



FCC Part 15C Test Report

FCC ID: 2APOFAST-R12

Product Name:	Glass Reader
Trademark:	N/A
Model Name :	AST-R12 AST-R12F
Prepared For :	Advanced System Technology Limited
Address :	Unit C, 7/F, Good Year Industrial Bldg., 119-121 How Ming Street, Kwun Tong, Kowloon, Hong Kong
Prepared By :	Shenzhen BCTC Testing Co., Ltd.
Address :	BCTC Building & 1-2F, East of B Building, Pengzhou Industrial, Fuyuan 1st Road, Qiaotou Community, Fuyong Street, Bao'an District, Shenzhen, China
Test Date:	Mar. 23 - Mar. 30, 2018
Date of Report :	Mar. 30, 2018
Report No.:	BCTC-LH180300511E



TEST RESULT CERTIFICATION

Applicant's name..... : **Advanced System Technology Limited**
Address..... : Unit C, 7/F, Good Year Industrial Bldg., 119-121 How Ming Street, Kwun Tong, Kowloon, Hong Kong

Manufacturer's Name..... : **Advanced System Technology Limited**
Address..... : Unit C, 7/F, Good Year Industrial Bldg., 119-121 How Ming Street, Kwun Tong, Kowloon, Hong Kong

Product description

Product name..... : Glass Reader
Trademark..... : N/A
Model and/or type reference : AST-R12

Standards..... : FCC Part15.225
ANSI C63.10-2013

This device described above has been tested by BCTC, and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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Prepared by(Engineer): Willem Wang

Willem Wang

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1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

FCC Part15 (15.225)			
Standard Section	Test Item	Judgment	Remark
15.207	Conducted Emission	N/A	
15.209 15.225(a)(b)(c)(d)	Radiated Emission	PASS	
15.215	20dB Bandwidth	PASS	
Part 15.225(e)	Frequency Tolerance	PASS	
15.203	Antenna Requirement	PASS	

NOTE:

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

1.1 TEST FACILITY

Shenzhen BCTC Testing Co., Ltd.

Add. : BCTC Building & 1-2F, East of B Building, Pengzhou Industrial, Fuyuan 1st Road, Qiaotou Community, Fuyong Street, Bao'an District, Shenzhen, China

FCC Test Firm Registration Number: 712850

IC Registered No.: 23583

1.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement $y \pm U$, where expanded uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95%.

No.	Item	Uncertainty
1	Conducted Emission Test	$\pm 1.38\text{dB}$
2	RF power,conducted	$\pm 0.16\text{dB}$
3	Spurious emissions,conducted	$\pm 0.21\text{dB}$
4	All emissions,radiated(<1G)	$\pm 4.68\text{dB}$
5	All emissions,radiated(>1G)	$\pm 4.89\text{dB}$
6	Temperature	$\pm 0.5^{\circ}\text{C}$
7	Humidity	$\pm 2\%$



2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Equipment	Glass Reader										
Trade Name	N/A										
Model Name	AST-R12 AST-R12F										
Model Difference	All the model are the same circuit and RF module, except model names and color.										
Product Description	<p>The EUT is a Glass Reader</p> <table border="1"><tr><td>Operation Frequency:</td><td>13.56MHz</td></tr><tr><td>Modulation Type:</td><td>ASK</td></tr><tr><td>Number Of Channel</td><td>1 CH</td></tr><tr><td>Antenna type:</td><td>PCB antenna</td></tr><tr><td>Antenna Gain (dBi)</td><td>0dBi</td></tr></table> <p>Based on the application, features, or specification exhibited in User's Manual, the EUT is considered as an ITE/Computing Device. More details of EUT technical specification, please refer to the User's Manual.</p>	Operation Frequency:	13.56MHz	Modulation Type:	ASK	Number Of Channel	1 CH	Antenna type:	PCB antenna	Antenna Gain (dBi)	0dBi
Operation Frequency:	13.56MHz										
Modulation Type:	ASK										
Number Of Channel	1 CH										
Antenna type:	PCB antenna										
Antenna Gain (dBi)	0dBi										
Channel List	Please refer to the Note 2.										
Power	DC 12V										
hardware version	--										
Software version	--										
Serial number	--										
Connecting I/O Port(s)	Please refer to the User's Manual										

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.



2.2 DESCRIPTION OF TEST MODES

To investigate the maximum EMI emission characteristics generated from EUT, the test system was pre-scanning tested based on the consideration of following EUT operation mode or test configuration mode which possibly have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Pretest Mode	Description
Mode 1	TX Mode
For Conducted & Radiated Emission	
Final Test Mode	Description
Mode 1	TX Mode

Note:

(1) The measurements are performed at the highest, middle, lowest available channels.

