ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Bluetooth Headset

MODEL No.: HTC-2400E

BRAND NAME: HorngTech

FCC ID: PO9-HTC-2400EH

REPORT NO: 020071-RF-ID

ISSUE DATE: Nov. 04, 2002

Prepared for

Horng Technical Enterprise Co., Ltd.
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Chia-Yi Hsien, Taiwan, R.O.C.

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VERIFICATION OF COMPLIANCE

Applicant:	**Horng Technical Enterprise Co., Ltd.** No. 1-5 Hsin-Pi, Chiu-Pi Li, Tai-Bao City, Chia-Yi Hsien, Taiwan, R.O.C.
Equipment Under Test:	Bluetooth Headset
BRAND NAME:	HorngTech
MODEL No.:	HTC-2400E
Serial Number:	N/A
File Number:	020071-RF-ID
Date of test:	Oct. 04 ~ Oct. 25, 2002

We hereby certify that:

The above equipment was tested by C&C Laboratory Co., 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 (1992) 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.

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

Approved By

Vincent Su / RF Dept. Vice Manager
C&C Laboratory Co., Ltd

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1. GENERAL INFORMATION

1.1 Product Description

The Horng Technical Enterprise Co., Ltd. Model: HTC-2400E (referred to as the EUT in this report) is a Bluetooth headset transceiver for cell phone.

The EUT is compliance with Bluetooth Standard.

A major technical descriptions of EUT is described as following:

A). Operation Frequency: 2402 – 2480MHz, 79 channels

B). Modulation type: Frequency Hopping Spread Spectrum (FHSS)

C). Antenna Designation: Non-User Replaceable (Fixed)

D). Power Supply: 4.5Vdc Chargeable Battery via 110V AC/DC Power Adaptor.

E). Receiver type: Super heterodyne

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: PO9-HTC-2400EH filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

1.3 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4 (1992). 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 C&C Laboratory, Co., Ltd. No. 81-1, 210 Lane, Pa-de 2nd Road, Lu-Chu Hsiang, Taoyuan, Taiwan, R.O.C.. The Open Area Test Sites and the Line Conducted labs are constructed and calibrated to meet the FCC requirements in documents ANSI C63.4: 1992 and CISPR 22/EN 55022 requirements.

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 EUT was operated in the engineering mode to fix the Tx / Rx frequency which was for the purpose of the measurements.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4-1992.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 a placed on as 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 13.1.4.1 of ANSI C63.4-1992.

2.4 Configuration of Tested System

Fig. 2-1 Configuration of Tested System

EUT

Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	FCC ID	Series No.	Note
E-1	Bluetooth headset	HorngTech	HTC-2400E	PO9-HTC-2400EH	N/A	EUT

3. SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	Conducted Emission	Compliant
§15.247(b)	Peak Output Power	Compliant
§15.247(a)(1)(ii)	20dB Bandwidth	Compliant
§15.247(c)	100 KHz Bandwidth Of Frequency Band Edges	Compliant
§15.209(a) (f)	Spurious Emission Radiated	Compliant
§15.247(a)(1)	Frequency Separation	Compliant
§15.247(a)(1)(ii)	Number of hopping frequency	Compliant
§15.247(a)(1)(ii)	Time of Occupancy	Compliant
§15.247(f)	Peak Power Spectral Density	Compliant
§15.203	Antenna Requirement	Compliant
§1.1307	RF Exposure	Compliant

4. DESCRIPTION OF TEST MODES

The EUT (Bluetooth headset) has been tested under engineering test mode.
And used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
Channel low (2402MHz), mid (2442MHz) and high(2480MHz) with highest data rate are chosen for testing.

5. CONDUCTED EMISSION TEST

5.1 Standard Applicable

According to §15.207. frequency within 150KHz to 30MHz shall not exceed below

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	**Average**
0.15 to 0.50	**66 to 56**	**56 to 46**
0.50 to 5	**56**	**46**
5 to 30	**60**	**50**

Note
1.The lower limit shall apply at the transition frequencies
2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

5.2 EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.4-1992.
2. The EUT was plug-in the AC/DC Power Adaptor was placed on the center of the back edge on the test table.
3. External I/O cables were draped along the edge of the test table and bundle when necessary.

5.3 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.

5.4 Measurement Equipment Used:

Conducted Emission Test Site # 3					
EQUIPMENT TYPE	**MFR**	**MODEL NO.**	**SERIAL NO.**	**LAST CAL.**	**CAL DUE.**
EMI Test Receiver	R&S	ESCS30	847793/012	12/19/2001	12/18/2002
LISN	R&S	ESH2-Z5	843285/010	12/10/2001	12/09/2002
LISN	EMCO	3825/2	9003-1628	07/26/2002	07/25/2003
Spectrum Analyzer	ADVANTEST	R3261C	71720533	08/06/2002	08/05/2003
2X2 WIRE ISN	R&S	ENY22	100020	06/20/2002	06/19/2003
FOUR WIRE ISN	R&S	ENY41	100006	06/20/2002	06/19/2003

5.5 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.

LINE CONDUCTED TEST

Model Number: HTC-2400E **Tested by:** Jean

Test Mode: Normal Operating **Detector Function:** Quasi-Peak

Temperature: 25^0C **Humidity:** 65 %RH

(The chart below shows the highest readings taken from the final data)

FREQ	Q.P.	AVG	Q.P.	AVG	Q.P.	AVG	NOTE
MHz	Raw dBuV	Raw dBuV	Limit dBuV	Limit dBuV	Margin dB	Margin dB	
0.605	53.90	44.20	56.00	46.00	-2.10	-1.80	L1
1.200	44.40	---	56.00	46.00	-11.60	---	L1
2.370	41.90	---	56.00	46.00	-14.10	---	L1
4.170	41.60	---	56.00	46.00	-14.40	---	L1
5.760	38.60	---	60.00	50.00	-21.40	---	L1
7.430	36.00	---	60.00	50.00	-24.00	---	L1
0.635	54.40	43.70	56.00	46.00	-1.60	-2.30	L2
1.260	46.80	38.50	56.00	46.00	-9.20	-7.50	L2
3.130	46.70	38.40	56.00	46.00	-9.30	-7.60	L2
3.940	46.90	38.20	56.00	46.00	-9.10	-7.80	L2
5.510	44.20	---	60.00	50.00	-15.80	---	L2
7.660	39.80	---	60.00	50.00	-20.20	---	L2

Remark：

(1) Measuring frequencies from 0.15 MHz to 30MHz。

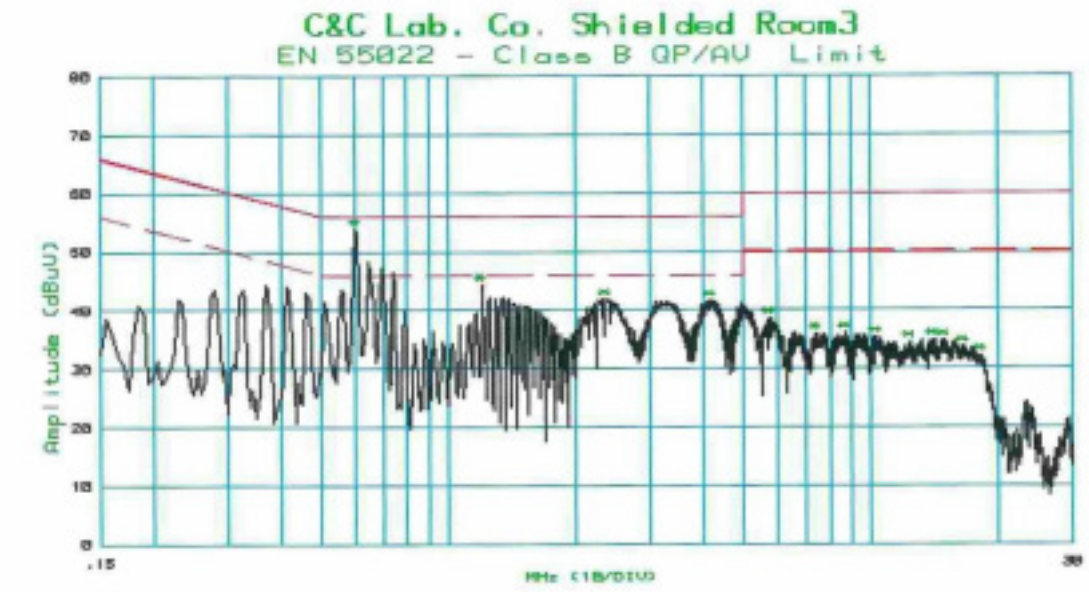
(2) The emissions measured in frequency range from 0.15 MHz to 30MHz were made with an instrument using Qusia-Peak detector and Average detector.

(3) "---" denotes the emission level was or more than 2dB below the Average limit, so no re-check anymore.

(4) The IF bandwidth of SPA between 0.15MHz to 30MHz was 10KHz;
The IF bandwidth of Test Receiver between 0.15MHz to 30MHz was 9KHz;

(5) L1 = Line One (Hot side) / L2 = Line Two (Neutral side)

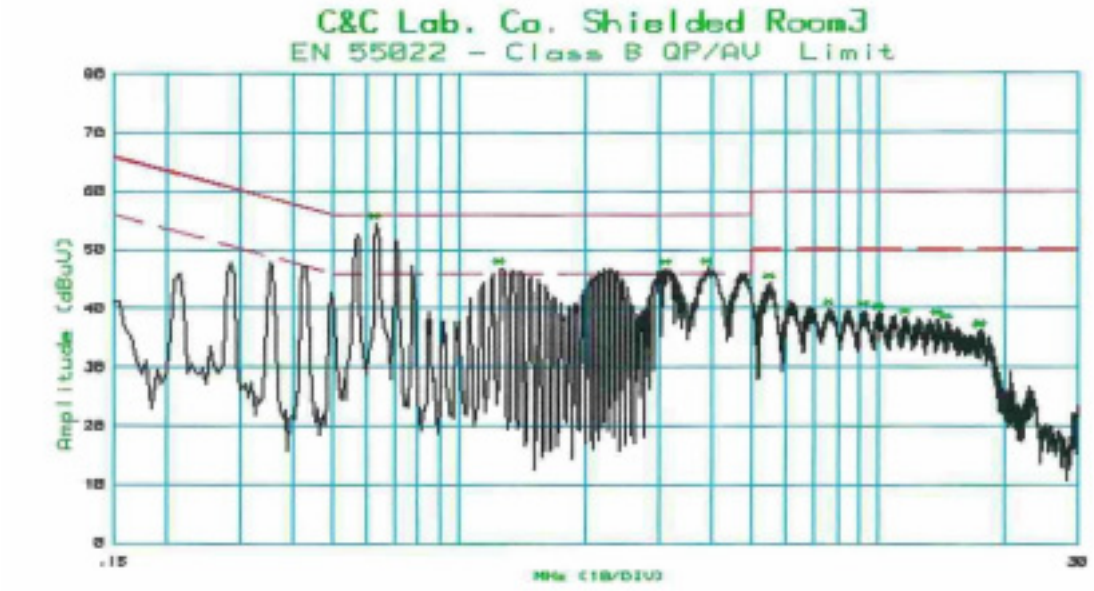
Conducted Emission Test Plot



Customer:1
Model :1
Mode :
Reading :Peak(R&S Receiver)
Remark :

File#: 2387
Humd.:65 (%)
Port :L1

Date :28 Oct 2002 12:35:43
Temp. :25 (C)
Tested by:JEAN



Customer:1
Model :1
Mode :
Reading :Peak(R&S Receiver)
Remark :

File#: 2386
Humd.:65 (%)
Port :L2

Date :28 Oct 2002 12:25:40
Temp. :25 (C)
Tested by:JEAN

6. PEAK OUTPUT POWER MEASUREMENT

6.1 Standard Applicable

According to §15.247(b)(2), for direct sequence systems, the maximum peak output power of the intentional radiator shall not exceed 1 Watt.

6.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter or spectrum.(Adjacent channel power function, set RBW,VBW=1 MHz)
3. Record the max. reading.
4. Repeat above procedures until all frequency measured were complete.

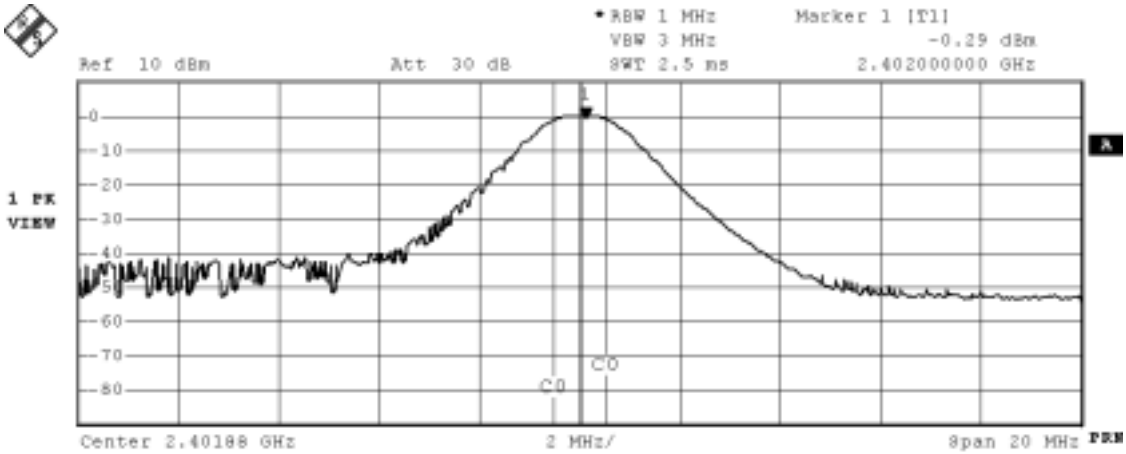
6.3 Measurement Result

CH	Reading Power dBm	Cable Loss dB	Output Power dBm	Output Power W	Limit (W)	Result
Low	-0.85	1.00	0.15	0.00104	1	PASS
Mid	-0.95	1.00	0.05	0.00101	1	PASS
High	-1.07	1.00	-0.07	0.00098	1	PASS

6.4 Measurement Equipment Used:

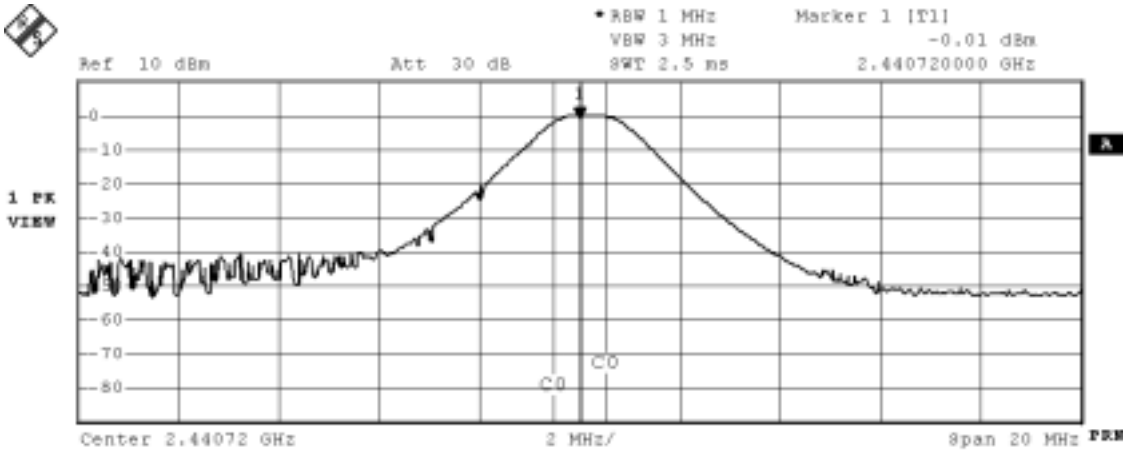
EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal. Due.
Power Meter	HP	436A	2709A29027	03/16/2002	03/15/2003
Power Sensor	HP	8481A	2702A61366	03/16/2002	03/15/2003
Spectrum Analyzer	R&S	FSP 30	1093.4495.30	07/23/2002	07/22/2003
Low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A

CH Low



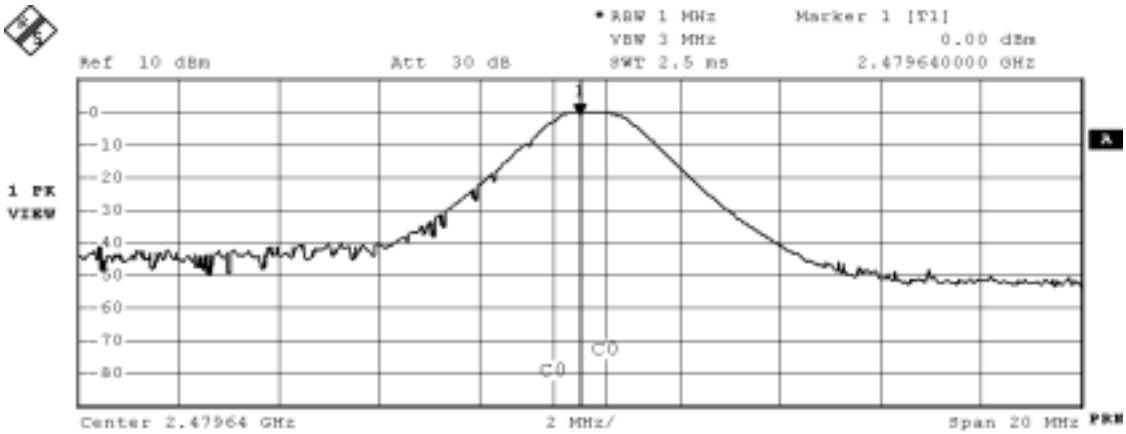
Tx Channel		NONE	
Power	-0.85 dBm	Bandwidth	1 MHz
		Reference	0.00 dBm

CH Mid



Tx Channel		NONE	
Power	-0.95 dBm	Bandwidth	1 MHz
		Reference	0.00 dBm

CH High



Tx Channel		NONE	
Power	-1.01 dBm	Bandwidth	1 MHz
		Reference	0.00 dBm

7. 20dB BAND WIDTH

7.1 Standard Applicable

According to §15.247(a)(1)(ii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz and 5725MHz – 5850MHz bands. The Maximum 20dB bandwidth of the hopping channel is 1MHz.

7.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW=10KHz (1 % of Bandwidth.), VBW=30KHz ,Span= 5MHz, Sweep=auto.
4. Mark the peak frequency and –20dB (upper and lower) frequency.
5. Repeat above procedures until all frequency measured were complete.

