

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

ELITE PROJECT: 26850

DATES TESTED: July 14, 1998

TEST PERSONNEL: Mark E. Longinotti

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

ENGINEERING TEST REPORT NO. 20955

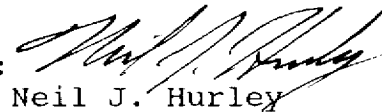
MEASUREMENT OF RF EMISSIONS

FROM A MODEL 41A5235 TRANSMITTER

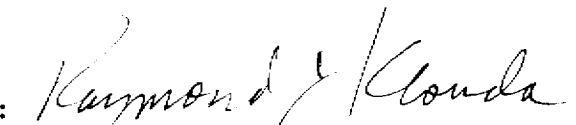
FOR: Chamberlain
Elmhurst, Illinois

PURCHASE ORDER NO.: 715321

Report By:


Neil J. Hurley

Approved By:


Raymond J. Klouda
Registered Professional
Engineer of Illinois - 44894

ENGINEERING TEST REPORT NO. 20955

ADMINISTRATIVE DATA AND SUMMARY OF TESTS

DESCRIPTION OF TEST ITEM: Transmitter

MODEL NO: 41A5235

SERIAL NO: 12

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 COMPANY
Radio Interference Consultants
Downers Grove, Illinois 60515

DATES TESTED: July 14, 1998

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

CUSTOMER: No Chamberlain Manufacturing personnel were present.

ELITE ELECTRONIC: Mark E. Longinotti

ELITE JOB NO.: 26850

ABSTRACT: The Model 41A5235 Transmitter, does meet the radiated emission requirements of the FCC "Code of Federal Regulations", Title 47, Part 15, Subpart C paragraphs 15.205 et seq. The radiated emissions level closest to the limit occurred at 433.0 MHz. The emissions level at this frequency was 5.5 dB within the limit. See data page 103 for more details.

TABLE OF CONTENTS

PARAGRAPH	DESCRIPTION OF CONTENTS	PAGE NO.
1.0	INTRODUCTION	1
1.1	Description of Test Item	1
1.2	Purpose	1
1.3	Deviations, Additions and Exclusions	1
1.4	Applicable Documents	1
1.5	Subcontractor Identification	2
2.0	TEST ITEM SETUP AND OPERATION	2
3.0	TEST SITE AND INSTRUMENTATION	2
3.1	Test Site	2
3.2	Test Instrumentation	2
4.0	REQUIREMENTS, PROCEDURES AND RESULTS	3
4.1	Powerline Conducted Emissions	3
4.1.1	Requirements	3
4.2	Radiated Emissions	3
4.2.1	Requirements	3
4.2.2	Procedures	4
4.2.3	Results	4
4.3	Occupied Bandwidth Measurements	5
4.3.1	Requirements	5
4.3.2	Procedures	5
4.3.3	Results	5
5.0	CONCLUSION	6
6.0	CERTIFICATION	6
TABLE I	EQUIPMENT LIST	7

MEASUREMENT OF RF EMISSIONS

FROM A MODEL 41A5235 TRANSMITTER

1.0 INTRODUCTION:

1.1 DESCRIPTION OF TEST ITEM: On July 14, 1998, a series of radio interference measurements were performed on a Model 41A5235 Transmitter, Serial No. 12, (hereinafter referred to as the test item). The test item was designed to transmit at approximately 433MHz using an internal antenna. The tests were performed for the Chamberlain Manufacturing Co. of Elmhurst, Illinois.

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 15.205 et seq 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 1997
- 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 the Elite Electronic Engineering Company, radio interference consultants of Downers Grove, Illinois.

2.0 TEST ITEM SETUP AND OPERATION:

For all tests the test item was placed on a 80cm high non-conductive stand.

Power to the transmitter was supplied by an internal 3V lithium battery. Since the test item was powered through a battery, it was ungrounded during the tests.

For all tests, the test item's transmit button was held down thereby setting the unit to transmit continuously. Transmission was verified by viewing the test item's fundamental frequency on the spectrum analyzer. The transmitting mechanism timed out after a set amount of time so all measurements were made prior to the device timing out. The transmitting mechanism automatically deactivated when released. The tests were performed with the test item operating at 433MHz.

