

# ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

## INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

**Product Name:** scala-driver Passenger

**Brand Name:** scala

**Model Name:** scala-driver Passenger

**FCC ID:** Q95ER03

**Report No.:** EF/2006/40017

**Issue Date:** May. 22, 2006

**FCC Rule Part:** §15.249

**Prepared for** Cardo Systems Inc.  
100 High Tower St., Pittsburgh PA 15205,  
USA

**Prepared by** SGS Taiwan Ltd.  
No. 134, Wu Kung Rd., Wuku Industrial  
Zone, Taipei County, Taiwan.



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## VERIFICATION OF COMPLIANCE

**Applicant:** Cardo Systems Inc.  
100 High Tower St., Pittsburgh PA 15205, USA

**Product Description:** scala-driver Passenger

**Brand Name:** scala

**FCC ID Number:** Q95ER03

**Model No.:** scala-driver Passenger

**Model Difference:** N/A

**File Number:** EF/2006/40017

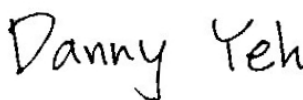


**Date of test:** Apr. 18, 2006 ~ May, 11, 2006

**Date of EUT Received:** Apr. 17, 2006

## We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4 (2003) and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.249.

The test results of this report relate only to the tested sample identified in this report.

<b>Test By:</b>		<b>Date</b>	May. 22, 2006
	<hr/>		<hr/>
	Danny Yeh		
<b>Prepared By:</b>		<b>Date</b>	May. 22, 2006
	<hr/>		<hr/>
	Gigi Yeh		
<b>Approved By:</b>		<b>Date</b>	May. 22, 2006
	<hr/>		<hr/>
	Vincent Su		

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## Version

Version No.	Date
00	May. 22, 2006

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## 1. GENERAL INFORMATION

### 1.1 Product Description

The Cardo Systems Inc., Model: scala-driver Passenger (referred to as the EUT in this report)  
The EUT is a 2.4GHz Headsets.

A major technical descriptions of EUT is described as following:

- A). Operation Frequency: 2402MHz, 1 channel
- B). Modulation Type: TDMA
- C). Antenna Designation: PIFA Antenna, 2 dBi, Non-User Replaceable (Fixed)
- D). Power Supply: 9Vdc from AC/DC power adaptor, model: YLT-TCA or  
3.7 Vdc from re-chargeable battery.

### 1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: **Q95ER03** filing to comply with Section 15.249 of the FCC Part 15, Subpart C Rules. The composite system (digital device) is compliance with Subpart B is authorized under a verification procedure.

### 1.3 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4 (2003). Radiated testing was performed at an antenna to EUT distance 3 meters.

### 1.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the address of SGS Taiwan Ltd. No. 134, Wu Kung Rd., Wuku Industrial Zone, Taipei Country, Taiwan. The Open Area Test Sites and the Line Conducted labs are constructed and calibrated to meet the FCC requirements in documents ANSI C63.4: 2003 and CISPR 22/EN 55022 requirements. Site No. 1(3 & 10 meters) Registration Number: 94644, Both OATS and Anechoic chamber (3 meters) was accredited by CNLA (0513).

### 1.5 Special Accessories

Not available for this EUT intended for grant.

### 1.6 Equipment Modifications

Not available for this EUT intended for grant.

## 2. System Test Configuration

### 2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

### 2.2 EUT Exercise

The Transmitter was operated in the engineering operating mode. the Tx frequency was fixed which was for the purpose of the measurements.

### 2.3 Test Procedure

#### 2.3.1 Conducted Emissions

The EUT is placed on a turn table which is 0.8 m above ground plane. According to the requirements in Section 7 and 13 of ANSI C63.4-2003. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and Average detector mode.

#### 2.3.2 Radiated Emissions

The EUT is placed on a turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter(EUT) was rotated through three orthogonal axes according to the requirements in Section 8 and 13 of ANSI C63.4-2003.

## 2.4 Limitation

### (1) Conducted Emission

According to section 15.207(a) Conducted Emission Limits is as following.

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 – 0.5	66 - 56	56 - 46
0.5 – 5	56	46
5 - 30	60	50

### (2) Radiated Emission 15.249(a)

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following.

