



Measurement of RF Interference from a Canopy 900MHz Access Point and Subscriber Module Using A Yagi Antenna

For : Motorola, Inc.
1301 East Algonquin Road
Schaumburg, IL 60196

P.O. No. : 40335
Date Tested : March 18, 2009
Test Personnel : Mark E. Longinotti
Specification : FCC "Code of Federal Regulations" Title 47
Part 15, Subpart C, Section 15.247 for Frequency
Hopping Intentional Radiators Operating within
The 902-928MHz

: RSS-210, Annex 8, for Frequency Hopping
: Systems Operating in the Bands 902 – 928MHz

: RSS-Gen

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THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE
WRITTEN APPROVAL OF ELITE ELECTRONIC ENGINEERING INCORPORATED.



REVISION HISTORY

Revision	Date	Description
—	March 20, 2009	Initial release

Measurement of RF Emissions from a Canopy 900MHz Access Point and Subscriber Module Using A Yagi Antenna

1 INTRODUCTION

1.1 Scope of Tests

This document presents the results of tests performed to determine if the Motorola, Inc. Canopy 900MHz Access Point and Subscriber Module would meet the FCC and Industry Canada requirements when using a Yagi Antenna. The test item is a Motorola, Inc. Canopy 900MHz Access Point and Subscriber Module, Serial No. 6069JS13C7. It is designed to transmit in the 902MHz to 924MHz band. The test was performed for Motorola, Inc. located in Schaumburg, IL and for Cascade Networks located in Longview, WA.

1.2 Purpose

The test series was performed to determine if the test item meets the peak output power and radiated RF emission requirements in the restricted bands per the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.247 for Intentional Radiators and per the Industry Canada RSS-210 and RSS-GEN. Testing was performed in accordance with ANSI C63.4-2003..

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 21°C and the relative humidity was 18%.

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 15, Subpart C, dated 1 October 2008
- FCC Public Notice, DA 00-705, "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems", Released March 30, 2000
- ANSI C63.4-2003, "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"
- Industry Canada Radio Standards Specification, RSS-Gen, "General Requirements and Information for the Certification of Radiocommunication Equipment", Issue 2, June 2007
- Industry Canada Radio Standards Specification, RSS-210, "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment", Issue 7, June 2007

3 TEST ITEM SETUP AND OPERATION

3.1 General Description

The test item is a Motorola, Inc., Canopy 900 MHz Access Point and Subscriber Module . A block diagram of the test item setup is shown as Figure 1.

3.1.1 Power Input

The test item was powered with 24VDC from a Motorola model ACPSSW-13A transformer via the 45 feet of Ethernet cable.

3.1.2 Grounding

The test item was grounded via the 45 feet of Ethernet cable to the transformer.

3.1.3 Support Equipment

The test item was submitted with a Panasonic ToughBook laptop that was used to power and communicate with the test item via one 45 foot long Ethernet cable.

3.1.4 Interconnect Cables

The test item was connected to the laptop via a 45 foot long Ethernet cable.

3.2 Operational Mode

For all tests the test item was placed on an 80cm high non-conductive stand. The test item and all peripheral equipment were energized. The test item was controlled and powered by the laptop computer. Through the computer the test item was set to transmit continuously in a continuous wave mode. The tests were performed with the test item transmitting at 902MHz, 915MHz and 928MHz.

3.3 Test Item Modifications

No modifications were required for compliance to the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.247 for Intentional Radiators and to the Industry Canada RSS-210 and RSS-GEN specifications.

4 TEST EQUIPMENT

4.1 Test Equipment List

A list of the test equipment used can be found on Table 8-1. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

4.2 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).

5 REQUIREMENTS, PROCEDURES AND RESULTS

5.1 Powerline Conducted Emissions

5.1.1 Requirements

The conducted emissions were not addressed in the test sequence since the antenna does not affect the conducted emission levels.



5.2 Peak Output Power

5.2.1 Requirement

Per section 15.247(b)(2), for frequency hopping systems operating in the 902-928MHz band, the peak output power shall not be greater than 1 watt for systems employing at least 50 hopping channels. For systems employing less than 50 hopping channels the peak output power shall not be greater than 0.25 watts

5.2.2 Procedures

The output of the test item was connected to the spectrum analyzer. The maximum meter reading was recorded. The peak power output was calculated for the low, middle and high hopping frequencies.

5.2.3 Results

The results are presented on page 11. The maximum antenna conducted output power measured from the transmitter was 18.5dBm which meets the 30 dBm limit. Per Cascade Networks personnel, the gain of the Yagi antenna is 17dB. Therefore, the maximum EIRP for the transmitter and antenna combination would be 35.5dBm (18.5dBm + 17dBm) which meets the De Facto 36 dBm limit.

5.3 Spurious Radiated Emissions

5.3.1 Requirement

Per section 15.247(c), the radiated emissions which fall in the restricted bands must meet the general limits of 15.209.

5.3.2 Procedures

The radiated tests were performed in a 32ft. x 20ft. x 18ft. hybrid absorber lined semi-anechoic 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. The floor of the chamber is used as the ground plane. The chamber complies with ANSI 63.4 and CISPR 16 requirements for site attenuation.

Preliminary radiated measurements are performed to determine the frequencies where the significant emissions might be found. With the test item at one set position and the measurement antenna at a set height (i.e. without maximizing), the radiated emissions were measured using peak detection with 100 kHz BW. This data was then automatically plotted up through 10 GHz.

Next, the harmonic or spurious emissions falling in the restricted bands were measured up through the 10th harmonic. For these measurements, the measurement bandwidths were set to 1 MHz RBW. The analyzer was set to linear mode with 10 Hz VBW in order to simulate an average detector. A pre-amplifier was used to increase the receiver sensitivity.

5.3.3 Results

The preliminary emissions levels were plotted. These plots are presented on pages 12 through 17. These plots show that the radiated spurious emissions were at least 20 dB below the level of the fundamental.

