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BNetzA-CAB-14/21-09

DAkkS Deutsche Akkreditierungsstelle D-PL-11020-03-01

SGS Germany GmbH

Test Report No.: K2N10003

Order No.: K2N1 **Pages:** 37

Client:	Océ Printing Systems GmbH & Co. KG R&D2 DSED 4
Equipment Under Test:	S29311-D2626-V02
Manufacturer / Importer:	Océ Printing Systems GmbH & Co. KG
Task:	Compliance with the requirements mentioned below:
Test Specification(s): [covered by accreditation]	• FCC 47 CFR Part 15 • RSS-210 Issue 9
Result:	The EUT complies with the requirements of the test specifications.

The results relate only to the items tested as described in this test report.

approved by:	**Date**	**Signature**
Bauer Lab Manager EMC	May 03, 2017	Josef Bauer

This document was signed electronically.

CONTENTS

1 Result Summary

The measurements described in this report were conducted pursuant to 47 CFR § 2.947 and § 2.1041 for the US. All applicable paragraphs of the 47 CFR Part 15 of the most current version of the rules were considered.

The measurements described in this report were also conducted pursuant to RSS Gen and RSS-210 for Canada. All applicable paragraphs of the RSS Gen and RSS-210 of the most current version of the rules were considered.

The following test program was performed according to the FCC/IC rules to assess the ability of the tested sample(s) to successfully satisfy the FCC/IC requirements listed in section 2.1 Specification(s) of this test report:

Test No.	Measurement	FCC/IC Rules	Page Number of this Report	Result
1	Conducted Emissions	§ 15.207 RSS Gen, 8.8	16	N/A[1]
2	Occupied Bandwidth	§ 15.215(c) RSS Gen, 6.6	17	compliant
3	Radiated Emissions	§ 15.205, § 15.209, § 15.225(a-d) RSS Gen, 8.9, 8.10 RSS-210, B.6 (a-d)	19	compliant
4	Frequency Stability	§ 15.225(e) RSS Gen, 8.11 RSS-210, B.6	26	compliant

Table 1-1: Results – Summary

In accordance with the FCC Rule §15.3 (o) the equipment was tested with the limits that are valid for an *intentional radiator*.

[1] N/A (Not Applicable). The EUT is foreseen solely for professional printers which are not designed to be connected to the public (AC) power line.

2 References

2.1 Specification(s)

[1] FCC 47 CFR Part 15:
Code of Federal Regulations.
Title 47: Telecommunication Part 15: Radio Frequency Devices

[2] ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

[3] FCC Public Notice DA 09-2478; Nov 25, 2009; Office of Engineering and Technology Clarifies Use of Recently Published ASC C63®
Measurement Standards for Compliance Testing of Intentional and Unintentional Radiators under Part 15

[4] KDB174176 D01 Line Conducted

[5] RSS-210 Issue 9, August 2016; License-exempt Radio Apparatus: Category I Equipment.

2.2 Glossary

AC	Alternating Current
AMN	Artificial Mains Network
AV	Average Detector
DC	Direct Current
EMC	Electromagnetic Compatibility
EUT	Equipment Under Test
HW	Hardware
LISN	Line Impedance Stabilization Network
N/A	Not Applicable
QP	Quasi Peak Detector

3 General Information

3.1 Identification of Client

Océ Printing Systems GmbH & Co. KG
R&D2 EHS3
Siemensallee 2
85586 Poing
Martin Eibl

3.2 Test Laboratory

SGS Germany GmbH
Hofmannstraße 50
81379 München

3.3 Time Schedule

Test No.:	1	2	3	4
Start of Test:	N/A	Dec 15, 2015	Oct 30, 2015	Nov 27, 2015
End of Test:	N/A	Dec 15, 2015	Nov 2, 2015	Nov 30, 2015

3.4 Participants

Name	Function
André Stéphane Nakpane	Accredited testing, Editor
Reinhold Böhm	Accredited testing, Editor
Martin Eibl	Operating of EUT

3.5 Environmental conditions

During the measurement, if not otherwise specified, the environmental conditions were within the listed ranges:
Temperature: 20 - 26 °C
Humidity: 30 - 60 %

4 Equipment Under Test

Test item description .....:	S29311-D2626-V02
Trade Mark .....:	
Manufacturer / Importer.....:	Océ Printing Systems GmbH & Co. KG
Model/Type .....:	S29311-D2626-V02
Number of tested samples.:	2
Serial Number(s) .....:	S29311-D2626-V02 / Sample Nr. M9.x
Ratings.....:	DC 24 V ± 10%
Primary functions of EUT...:	RFID
Type of modulation .....:	ASK 100% according to ISO 15693
Operating frequency bands:	13.110 – 14.010 MHz
Environment in which EUT is intended to be used .....:	Indoor 0°C to +35°C
Primary Function Type .....:	I
Device Type.....:	3

The EUT is a Multi-Standard fully integrated 13,56MHz Analog-front-end Data-Framing Reader RFID System for fixed use, operating according to ISO 15693. The antenna is a magnetic loop antenna with a rectangular shape. The EUTs uses amplitude shift keying (ASK). The antenna is matched to 50 ohms at 13.56 MHz.

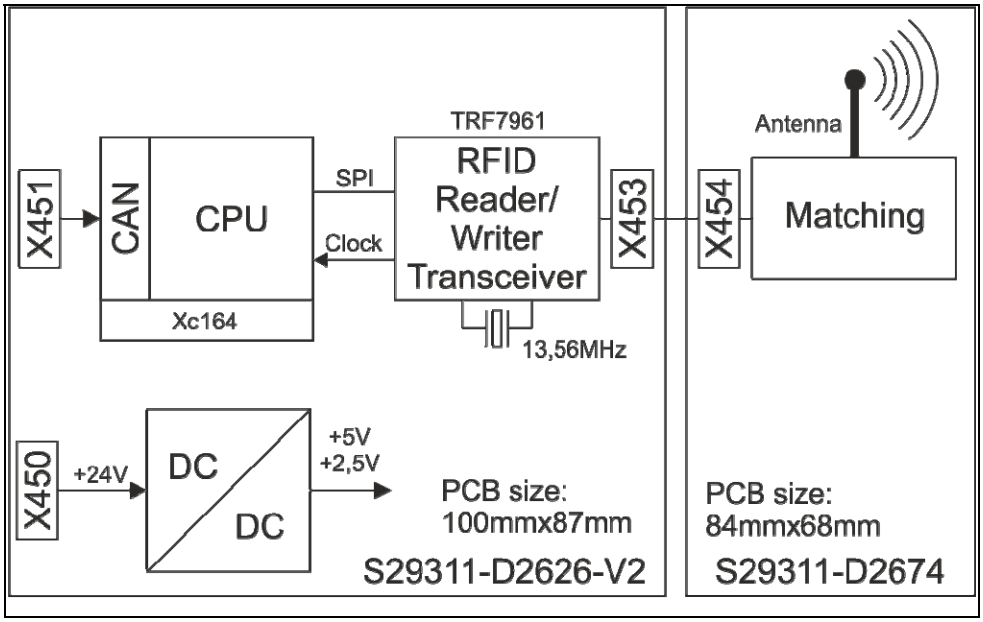


Figure 4-1: Block diagram of RFID device D2626-V02 with antenna PCB D2674

4.1 Operational conditions

4.1.1 Software

Software necessary for operating, controlling and monitoring the EUT:

Name	Identification Code/Issue	Task
Peak CAN Explorer	-	Control of Reader and monitoring of the Communication.

4.1.2 Radio parameters

The tested radio equipment was qualified acc. the following conditions:

Permitted Frequency Range			13.553 … 13.567 MHz
Frequency Separation			n/a
Number of Channels			1
Test Frequencies:			
	Transmitter		13.56 MHz
	Receiver		13.56 MHz
Transmitter:	**Rated Output Power (Prat)**		23 dBm
Modulation:	**Type**		ASK, 100%, ISO 15693
	Operation w/o modulation		No
Antenna:	**Type**		Dedicated (D2626-V02)
	Number of Antenna Ports		1
Power Src.:	**Type**		DC Supply
	Battery type (if applicable)		N/A
	Voltage	**nominal**	24V
		minimal	20.4V
		maximum:	27.6V

Table 4-1: Overview of EUT radio parameters

4.1.3 Operation Modes

If not stated otherwise, the following standard setup procedure for the EUT was used:

☒ Normal operation: EUT is power on and a continuous CAN communication established with the HF TAG stuck on EUT for testing purpose to have a two way communication.