Frequency (MHz)	Field strength of Fundamental	Field strength of Harmonics	Distance (m)
902 - 928	50 mV/m (94dBuV/m)	500 uV/m (54dBuV/m)	3
2400 – 2483.5	50 mV/m (94dBuV/m)	500 uV/m (54dBuV/m)	3
5725 – 5875	50 mV/m (94dBuV/m)	500 uV/m (54dBuV/m)	3
24.0 – 24.25 GHz	250 mV/m (107.95dBuV/m)	2500 uV/m (67.95dBuV/m)	3

**(3) Radiated Emission 15.249 (d)**

Emission Radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50dB below the level of the fundamental or to the general radiated emission limits in Section 15.209 as below, whichever is the lesser attenuation.

Frequency (MHz)	Field strength $\mu\text{V/m}$	Distance (m)	Field strength at 3m $\text{dB}\mu\text{V/m}$
1.705-30	30	30	69.54
30-88	100	3	40
88-216	150	3	43.5
216-960	200	3	46
Above 960	500	3	54

**(4) Radiated Emission 15.249(e)**

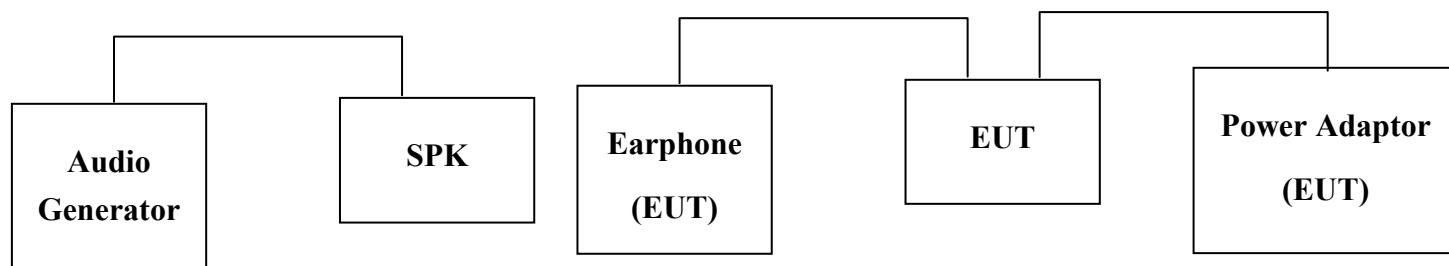
For frequencies above 1000MHz, the above field strength limits are based on average limits. The peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20dB under any condition of modulation.

- Remark:
1. Emission level in  $\text{dB}\mu\text{V/m}=20 \log (\mu\text{V/m})$
  2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
  3. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of  $\xi$  15.205
  4. Emission spurious frequency which appearing within the Restricted Bands specified in provision of  $\xi$  15.205, then the general radiated emission limits in  $\xi$  15.209 apply.



## 2.5 Configuration of Tested System

**Fig. 2-1 Configuration of TX**



**Table 2-2 Equipment Used in Tested System**

Item	Equipment	Mfr/Brand	Model/ Type No.	FCC ID	Series No.	Data Cable	Power Cord
1	Adaptor	YALITONG	YLT-TCA	N/A	N/A	NA/	N/A
2.	Earphone	N/A	PRO.2	N/A	N/A	N/A	N/A
3.	Audio Generator	TOPWARD	TFG-8104	N/A	853330	N/A	N/A
4	Speaker	GENIUNE	GS2240	N/A	AK1136916 931208	N/A	N/A

**Note:** All the above equipment/cables were placed in worse case positions to maximize emission signals during emission test.

**Grounding:** Grounding was in accordance with the manufacturer's requirements and conditions for the intended use.

### 3. Summary Of Test Results

FCC Rules	Description Of Test	Result
§ 15.207	Conducted Emission	Compliant
§ 15.249(a)(e)	Radiated Emission	Compliant
§ 15.249(d)	26dB band width Measurement	Compliant

#### Description of test modes

The EUT has been tested under normal operating mode with 1kHz audio signal

Frequency 2402MHz is chosen for full testing.