The harmonics and any other emissions that fall in the restricted frequency bands were then re-measured manually. This data is shown in the tables on pages 18 through 20. The field intensities levels for the harmonics in the restricted band were within the limit.

6 CONCLUSIONS

It was determined that the Motorola, Inc. Canopy 900MHz Access Point and Subscriber Module, Serial No. 6069JS13C7, when tested with a Yagi antenna, did fully meet the peak output power and radiated emissions in the



restricted bands requirements of the FCC "Code of Federal Regulations" Title 47, Subpart C, Part 15.247 for Intentional Radiators when tested per ANSI C63.4-2003.

It was also determined that the Motorola, Inc. Canopy 900MHz Access Point and Subscriber Module, Serial No. 6069JS13C7, when tested with a Yagi antenna, did fully meet the peak output power and radiated emissions in the restricted bands requirements of the Industry Canada RSS-210, Annex 8 for Intentional Radiators when tested per ANSI C63.4-2003.

7 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 Cascade Networks 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.



8 EQUIPMENT LIST

Table 8-1 Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APQ2	PREAMPLIFIER	ROHDE & SCHWARZ	TS-PR40	1000022	26.5GHZ-40GHZ	10/28/2008	10/28/2009
APW2	PREAMPLIFIER	PLANAR ELECTRONICS	PE2-35-120- 5R0-10	PL2925	1GHZ-20GHZ	12/16/2008	12/16/2009
CDS2	COMPUTER	GATEWAY	MFATXPNT NMZ 500L	0028483108	1.8GHZ	N/A	
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
SBA1	DC POWER SUPPLY	APLAB	ZS3205	99071032	0-32VDC;0-5A	NOTE 1	
T2D5	20DB, 25W ATTENUATOR	WEINSCHEL	46-20-43	AY9244	DC-18GHZ	1/22/2009	1/22/2010
T2DJ	20DB, 25W ATTENUATOR	WEINSCHEL	46-20-34	BS0923	DC-18GHZ	12/4/2008	12/4/2009

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.

