Measurement of RF Interference from a Model CA7100 In-wall Master Controller Transmitter

For : Intermatic
Spring Grove, IL

P.O. No. :
Date Received : November 10, 2005
Date Tested : November 10 and 11, 2005
Test Personnel : Richard E. King
Specification : FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C

Test Report By : Richard E. King

Witnessed by :
Bryan Povish
Mike Kass
Intermatic

Approved By :
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Registered Professional Engineer of Illinois - 44894

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REVISION HISTORY

Revision	Date	Description
—	12/06/2005	Initial release

Measurement of RF Emissions from an In-wall Master Controller CA7100 transmitter

1.0 INTRODUCTION:

1.1 Description of Test Item - This document represents the results of the series of radio interference measurements performed on a model In-wall Master Controller, Part No.CA7100, transmitter no serial number was assigned, (hereinafter referred to as the test item). The test item was designed to transmit at approximately 908.42MHz using an internal antenna. The test item was manufactured and submitted for testing by Intermatic located in Spring Grove, IL.

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 15.249 for Intentional Radiators. 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 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 2004

- 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"

1.5 Subcontractor 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.

1.6 Laboratory Conditions The temperature at the time of the test was 21.6°C and the relative humidity was 25%.

2.0 TEST ITEM SETUP AND OPERATION:

The test item is an In-wall Master Controller, Part No.CA7100. A block diagram of the test item setup is shown as Figure 1.

2.1 Power Input - The test item obtained 115V 60Hz power via a 3 wire, three foot long, unshielded power cord. The high and low leads were connected through a line impedance stabilization network (LISN) which was located on the copper ground plane. The network complies with the requirements of Paragraph 4.1.2 of ANSI C63.4-2003.

2.2 Grounding - The test item was grounded through the third wire of its input power cord.

2.3 Peripheral Equipment - No peripheral equipment was submitted with the test item.

2.4 Interconnect Cables - No interconnect cables were submitted with the test item.

2.5 Operational Mode - For all tests, the test item was placed on an 80cm high non-conductive stand. The test item was energized.

For all tests, the test item was set up to transmit continuously. The tests were performed with the test item transmitting at 908.42MHz.

3.0 TEST EQUIPMENT:

3.1 Test Equipment List - A list of the test equipment used can be found on Table I. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

3.2 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).

3.3 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 budgets were based on guidelines in "ISO Guide to the Expression of Uncertainty in Measurements" and NAMAS NIS81 "The Treatment of Uncertainty in EMC Measurements".

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

4.0 REQUIREMENTS, PROCEDURES AND RESULTS:

4.1 Powerline Conducted Emissions

4.1.1 Requirements – All radio frequency voltages on the power lines for any frequency or frequencies of an intentional radiator shall not exceed the limits in the following table:

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56*	56 to 46*
0.5 - 5	56	46
5 - 30	60	50

Note 1: The lower limit shall apply at the transition frequencies.
Note 2: If the levels measured using the QP detector meet both the QP and the Average limits, the test item is considered to have met both requirements and measurements do not need to be performed using the Average detector.

4.1.2 Procedures - The interference on each power lead was measured by connecting the measuring equipment to the appropriate meter terminal of the LISN. The meter terminal of the LISN not under test was terminated with 50 ohm. Measurements were first made over the entire frequency range from 150kHz through 30MHz with a peak detector and the results were automatically plotted. The data thus obtained was then searched by the computer for the highest levels. Quasi-peak measurements were automatically performed at the frequencies selected from the highest peak measurements, and the results printed.

4.1.3 Results - The plots of the peak preliminary conducted voltage levels on each power line are presented on pages 15 and 16. The conducted limit for intentional radiators is shown as a reference. The final quasi-peak results are presented on pages 17 and 18.

The emissions level closest to the limit (worst case) occurred at 282 kHz. The emissions level at this frequency was 30.4 dB within the limit. Photographs of the test setup for conducted emission levels are shown on Figure 2.

4.2 Radiated Measurements

4.2.1 Requirements - The test item must comply with the requirements of FCC "Code of Federal Regulations Title 47", Part 15, Subpart C, Section 15.205 et seq.

Paragraph 15.249(a) has the following radiated emission limits:

Fundamental Frequency MHz	Field Intensity mV/m @ 3 meters	Field Strength Harmonics and Spurious uV/m @ 3 meters
902 to 928	50	500

In addition, emissions appearing in the Restricted Bands of Operation listed in paragraph 15.205(a) shall not exceed the general requirements shown in paragraph 15.209.

4.2.2 Procedures - All 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. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2003 for site attenuation.

A preliminary radiated emissions test was performed to determine the emission characteristics of the test item. For the preliminary test, a broadband measuring antenna was positioned at a 3 meter distance from the test item. The entire frequency range from 30MHz to 10.0GHz 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 30MHz to 10.0GHz. Between 30MHz and 1000MHz, a tuned dipole antenna was used as the pick-up device. A broadband double ridged waveguide antenna was used as the pick-up device for all frequencies above 1GHz. 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) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.
(4) 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.

4.2.3 Results - The preliminary plots, with the test item transmitting at 908.42MHz, are presented on data pages 19 through 21. The plots are presented for a reference only, and are not used to determine compliance.

The final open area radiated levels, with the test item transmitting at 908.42MHz, are presented on data page 22. As can be seen from the data, all emissions measured from the test item were within the specification limits. The emissions level closet to the limit (worst case) occurred at 3633.7MHz. The emissions level at this frequency was 1.3dB within the limit. Photographs of the test setup for radiated emission levels at the fundamental are shown on Figure 3.

4.3 Occupied Bandwidth Measurements

4.3.1 Requirement - In accordance with paragraph 15.249(d), all emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuate by at least 50dB below the level of the fundamental or to the general radiated emissions limits in 15.209, which ever is the lesser attenuation.

4.3.2 Procedures - The test item was placed on an 80cm high non-conductive stand. The unit was set to transmit continuously. With an antenna positioned nearby, occupied bandwidth emissions were displayed on the spectrum analyzer. The resolution bandwidth was set to 100 kHz and span was set to 30 MHz. The frequency spectrum near the fundamental was plotted.

4.3.3 Results - The plot of the emissions near the fundamental frequency is presented on data page 22. As can be seen from this data page, the transmitter met the occupied bandwidth requirements. In addition, the 99% emission bandwidth measured 150 kHz when using the analyzer's special function key with the measurement BW set to 30 kHz.

5.0 CONCLUSIONS:

It was determined that the Intermatic In-wall Master Controller, Part No. CA7100, did meet the conducted and radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.249 for Intentional Radiators. Testing was performed in accordance with ANSI C63.4-2003.

