SENTON

■ EMV-Prüfzentrum ■ EMI/EMC-Testcenter ■

Straubing, August 02, 2000

T E S T - R E P O R T

No. 50511-00331

for

Micropilot S FMR 53X

Fluid Level Measuring Transmitter (with Rod and Horn Antennas)

Applicant:	Endress + Hauser GmbH & Co.
Purpose of testing:	To show compliance with FCC Code of Federal Regulations, CFR 47, Part 15, Subpart C, Sections 15.207 and 15.209

Table of Contents

1. Administrative Data

Equipment Under Test (EUT):	FMR 53X
Type of equipment:	Fluid Level Measuring Transmitter
Parts/accessories:	N.A.
Version of EUT:	The following versions of the EUT have been tested: - FMR 530 with Horn Antenna - FMR 531 with PTFE Rod antenna - FMR 532 with Planar Antenna - FMR 533 with Parabolic Antenna
FCC-ID:	**LCGFMR53X**

Applicant:	Endress + Hauser GmbH + Co.
(full address)	Hauptstrasse 1 D-79689 Maulburg
Contract identification:	007/00300647
Contact person:	Mr. Peter Klöfer
Manufacturer:	Applicant

Receipt of EUT:	June 06, 2000
Date of test:	June 06, 2000

Note: All tests were performed under normal installation conditions with the EUT installed in several tanks. Since it was not possible to transport the tanks used for testing to an open field test site, testing was performed at the mentioned factories:

- Plastic tank at Photo Print Electronic in D-79690 Schopfheim
- Concrete tank with open roof and windows at concrete factory Schweigert in D-79689 Maulburg
- Glass container and metallic tank at applicant´s factory in D-79689 Maulburg

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Responsible for testing:	Mr. Johann Roidt
Responsible for test report:	Mr. Johann Roidt

2. Summary of Test Results

The tested samples fully comply with the requirements for intentional radiators set forth in the

Code of Federal Regulations CFR 47
Part 15 Subpart C, Sections 15.207 and 15.209
of the
Federal Communication Commission (FCC).

Johann Roidt
Technical Manager

3. Operation Mode of EUT

The EUT was powered from a 18 V DC power source. During all measurements the EUT was set to normal measuring mode. During all measurements the EUT was placed vertically in non-metallic tanks.

The following applications were investigated in detail:

- EUT with Horn antenna
- EUT with Rod antenna.
- Applications in a plastic tank (fig. 1)
- Applications in a concrete tank with windows (fig. 2),
- Applications in a glass tank (fig.3)

4. Changes made to the EUT during this certification test

No changes have been made to the EUT during this certification test.

5. Configuration of EUT and Peripheral Devices

Configuration of cables to EUT

Unshielded two-wire power supply cable

Configuration of peripheral devices connected to EUT

Not applicable

6. Measuring Methods

6.1. Radiated Emissions above 1 GHz

Radiated emissions were measured in the frequency range 5 GHz to 8 GHz in transmit mode of the EUT.
The resolution bandwidth and the video bandwidth of the spectrum analyzer were set to 1 MHz, the sweep-time to 20 ms.
Since the EUT is a pulsed system with a duty cycle < 1:100, a desensitization factor of > 40 dB had to be expected. Analyzer readings of emissons at the limit for peak emissions at 3 meter distance would be approximately – 4 dBµV. The noise level of our very sensitive spectrum analyzer (ESMI, Rohde & Schwarz) plus a 40 dB preamplifier is approximately 5 dBµV.
The only way to achieve sufficient dynamic range is to reduce test distance. For the measurement described in this report, the test distance was reduced to 0.3 meter.

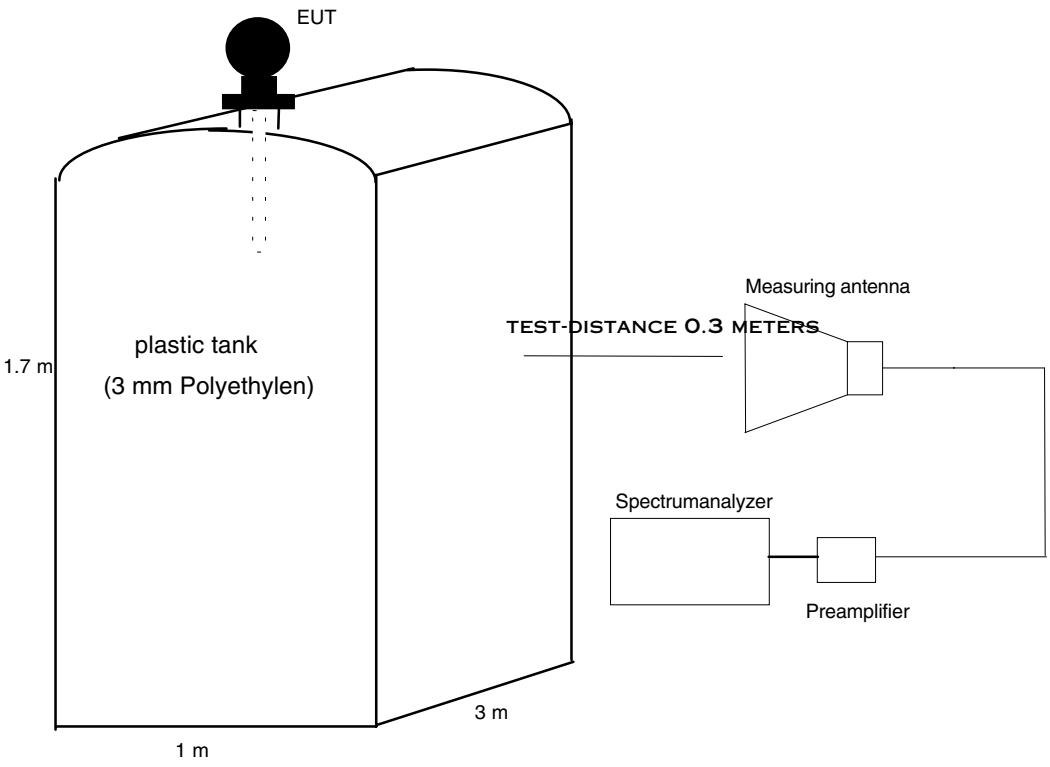


fig.1 application in plastic tank

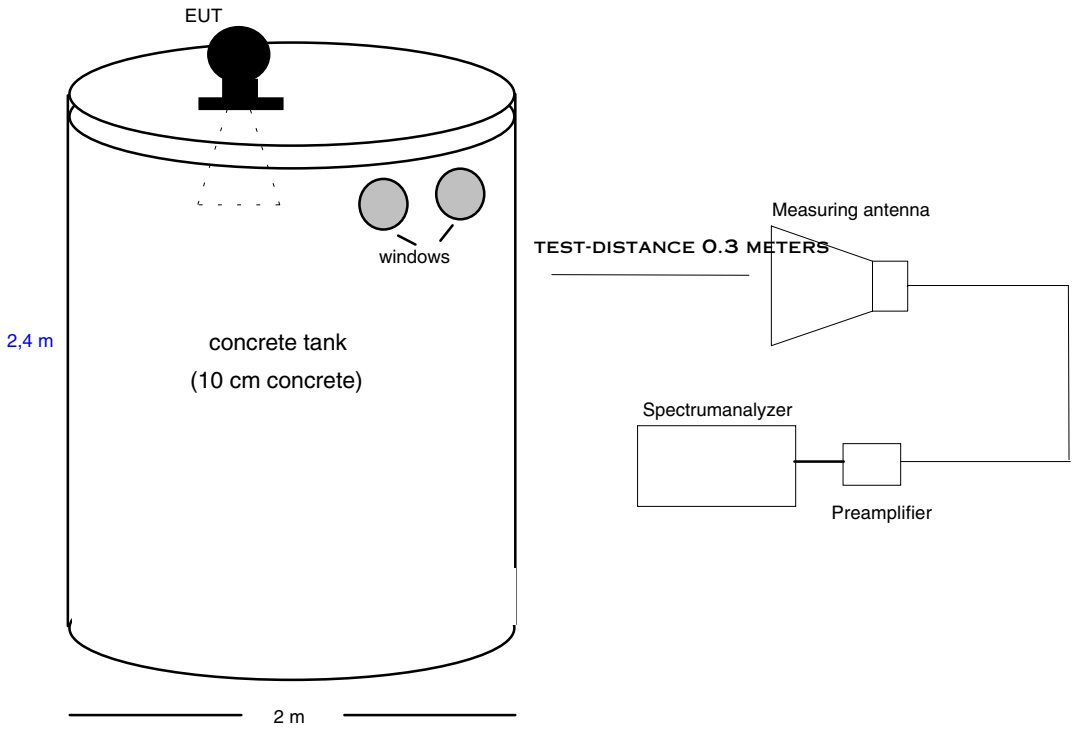


fig.2 application in a concrete tank

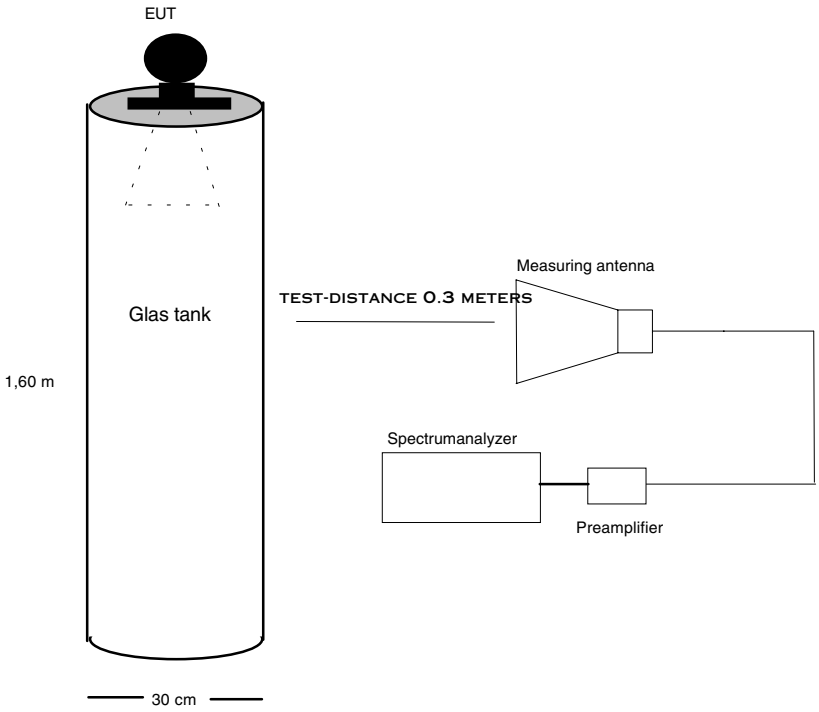


fig.3 application in a glass tank

6.2. Procedure for Preliminary Radiated Emission Tests

The procedure for preliminary radiated emission tests was based on section 13.4.1 of ANSI C63.4-1992.
The EUT was mounted in its normal operation condition on the tanks.

Prescans are made in the frequency ranges:

4 GHz - 8 GHz

with the receiving antenna set to horizontal and vertical polarization.

The following step-by-step procedure was used:

1) Monitor the frequency range with the antenna at 30 cm distance to the EUT, all venting openings as well as other locations on which radiation might be detected.

2) Move the antenna while maintaining the test distance to detect maximum radiation.

3) Make a hardcopy of the spectrum.

4) Repeat steps 1 through 3 for orthogonal antenna polarisation

6.2.1. Method for comparing spectrum analyzer output to the limit

The following procedure will be used:

1) Maximize the emission according to 6.2.

2) Set the spectrum analyzer to **Max Hold**

3) Wait until the noise is fully maximized.

4) Put the **marker** on top of the investigated signal

5) Note frequency and level of the investigated signal

6.3. Spectrum analyzer settings for final test

Frequency range	Detector	Resolution Bandwidth	Video Bandwidth	Scan time	Trace Mode
30 - 1000 MHz	Quasi Peak	100 kHz	1 MHz		Max Hold
> 1000 MHz	Peak	1 MHz	1 MHz	20 ms	Max Hold

6.5 Desensitization for Pulsed Emissions

Since the EUT 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 analyser settings to measure a line spectrum are defined as follows:

a) Bandwidth B < 0.3 x PRF

b) Scan time Ts > Fs / B^2

With the pulse repetition frequency (PRF) of the EUT of 3.6 MHz and the selected measuring bandwith of B =1 MHz the requirement a) was observed.

The scan width of Fs = 3 GHz and Bandwidth of B = 1 MHz leads to following values:

$Fs/B^2 = 3\ GHz / (1\ GHz)^2 = 3x\ 10^{-9}\ s$

The selected scan time of Ts= 20 ms meets requirement b). Hence, a line spectrum was measured, which could be seen, when the Pseudo-Noise-mode of the EUT was switched off (no influence on the measured amplitudes) and the frequency scale of the analyser zoomed.

The desensitization factor α_i was calculated according to HP Application note 150-2:

$$\alpha_i = 20\log(\tau eff / T) = -47.35\ dB$$

The calculation based on the pulse width τ eff = 1.2 ns and the pulse period T= 280 ns, which have been supplied by the applicant.

To avoid overloading the spectrum analyzer the internal preselector has been activated during final testing. A linearity check by adding a 3 dB attenuator to the input was used to ensure integrity of the test data.

6.6 Sample Calculation of Field Strength values for pulsed systems:

- Duty cycle correction factor

Period of pulses = 280 ns
Pulse width = 1.2 ns

Duty cycle correction factor (dB) = 20 log (Pulse width / Period of Pulses)
= 20log(1.2 / 280)
= - **47.35 dB**

- Calculation of Field Strength values

1) Measure Peak value with analyzer RBW set to 1 MHz, VBW set to 1 MHz, Ts set to 20 ms

2) Calculate Field Strength by adding antenna correction factor

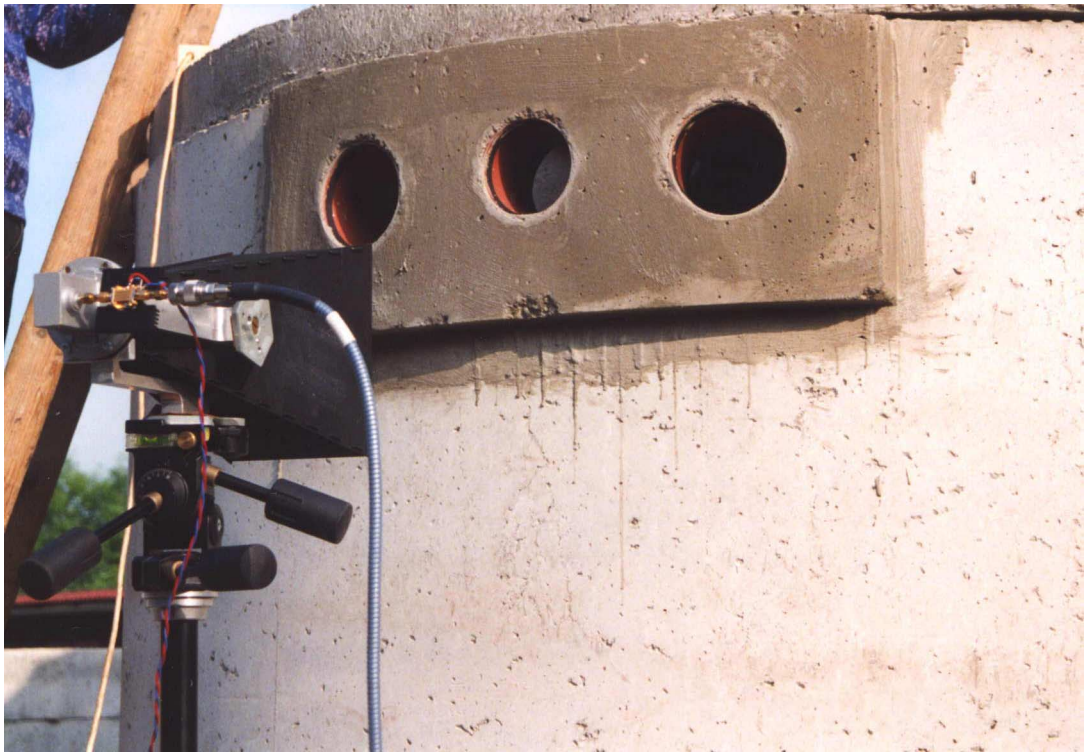
3) Calculate True Peak Field Strength by adding Desenstization Factor

4) Calculate Average value by subtracting Duty Cycle Correction Factor from True Peak Field Strength Value

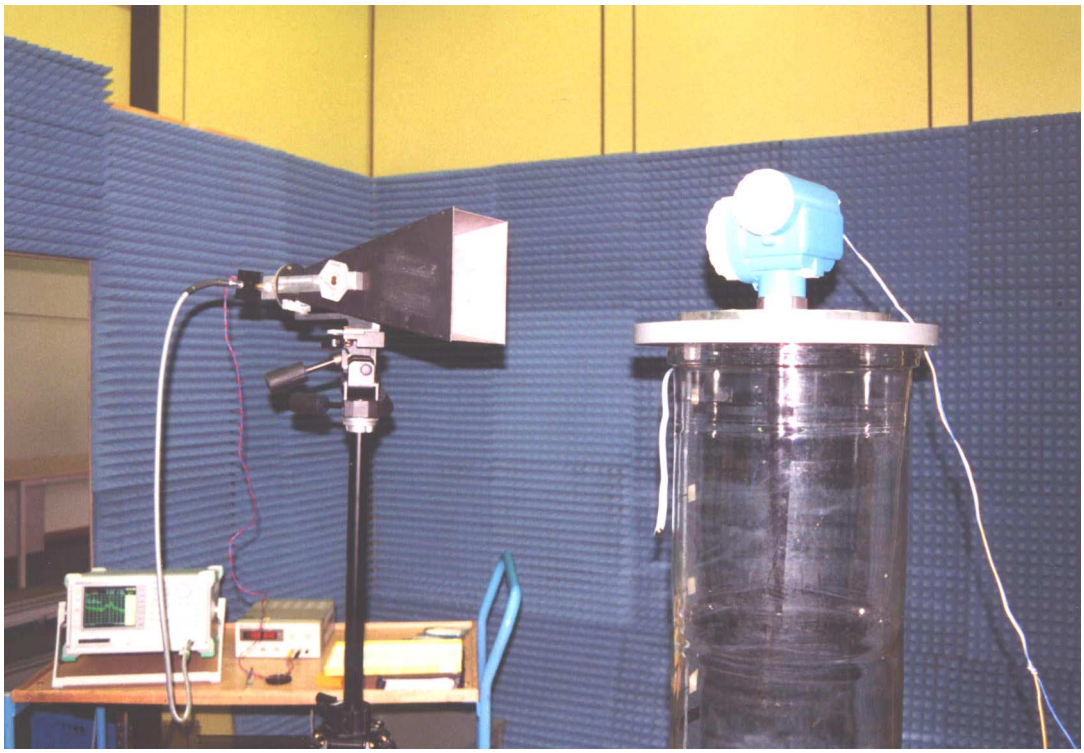
7. Photographs Taken During Testing

Test location plastic tank at PPE, Schopfheim

Test location concrete tank at Schweigert, Maulburg

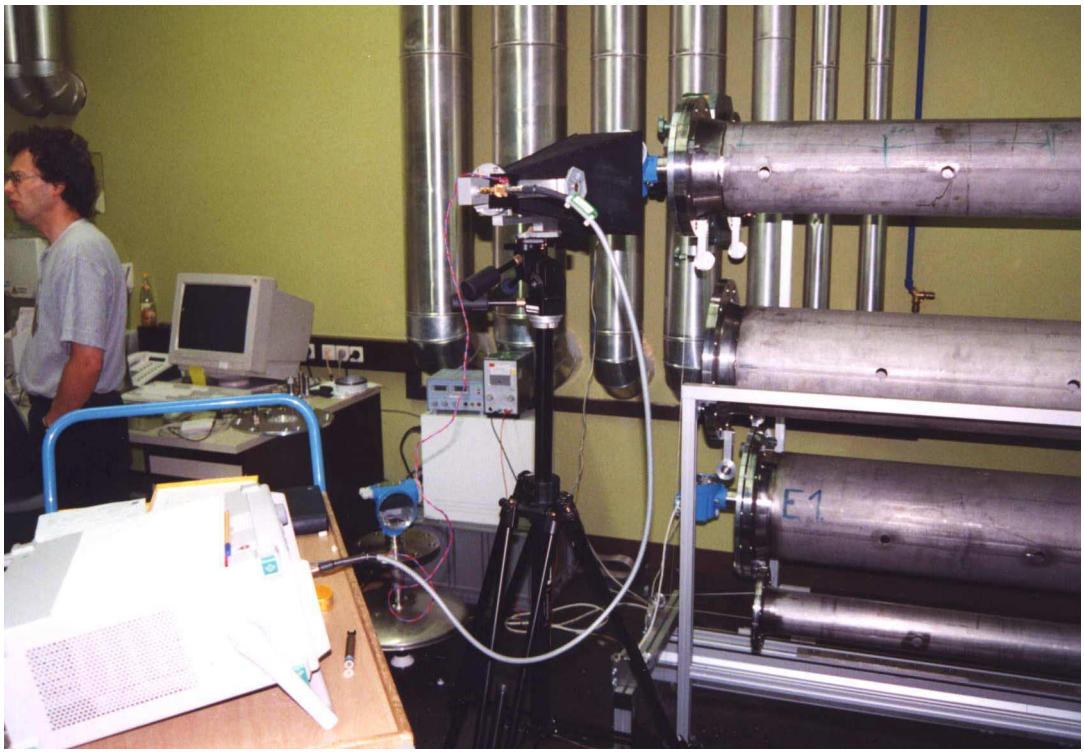


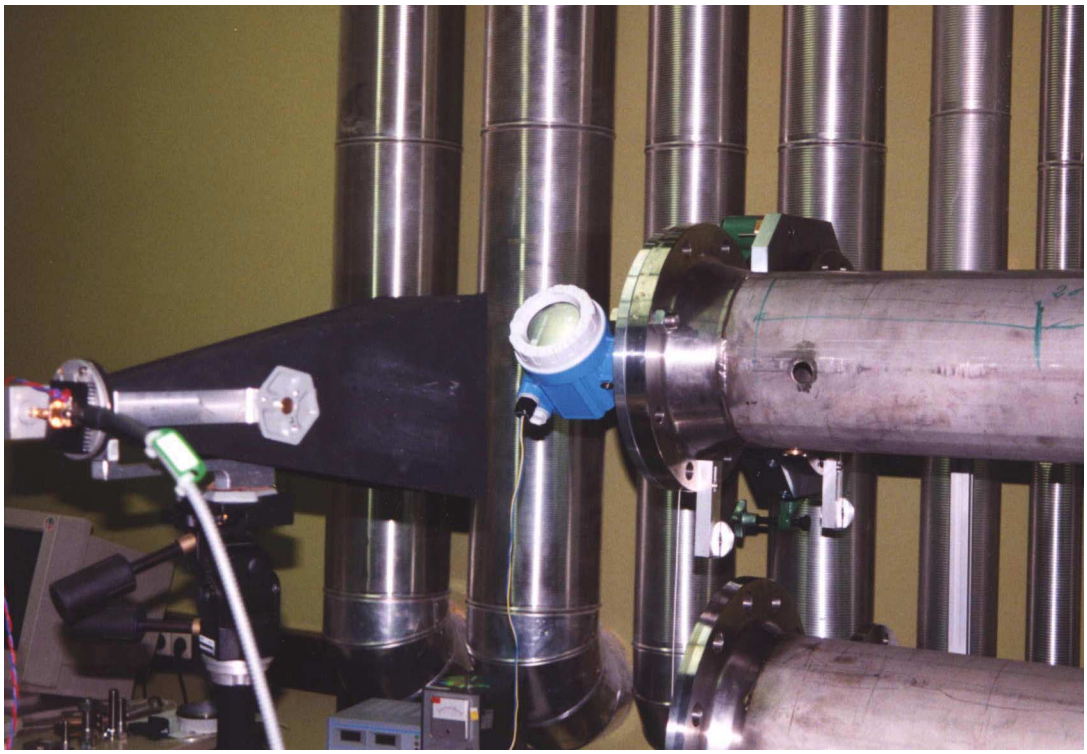
Test location glass tank at Endress+Hauser, Maulburg



Test location metallic tank at Endress+Hauser, Maulburg

Test location splash tube at Endress+Hauser, Maulburg





8. List of Measurements

FCC Part 15 Subpart C			
Section(s):	**Test**	**Page**	**Result**
	Transmit mode (TX):		
15.209	Field strength of emissions (fundamental)		passed

9. Test Results

Field Strength of Emissions according to FCC Rules, Part 15, Subpart C, Section 15.209 (Fundamental)

Model:	**FMR 530**
Type:	**with Horn Antenna**
Serial No.:	---
Application	Plastic tank
Applicant:	Endress + Hauser GmbH & Co.
Test Site:	Photo Print Electronic GmbH, Schopfheim
Distance:	0.3 meter
Date of Test	June 06, 2000
Test Operator:	J. Roidt

Charts 50 and 51

Frequency MHz	Detector	Antenna Pol.	Analyzer Reading dBµV	Antenna correction dB/m	Field Strength dBµV/m	Limit dBµV/m	Margin dB
6000.0	Peak	Horizontal	**-12.1** (1)	25.1	**59.15** (2)	74.0	**14.85**
6000.0	Average	Horizontal	**-12.1** (1)	25.1	**11.8** (3)	54.0	**42.2**

Sample calculation of Field Strength values:

Field Strength (dBµV/m) = Analyzer Reading (dBµV) + Antenna Correction (dB/m)

For duty cycle correction and desensitization factors see calculation overleaf

Note: Antenna correction includes cable losses as well.

