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TEST REF. NO: 00/1947-1
DATE: October 5, 2000

TEST REPORT

47 Cfr Ch. 1 (10-1-99 Edition).

CUSTOMER AND MANUFACTURER: Saab Marine Electronics AB
Box 13045
SE-402 51 Göteborg
Sweden

EQUIPMENT UNDER TEST (EUT): Radar Level Gauge. Model Saab Loopradar, s/n 010, with 8" Antenna, and with the Radar mounted in Tanks of different materials.

TEST SPEC.: 47 Cfr Ch. 1 (10-1-99 Edition):
Part 15, Subpart C, Field Disturbance Sensor.
§ 15.209. Radiated emission, fundamental frequency.

DATE OF TEST: September 20 - 21, 2000

TEST SITE: Svenska EMC Lab AB, Karlskrona, Sweden.
FCC List No 31040/SIT 1300F2.
SWEDAC accreditation No: 1713

TEST PERSONNEL: Svenska EMC Lab AB: Bo Gidlöw.
Saab Marine Electronics AB: Per Karlsson.

TEST RESULT: The EUT (Equipment Under Test) did pass the above mentioned test.

Karlskrona October 5, 2000

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Hans Östergren
Manager Svenska EMC Lab AB

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DATE OF RECEIPT: September 20, 2000

CONDITION OF EUT: No remarks. Operates as intended.

DESCRIPTION OF THE EUT:

The EUT is a Radar Tank Gauge used in industrial environments. The used radar frequency is 6.3 GHz. The output power is below 1 mW. To control the radar digital circuits are integrated in the same enclosure as the radar transmitter-receiver. A display and switches for the operation is built-in. The Radar was during the tests mounted on the top of three different types of tanks, plastic, metallic, and concrete, together with the 8" Horn Antenna. The same Radar was previous tested with four different horn antennas. See Test Report No 00/1947. Worst case was with the 8" Horn Antenna.

CALIBRATION DECLARATION:

The test equipment is calibrated as the calibration information in the Test Equipment list. Before starting of the tests the check points in the applicable Checklists were confirmed.

ESTIMATED UNCERTAINTY:

Expanded uncertainty (k = 2), Field Strength, emission 1 to 40 GHz:	± 3 dBµV/m
Frequency, 1 – 40 GHz:	± 100 kHz
Temperature:	± 1 °C
Humidity:	± 5 %

The uncertainties are for a confidence level of not less than 95 %.

TEST EQUIPMENT:

Type/Manufacturer/Bandwidth	**s/n**	**Calibration information**	
		Date	**Interval**
Spectrum Analyzer, HP 8566B	2950A06284	0003	12 months
Plotter, HP 7475A	2641L16543	NA	NA
Signal Amplifier, Aertech A55H-504, 4 – 8 GHz	55-1237	0009	12 months
Signal Amplifier, Aertech A55H-504, 4 – 8 GHz	55-1238	0009	12 months
Double Ridged Guide Antenna, EMCO 3115, 1 - 18 GHz	2338	9709	36 months
Coaxial Cable, Sucoflex 104, l = 5 m	050SU5MV	0001	12 months
Coaxial Cable, Sucoflex 104, l = 2.5 m	025SU3MV	0001	12 months
Antenna Mast System, Jyske EMC, h = 1 - 4 m	93-90172	NA	NA
Turn Table, Jyske EMC	93-90171	NA	NA
Open Area Test Site for 3 m antenna distance	01	0004	36 months

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TEST SET-UP AND PROCEDURE:

See Appendix 1 and 2. As laid out in ANSI C.63.4:1992 Document.

TEST CONDITIONS:

Rating: 115 VAC, 60 Hz, to the peripheral Power Supply. 24 VDC 60 mW to the Tank Radar.
Peripherals: AC/DC Power Supply, Trio PR-630, 115 VAC / 24 VDC. Class I.
Cables: Unshielded combined power line and signal cable of 1 m length without protective earth. Unshielded mains cable of 2.5 m length to the Power Supply.
Clock Frequency: 1.843 MHz. Radar center frequency 6.3 GHz.
Effective radiated power: Less than 0.1 mW.
Radar Pulse data: Pulse length 1.2 nanosecond. Repetition frequency 1 MHz.
See Appendix 4.
Modulation type: No modulation.
Modifications: No modifications.
Operating Conditions: Normal operating conditions. Active level gauging with level measurements. The EUT was programmed for 20 m measurement distance and for the Antenna types used during the tests. Tested at 115 VAC to the Power Supply, and within the range 18 to 36 VDC to the EUT.

