

# TEST REPORT

47 Cfr Ch. 1 (10-1-96 Edition): Part 15.

**CUSTOMER  
AND**

**MANUFACTURER:** Saab Marine Electronics AB  
Box 13045  
S-402 51 Göteborg  
Sweden

**EQUIPMENT  
UNDER  
TEST (EUT):**

Radar Level Gauge, TankRadar Pro TH40 with Horn Antenna,  
preproduction unit 4A.

**TEST SPEC.:**

47 Cfr Ch. 1 (10-1-96 Edition), Part 15:  
Subpart B, Class B.  
Subpart C, Field Disturbance Sensor.

**DATE:**

April 14 - 15, 1997

**TEST SITE:**

Swedish EMC Laboratories, Karlskrona, Sweden.  
FCC List No 31040/SIT 1300B3.

**TEST PERSONNEL:**

Svenska EMC Lab AB: Bo Gidlöw.  
Saab Marine Electronics AB: Mikael Kleman.

**TEST RESULT:**

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

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Karlskrona May 5, 1997



Hans Östergren  
Manager Svenska EMC Lab AB

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**TEST EQUIPMENT:**

Type/Manufacturer/Bandwidth	s/n	Calibration information	
		Date	Interval
<b>For emission test up to 1 GHz:</b>			
EMI Test System, Monitor EZM,	860157/014	960717	12 months
Rohde & Schwarz EP-6, 20 Hz - 1300 MHz			
Test Receiver, Rohde & Schwarz ESVP, 20 - 1300 MHz	893497/006	960719	12 months
Plotter Tektronix HC 100	JP05851	-	-
Biconical Antenna, Schwarzbeck BBA9106 30 - 300 MHz	93-92196.1	960531	12 months
Log-periodic Antenna, Schwarzbeck UHALP9107, 300 - 1000 MHz	91071205	960531	12 months
Antenna Mast System, Jyske EMC, h = 1 - 5 m	93-90172	NA	NA
Turn Table, Jyske EMC, h = 1.0 m	93-90171	NA	NA
Shielded Chamber, Jyske EMC, 11 x 6 x 4.5 m	93-90168	9703	36 months
Anechoic Chamber, 8 x 4.5 x 3 m	93-87151	9703	36 months
Open Field Test Site for 10 m antenna distance	-	9704	36 months
<b>For emission test at fundamental frequency 9.58 GHz:</b>			
Spectrum Analyzer, HP 8566B	2950A06284	960822	12 months
Plotter, HP 7475A	2641L16543	NA	NA
Signal Amplifier, Avantek AMN 12713	E6395	970416	12 months
Signal Amplifier, Avantek AMN 12713	E6396	970416	12 months
Standard Gain Horn Antenna, Narda mod. 640, 8.2 - 12.4 GHz	8909SME180588	NA	NA
Coaxial Cable, Sealectro u-wave-cable, l = 3 m	A4746	970416	12 months
Coaxial Cable, Sealectro u-wave-cable, l = 3 m	D0460	970416	12 months
Coaxial Cable, Sealectro u-wave-cable, l = 1 m	D0658	970416	12 months
<b>For emission test at frequencies above 12 GHz:</b>			
Spectrum Analyzer, HP 8566B	2950A06284	960822	12 months
Plotter, HP 7475A	2641L16543	NA	NA
Signal Mixer, HP 11970K, 18 - 26.5 GHz	2332A00478	970109	12 months
Signal Mixer, HP 11970A, 26.5 - 40 GHz	2332A00749	961217	12 months
Mixer Amplifier, HP 11975A, 2 - 8 GHz	2517A00748	960601	12 months
Standard Gain Horn Antenna, Flann 20 24 20, 18 - 26.5 GHz.	YA2762	970109	36 months
Standard Gain Horn Antenna, Flann 22 24 20, 26.5 - 40 GHz.	YA2763	970109	36 months

**TEST SET-UP AND PROCEDURE:**

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

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## DESCRIPTION OF THE EUT:

The EUT is a Radar Tank Gauge used in industrial environments. The used radar frequency is sweeping in the range 9.5 GHz to 10.5 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. After installation is the radar antenna totally enclosed in a metal tank and the unwanted radiation is therefor extremely low. The test sample was mounted on the top of a metal tank with the dimensions of approx. 1.3 x 1.3 x 1.3 m.

## TEST PERFORMANCE:

**Rating:** 100 - 240 VAC, 50 - 60 Hz, 10 W.

**Effective radiated power:** <1 mW.

**Peripherals:** Personal Computer, Lap Power Progresso Lap P120, s/n NB6194241B, Field Bus Modem, FBM 2170, P/N 9240002-632. Fluke 79, s/n 61500107.

**Power Line Filter:** X2-Capacitor, Rifa PME271, 0.022 micro-Farad, 2 x Y2-Capacitor Rifa PME271, 0.0047 micro-Farad. Choke Mainstar MFE10900 2 x 40 milli-Henry, 2 x Choke 33 micro-Henry. See Appendix 3.

**Cables:** Unshielded power line cable of 2.5 m length with protective earth. Shielded cable of 17.5 m length from the EUT to the FBM. Shielded cable of 1.5 m length from FBM to the PC. All shielded cables designed with contact hoods of metal.

**Configuration:** See Appendix 4.

**Clock Frequency:** 24.576 MHz, 49.152 MHz. Radar frequency locked at 9.588 GHz.

**Modifications:** No modifications.

**Operating Conditions:** Normal operating conditions. Active level gauging with level measurements 4 times pro second. During the radiation test above 1 GHz was the frequency sweep stopped at 9.588 GHz. Tested at 115 VAC.

**Conducted Emission test:** The conducted emission was measured on the Power input terminals through a 50 ohm 50 micro-Henry LISN (Line Impedance Stabilization Network) in the frequency range 0.45 to 30 MHz. The two lines were measured with a quasi-peak detector. See Appendix 6 - 7. Worst case was recorded.

### Radiated Electromagnetic Field (30 - 1000 MHz):

**Final Test.** Measured in the frequency range 30-1000 MHz at an antenna distance of 3 m, on the open field test site. The emission was maximized by rotating the table, varying the antenna height and the antenna polarization. See Appendix 8 and 9. Test instruments: Rohde & Schwarz EP-6 System, 30 MHz - 1000 MHz. Antennas: Schwarzbeck BBA9106, 30-300 MHz and UHALP9107, 300-1000 MHz. Worst case was recorded.

### Radiated Electromagnetic Field (1 - 40 GHz):

Measured in the frequency range 1 - 40 GHz 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 5.

