



**FCC Certification Test Report
for
Capricorn Electronics Inc.
FCC ID: CNACT200**

March 10, 2005

Prepared for:

**Capricorn Electronics Inc.
48 Capricorn Drive
Maiden, NC 28650**

Prepared By:

**Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879**



FCC Certification Test Program

FCC Certification Test Report for the Capricorn Electronics Inc. CT-200 Transmitter FCC ID: CNACT200

March 10, 2005

WLL JOB# 8560

Prepared by: Brian J. Dettling
Documentation Specialist

Reviewed by: Gregory M. Snyder
Chief EMC Engineer

Abstract

This report has been prepared on behalf of Capricorn Electronics Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Periodic Intentional Radiator under Part 15.231 of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for a Capricorn Electronics Inc. CT-200 Transmitter.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The Capricorn Electronics Inc. CT-200 Transmitter complies with the limits for a Periodic Intentional Radiator device under Part 15.231 of the FCC Rules and Regulations.

Table of Contents

Abstract.....	ii
1 Introduction.....	1
1.1 Compliance Statement	1
1.2 Test Scope.....	1
1.3 Contract Information.....	1
1.4 Test Dates	1
1.5 Test and Support Personnel	1
2 Equipment Under Test	2
2.1 EUT Identification & Description	2
2.2 Test Configuration	2
2.3 Testing Algorithm.....	2
2.4 Test Location	2
2.5 Measurements	3
2.5.1 References.....	3
2.6 Measurement Uncertainty.....	3
3 Test Equipment	4
4 Test Results.....	5
4.1 Duty Cycle Calculation and Transmitter Timing (§15.35 and §15.231(a)).....	5
4.2 Occupied Bandwidth: (FCC Part §2.1049 and §15.231)	8
4.3 Radiated Spurious Emissions: (FCC Part §2.1053 and 15.231(b))	9
4.3.1 Test Procedure	9

List of Tables

Table 1. Device Summary.....	2
Table 2: Test Equipment List.....	4
Table 3. Duty Cycle Correction.....	7
Table 4. Occupied Bandwidth Results.....	8
Table 6. Radiated Emissions Test Data, Unit Upright.....	10
Table 7: Radiated Emission Test Data, Unit Sideways	11
Table 8: Radiated Emission Test Data, Unit Flat	12

List of Figures

Figure 1. Duty Cycle Plot, Worst Case 100ms	6
Figure 2. Duty Cycle Plot, Pulse Width and Count	7
Figure 3. Occupied Bandwidth	8

1 Introduction

1.1 Compliance Statement

The Capricorn Electronics Inc. CT-200 Transmitter complies with the limits for a Periodic Intentional Radiator device under Part 15.231 of the FCC Rules and Regulations.

1.2 Test Scope

Tests for radiated emissions were performed. All measurements were performed according to the 2003 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer: Capricorn Electronics Inc.
48 Capricorn Drive
Maiden, NC 28650

Purchase Order Number: 1315

Quotation Number: 62168

1.4 Test Dates

Testing was performed on February 4, 2005.

1.5 Test and Support Personnel

Washington Laboratories, LTD James Ritter

2 Equipment Under Test

2.1 EUT Identification & Description

The Capricorn Electronics Inc. CT-200 Transmitter is part of a wireless security monitoring system and is intended for use in retirement communities, assisted living homes, and nursing homes.

The unit is a battery powered remote control operating at 313.5MHz.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Capricorn Electronics Inc.
FCC ID Number	CNACT200
EUT Name:	Transmitter
Model:	CT-200
FCC Rule Parts:	§15.231
Frequency Range:	313.5 MHz
Modulation:	OOK
Occupied Bandwidth:	29.6 kHz
Keying:	Manual
Type of Information:	Control
Number of Channels:	1
Antenna Type	Integral
Interface Cables:	None
Power Source & Voltage:	From 3Vdc battery

2.2 Test Configuration

The CT-200 was configured for continuous transmission and tested in a stand-alone arrangement. No I/O ports are available on the unit.

2.3 Testing Algorithm

The CT-200 was configured to continuously transmit a 30 bit word at 125 ms intervals (preset on unit by the client).

