



Measurement of RF Interference from a Model D60000270 Transmitter

For : Omron Automotive Electronics
: St. Charles, IL

P.O. No. : 46595

Date Received: September 17, 2004

Date Tested : September 20, 2004

Test Personnel: Daniel E. Crowder
EMC Test Engineer

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 Model D60000270 Transmitter

1.0 INTRODUCTION:

1.1 Description of Test Item - This document presents the results of the series of radio interference measurements performed on an Omron Automotive Electronics model D60000270 transmitter, (hereinafter referred to as the test item). No serial number was assigned to the test item. The test item was designed to transmit at approximately 315MHz using an internal antenna. The test item was manufactured and submitted for testing by Omron Automotive Electronics located in St. Charles, 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 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 2003
- 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.

1.6 Laboratory Conditions The temperature at the time of the test was 22°C and the relative humidity was 23%.

2.0 TEST ITEM SETUP AND OPERATION:

The test item is a model D60000270, 315MHz transmitter. A block diagram of the test item setup is shown as Figure 1.

2.1 Power Input - The test item was powered with 3VDC through a 3VDC battery.

2.2 Grounding - The test item was ungrounded during the tests.

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

2.4 Interconnect Cables - There were no interconnect cables 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 transmit button of the test item was held down during testing thereby setting the unit to transmit continuously. The transmitting mechanism automatically deactivated when the transmit button was released. The battery voltage was periodically checked to ensure proper operation. The test was performed with the test item transmitting at 315MHz.

2.6 Test Item Modifications - No modifications were required for compliance to the FCC Part 15C requirements.

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 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 required.

4.2 Duty Cycle Factor Measurements:

4.2.1 Procedures: The duty cycle factor is used to convert peak detected readings to average readings. This factor is computed from the time domain trace of the pulse modulation signal.

With the transmitter set up to transmit for maximum pulse density, the time domain trace is displayed on the spectrum analyzer. This trace is obtained by tuning center frequency to the transmitter frequency and then setting a zero span width with 10msec/div. The amplitude settings are adjusted so that the on/off transitions clear the 4th division from the bottom of the display. The markers are set at the beginning and end of a word period. If the word period exceeds 100 msec the word period is set to 100 msec. The on-time and off-time are then measured. The on-time is total time signal level exceeds the 4th division. Off-time is time under for the word period. The duty cycle is then computed as the (On-time/ word period) where the word period = (On-time + Off-time).

4.2.2 Results: The plot of the duty cycle is shown on page 11. The duty cycle factor was computed to be -15.87dB

4.3 Radiated Measurements

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

Paragraph 15.231(b) has the following radiated emission limits:

Fundamental Frequency MHz	Field Intensity uV/m @ 3 meters	Field Strength Harmonics and Spurious @ 3 meters
260 to 470	3,750 to 12,500*	375 to 1,250*

* - Linear Interpolation

For 315.0MHz, the limit at the fundamental is 6026.6uV/m @ 3m and the limit for the harmonics is 602.7uV/m @ 3m.

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.

4.3.2 Procedures - Open field 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 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 5.0GHz 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 5.0GHz. 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. The peak detected levels were converted to average levels using a duty cycle factor which was computed from the pulse train.

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.

4.3.3 Results - The preliminary plots, with the test item transmitting at 315MHz, are presented on pages 12 and 13. 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 315.0MHz, are presented on pages 14 and 15. 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 315.0MHz. The emissions level at this frequency was 1.7dB within the limit. See pages 14 and 15 for details. Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels

are shown on Figure 2.

4.4 Occupied Bandwidth Measurements

4.4.1 Requirement - In accordance with paragraph 15.231(c), all emissions within 20dB of the peak amplitude level of the center frequency are required to be within a band less than 0.25% of the center frequency wide.

4.4.2 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 30 kHz and span was set to 2 MHz. The frequency spectrum near the fundamental was plotted.

4.4.3 Results - The plot of the emissions near the fundamental frequency are presented on page 16. As can be seen from this data page, the transmitter met the occupied bandwidth requirements.

