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FCC TEST REPORT FCC ID:2A4W4-HMI-2012

Report Number	: ZKT-220225L1121E-1
Date of Test	Feb. 18, 2022 to Feb. 28, 2022
Date of issue	: Feb. 28, 2022
Total number of pages	. 24
Test Result	: PASS
Testing Laboratory	: Shenzhen ZKT Technology Co., Ltd.
Address	. 1/F, No. 101, Building B, No. 6, Tangwei Community Industrial Avenue, Fuhai Street, Bao'an District, Shenzhen, China
Applicant's name	: SHENZHEN ZAIFENGDA TECHNOLOGY CO.,LTD
Address	: Fudigang 2nd Industrial Estate 2-1, 2-2, Pingdong Community, Pingdi Street, Longgang Dist., Shenzhen, China
Manufacturer's name	: SHENZHEN ZAIFENGDA TECHNOLOGY CO.,LTD
Address	: Fudigang 2nd Industrial Estate 2-1, 2-2, Pingdong Community, Pingdi Street, Longgang Dist., Shenzhen, China
Test specification:	
Standard	FCC CFR Title 47 Part 15 Subpart C Section 15.225 ANSI C63.10:2013
Test procedure	:/
Non-standard test method	: N/A
Test Report Form No	TRF-EL-112_V0
Test Report Form(s) Originator	ZKT Testing
Master TRF	Dated: 2020-01-06
This device described above has been test (EUT) is in compliance with the lidentified in the report. This report shall not be reproduced en be altered or revised by ZKT, person	en tested by ZKT, and the test results show that the equipment under FCC requirements. And it is applicable only to the tested sample except in full, without the written approval of ZKT, this document may al only, and shall be noted in the revision of the document.
Product name	: SMART DOOR LOCK
Trademark	: N/A
Model/Type reference	: HMI-2012 HMI-2111, HMI-2121
Ratings	: Input: DC 6V(1.5V*4PCS batteries)
6153	

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1.VERSION

	Report No.	Version	Description	Approved
	ZKT-220225L1121E-1	Rev.01	Initial issue of report	Feb. 28, 2022
-				









2. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

FCC Part15 (15.225), Subpart C						
Standard Section	Standard Test Item					
FCC part 15.203	Antenna requirement	PASS				
FCC part 15.207	FCC part 15.207 AC Power Line Conducted Emission					
FCC part 15.225(a)(b)(c)(d)	Fundamental &Radiated Spurious Emission Measurement	PASS				
FCC part 15.215	Channel Bandwidth	PASS				
FCC part 15.225(e)	Frequency Tolerance	PASS	5			

NOTE:

(1)" N/A" denotes test is not applicable in this Test Report





2.1 TEST FACILITY

Shenzhen ZKT Technology Co., Ltd. Add. : 1/F, No. 101, Building B, No. 6, Tangwei Community Industrial Avenue, Fuhai Street, Bao'an District, Shenzhen, China

FCC Test Firm Registration Number: 692225 Designation Number: CN1299 IC Registered No.: 27033

2.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement y ± U \cdot where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2 \cdot providing a level of confidence of approximately 95 % \circ

No.	Item	Uncertainty	
1	Conducted Emission Test	±1.38dB	
2	RF power conducted	±0.16dB	
3	Spurious emissions conducted	±0.21dB	
4	All emissions radiated(<1G)	±4.68dB	
5	All emissions radiated(>1G)	±4.89dB	
6	Temperature	±0.5°C	
7	Humidity	±2%	







3. GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

HMI-2012				
odel 012 is				



3.2 DESCRIPTION OF TEST MODES

Transmitting mode	Keep the EUT in continuously transmitting NFC mode
Remark: EUT use new ba nominal rated supply volta	Ittery during the test, the test voltage was tuned from 85% to 115% of the age, and found that the worst case was under the nominal rated supply us shows that condition's data.

3.3 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

Radiated Emission



Conducted Spurious

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 U.	
_	

3.4 DESCRIPTION OF SUPPORT UNITS(CONDUCTED MODE)

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
E-1	SMART DOOR LOCK	N/A	HMI-2012	HMI-2111, HMI-2121	EUT
			212		1212

Item	Shielded Type	Ferrite Core	Length	Note
				2.2

Note:

- (1) The support equipment was authorized by Declaration of Confirmation.
- (2) For detachable type I/O cable should be specified the length in cm in ^rLength ^a column.

