

TEST REPORT

OF

FCC Part 15 Subpart C

FCC ID : UK4JASTECMODULE

Equipment Under Test : WIRELESS DIAGNOSTIC MODULE
Model No. : CAR-DOCTOR Module
Serial No. : N/A
Applicant : JASTEC CO., LTD.
Manufacturer : JASTEC CO., LTD
Date of Test(s) : 2006-08-01 ~ 2006-09-08
Date of Issue : 2006-09-08

In the configuration tested, the EUT complied with the standards specified above.

Remarks:

This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS Testing Korea Co., Ltd. or testing done by SGS Testing Korea Co., Ltd. in connection with distribution or use of the product described in this report must be approved by SGS Testing Korea Co., Ltd. in writing.

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VERIFICATION OF COMPLIANCE

Applicant : JASTEC CO., LTD.
Kind of Product : WIRELESS DIAGNOSTIC MODULE
Brand Name : N/A
Model Name : CAR-DOCTOR Module
Report File No. : STROR-06-067
Date of test : 2006-08-01 ~ 2006-09-08

APPLICABLE STANDARDS

STANDARD	TEST RESULT
Part 15 Subpart B, Subpart C §15.247	Complied

The above equipment was tested by SGS Testing Korea Co., Ltd. for compliance with the requirements set forth in the FCC RULES Part 15 Subpart C, Subpart §15.247. The results of testing in this report apply to the product system that was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Tested By:



Date

2006-09-08

Feol Jeong

Approved By



Date

2006-09-08

Albert Lim

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Appendix A – Photo of Spurious Radiated Emission Test

Appendix B – Photos of the EUT

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1. General Information

1-1. Testing Laboratory

SGS Testing Korea Co., Ltd.

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Telephone : +82 31 428 5700

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1-2. Details of Applicant

Applicant : JASTEC CO., LTD.

Address : Jastec B/D, 92-7, Kuumgok-Dong, Boon-dang Gu, Kyung-gi Do, Korea

Contact Person : SEUNG HO KIM

Phone No. : 82-031-719-5170

Fax No. : 82-031-719-5177

1-3. Description of EUT

Kind of Product	WIRELESS DIAGNOSTIC MODULE
Model Name	CAR-DOCTOR Module
Serial Number	N/A
Power Supply	DC 12 V (* DC 12 V is powered from a automobile DC 12 V system.)
Frequency Range	2440 MHz
Transmit Power	0.33 dBm
Modulation Technique	DSSS
Number of Channels	1 CH
Transmit Data Rate	1 Mbps (MAX)
Operating Conditions	-20 ~ +55
Antenna Type	Dipole Antenna (Left-handed SMA type)
Antenna Gain	2.5 dBi

1-4. Details of modification

-N/A

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1.5. Test Equipment List

EQUIPMENT	MANUFACTURER	MODEL	CAL DUE.
Spectrum Analyzer	Agilent	E4440A	May. 2007
Signal Generator	Agilent	E4438C	May. 2007
Attenuator	Agilent	MY42140907	May. 2007
DC Power Supply	Agilent	6674A	May. 2007
Preamplifier	Agilent	8449B	May. 2007
Spectrum Analyzer	Agilent	8563E	Dec. 2006
Test Receiver	Rohde & Schwarz	ESHS10	Aug. 2007
Biconical Antenna	EMCO	3110	Apr. 2007
Log-periodic	EMCO	3146	Jun. 2007
Horn Antenna	Electro-Metrics	RGA-60	Apr. 2007
Anechoic Chamber	SY Corporation	L W H 9.6 6.4 6.4	Aug. 2007

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1.6. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD:FCC 47 C.F.R. Part15, Subpart B and Subpart C		
Standard Section	Test Item	Result
15.107(a)	AC Power Conducted Emission	*Not applied
15.247(a)(2)	6 dB Bandwidth	PASS
15.247(b)	Maximum Peak Output Power	PASS
15.205(a) 15.209(a) 15.247(d)	Spurious Emission, Band Edge, and Restricted Bands	PASS
15.247(d)	Power Spectral Density	PASS
15.247(i) 1.1307(b)(1)	RF Exposure	PASS

