




Measurement of RF Interference from a
1/18 Scale 1963 Impala Lowrider RC Car
Transmitter

For : Craft House Corporation
Toledo, OH

Date Received: May 17, 2004
Date Tested : May 17, 2004
Test Personnel: Daniel E. Crowder
Specification : FCC "Code of Federal Regulations" Title 47
Part 15, Subpart C

Test Report By : 
Daniel E. Crowder

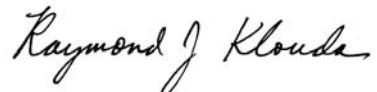
Approved By : 
Raymond J. Klouda
Registered Professional Engineer of
Illinois - 44894



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Measurement of RF Emissions from a 1/18 Scale 1963 Impala Lowrider RC Car 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 1/18 Scale 1963 Impala Lowrider RC Car Transmitter, (hereinafter referred to as the test item). The test item was designed to transmit at approximately 27MHz using an external antenna. The test item was manufactured and submitted for testing by Craft House Corporation located in Toledo, OH.

1.2 Purpose - The test series was performed to determine if the test item meets the radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.227 for Intentional Radiators. Testing was performed in accordance with ANSI C63.4-2001.

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 2003
- ANSI C63.4-2001, "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 22°C and the relative humidity was 46%.

2.0 TEST ITEM SETUP AND OPERATION:

The test item is a 1/18 Scale 1963 Impala Lowrider RC Car Transmitter. A block diagram of the test item setup is shown as Figure 1.

2.1 Power Input - The test item obtained 9VDC from a battery.

2.2 Grounding - Since the test item was powered with 9VDC from a battery, it was ungrounded

during the tests.

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. Preliminary measurements were performed and it was determined that the highest emissions were generated with the test item antenna vertical and fully extended and the operational switch set to the Cruise position. All measurements were performed with the test item in this configuration.

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.

The fundamental, harmonics and spurious emissions were measured with a spectrum analyzer. All measurements were taken with the resolution and video bandwidth of the measuring instrument adjusted to 10kHz below 30MHz, 100kHz between 30MHz and 1GHz and 1MHz above 1GHz.

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 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 –Since the test item was powered by internal batteries, no conducted emissions tests were performed.

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.

Per paragraph 15.227, radiated emissions over the frequency range from 26.96MHz to 27.28MHz shall not exceed 10,000uV/m (80dBuV/m) at 3 meters. The field strength of any emissions which appear outside of this band shall not exceed the general radiated emission limits in paragraph 15.209:

Frequency MHz	Distance between Test Item And Antenna in Meters	Field Strength uV/m	Field Strength dBuV/m
20-30	30	30	29.5
30-88	3	100	40
88-216	3	150	43.5
216-960	3	200	46
Above 960	3	500	54

Note: The tighter limit shall apply at the edge between the two frequency bands.

4.2.2 Procedures -

4.2.2.1 Preliminary Radiated Measurements - All preliminary tests 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 broadband measuring antenna was positioned at a 3 meter distance from the test item. The

entire frequency range from 25MHz to 1GHz was investigated using a peak detector function. The data was then processed by the computer to equivalent field intensity at the required test distance.

4.2.2.2 Final Radiated Measurements - Final open field measurements were manually performed in a 32ft. x 20ft. x 14ft. high shielded enclosure.

The broadband measuring antenna was positioned at a 3 meter distance from the test item. The entire frequency range from 25MHz to 1GHz was investigated using a peak detector function. The data was then processed by the computer to equivalent field intensity at the 3 meters. All significant broadband and narrowband signals were measured and recorded.

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

- 1) From 20MHz to 30MHz, measurements were made using a peak detector and a loop antenna
- 2) From 30MHz to 1GHz, measurements were made using a peak detector and a broadband bi-log antenna.
- 3) To ensure that maximum, or worst case, emission levels were measured, the following steps were taken:
 - (a) The test item was rotated so that all of its sides were exposed to the receiving antenna.
 - (b) Since the measuring antennas are linearly polarized, both horizontal and vertical field components were measured.
 - (c) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.
 - (d) 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 27MHz, 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 test item transmitting at 27MHz, are presented on page 14. As can be seen from the data, all emissions measured from the test item were within the specification limits. The emissions level closest to the limit (worst case) occurred at 189.98MHz. The emissions level at this frequency was 0.1dB within the limit. See page 14 for details. Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown on Figures 2 and 3.

