PHOENIX TESTLAB

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Test Report

Report Number:

F190466E2

Equipment under Test (EUT):

Keypad TA03 with electronic furniture code lock M410 TA
Keypad TA03 with electronic furniture code lock M610 TA

Applicant:

Martin Lehmann GmbH & Co. KG

Manufacturer:

Martin Lehmann GmbH & Co. KG

ilac-MRA DAkkS Deutsche Akkreditierungsstelle
D-PL-17186-01-01
D-PL-17186-01-02
D-PL-17186-01-03

References

[1] **ANSI C63.4:2014** American National Standard for Methods of Measuring of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

[2] **FCC 47 CFR Part 2:** General Rules and Regulations

[3] **FCC 47 CFR Part 15:** Radio Frequency Devices (Subpart B)

[4] **ICES-003 Issue 7: (October 2020)** Spectrum Management and Telecommunications. Interference-Causing Equipment Standard. Information Technology Equipment (Including Digital Apparatus) —Limits and Methods of Measurement

Test Result

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

Tested and written by:	Wolfgang KASALOWSKY	W. Kasalowsky	14.10.2021
	Name	Signature	Date
Reviewed and approved by:	Bernward ROHDE	B. Rohde	14.10.2021
	Name	Signature	Date

This test report is only valid in its original form.

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1 Identification

1.1 Applicant

Name:	Martin Lehmann GmbH & Co. KG
Address:	Uphauser Weg 82, 32429 Minden
Country:	Germany
Name for contact purposes:	Mr. Jan BECKENDORF
Phone:	+49 0571-50531-23
eMail address:	jan.beckendorf@lehmann-locks.com
Applicant represented during the test by the following person:	Mr. Jan BECKENDORF

1.2 Manufacturer

Name:	Martin Lehmann GmbH & Co. KG
Address:	Uphauser Weg 82, 32429 Minden
Country:	Germany
Name for contact purposes:	Mr. Jan BECKENDORF
Phone:	+49 0571-50531-23
eMail address:	jan.beckendorf@lehmann-locks.com
Manufacturer represented during the test by the following person:	Mr. Jan BECKENDORF

1.3 Test Laboratory

The tests were carried out by:

PHOENIX TESTLAB GmbH
Königswinkel 10
32825 Blomberg
Germany

Accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-06 and D-PL-17186-01-05, FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.4 EUT (Equipment under Test)

Type of equipment	Keypad with electronic furniture code lock
FVIN:*	Dedicated EMC test firmware
Lowest internal frequency:*	32.768 kHz
Highest internal frequency:*	48 MHz

*: declared by the applicant

	EUT number		
	1	2	3
Serial number: *	Engineering sample	Engineering sample	Engineering sample
PCB identifier: *	1221233	1221196, 15044401	15044401
Hardware version: *	Rev.02	1221216 (LUST32-51) (	1221181 (LUST32-50)
PMN: *	TA03	M410 TA	M610 TA
HVIN: *	MAIIC3M6	SLI2CBM6	SLI2CBM6
FCC ID:*	W2Y-MAIIC3M6	W2Y-SLI2CBM6	W2Y-SLI2CBM6
IC certification number:*	N.A.	N.A.	N.A.

*: declared by the applicant.

3 EUTs were used for the tests. In the overview (chapter 4) is shown which EUT was used for each test case.

Note: PHOENIX TESTLAB GmbH does not take samples. The samples used for tests are provided exclusively by the applicant.

1.5 Technical Data of Equipment

Power supply EUT: *	TA03: Powered from lock M410 TA: 1 x Battery CR123A M610 TA: 2 x Battery CR123A
Supply voltage EUT: *	U_{nom} = 3 V DC
Temperature range: *	Operating: -5°C to +60°C Storage: -25°C to +70°C
Lowest / highest internal clock frequency: *	32.768 kHz / 48 MHz

Ports / Connectors				
Identification	Connector		Length during test	Shielding (Yes / No)
	Keypad	Lock		
Connection cable	Micro-MaTch	Micro-MaTch	0.5 m	No
-	-	-	-	-

Ancillary equipment used for all tests
None

1.6 Dates

Date of receipt of test sample:	05.06.2019
Start of test:	05.06.2019
End of test:	06.06.2019

2 Operational States

Description of function of the EUT:

The EUT is an electronic combination lock with keypad TA03. The keypad is combined with lock M410 TA or M610 TA. Both combinations were tested.