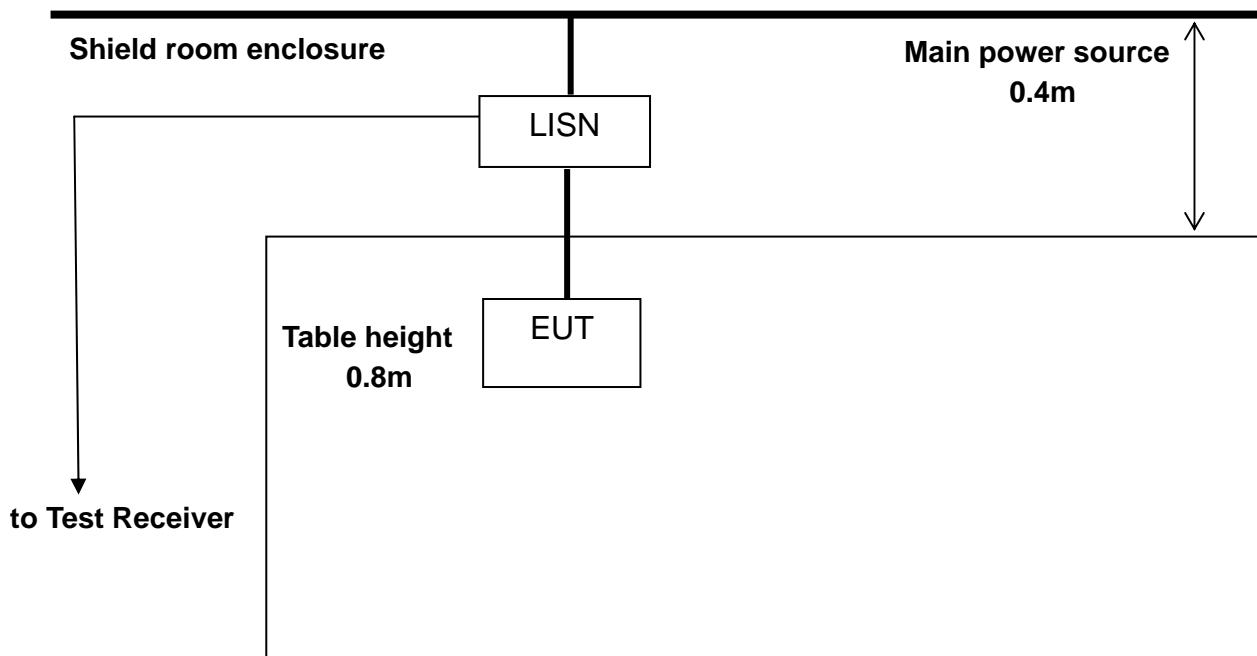
***Note :** This product' power is used DC 12 V.

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2. Conducted Power Line Test (Not applied)

-Note : This product' power is used DC 12 V.

2.1 Test Setup



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2.2 Limit

According to §15.107(a) for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 uH/50 ohm line impedance stabilization network(LISN).

Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15 – 0.50	66-56*	56-46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

* Decreases with the logarithm of the frequency.

2.3 Test Procedure

The test procedure is performed in a 12 ft \times 12 ft \times 8 ft (L \times W \times H) shielded room. The EUT along with its peripherals were placed on a 1.0m(W) \times 1.5m(L) and 0.8m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.

The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

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3. Spurious Emission, Band Edge, and Restricted Band Test

3.1 Test Setup

3-1-1. Spurious Radiated

The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 40 GHz Emissions.

