

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

ELITE PROJECT: 27993 DATES TESTED: September 7, 1999

TEST PERSONNEL: Daniel E. Crowder

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

ENGINEERING TEST REPORT NO. 22022
MEASUREMENT OF RF EMISSIONS FROM A
MODEL E13653-JLTX TRANSMITTER
FCC ID: GXZE13653-JLTX

FOR: Telemotive
Glendale Heights, Illinois

PURCHASE ORDER NO.: 3160-000 OP

Report By: *Richard E. King Fox*
Daniel E. Crowder

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

ENGINEERING TEST REPORT NO. 22022
ADMINISTRATIVE DATA AND SUMMARY OF TESTS

DESCRIPTION OF TEST ITEM: Transmitter

MODEL NO: E13653-JLTX

SERIAL NO: JLTX0001 & JLTX0002

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: September 7, 1999

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

CUSTOMER: No Telemotive personnel were present.

ELITE ELECTRONIC: Daniel E. Crowder

ELITE JOB NO.: 27993

ABSTRACT: The model E13653-JLTX 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 439.8MHz. The emissions level at this frequency was 2.9dB within the limit. See data pages 105 and 106 for more details.

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ENGINEERING TEST REPORT NO. 22022
MEASUREMENT OF RF EMISSIONS
FROM A MODEL E13653-JLTX TRANSMITTER
FCC ID: GXZE13653-JLTX

1.0 INTRODUCTION:

1.1 DESCRIPTION OF TEST ITEM: A series of radio interference measurements were performed on the model E13653-JLTX Transmitter, serial numbers JLTX0001 and JLTX0002, (hereinafter referred to as 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 1998
- 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"

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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 an 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 436.0MHz and 439.8MHz. Two units were provided for that purpose.

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 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

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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 a Bilog antenna. 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.

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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 levels. 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 so that for the worst case of pulse position. 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.

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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 through 106. Preliminary radiated emission test results show harmonics and spurious emissions which were subsequently investigated during the open field test.

The duty cycle factor was determined to be -9.9 dB. The plots 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.

The data for the open field measurements is presented on data page 107 and 108. As can be seen from the data, no excessive readings were detected. The radiated emissions level closest to the limit

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occurred at 439.8 MHz. The emissions level at this frequency was 2.9 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 a 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 109 and the plot of the emissions near the fundamental frequency of 439.8 MHz is presented on data page 110. As can be seen from these data pages, the transmitter met the occupied bandwidth requirements.

5.0 CONCLUSION:

It was found that the Telemotive model E13653-JLTX 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 which meet or exceed those specified in the test specification.

The data presented in this test report pertains to the test item

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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.

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TABLE 1: TEST EQUIPMENT LIST

ELITE ELECTRONIC ENG. INC.

