Shenzhen CTL Testing Technology Co., Ltd.
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TEST REPORT

FCC PART 15.225

Report Reference No. .....: **CTL1805022011-WF02**

Compiled by: (position+printed name+signature)	Allen Wang (File administrators)	Allen Wang
Tested by: (position+printed name+signature)	Nice Nong (Test Engineer)	Nice Nong
Approved by: (position+printed name+signature)	Ivan Xie (Manager)	Ivan Xie

Product Name.....: OKEY
Model/Type reference .....: OKEY100
Trade Mark.....: N/A
FCC ID .....: **2APXA-OKEY100**

Applicant's name .....: **OKEY CO., LTD.**
Address of applicant .....: Room 304-1, C02 Building, Chuangye Headquarters Base, Fuyuan Road North, Wuqing Development Zone, Tianjin, China 301700

Test Firm .....: **Shenzhen CTL Testing Technology Co., Ltd.**
Address of Test Firm .....: Floor 1-A, Baisha Technology Park, No.3011, Shahexi Road, Nanshan District, Shenzhen, China 518055

Test specification.....:
Standard.....: **FCC Part 15.225:** Operation within the band 13.110–14.010 MHz.
TRF Originator .....: Shenzhen CTL Testing Technology Co., Ltd.
Master TRF .....: Dated 2011-01

Date of Receipt.....: May 07, 2018
Date of Test Date.....: May 07, 2018–May 14, 2018
Data of Issue.....: May 14, 2018
Result.....: **Pass**

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TEST REPORT

Test Report No. :	CTL1805022011-WF02	May 14, 2018 Date of issue

Equipment under Test	:	OKEY
Model /Type	:	OKEY100
Listed Models	:	N/A
Applicant	:	**OKEY CO., LTD.**
Address	:	Room 304-1, C02 Building, Chuangye Headquarters Base, Fuyuan Road North, Wuqing Development Zone, Tianjin, China 301700
Manufacturer	:	**OKEY CO., LTD.**
Address	:	Room 304-1, C02 Building, Chuangye Headquarters Base, Fuyuan Road North, Wuqing Development Zone, Tianjin, China 301700

Test result	**Pass ***

∗ In the configuration tested, the EUT complied with the standards specified page 5.

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

** Modified History **

Version	Description	Issued Data	Report No.	Remark
Version 1.0	Initial Test Report Release	2018-05-14	CTL1805022011-WF02	Tracy Qi

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1. SUMMARY

1.1. Test Standards

The tests were performed according to following standards:

FCC Rules Part 15.225: Operation within the band 13.110–14.010 MHz

ANSI C63.10:2013 : American National Standard for Testing Unlicensed Wireless Devices

1.2. Test Description

FCC PART 15 .225		
FCC Part 15.207	AC Power Conducted Emission	PASS
FCC Part 2.1049	20dB Bandwidth	PASS
FCC Part 15.225(a) (b) (c)	In-band Emissions	PASS
FCC Part 15.225(d)/15.207	Out-of-band Emissions	PASS
FCC Part 15.225(e)	Frequency Stability Tolerance	PASS

Remark: The measurement uncertainty is not included in the test result.

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1.3. Test Facility

1.3.1 Address of the test laboratory

Shenzhen CTL Testing Technology Co., Ltd.
Floor 1-A, Baisha Technology Park, No. 3011, Shahexi Road, Nanshan, Shenzhen 518055 China

There is one 3m semi-anechoic chamber and two line conducted labs for final test. The Test Sites meet the requirements in documents ANSI C63.4 and CISPR 22/EN 55022 requirements.

1.3.2 Laboratory accreditation

The test facility is recognized, certified, or accredited by the following organizations:

IC Registration No.: 9618B

The 3m alternate test site of Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration No.: 9618B on November 13, 2013.

FCC-Registration No.: 399832

Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 399832, December 08, 2017.

