



# FCC Radio Test Report

## FCC ID: HLEPA520BTNF

This report concerns (check one) : ☒ Original Grant ☐ Class II Change

**Issued Date** : Feb. 11, 2014  
**Project No.** : 1312155  
**Equipment** : Rugged Mobile Computer  
**Model Name** : PA520  
  
**Applicant** : unitech electronics co., ltd.  
**Address** : 5F, No. 136, Lane 235, Pao-Chiao Rd.,  
Hsin-Tien Dist., New Taipei City, Taiwan

**Tested by:** Neutron Engineering Inc. EMC Laboratory  
**Date of Receipt:** Dec. 23, 2013  
**Date of Test:** Dec. 23, 2013 ~ Jan. 22, 2014

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**Declaration**

**Neutron** represents to the client that testing is done in accordance with standard procedures as applicable and that test instruments used has been calibrated with the standards traceable to National Measurement Laboratory (**NML**) of **R.O.C.**, or National Institute of Standards and Technology (**NIST**) of **U.S.A.**

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**Limitation**

For the use of the authority's logo is limited unless the Test Standard(s)/Scope(s)/Item(s) mentioned in this test report is (are) included in the conformity assessment authorities acceptance respective.



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### REPORT ISSUED HISTORY

Revised Version No.	Description	Issued Date
-	Initial Issue.	Feb. 11, 2014



## **1 CERTIFICATION**

Equipment : Rugged Mobile Computer  
Brand Name : unitech  
Model Name : PA520  
Applicant : unitech electronics co., ltd.  
Date of Test : Dec. 23, 2013 ~ Jan. 22, 2014  
Standards : FCC Part 15, Subpart C: 2012  
ANSI C63.4: 2009

The above equipment has been tested and found compliance with the requirement of the relative standards by Neutron Engineering Inc. EMC Laboratory.

The test data, data evaluation, and equipment configuration contained in our test report (Ref No. NEI-FCCP-4-1312155) were obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of TAF according to the ISO-17025 quality assessment standard and technical standard(s).

**2 SUMMARY OF TEST RESULTS**

Test procedures according to the technical standards:

Standard Section	Test Item	Result
15.207	Conducted emission	<b>PASS</b>
15.35 / 15.205 / 15.209 / 15.225	Radiated emission	<b>PASS</b>
15.225(e)	Frequency Stability	<b>PASS</b>
15.203	Antenna Requirement	<b>PASS</b>

NOTE:

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



## 2.1 TEST FACILITY

The test facilities used to collect the test data in this report:

### Conducted emission Test:

**C02:** (VCCI RN: C-3477; FCC RN: 614388; FCC DN: TW1054)

1F., No. 61, Ln. 77, Sing-ai Rd., Neihu Dist., Taipei City 114, Taiwan (R.O.C.)

### Radiated emission Test:

**CB08:** (FCC RN: 614388; FCC DN: TW1054; IC Assigned Code: 4428C-1)

1F., No. 61, Ln. 77, Sing-ai Rd., Neihu Dist., Taipei City 114, Taiwan (R.O.C.)

## 2.2 MEASUREMENT UNCERTAINTY

**The measurement uncertainty is not specified by FCC/Industry Canada rules and for reference only.**

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%**.

The measurement instrumentation uncertainty considerations contained in CISPR 16-4-2.

### A. Conducted emission test:

Test Site	Measurement Frequency Range	U , (dB)	NOTE
C02	150 kHz ~ 30 MHz	2.59	

### B. Radiated emission test:

Test Site	Item	Measurement Frequency Range	Uncertainty	NOTE
CB08	Radiated emission at 3m	Horizontal Polarization	30 - 200MHz	3.35 dB
			200 - 1000MHz	3.11 dB
			1 - 18GHz	3.97 dB
			18 - 40GHz	4.01 dB
	Vertical Polarization		30 - 200MHz	3.22 dB
			200 - 1000MHz	3.24 dB
			1 - 18GHz	4.05 dB
			18 - 40GHz	4.04 dB

Our calculated Measurement Instrumentation Uncertainty is shown in the tables above. These are our  $U_{lab}$  values in CISPR 16-4-2 terminology.

Since Table 1 of CISPR 16-4-2 has values of measurement instrumentation uncertainty, called  $U_{CISPR}$ , as follows:

Conducted Disturbance (mains port) – 150 kHz – 30 MHz : 3.6 dB

Radiated Disturbance (electric field strength on an open area test site or alternative test site) – 30 MHz – 1000 MHz : 5.2 dB

It can be seen that our  $U_{lab}$  values are smaller than  $U_{CISPR}$ .



### 3 GENERAL INFORMATION

#### 3.1 GENERAL DESCRIPTION OF EUT

Equipment	Rugged Mobile Computer	
Brand Name	unitech	
Model Name	PA520	
OEM Brand/Model Name	N/A	
Model Difference	N/A	
Product Description	The EUT is a Rugged Mobile Computer.	
	Operation Frequency:	13.56 MHz
	Antenna Designation:	LOOP Antenna
More details of EUT technical specification, please refer to the User's Manual.		
Power Source	1. Battery supplied. 2. DC Voltage supplied from External Power Supply.	
Power Rating	1. Li-ion BATTERY PACK: 3.7V 2. External Power Supply: I/P: AC 100-240V 50-60Hz 0.6A / O/P: DC 5V 3.0A	
Connecting I/O Port(s)	Please refer to the User's Manual	
Products Covered	1 * Reader (optional): 2D or 1D 1 * WLAN + Bluetooth Module 1 * RFID Module 1 * Li-ion BATTERY PACK: 3.7V 2200mAh, 8.14Wh 1 * USB Charging Cable 1 * External Power Supply: ENG, 3A-182WP05	
EUT Modification(s)	N/A	

