RADIO REPORT

FCC 47 CFR Part 15C
ISED Canada RSS-210

Operation within the 13.110 – 14.010 MHz band

Report Reference No	G0M-1912-8654-TFC225RI-V01
Testing Laboratory	Eurofins Product Service GmbH
Address	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation	 DAkkS - Registration number : D-PL-12092-01-03 (ISED) ISED Testing Laboratory site: 3470A-2 DAkkS - Registration number : D-PL-12092-01-04 (FCC) FCC Filed Test Laboratory, Reg.-No.: 96970
Applicant	wh Münzprüfer Dietmar Trenner GmbH
Address	Teltower Damm 276 14167 Berlin GERMANY
Test Specification	According to FCC/ISED rules
Standard	47 CFR Part 15C RSS-210, Issue 10, 2019-12 RSS-Gen, Issue 5, Amendment 1, 2019-03
Non-Standard Test Method	None
Equipment under Test (EUT):	
Product Description	Coin selector
Model(s)	EMP 500 v7 /CLB
Additional Model(s)	None
Brand Name(s)	None
Hardware Version(s)	EMP500 E4
Software Version(s)	EMP7.50.18; BLE1.00.18
FCC-ID	2AVM3EMP500V7CLB
IC	25831-EMP500V7CLB
Test Result	**PASSED**

Possible test case verdicts:	
Required by standard but not tested	N/T
Not required by standard	N/R
Not applicable to EUT	N/A
Test object does meet the requirement	P(PASS)
Test object does not meet the requirement	F(FAIL)
Testing:	
Test Lab Temperature	20 - 23 °C
Test Lab Humidity	32 – 38 %
Date of receipt of test item	2020-01-16
Report:	
Compiled by	Wilfried Treffke
Tested by (+ signature) (Responsible for Test)	Wilfried Treffke
Approved by (+ signature) (Head of Lab)	Christian Weber
Date of Issue	2020-02-05
Total number of pages	35
General Remarks:	
The test results presented in this report relate only to the object tested. **The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.** This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.	
Additional Comments:	

VERSION HISTORY

Version History			
Version	Issue Date	Remarks	Revised By
01	2020-02-05	Initial Release	

ABBREVIATIONS AND ACRONYMS

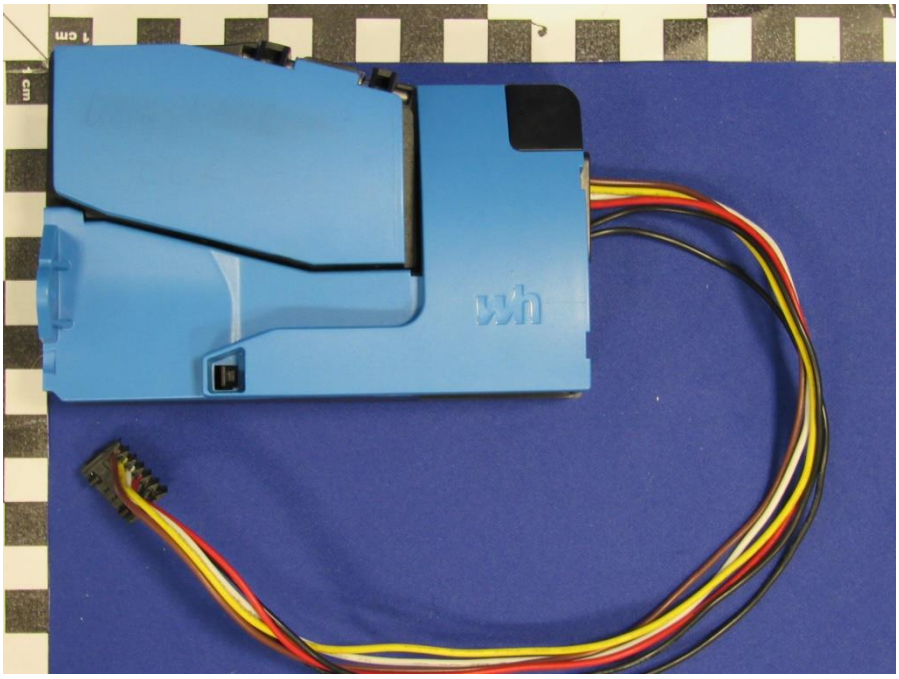
Acronyms	
Acronym	Description
EUT	Equipment Under Test
FCC	Federal Communications Commission
ISED	Innovation, Science and Economic Development Canada
RBW	Resolution bandwidth
RFID	Radio Frequency Identification
RMS	Root mean square
VBW	Video bandwidth
V_{NOM}	Nominal supply voltage

REPORT INDEX

1 Equipment (Test Item) Under Test

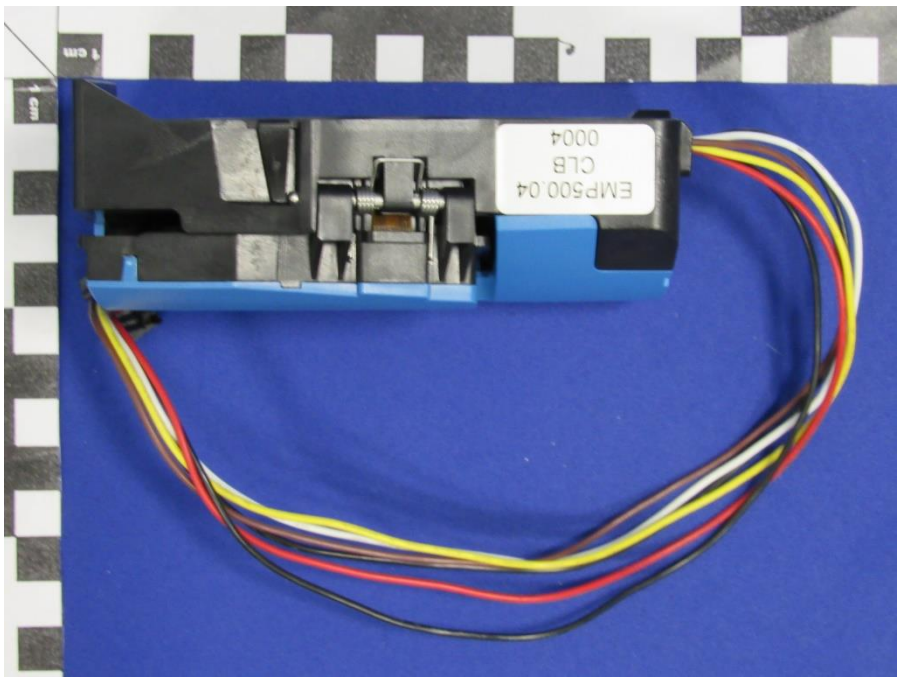
Description	Coin selector	
Model	EMP 500 v7 /CLB	
Additional Model(s)	None	
Brand Name(s)	None	
Serial Number(s)	None	
Hardware Version(s)	EMP500 E4	
Software Version(s)	EMP7.50.18; BLE1.00.18	
PMN	EMP 500 v7 /CLB	
HVIN	EMP 500 v7 /CLB	
FVIN	EMP7.50.18; BLE1.00.18	
HMN	N/A	
FCC-ID	2AVM3EMP500V7CLB	
IC	25831-EMP500V7CLB	
Equipment type	End Product	
Radio type	Transceiver	
Assigned frequency bands	13.110 - 14.010 MHz	
Radio technology	RFID	
Modulation	ASK	
Radio Module	Type	Bluetooth
	Model	CYBLE-222014-01
	Manufacturer	Cypress
	FCC-ID	WAP2005
	IC	7922A-2005
Antenna	Type	Integrated
	Model	PCB loop antenna
	Manufacturer	wh Münzprüfer Dietmar Trenner GmbH
	Gain	unspecified
Supply Voltage	V_{NOM}	12 VDC
Operating Temperature	T_{NOM}	25 °C
AC/DC-Adaptor	Model	None
	Vendor	None
	Input	None
	Output	None
Manufacturer	wh Münzprüfer Dietmar Trenner GmbH Teltower Damm 276 14167 Berlin GERMANY	