4.3 Band Edge Measurements

4.3.1 Requirement - In accordance with paragraph 15.227, all emissions outside of the 26.96MHz to 27.28MHz band shall not exceed the general radiated emission limits in paragraph 15.209.



The limits of paragraph 15.209 (30uV/m @ 30 meters) converted to the equivalent field intensity at 3 meters using linear extrapolation. A 20dB ($20\text{dB} = 20 * \text{Log}(30\text{m}/3\text{m})$) distance correction factor has been applied to the limit to allow a direct comparison of the data obtained at 3 meters.

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 3 meters from the test item, the fundamental frequency was displayed on the spectrum analyzer. The resolution bandwidth was set to 10kHz and span was set to 1MHz. The frequency spectrum near the fundamental was plotted with the marker set to the lower and upper band edge frequencies.

4.3.3 Results - The plots of the emissions near the fundamental frequency are presented on page 15. As can be seen from this data page, all emissions outside of the 26.96MHz to 27.28MHz band met the general radiated emission limits in paragraph 15.209.

5.0 CONCLUSIONS:

It was determined that the Craft House Corporation 1/18 Scale 1963 Impala Lowrider RC Car Transmitter, did fully meet the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.205 et seq. for Intentional Radiators, when tested per ANSI C63.4-2001.

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. 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: ANTENNAS								
NLS1	24" ACTIVE LOOP ANTENNA	EMCO	6502	8903-2329	0.01-30MHZ	02/09/04	12	02/09/05
NTA0	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2057	0.03-2GHZ	07/03/03	12	07/03/04
Equipment Type: CONTROLLERS								
CDD2	COMPUTER	HEWLETT PACKARD	D4171A#ABA	US61654645	---		N/A	
CMA0	MULTI-DEVICE CONTROLLER	EMCO	2090	9701-1213	---		N/A	
Equipment Type: RECEIVERS								
RACE	RF PRESELECTOR W/ RECEIVER	HEWLETT PACKARD	85685A	3010A01194	20HZ-2GHZ	06/11/03	12	06/11/04
RAE7	SPECTRUM ANALYZER	HEWLETT PACKARD	85660B	2516A01685	100HZ-22GHZ	06/13/03	12	06/13/04
RAF6	QUASIPeAK ADAPTOR W/ RECEI	HEWLETT PACKARD	85650A	2412A00403	0.01-1000MHZ	06/13/03	12	06/13/04
Equipment Type: TEST CHAMBERS (EMI)								
R21F	3M ANECHOIC CHAMBER MEETS	EMC TEST SYSTEM	3M ANECHOIC		30MHZ-18GHZ	06/13/03	12	06/13/04

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.



ELITE ELECTRONIC ENGINEERING INC.
ETR 33505-01
Radiated Emissions Test Setup Anechoic Ferrite Chamber