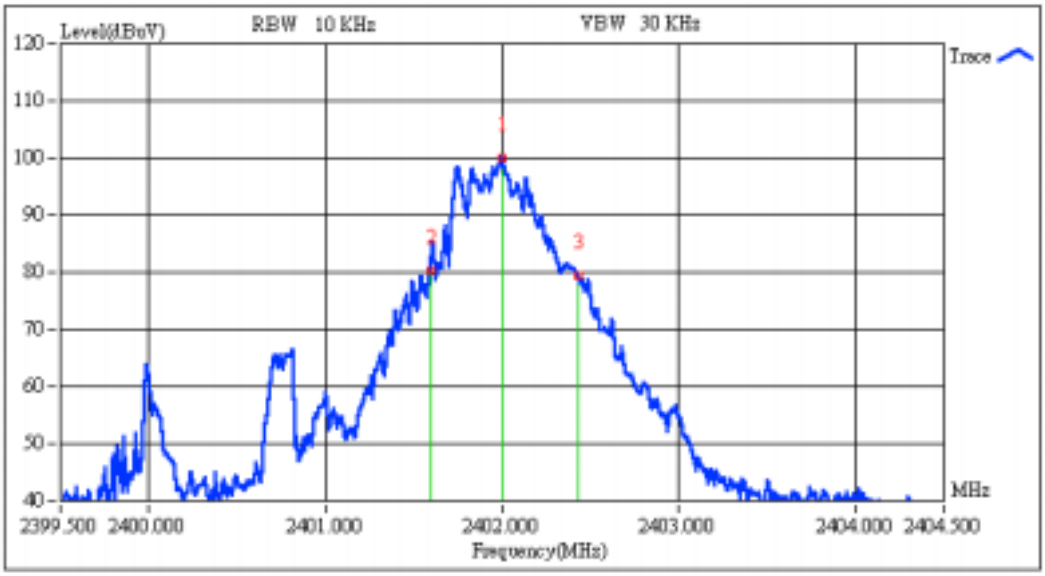
7.3 Measurement Result

CH	Bandwidth (MHz)	Limit (MHz)	Result
CH Low	0.83	1	PASS
CH Mid	0.81	1	PASS
CH High	0.85	1	PASS

7.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal. Due.
Spectrum Analyzer	R&S	FSP 30	1093.4495.30	07/23/2002	07/22/2003
cable loss	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A

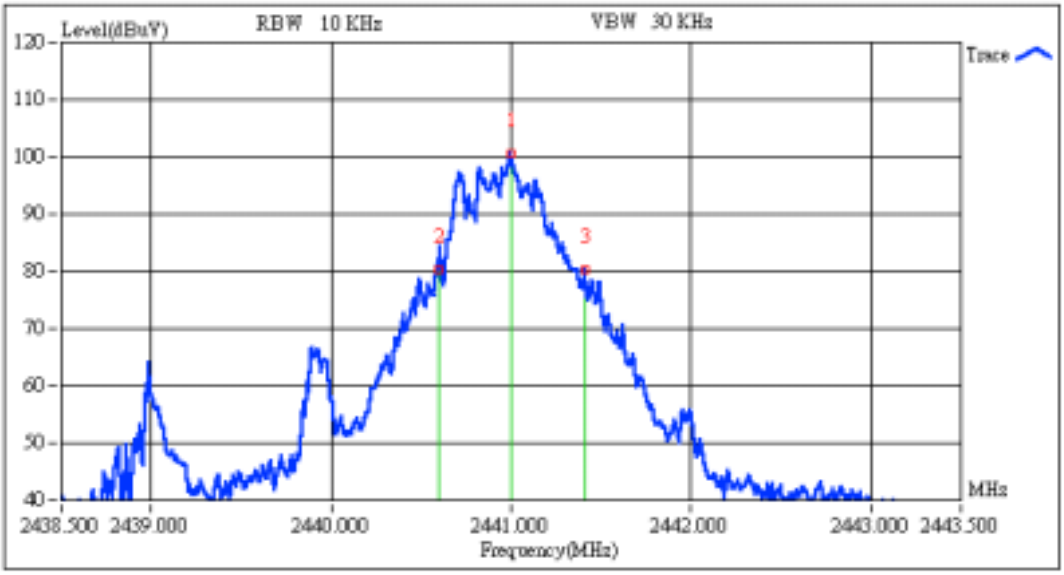
CH Low



Custom Name: Hong Tech
Engineer: MARKBA
Model Name: HTC-2400E
Report No.: 020071-R
Test Mode: CH LOW

Peak 0.00 MHz 0.00 dBuV
Band Width 0.830 MHz
Delta1 2401.60 MHz 80.26 dBuV
Delta2 2402.43 MHz 79.53 dBuV

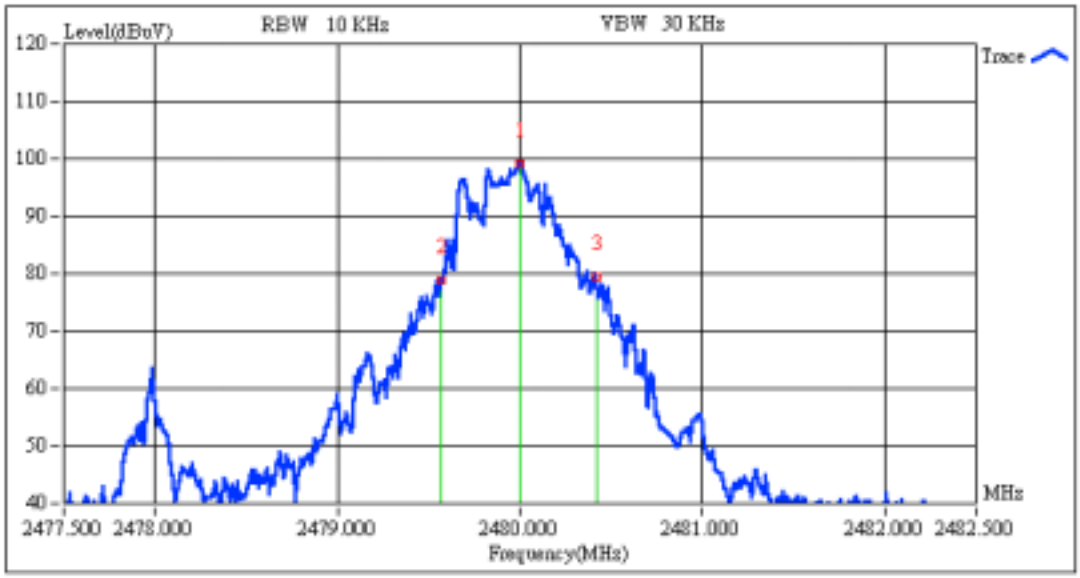
CH Mid



Custom Name: Hong Tech
Engineer: MARKBA
Model Name: HTC-2400E
Report No.: 020071-R
Test Mode: CH MID

Peak 0.00 MHz 0.00 dBuV
Band Width 0.810 MHz
Delta1 2440.60 MHz 80.38 dBuV
Delta2 2441.41 MHz 80.39 dBuV

CH High



Custom Name:	Engineer:		
Hong Tech	MARKBA	Peak 0.00 MHz	Band Width
Model Name:	Report No.:	0.00 dBuV	0.850 MHz
HTC-2400E	020071-R	Delta1 2479.57 MHz	Delta2 2480.42 MHz
Test Mode:		78.89 dBuV	79.51 dBuV
CH HIGH			

8. 100KHz BANDWIDTH OF BAND EDGES MEASUREMENT

8.1 Standard Applicable

According to §15.247(c), in any 100 KHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100KHz bandwidth within the band that contains the highest level of the desired power, In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in15.209(a).

8.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW,VBW=100KHz, Start = 2380.1MHz, Stop = 2405.2MHz or Start = 2474.9MHz, Stop = 2500MHz,Sweep = auto.
5. Mark Peak ,2.4GHz and 2.4835GHz and record the max. level.
6. Repeat above procedures until all frequency measured were complete.

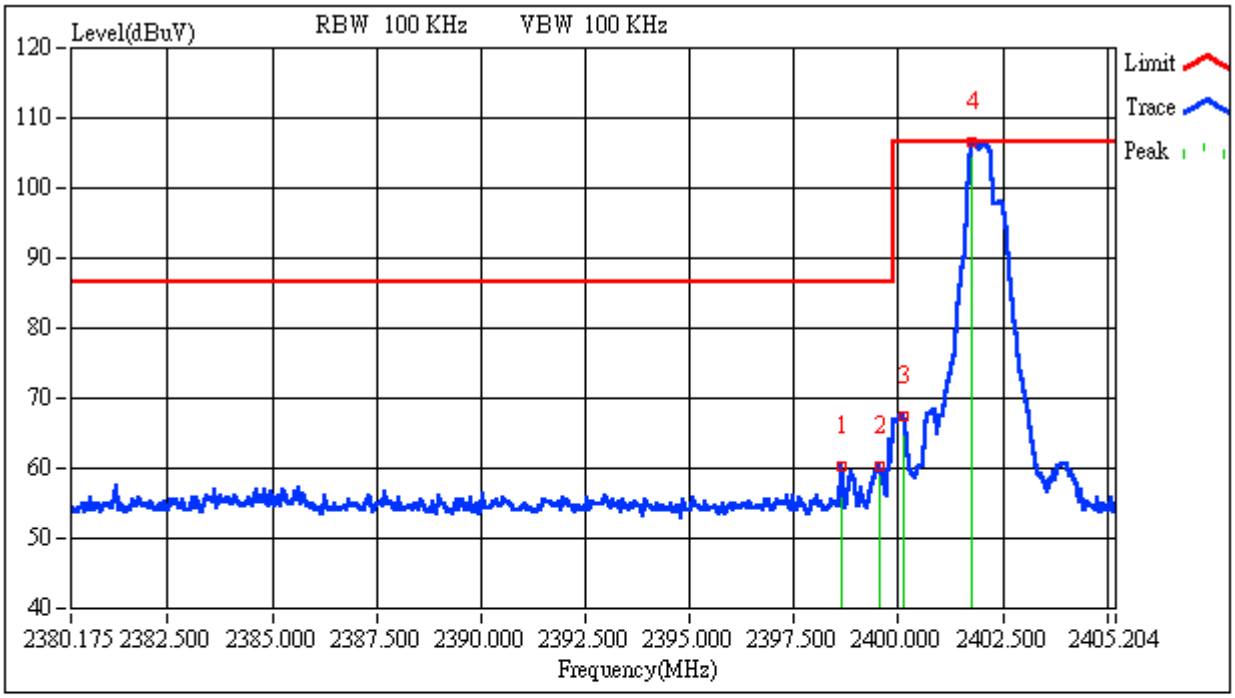
8.3 Measurement Result

Refer to attach spectrum analyzer data chart.

8.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal. Due.
Spectrum Analyzer	R&S	FSP 30	1093.4495.30	07/23/2002	07/22/2003
low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A

Out of Band Test Data CH-Low



Custom Name: Hong Tech

Engineer: Markba

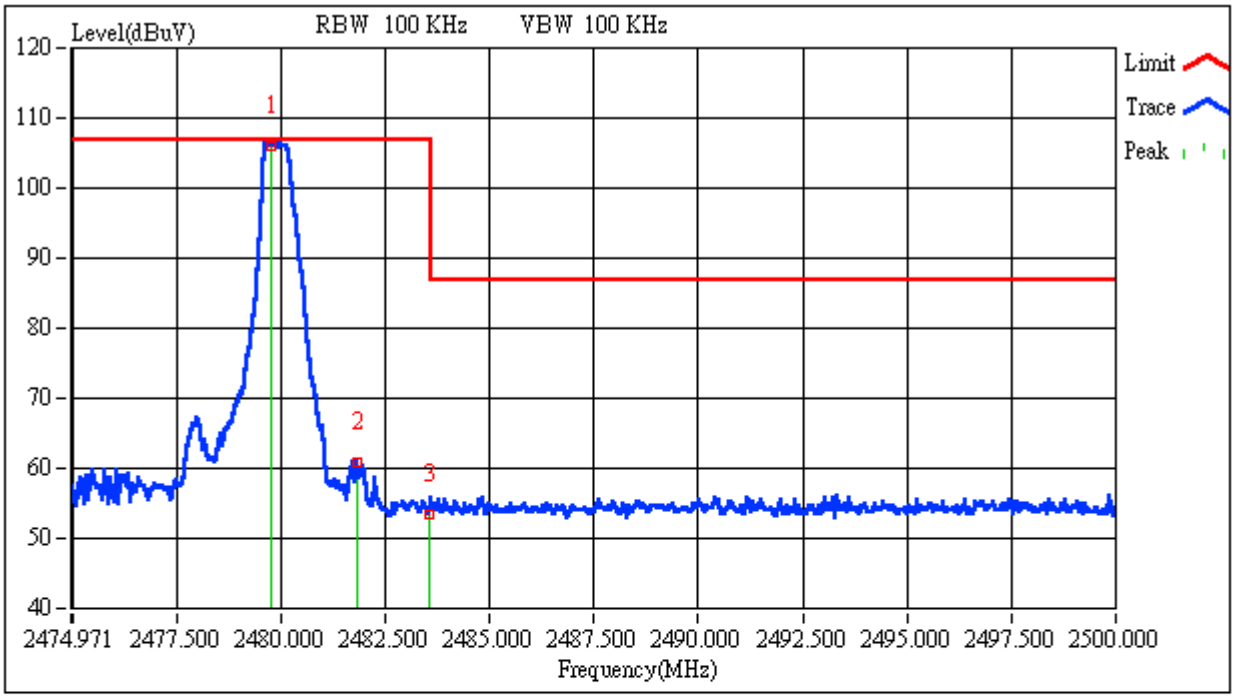
Model Name: HTC-2400E

Report No.: 020071-R

Test Mode: High

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)
1	2398.6461	60.39	0.00	0.00	60.39
2	2399.5472	60.39	0.00	0.00	60.39
3	2400.0978	67.33	0.00	0.00	67.33
4	2401.7497	106.70	0.00	0.00	106.70

Out of Band Test Data CH-High



Custom Name: Hong Tech

Engineer: Markba

Model Name: HTC-2400E

Report No.: 020071-R

Test Mode: High

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)
1	2479.7766	105.95	0.00	0.00	105.95
2	2481.8289	60.85	0.00	0.00	60.85
3	2483.5309	53.40	0.00	0.00	53.40

9. SPURIOUS RADIATED EMISSION TEST

9.1 Standard Applicable

According to §15.247(c), all other emissions outside these bands shall not exceed the general radiated emission limits specified in §15.209(a). And according to §15.33(a)(1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

9.2 EUT Setup

1. The radiated emission tests were performed in the 3 meter open-test site, using the setup in accordance with the ANSI C63.4-1992.
2. The EUT was put on the front of the test table.

9.3 Measurement Procedure

Conducted measurement for Antenna Port

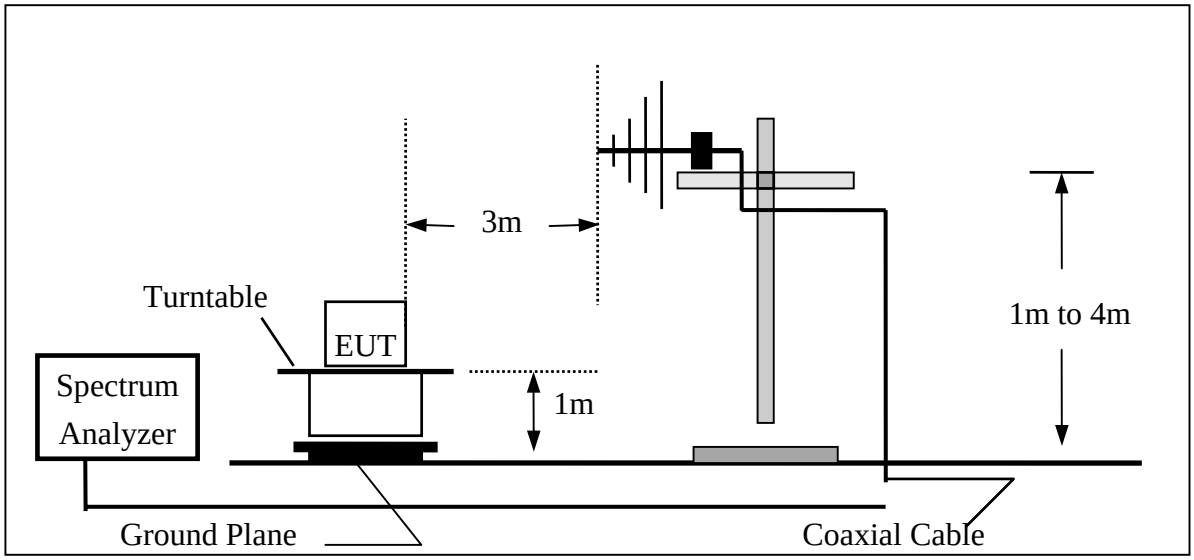
1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the RBW, VBW = 100KHz, Sweep = auto.
4. Set the frequency range from 30MHz- 1GHz, 1GHz- 3GHz, 3GHz – 8GHz, 8GHz – 13GHz, 13GHz – 26GHz.
5. Max hold and Peak.
6. Repeat above procedures until all frequency measured were complete.

Radiated measurement

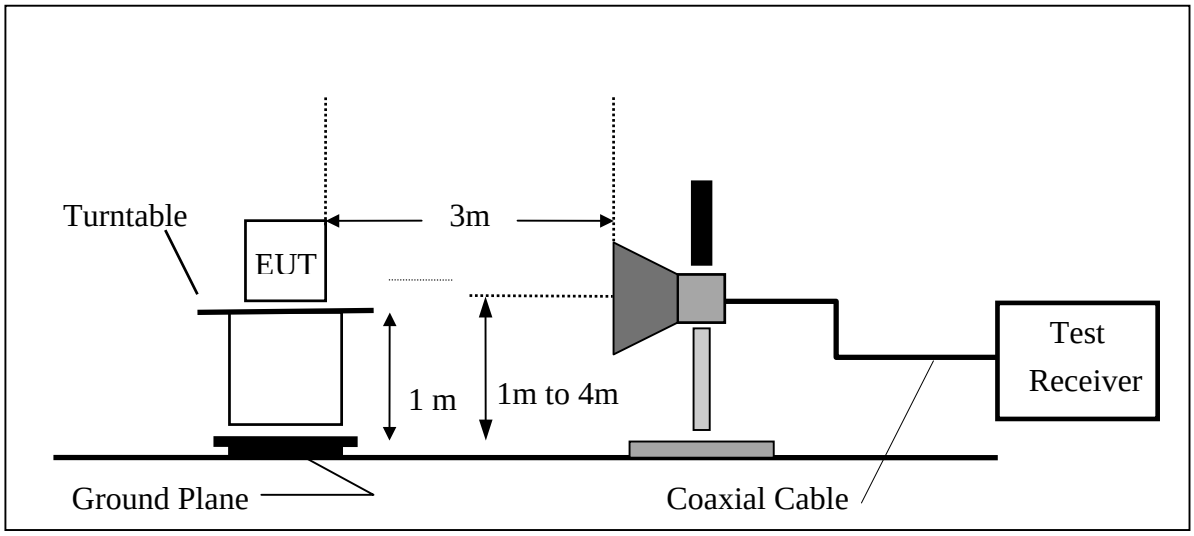
1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until all frequency measured were complete.