1.1 Photos – Equipment External

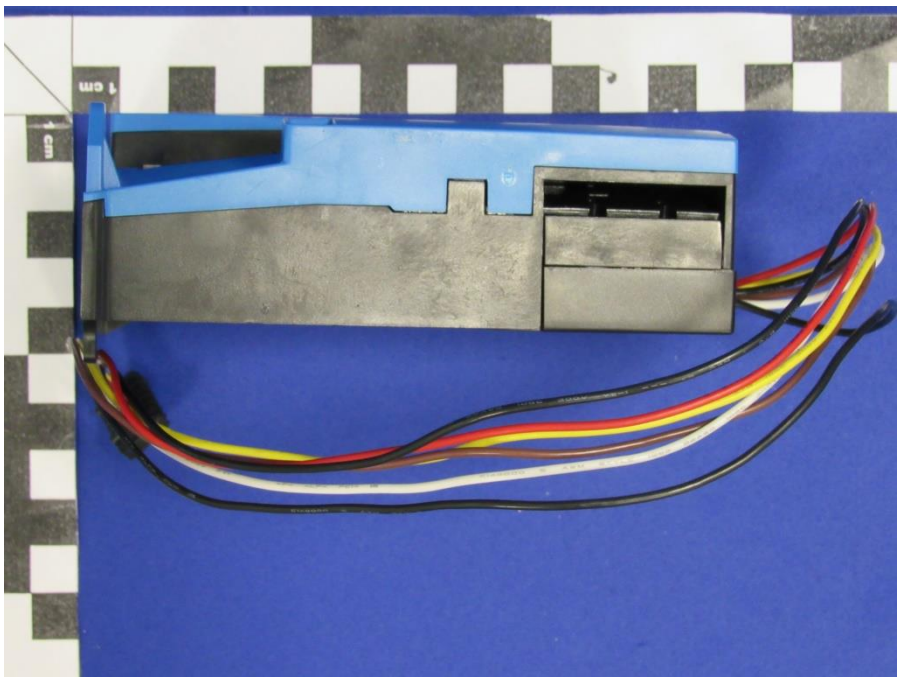
EUT front


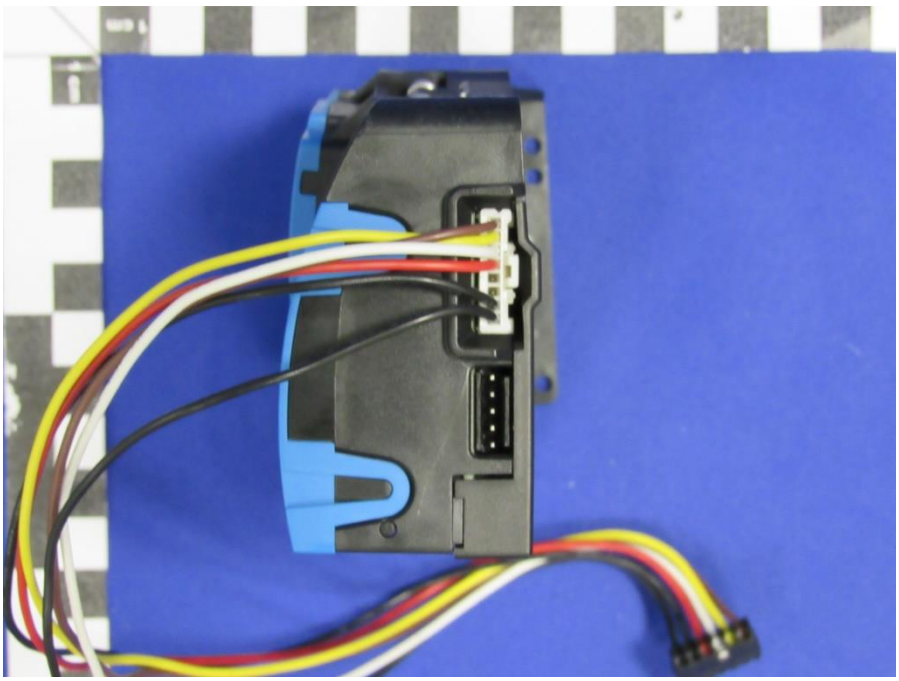
EUT back

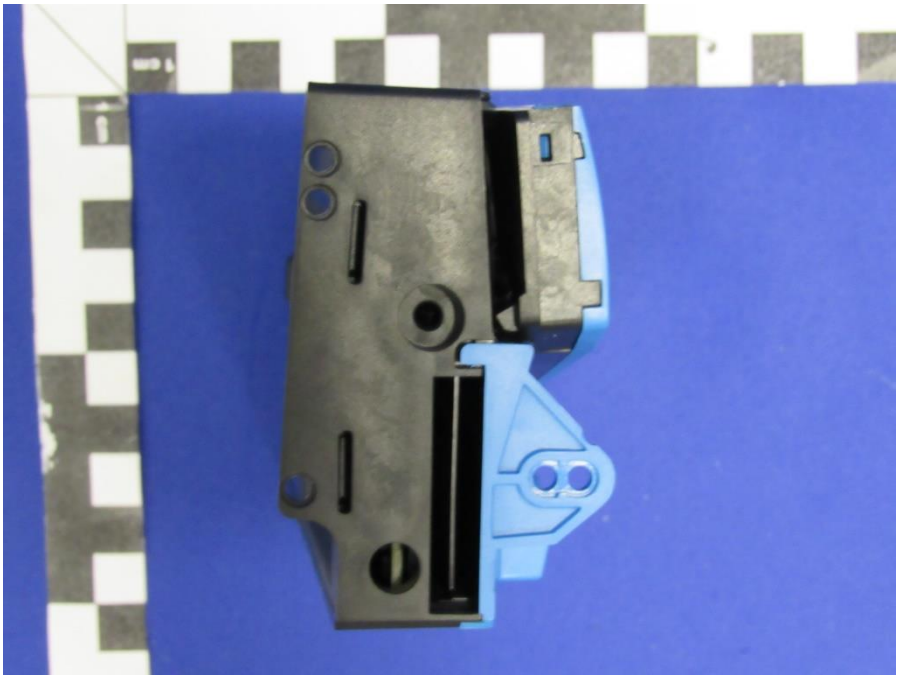

EUT top



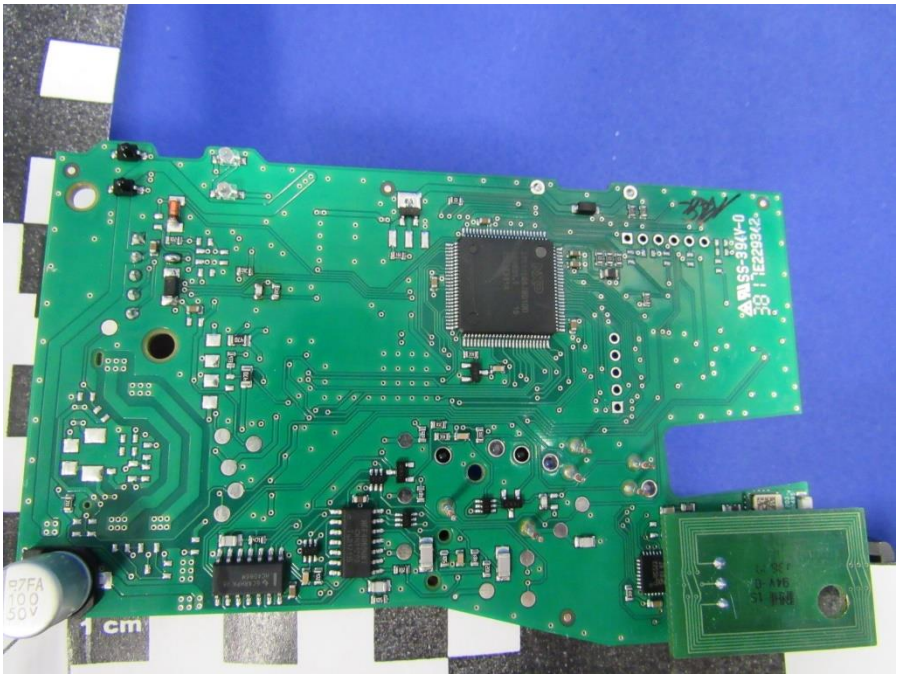
EUT bottom

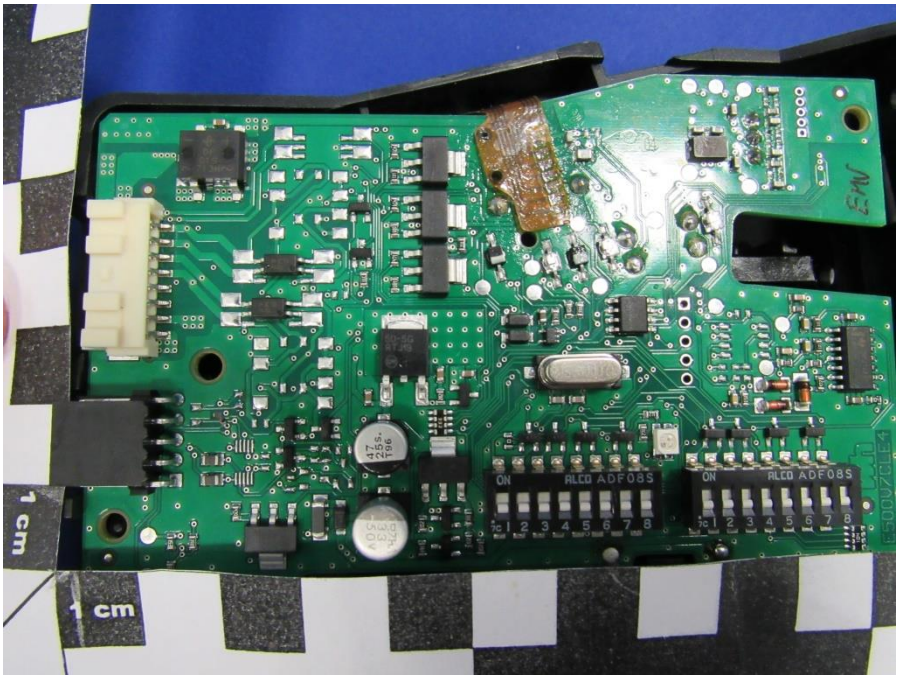


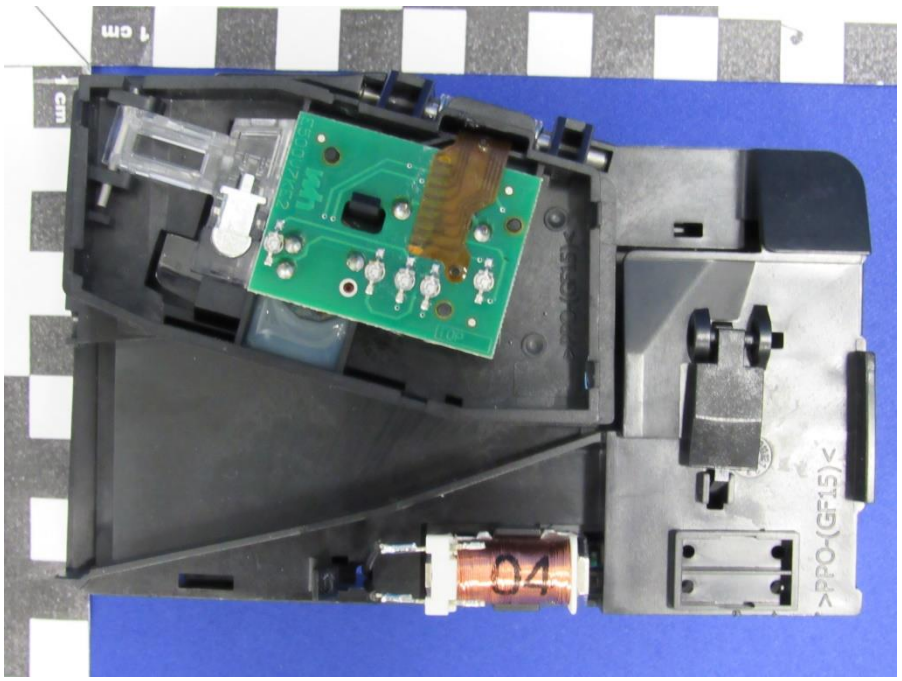
EUT right side


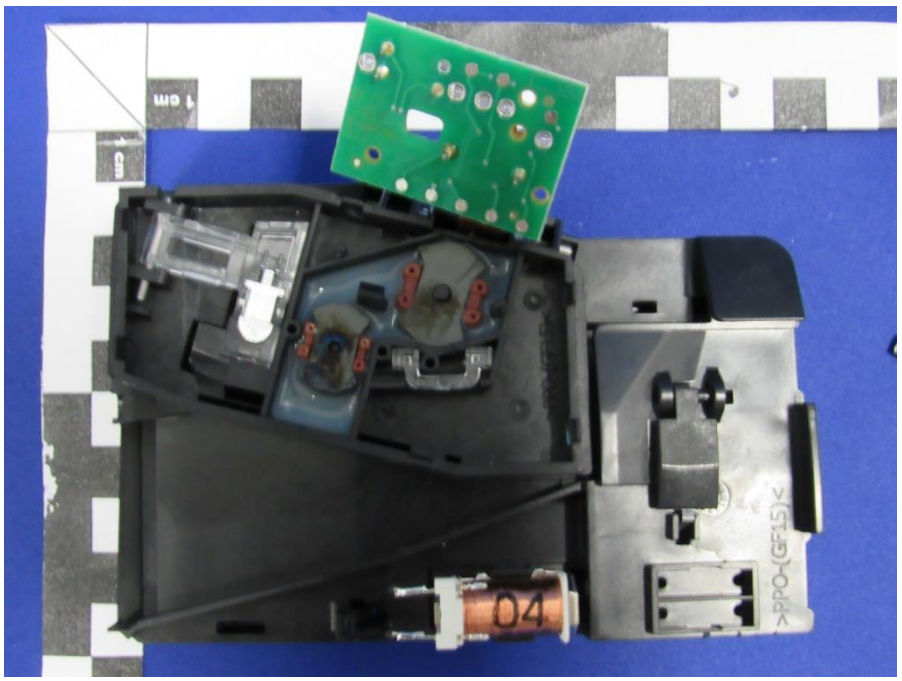
EUT left side


1.2 Photos – Equipment Internal

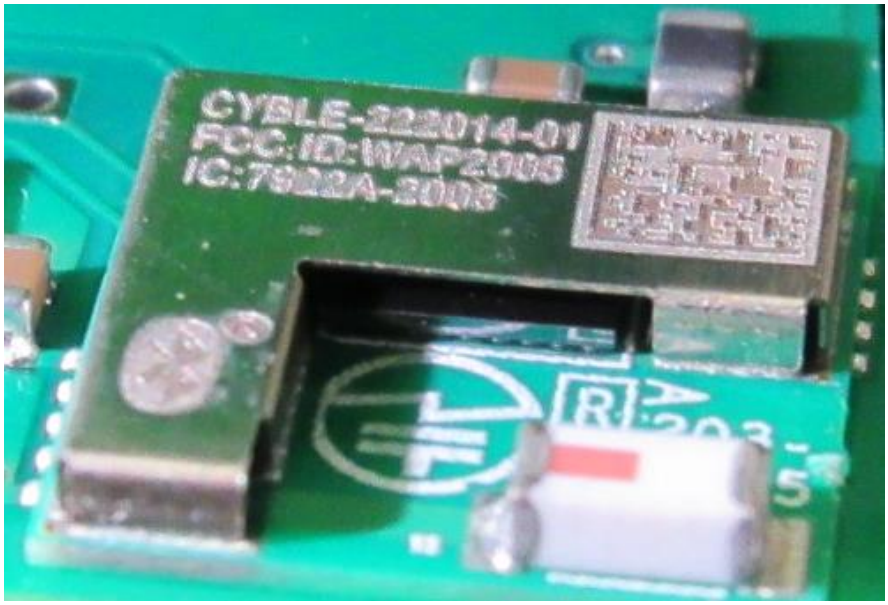
