



Neutron Engineering Inc.

FCC Radio Test Report

FCC ID: WL9KT21

This report concerns (check one) : ☒ Original Grant ☐ Class II Change

Issued Date : Dec, 17, 2009

Project No. : 0912C049

Equipment : 2.4GHz Radio Control system

Model Name : KT21

Applicant : ShenZhen ART-TECH R/C Hobby Co., Ltd.

Address : 3/F, No.1 Wanyelong Industrial Park, Liyuan Industrial Area, Tangtou Village, Shiyan Town, Baoan District, Shenzhen City, China

Manufacturer : ShenZhen ART-TECH R/C Hobby Co., Ltd.

Address : 3/F, No.1 Wanyelong Industrial Park, Liyuan Industrial Area, Tangtou Village, Shiyan Town, Baoan District, Shenzhen City, China

Tested by:

Neutron Engineering Inc. EMC Laboratory

Date of Test:

Dec. 07, 2009 ~ Dec. 16, 2009

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Declaration

Neutron represents to the client that testing is done in accordance with standard procedures as applicable and that test instruments used has been calibrated with the standards traceable to National Measurement Laboratory (**NML**) of **R.O.C.**, or National Institute of Standards and Technology (**NIST**) of **U.S.A.**

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For the use of the authority's logo is limited unless the Test Standard(s)/Scope(s)/Item(s) mentioned in this test report is (are) included in the conformity assessment authorities acceptance respective.



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1. CERTIFICATION

Equipment : 2.4GHz Radio Control system

Brand Name : Kyosho

Model Name : KT21

Applicant : ShenZhen ART-TECH R/C Hobby Co., Ltd.

Factory : ShenZhen ART-TECH R/C Hobby Co., Ltd.

Address : 3/F, No.1 Wanyelong Industrial Park, Liyuan Industrial Area, Tangtou Village,
Shiyan Town, Baoan District, Shenzhen City, China

Date of Test : Dec. 07, 2009 ~ Dec. 16, 2009

Test Item : ENGINEERING SAMPLE

Standards : FCC Part15, Subpart C(15.247) / ANCI C63.4 : 2003

The above equipment has been tested and found compliance with the requirement of the relative standards by Neutron Engineering Inc. EMC Laboratory.

The test data, data evaluation, and equipment configuration contained in our test report (Ref No. NEI-FCCP-1-0912C049) were obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of NVLAP and TAF according to the ISO-17025 quality assessment standard and technical standard(s).



2. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

FCC Part15 (15.247) , Subpart C				
Standard	Section	Test Item	Judgment	Remark
15.207		Conducted Emission	-	Note(2)
15.247	(c)	Antenna conducted Spurious Emission	PASS	
15.247	(a)(2)	6dB Bandwidth	PASS	
15.247	(b)	Peak Output Power	PASS	
15.247	(c)	Radiated Spurious Emission	PASS	
15.247	(d)	Power Spectral Density	PASS	
15.203		Antenna Requirement	PASS	
1.1307 1.1310 2.1091 2.1093		RF Exposure Compliance	PASS	

NOTE:

(1) "N/A" denotes test is not applicable in this Test Report

(2) The EUT use new battery



2.1 TEST FACILITY

The test facilities used to collect the test data in this report is **C01/OS02** at the location of No.132-1, Lane 329, Sec. 2, Palian Road, Shijr City, Taipei, Taiwan.

Neutron's test firm number is 95335

2.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement $y \pm U$, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately **95 %**.

A. Conducted Measurement :

Test Site	Method	Measurement Frequency Range	U , (dB)	NOTE
C01	ANSI	150 KHz ~ 30MHz	1.94	

B. Radiated Measurement :

Test Site	Method	Measurement Frequency Range	Ant. H / V	U , (dB)	NOTE
OS-01	ANSI	30MHz ~ 200MHz	V	3.82	
		30MHz ~ 200MHz	H	3.60	
		200MHz ~ 1,000MHz	V	3.86	
		200MHz ~ 1,000MHz	H	3.94	
OS-02	ANSI	30MHz ~ 200MHz	V	2.48	
		30MHz ~ 200MHz	H	2.16	
		200MHz ~ 1,000MHz	V	2.50	
		200MHz ~ 1,000MHz	H	2.66	



3. GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

Equipment	2.4GHz Radio Control system	
Brand Name	Kyosho	
Model Name	KT21	
OEM Brand/Model Name	N/A	
Model Difference	N/A	
Product Description	The EUT is a 2.4GHz Radio Control system.	
	Operation Frequency:	2404~2474 MHz
	Modulation Type:	DSSS
	Bit Rate of Transmitter	0.25 Mbps
	Number Of Channel	71CH .Please see Note 2.
	Antenna Designation:	Please see Note 3.
	Antenna Gain(Peak)	
	Output Power:	3.95dBm
Based on the application, features, or specification exhibited in User's Manual, the EUT is considered as an ITE/Computing Device. More details of EUT technical specification, please refer to the User's Manual.		
Channel List	Please refer to the Note 2.	
Power Source	DC Voltage supplied from 8*AA size battery	
Power Rating	DC 12V	
Connecting I/O Port(s)	Please refer to the User's Manual	
Products Covered	N/A	
EUT Modification(s)	N/A	

Note

:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.



2.

Channel List					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2404	28	2431	55	2458
2	2405	29	2432	56	2459
3	2406	30	2433	57	2460
4	2407	31	2434	58	2461
5	2408	32	2435	59	2462
6	2409	33	2436	60	2463
7	2410	34	2437	61	2464
8	2411	35	2438	62	2465
9	2412	36	2439	63	2466
10	2413	37	2440	64	2467
11	2414	38	2441	65	2468
12	2415	39	2442	66	2469
13	2416	40	2443	67	2470
14	2417	41	2444	68	2471
45	2418	42	2445	69	2472
46	2419	43	2446	70	2473
17	2420	44	2447	71	2474
18	2421	45	2448		
19	2422	46	2449		
20	2423	47	2450		
21	2424	48	2451		
22	2425	49	2452		
23	2426	50	2453		
24	2427	51	2454		
25	2428	52	2455		
26	2429	53	2456		
27	2430	54	2457		

3.

Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	Z&Y EXCELLENCE	C067-RF-003	Dipole ANT	U.FL	2.85



3.2 DESCRIPTION OF TEST MODES

To investigate the maximum EMI emission characteristics generated from EUT, the test system was pre-scanning tested based on the consideration of following EUT operation mode or test configuration mode which possibly have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Pretest Mode	Description
Mode 1	CH01, CH40, CH71

For Conducted Test	
Final Test Mode	Description
	N/A - denotes test is not applicable in this Test Report

For Radiated Test	
Final Test Mode	Description
Mode 1	CH01, CH40, CH71

Note:

- (1) The measurements are performed at the highest, middle, lowest available channels.
- (2) The EUT used new battery.
- (3) The EUT is considered a portable unit; it was pre-tested on the positioning of each 3 axis. The worst case was found positioned on Y-plane. Therefore only the test data of this Y-plane was used for radiated emission measurement test.

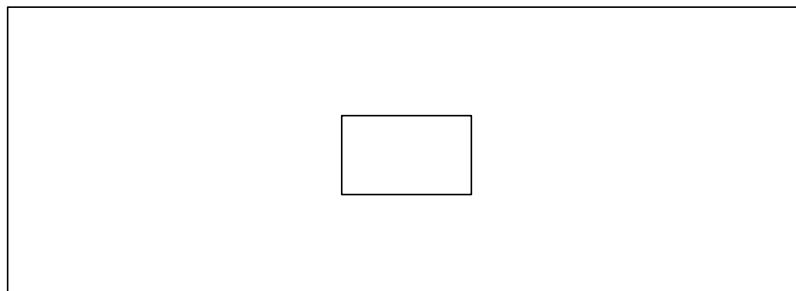


3.3 TABLE OF PARAMETERS OF TEXT SOFTWARE SETTING

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters of WLAN

Test software Version	Test Program: Hardware control		
Frequency	2404 MHz	2443 MHz	2474 MHz
Setting	DEF	DEF	DEF

3.4 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED





3.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Mfr/Brand	Model/Type No.	FCC ID	Series No.	Note
E-1	2.4GHz Radio Control system	Kyosho	KT21	WL9KT21	N/A	EUT

Item	Shielded Type	Ferrite Core	Length	Note

Note:

- (1) The support equipment was authorized by Declaration of Confirmation.
- (2) For detachable type I/O cable should be specified the length in cm in 『Length』 column.



4. EMC EMISSION TEST

4.1 CONDUCTED EMISSION MEASUREMENT

4.1.1 POWER LINE CONDUCTED EMISSION Limits (Frequency Range 150KHz-30MHz)

FREQUENCY (MHz)	Class A (dBuV)		Class B (dBuV)		Standard
	Quasi-peak	Average	Quasi-peak	Average	
0.15 -0.5	79.00	66.00	66 - 56 *	56 - 46 *	CISPR
0.50 -5.0	73.00	60.00	56.00	46.00	CISPR
5.0 -30.0	73.00	60.00	60.00	50.00	CISPR

0.15 -0.5	79.00	66.00	66 - 56 *	56 - 46 *	FCC
0.50 -5.0	73.00	60.00	56.00	46.00	FCC
5.0 -30.0	73.00	60.00	60.00	50.00	FCC

Note:

- (1) The tighter limit applies at the band edges.
- (2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

4.1.2 MEASUREMENT INSTRUMENTS LIST AND SETTING

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	LISN	EMCO	3816/2	00042991	Jan. 23, 2010
2	LISN	EMCO	3816/2	00042990	Jan. 23, 2010
3	Pulse Limiter	Electro-Metrics	EM-7600	112644	Nov. 25, 2010
4	50Ω Terminator	N/A	N/A	N/A	May.12, 2010
5	Test Cable	N/A	C01	N/A	Nov. 25, 2010
6	EMI Test Receiver	R&S	ESCI	100082	Mar. 06, 2010

Remark: " N/A" denotes No Model Name. , Serial No. or No Calibration specified.

The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

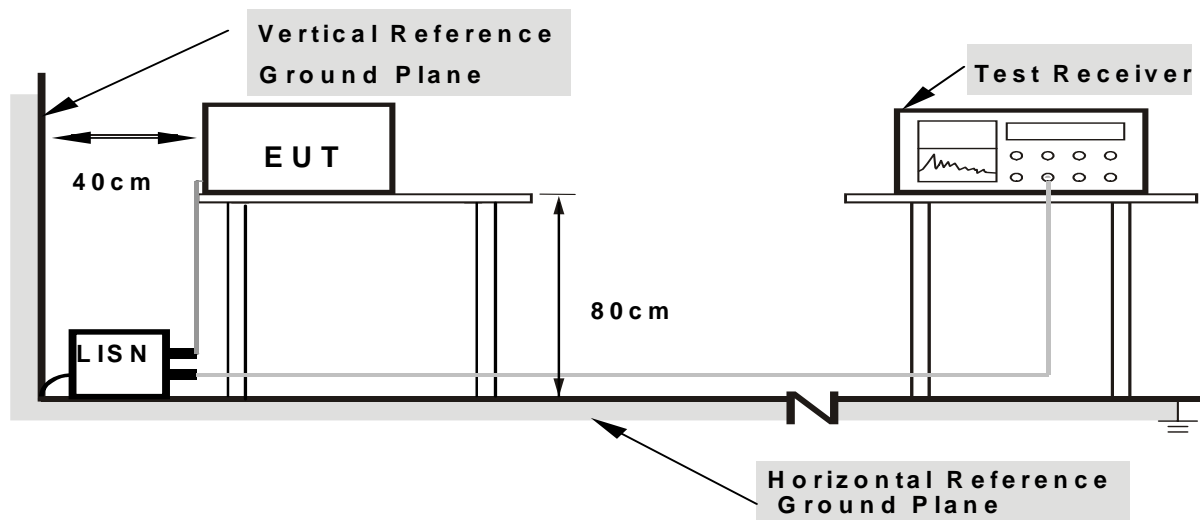
4.1.3 TEST PROCEDURE

- The EUT was placed 0.4 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- LISN at least 80 cm from nearest part of EUT chassis.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

4.1.4 DEVIATION FROM TEST STANDARD

No deviation

4.1.5 TEST SETUP



Note: 1.Support units were connected to second LISN.

2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

4.1.6 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.



4.1.7 TEST RESULTS

EUT :	2.4GHz Radio Control system	Model Name :	KT21
Temperature :	29 °C	Relative Humidity :	51 %
Pressure :	1010hPa	Test Power :	DC 12V
Test Mode :	N/A - denotes test is not applicable in this Test Report		

Remark

- (1) All readings are QP Mode value unless otherwise stated AVG in column of『Note』. If the QP Mode Measured value compliance with the QP Limits and lower than AVG Limits, the EUT shall be deemed to meet both QP & AVG Limits and then only QP Mode was measured, but AVG Mode didn't perform. In this case, a “ * ” marked in AVG Mode column of Interference Voltage Measured.
- (2) Measuring frequency range from 150KHz to 30MHz.
- (3) N/A - denotes test is not applicable in this Test Report

4.2 RADIATED EMISSION MEASUREMENT

4.2.1 RADIATED EMISSION LIMITS (Frequency Range 9KHz-1000MHz)

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micровolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	Class A (dBuV/m) (at 3m)		Class B (dBuV/m) (at 3m)	
	PEAK	AVERAGE	PEAK	AVERAGE
Above 1000	80	60	74	54

Notes:

- (1) The limit for radiated test was performed according to FCC PART 15C.
- (2) The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20log Emission level (uV/m).