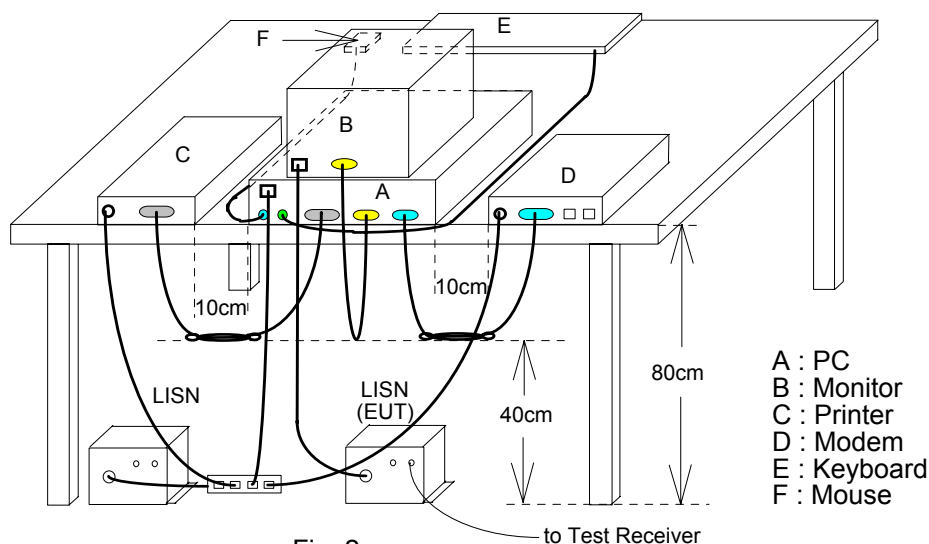
The X, Y and Z-axis of EUT were pre-test; X mode is the worst case and reported.

#### 4. Conducted Emissions Test (Not applicable in this report)

##### 4.1 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

##### 4.2 Test SET-UP (Block Diagram of Configuration)



##### 4.3 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMC Analyzer	HP	8594EM	3624A00203	09/02/2005	09/03/2006
EMI Test Receiver	R&S	ESCS30	828985/004	06/09/2005	06/10/2006
Transient Limiter	HP	11947A	3107A02062	09/02/2005	09/03/2006
LISN	Rolf-Heine	NNB-2/16Z	99012	12/31/2005	12/30/2006
LISN	Rolf-Heine	NNB-2/16Z	99013	12/24/2005	12/23/2006
Coaxial Cables	N/A	No. 3, 4	N/A	12/01/2005	12/01/2206

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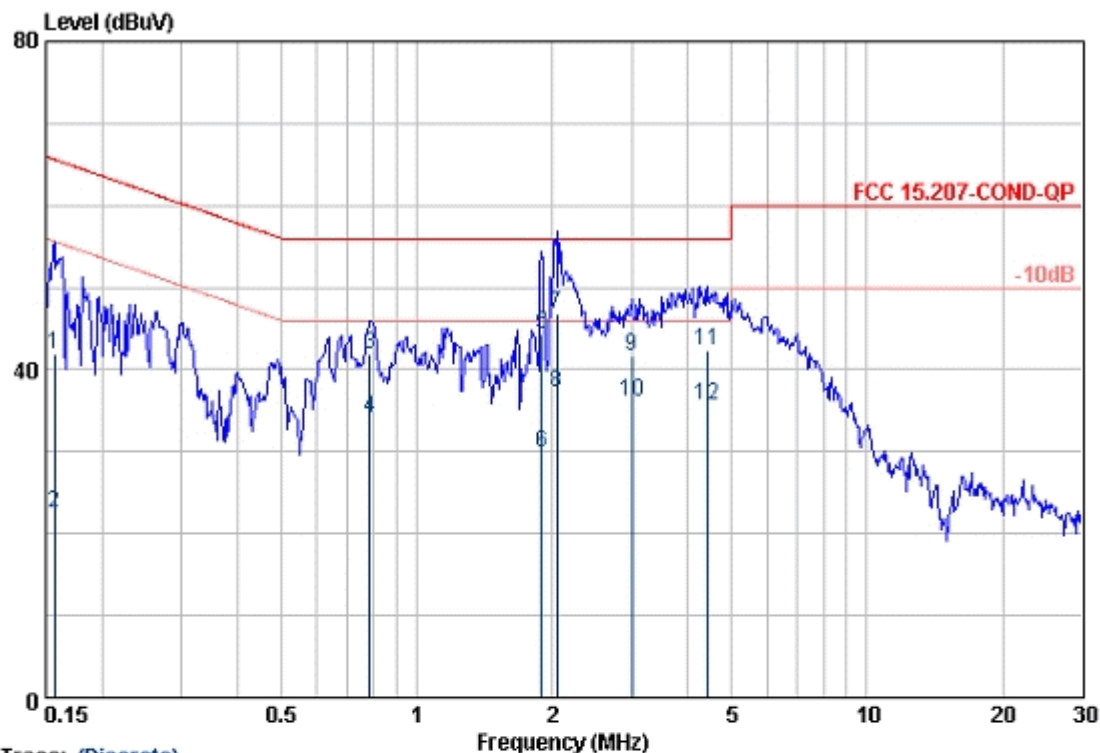
#### 4.4 Measurement Result:

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

## AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	OPERATION & CHARGE MODE		Test Date:	May. 10, 2006	
Temperature:	25 °C	Humidity:	65%	Test By:	Danny

Data: 1



Trace: (Discrete)

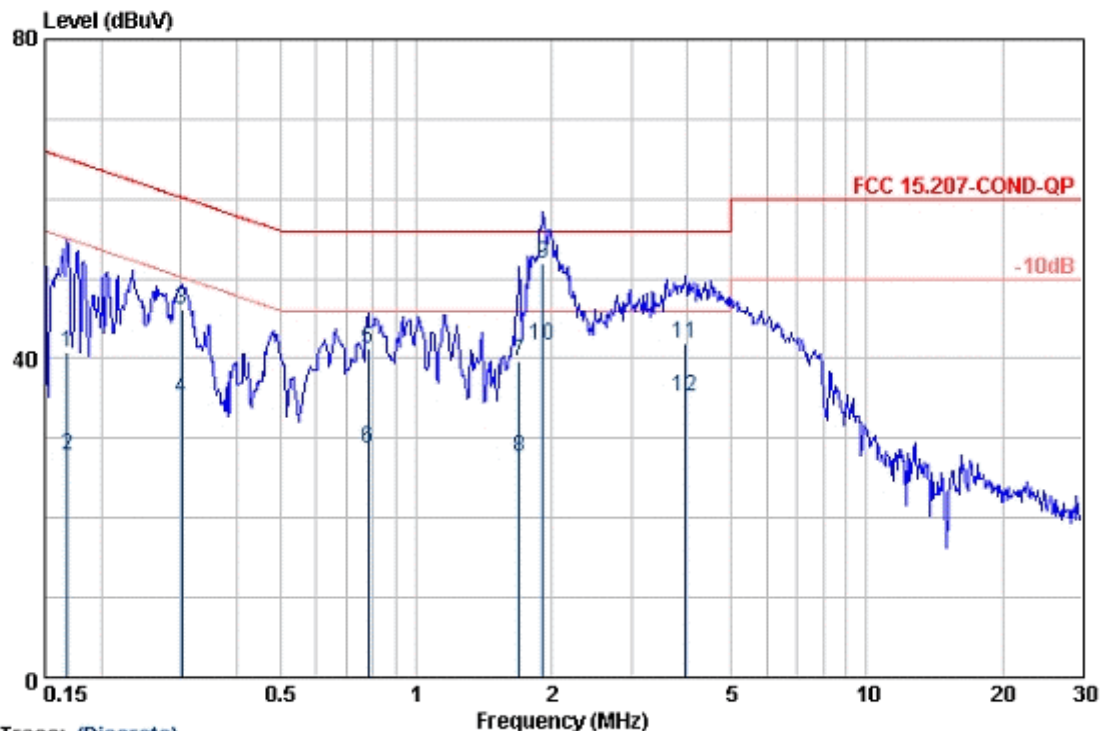
Site : RF Site  
Condition : FCC 15.207-COND-QP NNB-2/16Z(99012) LINE  
Project No. : EF-2006-40016  
Applicant : CARDO SYSTEM  
EUT Description : SCALA-DRIVER PASSENGER  
EUT Model : SCALA-DRIVER PASSENGER  
Test Mode : operation and charge  
Temp./Humid. : 25/65  
Operator : denny