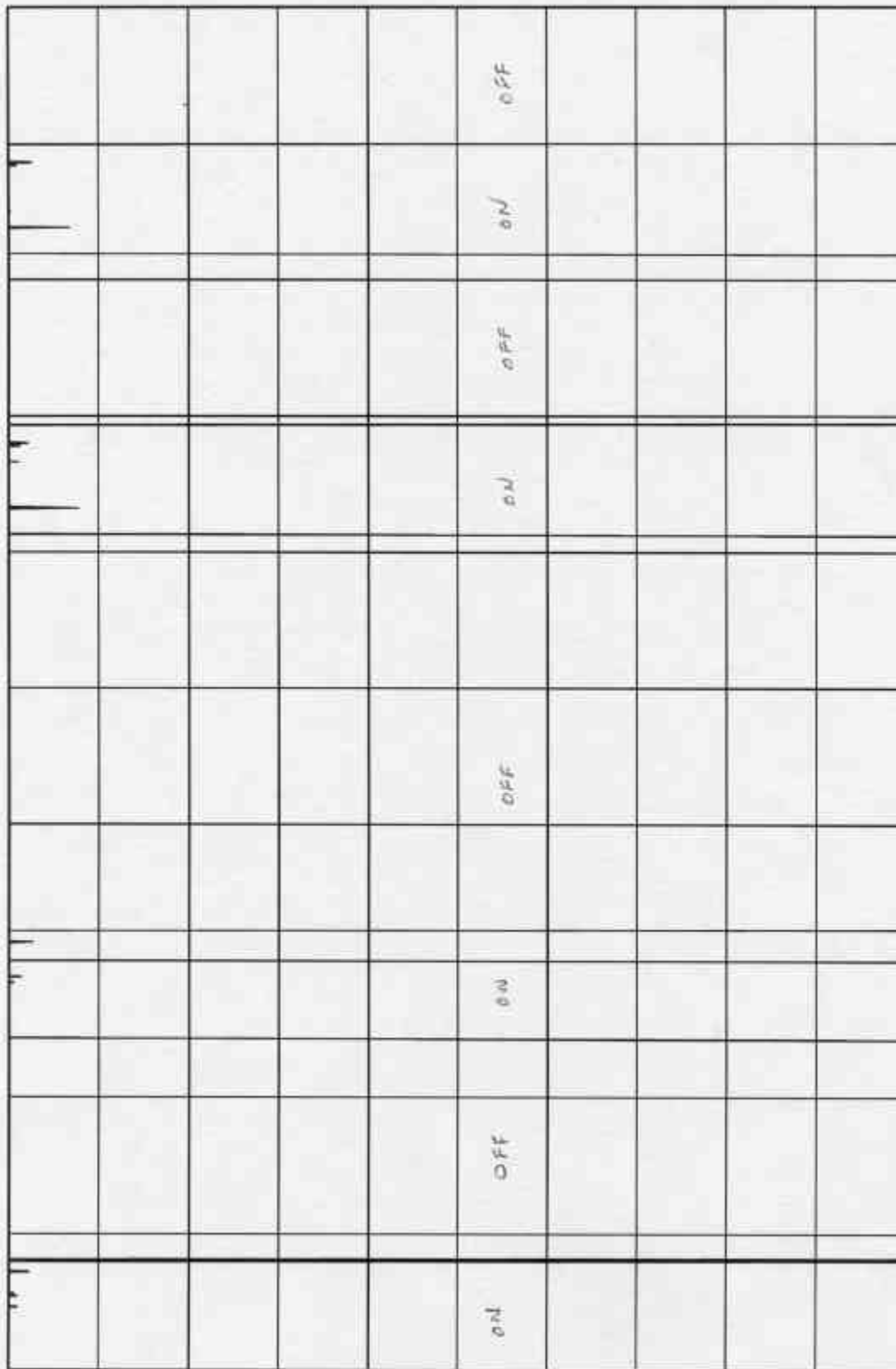
Page: 1

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	---	01/29/99	N/A	
Equipment Type: AMPLIFIERS								
APK0	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	3008A00662	1-26.5GHZ	01/29/99	12	01/29/00
Equipment Type: ANTENNAS								
NTA0	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2057	.03-2GHZ	04/10/99	12	04/10/00
NWG0	DOUBLE RIDGED WAVEGUIDE	AEL	M1479	104	1-12.4GHZ	09/02/99	12	09/02/00
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	01/26/99	12	01/26/00
RACB	RF PRESELECTOR	HEWLETT PACKARD	85685A	3506A01491	20HZ-2GHZ	01/28/99	12	01/28/00
RAF3	QUASIPeAK ADAPTER	HEWLETT PACKARD	85650A	3303A01775	0.01-1000MHZ	01/28/99	12	01/28/00

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.

ELITE ELECTRONIC ENGINEERING Co.
Downers Grove, IL 60515



TRANSMITTER DUTY CYCLE
FREQUENCY : 435.0086 MHz
ON TIME : 32.168 mSEC
OFF TIME : 67.832 mSEC
DUTY CYCLE = 32 or -9.9 dB
COMPUTED OVER 100 mSEC

MANUFACTURER : TELEMOTIVE
MODEL : E13653-JLTX
S/N : JLT0001
TEST DATE : 7 Sep 1999
NOTES : Tx AT 436.0MHz

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ETR 22022

[illegible]

