Global No.1 Testing Laboratory Universal Certification Solution

FCC Test Report

Product name: DIGITAL FURNITURE LOCK

Model: ML32HRH

Family model: ML32HRV, ML22HRH, ML22HRV

Standards: FCC CFR 47 PART 15 SUBPART C, Section 15.225

Applicant: Unilock Co., Ltd.

Test Report No.: UCSFR-1312-002

FCC ID: 2ABLG-ML32HRH

UCS Co., Ltd.

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CBTL IEC IECEE

FCC Test Report

Report Number	UCSFR-1312-002			
Applicant	Company Name	Unilock Co., Ltd.		
	Address	1409 Mega Bldg., SK n Techno Park, 190-1 Sangdaewon-dong, Jungwon-gu, Seongnam, Gyeonggi-do, South Korea		
Product	Product Name	DIGITAL FURNITURE LOCK		
	Model Name	ML32HRH		
	Family Model	ML32HRV, ML22HRH, ML22HRV		
	Manufacturer	Unilock Co., Ltd.		
	Serial No.	-	Country of origin	Korea
Other	Receipt Date	2013.10.18	Receipt Number	UCS-R-2013-590
	Issued Date	2013.12.23	Tested Date	2013.12.10 ~ 2013.12.13
Standard	**FCC CFR 47 PART 15 SUBPART C, SECTION 15.225**			
Tested by	Y. R. Jo (sign)			
Approved by	Y. M. Choi (sign)			

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Revision History

Rev.	Issue Date	Revisions	Revised By
-	2013.12.23	Initial Issue	Y. R. Jo

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1. APPLICANT AND MANUFACTURER INFORMATION

Applicant Name : Unilock Co., Ltd.

Address : 1409 Mega Bldg., SK n Techno Park, 190-1 Sangdaewon-dong, Jungwon-gu, Seongnam, Gyeonggi-do, South Korea

Manufacturer : Unilock Co., Ltd.

Address : 1409 Mega Bldg., SK n Techno Park, 190-1 Sangdaewon-dong, Jungwon-gu, Seongnam, Gyeonggi-do, South Korea

2. TEST RESULT CERTIFICATION

2.1 Applicable standards

Standard	Clause	Test Item	Result	Remarks
FCC CFR 47 Part 15 Subpart C	15.225(a) (b) (c)	Radiated Electric Field Emissions	Pass	-
	15.225(d)	Radiated Electric Field Emissions	Pass	-
	15.225(e)	Frequency Stability	Pass	
	15.207	AC Power Line Conducted Emissions	N/A	EUT is using the battery, so the test is not conducted.

3. LABORATORY INFORMATION

3.1 General

UCS Co., Ltd. established 1999 as the International agreed upon laboratory(CBTL, KOLAS) for Standard.

Internally, UCS Co., Ltd. is the designated test laboratory from Radio Research Laboratory of Korea Communications Commission and Korea Food & Drug Administration.

Based on its extensive experience and expertise, UCS Co., Ltd. is the Global test laboratory that has best professionalism in this field.

3.2 Test Site

- UCS Co., Ltd. (Universal Certification Solution)

3.3 Location

UCS Co., Ltd.

- #702, AnyangMegavally, 268 Hagui-ro Dongan-gu Anyang-si Gyeonggi-do, Korea.

ER Center

- #35-13 Hwalcho-gil 109beon-gil Hwaseong-si Gyeonggi-do, Korea

4. EUT INFORMATION

Equipment Class	DXX - Low Power Communication Device Transmitter
Product name	DIGITAL FURNITURE LOCK
Model name	ML32HRH
Power source	DC 4.5 V (AAA Alkaline batteries 3EA)
Frequency range	13.561 MHz
Modulation Technique	ASK
Antenna Type	Integral loop antenna
Dimensions(W×L×T)	RF Front (102 × 25 × 8) mm Battery Pack (92 × 40 × 26) mm

4.1 Family Model

The following lists consist of the added model and their differences:

Model name	Differences	
ML32HRV	Use RF Cam Lock Cylinder	Vertical Type
ML22HRH	Use RF Drawer Lock Cylinder	Horizontal Type
ML22HRV	Use RF Drawer Lock Cylinder	Vertical Type

Note: The Applicant/manufacturer is responsible for the compliance of all variants.