The EUT was supplied with 24 V DC

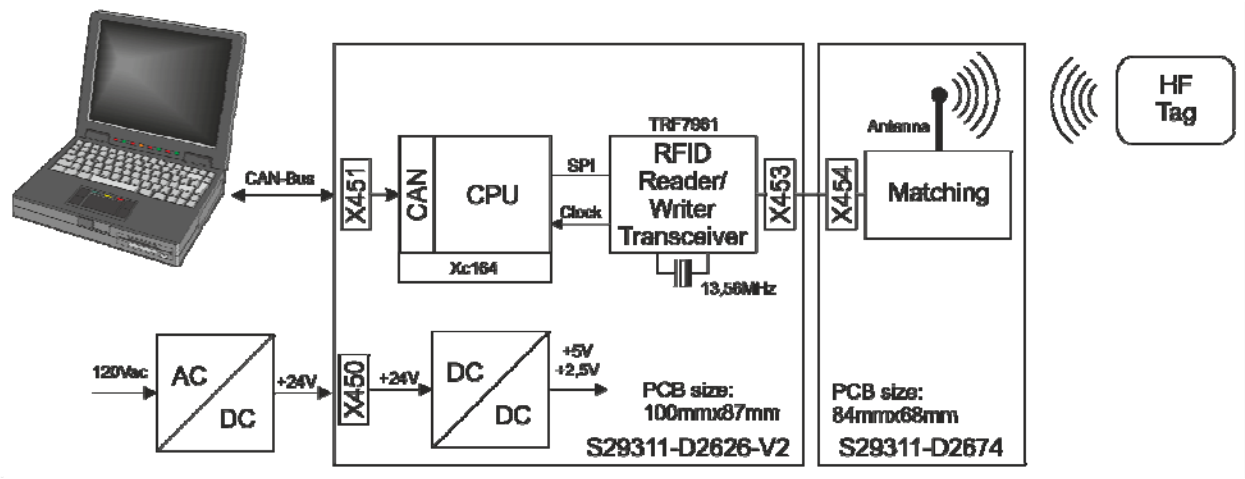


Figure 4-2: Configuration mode for test

4.2 Hardware Configuration

4.2.1 Components of the EUT

Name	Identification Code/Issue/Serial Number	Interface type	Quantity
D2626-V02	S29311-D2626-V02 / Sample Nr. M6.x	Induction loop	1
HF Tag	--	Induction loop	2

4.2.2 Interface description

All interfaces are identified independent whether they are tested or not.

4.2.2.1 Power supply port

Type (AC, DC, battery)	Voltage	Frequency	Current	Power	Connection / plug type
DC	24 V	--			EPS-

4.2.2.2 Earthing and Grounding connections [2]

Type	Task	Connected to	Test E/I/NA

4.2.2.3 Communication [3] and signal [4] ports

Type	Bit rate/frequency/ Signal	Task	Connected to
CAN BUS		Configuration and monitoring of commu-nication	PC

2 Safety ground, functional earth, specific ground connections

3 Connections to communication networks, analog, Ethernet, antenna, wireless, GPS,

4 Signaling, monitoring and control ports

4.2.3 Cabling

Name	Identification Code/Issue/ Serial Number	shield	Description of Connection / plug type	length	Quantity
CAN BUS		yes	Configuration and monitoring of communication	≤ 10m	1

4.2.4 Clock frequencies of the EUT resulting in determination of frequency range

System / Subsystem	Highest clock frequency
S29311-D2626-V02	13.56 MHz

The result of the table above with the highest frequency of internal source is basis of the determination of the necessity of measurement above 1 GHz. The highest internal source of an EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes.

See **FCC §15.33 a)** for relevant frequency range of **intentional radiators**.
See **FCC §15.33 b)** for relevant frequency range of **unintentional radiators**.

See e.g. the following table taken from FCC §15.33 b) 1)

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	**Upper frequency of measurement range (MHz)**
Below 1.705	30
1.705-108	1000
108-500	2000
500-1000	5000
Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower

4.2.5 External protection devices or measures

EMC relevant external protection devices or measures specified in the user's manual (e.g. overvoltage, shielding, bonding and grounding).

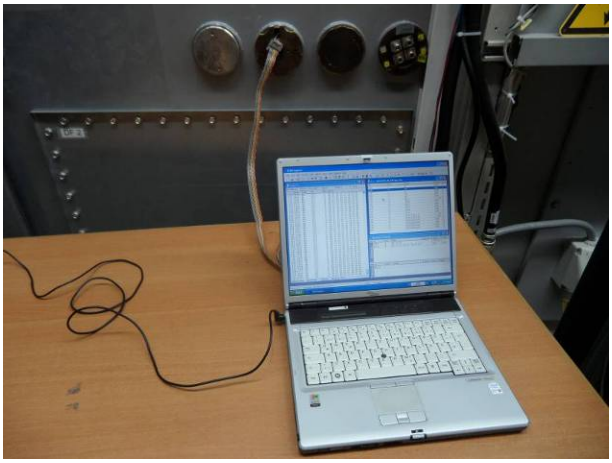
None

4.2.6 Modifications during the test

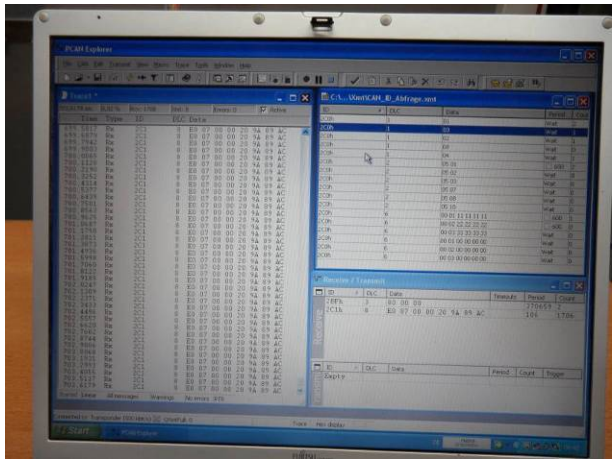
None.

4.2.7 Operation and monitoring equipment

Name / Identification	Task	Availability [5] C/L
Peak CAN Explorer running on PC	Control of Reader and monitoring of the Communication.	C



Notebook located outside anechoic chamber



Observation of communication

Figure 4-3: Operation and monitoring equipment

4.3 Deviations from Standard

Since the EUT is designed to be integrated in printed device providing a control DC source to the EUT, the conducted emission has been tested only on the DC port with AC requirements. Of course the host has been tested with the EUT in place.

[5] C: Provided by the customer, L: Available at laboratory

5 Test Equipment

5.1 Test Facility

The EMC-tests are carried out in the EMC-laboratory of SGS Germany, Consumer Testing Services, Hofmannstraße 50, 81379 München, Germany.

Chamber	**1**	**2**	**3**	**4 / 5**	**6**
Dimensions (net)	17.7 * 10.8 * 6.8 m	9.6 * 8.5 * 5.3 m	7.4 * 6.6 * 5.2 m	4.1 * 3.5 * 3.5m	6.4 * 4.3 * 4.3m
Max. Door Exit (w x h)	2.9 * 3.86 m	3.9 * 4.0 m	2.0 * 2.7 m	0.9 * 2.25 m	1.8 * 3.0 m
Shielding material	Sheet steel (Thickness:1.5mm on floor, 1.0 mm on walls and ceiling)	Sheet steel	Sheet steel	Sheet steel	Sheet steel
Absorbers	Hybrid absorbers on walls and ceiling (TDK), length 1 m	Hybrid absorbers on walls and ceiling (E+C), length 0.5 m	Hybrid absorbers on walls and ceiling (E+C), length 0.3 m	Without absorbers	Without absorbers
Floor	Metallic ground plane floor load: 12 t/m²	Metallic ground plane floor load: 1.5 t/m²	Metallic ground plane floor load: 1 t/m²	Metallic ground plane	Metallic ground plane
Turntable	∅ 4 m / 7 t	∅ 3.2 m / 1.5 t	∅ 2.0 m / 1 t		
Listings	FCC-listed until Nov. 2017, Reg. No.: 90932 Industry Canada listed until June 2018 Reg. No. 9058A-1	FCC-listed until Nov. 2017, Reg. No.: 97242 Industry Canada listed until June 2018 Reg. No. 9058A-2 VCCI-listed until Oct. 2016, Reg. No. R-2623, G-266	FCC-listed until Nov. 2017, Reg. No.: 299569 Industry Canada listed until June 2018 Reg. No. 9058A-3		VCCI-listed until Oct. 2016, Reg. No. C-2866 & No. T-1942
Specials	***Emission*:** ***30 – 1000 MHz (d = 10 m)*** - NSA acc. to: ・ EN 55022 ・ CISPR 16-1-4 ・ ANSI C63.4 ***1 – 18 GHz (d = 3 m)*** Site VSWR 1 – 18 GHz acc. to CISPR 16-1-4	***Emission*:** ***30 – 1000 MHz (d = 3 m)*** - NSA acc. to: ・ EN 55022 ・ CISPR 16-1-4 ・ ANSI C63.4 ***1 – 18 GHz (d = 3 m)*** Site VSWR 1 – 18 GHz acc. to CISPR 16-1-4	***Emission*:** ***30 – 1000 MHz (d = 3 m)*** - NSA acc. to: ・ EN 55022 ・ CISPR 16-1-4 ・ ANSI C63.4 ***1 – 18 GHz (d = 3 m)*** Site VSWR 1 – 18 GHz acc. to CISPR 16-1-4		
	Immunity: Field uniformity 27 – 6000 MHz acc. EN 61000-4-3	***Immunity:*** Field uniformity 80 – 6000 MHz acc. EN 61000-4-3	***Immunity:*** Field uniformity 80 – 6000 MHz acc. EN 61000-4-3		
FCC (Federal Communication Commission): Accreditation by Bundesministerium für Wirtschaft und Arbeit (BMWA; BNetzA-CAB-14/21-09) and Designation as **CAB (Conformity Assessment Body):** Designation Number DE0013; Test firm Registration #: 366296					
Designation **KBA** (**Kraftfahrt-Bundesamt**) as Technical Service category A and D. Registration Number: KBA-P 00083-97					
CB Testing Laboratory under the responsibility of SGS CEBEC as National Certification Body and to carry out testing within the **IECEE CB Scheme.**					

