FCC TEST REPORT

CATEGORY	:	Mobile Module
PRODUCT NAME	:	UHF TRANSCEIVER
FCC ID.	:	L9N-7880
FILING TYPE	:	Certification
BRAND (MODEL) NAME	:	AES (7880)
APPLICANT	:	**AES CORPORATION** 285 NEWBURY STREET PEABODY, MA 01960 USA
MANUFACTURER	:	**AES CORPORATION** 285 NEWBURY STREET PEABODY, MA 01960 USA
ISSUED BY	:	**SPORTON INTERNATIONAL INC.** 6F, No. 106, Sec. 1, Hsin Tai Wu Rd., His Chih, Taipei Hsien, Taiwan, R.O.C.

Statements:

The test result in this report refers exclusively to the presented test model / sample.

Without written approval of SPORTON International Inc., the test report shall not be reproduced except in full.

Certificate or Test Report could not be used by the applicant to claim the product endorsement by CNLA, NVLAP or any agency of U.S. government.

The test equipment used to perform the test are calibrated and traceable to NML/ROC or NIST/USA.

Dr. Alan Lane
Vice General Manager
Sporton International Inc.

Lab Code: 200079-0

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History of this test report

■ No additional attachment.

☐ Additional attachment were issued as following record:

Attachment No.	Issue Date	Description

1. General Description of Equipment under Test

1.1. Applicant

AES CORPORATION
285 NEWBURY STREET PEABODY, MA 01960 USA

1.2. Manufacturer

AES CORPORATION
285 NEWBURY STREET PEABODY, MA 01960 USA

1.3. Basic Description of Equipment under Test

This product is a radio data reader. It is used to wireless read the meter reading. The used modulation technique is FM. For other technique information, please reference section " Features of Equipment under Test ".

1.4. Features of Equipment under Test

ITEMS	DESCRIPTION
Type of Modulation	FM
Number of Channels	1
Frequency Band	450 ~ 470MHz
Carrier Frequencies	465MHz
Channel Bandwidth	25kHz
Output Power	28.45dBm
Antenna Type / Gain	Dipole / 2dBi
Function Type	Transceiver
Data Rate	4.8 kbps (Max)
Type of emission	4K9F1D
Power Rating (DC/AC, Voltage)	5 VDC
Consumption	0.5A
Temperature Range (Operating)	-20 ~ 70℃

2. Test Configuration of the Equipment under Test

2.1. Description of the Test

a. During testing, the equipment was placed on a non-conducting support.
b. The following test modes were performed:
   Mode 1: CH 01 (465MHz)
c. The EUT has been programmed to continuously transmit or receive during testing. The used peripherals as well as the configuration fulfill the requirements of ANSI C63.4:2001.
d. The configuration is operated in a manner which tends to maximize its emission characteristics in a typical application.
e. 3 meters measurement distance of semi-fully chamber was used in this test.

2.2. Frequency Range Investigated

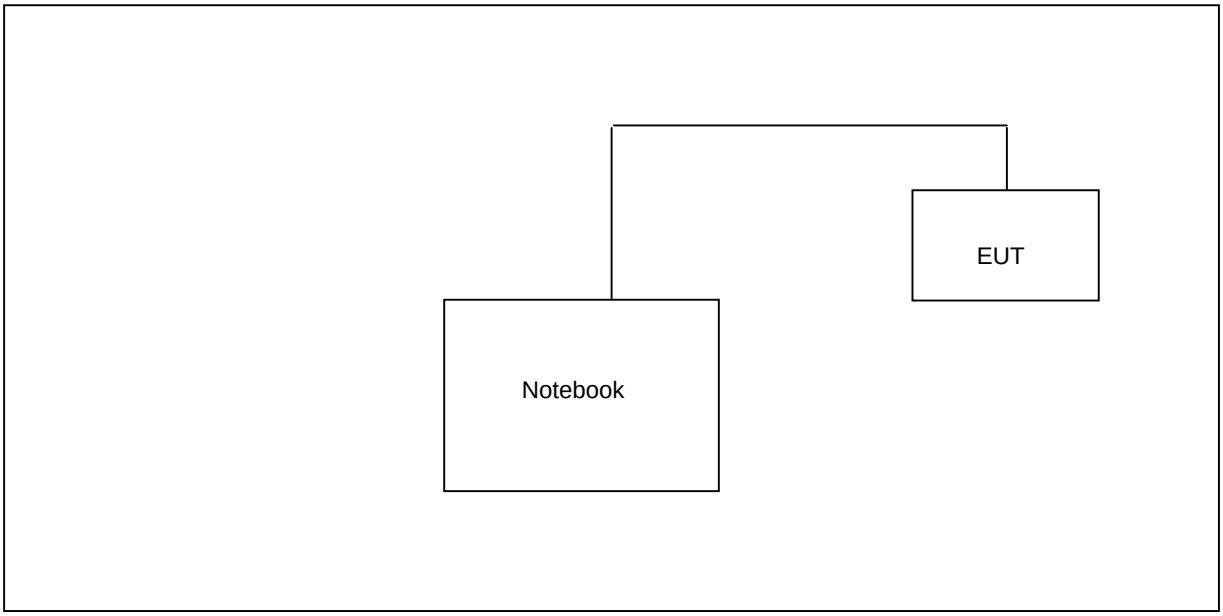
a. Conducted power line test: from 150 kHz to 30 MHz
b. Radiated emission test: from 30 MHz to 10th harmonic of the highest operating frequency or 40GHz, whichever is lower

2.3. Description of Test Supporting Units

Support Unit 1. – Notebook (COMPAQ)

FCC ID	: N/A
Model No.	: Presario 1500
Serial No.	: SP0004
Remark	: This support device was tested to comply with FCC standards and authorized under Declaration of Conformity.

2.4. Connection Diagram of Test System



2.5. Test Software

A test software for power and channel bandwidth control was provided. The notebook computer was used to control the EUT via the printer port.

3. Test Location and Standards

3.1. Test Location

Test Location : Sporton Hwa Ya Testing Building

Address : No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.
Tel: +886 3 327 3456 Fax: +886 3 318 0055

Test Site No. : CO01-HY, 03CH03-HY

3.2. Test Conditions

Normal Voltage : 5VDC from host
Extreme Voltage : NA
Normal Temperature : 20 ℃
Extreme Temperature : -20 ℃ and 70 ℃

3.3. Standards for Methods of Measurement

Here is the list of the standards followed in this test report.

ANSI C63.4-2001

TIA/EIA-603-A

47 CFR Part 90

3.4. DoC Statement

This EUT is also able to act as a receiver. So, Class B of DoC has to be followed. It has been verified according to the rule of 47 CFR part 15 Subpart B, and found that all the requirements has been fulfilled.

