

## Electromagnetic Emission

### FCC MEASUREMENT REPORT

#### CERTIFICATION OF COMPLIANCE FCC Part 15 Certification Measurement

PRODUCT	: DRIVING RECORDER
MODEL/Serial No.	: EB-105 / Proto type
MULTIPLE MODEL	: -
FCC ID	: 2ACFS-EB-105
APPLICANT	: EDI Inc. A-2804, Daesung D-polis Knowledge Industry Center, 543-1, Gasan-dong, Geumcheon-gu, Seoul, Korea, 153-719 Attn.: Doyun Kim / President/CEO
MANUFACTURER	: EDI Inc. A-2804, Daesung D-polis Knowledge Industry Center, 543-1, Gasan-dong, Geumcheon-gu, Seoul, Korea, 153-719
FCC CLASSIFICATION	: DTS (Part 15 Digital Transmission System)
TYPE OF MODULATION	: DSSS (CCK)
FREQUENCY CHANNEL	: 802.11b: 2 412 MHz to 2 472 MHz and Channel Spacing 5 MHz (13 Ch)
AIR DATE RATE	: 11 Mbps (802.11b)
ANTENNA TYPE	: Internal Antenna (Integral)
ANTENNA GAIN	: 3.50 dBi max
RF POWER	: 8.030 mW
RULE PART(S)	: FCC Part 15 Subpart C
FCC PROCEDURE	: ANSI C63.4-2009
TEST REPORT No.	: ETLE140402.0468
DATES OF TEST	: April 15, 2014 to April 18, 2014
REPORT ISSUE DATE	: May 28, 2014
TEST LABORATORY	: ETL Inc. (FCC Designation Number : KR0022)

The DRIVING RECORDER, Model EB-105 has been tested in accordance with the measurement procedures specified in ANSI C63.4-2009 at the ETL Test Laboratory and has been shown to be complied with the electromagnetic radiated emission limits specified in FCC Rule Part15 Subpart C section 15.247.

I attest to the accuracy of data. All measurement herein was performed by me or was made under my supervision and is correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

The results of testing in this report apply to the product/system which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Prepared by

Jeong Hwan, Pyo (Test Engineer)

May 28, 2014

Reviewed by

Kug Kyoung, Yoon (Chief Engineer)

May 28, 2014

**ETL Inc.**  
114, Gasan digital 2-ro, Geumcheon-gu, Seoul, 153-803, Korea  
Tel: 82-2-858-0786 Fax: 82-2-858-0788

*The test report merely corresponds to the test sample(s).*

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## FCC MEASUREMENT REPORT

**Scope** – *Measurement and determination of electromagnetic emission (EME) of radio frequency devices including intentional radiators and/or unintentional radiators for compliance with the technical rules and regulations of the U.S Federal Communications Commission(FCC)*

### General Information

<b>Applicant Name</b>	: EDI Inc.
<b>Address</b>	: A-2804, Daesung D-polis Knowledge Industry Center, 543-1, Gasan-dong, Geumcheon-gu, Seoul, Korea, 153-719
<b>Attention</b>	: Doyun Kim / President/CEO

- EUT Type** : DRIVING RECORDER
- Model Number** : EB-105
- S/N** : Proto type
- Modulation Technique** : DSSS (CCK)
- Frequency Channel** : 802.11b: 2 412 MHz to 2 472 MHz and Channel Spacing 5 MHz (13 Ch)
- Air Data Rate** : 11 Mbps (802.11b)
- Antenna Type** : Internal Antenna (Integral)
- Antenna Gain** : 3.50 dBi max
- RF Power** : 8.030 mW
- Environmental of Tests** : Temperature: (20.4 ± 0.9) °C  
Humidity: (51 ± 10) % R.H.  
Atmospheric Pressure: (101.0 ± 0.4) kPa
- FCC Rule Part(s)** : FCC Part 15 Subpart C
- Test Procedure** : ANSI C63.4-2009
- FCC Classification** : DTS (Part 15 Digital Transmission System)
- Place of Tests** : ETL Inc. Testing Lab. (FCC Designation Number : KR0022)

Radiated Emission test 1;  
97-4, Gureomae-gil, Seosin-myeon, Hwaseong-si,  
Gyeonggi-do, 445-882, Korea

Radiated Emission test 2 and Conducted Emission test;  
114, Gasan digital 2-ro, Geumcheon-gu, Seoul, 153-803, Korea

## 1. INTRODUCTION

The measurement test for radiated and conducted emission test was conducted at the ETL Inc. The site is constructed in conformance with the requirements of the ANSI C63.4-2009 and CISPR Publication 16. The ETL has site descriptions on file with the FCC for 3 m and 10 m site configurations. Detailed description of test facility was found to be in compliance with FCC Rules according to the ANSI C63.4-2009 and registered to the Federal Communications Commission (FCC Designation Number : KR0022).

The measurement procedure described in American National Standard for Method of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2009) was used in determining radiated and conducted emissions from the EDI Inc. Model: EB-105

## 2. PRODUCT INFORMATION

### 2.1 Equipment Description

The Equipment Under Test (EUT) is the DRIVING RECORDER (model: EB-105).

The model EB-105 is basic model that was tested.

### 2.2 General Specification

Item	Specification
Color	Black & Silver
Size	108.93 mm x 40.60 mm x 36.10 mm
Storage	Micro SD Card (16 GB/32 GB)
Camera	CMOS Image Sensor (2 M Pixel)
Viewing Angle	142.2° (D), 118.7° (H), 63.1° (V)
Resolution	Full HD (1 920 x 1 080)
Frame	Max 30 fps
WIFI	Built-in (802.11b)
GPS	Built-in (High Sensitivity)
Microphone	Built-in (Voice Recording)
Speaker	Built-in (Audio Guidance)
LEDs	Indication LEDs (Recording, GPS, WiFi), Security LED
G-Sensor	3-Axis Acceleration Sensor
Buttons	WiFi On/Off (short) & SD Card Format (long)
	MIC On/Off Button
Battery	Built-in Super Capacitor (File Closing)
Input Power	DC 12 V ~ 24 V
Power Consumption	About 4 W
Operation Temperature	(25 ± 45) °C
PC Viewer	Windows XP or later, (Mac OS: Later)
Mobile Viewer	Mobile App (Android 2.3 or later & iOS 5.0 or later)
High Internal Frequency	OSC → 40 MHz

### **3. DESCRIPTION OF TESTS**

The tests documented in this report were performed in accordance with ANSI C63.4-2009 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, 15.207, 15.209 and 15.247.

#### **3.1 Radiated Emission Measurement**

Radiated emission measurements were made in accordance with § 13 in ANSI C63.4-2009 "Measurement of Intentional radiators" The measurements were performed over the frequency range of 30 MHz to 40 GHz using antenna as the input transducer to a Spectrum analyzer or a Field Intensity Meter. The measurements were made with the detector set for "Peak, Quasi-peak, Average" within a bandwidth of 120 kHz and above 1 GHz is 1 MHz.

Preliminary measurements were made at 3 m using broadband antennas, and spectrum analyzer to determine the frequency producing the maximum emission in shielded room. Appropriate precaution was taken to ensure that all emission from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth and height with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 MHz to 1 000 MHz using Log-Bicon antenna. Above 1 GHz, linearly polarized double ridge horn antennas were used. Final measurements were made open site or SVSWR chamber at 3 m. The test equipment was placed on a styrofoam table. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. Each frequency found during pre-scan measurements was re-examined by manual. The EUT, support equipment and interconnecting cables were re-configured to the set-up producing the maximum emission for the frequency and were placed on top of a 0.8 m high nonmetallic 1.0 m x 1.5 m table. The EUT, support equipment, and interconnecting cables were rearranged and manipulated to maximize each emission. The turntable containing the system was rotated; the antenna height was varied 1 m to 4 m and stopped at the azimuth or height producing the maximum emission.

Varying the mode of operating frequencies of the EUT maximized each emission. The system was tested in all the three orthogonal planes and changing the polarity of the antenna. The worst-case emissions are recorded in the data tables. If necessary, the radiated emission measurement could be performed at a closer distance to ensure higher accuracy and the results were extrapolated to the specified distance using an inverse linear distance extrapolation factor (20 dB/decade) as per section 15.31(f).

Photographs of the worst-case emission can be seen in Photographs of the worst-case emission test setup can be seen in Appendix B.

## 3.2 Conducted Emission Measurement

Conducted emissions measurements were made in accordance with section § 13 in ANSI C63.4-2009 "measurement of intentional radiators". The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a  $50\ \Omega/50\ \mu\text{H}$  LISN as the input transducer to a Spectrum Analyzer or a Test Receiver. The measurements were made with the detector set for "Peak" amplitude within a bandwidth of 9 kHz or for "quasi-peak" within a bandwidth of 9 kHz.

