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October 16, 2015

Prüfbericht / *Test Report* Nr. / *No.* 5010209774-29641-1 (Edition 3)

Applicant:	Agrident GmbH
Type of equipment:	Handheld RFID Reader
Type designation:	APR500 BT
Order No.:	Verbal order
Test standards:	FCC Code of Federal Regulations, CFR 47, Part 15, Subpart C Sections 15.205, 15.207 and 15.209 Industry Canada Radio Standards Specifications RSS-GEN Issue 4, Sections 8.8, 8.9 and 8.10

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]:	APR500 BT
Serial number(s):	Protoype
Manufacturer:	Agrident GmbH
Type of equipment:	Handheld RFID Reader
Version:	--
FCC ID:	QG2APR500
Industry Canada ID:	6252A-APR500
Additional parts/accessories:	--

Technical data of EUT			
Application frequency range:	N/A		
Frequency range:	N/A		
Operating frequency:	134.2 kHz		
Type of modulation:	ASK		
Pulse train:	N/A		
Pulse width:	N/A		
Number of RF-channels:	1		
Channel spacing:	Wideband		
Designation of emissions[2]:	**9K6A1D**		
Type of antenna:	Internal/fix connected External (AEA 580)	0 dBi Gain 0 dBi Gain	50 Ohms impedance 50 Ohms impedance
Size/length of antenna:	Ferrite rod		
Connection of antenna:	☒ detachable	☐ not detachable	
Type of power supply:	AC supply		
Specifications for power supply:	nominal voltage: minimum voltage: maximum voltage: nominal frequency:	100 - 240 V 100 V 240 V 50/60 Hz	

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

2 Administrative Data

Application details	
Applicant (full address):	Agrident GmbH Steinklippenstrasse 10 30890 Barsinghausen / Germany
Contact person:	Torsten Bade
Order number:	Verbal order
Receipt of EUT:	20 August 2014
Date(s) of test:	6 October 2015
Note(s):	--

Report details	
Report number:	5010209774-29641-1
Edition:	3
Issue date:	16 October 2015

3 Identification of the Test Laboratory

Details of the Test Laboratory	
Company name:	TÜV SÜD Product Service GmbH
Address:	Aeussere Fruehlingstrasse 45 D-94315 Straubing Germany
Laboratory accreditation:	DAkkS Registration No. D-PL-11321-11-01
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: General Requirements for Compliance of Radio Apparatus RSS-GEN Issue 4, Sections 8.3, 8.8, 8.9 and 8.10** of Industry Canada (IC).

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

5 Operation Mode and Configuration of EUT

Operation Mode(s)
Continously reading a transponder

Configuration(s) of EUT
Unit in docking cradle, power supply via external AC adapter

List of ports and cables

Port	*Description*	*Classification*[3]	*Cable type*	*Cable length*
1	AC port of AC adapter	dc power	Unshielded	---
2	USB port	signal/control port	Shielded	3 m
3	External antenna	signal/control port	Shielded	1.2 m

List of devices connected to EUT

Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*
1	AC adapter	SF08-050100UX	A20130400096325	Agrident
2	External antenna	AEA 580	000517	Adrident
3	RF TAG	--	--	Agrident
4	Docking cradle	ADS500	7184401117	Agrident

List of support devices

Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*
1	None			
2				
3				
4				

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

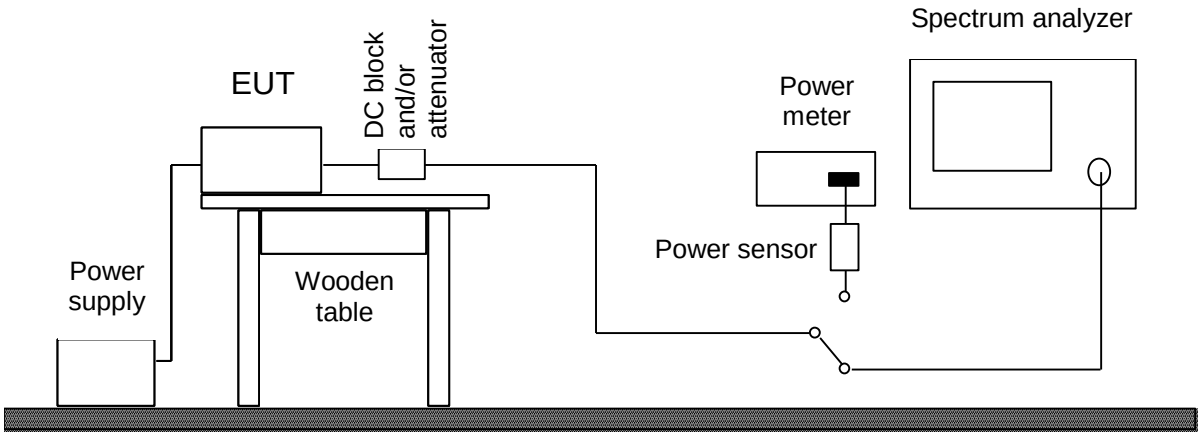
6 Measurement Procedures

6.1 Conducted Output Power

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 2, section 2.1046(a) IC RSS-Gen Issue 4, section 6.12
Guide:	CFR 47 Part 2, section 2.1046 / IC RSS-Gen Issue 4

Conducted output power is measured at the RF output terminals (e.g. antenna connector if antenna is detachable) when the transmitter is adjusted in accordance with the tune-up procedure, if applicable. The RF output terminals are connected to a spectrum analyzer and/or a power meter with appropriate sensor. 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 a spectrum analyzer is used and no other settings are specified resolution bandwidth shall be selected according to the carrier frequency f_c and set to 10 kHz (150 kHz $\leq f_c <$ 30 MHz), 100 kHz (30 MHz $\leq f_c <$ 1 GHz) or 1 MHz ($f_c \geq$ 1 GHz). The video bandwidth shall be at least three times greater than the resolution bandwidth. The settings used have to be indicated within the appropriate test record(s).

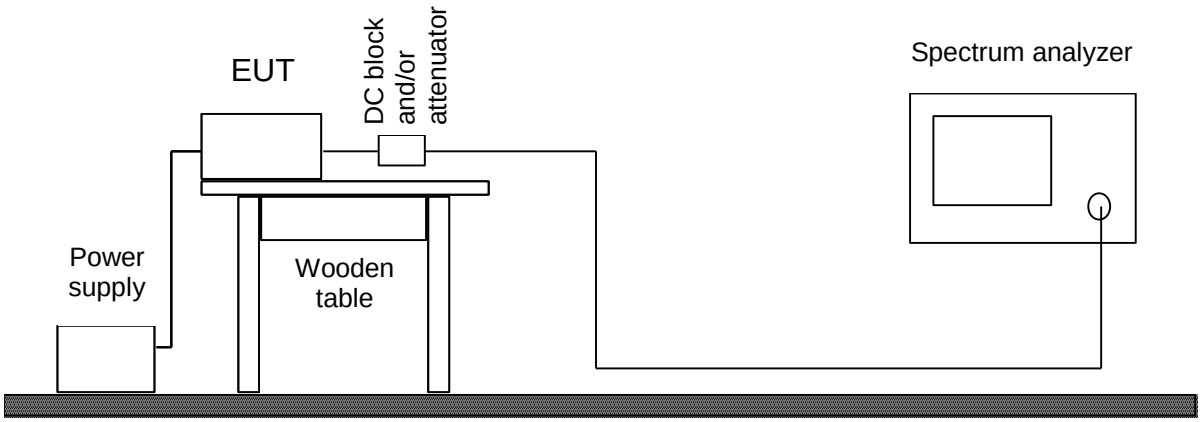


Test instruments used:

	Type	*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☒	Spectrum analyzer	FSP30	1666	100063	Rohde & Schwarz
☐	EMI test receiver	ESPI7	1711	836914/0002	Rohde & Schwarz
☐	EMI test receiver	ESMI	1569	839379/013 839587/006	Rohde & Schwarz
☐	Power meter	NRVS	1264	836856/015	Rohde & Schwarz
☐	Peak power sensor	NRV-Z31	1701	8579604.03	Rohde & Schwarz
☐	Power sensor	NRV-Z52	1499	837901/030	Rohde & Schwarz
☐	Power sensor	NRV-Z4	1034	863828/015	Rohde & Schwarz
☐	DC-block	7006	1636	A2798	Weinschel
☐	Attenuator	4776-10	1638	9412	Narda
☐	Attenuator	4776-20	1639	9503	Narda

6.2 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 4, section 6.6 IC RSS-210 Issue 8, section A1.1.3 ANSI C63.10, section 6.9.1
Guide:	ANSI C63.10 / IC RSS-Gen Issue 4, section 6.6
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).	