FREQUENCY RANGE OF RADIATED MEASUREMENT (For unintentional radiators)

Highest frequency generated or Upper frequency of measurement used in the device or on which the device operates or tunes (MHz)	Range (MHz)
Below 1.705	30
1.705 – 108	1000
108 – 500	2000
500 – 1000	5000
Above 1000	5 th harmonic of the highest frequency or 40 GHz, whichever is lower



4.2.2 MEASUREMENT INSTRUMENTS LIST AND SETTING

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Log-Bicon Antenna	Schwarzbeck	VULB 9160	3058	Nov. 25, 2010
2	Test Cable	N/A	10M_OS02	N/A	Nov. 25, 2010
3	Test Cable	N/A	OS02-1/-2/-3	N/A	Nov. 25, 2010
4	Pre-Amplifier	Anritsu	MH648A	M09961	Nov. 25, 2010
5	EMI Test Receiver	R&S	ESCI	100082	Jan. 29, 2010
6	Antenna Mast	Chance Most	CMTB-1.5	N/A	N/A
7	Turn Table	Chance Most	CMTB-1.5	N/A	N/A
8	Spectrum Analyzer	R&S	FSP_40	100129	Jan. 06, 2010
9	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-325	Oct. 22, 2010
10	Horn Antenna	Schwarzbeck	BBHA9170	9170187	Oct. 22, 2010
11	Microwave Pre-amplifier	Agilent	8449B	3008A01714	Mar. 08 2010
12	Microflex Cable	United Microwave	57793	1m	Mar. 08, 2010
13	Microflex Cable	United Microwave	A30A30-500 6	10M	Jul. 05, 2010

Remark: " N/A" denotes No Model Name / Serial No. and No Calibration specified.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 1MHz for Peak, Average=PK-20*log(duty cycle)

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP



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DUTY CYCLE : TX 2404MHz

Dwell time=ON/ON+OFF

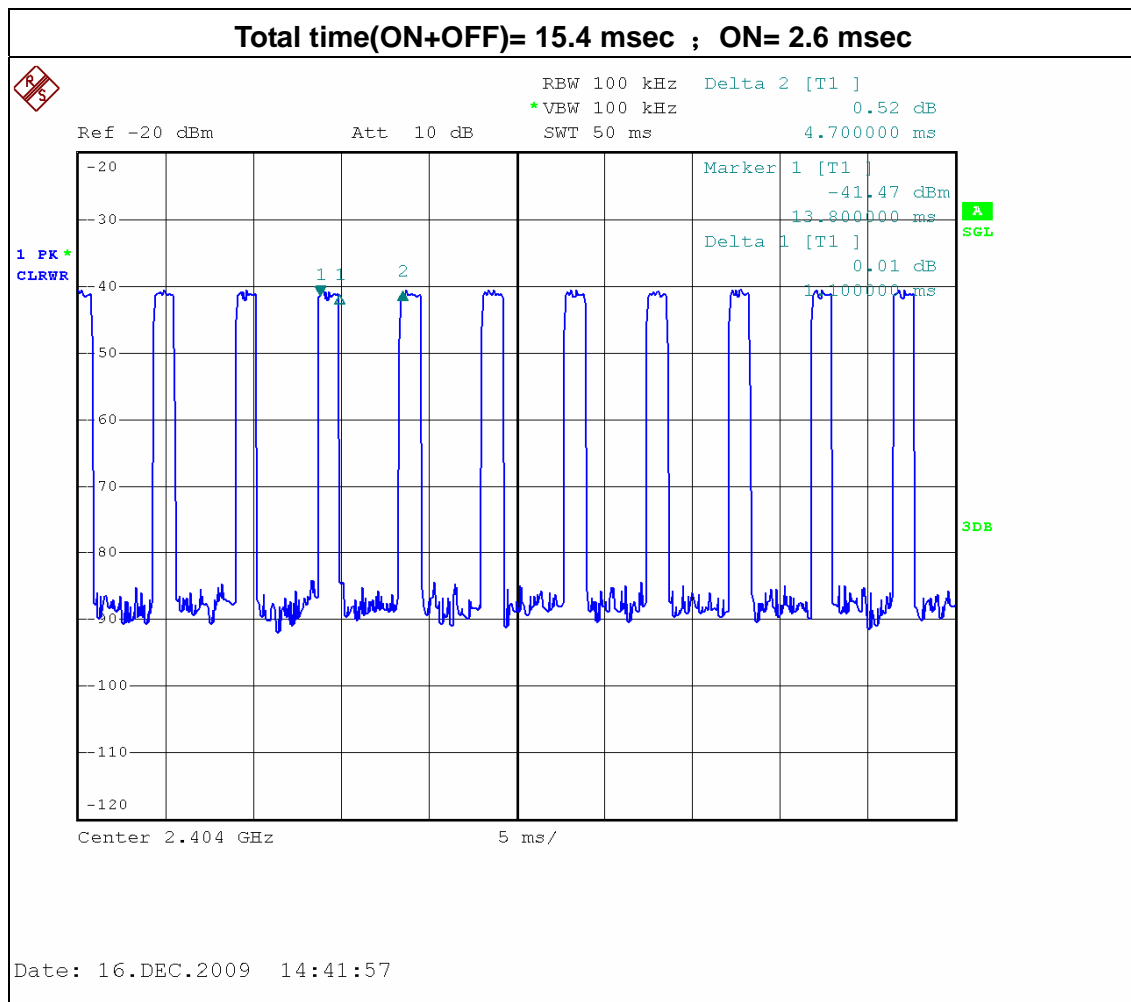
ON:1.1msec

ON+OFF:(total time):4.7msec

Dwell time:23.4%

AV=PK+20 log(Dwell time)

AV=PK-12.6





4.2.3 TEST PROCEDURE

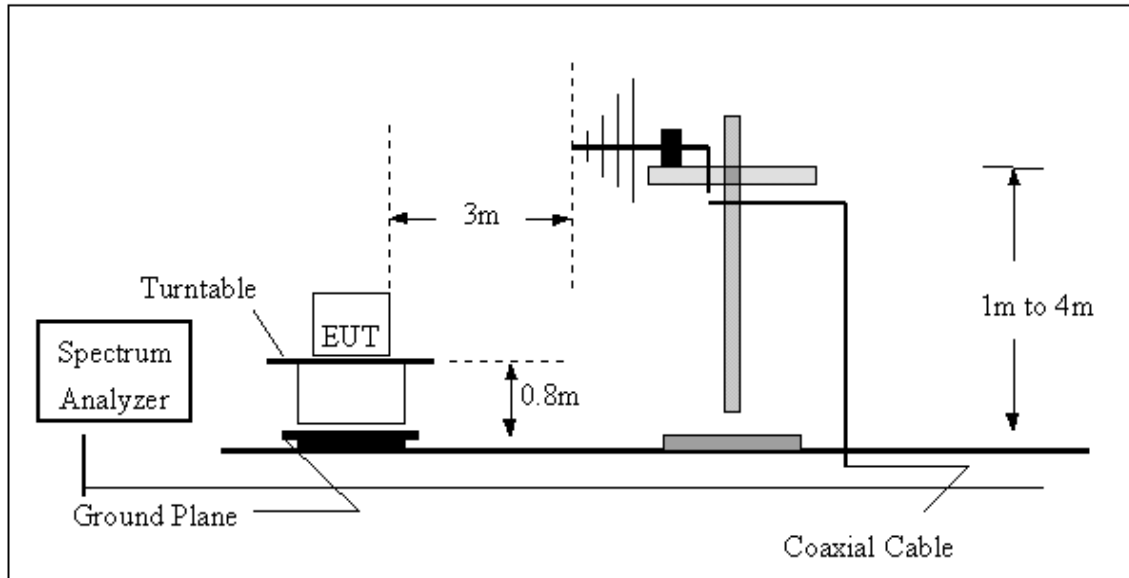
- a. The measuring distance of at 3 m shall be used for measurements at frequency up to 1GHz. For frequencies above 1GHz, any suitable measuring distance may be used.
- b. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter open area test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The height of the equipment or of the substitution antenna shall be 0.8 m; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
- f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

4.2.4 DEVIATION FROM TEST STANDARD

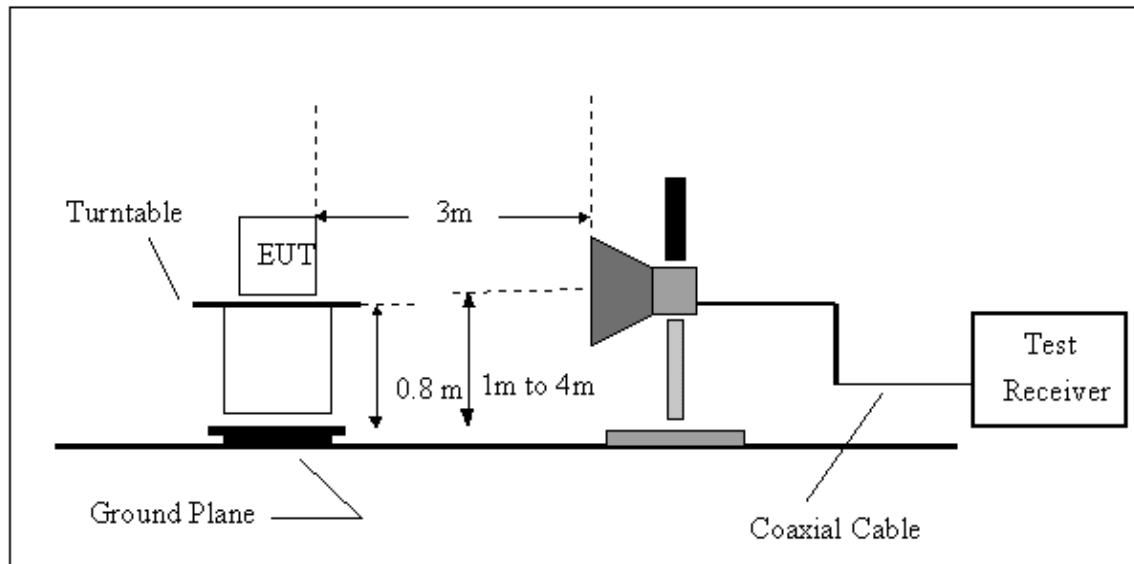
No deviation

4.2.5 TEST SETUP

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



(B) Radiated Emission Test Set-Up Frequency Above 1 GHz



4.2.6 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 4.1.6 Unless otherwise a special operating condition is specified in the follows during the testing.



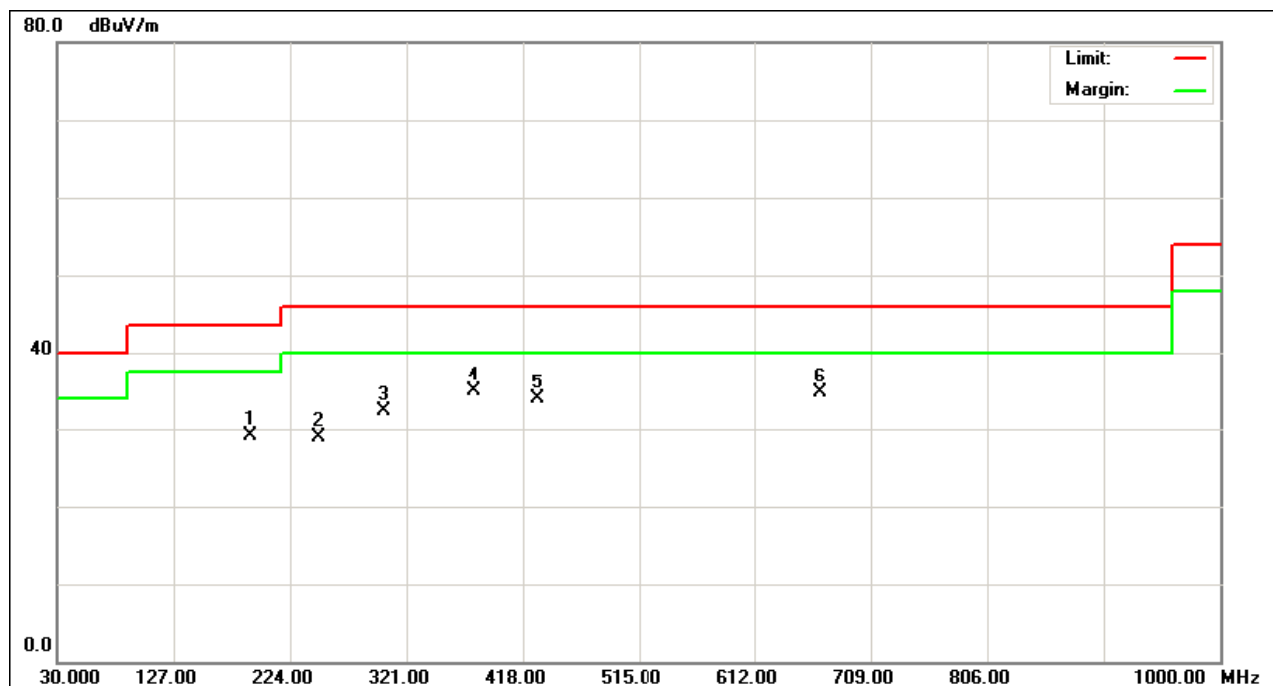
4.2.7 TEST RESULTS (BETWEEN 30 – 1000 MHZ)

EUT :	2.4GHz Radio Control system	Model Name :	KT21
Temperature :	22 °C	Relative Humidity :	45 %
Pressure :	1010 hPa	Test Voltage :	DC 12V
Test Mode :	TX 2474MHz		

Freq. (MHz)	Ant. H/V	Reading(RA) (dBuV)	Corr.Factor(CF) (dB)	Measured(FS) (dBuV/m)	Limits(QP) (dBuV/m)	Margin (dB)	Note
191.02	V	45.28	-16.15	29.13	43.50	- 14.37	
247.28	V	43.17	-14.31	28.86	46.00	- 17.14	
301.60	V	44.59	-12.37	32.22	46.00	- 13.78	
377.26	V	45.55	-10.71	34.84	46.00	- 11.16	
429.64	V	43.63	-9.63	34.00	46.00	- 12.00	
666.32	V	39.95	-5.16	34.79	46.00	- 11.21	

Remark :

- (1) Reading in which marked as QP or Peak means measurements by using are Quasi-Peak Mode or Peak Mode with Detector BW=120KHz ; SPA setting in RBW=120KHz, VBW =120KHz, Swp. Time = 0.3 sec./MHz ◦
- (2) All readings are Peak unless otherwise stated QP in column of 『Note』 . Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform ◦
- (3) Measuring frequency range from 30MHz to 1000MHz ◦
- (4) If the peak scan value lower limit more than 20dB, then this signal data does not show in table ◦