The line-conducted emission test is conducted inside a shielded anechoic chamber room with 1 m x 1.5 m x 0.8 m wooden table which is placed 0.4 m away from the vertical wall and 1.5 m away from the side wall of the chamber room. Two LISN are bonded to the shielded room. The EUT is powered from the LISN and the support equipment is powered from the other LISN. Power to the LISNs are filtered by a noise cut power line filters. All electrical cables are shielded by braided tinned steel tubing with inner  $\phi$  1.2 cm. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and these supply lines will be connected to the LISN. Non-inductive bundling to a 1 m length shortened all interconnecting cables more than 1 m. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the EMI Test Receiver to determine the frequency producing the maximum emission from the EUT. The frequency producing the maximum level was reexamined using to set Quasi-Peak mode by manual, after scanned by automatic Peak mode from 0.15 MHz to 30 MHz. The bandwidth of the spectrum analyzer was set to 9 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission.

Photographs of the worst-case emission can be seen in Photographs of the worst-case emission test setup can be seen in Appendix B.

### 3.3 FCC Part 15.205 Restricted Bands of Operations

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
<sup>1</sup> 0.495 - 0.505	16.694 75 - 16.695 25	608 - 614	5.35 - 5.46
2.173 5 - 2.190 5	16.804 25 - 16.804 75	960 - 1 240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1 300 - 1 427	8.025 - 8.5
4.177 25 - 4.177 75	37.5 - 38.25	1 435 - 1 626.5	9.0 - 9.2
4.207 25 - 4.207 75	73 - 74.6	1 645.5 - 1 646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1 660 - 1 710	10.6 - 12.7
6.267 75 - 6.268 25	108 - 121.94	1 718.8 - 1 722.2	13.25 - 13.4
6.311 75 - 6.312 25	123 - 138	2 200 - 2 300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2 310 - 2 390	15.35 - 16.2
8.362 - 8.366	156.524 75 - 156.525 25	2 483.5 - 2 500	17.7 - 21.4
8.376 25 - 8.386 75	156.7 - 156.9	2 690 - 2 900	22.01 - 23.12
8.414 25 - 8.414 75	162.012 5 - 167.17	3 260 - 3 267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3 332 - 3 339	31.2 - 31.8
12.519 75 - 12.520 25	240 - 285	3 345.8 - 3 358	36.43 - 36.5
12.576 75 - 12.577 25	322 - 335.4	3 600 - 4 400	( <sup>2</sup> )
13.36 - 13.41			

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490 MHz - 0.510 MHz.

<sup>2</sup> Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1 000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1 000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

## 4. TEST CONDITION

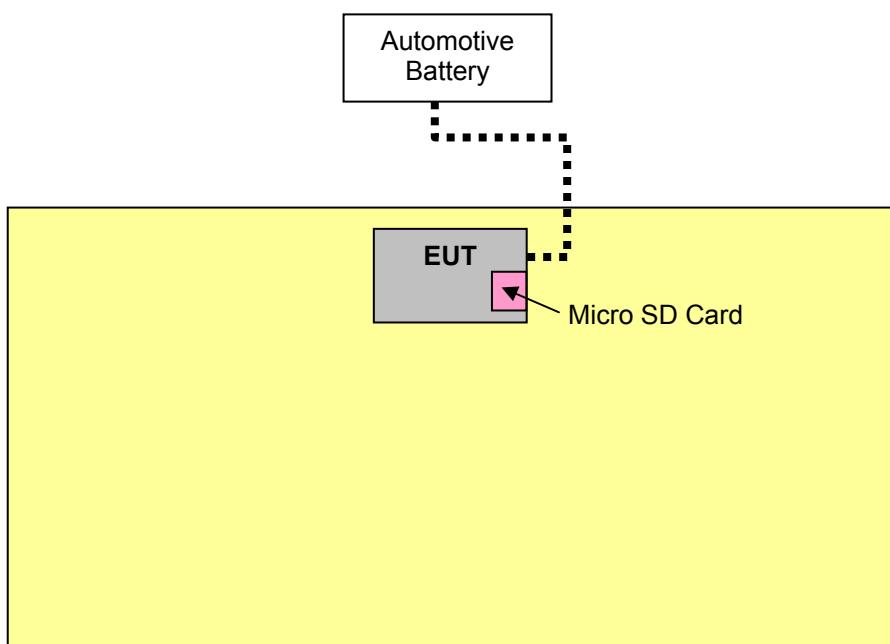
### 4.1 Test Configuration

The device was configured for testing in a typical fashion (as a customer would normally use it). During the tests, the following conditions and configurations were used.

### 4.2 Description of Test modes

DRIVING RECORDER that has the control software.

### 4.3 The setup drawing(s)



- : Signal line
- : AC Power line
- : DC Power line (Cigar Jack)
- : Adapter

## 5. TEST RESULTS

### 5.1 Summary of Test Results

The measurement results were obtained with the EUT tested in the conditions described in this report. Detailed measurement data and plots showing the maximum emission of the EUT are reported.

47 CFR Part 15, Subpart C	Measurement Required	Result
15.247(a)(2)	6 dB Bandwidth	Pass
15.247(b)(3)	Maximum Peak Output Power	Pass
15.247(d)	Bandwidth of Frequency Band Edges	Pass
15.247(e)	Power Spectral Density	Pass
15.209(a)	Spurious Emissions	Pass
15.207	Conducted Emissions	N/A *
1.1307(b)(1)	RF Exposure	Pass

\* This test was not applied. Because, EUT power supplies from an automotive battery.  
(DC 12 V – DC 24 V)

The data collected shows that the **EDI Inc. / DRIVING RECORDER / EB-105** complied with technical requirements of above rules part 15.207, 209 and 15.247 Limits.

The equipment is not modified anything, mechanical or circuits to improve EMI status during a measurement. No EMI suppression device(s) was added and/or modified during testing.

## 5.2 6 dB Bandwidth

EUT	DRIVING RECORDER / EB-105
Limit apply to	FCC Part 15.247(a)(2)
Test Date	April 15, 2014
Environmental of Test	21.2 °C, 43 % R.H., 101.2 kPa
Operating Condition	RF transmitting continuously during the tested.
Result	Passed

### Limit

The maximum 6 dB bandwidth shall be at least 500 kHz.

### Test Data

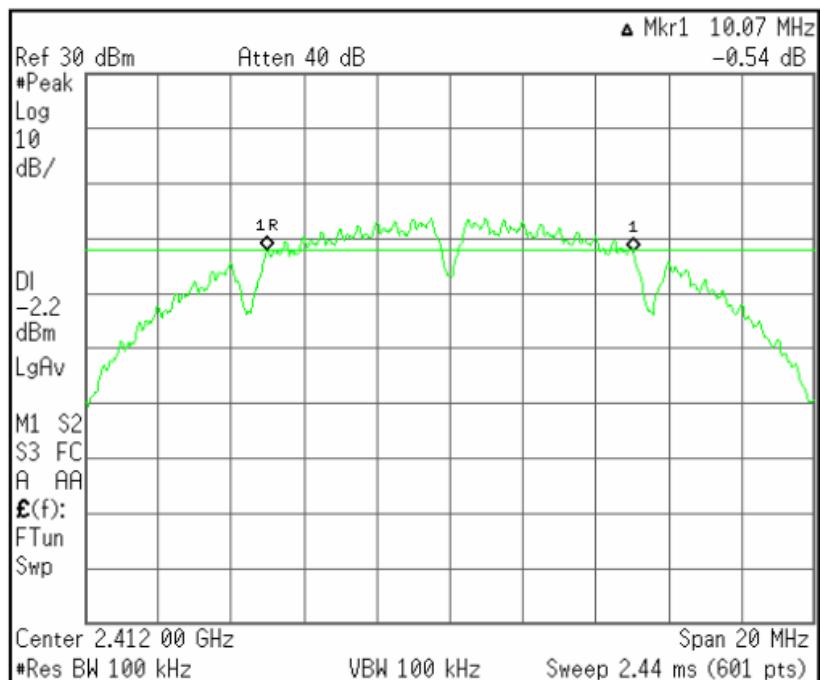
Mode	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit
802.11b	2 412	10.07	> 500 kHz
	2 442	10.10	
	2 472	10.10	

### NOTES:

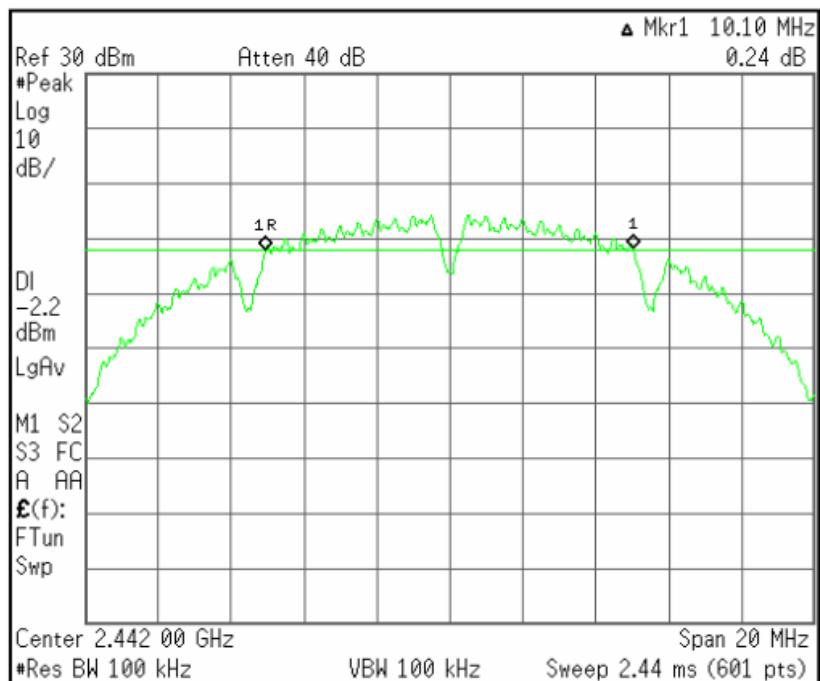
1. This test was applied both to DC 12 V and DC 24 V. (Worst case: DC 24 V)
2. Measure frequency separation of relevant channel using spectrum analyzer.
3. RBW 300 kHz, VBW 1 MHz, Sweep time Auto.
4. Please see the measured plot in next page.

