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Test Report

Report Number: F141583E1 2nd Version

Applicant:

deister electronic GmbH

Manufacturer:

deister electronic GmbH

Equipment under Test (EUT):

RFID system

KPM 5/3



Deutsche
Akkreditierungsstelle
D-PL-17186-01-01
D-PL-17186-01-02
D-PL-17186-01-03

REFERENCES

- [1] **ANSI C63.10:2013** American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- [2] **FCC 47 CFR Part 15** Radio Frequency Devices
- [3] **RSS-210 Issue 8 (December 2010)** Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
- [4] **RSS-Gen Issue 4 (November 2014)** General Requirements and Information for the Certification of Radiocommunication Equipment

TEST RESULT

The requirements of the tests performed as shown in the overview (chapter 4 of this test report) were fulfilled by the equipment under test.
The complete test results are presented in the following.

Test engineer:	Michael DINTER		2 February 2016
	_____ Name	_____ Signature	_____ Date
Authorized reviewer:	Bernd STEINER		2 February 2016
	_____ Name	_____ Signature	_____ Date

RESERVATION

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1 Identification

1.1 Applicant

Name:	deister electronic GmbH
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1.2 Manufacturer

Name:	deister electronic GmbH
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Country:	Germany
Name for contact purposes:	Mr. Thorsten Krohn
Tel:	+49-(0)-5105-516-111
Fax:	+49-(0)- 5105-516-217
e-mail address:	info@deister-gmbh.de

1.3 Test laboratory

The tests were carried out at: **PHOENIX TESTLAB GmbH**
Königswinkel 10
32825 Blomberg
Germany

Test Laboratory (CAB) accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025 under the Reg. No. D-PL-17186-01-02, recognized by Bundesnetzagentur under the Reg.-No. BNetzA-CAB-02/21-104. CAB Designation Number DE0004, listed by FCC 31040/SIT1300F2, IC OATS Listing 3469A-1.

1.4 EUT (Equipment Under Test)

Type of equipment:	13.56 MHz RFID Reader
Type designation / model name:	KPM5/3 (with keypad)
Serial No.:	-
FCC ID:	IXLPRM53KPM53
IC:	1893B - PRM53KPM53
Lowest internal frequency:	-
Highest internal frequency:	14.7456 MHz
Antenna type:	Internal loop antenna

Remark*: The IC and the FCC ID were not printed on the tested sample.

1.5 Technical data of equipment

Power supply: *	24 V DC supplied by external power supply		
Supply voltage: *	$U_{nom}=12 - 24 \text{ V DC}$	$U_{min}= 8 \text{ V}$	$U_{max}= 30 \text{ V}$
Type of modulation: *	ASK		
Operating frequency range: *	13.56 MHz		
Number of channels: *	1		
Antenna type: *	Internal loop antennas		
Duty cycle: *	100%		
Rated RF power: *	< 250 mW		
Data rate: *	2 kbaud up to 424 kbaud		
Temperature range: *	-25°C to 60°C		

* declared by the applicant.

Ports / Connectors			
Identification	Connector		Length during test
	EUT	Ancillary	
I/O and power supply	12 PIN	customized	2 m

1.6 Dates

Date of receipt of test sample:	3 July 2014
Start of test:	18 August 2014
End of test:	26 November 2014

2 Operational states and physical boundaries

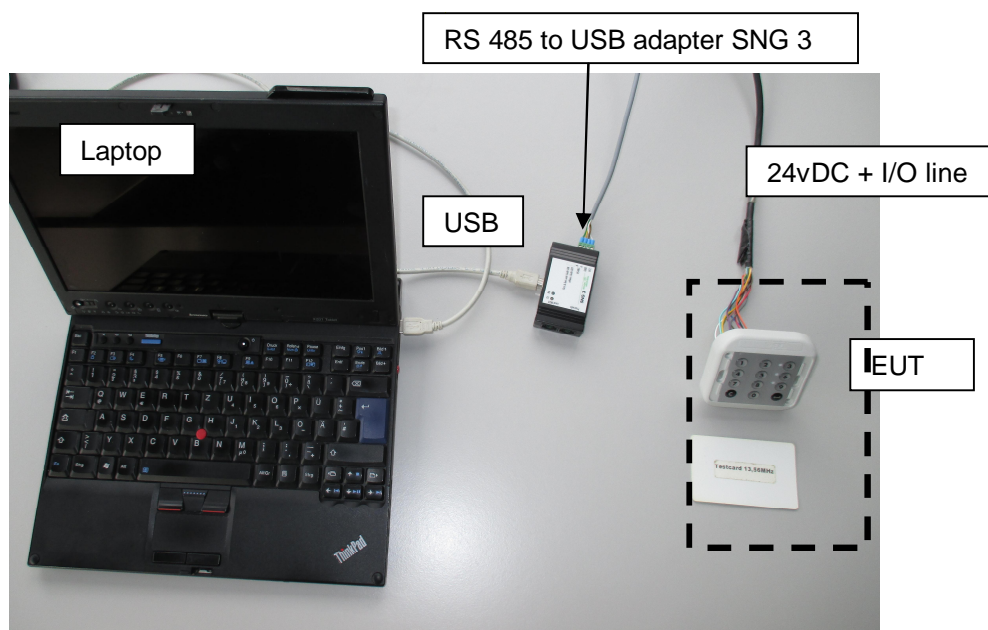
The EUT is a RFID transponder for universal use with additional keypad.
All tests were carried out with an unmodified test sample, which operates in normal mode.
During all test the EUT was reading a TAG.
Additionally the a RS 485 connection was established with an RS 485 to USB adapter SNG 3.
The transponder code was shown on the Laptop with a terminal program.