4. List of Measurements

4.1. Summary of the Test Results

Applied Standard: 47 CFR Part 90 and Part 2			
Paragraph	**FCC Rule**	**Description of Test**	**Result**
5.1	90.213	Carrier Frequency Stability	Pass
5.2	90.205	Carrier Power	Pass
5.3	90.210/90.211/90.691	Sideband Spectrum	Pass
5.4	90.210	Radiated Spurious Emission	Pass
5.5	90.210	Conducted Spurious Emission	Pass
5.6	90.214	Transient Frequency Behavior of Transmitter	Pass

5. Test Result

5.1. Test of Carrier Frequency Stability

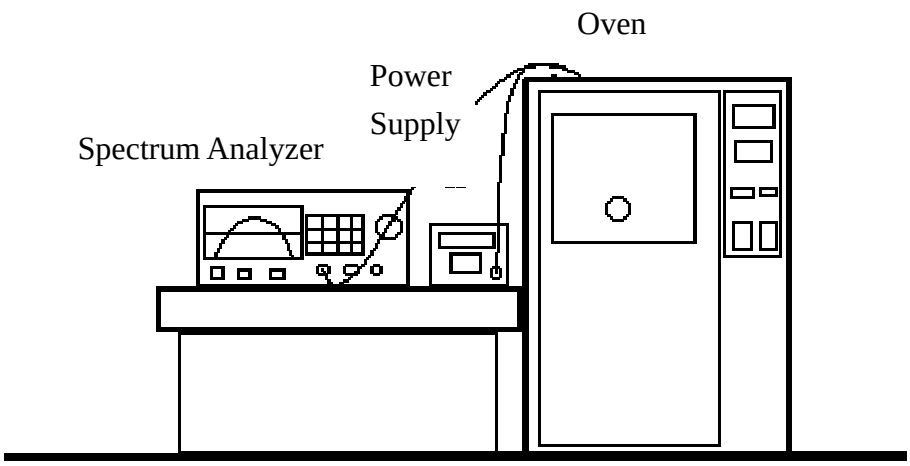
5.1.1. Measuring Instruments

Item 9 of the table on section 6.

5.1.2. Test Procedures

1. The transmitter output is connected to the spectrum analyzer through an attenuator.
2. Set RBW of spectrum analyzer to 1kHz and VBW to 1kHz.
3. Use peak detector mode, Max-hold and search the peak of trace 1.
4. According to the part 2.1055(d)(1), the supply voltage has to be changed from 85 to 115 percent of the nominal value.
5. According to the part 2.1055(a)(1), extreme temperature has to be changed from -30℃ to 50℃.
6. Read the frequency of the carrier and calculate the deviation.

5.1.3. Test Setup Layout



5.1.4. Test Result

- Modulation Type: Un-Modulated Carrier (CW)
- Temperature: 25°C
- Relative Humidity: 62 %
- Duty cycle of the equipment during the test: 100%

Frequency (MHZ)	Deviation (MHz)	Frequency Error ppm	Limits ppm	Temperature ℃
465.0039	0.0039	0.73	5	-30
465.0048	0.0048	0.90	5	-20
465.0055	0.0055	1.03	5	-10
465.0047	0.0047	0.88	5	0
465.0047	0.0047	0.88	5	10
465.0014	0.0014	0.26	5	20
465.0014	0.0014	0.26	5	30
465.0001	0.0001	0.02	5	40
464.9914	-0.0086	-1.62	5	50

Frequency (MHZ)	Deviation (MHz)	Frequency Error ppm	Limits ppm	Voltage V
465.0014	0.0014	0.26	5	5.00
465.0055	0.0055	1.03	5	4.25
464.9914	-0.0086	-1.62	5	5.75

5.2. Test of Carrier Power

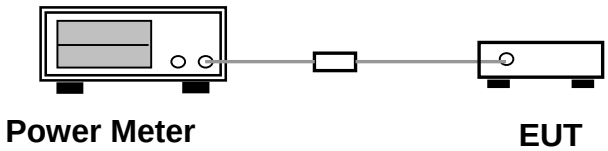
5.2.1. Measuring Instruments

Item 20 of the table on section 6.

5.2.2. Test Procedures

1. The transmitter output was connected to the power meter through an attenuator.
2. Measure the transmitter output power during the defined duty cycle
3. Use peak detector mode,.
4. Measurement power plus the antenna gain.

5.2.3. Test Setup Layout



5.2.4. Test Result

- Modulation Type: FM
- Temperature: 25°C
- Relative Humidity: 62 %
- Duty cycle of the equipment during the test : 100%

Note: ERP = Conducted Output Power + Antenna Gain – 2.14dB

Channel	Frequency (MHz)	Conducted Output Power (dBm)	ERP Output Power (dBm)	Limits (dBm)
01	465	28.45	28.31	33

5.3. Test of Sideband Spectrum

5.3.1. Measuring Instruments

Item 9 of the table on section 6.

5.3.2. Test Procedures

Conducted Test

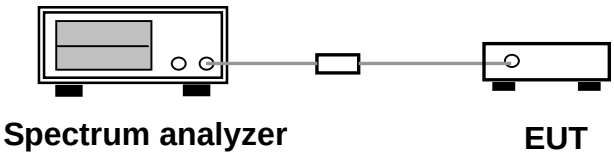
1. The transmitter output is connected to the spectrum analyzer through an attenuator.
2. Set RBW of spectrum analyzer to 300Hz and VBW to 1kHz.
3. Mark the frequency with maximum peak power as the center of the display of the spectrum
4. Set the span to 120kHz and the sweep time to Auto.
5. Record the power spectral and compare to the Mask.

Radiated Test

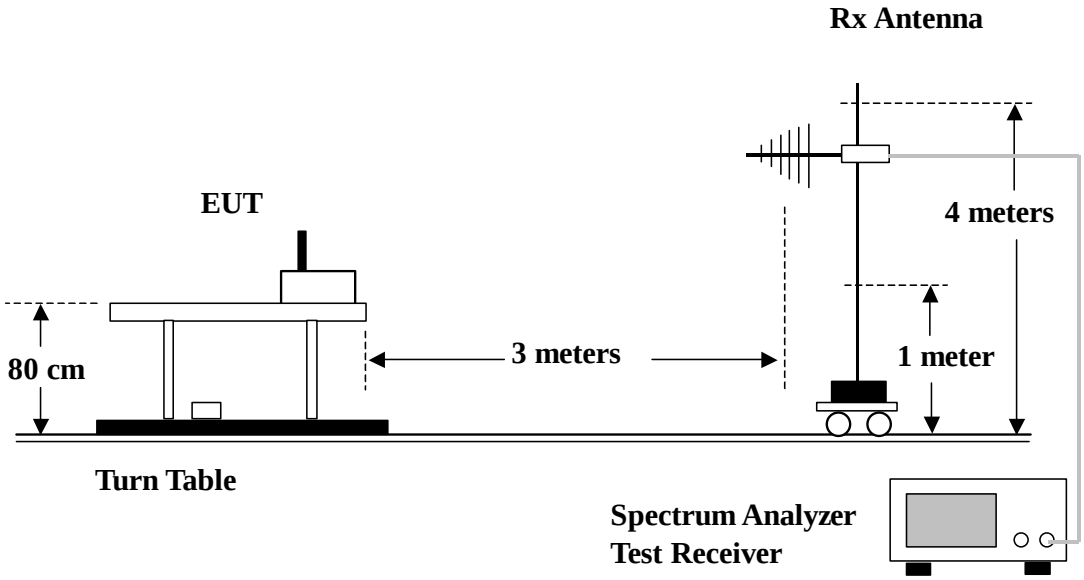
1. Configure the EUT according to ANSI C63.4.
2. The EUT was placed on the top of the turn table 0.8 meter above ground.
3. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turn table.
4. Power on the EUT and all the supporting units.
5. The turn table was rotated 360 degrees to determine the position of the highest radiation.
6. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emission field strength of both horizontal and vertical polarization.
7. For each suspected emission, the antenna tower was scan (from 1 M to 4 M) and then the turn table was rotated (from 0 degree to 360 degrees) to find the maximum reading.
8. Set the spectrum parameters is the same as “Conducted test.”. The reference level of mask is the un-modulation carrier field strength