(1) Corrected by –56.6 dB due to 0.3 m test distance and preamplifier gain
(2) Includes desensitization factor
(3) Includes duty cycle correction factor

Test instruments used: 101, 114, 149, 009 (see instruments list for details)

Field Strength of Emissions according to FCC Rules, Part 15, Subpart C, Section 15.209 (Fundamental)

Model:	**FMR 530**
Type:	**with Horn Antenna**
Serial No.:	---
Application	concrete tank with windows
Applicant:	Endress + Hauser GmbH & Co.
Test Site:	Schweigert GmbH, Maulburg
Distance:	0.3 meter
Date of Test	June 06, 2000
Test Operator:	J. Roidt

Chart 35 and 36

Frequency MHz	Detector	Antenna Pol.	Analyzer Reading dBµV	Antenna correction dB/m	Field Strength dBµV/m	Limit dBµV/m	Margin dB
6000.0	Peak	Horizontal	**-15.8** (1)	25.1	**56.65** (2)	74.0	**17.35**
6000.0	Average	Horizontal	**-15.8** (1)	25.1	**9.3**	54.0	**44.7**

Sample calculation of Field Strength values:

Field Strength (dBµV/m) = Analyzer Reading (dBµV) + Antenna Correction (dB/m)

For duty cycle correction and desensitization factors see calculation overleaf

Note: Antenna correction includes cable losses as well.

(1) Corrected by –56.6 dB due to 0.3 m test distance and preamplifier gain
(2) Includes desensitization factor
(3) Includes duty cycle correction factor

Test instruments used: 101, 114, 149, 009 (see instruments list for details)

Field Strength of Emissions according to FCC Rules, Part 15, Subpart C, Section 15.209 (Fundamental)

Model:	**FMR 530**
Type:	**with Horn Antenna**
Serial No.:	---
Application	Glass tank
Applicant:	Endress + Hauser GmbH & Co.
Test Site:	Endress + Hauser GmbH & Co.
Distance:	0.3 meter
Date of Test	June 06, 2000
Test Operator:	J. Roidt

Chart 19 and 20

Frequency MHz	Detector	Antenna Pol.	Analyzer Reading dBµV	Antenna correction dB/m	Field Strength dBµV/m	Limit dBµV/m	Margin dB
6554	Peak	Horizontal	**-13.1**	25.1	**59.35**	74.0	**12.35**
6554	Average	Horizontal	**-11.37** (1)	25.1	**12**	54.0	**42.0**

Sample calculation of Field Strength values:

Field Strength (dBµV/m) = Analyzer Reading (dBµV) + Antenna Correction (dB/m)

For duty cycle correction and desensitization factors see calculation overleaf

Note: Antenna correction includes cable losses as well.

(1) Corrected by –56.6 dB due to 0.3 m test distance and preamplifier gain
(2) Includes desensitization factor
(3) Includes duty cycle correction factor

Test instruments used: 101, 114, 149, 009 (see instruments list for details)

Field Strength of Emissions according to FCC Rules, Part 15, Subpart C, Section 15.209 (Fundamental)

Model:	**FMR 530**
Type:	**with Horn Antenna**
Serial No.:	---
Application	Metallic tank
Applicant:	Endress + Hauser GmbH & Co.
Test Site:	Endress + Hauser GmbH & Co.
Distance:	0.3 meter
Date of Test	June 06, 2000
Test Operator:	J. Roidt

Charts 29 and 30

Frequency MHz	Detector	Antenna Pol.	Analyzer Reading dBµV	Antenna correction dB/m	Field Strength dBµV/m	Limit dBµV/m	Margin dB
6304	Peak	Horizontal	**-13.6 (1)**	25.1	**58.85**	74.0	**15.12**
6304	Average	Horizontal	**-13.6 (2)**	25.1	**11.5**	54.0	**21.5**

Sample calculation of Field Strength values:

Field Strength (dBµV/m) = Analyzer Reading (dBµV) + Antenna Correction (dB/m)

For duty cycle correction and desensitization factors see calculation overleaf

Note: Antenna correction includes cable losses as well.

(1) Corrected by –56.6 dB due to 0.3 m test distance and preamplifier gain
(2) Includes desensitization factor
(3) Includes duty cycle correction factor

Test instruments used: 101, 114, 149, 009 (see instruments list for details)

Field Strength of Emissions according to FCC Rules, Part 15, Subpart C, Section 15.209 (Fundamental)

Model:	**FMR 531**
Type:	**with Rod Antenna**
Serial No.:	---
Application	Plastic tank
Applicant:	Endress + Hauser GmbH & Co.
Test Site:	Photo Print Electronic GmbH, Schopfheim
Distance:	0.3 meter
Date of Test	June 06, 2000
Test Operator:	J. Roidt

Chart 49

Frequency MHz	Detector	Antenna Pol.	Analyzer Reading dBµV	Antenna correction dB/m	Field Strength dBµV/m	Limit dBµV/m	Margin dB
6288	Peak	Horizontal	**-10.86** (1)	25.1	**59.95** (2)	74.0	**14.05**
6288	Average	Horizontal	**-10.86** (1)	25.1	**12.6** (3)	54.0	**41.4**

Sample calculation of Field Strength values:

Field Strength (dBµV/m) = Analyzer Reading (dBµV) + Antenna Correction (dB/m)

For duty cycle correction and desensitization factors see calculation overleaf

Note: Antenna correction includes cable losses as well.

(1) Corrected by –56.6 dB due to 0.3 m test distance and preamplifier gain
(2) Includes desensitization factor
(3) Includes duty cycle correction factor

Test instruments used: 101, 114, 149, 009 (see instruments list for details)

Field Strength of Emissions according to FCC Rules, Part 15, Subpart C, Section 15.209 (Fundamental)

Model:	**FMR 531**
Type:	**with Rod Antenna**
Serial No.:	---
Application:	Glass tank
Applicant:	Endress + Hauser GmbH & Co.
Test Site:	Endress + Hauser GmbH & Co.
Distance:	0.3 meter
Date of Test	June 06, 2000
Test Operator:	J. Roidt

Charts 17 and 18

Frequency MHz	Detector	Antenna Pol.	Analyzer Reading dBµV	Antenna correction dB/m	Field Strength dBµV/m	Limit dBµV/m	Margin dB
6472	Peak	Horizontal	**-9.3** (1)	25.1	**63.15** (2)	74.0	**9.85**
6472	Average	Horizontal	**-9.3** (1)	25.1	**15.8** (3)	54.0	**38.2**

Sample calculation of Field Strength values:

Field Strength (dBµV/m) = Analyzer Reading (dBµV) + Antenna Correction (dB/m)

For duty cycle correction and desensitization factors see calculation overleaf

Note: Antenna correction includes cable losses as well.

(1) Corrected by –56.6 dB due to 0.3 m test distance and preamplifier gain
(2) Includes desensitization factor
(3) Includes duty cycle correction factor

Test instruments used: 101, 114, 149, 009 (see instruments list for details)

Field Strength of Emissions according to FCC Rules, Part 15, Subpart C, Section 15.209 (Fundamental)

Model:	**FMR 533**
Type:	**with Parabolic Antenna**
Serial No.:	---
Application	Plastictank
Applicant:	Endress + Hauser GmbH & Co.
Test Site:	Photo Print Electronic GmbH, Schopfheim
Distance:	0.3 meter
Date of Test	June 06, 2000
Test Operator:	J. Roidt

Charts 47 and 48

Frequency MHz	Detector	Antenna Pol.	Analyzer Reading dBµV	Antenna correction dB/m	Field Strength dBµV/m	Limit dBµV/m	Margin dB
6184	Peak	Horizontal	**-9.4** (1)	25.1	**63.05** (2)	74.0	**11.95**
6184	Average	Horizontal	**-9.4** (1)	25.1	**15.7** (3)	54.0	**38.3**

Sample calculation of Field Strength values:

Field Strength (dBµV/m) = Analyzer Reading (dBµV) + Antenna Correction (dB/m)

For duty cycle correction and desensitization factors see calculation overleaf

Note: Antenna correction includes cable losses as well.

(1) Corrected by –56.6 dB due to 0.3 m test distance and preamplifier gain
(2) Includes desensitization factor
(3) Includes duty cycle correction factor

Test instruments used: 101, 114, 149, 009 (see instruments list for details)

Field Strength of Emissions according to FCC Rules, Part 15, Subpart C, Section 15.209 (Fundamental)

Model:	**FMR 533**
Type:	**with Parabolic Antenna**
Serial No.:	---
Application	Concrete tank with windows
Applicant:	Endress + Hauser GmbH & Co.
Test Site:	Schweigert GmbH, Maulburg
Distance:	0.3 meter
Date of Test	June 06, 2000
Test Operator:	J. Roidt

Charts 39 and 40

Frequency MHz	Detector	Antenna Pol.	Analyzer Reading dBµV	Antenna correction dB/m	Field Strength dBµV/m	Limit dBµV/m	Margin dB
6000	Peak	Horizontal	**-14.6** (1)	25.1	**57.85** (2)	74.0	**16.15**
6000	Average	Horizontal	**-14.6** (1)	25.1	**10.5** (3)	54.0	**43.5**

Sample calculation of Field Strength values:

Field Strength (dBµV/m) = Analyzer Reading (dBµV) + Antenna Correction (dB/m)

For duty cycle correction and desensitization factors see calculation overleaf

Note: Antenna correction includes cable losses as well.

(1) Corrected by –56.6 dB due to 0.3 m test distance and preamplifier gain
(2) Includes desensitization factor
(3) Includes duty cycle correction factor

Test instruments used: 101, 114, 149, 009 (see instruments list for details)

Field Strength of Emissions according to FCC Rules, Part 15, Subpart C, Section 15.209 (Fundamental)

Model:	**FMR 532**
Type:	**with Planar Antenna**
Serial No.:	---
Application	Splash Water Tube
Applicant:	Endress + Hauser GmbH & Co.
Test Site:	Endress + Hauser GmbH & Co.
Distance:	0.3 meter
Date of Test	June 06, 2000
Test Operator:	J. Roidt

Charts 25 and 26

Frequency MHz	Detector	Antenna Pol.	Analyzer Reading dBµV	Antenna correction dB/m	Field Strength dBµV/m	Limit dBµV/m	Margin dB
6296	Peak	Horizontal	**-10.3** (1)	25.1	**62.15** (2)	74.0	**11.85**
6296	Average	Horizontal	**-10.3** (1)	25.1	**14.8** (3)	54.0	**39.2**

Sample calculation of Field Strength values:

Field Strength (dBµV/m) = Analyzer Reading (dBµV) + Antenna Correction (dB/m)

For duty cycle correction and desensitization factors see calculation overleaf

Note: Antenna correction includes cable losses as well.

(1) Corrected by –56.6 dB due to 0.3 m test distance and preamplifier gain
(2) Includes desensitization factor
(3) Includes duty cycle correction factor

Test instruments used: 101, 114, 149, 009 (see instruments list for details)

10. Equipment List

General Test Equipment and Ancillaries

No.	Instrument/Ancillary	Type	Serial Number	Manufacturer
001	Open area test site	EG 1		Senton
002	Shielded room	No. 1	1451	Senton
003	Shielded room	No. 2	1452	Senton
004	Semi-anechoic room	No. 3	1453	Siemens
005	Shielded room	No. 4	3FD 100 544	Euroshield
006	Shielded room	No. 5	5468	Ray Proof Division
007	Temperature test chamber	HT4010	07065550	Heraeus
008	Cable	RG214	1309	Senton
009	Cable	200CM_001	1357	Rosenberger
010	Cable	150CM_001	1479	Rosenberger
011	Cable	150CM_002	1480	Rosenberger
012	Cable set EG1	RG214	1189 - 1191	Senton
013	Cable set cabin no. 1	RG214		Senton
014	Cable set cabin no. 2	RG214		Senton
015	Cable set cabin no. 3	RG214		Senton
016	Cable set cabin no. 4	RG214		Senton
017	DC power supply	NGSM 32/10	203	Rohde & Schwarz
018	DC power supply	NGB	2455	Rohde & Schwarz
019	DC power supply	NGA	386	Rohde & Schwarz
020	Isolating transformer	RT 5A	10387	Grundig
021	Isolating transformer	RT 5A	10416	Grundig
022	Digital multimeter	199	463386	Keithley
023	Multimeter	HP E2373A	2927J03345	Hewlett Packard

Test Equipment and Ancillaries used for Emission Tests

No.	Instrument/Ancillary	Type	Serial Number	Manufacturer
101	EMI test receiver/ Spectrum Analyzer with Harmonic Mixer Set (26.5 - 40 GHz)	ESMI FS-Z-40	839379/013 839587/006 845881/005	Rohde & Schwarz
102	Spectrum analyzer	R 3271	05050023	Advantest
103	Test receiver	ESH 3	880112/032	Rohde & Schwarz
104	Test receiver	ESHS 10	860043/016	Rohde & Schwarz
105	Test receiver	ESV	881414/009	Rohde & Schwarz
106	Test receiver	ESVP	881120/024	Rohde & Schwarz
107	Audio analyzer	UPA	862954	Rohde & Schwarz
108	Radio communication service monitor	CMS 54	838384/030	Rohde & Schwarz
109	Power meter	NRVS	836856/015	Rohde & Schwarz
110	Power sensor	NRV-Z52	837901/030	Rohde & Schwarz
111	Power sensor	NRV-Z4	863828/015	Rohde & Schwarz
112	Preamplifier	ESV-Z3	860907/004	Rohde & Schwarz
113	Preamplifier	R14601		Advantest
114	Preamplifier	ACX/080-3030	32640	CTT
115	Preamplifier	ACO/180-3530	32641	CTT
116	Signal generator	SMS	872166/039	Rohde & Schwarz
117	Signal generator	HP 8673 D	2930A00966	Hewlett Packard
118	Waveform generator	HP 33120 A	US34005375	Hewlett Packard
119	UHF attenuator set	DPU	300771/075	Rohde & Schwarz
120	UHF attenuator set	DPU	300788/006	Rohde & Schwarz
121	Attenuator	4776-10	9412	Narda
122	Attenuator	4776-20	9503	Narda
123	Pulse limiter	ESH 3-Z2	1144	Rohde & Schwarz
124	Pulse limiter	11947 A	3107A00566	Hewlett Packard
125	V-network	ESH 3-Z5	862770/018	Rohde & Schwarz
126	V-network	ESH 3-Z5	894785/005	Rohde & Schwarz
127	V-network	ESH 3-Z5	830952/025	Rohde & Schwarz
128	V-network	ESH 3-Z6	830722/010	Rohde & Schwarz
129	V-network	NSLK 8127	8127152	Schwarzbeck
130	Artificial mains network	ESH 2-Z5	842966/004	Rohde & Schwarz
131	T-network	ESH 3-Z4	890602/011	Rohde & Schwarz
132	T-network	ESH 3-Z4	890602/012	Rohde & Schwarz

Test Equipment and Ancillaries used for Emission Tests (continued)

No.	Instrument/Ancillary	Type	Serial Number	Manufacturer
134	High impedance probe	TK 9416	01	Schwarzbeck
135	High impedance probe	TK 9416	02	Schwarzbeck
136	Current probe	ESH 2-Z1	863366/18	Rohde & Schwarz
137	Current probe	ESV-Z1	862553/3	Rohde & Schwarz
138	Absorbing clamp	MDS 21	80911	Lüthi
139	Absorbing clamp	MDS 21	79690	Lüthi
140	Loop antenna	HFH2-Z2	882964/1	Rohde & Schwarz
141	Biconical antenna	HK 116	836239/02	Rohde & Schwarz
142	Biconical antenna	HK 116	842204/001	Rohde & Schwarz
143	Log. periodic antenna	HL 223	834408/12	Rohde & Schwarz
144	Log. periodic antenna	HL 223	841516/023	Rohde & Schwarz
145	Horn antenna 1 - 18 GHz	3115	9508-4553	Emco
146	Horn antenna 1.7 - 2.6 GHz	3160-03	9112-1003	Emco
147	Horn antenna 2.6 - 3.95 GHz	3160-04	9112-1001	Emco
148	Horn antenna 3.95 - 5.85 GHz	3160-05	9112-1001	Emco
149	Horn antenna 5.85 - 8.2 GHz	3160-06	9112-1001	Emco
150	Horn antenna 8.2 - 12.4 GHz	3160-07	9112-1008	Emco
151	Horn antenna 12.4 - 18 GHz	3160-08	9112-1002	Emco
152	Horn antenna 18 - 26.5 GHz	3160-09	9403-1025	Emco
152	Horn Antenna 26.5 - 40 GHz	3160-10	9704-1047	Emco
153	Stub tuner	904N	04	Narda
154	Mains analyzer	DPA 503	496 - 02	EM Test
155	Controller	HIS 500	X71010	EM Test
156	AC Amplifier	ACS 500	HK51736	EM Test
157	Mains impedance	AIF 500	X71062	EM Test
158	Dual Directional Coupler	778D	0826A01562	Hewlett Packard
159	Data Analyzer	DA-10	J-0048	Wandel & Goltermann

Test Equipment and Ancillaries used for Immunity Tests

No.	Type	Model	Serial Number	Manufacturer
201	ESD simulator	NSG 435	000290	Schaffner
202	EFT generator	NSG 1025	3020	Schaffner
203	Ultra compact simulator	UCS	1195-30	EM Test
204	Coupling clamp	CDN 8014	131	Schaffner
205	Coupling clamp	SL 400-071D	007	Schaffner
206	Coupling filter	FP 16	080554-14-84	Haefely
207	Oscilloscope	2225	203550	Tektronix
208	Signal generator	SMT 03	838129/029 837533/032	Rohde & Schwarz
209	Power amplifier	150 L	8835	Amplifier Research
210	Power amplifier	200 W 1000	12904	Amplifier Research
211	Power meter	NRVS	838624/016	Rohde & Schwarz
212	E-field generator	3107 B	2302	Emco
213	Biconical antenna	VHBA 9123	1018	Schwarzbeck
214	Log. periodic antenna	AT 1080	12834	Amplifier Research
215	Isotropic field probe	FP 2000	12847	Amplifier Research
216	Isotropic field monitor	FM 2004	12632	Amplifier Research
217	Ultra compact simulator	UCS	1195-30	EM Test
218	Surge generator	NSG 650	1679204	Schaffner
219	Coupling network	CDN 110	1649135	Schaffner
220	Coupling network	CDN 115	132	Schaffner
221	Dropping resistor	INA 110-40	121	Schaffner
222	Oscilloscope	HM 408	9005 F 3144	Hameg
223	Signal generator	SMX	883184/018	Rohde & Schwarz
224	Power amplifier	411 LA	299	ENI
225	Power amplifier	HVV 250	836956/004	Rohde & Schwarz
226	Power meter	NRV	863825/018	Rohde & Schwarz
227	Coupling network	FCC - 801- M3-25	117	FCC
228	Coupling network	FCC - 801- M4-25	17	FCC
229	Coupling network	FCC - 801- M5-25	16	FCC
230	Coupling network	FCC - 801- AF4	47	FCC
231	Coupling network	FCC - 801- AF4	48	FCC
232	Coupling network	FCC - 801-T4	68	FCC
233	Coupling network	FCC - 801- C1	64	FCC
234	Coupling network	CDN 801-M3	--	Senton
235	Coupling network	CDN 801-S37	--	Senton
236	Current clamp	FCC-120-9B	15	FCC
237	EM injection clamp	EM 101	35354	Lüthi
238	Ultra compact simulator	UCS 500	1195-30	EM Test
239	Transformer			Senton
240	Oscilloscope	54602B	US35060304	Hewlett Packard