2.3 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

Radiated Spurious Emission Test



2.4 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	Glass Reader	N/A	AST-R12	N/A	EUT
E-2	Battery	N/A	EMCAE023	N/A	Lab provide

Item	Shielded Type	Ferrite Core	Length	Note
C1	No	No	0.5m	

Note:

- (1) For detachable type I/O cable should be specified the length in cm in 『Length』 column.

**2.5 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)	Agilent	E4407B	MY45108040	2017.08.27	2018.08.26
2	Test Receiver (9kHz-7GHz)	R&S	ESPI	101318	2017.08.27	2018.08.26
3	Bilog Antenna (30MHz-1GHz)	R&S	VULB 9168	VULB91 68-438	2017.08.27	2018.08.26
4	Horn Antenna (1GHz-18GHz)	SCHWARZBECK	BBHA9120D	1201	2017.09.03	2018.09.02
5	Horn Antenna (14GHz-40GHz)	SCHWARZBECK	BBHA 9170	9170-181	2017.09.03	2018.09.02
6	Amplifier (9KHz-6GHz)	SCHWARZBECK	BBV9744	9744-0037	2017.08.27	2018.08.26
7	Amplifier (1GHz-18GHz)	SCHWARZBECK	BBV9718	9718-309	2017.08.27	2018.08.26
8	Amplifier (18GHz-40GHz)	SCHWARZBECK	BBV 9721	9721-205	2017.08.27	2018.08.26
9	Loop Antenna (9KHz-30MHz)	SCHWARZBECK	FMZB1519B	00014	2017.09.03	2018.09.02
10	RF cables1 (9kHz-1GHz)	R&S	R203	R20X	2017.08.27	2018.08.26
11	RF cables2 (1GHz-40GHz)	R&S	R204	R21X	2017.08.27	2018.08.26
12	Antenna connector	Florida RF Labs	N/A	RF 01#	2017.08.27	2018.08.26
13	Power Metter	ANRITSU	ML2487A	6K00001568	2017.08.27	2018.08.26
14	Power Sensor (AV)	ANRITSU	ML2491A	030989	2017.08.27	2018.08.26
15	Signal Analyzer 9kHz-26.5GHz	Agilent	N9010A	MY48030494	2017.08.27	2018.08.26
16	Test Receiver 20kHz-40GHz	R&S	ESU 40	100376	2017.08.27	2018.08.26
17	D.C. Power Supply	LongWei	PS-305D	010964729	2017.08.27	2018.08.26

Conduction Test equipment

Item	Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
1	Test Receiver	R&S	ESCI	1166.5950K03-1011 65-ha	2017.08.27	2018.08.26
2	LISN	SCHWARZBECK	NSLK8127	8127739	2017.08.27	2018.08.26
3	LISN	R&S	NSLK8126	8126487	2017.08.27	2018.08.26
4	RF cables	R&S	R204	R20X	2017.08.27	2018.08.26
5	Attenuator	R&S	ESH3-Z2	143206	2017.08.27	2018.08.26



3. EMC EMISSION TEST

3.1 RADIATED EMISSION MEASUREMENT

3.1.1 Radiated Emission Limits

- (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.

(Radiated Emission <30MHz (9KHz-30MHz, H-field)

According to FCC section 15.225, for <30MHz, Radiated emissions were measured according to ANSIC63.4. The EUT was set to transmit at the highest output power. The EUT was set 30 meter away from the measuring antenna. The loop antenna was positioned 1 meter above the ground from the center of the loop. The measuring bandwidth was set to 10KHz. (Note: During testing the receive antenna was rotated about its axis to maximize the emission from the EUT)

There was no detected Restricted bands and Radiated suprious emission below 30MHz. The 30m limit was converted to 3m Limit using square factor(x) as it was found by measurements as follows;

$$3 \text{ m Limit(dBuV/m)} = 20\log(X)+40\log(30/3)= 20\log(15,848)+40\log(30/3) =124\text{dBuV}$$

$$3 \text{ m Limit(dBuV/m)} = 20\log(X)+40\log(30/3)= 20\log(334)+40\log(30/3) =90.47\text{dBuV}$$

$$3 \text{ m Limit(dBuV/m)} = 20\log(X)+40\log(30/3)= 20\log(106)+40\log(30/3) =80.506\text{dBuV}$$

$$3 \text{ m Limit(dBuV/m)} = 20\log(X)+40\log(30/3)= 20\log(30)+40\log(30/3) =69.54\text{dBuV}$$

Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

LIMITS OF RADIATED EMISSION MEASUREMENT (Frequency Range 9kHz-1000MHz)