1.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen CTL Testing Technology Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for CTL laboratory is reported:

Test	Measurement Uncertainty	Notes
Transmitter power conducted	±0.57 dB	(1)
Transmitter power Radiated	±2.20 dB	(1)
Conducted spurious emission 9KHz-40 GHz	±2.20 dB	(1)
Occupied Bandwidth	±0.01ppm	(1)
Radiated Emission 30~1000MHz	±4.10dB	(1)
Radiated Emission Above 1GHz	±4.32dB	(1)
Conducted Disturbance0.15~30MHz	±3.20dB	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

2. GENERAL INFORMATION

2.1. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Normal Temperature:	25°C
Relative Humidity:	55 %
Air Pressure:	101 kPa

2.2. General Description of EUT

Product Name:	OKEY
Model/Type reference:	OKEY100
Power supply:	DC 3.0V from battery
NFC	
Operation frequency:	13.56MHz
Modulation :	ASK
No. of Channel :	1
Antenna type:	Loop Antenna

Note: For more details, please refer to the user's manual of the EUT.

2.3. Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.12	2017/06/02	2018/06/01
LISN	R&S	ESH2-Z5	860014/010	2017/06/02	2018/06/01
Bilog Antenna	Sunol Sciences Corp.	JB1	A061713	2017/06/02	2018/06/01
EMI Test Receiver	R&S	ESCI	103710	2017/06/02	2018/06/01
Spectrum Analyzer	Agilent	N9020	US46220290	2018/01/17	2019/01/16
Controller	EM Electronics	Controller EM 1000	N/A	2017/05/21	2018/05/20
Horn Antenna	Sunol Sciences Corp.	DRH-118	A062013	2017/05/19	2018/05/18
Active Loop Antenna	SCHWARZBECK	FMZB1519	1519-037	2017/05/19	2018/05/18
Amplifier	Agilent	8349B	3008A02306	2017/05/19	2018/05/18
Amplifier	Agilent	8447D	2944A10176	2017/05/19	2018/05/18
Temperature/Humidity Meter	Gangxing	CTH-608	02	2017/05/20	2018/05/19
High-Pass Filter	K&L	9SH10-2700/X12750-O/O	N/A	2017/05/20	2018/05/19

High-Pass Filter	K&L	41H10-1375/U12750-O/O	N/A	2017/05/20	2018/05/19
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-10M	10m	2017/06/02	2018/06/01
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2017/06/02	2018/06/01
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2017/06/02	2018/06/01
RF Cable	Megalon	RF-A303	N/A	2017/06/02	2018/06/01

The calibration interval was one year

2.4. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: **2APXA-OKEY100** filing to comply with Section 15.225 of the FCC Part 15, Subpart C Rules.

2.5. Modifications

No modifications were implemented to meet testing criteria.

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3. TEST CONDITIONS AND RESULTS

3.1. Conducted Emission (AC Main)

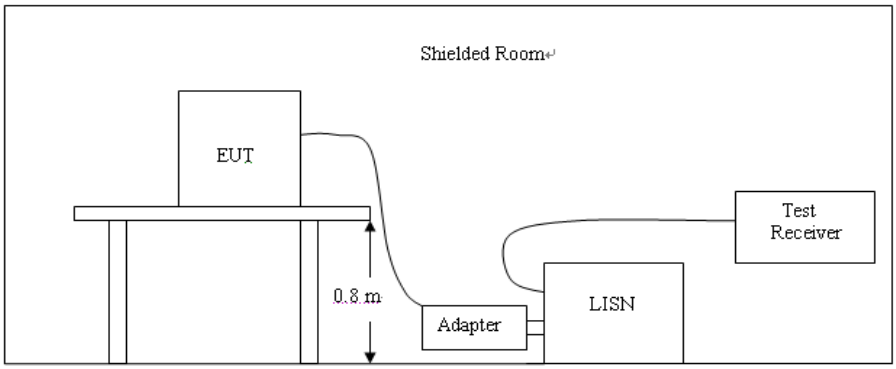
LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.207

Frequency range (MHz)	Limit (dBuV)	
	Quasi-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.