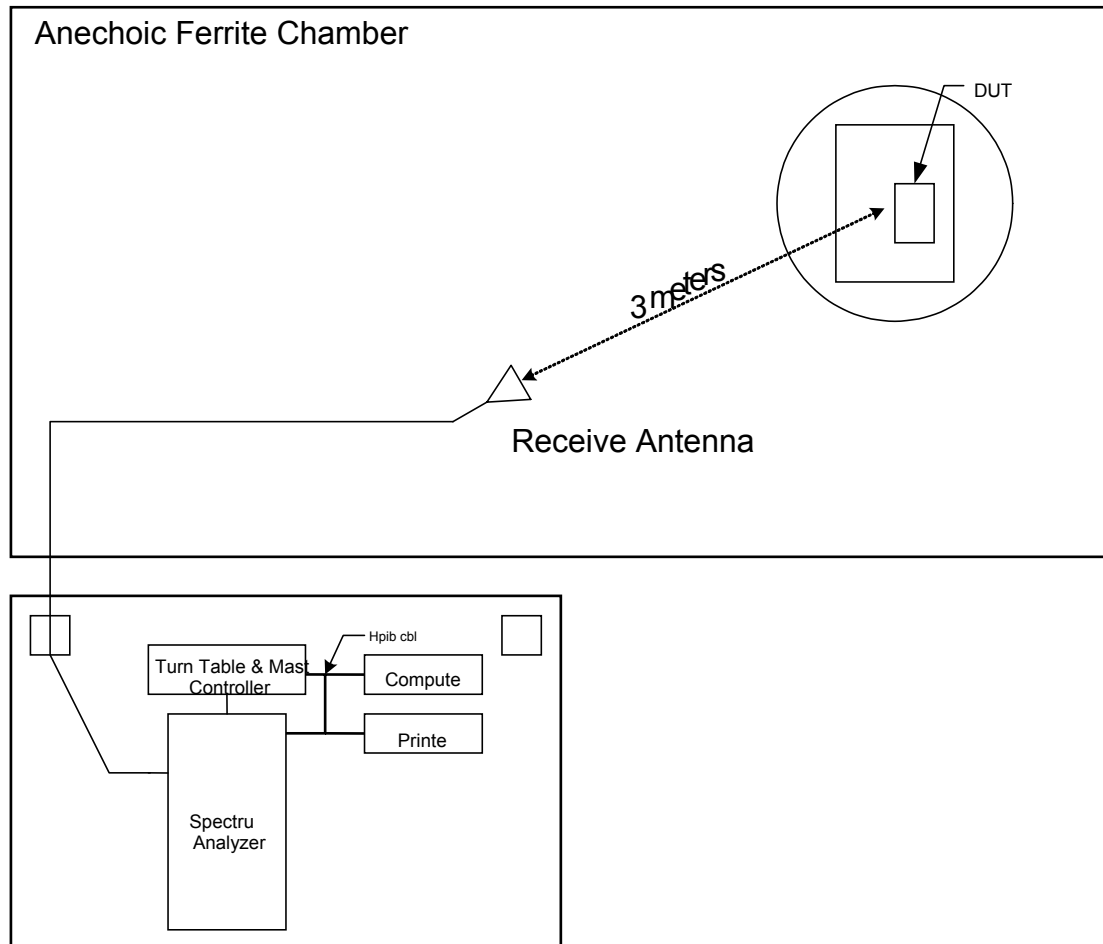
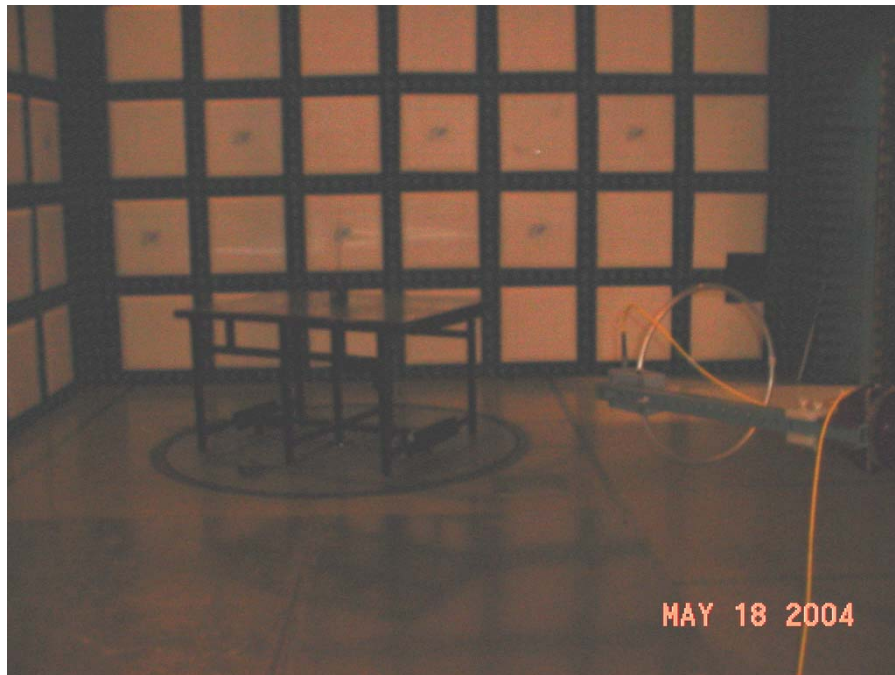


