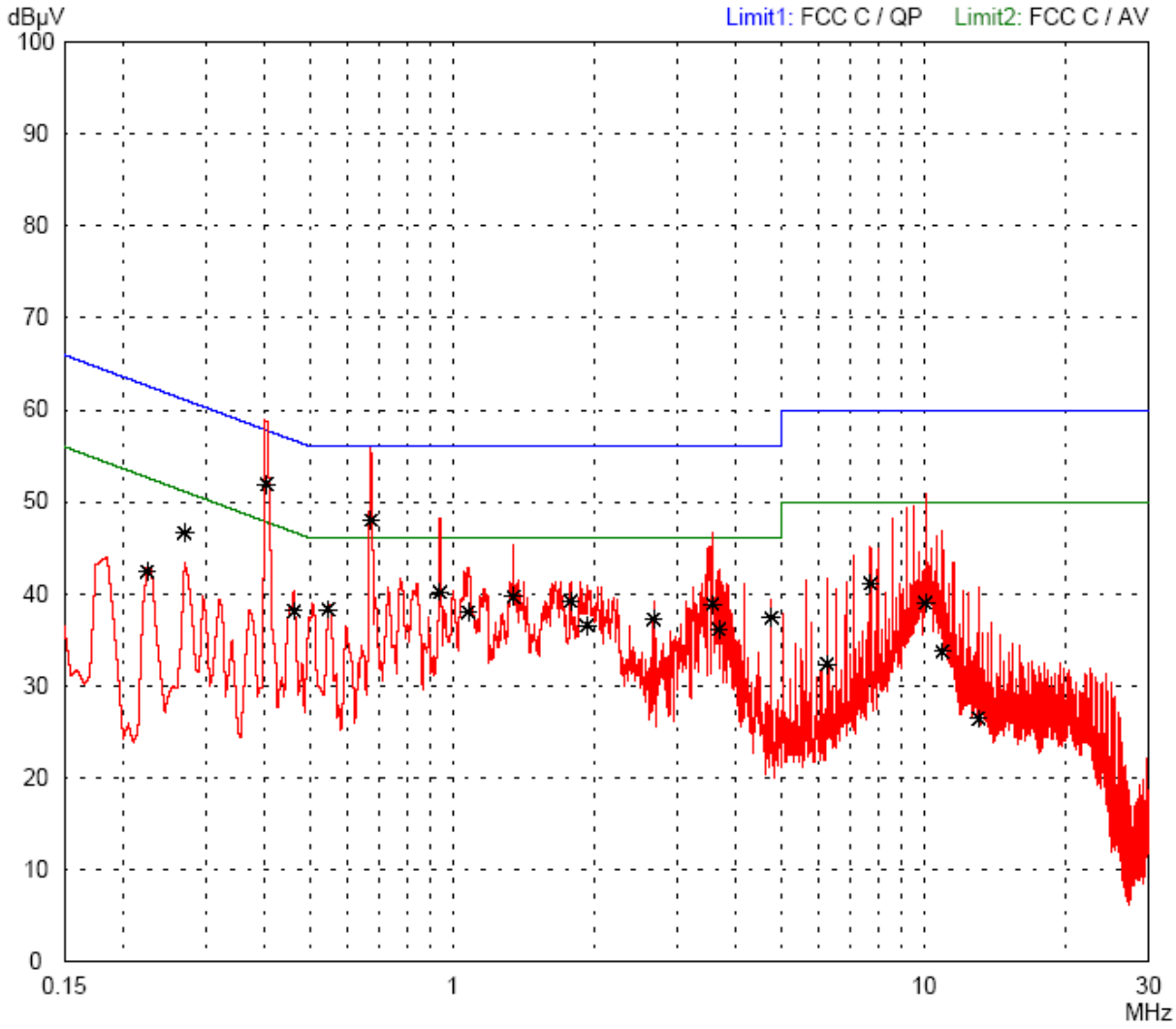
☐	CAN/CSA-CEI/IEC CISPR 22	Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment CAN/CSA CISPR 22-10 Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement (Adopted IEC CISPR 22:2008, sixth edition, 2008-09)	2002
☐	CAN/CSA CISPR 22-10	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement (Adopted IEC CISPR 22:2008, sixth edition, 2008-09)	2010
☒	TRC-43	Notes Regarding Designation of Emissions (Including Necessary Bandwidth and Classification), Class of Station and Nature of Service, published by Industry Canada	October, 2008

