



## Test Report

### FCC Part 15, Subpart C, Section 15.247 Industry Canada RSS-210, Issue 7

Report Number: CEN-RFGW-EX-Cert

Model: CEN-RFGW-EX

FCC ID: EROCEN-RFGW-EX  
IC: 5683C-CENRFGWEX

**Date: January 20, 2009**

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## **1. General Description**

### **1.1 Product Description**

The equipment under test (EUT) is a Crestron 2.4GHz transceiver, model: CEN-RFGW-EX. This transceiver consists of an Ember EM260 ZigBee/802.15.4 network processor.

### **1.2 Test Methodology**

Measurements were performed according to the following procedures and standards:

- ANSI C63.4: 2003
- FCC procedure, "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005
- Industry Canada RSS-Gen Issue 2
- Industry Canada RSS-210 Issue 7
- Industry Canada ICES-003 Issue 4

All measurements were performed in a 3-meter semi-anechoic chamber and the control room.

### **1.3 Test Facility**

The 3-meter semi-anechoic chamber used to collect conducted and radiated emission data is located at 22 Link Drive, Rockleigh, New Jersey. This test facility has been placed on file with the FCC, Registration Number: 412871, and Industry Canada, File: 46405-5683.



## 1.4 Test Equipment

Description	Model	Serial No.	Frequency Range	Calibration Date
R&S EMI Receiver	ESU40	100076	20 Hz – 40 GHz	Dec. 12, 2008
Teseq Bilog Antenna	CBL 6112D	25231	30 MHz – 2 GHz	Jan. 12, 2009
ETS-Lindgren Double Ridge Horn Antenna	3117	00047560	1 GHz – 18 GHz	Mar. 7, 2008
R&S Preamplifier	TS-PR18	100044	30 MHz – 18 GHz	Jan. 10, 2008
ETS-Lindgren Standard Gain Horn Antenna	3160-09	00078911	18 GHz – 26.5 GHz	Mar. 14, 2008
R&S Preamplifier	TS-PR26	100030	18 GHz – 26.5 GHz	Jan. 20, 2009
Solar Electronics LISN	9252-50-R-24-N	068545	10 kHz – 50 MHz	Feb. 21, 2008
Solar Electronics LISN	9252-50-R-24-N	068546	10 kHz – 50 MHz	Feb. 21, 2008

## 1.5 Evaluation Summary

Rule Section		Description/Parameters	Results
FCC	IC		
§15.203	N/A	Antenna Requirement	Complies
§15.212(a)(1)	§7.1.1 of RSS-Gen	Single Modular Transmitter	Not Applicable
§15.247(a)(2)	§A8.2(a) of RSS-210	6 dB bandwidth, 500 kHz	Complies
§15.247(b)(3)	§A8.4(4) of RSS-210	Power output, conducted, 1 Watt (30dBm)	Complies
§15.247(d)	§A8.5 of RSS-210	Band edge	Complies
§15.247(d)	§A8.5 of RSS-210	Conducted spurious emissions, 20 dBc	Complies
§15.247(e)	§A8.2(b) of RSS-210	Power spectral density (PSD), 8 dBm in any 3 kHz band.	Complies
§15.247(i)	§5.5 of RSS-Gen	RF safety	Complies
§15.207	Table 2 of RSS-Gen	Power line conducted emissions	Complies
§15.209, §15.247(d)	Table 2 of RSS-210	Radiated emissions and radiated spurious emissions	Complies
N/A	§4.8 of RSS-Gen	Receiver Spurious Emission	Complies

**Note:**

The channels selected for test were 11, 18, and 26.

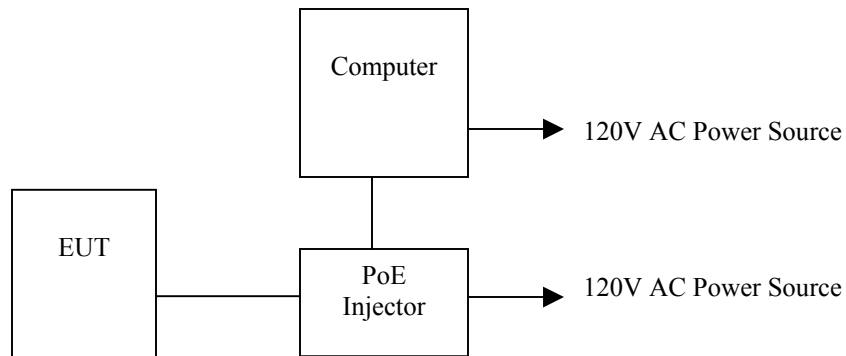
## 2. System Test Configuration

### 2.1 Justification

A power-over-Ethernet injector supplied power to the EUT through the LAN PoE port. A computer supplied test commands through the same LAN PoE port.

### 2.2 Block Diagram

Block diagram is shown below.



### 2.3 EUT Exercise Software and Mode(s) of Operation

The EUT was configured to transmit continuously. Channels 11 (2405 MHz), 18 (2440 MHz), and 26 (2480 MHz) were selected for test.

### 2.4 Cables

Qty	Description	Length (m)	From - To	Shielded/Unshielded
1	Power Cord	6	Power Source – Power-over-Ethernet Injector	Unshielded
1	Cat 5e	1	Computer – Power-over-Ethernet Injector	Unshielded
1	Cat 5e	30	Power-over-Ethernet Injector – EUT (radiated emission measurement)	Shielded
1	Cat 5e	7.5	Power-over-Ethernet Injector – EUT (conducted emission measurement)	Shielded

### 2.5 Special Accessories

There are no special accessories for compliance of this EUT.



## 2.6 *Support equipment*

No	Description	Manufacturer	Model No	Serial No
1	Power-over-Ethernet Injector	Crestron	PWE-4803RU	Not Labeled
2	Computer	DELL	PP01X	6WYKP01
3	Power Adapter	DELL	AA20031	CN-09364U-16291-14B-002R

## 2.7 *Equipment Modifications*

There were no modifications installed during compliance measurements.



### **3. Evaluation**

#### **3.1 *Antenna Requirements***

This module is validated with a dipole antenna from two sources:

- ACE Technology, model: ACE-2400NF
- Z&Y Excellence, model: C047-RF-002

ACE-2400NF and C047-RF-002 antennas have the same electric specifications with a reverse polarity SMA (RP-SMA) male connector.

The antennas' connectors are unique in the sense of complying with FCC §15.203, §15.204(b), and §15.204(c).



### **3.2 *Modular Transmitter***

This section is not applicable as the EUT is not a module.





### 3.3 Bandwidth

**Performance Criterion:** The 6 dB bandwidth shall be at least 500 kHz.

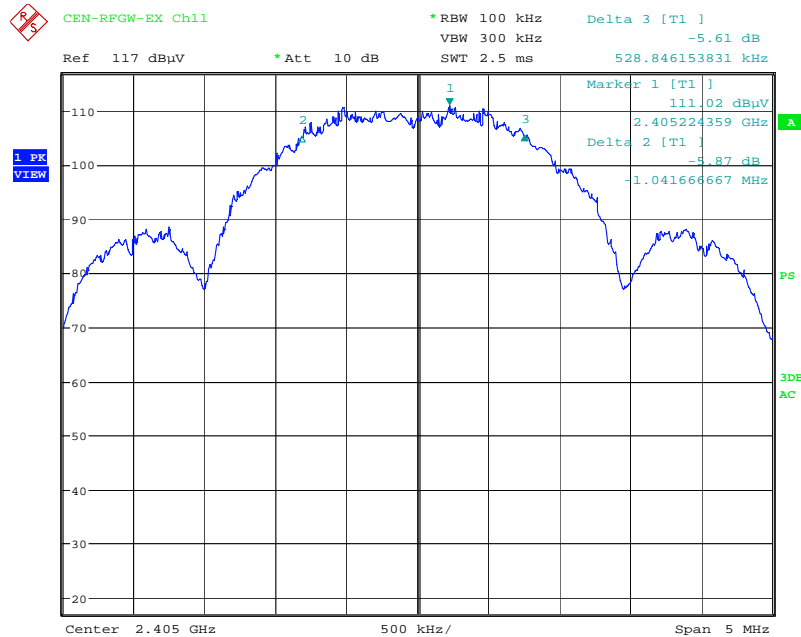
**Test Results:** Complies

**Test Details:** Refers to the following table and receiver screen captures. The EUT was tested in a continuous transmit mode with power level of 253.