5.3.3. Test Setup Layout

Conducted Test



Radiated Test

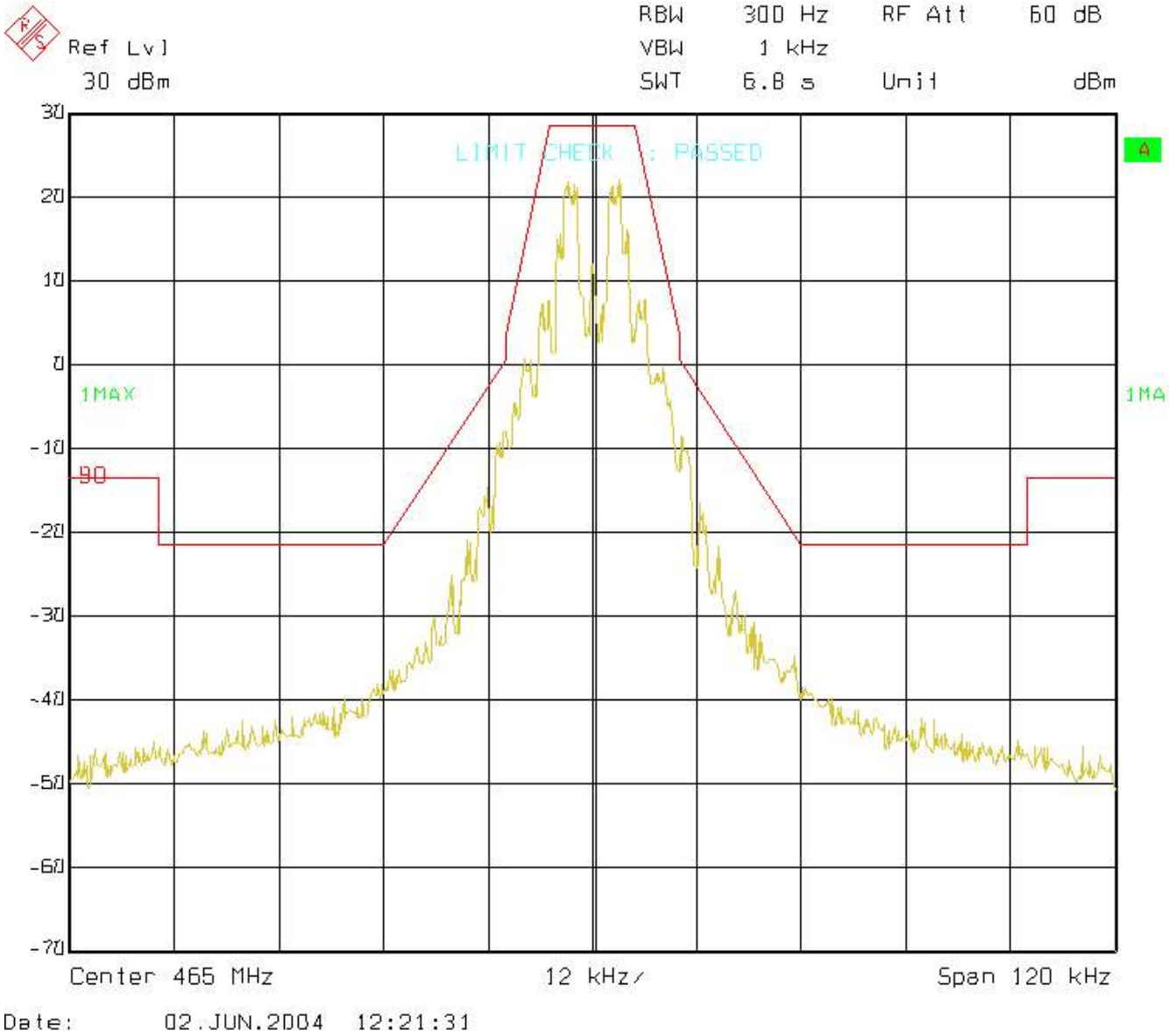


5.3.4. Test Result：See spectrum analyzer plots below

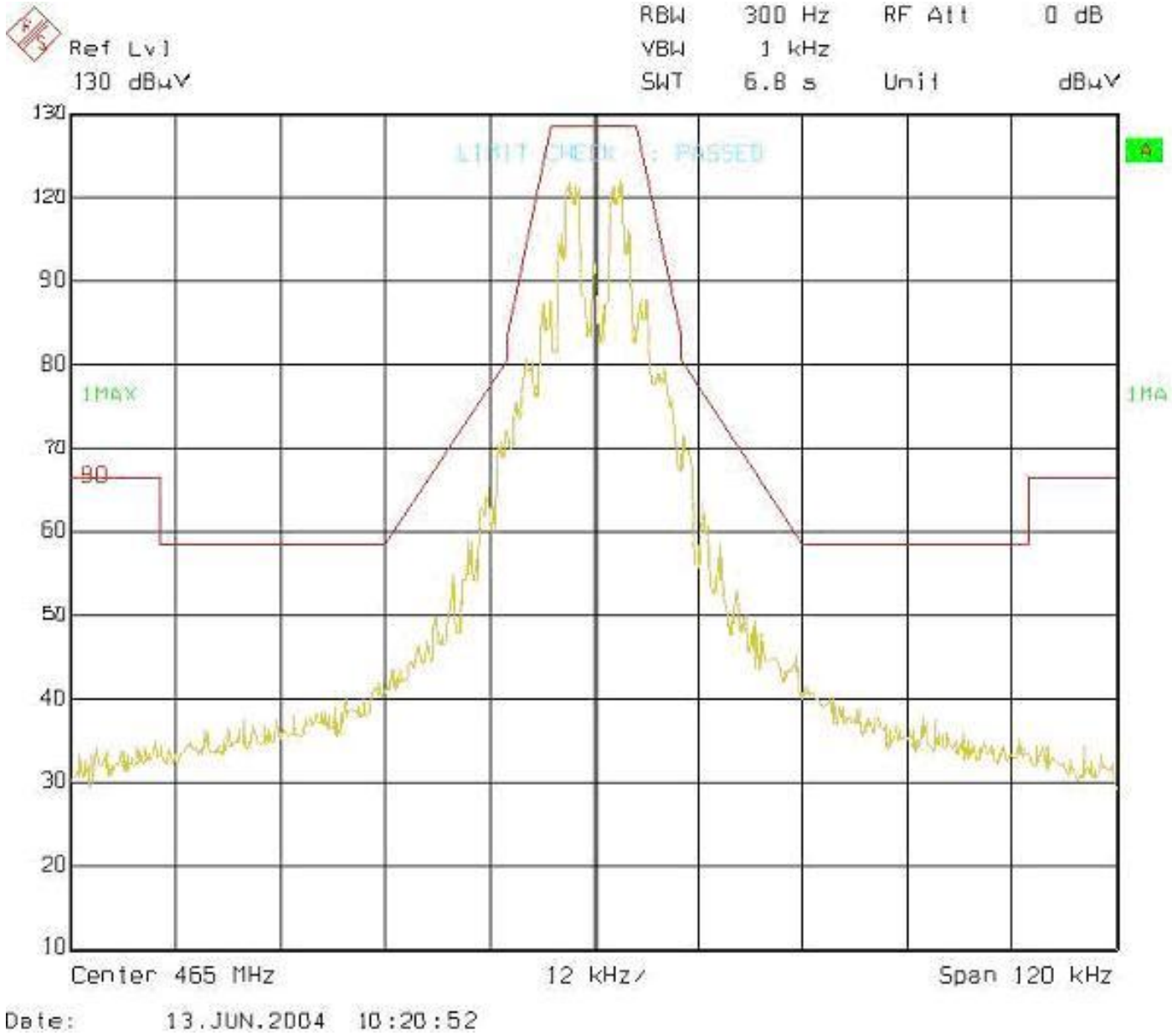
- Modulation Type: FM
- Temperature: 25°C
- Relative Humidity: 62 %
- Duty cycle of the equipment during the test: 100%

