

ELITE ELECTRONIC ENGINEERING INCORPORATED  
1516 CENTRE CIRCLE  
DOWNERS GROVE, ILLINOIS 60515-1082

ELITE PROJECT: 30109

DATE TESTED: August 8, 2001

TEST PERSONNEL: Mark E. Longinotti, NARTE® Certified EMC Engineer,  
ATL-0154-E

TEST SPECIFICATION: FCC "Code of Federal Regulations" Title 47  
Part 15, Subpart C, Section 15.205

ENGINEERING TEST REPORT NO. 24007  
MEASUREMENT OF RF INTERFERENCE FROM  
A MODEL 1A5536-3 TRANSMITTER

FOR: Chamberlain Manufacturing  
Elmhurst, IL

PURCHASE ORDER NO.: 716961

Report By:



Neil J. Hurley  
NARTE® Certified EMC Engineer  
ATL-0149-E

Approved By:



Raymond J. Klouda  
Registered Professional  
Engineer of Illinois - 44894

ENGINEERING TEST REPORT NO. 24007

ADMINISTRATIVE DATA AND SUMMARY OF TESTS

**DESCRIPTION OF TEST ITEM:** Transmitter

**MODEL NO:** 1A5536-3

**SERIAL NO:** None Assigned

**MANUFACTURER:** Chamberlain Manufacturing

**APPLICABLE SPECIFICATIONS:** FCC "Code of Federal Regulations"  
Title 47, Part 15, Subpart C

**QUANTITY OF ITEMS TESTED:** One (1)

**TEST PERFORMED BY:** ELITE ELECTRONIC ENGINEERING INCORPORATED  
Radio Interference Consultants  
Downers Grove, Illinois 60515

**DATE RECEIVED:** August 6, 2001

**DATE TESTED:** August 8, 2001

**PERSONNEL (OPERATORS, OBSERVERS, AND CO-ORDINATORS):**

**CUSTOMER:** No Chamberlain Manufacturing personnel were present.

**ELITE ELECTRONIC:** Mark E. Longinotti

**ELITE JOB NO.:** 30109

**ABSTRACT:** The model 1A5536-3 Transmitter, does meet the radiated emission and occupied bandwidth requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, for Intentional Radiators, when tested per ANSI C63.4-1992.

The radiated emissions level closest to the limit (worst case) occurred at 314.6MHz. The emissions level at this frequency was 4.6dB within the limit. See data page 19 for more details.

ENGINEERING TEST REPORT NO. 24007

TABLE OF CONTENTS

PARAGRAPH	DESCRIPTION OF CONTENTS	PAGE NO.
1.0	INTRODUCTION	4
1.1	DESCRIPTION OF TEST ITEM	4
1.2	PURPOSE	4
1.3	DEVIATIONS, ADDITIONS AND EXCLUSIONS	4
1.4	APPLICABLE DOCUMENTS	4
1.5	SUBCONTRACTOR IDENTIFICATION	4
1.6	LABORATORY CONDITIONS	5
2.0	TEST ITEM SETUP AND OPERATION	5
2.1	POWER INPUT	5
2.2	GROUNDING	5
2.3	PERIPHERAL EQUIPMENT	5
3.0	TEST EQUIPMENT	5
3.1	TEST EQUIPMENT LIST	5
3.2	CALIBRATION TRACEABILITY	6
3.3	MEASUREMENT UNCERTAINTY	6
4.0	REQUIREMENTS, PROCEDURES AND RESULTS	6
4.1	POWERLINE CONDUCTED EMISSIONS	6
4.1.1	REQUIREMENTS	6
4.2	DUTY CYCLE FACTOR MEASUREMENTS	7
4.2.1	PROCEDURES	7
4.2.2	RESULTS	7
4.3	RADIATED MEASUREMENTS	8
4.3.1	REQUIREMENTS	8
4.3.2	PROCEDURES	8
4.3.3	RESULTS	9
4.4	OCCUPIED BANDWIDTH MEASUREMENTS	10
4.4.1	REQUIREMENTS	10
4.4.2	PROCEDURES	10
4.4.3	RESULTS	10
5.0	CONCLUSION	10
6.0	CERTIFICATION	10
7.0	ENDORSEMENT DISCLAIMER	11
	TABLE I - EQUIPMENT LIST	12

TOTAL NUMBER OF PAGES IN THIS DOCUMENT,  
(INCLUDING DATA SHEETS): 20

THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE  
WRITTEN APPROVAL OF ELITE ELECTRONIC ENGINEERING INCORPORATED.

ENGINEERING TEST REPORT NO. 24007  
MEASUREMENT OF RF INTERFERENCE FROM  
A MODEL 1A5536-3 TRANSMITTER

**1.0 INTRODUCTION:**

**1.1 DESCRIPTION OF TEST ITEM:** This document presents the results of a series of radio interference measurements performed on a model 1A5536-3 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 315 MHz using an internal antenna. The tests were performed for Chamberlain Manufacturing of Elmhurst, 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 for Intentional Radiators. Testing was performed in accordance with ANSI C63.4-1992.

**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 2000
- ANSI C63.4-1992, "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 25°C and the relative humidity was 49%.

**2.0 TEST ITEM SETUP AND OPERATION:**

A block diagram of the test item setup is included as Figure 1.

**2.1 POWER INPUT:** The test item obtained 3VDC power from an internal battery.

**2.2 GROUNDING:** Since the test item was powered with 3VDC, it was ungrounded during the tests.

**2.3 PERIPHERAL EQUIPMENT:** No peripheral equipment or interconnect cables were submitted with the test item.

**2.5 OPERATIONAL MODE:** For all tests the test item was placed on a 80cm high non-conductive stand. The test item was energized.

For all tests, the appropriate button of the test item was held down thereby setting the unit to transmit continuously. The transmitting mechanism automatically deactivated when released. The battery voltage was periodically checked to ensure proper operation at maximum level. The tests were performed with the test item transmitting at 315MHz.