Channel	Frequency (MHz)	6 dB Bandwidth (kHz)
11	2405	1570.5
18	2440	1578.5
26	2480	1426.3

**Note:** The RF level in the plots is relative and is not the indication of RF output power.

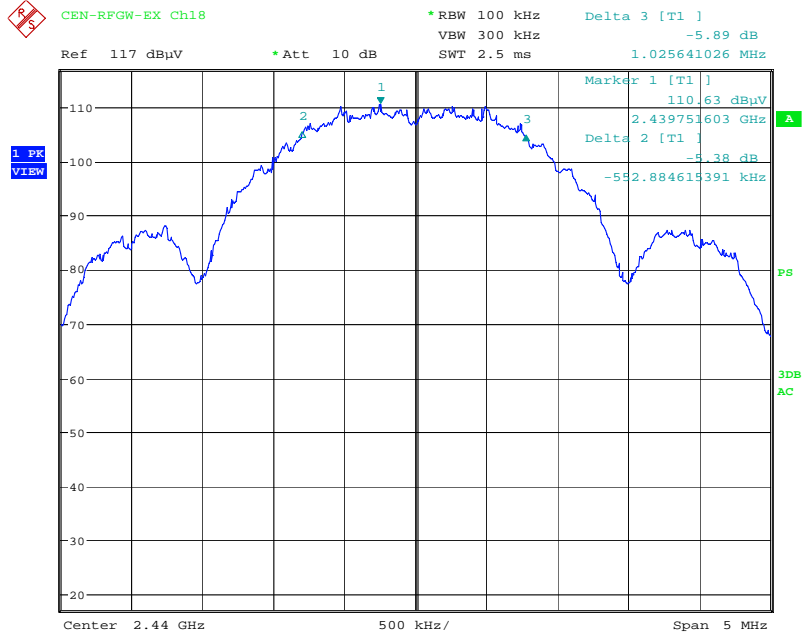
#### Channel 11:



Date: 12.JAN.2009 09:52:20

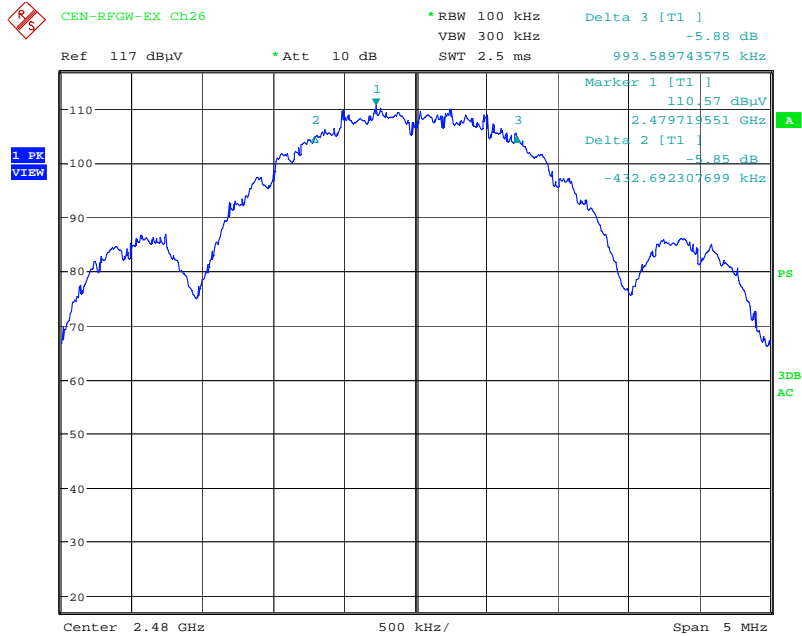


Channel 18:



Date: 12.JAN.2009 09:49:34

Channel 26:



Date: 12.JAN.2009 09:54:42



### 3.4 Power Output

**Performance Criterion:** The maximum peak conducted output power shall not exceed 1 Watt.

**Test Results:** Complies

**Test Details:** The available power settings of the Ember EM260 processor are listed below.

Power Settings (decimal, signed)	Power Settings (decimal, unsigned)
+3	3
+2	2
+1	1
0	0
-1	255
-2	254
-3	<b>253</b>
-4	252
-5	<b>251</b>
-6	250
-7	249
-8	248
-9	247
-11	245
-12	244
-14	242
-17	239
-20	236
-26	<b>230</b>
-43	213

The maximum output power settings of the EUT are listed below. The factory will set these maximum settings. The integrators and end users have no access to change these settings

Channel	Power Settings (decimal, unsigned)
11-18	253
19-25	251
26	230

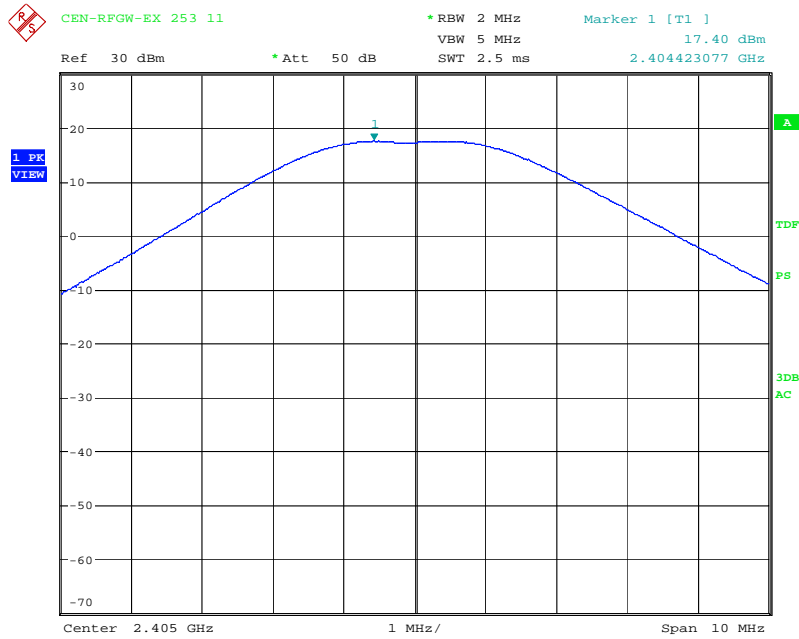


The EUT was tested in a continuous transmit mode. Refers to the following data table and receiver screen captures.

Channel	Frequency (MHz)	Power Level	Power	
			dBm	mW
11	2405	253	17.40	54.96
14	2420	253	17.22	52.73
18	2440	253	16.95	49.55
19	2445	251	14.87	30.69
22	2460	251	14.68	29.38
25	2475	251	14.49	28.12
26	2480	230	-4.63	0.35