5.0 CONCLUSIONS:

It was determined that the Omron Automotive Electronics model D60000270 Transmitter, did fully meet the 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 C63.4-2003.

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. 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								
XZG3	ATTENUATOR/SWITCH DRIVER	HEWLETT PACKARD	11713A	2421A03059	---		N/A	
Equipment Type: AMPLIFIERS								
APK3	PREAMPLIFIER	AGILENT TECHNOLOGIES	8449B	3008A01593	1-26.5GHZ	05/10/04	12	05/10/05
Equipment Type: ANTENNAS								
NDP0	TUNED DIPOLE ANTENNA	EMCO	3121C-DB3	311	140-400MHZ	01/23/04	12	01/23/05
NDQ0	TUNED DIPOLE ANTENNA	EMCO	3121C-DB4	311	400-1000MHZ	01/28/04	12	01/28/05
NWF0	RIDGED WAVE GUIDE	EMCO	3105	2035	1-12.4GHZ	01/05/04	12	01/05/05
Equipment Type: CONTROLLERS								
CDD2	COMPUTER	HEWLETT PACKARD	D4171A#ABA	US61654645	---		N/A	
Equipment Type: PRINTERS AND PLOTTERS								
HRE1	LASER JET 5P	HEWLETT PACKARD	C3150A	USHB061052	---		N/A	
Equipment Type: RECEIVERS								
RAC2	SPECTRUM ANALYZER	HEWLETT PACKARD	85660B	3638A08770	100HZ-22GHZ	02/10/04	12	02/10/05
RAF4	QUASIPeak ADAPTER	HEWLETT PACKARD	85650A	2043A00320	0.01-1000MHZ	02/11/04	12	02/11/05

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.

