

# TEST REPORT

OF

## FCC Part 15 Subpart C §15.231

FCC ID: PINHM-T008

Equipment Under Test : Remote Keyless Entry System  
Model Name : HM-T008  
Serial No. : N/A  
Applicant : Hyundai Autonet Co., Ltd.  
Manufacturer : Hyundai Autonet Co., Ltd.  
Date of Test(s) : 2006-10-22 ~ 2006-10-31  
Date of Issue : 2006-11-01

In the configuration tested, the EUT complied with the standards specified above.



The above test certificate is the accredited test results by Korea Laboratory Accreditation Scheme, which signed the ILAC-MRA.

Tested By:



Date

2006-11-02

Feel Jeong

Approved By



Date

2006-11-02

Albert Lim

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## 1. General Information

### 1.1. Testing Laboratory

SGS Testing Korea Co., Ltd.  
Wireless Div. 2FL, 18-34, Sanbon-dong, Gunpo-Si, Gyeonggi-do, Korea 435-040  
[www.electrolab.kr.sgs.com](http://www.electrolab.kr.sgs.com)  
Telephone : +82 +31 428 5700  
FAX : +82 +31 427 2371

### 1.2. Details of Applicant

Applicant : Hyundai Autonet Co., Ltd.  
Address : San 136-1, Ami-ri, Bubal-eub, Ichon-si, Kyoungki-do, 467-701 Korea  
Contact Person : Ki Hyeog Nam  
Phone No. : 82-31-639-1539  
Fax No. : 82-31-639-4138

### 1.3. Description of EUT

#### Remote Keyless Entry :

Kind of Product	Remote Keyless Entry System
Model Name	HM-T008
Serial Number	N/A
Power Supply	DC 3 V(Lithium)
Frequency Range	315 MHz
Modulation Technique	ASK
Frequency Generation	X-Tal
Number of Channels	1 CH
Operating Conditions	-20 °C ~ + 60 °C
Antenna Type	Integrated PCB Patten

### 1.4. Details of modification

-N/A

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### 1.5. Test Equipment List

EQUIPMENT	MANUFACTURER	MODEL	CAL DUE.
Spectrum Analyzer	Agilent	E4440A	May 2007
Spectrum Analyzer	HP	8565E	May 2007
Test Receiver	Rohde & Schwarz	ESU26	Aug. 2007
Ultra-Broadband Antenna	Rohde & Schwarz	HL562	Oct. 2007
Horn Antenna	Schwarzbeck	BBHA9120A	Jul. 2007
Anechoic Chamber	SY Corporation	L x W x H 9.6 x 6.4 x 6.4	Aug. 2007

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## 1.6. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD:FCC Part15, Subpart C		
Standard Section	Test Item	Result
15.231(b)	Field Strength of the Carrier, Spurious Emission	Complied
15.231(c)	Bandwidth of Operation frequency	Complied
15.231(a)	Transmission Time	Complied

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## 2. Field Strength of the Carrier

### 2.1. Test Setup

The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 40 GHz Emissions.

