

# Tantalus Systems Corp.

## TC-2200

### Report of Measurements

Per

**CFR47, FCC Part 15, Subpart B and C**

Revision 1.1

October 22, 2002

Approvals		
Written By:	<hr/> Craig Long	<hr/> Date
Checked by	<hr/> Robert Stirling, P.Eng.	<hr/> Date

Protocol Labs, Abbotsford B.C., Canada  
FCC Registration Number 96437  
Industry Canada Registration Number IC3384

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## FCC CFR47 Part 15/B Report of Measurements

### Testing Details:

TESTED BY: Robert Stirling\ Bruce Balston  
 TEST CONDITIONS: Temperature and Humidity: 24°C, 60%  
 TEST VOLTAGE: 240 VAC 60 Hz

### Test Facilities:

Protocol Labs  
 28945 McTavish Rd.  
 Abbotsford B.C., Canada, V4X 2E7  
 FCC Registration Number 96437  
 Industry Canada Registration Number IC3384

### Test Equipment List:

EMISSIONS:

Device	Model Number	Serial No.	Last Cal.	Next Cal
Antenna	EMCO 3141 Bilog	1127	09/13/01	09/13/02
Antenna	EMCO 3105	2024	09/10/01	09/10/02
Spectrum Analyzer	Hewlett Packard 8566B	2241A02102	01/10/02	01/10/03
RF-Preselector	Hewlett Packard 85685A	3107A01222	01/10/02	01/10/03
Quasi-Peak Adapter	Hewlett Packard 85650A	2043A00240	01/10/02	01/10/03
Power Meter	Marconi 6960B	237087/007	02/11/02	02/11/03
Power Sensor	Marconi	961823/002	02/11/02	02/11/03
Tower	Rhientech Labs	Custom	N/A	N/A
Turntable	Protocol	Custom	N/A	N/A

**Equipment Under Test:**

**THE TEST SYSTEM:**

**EUT** TC-2200 Series 433 MHz Remote Transceiver  
Manufacturer Tantalus Systems Corp.  
Part Number TC- 2200  
Serial Number Prototype  
Emissions Designator: F1D

**CABLING:**

Cable	Description	Shielded	Ferrite
Power	AC Input Power Cable	No	No

**TEST SETUP:**

For the unintentional radiator portion of the testing the EUT was placed in receive mode, and for the Spurious emissions testing the EUT was placed in transmit mode for the duration of the testing.

## TEST SUMMARY:

Test	Standard	Description	Result
Conducted Emissions	FCC 15.107 ,15.207 Class B Limits	The Conducted Emissions are measured on the phase and Neutral Power lines in the 0.15 - 30.0 MHz range.	Complies
Radiated Emissions	FCC15.109 15.209 Class B Limits	The Radiated Emissions are measured from 30 MHz to 1000 MHz	Complies
Radiated Spurious	FCC 2.103/ 2.1053, 15.231	The radiated emissions are measured up to the 10 <sup>th</sup> Harmonic	Complies
Occupied Bandwidth	FCC 2.1049	A Radiated measurement of the fundamental	Complies
Spurious Emissions at Antenna Terminal	FCC 2.1035/ 2.1051	The radiated emissions are measured in the 30-1000Mhz range	Complies

## MODIFICATIONS:

This unit requires no modifications for it to pass.

## CONCLUSION:

TC-2200 tested complies with the requirements of FCC CFR47 part 15/B and 15/C

## **Part 1 - Radiated Emission Testing**

DATE: August 21, 2002

TEST STANDARD: FCC CFR47, Part 15, Subpart B section 15.109/ 15.209 Class B

DEVICE DESCRIPTIONS: Refer to the Equipment Under Test Section, above, for EUT Descriptions.

TEST SETUP: The equipment was set up in a 3 meter open field test site. Emissions in both horizontal and vertical polarization's were measured while rotating the EUT on a turntable to maximize the emissions signal strength and the results recorded on the attached plots.

CABLING DETAILS: The EUT was set up using the manufacturer's specified normal cabling configuration.

