FCC Part 15
EMI TEST REPORT

of

E.U.T. : Bluetooth USB Dongle

MODEL : BD1100

FCC ID. : QWG030217

for

APPLICANT : Hassnet Inc.

ADDRESS : 6fl. Techno Complex Bldg. Korea University, 126-16, Anam-Dong 5-Ka, Seongbuk-Ku, Seoul, Korea.

Test Performed by

ELECTRONICS TESTING CENTER, TAIWAN
NO. 34, LIN 5, DING FU TSUN, LINKOU HSIANG,
TAIPEI HSIEN, TAIWAN, R.O.C.

Tel:(02)26023052 Fax:(02)26010910

http：// www.etc.org.tw；e-mail：etcemi@seed.net.tw

Report Number : ET92R-02-057-01

TEST REPORT CERTIFICATION

Applicant	: Hassnet Inc. 6fl. Techno Complex Bldg. Korea University, 126-16, Anam-Dong 5-Ka, Seongbuk-Ku, Seoul, Korea.
Manufacturer	: Hassnet Inc. 6fl. Techno Complex Bldg. Korea University, 126-16, Anam-Dong 5-Ka, Seongbuk-Ku, Seoul, Korea.
Description of EUT	:
a) Type of EUT	: Bluetooth USB Dongle
b) Trade Name	: BUD
c) Model No.	: BD1100
d) Power Supply	: DC 4.4V-5.25V
Regulation Applied	: FCC Rules and Regulations Part 15 Subpart B & C (2002)

I HEREBY CERTIFY THAT: The data shown in this report were made in accordance with the procedures given in ANSI C63.4, and the energy emitted by the device was founded to be within the limits applicable. I assume full responsibility for accuracy and completeness of these data.

Note: 1. The result of the testing report relates only to the item tested.
2. The testing report shall not be reproduced expect in full, without the written approval of ETC.

Issued Date : Apr. 19, 2003

Test Engineer : Tien Lu Liao
(Tien-lu Liau)

Approve & Authorized Signer : Will Yauo
Will Yauo, Manager
EMC Dept. II of ELECTRONICS
TESTING CENTER, TAIWAN

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1 GENERAL INFORMATION

1.1 Product Description

a) Type of EUT : Bluetooth USB Dongle
b) Trade Name : BUD
c) Model No. : BD1100
d) Power Supply : DC 4.4V~5.25V

1.2 Characteristics of Device

This Bluetooth USB Dongle designed with a transmitting method of hopping spread spectrum technology using the 2400 to 2483.5 MHz ISM band. It includes an integrated antenna and a USB connector interface, offering a simple Bluetooth solution for electronic devices with USB interface.

1.3 Test Methodology

For Bluetooth USB Dongle, both conducted and radiated emissions were performed according to the procedures illustrated in ANSI C63.4 (1992) and for processing gain measurement is according to FCC Public Notice. Other required measurements were illustrated in separate sections of this test report for details.

1.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the roof top of Building at No.34, Lin 5, Ding Fu Tsun, Linkou Hsiang, Taipei Hsien, Taiwan, R.O.C.
This site has been fully described in a report submitted to your office, and accepted in a letter dated Feb. 10, 2000.

2 PROVISIONS APPLICABLE

2.1 Definition

Unintentional radiator:
A device that intentionally generates and radio frequency energy for use within the device, or that sends radio frequency signals by conduction to associated equipment via connecting wiring, but which is not intended to emit RF energy by radiation or induction.

Class A Digital Device:
A digital device which is marketed for use in commercial or business environment; exclusive of a device which is market for use by the general public, or which is intended to be used in the home.

Class B Digital Device :
A digital device which is marketed for use in a residential environment notwithstanding use in a commercial, business of industrial environment. Example of such devices that are marketed for the general public.

Note : A manufacturer may also qualify a device intended to be marketed in a commercial, business, or industrial environment as a Class B digital device, and in fact is encouraged to do so, provided the device complies with the technical specifications for a Class B Digital Device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a digital device as a Class B Digital Device, Regardless of its intended use.

Intentional radiator:
A device that intentionally generates and emits radio frequency energy by radiation or induction.

2.2 Requirement for Compliance

(1) Conducted Emission Requirement

Except for Class A digital devices, for equpment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50ì H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

Frequency MHz	Quasi Peak dB μ V	Average dB μ V
0.15 - 0.5	66-56*	56-46*
0.5 - 5.0	56	46
5.0 - 30.0	60	50

* Decreases with the logarithm of the frequency

(2) Radiated Emission Requirement

For unintentional device, according to § 15.109(a), except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency MHz	Distance Meters	Radiated dB μ V/m	Radiated μ V/m
30 - 88	3	40.0	100
88 - 216	3	43.5	150
216 - 960	3	46.0	200
above 960	3	54.0	500

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

(3) Antenna Requirement

For intentional device, according to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

(4) Hopping Channel Separation

According to 15.247(a)(1), frequency hopping system shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

(5) Number of Hopping frequencies used

According to 15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 non-overlapping channels.

(6) Hopping Channel Bandwidth

According to 15.247(a)(1)(ii), for frequency hopping system operating in the 5725-5850 MHz band, the maximum 20dB bandwidth of the hopping channel is 1MHz.

(7) Dwell Time of each frequency

According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2400-2483.5 band, the average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

(8) Output Power Requirement

According to 15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt.

For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

(9) 100 kHz Bandwidth of Frequency Band Edges Requirement

According to 15.247(c), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

(10) Out-of-Band Conducted Emission Requirement

According to 15.247(c), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

(11) Peak Power Spectral Density Requirement

According to 15.247(d), for digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

2.3 Restricted Bands of Operation

Only spurious emissions are permitted in any of the frequency bands listed below :

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42-16.423	399.9-410	4.5-5.15
0.495 - 0.505 **	16.69475 - 16.69525	608-614	5.35-5.46
2.1735 - 2.1905	16.80425 - 16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475 - 156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3360-4400	Above 38.6
13.36-13.41			

** : Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz

2.4 Labeling Requirement

The device shall bear the following statement in a conspicuous location on the device :

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions : (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

2.5 User Information

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual.

The Federal Communications Commission Radio Frequency Interference Statement includes the following paragraph.

This equipment has been tested and found to comply with the limits for a Class B Digital Device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-- Reorient or relocate the receiving antenna.

-- Increase the separation between the equipment and receiver.

-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

-- Consult the dealer or an experienced radio / TV technician for help.

3. SYSTEM TEST CONFIGURATION

3.1 Justification

For both radiated and conducted emissions below 1 GHz, the system was configured for testing in a typical fashion as a customer would normally use it. The peripherals other than EUT were connected in normally standing by situation. Measurement was performed under the condition that a computer program was exercised to simulate data communication of EUT, and the transmission rate was set to maximum allowed by EUT. Three highest emissions were verified with varying placement of the transmitting antenna connected to EUT to maximize the emission from EUT.

For conducted emissions, only measured on TX and RX operation, for the digital circuits portion also function normally whenever TX or RX is operated. For radiated emissions, whichever RF channel is operated, the digital circuits' function identically. As the reason, measurement of radiated emissions from digital circuits is only performed with channel 11 by transmitting mode.

3.2 Devices for Tested System

Device	Manufacture	Model / FCC ID.	Cable Description
Bluetooth USB Dongle*	Hassnet Inc..	BD1100 QWG030217	----
NoteBook PC	Acer	340	----
Printer	EPSON	Stylus photo 700	1.2m Shielded Cable
Modem	Smar TEAM Co.	1200AT	1.8m Shielded Cable

Remark "*" means equipment under test.

4 RADIATED EMISSION MEASUREMENT

4.1 Applicable Standard

For unintentional radiator, the radiated emission shall comply with § 15.109(a).

For intentional radiators, according to § 15.247 (a), operation under this provision is limited to frequency hopping and direct sequence spread spectrum, and the out band emission shall be comply with § 15.247 (c)

4.2 Measurement Procedure

1. Setup the configuration per figure 1 and 2 for frequencies measured below and above 1 GHz respectively.
2. For emission frequencies measured below 1 GHz, a pre-scan is performed in a shielded chamber to determine the accurate frequencies of higher emissions will be checked on a open test site. As the same purpose, for emission frequencies measured above 1 GHz, a pre-scan also be performed with a 1 meter measuring distance before final test.
3. For emission frequencies measured below and above 1 GHz, set the spectrum analyzer on a 100 kHz and 1 MHz resolution bandwidth respectively for each frequency measured in step 2.
4. The search antenna is to be raised and lowered over a range from 1 to 4 meters in horizontally polarized orientation. Position the highness when the highest value is indicated on spectrum analyzer, then change the orientation of EUT on test table over a range from 0 ° to 360 ° with a speed as slow as possible, and keep the azimuth that highest emission is indicated on the spectrum analyzer. Vary the antenna position again and record the highest value as a final reading. A RF test receiver is also used to confirm emissions measured.

   Note : A high pass filter was used to avoid pre-amplifier saturated when measure TX operation mode in frequency band above 1 GHz.
5. Repeat step 4 until all frequencies need to be measured were complete.
6. Repeat step 5 with search antenna in vertical polarized orientations.
7. Check the three frequencies of highest emission with varying the placement of cables associated with EUT to obtain the worse case and record the result.

Figure 1 : Frequencies measured below 1 GHz configuration

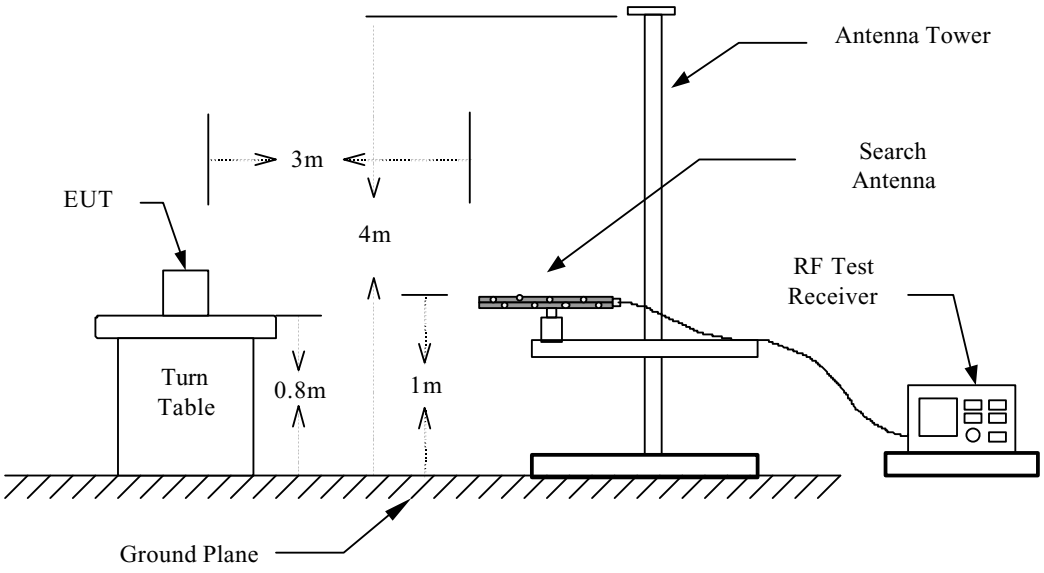
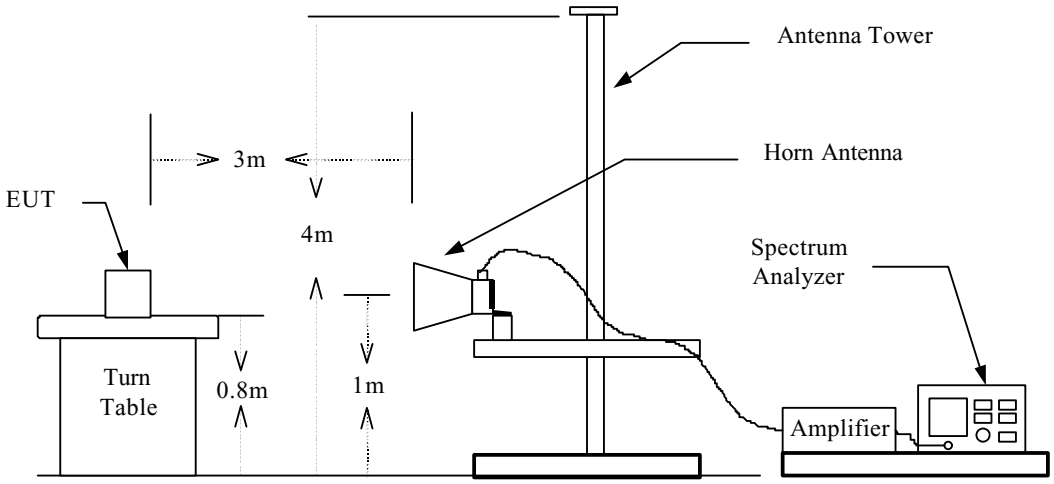


Figure 2 : Frequencies measured above 1 GHz configuration



4.3 Measuring Instrument

The following instrument are used for radiated emissions measurement:

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8568B	01/10/2004
Pre-selector	Hewlett-Packard	85685A	01/10/2004
Quasi Peak Detector	Hewlett-Packard	85650A	01/10/2004
RF Test Receiver	Rohde & Schwarz	ESVS 30	08/06/2003
RF Test Receiver	Rohde & Schwarz	ESBI	05/26/2003
Horn Antenna	EMCO	3115	08/08/2003
Log periodic Antenna	EMCO	3146	11/04/2003
Biconical Antenna	EMCO	3110B	11/04/2003
Preamplifier	Hewlett-Packard	8449B	05/29/2003
Preamplifier	Hewlett-Packard	8447D	04/03/2003
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2003

Measuring instrument setup in measured frequency band when specified detector function is used :

Frequency Band (MHz)	Instrument	Function	Resolution bandwidth	Video Bandwidth
30 to 1000	RF Test Receiver	Quasi-Peak	120 kHz	N/A
	Spectrum Analyzer	Peak	100 kHz	100 kHz
Above 1000	Spectrum Analyzer	Peak	1 MHz	1 MHz
	Spectrum Analyzer	Average	1 MHz	300 Hz

4.4 Radiated Emission Data

4.4.1 RF Portion(Max power)

a) Operation Mode : Receiving /Transmitting

Fundamental Frequency : 2402 MHz (Local Frequency : 2400.558 MHz)

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity : 65 %

Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak	Result Ave	Limit @3m (dBuV/m) Peak	Limit Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
*2400.457	47.8	38.0	48.6	42.0	-3.1	45.5	38.9	74.0	54.0	-15.1	145	1.3
*4800.914	---	---	---	---	2.5	---	---	74.0	54.0	---	---	---
*7201.371	---	---	---	---	5.7	---	---	74.0	54.0	---	---	---
*9601.828	---	---	---	---	7.2	---	---	74.0	54.0	---	---	---
*12002.285	---	---	---	---	9.2	---	---	74.0	54.0	---	---	---
4803.700	50.8	34.5	55.8	37.0	2.5	58.3	39.5	74.0	54.0	-14.5	160	1.3
7205.550	---	---	---	---	5.7	---	---	74.0	54.0	---	---	---
9607.400	---	---	---	---	7.2	---	---	74.0	54.0	---	---	---
12009.250	---	---	---	---	9.2	---	---	74.0	54.0	---	---	---
14411.100	---	---	---	---	11.5	---	---	74.0	54.0	---	---	---
16812.950	---	---	---	---	11.8	---	---	74.0	54.0	---	---	---
19214.800	---	---	---	---	8.9	---	---	74.0	54.0	---	---	---
21616.650	---	---	---	---	9.7	---	---	74.0	54.0	---	---	---
24018.500	---	---	---	---	10.3	---	---	74.0	54.0	---	---	---

Note :

1. Remark "*" means that the emission frequency is produced from local oscillator.
2. Remark "---" means that the emission level is too low to be measured (a pre-amplifier of about 35 dB is used).
3. Margins are derived from Peak or Average whichever is lower. If there is only peak value in Result field, the Margin is also referred to average limits.
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.

b) Operation Mode : Receiving /Transmitting

Fundamental Frequency : 2441.000 MHz (Local Frequency : 2439.500 MHz)

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity : 65 %

Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak	Result Ave	Limit @3m (dBuV/m) Peak	Limit Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
*2439.437	47.8	38.8	48.8	40.0	-2.9	45.9	37.1	74.0	54.0	-16.9	145	1.3
*4878.874	---	---	---	---	2.7	---	---	74.0	54.0	---	---	---
*7318.311	---	---	---	---	5.9	---	---	74.0	54.0	---	---	---
*9757.748	---	---	---	---	7.3	---	---	74.0	54.0	---	---	---
*12197.185	---	---	---	---	9.3	---	---	74.0	54.0	---	---	---
4882.314	---	---	48.2	33.4	2.7	50.9	36.1	74.0	54.0	-17.9	185	1.1
7323.471	---	---	---	---	5.9	---	---	74.0	54.0	---	---	---
9764.628	---	---	---	---	7.3	---	---	74.0	54.0	---	---	---
12205.785	---	---	---	---	9.3	---	---	74.0	54.0	---	---	---
14646.942	---	---	---	---	11.6	---	---	74.0	54.0	---	---	---
17088.099	---	---	---	---	13.3	---	---	74.0	54.0	---	---	---
19529.256	---	---	---	---	8.5	---	---	74.0	54.0	---	---	---
21970.413	---	---	---	---	9.9	---	---	74.0	54.0	---	---	---
24411.570	---	---	---	---	10.7	---	---	74.0	54.0	---	---	---

Note :

1. Remark "*" means that the emission frequency is produced from local oscillator.
2. Remark "---" means that the emission level is too low to be measured (a pre-amplifier of about 35 dB is used).
3. Margins are derived from Peak or Average whichever is lower. If there is only peak value in Result field, the Margin is also referred to average limits.
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.

c) Operation Mode : Receiving /Transmitting

Fundamental Frequency : 2480.000 MHz (Local Frequency : 2478.475 MHz)

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity : 65 %

Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak	Result Ave	Limit @3m (dBuV/m) Peak	Limit Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
*2478.560	47.8	37.9	47.8	40.1	-2.8	45.0	37.3	74.0	54.0	-16.7	145	1.3
*4957.120	---	---	---	---	2.8	---	---	74.0	54.0	---	---	---
*7318.311	---	---	---	---	5.9	---	---	74.0	54.0	---	---	---
*9757.748	---	---	---	---	7.3	---	---	74.0	54.0	---	---	---
*12197.185	---	---	---	---	9.3	---	---	74.0	54.0	---	---	---
4882.314	---	---	---	---	2.7	---	---	74.0	54.0	---	---	---
7323.471	---	---	---	---	5.9	---	---	74.0	54.0	---	---	---
9764.628	---	---	---	---	7.3	---	---	74.0	54.0	---	---	---
12205.785	---	---	---	---	9.3	---	---	74.0	54.0	---	---	---
14646.942	---	---	---	---	11.6	---	---	74.0	54.0	---	---	---
17088.099	---	---	---	---	13.3	---	---	74.0	54.0	---	---	---
19529.256	---	---	---	---	8.5	---	---	74.0	54.0	---	---	---
21970.413	---	---	---	---	9.9	---	---	74.0	54.0	---	---	---
24411.570	---	---	---	---	10.7	---	---	74.0	54.0	---	---	---

Note :

1. Remark "*" means that the emission frequency is produced from local oscillator.
2. Remark "---" means that the emission level is too low to be measured (a pre-amplifier of about 35 dB is used).
3. Margins are derived from Peak or Average whichever is lower. If there is only peak value in Result field, the Margin is also referred to average limits.
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.

