

EXHIBIT E  
REPORT OF MEASUREMENTS

**A. TEST REPORT**

The FCC ID: GXZE13653-P transmitter was tested and found to comply with the limits imposed by the FCC "Code of Federal Regulations", Title 47, Part 15, Subpart C, for intentional radiators.

The attached test report describes the results of the test in detail.

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

ELITE PROJECT: 26678      DATES TESTED: May 4, 1998

TEST PERSONNEL: Daniel E. Crowder

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

ENGINEERING TEST REPORT NO. 20736


MEASUREMENT OF RF EMISSIONS FROM A

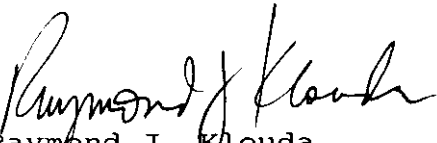
MODEL E13653-P TRANSMITTER

FCC ID: GXZE13653-P

FOR: Telemotive  
Glendale Heights, Illinois

PURCHASE ORDER NO.: 429762

Report By:   
Daniel E. Crowder  
Andrew V. Savikas

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

ENGINEERING TEST REPORT NO. 20736  
ADMINISTRATIVE DATA AND SUMMARY OF TESTS

**DESCRIPTION OF TEST ITEM:** Transmitter

**MODEL NO:** E13653-P

**SERIAL NO:** None Assigned

**MANUFACTURER:** Telemotive

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

**QUANTITY OF ITEMS TESTED:** Two (2)

**TEST PERFORMED BY:** ELITE ELECTRONIC ENGINEERING COMPANY  
Downers Grove, Illinois 60515

**DATE TESTED:** May 4, 1998

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

**CUSTOMER:** No Telemotive personnel were present.

**ELITE ELECTRONIC:** Daniel E. Crowder

**ELITE JOB NO.:** 26678

**ABSTRACT:** The model E13653-P Transmitter, does meet radiated emission requirements of the FCC "Code of Federal Regulations", Title 47, Part 15. The radiated emissions level closest to the limit occurred at 436.0MHz. The emissions level at this frequency was 2.6 dB within the limit. See data pages 105 and 106 for more details.

## ENGINEERING TEST REPORT NO. 20736

## 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	3
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 of Tests	5
4.3	Occupied Bandwidth Measurements	6
4.3.1	Requirements	6
4.3.2	Procedures	6
4.3.3	Results of Tests	6
5.0	CONCLUSION	6
6.0	CERTIFICATION	6
TABLE I	EQUIPMENT LIST	8

## ENGINEERING TEST REPORT NO. 20736

## MEASUREMENT OF RF EMISSIONS

## FROM A MODEL E13653-P TRANSMITTER

FCC ID: GXZE13653-M-T

**1.0 INTRODUCTION:**

**1.1 DESCRIPTION OF TEST ITEM:** A series of radio interference measurements were performed on the model E13653-P Transmitter, (hereinafter referred to as the test item). No serial number was assigned to the test item. The test item is designed to transmit between approximately 436 - 440 MHz using an internal antenna. Two units were provided to cover the frequency range. One of the test items was set to transmit at 436.0MHz and the other was set to transmit at 439.8MHz. The tests were performed for Telemotive of Glendale Heights, 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, for Intentional Radiators. The test methods prescribed in ANSI C63.4-1992 were used.

**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 1994

## ENGINEERING TEST REPORT NO. 20736

- 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 of Downers Grove, Illinois.

**2.0 TEST ITEM SETUP AND OPERATION:**

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

Power to the transmitter was supplied by an internal 7.5 VDC battery supply.

Since the test item was powered with batteries, it was ungrounded during the tests.

For all tests, the test item was specially programmed to transmit continuously when the on/off switch was activated. The transmitter was deactivated when the on/off switch was activated a second time. The battery voltage was periodically checked to ensure proper operation at maximum level. The tests were performed with the test item operating at both 436.0MHz and 439.8MHz (using two separate transmitters).

**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 floor 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

## ENGINEERING TEST REPORT NO. 20736

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.

**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 ridged waveguide antenna.

The fundamental and harmonics were measured with a Hewlett Packard 8566B 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 a 7.5 VDC volt 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.

## ENGINEERING TEST REPORT NO. 20736

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 436 MHz, the limit at the fundamental is 11083.3uV/m @ 3m and the limit on the harmonics is 1108uV/m @ 3m.

For 439.8 MHz, the limit at the fundamental is 11241.7 V/m @ 3m and the limit on the harmonics is 1124uV/m @ 3m.

In addition, paragraph 15.205(a) imposes the emissions levels in the Restricted Bands of operation.

#### 4.2.2 PROCEDURES:

Since the test item uses pulse code modulation, the duty cycle factor was used to convert the peak signal levels to average signal level. The duty cycle was calculated from the pulse train modulation. The duty cycle was calculated as the on time over sum of the on time plus the off time.