CABLE DESCRIPTIONS

<b>Cable</b>	<b>Name</b>	<b>Ferrite</b>	<b>Shielded</b>
Power	AC Input Power Cable	No	No

MINIMUM STANDARD: Class B Limits:

<b>Frequency (MHz)</b>	<b>Maximum Field Strength dBuV/m at 3m</b>
30 - 88	39.0
88 - 216	43.5
216 - 960	46.5
960 - up	49.5

MEASUREMENT DATA: See Appendix B for Plots, The blue trace represents all emissions, including ambient noise. 'All Suspects' are marked in purple. FCC Class B limits are marked in solid purple.

EMISSIONS DATA: See Table 5 and 6 in Appendix B for corresponding frequencies.

PERFORMANCE: Complies.

**Part 2 - Conducted Emissions**

DATE: August 21, 2002

TEST STANDARD: FCC CFR47, Part 15, Subpart B section 15.107/ 15.207 Class B

DEVICE DESCRIPTIONS: Refer to the Equipment Under Test Section, above, for EUT Descriptions.

TEST SETUP: The EUT was connected to the conducted emissions LISN apparatus.

METHOD OF MEASUREMENT: Measurements were made using a spectrum analyzer, Peak detector. Any emissions that are close to the limit are measured using a test receiver, CISPR Quasi-Peak detector. The TC-2200 was tested for conducted emission in receiving and transmitting mode at 240 VAC 60 Hz.

CABLING DETAILS: The EUT was set up using the manufacturer's specified normal cabling configuration.

CABLE DESCRIPTIONS

Cable	Name	Ferrite	Shielded
Power	AC Input Power Cable	No	No

MINIMUM STANDARD: Class B Limits:

Frequency (MHz)	Maximum Level (dBuV)	Maximum Level (dBuV)
	Quasi-Peak	Average
0.45 – 30.0	51.0	48.0

MEASUREMENT DATA: See Appendix B for Plots,

EMISSIONS DATA: See Table 1 , 2, 3 and 4 in Appendix B for corresponding frequencies.

PERFORMANCE: Complies.

### **Part 3 - Radiated Spurious Emissions**

DATE: August 21, 2002

TEST STANDARD: FCC CFR47, Part 2, 103, and 1053

DEVICE DESCRIPTIONS: Refer to the Equipment Under Test Section, above, for EUT Descriptions.

TEST SETUP: The equipment was set up at a 3 m measurement distance, and. Spurious emissions we measured in both horizontal and vertical polarization's with signal strength and the results recorded on the attached graph and tables.

CABLING DETAILS: The EUT was Set up using the manufacturer's specified normal cabling configuration.

MINIMUM STANDARD: The limit for harmonics is 20 dBc. The fundamental 's limit is 72.87 dB $\mu$ V/m.  
Calculation of Averde Correction Factor is;  
The average correction factor is computed by analyzing the worst case on time in any 100msec time period and using the formula:  
Correction Factor (dB) = 20\*log (worst case on time/100msec).  
Analysis of the systemtransmitter worst case on time in any 100 sec time period is an on time 11.3msec.  
Correction Factor (dB) = 20\*log(11.3/100) = -18.938

EMISSIONS DATA: See Appendix D, for Harmonics Data and Plots

MEASUREMENT PROCEDURE: A bilog and horn antenna located 3 meters away from the transmitter picks up any signal radiated from the transmitter. A spectrum analyzer covering the necessary frequency range is used to detect and measure any radiation picked up by the antenna. The testing procedure is repeated for both horizontal and vertical polarization's of the receiving antenna. Relative signal strength is indicated on the spectrum analyzer connected to this antenna., and the cable losses, amplifier gain and antenna correction factor are added to calculate the signal strength. Actual measurements are recorded on the attached graphs.

PERFORMANCE: Complies.



