

FCC Part 24(E) Test Report
for
Sierra Wireless, Inc.
on the
CDMA Transceiver
Model: AIRCARD 510
FCC ID: N7NACRD510

Test Report: J20007760A

Date of Report: March 20, 2000



NVLAP Laboratory Code 200201-0
Accredited for testing to FCC Parts 15

Tested by:	<i>Xi-Ming Yang</i>	Xi-Ming Yang
Reviewer:	<i>David Chernomordik</i>	David Chernomordik

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1 JOB DESCRIPTION

1.1 Client Information

The EUT has been tested at the request of

Company: Sierra Wireless, Inc.
 # 150-13575 Commerce Parkway
 Richmond, B.C.
 Canada V6V 2L1

Name of contact: Mr. Dominique Kwong
Telephone: (604) 231 1181
Fax: (604) 231 1109

1.2 Equipment under test (EUT)

Equipment type: CDMA Transceiver
Equipment class: Licensed Portable Transmitter (Held to ear)
Model number(s): AIRCARD 510
FCC ID: N7NACRD510
Manufacturer: SAME as above.
Use of Product : Data communications
Production is planned: Yes, No

Technical Specifications:

Type of Emission	
Modulation	CDMA
Range of RF Output	0.3 W (Peak EIRP)
Means for variation of operating power	Continuously variable
The dc voltage applied to and current into the several elements of the final RF amplifying device	Collector Voltage: Vdc Collector Current: mA
Frequency Range	1851 to 1909 MHz
Max. number of Channels	
Antenna	1/2λ whip
Detachable antenna ?	No
External input	Audio
Frequency Tolerance	ppm

EUT receive date: 2/11/00
 EUT received condition: Good condition prototype
 Test start date: 2/11/00
 Test end date: 3/11/00

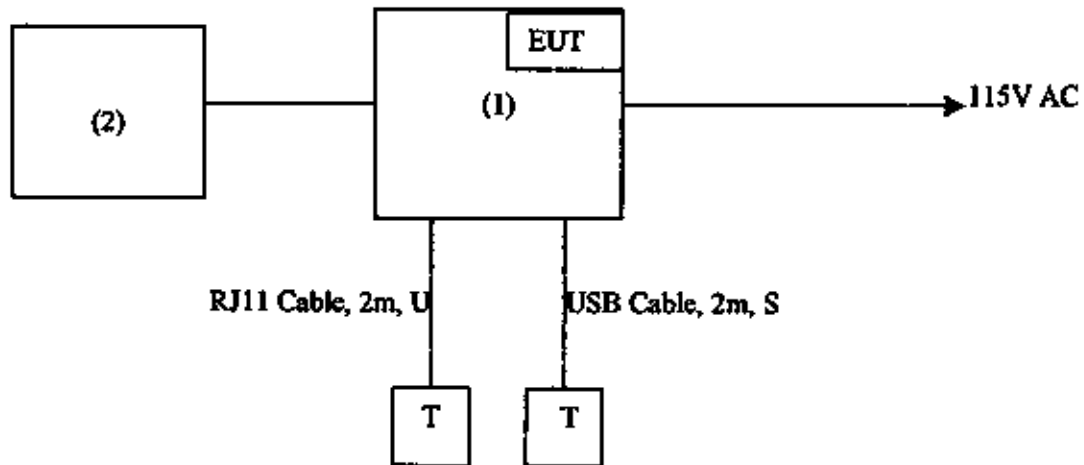
1.3 Test plan reference

FCC Part 2.1033, FCC Part 24 (E)

1.4 System test configuration

1.4.1 System block diagram & Support equipment

The diagram shown below details the placement of the equipment under test on the turntable.



S: Shielded	U: Unshield	F: With Ferrite Core
--------------------	--------------------	-----------------------------

Support Equipment					
Equip. #	Equipment	Manufacturer	Model #	S/N #	FCC ID
1	Computer	HP	F1260A	F1200-80055	DOC
2	Monitor	Dell Computer	D1428-HS	02922CV22495	GWGPM04EIX

1.4.2 Justification

The system was configured for testing in a typical manner in accordance with ANSI C63.4 standard.

1.4.3 Mode(s) of operation

The EUT was operating at continuous transmitting mode.

1.5 Modifications required for compliance

No modifications were implemented by Intertek Testing Services.

2 TEST SUMMARY

FCC RULE	DESCRIPTION OF TEST	RESULT	PAGE
Transmitter Section			
2.1046 24.232(b)	RF Power Output (Effective Isotropic Radiated Power)	Pass	6
2.1047	Modulation Characteristics	N/A	N/A
2.1049	Occupied Bandwidth	N/A	N/A
2.1051	Spurious Emission at Antenna Terminal	Pass	9
2.1053 24.236	Field Strength of Spurious Radiation	Pass	
2.1055 24.235	Frequency Stability Vs. Temperature Frequency Stability Vs. Voltage	Test was not requested by client	10
15.107	Line Conducted Emissions	*	DoC
Digital Section			
15.109(a)	Radiated Emissions	*	DoC

*Refer to DoC Report

3 EFFECTIVE RADIATED POWER

3.1 Test Description

Parameter:	FCC § 2.1046
Requirement:	FCC § 24.232(b)
Equivalent Isotropic Radiated Power (EIRP)	< 2 watts peak

3.2 Test Procedure

The EUT was positioned on a non-conductive turntable, 0.8m above the ground plane on an open test site.

The radiated emission at the fundamental frequency was measured at 3m distance with a test antenna and spectrum analyzer. During the measurement, the resolution and video bandwidth of the spectrum analyzer were set to 1 MHz. To maximize emissions, the system was rotated through 360°, the antenna height was varied from 1m to 4m, and the antenna polarization was changed.

The ERP was calculated using equation:

$$E = \frac{\sqrt{30 \cdot P \cdot G}}{D}$$

Where E = Field Strength (V/m),

D = Distance between two antennae (m)

G = Numeric Gain of Antenna (1 for isotropic antenna),

EIRP = P for G = 1

3.3 Test Results

See attached.

3.4 Modifications made during testing

None

3.5 Test Instrumentation

Hewlett Packard HP8566B Spectrum Analyzer (S.A.)

EMCO 3115 Horn Antenna

HP Pre-amp

4 MODULATION CHARACTERISTICS

4.1 Test Description

Parameter:	FCC § 2.1047
Requirement:	Not Applicable

5 OCCUPIED BANDWIDTH**5.1 Test description**

Parameter:	FCC §2.1049
Requirement:	FCC § 24.238
Emission Bandwidth Limits:	Not Applicable

5.2 Test Procedure

The antenna was disconnected from the transmitter and the short cable was connected to the transmitter RF output.

The RF output was connected to the input of the spectrum analyzer through sufficient attenuation. The resolution bandwidth (RBW) of the spectrum analyzer was set up to at least 1 MHz inside the frequency block. In the 1 MHz bands immediately outside and adjacent to the frequency block, the RBW may be reduced to at least 1% of emission bandwidth of the fundamental emission.

5.3 Test Results

Not applicable

5.4 Modifications made during testing

None

5.5 Test instrumentation

Leader LFG-1300S Function Generator

HP 8566B Spectrum Analyzer

HP 7470A Plotter

6 SPURIOUS EMISSION AT ANTENNA TERMINALS**6.1 Test description**

Parameter:	FCC §2.1051
Requirement:	FCC § 24.238
Emission Limits:	43 + 10log (P) dB

6.2 Test Procedure

The antenna was disconnected from the transmitter and the short cable was connected to the transmitter RF output.

The RF output was connected to the input of the spectrum analyzer through sufficient attenuation.

6.3 Test Results

See attached plots for the antenna conducted spurious emission :

Plot Number	Description
L.1-L.7	Low Channel, 1 MHz – 20 GHz
M.1-M.6	Middle Channel, 1 MHz – 20 GHz
H.1-H.8	High Channel, 1 MHz – 20 GHz