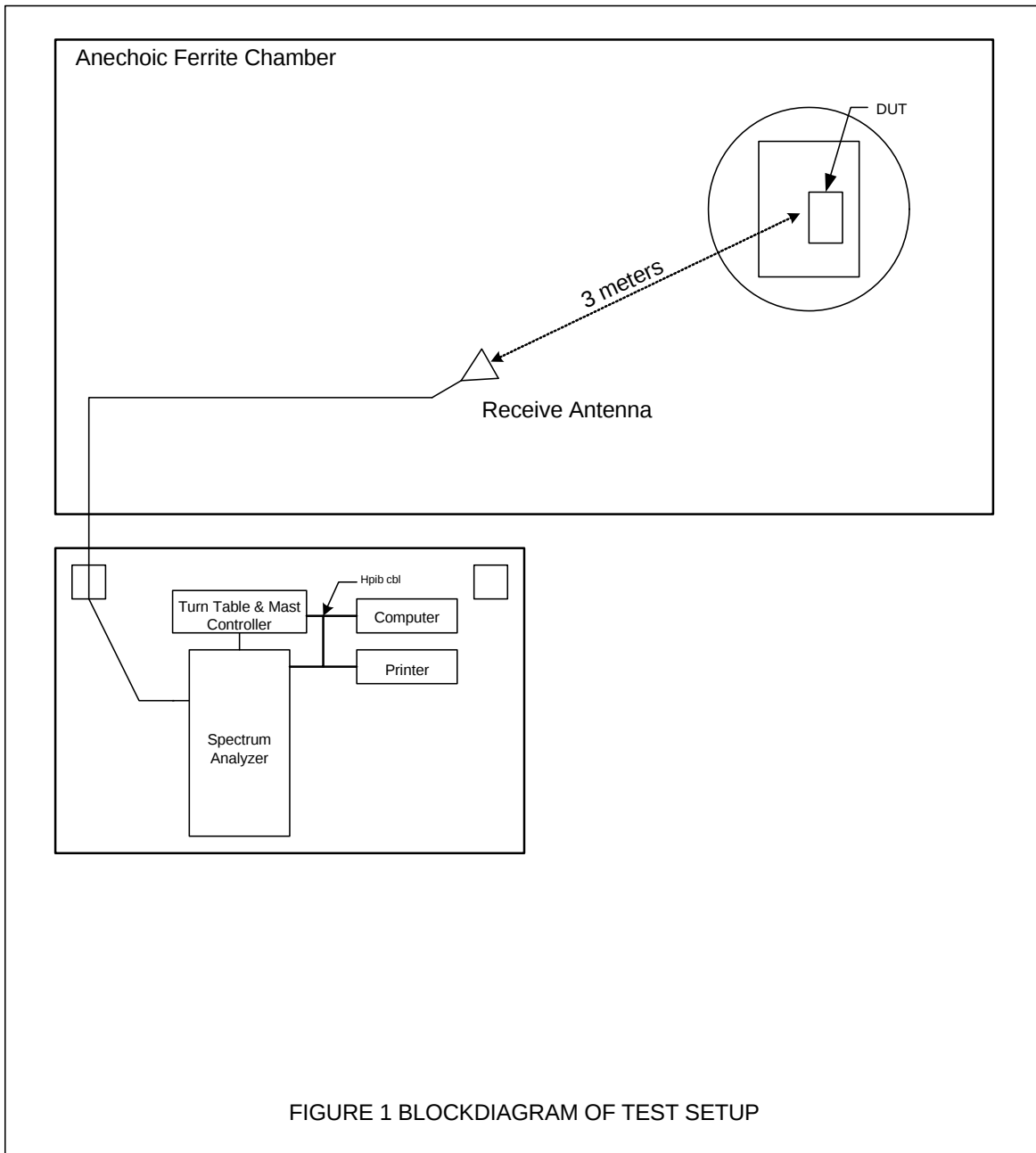
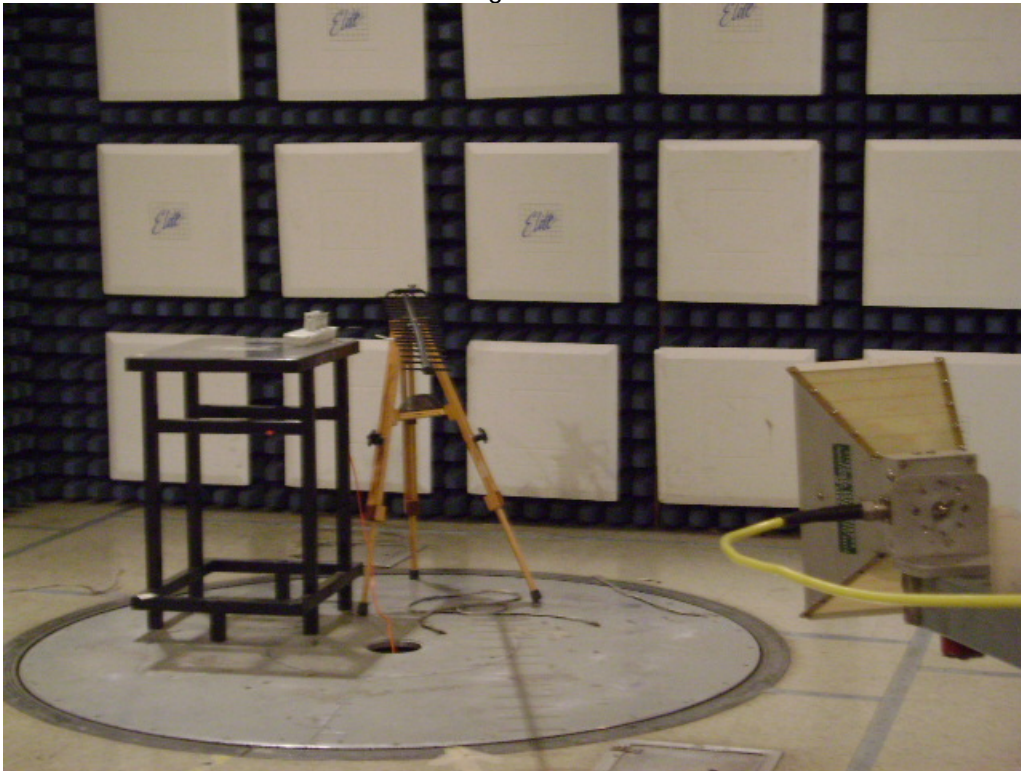
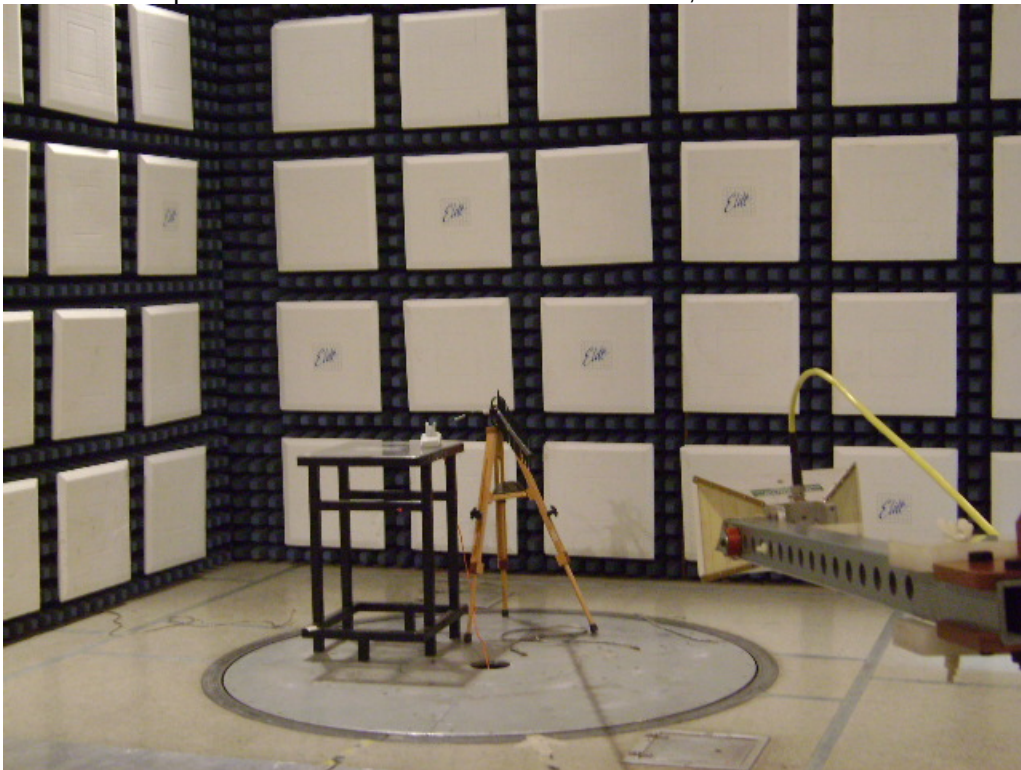


Figure 2



Test Setup for Radiated Emissions – 1GHz to 10GHz, Horizontal Polarization



Test Setup for Radiated Emissions – 1GHz to 10GHz, Vertical Polarization



MANUFACTURER : Motorola, Inc.
MODEL : Canopy 900MHz Access Point and Subscriber Module
S/N : 6069JS13C7
SPECIFICATION : FCC-15.247 and RSS-210 Annex 8, Peak Output Power
MODE : See Below
DATE : March 18, 2009
NOTES : Power Level set to CB000000

Frequency MHz	Meter Reading dBm	Attenuation dB	Peak Power dBm
902	-21.5	40.0	18.5
915	-21.6	40.0	18.4
928	-21.9	40.0	18.1

