

FCC Test Report

Product Name : WEL-3750/WEL7750/WEL3790/
WEL7790 RFID Electronic Lock
Model No. : L375, L775, WEL-7750, REP7001,
WEL-3750, RAP3001, WEL-3790, L379,
RAF3002, WEL-7790, L779, REF7002
FCC ID. : 2AMWX-L00005

Applicant : WFE TECHNOLOGY CORP

Address : 4F-8, NO.238, Chin-Hua N.Rd Taichung City 404, Taiwan

Date of Receipt : Jul. 17, 2017

Issued Date : Aug. 10, 2017

Report No. : 1770215R-RFUSP17V00

Version : V1.0



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Test Report Certification

Issued Date : Aug. 10, 2017

Report No. : 1770215R-RFUSP17V00



Product Name : WEL-3750/WEL7750/WEL3790/WEL7790 RFID Electronic Lock

Applicant : WFE TECHNOLOGY CORP

Address : 4F-8, NO.238, Chin-Hua N.Rd Taichung City 404, Taiwan

Manufacturer : WFE TECHNOLOGY CORP

Model No. : L375, L775, WEL-7750, REP7001, WEL-3750, RAP3001, WEL-3790, L379, RAF3002, WEL-7790, L779, REF7002

FCC ID. : 2AMWX-L00005

EUT Voltage : DC 6V (Power by Battery)

Testing Voltage : DC 6V (Power by Battery)

Trade Name : **WAFERLOCK®**

Applicable Standard : FCC CFR Title 47 Part 15 Subpart C Section 15.225

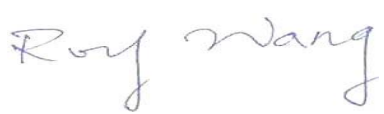
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Test Result : Complied

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Tested By : 
(Carter Hsu / Senior Engineer)

Approved By : 
(Roy Wang / Director)

Revision History

Report No.	Version	Description	Issued Date
1770215R-RFUSP17V00	V1.0	Initial issue of report	Aug. 10, 2017

Laboratory Information

We, **DEKRA Testing and Certification Co., Ltd.**, are an independent RF consultancy that was established the whole facility in our laboratories. The test facility has been accredited/accepted (audited or listed) by the following related bodies in compliance with ISO 17025 specified testing scopes:

Taiwan R.O.C.	:	TAF, Accreditation Number: 3024
USA	:	FCC, Registration Number: 0007939127
Canada	:	IC, Submission No: 181665 / IC Registration Number: 22397-1 / 22397-2 / 22397-3

The related certificate for our laboratories about the test site and management system can be downloaded from DEKRA Testing and Certification Co., Ltd. Web Site :

<http://www.dekra.com.tw/english/about/certificates.aspx?bval=5>

The address and introduction of DEKRA Testing and Certification Co., Ltd. laboratories can be founded in our Web site : http://www.dekra.com.tw/index_en.aspx

If you have any comments, Please don't hesitate to contact us. Our test sites as below:

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1. General Information

1.1. EUT Description

Product Name	WEL-3750/WEL7750/WEL3790/WEL7790 RFID Electronic Lock
Trade Name	WAFFERLOCK®
Model No.	L375, L775, WEL-7750, REP7001, WEL-3750, RAP3001, WEL-3790, L379, RAF3002, WEL-7790, L779, REF7002
Frequency Range	13.56MHz
Channel Number	1
Type of Modulation	ASK

Antenna Information	
Antenna Type	Printed
Antenna Gain	0dBi

Working Frequency of Each Channel	
Channel	Frequency
Channel 1	13.56MHz

Note:

1. This device is a WEL-3750/WEL7750/WEL3790/WEL7790 RFID Electronic Lock including BT function/315MHz/13.56MHz transmitting and receiving function.
2. The different of the each model is shown as below:
 1. Different firmware. L375,WEL-3750, RAP3001, L379,WEL-3790, RAF3002, L775, WEL-7750, REP7001, L779, WEL-7790, REF7002
 2. Different mortise. L375 WEL-3750, RAP3001 / L379,WEL-3790, RAF3002, is using ANSI profile mortise, and L775, WEL-7750, REP7001/ L779, WEL-7790, REF7002 is using European profile mortise.
 3. Adding finger print sensor handle on model L379, WEL-3790,RAF3002/ L779,WEL-7790, REF7002 including finger print sensor modulators and mTouch sensors on handles. Reader PCB, mTouch panel, antenna PCB, and main control PCB are same on all models.
3. These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15 Subpart C Paragraph 15.225 for spread spectrum devices.