9.4 Radiated Emission 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



9.5 Measurement Equipment Used:

Open Area Test Site # 3					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
Spectrum Analyzer	ADVANTEST	R3261A	N/A	03/19/2002	03/18/2003
Spectrum Analyzer	R&S	FSP 30	1093.4495.30	07/23/2002	07/22/2003
EMI Test Receiver	R&S	ESVS20	838804/004	01/05/2002	01/04/2003
Pre-Amplifier	HP	8447D	2944A09173	03/04/2002	03/03/2003
Bilog Antenna	SCHWAZBECK	VULB9163	145	07/06/2002	07/05/2003
Horn Antenna	EMCO	3115	9602-4659	04/16/2002	04/15/2003
Turn Table	EMCO	2081-1.21	9709-1885	N.C.R	N.C.R
Antenna Tower	EMCO	2075-2	9707-2060	N.C.R	N.C.R
Controller	EMCO	2090	9709-1256	N.C.R	N.C.R
RF Switch	ANRITSU	MP59B	M53867	N.C.R	N.C.R
Site NSA	C&C	N/A	N/A	11/17/2001	11/16/2002
Horn antenna	Schwarzbeck	BBHA 9120	D210	2/24/2002	2/23/2003
Pre-Amplifier	HP	8449B	3008B00965	10/01/2001	10/02/2002

9.6 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

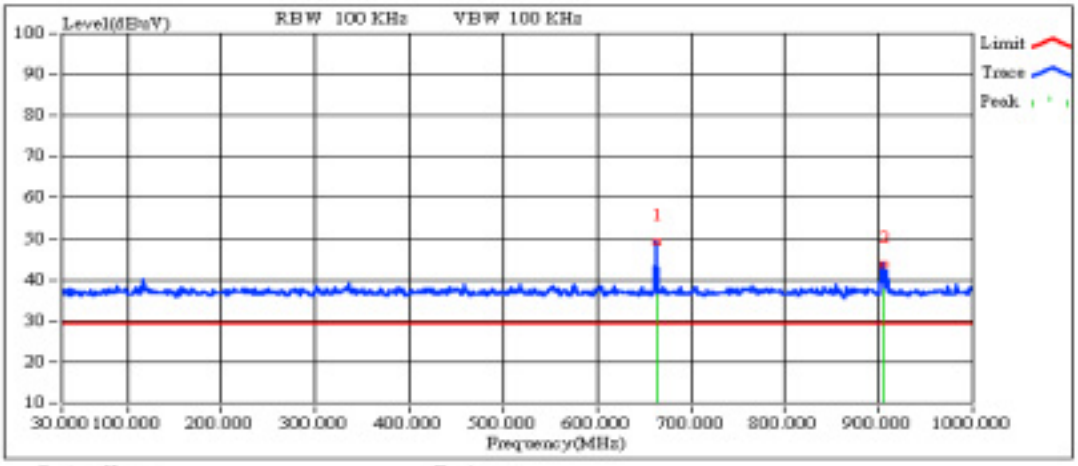
Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

NOTE:

The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 100kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1GHz.

9.7 Conducted Spurious Emission Measurement Result

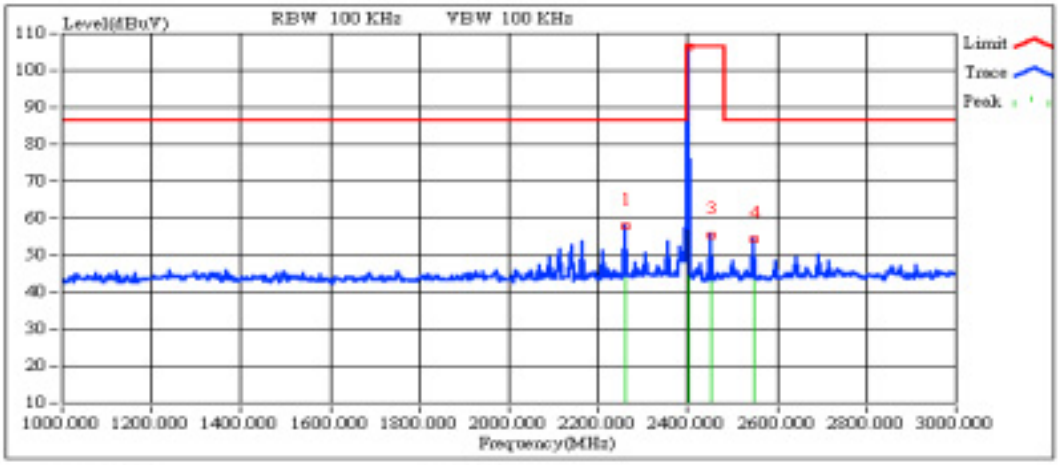
CH Low 30MHz – 1GHz



Custom Name: Hong Tech
Engineer: Markbs
Model Name: HTC-2400E
Report No.: 020071-R
Test Mode: Low

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)
1	664.3800	49.23	0.00	0.00	49.23
2	904.9400	43.76	0.00	0.00	43.76

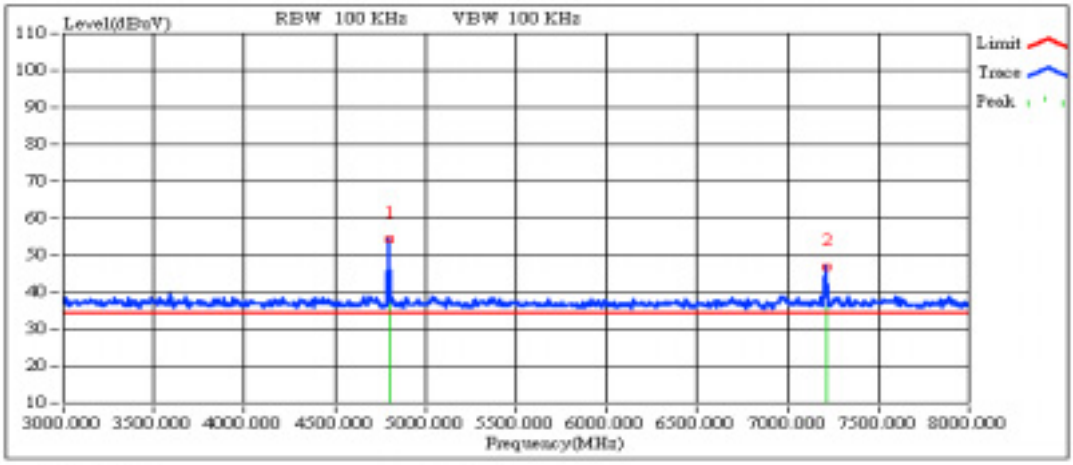
CH Low 1GHz- 3GHz



Custom Name: Hong Tech
Engineer: Markbs
Model Name: HTC-2400E
Report No.: 020071-R
Test Mode: Low

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)
1	2260.0000	58.01	0.00	0.00	58.01
2	2404.0000	106.59	0.00	0.00	106.59
3	2452.0000	55.35	0.00	0.00	55.35
4	2548.0000	54.11	0.00	0.00	54.11

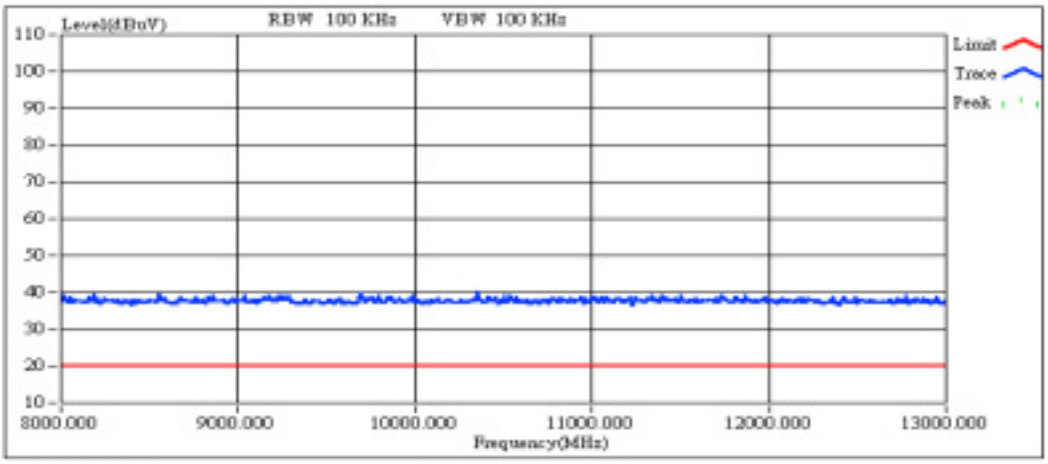
CH Low 3GHz – 8GHz



Custom Name: Hong Tech
Engineer: Markha
Model Name: HTC-2400E
Report No.: 020071-R
Test Mode: Low

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)
1	4800.0000	54.21	0.00	0.00	54.21
2	7210.0000	46.91	0.00	0.00	46.91

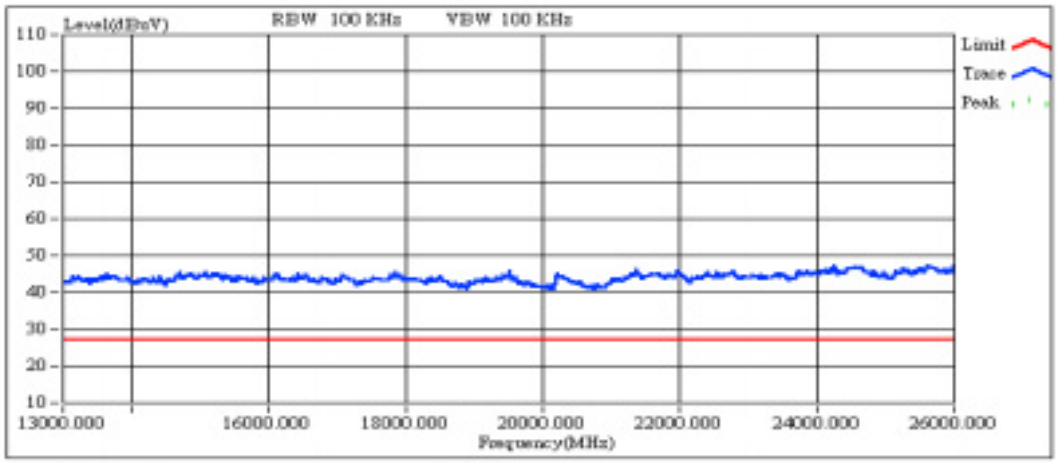
CH Low 8GHz- 13GHz



Custom Name: Hong Tech
Engineer: Markha
Model Name: HTC-2400E
Report No.: 020071-R
Test Mode: Low

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)

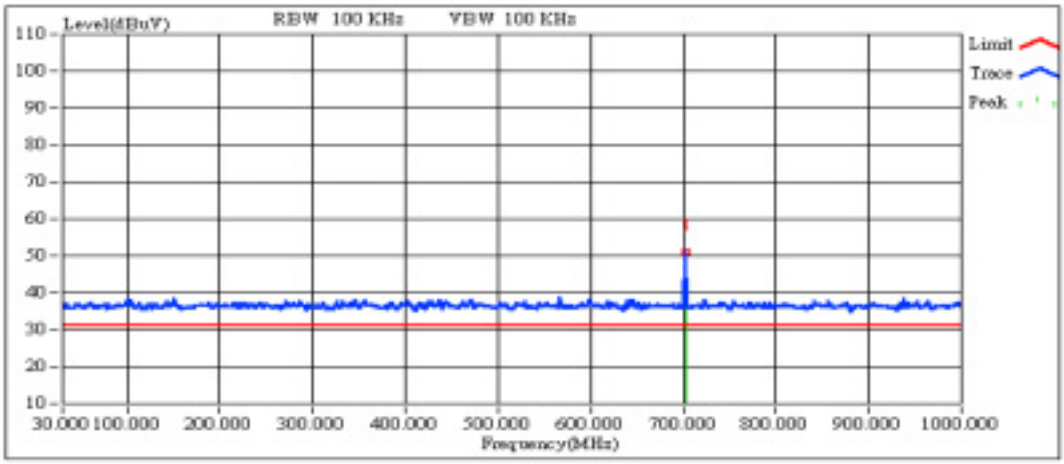
CH Low 13GHz – 26GHz



Custom Name: Hong Tech
Engineer: Mankba
Model Name: HTC-2400E
Report No.: 020071-R
Test Mode: Low

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)

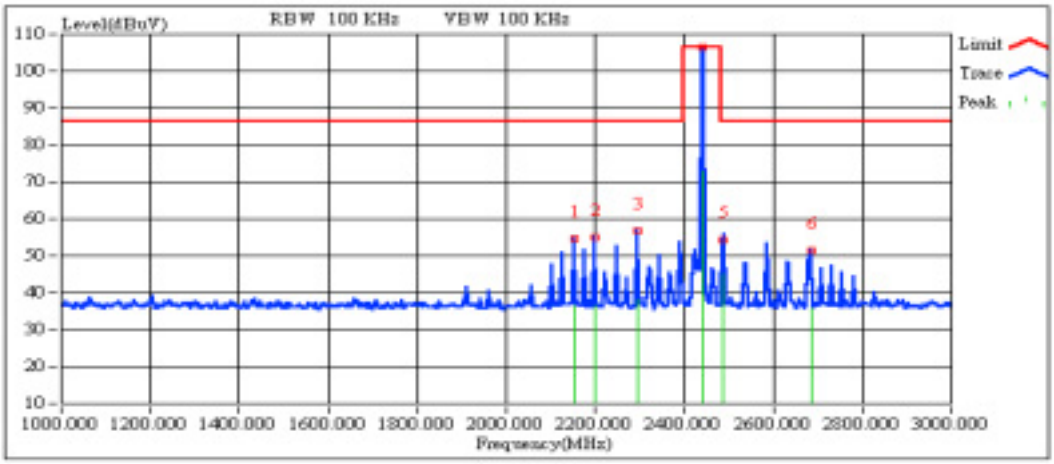
CH Mid 30MHz – 1GHz



Custom Name: Hong Tech
Engineer: Markbo
Model Name: HTC-2400E
Report No.: 020071-R
Test Mode: Mid

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)
1	703.1800	50.99	0.00	0.00	50.99

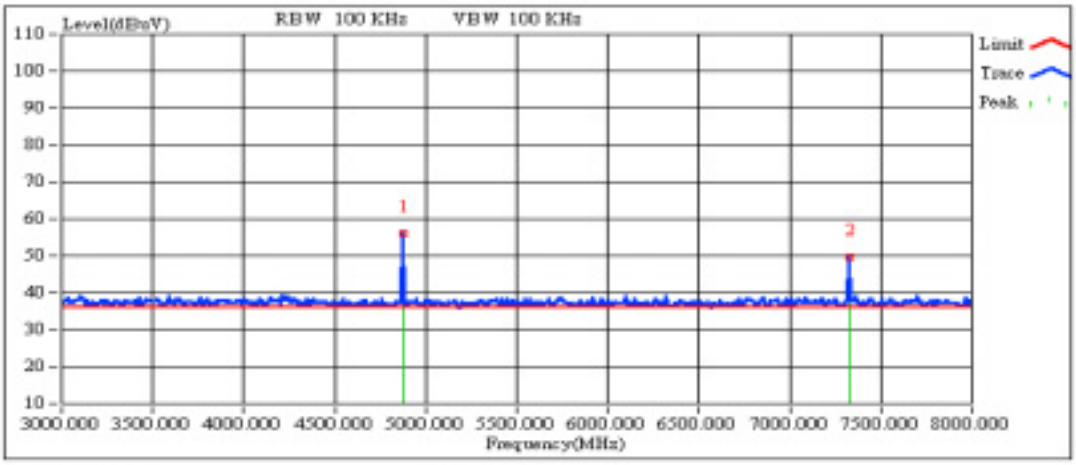
CH Mid 1GHz- 3GHz



Custom Name: Hong Tech
Engineer: Markbo
Model Name: HTC-2400E
Report No.: 020071-R
Test Mode: Mid

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)
1	2152.0000	54.47	0.00	0.00	54.47
2	2200.0000	54.83	0.00	0.00	54.83
3	2296.0000	56.89	0.00	0.00	56.89
4	2440.0000	106.52	0.00	0.00	106.52
5	2488.0000	54.46	0.00	0.00	54.46

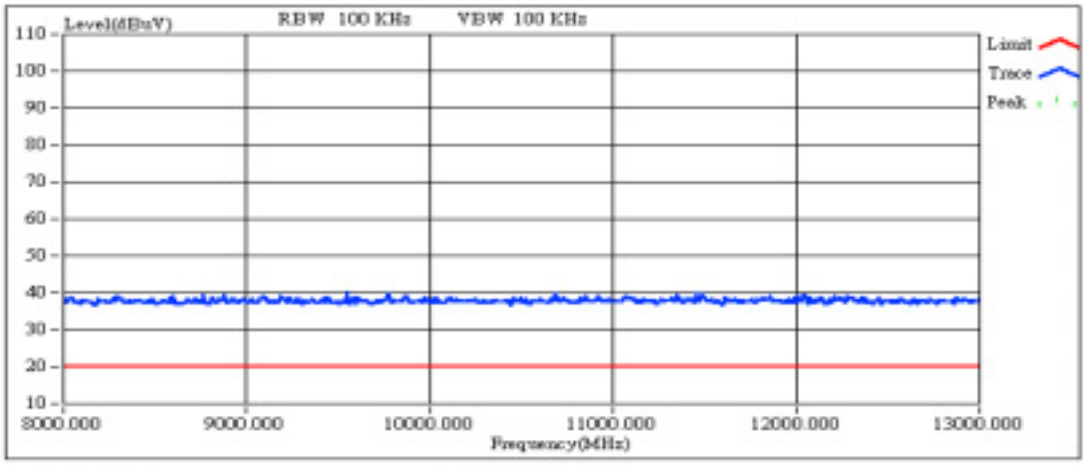
CH Mid 3GHz – 8GHz



Custom Name: Hong Tech
Engineer: Markbs
Model Name: HTC-2400E
Report No.: 020071-R
Test Mode: Mid