Peak Power (dBm) = Meter Reading (dBm) + Attenuation (dB)

Checked By:

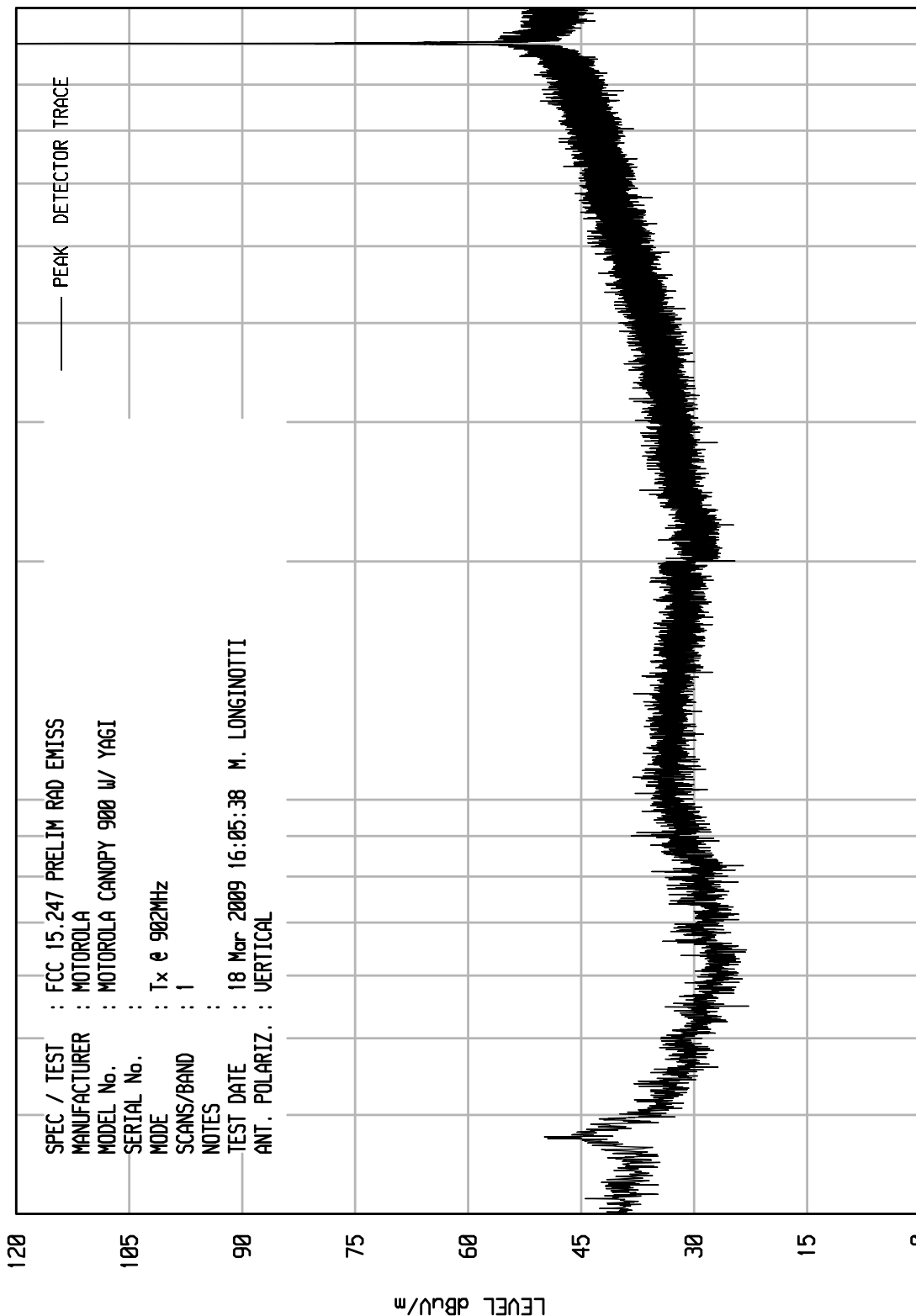
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UNIU RCU EMI RUN 6

