Measurement of RF Emissions from a PMLN5993A Wireless Dongle Transmitter

For	Motorola Solutions 1301 E. Algonquin Road Schaumburg, IL 60196
P.O. Number	NP5404217
Date Tested	October 10, 2011
Test Personnel	Richard E. King
Test Specification	FCC "Code of Federal Regulations" Title 47 Part15, Subpart C, 15.209 Industry Canada RSS-Gen
Test Report By:	Richard E. King EMC Engineer
Requested By:	Larry Larsen Motorola Solutions
Approved By:	Raymond J. Klouda Registered Professional Engineer of Illinois - 44894

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REVISION HISTORY

Revision	Date	Description
—	11 Nov 2011	Initial release

Measurement of RF Emissions from a Wireless Dongle, Model No. PMLN5993A Transmitter

1. INTRODUCTION

1.1. Scope of Tests

This report presents the results of the RF emissions measurements performed on a Wireless Dongle, Model No. PMLN5993A, Serial No. none, (hereinafter referred to as the Equipment Under Test (EUT)). The EUT was designed to transmit at approximately 125kHz using an internal antenna. The EUT was manufactured and submitted for testing by Motorola Solutions located in Schaumburg, IL.

1.2. Purpose

The test series was performed to determine if the EUT meets the radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.209 for Intentional Radiators. Testing was performed in accordance with ANSI C63.4-2003.

The test series was performed to determine if the EUT meets the radiated RF emission requirements of the Industry Canada RSS-Gen, Sections 7.2.4 (Table 4) and 7.2.5 (Table 6) for Transmitters. 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 American Association for Laboratory Accreditation (A2LA). A2LA Certificate Number: 1786.01.

1.5. Laboratory Conditions

The temperature at the time of the test was 22^{o}C and the relative humidity was 24%.

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 2011
- Industry Canada RSS-Gen, Issue 3, December 2010, “Spectrum Management and Telecommunications, Radio Standards Specification, General Requirements and Information for the Certification of Radio Apparatus”
- 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"

3. EUT SETUP AND OPERATION

3.1. General Description

The EUT is a Motorola Solutions, Wireless Dongle, Model No. PMLN5993A. It attaches to, and receives power from, a Motorola XPR 6550 portable radio. A block diagram of the EUT setup is shown as Figure 1.

3.1.1. Power Input

The EUT obtained 5VDC from the Motorola XPR 6550 portable radio that it was attached to. The Motorola XPR 6550 portable radio received 7.5VDC power from a 7.5V Nickel Metal Hydride battery.

3.1.2. Peripheral Equipment

The following peripheral equipment was submitted with the EUT:

Item	Description
Portable Radio	Motorola XPR 6550, M/N: AAH55JDH9LA1AN

3.1.3. Signal Input/Output Leads

No interconnect cables were submitted with the EUT for testing.

3.1.4. Grounding

The EUT was ungrounded during the tests.

3.2. Operational Mode

For all tests the EUT and all peripheral equipment were placed on an 80cm high non-conductive stand. The portable radio was energized. The EUT was programmed so that once the portable radio was powered up it would transmit continuously at 125kHz.

3.3. EUT Modifications

No modifications were required for compliance.

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 ANSI C63.4-2003. The receiver bandwidth was 200Hz for the 10kHz to 150kHz radiated emissions data and 9kHz for the 150kHz to 30MHz conducted emissions and radiated emissions data.

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 Emissions Measurements		
Combined Standard Uncertainty	1.07	-1.07
Expanded Uncertainty (95% confidence)	2.1	-2.1

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

5. TEST PROCEDURES

5.1. Powerline Conducted Emissions

5.1.1. Requirements

Since the EUT was powered with 5VDC from the portable radio that has no connections to AC Mains, no conducted emissions tests are required.

5.2. Radiated Measurements

5.2.1. Requirements

The EUT must comply with the requirements of FCC "Code of Federal Regulations Title 47", Part 15, Subpart C, Section 15.209 and Industry Canada, RSS-Gen, Section 7.2.5, Table 6.

Section 15.209(a) has the following radiated emission limits:

Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	2400/F(kHz)	30
1.705 – 30.0	30	30
30 -88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

Note 1: The lower limit shall apply at the transition frequencies.