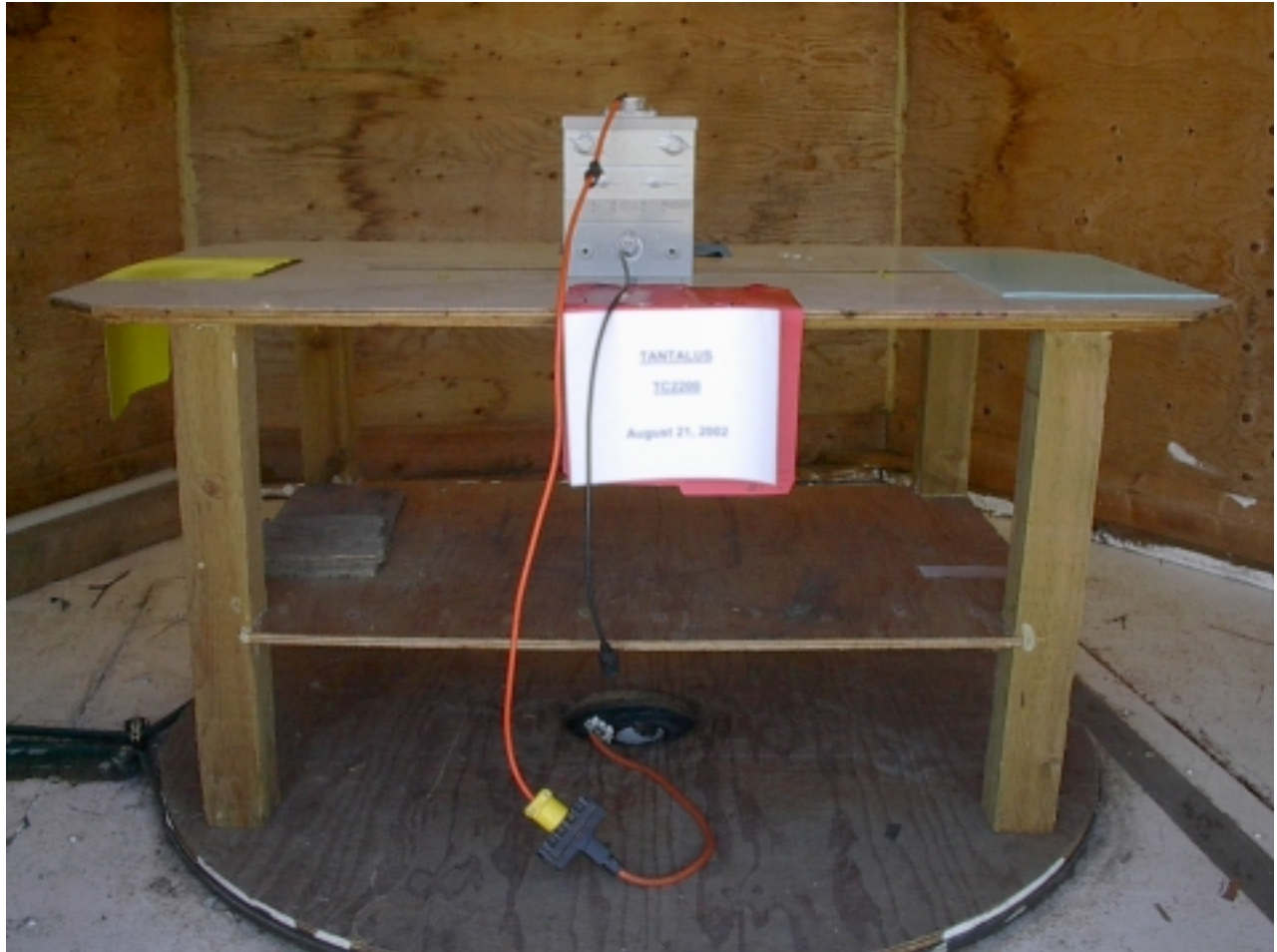
**Part 4 - Occupied Bandwidth**

DATE:	August 21, 2002
TEST STANDARD:	FCC CFR47, Part 2.1049
DEVICE DESCRIPTIONS:	Refer to the Equipment Under Test Section, above, for EUT Descriptions.
TEST SETUP:	The equipment under test was placed in its normal transmitting mode for the duration of the test.
CABLING DETAILS:	The EUT was Set up using the manufacturer's specified normal cabling configuration.
DWIDTH LIMIT:	<p>The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70MHz and below 900MHz. Bandwidth is determined at the points 20dB down from the modulated carrier. ( FCC Part 15.231)</p> <p>Calculation of 20dB Bandwidth and Result</p> <p>The 20dB bandwidth limit = <math>0.0025 * 434.423 \text{ MHz} = 1.08605 \text{ MHz}</math></p> <p>The measured 20dB bandwidth is 278.57kHz</p>
MEASUREMENT DATA:	See Appendix C for Graphs and Data
EMISSIONS DATA:	See Appendix C for corresponding frequencies