With the spectrum analyzer tuned to the fundamental, the span was set to 0 Hz to observe the pulse modulation. The amplitude and sweep time were adjusted to properly view the pulse train. This pulse train was then plotted. The data was dumped to a computer that determine the on-time and the off-time, and then calculated the duty cycle and the duty cycle factor in dB. The pulse train was selected for the worst case (maximum) duty cycle. The duty cycle factor was computed using the word-on time in a 100.0 millisecond word-period if the data word exceeded 100 msec.



## ENGINEERING TEST REPORT NO. 20736

For the open field radiated tests, the test item was placed on an 80 cm meter high non-conductive turntable, the test distance was 3 meters.

All measurements were made with a spectrum analyzer. The peak detected level of the fundamental and harmonics were corrected to average levels using a duty cycle 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:** Preliminary radiated emission test results are presented on data pages 103 and 104. Preliminary radiated emission test results show harmonics and spurious which was subsequently investigated during the open field test.

The duty cycle factor was determined to be -11.1 dB. The plot of the pulse train used to make this determination is presented on data pages 101 and 102. The on-time and the off-time used for the calculations are listed on this data page. Since the transmitter uses a random pulse period. The duty cycle was determined for the maximum number of pulses that appeared in any 100 msec period. Four pulses was the maximum number of pulses found in a 100 msec sequence. In most cases, the number of pulses was less than four.

The data for the open field measurements is presented on data

## ENGINEERING TEST REPORT NO. 20736

page 105 and 106. As can be seen from the data, no excessive readings were detected. The radiated emissions level closest to the limit occurred at 436 MHz. The emissions level at this frequency was 2.6 dB within the limit. The open field results reflect the final test configuration.

**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 80 centimeter 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 436 MHz is presented on data page 107. The plot of the emissions near the fundamental frequency of 439.8 MHz is presented on data page 108. As can be seen from this data page, the transmitter met the occupied bandwidth requirements.

**5.0 CONCLUSION:**

It was found that the Telemotive model E13653-P Transmitter does comply with the limits imposed by the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C for Intentional Radiators.

**6.0 CERTIFICATION:**

Elite Electronic Engineering Company certifies that the information contained in this report was obtained under conditions

ENGINEERING TEST REPORT NO. 20736

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. 20736

TABLE I: TEST EQUIPMENT LIST

## ELITE ELECTRONIC ENGINEERING

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	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								
NTA0	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2057	.03-2GHZ	03/18/98	13	04/18/99
NWF1	DOUBLE RIDGED WAVEGUIDE	EMCO	3105	2041	1-12.4GHZ	10/17/97	12	10/17/98
Equipment Type: CONTROLLERS								
CDD2	COMPUTER	HEWLETT PACKARD	D4171A#ABA	SUS61654645	N/A		N/A	
CMA0	MULTI-DEVICE CONTROLLER	EMCO	2090	9701-1213	---	10/21/97	12	10/21/98
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	01/24/98	12	01/24/99
RACB	RF PRESELECTOR	HEWLETT PACKARD	85685A	3506A01491	20HZ-2GHZ	01/24/98	12	01/24/99
RAF3	QUASIPeAK ADAPTER	HEWLETT PACKARD	85650A	3303A01775	0.01-1000MHZ	01/26/98	12	01/26/99