6.4 Modifications made during testing

None

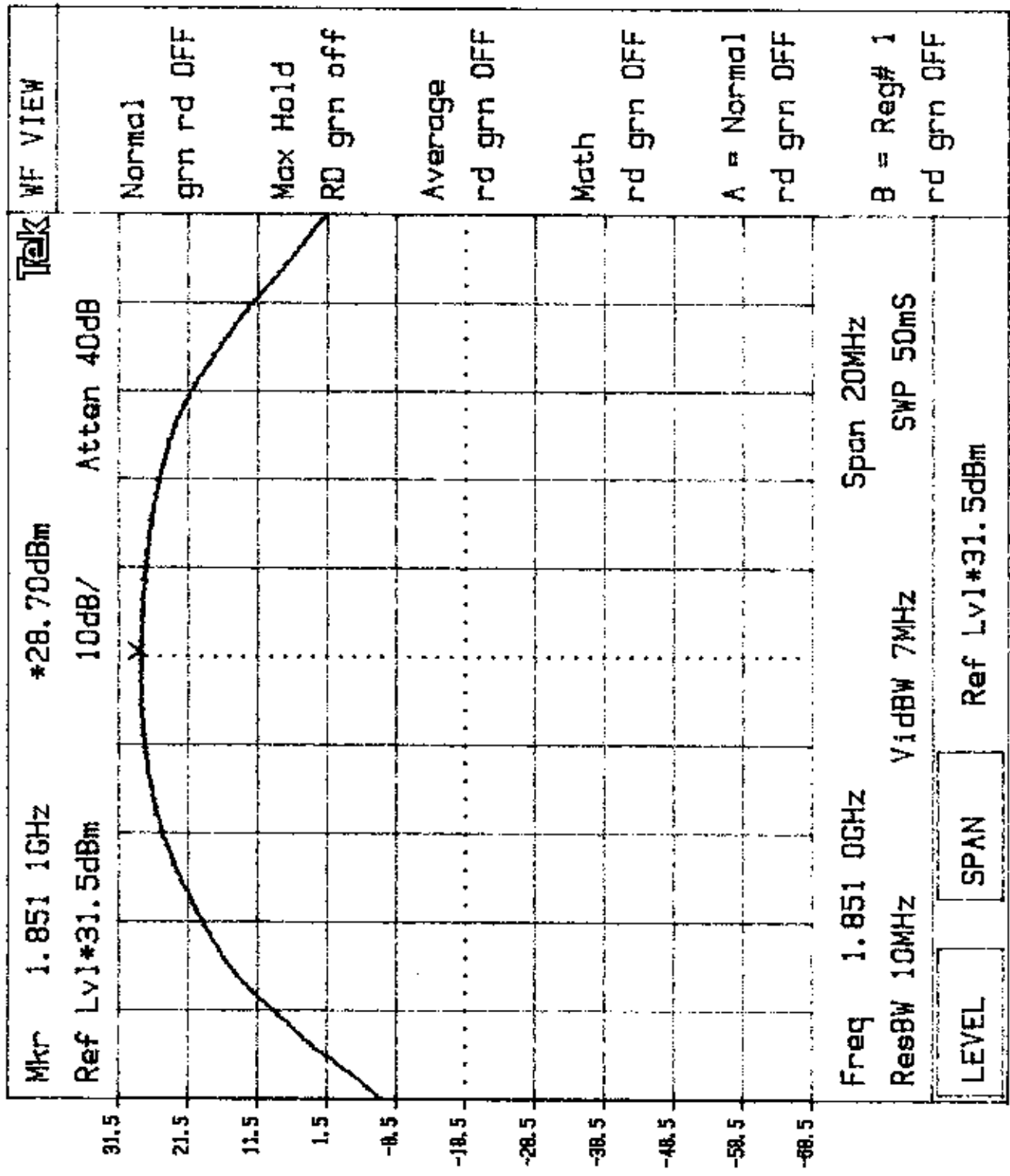
6.5 Test instrumentation

[X] Leader LFG-1300S Function Generator

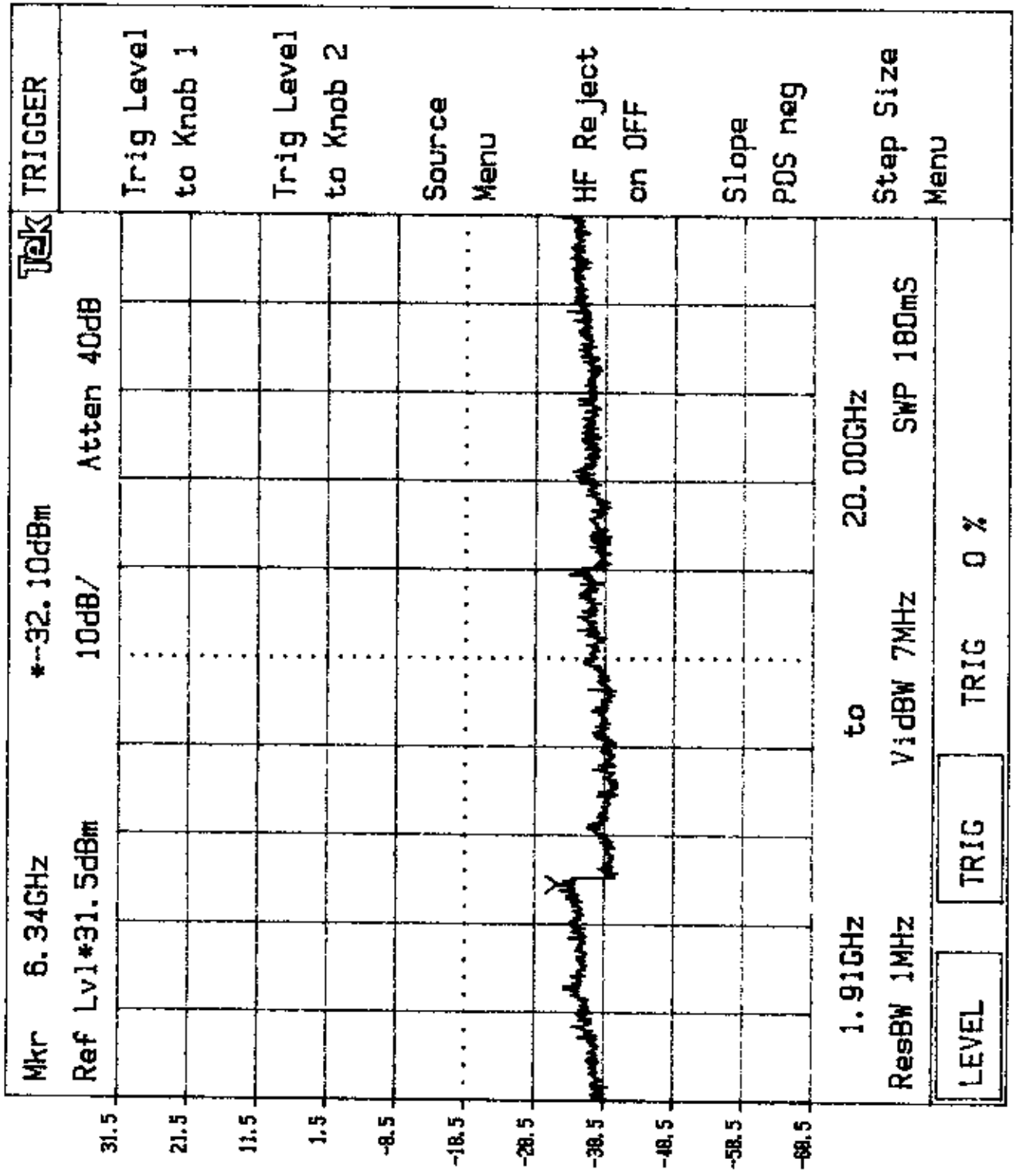
[X] HP 8566B Spectrum Analyzer

[X] HP 7470A Plotter

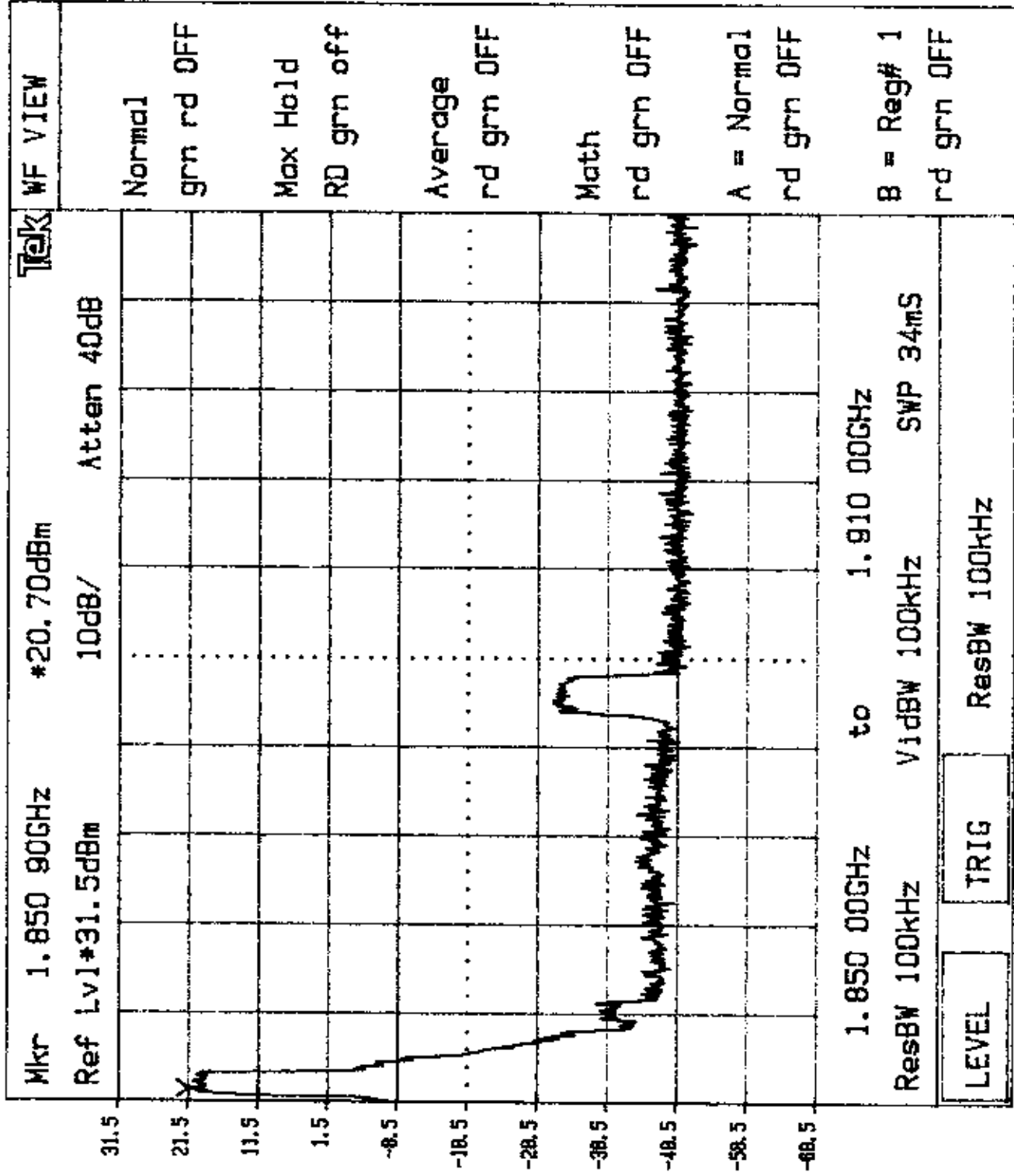
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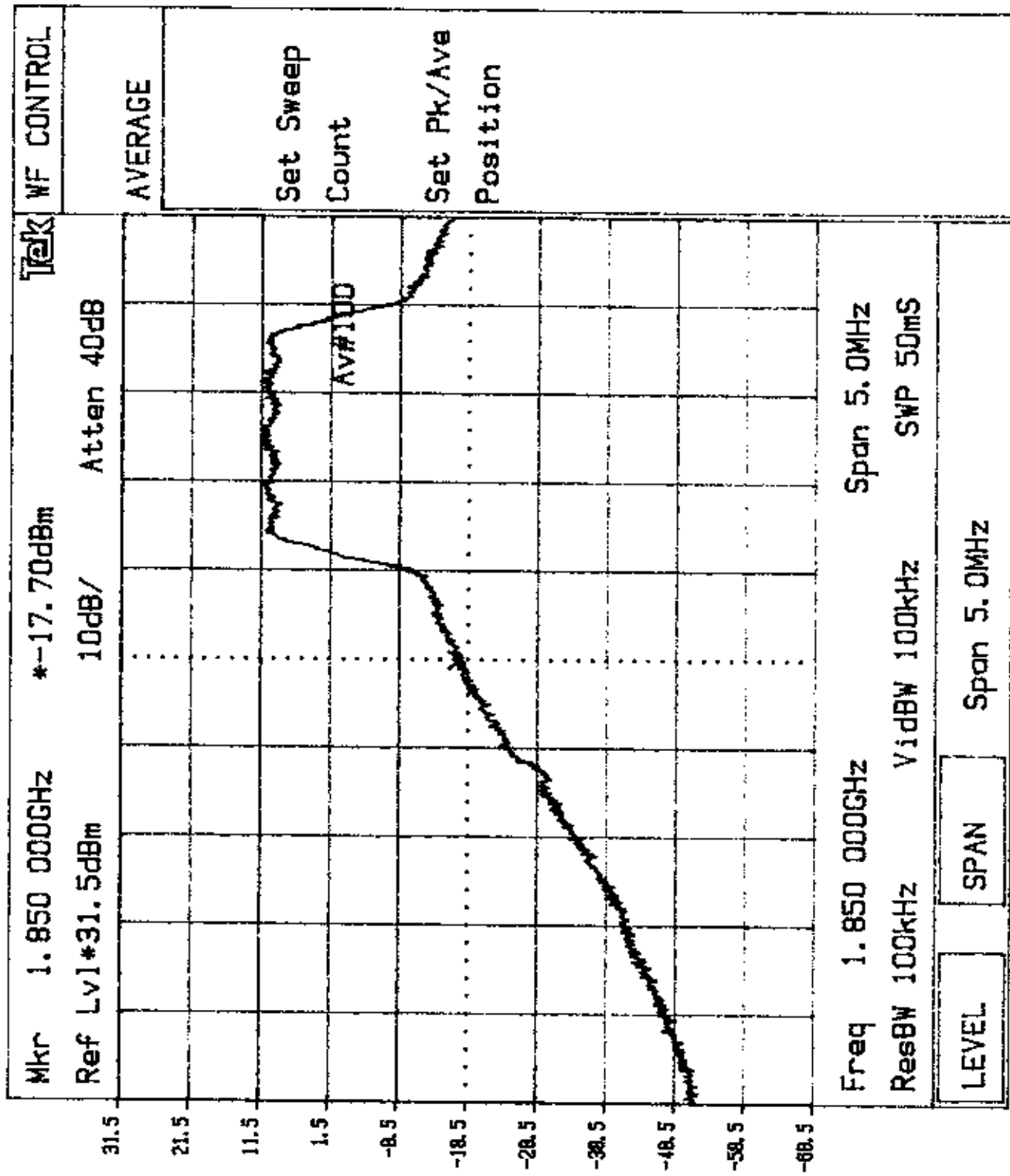
L.2