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**TEST PERFORMANCE (CONTINUED):**

**Measurements on the fundamental:** Antenna distance of 3 m was used. To find the frequency with the highest amplitude in the sweeping range the EUT was set in normal operating mode, with frequency sweeping. The analyzer was in max hold with average detector (RBW = 1 MHz, VBW = 10 kHz). The maximum amplitude was found at appr. 9.586 GHz. Then the sweep was stopped at this frequency. The emission of the fixed frequency was now maximized by rotating the table, varying the antenna height and the antenna polarization. Measured with peak detector and with average detector. See Appendix 10 and 11. The limit for class B at 3 m distance is with average detector 54 dBuV/m and with peak detector 74 dBuV/m.

**Measurements on the harmonics:** Measured up to 38.1925 GHz with stopped sweep on 9.586 GHz. Measurement at 3 m distance was not possible because the harmonics were too low. The distance was changed to 0.3 m and the limit linearly converted to this distance by adding 20 dB. The peak limit is 74 dBuV/m plus 20 dB = 94 dBuV/m. The antenna was moved around and over the EUT and the flanges of the EUT and around and over all other parts on the Tank there leakage could appear, both with vertical and horizontal antenna polarization. No emission was observed. The noise level was appr. 64 dBuV/m with peak detector. See Appendix 12 to 14.

To check the operation of the radar was the EUT (Radar Level Gauge TH40) removed from the Tank and the test antenna horn was put directly on the TH40 antenna. At this distance was the harmonics 19.172 GHz and 28.724 GHz observed, but only with very low levels, and no measured values will be present.

**SUMMARY OF RESULTS:**

A) In the frequency range of 0.45 to 1000 MHz:

The conducted emission margin to limit was -4.6 dB (QP) at 24.5755 MHz. See Appendix 6 - 7.  
The radiated emission margin to limit was 3.5 dB at 540.66 MHz. See Appendix 8 - 9.

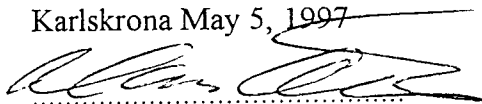
B) In the frequency range of 1 to 40 GHz: See Appendix 15.

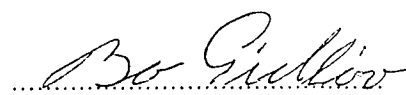
Margin to limit of the fundamental was with average detector -9 dB and with peak detector -17 dB as worst case.

Margin to limit of the harmonics was more than -30 dB with peak detector. No measurements with average detector were performed depending of the very low harmonics emission levels.

The Radar Level Gauge, TankRadar Pro TH40 with Horn Antenna, preproduction unit 4A, did pass the above mentioned tests in Part 15: Subpart B, Digital Devices Class B, and Subpart C, Field Disturbance Sensor.

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Karlskrona May 5, 1997

  
Hans Östergren  
Manager Svenska EMC Lab AB

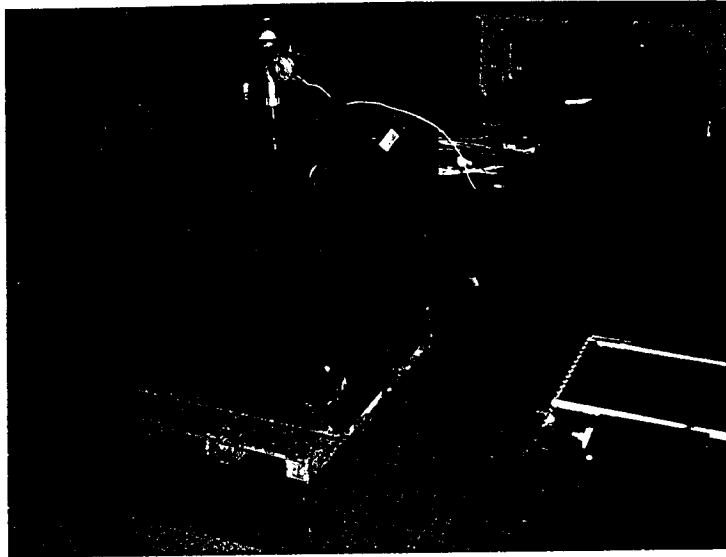
  
Bo Gidlöw  
Test Engineer

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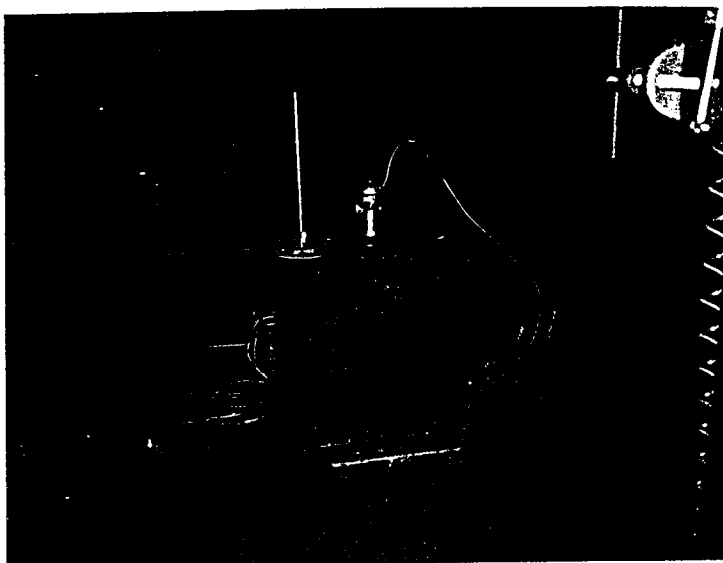
List over Appendixes.

<u>Appendix No</u>	<u>Note</u>
1	Test set-up, photos
2	Test set-up, photos
3	Power Line Filter
4	Configuration
5	Test equipment set-up
6	CE, 0.45 - 30 MHz, live
7	CE, 0.45 - 30 MHz, neutral
8	RE, 30 - 1000 MHz, 3 m
9	Calculation of Final Emission Levels, 30 - 1000 MHz
10	Fundamental, 9.586 GHz. Average
11	Fundamental, 9.586 GHz. Peak
12	Harmonic, 19.172 GHz
13	Harmonic, 28.7245 GHz
14	Harmonic, 38.1925 GHz
15	Calculation of Final Emission Levels, 1 - 40 GHz.