11. Charts Taken During Testing

Chart No. 50, FMR 530, Plastic Tank, Horizontal

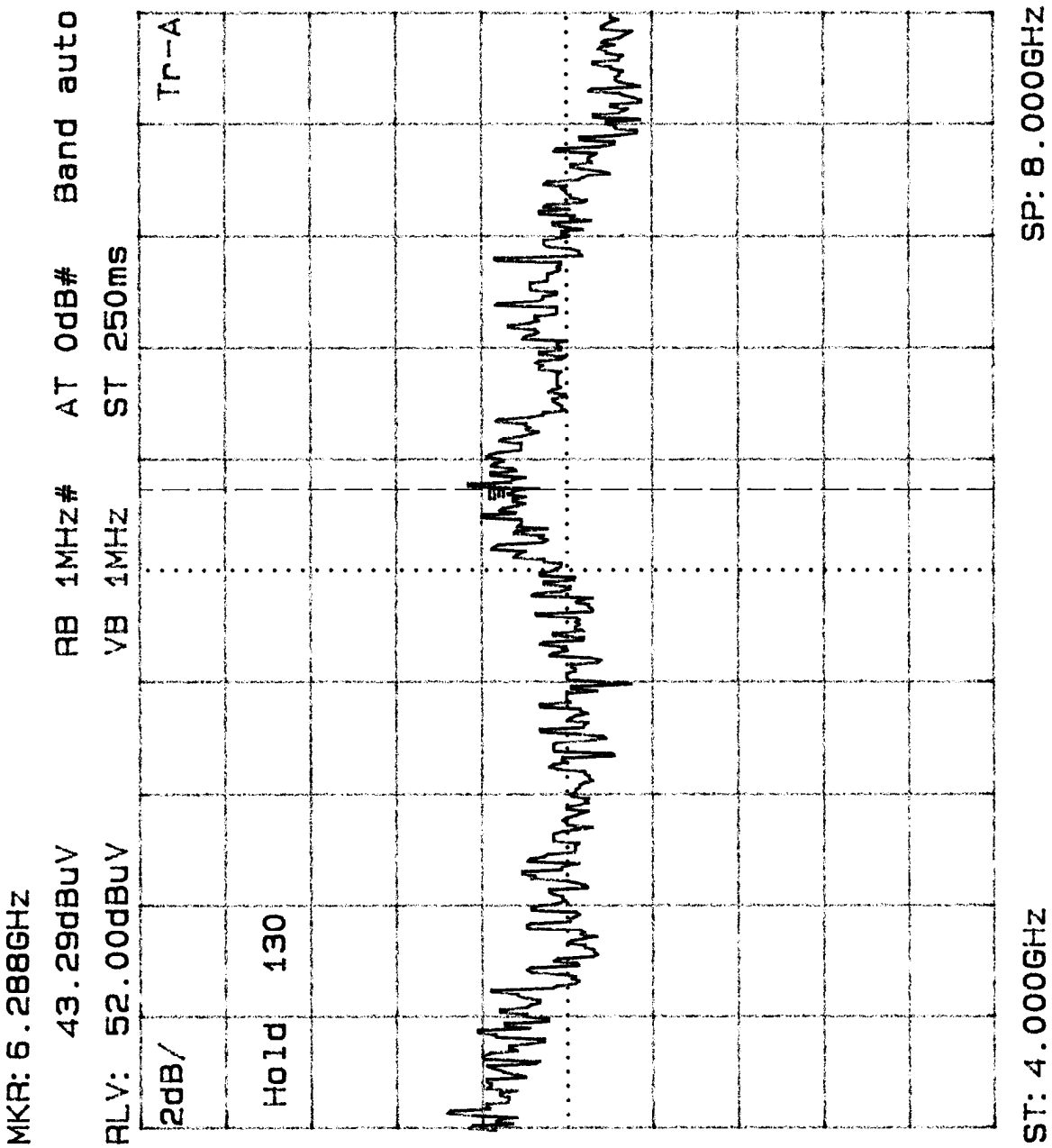


Chart No. 51, FMR 530, Plastic Tank, Vertical

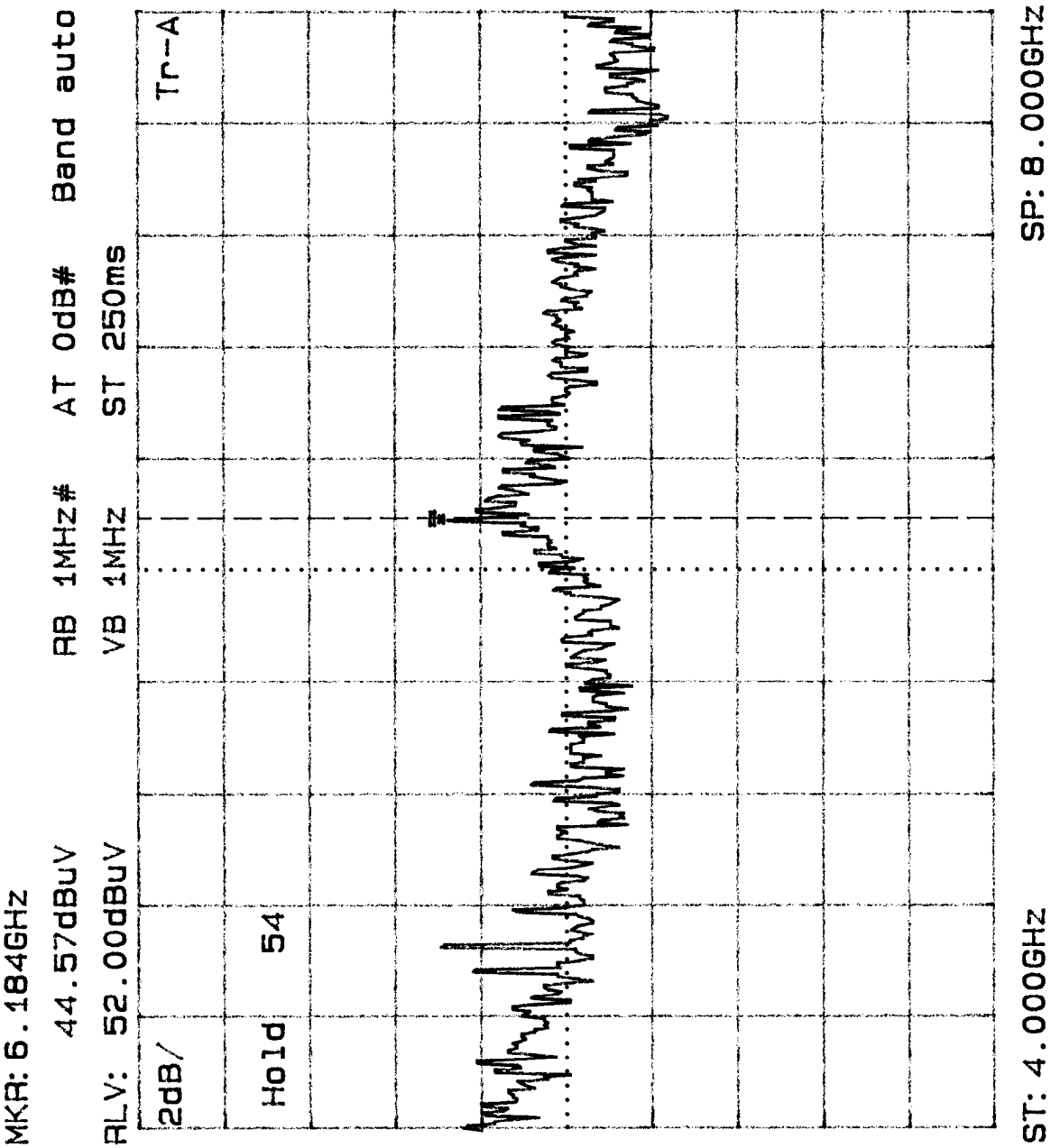


Chart No.35, FMR 530, Concrete Tank, Horizontal

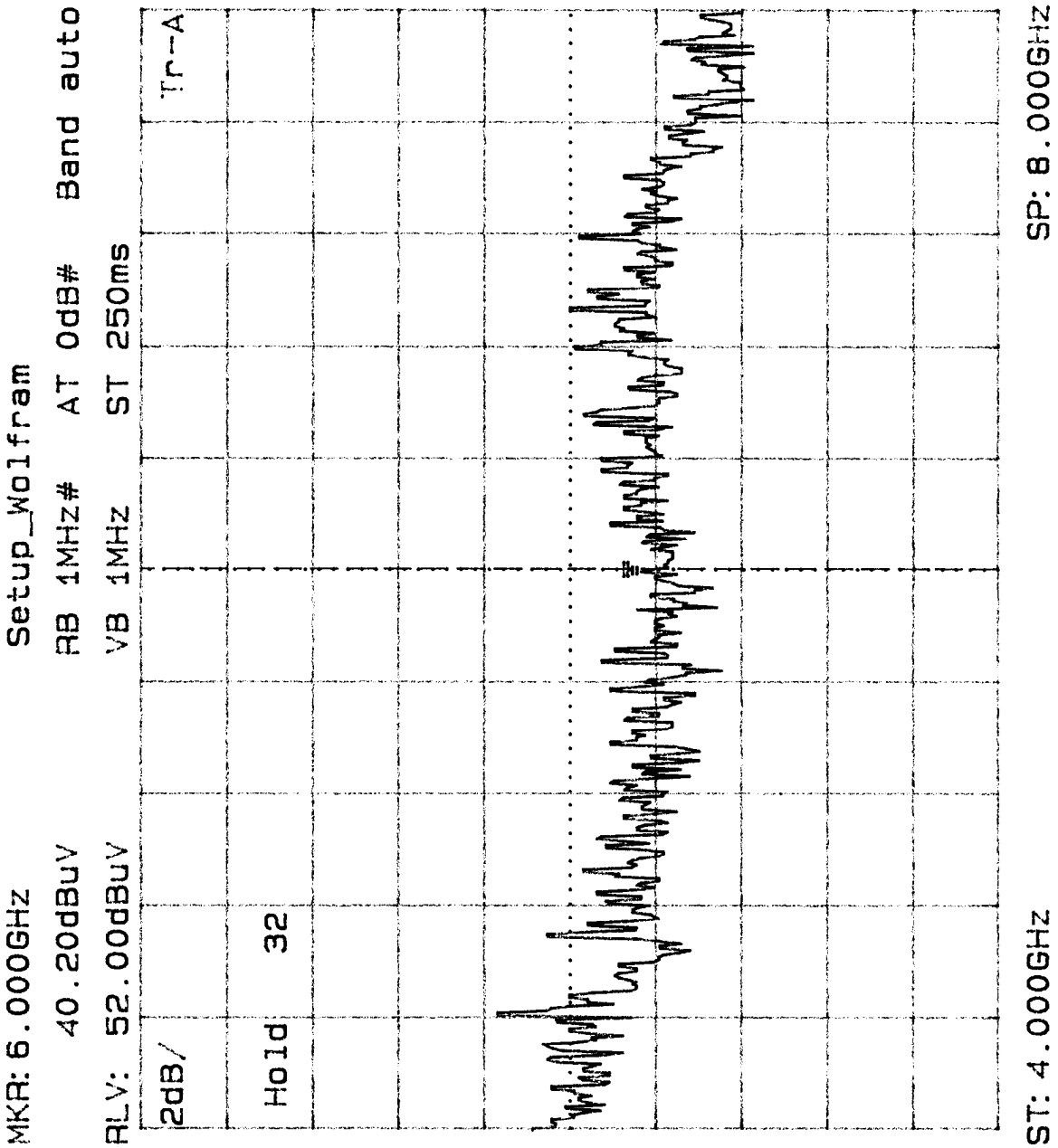


Chart No. 36, FMR 530, Concrete Tank, Vertical

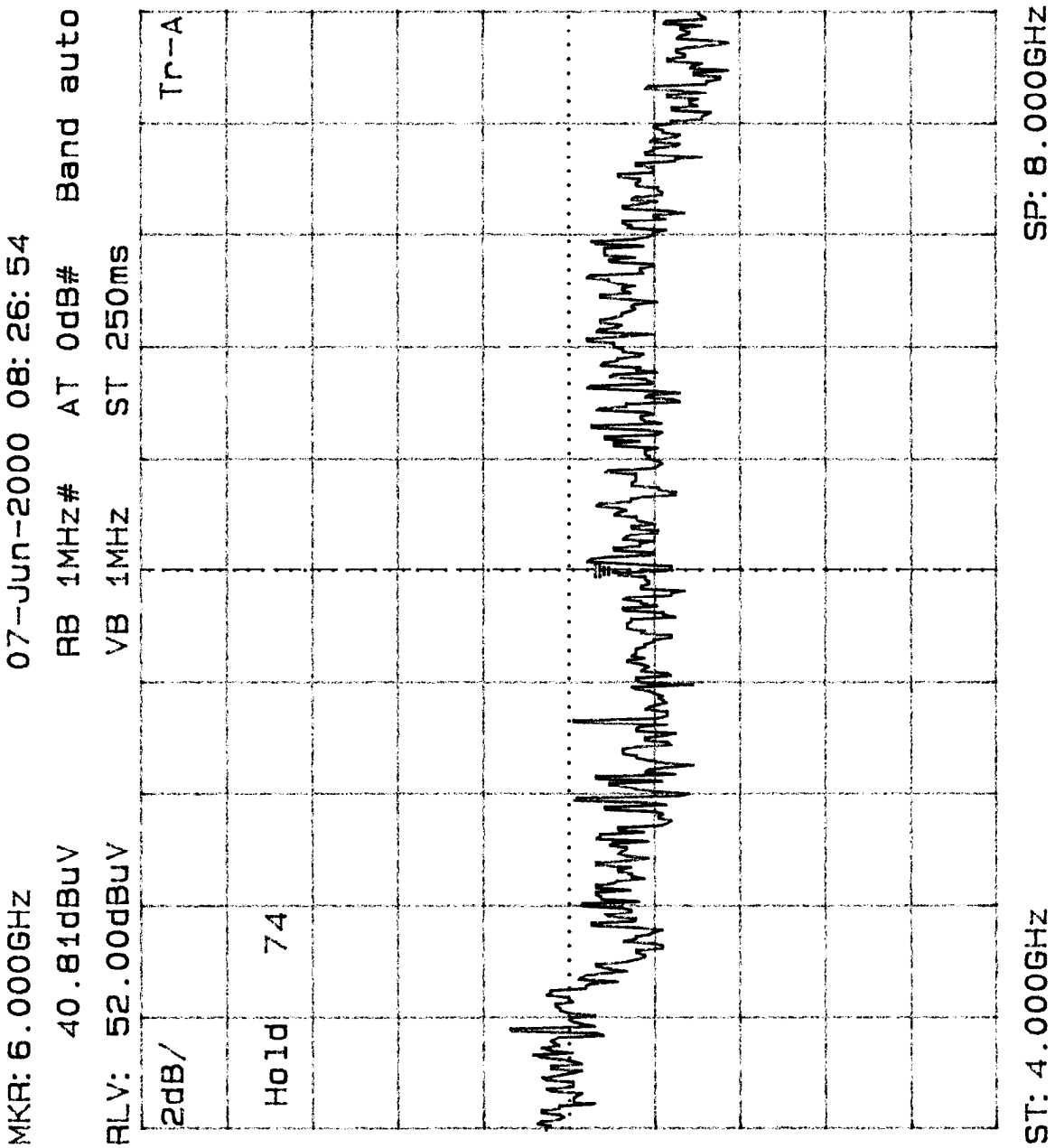


Chart No. 19, FMR 530, Glass Tank, Horizontal

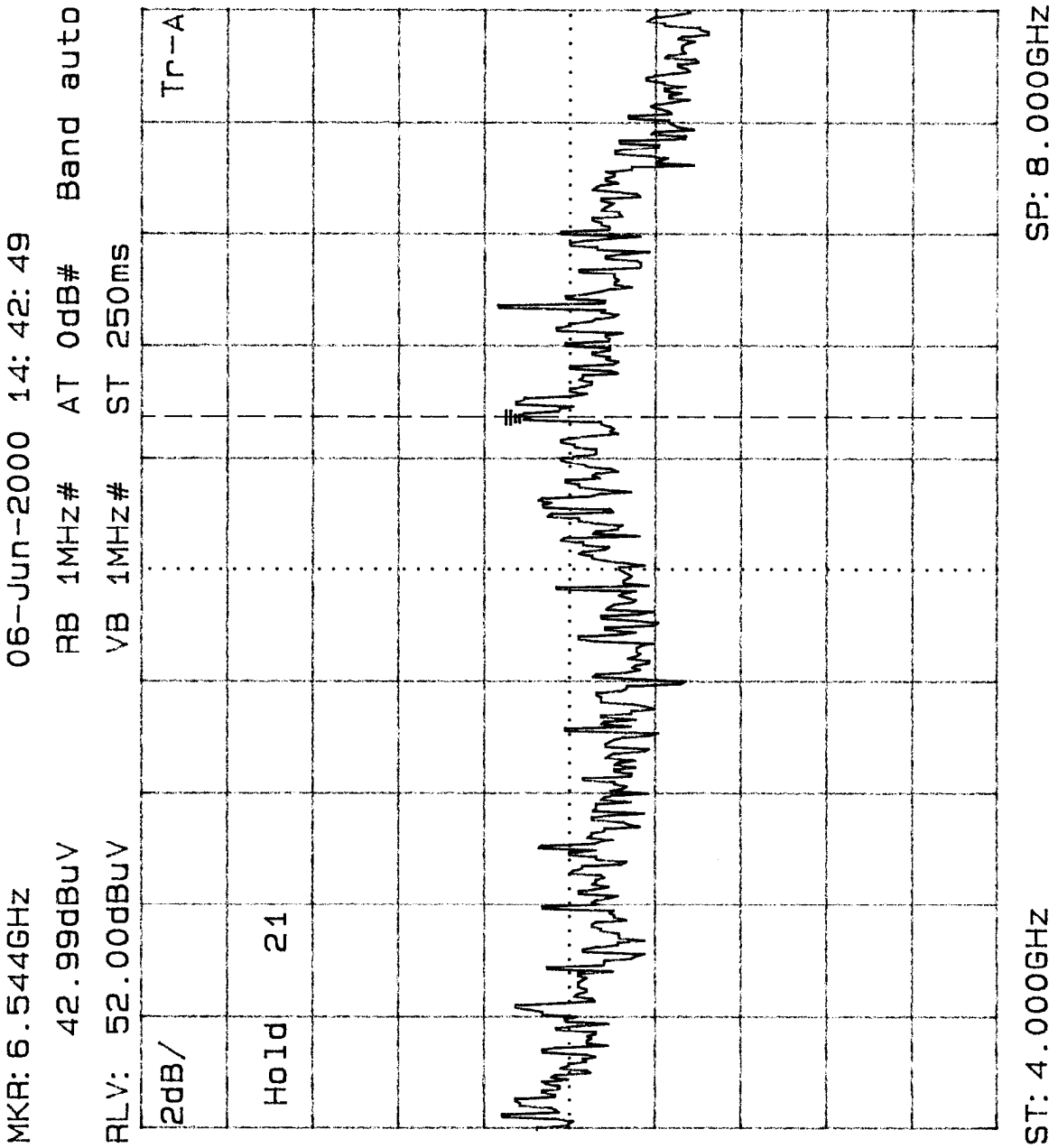


Chart No. 20, FMR 530, Glass Tank, Vertical

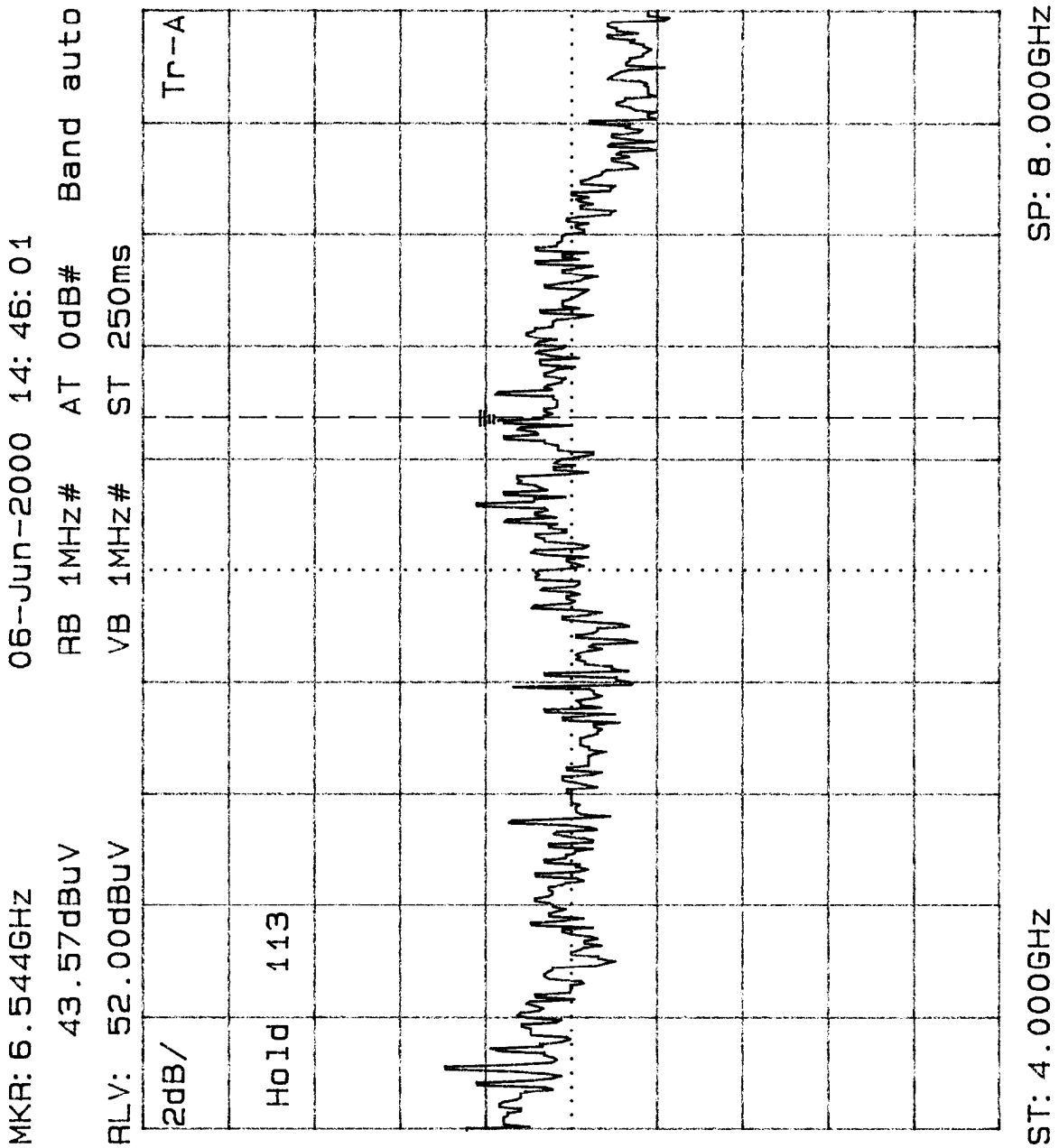


Chart No. 30, FMR 530, Metallic Tank, Horizontal