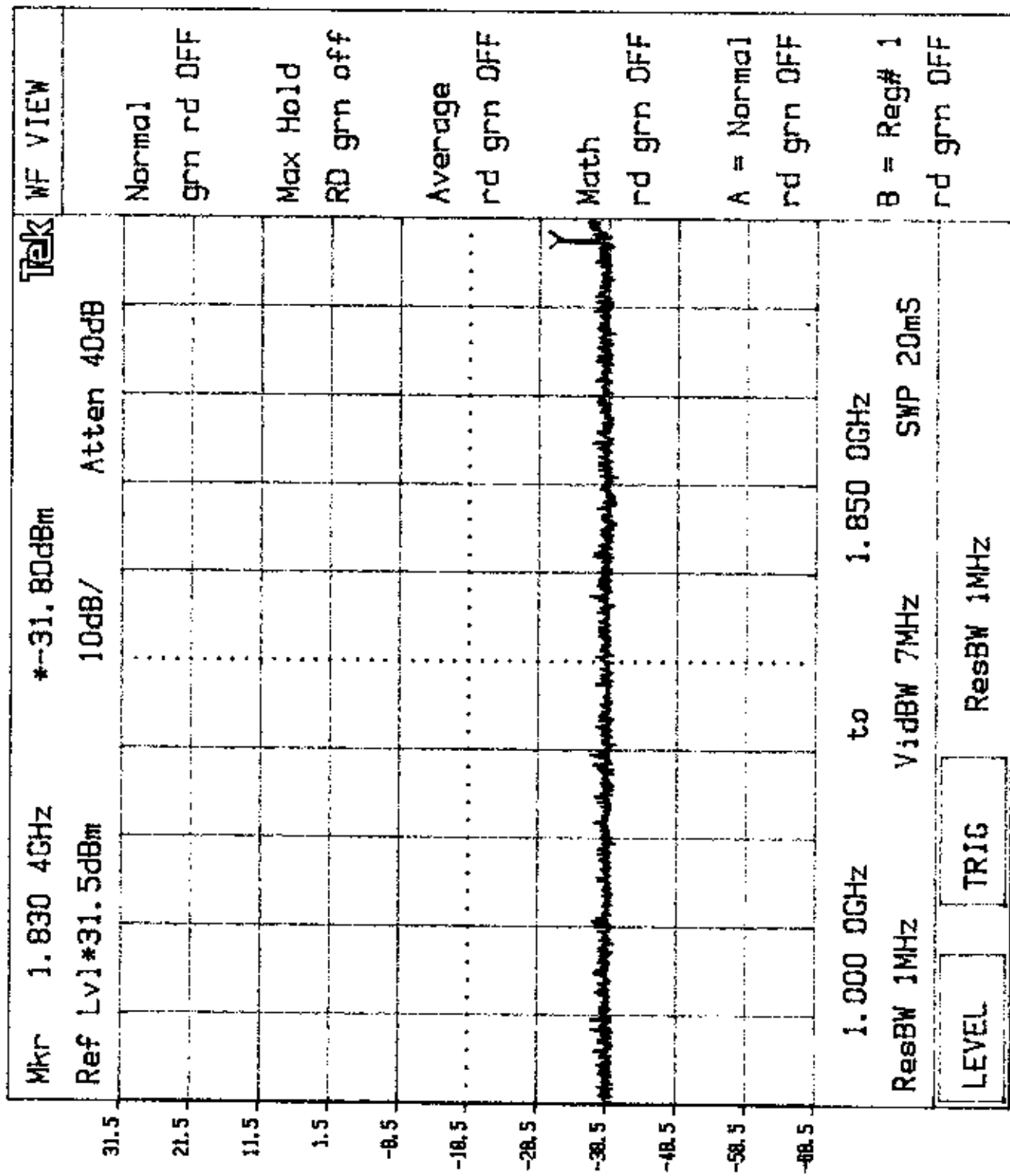
L.3



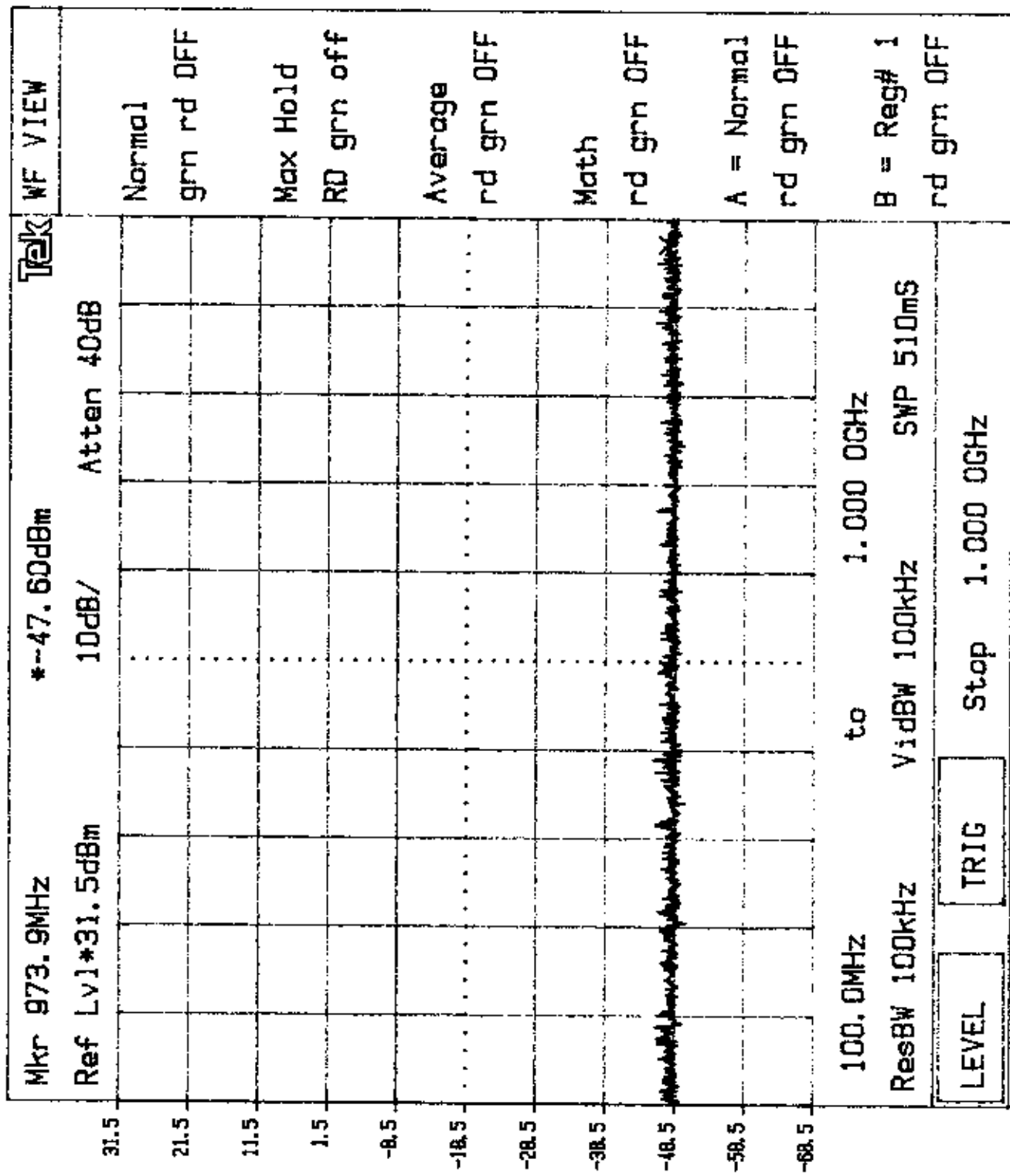
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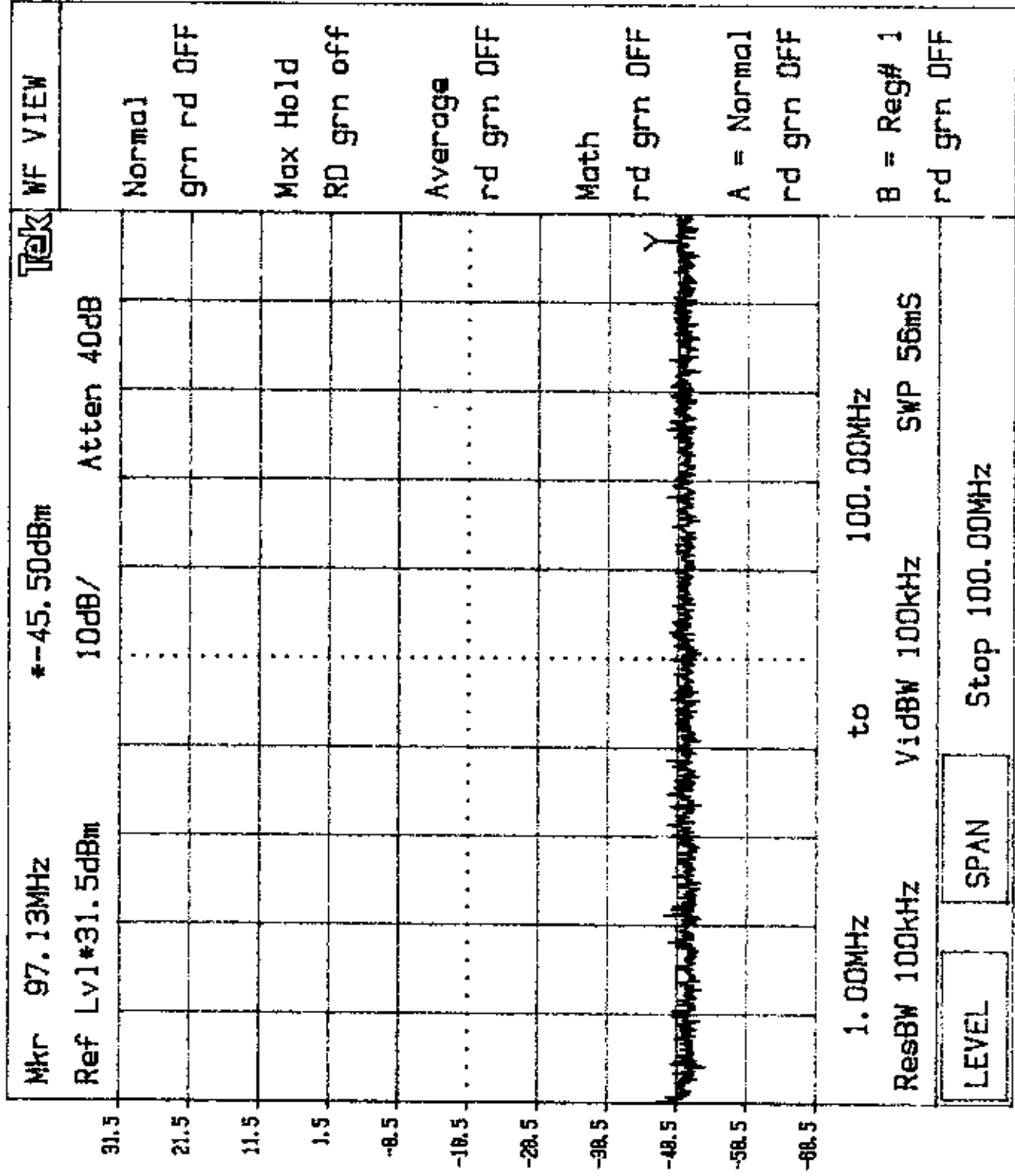
L.S