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)
1	4880.0000	56.19	0.00	0.00	56.19
2	7330.0000	49.50	0.00	0.00	49.50

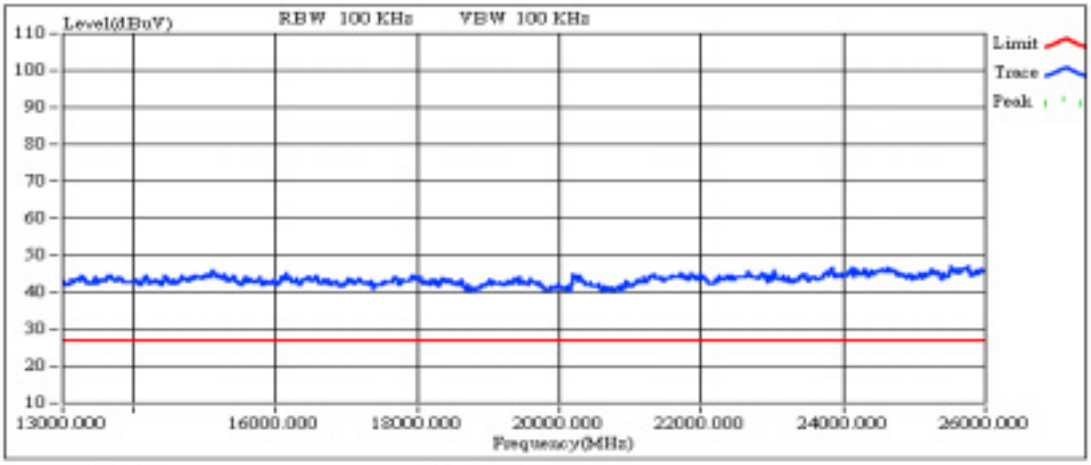
CH Mid 8GHz- 13GHz



Custom Name: Hong Tech
Engineer: Markbs
Model Name: HTC-2400E
Report No.: 020071-R
Test Mode: Mid

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)

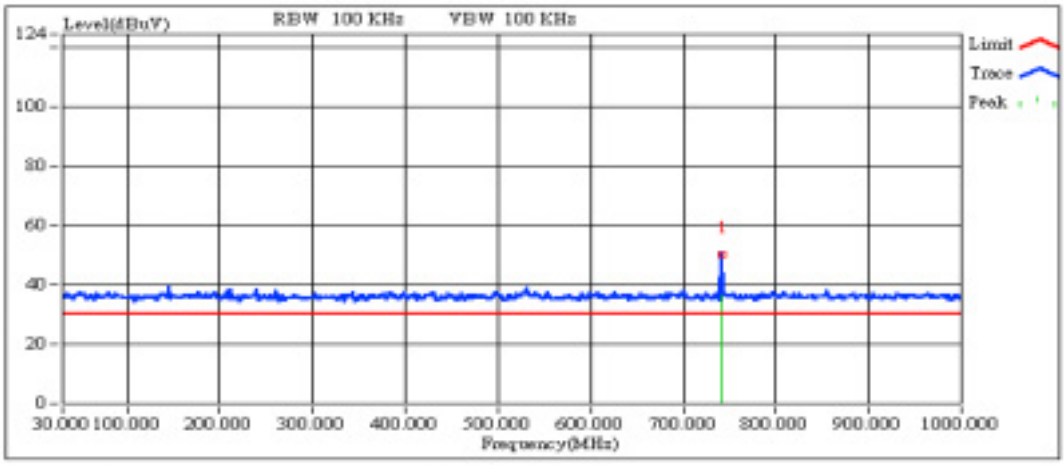
CH Mid 13GHz – 26GHz



Custom Name: Hong Tech
Engineer: Markba
Model Name: HTC-2400E
Report No.: 020071-R
Test Mode: Mid

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)

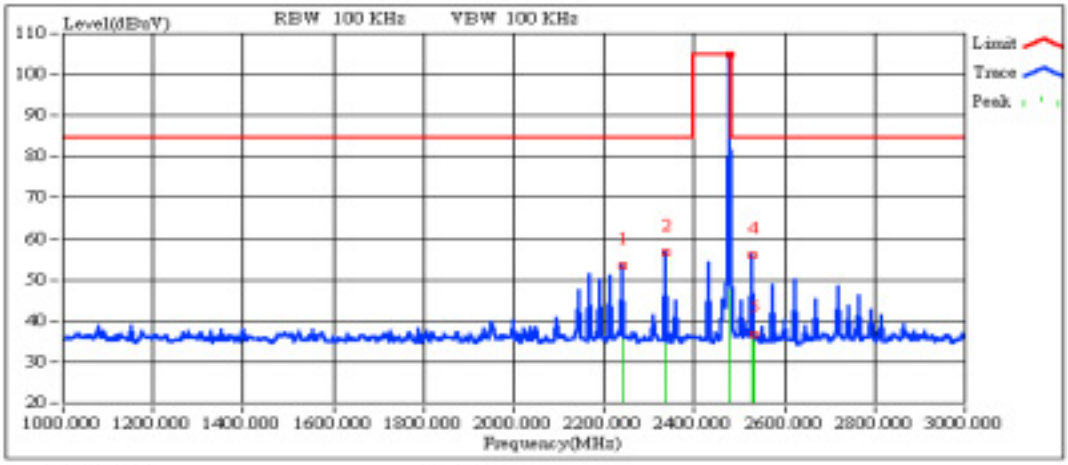
CH High 30MHz – 1GHz



Custom Name: Hong Tech
Engineer: Markba
Model Name: HTC-2400E
Report No.: 020071-R
Test Mode: High

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)
1	741.9800	50.35	0.00	0.00	50.35

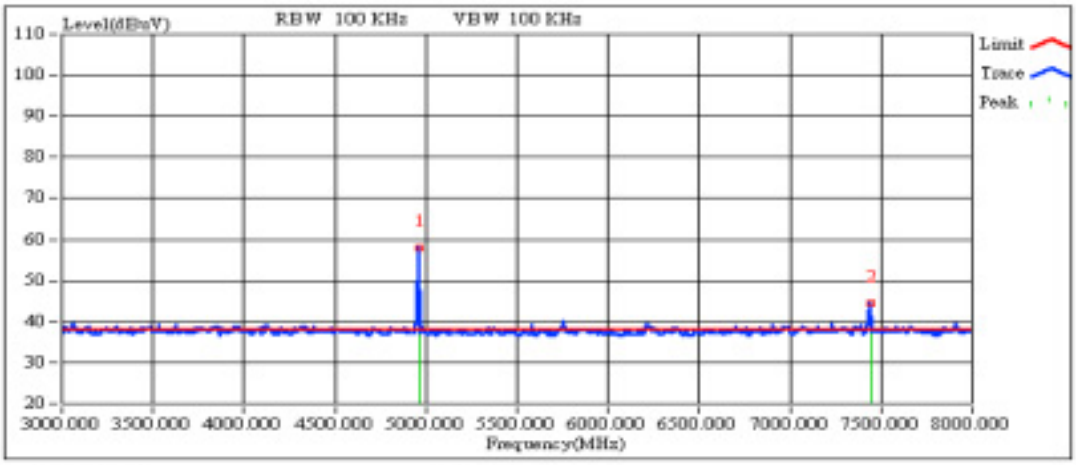
CH High 1GHz- 3GHz



Custom Name: Hong Tech
Engineer: Markba
Model Name: HTC-2400E
Report No.: 020071-R
Test Mode: High

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)
1	2240.0000	53.57	0.00	0.00	53.57
2	2336.0000	56.69	0.00	0.00	56.69
3	2480.0000	104.71	0.00	0.00	104.71
4	2528.0000	55.85	0.00	0.00	55.85
5	2532.0000	36.70	0.00	0.00	36.70

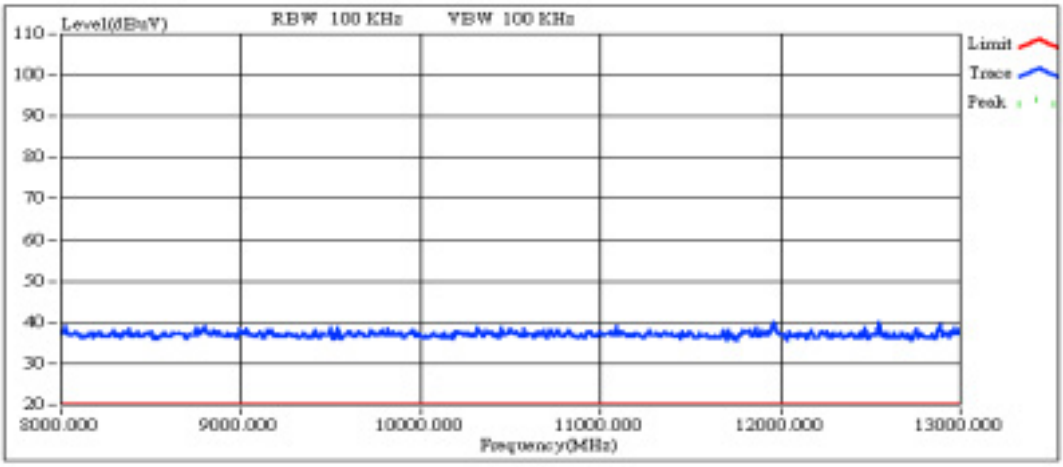
CH High 3GHz – 8GHz



Custom Name: Hong Tech
Engineer: Markbo
Model Name: HTC-2400E
Report No.: 020071-R
Test Mode: High

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)
1	4960.0000	57.91	0.00	0.00	57.91
2	7440.0000	44.52	0.00	0.00	44.52

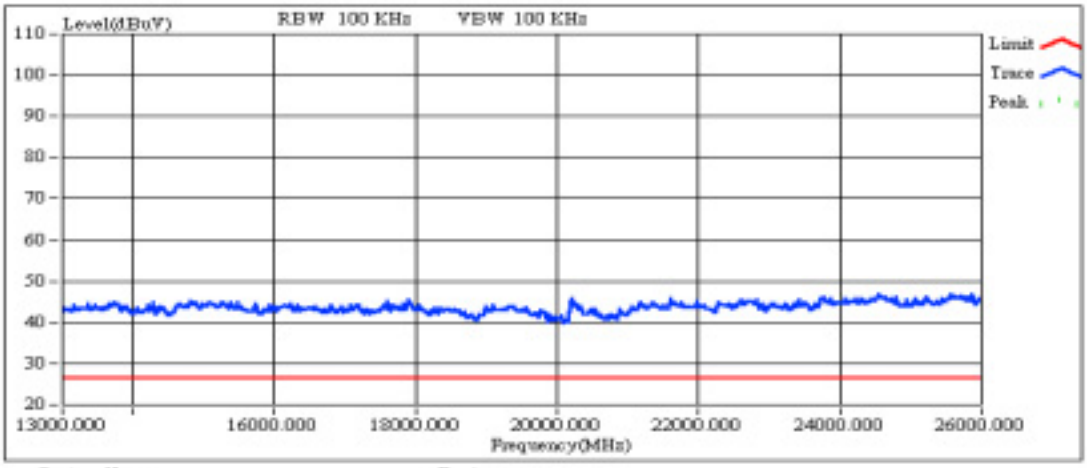
CH High 8GHz- 13GHz



Custom Name: Hong Tech
Engineer: Markbo
Model Name: HTC-2400E
Report No.: 020071-R
Test Mode: High

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)

CH High 13GHz – 26GHz



Custom Name: Hong Tech
Engineer: Markba
Model Name: HTC-2400E
Report No.: 020071-R
Test Mode: High

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)

9.8 Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode: TX CH Low Mode
Fundamental Frequency: 2402MHz
Temperature : 25 ℃
Humidity : 68 %

Test Date : Oct. 20, 2002
Test By: Jean
Pol: Ver./Hor

Freq. (MHz)	Ant.Pol. H/V	Detector Mode (PK/AV)	Reading (dBuV)	Ant./CL/ Amp. CF(dB)	Actual FS (dBuV/m)	Limit3m (dBuV/m)	Safe Margin (dB)
149.76	V	Peak	12.01	11.12	23.13	43.50	-20.37
383.88	V	Peak	11.72	19.85	31.57	46.00	-14.43
450.06	V	Peak	9.89	20.17	30.06	46.00	-15.94
383.88	H	Peak	17.51	19.85	37.36	46.00	-8.64
479.63	H	Peak	18.21	21.56	39.77	46.00	-6.23
527.50	H	Peak	17.1	23.48	40.58	46.00	-5.42
575.37	H	Peak	12.74	24.83	37.57	46.00	-8.43
600.72	H	Peak	15.16	25.36	40.52	46.00	-5.48

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 detector mode.

(3) 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

(4) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.

(5) 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.

(6) The IF bandwidth of SPA between 30MHz to 1GHz was 100KHz.

Operation Mode: TX CH Mid Mode
Fundamental Frequency: 2442MHz
Temperature : 25 ℃
Humidity : 68 %

Test Date : Oct. 20, 2002
Test By: Jean
Pol: Ver./Hor

Freq. (MHz)	Ant.Pol. H/V	Detector Mode (PK/AV)	Reading (dBuV)	Ant./CL/ Amp. CF(dB)	Actual FS (dBuV/m)	Limit3m (dBuV/m)	Safe Margin (dB)
383.88	V	Peak	11.72	19.85	31.57	46.00	-14.43
450.06	V	Peak	9.89	20.17	30.06	46.00	-15.94
383.88	H	Peak	21.91	19.85	41.76	46.00	-4.24
527.50	H	Peak	15.03	23.48	38.51	46.00	-7.49
551.44	H	Peak	12.89	24.31	37.2	46.00	-8.80
599.31	H	Peak	11.53	25.35	36.88	46.00	-9.12
624.65	H	Peak	13.65	25.13	38.78	46.00	-7.22

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 detector mode.

(3) 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

(4) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.

(5) 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.

(6) The IF bandwidth of SPA between 30MHz to 1GHz was 100KHz.

Operation Mode: TX CH High Mode
Fundamental Frequency: 2480MHz
Temperature : 25 ℃
Humidity : 68 %

Test Date : Oct. 20, 2002
Test By: Jean
Pol: Ver./Hor

Freq. (MHz)	Ant.Pol. H/V	Detector Mode (PK/AV)	Reading (dBuV)	Ant./CL/ Amp. CF(dB)	Actual FS (dBuV/m)	Limit3m (dBuV/m)	Safe Margin (dB)
383.88	V	Peak	11.72	19.85	31.57	46.00	-14.43
450.06	V	Peak	9.89	20.17	30.06	46.00	-15.94
383.88	H	Peak	20.56	19.85	40.41	46.00	-5.59
479.63	H	Peak	16.7	21.56	38.26	46.00	-7.74
527.50	H	Peak	16.15	23.48	39.63	46.00	-6.37
599.31	H	Peak	11.09	25.35	36.44	46.00	-9.56
624.65	H	Peak	13.4	25.13	38.53	46.00	-7.47

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 detector mode.

(3) 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

(4) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.

(5) 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.

(6) The IF bandwidth of SPA between 30MHz to 1GHz was 100KHz.

9.9 Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode:	TX Mode	Test Date :	10/15/2002
Fundamental Frequency:	2402MHz (CH Low)	Test By:	Jean
Temperature :	25 ℃	Pol:	Ver. / Hor.
Humidity :	68 %		

Freq. (MHz)	Ant.Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	CF (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)
2116.0	V	39.97		-7.16	32.81		74.00	54.00	-21.19
2260.0	V	41.47		-6.61	34.86		74.00	54.00	-19.14
2452.0	V	41.48		-5.93	35.55		74.00	54.00	-18.45
2116.0	H	47.69		-7.16	40.53		74.00	54.00	-13.47
2260.0	H	48.94		-6.61	42.33		74.00	54.00	-11.67
2372.0	H	49.26		-6.21	43.05		74.00	54.00	-10.95
2452.0	H	46.78		-5.93	40.85		74.00	54.00	-13.15

Remark：

(1) Measuring frequencies from 1GHz to the 10th harmonic of highest fundamental frequency。

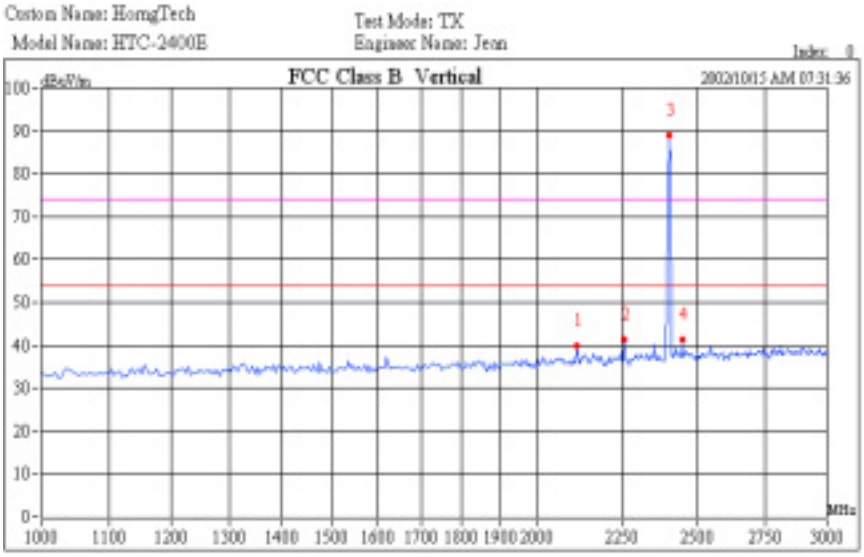
(2) Datas of measurement within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

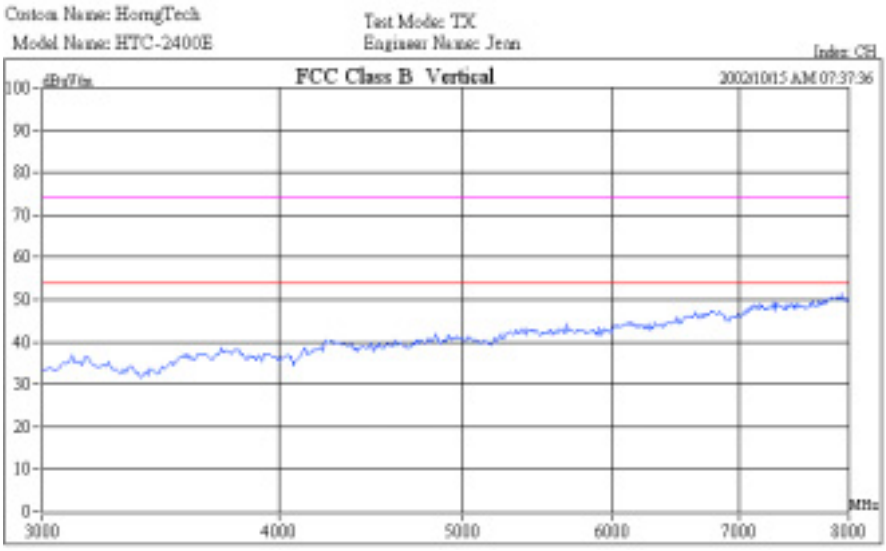
(3) Radiated emissions measured in frequency **above 1000MHz** were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column。

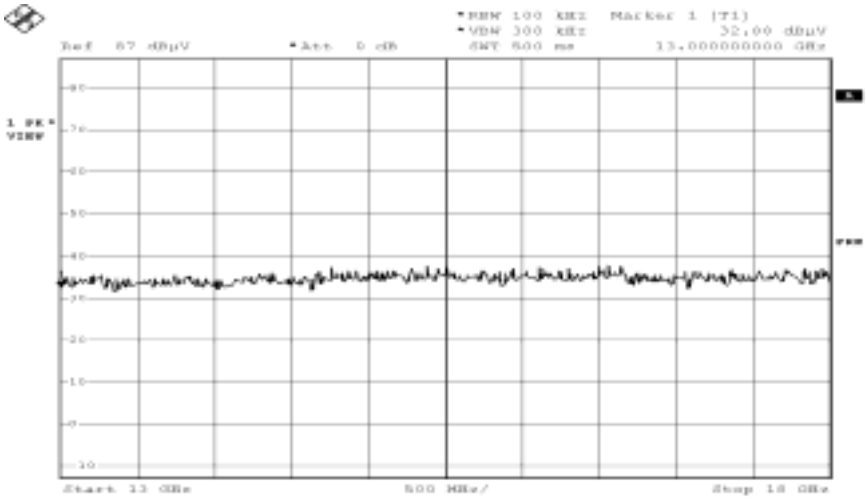
(4) Spectrum Setting : 30MHz – 1000MHz , RBW= 100KHz, VBW=100KHz, Sweep time = 200 ms. 1GHz- 8GHz, RBW= 1MHz, VBW= 1MHz, Sweep time= 200 ms.
The RBW is setting to 100KHz for frequency above 8GHz, for the purpose of ascertain this device haven't noise.

