



Measurement of RF Interference from a Model M190-T Transmitter

For : TouchTronics, Inc.
57315 Nagy Drive
Elkhart, IN 46517

P.O. No. : 9855
Date Tested : December 28, 2009
Test Personnel : Richard King
Specification : FCC "Code of Federal Regulations" Title 47
Part 15, Subpart C
: Industry Canada RSS-210
: Industry Canada RSS-GEN

Test Report By : *RICHARD E. KING*
Richard King

Witnessed By :
David Evans
TouchTronics, Inc.

Approved By : *Raymond J. Klouda*
Raymond J. Klouda
Registered Professional
Engineer of Illinois - 44894



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REVISION HISTORY

Revision	Date	Description
—	December 28, 2009	Initial release

Measurement of RF Emissions from a M190-T Transmitter

1 INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a TouchTronics, Inc., model M190-T part number 144404414-T transmitter, (hereinafter referred to as the test item). Two versions of the test item were submitted for testing, one with a Premco M190-A2 external antenna and one with a Premco M190-A3 external antenna. No serial number was assigned. The test item was designed to transmit at approximately 125kHz using the external antennas. The test item was manufactured and submitted for testing by TouchTronics, Inc. located in Elkhart, IN.

1.2 Purpose

The test series was performed to determine if the test item meets the conducted and 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 and the Industry Canada RSS-Gen section 7.2.2 and Industry Canada RSS-210 Table 3. 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 21.5°C and the relative humidity was 19%.

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 2009
- 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 RSS-210, Issue 7, June 2007, "Spectrum Management and Telecommunications Radio Standards Specification, Low-power License-exempt radio communication devices (All Frequency Bands): Category I Equipment"
- Industry Canada RSS-GEN, Issue 2, June 2007, "Spectrum Management and Telecommunications Radio Standards Specification, General Requirements and Information for the Certification of radio communication equipment"

3 TEST ITEM SETUP AND OPERATION

3.1 General Description

The test item is a model M190-T Transmitter. A block diagram of the test item setup is shown as Figure 1.

3.1.1 Power Input

The test item obtained 13.5VDC power via two 6-inch power leads.

3.1.2 Peripheral Equipment

The test item was connected to the external antennas via a 6-inch wiring harness.

3.1.3 Interconnect Cables

The test item was connected to the external antennas via a 6-inch long wiring harness.

3.1.4 Grounding

The test item was not grounded during the test.

3.2 Operational Mode

For all tests the test item and all peripheral equipment were placed on an 80cm high non-conductive stand. The test item and all peripheral equipment were energized.

3.3 Test Item Modifications

No modifications were required for compliance to the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.209 and the Industry Canada RSS-Gen section 7.2.2 and Industry Canada RSS-210 Table 3.

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.

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

Radiated Emission 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 test item is normally powered by 13.5VDC from a vehicle battery, no conducted emissions tests were required.

5.2 Propagation Loss Measurements

5.2.1 Requirements

Per 15.209(e), the provisions of 15.31 shall apply for measuring emissions at distances other than the distances specified in the table in 15.209(a). Per 15.31(f)(2) at frequencies below 30MHz, measurements may be performed at a distance closer than that specified in the regulations. However when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by making measurements at a minimum of two distances to determine the proper extrapolation factor.

5.2.2 Procedures

The test item was placed on an 80cm high non-conductive test stand. The active loop antenna was placed 2 meters away from the test item. The test item was programmed to transmit continuously. The field strength measurement was taken at the 2 meter distance. This process was repeated with the active loop antenna 3 meters, 4 meters and 5 meters away.

5.2.3 Results

The results of the propagation loss measurements are shown on data pages 13 and 14.

The propagation loss for the M190-T Transmitter with the M190-A2 external antenna was 54.2dB to convert readings taken at 3 meters to the 30 meter limit and 108.4dB to convert readings taken at 3 meters to the 300 meter limit.

The propagation loss for the M190-T Transmitter with the M190-A3 external antenna was 55dB to convert readings taken at 3 meters to the 30 meter limit and 110.1dB to convert readings taken at 3 meters to the 300 meter limit.

5.3 Radiated Measurements

5.3.1 Requirements

The test item must comply with the requirements of FCC "Code of Federal Regulations Title 47", Part 15, Subpart C, Section 15.209 and the Industry Canada RSS-210 Table 3. These standards have the following limits:

Measurement



Frequency MHz	Field Intensity uV/m	Distance meters
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/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

5.3.2 Procedures

A preliminary radiated emissions test was performed to determine the emission characteristics of the test item. For the preliminary test, an active loop antenna was positioned at a 3 meter distance from the test item. 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 emission measurements were then manually performed over the frequency range of 125 kHz to 1.25 MHz using an active loop antenna. All significant broadband and narrowband signals were measured and recorded.

