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Downers Grove, Illinois
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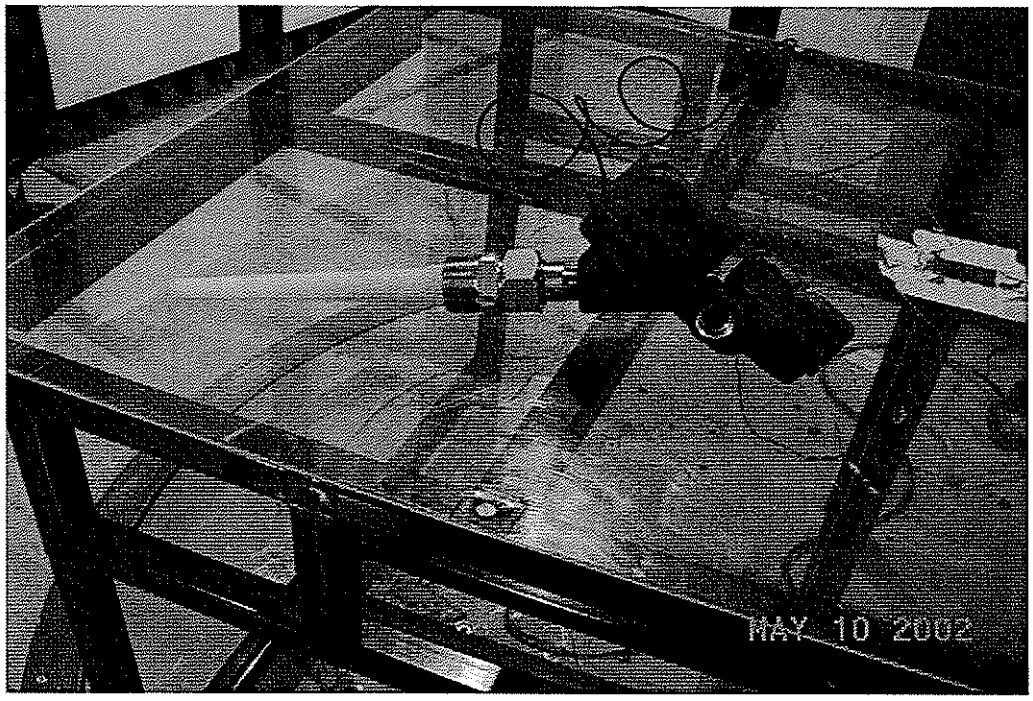
Engineering Test Report Number 31838-01



MEASUREMENT OF RF INTERFERENCE FROM A MODEL R95 FLUID LEVEL MEASUREMENT TRANSMITTER

FOR: **Magnetrol International**
5300 Belmont Rd.
Downers Grove, Illinois 60515

Dates Tested: January 13 through March 13, 2003

Test Specifications: FCC "Code of Federal Regulations" Title 47
Part 15, Subpart C, Section 15.205

ENGINEERING TEST REPORT NO. 31838-01

ADMINISTRATIVE DATA AND SUMMARY OF TESTS

DESCRIPTION OF TEST ITEM: Fluid Level Measurement Transmitter

MODEL NO: R95 **SERIAL NO:** None Assigned

MANUFACTURER: Magnetrol International

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 INCORPORATED
Radio Interference Consultants
Downers Grove, Illinois 60515

DATE RECEIVED: January 13, 2003

DATE TESTED: January 13 through March 13, 2003

PERSONNEL (OPERATORS, OBSERVERS, AND CO-ORDINATORS):
CUSTOMER: Paul Snider of Magnetrol International was present.
ELITE ELECTRONIC: Daniel E. Crowder

ELITE JOB NO.: 30941

ABSTRACT: The model R95 Fluid Level Measurement Transmitter, does meet the radiated emission requirements of 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.

Report By: Daniel E. Crowder - NCE

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

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TOTAL NUMBER OF PAGES IN THIS DOCUMENT, (INCLUDING DATA SHEETS): 23

1.0 INTRODUCTION:

1.1 DESCRIPTION OF TEST ITEM: This document presents the results of a series of radio interference measurements performed on a model R95 Fluid Level Measurement Transmitter, (hereinafter referred to as the test item). No serial number was assigned to the test item. The test item was designed to transmit at approximately 6.3GHz using either an external rod or horn antenna. The tests were performed for Magnetrol International of Downers Grove, Illinois.

1.2 PURPOSE: The test series was performed to determine if the test item meets the requirements for a Class 2 permissive change for the radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections for Intentional Radiators. Testing was performed in accordance with ANSI C63.4-2001.

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 2001

- ANSI C63.4-2001, "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 Elite Electronic Engineering Incorporated of Downers Grove, Illinois. The laboratory is accredited by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP Lab Code: 100278-0.

1.6 LABORATORY CONDITIONS: The temperature at the time of the test was 22°C and the relative humidity was 38%.

2.0 TEST ITEM SETUP AND OPERATION:

A block diagram of the test item setup is included as Figure 1. The test item was tested in multiple configurations. The test item was tested with either a rod antenna or horn antenna. The test item was tested in a metal tank, a plastic tank and concrete tank.

2.1 POWER INPUT: The test item was powered with 24VDC through a 24VDC power supply.

2.2 GROUNDING: Since the test item was powered with 24VDC power supply, it was ungrounded during the tests.

2.3 PERIPHERAL EQUIPMENT: There was no peripheral equipment submitted with the test item.

2.4 INTERCONNECT CABLES: The were no interconnect cables submitted with the test item.

2.5 OPERATIONAL MODE: For all tests the test item was energized and transmitting at 6.3GHz

3.0 TEST EQUIPMENT:

3.1 TEST EQUIPMENT LIST: 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.

The fundamental, harmonics and spurious emissions were measured with a spectrum analyzer. The spectrum analyzer readings were converted to peak using a peak desensitization factor and converted to average readings using a duty cycle factor.

3.2 CALIBRATION TRACEABILITY: Test equipment is maintained and calibrated on a regular basis. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

3.3 MEASUREMENT UNCERTAINTY: All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

The measurement uncertainty budgets were based on guidelines in "ISO Guide to the

Expression of Uncertainty in Measurements" and NAMAS NIS81 "The Treatment of Uncertainty in EMC Measurements".

The measurement uncertainty for these tests is presented below:

Conducted Emission Measurements:		
Combined Standard Uncertainty	1.07	-1.07
Expanded Uncertainty (95% confidence)	2.1	-2.1
Radiated Emission Measurements:		
Combined Standard Uncertainty	2.26	-2.18
Expanded Uncertainty (95% confidence)	4.5	-4.4

4.0 REQUIREMENTS, PROCEDURES AND RESULTS:

4.1 POWERLINE CONDUCTED EMISSIONS:

4.1.1 REQUIREMENTS: Since the test item has no connection to the AC mains, no conducted emissions tests were performed.

4.2 DESENSITIZATION AND DUTY CYCLE FOR PULSED EMISSIONS:

4.2.1 PROCEDURES: Since the test item transmits pulsed energy, the desensitization factor α has been calculated and included in the calculation for the final peak value.