3.0 TEST SITE AND INSTRUMENTATION:

3.1 TEST SITE: 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.

3.2 TEST INSTRUMENTATION: 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. All open field measurements

below 1000MHz were made with tuned dipole antennas. All measurements above 1000MHz were made with a double ridged waveguide antenna.

All measurements were performed with a Hewlett Packard spectrum analyzer. The spectrum analyzer readings were corrected to average readings using a duty cycle factor. It should be noted that all measurements were taken with the resolution and video bandwidth of the measuring instrument adjusted to 100kHz below 1GHz and 1MHz above 1GHz.

4.0 REQUIREMENTS, PROCEDURES AND RESULTS:

4.1 POWERLINE CONDUCTED EMISSIONS:

4.1.1 REQUIREMENTS: The test item was powered by an internal battery and not through the public power lines; therefore, conducted emissions measurements were not required.

4.2 RADIATED EMISSIONS:

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 15.231(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 433 MHz, the limit at the fundamental is 10958.3 uV/m @ 3m and the limit on the harmonics is 1095.8 uV/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.

4.2.2 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.

Final radiated emissions measurements were performed using a receiver with a quasi-peak detector. However, since a quasi-peak detector requires long integration time, it is not practical to automatically sweep through the entire frequency range using the quasi-peak detector. Therefore, preliminary radiated emissions from the test item were first scanned using a peak detector and automatically plotted. The frequencies where significant emission levels were detected in the preliminary sweeps were then remeasured using the quasi-peak detector.

For the final radiated tests, the test item was placed on a 1 meter high non-conductive stand, the test distance was 3 meters.

All measurements were made with a spectrum analyzer. The detected level of the fundamental and harmonics were corrected to average levels using a factor which was mathematically determined.

To ensure that maximum 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.

4.2.3 RESULTS: The pulse train for the test item while transmitting at 433MHz can be seen on data page 101. This data plot is a representative pulse train obtained from the test item. However, the rolling code duty cycle factor was computed using the maximum Word ON time as 31.0 milliseconds in a 100.0 millisecond period. Therefore, the maximum Duty Cycle can be $31.0/100.0 = 0.31$. The duty cycle factor $= 20 \log 0.310 = -10.2 \text{ dB}$. This information was provided by the manufacturer.

Preliminary radiated emission test results with the test item transmitting at 433MHz is presented on data page 102.

The data for the open field measurements with the test item transmitting at 433MHz is presented on data page 103. As can be seen, no excessive readings were detected. The radiated emissions level closest to the limit occurred at 433.0 MHz. The emissions level at this frequency was 5.5 dB within the limit.

Photographs of the test configurations which yielded the highest radiated emission levels are shown on Figures 1a and 1b.

4.3 OCCUPIED BANDWIDTH MEASUREMENTS:

4.3.1 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.

4.3.2 PROCEDURES: The test item was placed on an 80cm high non-conductive stand. The unit was set to transmit continuously. An antenna was positioned nearby and the emissions displayed on the HP

model 8566B spectrum analyzer. The frequency spectrum was then plotted.

4.3.3 RESULTS: The plot of the emissions near the fundamental frequency of 433MHz is presented on data page 104. As can be seen from this data page, the transmitter met the occupied bandwidth requirements.

5.0 CONCLUSION:

It was found that the Chamberlain Model 41A5235 Transmitter, does comply with the limits imposed by the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.205 et seq. for Intentional Radiators, when tested per ANSI C63.4-1992.

6.0 CERTIFICATION:

Elite Electronic Engineering Company 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 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.

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

ENGINEERING TEST REPORT NO. 20955

TABLE I: TEST EQUIPMENT LIST

ELITE ELECTRONIC ENG. CO.