**Note:** The insertion loss was compensated for in the receiver.

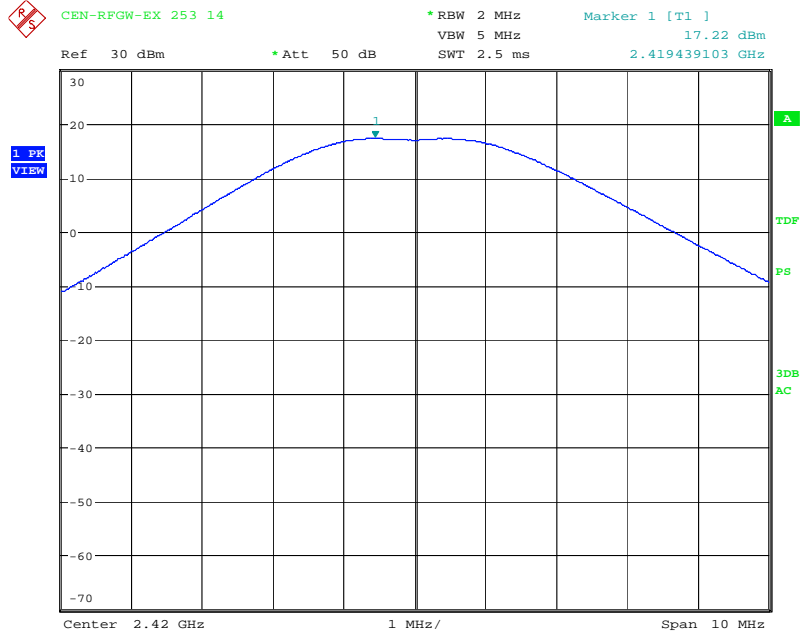
**Channel 11:**



Date: 19.JAN.2009 16:01:11

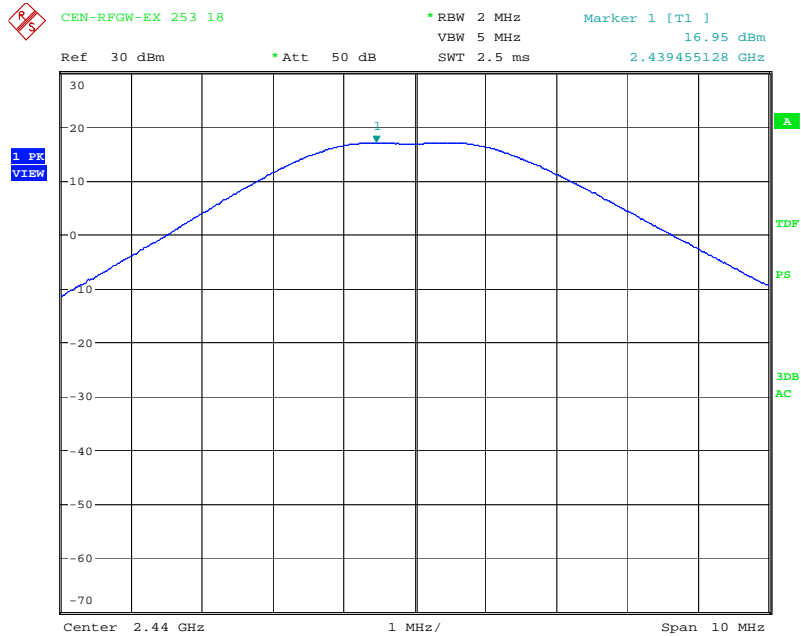


**Channel 14:**



Date: 19.JAN.2009 16:02:52

**Channel 18:**



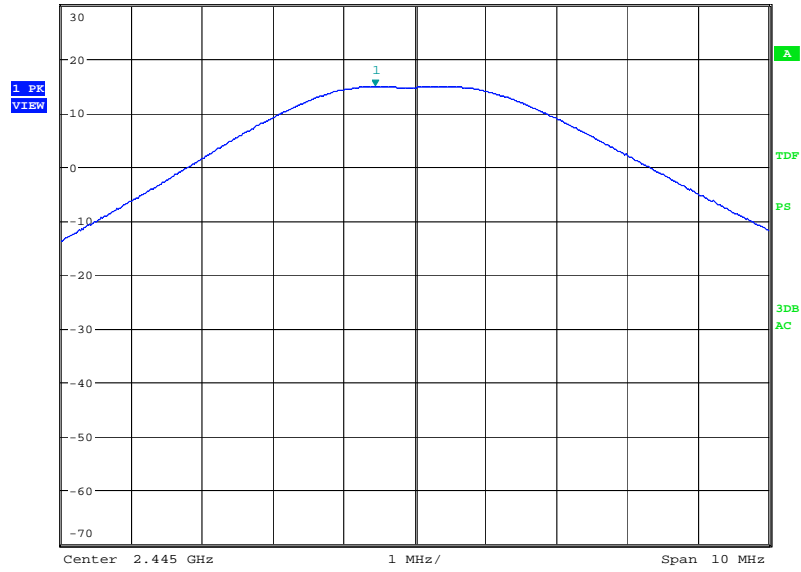
Date: 19.JAN.2009 16:03:48



Channel 19:



CEN-RFGW-EX 251 19 \*RBW 2 MHz Marker 1 [T1 ]  
Ref 30 dBm \*Att 50 dB VBW 5 MHz 14.87 dBm  
SWT 2.5 ms 2.444439103 GHz

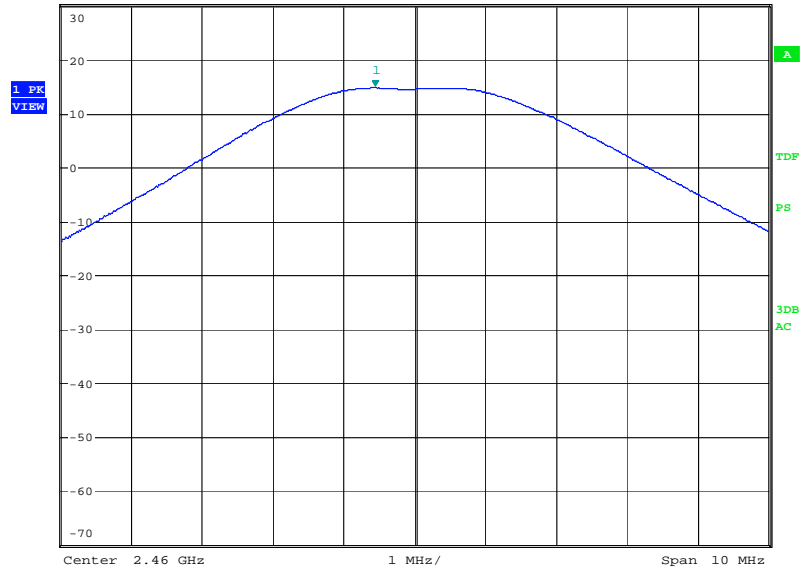


Date: 19.JAN.2009 16:04:55

Channel 22:



CEN-RFGW-EX 251 22 \*RBW 2 MHz Marker 1 [T1 ]  
Ref 30 dBm \*Att 50 dB VBW 5 MHz 14.68 dBm  
SWT 2.5 ms 2.459439103 GHz



Date: 19.JAN.2009 16:06:22



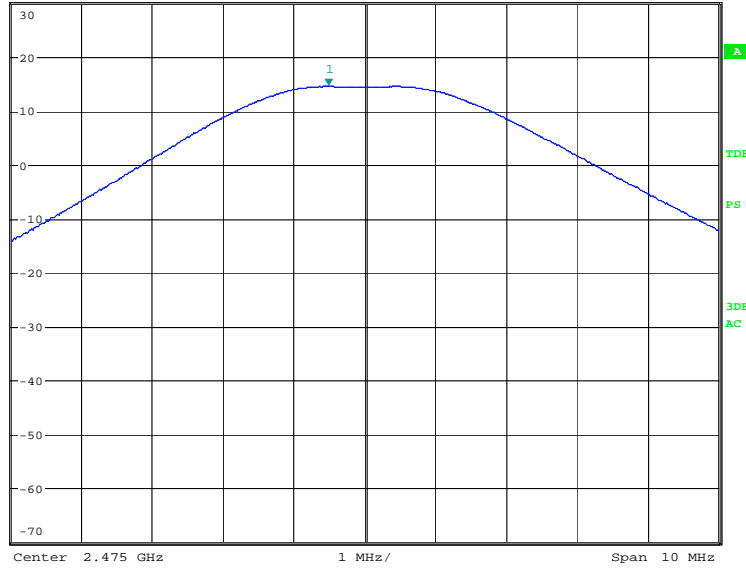
Channel 25:



CEN-RFGW-EX 251 25

\* RBW 2 MHz  
\* Att 50 dB  
\* VBW 5 MHz  
\* SWT 2.5 ms

Marker 1 [T1 ]  
14.49 dBm  
2.474487179 GHz



Date: 19.JAN.2009 16:08:42

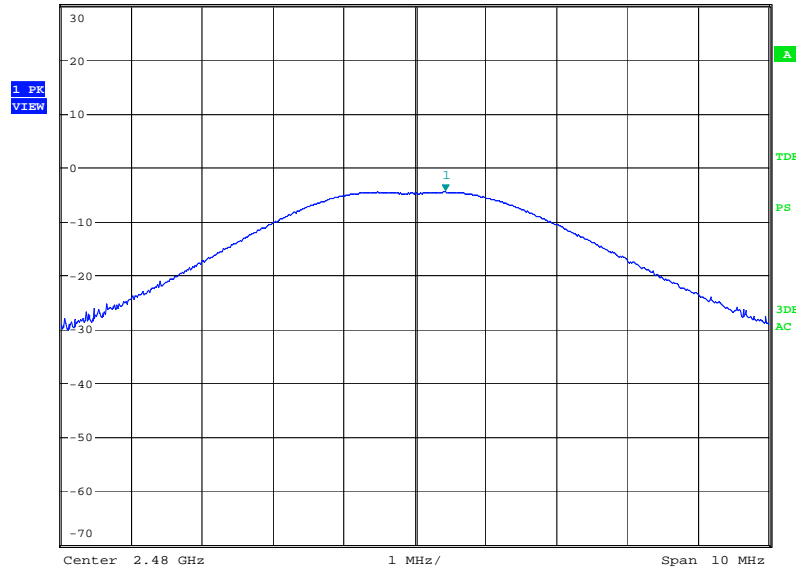
Channel 26:



CEN-RFGW-EX 230 26

\* RBW 2 MHz  
\* Att 50 dB  
\* VBW 5 MHz  
\* SWT 2.5 ms

Marker 1 [T1 ]  
-4.63 dBm  
2.480432692 GHz



Date: 19.JAN.2009 16:09:58



### 3.5 *Band Edge*

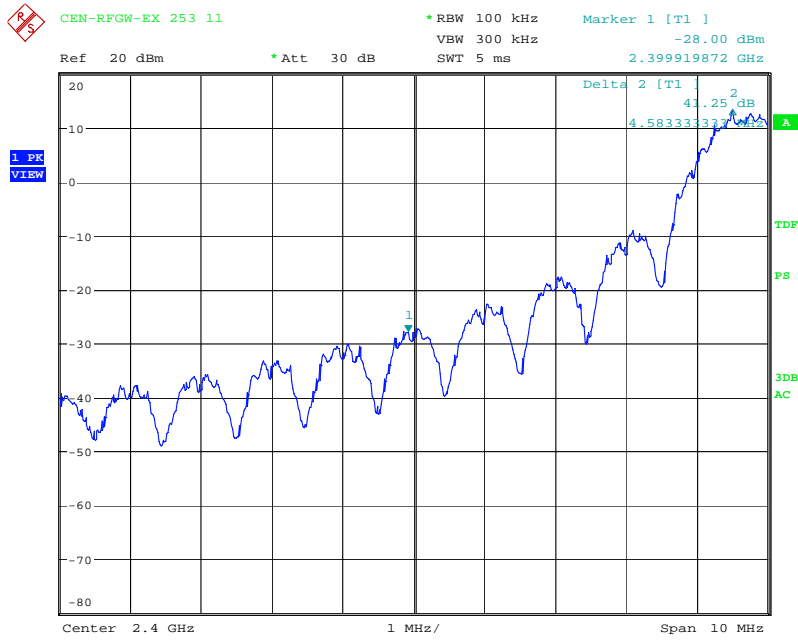
**Performance Criterion:** In any 100 kHz bandwidth outside the frequency band, the RF power shall be at least 20 dB below that in the 100 kHz bandwidth within the band.

**Test Results:** Complies

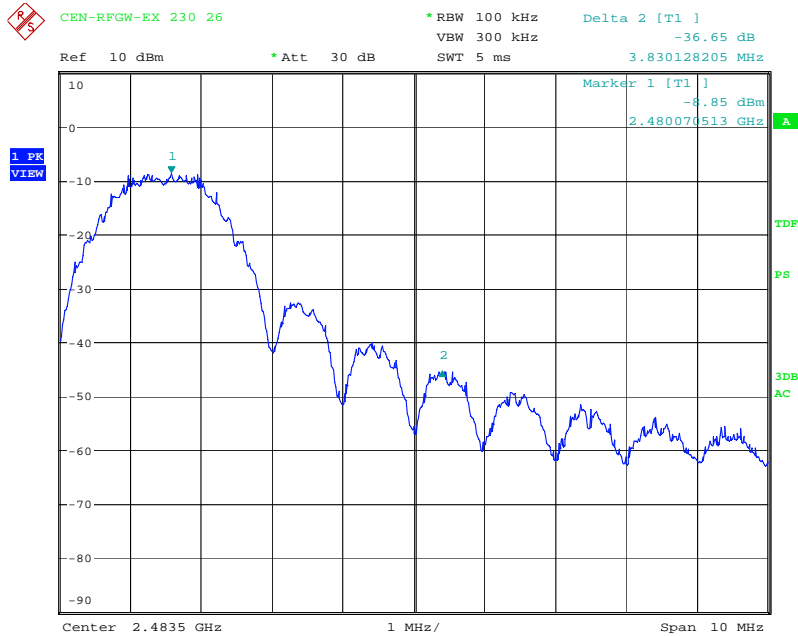
**Test Details:** Refers to the following receiver screen captures



**Band Edge, Conducted:**



Date: 19.JAN.2009 16:15:51



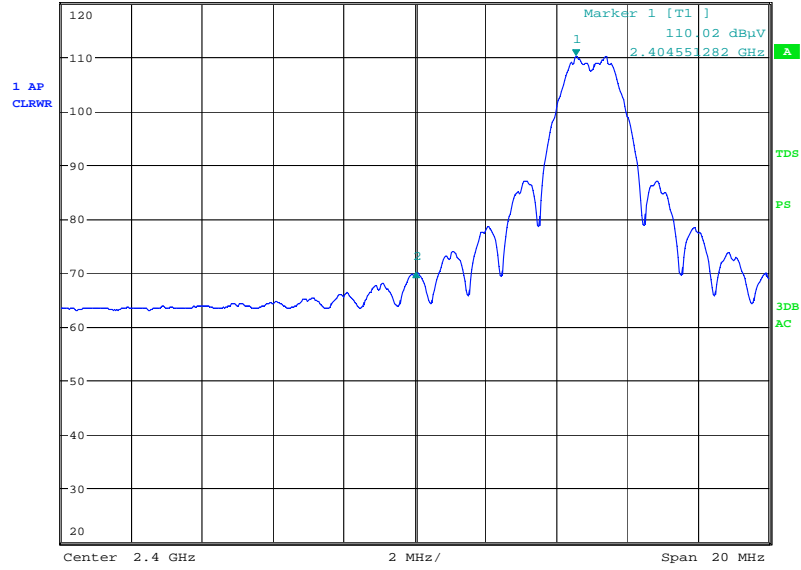
Date: 19.JAN.2009 16:13:47



### Band Edge, Radiated



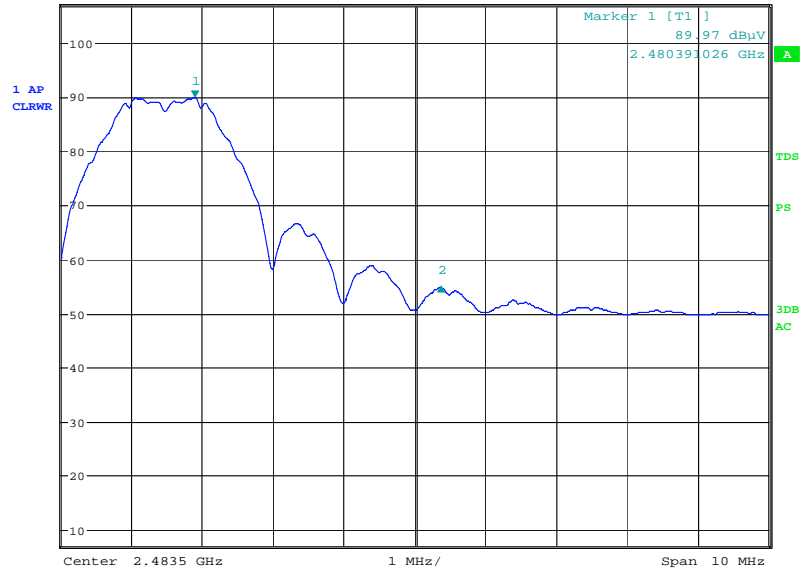
CEN-RFGW-EX BT 253 11      \*RBW 100 kHz      Delta 2 [T1 ]  
\*VBW 10 Hz      -40.06 dB  
Ref 120 dB $\mu$ V      \*Att 20 dB      SWT 16 s      -4.519230769 MHz



