

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

ELITE PROJECT: 27495 DATES TESTED: February 19, 1999

TEST PERSONNEL: Daniel E. Crowder

TEST SPECIFICATION: Federal Communication Commission (FCC) Part 90

ENGINEERING TEST REPORT NO. 21477
MEASUREMENT OF RF INTERFERENCE FOR
A TRANSMITTER COMBINER S/N 1

FOR: FLEETWOOD GROUP, INC.
Holland, MI

PURCHASE ORDER NO: P2661

Report By:
Daniel E. Crowder

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

ENGINEERING TEST REPORT NO. 21477

ADMINISTRATIVE DATA AND SUMMARY OF TESTS

DESCRIPTION OF TEST ITEM: Transmitter Combiner for up to 8 Channels

MODEL NO: Combiner

SERIAL NO: 1

FCC ID:

MANUFACTURER: Fleetwood Group, Inc.

APPLICABLE SPECIFICATIONS: FCC Parts 2 and 90

QUANTITY OF ITEMS TESTED: One (1)

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

DATES TESTED: February 19, 1999

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

CUSTOMER: Warren Guthrie

ELITE ELECTRONIC: Daniel E. Crowder

ELITE JOB NO.: 27495

ABSTRACT: The 8 channel transmitter combiner complies with the technical requirements in FCC PART 90.217. See test results and data pages for more details.

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MEASUREMENT OF RF INTERFERENCE FROM
A TRANSMITTER COMBINER

1.0 INTRODUCTION:

1.1 DESCRIPTION OF TEST ITEM: This report present the results of the radio interference measurements performed on an 8 channel transmitter combiner, Serial No. 1, (hereinafter referred to as the test item). The test item is used to combine the outputs of up to eight separate transmitters. It allows the use of a single antenna in place of the eight that would normally be required. The combiner has no gain. It includes bandpass filtering. The nominal output is 20mW per channel. The test were performed for Fleetwood Group Inc. of Holland, MI.

1.2 PURPOSE: The test series was performed to determine if the test item meets the occupied bandwidth, intermodulation products and spurious emissions requirements of the FCC Part 90.217.

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 90
- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 2
- ANSI C63.4-1992, "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage

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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 Inc. of Downers Grove, Illinois.

2.0 TEST ITEM SETUP AND OPERATION:

2.1 SETUP: The test item was powered with 115 VAC. Up to four input signals were supplied from four separate Fleetwood transmitters. These transmitters were set to 216.0, 217.0, 219.0, and 219.5 Mhz. Their outputs are not adjustable.

2.2 MODULATION: The test signals were FSK modulated per normal operation.

2.3 FREQUENCY SELECTION: The transmitters were set to 216.0, 217.0, 219.0 and 219.5 MHz. The frequencies were selected to cover the band edges and so that the intermodulation products would lie in band.

3.0 TEST EQUIPMENT:

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.

4.0 REQUIREMENTS, PROCEDURES AND RESULTS:

4.1 OCCUPIED BANDWIDTH MEASUREMENTS:

4.1.1 REQUIREMENTS: In accordance with Paragraph 90.217, for equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the

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bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

4.1.2 PROCEDURES:

(a) The test item was setup as described in para. 2.0.

(b) With the transmitter at 219.0 MHz operating, the output of the combiner was measured and recorded using the spectrum analyzer. A measurement bandwidth of 300 Hz was selected. The span was set to 100 kHz.

(c) The input signal to the combiner was also measured and recorded.

4.1.3 RESULTS: The plots of the occupied bandwidth measured are presented on data pages A1 through A2.

The limits, shown on the plots, are referenced to the power measured from the unmodulated carrier. The output power measured 13.2 dBm.

As can be seen from the data, the test item output met the occupied bandwidth requirements with the input from the Fleetwood transmitter. The input signal was presented for reference.

4.2 SPURIOUS EMISSIONS AND INTERMODULATION PRODUCTS AT ANTENNA TERMINAL:

4.2.1 REQUIREMENTS: This test determines whether the test item produces excessive spurious emissions or intermodulation products.

In accordance with paragraph FCC 90.217, the spurious emissions

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and intermodulation products shall be attenuated below the unmodulated carrier power (P) by at least 30dB. The peak power of the emissions shall be measured at the antenna terminal from 30MHz up to the 10th harmonic of the fundamental frequency.

4.2.2 PROCEDURES:

In general, this test will measure spurious emissions and intermodulation products when four inband signals are introduced at the input.

(a) The test item was setup per para 2.0. All four transmitter were connected and turned on.

(b) The output of the test item connected to the spectrum analyzer. The measurement bandwidth was set to 30 kHz which is greater than the emission bandwidth. With the span set for 10 MHz, the inband signal levels were measured and recorded.

(c) Next, the frequency span was adjusted to cover 30 MHz up to 1000 MHz. The emission levels over this frequency range were measured and recorded.

(d) Finally, the emissions over the frequency range from 1000 MHz up to 2500 MHz were measured and recorded. This range covers up through the 10th harmonic.

4.2.3 RESULTS: The plots of the antenna conducted output measurements are presented on data pages A3 through A5.

As can be seen from the data, the test item did not produce spurious emissions or intermodulation products in excess of 30 dB below unmodulated carrier level when four transmitters were connected

to the input with nominal output powers of 20 mW per transmitter.