5.2 Calibration of the Test Equipment

All relevant test equipment has a valid calibration. Additionally the used signal analyzers have a built-in self-calibration procedure. This calibration procedure was activated prior to the measurements so that the analyzer is deemed to be accurate. High quality cables were used to connect the measurement equipment. The actual loss of the attenuators and the cables was measured with a high precision network analyzer and taken into account for all measurements.

5.3 Measurement Uncertainty

As far as the underlying standards include requirements concerning the uncertainty of measuring instruments or measuring methods, they are met.
The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities.

The expanded measurement uncertainty of the measuring chain was calculated for all tests according to the “ISO Guide to the expression of uncertainty in measurement (GUM)”. The results are documented in an “internal controlled document”.

The measuring accuracy for all measuring devices is given in their technical description. The measuring instruments, including any accessories, are calibrated respectively verified to ensure the necessary accuracy. Depending on the kind of measuring equipment it is checked within regular intervals or directly before the measurement is performed. Adjustments are made and correction factors applied to measured data in accordance with the specifications of the specific instrument.

The expanded measurement instrumentation uncertainty of our Test Laboratory meets the requirements of IEC CISPR 16-4-2 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modeling – Uncertainty in EMC measurements” and the relevant basic standards for all listed Tests.

6 Test Conditions and Results

6.1 Test No. 1: Conducted Emissions (§ 15.207)

6.1.1 Purpose

The AC power-line conducted emissions caused by the EUT via the power lines were measured pursuant to [4] KDB174176 in the frequency range from 150 kHz to 30 MHz.

6.1.2 Limits

Following conducted emission limits are specified by [1] § 15.207:

Frequency of Emission [MHz]	Conducted Limit [dBµV]	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5.0	56	46
5.0-30.0	60	50

Table 6-1: Limits – Conducted Emissions

6.1.3 Test Procedure and Results

Measured levels of power-line conducted emission are the radio-noise voltage levels across the 50 Ω LISN port (to which the EUT is connected) terminated into a 50 Ω EMI receiver. All radio-noise voltage measurements are made on each current carrying conductor at the plug end of the EUT power cord. The measurement is performed using a receiver with peak and average detector.
Only if the measured peak value is near or above the quasi-peak limit the detector function is changed to quasi-peak for final measurement of the highest voltage levels.

Exploratory emission measurements are to be performed considering operation states and cable arrangement to evaluate configuration with highest emission levels (C63.10-2013, Clause 6.2.4).

Acc. C63.10-2013 Annex B.2.8.3 AC power-line conducted emissions measurements are to be separately carried out only on each of the phase ("hot") line(s) and (if used) on the neutral line(s), but not on the ground [protective earth) line(s).

EMC-Test-SW: EMC32 version 9.21 (R&S)

Result:

verdict:	**N/A[1]**

6.2 Test No. 2: Occupied Bandwidth (§ 15.215c)

6.2.1 Purpose

The occupied bandwidth of the EUT was measured pursuant to [2] ANSI 63.10 Clause 6.9.2. The measurement was performed to verify the 20 dB bandwidth of the emission.

6.2.2 Limits

According to § 15.215 intentional radiators operating under the alternative provisions to the general emission limits, as contained in [1] § 15.217 through § 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

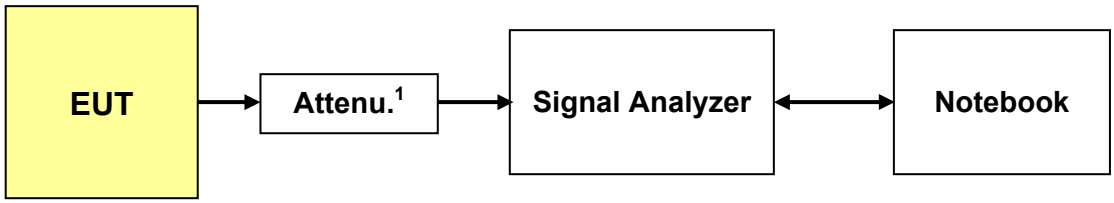
6.2.3 EUT Operating Condition

The standard setup procedure as described in section 4.1.3 of this report was used.

Climatic condition during test

Temperature (°C): 22.4
Rel. Humidity (%): 32.9

6.2.4 Test Configuration



1) Attenuator (if applicable)

Figure 6-1: Test Configuration – Occupied Bandwidth

Photographs of the EUT setup for occupied bandwidth measurement are shown on page 31 of this report.

6.2.5 Test instruments and accessories

ID	Measuring Instrument	Specification	Status	Calibration due
P1845	Spectrum Analyzer	20 Hz bis 26,5 GHz; Linearität: 0,1 dB (0 dB bis –70 dB)	cal	Feb 2016
P1740	Frequency Standard		cal	Feb 2016
P0861	attenuator 30dB	30dB, nur bis max 1 GHz	chk	Jun 2016
P0076	antenna (inductive surface antenna)		ind	
P1809	multimeter, digital (MZ01)	60 mV...600V, 60mA....10A, 600Ohm...40MOhm, 0.1Hz...1kHz, -50,0 °C ...+400,0°C	cal	Jun 2016
P1911	Data logger for pressure, humidity and temperature (Spibe)	0...100%rF/ 0...100%rH; -20....+ 70°C/ -4... + 158°Ftd; 6000....1100mbar	chk	Dec 2016
P1596	Multimeter / True RMS	1000 V(DC), 1000 V(AC), 10 A(DC), 10 A(AC), 500 MOhm, 50 nS, 50000 µF, 1 MHz, -200 °C/+1350 °C, -52/60 dB	cal	Jun 2016
P0394	power supply	32 V / 1.5 A	ind	

cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary

6.2.6 Test Procedure and Results

The 20 dB bandwidth of the carrier emission is measured using a spectrum analyzer.
In order to measure the modulated signal properly, a resolution bandwidth that is small compared with the bandwidth required by the procuring or regulatory agency shall be used on the measuring instrument. However, the resolution bandwidth of the measuring instrument shall be set to a value within 1 % to 5% of the signal bandwidth requirements.

Screenshots of the measurements are included on pages 28 of this report.
The following table summarizes the results:

The occupied bandwidth was found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.

Result:

Carrier Frequency [MHz]	Occupied Bandwidth [kHz]	Result
13.56	36.538	compliant
Measurement Uncertainty:		±48kHz

Table 6-2: Results – Occupied Bandwidth

6.3 Test No. 3: Radiated Emissions (§ 15.205, § 15.209, § 15.225a-d)

6.3.1 Purpose

The radiated emissions of the EUT were measured pursuant to [2] ANSI 63.10 Clause 6.4 and 6.5. The measurement was performed to verify that emissions radiated directly from the cabinet, control circuits, power leads or intermediate circuit elements are attenuated below the specified limits.

6.3.2 Limits

According to § 15.205, only spurious emissions are permitted in restricted band of operation.