Worst case emission levels are provided in the test results data.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

Land Mobile FM or PM Communications Equipment Measurement and Performance Standards (ANSI/TIA/EIA-603-93)

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ± 2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5 (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.

3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

Table 2: Test Equipment List

Equipment	WLL Asset #	Calibration Due
Hewlett-Packard 8568B Spectrum Analyzer	0073	7/08/05
Hewlett-Packard 85650A Quasi-Peak Adapter	0069	7/08/05
Hewlett-Packard 8593A Spectrum Analyzer	0074	8/17/05
Hewlett-Packard 8449B Microwave Preamp	0312	9/29/05
ARA LPB-2520 BiconiLog Antenna	0007	9/14/05
ARA DRG118/A Microwave Horn Antenna	0425	4/17/05
Hewlett-Packard 85685A RF Preselector	0071	7/08/05

4 Test Results

4.1 Duty Cycle Calculation and Transmitter Timing (§15.35 and §15.231(a))

Measurements may be adjusted where pulsed RF is utilized to find the average level associated with a quantity. This calculation is applied to limits for pulsed licensed and unlicensed devices.

On time = $N_1L_1+N_2L_2+\dots+N_{N-1}L_{N-1}+N_NL_N$, where N_1 is number of type 1 pulses, L_1 is length of type 1 pulses, etc.

- For Unlicensed Intentional Radiators under 47CFR Part 15, all duty cycle measurements compared to a 100 millisecond period
- i.e. duty cycle = on time/100 milliseconds or period, whichever is less
- Restating the basic formula:

- Duty cycle = $(N_1L_1+N_2L_2+\dots+N_{N-1}L_{N-1}+N_NL_N)/100$ or T , whichever is less

Where T is the period of the pulse train.

The following Figures show the plots of the modulated carrier. The spectrum analyzer was set to Zero Span and the video triggered to collect the pulse train of the modulation. Calculations of the duty cycle correction factor were obtained from time data provided by the plots.

Per the manufacturer supplied technical description the transmitter will stop transmitting within 5 seconds after release of the switch. For the alarm response the unit stops transmitting after 3.6 seconds. For the responder transmit signal the unit stops transmitting after 2 seconds. The system integrity or supervision signal occurs every 66 minutes for 1.52 seconds complying with §15.231(a)(3) of 2 seconds/60 minutes maximum.