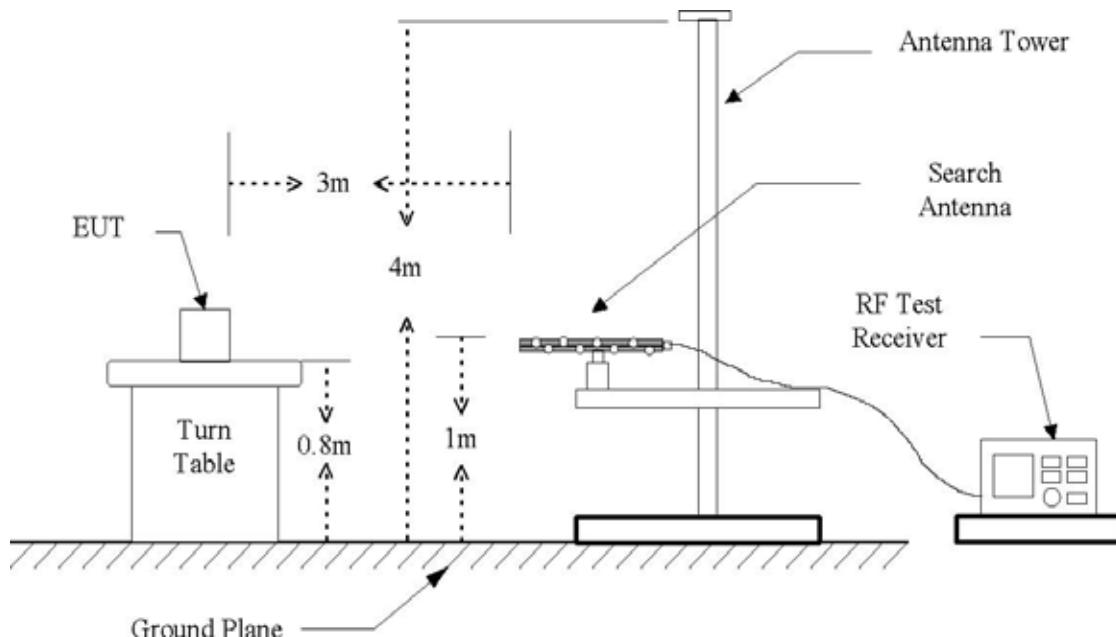


Figure 1 : Frequencies measured below 1 GHz configuration

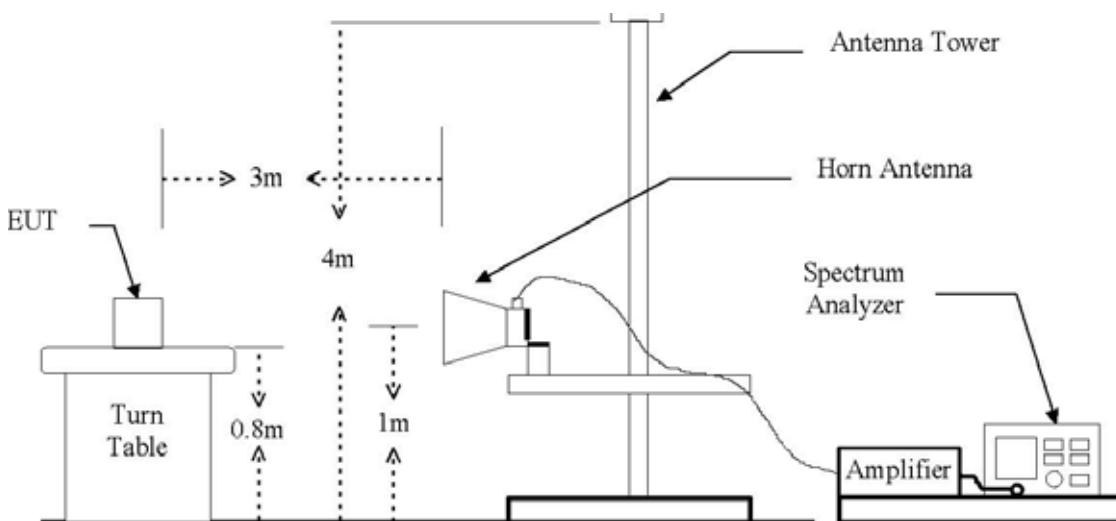
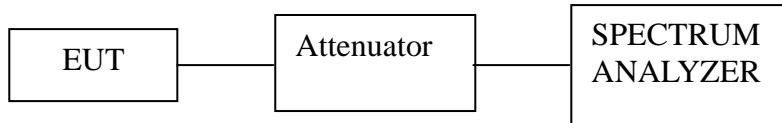