TEST CONFIGURATION



TEST PROCEDURE

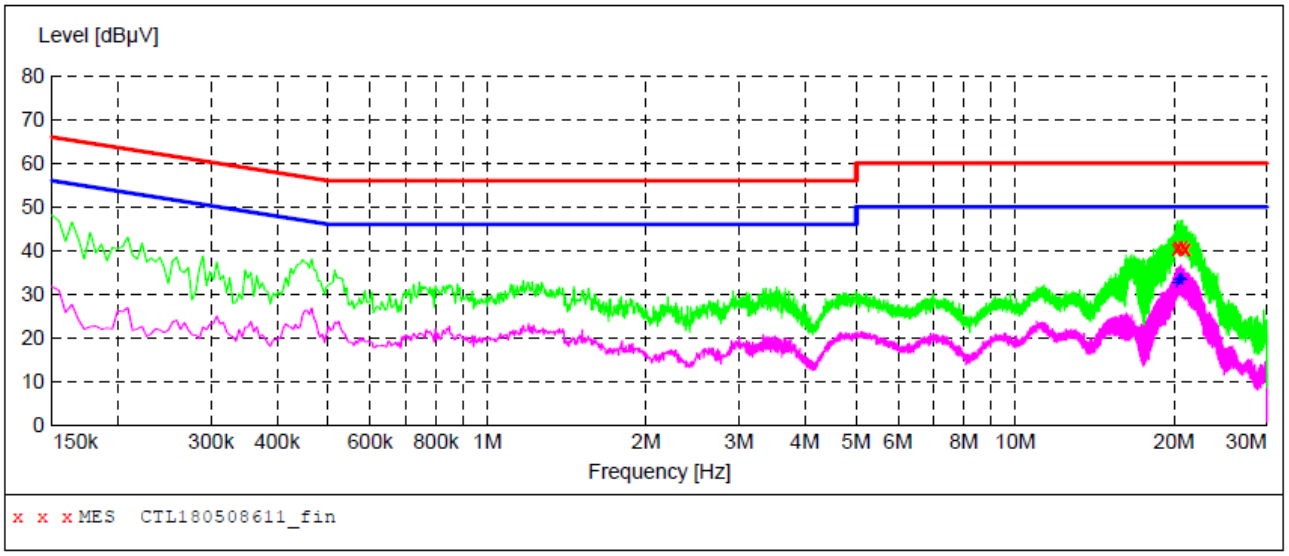
1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a flood stand system; a wooden table with a height of 0.1 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
2. Support equipment, if needed, was placed as per ANSI C63.10-2013
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
4. If a EUT received DC power from the USB Port of Notebook PC, the PC's adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipments received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

TEST RESULTS

LINE	L

SCAN TABLE: "Voltage (9K-30M)FIN"

Short Description: 150K-30M Voltage



MEASUREMENT RESULT: "CTL180508611_fin"

08/05/2018 12:02

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
20.204000	40.20	11.0	60	19.8	QP	L1	GND
20.360000	40.80	11.0	60	19.2	QP	L1	GND
20.414000	41.10	11.0	60	18.9	QP	L1	GND
20.798000	41.00	11.0	60	19.0	QP	L1	GND
20.966000	40.40	11.0	60	19.6	QP	L1	GND
21.050000	40.30	11.0	60	19.7	QP	L1	GND

MEASUREMENT RESULT: "CTL180508611_fin2"