Page: 1

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Cal Inv	Due Date
Equipment Type: ACCESSORIES, MISCELLANEOUS								
XPQ1	HIGH PASS FILTER	K&L MICROWAVE	4IH30-1804/T	002	1.8-10GHZ	02/23/98	12	02/23/99
XZG0	ATTENUATOR/SWITCH DRIVER	HEWLETT PACKARD	11713A	3439A00325	---	01/24/98	12	01/24/99
Equipment Type: AMPLIFIERS								
APK0	PREAMPLIFIER	HEWLETT PACKARD	8449B	3008A00662	1-26.5GHZ	01/27/98	12	01/27/99
Equipment Type: ANTENNAS								
NBC1	BICONICAL ANTENNA	TENSOR	4104	2014	20-220MHZ	07/10/98	12	07/10/99
NDQ0	TUNED DIPOLE ANTENNA	EMCO	3121C-DB4	311	400-1000MHZ	09/18/97	12	09/18/98
NSC0	LOG SPIRAL ANTENNA	EMCO	3101	2661	200-1000MHZ	07/25/97	12	07/25/98
NWG0	DOUBLE RIDGED WAVEGUIDE	AEL	H1479	104	1-12.4GHZ	10/17/97	12	10/17/98
Equipment Type: CONTROLLERS								
CDD2	COMPUTER	HEWLETT PACKARD	D4171A#ABA	SUS61654645	N/A			N/A
Equipment Type: PRINTERS AND PLOTTERS								
HRE0	LASERJET 5P PRINTER	HEWLETT PACKARD	C3150A	USHB007254	---			N/A
Equipment Type: RECEIVERS								
RAC1	SPECTRUM ANALYZER	HEWLETT PACKARD	85660B	3407A08369	100HZ-22GHZ	01/24/98	12	01/24/99
RACB	RF PRESELECTOR	HEWLETT PACKARD	85685A	3506A01491	20HZ-2GHZ	01/26/98	12	01/26/99
RAF3	QUASIPeAK ADAPTER	HEWLETT PACKARD	85650A	3303A01775	0.01-1000MHZ	01/26/98	12	01/26/99

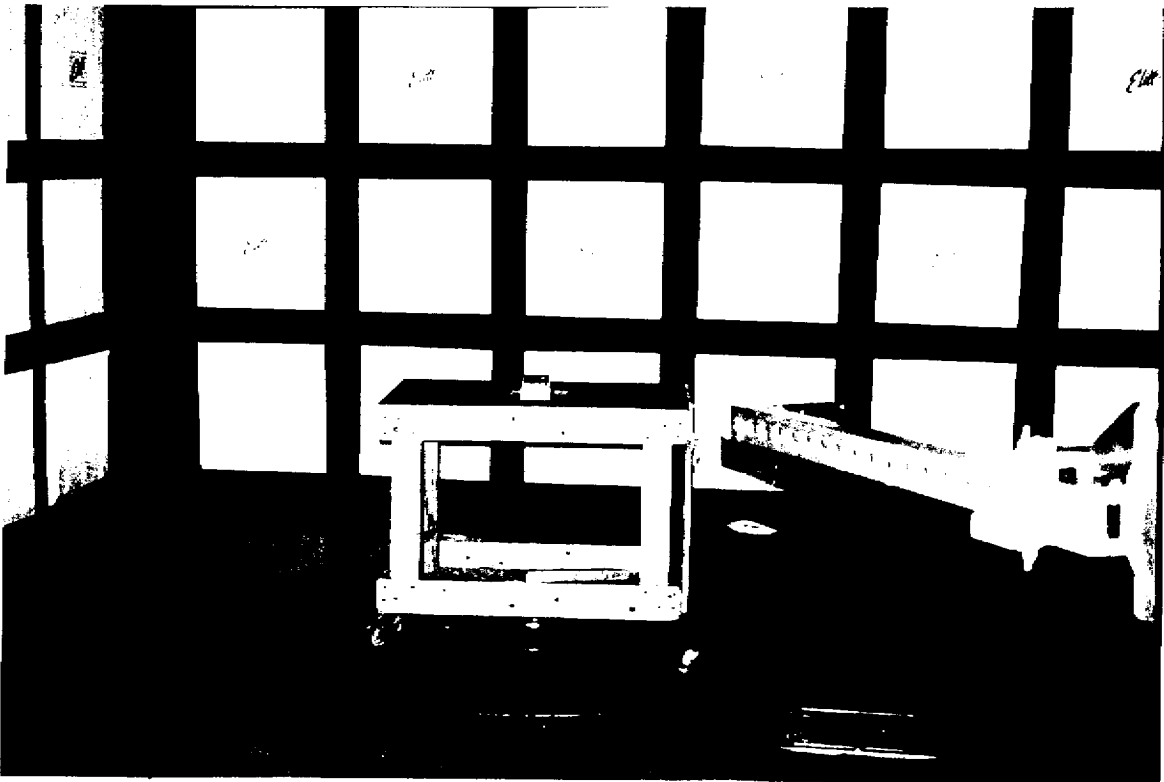
Cal. Interval: Listed in Months I/O: Initial Only N/A: Not Applicable