PCB 1 with Antenna PCB top view


PCB 1 bottom view


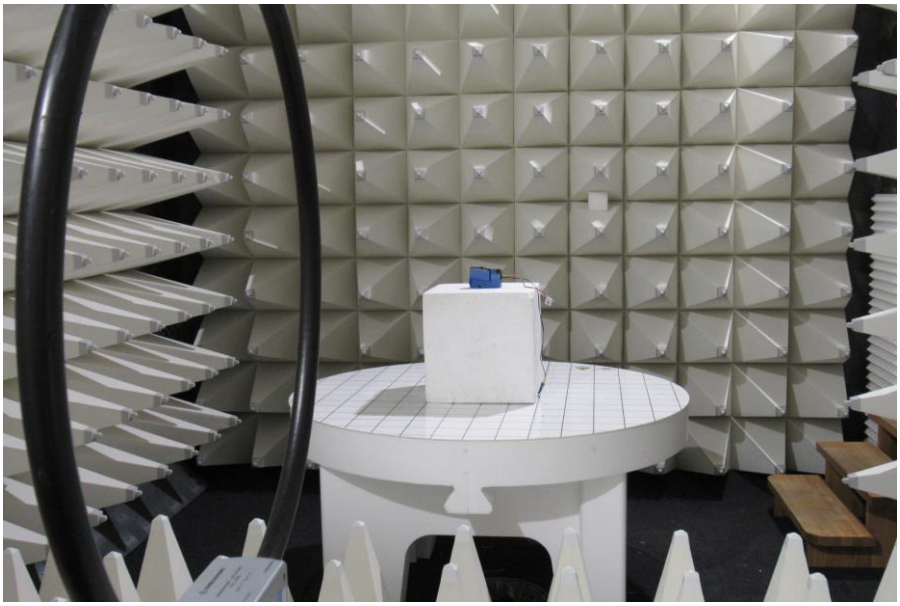
PCB 2 top view


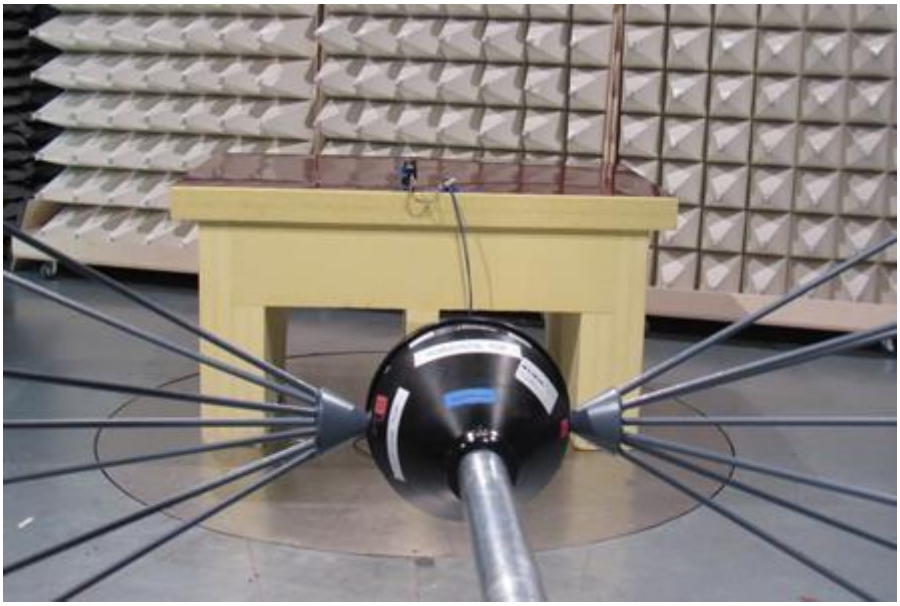
PCB 2 bottom view


RFID module


Bluetooth module


1.3 Photos – Test Setup

Radiated setup 1


Radiated setup 2


Conducted Setup


1.4 Support Equipment

Product Type	Device	Manufacturer	Model	Comment
None				
Description:				
AE	Auxiliary Equipment			
SIM	Simulator			
CBL	Connecting Cable			
SFT	Software			
Comment:				