10 mSEC/DIV

TRANSMITTER DUTY CYCLE

FREQUENCY: 439.0317 MHz

ON TIME : 32.068 mSEC

OFF TIME : 67.932 mSEC

DUTY CYCLE = 32 or -9.9 dB

COMPUTED OVER 100 mSEC

MANUFACTURER : TELEMOTIVE

MODEL : E13653-JLTX

N/S
: JLT X0002

TEST DATE : 7 Sep 1999

NOTES
: Tx AT 436.0MHz

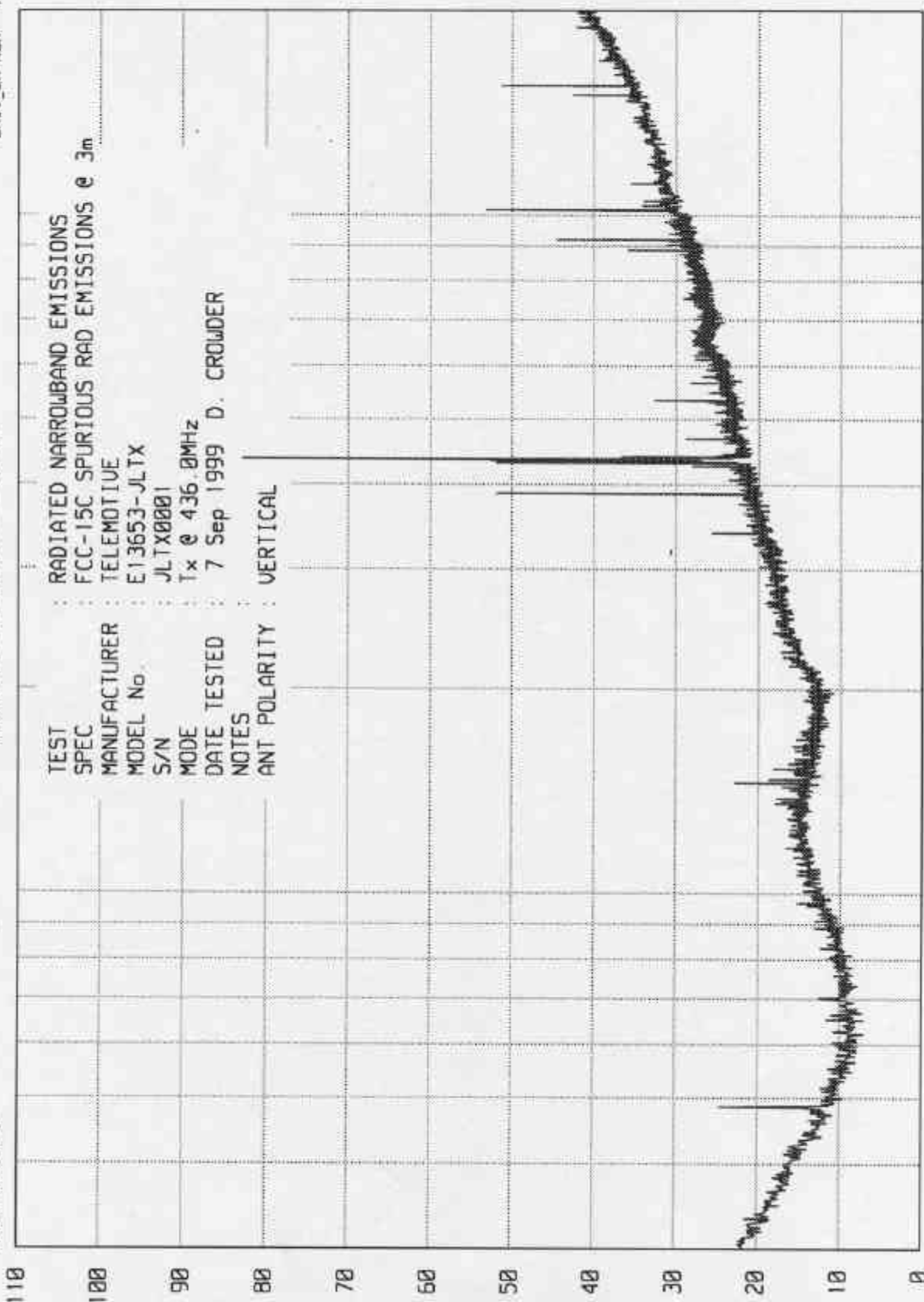
EE

ELITE ELECTRONIC ENGINEERING Co.