FIGURE 1 BLOCK DIAGRAM OF TEST SETUP

FIGURE 2

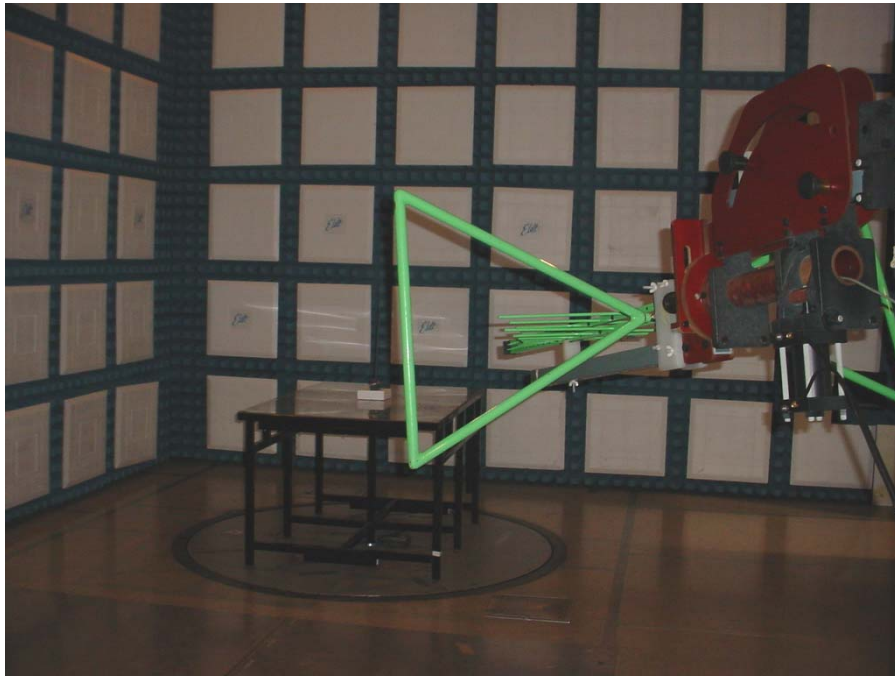


TEST SETUP FOR RADIATED EMISSIONS MEASUREMENTS
MAXIMIZED FOR MEASUREMENT OF WORST CASE EMISSIONS



TEST SETUP FOR RADIATED EMISSIONS MEASUREMENTS
MAXIMIZED FOR MEASUREMENT OF WORST CASE EMISSIONS

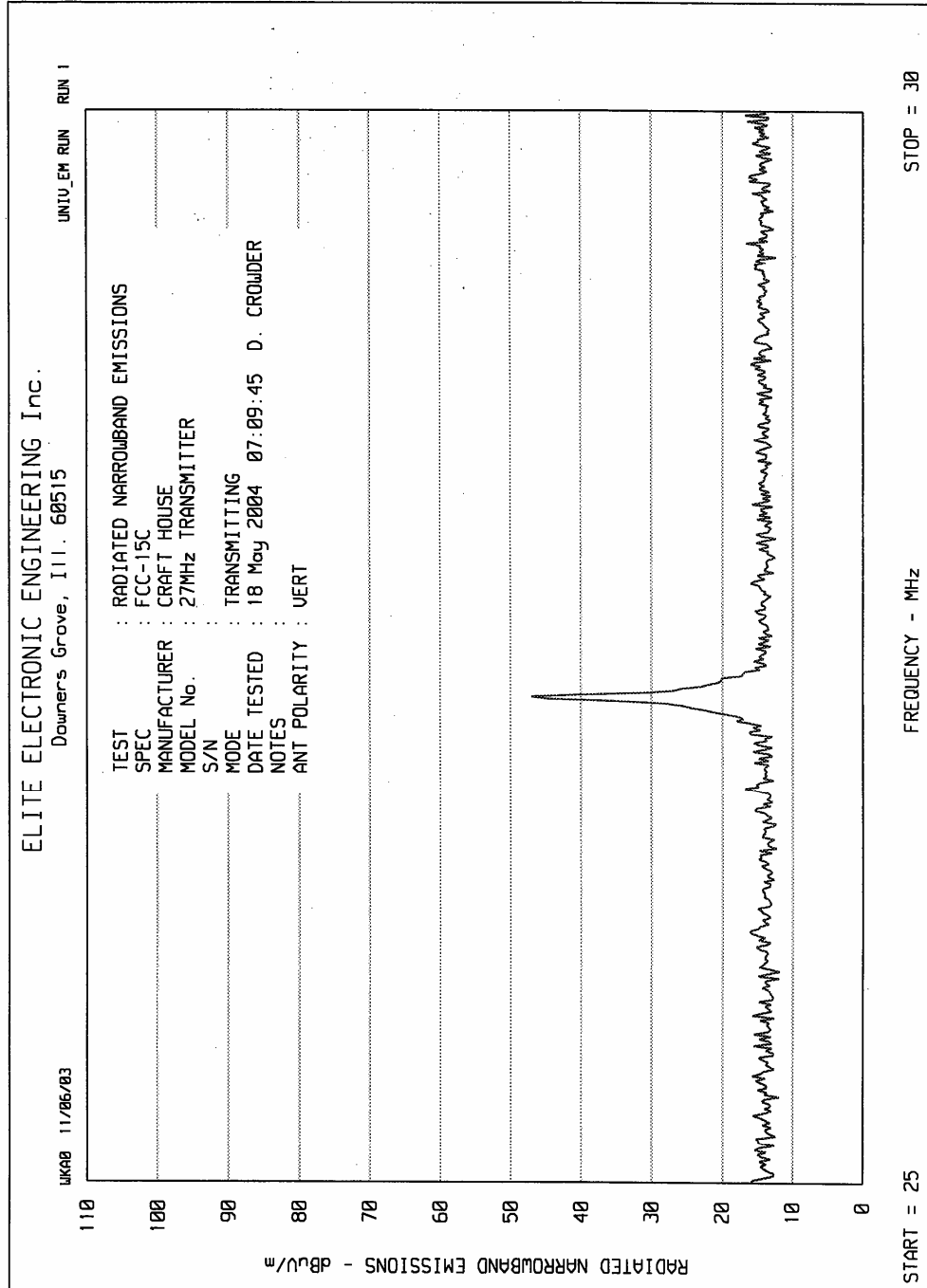
FIGURE 3

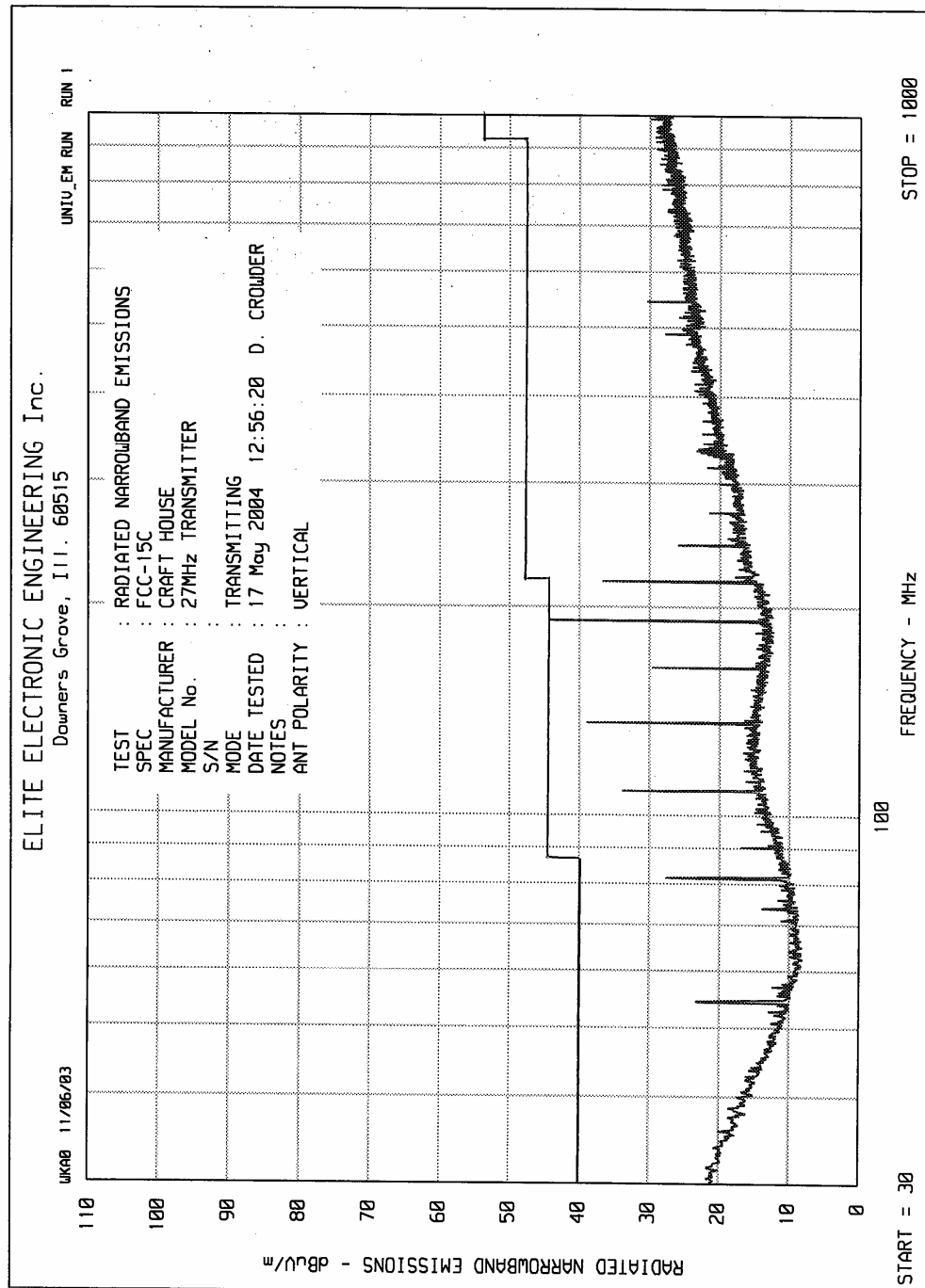


TEST SETUP FOR RADIATED EMISSIONS MEASUREMENTS
MAXIMIZED FOR MEASUREMENT OF WORST CASE EMISSIONS
HORIZONTAL POLARIZATION



TEST SETUP FOR RADIATED EMISSIONS MEASUREMENTS
MAXIMIZED FOR MEASUREMENT OF WORST CASE EMISSIONS
VERTICAL POLARIZATION