In the HP Application Note 150-2, The spectrum analyzer settings to measure a line spectrum are defined as follows:

1. Bandwidth $B < 0.3 * PRF$
2. Scan Time $Ts > Fs/B^2$

With the pulse repetition frequency (PRF) of the test item of 1.9MHz and the selected measurement bandwidth of 100kHz, the requirement 1. was observed.

The scan width of Fs = 50MHz and bandwidth of B = 100kHz leads to following values:

$$Fs/B^2 = 50MHz/(100kHz)^2 = 5mSec$$

The selected scan time of Ts = 37.5mSec meets requirement 2. Hence a line spectrum was measured.

The desensitization factor α was calculated according to HP application note 150-2.

$$\alpha = 20\text{Log}(\tau\text{eff}/T)$$
$$= 20\text{Log}(1.5\text{nSec}/540\text{nSec})$$
$$= -51\text{dB}$$

The duty cycle factor is used to convert peak detected readings to average readings

$$\text{Duty Cycle} = 20\text{Log}(\text{Teff}/T)$$
$$= 20\text{Log}(1.5\text{nSec}/540\text{nSec})$$
$$= -51\text{dB}$$

The calculations are based on the pulse width Teff = 1.5nSec and the pulse period T = 540nSec, which were supplied by the applicant.

4.2.2 RESULTS: A plot showing the PRF and pulse duration is presented on page 14. The information was supplied by Magnetrol International. With the test item transmitting at 6.3GHz, the peak desensitization factor is 51dB and the duty cycle IS-51dB.

4.3 RADIATED MEASUREMENTS:

4.3.1 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 15.209 has the following radiated emission limits:

Frequency MHz	Field Intensity uV/m @ 3 meters
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

4.3.2 PROCEDURES: All preliminary 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.

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.

Preliminary radiated emissions measurements were first performed using a peak detector and automatically plotted. The frequencies where significant emission levels were noted were then remeasured.

With the broadband measuring antennas positioned at a 0.3 meter distance from the test item, the frequency range from 30MHz to 18GHz was investigated using a peak detector function with the antennas set for vertical polarization.

Final radiated emissions were performed at Magnetrol's production facility for the metal tank mount configuration and at the Downers Grove, Illinois waste water treatment plant for the plastic and concrete tank mount configurations.. All significant broadband and narrowband emissions found in the preliminary sweeps using the following methods:

1) Measurements were made using a peak detector and a double ridged waveguide antenna at a 30cm test distance.

2) To ensure that maximum, or worst case, emission levels were measured, the following steps were taken:

   (a) The test item was rotated so that all of its sides when configured according to Para. 2.0 were exposed to the receiving antenna.

   (b) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.

   (c) The fundamental through the 10th harmonic of the transmit frequency were measured.

4.3.3 RESULTS: The preliminary plots, with the test item transmitting at 6.3 GHz, are presented on pages 15 through 18. The plots are presented for a reference only, and are not used to determine compliance.

The final open area radiated levels, with the test item transmitting at 6.3GHz, are presented on pages 19 through 21.

Plots of spectrum at the fundamental frequency are presented on pages 22 and 23. As

can be seen from the data, all emissions measured from the test item were within the specification limits. Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown on Figure 2.

5.0 CONCLUSION:

It was found that the Magnetrol International model R95 Fluid Level Measurement Transmitter, does meet the requirements of a Class 2 permissive change to the radiated emission requirements of 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 Incorporated 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 only 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.

7.0 ENDORSEMENT DISCLAIMER:

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

TABLE I: 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	---		N/A	
Equipment Type: AMPLIFIERS								
APH0	POWER AMPLIFIER	HEWLETT PACKARD	11975A	2304A00322	2-8GHZ		NOTE 1	
APK0	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	3008A00662	1-26.5GHZ	02/22/03	12	02/22/04
Equipment Type: ANTENNAS								
NHG0	STANDARD GAIN HORN ANTENNA	NARDA	638	---	18-26.5GHZ		NOTE 1	
NHH1	STANDARD GAIN HORN ANTENNA	NARDA	V637	---	26.5-40GHZ		NOTE 1	
NHJ0	STANDARD HORN ANTENNA	MILLITECH	SGH-19-RP000	016	40-60GHZ		NOTE 1	
NTA0	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL611	2057	0.03-2GHZ	05/09/02	12	05/09/03
NWI1	RIDGED WAVE GUIDE	AEL	H1498	154	2-18GHZ	09/18/02	12	09/18/03
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	01/18/03	12	01/18/04
RACB	RF PRESELECTOR	HEWLETT PACKARD	85685A	3506A01491	20HZ-2GHZ	01/18/03	12	01/18/04
RAF3	QUASIPEAK ADAPTER	HEWLETT PACKARD	85650A	3303A01775	0.01-1000MHZ	01/18/03	12	01/18/04
RAH0	FREQUENCY MIXER	HEWLETT PACKARD	11970K	2332A00270	18-26GHZ		N/A	
RAI0	FREQUENCY MIXER	HEWLETT PACKARD	11970A	2332A00292	26-40GHZ		N/A	
RAJ0	FREQUENCY MIXER	HEWLETT PACKARD	11970U	2332A00210	40-60GHZ		N/A	
Equipment Type: TEST CHAMBERS (EMI)								
R21F	3M ANECHOIC CHAMBER MEETS	EMC TEST SYSTEM	3M ANECHOIC		30MHZ-18GHZ	05/18/02	12	05/18/03

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.

