



**Neutron Engineering Inc.**

# RFID 13.56 MHz Radio Test Report

**FCC ID: HLEMT800BTNF**

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

**Issued Date** : Jul. 18, 2013

**Project No.** : 1306087

**Equipment** : Master Controller

**Model Name** : MT800

**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:** Jun. 19, 2013

**Date of Test:** Jun. 19, 2013 ~ Jul. 12, 2013

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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.	Jul. 18, 2013



## **1 CERTIFICATION**

Equipment : Master Controller

Brand Name : unitech; TASHI

Model Name : MT800

Applicant : unitech electronics co., ltd.

Date of Test : Jun. 19, 2013 ~ Jul. 12, 2013

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-3-1306087) 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. Portable device; SAR report is required.
3. The EUT include WiFi & Bluetooth function and RFID function, this report covers EUT RFID function only. Its WiFi & Bluetooth function testing is covered in another test report: NEI-FCCP-1-1306087(WLAN), NEI-FCCP-2-1306087(Bluetooth).



## 2.1 TEST FACILITY

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

### Conducted emission Test:

**C01:** (VCCI RN: C-2918; FCC RN: 95335; FCC DN: TW1010)

No.132-1, Ln. 329, Sec. 2, Balian Rd., Xizhi Dist., New Taipei City 221, Taiwan  
(R.O.C.)

### Radiated emission Test (Below 1 GHz):

**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.)

### Radiated emission Test (Above 1 GHz):

**CB08:** (VCCI RN: G-91; 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 expended 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
C01	150 kHz ~ 30 MHz	1.94	

### 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	Master Controller				
Brand Name	unitech; TASHI				
Model Name	MT800				
OEM Brand/Model Name	N/A				
Model Difference	N/A				
Product Description	<p>The EUT is a Master Controller.</p> <table border="1"><tr><td>Operation Frequency:</td><td>13.56 MHz</td></tr><tr><td>Antenna Designation:</td><td>PIFA Antenna</td></tr></table> <p>The EUT has three appearances. All are identical in electrically schematic the only difference is the appearance. More details of EUT technical specification, please refer to the User's Manual.</p>	Operation Frequency:	13.56 MHz	Antenna Designation:	PIFA Antenna
Operation Frequency:	13.56 MHz				
Antenna Designation:	PIFA Antenna				
Power Source	Voltage supplied from External Power Supply.				
Power Rating	1. EUT: I/P: DC 12V 2A 2. External Power Supply: I/P: AC 100-240V 1.0A MAX 50-60Hz / O/P: DC +12V 2.0A 24W MAX.				
Connecting I/O Port(s)	Please refer to the User's Manual				
Products Covered	1 * Wi-Fi & Bluetooth Module: SDC-SSD40NBT 1 * RFID Module 1 * Panel: LG Display, LD070WS2(SL)(01) 1 * Li-ion battery: 204562G 3.7V 900mA 3.33Wh 1 * SWITCHING ADAPTER with an additional ferrite core: Sunny, SYS1319-2412-T3				
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 generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible 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	Transmit

Conducted emission test	
Final Test Mode	Description
Mode 1	Transmit

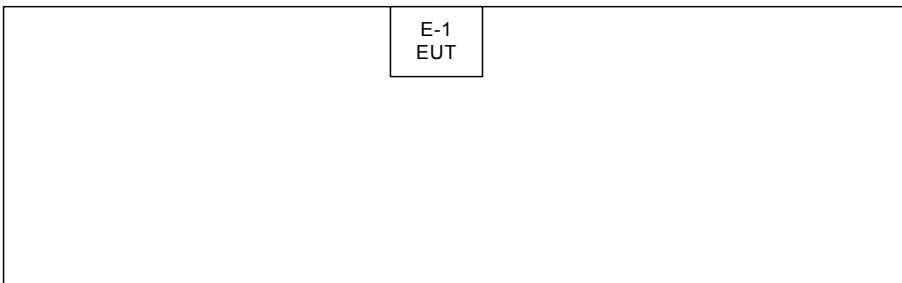
Radiated emission test	
Final Test Mode	Description
Mode 1	Transmit