**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. The spectrum analyzer peak detected readings

were converted to average readings using a duty cycle factor. All measurements were taken with the resolution and video bandwidth of the measuring instrument adjusted to 100kHz below 1GHz and 1MHz above 1GHz.

The duty cycle factor was calculated from the pulse train for the test item. A data plot was obtained to determine the duty cycle factor. The duty cycle factor was computed as the Word ON time divided by the Word period (ON time + OFF time). The duty cycle factor in dB =  $20 \log (\text{Word ON}/\text{Word period})$ . If the word period is more than 100 milliseconds, then the duty cycle would be computed on the maximum Word ON time during a 100 millisecond period.

**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:

<u>Radiated Emission Measurements:</u>		
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 of an intentional radiator shall be below 250uV (quasi-

peak) over the frequency range from 0.45MHz to 30MHz. It is also to be noted that if emitted levels in the peak detector function do not exceed the above limits, the test item does meet the intent of these 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 setting are adjusted so that the on/off transitions clear the 4th division from the bottom of the display. The markers are set at 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  $(\text{On-time} / \text{word period})$  where the word period =  $(\text{On-time} + \text{Off-time})$ .

**4.2.2 RESULTS:** A representative plots of the duty cycle is shown on data page 16. Since the transmitter uses a rolling code the duty cycle used was calculated based on the worst case. The worst case information was supplied by Chamberlain Manufacturing. With the test item transmitting at 315MHz, the worst case duty cycle would be a 31 msec Word ON time during a 100 millisecond period. The duty cycle

factor is  $20 \cdot \log(31/100) = -10.2\text{dB}$ .

#### 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.

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 314.6 MHz, the limit at the fundamental is 6025uV/m @ 3m and the limit on the harmonics is 602.5uV/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:** All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. 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 1992 for site attenuation.

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.

Preliminary radiated emissions measurements were first performed using a peak detector and automatically plotted. The frequencies where



significant emission levels were noted were then remeasured.

With the broadband measuring antennas positioned at a 3 meter distance from the test item, the frequency range from 30MHz to 1GHz was investigated using a peak detector function with the antennas set for vertical polarization.

Final radiated emissions were performed on all significant broadband and narrowband emissions found in the preliminary sweeps using the following methods:

- 1) Measurements were made using a peak detector and a tuned dipole below 1GHz and a horn antenna above 1GHz.
- 2) 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) The fundamental through the 10th harmonic of the transmit frequency were measured.
  - (e) The peak detected levels were converted to average levels using a duty cycle factor which was computed from the pulse train.

**4.3.3 RESULTS:** The preliminary plots, with the test item transmitting at 315MHz, are presented on data pages 17 and 18. 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 MHz, are presented on data page 19. 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 314.6MHz. The emissions level at this frequency was 4.6dB within the limit. See data page 19 for details. Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown on Figures 2 and 3.

#### **4.4 OCCUPIED BANDWIDTH MEASUREMENTS:**

**4.4.1 REQUIREMENTS:** 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 data page 20. As can be seen from this data page, the transmitter met the occupied bandwidth requirements.

#### **5.0 CONCLUSION:**

It was found that the Chamberlain Manufacturing model 1A5536-3 Transmitter, does meet the radiated emission and occupied bandwidth requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, for Intentional Radiators, when tested per ANSI C63.4-1992.

#### **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 specification.

The data presented in this test report pertains only 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.