Frequency range (MHz)	Field Strength@30m		Field Strength@3m
	$\mu\text{V/m}$	$\text{dB}\mu\text{V/m}$	$\text{dB}\mu\text{V/m}$
Below 13.110	30	29.5	69.5
13.110 ~ 13.410	106	40.5	80.5
13.410 ~ 13.553	334	50.5	90.5
13.553 ~13.617	15.848	84	124
13.617 ~ 13.710	334	50.5	90.5
13.710 ~14.010	106	40.5	80.5
Above 14.010	30	29.5	69.5

NOTE:

a) Field Strength ($\text{dB}\mu\text{V/m}$) = $20*\log[\text{Field Strength } (\mu\text{V/m})]$.

b) In the emission tables above, the tighter limit applies at the Band edge.

Radiated Emission >30MHz (30MHz-1GHz, E-field)

According to FCC section 15.205, the field strength of radiated emissions from intentiona radiators at a distance of 3 meters shall not exceed the following values:



Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~90kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	90kHz~110kHz / RB 200Hz for QP
Start ~ Stop Frequency	110kHz~490kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	490kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

3.1.2 TEST PROCEDURE

Below 1GHz test procedure as below:

- The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

NOTE:

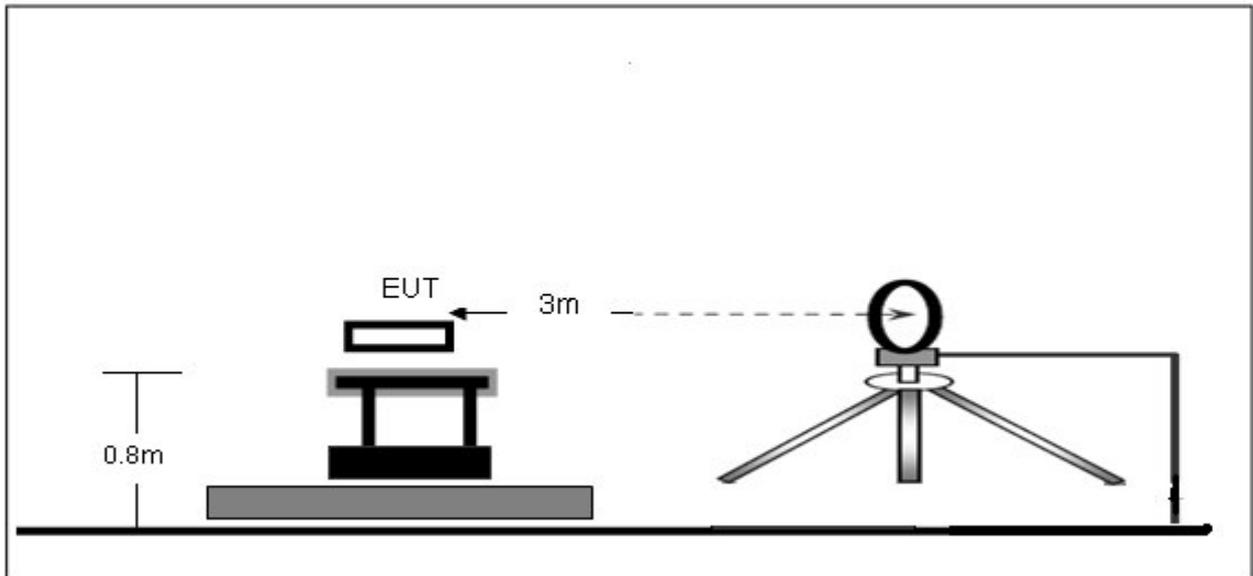
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported

3.1.3 DEVIATION FROM TEST STANDARD

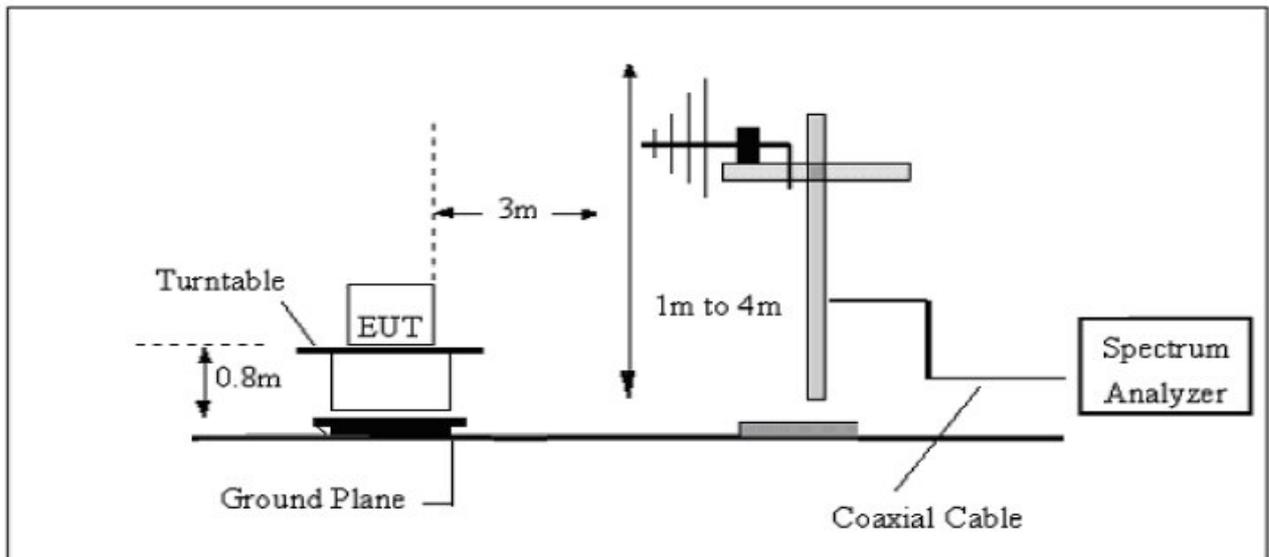
No deviation

3.1.4 TEST SETUP

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



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



3.1.5 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.



3.1.6 TEST RESULTS (BETWEEN 9KHZ – 30 MHZ)

Temperature:	20°C	Relative Humidity:	48%
Pressure:	1010 hPa	Test Voltage :	DC 12V
Test Mode :	Mode 1	Polarization :	--

Freq. (MHz)	Reading (dBuV/m)	Correct Factor dB	Measurement dBuV/m	Limit (dBuV/m)	Margin (dB)	State P/F
13.56	72.62	-18.87	53.75	124.00	70.25	PASS
27.12	51.07	-14.92	36.15	69.54	33.39	PASS

Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.

The limit is specified at a test distance of 30 metres. However, as specified by FCC Section 15.31 (f)(2), measurements may be performed at a closer distance and the measured level corrected to the specified measurement distance by making the measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor.

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

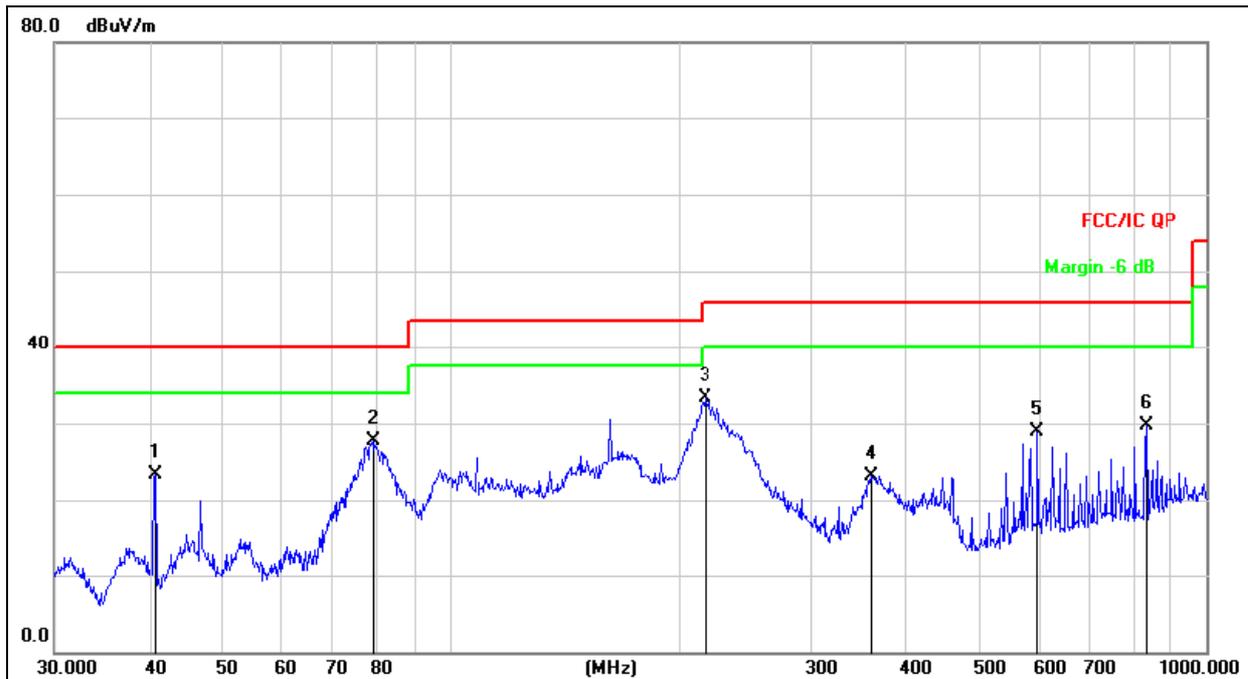
Distance extrapolation factor = $40 \log(\text{specific distance}/\text{test distance})$ (dB);

Limit line = specific limits(dBuv) + distance extrapolation factor.