## Plots of 6 dB Bandwidth

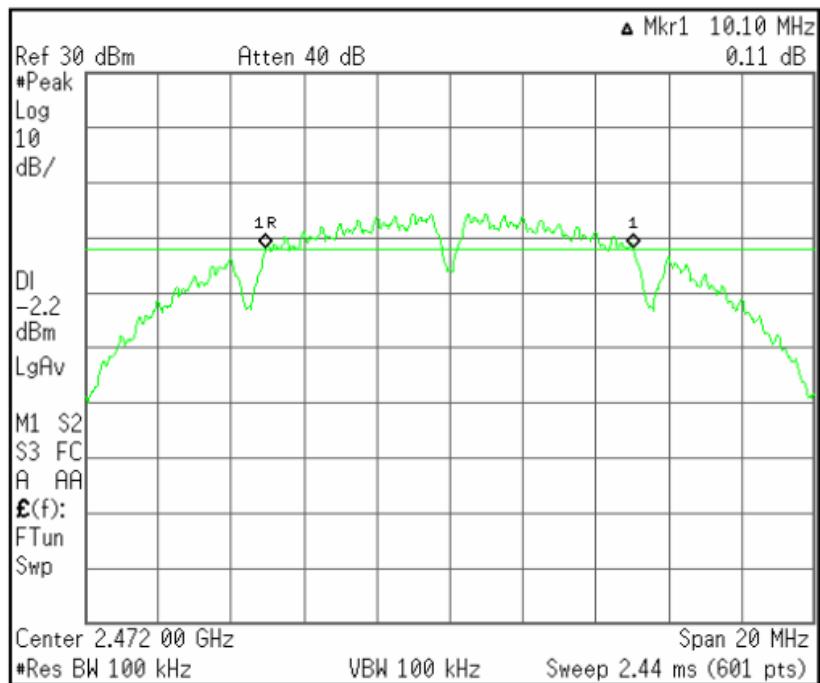
[2 412 MHz]



[2 442 MHz]



[2 472 MHz]



## 5.3 Maximum Peak Conducted Output Power

EUT	DRIVING RECORDER / EB-105
Limit apply to	FCC Part 15.247(b)(3)
Test Date	April 15, 2014
Environmental of Test	20.9 °C, 45 % R.H., 101.2 kPa
Operating Condition	RF transmitting continuously during the tested.
Result	Passed

### Limit

The maximum peak conducted output power of the intentional radiator shall not exceed the following:

For frequency hopping systems operating in the 2 400.0 MHz - 2 483.5 MHz band: 1 Watt

### Test Data

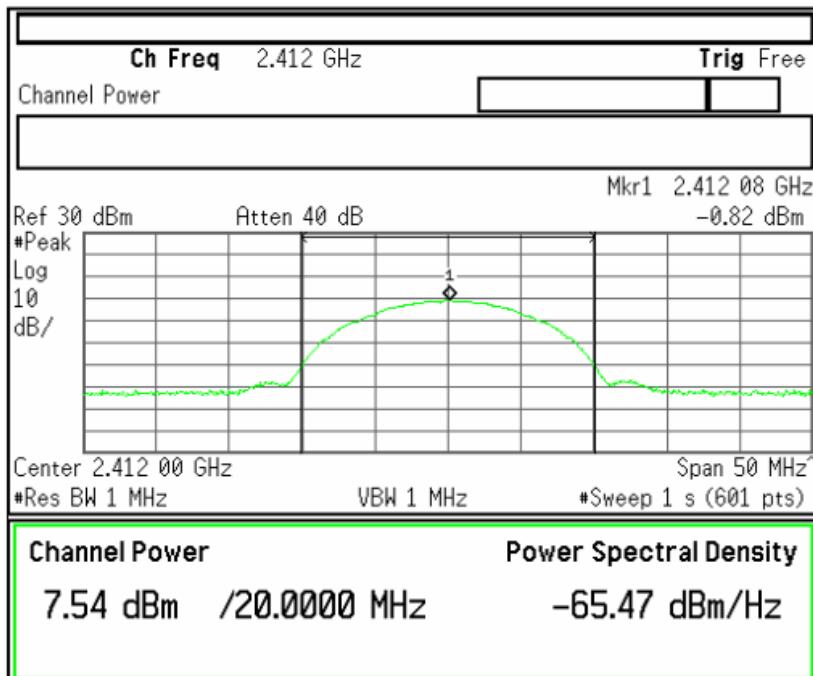
Mode	Frequency [MHz]	Output Power [dBm]	Limit
802.11b	2 412	7.54	< 30.00 dBm (1 W)
	2 442	8.84	
	2 472	9.05	

### NOTES:

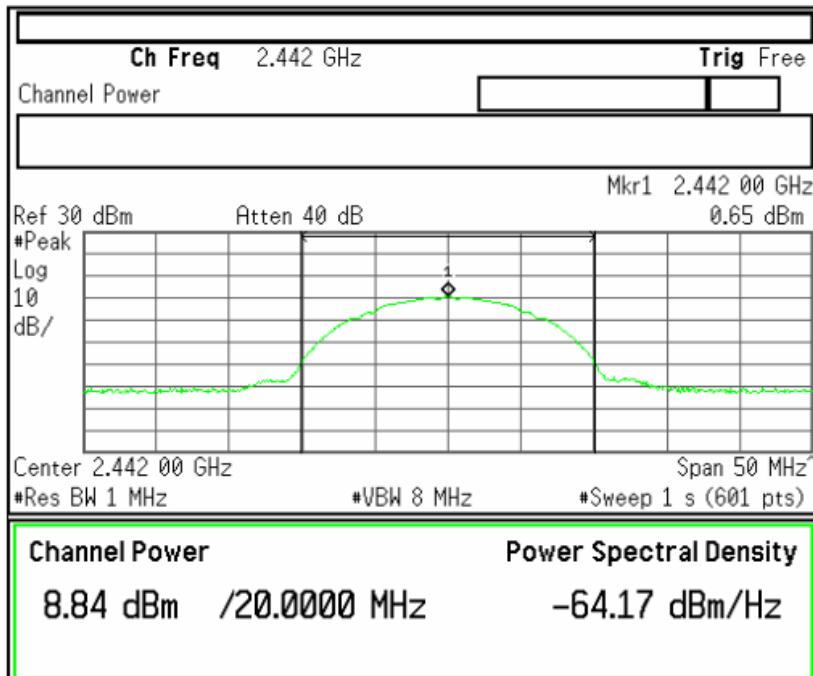
1. This test was applied both to DC 12 V and DC 24 V. (Worst case: DC 24 V)
2. Measure conducted Channel power of relevant channel using spectrum analyzer.
3. RBW 1 MHz, VBW 8 MHz
4. Please see the measured plot in next page.