ENGINEERING TEST REPORT NO. 24007

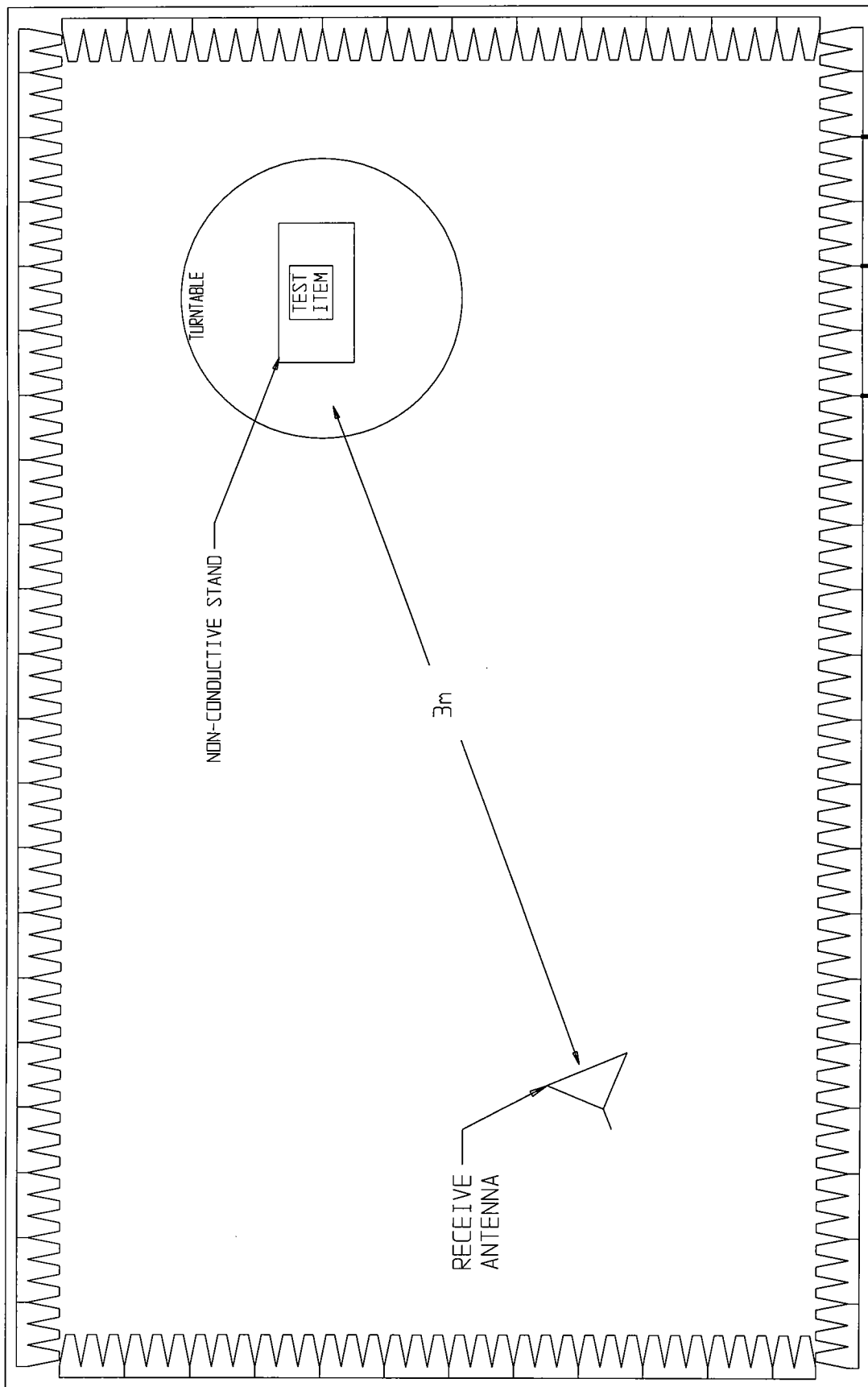
TABLE I: TEST EQUIPMENT LIST

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								
XZG0	ATTENUATOR/SWITCH DRIVER	HEWLETT PACKARD	11713A	3439A02724	---	01/31/00	N/A	
Equipment Type: AMPLIFIERS								
APK0	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	3008A00662	1-26.5GHZ	02/15/01	12	02/15/02
Equipment Type: ANTENNAS								
NDP0	TUNED DIPOLE ANTENNA	EMCO	3121C-DB3	311	140-400MHZ	11/29/00	12	11/29/01
NDQ0	TUNED DIPOLE ANTENNA	EMCO	3121C-DB4	311	400-1000MHZ	11/29/00	12	11/29/01
NTA0	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2057	0.03-2GHZ	05/09/01	12	05/09/02
NWF2	RIDGED WAVE GUIDE	ELECTRO-METRICS	RGA 180	2521	1-12.4GHZ	08/03/01	12	08/03/02
Equipment Type: CONTROLLERS								
CDD2	COMPUTER	HEWLETT PACKARD	D4171A#ABA	US61654645	---		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	
Equipment Type: RECEIVERS								
RAC1	SPECTRUM ANALYZER	HEWLETT PACKARD	85660B	3407A08369	100HZ-22GHZ	01/16/01	12	01/16/02
RACB	RF PRESELECTOR	HEWLETT PACKARD	85685A	3506A01491	20HZ-2GHZ	05/09/01	12	05/09/02
RAF3	QUASISPEAK ADAPTER	HEWLETT PACKARD	85650A	3303A01775	0.01-1000MHZ	01/17/01	12	01/17/02
Equipment Type: TEST CHAMBERS (EMI)								
R21F	3M ANECHOIC CHAMBER MEETS	EMC TEST SYSTEM	3M ANECHOIC		30MHZ-18GHZ	05/18/01	12	05/18/02

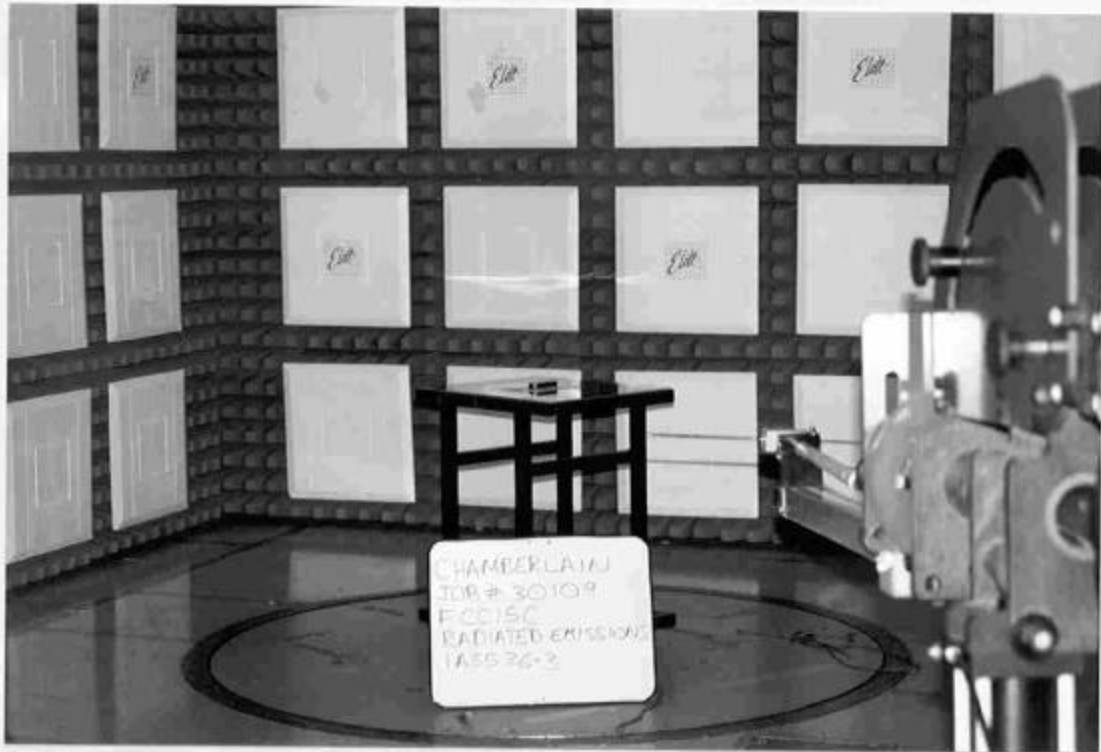
Cal. Interval: Listed in Months I/O: Initial Only N/A: Not Applicable  
 Note 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.