(5) Analyzer setting P(Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=10Hz

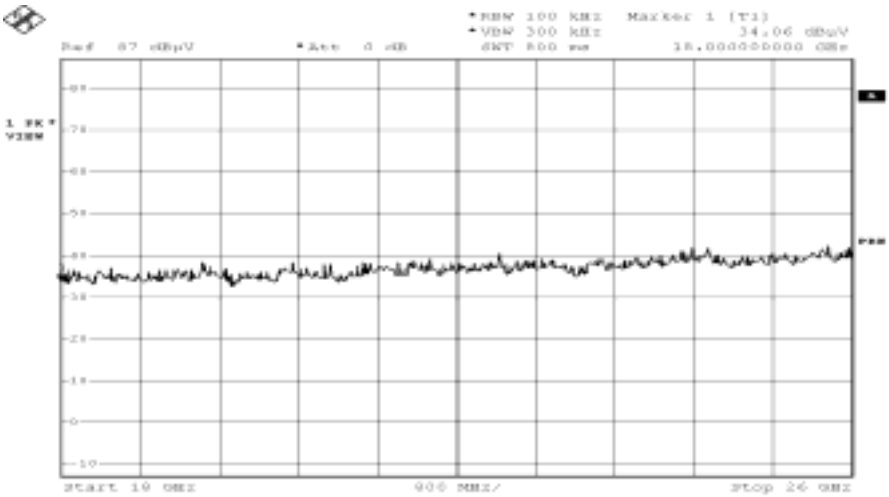
Radiated Emission test data plot (CH Low V)





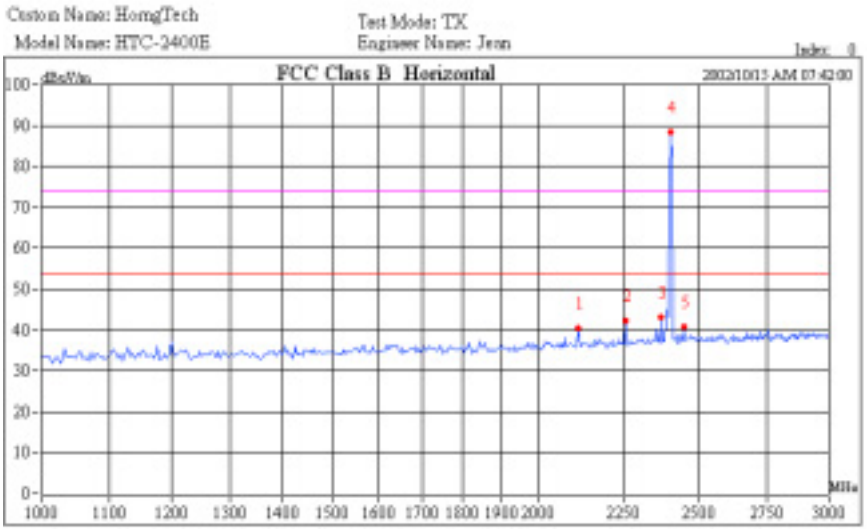


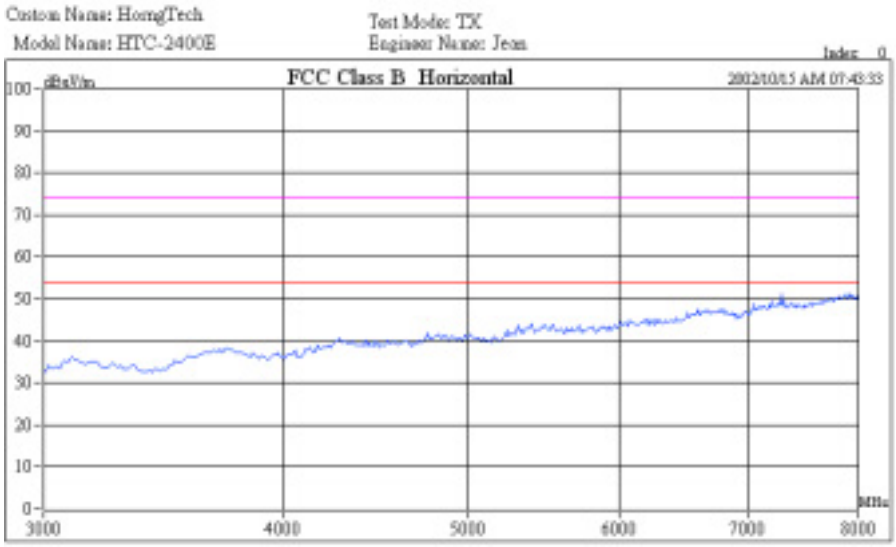
Comment A: TX Duty cycle
Date: 18.SEP.2002 06:11:53

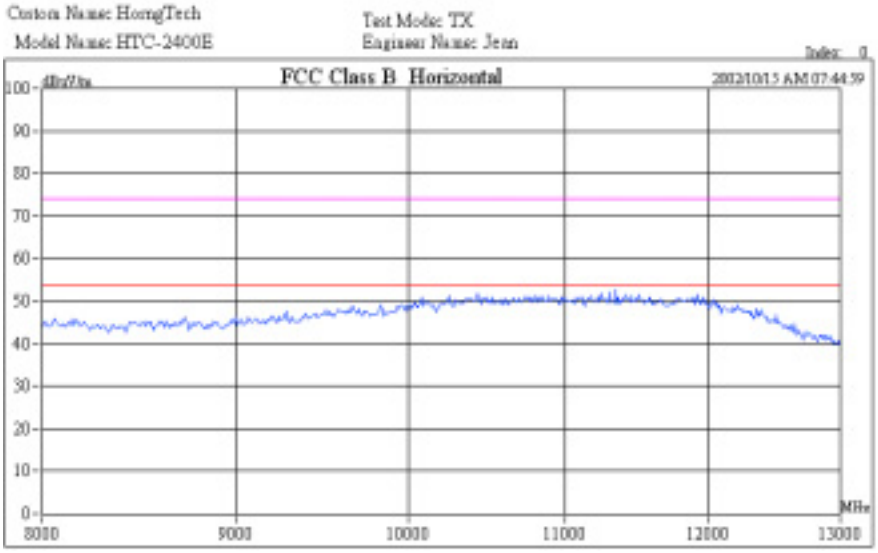


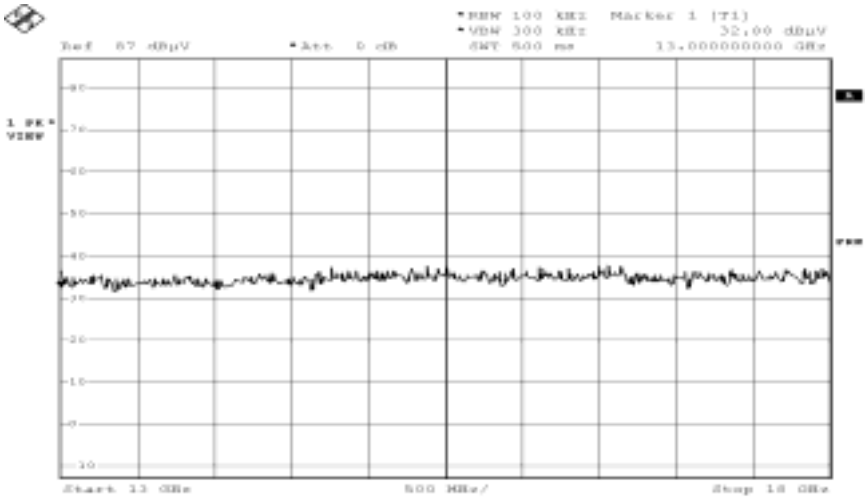
Comment A: TX Duty cycle
Date: 18.SEP.2002 06:14:50

Radiated Emission test data plot (CH Low H)

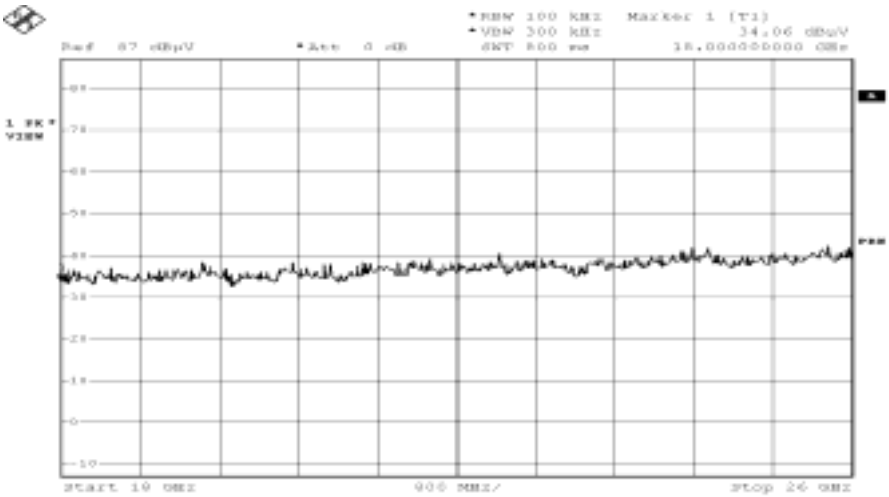








Comment A: TX Duty cycle
Date: 18.SEP.2002 06:11:53



Comment A: TX Duty cycle
Date: 18.SEP.2002 06:14:50

Operation Mode:	TX Mode	Test Date :	10/15/2002
Fundamental Frequency:	2442MHz (CH Mid)	Test By:	Jean
Temperature :	25 ℃	Pol:	Ver. / Hor.
Humidity :	68 %		

Freq. (MHz)	Ant.Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	CF (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)
2204.0	V	45.98		-6.83	39.15		74.00	54.00	-14.85
2300.0	V	46.33		-6.45	39.88		74.00	54.00	-14.12
2300.0	H	49.52		-6.45	43.07		74.00	54.00	-10.93
2396.0	H	47.99		-6.13	41.86		74.00	54.00	-12.14
2492.0	H	48.04		-5.78	42.26		74.00	54.00	-11.74

Remark：

(1) Measuring frequencies from 1GHz to the 10th harmonic of highest fundamental frequency。

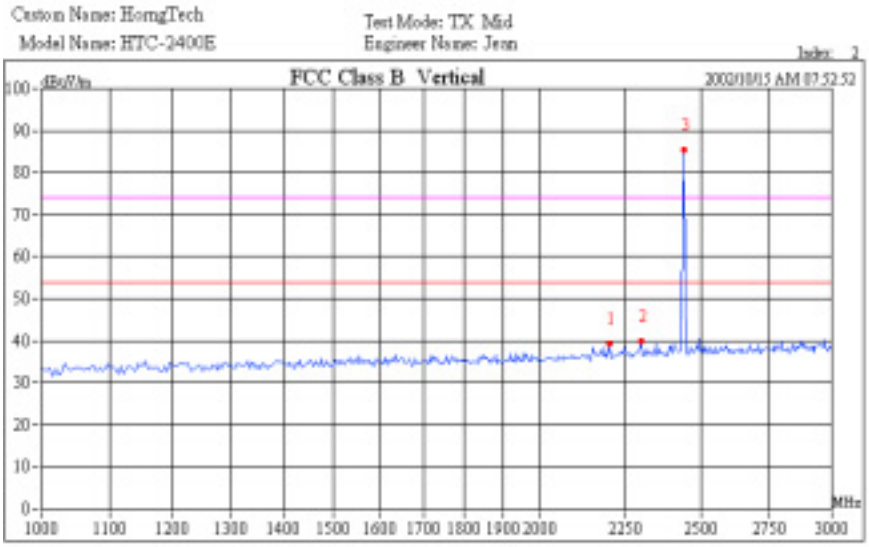
(2) Datas of measurement within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

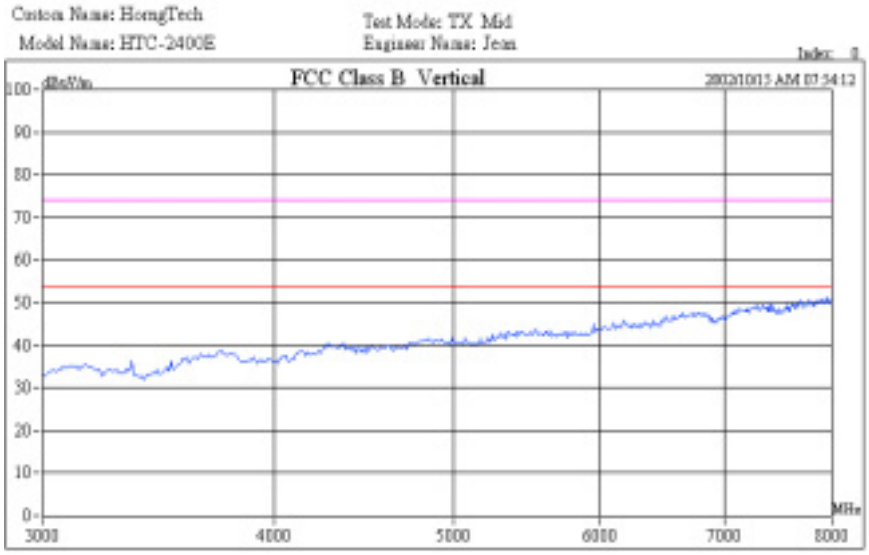
(3) Radiated emissions measured in frequency **above 1000MHz** were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column。

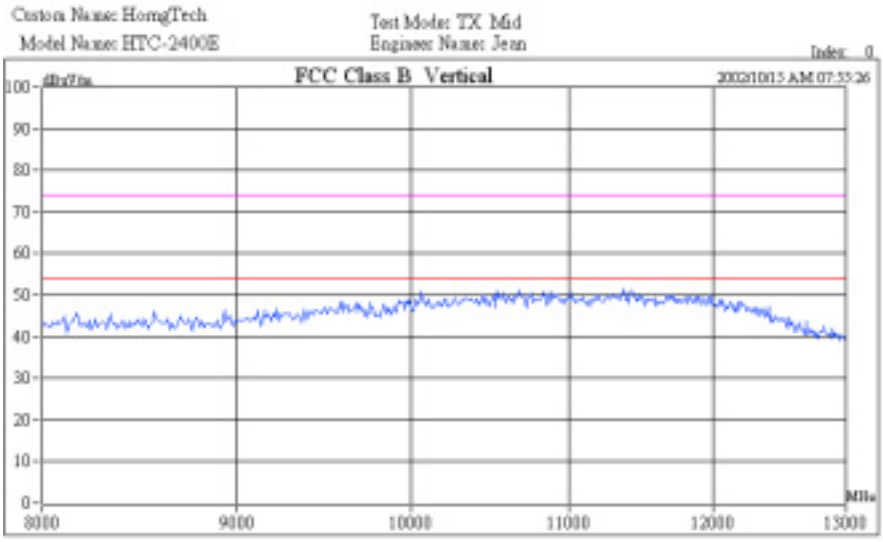
(4) Spectrum Setting : 30MHz – 1000MHz , RBW= 100KHz, VBW=100KHz, Sweep time = 200 ms. 1GHz- 8GHz, RBW= 1MHz, VBW= 1MHz, Sweep time= 200 ms.
The RBW is setting to 100KHz for frequency above 8GHz, for the purpose of ascertain this device haven't noise.