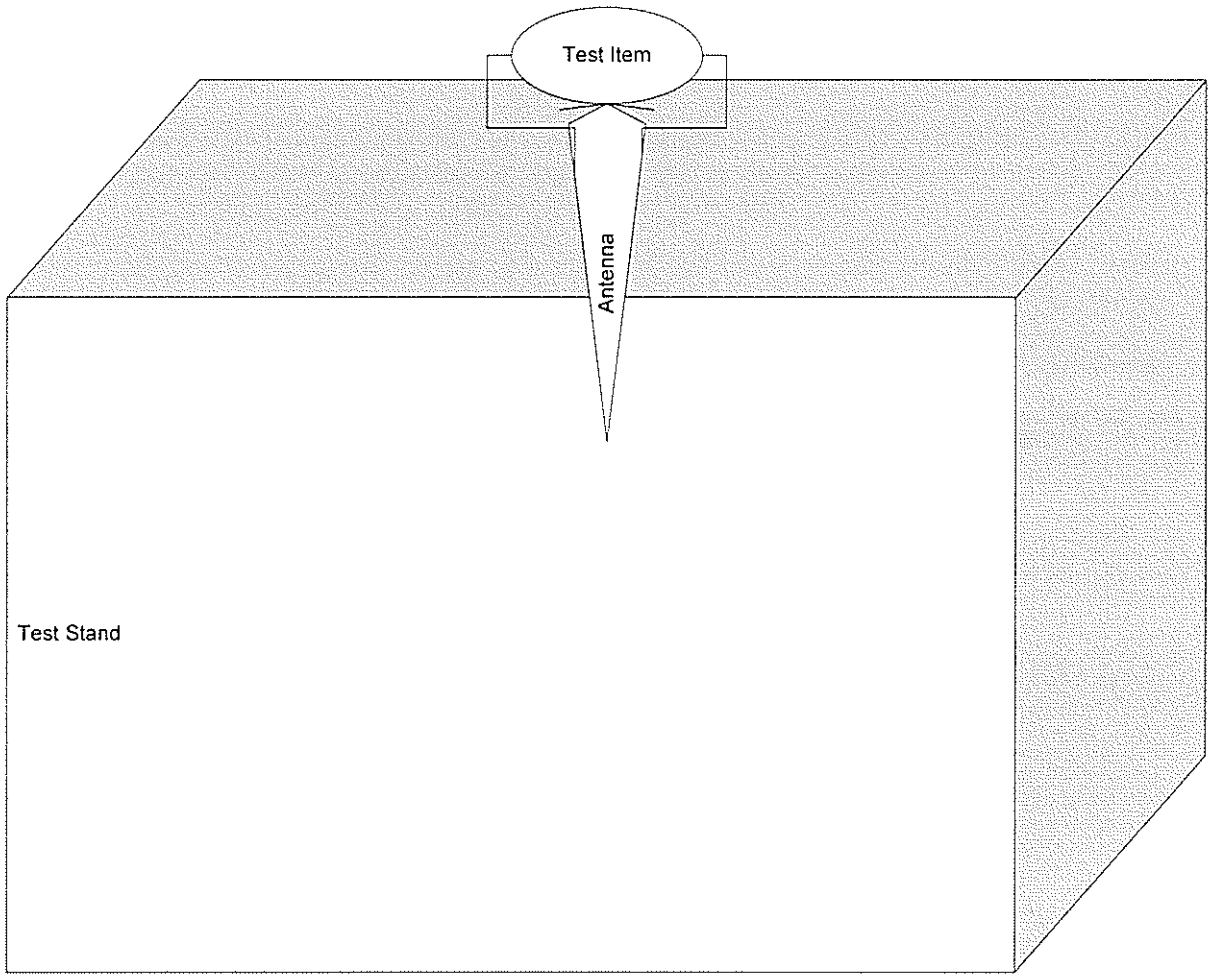

FIGURE 1 - TEST ITEM IN NORMAL CONFIGURATION (ANTENNA POINTED DOWN)

