TEST REPORT

of

FCC Part 15 Subpart C §15.247

FCC ID : ZK2GT12L

Equipment Under Test	:	Remote Controller
Model Name	:	GT-12
Serial No.	:	N/A
Applicant	:	GIYOUNG Electronics Co., Ltd.
Manufacturer	:	GIYOUNG Electronics Co., Ltd.
Date of Test(s)	:	2011.07.25 ~ 2011.10.06
Date of Issue	:	2011.10.06

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

Tested By: **Wonsuk Kim** **Date** **2011.10.06**

Approved By: **Feel Jeong** **Date** **2011.10.06**

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)
- 705, Dongchun-Dong Sooji-Gu, Yongin-Shi, Kyungki-Do, South Korea.
- Wireless Div. 2FL, 18-34, Sanbon-dong, Gunpo-si, Gyeonggi-do, Korea 435-040

www.kr.sgs.com/ee
Telephone : +82 +31 428 5700
FAX : +82 +31 427 2371

1.2. Details of Applicant

Applicant : GIYOUNG Electronics Co., Ltd.
Address : RM319, The O Valley, 555-9, Hogye-dong, Dongan-gu, Anyang-si, Gyeonggi-do, Korea
Contact Person : Yoo-Seok Jeong
Phone No. : +82 +31 479 3757
Fax : +82 +31 479 3759

1.3. Description of EUT

Kind of Product	Remote Controller
Model Name	GT-12
Serial Number	N / A
Power Supply	DC 3.3 V
Frequency Range	2 405 ~ 2 480 ㎒
Modulation Technique	DSSS
Number of Channels	76
Antenna Type	Connector type (Helical Antenna)
Antenna Gain	3.76 dBi

1.4. Declaration by the manufacturer

- N/A

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1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal Due.
Signal Generator	R&S	E4438C	MY42082477	Mar. 31, 2012
Spectrum Analyzer	R&S	FSV30	100768	Mar. 31, 2012
Power Sensor	R&S	NRP-Z81	100748	Apr. 04, 2012
Attenuator	Agilent	8494B	MY42141937	Apr. 01, 2012
DC power Supply	Agilent	U8002A	MY48490027	Jan. 05, 2012
Preamplifier	H.P	8447F	2944A03909	Jul. 04, 2012
Preamplifier	R & S	SCU 18	10117	Mar. 23, 2012
High Pass Filter	Wainwright	WHK3.0/18G-10SS	344	Sep. 29, 2011
Test Receiver	R & S	ESU26	100109	Feb. 21, 2012
Bilog Antenna	SCHWARZBECK MESSELEKTRONIK	VULB9163	396	Apr. 27, 2013
Horn Antenna	R & S	HF 906	100326	Oct. 08, 2011
Horn Antenna	SCHWARZBECK	BBH 9120D	BBHA9170431	Mar. 17, 2012
Anechoic Chamber	SY Corporation	L × W × H (9.6 m×6.4 m×6.6 m)	N.C.R.	N.C.R.

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1.6. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD:FCC Part15 subpart C		
Standard section	**Test Item**	**Result**
15.205(a) 15.209 15.247(d)	Transmitter Radiated Spurious Emissions Conducted Spurious Emission	Complied
15.247(a)(2)	6 dB Bandwidth	Complied
15.247(b)(3)	Maximum Peak Output Power	Complied
15.247(e)	Power Spectral Density	Complied

1.7. Test report revision

Revision	Report number	Description
0	F690501/RF-RTL004927	Initial
1	F690501/RF-RTL004927-1	Retest for radiated emission

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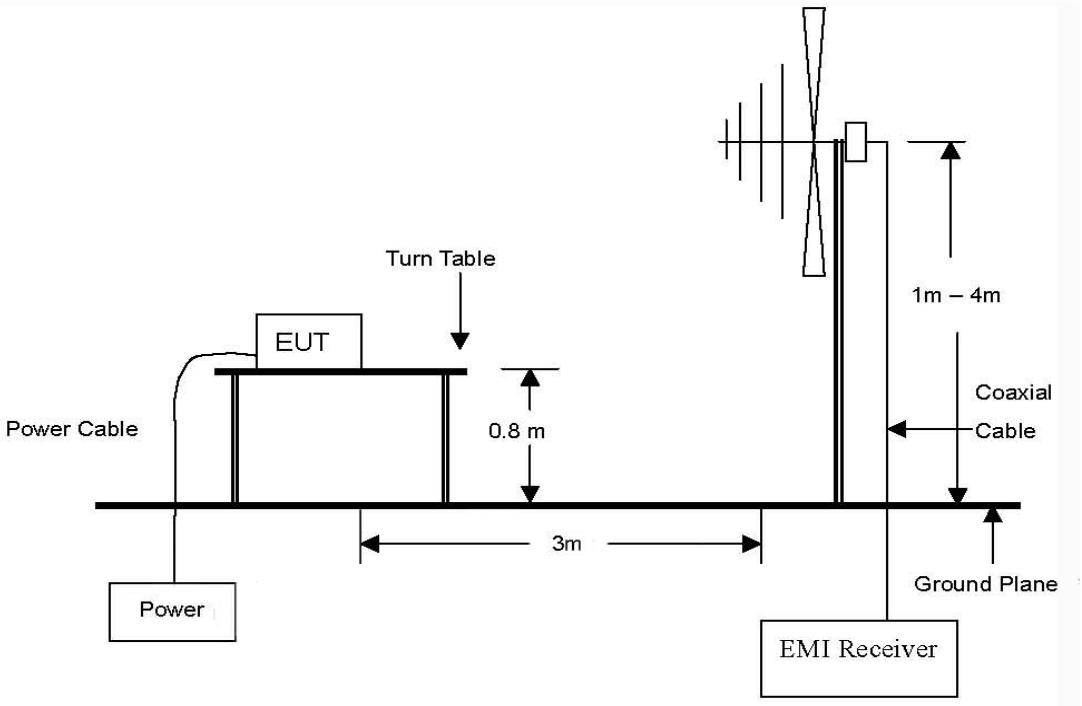
2. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission

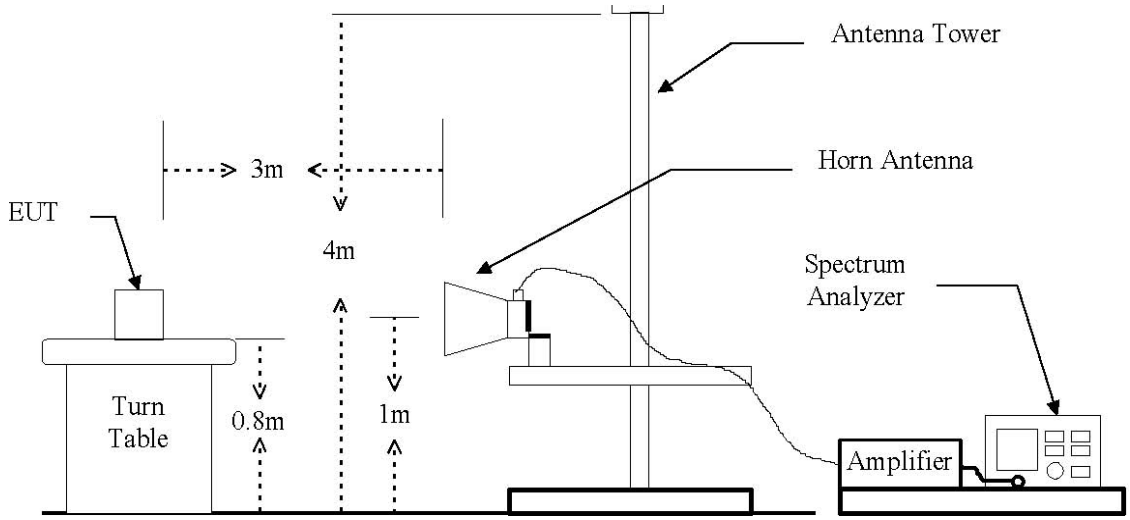
2.1. Test Setup

2.1.1. Transmitter Radiated Spurious Emissions

The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to 24 ㎓ Emissions.



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2.1.2. Conducted Spurious Emission

2.2. Limit

According to §15.247(d), in any 100 ㎑ 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 ㏈ below that in the 100 ㎑ 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 ㏈ instead of 20 ㏈. 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), Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table：

Frequency (㎒)	Distance (Meters)	Field Strength (㏈㎶/m)	Field Strength (㎶/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

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2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2003

2.3.1. Test Procedures for Radiated Spurious Emissions

1. 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.
2. During performing radiated emission below 1 ㎓, 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 ㎓, the EUT was set 3 meter away from the interference-receiving antenna.
3. 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 polarizations of the antenna are set to make the measurement.
4. 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.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was 10 ㏈ 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 ㏈ 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 ㎑ for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 ㎓.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ for Peak detection and frequency above 1 ㎓.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 ㎒ and the video bandwidth is 50 ㎐ for Average detection (AV) at frequency above 1 ㎓.

2.3.2. Test Procedures for Conducted Spurious Emissions

1. The transmitter output was connected to the spectrum analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW = 100 ㎑, VBW = 100 ㎑.

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2.4. Test Results

Ambient temperature : (23 ± 2) ℃
Relative humidity : 46 % R.H.

2.4.1. Spurious Radiated Emission

The frequency spectrum from 30 ㎒ to 1 000 ㎒ was investigated. Emission levels are not reported much lower than the limits by over 30 ㏈. All reading values are peak values.

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (㏈㎶)	Detect Mode	Pol.	AF (㏈/m)	AMP + CL (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
Below 1 000.000	Not detected	-	-	-	-	-	-	-

Remark:

1. All spurious emission at channels are almost the same below 1 ㎓, so that the channel was chosen at representative in final test.
2. Actual = Reading + AF + AMP + CL

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2.4.2. Spurious Radiated Emission

The frequency spectrum above 1000 ㎒ was investigated. Emission levels are not reported much lower than the limits by over 30 ㏈.

