



## Measurement of RF Emissions from an AT650P 50 watt DTV transmitter

For : Linear Industries, Inc.  
2531 Technology Drive  
Elgin, IL 60124

P.O. No. : 035-LII-09  
Date Tested : May 20 and 22, 2009  
Test Personnel : Mark E. Longinotti  
Specification : FCC Part 74, Subpart G

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**REVISION HISTORY**

Revision	Date	Description
—	May 26, 2009	Initial release

## Measurement of RF Emissions from an AT650P 50 watt DTV transmitter

### 1 INTRODUCTION

#### 1.1 Scope of Tests

This report presents the results of the RF emissions measurements performed on a 50 watt DTV transmitter, Model No. AT650P, Serial No. 0005, (hereinafter referred to as the test item). The test item was designed to transmit on channel 11 (210MHz – 216MHz) with a rated output power of 50 watts. The test item was manufactured and submitted for testing by Linear Industries, Inc. located in Elgin, IL.

#### 1.2 Purpose

The test series was performed to determine if the test item meets the field strength of spurious emissions requirements of the Code of Federal Regulations Title 47, Part 74, Subpart G. Testing was performed in accordance with TIA-603-C-2004.

#### 1.3 Deviations, Additions and Exclusions

There were no deviations, additions to, or exclusions from the test specification during this test series.

#### 1.4 EMC Laboratory Identification

This series of tests was performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois. The laboratory is accredited by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP Lab Code: 100278-0.

#### 1.5 Laboratory Conditions

The temperature at the time of the test was 23°C and the relative humidity was 34%.

### 2 APPLICABLE DOCUMENTS

The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 74, dated 1 October 2008
- TIA-603-C-2004, "Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards"

### 3 TEST ITEM SET-UP AND OPERATION

#### 3.1 General Description

The test item is a Linear Industries, Inc., digital television transmitter, Model No. AT650P. The test item is designed to transmit on channel 11 (210MHz – 216MHz) with a rated output power of 50 watts. A block diagram of the test item set-up is shown as Figure 1.

##### 3.1.1 Power Input

The test item obtained 115V 60Hz power via a 3 wire, 6 foot long, unshielded power cord.

##### 3.1.2 Peripheral Equipment

The following peripheral equipment was submitted with the test item:



Item	Description
Dummy Load	JFW Model 50T-032-1.0, 50 ohm, 100 watt dummy load was connected to the output of the test item.

### 3.1.3 Signal Input/Output Leads

The following interconnect cables were submitted with the test item:

Item	Description
Coaxial Cable	Used to connect the output of the test item to the dummy load.

### 3.1.4 Grounding

The test item was grounded only through the third wire of its input power cord.

### 3.2 Operational Mode

For all tests, the test item was transmitting on channel 11 (210MHz – 216MHz). The test was performed with the test item transmitting at 50 watts.

### 3.3 Test Item Modifications

No modifications were required to comply with the test series.

## 4 TEST FACILITY AND TEST INSTRUMENTATION

### 4.1 Shielded Enclosure

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. With the exception of the floor, the reflective surfaces of the shielded chamber are lined with ferrite tiles on the walls and ceiling. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2003 for site attenuation.

### 4.2 Test Instrumentation

The test instrumentation and auxiliary equipment used during the tests are listed in Table 9-1. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

Conducted and radiated emission measurements were performed with a spectrum analyzer. This receiver allows measurements with the bandwidths and detector functions specified by the FCC. The receiver bandwidth was 120kHz for the 30MHz to 1000MHz radiated emissions data and 1MHz for radiated emissions above 1000MHz.

### 4.3 Calibration Traceability

Test equipment is maintained and calibrated on a regular basis. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

### 4.4 Measurement Uncertainty

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

The measurement uncertainty for these tests is presented below:

Conducted Emission Measurements		
Combined Standard Uncertainty	1.07	-1.07



Expanded Uncertainty (95% confidence)	2.1	-2.1
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Radiated Emission Measurements		
Combined Standard Uncertainty	2.26	-2.18
Expanded Uncertainty (95% confidence)	4.5	-4.4

## 5 TEST PROCEDURES

### 5.1 Conducted Output Power

#### 5.1.1 Requirements

Per 74.750(2), Radio frequency harmonics of the visual and aural carriers, measured at the output terminals of the transmitter, shall be attenuated no less than 60 dB below the peak visual output power within the assigned channel. All other emissions appearing on frequencies more than 3 megacycles above or below the upper and lower edges, respectively, of the assigned channel shall be attenuated no less than:

- 1) 30 dB for transmitters rated at no more than 1 watt power output.
- 2) 50 dB for transmitters rated at more than 1 watt power output.
- 3) 60 dB for transmitters rated at more than 100 watts power output.

#### 5.1.2 Procedures

The RF output port of the test item was connected to a power meter through 40 dB of attenuation. The test item was powered up and the output power reading was noted on the power meter.

#### 5.1.3 Results

The conducted output power of the test item was 50 watts (47dBm).