Date: 19.JAN.2009 09:14:12



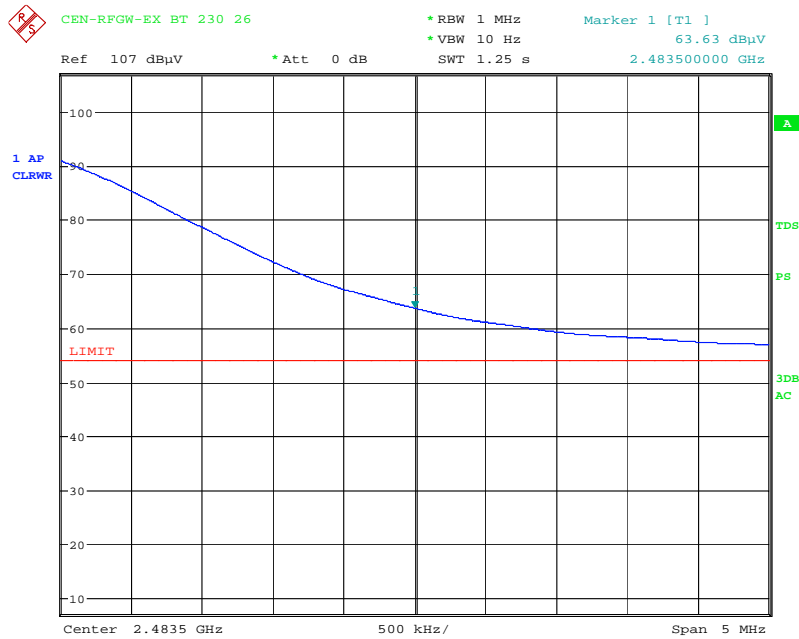
CEN-RFGW-EX BT 230 26      \*RBW 100 kHz      Delta 2 [T1 ]  
\*VBW 10 Hz      -35.20 dB  
Ref 107 dB $\mu$ V      \*Att 0 dB      SWT 8 s      3.477564103 MHz



Date: 19.JAN.2009 08:49:29



## Band Edge, Radiated



Date: 14.JAN.2009 12:25:52

NOTE: This data was taken at 3-meter distance showing the compliance of band edge at the restricted band of 2483.5MHz. Antenna factor and cable loss were compensated for in the receiver. Calculation of duty cycle correction factor (11 dB) is attached in a separate file.



### 3.6 *Conducted Spurious Emissions*

**Performance Criterion:** In any 100 kHz bandwidth outside the frequency band, the RF power shall be at least 20 dB below that in the 100 kHz bandwidth within the band.

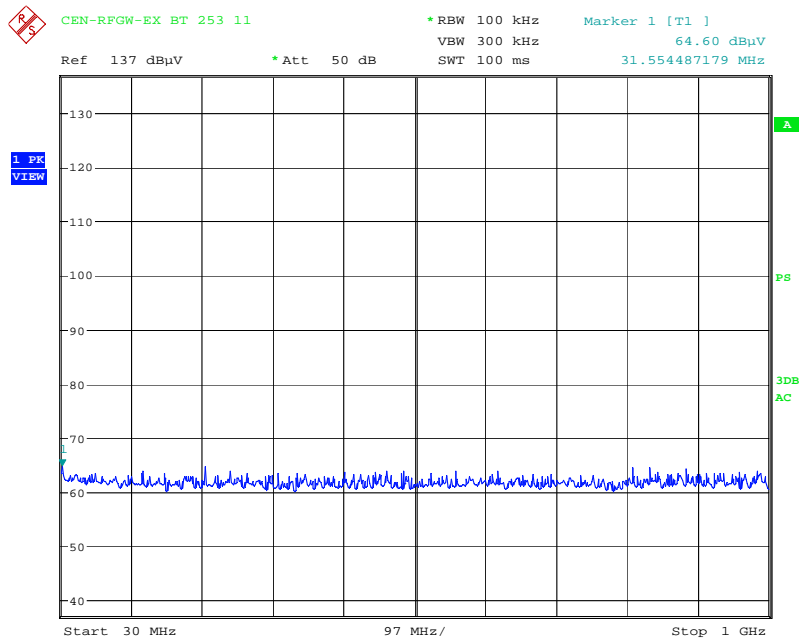
**Test Results:** Complies

**Test Details:** Refers to the following receiver screen captures

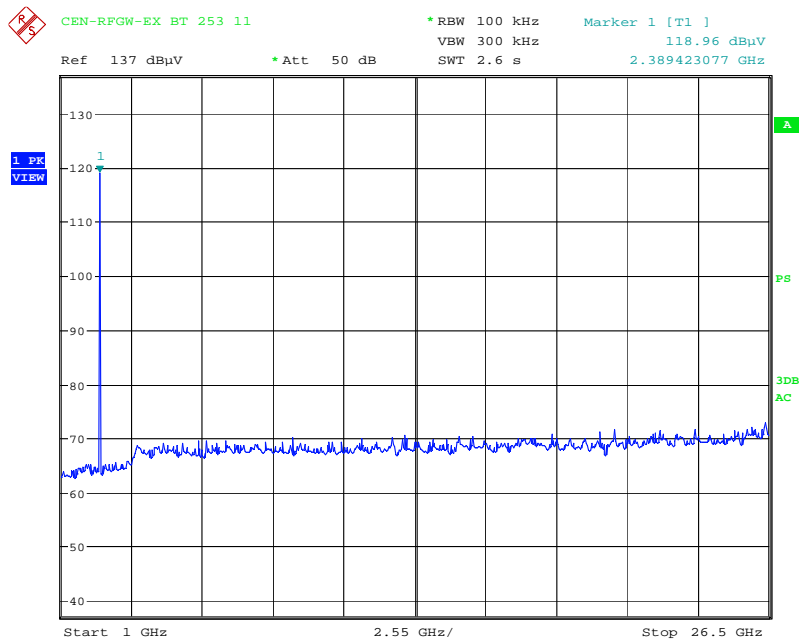
**Note:** The EUT was tested in a continuous transmit mode with maximum power level of 253. The RF level in the screen captures is relative and is not the indication of RF output power. The insertion loss was compensated for in the receiver.