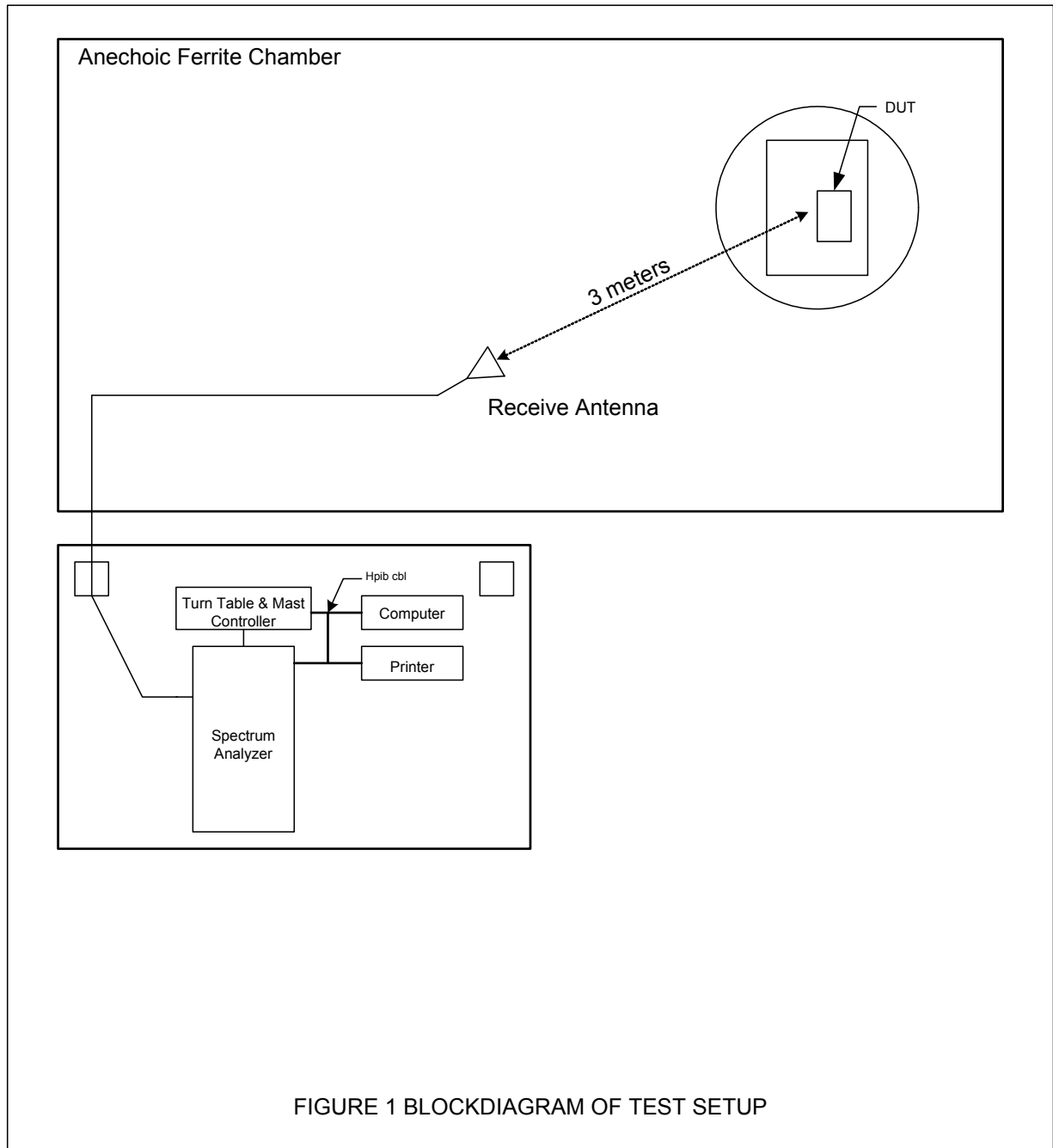
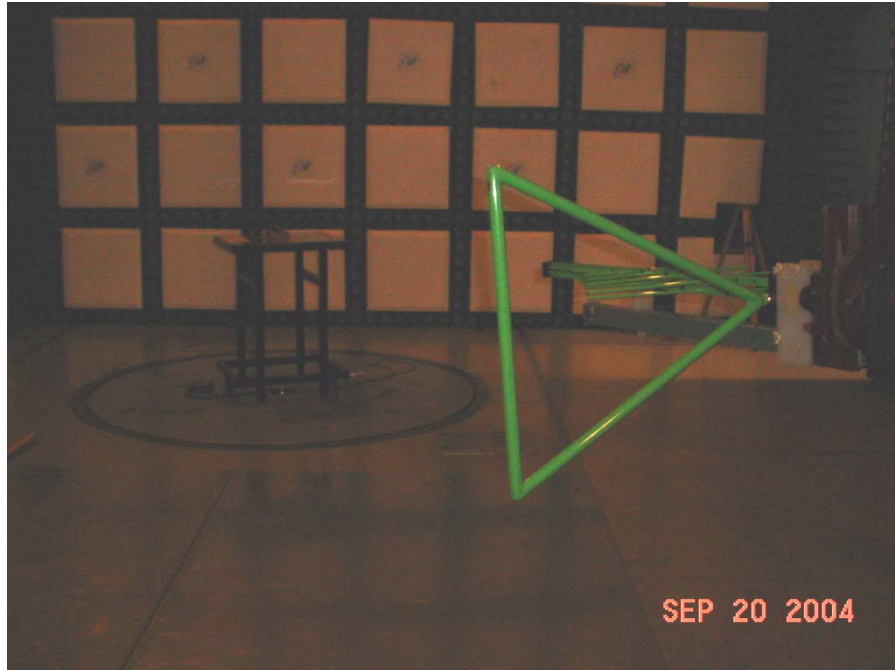
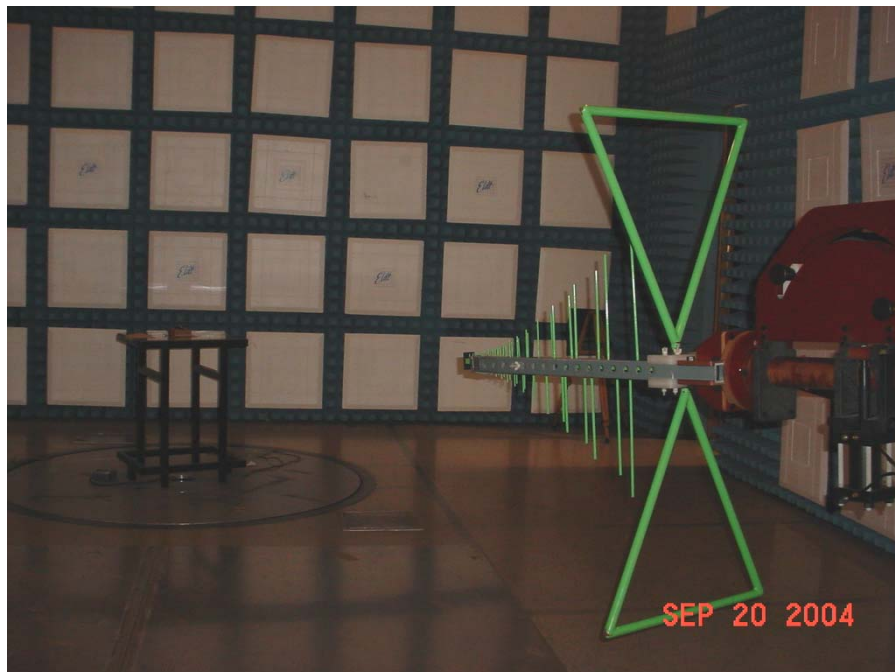