6.0 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 Intermatic 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.

7.0 ENDORSEMENT DISCLAIMER:

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

TABLE I: TEST EQUIPMENT LIST

ELITE ELECTRONIC ENG. INC. Page: 1

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Cal Inv	Due Date
Equipment Type: ACCESSORIES, MISCELLANEOUS								
XLJW	5W,50 OHM TERMINATION	JFW INDUSTRIES	50T-052	31	DC-2GHZ	10/10/05	12	10/10/06
XZG4	ATTENUATOR/SWITCH DRIVER	HEWLETT PACKARD	11713A	2223A01683	---		N/A	
Equipment Type: AMPLIFIERS								
APK4	PREAMPLIFIER OPT H02	HEWLETT PACKARD	8449B	3008A00329	1-26.5GHZ	01/27/05	12	01/27/06
Equipment Type: ANTENNAS								
NDQ0	TUNED DIPOLE ANTENNA	EMCO	3121C-DB4	311	400-1000MHZ	02/01/05	12	02/01/06
NTA1	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2054	0.03-2GHZ	08/08/05	12	08/08/06
NWH0	RIDGED WAVE GUIDE	TENSOR	4105	2081	1-12.4GHZ	10/01/05	12	10/01/06
Equipment Type: ATTENUATORS								
T1E1	10DB, 25W ATTENUATOR	WEINSCHEL	46-10-43	AU1883	DC-18GHZ	12/02/04	12	12/02/05
Equipment Type: CONTROLLERS								
CDS2	COMPUTER	GATEWAY	MFATXPNT NMZ	0028483108	1.8GHZ		N/A	
Equipment Type: PROBES; CLAMP-ON & LISNS								
PLL9	50UH LISN 462D	ELITE	462D/70A	010	0.01-400MHZ	03/04/05	12	03/04/06
PLLA	50UH LISN 462D	ELITE	462D/70A	011	0.01-400MHZ	03/04/05	12	03/04/06
Equipment Type: PRINTERS AND PLOTTERS								
HRE1	LASER JET 5P	HEWLETT PACKARD	C3150A	USHB061052	---		N/A	
Equipment Type: RECEIVERS								
RACA	RF PRESELECTOR	HEWLETT PACKARD	85685A	2926A00980	20HZ-2GHZ	02/05/05	12	02/05/06
RAEC	SPECTRUM ANALYZER	HEWLETT PACKARD	8566B	3014A06690	100HZ-22GHZ	02/02/05	12	02/02/06
RAF3	QUASIPEAK ADAPTER	HEWLETT PACKARD	85650A	3303A01775	0.01-1000MHZ	02/04/05	12	02/04/06

Cal. Interval: Listed in Months 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.

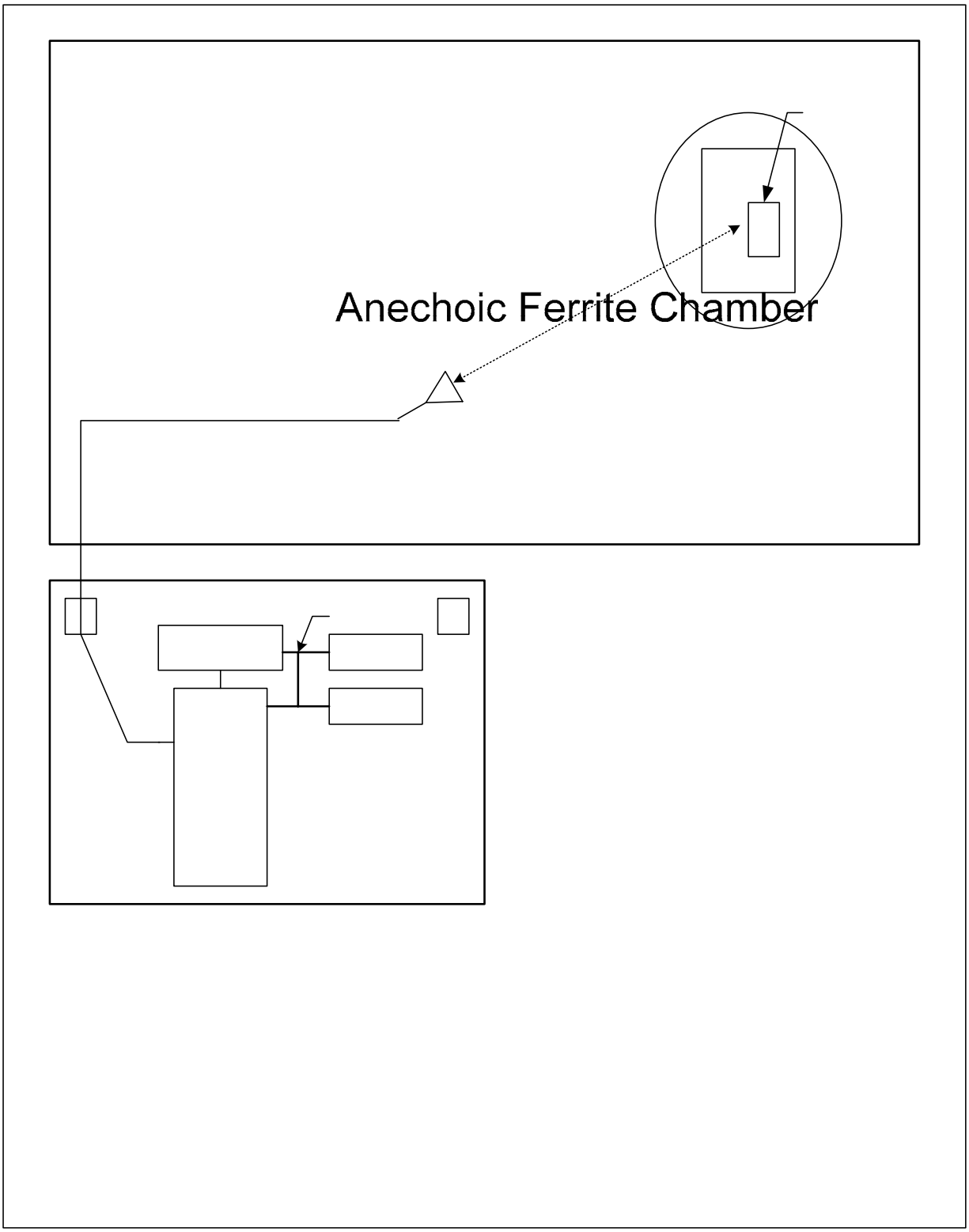
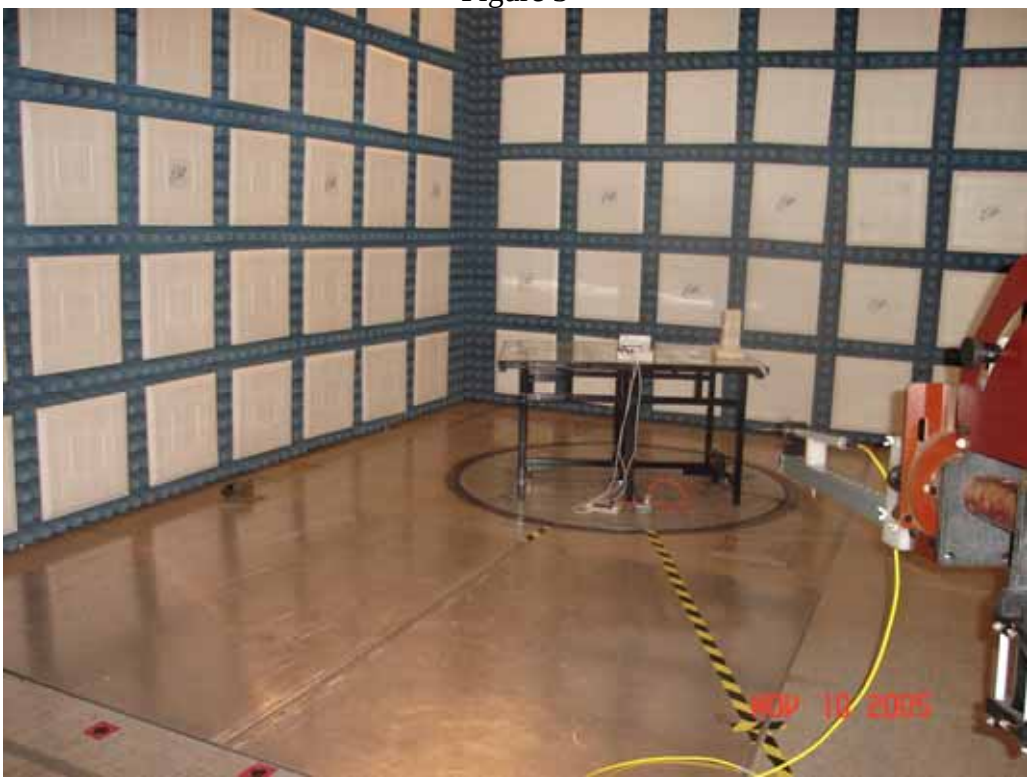