4.4.2 RF Portion(Min power)

a) Operation Mode : Receiving /Transmitting

Fundamental Frequency : 2402 MHz (Local Frequency : 2400.558 MHz)

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity : 65 %

Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak	Result Ave	Limit @3m (dBuV/m) Peak	Limit Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
*2400.457	---	---	51.5	45.2	-3.1	48.4	42.1	74.0	54.0	-11.9	145	1.3
*4800.914	---	---	---	---	2.5	---	---	74.0	54.0	---	---	---
*7201.371	---	---	---	---	5.7	---	---	74.0	54.0	---	---	---
*9601.828	---	---	---	---	7.2	---	---	74.0	54.0	---	---	---
*12002.285	---	---	---	---	9.2	---	---	74.0	54.0	---	---	---
4803.784	58.7	39.5	55.7	38.7	2.5	61.2	42.0	74.0	54.0	-12.0	160	1.3
7205.676	---	---	---	---	5.7	---	---	74.0	54.0	---	---	---
9607.568	---	---	---	---	7.2	---	---	74.0	54.0	---	---	---
12009.460	---	---	---	---	9.2	---	---	74.0	54.0	---	---	---
14411.352	---	---	---	---	11.5	---	---	74.0	54.0	---	---	---
16813.244	---	---	---	---	11.8	---	---	74.0	54.0	---	---	---
19215.136	---	---	---	---	8.9	---	---	74.0	54.0	---	---	---
21617.028	---	---	---	---	9.7	---	---	74.0	54.0	---	---	---
24018.920	---	---	---	---	10.3	---	---	74.0	54.0	---	---	---

Note :

1. Remark "*" means that the emission frequency is produced from local oscillator.
2. Remark "---" means that the emission level is too low to be measured (a pre-amplifier of about 35 dB is used).
3. Margins are derived from Peak or Average whichever is lower. If there is only peak value in Result field, the Margin is also referred to average limits.
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.

b) Operation Mode : Receiving /Transmitting

Fundamental Frequency : 2441.000 MHz (Local Frequency : 2439.500 MHz)

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity : 65 %

Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak	Result Ave	Limit @3m (dBuV/m) Peak	Limit Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
*2439.437	---	---	50.7	43.2	-2.9	47.8	40.3	74.0	54.0	-13.7	180	1.1
*4878.874	---	---	---	---	2.7	---	---	74.0	54.0	---	---	---
*7318.311	---	---	---	---	5.9	---	---	74.0	54.0	---	---	---
*9757.748	---	---	---	---	7.3	---	---	74.0	54.0	---	---	---
*12197.185	---	---	---	---	9.3	---	---	74.0	54.0	---	---	---
4881.784	56.2	38.8	53.0	37.3	2.7	58.9	41.5	74.0	54.0	-12.5	185	1.0
7322.676	---	---	---	---	5.9	---	---	74.0	54.0	---	---	---
9763.568	---	---	---	---	7.3	---	---	74.0	54.0	---	---	---
12204.460	---	---	---	---	9.3	---	---	74.0	54.0	---	---	---
14645.352	---	---	---	---	11.6	---	---	74.0	54.0	---	---	---
17086.244	---	---	---	---	13.3	---	---	74.0	54.0	---	---	---
19527.136	---	---	---	---	8.5	---	---	74.0	54.0	---	---	---
21968.028	---	---	---	---	9.9	---	---	74.0	54.0	---	---	---
24408.920	---	---	---	---	10.7	---	---	74.0	54.0	---	---	---

Note :

1. Remark "*" means that the emission frequency is produced from local oscillator.
2. Remark "---" means that the emission level is too low to be measured (a pre-amplifier of about 35 dB is used).
3. Margins are derived from Peak or Average whichever is lower. If there is only peak value in Result field, the Margin is also referred to average limits.
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.

c) Operation Mode : Receiving /Transmitting

Fundamental Frequency : 2480.000 MHz (Local Frequency : 2478.475 MHz)

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity : 65 %

Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak	Result Ave	Limit @3m (dBuV/m) Peak	Limit Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
*2478.560	---	---	48.8	39.2	-2.8	46.0	36.4	74.0	54.0	-17.6	145	1.3
*4957.120	---	---	---	---	2.8	---	---	74.0	54.0	---	---	---
*7435.680	---	---	---	---	6.1	---	---	74.0	54.0	---	---	---
*9914.240	---	---	---	---	7.4	---	---	74.0	54.0	---	---	---
*12392.800	---	---	---	---	9.4	---	---	74.0	54.0	---	---	---
4959.784	54.5	38.2	53.5	37.5	2.8	57.3	41.0	74.0	54.0	-13.0	185	1.1
7439.676	---	---	---	---	6.1	---	---	74.0	54.0	---	---	---
9919.568	---	---	---	---	7.4	---	---	74.0	54.0	---	---	---
12399.460	---	---	---	---	9.4	---	---	74.0	54.0	---	---	---
14879.352	---	---	---	---	11.5	---	---	74.0	54.0	---	---	---
17359.244	---	---	---	---	15.2	---	---	74.0	54.0	---	---	---
19839.136	---	---	---	---	8.6	---	---	74.0	54.0	---	---	---
22319.028	---	---	---	---	10.2	---	---	74.0	54.0	---	---	---
24798.920	---	---	---	---	11.0	---	---	74.0	54.0	---	---	---

Note :

1. Remark "*" means that the emission frequency is produced from local oscillator.
2. Remark "---" means that the emission level is too low to be measured (a pre-amplifier of about 35 dB is used).
3. Margins are derived from Peak or Average whichever is lower. If there is only peak value in Result field, the Margin is also referred to average limits.
4. The expanded uncertainty of the radiated emission tests is 3.53 dB.

4.4.3 Radiated Emissions in Restricted Bands

a) Operation Mode : Receiving /Transmitting (Min Power)

Test Date : Mar. 17, 2003 Temperature: 22 ℃ Humidity : 65 %

Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak	Ave	Limit @3m (dBuV/m) Peak	Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
1200.000	48.5	47.7	---	---	-8.8	39.7	38.9	74.0	54.0	-15.1	180	1.0
1385.000	---	---	---	---	-8.0	---	---	74.0	54.0	---	---	---
1580.000	---	---	---	---	-7.0	---	---	74.0	54.0	---	---	---
1646.000	47.5	46.8	---	---	-6.7	40.8	40.1	74.0	54.0	-13.9	175	1.1
1700.000	47.9	47.6	---	---	-6.3	41.6	41.3	74.0	54.0	-12.7	185	1.1
1720.000	---	---	---	---	-6.2	---	---	74.0	54.0	---	---	---
2220.000	---	---	---	---	-3.8	---	---	74.0	54.0	---	---	---
2380.000	---	---	---	---	-3.2	---	---	74.0	54.0	---	---	---
2500.000	---	---	---	---	-2.7	---	---	74.0	54.0	---	---	---
2800.000	---	---	---	---	-1.8	---	---	74.0	54.0	---	---	---
3260.000	---	---	---	---	-0.6	---	---	74.0	54.0	---	---	---
3335.000	---	---	---	---	-0.4	---	---	74.0	54.0	---	---	---
3350.000	---	---	---	---	-0.4	---	---	74.0	54.0	---	---	---
4000.000	---	---	---	---	2.0	---	---	74.0	54.0	---	---	---
4800.000	---	---	---	---	2.5	---	---	74.0	54.0	---	---	---
5400.000	---	---	---	---	4.1	---	---	74.0	54.0	---	---	---
7500.000	---	---	---	---	6.2	---	---	74.0	54.0	---	---	---
8450.000	---	---	---	---	6.8	---	---	74.0	54.0	---	---	---
9100.000	---	---	---	---	7.0	---	---	74.0	54.0	---	---	---
9400.000	---	---	---	---	7.2	---	---	74.0	54.0	---	---	---
15500.000	---	---	---	---	9.0	---	---	74.0	54.0	---	---	---
20000.000	---	---	---	---	8.6	---	---	74.0	54.0	---	---	---
22500.000	---	---	---	---	10.3	---	---	74.0	54.0	---	---	---
23800.000	---	---	---	---	10.4	---	---	74.0	54.0	---	---	---
31600.000	---	---	---	---	48.4	---	---	74.0	54.0	---	---	---
36450.000	---	---	---	---	46.7	---	---	74.0	54.0	---	---	---

Note :

1. Remark "---" means that the emissions level is too low to be measured.

2. The expanded uncertainty of the radiated emission tests is 3.53 dB.

b) Operation Mode : Receiving /Transmitting (Max Power)

Test Date : Mar. 17, 2003 Temperature: 22 ℃ Humidity : 65 %

Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak	Ave	Limit @3m (dBuV/m) Peak	Ave.	Margin (dB)	Table Deg. (Deg.)	Ant. High (m)
1100.000	---	---	---	---	-9.3	---	---	74.0	54.0	---	---	---
1400.000	---	---	---	---	-7.9	---	---	74.0	54.0	---	---	---
1550.000	---	---	---	---	-7.2	---	---	74.0	54.0	---	---	---
1645.900	47.5	46.8	---	---	-6.7	40.8	40.1	74.0	54.0	-13.9	175	1.1
1708.000	47.0	46.5	---	---	-6.3	40.7	40.2	74.0	54.0	-13.8	180	1.1
1719.800	---	---	---	---	-6.2	---	---	74.0	54.0	---	---	---
2250.000	---	---	---	---	-3.7	---	---	74.0	54.0	---	---	---
2350.000	---	---	---	---	-3.3	---	---	74.0	54.0	---	---	---
2494.800	46.0	45.3	---	---	-2.7	43.3	42.6	74.0	54.0	-11.4	180	1.4
2750.000	---	---	---	---	-2.0	---	---	74.0	54.0	---	---	---
3265.000	---	---	---	---	-0.6	---	---	74.0	54.0	---	---	---
3338.000	---	---	---	---	-0.4	---	---	74.0	54.0	---	---	---
3355.000	45.7	45.1	---	---	-0.3	45.4	44.8	74.0	54.0	-9.2	180	1.1
4120.000	44.5	43.9	---	---	2.0	46.5	45.9	74.0	54.0	-8.1	90	1.0
5000.000	---	---	---	---	2.9	---	---	74.0	54.0	---	---	---
5380.000	---	---	---	---	4.0	---	---	74.0	54.0	---	---	---
7350.000	---	---	---	---	6.0	---	---	74.0	54.0	---	---	---
8340.000	46.5	45.9	---	---	6.7	53.2	52.6	74.0	54.0	-1.4	190	1.0
9100.000	---	---	---	---	7.0	---	---	74.0	54.0	---	---	---
9400.000	---	---	---	---	7.2	---	---	74.0	54.0	---	---	---
11000.000	---	---	---	---	8.5	---	---	74.0	54.0	---	---	---
13300.000	---	---	---	---	10.7	---	---	74.0	54.0	---	---	---
14490.000	---	---	---	---	11.6	---	---	74.0	54.0	---	---	---
15800.000	47.0	46.5	---	---	8.3	55.3	54.8	74.0	54.0	0.8	180	1.4
18000.000	---	---	---	---	17.4	---	---	74.0	54.0	---	---	---
22500.000	---	---	---	---	10.3	---	---	74.0	54.0	---	---	---
23800.000	---	---	---	---	10.4	---	---	74.0	54.0	---	---	---
31500.000	---	---	---	---	48.3	---	---	74.0	54.0	---	---	---
36470.000	---	---	---	---	46.7	---	---	74.0	54.0	---	---	---

Note :

1. Remark "---" means that the emissions level is too low to be measured.

2. The expanded uncertainty of the radiated emission tests is 3.53 dB.

4.4.4 Other Emissions

Operation Mode : Receiving /Transmitting

Test Date : Mar. 17, 2003 Temperature: 22 ℃ Humidity : 65 %

Frequency (MHz)	Ant-Pol H/V	Meter Reading (dBuV)	Corrected Factor (dB)	Result @3m (dBuV/m)	Limit @3m (dBuV/m)	Margin (dB)	Table Degree (Deg.)	Ant. High (m)
40.077	V	42.2	-11.8	30.4	40.0	-9.6	180	1.0
143.267	V	42.3	-10.5	31.8	43.5	-11.7	175	1.0
240.523	H	38.9	-4.5	34.4	46.0	-11.6	190	4.0
280.594	H	40.7	-2.7	38.0	46.0	-8.0	170	4.0
432.011	H	41.9	-5.5	36.4	46.0	-9.6	185	4.0
528.038	H	44.5	-5.0	39.5	46.0	-6.5	195	4.0
624.048	V	44.6	-3.3	41.3	46.0	-4.7	180	1.5

Note :

1. Remark "---" means that the emissions level is too low to be measured.

2. The expanded uncertainty of the radiated emission tests is 3.53 dB.

4.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor, High Pass Filter Loss (if used) and Cable Loss, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation calculation is as follows:

Result = Reading + Corrected Factor

where

Corrected Factor = Antenna FACTOR + Cable Loss + High Pass Filter Loss - Amplifer

4.6 Photos of Radiation Measuring Setup

Please see Exhibit F-Test Setup Photos

5 CONDUCTED EMISSION MEASUREMENT

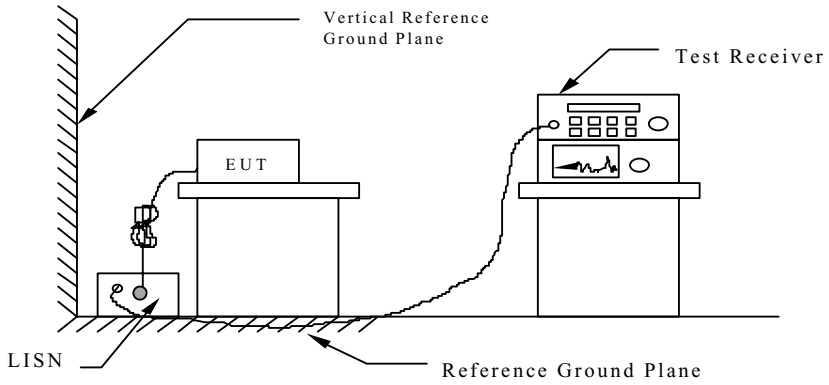
5.1 Standard Applicable

For unintentional and intentional device, Line Conducted Emission Limits are in accordance to § 15.107(a) and § 15.207(a) respectively.

5.2 Measurement Procedure

1. Setup the configuration per figure 3.
2. A preliminary scan with a spectrum monitor is performed to identify the frequency of emission that has the highest amplitude relative to the limit by operating the EUT in selected modes of operation, typical cable positions, and with a typical system configuration.
3. Record the 6 or 8 highest emissions relative to the limit.
4. Measure each frequency obtained from step 3 by a test receiver set on quasi peak detector function, and then record the accuracy frequency and emission level. If all emissions measured in the specified band are attenuated more than 20 dB from the limit, this step would be ignored, and the peak detector function would be used.
5. Confirm the highest three emissions with variation of the EUT cable configuration and record the final data.
6. Repeat all above procedures on measuring each operation mode of EUT.

Figure 3 : Conducted emissions measurement configuration



5.3 Conducted Emission Data

a) Low Channel

Operation Mode : Transmitting / Receiving
Test Date : Mar. 14, 2003 Temperature : 23 ℃ Humidity: 60 %

Freq.	Meter Reading (dB μ V)				Factor	Limit (dB μ V)		Result (dB μ V)			
	Q.P Value		AVG. Value			Q.P	AVG.	Q.P Value		AVG. Value	
(MHz)	N	L1	N	L1	(dB)	Value	Value	N	L1	N	L1
0.201	30.7	30.4	----	----	0.2	63.6	53.6	30.9	30.6	----	----
0.334	20.9	21.6	----	----	0.3	59.4	49.4	21.2	21.9	----	----
0.535	21.3	19.2	----	----	0.3	56.0	46.0	21.6	19.5	----	----
0.734	20.7	19.5	----	----	0.3	56.0	46.0	21.0	19.8	----	----
1.004	18.6	19.3	----	----	0.3	56.0	46.0	18.9	19.6	----	----
4.473	15.6	14.9	----	----	0.6	56.0	46.0	16.2	15.5	----	----
14.961	27.1	25.9	----	----	1.1	60.0	50.0	28.2	27.0	----	----

Note : 1. Please see appendix 1 for Plotted Data
2. The expanded uncertainty of the conducted emission tests is 2.45 dB.

b) Mide Channel

Operation Mode : Transmitting / Receiving
Test Date : Mar. 14, 2003 Temperature : 23 ℃ Humidity: 60 %

Freq.	Meter Reading (dB μ V)				Factor	Limit (dB μ V)		Result (dB μ V)			
	Q.P Value		AVG. Value			Q.P	AVG.	Q.P Value		AVG. Value	
(MHz)	N	L1	N	L1	(dB)	Value	Value	N	L1	N	L1
0.197	28.1	28.1	----	----	0.2	63.7	53.7	28.3	28.3	----	----
0.263	20.8	20.9	----	----	0.2	61.3	51.3	21.0	21.1	----	----
0.466	20.1	20.0	----	----	0.3	56.6	46.6	20.4	20.3	----	----
0.801	20.0	20.1	----	----	0.3	56.0	46.0	20.3	20.4	----	----
0.934	20.6	20.7	----	----	0.3	56.0	46.0	20.9	21.0	----	----
15.152	28.3	28.0	----	----	1.1	60.0	50.0	29.4	29.1	----	----

Note : 1. Please see appendix 1 for Plotted Data
2. The expanded uncertainty of the conducted emission tests is 2.45 dB.

c) Hi Channel

Operation Mode : Transmitting / Receiving
Test Date : Mar. 14, 2003 Temperature : 23 ℃ Humidity: 60 %

Freq.	Meter Reading (dB μ V)				Factor	Limit (dB μ V)		Result (dB μ V)			
	Q.P Value		AVG. Value			Q.P	AVG.	Q.P Value		AVG. Value	
(MHz)	N	L1	N	L1	(dB)	Value	Value	N	L1	N	L1
0.201	30.2	30.1	----	----	0.2	63.6	53.6	30.4	30.3	----	----
0.228	20.8	19.6	----	----	0.2	62.5	52.5	21.0	19.8	----	----
0.267	23.2	24.3	----	----	0.2	61.2	51.2	23.4	24.5	----	----
0.334	21.4	22.0	----	----	0.3	59.4	49.4	21.7	22.3	----	----
0.531	20.8	18.7	----	----	0.3	56.0	46.0	21.1	19.0	----	----
0.664	20.3	20.8	----	----	0.3	56.0	46.0	20.6	21.1	----	----
14.820	24.0	23.9	----	----	1.1	60.0	50.0	25.1	25.0	----	----

Note : 1. Please see appendix 1 for Plotted Data
2. The expanded uncertainty of the conducted emission tests is 2.45 dB.

5.4 Result Data Calculation

The result data is calculated by adding the LISN Factor to the measured reading. The basic equation with a sample calculation is as follows:

RESULT = READING + LISN FACTOR

Assume a receiver reading of 22.5 dB μ V is obtained, and LISN Factor is 0.1 dB, then the total of disturbance voltage is 22.6 dB μ V.

RESULT = 22.5 + 0.1 = 22.6 dB μ V
Level in μ V = Common Antilogarithm[(22.6 dB μ V)/20]
= 13.48 μ V

5.5 Conducted Measurement Equipment

The following test equipment are used during the conducted test.

Equipment	Manufacturer	Model No.	Next Cal. Due
EMI Test Receiver	Rohde and Schwarz	ESCS 30	11/27/2003
Line Impedance Stabilization network	Rohde and Schwarz	ESH2-Z5	09/03/2003
Monitor	IBM	E54	N.C.R.
Printer	HP	LaserJet 1000	N.C.R.
Shielded Room	Riken		N.C.R.
Computer	Acer	Veriton	N.C.R.
EMI Test Receiver	Rohde and Schwarz	ESCS 30	11/27/2003

5.6 Photos of Conduction Measuring Setup

Please see Exhibit F-Test Setup Photos

6 ANTENNA REQUIREMENT

6.1 Standard Applicable

For intentional device, according to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

6.2 Antenna Connected Construction

The antenna of this unit is designed to be mounted permanently on the device. No consideration of replacement. Please see construction Photos Of Exhibit B for details.

7 HOPPING CHANNEL SEPARATION

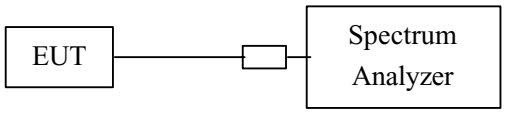
7.1 Standard Applicable

According to 15.247(a)(1), frequency hopping system shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

7.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. The EUT must have its hopping function enabled. Then set it to any one convenient frequency within its operating range.
3. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peaks of two adjacent channels
   Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span
   Video (or Average) Bandwidth (VBW) ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
4. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all frequencies measured were complete.

Figure 4 : Measurement configuration.



7.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2003
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

7.4 Measurement Data

Model : Max power

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity: 65 %

1) 2402MHz : Adjacent Hopping Channel Separation is 1000 kHz
2) 2441MHz : Adjacent Hopping Channel Separation is 1000 kHz
3) 2480MHz : Adjacent Hopping Channel Separation is 1000 kHz

Model : Min power

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity: 65 %

1) 2402MHz : Adjacent Hopping Channel Separation is 1000 kHz
2) 2441MHz : Adjacent Hopping Channel Separation is 1000 kHz
3) 2480MHz : Adjacent Hopping Channel Separation is 1000 kHz

Note : 1. Please see appendix 2 for Plotted Data

2. The expanded uncertainty of the hopping channel separation tests is 1000Hz.

8 NUMBER OF HOPPING FREQUENCY USED

8.1 Standard Applicable

According to 15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 non-overlapping channels.

8.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. The EUT must have its hopping function enabled.
3. Use the following spectrum analyzer settings:
   Span = the frequency band of operation
   RBW ≥ 1% of the span
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
4. Allow the trace to stabilize. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all frequencies measured were complete.

8.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2003
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

8.4 Measurement Data

Model : Max power

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity: 65 %

There are 79 hopping frequencies in a hopping sequence.

Model : Min power

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity: 65 %

There are 79 hopping frequencies in a hopping sequence.

Note : 1. Please see appendix 3 for Plotted Data

2. The expanded uncertainty of umber of hopping frequency used tests is 1000Hz.

9 CHANNEL BANDWIDTH

9.1 Standard Applicable

According to 15.247(a)(1)(ii), for frequency hopping system operating in the 5725-5850 MHz band, the maximum 20dB bandwidth of the hopping channel is 1MHz.

9.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
3. Use the following spectrum analyzer settings:
   Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
   RBW ≥ 1% of the 20 dB bandwidth
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all frequencies measured were complete.