Per FCC "Code of Federal Regulations Title 47", Part 15, paragraph 15.31(f)(1) and Industry Canada RSS-Gen, Section 7.2.7(b), at frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations. When performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by using the square of an inverse linear distance extrapolation factor (40 dB/decade).

5.2.2. Procedures

Radiated measurements were performed in a 32ft. x 20ft. x 14ft. high shielded enclosure. 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.

A preliminary radiated emissions test was performed to determine the emission characteristics of the EUT. For the preliminary test, an active loop antenna was positioned at a 30 cm distance from the EUT. The entire

frequency range from 10kHz to 30MHz was investigated using a peak detector function. The data was then processed by the computer to calculate equivalent field intensity.

The final open field emission tests were then manually performed over the frequency range of 125kHz to 1.25MHz using an active loop antenna at a 3 meter test distance. All significant broadband and narrowband signals were measured and recorded. For measurements below 0.490MHz, the data was converted to equivalent field intensity at 300 meters using the inverse linear distance extrapolation factor of 40dB/decade. Since the test distance of 3 meters is 2 decades closer than the specification test distance of 300 meters, a distance correction factor of 80dB was used (80 dB = 40dB/decade x 2 decades). For measurements above 0.490MHz, the data was converted to equivalent field intensity at 30 meters using the inverse linear distance extrapolation factor of 40dB/decade. Since the test distance of 3 meters is 1 decade closer than the specification test distance of 30 meters, a distance correction factor of 40dB was used (40 dB = 40dB/decade x 1 decade). The resultant field strength (FS) is a summation in decibels (dB) of the receiver meter reading (MTR), the antenna correction factor (AF), and the cable loss factor (CF). If an external pre-amplifier is used, the total is reduced by its gain (-PA). If a distance correction (DC) is required, it is added to the total.

Formula 1: FS (dBuV/m) = MTR (dBuV) + AF (dB/m) + CF (dB) + (- PA (dB)) + DC (dB)

To convert the Field Strength dBuV/m term to uV/m, the dBuV/m is first divided by 20. The Base 10 AntiLog is taken of this quotient. The result is the Field Strength value in uV/m terms.

Formula 2: FS (uV/m) = AntiLog [(FS (dBuV/m))/20]

To ensure that maximum or worst case, emission levels were measured, the following steps were taken:

1) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
2) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured. In the vertical polarization, the active loop antenna was rotated 360 degrees about its vertical axis.
3) For hand-held or body-worn devices, the EUT was rotated through three orthogonal axes to determine which orientation produces the highest emission relative to the limit.

5.2.3.Results

The preliminary plots, with the EUT transmitting at 125kHz, are presented on pages 12 and 13. The plots are presented for a reference only, and are not used to determine compliance.

The final radiated levels, with the EUT transmitting at 125kHz, are presented on page 14. As can be seen from the data, all emissions measured from the EUT were within the specification limits. All emissions measured from the EUT at 3 meters were ambient. Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown on Figure 2.

6. OTHER TEST CONDITIONS

6.1. Test Personnel and Witnesses

All tests were performed by qualified personnel from Elite Electronic Engineering Incorporated.

6.2. Disposition of the EUT

The EUT and all associated equipment were returned to Motorola Solutions upon completion of the tests.

7. CONCLUSIONS

It was determined that the Motorola Solutions Wireless Dongle, Model No. PMLN5993A, did to meet the radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.207 and 15.209 for Intentional Radiators, when tested per ANSI C63.4-2003.

It was also determined that the Motorola Solutions Wireless Dongle, Model No. PMLN5993A, did meet the radiated emission requirements of the Industry Canada, RSS-Gen, Section 7.2.4 (Table 4) and 7.2.5 (Table 6) for Transmitters, when tested per ANSI C63.4-2003.

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 EUT at the test date Any electrical or mechanical modification made to the EUT 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
CDW4	DESKTOP COMPUTER	ELITE	PENTIUM 4	005	3.8GHZ	N/A	
CMA1	Controllers	EMCO	2090	9701-1213	---	N/A	
NLS0	24" ACTIVE LOOP ANTENNA	EMCO	6502	89979	10KHZ-30MHZ	5/12/2011	5/12/2012

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.