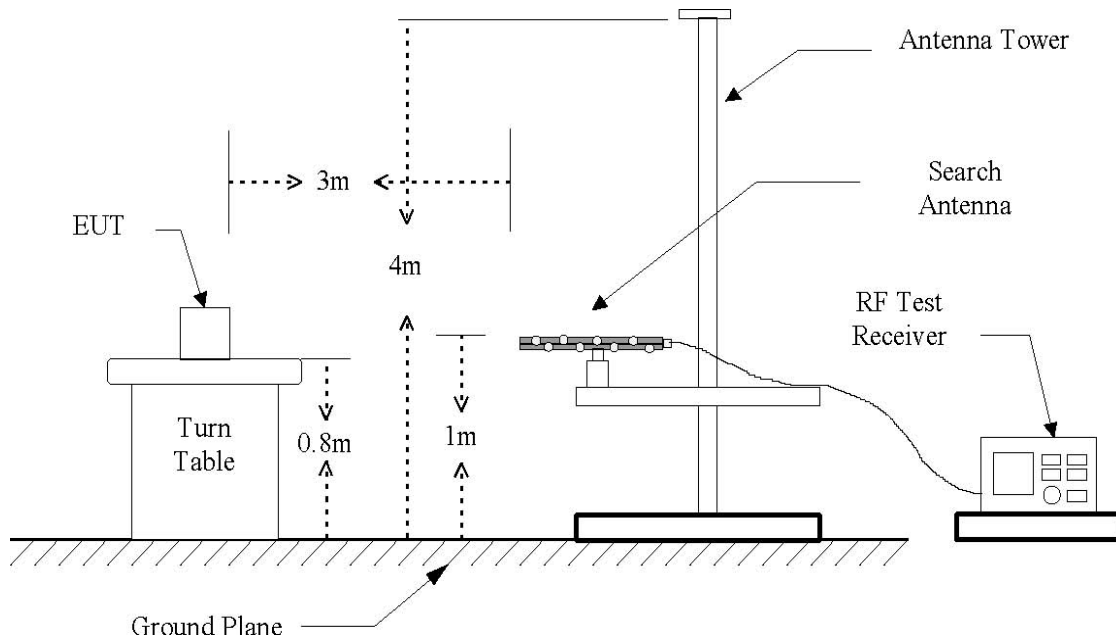


Figure 1 : Frequencies measured below 1 GHz configuration

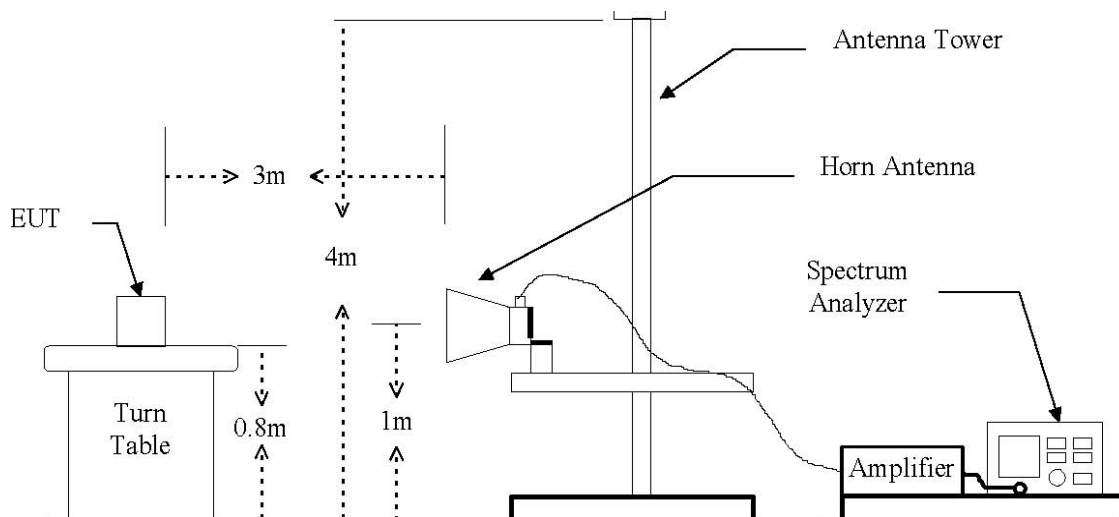


Figure 2 : Frequencies measured above 1 GHz configuration

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## 2.2. Limit

In addition to the provisions of Section 15.205, the field strength of emissions from intentional radiators operated under this Section shall not exceed the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental (microvolts/meter)	Field Strength of Spurious Emissions (microvolts/meter)
40.66 – 47.70	2,250	225
70 - 130	1,250	125
130 – 174	1,250 to 3,750 **	125 to 375 **
174 – 260	3,750	375
260 – 470	3,750 to 12,500 **	375 to 1,250 **
Above 470	12,500	1,250

\*\* linear interpolations

Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows : for the band 130-174 MHz,  $\mu\text{V/m at 3 meters} = 56.81818(F) - 6136.3636$ ; for the band 260-470 MHz,  $\mu\text{V/m at 3 meters} = 41.6667(F) - 7083.333$ . The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.

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### 2.3. Test Procedures for emission from 30 MHz to 1000 MHz

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2003

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 1 meter away from the interference-receiving antenna.
- c. The antenna is a broadband antenna, and its 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.
- d. 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 and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was 10 dB 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 10 dB 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 :**

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1MHz for Peak detection and frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1 GHz.