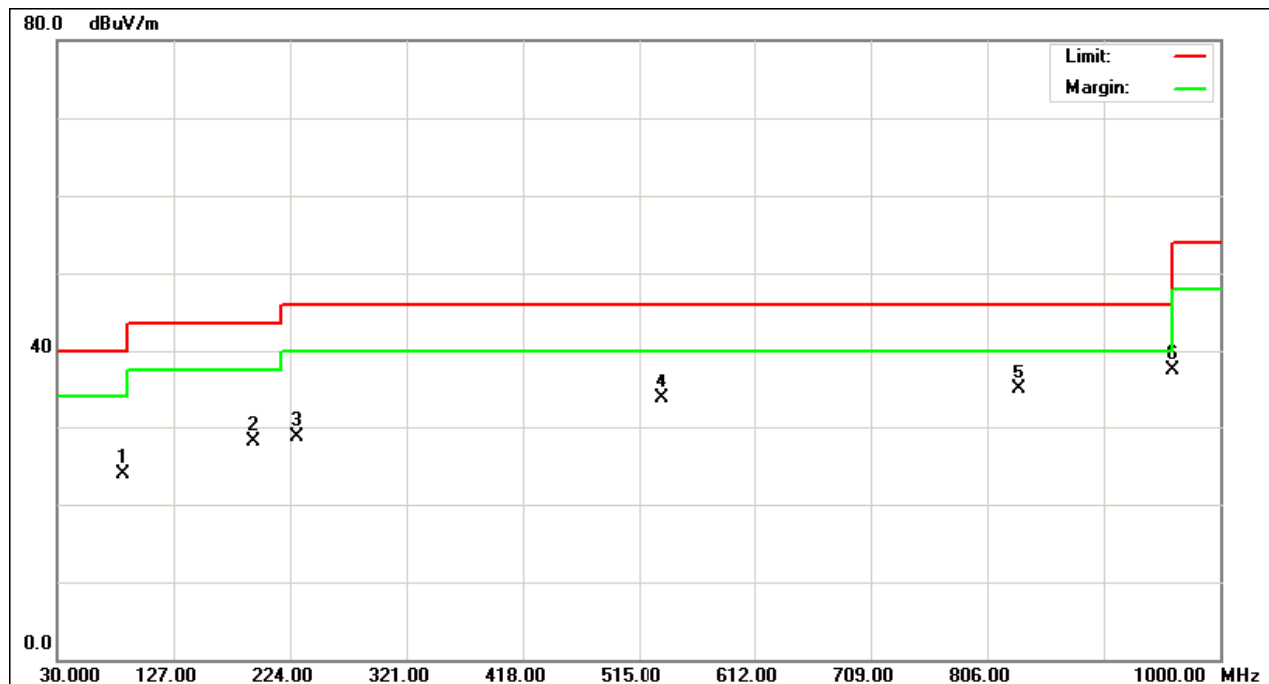


EUT :	2.4GHz Radio Control system	Model Name :	KT21
Temperature :	22 °C	Relative Humidity :	45 %
Pressure :	1010 hPa	Test Voltage :	DC 12V
Test Mode :	TX 2474MHz		

Freq. (MHz)	Ant. H/V	Reading(RA) (dBuV)	Corr.Factor(CF) (dB)	Measured(FS) (dBuV/m)	Limits(QP) (dBuV/m)	Margin (dB)	Note
84.32	H	43.65	-19.74	23.91	40.00	- 16.09	
193.93	H	44.51	-16.31	28.20	43.50	- 15.30	
229.82	H	43.87	-15.20	28.67	46.00	- 17.33	
353.37	H	41.63	-7.93	33.70	46.00	- 12.30	
832.19	H	36.76	-1.85	34.91	46.00	- 11.09	
960.23	H	37.21	0.37	37.58	46.00	- 16.42	

Remark :

- (1) Reading in which marked as QP or Peak means measurements by using are Quasi-Peak Mode or Peak Mode with Detector BW=120KHz ; SPA setting in RBW=120KHz, VBW =120KHz, Swp. Time = 0.3 sec./MHz ◦
- (2) All readings are Peak unless otherwise stated QP in column of 『Note』 . Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform ◦
- (3) Measuring frequency range from 30MHz to 1000MHz ◦
- (4) If the peak scan value lower limit more than 20dB, then this signal data does not show in table ◦





4.2.8 TEST RESULTS (ABOVE 1000 MHZ)

EUT :	2.4GHz Radio Control system	Model Name :	KT21
Temperature :	22 °C	Relative Humidity :	45 %
Pressure :	1010 hPa	Test Voltage :	DC 12V
Test Mode :	TX 2404MHz		

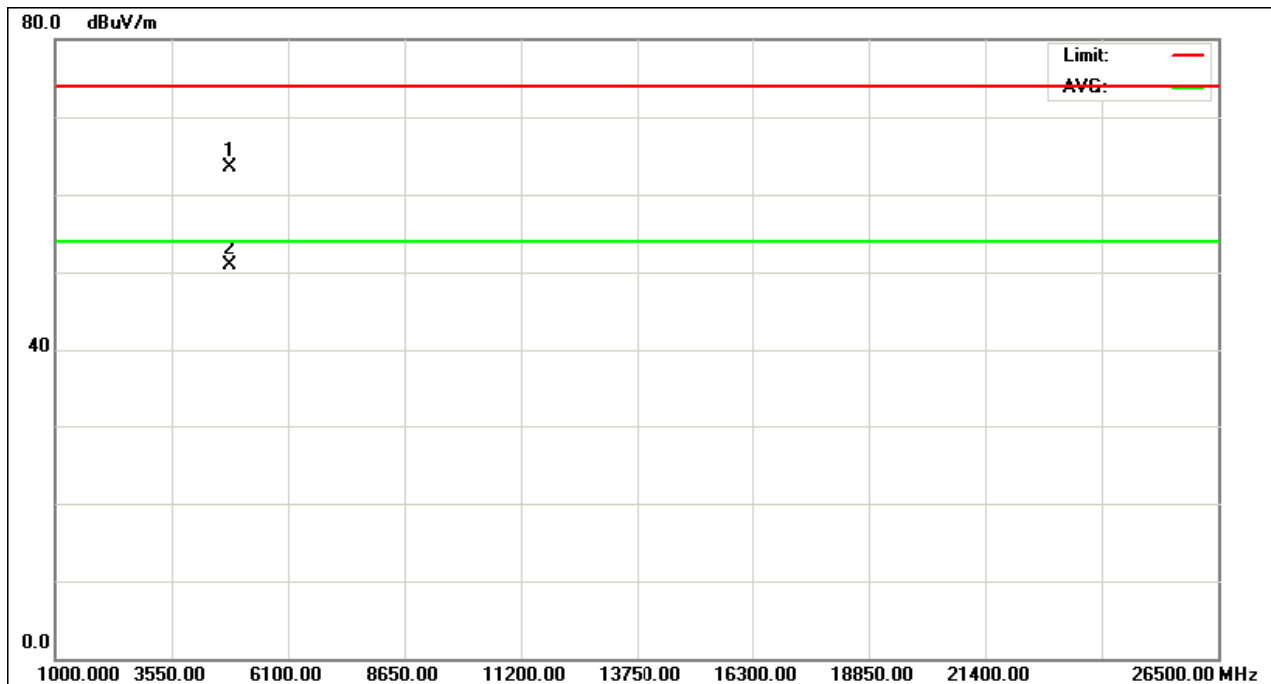
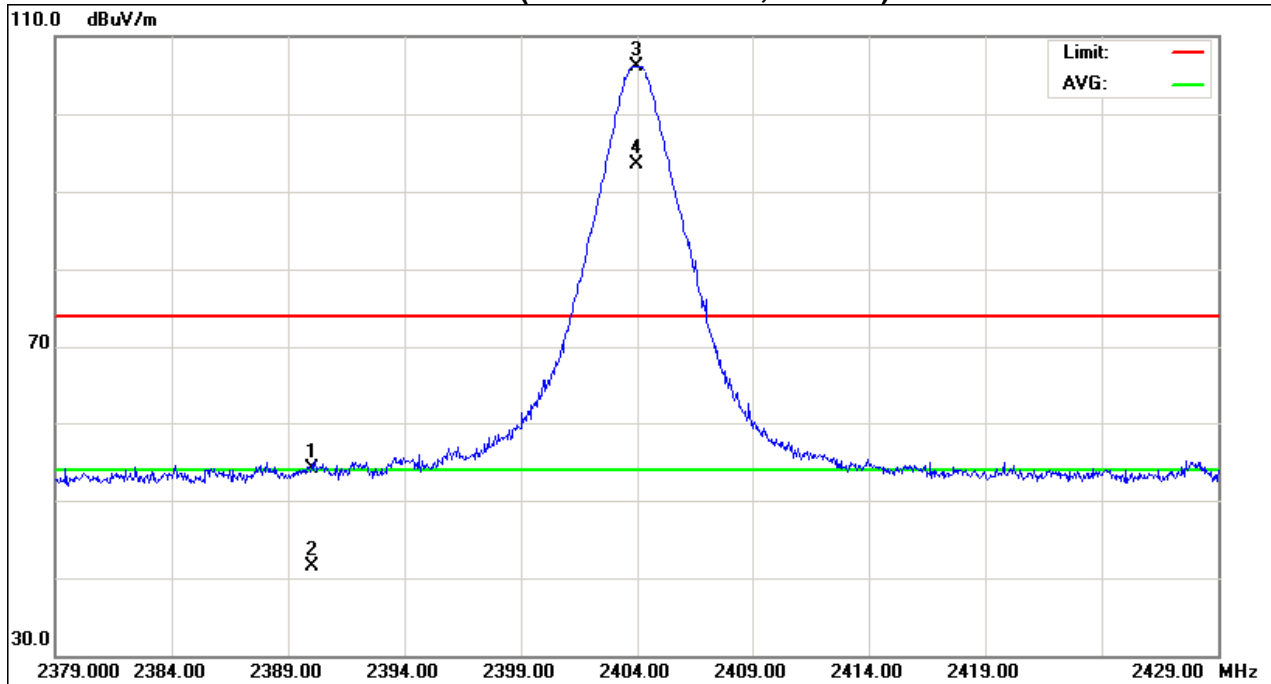
Freq. (MHz)	Ant.Pol. H/V	Reading		Ant./CF CF(dB)	Act.		Limit		Note
		Peak (dBuV)	AV (dBuV)		Peak (dBuV/m)	AV (dBuV/m)	Peak (dBuV/m)	AV (dBuV/m)	
2390.00	V	21.90	9.30	32.30	54.20	41.60	74.00	54.00	Y/E
2403.95	V	73.87	61.27	32.31	106.18	93.58			Y/F
4807.90	V	58.44	45.84	5.02	63.46	50.86	74.00	54.00	Y/H

Remark :

- (1) All readings are Peak unless otherwise stated QP in column of 『Note』 . Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform ◦
- (2) Measuring frequency range from 30MHz to 1000MHz or the 10th harmonic of highest fundamental frequency ◦ "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency. (This judgment method includes the Band Edge Requirement.)
- (3) Radiated emissions measured in frequency range above 1000MHz were made with an instrument using Peak detector mode and AV detector mode of the emission ◦
- (4) Data 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) A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.
- (6) EUT Orthogonal Axis :
"X" - denotes Laid on Table ; "Y" - denotes Vertical Stand ; "Z" - denotes Side Stand
- (7) During the measurements above 1 GHz it is taken care of that the EUT is always within the 3 dB cone of radiation BW of the used antenna
- (8) The average value of fundamental frequency is:
Average = Peak value + 20log(Duty cycle) ◦ Final AV=PK-12.6



TX CH01 (Above 1000 MHz, Vertical)





EUT :	2.4GHz Radio Control system	Model Name :	KT21
Temperature :	22 °C	Relative Humidity :	45 %
Pressure :	1010 hPa	Test Voltage :	DC 12V
Test Mode :	TX 2404MHz		

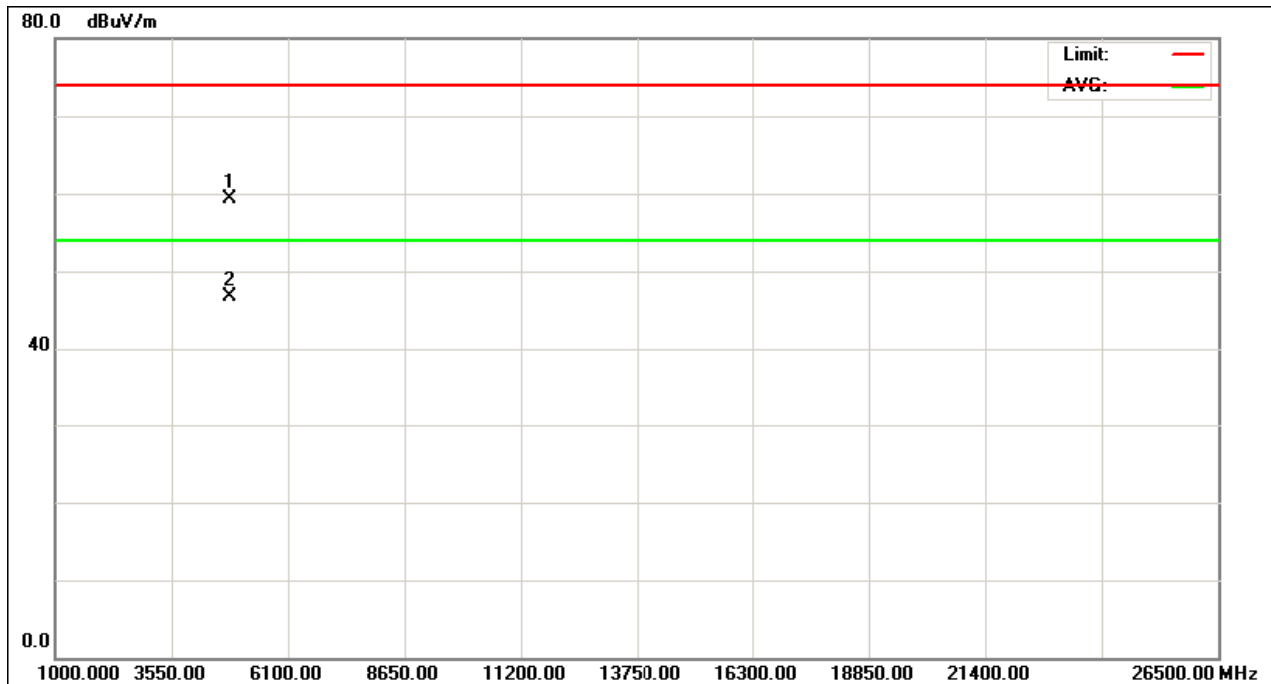
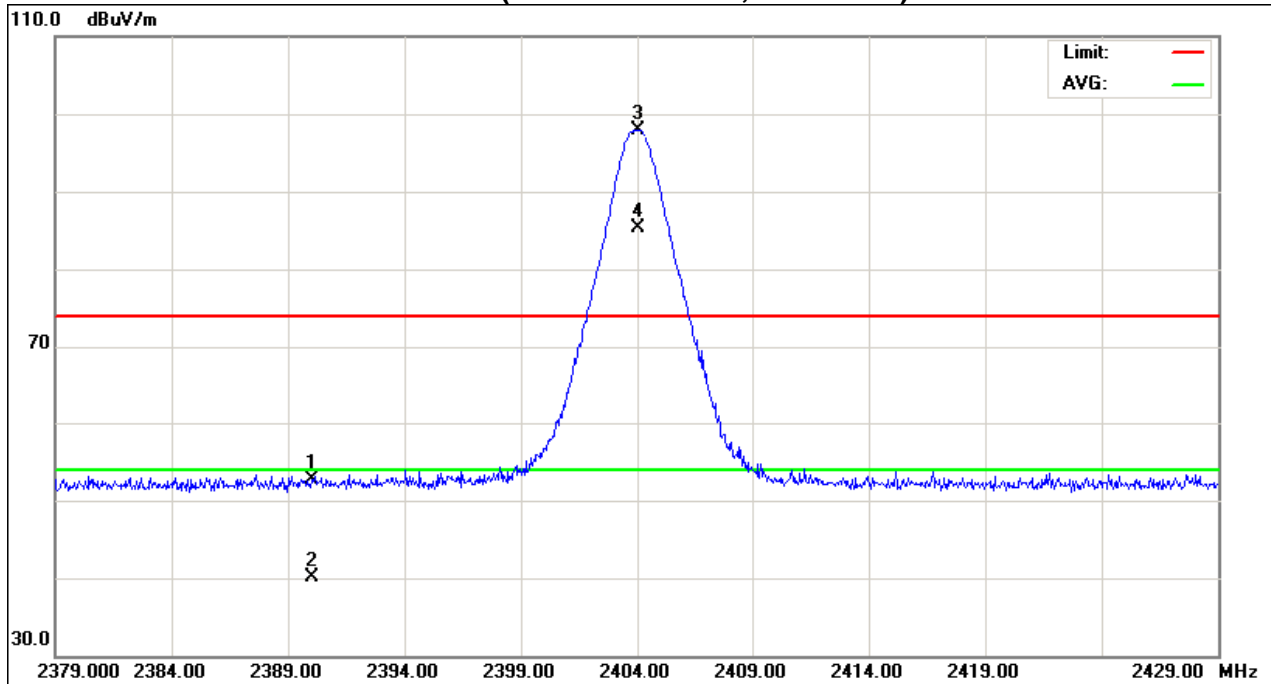
Freq. (MHz)	Ant.Pol. H/V	Reading		Ant./CF CF(dB)	Act.		Limit		Note
		Peak (dBuV)	AV (dBuV)		Peak (dBuV/m)	AV (dBuV/m)	Peak (dBuV/m)	AV (dBuV/m)	
2390.00	H	20.40	7.80	32.30	52.70	40.10	74.00	54.00	Y/E
2404.00	H	65.61	53.01	32.31	97.92	85.32			Y/F
4808.70	H	54.25	41.65	5.02	59.27	46.67	74.00	54.00	Y/H

