

APPLICATION CERTIFICATION

On Behalf of  
Orion Energy Systems Ltd.

Radio Frequency (RF) Transmitter  
Model No.: WTRA-4C

FCC ID: UTVWTRA4CTX

Prepared for : Orion Energy Systems Ltd.  
Address : 1204 Pilgrim Road, Plymouth, WI 53073, USA

Prepared by : ACCURATE TECHNOLOGY CO. LTD  
Address : F1, Bldg. A, Changyuan New Material Port, Keyuan Rd.  
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Report Number : ATE20062808  
Date of Test : January 19, 2007  
Date of Report : January 22, 2007

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## Test Report Certification

Applicant : Orion Energy Systems Ltd.  
 Manufacturer : Foshan Tuodi Electronics Co., Ltd.  
 EUT Description : Radio Frequency (RF) Transmitter  
                           (A) MODEL NO.: WTRA-4C  
                           (B) SERIAL NO.: N/A  
                           (C) POWER SUPPLY: AC120V/60Hz

Measurement Procedure Used:

FCC Rules and Regulations Part 15 Subpart C Section 15.231, Section 15.207: 2006

The device described above is tested by ACCURATE TECHNOLOGY CO. LTD to determine the maximum emission levels emanating from the device. The maximum emission levels are compared to the FCC Part 15 Subpart C Section 15.231, RSS-210 Issue 6 September 2005 limits. The measurement results are contained in this test report and ACCURATE TECHNOLOGY CO. LTD is assumed full responsibility for the accuracy and completeness of these measurements. Also, this report shows that the Equipment Under Test (EUT) is to be technically compliant with the FCC requirements.

This report applies to above tested sample only. This report shall not be reproduced in part without written approval of ACCURATE TECHNOLOGY CO. LTD.

Date of Test : January 19, 2007

Prepared by :   
 (Engineer)

Reviewer :   
 (Quality Manager)

Approved & Authorized Signer :   
 (Manager)

# 1. GENERAL INFORMATION

## 1.1. Description of Device (EUT)

EUT : Radio Frequency (RF) Transmitter  
 Model Number : WTRA-4C  
 Power Supply : AC 120V/60Hz  
 Applicant : Orion Energy Systems Ltd.  
 Address : 1204 Pilgrim Road, Plymouth, WI 53073, USA  
 Manufacturer : Foshan Tuodi Electronics Co., Ltd.  
 Address : Fuwan Industrial Zone, Gaoming, Foshan, Guangdong  
 China 528531  
 Date of sample received : January 17, 2007  
 Date of Test : January 19, 2007

## 1.2. Description of Test Facility

EMC Lab : Accredited by TUV Rheinland Shenzhen, May 10, 2004  
 Accredited by FCC, May 10, 2004  
 The Certificate Registration Number is 253065  
 Accredited by Industry Canada, May 18, 2004  
 The Certificate Registration Number is IC 5077  
 Name of Firm : ACCURATE TECHNOLOGY CO. LTD  
 Site Location : F1, Bldg. A, Changyuan New Material Port, Keyuan Rd.  
 Science & Industry Park, Nanshan, Shenzhen, Guangdong  
 P.R. China

## 1.3. Measurement Uncertainty

Conducted emission expanded uncertainty = 2.23dB, k=2  
 Radiated emission expanded uncertainty = 4.12dB, k=2

## 2. MEASURING DEVICE AND TEST EQUIPMENT

**Table 1: List of Test and Measurement Equipment**

Kind of equipment	Manufacturer	Type	S/N	Calibrated until
EMI Test Receiver	Rohde&Schwarz	ESCS30	100307	03.31.2007
EMI Test Receiver	Rohde&Schwarz	ESI26	838786/013	01.24.2008
Bilog Antenna	Schwarzbeck	VULB9163	9163-194	03.31.2007
Bilog Antenna	Chase	CBL6112B	2591	01.24.2008
Horn Antenna	Rohde&Schwarz	HF906	100013	01.24.2008
Spectrum Analyzer	Anritsu	MS2651B	6200238856	03.31.2007
Pre-Amplifier	Agilent	8447D	2944A10619	03.31.2007
L.I.S.N.	Rohde&Schwarz	ESH3-Z5	100305	03.31.2007
L.I.S.N.	Rohde&Schwarz	ESH3-Z5	100310	03.31.2007

### 3. CONDUCTED EMISSION FOR FCC PART 15 SECTION 15.207(A)

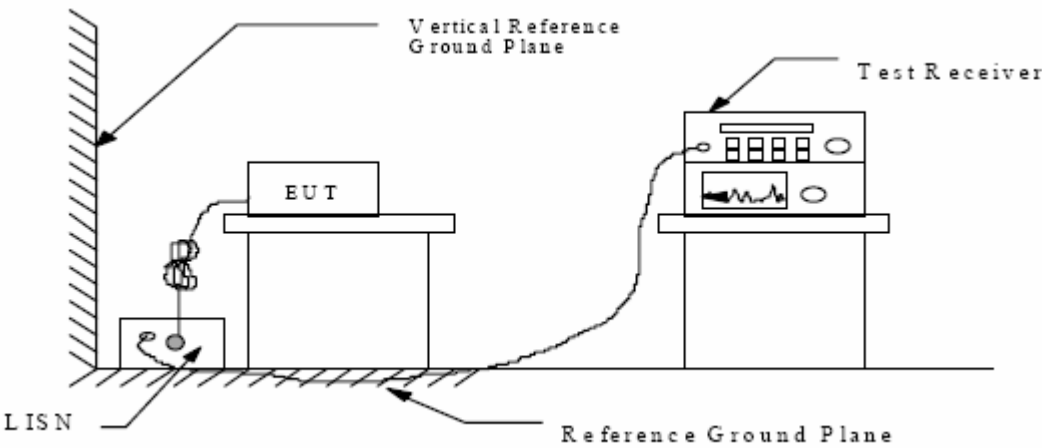
#### 3.1. Block Diagram of Test Setup

##### 3.1.1. Block diagram of connection between the EUT and simulators



(EUT: Radio Frequency (RF) Transmitter)

##### 3.1.2. Shielding Room Test Setup Diagram



(EUT: Radio Frequency (RF) Transmitter)

#### 3.2. The Emission Limit For Section 15.207(a)

##### 3.2.1 Radiation Emission Measurement Limits According to Section 15.207(a)

Frequency (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 - 5	56	46
5 - 30	60	50

\* Decreases with the logarithm of the frequency.

### 3.3.EUT Configuration on Measurement

The following equipment are installed on the emission Measurement to meet the commission requirements and operating regulations in a manner which tends to maximize its emission characteristics in normal application.

#### 3.3.1. Radio Frequency (RF) Transmitter (EUT)

Model Number : WTRA-4C  
Serial Number : N/A  
Manufacturer : Foshan Tuodi Electronics Co., Ltd.

### 3.4.Operating Condition of EUT

3.4.1.Setup the EUT and simulator as shown as Section 3.1.

3.4.2.Turn on the power of all equipment.

3.4.3. Let the EUT work in measuring modes (TX) measure it.

### 3.5.Test Procedure

The EUT is put on the plane 0.8m high above the ground by insulating support and is connected to the power mains through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm coupling impedance for the EUT system. Please refer the block diagram of the test setup and photographs. Both sides of AC lines are checked to find out the maximum conducted emission. In order to find the maximum emission levels, the relative positions of equipment and all of the interface cables shall be changed according to ANSI C63.4: 2003 on Conducted Emission Measurement.

The bandwidth of test receiver (R & S ESCS30) is set at 9kHz.

The frequency range from 150kHz to 30MHz is checked.

All the scanning waveforms are attached in Appendix I.

### 3.6.Power Line Conducted Emission Measurement Results

**PASS.**

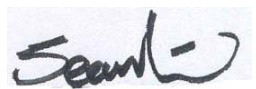
The frequency range from 150kHz to 30MHz is checked.

Date of Test:	<u>January 19, 2007</u>	Temperature:	<u>25°C</u>
EUT:	<u>Radio Frequency (RF) Transmitter</u>	Humidity:	<u>55%</u>
Model No.:	<u>WTRA-4C</u>	Power Supply:	<u>AC120V/60Hz</u>
Test Mode:	<u>TX</u>	Test Engineer:	<u>Andy</u>

Test Line	Frequency MHz	Emission Level(dBμV)		Limits(dBμV)		Margin(dBμV)	
		QP	AV	QP	AV	QP	AV
Va	-	-	-	-	-	-	-
Vb	-	-	-	-	-	-	-

The Remark “- “ means that the emission level is too low to be measured.

Spectral diagrams in appendix I display the measurement of un-weighted peak values.

