




Measurement of RF Interference from a Model KF340-3 Transmitter

For : Gama Electronics
1240 Cobblestone Way
Woodstock, IL 60126

P.O. No. : 13914
Date Received: July 14, 2005
Date Tested : July 14 through July 25, 2005
Test Personnel: Daniel E. Crowder; Richard E. King
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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**THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE
WRITTEN APPROVAL OF ELITE ELECTRONIC ENGINEERING INCORPORATED.**

Revision History

Revision	Date	Description
—		Initial release

Measurement of RF Emissions from a Model KF340-3 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 KF340-3 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 340MHz using an internal antenna. The test item was manufactured and submitted for testing by Gama Electronics located in Woodstock, 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 15.231 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 23°C and the relative humidity was 62%.

2.0 TEST ITEM SET-UP AND OPERATION:

The test item is a Model KF340-3 Transmitter. A block diagram of the test item setup is shown as Figure 1.

2.1 Power Input - The test item obtained 12VDC from an internal battery.

2.2 Grounding - Since the test item was powered with 12VDC from an internal 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 used or submitted with the test item:

2.5 Operational Mode - For all tests the test item and all peripheral equipment were 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 340MHz.

2.6 Test Item Modifications - The removal of the final drive circuit was 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 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".

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 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 - A plot of the duty cycle is shown on data page 12. The duty cycle factor was computed to be -8.9dB.

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 340MHz, the limit at the fundamental is 7083.3uV/m @ 3m and the limit on the harmonics is 708.3uV/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 4.0GHz 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 4.0GHz. 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 340MHz, are presented on data pages 13 and 14. 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 340MHz, are presented on data page 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 1020MHz. The emissions level at this frequency was 4.7dB within the limit. See data page 16 for details. Photographs of the test configuration 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. In addition, the 99% bandwidth was measured using the special function on the spectrum analyzer.



4.4.3 Results - The plot of the emissions near the fundamental frequency are presented on data page 16. As can be seen from this data page, the transmitter met the occupied bandwidth requirements. The 99% bandwidth measured 124 kHz.

5.0 CONCLUSIONS:

It was determined that the Gama Electronics Model KF340-3 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

Equipment Type: ACCESSORIES, MISCELLANEOUS							

XZG0	ATTENUATOR/SWITCH DRIVER	HEWLETT PACKARD	11713A	3439A02724	---		N/A
Equipment Type: AMPLIFIERS							

APK0	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	3008A00662	1-26.5GHZ	02/07/05	12
	02/07/06						
Equipment Type: ANTENNAS							

NDP1	TUNED DIPOLE ANTENNA	EMCO	3121C-DB3	313	140-400MHZ	03/02/05	12
	03/02/06						
NDQ1	TUNED DIPOLE ANTENNA	EMCO	3121C-DB4	313	400-1000MHZ	03/02/05	12
	03/02/06						
NTA0	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2057	0.03-2GHZ	07/12/04	12
	08/12/05						
Equipment Type: CONTROLLERS							

CDS2	COMPUTER	GATEWAY	MFATXPNT NMZ	0028483108	1.8GHZ		N/A
CMA0	MULTI-DEVICE CONTROLLER	EMCO	2090	9701-1213	---		N/A
Equipment Type: PRINTERS AND PLOTTERS							

HRE1	LASER JET 5P	HEWLETT PACKARD	C3150A	USHB061052	---		N/A
HRE2	LASER JET 5P	HEWLETT PACKARD	C3150A	USHB061201	---		N/A
Equipment Type: RECEIVERS							

RAC1	SPECTRUM ANALYZER	HEWLETT PACKARD	85660B	3407A08369	100HZ-22GHZ	02/04/05	12
	02/04/06						
RACB	RF PRESELECTOR	HEWLETT PACKARD	85685A	3506A01491	20HZ-2GHZ	02/07/05	12
	02/07/06						
RAF3	QUASIPeAK ADAPTER	HEWLETT PACKARD	85650A	3303A01775	0.01-1000MHZ	02/04/05	12
	02/04/06						
RAKI	RF SECTION	HEWLETT PACKARD	85462A	3411A00181	0.009-6500MHZ	02/11/05	12
	02/11/06						



RAKJ RF FILTER SECTION
02/11/06

HEWLETT PACKARD 85460A

3330A00154 ---

02/11/05 12

=====

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.