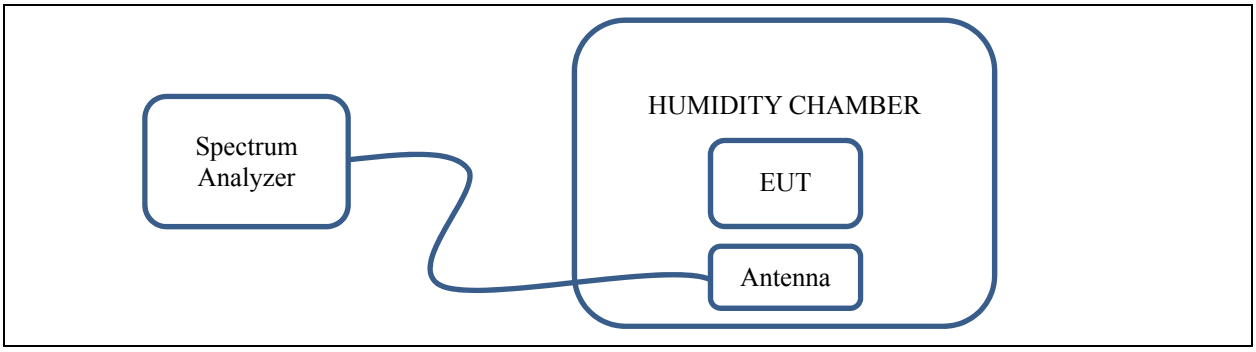
5. Measurement conditions

5.1 Description of test modes

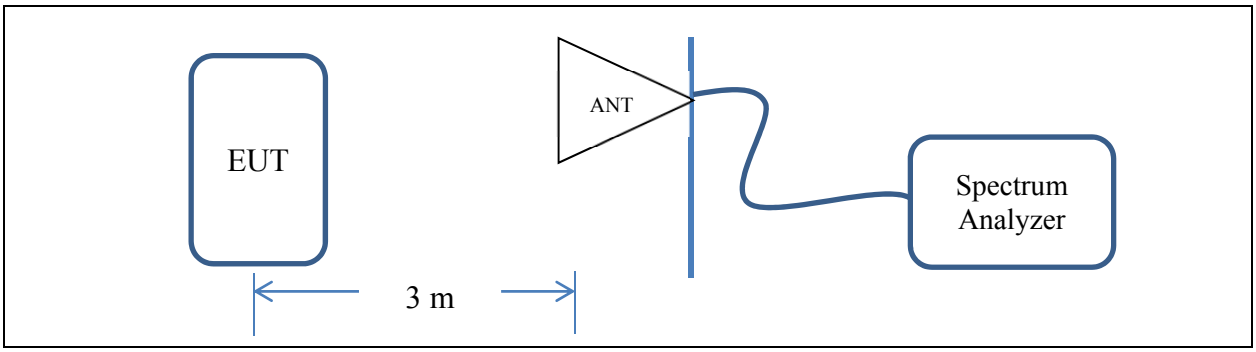
- The EUT had been tested under the operating condition.
- There are one channels have been tested as following:

Channel	Frequency (MHz)
Fundamental	13.561

5.2 Description of test configuration



[System Block Diagram of Test Configuration 1]



[System Block Diagram of Test Configuration 2]

5.3 Setup of equipmet under test

5.3.1. Description of support units

- The EUT has been tested as an independent unit along with the following necessary Accessories or support units, which are adopted to form a representative test configuration.