Reviewer : 



## 4. THE FIELD STRENGTH OF RADIATION EMISSION

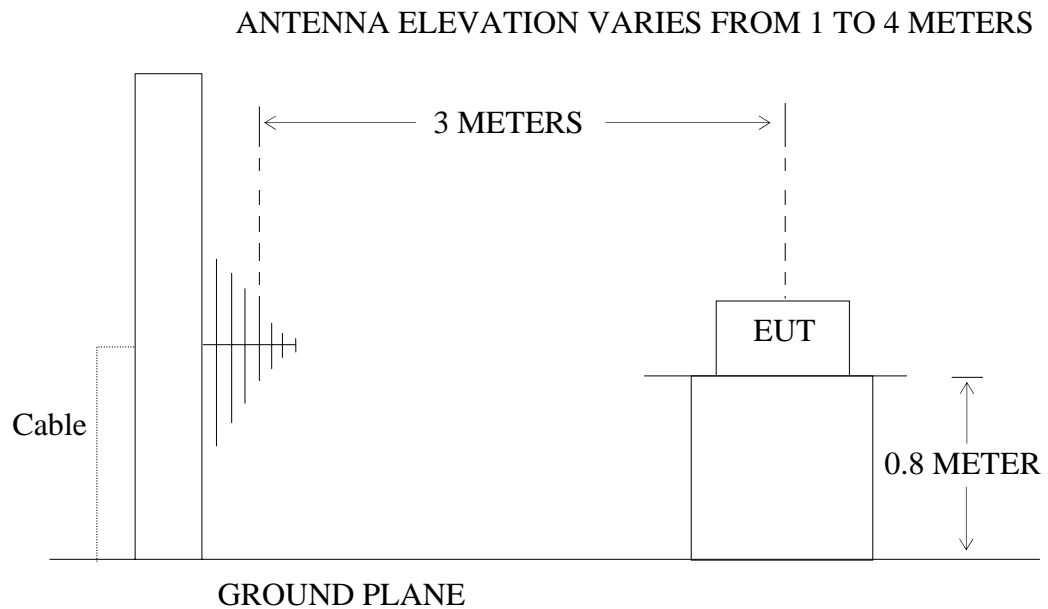
### 4.1. Block Diagram of Test Setup

#### 4.1.1. Block diagram of connection between the EUT and simulators



(EUT: Radio Frequency (RF) Transmitter)

#### 4.1.2. Anechoic Chamber Test Setup Diagram



(EUT: Radio Frequency (RF) Transmitter)

### 4.2. The Field Strength of Radiation Emission Measurement Limits

#### 4.2.1 Radiation Emission Measurement Limits According to FCC Part 15 Section 15.231(b)

Frequency Range of Fundamental [MHz]	Field Strength of Fundamental Emission [Average] [ $\mu\text{V/m}$ ]	Field Strength of Spurious Emission [Average] [ $\mu\text{V/m}$ ]
40.66-40.70	2250	225
70-130	1250	125
130-174	1250-3750	125-375
174-260	3750	375
260-470	3750-12500	375-1250

Above 470	12500	1250
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Where F is the frequency in MHz, The formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130-174MHz,  $\mu\text{V/m}$  at 3 meters= $56.81818(F)-6136.3636$ ; For the band 260-470MHz,  $\mu\text{V/m}$  at 3 meters= $41.6667(F)-7083.3333$ . The maximum permissible unwanted emission level is 20dB below the maximum permitted fundamental level.

#### 4.2.2 Restricted Band Radiation Emission Measurement Limits According to FCC part 15 Section 15.205 and Section15.209.

### 4.3.Configuration of EUT on Measurement

The following equipment are installed on Radiated Emission Measurement to meet the commission requirements and operating regulations in a manner which tends to maximize its emission characteristics in normal application.

#### 4.3.1. Radio Frequency (RF) Transmitter (EUT)

Model Number : WTRA-4C  
 Serial Number : N/A  
 Manufacturer : Foshan Tuodi Electronics Co., Ltd.

### 4.4.Operating Condition of EUT

4.4.1.Setup the EUT and simulator as shown as Section 3.1.

4.4.2.Turn on the power of all equipment.

4.4.3. Let the EUT work in measuring modes (TX) measure it.

### 4.5.Test Procedure

The EUT and its simulators are placed on a turntable, which is 0.8 meter high above ground. The turntable can rotate 360 degrees to determine the position of the maximum emission level. EUT is set 3.0 meters away from the receiving antenna, which is mounted on an antenna tower. The antenna can be moved up and down between 1.0 meter and 4 meters to find out the maximum emission level. Broadband antenna (calibrated bi-log antenna) is used as receiving antenna. Both horizontal and vertical polarizations of the antenna are set on measurement. In order to find the maximum emission levels, all of the EUT location must be manipulated according to ANSI 63.4 on radiated emission measurement.

The bandwidth of test receiver (R&S ESI26) is set at 120KHz in 30-1000MHz, and 1MHz in 1000-4000MHz.

The frequency range from 30MHz to 4000MHz is checked.

#### 4.6. The Field Strength of Radiation Emission Measurement Results

**PASS.**

The frequency range 30MHz to 4000MHz is investigated.

Date of Test:	January 19, 2007	Temperature:	26°C
EUT:	Radio Frequency (RF) Transmitter	Humidity:	57%
Model No.:	WTRA-4C	Power Supply:	AC 120V/60Hz
Test Mode:	TX	Test Engineer:	Andy

Frequency (MHz)	Reading (dBμV/m)	Factor Corr.	Average Factor	Result(dBμV/m)		Limit(dBμV/m)		Margin(dBμV/m)		Polarization
	PEAK	(dB)	(dB)	AV	PEAK	AV	PEAK	AV	PEAK	
315.095	99.4	-18.8	-8.4	72.2	80.6	75.6	95.6	3.4	15.0	Horizontal
630.191	67.2	-13.9	-8.4	44.9	53.3	55.6	75.6	10.7	22.3	
945.285	58.9	-11.6	-8.4	38.9	47.3	55.6	75.6	16.7	28.3	
1260.381	62.7	-7.3	-8.4	47.0	55.4	55.6	75.6	8.6	20.2	
*1575.475	59.4	-6.3	-8.4	44.7	53.1	54	74	9.3	20.9	
1890.571	56.6	-5.3	-8.4	42.9	51.3	55.6	75.6	12.7	24.3	
*2205.665	59.4	-4.3	-8.4	46.7	55.1	54	74	7.3	18.9	
2520.762	52.9	-3.2	-8.4	41.3	49.7	55.6	75.6	14.3	20.0	
*2835.855	37.5	-2.3	-8.4	26.8	35.2	54	74	27.2	38.8	
3150.955	37.7	-1.4	-8.4	27.9	36.3	55.6	75.6	27.7	39.3	
315.095	98.6	-18.8	-8.4	71.4	79.8	75.6	95.6	4.2	15.8	Vertical
630.191	73.7	-13.9	-8.4	51.4	59.8	55.6	75.6	4.2	15.8	
945.285	49.7	-11.6	-8.4	29.7	38.1	55.6	75.6	25.9	37.5	
1260.381	63.6	-7.3	-8.4	47.9	56.3	55.6	75.6	7.7	19.3	
*1575.475	65.4	-6.3	-8.4	50.7	59.1	54	74	3.3	14.9	
1890.571	54.9	-5.3	-8.4	41.2	49.6	55.6	75.6	14.4	26.0	
*2205.665	61.9	-4.3	-8.4	49.2	57.6	54	74	4.8	16.4	
2520.762	59.3	-3.2	-8.4	47.7	56.1	55.6	75.6	7.9	19.5	
*2835.855	43.9	-2.3	-8.4	33.2	41.6	54	74	20.8	32.4	
3150.955	40.6	-1.4	-8.4	30.8	39.2	55.6	75.6	24.8	36.4	

Note:

1. \*: Denotes restricted band of operation.

Measurements were made using a peak detector and average detector. Any emission Above 1000MHz and falling within the restricted bands of FCC Part 15 Section 15.205 were compliance with the emission limit of FCC Part 15 Section 15.209.

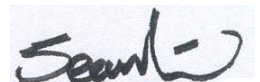
2. The field strength is calculated by adding the antenna factor, high pass filter loss(if used) and cable loss, and subtracting the amplifier gain(if any)from the measured reading. The basic equation calculation is as follows:

Result = Reading + Corrected Factor

Where Corrected Factor = Antenna Factor + Cable Loss + High Pass Filter Loss – Amplifier Gain

3. FCC Limit for Average Measurement =  $41.6667(315) - 7083.3333 = 6041.6772\mu\text{V/m}$   
 $= 75.6\text{dB}\mu\text{V/m}$
4. The spectral diagrams in appendix I display the measurement of peak values.