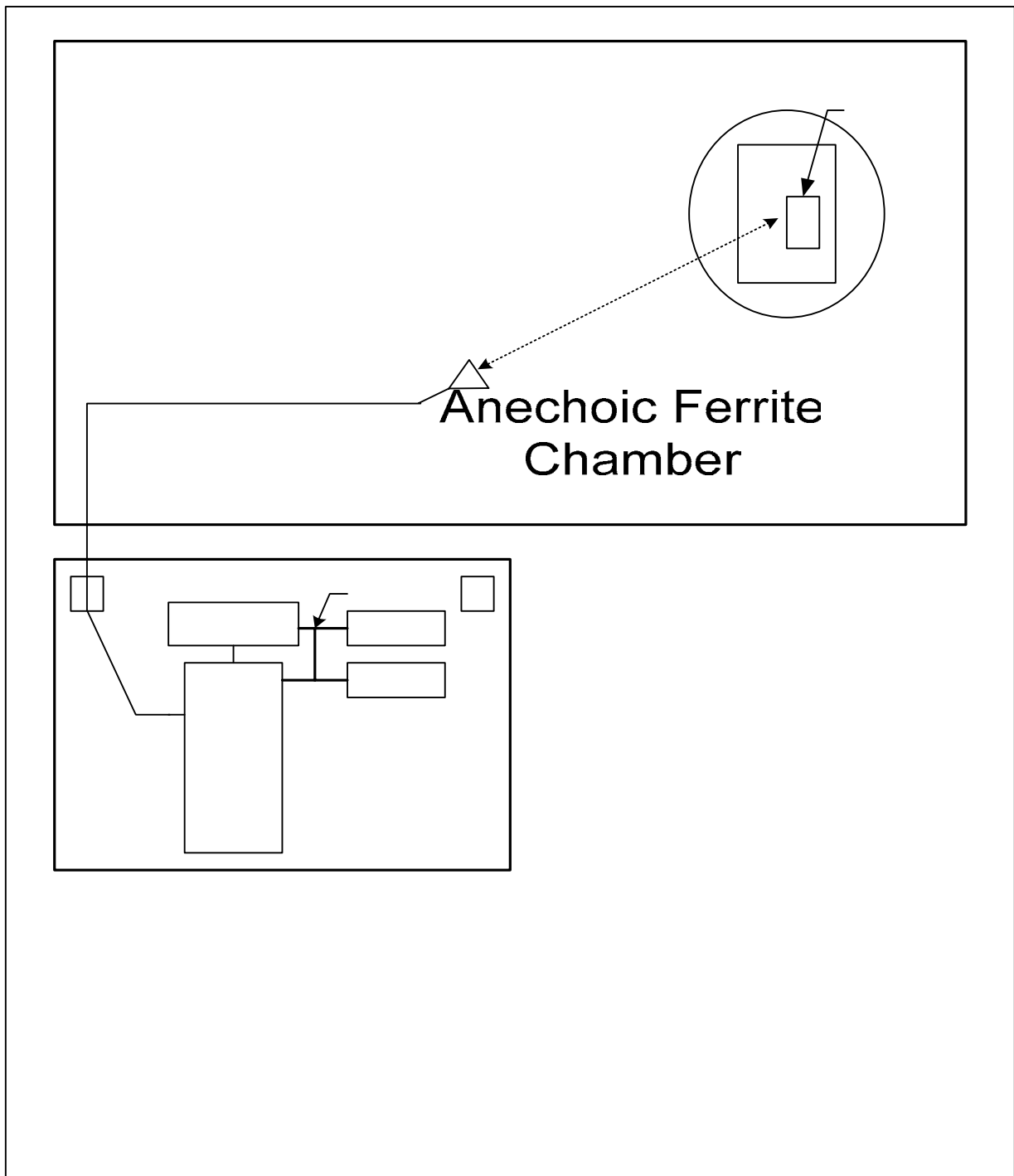
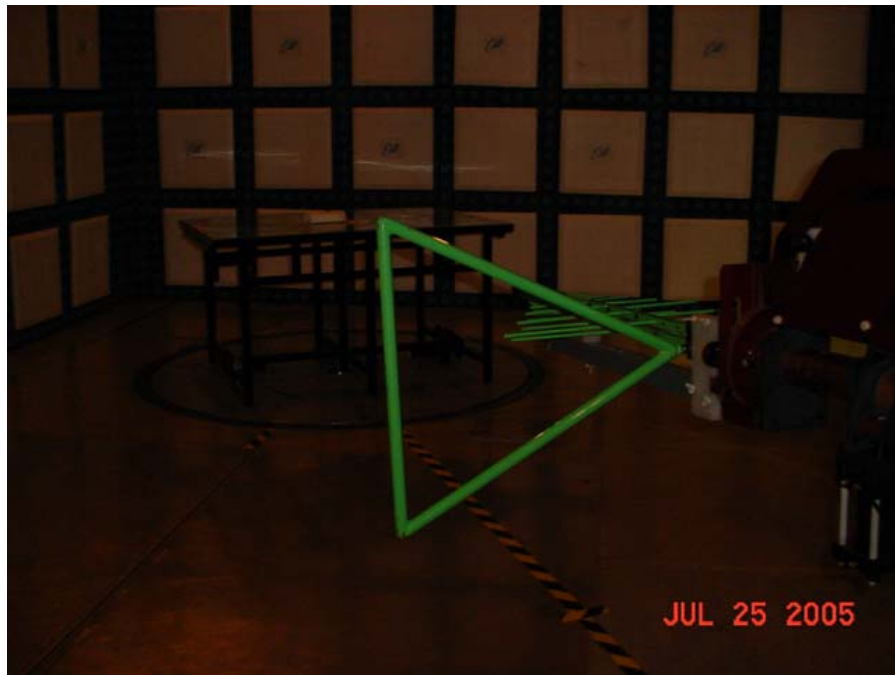