	Freq	Pol/Phase	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz		dBuV	dB	dBuV	dBuV	dB	
1	0.16	LINE	41.77	0.20	41.97	65.65	-23.68	QP
2	0.16	LINE	22.22	0.20	22.42	65.65	-43.23	AVERAGE
3	0.79	LINE	41.75	0.21	41.96	56.00	-14.04	QP
4	0.79	LINE	33.82	0.21	34.03	56.00	-21.97	AVERAGE
5	1.89	LINE	44.21	0.22	44.43	56.00	-11.57	QP
6	1.89	LINE	29.73	0.22	29.95	56.00	-26.05	AVERAGE
7	2.04	LINE	46.51	0.22	46.73	56.00	-9.27	QP
8	2.04	LINE	36.95	0.22	37.17	56.00	-18.83	AVERAGE
9	3.01	LINE	41.40	0.28	41.68	56.00	-14.32	QP
10	3.01	LINE	35.77	0.28	36.05	56.00	-19.95	AVERAGE
11	4.41	LINE	41.96	0.35	42.31	56.00	-13.69	QP
12	4.41	LINE	35.21	0.35	35.56	56.00	-20.44	AVERAGE

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Operation Mode:	OPERATION & CHARGE MODE			Test Date:	May. 10, 2006
Temperature:	25 °C	Humidity:	65%	Test By:	Danny

Data: 2



Trace: (Discrete)

Site : RF Site  
Condition : FCC 15.207-COND-QP NNB-2/16Z(99012) NEUTRAL  
Project No. : EF-2006-40016  
Applicant : CARDO SYSTEM  
EUT Description : SCALA-DRIVER PASSENGER  
EUT Model : SCALA-DRIVER PASSENGER  
Test Mode : operation and charge  
Temp./Humid. : 25/65  
Operator : denny

	Freq	Pol/Phase	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz		dBuV	dB	dBuV	dBuV	dB	
1	0.17	NEUTRAL	40.53	0.20	40.73	65.03	-24.30	QP
2	0.17	NEUTRAL	27.54	0.20	27.74	65.03	-37.29	AVERAGE
3	0.30	NEUTRAL	45.94	0.20	46.14	60.19	-14.05	QP
4	0.30	NEUTRAL	34.85	0.20	35.05	60.19	-25.14	AVERAGE
5	0.78	NEUTRAL	40.98	0.21	41.19	56.00	-14.81	QP
6	0.78	NEUTRAL	28.54	0.21	28.75	56.00	-27.25	AVERAGE
7	1.69	NEUTRAL	39.34	0.22	39.56	56.00	-16.44	QP
8	1.69	NEUTRAL	27.40	0.22	27.62	56.00	-28.38	AVERAGE
9	1.91	NEUTRAL	51.62	0.22	51.84	56.00	-4.16	QP
10	1.91	NEUTRAL	41.49	0.22	41.71	56.00	-14.29	AVERAGE
11	3.96	NEUTRAL	41.48	0.34	41.82	56.00	-14.18	QP
12	3.96	NEUTRAL	34.90	0.34	35.24	56.00	-20.76	AVERAGE

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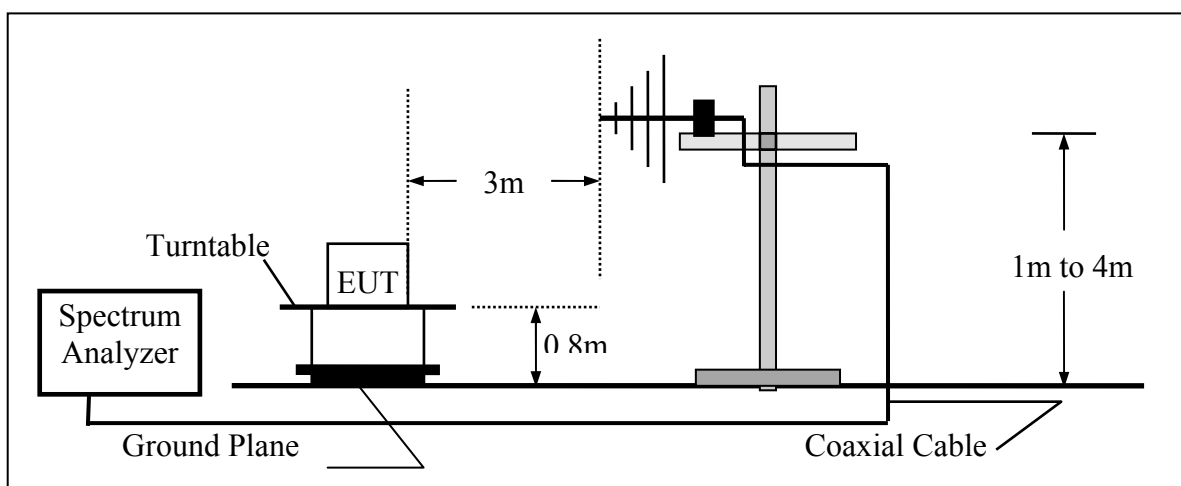
## 5. Radiated Emission Test

