Ericsson Type Acceptance Radio Transceiver **Test Report**	
Product description	28 GHz Hub and 28Ghz Subscriber Radio Transceiver
Product Number	UKL 601 03/xx
FCC ID	OOLUKL60103

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Abstract
In the document are reported the results of some measurements performed on MINI-LINK BAS RAU P1.

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1 ABBREVATIONS

EUT	Equipment Under Test
IF	Intermediate Frequency
MMU	ModeM Unit
P_{out}	Output power
RAU	RAdio Unit
RF	Radio Frequency
T	Temperature
V	RAU Voltage Supply

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2 REFERENCES

[1] Federal Communications Commission part. 2-Frequency allocations and radio treaty matters; general rules and regulations

[2] Federal Communications Commission part.101-Fixed microwave services

[3] 1/102 64-UKL 601 03, rev.PA1, Ericsson Type Acceptance Radio Transceiver

3 INTRODUCTION

This test report is submitted to the FCC for the acceptance of the Ericsson Microwave AB radios operating in the LMDS band 27.5 to 28.35 GHz band.

Ericsson radios are full compliant to the specification stated in the FCC part 2 and FCC part 101

The aim of the following tests is to give evidence of compliance to the relevant requirements of Federal Communications Commission ([1], [2], [3]

1. Occupied bandwidth
2. Output spectrum (spectrum mask)
3. Frequency stability vs temperature and supply voltage
4. Frequency tolerance
5. Spurious emission at antenna terminal
6. Field strength of spurious radiation

The EUT is a radio node UKL 601 03/12 at 28.05 GHz

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The measurement set-up is sketched in fig.1

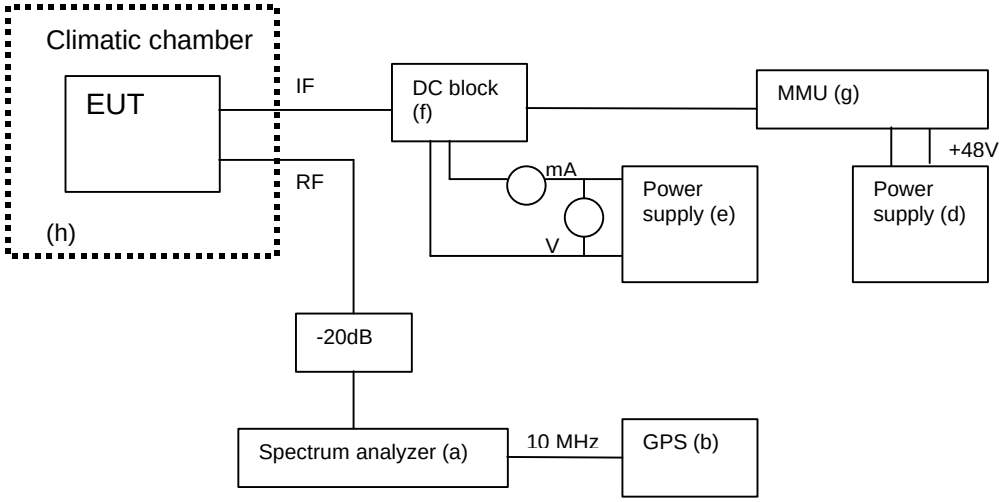

Figure 1 – Sketch of measurement set-up

4 LIST OF INSTRUMENTS

(a) Spectrum analyser HP8565E

(b) Exac Time 9390 Global Positioning System Time Code and Frequency Generator

(c) 2 X Multimeter HP 973A

(d) DC Power Supply HP E3631A

(e) DC Power Supply Lareet Mod.AST60/6

(f) DC block Minicircuit 15542

(g) Modem Unit

(h) Climatic Chamber Angelantoni Hygros 250

All the instruments are calibrated from a certified laboratory and the calibration information are filed in a dedicated binder

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5 MEASUREMENTS

5.1 RF OUTPUT POWER

5.1.1 Conditions

T=20°C

V=44:60 V

P_{out}=P_{max}=23.6 dBm (25 dB attenuation outside RAU)

TX always ON

Modulation OFF

f_{TX}=28.050 GHz

Radio Control Loop OFF

5.1.2 Results

P/N	dBm @Fo
UKL 601 03/12	23.6

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Table 1- Output power stability

Temperature (°C)	Output power (dBm)		
	V=44V	V=52V	V=60V
-30	-3.1	-3.1	-3.1
-20	-3.3	-3.3	-3.3
-10	-3.8	-3.8	-3.8
0	-3.8	-3.8	-3.8
10	-4.0	-4.0	-4.0
20	-4.3	-4.3	-4.3
25	-4.8	-4.8	-4.8
30	-4.8	-4.8	-4.8
40	-5.0	-5.0	-5.0
50	-5.5	-5.5	-5.5
60	-5.8	-5.8	-5.8

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5.2 OCCUPIED BANDWIDTH

5.2.1 Conditions

T=20°C

V=52V

TX always ON

Modulation ON

f_{TX}=28.050 GHz

P_{out}=P_{max}=23.6 dBm (20dB attenuation outside RAU)

Spectrum analyser settings:

SPAN=160MHz, RBW=100KHz, VBW=300Hz, f_c=28050000KHz

5.2.2 Results

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limit, the mean power radiated is equal to a certain percentage of the total mean radiated power. The percentage used in the measurement was 1%, so the occupied bandwidth refers to 99% of the total mean radiated power.

Occupied bandwidth (99%) = 28.8 MHz

See fig. 2

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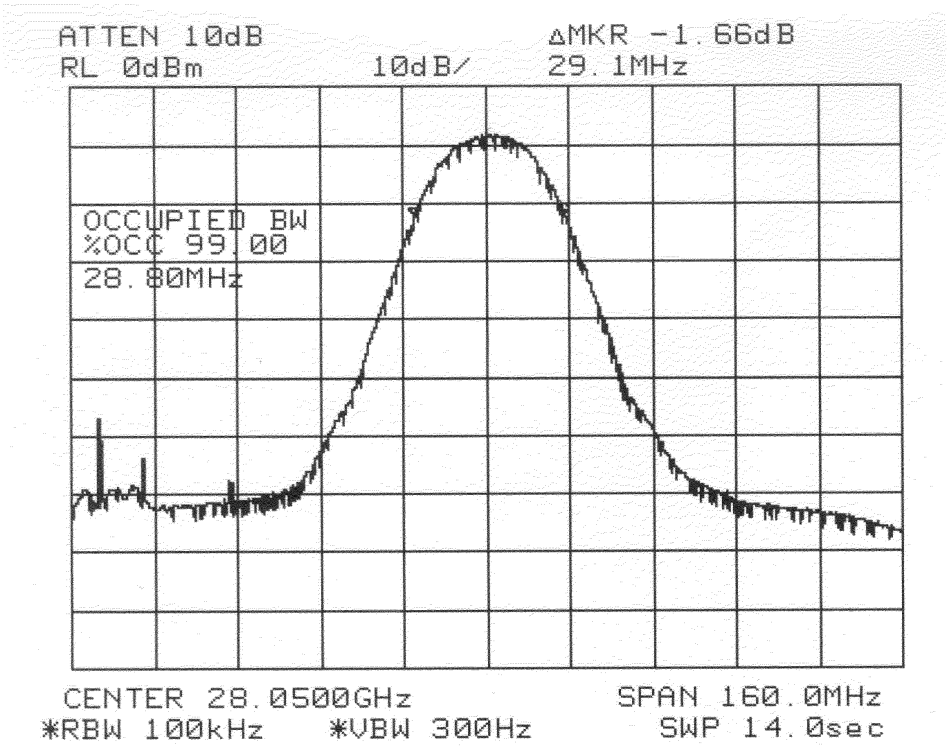

Figure 2- Occupied bandwidth measurement

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5.3 SPECTRUM MASK

5.3.1 Conditions

T=20°C

V=52V

f_{TX}=28 GHz

P_{out}=P_{max}=23.6 dBm (20dB attenuation outside RAU)

TX always ON

Modulation ON

Spectrum analyser settings:

SPAN=160MHz, RBW=100KHz, VBW=300Hz, f_c=28 GHz

5.3.2 Results

In tables 1 and 2 are reported the attenuation values A(Δf) with respect to the fundamental level at several frequency offset Δf according to [2] sec.101.111 par.(ii) and [3] sec.5.5.4. The Δf and the limits in table 1 are evaluated considering B=850 MHz in par.(ii) sec.101.111 of FCC. The limits are then normalised according to measurement bandwidth.

Table 2 – FCC (B = 850) MHz Spectrum Mask

Δf [MHz]	-425	-850	-1275	-1700	-2125	+425	+850	+1275	+1700	+2125
Limit [dB]	40.3	56	56	56	56	40.3	56	56	56	56
A(Δf) [dB]	66.5	66.5	65.6	60	57(*)	65	65.5	65	65	64.5

(*) In this range, the noise level of the spectrum is higher.

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5.4 FREQUENCY STABILITY

5.4.1 Conditions

f_{TX}=28 GHz

P_{out}=P_{max}=23.6 dBm (20dB attenuation outside RAU)

TX always ON

Modulation OFF

Spectrum analyser settings:

SPAN=2MHz, RBW=30KHz, VBW=30Hz

5.4.2 Results

See table 3.

The frequency never changes when the supply voltages are modified from the minimum to the maximum value.

We have a variation of 56 kHz going from –30°C to 60°C. That's a variation of about 2ppm.

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Table 3- Frequency stability

Temperature (°C)	Frequency (kHz)		
	V=44V	V=52V	V=60V
-30	27,999,970	27,999,970	27,999,970
-20	27,999,970	27,999,970	27,999,970
-10	27,999,976	27,999,976	27,999,976
0	27,999,983	27,999,983	27,999,983
10	27,999,986	27,999,986	27,999,986
20	27,999,994	27,999,994	27,999,994
25	28,000,000	28,000,000	28,000,000
30	28,000,004	28,000,004	28,000,004
40	28,000,010	28,000,010	28,000,010
50	28,000,017	28,000,017	28,000,017
60	28,000,027	28,000,027	28,000,027

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5.5 FREQUENCY TOLERANCE

5.5.1 Conditions

f_{TX}=28 GHz

P_{out}=P_{max}=23.6 dBm (20dB attenuation outside RAU)

TX always ON

Modulation OFF

Spectrum analyser settings:

SPAN=200KHz, RBW=10KHz, VBW=3Hz

5.5.2 Results

See table 4

Table 4

Set frequency (KHz)	28,098,000	28,000,000	27,900,000
Measured frequency (KHz)	28,097,989.7	27,999,990.0	27,899,989.0
Delta (ppm)	0.3	0.4	0,3

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6 ANNEX 1 - SPURIOUS EMISSION AT ANTENNA TERMINAL

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CONDUCTED SPURIOUS EMISSION W-BAS

Abstract

Spurious emission up to 75 GHz is measured at the antenna port of a W-Bas Node unit for FCC Type Approval Test Report

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2 Test date 2
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1 TEST FACILITIES DESCRIPTION

The Spurious emission tests was performed at Ericsson Microwave System in Moelndal, Sweden. The facilities at the SML/TV department is an open lab environment. The temperature is 20 - 25 ^{o}C and RH 40-70 %.

2 TEST DATE

The test was performed 1999-09-06 by Johnny Selim.

3 EQUIPMENT UNDER TEST

Outdoor unit: UKL 60103/12

Indoor Unit: HRY 10201/3 MMU 34+2 Mb S/N 2005203

4 TESTMODE

All tests are done in continious mode, and a supply voltage of +48 V.

5 TEST EQUIPMENT

Test set up # 1

See Photo 1 - 2.

Spectrum Analyser: HP 8565E YY 1926 Calib. due to 2000-04

Coaxial cable: Suhner Sucoflex 100 SN 626/2E DC - 40 GHz. Test certificate se diagram 1.

Waveguide to coaxial transition: Flann 21093-KF20 S/N 232

Test set up # 2

See Photo 3 - 4.

Spectrum Analyser: HP 8565E YY 1926 Calib. due to 2000-04

Waveguide transition: WG 21 - WG 22 Flann 21000-22 S/N 103

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Directional coupler: Flann 22130-10 (10 dB) YD 5979

Waveguide termination: WG 22 Flann 22040 YV2642

Waveguide transition: WG 22 - WG 23 Flann 22000-23 YA 2954

Waveguide to coaxial transition: Wiltron 35WR22VF YA2948

Coaxials transitions: 2.4(f) - 2.4(f), 2.4(m) - APC 3.5(f), APC 3.5(m) - APC 3.5(m)

Test set up # 2

See Photo 5.

Spectrum Analyser: HP 8565E YY 1926 Calib. due to 2000-04

Waveguide transition: WG 21 - WG 22 Flann 21000-22 S/N 103

Directional coupler: Flann 22130-10 (10 dB) YD 5979

Waveguide termination: WG 22 Flann 22040 YV2642

Waveguide transition: WG 22 - WG 24 Flann 22000-24 S/N 63

Waveguide transition: WG 24 - WG 25 Flann 24000-25 S/N 79

Preselected mixer: HP 11974 V YX 2068 Calibr. 2000 -04

Preselector Power supply: HP11974-60028 Belongs to YX2068

Calibration instruments: HP83650L Swept CW Generator (0 - 50 GHz) YO2559 Calibr. due to 1999-10.

Power Meter HP4418A YE2516 Calibr. due to 2000-08.

Power sensor HP 8487A YE 2509 Calibr. due to 1999-10.

6 TEST METHODE

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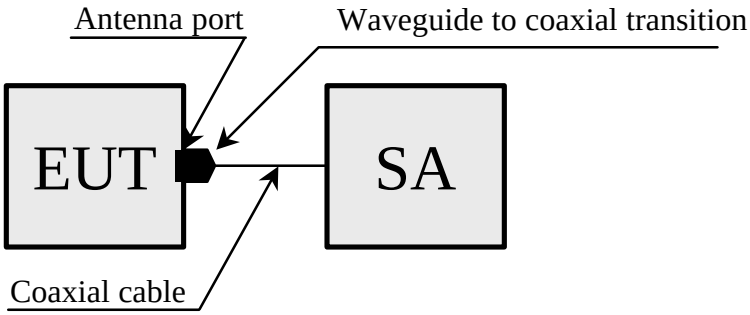
The tests are done using three different test set up for different frequency band. See Figure 1 - 3.



EUT = Equipment Under Test

SA = Spectrum Analyzer

Figure 1. Test set up # 1

In test set up #1 spurious emission between 9 kHz and 33 GHz is measured at the antenna port.

The test set up can be seen in Photo 1 - 2.

The test certificate for the coaxial cable is submitted in diagram 1.

The wanted signal is in diagram 2, and the test results are submitted in diagram 3 - 10.

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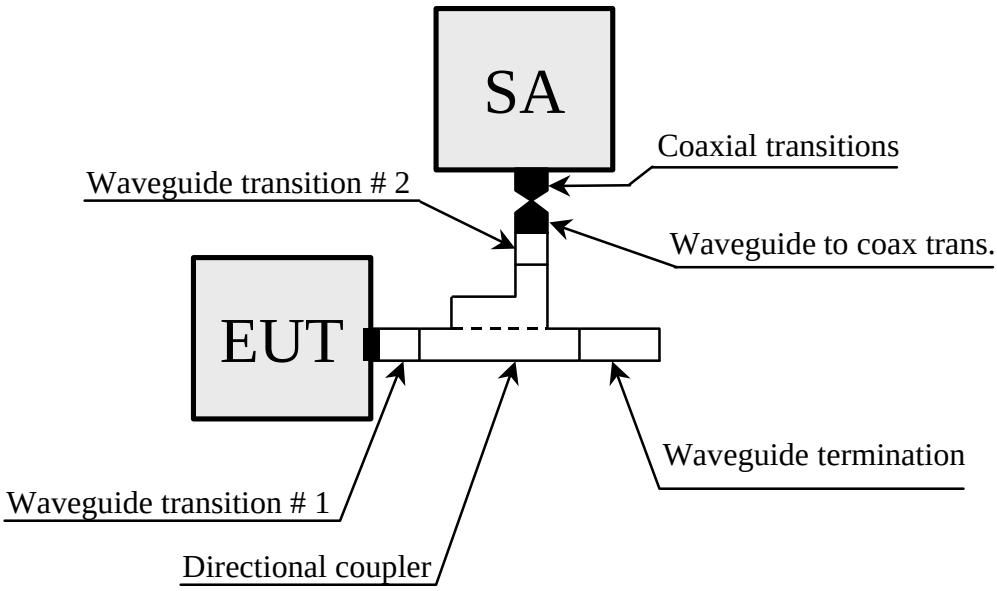

Figure 2. Test set up # 2

In test set up #2 spurious emission between 33 GHz and 50 GHz is measured at the antenna port, via a 10 dB directional coupler.

The directional coupler is used in order to terminate the wanted signal properly and avoid the output signal to be reflected back into the Equipment Under Test

The test set up can be seen in Photo 3 - 4.

The wanted signal is in diagram 11, and the test results are submitted in diagram 12- 15.