1.5 Test Modes

Mode	Description
Transmit / Receive	Mode = Transmit Modulation = OOK Duty cycle = 100 %
Comment:	

1.6 Test Frequencies

Designator	Mode	Channel	Frequency [MHz]
F1	Tx / Rx	0	13.56

1.7 Sample emission level calculation

The following is a description of terms and a sample calculation, as appears in the radiated emissions data table. The numbers used in the calculation are for example only. There is no direct correlation to the specific data taken for the product described in this document:

Reading:

This is the reading obtained on the spectrum analyzer in dBµV. Any external preamplifiers used are taken into account through internal analyzer settings.

A.F.:

This is the antenna factor for the receiving antenna. It is a conversion factor, which converts electric fields strengths to voltages, which can be measured directly on the spectrum analyzer. It is treated as a loss in dB. Cable losses have been included with the A.F. to simplify the calculations. The antenna factor is used in calculations as follows:

Reading on Analyzer (dBµV) + A.F. (dB/m) = Net field strength (dBµV/m)

Net:

This is the net field strength measurement (as shown above).

Limit:

This is the FCC Class B radiated emission limit (in units of dBµV/m). The FCC limits are given in units of µV/m. The following formula is used to convert the units of µV/m to dBµV/m:

Limit (dBµV/m) = 20*log (µV/m)

Margin:

This is the margin of compliance below the FCC limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Example only:

Reading + AF	= Net Reading	:	Net reading - FCC limit	= Margin
+21.5 dBµV + 26 dB/m	= 47.5 dBµV/m	:	47.5 dBµV/m - 57.0 dBµV/m	= -9.5 dB

2 Result Summary

FCC 47 CFR Part 15C, ISED RSS-210				
Product Standard Reference	**Requirement**	**Reference Method**	**Result**	**Remarks**
RSS-Gen 6.7	Occupied Bandwidth	ANSI C63.10-2013	N/R	Informational only
FCC 15.225(a-c) ISED RSS-210 B.6(a)	Fundamental in-band field strength emissions	ANSI C63.10-2013	PASS	
FCC 15.225(d) FCC 15.209 ISED RSS-210 B.6	Emission radiated outside the specified frequency band	ANSI C63.10-2013	PASS	
FCC 15.225(e) ISED RSS-210 B.6	Frequency stability	ANSI C63.10-2013	PASS	
ISED RSS-Gen 4.10 ISED RSS-Gen 7.1	Receiver radiated spurious emissions	ANSI C63.10-2013	N/A	Permanently co-located transmitter
47 CFR 15.207 RSS-Gen 8.8	AC power line conducted emissions	ANSI C63.10-2013	PASS	
Comment:				

Possible Test Case Verdicts	
PASS	Test object does meet the requirements
FAIL	Test object does not meet the requirements
N/T	Required by standard but not tested
N/R	Not required by standard for the test object

3 Test Conditions and Results

3.1 Test Conditions and Results - Occupied bandwidth

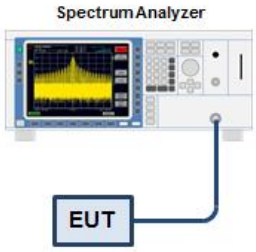
3.1.1 Information

Test Information	
Product Standard Reference	ISED RSS-Gen 6.7
Measurement Method	Conducted

3.1.2 Limits

Limits
None (Informational only)

3.1.3 Setup

Test Setup


3.1.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSU 26	EF01407	2019-07	2020-07

3.1.5 Procedure

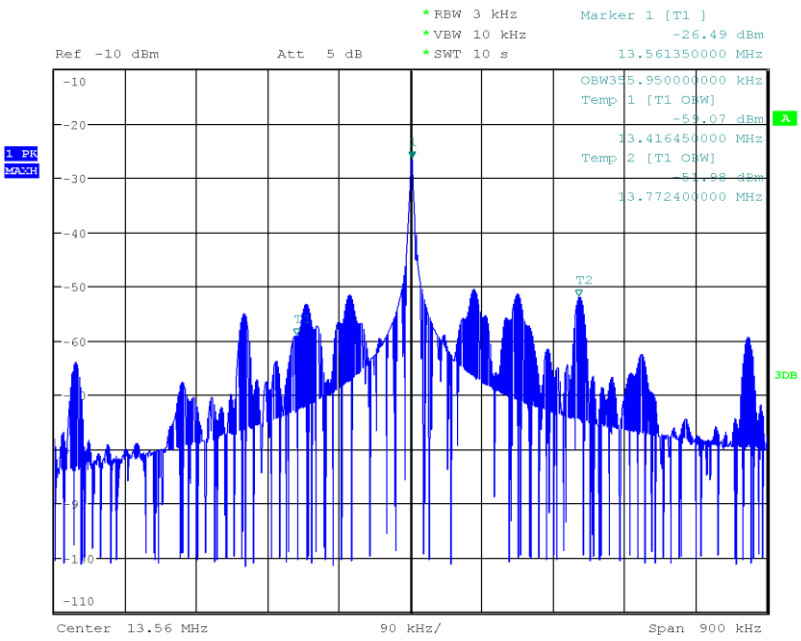
Test Procedure
1. EUT set to test mode (Communication tester is used if needed) 2. Span set to at least twice the emission spectrum 3. Resolution bandwidth set between 1 % to 5 % of OBW 4. Occupied Bandwidth (99 %) measurement with spectrum analyzer built in measurement function

3.1.6 Results

Test Results	
Channel [MHz]	Bandwidth [kHz]
13.56	356

Occupied Bandwidth

Project Number:	G0M-1912-8654
Applicant:	wh Münzprüfer Dietmar Trenner GmbH
Model Description:	Coin selector
Model:	EMP 500 v7 /CLB
Reference Standards:	RSS-Gen
Reference Method:	ANSI C63.10:2013, Section 6.9.3
Operational Mode:	ASK, Channel: 13.56 MHz
Operating Conditions:	Tnom/Vnom
Operator:	Wilfried Treffke
Test Site:	Eurofins Product Service GmbH
Test Date:	2020-01-16
Occupied Bandwidth [MHz]:	0.356



3.2 Test Conditions and Results - Fundamental in-band field strength emissions

3.2.1 Information

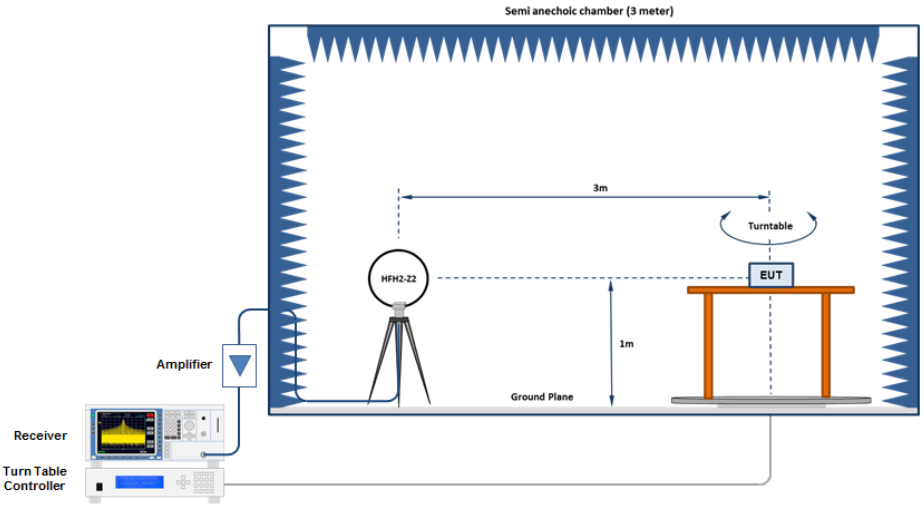
Test Information	
Product Standard Reference	FCC 15.225(a-c) / ISED RSS-210 B.6(a)
Measurement Method	Radiated

3.2.2 Limits

Limits			
Frequency ragne [MHz]	Limit [µV/m]	Limit [dBµV/m]	Limit Distance [m]
13.553 - 13.567	15848	84	30
13.410 - 13.553 13.567 - 13.710	334	50.5	30
13.110 - 13.410 13.710 - 14.010	106	40.5	30

3.2.3 Setup

Test Setup < 30 MHz



3.2.4 Equipment

Test Software			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	RadiMation	2015.2.4

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC2	EF00197	-	-
Spectrum Analyzer	R&S	FSU 26	EF01003	2019-07	2020-07
Antenna	R&S	HFH2-Z2	EF00184	2017-12	2020-12

3.2.5 Procedure

Test Procedure
1. EUT set to test mode 2. Span it set according to measurement range 3. Resolution bandwidth below 1 GHz is set according to CISPR 16 with peak/quasi-peak detector 4. Below 30MHz an extrapolation according ANSI 63.10; 6.4.4.2 is used.

