

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

ELITE PROJECT: 26892      DATES TESTED: July 30, 1998

TEST PERSONNEL: Daniel E. Crowder

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

ENGINEERING TEST REPORT NO. 20926

MEASUREMENT OF RF EMISSIONS

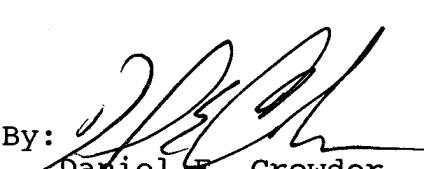
FROM A MODEL CRS1200/CRS10000

KEYPAD TRANSMITTER

FOR: Fleetwood Electronics  
Holland, Michigan

PURCHASE ORDER NO.: P2015-00

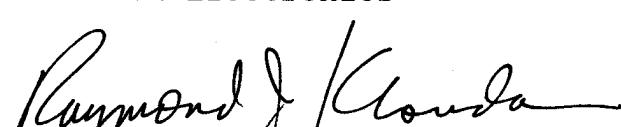
Report By:

  
Daniel E. Crowder

Witnessed By:

Warren Guthrie  
Fleetwood Electronics

Approved By:

  
Raymond J. Klonda  
Registered Professional  
Engineer of Illinois - 44894

ENGINEERING TEST REPORT NO. 20926

#### ADMINISTRATIVE DATA AND SUMMARY OF TESTS

**DESCRIPTION OF TEST ITEM:** Keypad Transmitter

**MODEL NO:** CRS1200/CRS10000 **SERIAL NO:** None Assigned

**MANUFACTURER:** Fleetwood Electronics

**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  
Downers Grove, Illinois 60515

DATES TESTED: July 30, 1998

**PERSONNEL (OPERATORS, OBSERVERS, AND CO-ORDINATORS):**  
CUSTOMER: Warren Guthrie of Fleetwood Electronics was present.  
ELITE ELECTRONIC: Daniel E. Crowder

ELITE JOB NO.: 26892

**ABSTRACT:** The model CRS1200/CRS10000 Keypad Transmitter, does meet the radiated emission requirements of the FCC "Code of Federal Regulations", Title 47, Part 15, Subpart C. The radiated emissions level closest to the limit occurred at 1108.5 MHz. The emissions level at this frequency was 0.8dB within the limit. At the transmit frequency, at worst the emissions were 2.5 dB within the limit. See data pages 107 through 109 for more details.

## ENGINEERING TEST REPORT NO. 20926

## TABLE OF CONTENTS

<u>PARAGRAPH</u>	<u>DESCRIPTION OF CONTENTS</u>	<u>PAGE NO.</u>
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	1
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	3
4.2.3	Results of Tests	4
4.3	Occupied Bandwidth Measurements	5
4.3.1	Requirements	5
4.3.2	Procedures	5
4.3.3	Results of Tests	5
5.0	CONCLUSION	5
6.0	CERTIFICATION	6
	TABLE I - EQUIPMENT LIST	7

ENGINEERING TEST REPORT NO. 20926  
MEASUREMENT OF RF EMISSIONS  
FROM A MODEL CRS1200/CRS10000  
KEYPAD TRANSMITTER

**1.0 INTRODUCTION:**

**1.1 DESCRIPTION OF TEST ITEM:** This report present the results of a series of radio interference measurements were performed on a model CRS1200/CRS10000 Keypad Transmitter, (hereinafter referred to as the test item). The test item was designed to transmit in the frequency range of 345MHz to 370MHz using an internal antenna. The tests were performed for Fleetwood Electronics of Holland, Michigan.

**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, Section 15.231(b) 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

ENGINEERING TEST REPORT NO. 20926

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 9VDC battery. The battery voltage was periodically checked to ensure proper operation at the maximum level.

Since the test item was powered with 9VDC battery, it was ungrounded during the tests.

Normally, when activated, the test item will only transmit a 10 msec burst at the maximum rate of one burst in a 5 second period. For the test, the test item was modified to transmit continuously once activated.

Since the frequency range of operation is greater than ten megahertz, separate tests were performed with the test item operating at channel 1 (344.88 MHz), channel 4 (355.48MHz), and channel 8 (369.53 MHz).

**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

ENGINEERING TEST REPORT NO. 20926

manuals supplied by the manufacturer. All open field measurements below 1000MHz were made with bilog antenna. 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 peak detector readings were corrected to average detector readings using a duty cycle factor. The bandwidth was 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 15.231(b).

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

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:** With the test item operating at Channel 1, preliminary radiated emissions were first scanned using a peak

ENGINEERING TEST REPORT NO. 20926

detector and automatically plotted. For the measurement, the antenna was horizontally polarized and set at a distance of 3 meters from the test item.

The frequencies where significant emission levels were detected in the preliminary sweeps and up to the 10th harmonics of the transmit frequency were then remeasured manually again using peak detector.

The detected levels 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.

The preliminary and final emission tests was the repeated for Channel 4 and channel 8.

**4.2.3 RESULTS:** Since the test item had been modified for continuous operation, the duty cycle factor was determine using information supplied by the manufacturer.

Maximum on-time = 10 msec

Minimum time between bursts = 5 seconds.

Maximum Duty cycle (for 100 msec period) =  $10\text{msec}/100\text{msec} = 0.1$   
Duty cycle factor = -20 dB

Preliminary peak radiated emission test results are presented on data pages 101 through 106.

The data for the maximized average emission measurements are presented on data pages 107 through 109. The radiated emissions level

ENGINEERING TEST REPORT NO. 20926

closest to the limit or worst case occurred at 1108.5 MHz. The emissions level at this frequency was 0.8 dB within the limit. The maximum level occurred at the transmit frequency when set to Channel 4. For Channel 4, the maximum was 2.5 dB within the limit.

Photographs of the test configurations which yielded the maximum 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 and set for Channel 1. 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. The emissions  $\pm$  1 MHz of the transmit frequency were recorded. The measurement bandwidth was set to 10 kHz.

**4.3.3 RESULTS:** The plot of the emissions near the fundamental frequency for Channel 1, 4 and 8 are presented on data pages 110 through 111. As can be seen from the data, the transmitter met the occupied bandwidth requirements.

**5.0 CONCLUSION:**

It was found that the Model CRS1200/CRS10000 Keypad Transmitter, does comply with the limits imposed by the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, for Intentional Radiators, when tested per ANSI C63.4-1992.

ENGINEERING TEST REPORT NO. 20926

**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. 20926

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
<b>Equipment Type: ACCESSORIES, MISCELLANEOUS</b>								
XZG0	ATTENUATOR/SWITCH DRIVER	HEWLETT PACKARD	11713A	3439A00325	---	01/24/98	12	01/24/99
<b>Equipment Type: AMPLIFIERS</b>								
APKO	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	3008A00662	1-26.5GHZ	01/27/98	12	01/27/99
<b>Equipment Type: ANTENNAS</b>								
NTA1	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2054	.03-2GHZ	05/12/98	12	05/12/99
NWHO	DOUBLE RIDGED WAVEGUIDE	TENSOR	4105	2081	1-12.4GHZ	08/26/98	12	08/26/99
<b>Equipment Type: RECEIVERS</b>								
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.