The following states were defined as the operating conditions:

The controller at the keypad TA03 is the master. The keypad sends every 200 ms a telegram “no key activated” to the lock (slave). A telegram is sent back from the lock to the keypad which indicates the direction of the movement of the bolt. The keypad activates a LED flashing green or yellow depending of the direction of the movement of the bolt. After 13 telegrams the direction of the bolt is toggled. The LED at the keypad flashes red if errors occur in the bus communication.

The system was setup as follows:

Keypad and lock are mounted at a wooden panel and connected by a cable with the length of 500 mm.

3 Additional Information

The EUT was not labeled as required by FCC / IC.

The EUT was classified by the applicant as CLASS B equipment.

4 Overview

Conducted emissions FCC 47 CFR Part 15 section 15.107 (a),(b) [3] ICES-003 Issue 7 section 3.2.1[4]					
Application	Frequency range	Limits	Reference standard	Tested EUT	Status
AC supply line Class B	0.15 to 0.5 MHz 0.5 to 5 MHz 5 to 30 MHz	66 to 56 dB(µV) QP* 56 to 46 dB(µV) AV* 56 dB(µV) QP 46 dB(µV) AV 60 dB(µV) QP 50 dB(µV) AV	ANSI C63.4	-	Not applicable because of battery powered EUT
*: Decreases with the logarithm of the frequency					

Radiated emissions FCC 47 CFR Part 15 section 15.109 (a),(b) [3]					
Application	Frequency range	Limits	Reference standard	Tested EUT	Status
Radiated Emission Class B	30 to 88 MHz 88 to 216 MHz 216 to 960 MHz 960 to 1000 MHz above 1000 MHz	40.0 dB(µV/m) QP at 3 m 43.5 dB(µV/m) QP at 3 m 46.0 dB(µV/m) QP at 3 m 54.0 dB(µV/m) QP at 3 m 54.0 dB(µV/m) AV at 3 m 74.0 dB(µV/m) PK at 3 m	ANSI C63.4	1 & 2 and 1 & 3	Passed

Radiated emissions ICES-003 Issue 7 section 3.2.2 [4]					
Application	Frequency range	Limits	Reference standard	Tested EUT	Status
Radiated Emission Class B	30 to 88 MHz 88 to 216 MHz 216 to 230 MHz 230 to 960 MHz 960 to 1000 MHz above 1000 MHz	40.0 dB(µV/m) QP at 3 m 43.5 dB(µV/m) QP at 3 m 46.0 dB(µV/m) QP at 3 m 47.0 dB(µV/m) QP at 3 m 54.0 dB(µV/m) QP at 3 m 54 dB(µV/m) AV at 3 m 74 dB(µV/m) PK at 3 m	ANSI C63.4	1 & 2 and 1 & 3	Passed

Remark: As declared by the applicant the highest internal clock frequency is < 108 MHz.
Therefore, the radiated emission measurement must be carried out up to 1 GHz.

5 Results

5.1 Radiated emissions

5.1.1 Test method

The radiated emission measurement is subdivided into four stages.

- A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 30 MHz to 1 GHz.
- A final measurement carried out on an open area test side with reflecting ground plane and various antenna heights in the frequency range 30 MHz to 1 GHz.
- A preliminary measurement carried out in a fully anechoic chamber with a various antenna height of 100 to 250 cm at a distance of 1.90 m to the EUT position in the frequency range 1 GHz to 40 GHz.
- A final measurement carried out in a fully anechoic chamber and various antenna height of 100 to 250 cm at a distance of 1.90 m to the EUT position in the frequency range 1 GHz to 40 GHz.