Figure 2



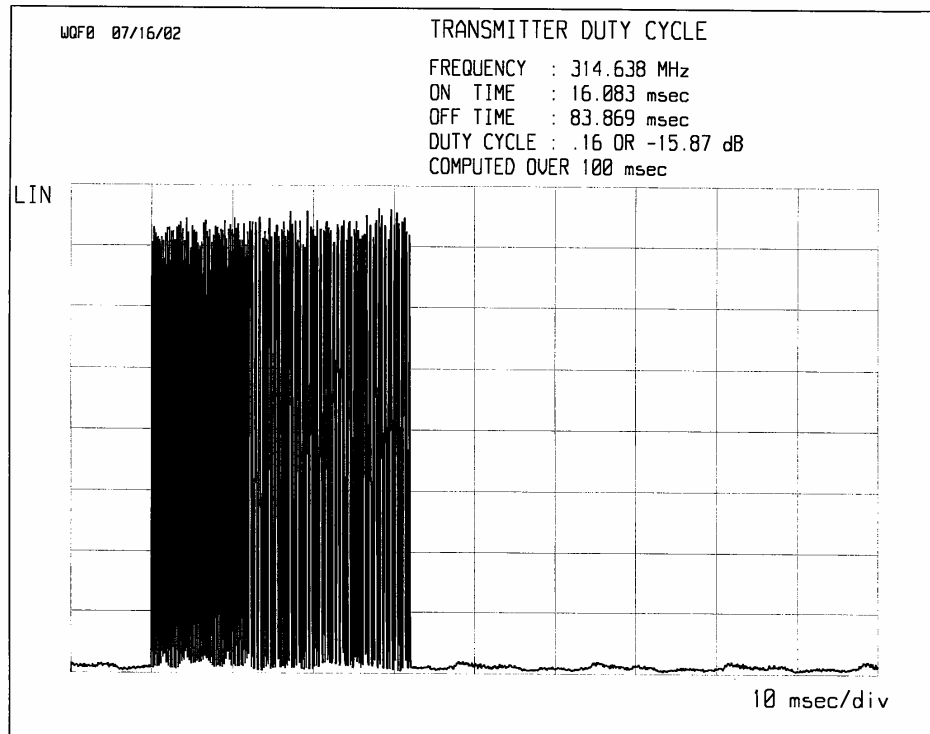
Test Setup for Highest Radiated Emissions Measurement
Horizontal Polarity