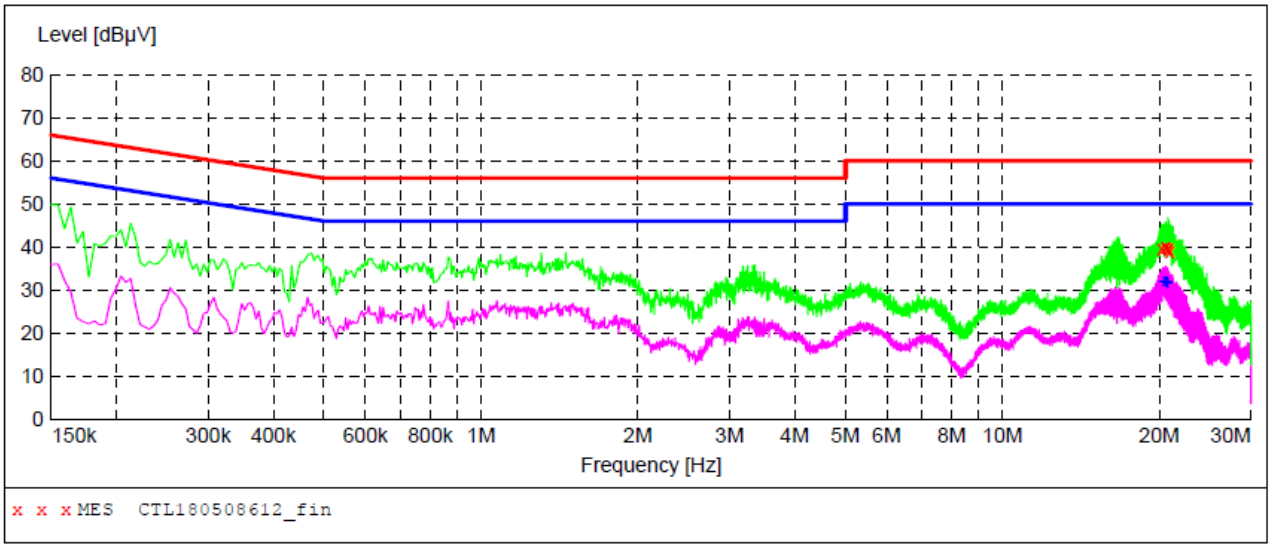
08/05/2018 12:02

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
20.222000	32.70	11.0	50	17.3	AV	L1	GND
20.390000	33.50	11.0	50	16.5	AV	L1	GND
20.414000	33.40	11.0	50	16.6	AV	L1	GND
20.534000	33.60	11.0	50	16.4	AV	L1	GND
20.594000	33.60	11.0	50	16.4	AV	L1	GND
20.732000	33.50	11.0	50	16.5	AV	L1	GND

LINE	N

SCAN TABLE: "Voltage (9K-30M)FIN"

Short Description: 150K-30M Voltage



MEASUREMENT RESULT: "CTL180508612_fin"

08/05/2018 12:05

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
20.186000	39.50	11.0	60	20.5	QP	N	GND
20.564000	40.00	11.0	60	20.0	QP	N	GND
20.588000	40.10	11.0	60	19.9	QP	N	GND
20.810000	39.70	11.0	60	20.3	QP	N	GND
20.828000	39.50	11.0	60	20.5	QP	N	GND
20.936000	38.80	11.0	60	21.2	QP	N	GND

MEASUREMENT RESULT: "CTL180508612_fin2"

08/05/2018 12:05

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
20.354000	32.10	11.0	50	17.9	AV	N	GND
20.522000	32.10	11.0	50	17.9	AV	N	GND
20.564000	32.20	11.0	50	17.8	AV	N	GND
20.630000	32.00	11.0	50	18.0	AV	N	GND
20.666000	31.90	11.0	50	18.1	AV	N	GND
20.732000	31.80	11.0	50	18.2	AV	N	GND

3.2. Radiated Emission

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.

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.

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.

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.

Frequency (MHz)	Distance (Meters)	Radiated (dBuV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-13.110	3	69.54	30
13.110-13.410	3	80.50	106
13410-13.553	3	90.47	334
13.553-13.567	3	124.00	15848
13.567-13.710	3	90.47	334
13.710-14.010	3	80.50	106
14.010-30.0	3	69.54	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

Test Procedure

1. The EUT was placed on 80cm wooden desk above ground plane which on a turn table.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL – AG