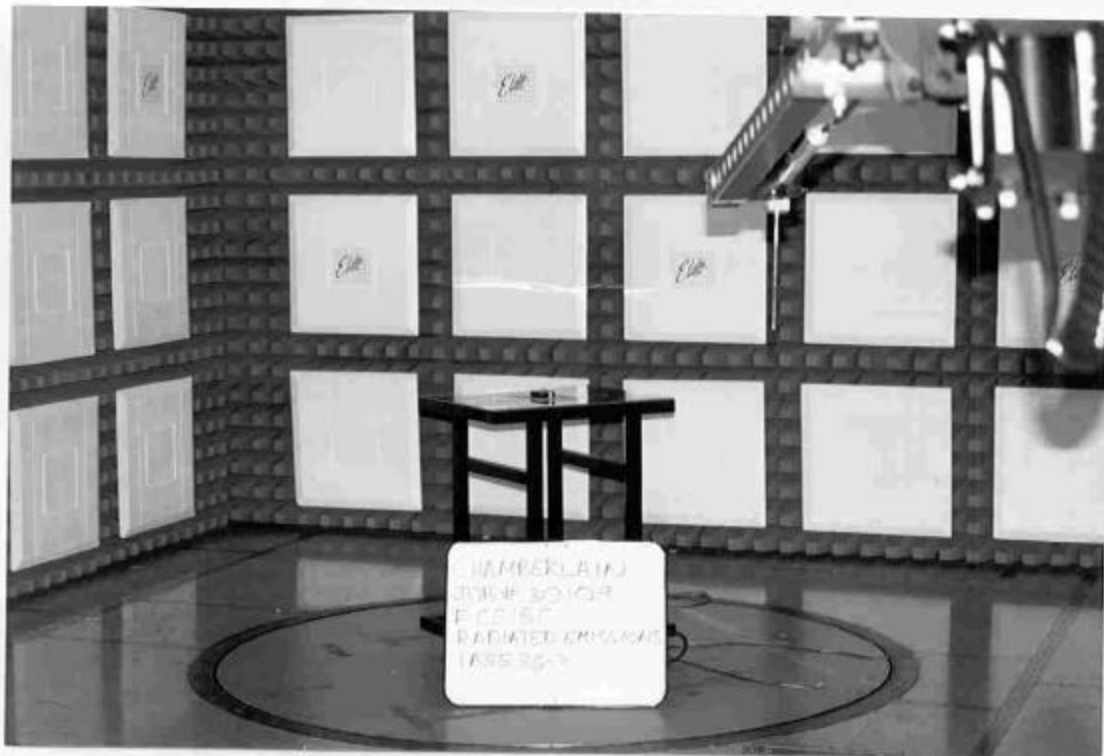
ETR 24007

FIGURE 1 BLOCK DIAGRAM OF TEST ITEM AND PERIPHERAL EQUIPMENT SETUP

FIGURE 2

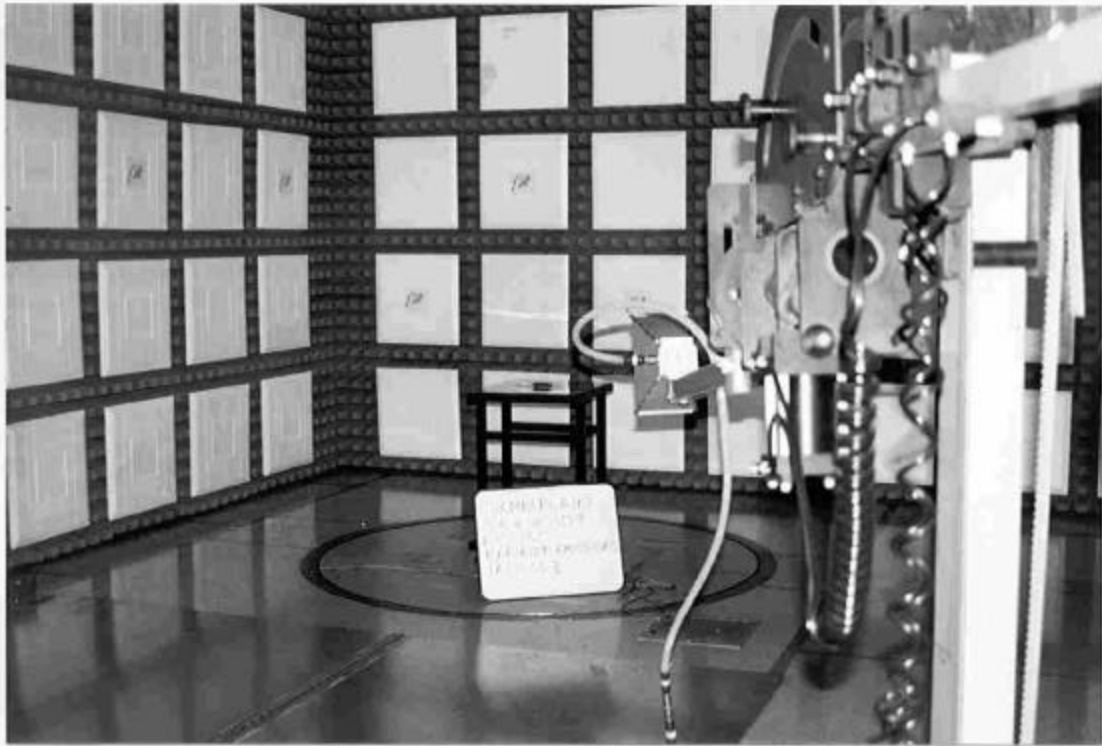


TEST SETUP FOR RADIATED EMISSIONS MEASUREMENTS  
MAXIMIZED FOR MEASUREMENT OF WORST CASE EMISSIONS  
HORIZONTAL POLARIZATION