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## 2.4. Test Result

Ambient temperature: 22 °C Relative humidity: 46 %

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)
315	64.7	Peak	H	11.39	2.06	78.15	95.62*	17.47
315	57.81	Average	H	11.39	2.06	71.26	75.62	4.36

### Remark:

To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

### Note:

1. A Peak limit is 20 dB above the average limit.
2. “\*” ; Peak Limit
3. Average Reading = Peak Reading -6.89 dB
4. Maximum Modulation Percentage (M%)

### Calculation

Average Reading = Peak Reading (dBuV)+20 log (Duty Cycle)

In order to determine possible maximum modulation percentage, Calculations are made to the EUT.

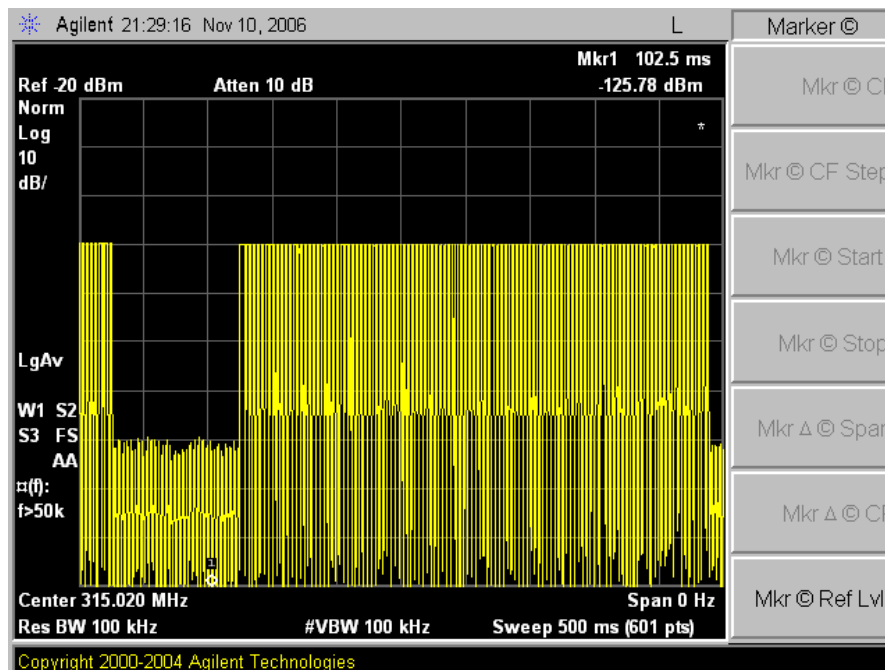
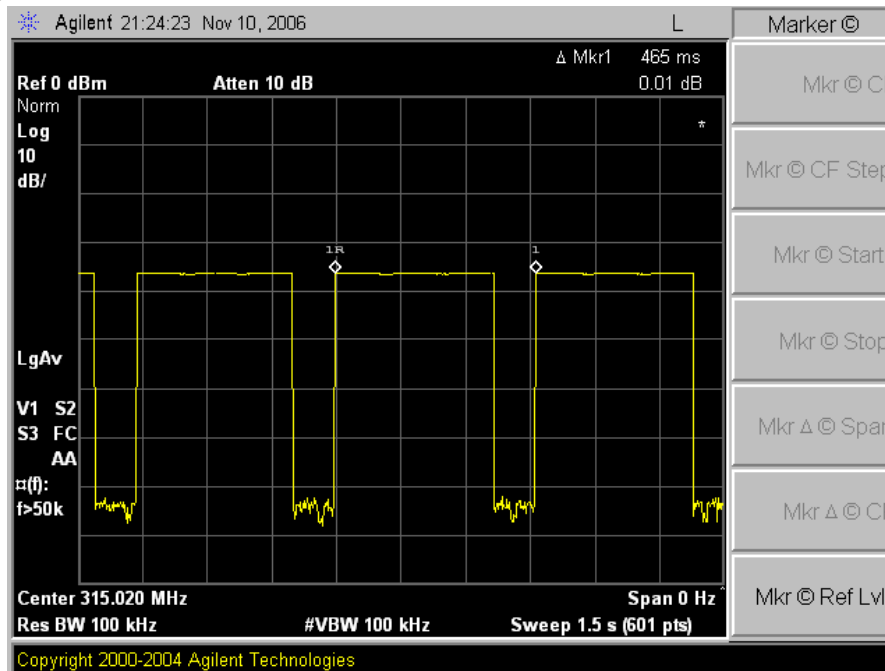
We measured ;

