

FCC PART 15.225

TEST REPORT

For

Advanced Card Systems Ltd.

Units 2010-2013, 20th Floor, Chevalier Commercial Centre, 8 Wang Hoi Road,
Kowloon Bay, Hong Kong

FCC ID: V5MACR321

Report Type: Original Report	Product Type: Ticket Validator
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Report Number: RSZ131225007-00B	
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Note: This test report is prepared for the customer shown above and for the equipment described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp.

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Advanced Card Systems Ltd.*'s product, model number: *ACR321 (FCC ID: V5MACR321)* or the "EUT" in this report was a *Ticket Validator*, which was measured approximately: 28.5 cm (L) x 16.5 cm (W) x 5.4 cm (H), rated input voltage: DC10~36V, with 3.7 V rechargeable Li-ion battery.

**All measurement and test data in this report was gathered from production sample serial number: 1312134 (Assigned by the applicant). The EUT supplied by the applicant was received on 2013-12-25.*

Objective

This Type approval report is prepared on behalf of *Advanced Card Systems Ltd.* in accordance with Part 2-Subpart J, and Part 15-Subparts A, B and C of the Federal Communication Commissions rules.

The objective is to determine the compliance of the EUT with FCC rules, sec 15.203, 15.205, 15.207, 15.209 and 15.225.

Related Submittal(s)/Grant(s)

Part 15.247 DTS, Part 22H&24E PCB and 15B JBP submission with FCC ID: V5MACR321.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-2009, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Lab Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement uncertainty with radiated emission is 5.91 dB for 30MHz-1GHz and 4.92 dB for above 1GHz, 1.95dB for conducted measurement.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp.(Shenzhen) to collect test data is located on the 6/F, the 3rd Phase of WanLi Industrial Building, ShiHua Road, FuTian Free Trade Zone Shenzhen, Guangdong, China.

Test site at Bay Area Compliance Laboratories Corp. (Shenzhen) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on December 06, 2010. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2009.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 382179. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Justification

The system was configured for testing in a typical fashion (as normally used by a typical user).

EUT Exercise Software

No exercise software.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT.

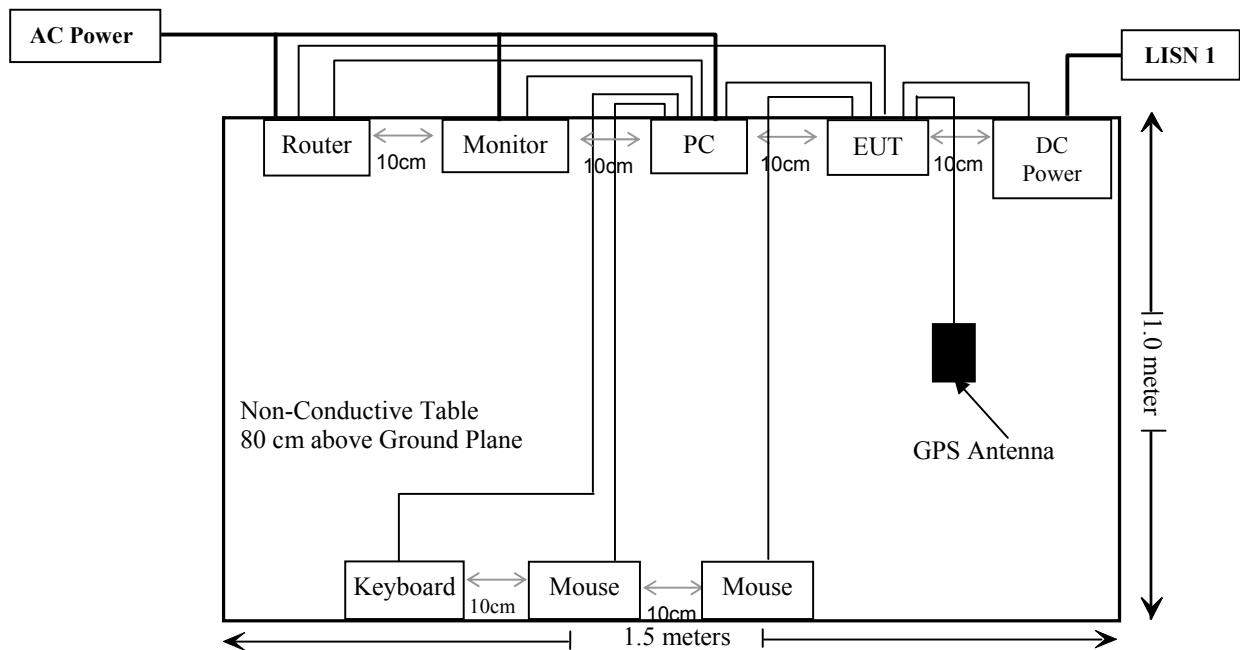
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number	Quantity
DELL	PC	VOSTRO 220S	127BP2X	1
DELL	LCD Monitor	E178WFPC	CN-OWY564-64180-7C4-2SQH	1
GW InsTEK	DC Power	GPS-3030DD	EM832096	1
SAGEM	Router	SAGEM F@ST TM 2604 White	N/A	1
DELL	Keyboard	L100	CNORH656658907BL05DC	1
DELL	Mouse	MOC5UO	G1900NKD	1
DELL	Mouse	MOC5UO	G1B009ZQ	1