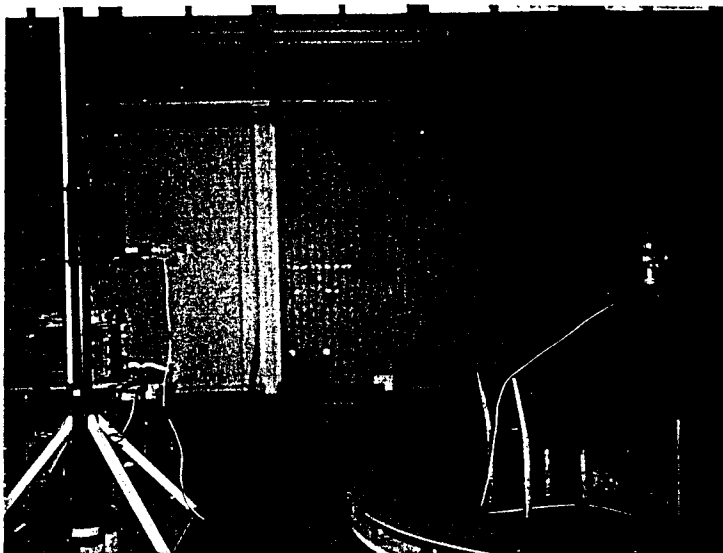
Test set-up, Conducted Emission



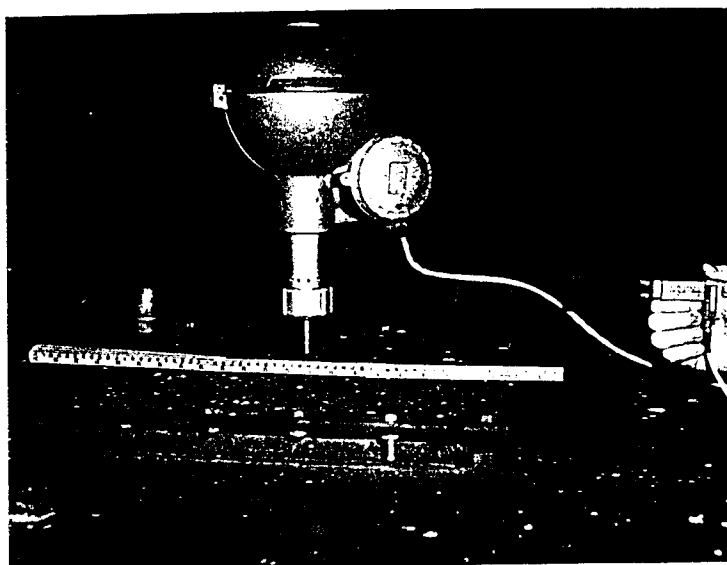
Test set-up, Radiated Emission 30 - 1000 MHz



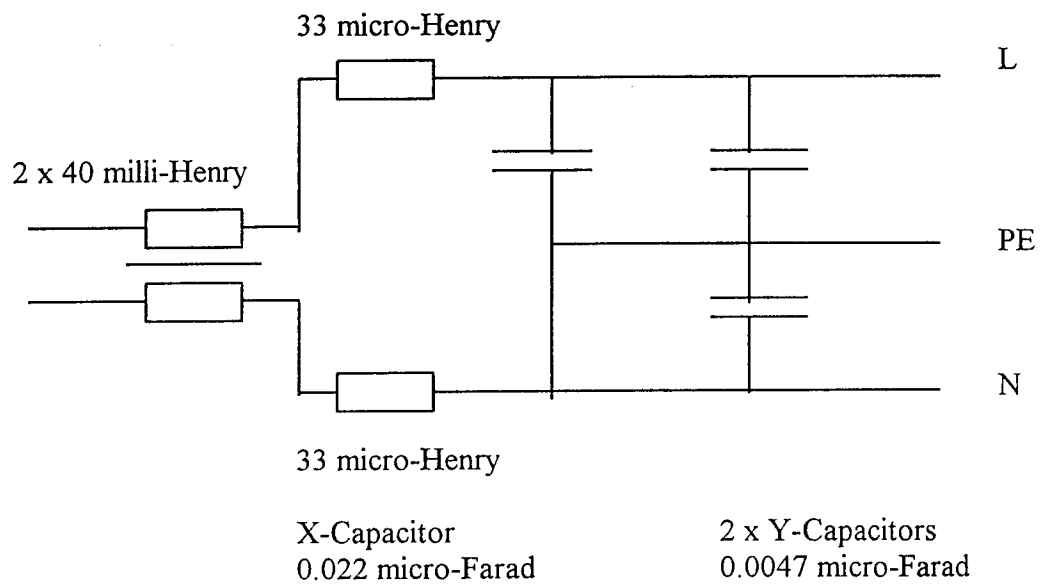
Test set-up, radiated emission fundamental