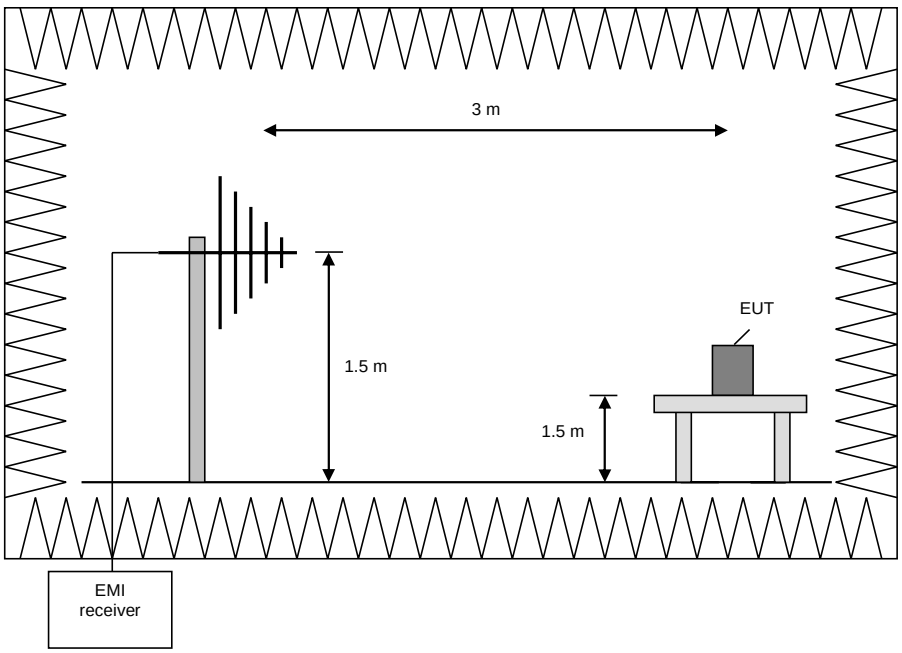
Preliminary measurement (30 MHz to 1 GHz)

In the first stage a preliminary measurement will be performed in a fully anechoic chamber with a measuring distance of 3 meter. 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 150 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 [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 polarization 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 spectrum analyzer will be set to the following values:

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	100 kHz



Procedure preliminary measurement:

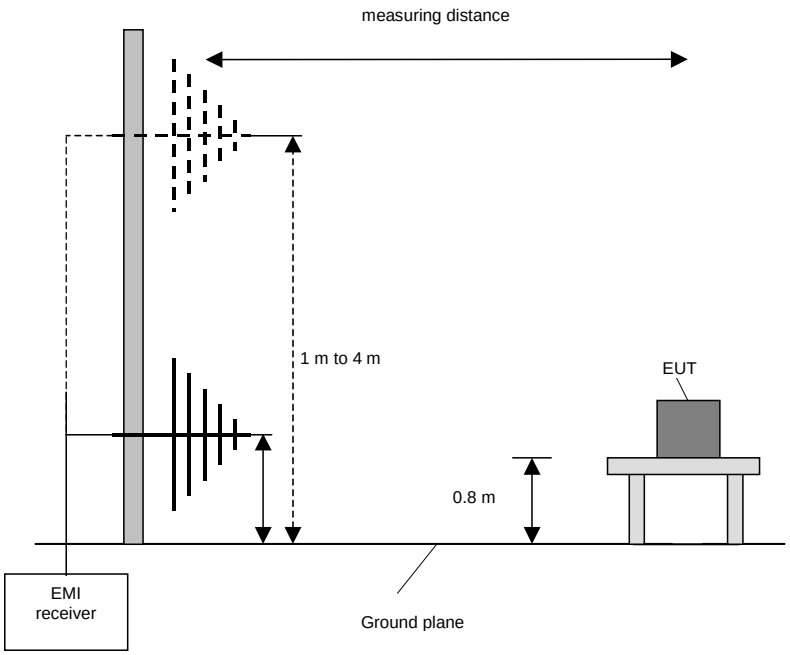
Prescans were performed in the frequency range 30 MHz to 1 GHz.
The following procedure will be used:
Monitor the frequency range at horizontal polarization and a EUT azimuth of 0 °.
Manipulate the system cables within the range to produce the maximum level of emission.
Rotate the EUT by 360 ° to maximize the detected signals.
Make a hardcopy of the spectrum.
Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
Repeat 1) to 4) with the other orthogonal axes of the EUT if handheld equipment.
Repeat 1) to 5) with the vertical polarization 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 polarization 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:

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

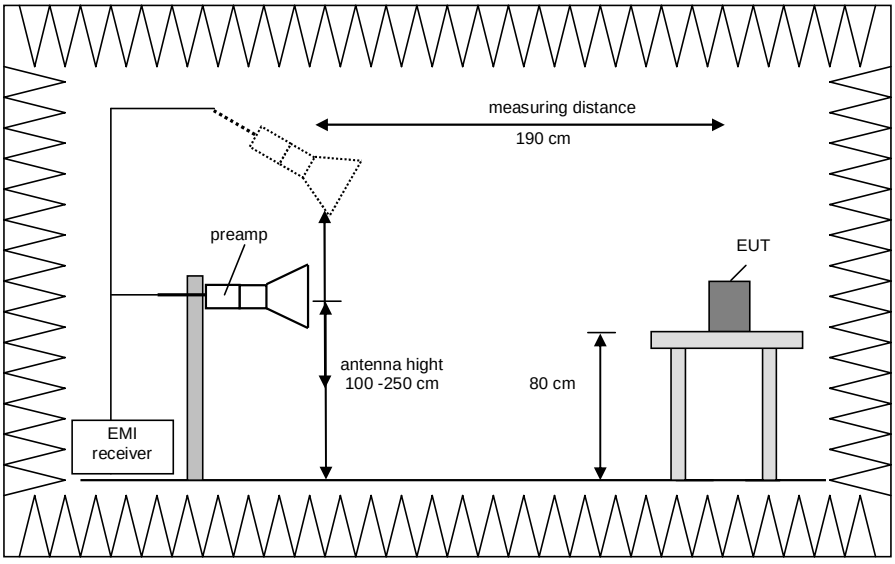
Preliminary and final measurement (1 GHz to 40 GHz)

This measurement will be performed in a fully anechoic chamber. 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 C63.4 [1].
The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth (preliminary)	Resolution bandwidth (final)
1 GHz to 40 GHz	1 MHz	1 MHz

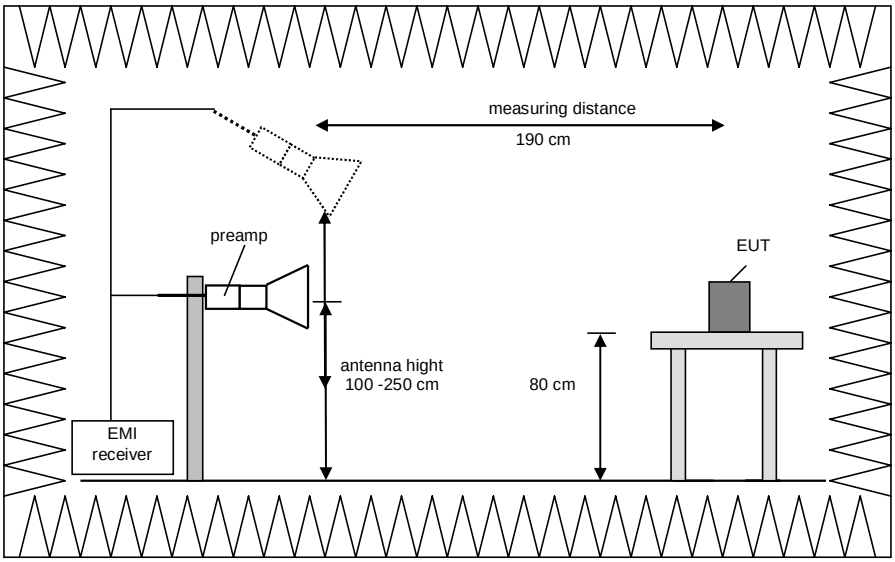
Preliminary measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used antenna. The spectrum analyser set to MAX Hold mode and a resolution bandwidth of 1MHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna in a measuring distance of 1.9 m. The antenna high was varied from 100 cm up to 250 cm.
The EUT was turned around 360 ° at each antenna high and polarisation and the maximum values were stored by the EMC 32 software.
After storing the maximum plot the antenna was set to the position where the maximum value for each emission was found for the final measurement.