## Conducted Spurious Emission – Channel 11



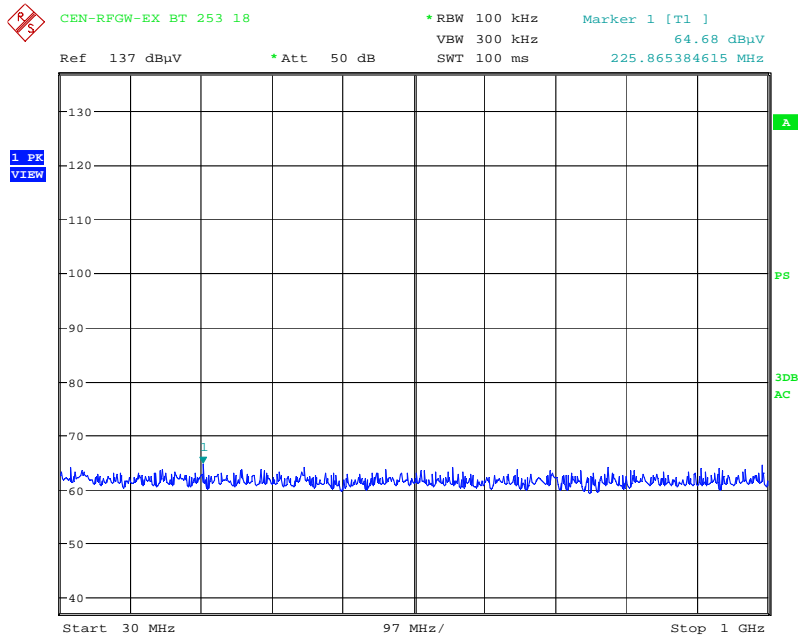
Date: 12.JAN.2009 13:46:50



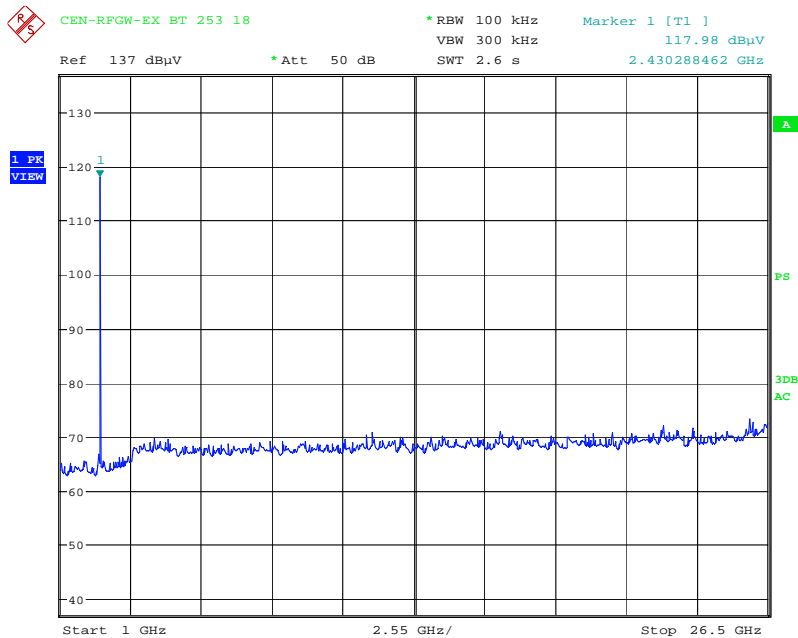
Date: 12.JAN.2009 13:46:00



### Conducted Spurious Emission – Channel 18



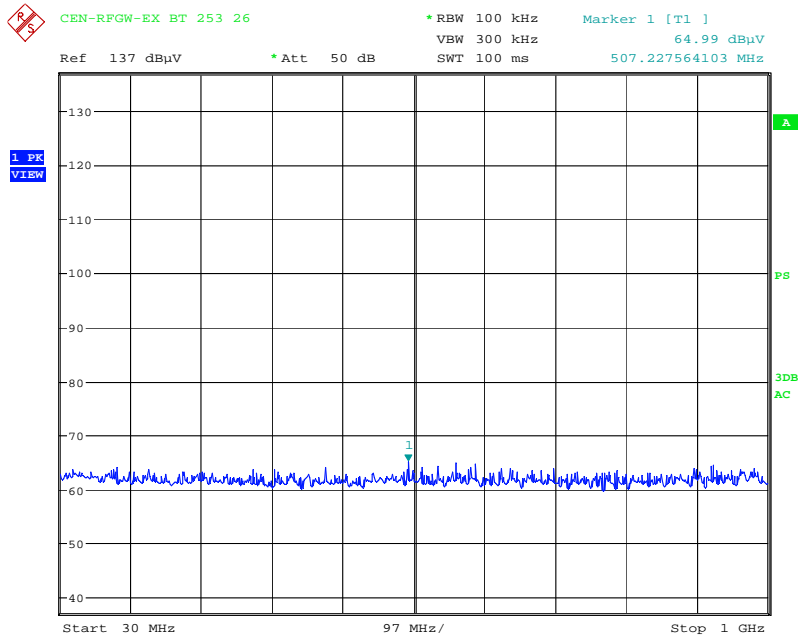
Date: 12.JAN.2009 13:43:37



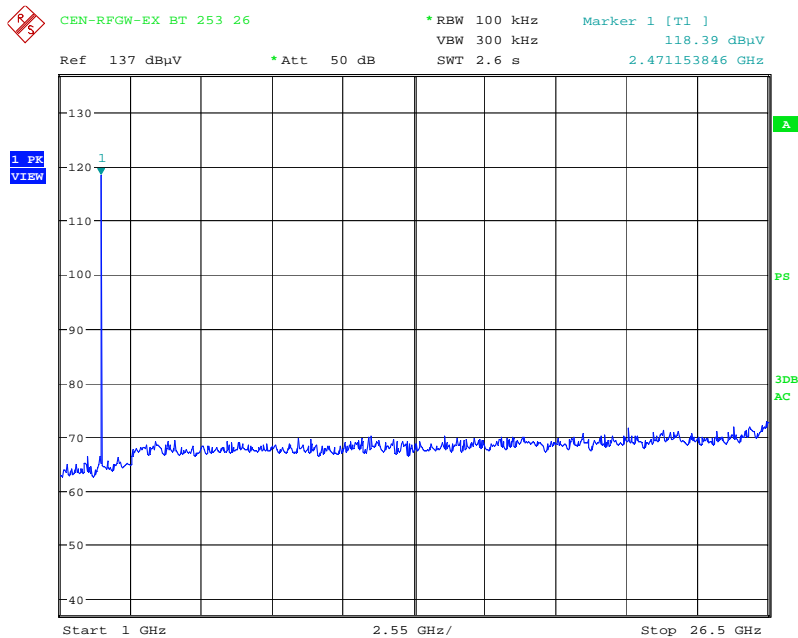
Date: 12.JAN.2009 13:44:30



## Conducted Spurious Emission – Channel 26



Date: 12.JAN.2009 13:38:47



Date: 12.JAN.2009 13:37:18



### 3.7 Power Spectral Density

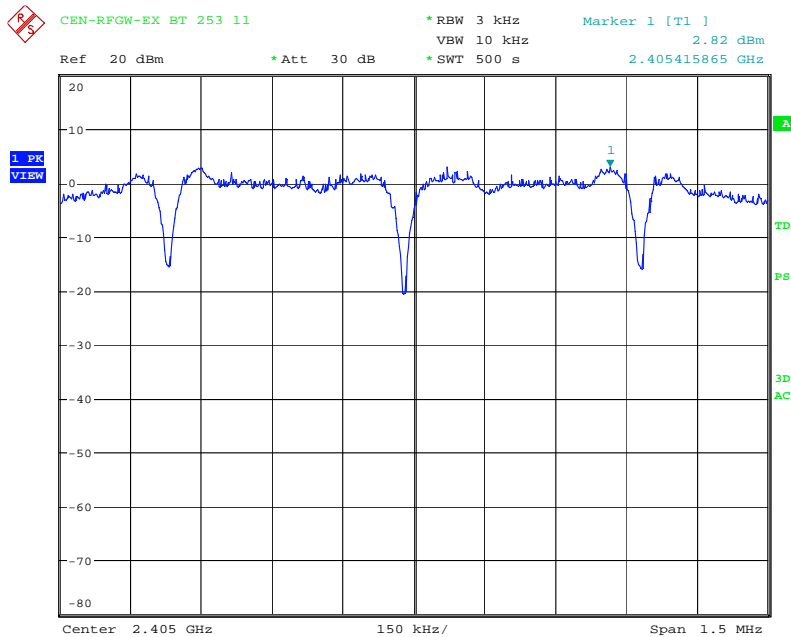
**Performance Criterion:** The power spectral density shall not be greater than 8 dBm in any 3 kHz band.

**Test Results:** Complies

**Test Details:** The EUT was tested in a continuous transmit mode with maximum power level of 253. Refers to the following table and receiver screen captures. The insertion loss was compensated for in the receiver.