The conducted emission measurement on the power supply line was carried out on a AC/DC adapter
Phoenix Contact MINI-PS-100-240AC/24DC/C2LPS Order-No: 2866336.
During all tests the EUT was supplied with 24 V DC via an AC/DC adapter by an AC-mains network with
120 V AC / 60 Hz.

No spurious emission measurement of the receiver was carried out, because the co located transmitter
transmits continuously.

The physical boundaries of the EUT are shown below.

Physical boundaries of the EUT



3 Additional information

During the tests, the EUT was not labelled with a FCC or IC -label.

The following Laptop PC was used for the measurements.

Lenovo Think Pad x201 tablet

External power supply Phoenix Contact MINI-PS-100-240AC/24DC/C2LPS Order-No: 2866336

RFID TAG type 13.56 MHz: Mifare Classic (Mifare 1 S70) ISO card, ISO14443

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-210 Issue 8 [3] and RSS-Gen, Issue 4 [4]	Status	Refer page
Conducted emissions on supply line	0.15 - 30	15.207 (a)	8.8 [4]	Passed	9 et seq.
Radiated emissions	0.009 - 1,000	15.205 (a) 15.209 (a)	8.9 [4] 2.5 [3]	Passed	12 et seq.
99 % bandwidth	13.56 MHz	-	6.6 [4]	Passed	Annex D

5 Test results

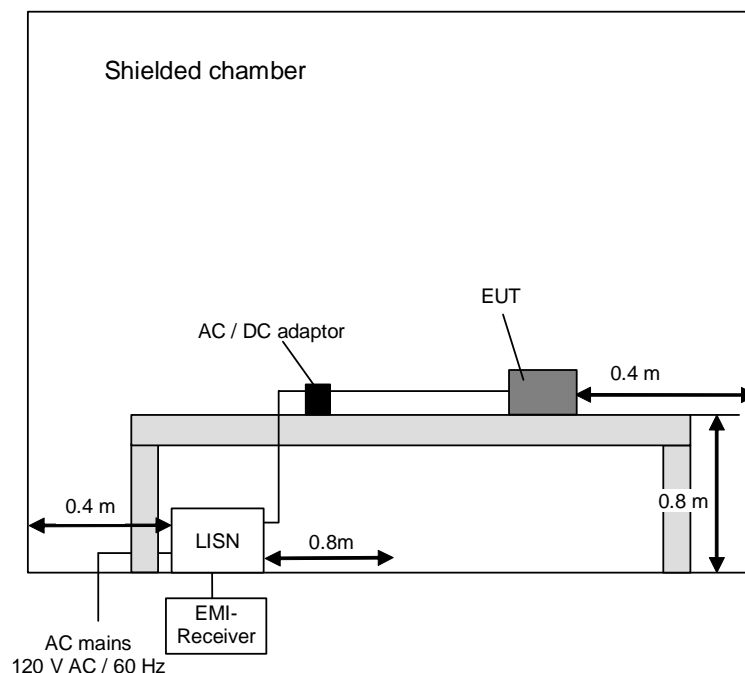
5.1 Conducted emission measurement on AC mains (150 kHz to 30 MHz)

5.1.1 Method of measurement conducted emission

This test will be carried out in a shielded chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm above the ground plane. Floor-standing devices will be placed directly on the ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.10 [1].

The frequency range 150 kHz to 30 MHz will be measured with an EMI Receiver set to MAX Hold mode with peak and average detector and a resolution bandwidth of 9 kHz. A scan will be carried out on the phase (or plus pole in case of DC powered devices) of the AC mains network. If levels detected 10 dB below the appropriable limit, this emission will be measured with the average and quasi-peak detector on all lines.

Frequency range	Resolution bandwidth
150 kHz to 30 MHz	9 kHz



5.1.2 Test result (conducted emission measurement on AC mains)

Ambient temperature:	20 °C	Relative humidity:	45 %
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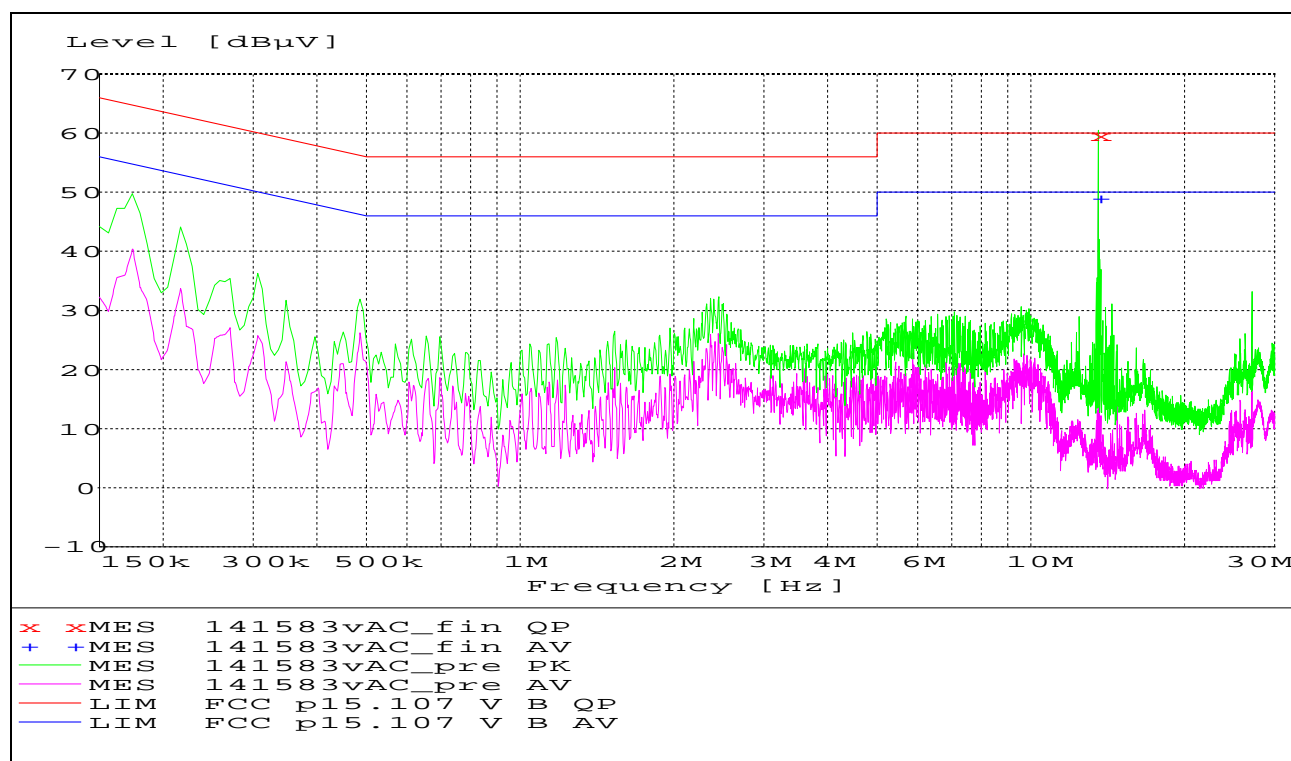
Position of EUT: The EUT was set-up on a wooden table of a height of 0.8 m.