3.1.7 TEST RESULTS (BETWEEN 30MHZ – 1GHZ)

Temperature :	26°C	Relative Humidity :	54%
Pressure :	1010 hPa	Polarization :	Horizontal
Test Voltage :	DC 12V		
Test Mode :	Mode 1		

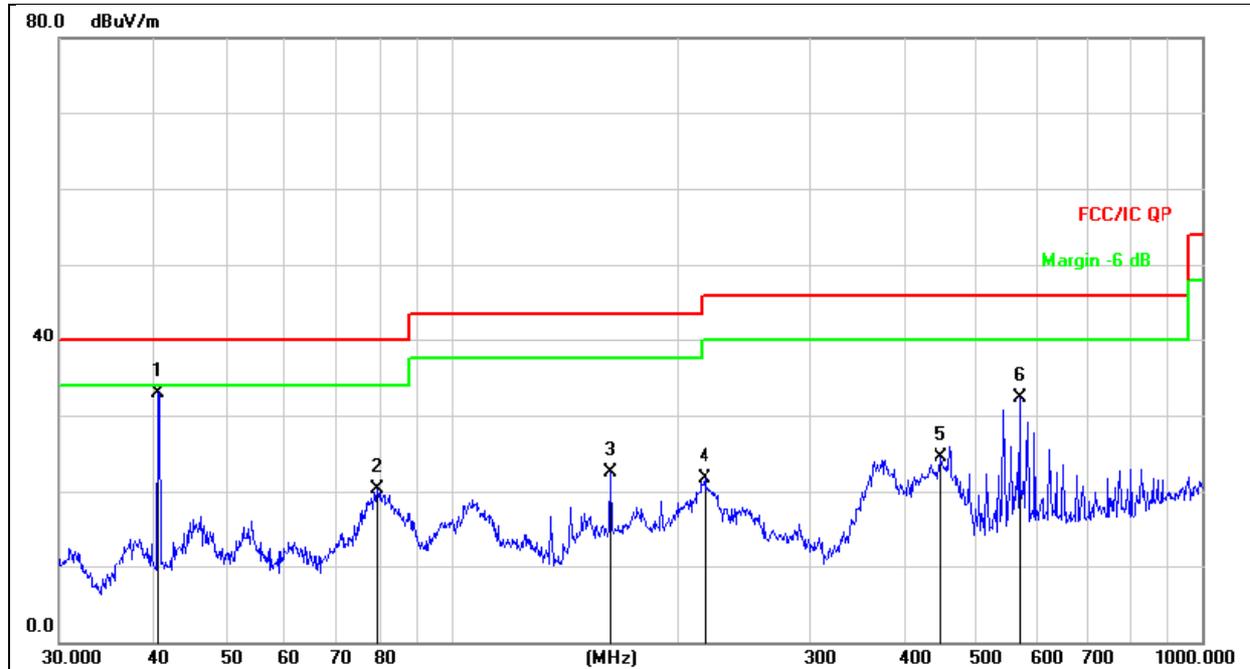


Remark:
Factor = Antenna Factor + Cable Loss – Pre-amplifier.

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1		40.7016	37.85	-14.63	23.22	40.00	-16.78	QP
2	*	78.9652	47.02	-19.41	27.61	40.00	-12.39	QP
3		216.7828	49.43	-16.19	33.24	46.00	-12.76	QP
4		359.1859	35.35	-12.18	23.17	46.00	-22.83	QP
5		597.2233	35.76	-6.77	28.99	46.00	-17.01	QP
6		830.4002	33.34	-3.57	29.77	46.00	-16.23	QP



Temperature :	26°C	Relative Humidity :	54%
Pressure :	1010 hPa	Polarization :	Vertical
Test Voltage :	DC 12V		
Test Mode :	Mode 1		



Remark:
Factor = Antenna Factor + Cable Loss – Pre-amplifier.