Tp (ms)	Ton (ms)	M % =(Ton/Tp)*100%	C.F.=20log(Ton/Tp)
465*	( 1*4 ) + ( 31*1.33 ) = 45.23	45.23	-6.89

\* **Remark:** Tp>100ms. Use 100 ms for calculation

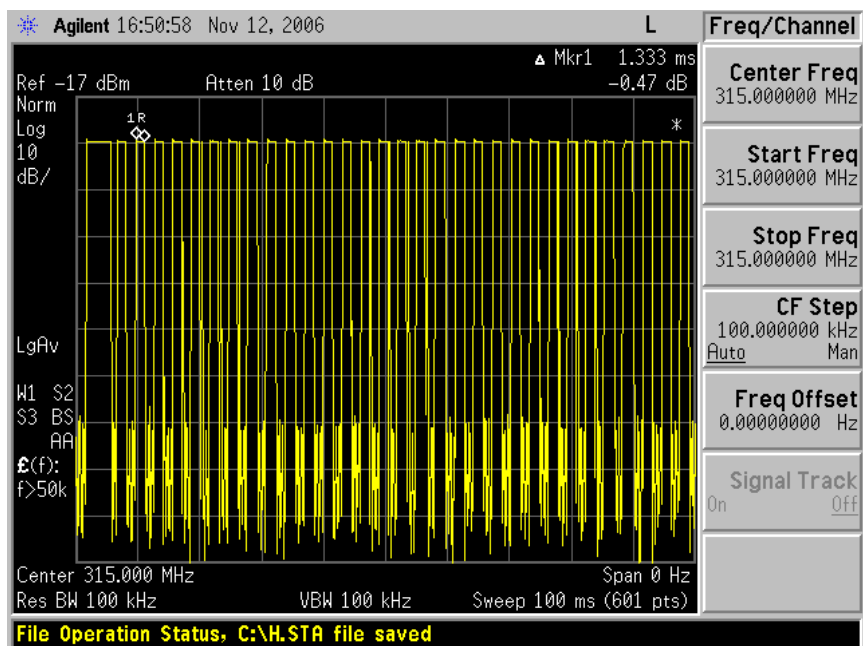
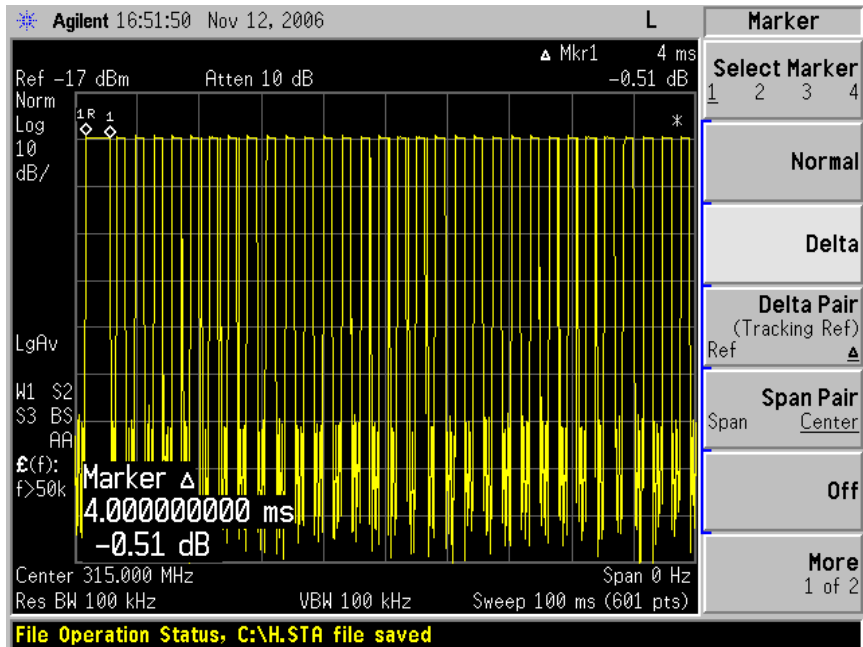
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Tp



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## Ton



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### 3. Spurious Emission

#### 3.1. Test Setup

The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 40 GHz Emissions.