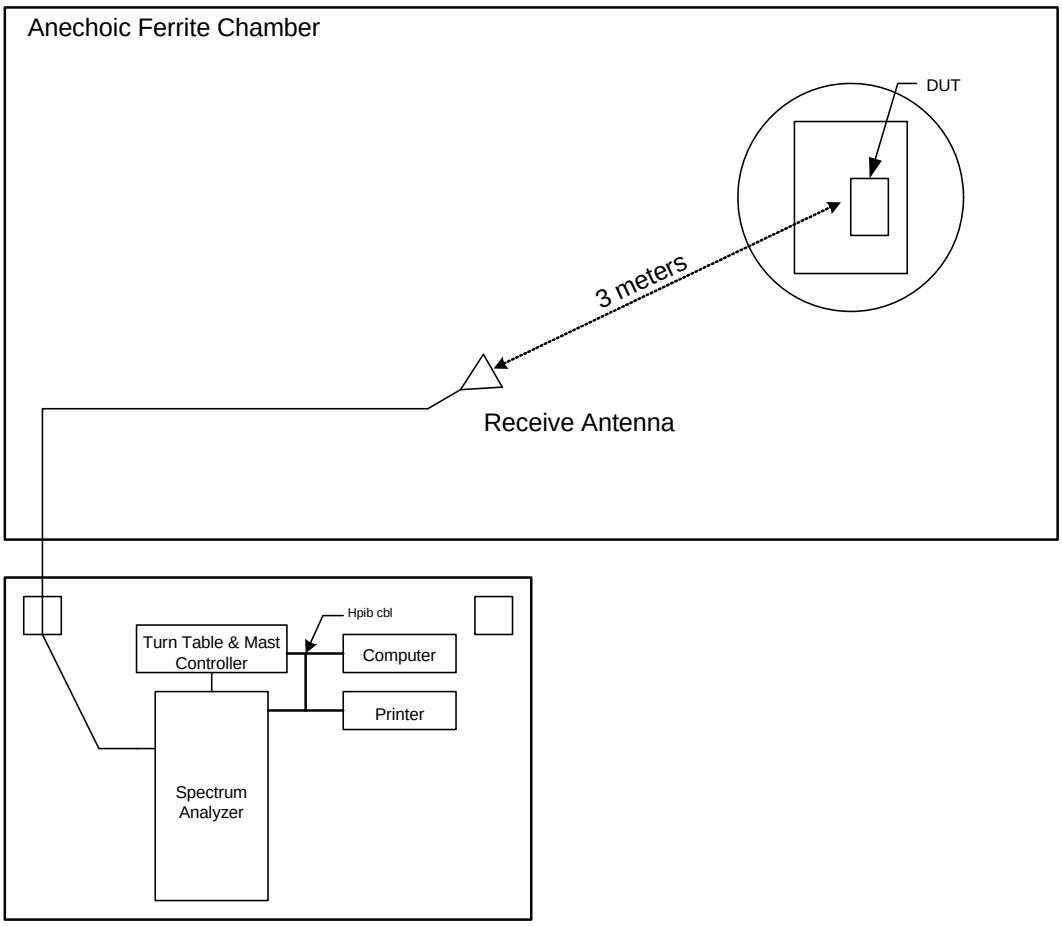
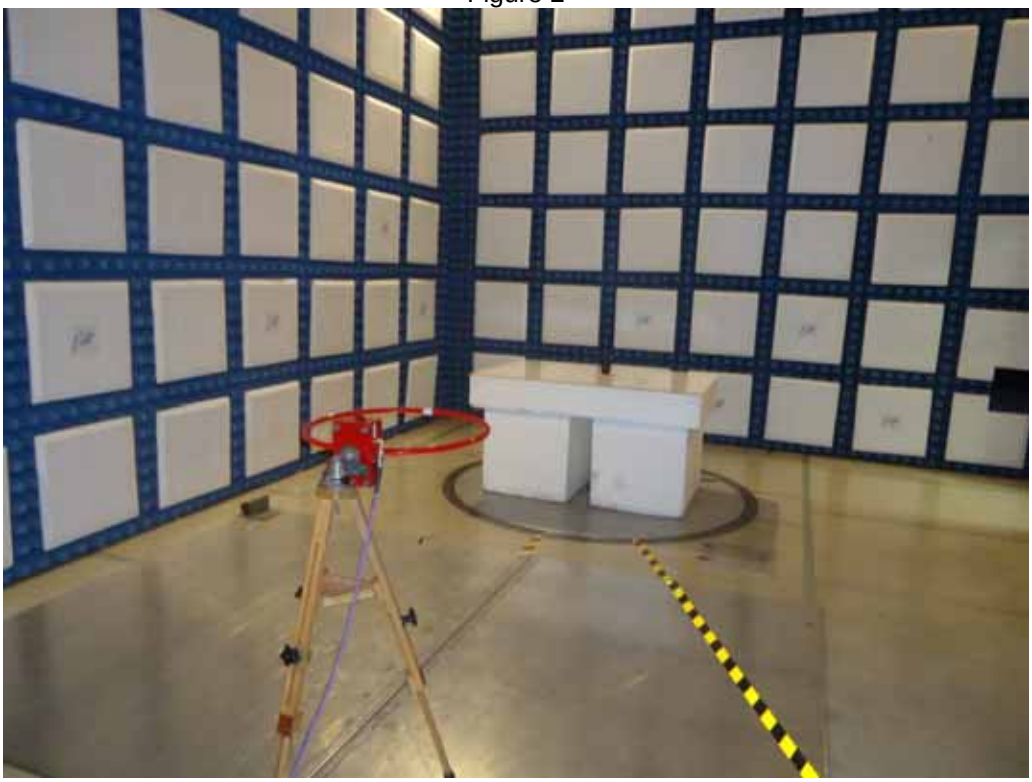