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3.5 EQUIPMENTS LIST FOR ALL TEST ITEMS

Radiation Test equipment

Item	Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
1	Spectrum Analyzer (9kHz-26.5GHz)	KEYSIGHT	9020A	MY45109572	Sep. 22, 2021	Sep. 21, 2022
2	Spectrum Analyzer (1GHz-40GHz)	Agilent	E4446A	100363	Sep. 22, 2021	Sep. 21, 2022
3	Test Receiver (9kHz-7GHz)	R&S	ESCI7	101169	Sep. 22, 2021	Sep. 21, 2022
4	Bilog Antenna (30MHz-1400MHz)	Schwarzbeck	VULB9168	00877	Sep. 22, 2021	Sep. 21, 2022
5	Horn Antenna (1GHz-18GHz)	SCHWARZBEC K	BBHA9120D	1541	Sep. 22, 2021	Sep. 21, 2022
6	Horn Antenna (18GHz-40GHz)	A.H. System	SAS-574	588	Sep. 22, 2021	Sep. 21, 2022
7	Amplifier (30-1000MHz)	EM Electronics	EM330 Amplifier	N/A	Sep. 22, 2021	Sep. 21, 2022
8	Amplifier (1GHz-40GHz)	QuanJuDa	DLE-161	097	Sep. 22, 2021	Sep. 21, 2022
9	Loop Antenna (9KHz-30MHz)	SCHWARZBEC K	FMZB1519B	014	Sep. 22, 2021	Sep. 21, 2022
10	RF cables1 (9kHz-30MHz)	N/A	9kHz-30MHz	N/A	Sep. 22, 2021	Sep. 21, 2022
11	RF cables2 (30MHz-1GHz)	N/A	30MHz-1GHz	N/A	Sep. 22, 2021	Sep. 21, 2022
12	RF cables3 (1GHz-40GHz)	N/A	1GHz-40GHz	N/A	Sep. 22, 2021	Sep. 21, 2022
13	CMW500 Test	R&S	CMW500	106504	Sep. 22, 2021	Sep. 21, 2022
14	ESG Signal Generator	Agilent	E4421B	GB40051203	Sep. 22, 2021	Sep. 21, 2022
15	Signal Generator	Agilent	N5182A	MY47420215	Sep. 22, 2021	Sep. 21, 2022
16	D.C. Power Supply	LongWei	TPR-6405D	Ι	١	- <u>-</u>
17	Software	Frad	EZ-EMC	FA-03A2 RE	١	
18	Power Meter	MWRFtest	MW100-RFCB	١	Sep. 22, 2021	Sep. 21, 2022

Conduction Test equipment

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
1	LISN	R&S	ENV216	101471	Sep. 22, 2021	Sep. 21, 2022
2	LISN	CYBERTEK	EM5040A	E185040014 9	Sep. 22, 2021	Sep. 21, 2022
3	Test Cable	N/A	C01	N/A	Sep. 22, 2021	Sep. 21, 2022
4	Test Cable	N/A	C02	N/A	Sep. 22, 2021	Sep. 21, 2022
5	EMI Test Receiver	R&S	ESRP3	101946	Sep. 22, 2021	Sep. 21, 2022
6	Absorbing Clamp	DZ	ZN23201	N/A	Sep. 22, 2021	Sep. 21, 2022



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4. EMC EMISSION TEST

4.1 CONDUCTED EMISSION MEASUREMENT

	Test Requirement:	FCC Part15 C Section 15.207
6	Test Method:	ANSI C63.10:2013
	Test Frequency Range:	150KHz to 30MHz
1	Receiver setup:	RBW=9KHz, VBW=30KHz, Sweep time=auto

4.1.1 POWER LINE CONDUCTED EMISSION Limits

	Limit (dBuV)		Standard
FREQUENCT (MHZ)	Quas-peak	Average	Stanuaru
0.15 -0.5	66 - 56 *	56 - 46 *	FCC
0.50 -5.0	56.00	46.00	FCC
5.0 -30.0	60.00	50.00	FCC

Note:

(1) *Decreases with the logarithm of the frequency.