To ensure that maximum or worst case, 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 antenna is linearly polarized, both horizontal and vertical field components were measured.
- 3) For hand-held or body-worn devices, the test item was rotated through three orthogonal axes to determine which orientation produces the highest emission relative to the limit.

5.3.3 Results

The preliminary plot, with the test item and the external antenna M190-A2 is shown on data page 15. The final radiated levels, with the test item transmitting at 125kHz, are presented on data page 16. 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.

The preliminary plot, with the test item and the external antenna M190-A3 is shown on data page 17. The final radiated levels, with the test item transmitting at 125kHz, are presented on data page 18. 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 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 witnessed by TouchTronics, Inc. personnel.

6.2 Disposition of the Test Item

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

7 CONCLUSIONS

It was determined that the TouchTronics, Inc. model M190-T part number 144404414-T Transmitter with external antennas M190-A2 and M190-A3, Serial No. none assigned, did fully meet the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C,



Section 15.207 and 15.209 and the Industry Canada RSS-Gen section 7.2.2 and Industry Canada RSS-210 Table 3. Testing was performed in accordance with 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 test item at the test date as operated by TouchTronics, 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
CDS2	COMPUTER	GATEWAY	MFATXPNT NMZ 500L	0028483108	1.8GHZ	N/A	
HRE1	LASER JET 5P	HEWLETT PACKARD	C3150A	USHB061052	---	N/A	
NLS1	24" ACTIVE LOOP ANTENNA	EMCO	6502	8903-2329	0.01-30MHZ	4/28/2009	4/28/2010
RBB0	EMI TEST RECEIVER 20HZ TO 40 GHZ.	ROHDE & SCHWARZ	ESIB40	100250	20 HZ TO 40GHZ	3/11/2009	3/11/2010
SEK0	DC POWER SUPPLY	LABORNETZGERAT	L3205	94081001	0-32VDC;0-5A	NOTE 1	

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.