3.2.6 Results

Test Results					
Channel [MHz]	Emission [MHz]	Level @ 30 m [dBµV/m]	Detector	Limit @ 30 m [dBµV/m]	Margin
13.56	13.561	28.30	pk	84.00	-55.71 dB

3.3 Test Conditions and Results - Emissions radiated outside the specified frequency band

3.3.1 Information

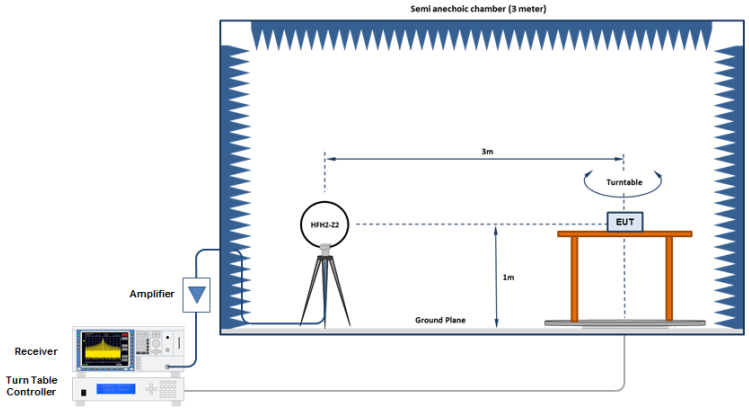
Test Information	
Product Standard Reference	FCC 15.225(d) / ISED RSS-210 B.6
Measurement Method	Radiated

3.3.2 Limits

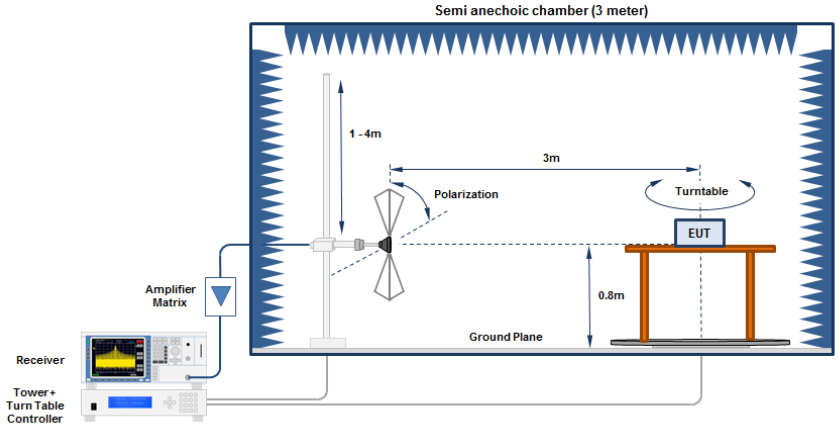
Limits				
Frequency range [MHz]	Detector	Limit [µV/m]	Limit [dBµV/m]	Limit Distance [m]
0.009 - 0.490	Quasi-Peak	2400/F[kHz]	48.5 - 13.8	300
0.490 - 1.705	Quasi-Peak	2400/F[kHz]	13.8 - 2.97	30
1.705 -30	Quasi-Peak	30	29.5	30
30 - 88	Quasi-Peak	100	40	3
88 -216	Quasi-Peak	150	43.5	3

3.3.3 Setup

Test Setup < 30 MHz



Test Setup 30 -216 MHz



3.3.4 Equipment

Test Software			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	RadiMation	2015.2.4

Test Equipment < 30 MHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC2	EF00062	2018-07	2021-07
Loop Antenna	R&S	HFH2-Z2	EF00184	2017-12	2020-12
Spectrum Analyzer	R&S	FSU 26	EF01407	2019-07	2020-07

Test Equipment 30 - 216 MHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC1	EF00062	2018-07	2021-07
Measurement Receiver	R&S	N9038A-526/WXP	EF01070	2019-09	2020-09
Antenna	R&S	HK116	EF00203	2018-06	2020-06

3.3.5 Procedure

Test Procedure
1. EUT set to test mode 2. Span it set according to measurement range 3. Resolution bandwidth below 1 GHz is set according to CISPR 16 with peak/quasi-peak detector and RBW of 1 MHz with peak/average detector is used above 1 GHz 4. Below 30MHz an extrapolation according ANSI 63.10; 6.4.4.2 is used. 5. Markers are set to maximum emission levels

3.3.6 Results

Test Results						
Channel [MHz]	Emission [MHz]	Level [dBµV/m]	Detector	Polarization	Limit [dBµV/m]	Margin [dB]
13.56	24.063	14.50	pk	ver	29.50	-14.98
13.56	75.6	13.35	pk	hor	40.00	-26.65
13.56	138.36	16.46	pk	ver	43.50	-27.04

3.4 Test Conditions and Results - Frequency stability

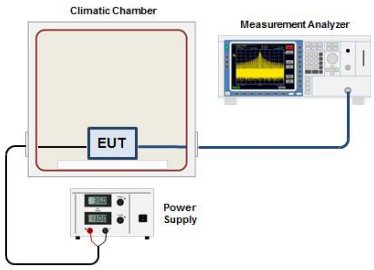
3.4.1 Information

Test Information	
Product Standard Reference	FCC 15.225(e) / ISED RSS-210 B.6
Measurement Method	Conducted

3.4.2 Limits

Limits
Frequency error limit
±0.01% (±100ppm)

3.4.3 Setup

Test Setup


3.4.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSU 26	EF01407	2019-07	2020-07

3.4.5 Procedure

Test Procedure
1. EUT set to test mode 2. The ambient temperature and supply voltage is set according to measurement conditions 3. Span is set to capture fundamental emission 4. Frequency error is measured with frequency counter measurement function

3.4.6 Results

Test Results				
Channel [MHz]	Temperatur [°C]	Voltage [V]	Measured Frequency [MHz]	Error [ppm]
13.56	20	12	13.5602875	21.20
13.56	20	10	13.5602875	21.20
13.56	20	26	13.5602875	21.20
13.56	-20	12	13.5603205	23.64
13.56	-10	12	13.5603250	23.97
13.56	0	12	13.5603250	23.97
13.56	10	12	13.5602875	21.20
13.56	30	12	13.5602500	18.44
13.56	40	12	13.5602250	16.59
13.56	50	12	13.5602125	15.67

3.5 Test Conditions and Results - AC powerline conducted emissions

3.5.1 Information

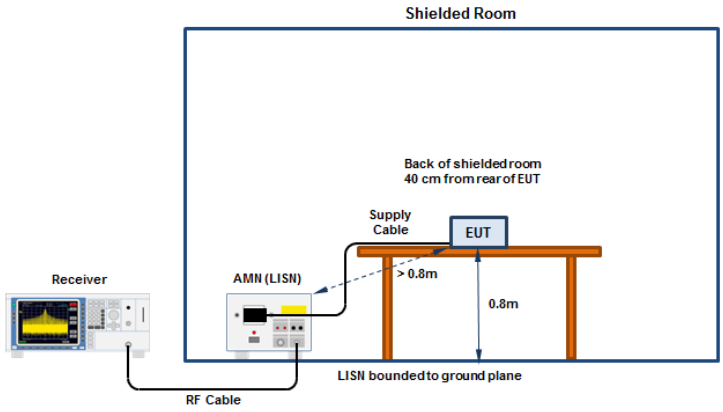
Test Information	
Reference	FCC § 15.207; ISED RSS-Gen, Issue 5
Measurement Method	ANSI C63.10 6.2
Operator	Wilfried Treffke
Date	2020-01-15

3.5.2 Limits

Limits		
Frequency [MHz]	Quasi-Peak [dBµV]	Average [dBµV]
0.15 - 0.5	66 - 56*	56 - 46*
0.5 - 5	56	46
5 - 30	60	50
* Limit decreases linearly with the logarithm of the frequency		