Remark :

- (1) All readings are Peak unless otherwise stated QP in column of 『Note』 . Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform ◦
- (2) Measuring frequency range from 30MHz to 1000MHz or the 10th harmonic of highest fundamental frequency ◦ "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency. (This judgment method includes the Band Edge Requirement.)
- (3) Radiated emissions measured in frequency range above 1000MHz were made with an instrument using Peak detector mode and AV detector mode of the emission ◦
- (4) Data 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) A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.
- (6) EUT Orthogonal Axis :
"X" - denotes Laid on Table ; "Y" - denotes Vertical Stand ; "Z" - denotes Side Stand
- (7) During the measurements above 1 GHz it is taken care of that the EUT is always within the 3 dB cone of radiation BW of the used antenna
- (8) The average value of fundamental frequency is:
Average = Peak value + 20log(Duty cycle) ◦ Final AV=PK-12.6



TX CH01 (Above 1000 MHz, Horizontal)





EUT :	2.4GHz Radio Control system	Model Name :	KT21
Temperature :	22 °C	Relative Humidity :	45 %
Pressure :	1010 hPa	Test Voltage :	DC 12V
Test Mode :	TX 2443MHz		

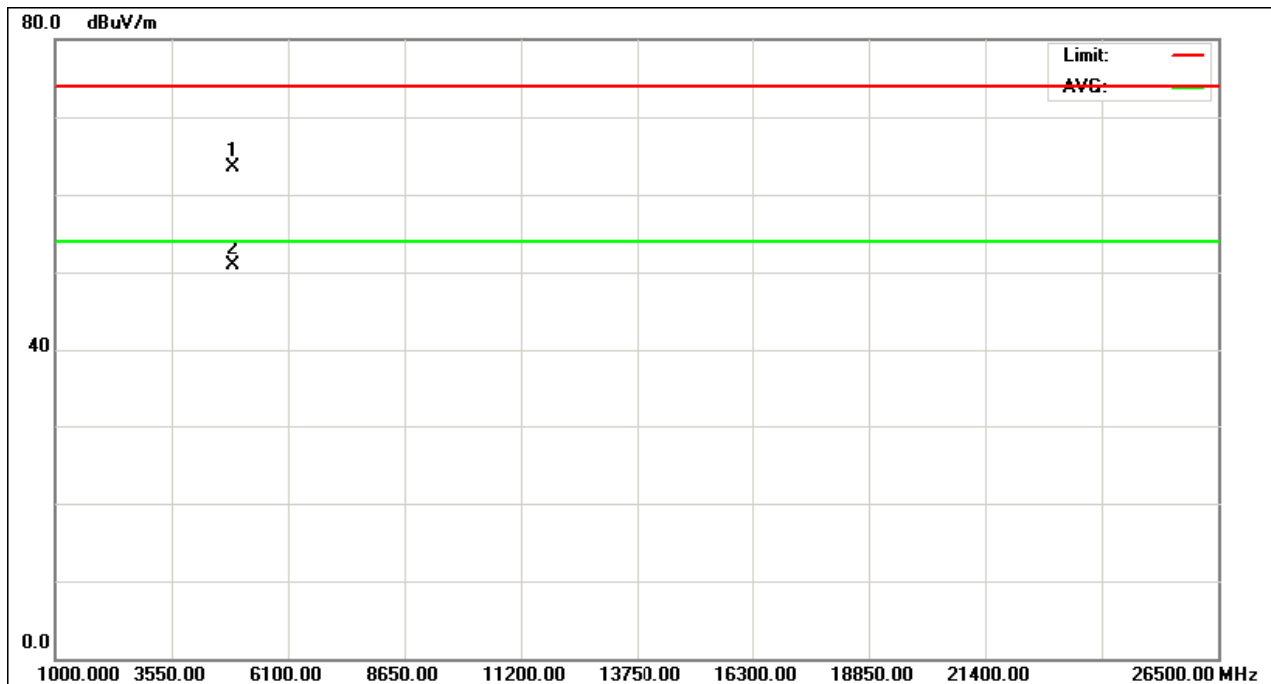
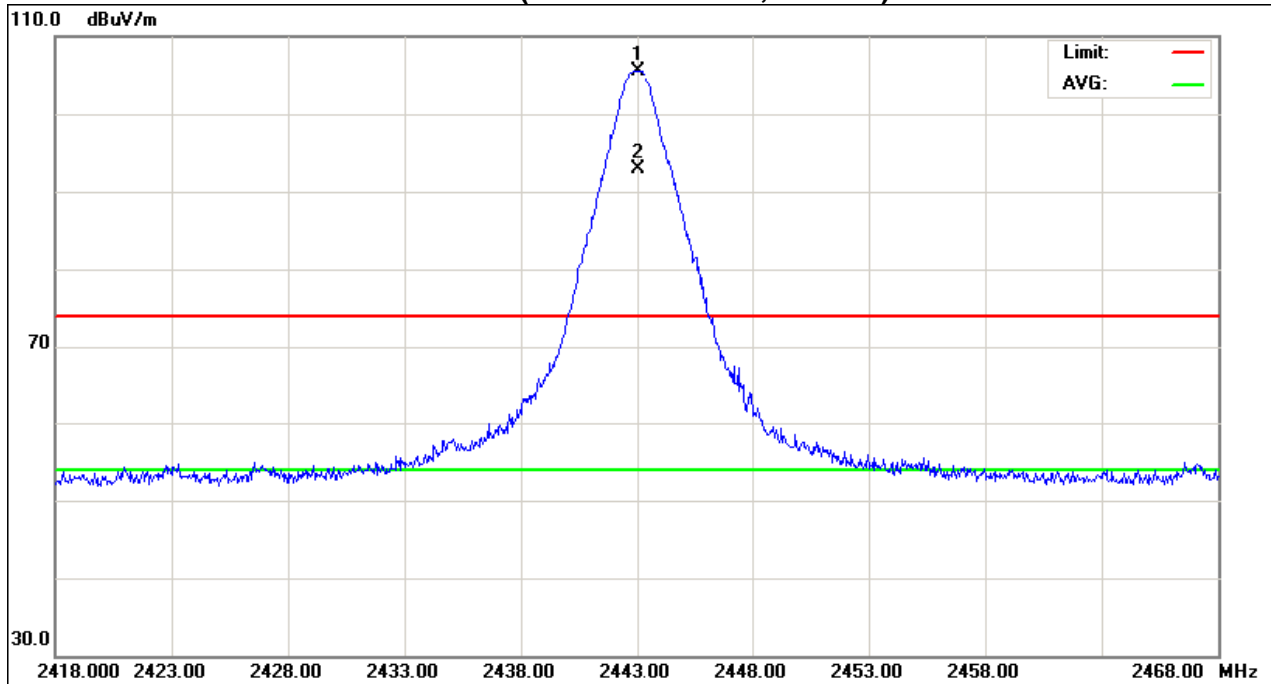
Freq.	Ant.Pol.	Reading		Ant./CF	Act.		Limit		Note
		Peak	AV		Peak	AV	Peak	AV	
(MHz)	H/V	(dBuV)	(dBuV)	CF(dB)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	Y/F
2443.00	V	73.28	60.68	32.30	105.58	92.98			Y/F
4885.95	V	58.36	45.76	5.20	63.56	50.96	74.00	54.00	Y/H

Remark :

- (1) All readings are Peak unless otherwise stated QP in column of 『Note』 . Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform ◦
- (2) Measuring frequency range from 30MHz to 1000MHz or the 10th harmonic of highest fundamental frequency ◦ "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency. (This judgment method includes the Band Edge Requirement.)
- (3) Radiated emissions measured in frequency range above 1000MHz were made with an instrument using Peak detector mode and AV detector mode of the emission ◦
- (4) Data 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) A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.
- (6) EUT Orthogonal Axis :
"X" - denotes Laid on Table ; "Y" - denotes Vertical Stand ; "Z" - denotes Side Stand
- (7) During the measurements above 1 GHz it is taken care of that the EUT is always within the 3 dB cone of radiation BW of the used antenna
- (8) The average value of fundamental frequency is:
Average = Peak value + 20log(Duty cycle) ◦ Final AV=PK-12.6



TX CH40 (Above 1000 MHz, Vertical)





EUT :	2.4GHz Radio Control system	Model Name :	KT21
Temperature :	22 °C	Relative Humidity :	45 %
Pressure :	1010 hPa	Test Voltage :	DC 12V
Test Mode :	TX 2443MHz		

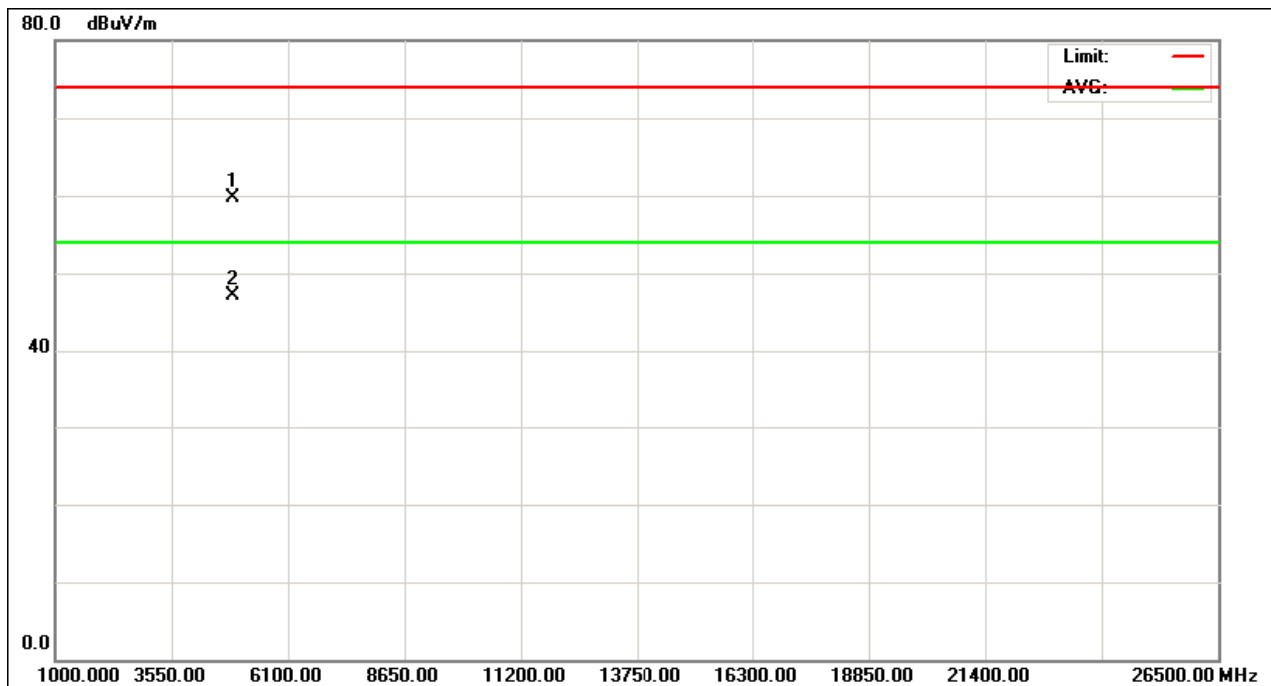
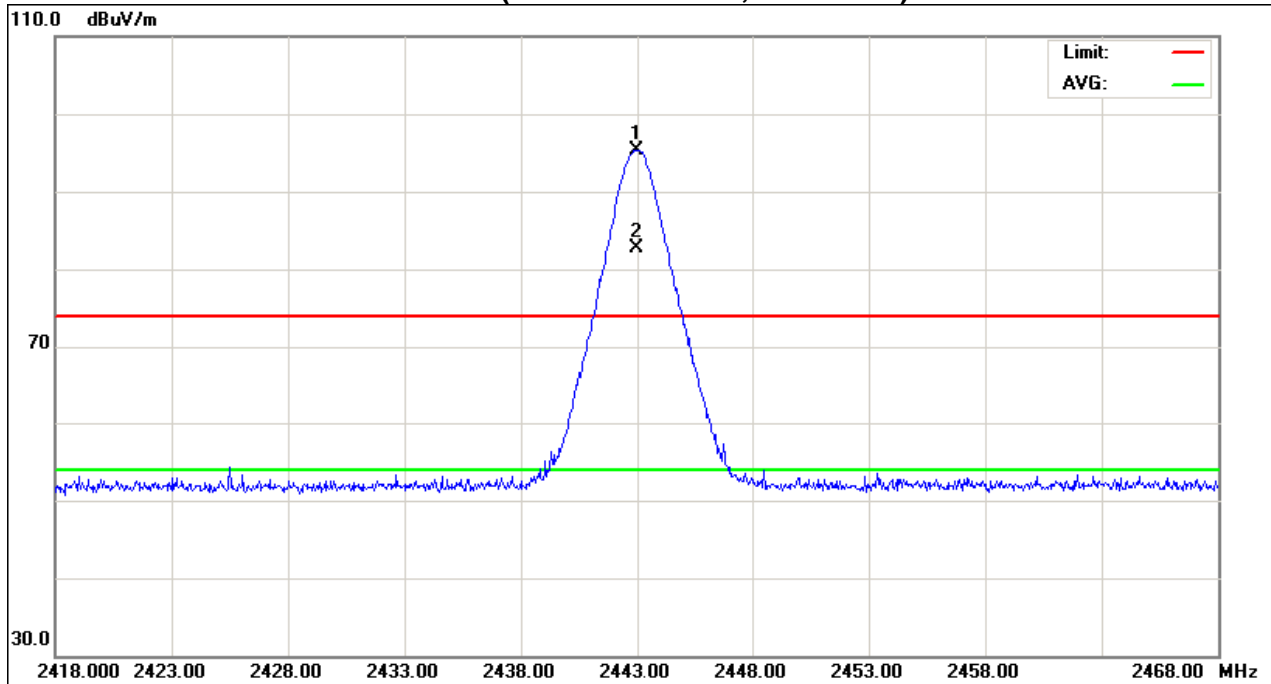
Freq.	Ant.Pol.	Reading		Ant./CF	Act.		Limit		Note
		Peak	AV		Peak	AV	Peak	AV	
(MHz)	H/V	(dBuV)	(dBuV)	CF(dB)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	
2442.95	H	63.38	50.79	31.91	95.30	82.70			Y/F
4885.90	H	54.57	41.97	5.20	59.77	47.17	74.00	54.00	Y/H