Reviewer :



## 5. 20DB OCCUPIED BANDWIDTH

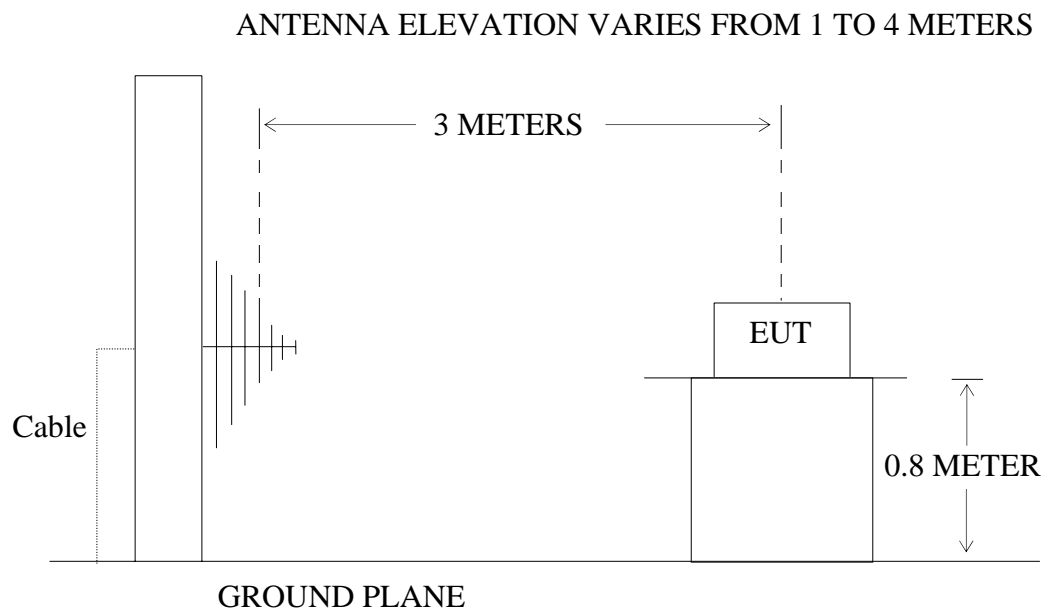
### 5.1. Block Diagram of Test Setup

#### 5.1.1. Block diagram of connection between the EUT and simulators



(EUT: Radio Frequency (RF) Transmitter)

#### 5.1.2. Anechoic Chamber Test Setup Diagram



(EUT: Radio Frequency (RF) Transmitter)

### 5.2. The Bandwidth of Emission Limit According To FCC Part 15 Section

#### 15.231(c)

The bandwidth of emission shall be no wider than 0.25% of the center frequency. Therefore, the bandwidth of the emission limit is  $315\text{MHz} \times 0.25\% = 787.5\text{KHz}$ . Bandwidth is determined at the two points 20 dB down from the top of modulated carrier.

### 5.3.EUT Configuration on Measurement

The following equipment are installed on the bandwidth of emission Measurement to meet the commission requirements and operating regulations in a manner which tends to maximize its emission characteristics in normal application.

#### 5.3.1.Radio Frequency (RF) Transmitter (EUT)

Model Number : WTRA-4C  
Serial Number : N/A  
Manufacturer : Foshan Tuodi Electronics Co., Ltd.

### 5.4.Operating Condition of EUT

5.4.1.Setup the EUT and simulator as shown as Section 4.1.

5.4.2.Turn on the power of all equipment.

5.4.3.Let the EUT work in measuring mode (TX) measure it.

### 5.5.Test Procedure

5.5.1. Set SPA Center Frequency = Fundamental frequency, RBW = 10kHz, VBW = 10kHz, Span = 200kHz.

5.5.2. Set SPA Max hold. Mark peak, -20dB

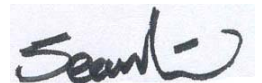
## 5.6. Measurement Result

**The EUT does meet the FCC requirement.**

-20dB bandwidth = 41.6KHz < 787.5KHz.

The spectral diagrams in appendix I.

Reviewer :

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## 6. RELEASE TIME MEASUREMENT

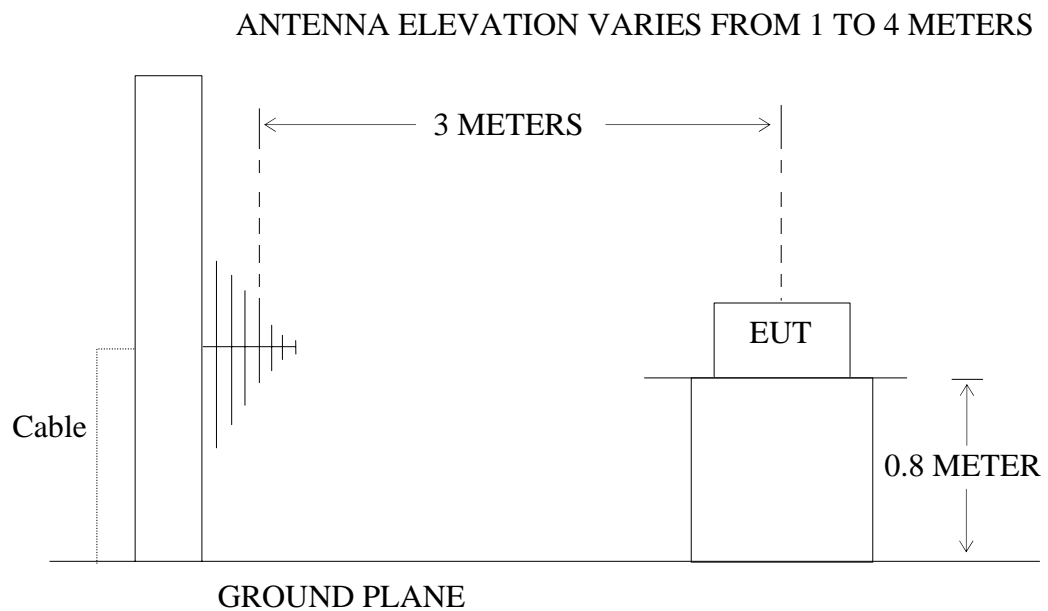
### 6.1. Block Diagram of Test Setup

#### 6.1.1. Block diagram of connection between the EUT and simulators



(EUT: Radio Frequency (RF) Transmitter)

#### 6.1.2. Anechoic Chamber Test Setup Diagram



(EUT: Radio Frequency (RF) Transmitter)

### 6.2. Release Time Measurement According To FCC Part 15 Section 15.231(a)

Section 15.231(a) (2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.



### 6.3.EUT Configuration on Measurement

The following equipment are installed on Release Time Measurement to meet the commission requirements and operating regulations in a manner which tends to maximize its emission characteristics in normal application.

#### 6.3.1. Radio Frequency (RF) Transmitter (EUT)

Model Number : WTRA-4C  
Serial Number : N/A  
Manufacturer : Foshan Tuodi Electronics Co., Ltd.

### 6.4.Operating Condition of EUT

6.4.1.Setup the EUT and simulator as shown as Section 5.1.

6.4.2.Turn on the power of all equipment.

6.4.3.Let the EUT work in measuring mode (TX) measure it.

### 6.5.Test Procedure

6.5.1. Set SPA Center Frequency = Fundamental frequency, RBW = 10kHz, VBW = 10kHz, Span = 0Hz. Sweep time = 10seconds.

6.5.2. Set EUT as normal operation and press Transmitter button.

6.5.3. Set SPA View. Delta Mark time.

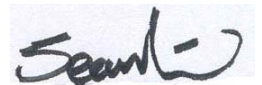
## 6.6. Measurement Result

**The release time less than 5 seconds.**

Release Time= 1.046860 seconds

The spectral diagrams in appendix I.

Reviewer :

A handwritten signature in black ink, appearing to read "Sean", is written over a light blue rectangular background. The signature is stylized with a large, looped 'S' and a checkmark-like flourish at the end.

## 7. AVERAGE FACTOR MEASUREMENT

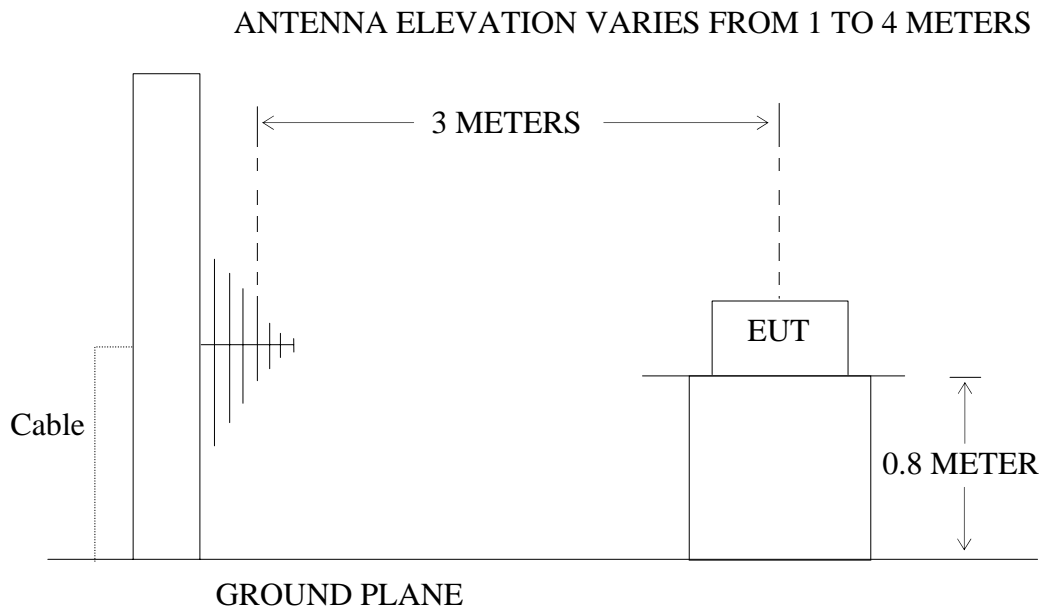
### 7.1. Block Diagram of Test Setup

#### 7.1.1. Block diagram of connection between the EUT and simulators



(EUT: Radio Frequency (RF) Transmitter)

#### 7.1.2. Anechoic Chamber Test Setup Diagram



(EUT: Radio Frequency (RF) Transmitter)

### 7.2. Average factor Measurement

Average factor in dB =  $20 \log (\text{duty cycle})$

7.2.1. The specification for output field strengths in accordance with the FCC rules specify measurements with an average detector. During testing, a spectrum analyzer incorporating a peak detector was used. Therefore, a reduction factor can be applied to the resultant peak signal level and compared to the limit for measurement instrumentation incorporating an average detector.