WKA1 01/10/08



STOP = 1000

FREQUENCY MHz

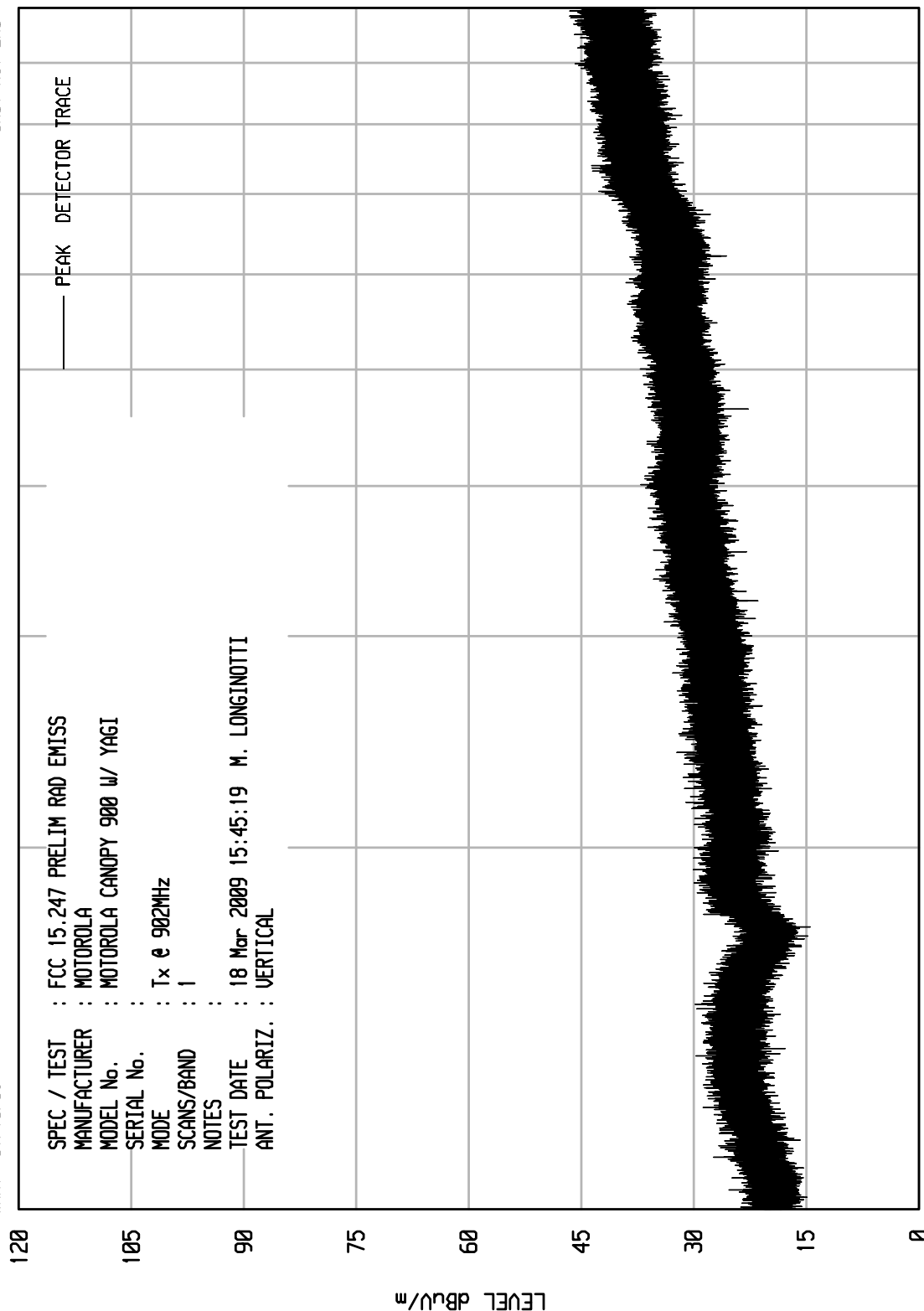
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WKA1 01/10/08