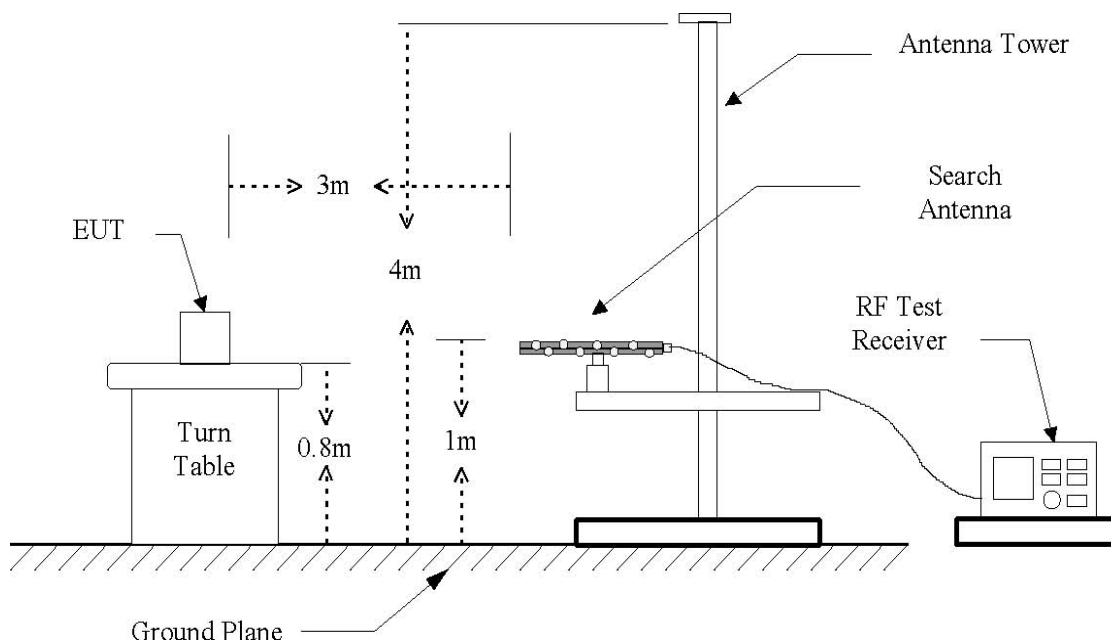


Figure 1 : Frequencies measured below 1 GHz configuration

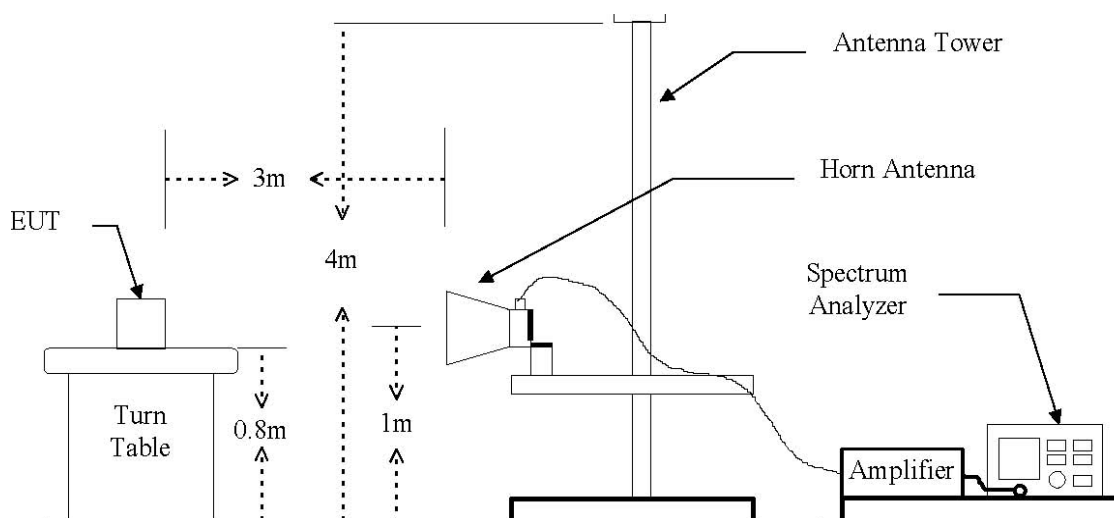


Figure 2 : Frequencies measured above 1 GHz configuration

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### 3.2. Limit

In addition to the provisions of Section 15.205, the field strength of emissions from intentional radiators operated under this Section shall not exceed the following:

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260 – 470	3,750 to 12,500 **	375 to 1,250 **
Above 470	12,500	1,250

\*\* linear interpolations

Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows : for the band 130-174 MHz.,  $\mu\text{V/m}$  at 3 meters =  $56.81818(F)-6136.3636$ ; for the band 260-470 MHz,  $\mu\text{V/m}$  at 3 meters =  $41.6667(F)-7083.333$ . The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.

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### 3. 3. Test Procedures for emission from 30 MHz to 1000 MHz

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- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
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- c. The antenna is a broadband antenna, and its 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.
- d. 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 and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was 10 dB 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 10 dB 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 :**