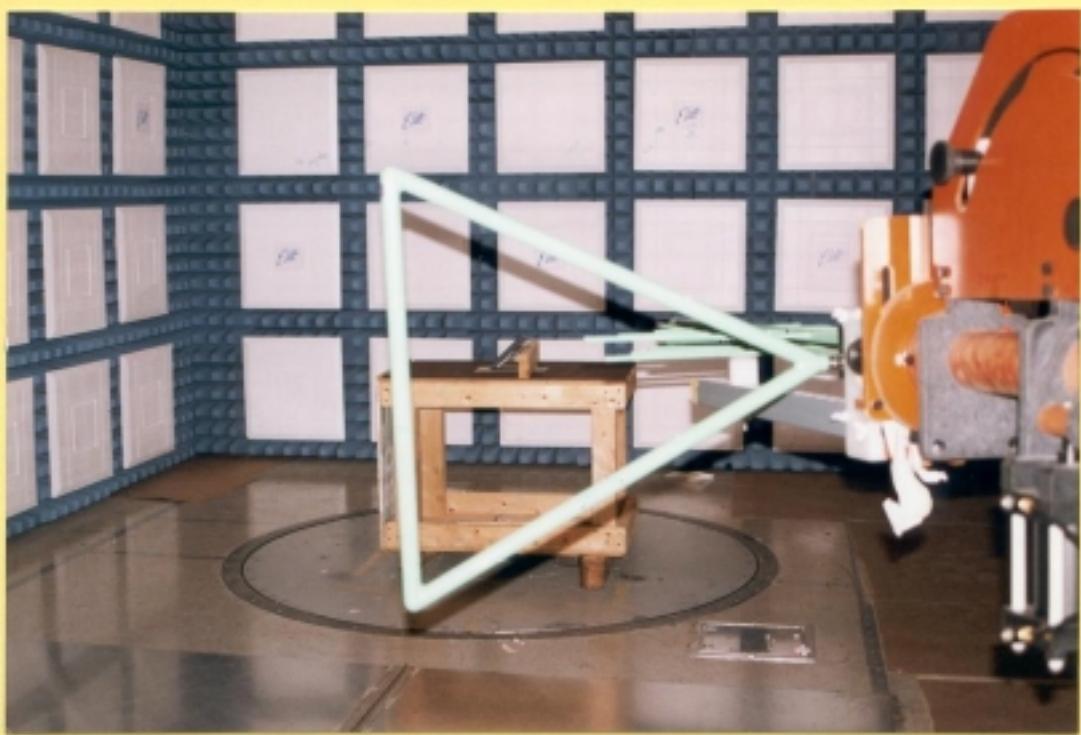


FIGURE 1a TEST SETUP FOR MEASUREMENT OF RADIATED EMISSIONS, HORIZONTAL POLARIZATION

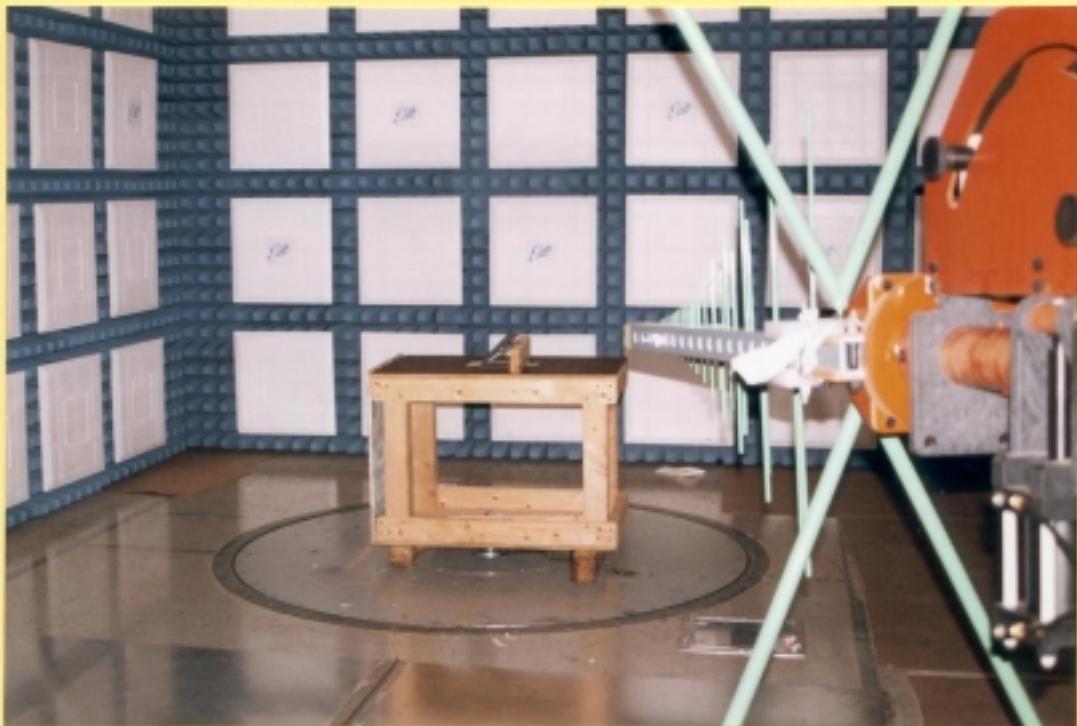


FIGURE 1b TEST SETUP FOR MEASUREMENT OF RADIATED EMISSIONS, VERTICAL POLARIZATION

ELITE ELECTRONIC ENGINEERING Co.