4.3 FIELD STRENGTH OF SPURIOUS EMISSIONS:

4.3.1 REQUIREMENTS: In accordance with Paragraph 90.217, on any frequency removed from the assigned frequency by more than 40 kHz shall be attenuated by 30 dB. For an output level of 13.2 dBm, this requirement translates to a equivalent radiated power (ERP) limit of -16.8 dBm. The emissions shall be measured from 30MHz up to the 10th harmonic of the fundamental frequency.

4.3.2 PROCEDURES:

4.3.2.1 Preliminary Test: A preliminary test was performed in a 17ft. x 10ft. x 8ft. high shielded enclosure to prevent emissions from other sources, such as radio and TV stations from interfering with the measurements.

(a) The test item was placed on 0.8 meter high table. Its output was terminated in 50 ohms. Only one transmitter tuned to 216.0 MHz was used for this test. This transmitter was setup outside of the test enclosure so that its emissions would not be measured.

(b) The measurement antennas were positioned at a 1 meter distance from the test item. The frequency range from 30MHz to 2.5 GHz was investigated. The readings were taken with a peak detector function.

4.3.2.2 Open Area Test: The open field measurements were performed at Elite's open field test site located in Downers Grove, Illinois. The open field test site is located in a clear area and is equipped with a 1/4-inch wire mesh ground plane.

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(a) The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.

(b) The antenna output was terminated in 50 ohms.

(c) Detected emissions were maximized at each frequency by rotating the test item and adjusting the receive antenna height and polarization. The maximum meter reading was recorded.

(d) Measurement BW was 100 kHz. Peak reading were recorded.

(e) The equivalent power into a dipole antenna was calculated from the field intensity levels measured at 3 meters using the equation shown below:

$$P_g = E^2 4\pi d^2 / 120\pi = E^2 d^2 / 30$$

where P = power in watts

g = arithmetic gain of transmitting antenna over isotropic radiator.

E = maximum field strength in volts/meter

d = measurement distance in meter

Using a dipole gain of 1.67 or 2.2 dB and a test distance of 3 meters, this equation reduces to:

$$P(\text{dBm}) = E(\text{dBuV/m}) - 97.2\text{dB}$$

4.3.3 RESULTS RADIATED TEST:

The preliminary plots are presented on data pages A6 and A7. Factors for the antenna were added to the data before it was plotted.

This data is only presented for a reference, and is not used to determine compliance. All significant radiated emissions were subsequently measured at an open field test site.

The final open field radiated levels are presented on data page A8. Based on the preliminary measurements, the open field

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measurements were limited to measuring the harmonics. Ambient level were recorded if the harmonic signals were not detected above the ambient level. As can be seen from the data, the radiated emissions were well below the specification limit.

5.0 CONCLUSION:

The Fleetwood Transmitter Combiner, S/N 1 complies with the technical requirements of the FCC Part 90.217.

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.