MEASUREMENT PROCEDURE:	The occupied bandwidth test was performed on the equipment under test while it was transmitting at full power. The occupied bandwidth test was conducted in accordance with FCC Part 2.
PERFORMANCE:	Complies.

## Appendix A: Photos



Emissions Test Setup Front View



Emissions Test Setup Rear View

## **Appendix B: FCC Part 15/B Measurement Data and Plots**

### **Measurement Data**

#### **Conducted Emissions**

#### **Non Transmitting**

**Table 1: Line 1 FCC Class B**

Frequency (MHz)	Peak (dBuV)	DeLim-Pk (dB)
6.815	38	-10.0
.4883	30.5	-17.5
.5515	28.4	-19.6
.4806	28.2	-19.8
.6263	27.2	-20.8

**Table 2: Line 2 FCC Class B**

Frequency (MHz)	Peak (dBuV)	DeLim-Pk (dB)
6.815	36.7	-11.3
.4857	31.9	-16.1
.4656	31.9	-16.7
.5041	30.2	-17.8
.4534	29.9	-18.1

#### **Transmitting**

**Table 3: Line 1 FCC Class B**

Frequency (MHz)	Peak (dBuV)	DeLim-Pk (dB)
6.961	35.2	-15.8
.4731	29.1	-18.9
.4883	28.7	-19.3
.4559	28.4	-19.6
.5203	27.8	-20.2

**Table 4: Line 2 FCC Class B**

Frequency (MHz)	Peak (dBuV)	DeLim-Pk (dB)
6.961	35.8	-12.2
20.06	34.2	-13.8
13.93	31	-17.0
.4631	28.5	-19.5
.4706	28.4	-19.6
.4832	26.7	-21.3