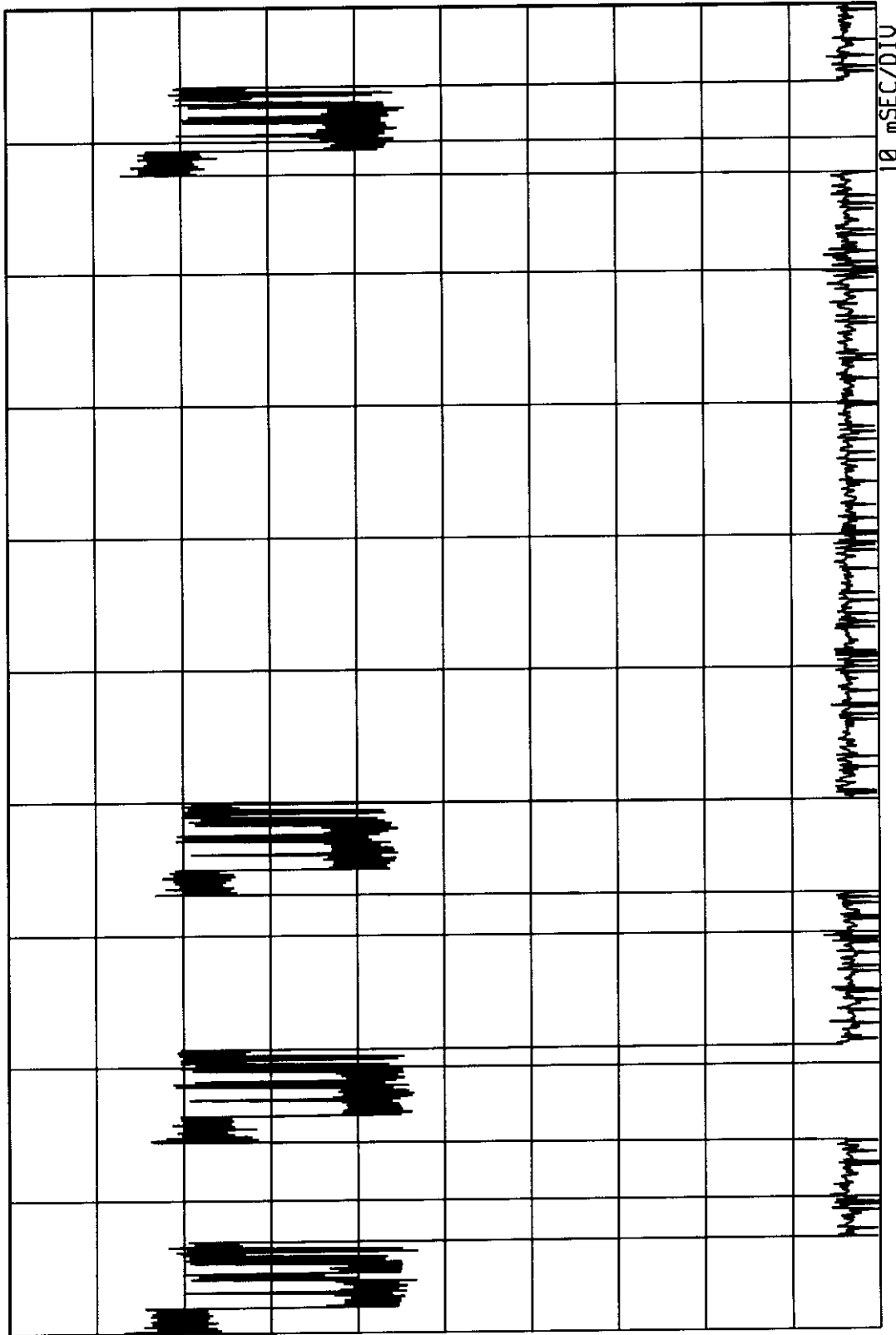
Cal. Interval: Listed in Months I/O: Initial Only N/A: Not Applicable

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.

Date: 05/29/98

Location = "EEE" Job Number = "26678"

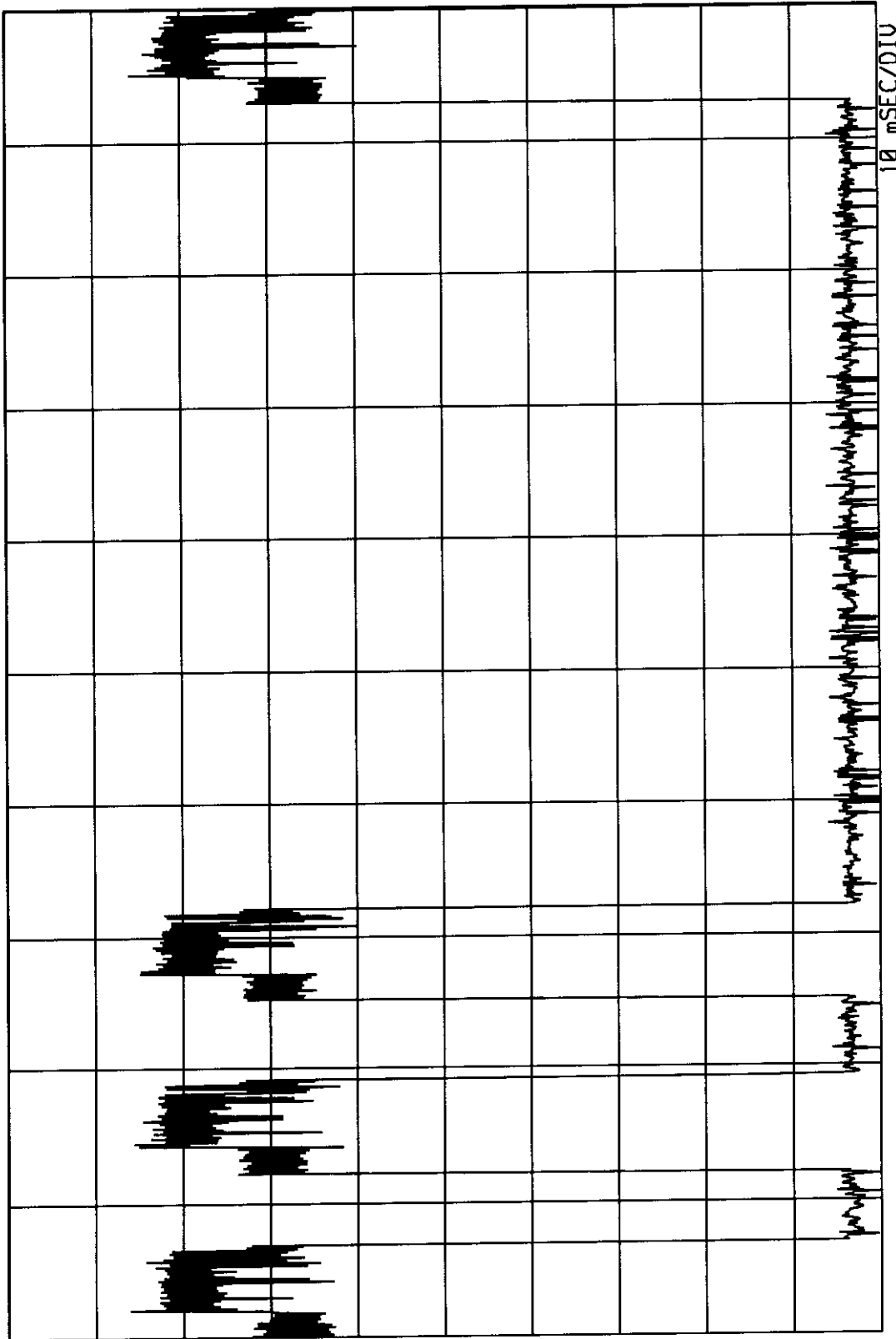
ELITE ELECTRONIC ENGINEERING Co.  
Downers Grove, IL 60515