Channel	Frequency (MHz)	Result	Limits Mask
01	465	Pass	C

Conducted Modulation Type: FM (Channel 01)：



Radiated Modulation Type: FM (Channel 01)：



5.4. Test of Spurious Radiated Emission

5.4.1. Measuring Instruments

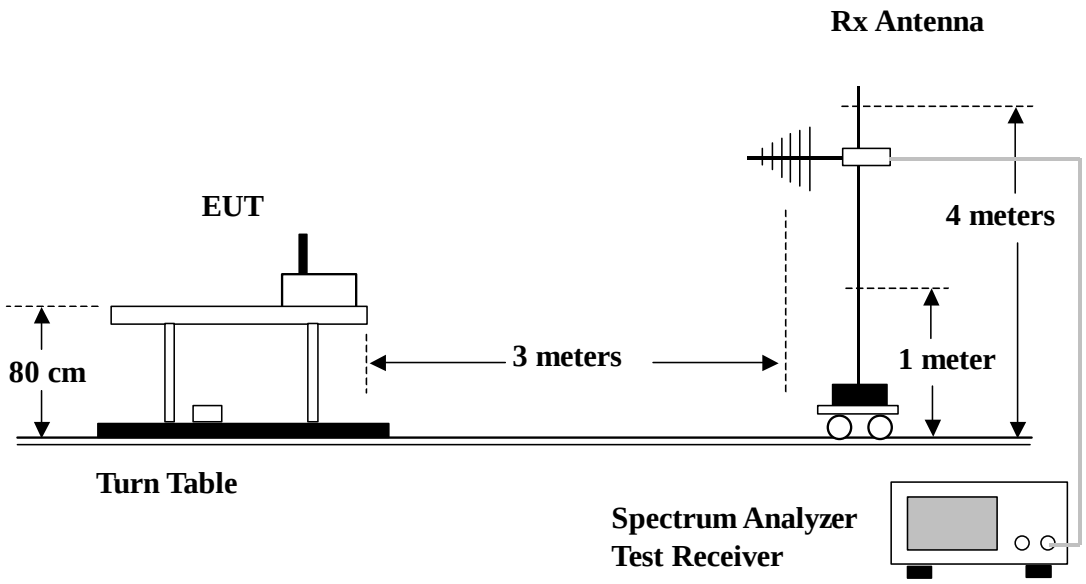
Please reference item 8~19 in chapter 6 for the instruments used for testing.

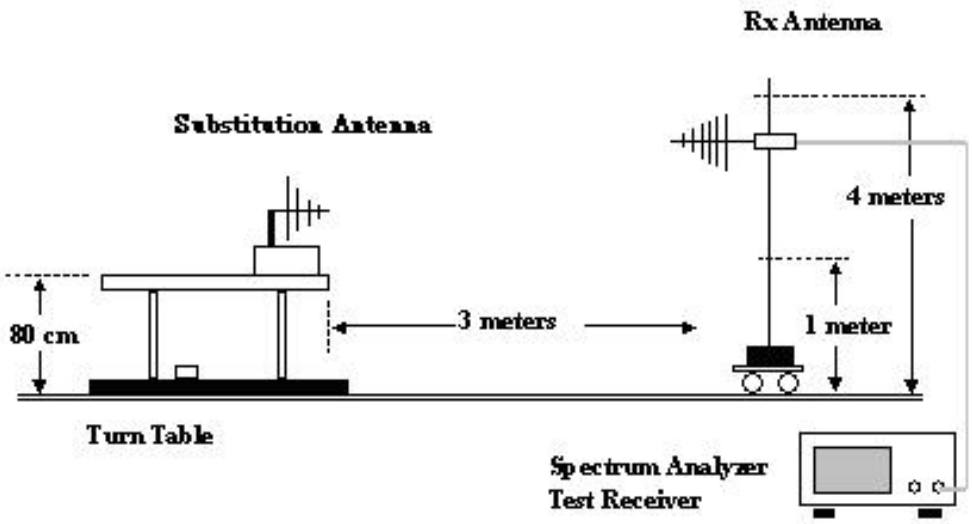
5.4.2. Test Procedures

1. Configure the EUT according to ANSI C63.4.
2. The EUT was placed on the top of the turn table 0.8 meter above ground.
3. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turn table.
4. Power on the EUT and all the supporting units.
5. The turn table was rotated 360 degrees to determine the position of the highest radiation.
6. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emission field strength of both horizontal and vertical polarization.
7. For each suspected emission, the antenna tower was scan (from 1 M to 4 M) and then the turn table was rotated (from 0 degree to 360 degrees) to find the maximum reading.
8. Adjust the spectrum analyzer for the following settings:
   1) Resolution Bandwidth = 10 kHz for spurious emissions below 1 GHz and 1 MHz for spurious emissions above 1GHz.
   2) Video Bandwidth = 300 kHz for spurious emissions below 1 GHz, and 3 MHz for spurious emissions above 1 GHz.
   3) Sweep Speed slow enough to maintain measurement calibration.
   4) Detector Mode = Positive Peak.
9. Remove the transmitter and replace it with a broadband substitution antenna.
10. With the substitution antennas at horizontally polarized and with the signal generator tuned to a particular spurious frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading (item 7) . This should be done carefully repeating the adjustment of the test antenna and generator output.
11. P_d(dBm) = P_g(dBm) – cable loss (dB) + antenna gain (dBi). Pd is the dipole equivalent power and Pg is the generator output power into the substitution antenna.
12. Radiated spurious emissions in dB = 43 + 10 $\log_{10}$ (power out in Watts) or an equivalent absolute level of -13 dBm

13. or Radiated spurious emissions (dB) =10 log10(Tx power mW))-Pd< [43 + 10 $\log_{10}$ (power out in Watts)]

5.4.3. Test Setup Layout





5.4.4. Test Results and Limit

Note:
Emission level (dBuV/m) = 20 log Emission level (uV/m)
Corrected Reading: Probe Factor + Cable Loss + Read Level - Preamp Factor = Level

Test Mode	Mode 1	**Temperature**	26 deg. C	**Tested By**	Steve Chen
Freq. Range	30MHz~1GHz	**Humidity**	64%		

(A) Polarization: Horizontal

Frequency (MHz)	Level (dBm)	Over Limit (dB)	Limit Line (dBm)	Signal Generator (dBuV)	Antenna Gain (dBi)	Cable Loss (dB)	Detect Mode
138	-62.41	-49.41	-13.00	-60.90	1.00	2.51	PK
142	-64.44	-51.44	-13.00	-63.40	1.50	2.54	PK
196	-66.15	-53.15	-13.00	-64.80	1.20	2.55	PK
343	-60.18	-47.18	-13.00	-59.40	1.80	2.58	PK
397	-55.39	-42.39	-13.00	-54.60	1.80	2.59	PK
490	-60.20	-47.20	-13.00	-58.90	1.30	2.60	PK

(B) Polarization: Vertical

Frequency (MHz)	Level (dBm)	Over Limit (dB)	Limit Line (dBm)	Signal Generator (dBuV)	Antenna Gain (dBi)	Cable Loss (dB)	Detect Mode
76.58	-57.31	-44.31	-13.00	-55.80	1.00	2.51	PK
89.5	-60.64	-47.64	-13.00	-59.60	1.50	2.54	PK
114.83	-54.25	-41.25	-13.00	-52.90	1.20	2.55	PK
217.6	-63.58	-50.58	-13.00	-62.80	1.80	2.58	PK
364.8	-71.59	-58.59	-13.00	-70.80	1.80	2.59	PK
396.8	-63.90	-50.90	-13.00	-62.60	1.30	2.60	PK
787.2	-60.80	-47.80	-13.00	-60.40	2.80	3.20	

Test Mode	Mode 1	Temperature	26 deg. C	Tested By	Steve Chen
Freq. Range	1GHz~5GHz	Humidity	64%		