### 7.3.EUT Configuration on Measurement

The following equipment are installed on average factor Measurement to meet the commission requirements and operating regulations in a manner which tends to maximize its emission characteristics in normal application.

#### 7.3.1. Radio Frequency (RF) Transmitter (EUT)

Model Number : WTRA-4C  
Serial Number : N/A  
Manufacturer : Foshan Tuodi Electronics Co., Ltd.

### 7.4.Operating Condition of EUT

7.4.1.Setup the EUT and simulator as shown as Section 5.1.

7.4.2.Turn on the power of all equipment.

7.4.3.Let the EUT work in measuring mode (TX) measure it.

### 7.5.Test Procedure

7.5.1. The time period over which the duty cycle is measured is 100 milliseconds, or the repetition cycle, whichever is a shorter time frame. The worst case (highest percentage on) duty cycle is used for the calculation.

7.5.2. Set EUT as normal operation.

7.5.3. Set SPA View. Delta Mark time.

## 7.6. Measurement Result

**The duty cycle is simply the on time divided by the period:**

The duration of one cycle = 64.6ms

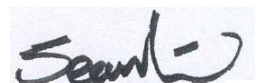
Effective period of the cycle =  $(8 \times 1.58) + (17 \times 0.7)$  ms = 24.54ms

DC =  $24.54\text{ms}/64.6\text{ms} = 0.3799$

**Therefore, the average factor is found by  $20\log 0.3799 = -8.4\text{dB}$**

The spectral diagrams in appendix I.

Reviewer :



# APPENDIX I (Test Curves)

CONDUCTION EMISSION STANDARD FCC PART15B

19. Jan 07 10:39

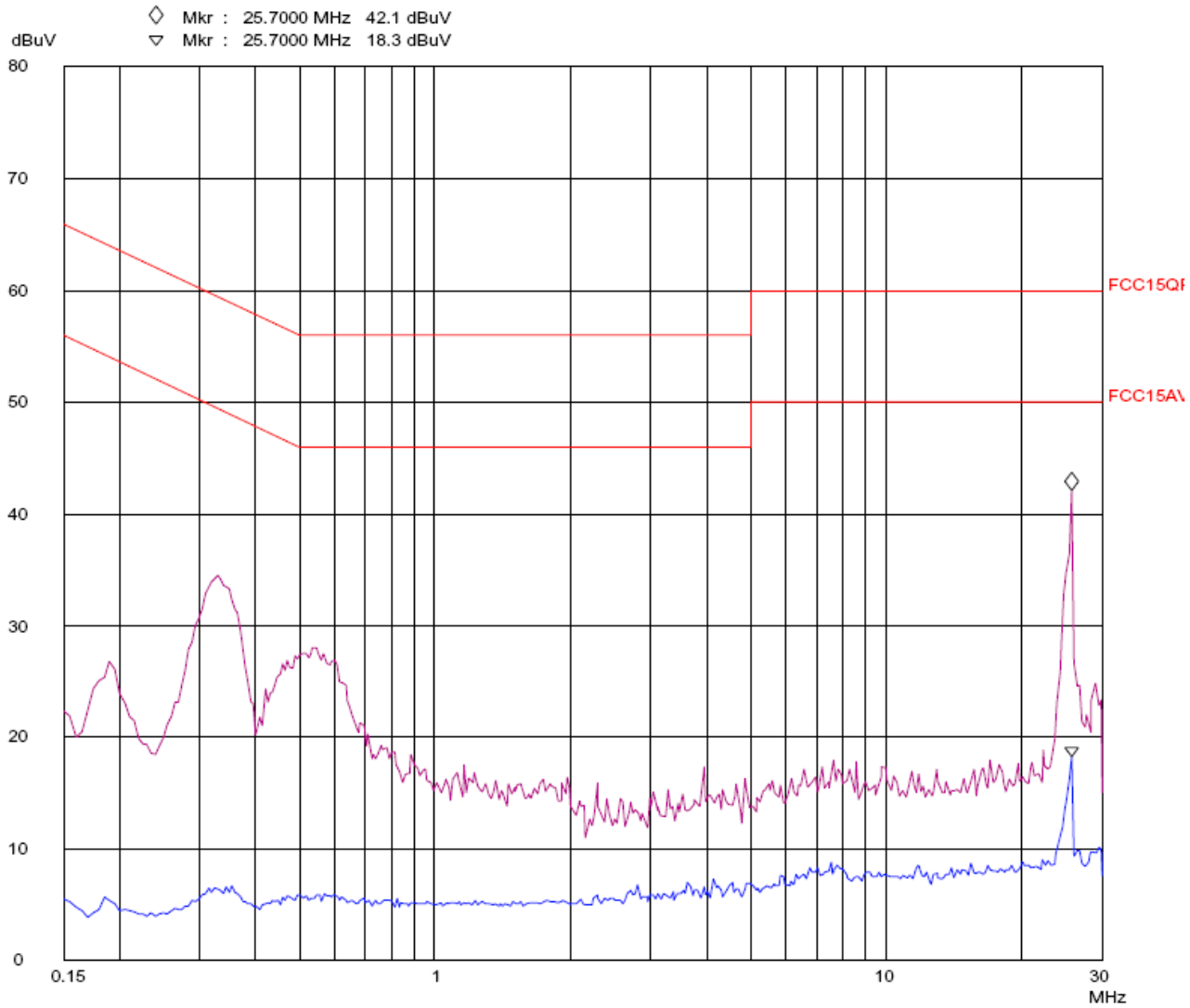
EUT: Radio Frequency (RF) Transmitter  
Manuf: Orion Energy  
Op Cond: TX  
Operator: Andy.tan  
Test Spec: Va 120V/60Hz  
Comment: Tem25°C Humi55%  
Sample no.:064124 m/n:WTRA-4C

Scan Settings (3 Ranges)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp
150k	2M	5k	9k	PK+AV	10ms	AUTO	LN OFF
2M	10M	10k	9k	PK+AV	1ms	AUTO	LN OFF
10M	30M	25k	9k	PK+AV	1ms	AUTO	LN OFF