4.1.2 TEST PROCEDURE

- a. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- d. LISN at least 80 cm from nearest part of EUT chassis.
- e. For the actual test configuration, please refer to the related Item -EUT Test Photos.

4.1.3 DEVIATION FROM TEST STANDARD No deviation







from other units and other metal planes

4.1.5 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

4.1.6 TEST RESULTS

The EUT is powered by the DC only, the test item is not applicable.





4.2 RADIATED EMISSION MEASUREMENT

Test Requirement:	FCC Part15 C Sect	ion 15.209			3
Test Method:	ANSI C63.10:2013	DD			
Test Frequency Range:	9kHz to 1GHz				
Test site:	Measurement Dista	ince: 3m			
Receiver setup:	Frequency	Detector	RBW	VBW	Value
	9KHz-150KHz	Quasi-peak	200Hz	600Hz	Quasi-peak
	150KHz-30MHz	Quasi-peak	9KHz	30KHz	Quasi-peak
	30MHz-1GHz	Quasi-peak	100KHz	300KHz	Quasi-peak
		Peak	1MHz	3MHz	Peak
	Above IGH2	Peak	1MHz	10Hz	Average
	Note: According to kHz and above 10 bands are based or	§ 15.209, the 000 MHz. Radi n measurements	frequency ated emiss s employing	bands 9-90 sion limits g an averag	0 kHz, 110-490 in these three ge detector.

4.2.1 RADIATED EMISSION LIMITS

Frequencies	Field Strength	Measurement Distance
(MHz)	(micorvolts/meter)	(meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

Field Strength of Fundamental Limit:

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. 15,848 microvolts/meter at 3 meters=124 dBuV/m. 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. 334 microvolts/meter at 3 meters=90.47 dBuV/m.

4.2.2 TEST PROCEDURE

- a. The measuring distance of at 3 m shall be used for measurements at frequency up to 25GHz. For frequencies above 1GHz, any suitable measuring distance may be used.
- b. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-chamber test. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The height of the equipment or of the substitution antenna shall be 0.8m; above 1GHz, the height was 1.5m, the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

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- d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
- f. For the actual test configuration, please refer to the related Item -EUT Test Photos.
- g. For the radiated emission test above 1GHz:

Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response.

The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported

4.2.3 DEVIATION FROM TEST STANDARD



4.2.4 TEST SETUP

No deviation

(A) Radiated Emission Test-Up Frequency Below 30MHz





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(B) Radiated Emission Test-Up Frequency 30MHz~1GHz



(C) Radiated Emission Test-Up Frequency Above 1GHz



4.2.5 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.





4.2.6 TEST RESULTS

Field Strength of Fundamental

	V A V A			- A			- V.A.I
Frequency	Reading	Correction	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	(H/V)	
13.46	55.09	15.82	70.91	90.47	-19.56	Н	QP
13.46	56.51	15.82	72.33	90.47	-18.14	V	QP
13.553	58.32	15.61	73.93	90.47	-16.54	Н	QP
13.553	57.54	15.61	73.15	90.47	-17.32	V	QP
13.56	88.98	12.33	101.31	124	-22.69	Н	Peak
13.56	86.94	12.33	99.27	124	-24.73	V	Peak
13.567	59.51	12.33	71.84	90.47	-18.63	Н	QP
13.567	57.71	12.33	70.04	90.47	-20.43	V	QP
13.65	53.22	15.82	69.04	90.47	-21.43	Н	QP
13.65	51.46	15.82	67.28	90.47	-23.19	V	QP



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Note: Limit dBuV/m @3m = Limit dBuV/m @300m+ 80 Limit dBuV/m @3m = Limit dBuV/m @30m + 40 9 kHz~30 MHz

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(kHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Deteotor Type
42.35	53.49	15.15	68.64	115.07	-46.43	AVG
88.09	52.85	15.2	68.05	108.71	-40.66	AVG
214.75	55.03	16.33	71.36	100.97	-29.61	AVG
1360.28	35.97	16.87	52.84	64.93	-12.09	QP
2235.43	27.33	17.62	44.95	69.54	-24.59	QP
3381.55	25.06	18.32	43.38	69.54	-26.16	QP
7102.19	20.60	18.64	39.24	69.54	-30.30	QP
8990.52	17.20	19.26	36.46	69.54	-33.08	QP
12328.22	17.04	19.32	36.36	69.54	-33.18	QP

Note:

Pre-scan in the all of mode, the worst case in of was recorded. Factor = antenna factor + cable loss – pre-amplifier. Margin = Emission Level- Limit.