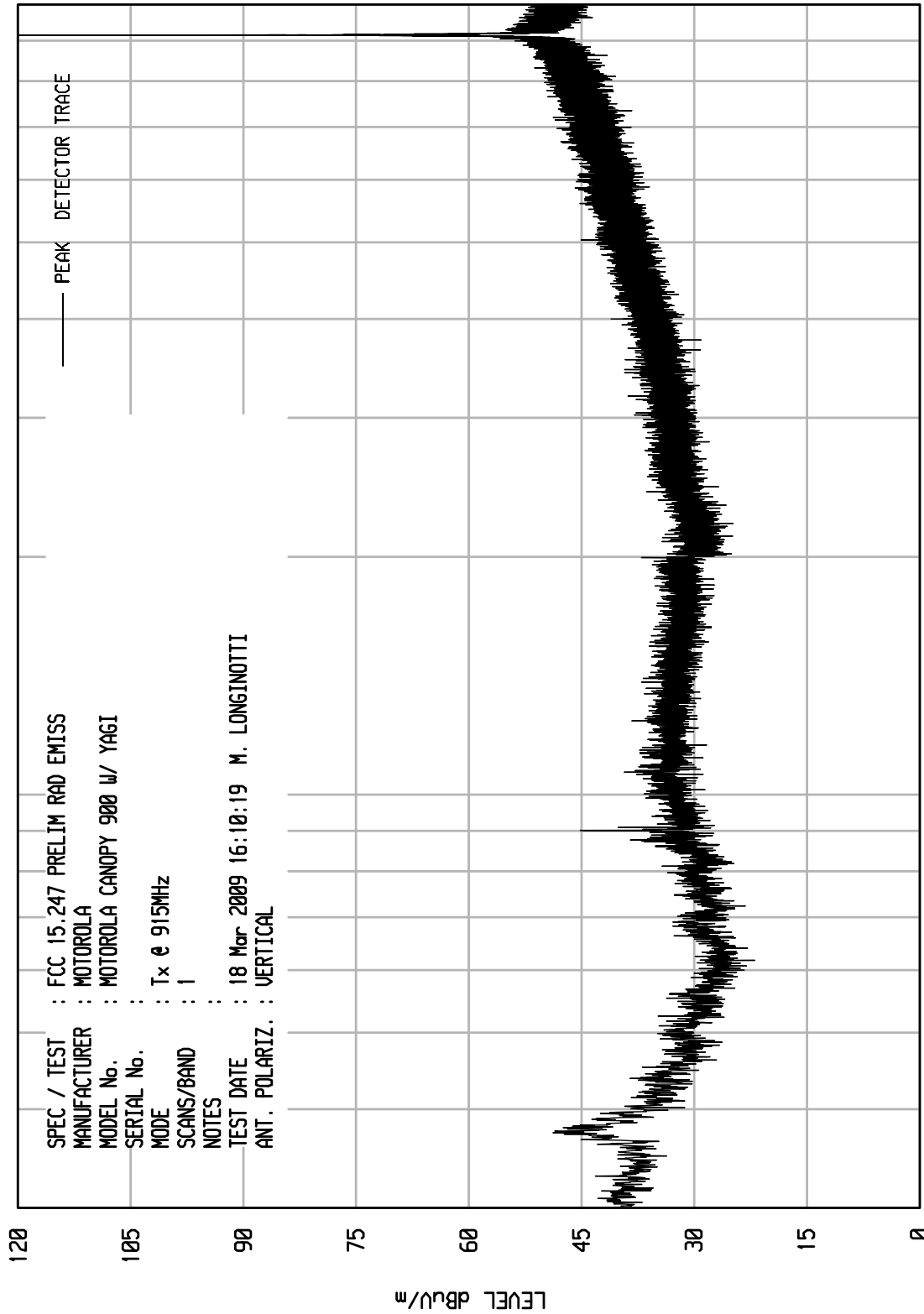
UNITV RCU EMI RUN 3



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UNIU RCU EMI RUN 10

WKA1 01/10/08



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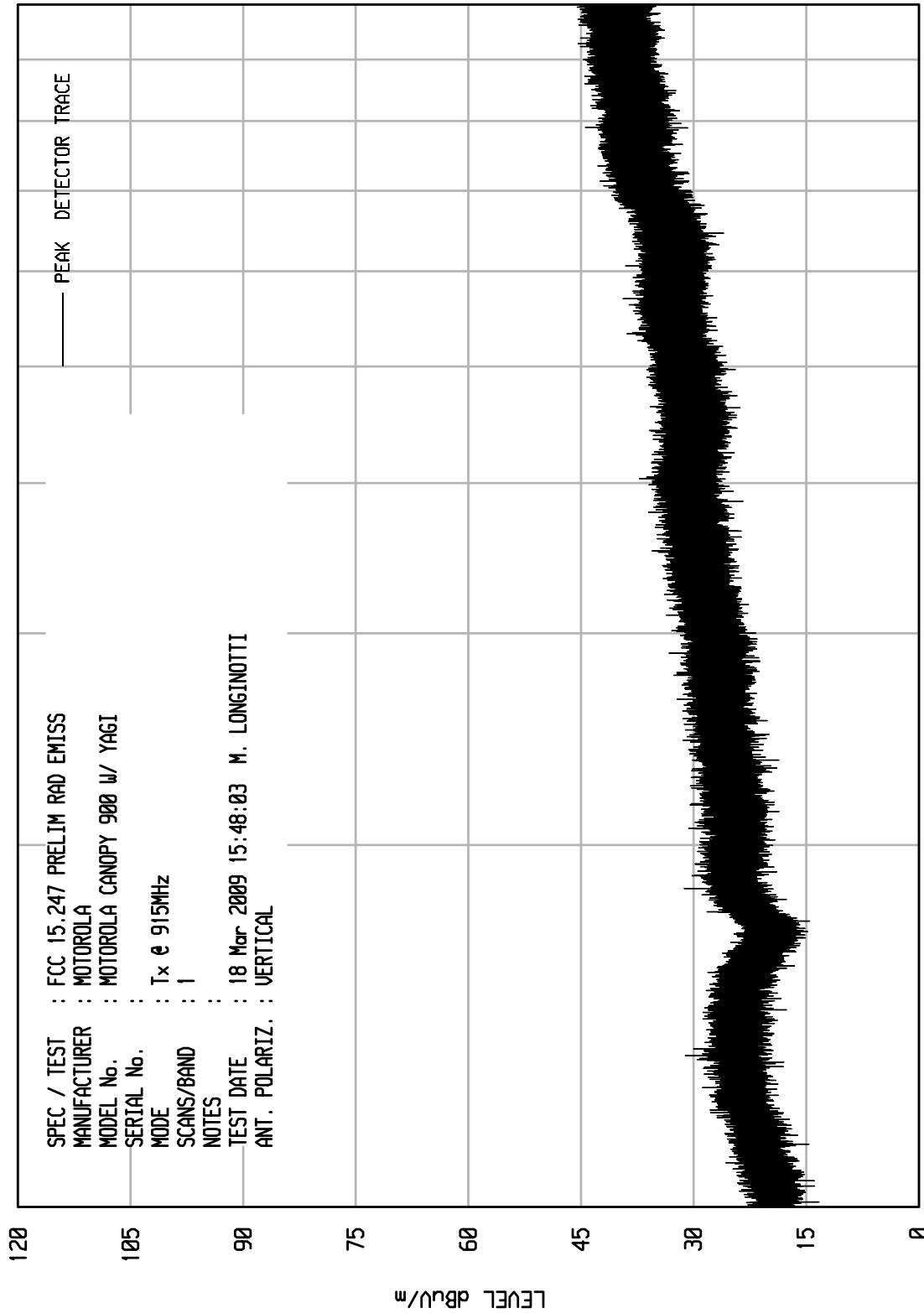
START = 30