Frequency Stability test	
Final Test Mode	Description
Mode 1	Transmit

Antenna Requirement test	
Final Test Mode	Description
Mode 1	Transmit



**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	Master Controller	unitech; TASHI	MT800	HLEMT800BTNF	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	TWO-LINE V-NETWORK	R&S	ENV216	101050	Apr. 22, 2014
2	Test Cable	TIMES	CFD300-NL	C01	Jun. 16, 2014
3	EMI Test Receiver	R&S	ESCI	100082	Mar. 21, 2014
4	Measurement Software	EZ	EZ_EMCA (Version NB-02A)	N/A	N/A

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

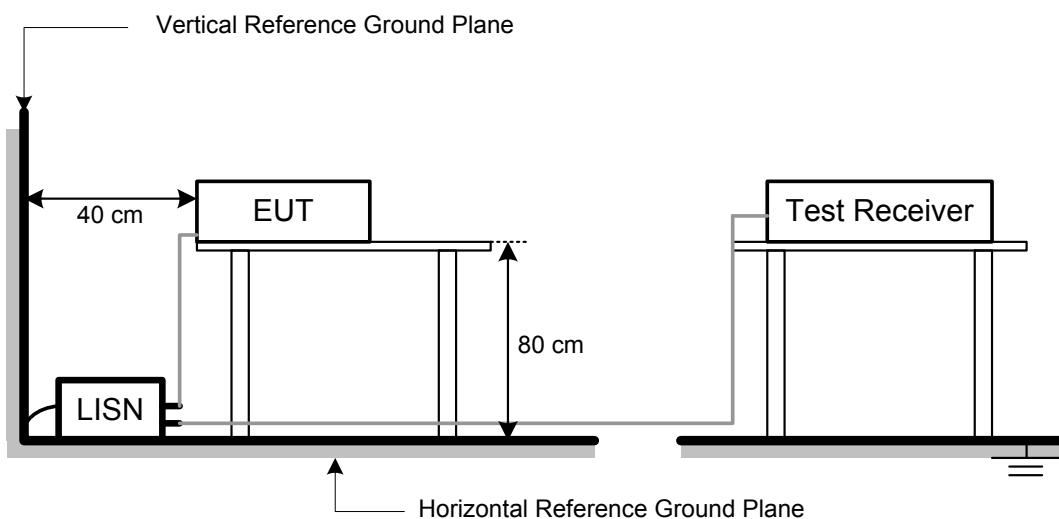
#### 4.3 TEST PROCEDURES

- 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.

**NOTE:**

- a. 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).
- b. 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**