## Plots of Maximum Peak Output Power Bandwidth

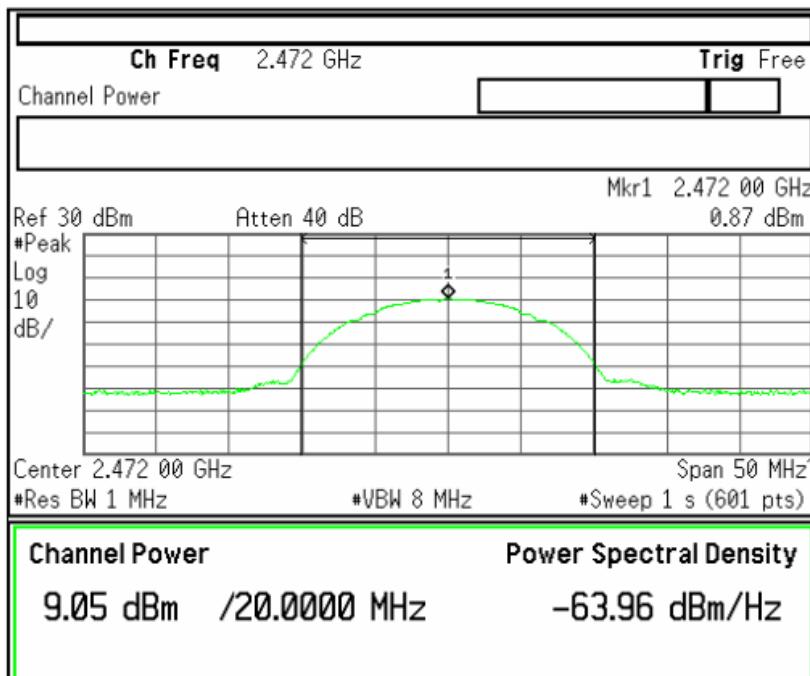
[2 412 MHz]



[2 442 MHz]



[2 472 MHz]



## 5.4 Bandwidth of Frequency Band Edges

EUT	DRIVING RECORDER / EB-105
Limit apply to	FCC Part 15.247(d)
Test Date	April 16, 2014
Environmental of Test	20.9 °C, 45 % R.H., 101.3 kPa
Operating Condition	RF transmitting continuously during the tested.
Result	Passed

### Limit

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 emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

### Test Results

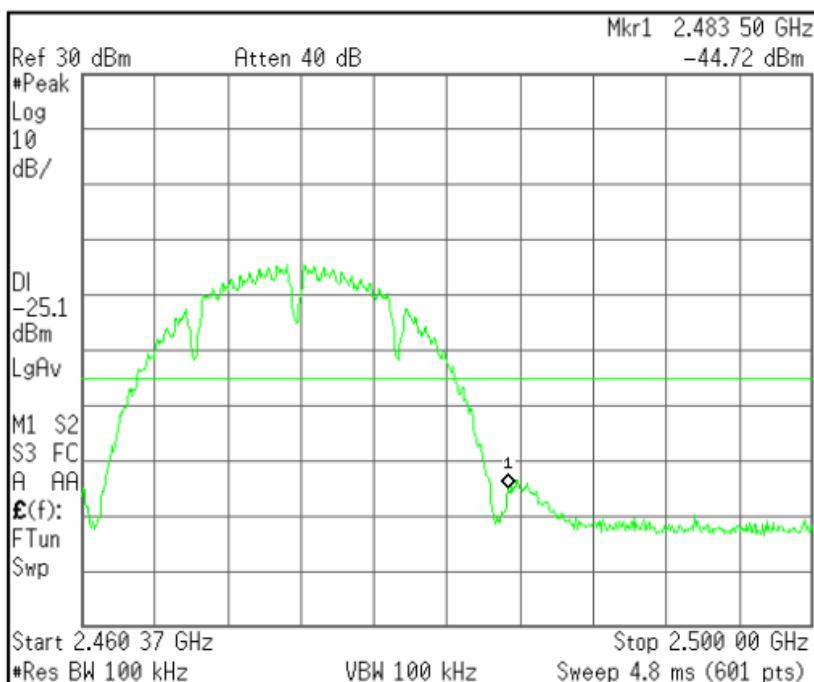
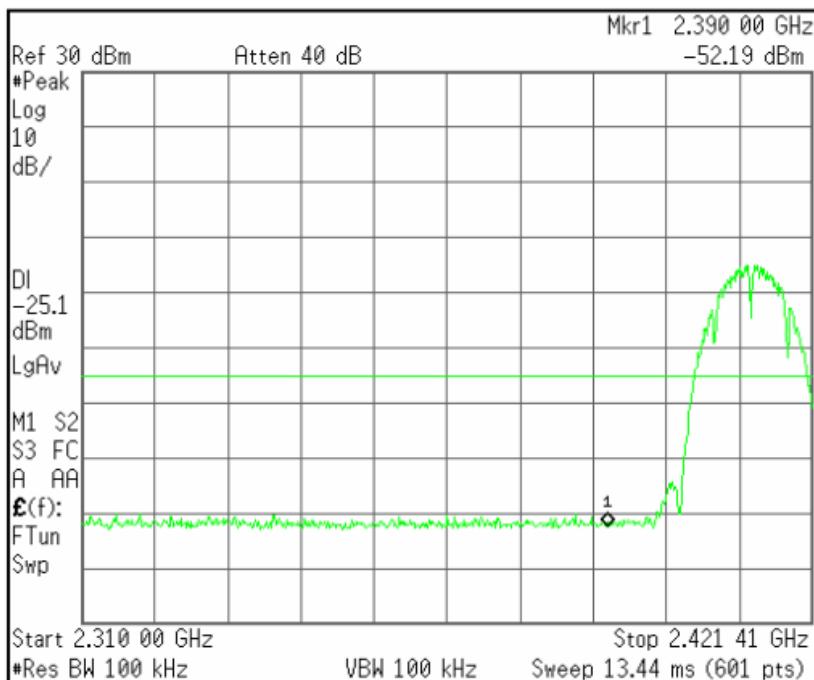
- Refer to see the measured plot in next page.

### NOTES:

1. This test was applied both to DC 12 V and DC 24 V. (Worst case: DC 24 V)
2. The test was performed to make a direct field strength measurement at the band edge frequencies.

## Plots of Bandwidth of Frequency Band Edges

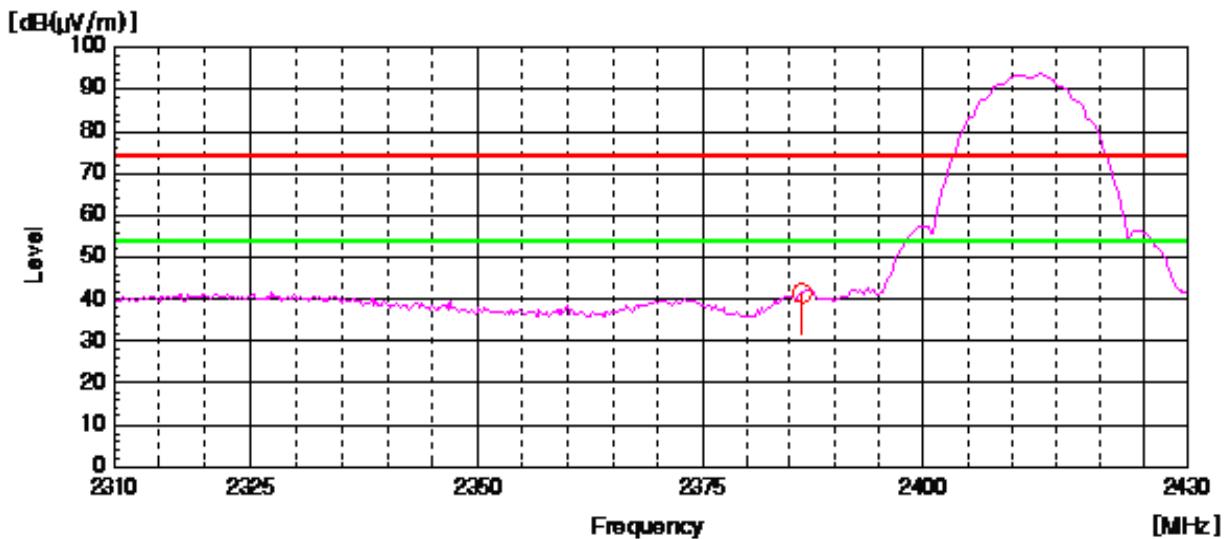
Conducted



## Radiated

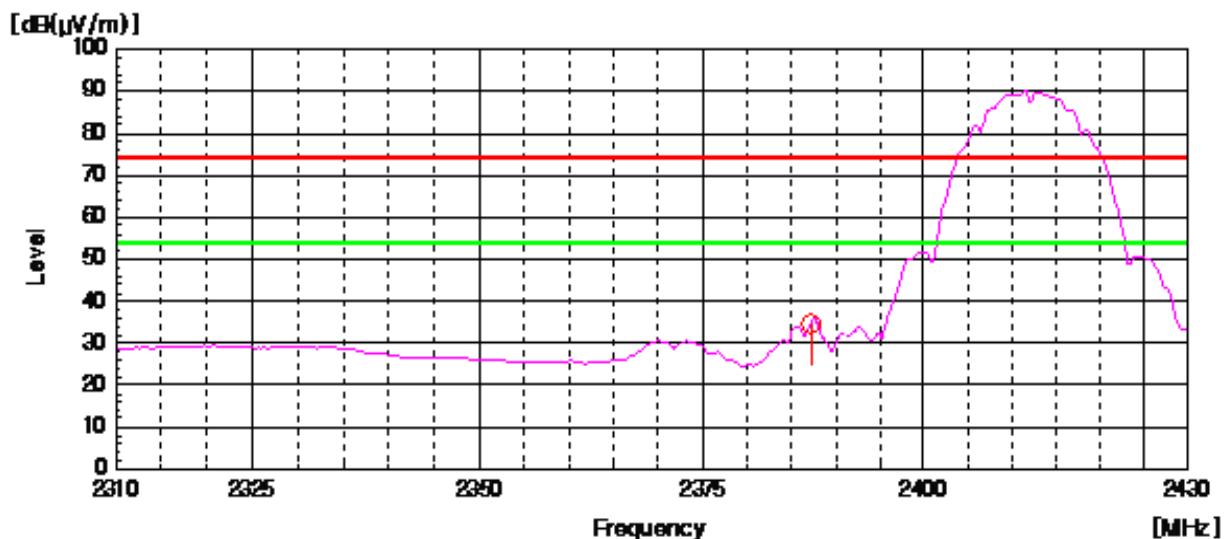
Peak Detector: RBW: 1 MHz, VBW: 1 MHz (2 310 MHz - 2 390 MHz), Worst case (Low, Horizontal)