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 1a



TEST SETUP FOR MEASUREMENT OF RADIATED EMISSIONS
HORIZONTAL POLARIZATION



TEST SETUP FOR MEASUREMENT OF RADIATED EMISSIONS
VERTICAL POLARIZATION

FIGURE 1b

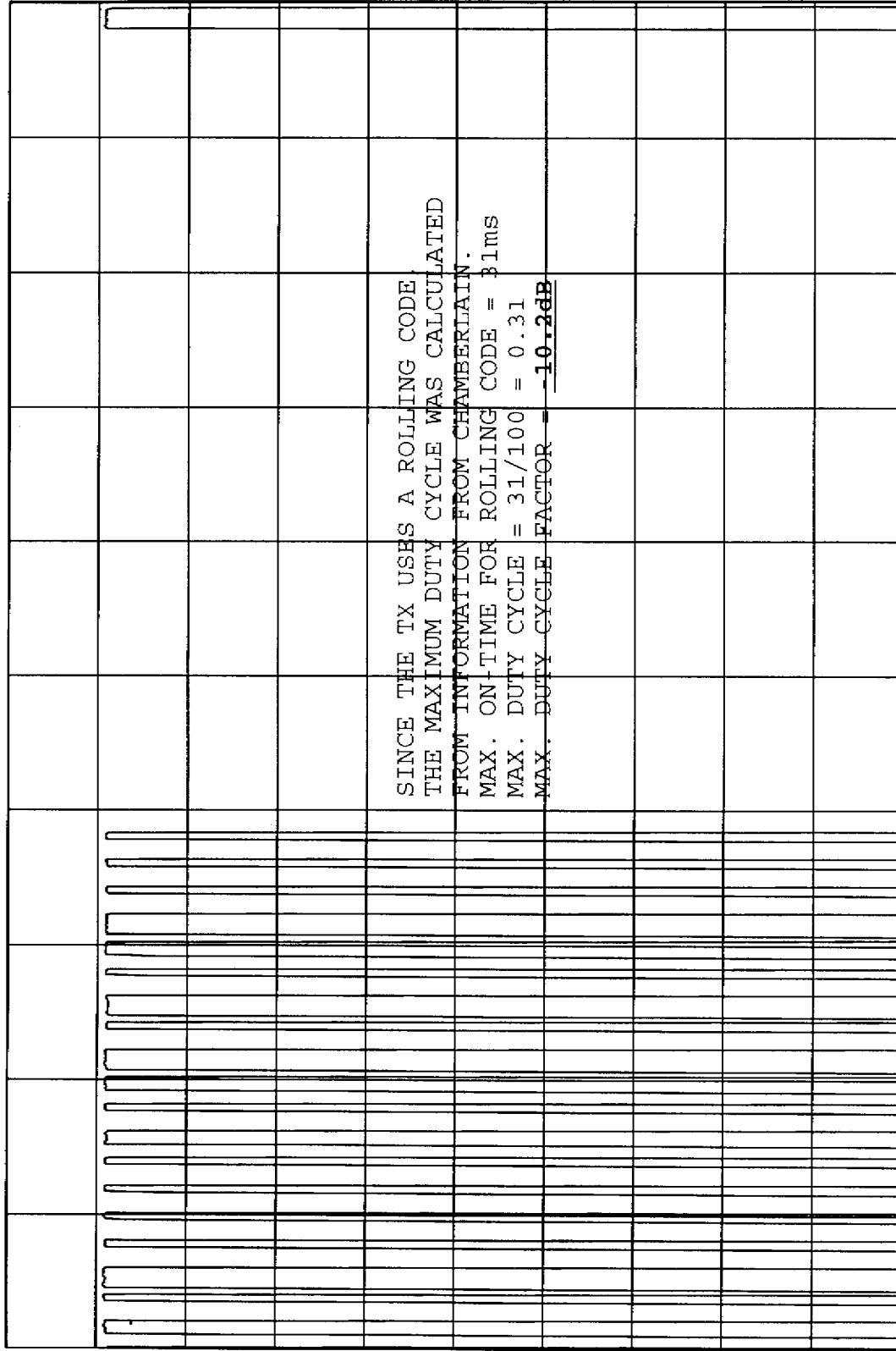


TEST SETUP FOR MEASUREMENT OF RADIATED EMISSIONS
HORIZONTAL POLARIZATION



TEST SETUP FOR MEASUREMENT OF RADIATED EMISSIONS
VERTICAL POLARIZATION

ELITE ELECTRONIC ENGINEERING Co.
Downers Grove, IL 60515



10 mSEC/DIV

SINCE THE TX USES A ROLLING CODE
THE MAXIMUM DUTY CYCLE WAS CALCULATED
FROM INFORMATION FROM CHAMBERLAIN.
MAX. ON-TIME FOR ROLLING CODE = 31ms
MAX. DUTY CYCLE = $31/100 = 0.31$
MAX. DUTY CYCLE FACTOR = -10.2dB