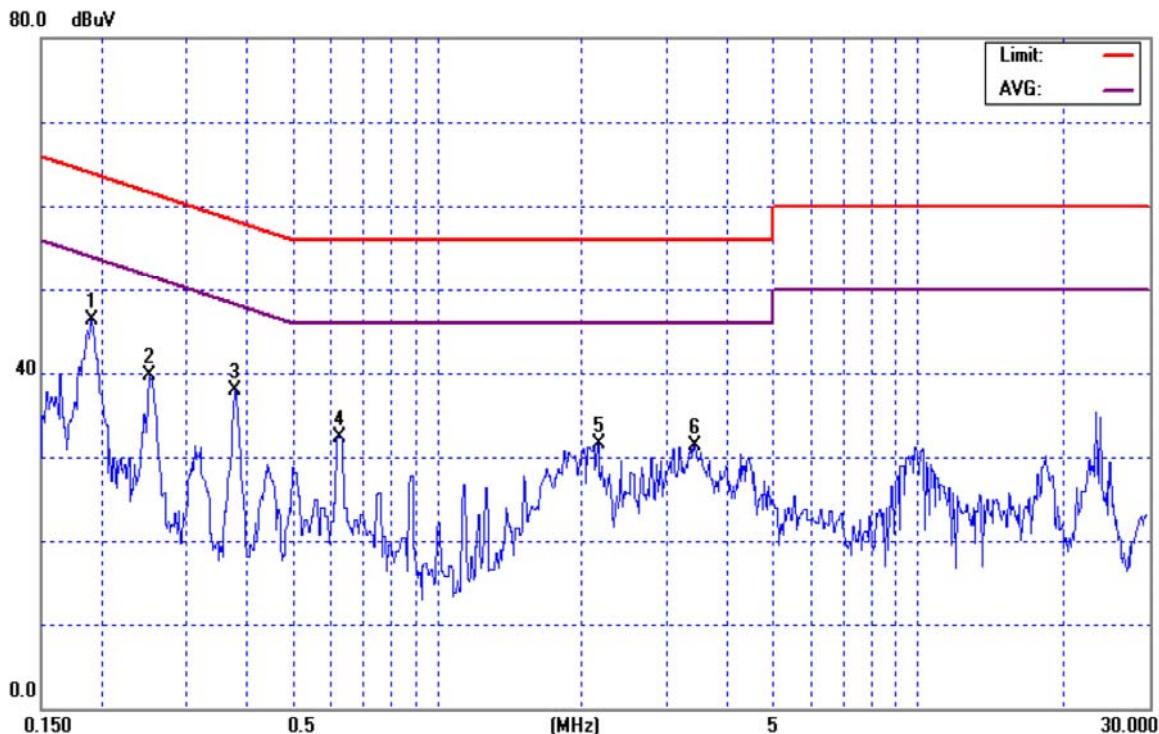
The EUT used during radiated and/or conducted emission measurement was designed to exercise in a manner similar to a typical use.



#### 4.7 TEST RESULTS

E.U.T	Master Controller	Model Name	MT800
Temperature	24°C	Relative Humidity	48%
Test Voltage	AC 120V/60Hz		
Test Mode	Transmit		