External I/O Cable

Cable Description	Length (m)	From/Port	To
Unshielding Detachable USB Cable	1.5	Host PC	Mouse
Unshielding Detachable USB Cable	1.5	EUT	Mouse
Unshielding Detachable K/B Cable	1.5	Host PC	Keyboard
Unshielding Detachable VGA Cable	1.5	Host PC	LCD Monitor
Shielding Detachable RJ45 Cable	1.5	EUT	Router
Shielding Detachable RJ45 Cable	1.5	PC	Router
Unshielding Detachable Power Cable	1.0	DC Power	EUT
Unshielding Detachable RS232 Cable	1.0	EUT	PC

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207	AC Line Conducted Emission	Compliance
§15.225 §15.209 §15.205	Radiated Emission Test	Compliance
§15.225(e)	Frequency Stability	Compliance
§15.215(c)	20dB Emission Bandwidth Testing	Compliance

FCC§15.203 - ANTENNA REQUIREMENT

Applicable Standard

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 shall be considered sufficient to comply with the provisions of this section.

Antenna Connected Construction

The EUT has an integral antenna, which was permanently attached; fulfill the requirement of this section. Please see EUT photo for details.

FCC §15.207 – AC LINE CONDUCTED EMISSION

Applicable Standard

FCC§15.207

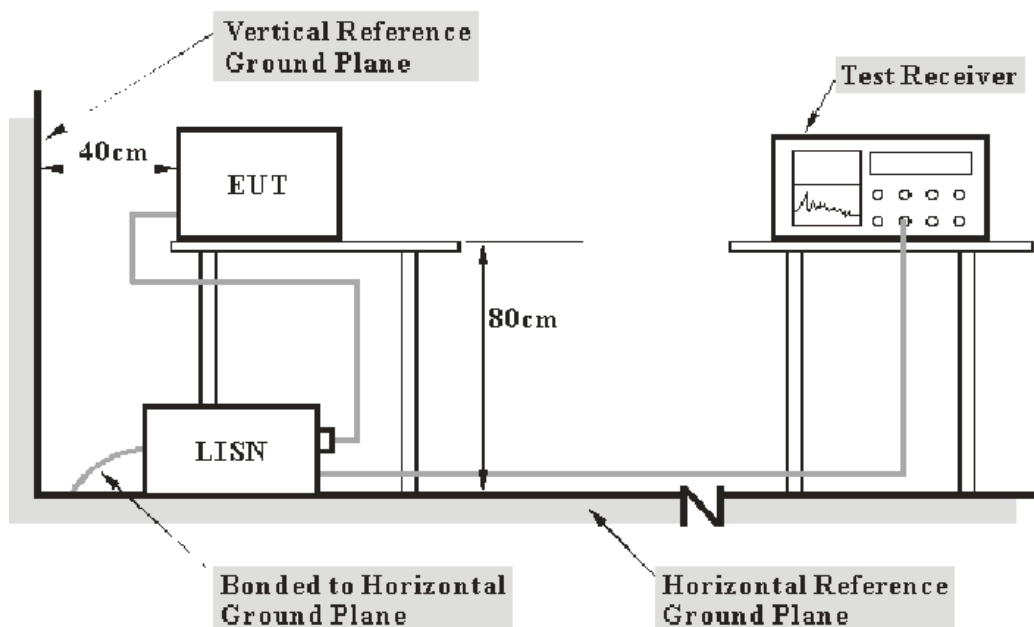
Measurement Uncertainty

Input quantities to be considered for conducted disturbance measurements may be receiver reading, attenuation of the connection between AMN/ISN and receiver, AMN/ISN voltage division factor, AMN/ISN VDF frequency interpolation and receiver related input quantities, etc.

Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of conducted disturbance test at Bay Area Compliance Laboratories Corp. (Shenzhen) is shown as below. And the uncertainty will not be taken into consideration for the test data recorded in the report