Remark :

- (1) All readings are Peak unless otherwise stated QP in column of 『Note』 . Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform ◦
- (2) Measuring frequency range from 30MHz to 1000MHz or the 10th harmonic of highest fundamental frequency ◦ "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency. (This judgment method includes the Band Edge Requirement.)
- (3) Radiated emissions measured in frequency range above 1000MHz were made with an instrument using Peak detector mode and AV detector mode of the emission ◦
- (4) Data 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) A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.
- (6) EUT Orthogonal Axis :
"X" - denotes Laid on Table ; "Y" - denotes Vertical Stand ; "Z" - denotes Side Stand
- (7) During the measurements above 1 GHz it is taken care of that the EUT is always within the 3 dB cone of radiation BW of the used antenna
- (8) The average value of fundamental frequency is:
Average = Peak value + 20log(Duty cycle) ◦ Final AV=PK-12.6



TX CH40 (Above 1000 MHz, Horizontal)





EUT :	2.4GHz Radio Control system	Model Name :	KT21
Temperature :	22 °C	Relative Humidity :	45 %
Pressure :	1010 hPa	Test Voltage :	DC 12V
Test Mode :	TX 2474MHz		

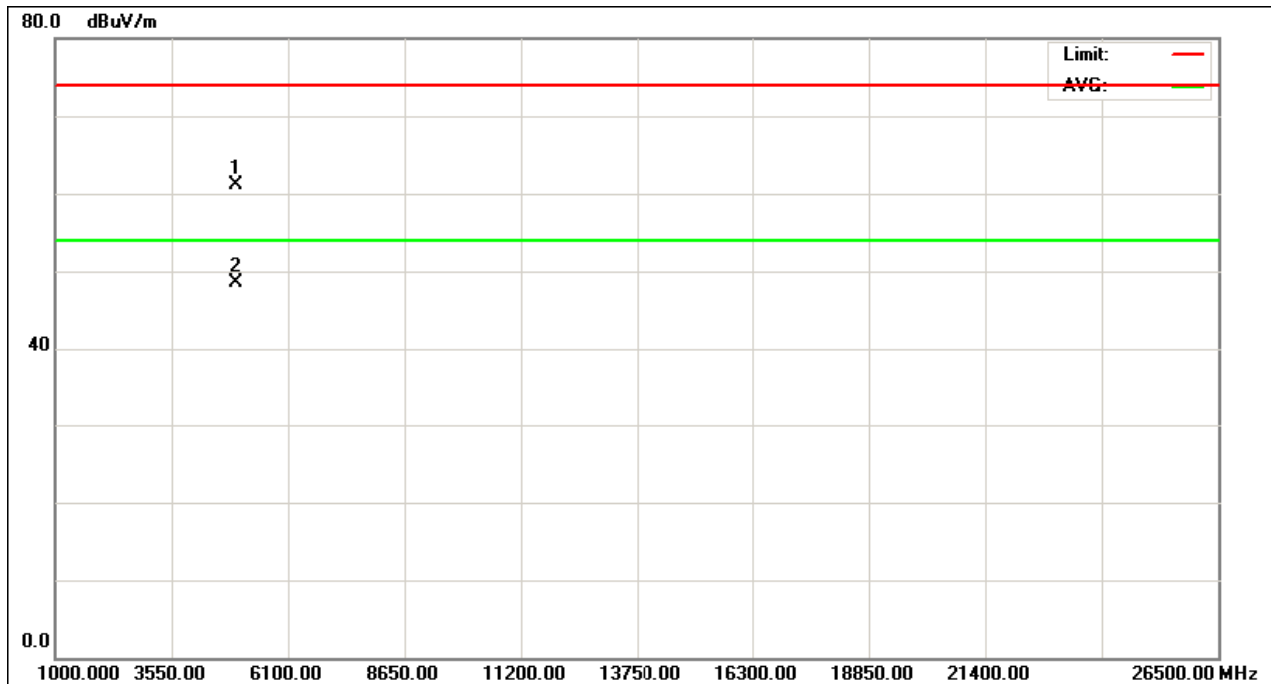
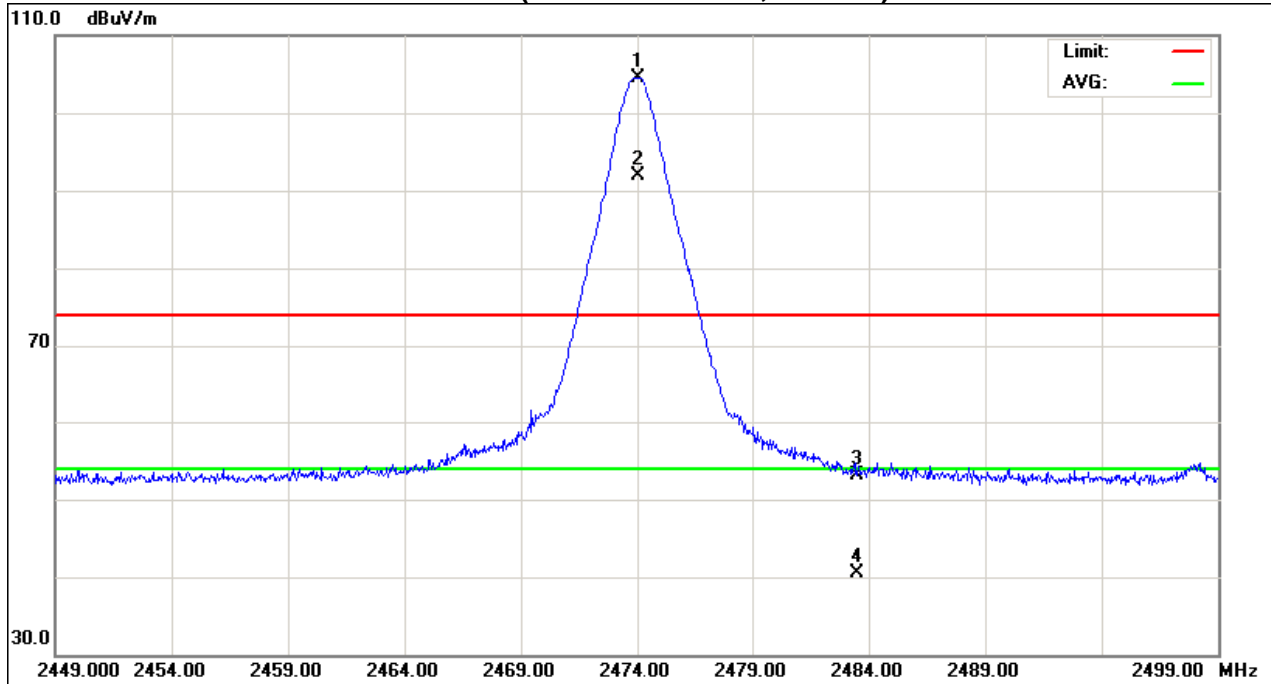
Freq.	Ant.Pol.	Reading		Ant./CF	Act.		Limit		Note
		Peak	AV		Peak	AV	Peak	AV	
(MHz)	H/V	(dBuV)	(dBuV)	CF(dB)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	
2474.00	V	72.58	59.98	32.00	104.58	91.98			Y/F
2483.50	V	21.08	8.48	32.03	53.11	40.51	74.00	54.00	Y/E
4947.90	V	55.74	43.14	5.36	61.10	48.50	74.00	54.00	Y/H

Remark :

- (1) All readings are Peak unless otherwise stated QP in column of 『Note』 . Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform ◦
- (2) Measuring frequency range from 30MHz to 1000MHz or the 10th harmonic of highest fundamental frequency ◦ "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency. (This judgment method includes the Band Edge Requirement.)
- (3) Radiated emissions measured in frequency range above 1000MHz were made with an instrument using Peak detector mode and AV detector mode of the emission ◦
- (4) Data 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) A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.
- (6) EUT Orthogonal Axis :
"X" - denotes Laid on Table ; "Y" - denotes Vertical Stand ; "Z" - denotes Side Stand
- (7) During the measurements above 1 GHz it is taken care of that the EUT is always within the 3 dB cone of radiation BW of the used antenna
- (8) The average value of fundamental frequency is:
Average = Peak value + 20log(Duty cycle) ◦ Final AV=PK-12.6



TX CH71 (Above 1000 MHz, Vertical)





EUT :	2.4GHz Radio Control system	Model Name :	KT21
Temperature :	22 °C	Relative Humidity :	45 %
Pressure :	1010 hPa	Test Voltage :	DC 12V
Test Mode :	TX 2474MHz		

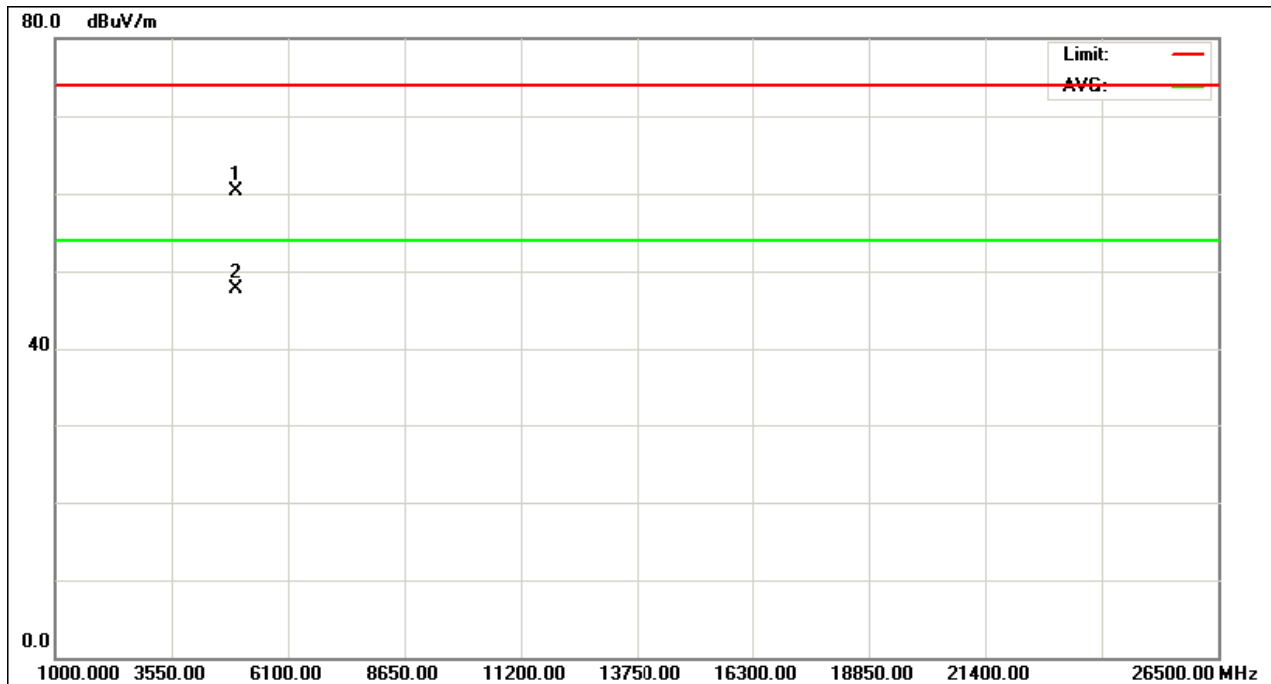
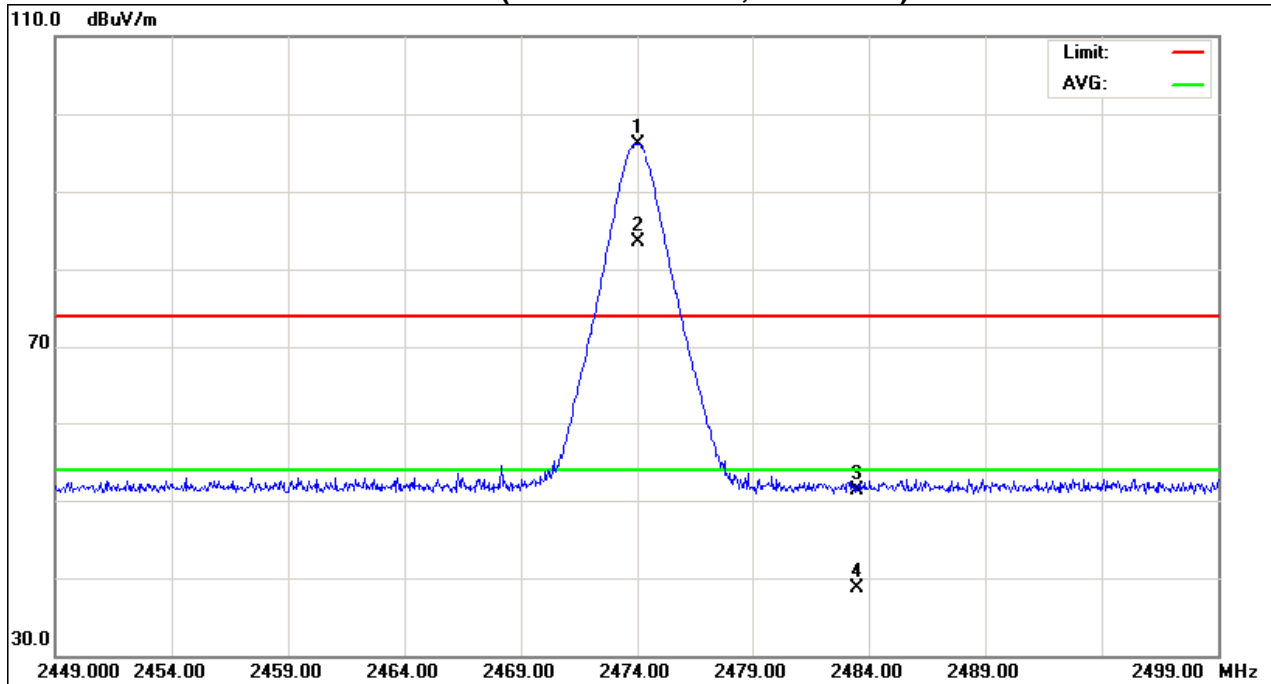
Freq.	Ant.Pol.	Reading		Ant./CF	Act.		Limit		Note
		Peak	AV		Peak	AV	Peak	AV	
(MHz)	H/V	(dBuV)	(dBuV)	CF(dB)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	
2474.05	H	64.18	51.58	32.00	96.18	83.58			YF
2483.50	H	19.21	6.61	32.03	51.24	38.64	74.00	54.00	Y/E
4948.15	H	54.93	42.33	5.36	60.29	47.69	74.00	54.00	Y/H