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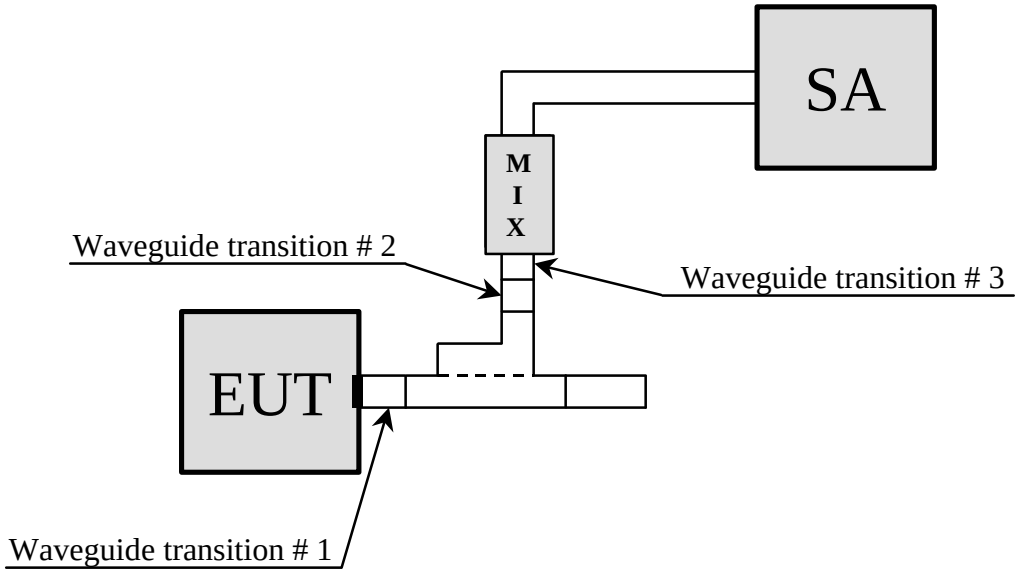

MIX= Preselected mixer

Figure 3. Test set up # 3

In test set up #3 spurious emission between 50 GHz and 75 GHz is measured at the antenna port, via a 10 dB directional coupler and a Preselected mixer

The test set up can be seen in Photo 5.

In order to calibrate the test set up an CW generator at 50 GHz was used. An input level of -10 dBm was injected at the point where the EUT antenna port is connected. The outpout signal was measured with the Spectrum analyzer and submitted in diagram 16. From diagram 16 we can see that the insertion loss between the antenna port and the Preselected mixer is 1.8 dB. This also include the confidencce interval of the coupling factor of the directional coupler.

The test results are submitted in diagram 17 - 20.

7 TEST RESULTS

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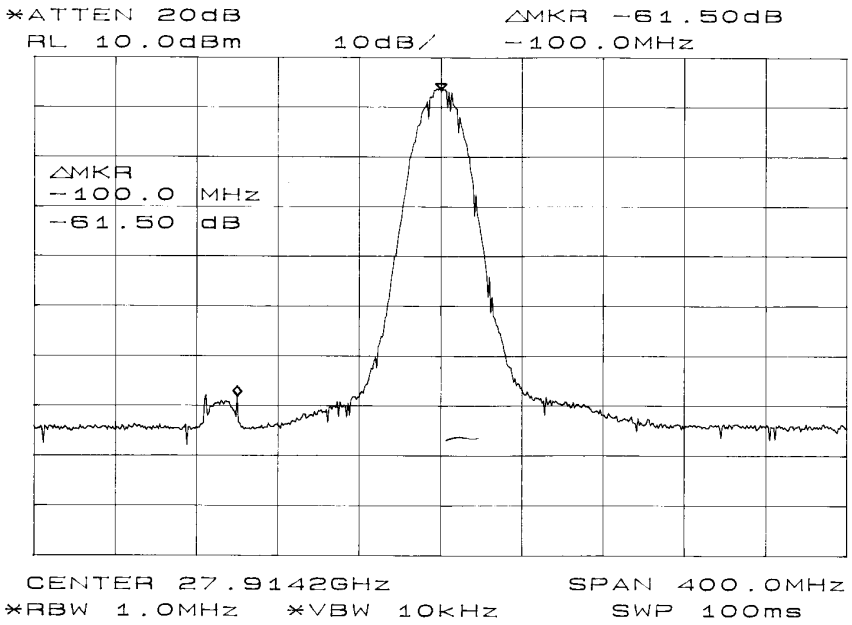
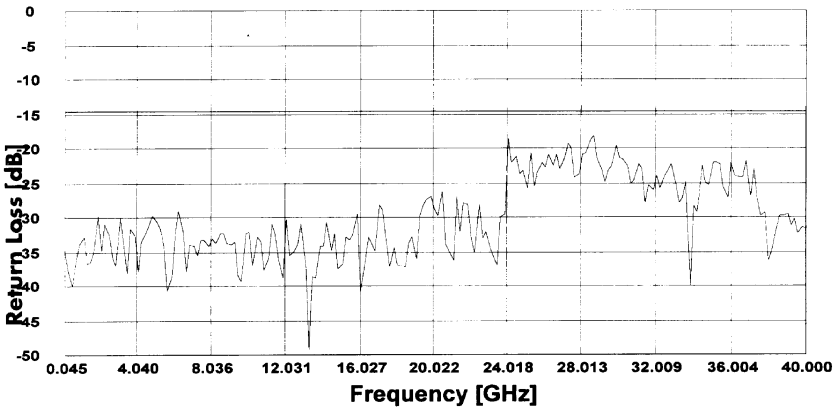
Test Certificate

Microwave Cable Assembly

Frequency range [GHz]	Insertion Loss min [dB]	Return Loss max [dB]
0.0 - 4.0	-0.41	-29.89

Type: **Sucoflex 102E**
Serial no.: 626/2E
Cable length: 500.00 mm
Connector 1: 11 K-252





HUBER+SUHNER AG, RF Interconnection Division, CH-9100 Herisau, Switzerland
Phone: +41 (0)71 353 41 11; Fax: +41 (0)71 353 45 90; Telex: 882 729

DIAGRAM 1

DIAGRAM 2

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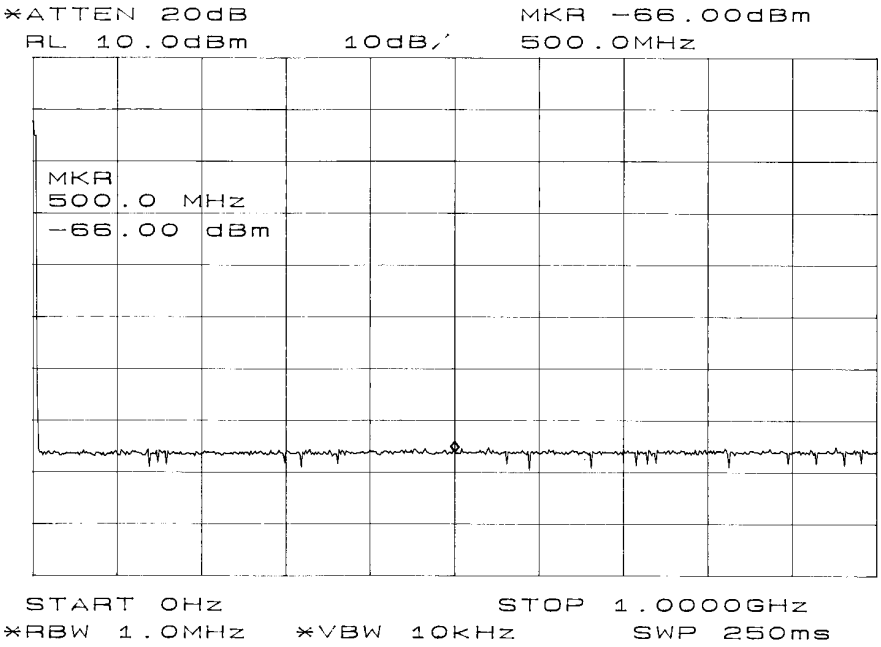

DIAGRAM 3

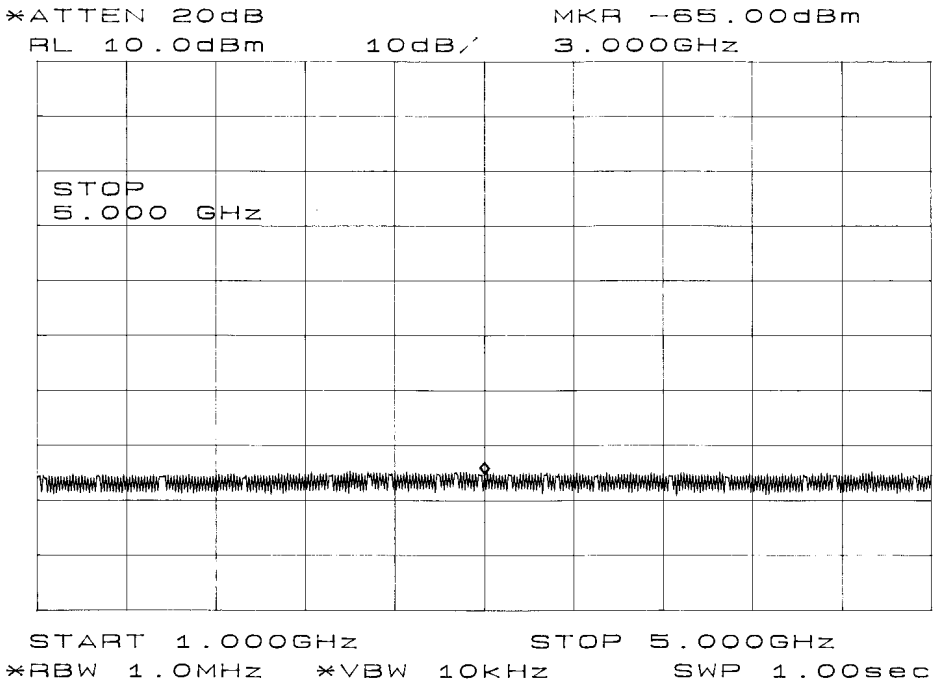

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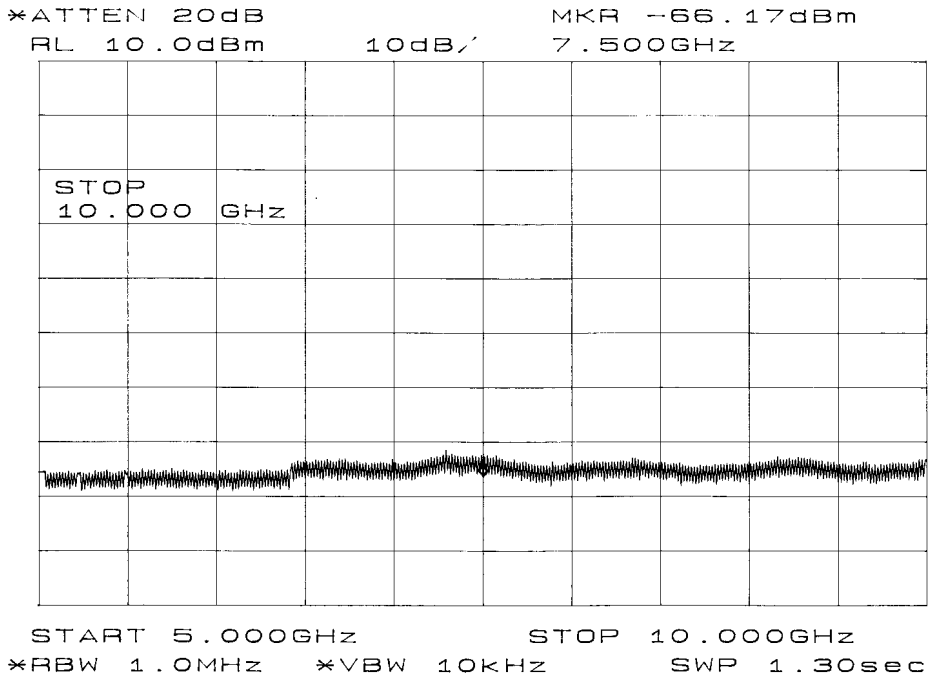
DIAGRAM 4



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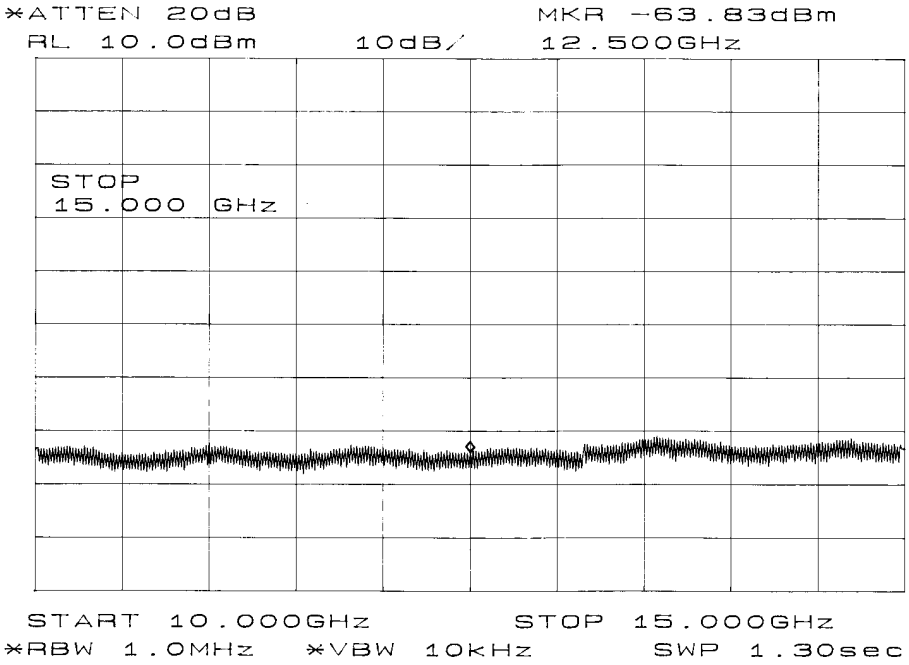