9.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2003
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

9.4 Measurement Data

Model : Max power

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity: 65 %

1) 2402MHz : Channel Bandwidth is 977 kHz
2) 2441MHz : Channel Bandwidth is 977 kHz
3) 2480MHz : Channel Bandwidth is 977 kHz

Model : Min power

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity: 65 %

1) 2402MHz : Channel Bandwidth is 890 kHz
2) 2441MHz : Channel Bandwidth is 883 kHz
3) 2480MHz : Channel Bandwidth is 883 kHz

Note : 1. Please see appendix 4 for Plotted Data

2. The expanded uncertainty ofchannel bandwidth tests is 1000Hz.

10 DWELL TIME ON EACH CHANNEL

10.1 Standard Applicable

According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2400-2483.5 band, the average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

10.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. The EUT must have its hopping function enabled.
3. Use the following spectrum analyzer settings:
   Span = zero span, centered on a hopping channel
   RBW = 1 MHz
   VBW ≥ RBW
   Sweep = as necessary to capture the entire dwell time per hopping channel
   Detector function = peak
   Trace = max hold
4. Use the marker-delta function to determine the dwell time. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all frequencies measured were complete.

10.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2003
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

10.4 Measurement Data

The number of hopping channels = 79.
The period of 0.4 seconds multiplied by the number of hopping channels employed = 31.6 seconds.

Model : Max power

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity: 65 %

1) 2402MHz : the dwell time is 0.600 x (102/10) x 31.6 ＝ 193.39 ms
2) 2441MHz : the dwell time is 0.600 x (102/10) x 31.6 ＝ 193.39 ms
3) 2480MHz : the dwell time is 0.600 x (102/10) x 31.6 ＝ 193.39 ms

Model : Min power

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity: 65 %

1) 2402MHz : the dwell time is 0.600 x (102/10) x 31.6 ＝ 193.39 ms
2) 2441MHz : the dwell time is 0.600 x (102/10) x 31.6 ＝ 193.39 ms
3) 2480MHz : the dwell time is 0.600 x (102/10) x 31.6 ＝ 193.39 ms

The maximum time of occupancy for a particular channel is 193.39 msec within a period of 0.4 seconds multiplied by the number of hopping channels employed, which is less than the 400 msec allowed by the rules; therefore, it meets the requirements of this section.

Note : 1. Please see appendix 5 for Plotted Data
2. The expanded uncertainty of dwell time on each channel tests is 1000Hz.

11 OUTPUT POWER MEASUREMENT

11.1 Standard Applicable

According to 15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt.
For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

11.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Use the following spectrum analyzer settings:
   Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
   RBW > the 20 dB bandwidth of the emission being measured
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all frequencies measured were complete.

11.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2003
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

11.4 Measurement Data

Model : Max power

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity: 65 %

1) 2402MHz : Output Peak Power is 12.0 dBm = **15.849** mW
2) 2441MHz : Output Peak Power is 12.0 dBm = **15.849** mW
3) 2480MHz : Output Peak Power is 12.0 dBm = **15.849** mW

Model : Min power

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity: 65 %

1) 2402MHz : Output Peak Power is –14.00 dBm = **0.0398** mW
2) 2441MHz : Output Peak Power is –13.83 dBm = **0.0414** mW
3) 2480MHz : Output Peak Power is –13.67 dBm = **0.0429** mW

Note : 1. Please see appendix 6 for Plotted Data

2. The expanded uncertainty of output power measurement tests is 2dB.

12 100 kHz BANDWIDTH OF BAND EDGES MEASUREMENT

12.1 Standard Applicable

According to 15.247(c), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

12.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation
   RBW ≥ 1% of the span
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
4. Allow the trace to stabilize. Set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all measured frequencies were complete.

12.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2003
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

12.4 Measurement Data

Model : Max power

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity: 65 %

a) Lower Band Edge : All emissions are attenuated more than 20dB from the carrier.
b) Upper Band Edge : All emissions are attenuated more than 20dB from the carrier.

Model : Min power

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity: 65 %

a) Lower Band Edge : All emissions are attenuated more than 20dB from the carrier.
b) Upper Band Edge : All emissions are attenuated more than 20dB from the carrier.

Note : 1. Please see appendix 7 for Plotted Data
2. The expanded uncertainty of the out-of-band conducted emission tests is 2dB.

13 OUT-OF-BAND CONDUCTED EMISSION MEASUREMENT

13.1 Standard Applicable

According to 15.247(c), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

13.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Use the following spectrum analyzer settings:

   Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

   RBW = 100 kHz

   VBW ≥ RBW

   Sweep = auto

   Detector function = peak

   Trace = max hold.
4. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all measured frequencies were complete.

13.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2003
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

13.4 Measurement Data

Model : Max power

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity: 65 %

a) 1 GHz to 5 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.
b) 5 GHz to 25 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.

Model : Min power

Test Date : Mar. 17, 2003 Temperature : 22 ℃ Humidity: 65 %

a) 1 GHz to 5 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.
b) 5 GHz to 25 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.

Note : 1. Please see appendix 8 for Plotted Data

2. The expanded uncertainty of the out-of-band conducted emission tests is 2dB.

14 PEAK POWER SPECTRAL DENSITY MEASUREMENT

14.1 Standard Applicable

According to 15.247(d), for digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

14.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set EUT to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Use the following spectrum analyzer settings:
   Span = 300 kHz, centered on highest level appearing on spectral display
   RBW = 3 kHz
   VBW ≥ RBW
   Sweep = 100 s
   Detector function = peak
   Trace = max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all measured frequencies were complete.

14.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Hewlett-Packard	8564E	04/14/2003
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

14.4 Measurement Data

Model : Max power

Test Date : May 17, 2003 Temperature : 22 ℃ Humidity: 65 %

a) Channel 01 : Maximun Power Density of 3 kHz Bandwidth is 1.33dBm
b) Channel 07 : Maximun Power Density of 3 kHz Bandwidth is 1.67 dBm
c) Channel 11 : Maximun Power Density of 3 kHz Bandwidth is 0.33dBm

Model : Min power

Test Date : May 17, 2003 Temperature : 22 ℃ Humidity: 65 %

a) Channel 01 : Maximun Power Density of 3 kHz Bandwidth is –23.17dBm
b) Channel 07 : Maximun Power Density of 3 kHz Bandwidth is –22.50 dBm
c) Channel 11 : Maximun Power Density of 3 kHz Bandwidth is –22.83dBm

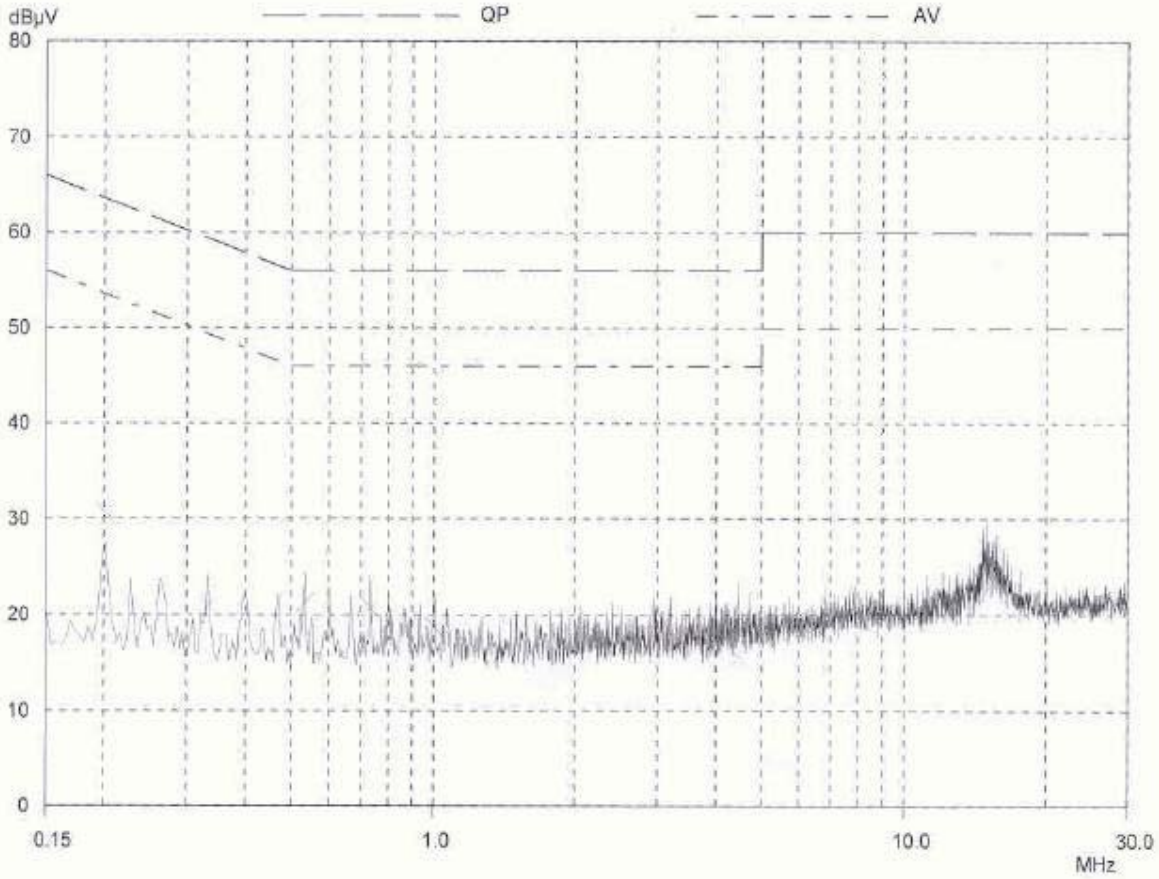
Note : 1. Please see appendix 9 for Plotted Data
2. The expanded uncertainty of the power density tests is 2dB.

Appendix 1 : Plotted Data of Power Line Conducted Emissions

CONDUCTION EMISSION TEST

EUT:
Manuf:
Op Cond: Max. Power(Low Channel)
Operator:
Test Spec: EN55013
Comment: N

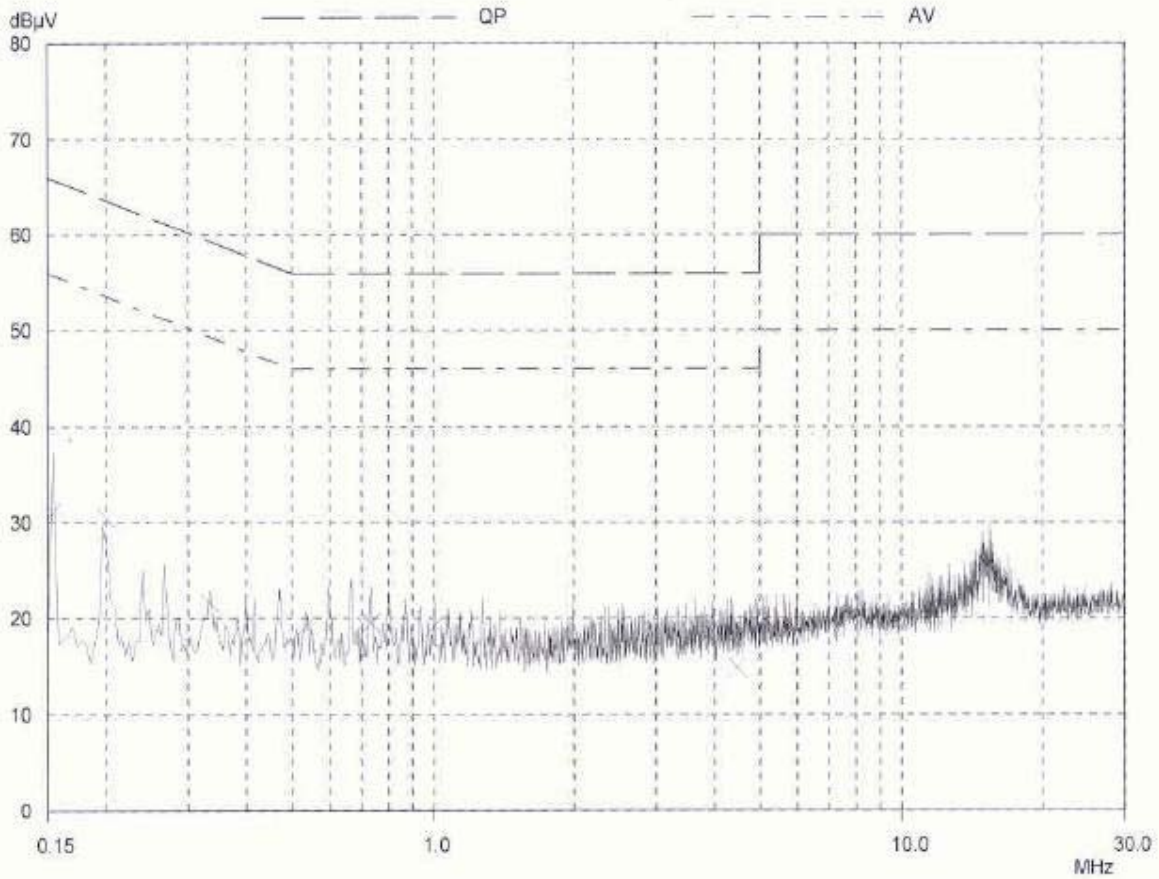
Final Measurement:
Detector: X QP
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB



CONDUCTION EMISSION TEST

EUT:
Manuf:
Op Cond: Max. Power(Low Channel)
Operator:
Test Spec: EN55013
Comment: L1

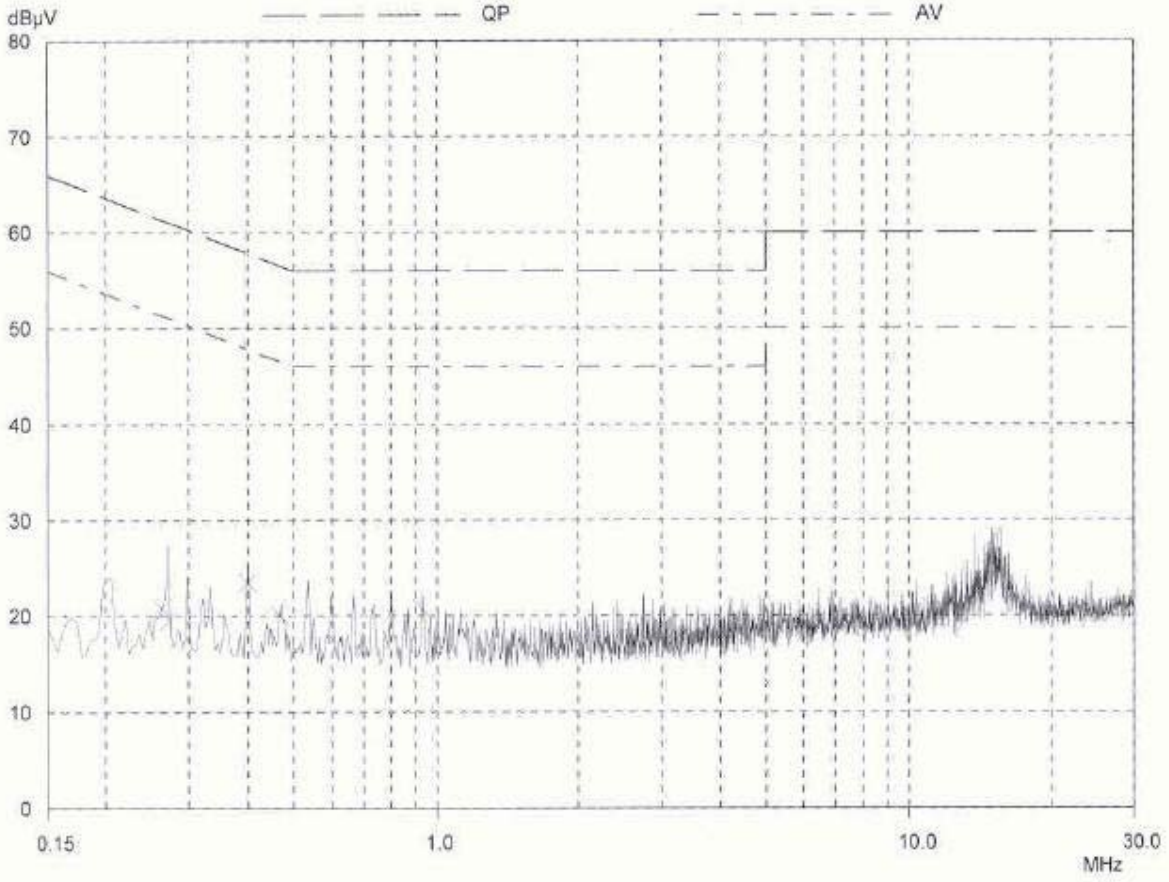
Final Measurement:
Detector: X QP
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB



CONDUCTION EMISSION TEST

EUT:
Manuf:
Op Cond: Max. Power(M id Channel)
Operator:
Test Spec: EN55013
Comment: N

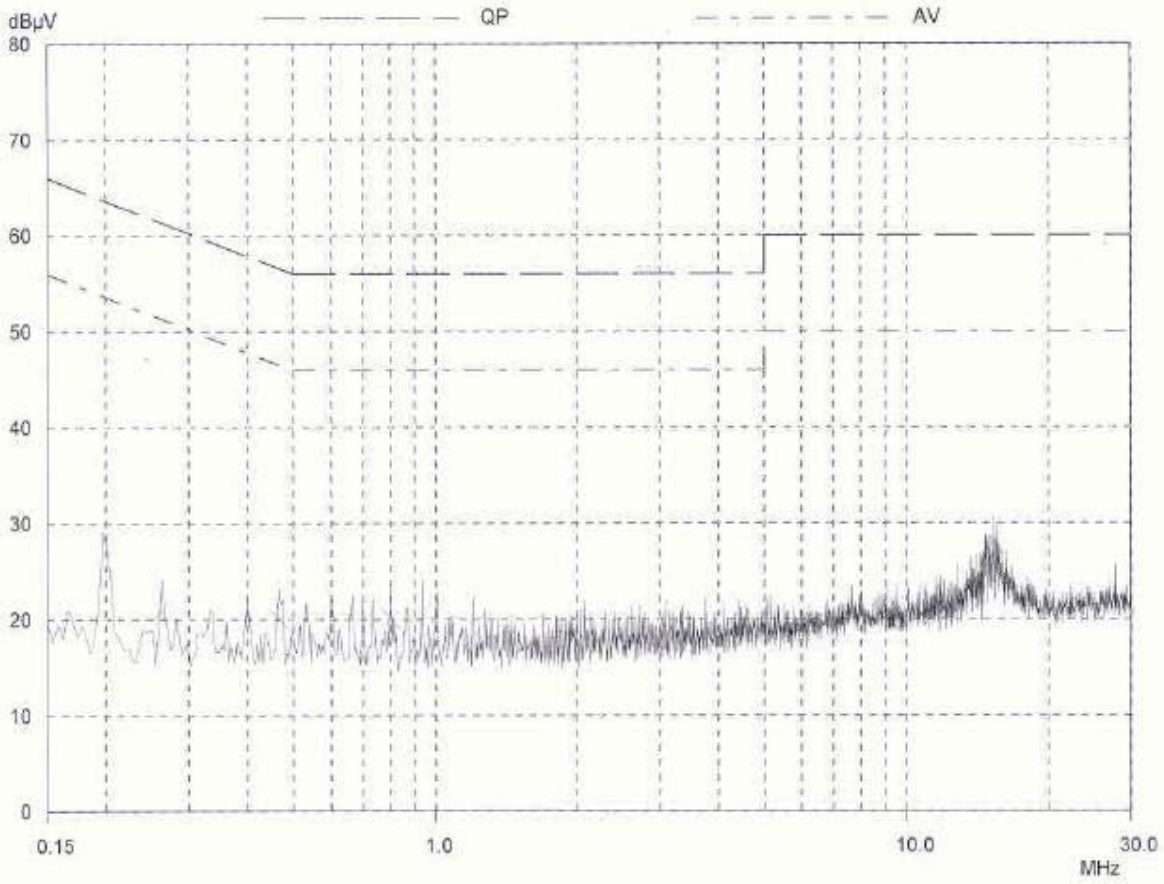
Final Measurement:
Detector: X QP
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB



CONDUCTION EMISSION TEST

EUT:
Manuf:
Op Cond: Max. Power(M id Channel)
Operator:
Test Spec: EN55013
Comment: L1