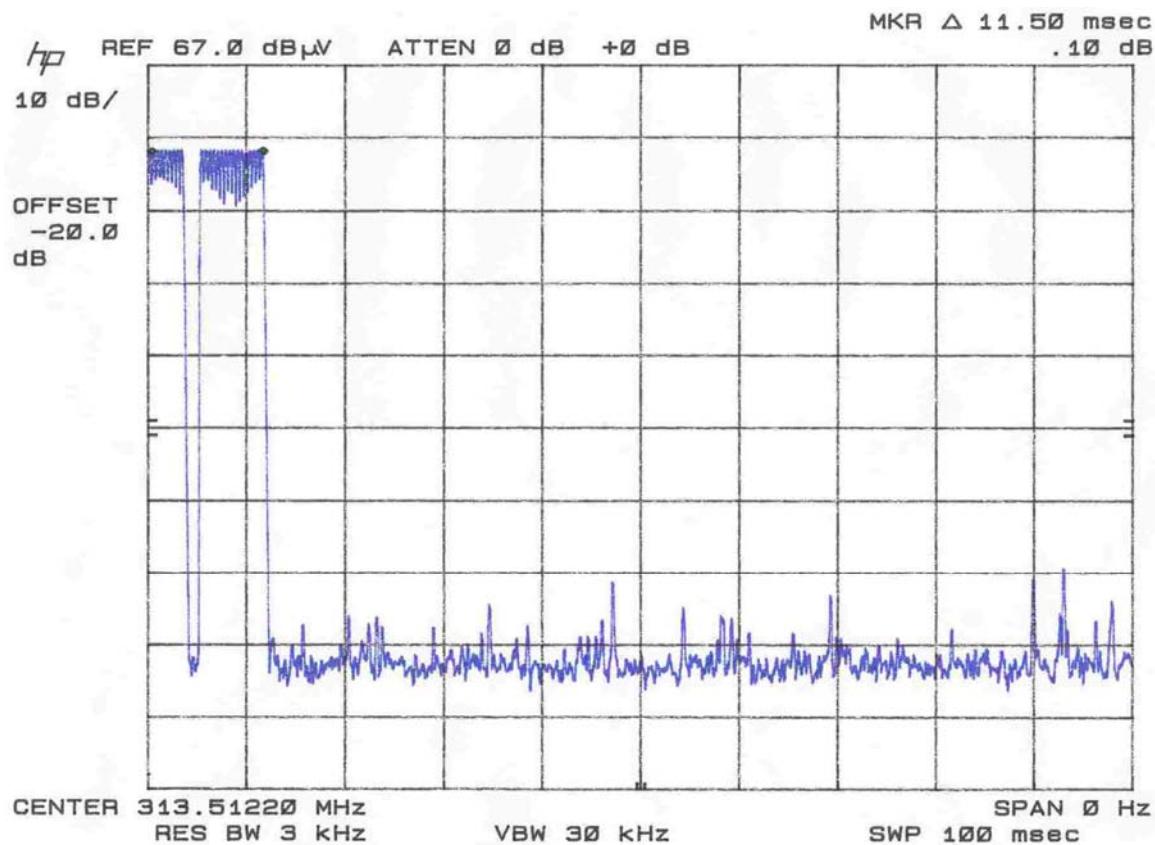


Figure 1. Duty Cycle Plot, Worst Case 100ms

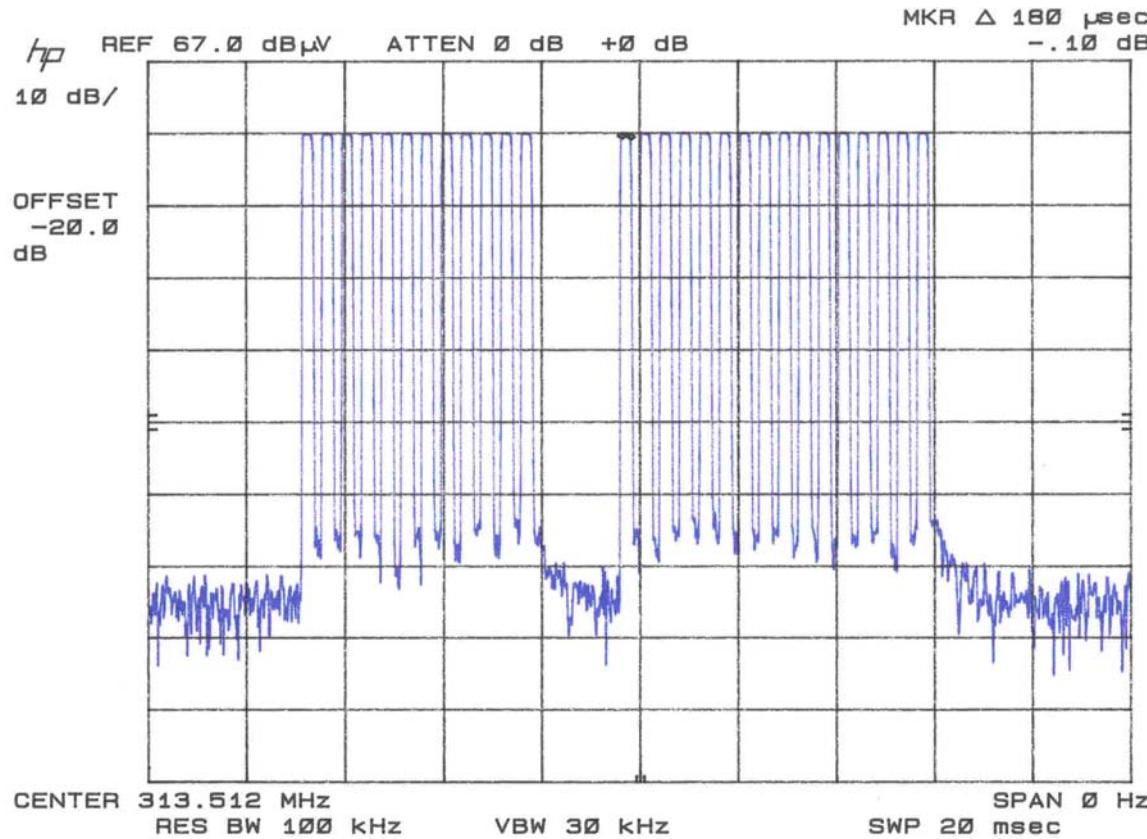


Figure 2. Duty Cycle Plot, Pulse Width and Count

From the data in Figure 1 and Figure 2, the following calculations are made.