MANUFACTURER : CRAFT HOUSE CORP.
MODEL NO. : 27MHz TRANSMITTER
SERIAL NO. : NONE ASSIGNED
MODE : Tx @ 27MHz
DATE TESTED : MAY 18, 2004
NOTES : ANTENNA FULLY EXTENDED

FREQUENCY	ANTENNA	METER		ANTENNA	CABLE			
MHz	POLARITY	READING	AMBIENT	FACTOR	FACTOR	TOTAL	TOTAL	LIMIT
		dBuV		dB	dB	dBuV/m	uV/m	uV/m
27.15	VERTICAL	59.8		8.9	0.4	69.1	2851.0	10,000
	HORIZONTAL	61.4		8.9	0.4	70.7	3427.7	10,000
54.13	VERTICAL	9.7		8.3	0.5	18.5	8.4	100
	HORIZONTAL	19.7		8.3	0.5	28.5	26.6	100
81.43	VERTICAL	23.5		8.2	0.5	32.2	40.7	100
	HORIZONTAL	27.7		8.2	0.5	36.4	66.1	100
108.57	VERTICAL	21.5		11.9	0.5	33.9	49.5	150
	HORIZONTAL	24.4		11.9	0.5	36.8	69.2	150
135.7	HORIZONTAL	28.7		12.5	0.7	41.9	124.5	150
	VERTICAL	27.0		12.5	0.7	40.2	102.3	150
162.13	HORIZONTAL	16.8		10.9	0.8	28.5	26.6	150
	VERTICAL	17.7		10.9	0.8	29.4	29.5	150
189.98	VERTICAL	32.0		10.5	0.8	43.3	146.2	150
	HORIZONTAL	32.1		10.5	0.8	43.4	147.9	150
217.145	VERTICAL	28.4		11.6	1.0	41.0	112.2	200
	HORIZONTAL	26.6	AMBIENT	11.6	1.0	39.2	91.2	200
244.3	VERTICAL	21.8	AMBIENT	13.1	1.1	36.0	63.1	200
	HORIZONTAL	20.3	AMBIENT	13.1	1.1	34.5	53.1	200
271.46	VERTICAL	11.0	AMBIENT	13.8	1.2	26.0	20.0	200
	HORIZONTAL	12.1	AMBIENT	13.8	1.2	27.1	22.6	200

Checked By: 

ELITE ELECTRONIC ENGINEERING Inc.