Final measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used antenna. The antenna high was varied from 100 cm up to 250 cm depending where the maximum was found during the preliminary measurement in a measuring distance of 1.9 m.
The EMI Receiver set to peak and average mode and a resolution bandwidth of 1 MHz. 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 ° in order to have the antenna inside the cone of radiation.



Procedure of measurement:

The measurements were performed in the frequency range 1 to 40 GHz.
The following procedure will be used by software EMC32 assisted:

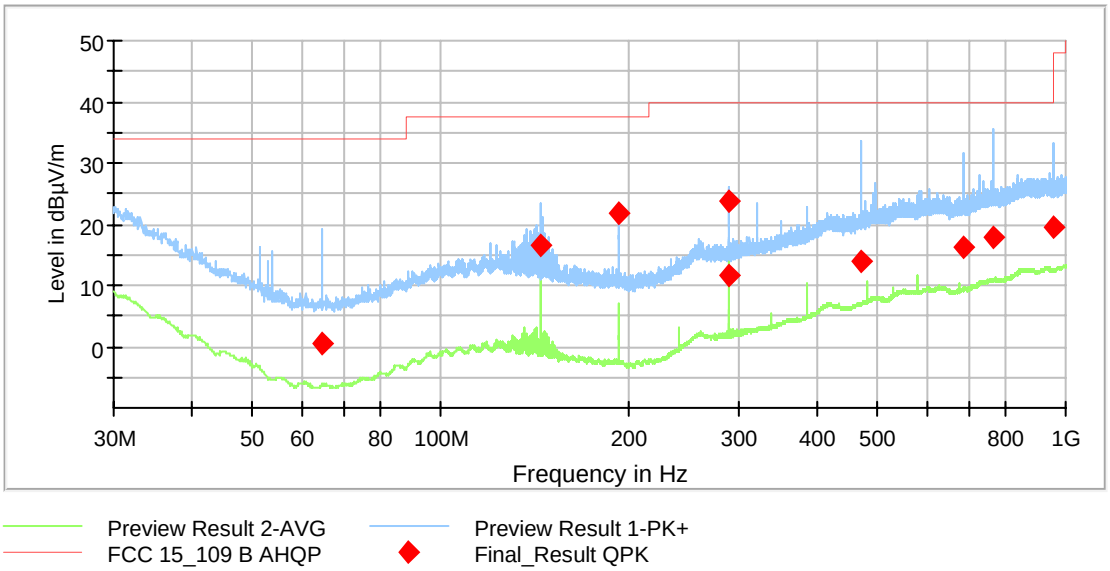
1) Monitor the frequency range at horizontal and vertical polarisation and turn the EUT 360°.
2) Change the antenna high and repeat 1) with 100, 125, 150, 175, 200, 225 and 250 cm high and an elevation pointing towards the EUT.
3) The EUT was turned around 360 ° at each antenna high and polarisation and the maximum values were stored by the EMC 32 software.
4) After storing the maximum plot the antenna was set to the position where the maximum value for each emission was found for the final measurement.
5) Start the single measurement mode in the EMC 32 software and do the final measurement at each frequency with the antenna polarisation and azimuth and the peak and average detector, which causes the maximum emission. Take the scan table for the final measurement with the correct resolution bandwidth, measure time, detector and save the maximum values manually in the EMC 32.
6) Repeat steps 1) to 5) for the next antenna spot if the EUT is larger than the antenna beam width.

Step 1) to 4) are defined as preliminary measurement.