Downers Grove, Ill. 60515

UK008 02/24/98

UNIT EM RUN RUN 1



100

1000

ART = 30

FREQUENCY - MHz

STOP = 2000

ETR 22022

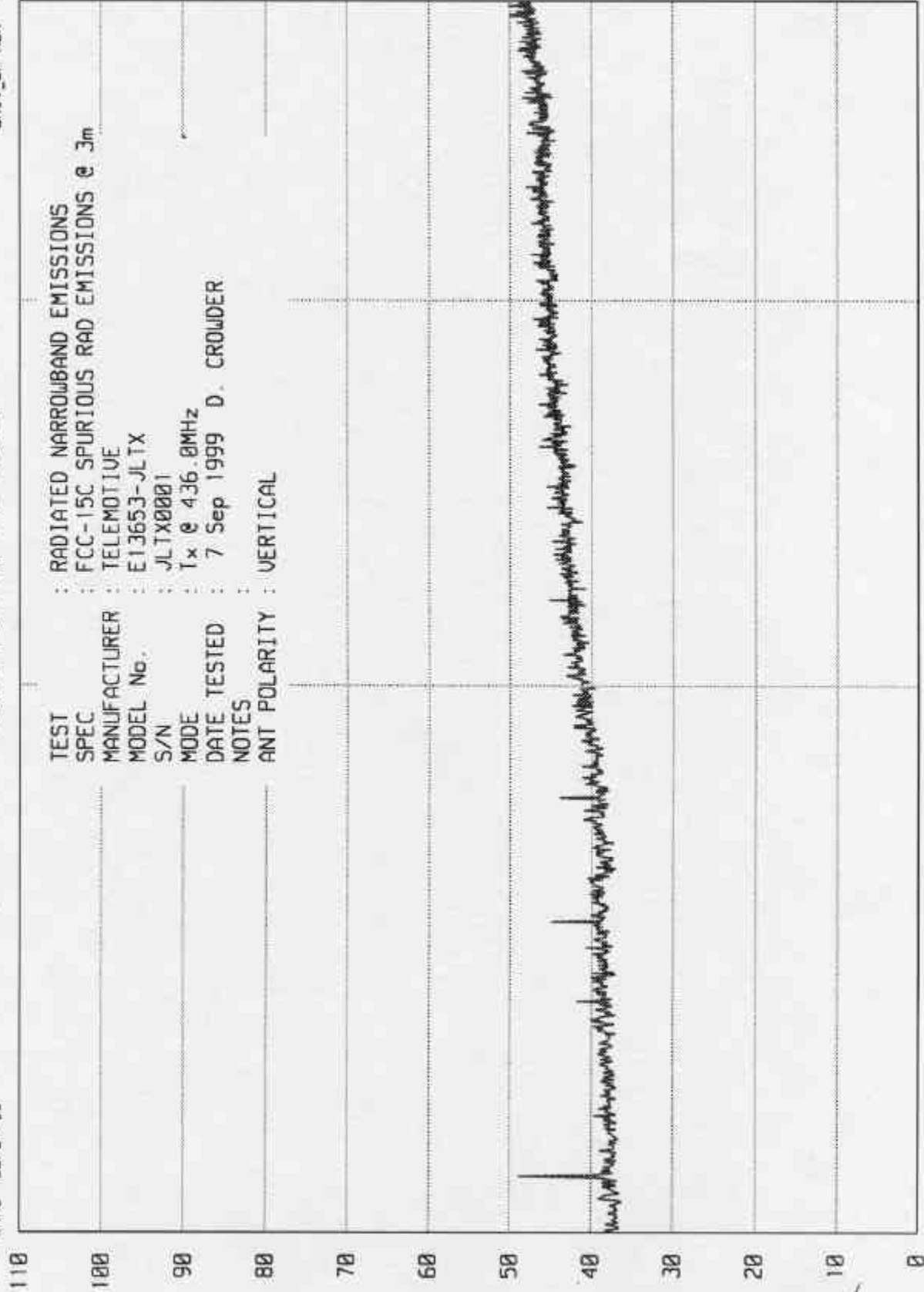
EE

ELITE ELECTRONIC ENGINEERING Co.