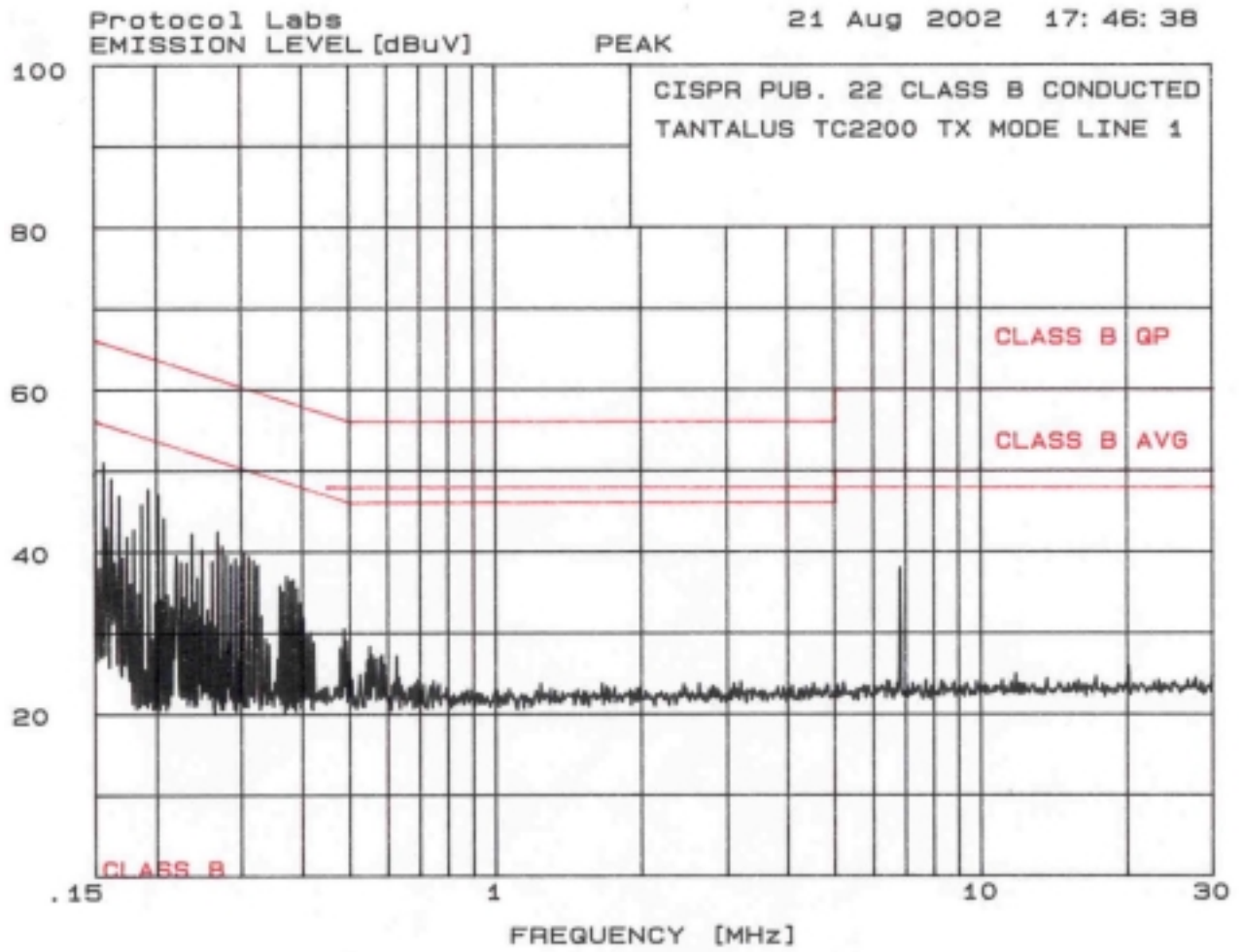
**Table 5: Radiated Emissions**

<b>Frequency (MHz)</b>	<b>Pol</b>	<b>Height (m)</b>	<b>Angle (deg)</b>	<b>Un Corr Pk (dB)</b>	<b>Tot Corr (dB)</b>	<b>Peak (dBuV/m)</b>	<b>DelLim- Pk (dB)</b>
201.709314	Vert	1.0	275	6.30	11.92	18.22	-25.28
222.555627	Vert	1.0	345	12.50	13.35	25.85	-20.15
229.531105	Vert	1.0	345	14.40	13.61	28.01	-17.99
445.142968	Vert	1.0	0	17.20	19.74	36.94	-9.06
201.705686	Horz	1.5	275	7.80	11.92	19.72	-23.78
222.558932	Horz	1.5	90	14.10	13.35	27.45	-18.55
229.525299	Horz	1.5	90	18.10	13.61	31.71	-14.29
445.139249	Horz	1.7	315	20.40	19.74	40.14	-5.86