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DIAGRAM 6

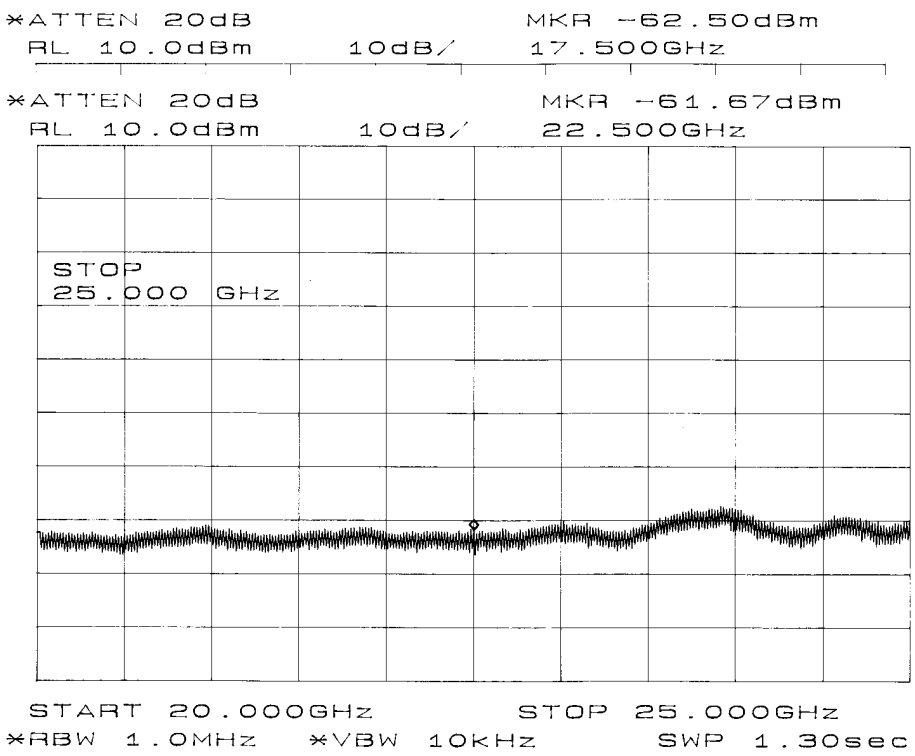

DIAGRAM 7

DIAGRAM 8

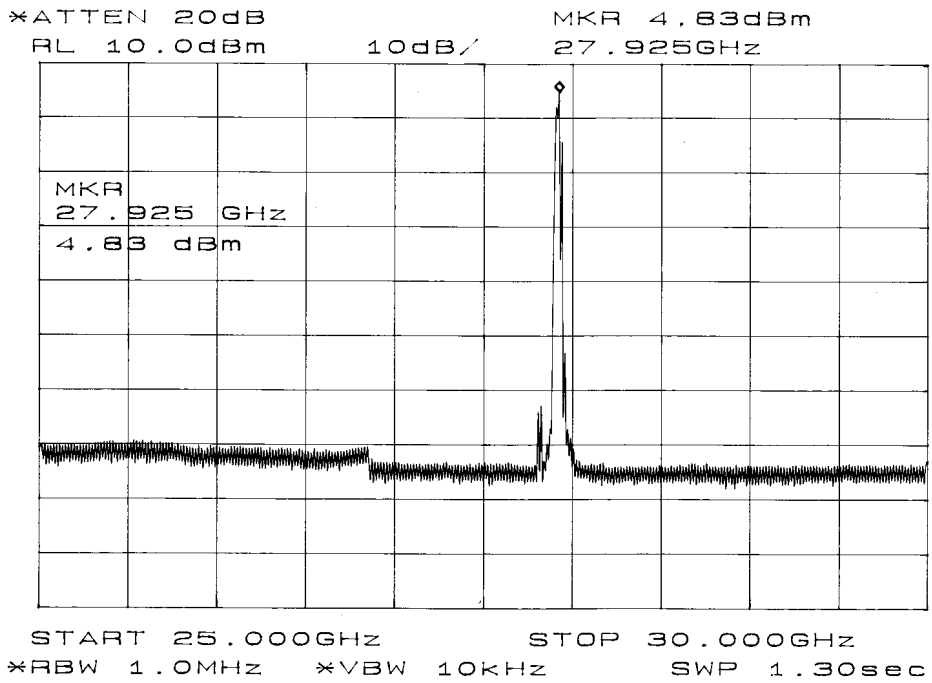

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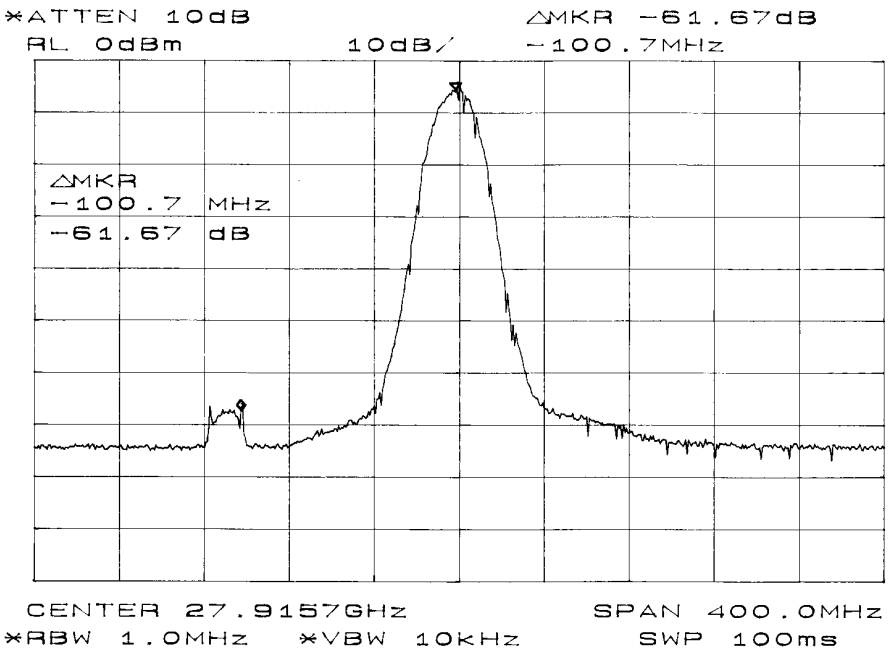
DIAGRAM 9



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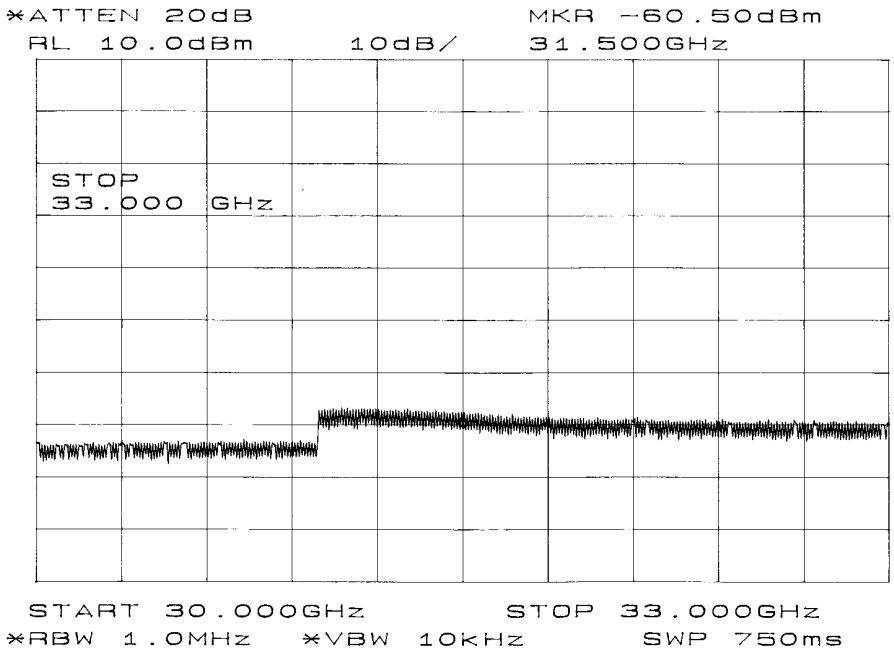

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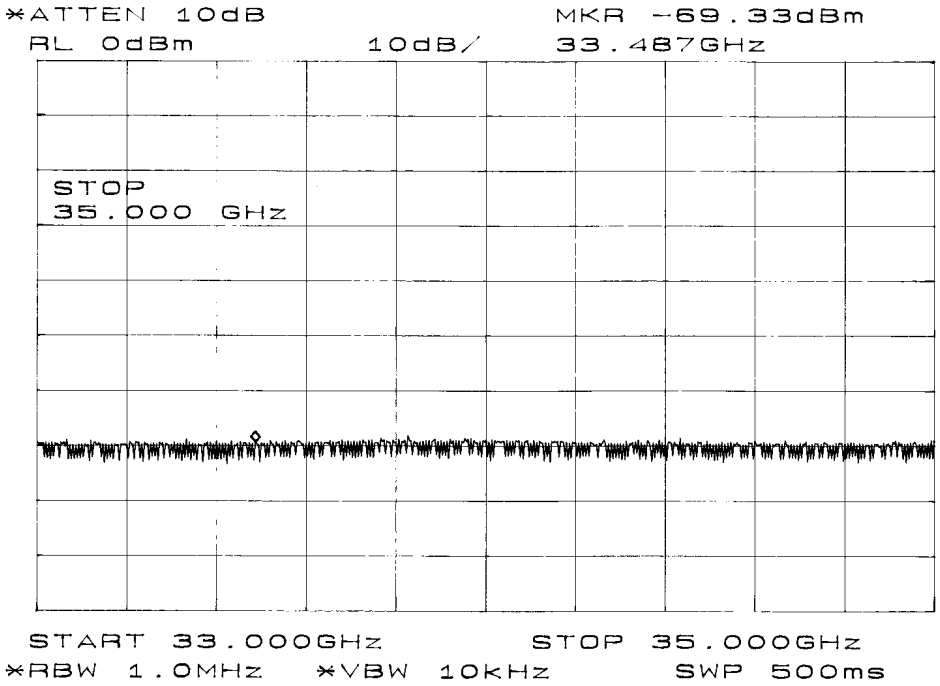
DIAGRAM 11



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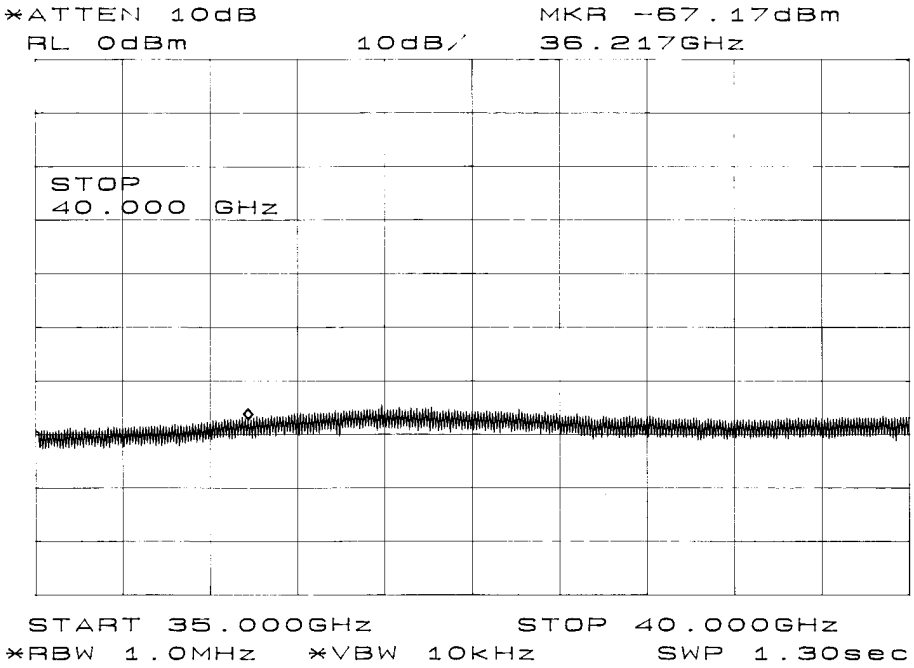

DIAGRAM 13

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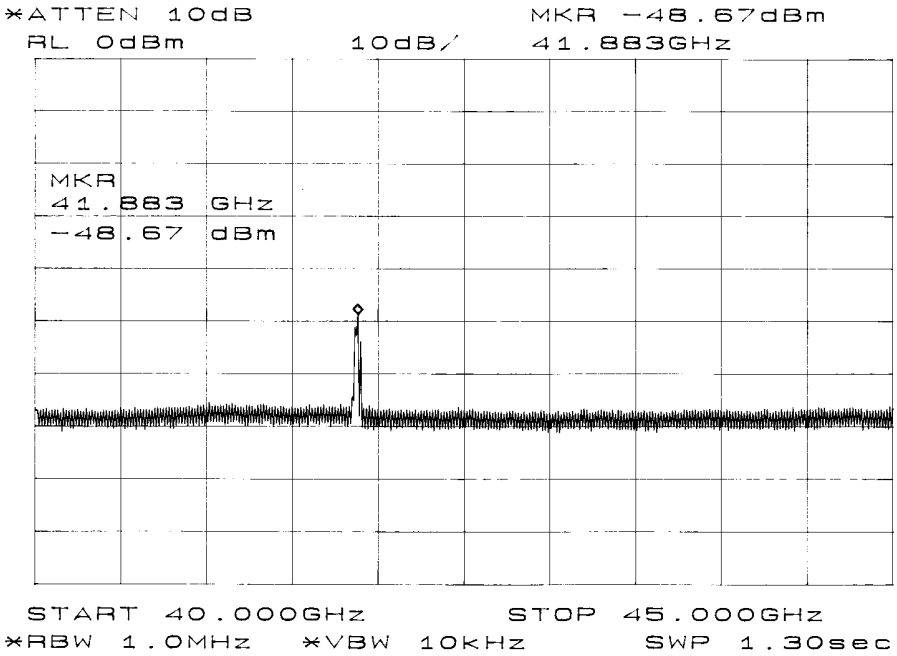

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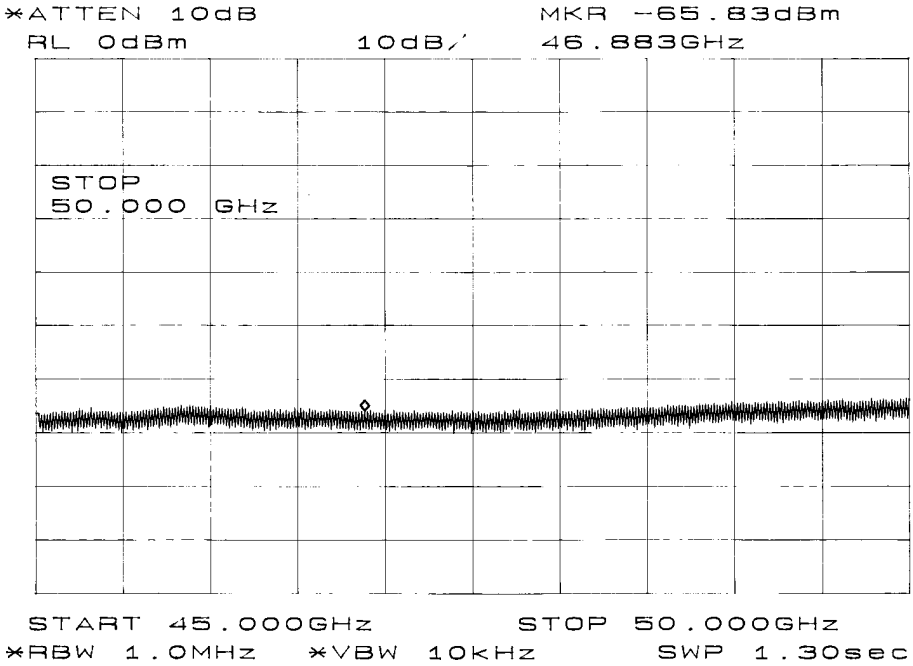

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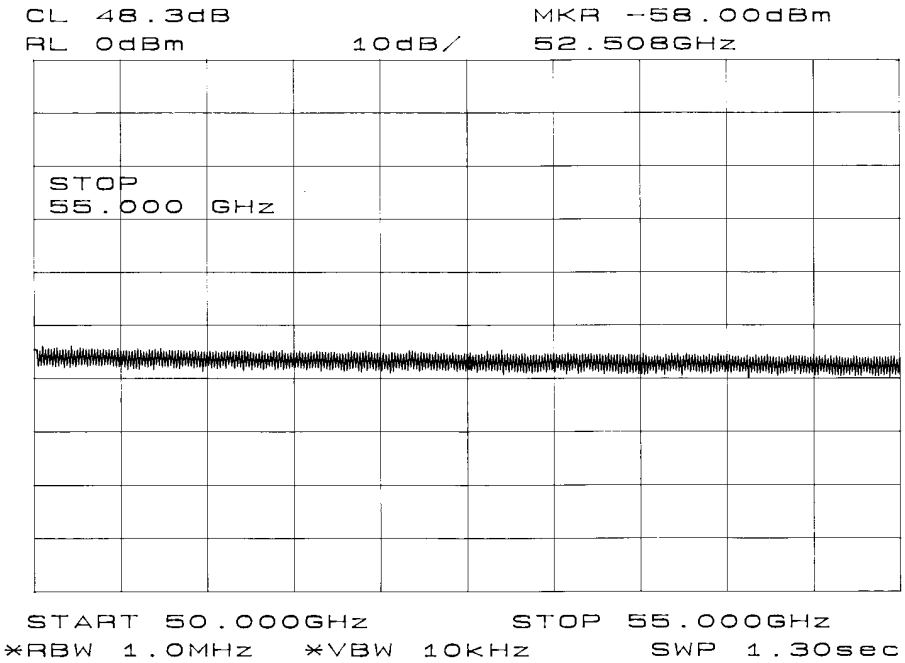
DIAGRAM 15



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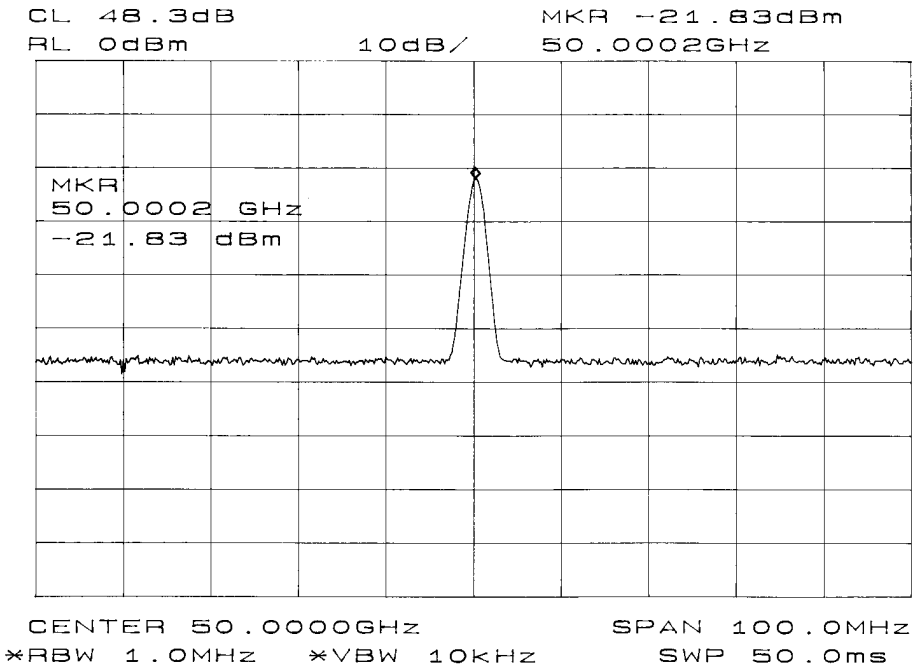