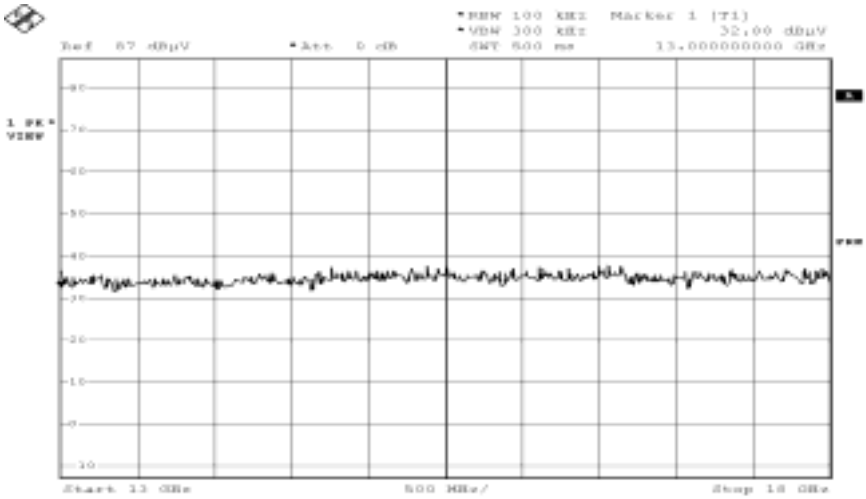
(5) Analyzer setting P(Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=10Hz

Radiated Emission test data plot (CH Mid V)

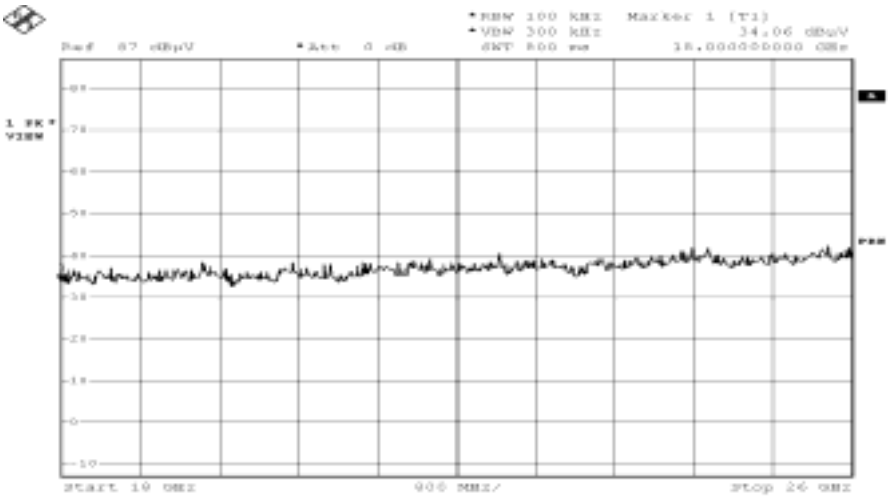






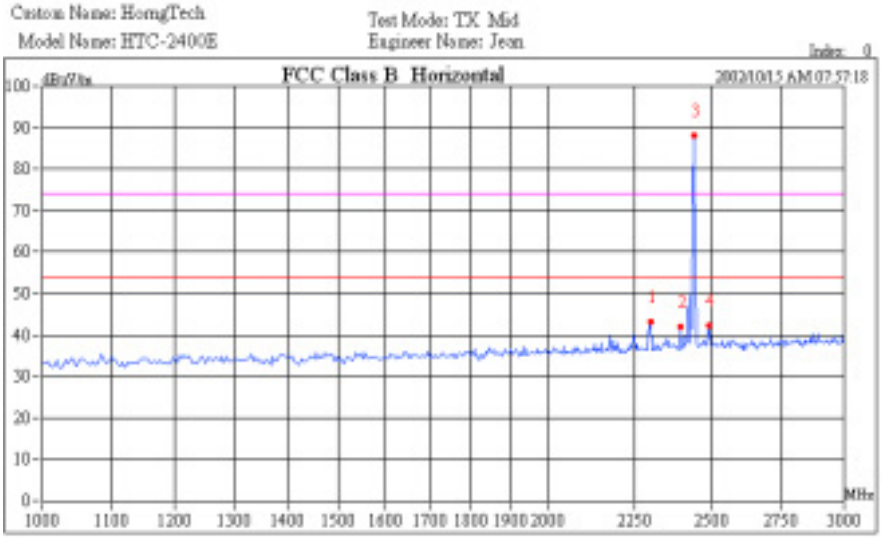


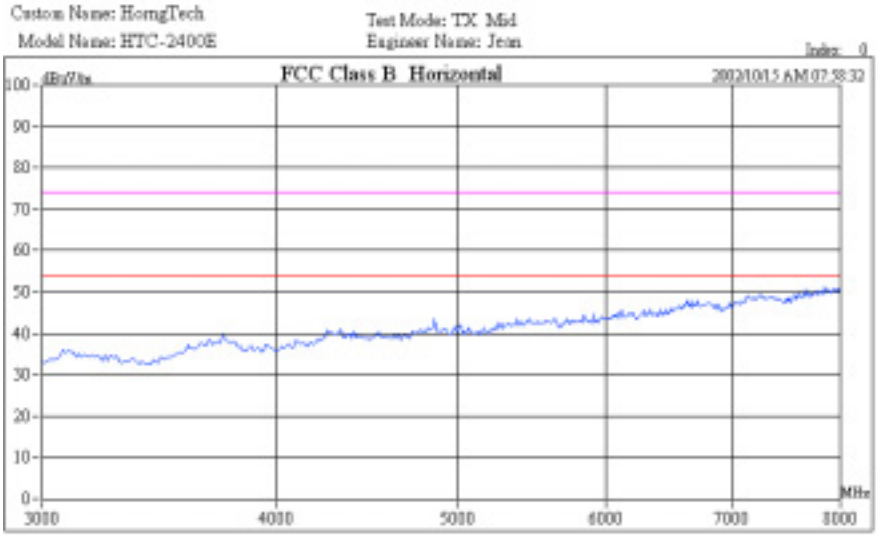
Comment A: TX Duty cycle
Date: 18.SEP.2002 06:11:53

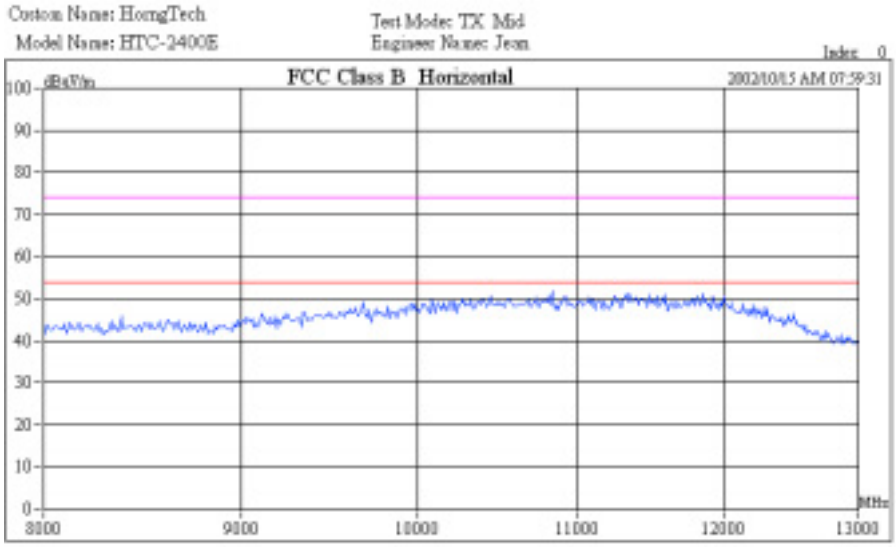


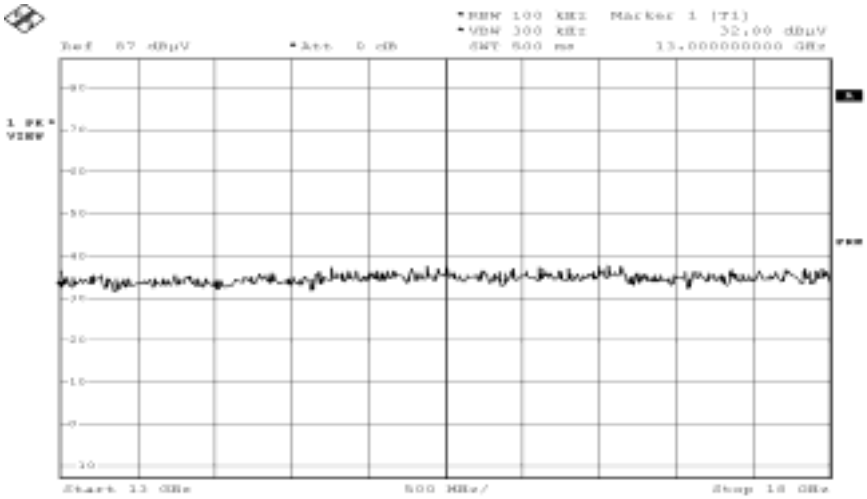
Comment A: TX Duty cycle
Date: 18.SEP.2002 06:14:50

Radiated Emission test data plot (CH Mid H)

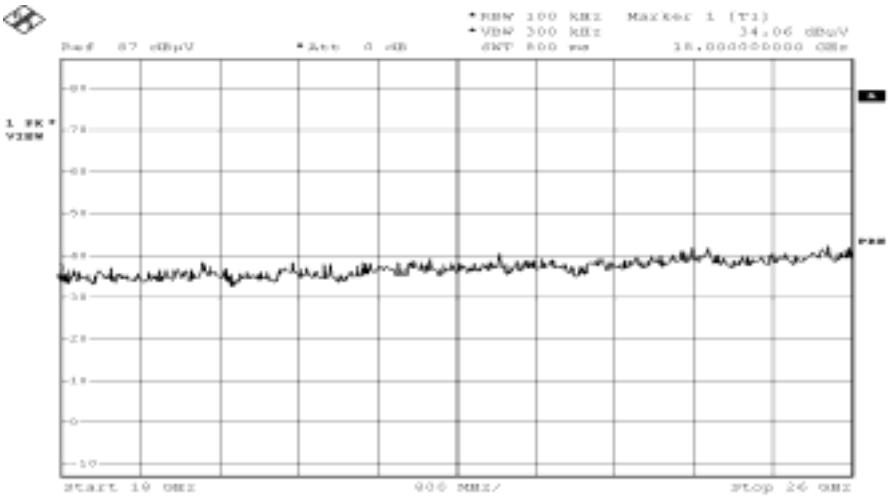








Comment A: TX Duty cycle
Date: 18.SEP.2002 06:11:53



Comment A: TX Duty cycle
Date: 18.SEP.2002 06:14:50

Operation Mode:	TX Mode	Test Date :	10/15/2002
Fundamental Frequency:	2480MHz (CH High)	Test By:	Jean
Temperature :	25 ℃	Pol:	Ver. / Hor.
Humidity :	68 %		

Freq. (MHz)	Ant.Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	CF (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)
2240.0	V	46.78		-6.69	40.09		74.00	54.00	-13.91
2336.0	V	47.37		-6.33	41.04		74.00	54.00	-12.96
2436.0	V	47.65		-5.98	41.67		74.00	54.00	-12.33
2532.0	V	46.40		-5.69	40.71		74.00	54.00	-13.29
2240.0	H	48.19		-6.69	41.50		74.00	54.00	-12.50
2336.0	H	49.11		-6.33	42.78		74.00	54.00	-11.22
2436.0	H	47.83		-5.98	41.85		74.00	54.00	-12.15
2532.0	H	47.11		-5.69	41.42		74.00	54.00	-12.58

Remark：

(1) Measuring frequencies from 1GHz to the 10th harmonic of highest fundamental frequency。

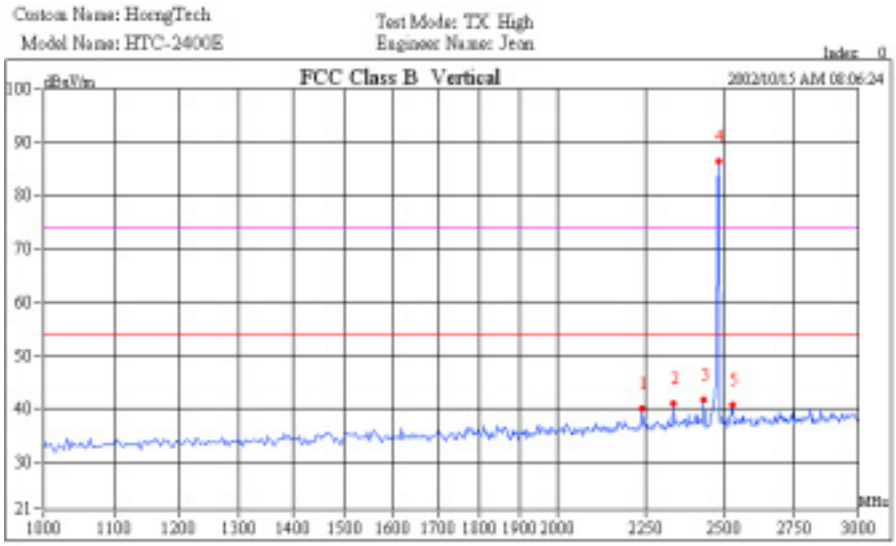
(2) Datas of measurement within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

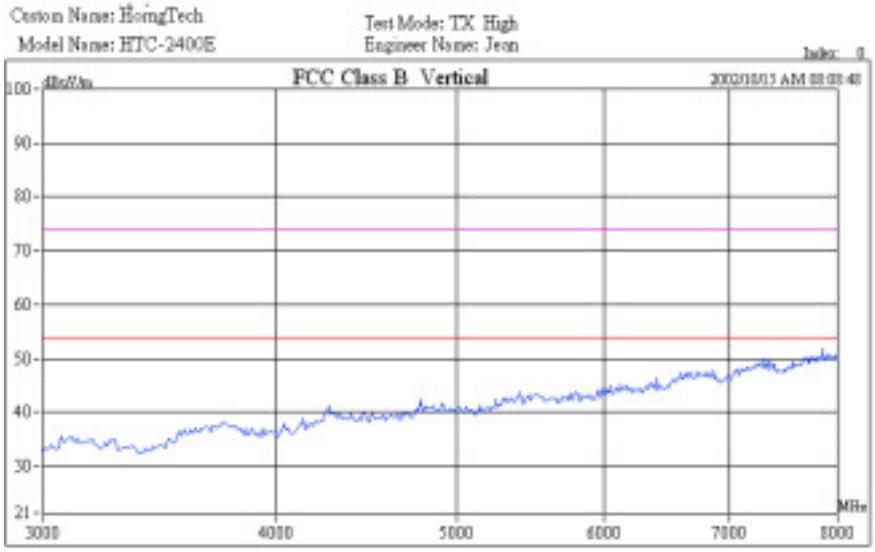
(3) Radiated emissions measured in frequency **above 1000MHz** were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column。

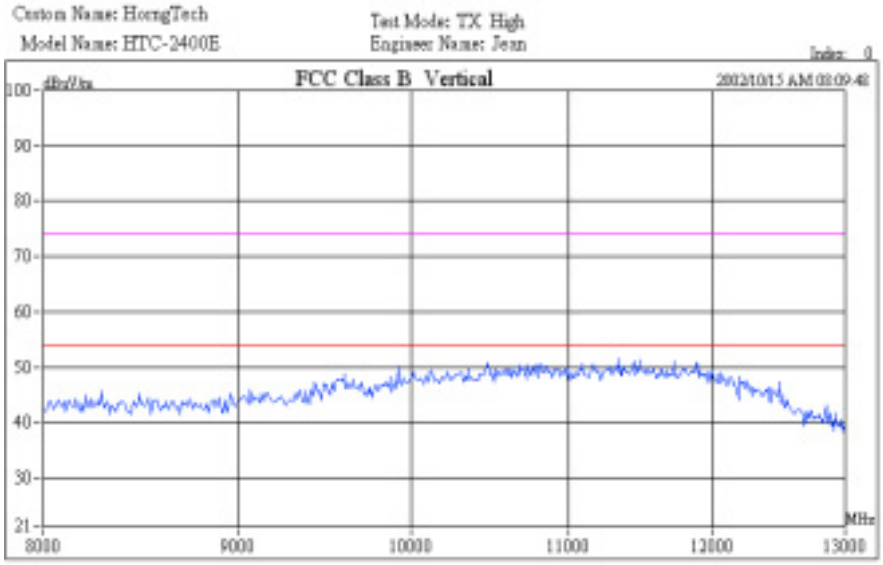
(4) Spectrum Setting : 30MHz – 1000MHz , RBW= 100KHz, VBW=100KHz, Sweep time = 200 ms. 1GHz- 8GHz, RBW= 1MHz, VBW= 1MHz, Sweep time= 200 ms.
The RBW is setting to 100KHz for frequency above 8GHz, for the purpose of ascertain this device haven't noise.

