

# CFR 47 Part 22H EMC TEST REPORT

**Report No.:** EME-031333

**Model No.:** Q600

**Issued Date:** Dec. 17, 2003

**Applicant:** BENQ Corporation  
No. 157, Shan-Ying Road, Gueishan, Taoyuan 333,  
Taiwan

**Test By:** Intertek Testing Services Taiwan Ltd.  
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Project Engineer



Jerry Liu

Reviewed By



Elton Chen

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**Summary of Tests****Q600 Mobile Phone-Model: Q600  
FCC ID: JVPH1222**

<i>Test</i>	<i>Reference</i>	<i>Results</i>
Effective Radiated Power (ERP)	C.F.R. 47 Part 22 Section 22.913 (a)	Complies
Transmitter Frequency Stability Versus Temperature	C.F.R. 47 Part 22 Section 22.355	Complies
Transmitter Frequency Stability Versus Voltage	C.F.R. 47 Part 22 Section 22.355	Complies
Occupied Bandwidth	C.F.R. 47 Part 22 Section 2.1049 (i)	Complies
Band Edges	C.F.R. 47 Part 2 Section 2.1053	Complies
Radiated Spurious Emission test	C.F.R. 47 Part 15 Section 15.109	Complies
Power Line Conducted Emission test	C.F.R. 47 Part 15 Section 15.107	Complies

## 1. General information

### 1.1 Identification of the EUT

Applicant:	BENQ Corporation
Product:	Q600 Mobile Phone
Model Number:	Q600
Series Number:	Not Labeled
ESN Number:	7148001
FCC ID.:	JVPH1222
Frequency Range (Tx):	824-849MHz
Frequency Range (Rx):	869-894MHz
Type of Modulation:	OQPSK
Nominal Power:	3.8Vdc 580mA
End Point Voltage:	3.4Vdc
Power Cord:	N/A
Sample Received:	Dec. 8, 2003
Test Date(s):	Dec. 8, 2003 to Dec. 16, 2003

### 1.2 Additional information about the EUT

The EUT is a single band (850MHz) CDMA mobile phone.

For more detail features, please refer to User's manual as file name "Installation guide.pdf"

### 1.3 Antenna description

The antenna is affixed to the EUT using a unique connector, which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector.

Antenna Gain: 2.51dBi

Antenna Type: Helix

Connector Type: HRS (MS-156)

### 1.4 Voltage and current through final PA

According to 2.1033 (c) (8) the voltage is 3.8Vdc, and the current is 0.37A.

### 1.5 Supporting Equipment

Peripherals	Manufacturer	Product No.	Serial No.	FCC ID
Earphone	PHIHONG	HSM0961	N/A	N/A

## 2. Test Specifications

### 2.1 Test Methods and Procedures

#### *ANSI/TIA-603-B-2002*

Land Mobile Communications Equipment, Measurements and performance Standards

#### *ANSI C63.4 (2001)*

America National Standard Methods of Measurement of Electromagnetic Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz.

### 2.2 Operation Mode

During testing, the EUT was powered by a nominal 3.8Vdc battery.

The EUT was transmitted continuously with its maximum output power during the tests, unless otherwise stated.

The test configuration is defined as below:



Setup 1

Setup 2

Setup 3

#### 2.2.1 Tested Channels

	Channel Identification	Channel Number	Channel Frequency (MHz)
Tested channels (Transmit)	Low	1013	824.70
	Middle	384	836.52
	High	777	848.31

### 2.3 Test equipment

Equipment	Brand	Specification	Model No.	Series No.	Last Cal.Date
EMI Test Receiver	Rohde & Schwarz	9kHz~2.75GHz	ESCS 30	825788/014	Feb. 18, 2003
EMI Test Receiver	Rohde & Schwarz	20Hz~26.5GHz	ESMI	825428/005	June 10, 2003
Spectrum Analyzer	Rohde & Schwarz	9kHz~30GHz	FSP 30	100137	July 10, 2003
Spectrum Analyzer	Rohde & Schwarz	20Hz~40GHz	FSEK 30	100186	Oct. 20, 2003
Horn Antenna	EMCO	1GHz~18GHz	3115	9906-5890	Oct. 15, 2003
Horn Antenna	SCHWARZBECK	14GHz~40GHz	BBHA 9170	159	June 21, 2003
Bilog Antenna	SCHWARZBECK	25MHz~1.7GHz	VULB 9160	3133	Feb. 21, 2003
Microwave Amplifier	Agilent	2GHz~26.5GHz	8348A	3111A00567	Dec. 20, 2002
Crystal Detector	Agilent	10MHz~18GHz	8472B	MY42240243	N/A
Signal Generator	Rohde & Schwarz	20MHz~27GHz	SMR27	100036	Aug. 15, 2003
Two Channel Digital Storage Oscilloscope	Tektronix	N/A	TDS1012	C031679	Aug. 16, 2003
Precision Half-Wave Dipole Set	Rohde & Schwarz	300M-1GHz	HZ-13	848530/0005	July 10, 2003
Temperature Humidity Test Chamber	JUROR	N/A	TR-4010	S22033	Aug. 29, 2003
RF Power Meter	Boonton	10kHz~100GHz	4231A	79401	Mar. 25, 2003
Power Sensor	Boonton	30MHz~8GHz	51011-EMC	32482	Mar. 25, 2003

Note: The above equipments are within the valid calibration period.



### 3. Effective Radiated Power (ERP)

#### 3.1 Operating environment

Temperature:	25	°C
Relative Humidity:	56	%
Atmospheric Pressure	1023	hPa

#### 3.2 Test setup & procedure

Tests were performed to identify the maximum effective radiated output power (ERP) from the EUT in the three orthogonal axes.

The ERP was measured with the EUT arranged on a non-conducting table on a semi-anechoic chamber.

The test procedure is consist of three parts:

1. Measured the highest peak readings in horizontal & vertical polarity in the three orthogonal axes.
2. Use the substitution method to perform final tests.
  - I. The EUT was substituted with a half wave dipole.
  - II. The substituted antenna was set to the same center location as the EUT in horizontal or vertical polarity.
  - III. The substituted antenna was connected with a 6dB attenuator for impedance matching purpose between S/G and substituted antenna.
  - IV. The S/G was tuned to the frequency according to the measurement results from step 1.
  - V. The measuring antenna was raised and lowered to obtain a maximum reading.
  - VI. The level of S/G was adjusted until the maximum reading is the same as recorded EUT level. (A power amplifier maybe used to produce the wanted power)
3. The ERP was calculated as:

$$\text{ERP} = \text{S/G level} - \text{cable loss} + \text{antenna gain}$$

The maximum ERP test results are recorded in the following table.

**3.3 Measured data of Effective Radiated Power (ERP) test results**

Channel	Frequency (MHz)	Conducted Power (dBm)	Antenna Polarity (H/V)	E.R.P. (dBm)	Limit (dBm)	Margin (dB)	Remark
Low	824.7	24.30	H	30.94	38.4	-7.46	Setup 1
Middle	836.52	24.14	H	31.10	38.4	-7.30	Setup 1
High	848.31	24.06	H	31.18	38.4	-7.22	Setup 1

Remark:

Margin (dB) = E.R.P. (dBm) – Limit (dBm)

Expanded uncertainty (k=2) of Effective Radiated Power (ERP) measurement is  $\pm 4.2$  dB.

## 4. Transmitter Frequency Stability Versus Temperature

### 4.1 Operating environment

Temperature: -30 ~ 50 °C  
Atmospheric Pressure 1023 hPa

### 4.2 Test setup & procedure

The EUT was operated in an environmental control chamber, and measurements were performed at extreme temperature conditions.

The EUT was controlled to produce a single carrier (CW) by a special software “Magnify V6.0.0.3”

Tests were performed to identify the maximum frequency error of the EUT with variations in ambient temperature.

The EUT was switched off for a minimum of 30 minutes between each stage of testing while the environmental chamber stabilized at the next temperature within the stated temperature range.

The frequency error using the following formula as defined by TIA/EIA/603:

$$\text{ppm error} = \left( \frac{MCF_{\text{MHz}}}{ACF_{\text{MHz}}} - 1 \right) * 10^6$$

Where  $MCF_{\text{MHz}}$  is the measured carrier frequency

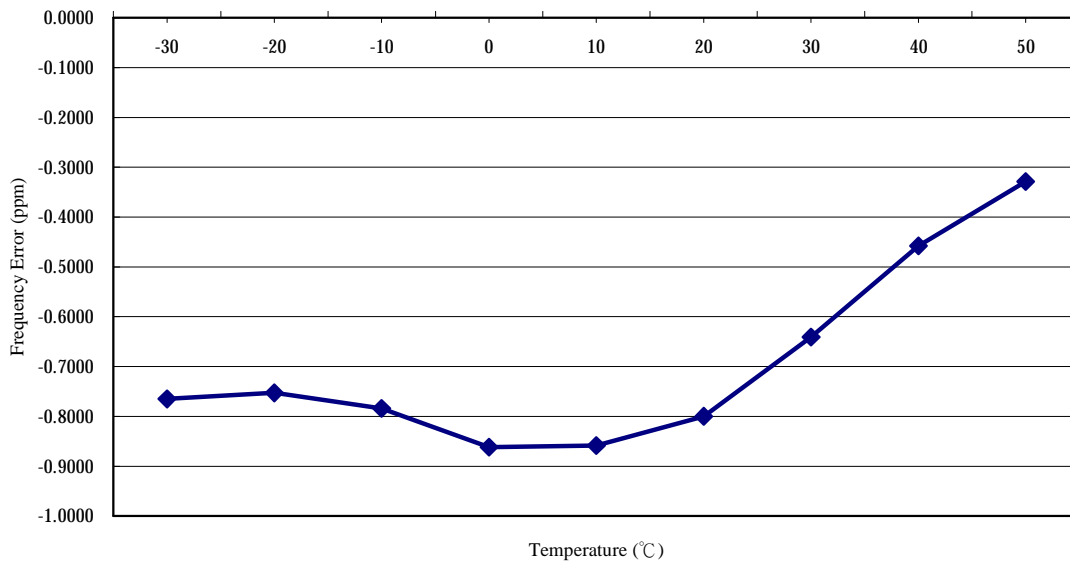
$ACF_{\text{MHz}}$  is the assigned carrier frequency

### 4.3 Measured data of Transmitter Frequency Stability Versus Temperature test results

*Test Condition: Middle Channel*

Temperature (°C)	Nominal Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (ppm)	Limit (ppm)
-30	836.52	836.519360	-0.7651	2.5
-20	836.52	836.51937	-0.7531	2.5
-10	836.52	836.519344	-0.7842	2.5
0	836.52	836.519279	-0.8619	2.5
10	836.52	836.519282	-0.8583	2.5
20	836.52	836.519331	-0.7997	2.5
30	836.52	836.519464	-0.6407	2.5
40	836.52	836.519617	-0.4578	2.5
50	836.52	836.519725	-0.3287	2.5

**Frequency Tolerance FCC 22.355**



## 5. Transmitter Frequency Stability Versus Voltage

### 5.1 Operating environment

Temperature: 25 °C  
Relative Humidity: 56 %  
Atmospheric Pressure 1023 hPa

### 5.2 Test setup & procedure

Tests were performed to identify the maximum frequency error of the EUT with variations in nominal operating voltage.

The EUT was controlled to produce a single carrier (CW) by a special software “Magnify V6.0.0.3”

Measurements were performed at voltage extremes between the declared nominal supply voltage and at the declared end point voltage.

The frequency error using the following formula as defined by TIA/EIA/603:

$$\text{ppm error} = \left( \frac{MCF_{\text{MHz}}}{ACF_{\text{MHz}}} - 1 \right) * 10^6$$

Where  $MCF_{\text{MHz}}$  is the measured carrier frequency

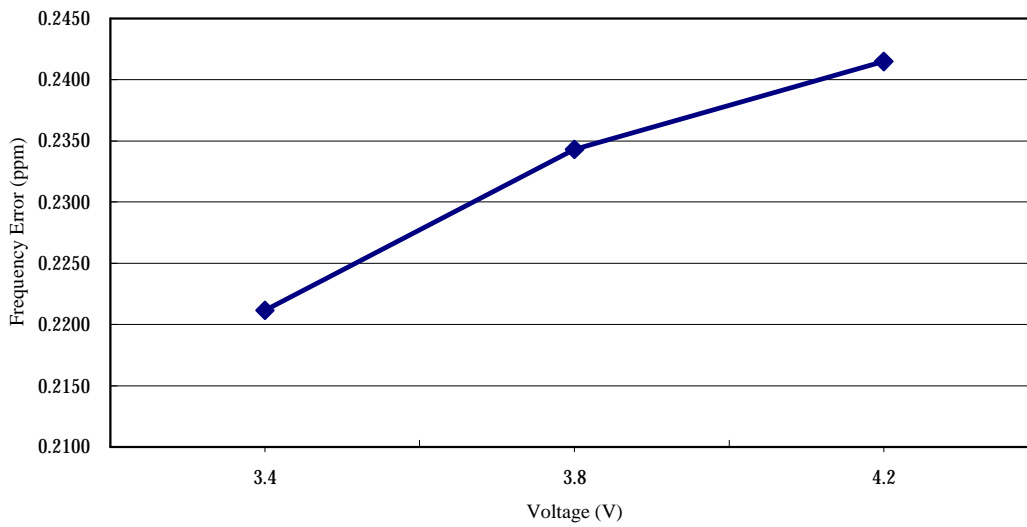
$ACF_{\text{MHz}}$  is the assigned carrier frequency

**5.3 Measured data of Transmitter Frequency Stability Versus Voltage test result**

*Test Condition: Middle Channel*

Supply Voltage (Vdc)	Nominal Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (ppm)	Limit (ppm)
3.4	836.52	836.520185	0.2212	2.5
3.8	836.52	836.520196	0.2343	2.5
4.2	836.52	836.520202	0.2415	2.5

**Frequency Tolerance FCC 22.355**



## 6. Occupied Bandwidth

### 6.1 Operating environment

Temperature: 25 °C  
Relative Humidity: 56 %  
Atmospheric Pressure 1023 hPa

### 6.2 Test setup & procedure

Tests were performed to identify the maximum bandwidth occupied by the fundamental frequency of the EUT.