No.	Equipment	Manufacturer	Model	Note
1	DIGITAL FURNITURE LOCK	Unilock Co., Ltd.	ML32HRH	EUT
-	-	-	-	-

6. Limite And Result

6.1 Radiated Electric Field Emissions

6.1.1 Regulation

According to §15.225(a), The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

According to §15.225(b), Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

According to §15.225(c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

6.1.2 Test Condition

- The EUT is placed on a turntable, which is 0.8m above ground plane.
- Three orientation for the EUT were tried to find out which orientation produces the worst emissions.
- The loop antenna was also moved around to find out worst position for the emissions.
- Set RBW of Spectrum analyzer to 9 kHz, VBW=300 kHz, Sweep=auto
- The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 uV/m at 30 meters.

6.1.3 Test result

Table 1 : Measured values of the Radiated Electric Field Emissions

Frequency (MHz)	Polarization (V/H)	Cable Loss +Ant. Factor	Reading dBμV/m @ 3 m	Actual dBμV/m @ 3 m	Actual dBμV/m @ 30 m	Actual μV/m @ 30 m	Limit (μV/m)	Verdict
13.303	H	9.54	12.15	21.69	-18.31	0.12	< 106 μV/m @ 30 m	PASS
13.342	V	9.54	9.65	19.19	-20.81	0.09		PASS
13.553	H	9.53	19.64	29.17	-10.83	0.29	< 334 μV/m @ 30 m	PASS
13.553	V	9.53	16.24	25.77	-14.23	0.19		PASS
13.561	H	9.53	33.18	42.71	2.71	1.37	< 15,848 μV/m @ 30 m	PASS
13.562	V	9.53	36.59	46.12	6.12	2.02		PASS
13.567	H	9.52	23.04	32.56	-7.44	0.43	< 334 μV/m @ 30 m	PASS
13.567	V	9.52	19.98	29.5	-10.50	0.30		PASS
13.718	H	9.52	10.37	19.89	-20.11	0.10	< 106 μV/m @ 30 m	PASS
13.902	V	9.51	10.44	19.95	-20.05	0.10		PASS

6.2 Radiated Electric Field Emissions

6.2.1 Regulation

According to §15.225(d), The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Field strength (μV/m)	Field strength (dBμV/m)	Measurement distance (meters)
0.009 - 0.490	2 400/F (kHz)	-	300
0.490 - 1.705	24 000/F (kHz)	-	30
1.705 - 30	30	29.5	30
30 – 88	100	40.0	3
88 – 216	150	43.5	3
216 – 960	200	46.0	3
Above 960	500	54.0	3

According to §15.109(a), for an unintentional device, except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the above table.

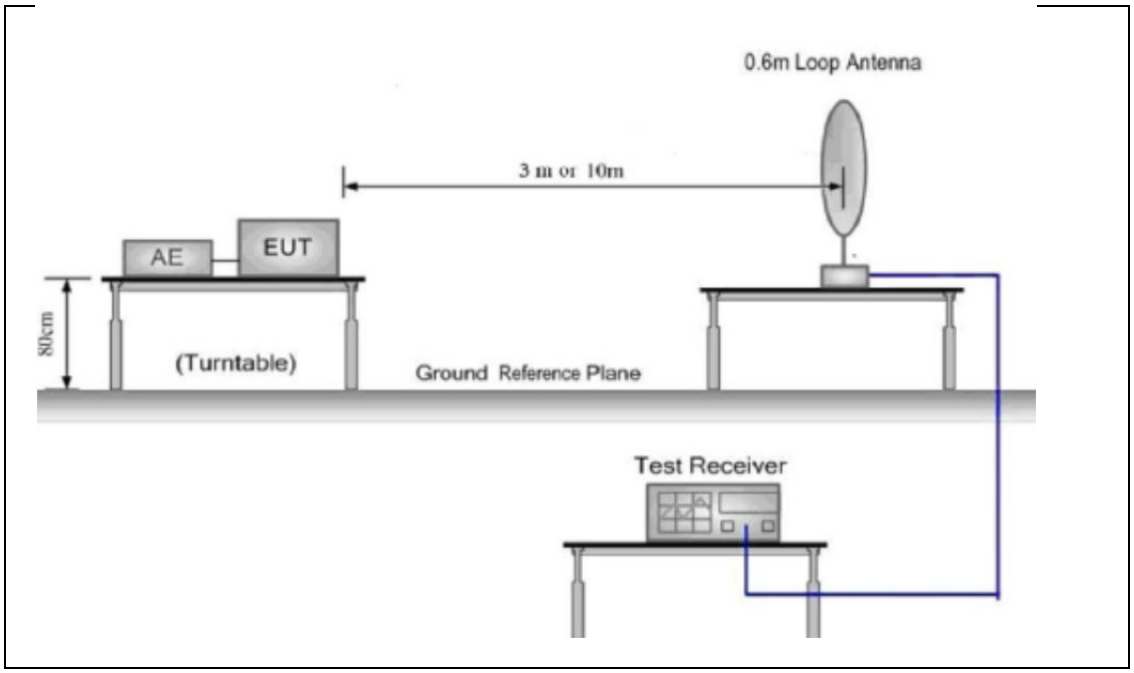
** The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector and above 1000 MHz are based on the average value of measured emissions.