Cable guide: The cable of the EUT was fixed on the wooden table. For further information of the cable guide refer to the pictures in annex A of this test report.

Test record: The test was carried out in normal operation mode of the EUT (reading a TAG). All results are shown in the following.

Power supply: During this test the EUT was powered with 24 V DC via an AC adapter Phoenix Contact MINI-PS-100-240AC/24DC/C2LPS Order-No: 2866336 with 120 V AC / 60 Hz AC-mains network.

Operation states: As described in chapter 2.



Data record name: 141583vAC

Result measured with the quasipeak detector (marked by an x):

Frequency MHz	Level dBμV	Transducer dB	Limit dBμV	Margin dB	Line	PE
13.559100	59.60	1.8	60.0	0.4	-	GND

Result measured with the average detector (marked by a +):

Frequency MHz	Level dBμV	Transducer dB	Limit dBμV	Margin dB	Line	PE
13.559100	49.10	1.8	50.0	0.9	+	FLO

Test: Passed

TEST EQUIPMENT USED:

20 - 22

5.2 Radiated emissions

5.2.1 Method of measurement (radiated emissions)

The radiated emission measurement is subdivided into three stages.

- A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 9 kHz to 1 GHz.
- A final measurement carried out on an outdoor test side without reflecting ground plane and a fixed antenna height in the frequency range 9 kHz to 30 MHz.
- A final measurement carried out on an open area test side with reflecting ground plane and various antenna height in the frequency range 30 MHz to 1 GHz.

All measurements will be carried out with the EUT working on the middle and upper and lower edge of the assigned frequency band.

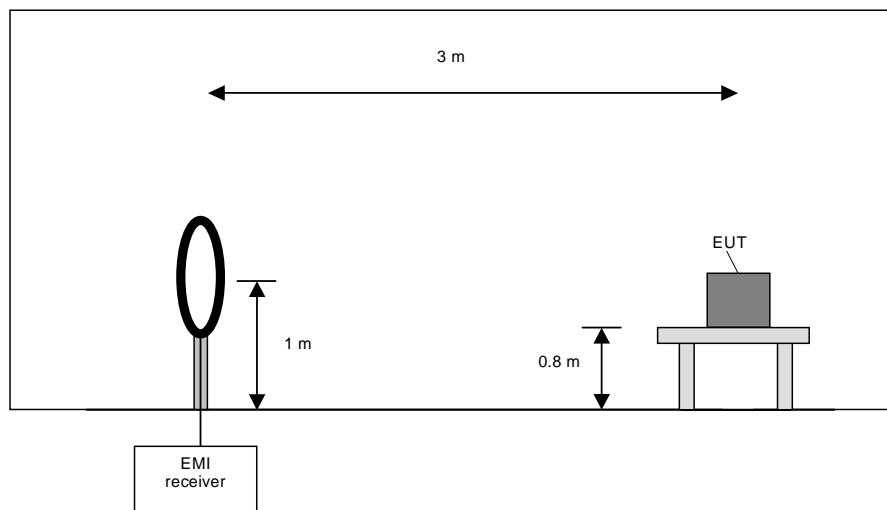
Preliminary measurement (9 kHz to 30 MHz):

In the first stage a preliminary measurement will be performed in a shielded room with a measuring distance of 3 meters. Table top devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The setup of the Equipment under test will be in accordance to ANSI C63.10 [1].

The frequency range 9 kHz to 30 MHz will be monitored with a spectrum analyser while the system and its cables will be manipulated to find out the configuration with the maximum emission levels if applicable. The EMI Receiver will be set to MAX Hold mode. The EUT and the measuring antenna will be rotated around their vertical axis to found the maximum emissions.

The resolution bandwidth of the spectrum analyser will be set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	10 kHz



Preliminary measurement procedure:

Prescans were performed in the frequency range 9 kHz to 150 kHz and 150 kHz to 30 MHz.

The following procedure will be used:

- 1) Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
- 2) Manipulate the system cables within the range to produce the maximum level of emission.
- 3) Rotate the EUT by 360 ° to maximize the detected signals.
- 4) Make a hardcopy of the spectrum.
- 5) Measure the frequencies of highest detected emission with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
- 6) Repeat steps 1) to 5) with the other orthogonal axes of the EUT (because of EUT is a module and might be used in a handheld equipment application).
- 7) Rotate the measuring antenna and repeat steps 1) to 5).