##### Phase: Line

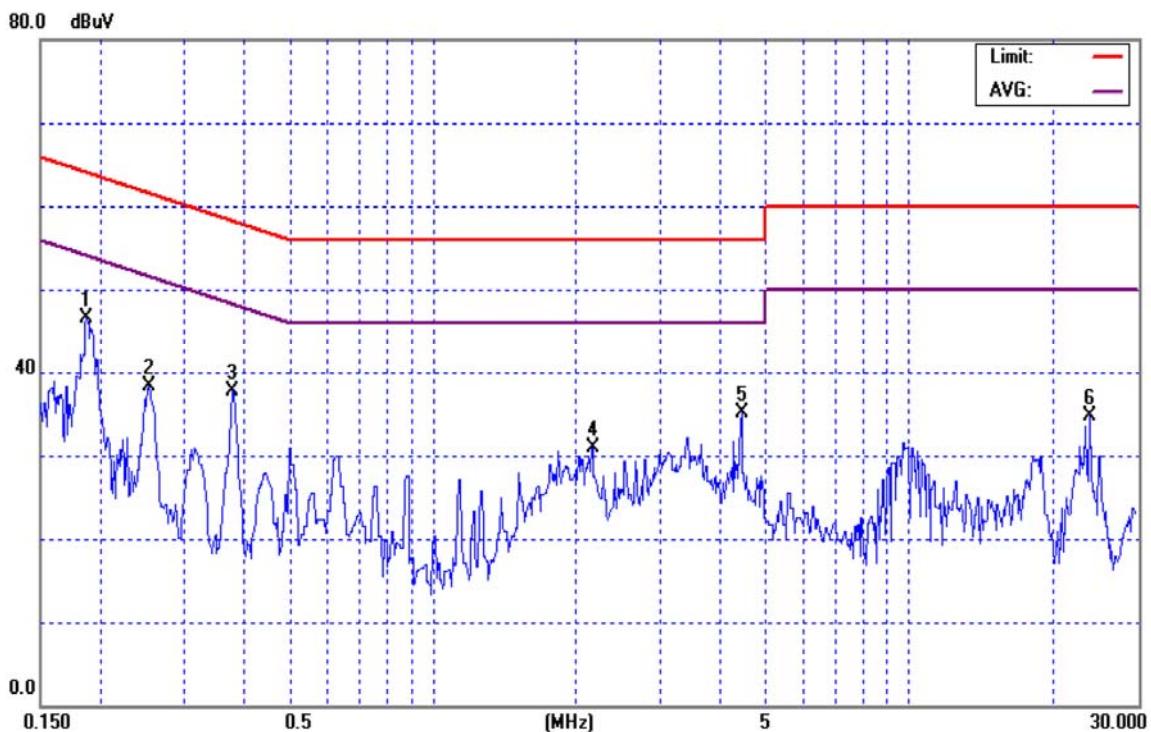


No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Detector	Comment
			Level	Factor	ment				
1	*	0.1906	36.79	9.59	46.38	64.01	-17.63	peak	
2		0.2515	30.05	9.60	39.65	61.71	-22.06	peak	
3		0.3789	28.29	9.66	37.95	58.30	-20.35	peak	
4		0.6260	22.70	9.66	32.36	56.00	-23.64	peak	
5		2.1560	21.94	9.65	31.59	56.00	-24.41	peak	
6		3.4250	21.55	9.69	31.24	56.00	-24.76	peak	



E.U.T	Master Controller	Model Name	MT800
Temperature	24°C	Relative Humidity	48%
Test Voltage	AC 120V/60Hz		
Test Mode	Transmit		

Phase: Neutral



No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Detector	Comment
			Level	Factor	ment				
1	*	0.1871	36.85	9.57	46.42	64.16	-17.74	peak	
2		0.2529	28.63	9.58	38.21	61.66	-23.45	peak	
3		0.3789	28.13	9.64	37.77	58.30	-20.53	peak	
4		2.1560	21.28	9.63	30.91	56.00	-25.09	peak	
5		4.4420	25.41	9.72	35.13	56.00	-20.87	peak	
6		24.0000	24.78	9.98	34.76	60.00	-25.24	peak	



## 5 RADIATED EMISSION

### 5.1 LIMITS

<b>FCC Part 15.209</b>				
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

<b>FCC Part 15.225(a)/(b)/(c)</b>				
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	106	30 m	106*100	80.5
13.710 – 14.010				

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-40	100129	Oct. 01, 2013
2	Test Cable	LMR	LMR-400	12m	May. 14, 2014
3	Test Cable	LMR	LMR-400	3m	May. 14, 2014
4	Pre-Amplifier	Anritsu	MH648A	M92649	Jun. 18, 2014
5	Log-Bicon Antenna	Schwarzbeck	VULB9168-352	9168-352	Jun. 11, 2014
6	Preamplifier With Adaptor	EMC	EMC2654045	980030	Feb. 18, 2014
7	Horn Antenna	Schwarzbeck	BBHA 9170	187	Dec. 24, 2013
8	Loop Ant.	EMCO	6502	00042960	Jul. 25, 2013

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

## 5.3 TEST PROCEDURE

- a. The measuring distance of at 3 m shall be used for measurements at frequency up to 1GHz. 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 3m or 10 meter open area test site. 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 0.8 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.
- d. 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.
- 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.