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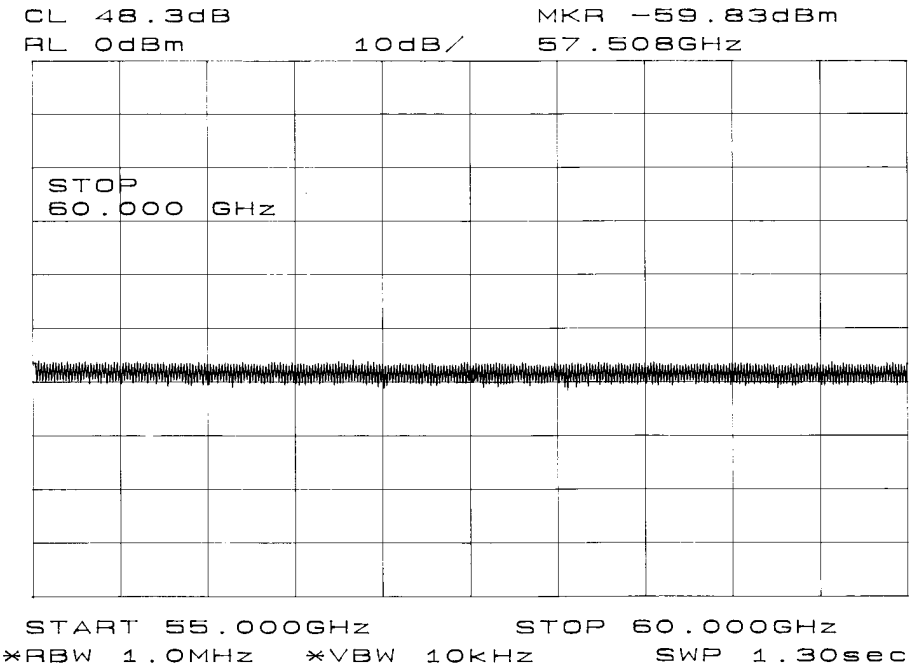
DIAGRAM 17



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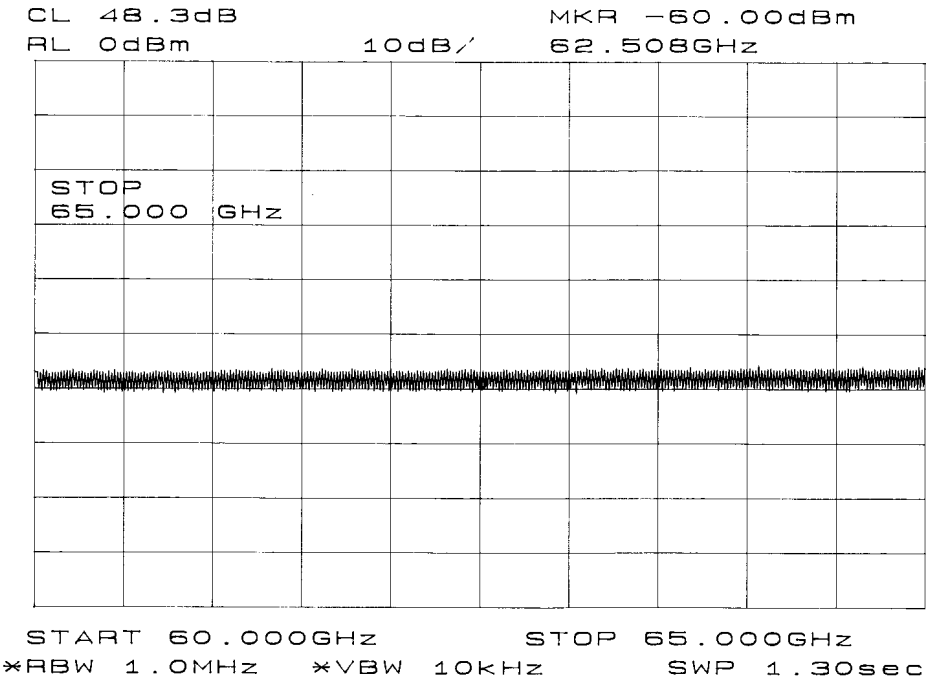

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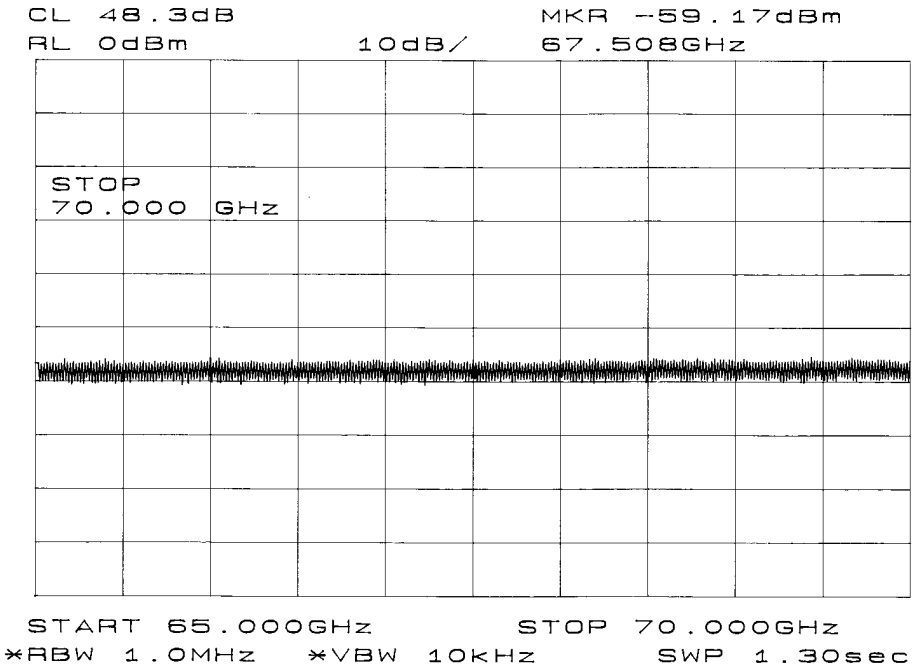
DIAGRAM 19



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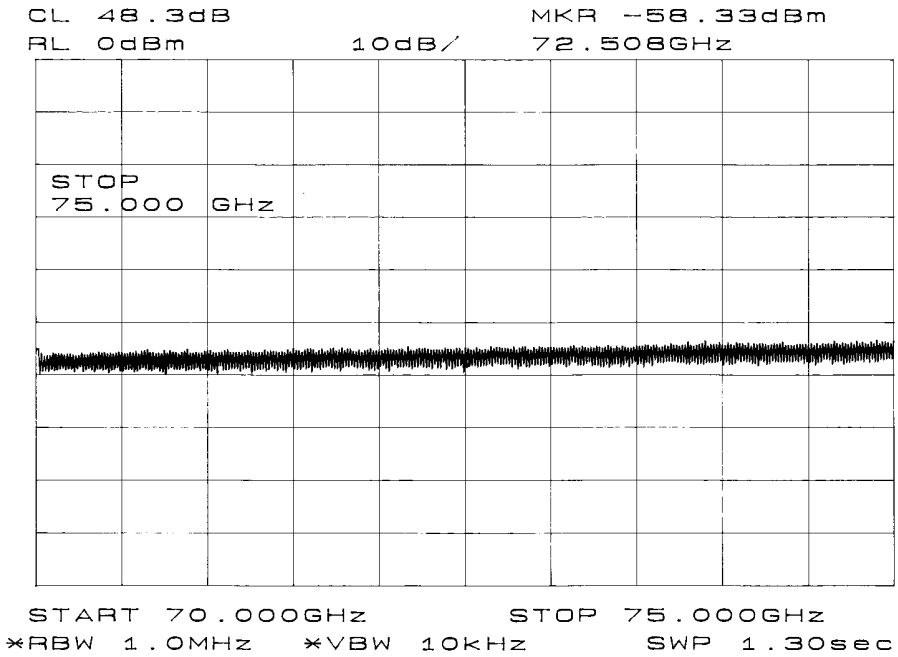

8 PHOTOS

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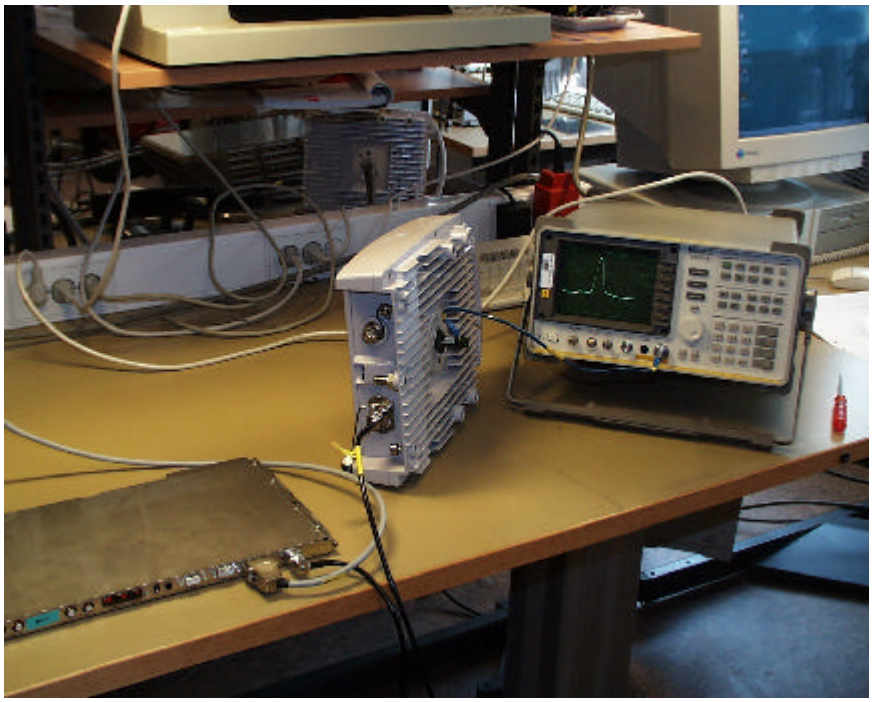

Photo 1

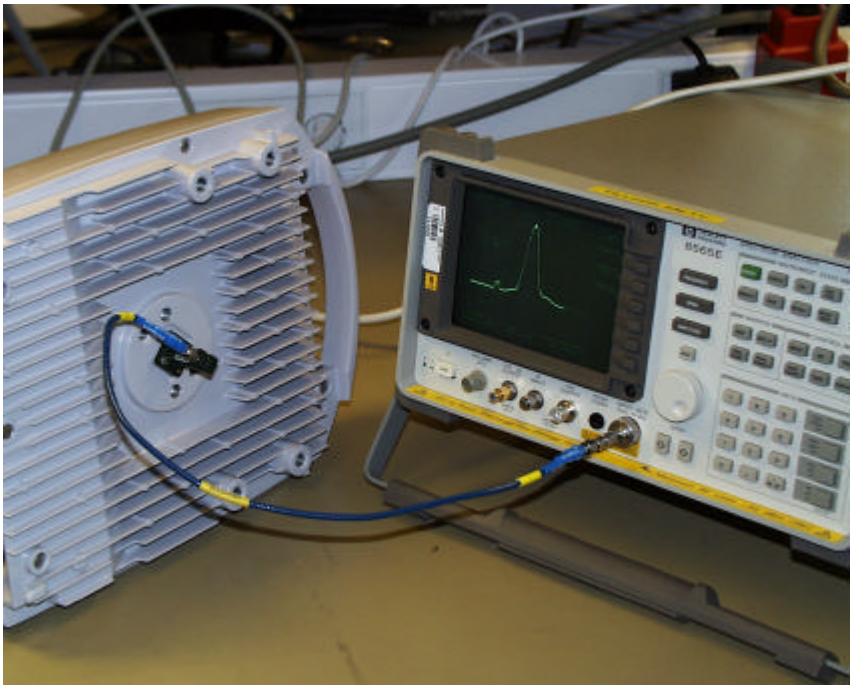

Photo 2

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Photo 3

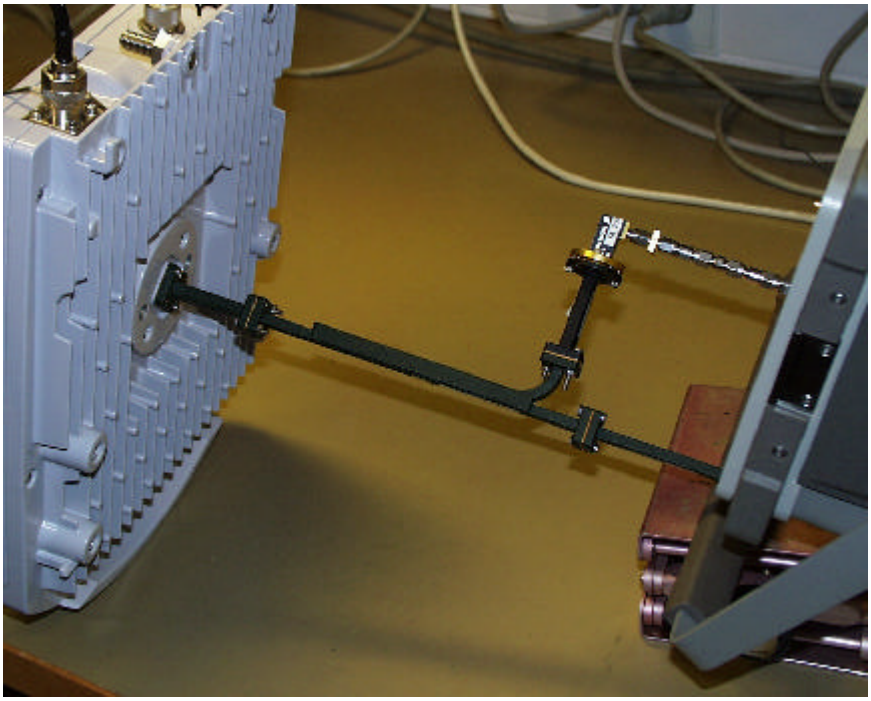

Photo 4

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Photo 5

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7 ANNEX 2 - FIELD STRENGTH OF SPURIOUS RADIATION

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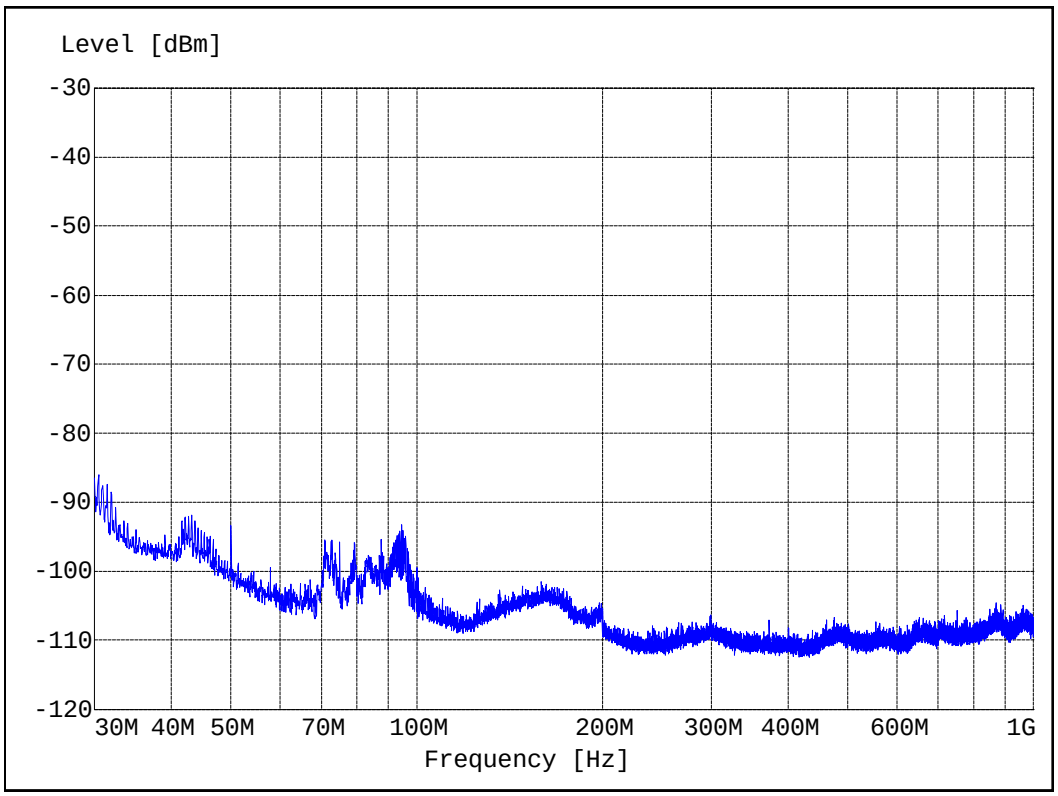

Figure 1 Front towards measuring antenna.