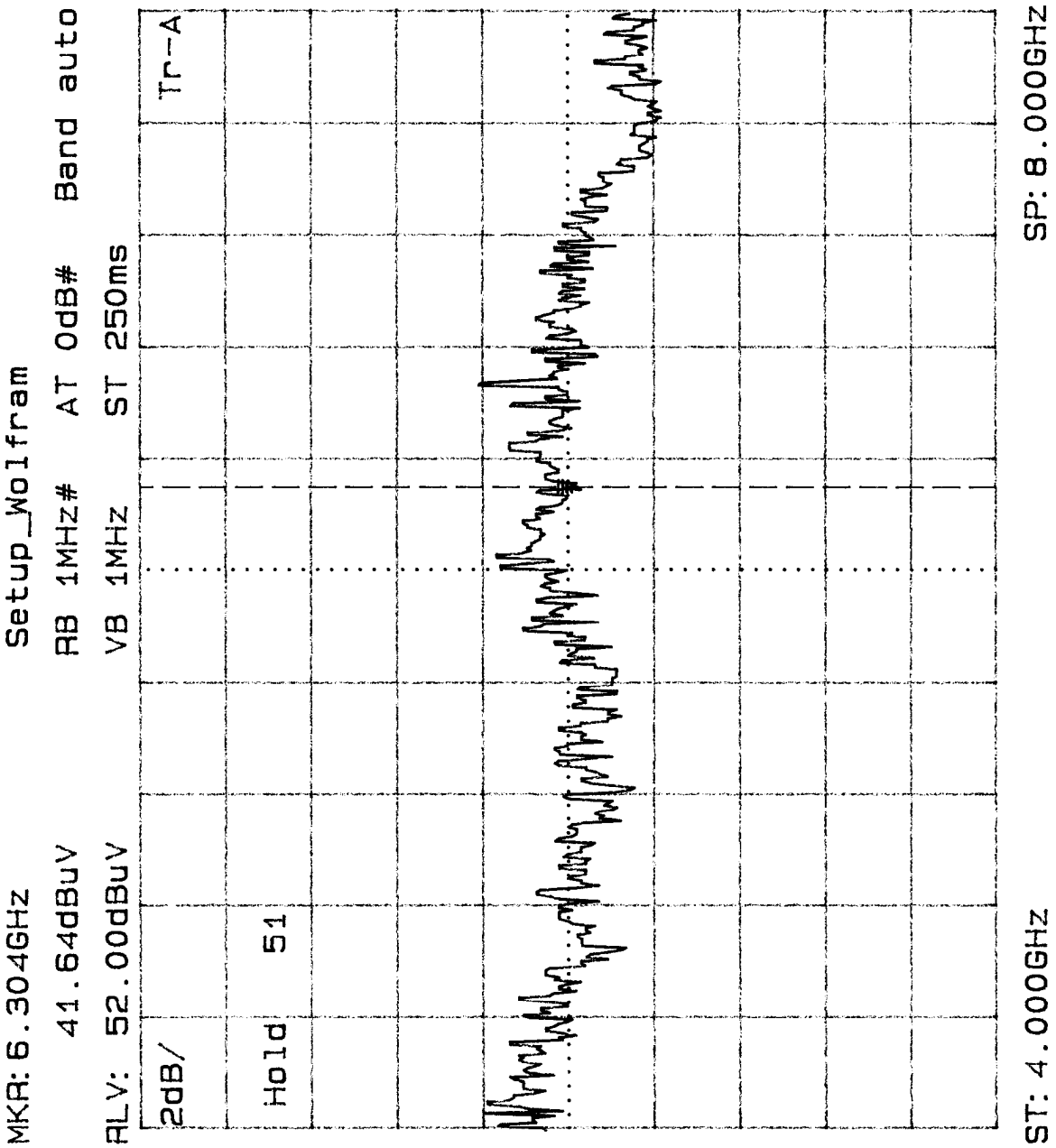


Chart No. 49, FMR 531, Plastic Tank, Horizontal

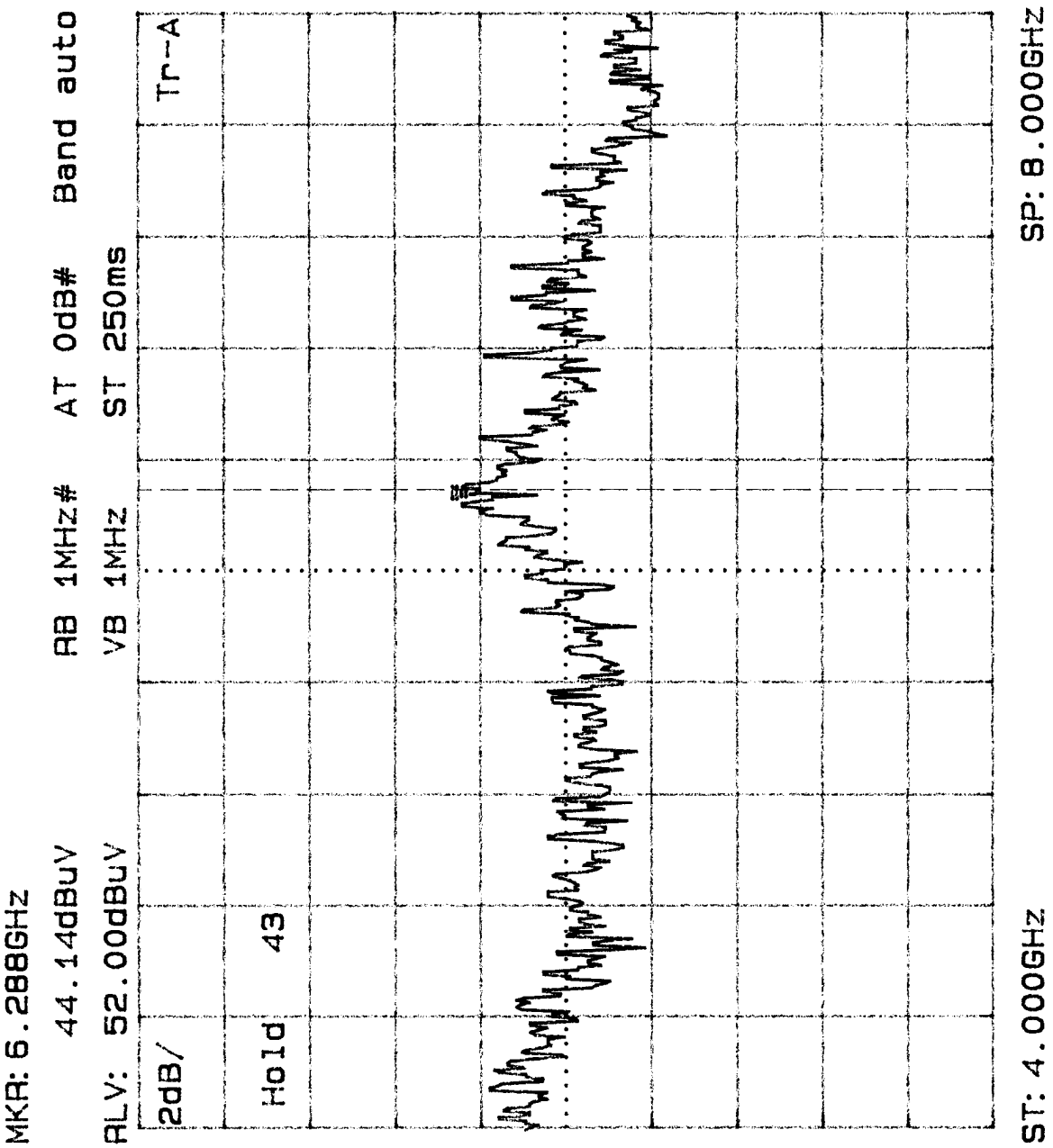


Chart No. 17, FMR 531, Glass Tank, Horizontal

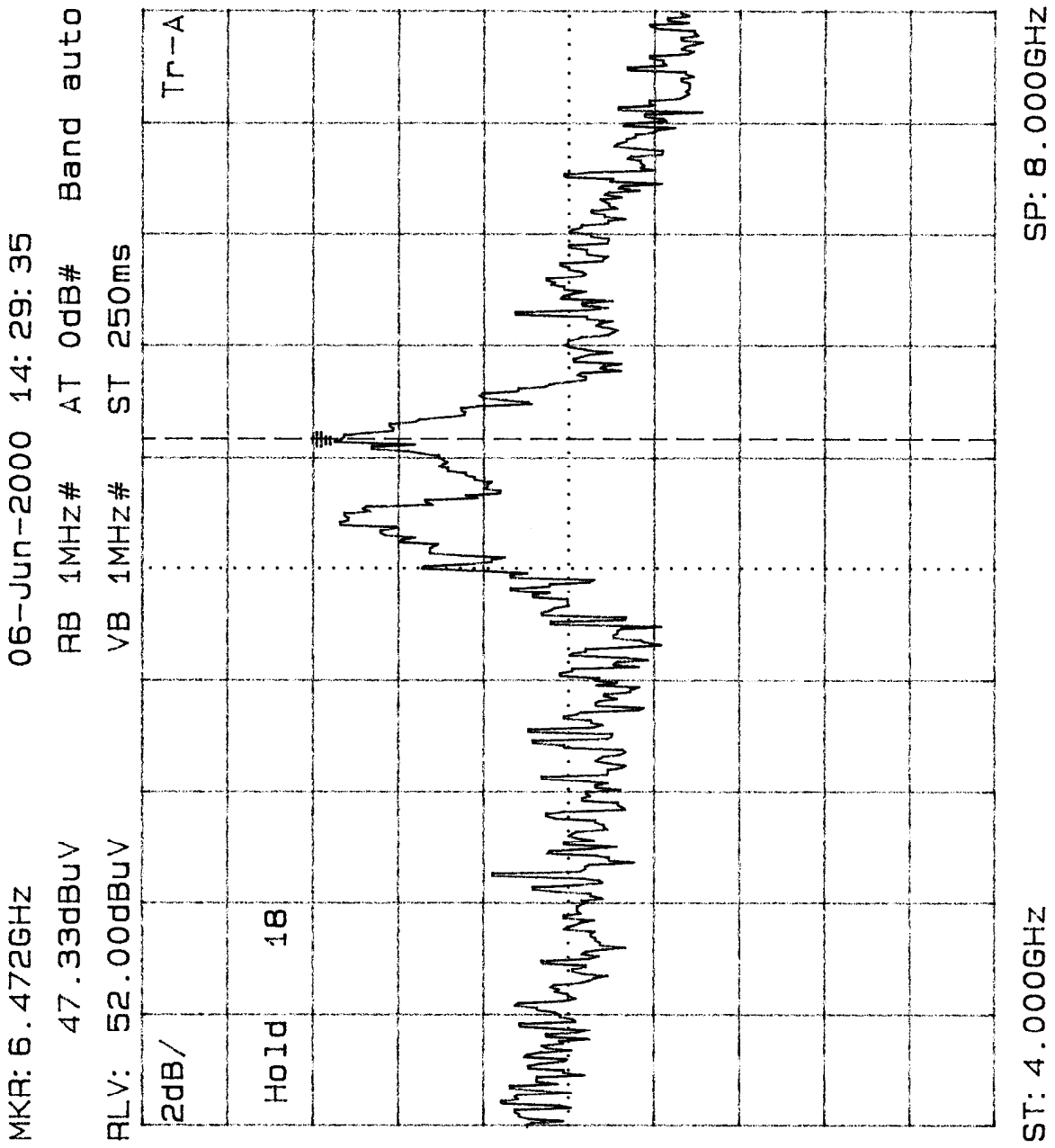


Chart No. 18, FMR 531, Glass Tank, Vertical

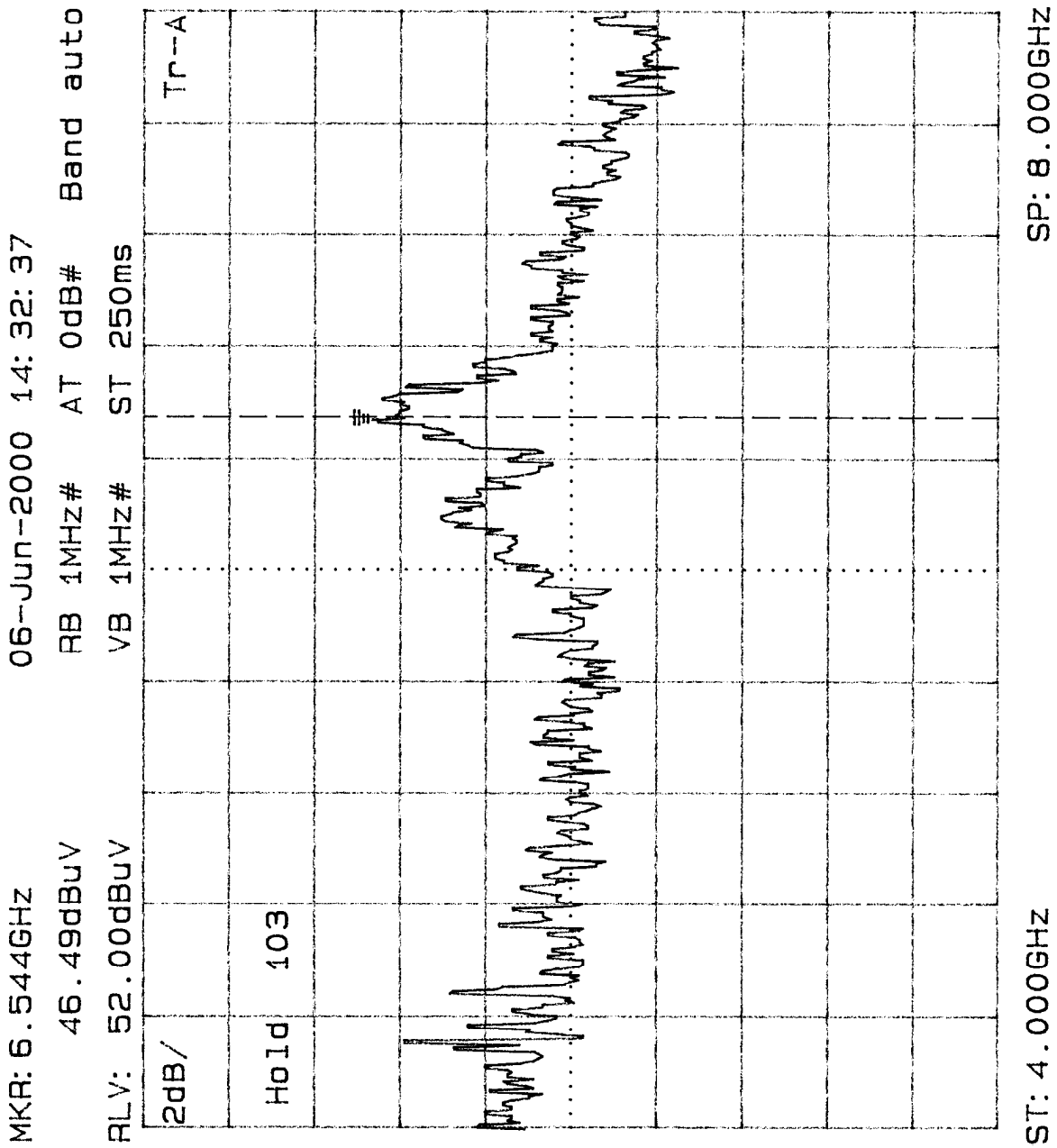


Chart no. 47, FMR 533, Plastic Tank, Horizontal

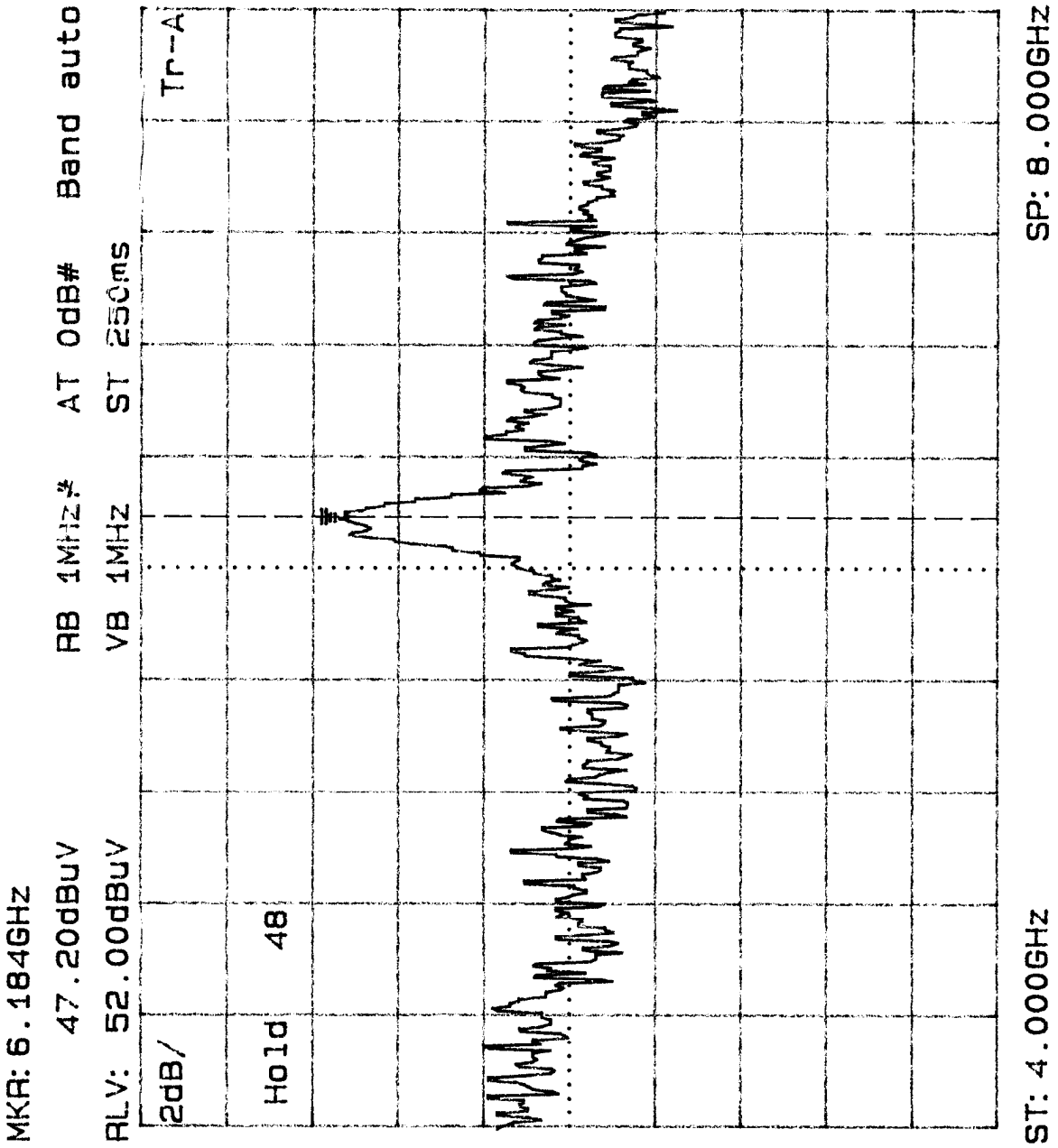


Chart No. 48, FMR 533, Plastic Tank, Vertical

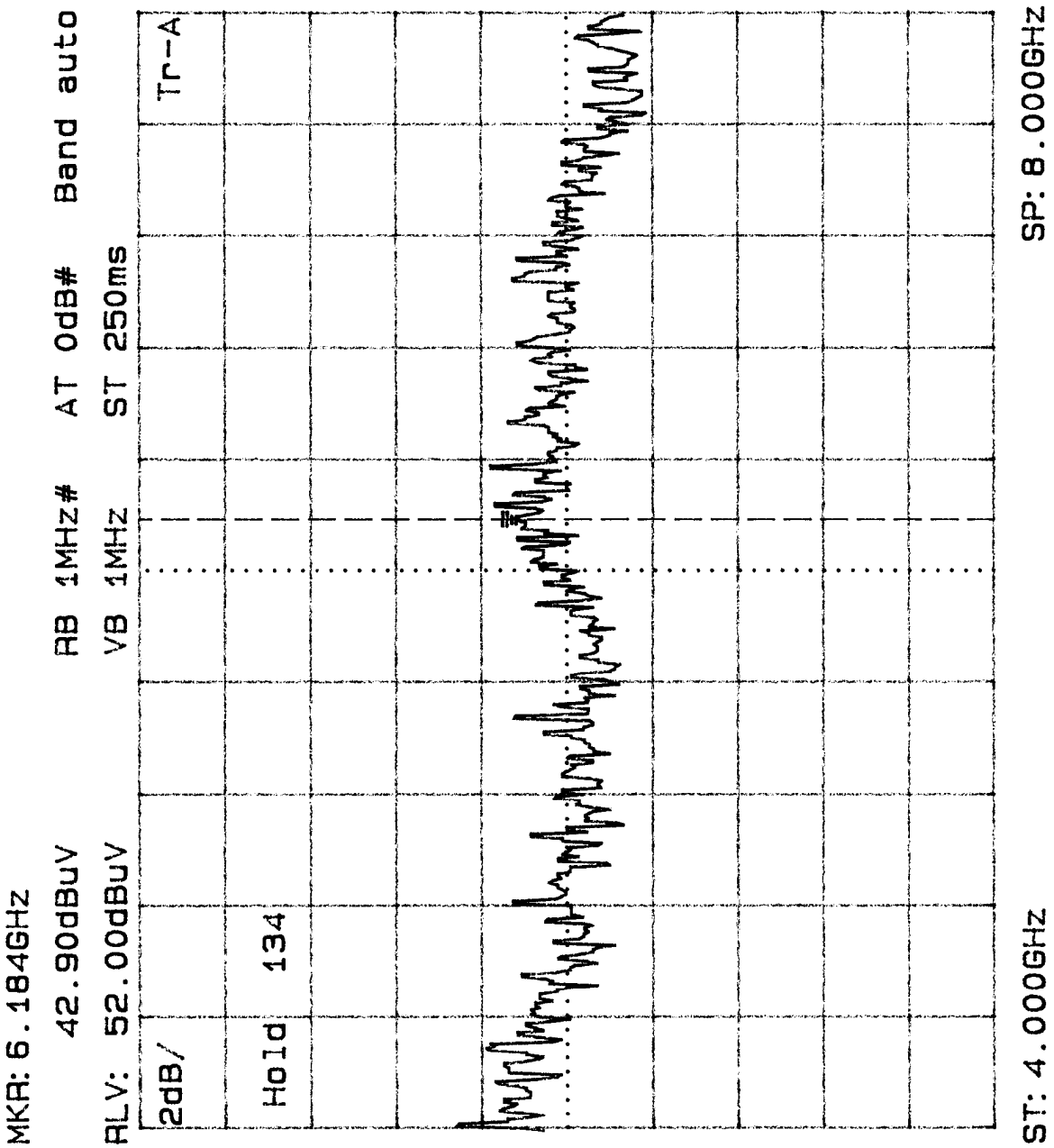


Chart No. 39, FMR 533, Concrete Tank, Horizontal

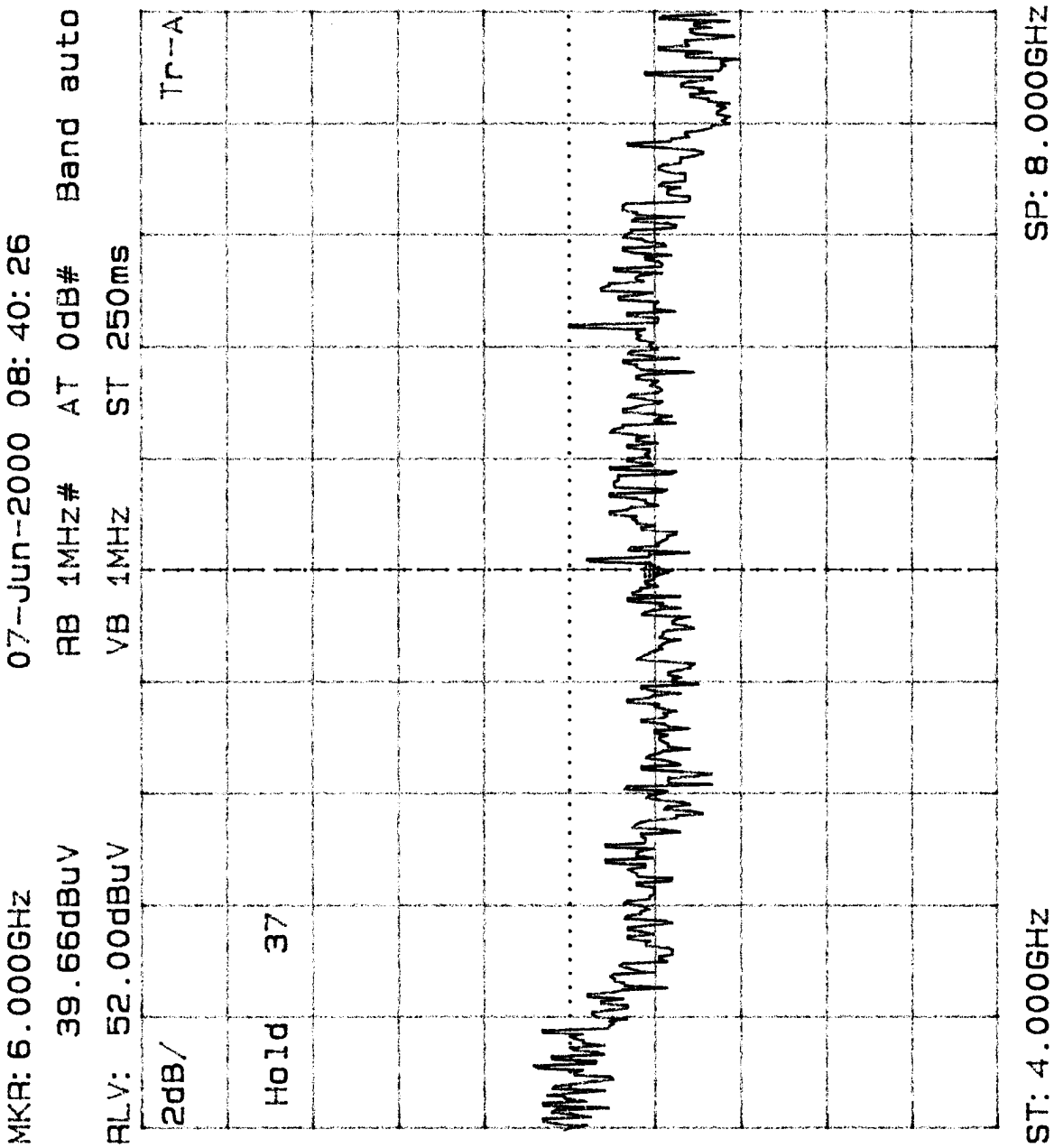


Chart No. 40, FMR 533, Concrete Tank, Vertical