Pulse Width = 180 μ s, Number of Pulses/100ms = 28

On Time Per Code Group: 5.04 mS (one code group/100ms)

Worst case on time per 100 mS: 5.04 mS (measured)

The data are summarized in the following table.

Table 3. Duty Cycle Correction

Measurement Time	Total ON Time (worst case)	Duty Cycle (%)	Duty Cycle (dB)
100 mS	5.04 mS	5.04	-20 (Max)

4.2 Occupied Bandwidth: (FCC Part §2.1049 and §15.231)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer via a receive antenna.

FCC Part 15.231 states that the 20 dB bandwidth of the modulated carrier shall be as follows:

Frequency Range (MHz)	Occupied Bandwidth Limit
70-900 MHz	0.25%
>900 MHz	0.5%

At full modulation, the occupied bandwidth was measured as shown:

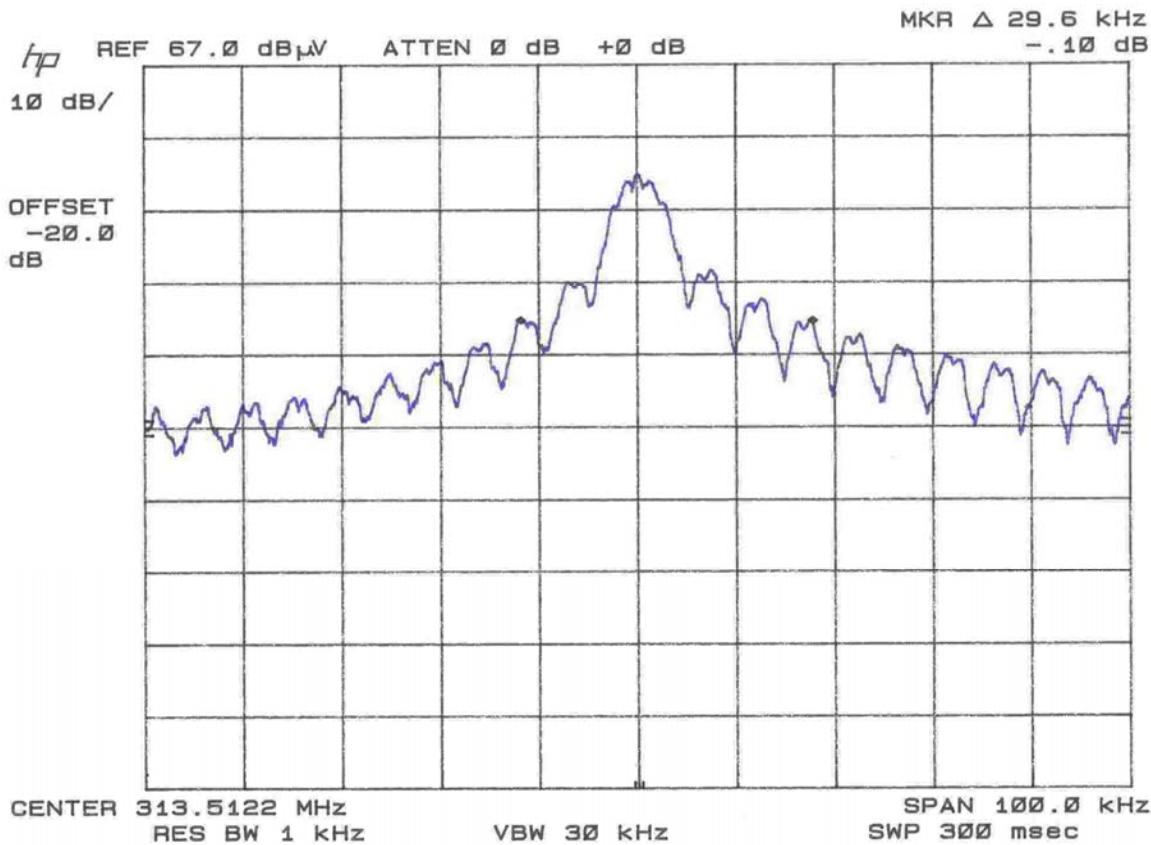


Figure 3. Occupied Bandwidth

Table 4 provides a summary of the Occupied Bandwidth Results.