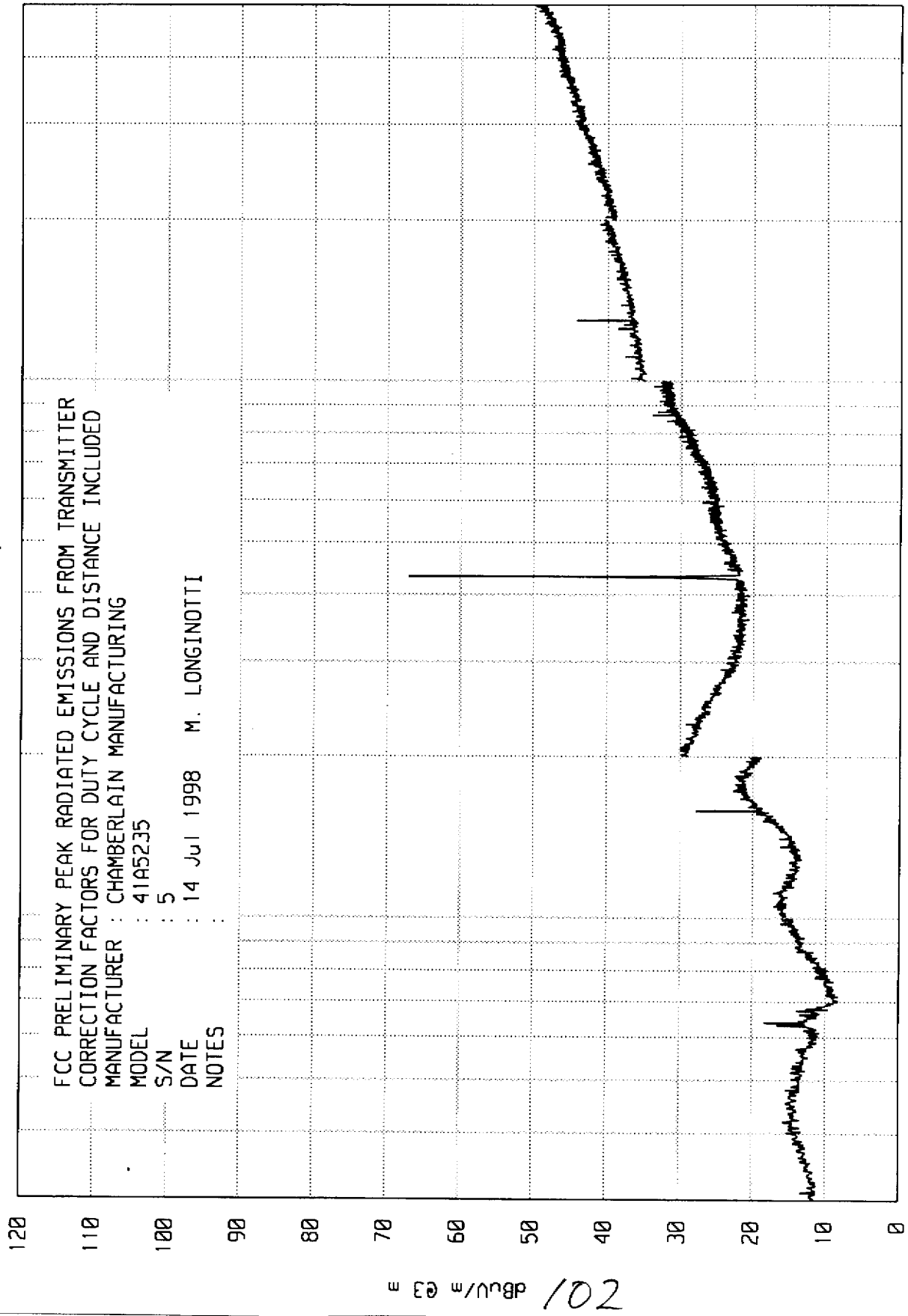
TRANSMITTER DUTY CYCLE

FREQUENCY: 432.7332 MHz
ON TIME : 19.081 mSEC
OFF TIME : 80.919 mSEC
DUTY CYCLE = .19 or -14.42 dB
COMPUTED OVER 100 mSEC

MANUFACTURER : CHAMBERLAIN MANUFACTURING

MODEL : 41A5235
S/N : 12
TEST DATE : 14 Jul 1998
NOTES :

EE ELITE ELECTRONIC ENGINEERING Co.
Downers Grove, Ill. 60515



FCC PRELIMINARY PEAK RADIATED EMISSIONS FROM TRANSMITTER
CORRECTION FACTORS FOR DUTY CYCLE AND DISTANCE INCLUDED
MANUFACTURER : CHAMBERLAIN MANUFACTURING
MODEL : 41A5235
S/N : 5
DATE : 14 Jul 1998 M. LONGINOTTI
NOTES :

102

SPECIFICATION : FCC PART 15C(REV OCT 1, 94) TRANSMITTER OPEN FIELD DATA
MANUFACTURER : CHAMBERLAIN MANUFACTURING
MODEL : 41A5235
S/N : 12
TEST DATE : 14 Jul 1998
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	NOTE
433.00	V	51.5	2.4	21.0	-10.2	64.6	1704.7	10958.3	
433.00	H	62.1	2.4	21.0	-10.2	75.3	5809.5	10958.3	