6.2.2 Test Procedure

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters for above 30 MHz, and at 1 meter distance for below 30 MHz.
2. The EUT was placed on the top of the 0.8 meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.
3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, from 30 to 1 000 MHz using the Trilog broadband antenna, and from 1 GHz to tenth harmonic of the highest fundamental frequency using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6. The EUT is situated in three orthogonal planes (if appropriate)
7. The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT.
8. If the emission on which a radiated measurement must be made is located at the edge of the authorized band of operation, then the alternative “marker-delta” method may be employed.

6.2.3 Test Setup Layout

6.2.3.1 Radiated Emission Test Set-Up, Frequency Below 30 MHz



6.2.3.2 Radiated Emission Test Set-UP Frequency Below 1 000 MHz

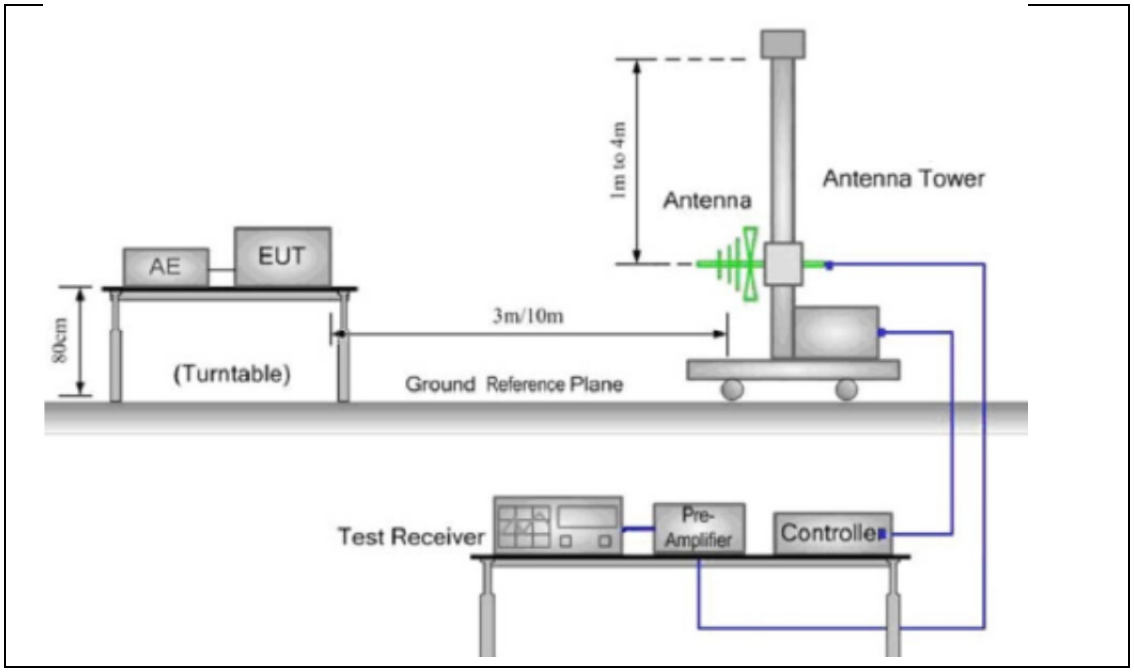


Table 3 : Measured values of the Radiated Electric Field Emissions						
Frequency (MHz)		**Detect Mode**	**Polarization (V/H)**	**Emission Level (dBμV/m)**	**Limit (dBμV/m) @ 3m**	**Margin (dB)**
13.561	1.75	Quasi-peak	H	24.94	69.50	44.56
	4.86	Quasi-peak	V	19.80	69.50	49.70
	7.19	Quasi-peak	H	16.66	69.50	52.84
	25.20	Quasi-peak	V	14.34	69.50	55.16
	28.02	Quasi-peak	V	15.08	69.50	54.42
	35.80	Quasi-peak	V	34.79	40.00	5.21
	297.70	Quasi-peak	V	37.59	46.00	8.41
	596.50	Quasi-peak	H	40.79	46.00	5.21
	705.10	Quasi-peak	V	39.99	46.00	6.01
	732.30	Quasi-peak	V	36.89	46.00	9.11
	759.40	Quasi-peak	H	34.49	46.00	11.51

Note.
1. Margin (dB) = Limit – Emission Level
2. H = Horizontal, V = Vertical Polarization

6.3 Frequency Stability

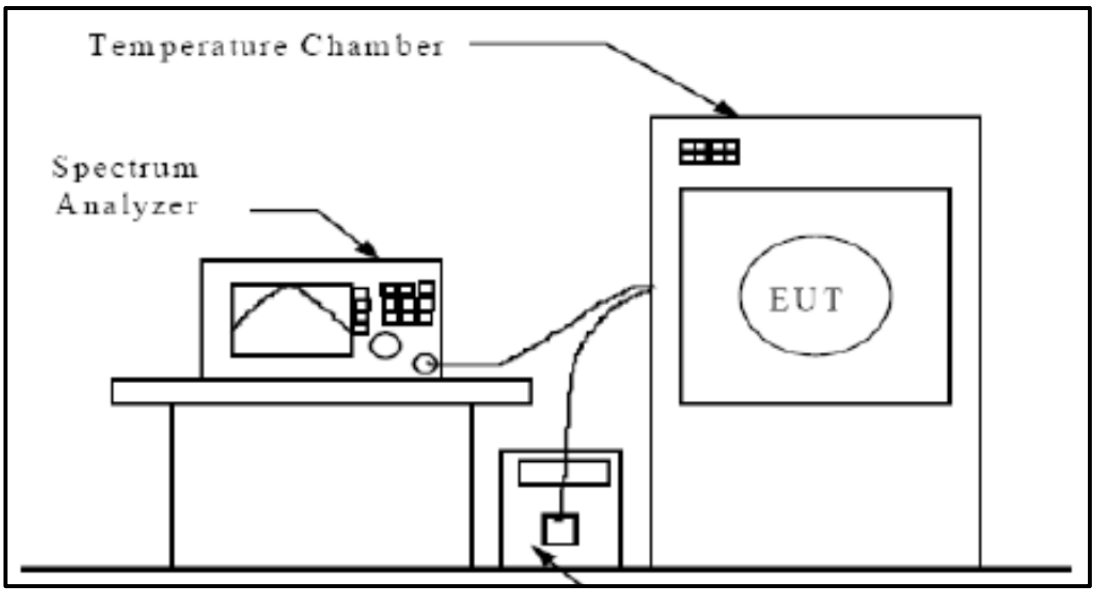
6.3.1 Regulation

According to §15.225(e), The frequency tolerance of the carrier signal shall be maintained within ±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.