5.1.2 Results preliminary measurement 30 MHz to 1 GHz

Ambient temperature:	22 °C	Relative humidity:	60 %

Test description:	Radiated emission measurement
EUT:	**Keypad TA03 with lock M410 TA**
Manufacturer:	Martin Lehmann GmbH & Co. KG
Operating conditions:	As described in chapter 2
Test site:	Phoenix TESTLAB GmbH, anechoic chamber M20
Operator:	Wolfgang Kasalowsky
Comment:	-
Date of test	05.06.2019

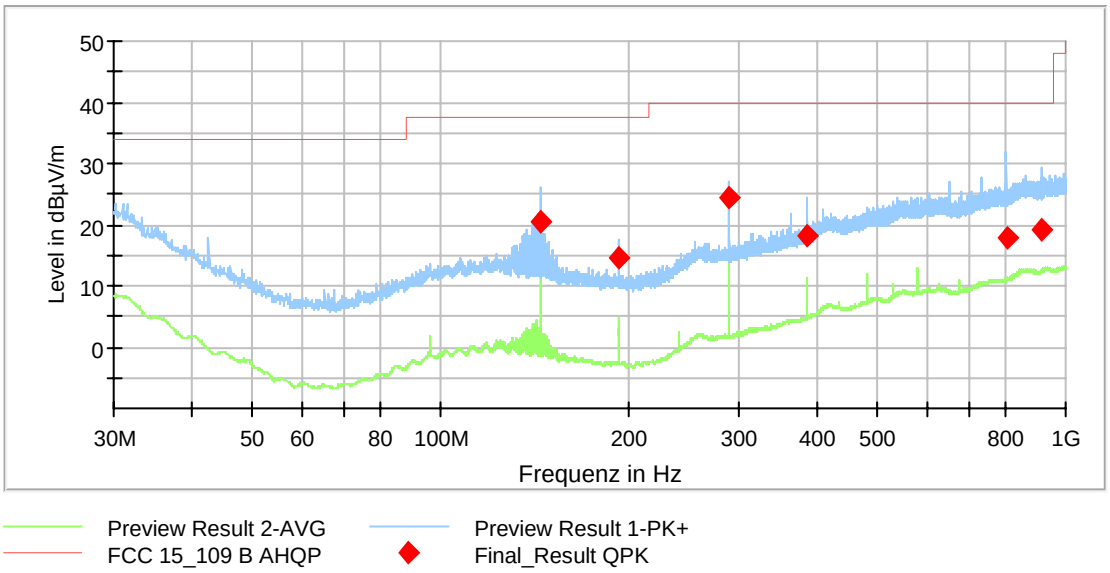


The following frequencies were found during the preliminary radiated emission test:

Frequency (MHz)
64.680
144.660
193.020
289.200
289.380
469.500
686.580
766.140
957.660

These frequencies have to be measured in a final measurement.

Test description:	Radiated emission measurement
EUT:	**Keypad TA03 with lock M610 TA**
Manufacturer:	Martin Lehmann GmbH & Co. KG
Operating conditions:	As described in chapter 2
Test site:	Phoenix TESTLAB GmbH, anechoic chamber M20
Operator:	Wolfgang Kasalowsky
Comment:	-
Date of test	05.06.2019



The following frequencies were found during the preliminary radiated emission test:

Frequency (MHz)
144.840
193.140
289.680
386.040
804.420
915.000

These frequencies have to be measured in a final measurement.