Figure 2 : Frequencies measured above 1 GHz configuration

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3-1-2. Spurious RF Conducted Emissions**3.2 Limit**

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement , provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval , as permitted under paragraph(b)(3) of this section , the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

According to § 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values :

Frequency (MHz)	Distance (Meters)	Radiated (dB μ V/m)	Radiated (μ V/m)
30 - 88	3	40.0	100
88 – 216	3	43.5	150
216 – 960	3	46.0	200
Above 960	3	54.0	500

According to §15.109(a), for an unintentional device, except for Class A digital devices, the field strength of radiated emission from unintentional radiators at a distance of 3 meters shall not exceed the above table.

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3.3 Test Procedures

3-3-1. Spurious Radiated Emissions

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 1 meter away from the interference-receiving antenna.
- c. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarization of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

NOTE :

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1MHz for Peak detection and frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1 GHz.

3-3-2 Spurious RF Conducted Emissions

The transmitter output was connected to the spectrum analyzer via a low loss cable.

Set both RBW and VBW of spectrum analyzer with suitable frequency span including 100 kHz bandwidth from band edge. The band edges was measured and recorded.

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3.4. Test Result

Ambient temperature: 23 Relative humidity: 50 %

3-4-1. Spurious Radiated Emissions

The frequency spectrum from 30 MHz to 1000 MHz was investigated. All emissions are not reported much lower than the prescribed limits. All reading values are quasi-peak values.

Antenna : Radiated Spurious Emission 30 MHz ~1000 MHz Test Data (Worst-Case Configuration)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
173.1	18.67	Q.P.	V	14.81	1.34	34.82	46.0	10.52
299.8	18.91	Q.P.	V	15.86	1.82	36.59	46.0	9.29

REMARKS :

1. All spurious emission at channels are almost the same below 1 GHz, so that the channel was chosen at representative in final test
2. “*” means the restricted band.
- 3..Actual = Reading + AF + CL.

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The frequency spectrum above 1000 MHz was investigated. All emissions are not reported much lower than the prescribed limits. Reading values are both peak and average values.

Antenna : Radiated Emission Test Data (Above 1 GHz)