Test instruments used for conducted measurements:

	Type	*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☐	Spectrum analyzer	FSP30	1666	100036	Rohde & Schwarz
☐	EMI test receiver	ESPI7	1711	836914/0002	Rohde & Schwarz
☐	EMI test receiver	ESMI	1569	839379/013 839587/006	Rohde & Schwarz
☐	Power meter	NRVS	1264	836856/015	Rohde & Schwarz
☐	Peak power sensor	NRV-Z31	1701	8579604.03	Rohde & Schwarz
☐	Power sensor	NRV-Z52	1499	837901/030	Rohde & Schwarz
☐	Power sensor	NRV-Z4	1034	863828/015	Rohde & Schwarz
☐	DC-block	7006	1636	A2798	Weinschel
☐	Attenuator	4776-10	1638	9412	Narda
☐	Attenuator	4776-20	1639	9503	Narda

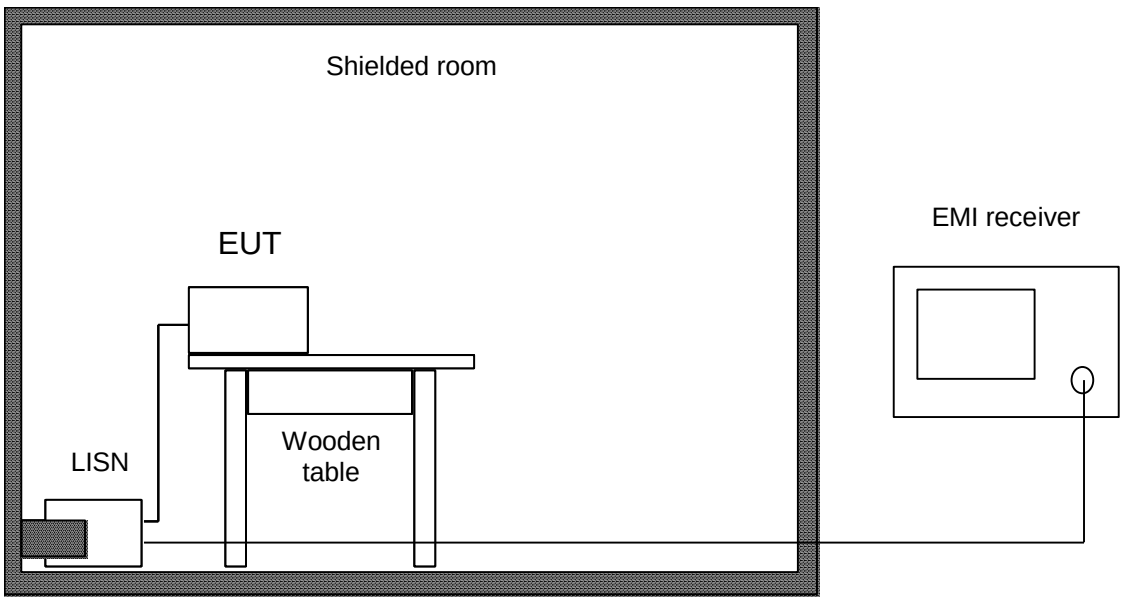
6.3 Conducted AC Powerline Emission

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, section 15.207 IC RSS-Gen Issue 4, section 8.8
Guide:	ANSI C63.10 / 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 C63.10, 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 4, sections 8.9 and 8.10
Guide:	ANSI C63.10

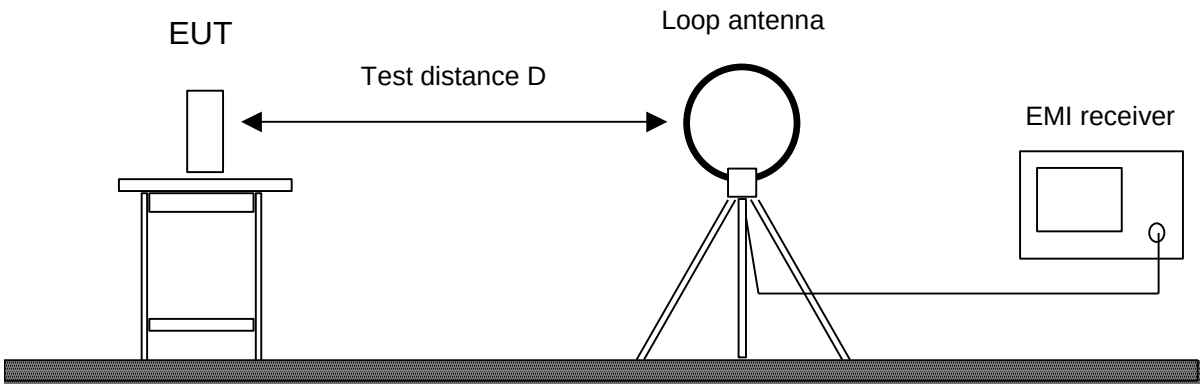
Radiated emission in the frequency range 9 kHz to 30 MHz is measured using an active loop antenna. First the whole spectrum of emission caused by the equipment is recorded at a distance of 3 meters in a fully or semi anechoic room with the detector of the spectrum analyzer or EMI receiver set to peak. 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
☐	Test receiver		ESHS 10	1028	860043/016	Rohde & Schwarz
☐	Preamplifier	Cabin no. 2	CPA9231A	1716	3557	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 in Fully or Semi Anechoic Room

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, section 15.209 IC RSS-GEN Issue 4, section 8.9
Guide:	ANSI C63.10

Radiated emission in fully or semi 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 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.

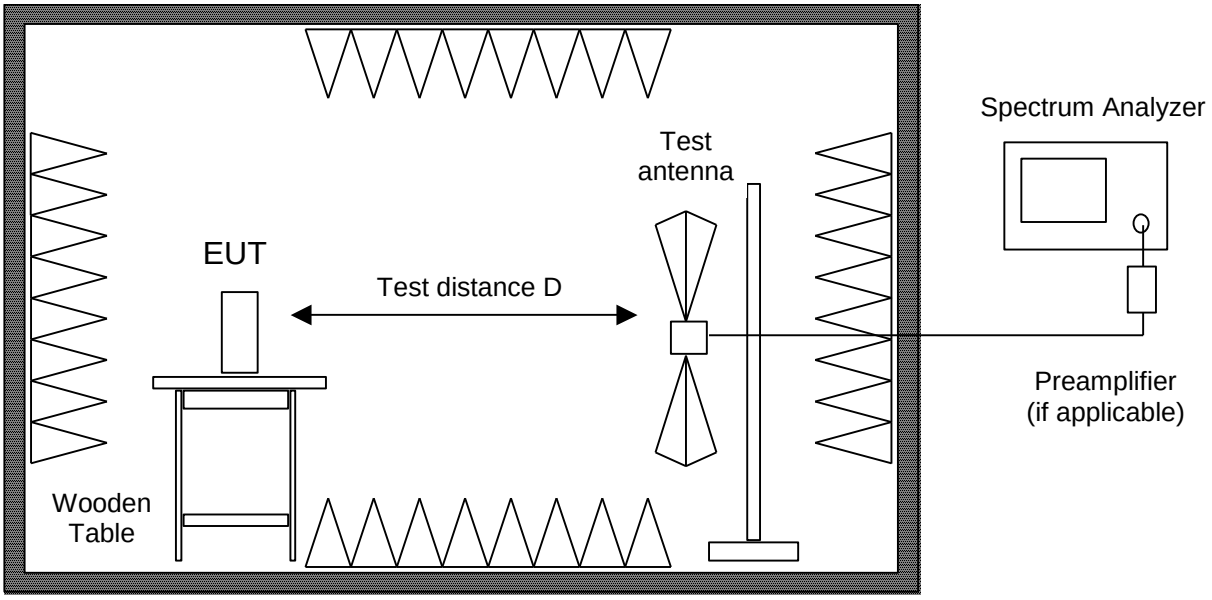
All tests below 8.2 GHz are performed at a test distance D of 3 meters. For higher frequencies the test distance may be reduced (e.g. to 1 meter) due to the sensitivity of the measuring instrument(s) and the test results are calculated according to CFR 47 Part 15 section 15.31(f)(1) using an extrapolation 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 a semi anechoic room complying with the NSA requirements of ANSI C63.10 for alternative test sites is used (see 6.6). If prescans are recorded in fully anechoic room they are indicated appropriately.