**NOTE: (FCC PART 15.209)**

- a. Reading in which marked as QP or Peak means measurements by using are Quasi-Peak Mode with Detector BW=120 kHz.
- b. 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)**

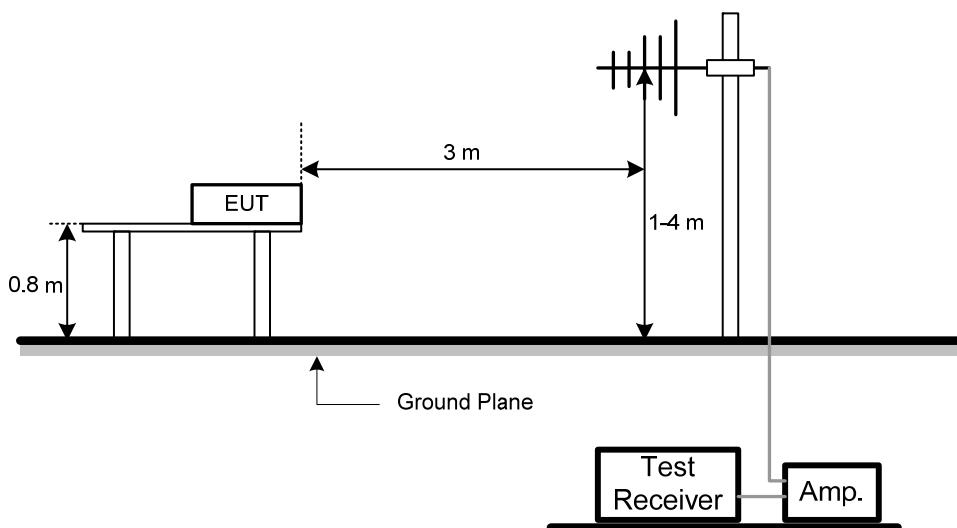
- a. Spectrum Setting:  
9 KHz – 150 KHz, RBW= 200Hz, VBW=200Hz, Sweep time = 200 ms.  
150 K Hz – 30 MHz, RBW= 10 KHz, VBW=10 KHz, Sweep time = 200 ms.  
30 MHz – 1000 MHz, RBW= 100KHz, VBW=100KHz, Sweep time = 200 ms.
- b. All readings are Peak unless otherwise stated QP in column of Note. Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform.
- c. 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