According to § 15.209 and 15.225(a-d), the radiated emissions of an intentional radiator must not exceed following field strength levels:

Frequency of Emission [MHz]	Field strength [µV/m]	Meas. Distance [m]
0.009-0.490	2400/F [kHz]	300
0.490-1.705	24000/F [kHz]	30
1.705-13.110	30	30
13.110-13.410	106	30
13.410-13.553	334	30
13.553-13.567	15848	30
13.567-13.710	334	30
13.710-14.010	106	30
14.010-30.00	30	30
30–88	100	3
88–216	150	3
216–960	200	3
Above 960	500	3

Table 6-3: Limits – Radiated Emissions

6.3.3 EUT Operating Condition

The standard setup procedure as described in section 4.1.3 of this report was used.

6.3.4 Test Configuration

The measurements were performed in an anechoic chamber. The radiated test site complies with the site attenuation requirements listed in ANSI C63.4 and is listed with the FCC.

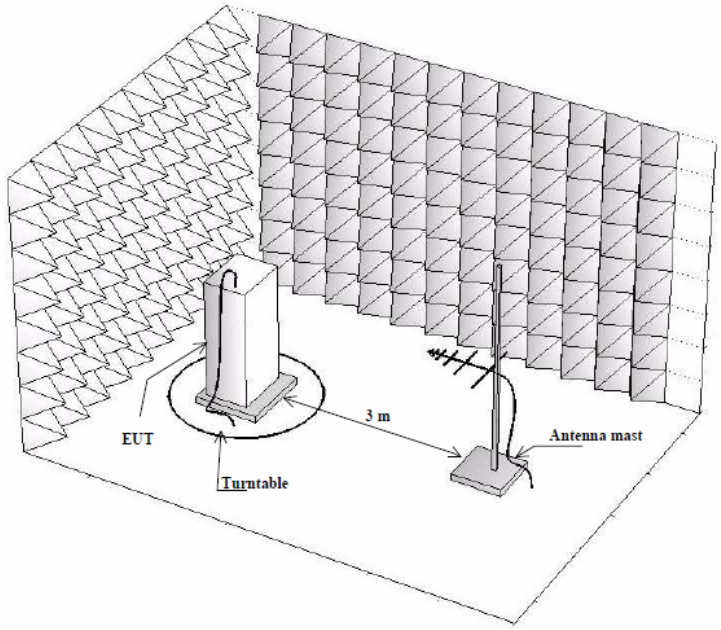


Figure 6-2: Test Configuration – Radiated Emissions – 30 MHz to 1 GHz

Photographs of the EUT in the anechoic chamber are shown on page 31 of this report.

6.3.5 Test Procedure and Results

6.3.5.1 Radiated emissions - 30 MHz to 1000 MHz (§ 15.205, § 15.209)

Phenomena	Reference	Frequency Range	Criteria	Verdict
Radio Disturbance Electric Field	FCC 47 CFR Part 15 §15.209	30 MHz - 1 GHz distance 3m	Class A	P
Radio Disturbance Electric Field	ICES-003	30 MHz - 1 GHz distance 3m	Class A	P

(The radiated emission limits < 1 GHz of FCC 47 CFR Part 15 §15.209 Class A/B are identical with ICES-003 class A/B.)

Test procedure:

Radiated measurements are performed in a semi-anechoic chamber meeting the normalized site attenuation of ANSI C63.4 and listed with the FCC. The applicable frequency spectrum is scanned with a calibrated RF measuring system using an appropriate broadband antenna and an EMI-receiver/spectrum analyzer and compared to the required limits. The measuring instrument performs the field strength calculations automatically. The measuring software provides resident AF and CF figures for individual antennas and cables. The receiver/analyzer is set to "peak" mode from 30 MHz to 1 GHz. On any emission of concern, the receiver is set to quasi-peak mode.

"Maximization" of each suspect frequency is accomplished by a combination of a 360° azimuth search using a turntable and varying the antenna to ground plane height from 1 m to 4 m. Also, both the vertical and horizontal polarization is scanned in the required frequency range per ANSI C63.10.
Maximization of emission results starts at 0° of the turn table with antenna in horizontal polarization is set to 1 m. While the turntable slowly moves to 360°, the spectrum analyzer is sweeping from 30 to 1000 MHz and maximum data is recorded. Antenna is set to 2 m and turntable slowly moves back to 0° while the spectrum analyzer is sweeping again. This is repeated until the antenna height of 4 m is reached.
The antenna polarization is set to vertical and the procedure described above is repeated.
For each frequency the measuring software stores the maximum level as well as the corresponding settings of turntable and antenna. An azimuth resolution of about 3° is realized using this method.
At least the six highest frequencies are selected automatically by the software for performing the final measurements.
At each of these frequencies the turntable as well as the antenna is set to the corresponding settings. Then the antenna is slowly moved 50 cm down/up related to initial position while the receiver is measuring at this frequency. The highest emission level and the corresponding height are recorded. At this final position, the measurement is performed with quasi-peak detector.
Exploratory emission measurements are to be performed considering operation states and cable arrangement to evaluate configuration with highest emission levels (C63.10-2013, Clause 6.6.4.2).

Test location: semi anechoic chamber No. 3

EMC-Test-SW: EMC32 version 9.21 (R&S)

Instruments and accessories

ID	Measuring Instrument	Specification	Status	Calibration due
P0311	antenna	30 - 1000 MHz E	cal	Apr 2018
P0338	test chamber 3	7.4 x 6.6 x 5.2 m (net), 0.4 m hybrid absorbers	chk	Feb 2016
P1303	Mast	1 - 4m, hor./vert.	cnn	
P1304	Controller		cnn	
P1326	EMI receiver	20Hz - 26.5GHz, FFT-Scan, Preamplifier 100kHz - 26.5GHz, 30dB	cal	Jul 2016
P1567	power supply		cnn	

cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary

Result:

verdict:	**compliant**

The following table shows the measured radiated emissions. Plots of the measurements are included on pages 29 of this report.

Result table:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.242500	17.84	49.60	31.76	2000.0	120.000	144.0	V	45.0	19.6
39.409000	12.63	49.60	36.97	2000.0	120.000	118.0	V	264.0	14.5
122.004500	33.65	54.00	20.35	2000.0	120.000	222.0	V	23.0	13.2
203.387500	33.00	54.00	21.00	2000.0	120.000	109.0	H	329.0	11.2
271.142000	32.86	56.90	24.04	2000.0	120.000	192.0	V	340.0	14.2
419.988500	42.38	56.90	14.52	2000.0	120.000	211.0	H	220.0	18.8

6.3.5.2 Radiated Emissions – 9 kHz to 30 MHz (§ 15.225a-d, §15.209)

Phenomena	Reference	Test Specification	Criteria	Verdict [6]
Radio Disturbance Magnetic Field	FCC 47 CFR Part 15 §15.225a-d	9 kHz -30 MHz Distance 3 m	Class B	P

Climatic condition during test

Temperature (°C): 22.7 – 23.6
Rel. Humidity (%): 34.4 – 34.8

Test procedure:

Radiated measurements are performed in a semi-anechoic chamber listed with the FCC. The applicable frequency spectrum is scanned with a calibrated RF measuring system using an appropriate loop antenna and an EMI-receiver/spectrum analyzer and compared to the required limits. The measuring instrument performs the field strength calculations automatically. The measuring software provides resident AF and CF figures for individual antennas and cables. The receiver/analyzer is set to "peak" mode from 9 kHz to 30 MHz. For the RFID Maskfrequency range is limited from 12.66 MHz to 14.46 MHz.

“Maximization” is accomplished by a combination of a 360° azimuth search using a turntable. Also, both the vertical and horizontal polarization is scanned in the required frequency range per ANSI C63.10.

Limits:

Compliance with § 15.225a-d requires that the field strength of any emissions shall not exceed limits given in µV/m at 30 meters.

The magnetic field measurements have been performed using a loop antenna at a measuring distance of 3 meters. Thus FCC compliance limits need to be extrapolated at different limit distance (300m, 30 m) to the used measuring distance of 3 meters by calculation as given in Annex A.

The following table shows the measured radiated emissions. Plots of the measurements are included on pages 29 of this report.

Test location: semi anechoic chamber No. 2

EMC-Test-SW: EMC32 version 9.21 (R&S)

[6] P (Pass): test object meets the requirement; F (Fail): test object does not meet the requirement;
N/A: test case does not apply to the test object; NR: test case is not requested by the client. FCC requires radiated emission testing up to the 5th harmonic of the highest clock rate of the tested system.