The tests were performed in radiated measurement configuration.

The EUT was operated at its normal modulation.

The occupied bandwidth was measured using the built in occupied bandwidth function of spectrum analyzer. It was set to measure the bandwidth where 99% of the signal power was contained. The RBW was set to 30kHz, and VBW  $\geq$  RBW.

### 6.3 Measured data of Occupied Bandwidth test result

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)
Low	824.70	1.272
Middle	836.52	1.268
High	848.31	1.284

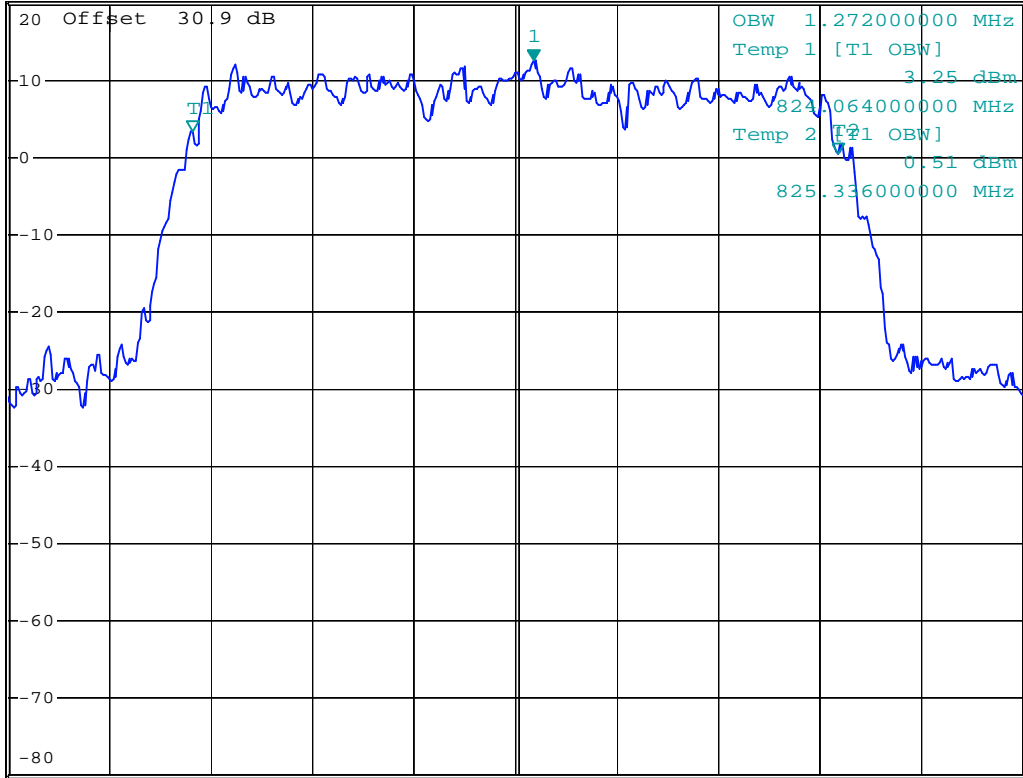
Please see the plots below.



**MARKER 1**  
 824.736 MHz  
 Ref 20 dBm Att 10 dB

\*RBW 30 kHz Marker 1 [T1 ]  
 VBW 100 kHz 12.63 dBm  
 SWT 2.5 ms 824.736000000 MHz

1 PK  
 VIEW



Center 824.7 MHz 200 kHz/ Span 2 MHz

Comment A: BenQ Q600 Occupied Bandwidth at Bottom channel  
 Date: 10.DEC.2003 16:51:10

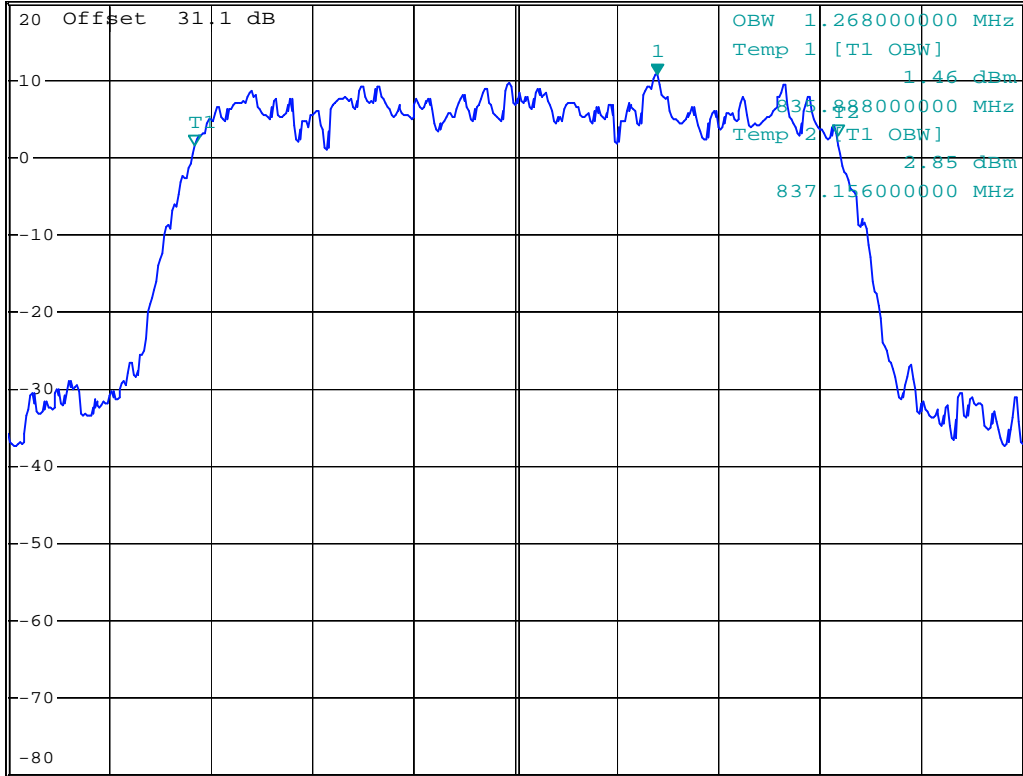




**MARKER 1**  
 836.8 MHz  
 Ref 20 dBm Att 10 dB

\*RBW 30 kHz Marker 1 [T1 ]  
 VBW 100 kHz 10.67 dBm  
 SWT 2.5 ms 836.80000000 MHz

1 PK  
 VIEW



A

LVL

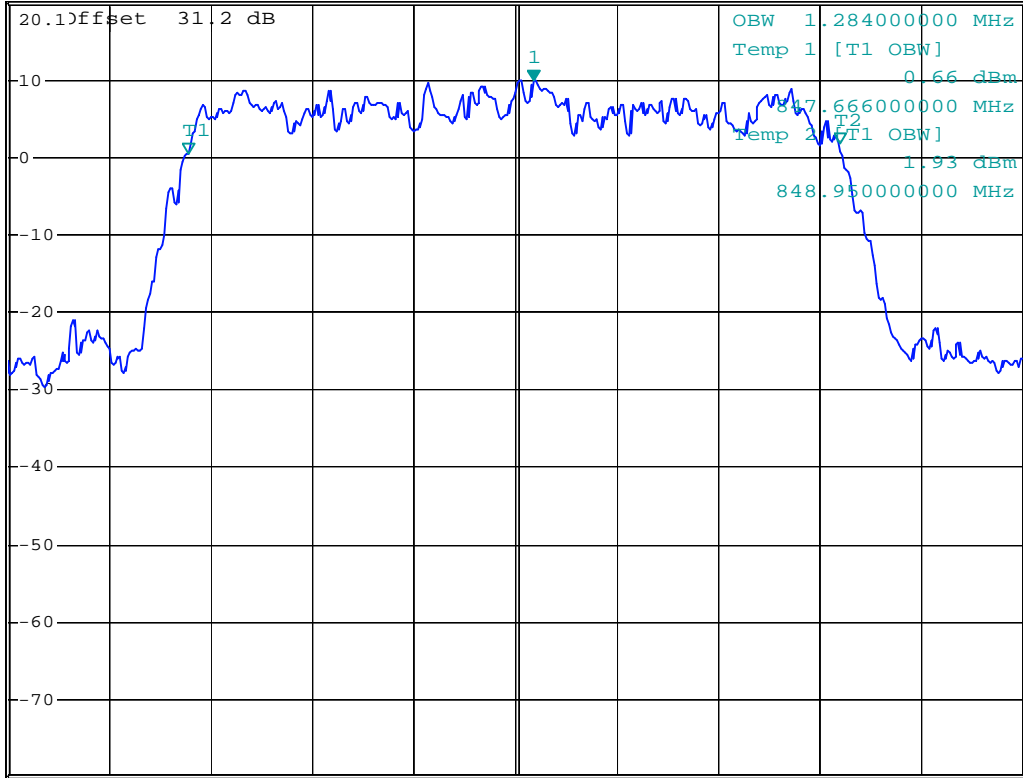
Comment A: BenQ Q600 Occupied Bandwidth at Middle channel  
 Date: 10.DEC.2003 16:58:50



**MARKER 1**  
 848.346 MHz  
 Ref 20.1 dBm Att 10 dB

\*RBW 30 kHz Marker 1 [T1 ]  
 VBW 100 kHz 10.04 dBm  
 SWT 2.5 ms 848.346000000 MHz

1 PK  
 VIEW



Center 848.31 MHz 200 kHz/ Span 2 MHz

Comment A: BenQ Q600 Occupied Bandwidth at Top channel  
 Date: 10.DEC.2003 16:56:47

## 7. Band Edges Test

### 7.1 Operating environment

Temperature: 25 °C  
Relative Humidity: 57 %  
Atmospheric Pressure 1023 hPa

### 7.2 Test setup & procedure

Tests were performed to identify the maximum emission levels at the band edges of the frequency block of operation.

### 7.3 Measured data of Band Edges test result

Channel	Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dBm)
Low	824.00	-14.69	-13	-1.69
High	849.00	-14.04	-13	-1.04

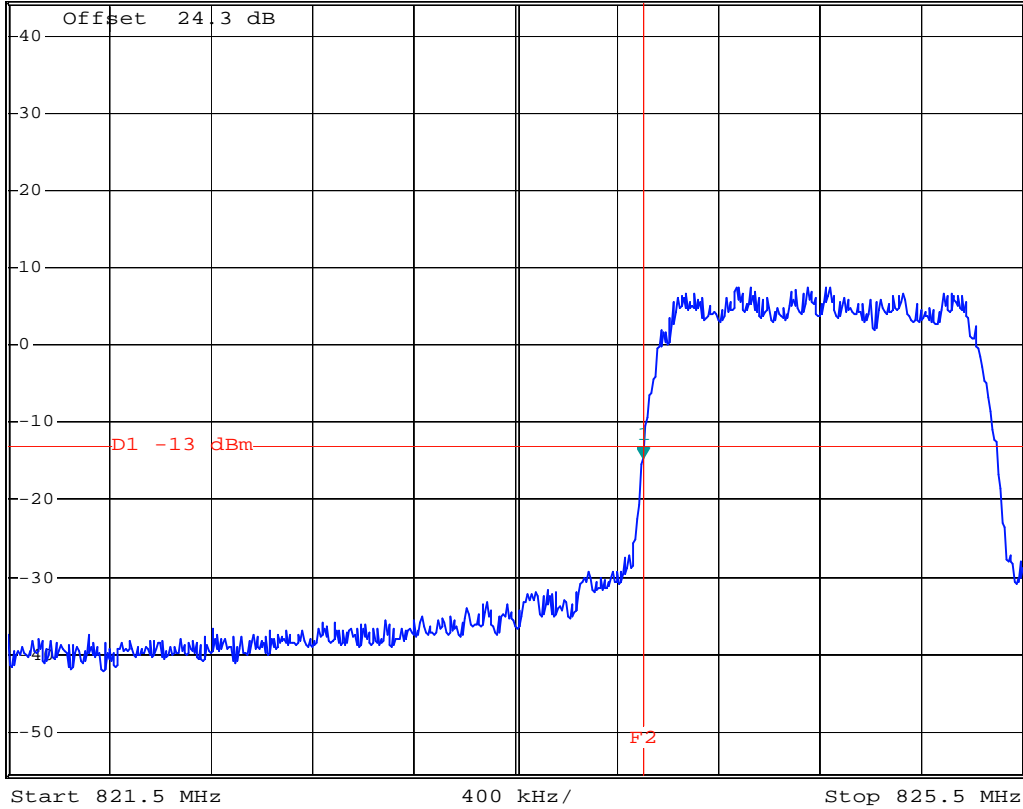
Please see the plots below.