Low Channel (2 405 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (㏈㎶)	Detect Mode	Pol.	AF (㏈/m)	CL (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
*2 390.00	32.54	Peak	V	28.09	5.31	65.94	74.00	8.06
*2 390.00	8.77	Average	V	28.09	5.31	42.17	54.00	11.83

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (㏈㎶)	Detect Mode	Pol.	AF (㏈/m)	AMP+CL (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
4 809.20	45.17	Peak	V	32.61	-35.73	42.05	74.00	31.95
7 216.15	44.96	Peak	V	35.81	-31.31	49.46	74.00	24.54
Above 7 300.00	Not Detected	-	-	-	-	-	-	-

Middle Channel (2 445 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (㏈㎶)	Detect Mode	Pol.	AF (㏈/m)	AMP+CL (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
4 888.75	46.28	Peak	V	32.94	-35.71	43.51	74.00	30.49
7 336.30	44.95	Peak	V	35.95	-31.20	49.70	74.00	24.30
Above 7 400.00	Not Detected	-	-	-	-	-	-	-

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High Channel (2 48 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 483.50	33.37	Peak	V	28.09	5.67	67.13	74.00	6.87
*2 483.50	9.91	Average	V	28.09	5.67	43.67	54.00	10.33

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
4 958.89	46.79	Peak	V	33.22	-35.56	44.45	74.00	29.55
7 441.35	46.12	Peak	V	35.94	-29.30	52.76	74.00	21.24
Above 7 500.00	Not Detected	-	-	-	-	-	-	-

Remarks ;

1. "*" means the restricted band.
2. Measuring frequencies from 1 ㎓ to the 10th harmonic of highest fundamental Frequency.
3. Radiated emissions measured in frequency above 1 000 ㎒ were made with an instrument using peak/average detector mode.
4. Average test would be performed if the peak result were greater than the average limit.
5. Actual = Reading + AF + AMP + CL
6. VBW is applied to period for testing average mode.
   EUT period is 22 ms. F= 1/T => 1/22 = 45 Hz

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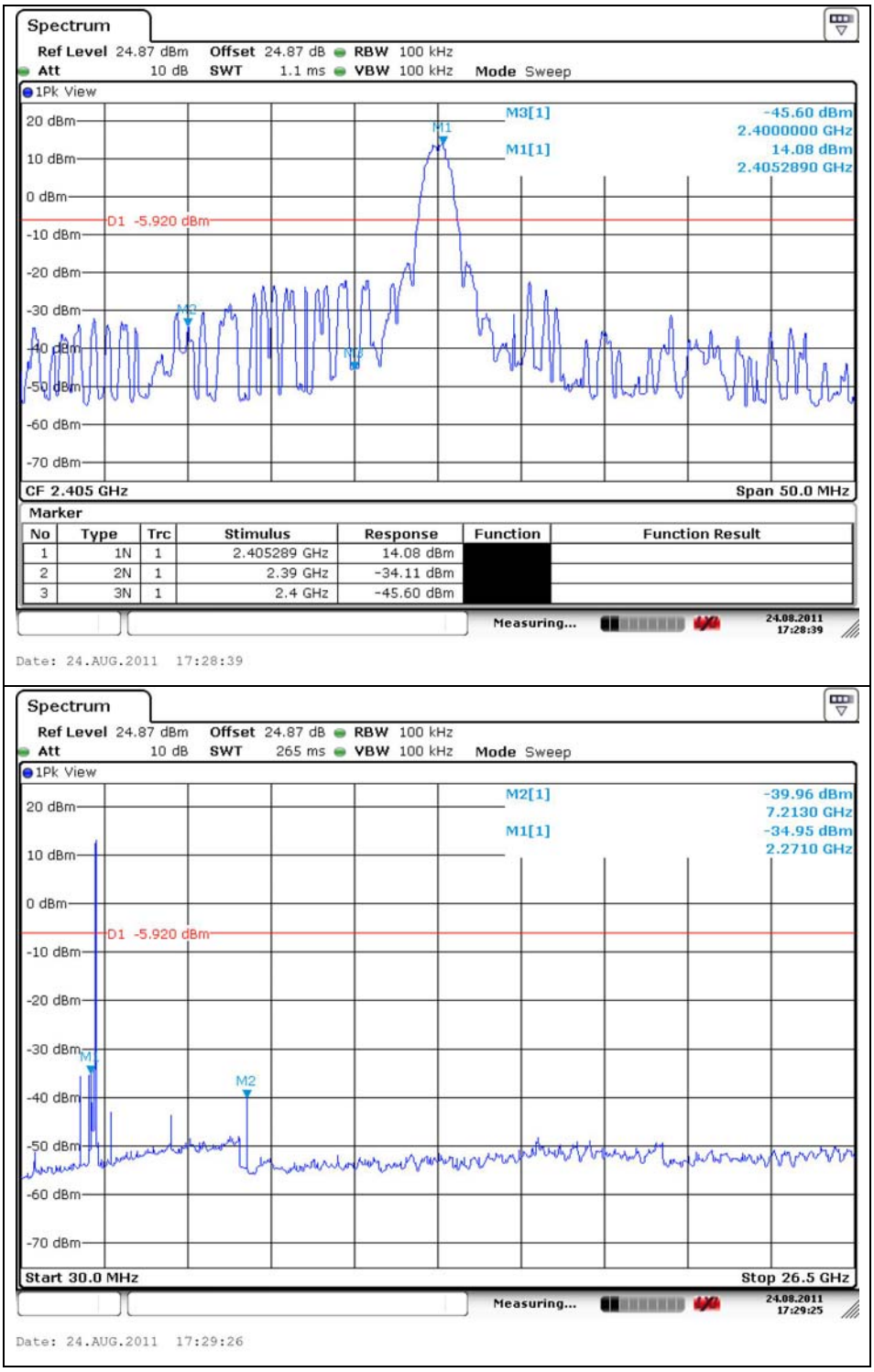
2.4.3. Spurious RF Conducted Emissions: Plot of Spurious RF Conducted Emission