Radiated emission, check of harmonics

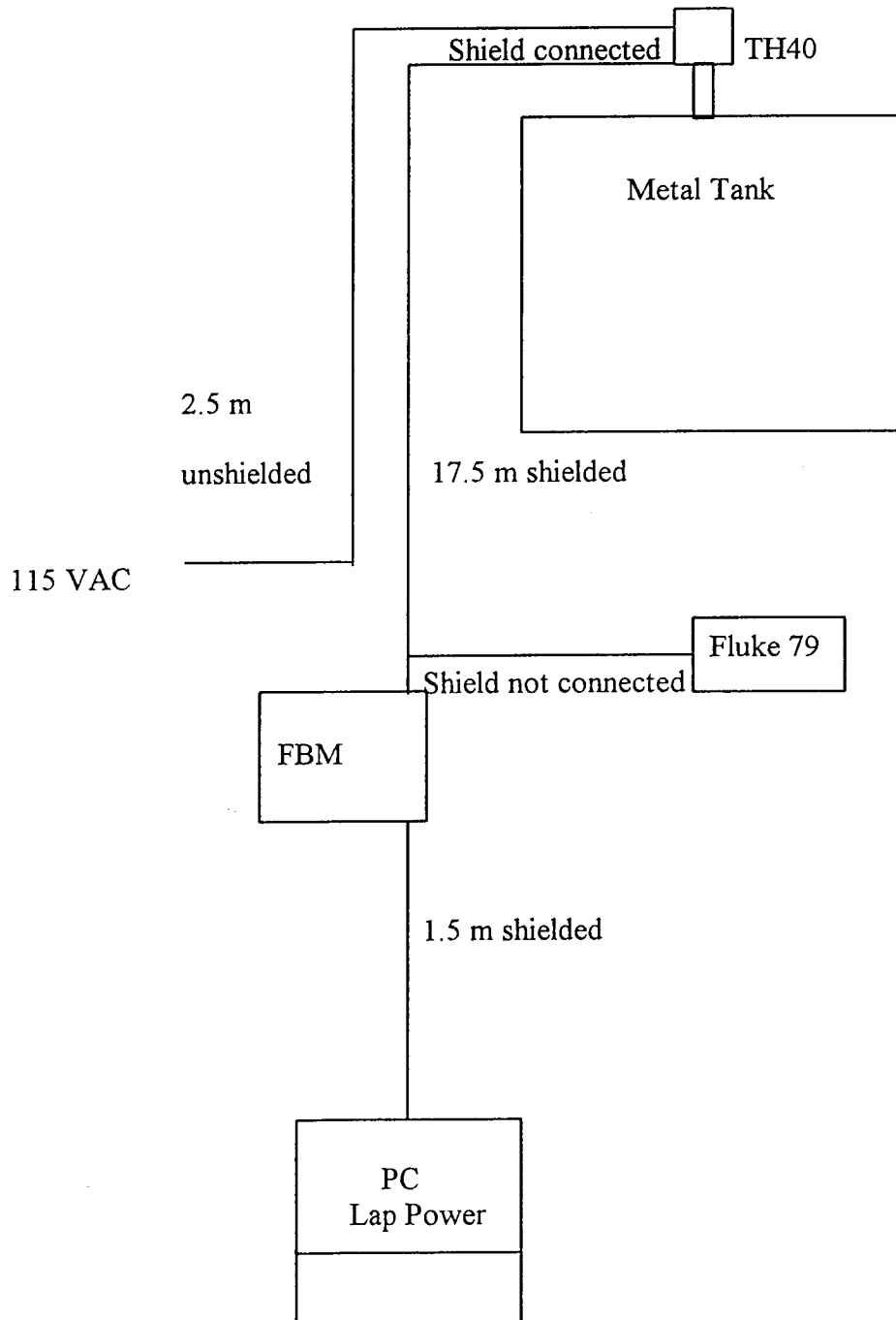


Power Line Filter



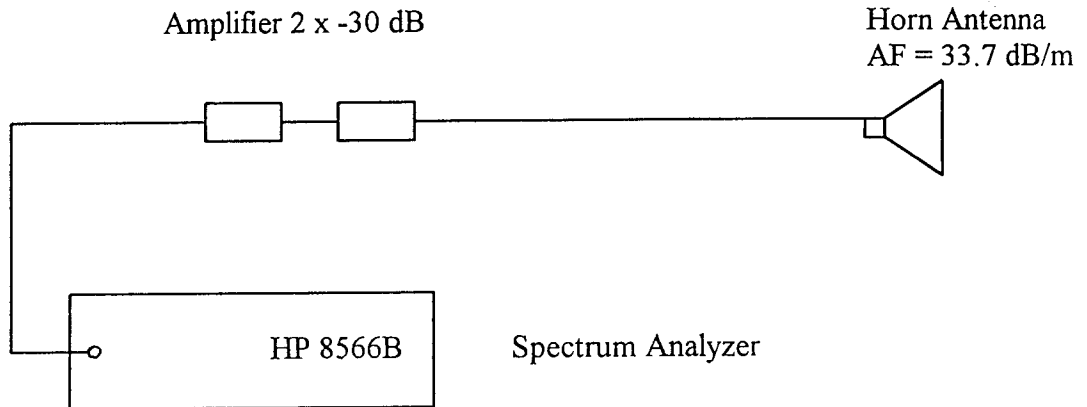


Configuration

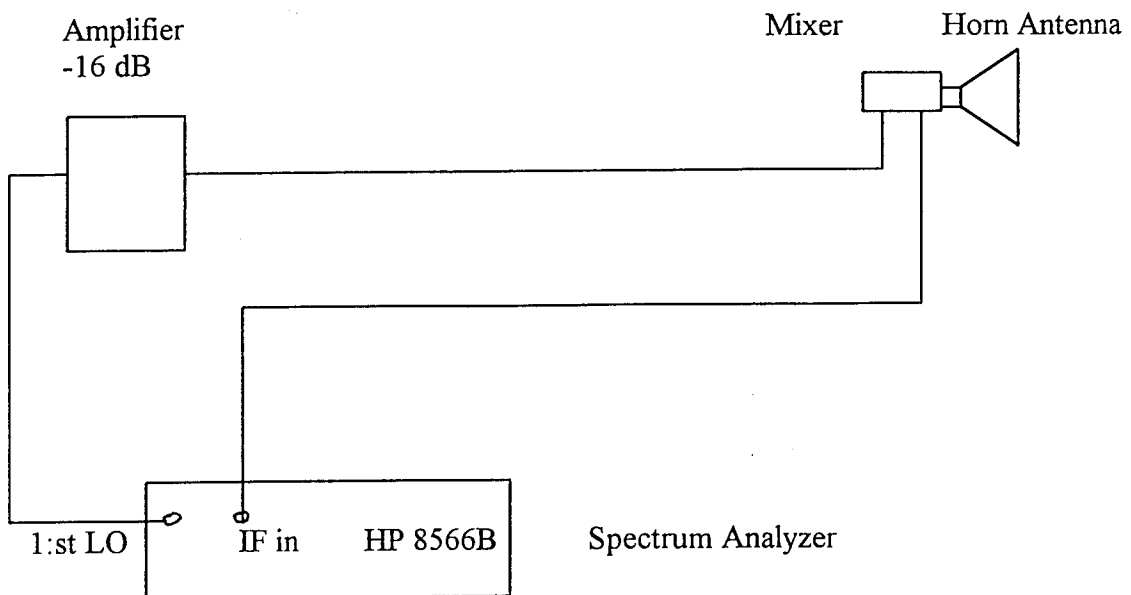


Test equipment set-up

F0, 8.2 - 12.4 GHz:



F1 - F3, 18 - 40 GHz:



2.

SAAB MARINE ELECTRONICS AB  
Conducted Emission Test

Start of Test: 14. APR '97, 10:29  
E.U.T.: TANKRADAR PRO  
Oper. Condition: Active  
Operator: Bo Gidloew  
Test Spec: FCC Part 15, Subpart B. Conducted RFI Class B (and A)

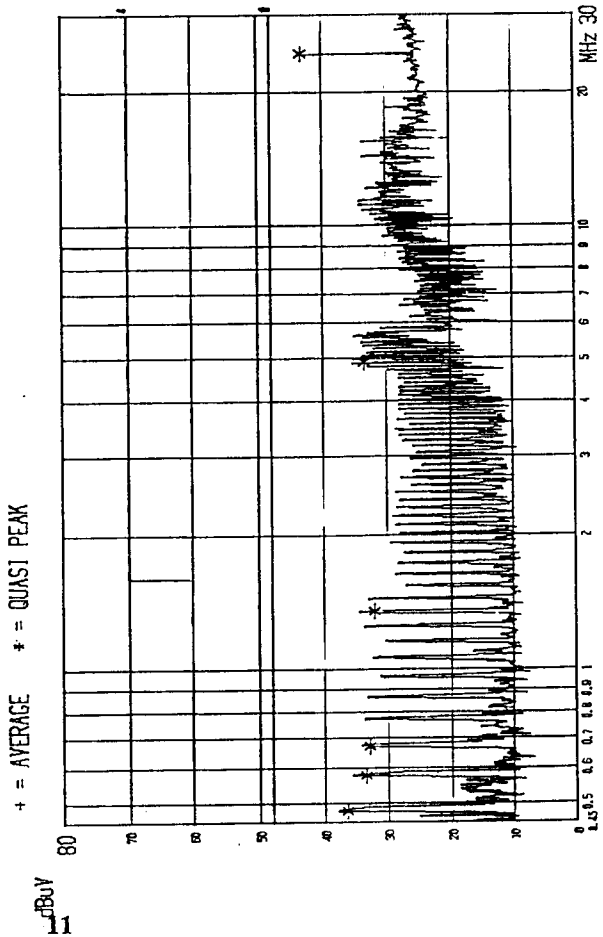
Start Fr. Stop Fr. IF-BW Display Att. Transducer  
MHz kHz Mode dB type  
0.4500 30.0000 10.00 Max Hold 0 LISN 50