MANUFACTURER : TELEMOTIVE  
MODEL : E13653-P  
S/N : NONE ASSIGNED  
TEST DATE : 4 May 1998  
NOTES : Tx AT 436MHz

TRANSMITTER DUTY CYCLE  
FREQUENCY: 435.994 MHz  
ON TIME : 27.572 mSEC  
OFF TIME : 72.428 mSEC  
DUTY CYCLE = .28 or -11.06 dB  
COMPUTED OVER 100 mSEC

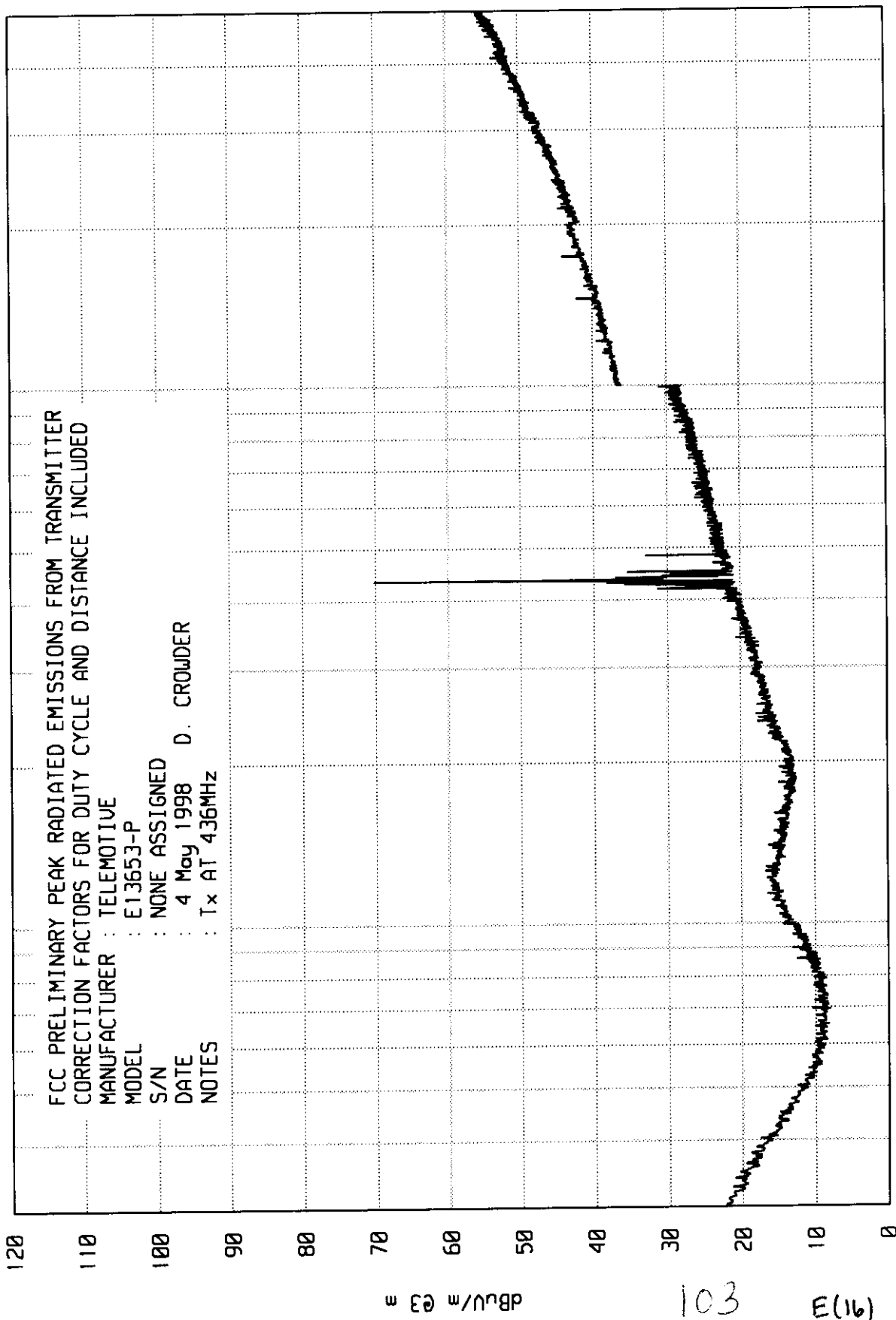
ELITE ELECTRONIC ENGINEERING Co.  
Downers Grove, IL 60515