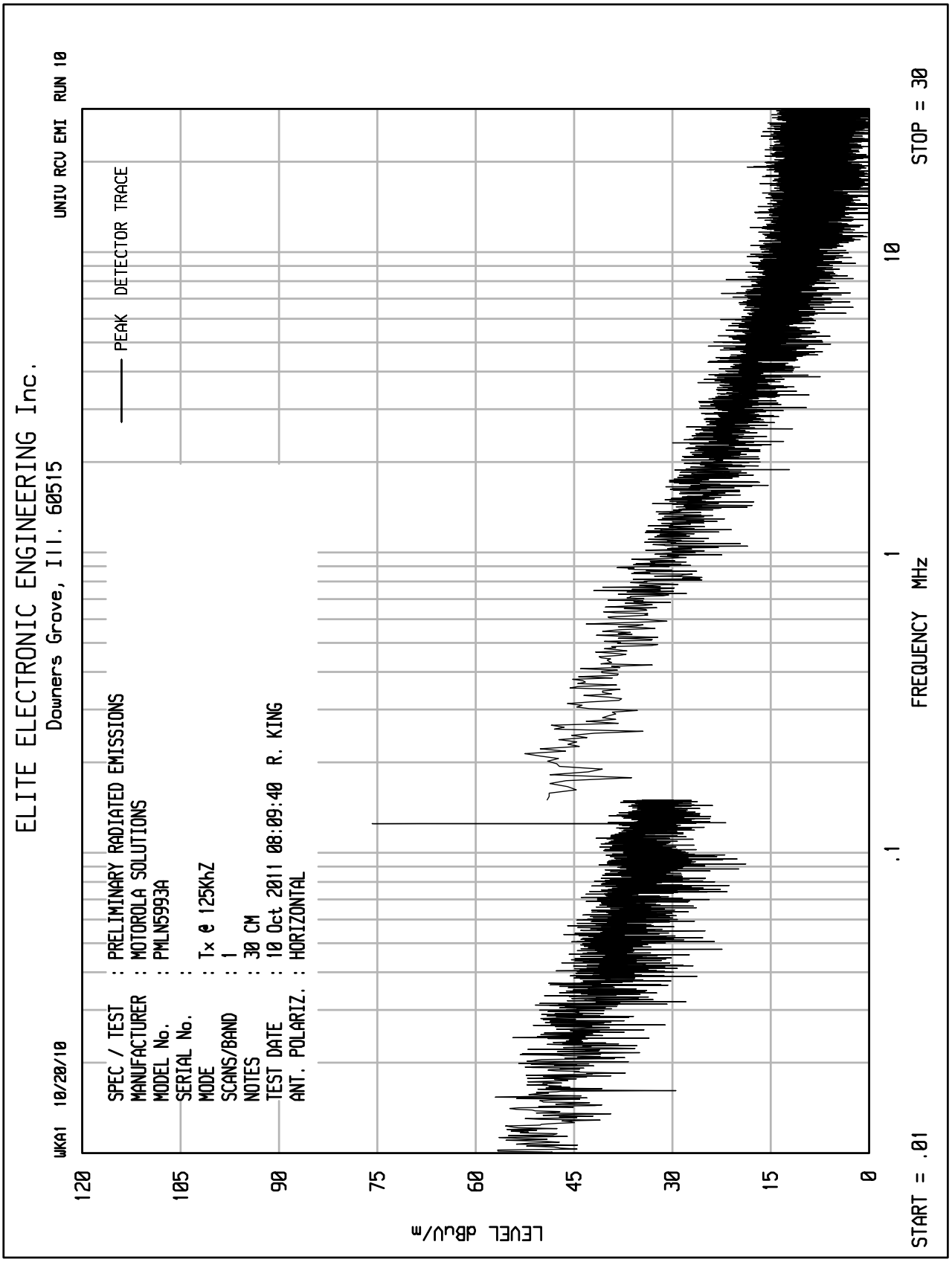
FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