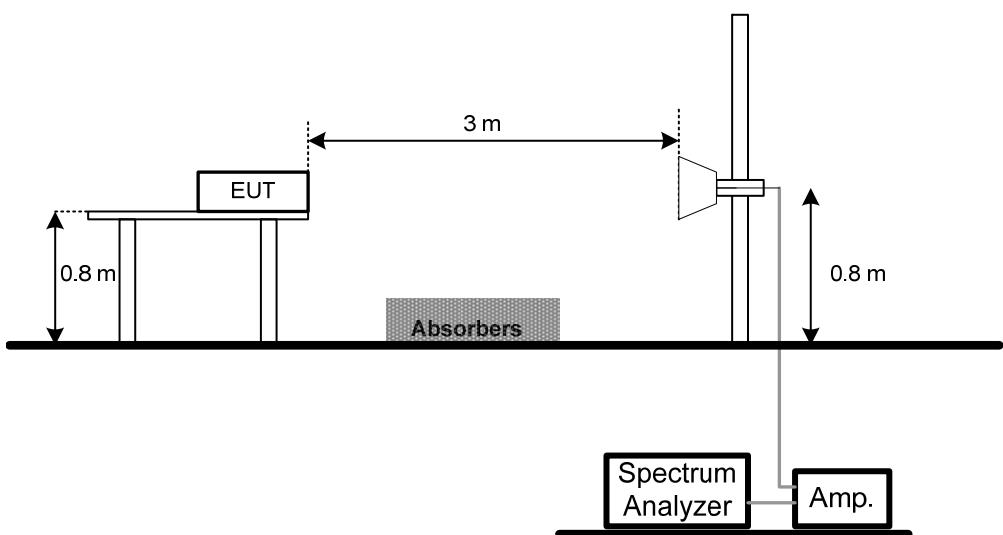
No deviation

## 5.5 TEST SETUP

**Below 1 GHz**



**Above 1 GHz**





## **5.6 EUT OPERATING CONDITIONS**

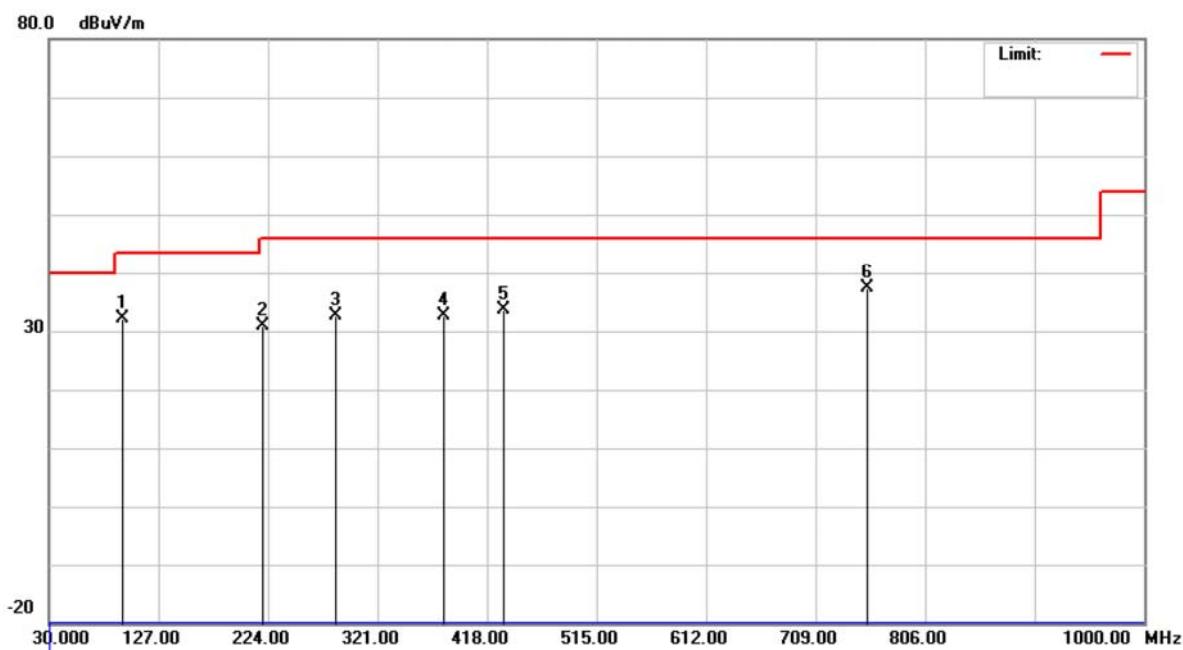
The EUT tested system was configured as the statements of **4.1.6** Unless otherwise a special operating condition is specified in the follows during the testing.



## 5.7 TEST RESULTS- FCC PART 15.209

E.U.T	Master Controller	Model Name	MT800
Temperature	26 °C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz		
Test Mode	Transmit		