Fully or semi anechoic room

Test instruments used:

	Type		Designation	Inv.-no.	Serial No. or ID	Manufacturer
☐	Spectrum analyzer		FSP30	1666	100036	Rohde & Schwarz
☐	EMI test receiver	Cabin no. 3	ESPI7	2010	101018	Rohde & Schwarz
☒	EMI test receiver		ESU8	2044	100232	Rohde & Schwarz
☐	EMI test receiver		ESMI	1569	839379/013 839587/006	Rohde & Schwarz
☐	Preamplifier	Cabin no. 2	CPA9231A	1716	3557	Schaffner
☐	Preamplifier		R14601	1142	13120026	Advantest
☐	Preamplifier (1 - 8 GHz)		AFS3-00100800-32-LN	1684	847743	Miteq
☐	Preamplifier (0.5 - 8 GHz)		AMF-4D-005080-25-13P	1685	860149	Miteq
☐	Preamplifier (8 - 18 GHz)		ACO/180-3530	1484	32641	CTT
☐	External Mixer		WM782A	1576	845881/005	Tektronix
☐	Harmonic Mixer Accessories		FS-Z30	1577	624413/003	Rohde & Schwarz
☐	Trilog antenna	Cabin no. 2	VULB 9163	1802	9163-214	Schwarzbeck
☐	Trilog antenna	Cabin no. 3	VULB 9163	1722	9163-188	Schwarzbeck
☒	Trilog antenna	Cabin no. 8	VULB 9163	2058	9163-408	Schwarzbeck
☐	Horn antenna		3115	1516	9508-4553	EMCO
☐	Horn antenna		3160-03	1010	9112-1003	EMCO
☐	Horn antenna		3160-04	1011	9112-1001	EMCO
☐	Horn antenna		3160-05	1012	9112-1001	EMCO
☐	Horn antenna		3160-06	1013	9112-1001	EMCO
☐	Horn antenna		3160-07	1014	9112-1008	EMCO
☐	Horn antenna		3160-08	1015	9112-1002	EMCO
☐	Horn antenna		3160-09	1265	9403-1025	EMCO
☐	Horn antenna		3160-10	1575	399185	EMCO
☐	Fully anechoic room		No. 2	1452	---	Albatross
☐	Semi anechoic room		No. 3	1453	---	Siemens
☒	Semi anechoic room		No. 8	2057	---	Albatross

6.6 Radiated Emission at Alternative Test Site

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, section 15.209 IC RSS-GEN Issue 4, sections 8.10(b)(c) and 8.9
Guide:	ANSI C63.10

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 C63.10 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.

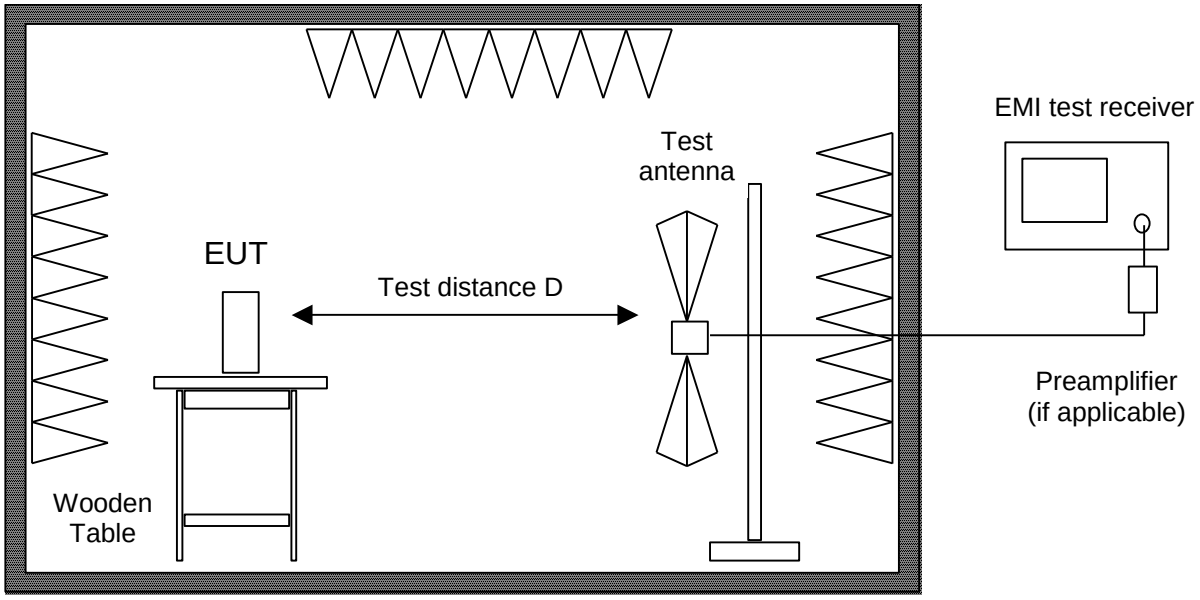
If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete 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	2058	9163-408	Schwarzbeck
☒	Semi anechoic room		No. 8	2057	---	Albatross

7 Photographs Taken During Testing

8 Test Results

FCC CFR 47 Parts 2 and 15			
Section(s)	*Test*	*Page*	*Result*
15.203	*Antenna requirement*	27	*Test passed*
2.1046(a)	Conducted output power	---	Recorded
2.202(a)	Occupied bandwidth	29	Recorded
2.201, 2.202	Class of emission	36	Calculated
15.35(c)	Pulse train measurement for pulsed operation	---	Not applicable
15.205(a)	Restricted bands of operation	37	Test passed
15.207	Conducted AC powerline emission 150 kHz to 30 MHz	38	Test passed
15.205(b) 15.209	Radiated emission 9 kHz to 30 MHz	41	Test passed
15.205(b) 15.209	Radiated emission 30 MHz to 1 GHz	43	Test passed

IC RSS-GEN Issue 4			
Section(s)	*Test*	*Page*	*Result*
8.3	Transmitter Antenna for Licence-Exempt Radio Apparatus		
6.12	Transmitter output power (conducted)	---	Recorded
6.6	Occupied Bandwidth	29	Recorded
8	Designation of emissions	36	Calculated
8.8	Transmitter AC power lines conducted emissions 150 kHz to 30 MHz	38	Test passed
8.10	Restricted bands and unwanted emission frequencies	37	Test passed
8.9	Unwanted emissions 9 kHz to 30 MHz	41	Test passed
8.9	Unwanted emissions 30 MHz to 1 GHz	43	Test passed
---	Exposure of Humans to RF Fields	45	Exempted from SAR and RF evaluation

8.1 Antenna requirement

Rules and specifications:	CFR 47 Part 2, section 15.203 IC RSS-Gen Issue 4, section 8.3
Guide :	N/A
Description :	An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded

Type of antenna connector:	Industrial 8-pin multi-contact connector

Result:	**This antenna connector meets the requirements for unique coupling according to section 15.203 of the FCC Rules.**

8.2 Occupied Bandwidth

Rules and specifications:	CFR 47 Part 2, section 2.202(a) ANSI C63.10, section 6.9.1
Guide:	ANSI C63.10
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 C63.10; 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:

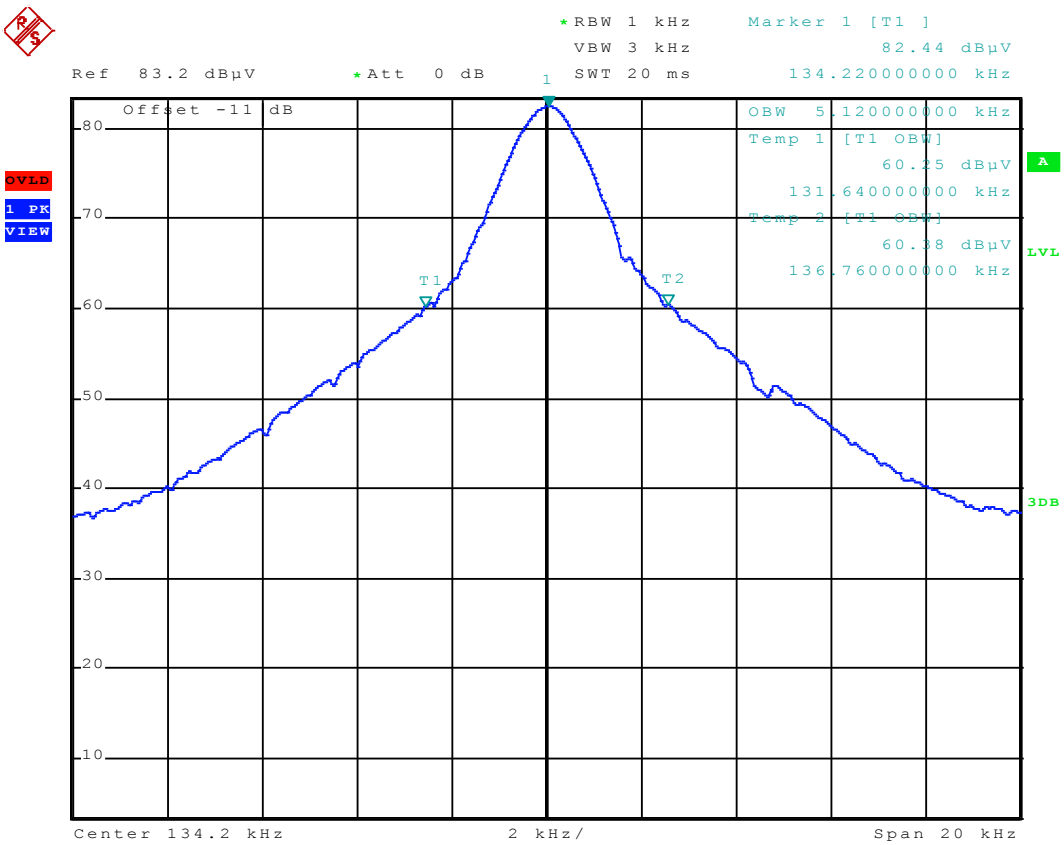
Fundamental frequency	Minimum resolution bandwidth
9 kHz to 30 MHz	1 kHz
30 MHz to 1000 MHz	10 kHz
1000 MHz to 40 GHz	100 kHz

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

Measurement procedure:	Bandwidth Measurements (6.2)

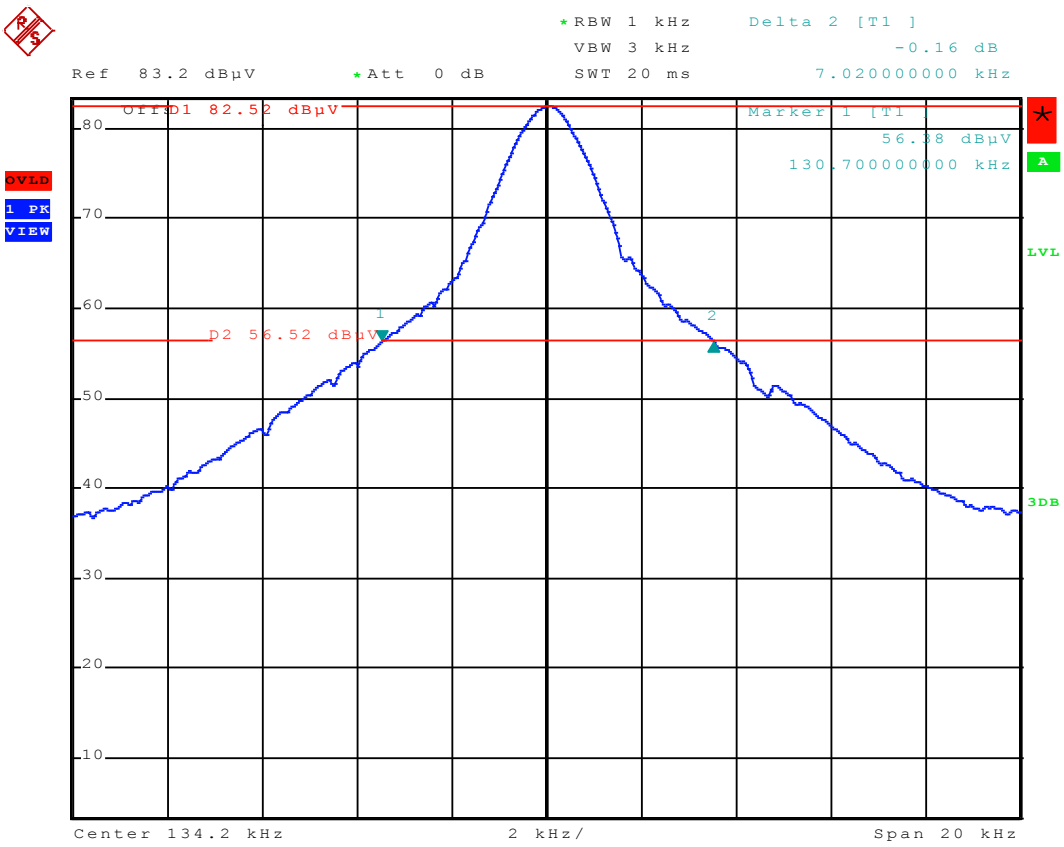
Comment:	
Date of test:	6 October 2015
Test site:	Fully anechoic room, cabin no. 2

Occupied Bandwidth (99 %):



Occupied Bandwidth (99 %):	**5.12 kHz**

Occupied Bandwidth (-26 dB):



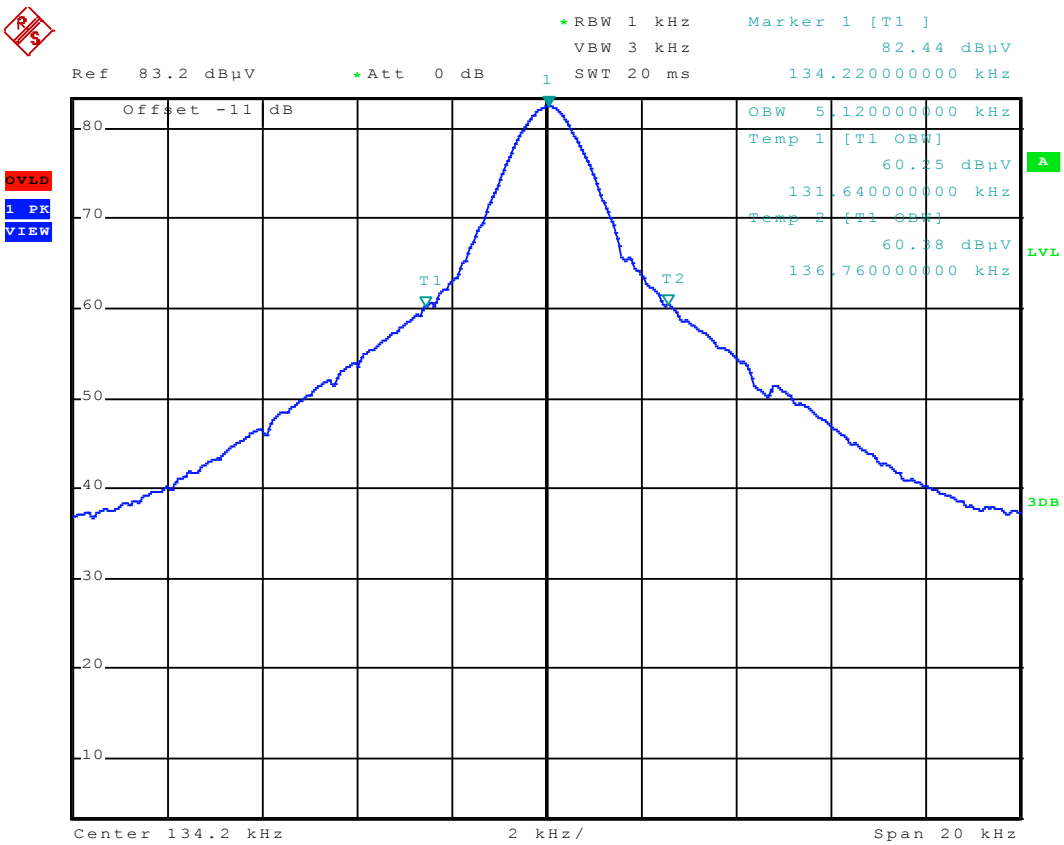
Occupied Bandwidth (-26 dB):	**7.02 kHz**