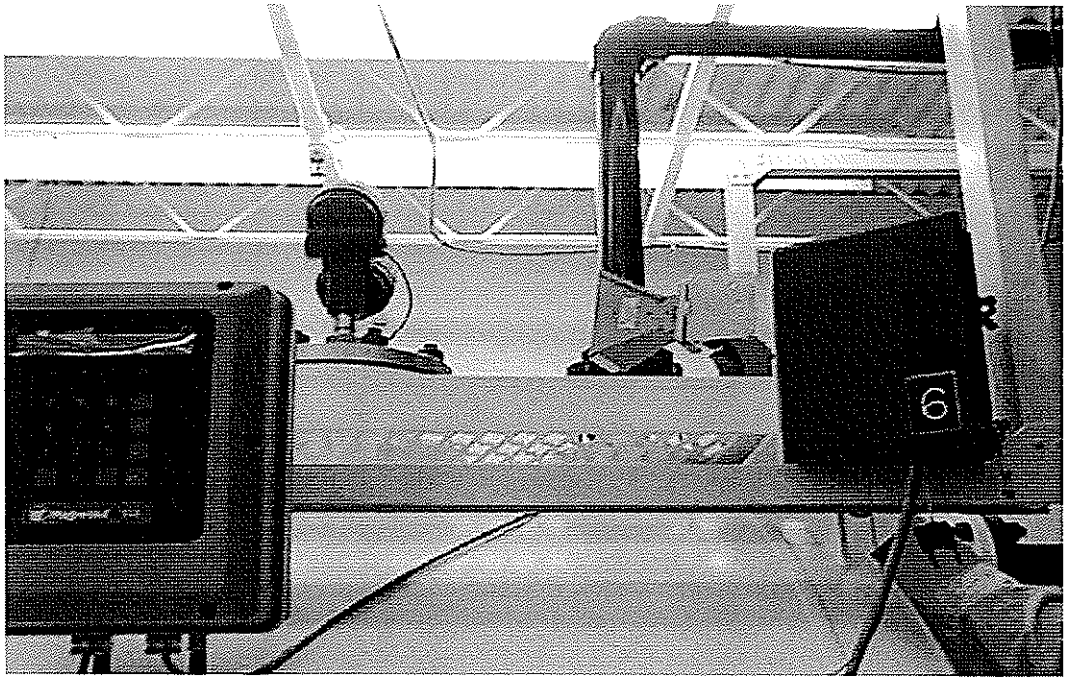

FIGURE 2 - TEST SETUP FOR HIGHEST RADIATED EMISSIONS MEASUREMENT IN A METAL TANK

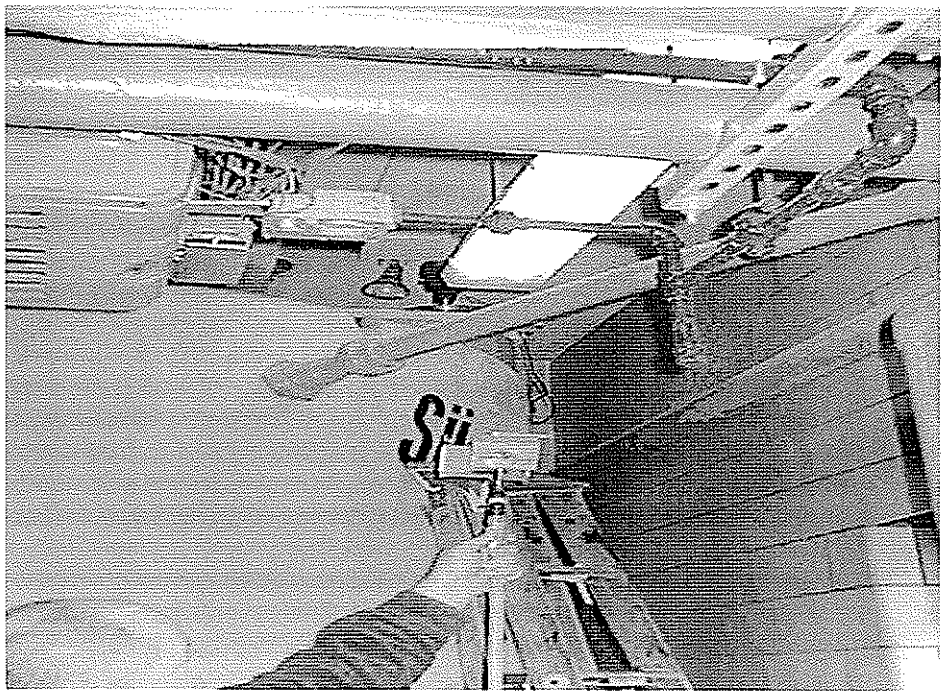

FIGURE 2 - TEST SETUP FOR HIGHEST RADIATED EMISSIONS MEASUREMENT IN A PLASTIC TANK

FIGURE 2 - TEST SETUP FOR HIGHEST RADIATED EMISSIONS MEASUREMENT IN A CONCRETE TANK

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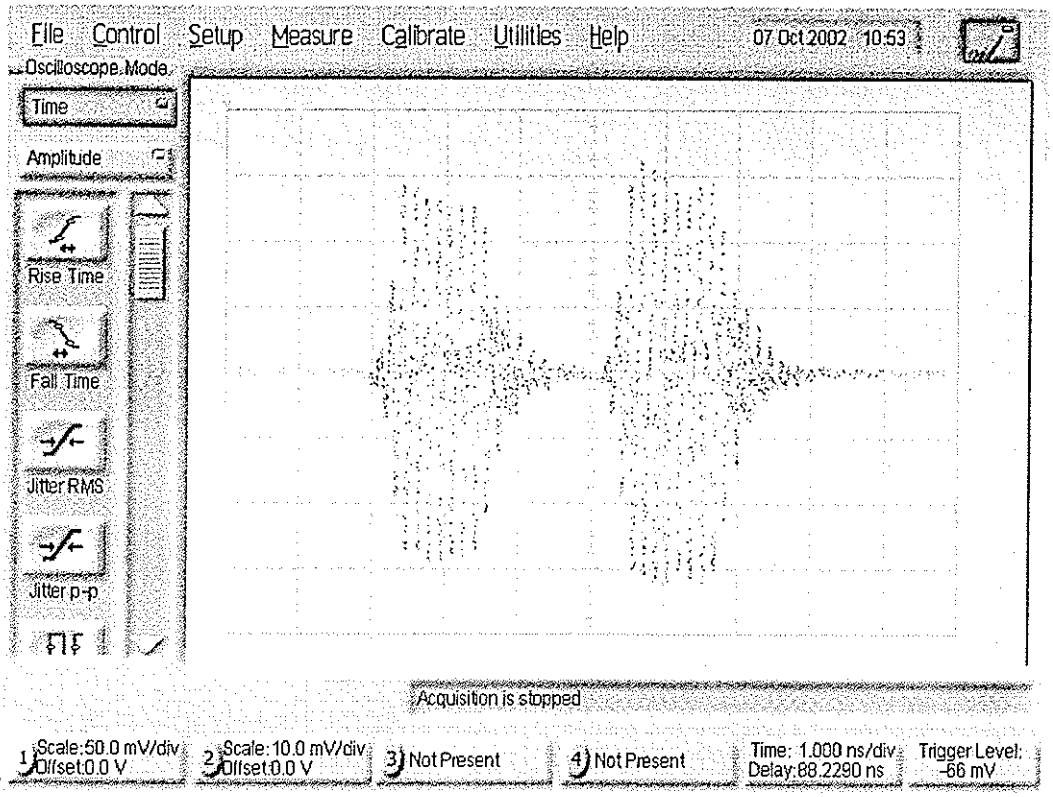
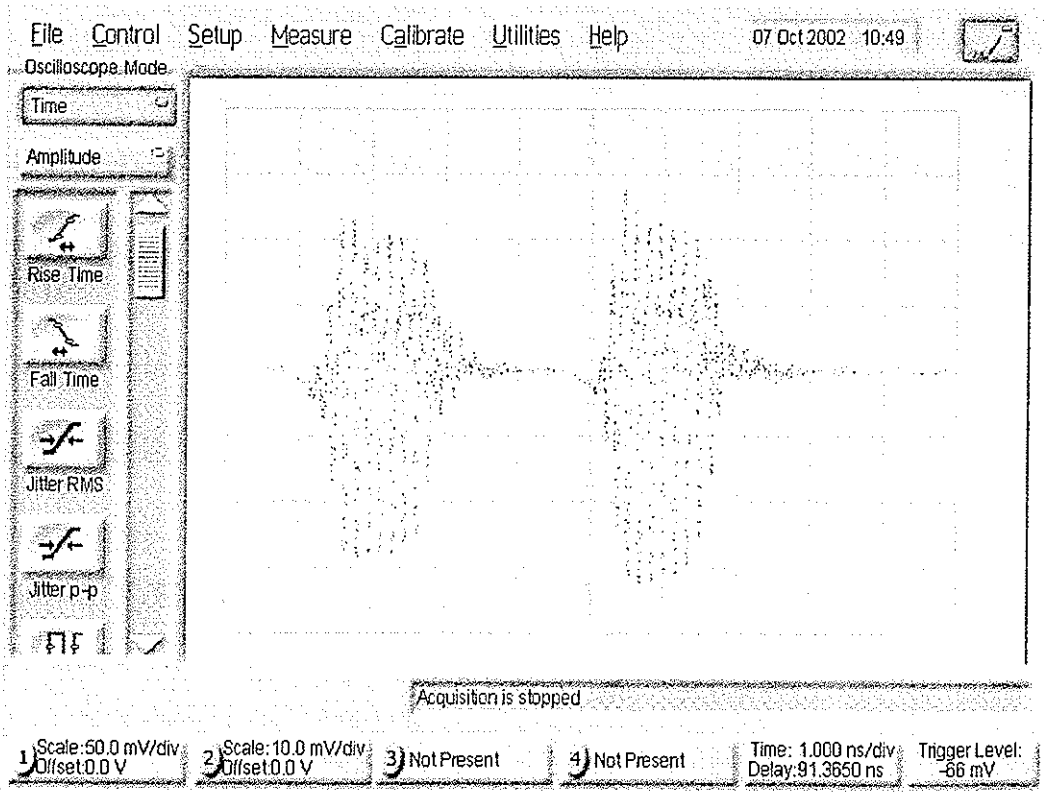