Low Channel



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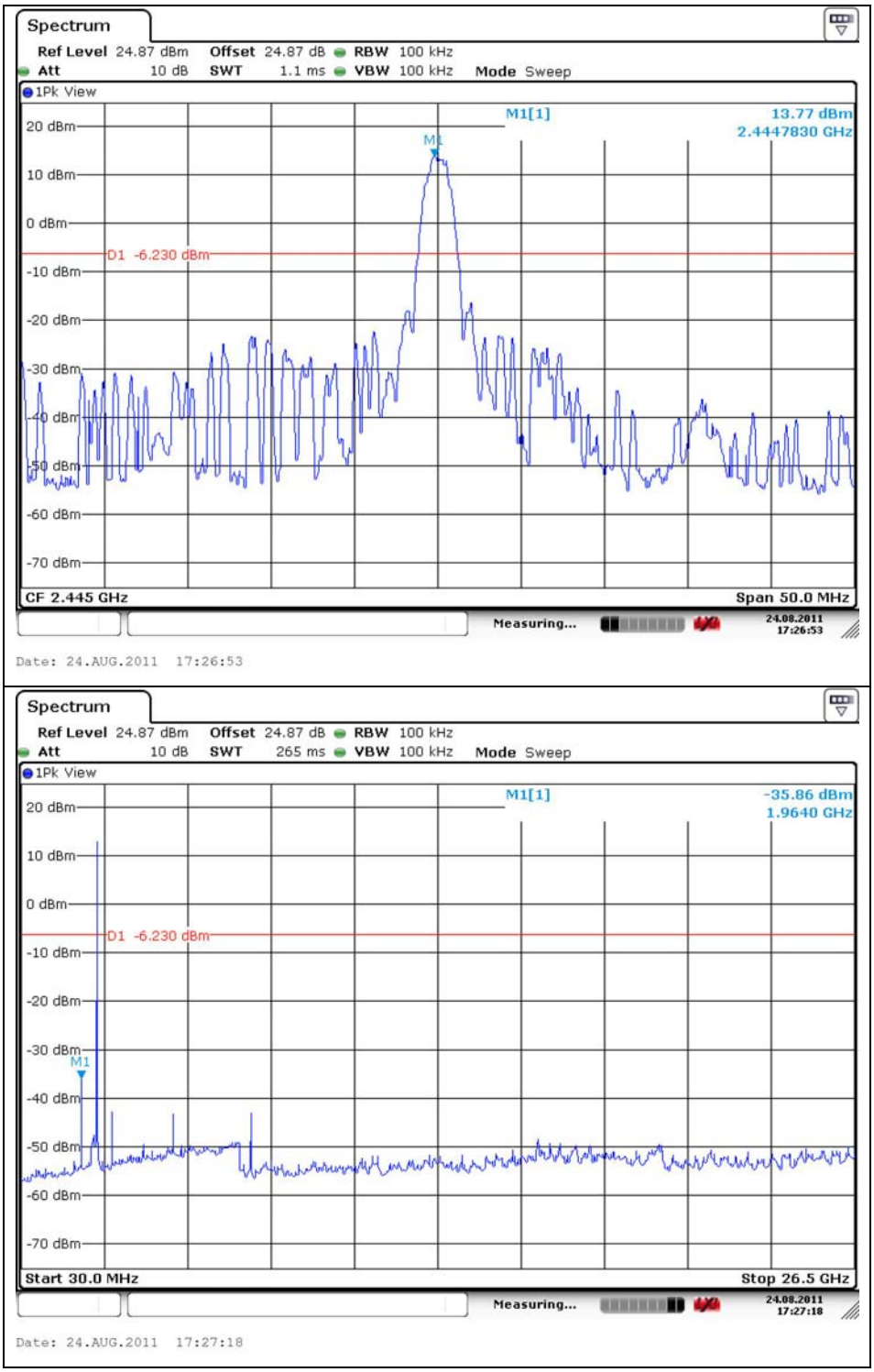
Middle Channel