### 5.1 Measurement Procedure

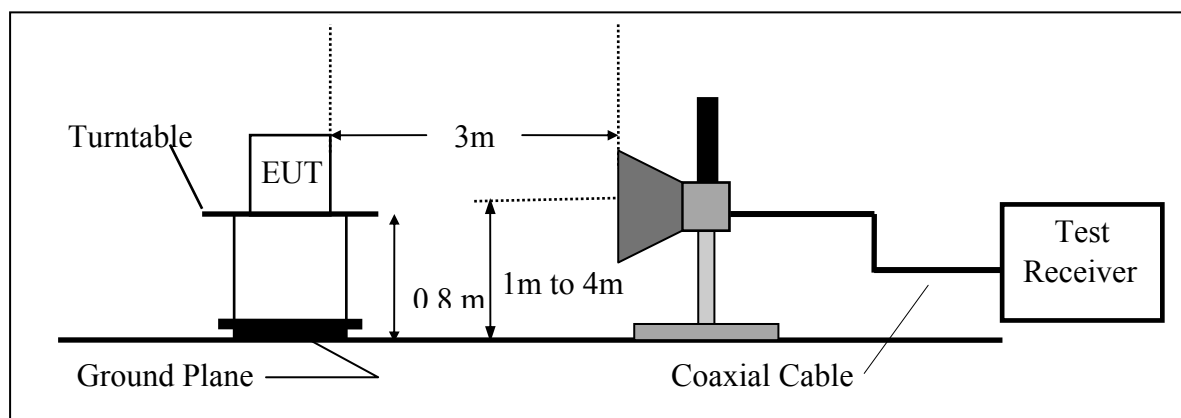
1. The EUT was placed on a turntable that is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measured were complete.

### 5.2 Test SET-UP (Block Diagram of Configuration)

(A) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(B) Radiated Emission Test Set-UP Frequency Over 1 GHz



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### 5.3 Measurement Equipment Used:

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	E4446A	MY43360126	03/29/2006	03/28/2007
Spectrum Analyzer	Agilent	E7405A	US41160416	08/27/2005	08/26/2006
Bilog Antenna	SCHWAZBECK	VULB9163	152	06/03/2005	06/02/2006
Horn antenna	Schwarzbeck	BBHA 9120D	309/320	08/16/2005	08/15/2006
Horn antenna	Schwarzbeck	BBHA 9170	184/185	07/04/2005	07/03/2006
Pre-Amplifier	HP	8447D	2944A09469	07/19/2005	07/18/2006
Pre-Amplifier	HP	8449B	3008A00578	02/26/2006	02/25/2007
Turn Table	HD	DT420	N/A	N.C.R	N.C.R
Antenna Tower	HD	MA240-N	240/657	N.C.R	N.C.R
Controller	HD	HD100	N/A	N.C.R	N.C.R
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA-10M	10m	10/09/2005	10/08/2006
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	10/09/2005	10/08/2006
Site NSA	SGS	966 chamber	N/A	11/17/2005	11/16/2006

### 5.4 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	



## 5.5 Measurement Result

### Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode	TX CH Low	Test Date	May. 10, 2006
Fundamental Frequency	2402MHz	Test By	Danny
Temperature	25 °C	Pol	Ver./Hor
Humidity	65 %		