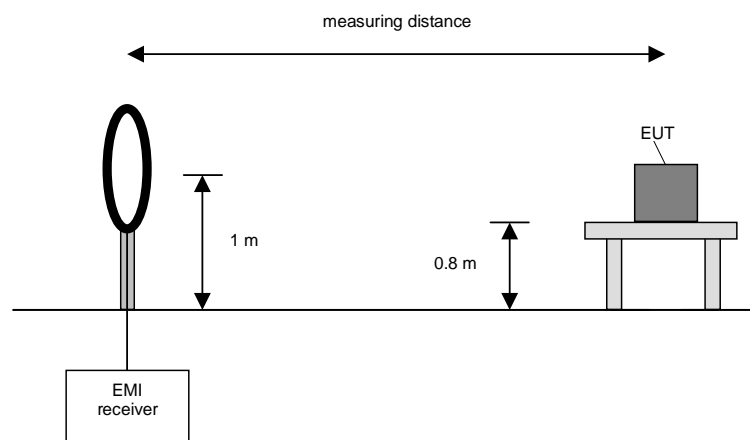
Final measurement (9 kHz to 30 MHz):

In the second stage a final measurement will be performed on an open area test site with no conducting ground plane in a measuring distances of 3 m, 10 m and 30 m. In the case where larger measuring distances are required the results will be extrapolated based on the values measured on the closer distances according to Section 15.31 (f) (2) [2]. The final measurement will be performed with a EMI Receiver set to Quasi Peak detector except for the frequency bands 9 kHz to 90 kHz and 110 kHz to 490 kHz where an average detector will be used according Section 15.209 (d) [2].

On the during the preliminary measurement detected frequencies the final measurement will be performed while rotating the EUT and the measuring antenna in the range of 0 ° to 360 ° around their vertical axis until the maximum value is found.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz



Final measurement procedure:

The following procedure will be used:

- 1) Monitor the frequency range with the measuring antenna at vertical orientation parallel to the EUT at an azimuth of 0 °.
- 2) Rotate the EUT by 360 ° to maximize the detected signals and note the azimuth and orientation.
- 3) Rotate the measuring antenna to find the maximum and note the value.
- 4) Rotate the measuring antenna and repeat steps 1) to 3) until the maximum value is found.
- 5) Repeat steps 1) to 4) with the other orthogonal axes of the EUT (because of EUT is a module and might be used in a handheld equipment application).

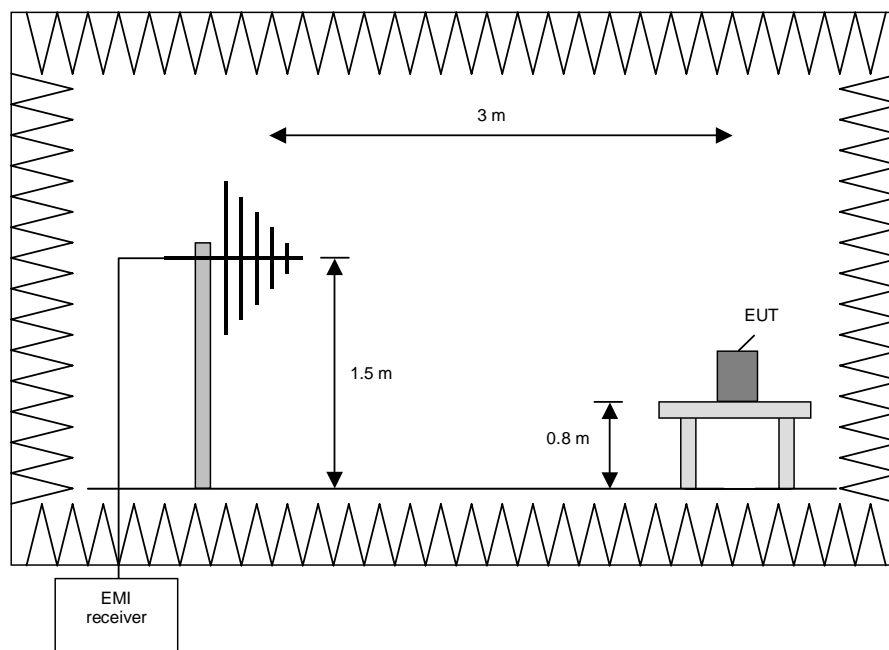
Preliminary measurement (30 MHz to 1 GHz)

In the first stage a preliminary measurement will be performed in a fully anechoic chamber with a measuring distance of 3 meter. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.10 [1].

The frequency range 30 MHz to 1 GHz will be measured with an EMI Receiver set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
30 MHz to 230 MHz	100 kHz
230 MHz to 1 GHz	100 kHz



Procedure preliminary measurement:

Prescans were performed in the frequency range 30 MHz to 230 MHz and 230 MHz to 1 GHz.

The following procedure will be used:

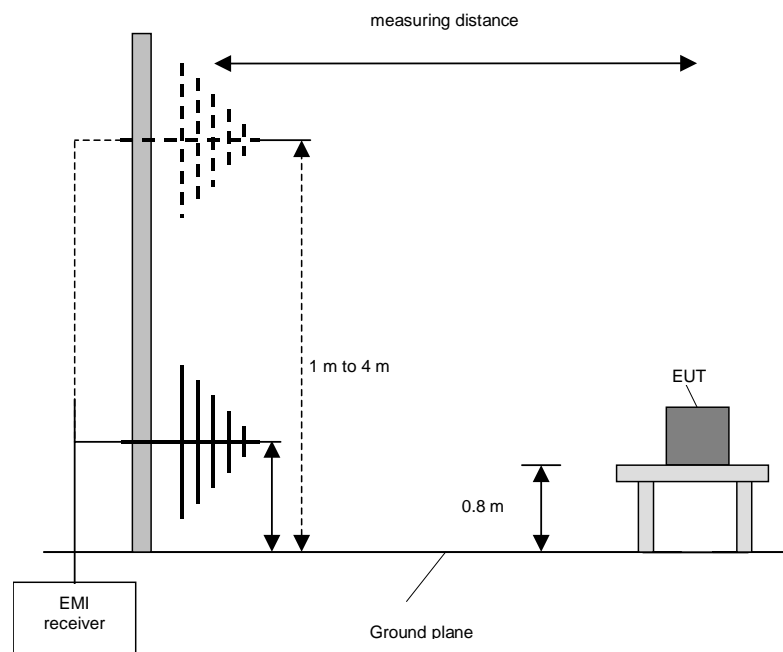
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
6. Repeat 1) to 4) with the other orthogonal axes of the EUT (because of EUT is a module and might be used in a handheld equipment application).
7. Repeat 1) to 5) with the vertical polarisation of the measuring antenna.

Final measurement (30 MHz to 1 GHz)

A final measurement on an open area test site will be performed on selected frequencies found in the preliminary measurement. During this test the EUT will be rotated in the range of 0 ° to 360 °, the measuring antenna will be set to horizontal and vertical polarisation and raised and lowered in the range from 1 m to 4 m to find the maximum level of emissions.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	120 kHz



Procedure final measurement:

The following procedure will be used:

- 1) Measure on the selected frequencies at an antenna height of 1 m and a EUT azimuth of 23 °.
- 2) Move the antenna from 1 m to 4 m and note the maximum value at each frequency.
- 3) Rotate the EUT by 45 ° and repeat 2) until an azimuth of 337 ° is reached.
- 4) Repeat 1) to 3) for the other orthogonal antenna polarization.
- 5) Move the antenna and the turntable to the position where the maximum value is detected.
- 6) Measure while moving the antenna slowly +/- 1 m.
- 7) Set the antenna to the position where the maximum value is found.
- 8) Measure while moving the turntable +/- 45 °.
- 9) Set the turntable to the azimuth where the maximum value is found.
- 10) Measure with Final detector (QP and AV) and note the value.
- 11) Repeat 5) to 10) for each frequency.
- 12) Repeat 1) to 11) for each orthogonal axes of the EUT (because of EUT is a module and might be used in a handheld equipment application).

5.2.2 Preliminary radiated emission tests (9 kHz to 30 MHz)

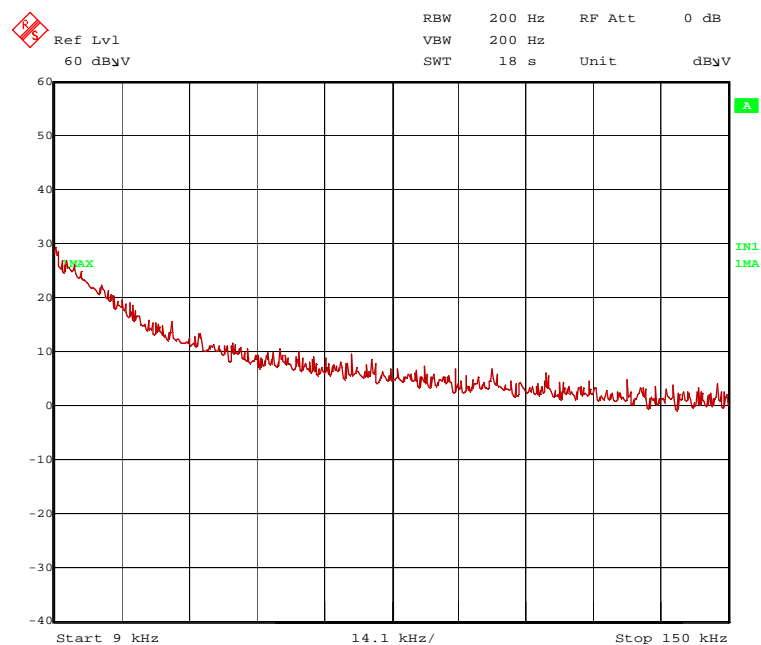
Ambient temperature:	20 °C	Relative humidity:	45 %
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Position of EUT: The EUT was set-up on a wooden table of a height of 0.8 m.

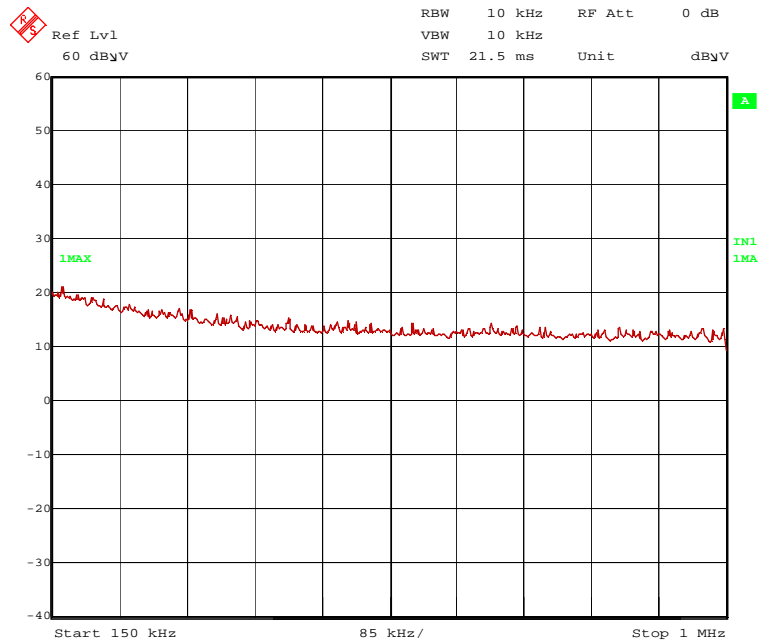
Cable guide: The cable of the EUT was fixed on the wooden table. For further information of the cable guide refer to the pictures in annex A of this test report.