**MARKER 1**  
 824 MHz  
 Ref 44.3 dBm \*Att 30 dB

\*RBW 30 kHz Marker 1 [T1 ]  
 \*VBW 30 kHz -14.63 dBm  
 SWT 10 ms 824.00000000 MHz

1 PK\*  
 VIEW



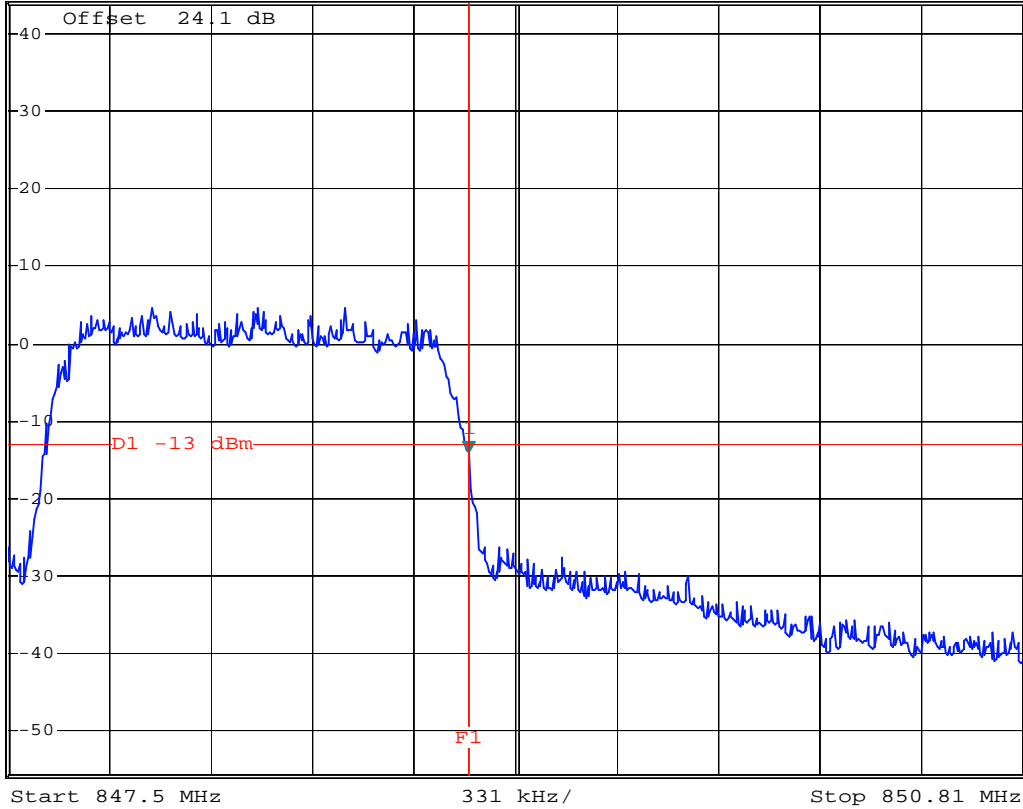
Comment A: BenQ Q600 Band-edge at low channelL{  
 F2=824MHz  
 Date: 16.DEC.2003 14:07:03



**MARKER 1**  
 849 MHz  
 Ref 44.1 dBm \*Att 30 dB

\*RBW 30 kHz Marker 1 [T1 ]  
 \*VBW 30 kHz -14.04 dBm  
 SWT 10 ms 849.00000000 MHz

1 PK\*  
 VIEW



Comment A: BenQ Q600 Band-edge at high channel↑  
 F1=849MHz  
 Date: 16.DEC.2003 14:11:45

## 8. Radiated Spurious Emission test

### 8.1 Operating environment

Temperature:	25	°C	(10-40°C)
Relative Humidity:	55	%	(10-90%)
Atmospheric Pressure	1023	hPa	(860-1060hPa)

### 8.2 Test setup & procedure

Tests were performed to identify the maximum out of band transmitter spurious emissions from the EUT in the band up to ten times the highest fundamental frequency.

The signal is maximized through rotation and placement in the three orthogonal axes.

The test was measured with the EUT arranged on a non-conducting table on a semi-anechoic chamber.

The test procedure is consist of three parts:

1. Measured the highest out of band transmitter spurious emission in horizontal & vertical polarity in the three orthogonal axes.
2. Use the substitution method to perform final tests.
  - I. The EUT was substituted with a half wave dipole or a horn antenna which depend on the frequency band under investigation.
  - II. The substituted antenna was set to the same center location as the EUT in horizontal or vertical polarity.
  - III. The substituted antenna was connected with a 6dB attenuator for impedance matching purpose between S/G and substituted antenna.
  - IV. The S/G was tuned to the frequency according to the measurement results from step 1.
  - V. The measuring antenna was raised and lowered to obtain a maximum reading.
  - VI. The level of S/G was adjusted until the maximum reading is the same as recorded emission level.
3. The ERP/EIRP was calculated as:

$$\text{ERP/EIRP} = \text{S/G level} - \text{cable loss} + \text{antenna gain}$$

The EUT configuration please refer to the “Spurious set-up photo.pdf”.

### **8.3 Emission limits**

An emission shall either be attenuated by at least  $43 + 10 \text{ Log (P)}$  dB below the transmitter power (P) for transmitters.

The transmit limit always reduces to  $-13$  dBm as such.

### **8.4 Uncertainty of Radiated Emission**

Uncertainty was calculated in accordance with NAMAS NIS 81.

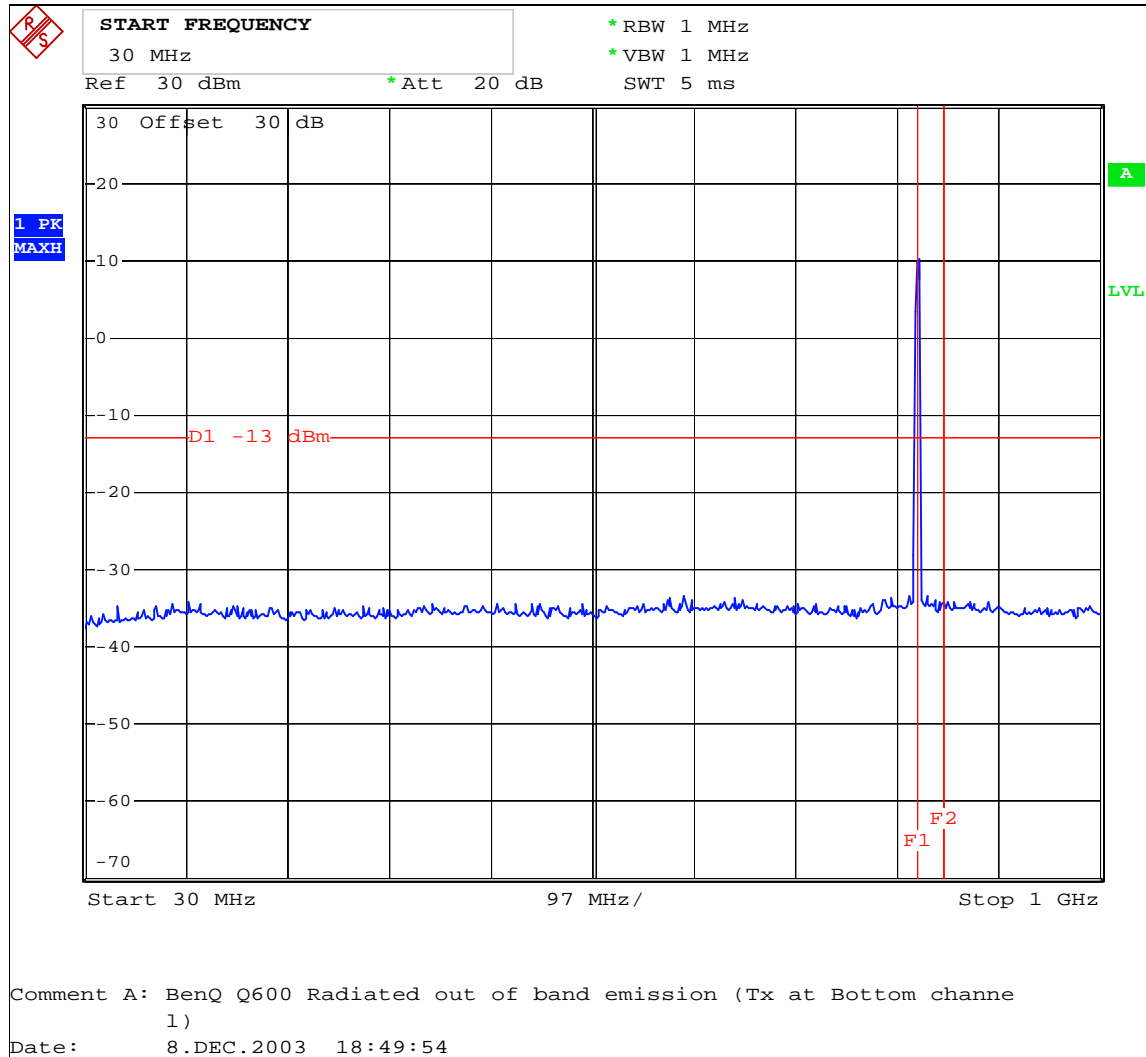
Expanded uncertainty (k=2) of radiated emission measurement is  $\pm 4.98$  dB.

### **8.5 Radiated spurious emission test data**

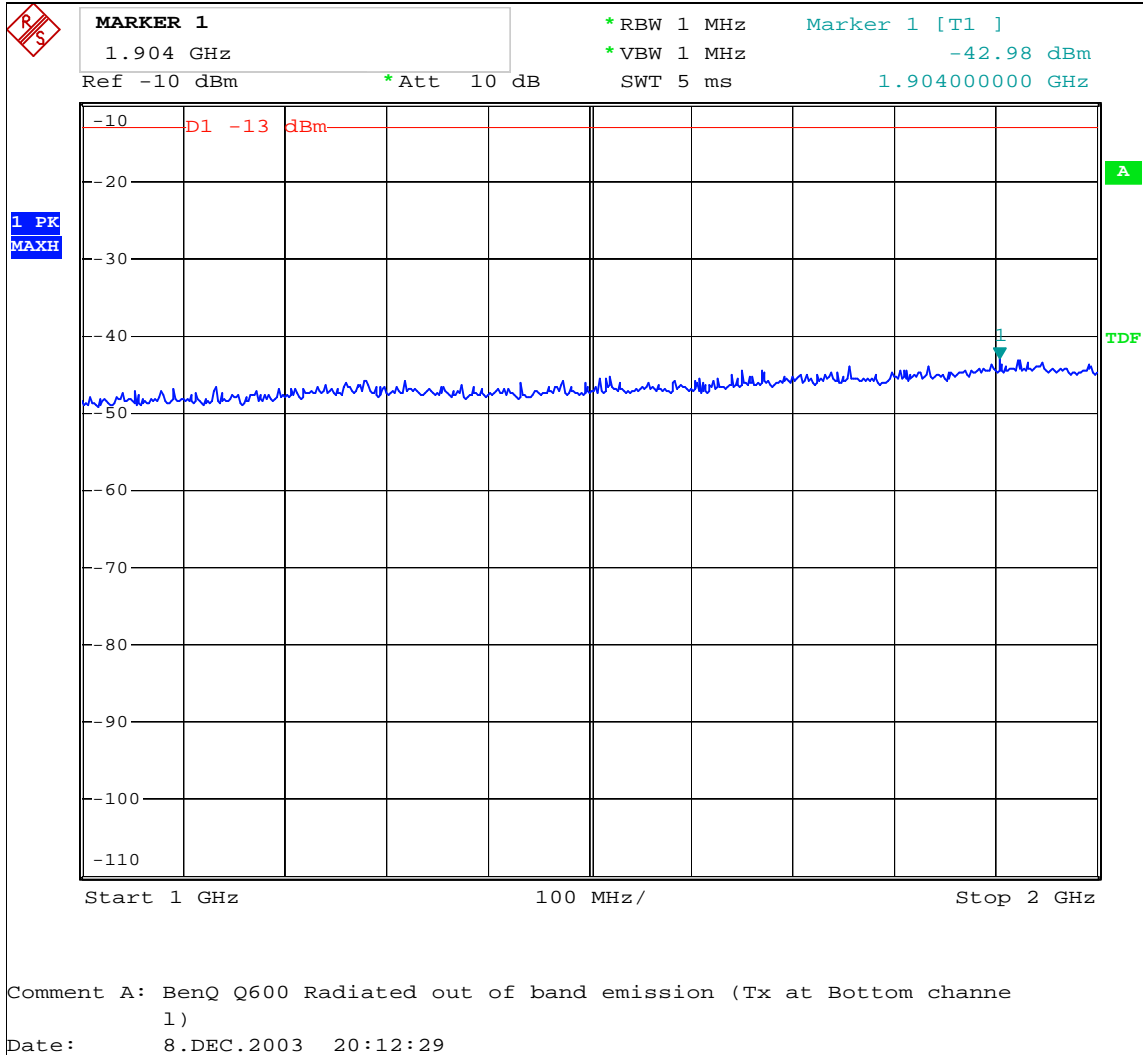
There is no emission found above the noise floor from 30MHz to 10GHz.