Freq. (MHz)	Ant.Pol. H/V	Detector Mode (PK/QP)	Reading (dBuV)	Factor (dB)	Actual FS (dBuV/m)	Limit3m (dBuV/m)	Safe Margin (dB)
33.88	V	Peak	46.18	-15.12	31.06	40.00	-8.94
56.19	V	Peak	48.2	-14.95	33.25	40.00	-6.75
33.88	H	Peak	41.17	-15.12	26.05	40.00	-13.95

#### Remark :

- (1) Measuring frequencies from 30 MHz to the 1GHz。
- (2) Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using Peak/QP detector mode.
- (3) Datas of measurement within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (4) The IF bandwidth of SPA between 30MHz to 1GHz was 100KHz, VBW=300KHz.

**Radiated Spurious Emission Measurement Result (above 1GHz)**

Operation Mode: TX CH Low  
 Fundamental Frequency: 2402MHz  
 Temperature : 25 °C  
 Humidity : 65 %

Test Date : May. 10, 2006  
 Test By: Danny  
 Pol: Vertical

Freq. (MHz)	Ant. Pol. H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Factor (dB)	Actual Peak FS (dBuV/m)	Actual AV FS (dBuV/m)	Peak Limit at 3m (dBuV/m)	AV Limit at 3m (dBuV/m)	Margin (dB)	
2402.0	V	82.97	--	-3.00	79.97	--	114.00	94.00	-14.03	F
2400.0	V	47.66	--	-3.40	44.26	--	74.00	54.00	-9.74	F
2331.8	V	54.78	35.1	-3.71	51.07	31.39	74.00	54.00	-22.61	H
2383.8	V	53.63	35.03	2.96	56.59	37.99	74.00	54.00	-16.01	E
2411.4	V	54.28	--	-3.34	50.94	--	74.00	54.00	-3.06	E
2440.4	V	52.39	--	-3.20	49.19	--	74.00	54.00	-4.81	H
7206.0	V	--	--			--	74.00	54.00		H
9608.0	V	--	--			--	74.00	54.00		H
12010.0	V	--	--			--	74.00	54.00		H
14412.0	V	--	--			--	74.00	54.00		H
16814.0	V	--	--			--	74.00	54.00		H
19216.0	V	--	--			--	74.00	54.00		H
21618.0	V	--	--			--	74.00	54.00		H
24020.0	V	--	--			--	74.00	54.00		H

Remark :

- (1) Measuring frequencies from 30MHz to the 10th of fundamental frequency.
- (2) Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB
- (3) "F" denotes fundamental frequency; "H" denotes harmonics frequency. "S" denotes spurious frequency.
- (4) Datas of measurement within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (5) Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- (6) Spectrum AV mode IF B bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

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**Radiated Spurious Emission Measurement Result (above 1GHz)**

Operation Mode: TX CH Low

Test Date : May. 10, 2006

Fundamental Frequency: 2402MHz

Test By: Danny

Temperature : 25 °C

Pol: Horizontal

Humidity : 68 %

Freq. (MHz)	Ant.Pol. H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Factor (dB)	Actual Peak FS (dBuV/m)	Actual AV FS (dBuV/m)	Peak Limit at 3m (dBuV/m)	AV Limit at 3m (dBuV/m)	Margin (dB)	
2402.0	H	82.91	--	-3.40	79.51	--	74.00	54.00	25.51	F
2400.0	H	46.69	--	-3.40	43.29	--	74.00	54.00	-10.71	F
1188.5	H	41.84	--	-8.65	33.19	--	74.00	54.00	-20.81	E
2331.8	H	54.59	35.21	-3.71	50.88	31.50	74.00	54.00	-22.50	H
2383.8	H	53.63	34.89	-3.49	50.14	31.40	74.00	54.00	-22.60	H
2441.4	H	53.95	--	-3.40	50.55	--	74.00	54.00	-3.45	E
2443.0	H	43.20	--	-3.17	40.03	--	74.00	54.00	-13.97	E
4796.0	H	58.43	34.16	2.95	61.38	37.11	74.00	54.00	-16.89	H
4804.0	H	--	--			--	74.00	54.00		H
7206.0	H	--	--			--	74.00	54.00		H
9608.0	H	--	--			--	74.00	54.00		H
12010.0	H	--	--			--	74.00	54.00		H
14412.0	H	--	--			--	74.00	54.00		H
16814.0	H	--	--			--	74.00	54.00		H
19216.0	H	--	--			--	74.00	54.00		H
21618.0	H	--	--			--	74.00	54.00		H
24020.0	H	--	--			--	74.00	54.00		H