3.5.3 Setup

Test Setup



3.5.4 Equipment

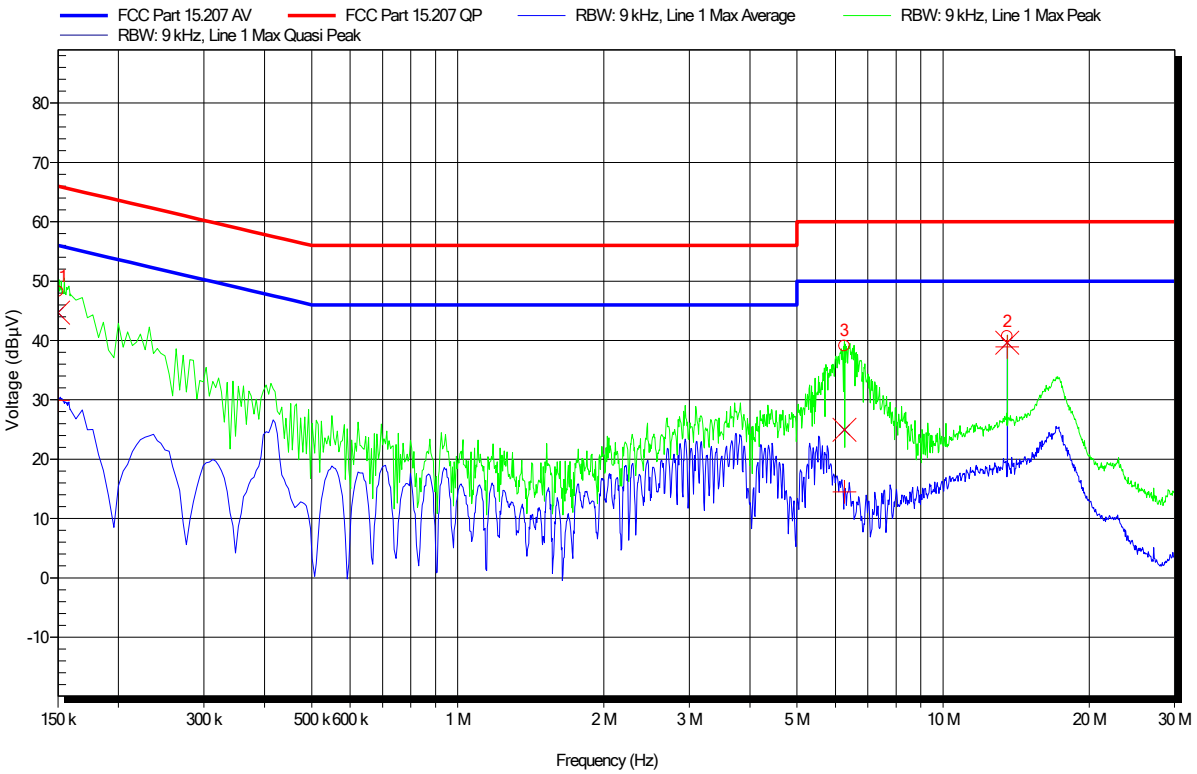
Test Software			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	RadiMation	2016.1.10

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
EMI Test Receiver	R&S	ESR7	EF00943	2019-10	2020-10
LISN	R&S	ESH3-Z5	EF00036	2019-07	2021-07

Conducted emissions at the mains power port according to FCC Part 15 B

Project Number:	G0M-1912-8654
Applicant:	wh Münzprüfer Berlin GmbH
Model Description:	Coin selector
Model:	EMP 500 v7 /CLB
Test Sample ID:	27373
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Treffke
Test Date:	2020-01-15
Operating Conditions:	ambient temperature: 23 power input: 120 V 60 Hz
LISN:	ESH3-Z5 (L)
Mode:	BLE + NFC

Index 8



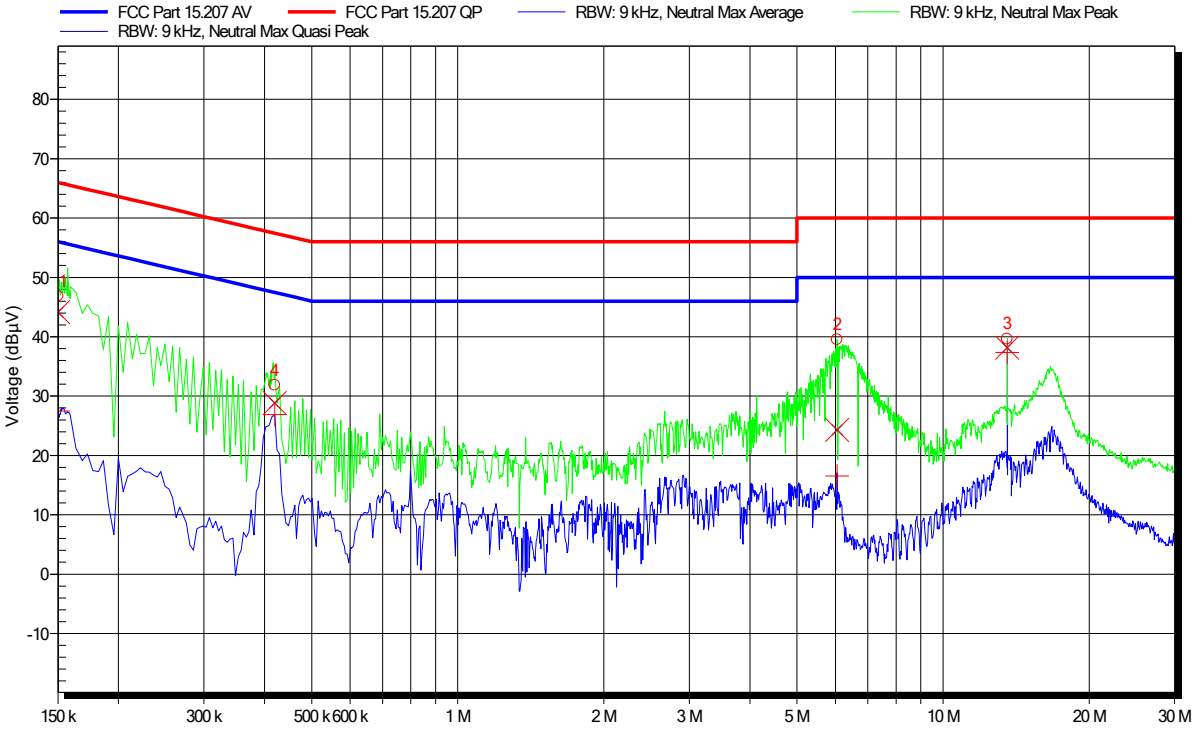
Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	LISN
1	150 kHz	44.7 dBµV	66 dBµV	-21.3 dB	Pass	Line 1
2	13.561 MHz	39.6 dBµV	60 dBµV	-20.4 dB	Pass	Line 1
3	6.262 MHz	24.96 dBµV	60 dBµV	-35.04 dB	Pass	Line 1

Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status	LISN
1	150 kHz	29.93 dBµV	56 dBµV	-26.07 dB	Pass	Line 1
2	13.561 MHz	38.92 dBµV	50 dBµV	-11.08 dB	Pass	Line 1
3	6.262 MHz	14.46 dBµV	50 dBµV	-35.54 dB	Pass	Line 1

Conducted emissions at the mains power port according to FCC Part 15 B

Project Number:	G0M-1912-8654
Applicant:	wh Münzprüfer Berlin GmbH
Model Description:	Coin selector
Model:	EMP 500 v7 /CLB
Test Sample ID:	27373
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Treffke
Test Date:	2020-01-15
Operating Conditions:	ambient temperature: 23 power input: 120 V 60 Hz
LISN:	ESH3-Z5 (N)
Mode:	BLE + NFC

Index 9



Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	LISN
1	150 kHz	44.16 dBµV	66 dBµV	-21.84 dB	Pass	Neutral
2	6.048 MHz	24.28 dBµV	60 dBµV	-35.72 dB	Pass	Neutral
3	13.561 MHz	38.17 dBµV	60 dBµV	-21.83 dB	Pass	Neutral
4	420 kHz	28.85 dBµV	57.45 dBµV	-28.6 dB	Pass	Neutral

Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status	LISN
1	150 kHz	27.51 dBµV	56 dBµV	-28.49 dB	Pass	Neutral
2	6.048 MHz	16.54 dBµV	50 dBµV	-33.46 dB	Pass	Neutral
3	13.561 MHz	37.34 dBµV	50 dBµV	-12.66 dB	Pass	Neutral
4	420 kHz	26.88 dBµV	47.45 dBµV	-20.57 dB	Pass	Neutral