New



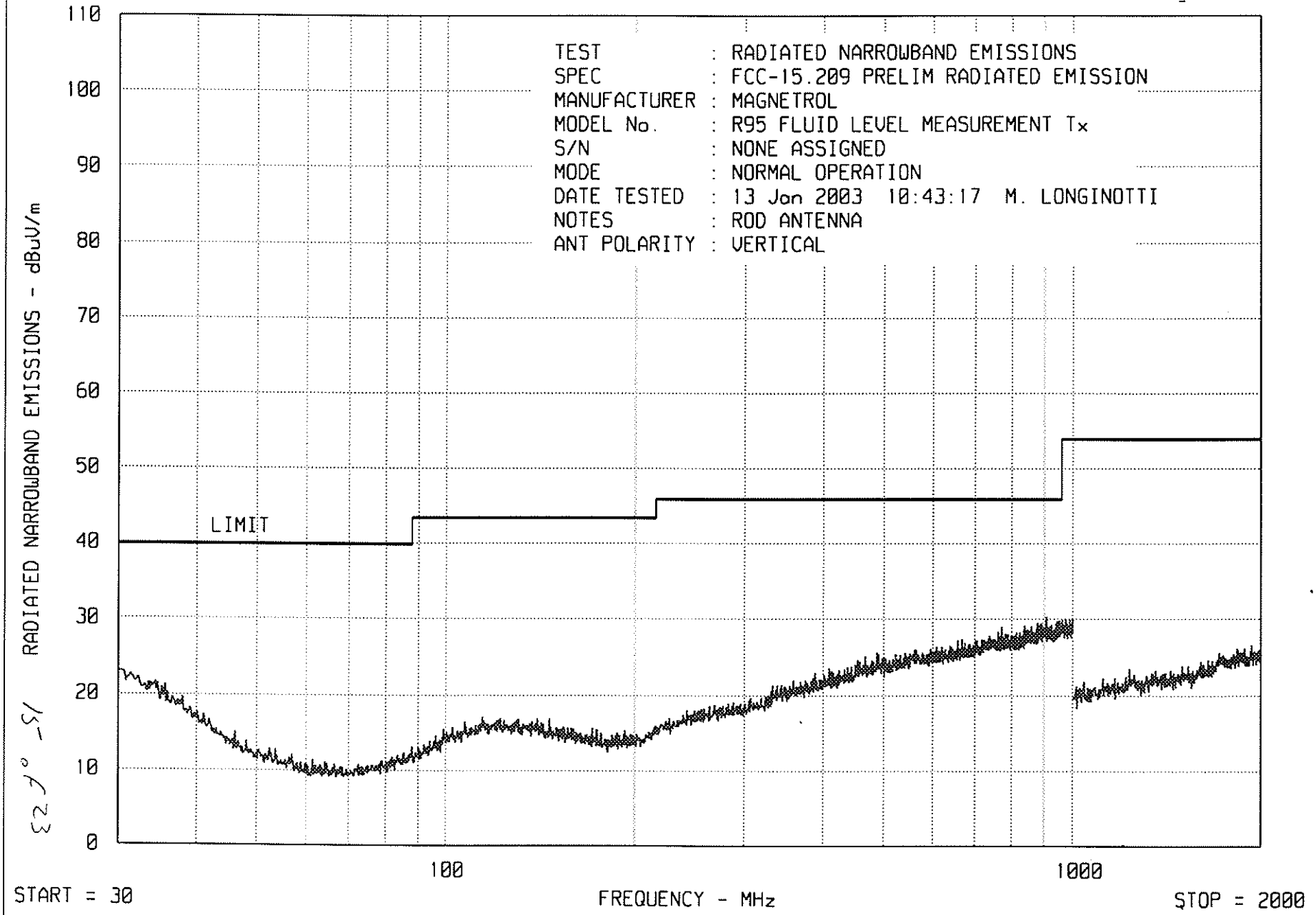
Old

ELITE ELECTRONIC ENGINEERING Inc.

Downers Grove, Ill. 60515

WKA0 11/15/02

UNIV_EM RUN RUN 1



32.7° -5/

ETL 31638-61

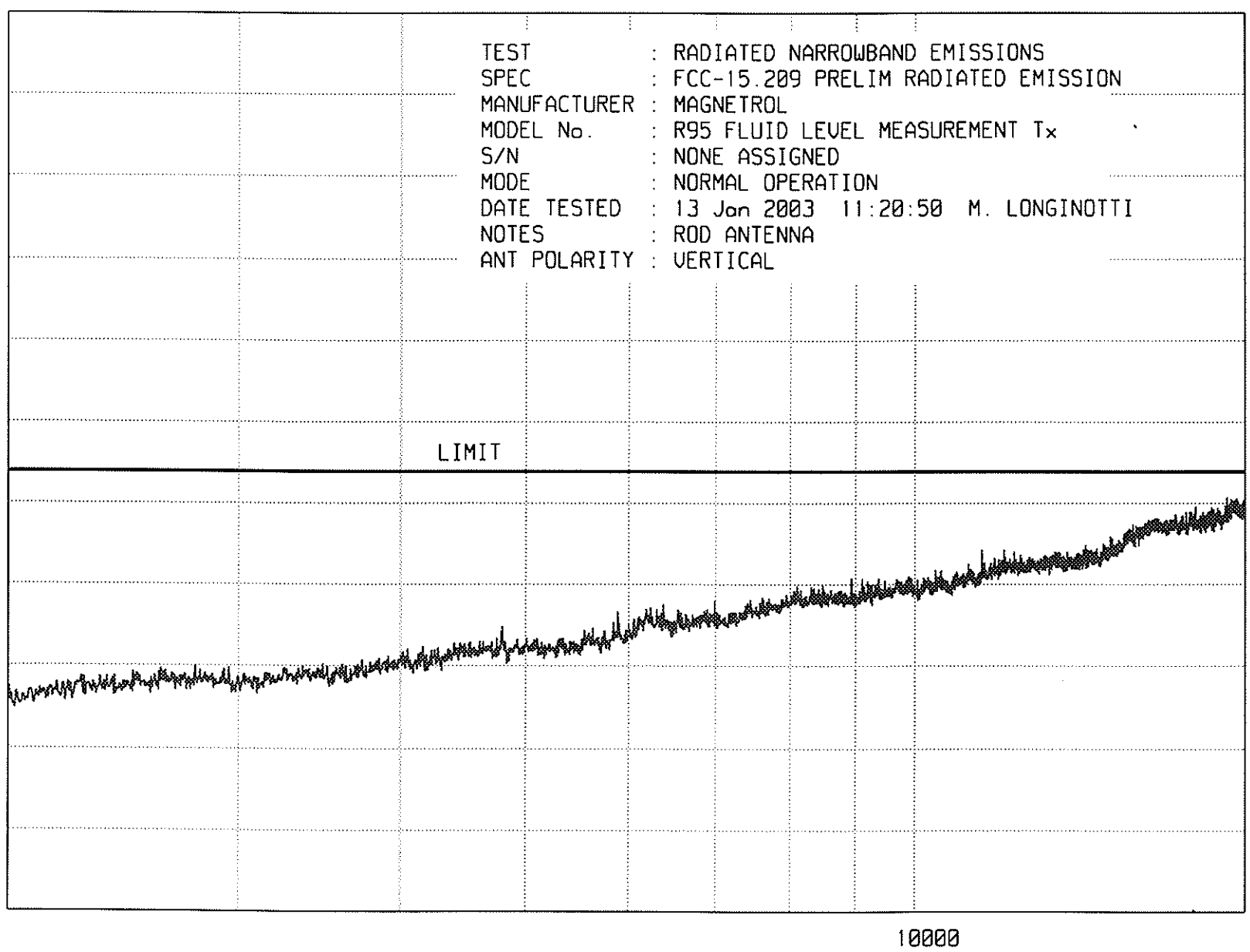
ELITE ELECTRONIC ENGINEERING Inc.