TEST PERFORMANCE:

§ 15.209: Radiated Electromagnetic Field:

Measured at the fundamental frequency on the open area test site. The emission was maximized by rotating the table, varying the antenna height 1 to 4 m and the antenna polarization in vertical or horizontal positions. Test instruments according to "TEST EQUIPMENT"- list on page 2.
Test equipment set-up as in Appendix 3.
The radar was mounted on the following tanks:
A) Steel tank, height 100 cm, width 100 cm, and depth 100 cm.
B) Tank of concrete, height 76 cm, and inner diameter 40 cm.
C) Plastic tank, height 155 cm, and diameter 105 cm.
At measurement on 3 m antenna distance were no signal observed. The fundamental emission was too low. The distance was changed to 0.1 m and the limit linearly converted to this distance by adding 30 dB. The peak limit is at 3 m 20 dB + 54 dB (AV. limit) = 74 dBuV/m. At 0.1 m distance is the peak limit then 74 dBµV/m plus 30 dB = 104 dBuV/m.
The analyzer was in max. hold with peak detector (RBW = 1 MHz, VBW = 1 MHz).
Maximum emission was searched for by rotating the table, varying the antenna height and the antenna polarization. No emissions at all were observed at 0.1 m distance from the three types of tanks.

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SUMMARY OF RESULTS:

No influence of different input voltage in the range 18 to 36 VDC.

The peak pulse response of the Spectrum Analyzer has to be corrected for losses at very short pulses. See HP Application Note 150-2:1971, page 14 to 17, desensitization factor.

With tanks of metal, plastic or of concrete no emission could be measured at 0.1 m antenna distance. Margin to limit was with plastic tank – 12.5 dB peak (= noise level) as worst case (8" Antenna). See Appendix 8.

The Radar Level Gauge, Model Saab Loopradar, s/n 010, with worst case 8" Antenna, did pass the above mentioned tests in Part 15, Subpart C, Field Disturbance Sensor.

Karlskrona October 5, 2000

Hans Östergren
Manager Svenska EMC Lab AB

Bo Gidlöw
Test Engineer

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List over Appendixes.

Appendix No	Note
1	Test set-up, photos
2	Test set-up, photos
3	Test equipment set-up
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6	Fundamental, 6.3 GHz. Tank of concrete, 10 cm distance
7	Fundamental, 6.3 GHz. Tank of plastic, 10 cm distance
8	Calculation of Final Emission Levels