Minervavägen 20 S-371 41 Karlskrona  
Tel.+46 (0)455 802 90 Fax.+46 (0)455 102 88

Frequency MHz	Average dBuV	AV-Margin dBuV	Quasi dBuV	Peak dBuV	QP-Margin dBuV
0.4797	-	-	-	36.5	-11.5
0.5758	-	-	-	33.5	-14.5
0.6717	-	-	-	32.9	-15.1
1.3435	-	-	-	32.0	-16.0
4.8957	-	-	-	33.5	-14.5
24.5755	-	-	-	43.3	-4.7

\* Limit exceeded



Conducted Emission on 115 V ac line terminal

Appendix 6 (15)  
TEST REF. NO: 97/1750  
DATE: May 5, 1997

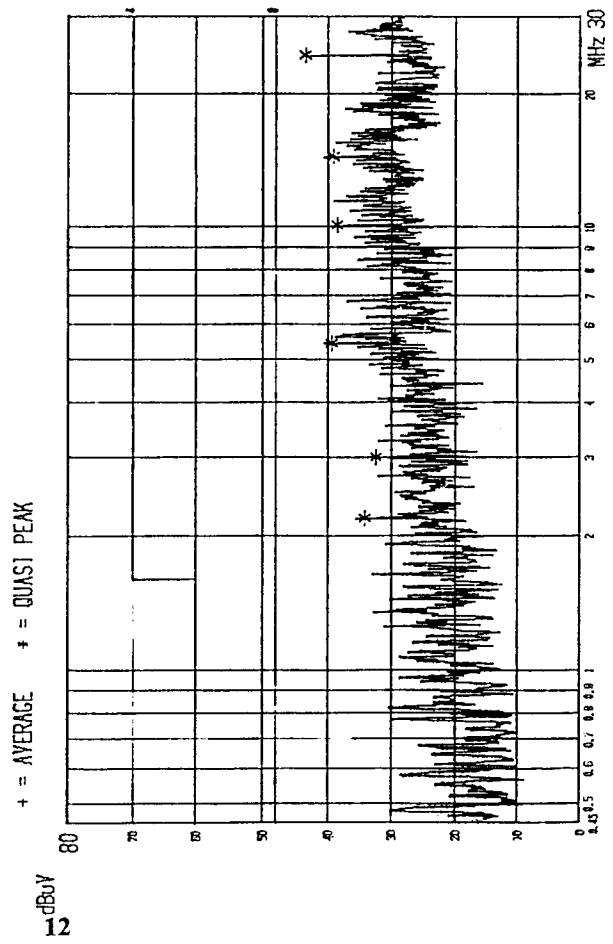
Frequency MHz	Average dBuV	AV-Margin dBuV	Quasi dBuV	Peak dBuV	QP-Margin dBuV
2.1848	-	-	-	34.3	-13.7
3.0034	-	-	-	32.4	-15.6
5.4612	-	-	-	39.4	-8.6
5.6497	-	-	-	29.4	-18.6
10.1031	-	-	-	38.7	-9.3
14.4730	-	-	-	39.3	-8.7
24.5756	-	-	-	43.4	-4.6

\* Limit exceeded

SAAB MARINE ELECTRONICS AB  
Conducted Emission Test

Start of Test: 14. APR '97, 10:14  
E.U.T.: TANKRADAR PRO  
Oper. Condition: Active  
Operator: Bo Gidloew  
Test Spec: FCC Part 15, Subpart B. Conducted RFI Class B (and A)

Start Fr. 0.4500 Stop Fr. 30.0000  
MHz kHz  
Display Mode Max Hold 0 LISN 50  
Att. dB type



Conducted Emission on 115 V ac neutral terminal

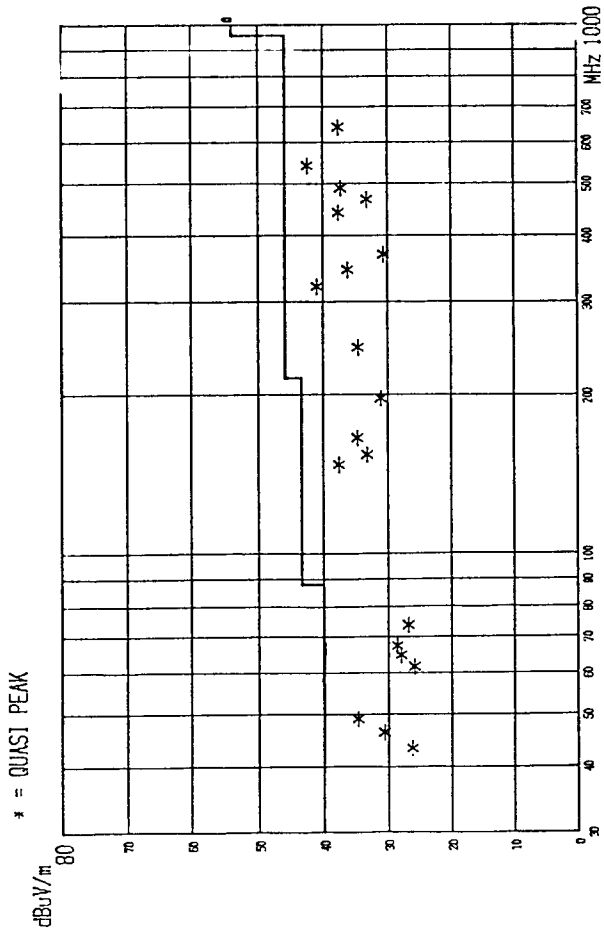
SAAB MARINE ELECTRONICS AB  
 Radiated Emission test on OATS

Start of Test: 15.APR'97, 08:33  
 E.U.T.: TANKRADAR PRO  
 Oper. Condition: Active  
 Operator: Bo Gidloew  
 Test Spec: FCC Part 15, Subpart B, Class B, 3 m OATS