Occupied Bandwidth (continued)

Rules and specifications:	IC RSS-Gen Issue 4, section 6.6
Guide:	IC RSS-Gen Issue 4, section 6.6
Description:	If not specified in the applicable RSS the occupied bandwidth is measuredas 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 (6.2)

Comment:	
Date of test:	21 August 2014
Test site:	Fully anechoic room, cabin no. 2

Occupied Bandwidth (99 %):

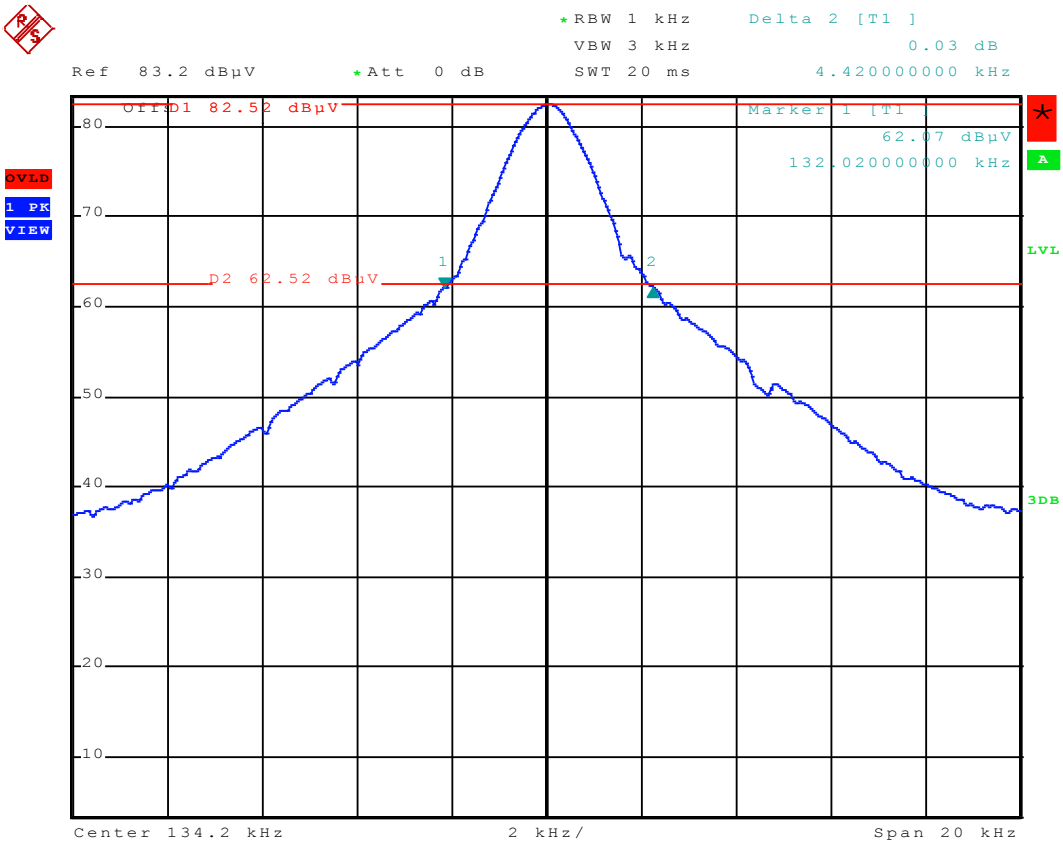


Occupied Bandwidth (99 %):	**5.12 kHz**

8.3 Bandwidth of the Emission

Rules and specifications:	CFR 47 Part 15, section 15.209 IC RSS-GEN Issue 4, section 8.9
Guide:	ANSI C63.10
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 (6.2)

Comment:	
Date of test:	6 October 2015
Test site:	Fully anechoic room, cabin no. 2



Bandwidth of the emission:	**4.42 kHz**

8.4 Designation of Emissions

Rules and specifications:	CFR 47 Part 2, sections 2.201 and 2.202 IC RSS-Gen Issue 4, section 9
Guide:	ANSI C63.10 / TRC-43

Type of modulation:	Amplitude Modulation

B_n = Necessary Bandwidth B = Modulation rate K = Overall numerical factor	$B_n = 2BK$ B = 4.8 kHz K = 1
Calculation:	$B_n = 2 \cdot (4.8\ \text{kHz}) \cdot 1 = 9.6\ \text{kHz}$

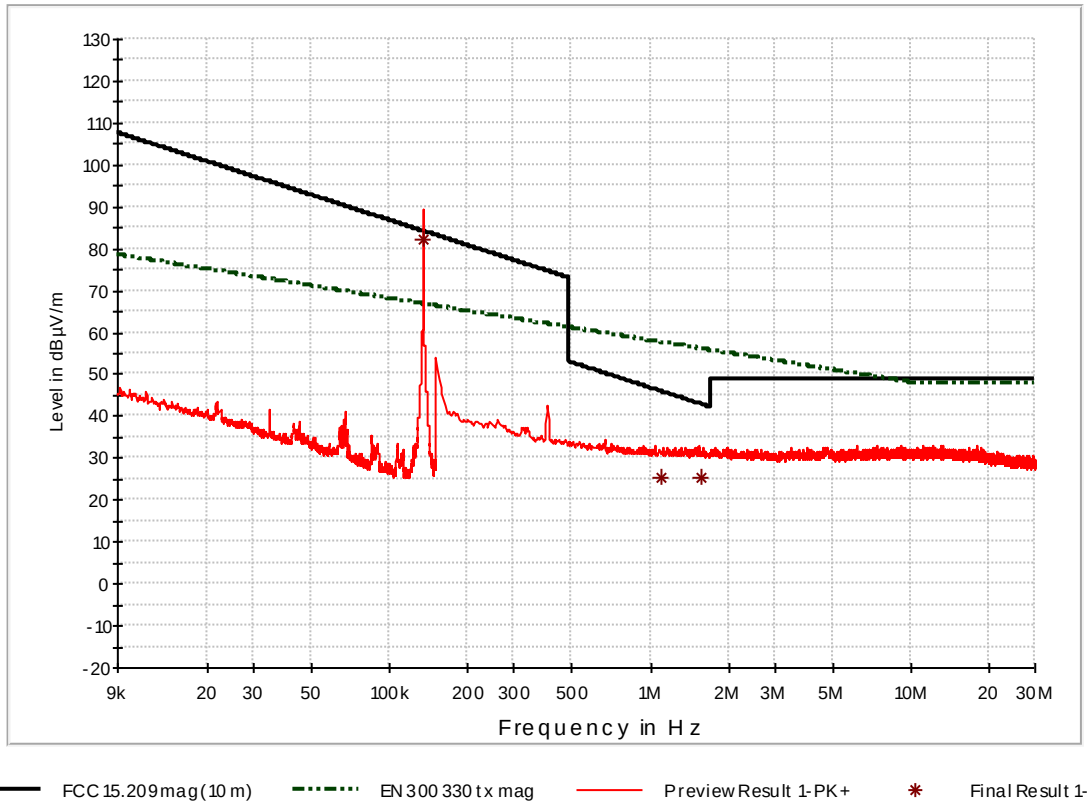
Designation of Emissions:	**9K6A1D**

8.5 Restricted Bands of Operation

Rules and specifications:	CFR 47 Part 15, section 15.205(a) IC RSS-Gen Issue 4, section 8.10
Guide:	ANSI C63.10
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 8, section 2.2(a).
Measurement procedure:	Radiated Emission Measurement 9 kHz to 30 MHz (6.4)

Comment: Date of test: Test site:	Tested with external antenna, representing worst case configuration 6 October 2015 Fully anechoic room, cabin no. 2
Test distance:	3 meters