1.2. Test Mode

DEKRA has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Test Mode	
TX	Mode 1: Transmit

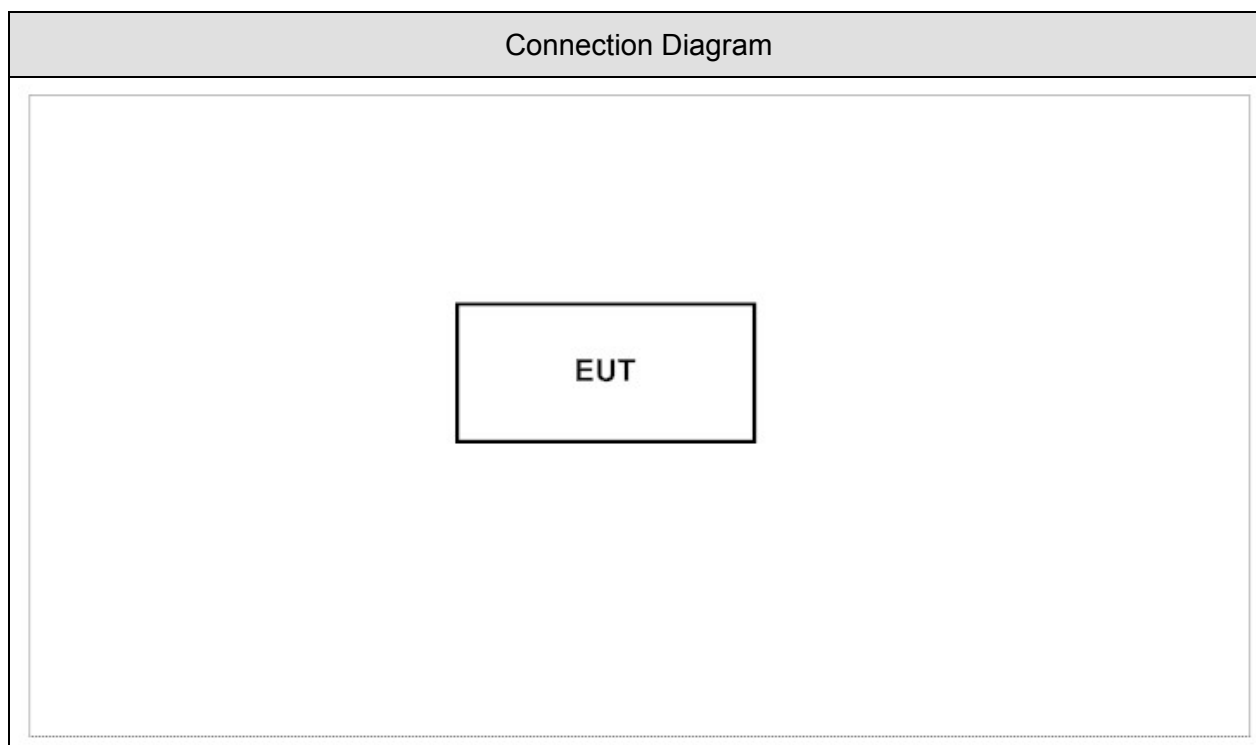
Emission	
Conducted Emission	No
Occupied Bandwidth	No
Radiated Emission	Yes
Frequency Tolerance	Yes

1.3. Tested System Details

The types for all equipments, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product	Manufacturer	Model No.	Serial No.	FCC ID	Power Cord
N/A					

1.4. Configuration of tested System



1.5. EUT Exercise Software

1	Setup the EUT as shown in Section 1.4.
2	Turn on the EUT power.
3	Configure the test mode, the test channel, and the data rate.
4	Press "Start TX" to start the continuous transmitting.
5	Verify that the EUT works properly.

1.6. Test Facility

Ambient conditions in the laboratory:

Items	Test Item	Required (IEC 68-1)	Actual	Test Site
Temperature (°C)	FCC PART 15 C 15.225 Conducted Emission	15 - 35	25°C	--
Humidity (%RH)		25 - 75	45%RH	
Barometric pressure (mbar)		860 - 1060	950-1000	
Temperature (°C)	FCC PART 15 C 15.225 Occupied Bandwidth	15 - 35	25°C	--
Humidity (%RH)		25 - 75	45%RH	
Barometric pressure (mbar)		860 - 1060	950-1000	
Temperature (°C)	FCC PART 15 C 15.225 Radiated Emission	15 - 35	25°C	1/2
Humidity (%RH)		25 - 75	65%RH	
Barometric pressure (mbar)		860 - 1060	950-1000	
Temperature (°C)	FCC PART 15 C 15.225 Frequency Tolerance	15 - 35	25°C	1
Humidity (%RH)		25 - 75	45%RH	
Barometric pressure (mbar)		860 - 1060	950-1000	

Note: Test Site information refers to Laboratory Information.