 Peak Limit Line  
 AV Limit Line



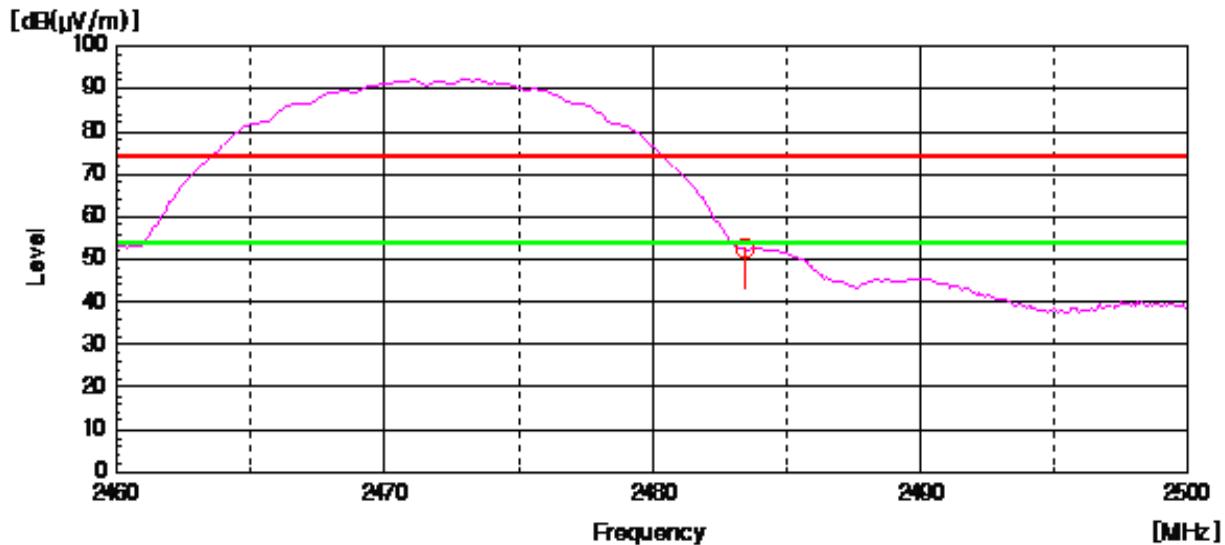
AV Detector: RBW: 1 MHz, VBW: 10 Hz (2 310 MHz - 2 390 MHz), Worst case (Low, Horizontal)

 Peak Limit Line  
 AV Limit Line



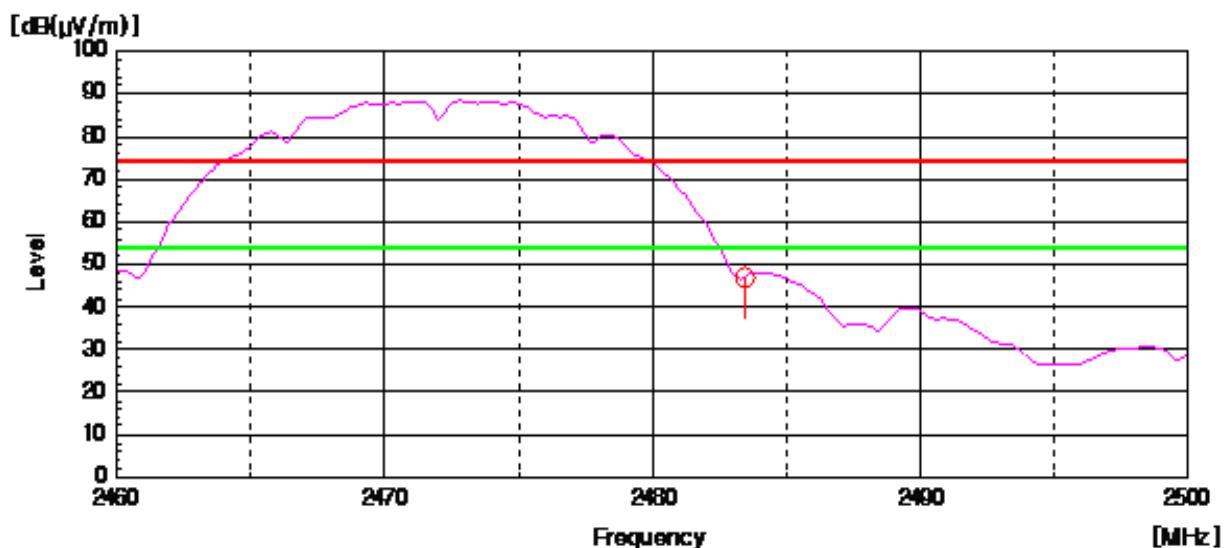
Peak Detector: RBW: 1 MHz, VBW: 1 MHz (2 483.5 MHz - 2 500 MHz), Worst case (High, Horizontal)

 Peak Limit Line  
 AV Limit Line



AV Detector: RBW: 1 MHz, VBW: 10 Hz (2 483.5 MHz - 2 500 MHz), Worst case (High, Horizontal)

 Peak Limit Line  
 AV Limit Line



## 5.5 Power Spectral Density

EUT	DRIVING RECORDER / EB-105
Limit apply to	FCC Part 15.247(e)
Test Date	April 15, 2014
Environmental of Test	21.2 °C, 41 % R.H., 101.1 kPa
Operating Condition	RF transmitting continuously during the tested.
Result	Passed

### Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during 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.

### Test Data

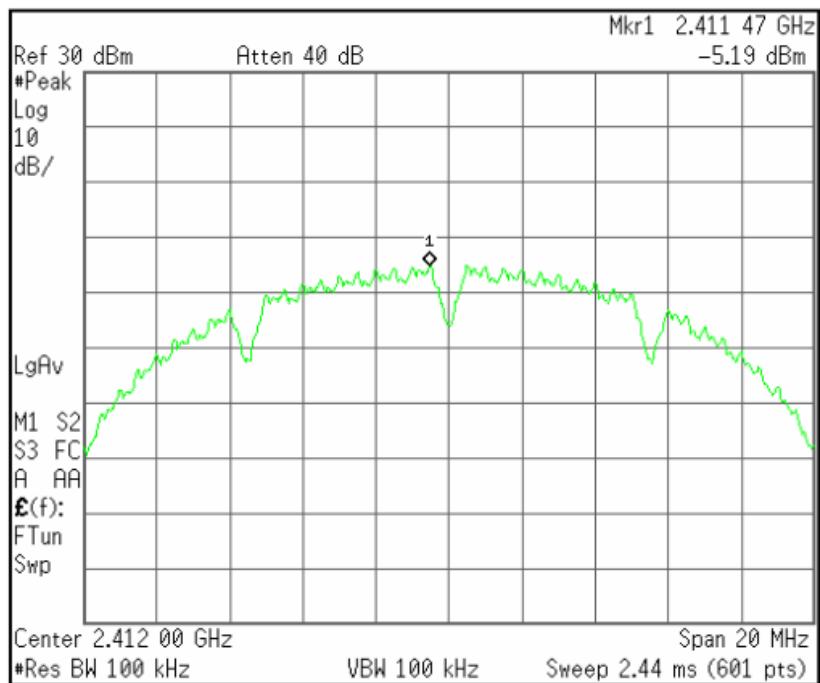
Mode	Frequency [MHz]	PSD [dBm]	Limit
802.11b	2 412	-5.19	8.00 dBm
	2 442	-4.80	
	2 472	-4.60	

### NOTES:

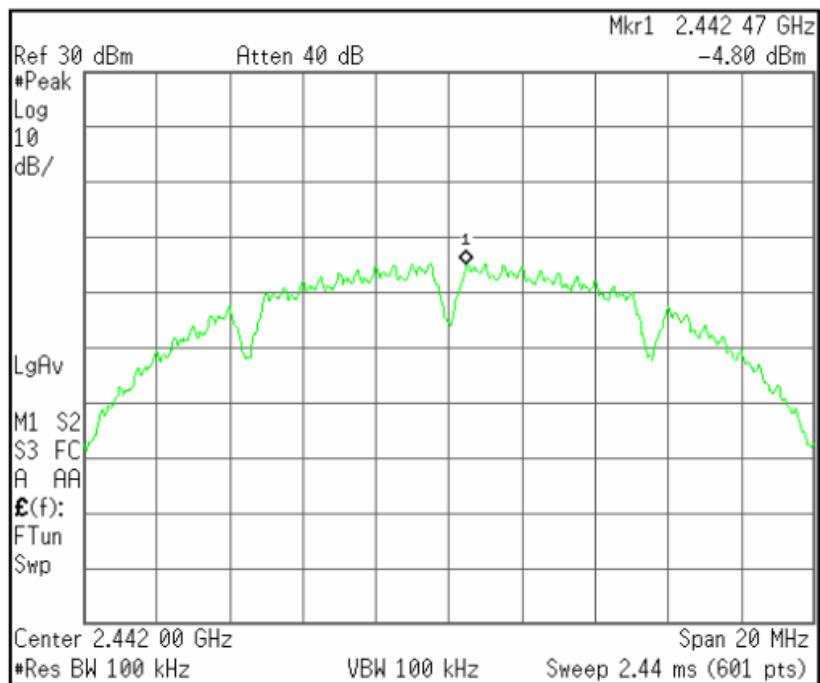
1. This test was applied both to DC 12 V and DC 24 V. (Worst case: DC 24 V)
2. Measure power spectral density of relevant channel using spectrum analyzer.
3. RBW 100 kHz, VBW 300 kHz, span 1 MHz, Sweep time (= span / 3 kHz).
4. Please see the measured plot in next page.