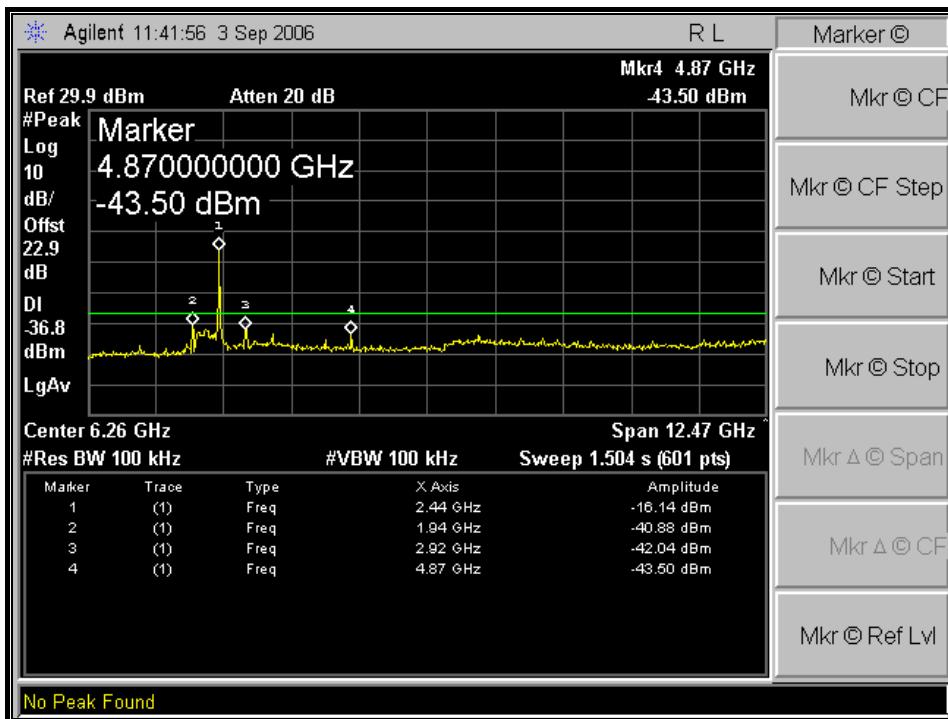
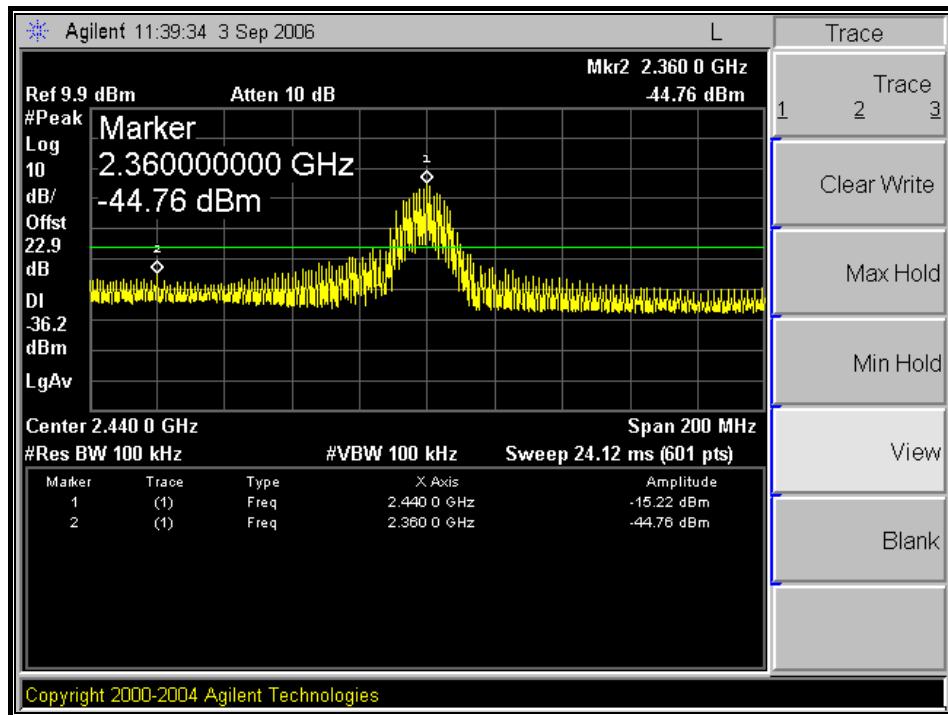
Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	AF/CL (dB/m)/(dB)	Amp Gain (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2231	56.27	Peak	V	27.58/5.36	36.54	52.67	74	21.33
2231	50.68	Average	V	27.58/5.36	36.54	47.08	54	6.92
*2390	55.67	Peak	V	28.10/5.56	36.52	52.81	74	21.19
*2390	37.60	Average	V	28.10/5.56	36.52	34.74	54	19.26
*2483.5	52.00	Peak	V	26.91/8.32	36.52	50.71	74	23.29
*2483.5	47.57	Average	V	26.91/8.32	36.52	43.26	54	10.74
2929	58.41	Peak	V	27.76/6.09	36.63	55.63	74	18.37
2929	47.09	Average	V	27.76/6.09	36.63	44.31	54	9.69
3421	53.09	Peak	V	30.99/6.72	36.59	54.21	74	19.79
3421	46.81	Average	V	30.99/6.72	36.59	47.93	54	6.07
4395	52.45	Peak	V	32.70/8.23	36.45	56.93	74	17.07
4395	45.75	Average	V	32.70/8.23	36.45	50.23	54	3.77
4885	52.75	Peak	V	32.93/8.27	36.35	57.60	74	16.40
4885	46.03	Average	V	32.93/8.27	36.35	50.88	54	3.12