Anechoic Ferrite Chamber
Hpib cbl
Turn Table & Mast

Figure 2

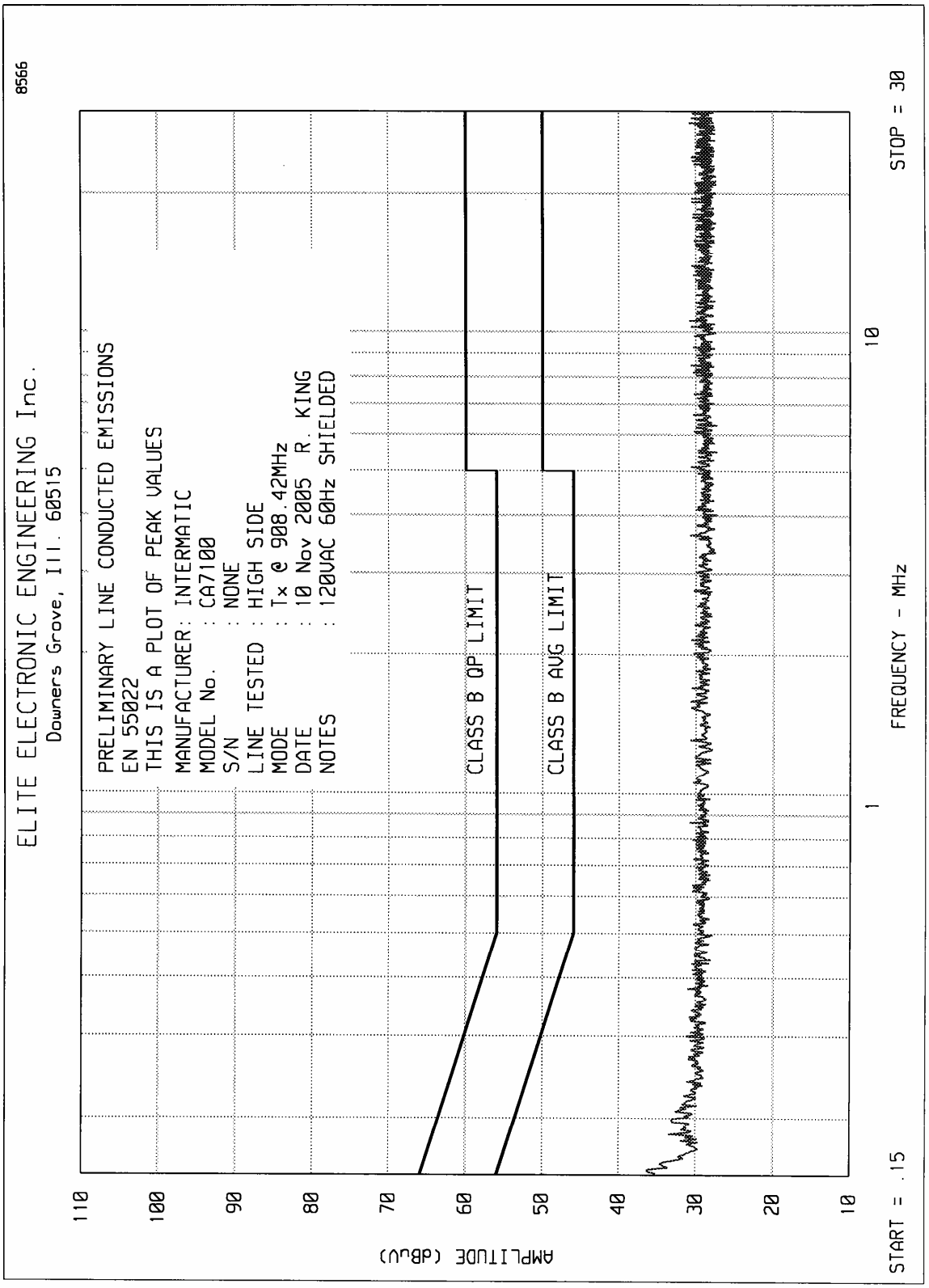
Test Setup for Conducted Emissions

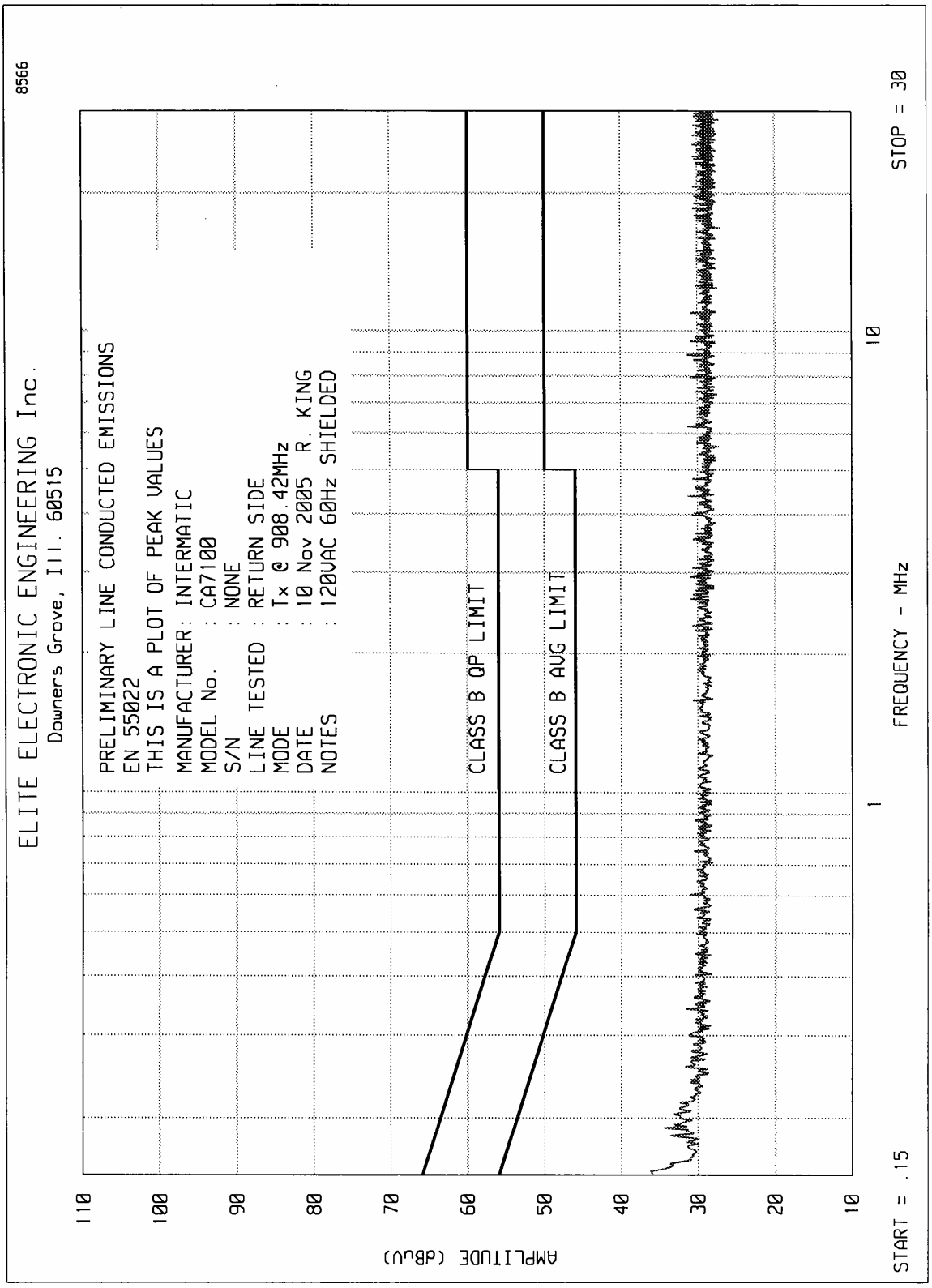
Figure 3



Test Setup for Radiated Emissions, 30MHz to 1GHz – Horizontal Polarization

Test Setup for Radiated Emissions, 30MHz to 1GHz – Vertical Polarization


8566
ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
PRELIMINARY LINE CONDUCTED EMISSIONS
EN 55022
THIS IS A PLOT OF PEAK VALUES
MANUFACTURER: INTERMATIC
MODEL No. : CA7100
S/N : NONE
LINE TESTED : HIGH SIDE
MODE : Tx @ 908.42MHz
DATE : 10 Nov 2005 R. KING
NOTES : 120VAC 60Hz SHIELDED
CLASS B QP LIMIT
CLASS B AVG LIMIT
AMPLITUDE (dBuV)
110
100
90
80
70
60
50
40
30
20
10
START = .15
1
10
STOP = 30
FREQUENCY - MHz


8566
ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
PRELIMINARY LINE CONDUCTED EMISSIONS
EN 55022
THIS IS A PLOT OF PEAK VALUES
MANUFACTURER: INTERMATIC
MODEL No. : CA7100
S/N : NONE
LINE TESTED : RETURN SIDE