10 mSEC/DIV

TRANSMITTER DUTY CYCLE	MANUFACTURER : TELEMOTIVE
FREQUENCY : 439.7526 MHz	MODEL : E13653-P
ON TIME : 27.672 mSEC	S/N : NONE ASSIGNED
OFF TIME : 72.328 mSEC	TEST DATE : 4 May 1998
DUTY CYCLE = .28 or -11.06 dB	NOTES : Tx AT 439.8MHz
COMPUTED OVER 100 mSEC	

ELITE ELECTRONIC ENGINEERING Co.  
Downers Grove, Ill. 60515



FCC PRELIMINARY PEAK RADIATED EMISSIONS FROM TRANSMITTER  
CORRECTION FACTORS FOR DUTY CYCLE AND DISTANCE INCLUDED  
MANUFACTURER : TELEMOTIVE  
MODEL : E13653-P  
S/N : NONE ASSIGNED  
DATE : 4 May 1998 D. CROWDER  
NOTES : Tx AT 436MHz

STOP = 5000

FREQUENCY - MHz

START = 30

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

FCC PRELIMINARY PEAK RADIATED EMISSIONS FROM TRANSMITTER  
CORRECTION FACTORS FOR DUTY CYCLE AND DISTANCE INCLUDED

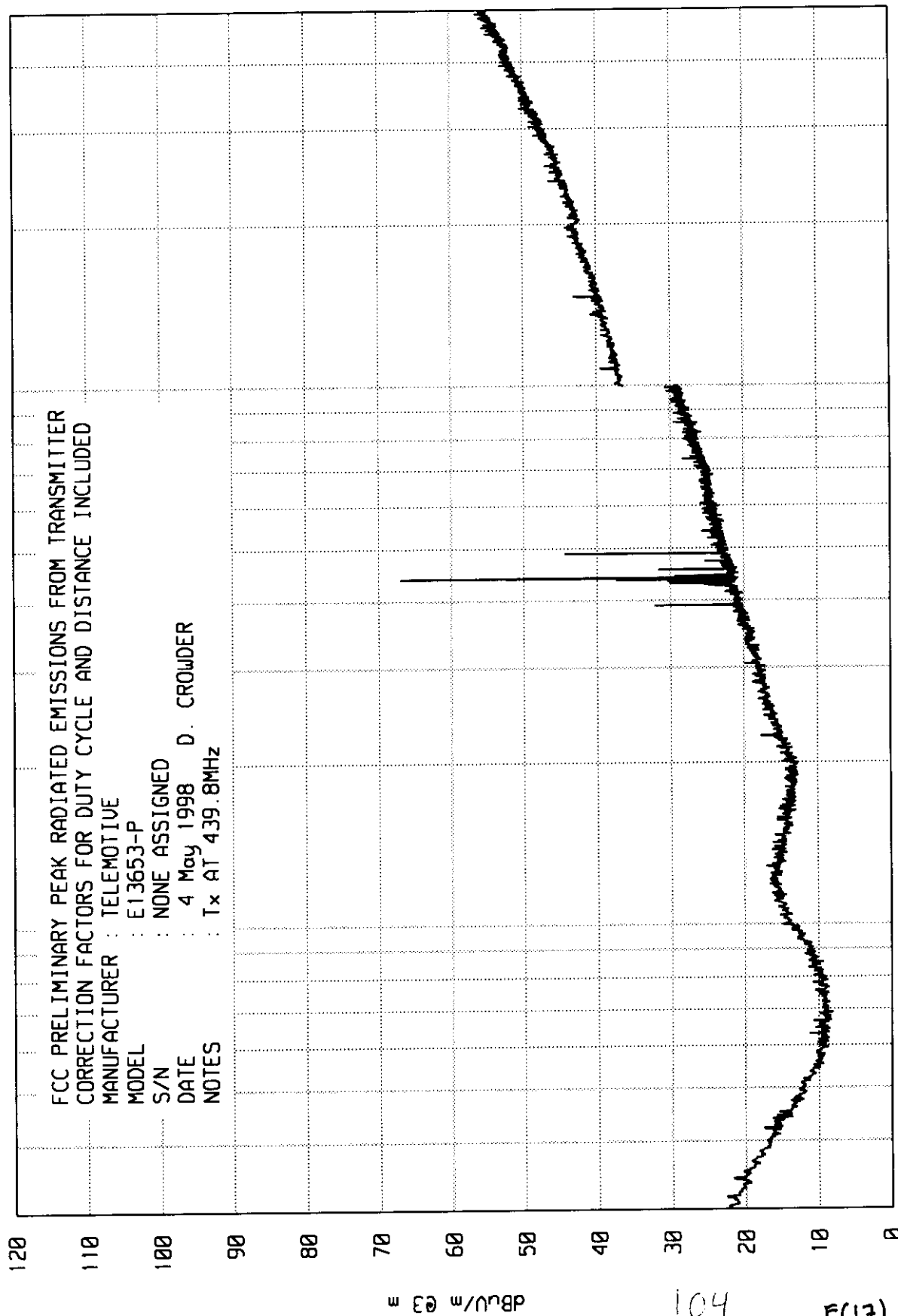
MANUFACTURER : TELEMOTIVE

MODEL : E13653-P

S/N : NONE ASSIGNED

DATE : 4 May 1998 D. CROWDER

NOTES : Tx AT 439.8MHz



STOP = 5000

FREQUENCY - MHz

START = 30

E(17)

104



ENGINEERING TEST REPORT NO. 20736  
ELITE ELECTRONIC ENGINEERING COMPANY

MANUFACTURER : TELEMOTIVE  
MODEL : E13653-P  
S/N : NONE ASSIGNED  
SPECIFICATION : FCC-15C OPEN FIELD RADIATED EMISSIONS  
DATE : MAY 4, 1998  
NOTES : TRANSMIT AT 436MHz

80.7  
60.9  
54