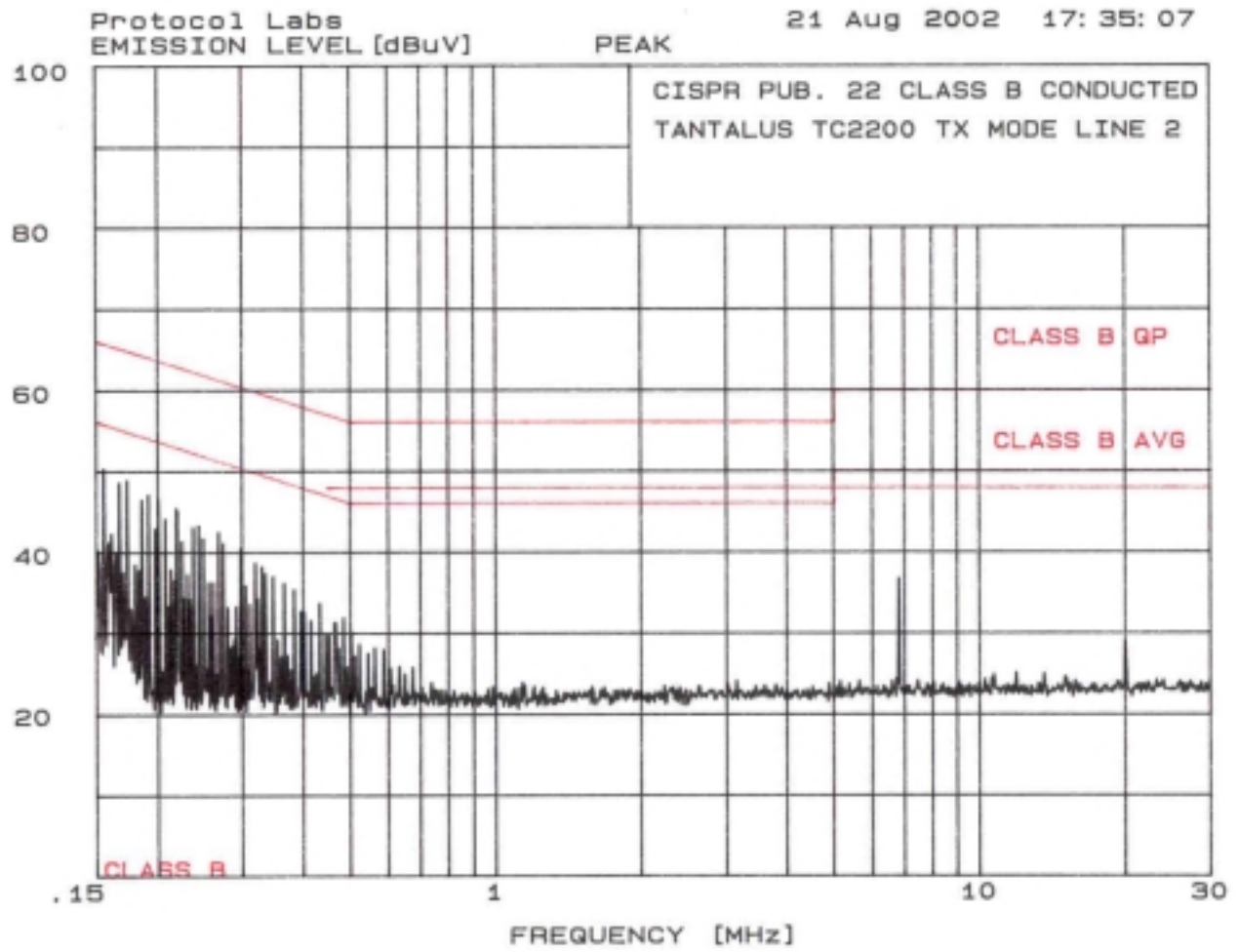
**Table 6: Product Emissions**

<b>Frequency (MHz)</b>	<b>Pol</b>	<b>Height (cm)</b>	<b>Angle (deg)</b>	<b>Un Corr Pk (dB)</b>	<b>Tot Corr (dB)</b>	<b>Peak (dBuV/m)</b>	<b>DelLim- Pk (dB)</b>
445.139249	Horz	1.7	315	20.40	19.74	40.14	-5.86
229.525299	Horz	1.5	90	18.10	13.61	31.71	-14.29
222.558932	Horz	1.5	90	14.10	13.35	27.45	-18.55
201.705686	Horz	1.5	275	7.80	11.92	19.72	-23.78