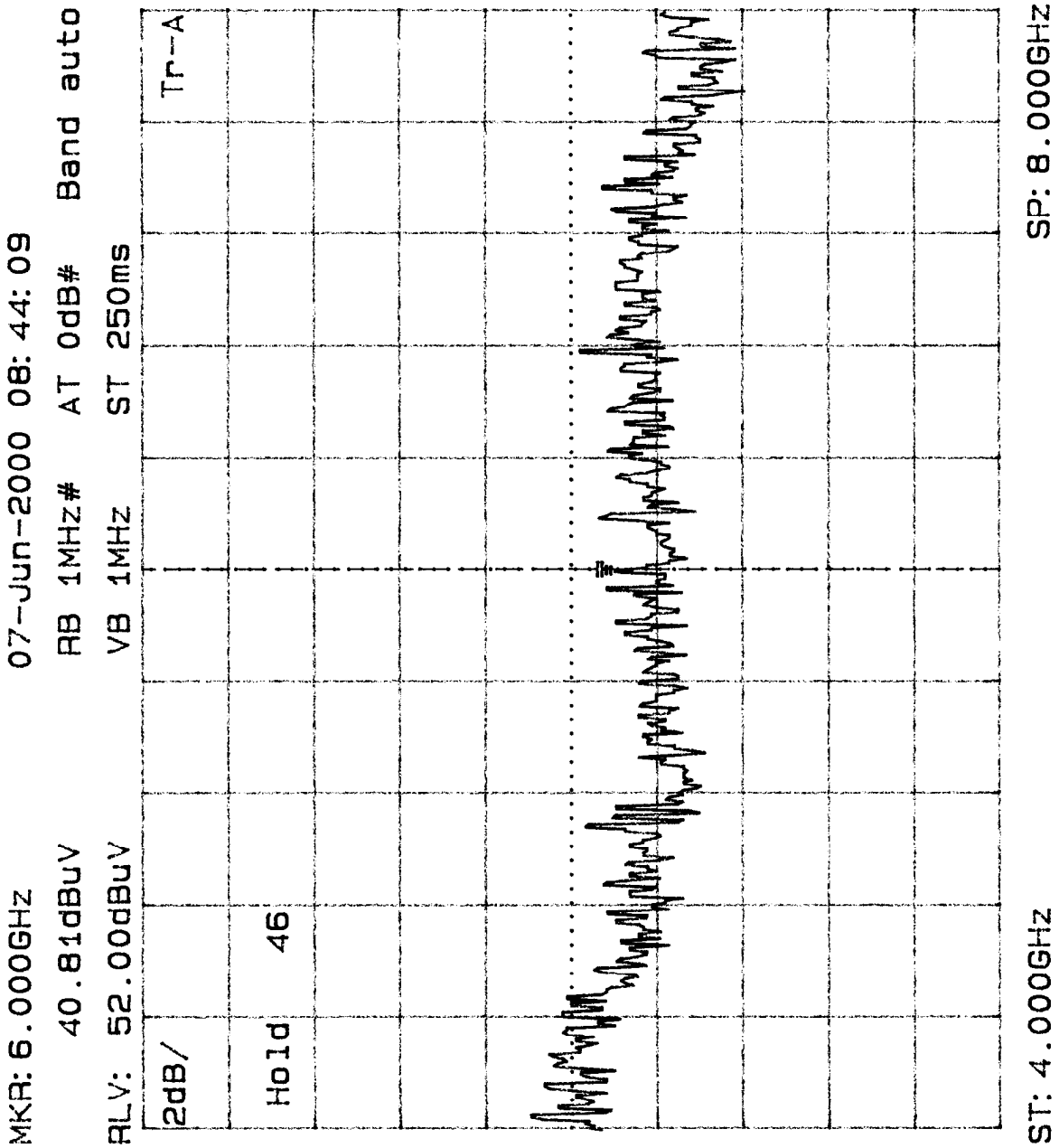


Chart No. 25, FMR 532, Splash Tube, Horizontal

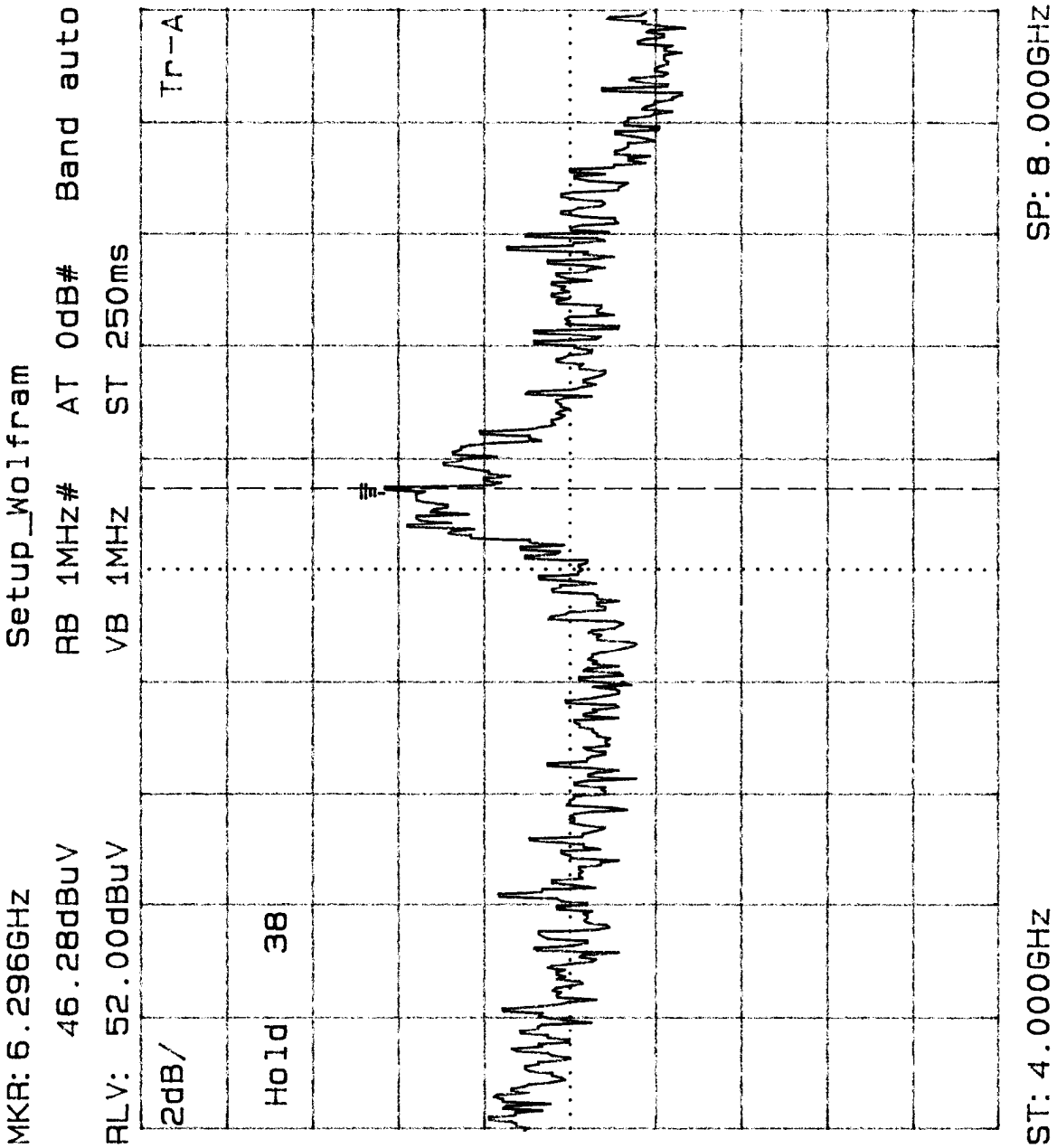
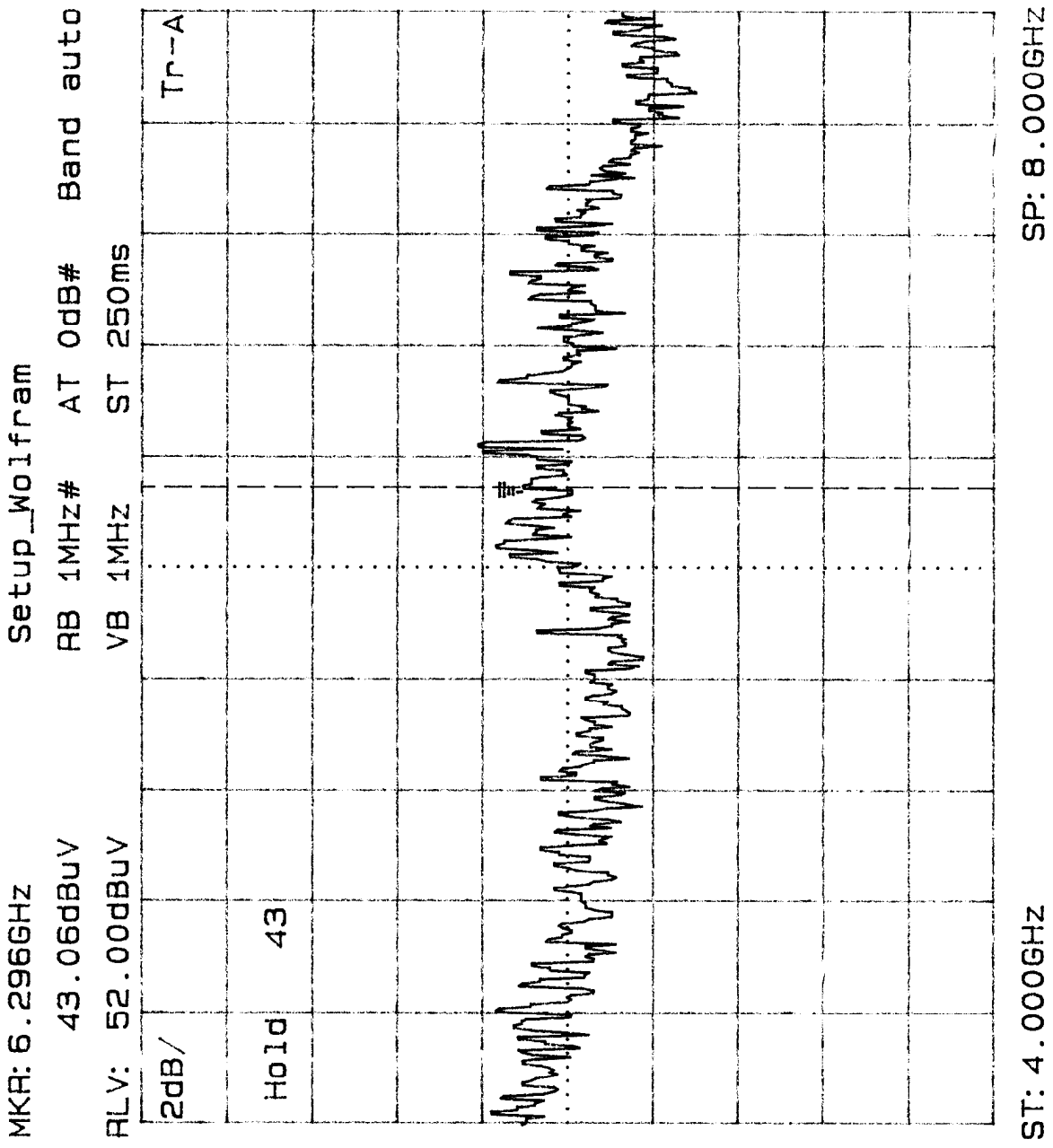


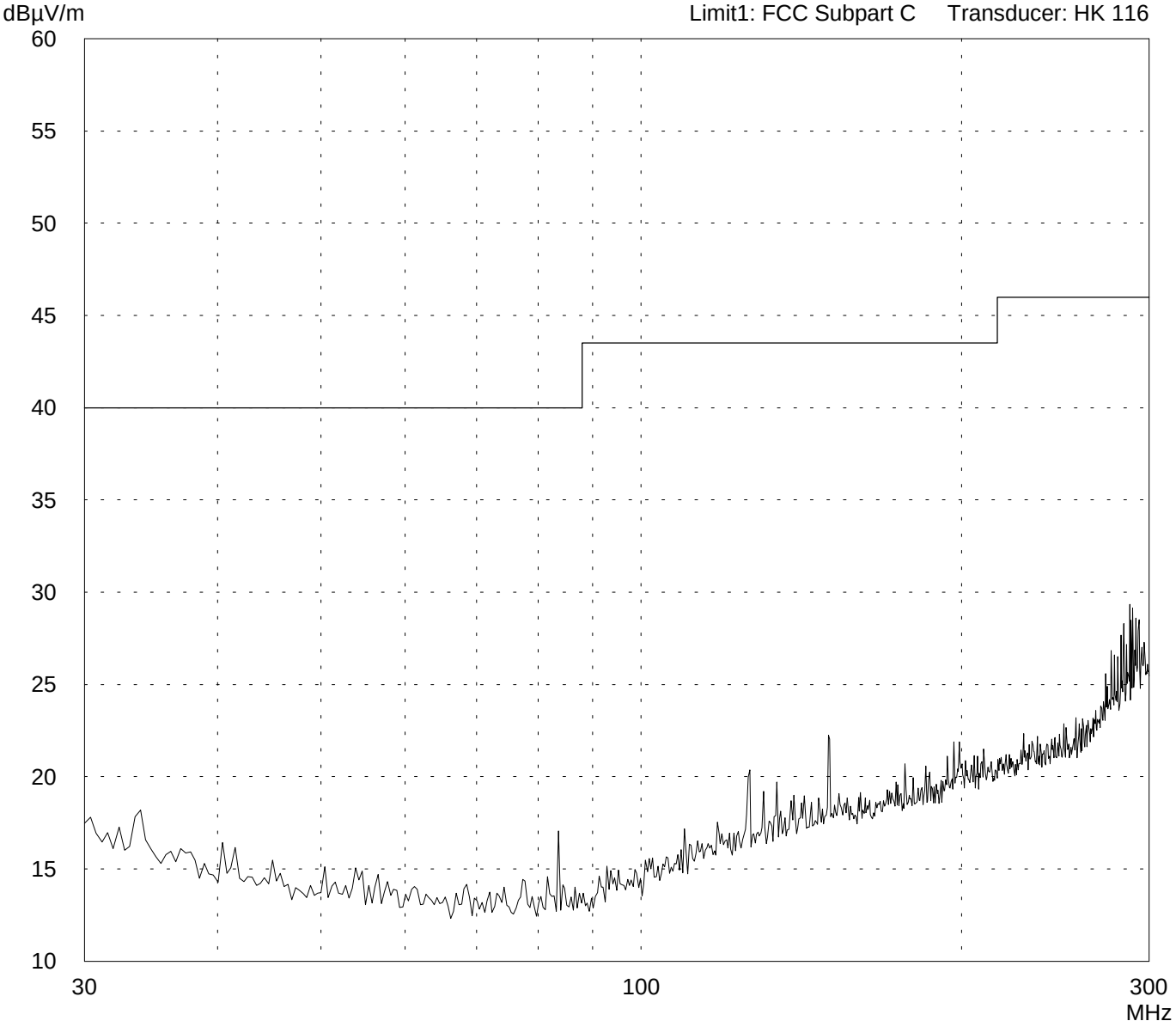
Chart No. 26, FMR 532, Splash Tube, Vertical



Radiated Emission Test 30 MHz - 300 MHz
according to FCC Part 15 Subpart C

Model: Micropilot S	Mode: Normal operation Vertical position
Serial no.: Prototype	
Applicant: Endress + Hauser	
Test site: Semi anechoic room, cabin no. 3	
Tested on: Test distance 3 meters Horizontal Polarization	
Date of test: 06/26/2000 — Operator: J. Roidt	
Test performed: automatically — File name:	