6.3.2 Test Condition

1. Frequency stability vs. temperature measurement
   - The EUT was placed into the constant temperature chamber.
   - The spectrum analyzer was used to read the EUT operating frequency.
   - Set the constant temperature chamber temperature within the range of -20 °C to +50 °C
2. Frequency stability vs. input voltage measurement
   - The EUT was placed into the constant temperature chamber and set the temperature to 20 °C.
   - The spectrum analyzer was used to read the EUT operating frequency.
   - The EUT is powered with the DC Power Supplied it with 85 % and 115 % voltage, and measured the EUT operating frequency.

6.3.3 Test Setup Layout



6.3.4 Test result

<table>
<tr><th colspan="7">Table 4 : Measured values of the Frequency Stability</th></tr>
<tr><th rowspan="2">Frequency (Hz)</th><th colspan="4">Test Data (Hz)</th><th rowspan="2">Limit (Hz)</th><th rowspan="2">Verdict</th></tr>
<tr><th>-20 °C</th><th>-10 °C</th><th>0 °C</th><th>+10 °C</th></tr>
<tr><td rowspan="7">13 561 000</td><td>13 561 064</td><td>13 561 063</td><td>13 561 084</td><td>13 561 096</td><td rowspan="7">± 1 356 Hz
(13 559 644
~
13 562 356)</td><td rowspan="7">PASS</td></tr>
<tr><td>+20 °C</td><td>+30 °C</td><td>+40 °C</td><td>+50 °C</td></tr>
<tr><td>13 561 111</td><td>13 561 141</td><td>13 561 154</td><td>13 561 152</td></tr>
<tr><td colspan="4">Test Voltage</td></tr>
<tr><td colspan="2">Power 85 %</td><td colspan="2">Power 115 %</td></tr>
<tr><td colspan="2">13 561 114</td><td colspan="2">13 561 115</td></tr>
</table>

*Note
- Limit : Operating frequency X (±) 0.000 1 = (±) 1 356 Hz
- Within the band : 13 559 644 Hz – 13 562 356 Hz

6.4. AC Power Line Conducted Emissions

6.4.1. Regulation

According to §15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Qausi-peak	Average
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 – 5	56	46
5 – 30	60	50

* Decreases with the logarithm of the frequency.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

6.4.2. Test Procedure

1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5m away from the side wall of the shielded room.
2. Each current-carrying conductor of the EUT power cord was individually connected through a 50Ω/50μH LISN, which is an input transducer to a Spectrum Analyzer or an EMI/Field Intensity Meter, to the input power source.
3. Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
4. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
5. The measurements were made with the detector set to PEAK amplitude within a bandwidth of 10kHz or to QUASI-PEAK and AVERAGE within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.

6.4.3. Test Results

Table 5-1 : Measured values of the AC Power Line Conducted Emissions (DVD Rental Machine)								
Frequency (MHz)	**Mode**	**Hot/Neutral (H/N)**	**Measured Value (dBµV)**	**Correction Factor (dB)**	**Cable Loss (dB)**	**Emission Level (dBµV)**	**Limit (dBµV)**	**Margin (dB)**

EUT is using the battery, so the test is not conducted.