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UNIV\_EM RUN RUN 1

UKAO 02/24/98

110

100

90

80

70

60

50

40

30

20

10

0

RADIATED NARROWBAND EMISSIONS - dBu/m

101

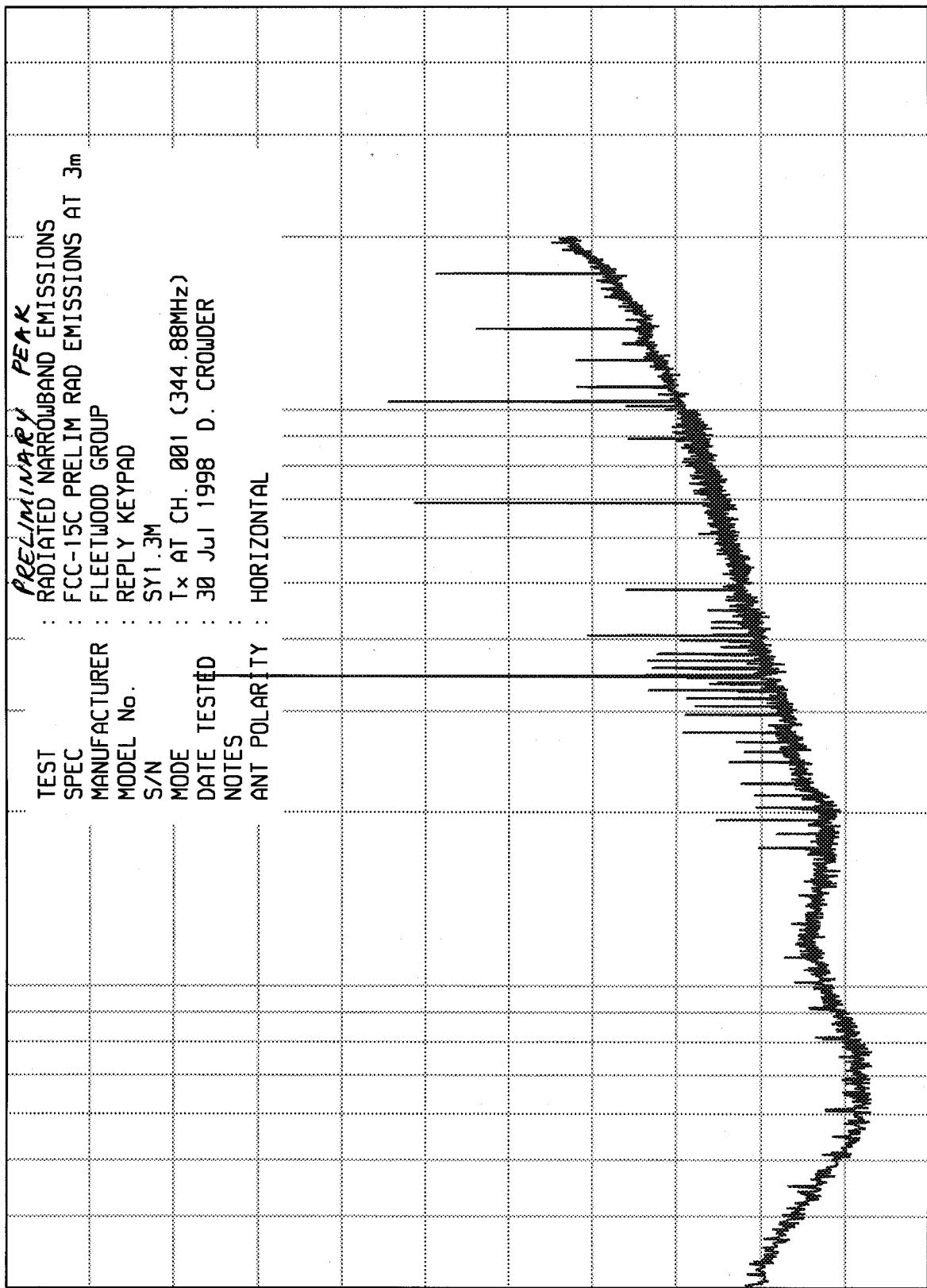
START = 30

100

100

FREQUENCY - MHz

STOP = 5000

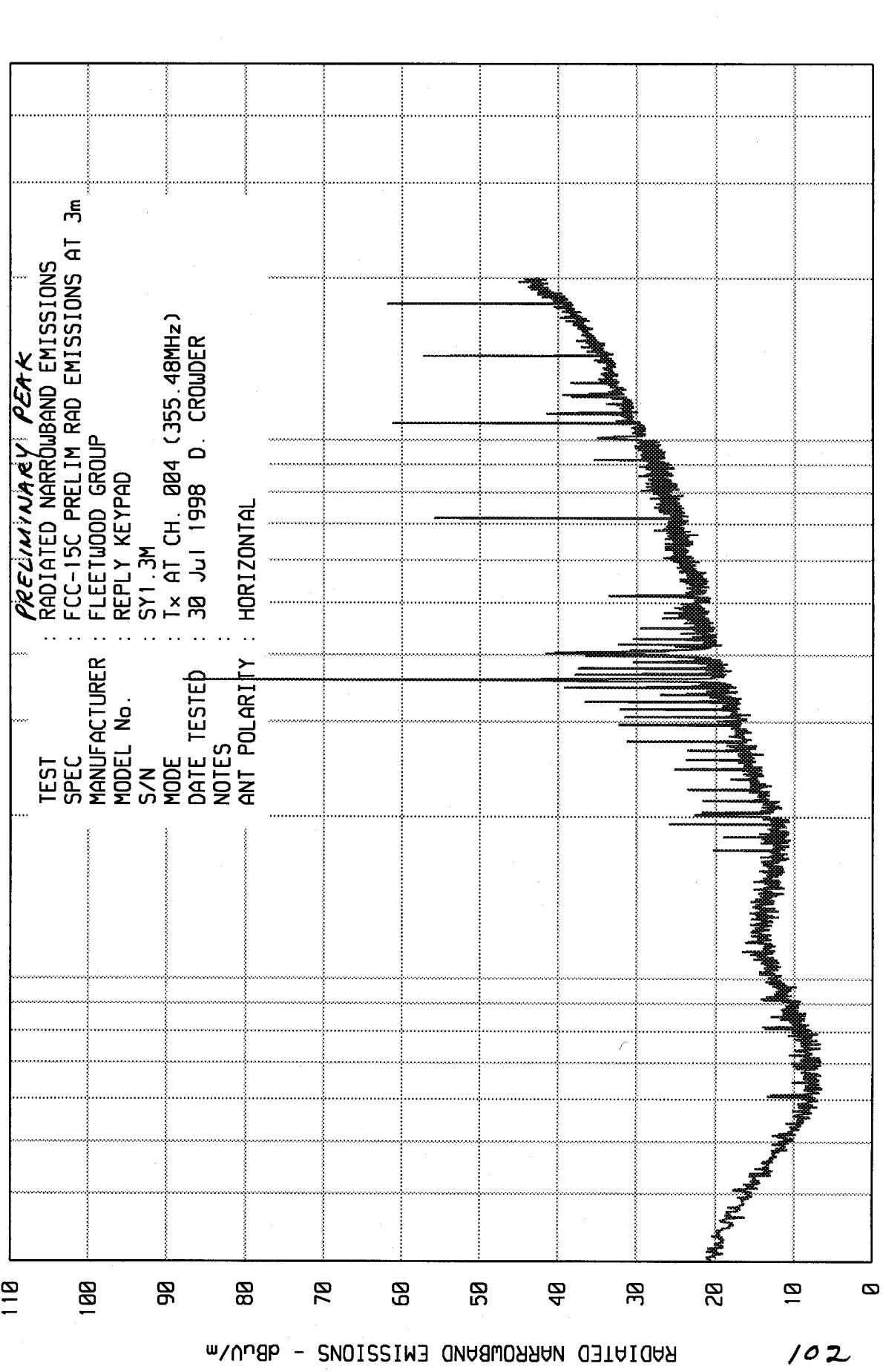


**ELITE ELECTRONIC ENGINEERING Co.**

Downers Grove, Ill. 60515

UNIV\_EM RUN RUN 1

UKAB 02/24/98



EEC

ELITE ELECTRONIC ENGINEERING Co.  
Downers Grove, Ill. 60515