(A) Polarization: Horizontal

Frequency (MHz)	Level (dBm)	Over Limit (dB)	Limit Line (dBm)	Signal Generator (dBuV)	Antenna Gain (dBi)	Cable Loss (dB)	Detect Mode
1195	-57.50	-44.50	-13.00	-60.40	6.50	3.60	PK
1324	-59.60	-46.60	-13.00	-62.60	6.70	3.70	PK
1460	-62.75	-49.75	-13.00	-66.70	7.80	3.85	PK
1589	-58.89	-45.89	-13.00	-64.45	9.50	3.94	PK
1622	-60.30	-47.30	-13.00	-65.50	9.40	4.20	PK
2317	-59.42	-46.42	-13.00	-64.40	9.20	4.22	PK
2519	-55.28	-42.28	-13.00	-60.40	9.40	4.28	PK
2609	-53.04	-40.04	-13.00	-58.50	9.80	4.34	PK
2639	-54.38	-41.38	-13.00	-59.40	9.40	4.38	PK

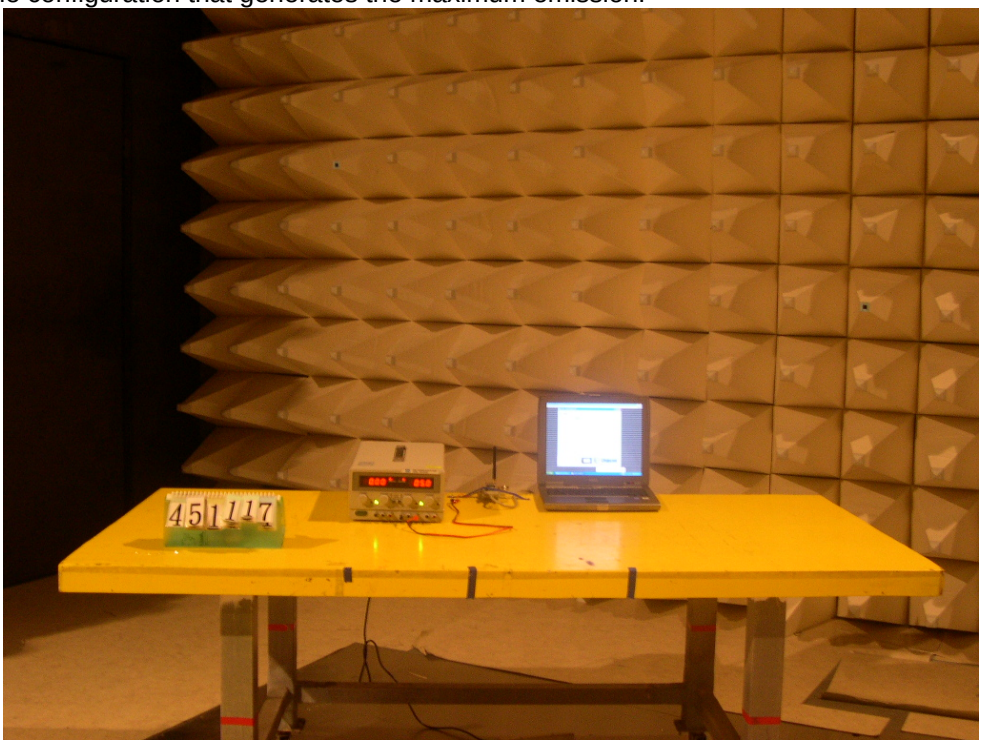
(B) Polarization: Vertical

Frequency (MHz)	Level (dBm)	Over Limit (dB)	Limit Line (dBm)	Signal Generator (dBuV)	Antenna Gain (dBi)	Cable Loss (dB)	Detect Mode
1195	-55.55	-42.55	-13.00	-58.45	6.50	3.60	PK
1324	-55.90	-42.90	-13.00	-58.90	6.70	3.70	PK
1460	-53.65	-40.65	-13.00	-57.60	7.80	3.85	PK
1589	-49.24	-36.24	-13.00	-54.80	9.50	3.94	PK
1622	-53.80	-40.80	-13.00	-59.00	9.40	4.20	PK
2317	-53.22	-40.22	-13.00	-58.20	9.20	4.22	PK
2519	-57.48	-44.48	-13.00	-62.60	9.40	4.28	PK
2609	-54.94	-41.94	-13.00	-60.40	9.80	4.34	PK
2639	-52.58	-39.58	-13.00	-57.60	9.40	4.38	PK

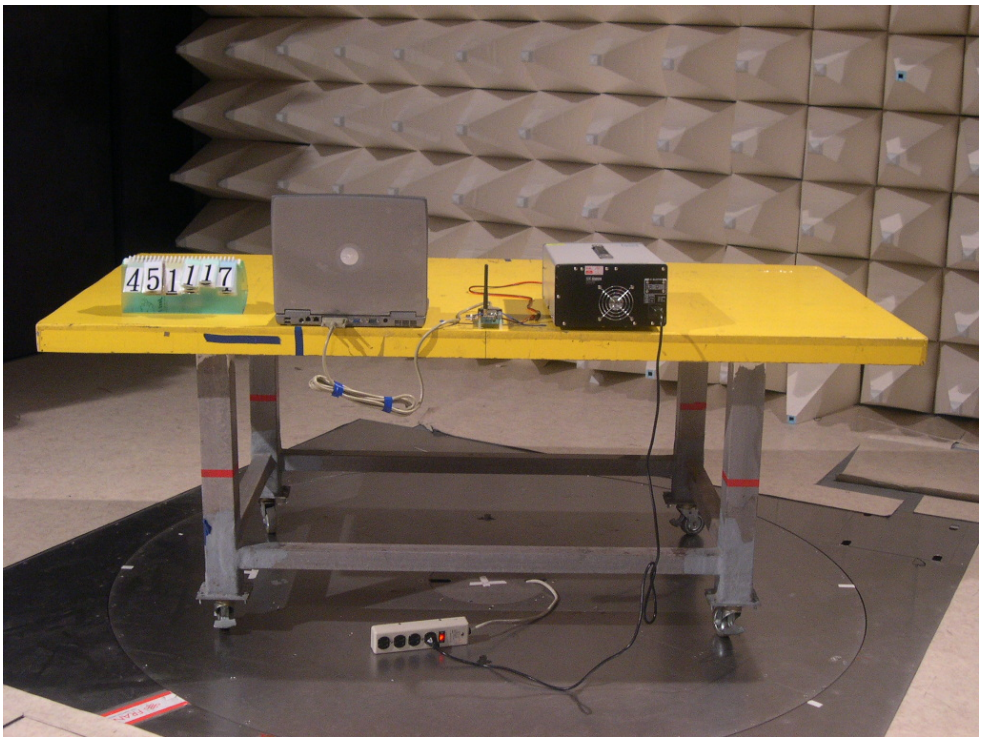
5.4.5. Photographs of Radiated Emission Test Configuration

- The photographs show the configuration that generates the maximum emission.

FRONT VIEW



REAR VIEW



5.5. Test of Spurious Conducted Emission

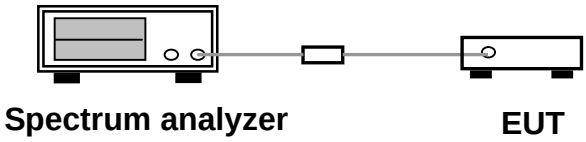
5.5.1. Measuring Instruments

Please reference item 9 in chapter 6 for the instruments used for testing.