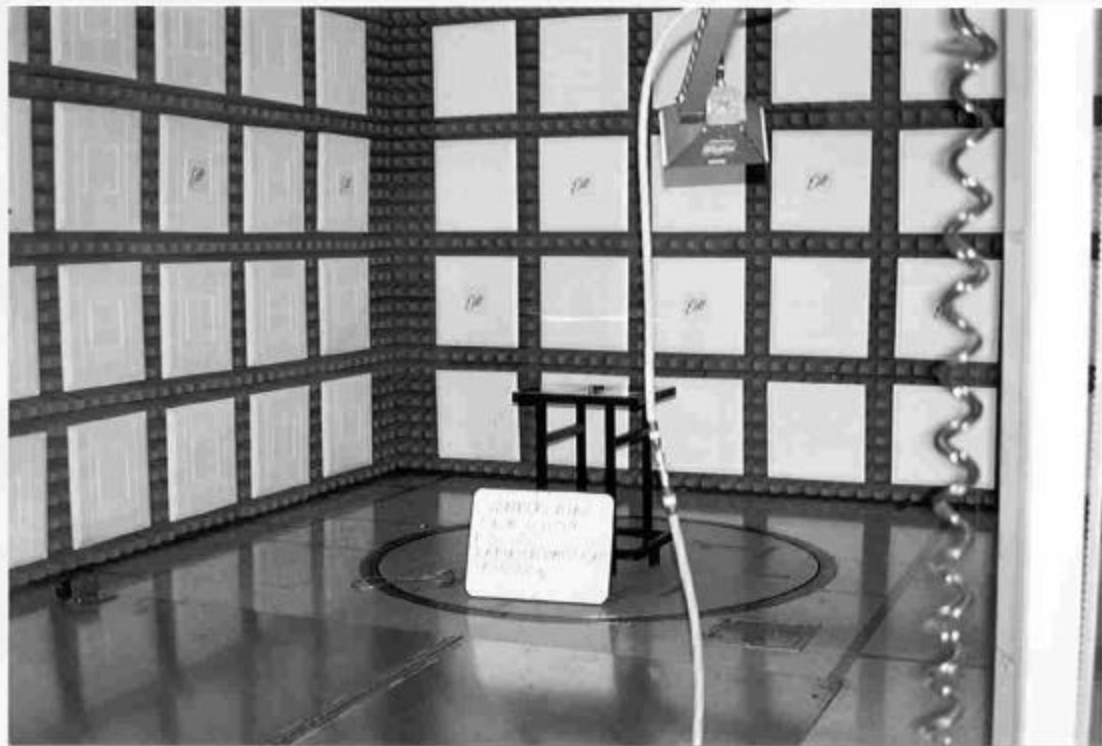


TEST SETUP FOR RADIATED EMISSIONS MEASUREMENTS  
MAXIMIZED FOR MEASUREMENT OF WORST CASE EMISSIONS  
VERTICAL POLARIZATION