## Plots of Power Spectral Density

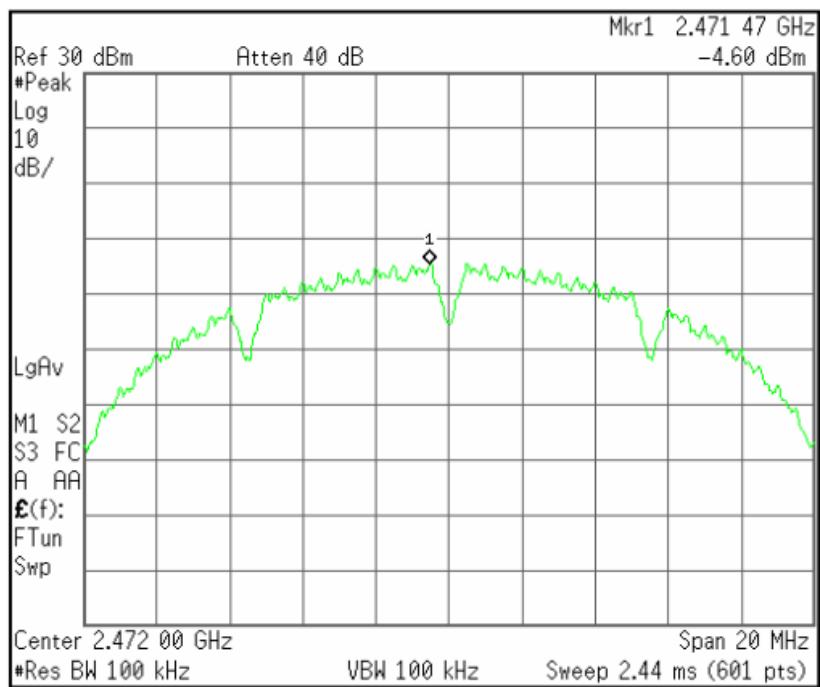
[2 412 MHz]



[2 442 MHz]



[2 472 MHz]



## 5.6 Spurious Emissions

EUT	DRIVING RECORDER / EB-105
Limit apply to	FCC Part 15.209
Test Date	April 17, 2014 to April 18, 2014
Environmental of Test	(20.4 ± 0.9) °C, (52 ± 9) % R.H., (101.0 ± 0.4) kPa
Operating Condition	Low CH, Middle CH, High CH Transmission
Result	Passed

### Limit

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:

Frequencies [MHz]	Field Strength [µV/m]	Measurement Distance [m]
0.009 - 0.490	2 400/F(kHz)	300
0.490 - 1.705	24 000/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

\* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 MHz - 72 MHz, 76 MHz - 88 MHz, 174 MHz - 216 MHz or 470 MHz - 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

### Test Results

- Refer to see the measured plot in next page.

## Radiated Emissions Test data

### - 9 kHz to 30 MHz

Test Date	April 18, 2014
Environmental of Test	19.5 °C, 60 % R.H., 100.7 kPa

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical. Detector mode: CISPR Quasi-Peak mode (100 Hz, 9 kHz)

Frequency [MHz]	Reading [dB(µV)]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Result [dB(µV/m)]	Limit [dB(µV/m)]	Margin [dB]
<b>Emission attenuated more than 20 dB below the limit are not reported.</b>							

**Result: All emissions below noise floor of 20 dB(µV/m).**

#### NOTES:

1. This test was applied both to DC 12 V and DC 24 V.
2. \* H : Horizontal polarization , \*\* V : Vertical polarization
3. Result = Reading + Antenna factor + Cable loss
4. Margin = Limit - Result
5. The measurement was performed for the frequency range 9 kHz to 30 MHz according to FCC Part 15.209.

## - Below 1 GHz (30 MHz to 1 GHz)

Test Date	April 18, 2014
Environmental of Test	20.2 °C, 58 % R.H., 100.6 kPa

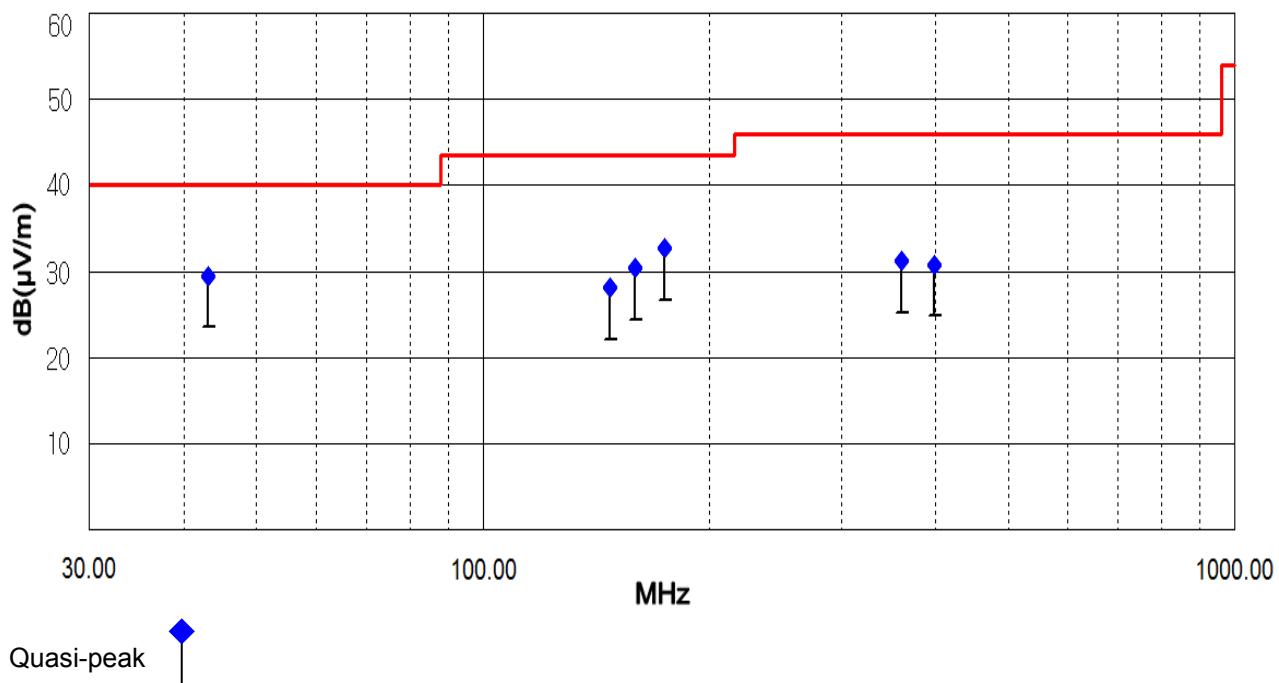
The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical. Detector mode: CISPR Quasi-Peak mode (6 dB Bandwidth: 120 kHz)

Frequency [MHz]	Reading [dB(µV)]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB(µV)]	Height [cm]	Result [dB(µV/m)]	Limit [dB(µV/m)]	Margin [dB]
43.09	17.00	V	11.45	1.05	100	29.50	40.00	10.50
147.80	13.96	V	12.55	1.59	105	28.10	43.50	15.40
159.26	16.33	V	12.43	1.64	110	30.40	43.50	13.10
174.53	19.45	H	11.53	1.72	355	32.70	43.50	10.80
360.80	14.17	H	14.63	2.40	310	31.20	46.00	14.80
398.98	12.68	H	15.58	2.54	280	30.80	46.00	15.20

### NOTES:

1. This test was applied both to DC 12 V and DC 24 V. (Worst case: DC 24 V)
2. \* H : Horizontal polarization , \*\* V : Vertical polarization
3. Result = Reading + Antenna factor + Cable loss
4. Margin value = Limit - Result
5. The measurement was performed for the frequency range above 30 MHz according to FCC Part 15.209.