FREQ. (MHz)	ANT POL	MTR RDG (dBuV)	ANT FAC dB	CABLE FAC dB	DUTY CYCLE dB	PRE-AMP GAIN dB	TOTAL dBuV/m	TOTAL uV/m	LIMIT uV/m
436.0	H	70.3	16.7	2.4	-11.1		78.3	8222.4	11083.3
	V	57.8	16.7	2.4	-11.1		65.8	1949.8	11083.3
872.0	H	25.2	21.7	3.7	-11.1		39.5	94.4	1108
	V	23.7	21.7	3.7	-11.1		38.0	79.4	1108
1308.0	H	56.8	24.9	5.0	-11.1	36.7	38.9	88.1	500
	V	56.2	24.9	5.0	-11.1	36.7	38.3	82.2	500
1744.0	H	58.0	26.3	6.2	-11.1	36.2	43.2	144.5	1108
	V	59.5	26.3	6.2	-11.1	36.2	44.7	171.8	1108
2180.0	H	46.9	27.9	7.1	-11.1	36.2	34.6	53.7	1108
	V	49.4	27.9	7.1	-11.1	36.2	37.1	71.6	1108
2616.0	H	43.1 AMB	29.3	7.8	-11.1	36.0	33.1	45.2	1108
	V	43.2 AMB	29.3	7.8	-11.1	36.0	33.2	45.7	1108
3052.0	H	43.0 AMB	30.6	8.5	-11.1	36.0	35.0	56.2	1108
	V	42.7 AMB	30.6	8.5	-11.1	36.0	34.7	54.3	1108
3488.0	H	43.0 AMB	31.7	9.5	-11.1	35.8	37.3	73.3	1108
	V	43.2 AMB	31.7	9.5	-11.1	35.8	37.5	75.0	1108
3924.0	H	42.2 AMB	32.7	10.4	-11.1	35.3	38.9	88.1	500
	V	42.8 AMB	32.7	10.4	-11.1	35.3	39.5	94.4	500
4360.0	H	41.8 AMB	32.8	11.3	-11.1	35.3	39.5	94.4	500
	V	41.9 AMB	32.8	11.3	-11.1	35.3	39.6	95.5	500

CHECKED BY: *DEL*

105

ENGINEERING TEST REPORT NO. 20736  
ELITE ELECTRONIC ENGINEERING COMPANY

MANUFACTURER : TELEMOTIVE  
 MODEL : E13653-P  
 S/N : NONE ASSIGNED  
 SPECIFICATION : FCC-15C OPEN FIELD RADIATED EMISSIONS  
 DATE : MAY 4, 1998  
 NOTES : TRANSMIT AT 439.8MHz