K8 CISPR 16-2-3 Magnetic Field Strength 9kHz - 30 MHz



Test Result:	Test passed

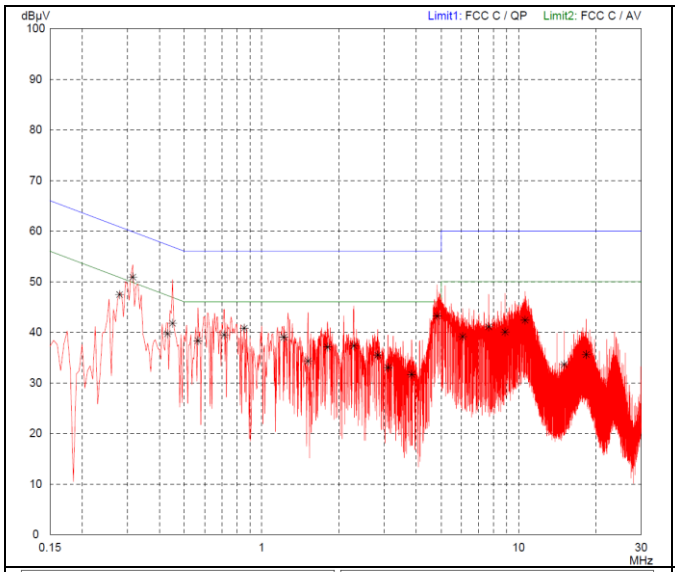
8.6 Conducted Powerline Emission Measurement 150 kHz to 30 MHz

Rules and specifications:	CFR 47 Part 15, section 15.207 IC RSS-GEN Issue 4, section 8.8		
Guide:	ANSI C63.10 / CISPR 22		
Limit:	Frequency of Emission (MHz)	Conducted Limit (dBµV)	
		Quasi-peak	Average
	0.15 - 0.5	66 to 56	56 to 46
	0.5 - 5	56	46
	5 - 30	60	50
Measurement procedure:	Conducted AC Powerline Emission (6.3)		

Comment:	Tested with external antenna, representing worst case configuration
Date of test:	6 October 2015
Test site:	Shielded room, cabin no. 1

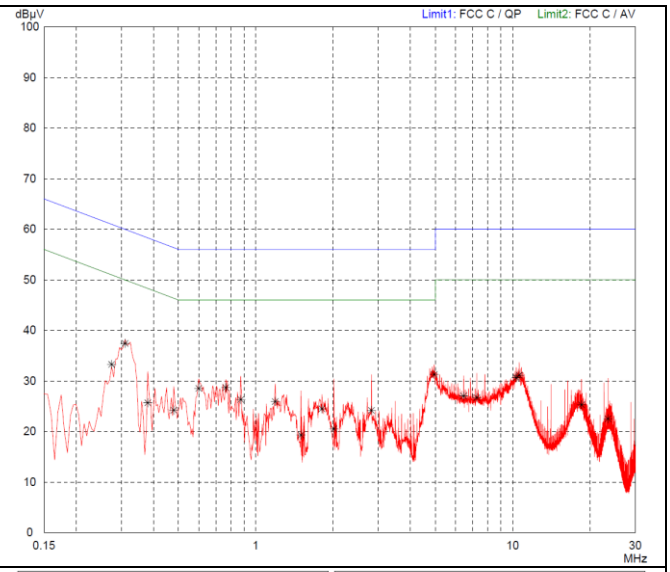
Test Result:	Test passed

Tested on:	AC Port / Live Terminal



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

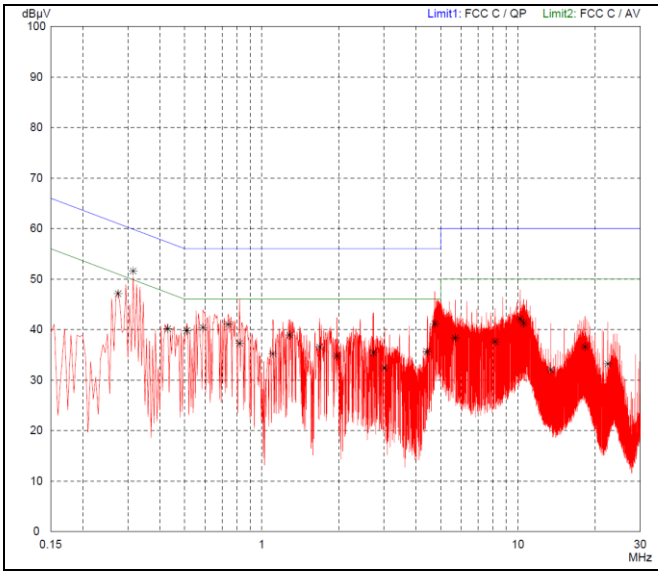
Frequency MHz	Reading dBµV	Correction factor dB	Value dBµV	Limit dBµV	Margin dB
0.280	47.4		47.4	60.8	13.4
0.315	50.9		50.9	59.8	8.9
0.430	39.7		39.7	57.3	17.6
0.450	41.8		41.8	56.9	15.1
0.565	38.3		38.3	56.0	17.7
0.715	39.5		39.5	56.0	16.5
0.855	40.8		40.8	56.0	15.2
1.220	39.0		39.0	56.0	17.0
1.515	34.3		34.3	56.0	21.7
1.805	37.0		37.0	56.0	19.0
2.285	37.3		37.3	56.0	18.7
2.830	35.5		35.5	56.0	20.5
3.105	33.0		33.0	56.0	23.0
3.835	31.6		31.6	56.0	24.4
4.815	43.2		43.2	56.0	12.8
6.060	39.1		39.1	60.0	20.9
7.650	41.1		41.1	60.0	18.9
8.860	40.0		40.0	60.0	20.0
10.600	42.4		42.4	60.0	17.6
15.030	33.6		33.6	60.0	26.4
18.330	35.6		35.6	60.0	24.4



Detector: Average / Final Results: AV
Final results: 20 dB Margin 25 Subranges

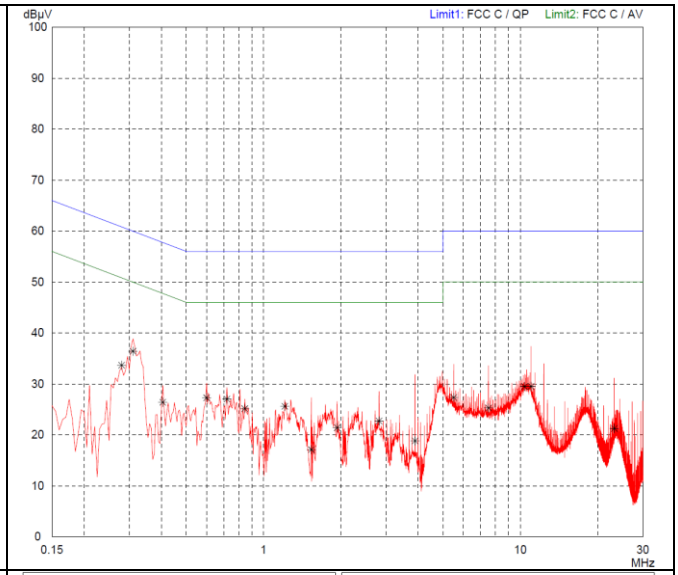
Frequency MHz	Reading dBµV	Correction factor dB	Value dBµV	Limit dBµV	Margin dB
0.275	33.3		33.3	51.0	17.7
0.310	37.4		37.4	50.0	12.6
0.380	25.7		25.7	48.3	22.6
0.480	24.2		24.2	46.3	22.1
0.600	28.5		28.5	46.0	17.5
0.765	28.7		28.7	46.0	17.3
0.875	26.3		26.3	46.0	19.7
1.190	25.9		25.9	46.0	20.1
1.500	19.3		19.3	46.0	26.7
1.810	24.5		24.5	46.0	21.5
2.015	20.5		20.5	46.0	25.5
2.820	24.2		24.2	46.0	21.8
4.950	31.3		31.3	46.0	14.7
6.440	27.0		27.0	50.0	23.0
7.250	26.7		26.7	50.0	23.3
10.325	30.6		30.6	50.0	19.4
10.605	31.1		31.1	50.0	18.9
18.520	25.3		25.3	50.0	24.7
23.485	22.5		22.5	50.0	27.5