UNIV\_EM RUN RUN 1

WKA# 02/24/98

110

100

90

80

70

60

50

40

30

20

10

0

RADIATED NARROWBAND EMISSIONS - dB<sub>U</sub>/m

START = 30

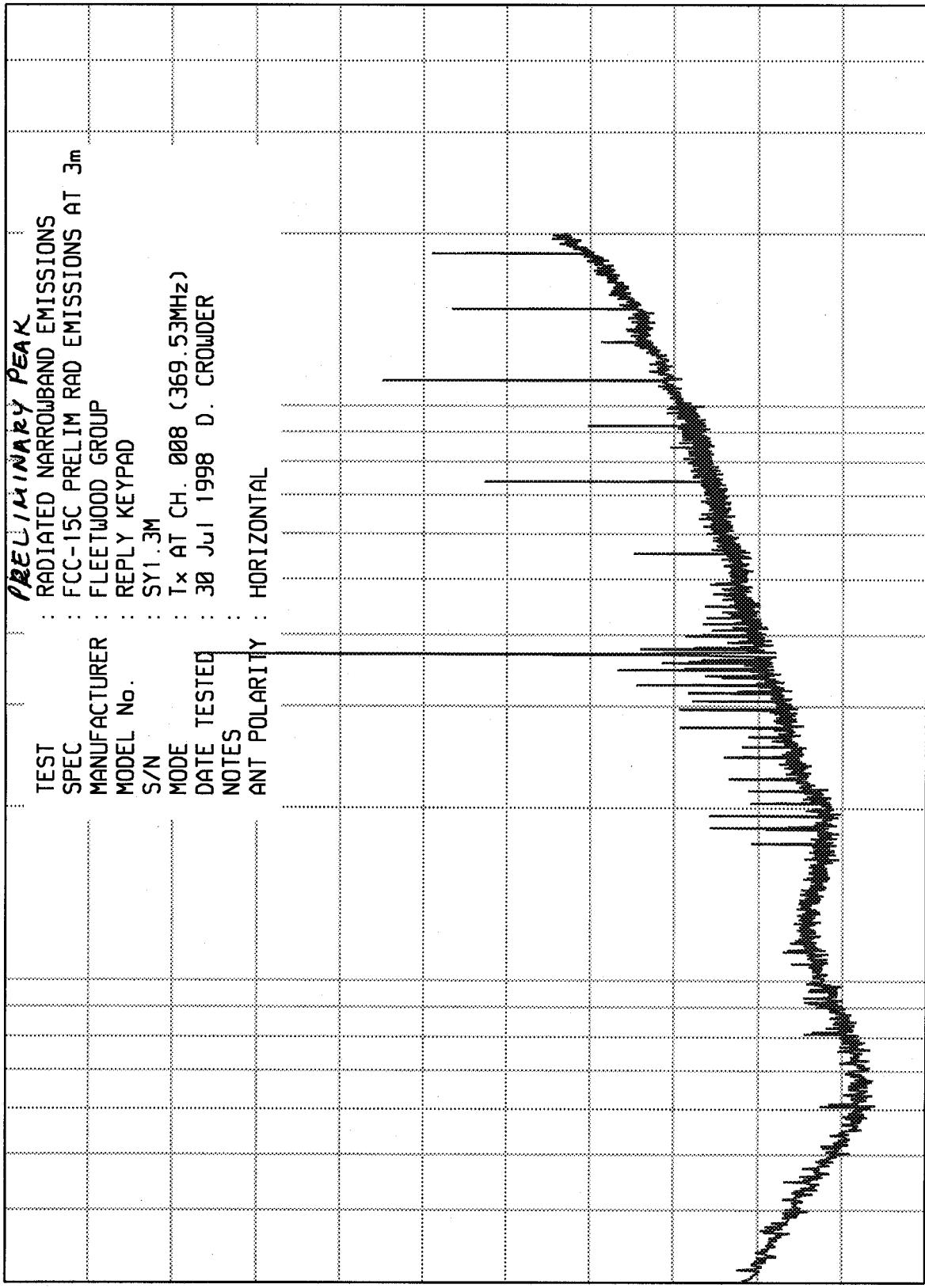
103

100

1000

FREQUENCY - MHz

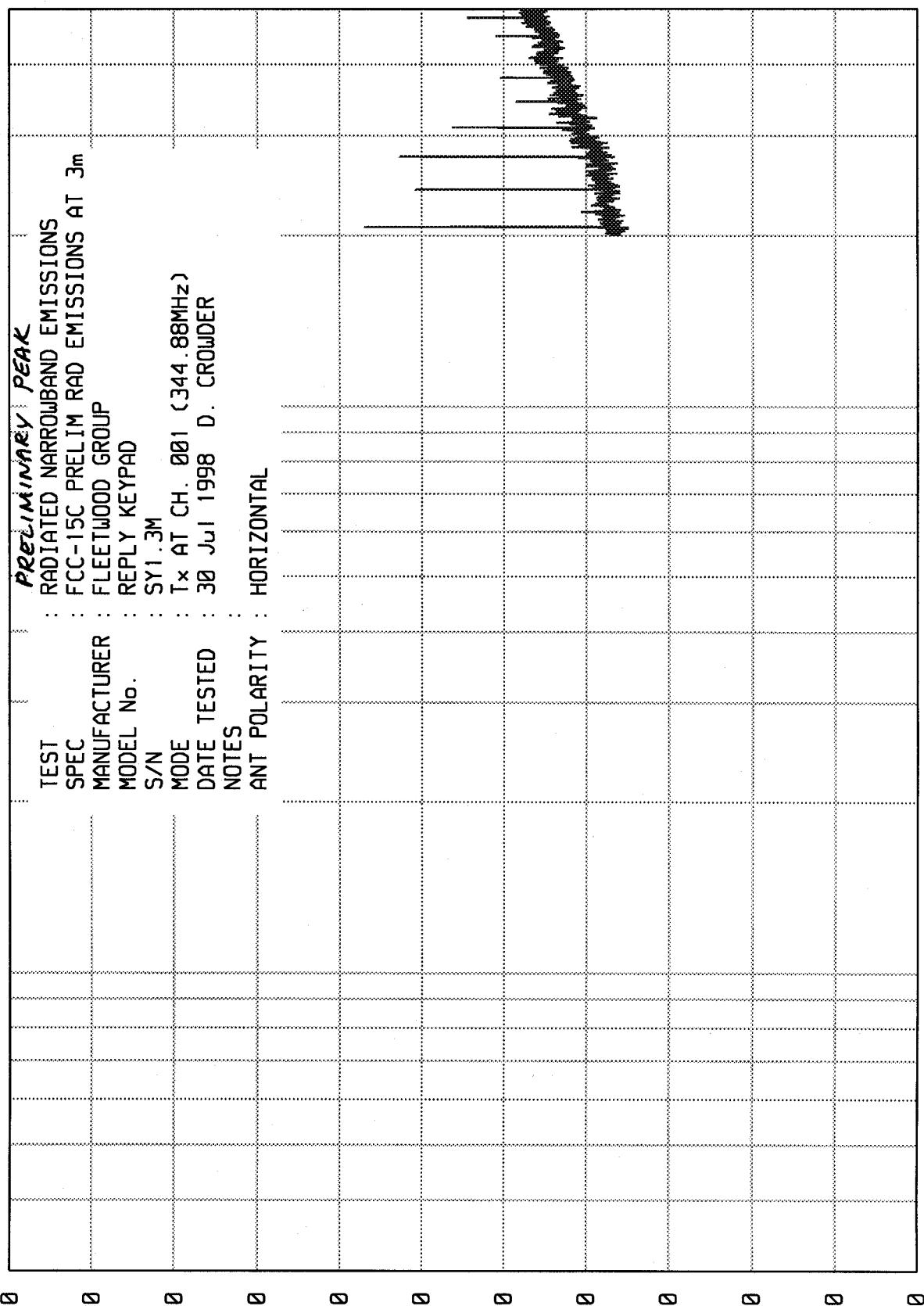
STOP = 5000



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Downers Grove, Ill. 60515

WKAQ 02/24/98

UNIV\_EM RUN RUN 1



RADIATED NARROWBAND EMISSIONS - dBu/m

104

*EEC* ELITE ELECTRONIC ENGINEERING Co.