FREQ. (MHz)	ANT POL	MTR RDG (dBuV)	ANT FAC dB	CABLE FAC dB	DUTY CYCLE dB	PRE-AMP GAIN dB	TOTAL dBuV/m	TOTAL uV/m	LIMIT uV/m
439.8	H	69.2	16.7	2.4	-11.1		77.2	7244.4	11241.7
	V	54.6	16.7	2.4	-11.1		62.6	1349.0	11241.7
879.6	H	15.8	21.8	3.7	-11.1		30.2	32.4	1124
	V	14.8	21.8	3.7	-11.1		29.2	28.8	1124
1319.4	H	54.6	24.9	5.1	-11.1	36.7	36.8	69.2	500
	V	56.8	24.9	5.1	-11.1	36.7	49.0	89.1	500
1759.2	H	51.9	26.4	6.2	-11.1	36.2	37.2	72.4	1124
	V	49.2	26.4	6.2	-11.1	36.2	34.5	53.1	1124
2199.0	H	44.2	27.9	7.1	-11.1	36.2	31.9	39.4	1124
	V	45.4	27.9	7.1	-11.1	36.2	33.1	45.2	1124
2638.8	H	42.0 AMB	29.4	7.8	-11.1	36.0	32.1	40.3	1124
	V	41.4 AMB	29.4	7.8	-11.1	36.0	31.5	37.6	1124
3078.6	H	42.4 AMB	30.7	8.6	-11.1	36.0	34.6	53.6	1124
	V	43.1 AMB	30.7	8.6	-11.1	36.0	35.3	58.2	1124
3518.4	H	42.8 AMB	31.7	9.6	-11.1	35.8	37.2	72.4	1124
	V	42.4 AMB	31.7	9.6	-11.1	35.8	36.8	69.2	1124
3958.2	H	41.9 AMB	32.8	10.5	-11.1	35.3	38.8	87.1	500
	V	41.8 AMB	32.8	10.5	-11.1	35.3	38.7	86.1	500
4398.0	H	42.1 AMB	32.7	11.3	-11.1	35.3	39.7	96.6	500
	V	41.7 AMB	32.7	11.3	-11.1	35.3	39.3	92.3	500

CHECKED BY: 

# ELITE ELECTRONIC ENGINEERING CO

MKR 436.000 MHz  
-63.00 dBm

hp

REF -20.0 dBm

ATTEN 0 dB

10 dB/

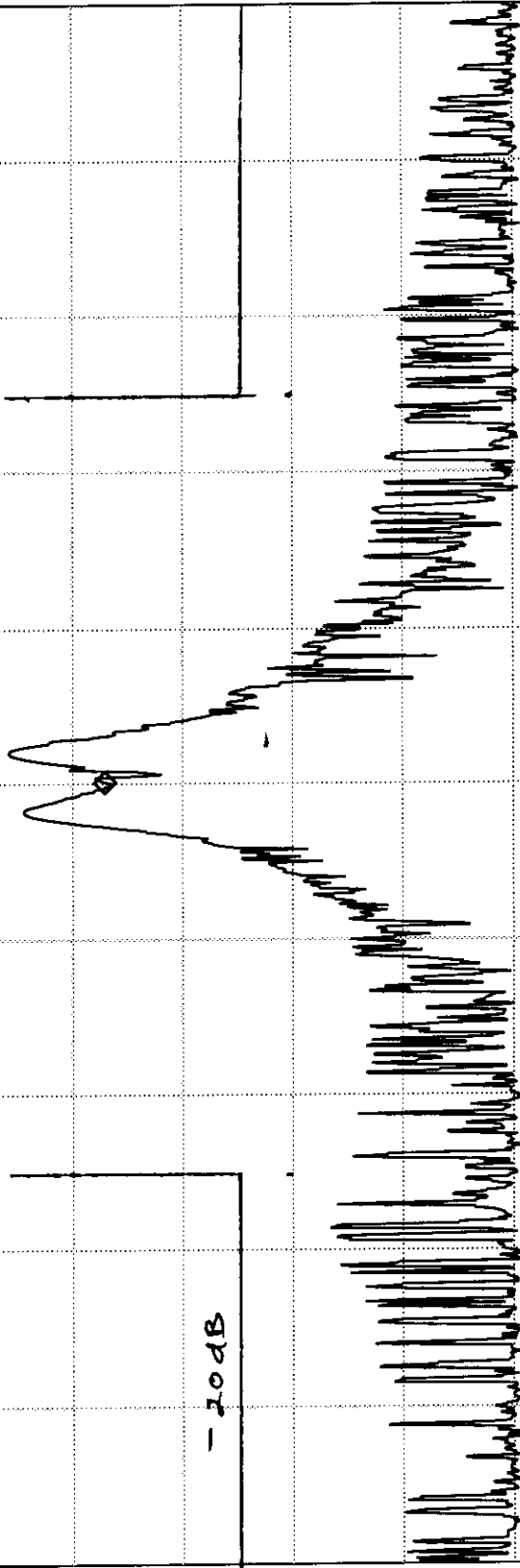
OFFSET  
-10.0  
dB

MANUFACTURER :  
MODEL :  
S/N :  
TEST PERFORMED :  
MODE :  
NOTES :

TELEMETIVE  
E13653-P  
NONE ASSIGNED  
FCC-15C OCCUPIED BANDWIDTH  
Tx AT 436MHz

D. CROWDER  
4 May 1998  
10:22:12

0.25% BW



-20dB

E(20)