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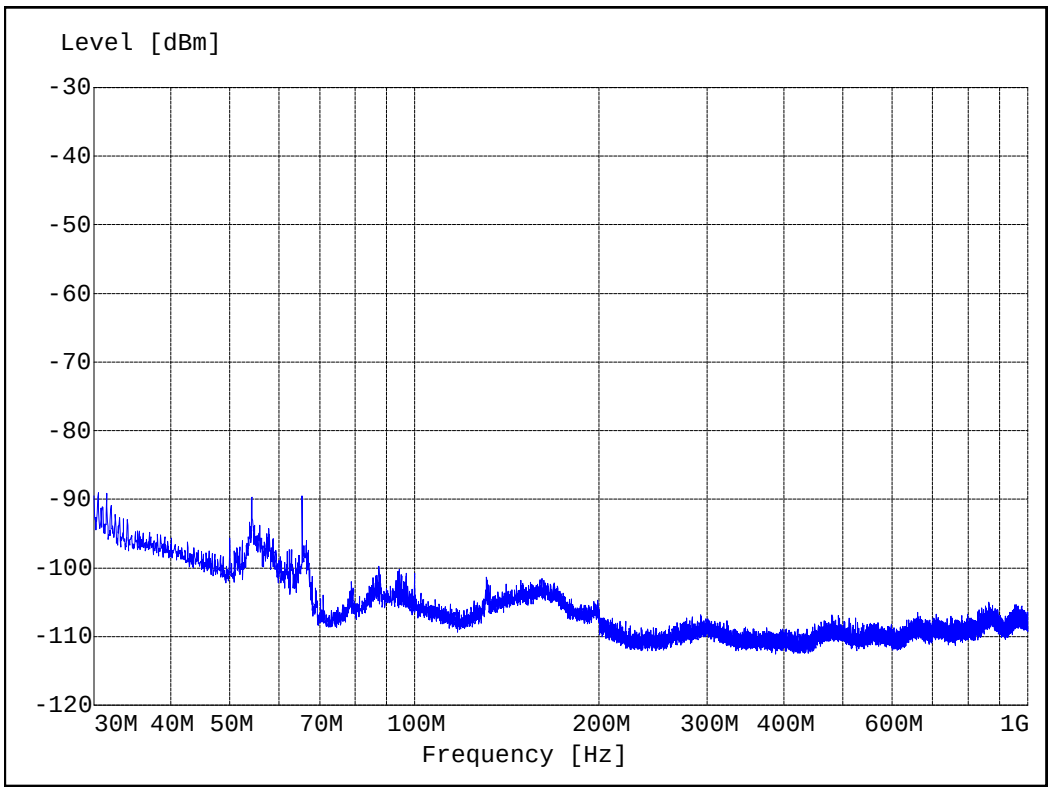

Figure 2 Rear towards measuring antenna.

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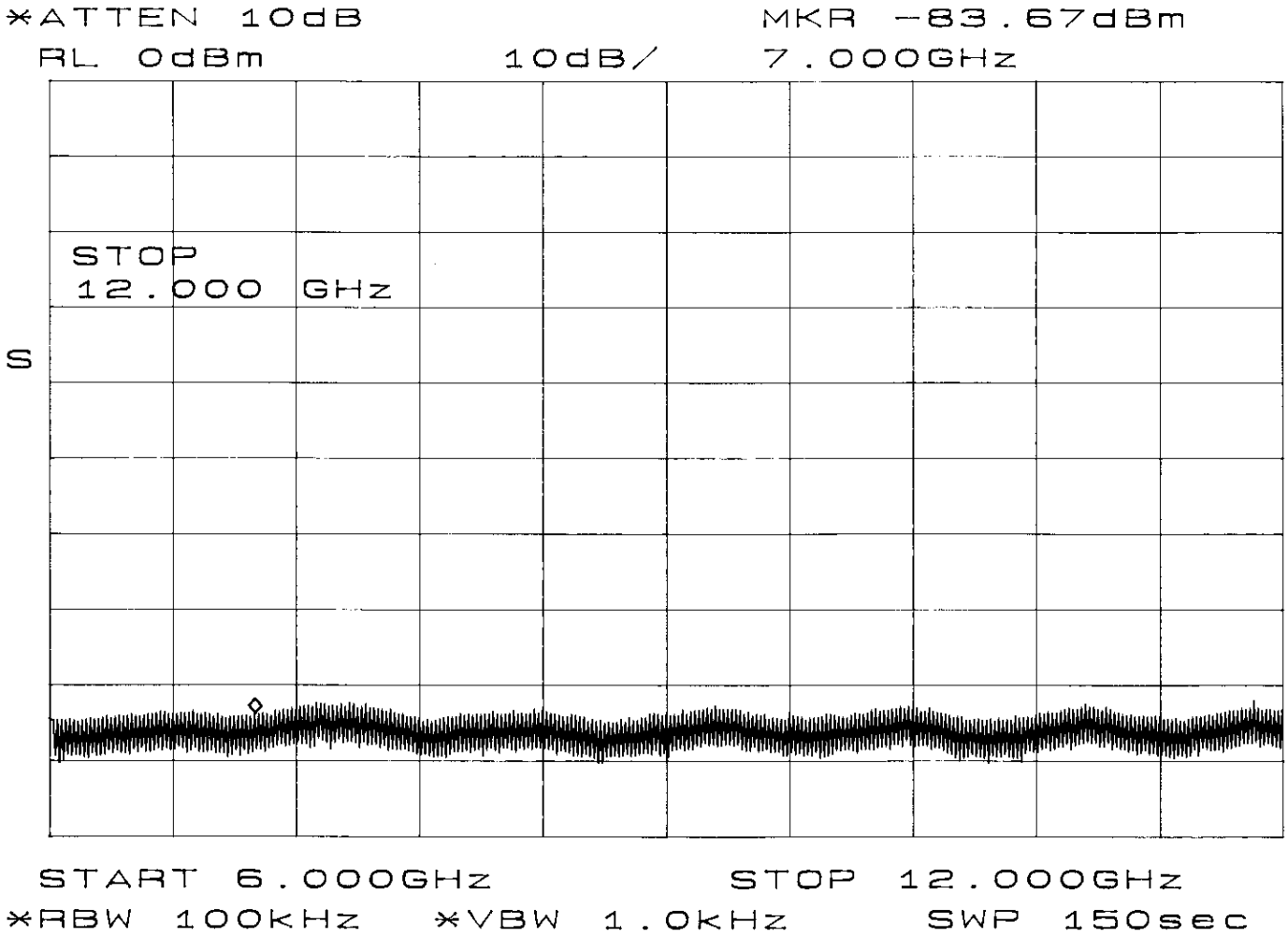
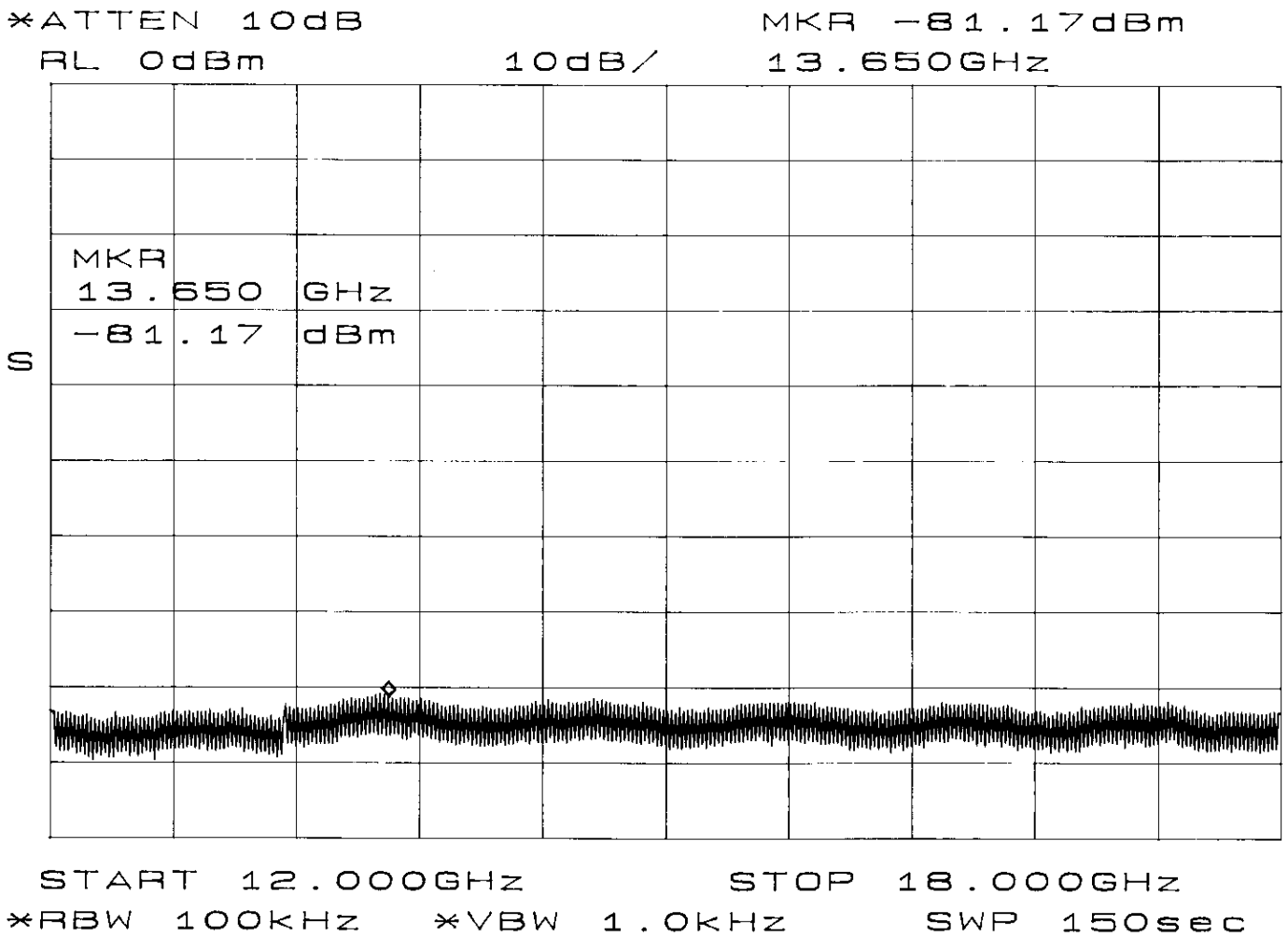
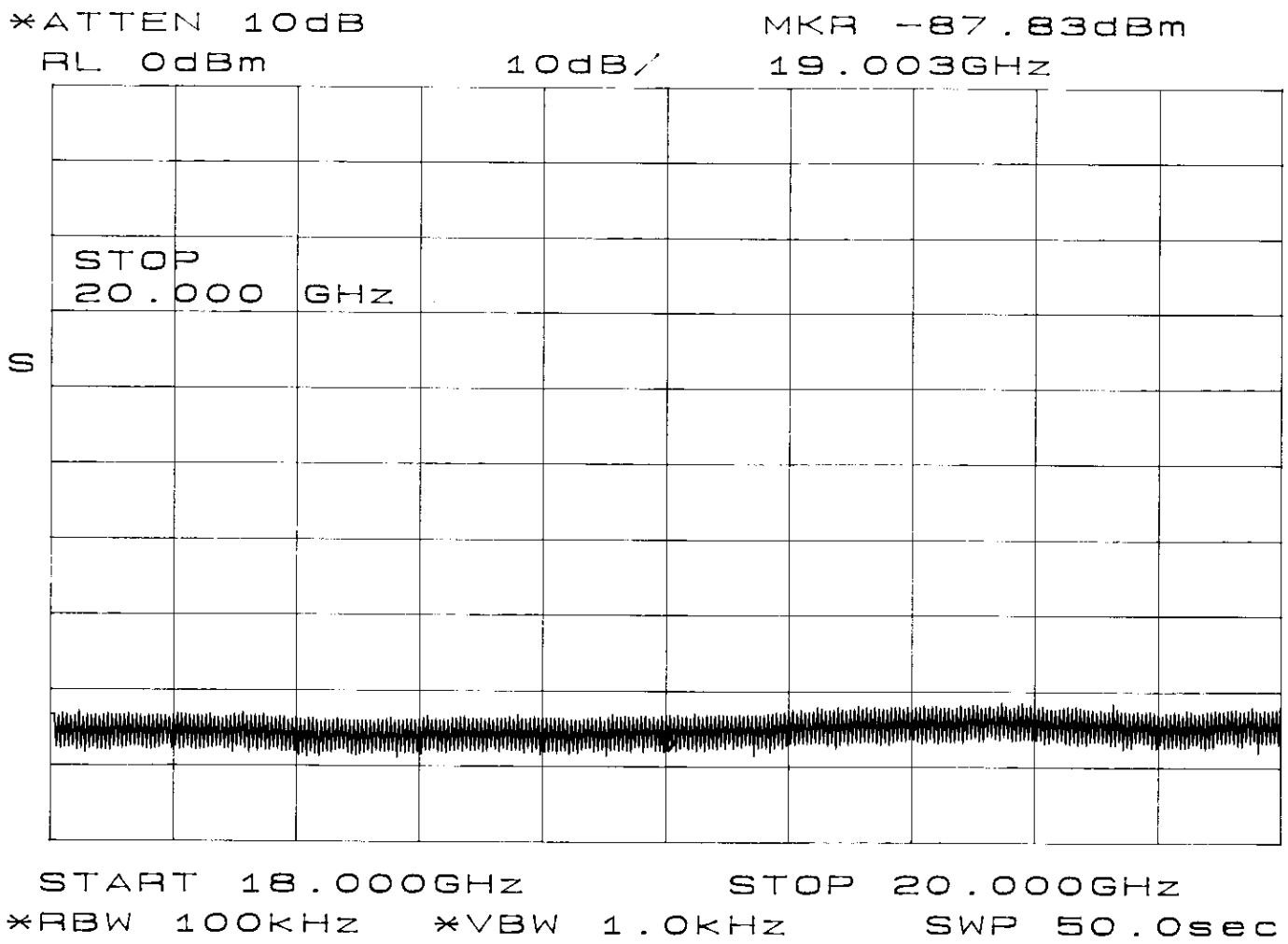
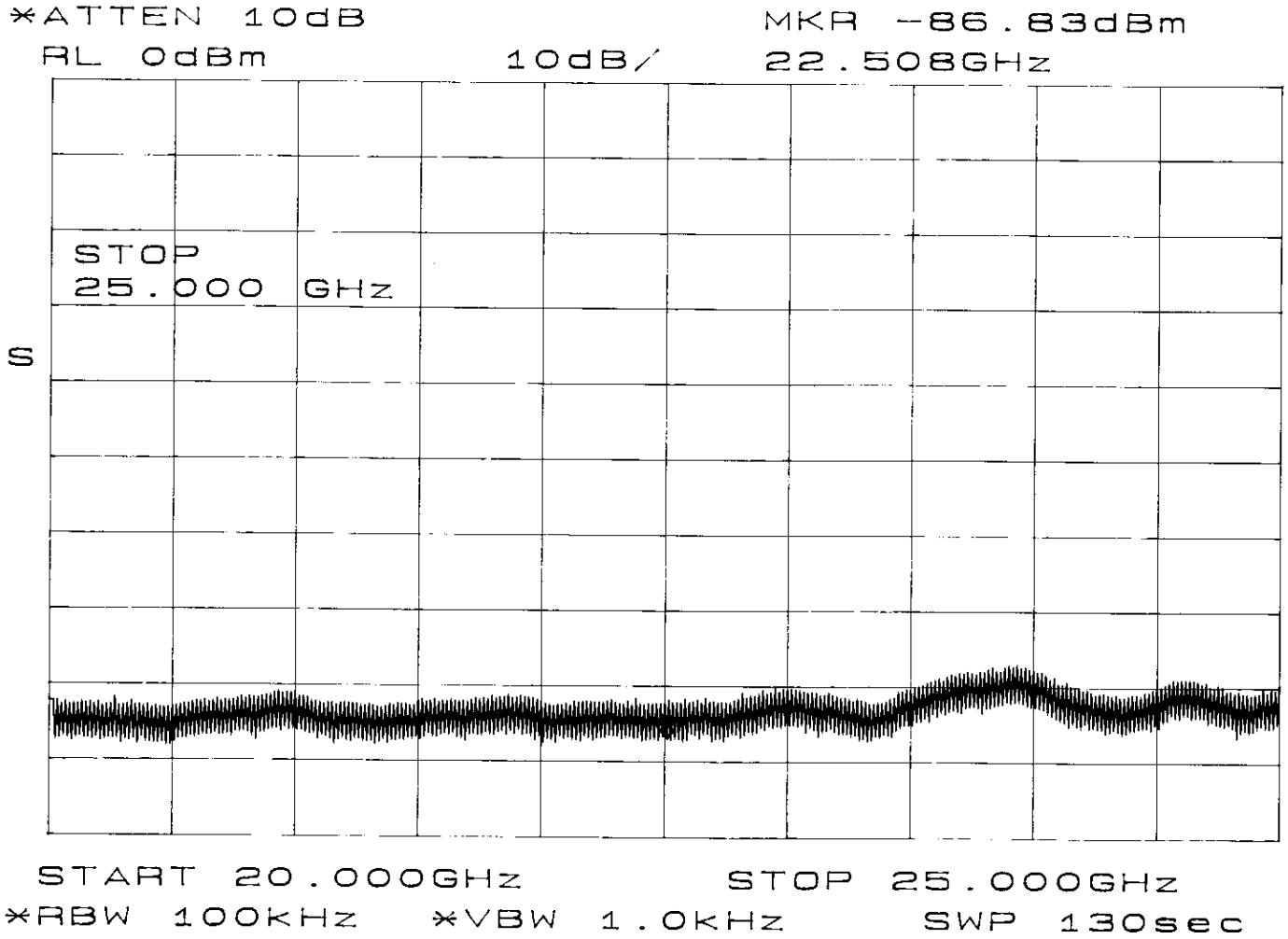
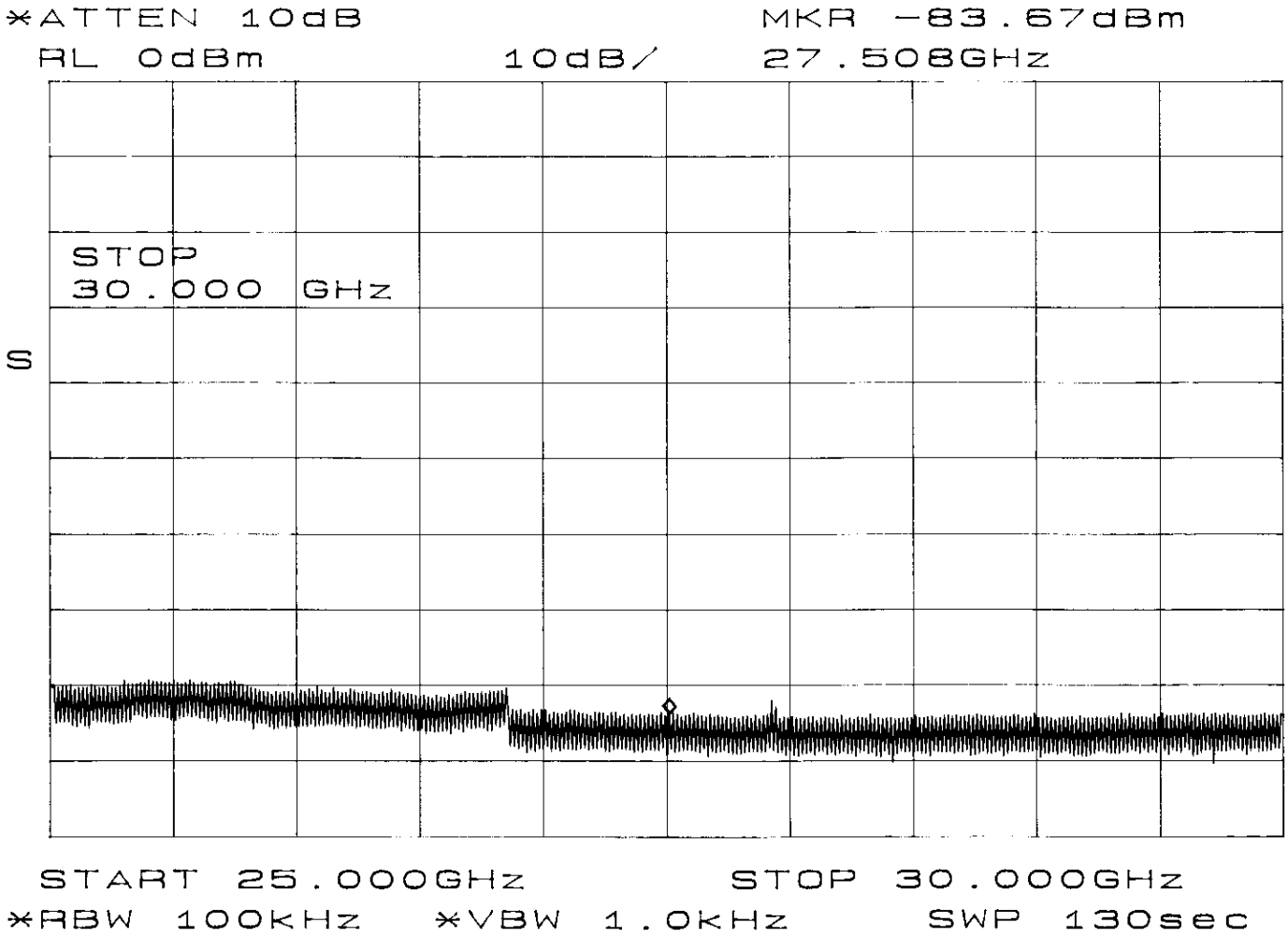
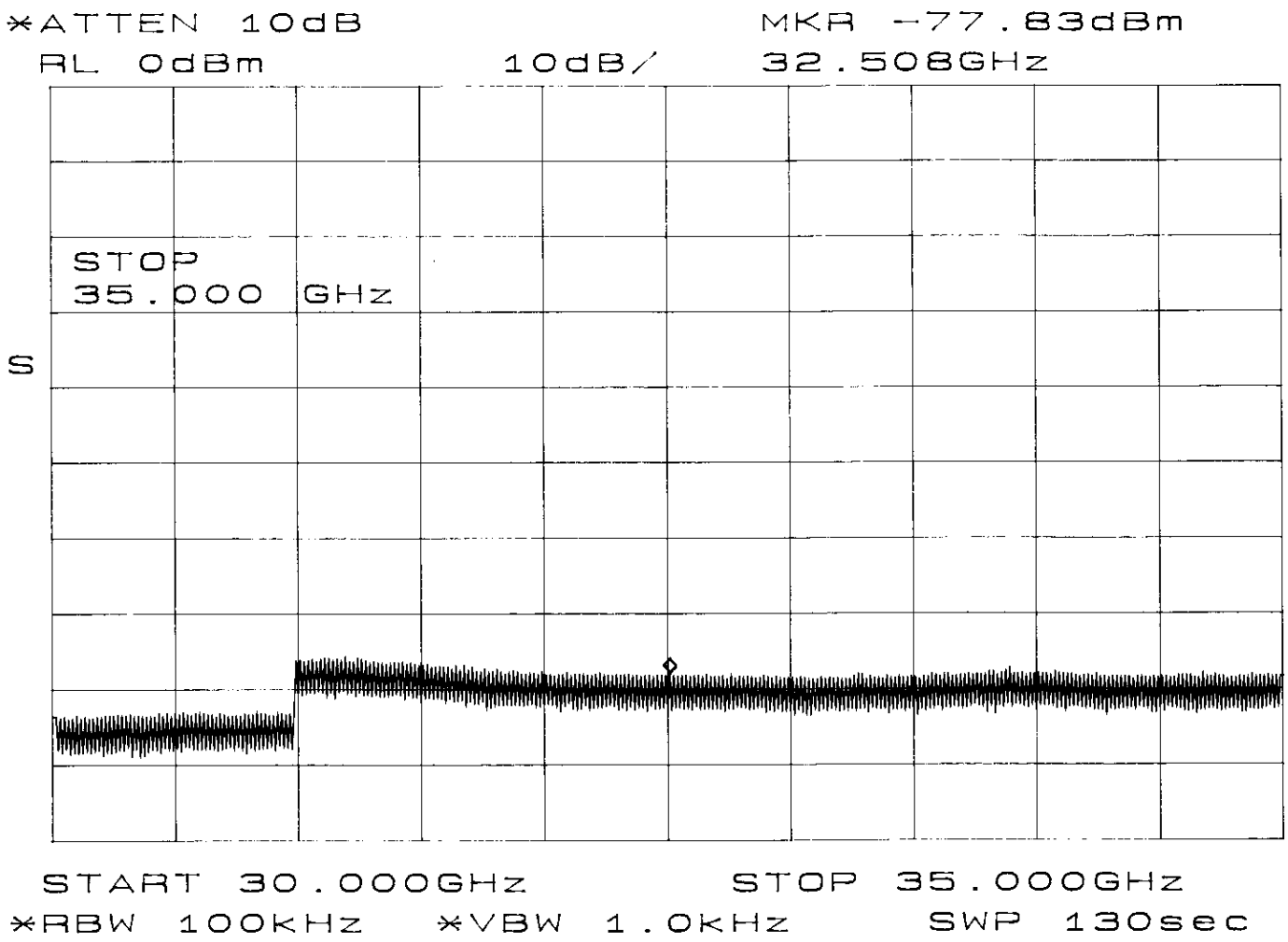