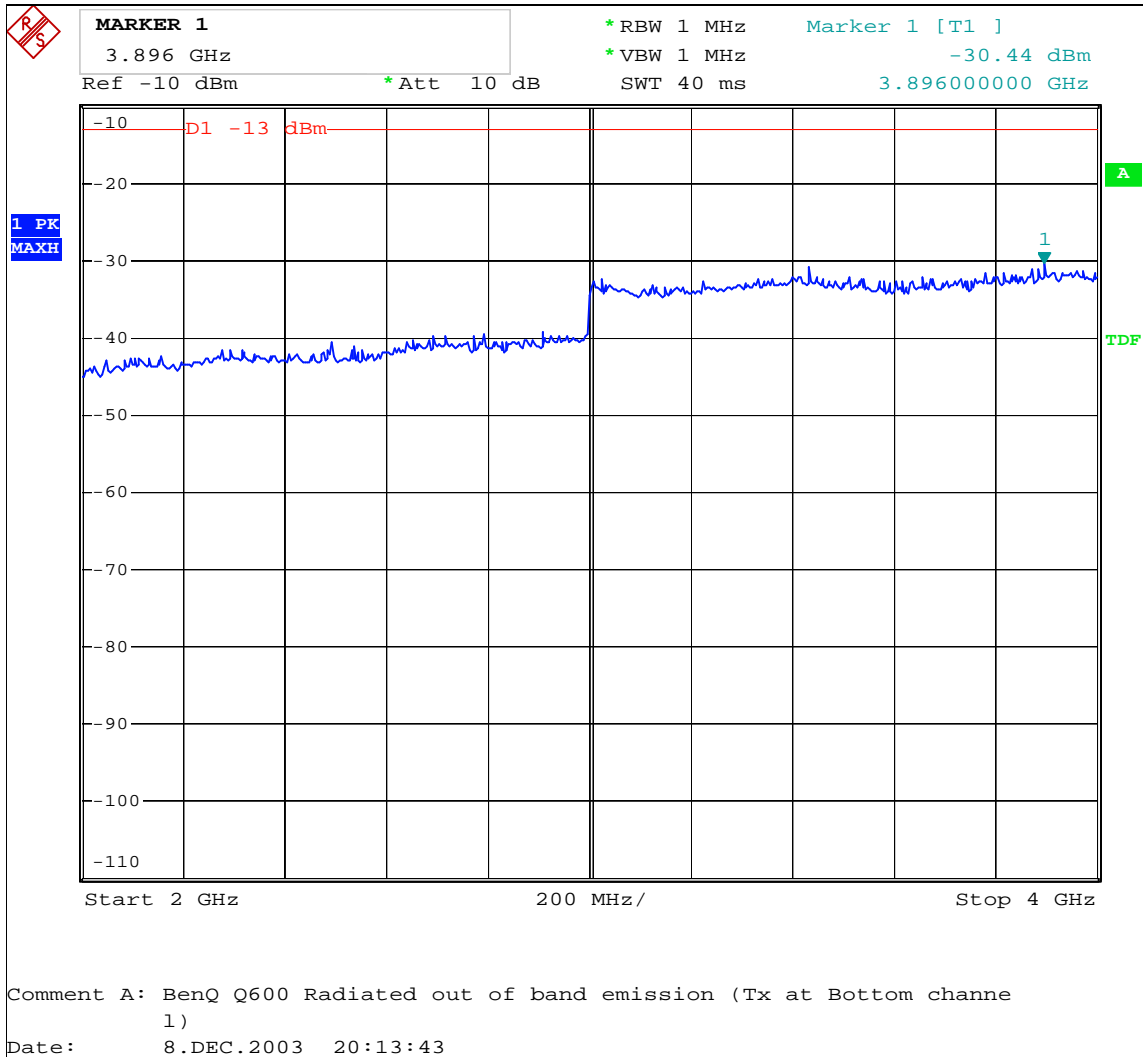
Please see the plot below.