MODE : Tx @ 908.42MHz
DATE : 10 Nov 2005 R. KING
NOTES : 120VAC 60Hz SHIELDED
CLASS B QP LIMIT
CLASS B AVG LIMIT
AMPLITUDE (dBuV)
110
100
90
80
70
60
50
40
30
20
10
START = .15
1
10
STOP = 30
FREQUENCY - MHz

ETR No.
ELITE ELECTRONIC ENGINEERING CO.

MANUFACTURER : INTERMATIC
MODEL : CA7100
S/N : NONE
SPECIFICATION : EN 55022, CLASS B
TEST : LINE CONDUCTED EMISSIONS
LINE TESTED : HIGH SIDE
MODE : Tx @ 908.42MHz
DATE : 10 Nov 2005
NOTES : 120VAC 60Hz SHIELDED
RECEIVER : HP 8566 w/ HP85650A QP ADAPTOR
VALUES MEASURED WITH QP DETECTOR USING 9kHz BANDWIDTH

FREQUENCY MHz	METER RDG. dBuV	QP LIMIT dBuV	AVG RDG dBuV	AVG LIMIT dBuV	NOTES
.150	29.2	66.0		56.0	
.375	27.3	58.4		48.4	
.624	27.2	56.0		46.0	
1.292	27.1	56.0		46.0	
2.283	27.1	56.0		46.0	
4.084	27.1	56.0		46.0	
6.619	26.8	60.0		50.0	
8.449	26.8	60.0		50.0	
10.898	26.8	60.0		50.0	
14.311	26.8	60.0		50.0	
17.720	26.6	60.0		50.0	
19.973	26.6	60.0		50.0	
23.525	26.8	60.0		50.0	
25.699	26.6	60.0		50.0	