Test record: The test was carried out in normal operation mode of the EUT (reading a TAG). All results are shown in the following.

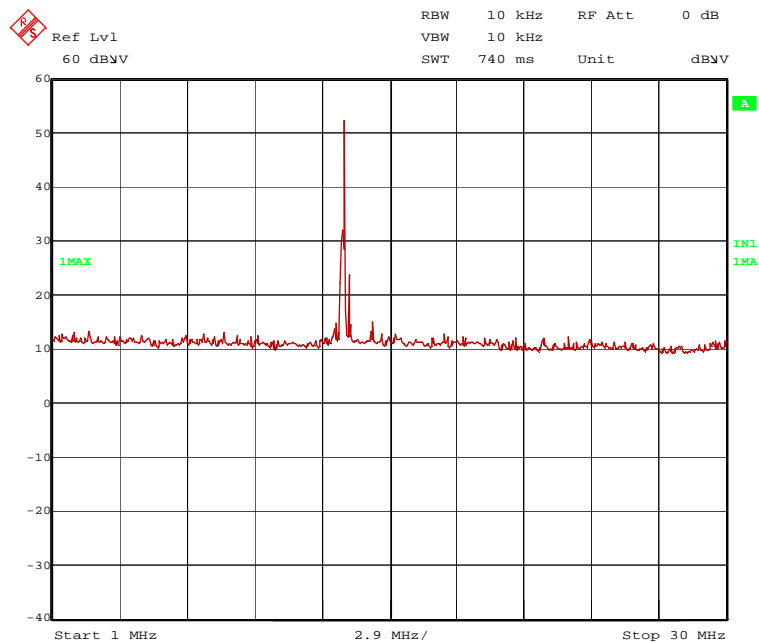
Power supply: During this test the EUT was powered with 24 V DC.



141583m_3.wmf: Spurious emissions from 9 kHz to 150 kHz



141583m_3.wmf: Spurious emissions from 150 kHz to 1 MHz



141583m_2.wmf: Spurious emissions from 1 MHz to 30 MHz

The following emission was found according to FCC 47 CFR Part 15 section 15.209 (a).

13.56 MHz (wanted signal is according to FCC 47 CFR Part 15)

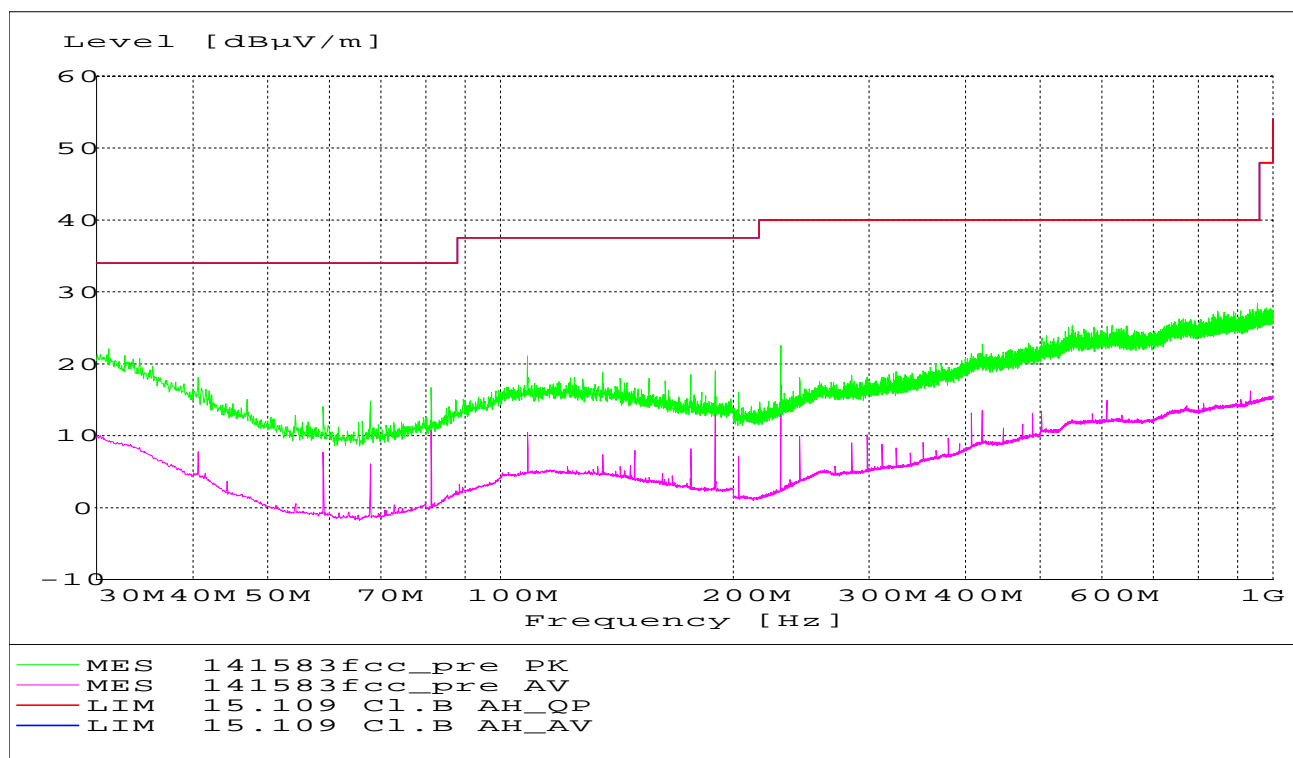
This frequency has to be measured on the outdoor test site. The results were presented in the following.