Port	Measurement uncertainty
AC Mains	3.26 dB (k=2, 95% level of confidence)
CAT 3	3.70 dB (k=2, 95% level of confidence)
CAT 5	3.86 dB (k=2, 95% level of confidence)
CAT 6	4.64 dB (k=2, 95% level of confidence)

EUT Setup



- Note: 1. Support units were connected to second LISN.
 2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.4-2009 measurement procedure. The specification used was with the FCC Part 15.207.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The EUT was powered by a 12V DC power which was connected to a 120VAC /60 Hz power source.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCS30	100176	2013-06-17	2014-06-17
Rohde & Schwarz	LISN	ENV216	3560.6650.12-101613-Yb	2013-05-07	2014-05-07
Rohde & Schwarz	LISN	ESH2-Z5	892107/021	2013-08-22	2014-08-22
Rohde & Schwarz	Transient Limiter	ESH3Z2	DE25985	2013-10-15	2014-10-15
Rohde & Schwarz	CE Test software	EMC 32	V8.53	-	-

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

Test Procedure

During the conducted emission test, the EUT was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN/ISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

$$\text{Correction Factor} = \text{LISN VDF} + \text{Cable Loss} + \text{Transient Limiter Attenuation}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207, with the worst margin reading of:

7.9 dB at 0.153500 MHz in the **Neutral** conducted mode

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level is in compliance with the limit if

$$L_m + U_{(Lm)} \leq L_{lim} + U_{cispr}$$

in BACL., $U_{(Lm)}$ is less than U_{cispr} , if L_m is less than L_{lim} , it implies that the EUT complies with the limit.