10 Revision History

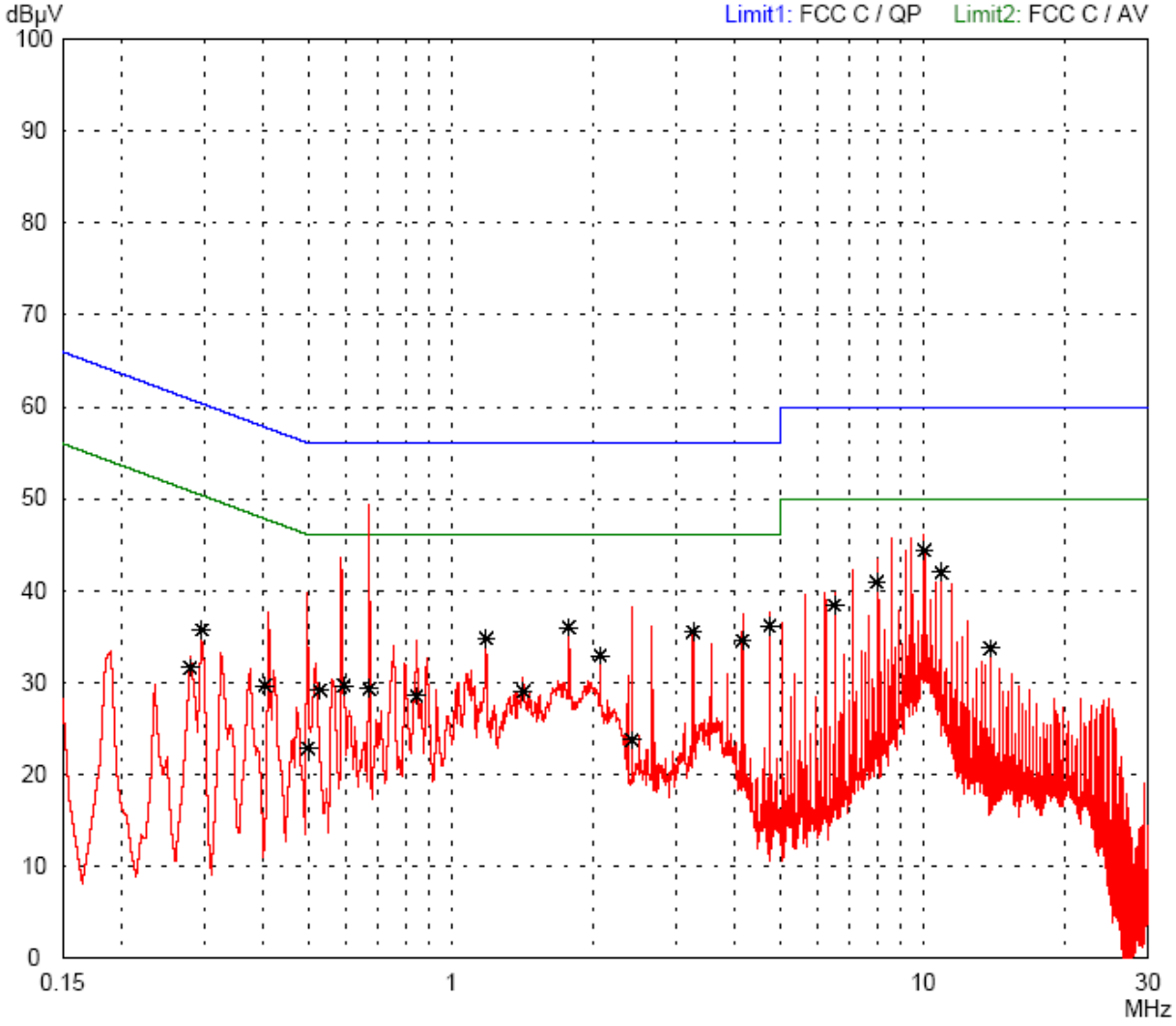
Revision History			
Edition	*Date*	*Issued by*	*Modifications*
1	08.02.11	M. Steindl (cj)	First Edition
2	26.07.2013	A. Weckmüller	Update