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dB/m	Over dB	Detector
1	*	40.5591	47.53	-14.65	32.88	40.00	-7.12	QP
2		79.5209	39.90	-19.52	20.38	40.00	-19.62	QP
3		162.6106	41.52	-18.95	22.57	43.50	-20.93	QP
4		216.7828	37.82	-16.19	21.63	46.00	-24.37	QP
5		447.9821	35.10	-10.63	24.47	46.00	-21.53	QP
6		570.6100	39.65	-7.30	32.35	46.00	-13.65	QP

4. BANDWIDTH TEST

4.1 APPLIED PROCEDURES

FCC Part15 (15.225)	
Section	Test Item
15.225	Bandwidth

4.1.1 TEST PROCEDURE

1. Set RBW = 10 kHz.
2. Set the video bandwidth (VBW) \geq RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

4.1.2 DEVIATION FROM STANDARD

No deviation.

4.1.3 TEST SETUP



4.1.4 EUT OPERATION CONDITIONS

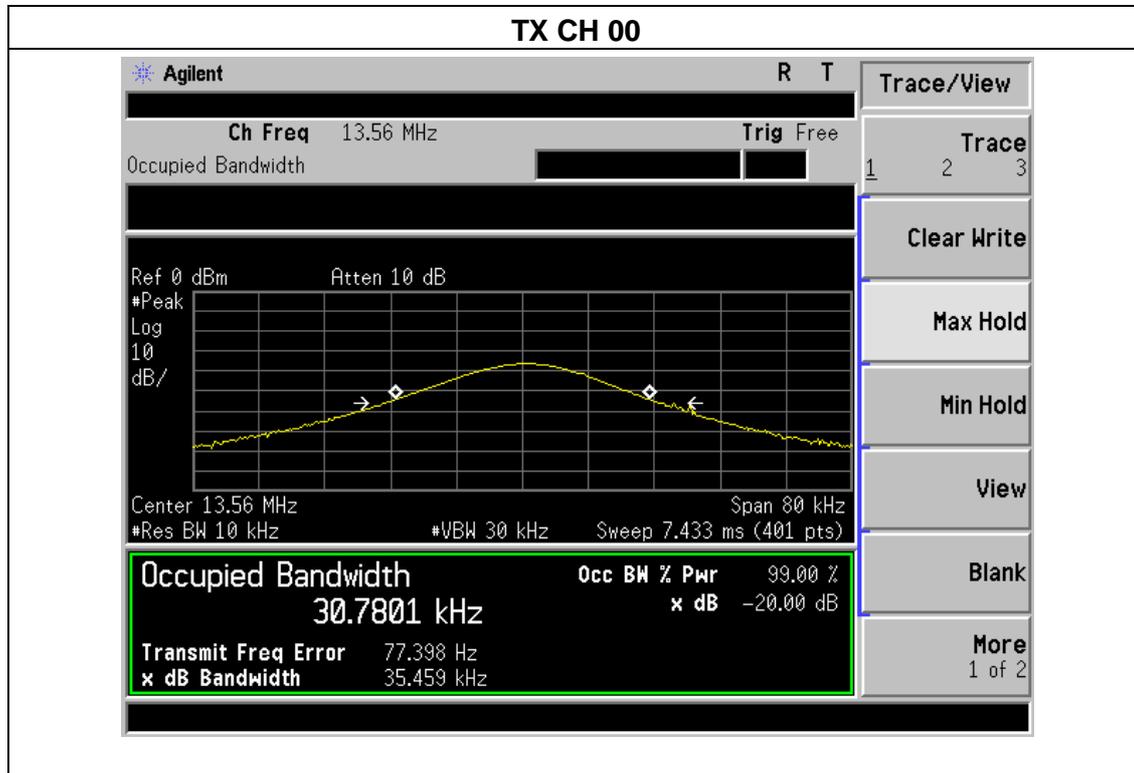
The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.



4.1.5 TEST RESULTS

Temperature :	25°C	Relative Humidity :	60%
Pressure :	1012 hPa	Test Voltage :	DC 12V
Test Mode :	TX Mode		

Frequency (MHz)	20dB bandwidth (KHz)
13.56	35.459



5. TRANSMITTER FREQUENCY STABILITY

5.1 LIMITS

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: $\pm 0.01\%$ of 13.56MHz=1356Hz

5.1.1 TEST PROCEDURE

1. Set RBW = 10 kHz.
2. Set the video bandwidth (VBW) \geq 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.

5.1.2 DEVIATION FROM STANDARD

No deviation.

5.1.3 TEST SETUP



5.1.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.