### 5.2 Field Strength of Spurious Emissions

#### 5.2.1 Requirements

Per 74.750(2), Radio frequency harmonics of the visual and aural carriers, measured at the output terminals of the transmitter, shall be attenuated no less than 60 dB below the peak visual output power within the assigned channel. All other emissions appearing on frequencies more than 3 megacycles above or below the upper and lower edges, respectively, of the assigned channel shall be attenuated no less than:

- 1) 30 dB for transmitters rated at no more than 1 watt power output.
- 2) 50 dB for transmitters rated at more than 1 watt power output.
- 3) 60 dB for transmitters rated at more than 100 watts power output.

#### 5.2.2 Procedures

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

Preliminary radiated emissions measurements were first performed using a peak detector and automatically



plotted. The broadband measuring antenna was positioned at a 3 meter distance from the test item. The entire frequency range from 30MHz to 2.5GHz was investigated using a peak detector function. All preliminary tests were performed with the test item transmitting at Channel 11 (210MHz – 216MHz) into a dummy load.

All significant broadband and narrowband signals found in the preliminary sweeps were then measured using a peak detector at a test distance of 3 meters. The measurements were made with a bilog or double ridged waveguide antenna over the frequency range of 30MHz to 2.5GHz. To ensure that maximum emission levels were measured, the following steps were taken:

- 1) The test item was rotated so that all of its sides were exposed to the receiving antenna.
- 2) Since the measuring antennas are linearly polarized, both horizontal and vertical field components were measured.
- 3) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.

The equivalent power was determined from the field intensity levels measured at 3 meters using the substitution method. To determine the emission power a tuned dipole or double ridged waveguide antenna was set in place of the test item and connected to a calibrated signal generator. The output of the signal generator was adjusted to match the received level at the spectrum analyzer. The signal level was recorded. The reading was corrected to compensate for cable loss, as required, and when the double ridged waveguide antenna was used, increased by the difference in gain between the dipole and the waveguide antenna.

#### 5.2.3 Results

The preliminary radiated emissions plots are presented on pages 13 through 16. Factors for the antennas and cables were added to the data before it was plotted. This data is only presented for a reference, and is not used as official data.

The final radiated levels are presented on page 17. The radiated emissions were measured through the 10th harmonic. As can be seen from the data, all emissions measured from the test item were within the specification limits. Photographs of the test configuration which yielded the highest or worst case, radiated emission levels are shown on Figure 2 and Figure 3.

## 6 OTHER TEST CONDITIONS

### 6.1 Test Personnel and Witnesses

All tests were performed by qualified personnel from Elite Electronic Engineering Incorporated. The test series was partially witnessed by Linear Industries, Inc. personnel.

### 6.2 Disposition of the Test Item

The test item and all associated equipment were returned to Linear Industries, Inc. upon completion of the tests.

## 7 CONCLUSIONS

It was determined that the Linear Industries, Inc. 50 watt DTV transmitter, Model No. AT650P, Serial No. 0005, did fully meet the spurious radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 74, Subpart G, when tested per TIA-603-C-2004.

## 8 CERTIFICATION

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specifications.



The data presented in this test report pertains to the test item at the test date as operated by Linear Industries, Inc. personnel. Any electrical or mechanical modification made to the test item subsequent to the specified test date will serve to invalidate the data and void this certification.

This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.





## 9 EQUIPMENT LIST

Table 9-1 Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
GXA1	MXG MW ANALOG SIGNAL GENERATOR	AGILENT TECHNOLOGIES	N5183A	MY47420353		2/5/2009	2/5/2010
MPC1	DUAL POWER METER	HEWLETT PACKARD	EPM-442A	US37480258	0.1MHZ-50GHZ	2/11/2009	2/11/2010
MPC1	POWER SENSOR	HEWLETT PACKARD	8482A	US3318A27650	0.1-4200MHZ	4/28/2009	4/28/2010
NDP1	TUNED DIPOLE ANTENNA	EMCO	3121C-DB3	313	140-400MHZ	3/24/2009	3/24/2010
NDQ1	TUNED DIPOLE ANTENNA	EMCO	3121C-DB4	313	400-1000MHZ	3/24/2009	3/24/2010
NTA1	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL6112	2054	0.03-2GHZ	9/2/2008	9/2/2009
NWH0	RIDGED WAVE GUIDE	TENSOR	4105	2081	1-12.4GHZ	10/25/2008	10/25/2009
RBB0	EMI TEST RECEIVER 20HZ TO 40 GHZ.	ROHDE & SCHWARZ	ESIB40	100250	20 HZ TO 40GHZ	3/11/2009	3/11/2010
T2H1	20DB, 100W ATTENUATOR	BIRD ELECTRONIC CORP	8343-200	4877	DC-1GHZ	2/20/2009	2/20/2010
T2H6	20DB, 100W ATTENUATOR	BIRD ELECTRONIC CORP	100-SA-MNF-20	0124967	DC-1GHZ	6/16/2008	6/16/2009
XLK5	100W 50 OHM TERMINATION	JFW INDUSTRIES	50T-032-1.0	006	DC-1GHZ	4/27/2009	4/27/2010