Note:

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



### 3.2 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 Test Mode	Description
Mode 1	Transmitting

#### Conducted emission test

Final Test Mode	Description
Mode 1	Transmitting

#### Radiated emission test

Final Test Mode	Description
Mode 1	Transmitting

#### Frequency Stability test

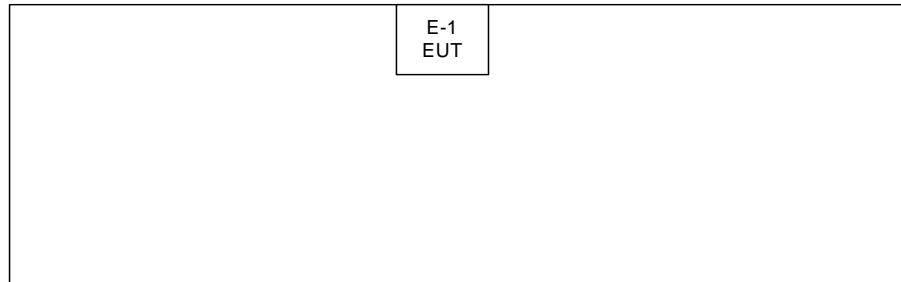
Final Test Mode	Description
Mode 1	Transmitting

#### Antenna Requirement test

Final Test Mode	Description
Mode 1	Transmitting



### 3.3 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED



**3.4 DESCRIPTION OF SUPPORT UNITS**

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.	FCC ID	Series No.	Note
E-1	Rugged Mobile Computer	unitech	PA520	HLEPA520BTNF	N/A	EUT

Item	Shielded Type	Ferrite Core	Length	Note
N/A	-	-	-	-

Note:

- (1) The support equipment was authorized by Declaration of Conformity (DOC).



## 4 CONDUCTED EMISSION

### 4.1 LIMITS

FREQUENCY (MHz)	Class A (dBuV)		Class B (dBuV)	
	Quasi-peak	Average	Quasi-peak	Average
0.15 - 0.5	79.00	66.00	66 - 56 *	56 - 46 *
0.50 - 5.0	73.00	60.00	56.00	46.00
5.0 - 30.0	73.00	60.00	60.00	50.00

NOTE:

1. The tighter limit applies at the band edges.
2. The limit of " \* " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.
3. The test result calculated as following:  
Measurement Value = Reading Level + Correct Factor  
Correct Factor = Insertion Loss + Cable Loss + Attenuator Factor(if use)  
Margin Level = Measurement Value – Limit Value

### 4.2 MEASUREMENT INSTRUMENTS LIST

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	LISN	Schwarzbeck	NSLK 8127	8127685	Feb. 24, 2014
2	Test Cable	TIMES	CFD300-NL	C01	Jun. 16, 2014
3	EMI Test Receiver	Agilent	N9038A	MY51210215	Mar. 21, 2014
4	Measurement Software	EZ	EZ_EMC (Version NB-02A)	N/A	N/A

NOTE: **N/A**: denotes No Model Name, No Serial No. or No Calibration specified.



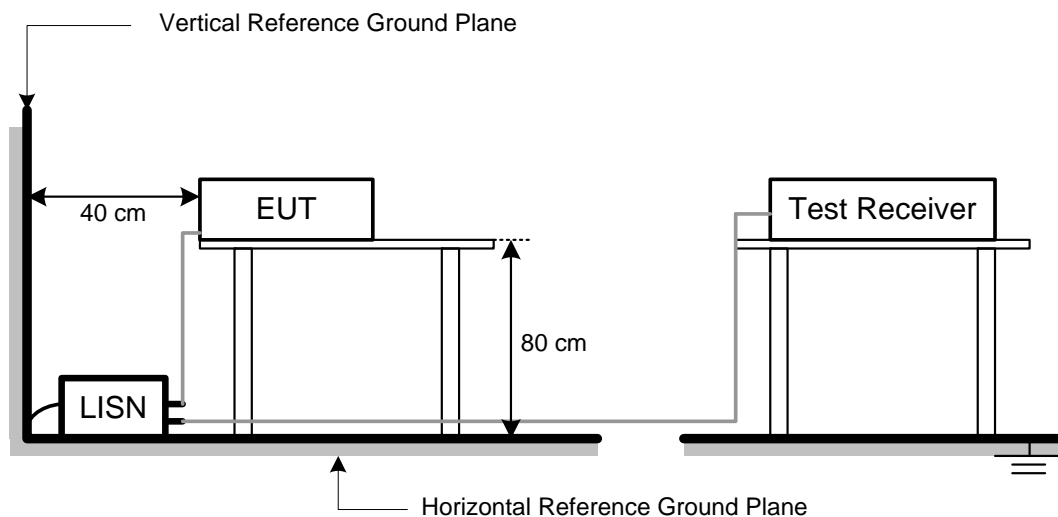
#### 4.3 TEST PROCEDURES

- 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.
- 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.
- 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.
- LISN at least 80 cm from nearest part of EUT chassis.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

**NOTE:**

- Reading in which marked as Peak, QP or AVG means measurements by using are Quasi-Peak or Average Mode with Detector BW=9 kHz (6 dB Bandwidth).
- All readings are Peak Mode value unless otherwise stated QP or AVG in column of Note. If the Peak or QP Mode Measured value compliance with the QP Limits and lower than AVG Limits, the EUT shall be deemed to meet both QP & AVG Limits and then only Peak or QP Mode was measured, but AVG Mode didn't perform.