Downers Grove, Ill. 60515

UNIV\_EM RUN 1

UKAB 02/24/98

110

100

UNIV\_EM RUN 1

90

80

70

60

50

40

30

20

10

0

RADIATED NARROWBAND EMISSIONS - dB<sub>UV</sub>/m

105

START = 30

FREQUENCY - MHz

100

1000

STOP = 5000

*PEAK* *MINIMUM* *PEAK*

RADIATED NARROWBAND EMISSIONS  
FCC-15C PRELIM RAD EMISSIONS AT 3m

FLEETWOOD GROUP

REPLY KEYPAD

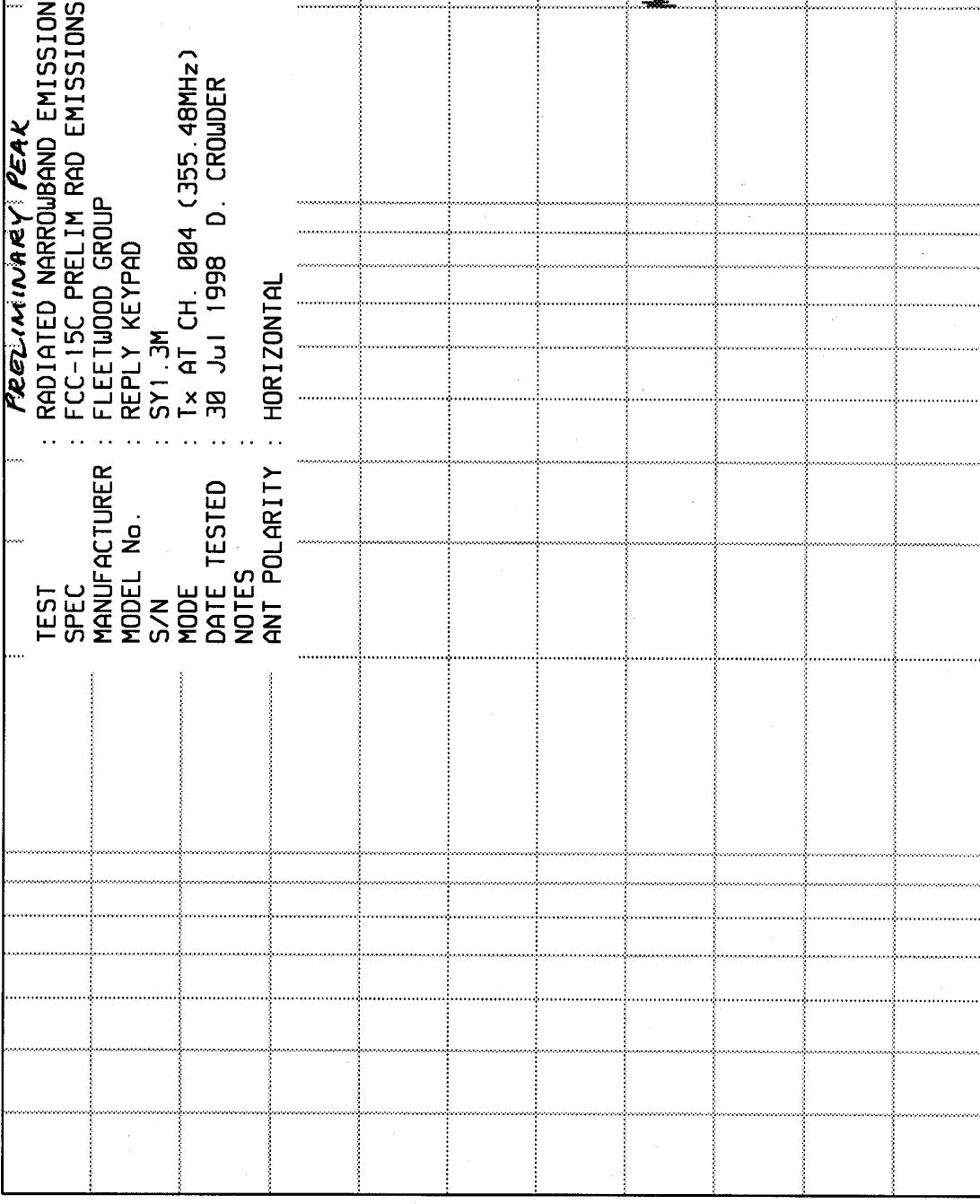
MODEL NO.