— : Limit



## - Above 1 GHz (1 GHz to 25 GHz)

Test Date	April 17, 2014									
Environmental of Test	21.3 °C, 45 % R.H., 101.4 kPa									

### 1. Low CH

Frequency [MHz]	Reading [dB(µV)]		Polarity (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Result [dB(µV/m)]		Limit [dB(µV/m)]		Margin [dB]	
	Peak	Average				Peak	Average	Peak	Average	Peak	Average
1 864.56	69.76	58.16	H	25.98	-37.44	58.30	46.70	73.97	53.97	15.67	7.27

### 2. Middle CH

Frequency [MHz]	Reading [dB(µV)]		Polarity (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Result [dB(µV/m)]		Limit [dB(µV/m)]		Margin [dB]	
	Peak	Average				Peak	Average	Peak	Average	Peak	Average
1 880.34	68.50	57.20	H	26.01	-37.41	57.10	45.80	73.97	53.97	16.87	8.17

### 3. High CH

Frequency [MHz]	Reading [dB(µV)]		Polarity (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Result [dB(µV/m)]		Limit [dB(µV/m)]		Margin [dB]	
	Peak	Average				Peak	Average	Peak	Average	Peak	Average
1 903.44	68.81	58.71	H	26.06	-37.37	57.50	47.40	73.97	53.97	16.47	6.57

**Result: No signal detect above second harmonic.**

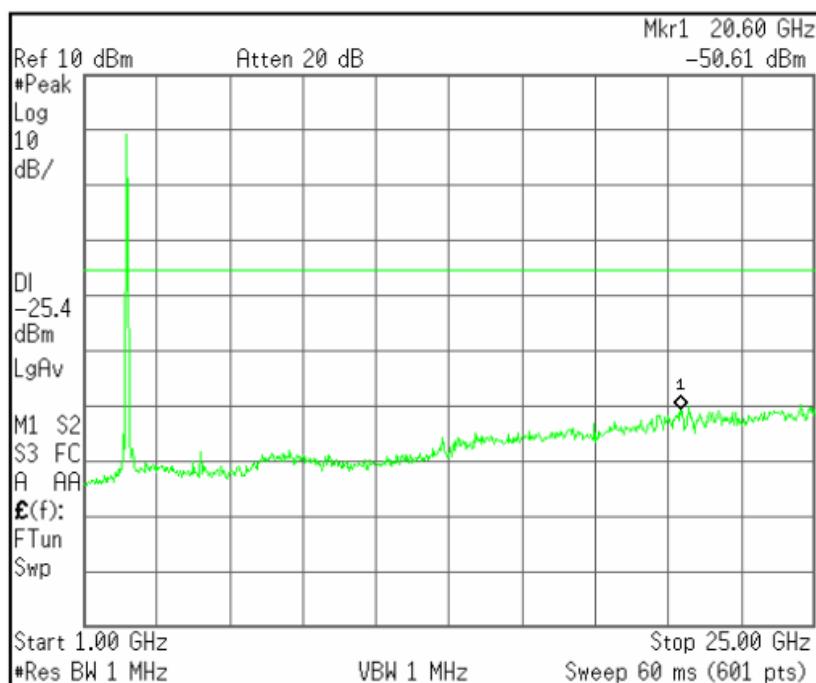
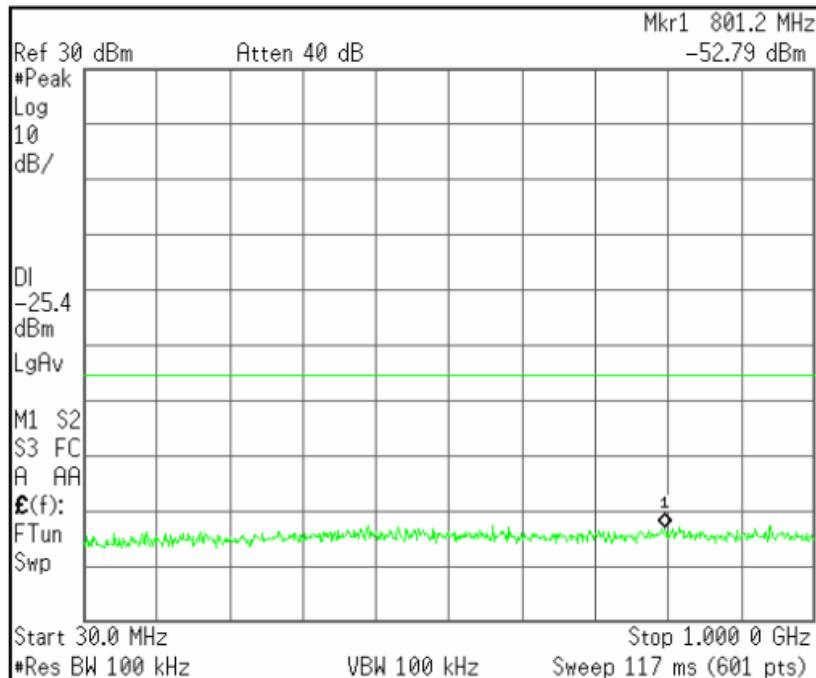
#### NOTES:

1. This test was applied both to DC 12 V and DC 24 V. (Worst case: DC 24 V)
2. \* H : Horizontal polarization , \*\* V : Vertical polarization
3. Factor = Antenna factor + Cable loss + Preamp
4. Result = Reading + Factor
5. Margin = Limit - Result
6. Measuring frequencies from 1GHz to the 10<sup>th</sup> harmonic of highest fundamental frequency.
7. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded(ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
8. Spectrum setting:
  - a. Peak Setting 1 GHz to 10<sup>th</sup> harmonics of fundamental, RBW = 1 MHz, VBW = 1 MHz, Sweep = Auto
  - b. AV Setting 1 GHz to 10<sup>th</sup> harmonics of fundamental, RBW = 1 MHz, VBW = 10 Hz, Sweep = Auto

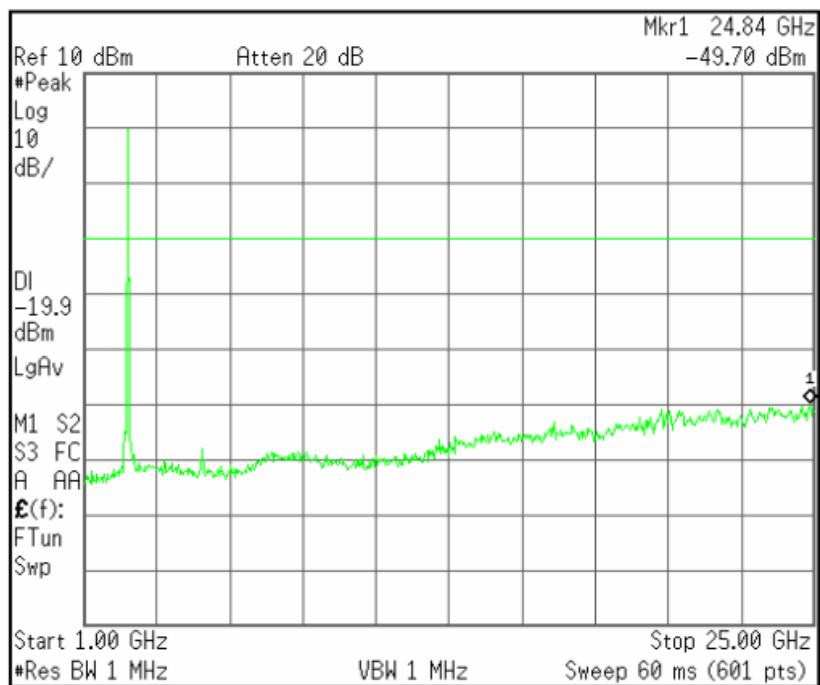
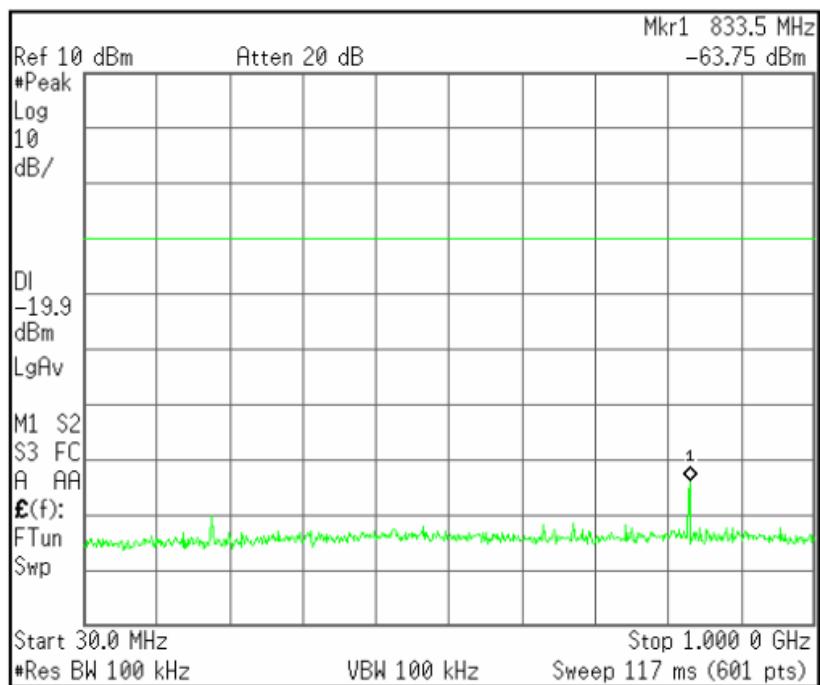
## Plots of Spurious Emissions (Conducted Measurement)