Remark :

- (1) Measuring frequencies from 30MHz to the 10th of fundamental frequency .
- (2) Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB
- (3) "F" denotes fundamental frequency; "H" denotes harmonics frequency. "S" denotes spurious frequency.
- (4) Datas of measurement within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (5) Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- (6) Spectrum AV mode IF B bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

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## 6. 26 dB Band Width Measurement

### 6.1 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set ETU normal operating mode.
3. Set SPA Center Frequency = fundamental frequency, RBW, VBW = 100KHz, Span = 3MHz.
4. Set SPA Max hold. Mark peak, -26dB.

### 6.2 Test SET-UP (Block Diagram of Configuration)

Same as 4.2 Radiated Emission Measurement.

### 6.3 Measurement Equipment Used:

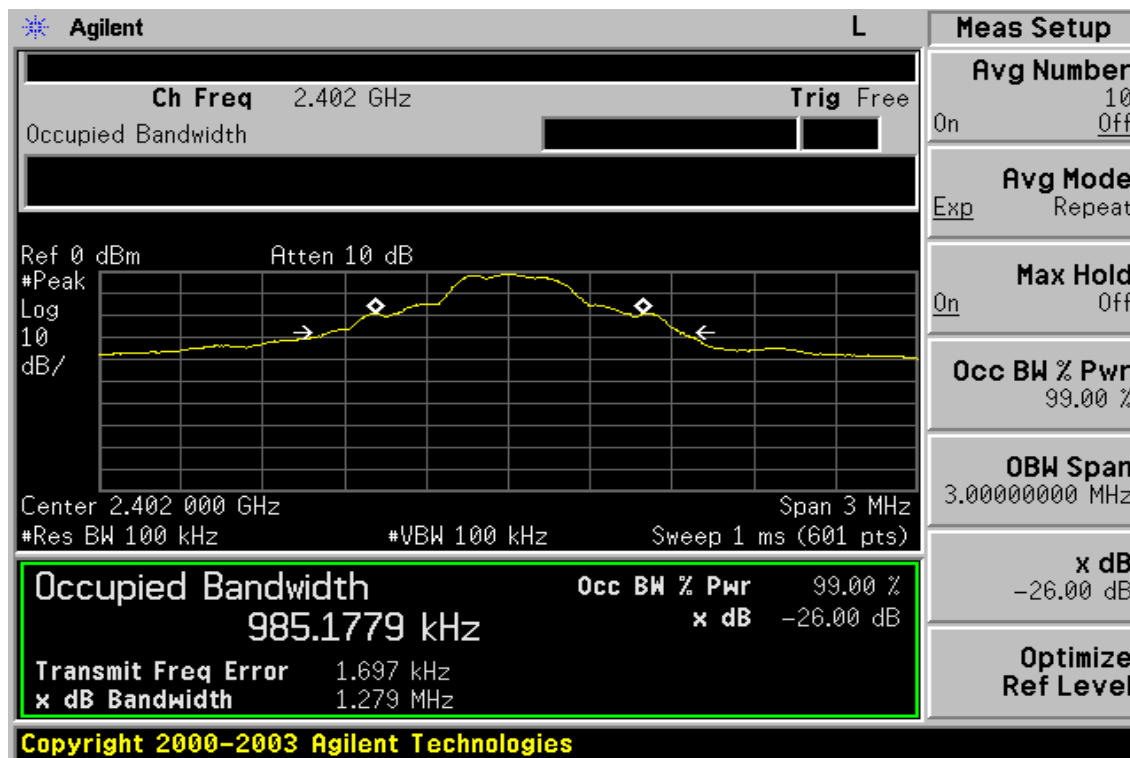
Same as 4.2 Radiated Emission Measurement.

### 6.4 Measurement Results:

26dB Bandwidth = 1.279 MHz

Refer to attached data chart.

## 26 dB Band Width test Plot



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