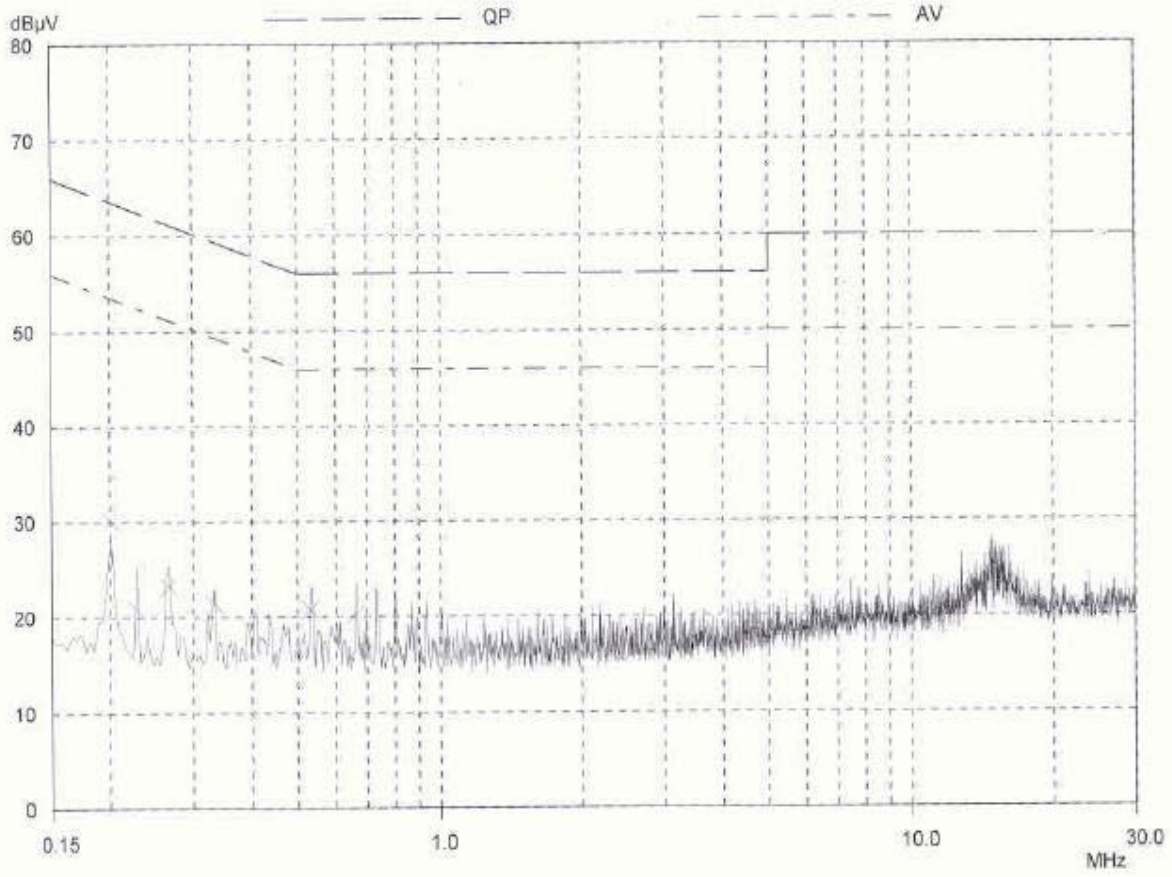
Final Measurement:
Detector: X QP
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB



CONDUCTION EMISSION TEST

EUT:
Manuf:
Op Cond: Max. Power(Hi Channel)
Operator:
Test Spec: EN55013
Comment: N

Final Measurement:
Detector: X QP
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB

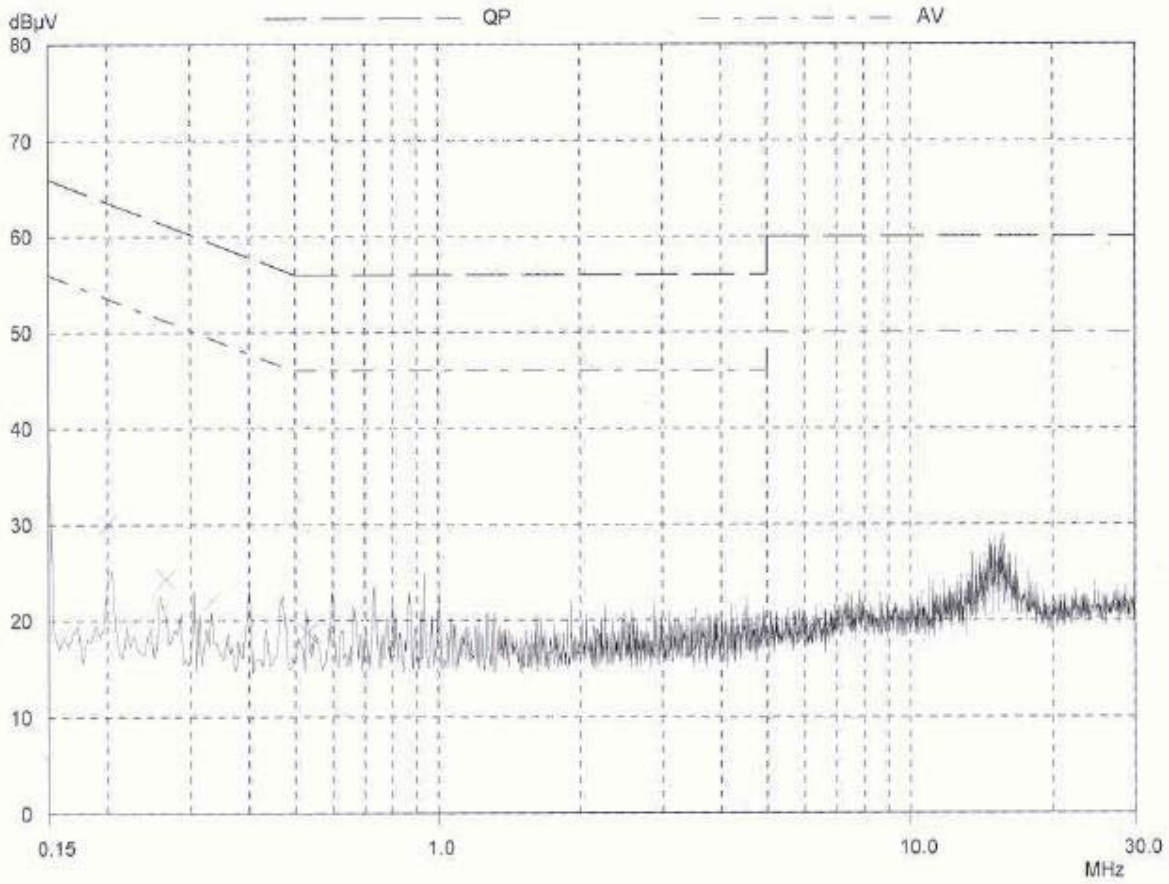


CONDUCTION EMISSION TEST

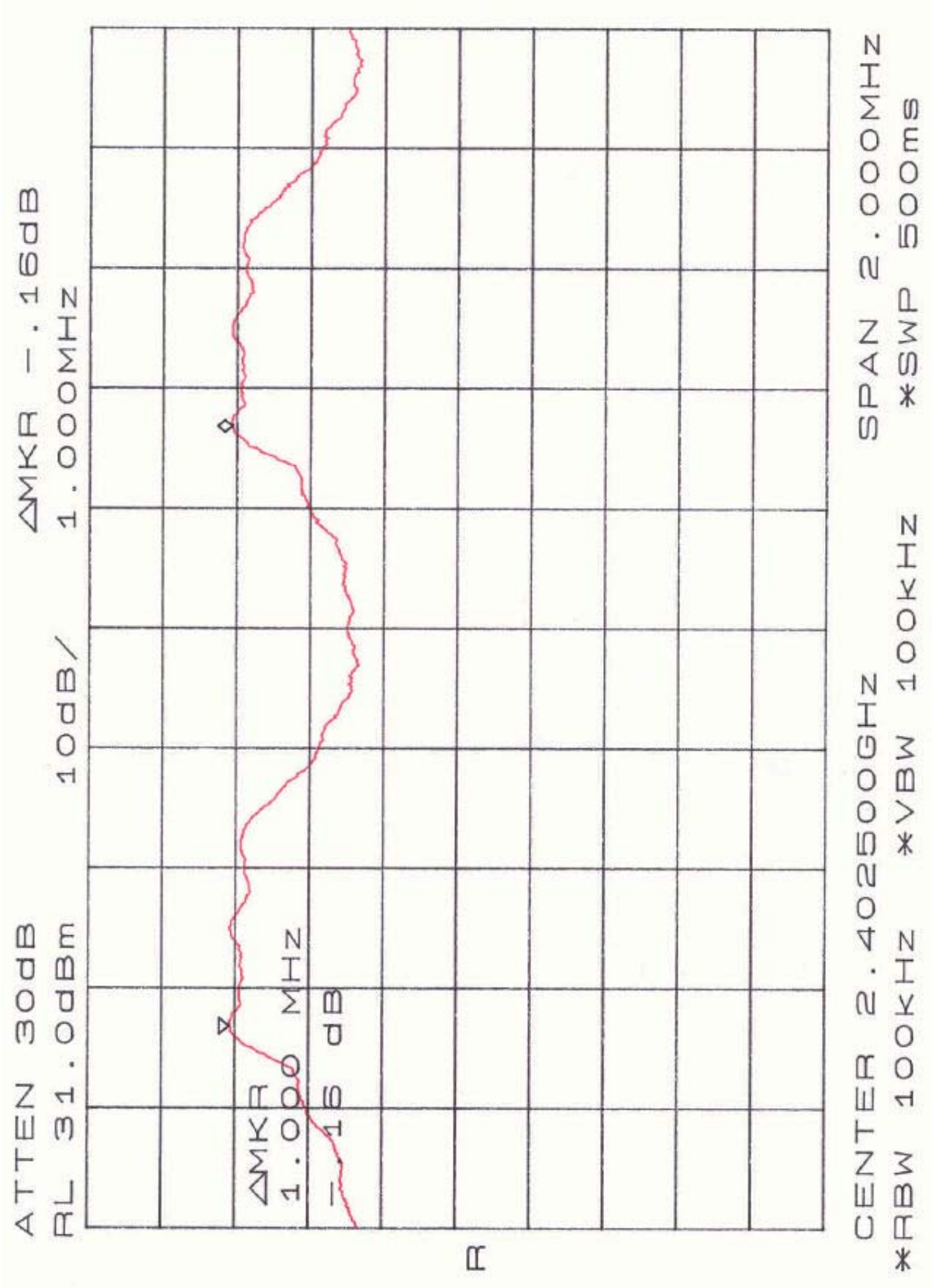
EUT:
Manuf:
Op Cond: Max. Power(Hi Channel)
Operator:
Test Spec: EN55013
Comment: L1

Final Measurement:

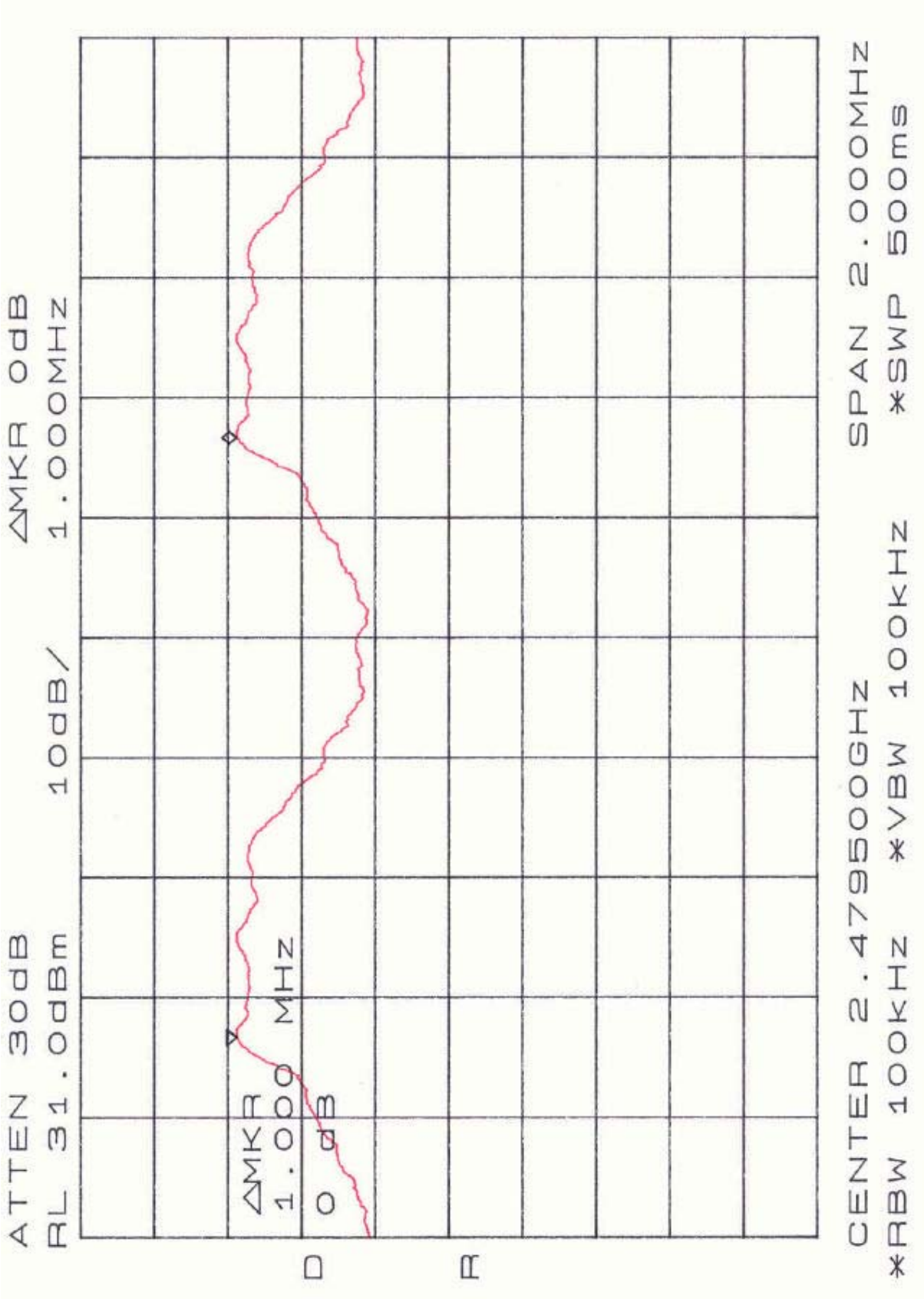
Detector:	X QP
Meas Time:	1sec
Peaks:	8
Acc Margin:	25 dB

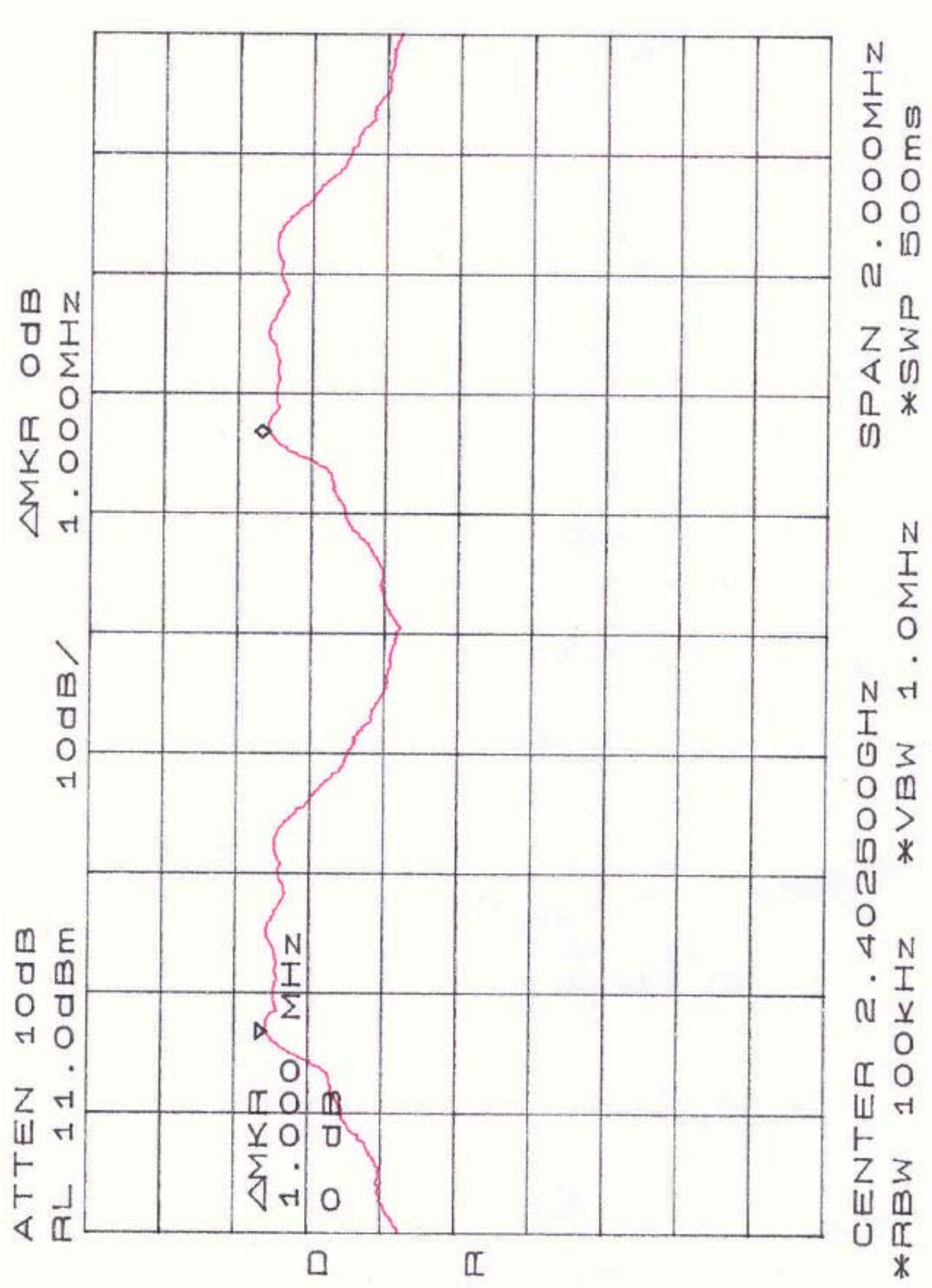


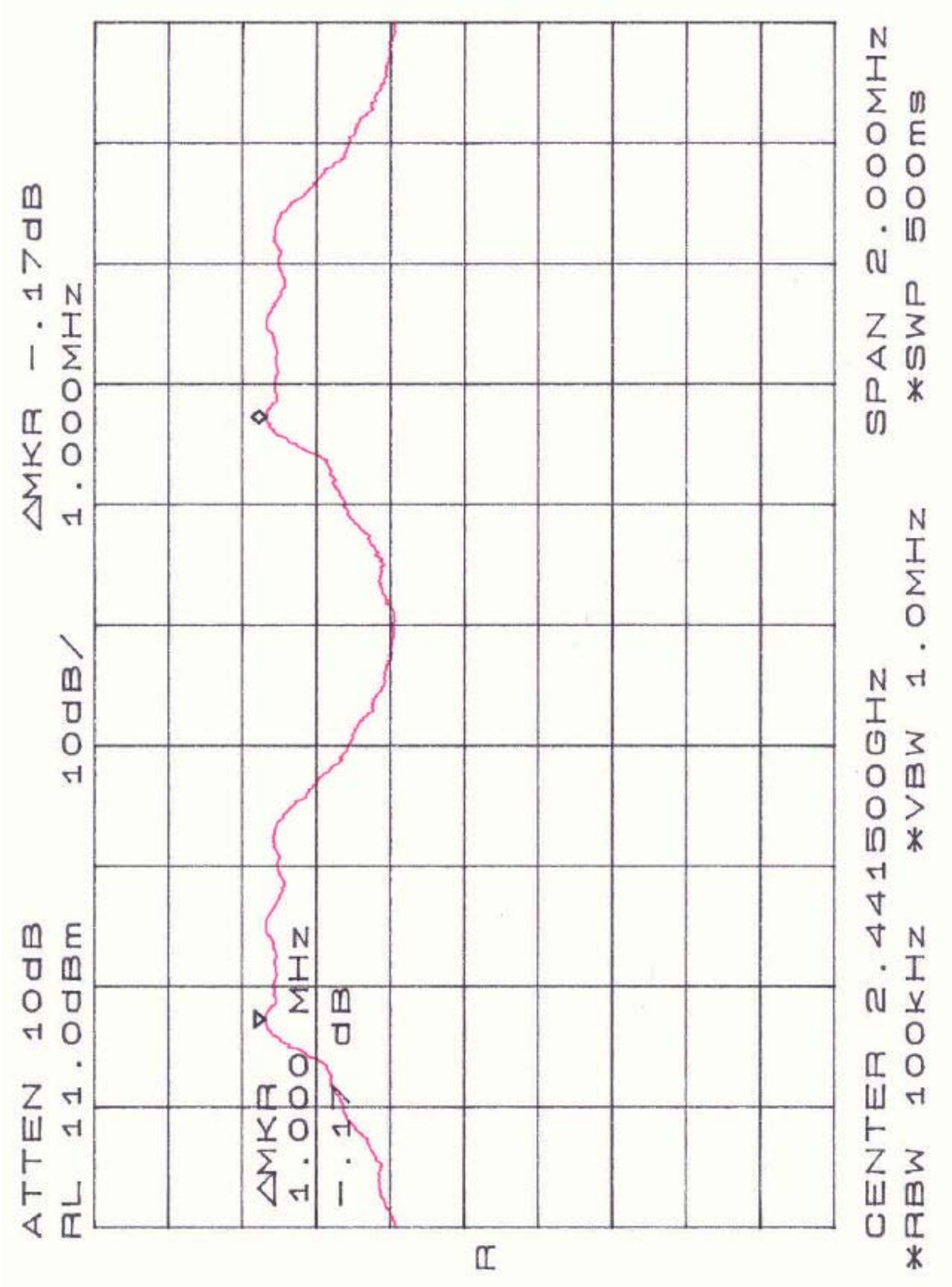
Appendix 2 : Plotted Data for Separation of Adjacent Channel