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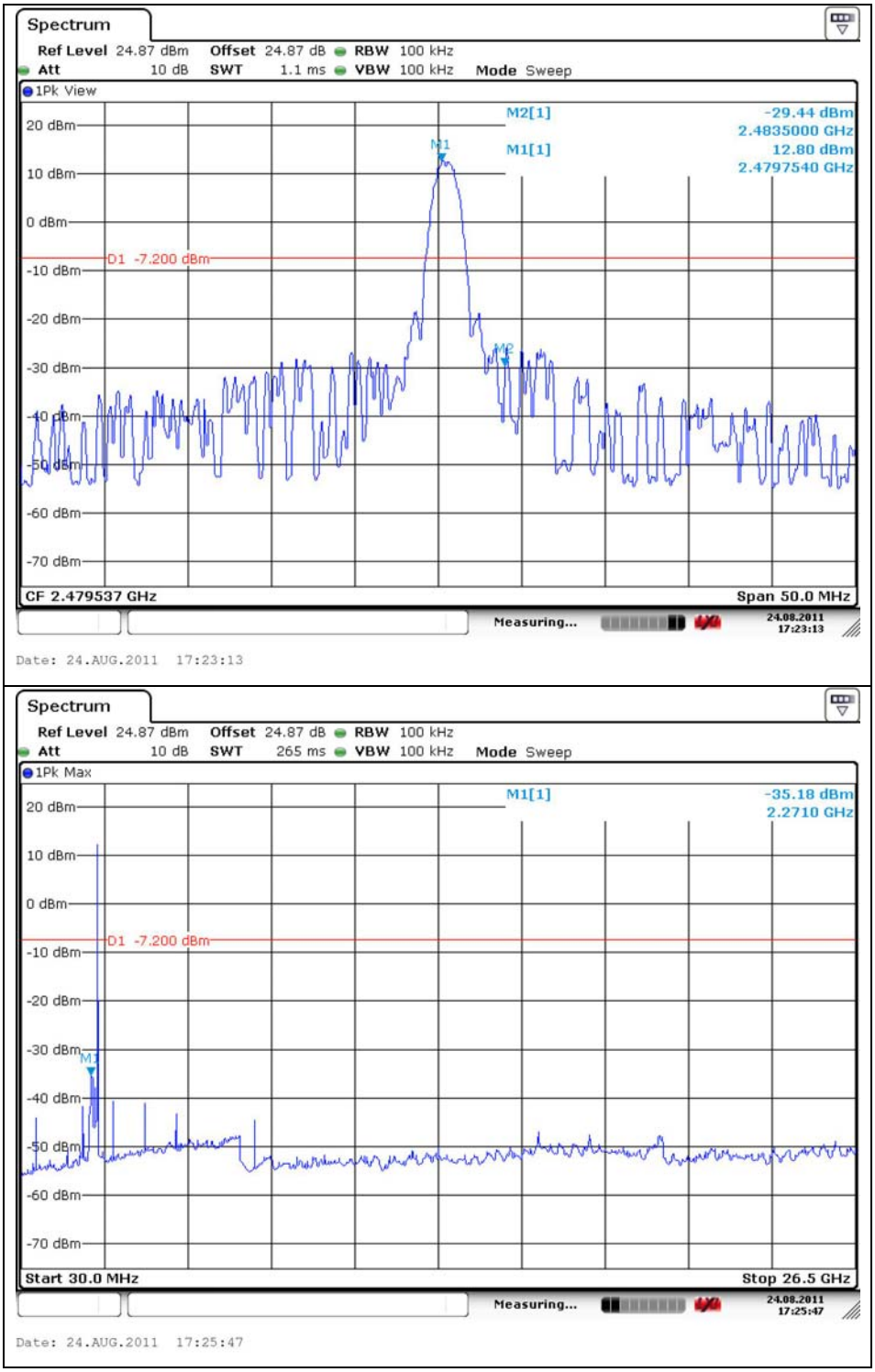
High Channel



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3. 6 dB Bandwidth Measurement

3.1. Test Setup

3.2. Limit

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902 ~928 ㎒, 2 400 ~ 2 483.5 ㎒, and 5 725 ~ 5 825 ㎒ bands. The minimum of 6 dB Bandwidth shall be at least 500 ㎑

3.3. Test Procedure

1. The 6 dB band width was measured with a spectrum analyzer connected to RF antenna connector(conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer. Display Line and Marker Delta functions, the 6 dB band width of the emission was determined.

2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW = 100 ㎑, VBW = 100 ㎑, Span = 10 ㎒.

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3.4. Test Results

Ambient temperature : (23 ± 2) ℃
Relative humidity : 46 % R.H.

Operation Mode	Channel	Channel Frequency (㎒)	6 ㏈ Bandwidth (㎒)	Minimun Limit (㎒)
DSSS	Low	2 405	1.447	0.5
	Middle	2 445	1.534	
	High	2 480	1.375	