UKAB 02/24/98

Downer's Grove, Ill. 60515

UNITV_EM RUN RUN 2



ART = 2000

FREQUENCY - MHz

STOP = 5000

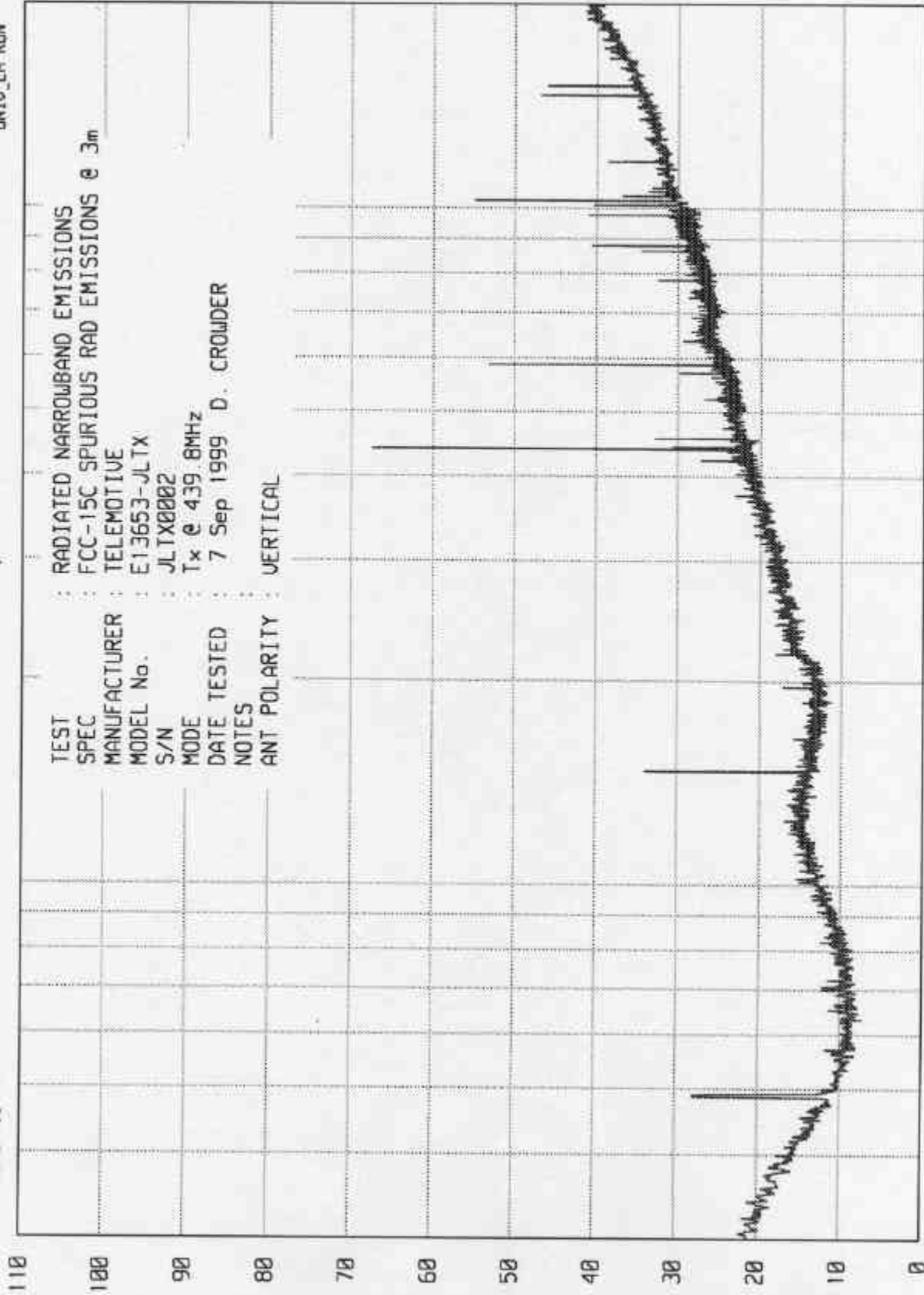
ETR 22022

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Downers Grove, Ill. 60515

UKA8 02/24/98

UNIT EM RUN RUN 1



TEST : RADIATED NARROWBAND EMISSIONS
 SPEC : FCC-15C SPURIOUS RAD EMISSIONS @ 3m
 MANUFACTURER : TELEMOTIVE
 MODEL No. : E13653-JLTX
 S/N : JLT0002
 MODE : Tx @ 439.8MHz
 DATE TESTED : 7 Sep 1999 D. CROWDER
 NOTES :
 ANT POLARITY : VERTICAL