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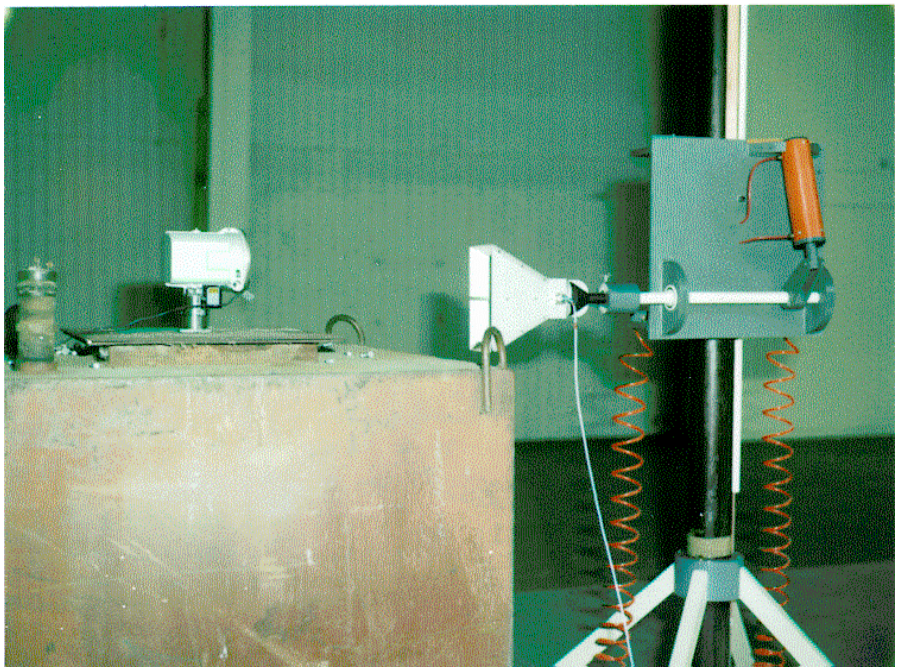
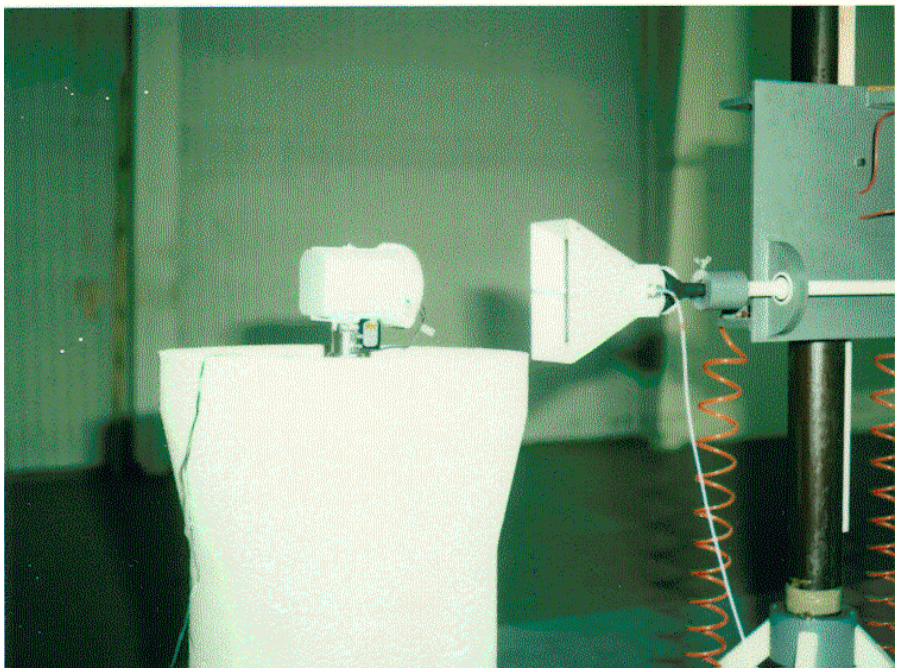
Test set-up, emission from tank of steel



Test set-up, emission from tank of concrete



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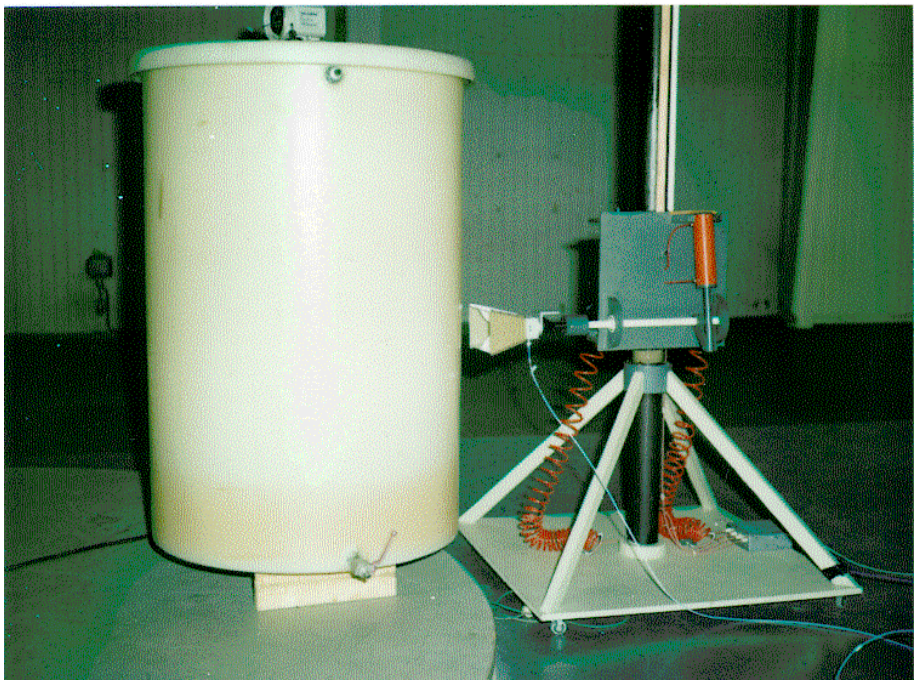
Test set-up, emission from tank of plastic