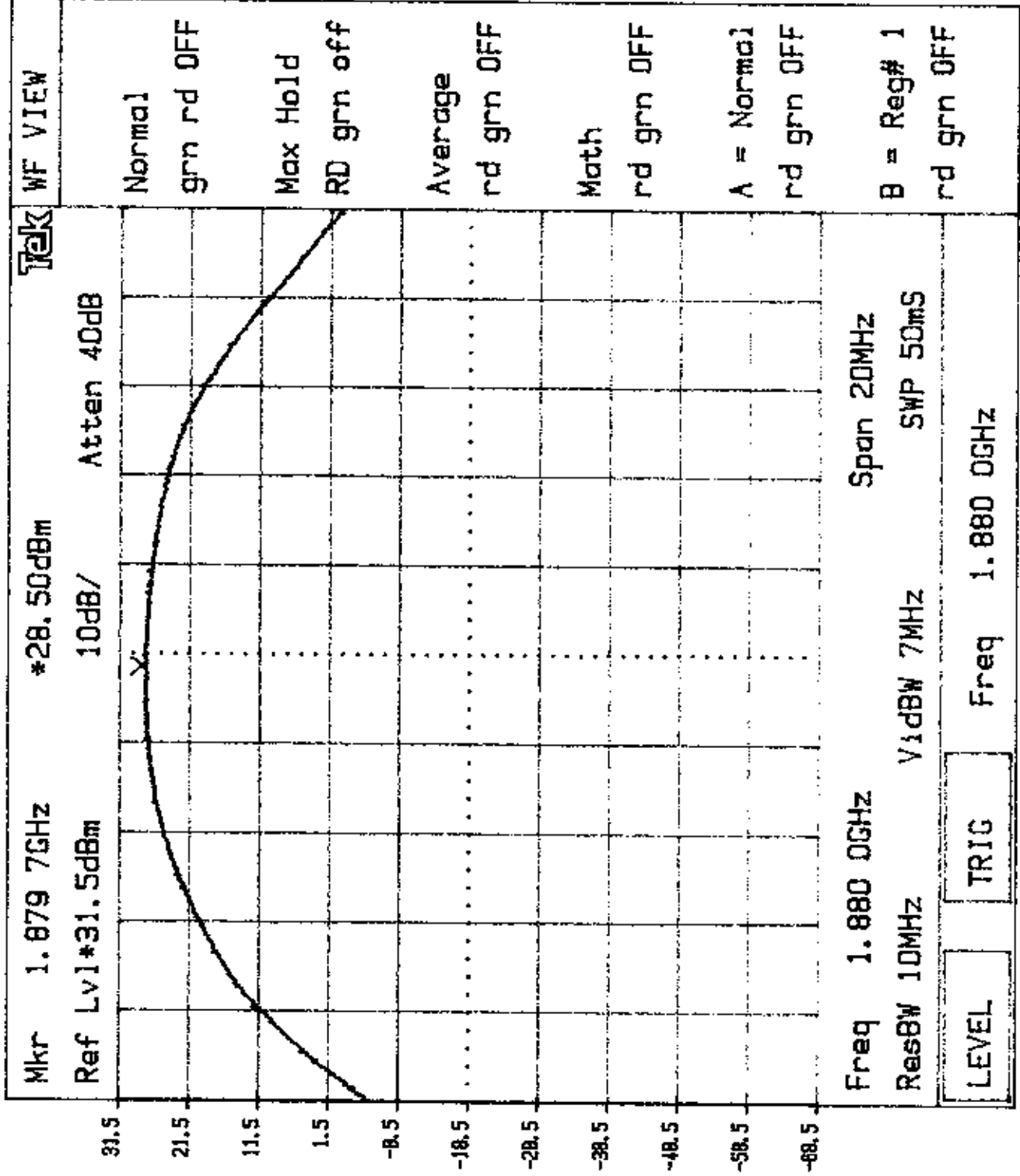
L.6



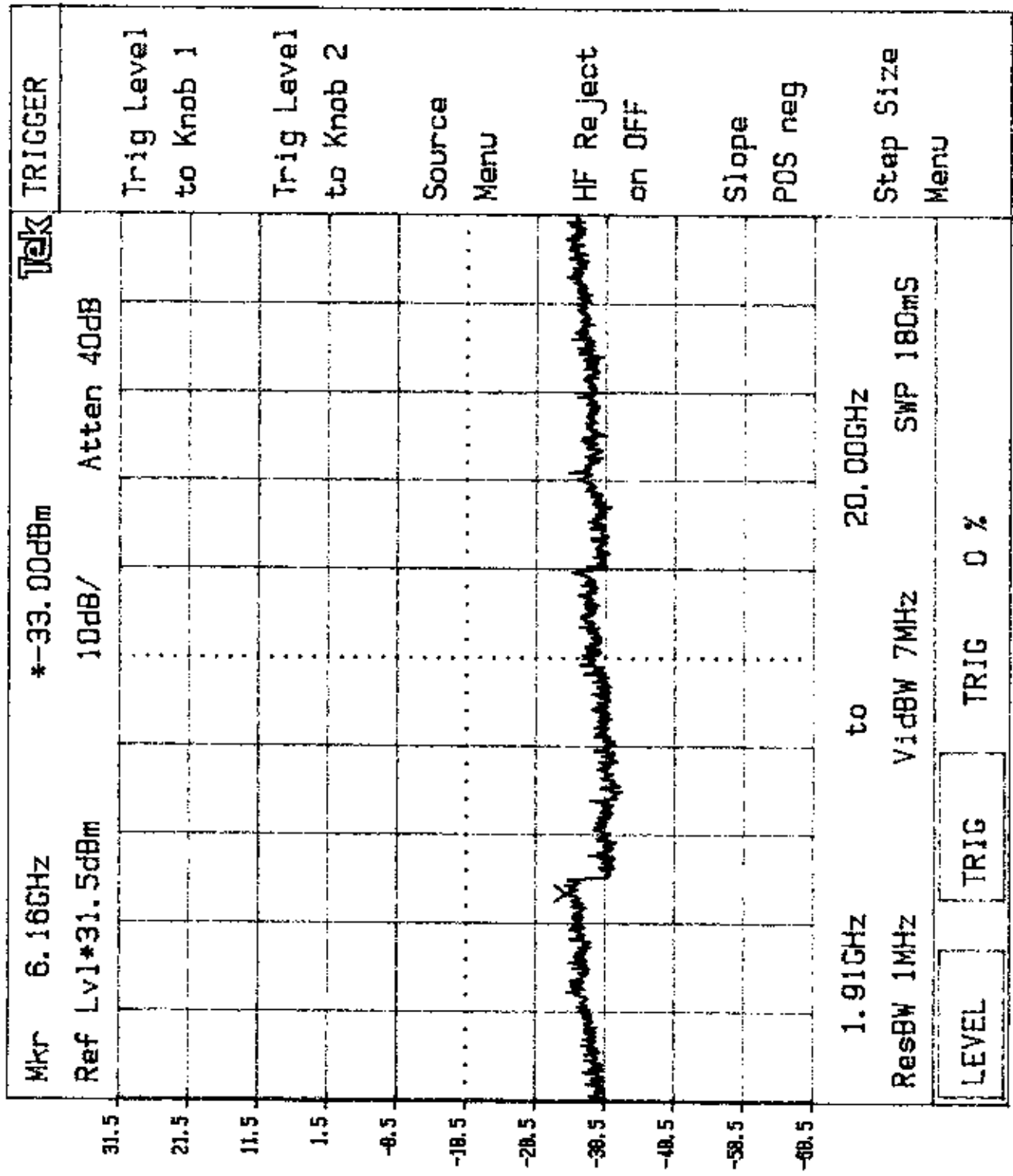
L.7



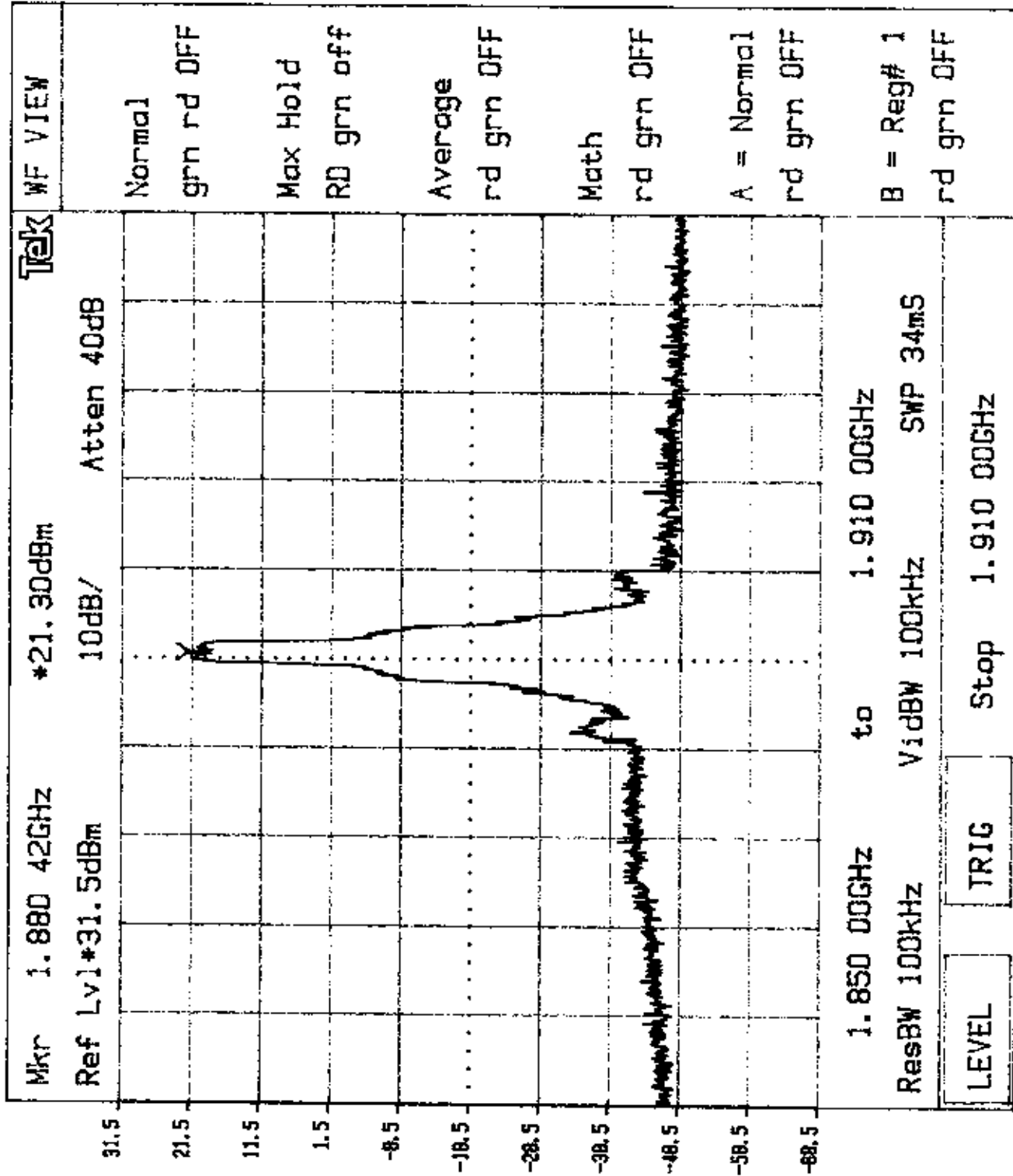
M. 1



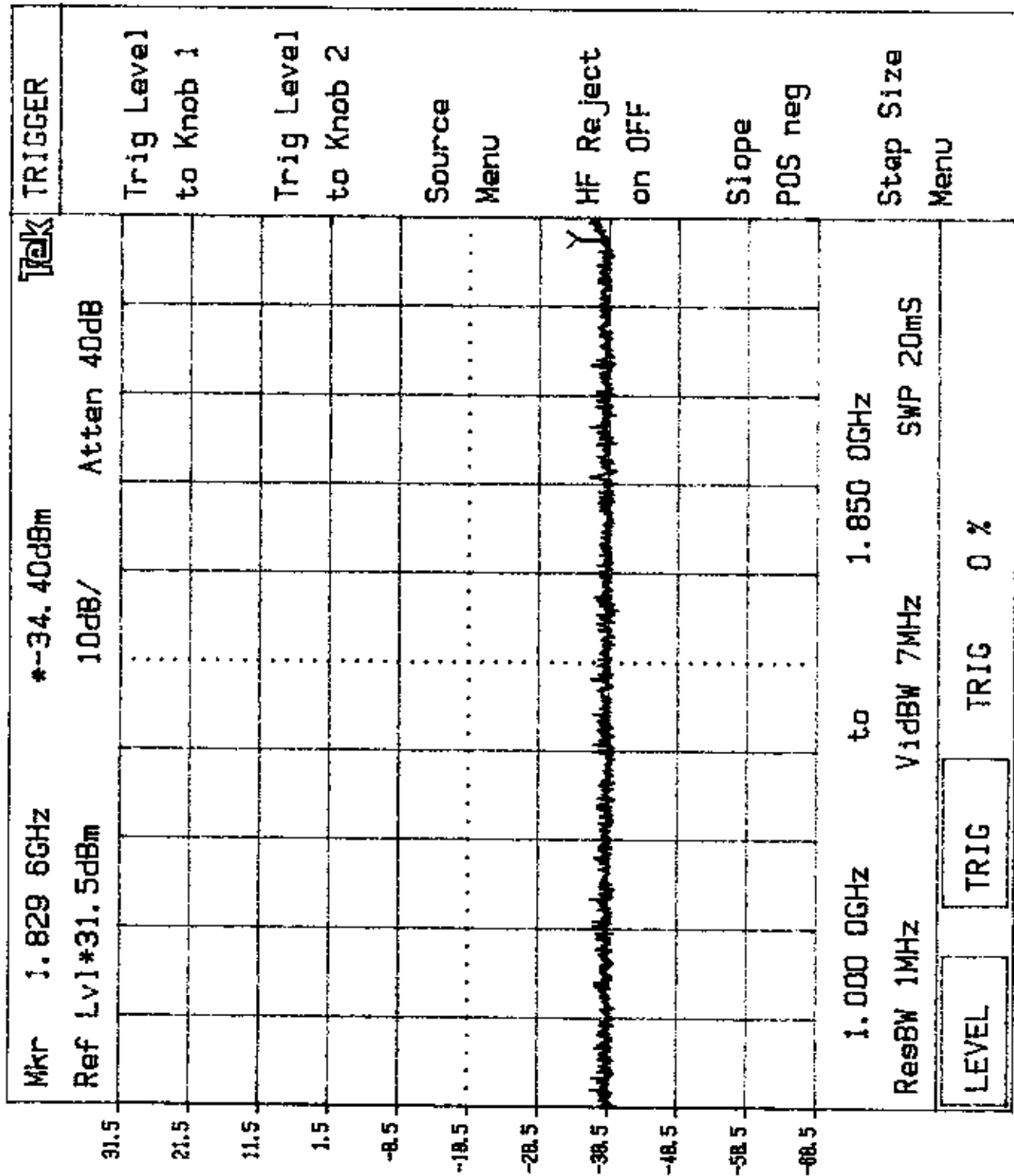
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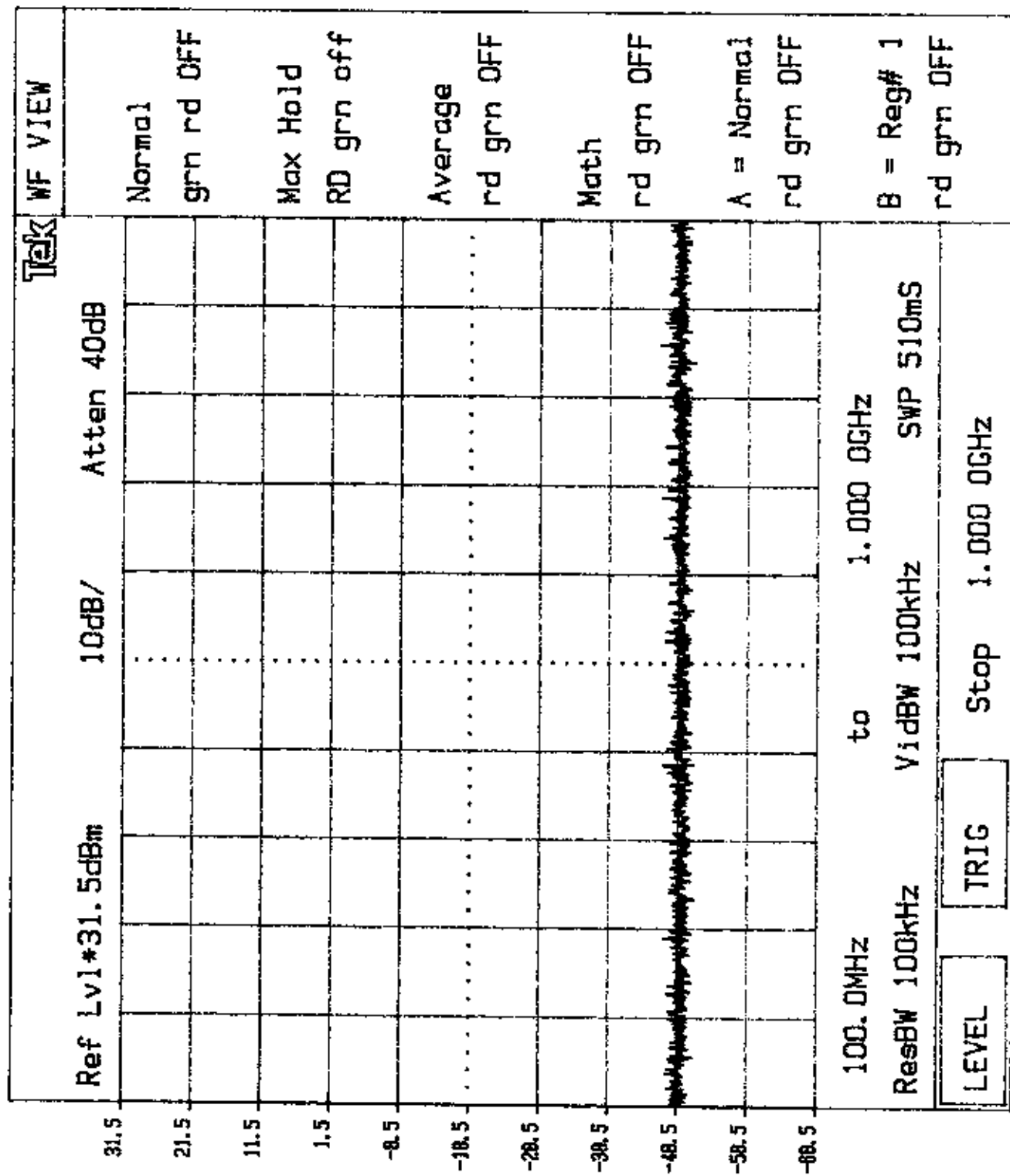
M. 3