Test equipment used the test:

1 – 4, 8

5.2.3 Preliminary radiated emission tests (30 MHz to 1 GHz)

Title: Emission measurement according FCC
EMI Test receiver ESI Rohde & Schwarz
EUT: KPM 5/3
Manufacturer: deister electronic GmbH
Operating Condition: continuous reading tag 13.56 MHz and rs485 data reading via terminal program
Test site: fully anechoic chamber M20; PHOENIX TEST LAB GmbH
Operator: M.DINTER
Comment: power supply: 24 V DC
tx 13.56 MHz



Data record name: 141583fcc

The following frequencies were found outside and inside the restricted bands found according to FCC 47 CFR Part 15 section 15.209.

108.400 MHz; 189.840 MHz and 230.480 MHz

Test equipment used the test:

1 – 7

5.2.4 Final radiated emission test (9 kHz to 30 MHz)

Ambient temperature:	14 °C	Relative humidity:	56 %
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Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m, 10 m and 30 m.

Cable guide: The cable of the EUT was fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex A of this test report.

Test record: The test was carried out in normal operation mode of the EUT (awaiting a TAG). All results are shown in the following.

Power supply: During this test the EUT was supplied with 24 V_{DC} via AC Adapter powered with 120 V AC / 60 Hz.

Test results: The test results were calculated with the following formula:

$$\text{Result [dB}\mu\text{V/m]} = \text{reading [dB}\mu\text{V]} + \text{antenna factor [dB/m]}$$

Results with measuring distance of 3 m						
Frequency MHz	Result dB μ V/m	Limit(* dB μ V/m	Margin dB	Detector	Readings dB μ V	Antenna factor * dB/m
13.56	68.4	69.5	1.1	QP	48.4	20.0
Results with measuring distance of 10 m						
Frequency MHz	Result dB μ V/m	Limit(* dB μ V/m	Margin dB	Detector	Readings dB μ V	Antenna factor * dB/m
13.56	49.4	49.5	0.1	QP	29.4	20.0
Signal was below the noise floor of the measuring system						
Measurement uncertainty			+2.2 dB / -3.6 dB			

*: Cable loss included

(*: Limits according to 15.209

(*: Limits extrapolated with a factor (40dB/decade) from the result at 3 m and 10 m according to Part 15.31 (f)(2)

Remark: At the 30 m distance the TX level was too low for measuring the signal of the 13.56 MHz.

Test: Passed

Test equipment used for the test:

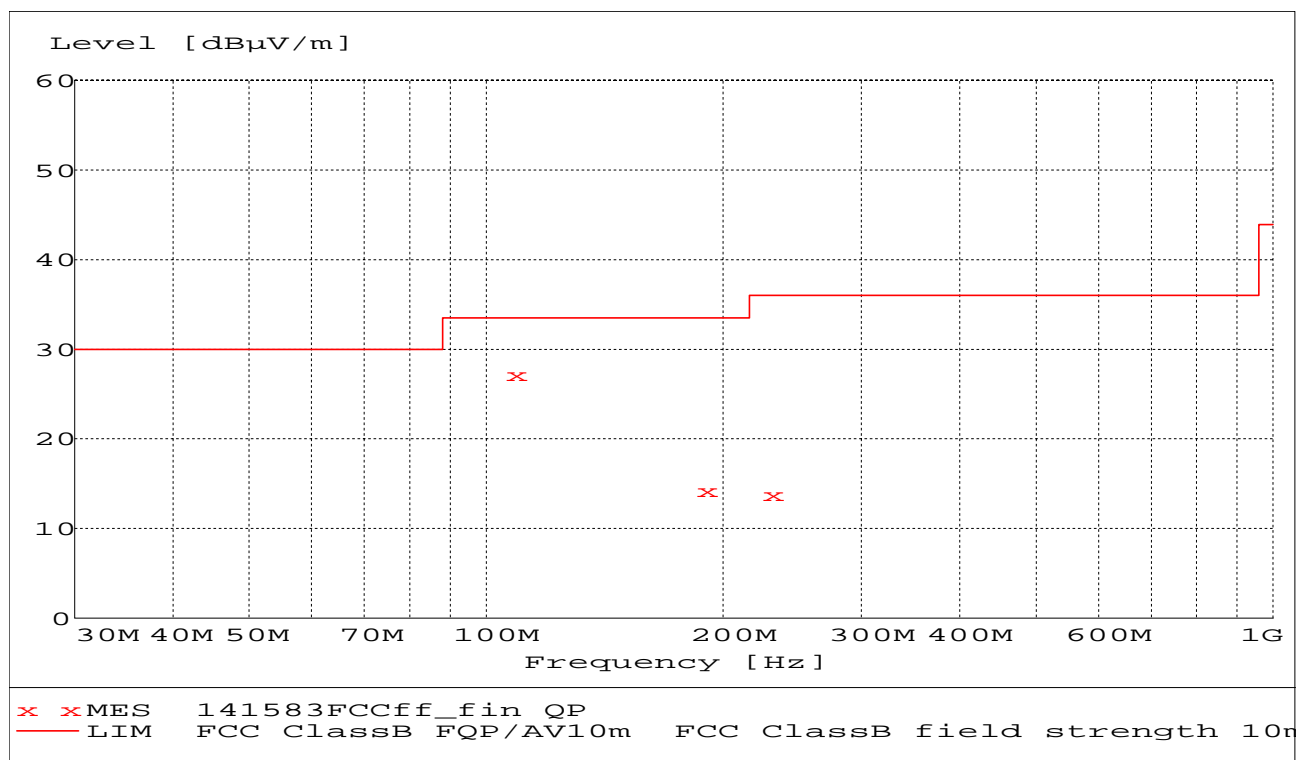
8 – 9, 11

5.2.5 Final radiated emission test (30 MHz to 1 GHz)

Ambient temperature:	6 °C	Relative humidity:	46 %
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Title: Final measurement on 10 m open area test site according to FCC
 Test-Receiver ESIB7 from Rohde & Schwarz
 EUT: KPM 5/3
 Manufacturer: deister electronic GmbH
 Operating Condition: continuous reading tag 13.56 MHz and rs485 data reading via terminal program
 Test site: PHOENIX TESTLAB Blomberg; open area test site M6
 Operator: M.DINTER
 Comment: power supply: 24 V DC
 tx 13.56 MHz

The measured points and the limit line in the following diagram refer to the standard measurement of the emitted interference in compliance with the above mentioned standard. The measured points marked with "x" are the measured results of the standard subsequent measurement on the open area test site.