Test Setup for Highest Radiated Emissions Measurement
Vertical Polarity

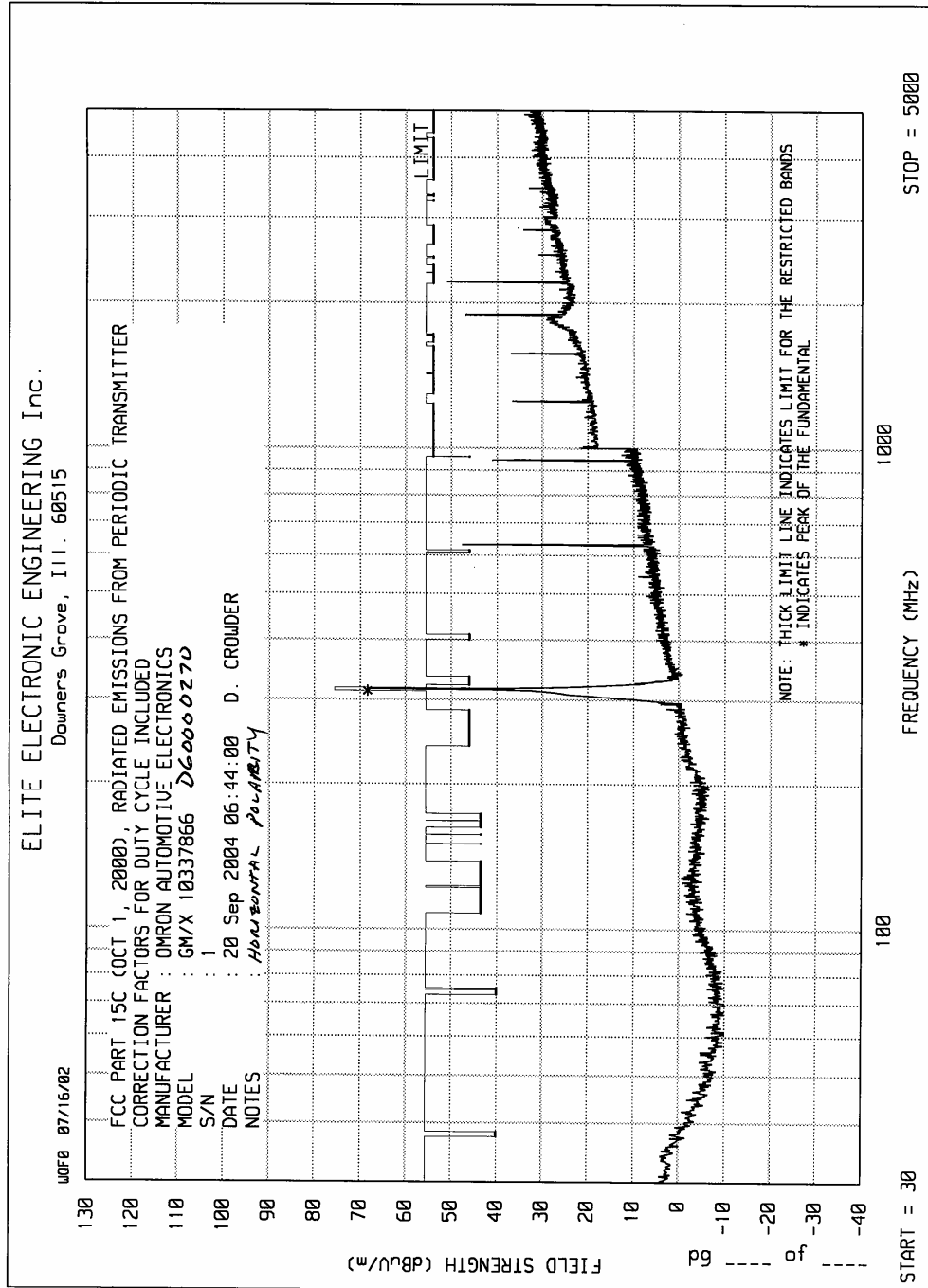