501

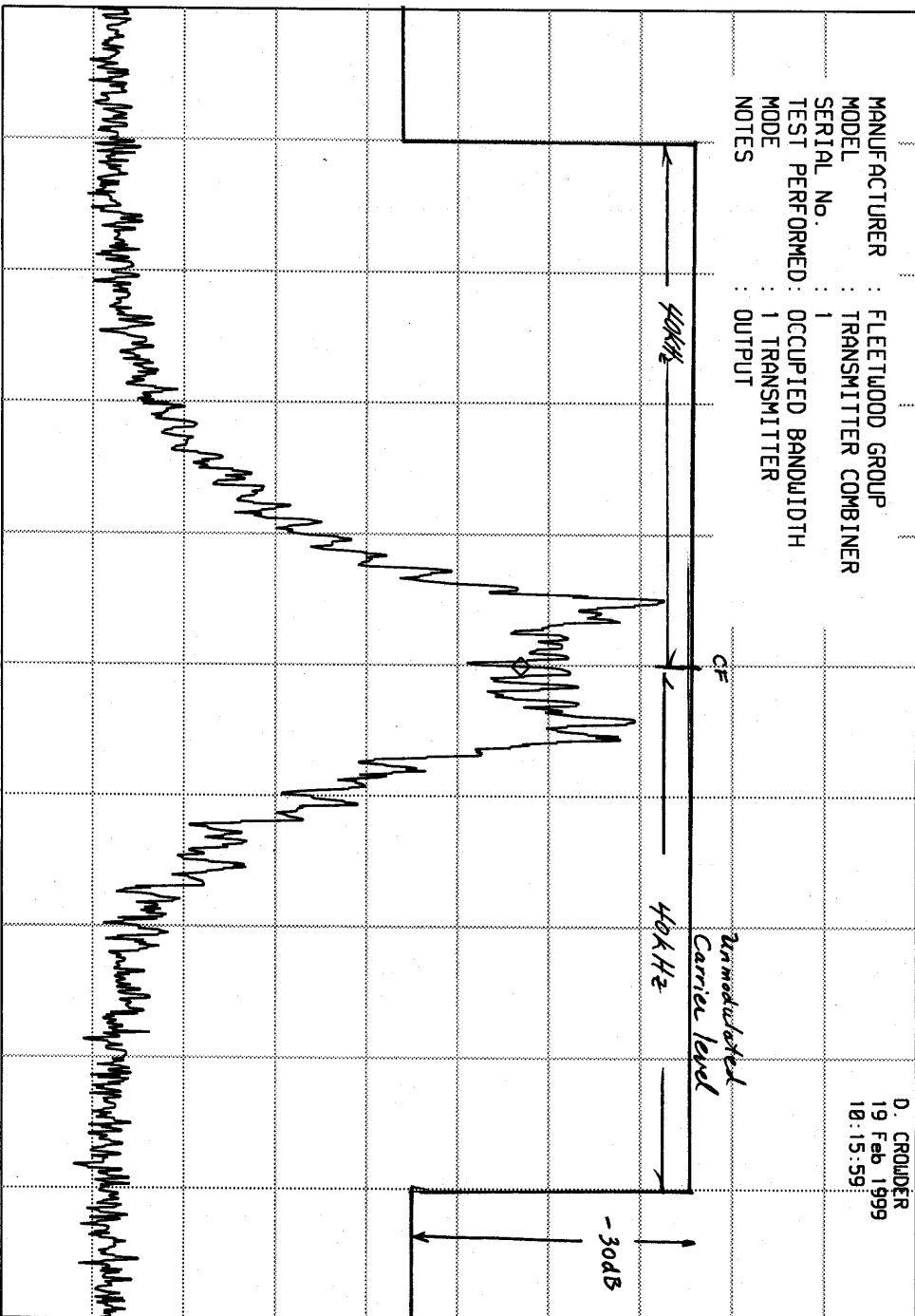
ELITE ELECTRONIC ENGINEERING CO

hp REF 28.0 dBm ATTN 20 dB + 10 dB Ext MKR 219.012 8 MHz -15.10 dBm

10 dB/
OFFSET
30.0
dB

MANUFACTURER : FLEETWOOD GROUP
MODEL : TRANSMITTER COMBINER
SERIAL No. : 1
TEST PERFORMED : OCCUPIED BANDWIDTH
MODE : 1 TRANSMITTER
NOTES : OUTPUT