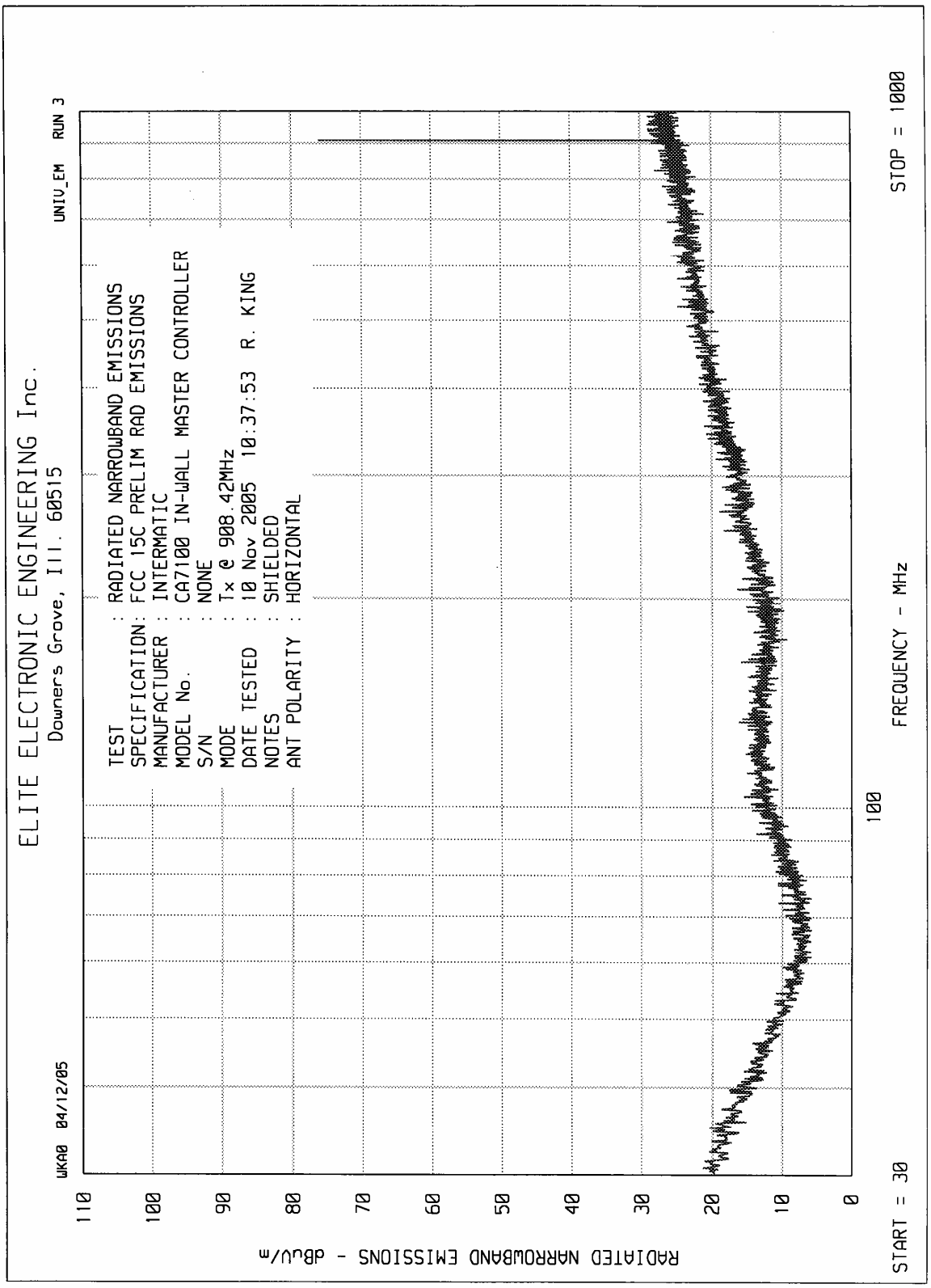
CHECKED BY: Richard E. King
R. KING

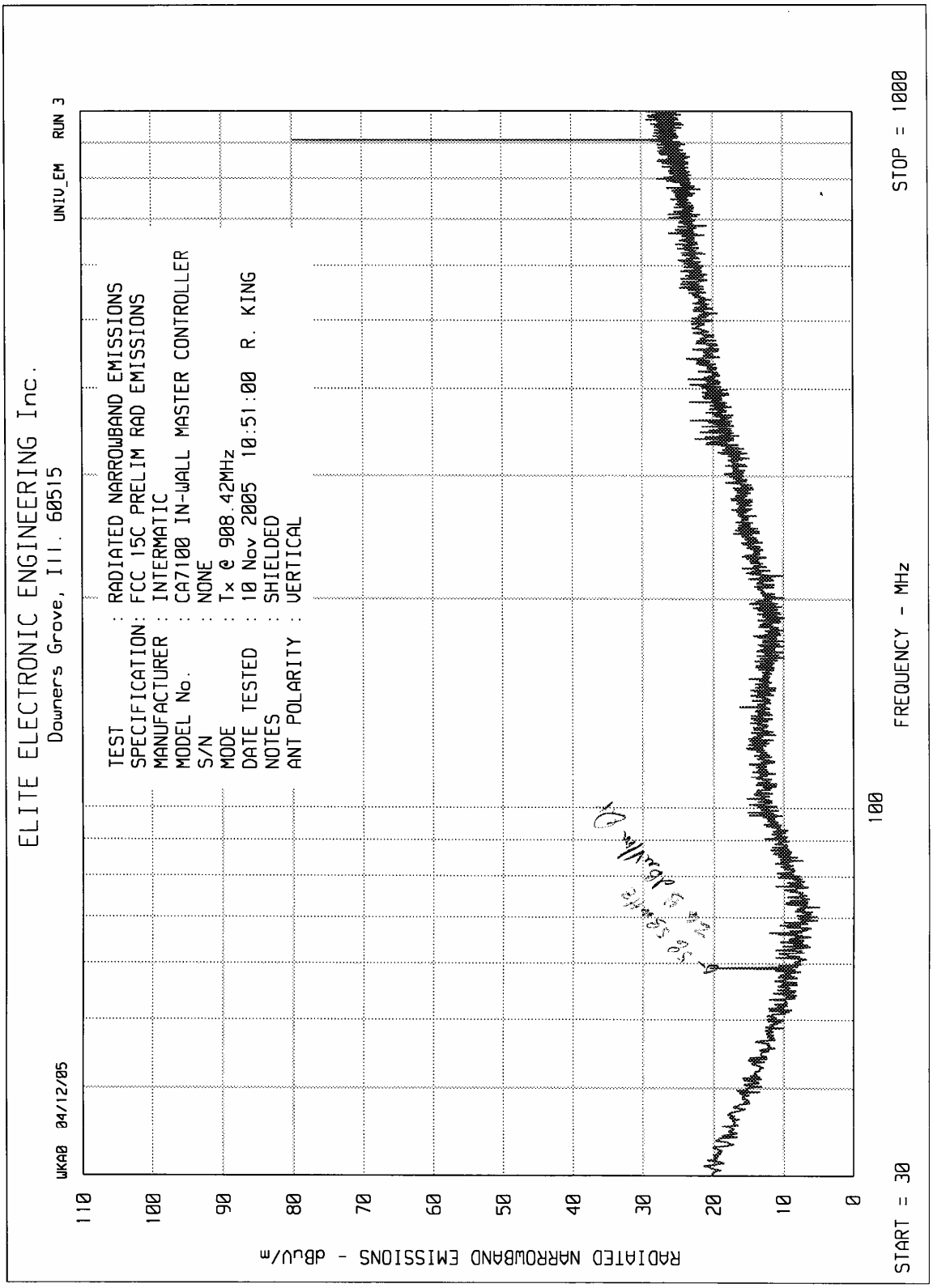
ETR No.
ELITE ELECTRONIC ENGINEERING CO.