100

1000

ART = 30

FREQUENCY - MHz

STOP = 2000

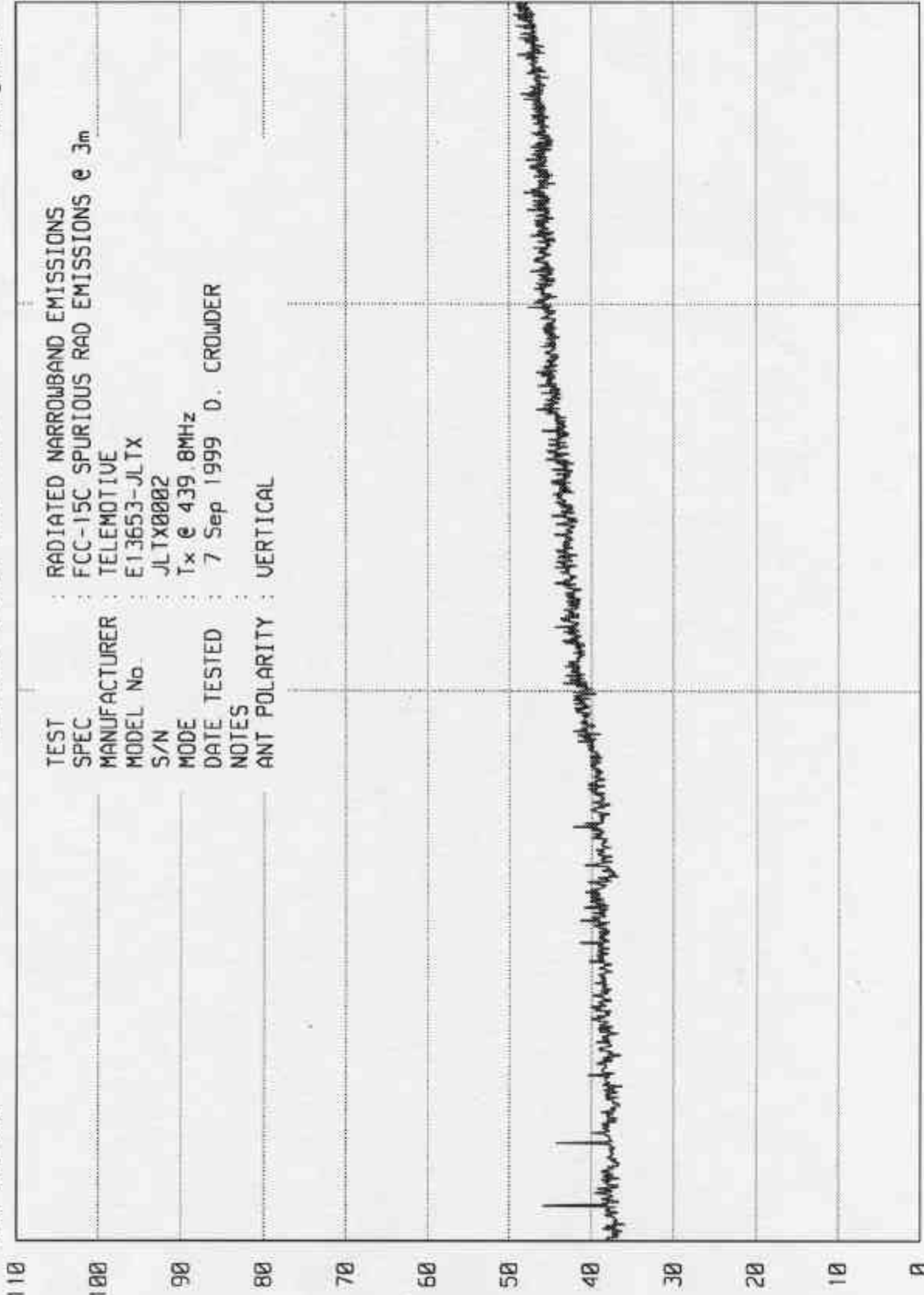
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EE