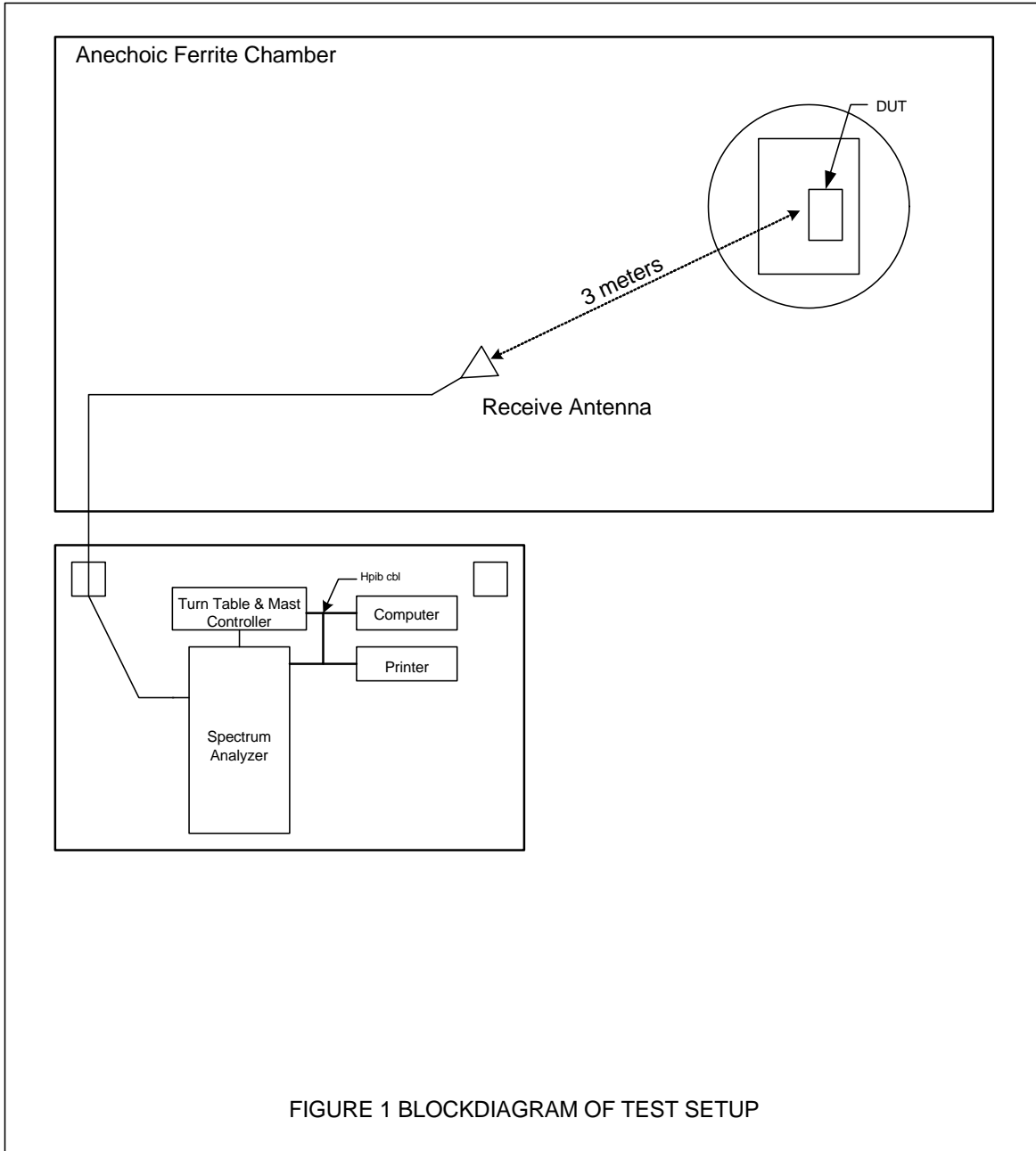
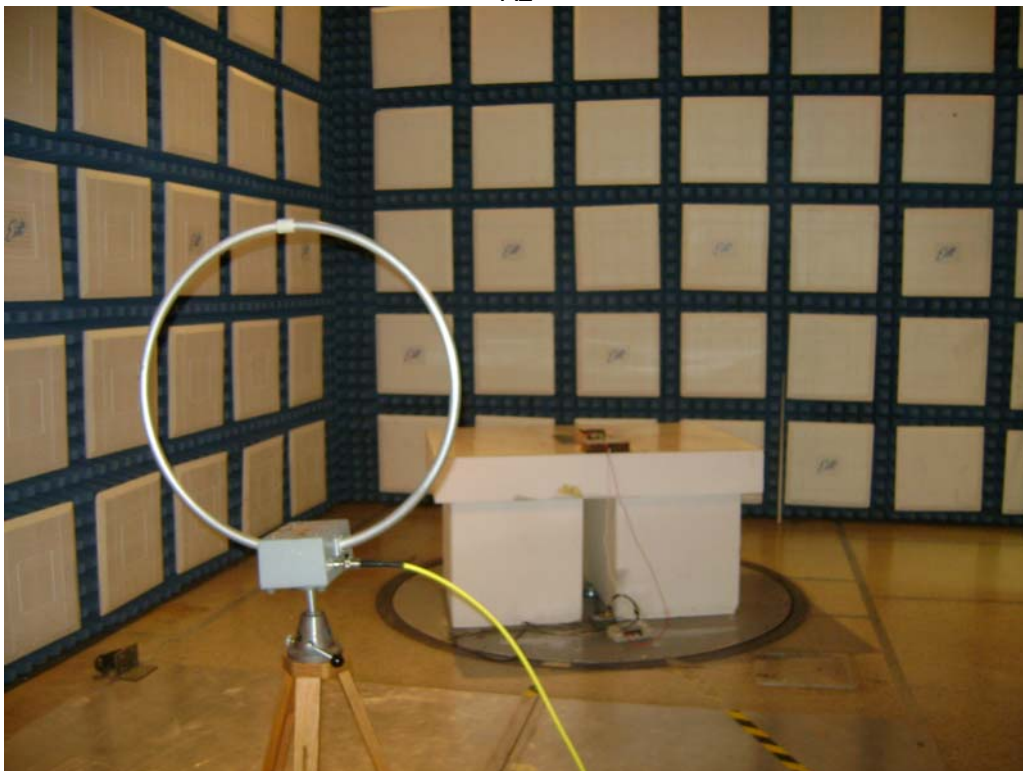