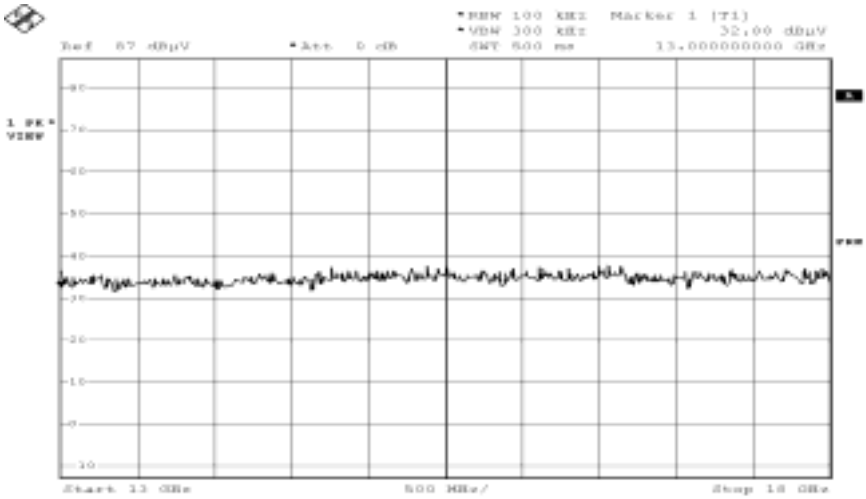
(5) Analyzer setting P(Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=10Hz

Radiated Emission test data plot (CH High V)

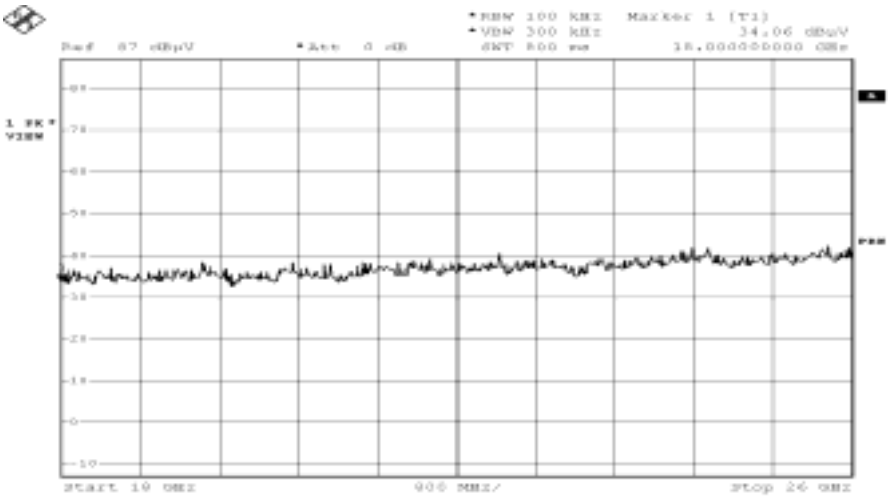






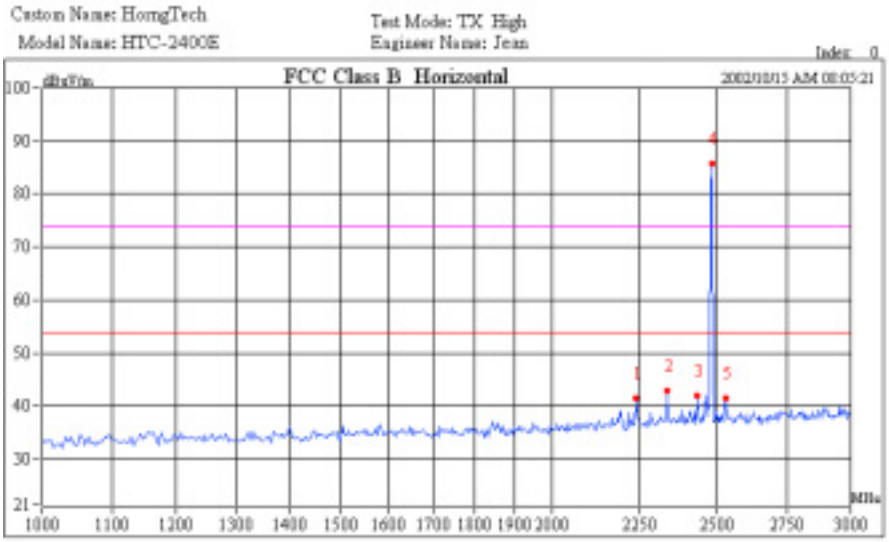


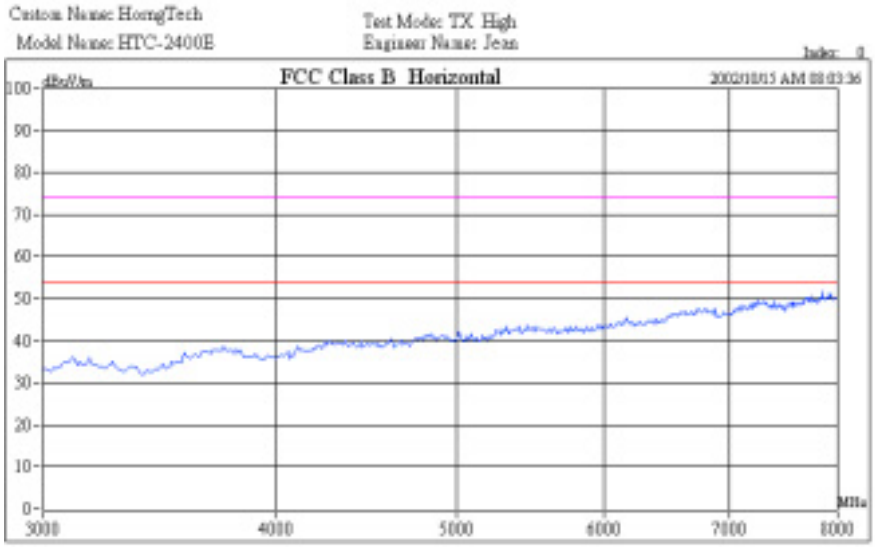
Comment A: TX Duty cycle
Date: 18.SEP.2002 06:11:53

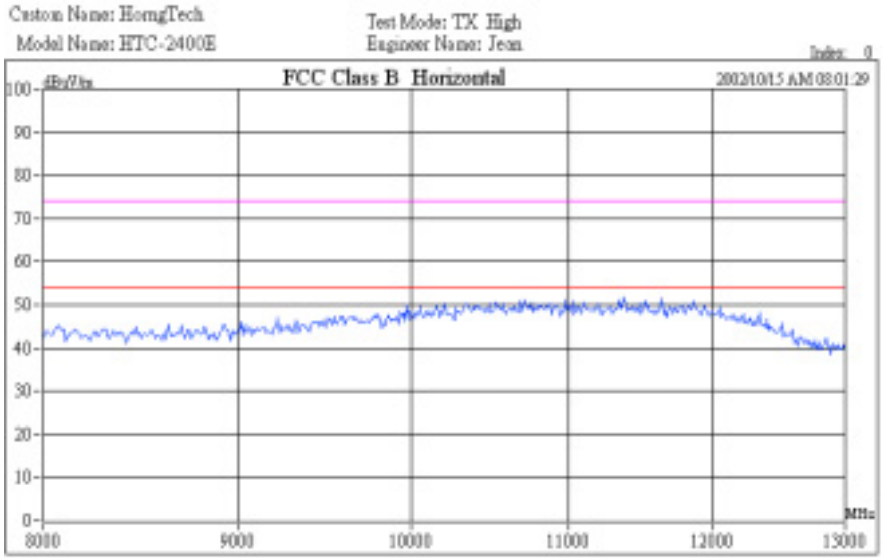


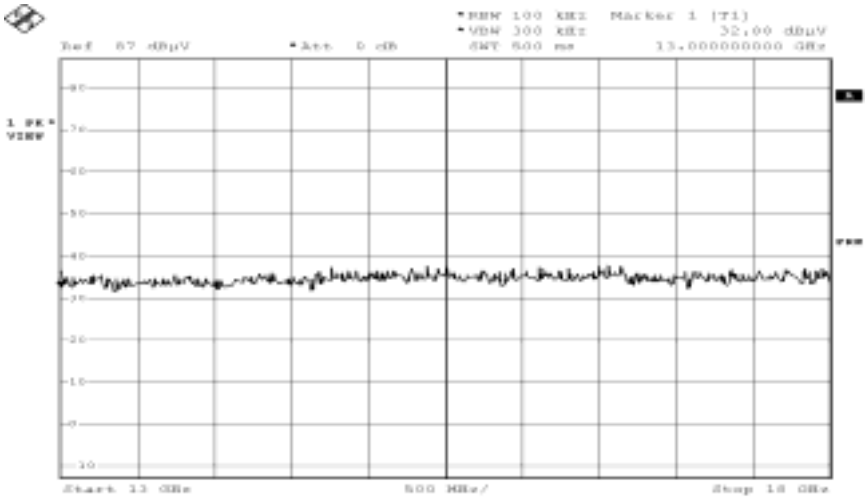
Comment A: TX Duty cycle
Date: 18.SEP.2002 06:14:50

Radiated Emission test data plot (CH High H)

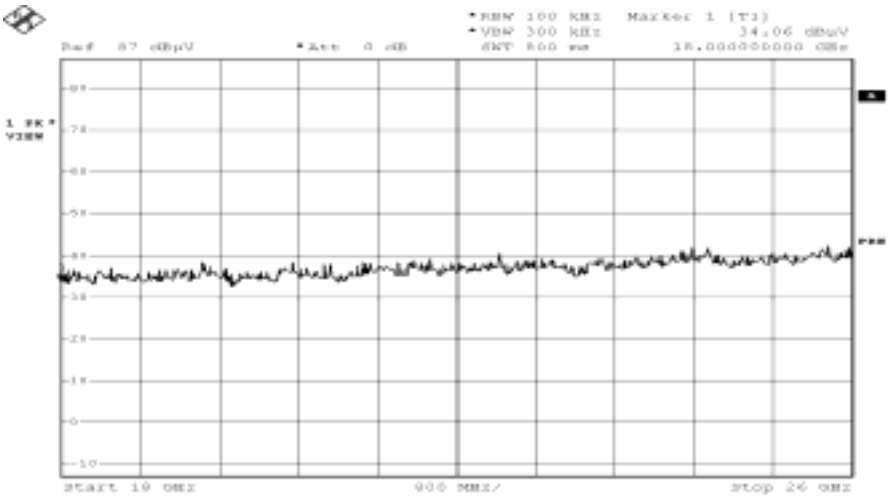








Comment A: TX Duty cycle
Date: 18.SEP.2002 06:11:53



Comment A: TX Duty cycle
Date: 18.SEP.2002 06:14:50

10. FREQUENCY SEPARATION

10.1 Standard Applicable

According to §15.247(a), Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the 20dB bandwidth of the hopping channel, whichever is greater.

10.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = middle of hopping channel .
4. Set the spectrum analyzer as RBW,VBW=100KHz, Adjust Span to 3.5 MHz, Sweep = auto.
5. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

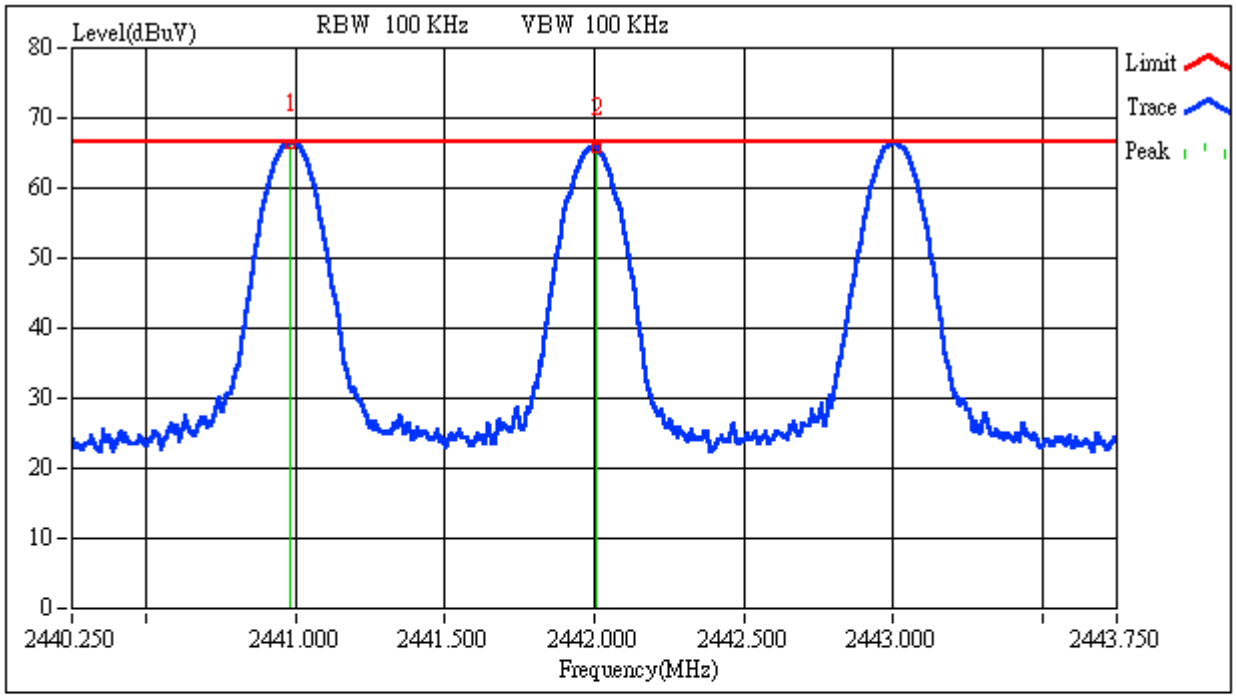
10.3 Measurement Result

Channel separation	Limit	Result
MHz	kHz	
1.03	>= 25	PASS

10.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal. Due.
Spectrum Analyzer	R&S	FSP 30	1093.4495.30	07/23/2002	07/22/2003
low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A

Frequency Separation Test Data



Custom Name: Hong Tech

Engineer: Markba

Model Name: HTC-2400E

Report No.: 020071-R

Test Mode: TX Channel Sep.

	Frequency(MHz)	Read Level (dBuV)	Probe (dB)	Cable Loss (dB)	Level(dBuV)
1	2440.9780	66.30	0.00	0.00	66.30
2	2442.0070	65.67	0.00	0.00	65.67

11. NUMBER OF HOPPING FREQUENCY

11.1 Standard Applicable

According to §15.247(a)(1)(ii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz and 5725MHz – 5850MHz bands shall use at least 75 hopping frequencies.

11.2 Measurement Procedure

1. Place the EUT on the table and set it in hopping in mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set spectrum analyzer Start=2400MHz, Stop = 2483.5MHz, Sweep = auto.
4. Set the spectrum analyzer as RBW,VBW=100KHz,
5. Max hold, view and count how many channel in the band.

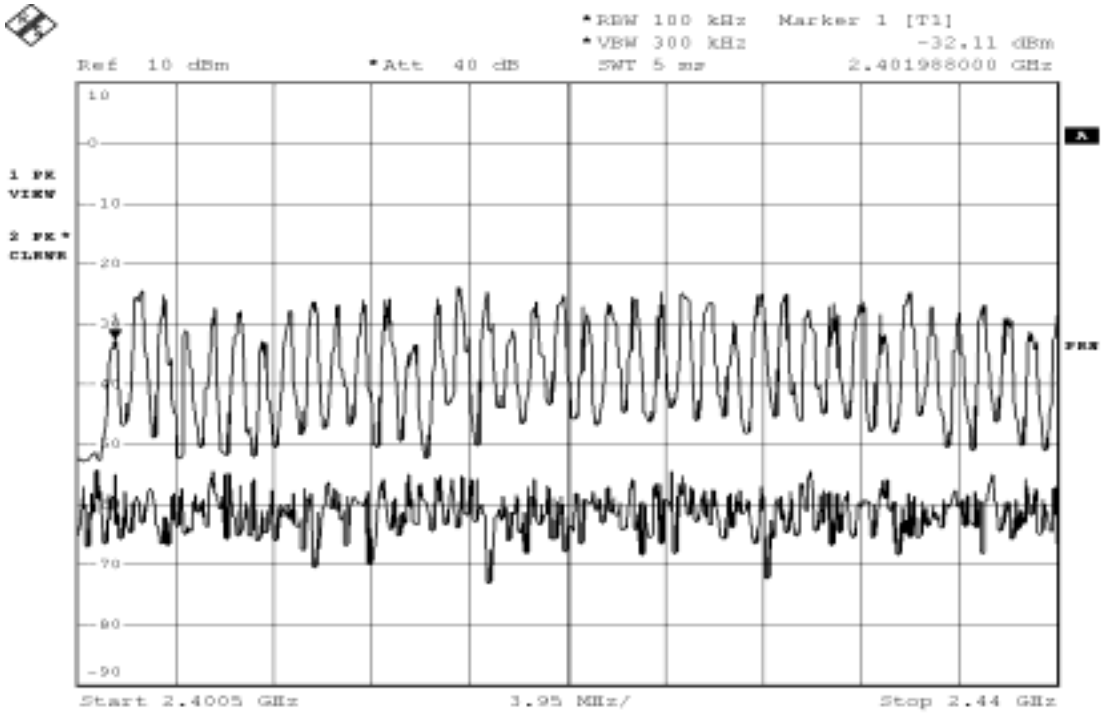
11.3 Measurement Result

Limit (CH)	Hopping channel Measurement result (CH)	Result
75	79	PASS

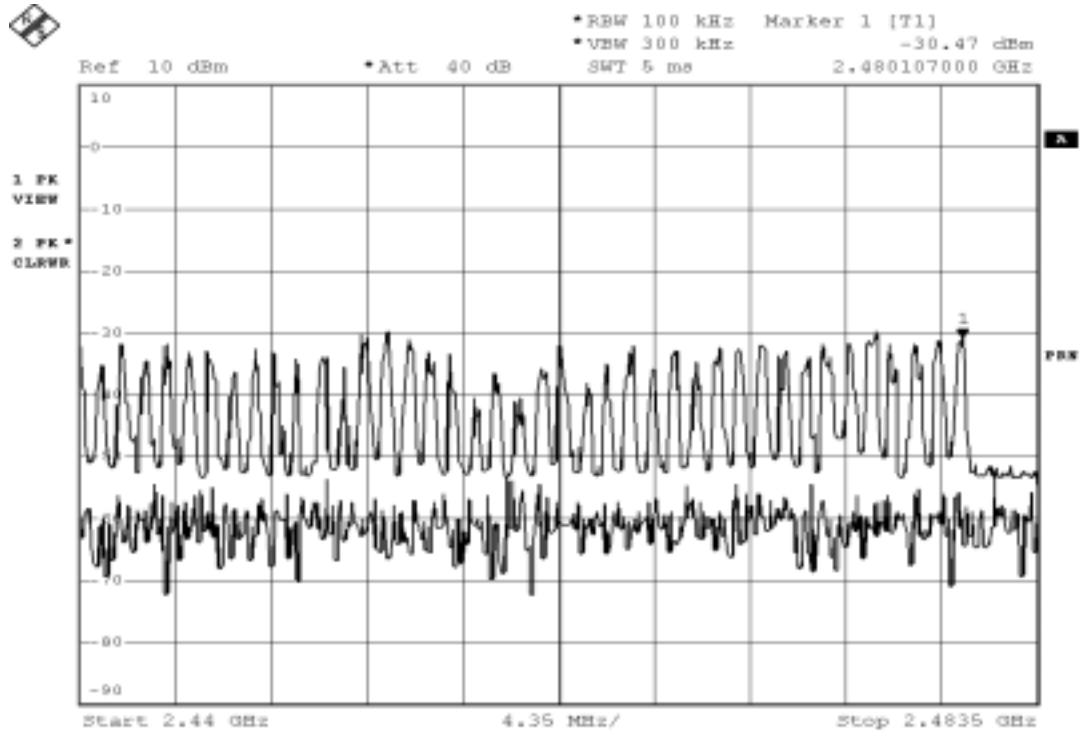
11.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal. Due.
low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A
Spectrum Analyzer	R&S	FSP 30	1093.4495.30	07/23/2002	07/22/2003

Frequency between 2400-2440



Frequency between 2440-2483.5



12. TIME OF OCCUPANCY (DWELL TIME)

12.1 Standard Applicable

According to §15.247(a)(1)(ii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz and 5725MHz – 5850MHz bands. The average time of occupancy on any frequency shall not greater than 0.4 s within a period of 0.4 seconds multiplied by the number of hopping channel employed.

12.2 Measurement Procedure

1. Place the EUT on the table and set it in hopping on mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW,VBW=100KHz, Span = 0Hz.
5. Repeat above procedures until all frequency measured were complete.