1. Margin (dB) = Limit – Emission Level
2. Emission Level = Measured Value + CF + CL

6.4.4. Plot of the AC Power Line Conducted Emissions

HOT LINE

N/A

NEUTRAL LINE

N/A

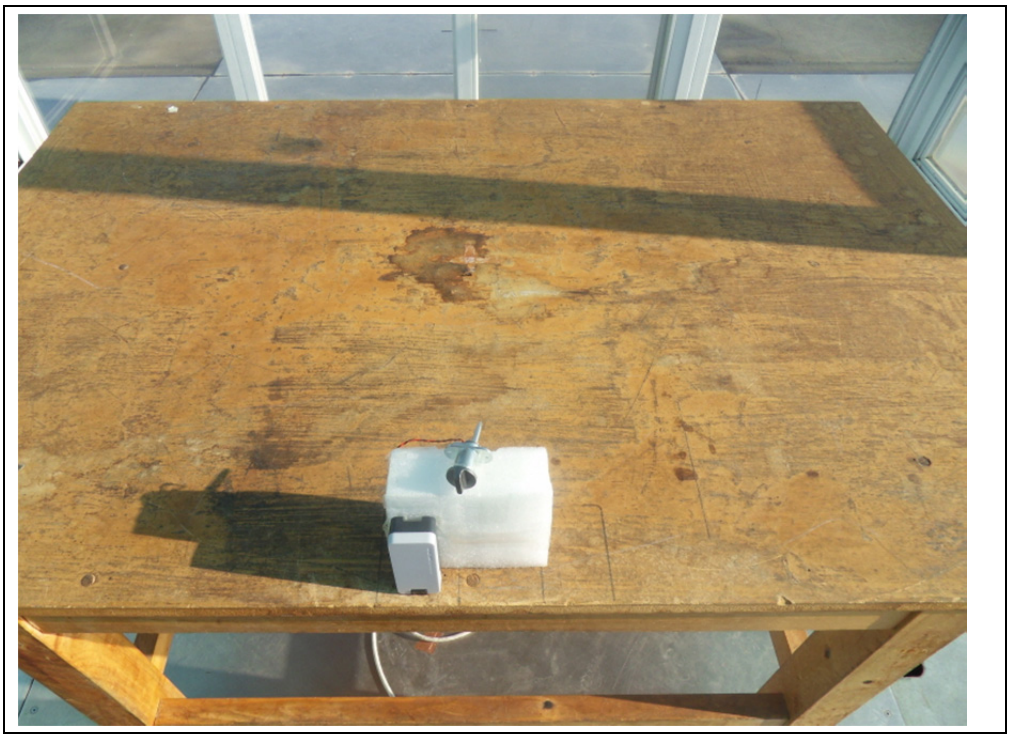
7. TEST EQUIPMENT USED FOR TEST

Used equipment	Description	Manufacturer	Model Name	Serial Number	Specifications	Next Cal. Data
■	Spectrum Analyzer	HP	E4407B	US3901025	9 kHz ~ 26.5 GHz	2014-02-21
□	MICROWAVE FREQUENCY COUNTER	ANRITSU	MF2414B	6200003197	10 Hz ~ 26.5 GHz	2014-09-02
□	EPM-P SERIES POWER METER	Agilent	E4416A	GB38272722	1 CH 100-240 VAC	2014-09-02
□	Power Sensor	Agilent	8481A	US41030240	MAX.23 dBm, AVG. 18 GHz	2014-09-05
■	Signal Generator	AGILENT	83630B	3844A00770	10 MHz ~ 26.5 GHz	2014-02-19
□	Power Divider	HP	11636B	07317	DC ~ 26.5 GHz	2014-09-02
□	Power Divider	HP	11636B	07412	DC ~ 26.5 GHz	2014-09-02
■	Test receiver	ROHDE&SCHWARZ	ESPI3	101171	9 kHz ~ 3 GHz	2014-08-08
■	Amplifier	SONOMA	310N	291723	9 kHz ~ 1 GHz	2014-09-02
■	Signal Generator	ROHDE&SCHWARZ	SMC100A	101441	9 kHz ~ 3.2 GHz	2014-09-02
□	BI-LOG ANT	TDK	HLP-3003C	130526	30 MHz ~ 3 GHz	2014-03-22
■	Loop Antenna	EMCO	6502	9801-3191	9 kHz ~ 30 MHz	2014-02-02
□	Horn antenna	Schwarzbeck	BBHA 9120 D	768	1 GHz ~ 18 GHz	2015-12-11
□	Horn antenna	Schwarzbeck	BBHA 9120 D	769	1 GHz ~ 18 GHz	2015-11-29
■	Spectrum Analyzer	ROHDE&SCHWARZ	FSP13	100640	9 kHz ~ 13.6 GHz	2014-01-07
□	Amplifier	TESTEK	TS-PA1	110013	1 GHz ~ 6 GHz	2014-09-02
□	Slidacs	Daekwang	-	-	5 kVA, OUTPUT:AC: 300 V	-
□	DC Power Supply	Fine Suntronix	IT6720	4001132	1 CH 60 V 5 A	-
□	System Power Supply	HP	6032A	US38322315	60 V 50 A	2014-03-20
■	DC Power Supply	Maynuo	M8811	080001096001110 3046	30 V 5 A	2014-09-02
□	Vibration Tester	Gana	GNV-500	-	(0 ~ 60) Hz/50 kg	2014-09-02
■	HUMIDITY CHAMBER	BUM JIN Eng.	-	-	(-40 ~ 120) °C, 95 %R.H.	2014-10-04
□	Drop Tester	JUNG JIN Eng	-	-	(0 ~ 120) cm	-
■	Bilog Antenna	Teseq GmbH	CBL 6143A	35039	-	2014-06-17
■	Spectrum Analyzer	Agilent	E4440A	MY46186407	3 Hz ~ 26.5 GHz	2014-01-20
■	RF Selector	TOYO Corporation	NS4900	1003-335	-	N/A
■	Band Selector	TOYO Corporation	NS5800	1003-010	-	N/A
■	Band Selector	TOYO Corporation	NS5800	1003-135	-	N/A
■	Amplifier	SONOMA INSTRUMENT	371	321041	-	2014-03-30
■	Attenuator	Weinschel Engineering	10	AJ1239	-	2014-07-26