Table 4. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fai l
313.5 MHz	29.6 kHz	783.75kHz	Pass

4.3 Radiated Spurious Emissions: (FCC Part §2.1053 and 15.231(b))

The EUT must comply with requirements for radiated spurious emissions per the limits given in §15.231(a). In addition, any emissions appearing in the restricted bands listed in §15.205 must comply with the general emission limits of 15.209.

4.3.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. Both the horizontal and vertical field components were measured.

The emissions were measured using the following resolution bandwidths:

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	100kHz	>100kHz
>1000 MHz	1 MHz	1MHz (peak)

Emissions were measured to the 10th harmonic of the transmit frequency. The unit was tested in three orthogonal planes. Worst case emission levels are reported.

The following is a sample calculation used in the data tables for calculating the final field strength of spurious emissions and comparing these levels to the specified limits.

Sample Calculation:

Spectrum Analyzer Voltage (SA Level): V dB μ V (Peak)

Antenna Factor (Ant Corr): AFdB/m

Cable Loss Correction (Cable Corr): CCdB

Duty Cycle Correction (Average) DCCdB

Amplifier Gain: GdB

Electric Field (Corr Level): $EdB\mu V/m = VdB\mu V + AFdB/m + CCdB + DCCdB - GdB$

Table 5. Radiated Emissions Test Data, Unit Upright

CLIENT:	Capricorn	DATE:	2/4/2005
TESTER:	James Ritter	JOB #:	8560
EUT:	CT-200	Test Requirements:	
CONFIGURATION:	30bit word x'd every 125ms	TEST STANDARD:	FCC Part 15.231
S/N:	1	DISTANCE:	3m
		CLASS:	B

Low Frequency Test Equipment/Limit:

ANTENNA:	A_00007
CABLE:	CSITE2_3m
LIMIT:	LFCC_3m_Class_B

High Frequency Test Equipment/Limit:

ANTENNA:	A_00004
CABLE:	CSITE2_HF
AMPLIFIER:	A_00312

Frequency (MHz)	Polarity H/V	Az Deg	Ant. Hght (m)	SA Level Peak (dBuV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Duty Cycle Corr (dB)	Corr. Level (dBuV/m)	Corr. Level (uV/m)	Limit (uV/m)	Margin dB
313.50	V	120.0	1.0	55.8	13.1	2.7	0.0	-20.0	51.6	380.2	5979.2	-23.9
627.00	V	150.0	1.2	16.5	18.5	3.7	0.0	-20.0	18.7	8.6	597.9	-36.8
940.50	V	270.0	1.3	8.2	21.4	4.6	0.0	-20.0	14.2	5.1	597.9	-41.4
1254.00	V	190.0	1.0	46.5	25.7	1.9	31.8	-20.0	22.2	12.9	597.9	-33.3
1567.50	V	200.0	1.0	54.7	26.8	2.6	31.5	-20.0	32.6	42.7	500.0	-21.4
1881.00	V	180.0	1.0	55.0	27.7	3.2	31.2	-20.0	34.7	54.5	597.9	-20.8
2194.50	V	180.0	1.0	62.3	28.5	3.3	32.1	-20.0	42.0	125.2	597.9	-13.6
2508.00	V	200.0	1.0	57.8	29.1	3.1	33.6	-20.0	36.4	66.4	597.9	-19.1
2821.50	V	180.0	1.0	57.8	29.7	2.9	34.8	-20.0	35.5	59.9	500.0	-18.4
3135.00	V	190.0	1.0	49.2	30.2	2.8	35.4	-20.0	26.7	21.5	597.9	-28.9
313.50	H	180.0	1.2	63.1	13.1	2.7	0.0	-20.0	58.9	881.1	5979.2	-16.6
627.00	H	190.0	2.5	18.9	18.5	3.7	0.0	-20.0	21.1	11.4	597.9	-34.4
940.50	H	25.0	1.5	19.6	21.4	4.6	0.0	-20.0	25.6	19.0	597.9	-30.0
1254.00	H	190.0	1.0	52.0	25.7	1.9	31.8	-20.0	27.7	24.4	597.9	-27.8
1567.50	H	180.0	1.0	50.5	26.8	2.6	31.5	-20.0	28.4	26.4	500.0	-25.6
1881.00	H	145.0	1.0	56.0	27.7	3.2	31.2	-20.0	35.7	61.1	597.9	-19.8
2194.50	H	145.0	1.0	61.3	28.5	3.3	32.1	-20.0	41.0	111.6	597.9	-14.6
2508.00	H	150.0	1.0	53.3	29.1	3.1	33.6	-20.0	31.9	39.5	597.9	-23.6
2821.50	H	210.0	1.0	51.0	29.7	2.9	34.8	-20.0	28.7	27.3	500.0	-25.3
3135.00	H	190.0	1.0	46.7	30.2	2.8	35.4	-20.0	24.2	16.2	597.9	-31.4