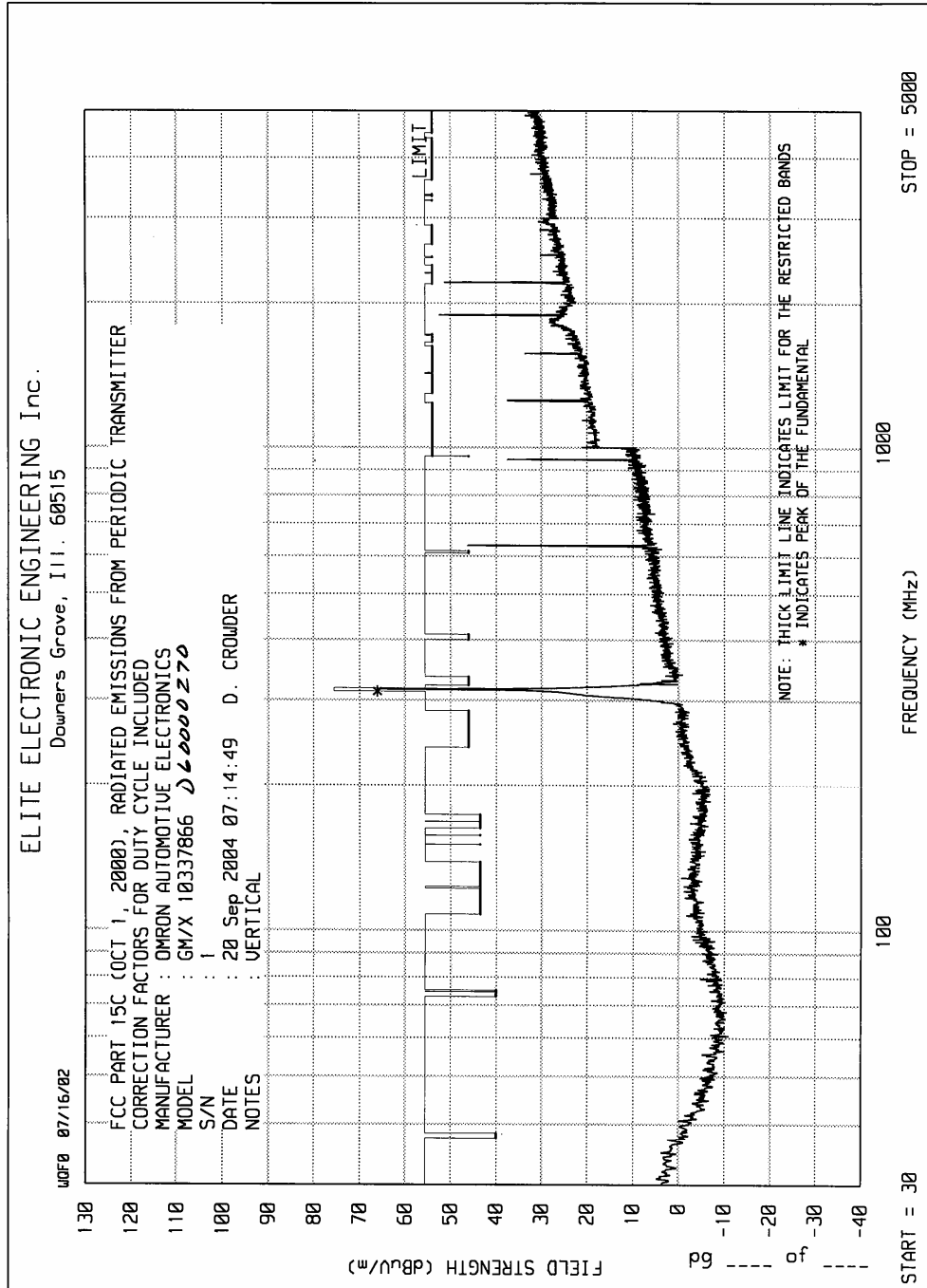
ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, IL 60515