2. Conducted Emission

2.1. Test Equipment

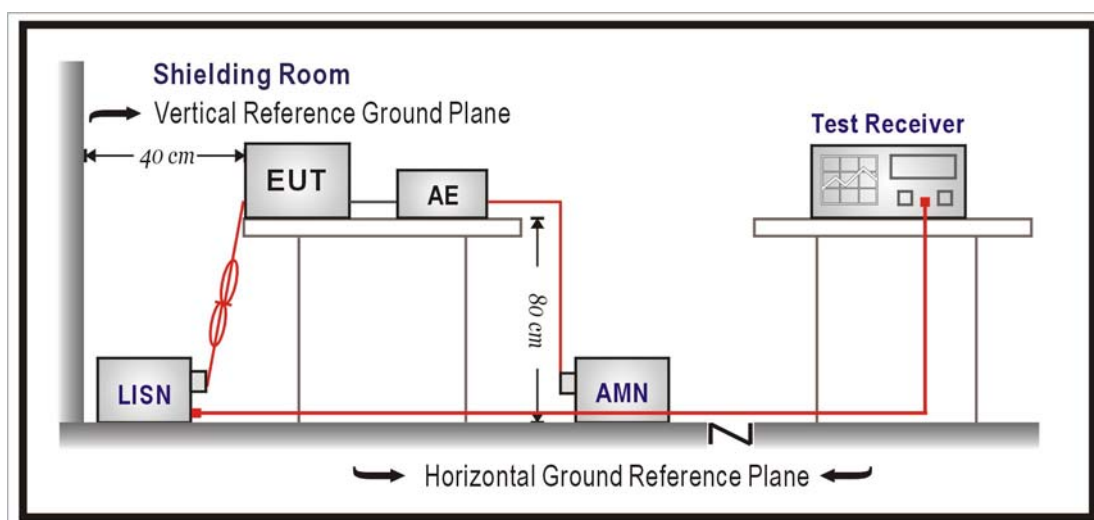
The following test equipment are used during the test:

Conducted Emission / SR2

Instrument	Manufacturer	Model No.	Serial No.	Next Cal. Date
Artificial Mains Network	R&S	ENV4200	848411/010	2016/01/25
LISN	R&S	ENV216	100092	2016/08/17
Test Receiver	R&S	ESCS 30	825442/014	2016/07/16

Note: All equipment upon which need to calibrated are with calibration period of 1 year.

2.2. Test Setup



2.3. Limits

Limits (dBuV)		
Frequency MHz	QP	AV
0.15 - 0.50	66-56	56-46
0.50-5.0	56	46
5.0 - 30	60	50

Remarks : In the above table, the tighter limit applies at the band edges.

2.4. Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refers to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4: 2003 on conducted measurement.

Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz.

2.5. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.207: 2007

2.6. Uncertainty

The measurement uncertainty is defined as ± 2.26 dB.

2.7. Test Result

EUT using DC input voltage, so the project does not have to test for testing.

3. Radiated Emission

3.1. Test Equipment

The following test equipment are used during the test:

Radiated Emission (Fundamental) / Site3

Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
Bilog Antenna	Schaffner	CBL6112B	2797	2016/08/14
Spectrum Analyzer	Advantest	R3132	100803278	2016/11/04
Test Receiver	R&S	ESCS 30	836858/022	2017/01/14
Coaxial Switch	Anritsu	MP59B	6201464326	2016/08/14
Coaxial Cable	Belden	Belden 9913	Site3	2016/08/14
Quietek EMI system	Quietek	Version 2.2	Site3	N/A

Radiated Emission (<30MHz) / Site 3

Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
Bilog Antenna	Schaffner	CBL6112B	2797	2016/08/14
Spectrum Analyzer	Advantest	R3132	100803278	2016/11/04
Test Receiver	R&S	ESCS 30	836858/022	2017/01/14
Coaxial Switch	Anritsu	MP59B	6201464326	2016/08/14
Coaxial Cable	Belden	Belden 9913	Site3	2016/08/14
Quietek EMI system	Quietek	Version 2.2	Site3	N/A