5.5.2. Test Procedures

1. The transmitter output is connected to the spectrum analyzer through an attenuator
2. Adjust the spectrum analyzer for the following settings:
   1) Resolution Bandwidth = 10 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1GHz.
   2) Video Bandwidth = 300 kHz for spurious emissions below 1 GHz, and 3 MHz for spurious emissions above 1 GHz.
   3) Sweep Speed slow enough to maintain measurement calibration.
   4) Detector Mode = Positive Peak.
3. Limits=28.45-43+10log(0.7)=-13dBm

5.5.3. Test Setup Layout

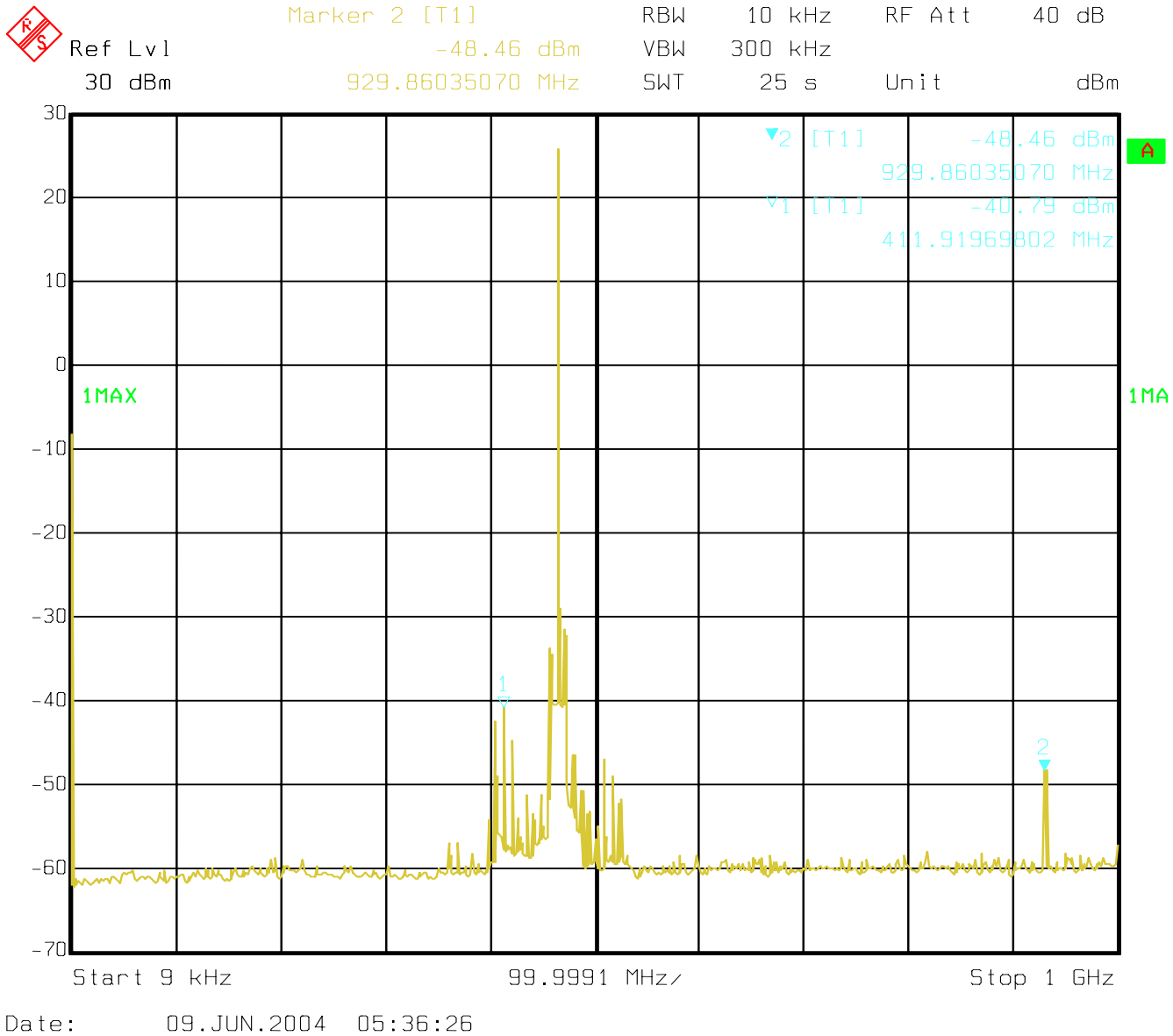


5.5.4. Test Results and Limit

Test Mode	Mode 1	Temperature	26 deg. C	Tested By	Steve Chen
Freq. Range	30MHz~1GHz	Humidity	64%		

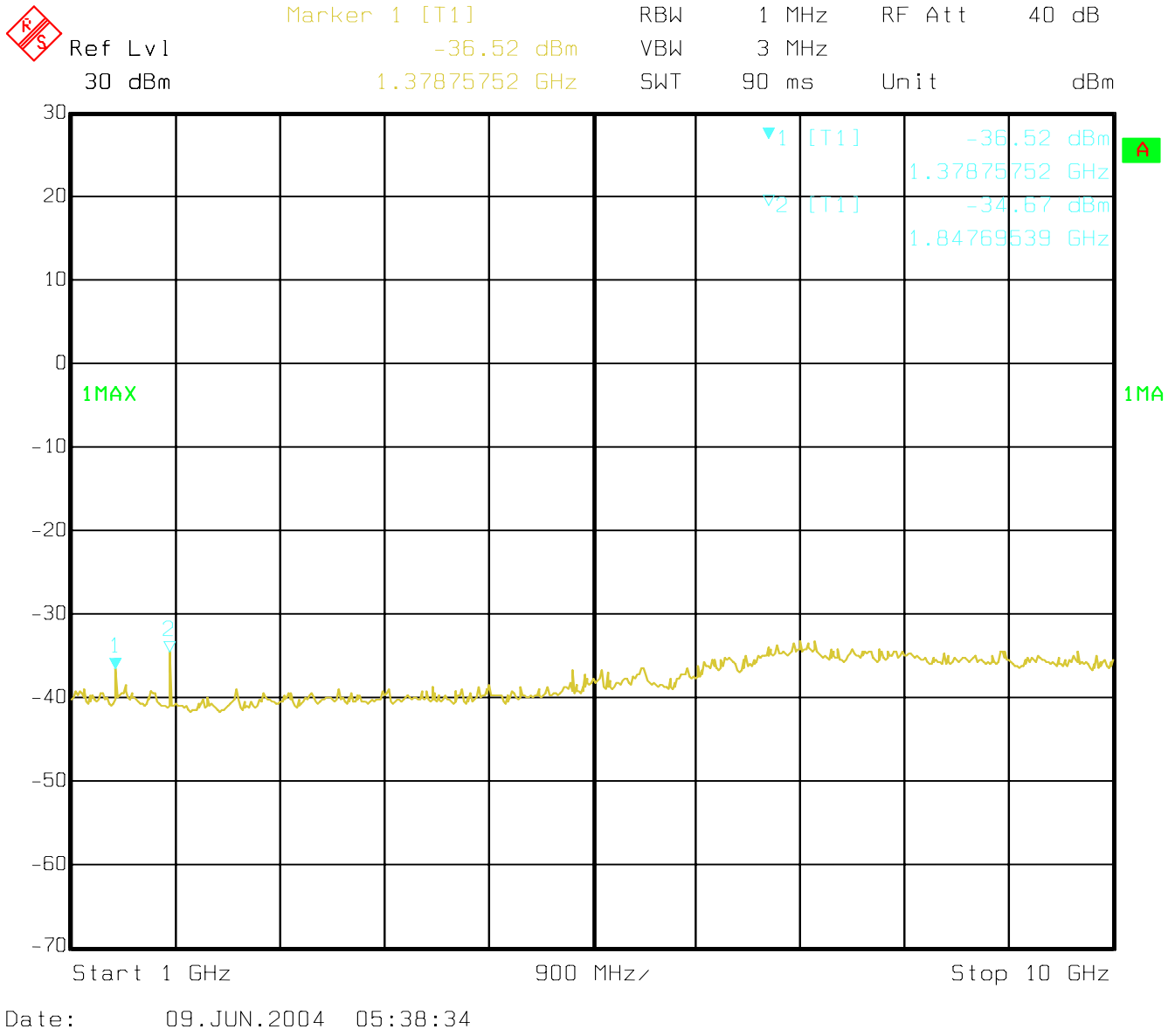
Frequency (MHz)	Result (dBm)	Cable Loss (dB)	Limits (dBm)
411.91	-40.79	1.0	-13
929.86	-48.46	1.5	-13
1378.75	-36.52	1.8	-13
1874.69	-34.67	1.8	-13