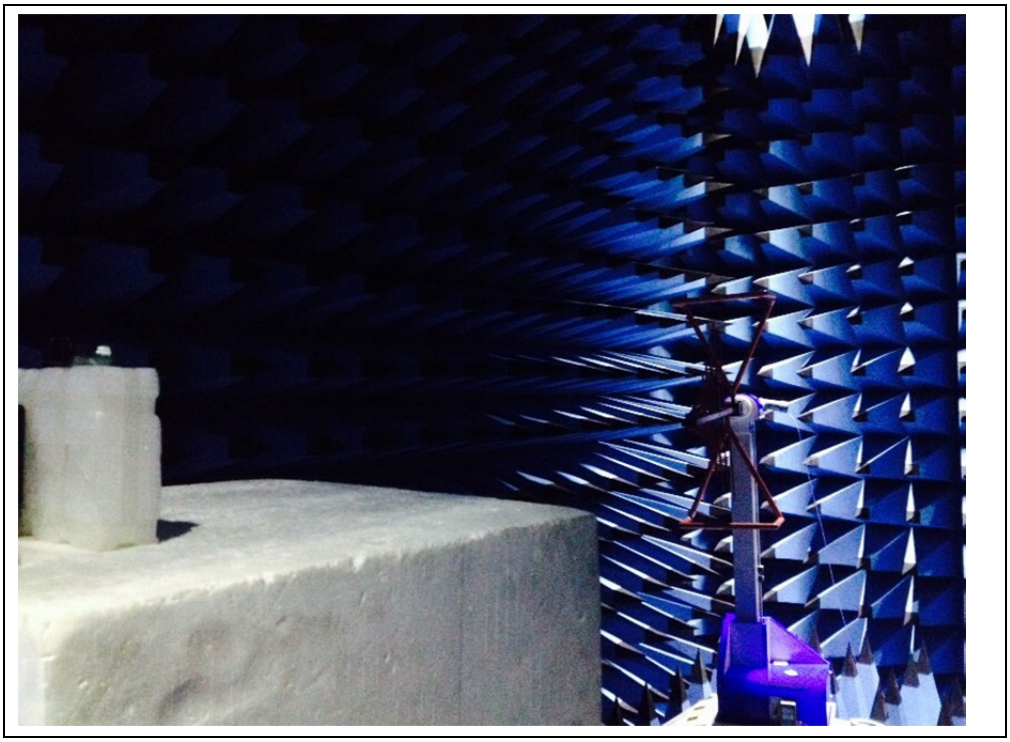
8. SETUP PHOTOS

8.1. Radiation emission test setup

8.1.1. Below 30 MHz



8.1.2. Below 1 000 MHz



9. EUT Photographs

9.1 Front view

9.2 Back view