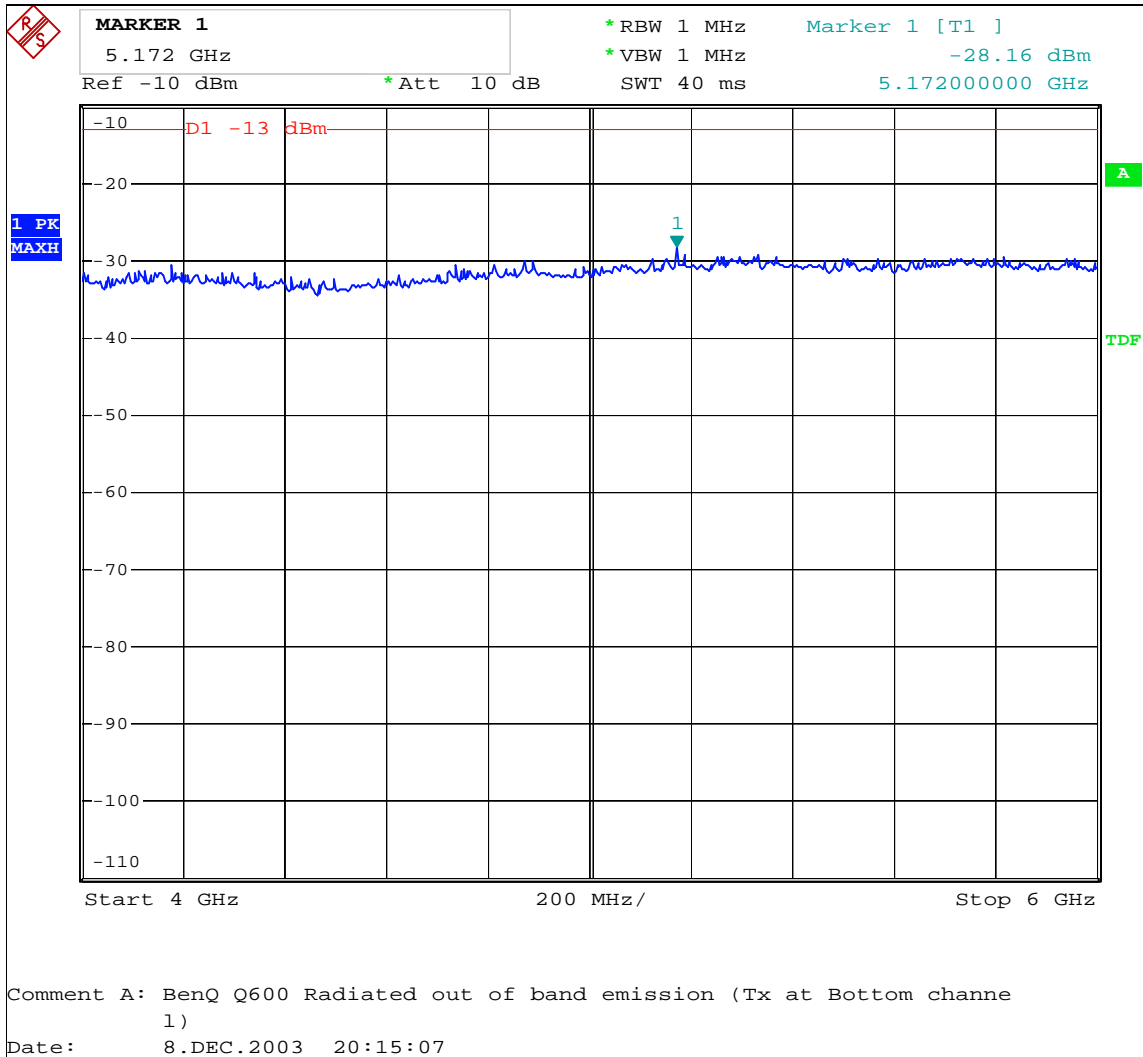
*Test Condition: Low Channel*

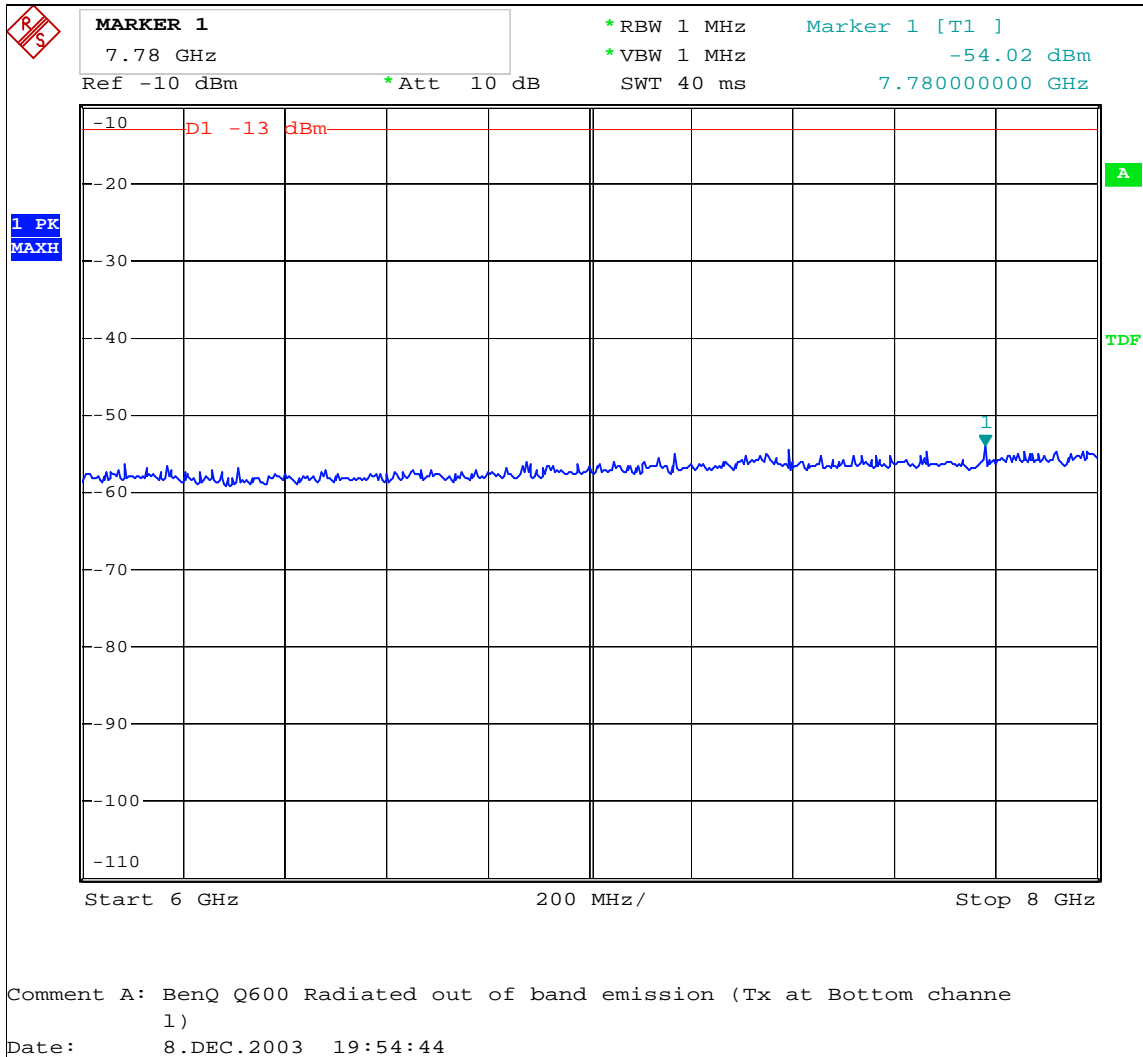


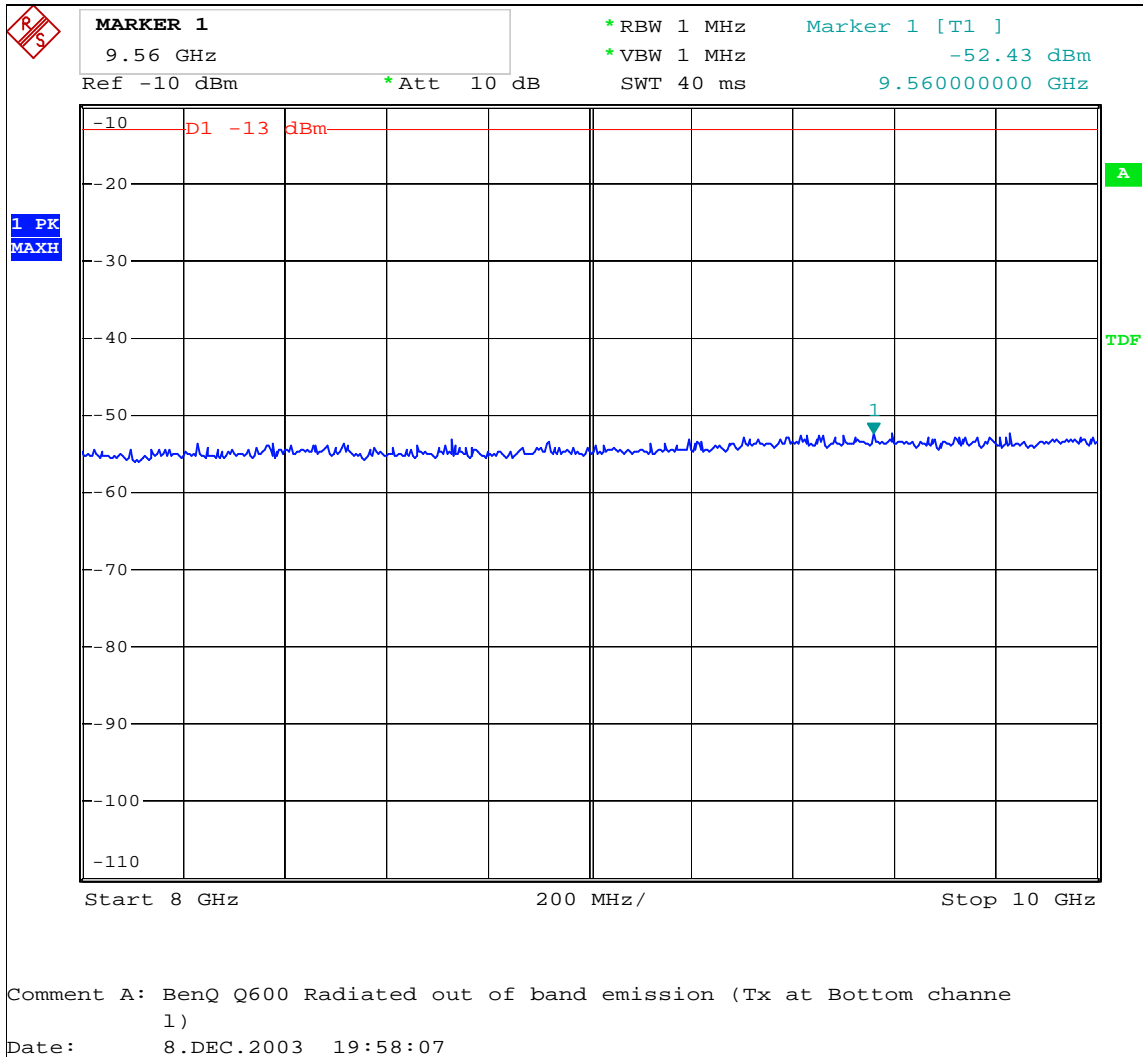




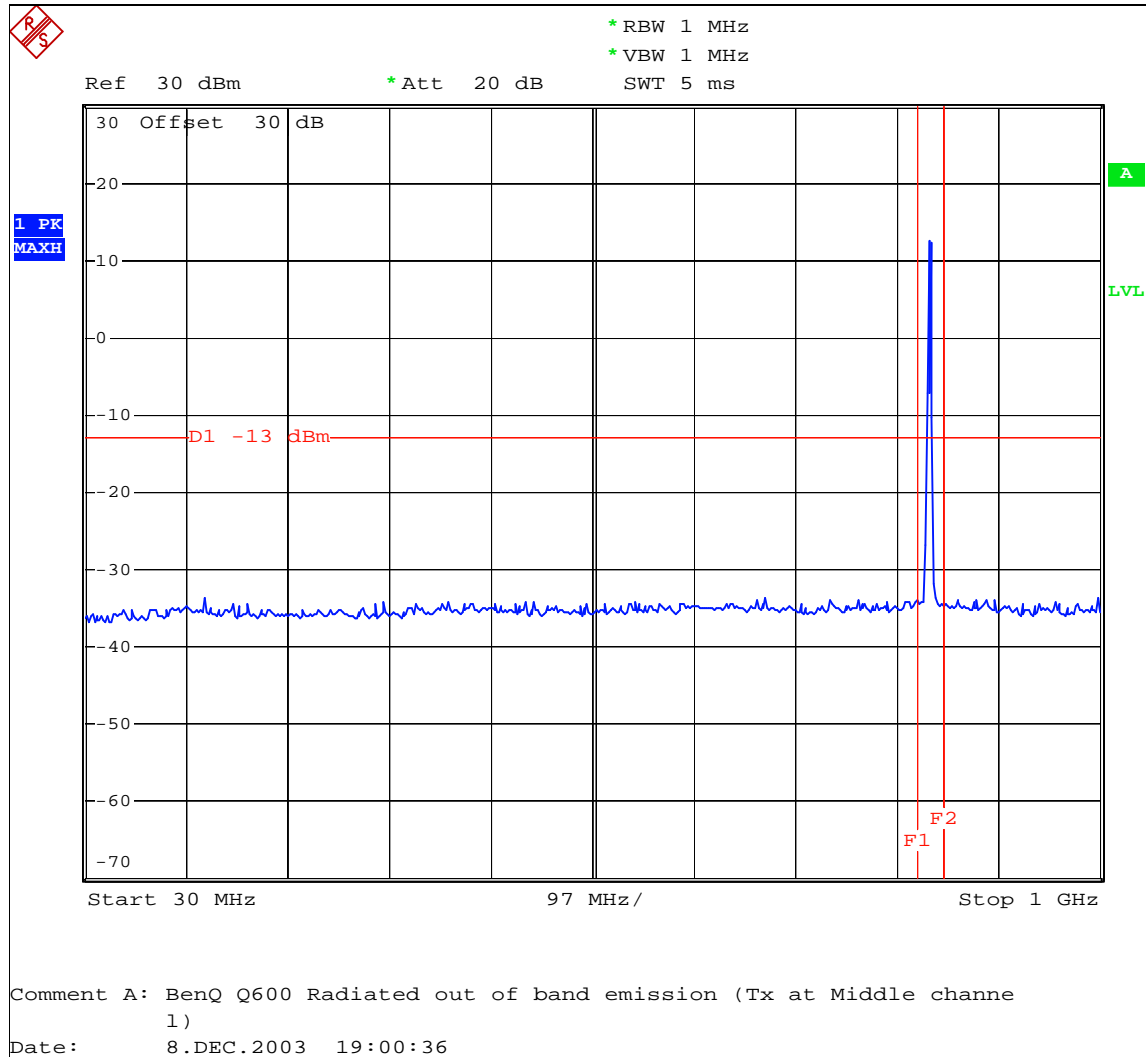


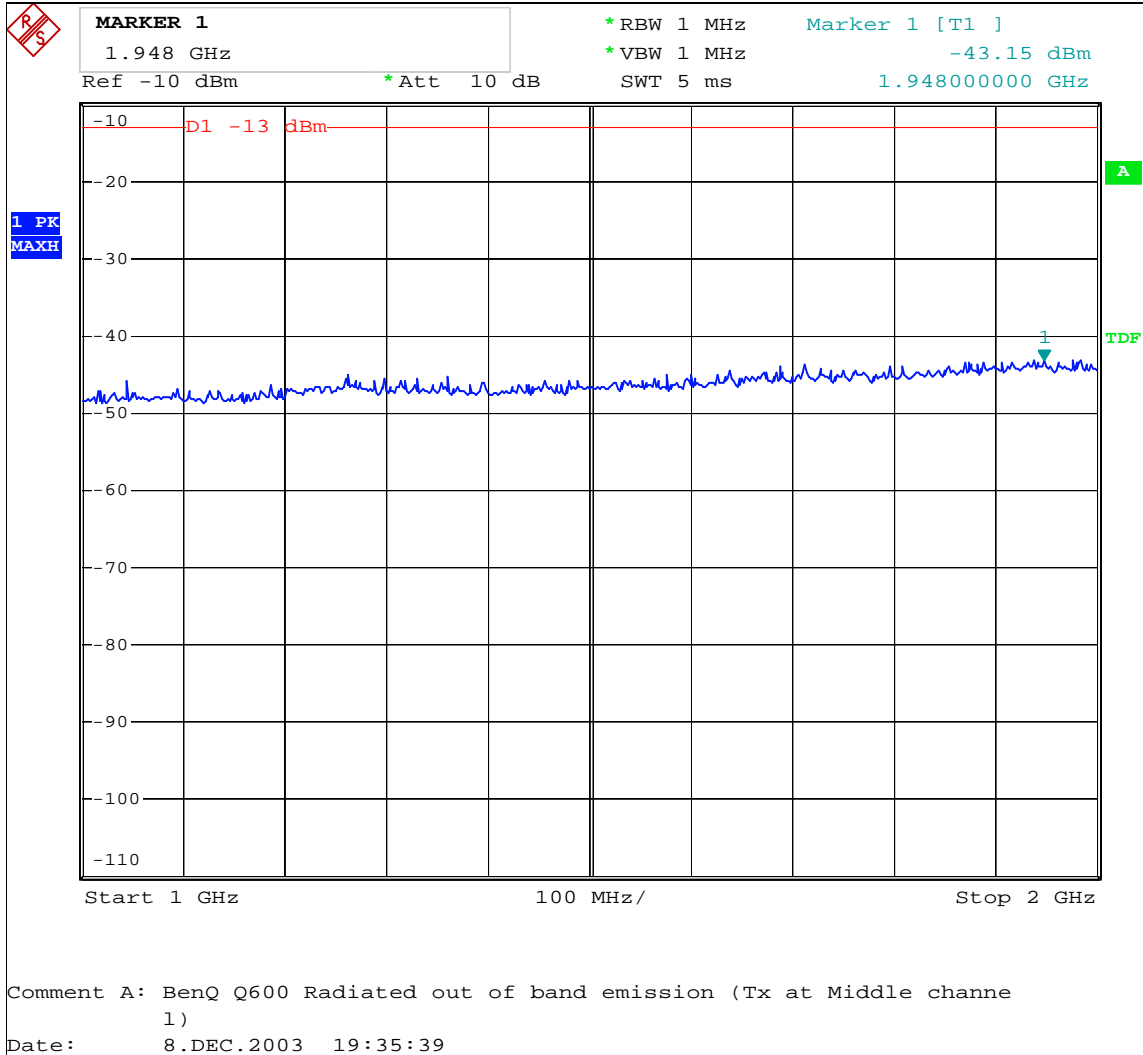


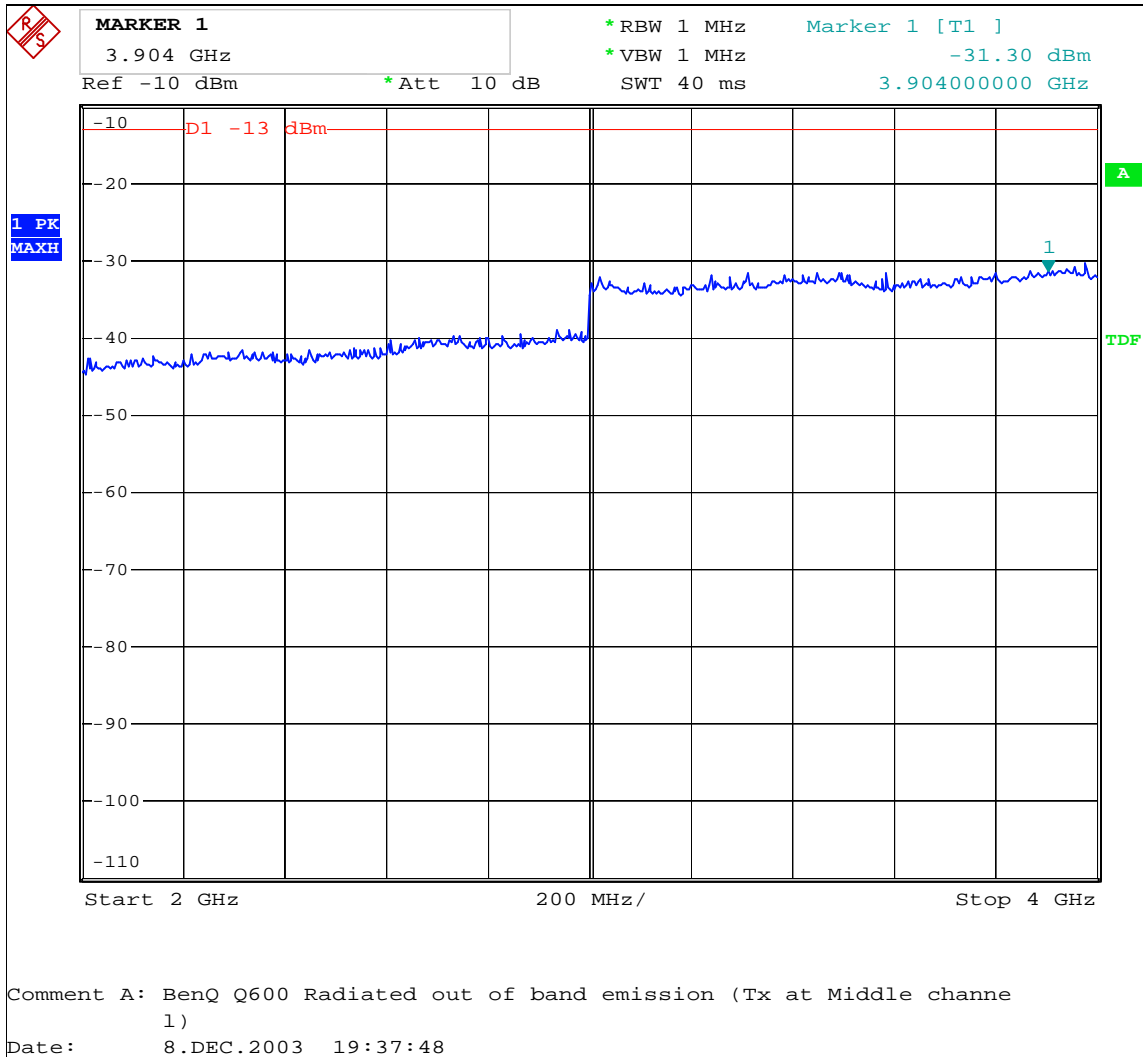




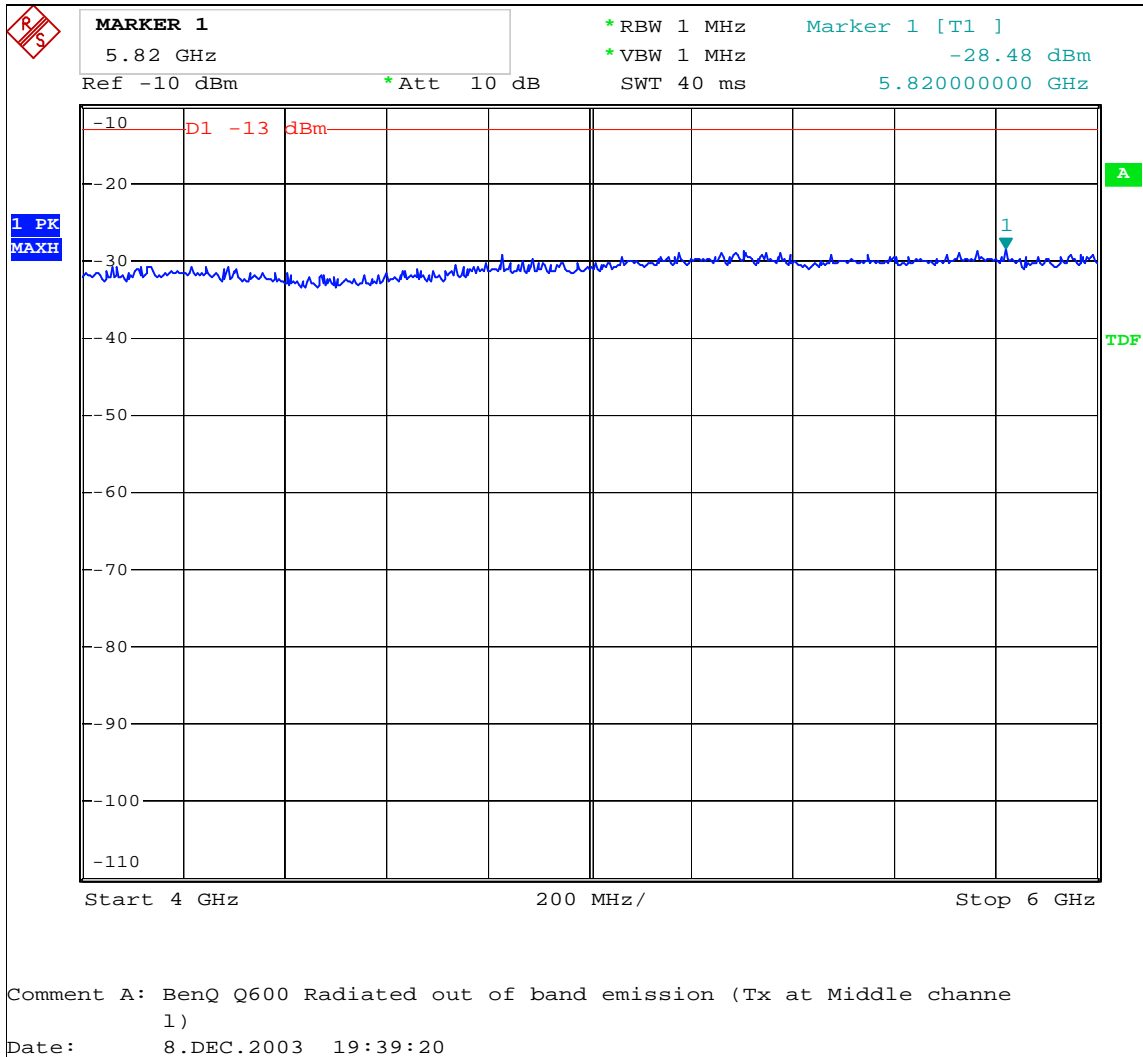
*Test Condition: Middle Channel*

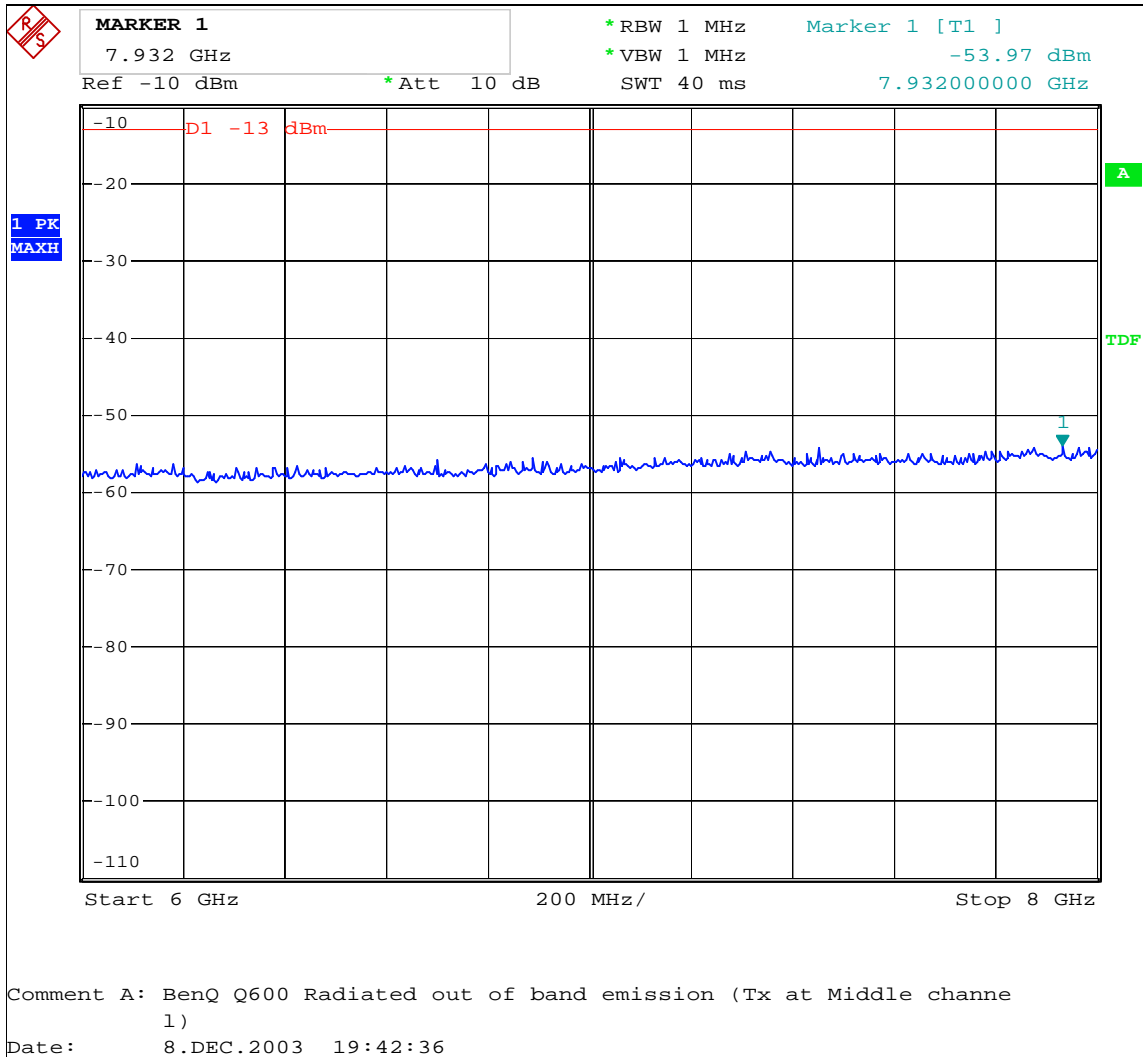


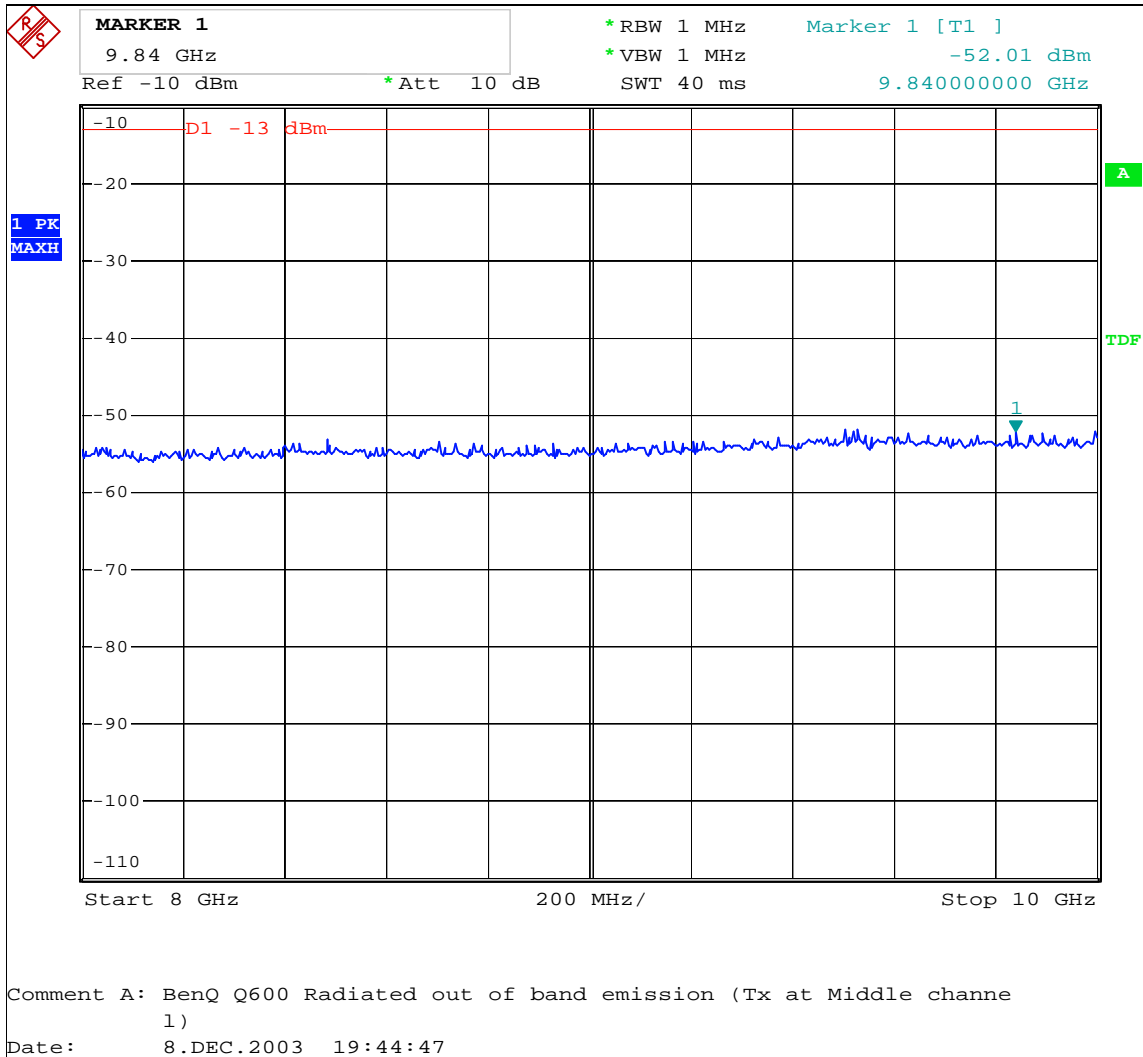




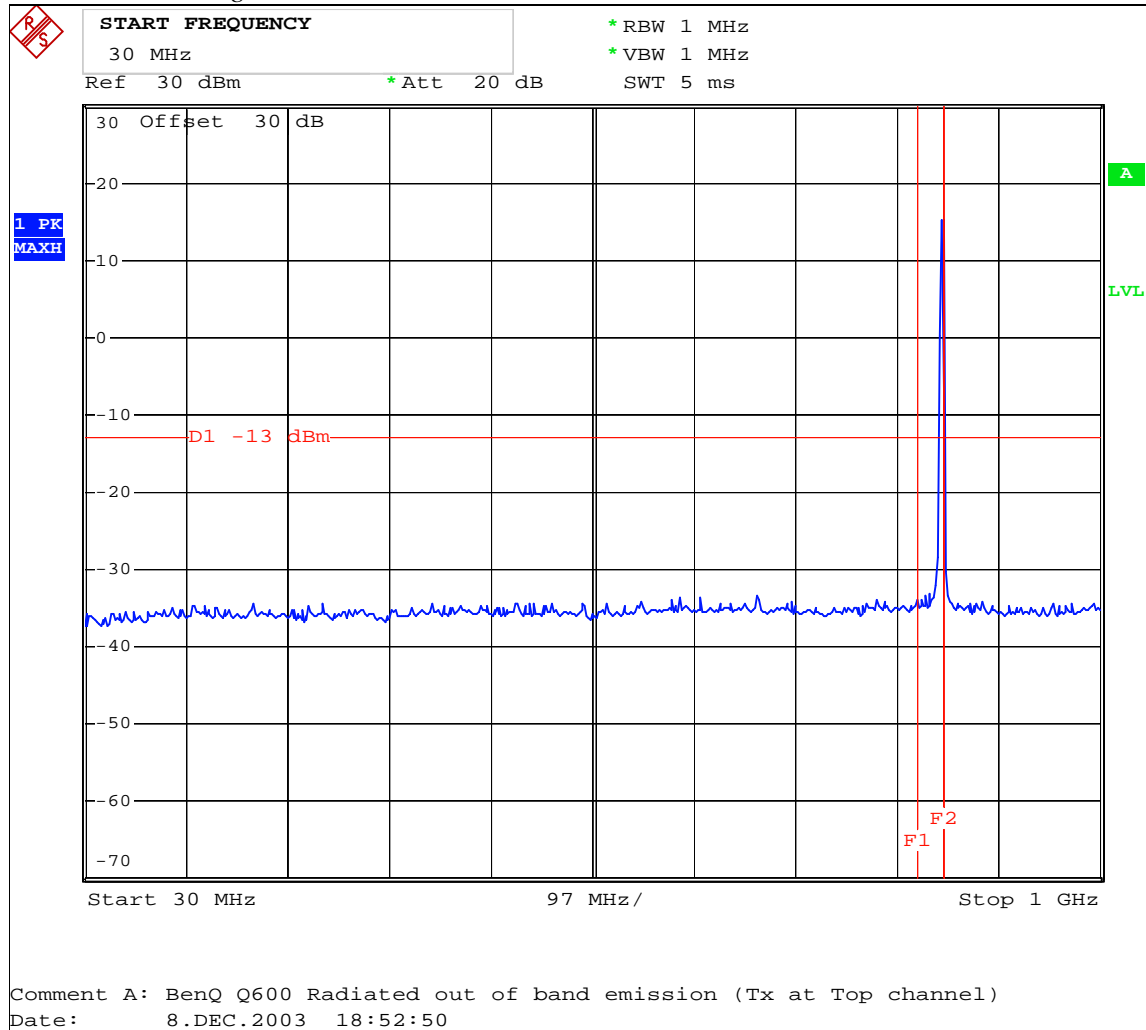


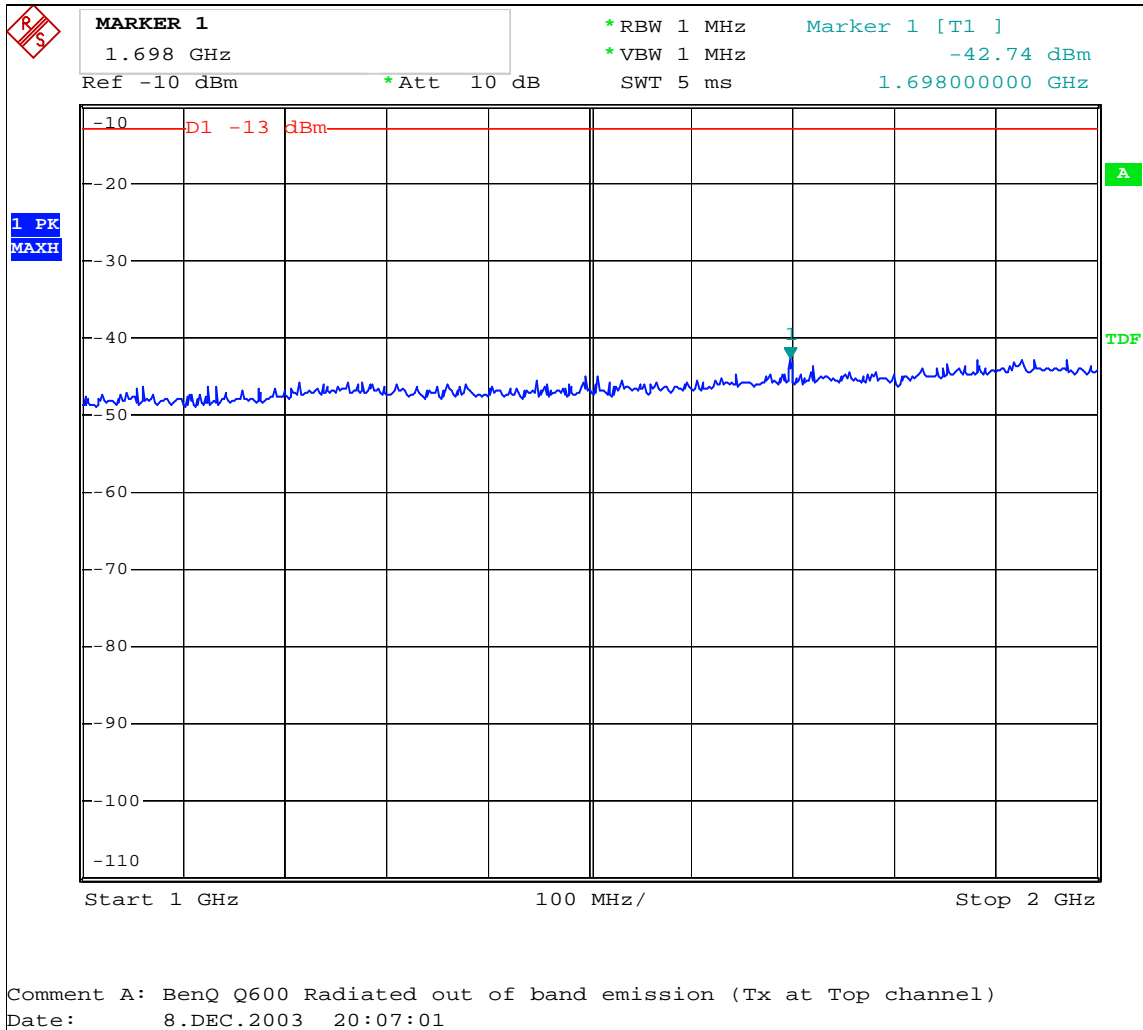


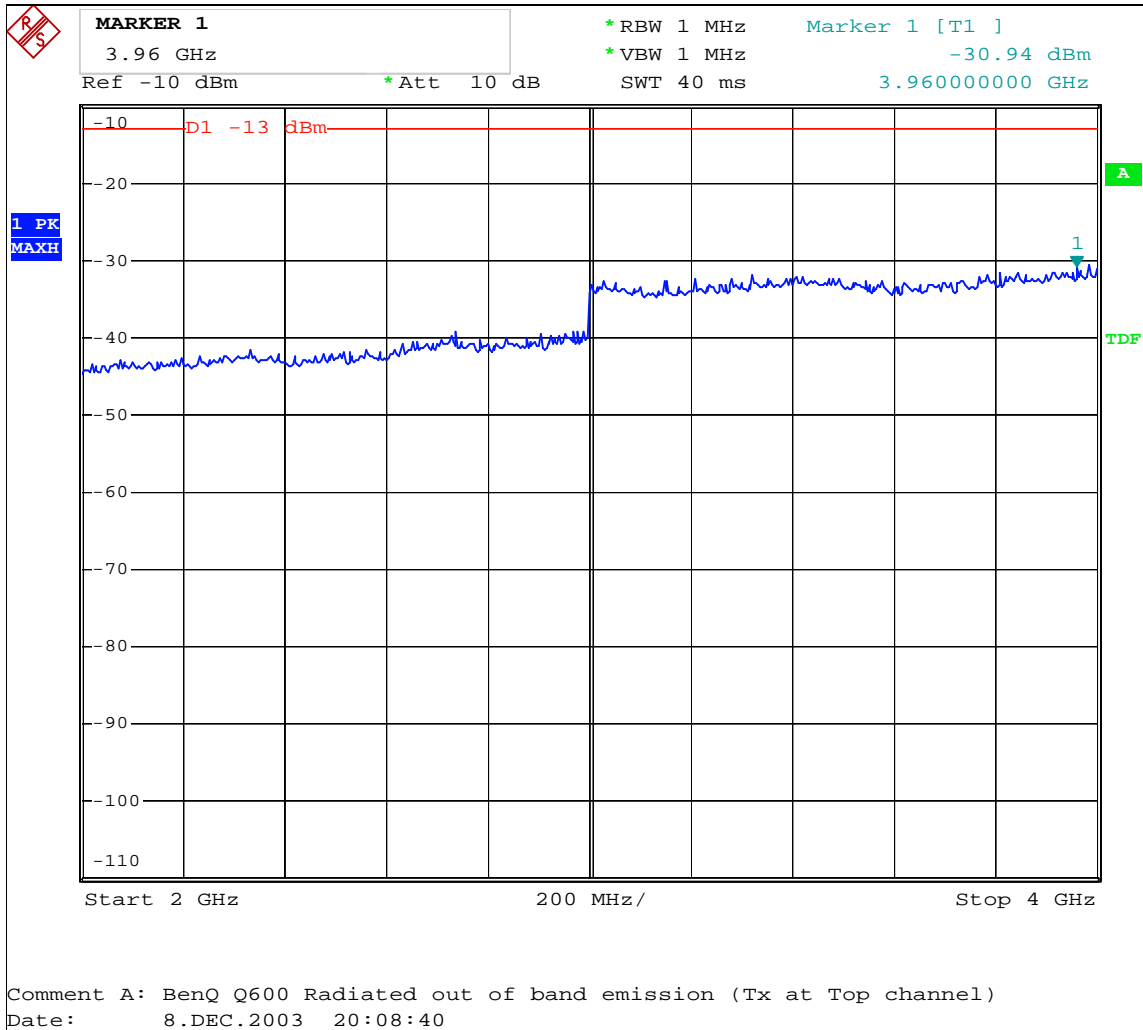


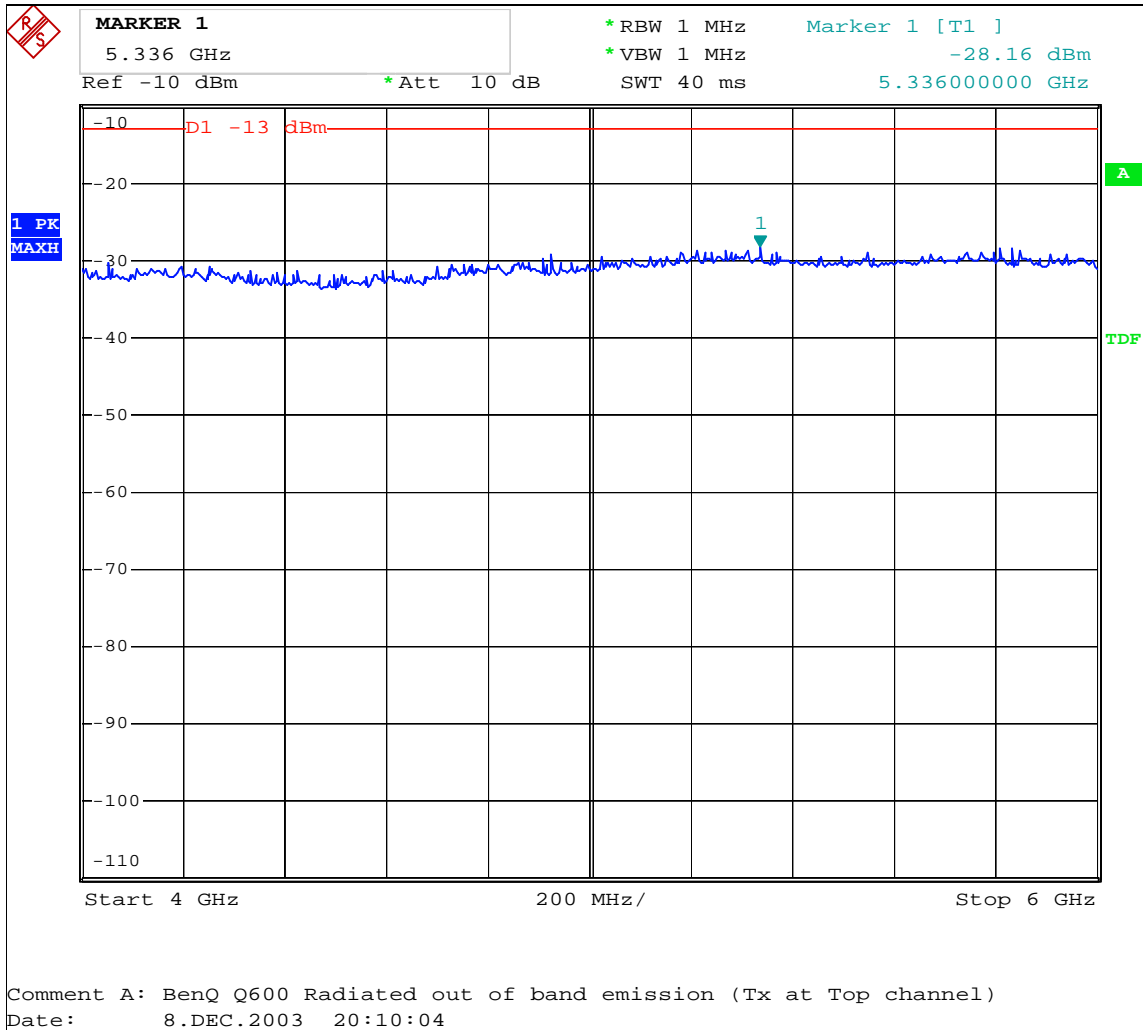


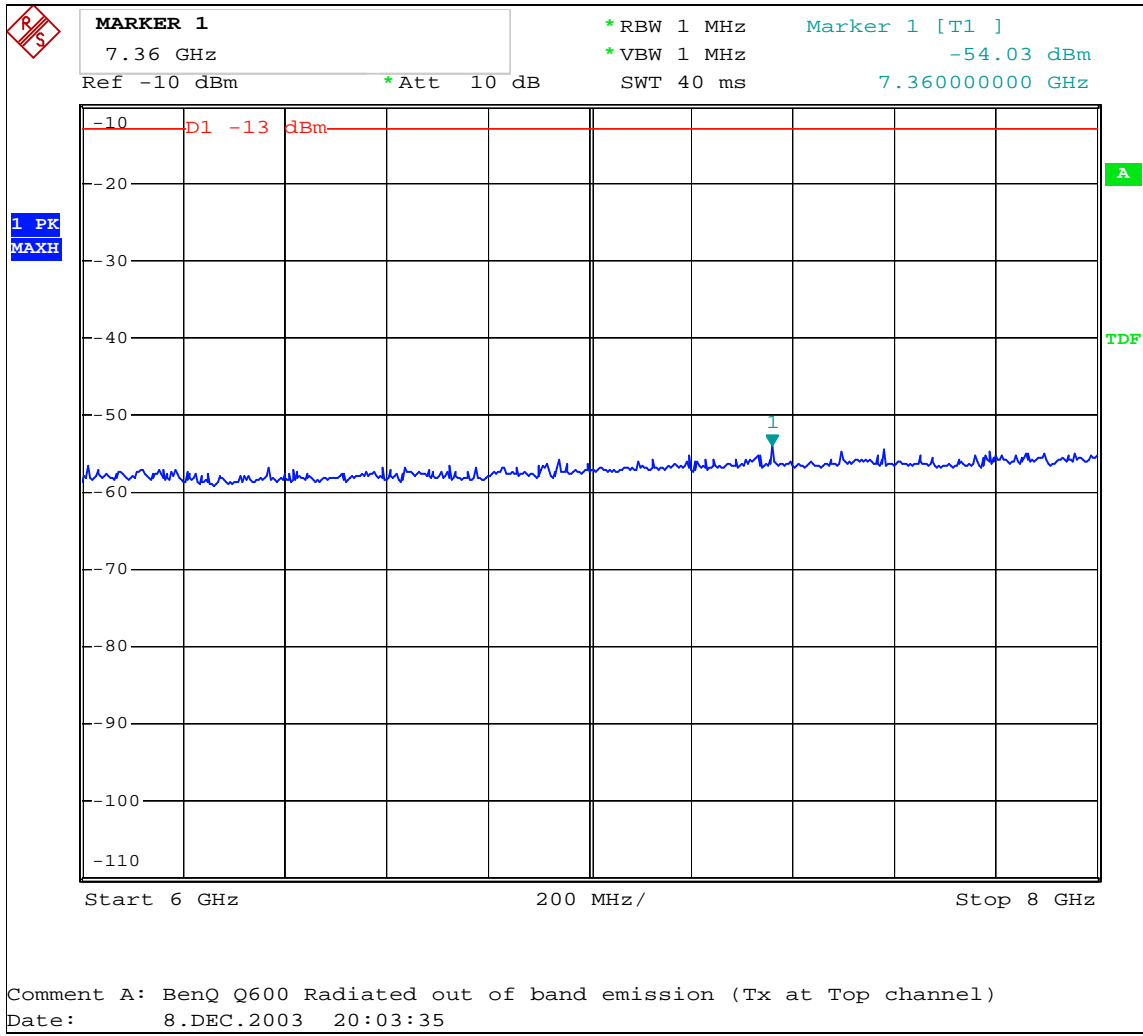
*Test Condition: High Channel*