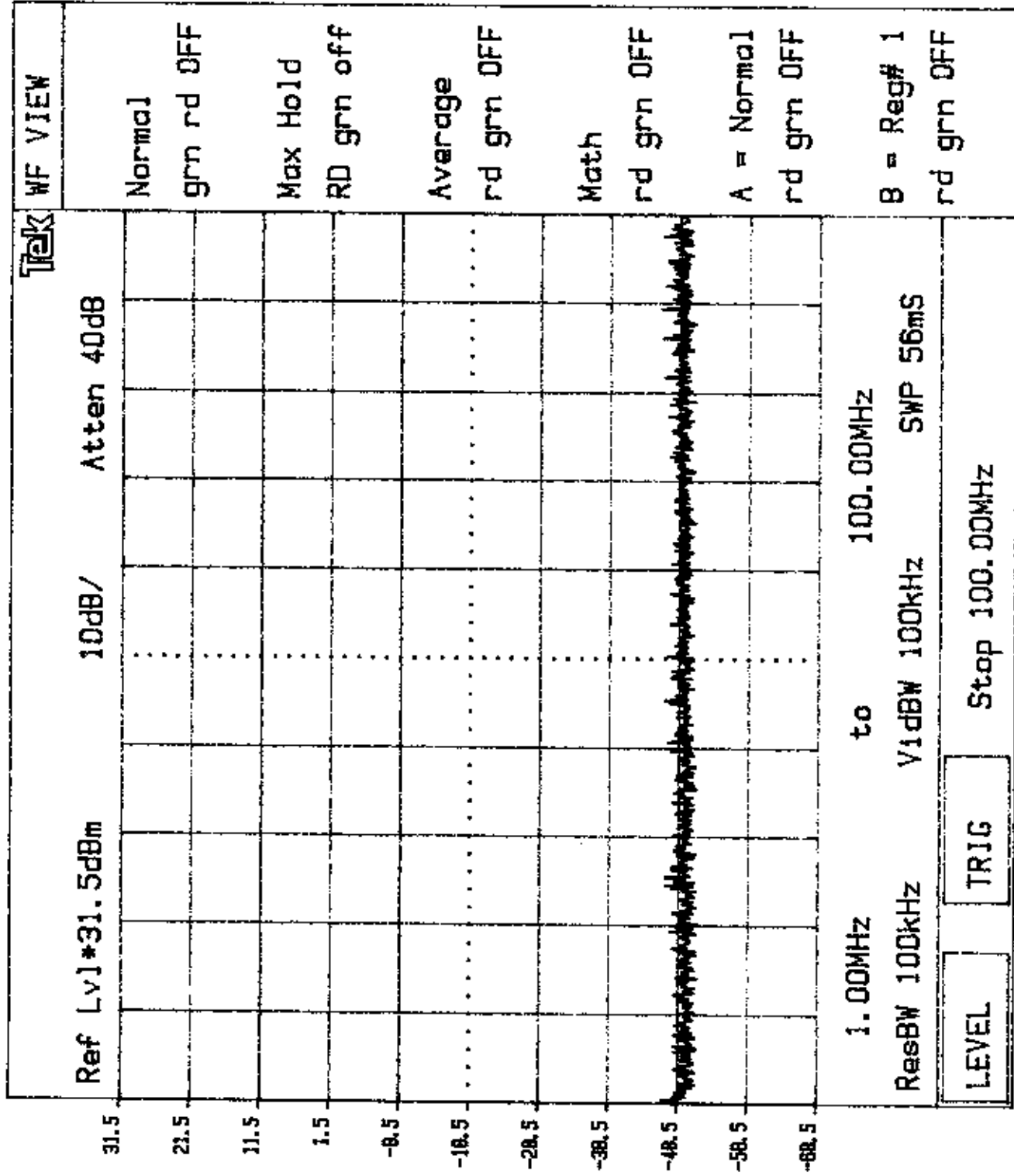
M, 4



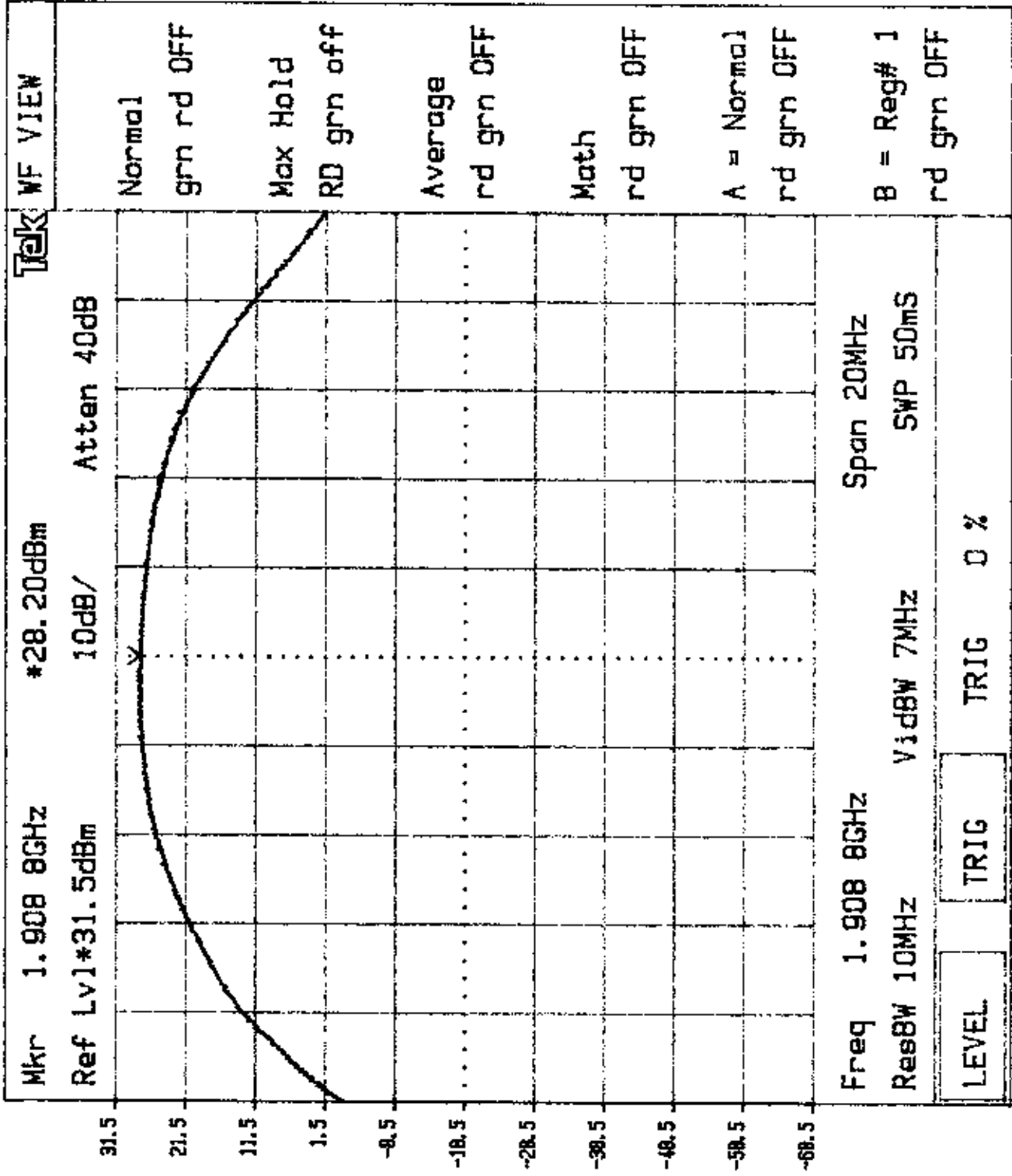
M.S



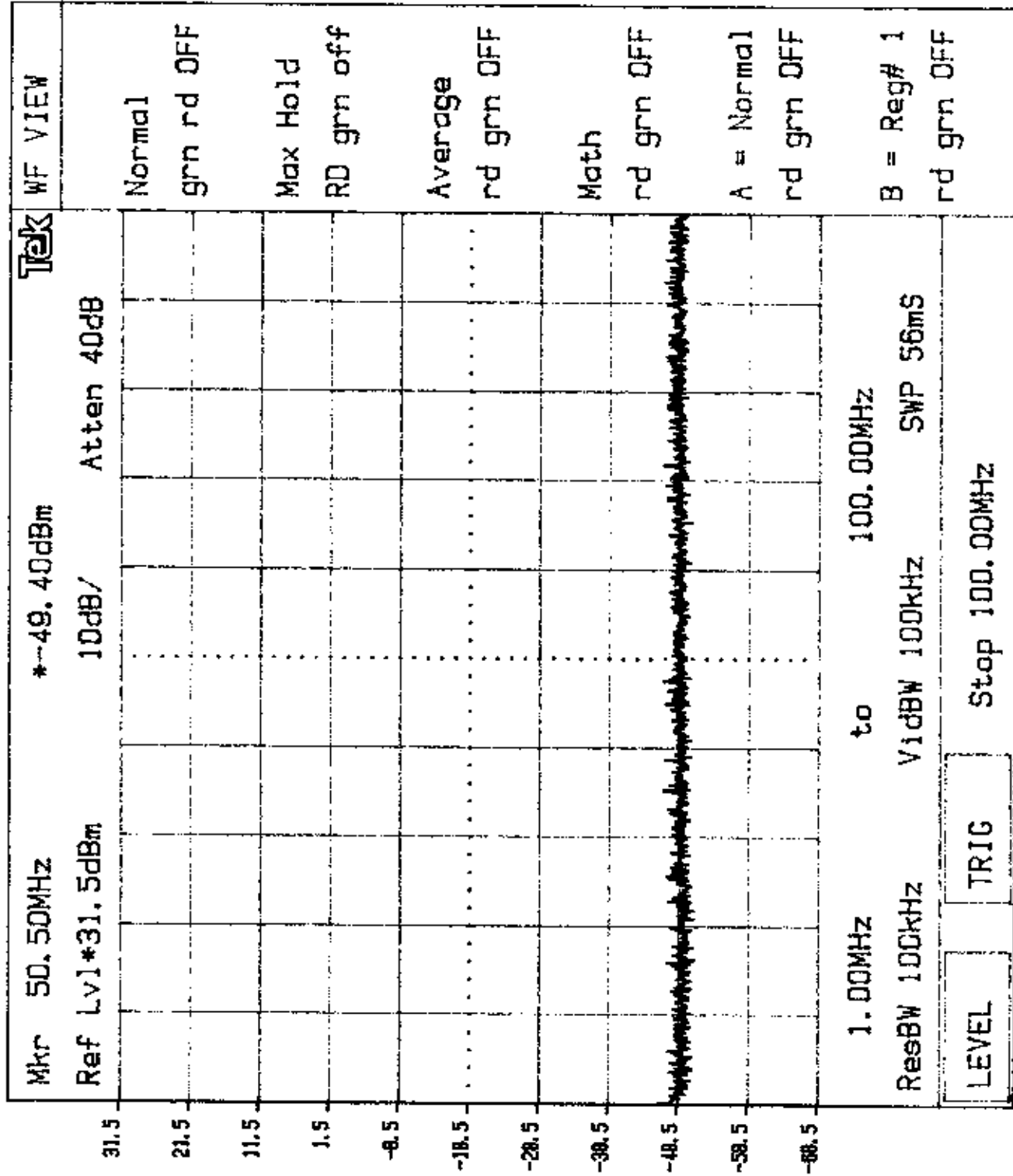
M. 6



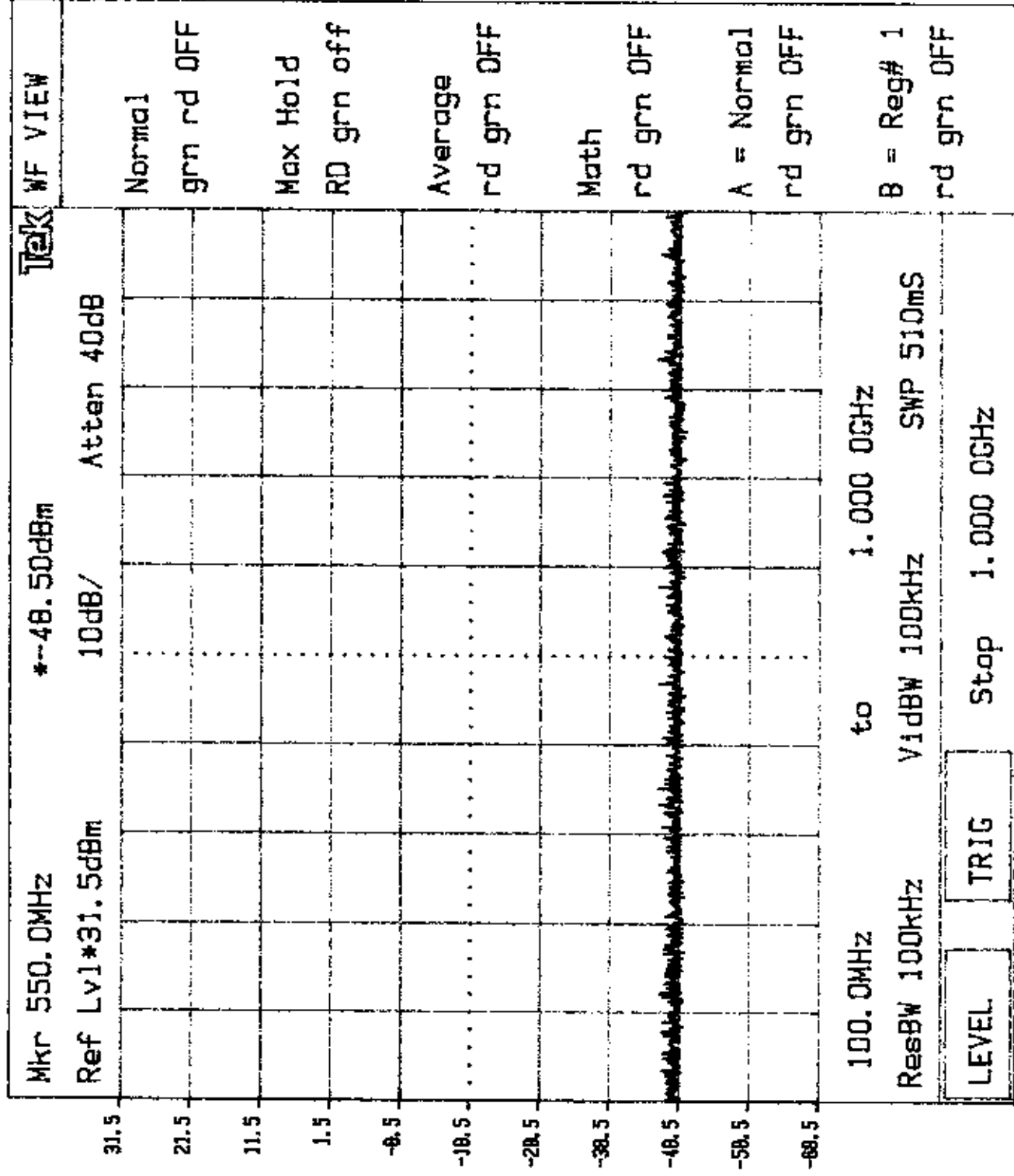
H.1



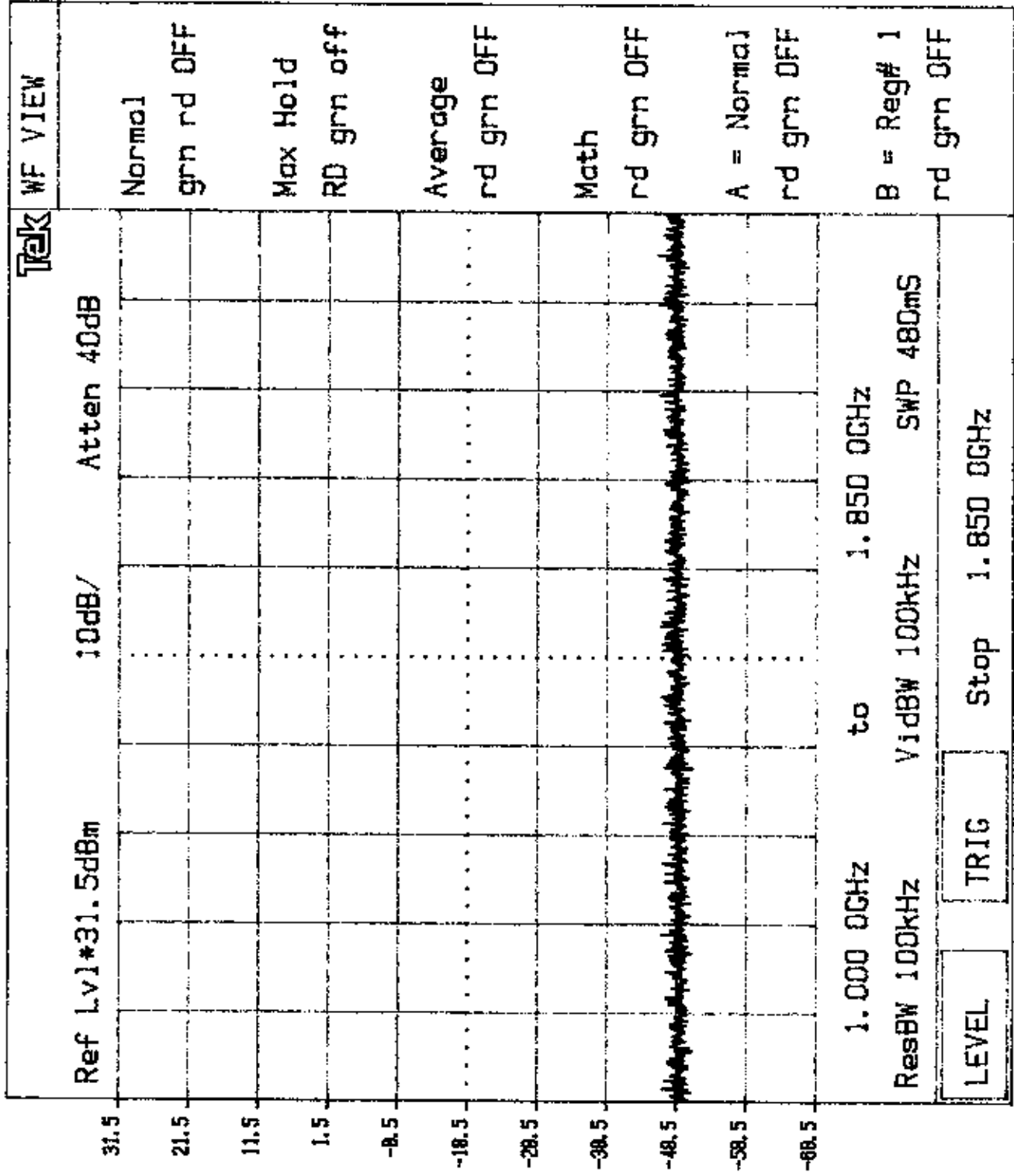
H. 2



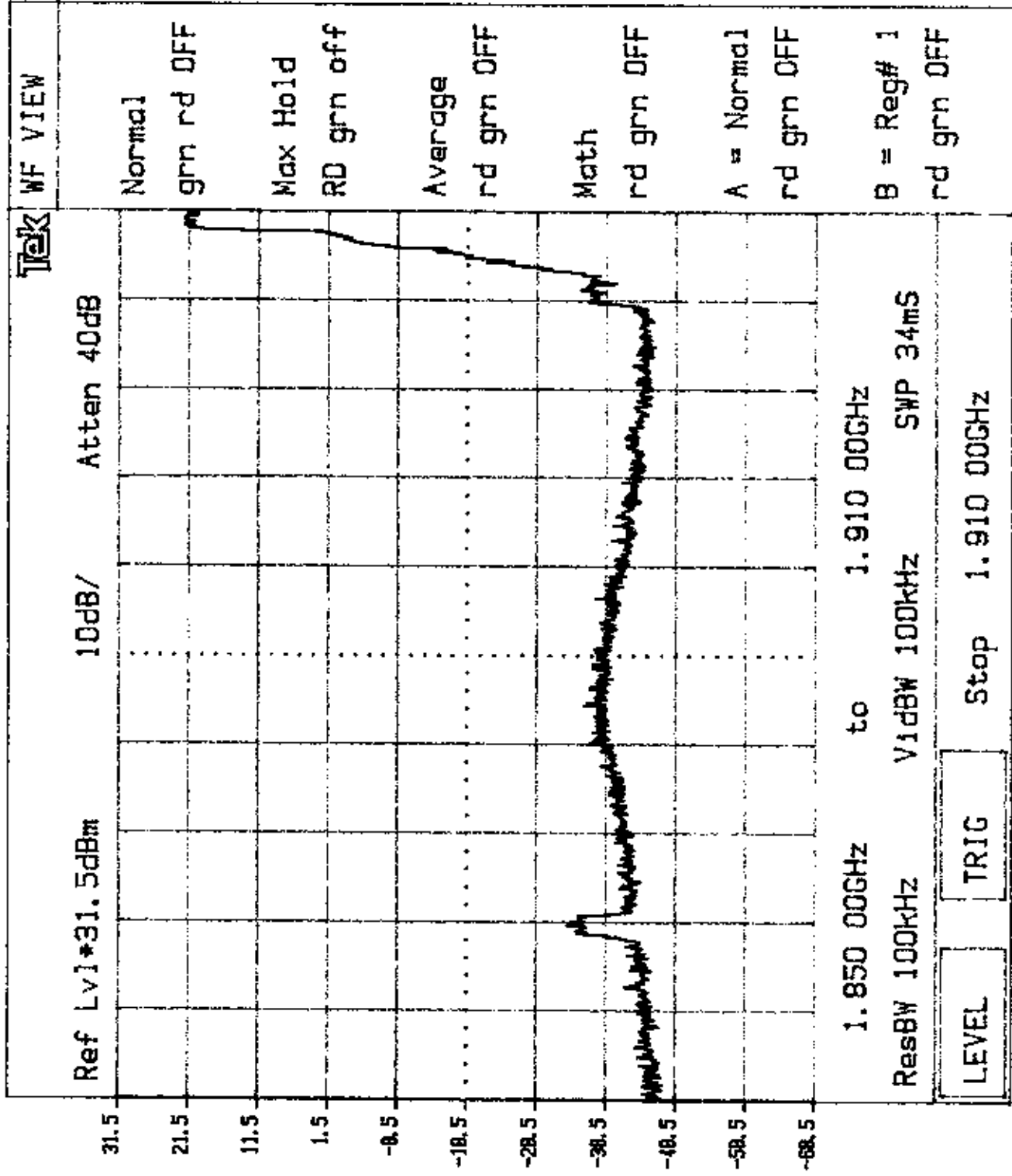