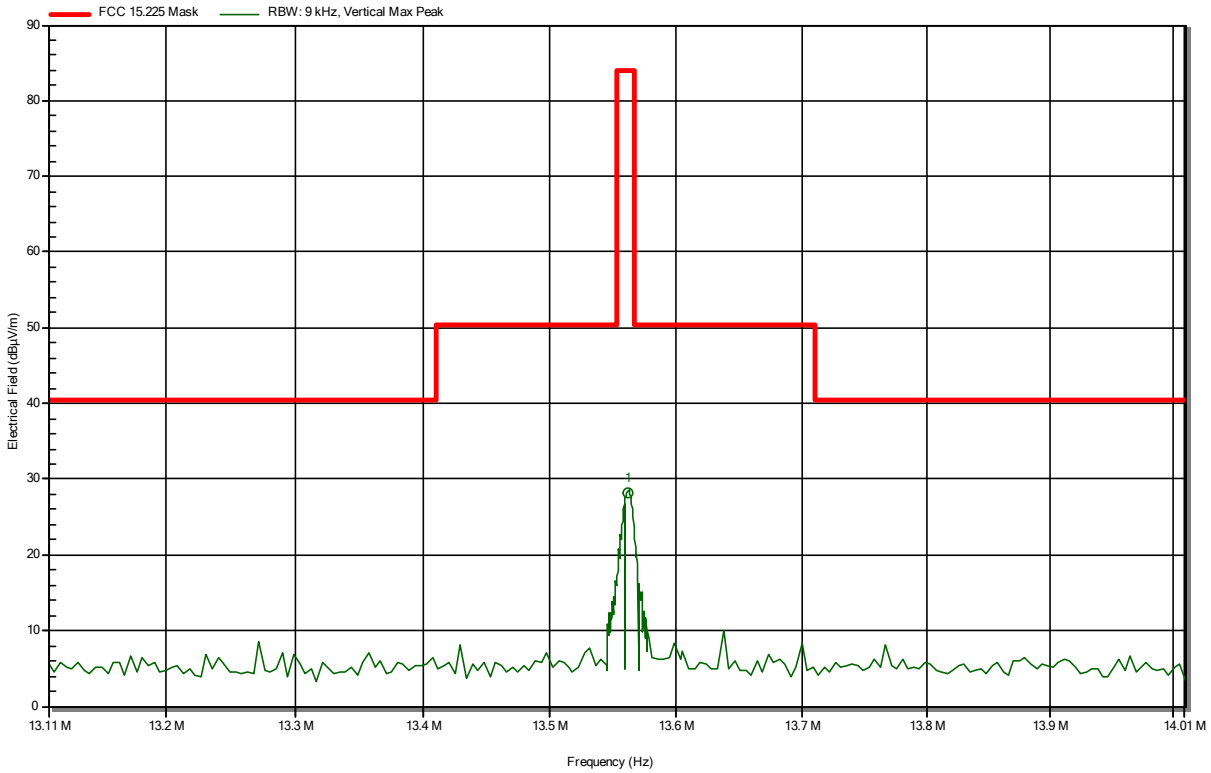
ANNEX A Transmitter in-band emissions

Spurious emissions according to FCC 15.225

Project number:	G0M-1912-8654
Applicant:	wh Münzprüfer Berlin GmbH
EUT Name:	Coin selector
Model:	EMP 500 v7 /CLB
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Treffke
Test Conditions:	Tnom: 22 °C, Vnom: 12 VDC (AC/DC adaptor)
Antenna:	HFH2-Z2
Measurement distance:	3 m converted to 30 m
Mode:	TX; NFC; ASK; 13.56 MHz
Test Date:	2020-01-17
Note:	

Index 51

RadiMation



Frequency	Peak	Peak Limit	Peak Difference	Peak Status
13.561 MHz	28.3 dBµV/m	84 dBµV/m	-55.71 dB	Pass

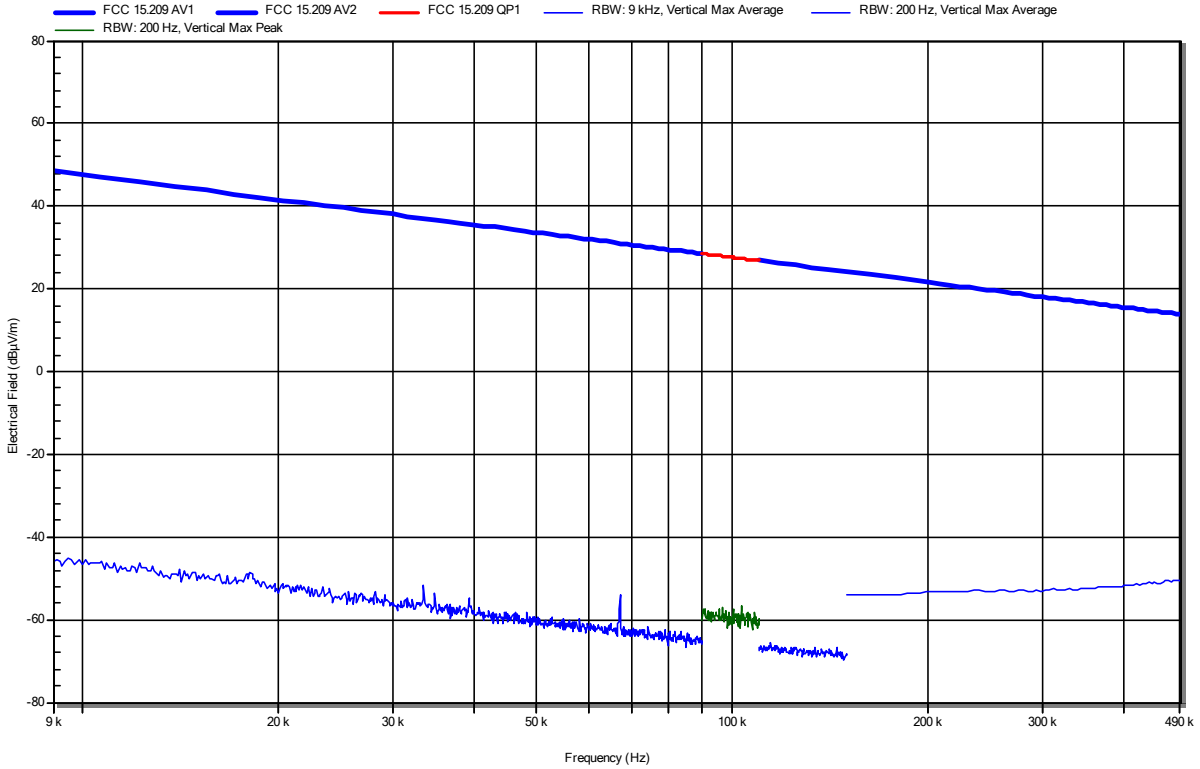
ANNEX B Transmitter radiated spurious emissions

Spurious emissions according to FCC 15.225

Project number:	G0M-1912-8654
Applicant:	wh Münzprüfer Berlin GmbH
EUT Name:	Coin selector
Model:	EMP 500 v7 /CLB
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Treffke
Test Conditions:	Tnom: 22 °C, Vnom: 12 VDC (AC/DC adaptor)
Antenna:	HFH2-Z2
Measurement distance:	3 m converted to 300 m
Mode:	TX; NFC; ASK; 13.56 MHz
Test Date:	2020-01-17
Note:	