Instruments and accessories

ID	Measuring Instrument	Specification	Status	Calibration due
P1284	Controller		cnn	
P1367	video camera MZ2		ind	
P1327	EMI receiver	20Hz - 40GHz, FFT-Scan, Preamplifier 100kHz - 40GHz, 30dB	cal	Jul 2017
P0073	antenna	0.01 - 30 MHz	chk	Jun 2017
P1913	Data logger for humidity and temperature (MZ2)	Sensortyp NTC: -20....+ 70°C, Auflösung: 0.1 °C; Genauigkeit: +/- 0.4 °C; Feuchtesensor kapazitiv: 0 ... 100 %rF; Genauigkeit: +/- 2 %rF bei 25 °C; Au	cal	Dec 2015
P1567	power supply		cnn	
P1558	multimeter, digital	60 mV...600V, 60mA....10A, 600Ohm...40MOhm, 0.1Hz...1kHz, -50,0 °C ...+400,0°C	cal	Apr 2016
P0337	test chamber 2	9.6 x 8.5 x 5.3 m (net), 0.5 m hybrid absorbers	chk	Feb 2016

cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary

Result:

verdict:	**compliant**

Final result (Quasipeak) according to §15.225a-c

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB)
12.987000	26.05	50.94	24.89	1000.0	9.000	H	0.0	20.3
13.217600	27.71	61.90	34.19	1000.0	9.000	H	0.0	20.3
13.304400	30.32	61.90	31.58	1000.0	9.000	H	0.0	20.3
13.558200	73.05	105.39	32.34	1000.0	9.000	V	270.0	20.3
13.559200	77.23	105.39	28.16	1000.0	9.000	H	0.0	20.3
13.559700	75.92	105.39	29.47	1000.0	9.000	H	44.0	20.3
13.794900	28.01	61.90	33.89	1000.0	9.000	H	0.0	20.3
13.847200	27.10	61.90	34.80	1000.0	9.000	H	0.0	20.3
14.023200	26.38	50.94	24.56	1000.0	9.000	H	0.0	20.3
14.098100	25.39	50.94	25.55	1000.0	9.000	H	0.0	20.3
Measurement Uncertainty:						+3.1 dB / -3.9 dB		

Final result (Quasipeak) according to §15.225d and §15.209

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB)
0.017798	13.90	122.60	108.70	1000.0	0.200	V	90.0	-31.5
0.162000	38.89	103.41	64.52	1000.0	9.000	H	134.0	20.0
0.575450	29.20	72.40	43.20	1000.0	9.000	H	44.0	20.1
0.661540	30.35	71.19	40.84	1000.0	9.000	H	315.0	20.1
1.178540	27.07	66.18	39.11	1000.0	9.000	H	134.0	20.1
1.363550	27.02	64.91	37.89	1000.0	9.000	H	0.0	20.1
1.692500	27.15	63.03	35.88	1000.0	9.000	H	315.0	20.1
1.718410	26.43	69.54	43.11	1000.0	9.000	H	44.0	20.1
Measurement Uncertainty:						+3.1 dB / -3.9 dB		

The measured emission levels were found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.

6.4 Test No. 4: Frequency Stability (§ 15.225e)

6.4.1 Purpose

The frequency stability of the EUT was measured pursuant to [2] ANSI 63.10 Clause 6.8. The measurement was performed to verify that the frequency deviation of the emission stays within the assigned frequency block under extreme temperature conditions (-20°C to +50°C) and supply voltage conditions according to § 15.225(e).

6.4.2 Limits

According to § 15.225(e), the carrier frequency of the EUT shall be maintained within 0.01 percent (100 ppm) of the operating frequency, independent of the ambient temperature (-20°C to 50°C) and the primary supply voltage (85% to 115% of the rated voltage).

6.4.3 EUT Operating Condition

The standard setup procedure as described in section 4.1.3 of this report was used.

6.4.4 Test Configuration

Frequency Stability with Temperature Variation:

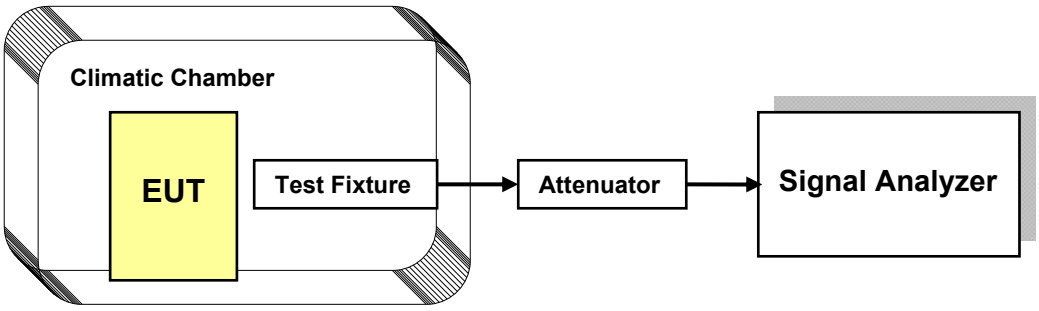


Figure 6-3: Test Configuration – Frequency Stability with temperature variation

Frequency Stability with Voltage Variation:

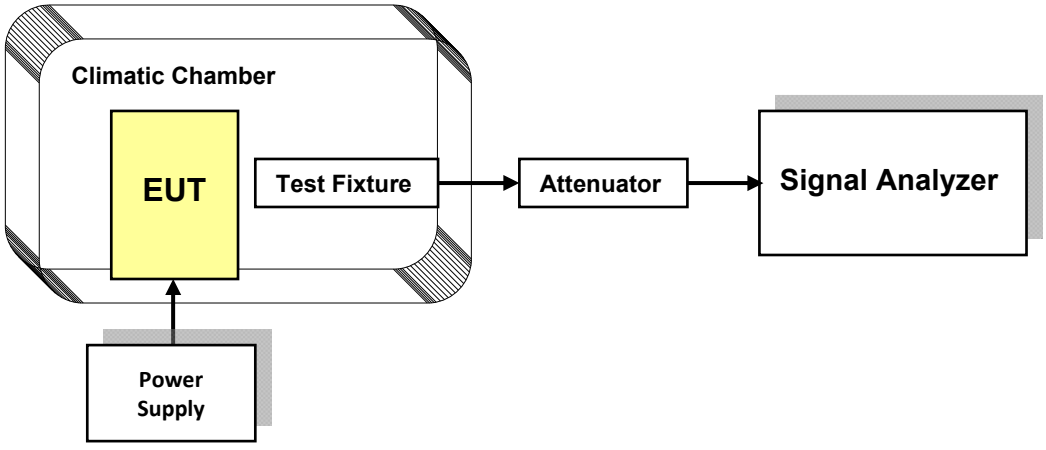


Figure 6-4: Test Configuration – Frequency Stability with voltage variation

6.4.5 Test Procedure and Results

Frequency Stability with Temperature Variation:

The primary supply voltage to the EUT was set to the rated voltage and the temperature of the environmental chamber is varied in 10 degree steps from -20 degrees celsius to +50 degrees celsius. The EUT is allowed to stabilize at each temperature and the frequency error is measured.

Carrier Frequency: 13.56 MHz						
Supply Voltage (DC)	**Ambient Temperature**	**Frequency Deviation**		**Maximum allowed Deviation**		**Result**
[V]	**[°C]**	**[Hz]**	**[ppm]**	**[Hz]**	**[ppm]**	
24V	-20	-139.1	-10.26	±1356	±100	compliant
	-10	-93.9	-6.92	±1356	±100	compliant
	0	-76.6	-5.65	±1356	±100	compliant
	+10	-81.5	-6.01	±1356	±100	compliant
	+20	-98.4	-7.26	±1356	±100	compliant
	+30	-120.5	-8.89	±1356	±100	compliant
	+40	-139.2	-10.27	±1356	±100	compliant
	+50	-145.8	-10.75	±1356	±100	compliant
Measurement Uncertainty:					±3.6 Hz	

Table 6-4: Results – Frequency Stability with temp. variation for DC Supply

Frequency Stability with Voltage Variation:

The EUT is placed in an environmental chamber and allowed to stabilize at +20 degrees celsius for at least 15 minutes. With the voltage input to the EUT set to 85% of the rated supply voltage, the frequency error is measure. This procedure is repeated at 100% and 115% of the rated supply voltage.