#### 4.4 TEST SETUP LAYOUT



#### 4.5 DEVIATION FROM TEST STANDARD

No deviation



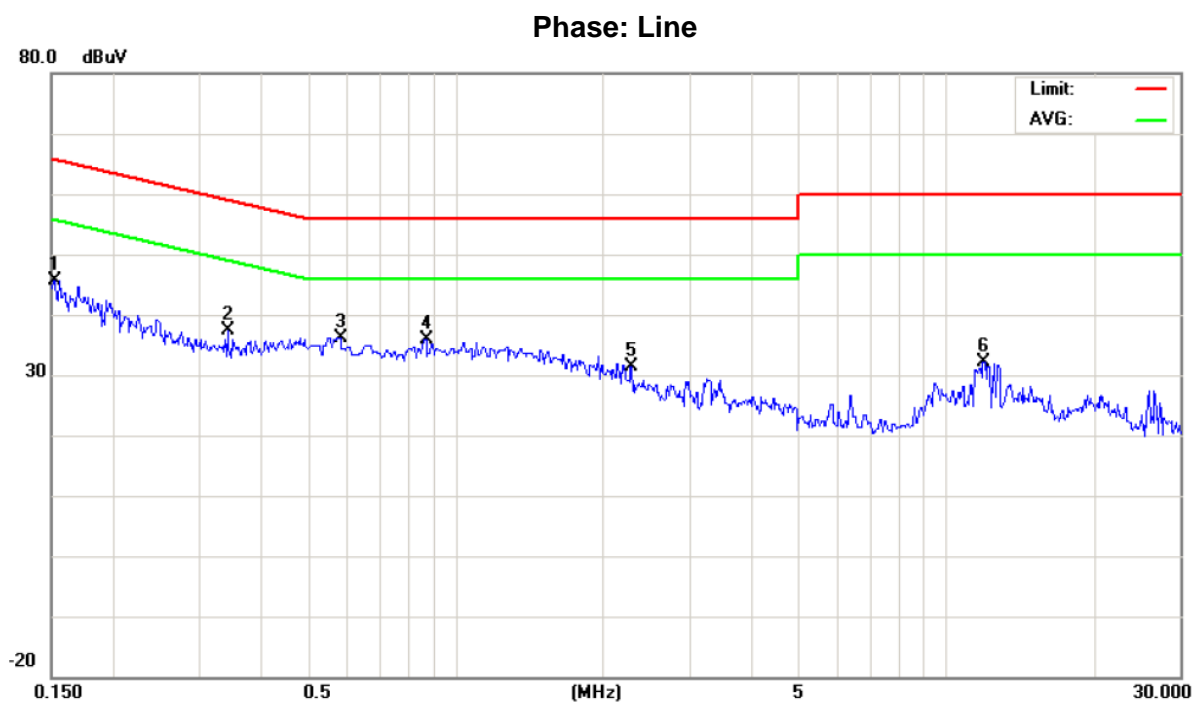
#### **4.6 EUT OPERATING CONDITIONS**

The EUT used during radiated and/or conducted emission measurement was designed to exercise in a manner similar to a typical use.



#### 4.7 TEST RESULTS

EUT	Rugged Mobile Computer	Model Name	PA520
Temperature	24°C	Relative Humidity	46%
Test Voltage	AC 120V/60Hz		
Test Mode	Transmitting		

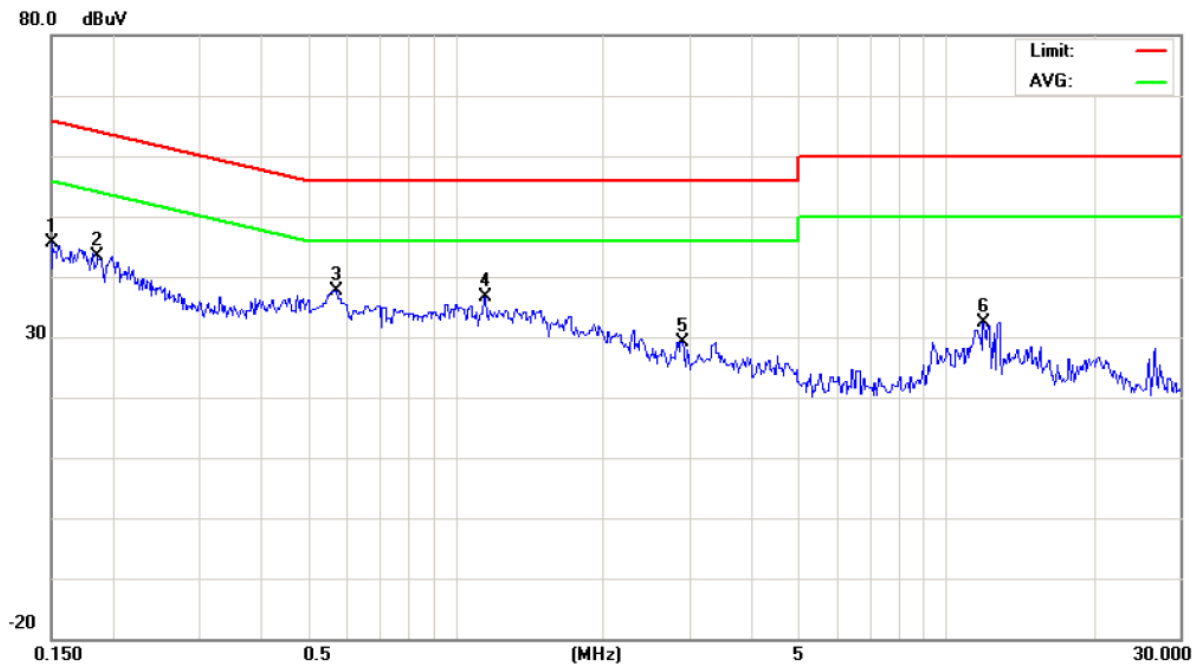


No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1520	36.93	8.71	45.64	65.89	-20.25	peak	
2		0.3417	29.66	7.81	37.47	59.16	-21.69	peak	
3	*	0.5810	27.54	8.71	36.25	56.00	-19.75	peak	
4		0.8690	26.55	9.38	35.93	56.00	-20.07	peak	
5		2.2729	21.91	9.35	31.26	56.00	-24.74	peak	
6		11.9000	22.71	9.35	32.06	60.00	-27.94	peak	