Remark :

- (1) All readings are Peak unless otherwise stated QP in column of 『Note』 . Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform ◦
- (2) Measuring frequency range from 30MHz to 1000MHz or the 10th harmonic of highest fundamental frequency ◦ "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency. (This judgment method includes the Band Edge Requirement.)
- (3) Radiated emissions measured in frequency range above 1000MHz were made with an instrument using Peak detector mode and AV detector mode of the emission ◦
- (4) Data 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) A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.
- (6) EUT Orthogonal Axis :
 "X" - denotes Laid on Table ; "Y" - denotes Vertical Stand ; "Z" - denotes Side Stand
- (7) During the measurements above 1 GHz it is taken care of that the EUT is always within the 3 dB cone of radiation BW of the used antenna
- (8) The average value of fundamental frequency is:
 Average = Peak value + 20log(Duty cycle) , Final AV=PK-12.6



TX CH71 (Above 1000 MHz, Horizontal)





4.2.9 TEST RESULTS (RESTRICTED BANDS REQUIREMENTS)

EUT :	2.4GHz Radio Control system	Model Name :	KT21
Temperature :	22 °C	Relative Humidity :	45 %
Pressure :	1010 hPa	Test Voltage :	DC 12V
Test Mode :	TX 2404MHz/2474MHz (Vertical)		
Note :	1. The transmitter was setup to transmit at the lowest channel (CH01). Then the field strength was measured at 2310-2390 MHz. 2. The transmitter was setup to transmit at the highest channel (CH71). Then the field strength was measured at 2483.5-2500 MHz.		

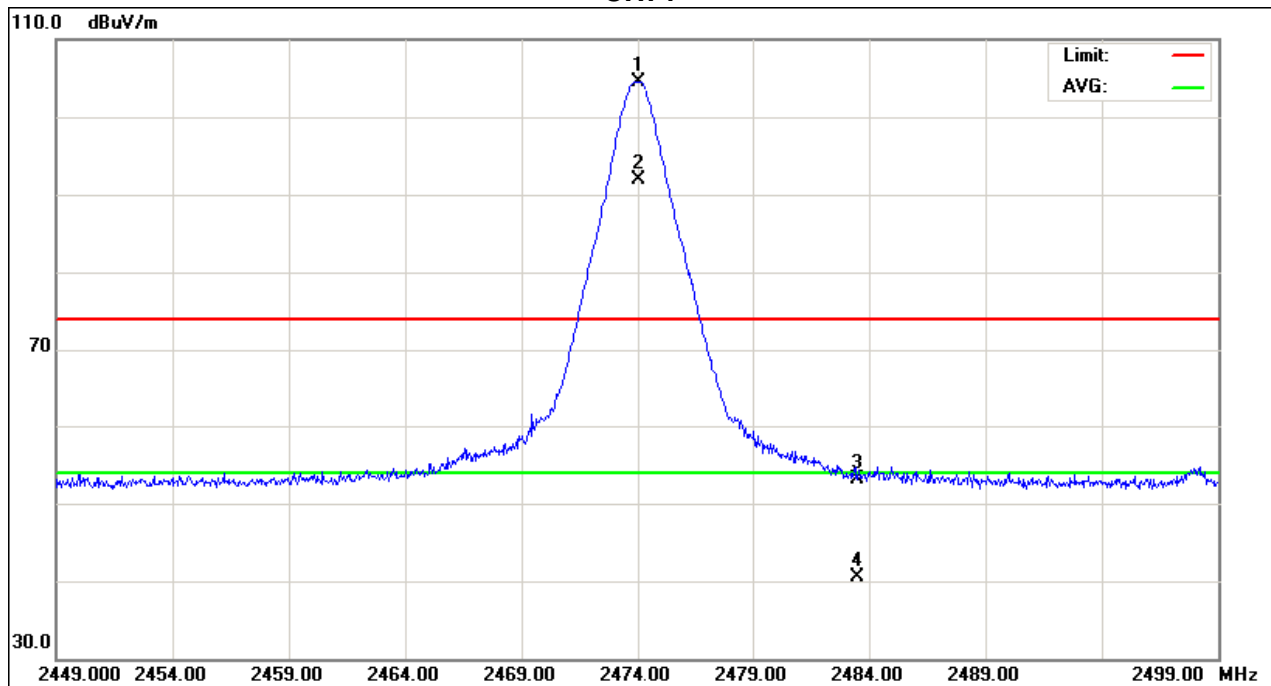
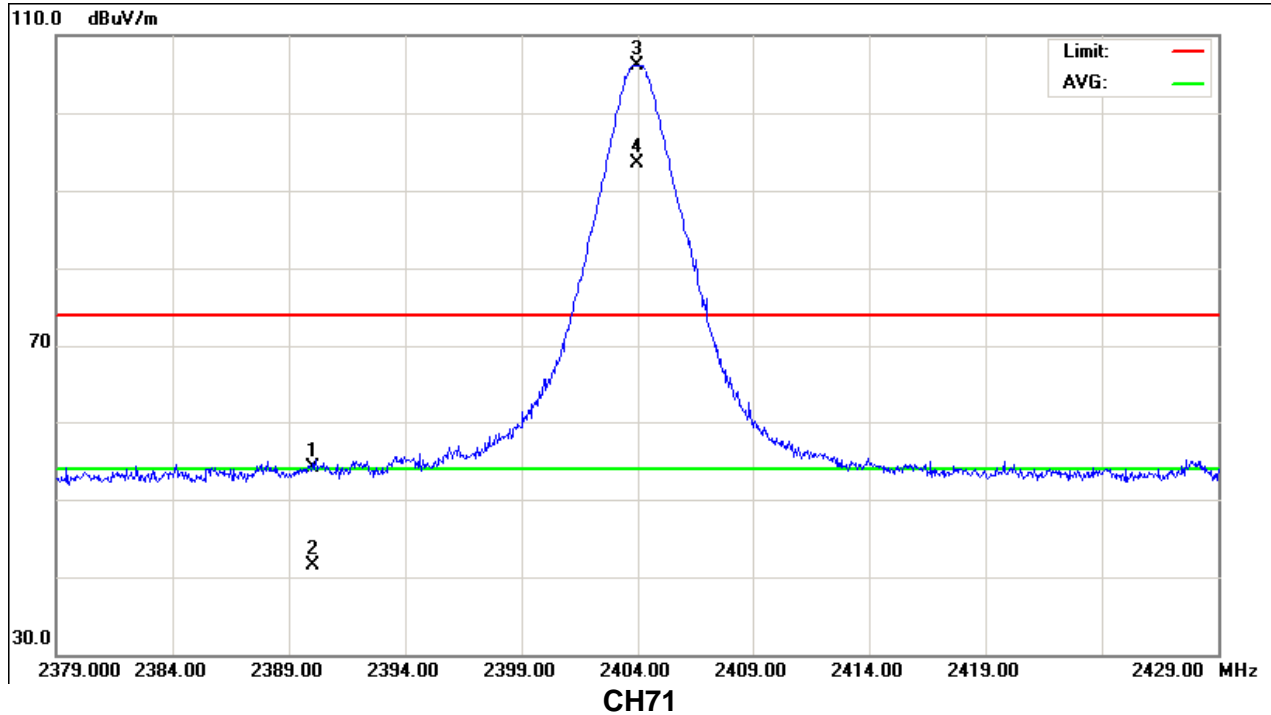
Freq.	Ant.Pol.	Reading		Ant./CF	Act.		Limit		Note
		Peak	AV		Peak	AV	Peak	AV	
(MHz)	H/V	(dBuV)	(dBuV)	CF(dB)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	
2390.00	V	21.90	9.30	32.30	54.20	41.60	74.00	54.00	CH01
2483.50	V	21.08	8.48	32.03	53.11	40.51	74.00	54.00	CH71

Remark :

- (1) Radiated emissions measured in frequency range above 1000MHz were made with an instrument using Peak detector mode and AV detector mode of the emission ◦
- (2) EUT Orthogonal Axis :
 "X" - denotes Laid on Table ; "Y" - denotes Vertical Stand ; "Z" - denotes Side Stand
- (3) During the measurements above 1 GHz it is taken care of that the EUT is always within the 3 dB cone of radiation BW of the used antenna
- (4) The average value of fundamental frequency is:
 Average = Peak value + 20log(Duty cycle) , Final AV=PK-12.6



Restricted Bands Requirements, Vertical
CH01





EUT :	2.4GHz Radio Control system	Model Name :	KT21
Temperature :	22 °C	Relative Humidity :	45 %
Pressure :	1010 hPa	Test Voltage :	DC 12V
Test Mode :	TX 2404MHz/2474MHz (Horizontal)		
Note :	1. The transmitter was setup to transmit at the lowest channel (CH01). Then the field strength was measured at 2310-2390 MHz. 2. The transmitter was setup to transmit at the highest channel (CH71). Then the field strength was measured at 2483.5-2500 MHz.		

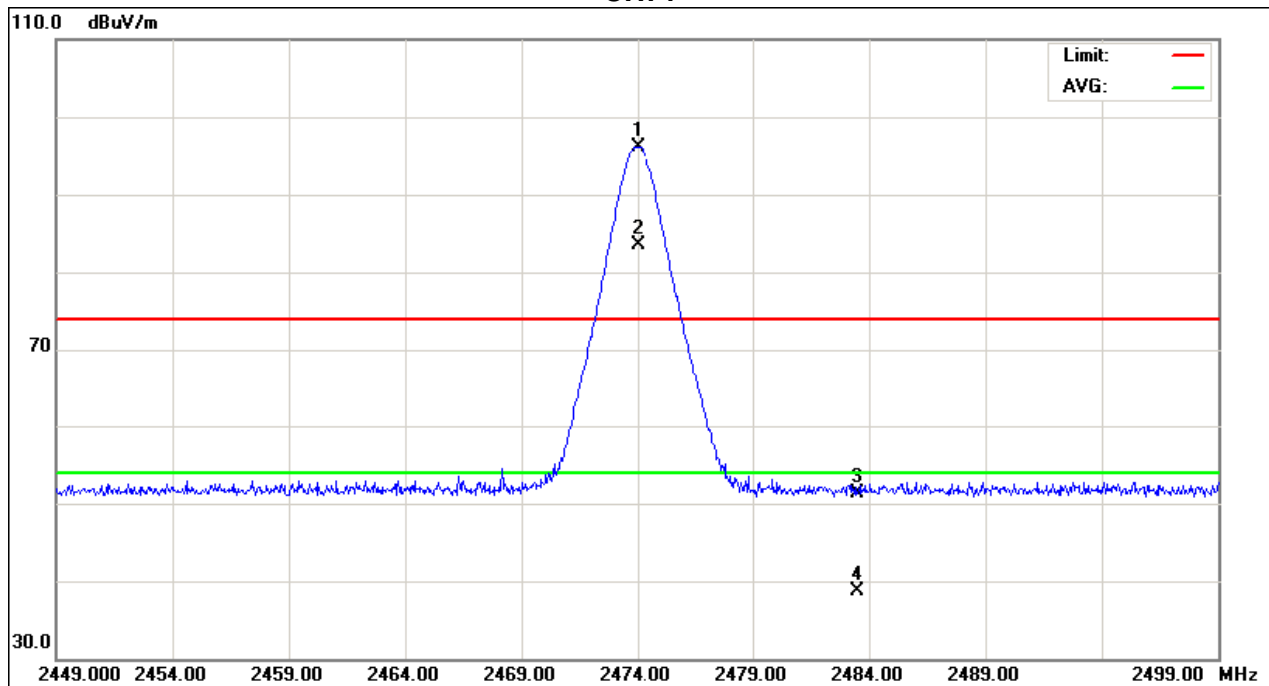
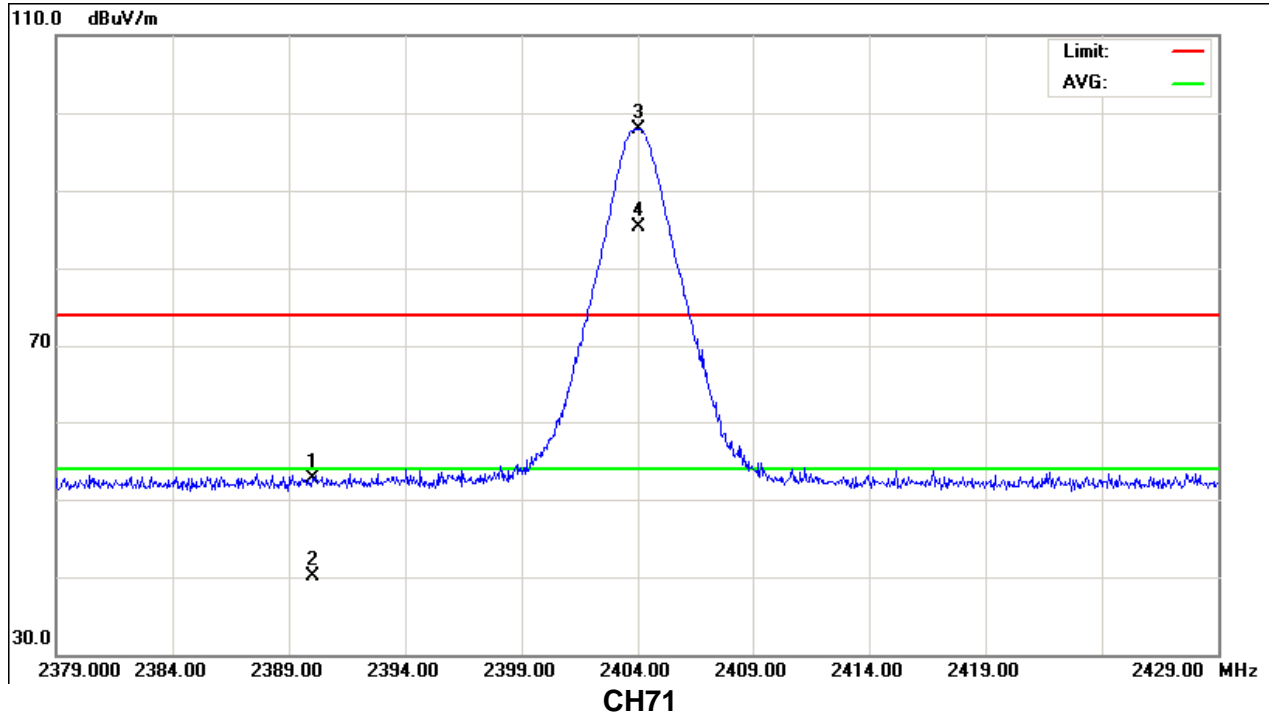
Freq.	Ant. Pol.	Reading		Ant./CF	Act.		Limit		Note
		Peak	AV		Peak	AV	Peak	AV	
(MHz)	H/V	(dBuV)	(dBuV)	CF(dB)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	
2390.00	H	20.40	7.80	32.30	52.70	40.10	74.00	54.00	CH01
2483.50	H	19.21	6.61	32.03	51.24	38.64	74.00	54.00	CH71