Detector: Peak	List of values: 10 dB Margin — 50 Subranges

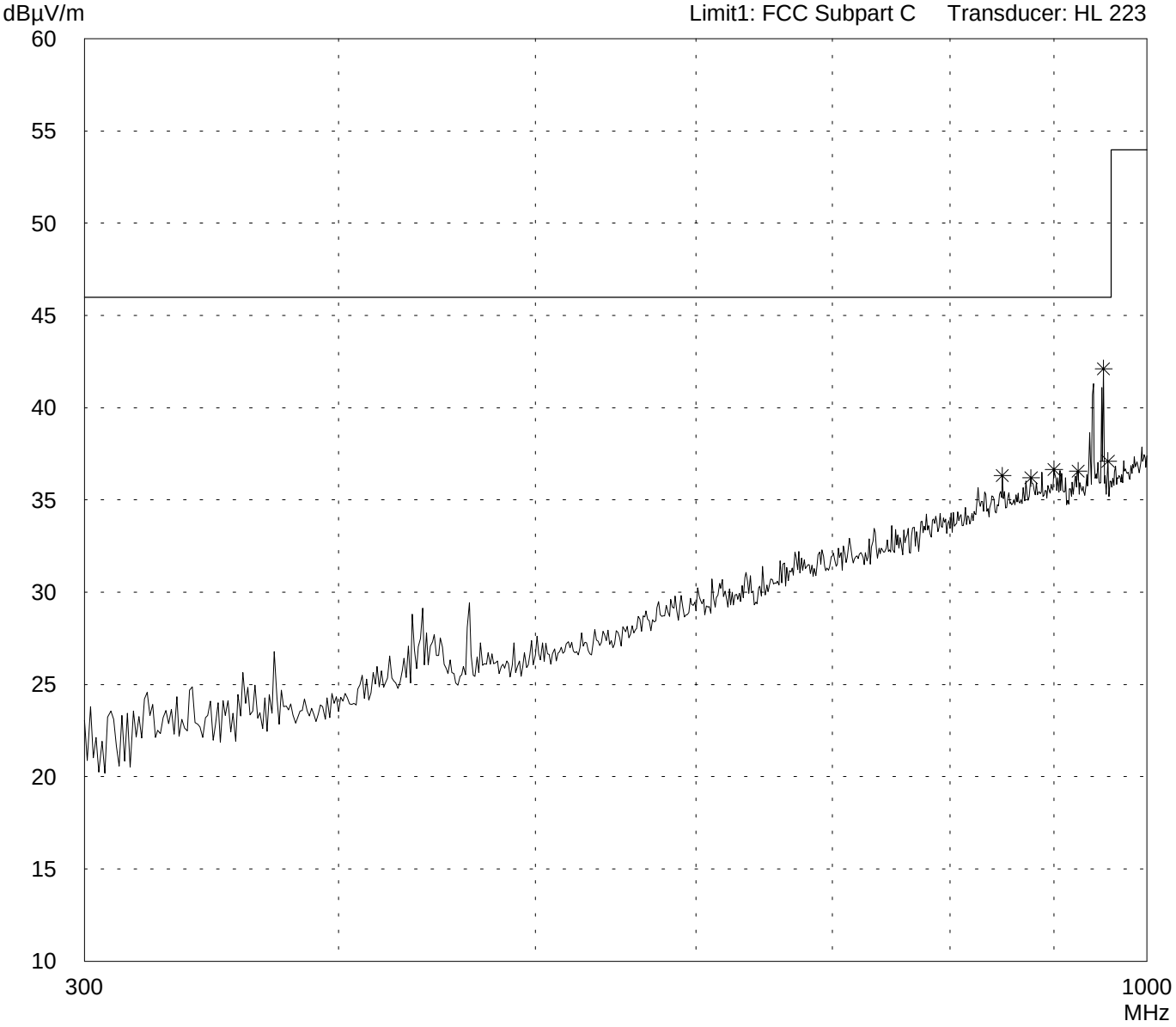


Result: Prescan	Project file: 50511-00331 — Page 49 of 68 Pages

Radiated Emission Test 300 MHz - 1 GHz
according to FCC Part 15 Subpart C

Model: Micropilot S	Mode: Normal operation Vertical position
Serial no.: Prototype	
Applicant: Endress + Hauser	
Test site: Semi anechoic room, cabin no. 3	
Tested on: Test distance 3 meters Horizontal Polarization	
Date of test: 06/26/2000 — Operator: J. Roidt	
Test performed: automatically — File name:	

Detector: Peak	List of values: 10 dB Margin — 50 Subranges

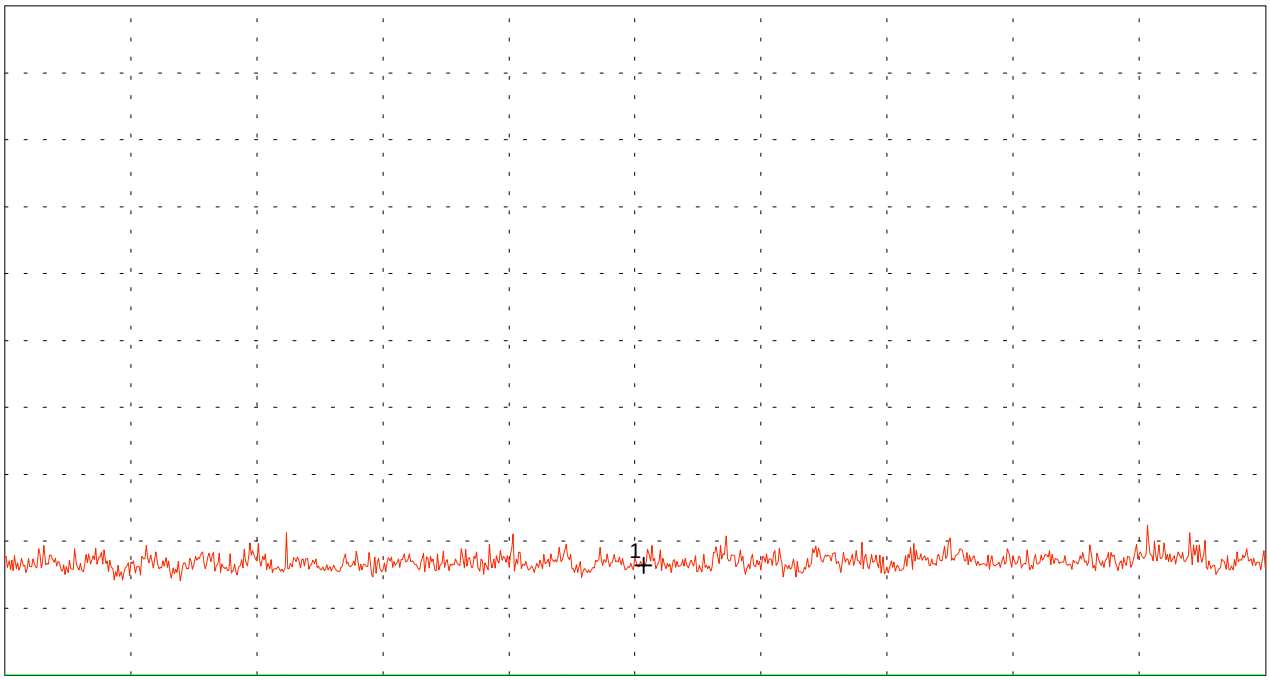


Result: Prescan	Project file: 50511-00331 — Page 50 of 68 Pages

Radiated Emissions Measurement according to FCC Rules

Model: Micropilot S	Mode: - Normal operation conditions - Horizontal polarization - EMCO 3115
Serial No.:	
Applicant: Endress + Hauser	

Ref.Level 45.5 dBµV ATT 0 dB Ref. Offset -35 dB
5 dB/Div.



Start 1.000 GHz Stop 2.600 GHz
RBW 1 MHz VBW 1 MHz SWP 20 ms

Multi Marker List

No. 1 1.810667 GHz 3.69 dBµV

Tested by: Johann Roidt	Project-No.:
Date: June 28, 2000	Page 51 of 68 Pages

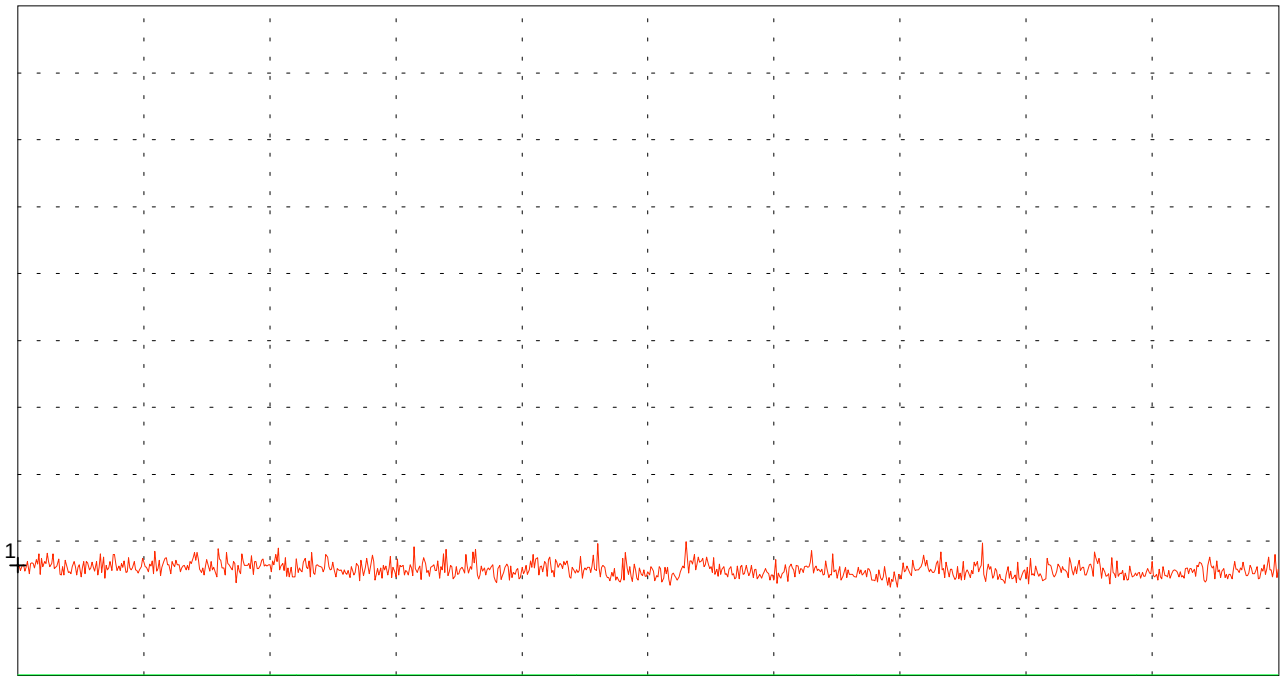
Radiated Emissions Measurement according to FCC Rules

Model: Micropilot S	Mode: - Normal operation conditions - Horizontal polarization - EMCO 3115
Serial No.:	
Applicant: Endress + Hauser	

Ref.Level 50 dBµV
5 dB/Div.

ATT 0 dB

Ref. Offset -30.5 dB



Start 2.600 GHz
RBW 1 MHz

VBW 1 MHz

Stop 3.950 GHz
SWP 20 ms

Multi Marker List

No. 1	2.600000 GHz	8.21 dBµV

Tested by: Johann Roidt	Project-No.:
Date: June 28, 2000	Page 52 of 68 Pages

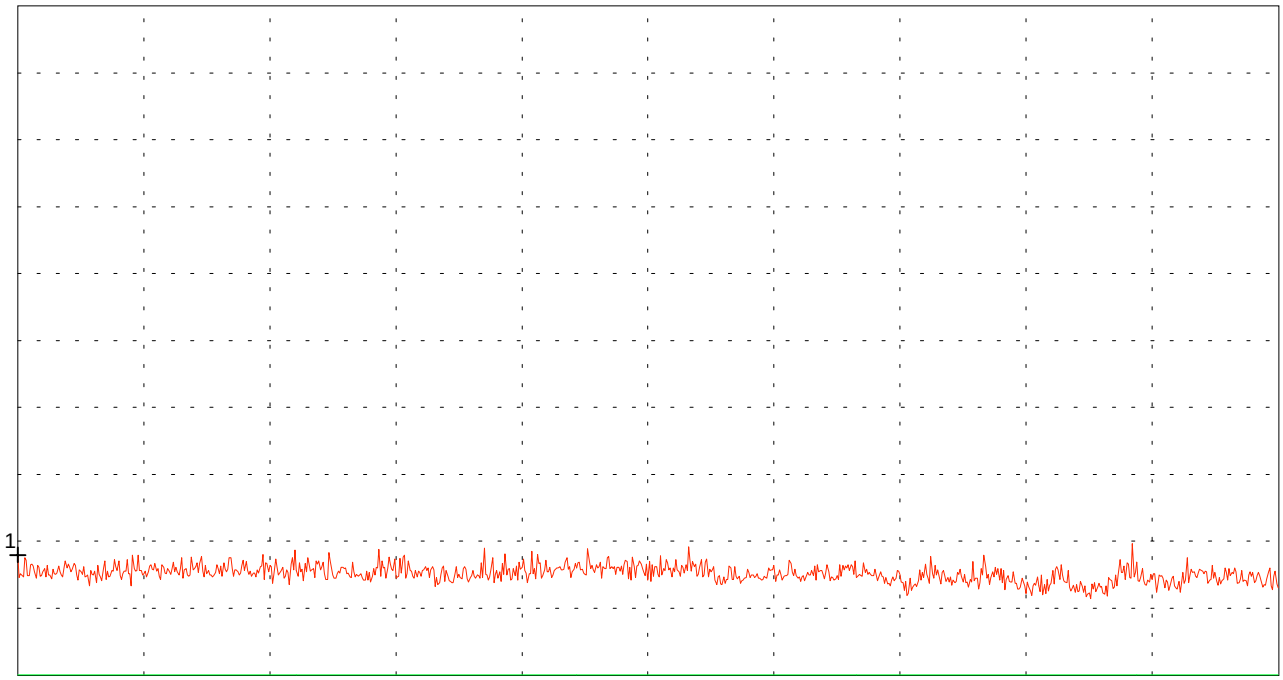
Radiated Emissions Measurement according to FCC Rules

Model: Micropilot S	Mode: - Normal operation conditions - Horizontal polarization - EMCO 3115
Serial No.:	
Applicant: Endress + Hauser	

Ref.Level 50 dBµV
5 dB/Div.

ATT 0 dB

Ref. Offset -30.5 dB



Start 3.950 GHz
RBW 1 MHz

VBW 1 MHz

Stop 5.850 GHz
SWP 20 ms

Multi Marker List

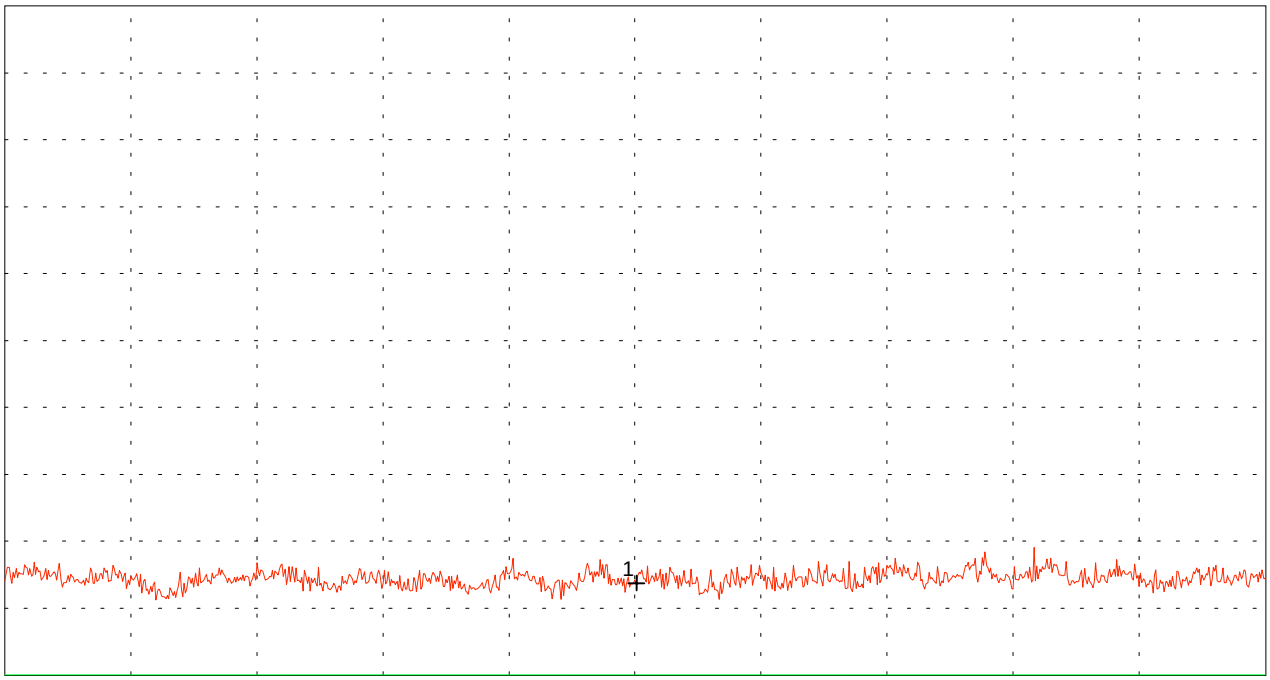
No. 1	3.950000 GHz	8.96 dBµV

Tested by: Johann Roidt	Project-No.:
Date: June 28, 2000	Page 53 of 68 Pages

Radiated Emissions Measurement according to FCC Rules

Model: Micropilot S	Mode: - Normal operation conditions - Horizontal polarization - EMCO 3160
Serial No.:	
Applicant: Endress + Hauser	

Ref.Level 50 dBµV ATT 0 dB Ref. Offset -30.5 dB
5 dB/Div.



Start 5.850 GHz Stop 8.200 GHz
RBW 1 MHz VBW 1 MHz SWP 20 ms

Multi Marker List

No. 1 7.027611 GHz 6.86 dBµV

Tested by: Johann Roidt	Project-No.:
Date: June 28, 2000	Page 54 of 68 Pages

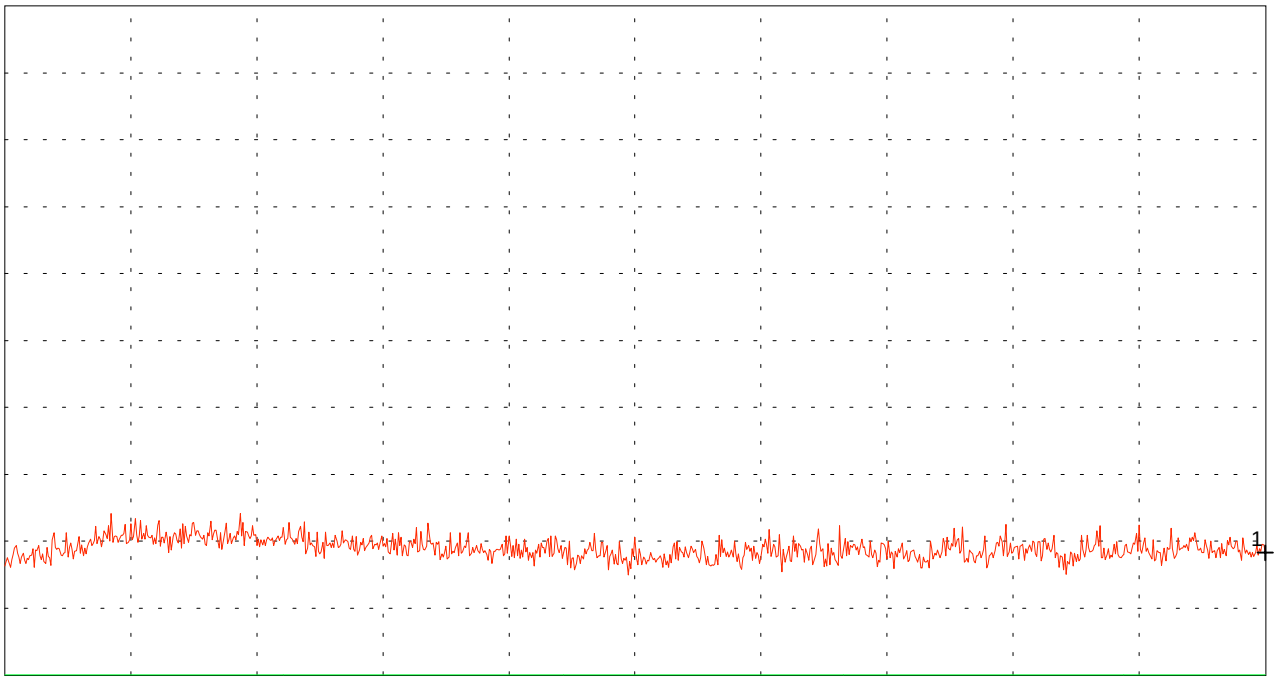
Radiated Emissions Measurement according to FCC Rules

Model: Micropilot S	Mode: - Normal operation conditions - Horizontal polarization - EMCO 3160
Serial No.:	
Applicant: Endress + Hauser	

Ref.Level 45.5 dBµV
5 dB/Div.

ATT 0 dB

Ref. Offset -35 dB



Start 8.200 GHz
RBW 1 MHz

VBW 1 MHz

Stop 12.400 GHz
SWP 20 ms

Multi Marker List

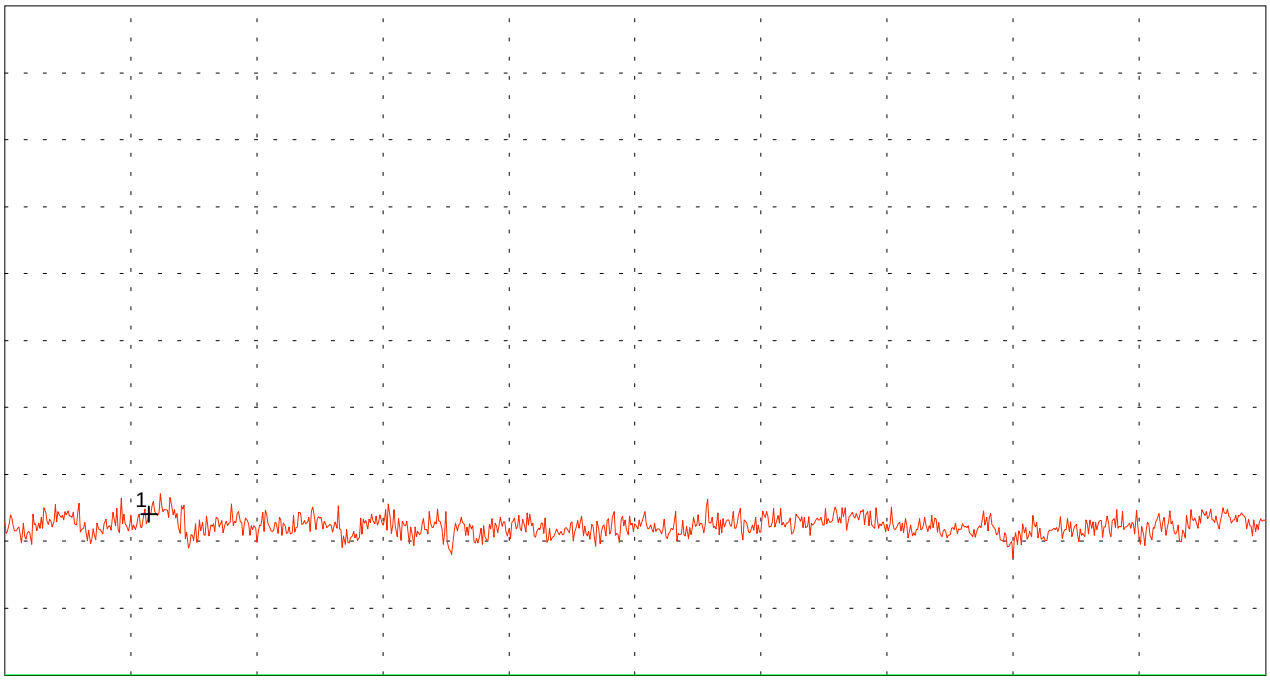
No. 1	12.400000 GHz	4.62 dBµV

Tested by: Johann Roidt	Project-No.:
Date: June 28, 2000	Page 55 of 68 Pages

Radiated Emissions Measurement according to FCC Rules

Model: Micropilot S	Mode: - Normal operation conditions - Horizontal polarization - EMCO 3160
Serial No.:	
Applicant: Endress + Hauser	

Ref.Level 45.5 dBµV ATT 0 dB Ref. Offset -35 dB
5 dB/Div.