Table 6: Radiated Emission Test Data, Unit Sideways

CLIENT:	Capricorn	DATE:	2/4/2005
TESTER:	James Ritter	JOB #:	8560
EUT:	CT-200	<u>Test Requirements:</u>	
CONFIGURATION:	30bit word x'd every 125ms	TEST STANDARD:	FCC Part 15.231
S/N:	1	DISTANCE:	3m
		CLASS:	B

Low Frequency Test Equipment/Limit:

ANTENNA:	A_00007
CABLE:	CSITE2_3m
LIMIT:	LFCC_3m_Class_B

High Frequency Test Equipment/Limit:

ANTENNA:	A_00004
CABLE:	CSITE2_HF
AMPLIFIER:	A_00312

Frequency (MHz)	Polarity H/V	Az Deg	Ant. Hght (m)	SA Level Peak (dBuV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Duty Cycle Corr (dB)	Corr. Level (dBuV/m)	Corr. Level (uV/m)	Limit (uV/m)	Margin dB
313.50	V	90.0	2.0	62.6	13.1	2.7	0.0	-20.0	58.4	831.8	5979.2	-17.1
627.00	V	90.0	1.2	24.3	18.5	3.7	0.0	-20.0	26.5	21.2	597.9	-29.0
940.50	V	90.0	1.3	17.8	21.4	4.6	0.0	-20.0	23.8	15.4	597.9	-31.8
1254.00	V	45.0	1.0	50.7	25.7	1.9	31.8	-20.0	26.4	20.9	597.9	-29.1
1567.50	V	200.0	1.0	50.5	26.8	2.6	31.5	-20.0	28.4	26.4	500.0	-25.6
1881.00	V	190.0	1.0	55.2	27.7	3.2	31.2	-20.0	34.9	55.6	597.9	-20.6
2194.50	V	180.0	1.0	62.7	28.5	3.3	32.1	-20.0	42.3	130.2	597.9	-13.2
2508.00	V	270.0	1.0	52.5	29.1	3.1	33.6	-20.0	31.1	35.9	597.9	-24.4
2821.50	V	45.0	1.0	54.7	29.7	2.9	34.8	-20.0	32.4	41.6	500.0	-21.6
3135.00	V	190.0	1.0	48.7	30.2	2.8	35.4	-20.0	26.2	20.3	597.9	-29.4
313.50	H	180.0	1.2	46.7	13.1	2.7	0.0	-20.0	42.5	133.4	5979.2	-33.0
627.00	H	90.0	2.5	20.0	18.5	3.7	0.0	-20.0	22.2	12.9	597.9	-33.3
940.50	H	180.0	1.5	15.3	21.4	4.6	0.0	-20.0	21.3	11.6	597.9	-34.3
1254.00	H	90.0	1.0	44.7	25.7	1.9	31.8	-20.0	20.4	10.5	597.9	-35.1
1567.50	H	45.0	1.0	50.5	26.8	2.6	31.5	-20.0	28.4	26.4	500.0	-25.6
1881.00	H	90.0	1.0	56.2	27.7	3.2	31.2	-20.0	35.9	62.3	597.9	-19.6
2194.50	H	145.0	1.0	55.7	28.5	3.3	32.1	-20.0	35.3	58.2	597.9	-20.2
2508.00	H	45.0	1.0	56.0	29.1	3.1	33.6	-20.0	34.6	53.8	597.9	-20.9
2821.50	H	190.0	1.0	54.0	29.7	2.9	34.8	-20.0	31.7	38.5	500.0	-22.3
3135.00	H	180.0	1.0	46.8	30.2	2.8	35.4	-20.0	24.3	16.5	597.9	-31.2