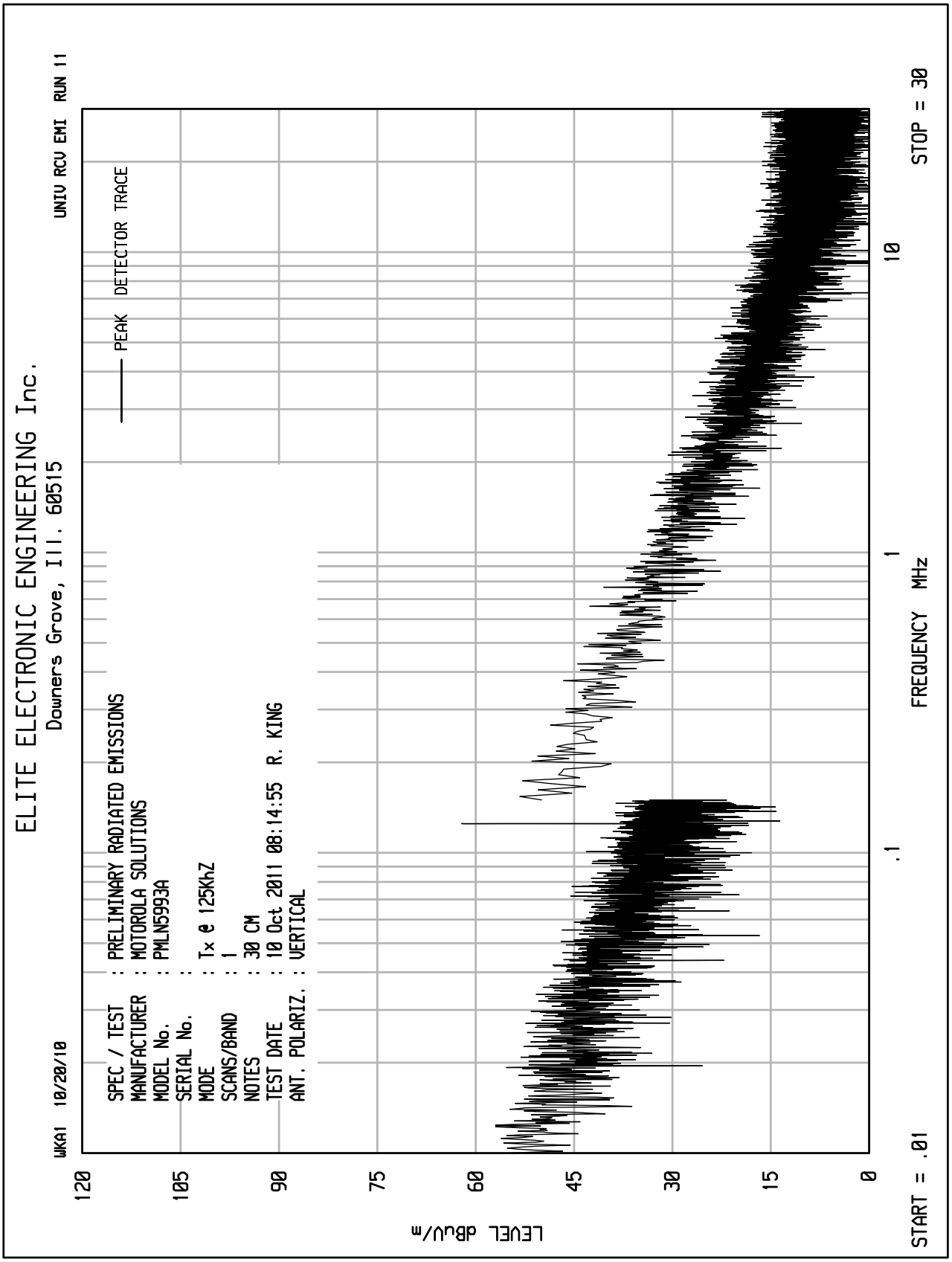
Figure 2



Test Setup for Radiated Emissions, 10kHz to 30MHz – Horizontal Polarization

Test Setup for Radiated Emissions, 10kHz to 30MHz – Vertical Polarization


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 10
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MOTOROLA SOLUTIONS
MODEL No. : PMLN5993A
SERIAL No. :
MODE : Tx @ 125Khz
SCANS/BAND : 1
NOTES : 30 CM
TEST DATE : 10 Oct 2011 08:09:40 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = .01
.1
1
10
STOP = 30
FREQUENCY MHz


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 11
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : MOTOROLA SOLUTIONS
MODEL No. : PMLN5993A
SERIAL No. : Tx @ 125Khz
MODE : 1
SCANS/BAND : 30 CM
NOTES : 10 Oct 2011 08:14:55 R. KING
TEST DATE : VERTICAL
ANT. POLARIZ.
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = .01
.1
1
10
STOP = 30
FREQUENCY MHz

MANUFACTURER : Motorola
EUT : Wireless Dongle
MODEL NUMBER : PMLN5993A
TEST MODE : Transmit at 125kHz
TEST DATE : October 10, 2011
TEST PARAMETERS : FCC CFR 47, Part 15, Subpart C, Section 15.209 Radiated Emissions
TEST PARAMETERS : Industry Canada RSS-Gen, Section 7.2.5 Table 6 Radiated Emissions
TEST DISTANCE : 3 meters
NOTES : Tested with Motorola XPR 6550 Portable Radio