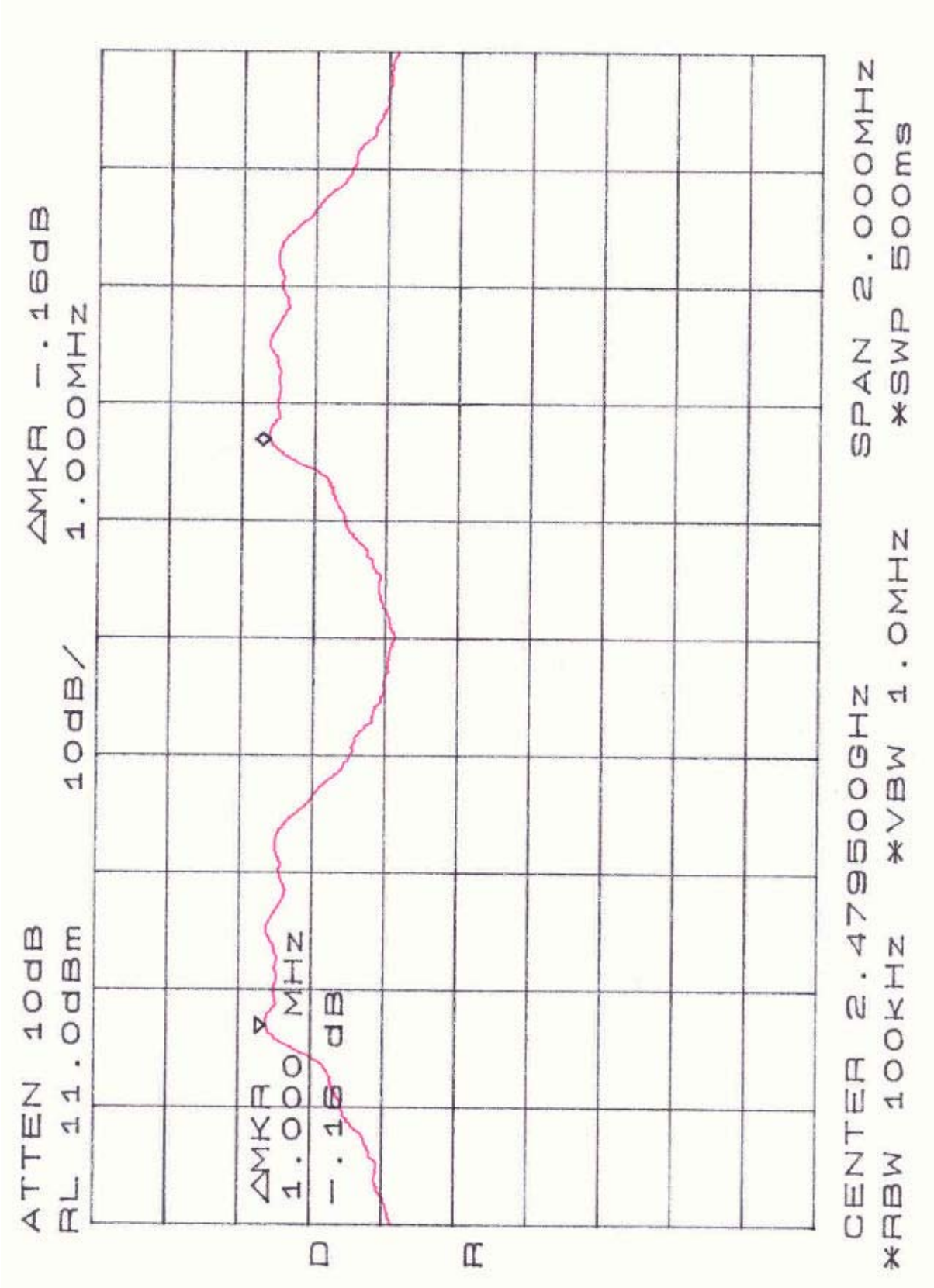

ATTEN 30dB
RL 31.0dBm
10dB/
ΔMKR -.16dB
1.000MHz
ΔMKR
1.000 MHz
-.16 dB
CENTER 2.402500GHz
*RBW 100kHz
*VBW 100kHz
SPAN 2.000MHz
*SWP 500ms

ATTEN 30dB
RL 31.0dBm
10dB/
ΔMKR -.17dB
1.000MHz
ΔMKR
1.000 MHz
-.17 dB
CENTER 2.44050GHz
*RBW 100kHz
*VBW 100kHz
SPAN 2.000MHz
*SWP 500ms

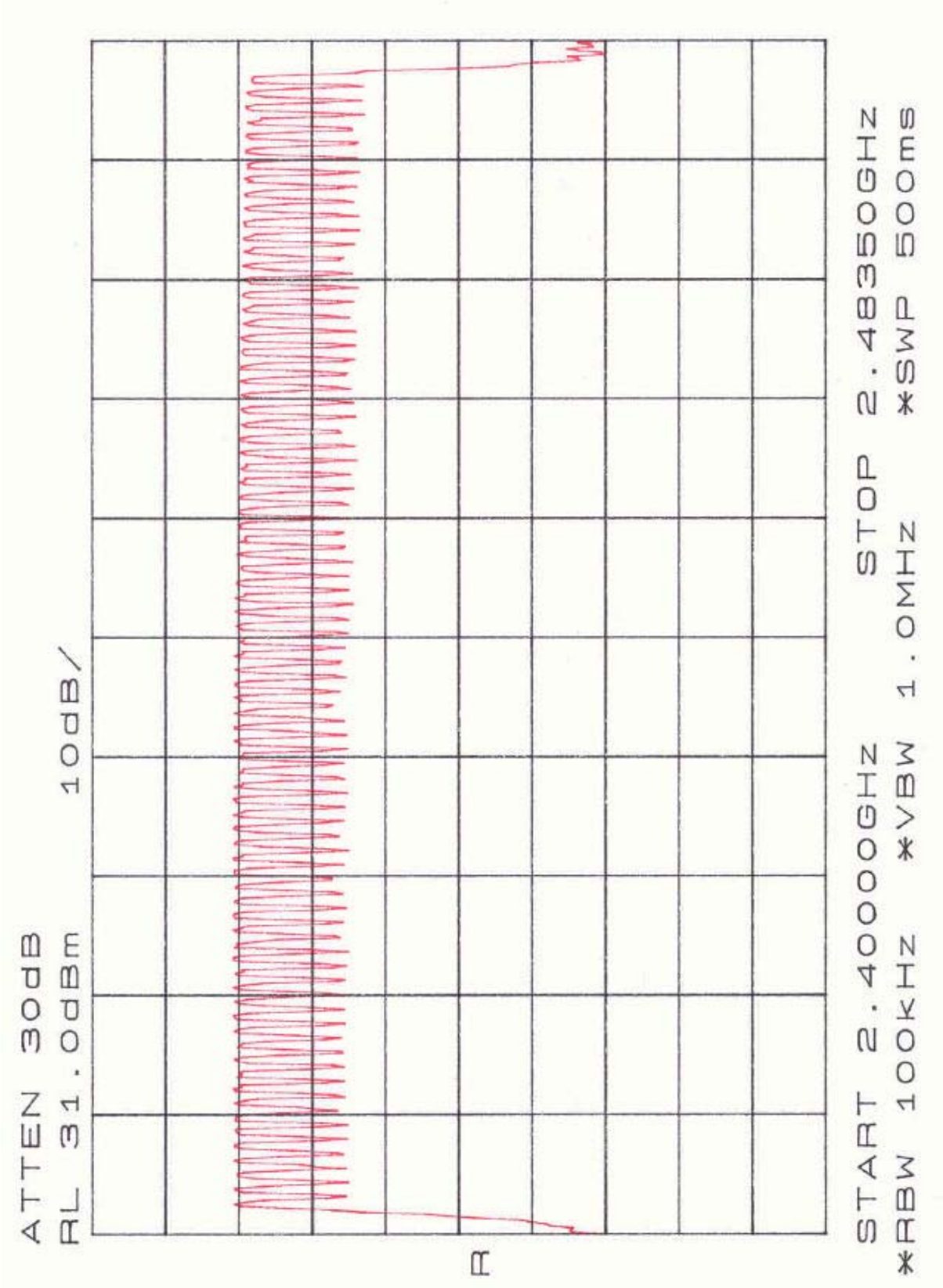

ATTEN 30dB
RL 31.0dBm
10dB/
ΔMKR 0dB
1.000MHz
ΔMKR
1.000
MHz
0 dB
CENTER 2.479500GHz
*RBW 100kHz
*VBW 100kHz
SPAN 2.000MHz
*SWP 500ms

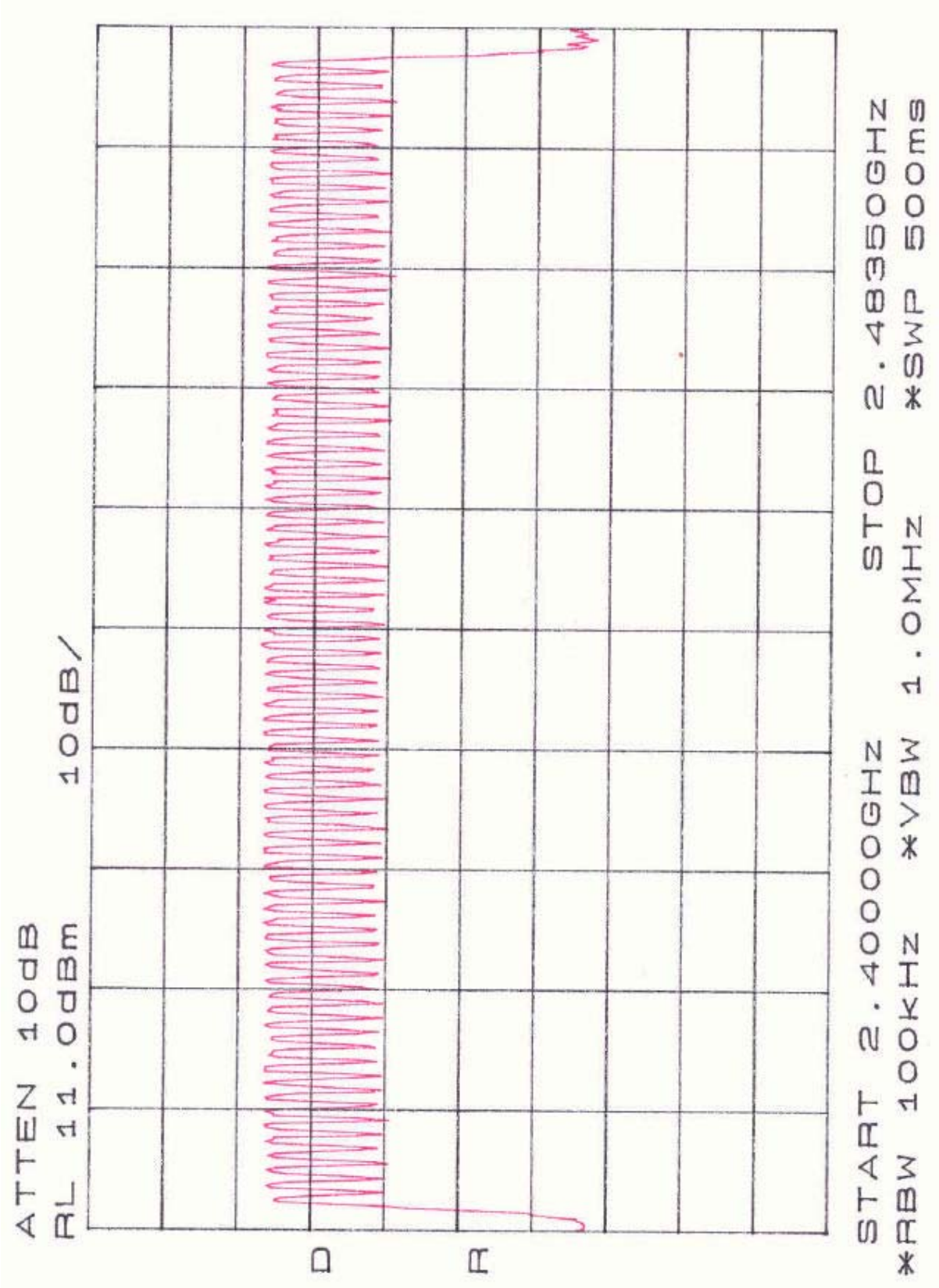

ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR 0dB
1.000MHz
ΔMKR
1.000
MHz
0 dB
CENTER 2.402500GHz
*RBW 100kHz
*VBW 1.0MHz
SPAN 2.000MHz
*SWP 500ms


ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR -.17dB
1.000MHz
ΔMKR
1.000 MHz
-.17 dB
CENTER 2.44150GHz
*RBW 100kHz
*VBW 1.0MHz
SPAN 2.000MHz
*SWP 500ms

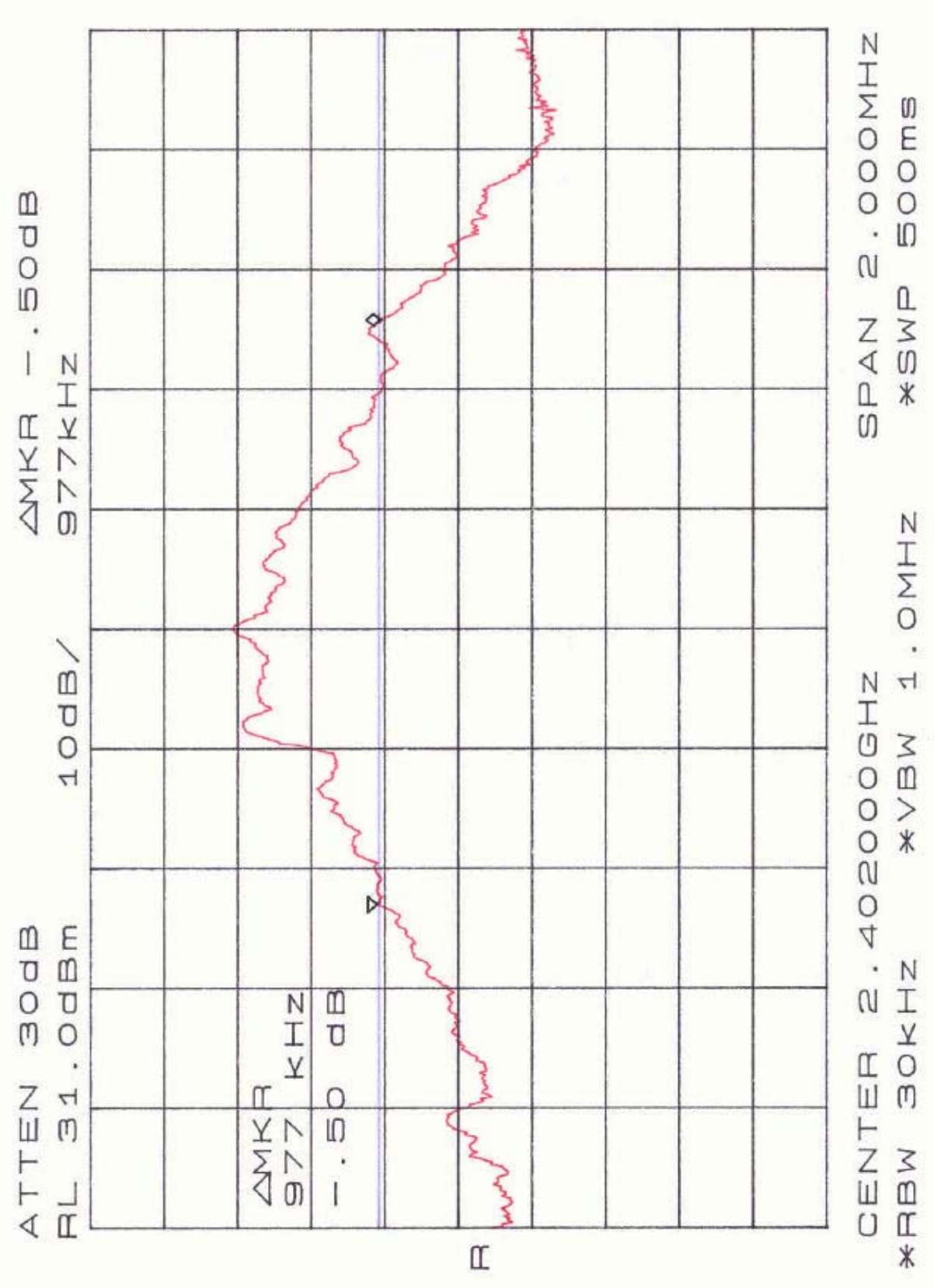

ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR -.16dB
1.000MHz
ΔMKR
1.000 MHz
-.16 dB
D
R
CENTER 2.47950GHz
*RBW 100kHz
*VBW 1.0MHz
SPAN 2.000MHz
*SWP 500ms

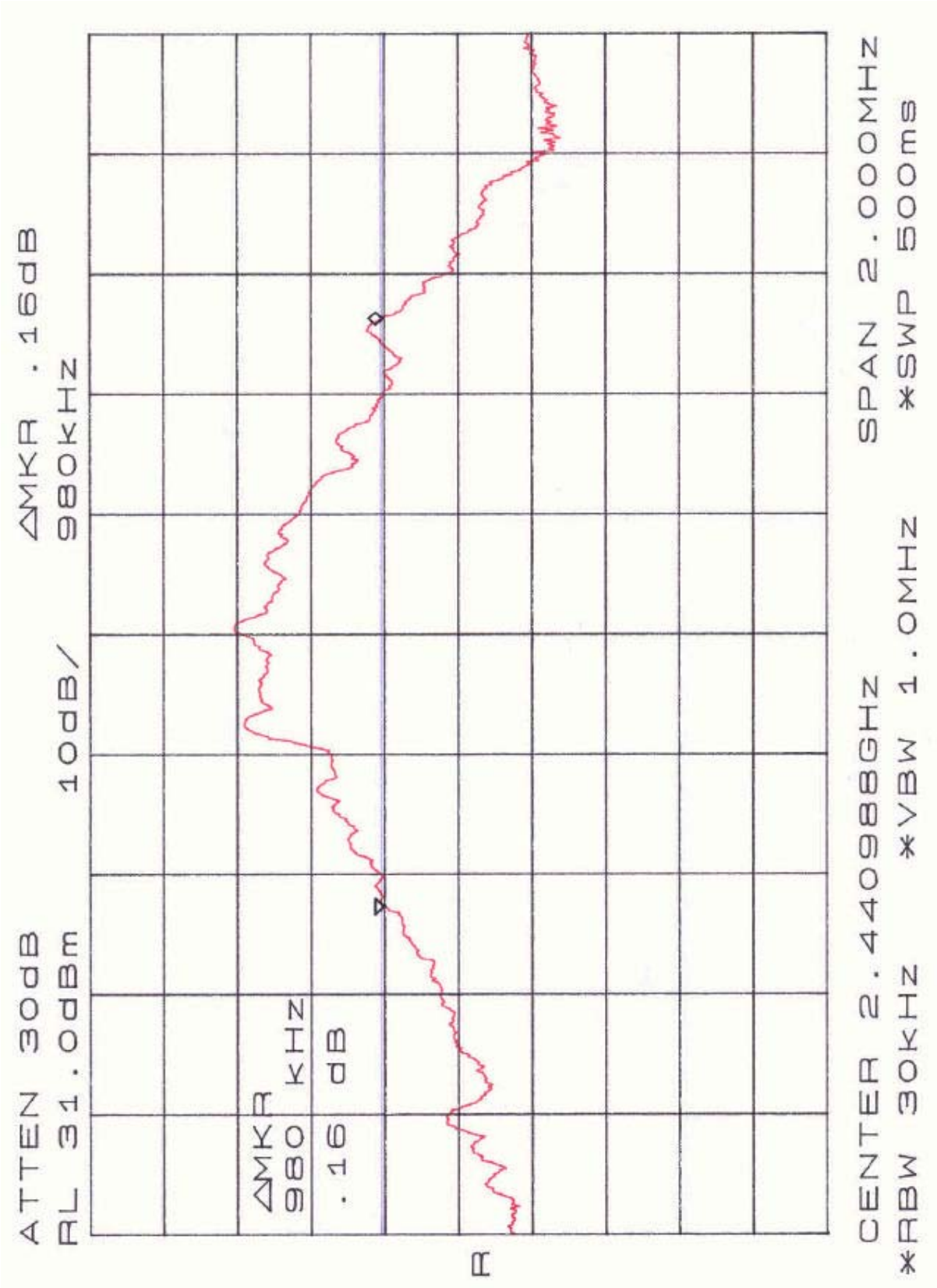
Appendix 3 : Plotted Data for Total Used Hopping Frequencies