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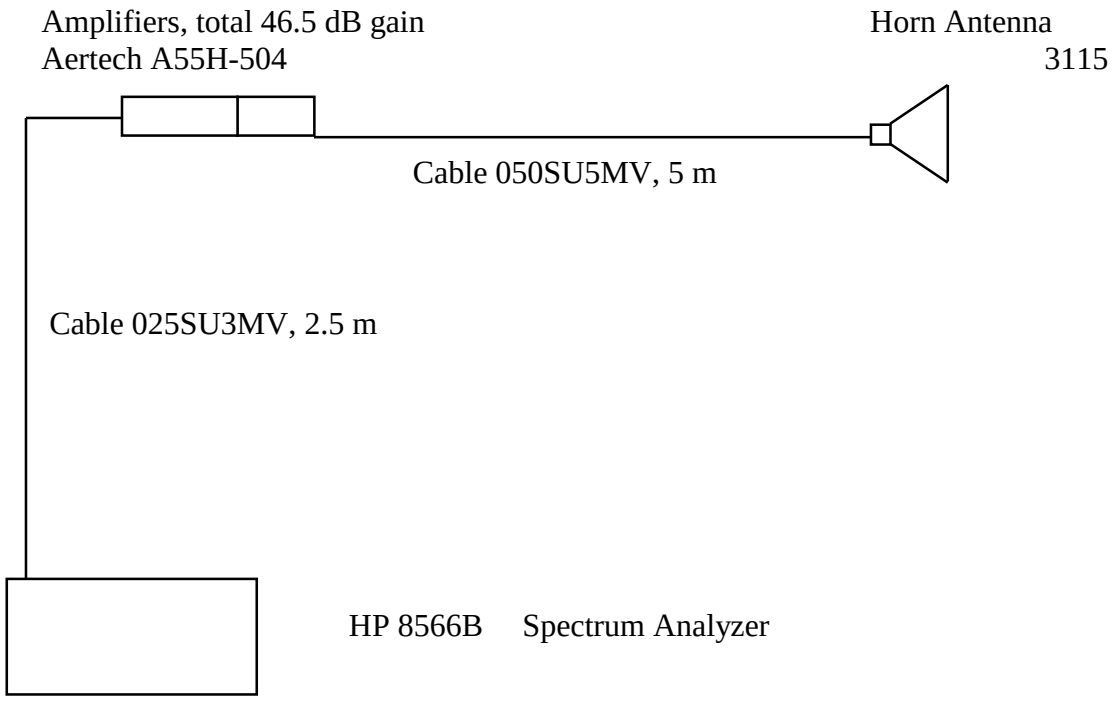
Test equipment set-up

Fundamental:



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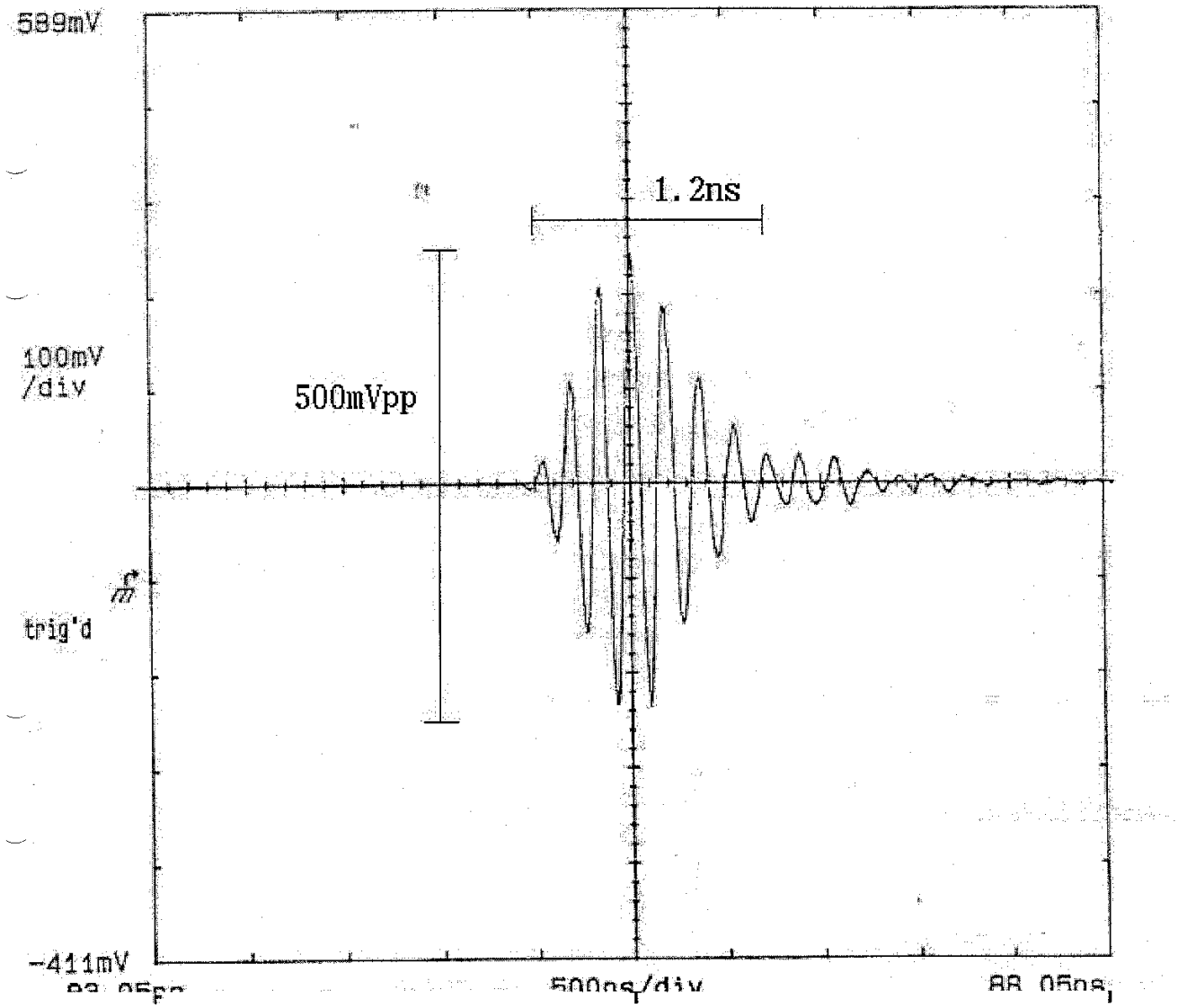
Radar pulse data