5.1.5 TEST RESULTS

Temperature :	25°C	Relative Humidity :	60%
Pressure :	1012 hPa	Test Voltage :	DC 12V
Test Mode :	TX Mode		

13.56MHz

VOLTAGE (%)	Test Conditions		Frequency(Hz)	Deviation(%)	Limit	Result
	Power(Vdc)	Temperature (°C)				
100	12	+20°C(Ref)	13559667	0.00246	±0.01%	PASS
100		-20	13559669	0.00244	±0.01%	
100		-10	13559668	0.00245	±0.01%	
100		0	13559667	0.00246	±0.01%	
100		10	13559668	0.00245	±0.01%	
100		20	13559668	0.00245	±0.01%	
100		25	13559668	0.00245	±0.01%	
100		30	13559339	0.00244	±0.01%	
100		40	13559668	0.00245	±0.01%	
100		50	13559667	0.00246	±0.01%	
Battery End Point	10.2	20	13559338	0.00245	±0.01%	
115	13.8	20	13559339	0.00244	±0.01%	



6. ANTENNA REQUIREMENT

6.1 STANDARD REQUIREMENT

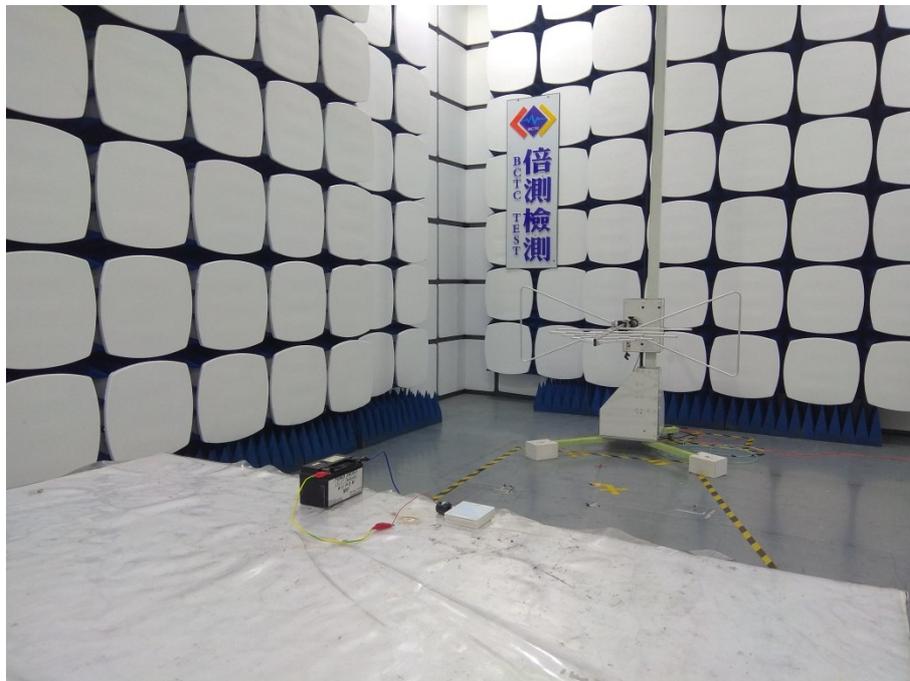
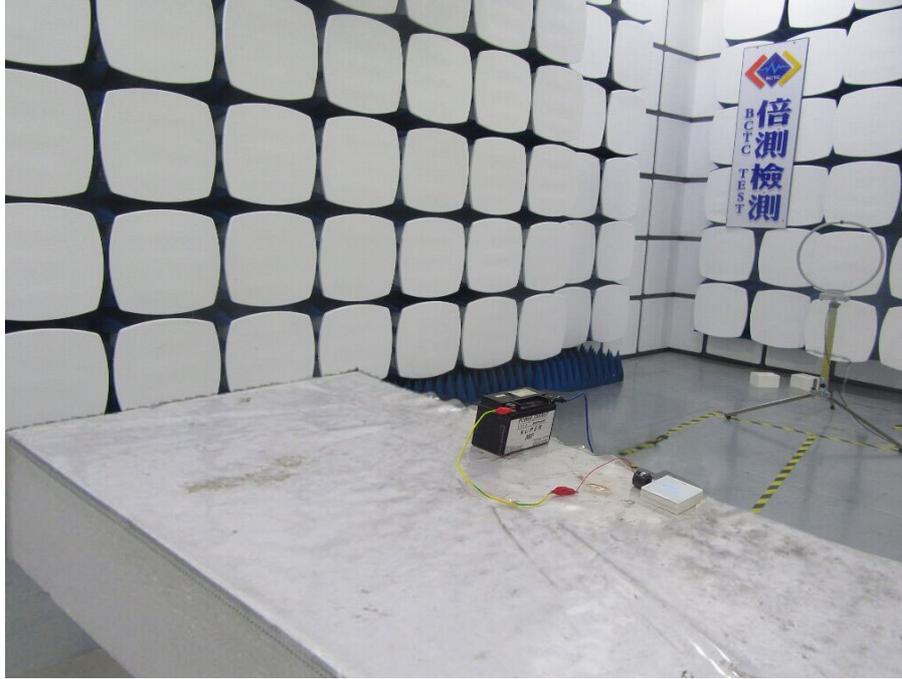
15.203 requirement: For intentional device, according to 15.203: an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