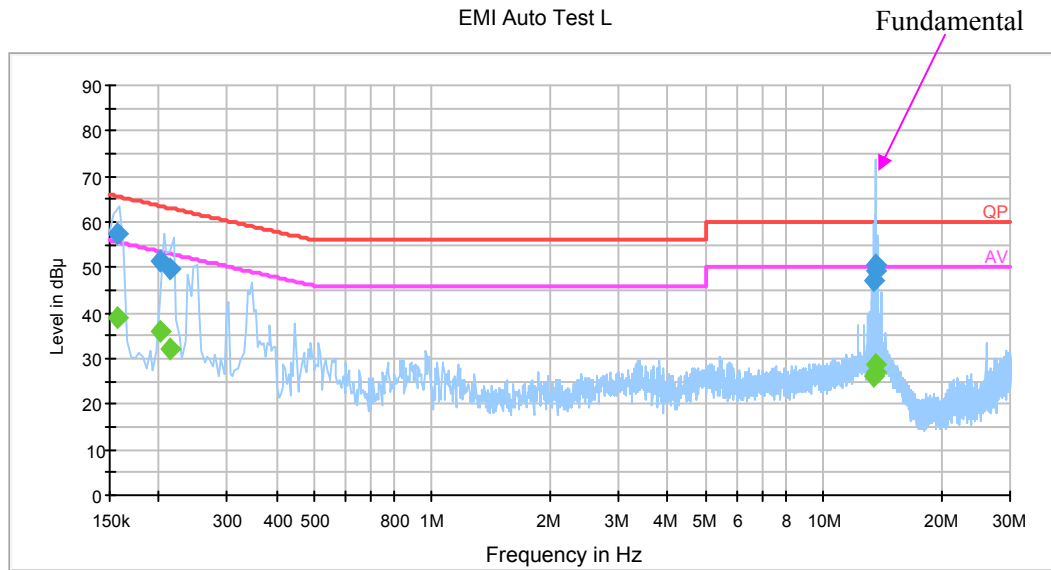
Test Data

Environmental Conditions

Temperature:	20~21 °C
Relative Humidity:	51~53 %
ATM Pressure:	101.0~101.1 kPa

The testing was performed by Rocky Kang on 2014-02-22 and 2014-04-04.

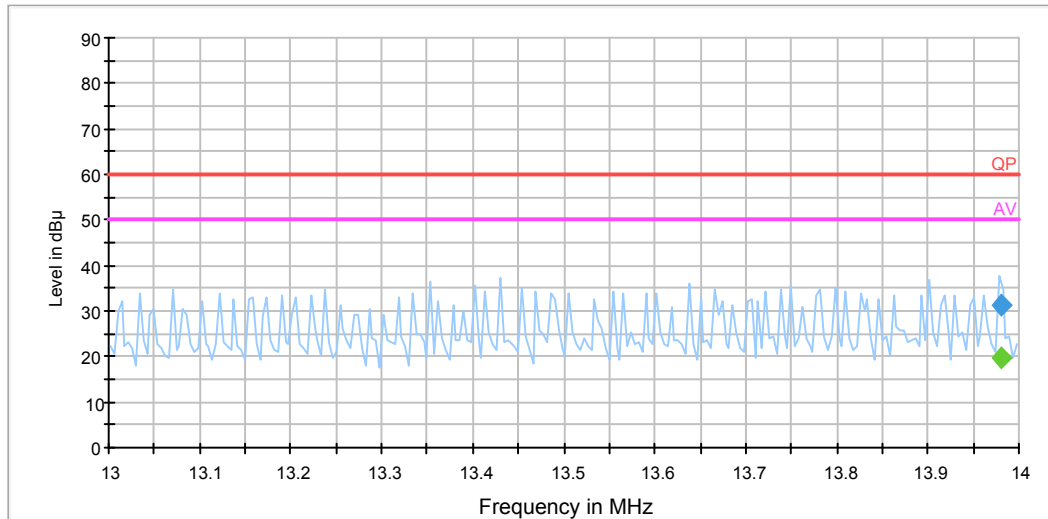
Test Mode: Transmitting

AC 120V/60 Hz, Line:

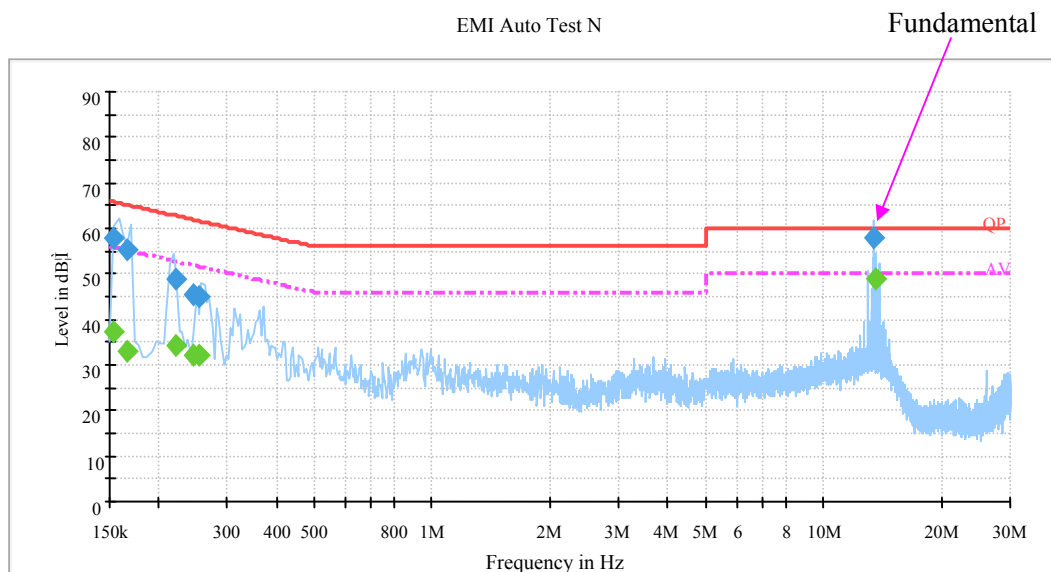
Frequency (MHz)	Corrected Amplitude (dB μ V)	Correction Factor (dB)	Limit (dB μ V)	Margin (dB)	Detector (PK/Ave./QP)
0.157500	57.6	19.6	19.6	8.0	QP
0.157500	39.1	19.6	19.6	16.5	Ave.
0.201500	51.4	19.6	19.6	12.2	QP
0.201500	35.9	19.6	19.6	17.6	Ave.
0.213500	49.9	19.5	19.5	13.2	QP
0.213500	32.1	19.5	19.5	21.0	Ave.
13.410810	47.3	19.7	19.7	12.7	QP
13.410810	26.0	19.7	19.7	24.0	Ave.
13.574570	50.7	19.8	19.8	9.3	QP
13.574570	28.7	19.8	19.8	21.3	Ave.
13.631710	49.1	19.8	19.8	10.9	QP
13.631710	26.9	19.8	19.8	23.1	Ave.

Cut off the RFID Antenna and add a dummy load, test result between 13~14MHz is below.

EMI Auto Test L



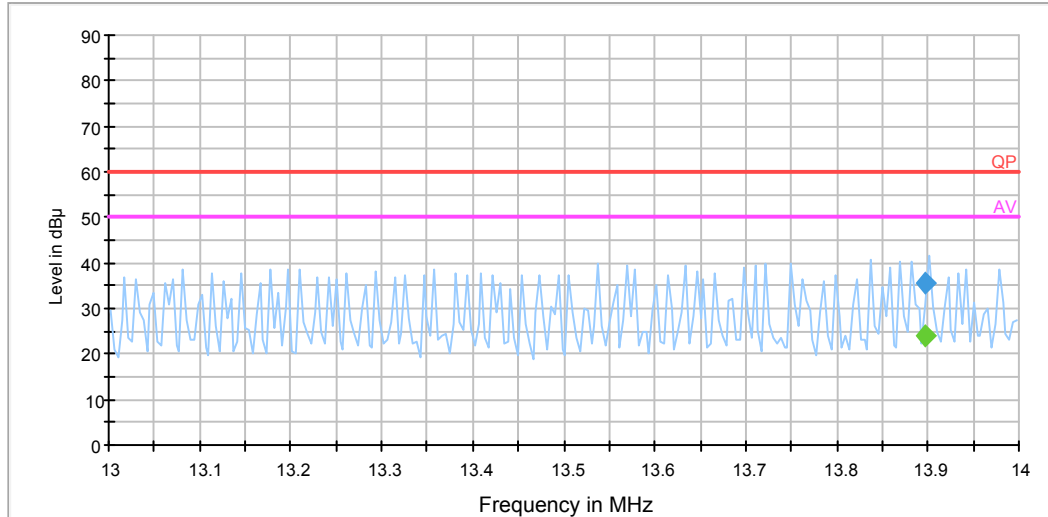
Frequency (MHz)	Corrected Amplitude (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/Ave./QP)
13.980330	31.2	19.8	60.0	28.8	QP
13.980330	19.9	19.8	50.0	30.1	Ave.