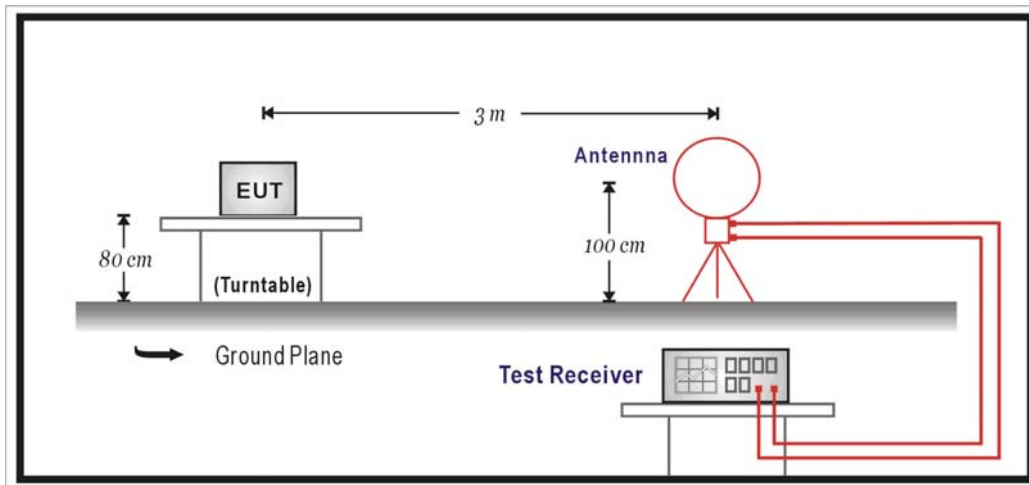
Radiated Emission (30MHz~1GHz) / CB4-H

Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
Bilog Antenna	Schaffner	CBL6112B	2891	2017/08/14
Horn Antenna	Schwarzbeck	BBHA 9120	D312	2017/10/25
Horn Antenna	Schwarzbeck	BBHA 9170	203	2017/08/28
Signal & Spectrum Analyzer	R&S	FSV40	101049	2018/01/22
Pre-Amplifier	EMCI	EMC0031835	980233	2018/02/02
Pre-Amplifier	Schwarzbeck	DBL-1840N506	013	2017/09/29
Pre-Amplifier	Miteq	JS41-00104000 0 -58-5P	1573954	2017/10/04
k Type Cable	Huber+Suhner	SF 102	25623/2	2018/01/19

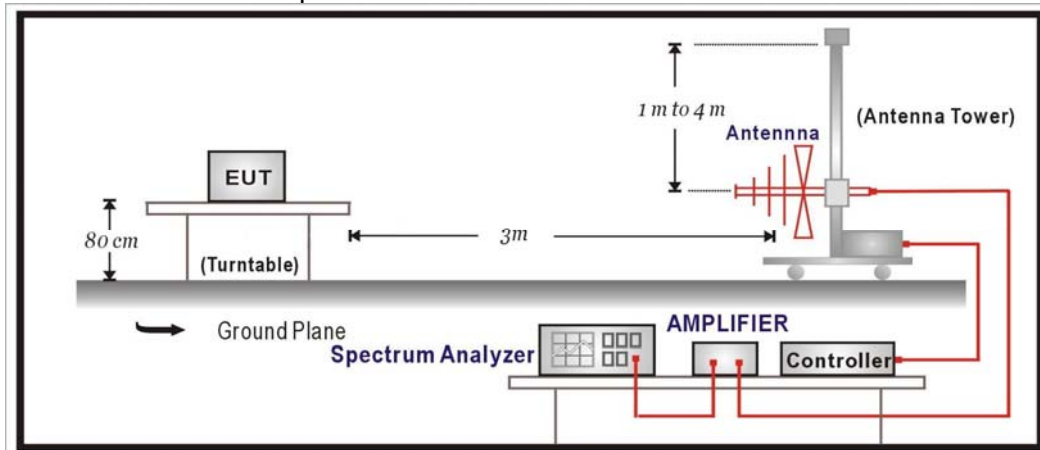
Note: All equipment that need to calibrate are with calibration period of 1 year.

3.2. Test Setup

Under 30MHz Test Setup:



Under 1GHz Test Setup:



3.3. Limits

➤ FCC Part 15 Subpart C Paragraph 15.225 Limit

The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

FCC Part 15 Subpart C Paragraph 15.225 Limits				
Field strength of fundamental				
Frequency (MHz)	30m		3m	
	uV/m	dBuV/m	uV/m	dBuV/m
13.553~13.567	15,848	84	1,584,800	124

Remarks : 1. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

➤ General Radiated Emission Limits

FCC Part 15 Paragraph 15.209 Limits		
Frequency MHz	Field Strength (Microvolts/meter)	Distance (Meters)
0.009-0.490	2400/F (kHz)	300
0.490-1.705	24000/F (kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark:

1. The tighter limit shall apply at the edge between two frequency bands.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
3. RF Voltage (dBuV/m) = $20 \cdot \log$ RF Voltage (uV/m)
4. When the very low emission of EUT, the 3m measurement distance was performed. Regards to an inverse linear extrapolation 40dB/dec is adopted. The collection factor will be 80dB for this case.

3.4. Test Procedure

The EUT and its simulators are placed on a turn table which is 0.8 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level.

Regard to the characteristic and operation band of EUT, Loop antenna was used for this measurement. The measurement method is based on ANSI C63.4 section 8.

Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.4:2003 on radiated measurement.

Radiated emissions were investigated over the frequency range from 9kHz to 30MHz using a receive bandwidth of 9kHz and 30MHz to 1GHz using a receiver bandwidth of 120kHz.

Radiated was performed at an antenna to EUT distance of 3 meters.

The frequency range from 30MHz to 10th harmonics is checked.

The emission limit shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000MHz.

Radiated emission limit in these three bands are based on measurements employing an average detector.