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UNIU RCU EMI RUN 4

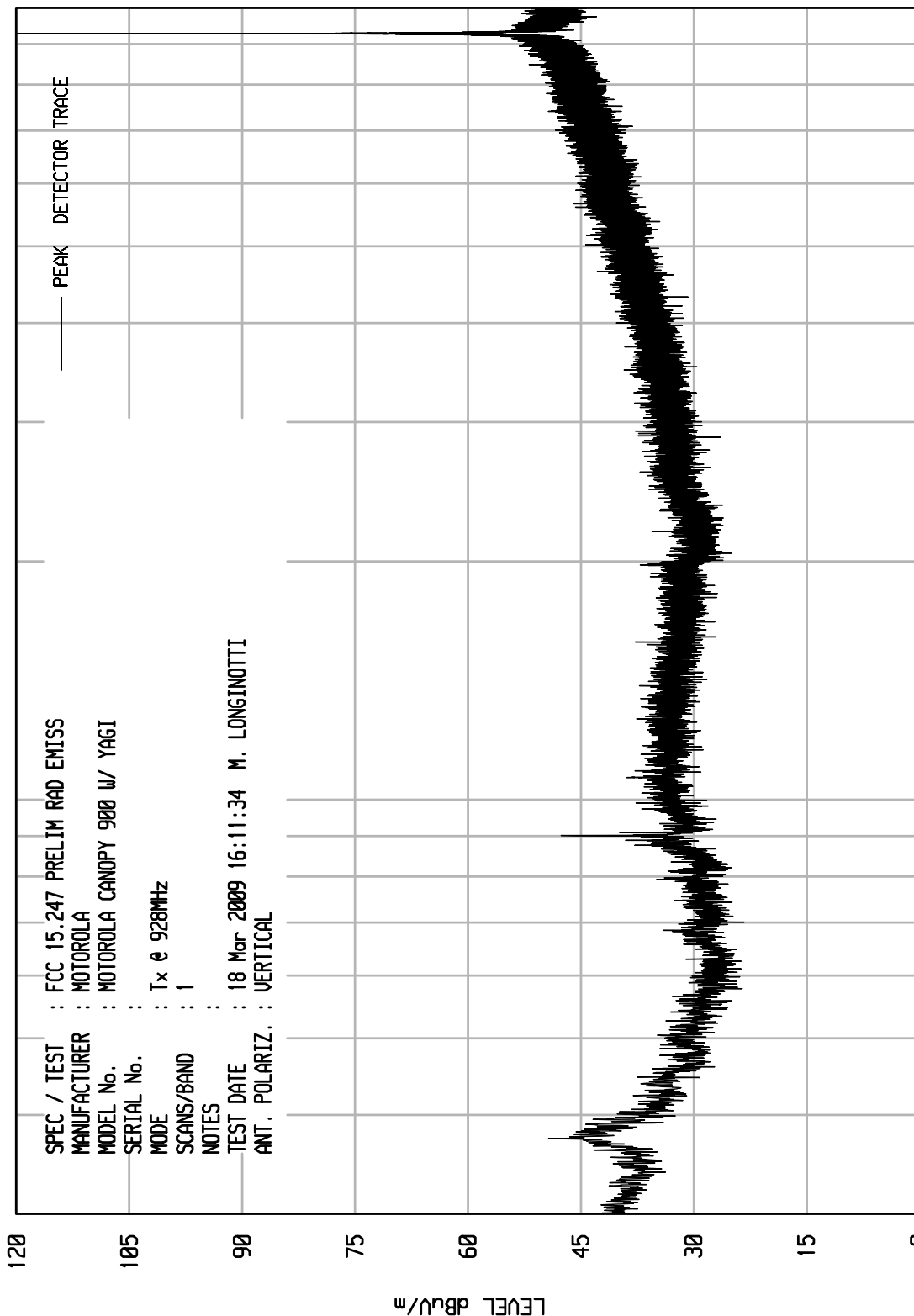
WKA1 01/10/08



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Downers Grove, Ill. 60515

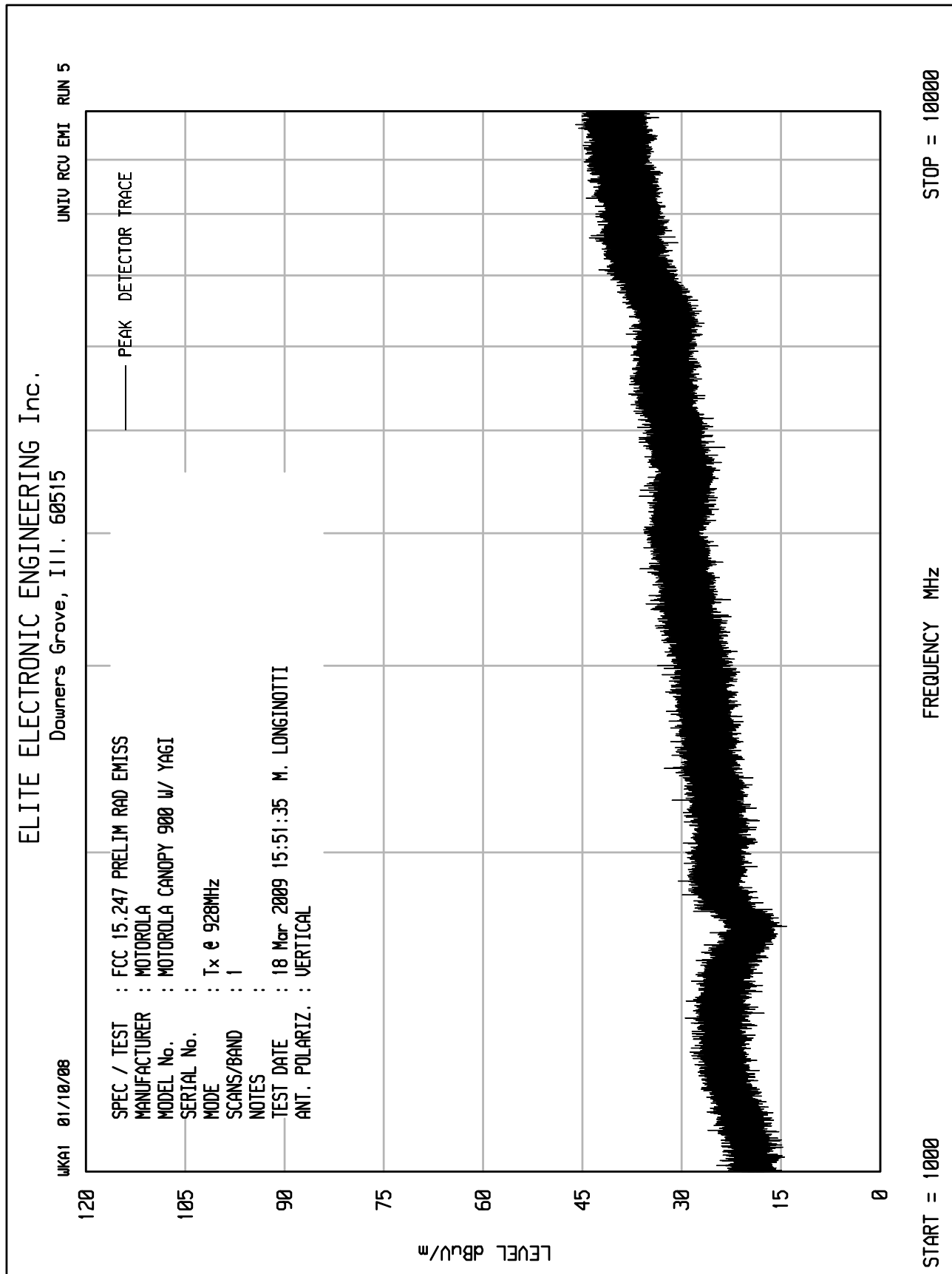
UNIU RCU EMI RUN 11

WKA1 01/10/08



STOP = 1000

START = 30





MANUFACTURER : Motorola, Inc.
MODEL : Canopy 900MHz Access Point and Subscriber Module
S/N : 6069JS13C7
SPECIFICATION : FCC-15C, Spurious Radiated Emissions in Restricted Bands
MODE : Transmit at 902MHz
DATE : March 18, 2009
NOTES : Tested with a Yagi Antenna
NOTES : Power Level set to CB000000