S/N SY1.3M

MODE Tx AT CH. 004 (355.48MHz)  
DATE TESTED 30 Jul 1998 D. CROWDER

NOTES

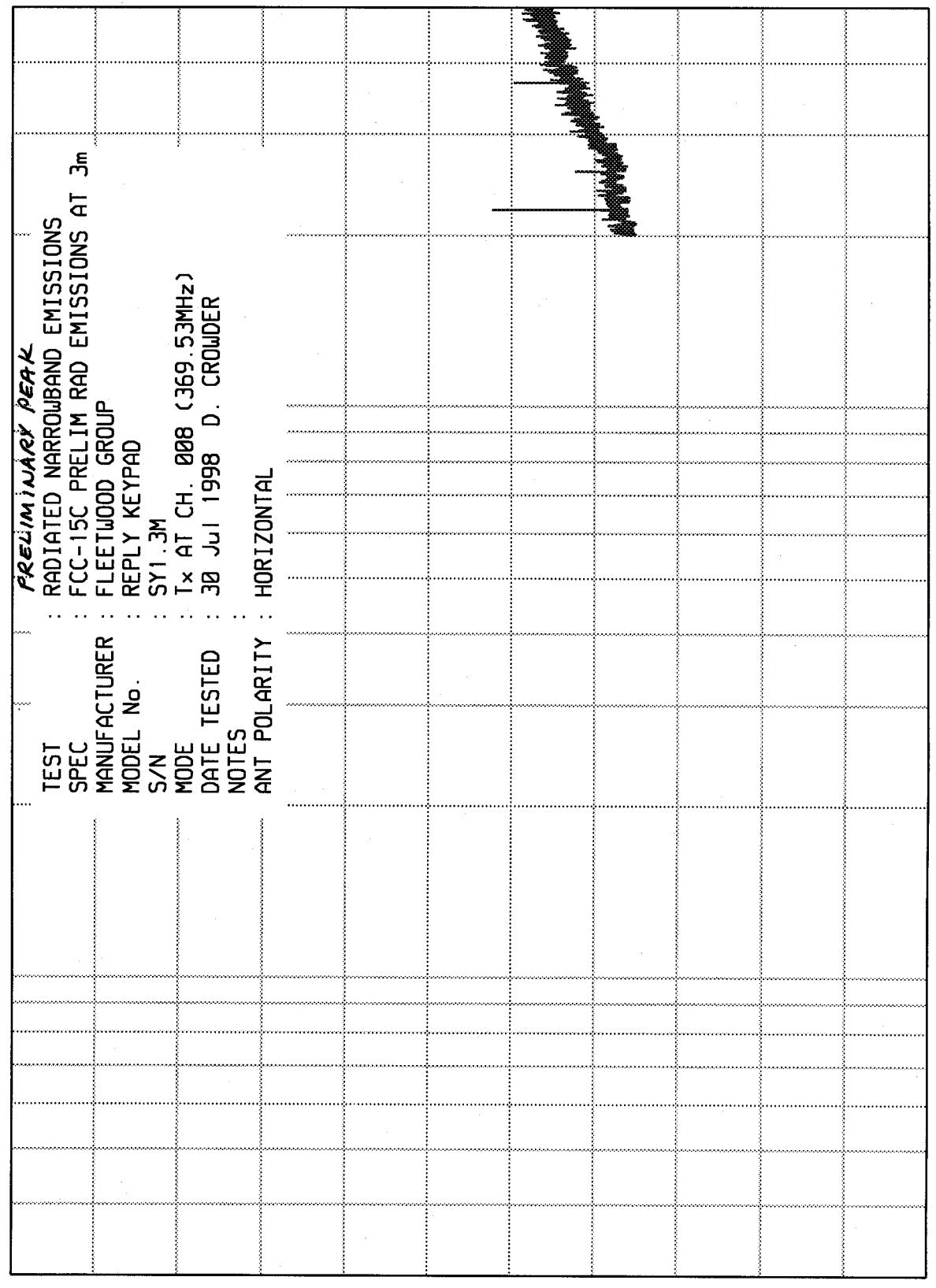
ANT POLARITY : HORIZONTAL



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

WKAQ 02/24/98

UNIV\_EM RUN RUN 1



RADIATED NARROWBAND EMISSIONS - dBm/m

100

ENGINEERING TEST REPORT NO.  
ELITE ELECTRONIC ENGINEERING COMPANY

MANUFACTURER : FLEETWOOD GROUP  
 MODEL : REPLY DL KEYPAD  
 S/N : SY1.3M  
 SPECIFICATION : FCC-15C OPEN FIELD RADIATED EMISSIONS *(AVERAGE)*  
 DATE : JULY 30, 1998  
 NOTES : TRANSMIT AT CH. 001 (344.88MHz)

FREQ. (MHz)	ANT POL	MTR RDG (dBuV)	ANT FAC dB	CABLE FAC dB	DUTY CYCLE	PRE-AMP GAIN dB	TOTAL			LIMIT uV/m
							dBuV/m	uV/m	uV/m	
344.9	H	77.7	15.3	2.0	-20.0		75.0	5623.4	7287.6	
344.9	V	65.2	15.3	2.0	-20.0		62.5	1333.5	7287.6	
689.8	H	44.6	20.0	3.2	-20.0		47.8	245.5	729	
689.8	V	37.2	20.0	3.2	-20.0		40.4	104.7	729	
1034.6	H	78.5	24.9	5.0	-20.0	37.3	51.1	358.9	500	
1034.6	V	68.9	24.9	5.0	-20.0	37.3	41.5	118.9	500	
1379.5	H	68.4	25.5	6.2	-20.0	36.8	43.3	146.2	500	
1379.5	V	64.7	25.5	6.2	-20.0	36.8	39.6	95.5	500	
1724.4	H	64.2	27.0	7.1	-20.0	36.2	42.1	127.4	729	
1724.4	V	62.3	27.0	7.1	-20.0	36.2	40.2	102.3	729	
2069.3	H	60.6	28.0	7.8	-20.0	36.2	40.2	102.3	729	
2069.3	V	60.7	28.0	7.8	-20.0	36.2	40.3	103.5	729	
2414.2	H	52.0	29.1	8.5	-20.0	36.0	33.6	47.9	729	
2414.2	V	60.8	29.1	8.5	-20.0	36.0	42.4	131.8	729	
2759.1	H	48.0	30.2	9.5	-20.0	36.0	31.7	38.5	500	
2759.1	V	51.7	30.2	9.5	-20.0	36.0	35.4	58.9	500	
3103.9	H	48.4	31.1	10.4	-20.0	36.0	33.9	49.5	729	
3103.9	V	48.1	31.1	10.4	-20.0	36.0	33.6	47.9	729	
3448.8	H	43.6	32.2	11.3	-20.0	35.8	31.3	36.7	729	
3448.8	V	45.2	32.2	11.3	-20.0	35.8	32.9	44.2	729	

CHECKED BY: 

ENGINEERING TEST REPORT NO.  
ELITE ELECTRONIC ENGINEERING COMPANY

MANUFACTURER : FLEETWOOD GROUP  
 MODEL : REPLY DL KEYPAD  
 S/N : SY1.3M  
 SPECIFICATION : FCC-15C OPEN FIELD RADIATED EMISSIONS (AVERAGE)  
 DATE : JULY 30, 1998  
 NOTES : TRANSMIT AT CH. 004 (358.48MHz)

FREQ. (MHz)	ANT POL	MTR RDG (dBuV)	ANT FAC dB	CABLE FAC dB	DUTY CYCLE dB	PRE-AMP			TOTAL dBuV/m	TOTAL uV/m	LIMIT uV/m
						GAIN dB	TOTAL dBuV/m	TOTAL uV/m			
358.5	H	77.8	15.5	2.1	-20.0		75.4	5888.4	7854.3		
358.5	V	68.8	15.5	2.1	-20.0		66.4	2089.3	7854.3		
717.0	H	43.8	20.2	3.3	-20.0		47.3	231.7	785		
717.0	V	38.6	20.2	3.3	-20.0		42.1	127.4	785		
1075.4	H	77.8	25.1	5.0	-20.0	37.3	50.6	338.8	500		
1075.4	V	66.7	25.1	5.0	-20.0	37.3	39.5	94.4	500		
1433.8	H	64.5	25.6	6.2	-20.0	36.8	39.5	94.4	785		
1433.8	V	64.9	25.6	6.2	-20.0	36.8	39.9	98.9	785		
1792.3	H	62.5	27.1	7.1	-20.0	36.2	40.5	105.9	785		
1792.3	V	59.7	27.1	7.1	-20.0	36.2	37.7	76.7	785		
2150.7	H	65.8	28.2	7.8	-20.0	36.2	45.6	190.5	785		
2150.7	V	63.9	28.2	7.8	-20.0	36.2	43.7	153.1	785		
2509.2	H	53.3	29.3	8.5	-20.0	36.0	35.1	56.9	785		
2509.2	V	58.8	29.3	8.5	-20.0	36.0	40.6	107.2	785		
2867.6	H	49.0	30.4	9.5	-20.0	36.0	32.9	44.2	500		
2867.6	V	49.6	30.4	9.5	-20.0	36.0	33.5	47.3	500		
3226.1	H	45.5	31.3	10.4	-20.0	36.0	31.2	36.3	785		
3226.1	V	45.7	31.3	10.4	-20.0	36.0	31.4	37.2	785		
3584.6	H	46.5	32.5	11.3	-20.0	35.8	34.5	53.1	785		
3584.6	V	45.6	32.5	11.3	-20.0	35.8	33.6	47.9	785		

CHECKED BY: 

ENGINEERING TEST REPORT NO.  
ELITE ELECTRONIC ENGINEERING COMPANY

MANUFACTURER : FLEETWOOD GROUP  
 MODEL : REPLY DL KEYPAD  
 S/N : SY1.3M  
 SPECIFICATION : FCC-15C OPEN FIELD RADIATED EMISSIONS *(AVERAGE)*  
 DATE : JULY 30, 1998  
 NOTES : TRANSMIT AT CH. 008 (369.52MHz)