D. CROUDER
19 Feb 1999
10:15:59



CENTER 219.012 MHz RES BW 300 Hz (1) VBW 3 kHz SPAN 100 kHz SLP 7.50 sec

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SP2

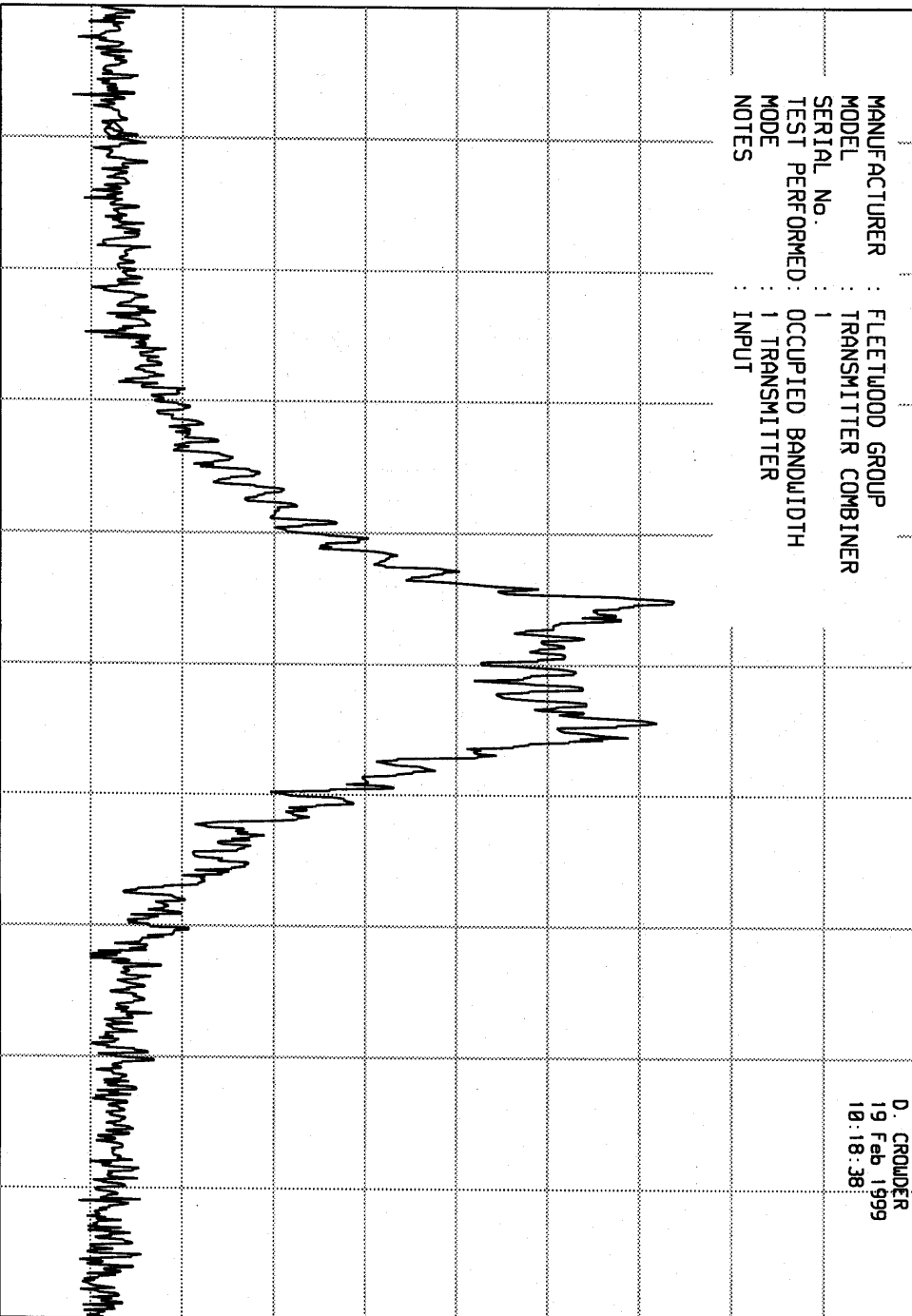
ELITE ELECTRONIC ENGINEERING CO

hp REF 28.0 dBm ATTN 20 dB + 10 dB Ext MKR 218.972 2 MHz -59.60 dBm

10 dB/
OFFSET
30.0
dB

MANUFACTURER : FLEETWOOD GROUP
MODEL : TRANSMITTER COMBINER
SERIAL No. : 1
TEST PERFORMED : OCCUPIED BANDWIDTH
MODE : 1 TRANSMITTER
NOTES : INPUT

D. CROWDER
19 Feb 1999
10:18:38



CENTER 219.012 MHz
RES BW 300 Hz (1) VBW 3 kHz
SPAN 100 kHz
SWP 7.50 sec

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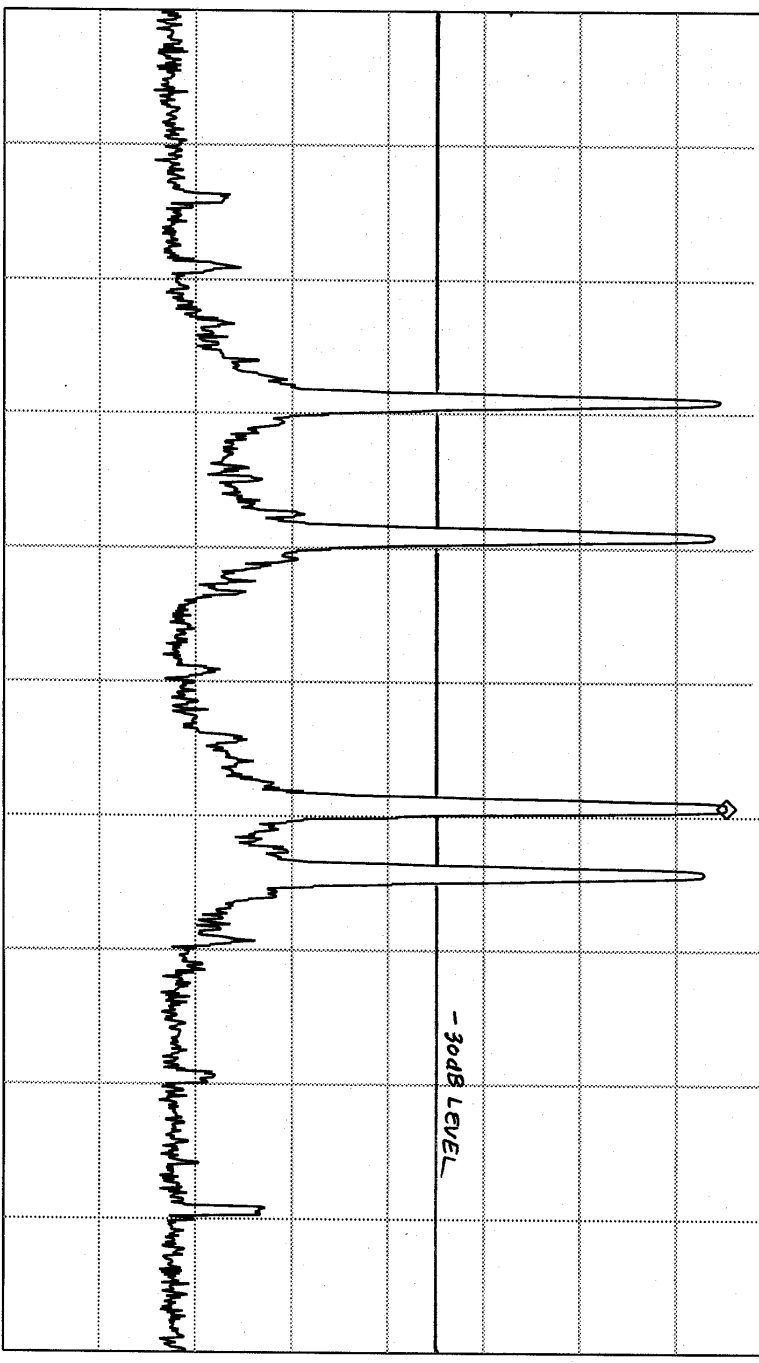
SA3