EUT	Rugged Mobile Computer	Model Name	PA520
Temperature	24°C	Relative Humidity	46%
Test Voltage	AC 120V/60Hz		
Test Mode	Transmitting		

**Phase: Neutral**



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1507	36.81	8.71	45.52	65.96	-20.44	peak	
2		0.1863	33.45	10.00	43.45	64.20	-20.75	peak	
3	*	0.5720	29.04	8.69	37.73	56.00	-18.27	peak	
4		1.1479	27.09	9.63	36.72	56.00	-19.28	peak	
5		2.8850	19.76	9.39	29.15	56.00	-26.85	peak	
6		11.9000	23.03	9.35	32.38	60.00	-27.62	peak	



## 5 RADIATED EMISSION

### 5.1 LIMITS

FCC Part 15.209				
Frequency (MHz)	Field Strength Limitation		Field Strength Limitation at 3m Measurement Dist	
	(uV/m)	Dist	(uV/m)	(dBuV/m)
0.009 – 0.490	2400 / F(KHz)	300m	10000 * 2400/F(KHz)	20log 2400/F(KHz) + 80
0.490 – 1.705	24000 / F(KHz)	30m	100 * 24000/F(KHz)	20log 24000/F(KHz) + 40
1.705 – 30.00	30	30m	100* 30	20log 30 + 40
30.0 – 88.0	100	3m	100	20log 100
88.0 – 216.0	150	3m	150	20log 150
216.0 – 960.0	200	3m	200	20log 200
Above 960.0	500	3m	500	20log 500
FCC Part 15.225(a)/(b)/(c)				
Frequency (MHz)	Field Strength Limitation		Field Strength Limitation at 3m Measurement Dist	
	(uV/m)	Dist	(uV/m)	(dBuV/m)
13.553 – 13.567	15,848	30 m	15,848*100	124
13.567 – 13.710	334	30 m	334*100	90.5
13.110 – 13.410 13.710 – 14.010	106	30 m	106*100	80.5

**NOTE:**

- (1) The tighter limit shall apply at the boundary between two frequency range.
- (2) Limitation expressed in dBuV/m is calculated by 20log Emission Level (uV/m).
- (3) If measurement is made at 3m distance, then F.S Limitation at 3m distance is adjusted by using the formula of  $L_{d1} = L_{d2} * (d_2/d_1)^2$ .  
Example:  
F.S Limit at 30m distance is 30uV/m , then F.S Limitation at 3m distance is adjusted as  $L_{d1} = L_1 = 30uV/m * (10)^2 = 100 * 30 uV/m$
- (4) The test result calculated as following:  
Measurement Value = Reading Level + Correct Factor  
Correct Factor = Insertion Loss + Cable Loss + Attenuator Factor(if use)  
Margin Level = Measurement Value – Limit Value

**5.2 MEASUREMENT INSTRUMENTS LIST**

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP-30	100854	Sep. 08, 2014
2	Microflex Cable	Harbour industries	27478LL142	1m	May. 13, 2014
3	Test Cable	LMR	LMR-400	12m	May. 14, 2014
4	Test Cable	LMR	LMR-400	3m	May. 14, 2014
5	Pre-Amplifier	Anritsu	MH648A	M92649	Jun. 18, 2014
6	Log-Bicon Antenna	Schwarzbeck	VULB9168-352	9168-352	Jun. 11, 2014
7	Preamplifier With Adaptor	EMC	EMC2654045	980030	Feb. 18, 2014
8	Loop Ant.	EMCO	6502	00042960	Sep. 29, 2014

Remark: "N/A" denotes No Model Name, No Serial No. or No Calibration specified.

**5.3 TEST PROCEDURE**

- The measuring distance of at 3 m shall be used for measurements at frequency up to 1GHz.
- The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3m or 10 meter open area test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- The height of the equipment or of the substitution antenna shall be 0.8 m; 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.
- The initial step in collecting radiated 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.
- 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.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

**NOTE: (FCC PART 15.209)**

- Reading in which marked as QP or Peak means measurements by using are Quasi-Peak Mode with Detector BW=120 kHz.
- All readings are Peak unless otherwise stated QP in column of Note. Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform.