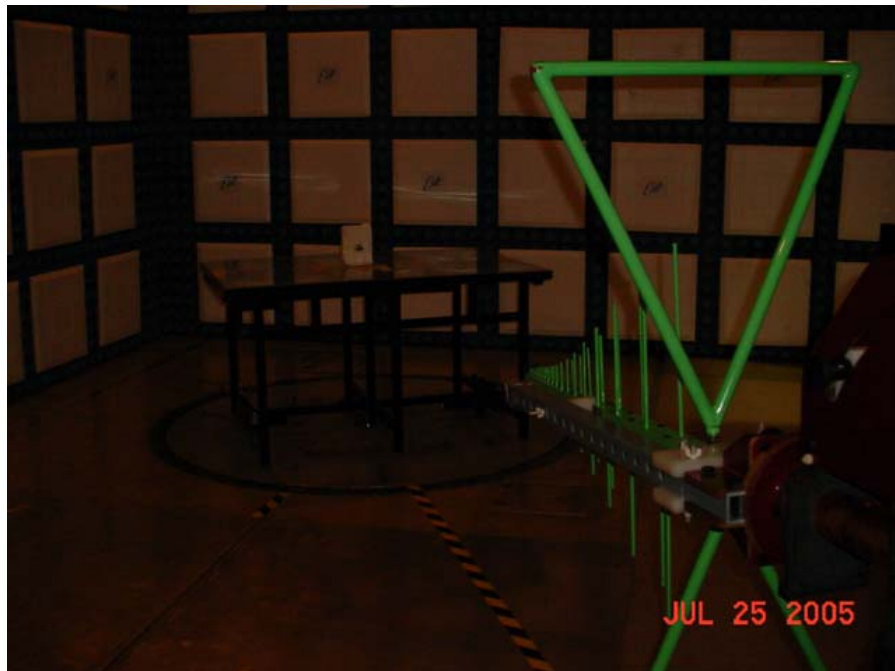