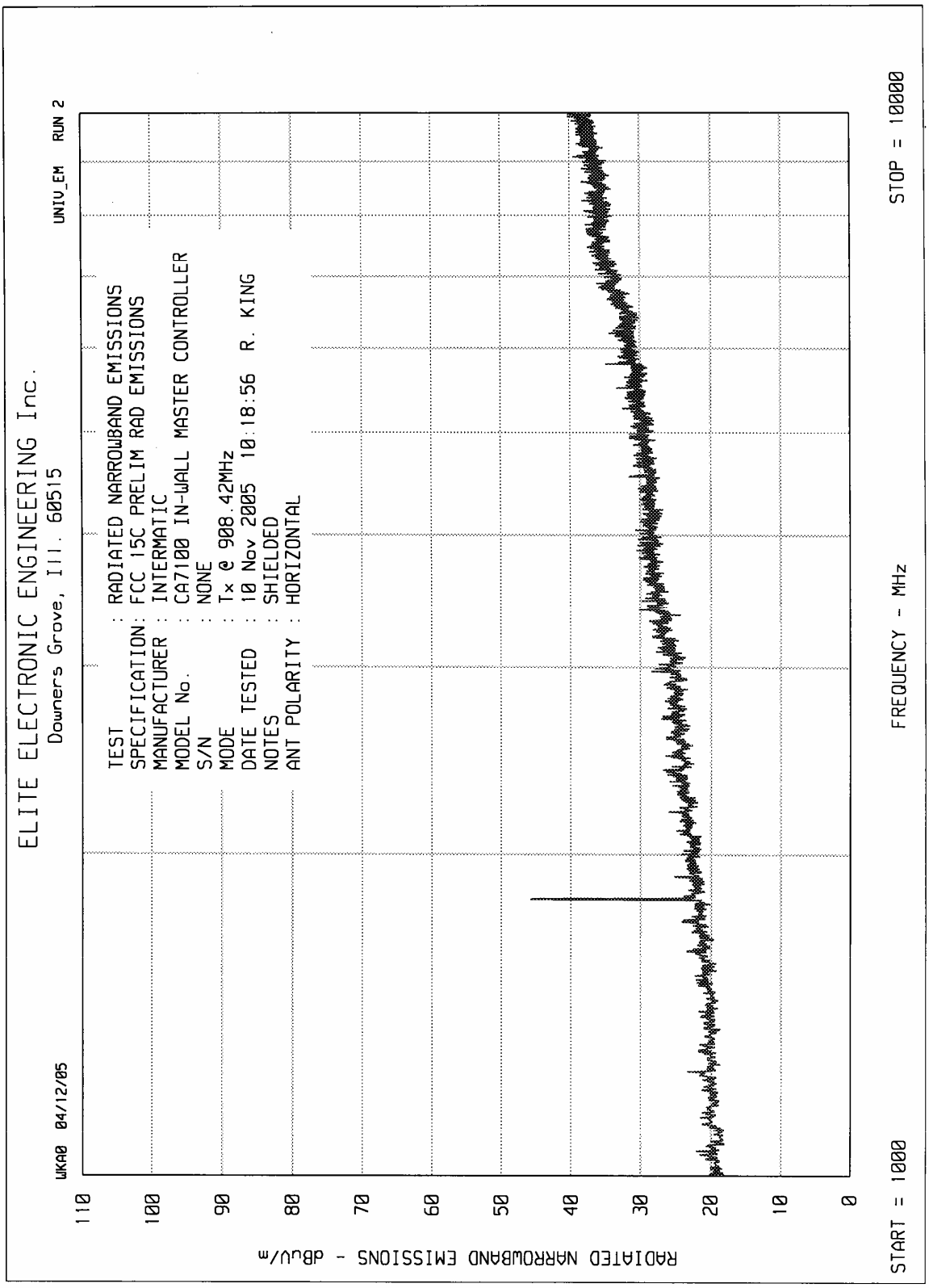
MANUFACTURER : INTERMATIC
MODEL : CA7100
S/N : NONE
SPECIFICATION : EN 55022, CLASS B
TEST : LINE CONDUCTED EMISSIONS
LINE TESTED : RETURN SIDE
MODE : Tx @ 908.42MHz
DATE : 10 Nov 2005
NOTES : 120VAC 60Hz SHIELDED
RECEIVER : HP 8566 w/ HP85650A QP ADAPTOR
VALUES MEASURED WITH QP DETECTOR USING 9kHz BANDWIDTH