3.5. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.225: 2007

3.6. Uncertainty

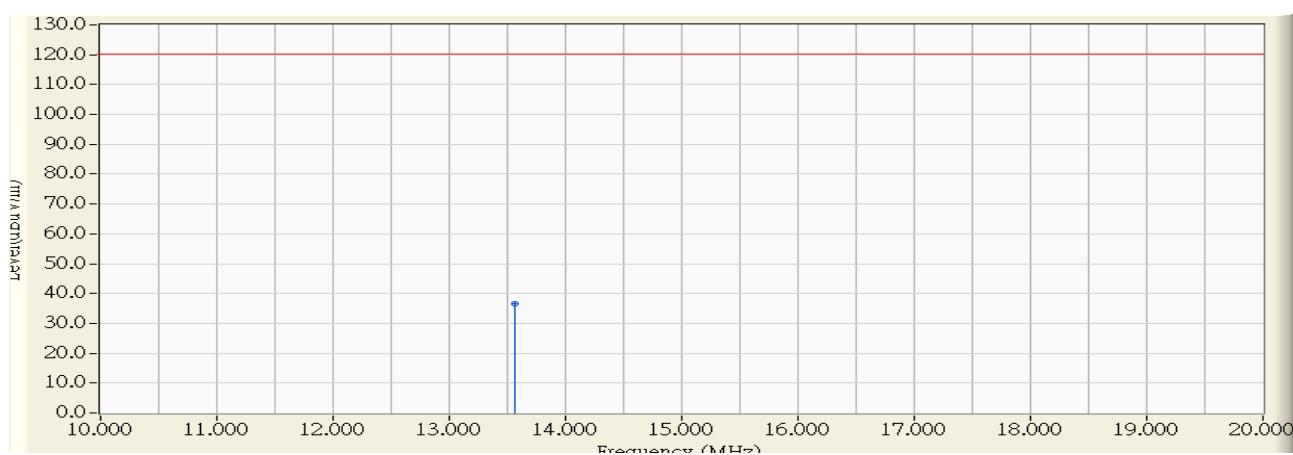
The measurement uncertainty

30MHz~1GHz as $\pm 3.19\text{dB}$

3.7. Test Result

Product	WEL-3750/WEL7750/WEL3790/WEL7790 RFID Electronic Lock
Test Item	Fundamental Radiated Emission
Test Mode	Mode 1: Transmit
Date of Test	2016/07/07

Test conditions	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV/m@3m)	Measure Level (dBuV/m@3m)	Limit (dBuV/m@3m)
X-axis	13.56	20.41	16.2	36.61	120



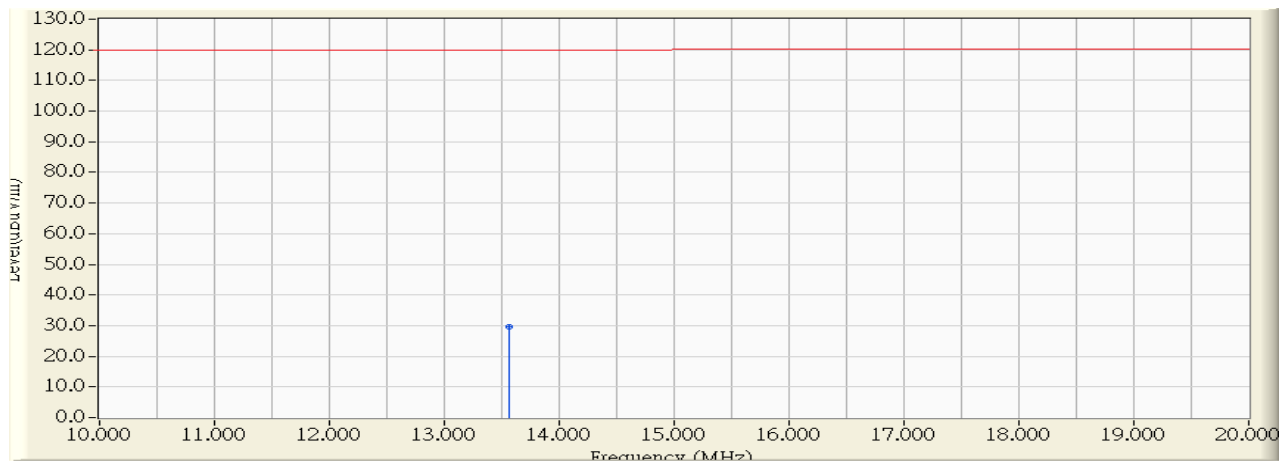
Note: Measurement Level = Reading Level +Correct factor

$$\text{dBuV/m} = 20\log(\text{uV/m}) = 60 + 20\log(\text{mV/m})$$

$$\text{dBuV/m@ 3m} = \text{dBuV/m@ 30m} + 40\log(30\text{m}/3\text{m})$$

Product	WEL-3750/WEL7750/WEL3790/WEL7790 RFID Electronic Lock
Test Item	Fundamental Radiated Emission
Test Mode	Mode 1: Transmit
Date of Test	2016/07/07

Test conditions	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV/m@3m)	Measure Level (dBuV/m@3m)	Limit (dBuV/m@3m)
Y-axis	13.56	20.41	9.3	29.71	120