### Polarization: Vertical

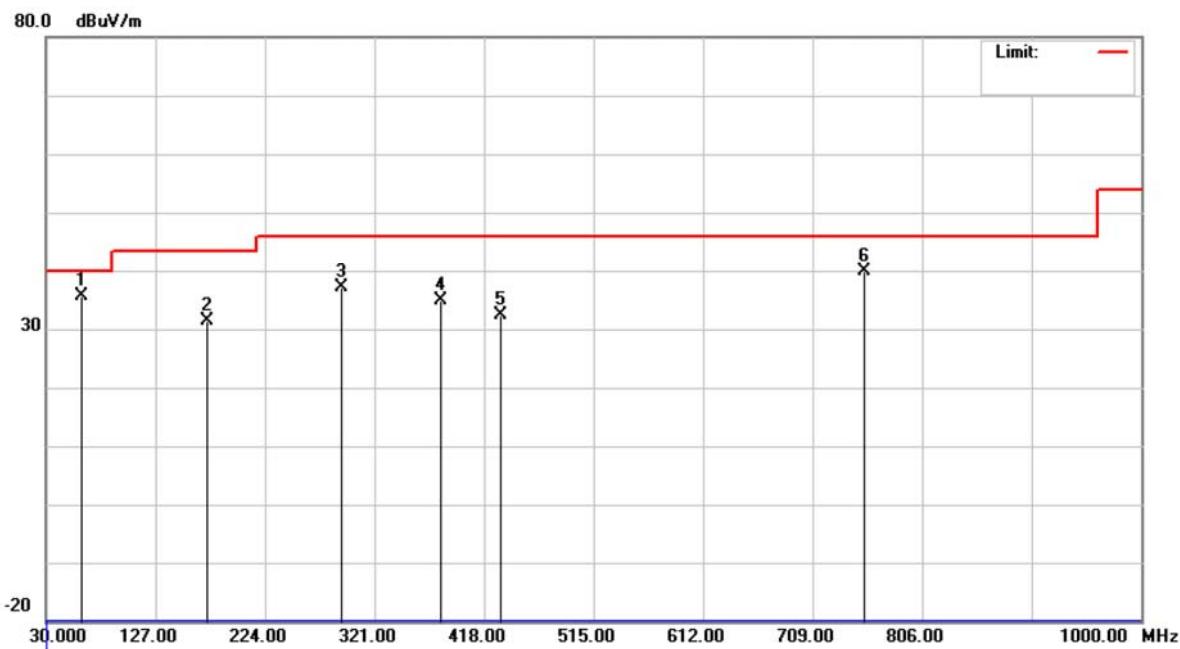


No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Detector	Comment
			Level	Factor	ment				
1		95.4749	52.36	-20.30	32.06	43.50	-11.44	peak	
2		219.1499	48.47	-17.53	30.94	46.00	-15.06	peak	
3		284.6250	47.49	-14.78	32.71	46.00	-13.29	peak	
4		379.2000	44.79	-12.28	32.51	46.00	-13.49	peak	
5		432.5499	44.62	-10.89	33.73	46.00	-12.27	peak	
6	*	755.0750	43.22	-5.75	37.47	46.00	-8.53	peak	



E.U.T	Master Controller	Model Name	MT800
Temperature	26 °C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz		
Test Mode	Transmit		