Carrier Frequency: 13.56 MHz						
Supply Voltage (DC)	**Ambient Temperature**	**Frequency Deviation [ppm]**		**Maximum allowed Deviation**		**Result**
[V]	**[°C]**	**[Hz]**	**[ppm]**	**[Hz]**	**[ppm]**	
20.4	+20	-98.1	-7.23	±1356	±100	compliant
24.0		-94.2	-6.95	±1356	±100	compliant
27.6		-98.4	-7.26	±1356	±100	compliant
Measurement Uncertainty:					±3.6 Hz	

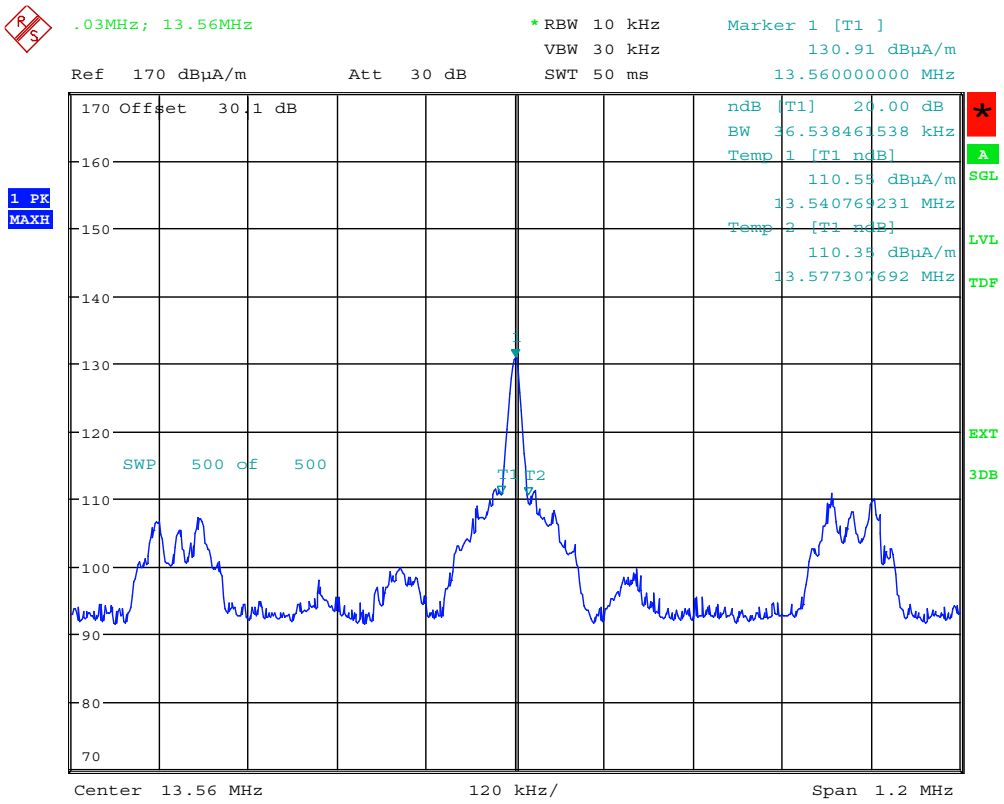
Table 6-5: Results – Frequency Stability with voltage variation for DC Supply

The measured frequency stability was found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.

7 Test Data and Screenshots

7.1 Spectral Plots

7.1.1 Test No. 2: Occupied Bandwidth (§ 15.215c)



Occupied bandwidth Measurement

With respect to reference level: 20dB

Date: 14.DEC.2015 14:23:20

Figure 7-1: Occupied Bandwidth (Carrier Frequency 13.56 MHz)

7.1.2 Test No. 3: Radiated Emissions (§ 15.205, § 15.209, § 15.225a-d)

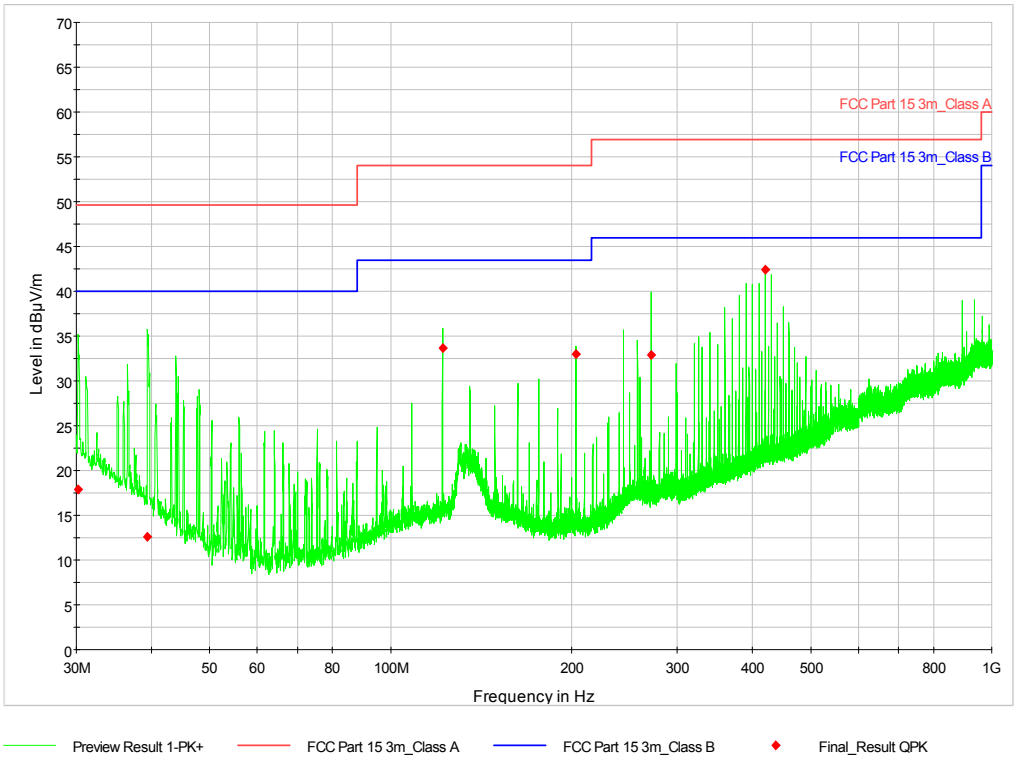


Figure 7-2: Radiated Emissions - 30 MHz to 1 GHz (§ 15.205, 15.209)

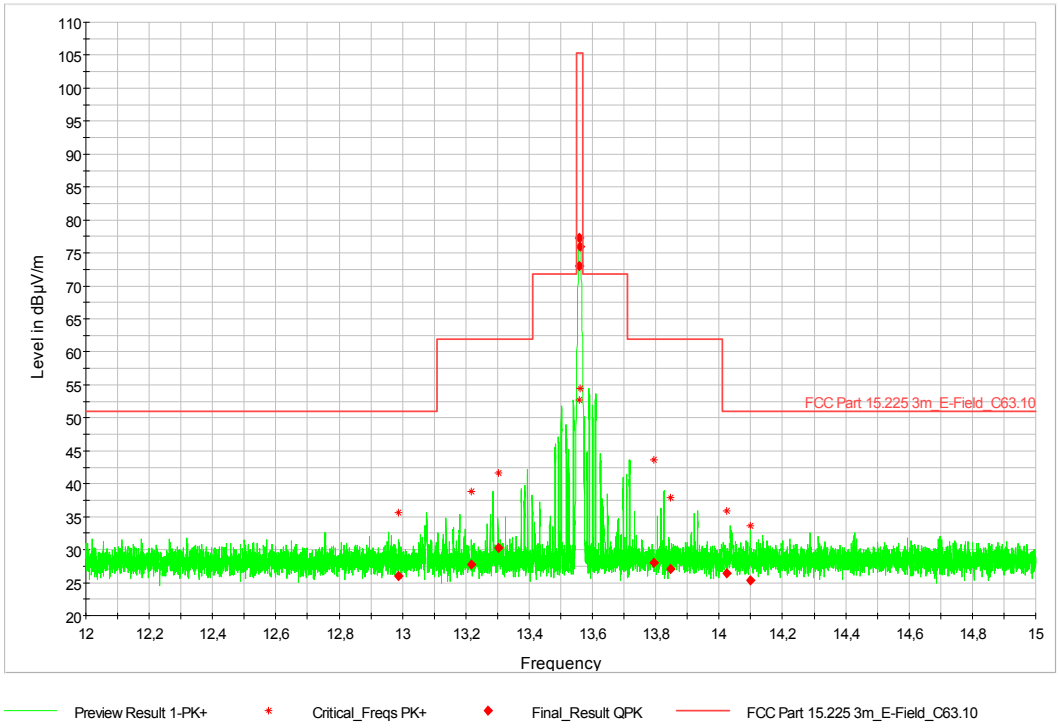


Figure 7-3: Radiated Emissions – 13.110 MHz to 14.010 MHz (§ 15.225a-c)