Start Fr. Stop Fr. IF-BW Detec Att. Meas.T. Transd.  
 MHz kHz tor dB s type  
 30.0000 299.9999 120 Peak LN 0.020 BICON  
 300.0000 1000.0000 120 Peak LN 0.020 LOG-PER

Frequency MHz	measured Level. dBuV/m	Margin dB	Q P h/v	Pol	Height m	Azimuth deg.
43.1440	26.2	-13.8		v	1.00	135
46.3570	30.7	-9.3		v	1.00	315
49.1510	34.9	-5.1		v	1.00	315
61.4430	25.9	-14.1		v	1.00	180
64.7180	28.1	-11.9		v	1.00	270
67.4490	28.6	-11.4		v	1.00	270
73.7320	26.8	-13.2		v	1.00	225
147.4540	37.6	-5.8		v	1.00	135
153.6290	33.2	-10.2		v	1.00	135
165.8670	34.8	-8.6		h	2.00	225
196.6060	31.0	-12.4		v	2.00	45
245.7580	34.7	-11.3		v	1.00	135
319.4850	41.0	-5.0		v	2.60	180
344.0600	36.2	-9.8		v	2.60	135
368.6370	30.6	-15.4		v	2.60	315
442.3640	37.6	-8.4		v	2.60	45
466.9390	33.3	-12.7		v	2.60	45
491.5150	37.2	-8.8		v	2.30	45
540.6660	42.5	-3.5		v	2.30	315
638.9700	37.6	-8.4		v	2.80	90

\* Limit exceeded



Radiated Emissions on OATS at 3 m. distance

**Radiated Fieldstrength Test. Calculation of Final Emission Levels**

**Test spec:** 47 Cfr Ch. 1 (10-1-96 Edition):  
 Part 15, Subpart B, Class B.  
 Radiated emission, Open Area Test Site  
 3 m antenna distance.

**EUT:** Radar Level Gauge, TankRadar Pro TH40 with Horn Antenna,  
 preproduction unit 4A.

**Operation:** Normal operating conditions. Active level gauging with level measurements  
 4 times pro second

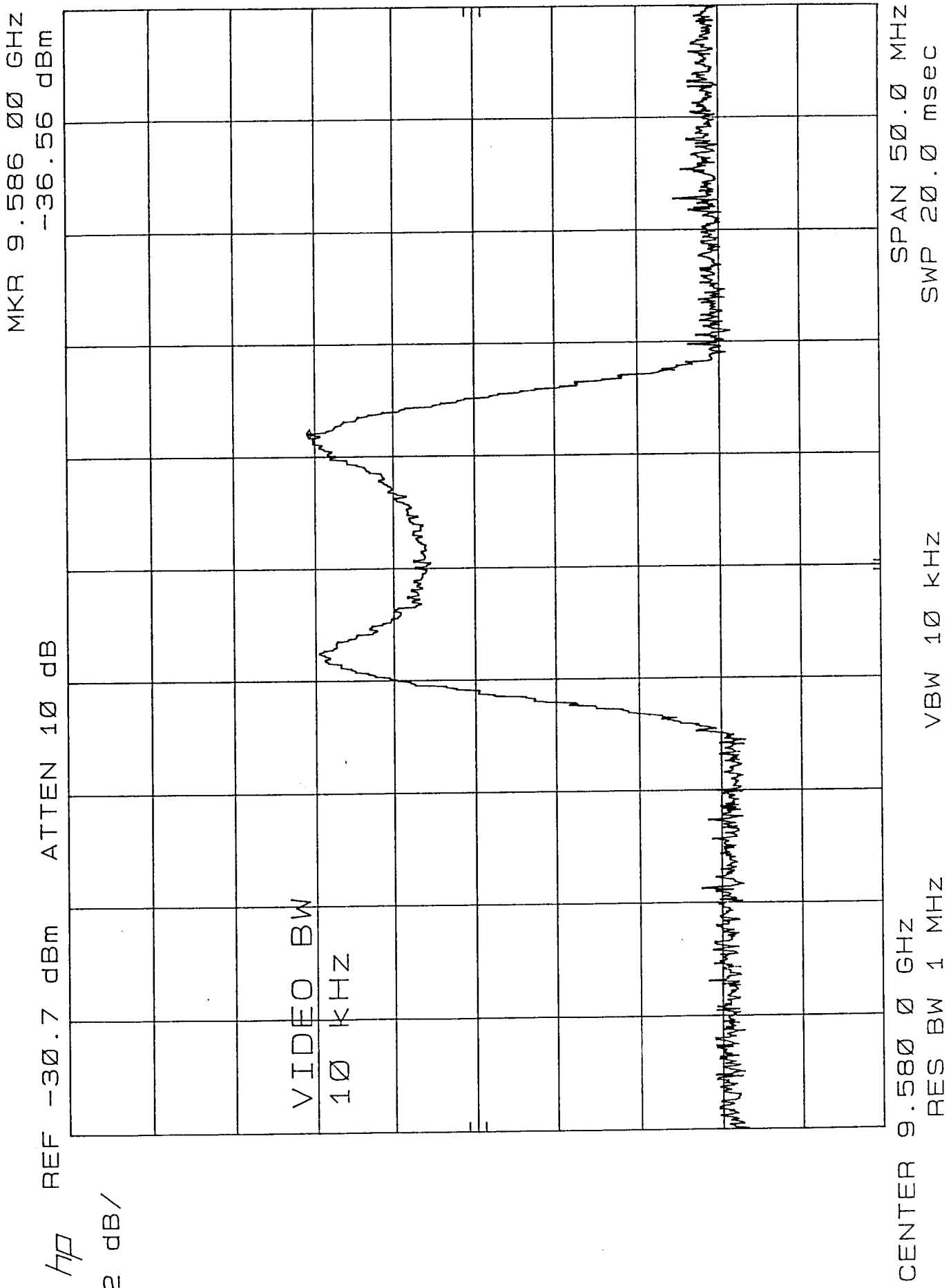
Field strength (dBuV/m) = Amplitude (dBuV) + Antenna factor (dB/m) + cable loss (dB)

Tested frequency range: 30 - 1000 MHz  
 Measured quasi-peak values.