ELITE ELECTRONIC ENGINEERING CO

hp REF 28.0 dBm ATTN 10 dB + 10 dB Ext MKR 219.06 MHz 3.20 dBm

10 dB/
OFFSET
30.0
dB

MANUFACTURER	FLEETWOOD GROUP	0. CROUDER
MODEL	TRANSMITTER COMBINER	19 Feb 1999
SERIAL No.	1	10:07:43
TEST PERFORMED	ANTENNA COND & INTERMOD PRODUCTS	
MODE	4 TRANSMITTERS	
NOTES	OUTPUT	



CENTER 218.1 MHz RES BW 30 KHz(1) UBW 300 kHz SPAN 10.0 MHz SUP 75.0 msec

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SN4

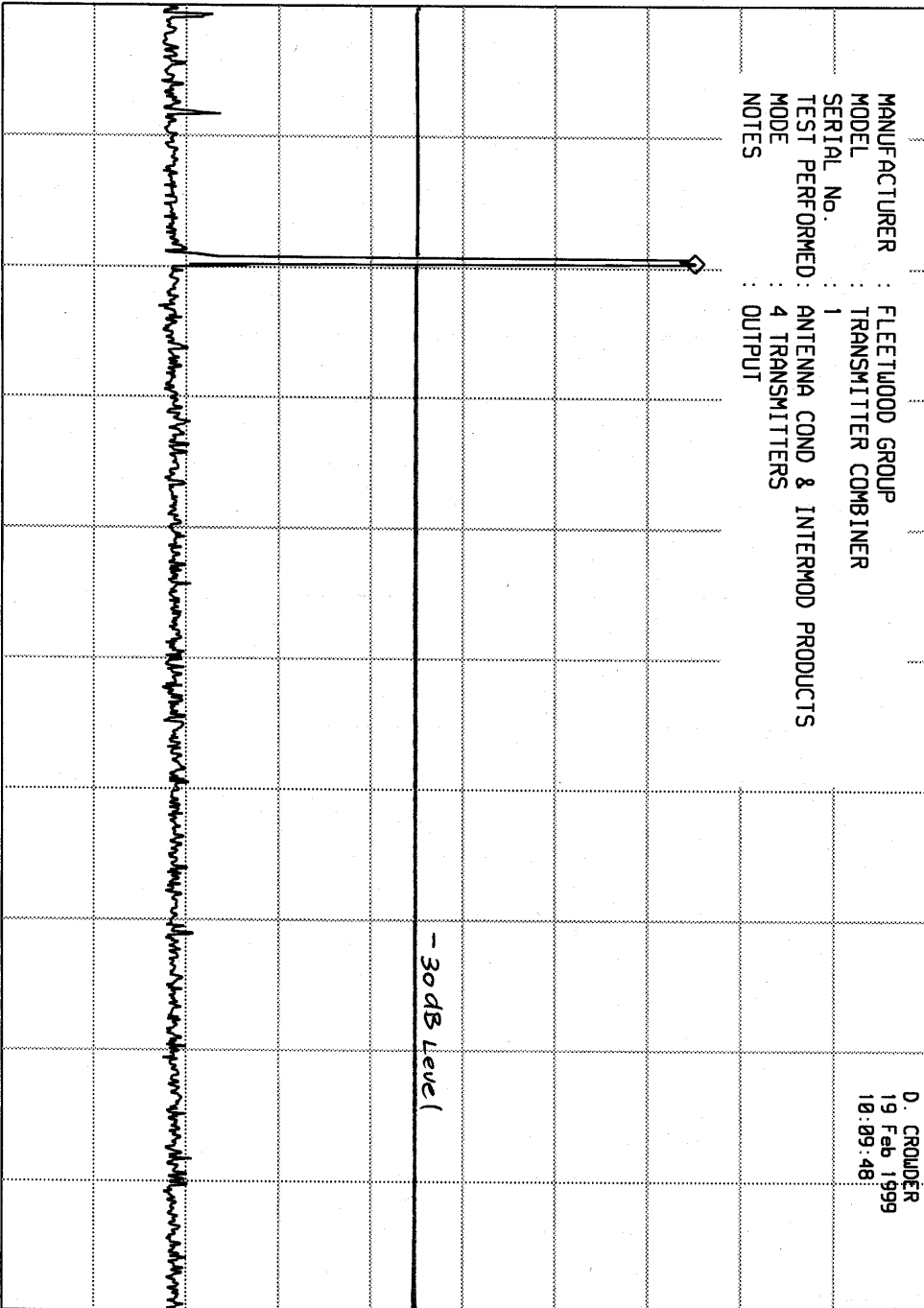
ELITE ELECTRONIC ENGINEERING CO

hp REF 28.0 dBm ATTN 10 dB + 10 dB EXT MKR 219.2 MHz 3.10 dBm

10 dB/
OFFSET
30.0
dB

MANUFACTURER : FLEETWOOD GROUP
MODEL : TRANSMITTER COMBINER
SERIAL No. : 1
TEST PERFORMED : ANTENNA COND & INTERMOD PRODUCTS
MODE : 4 TRANSMITTERS
NOTES : OUTPUT