REMARKS :

1. “*” means the restricted band.
2. Actual = Reading + AF + CL - Amp Gain
3. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency
4. Measurements above only up to 6 maximum emission noted, or would be lesser if No specific emission from the EUT are recorded (ie: margin>20 dB from the applicable limit) and considered that's already beyond the background noise floor.
5. Radiated emission measured in frequency above 1000 MHz were made with an Instrument using Peak detector mode and average detector mode of the emission Shown in Actual FS column.
6. Spectrum setting:
 - a. Peak Setting 1 GHz to 10th harmonics of fundamental, RBW=1 MHz, VBW=1 MHz, Sweep time : Auto
 - b. Average Setting 1 GHz to 10th harmonics of fundamental, RBW=1 MHz, VBW=10 Hz, Sweep time : Auto

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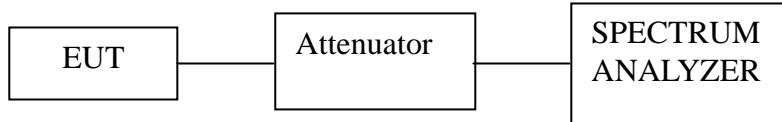
3-4-2. Spurious RF Conducted Emissions : Plot of Spurious RF Conducted Emissions



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4. 6 dB Bandwidth Measurement

4.1. Test Setup



4.2. Limits

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902 ~928 MHz, 2400 ~ 2483.5 MHz, and 5725 ~ 5825 MHz bands. The minimum of 6dB Bandwidth shall be at least 500 kHz

4.3. Test Procedure

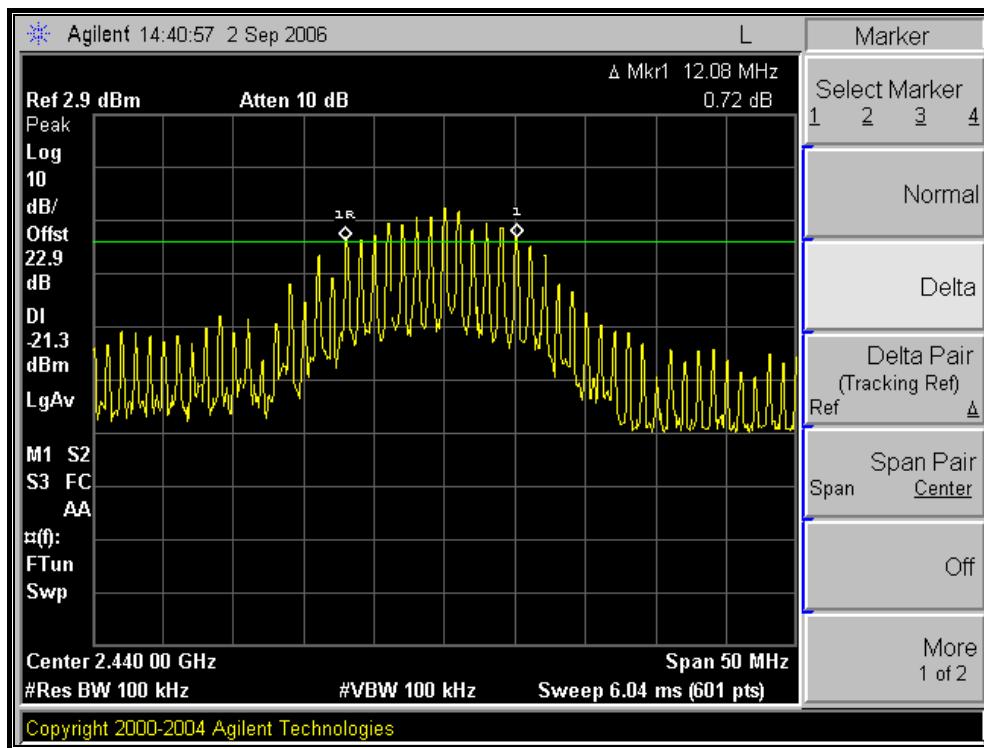
The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=100 kHz and VBW=100 kHz. The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB.