Tested on:	AC Port / Neutral Terminal



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

Frequency MHz	Reading dBµV	Correction factor dB	Value dBµV	Limit dBµV	Margin dB
0.275	47.1		47.1	61.0	13.9
0.315	51.6		51.6	59.8	8.2
0.430	40.1		40.1	57.3	17.2
0.510	39.8		39.8	56.0	16.2
0.590	40.4		40.4	56.0	15.6
0.740	41.0		41.0	56.0	15.0
0.820	37.2		37.2	56.0	18.8
1.105	35.2		35.2	56.0	20.8
1.285	38.9		38.9	56.0	17.1
1.685	36.5		36.5	56.0	19.5
1.965	34.7		34.7	56.0	21.3
2.730	35.4		35.4	56.0	20.6
3.020	32.4		32.4	56.0	23.6
4.425	35.6		35.6	56.0	20.4
4.730	41.1		41.1	56.0	14.9
5.690	38.3		38.3	60.0	21.7
8.140	37.6		37.6	60.0	22.4
10.200	42.1		42.1	60.0	17.9
10.535	41.2		41.2	60.0	18.8
13.425	32.0		32.0	60.0	28.0
18.255	36.6		36.6	60.0	23.4
22.415	33.2		33.2	60.0	26.8



Detector: Average / Final Results: AV
Final results: 20 dB Margin 25 Subranges

Frequency MHz	Reading dBµV	Correction factor dB	Value dBµV	Limit dBµV	Margin dB
0.280	33.7		33.7	50.8	17.1
0.310	36.4		36.4	50.0	13.6
0.405	26.4		26.4	47.8	21.4
0.600	27.3		27.3	46.0	18.7
0.720	27.0		27.0	46.0	19.0
0.845	25.1		25.1	46.0	20.9
1.210	25.6		25.6	46.0	20.4
1.535	17.1		17.1	46.0	28.9
1.935	21.4		21.4	46.0	24.6
2.815	22.7		22.7	46.0	23.3
3.890	18.8		18.8	46.0	27.2
5.500	27.3		27.3	50.0	22.7
7.515	25.3		25.3	50.0	24.7
10.385	29.5		29.5	50.0	20.5
11.005	29.5		29.5	50.0	20.5
23.220	21.2		21.2	50.0	28.8

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 4, section 8.9			
Guide:	ANSI C63.10			
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:	Tested with internal and external antenna, final evaluation performed with external antenna
Date of test:	6 October 2015
Test site:	Semi-anechoic chamber 3 m test distance

Test Result:	Test passed

Final Result

Frequency MHz	Reading dBµV	Polarisation	Detector	Antenna correction dB/m	Distance Correction (dB)	Field Strength value dBµV/m	Limit dBµV/m	Margin (dB)
0.1342	**62.2**	**Vertical**	**Peak**	**20.0**	**-80.0**	**2.2**	**25.05**	**22.85**
0.1342	**60.2**	**Vertical**	**Average**	**20.0**	**-80.0**	**0.0**	**25.05**	**25.05**

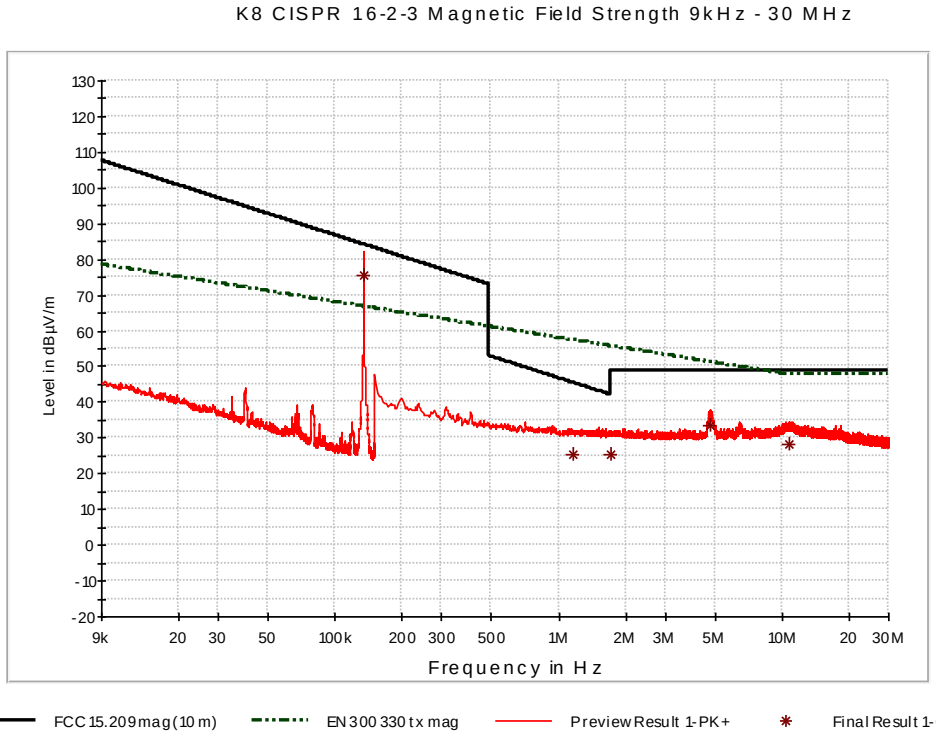
Sample calculation of final values:

Distance Correction Factor (dB) = 40 dB/Decade

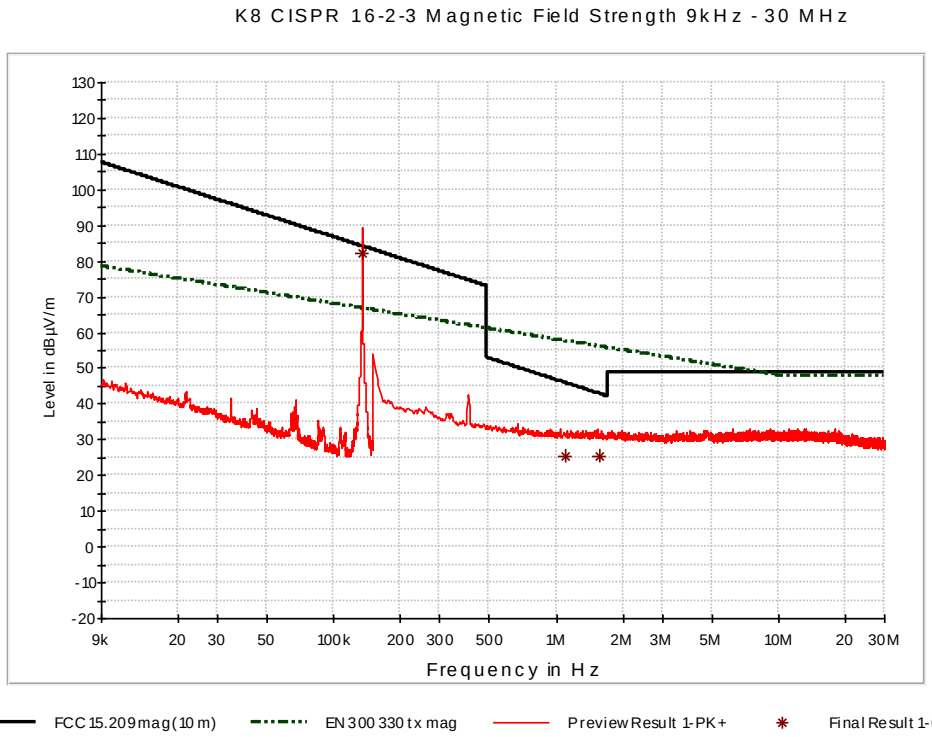
Final Value (dBµV/m) = Reading Value (dBµV) + Antenna Correction Factor (dB/m) + Distance Correction Factor (dB)

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

Internal Antenna



External Antenna



8.8 Radiated Emission Measurement 30 MHz to 1 GHz

Rules and specifications:	CFR 47 Part 15, section 15.209 IC RSS-GEN Issue 4, section 8.9		
Guide:	ANSI C63.10		
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 in Fully or Semi Anechoic Room (6.5) Radiated Emission at Alternative Test Site (6.6)		