Data record name: 141583FCCff

The results of the standard subsequent measurement on the open area test site are indicated in the table below. The limits as well as the measured results (levels) refer to the above mentioned standard while taking account of the specified requirements for a 10 m measuring distance.

Spurious emissions in restricted bands									
Frequency	Result	Limit	Margin	Readings	Antenna factor	Cable loss	Height	Azimuth	Pol.
MHz	dBμV/m	dBμV/m	dB	dBμV	dB/m	dB	cm	deg	
108.400	27.20	33.5	6.3	14.5	11.6	1.1	121	135	vertical
Spurious emissions outside restricted bands									
Frequency	Result	Limit	Margin	Readings	Antenna factor	Cable loss	Height	Azimuth	Pol.
MHz	dBμV/m	dBμV/m	dB	dBμV	dB/m	dB	cm	deg	
189.840	14.30	33.5	19.2	3.8	9.0	1.5	318	90	horizontal
230.480	13.80	36.0	22.2	1.9	10.3	1.6	265	286	horizontal
Measurement uncertainty				+2.2 dB / -3.6 dB					

Test: Passed

Test equipment used for the test:

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6 Report history

Report Number	Date	Comment
F141583E1	13 January 2015	Document created
F141583E1 2 nd Version	2 February 2016	Editorial changes: Update from ANSI C63.4-2009 to ANSI C63.10-2013

7 Test equipment and ancillaries used for tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
1	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Weekly verification (system cal.)	
2	Measuring receiver	ESI 40	Rohde & Schwarz	100064	480355	26/02/2014	02/2016
3	Controller	HD100	Deisel	100/670	480326	-	-
4	Turntable	DS420HE	Deisel	420/620/80	480315	-	-
5	Antenna support	AS615P	Deisel	615/310	480187	-	-
6	Antenna	CBL6112 B	Chase	2688	480328	14/04/2014	04/2017
7	RF-cable No. 30	RTK 081	Rosenberger	-	410141	Weekly verification (system cal.)	
8	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	18/02/2012	02/2016
9	EMI test receiver	ESPC	Rohde & Schwarz	843756/006	480150	24/02/2014	02/2016
10	RF-cable No. 10	RG223	Phoenix-Test-Lab	-	410102	Weekly verification	
11	Outdoor test site	-	Phoenix-Test-Lab	-	480293	-	
12	Open area test site	-	Phoenix Test-Lab	-	480085	Weekly verification (system cal.)	
13	Measuring receiver	ESIB7	Rohde & Schwarz	100304	480521	06/02/2013	02/2015
14	Controller	HD100	Deisel	100/670	480139	-	
15	Turntable	DS420HE	Deisel	420/620/80	480087	-	
16	Antenna support	AS615P	Deisel	615/310	480086	-	-
17	Antenna	CBL6111 D	Chase	25761	480894	18/09/2014	09/2017
18	EMI Software	ES-K1	Rohde & Schwarz	-	480111	-	
19	Horn Antenna	3115 A	EMCO	9609-4918	480183	9/11/2011	11/2014
20	Shielded chamber M4	-	Siemens	B83117S1-X158	480088	Weekly verification (system cal.)	
21	EMI Software	ES-K1	Rohde & Schwarz	-	480111	not necessary	
22	LISN	NSLK8128	Schwarzbeck	8128155	480058	20/12/2012	12/2014
23	LISN	MN2050B	Chase	1133	480146	2/12/2012	12/2014
26	Spectrum analyser	FSW43	Rohde & Schwarz	100586	481720	10/09/2013	09/2015
27	Loop Antenna Ø = 225 mm	-	Phoenix Test-Lab	-	410085	Weekly verification	
28	Spectrum analyser	FSW	Rohde & Schwarz	100586	481720	27/02/2014	02/2016
29	Spectrum analyser	FSU	Rohde & Schwarz	200125	480956	24/02/2014	02/2016

8 List of annexes

ANNEX A	Test setup photos:	6 pages
	Test setup fully anechoic chamber (H-Field)	141583emi1.jpg
	Test setup fully anechoic chamber (E-Field)	141583emi2.jpg
	Test setup outdoor test site (H-Field)	141583emi3.jpg
	Test setup open area test site (E-Field)	141583emi4.jpg
	Test setup shielded chamber	141583emic1.jpg
	Test setup shielded chamber	141583emic2.jpg
ANNEX B	External photos:	4 pages
	EUT, 3D top view	141583eut1.jpg
	EUT, 3D bottom view	141583eut2.jpg
	EUT, top view	141583eut3.jpg
	EUT, bottom view	141583eut4.jpg
ANNEX C	Internal photos:	4 pages
	EUT, Main PCB bottom view	141583pcb1.jpg
	EUT, Loop PCB top view	141583pcb2.jpg
	EUT, Loop PCB bottom view	141583pcb3.jpg
	EUT, Main PCB top view	141583pcb4.jpg
ANNEX D	Additional measurement results for industry Canada:	2 pages