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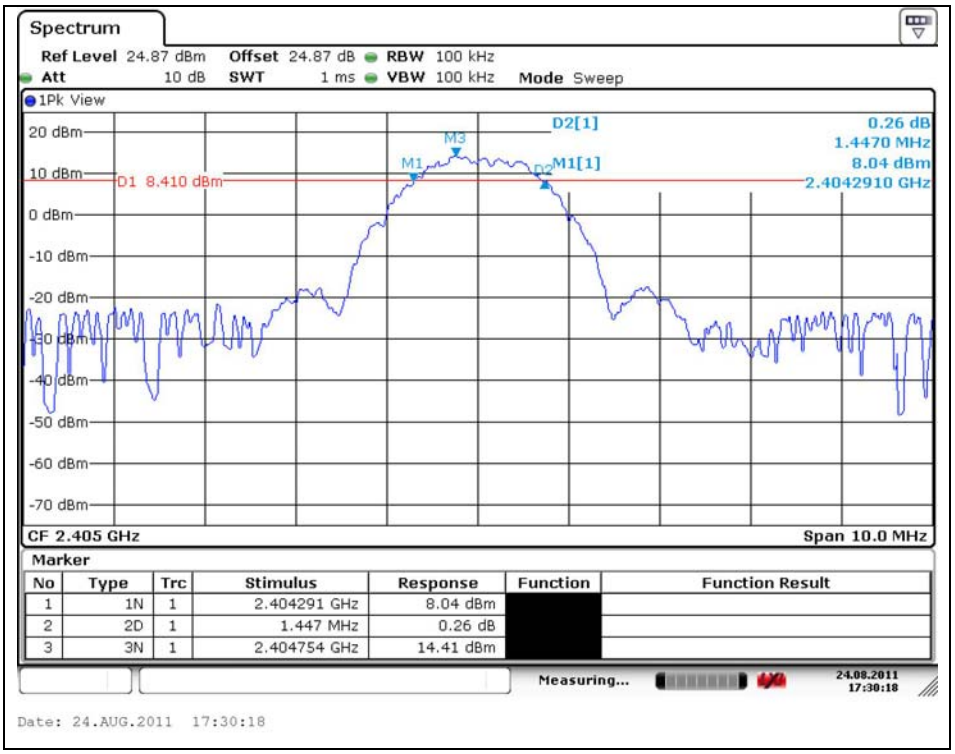
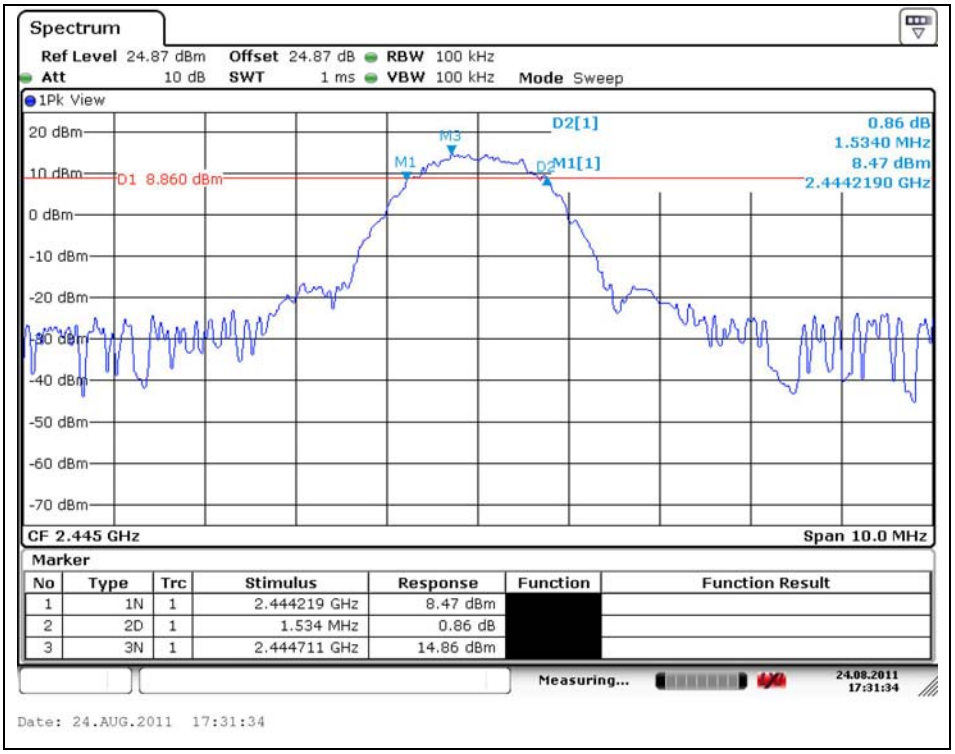
Low Channel



Middle Channel



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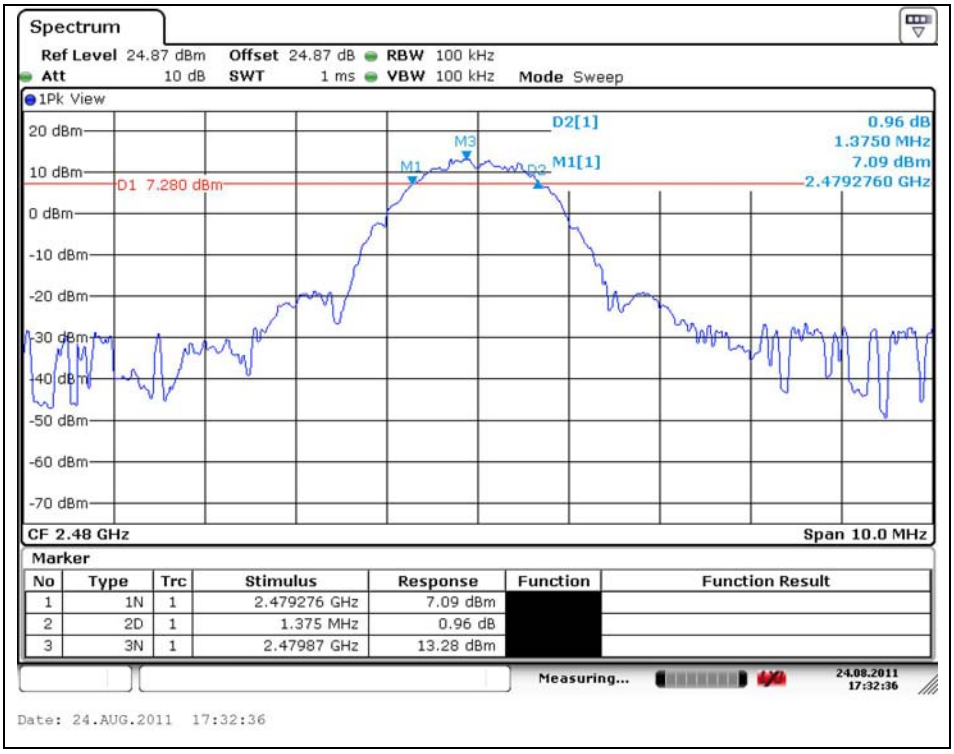
High Channel



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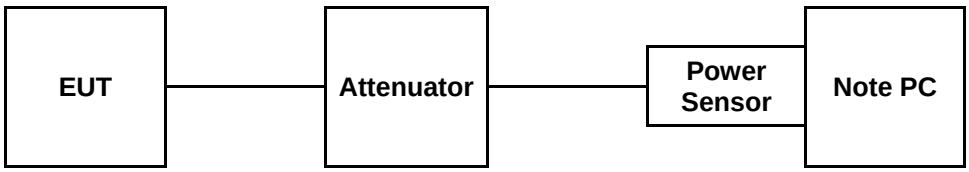
4. Maximum Peak Output Power Measurement

4.1. Test Setup



4.2. Limit

According to §15.247(b)(3), for systems using digital modulation in the 902 ~ 928 ㎒, 2 400 ~2 483.5 ㎒, and 5 725 ~ 5 850 ㎒ 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 signaling 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 ㏈i. Except as shown in paragraph(c) of this section, if transmitting antenna of directional gain greater than 6 ㏈i 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 ㏈ that the directional gain of the antenna exceeds 6㏈i.