Downers Grove, Ill. 60515

WKA0 11/15/02

UNIV_EM RUN RUN 2

TEST : RADIATED NARROWBAND EMISSIONS
SPEC : FCC-15.209 PRELIM RADIATED EMISSION
MANUFACTURER : MAGNETROL
MODEL No. : R95 FLUID LEVEL MEASUREMENT Tx
S/N : NONE ASSIGNED
MODE : NORMAL OPERATION
DATE TESTED : 13 Jan 2003 11:20:50 M. LONGINOTTI
NOTES : ROD ANTENNA
ANT POLARITY : VERTICAL



32 @ 3m

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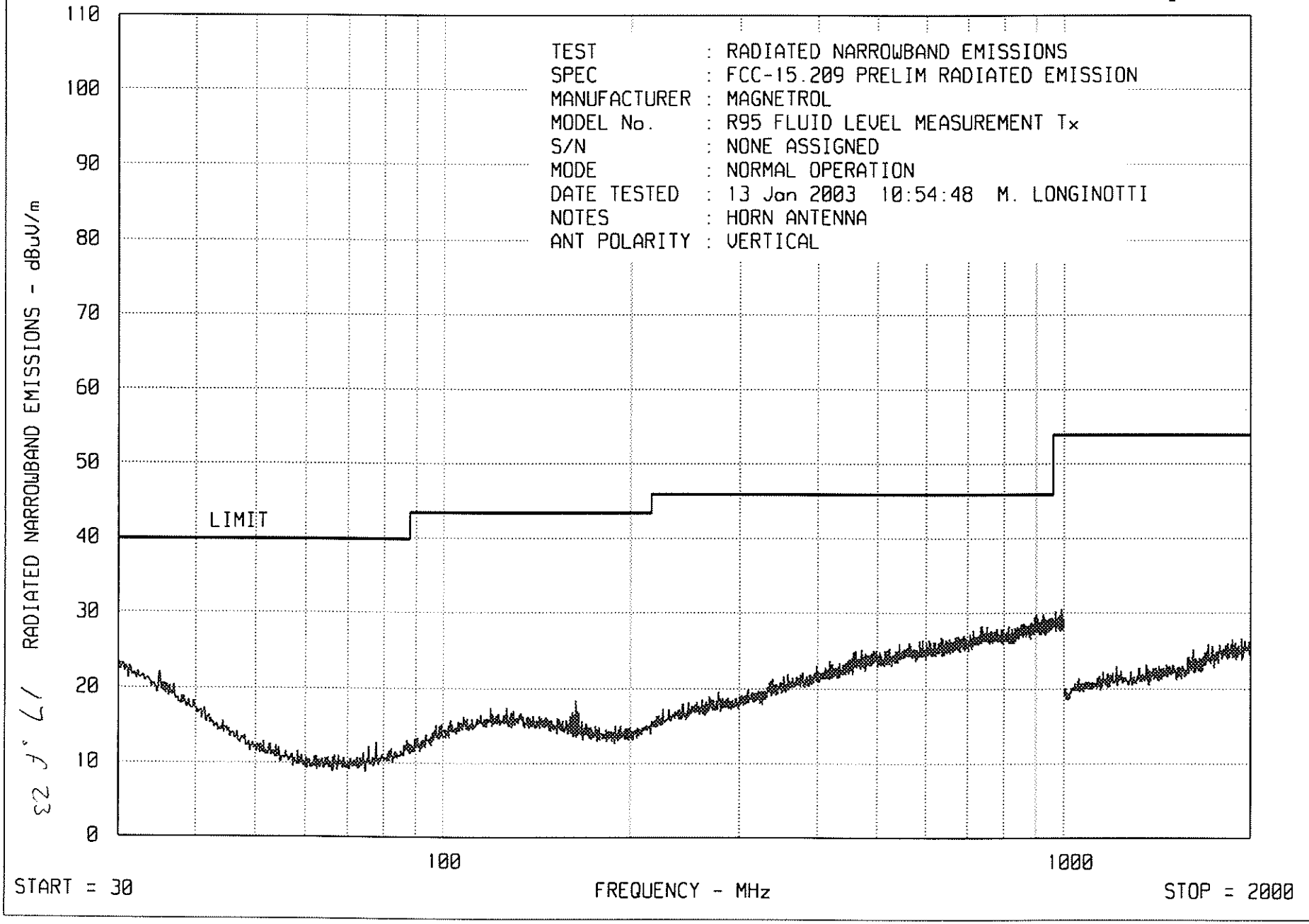
ELITE ELECTRONIC ENGINEERING Inc.

Downers Grove, Ill. 60515

WKA0 11/15/02

UNIV_EM RUN RUN 1



S2 J' L1

STL 31838-01

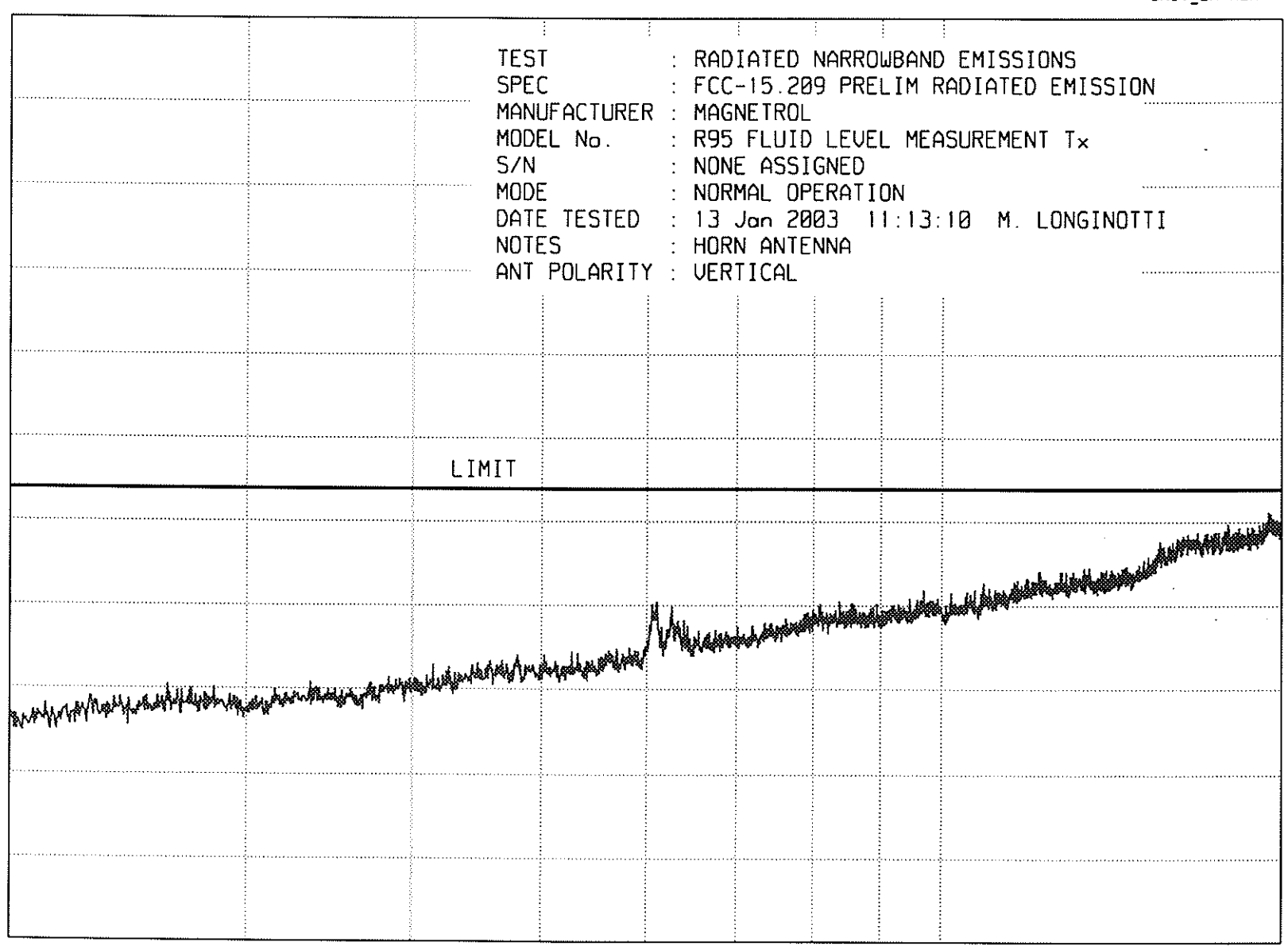
ELITE ELECTRONIC ENGINEERING Inc.