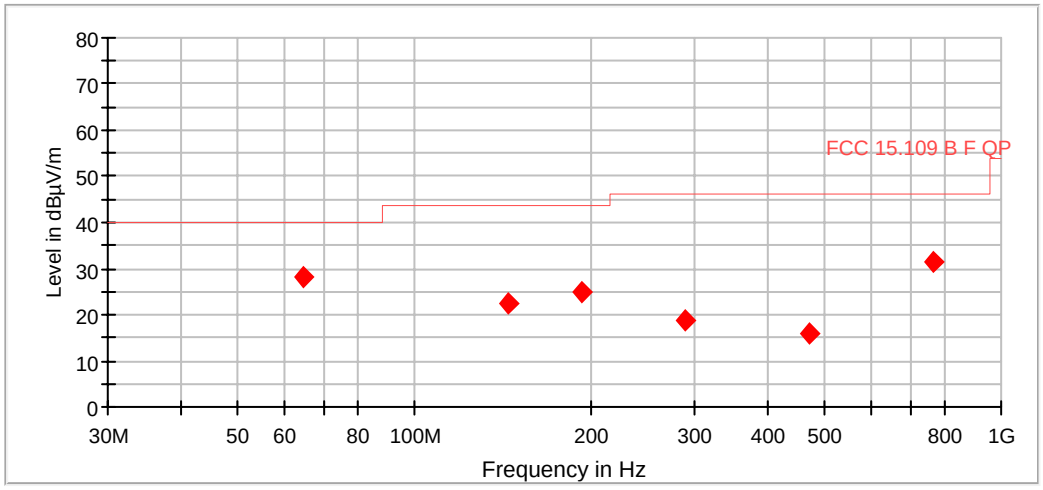
Test equipment (please refer to chapter 6 for details)
1 - 7

5.1.3 Result final measurement from 30 MHz to 1 GHz

Ambient temperature	22 °C	Relative humidity	60 %

Test description:	Radiated emission measurement according to FCC PART 15
EUT:	**Keypad TA03 with lock M410 TA**
Manufacturer:	Martin Lehmann GmbH & Co. KG
Operating conditions:	As described in chapter 2
Test site:	Phoenix TESTLAB GmbH, anechoic chamber M06
Operator:	Wolfgang Kasalowsky
Comment:	-
Date of test	06.06.2019

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 "◆" are the measured results of the standard subsequent measurement on the open area test site.



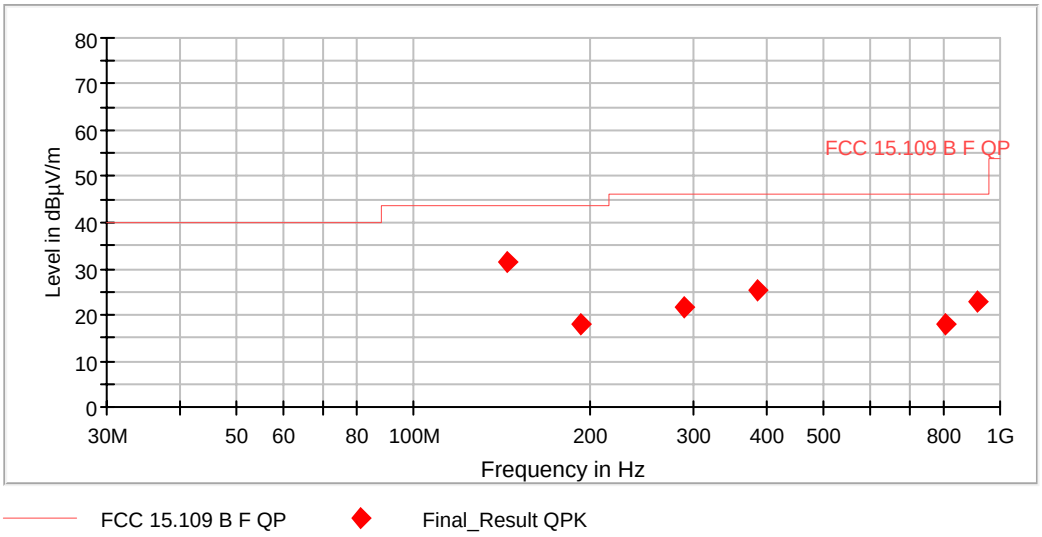
The results of the standard subsequent measurement on the open area test site are indicated in the table below. The limits as well as the measured results (levels) refer to the above mentioned standard while taking account of the specified requirements for a 3 m measuring distance.