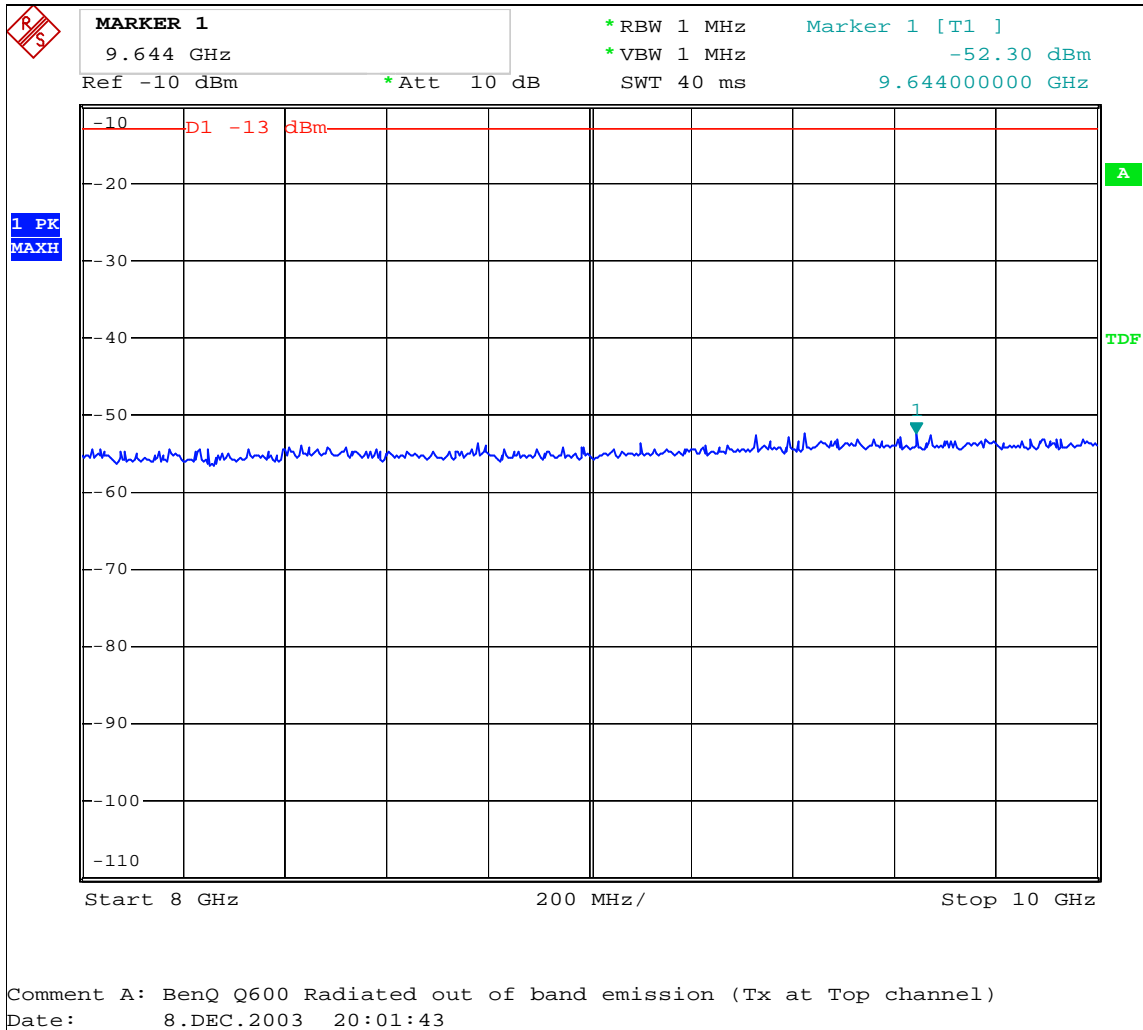












## 9. Power Line Conducted Emission test §FCC 15.107

### 9.1 Operating environment

Temperature:	25	°C	(10-40°C)
Relative Humidity:	55	%	(10-90%)
Atmospheric Pressure	1023	hPa	(860-1061hPa)

### 9.2 Test setup & procedure

The EUT are connected to the main power through a line impedance stabilization network (LISN). This provides a 50 ohm/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination.

Both sides (Line and Neutral) of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4/2001 on conducted measurement. The AC power conducted emissions was invested over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz.

Please see the plots below.