Figure 2

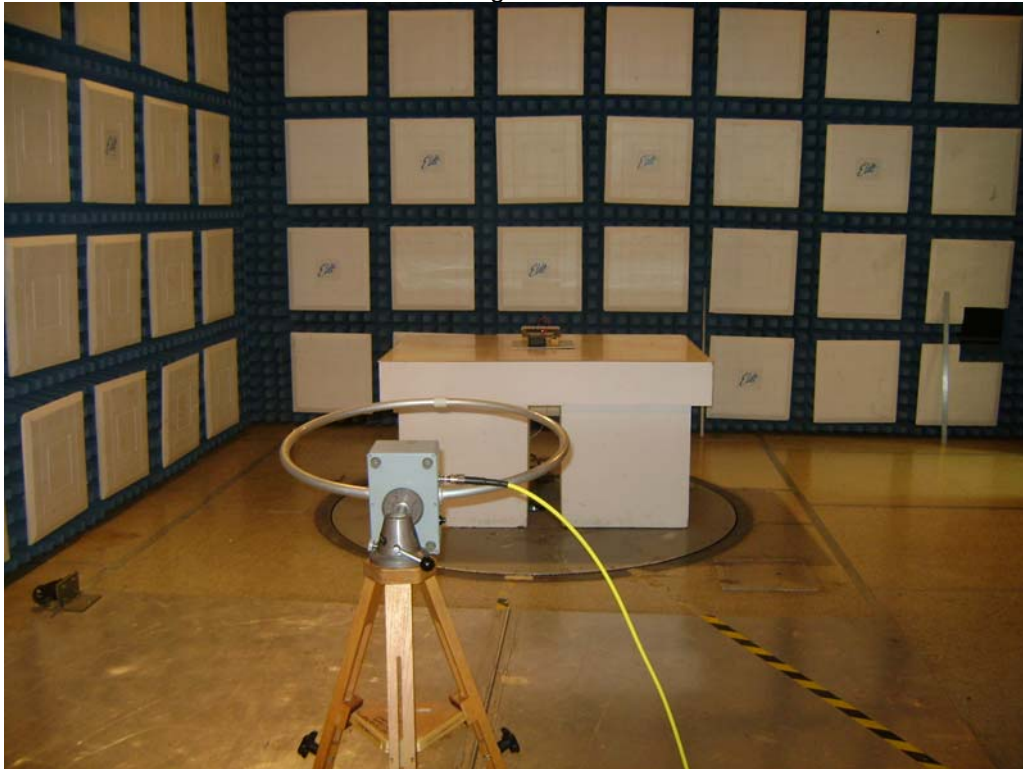


Test Set-up for Radiated Emissions – Horizontal Polarization, External Antenna M190-A2