Start 12.400 GHz Stop 18.000 GHz
RBW 1 MHz VBW 1 MHz SWP 40 ms

Multi Marker List

No. 1 13.040889 GHz 7.52 dBµV

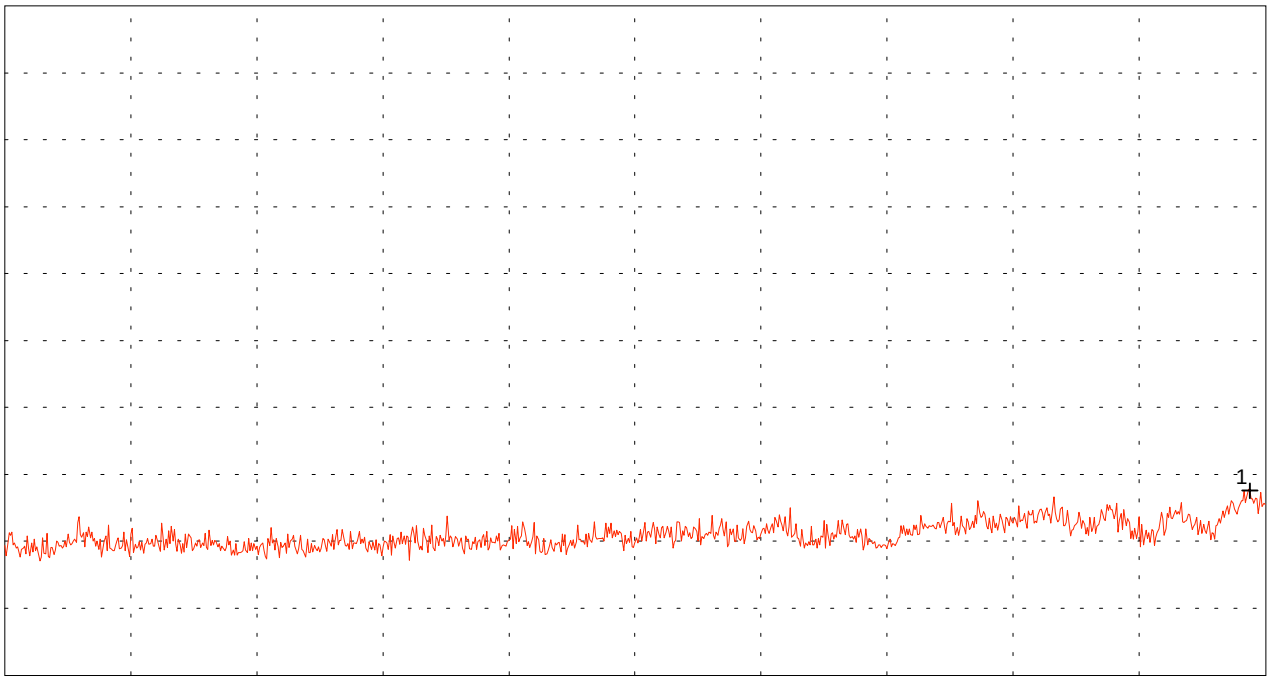
Tested by: Johann Roidt	Project-No.:
Date: June 28, 2000	Page 56 of 68 Pages

Radiated Emissions Measurement according to FCC Rules

Modell: Micropilot S	Kommentar: Normal operation condition, EUT vertical RX antenna EMCO 3160-09 Test Distance 0.5 meter Horizontal Polarisation
Geräte-Nummer: ---	
Auftraggeber: Endress + Hauser	

Ref.Level 57 dBµV
5 dB/Div.

ATT 0 dB



Start 18.000 GHz
RBW 1 MHz

VBW 1 MHz

Stop 26.500 GHz
SWP 40 ms

Multi-Marker-Liste

Nr. 1	26.396111 GHz	20.77 dBµV

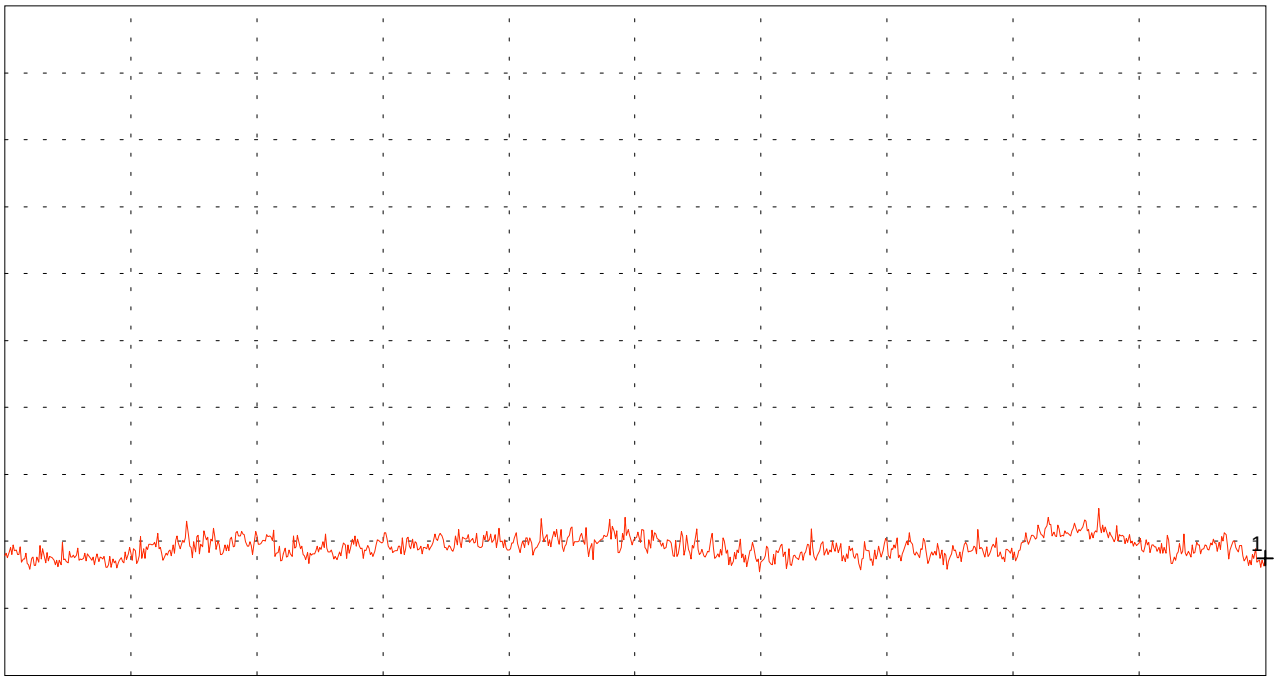
Prüfer: Johann Roidt	Projekt-Nr.: 50511-00331
Datum: June 28, 2000	

Radiated Emissions Measurement according to FCC Rules

Modell: Micropilot S	Kommentar: Normal operation condition, EUT vertical RX Antenna EMCO 3160-10 + TEK WM782A Waveguide Mixer Test Distance 0.5 meter Horizontal Polarisation
Geräte-Nummer: ---	
Auftraggeber: Endress + Hauser	

Ref.Level 57 dBµV
5 dB/Div.

ATT 0 dB



Start 26.500 GHz
RBW 1 MHz

VBW 1 MHz

Stop 40.000 GHz
SWP 60 ms

Multi-Marker-Liste

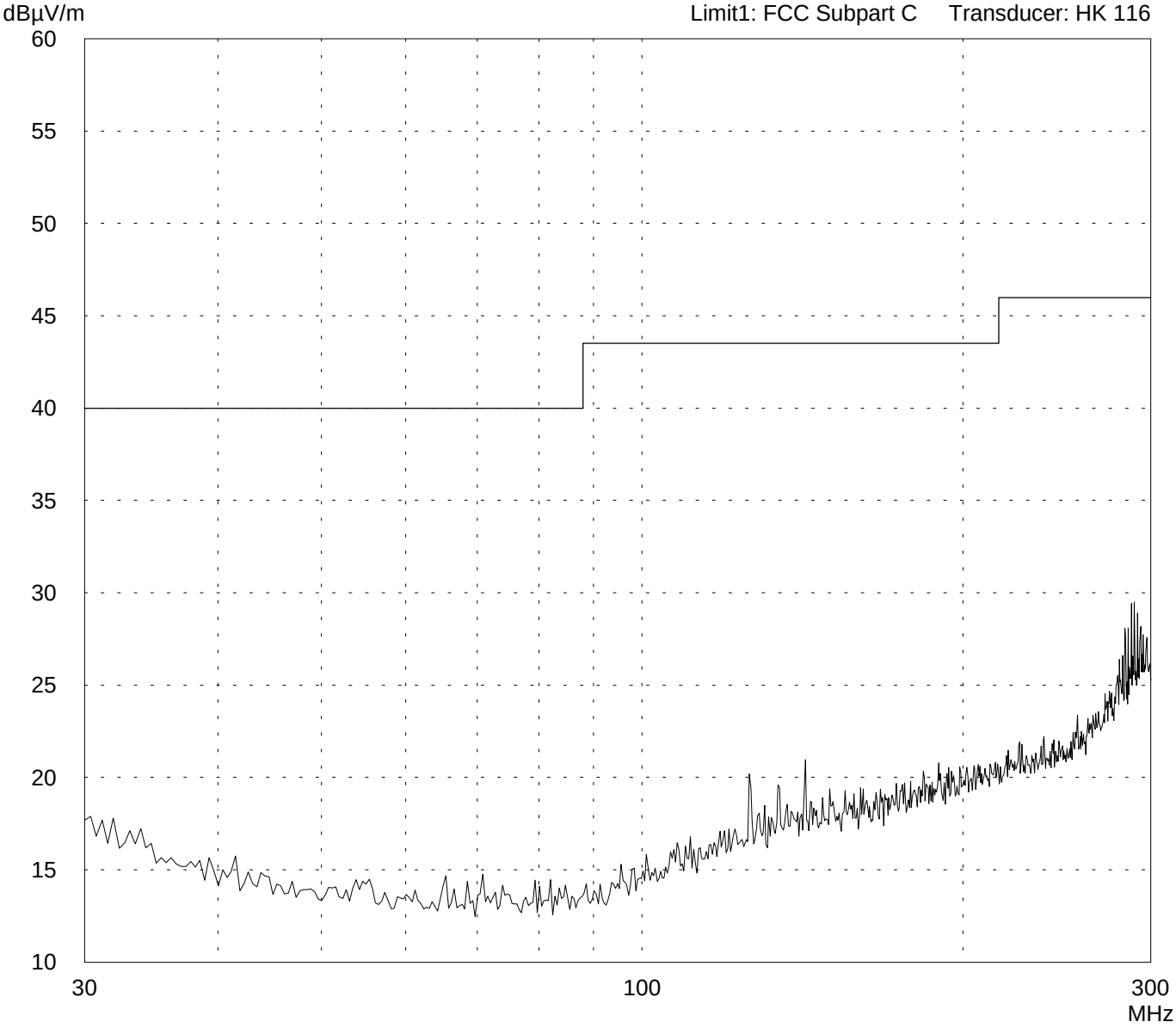
Nr.		
1	40.000000 GHz	15.72 dBµV

Prüfer: Johann Roidt	Projekt-Nr.: 50511-00331
Datum: June 28, 2000	

Radiated Emission Test 30 MHz - 300 MHz
according to FCC Part 15 Subpart C

Model: Micropilot S	Mode: Normal operation Vertical position
Serial no.: Prototype	
Applicant: Endress + Hauser	
Test site: Semi anechoic room, cabin no. 3	
Tested on: Test distance 3 meters Vertical Polarization	
Date of test: 06/26/2000 — Operator: J. Roidt	
Test performed: automatically — File name:	

Detector: Peak	List of values: 10 dB Margin — 50 Subranges

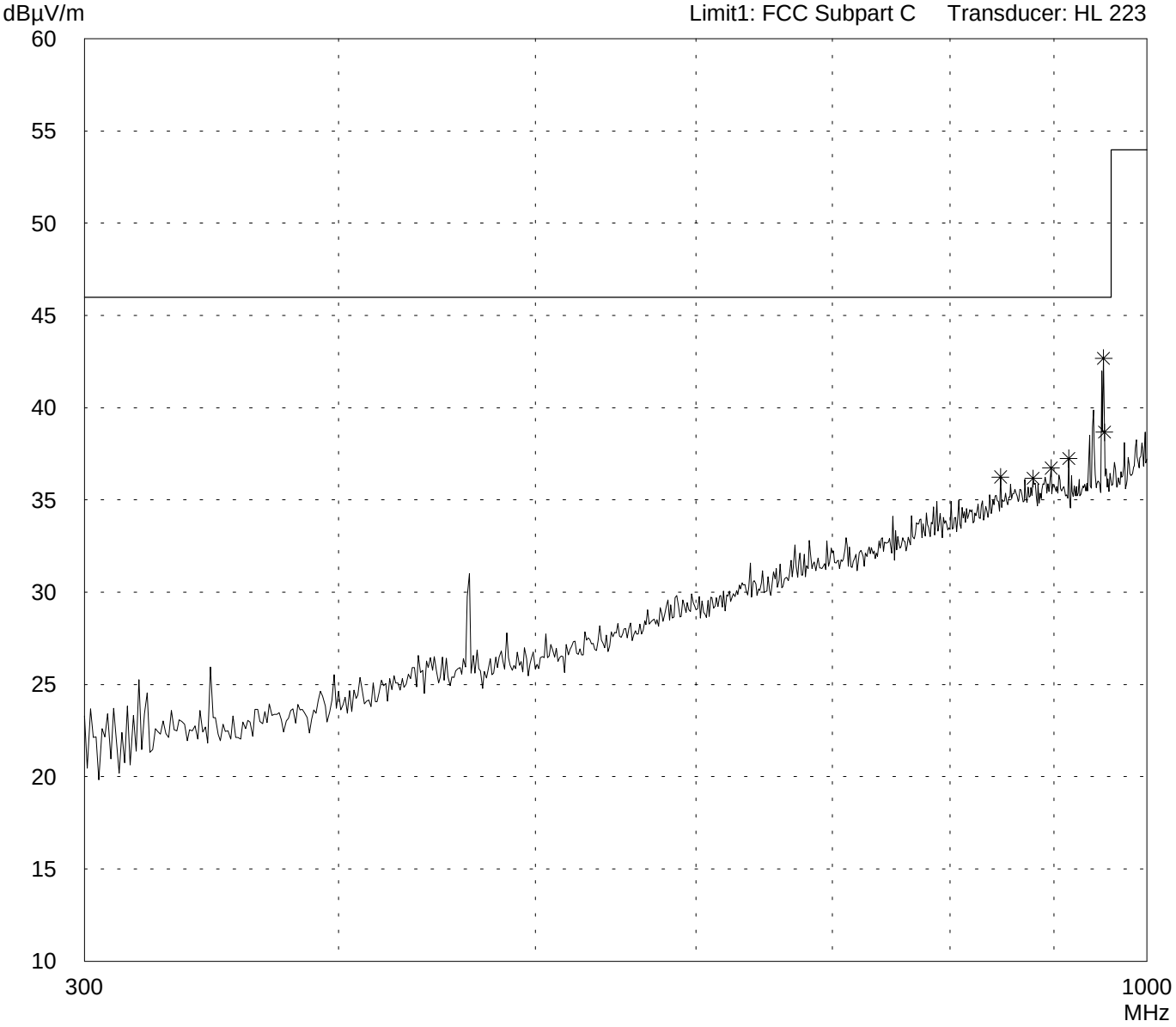


Result: Prescan	Project file: 50511-00331 — Page 59 of 68 Pages

Radiated Emission Test 300 MHz - 1 GHz
according to FCC Part 15 Subpart C

Model: Micropilot S	Mode: Normal operation Vertical position
Serial no.: Prototype	
Applicant: Endress + Hauser	
Test site: Semi anechoic room, cabin no. 3	
Tested on: Test distance 3 meters Vertical Polarization	
Date of test: 06/26/2000 — Operator: J. Roidt	
Test performed: automatically — File name:	

Detector: Peak	List of values: 10 dB Margin — 50 Subranges

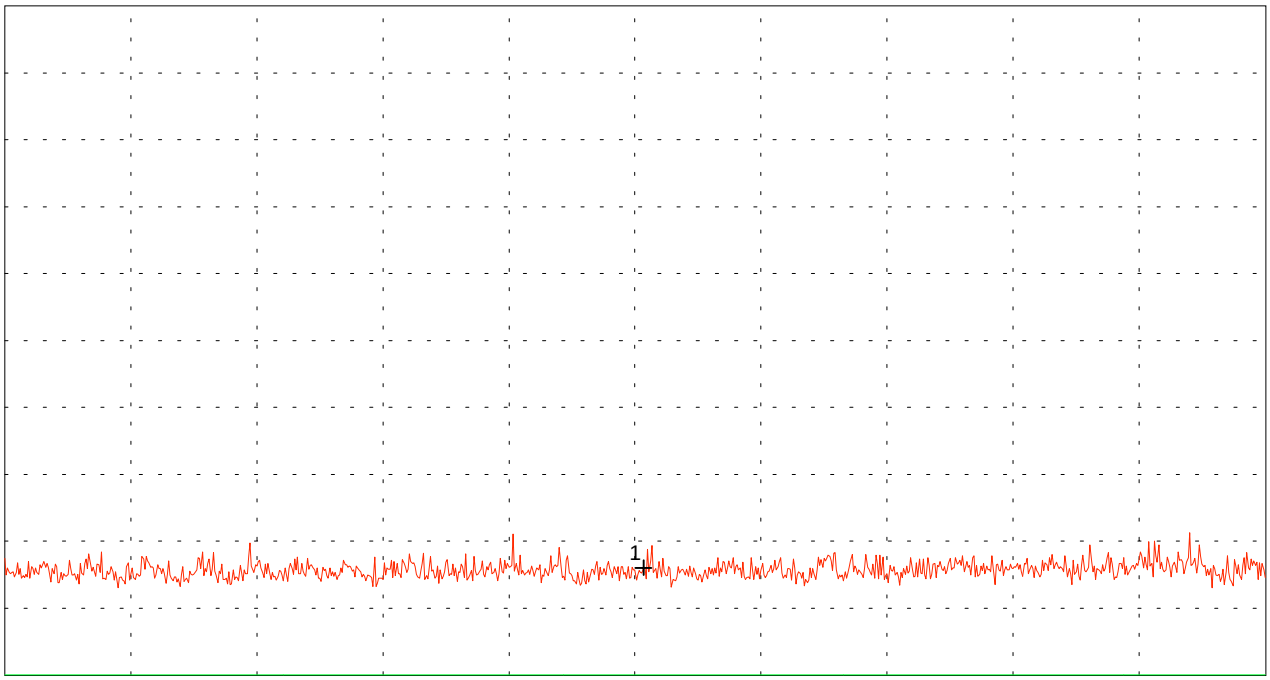


Result: Prescan	Project file: 50511-00331 — Page 60 of 68 Pages

Radiated Emissions Measurement according to FCC Rules

Model: Micropilot S	Mode: - Normal operation conditions - Vertical polarization - EMCO 3115
Serial No.:	
Applicant: Endress + Hauser	

Ref.Level 45.5 dBµV ATT 0 dB Ref. Offset -35 dB
5 dB/Div.



Start 1.000 GHz Stop 2.600 GHz
RBW 1 MHz VBW 1 MHz SWP 20 ms

Multi Marker List

No. 1 1.810667 GHz 3.52 dBµV

Tested by: Johann Roidt	Project-No.:
Date: June 28, 2000	Page 61 of 68 Pages

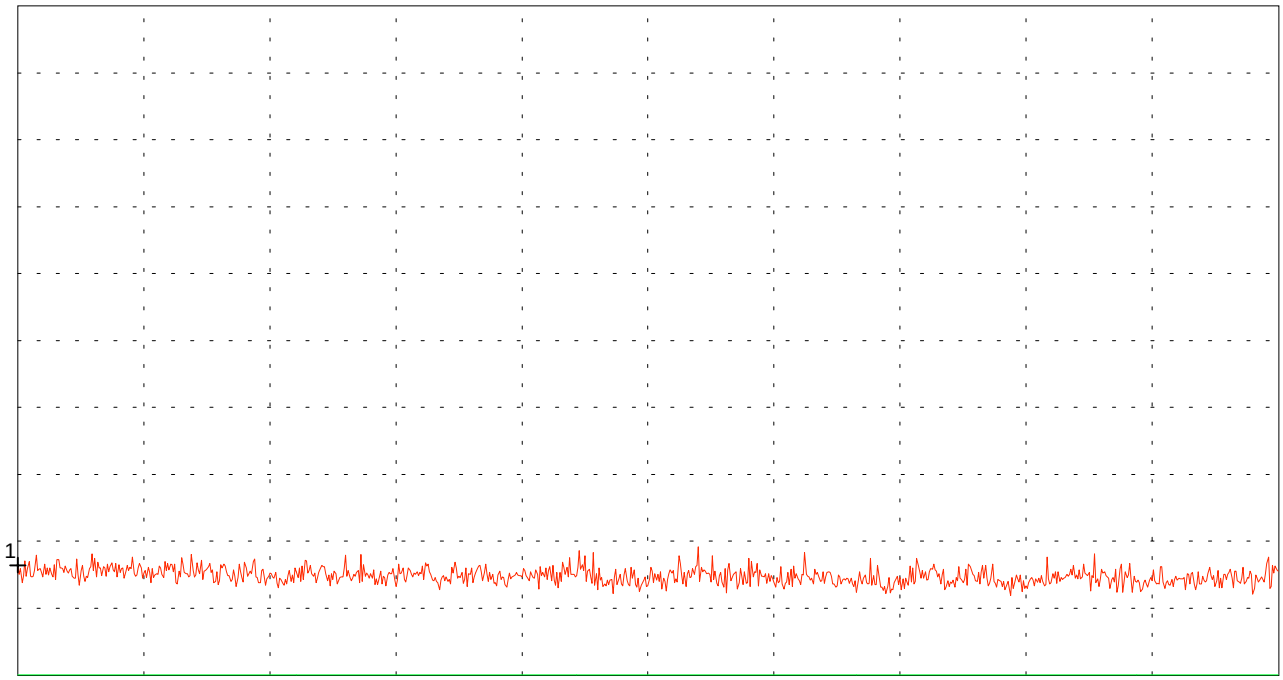
Radiated Emissions Measurement according to FCC Rules

Model: Micropilot S	Mode: - Normal operation conditions - Vertical polarization - EMCO 3115
Serial No.:	
Applicant: Endress + Hauser	

Ref.Level 50 dBµV
5 dB/Div.