### Emissions Plots



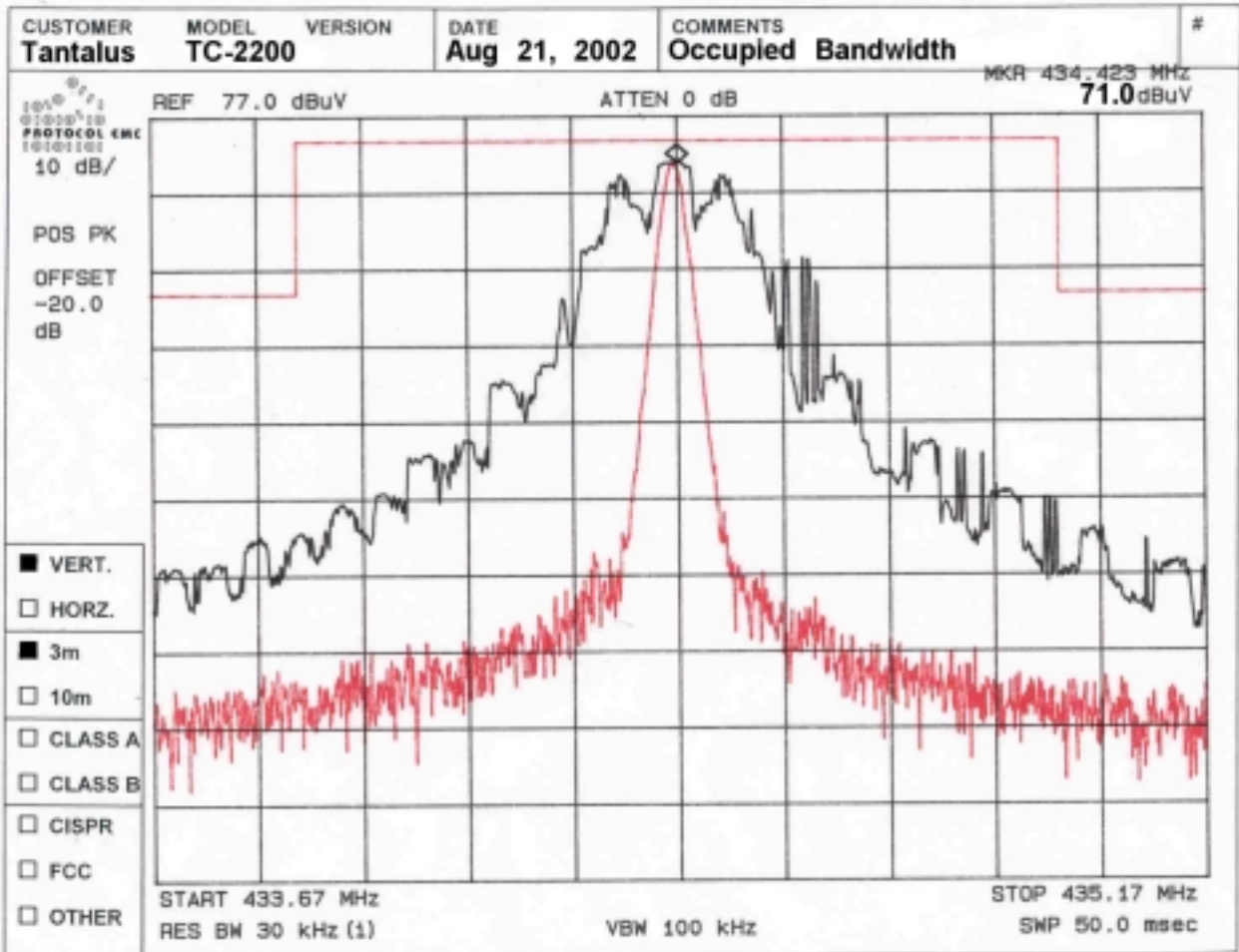
Transmitting Line 1



Transmitting Line 2

# Appendix C: Occupied Bandwidth

Occupied Bandwidth for 434.423 MHz

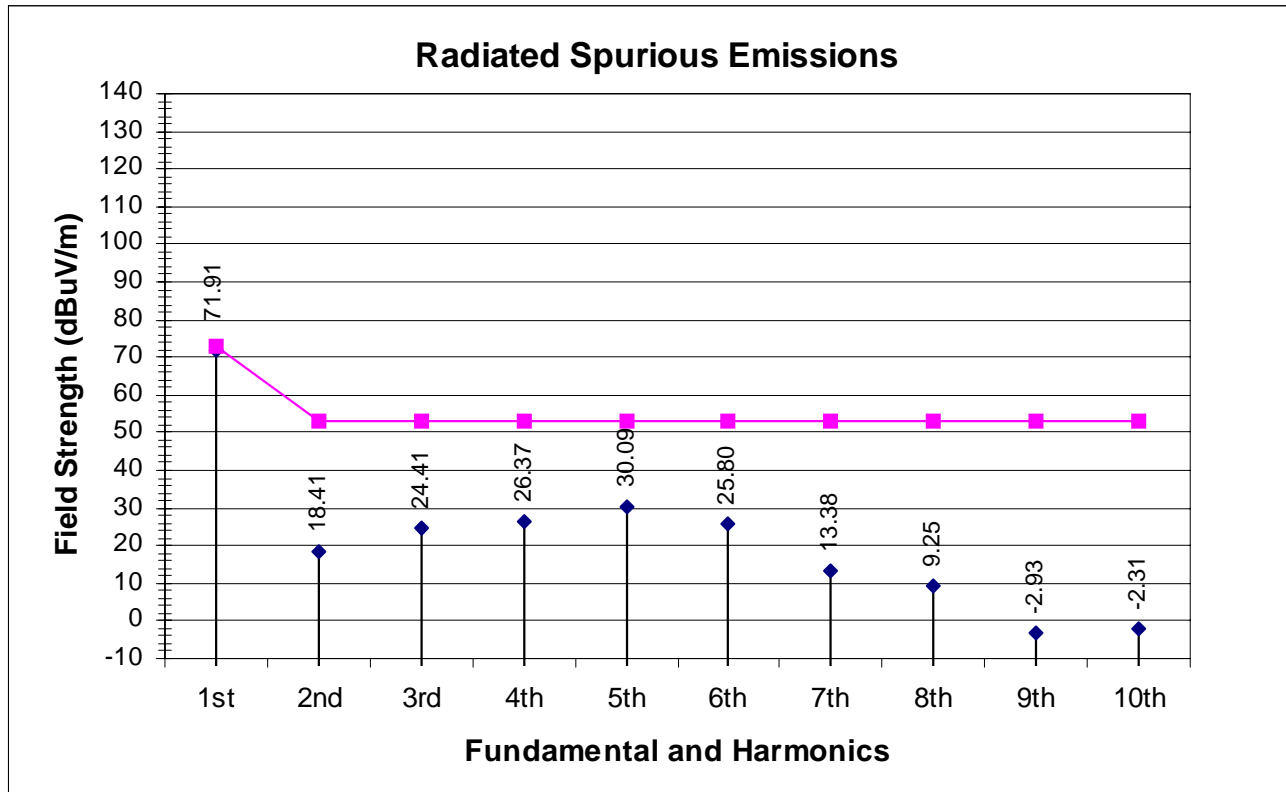


Occupied Bandwidth Plot



## Appendix D: Harmonic Measurements

Harmonics for 434.423 MHz



Harmonic	Frequency (MHz)	Polarity	Uncor Pk (dBuV)	Tot Corr (dB)	Peak (dbuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Delta Limit (dB)	dBc
1st	434.42	V	71.0	19.85	90.85	71.91	72.87	-0.96	--
2nd	868.84	V	10.4	26.95	37.35	18.41	52.87	-34.46	-54.46
3rd	1303.26	V	11.4	31.95	43.35	24.41	52.87	-28.46	-48.46
4th	1737.68	H	10.2	35.11	45.31	26.37	52.87	-26.5	-46.50
5th	2172.1	V	41.8	7.22	49.02	30.09	52.87	-22.78	-42.78
6th	2606.52	H	41.6	3.13	44.73	25.80	52.87	-27.07	-47.07
7th	3040.94	V	32.7	-0.38	32.31	13.38	52.87	-39.49	-59.62
8th	3475.36	V	31.7	-3.51	28.188	9.25	52.87	-43.62	-63.62
9th	3909.78	H	23.1	-7.08	16.01	-2.93	52.87	-55.8	-75.80
10th	4344.2	V	25.3	-8.66	16.63	-2.31	52.87	-55.18	-75.18