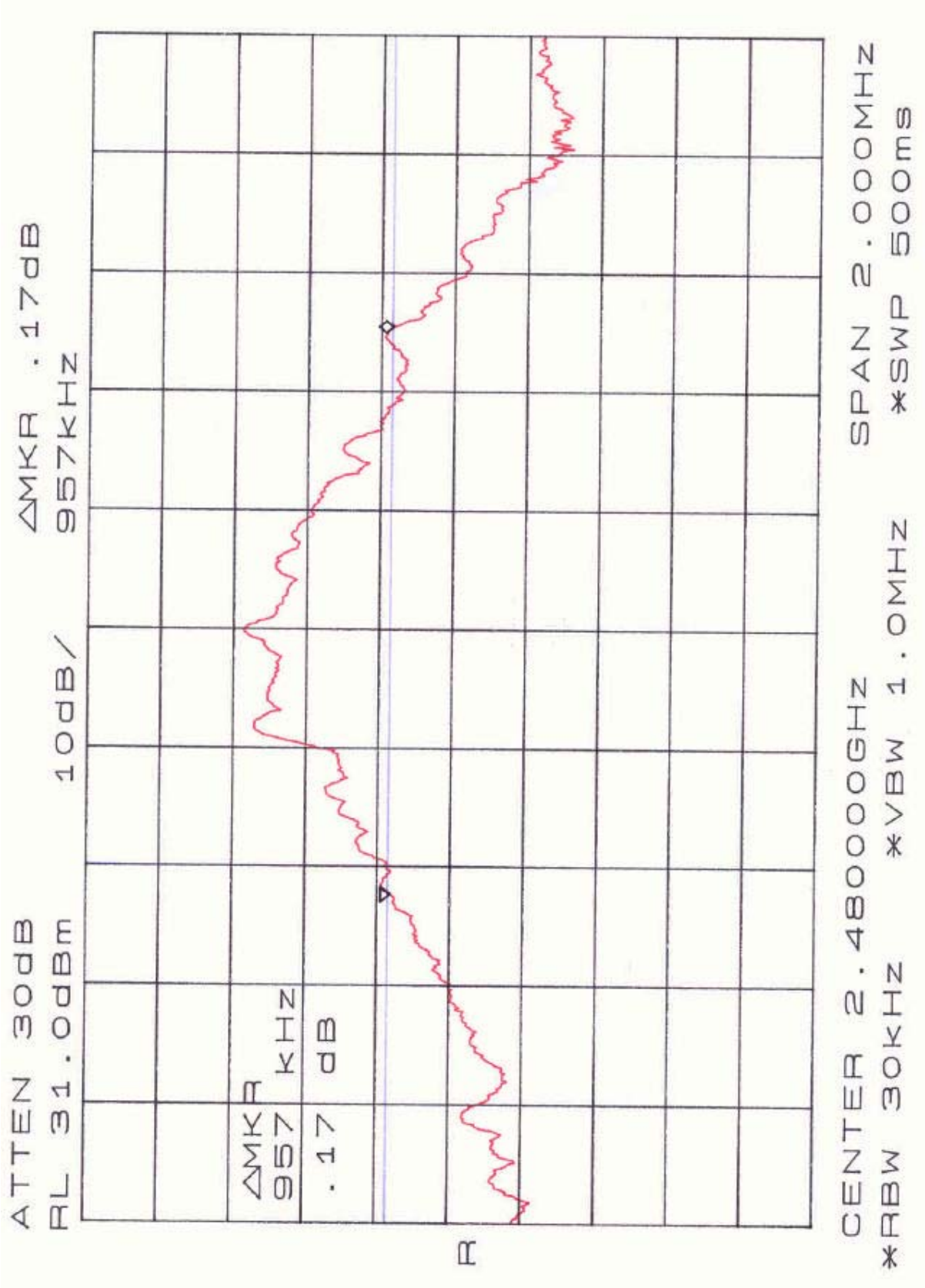

ATTEN 30dB
RL 31.0dBm
10dB/
R
START 2.40000GHz
*RBW 100kHz
*VBW 1.0MHz
STOP 2.48350GHz
*SWP 50ms

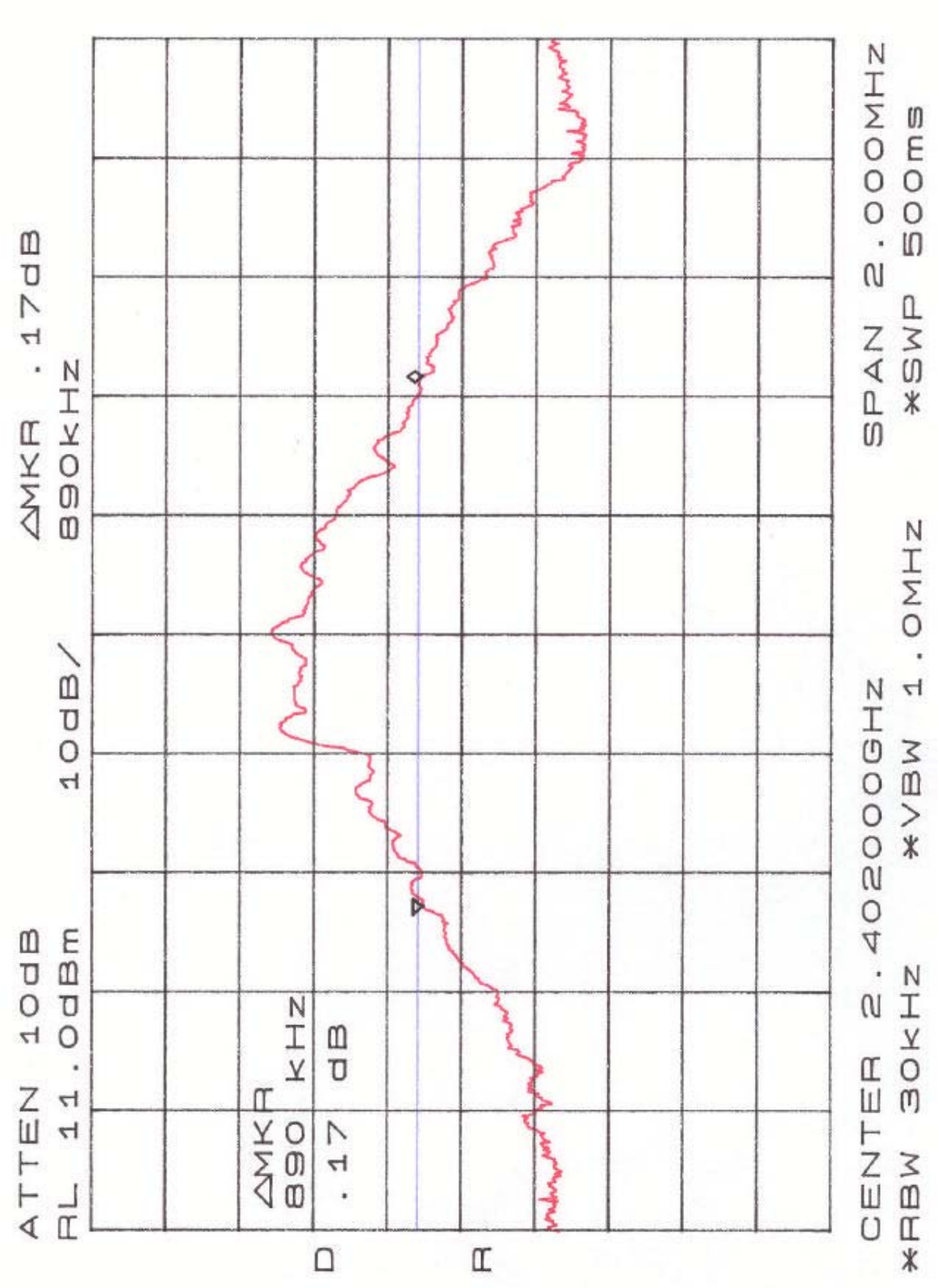

ATTEN 10dB
RL 11.0dBm
10dB/
D
R
START 2.40000GHz
*RBW 100KHz
*VBW 1.0MHz
STOP 2.48350GHz
*SWP 500ms

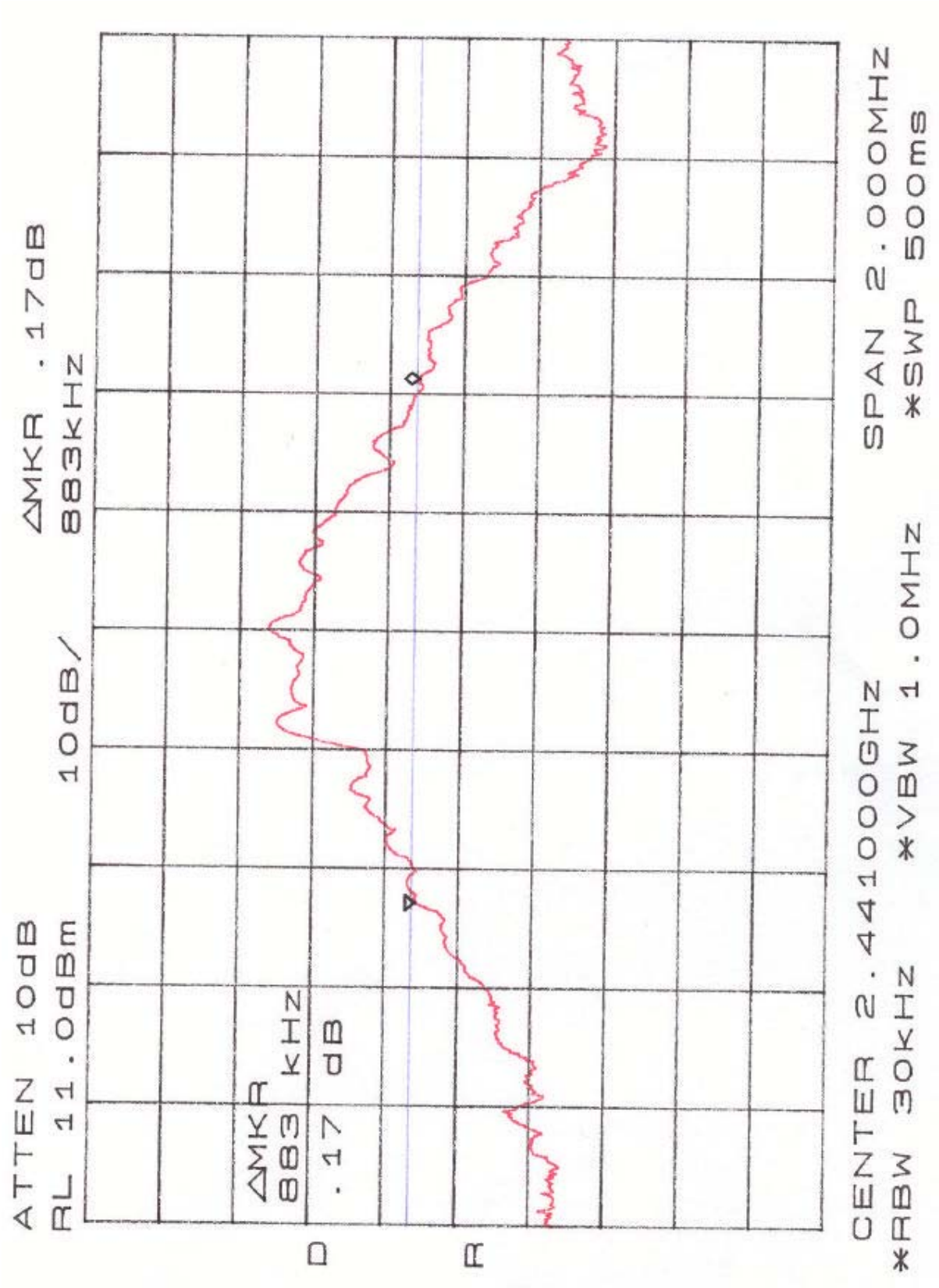
Appendix 4 : Plotted Data for Channel Bandwidth

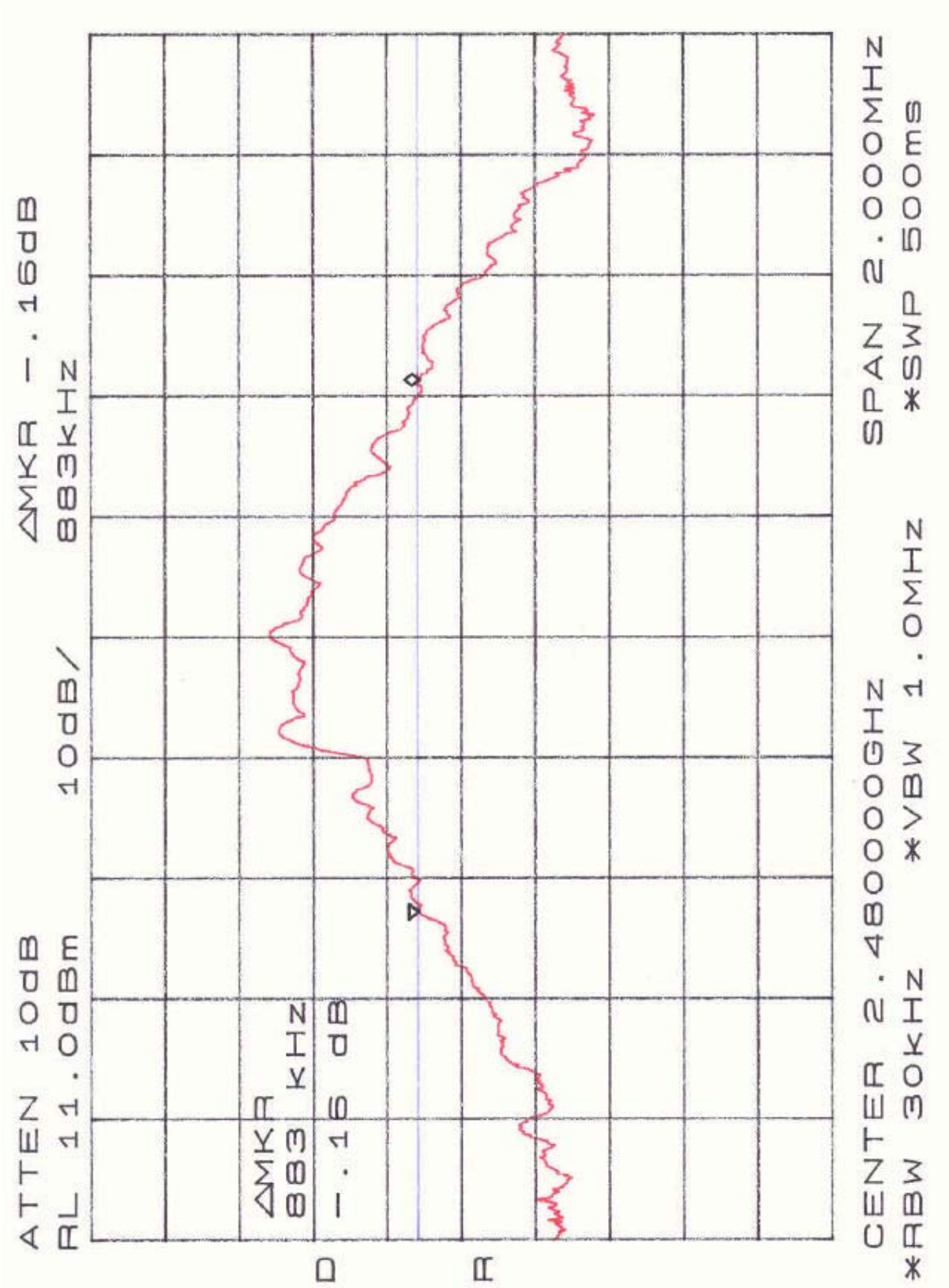

ATTEN 30dB
RL 31.0dBm
10dB/
ΔMKR -.50dB
977kHz
ΔMKR
977 kHz
-.50 dB
CENTER 2.402000GHz
*RBW 30kHz
*VBW 1.0MHz
SPAN 2.000MHz
*SWP 500ms


ATTEN 30dB
RL 31.0dBm
10dB/
ΔMKR .16dB
980kHz
ΔMKR
980 kHz
.16 dB
CENTER 2.44098GHz
*RBW 30kHz
*VBW 1.0MHz
SPAN 2.000MHz
*SWP 500ms

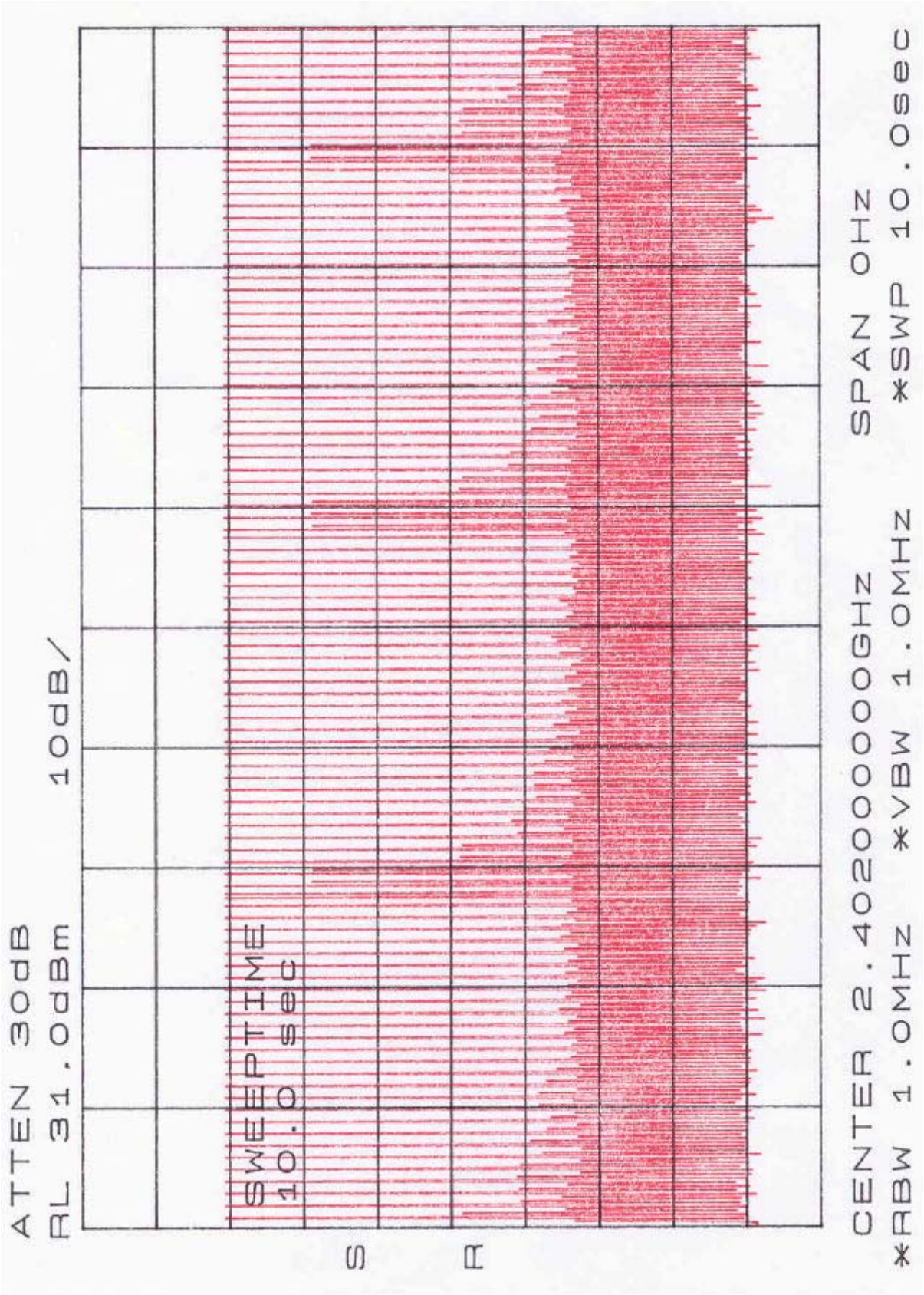

ATTEN 30dB
RL 31.0dBm
10dB/
ΔMKR .17dB
957kHz
ΔMKR
957 kHz
.17 dB
R
CENTER 2.48000GHz
*RBW 30kHz
*VBW 1.0MHz
SPAN 2.000MHz
*SWP 500ms

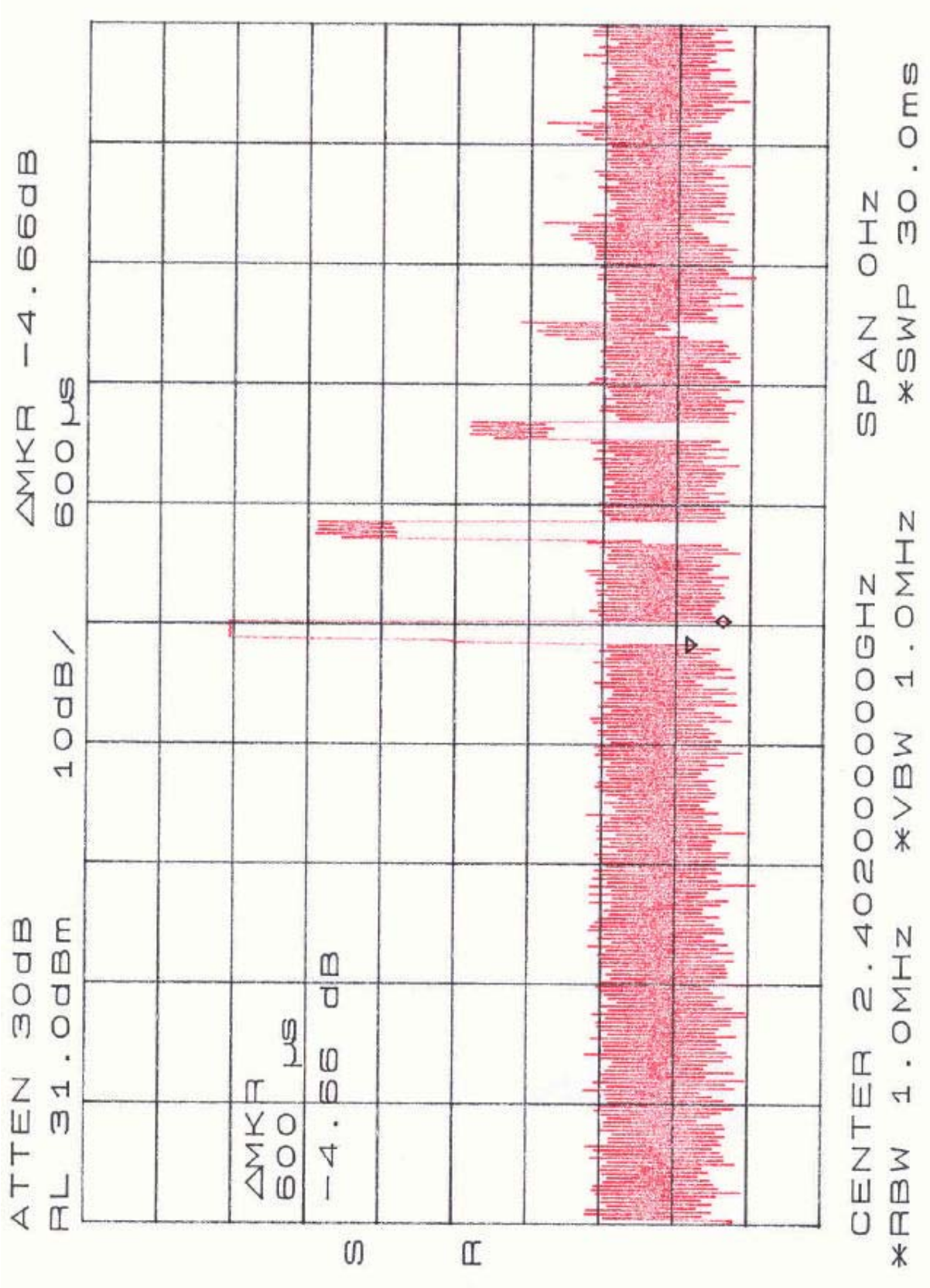

ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR .17dB
890kHz
ΔMKR
890 kHz
.17 dB
D
R
CENTER 2.402000GHz
*RBW 30kHz
*VBW 1.0MHz
SPAN 2.000MHz
*SWP 500ms