**NOTE: (FCC PART 15.225)**

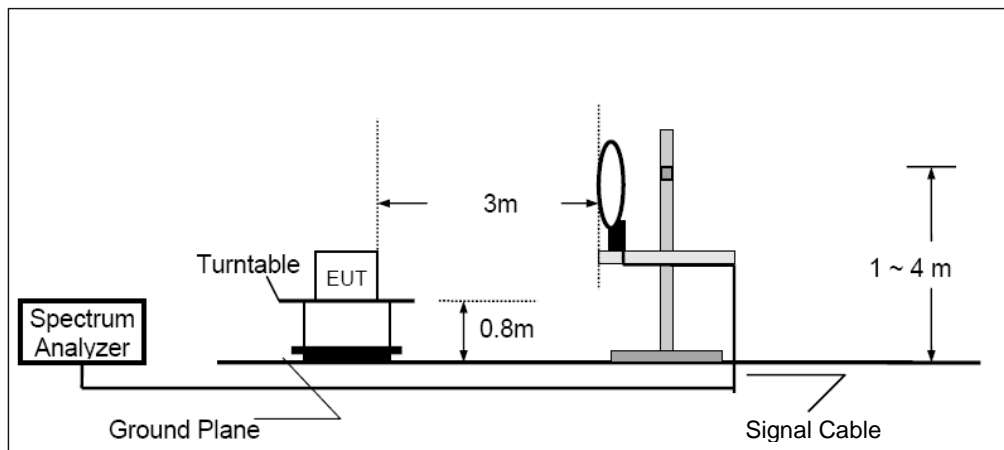
- Spectrum Setting:  
9 KHz – 150 KHz, RBW= 200Hz, VBW=200Hz, Sweep time = 200 ms.  
150 K Hz – 30 MHz, RBW= 10 KHz, VBW=10 KHz, Sweep time = 200 ms.  
30 MHz – 1000 MHz, RBW= 100KHz, VBW=100KHz, Sweep time = 200 ms.
- All readings are Peak unless otherwise stated QP in column of Note. Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform.
- The Log-Bicon Antenna will use to test frequency range from 30MHz to 1000MHz and the Loop Antenna will use to test frequency below 30MHz.

## 5.4 DEVIATION FROM TEST STANDARD

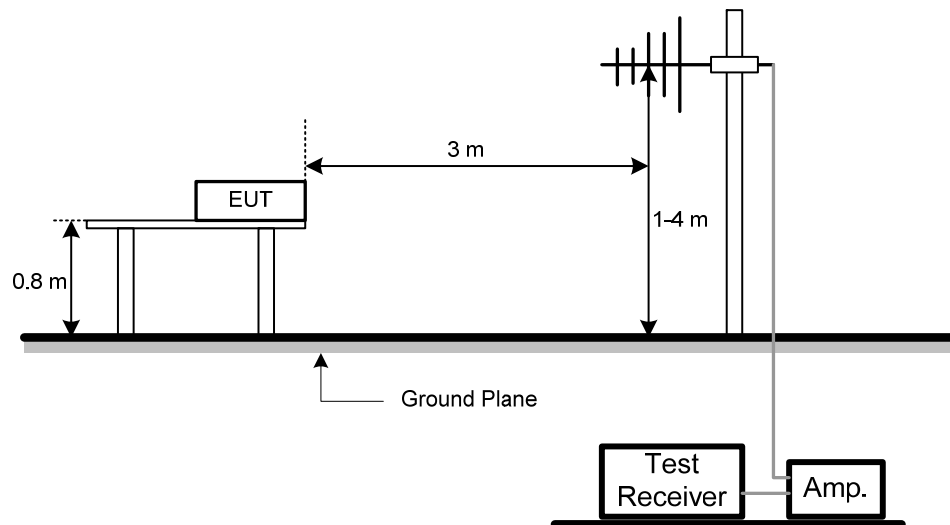
No deviation

## 5.5 TEST SETUP

### Below 30 MHz



### 30 MHz to 1 GHz





## **5.6 EUT OPERATING CONDITIONS**

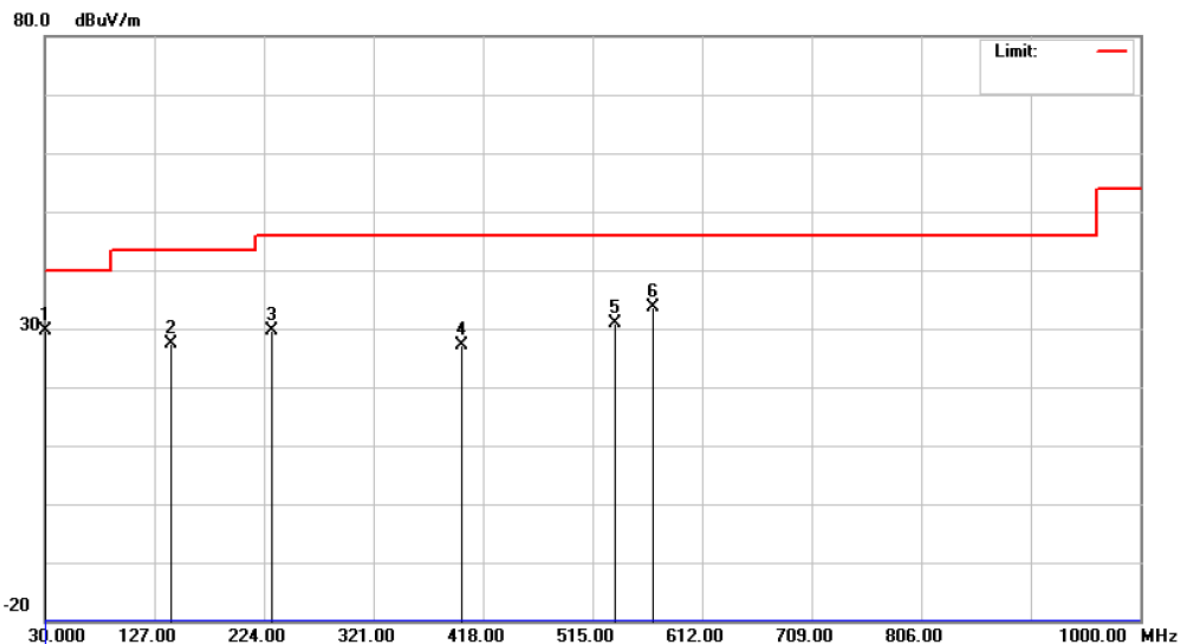
The EUT tested system was configured as the statements of **4.1.6** Unless otherwise a special operating condition is specified in the follows during the testing.