Channel	Frequency (MHz)	Power Spectral Density (dBm)
11	2405	2.82
18	2440	2.39
26	2480	2.34

#### Channel 11:

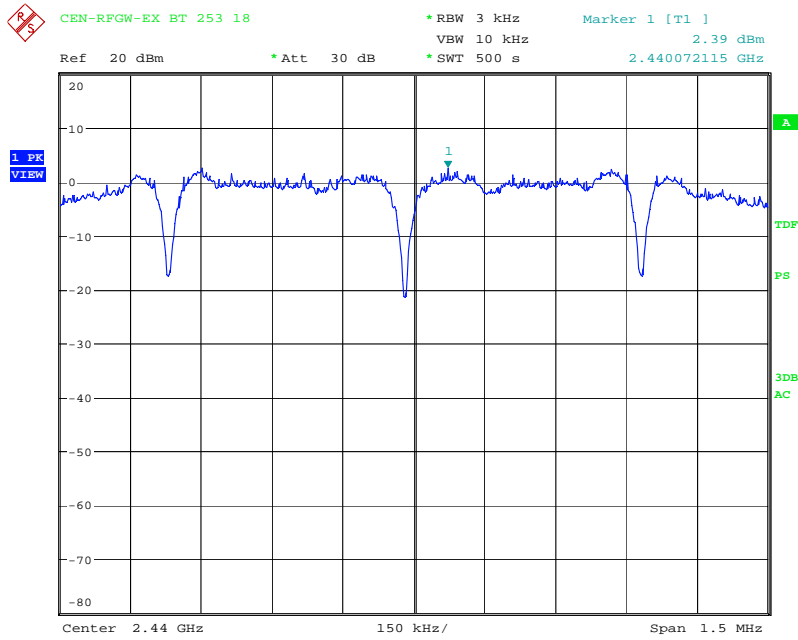


Date: 12.JAN.2009 12:25:11



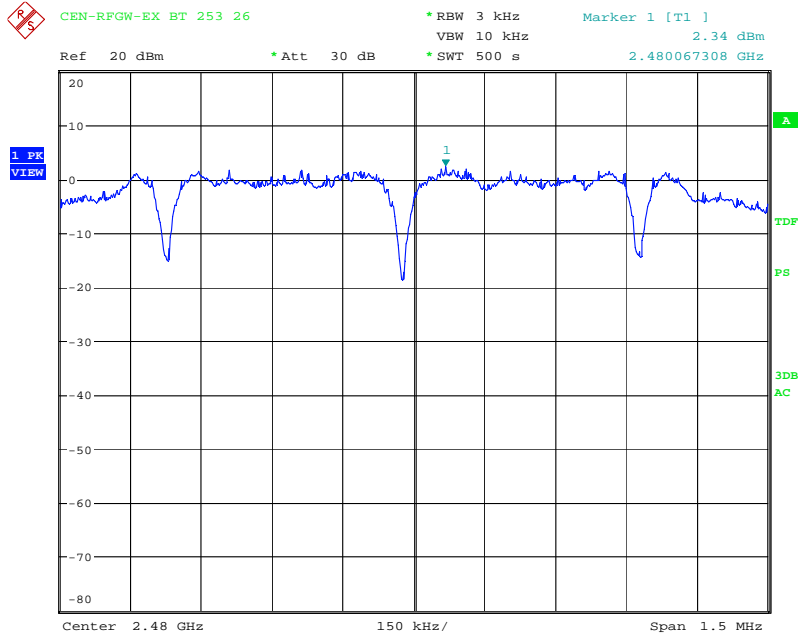


Channel 18:



Date: 12.JAN.2009 12:36:03

Channel 26:



Date: 12.JAN.2009 12:52:48



### 3.8 *RF Safety*

**Performance Criterion:** The human RF exposure limit is 1 mW/cm<sup>2</sup>.

**Test Results:** Complies

**Details:** The maximum permissible exposure (MPE) is predicted by using Equation (3) of Section 2 of FCC 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)

P = 54.96 mW (17.4 dBm), G = 1.585 (2 dBi), R = 20 cm

$$S = 0.0173 \text{ mW/cm}^2$$

MPE limit for uncontrolled exposure at prediction frequency: 1 mW/cm<sup>2</sup>

Maximum allowable antenna gain: 19.6 dBi

Margin of Compliance at 20 cm = **17.6 dB**



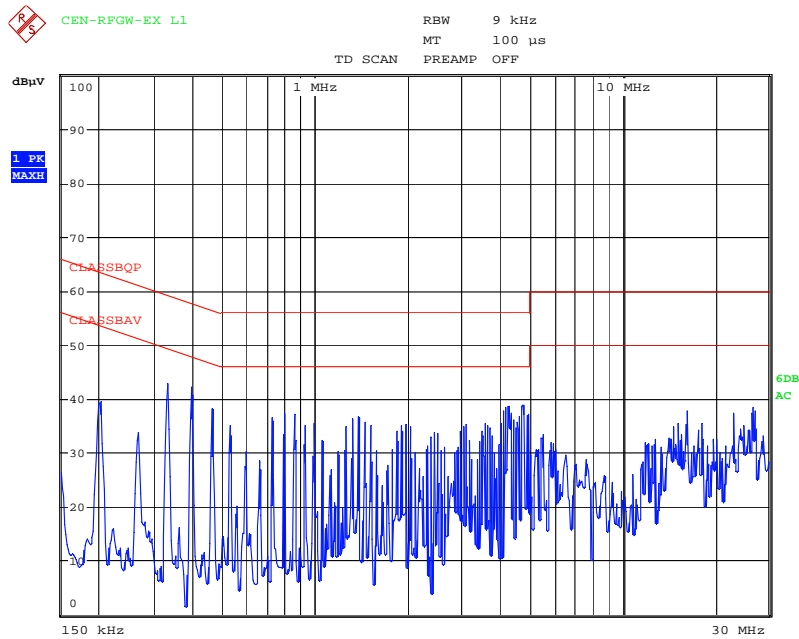
### 3.9 Power Line Conducted Emissions

**Performance Criterion:** AC power line conducted emissions shall not exceed the limits specified in FCC § 15.207 and Table 2 of IC RSS-Gen.

**Test Results:** Complies.

**Test Details:** Refers to the following receiver screen captures. The screen captures represent Peak emissions.

**Line 1:**



Date: 31.DEC.2008 09:13:09

**Line 1:**

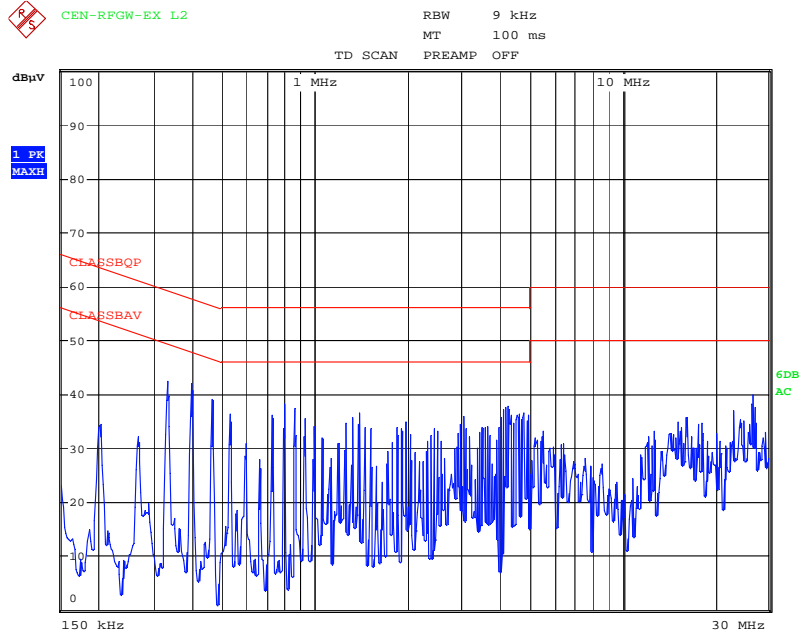
Freq. (MHz)	Level (dBuV)		Limits (dBuV)		Margin (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	
0.331	44.1	43.6	60.8	50.8	7.2
0.398	43.9	43.4	58.9	48.9	5.5
0.464	40.4	39.7	57	47	7.3
0.994	35.8	34.9	56	46	11.1
4.24	39.6	38.9	56	46	7.1
4.77	39.3	38.6	56	46	7.4

Tested Dec. 31, 2008



## Power Line Conducted Emissions

### Line 2:



Date: 31.DEC.2008 09:23:25

### Line 2:

Freq. (MHz)	Level (dBuV)		Limits (dBuV)		Margin (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	
0.331	43.4	42.9	60.8	50.8	7.9
0.398	42.8	42.2	58.9	48.9	7.7
0.464	39.7	39.0	57	47	8.0
0.795	38.6	38.0	56	46	8.0
4.18	38.3	38.0	56	46	8.0
4.77	38.2	37.5	56	46	8.5