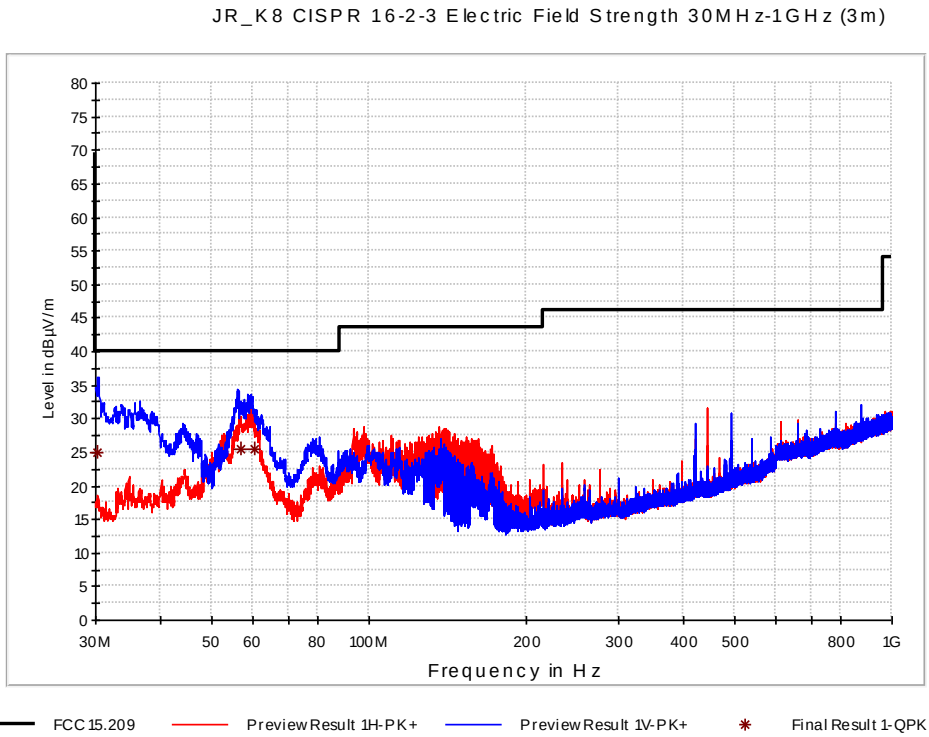
Comment:	Tested with internal and external antenna, final evaluation performed with external antenna
Date of test:	6 October 2015
Test site:	Frequencies ≤ 1 GHz: Semi-anechoic room, cabin no. 8 Frequencies > 1 GHz: Fully anechoic room, cabin no. 2
Test distance:	3 meters

Test Result:	Test passed

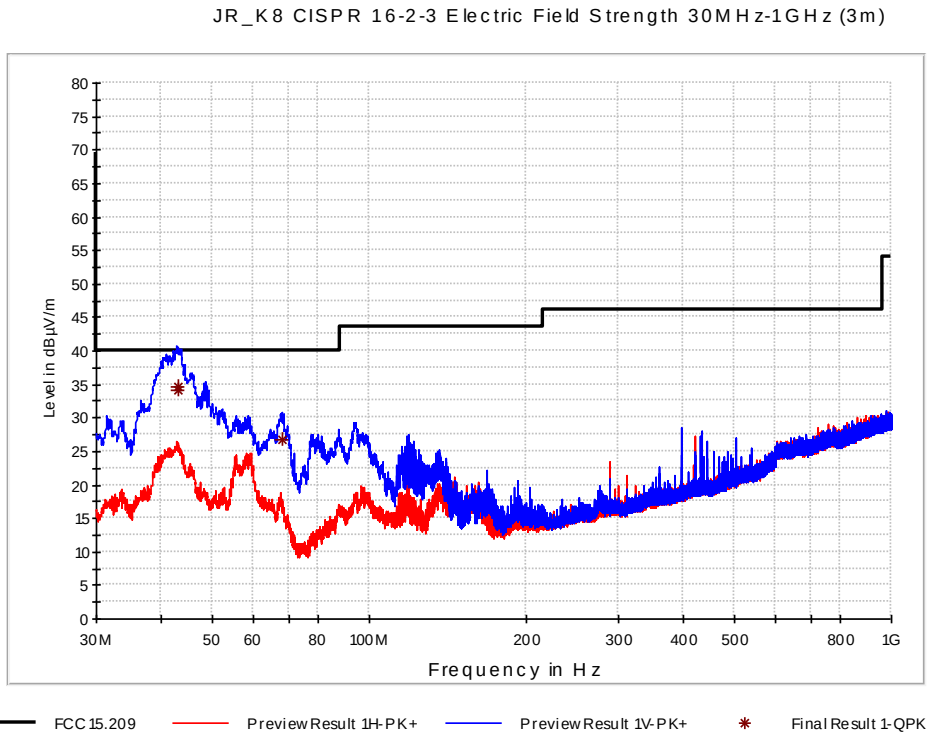
Final Result

Frequency MHz	Reading dBµV	Polarisation	Detector	Antenna correction dB/m	Distance Correction (dB)	Field Strength value dBµV/m	Limit dBµV/m	Margin (dB)
43.060	**18.8**	**Vertical**	**Quasi Peak**	**15.9**	**0**	**34.7**	**40.0**	**5.3**
43.150	**18.2**	**Vertical**	**Quasi Peak**	**15.9**	**0**	**34.1**	**40.0**	**5.9**
67.940	**16.3**	**Vertical**	**Quasi Peak**	**10.6**	**0**	**26.9**	**40.0**	**13.1**

Internal Antenna



External Antenna



Sample calculation of final values:

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

8.9 Exposure of Humans to RF Fields

Rules and specifications:	IC RSS-Gen Issue 4, section 3.2
Guide:	IC RSS-102 Issue 5, 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 = **0.010 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[4] 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[4]: $EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP$ = **..... W**				
with: Field strength in V/m: FS = **..... V/m**			☐	
Distance between the two antennas in m: D = **..... 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 = **0.010 W**				

[4] 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

☒	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, 2014
☒	CFR 47 Part 15	Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)	October 1, 2014
☒	ANSI C63.10	American national Standard of Procedures for Compilance Testing of Unlicensed Wireless Devices	June 27, 2013 (published on September 13, 2013)
☐	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)
☐	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	June 7, 2009 (published on September 15, 2009)
☒	RSS-Gen	Radio Standards Specification RSS-Gen Issue 4 containing General Requirements and Information for the Certification of Radiocommunication Equimpment, published by Industry Canada	November 2014
☒	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 5: Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), published by Industry Canada	March 2015
☐	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 Test Equipment List with Calibration Data

Type	*Inv.-No.*	*Type Designation*	*Serial Number*	*Manufacturer*	*Calibration Organization*	*Last Calibration*	*Next Calibration*
EMI test receiver	1028	ESHS10	860043/016	Rohde & Schwarz	Rohde & Schwarz	09/2015	09/2016
EMI test receiver	2044	ESU8	100232	Rohde & Schwarz	Rohde & Schwarz	02/2015	02/2016
Spectrum analyser	1666	FSP30	100063	Rohde & Schwarz	Rohde & Schwarz	05/2014	11/2015
Spectrum analyser	2364	FSV 40	101448	Rohde & Schwarz	Rohde & Schwarz	09/2015	09/2017
V-network	1059	ESH3-Z5	894785/005	Rohde & Schwarz	Rohde & Schwarz	08/2015	08/2017
Loop antenna	1016	HFH2-Z2	882964/0001	Rohde & Schwarz	Rohde & Schwarz	11/2014	11/2016
TRILOG Broadband Antenna	2058	VULB 9163	9163-408	Schwarzbeck	Schwarzbeck	06/2014	06/2016

Note 1: No calibration required.
Note 2: Not calibrated separately but with the whole test system when recording calibration data.
Note 3: No calibration required. Devices are checked before use.
Note 4: No calibration required. Devices are checked by calibrated equipment during test.

11 Revision History

Revision History			
Edition	*Date*	*Issued by*	*Modifications*
1	22 Aug 2014	J. Roidt	First Edition
2	30 April 2015	J. Roidt	Update according TCB‘ request
3	16 Oct. 2015	M. Biberger	Referenced regulation updated, re-checked and dates of tests updated