11 Charts taken during testing

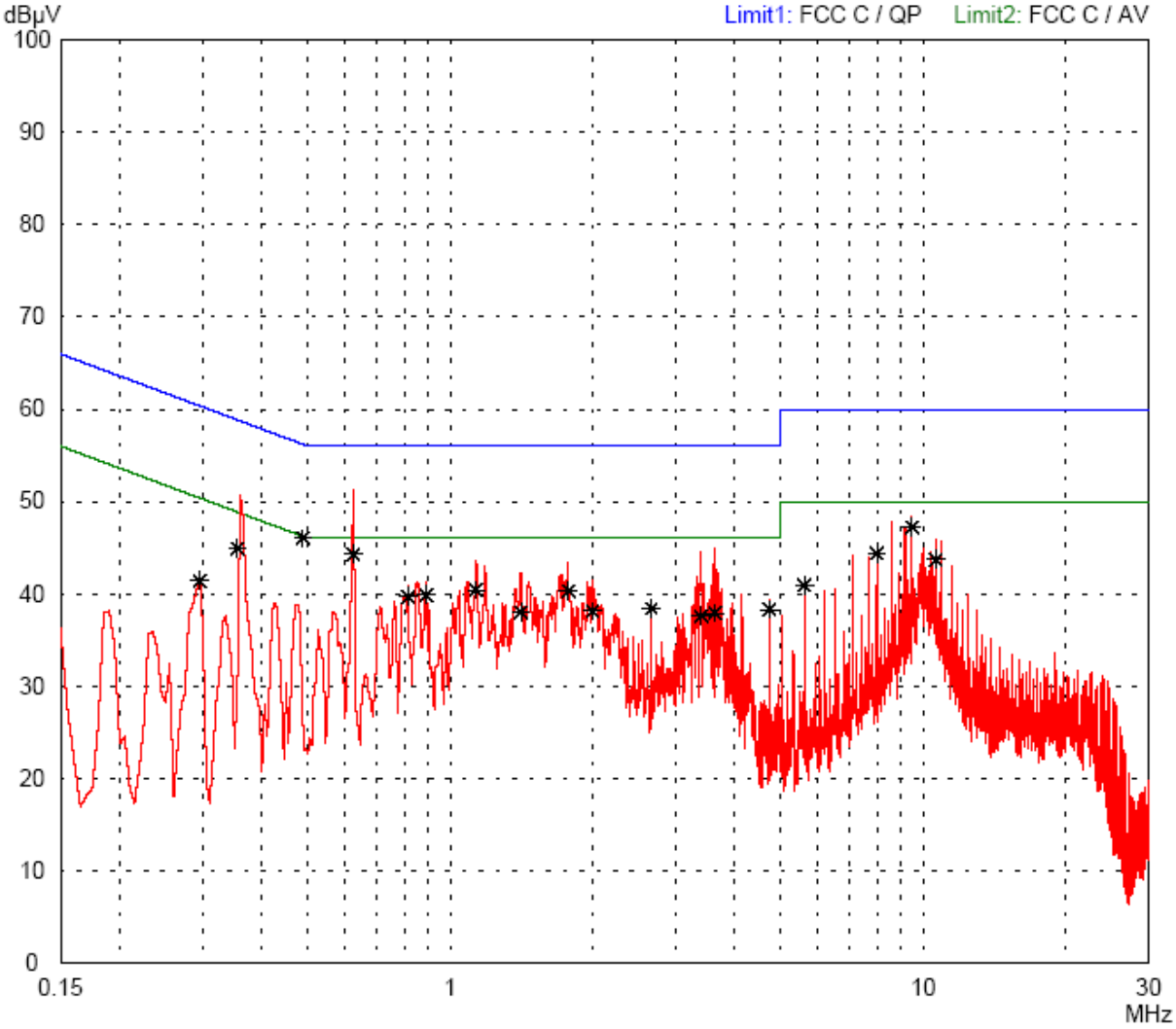
Model: LF80_RDC	Mode: - DC 24 V power supply - Reading tag continuously
Serial no.: ---	
Applicant: Brooks Automation GmbH	
Test site: Shielded room, cabin no. 4	
Tested on: Linecord PLUS	
Date of test: 01/27/2011 / Operator: M. Steindl	
Test performed: semi automatically / File name:	
Detector: Peak / Final Results: QP	Final results: 20 dB Margin 25 Subranges