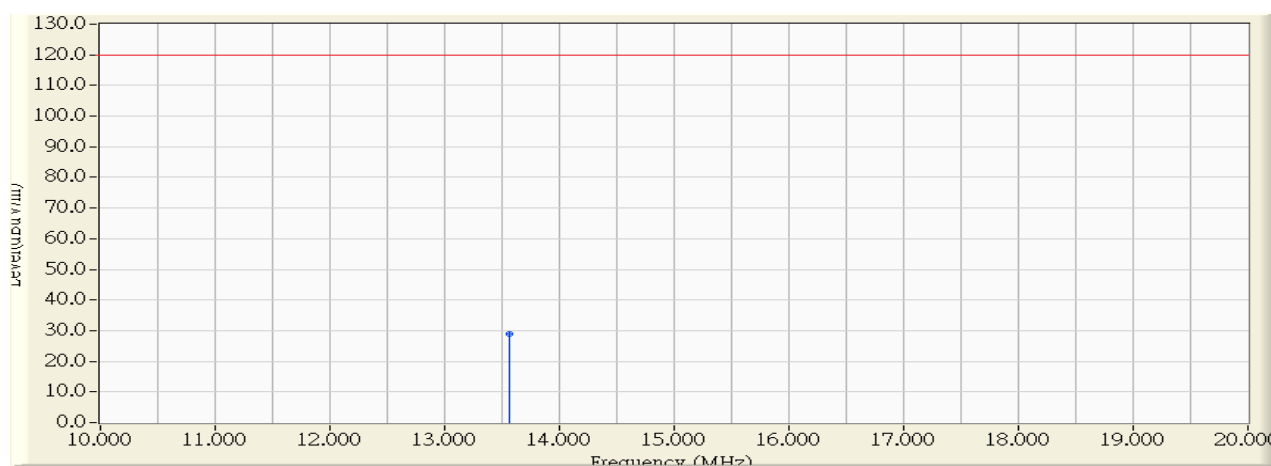
Note: Measurement Level = Reading Level +Correct factor

$$\text{dBuV/m} = 20\log(\text{uV/m}) = 60 + 20\log(\text{mV/m})$$

$$\text{dBuV/m@ 3m} = \text{dBuV/m@ 30m} + 40\log(30\text{m}/3\text{m})$$

Product	WEL-3750/WEL7750/WEL3790/WEL7790 RFID Electronic Lock
Test Item	Fundamental Radiated Emission
Test Mode	Mode 1: Transmit
Date of Test	2016/07/07

Test conditions	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV/m@3m)	Measure Level (dBuV/m@3m)	Limit (dBuV/m@3m)
Z-axis	13.56	20.41	8.6	29.01	120



Note: Measurement Level = Reading Level +Correct factor

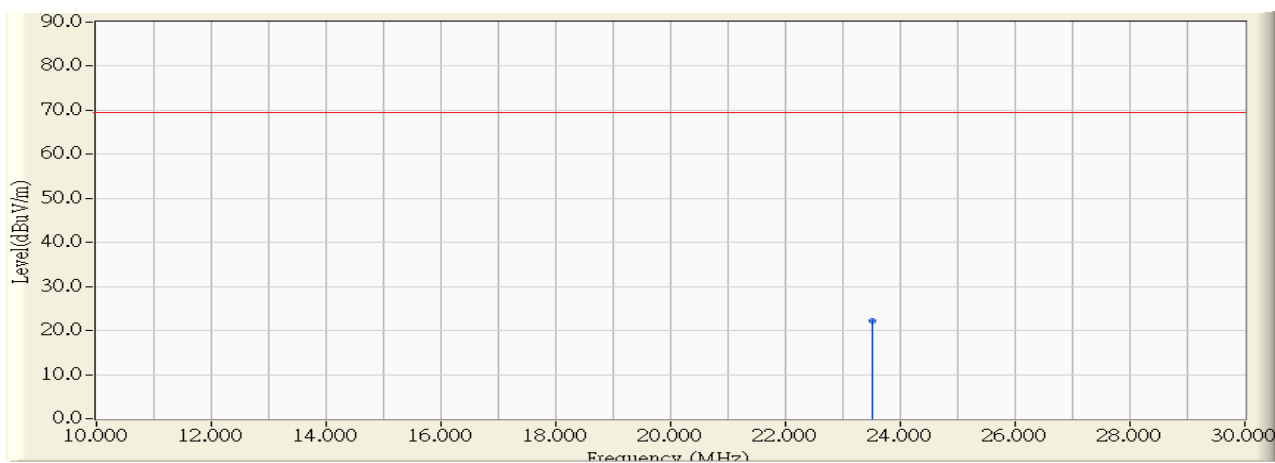
$$\text{dBuV/m} = 20\log(\mu\text{V/m}) = 60 + 20\log(\text{mV/m})$$

$$\text{dBuV/m@ 3m} = \text{dBuV/m@ 30m} + 40\log(30\text{m}/3\text{m})$$

Product	WEL-3750/WEL7750/WEL3790/WEL7790 RFID Electronic Lock
Test Item	Radiated Emission
Test Mode	Mode 1: Transmit
Date of Test	2016/07/07