D. CROWDER
19 Feb 1999
10:09:48



START 30 MHz RES BW 30 kHz(1) VBW 300 kHz STOP 1.000 GHz SWP 7.28 sec

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ENGINEERING TEST REPORT NO. 21477

505

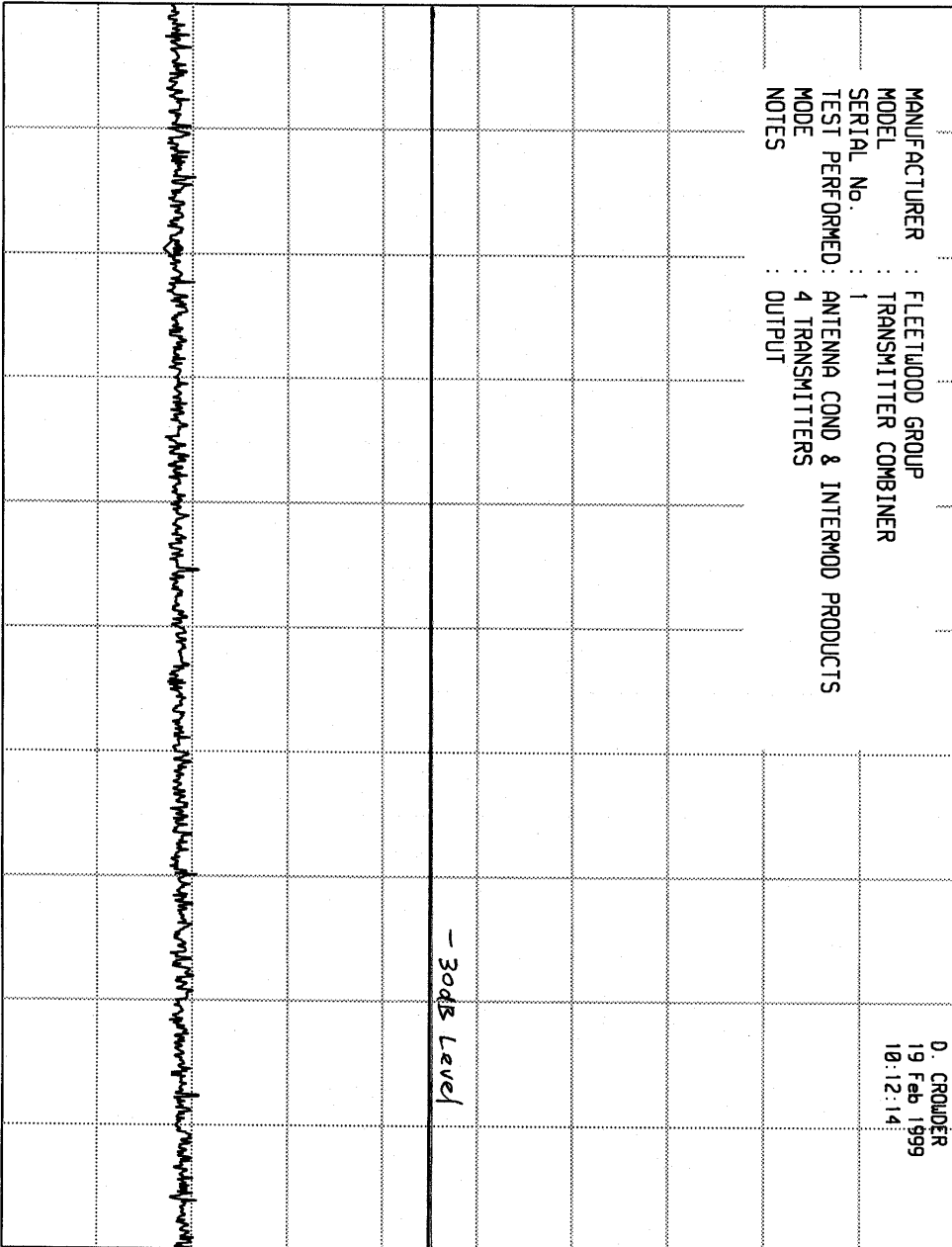
ELITE ELECTRONIC ENGINEERING CO

hp REF 28.0 dBm ATTN 40 dB + 10 dB ~~EXT~~ MKR 1.293 GHz
-54.10 dBm

10 dB/
OFFSET
30.0
dB

MANUFACTURER : FLEETWOOD GROUP
MODEL : TRANSMITTER COMBINER
SERIAL No. : 1
TEST PERFORMED : ANTENNA COND & INTERMOD PRODUCTS
MODE : 4 TRANSMITTERS
NOTES : OUTPUT