## 5.7 TEST RESULTS- FCC PART 15.209

EUT	Rugged Mobile Computer	Model Name	PA520
Temperature	25 °C	Relative Humidity	62%
Test Voltage	AC 120V/60Hz		
Test Mode	Transmitting		

### Polarization: Vertical

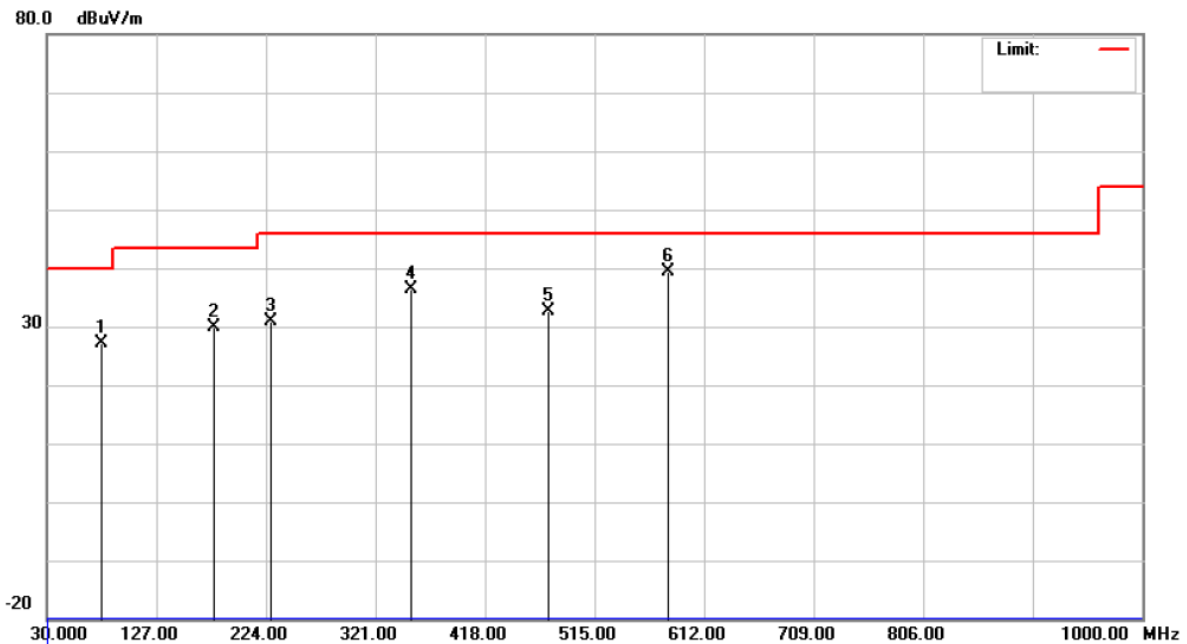


No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1	*	30.0000	44.50	-14.86	29.64	40.00	-10.36	peak	
2		141.5500	41.83	-14.56	27.27	43.50	-16.23	peak	
3		231.2749	45.82	-16.19	29.63	46.00	-16.37	peak	
4		398.6000	38.26	-11.24	27.02	46.00	-18.98	peak	
5		534.4000	39.52	-8.62	30.90	46.00	-15.10	peak	
6		568.3499	41.33	-7.68	33.65	46.00	-12.35	peak	



EUT	Rugged Mobile Computer	Model Name	PA520
Temperature	25 °C	Relative Humidity	62%
Test Voltage	AC 120V/60Hz		
Test Mode	Transmitting		

**Polarization: Horizontal**

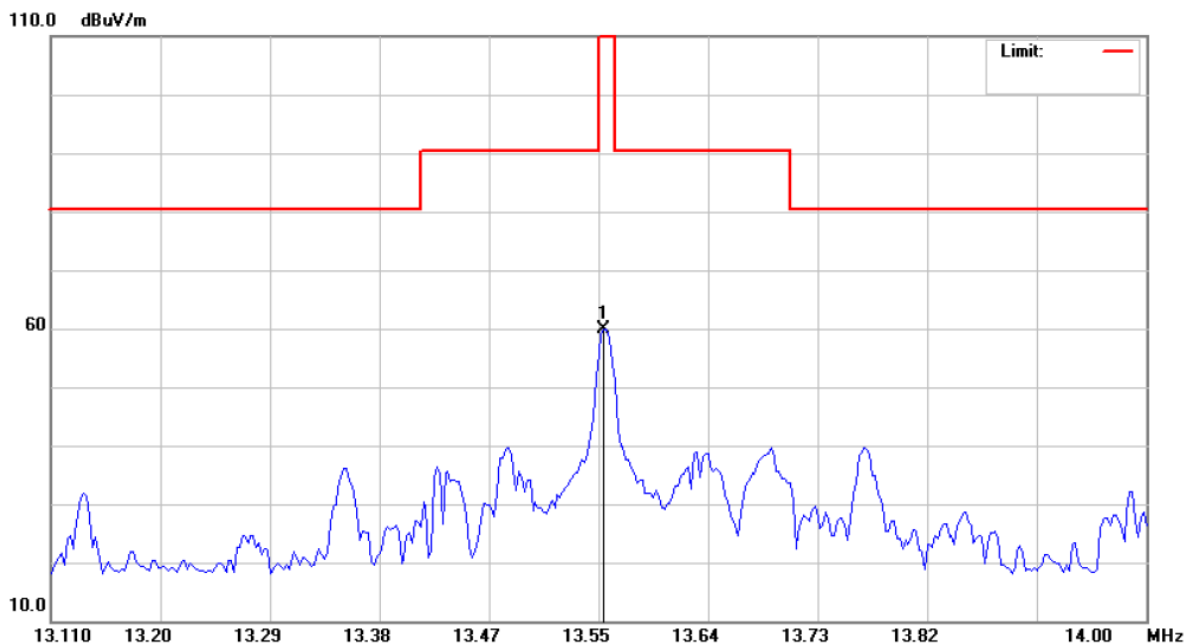


No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		78.5000	45.53	-18.33	27.20	40.00	-12.80	peak	
2		177.9250	45.48	-15.62	29.86	43.50	-13.64	peak	
3		228.8500	47.28	-16.36	30.92	46.00	-15.08	peak	
4		352.5249	48.86	-12.46	36.40	46.00	-9.60	peak	
5		473.7749	42.20	-9.63	32.57	46.00	-13.43	peak	
6	*	580.4749	46.60	-7.33	39.27	46.00	-6.73	peak	