Below 1GHz



Date: 09.JUN.2004 05:36:26

Above 1GHz


Marker 1 [T1]
-36.52 dBm
1.37875752 GHz
RBW 1 MHz
VBW 3 MHz
SWT 90 ms
RF Att 40 dB
Unit dBm
Ref Lvl
30 dBm
1 [T1] -36.52 dBm
1.37875752 GHz
2 [T1] -34.67 dBm
1.84769539 GHz
A
1MAX
1MA
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
Start 1 GHz
900 MHz/
Stop 10 GHz
Date: 09.JUN.2004 05:38:34

5.6. Test of Transient Frequency Behavior of Transmitter

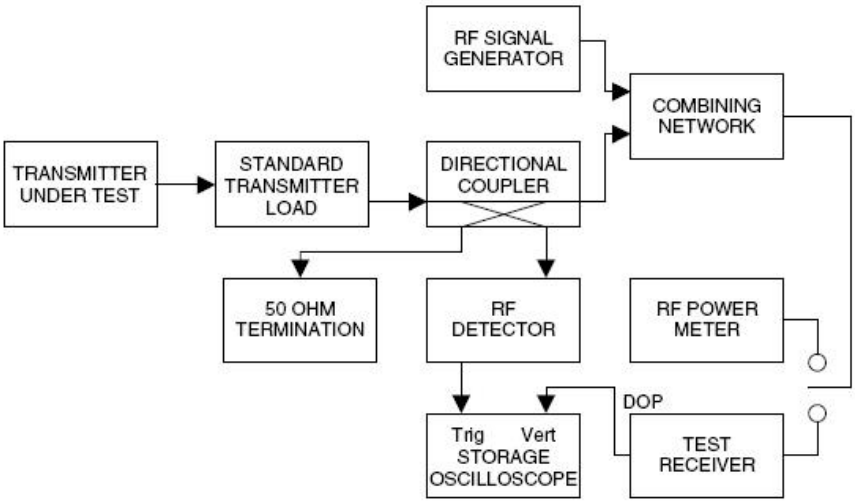
5.6.1. Measuring Instruments

Item 9, 25, 27 of the table on section 6.

5.6.2. Test Procedures

1. SG to the assigned transmitter frequency and modulate it with a 1 kHz tone at ±25 kHz deviation and set its output level to below 30dB of EUT signal level to receiver.
2. Set the horizontal sweep rate on the storage oscilloscope to 10 ms per division and adjust the display to continuously view the 1000 Hz tone from the DOP. Adjust the vertical amplitude control of the oscilloscope to display the 1000 Hz at ±4 divisions vertically centered on the display.
3. Transmitter on and observe the stored display. The output at the DOP, due to the change in the ratio of power between the signal generator input power and the transmitter output power will, because of the capture effect of the test receiver, produce a change in display: For the first part of the sweep it will show the 1 kHz test signal. Then once the receiver's demodulator has been captured by the transmitter power, the display will show the frequency difference from the assigned frequency to the actual transmitter frequency versus time. The instant when the 1 kHz test signal is completely suppressed (including any capture time due to phasing) is considered to be *ton* . The trace should be maintained within the allowed divisions during the period *t*1 and *t*2 . See the figure in the appropriate standards section.
4. During the time from the end of *t*2 to the beginning of t3 the frequency difference should not exceed the limits set by the FCC in 47 CFR 90.214 and outlined in 3.2.2. The allowed limit is equal to the transmitter frequency times its FCC frequency tolerance times ±4 display divisions divided by 25 kHz. For example, at a transmitter assigned frequency of 500 MHz and a frequency tolerance of 5 ppm. This would be 500 MHz times 5 ppm times ±4 divisions divided by 25 kHz. This equals ±0.4 divisions in this example. Greater vertical sensitivity may be required to view this accurately
5. Adjust the oscilloscope trigger controls so it will trigger on a decreasing magnitude from the RF peak detector, at 1 division from the right side of the display, when the transmitter is turned off. Set the controls to store the display. The moment when the 1 kHz test signal starts to rise is considered to provide *toff*