*ATTEN 10dB
MKR -83.67dBm
RL 0dBm
10dB/
7.000GHz
STOP
12.000 GHz
S
START 6.000GHz
STOP 12.000GHz
*RBW 100kHz
*VBW 1.0kHz
SWP 150sec


*ATTEN 10dB
MKR -81.17dBm
RL 0dBm
10dB/
13.650GHz
MKR
13.650 GHz
-81.17 dBm
S
START 12.000GHz
STOP 18.000GHz
*RBW 100kHz
*VBW 1.0kHz
SWP 150sec


*ATTEN 10dB
MKR -87.83dBm
RL 0dBm
10dB/
19.003GHz
STOP
20.000 GHz
S
START 18.000GHz
STOP 20.000GHz
*RBW 100KHz
*VBW 1.0KHz
SWP 50.0sec


*ATTEN 10dB
MKR -86.83dBm
RL 0dBm
10dB/
22.508GHz
STOP
25.000 GHz
S
START 20.000GHz
STOP 25.000GHz
*RBW 100kHz
*VBW 1.0kHz
SWP 130sec


*ATTEN 10dB
MKR -83.67dBm
RL 0dBm
10dB/
27.508GHz
STOP
30.000 GHz
S
START 25.000GHz
STOP 30.000GHz
*RBW 100kHz
*VBW 1.0kHz
SWP 130sec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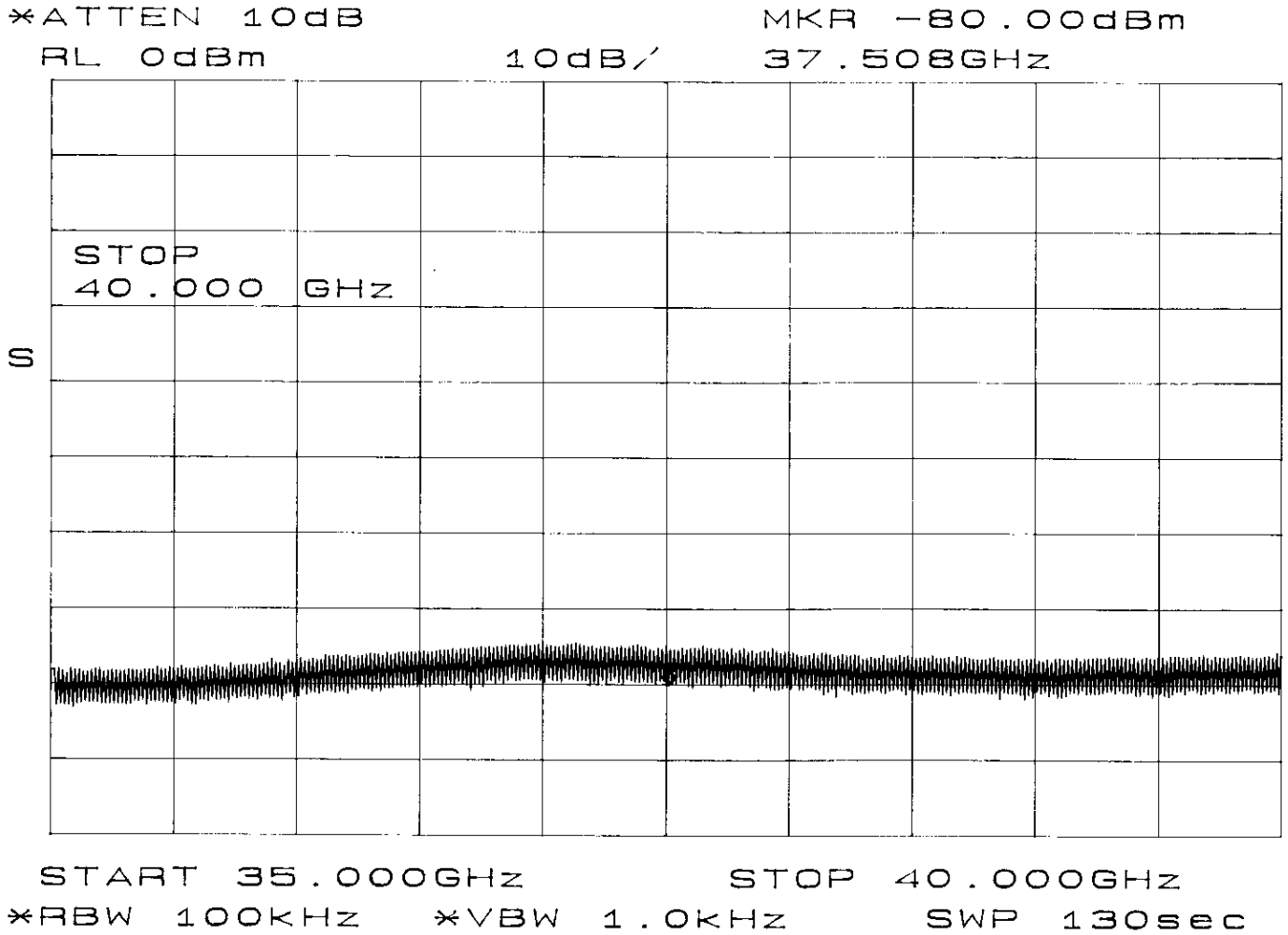
MKR -77.83dBm
RL 0dBm
10dB/
32.508GHz
STOP
35.000 GHz
S
START 30.000GHz
STOP 35.000GHz
*RBW 100kHz
*VBW 1.0kHz
SWP 130sec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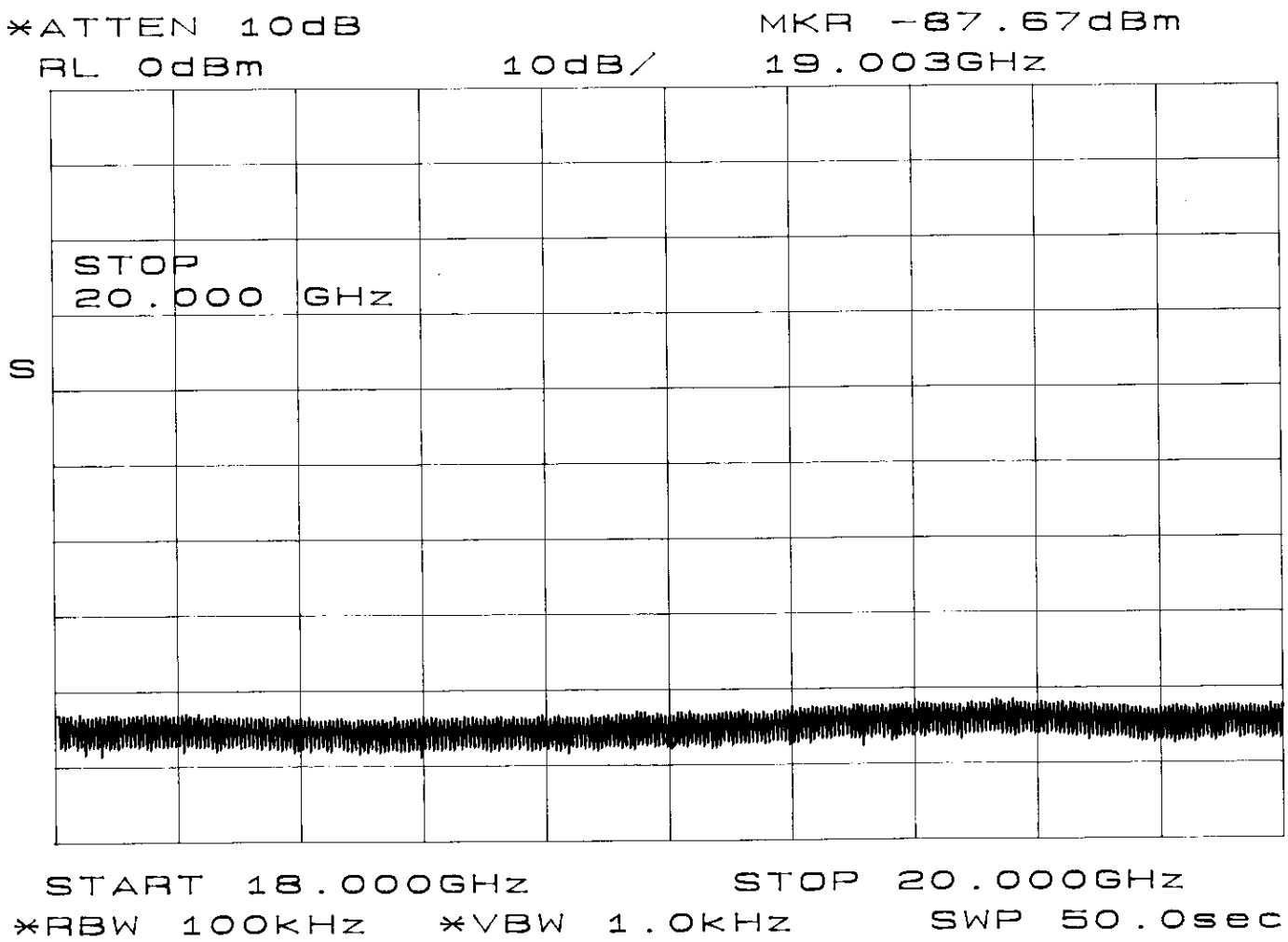
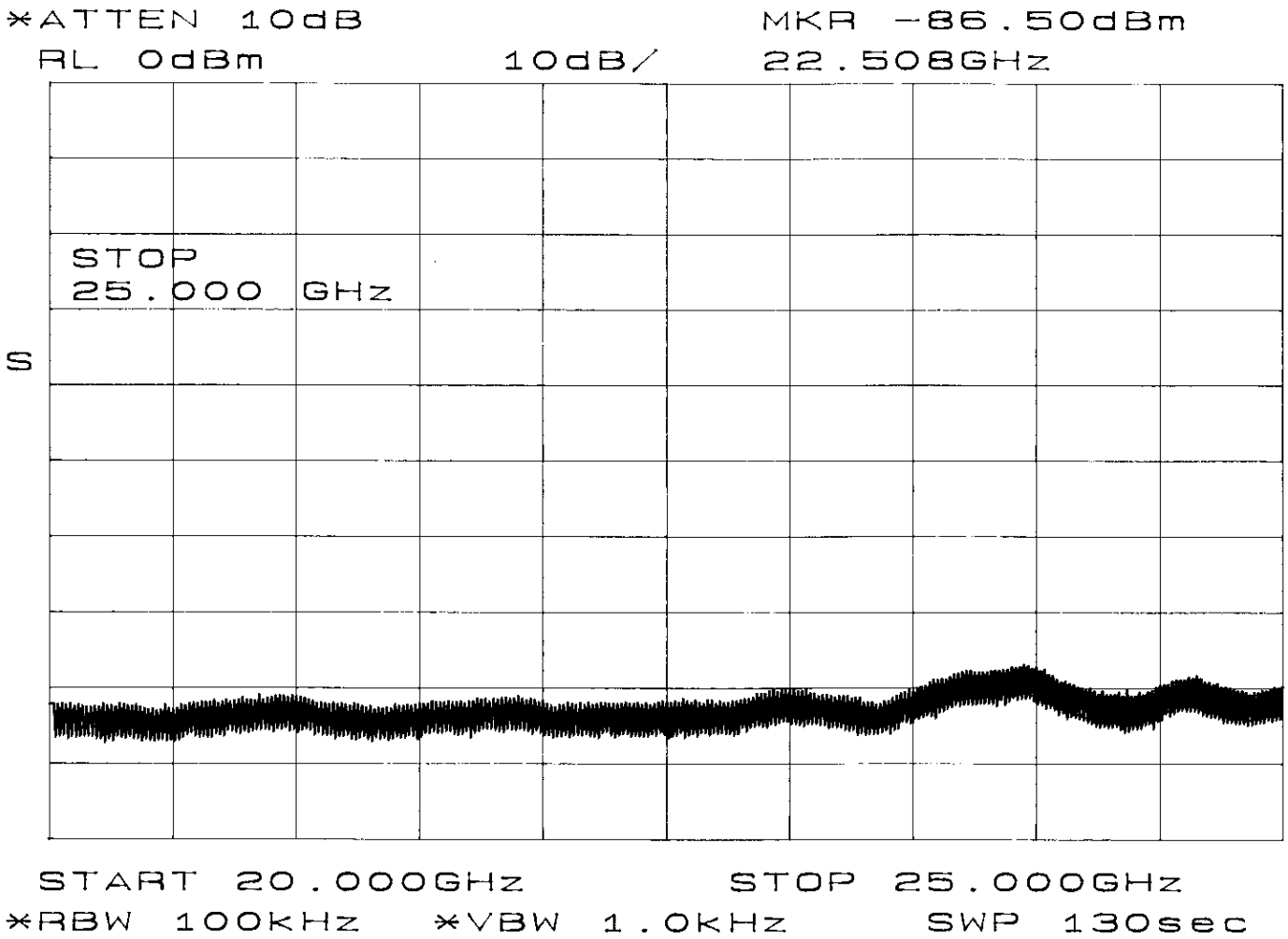
MKR -80.00dBm
RL 0dBm
10dB/
37.508GHz
STOP
40.000 GHz
S
START 35.000GHz
STOP 40.000GHz
*RBW 100kHz
*VBW 1.0kHz
SWP 130sec