I/O: Initial Only

N/A: Not Applicable

Note 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

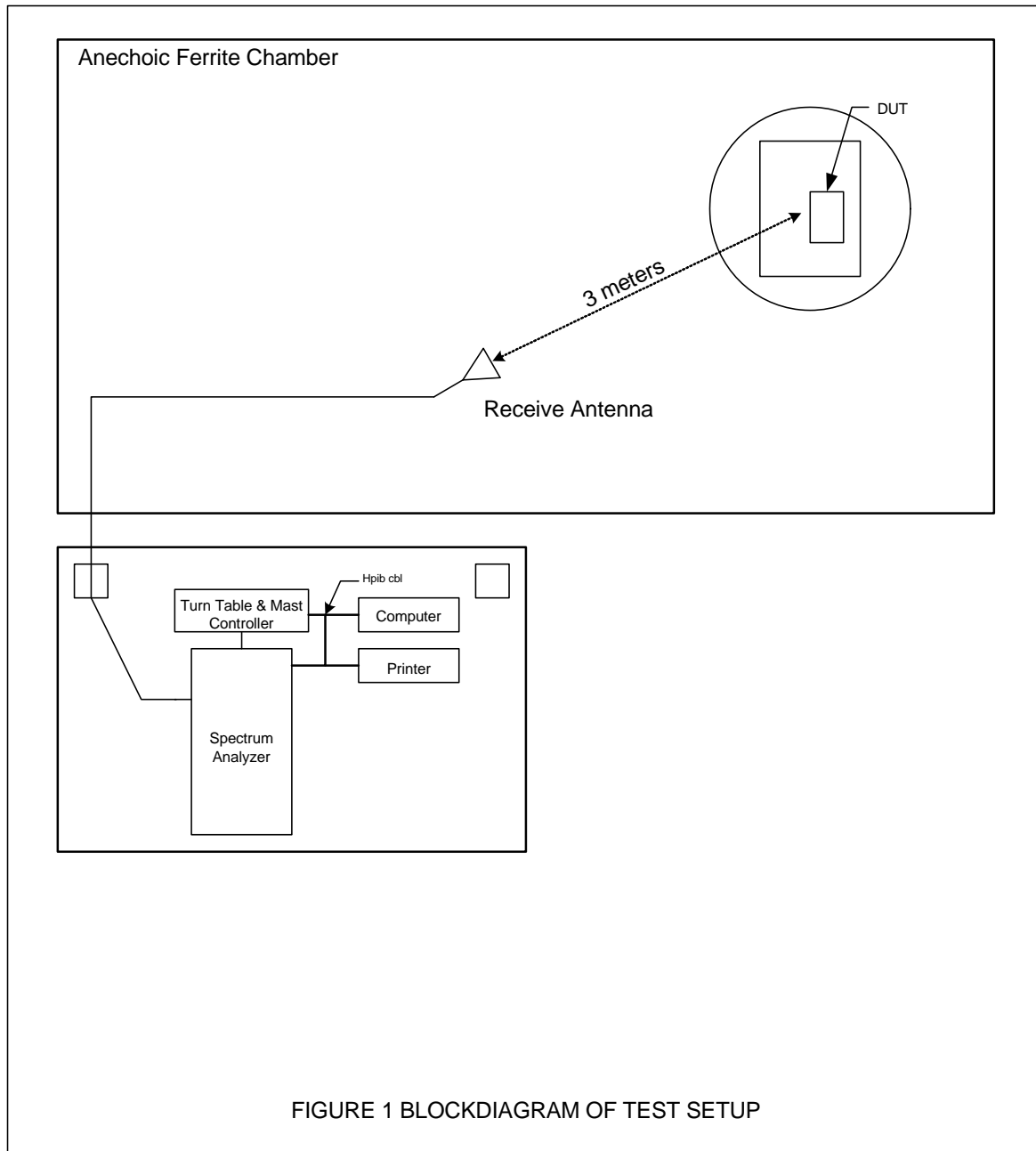
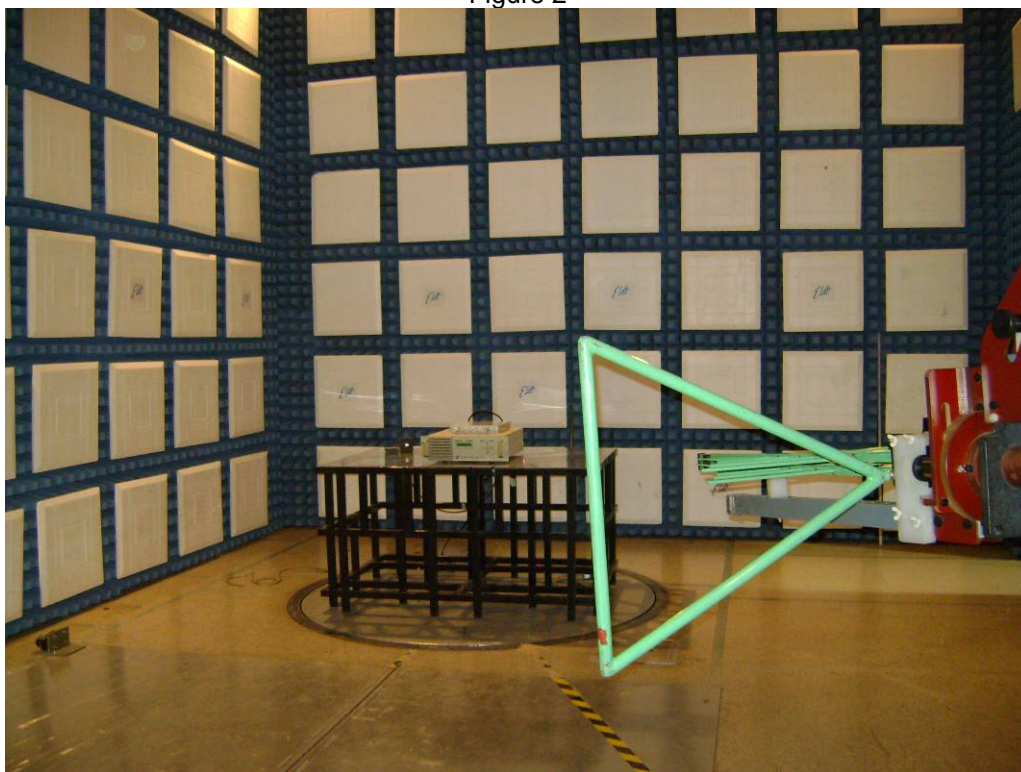
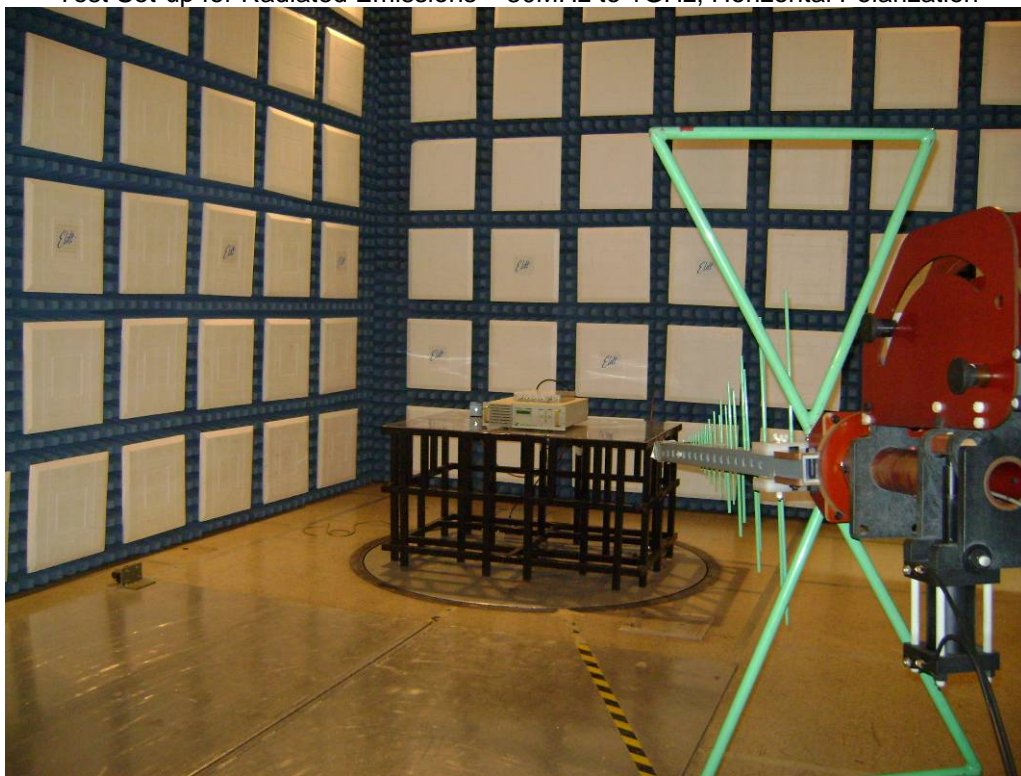