**Polarization: Horizontal**

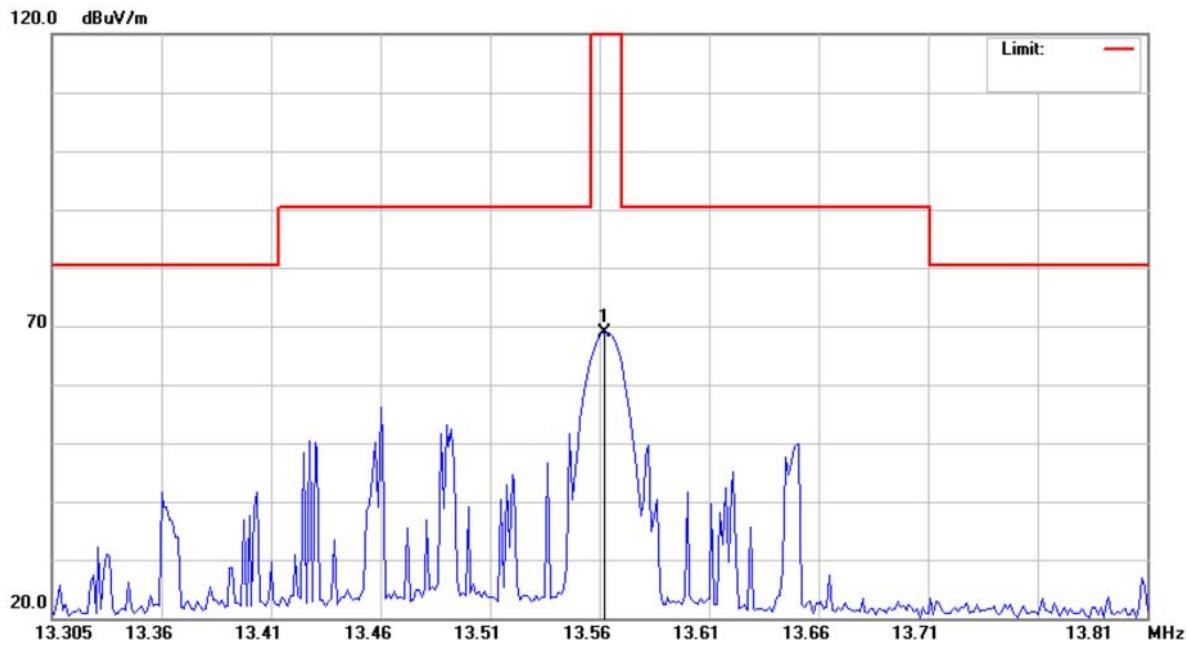


No. Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over		
						Detector	Comment	
1 *	61.5250	51.50	-15.76	35.74	40.00	-4.26	peak	
2	173.0749	46.61	-15.20	31.41	43.50	-12.09	peak	
3	291.8999	51.71	-14.60	37.11	46.00	-8.89	peak	
4	379.2000	47.15	-12.28	34.87	46.00	-11.13	peak	
5	432.5499	43.39	-10.89	32.50	46.00	-13.50	peak	
6	755.0750	45.67	-5.75	39.92	46.00	-6.08	peak	



### 5.8 TEST RESULTS- FCC PART 15.225

E.U.T	Master Controller	Model Name	MT800
Temperature	26 °C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz		
Test Mode	Transmit		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure- ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	*	13.5600	57.76	11.18	68.94	124.0	-55.06	peak	



E.U.T	Master Controller	Model Name	MT800
Temperature	26 °C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz		
Test Mode	Transmit		



No. Mk.	Freq. MHz	Reading Level dB <sub>uV</sub>	Correct Factor	Measure- ment dB <sub>uV/m</sub>	Limit dB <sub>uV/m</sub>	Over	
						Detector	Comment
1 *	27.1210	42.87	9.92	52.79	69.54	-16.75	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-40	100129	Oct. 01, 2013

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

### 6.3 TEST PROCEDURE

- a. 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.
- b. At room temperature (25±5°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**

E.U.T	Master Controller	Model Name	MT800
Temperature	26 °C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz		
Test Mode	Transmit		

**Frequency Stability Versus Environmental Temperature**

	Temperature (°C)	Voltage (AC)	Frequency (MHz)	Frequency Error (kHz)	Limit (kHz)	Result
	20	120V	13.56084			
0 min	50	120V	13.56084	0.000	+/- 1.356	PASS
	-20	120V	13.56920	8.360	+/- 1.356	PASS
2 min	50	120V	13.56084	0.000	+/- 1.356	PASS
	-20	120V	13.56088	0.040	+/- 1.356	PASS
5 min	50	120V	13.56084	0.000	+/- 1.356	PASS
	-20	120V	13.56088	0.040	+/- 1.356	PASS
10 min	50	120V	13.56088	0.040	+/- 1.356	PASS
	-20	120V	13.56092	0.080	+/- 1.356	PASS

**Frequency Stability Versus Input Voltage**

Temperature (°C)	Voltage (AC)		Frequency (MHz)	Frequency Error (kHz)	Limit (kHz)	Result
20	V-nom	120	13.56084			
20	V-min	102	13.56088	0.04	+/- 1.356	PASS
20	V-max	138	13.56088	0.04	+/- 1.356	PASS