6.2 EUT ANTENNA

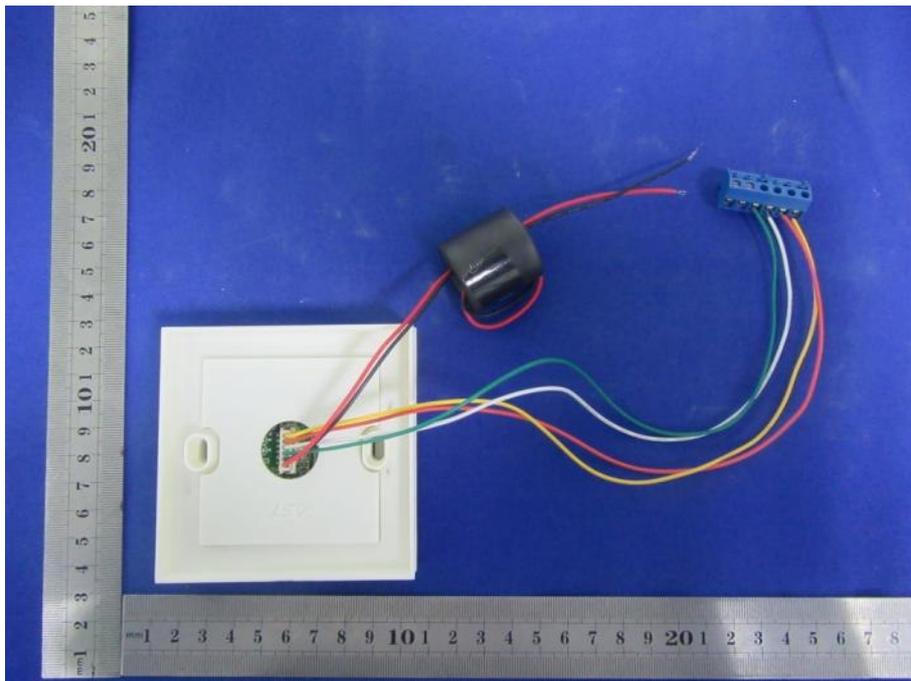
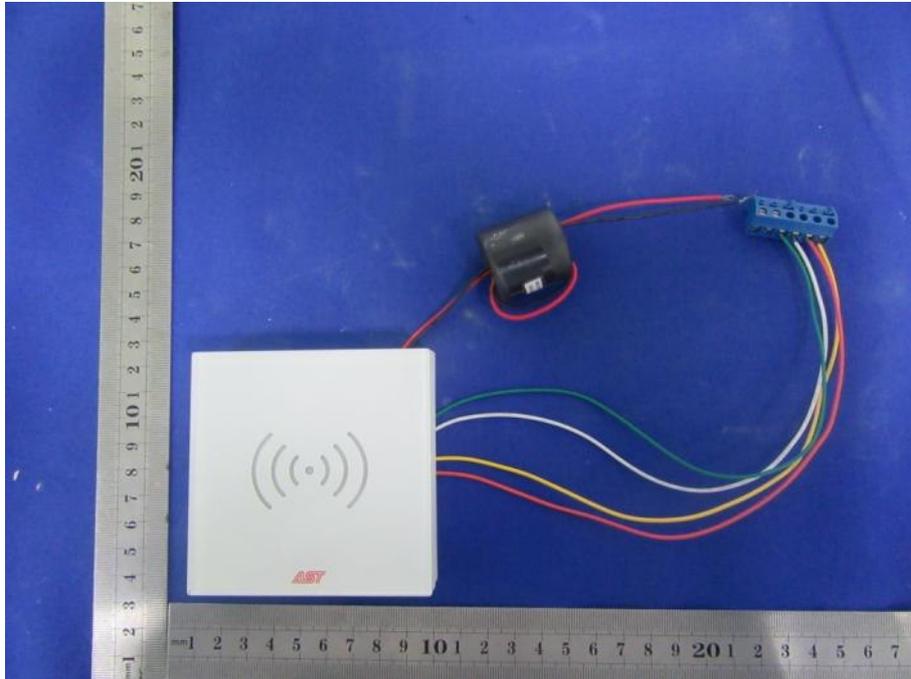
The EUT antenna is PCB antenna,. It comply with the standard requirement.

7. TEST SEUUP PHOTO

Radiated Measurement Photos



8. EUT PHOTO



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