4.3. Test Procedure

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to power sensor.

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4.4. Test Results

Ambient temperature : (23 ± 2) ℃
Relative humidity : 46 % R.H.

Operation Mode	Channel	Channel Frequency (㎒)	Attenuator + Cable offset (㏈)	Peak Power Result (㏈m)	Peak Power Limit (㏈m)
DSSS	Low	2 405	23.25	19.88	30
	Middle	2 445	23.25	19.47	
	High	2 480	23.25	17.65	

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5. POWER SPECTRAL DENSITY MEASUREMENT

5.1. Test Setup

5.2. Limit

§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 ㏈ m in any 3 ㎑ 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.

5.3. Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in test setup without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
3. By using the Max Hold function record the separation of adjacent channels.
4. Repeat above procedures until all frequencies measured were complete.
5. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using ; RBW = 3 ㎑, VBW = 10 ㎑, Span = 300 ㎑ and Sweep = 100 s.

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5.4. Test Results

Ambient temperature : (23 ± 2) ℃
Relative humidity : 46 % R.H.

Operation Mode	Frequency	Final RF Power Level in 3 ㎑ BW (㏈m)	Maximum Limit (㏈m)
DSSS	2 405 ㎒	3.05	8
	2 445 ㎒	5.25	
	2 480 ㎒	1.61	

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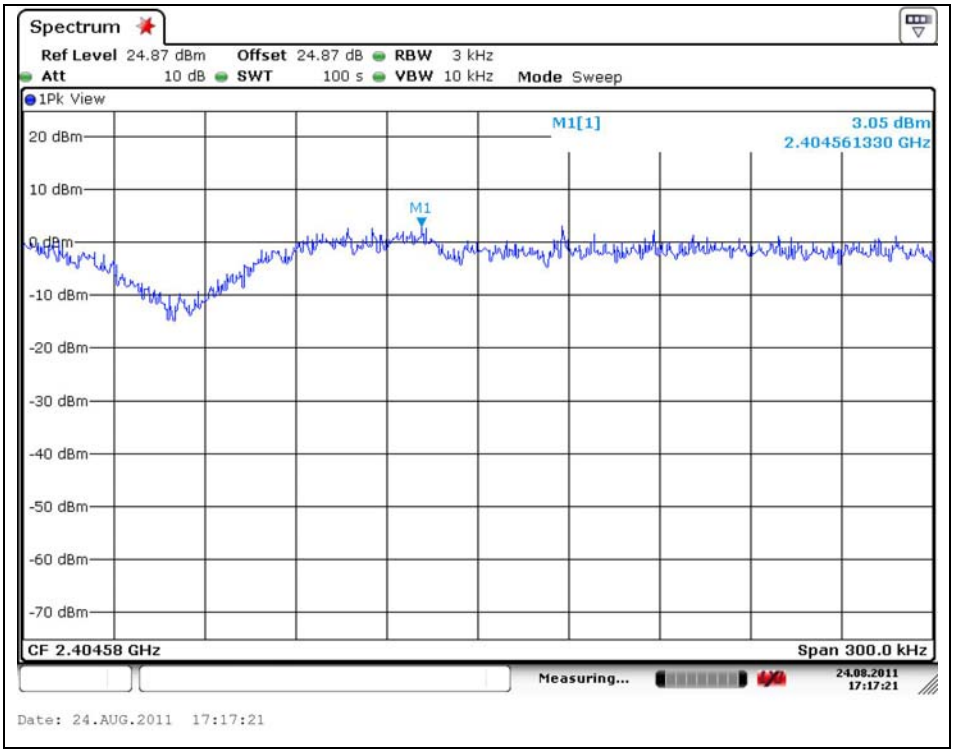
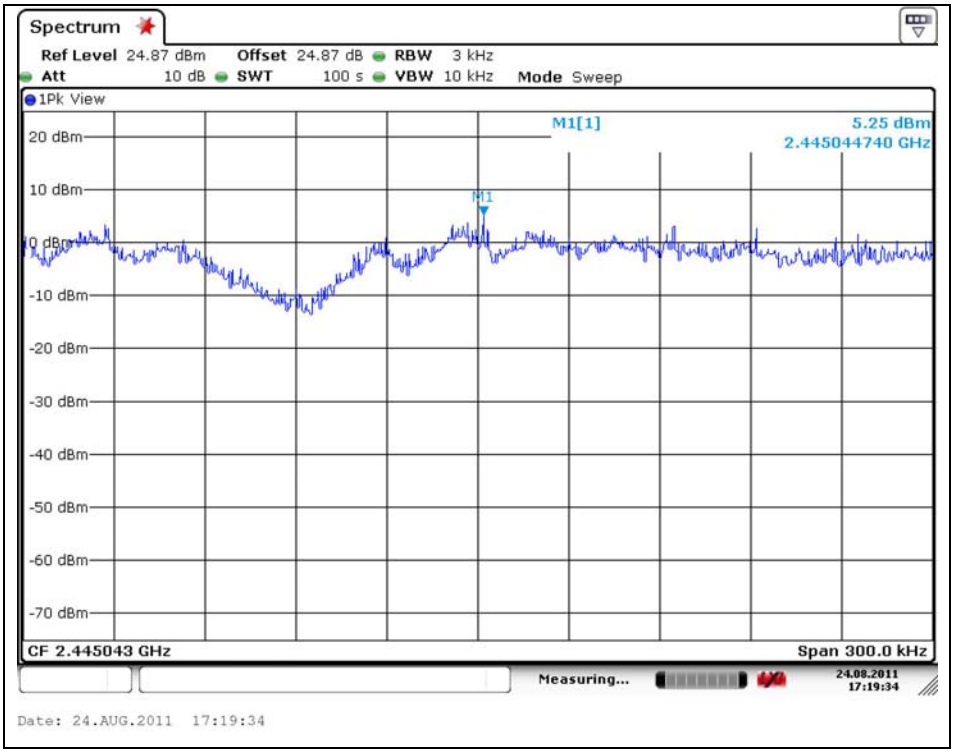
Low Channel