Freq.	App.	Ampl	Cable loss	Ant fact	Field streng.	Limit	Dist	Mar- gin	Ant. height	Ant. pola r
MHz	No	dBuV	dB	dB/m	dBuV/m	dBuV/m	m	dB	m	v/h
46.357	8	16.0	1.7	13.0	30.7	40	3	- 9.3	1.0	v
49.151	8	22.0	1.8	11.1	34.9	40	3	- 5.1	1.0	v
147.45	8	19.8	3.2	14.6	37.6	43.4	3	- 5.8	1.0	v
153.63	8	14.9	3.3	15.0	33.2	43.4	3	-10.2	1.0	v
165.87	8	16.0	3.4	15.4	34.8	43.4	3	- 8.6	2.0	h
319.49	8	20.2	4.8	16.0	41.0	46	3	- 5.0	2.6	v
344.06	8	14.2	4.9	16.1	36.2	46	3	- 9.8	2.6	v
442.36	8	14.0	5.7	17.9	37.6	46	3	- 8.4	2.6	v
491.52	8	12.2	6.0	19.0	37.2	46	3	- 8.8	2.3	v
540.66	8	16.7	6.3	19.5	42.5	46	3	- 3.5	2.3	v
638.97	8	9.0	6.8	21.8	37.6	46	3	- 8.4	2.8	v

13.

hp  
 2 dB/

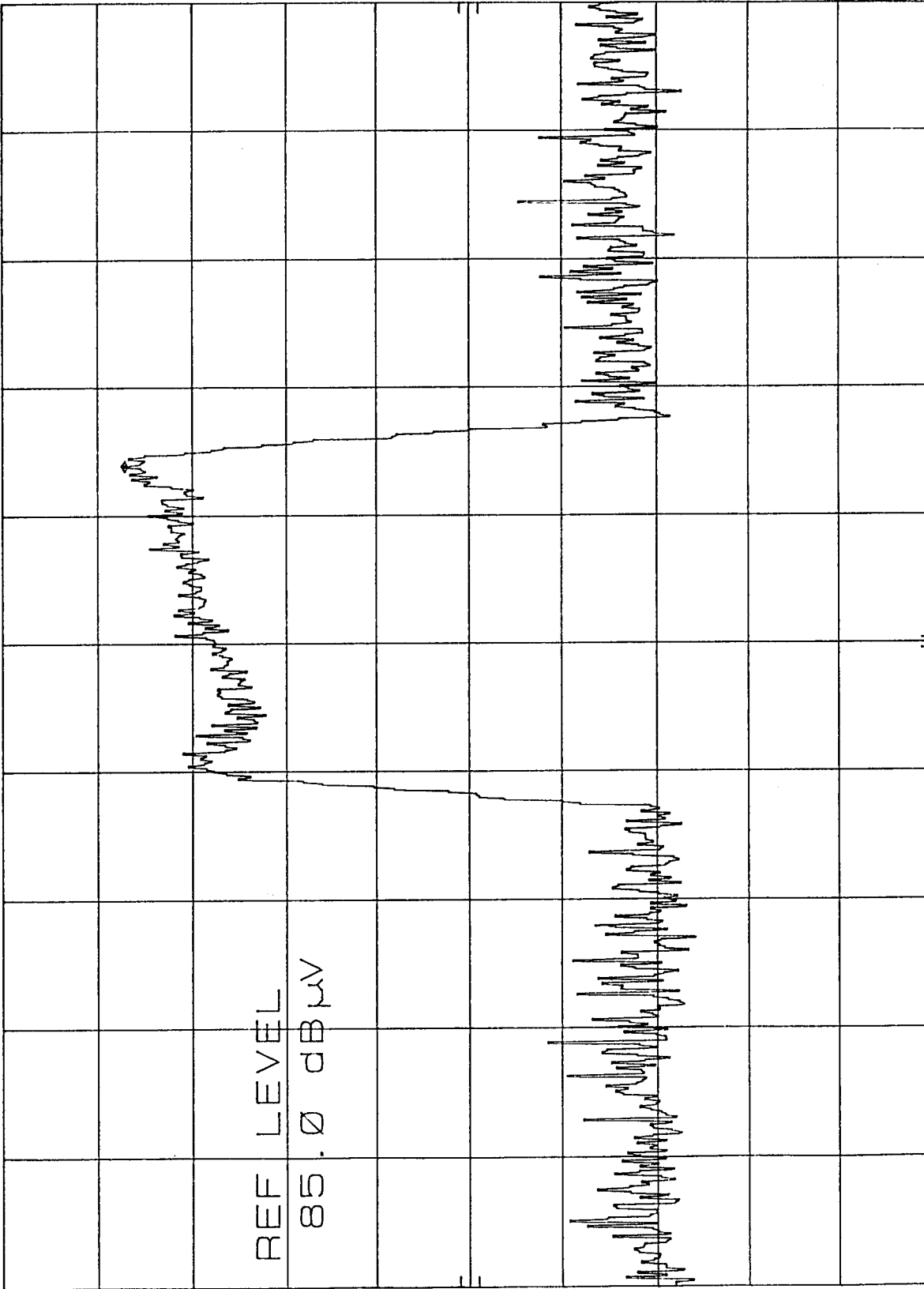


141.