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3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1 GHz.

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### 3.4. Test Result

Ambient temperature: 22 °C      Relative humidity: 46 %

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	AF/CL (dB/m)/(dB)	Amp Gain (dB)	Actual (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)
590	24.8	Peak	V	16.76 / 2.79	-	44.35	55.62	11.27
910	22.5	Peak	V	20.64 / 3.57	-	46.74	55.62	8.88
Above 1000	Not Detected							

**Remark:**

To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

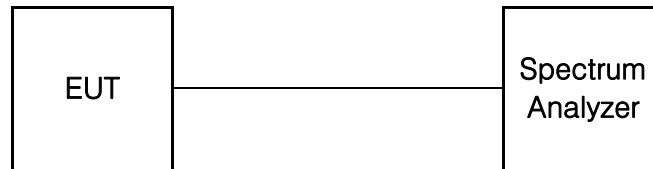
**Note:**

A Peak limit is 20 dB above the average limit.

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## 4. Bandwidth of Operation Frequency

### 4.1. Test Setup



### 4.2. Limit

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

Limit of 20 dB bandwidth:  $315 \text{ MHz} * 0.0025 = 787.5 \text{ kHz}$

### 4.3. Test Procedure

1. The transmitter output is connected to the spectrum analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using BBW=1 kHz, VBW=1 kHz and Span=100 kHz.
3. The bandwidth of fundamental frequency was measured and recorded.

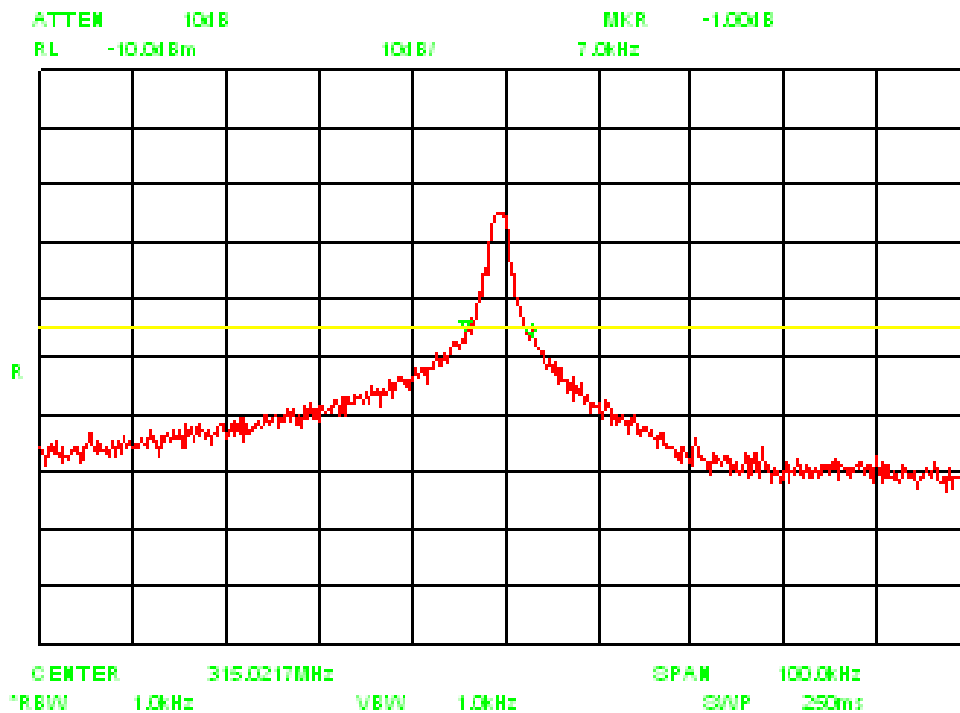
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#### 4.4. Test Result