Final Measurement: x QP / + AV  
Meas Time: 1 s

Transducer No. Start Stop Name  
1 9k 30M confac



# CONDUCTION EMISSION STANDARD FCC PART15B

19. Jan 07 10:36

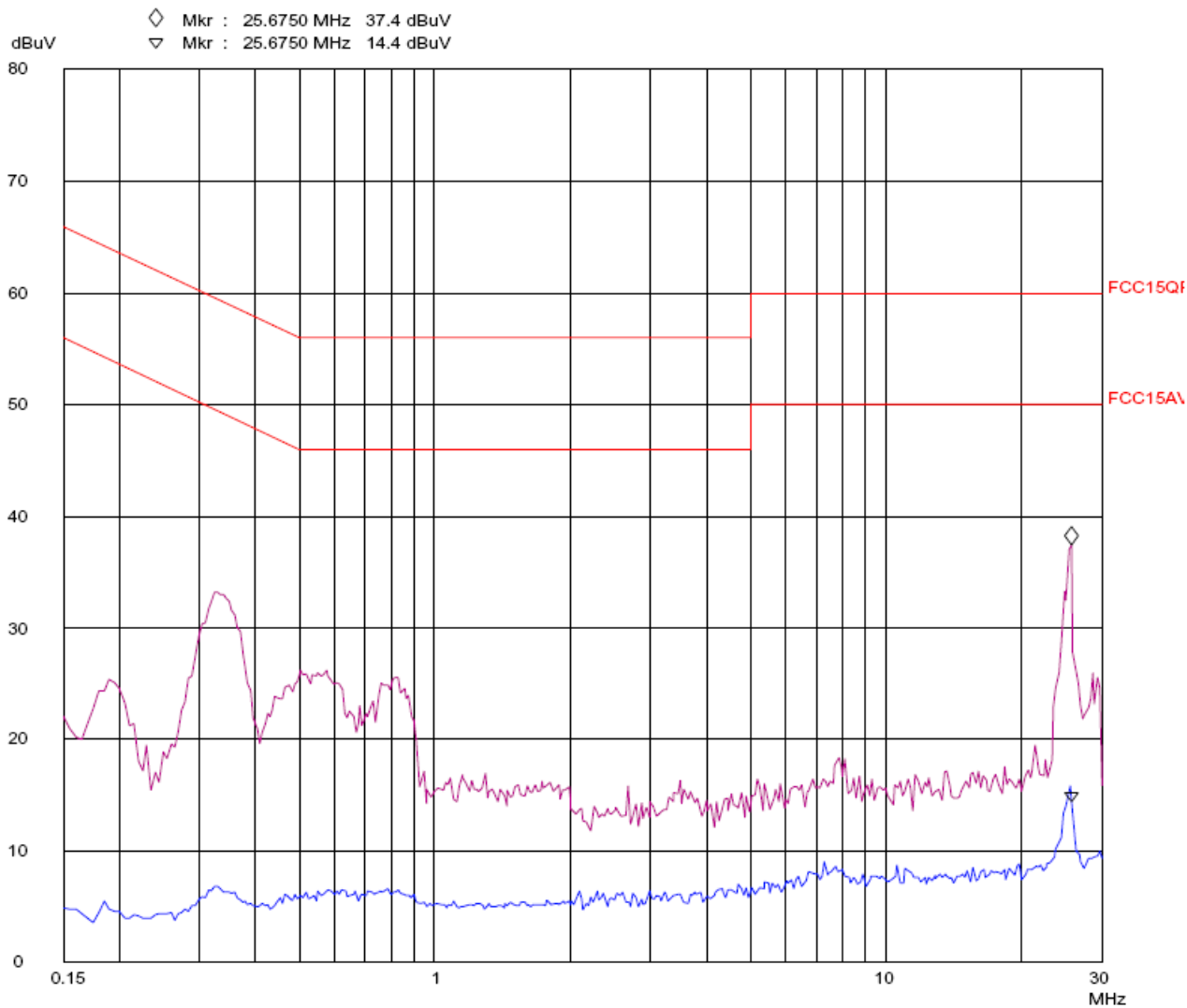
EUT: Radio Frequency (RF) Transmitter  
 Manuf: Orion Energy  
 Op Cond: TX  
 Operator: Andy.tan  
 Test Spec: Vb 120V/60Hz  
 Comment: Tem25'C Humi55%  
 Sample no.:064124 m/n:WTRA-4C

## Scan Settings (3 Ranges)

Frequencies			Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten Preamp
150k	2M	5k	9k	PK+AV	10ms AUTO LN	OFF
2M	10M	10k	9k	PK+AV	1ms AUTO LN	OFF
10M	30M	25k	9k	PK+AV	1ms AUTO LN	OFF

Final Measurement: x QP / + AV  
 Meas Time: 1 s

Transducer No. Start Stop Name  
 1 9k 30M confac



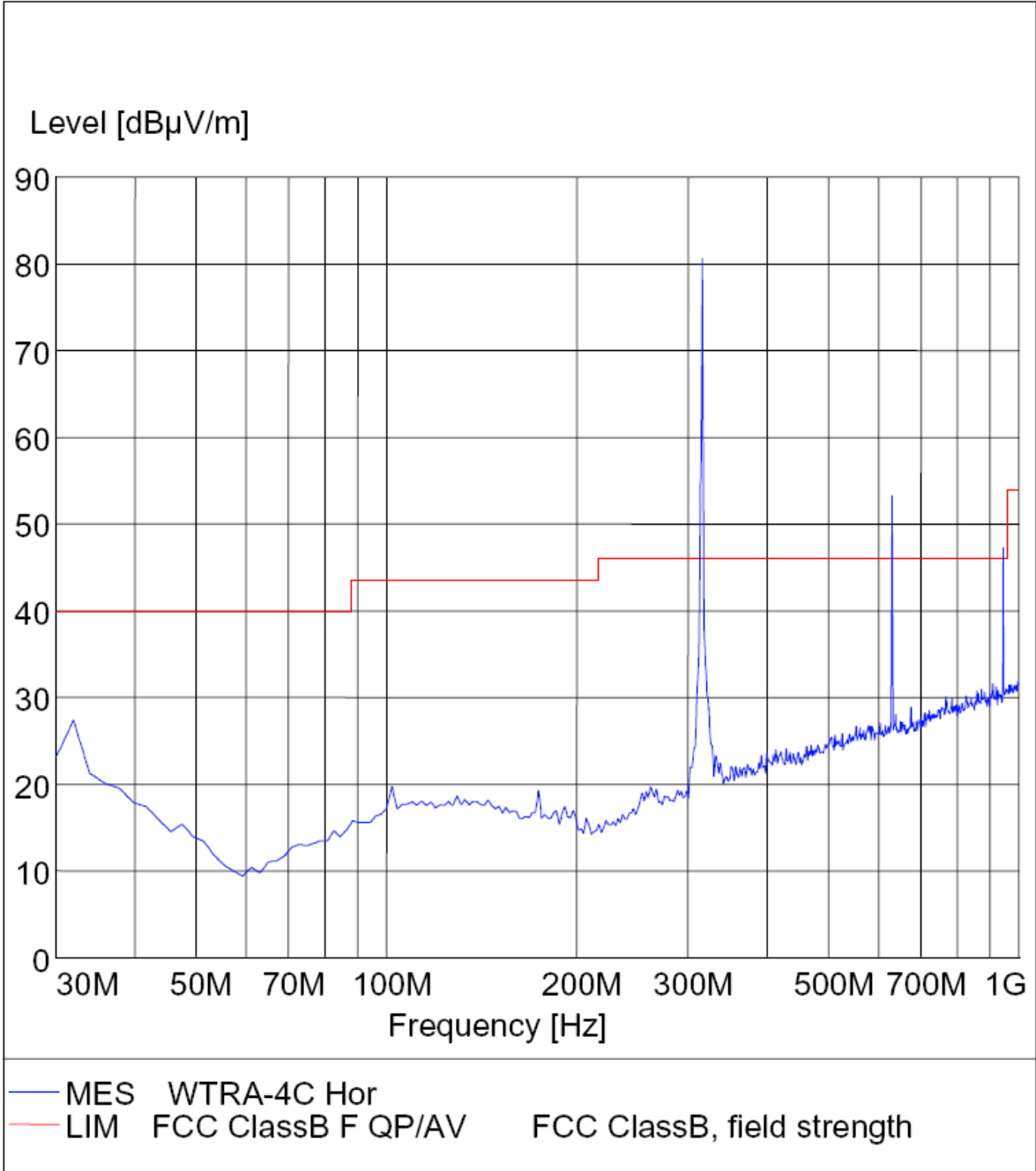


Radiated Emission

FCC Part 15

EUT: Radio Frequency(RF) Transmitter  
Manufacturer: Orion Energy  
Operating Condition: TX  
Test Site: ATC EMC Lab.SAC  
Operator: Andy  
Test Specification: Horizontal  
Comment : AC 120V/60Hz