FIGURE 3

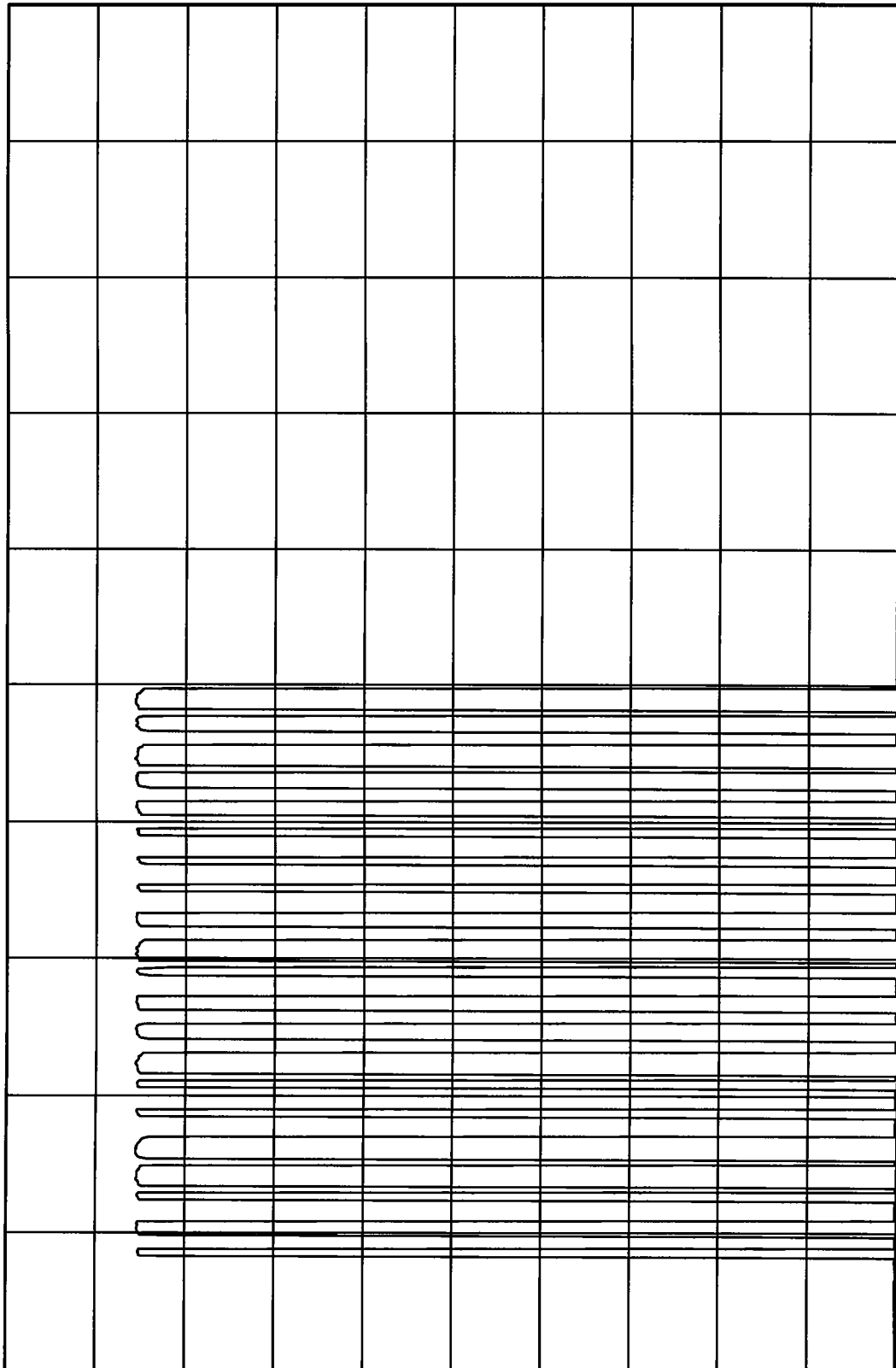


TEST SETUP FOR RADIATED EMISSIONS MEASUREMENTS  
MAXIMIZED FOR MEASUREMENT OF WORST CASE EMISSIONS  
HORIZONTAL POLARIZATION



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

ELITE ELECTRONIC ENGINEERING Co.  
Downers Grove, IL 60515



10 mSEC/DIV

TRANSMITTER DUTY CYCLE  
 FREQUENCY: 315.147 MHz  
 ON TIME : 22.577 mSEC  
 OFF TIME : 77.423 mSEC  
 DUTY CYCLE = .23 or -12.77 dB  
 COMPUTED OVER 100 mSEC

MANUFACTURER : CHAMBERLAIN  
 MODEL : 1A5536-3  
 S/N : NONE ASSIGNED  
 TEST DATE : 8 Aug 2001  
 NOTES : TX @ 315MHz



ELITE ELECTRONIC ENGINEERING Co.

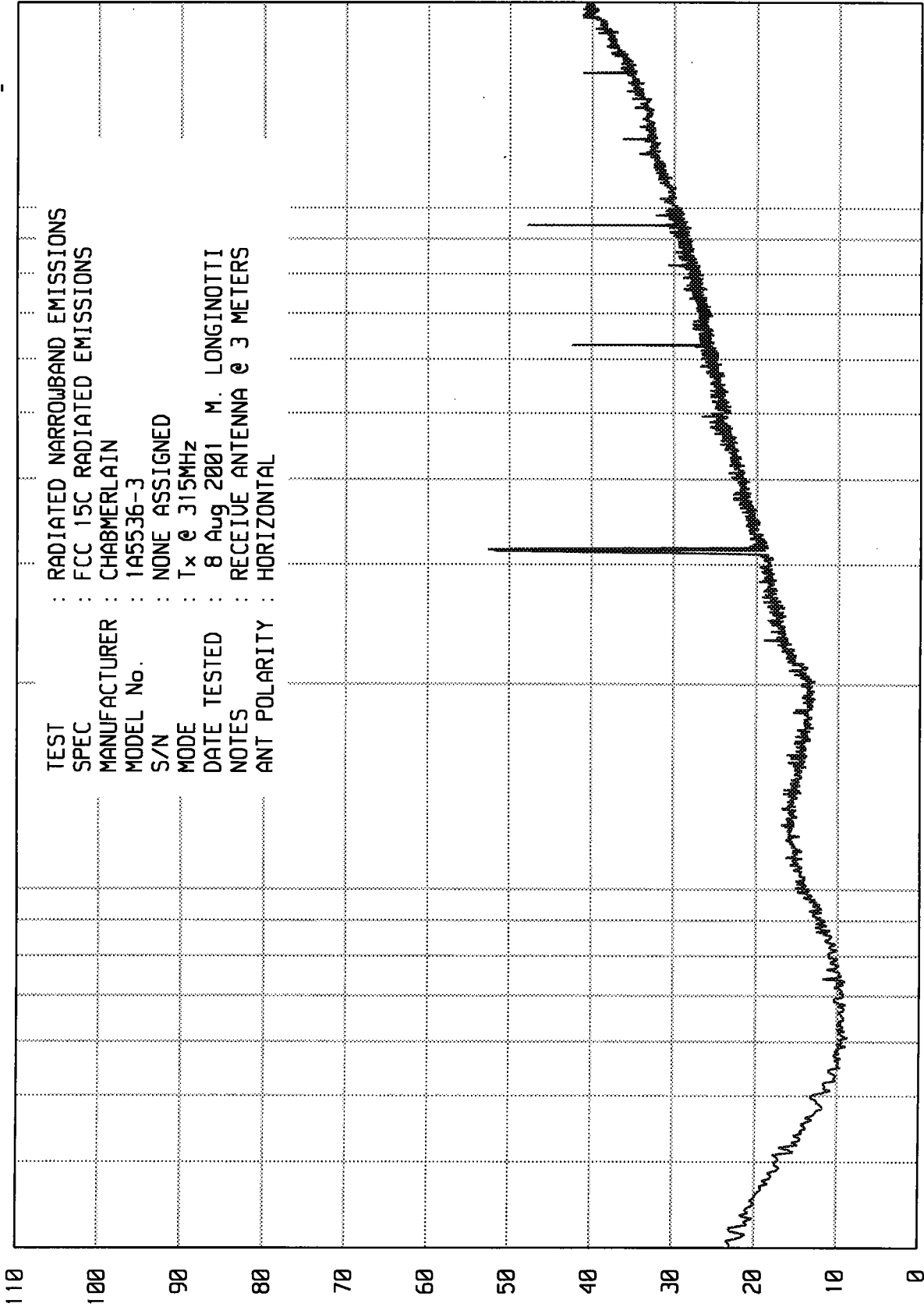
Downers Grove, Ill. 60515

UNTU\_EM RUN RUN 1

WKA00 05/03/01

EEE

TEST : RADIATED NARROWBAND EMISSIONS  
 SPEC : FCC 15C RADIATED EMISSIONS  
 MANUFACTURER : CHAMBERLAIN  
 MODEL No. : 1A5536-3  
 S/N : NONE ASSIGNED  
 MODE : Tx @ 315MHz  
 DATE TESTED : 8 Aug 2001 M. LONGINOTTI  
 NOTES : RECEIVE ANTENNA @ 3 METERS  
 ANT POLARITY : HORIZONTAL