Remark :

- (1) Radiated emissions measured in frequency range above 1000MHz were made with an instrument using Peak detector mode and AV detector mode of the emission .
- (2) EUT Orthogonal Axis :
 "X" - denotes Laid on Table ; "Y" - denotes Vertical Stand ; "Z" - denotes Side Stand
- (3) During the measurements above 1 GHz it is taken care of that the EUT is always within the 3 dB cone of radiation BW of the used antenna
- (4) The average value of fundamental frequency is:
 Average = Peak value + 20log(Duty cycle) , Final AV=PK-12.6



Restricted Bands Requirements, Horizontal
CH01



**5. BANDWIDTH TEST****5.1 Applied procedures / limit**

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247 (a)(2)	Bandwidth	$\geq 500\text{KHz}$ (6dB bandwidth)	2400-2483.5	PASS

5.1.1 MEASUREMENT INSTRUMENTS LIST

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP_40	100129	Jan. 06, 2010

Remark: " N/A" denotes No Model Name. , Serial No. or No Calibration specified.

5.1.2 TEST PROCEDURE

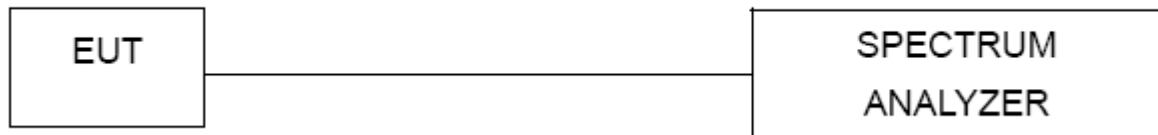
- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
- Spectrum Setting : RBW= 100KHz, VBW=100KHz, Sweep time = 20 ms.

5.1.3 DEVIATION FROM STANDARD

No deviation.



5.1.4 TEST SETUP



5.1.5 EUT OPERATION CONDITIONS

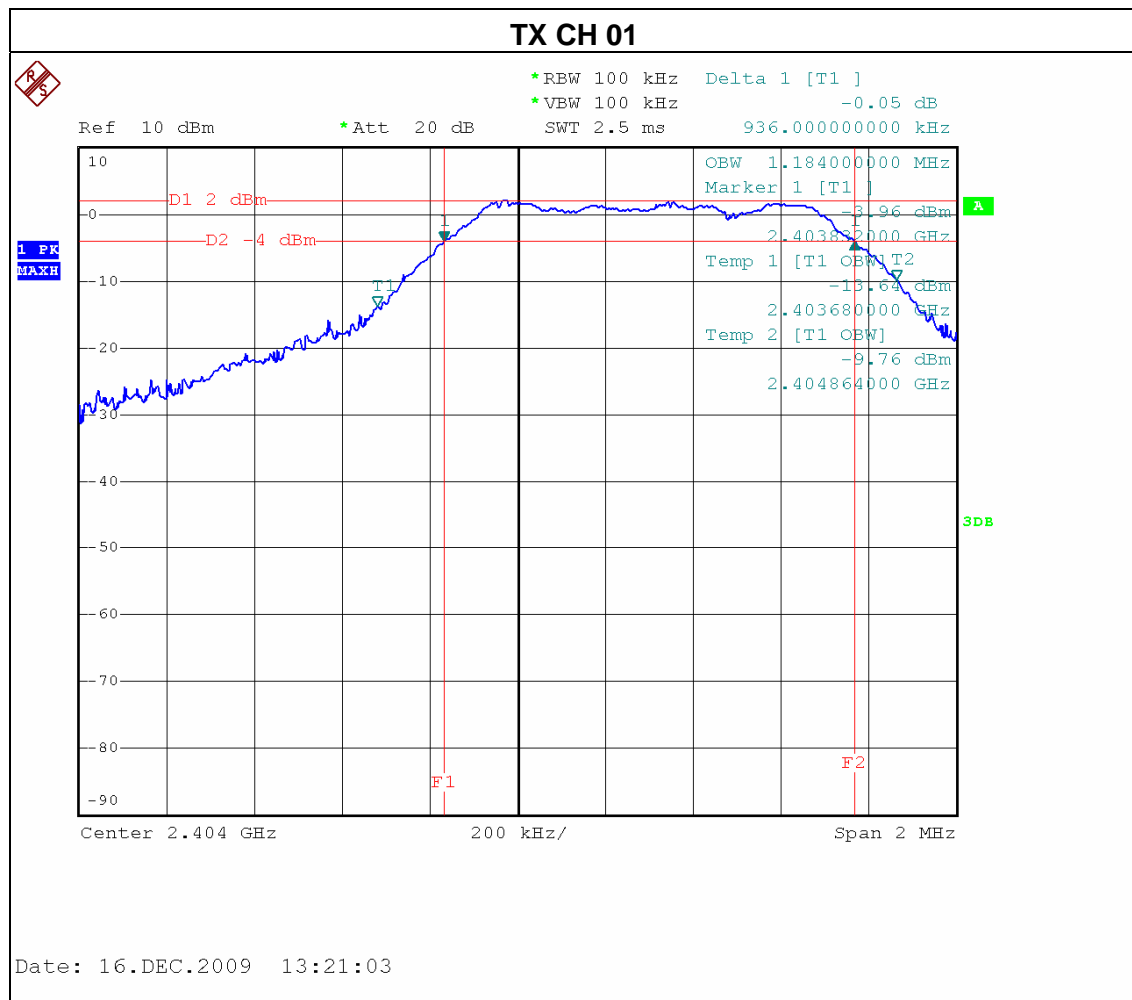
The EUT tested system was configured as the statements of 4.1.6 Unless otherwise a special operating condition is specified in the follows during the testing.



5.1.6 TEST RESULTS

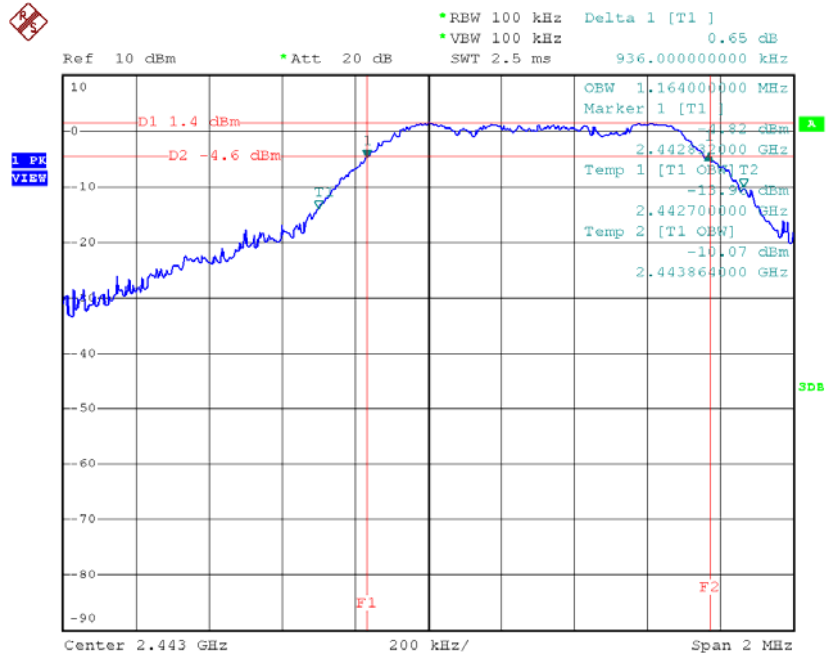
EUT :	2.4GHz Radio Control system	Model Name :	KT21
Temperature :	22 °C	Relative Humidity :	45 %
Pressure :	1016 hPa	Test Voltage :	DC 12V
Test Mode :	TX /CH01, CH40, CH71		

Test Channel	Frequency (MHz)	Bandwidth (KHz)	99% Occupied BW (MHz)	LIMIT (MHz)
CH01	2404	936.00	1.184	>=500KHz
CH40	2443	936.00	1.164	>=500KHz
CH71	2474	936.00	1.164	>=500KHz



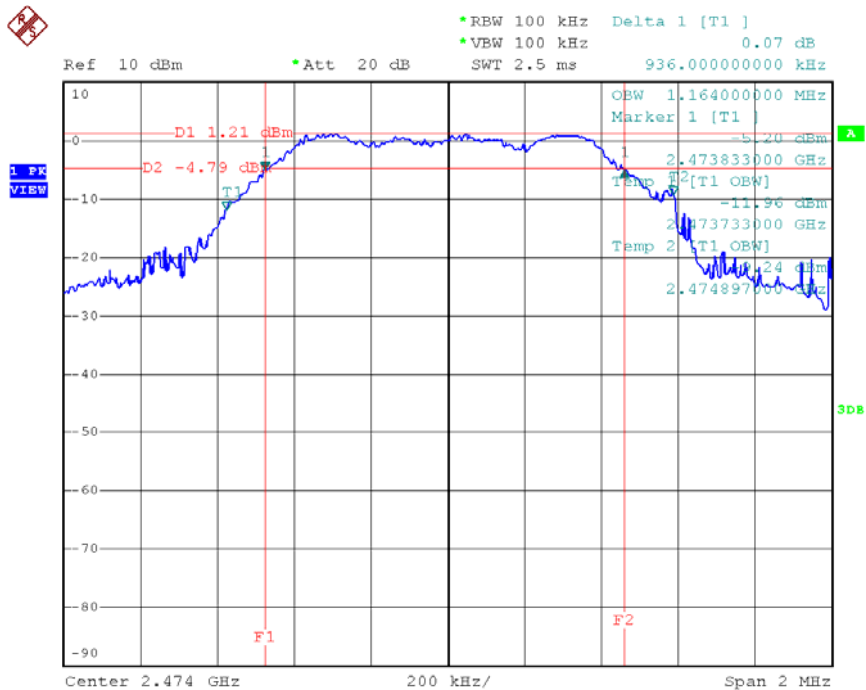


TX CH 40



Date: 16.DEC.2009 13:22:25

TX CH 80



Date: 16.DEC.2009 13:11:08



6. PEAK OUTPUT POWER TEST

6.1 Applied procedures / limit

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247 (b)(1)	Peak Output Power	1 watt or 30dBm	2400-2483.5	PASS

6.1.1 MEASUREMENT INSTRUMENTS LIST

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Power Meter	Anritsu	ML2487A	6K00004714	Feb. 11, 2010
2	Power Meter Sensor	Anritsu	MA2491A	34138	Feb. 11, 2010

Remark: " N/A" denotes No Model Name. , Serial No. or No Calibration specified.

6.1.2 TEST PROCEDURE

- a. The EUT was directly connected to the power metter and antenna output port as show in the block diagram below,

6.1.3 DEVIATION FROM STANDARD

No deviation.

6.1.4 TEST SETUP



6.1.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 4.1.6 Unless otherwise a special operating condition is specified in the follows during the testing.



6.1.6 TEST RESULTS

EUT :	2.4GHz Radio Control system	Model Name :	KT21
Temperature :	22 °C	Relative Humidity :	45 %
Pressure :	1016 hPa	Test Voltage :	DC 12V
Test Mode :	TX /CH01, CH40, CH71		

Test Channel	Frequency (MHz)	Peak Output Power (dBm)	LIMIT (dBm)	LIMIT (W)
CH01	2404 MHz	3.95	30	1
CH40	2443 MHz	3.85	30	1
CH71	2474 MHz	3.63	30	1



7. ANTENNA CONDUCTED SPURIOUS EMISSION

7.1 Applied procedures / limit

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

7.1.1 MEASUREMENT INSTRUMENTS LIST

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP_40	100129	Jan. 06, 2010

Remark: " N/A" denotes No Model Name. , Serial No. or No Calibration specified.

The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	100 MHz
RB / VB (emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 10Hz for Average
RB / VB (other emission)	100 KHz /100 KHz for Peak

7.1.2 TEST PROCEDURE

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
- Spectrum Setting : RBW= 100KHz, VBW=100KHz, Sweep time = 10 ms.

7.1.3 DEVIATION FROM STANDARD

No deviation.

7.1.4 TEST SETUP





7.1.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 4.1.6 Unless otherwise a special operating condition is specified in the follows during the testing.