864.83	H	26.3	3.7	26.7	-10.2	46.5	211.5	1095.8	
864.84	V	15.7	3.7	26.7	-10.2	35.9	62.4	1095.8	
1297.30	H	30.0	2.7	25.1	-10.2	47.5	237.1	1095.8	
1297.40	V	29.3	2.7	25.1	-10.2	46.8	218.7	1095.8	
1729.74	H	18.0	3.1	26.4	-10.2	37.3	73.0	1095.8	
1730.01	V	19.8	3.1	26.4	-10.2	39.1	90.4	1095.8	
2162.17	V	22.3	3.5	27.9	-10.2	43.4	148.3	1095.8	
2165.09	H	23.0	3.5	27.9	-10.2	44.1	161.0	1095.8	
2594.57	V	13.6	3.9	29.2	-10.2	36.4	66.3	1095.8	
2594.62	H	11.9	3.9	29.2	-10.2	34.8	54.8	1095.8	
3027.08	V	9.0	4.3	30.8	-10.2	33.8	49.0	1095.8	
3027.30	H	16.3	4.3	30.8	-10.2	41.2	114.2	1095.8	
3459.66	V	9.3	4.7	31.6	-10.2	35.4	59.0	1095.8	
3459.72	H	13.4	4.7	31.6	-10.2	39.5	94.1	1095.8	
3893.20	V	7.2AMB	5.1	32.7	0.0	44.9	175.9	500.0	*
3893.20	H	6.9AMB	5.1	32.7	0.0	44.7	170.9	500.0	*
4326.37	V	6.9AMB	5.5	32.8	0.0	45.2	181.4	500.0	*
4326.37	H	7.2AMB	5.5	32.8	0.0	45.5	187.7	500.0	*