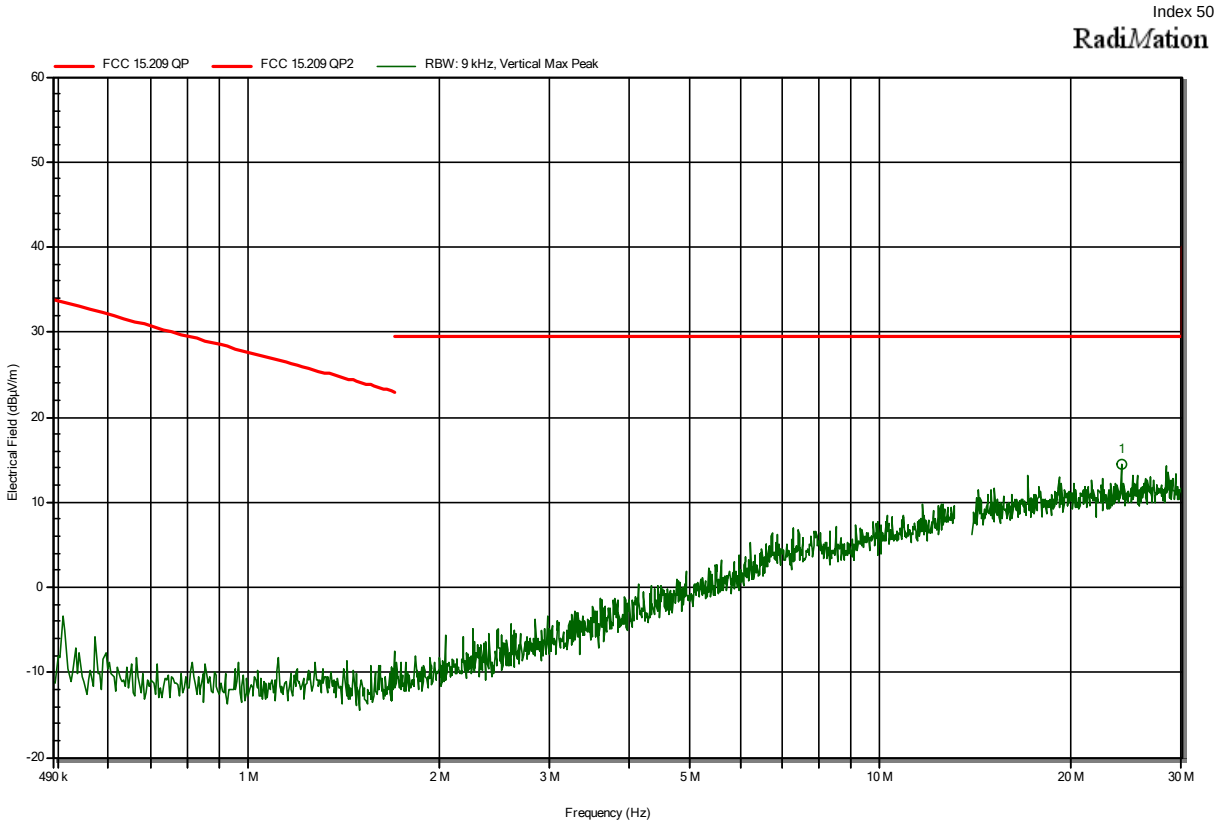
Index 49

RadiMation



Spurious emissions according to FCC 15.225

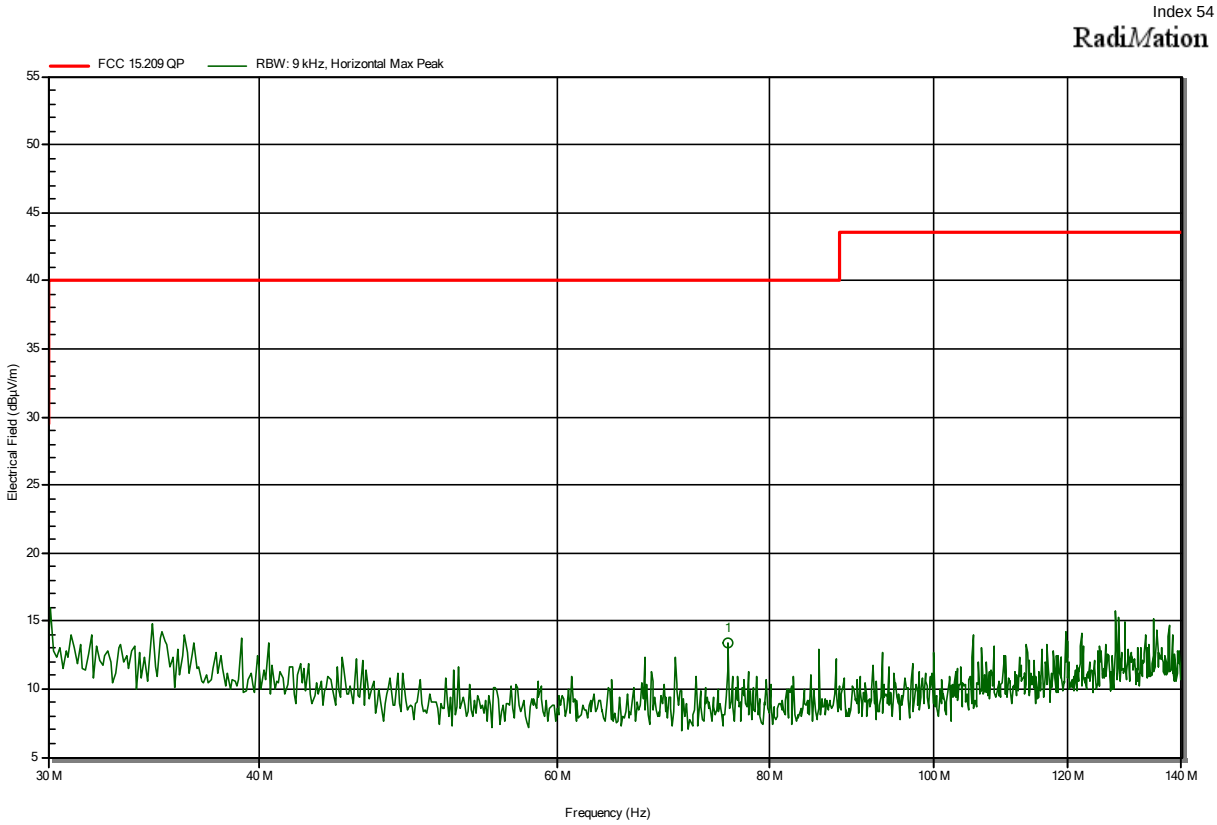
Project number:	G0M-1912-8654
Applicant:	wh Münzprüfer Berlin GmbH
EUT Name:	Coin selector
Model:	EMP 500 v7 /CLB
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Treffke
Test Conditions:	Tnom: 22 °C, Vnom: 12 VDC (AC/DC adaptor)
Antenna:	HFH2-Z2
Measurement distance:	3 m converted to 30 m
Mode:	TX; NFC; ASK; 13.56 MHz
Test Date:	2020-01-17
Note:	



Frequency	Peak	Peak Limit	Peak Difference	Peak Status
24.063 MHz	14.5 dBµV/m	29.5 dBµV/m	-14.98 dB	Pass

Spurious emissions according to FCC 15.225

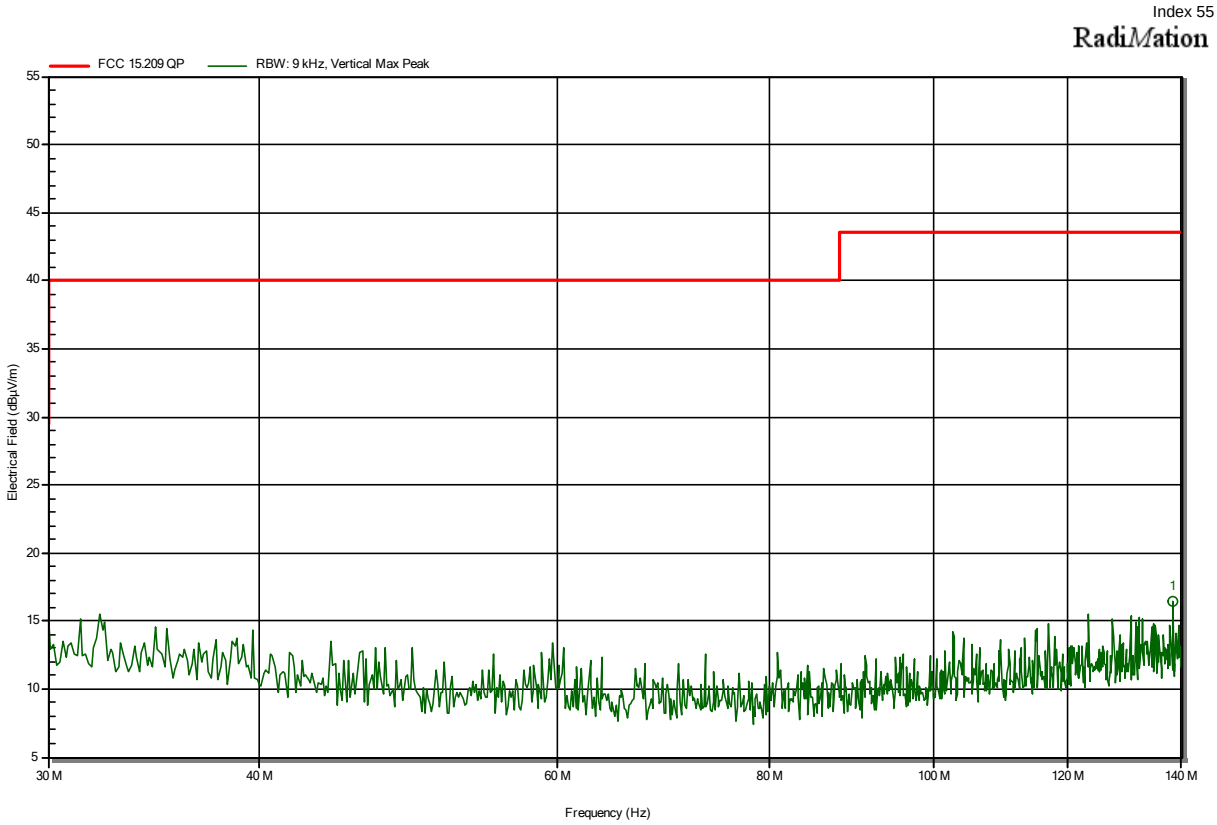
Project number:	G0M-1912-8654
Applicant:	wh Münzprüfer Berlin GmbH
EUT Name:	Coin selector
Model:	EMP 500 v7 /CLB
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Treffke
Test Conditions:	Tnom: 22 °C, Vnom: 12 VDC (AC/DC adaptor)
Antenna:	HK 116, Horizontal
Measurement distance:	3 m
Mode:	TX; NFC; ASK; 13.56 MHz
Test Date:	2020-01-17
Note:	



Frequency	Peak	Peak Limit	Peak Difference	Status
75.6 MHz	13.35 dBµV/m	40 dBµV/m	-26.65 dB	Pass

Spurious emissions according to FCC 15.225

Project number:	G0M-1912-8654
Applicant:	wh Münzprüfer Berlin GmbH
EUT Name:	Coin selector
Model:	EMP 500 v7 /CLB
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Treffke
Test Conditions:	Tnom: 22 °C, Vnom: 12 VDC (AC/DC adaptor)
Antenna:	HK 116, Vertical
Measurement distance:	3 m
Mode:	RX; NFC; ASK; 13.56 MHz
Test Date:	2020-01-17
Note:	



Frequency	Peak	Peak Limit	Peak Difference	Status
138.36 MHz	16.46 dBµV/m	43.5 dBµV/m	-27.04 dB	Pass