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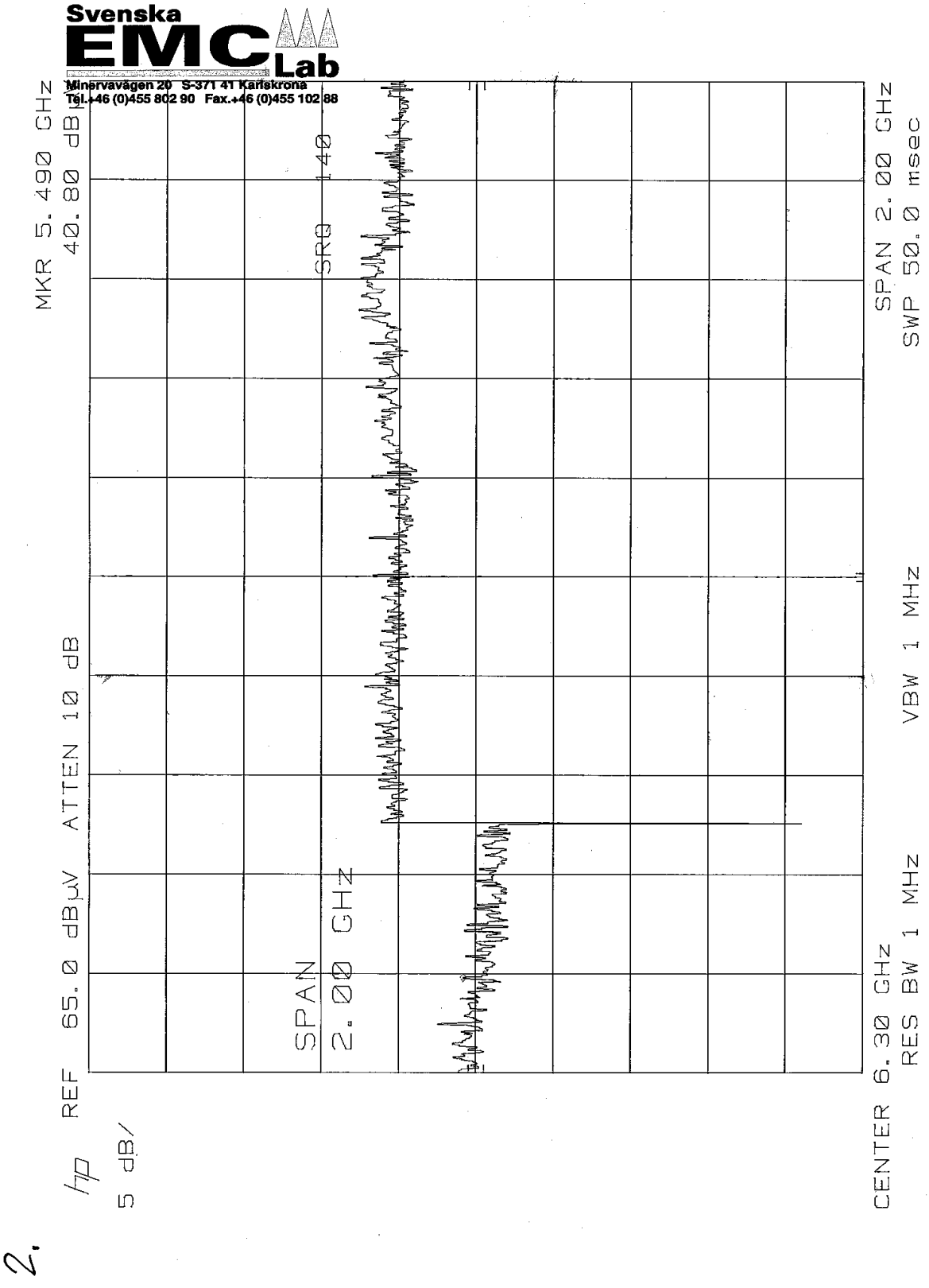
Tank of steel