AC 120V/60 Hz, Neutral

Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.153500	57.9	19.6	65.8	7.9	QP
0.153500	37.4	19.6	55.8	18.4	Ave.
0.165500	55.1	19.6	65.2	10.1	QP
0.165500	32.9	19.6	55.2	22.3	Ave.
0.222500	48.7	19.5	62.7	14.1	QP
0.222500	34.4	19.5	52.7	18.3	Ave.
0.245500	45.3	19.5	61.9	16.6	QP
0.245500	32.1	19.5	51.9	19.8	Ave.
0.253500	45.1	19.5	61.6	16.6	QP
0.253500	32.0	19.5	51.6	19.7	Ave.
13.560250	58.0	19.8	60.0	2.0	QP
13.560250	48.9	19.8	50.0	1.1	Ave.

Cut off the RFID Antenna and add a dummy load, test result between 13~14MHz is below.

EMI Auto Test N



Frequency (MHz)	Corrected Amplitude (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/Ave./QP)
13.897470	35.6	19.9	60.0	24.4	QP
13.897470	23.9	19.9	50.0	26.1	Ave.

Note:

- 1) Correction Factor = LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
The corrected factor has been input into the transducer of the test software.
- 2) Corrected Amplitude = Reading + Correction Factor
- 3) Margin = Limit – Corrected Amplitude

FCC§15.225, §15.205 & §15.209 - RADIATED EMISSIONS TEST

Applicable Standard

As per FCC Part 15.225

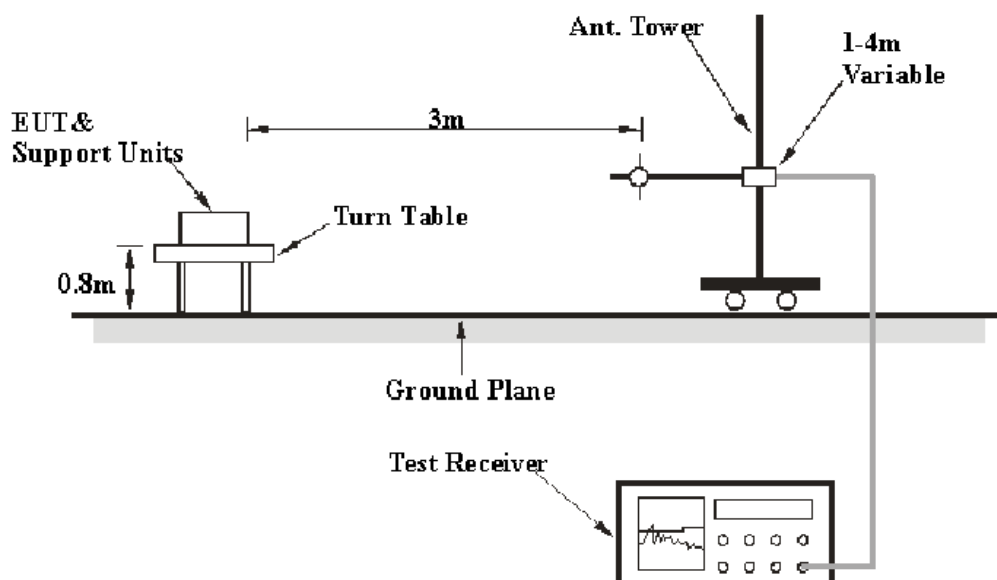
- (a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- (b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- (c) Within the bands 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.

Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of radiation emissions at Bay Area Compliance Laboratories Corp. (Shenzhen) is shown in below table. And the uncertainty will not be taken into consideration for the test data recorded in the report

EUT Setup



The radiated emission tests were performed in the 3-meter chamber a test site, using the setup accordance with the ANSI C63.4-2009. The specification used was the FCC Part Subpart C limits.

The EUT was powered by a 12V DC power which was connected to a 120VAC /60 Hz power source.

EMI Test Receiver Setup

According to FCC Rules, 47 CFR 15.33, the EUT emissions were investigated up to 1000 MHz.

During the radiated emission test, the EMI test Receiver was set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Detector
9 kHz – 150 kHz	300 Hz	1 kHz	/	QP
150 kHz –30 MHz	10 kHz	30 kHz	/	QP
30 MHz – 1000 MHz	100 kHz	300 kHz	/	QP

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Corrected Factor}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCI	101122	2013-09-25	2014-09-25
HP	Amplifier	8447E	1937A01046	2013-09-30	2014-09-30
Sunol Sciences	Bi-log Antenna	JB1	A040904-2	2011-11-28	2014-11-27
ETS	Passive Loop Antenna	6512	00029604	2011-11-30	2014-11-29

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

Test Results Summary

According to the data in the following table, the EUT complied with the FCC Part 15.209 with the worst margin reading of:

8.0 dB at 823.27 MHz in the Horizontal polarization

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level is in compliance with the limit if

$$L_m + U_{(Lm)} \leq L_{lim} + U_{cispr}$$

In BACL, $U_{(Lm)}$ is less than U_{cispr} , if L_m is less than L_{lim} , it implies that the EUT complies with the limit.

Test Data

Environmental Conditions

Temperature:	21 °C
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

The testing was performed by Rocky Kang on 2014-02-22.

Test mode: Transmitting

Indicated		Table Angle Degree	Antenna Height (m)	Detector PK/QP/Ave.	Correction Factor			Corrected Amplitude (dBμV/m) @3m	FCC Part 15.225/15.209	
Frequency (MHz)	Maximum Reading (dBμV)				Ant. Factor (dB)	Cable Loss (dB)	Pre-Amp. Gain (dB)		Limit (dBμV/m) @3m	Margin (dB)
0.104	0.64	0	1.1	QP	65.8	0.25	0	66.69	107	40.31
26.31	6.57	0	1.2	QP	30.6	0.25	0	37.42	69.5	32.08

Indicated			Table Angle Degree	Antenna Height (m)	Detector PK/QP/Ave.	Correction Factor			Corrected Amplitude (dBμV/m) @3m	FCC Part 15.225	
Frequency Range (MHz)	Mark point (MHz)	Maximum Reading (dBμV)				Ant. Factor (dB)	Cable Loss (dB)	Pre-Amp. Gain (dB)		Limit (dBμV/m) @3m	Margin (dB)
13.110-13.410	13.228	12.24	0	1.2	QP	32.1	0.25	0	44.59	80.5	Pass
13.410-13.553	13.513	19.68	0	1.3	QP	32.1	0.25	0	52.03	90.5	Pass
13.553-13.567	13.563	36.52	0	1.2	QP	32.1	0.25	0	68.87	124	Pass
13.567-13.710	13.569	21.47	0	1.2	QP	32.1	0.25	0	53.82	90.5	Pass
13.710-14.010	13.965	13.41	0	1.1	QP	32.1	0.25	0	45.76	80.5	Pass

Frequency (MHz)	Corrected Amplitude (dBμV/m)	Detector PK/QP/Ave.	Antenna Height (m)	Antenna Polarity (H/V)	Turntable Position (deg)	Correction Factor (dB)	Limit (dBμV/m)	Margin (dB)
146.78	35.1	QP	1.7	H	112.0	-14.4	43.5	8.4
452.18	35.0	QP	1.2	V	79.0	-9.5	46	11.0
551.39	32.5	QP	1.1	H	223.0	-7.6	46	13.5
794.32	33.4	QP	1.2	H	10.0	-5.5	46	12.6
823.27	38.0	QP	1.5	H	32.0	-4.2	46	8.0

FCC§15.225(e) - FREQUENCY STABILITY**Applicable Standard**

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.

Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to PC, then to an external AC power supply and loop antenna was connected to a Spectrum Analyzer. The EUT was placed inside the temperature chamber.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the Spectrum Analyzer.

Frequency Stability vs. Voltage: An external variable AC power supply Source. The voltage was set to 115% of the nominal value and was then decreased until the transmitter light no longer illuminated; i.e., the end point. The output frequency was recorded for each voltage.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCI	101122	2013-09-25	2014-09-25
ESPEC	Temperature & Humidity Chamber	EL-10KA	09107726	2013-11-01	2014-11-01

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

Temperature:	21 °C
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

The testing was performed by Rocky Kang on 2014-02-22.

Test Mode: Transmitting

Test Result: Pass

Power Supply	Temperature (°C)	Measured Frequency (MHz)	Frequency Error	Part 15.225 Limit
DC 10V	-20	13.56045	0.0033%	±0.01%
	20	13.56039	0.0029%	±0.01%
	50	13.56023	0.0017%	±0.01%
DC 12V	-20	13.55953	-0.0035%	±0.01%
	20	13.56045	0.0033%	±0.01%
	50	13.56046	0.0034%	±0.01%
DC 36V	-20	13.56042	0.0031%	±0.01%
	20	13.56058	0.0043%	±0.01%
	50	13.56061	0.0045%	±0.01%

§15.215(c) - 20dB EMISSION BANDWIDTH TESTING

Requirement

Per 15.215 (c) 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 the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCI	101122	2013-09-25	2014-09-25
ETS	Passive Loop Antenna	6512	00029604	2011-11-30	2014-11-29

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.

Test Data

Environmental Conditions

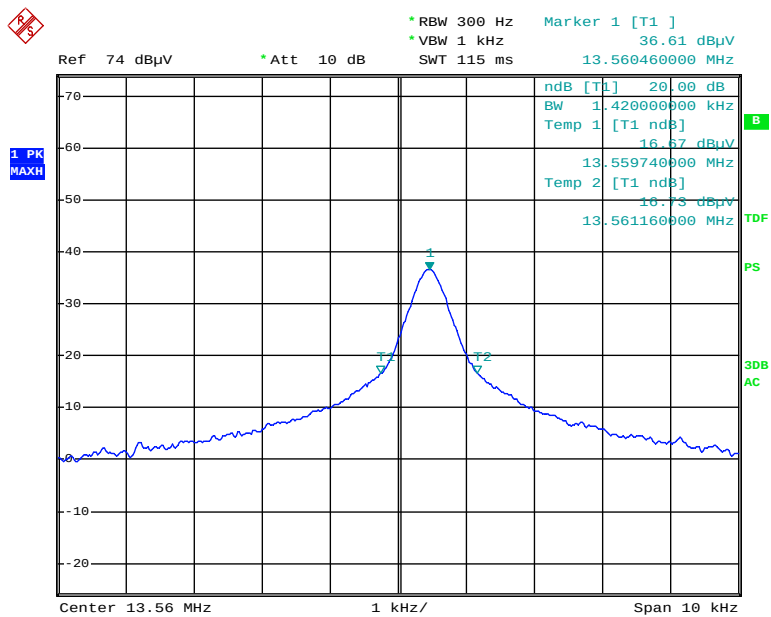
Temperature:	20 °C
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

The testing was performed by Rocky Kang on 2014-01-08.

Test Mode: Transmitting

Test Result: Pass

20 dB Emission Bandwidth



Date: 8.JAN.2014 13:49:33

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