Figure 2



Test Set-up for Radiated Emissions – 30MHz to 1GHz, Horizontal Polarization

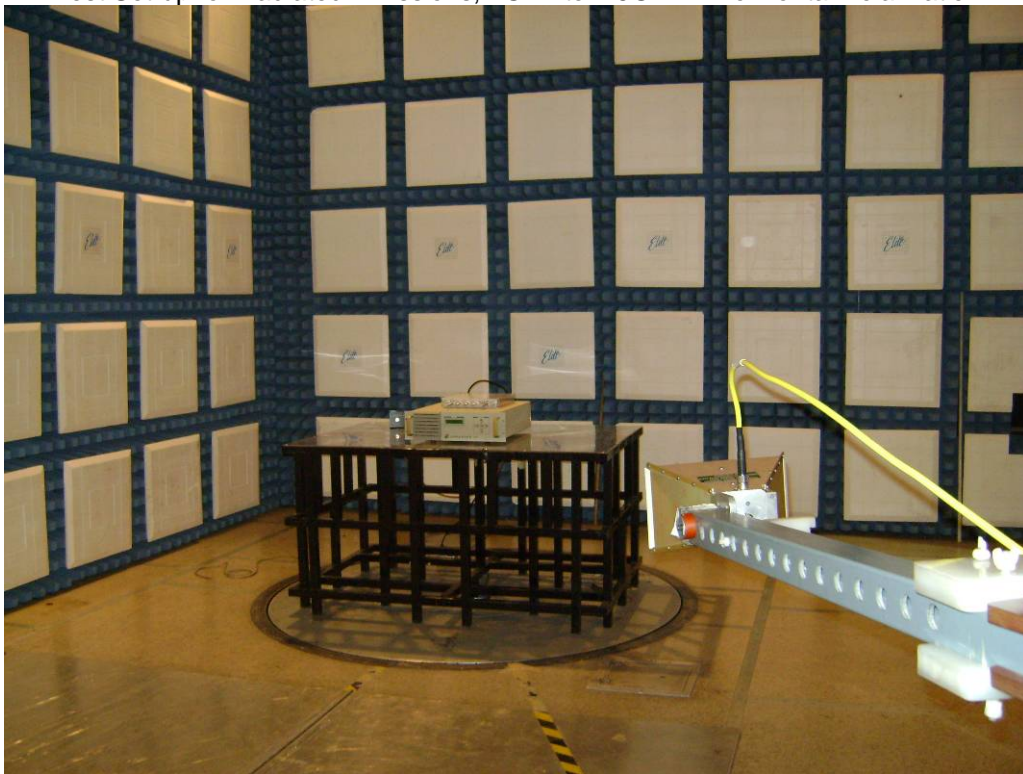


Test Set-up for Radiated Emissions – 30MHz to 1GHz, Vertical Polarization

Figure 3



Test Set-up for Radiated Emissions, 1GHz to 2.5GHz – Horizontal Polarization



Test Set-up for Radiated Emissions, 30MHz to 2.5GHz – Vertical Polarization

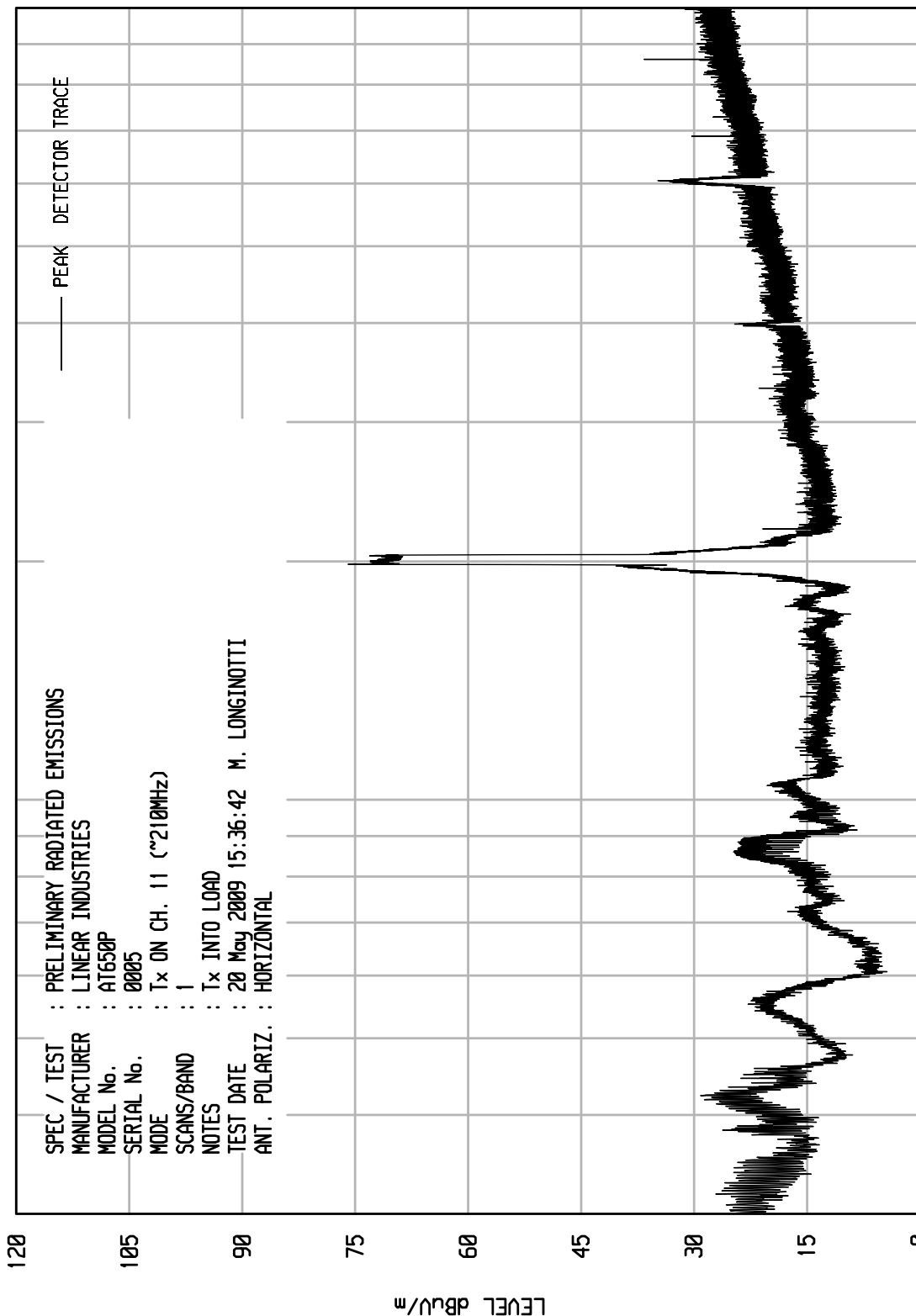


# ELITE ELECTRONIC ENGINEERING Inc.

Downers Grove, Ill. 60515

WKA1 01/30/09

UNITV RCU EMI RUN 1



SPEC / TEST : PRELIMINARY RADIATED EMISSIONS

MANUFACTURER : LINEAR INDUSTRIES

MODEL No. : AT650P

SERIAL No. : 0005

MODE : Tx ON CH. 11 (~210MHz)