## 5.8 TEST RESULTS- FCC PART 15.225

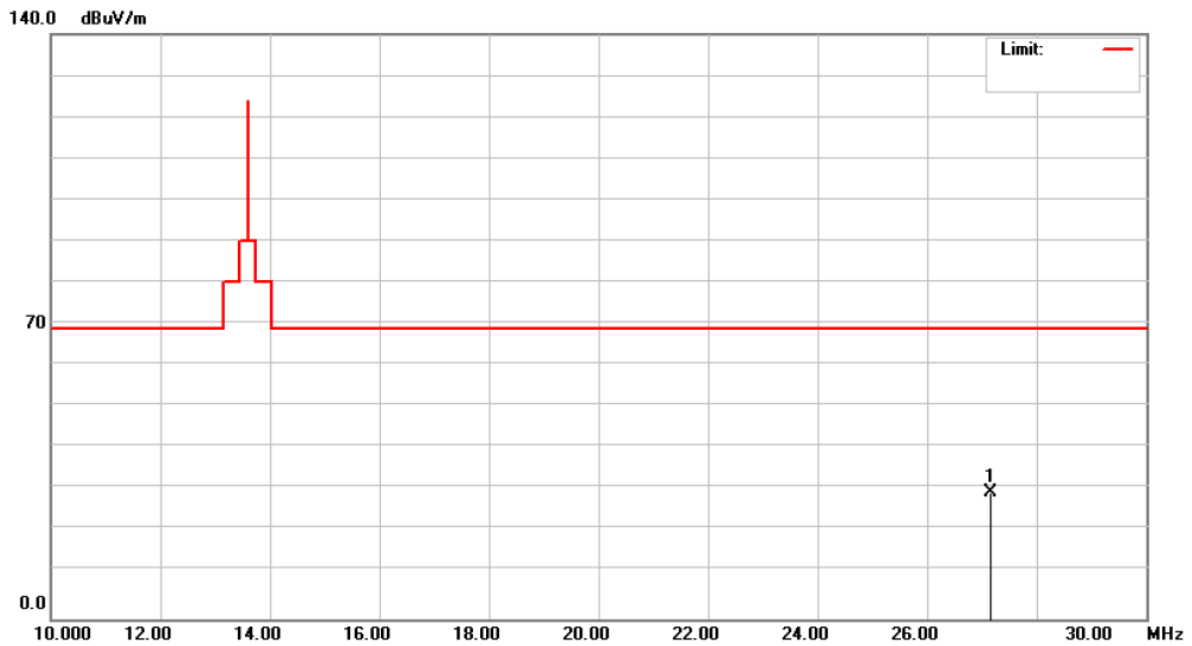
EUT	Rugged Mobile Computer	Model Name	PA520
Temperature	25 °C	Relative Humidity	62%
Test Voltage	AC 120V/60Hz		
Test Mode	Transmitting		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	*	13.5594	48.72	11.18	59.90	124.00	-64.10	peak	



EUT	Rugged Mobile Computer	Model Name	PA520
Temperature	25 °C	Relative Humidity	62%
Test Voltage	AC 120V/60Hz		
Test Mode	Transmitting		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1	*	27.1213	20.23	9.92	30.15	69.54	-39.39	peak	



## 6 FREQUENCY STABILITY

### 6.1 LIMITS

#### FCC Part 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.

### 6.2 MEASUREMENT INSTRUMENTS LIST

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP-30	100854	Sep. 08, 2014

Remark: "N/A" denotes No Model Name, No Serial No. or No Calibration specified.

### 6.3 TEST PROCEDURE

- The equipment under test was connected to an external AC power supply and the RF output was connected to a frequency counter via feed through attenuators. The EUT was placed inside the temperature chamber.  
After the temperature stabilized for approximately 20 minutes, the frequency of the output signal was recorded from the counter.
- At room temperature ( $25\pm5^{\circ}\text{C}$ ), an external variable AC power supply was connected to the EUT. The frequency of the transmitter was measured for 115%, 100% and 85% of the nominal operating input voltage.

### 6.4 DEVIATION FROM TEST STANDARD

No deviation

### 6.5 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of **4.1.6** Unless otherwise a special operating condition is specified in the follows during the testing.



## 6.6 TEST RESULTS

EUT	Rugged Mobile Computer	Model Name	PA520
Temperature	25 °C	Relative Humidity	62%
Test Voltage	AC 120V/60Hz		
Test Mode	Transmitting		

### Frequency Stability Versus Environmental Temperature

	Temperature (°C)	Voltage (AC)	Frequency (MHz)	Frequency Error (kHz)	Limit (kHz)	Result
	20	120V	13.56020			
0 min	50	120V	13.56020	0.000	+/- 1.356	PASS
	-20	120V	13.55980	-0.400	+/- 1.356	PASS
2 min	50	120V	13.56020	0.000	+/- 1.356	PASS
	-20	120V	13.55980	-0.400	+/- 1.356	PASS
5 min	50	120V	13.56020	0.000	+/- 1.356	PASS
	-20	120V	13.55980	-0.400	+/- 1.356	PASS
10 min	50	120V	13.56040	0.200	+/- 1.356	PASS
	-20	120V	13.55960	-0.600	+/- 1.356	PASS