Ambient temperature: 21 °C      Relative humidity: 47 %

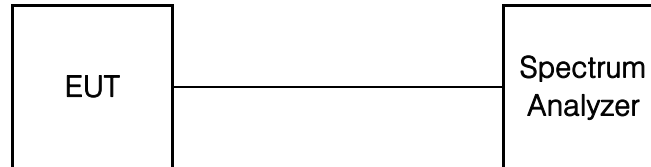
Carrier Frequency	Bandwidth of the emission (kHz)	Limit (kHz)	Remark
315	7	787.5	The point 20 dB down from the modulated carrier



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## 5. Transmission Time

### 5.1. Test Setup



### 5.2. Limit

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

### 5.3. Test Procedure

1. The transmitter output is connected to the spectrum analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using BBW=1 kHz, VBW=1 kHz, Span=0 Hz, Sweep Time=5 sec
3. The bandwidth of fundamental frequency was measured and recorded.

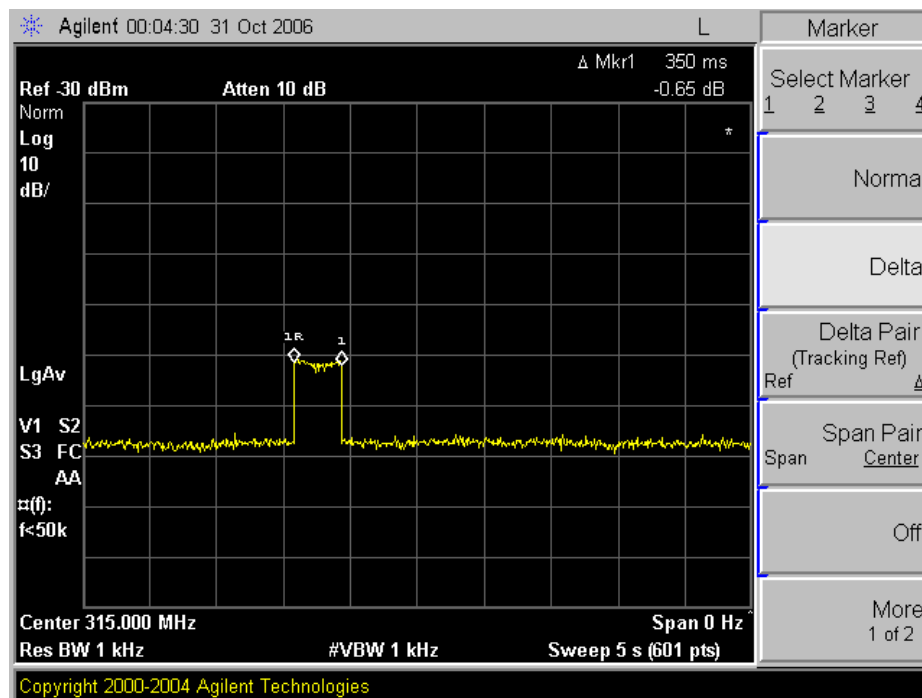
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## 5.4. Test Result

Ambient temperature: 21 °C      Relative humidity: 47 %

Carrier Frequency	Bandwidth of the emission (sec)	Limit (sec)	Remark
315	0.35	5	-



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**Appendix A. Photo of Field Strength & Spurious Emission Test**

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