*ATTEN 10dB
MKR -87.67dBm
RL 0dBm
10dB/
19.003GHz
STOP
20.000 GHz
S
START 18.000GHz
STOP 20.000GHz
*RBW 100kHz
*VBW 1.0kHz
SWP 50.0sec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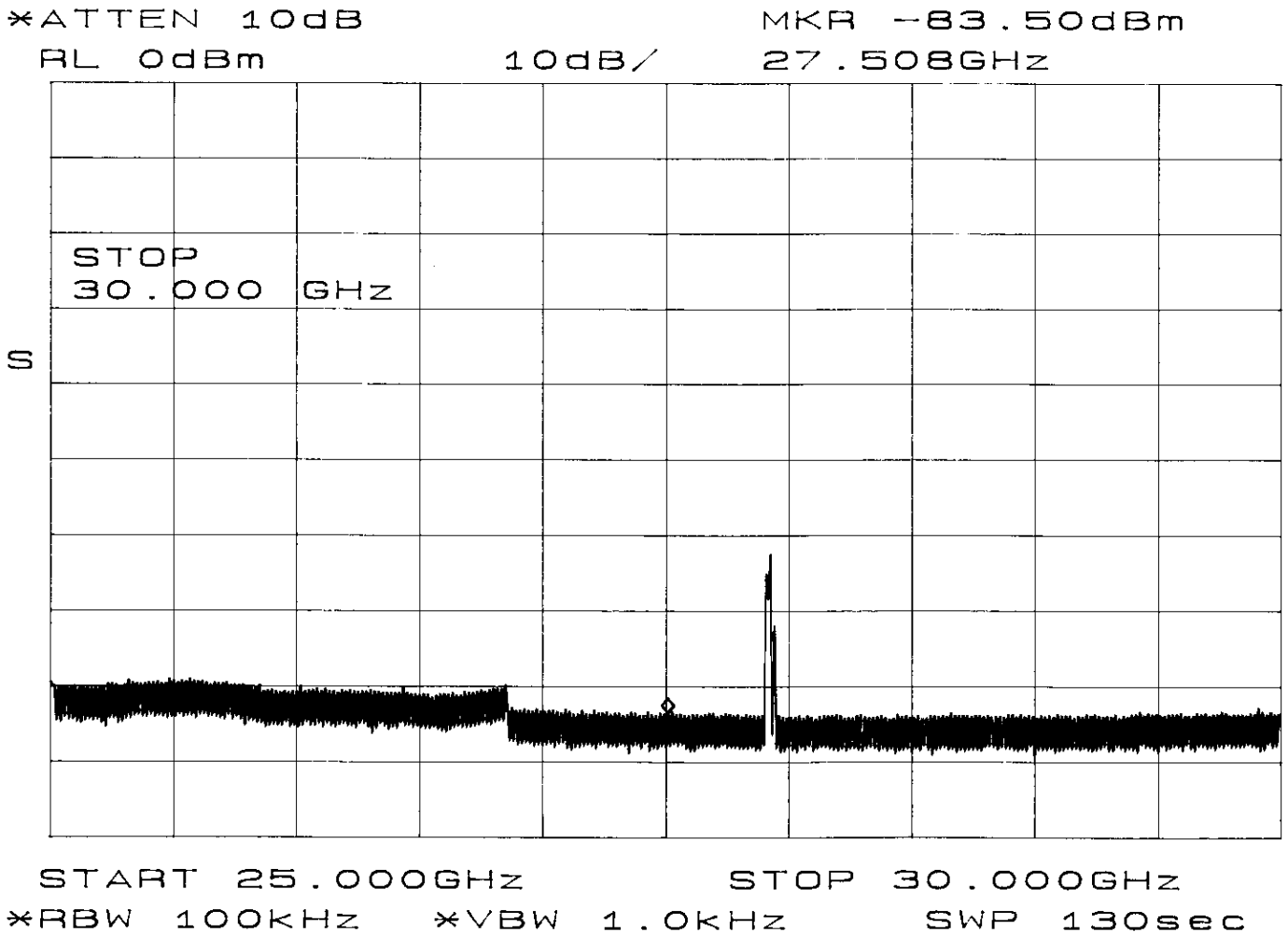
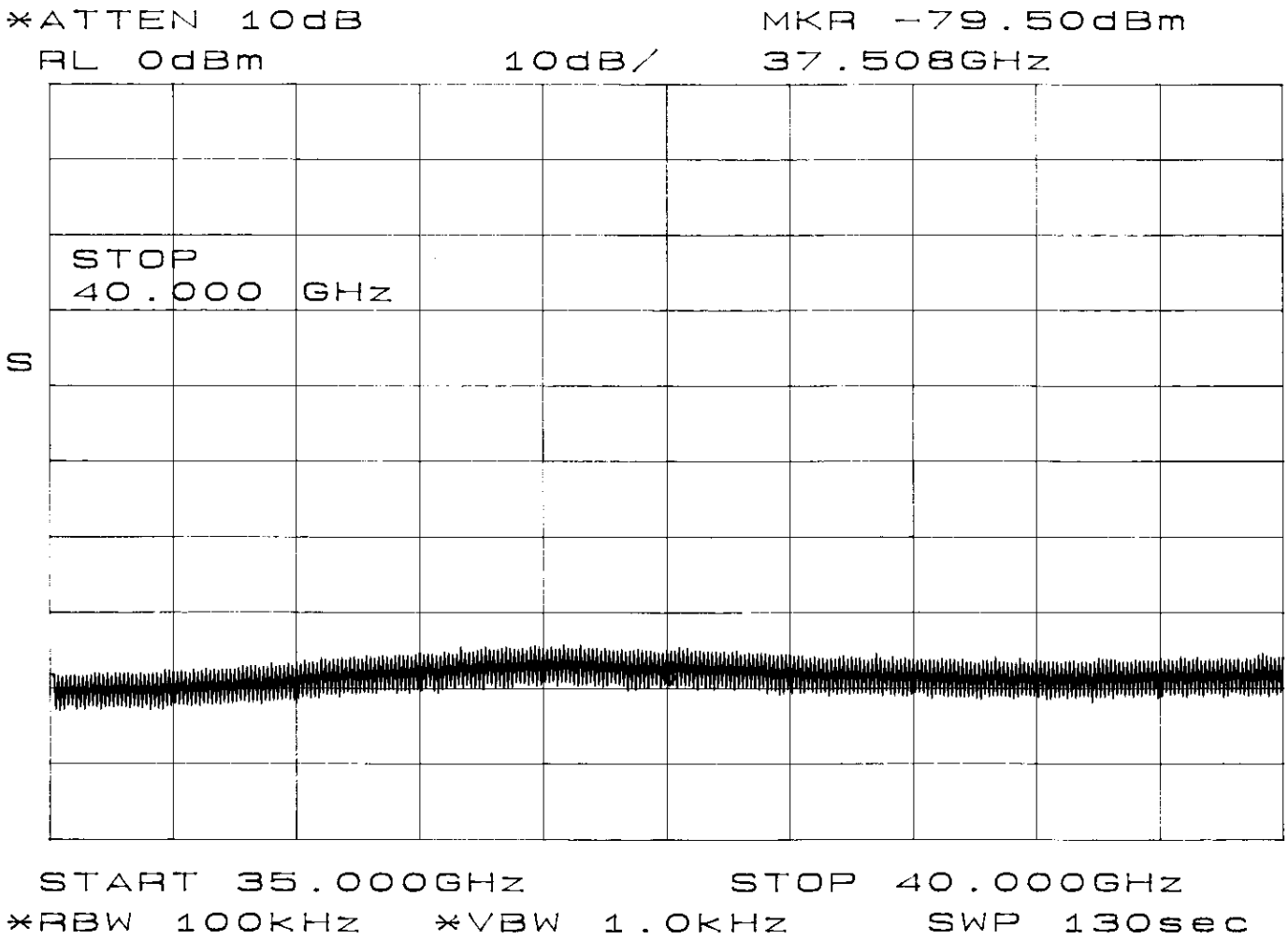
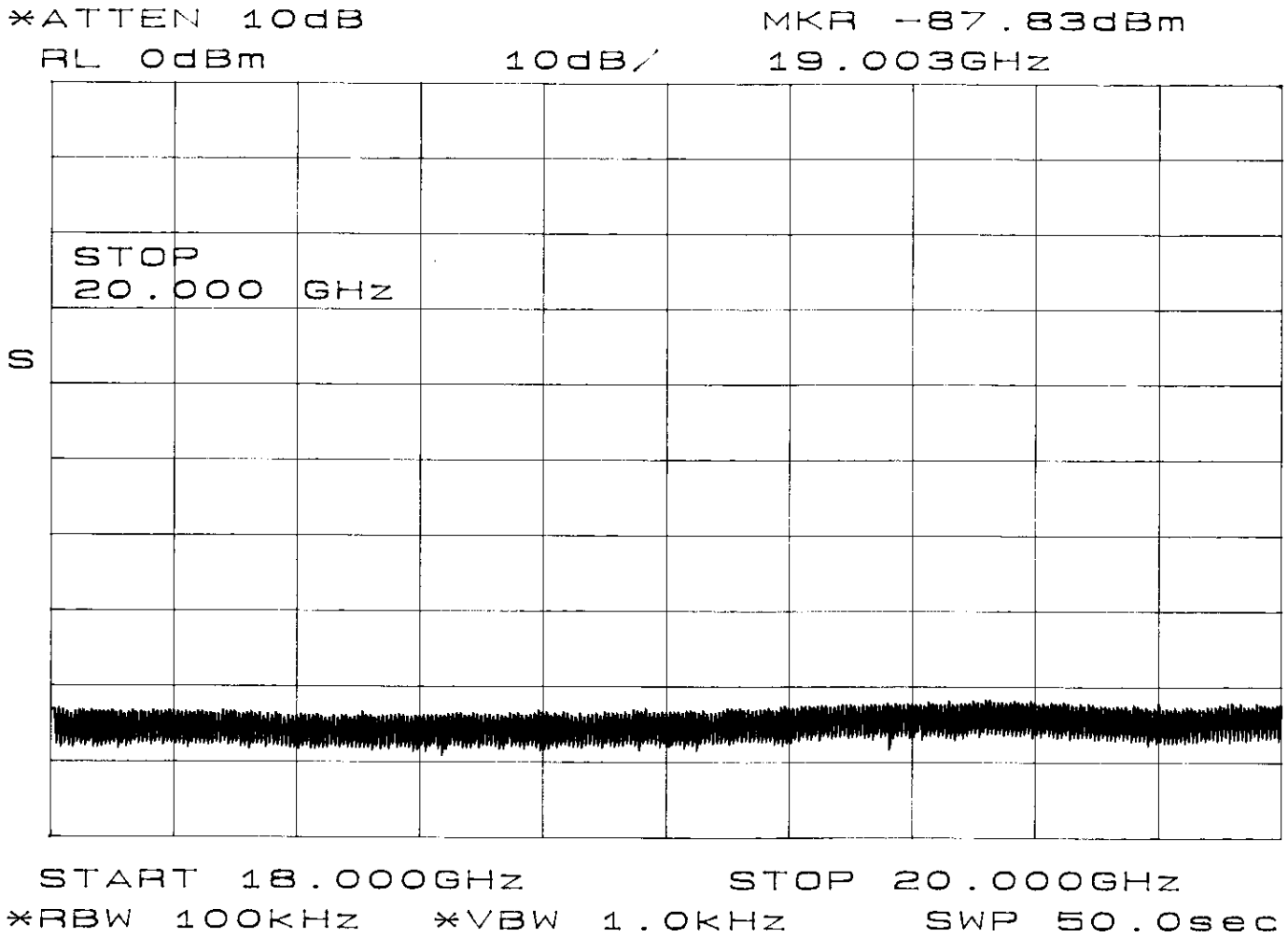
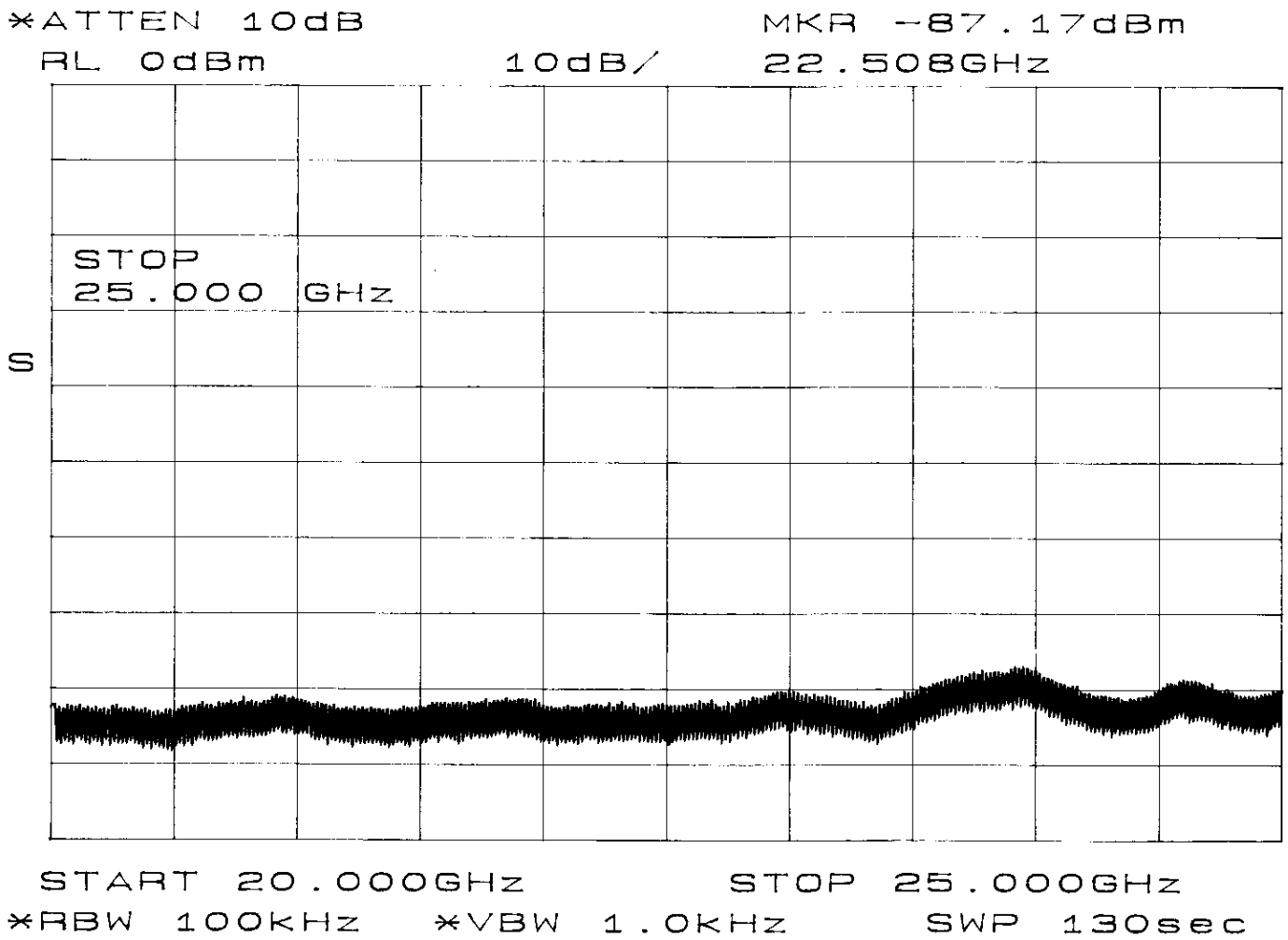
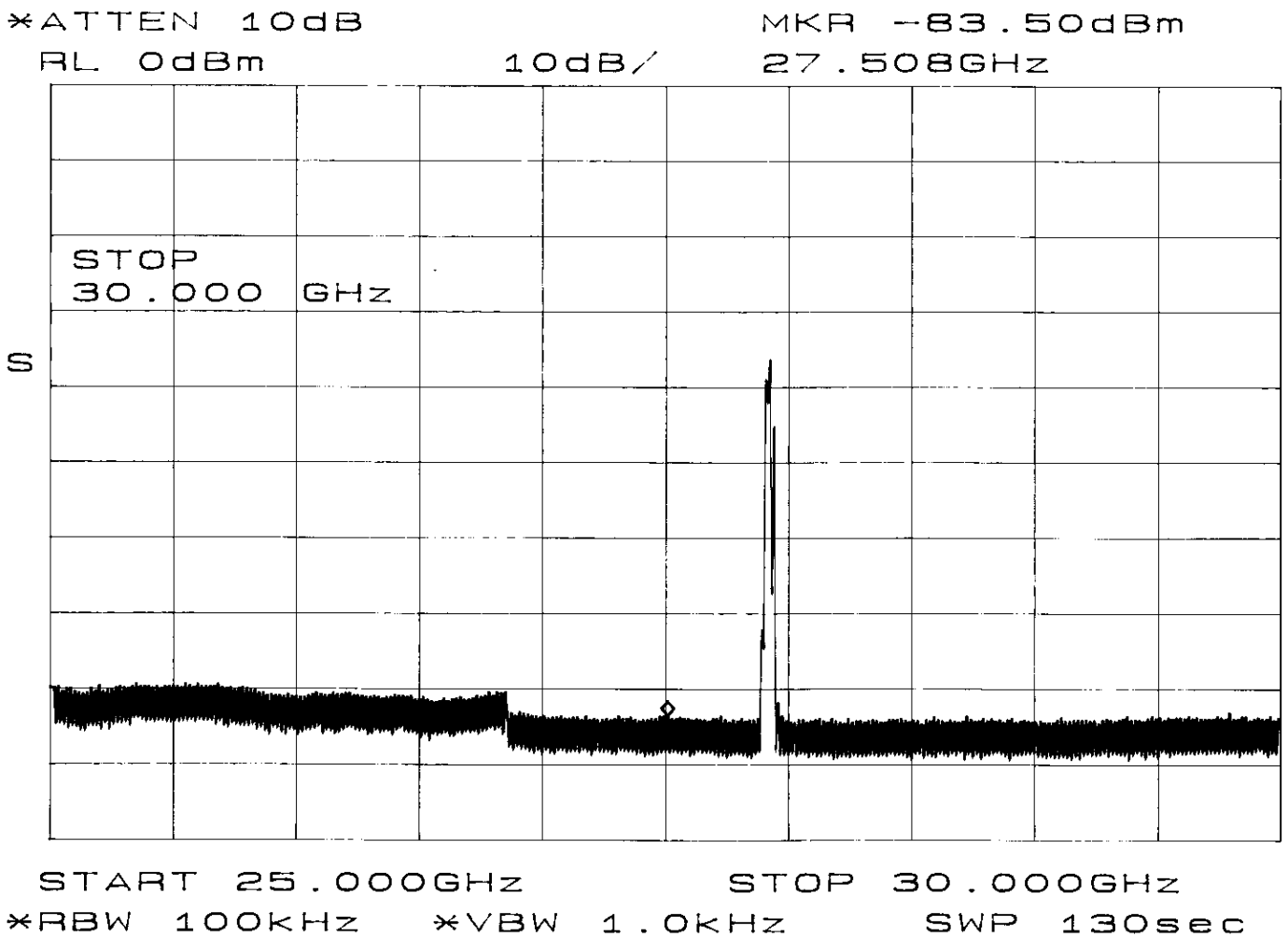
MKR -86.50dBm
RL 0dBm
10dB/
22.508GHz
STOP
25.000 GHz
S
START 20.000GHz
STOP 25.000GHz
*RBW 100kHz
*VBW 1.0kHz
SWP 130sec