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Downers Grove, Ill. 60515

UK08 02/24/98

UNIT EM RUN RUN 2



ART = 2000

FREQUENCY - MHz

STOP = 5000

ETR 22022

ETR No. 22022
DATA PAGE

SPECIFICATION : FCC PART 15C (REV OCT 1, 94) TRANSMITTER OPEN FIELD DATA
MANUFACTURER : TELEMOTIVE
MODEL : E13653-JLTX
S/N : JLTX0001
TEST DATE : 7 Sep 1999
NOTES :
TEST ANTENNA : CHASE BI-LOG & 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
436.00	H	65.8	2.4	16.9	-9.9	75.2	5739.6	11083.3	
436.00	V	68.6	2.4	16.9	-9.9	78.0	7922.9	11083.3	
872.00	H	20.5	3.7	22.0	-9.9	36.3	65.2	1108.3	
872.00	V	25.3	3.7	22.0	-9.9	41.1	113.3	1108.3	
1308.00	H	19.2	5.0	24.9	-9.9	39.2	91.1	500.0	*
1308.00	V	23.5	5.0	24.9	-9.9	43.5	149.5	500.0	*
1744.00	H	18.5	6.2	26.5	-9.9	41.3	116.6	1108.3	
1744.00	V	12.6	6.2	26.5	-9.9	35.4	59.1	1108.3	
2180.00	H	16.2	7.1	28.0	-9.9	41.3	116.7	1108.3	
2180.00	V	14.5	7.1	28.0	-9.9	39.6	96.0	1108.3	
2616.00	H	7.4	7.8	29.2	-9.9	34.6	53.4	1108.3	
2616.00	V	9.7	7.8	29.2	-9.9	36.9	69.7	1108.3	
3052.00	H	8.3	8.5	31.1	-9.9	37.9	79.0	1108.3	
3052.00	V	10.0	8.5	31.1	-9.9	39.6	96.0	1108.3	
3488.00	H	8.3	9.5	32.3	-9.9	40.2	102.3	1108.3	
3488.00	V	8.0	9.5	32.3	-9.9	39.9	98.8	1108.3	
3924.00	H	7.6	10.4	33.4	-9.9	41.6	119.6	500.0	*
3924.00	V	6.8	10.4	33.4	-9.9	40.8	109.1	500.0	*
4360.00	H	7.2	11.3	33.1	-9.9	41.6	120.9	500.0	*
4360.00	V	8.5	11.3	33.1	-9.9	42.9	140.4	500.0	*

* DENOTES A FREQUENCY CONFLICT WITH RESTRICTED BANDS

checked by:

DM

D. CROWDER

ETR No. 22022
DATA PAGE

SPECIFICATION : FCC PART 15C (REV OCT 1, 94) TRANSMITTER OPEN FIELD DATA
MANUFACTURER : TELEMOTIVE
MODEL : E13653-JLTX
S/N : JLTX0002
TEST DATE : 7 Sep 1999
NOTES :
TEST ANTENNA : CHASE BI-LOG & 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 NOT uV/m @3m
439.80	H	64.7	2.4	17.0	-9.9	74.1	5096.8	11241.7
439.80	V	63.1	2.4	17.0	-9.9	72.5	4239.3	11241.7
879.60	H	21.6	3.7	22.0	-9.9	37.4	74.4	1124.2
879.60	V	20.0	3.7	22.0	-9.9	35.8	61.9	1124.2
1319.40	H	17.9	5.1	24.9	-9.9	38.0	79.1	500.0
1319.40	V	14.4	5.1	24.9	-9.9	34.5	52.9	500.0
1759.20	H	10.7	6.2	26.6	-9.9	33.6	48.0	1124.2
1759.20	V	10.7	6.2	26.6	-9.9	33.6	48.0	1124.2
2139.00	H	9.6	7.0	27.9	-9.9	34.6	53.5	1124.2
2139.00	V	9.0	7.0	27.9	-9.9	34.0	49.9	1124.2
2638.80	H	7.0	7.8	29.4	-9.9	34.3	51.9	1124.2
2638.80	V	7.0	7.8	29.4	-9.9	34.3	51.9	1124.2
3078.60	H	8.2	8.6	31.1	-9.9	38.0	79.4	1124.2
3078.60	V	8.2	8.6	31.1	-9.9	38.0	79.4	1124.2
3518.40	H	7.3	9.6	32.4	-9.9	39.3	92.8	1124.2
3518.40	V	7.1	9.6	32.4	-9.9	39.1	90.6	1124.2
3958.20	H	6.8	10.5	33.5	-9.9	40.9	111.0	500.0
3958.20	V	6.9	10.5	33.5	-9.9	41.0	112.3	500.0
4398.00	H	7.0	11.3	33.0	-9.9	41.5	118.3	500.0
4398.00	V	7.8	11.3	33.0	-9.9	42.3	129.7	500.0

* DENOTES A FREQUENCY CONFLICT WITH RESTRICTED BANDS

checked by:


D. CROWDER

ELITE ELECTRONIC ENGINEERING CO

MKR 435.960 MHz
64.50 dBu

REF 94.4 dBu ATTN 10 dB

1 dB/

FSET
0.0
dB

MANUFACTURER : TELEMOTIVE
MODEL : E13653-JLTX
SERIAL No. : JLT00001
TEST PERFORMED : FCC-15C OCCUPIED BANDWIDTH
MODE : Tx @ 436.0MHz
NOTES :