MKR 9.586 90 GHZ  
 82.44 dB $\mu$ V

REF 85.0 dB $\mu$ V ATTEN 10 dB

hp  
 2 dB/



SPAN 50.0 MHz  
 SWP 20.0 msec

VBW 1 MHz

CENTER 9.580 0 GHZ  
 RES BW 1 MH

*3 m. dist*



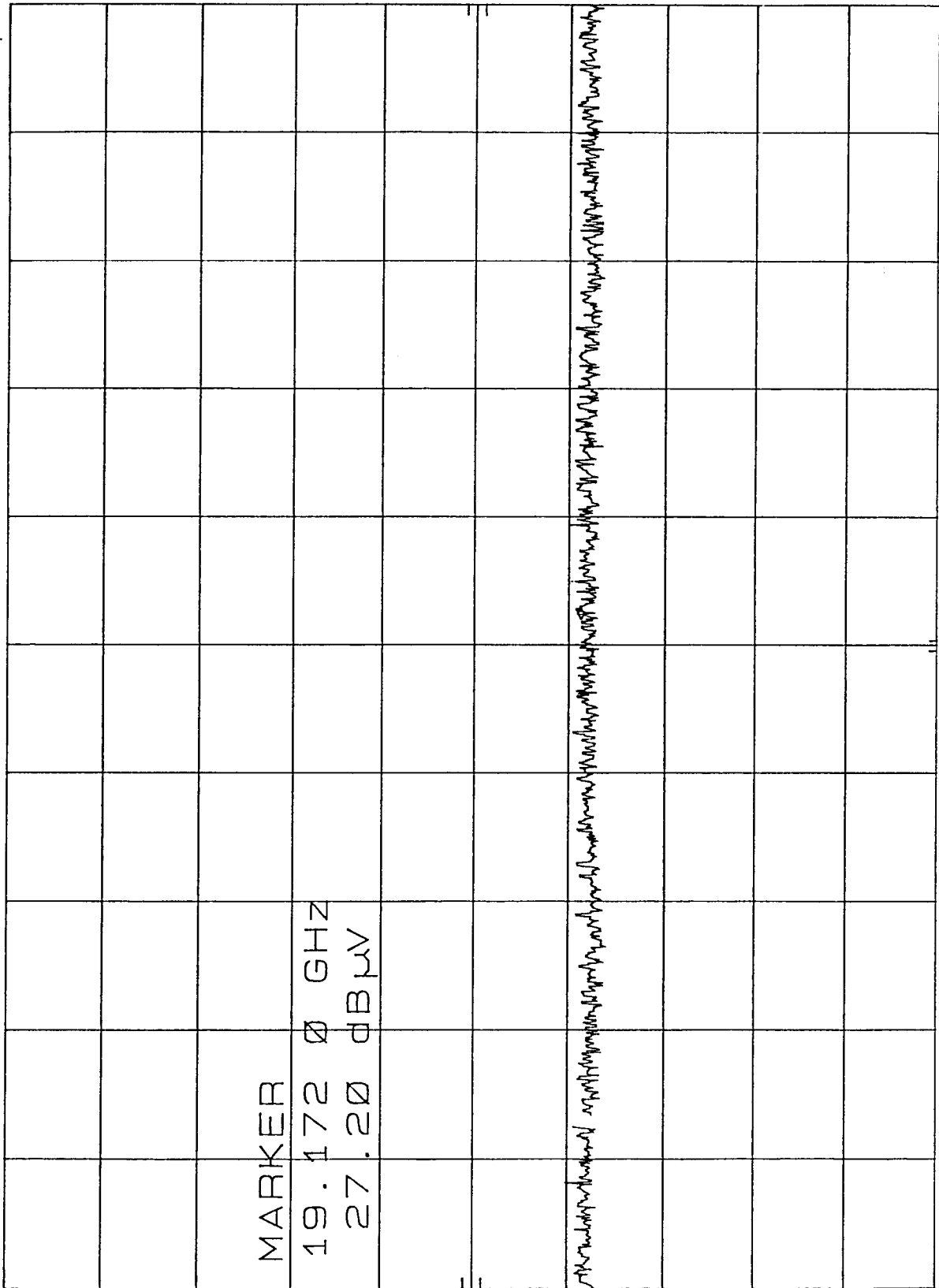
16.

HP MKR 19.172 GHz  
 27.20 dBµV

REF 88.5 dBµV HARMONIC 6L

10 dB/

CNVLOSS 21.5 dB



CENTER 19.160 GHz  
 RES BW 30 KHZ  
 SPAN 500 MHZ  
 SWP 1.50 sec  
 VBW 30 KHZ

M. Z. inc. dist.

18.

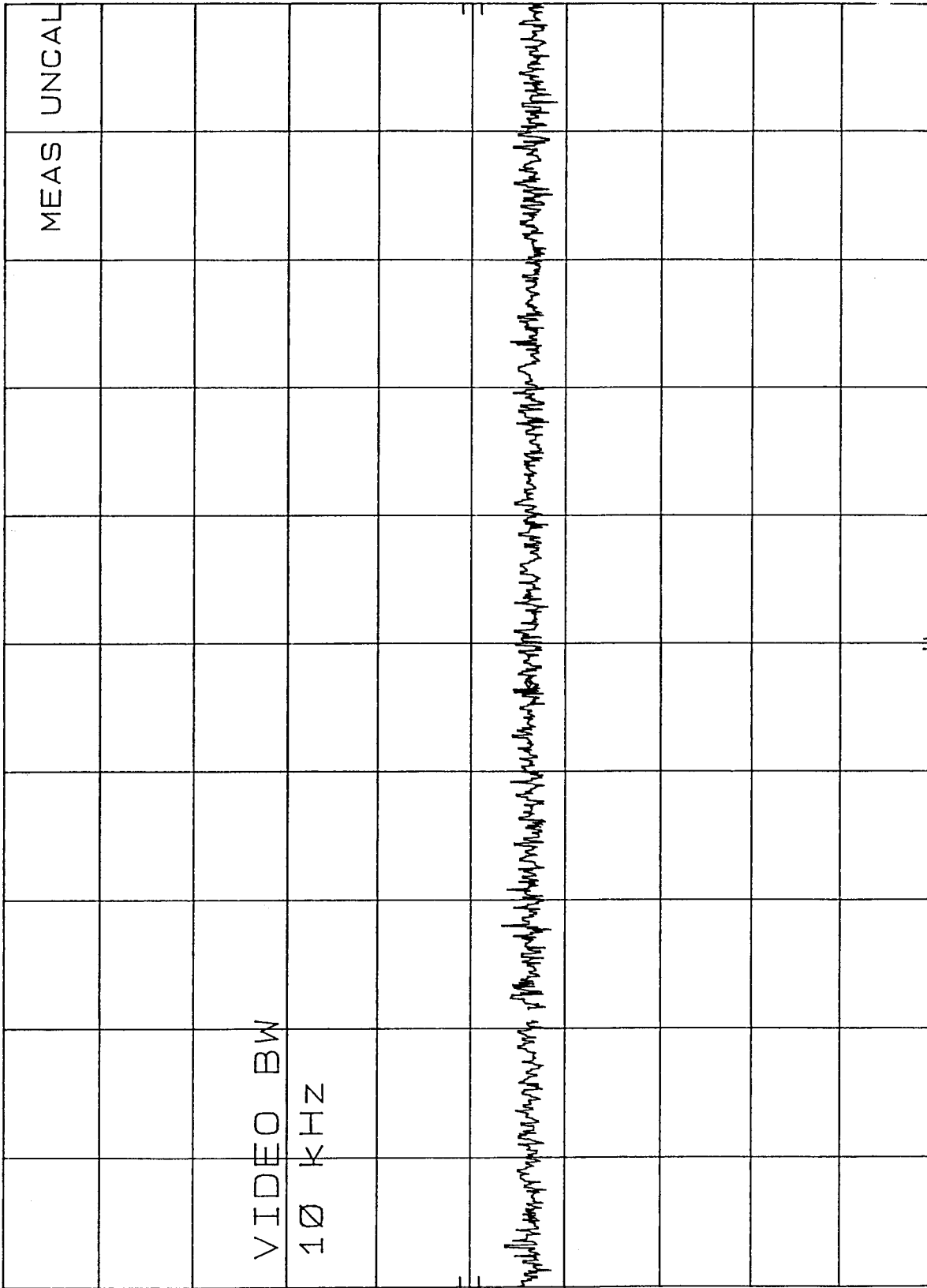
MKR 28.724 5 GHZ  
 20.40 dBµV

REF 76.5 dBµV HARMONIC 8L

HP 10 dB/

CNVLOSS 21.5 dB

VIDEO BW  
 10 KHZ



CENTER 28.740 GHZ  
 RES BW 10 KHZ  
 SPAN 500 MHZ  
 WP 1.50 sec  
 VBW 10 KHZ