M/N: WTRA-4C

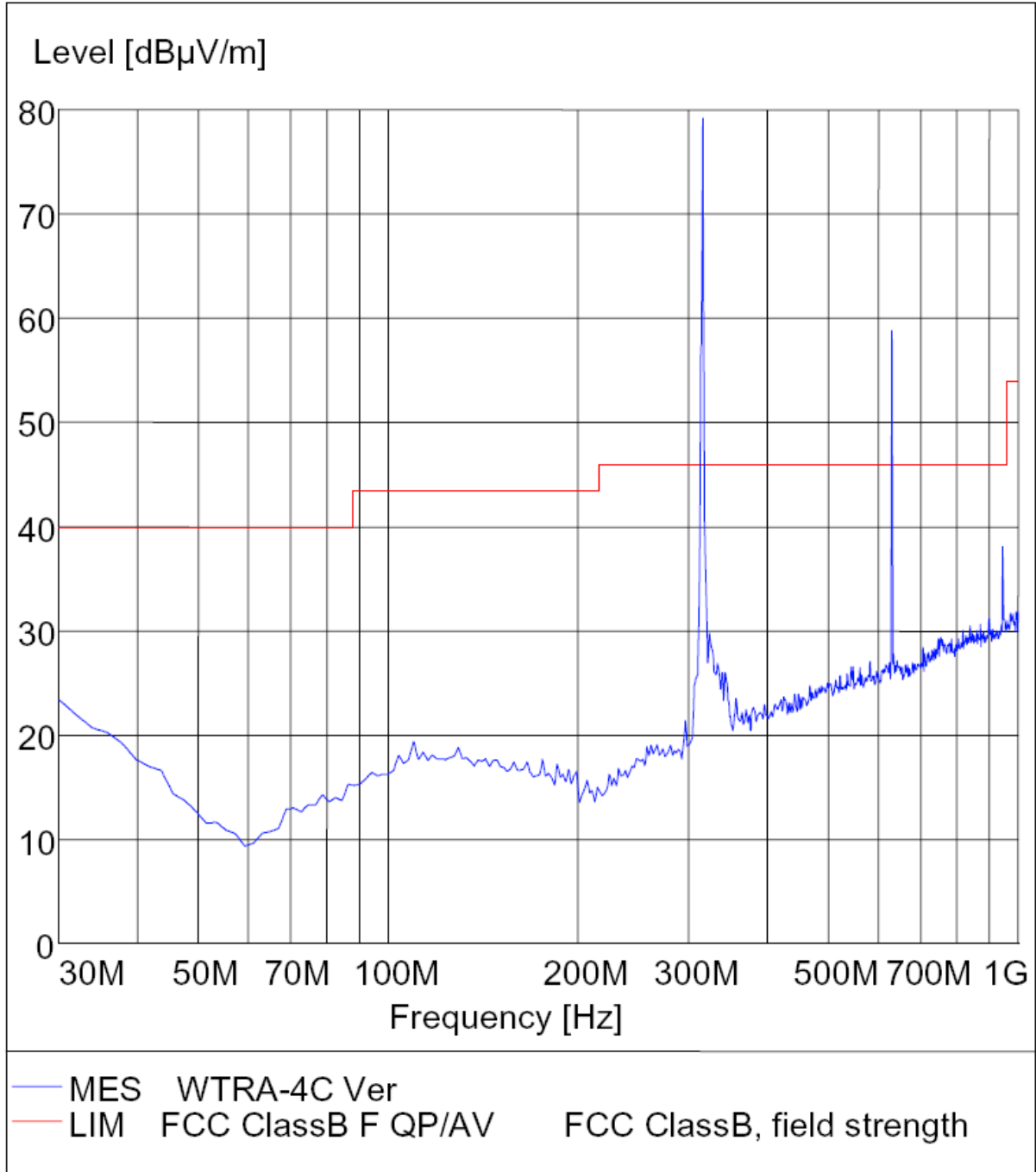


Radiated Emission

FCC Part 15

EUT: Radio Frequency(RF) Transmitter  
Manufacturer: Orion Energy  
Operating Condition: TX  
Test Site: ATC EMC Lab.SAC  
Operator: Andy  
Test Specification: Vertical  
Comment : AC 120V/60Hz

M/N: WTRA-4C

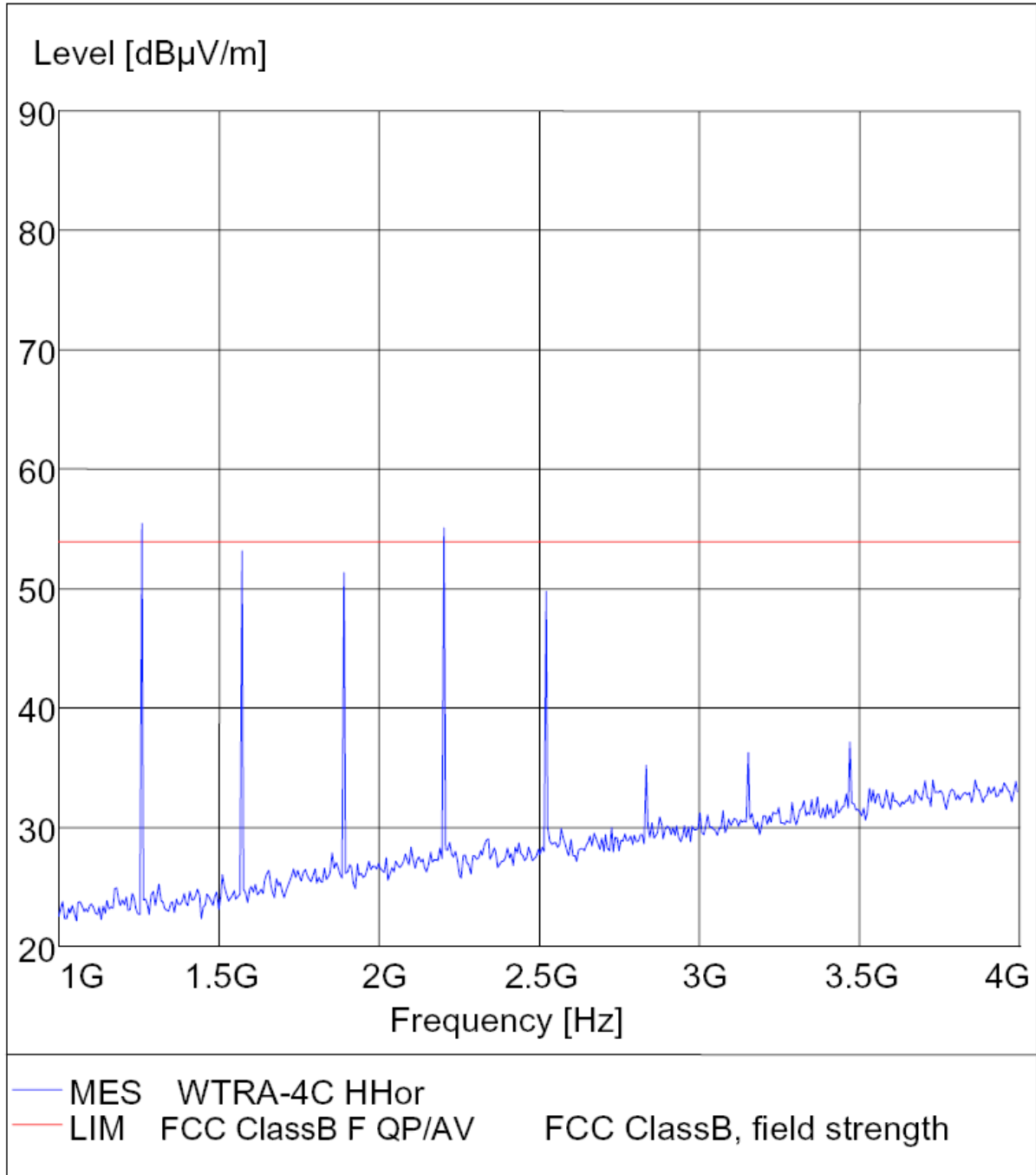


Radiated Disturbance

FCC Part 15

EUT: Radio Frequency(RF) Transmitter  
Manufacturer: Orion Energy  
Operating Condition: TX  
Test Site: ATC EMC Lab.SAC  
Operator: Andy  
Test Specification: Horizontal  
Comment : AC 120V/60Hz