RADIATED EMISSIONS - dBuV/m

START = 30

FREQUENCY - MHz

100

1000

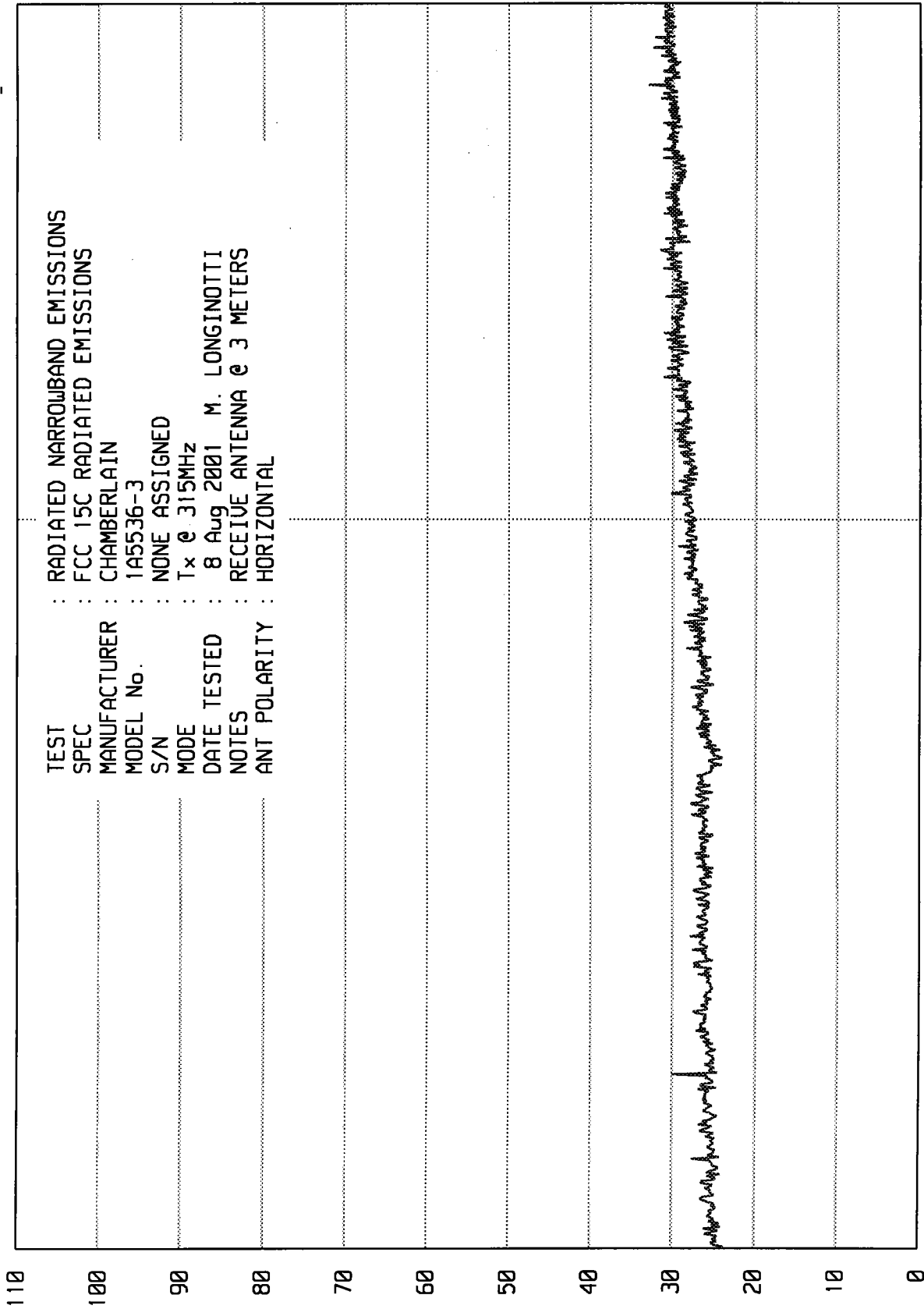
STOP = 2000

ELITE ELECTRONIC ENGINEERING Co.

Downers Grove, Ill. 60515

UNTU\_EM RUN RUN 1

WKA0 05/03/01



TEST : RADIATED NARROWBAND EMISSIONS  
 SPEC : FCC 15C RADIATED EMISSIONS  
 MANUFACTURER : CHAMBERLAIN  
 MODEL No. : 1A5536-3  
 S/N : NONE ASSIGNED  
 MODE : Tx @ 315MHz  
 DATE TESTED : 8 Aug 2001 M. LONGINOTTI  
 NOTES : RECEIVE ANTENNA @ 3 METERS  
 ANT POLARITY : HORIZONTAL