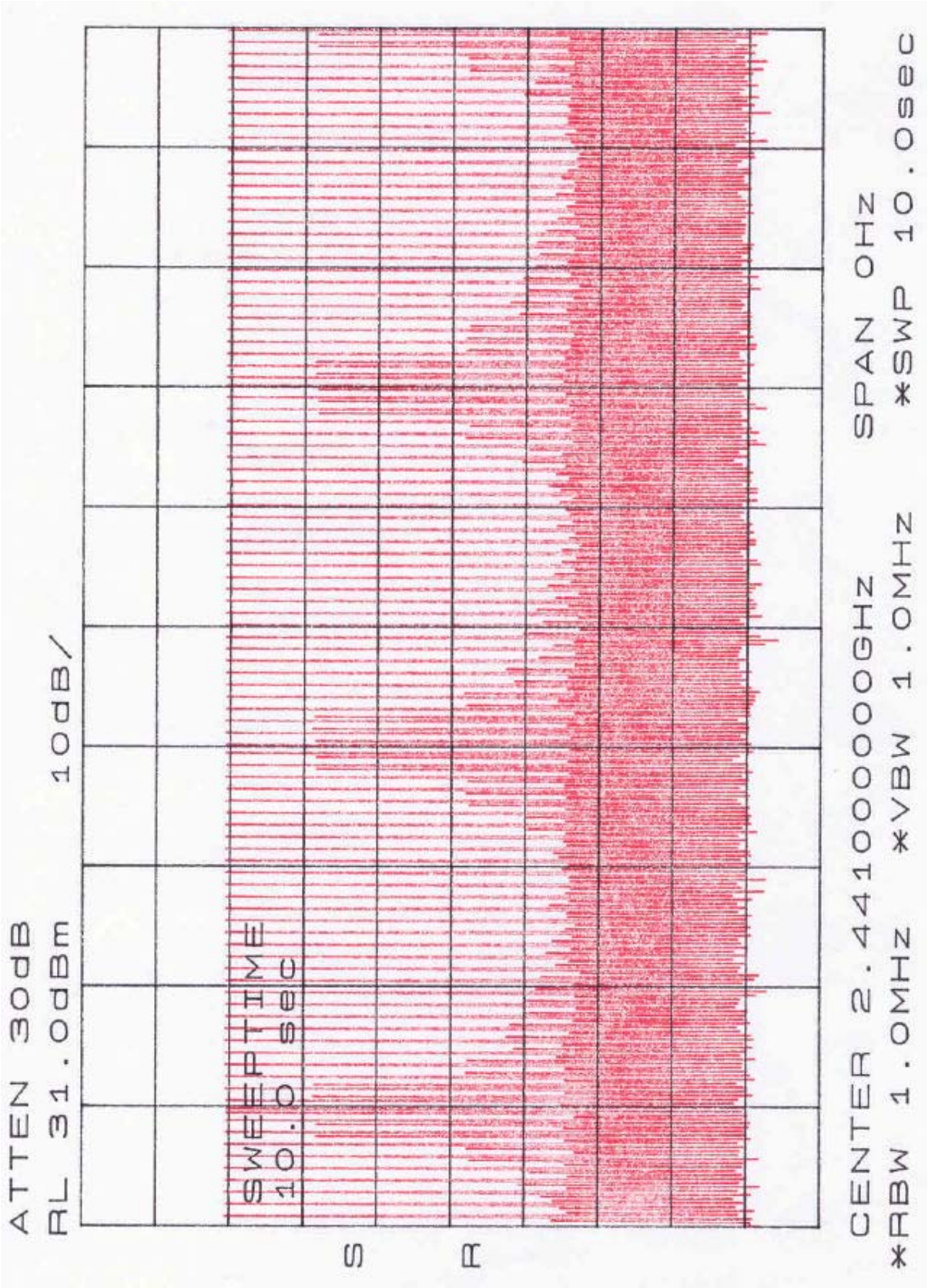

ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR .17dB
883kHz
ΔMKR
883 kHz
.17 dB
D
R
CENTER 2.44100GHz
*RBW 30kHz
*VBW 1.0MHz
SPAN 2.000MHz
*SWP 500ms

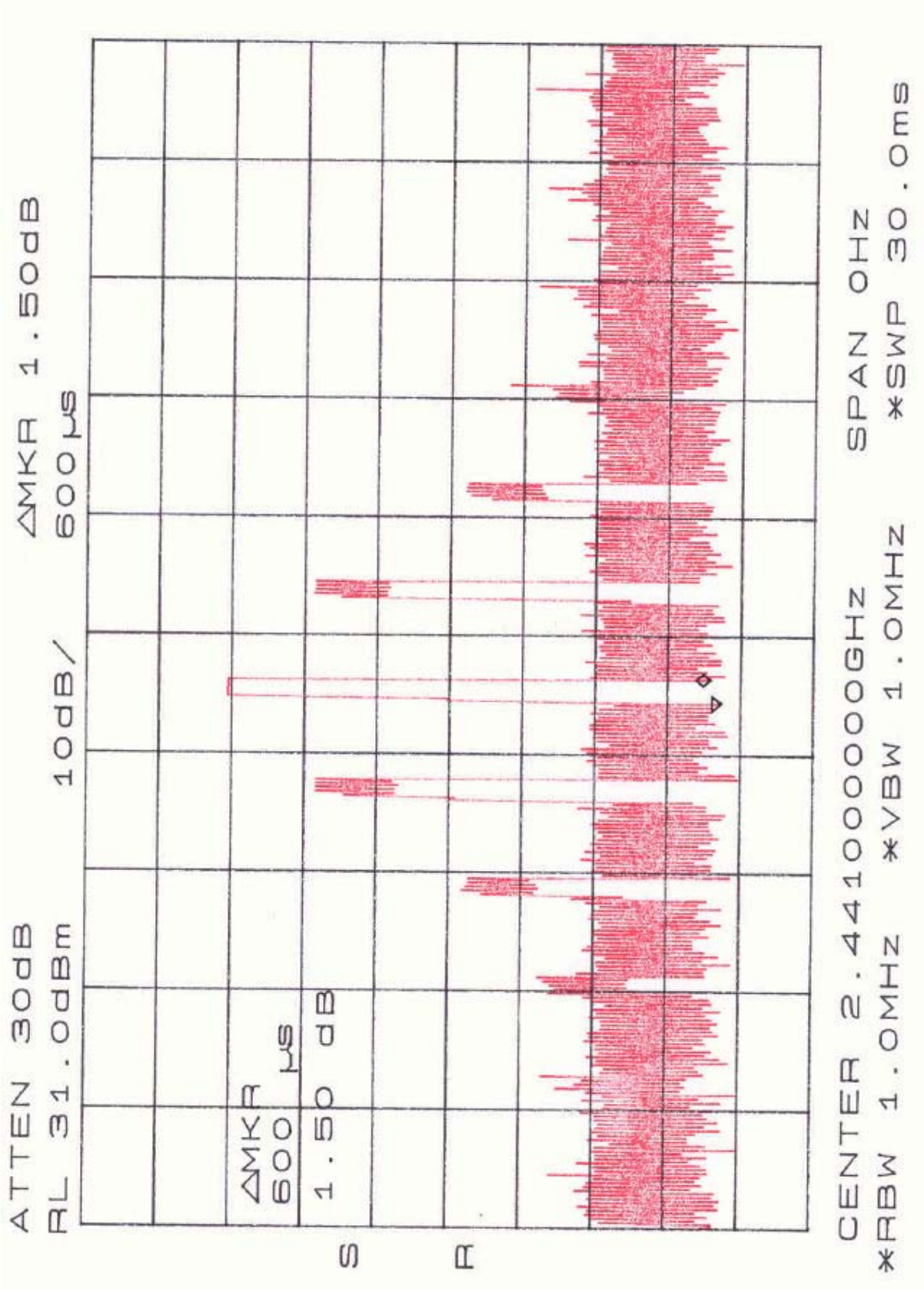

ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR -.16dB
883kHz
ΔMKR
883 kHz
-.16 dB
D
R
CENTER 2.48000GHz
*RBW 30kHz
*VBW 1.0MHz
SPAN 2.000MHz
*SWP 500ms

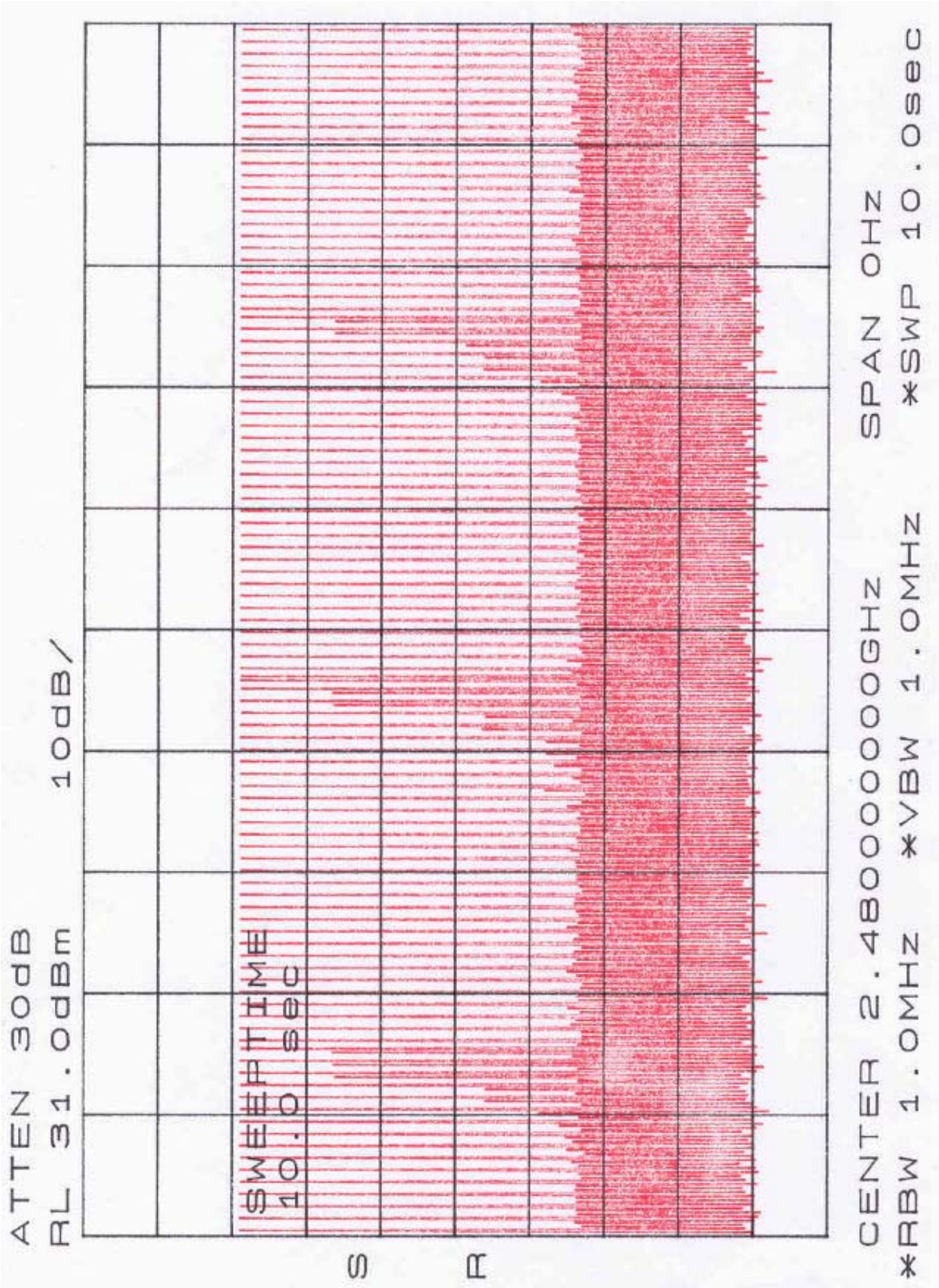
Appendix 5 : Plotted Data for Channel Dwell Time

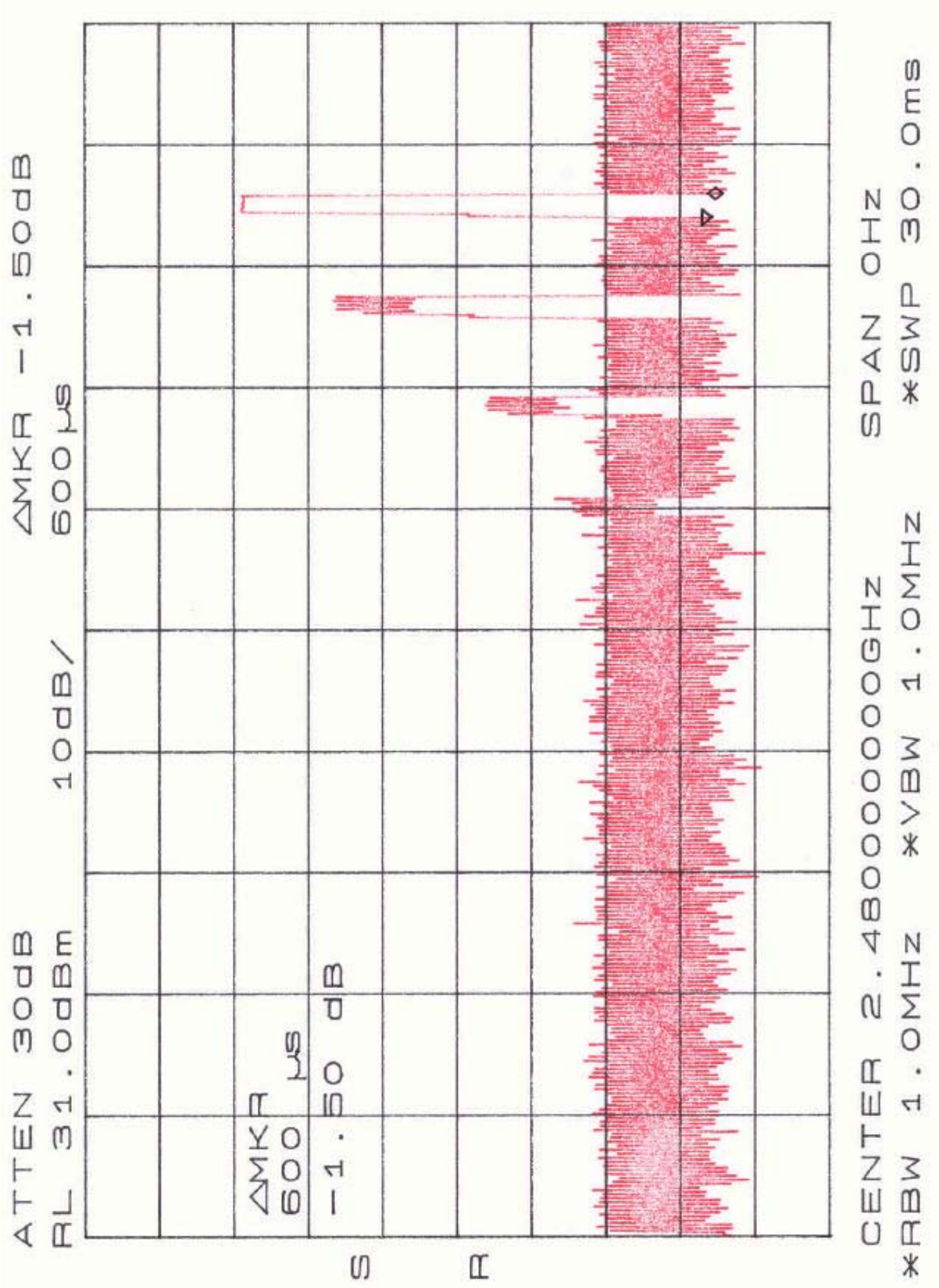

ATTEN 30dB
RL 31.0dBm
10dB/
SWEEP TIME
10.0 sec
S
R
CENTER 2.402000000GHz
*RBW 1.0MHz
*VBW 1.0MHz
SPAN 0Hz
*SWP 10.0sec

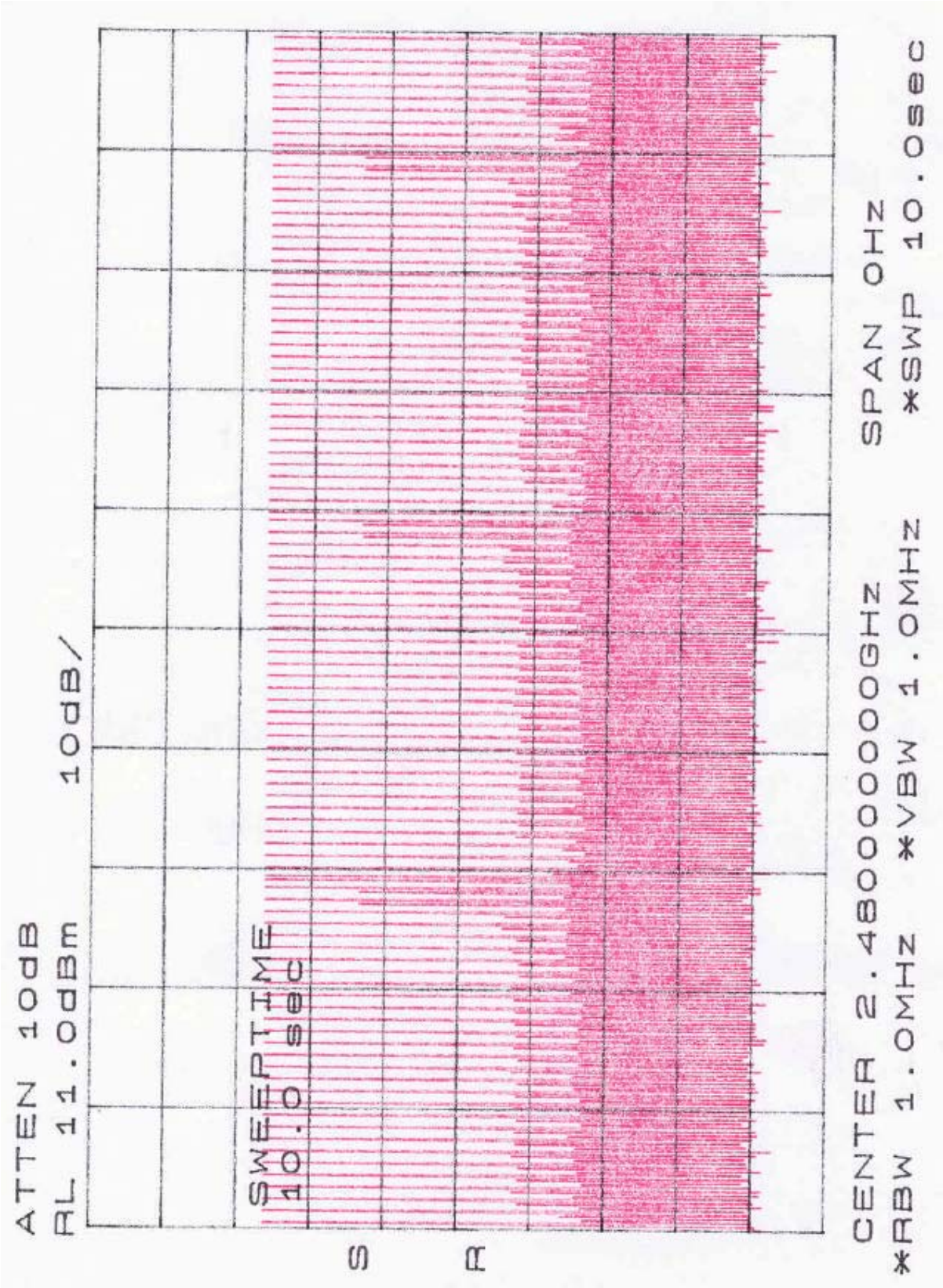

ATTEN 30dB
RL 31.0dBm
10dB/
ΔMKR -4.66dB
600 μs
ΔMKR
600 μs
-4.66 dB
S
R
CENTER 2.402000000GHz
*RBW 1.0MHz
*VBW 1.0MHz
SPAN 0Hz
*SWP 30.0ms