ATT 0 dB

Ref. Offset -30.5 dB



Start 2.600 GHz
RBW 1 MHz

VBW 1 MHz

Stop 3.950 GHz
SWP 20 ms

Multi Marker List

No. 1	2.600000 GHz	8.21 dBµV

Tested by: Johann Roidt	Project-No.:
Date: June 28, 2000	Page 62 of 68 Pages

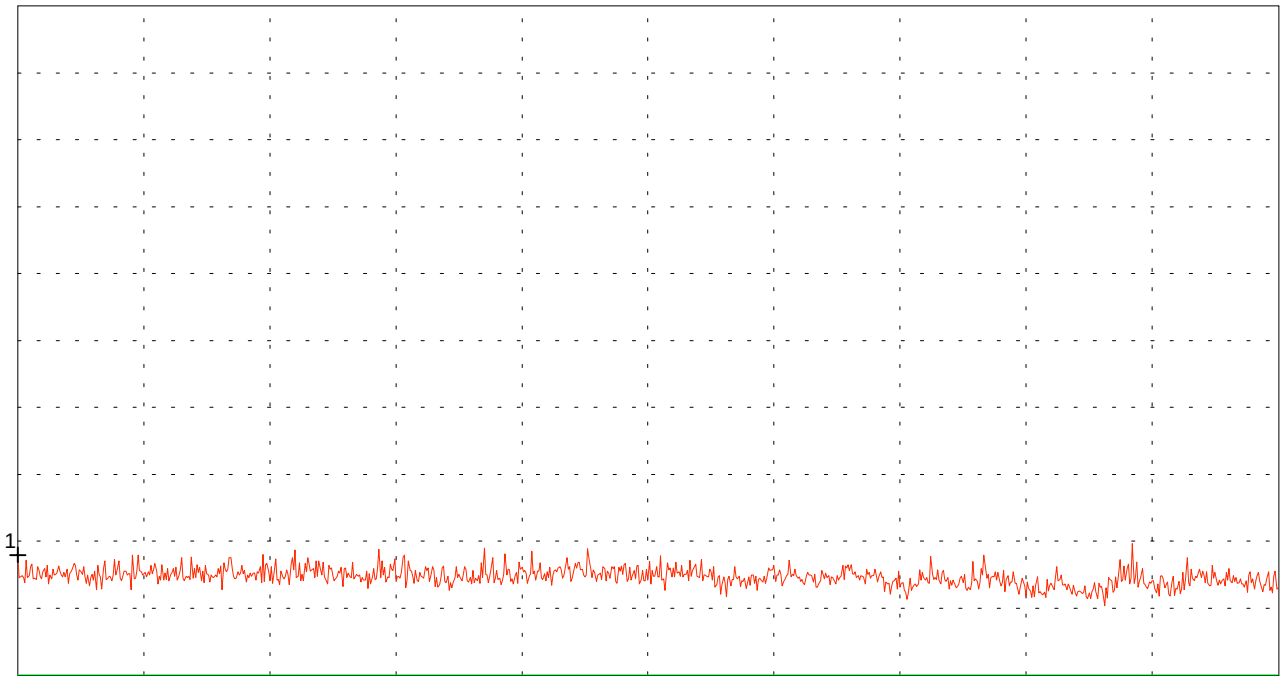
Radiated Emissions Measurement according to FCC Rules

Model: Micropilot S	Mode: - Normal operation conditions - Vertical polarization - EMCO 3115
Serial No.:	
Applicant: Endress + Hauser	

Ref.Level 50 dBµV
5 dB/Div.

ATT 0 dB

Ref. Offset -30.5 dB



Start 3.950 GHz
RBW 1 MHz

VBW 1 MHz

Stop 5.850 GHz
SWP 20 ms

Multi Marker List

No. 1	3.950000 GHz	8.96 dBµV

Tested by: Johann Roidt	Project-No.:
Date: June 28, 2000	Page 63 of 68 Pages

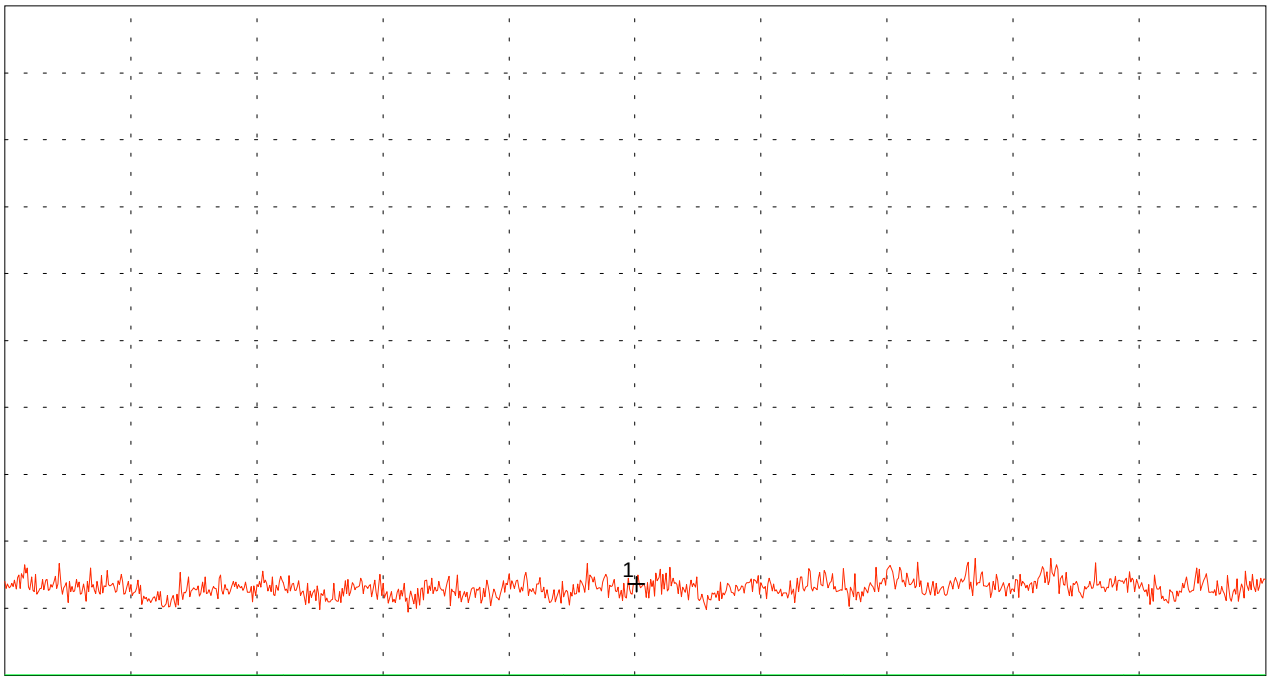
Radiated Emissions Measurement according to FCC Rules

Model: Micropilot S	Mode: - Normal operation conditions - Vertical polarization - EMCO 3160
Serial No.:	
Applicant: Endress + Hauser	

Ref.Level 50 dBµV
5 dB/Div.

ATT 0 dB

Ref. Offset -30.5 dB



Start 5.850 GHz
RBW 1 MHz

VBW 1 MHz

Stop 8.200 GHz
SWP 20 ms

Multi Marker List

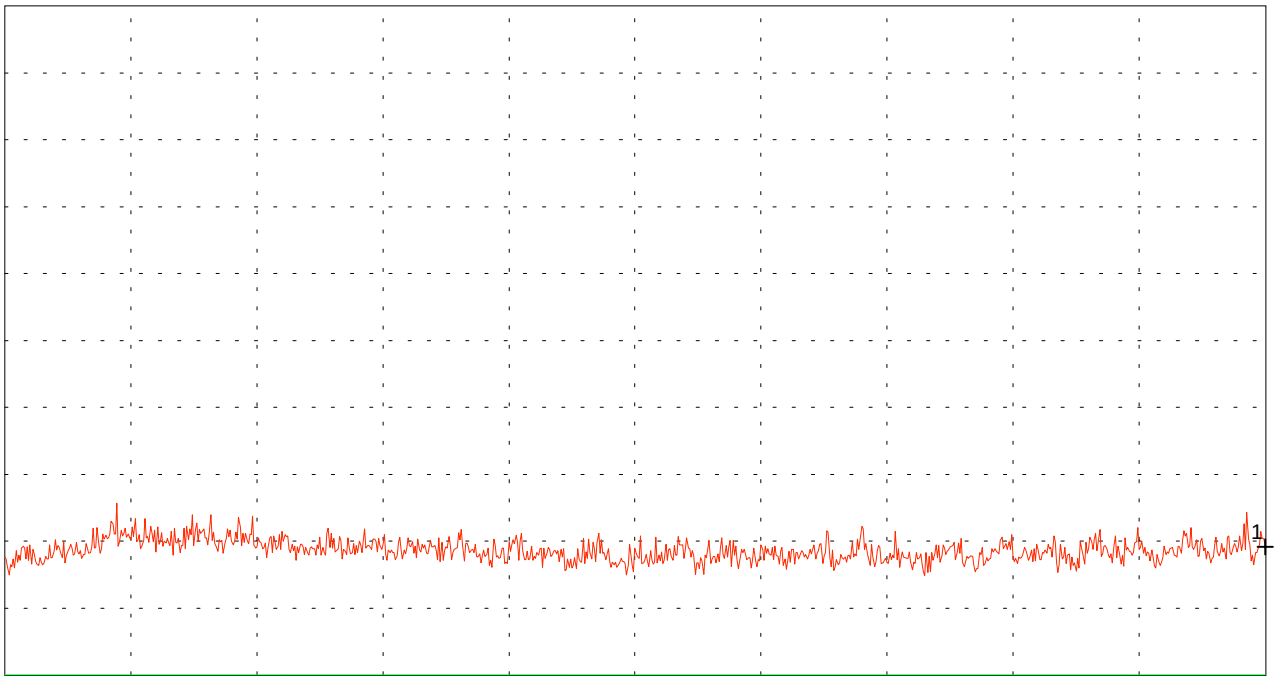
No. 1	7.027611 GHz	6.79 dBµV

Tested by: Johann Roidt	Project-No.:
Date: June 28, 2000	Page 64 of 68 Pages

Radiated Emissions Measurement according to FCC Rules

Model: Micropilot S	Mode: - Normal operation conditions - Vertical polarization - EMCO 3160
Serial No.:	
Applicant: Endress + Hauser	

Ref.Level 45.5 dBµV ATT 0 dB Ref. Offset -35 dB
5 dB/Div.



Start 8.200 GHz Stop 12.400 GHz
RBW 1 MHz VBW 1 MHz SWP 20 ms

Multi Marker List

No. 1 12.400000 GHz 5.08 dBµV

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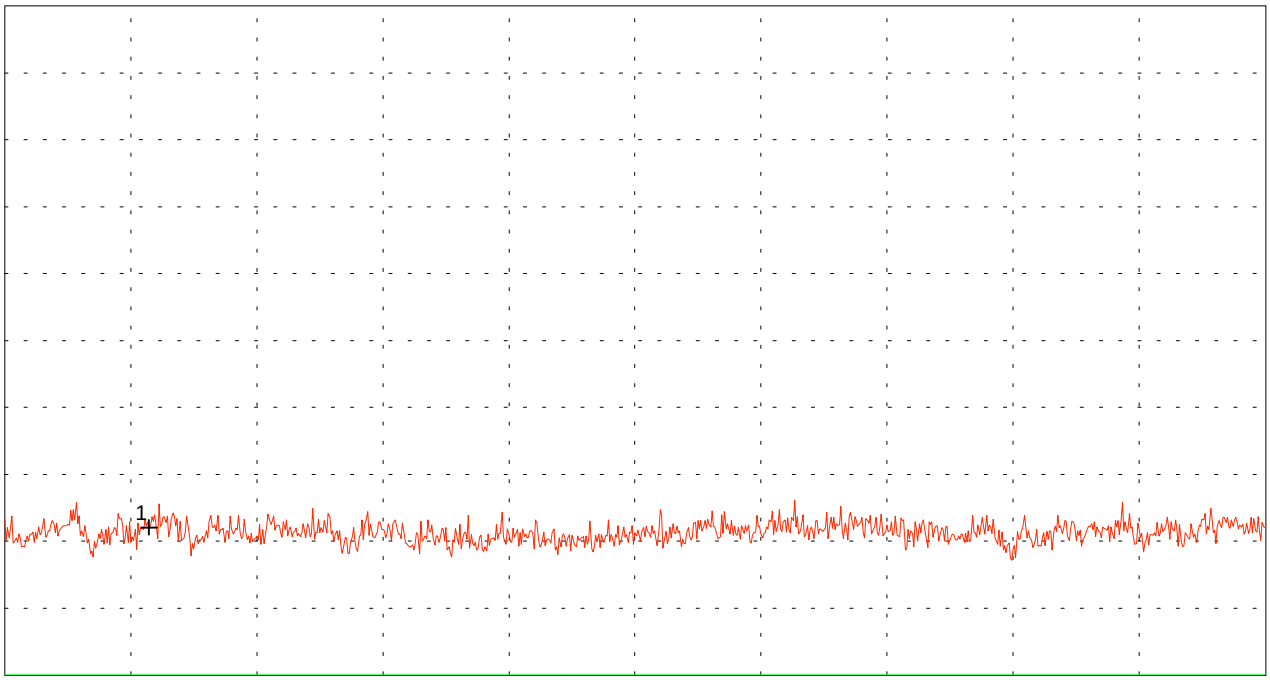
Radiated Emissions Measurement according to FCC Rules

Model: Micropilot S	Mode: - Normal operation conditions - Vertical polarization - EMCO 3160
Serial No.:	
Applicant: Endress + Hauser	

Ref.Level 45.5 dBµV ATT 0 dB Ref. Offset -35 dB
5 dB/Div.



Start 12.400 GHz Stop 18.000 GHz
RBW 1 MHz VBW 1 MHz SWP 40 ms

Multi Marker List

No. 1 13.040889 GHz 6.53 dBµV

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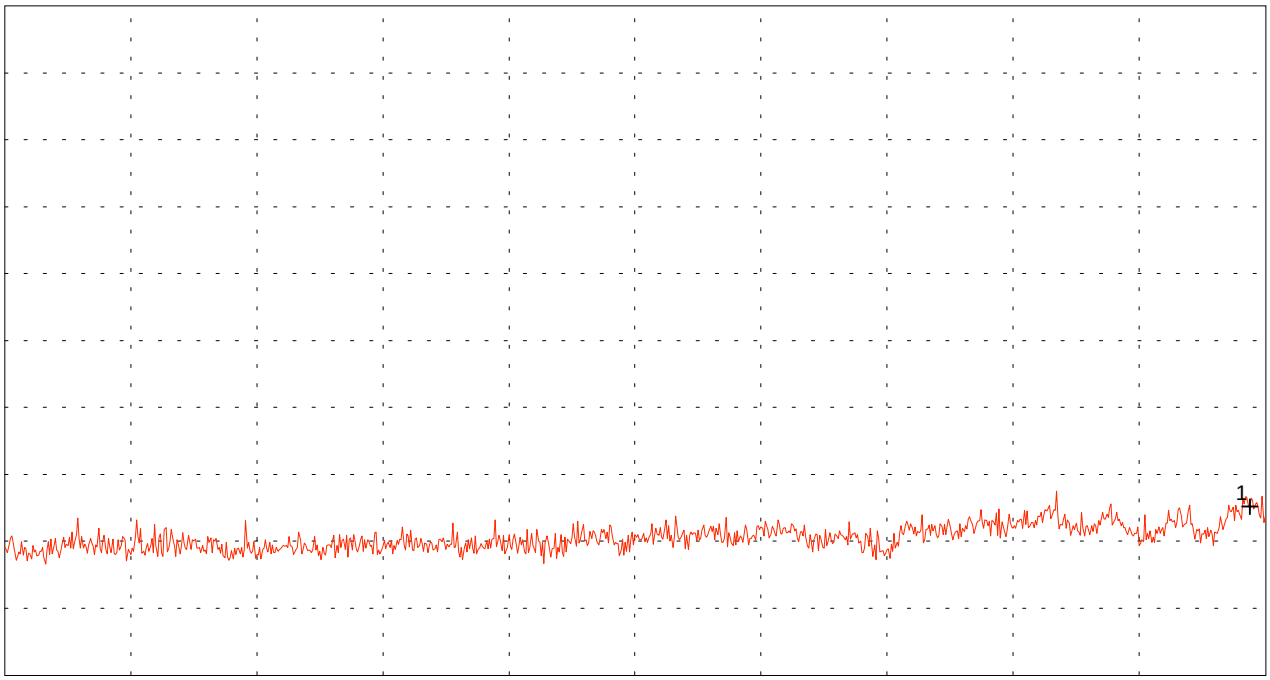
Radiated Emissions Measurement according to FCC Rules

Modell: Micropilot S	Kommentar: Normal operation condition, EUT vertical RX antenna EMCO 3160-09 Test Distance 0.5 meter Vertical Polarisation
Geräte-Nummer: ---	
Auftraggeber: Endress + Hauser	

Ref.Level 57 dBµV
5 dB/Div.

ATT 0 dB



Start 18.000 GHz
RBW 1 MHz

VBW 1 MHz

Stop 26.500 GHz
SWP 40 ms

Multi-Marker-Liste

Nr. 1 26.396111 GHz 19.57 dBµV

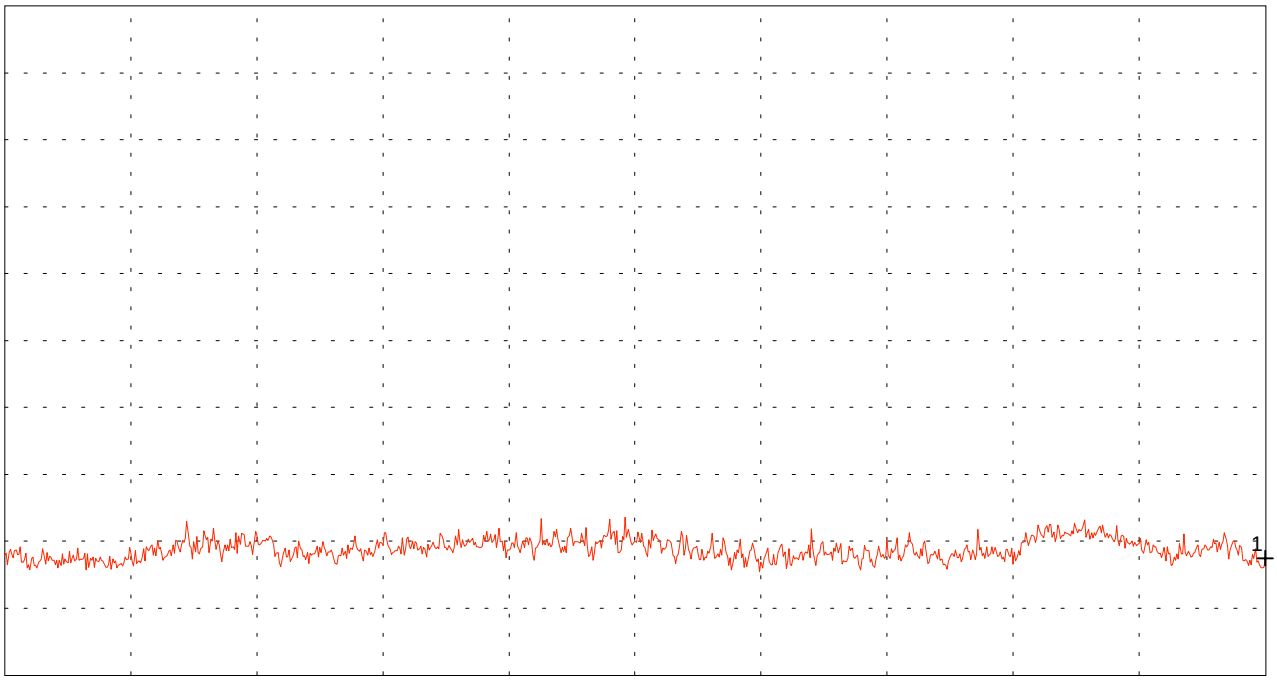
Prüfer: Johann Roidt	Projekt-Nr.: 50511-00331
Datum: June 28, 2000	

Radiated Emissions Measurement according to FCC Rules

Modell: Micropilot S	Kommentar: Normal operation condition, EUT vertical RX Antenna EMCO 3160-10 + TEK WM782A Waveguide Mixer Test Distance 0.5 meter Vertical Polarisation
Geräte-Nummer: ---	
Auftraggeber: Endress + Hauser	

Ref.Level 57 dBµV
5 dB/Div.

ATT 0 dB



Start 26.500 GHz
RBW 1 MHz

VBW 1 MHz

Stop 40.000 GHz
SWP 60 ms

Multi-Marker-Liste

Nr. 1	40.000000 GHz	15.72 dBµV

Prüfer: Johann Roidt	Projekt-Nr.: 50511-00331
Datum: June 28, 2000	