SCANS/BAND : 1

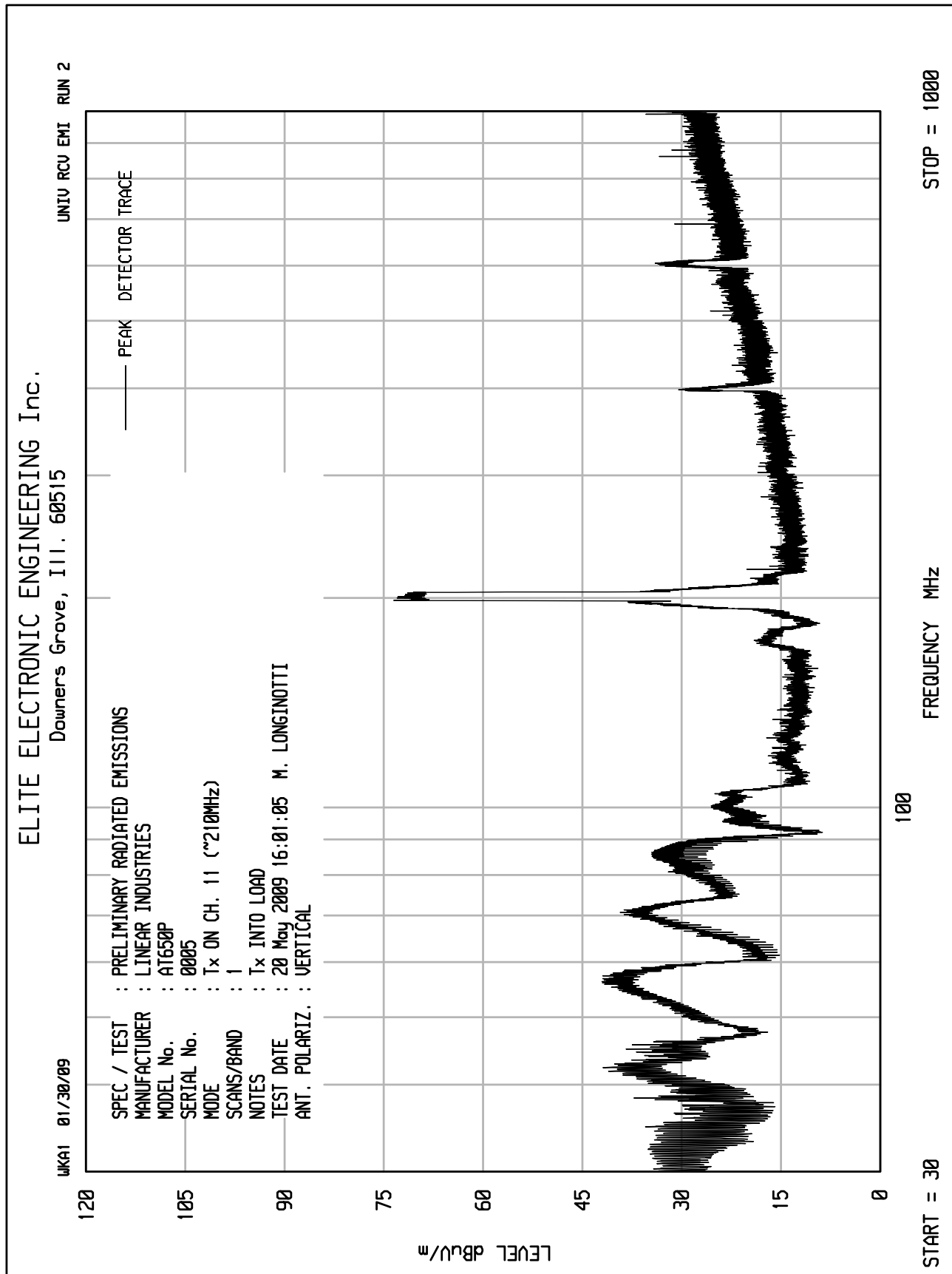
NOTES : Tx INTO LOAD

TEST DATE : 20 May 2009 15:36:42 M. LONGINOTTI

ANT. POLARIZ. : HORIZONTAL

START = 30

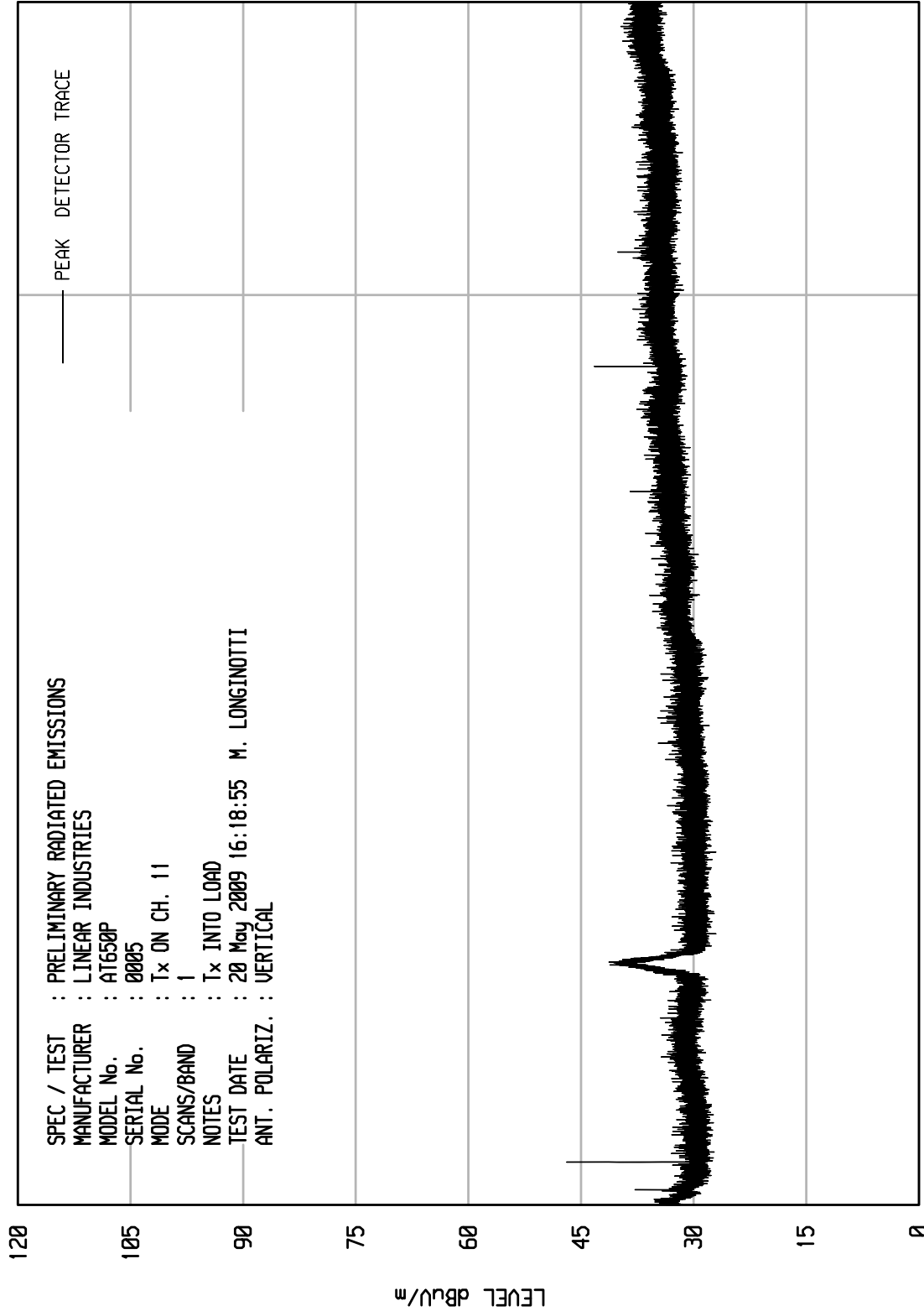
STOP = 1000



ELITE ELECTRONIC ENGINEERING Inc.  
Downers Grove, Ill. 60515

UNIU RCU EMI RUN 4

WKA1 01/30/09



SPEC / TEST : PRELIMINARY RADIATED EMISSIONS  
MANUFACTURER : LINEAR INDUSTRIES  
MODEL No. : AT650P  
SERIAL No. : 0005  
MODE : Tx ON CH. 11  
SCANS/BAND : 1  
NOTES : Tx INTO LOAD  
TEST DATE : 20 May 2009 16:18:55 M. LONGINOTTI  
ANT. POLARIZ. : VERTICAL