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4.4. Test Result

Ambient temperature: 23 Relative humidity: 50 %

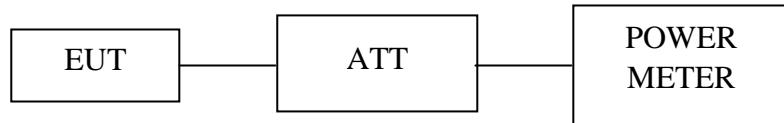
Channel No.	Channel Frequency (MHz)	6dB Bandwidth (MHz)	Minimum Limit (MHz)
1	2440	12.08	0.5



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5. Maximum Peak Output Power Measurement

5.1. Test Setup



5.2. Limit

According to §15.247(b)(3), for systems using digital modulation in the 902 ~ 928 MHz, 2400 ~2483.5 MHz, and 5725 ~ 5850 MHz band: 1 Watt. As an alternative to a peak power measurement.

Compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antenna elements. The average must not include any intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to §15.247(b)(4), the conducted output power limit specified in paragraph(b) of this section is based on the use of antenna with directional gains that do not exceed 6 dBi. Except as shown in paragraph(c) of this section, if transmitting antenna of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraph(b)(1), (b)(2), and (b)(3) of this section , as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi

5.3. Test Procedure

The RF power output was measured with a Power meter connected to the Antenna connector (conducted measurement)while EUT was operating in transmit mode at the appropriate center frequency.

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5.4. Test Result

Ambient temperature: 23 Relative humidity: 50 %

Channel No.	Channel Frequency (MHz)	Average Power Output (dBm)	Peak Power Output (dBm)	Peak Power Limit (dBm)	Margin (dB)
1	2440	-6.19	0.33	30	29.67

NOTE:

1. Cable loss = 2.90 dB, Attenuator = 20 dB.
2. The results are calculated as the following equation :
3. Peak Power Output = Peak Power Reading + Cable loss + Attenuator

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6. Power Spectral Density Measurement

6.1. Test Setup



6.2. Limit

According to §15.247(e), For digitally modulated system, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph(b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density

6.3. Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator, the bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW=3 kHz and VBW>=3 kHz, set sweep time=span / 3 kHz.

The power spectral density was measured and recorded.

The sweep time is allowed to be longer than span / 3 kHz for a full response of the mixer in the spectrum analyzer.