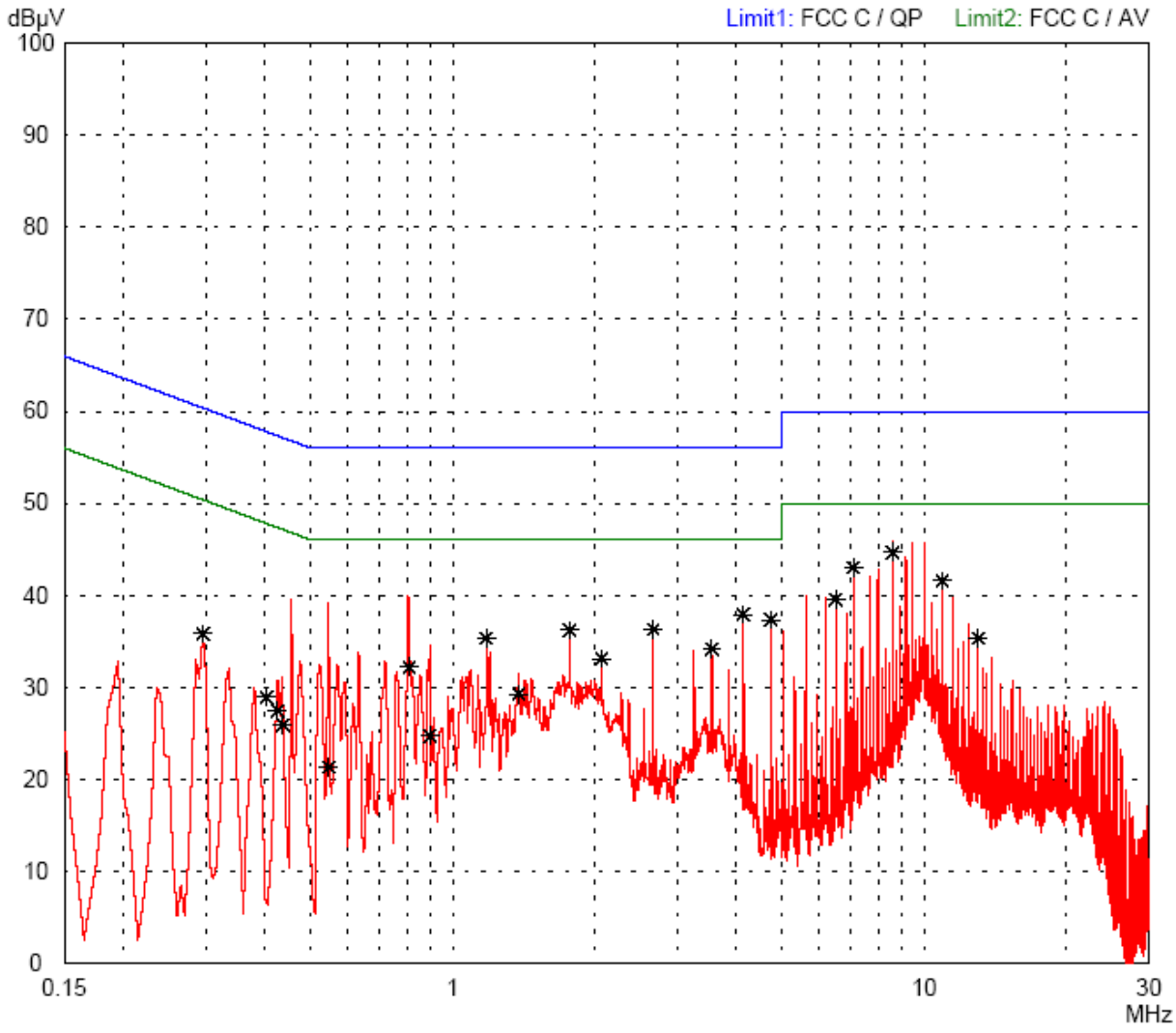
Model: LF80_RDC	Mode: - DC 24 V power supply - Reading tag continuously
Serial no.: ---	
Applicant: Brooks Automation GmbH	
Test site: Shielded room, cabin no. 4	
Tested on: Linecord PLUS	
Date of test: 01/27/2011 / Operator: M. Steindl	
Test performed: semi automatically / File name:	
Detector: Average / Final Results: AV	Final results: Selected by hand