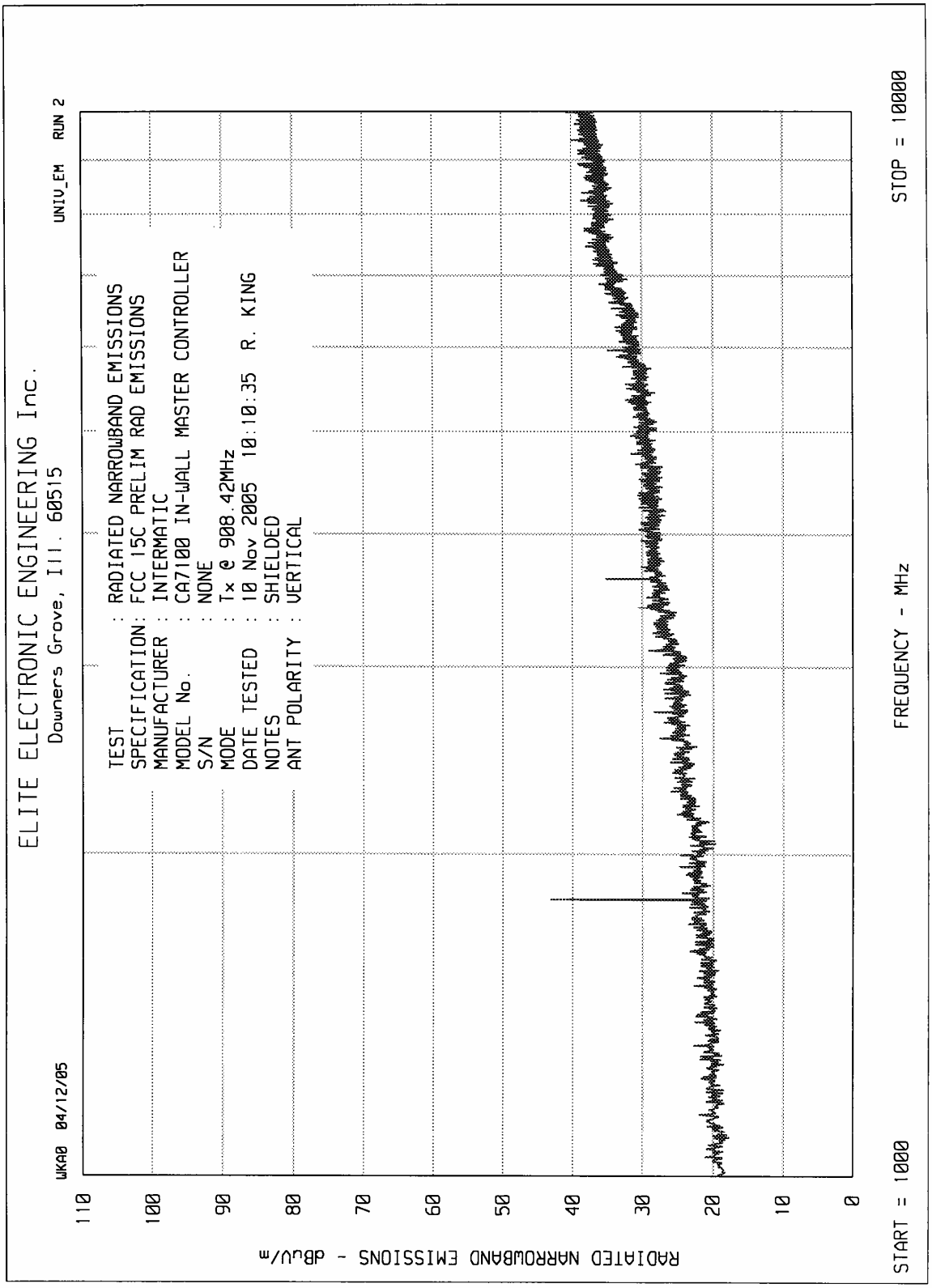
FREQUENCY MHz	METER RDG. dBuV	QP LIMIT dBuV	AVG RDG dBuV	AVG LIMIT dBuV	NOTES
.247	27.8	61.9		51.9	
.593	27.3	56.0		46.0	
.803	27.2	56.0		46.0	
1.583	27.2	56.0		46.0	
2.945	27.1	56.0		46.0	
4.350	27.1	56.0		46.0	
6.188	26.8	60.0		50.0	
8.843	26.8	60.0		50.0	
12.481	26.8	60.0		50.0	
15.559	26.6	60.0		50.0	
18.317	26.6	60.0		50.0	
20.641	26.8	60.0		50.0	
24.210	26.6	60.0		50.0	
27.916	26.6	60.0		50.0	

CHECKED BY: Richard E. King
R. KING


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV_EM RUN 3
WKA0 04/12/05
TEST : RADIATED NARROWBAND EMISSIONS
SPECIFICATION: FCC 15C PRELIM RAD EMISSIONS
MANUFACTURER : INTERMATIC
MODEL No. : CA7100 IN-WALL MASTER CONTROLLER
S/N : NONE
MODE : Tx @ 908.42MHz
DATE TESTED : 10 Nov 2005 10:37:53 R. KING
NOTES : SHIELDED
ANT POLARITY : HORIZONTAL
RADIATED NARROWBAND EMISSIONS - dBuV/m
110
100
90
80
70
60
50
40
30
20
10
0
START = 30
100
FREQUENCY - MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV_EM RUN 3
WKAB 04/12/05
TEST : RADIATED NARROWBAND EMISSIONS
SPECIFICATION: FCC 15C PRELIM RAD EMISSIONS
MANUFACTURER : INTERMATIC
MODEL No. : CA7100 IN-WALL MASTER CONTROLLER
S/N : NONE
MODE : Tx @ 908.42MHz
DATE TESTED : 10 Nov 2005 10:51:00 R. KING
NOTES : SHIELDED
ANT POLARITY : VERTICAL
RADIATED NARROWBAND EMISSIONS - dBuV/m
110
100
90
80
70
60
50
40
30
20
10
0
START = 30
100
FREQUENCY - MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV_EM RUN 2
WKA0 04/12/05
TEST : RADIATED NARROWBAND EMISSIONS
SPECIFICATION: FCC 15C PRELIM RAD EMISSIONS
MANUFACTURER : INTERMATIC
MODEL No. : CA7100 IN-WALL MASTER CONTROLLER
S/N : NONE
MODE : Tx @ 908.42MHz
DATE TESTED : 10 Nov 2005 10:18:56 R. KING
NOTES : SHIELDED
ANT POLARITY : HORIZONTAL
RADIATED NARROWBAND EMISSIONS - dBuV/m
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 10000