Test Date	April 17, 2014
Environmental of Test	21.1 °C, 43 % R.H., 101.3 kPa

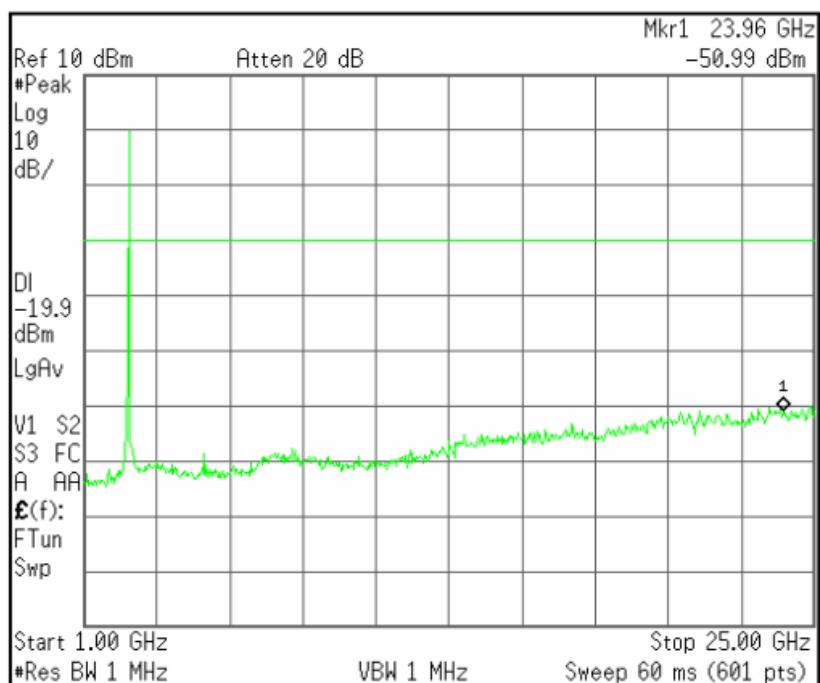
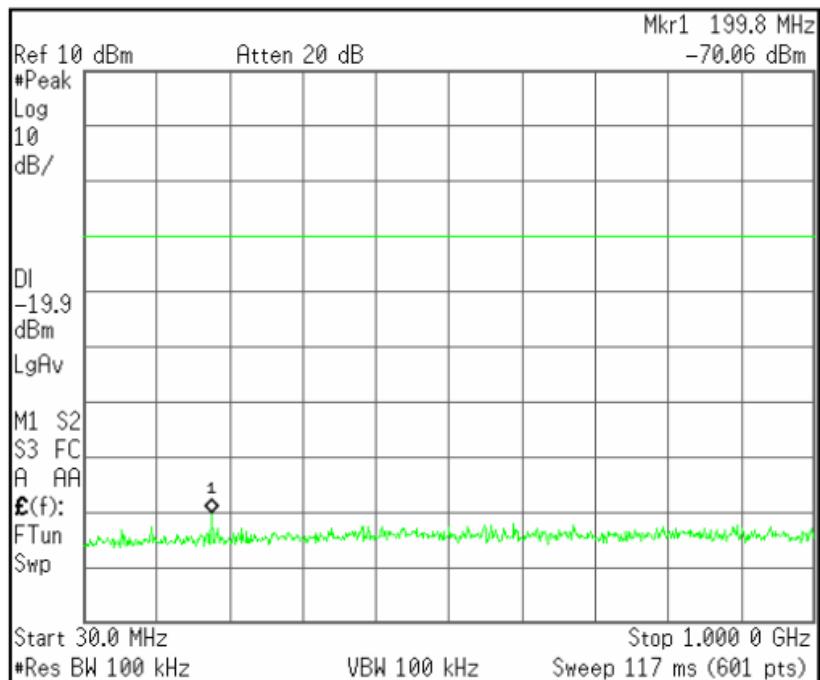
[CH Low]



[CH Mid]



[CH High]



## 5.7 Radio Frequency Exposure

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 of the Commission's guidelines. See § 1.1307(b)(1) of this Chapter.

### Limit

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 <sup>2</sup> ]	Averaging Time  E  <sup>2</sup> ,  H  <sup>2</sup> or S [minutes]
0.3 - 1.34	614	1.63	(100)	30
1.34 - 30	824/f	2.19/f	(180/f <sup>2</sup> )	30
30 - 300	27.5	0.073	0.2	30
300 - 1 500	--	--	f/1 500	30
<b>1 500 - 100 000</b>	--	--	<b>1.0</b>	30

f = frequency in MHz

\*Plane-wave equivalent power density

### MPE Prediction

Predication of MPE limit at a given distance.

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density (in appropriate units, e.g. mW/cm<sup>2</sup>)

P = power input to the antenna (in appropriate units, e.g., mW)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

Maximum peak output power at antenna input	:	9.05 dBm (8.03 mW)
Prediction distance	:	20 cm
Predication frequency	:	2 472 MHz
Antenna gain(Max)	:	3.50 dBi (2.24 numeric)
Power density at predication frequency at 20 cm	:	0.003579 mW/cm <sup>2</sup>
	:	
MPE Limit for	:	1 mW/cm <sup>2</sup>

### Test Result

The power density level at 20 cm is 0.003579 mW/cm<sup>2</sup> which is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2 412 MHz to 2 472 MHz.

## 6. SAMPLE CALCULATION

### Sample Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor.  
The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - PA$$

Where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

PA\* = Preamplifier Factor

\* PA is only be used for the measuring frequency above 1 GHz.

$$dB(\mu V) = 20 \log_{10} (\mu V) : \text{Equation}$$

$$dB(\mu V) = dBm + 107$$

Example : @ 1 903.44 MHz

$$\text{Class B Limit} = 53.97 \text{ dB}(\mu V/m) \text{ (Average)}$$

$$\text{Reading} = 58.71 \text{ dB}(\mu V)$$

$$\text{Antenna Factor} + (\text{Cable loss} + \text{Amp. Gain}) = 26.06 + (-37.37) = -11.31 \text{ dB}(\mu V/m)$$

$$\text{Total} = 47.40 \text{ dB}(\mu V/m)$$

$$\text{Margin} = 53.97 - 47.40 = 6.57 \text{ dB}$$

$$= 6.57 \text{ dB below Limit}$$

## 7. List of test equipments used for measurements

Test Equipment		Model	Mfg.	Serial No.	Cal. Date	Cal. Due Date
<input checked="" type="checkbox"/>	EMI Test Receiver	ESVS 10	R&S	835165/001	14.03.18	15.03.18
<input checked="" type="checkbox"/>	EMI Test Receiver	ESCI7	R&S	100851	13.09.05	14.09.05
<input checked="" type="checkbox"/>	Loop Antenna	6502	EMCO	00033743	12.09.24	14.09.24
<input checked="" type="checkbox"/>	LogBicon Antenna	VULB9160	Schwarzbeck	3082	13.07.25	15.07.25
<input checked="" type="checkbox"/>	Horn Antenna	BBHA 9120D	Schwarzbeck	277	12.05.10	14.05.10
<input checked="" type="checkbox"/>	Spectrum Analyzer	E7405A	H.P.	US41160290	13.09.05	14.09.05
<input checked="" type="checkbox"/>	PSA Series Spectrum Analyzer	E4440A	Agilent	US40420382	13.09.11	14.09.11
<input checked="" type="checkbox"/>	Amplifier	TK-PA18	TESTEK	120020	13.09.05	14.09.05
<input checked="" type="checkbox"/>	System Power Supply	6030A	Agilent	1036546	14.03.17	15.03.17
<input checked="" type="checkbox"/>	Band Reject Filter	WRCGV 2402/2480-2382/2500-52/10SS	Wainwright Instrument	2	13.09.05	14.09.05
<input checked="" type="checkbox"/>	Highpass Filter	WKKX3.0 /18G-6SS	Wainwright Instrument	15	14.03.18	15.03.18
<input checked="" type="checkbox"/>	Power Meter	NRVS	R&S	834053/060	13.09.05	14.09.05
<input checked="" type="checkbox"/>	Turn-Table	DS1200-S	Innco Systems GmbH	2740311	N/A	N/A
<input checked="" type="checkbox"/>	Turn-Table	TT 1.35 SI	SES	-	N/A	N/A
<input checked="" type="checkbox"/>	Antenna Master	AM 4.5	SES	-	N/A	N/A