Between 30MHz - 1GHz

Horizontal







Remarks:

1.Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor

2. The emission levels of other frequencies are very lower than the limit and not show in test report.







5. FREQUENCY TOLERANCE

Test Requirement:	FCC Part15 C Section 15.225(e)
Test Method:	ANSI C63.10:2013

5.1 LIMIT

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.

Limit: ±0.01% of 13.56MHz=±1356Hz

5.2 TEST PROCEDURE

- 1. Set RBW = 10 kHz.
- 2. Set the video bandwidth (VBW) ≥RBW.
- 3. Detector = Peak.
- 4. Trace mode = max hold.
- 5. Sweep = auto couple.
- 6. Allow the trace to stabilize.

7. The transmitter output (antenna port) was connected to the spectrum analyzer.

5.3 DEVIATION FROM TEST STANDARD No deviation





5.5 TEST RESULT

	Test Conditions		Frequency	y Deviation	
Frequency MHz	Power(Vdc)	Temperature (℃)	Measured Freq. (MHz)	Deviation (%)	Limit
	Normal	-20	13.5603	0.0022	
	Normal	-10	13.5603	0.0022	
	Normal	0	13.5603	0.0022	
	Normal	10	13.5602	0.0015	
12 56	Normal	20	13.5601	0.0007	+0.01%
13.50	Normal	30	13.5601	0.0007	10.01%
	Normal	40	13.5601	0.0007	
	Normal	50	13.5602	0.0015	
	Normal*85%	20	13.5603	0.0022]
	Normal *115%	20	13.5603	0.0022]



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6. CHANNEL BANDWIDTH

Test Requirement:	FCC Part15 C Section 15.215
Test Method:	ANSI C63.10: 2013

6.1 APPLIED PROCEDURES / LIMIT

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that 20dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equip compliance with the 20dB attenuation specification may base on measurement at the intentional radiator's antenna output terminal unless the intentional radiator uses a permanently attached antenna, in which case compliance shall be deomonstrated by measuring the radiated emissions.

6.2 TEST PROCEDURE

- 1. Set RBW = 1 kHz.
- 2. Set the video bandwidth (VBW) ≥RBW.
- 3. Detector = Peak.
- 4. Trace mode = max hold.
- 5. Sweep = auto couple.
- 6. Allow the trace to stabilize.



6.3 DEVIATION FROM STANDARD

No deviation.

6.4 TEST SETUP

EUT	SPECTRUM
	ANALYZER

6.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.









Result

Pass

6.6 TEST RESULT

Test channel

1

Temperature :	24.6℃	Relative Humidity :	53%
Test Mode :	ASK	Test Voltage :	DC 6V

20dB Channel Bandwidth

(KHz)

11.25



		CH 01		
Keysight Spectrum Analyzer - Occupied BW				
Center Freg 13.561000 MH	Z	Center Freq: 13.561000 M	MHz	Radio Std: None
	↔ #IFGain:Low	→ Trig: Free Run #Atten: 10 dB	Avg Hold: 100/100	Radio Device: BTS
Ref Offset 1.37 dB 10 dB/div Ref -18.63 dBm				
-28.6				
-38.6				
-48.6				
-58.6				
-68.6				
-78.6				
-88.6				
-98.6				
-109				
Center 13.56 MHz #Res BW 3 kHz		#VBW 10 kHz		Span 20 kH Sweep 2.667 m
Occupied Bandwidth		Total Power	-68.2 dBm	
10	.840 kHz			
Transmit Freq Error	611 Hz	% of OBW Power	99.00 %	
	44 OF 141-	w dD	20.00 40	

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STATUS







7.ANTENNA REQUIREMENT

Standard requirement:	FCC Part15 C Section 15.203
15.203 requirement:	
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.	
EUT Antenna:	
The antennas is Loop Antenna, the best case gain of the antennas is 0dBi, reference to the appendix II for details	









8. TEST SETUP PHOTO

Reference to the appendix I for details.

9. EUT CONSTRUCTIONAL DETAILS

Reference to the appendix II for details.

***** END OF REPORT ****