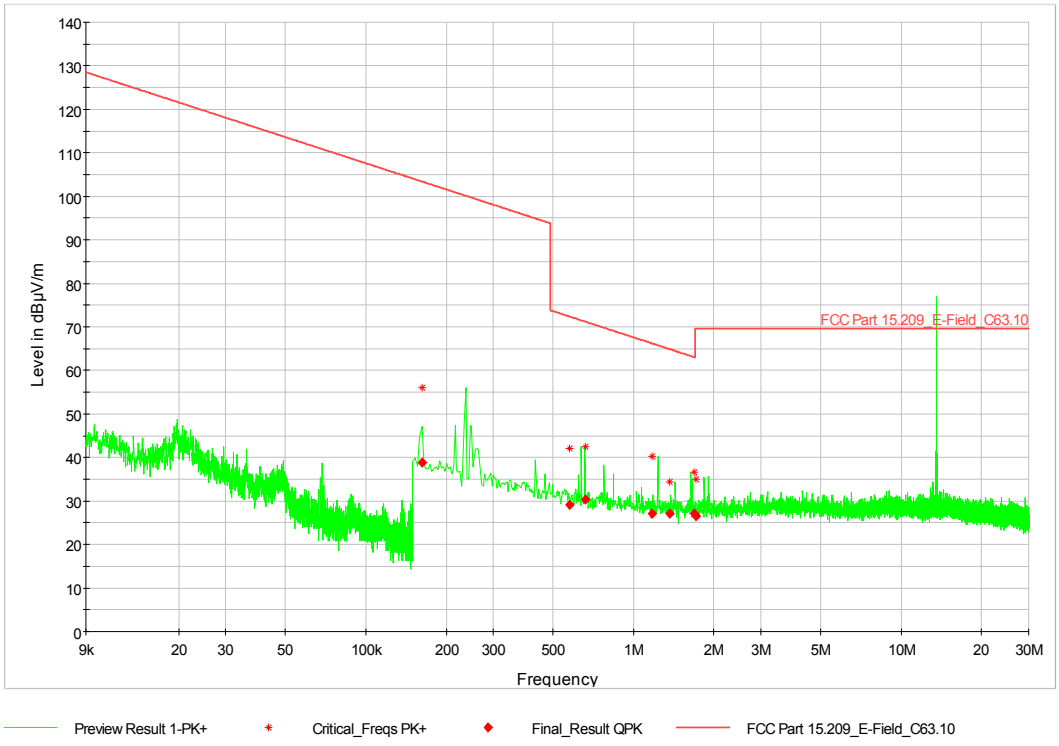
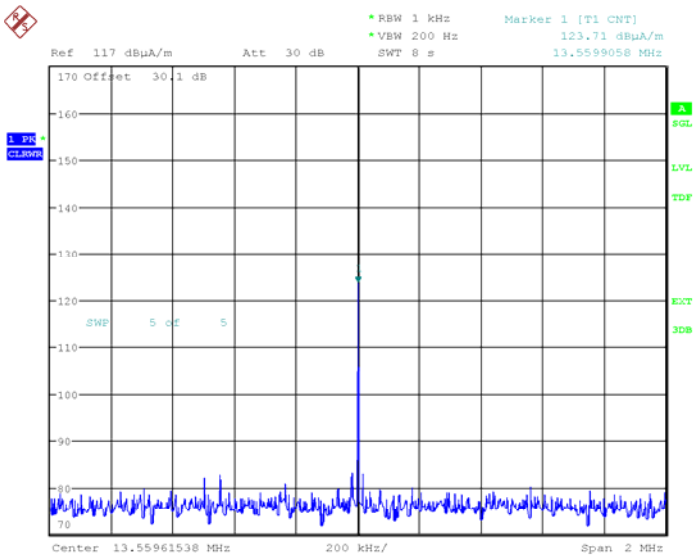


Figure 7-4: Radiated Emissions – 9 kHz to 30 MHz (§ 15.225d)

7.1.3 Test No. 4: Frequency Stability (§ 15.225e)



Frequency stability Measurement
Stability with respect to ambient temperature at Startup
Temperature: 20°C
Date: 30.NOV.2015 11:14:31