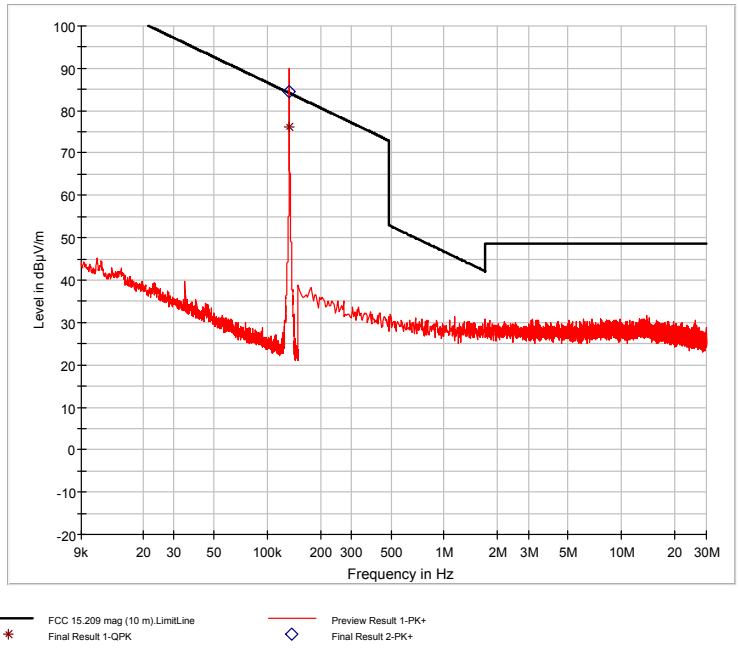


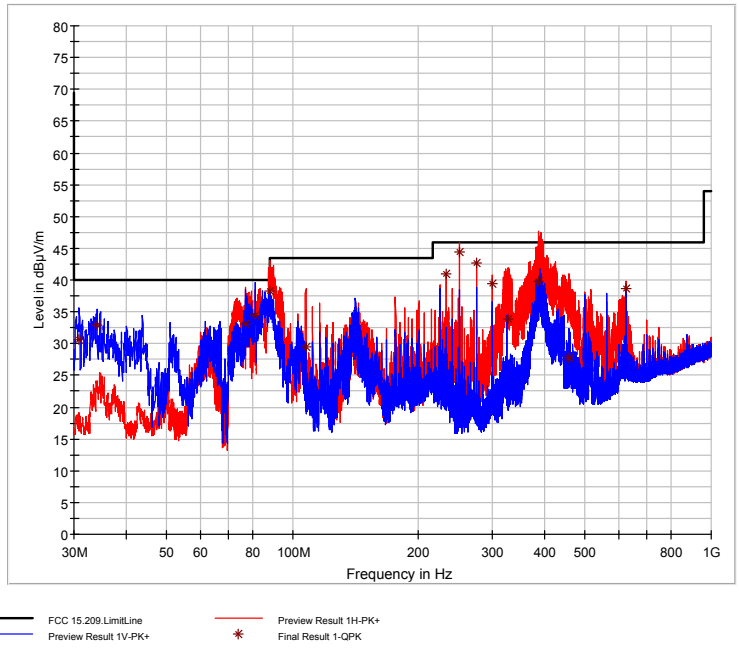
Model: LF80_RDC	Mode: - DC 24 V power supply - Reading tag continuously
Serial no.: ---	
Applicant: Brooks Automation GmbH	
Test site: Shielded room, cabin no. 4	
Tested on: Linecord DC 24 V MINUS	
Date of test: 01/27/2011 / Operator: M. Steindl	
Test performed: semi automatically / File name:	
Detector: Peak / Final Results: QP	Final results: 20 dB Margin 25 Subranges



Model: LF80_RDC	Mode: - DC 24 V power supply - Reading tag continuously
Serial no.: ---	
Applicant: Brooks Automation GmbH	
Test site: Shielded room, cabin no. 4	
Tested on: Linecord DC 24 V MINUS	
Date of test: 01/27/2011 / Operator: M. Steindl	
Test performed: semi automatically / File name:	
Detector: Average / Final Results: AV	Final results: Selected by hand




Level in dBµV/m
Frequency in Hz
FCC 15.209 mag (10 m).LimitLine
Final Result 1-QPK
Preview Result 1-PK+
Final Result 2-PK+


Level in dBµV/m
Frequency in Hz
FCC 15.209.LimitLine
Preview Result 1V-PK+
Preview Result 1H-PK+
Final Result 1-QPK

12 Calibration data

Test Equipment List with Calibration Data

Test report number(s): 69557-03146-1

Date of test:
02/2011

Type	*Inv.-No.*	*Type Designation*	*Serial Number*	*Manufacturer*	*Calibration Organization*	*Date of Calibration*	
						Last	*Next*
EMI test receiver	1028	ESHS10	860043/016	Rohde & Schwarz	Rohde & Schwarz	10/2010	04/2012
EMI test receiver	2044	ESU8	100232	Rohde & Schwarz	Rohde & Schwarz	12/2010	06/2012
V-network	1059	ESH3-Z5	894785/005	Rohde & Schwarz	Rohde & Schwarz	11/2010	11/2012
Loop antenna	1016	HFH2-Z2	882964/0001	Rohde & Schwarz	Rohde & Schwarz	09/2009	03/2011
TRILOG Broadband Antenna	1802	VULB 9163	9163-214	Schwarzbeck	Schwarzbeck	11/2009	05/2011

Note: Date of next calibration contains maximum tolerance if applicable.