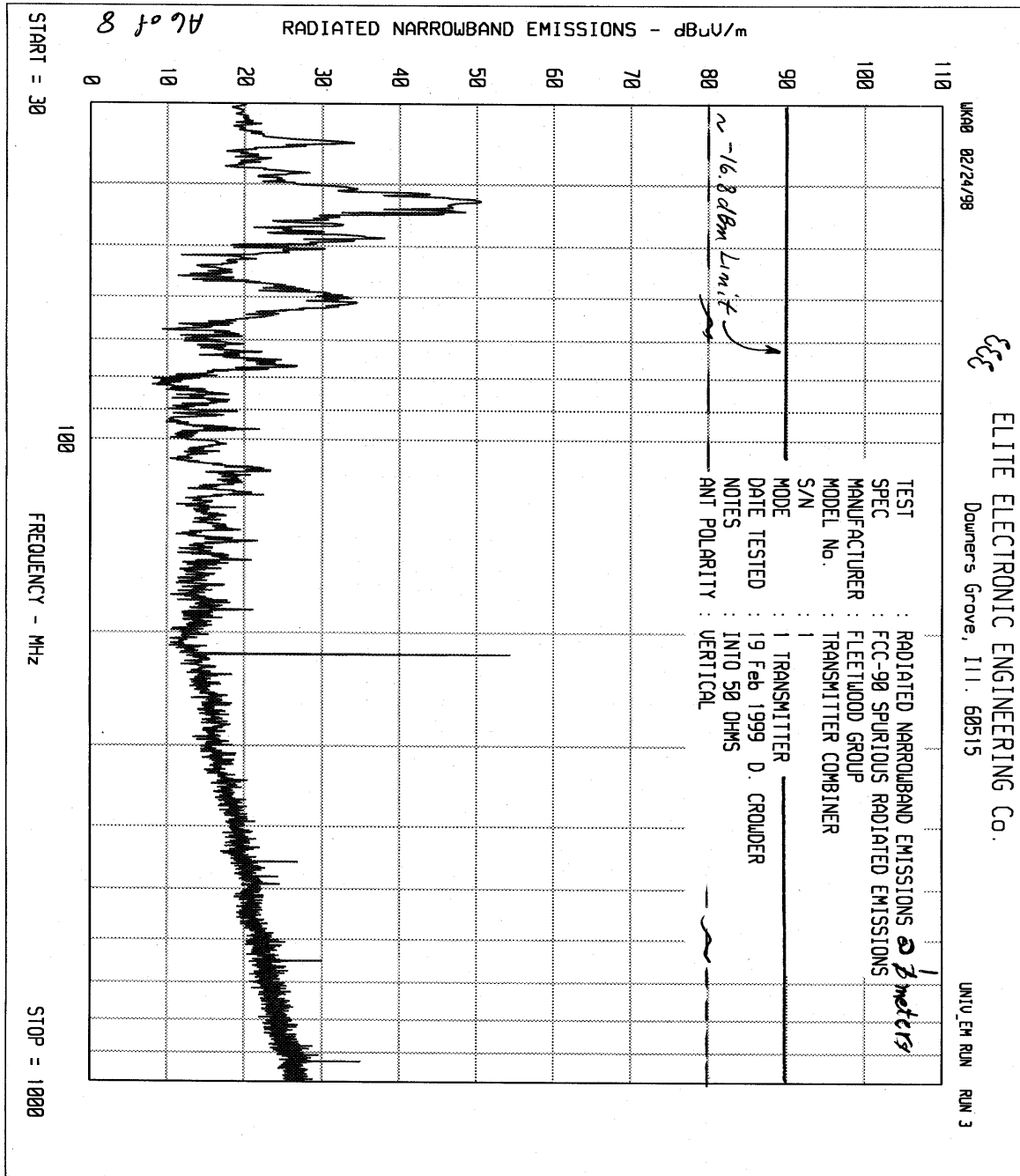
D. CROWDER
19 Feb 1999
10:12:14



START 1.00 GHz STOP 2.50 GHz
RES BW 30 kHz(1) VBW 300 kHz SWP 11.3 sec

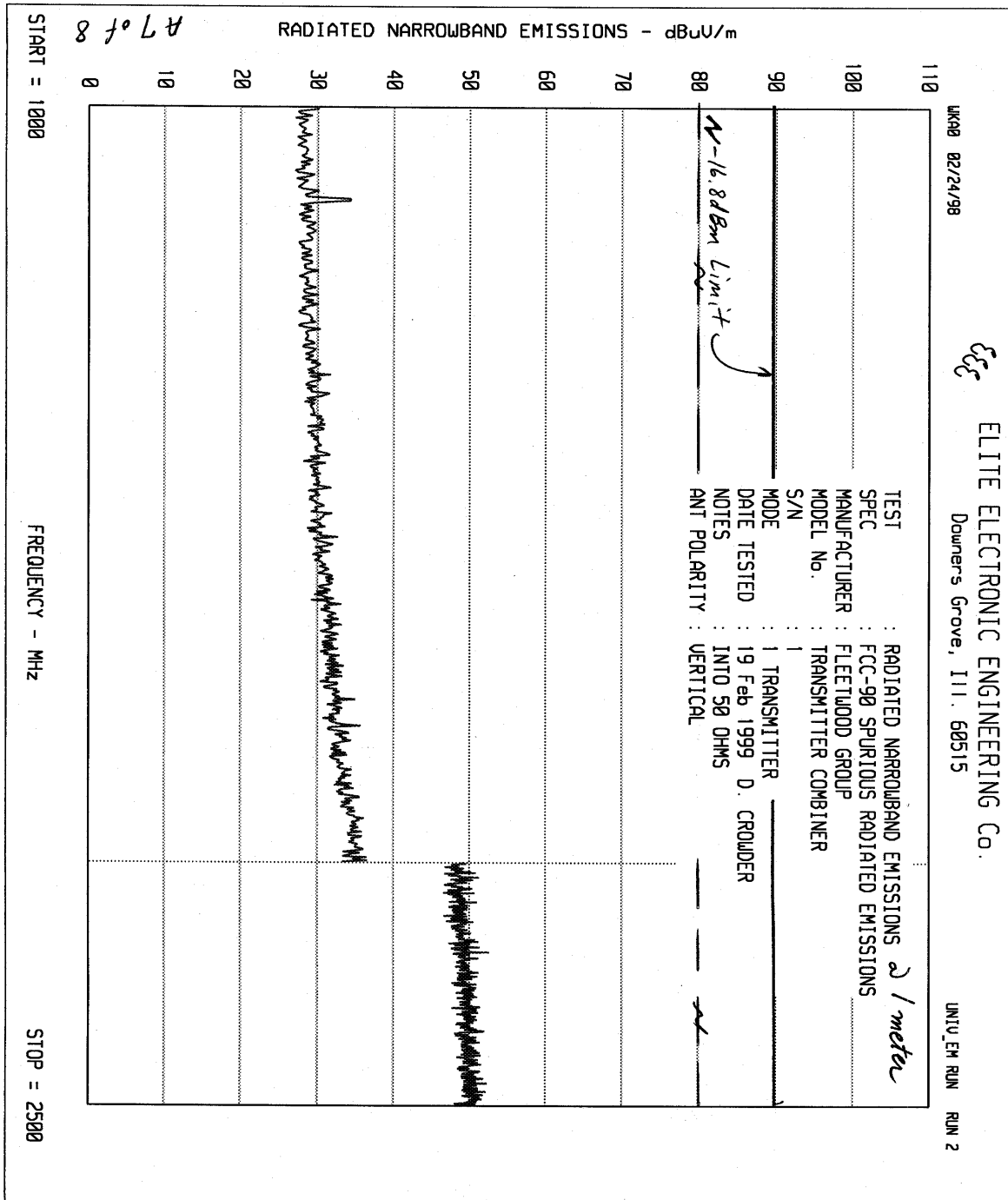
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EPR 21477

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ETR 21477

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ELITE ELECTRONIC ENGINEERING, INC.

MANUFACTURER : FLEETWOOD GROUP
MODEL : TRANSMITTER COMBINER
S/N : 1
SPECIFICATION : FCC-90 OPEN FIELD SPURIOUS RADIATED EMISSIONS
DATE : FEBRUARY 19, 1999
NOTES : ONE TRANSMITTER INTO 50 OHMS
TEST DISTANCE IS 3 METERS

FREQ. (MHz)	ANT POL	MTR RDG (dBuV)	ANT FAC dB	CABLE FAC dB	CONV. F.I. to dBm(dipole)	TOTAL dBm	ERP LIMIT dBm
432.0	H	21.1	16.5	2.1	97.2	-57.5	-16.8
	V	25.7	16.5	2.1	97.2	-52.9	-16.8
648.0	H	24.9	19.5	2.3	97.2	-50.5	-16.8
	V	30.3	19.5	2.3	97.2	-45.1	-16.8
864.0	H	9.7	21.6	2.5	97.2	-63.4	-16.8
	V	16.5	21.6	2.5	97.2	-56.6	-16.8
1080.0	H	29.5	23.7	2.7	97.2	-41.3	-16.8
	V	27.3	23.7	2.7	97.2	-43.5	-16.8
1296.0	H	16.9 AMB	24.4	2.9	97.2	-53.0	-16.8
	V	19.2	24.4	2.9	97.2	-50.7	-16.8