FREQ. (MHz)	ANT POL	MTR RDG (dBuV)	ANT FAC dB	CABLE FAC dB	DUTY CYCLE	PRE-AMP			TOTAL dBuV/m	TOTAL uV/m	LIMIT uV/m
						GAIN dB	TOTAL dBuV/m	TOTAL uV/m			
369.5	H	76.7	15.7	2.1	-20.0		74.5	5308.8		8312.7	
369.5	V	68.2	15.7	2.1	-20.0		66.0	1995.3		8312.7	
739.1	H	46.2	20.5	3.3	-20.0		50.0	316.2		831	
739.1	V	38.5	20.5	3.3	-20.0		42.3	130.3		831	
1108.5	H	80.2	25.3	5.0	-20.0	37.3	53.2	457.1		500	
1108.5	V	65.1	25.3	5.0	-20.0	37.3	38.1	80.4		500	
1478.1	H	70.0	25.8	6.2	-20.0	36.8	45.2	182.0		500	
1478.1	V	61.0	25.8	6.2	-20.0	36.8	36.2	64.6		500	
1847.6	H	64.0	27.2	7.1	-20.0	36.2	42.1	127.4		831	
1847.6	V	60.1	27.2	7.1	-20.0	36.2	38.2	81.3		831	
2217.1	H	56.6	28.4	7.8	-20.0	36.2	36.6	67.6		500	
2217.1	V	60.3	28.4	7.8	-20.0	36.2	40.3	103.5		500	
2586.7	H	48.9	29.5	8.5	-20.0	36.0	30.9	35.1		831	
2586.7	V	60.1	29.5	8.5	-20.0	36.0	42.1	127.4		831	
2956.2	H	50.2	30.5	9.5	-20.0	36.0	34.2	51.3		831	
2956.2	V	46.2	30.5	9.5	-20.0	36.0	30.2	32.4		831	
3325.7	H	44.2	31.5	10.4	-20.0	36.0	30.1	32.0		831	
3325.7	V	43.5	31.5	10.4	-20.0	36.0	29.4	29.5		831	
3695.3	H	42.7	32.8	11.3	-20.0	35.8	31.0	35.5		500	
3695.3	V	46.1	32.8	11.3	-20.0	35.8	34.4	52.5		500	

CHECKED BY: 

ELITE ELECTRONIC ENGINEERING CO

MKR ~ 386 kHz  
3.60 dB

hp REF -10.0 dBm ATTEN 0 dB

MANUFACTURER: FLEETWOOD GROUP  
TEST ITEM : OCCUPIED BANDWIDTH  
S/N : REPLY KEYPAD  
MODE : SY1.3M  
Tx @ Ch. 1 (344.88MHz)

DL  
-67.2  
dBm

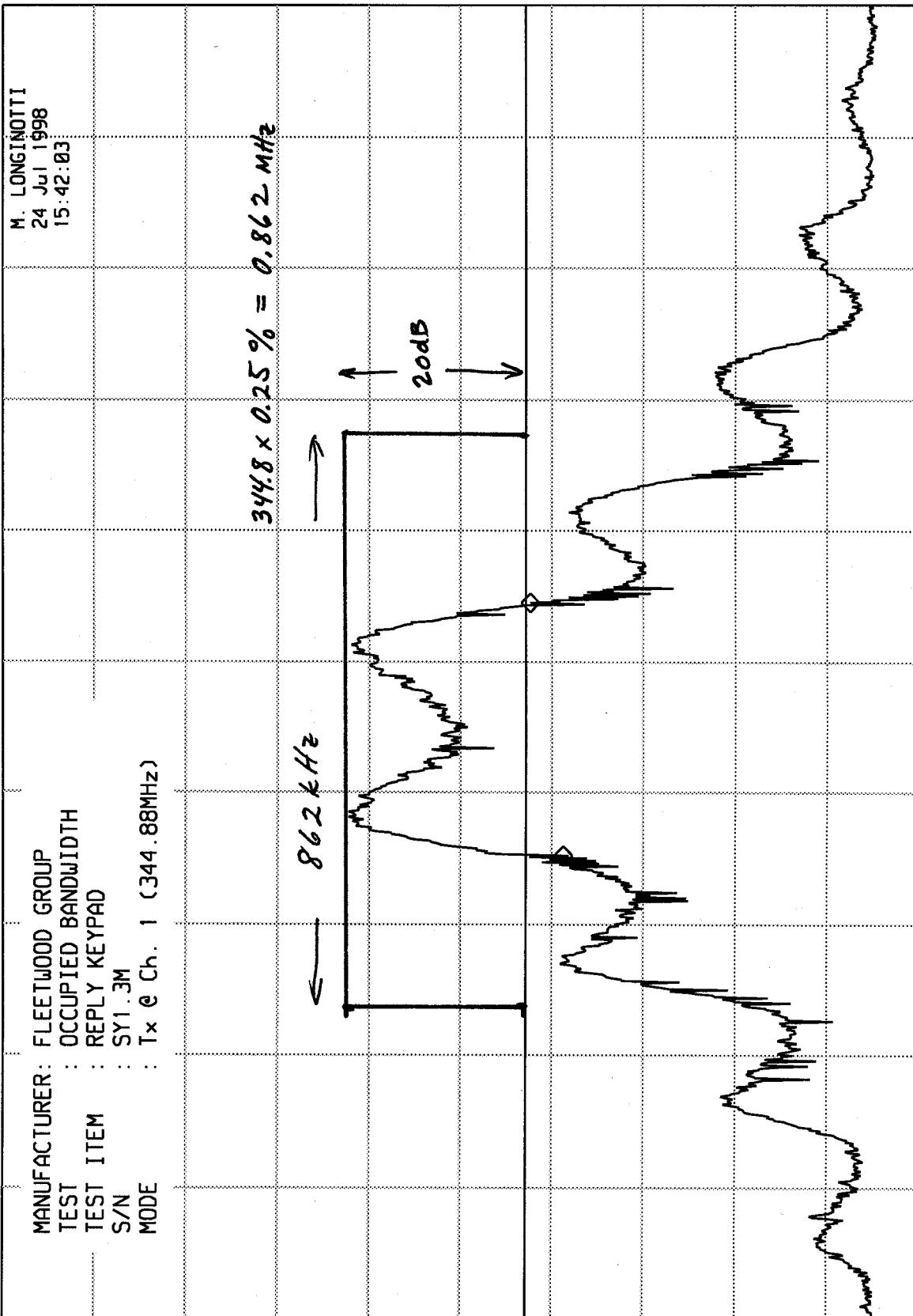
$$344.8 \times 0.25 \% = 0.862 \text{ MHz}$$