H.3



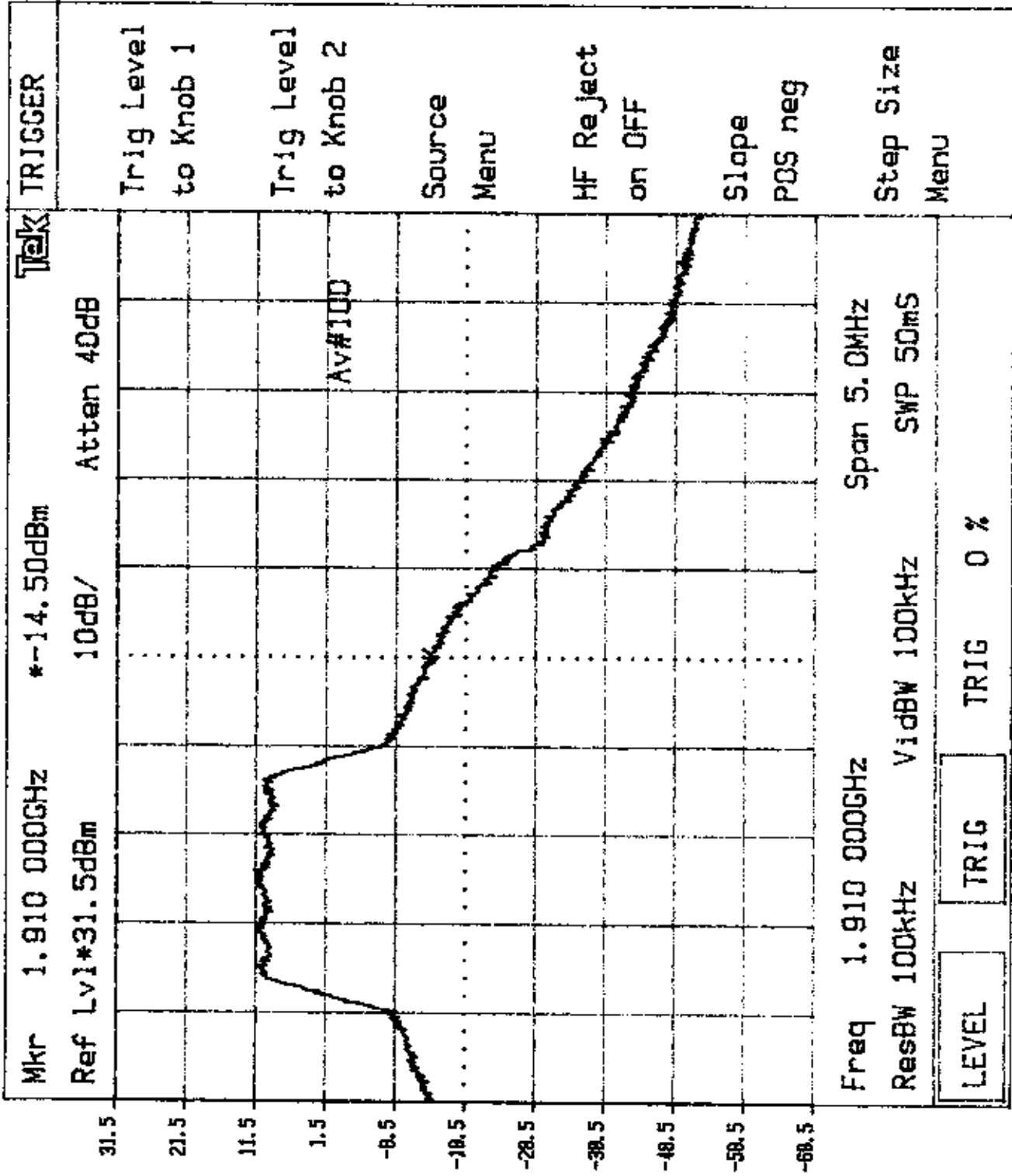
H.4



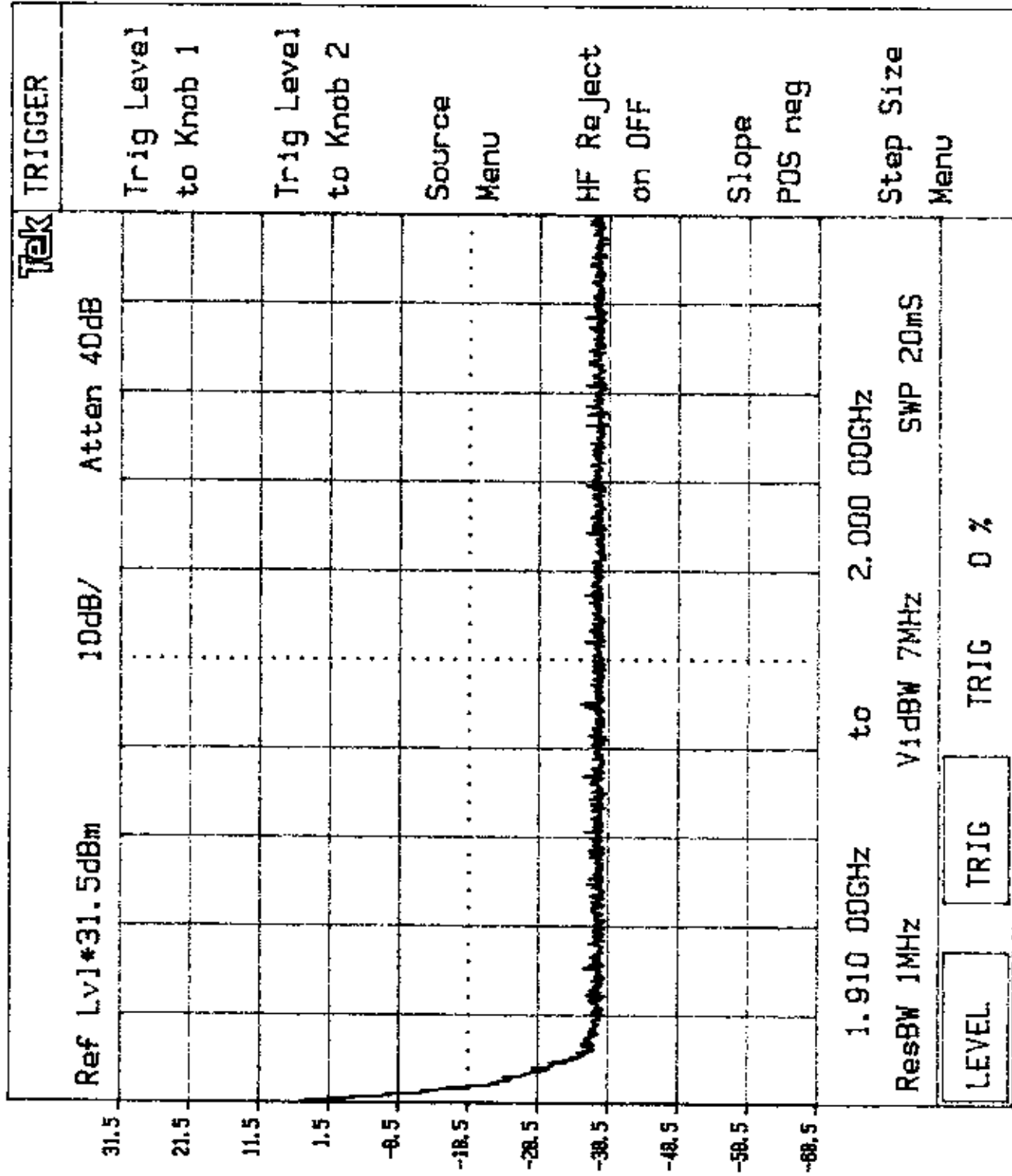
H.S



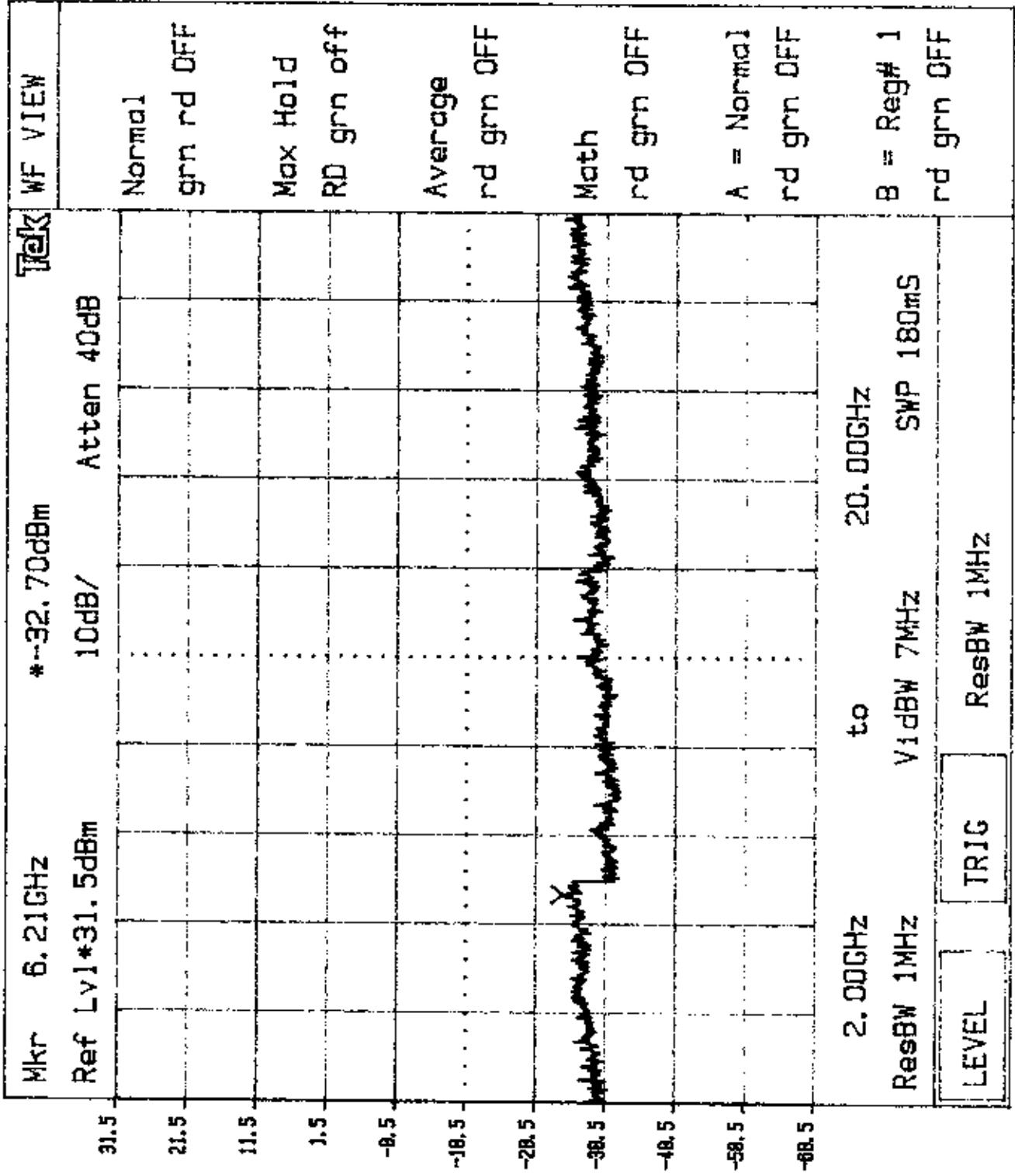
H.6



H.7



H.8



7 RADIATED SPURIOUS EMISSIONS**7.1 Test description**

Parameter:	FCC §2.1053
Requirement:	FCC § 24.236, § 24.238
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7.2 Test Procedure

The transmitter was placed on a wooden turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3 orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated, with measurement equipment RBW setting at 1 MHz.