START = 1000

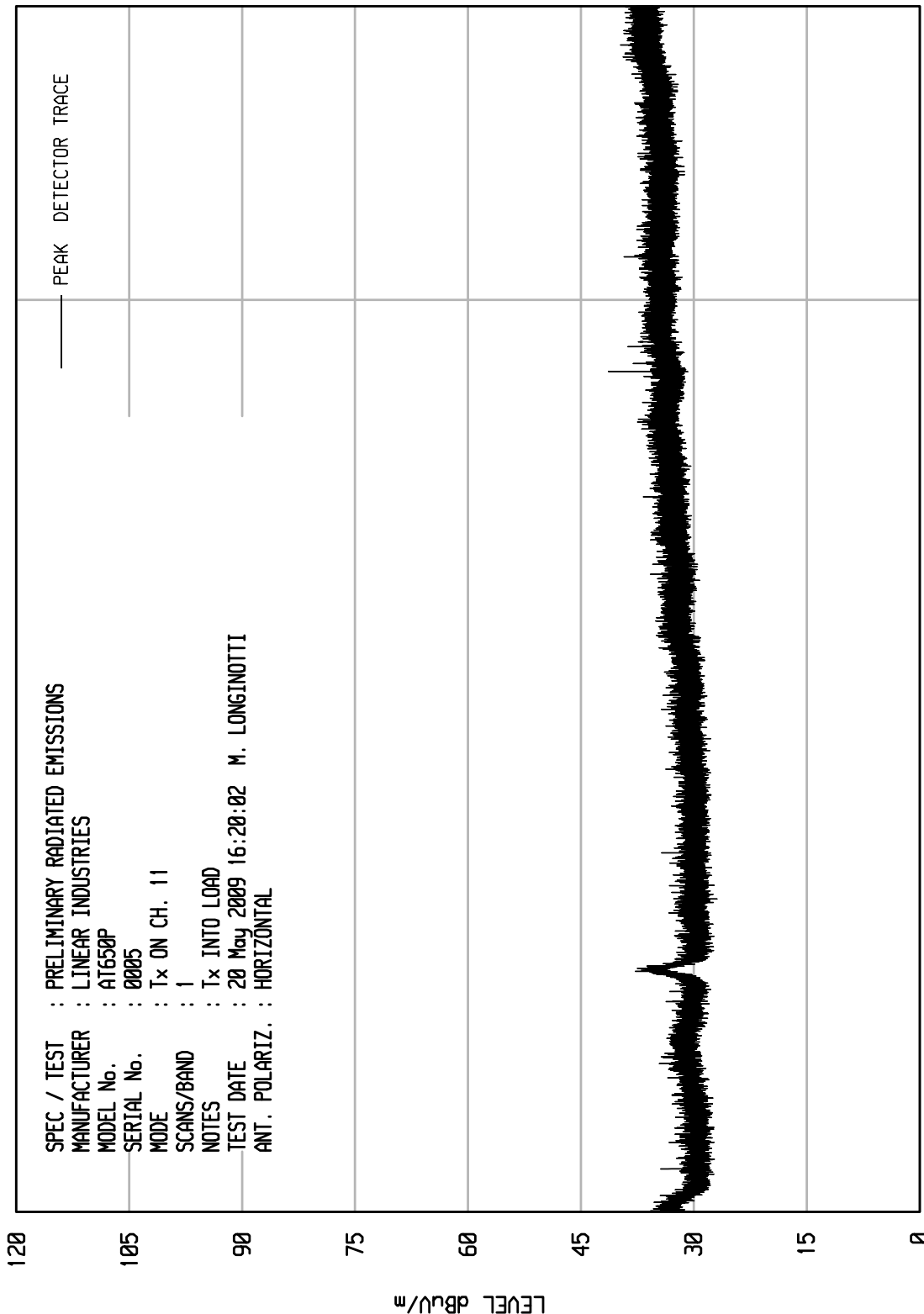
FREQUENCY MHz

STOP = 2500

ELITE ELECTRONIC ENGINEERING Inc.  
Downers Grove, Ill. 60515

UNIU RCU EMI RUN 5

WKA1 01/30/09



START = 1000

FREQUENCY MHz

STOP = 2500





MANUFACTURER : Linear Industries, Inc.  
MODEL : AT650P Digital Television Transmitter  
SERIAL NO. : 0005  
SPECIFICATION : FCC Part 74 Spurious Radiated Emissions  
DATE : May 20 – 22, 2009  
NOTES : Transmit at Channel 11, 50 watts into a load  
: Test Distance is 3 meters

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	Matched SIG. GEN. (dB)	Ant Gain (dB)	CBL (dB)	Total* (dBm)	Limit** (dBm)
399.3	H	12.6		-70.9	0.0	0.8	-71.7	-3.0
399.3	V	15.8		-66.1	0.0	0.8	-66.9	-3.0
602.0	H	18.3		-60.5	0.0	1.3	-61.8	-3.0
604.0	V	15.8		-62.0	0.0	1.3	-63.3	-3.0
802.7	H	5.2	Ambient	-75.4	0.0	1.6	-77.0	-3.0
802.7	V	4.8	Ambient	-77.1	0.0	1.6	-78.7	-3.0
1003.4	H	25.8		-50.2	3.8	1.8	-48.2	-3.0
1003.4	V	22.8		-54.5	3.8	1.8	-52.5	-3.0
1204.0	H	31.3		-45.0	4.8	2.0	-42.2	-3.0
1204.0	V	38.3		-38.0	4.8	2.0	-35.2	-3.0
1404.7	H	17.0	Ambient	-59.2	5.6	2.2	-55.8	-3.0
1404.7	V	16.8	Ambient	-60.4	5.6	2.2	-57.0	-3.0
1605.4	H	15.4	Ambient	-61.5	6.0	2.4	-58.0	-3.0
1605.4	V	16.0	Ambient	-61.3	6.0	2.4	-57.8	-3.0
1806.0	H	16.4	Ambient	-58.3	6.0	2.6	-54.9	-3.0
1806.0	V	15.9	Ambient	-58.8	6.0	2.6	-55.4	-3.0
2006.7	H	16.2	Ambient	-57.8	6.0	2.8	-54.5	-3.0
2006.7	V	15.9	Ambient	-57.1	6.0	2.8	-53.8	-3.0
1033.20	H	18.1		-58.7	3.9	2.0	-56.8	-3.0
1033.20	V	22.6		-54.9	3.9	2.0	-53.0	-3.0

\* ERP = matched signal + antenna gain - cable loss

\*\* Limit = power (dBm) – 50dB = 50W – 50dBm = 47dBm – 50dBm = -3.0dBm

Checked By: MARK E. LONGINOTTI