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

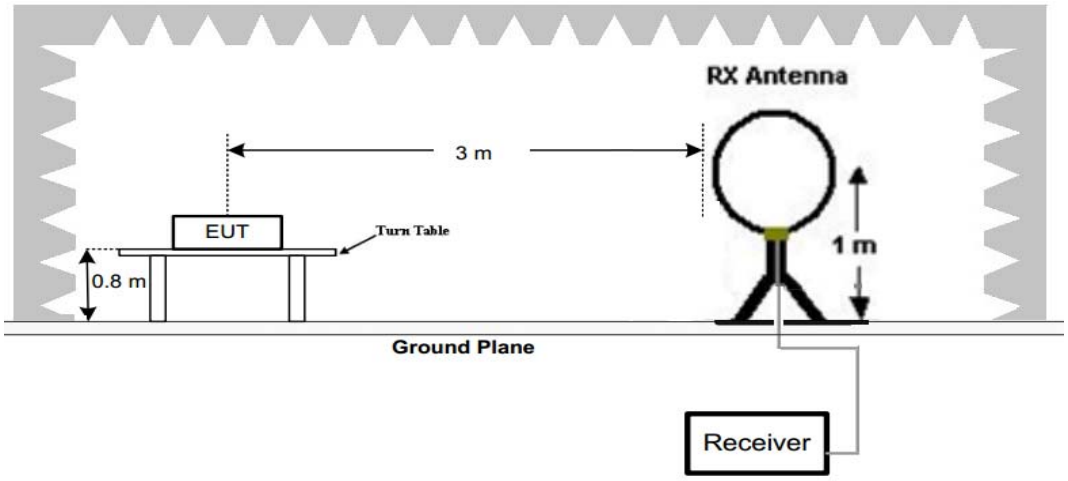
For example

Frequency (MHz)	FS (dBuV/m)	RA (dBuV/m)	AF (dB)	CL (dB)	AG (dB)	Transd (dB)
150.00	40	58.1	12.2	1.6	31.90	-18.1

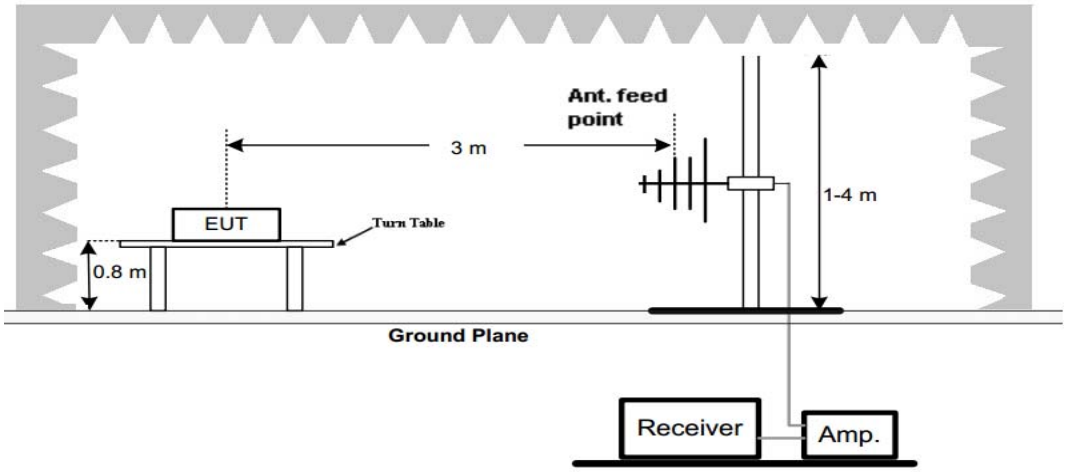
Transd=AF +CL-AG

Test Configuration

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



(B) Radiated Emission Test Set-Up, Frequency below 1000MHz



Test Results

3.2.1 In-band Emissions

Frequency(MHz):			13.56		Polarity:		HORIZONTAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)	Detector	Limit (dBuV/m)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Correction Factor (dB/m)
1	13.15	43.95	PK	69.5	39.25	5.26	-0.56	4.70
2	13.55	50.17	PK	69.5	45.38	5.36	-0.57	4.79
3	13.56	90.04	PK	124.00	85.16	5.45	-0.57	4.88
4	13.57	49.61	PK	69.5	44.47	5.49	-0.35	5.14
5	13.75	42.84	PK	69.5	37.51	5.63	-0.30	5.33

Frequency(MHz):			13.56		Polarity:		VERTICAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)	Detector	Limit (dBuV/m)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Correction Factor (dB/m)
1	13.15	44.19	PK	69.5	39.49	5.26	-0.56	4.70
2	13.55	51.36	PK	69.5	46.57	5.36	-0.57	4.79
3	13.56	91.48	PK	124.00	86.60	5.45	-0.57	4.88
4	13.57	50.26	PK	69.5	45.12	5.49	-0.35	5.14
5	13.75	43.72	PK	69.5	38.39	5.63	-0.30	5.33