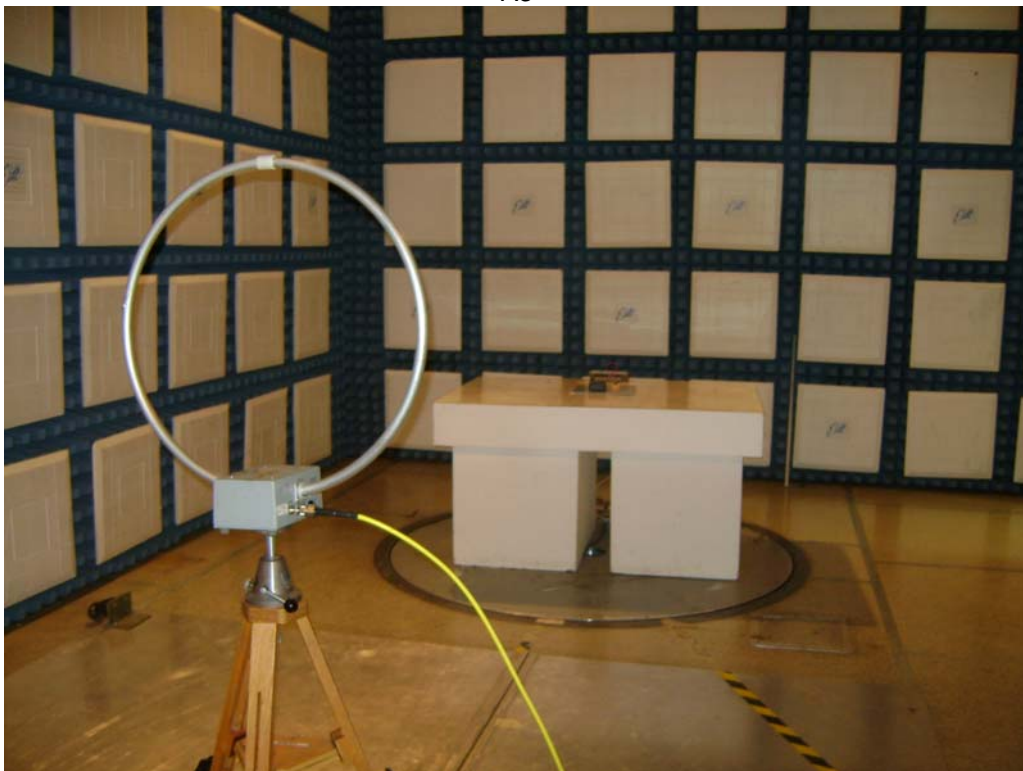


Test Set-up for Radiated Emissions – Vertical Polarization, External Antenna M190-A2

Figure 3



Test Setup for Radiated Emissions – Horizontal Polarization, External Antenna M190-A3



Test Setup for Radiated Emissions – Vertical Polarization, External Antenna M190-A3





PROPAGATION LOSS MEASUREMENTS AND CALCULATIONS FOR M190-T WITH AN M190-A2 EXTERNAL ANTENNA

TEST DISTANCE (meters)	METER READING (dBuV)
2	111.42
5	89.86

$$\text{PROPAGATION LOSS} = 20 * \text{LOG} (D_m/D_l)^N$$

WHERE : D_m = DISTANCE OF MEASUREMENT

: D_l = LIMIT DISTANCE

: N = SLOPE OF THE LINE

SOLVING FOR N:

$$N = (dBV_2 - dBV_1) / (20 * \text{LOG}(D_2/D_1))$$

$$N = (89.86 - 111.42) / (20 * \text{LOG}(5/2))$$

$$N = -2.7$$

PLACING THE SLOPE (N) INTO THE PROPAGATION LOSS EQUATION GIVES YOU:

$$\text{PROPAGATION LOSS} = 20 * \text{LOG}(3/30)^{-2.7}$$

$$= 54.2 \text{ AT } 30 \text{ METER TEST DISTANCE}$$

$$\text{PROPAGATION LOSS} = 20 * \text{LOG}(3/300)^{-2.7}$$

$$= 108.4\text{dB AT } 300 \text{ METER TEST DISTANCE}$$



PROPAGATION LOSS MEASUREMENTS AND CALCULATIONS FOR M190-T WITH AN M190-A3 EXTERNAL ANTENNA

TEST DISTANCE (meters)	METER READING (dBuV)
2	107.96
5	86.09

$$\text{PROPAGATION LOSS} = 20 * \text{LOG} (D_m/D_l)^N$$

WHERE : D_m = DISTANCE OF MEASUREMENT

: D_l = LIMIT DISTANCE

: N = SLOPE OF THE LINE

SOLVING FOR N:

$$N = (dBV_2 - dBV_1) / (20 * \text{LOG}(D_2/D_1))$$

$$N = (86.09 - 107.96) / (20 * \text{LOG}(5/2))$$

$$N = -2.8$$

PLACING THE SLOPE (N) INTO THE PROPAGATION LOSS EQUATION GIVES YOU:

$$\text{PROPAGATION LOSS} = 20 * \text{LOG}(3/30)^{-2.8}$$

$$= 55.0\text{dB AT 30 METER TEST DISTANCE}$$

$$\text{PROPAGATION LOSS} = 20 * \text{LOG}(3/300)^{-2.8}$$

$$= 110.1\text{dB AT 300 METER TEST DISTANCE}$$

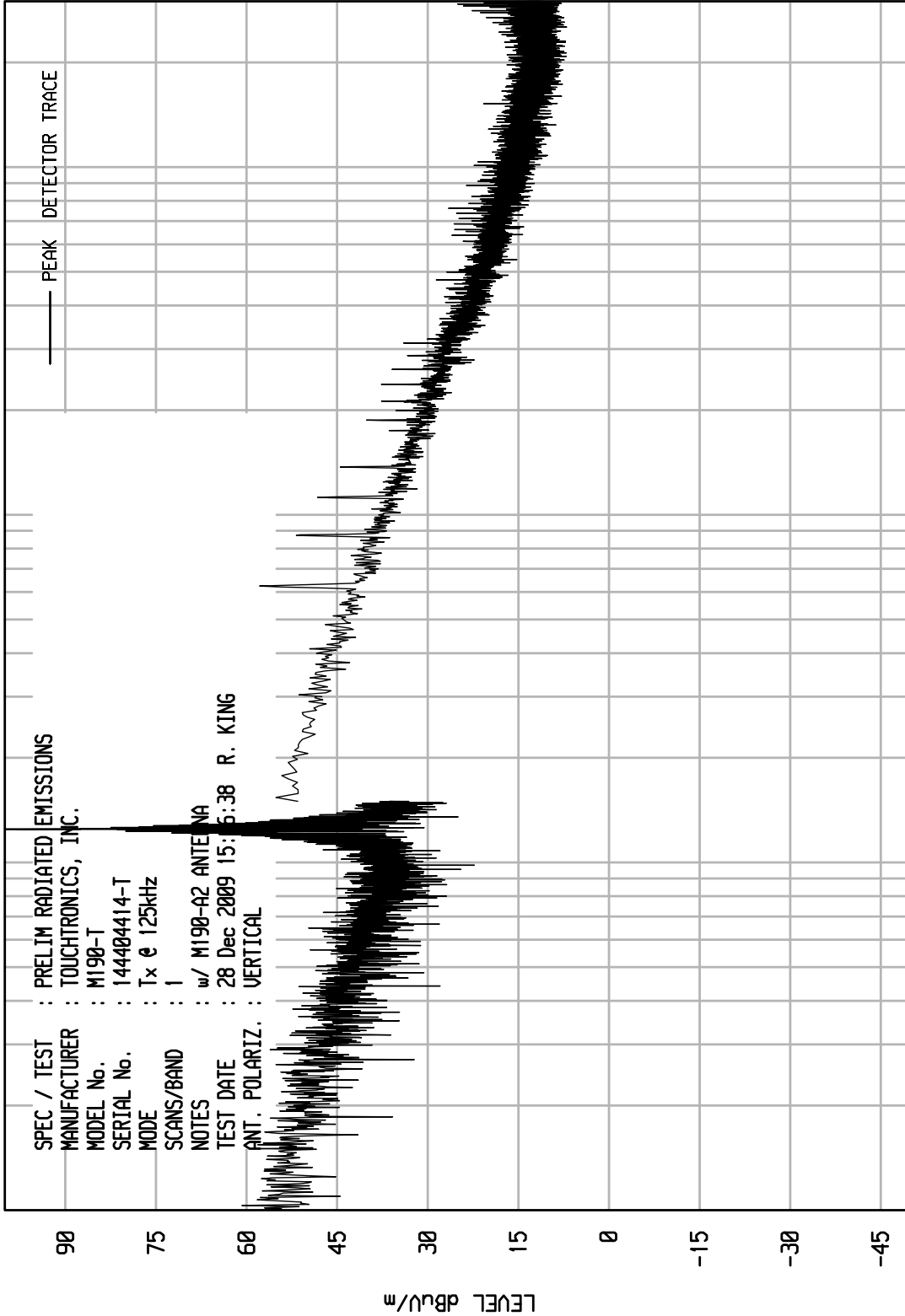
ELITE ELECTRONIC ENGINEERING Inc.

Downers Grove, Ill. 60515

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SPEC / TEST : PRELIM RADIATED EMISSIONS
 MANUFACTURER : TOUCHTRONICS, INC.
 MODEL No. : M190-T
 SERIAL No. : 144404414-T
 MODE : Tx @ 125kHz
 SCANS/BAND : 1
 NOTES : w/ M190-A2 ANTENNA
 TEST DATE : 28 Dec 2009 15:5:38 R. KING
 ANT. POLARIZ. : VERTICAL



START = .01

STOP = 30



DATA PAGE

Manufacturer : TouchTronics, Inc.
 Model No. : M190-T
 Part No. : 144404414-T
 Serial No. : None Assigned
 Mode : Tx @ 125kHz
 Date Tested : December 28, 2009
 Test Distance : 3 meters
 Test Performed : FCC 15.209 Radiated Emissions
 Notes : External Antenna M190-A2