1512.0	H	17.1 AMB	25.1	3.1	97.2	-51.9	-16.8
	V	16.8 AMB	25.1	3.1	97.2	-52.2	-16.8
1728.0	H	18.1 AMB	26.6	3.3	97.2	-49.2	-16.8
	V	18.1 AMB	26.6	3.3	97.2	-49.2	-16.8
1944.0	H	17.9 AMB	27.5	3.5	97.2	-48.3	-16.8
	V	18.2 AMB	27.5	3.5	97.2	-48.0	-16.8
2160.0	H	30.6 AMB	28.1	3.7	97.2	-34.8	-16.8
	V	30.8 AMB	28.1	3.7	97.2	-34.6	-16.8

$$\text{Limit} = 13.2 \text{ dBm} - 30 \text{ dB} = -16.8 \text{ dBm}$$

CHECKED BY: RJK

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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: ANTENNAS								
NTAO	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2057	.03-2GHZ	03/18/98	12	03/18/99
NWHO	DOUBLE RIDGED WAVEGUIDE	TENSOR	4105	2081	1-12.4GHZ	08/26/98	12	08/26/99
Equipment Type: PROBES; CLAMP-ON & LISNS								
RAE4	SPECTRUM ANALYZER	HEWLETT PACKARD	8566B	3638A08788	100HZ-22GHZ	12/21/98	6	06/21/99
Equipment Type: RECEIVERS								
RACD	RF PRESELECTOR	HEWLETT PACKARD	85685A	3010A01205	20HZ-2GHZ	01/29/99	12	01/29/00

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.

Date: 03/02/99

Location = "EEE" Job Number = "27495"