Middle Channel



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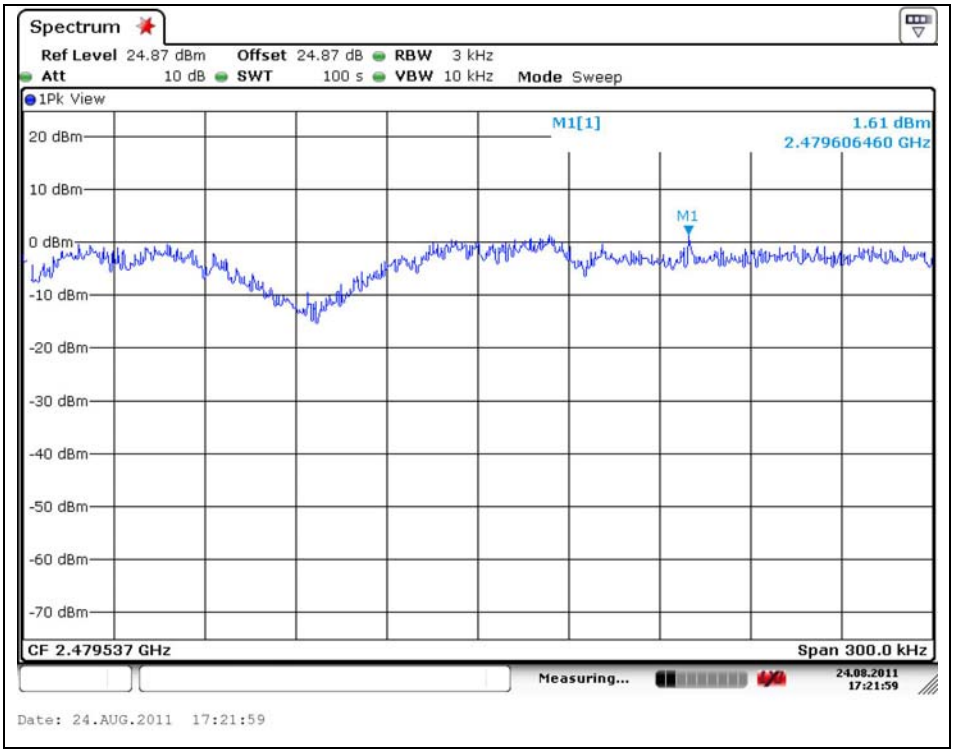
High Channel



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6. Antenna Requirement

6.1. 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.

6.2. Antenna Connected Construction

Antenna used in this product is Connector type (Helical Antenna) gain of 3.76 dBi.

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7. RF Exposure Evaluation

7.1 Environmental evaluation and exposure limit according to FCC CFR 47 part 1, 1.1307(b), 1.1310

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 (㎒)	Electric Field Strength(V/m)	Magnetic Field Strength (A/m)	Power Density (㎽/㎠)	Average Time
(A) Limits for Occupational /Control Exposures				
300 – 1 500	--	--	F/300	6
1 500 – 100 000	--	--	5	6
(B) Limits for General Population/Uncontrol Exposures				
300 – 1 500	--	--	F/1500	6
1 500 – 100 000	**--**	**--**	**1**	**30**

7.1.1. Friis transmission formula: Pd = (Pout*G)/(4*pi*R^2)

Where Pd = power density in ㎽/㎠

Pout = output power to antenna in ㎽

G = gain of antenna in linear scale

Pi = 3.1416

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

Pd the limit of MPE, 1 ㎽/㎠. 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.

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7.1.2. Test Result of RF Exposure Evaluation

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

7.1.3. Output Power into Antenna & RF Exposure Evaluation Distance

Channel	Channel Frequency (㎒)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 ㎝ (㎽/㎠)	LIMITS (㎽/㎠)
Low	2 405	7.16	3.76	0.002 459	1
Middle	2 445	7.79	3.76	0.002 843	1
High	2 480	6.20	3.76	0.001 971	1

Note :
1. The power density Pd (5th column) at a distance of 20 ㎝ calculated from the friis transmission formula is far below the limit of 1 ㎽/㎠ .
2. The average power is lower than SAR standard(the output power is > $300 \cdot [f(GHz)]^{0.5}$ mW).
3. Adjust the period of operating transmission in test program in order to use power sensor and then measure average power and peak power about each frequencies.

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