Table 7: Radiated Emission Test Data, Unit Flat

CLIENT:	Capricorn	DATE:	2/4/2005
TESTER:	James Ritter	JOB #:	8560
EUT:	CT-200	Test Requirements:	
CONFIGURATION:	30bit word x'd every 125ms	TEST STANDARD:	FCC Part 15.231
S/N:	1	DISTANCE:	3m
		CLASS:	B

Low Frequency Test Equipment/Limit:

ANTENNA:	A_00007
CABLE:	CSITE2_3m
LIMIT:	LFCC_3m_Class_B

High Frequency Test Equipment/Limit:

ANTENNA:	A_00004
CABLE:	CSITE2_HF
AMPLIFIER:	A_00312

Frequency (MHz)	Polarity H/V	Az Deg	Ant. Hght (m)	SA Level Peak (dBuV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Duty Cycle Corr (dB)	Corr. Level (dBuV/m)	Corr. Level (uV/m)	Limit (uV/m)	Margin dB
313.50	V	90.0	1.0	54.4	13.1	2.7	0.0	-20.0	50.2	323.6	5979.2	-25.3
627.00	V	90.0	1.2	10.2	18.5	3.7	0.0	-20.0	12.4	4.2	597.9	-43.1
940.50	V	145.0	1.3	18.5	21.4	4.6	0.0	-20.0	24.5	16.7	597.9	-31.1
1254.00	V	190.0	1.0	44.0	25.7	1.9	31.8	-20.0	19.7	9.7	597.9	-35.8
1567.50	V	120.0	1.0	47.6	26.8	2.6	31.5	-20.0	25.5	18.9	500.0	-28.5
1881.00	V	270.0	1.0	62.0	27.7	3.2	31.2	-20.0	41.7	122.0	597.9	-13.8
2194.50	V	280.0	1.0	58.7	28.5	3.3	32.1	-20.0	38.3	82.2	597.9	-17.2
2508.00	V	120.0	1.0	53.0	29.1	3.1	33.6	-20.0	31.6	38.1	597.9	-23.9
2821.50	V	0.0	1.0	49.5	29.7	2.9	34.8	-20.0	27.2	23.0	500.0	-26.8
3135.00	V	290.0	1.0	43.2	30.2	2.8	35.4	-20.0	20.7	10.8	597.9	-34.8
313.50	H	0.0	1.0	63.6	13.1	2.7	0.0	-20.0	59.4	933.3	5979.2	-16.1
627.00	H	180.0	2.5	7.8	18.5	3.7	0.0	-20.0	10.0	3.2	597.9	-45.5
940.50	H	0.0	3.2	20.0	21.4	4.6	0.0	-20.0	26.0	19.9	597.9	-29.6
1254.00	H	120.0	1.0	44.8	25.7	1.9	31.8	-20.0	20.6	10.7	597.9	-35.0
1567.50	H	270.0	1.0	47.2	26.8	2.6	31.5	-20.0	25.1	18.0	500.0	-28.9
1881.00	H	270.0	1.0	55.3	27.7	3.2	31.2	-20.0	35.0	56.4	597.9	-20.5
2194.50	H	290.0	1.0	61.0	28.5	3.3	32.1	-20.0	40.6	107.5	597.9	-14.9
2508.00	H	90.0	1.0	57.0	29.1	3.1	33.6	-20.0	35.6	60.3	597.9	-19.9
2821.50	H	90.0	1.0	52.5	29.7	2.9	34.8	-20.0	30.2	32.4	500.0	-23.8
3135.00	H	270.0	1.0	46.2	30.2	2.8	35.4	-20.0	23.7	15.3	597.9	-31.8