Downers Grove, Ill. 60515

WKA0 11/15/02

UNIV_EM RUN RUN 2

TEST : RADIATED NARROWBAND EMISSIONS
SPEC : FCC-15.209 PRELIM RADIATED EMISSION
MANUFACTURER : MAGNETROL
MODEL No. : R95 FLUID LEVEL MEASUREMENT Tx
S/N : NONE ASSIGNED
MODE : NORMAL OPERATION
DATE TESTED : 13 Jan 2003 11:13:10 M. LONGINOTTI
NOTES : HORN ANTENNA
ANT POLARITY : VERTICAL



START = 2000

FREQUENCY - MHz

STOP = 18000

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ETR 31838-01
DATA SHEET

MANUFACTURER : MAGNETROL
MODEL : R95 FLUID LEVEL MEASUREMENT TRANSMITTER
S/N : NONE ASSINGED
SPECIFICATION : FCC-15C OPEN FIELD SPURIOUS RADIATED EMISSIONS
DATE : MARCH 13, 2003
NOTES : TRANSMITTING @ 6.3GHz;
: TEST DISTANCE IS 0.3 METERS
CONCRETE TANK

FREQ. (GHz)	ANT POL	MTR RDG (dBuV)	ANT FAC dB	CABLE FAC dB	PRE AMP dB	DIST CORR dB	PEAK DESEN dB	DUTY CYCLE dB	TOTAL dBuV/m	LIMIT dBuV/m
HORN ANTENNA										
6.3	H	39.7	36.9	0.9	36.1	20	51	51	21.4	54
	V	41.2	36.9	0.9	36.1	20	51	51	22.9	54
ROD ANTENNA										
6.3	H	39.4	36.9	0.9	36.1	20	51	51	21.1	54
	V	40.8	36.9	0.9	36.1	20	51	51	22.5	54

TOTAL (dBuV/m) = MTR RDG (dBuV) + ANT FAC (dB) + CABLE FAC (dB) - PRE AMP GAIN (dB)
- DIST CORR FAC (dB) + PEAK DESENSITIZATION (dB) - DUTY CYCLE (dB)

* - Peak level < 20dB above average limit in all cases

CHECKED BY:
Daniel E. Crowder

ETR 31838-01
DATA SHEET

MANUFACTURER : MAGNETROL
MODEL : R95 FLUID LEVEL MEASUREMENT TRANSMITTER
S/N : NONE ASSINGED
SPECIFICATION : FCC-15C OPEN FIELD SPURIOUS RADIATED EMISSIONS
DATE : MARCH 13, 2003
NOTES : TRANSMITTING @ 6.3GHz;
: TEST DISTANCE IS 0.3 METERS
METAL TANK

FREQ. (GHz)	ANT POL	MTR RDG (dBuV)	ANT FAC dB	CABLE FAC dB	PRE AMP dB	DIST CORR dB	PEAK DESEN dB	DUTY CYCLE dB	TOTAL dBuV/m	LIMIT dBuV/m
HORN ANTENNA										
6.3	H	35.8	36.9	0.9	36.1	20	51	51	17.5	54
	V	36.2	36.9	0.9	36.1	20	51	51	17.9	54
ROD ANTENNA										
6.3	H	35.5	36.9	0.9	36.1	20	51	51	17.2	54
	V	35.9	36.9	0.9	36.1	20	51	51	17.6	54

TOTAL (dBuV/m) = MTR RDG (dBuV) + ANT FAC (dB) + CABLE FAC (dB) - PRE AMP GAIN (dB)
- DIST CORR FAC (dB) + PEAK DESENSITIZATION (dB) - DUTY CYCLE (dB)

* - Peak level < 20dB above average limit in all cases

CHECKED BY:
Daniel E. Crowder

ETR 31838-01
DATA SHEET

MANUFACTURER : MAGNETROL
MODEL : R95 FLUID LEVEL MEASUREMENT TRANSMITTER
S/N : NONE ASSINGED
SPECIFICATION : FCC-15C OPEN FIELD SPURIOUS RADIATED EMISSIONS
DATE : MARCH 13, 2003
NOTES : TRANSMITTING @ 6.3GHz;
: TEST DISTANCE IS 0.3 METERS
PLASTIC TANK