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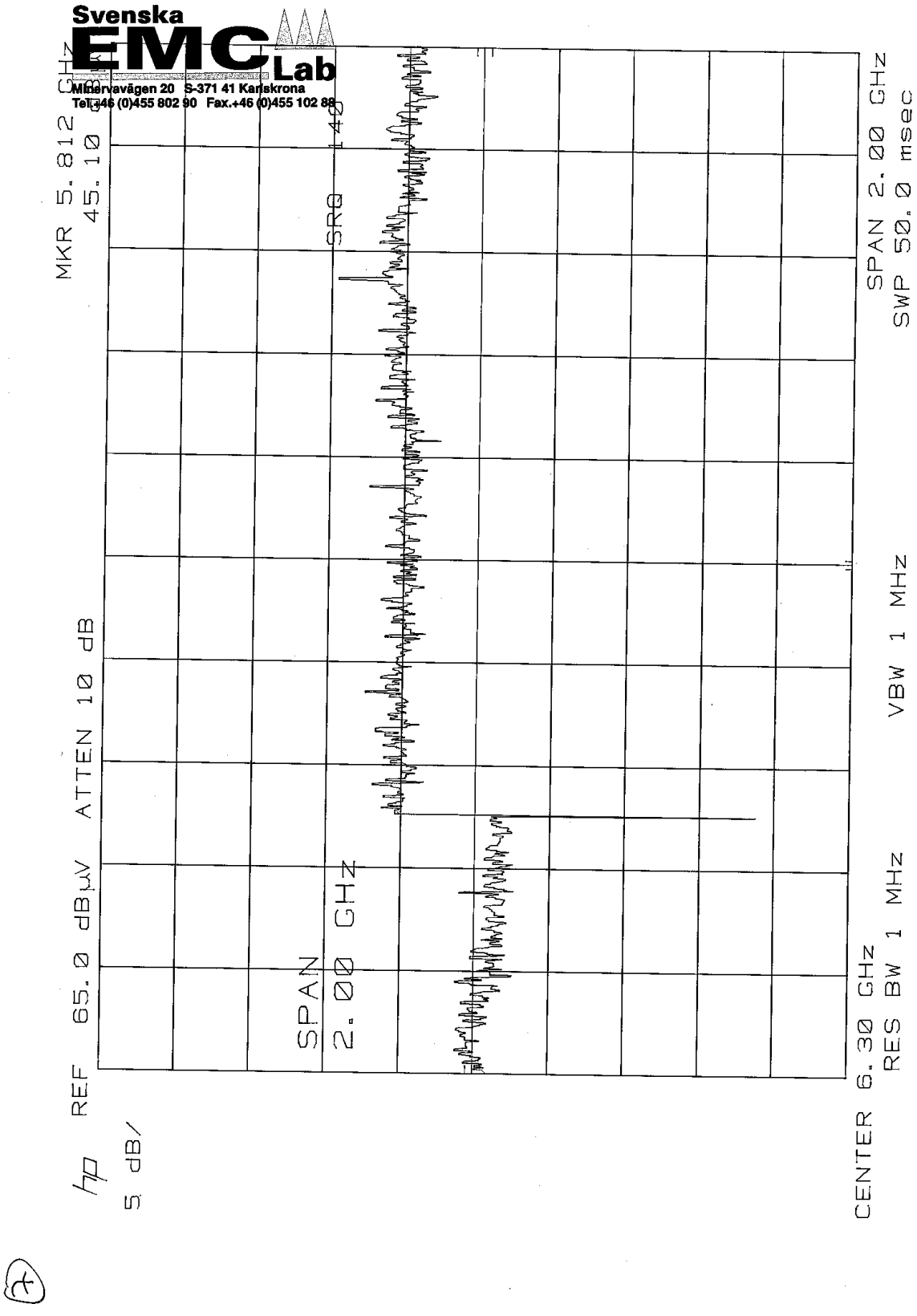
Tank of concrete