The spurious harmonic attenuation was calculated as the difference between E in dB(uV/m) at the fundamental frequency and at the spurious emission frequency.

Spurious attenuation in dB = $43 + 10\text{Log}_{10}(\text{Power in Watts})$

7.3 Test Results

Please see the following pages for:

- Spurious harmonic attenuation
- FCC Part 15.109 Radiated Emission

7.4 Modifications made during testing

None

7.5 Test instrumentation

- CDI B100/200/300 Biconical Antennas
- EMCO Bi-logcon Antenna
- EMCO 3115 Horn Antenna
- HP 8566B Spectrum Analyzer
- Preamplifiers

ITS Intertek Testing Services

Radiated Emissions Test Data

Compan Y:	Sierra	Model #:		Reg:	FCC 2,993
EUT:		S/N or FCC #:		Test Dist:	3 meter
Project #:		Test Date:	February 11, 2000	TP:	0.10 Watt
Test Mode:		Engineer:	Xi Ming Y.	Min. Attn:	33.50 dBc

Number:	Antenna Used			Pre-Amp Used			Cable Used			Transducer Used
	2	14	21	0	8	13	0	0	12	0
Model:	EMCO 013	EMCO 013	EMCO 013	None	001 P1000	ACC 400	None	None	Gen. Mat.	None

Frequen- cy (MHz)	Reading (dBu)	Detector (Peak/Ave)	Ant. Amp (dB)	Ant. Pol (V)	Ant. Factor (dB/m)	Pre-Amp (dB)	Insert. Loss (dB)	Net (dBu/m)	ERP (mW)	EIRP (mW)	Margin (dB)
1851.29	93.2	Peak	8	0	V	27.2	0.0	2.1	122.5	3.25E+02	533
1851.29	90.8	Ave.	8	0	V	27.2	0.0	2.1	120.1	1.87E+02	307
1880.00	93.3	Peak	8	0	V	27.2	0.0	2.1	122.6	3.33E+02	546
1880.00	90.2	Ave.	8	0	V	27.2	0.0	2.1	119.5	1.63E+02	267
1908.80	91.5	Peak	8	0	V	27.2	0.0	2.1	120.8	2.20E+02	361
1908.80	89.0	Ave.	8	0	V	27.2	0.0	2.1	118.3	1.24E+02	203

- Notes:**
- a) O.C.F.: Other Correction Factor
 - b) Insert. Loss = Cable A + Cable B + Cable C + Transducer.
 - c) Net = Reading + Antenna Factor - Pre-Amp + Insert. Loss.
 - d) Attn. = Field Strength (Fundamental) - Field Strength (Harmonics).
 - e) Negative signs (-) in Margin column signify levels below the limits.

Radiated Emissions Test Data

Company:	Sierra Wireless Inc.	Model #:	Aircard 510	Reg:	FCC 2.993
EUT:		S/N or FCC #:		Test Dist:	3 meter
Project #:		Test Date:	March 30, 2000	TP:	0.20 Watt
Test Mode:	Tx@Lo W	Engineer:	Xi Ming Y.	Min. Attn:	36.01 dBc

	Antenna Used			Pre-Amp Used			Cable Used			Transducer Used	
Number:	2	21	8	13	8	10	0	0	12	0	
Model:	EMCO 3145	3100-8	EMCO 3115	ADP400	CDL P1000	AET18085	None	None	Gen. Mat.	None	

Frequency	Reading	Detector	Ant. Amp		Ant. Pol.	Ant. Factor	Pre-Amp	Insert. Loss	Net	ERP	Attn.	Margin
MHz	dB(µV)	FREQ	#	#	H/V	dB(1m)	dB	dB	dB(µV/m)	mW	dBc	dB
1851.29	90.8	Ave.	8	0	V	27.2	0.0	2.1	120.1	1.87E+02	0.0	N/A
3702.28	40.0	Ave.	8	8	V	33.1	27.8	2.7	48.0	1.14E-05	72.2	-36.1
5553.28	31.6	Ave.	8	8	V	36.2	28.3	3.7	43.2	3.84E-06	76.9	-40.9
7405.22	42.6	Ave.	8	8	V	38.0	28.0	4.3	56.9	8.98E-05	63.2	-27.2
9256.41	34.0	Ave.	8	8	V	40.4	27.0	4.7	52.1	2.99E-05	68.0	-32.0
11107.49	40.0	Ave.	8	10	V	40.6	39.9	5.6	46.3	7.80E-06	73.8	-37.8
12958.49	31.0	Ave.	8	10	V	41.6	39.1	6.1	39.6	1.65E-06	80.6	-44.5
14809.49	28.8	Ave.	8	10	V	42.1	37.4	6.8	40.3	1.94E-06	79.9	-43.8
16660.49	28.8	Ave.	8	10	V	41.5	39.4	7.2	38.1	1.17E-06	82.1	-46.0
18511.49	26.0	Ave.	21	13	V	40.2	23.3	7.6	50.5	2.05E-05	69.6	-33.6

- Notes:**
- a) O.C.F. Other Correction Factor
 - b) Insert. Loss = Cable A + Cable B + Cable C + Transducer.
 - c) Net = Reading + Antenna Factor - Pre-Amp + Insert. Loss.
 - d) Attn. = Field Strength (Fundamental) - Field Strength (Harmonics).
 - e) Negative signs (-) in Margin column signify levels below the limits.

Radiated Emissions Test Data

Company	Sierra Wireless Inc.	Model #:	Aircard 510	Req	FCC 2.993
EUT:		S/N or FCC #:		Test Dist.	3 meter
Project #:		Test Date:	March 30, 2000	TP	0.20 Watt
Test Mode:	Tx@Mid Ch.	Engineer:	Xi Ming Y.	Min. Attn.	30.01 dBc

Number	Antenna Used			Pre-Amp Used			Cable Used			Transducer Used
	2	21	8	13	8	10	0	0	12	0
Model:	EMCO 3143	3160-3	EMCO 3115	ACO/400	CDI P1000	AFT1895S	None	None	Gra. Me-L	None

Frequency MHz	Reading dB(A)	Detector P/A/Q	Ant #	Amp #	Ant. Pol. H/V	Ant. Factor dB(1/m)	Pre-Amp dB	Insert. Loss dB	Net dB(μV/m)	ERP mW	Attn. dBc	Margin dB
1880.00	90.2	Ave.	8	0	V	27.2	0.0	2.1	119.5	1.63E+02	0.0	N/A
3760.00	40.3	Ave.	8	8	V	33.1	27.8	2.7	48.2	1.22E-05	71.3	-35.2
5640.00	30.6	Ave.	8	8	V	38.2	28.3	3.7	42.2	3.05E-06	77.3	-41.3
7520.00	42.8	Ave.	8	8	V	37.8	28.0	4.6	57.2	9.49E-05	62.4	-26.3
9400.00	30.0	Ave.	8	8	V	40.4	27.3	4.7	47.8	1.11E-05	71.7	-35.7
11280.00	41.5	Ave.	8	10	V	40.6	39.9	5.6	47.8	1.10E-05	71.7	-35.7
13160.00	37.5	Ave.	8	10	V	41.0	39.2	6.1	45.4	6.33E-06	74.1	-38.1
15040.00	31.4	Ave.	8	10	V	42.3	38.3	6.6	42.0	2.91E-06	77.5	-41.5
16920.00	30.0	Ave.	8	10	V	41.5	39.4	7.2	39.3	1.54E-06	80.3	-44.2
18800.00	26.0	Ave.	21	13	V	40.2	23.3	7.6	50.5	2.05E-05	69.0	-33.0

- Notes:**
- a) O.C.F. Other Correction Factor
 - b) Insert. Loss = Cable A + Cable B + Cable C + Transducer.
 - c) Net = Reading + Antenna Factor - Pre-Amp + Insert. Loss.
 - d) Attn. = Field Strength (Fundamental) - Field Strength (Harmonics).
 - e) Negative signs (-) in Margin column signify levels below the limits.

Radiated Emissions Test Data

Company	Sierra Wireless Inc.	Model #	Aircard 510	Req	FCC 2.993
EUT:		S/N or FCC #:		Test Dist	3 meter
Project #:		Test Date:	March 30, 2000	TP	0.20 Watt
Test Mode:	Tx@High Ch.	Engineer:	Xi Ming Y.	Min. Antn.	36.01 dBi

Number	Antenna Used			Pre-Amp Used			Cable Used			Transducer Used	
	2	21	8	13	8	10	0	0	12	0	
Model	EMCC 3143	3160-0	EMCC 3115	ACO/400	CDL P1000	AFT18855	None	None	Grn_MeL	None	

Frequency	Reading	Detector	Ant #	Amp #	Ant. Pol.	Ant. Factor	Pre-Amp	Insert. Loss	Net	ERP	Attn.	Margin
Mhz	dB(1W)	P/A/Q	#	#	H/V	dB(1m)	dB	dB	dB(1V/m)	mW	dBc	dB
1908.80	89.0	Ave.	8	0	V	27.2	0.0	2.1	118.3	1.24E+02	0.0	N/A
3817.80	37.0	Ave.	8	8	V	33.1	27.8	2.7	45.0	5.72E-06	73.4	-37.3
5726.70	29.0	Ave.	8	8	V	36.2	28.3	3.7	40.6	2.11E-06	77.7	-41.7
7635.00	43.8	Ave.	8	8	V	37.8	27.8	4.6	58.4	1.25E-04	60.0	-23.9
9543.90	31.0	Ave.	8	8	V	39.3	27.3	5.0	48.0	1.15E-05	70.3	-34.3
11452.80	42.2	Ave.	8	10	V	40.6	39.9	5.6	48.5	1.30E-05	69.8	-33.8
13361.70	34.0	Ave.	8	10	V	41.0	39.2	6.1	41.9	2.83E-06	76.4	-40.4
15270.60	30.0	Ave.	8	10	V	42.3	38.3	6.6	40.6	2.11E-06	77.7	-41.7
17179.50	30.0	Ave.	8	10	V	43.8	38.8	7.5	42.5	3.24E-06	75.8	-39.8
19088.40	26.0	Ave.	21	13	V	40.2	23.3	7.7	50.6	2.10E-05	67.7	-31.7

- Notes:**
- a) O.C.F.: Other Correction Factor
 - b) Insert. Loss = Cable A + Cable B + Cable C + Transducer
 - c) Net = Reading + Antenna Factor - Pre-Amp + Insert. Loss.
 - d) Attn. = Field Strength (Fundamental) - Field Strength (Harmonics).
 - e) Negative signs (-) in Margin column signify levels below the limits

8 FREQUENCY STABILITY**8.1 Test description**

Parameter:	FCC §2.1055
Requirement:	FCC § 24.235
Frequency Tolerance:	Sufficient to ensure that the fundamental omission stays within the authorized frequency block

8.2 Test Procedure

The ppm frequency error of the transmitter was calculated by:

$$ppm \text{ error} = \left(\frac{MCF}{ACF} - 1 \right) \cdot 10^6$$

Where MCF is the Measured Carrier Frequency in MHz

ACF is the Assigned Carrier Frequency in MHz

8.2.1 Frequency Stability vs. Temperature

The equipment under test was connected to an external DC power supply and the RF output was connected to a frequency counter via feedthrough attenuators. The EUT was placed inside the temperature chamber.

After the temperature stabilized for approximately 20 minutes, the frequency of the output signal was recorded from the counter.

8.2.2 Frequency Stability vs. Voltage

At room temperature (25 ± 5 °C), an external variable DC power supply was connected to the EUT. The frequency of the transmitter was measured for 115%, 100% and 85% of the nominal operating input voltage.

8.4 Test Results

Test was not requested.

8.5 Modifications made during testing

None

8.6 Test instrumentation

Data provided by applicant

- Temperature Chamber, -50C to +100C
- Hewlett Packard 5383A Frequency Counter
- Tektronix 2784 Spectrum Analyzer
- Goldstar DC Power Supply, GR303

9 AC LINE CONDUCTED EMISSIONS**9.1 Test description**

Parameter:	ANSI C63.4
Requirement:	FCC § 15.107

9.2 Test Procedure

The EUT was connected to the DC power supply, that was connected to the AC line through the LISNs.

Both HOT and NEUTRAL leads were tested.

9.3 Test Results

Passed, see separate DoC report.

9.4 Modifications made during testing

None

9.5 Test instrumentation

HP 8566B Spectrum Analyzer

LISN