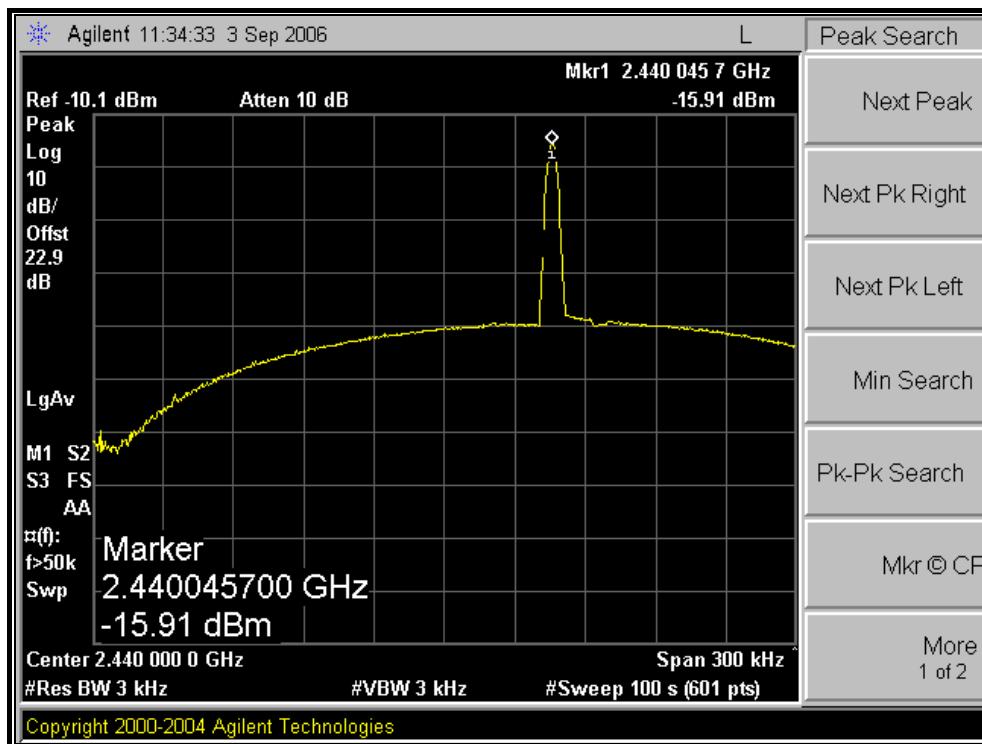
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6.4. Test Result

Ambient temperature: 23 Relative humidity: 50 %

Channel No.	Channel Frequency (MHz)	Final RF Power Level in 3 kHz BW (dBm)	Maximum Limit (dBm)	Margin (dB)
1	2440	-15.91	8	23.91

Plot of Power Spectral Density



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7. Antenna Requirement

7.1. Standard Applicable

For intentional device, according to FCC 47 CFR Section §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section § 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the gain of the antenna exceeds 6 dBi.

7.2. Antenna Connected Construction

Antenna used in this product is connected in dipole antenna(Left-handed SMA type) of 2.5 dBi (2.4 GHz)

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8. RF Exposure Evaluation

According to FCC 1.1310 : The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in §1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength(V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time
(A) Limits for Occupational /Control Exposures				
300 – 1500	--	--	F/300	6
1500 - 100000	--	--	5	6
(B) Limits for General Population/Uncontrol Exposures				
300 – 1500	--	--	F/1500	6
<u>1500 - 100000</u>	--	--	<u>1</u>	<u>30</u>

8.1. Friis transmission formula (Pd)

$$Pd = (Pout * G) / (4 * \pi * R^2)$$

Where, Pd = power density in mW/cm²

Pout = output power to antenna in mW

G = gain of antenna in linear scale

Pi = 3.1416

R = distance between observation point and center of the radiator in cm

Pd the limit of MPE, 1 mW/cm². If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance where the MPE limit is reached.

8.2. EUT Operating Condition

A software provided by client enabled the EUT to transmit and receive data at low, middle and high channel individually.

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8.3. Test Result of RF Exposure Evaluation

Test Item : RF Exposure Evaluation Data
Test Mode : Normal Operation

8.3.1. Output Power into Antenna & RF Exposure Evaluation Distance

Antenna gain : 2.5 dBi

Channel No.	Channel Frequency (MHz)	Output Peak Power to Antenna (dBm)	Antenna Gain (dBi)	Power Density at 20cm (mW/cm ²)	LIMITS (mW/cm ²)
1	2440	0.33	2.5	0.0004	1

NOTE :

The power density Pd (4th column) at a distance of 20cm calculated from the friis transmission formula is far below the limit of 1 mW/ cm².

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