Spurious Emission (<30MHz) at 3m

Test conditions	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV/m@3m)	Measure Level (dBuV/m@3m)	Limit (dBuV/m@3m)
X-axis	23.51	19.95	2.3	22.25	69.54

**Note:**

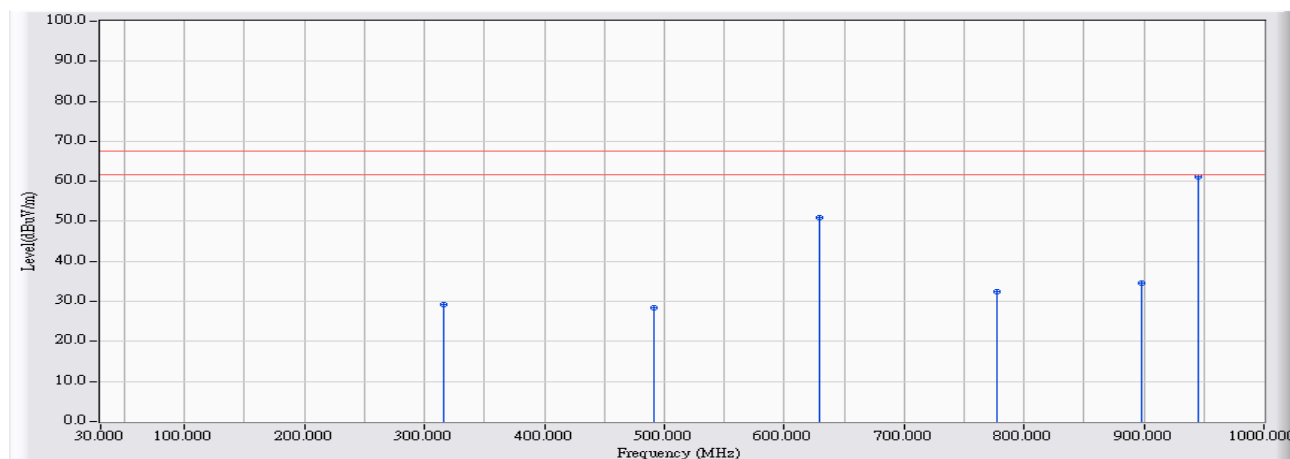
Measurement Level = Reading Level +Correct factor

$\text{dBuV/m} = 20\log(\text{uV/m}) = 60 + 20\log(\text{mV/m})$

$\text{dBuV/m@ 3m} = \text{dBuV/m@ 30m} + 40\log(30\text{m}/3\text{m})$

Spurious Emission (30MHz~1GHz)

Site : CB4-H	Time : 2017/03/01
Limit : NCC_3.4.2_H_315MHz_03M_PK	Margin : 6
Probe : CB4-H_FCC_EFS_S2_30M-1GHz_1116 - HORIZONTAL	Power : DC 6V (Power by Battery)
EUT : WEL-3750/WEL7750/WEL3790/WEL7790 RFID Electronic Lock	Note : X-axis

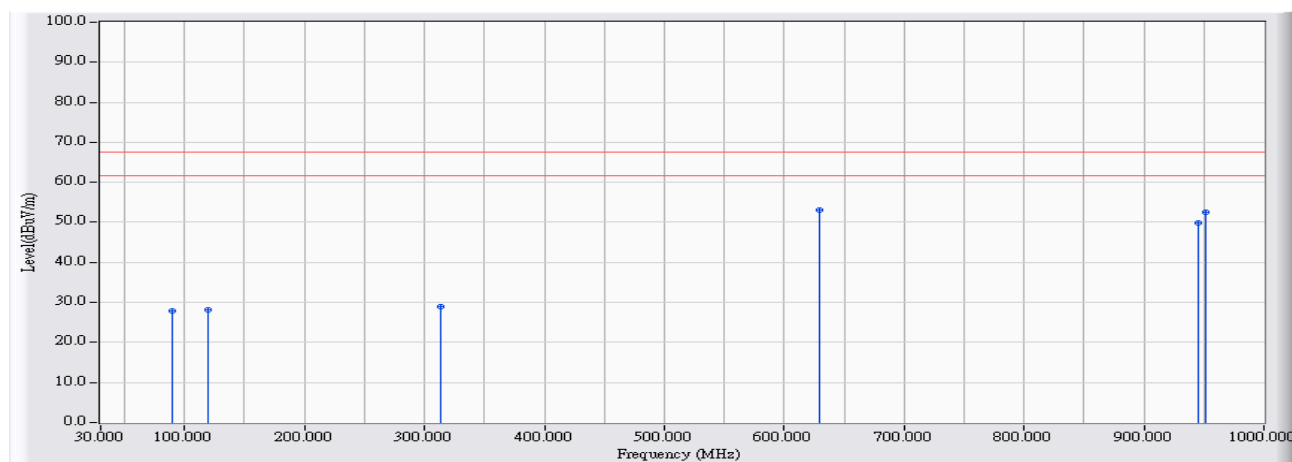


		Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1		316.024	-19.044	48.366	29.321	-38.339	67.660	PEAK
2		491.286	-14.174	42.540	28.366	-39.294	67.660	PEAK
3		629.885	-12.150	63.030	50.880	-16.780	67.660	PEAK
4		776.825	-9.842	42.187	32.346	-35.314	67.660	PEAK
5		898.645	-8.760	43.351	34.590	-33.070	67.660	PEAK
6	*	944.813	-7.203	68.353	61.150	-6.510	67.660	PEAK