Frequency (MHz)	Ant Pol	Meter Reading (dBuV)	Amb	Cable Fac (dB)	Ant Fac (dB)	Propagation Loss (dB)	Total dBuV/m at 300m/30m	Total uV/m at 300m/30m	Limit uV/m at 300m/30m	Margin (dB)
0.125	H	96.4		0.0	10.8	-108.4	-1.2	0.868	19.2	-26.9
0.125	V	103.1		0.0	10.8	-108.4	5.5	1.874	19.2	-20.2
0.250	H	48.2		0.0	10.6	-108.4	-49.6	0.003	9.6	-69.3
0.250	V	46.2		0.0	10.6	-108.4	-51.6	0.003	9.6	-71.2
0.375	H	52.0		0.0	10.7	-108.4	-45.8	0.005	6.4	-61.9
0.375	V	58.2		0.0	10.7	-108.4	-39.5	0.011	6.4	-55.7
0.500	H	38.5	*	0.0	10.7	-54.2	-5.0	0.561	48.0	-38.6
0.500	V	38.8	*	0.0	10.7	-54.2	-4.7	0.580	48.0	-38.4
0.625	H	42.7		0.0	10.7	-54.2	-0.8	0.917	38.4	-32.4
0.625	V	46.9		0.0	10.7	-54.2	3.4	1.475	38.4	-28.3
0.750	H	34.8	*	0.0	10.5	-54.2	-8.9	0.358	32.0	-39.0
0.750	V	35.4	*	0.0	10.5	-54.2	-8.3	0.387	32.0	-38.4
0.875	H	36.8		0.0	10.6	-54.2	-6.9	0.453	27.4	-35.6
0.875	V	43.0		0.0	10.6	-54.2	-0.6	0.934	27.4	-29.3
1.000	H	31.1	*	0.0	10.7	-54.2	-12.4	0.241	24.0	-40.0
1.000	V	31.6	*	0.0	10.7	-54.2	-11.9	0.254	24.0	-39.5
1.125	H	34.2		0.0	10.7	-54.2	-9.2	0.345	21.3	-35.8
1.125	V	38.6		0.0	10.7	-54.2	-4.8	0.573	21.3	-31.4
1.250	H	27.1	*	0.0	10.7	-54.2	-16.4	0.152	19.2	-42.0
1.250	V	28.6	*	0.0	10.7	-54.2	-14.9	0.180	19.2	-40.6

Total (dBuV/m) = Meter Reading + Cable Factor + Ant Factor + Propagation Loss

Limit distance is 300 meters from 9kHz to 490kHz. Limit distance is 30 meters from 490kHz to 1.705MHz

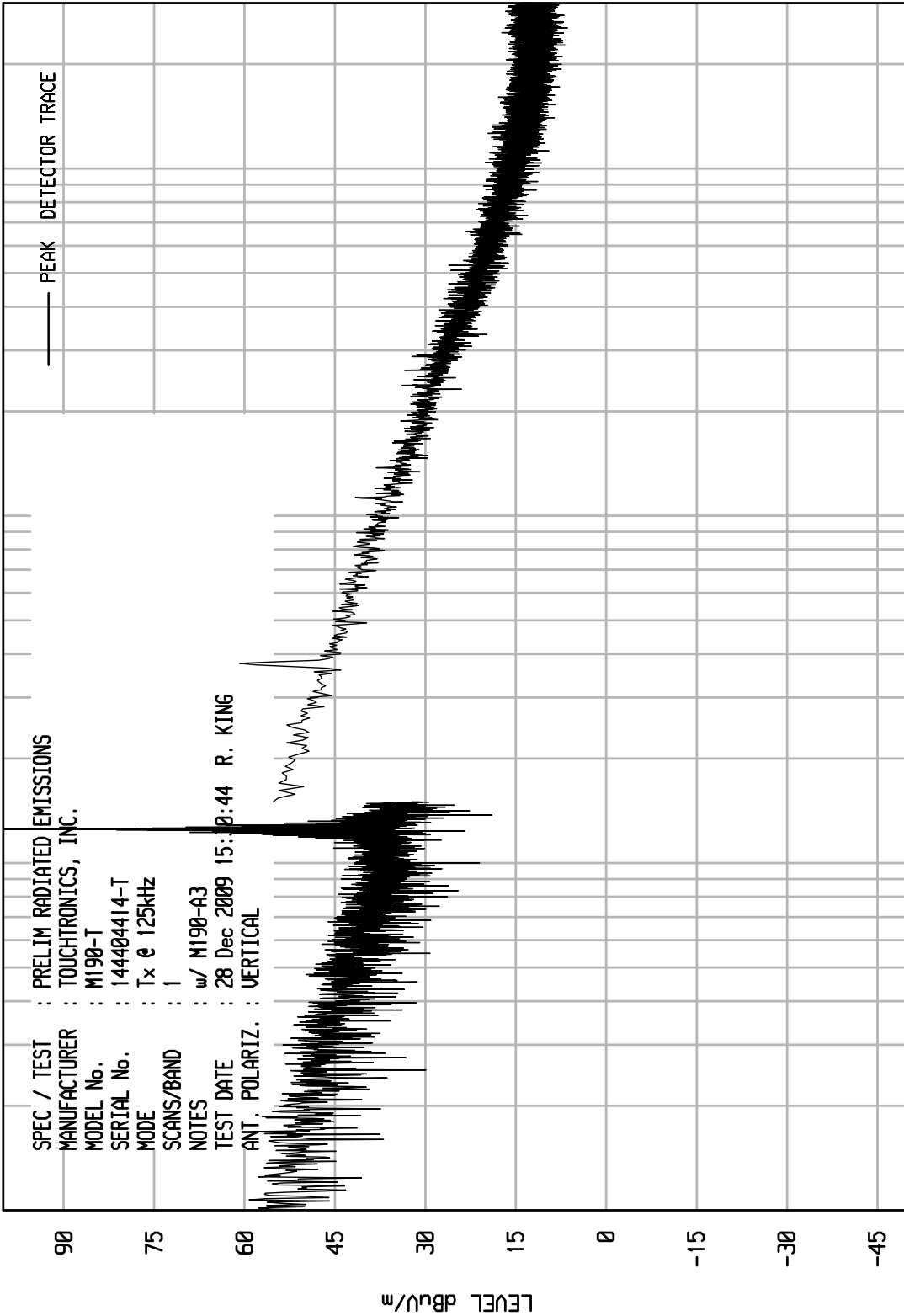
Checked BY RICHARD E. KING :