M/N: WTRA-4C

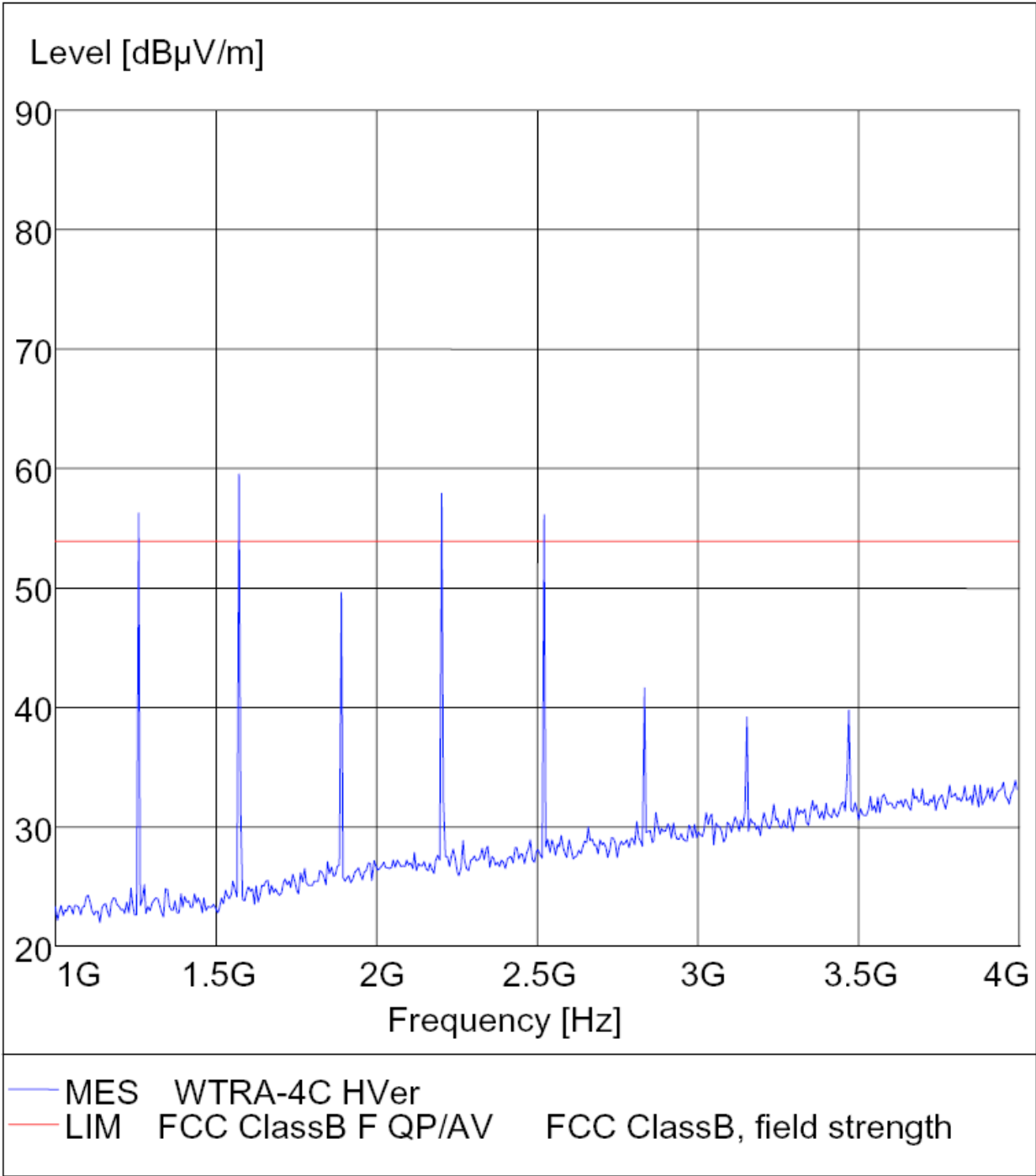


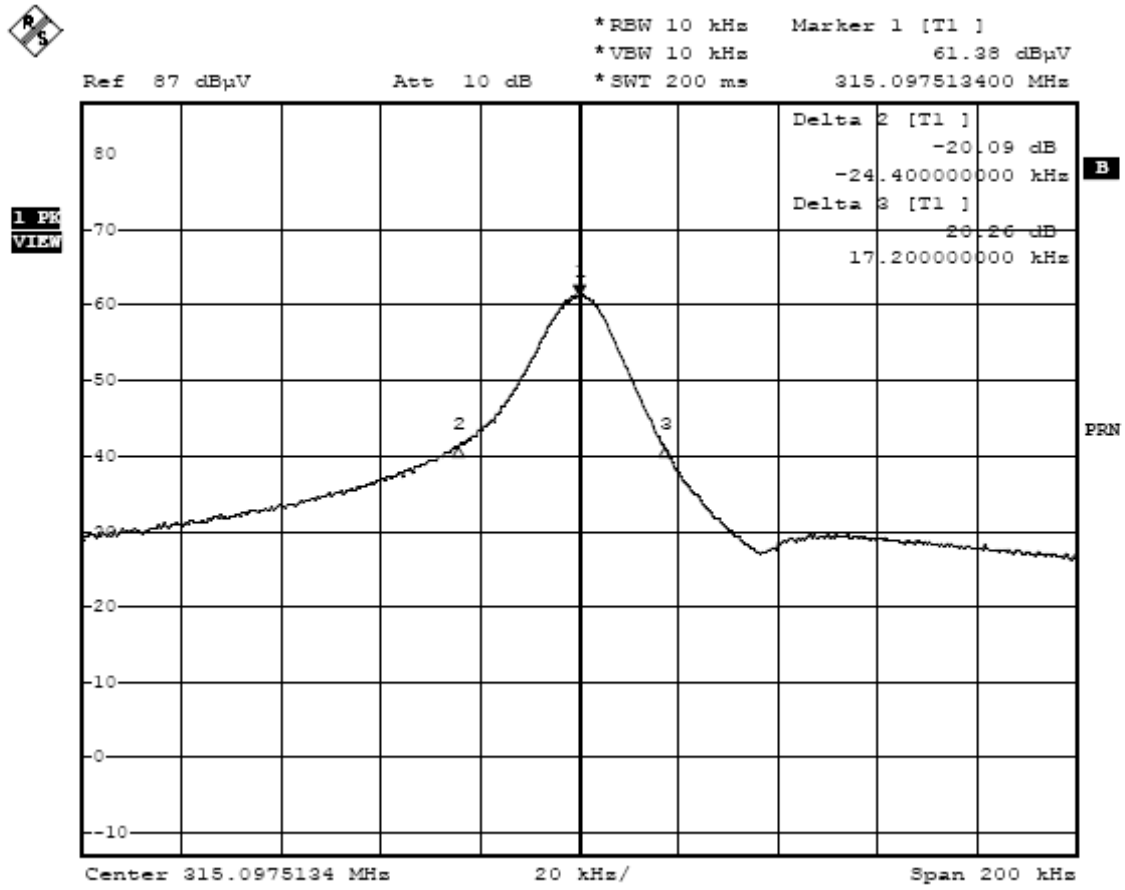
Radiated Disturbance

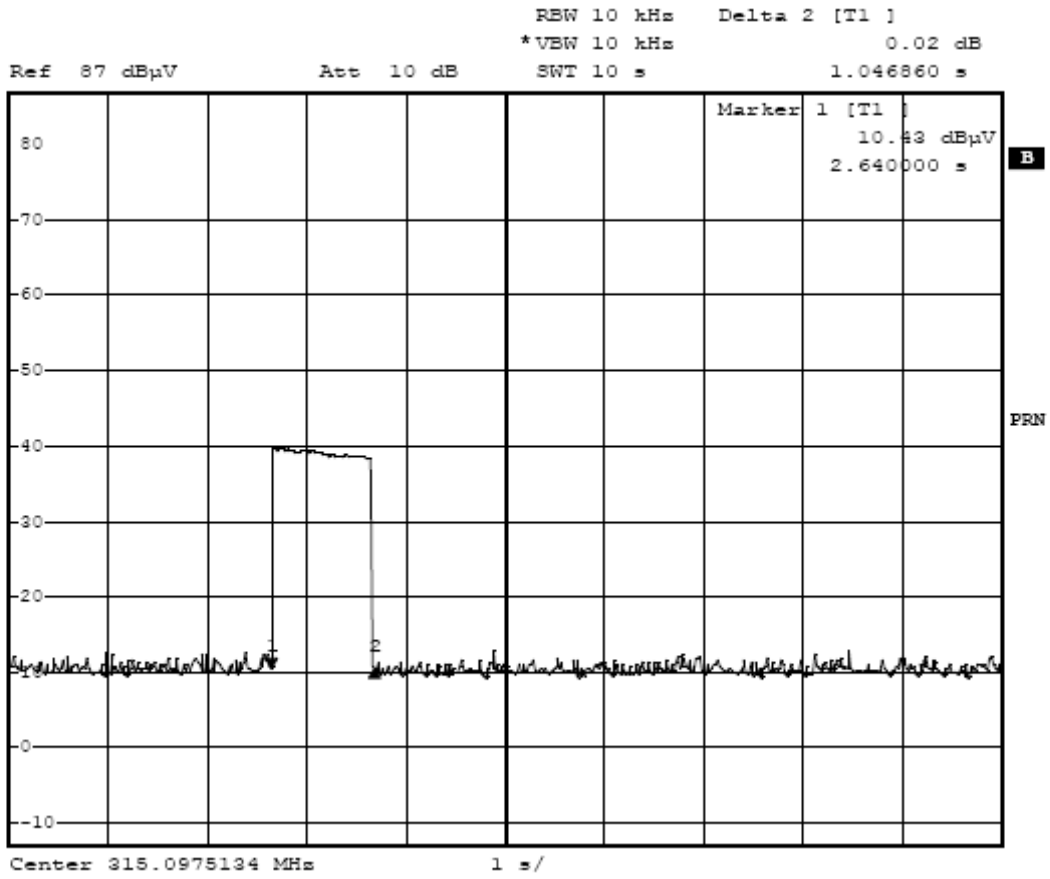
FCC Part 15

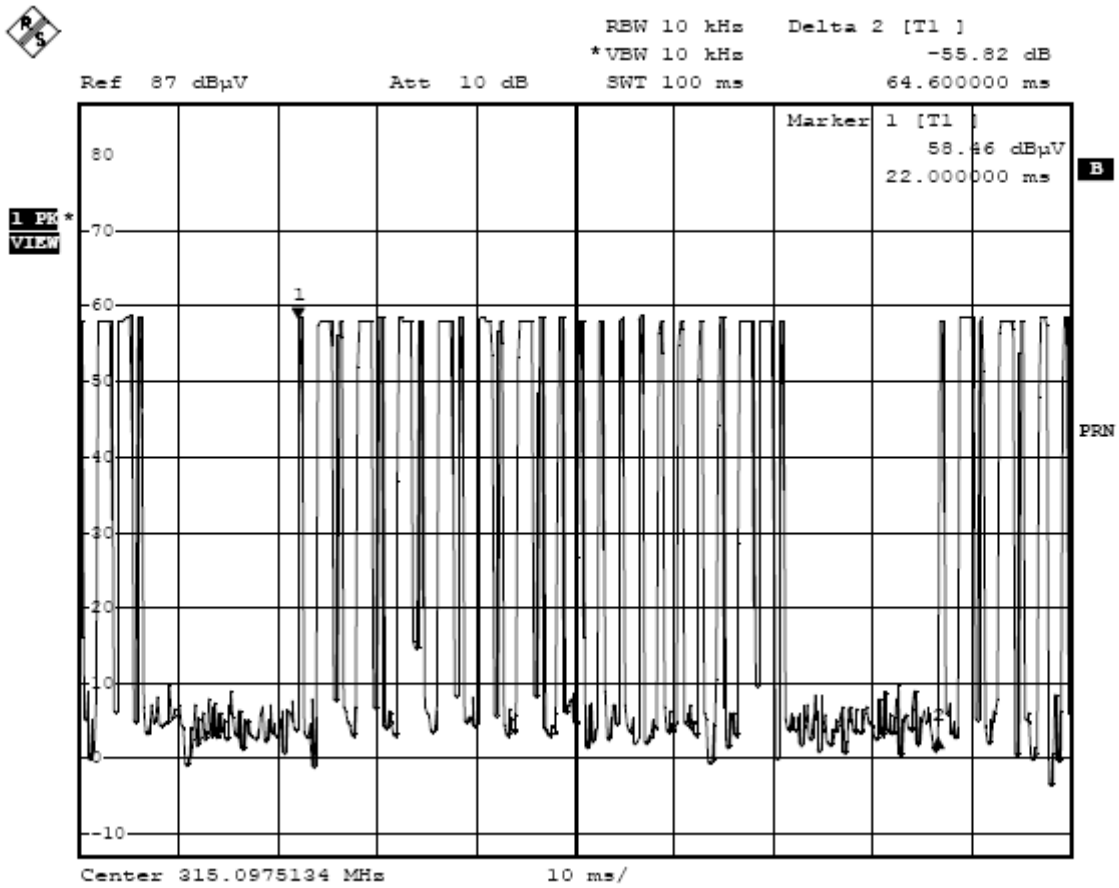
EUT: Radio Frequency (RF) Transmitter  
Manufacturer: Orion Energy  
Operating Condition: TX  
Test Site: ATC EMC Lab.SAC  
Operator: Andy  
Test Specification: Vertical  
Comment : AC 120V/60Hz

M/N: WTRA-4C

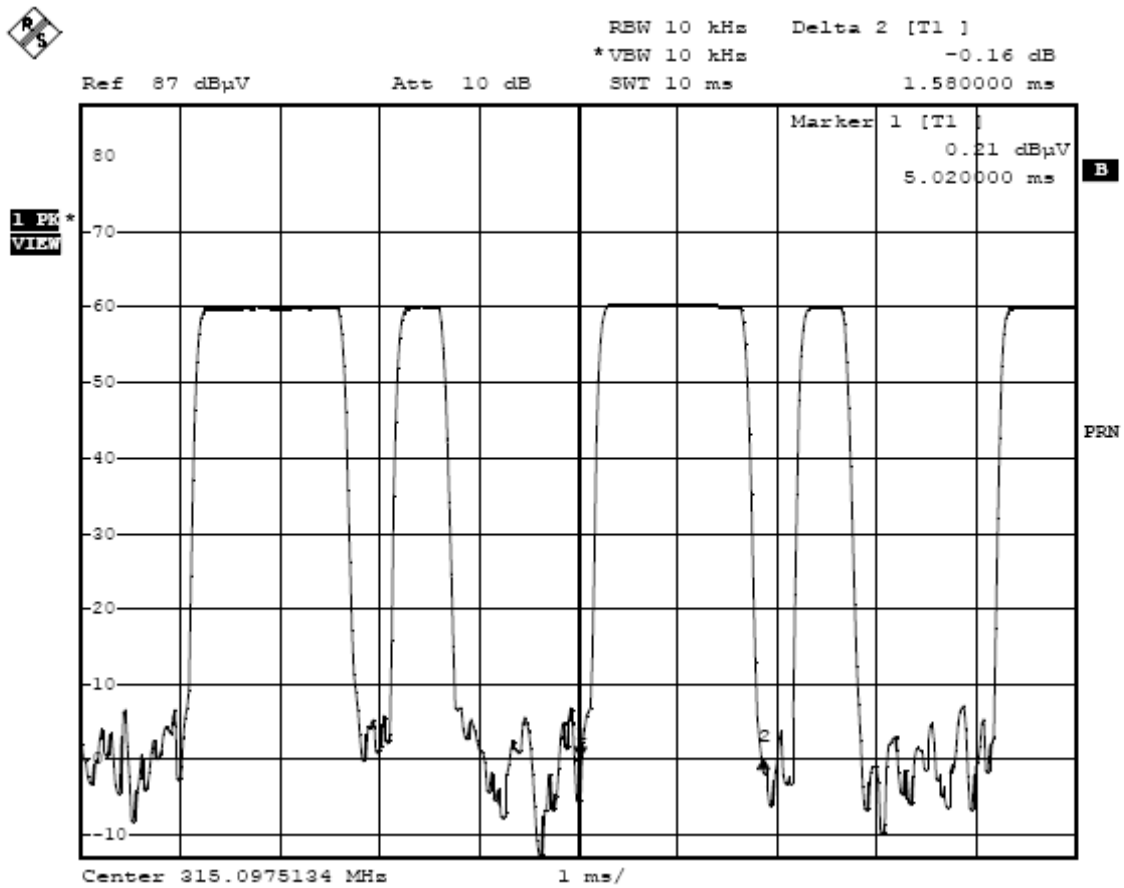