### Frequency Stability Versus Input Voltage

Temperature (°C)	Voltage (AC)		Frequency (MHz)	Frequency Error (kHz)	Limit (kHz)	Result
20	V-nom	120	13.56020			
20	V-min	102	13.56000	-0.2	+/- 1.356	PASS
20	V-max	138	13.56040	0.2	+/- 1.356	PASS



**7 EUT TEST PHOTO**

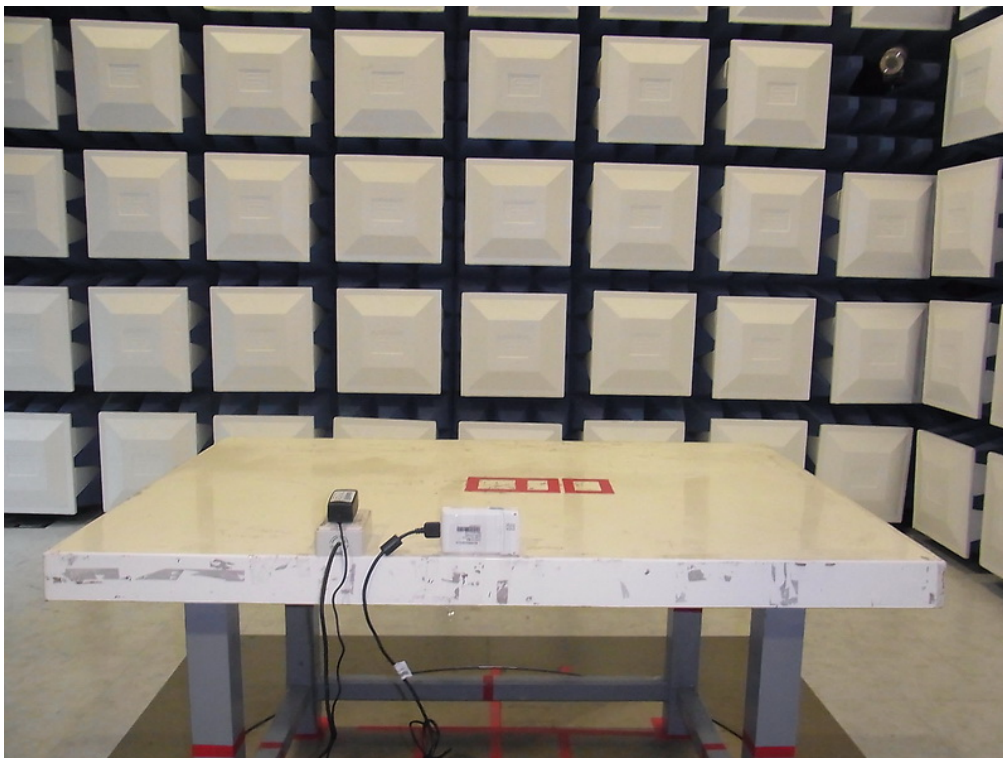
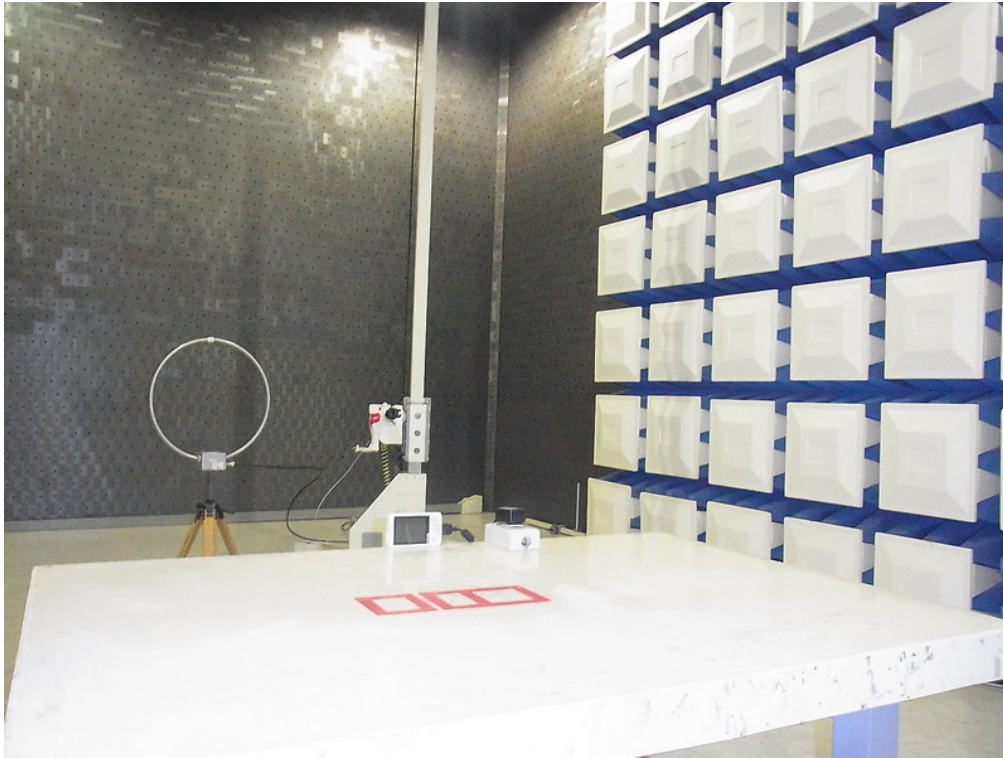
**Conducted emission test photos**

**Transmitting**



**Radiated emission below 30 MHz test photos**

**Transmitting**



**Radiated emission 30 MHz to 1 GHz test photos**

**Transmitting**