D. CROWDER
7 Sep 1999
13:07:00

0.25% BW



20dB

ENTER 436.00 MHz

RES BW 30 kHz (1)

VBW 300 kHz

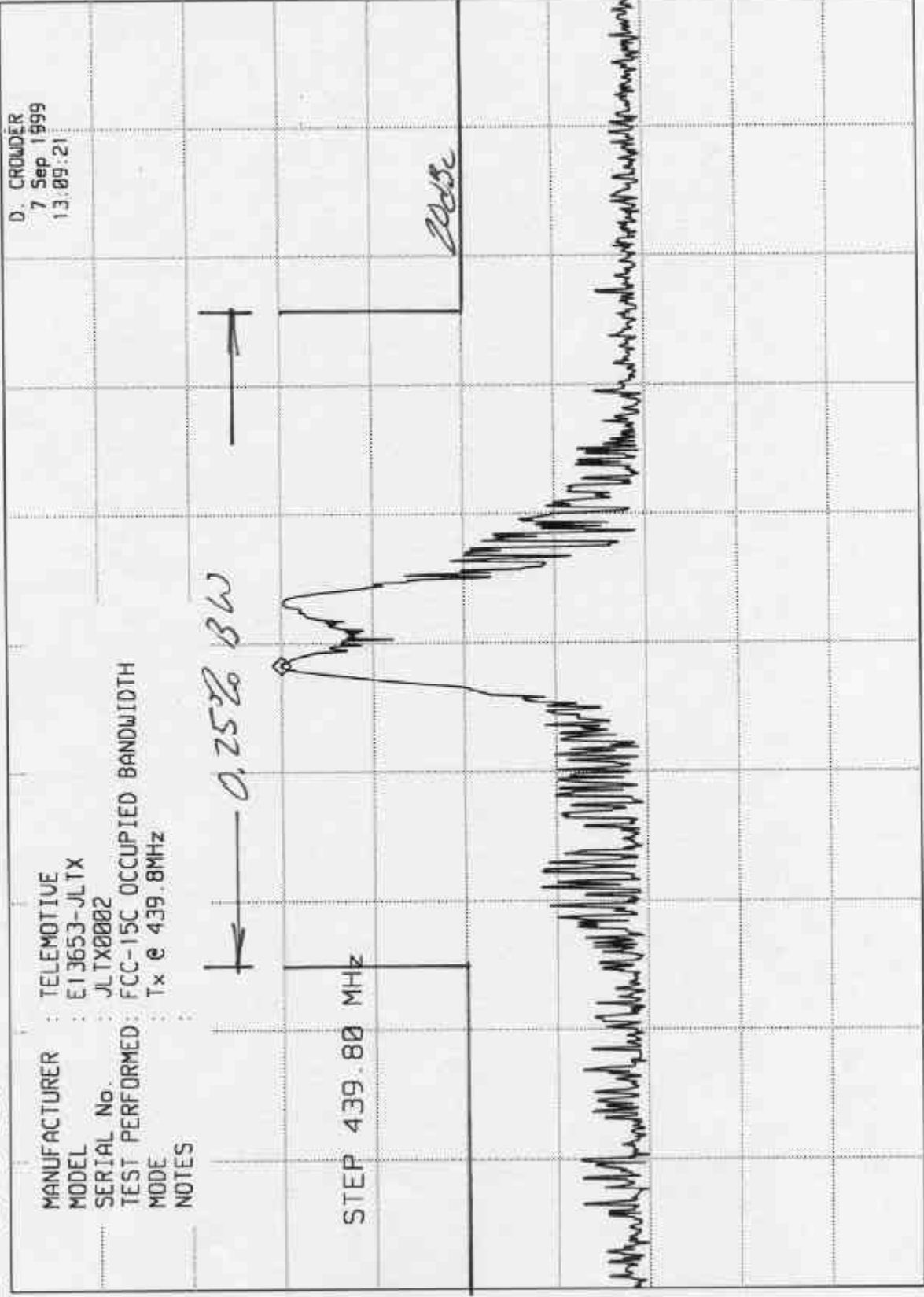
SPAN 2.00 MHz
SWP 20.0 msec

ETR 22022

ELITE ELECTRONIC ENGINEERING CO

MKR 439.764 MHz
59.30 dBu

REF 89.3 dBu ATTN 10 dB



ENTER 439.80 MHz
RES BW 30 kHz (i)

UBW 300 kHz

SPAN 2.00 MHz
SWP 20.0 msec

ETR 22022