* DENOTES A FREQUENCY CONFLICT WITH RESTRICTED BANDS

checked by: Mark E. Longinotti
M. LONGINOTTI

ELITE ELECTRONIC ENGINEERING CO

MKR 432.426 MHz
-39.90 dBm

hp

REF -30.0 dBm

ATTEN 0 dB

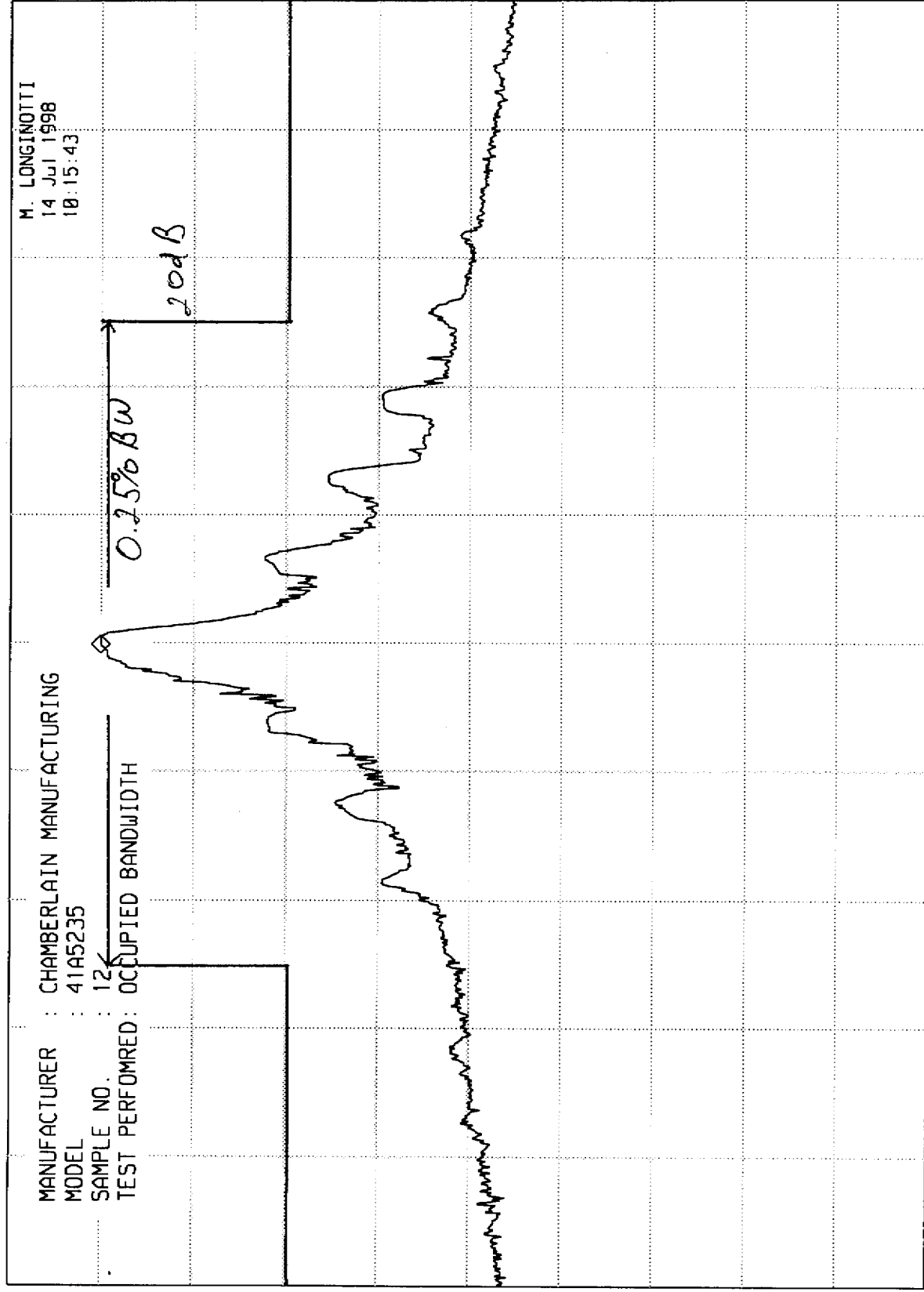
10 dB/

MANUFACTURER : CHAMBERLAIN MANUFACTURING
MODEL : 41A5235
SAMPLE NO. : 12
TEST PERFORMED: OCCUPIED BANDWIDTH

M. LONGINOTTI
14 Jul 1998
10:15:43

0.25% BW
20dB

ETR 20955



CENTER 432.43 MHz

RES BW 30 kHz(i)

VBW 300 kHz

SPAN 2.00 MHz

SWP 20.0 msec