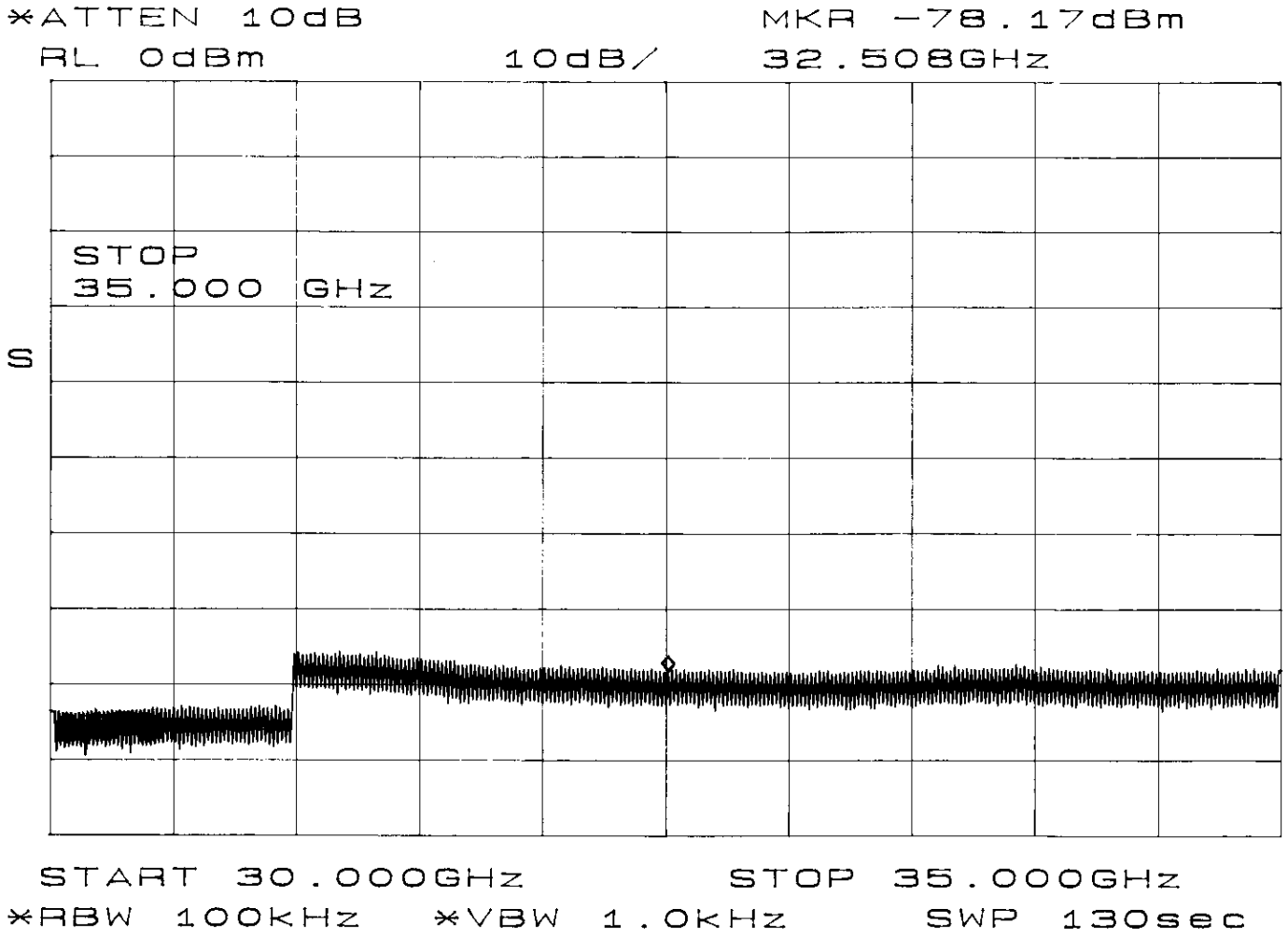

*ATTEN 10dB
MKR -83.50dBm
RL 0dBm
10dB/
27.508GHz
STOP
30.000 GHz
S
START 25.000GHz
STOP 30.000GHz
*RBW 100kHz
*VBW 1.0kHz
SWP 130sec

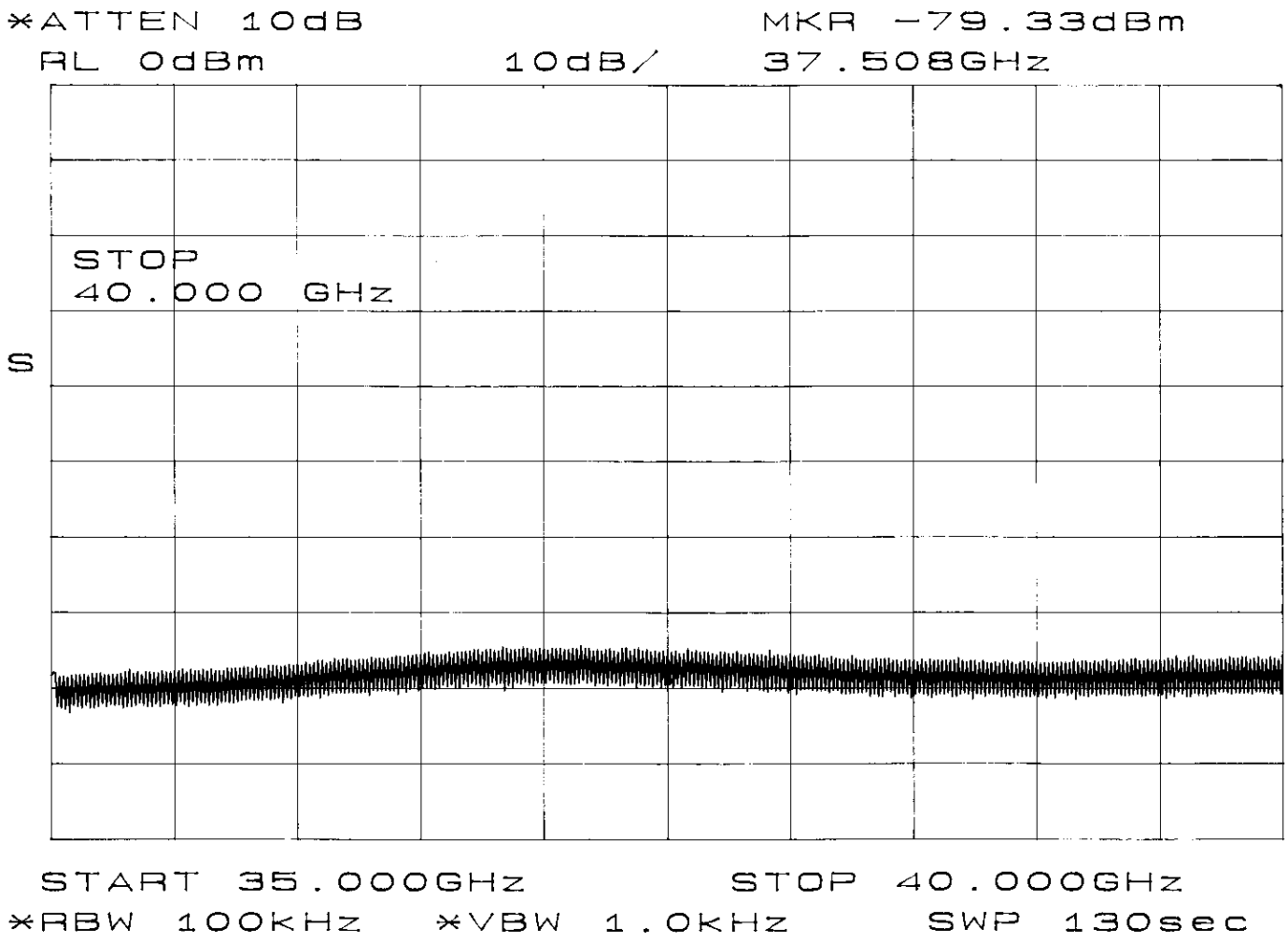

*ATTEN 10dB
MKR -79.50dBm
RL 0dBm
10dB/
37.508GHz
STOP
40.000 GHz
S
START 35.000GHz
STOP 40.000GHz
*RBW 100kHz
*VBW 1.0kHz
SWP 130sec


*ATTEN 10dB
MKR -87.83dBm
RL 0dBm
10dB/
19.003GHz
STOP
20.000 GHz
S
START 18.000GHz
STOP 20.000GHz
*RBW 100kHz
*VBW 1.0kHz
SWP 50.0sec


*ATTEN 10dB
MKR -87.17dBm
RL 0dBm
10dB/
22.508GHz
STOP
25.000 GHz
S
START 20.000GHz
STOP 25.000GHz
*RBW 100kHz
*VBW 1.0kHz
SWP 130sec


*ATTEN 10dB
MKR -83.50dBm
RL 0dBm
10dB/
27.508GHz
STOP
30.000 GHz
S
START 25.000GHz
STOP 30.000GHz
*RBW 100kHz
*VBW 1.0kHz
SWP 130sec


*ATTEN 10dB
MKR -78.17dBm
RL 0dBm
10dB/
32.508GHz
STOP
35.000 GHz
S
START 30.000GHz
STOP 35.000GHz
*RBW 100kHz
*VBW 1.0kHz
SWP 130sec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RL 0dBm
10dB/
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STOP
40.000 GHz
S
START 35.000GHz
STOP 40.000GHz
*RBW 100KHz
*VBW 1.0KHz
SWP 130sec