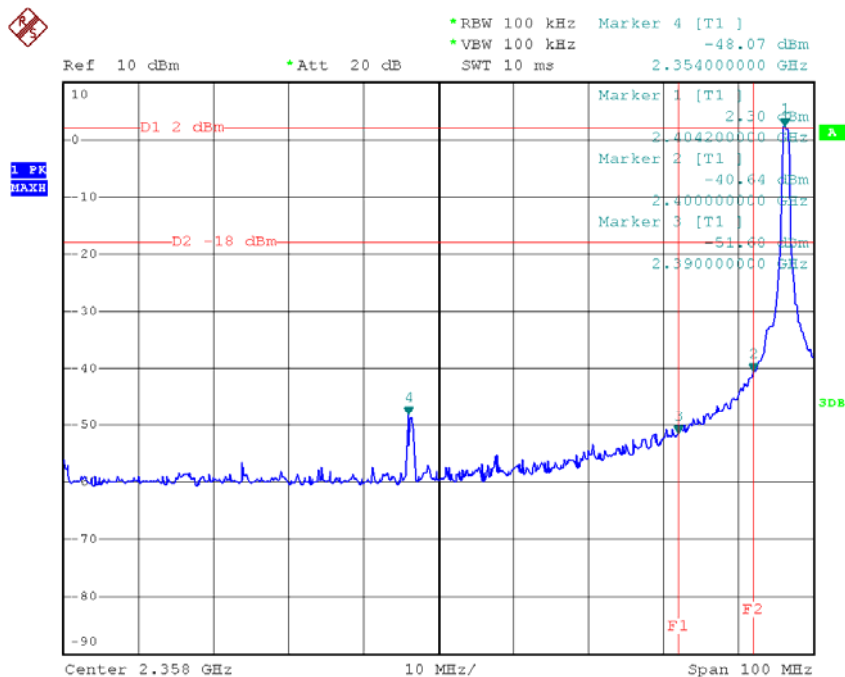
**7.1.6 TEST RESULTS**

EUT :	2.4GHz Radio Control system	Model Name :	KT21
Temperature :	22 °C	Relative Humidity :	45 %
Pressure :	1016 hPa	Test Voltage :	DC 12V
Test Mode :	TX /CH01, CH71		

Channel of Worst Data: CH01			
The max. radio frequency power in any 100kHz bandwidth outside the frequency band		The max. radio frequency power in any 100 kHz bandwidth within the frequency band.	
FREQUENCY(MHz)	POWER(dBm)	FREQUENCY(MHz)	POWER(dBm)
2354.00	-48.07	2485.91	-50.56
Result			
In any 100kHz bandwidth outside the frequency band, the radio frequency power is at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.			

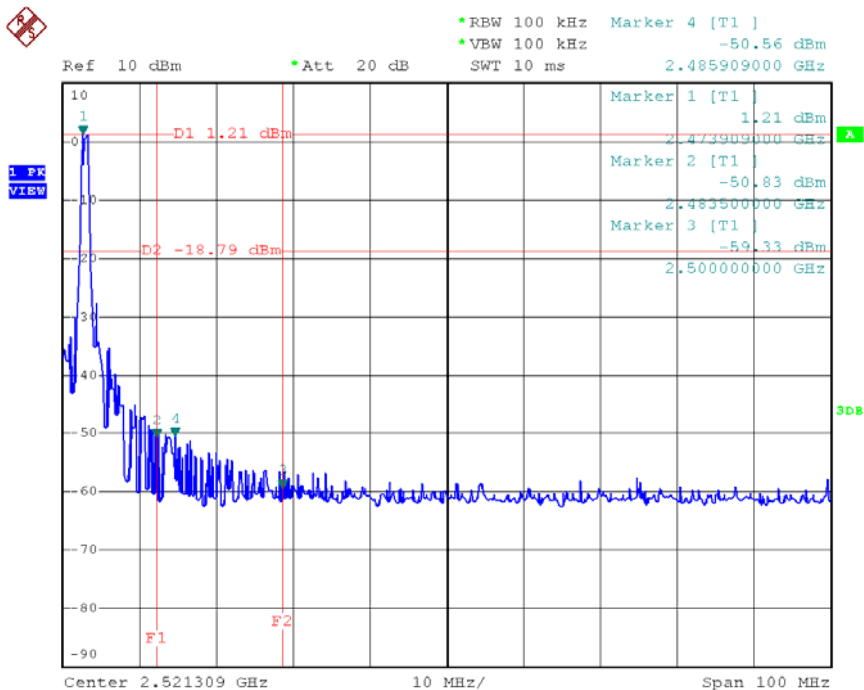


TX CH01



Date: 16.DEC.2009 13:19:13

TX CH71



Date: 16.DEC.2009 13:12:53



8. POWER SPECTRAL DENSITY TEST

8.1 Applied procedures / limit

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247 (d)	Power Spectral Density	8 dBm (in any 3KHz)	2400-2483.5	PASS

8.1.1 MEASUREMENT INSTRUMENTS LIST

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP_40	100129	Jan. 06, 2010

Remark: " N/A" denotes No Model Name. , Serial No. or No Calibration specified.

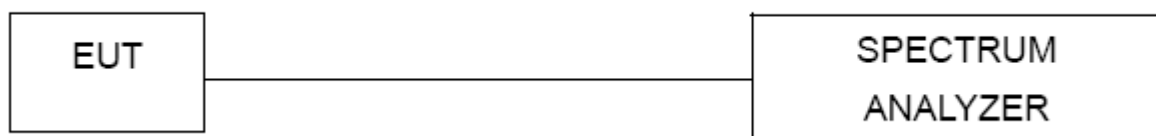
8.1.2 TEST PROCEDURE

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
- Spectrum Setting : RBW=3KHz, VBW=30 KHz, Sweep time = 500s.

8.1.3 DEVIATION FROM STANDARD

No deviation.

8.1.4 TEST SETUP



8.1.5 EUT OPERATION CONDITIONS

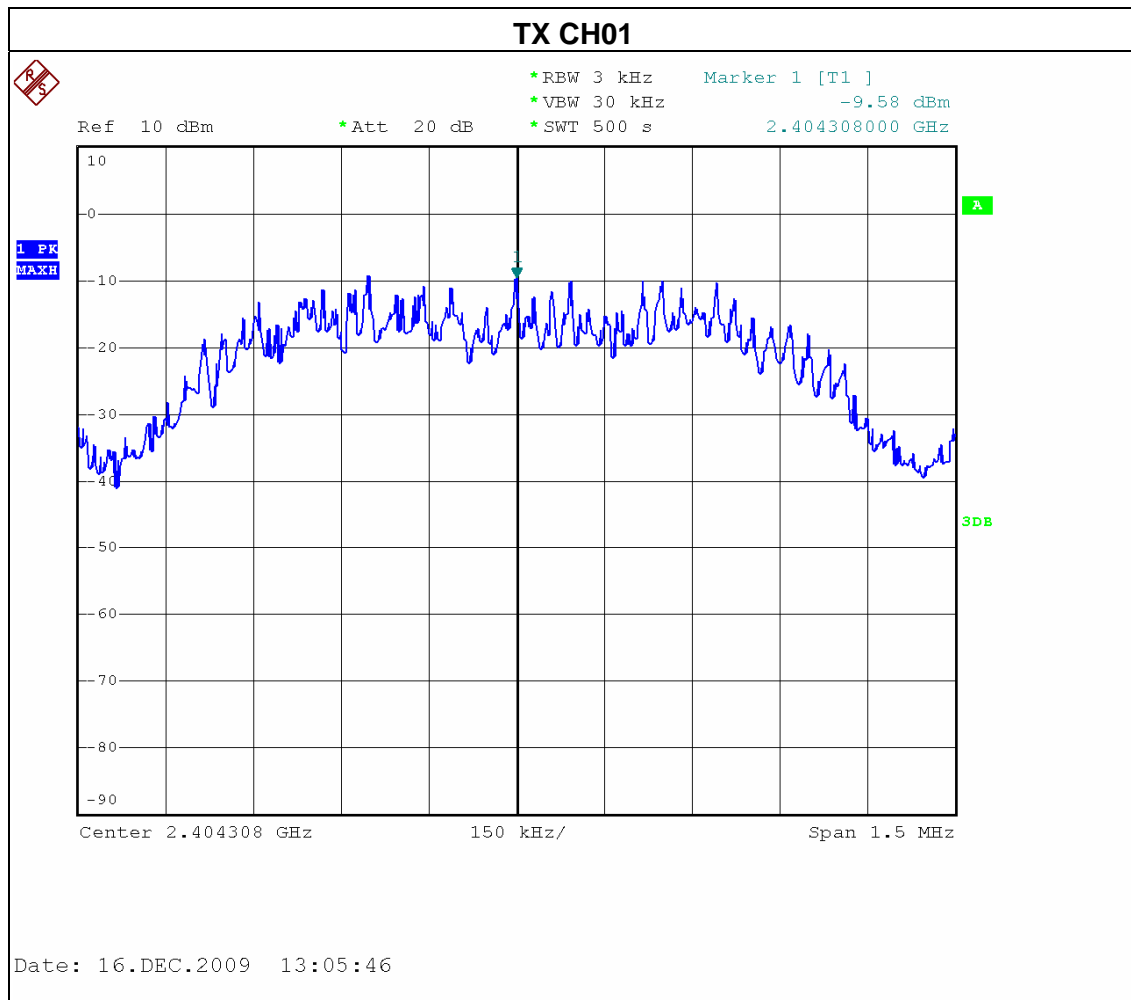
The EUT tested system was configured as the statements of 4.1.6 Unless otherwise a special operating condition is specified in the follows during the testing.



8.1.6 TEST RESULTS

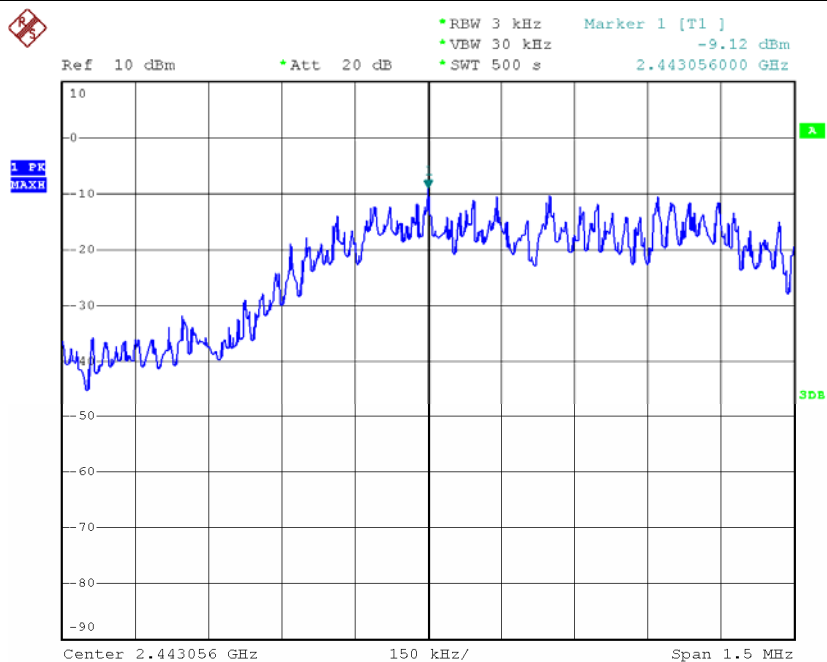
EUT :	2.4GHz Radio Control system	Model Name :	KT21
Temperature :	22 °C	Relative Humidity :	45 %
Pressure :	1016 hPa	Test Voltage :	DC 12V
Test Mode :	TX /CH01, CH40, CH71		

Test Channel	Frequency (MHz)	Power Density (dBm)	LIMIT (dBm)
CH01	2404 MHz	-9.58	8
CH40	2443 MHz	-9.12	8
CH71	2474 MHz	-9.57	8



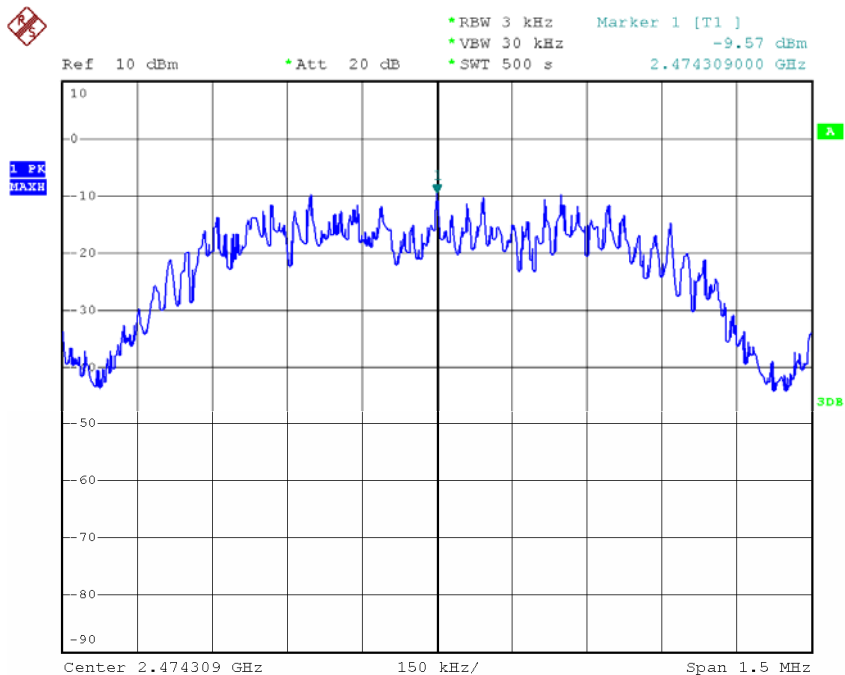


TX CH40



Date: 16.DEC.2009 13:06:29

TX CH71



Date: 16.DEC.2009 13:06:55



9. RF EXPOSURE TEST

9.1 APPLIED PROCEDURES / LIMIT

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.2 m normally can be maintained between the user and the device.

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842 / f	4.89 / f	(900 / f)*	6
30-300	61.4	0.163	1.0	6
300-1500			F/300	6
1500-100,000			5	6

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/1500	30
1500-100,000			1.0	30

Note: f = frequency in MHz ; *Plane-wave equivalent power density

9.1.1 MPE CALCULATION METHOD

$$E \text{ (V/m)} = \frac{\sqrt{30 \times P \times G}}{d}$$

$$\text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

E = Electric field (V/m)

P = Peak RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$

From the peak EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained

9.1.2 DEVIATION FROM STANDARD

No deviation.

9.1.3 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 4.1.6 Unless otherwise a special operating condition is specified in the follows during the testing.



9.1.4 TEST RESULTS

EUT :	2.4GHz Radio Control system	Model Name :	KT21
Temperature :	22 °C	Relative Humidity :	45 %
Pressure :	1016 hPa	Test Voltage :	DC 12V
Test Mode :	TX CH01, CH40, CH71		

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
2.85	1.9275	3.95	2.4831	0.000953	1	Complies
2.85	1.9275	3.85	2.4266	0.000931	1	Complies
2.85	1.9275	3.63	2.3067	0.000885	1	Complies



10. EUT TEST PHOTO

Radiated Measurement Photos