862 kHz

20 dB

110

CENTER 345.00 MHz  
RES BW 10 kHz (i) UBW 300 Hz  
SPAN 2.00 MHz  
SWP 3.20 sec



## ELITE ELECTRONIC ENGINEERING CO

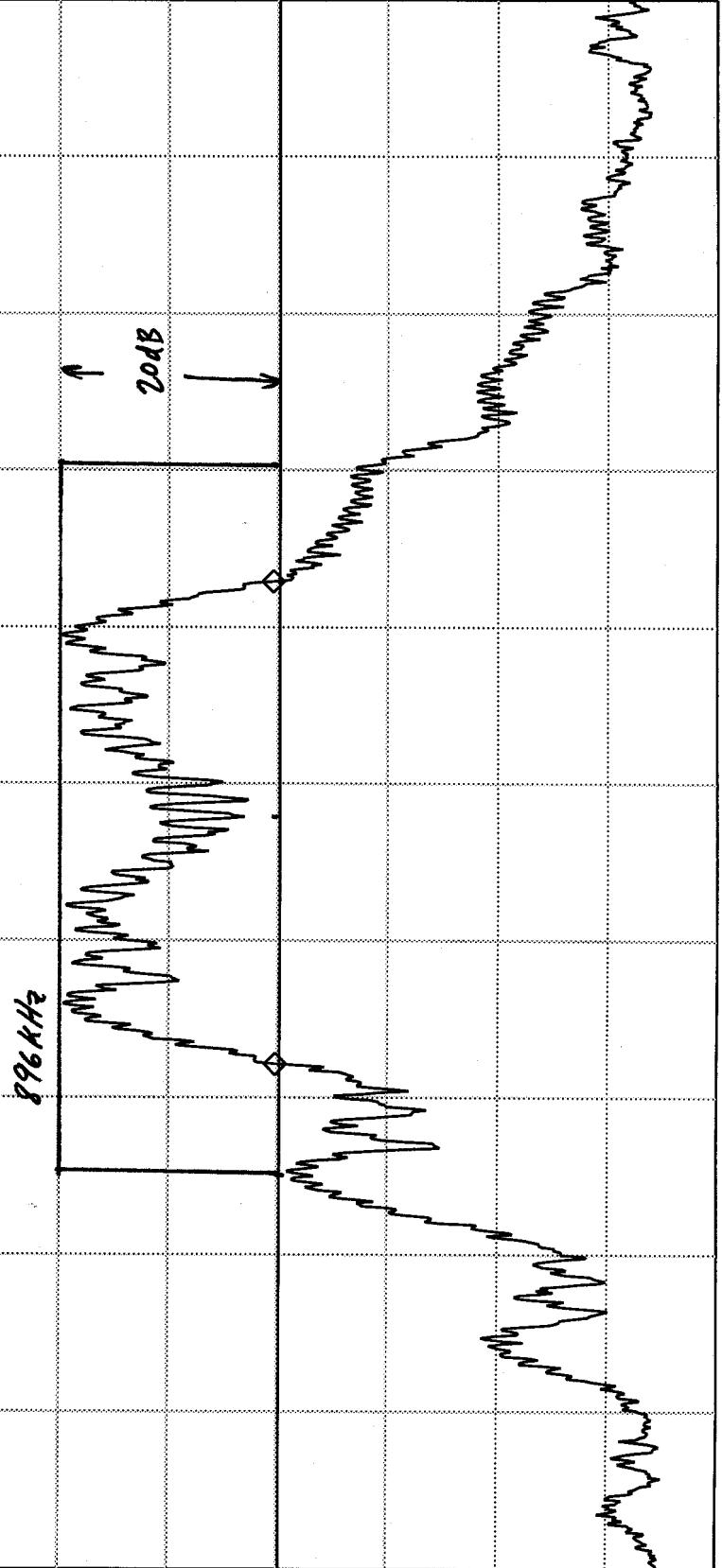
MKR ^-616 kHz  
-0 . 20 dB

hp REF -10.0 dBm ATTEN 0 dB

MANUFACTURER:	FLEETWOOD GROUP
TEST ITEM	OCCUPIED BANDWIDTH
TEST ITEM	REPLY KEYPAD
S/N	SY1.3M
MODE	Tx @ Ch. 4 (358.48MHz)

DL -70.2 dBm

$$358.48 \times 0.25\% = 0.896 \text{ MHz}$$



CENTER

358.54 MHz

RES BW 10 kHz (i)

UBW 300 Hz

SPAN 2.00 MHz  
SWP 3.20 sec

11

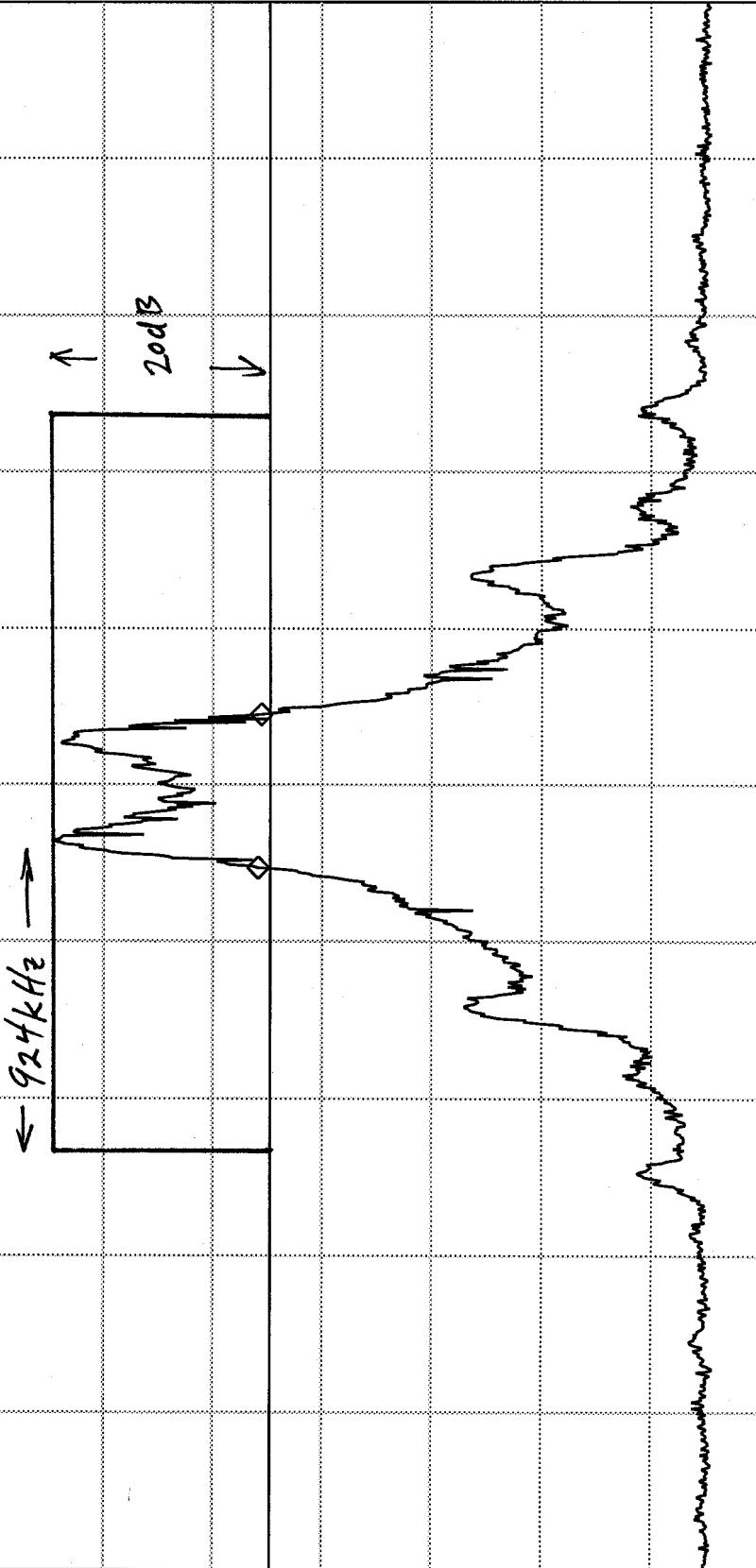
## ELITE ELECTRONIC ENGINEERING CO

REF -10.0 dBm ATTN 0 dB  
 10 dB/ 0.30 dB  
 MKR ^-196 kHz

MANUFACTURER: FLEETWOOD GROUP  
 TEST : OCCUPIED BANDWIDTH  
 TEST ITEM : REPLY KEYPAD  
 S/N : SY1.3M  
 MODE : Tx @ Ch. 8 (369.5MHz)

DL -65.3 dBm

$$369.53 \times 0.25\% = 0.924 \text{ kHz}$$



‡ = 12

CENTER 369.54 MHz

RES BW 10 kHz (i)

VBW 300 Hz

SPAN 2.00 MHz  
 SWP 3.20 sec

M. LONGNOTTI  
 24 Jul 1998  
 15:38:11