Figure 2

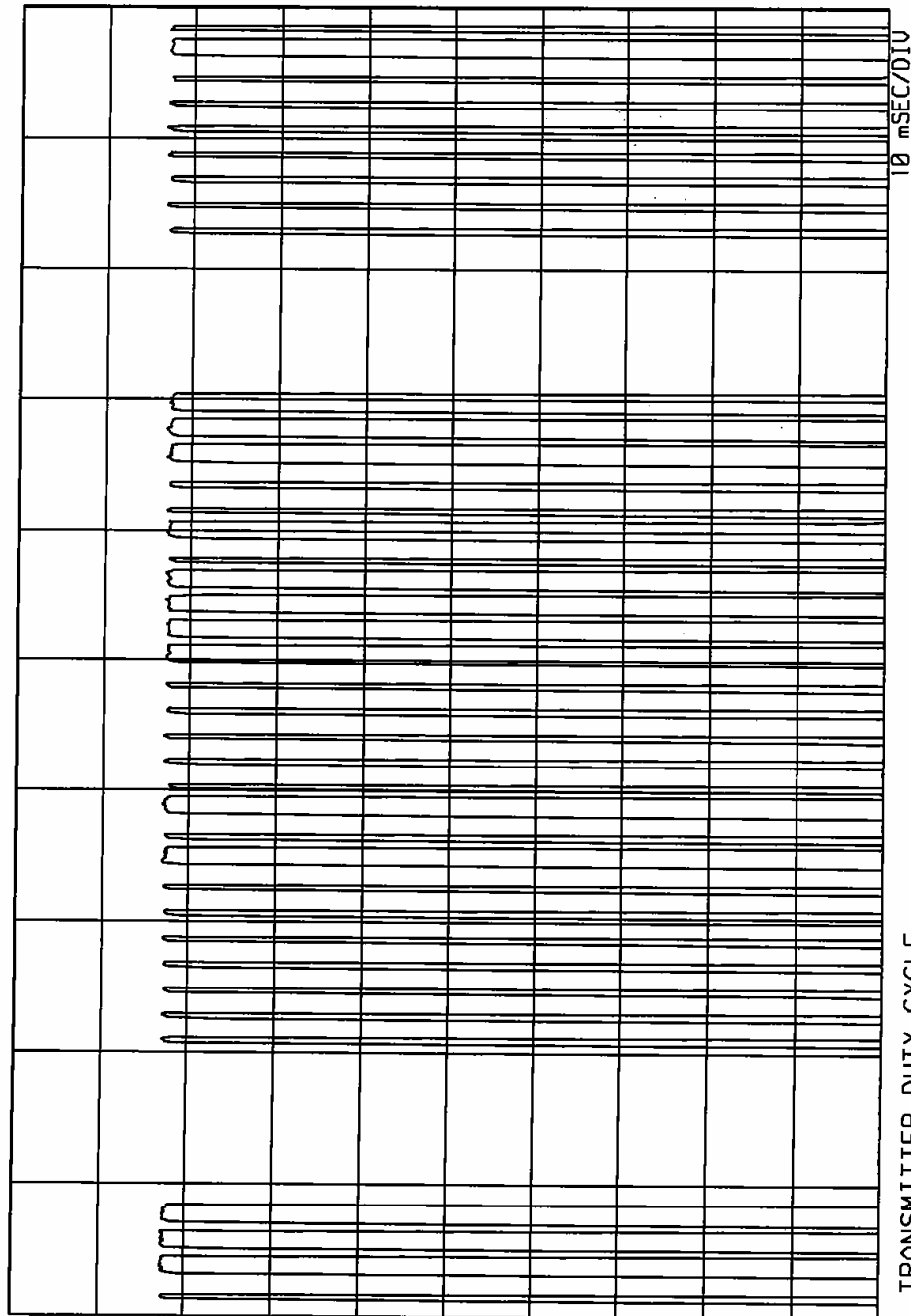


Test Set-up for Radiated Emissions Horizontal Polarity



Test Set-up for Radiated Emissions Vertical Polarity

ELITE ELECTRONIC ENGINEERING Co.
Downers Grove, IL 60515

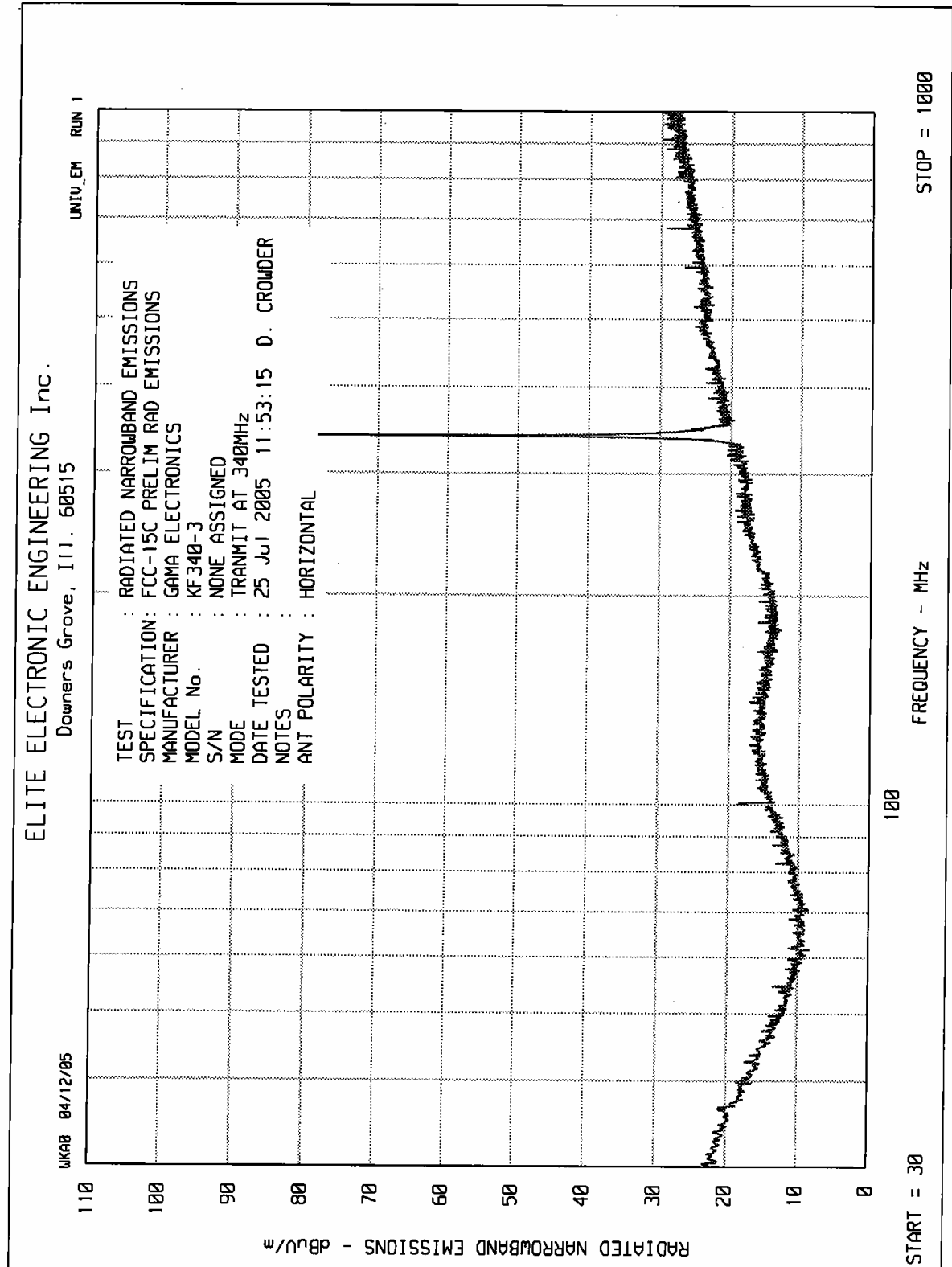


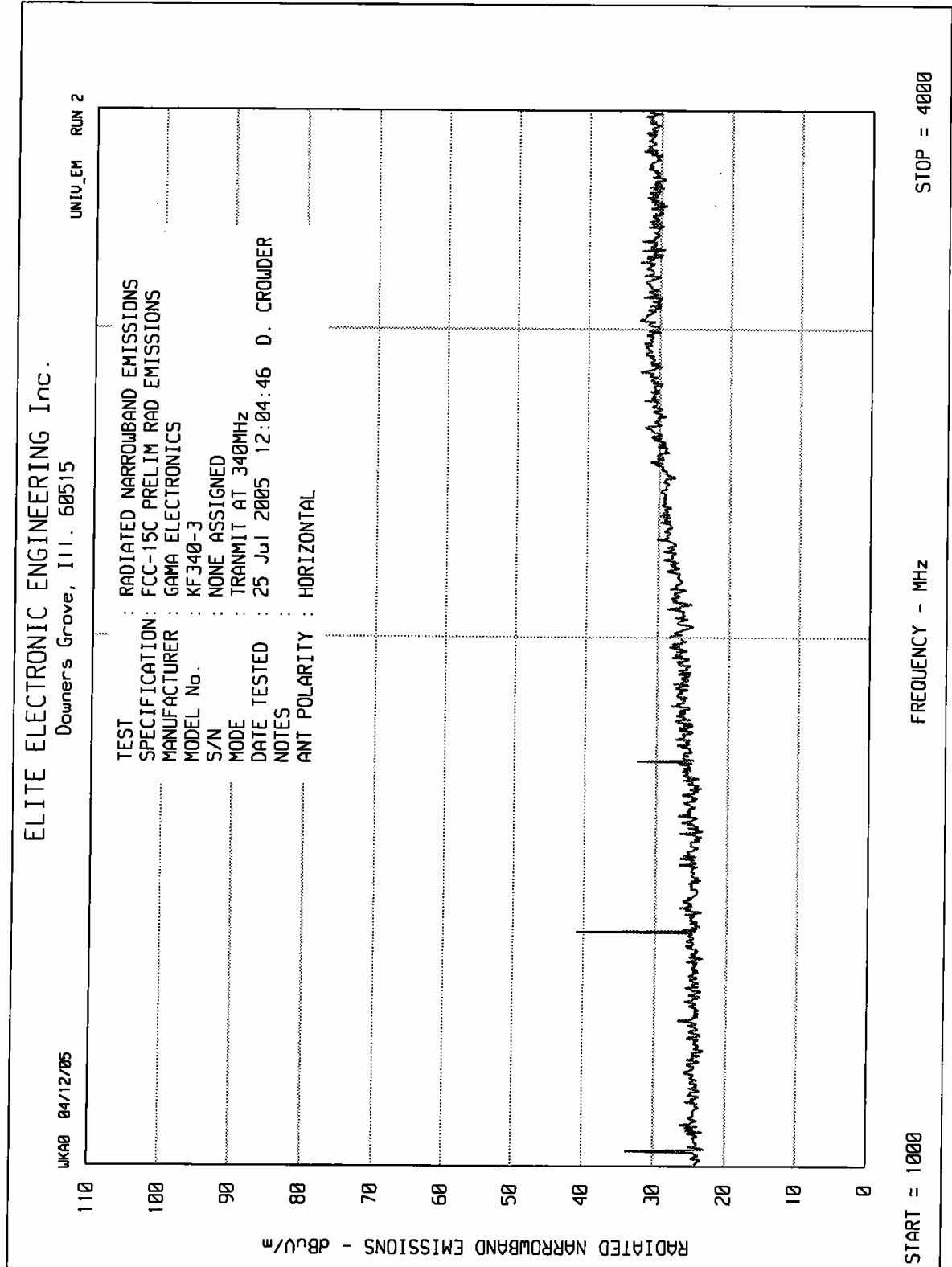
TRANSMITTER DUTY CYCLE

FREQUENCY : 339.9745 MHz
ON TIME : 19.68 mSEC
OFF TIME : 34.565 mSEC
DUTY CYCLE = .36 or -8.87 dB
COMPUTED OVER 1 DATA WORD

MANUFACTURER : GAMA ELECTRONICS