5.6.3. Test Setup Layout

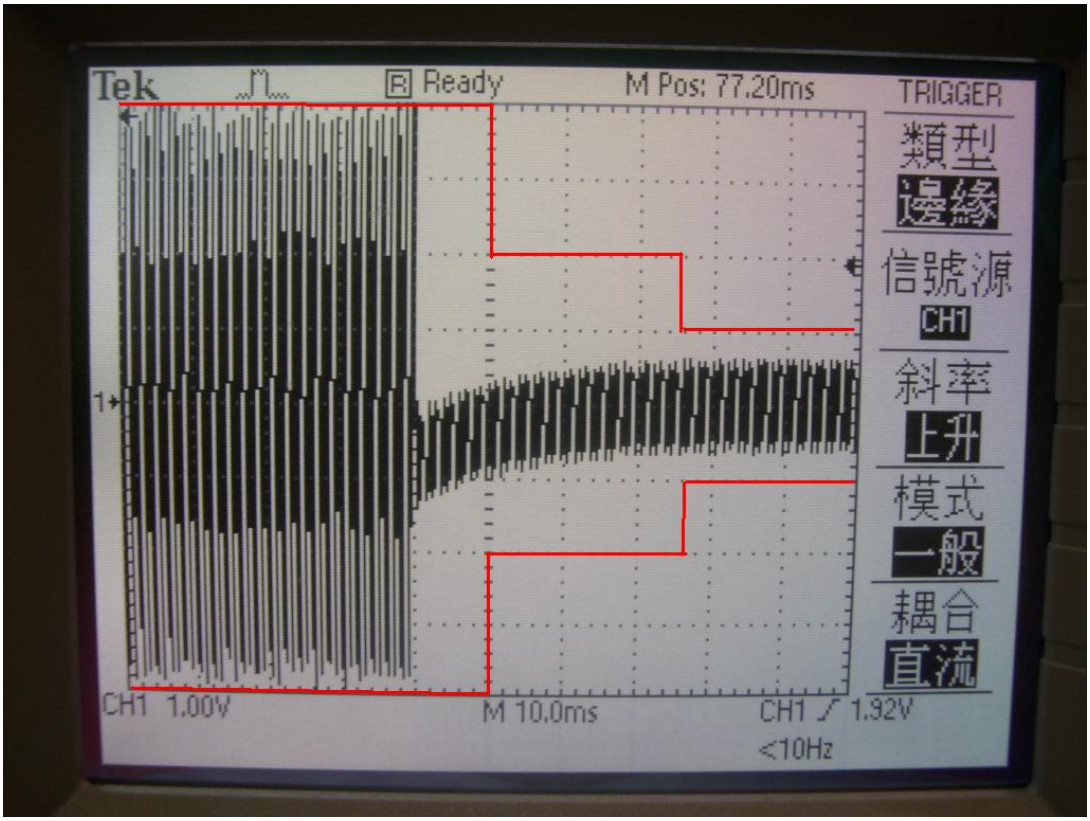


5.6.4. Test Result : please see the spectrum plot after the table

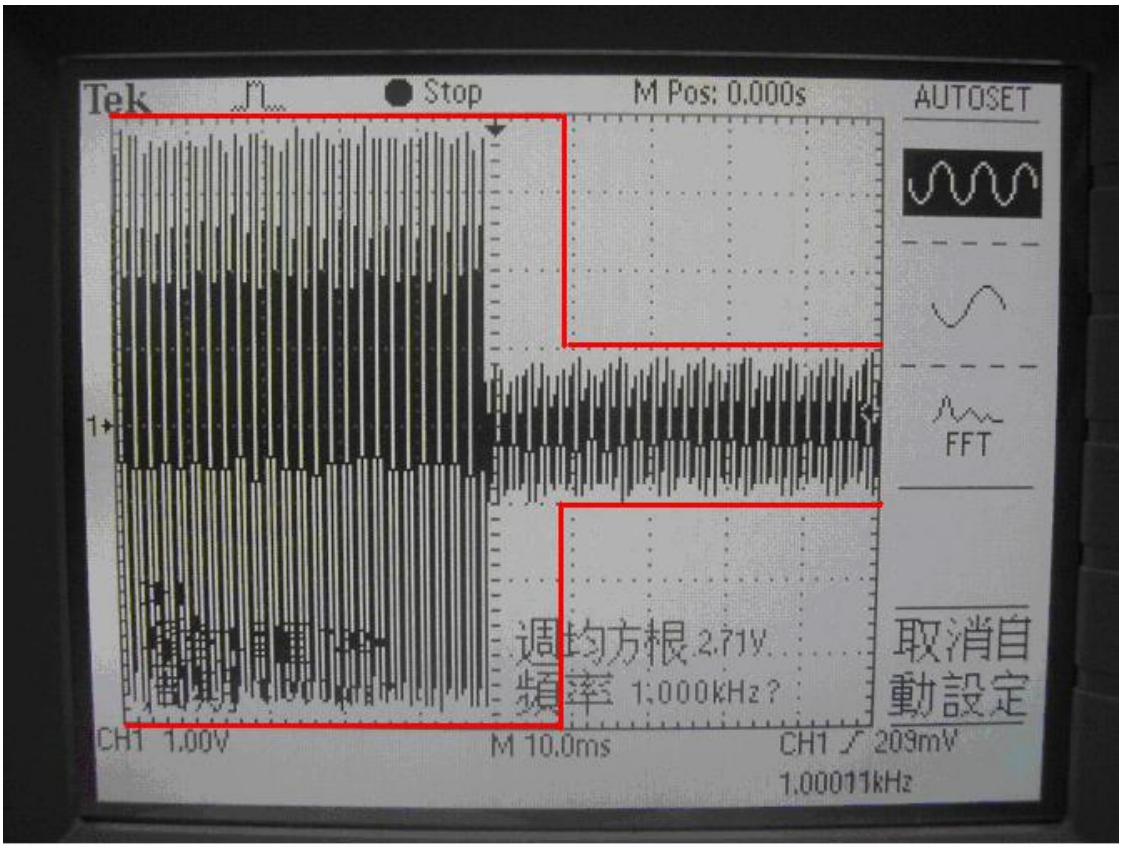
- Modulation Type: FM
- Temperature: 25°C
- Relative Humidity: 62 %
- Duty cycle of the equipment during the test: 100%

Time Interval (ms)	Deviation (kHz)	Frequency Stability ppm	Result
t1	25	-	Pass
t2	12.5	-	Pass
t3	25	-	Pass
t_{on}	default	5	Pass

Mode 1: t1, t2


Tek
Ready
M Pos: 77.20ms
TRIGGER
類型
邊緣
信號源
CH1
斜率
上升
模式
一般
耦合
直流
CH1 1.00V
M 10.0ms
CH1 ∕ 1.92V
<10Hz

Mode 1 t3


Tek
Stop
M Pos: 0.000s
AUTOSET
FFT
週均方根 2.71V
頻率 1.000kHz?
取消自
動設定
CH1 1.00V
M 10.0ms
CH1 ∕ 209mV
1.00011kHz

6. List of Measuring Equipments Used

Items	Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
1	EMC Receiver	R&S	ESCS 30	100132	9 KHz – 2.75 GHz	Jun. 12, 2003	Conduction (CO01-HY)
2	LISN	MessTec	NNB-2/16Z	2001-008	9 KHz – 30 MHz	Apr. 29, 2003	Conduction (CO01-HY)
3	LISN (Support Unit)	MessTec	NNB-2/16Z	2001-009	9 KHz – 30 MHz	Apr. 29, 2003	Conduction (CO01-HY)
4	EMI Filter	LINDGREN	LRE-2060	1004	< 450 Hz	N/A	Conduction (CO01-HY)
5	EMI Filter	LINDGREN	N6006	201052	0 ~ 60 Hz	N/A	Conduction (CO01-HY)
6	RF Cable-CON	Suhner Switzerland	RG223/U	CB029	9KHz~30MHz	Jan. 07, 2003	Conduction (CO01-HY)
7	50 ohm BNC type Terminal	NOBLE	50ohm	TM009	50 ohm	Apr. 24, 2003	Conduction (CO01-HY)
8	3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	30MHz~1GHz 3m	Jun. 21, 2003	Radiation (03CH03-HY)
9	Spectrum analyzer	R&S	FSP40	100004	9KHZ~40GHz	Aug. 07, 2003	Radiation (03CH03-HY)
10	Receiver	SCHAFFNER	SCR 3501	417	9 KHz –1GHz	Feb. 20, 2003	Radiation (03CH03-HY)
11	Amplifier	HP	8447D	2944A09072	100KHz – 1.3GHz	Nov. 05, 2003	Radiation (03CH03-HY)
12	Bilog Antenna	SCHAFFNER	CBL6112B	2687	30MHz –2GHz	Dec. 21, 2002	Radiation (03CH03-HY)
13	RF Cable-R03m	Jye Bao	RG142	CB021	30MHz~1GHz	Jan. 02, 2003	Radiation (03CH03-HY)
14	Amplifier	MITEQ	AFS44	879981	100MHz~26.5GHz	Jul. 23, 2003	Radiation (03CH03-HY)
15	Horn Antenna	COM-POWER	AH-118	10094	1GHz – 18GHz	Apr. 10, 2003	Radiation (03CH03-HY)
16	Turn Table	HD	DS 420	420/650/00	0 ~ 360 degree	N/A	Radiation (03CH03-HY)
17	Antenna Mast	HD	MA 240	240/560/00	1 m - 4 m	N/A	Radiation (03CH03-HY)
18	Horn Antenna	Schwarzbeck	BBHA9170	BBHA9170154	15GHz~40GHz	Jun. 02, 2003	Radiation (03CH03-HY)
19	RF Cable-HIGH	Jye Bao	RG142	CB030-HIGH	1GHz~29.5GHz	Mar. 14, 2003	Radiation (03CH03-HY)
20	Power meter	R&S	NRVS	100444	DC~40GHz	May 28, 2003	Conducted

Items	Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
21	Power sensor	R&S	NRV-Z55	100049	DC~40GHz	May 28, 2003	Conducted
22	Power Sensor	R&S	NRV-Z32	100057	30MHz-6GHz	May 28, 2003	Conducted
23	AC power source	HPC	HPA-500W	HPA-9100024	AC 0~300V	May 27, 2003	Conducted
24	Temp. and Humidity Chamber	KSON	THS-C3L	612	N/A	Oct. 01, 2003	Conducted
25	Oscilloscope	Tektronix	TDS1012	C038520	100MHz 2Ch.	Jan. 28, 2004	Conducted
26	DC Detector	Narda	FSCM99899	4503A	0.1MHZ~18GHz	Jan. 25, 2004	Conducted
27	Signal Generator	R&S	SMR40	837900/23	1GHz~40GHz	Nov. 06, 2003	Conducted

※ Calibration Interval of instruments listed above is one year.