RADIATED EMISSIONS - dBu/m

START = 2000 FREQUENCY - MHz STOP = 4000

ETR No.  
DATA PAGE

SPECIFICATION : FCC PART 15C (REV OCT 1, 94) TRANSMITTER OPEN FIELD DATA  
 MANUFACTURER : CHAMBERLAIN  
 MODEL : 1A5536-3  
 S/N : NONE ASSIGNED  
 TEST DATE : 8 Aug 2001  
 NOTES : Tx @ 315MHz  
 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
314.60	H	60.7	1.8	18.7	-10.2	71.0	3555.1	6025.0	
314.60	V	41.0	1.8	18.7	-10.2	51.3	368.0	6025.0	
630.00	H	22.9	2.7	24.6	-10.2	40.0	99.6	602.5	
630.00	V	13.7	2.7	24.6	-10.2	30.8	34.5	602.5	
944.00	H	18.4	3.4	28.5	-10.2	40.1	101.2	602.5	
944.00	V	10.1	3.4	28.5	-10.2	31.8	38.9	602.5	
1259.00	H	13.6	2.3	24.9	-10.2	30.6	34.0	602.5	
1259.00	V	12.0AMB	2.3	24.9	0.0	39.2	91.6	602.5	
1573.00	H	29.2	2.6	25.9	-10.2	47.4	235.4	500.0	*
1573.00	V	22.5	2.6	25.9	-10.2	40.7	108.8	500.0	*
1887.00	H	14.5	2.8	27.3	-10.2	34.4	52.2	602.5	
1887.00	V	9.6AMB	2.8	27.3	0.0	39.7	96.1	602.5	
2203.00	H	12.5	3.1	28.3	-10.2	33.7	48.4	500.0	*
2203.00	V	6.3AMB	3.1	28.3	0.0	37.7	76.8	500.0	*
2517.00	H	7.7AMB	3.4	29.2	0.0	40.3	103.4	602.5	
2517.00	V	6.7AMB	3.4	29.2	0.0	39.3	92.2	602.5	
2832.00	V	5.9AMB	3.8	30.1	0.0	39.8	97.8	500.0	*
2832.00	H	7.0AMB	3.8	30.1	0.0	40.9	111.0	500.0	*
3147.00	H	8.9AMB	4.0	31.1	0.0	44.0	158.1	602.5	
3147.00	V	7.0AMB	4.0	31.1	0.0	42.1	127.0	602.5	

\* DENOTES A FREQUENCY CONFLICT WITH RESTRICTED BANDS

checked by:

  
M. LONGINOTTI

ELITE ELECTRONIC ENGINEERING CO

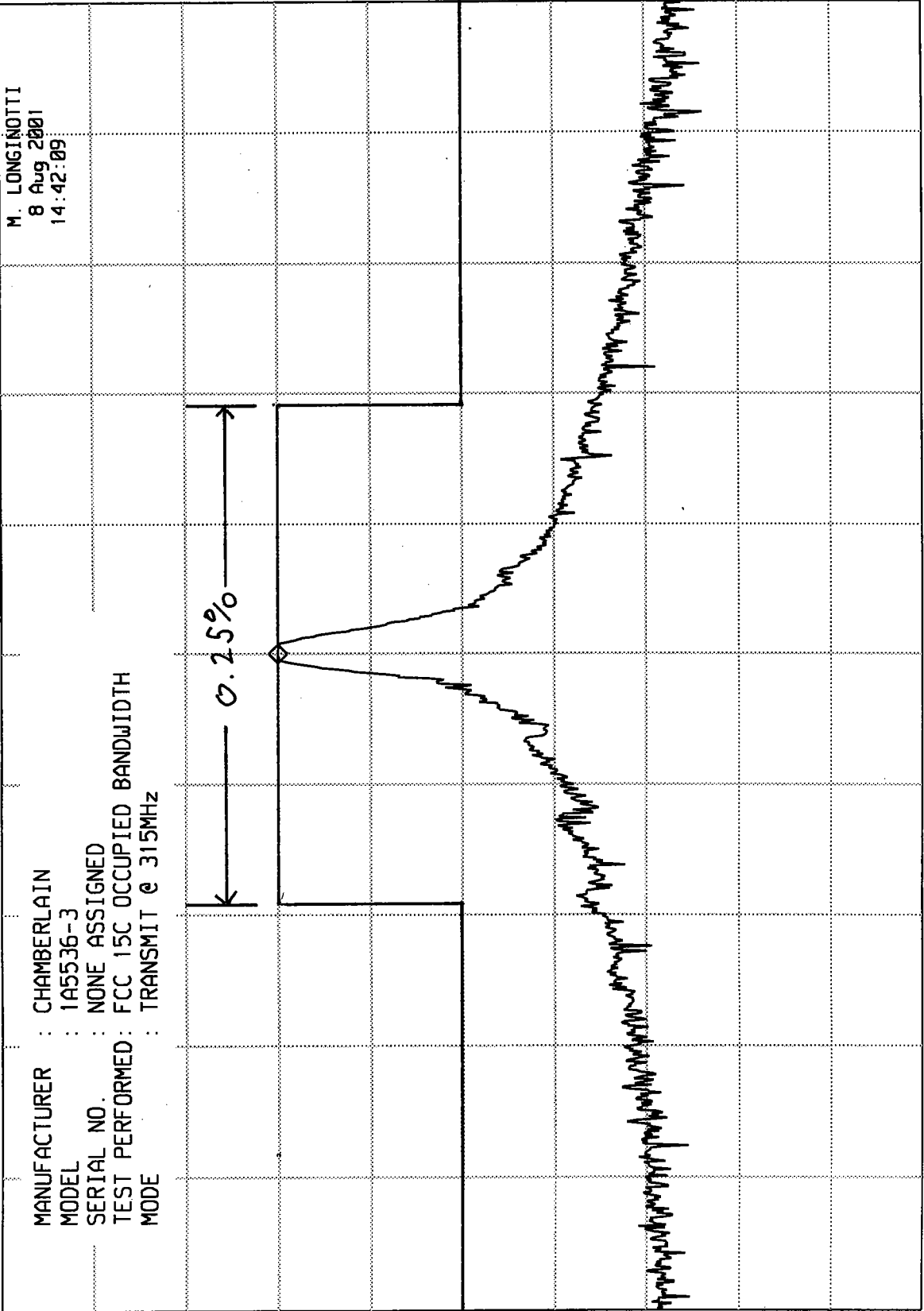
MKR 314.622 MHz  
-40.90 dBm

hp

REF -10.9 dBm

ATTEN 10 dB

10 dB/



SPAN 2.00 MHz  
SWP 20.0 msec

VBW 300 kHz

CENTER 314.62 MHz  
RES BW 30 kHz (i)