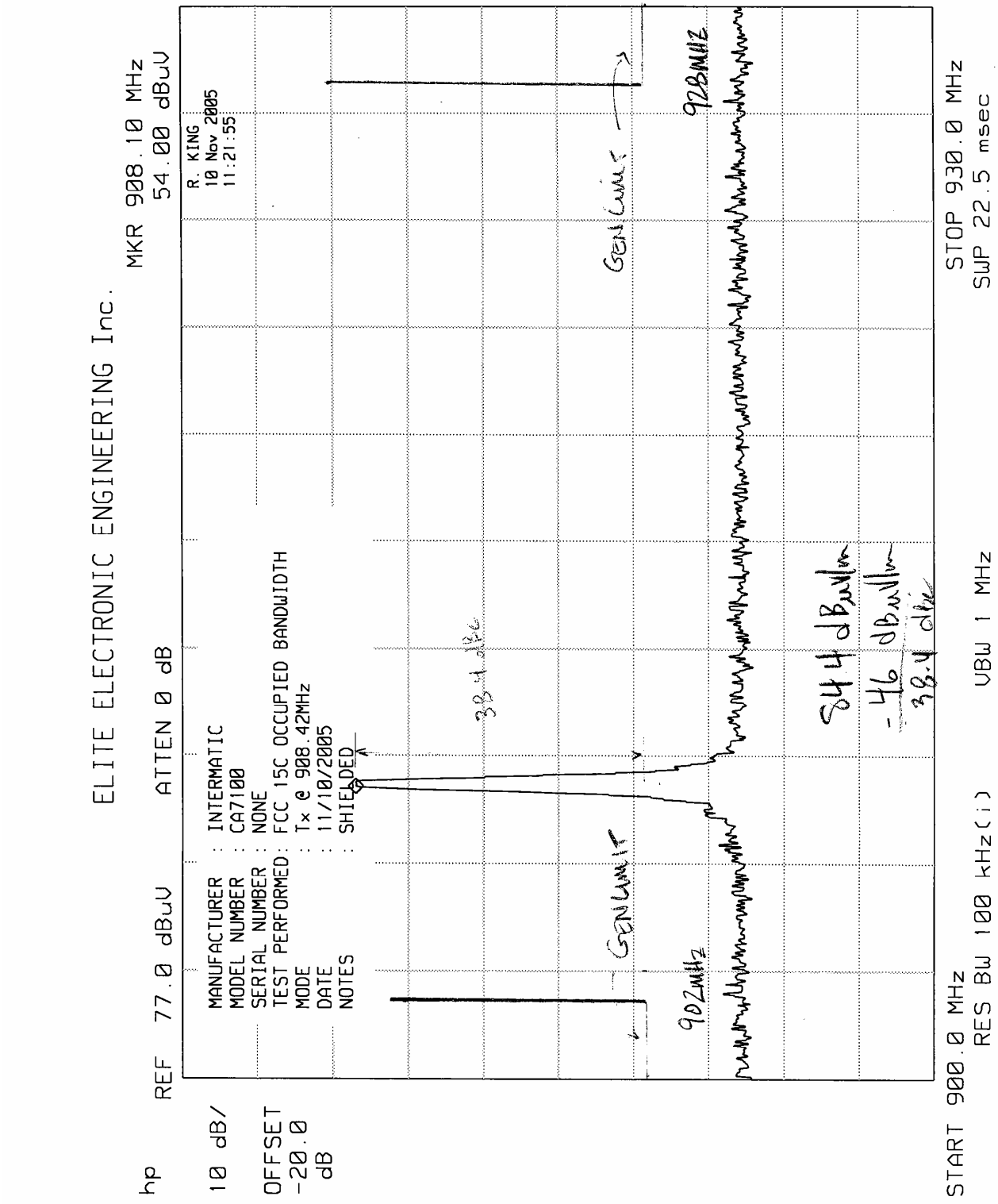

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV_EM RUN 2
WKA0 04/12/05
TEST : RADIATED NARROWBAND EMISSIONS
SPECIFICATION: FCC 15C PRELIM RAD EMISSIONS
MANUFACTURER : INTERMATIC
MODEL No. : CA7100 IN-WALL MASTER CONTROLLER
S/N : NONE
MODE : 1x @ 908.42MHz
DATE TESTED : 10 Nov 2005 10:10:35 R. KING
NOTES : SHIELDED
ANT POLARITY : VERTICAL
RADIATED NARROWBAND EMISSIONS - dBuV/m
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 10000

MANUFACTURER : Intermatic
MODEL : CA7100
S/N : None given
SPECIFICATION : FCC-15C Radiated Emissions
MODE : Tx @ 908.42MHz Shielded
DATE : November 10, 2005
NOTES : Shielded

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
908.4	H	54.7		1.9	27.8	0.0	0.0	84.4	16690.8	50000.0	-9.5
908.4	V	45.9		1.9	27.8	0.0	0.0	75.6	6060.1	50000.0	-18.3
1816.8	H	20.8		2.9	27.5	0.0	0.0	51.2	363.7	500.0	-2.8
1816.8	V	17.5		2.9	27.5	0.0	0.0	47.8	246.7	500.0	-6.1
2725.3	H	33.2		3.8	30.2	-33.4	0.0	33.8	48.8	500.0	-20.2
2725.3	V	35.0		3.8	30.2	-33.4	0.0	35.5	59.7	500.0	-18.5
3633.7	H	48.0		4.4	33.9	-33.6	0.0	52.7	432.4	500.0	-1.3
3633.7	V	38.5		4.4	33.9	-33.6	0.0	43.2	144.8	500.0	-10.8
4542.1	H	27.6	*	4.8	34.0	-32.2	0.0	34.2	51.4	500.0	-19.8
4542.1	V	27.6	*	4.8	34.0	-32.2	0.0	34.2	51.4	500.0	-19.8
5450.5	H	25.4	*	5.2	36.4	-31.9	0.0	35.1	57.0	500.0	-18.9
5450.5	V	37.6		5.2	36.4	-31.9	0.0	47.3	232.6	500.0	-6.6
6358.9	H	27.9	*	5.9	36.2	-31.6	0.0	38.3	82.6	500.0	-15.6
6358.9	V	27.9	*	5.9	36.2	-31.6	0.0	38.3	82.6	500.0	-15.6
7267.4	H	28.2	*	6.6	38.1	-31.4	0.0	41.5	119.5	500.0	-12.4
7267.4	V	28.2	*	6.6	38.1	-31.4	0.0	41.5	119.5	500.0	-12.4
8175.8	H	27.3	*	7.1	37.9	-31.7	0.0	40.6	107.5	500.0	-13.3
8175.8	V	27.3	*	7.1	37.9	-31.7	0.0	40.6	107.5	500.0	-13.3
9084.2	H	27.8	*	7.5	38.5	-31.8	0.0	42.0	125.4	500.0	-12.0
9084.2	V	27.8	*	7.5	38.5	-31.8	0.0	42.0	125.4	500.0	-12.0

Checked BY : Richard E. King

Richard E. King


ELITE ELECTRONIC ENGINEERING Inc.
MKR 908.10 MHz
54.00 dBuV
hp
REF 77.0 dBuV
ATTEN 0 dB
10 dB/
OFFSET
-20.0
dB
MANUFACTURER : INTERMATIC
MODEL NUMBER : CA7100
SERIAL NUMBER : NONE
TEST PERFORMED: FCC 15C OCCUPIED BANDWIDTH
MODE : Tx @ 908.42MHz
DATE : 11/10/2005
NOTES : SHIELDED
R. KING
10 Nov 2005
11:21:55
GENLINK
902MHz
GENLINK
928MHz
START 900.0 MHz
RES BW 100 kHz(i)
VBW 1 MHz
STOP 930.0 MHz
SWP 22.5 msec