Figure 7-5: Frequency statibilty – 20°C/24V at startup

7.2 Test Setups

7.2.1 Test No. 2: Occupied Bandwidth (§ 15.215c)

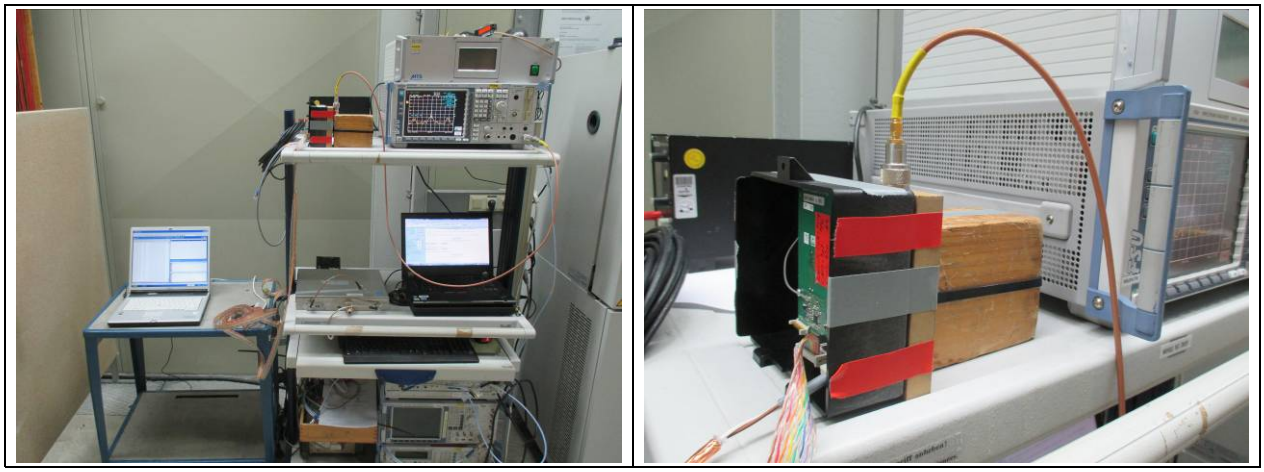


Figure 7-6: Test Setup Occupied Bandwidth

7.2.2 Test No. 3: Radiated Emissions (§ 15.205, § 15.209, § 15.225a-d)

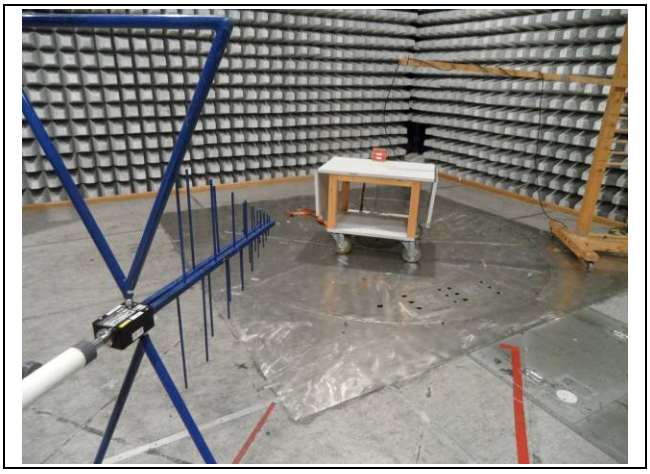


Figure 7-7: Test Setup Radiated Emission 30 MHz – 1 GHz

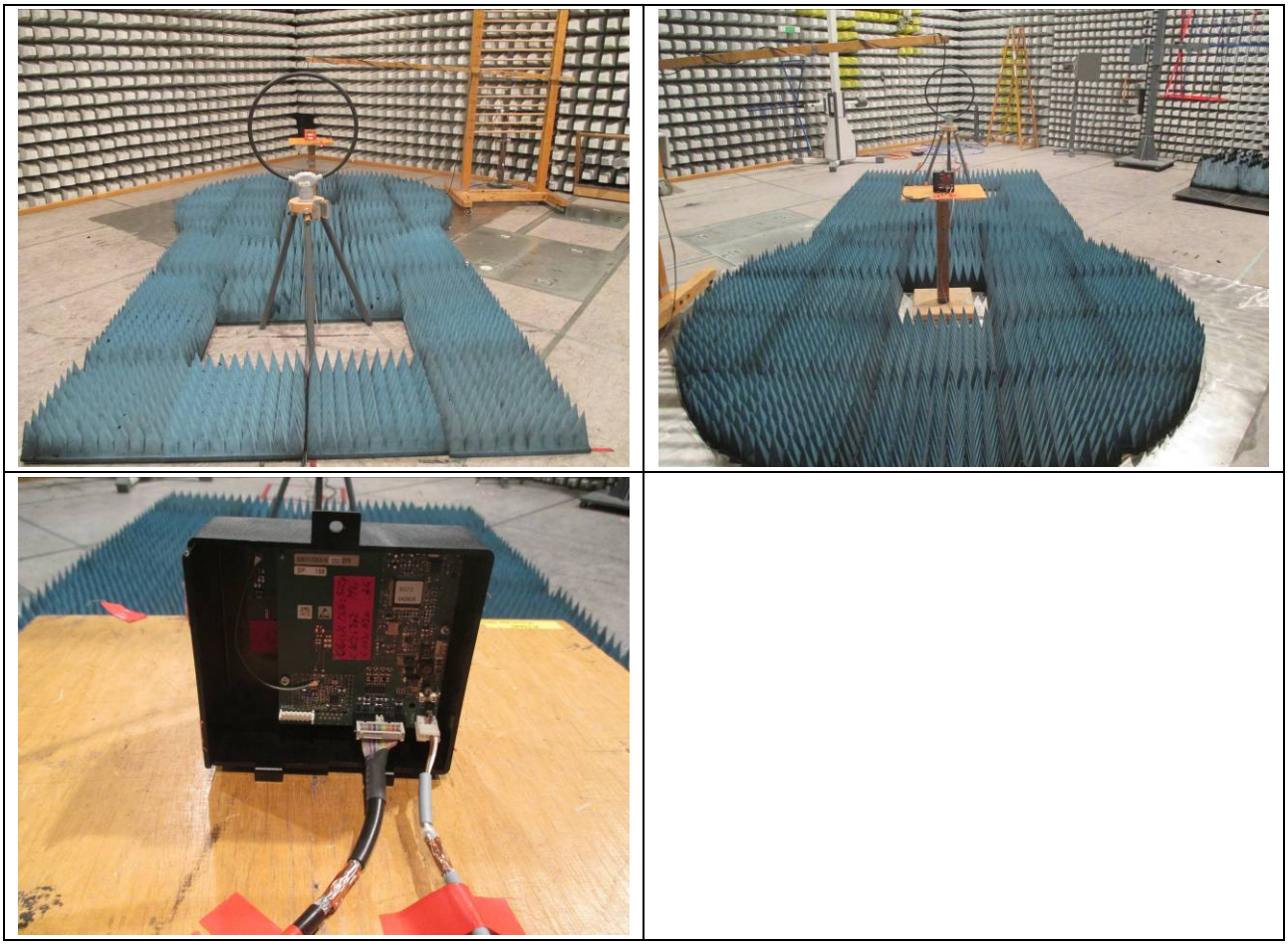


Figure 7-8: Test Setup Radiated Emission 9 kHz – 30 MHz

7.2.3 Test No. 4: Frequency Stability (§ 15.225e)

Figure 7-9: Test Setup – Frequency Stability with voltage or Temperature variation

7.3 Photographs of EUT and accessories

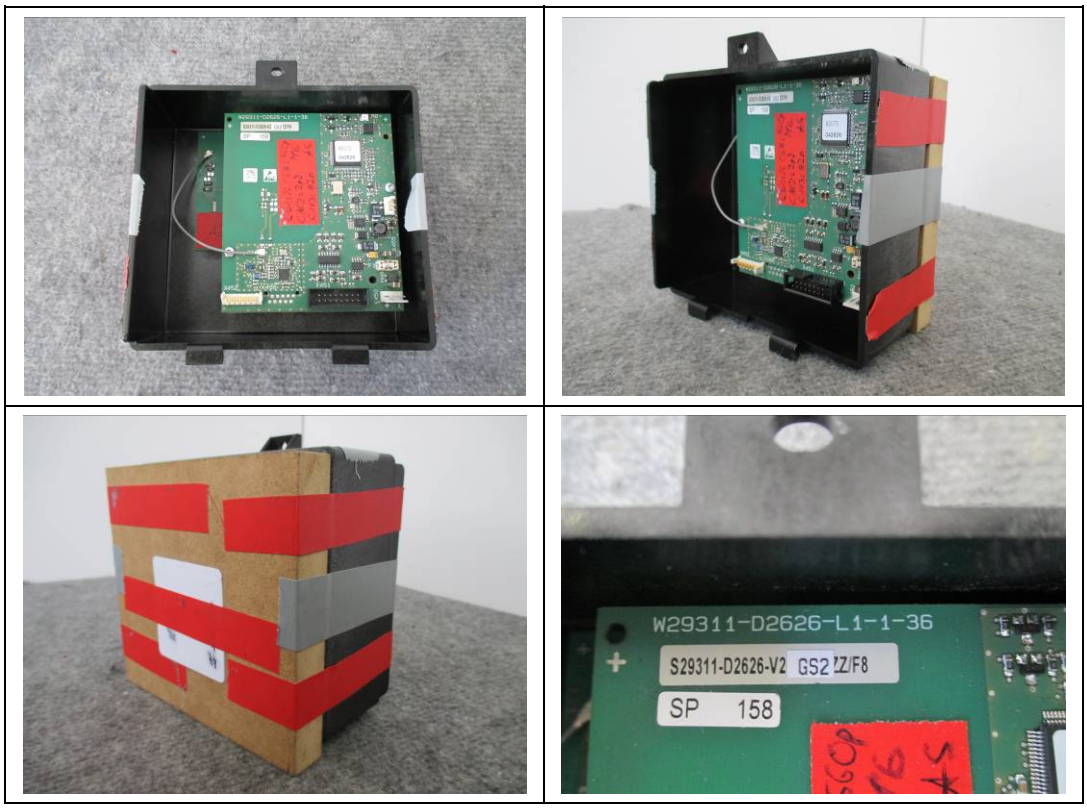


Figure 7-10: S29311-D2626-V02 with antenna PCB D2674

7.4 Annex A

Compliance with § 15.225a-d and § 15.225 requires that the field strength of any emissions shall not exceed limits given in µV/m at a specified limit distances.

Since measurement has been made with a loop antenna at a measurement distance of 3 meters the compliance limit was extrapolated from the respective limit distances to 3 meters by calculation according to C63.10-2013 chapter 6.6.4.2.

FCC Electric fields limit [µV/m]:	$L_{\mu V/m}$
Converted FCC Electric fields limit [dBµV/m]:	$FS_{limit} = 20 \log (L_{\mu V/m}) + 120$
Reference limit distance [m]:	d_{limit}
distance of the measurement point [m]:	$d_{measure}$
Nearfield distance [m] :	$d_{nearfield} = 47.77/f_{MHz}$

If the single point measured closer to the EUT than λ/2π and limit distance greater than λ/2π following equation has been used

$$\mathbf{FS_{max}}[dB\mu V/m] = FS_{limit} + 40\log(d_{nearfield/}\ d_{measure)} + 20\log(d_{limit/}\ d_{nearfied)}$$

If the single point measured greater than λ/2π following equation has been used

$$\mathbf{FS_{max}}[dB\mu V/m] = FS_{limit} + 20\log(d_{limit/}\ d_{measure}$$

If both the single point and the limit distance are equal or closer to the EUT than λ/2π following equation has been used

$$\mathbf{FS_{max}}[dB\mu V/m] = FS_{limit} + 40\log(d_{limit/}\ d_{measure)}$$

Using the equations above appropriately yield following conversion table

Frequency Ranges [MHz]	**L [µV/m]**	d_{limit} **[m]**	FS_{limit} **[dBµV/m]**	$\mathbf{FS_{max}}$**[m [dBµV/m]**	$d_{measure}$ **[m]**
12.660	30	30	29.54	50.94	3
13.110	30	30	29.54	50.94	3
13.110	106	30	40.51	61.90	3
13.410	106	30	40.51	61.90	3
13.410	334	30	50.47	71.87	3
13.553	334	30	50.47	71.87	3
13.553	15848	30	84.00	105.39	3
13.567	15848	30	83.00	105.39	3
13.567	334	30	50.47	71.87	3
13.710	334	30	50.47	71.87	3
13.710	106	30	40.51	61.90	3
14.010	106	30	40.51	61.90	3
14.010	30	30	29.54	50.94	3
14.460	30	30	29.54	50.94	3

Table 7-1: Conversion table for radiated emissions limits § 15.225a-c

Frequency Ranges [MHz]	**L** [µV/m]	d_{limit} [m]	FS_{limit} [dBµV/m]	**FS_{max}[m** [dBµV/m]	$d_{measure}$ [m]
0.009	266.67	300	48.52	128.52	3
0.490	4.90	300	13.80	93.80	3
0.490	48.98	30	33.80	73.80	3
1.705	14.08	30	22.97	62.97	3
1.705	30.00	30	29.54	69.54	3
30.0	30.00	30	29.54	69.54	3

Table 7-2: Conversion table for radiated emissions limits § 15.225d

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