12.3 Measurement Result

A period time = 0.4 (s) X 79 = 31.6 (s)

Channel Low : 0.450 (mS) * (1600/79) * 31.6 (S) = 288 (mS)

Channel Mid : 0.460 (mS) * (1600/79) * 31.6 (S) = 294.4 (mS)

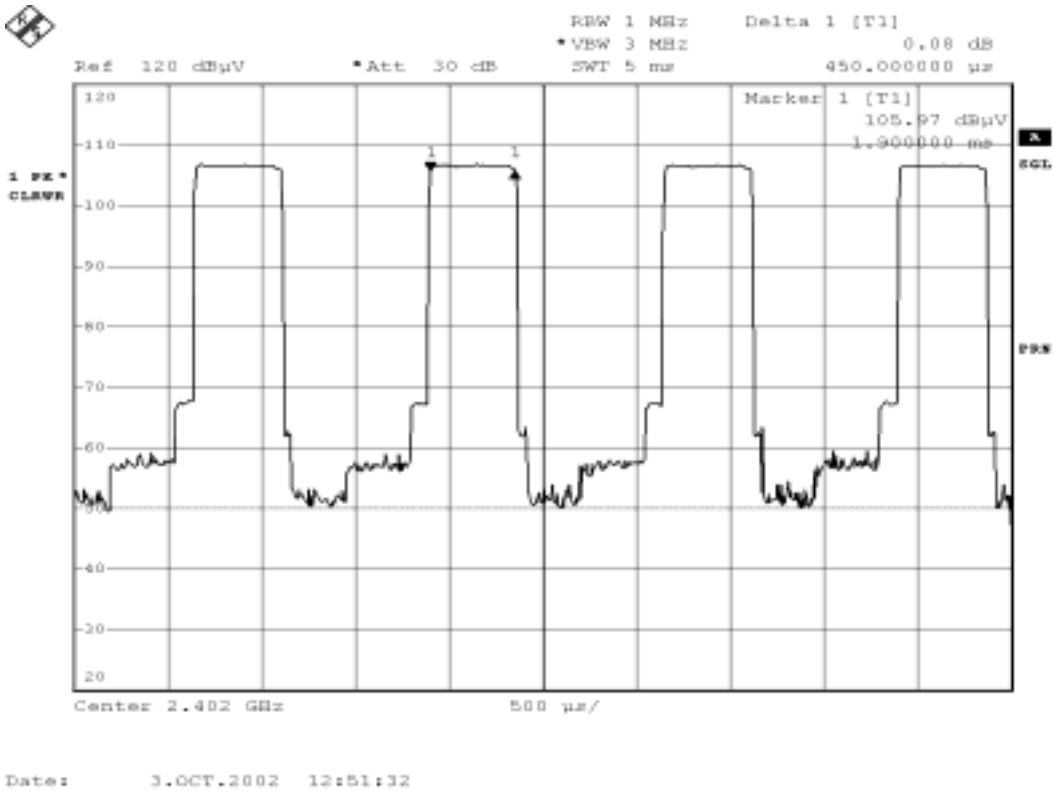
Channel High : 0.480 (mS) * (1600/79) * 31.6 (S) = 307.2 (mS)

CH	Pulse Time ms	Total of Dwell Time (ms)	Period time (ms)	Limit (ms)
Low	0.45	288.00	31.60	400.00
Mid	0.46	294.40	31.60	400.00
High	0.48	307.20	31.60	400.00

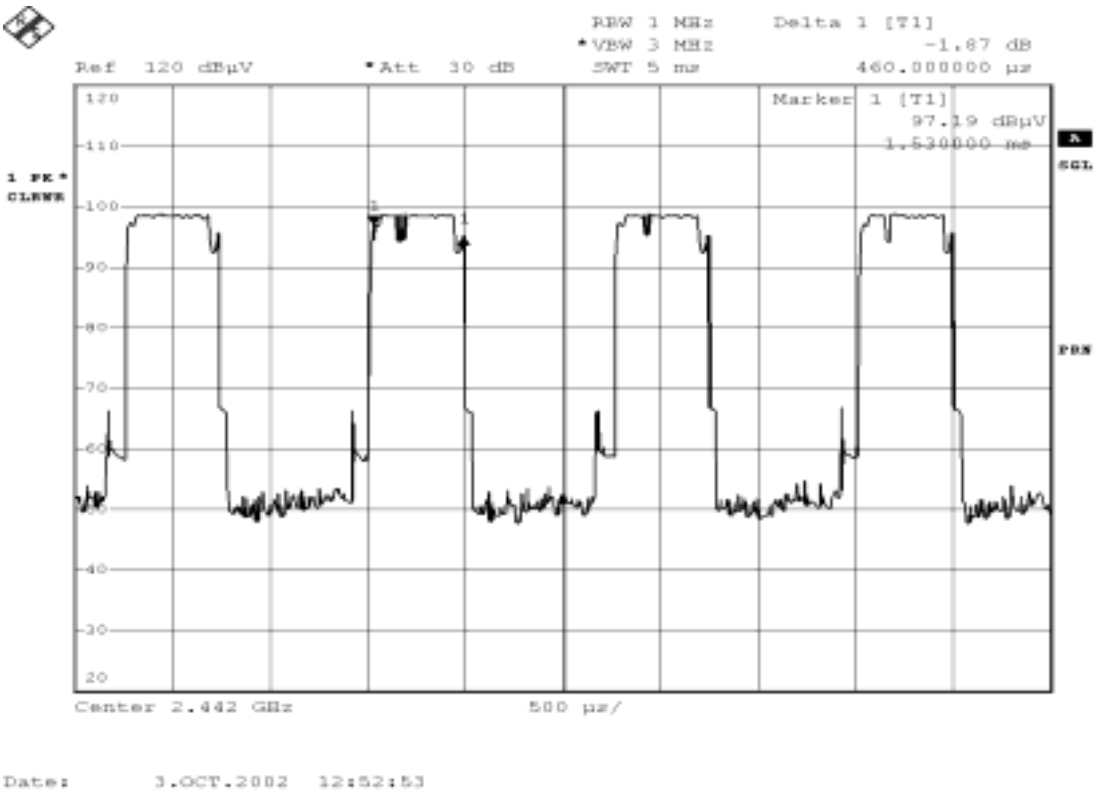
12.4 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal. Due.
low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A
Spectrum Analyzer	R&S	FSP 30	1093.4495.30	07/23/2002	07/22/2003

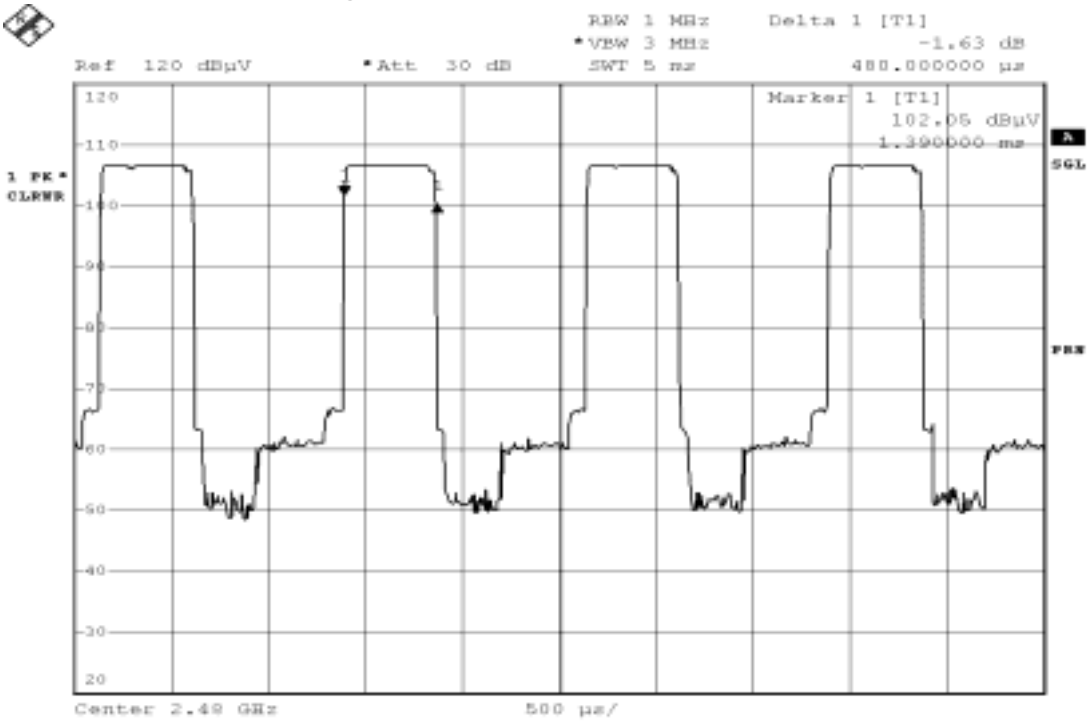
Dwell Time Test Data *CH-Low*



Dwell Time Test Data *CH-Mid*



Dwell Time Test Data *CH-High*



13. Peak Power Spectral Density

13.1 Standard Applicable

According to §15.247(d), for direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3kHz band during any time interval of continuous transmission.

13.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW = 3KHz, VBW = 10KHz, Span = 300KHz, Sweep=100s
4. Record the max. reading.
5. Repeat above procedures until all frequency measured were complete.

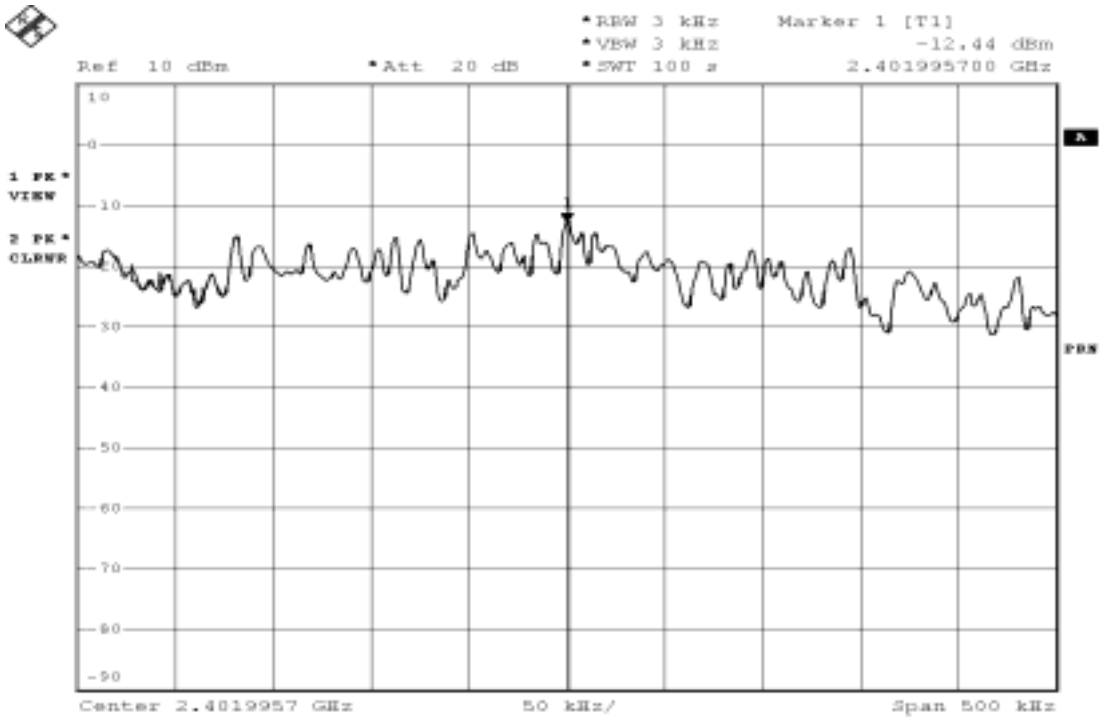
13.3 Measurement Result

	Reading dBm	Cable loss dB	Power Density (dBm)	Limit (dBm)
CH Low	-12.44	1.00	-11.44	8
CH Mid	-12.48	1.00	-11.48	8
CH High	-12.06	1.00	-11.06	8

13.4 Measurement Equipment Used:

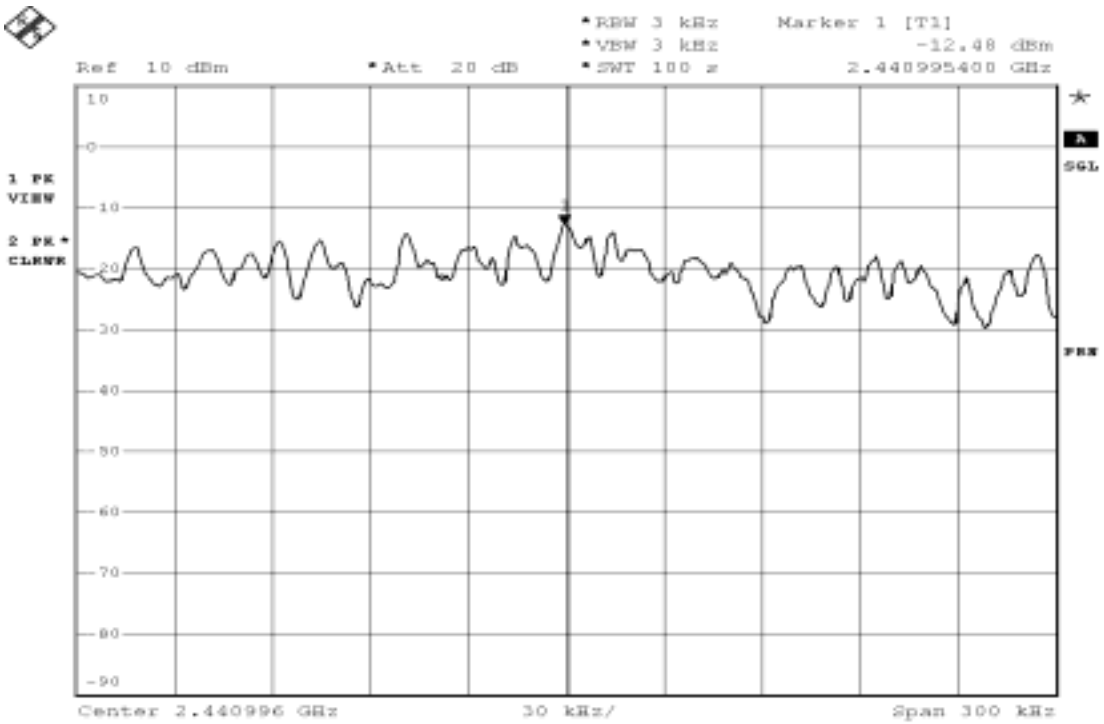
EQUIPMENT TYPE	MFR	Model No.	Serial No.	LAST CAL.	Cal. Due.
low loss cable	Huber + Suhner	Sucoflex 104	N/A	N/A	N/A
Spectrum Analyzer	R&S	FSP 30	1093.4495.30	07/23/2002	07/22/2003

Power Spectral Density Test Plot (CH-Low)



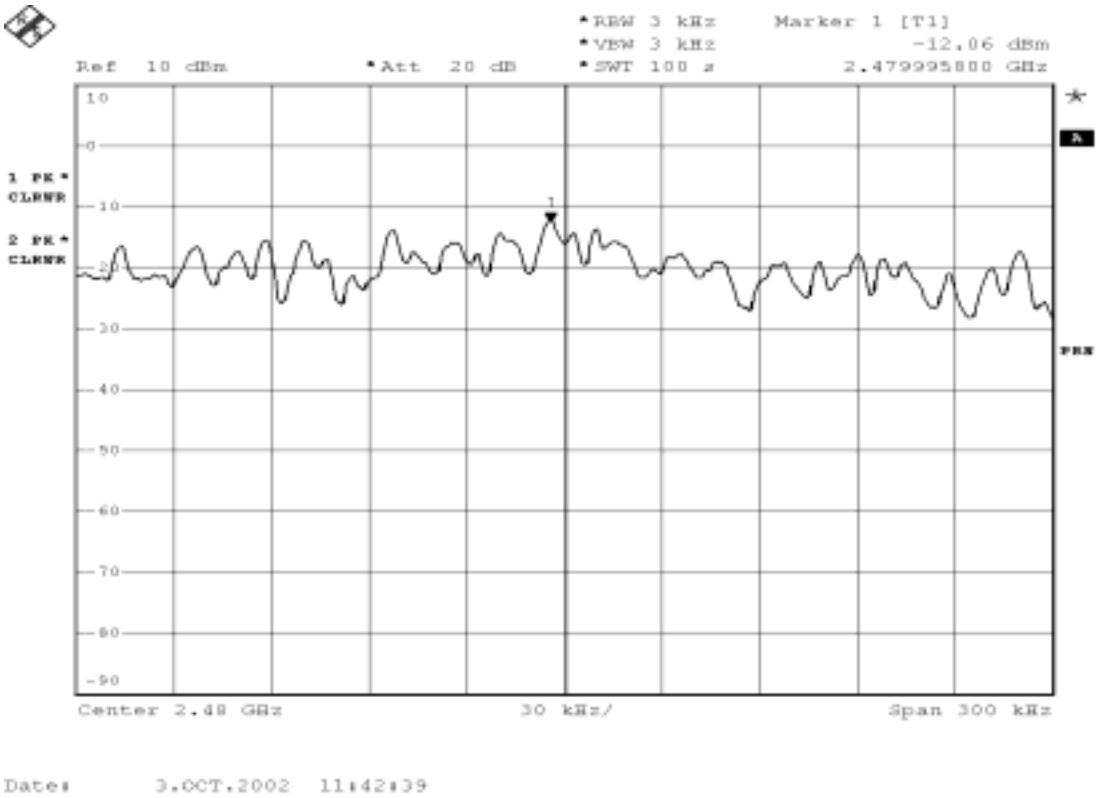
Date: 3.OCT.2002 11:54:31

Power Spectral Density Test Plot (CH-Mid)



Date: 3.OCT.2002 11:51:10

Power Spectral Density Test Plot (CH-High)



14. ANTENNA REQUIREMENT

14.1 Standard Applicable

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

And according to §15.246(1), if transmitting antennas of directional gain greater than 6dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

14.2 Antenna Connected Construction

The directional gins of antenna used for transmitting is 0 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.

15. RF EXPOSURE

15.1 Standard Applicable

According to §15.247(b)(4) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

The separation distance to body is less than 2.5cm The allow max output = 60/F(GHz) = 60/2.402 = 24.97 mW

The EUT max output power is 0.15 dBm (1.04mW) less than 24.97 mW, the SAR test is not requirement.

15.2 Measurement Result

N/A