MODEL : 1282690

S/N :
TEST DATE : 14 Jul 2005
NOTES : Tx @ 340.0 MHz





ETR No.
DATA PAGE

SPECIFICATION : FCC PART 15C TRANSMITTER OPEN FIELD DATA
MANUFACTURER : GAMA ELECTRONICS
MODEL : KF340-3
S/N : NONE ASSIGNED
TEST DATE : 25 Jul 2005
NOTES :
TEST ANTENNA : ROBERTS DIPOLE & DRWG ANTENNAS

FREQUENCY MHz	ANT POL	MTR RDG dBuV	CBL FAC dB	ANT FAC dB	DUTY CYCLE dB	TOTAL dBuV/m @3m	TOTAL uV/m @3m	LIMIT uV/m @3m	NOTES
340.00	V	48.7	1.4	19.1	-8.9	60.3	1033.1	7083.3	
340.00	H	59.1	1.4	19.1	-8.9	70.7	3420.9	7083.3	
680.00	H	16.6	1.8	24.9	-8.9	34.4	52.7	708.3	
680.00	V	12.0	1.8	24.9	-8.9	29.8	31.0	708.3	
1020.00	H	30.2	2.0	25.9	-8.9	49.3	290.7	500.0	*
1020.00	V	20.2	2.0	25.9	-8.9	39.3	91.9	500.0	*
1360.00	H	22.1	2.4	26.5	-8.9	42.2	128.1	500.0	*
1360.00	V	14.0	2.4	26.5	-8.9	34.1	50.4	500.0	*
1700.00	H	14.2	2.8	27.6	-8.9	35.7	60.8	500.0	*
1700.00	V	13.9	2.8	27.6	-8.9	35.4	58.7	500.0	*
2040.00	H	3.0	3.0	29.0	-8.9	26.1	20.2	708.3	
2040.00	V	4.0	3.0	29.0	-8.9	27.1	22.7	708.3	
2380.00	H	11.8	3.4	30.2	-8.9	36.5	67.1	500.0	*
2380.00	V	5.4	3.4	30.2	-8.9	30.1	32.1	500.0	*
2720.00	H	3.8	3.8	31.4	-8.9	30.0	31.8	500.0	*
2720.00	V	2.9	3.8	31.4	-8.9	29.1	28.7	500.0	*
3060.00	H	3.2	4.0	32.3	-8.9	30.6	34.0	708.3	
3060.00	V	3.1	4.0	32.3	-8.9	30.5	33.6	708.3	
3400.00	H	3.2	4.2	32.3	-8.9	30.8	34.9	708.3	
3400.00	V	2.3	4.2	32.3	-8.9	29.9	31.4	708.3	

* DENOTES A FREQUENCY CONFLICT WITH RESTRICTED BANDS

checked by:


B. CROWDER

ELITE ELECTRONIC ENGINEERING Inc.