MANUFACTURER : OMRON AUTOMOTIVE ELECTRONICS
MODEL : GM/X 10337866 060000270
S/N : 1
NOTES :
DATE : 20 Sep 2004 06:44:00 D. CROWDER

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HARMONIC AND EXCESSIVE EMISSIONS FROM TRANSMITTER

SPECIFICATION : FCC PART 15C (OCT 1, 2000)
MANUFACTURER : OMRON AUTOMOTIVE ELECTRONICS
MODEL : GM/X 10337866 *060000270*
S/N : 1
DATE : 20 Sep 2004 06:44:00 D. CROWDER
NOTES : *HORIZONTAL*
DUTY CYCLE : -15.87 dB
TOTAL FAC. = ANTENNA + CABLE + DUTY CYCLE FAC. + EXT. ATTENUATION (dB)

HARM. INDEX	FREQ MHz	METER READING dBuV	TOTAL FACTOR dB	TOTAL dBuV/m @3m	TOTAL uV/m @3m	LIMIT uV/m @3m	EMI.-LIM MARGIN dB	RESTR. BAND
FUND.	314.6	68.3	.1	68.4	2625.3	6026.6	-7.2	NO
2	629.3	41.8	5.9	47.7	242.7	602.7	-7.9	NO
3	943.9	31.9	9.2	41.0	112.4	602.7	-14.6	NO
4	1258.6	25.4	11.3	36.7	68.2	602.7	-18.9	NO
5	1573.2	24.3	12.6	36.9	70.3	500.0	-17.0	YES
6	1887.8	32.5	14.3	46.9	220.1	602.7	-8.7	NO
7	2202.5	35.3	15.8	51.0	356.1	500.0	-2.9	YES
8	2517.1	13.8	17.1	30.9	35.2	602.7	-24.7	NO
9	2831.7	15.9	18.4	34.3	52.0	500.0	-19.7	YES
10	3146.4	9.1	19.6	28.7	27.3	602.7	-26.9	NO

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HARMONIC AND EXCESSIVE EMISSIONS FROM TRANSMITTER

SPECIFICATION : FCC PART 15C (OCT 1, 2000)
MANUFACTURER : OMRON AUTOMOTIVE ELECTRONICS
MODEL : GM/X 10337866 *060008270*
S/N : 1
DATE : 20 Sep 2004 07:14:49 D. CROWDER
NOTES : VERTICAL
DUTY CYCLE : -15.87 dB
TOTAL FAC. = ANTENNA + CABLE + DUTY CYCLE FAC. + EXT. ATTENUATION (dB)

HARM. INDEX	FREQ MHz	METER READING dBuV	TOTAL FACTOR dB	TOTAL dBuV/m @3m	TOTAL uV/m @3m	LIMIT uV/m @3m	EMI.-LIM MARGIN dB	RESTR. BAND
FUND.	314.6	66.0	.1	66.1	2009.9	6026.6	-9.5	NO
2	629.3	40.3	5.9	46.2	204.8	602.7	-9.4	NO
3	943.9	28.3	9.2	37.5	74.6	602.7	-18.1	NO
4	1258.6	26.3	11.3	37.6	75.5	602.7	-18.0	NO
5	1573.2	21.1	12.6	33.7	48.4	500.0	-20.3	YES
6	1887.8	38.2	14.3	52.5	420.4	602.7	-3.1	NO
7	2202.5	35.6	15.8	51.4	371.1	500.0	-2.6	YES
8	2517.1	13.1	17.1	30.2	32.3	602.7	-25.4	NO
9	2831.7	11.9	18.4	30.3	32.9	500.0	-23.6	YES
10	3146.4	8.8	19.7	28.5	26.6	602.7	-27.1	NO

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ELITE ELECTRONIC ENGINEERING INC.