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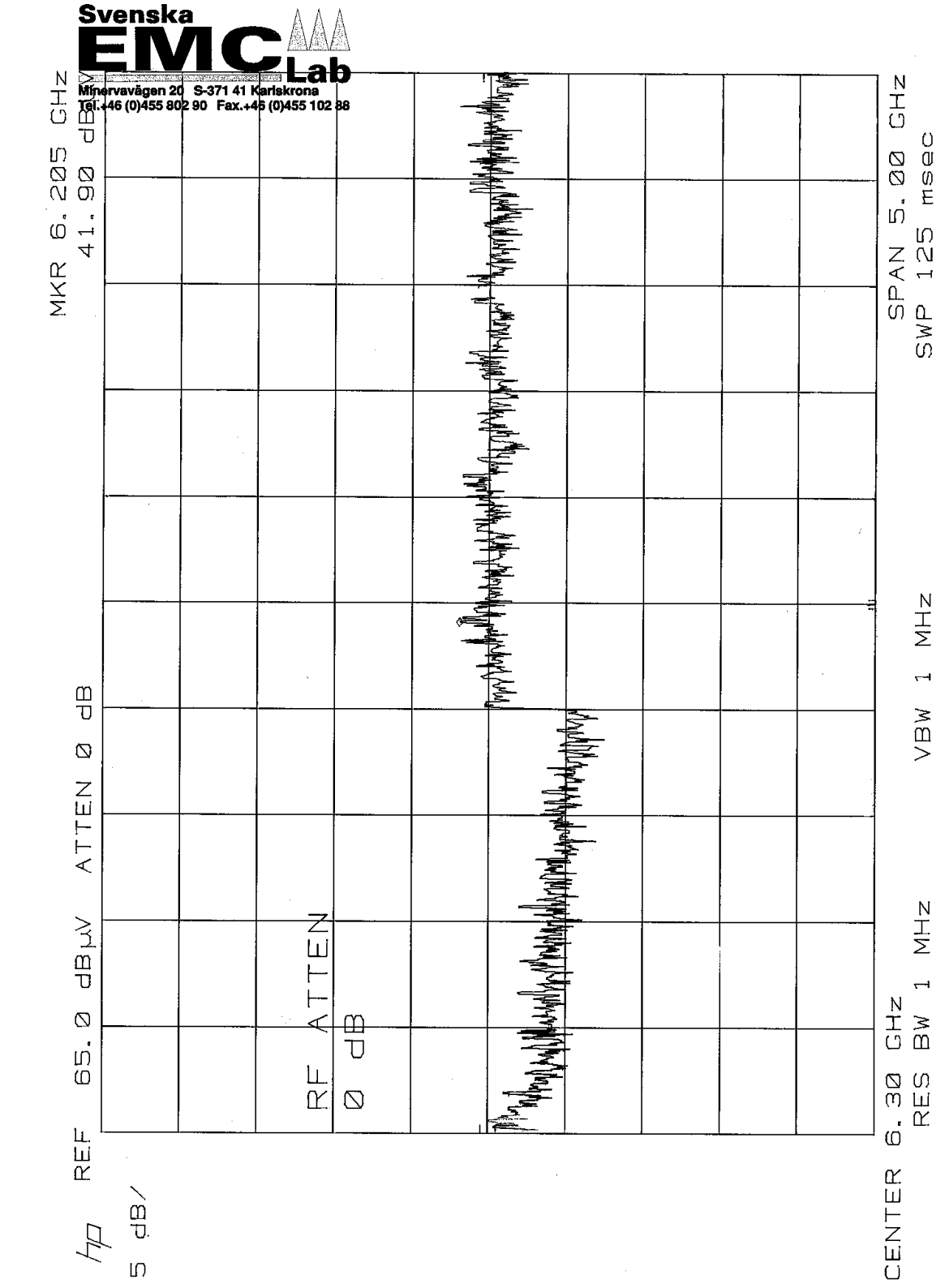
DATE: October 5, 2000

Tank of plastic



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Radiated Fieldstrength Test. Calculation of Final Emission Levels

EUT: Radar Level Gauge. Model Saab Loopradar, s/n 010 with 8" Horn Antenna, mounted in Tanks of different materials.

Test spec.: 47 Cfr Ch. 1 (10-1-99 Edition):
Part 15, Subpart C, Field Disturbance Sensor.
Radiated emission, Open Area Test Site
3 m and 0.1 m antenna distance.

Date: September 20 - 21, 2000

Operation: Normal operating conditions

Field strength (dBuV/m) = Amplitude (dBuV) + Antenna factor (dB/m) + cable loss (dB) + Gain (dB) + 55 dB*

* = pulse desensitization αp. See HP Application Note 150-2:1971, page 14 to 17.

Tested frequency: Fundamental, 6.3 GHz

Measured maximum peak values.

RBW = 1 MHz, VBW = 1 MHz

Ampl. peak.	Tank material	Antenna factor	Preamp total gain	Cable loss	αp	Field strength	Distance	Limit	Margin to limit	Note
dBµV		dB/m	dB	dB dB	dB	dBµV/m	m	dBµV/m	dB	
46	Steel	35.3	- 46.5	3.8 1.9	55	95.5	0.1	104	- 8.5	Noise level.
46	Concrete	35.3	- 46.5	3.8 1.9	55	95.5	0.1	104	- 8.5	Noise level
42	Plastic	35.3	- 46.5	3.8 1.9	55	91.5	0.1	104	- 12.5	Noise level