Richard E. King

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515

UNITU RCU EMI RUN 3

WKA1 01/30/09





DATA PAGE

Manufacturer : TouchTronics, Inc.
 Model No. : M190-T
 Part No. : 144404414-T
 Serial No. : None Assigned
 Mode : Tx @ 125kHz
 Date Tested : December 28, 2009
 Test Distance : 3 meters
 Test Performed : FCC 15.209 Radiated Emissions
 Notes : External Antenna M190-A3

Frequency (MHz)	Ant Pol	Meter Reading (dBuV)	Amb	Cable Fac (dB)	Ant Fac (dB)	Propagation Loss (dB)	Total dBuV/m at 300m/30m	Total uV/m at 300m/30m	Limit uV/m at 300m/30m	Margin (dB)
0.125	H	92.8		0.0	10.8	-110.1	-6.5	0.472	19.2	-32.2
0.125	V	99.6		0.0	10.8	-110.1	0.3	1.037	19.2	-25.4
0.250	H	47.1		0.0	10.6	-110.1	-52.4	0.002	9.6	-72.1
0.250	V	42.9		0.0	10.6	-110.1	-56.5	0.001	9.6	-76.2
0.375	H	49.1		0.0	10.7	-110.1	-50.4	0.003	6.4	-66.5
0.375	V	55.7		0.0	10.7	-110.1	-43.7	0.007	6.4	-59.9
0.500	H	36.3	*	0.0	10.7	-55.0	-8.1	0.395	48.0	-41.7
0.500	V	38.7		0.0	10.7	-55.0	-5.6	0.523	48.0	-39.3
0.625	H	40.9		0.0	10.7	-55.0	-3.4	0.675	38.4	-35.1
0.625	V	43.8		0.0	10.7	-55.0	-0.5	0.946	38.4	-32.2
0.750	H	35.2	*	0.0	10.5	-55.0	-9.3	0.342	32.0	-39.4
0.750	V	34.6	*	0.0	10.5	-55.0	-9.9	0.321	32.0	-40.0
0.875	H	34.9		0.0	10.6	-55.0	-9.5	0.336	27.4	-38.2
0.875	V	39.0		0.0	10.6	-55.0	-5.4	0.536	27.4	-34.2
1.000	H	31.6	*	0.0	10.7	-55.0	-12.7	0.232	24.0	-40.3
1.000	V	31.7	*	0.0	10.7	-55.0	-12.6	0.234	24.0	-40.2
1.125	H	32.8		0.0	10.7	-55.0	-11.5	0.267	21.3	-38.0
1.125	V	34.5		0.0	10.7	-55.0	-9.8	0.324	21.3	-36.4
1.250	H	28.0	*	0.0	10.7	-55.0	-16.3	0.153	19.2	-42.0
1.250	V	30.3	*	0.0	10.7	-55.0	-14.0	0.200	19.2	-39.6

Total (dBuV/m) = Meter Reading + Cable Factor + Ant Factor + Propagation Loss

Limit distance is 300 meters from 9kHz to 490kHz. Limit distance is 30 meters from 490kHz to 1.705MHz

Checked BY *RICHARD E. King* :

Richard E. King