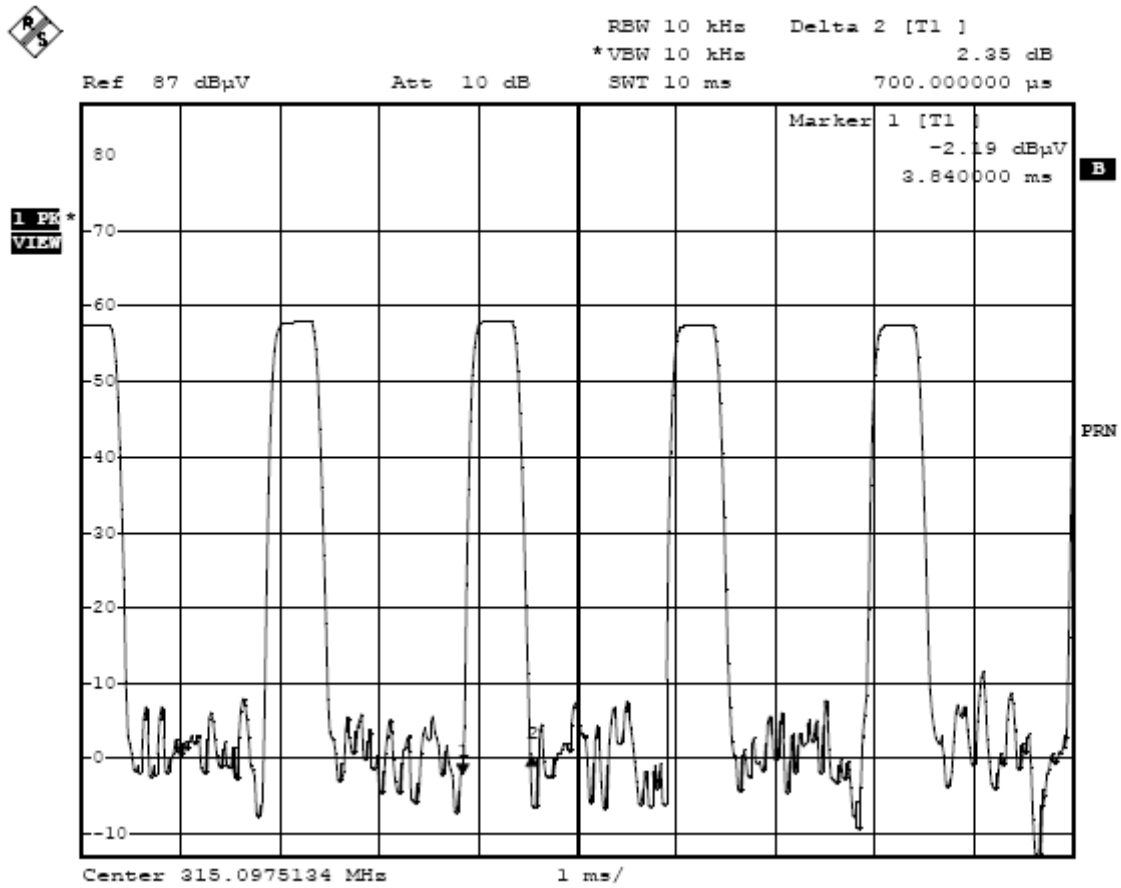


The graph shows the pattern of coding during the signal transmission.  
 The time interval of one coding period starts from marker 1 to marker 2,  
 Hence the total time of one period is 64.6ms.  
 It sums of 8 long 'on' signals and 17 short 'on' signals.



The graph show the duration of long 'on' signal. From marker 1 to marker 2, duration is 1.58ms.





The graph show the duration of short 'on' signal. From marker 1 to marker 2, duration is 0.7ms.