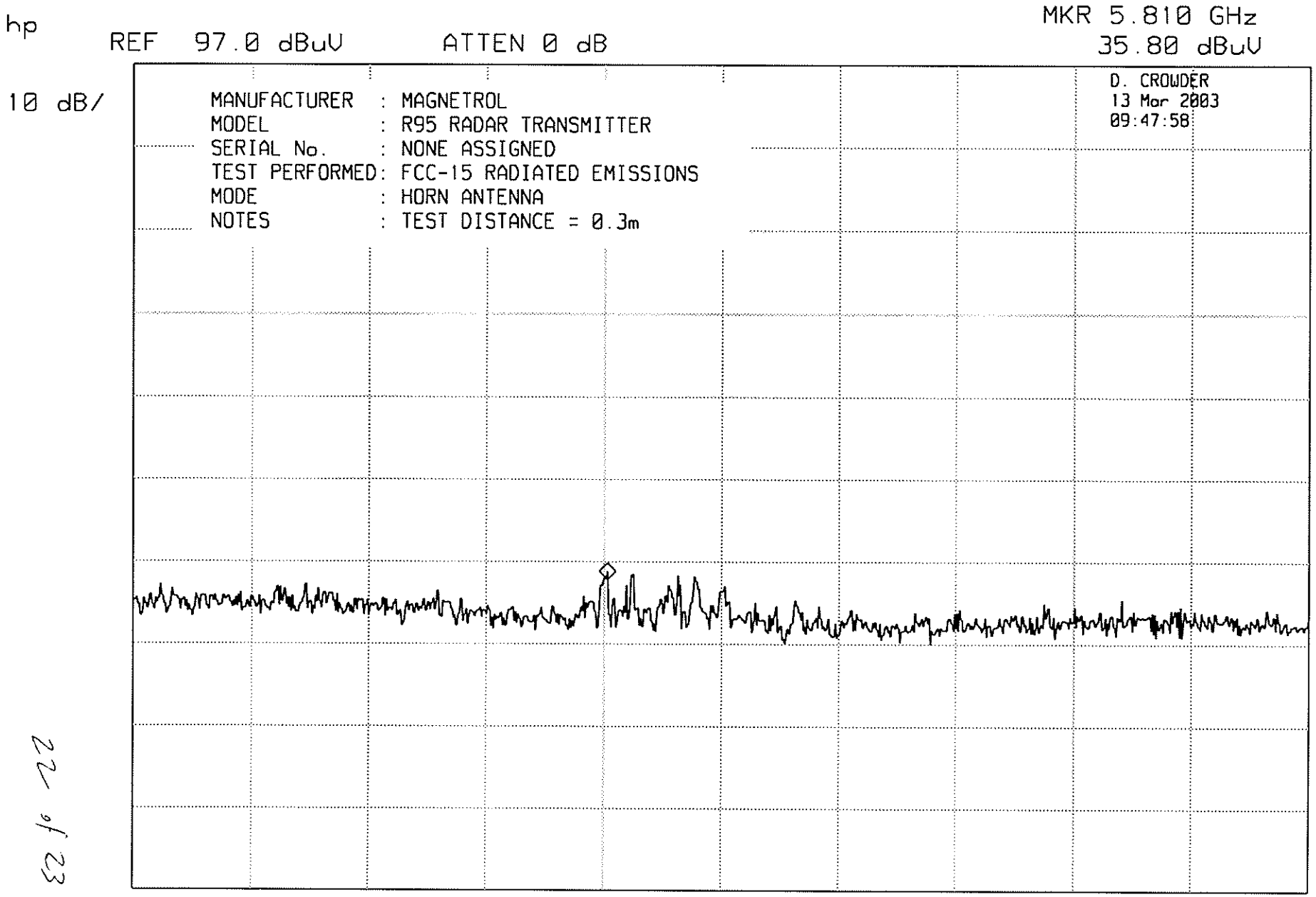
FREQ. (GHz)	ANT POL	MTR RDG (dBuV)	ANT FAC dB	CABLE FAC dB	PRE AMP dB	DIST CORR dB	PEAK DESEN dB	DUTY CYCLE dB	TOTAL dBuV/m	LIMIT dBuV/m
HORN ANTENNA										
6.3	H	36.8	36.9	0.9	36.1	20	51	51	18.5	54
	V	40.2	36.9	0.9	36.1	20	51	51	21.9	54
ROD ANTENNA										
6.3	H	35.2	36.9	0.9	36.1	20	51	51	16.9	54
	V	38.1	36.9	0.9	36.1	20	51	51	19.8	54

TOTAL (dBuV/m) = MTR RDG (dBuV) + ANT FAC (dB) + CABLE FAC (dB) - PRE AMP GAIN (dB)
- DIST CORR FAC (dB) + PEAK DESENSITIZATION (dB) - DUTY CYCLE (dB)

* - Peak level < 20dB above average limit in all cases

CHECKED BY:
Daniel E. Crowder

ELITE ELECTRONIC ENGINEERING Inc.



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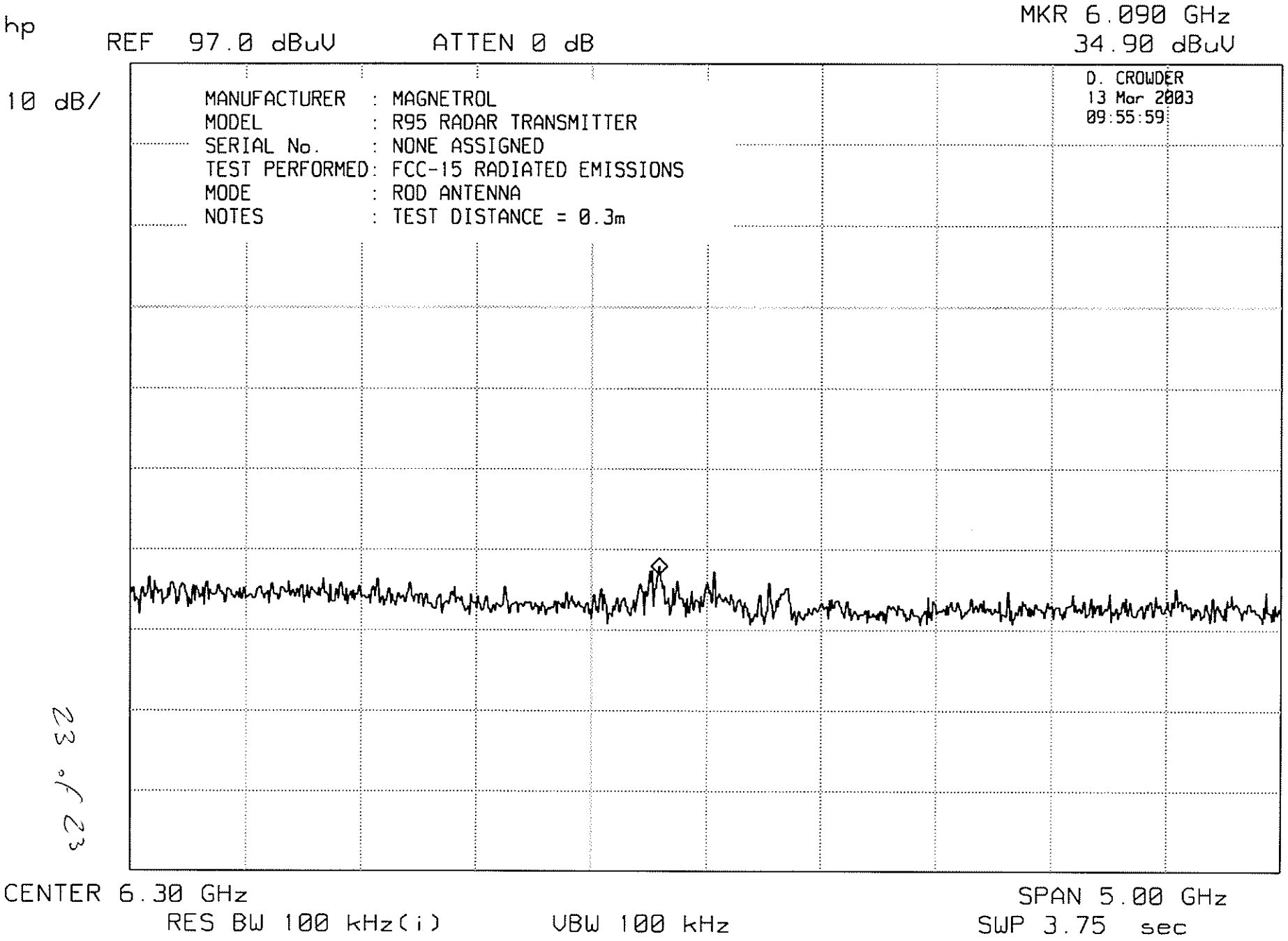

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