Note:

1. All Reading Levels are Quasi-Peak value.
2. “ * ”, means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor.

Site : CB4-H	Time : 2017/03/01
Limit : NCC_3.4.2_H_315MHz_03M_PK	Margin : 6
Probe : CB4-H_FCC_EFS_S2_30M-1GHz_1116 - VERTICAL	Power : DC 6V (Power by Battery)
EUT : WEL-3750/WEL7750/WEL3790/WEL7790 RFID Electronic Lock	Note : X-axis



	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	90.231	-25.469	53.272	27.803	-39.857	67.660	PEAK
2	119.134	-21.230	49.504	28.273	-39.387	67.660	PEAK
3	313.600	-19.122	48.044	28.922	-38.738	67.660	PEAK
4	* 629.885	-12.150	65.253	53.103	-14.557	67.660	PEAK
5	944.813	-7.203	56.980	49.777	-17.883	67.660	PEAK
6	951.117	-7.179	59.595	52.417	-15.243	67.660	PEAK

Note:

1. All Reading Levels are Quasi-Peak value.
2. “ * ”, means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor.

4. Frequency Stability

4.1. Test Equipment

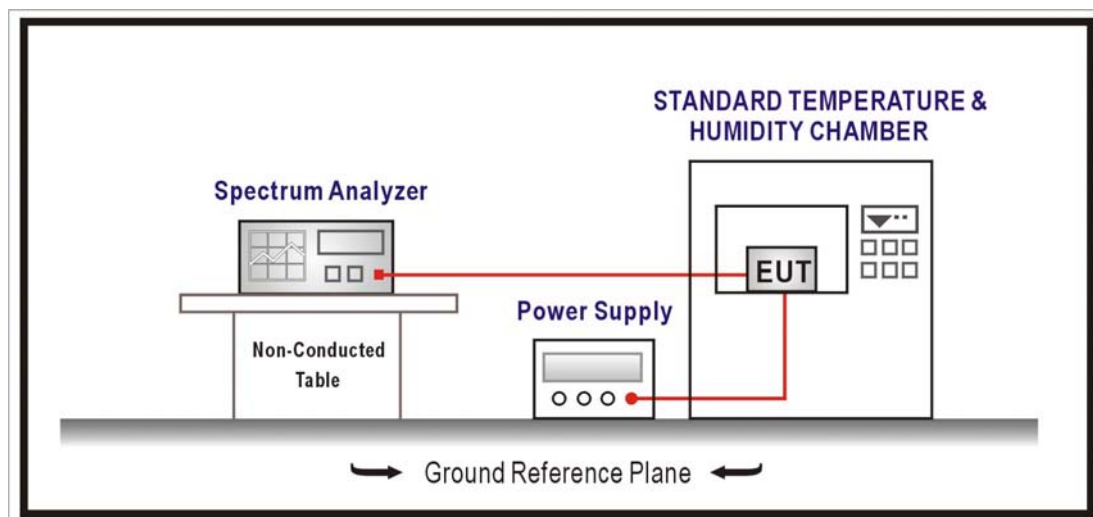
The following test equipments are used during the radiated emission tests:

Frequency Stability / SR7

Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
Spectrum Analyzer	R&S	FSP	100561	2016/12/28
Temperature & Humidity Chamber	WIT	TH-1S-B	1082101	2017/01/18

Note: All equipments that need to calibrate are with calibration period of 1 year.

4.2. Test Setup



4.3. Test Procedure

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to 50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

4.4. Uncertainty

The measurement uncertainty is defined as ± 150 Hz

4.5. Test Result

Product	WEL-3750/WEL7750/WEL3790/WEL7790 RFID Electronic Lock
Test Item	Frequency Tolerance
Test Mode	Mode 1: Transmit
Date of Test	2016/07/20

Temperature Interval (°C)	AC Voltage (V)	Frequency (MHz)	Deviation (ppm)	Result
-20	6	13.56005	3.3524	PASS
-10		13.56002	1.7373	PASS
0		13.56022	16.2493	PASS
10		13.55998	-1.2549	PASS
20		13.55999	-0.6320	PASS
30		13.55990	-7.0235	PASS
40		13.56000	-0.1126	PASS
50		13.55995	-3.5803	PASS

Temperature Interval (°C)	AC Voltage (V)	Frequency (MHz)	Deviation (ppm)	Result
25	5.1	13.55997	-2.1848	PASS
	6	13.55998	-1.5732	PASS
	6.9	13.55996	-2.6038	PASS