Tested Dec. 31, 2008

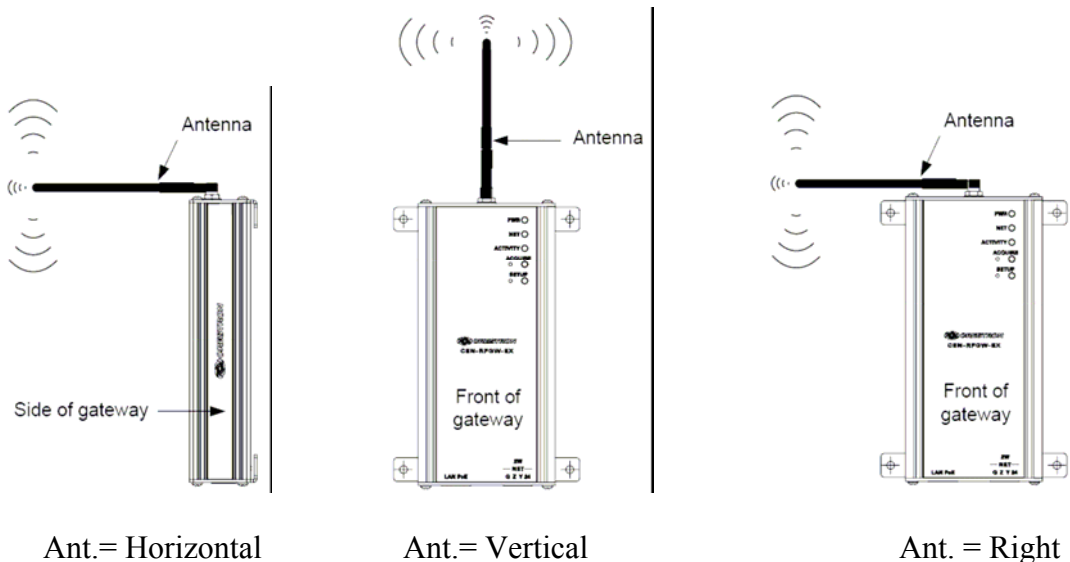
### 3.10 Radiated Emissions and Radiated Spurious Emissions

**Performance Criterion:** In any 100 kHz bandwidth outside the frequency band, the RF power shall be at least 20 dB below that in the 100 kHz bandwidth within the band. Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified in FCC § 15.209(a) and Table 2 of IC RSS-210.

**Test Results:** Complies

**Test Details:** For each scan of radiated and radiated spurious emission measurement, the procedures for maximizing emissions were followed. The EUT was rotated and antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. All radiated and radiated spurious emission measurements, up to 18 GHz, were performed at 3-meter distance between an antenna and the EUT. Above 18 GHz, radiated spurious emission measurement was performed at 1-meter distance. For the frequency range 30-1000MHz, measurement was made using a quasi-peak detector with a 120 kHz bandwidth. For the frequency range above 1 GHz, measurement was made using a peak detector with a 1 MHz bandwidth.

EUT was tested in three orthogonal orientations (XY, YZ, and ZX planes) with antenna at horizontal, vertical, and right orientations.





Refers to the following tables for test data. Antenna factor, cable loss, and preamplifier gain were compensated for in the receiver. Calculation of duty cycle correction factor is attached in a separate file.

Antenna Polarization	Freq. (MHz)	EUT Orientation	Channel	Emission Level (dBuV/m)	FCC & IC Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Turntable Angle (deg.)
V	375.0	YZ	11	35.0	46	11.0	161.3	0.0
V	450.0	XY	26	38.8	46	7.2	202.1	0.0
V	525.0	YZ	18	32.9	46	13.1	100.0	191.5
V	600.0	YZ	18	45.3	46	0.7	100.0	83.8
H	1200.0	XY	18	39.2	54	14.8	100.0	35.5
H	3450.0	XY	26	47.2	54	6.8	100.0	151.9

Tested Jan. 5-8, 2009

Antenna Polarization	Frequency (MHz)	Channel No.	Power Setting	EUT Orientation	EUT Antenna Orientation	Measured Data (dBuV/m)	Duty Cycle Correction Factor (dB)	Corrected Data	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Turntable Degree
H	4810	11	253	XY	R	64.18	11	53.18	54	0.82	123.6	358.7
H	2390	11	253	XY	R	57.88	11	46.88	54	7.12	123.6	358.7
H	12025	11	253	XY	R	52.1	11	41.1	54	12.9	124.9	345.6
H	19240	11	253 (NF)	XY	R	43.55	11	32.55	54	21.45	-	-
H	4880	18	253	XY	R	63.06	11	52.06	54	1.94	122.4	349.1
H	7320	18	253	XY	R	64.89	11	53.89	54	0.11	122.5	356.3
H	12200	18	253	XY	R	52.94	11	41.94	54	12.06	122.4	349.4
H	19520	18	253 (NF)	XY	R	43.87	11	32.87	54	21.13	-	-
H	4950	25	251	XY	R	62.07	11	51.07	54	2.93	124.9	356.4
H	7425	25	251	XY	R	61.9	11	50.9	54	3.1	124.6	357
H	12375	25	251	XY	R	49.5	11	38.5	54	15.5	122.9	357.5
H	19800	25	251 (NF)	XY	R	44.02	11	33.02	54	20.98	-	-
H	22275	25	251 (NF)	XY	R	43.21	11	32.21	54	21.79	-	-
H	4960	26	230 (NF)	XY	R	47.35	11	36.35	54	17.65	119.2	358
H	7440	26	230 (NF)	XY	R	-	11	-	-	-	-	-
H	12400	26	253	XY	R	56.72	11	45.72	54	8.28	119.7	357.9
H	12400	26	230 (NF)	XY	R	NF	11	-	-	-	-	-
H	19840	26	230 (NF)	XY	R	43.58	11	32.58	54	21.42	-	-
H	22320	26	230 (NF)	XY	R	43.45	11	32.45	54	21.55	-	-

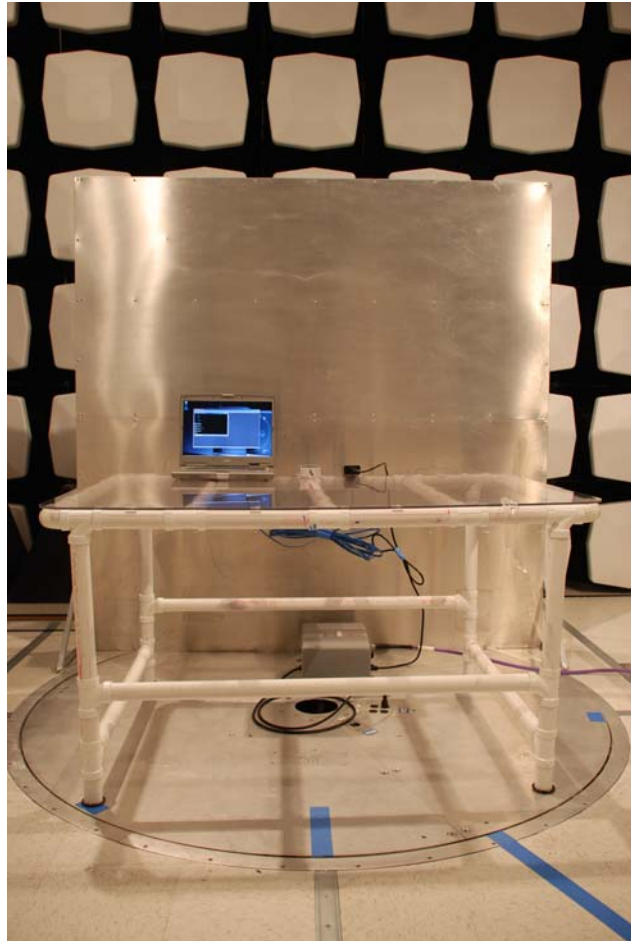
NF: Noise Floor

Tested Jan. 14-16, 2009

## 4. Test Setup Photos

### Conducted Emission Configuration Photographs

Worst-case conducted emission, front view



## Conducted Emission Configuration Photographs

Worst-case conducted emission, side view





## Radiated Emission Configuration Photographs

Worst-case radiated emission, front view



Worst-case radiated emission, side view