FREQ	ANT	MTR		ANT	CABLE	PRE	TOTAL	TOTAL	LIMIT
MHz	POL	RDG dBuV	BW	FAC	LOSS	AMP	dBuV/m	uV/m	uV/m
2706.0	H	34.9	1M/10	30.2	3.9	-37.0	32.0	39.9	500.0
	V	34.9	1M/10	30.2	3.9	-37.0	32.0	39.9	500.0
3608.0	H	33.8	1M/10	33.9	4.7	-36.5	35.8	61.7	500.0
	V	33.9	1M/10	33.9	4.7	-36.5	35.9	62.5	500.0
4510.0	H	33.0	1M/10	33.9	5.5	-35.9	36.5	66.9	500.0
	V	32.8	1M/10	33.9	5.5	-35.9	36.3	65.4	500.0
5412.0	H	33.4	1M/10	36.3	6.2	-35.8	40.0	100.5	500.0
	V	33.5	1M/10	36.3	6.2	-35.8	40.1	101.7	500.0
8118.0	H	33.3	1M/10	38.0	8.0	-35.4	43.9	156.4	500.0
	V	33.5	1M/10	38.0	8.0	-35.4	44.1	160.1	500.0
9020.0	H	34.0	1M/10	38.5	8.8	-35.2	46.1	201.1	500.0
	V	34.1	1M/10	38.5	8.8	-35.2	46.2	203.4	500.0

Total (dBuV/m) = MTR RDG (dBuV) + ANT FAC (dB) + CABLE LOSS (dB) + PRE AMP (dB)

Checked By:

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MANUFACTURER : Motorola, Inc.
MODEL : Canopy 900MHz Access Point and Subscriber Module
S/N : 6069JS13C7
SPECIFICATION : FCC-15C, Spurious Radiated Emissions in Restricted Bands
MODE : Transmit at 915MHz
DATE : March 18, 2009
NOTES : Tested with a Yagi Antenna
NOTES : Power Level set to CB000000

FREQ	ANT	MTR		ANT	CABLE	PRE	TOTAL	TOTAL	LIMIT
MHz	POL	RDG dBuV	BW	FAC	LOSS	AMP	dBuV/m	uV/m	uV/m
2745.0	H	34.9	1M/10	30.3	3.9	-36.9	32.2	40.8	500.0
	V	35.1	1M/10	30.3	3.9	-36.9	32.4	41.7	500.0
3660.0	H	34.4	1M/10	33.9	4.7	-36.5	36.6	67.5	500.0
	V	34.6	1M/10	33.9	4.7	-36.5	36.8	69.1	500.0
4575.0	H	33.5	1M/10	34.1	5.5	-35.9	37.2	72.9	500.0
	V	33.0	1M/10	34.1	5.5	-35.9	36.7	68.8	500.0
7320.0	H	33.6	1M/10	38.2	7.7	-35.5	44.0	158.8	500.0
	V	33.6	1M/10	38.2	7.7	-35.5	44.0	158.8	500.0
8235.0	H	33.8	1M/10	37.9	8.1	-35.3	44.4	166.3	500.0
	V	33.9	1M/10	37.9	8.1	-35.3	44.5	168.2	500.0
9150.0	H	33.8	1M/10	38.5	8.7	-35.2	45.9	197.2	500.0
	V	33.9	1M/10	38.5	8.7	-35.2	46.0	199.5	500.0

Total (dBuV/m) = MTR RDG (dBuV) + ANT FAC (dB) + CABLE LOSS (dB) + PRE AMP (dB)

Checked By:

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MANUFACTURER : Motorola, Inc.
MODEL : Canopy 900MHz Access Point and Subscriber Module
S/N : 6069JS13C7
SPECIFICATION : FCC-15C, Spurious Radiated Emissions in Restricted Bands
MODE : Transmit at 928MHz
DATE : March 18, 2009
NOTES : Tested with a Yagi Antenna
NOTES : Power Level set to CB000000

FREQ	ANT	MTR		ANT	CABLE	PRE	TOTAL	TOTAL	LIMIT
MHz	POL	RDG dBuV	BW	FAC	LOSS	AMP	dBuV/m	uV/m	uV/m
2784.0	H	36.8	1M/10	30.4	4.0	-36.9	34.3	51.9	500.0
	V	35.0	1M/10	30.4	4.0	-36.9	32.5	42.1	500.0
3712.0	H	33.7	1M/10	34.0	4.8	-36.5	36.1	63.5	500.0
	V	34.1	1M/10	34.0	4.8	-36.5	36.5	66.5	500.0
4640.0	H	32.2	1M/10	34.3	5.6	-35.9	36.2	64.5	500.0
	V	33.0	1M/10	34.3	5.6	-35.9	37.0	70.7	500.0
7424.0	H	31.7	1M/10	38.5	7.7	-35.5	42.4	131.6	500.0
	V	32.9	1M/10	38.5	7.7	-35.5	43.6	151.0	500.0
8352.0	H	32.3	1M/10	37.8	8.2	-35.3	42.9	140.4	500.0
	V	33.7	1M/10	37.8	8.2	-35.3	44.3	165.0	500.0

Total (dBuV/m) = MTR RDG (dBuV) + ANT FAC (dB) + CABLE LOSS (dB) + PRE AMP (dB)

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