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)		Margin (dB)		Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
		FCC	IC	FCC	IC						
64.680	28.3	40.0	40.0	11.7	11.7	1000.0	120.000	155.0	V	242.0	12.6
144.660	22.4	43.5	43.5	21.1	21.1	1000.0	120.000	343.0	H	154.0	18.8
193.020	24.9	43.5	43.5	18.6	18.6	1000.0	120.000	102.0	V	271.0	16.4
289.200	18.6	46.0	47.0	27.4	28.4	1000.0	120.000	114.0	H	118.0	21.4
469.500	15.9	46.0	47.0	30.1	31.1	1000.0	120.000	150.0	V	13.0	26.7
766.140	31.2	46.0	47.0	14.8	15.8	1000.0	120.000	400.0	H	13.0	32.2
Measurement uncertainty						+/- 4.78 dB					

Test description:	Radiated emission measurement according to FCC PART 15
EUT:	**Keypad TA03 with lock M610 TA**
Manufacturer:	Martin Lehmann GmbH & Co. KG
Operating conditions:	As described in chapter 2
Test site:	Phoenix TESTLAB GmbH, anechoic chamber M06
Operator:	Wolfgang Kasalowsky
Comment:	-
Date of test	06.06.2019

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 "◆" are the measured results of the standard subsequent measurement on the open area test site.



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 3 m measuring distance.

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)		Margin (dB)		Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
		FCC	IC	FCC	IC						
144.840	31.6	40.0	40.0	11.9	11.9	1000.0	120.000	155.0	V	242.0	12.6
193.140	18.0	43.5	43.5	25.5	25.5	1000.0	120.000	343.0	H	154.0	18.8
289.600	21.8	43.5	43.5	24.2	25.2	1000.0	120.000	102.0	V	271.0	16.4
386.040	25.4	46.0	47.0	20.6	21.6	1000.0	120.000	114.0	H	118.0	21.4
804.420	18.0	46.0	47.0	28.0	29.0	1000.0	120.000	150.0	V	13.0	26.7
915.000	22.9	46.0	47.0	23.1	24.1	1000.0	120.000	400.0	H	13.0	32.2
Measurement uncertainty						+/- 4.78 dB					

The correction factor was calculated as follows:
Corr. (dB) = cable attenuation (dB) + 6 dB attenuator (dB) + antenna factor (dB)
Therefore the reading can be calculated as follows: Reading (dBµV/m) = result QuasiPeak (dBµV/m) - Corr. (dB)

Test equipment (please refer to chapter 6 for details)
4, 8 - 13

6 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Turntable	DS420 HE	Deisel	420/620/00	480315	Calibration not necessary	
2	Antenna support	AS620P	Deisel	620/375	480325	Calibration not necessary	
3	Multiple Control Unit	MCU	Maturo GmbH	MCU/043/971107	480832	Calibration not necessary	
4	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
5	Antenna (Bilog)	CBL6112B	Schaffner EMV GmbH (-Chase)	2688	480328	19.06.2017	06.2020
6	EMI Receiver / Spectrum Analyser	ESW44	Rohde & Schwarz	101635	482467	29.03.2018	03.2020
7	RF-Cable No. 36	Sucoflex 106B	Suhner	500213/6B	482325	Calibration not necessary	
8	Open area test site M6	Freifeld M6	Phoenix Contact	-	480085	Calibration not necessary	
9	Antenna mast	MA240-0	Inn-Co GmbH	MA240-0/030/6600603	480086	Calibration not necessary	
10	Turntable	DS412	Deisel	412/316	480087	Calibration not necessary	
11	Controller	HD100	Deisel	100/349	480139	Calibration not necessary	
12	Antenna (Bilog)	CBL6111D	Schaffner Elektrotest GmbH / Teseq GmbH	25761	480894	19.10.2017	10.2020
13	EMI Receiver	ESR7	Rohde & Schwarz	101939	482558	19.09.2017	09.2019

7 Test site Validation

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
OATS M6	480085	30 – 1000 MHz	NSA	ANSI C63.4-2014	25.10.2018	24.10.2020

8 Report History

Report Number	Date	Comment
F190466E2	14.10.2021	Initial Test Report
-	-	-

9 List of Annexes

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Annex C	EUT Internal Photos	14 pages