CENTER 436.00 MHz  
RES BW 30 kHz (1)  
SPAN 2.00 MHz  
SWP 20.0 msec  
UBW 300 kHz

# ELITE ELECTRONIC ENGINEERING CO

MKR 439.800 MHz  
-64.30 dBm

hp

REF -20.0 dBm

ATTEN 0 dB

10 dB/

OFFSET  
-10.0  
dB

MANUFACTURER : TELEMOTIVE  
MODEL : E13653-P  
S/N : NONE ASSIGNED  
TEST PERFORMED : FCC-15C OCCUPIED BANDWIDTH  
MODE : Tx AT 439.8MHz  
NOTES :

D. CROWDER  
4 May 1998  
10:20:25

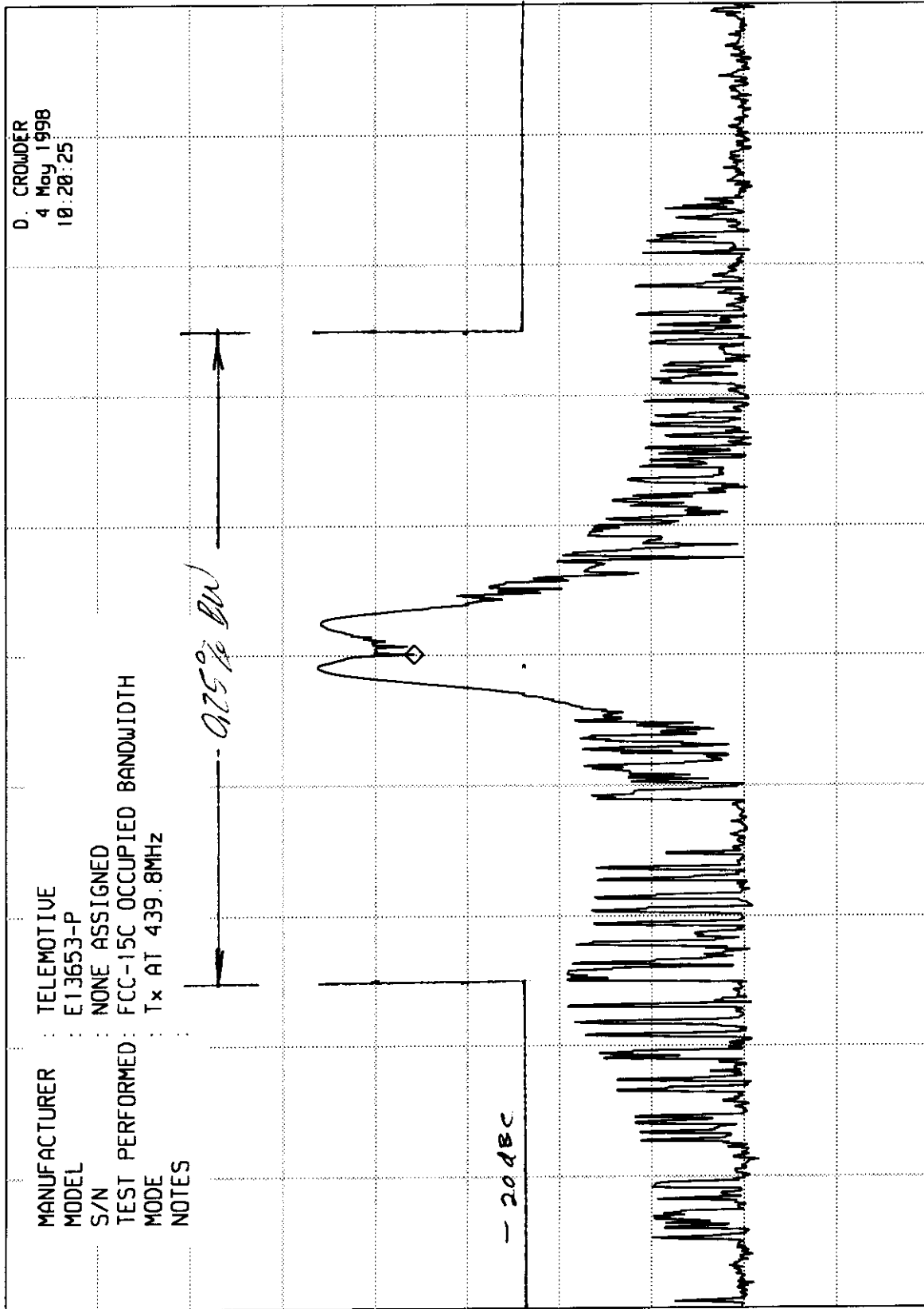
*0.25% BW*

*-20dBc*

*100 20 7.50*

*108*

E(21)



CENTER 439.80 MHz

RES BW 30 kHz(i)

VBW 300 kHz

SPAN 2.00 MHz  
SWP 20.0 msec