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)
3. Margin value = Limit value- Emission level.
4. The other emission levels were very low against the limit，only worse case is reported

3.2.2 Out-of-band Emissions

Frequency(MHz):			13.56			Polarity:		HORIZONTAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)	Detector	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Correction Factor (dB/m)
1	27.12	37.25	PK	69.54	32.29	29.75	7.25	0.25	7.50
2	40.68	30.06	PK	40.00	9.94	21.25	8.25	0.56	8.81
3	54.24	31.79	PK	40.00	8.21	22.75	8.30	0.74	9.04
4	67.80	27.33	PK	40.00	12.67	17.80	8.55	0.98	9.53

Frequency(MHz):			13.56			Polarity:		VERTICAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)	Detector	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Correction Factor (dB/m)
1	27.12	36.94	PK	69.54	32.60	29.44	7.25	0.25	7.50
2	40.68	30.47	PK	40.00	9.53	21.66	8.25	0.56	8.81
3	54.24	31.38	PK	40.00	8.62	22.34	8.30	0.74	9.04
4	67.80	28.01	PK	40.00	11.99	18.48	8.55	0.98	9.53

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)
3. Margin value = Limit value- Emission level.
4. The other emission levels were very low against the limit.
5. Test from 9KHz to 1GHz，only worse case is reported

3.3. 20dB Bandwidth

Limit

No limit for 20dB bandwidth.

Test Procedure

The 20dB bandwidth is measured with a spectrum analyzer connected via a receive antenna placed near the EUT while the EUT is operating in transmission mode.

The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

Test Configuration

Test Results

Modulation	Frequency(MHz)	20dB bandwidth (KHz)	Frequency range(MHz)	Result
ASK	13.56	2.770	13.55936~13.56182	Pass

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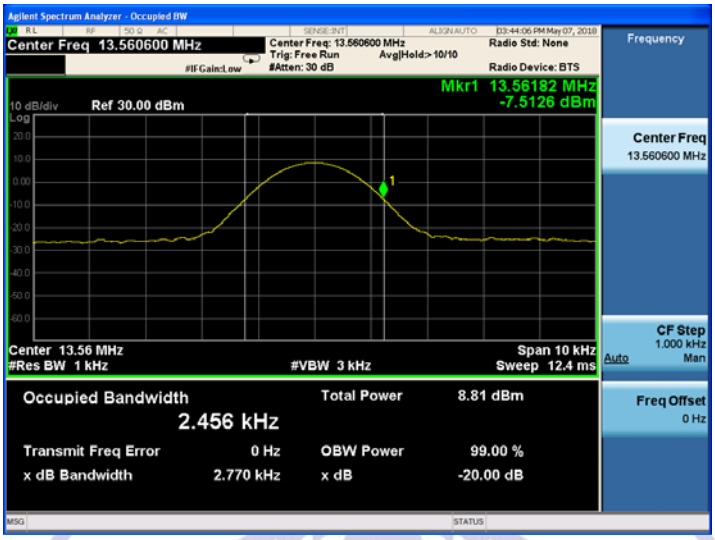

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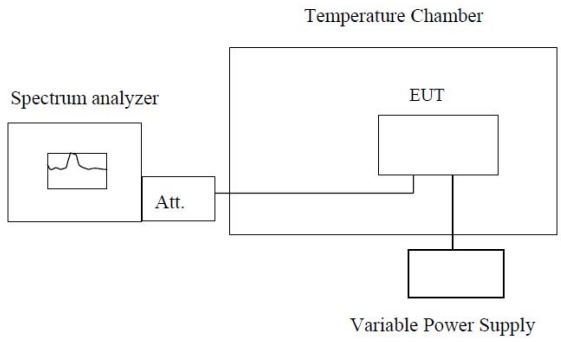
3.4. Frequency Stability Test Data

LIMIT

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.