## Emission Limit

Freq. (MHz)	Conducted Limit (dBuV)	
	Q.P.	Ave.
0.15~0.50	66 – 56*	56 – 46*
0.50~5.00	56	46
5.00~30.0	60	50

\*Decreases with the logarithm of the frequency.

**9.3 Uncertainty of Conducted Emission**

Expanded uncertainty (k=2) of conducted emission measurement is  $\pm 2.6$  dB.

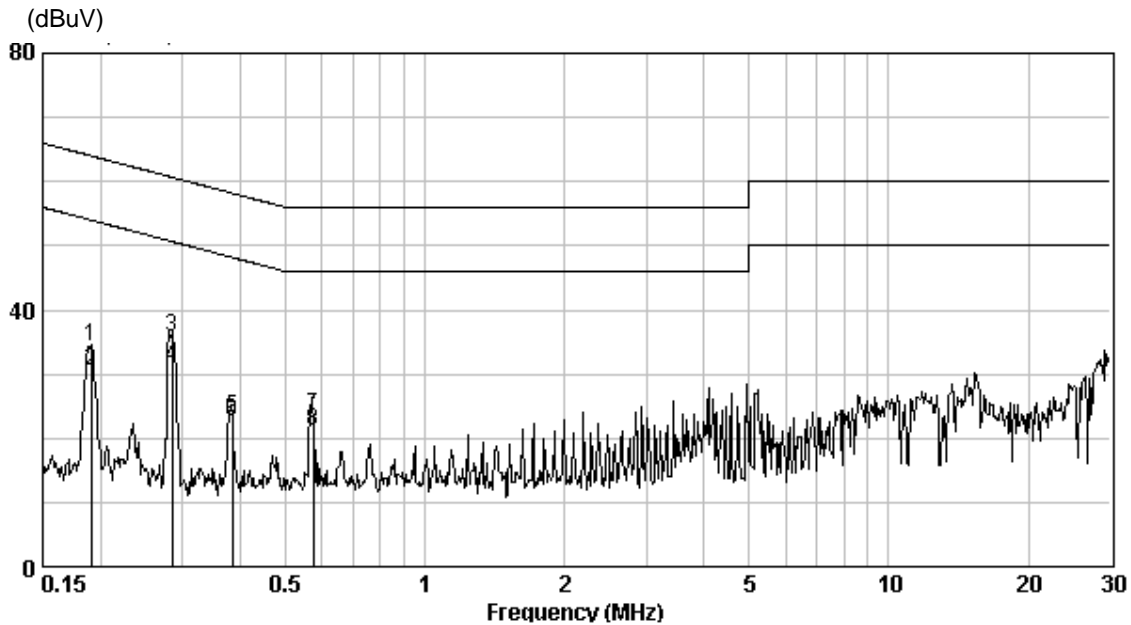
### 9.4 Power Line Conducted Emission test data

Phase: Line  
 EUT: Q600  
 Test Condition: Rx/ Idle mode

Freq. (MHz)	Correction Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.191	0.1	34.41	64.01	-29.6	QP
0.191	0.1	30.5	54.01	-23.51	AVERAGE
0.285	0.1	35.66	60.66	-25	QP
0.285	0.1	30.99	50.66	-19.67	AVERAGE
0.384	0.1	23.14	58.19	-35.05	QP
0.384	0.1	22.66	48.19	-25.53	AVERAGE
0.574	0.1	23.37	56	-32.63	QP
0.574	0.1	20.97	46	-25.03	AVERAGE

Remark:

1. Correction Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Margin (dB) = Level (dBuV) – Limit (dBuV)



Phase: Neutral  
 Model No.: Q600  
 Test Condition: Rx/ Idle mode

Freq. (MHz)	Correction Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector
0.191	0.1	35.19	64.01	-28.82	QP
0.191	0.1	32.28	54.01	-21.73	AVERAGE
0.286	0.1	31.78	60.64	-28.86	QP
0.286	0.1	28.43	50.64	-22.21	AVERAGE
0.381	0.1	25.96	58.26	-32.3	QP
0.381	0.1	25.22	48.26	-23.04	AVERAGE
0.568	0.1	25.49	56.00	-30.57	QP
0.568	0.1	19.75	46.00	-26.25	AVERAGE

Remark:

1. Correction Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Margin (dB) = Level (dBuV) – Limit (dBuV)