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Dist. Corr. (dB)	Total dBuV/m at 3 M	Total uV/m at 300m/30m	Limit uV/m at 300m/30m	Margin (dB)
0.125	H	31.7	*	0.0	10.7	-80.0	-37.6	0.0132	19.2	-63.2
0.125	V	31.6	*	0.0	10.7	-80.0	-37.7	0.0131	19.2	-63.3
0.250	H	42.6	*	0.0	10.4	-80.0	-27.0	0.0447	9.6	-46.6
0.250	V	42.5	*	0.0	10.4	-80.0	-27.1	0.0442	9.6	-46.7
0.375	H	39.8	*	0.0	10.4	-80.0	-29.8	0.0324	6.4	-45.9
0.375	V	39.7	*	0.0	10.4	-80.0	-29.9	0.0320	6.4	-46.0
0.500	H	36.6	*	0.0	10.4	-40.0	7.0	2.2387	48.0	-26.6
0.500	V	36.1	*	0.0	10.4	-40.0	6.5	2.1135	48.0	-27.1
0.625	H	34.2	*	0.0	10.5	-40.0	4.7	1.7127	38.4	-27.0
0.625	V	33.7	*	0.0	10.5	-40.0	4.2	1.6169	38.4	-27.5
0.750	H	32.4	*	0.0	10.5	-40.0	2.9	1.3886	32.0	-27.3
0.750	V	32.1	*	0.0	10.5	-40.0	2.6	1.3415	32.0	-27.6
0.875	H	31.7	*	0.0	10.6	-40.0	2.3	1.2996	27.4	-26.5
0.875	V	31.3	*	0.0	10.6	-40.0	1.9	1.2411	27.4	-26.9
1.000	H	29.2	*	0.0	10.6	-40.0	-0.2	0.9772	24.0	-27.8
1.000	V	30.2	*	0.0	10.6	-40.0	0.8	1.0965	24.0	-26.8
1.125	H	29.0	*	0.0	10.6	-40.0	-0.4	0.9569	21.3	-27.0
1.125	V	29.3	*	0.0	10.6	-40.0	-0.1	0.9905	21.3	-26.7
1.250	H	27.6	*	0.0	10.6	-40.0	-1.8	0.8158	19.2	-27.4
1.250	V	26.2	*	0.0	10.6	-40.0	-3.2	0.6944	19.2	-28.8

Limit distance is 300 meters below 490kHz. Limit distance is 30 meters from 490kHz to 1.705MHz

Checked BY Richard E. King :

Richard E. King