TEST CONFIGURATION



Note : Measurement setup for testing on Antenna connector

TEST PROCEDURE

1. The equipment under test was connected to an external DC power supply and input rated voltage.
2. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators.
3. The EUT was placed inside the temperature chamber.
4. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20℃ operating frequency as reference frequency.
5. Turn EUT off and set the chamber temperature to –20℃. After the temperature stabilized for approximately 30 minutes recorded the frequency.
6. Repeat step measure with 10℃ increased per stage until the highest temperature of +50℃ reached.
7. Reduce the input voltage to specified extreme voltage variation (+/- 15%) or endpoint, record the maximum frequency change.

TEST RESULTS

Reference Frequency: 13.56MHz				
Voltage (V)	Temperature (℃)	Frequency (Hz)	Frequency Deviation(Hz)	Deviation (%)
3.0VDC	-20	13,560,098	98	0.000723
	-10	13,560,072	72	0.000531
	0	13,559,981	-19	-0.000140
	+10	13,560,067	67	0.000494
	+20	13,560,032	32	0.000236
	+25	13,560,037	37	0.000273
	+30	13,560,048	48	0.000354
	+40	13,560,063	63	0.000465
	+50	13,560,079	79	0.000583
3.45VDC	+20	13,560,118	118	0.000870
2.55VDC	+20	13,560,104	104	0.000767

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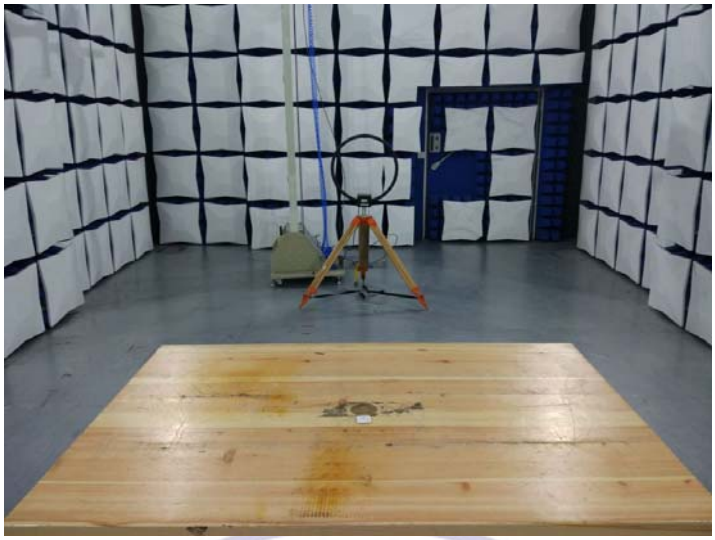
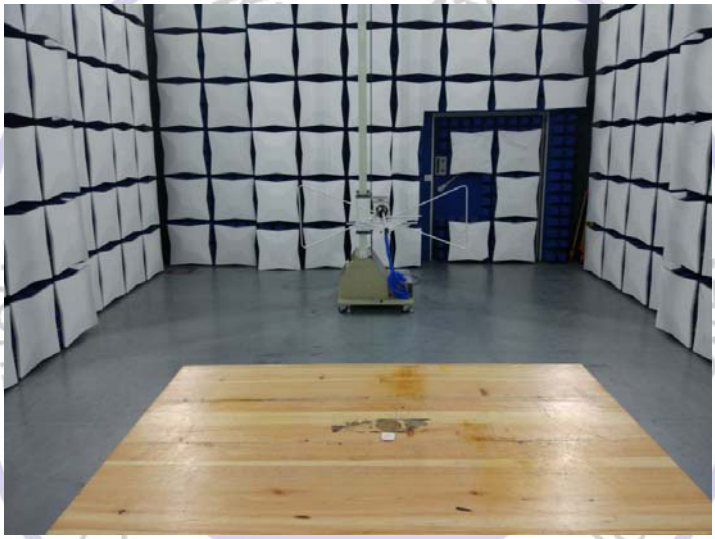
4. EUT TEST PHOTO

Radiated Emission





Conducted Emission

5. External and Internal Photos of the EUT

Reference to the test report No. CTL1805022011-WF01

**********End of Report**********

Shenzhen CTL Testing Technology Co.,Ltd.
华检检测