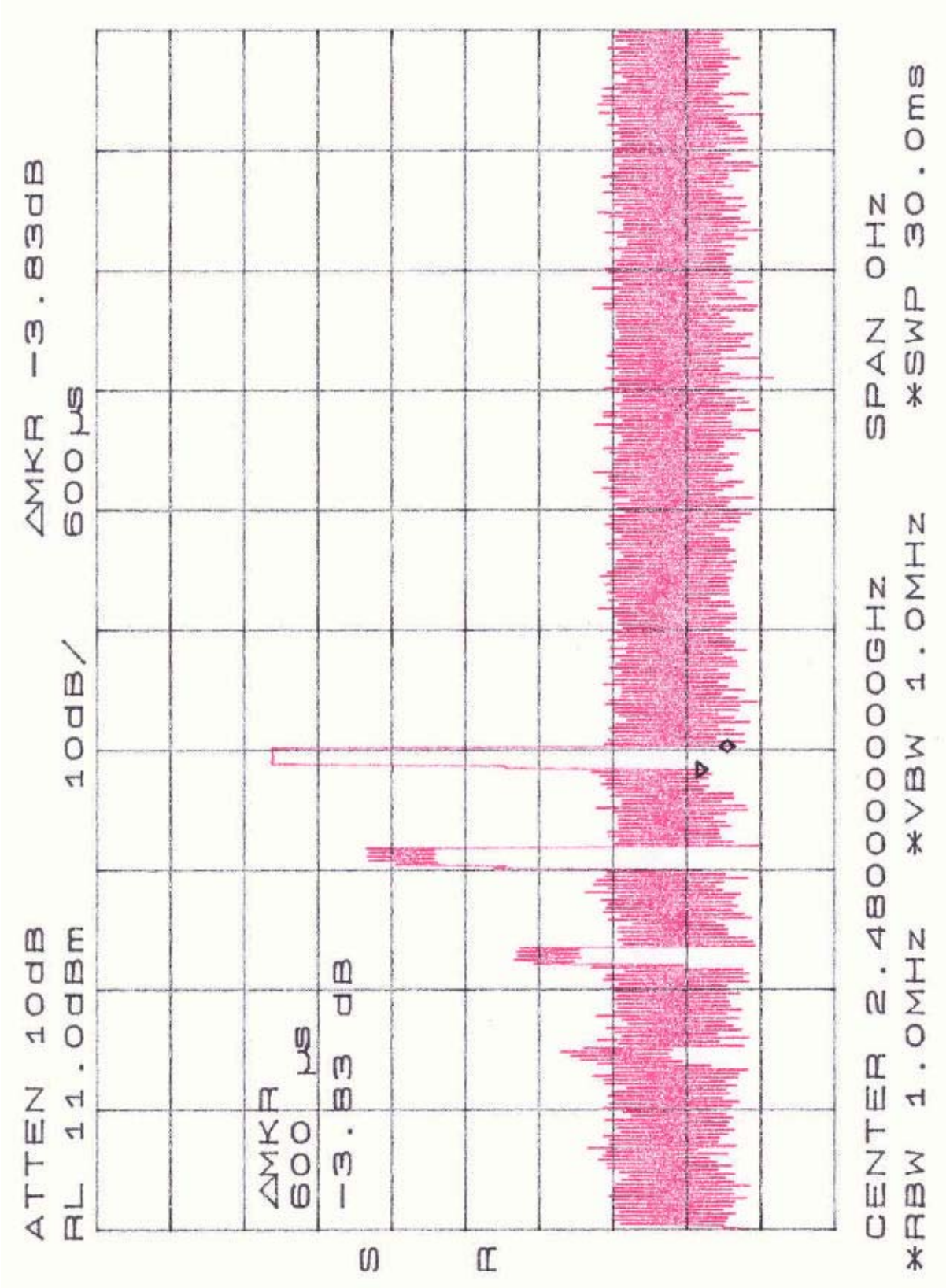

ATTEN 30dB
RL 31.0dBm
10dB/
SWEEPTIME
10.0 sec
S
R
CENTER 2.441000000GHz
*RBW 1.0MHz
*VBW 1.0MHz
SPAN 0Hz
*SWP 10.0sec

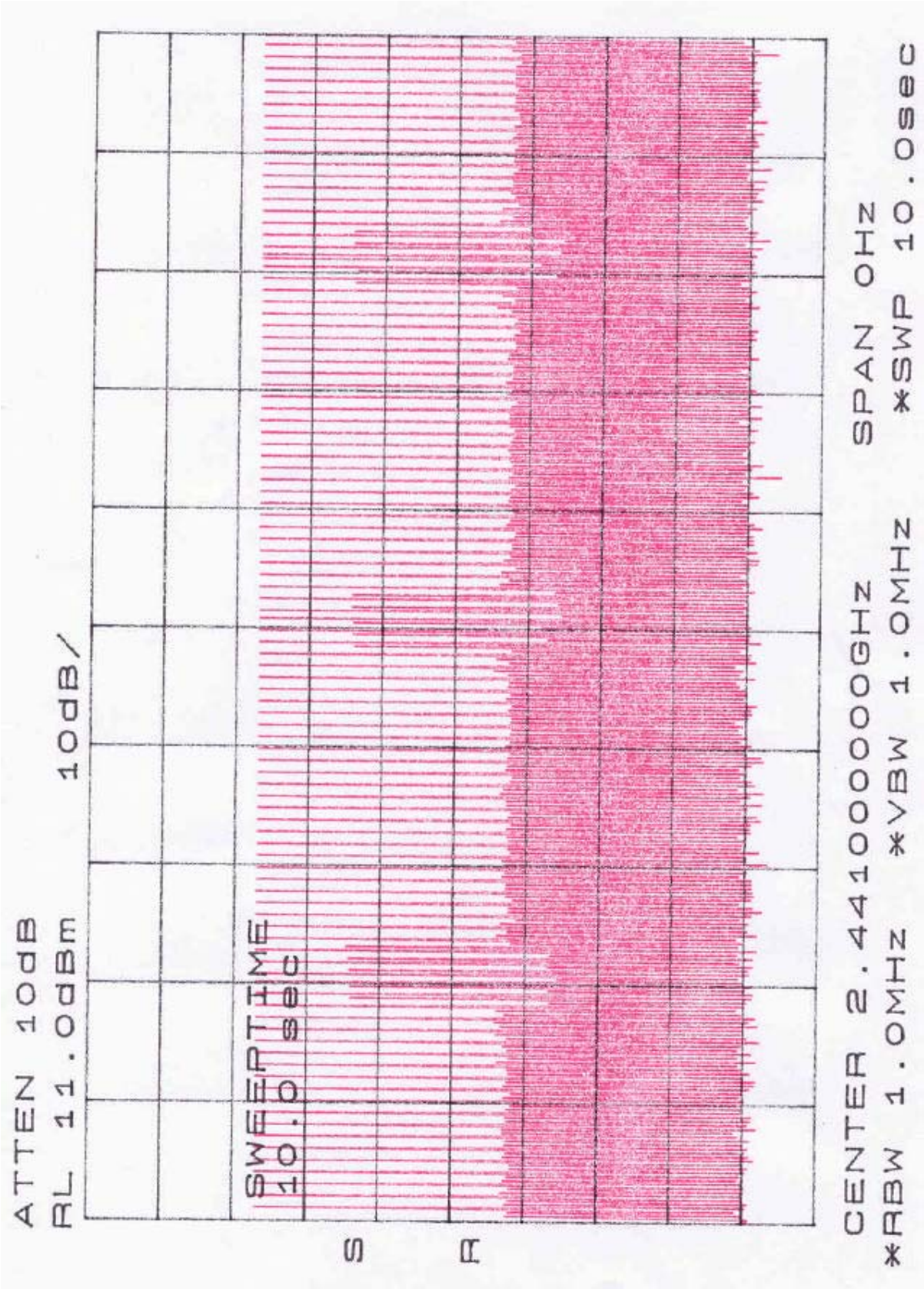

ATTEN 30dB
RL 31.0dBm
10dB/
ΔMKR 1.50dB
600 μs
ΔMKR
600 μs
1.50 dB
S
R
CENTER 2.441000000GHz
*RBW 1.0MHz
*VBW 1.0MHz
SPAN 0Hz
*SWP 30.0ms

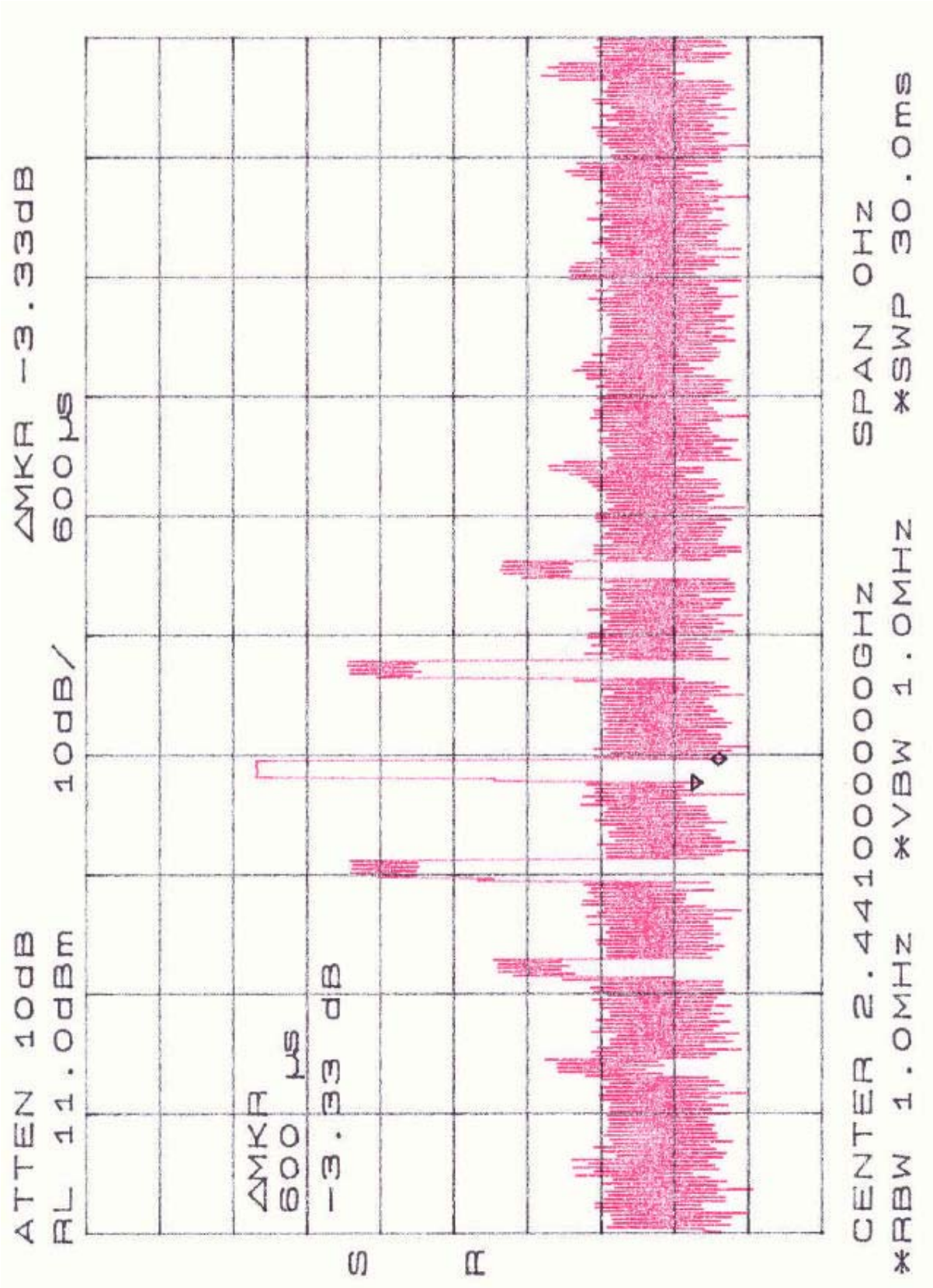

ATTEN 30dB
RL 31.0dBm 10dB/
SWEEPTIME
10.0sec
S
R
CENTER 2.48000000GHz SPAN 0Hz
*RBW 1.0MHz *VBW 1.0MHz *SWP 10.0sec

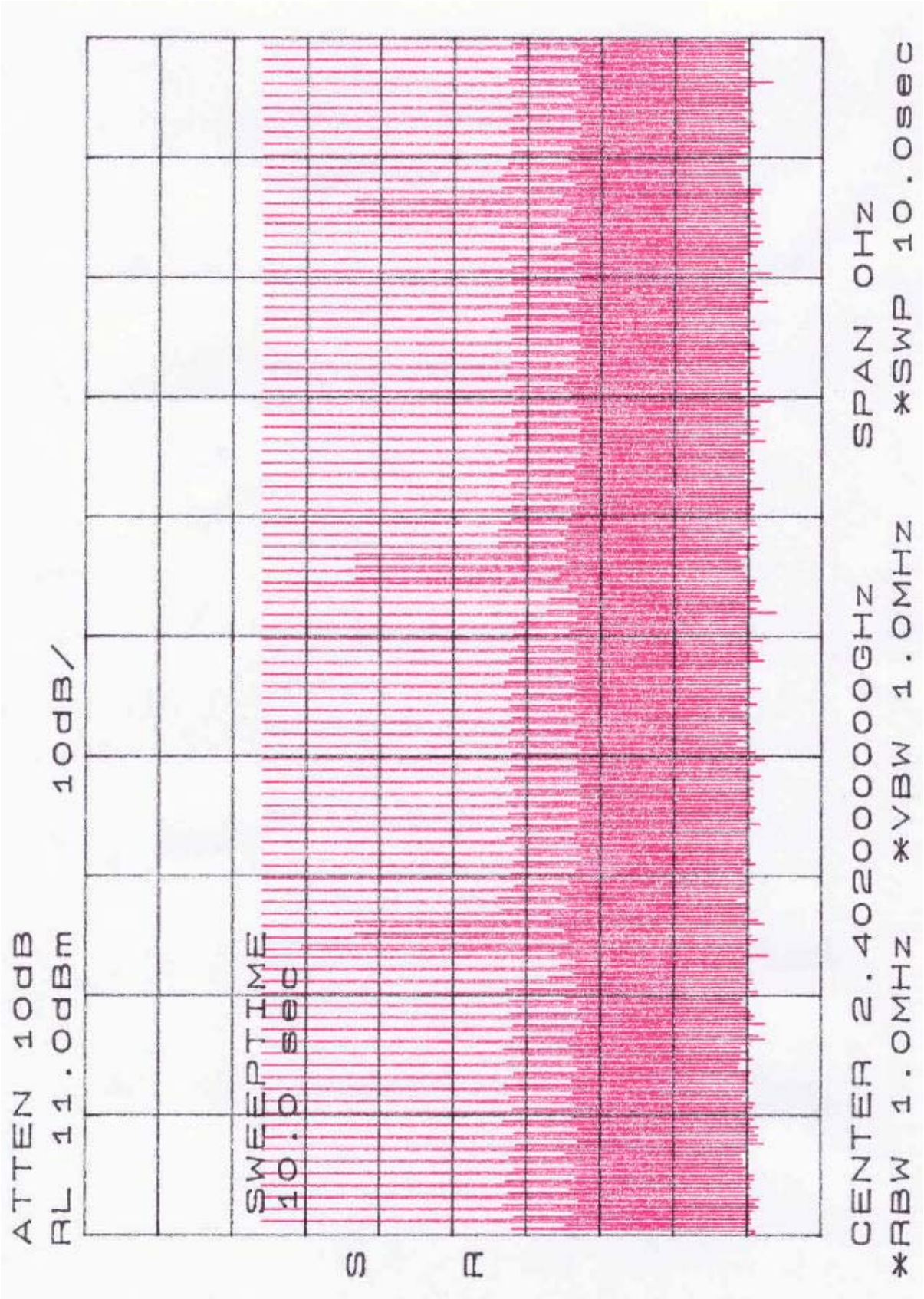

ATTEN 30dB
RL 31.0dBm
10dB/
ΔMKR -1.50dB
600μs
ΔMKR
600 μs
-1.50 dB
S
R
CENTER 2.480000000GHz
*RBW 1.0MHz
*VBW 1.0MHz
SPAN 0Hz
*SWP 30.0ms

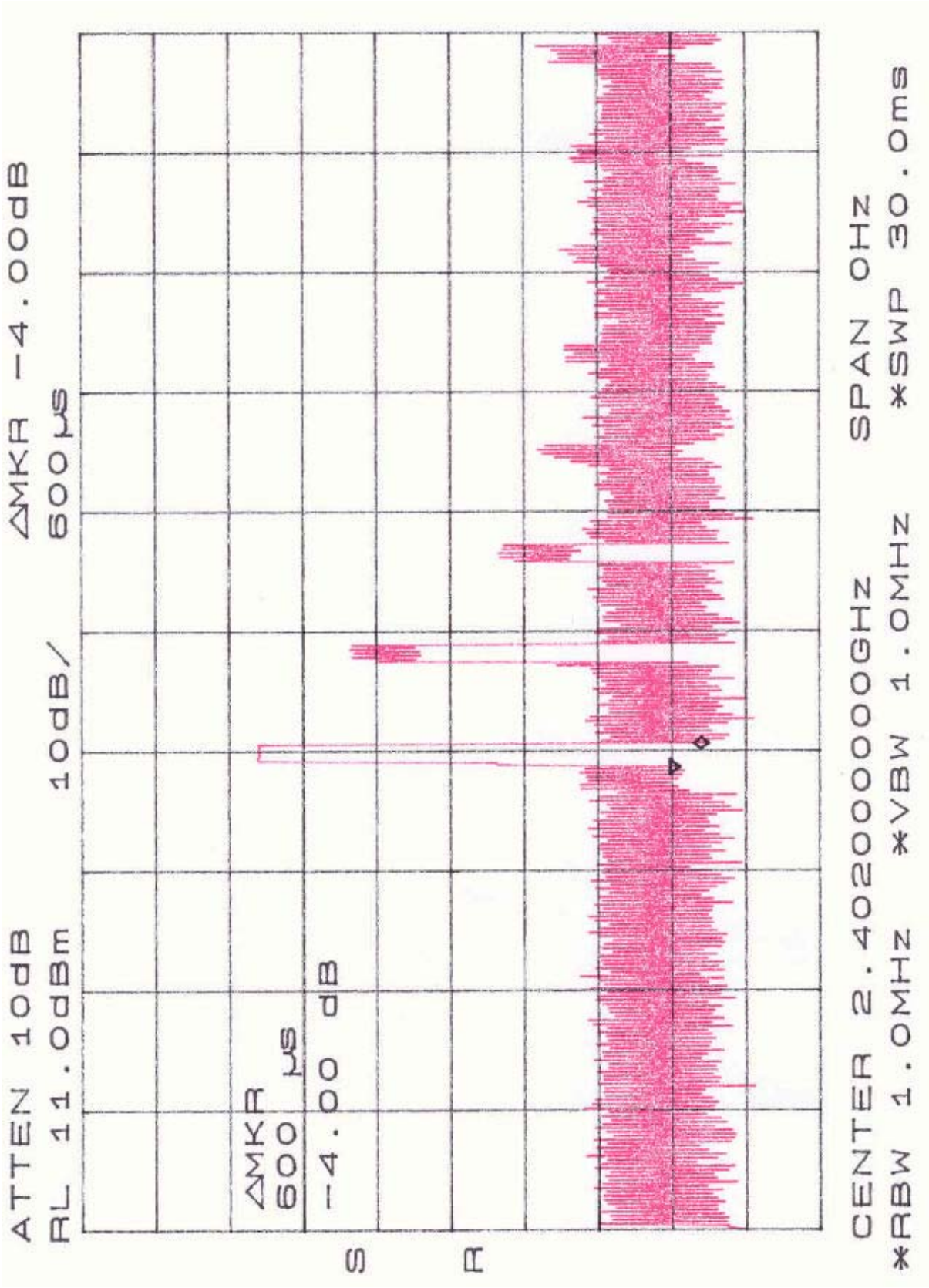

ATTEN 10dB
RL 11.0dBm
10dB/
SWEEPTIME
10.0 sec
S
R
CENTER 2.480000000GHz
*RBW 1.0MHz
*VBW 1.0MHz
SPAN 0Hz
*SWP 10.0sec


ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR -3.83dB
600 μs
ΔMKR
600 μs
-3.83 dB
S
R
CENTER 2.480000000GHz
*RBW 1.0MHz
*VBW 1.0MHz
SPAN 0Hz
*SWP 30.0ms


ATTEN 10dB
RL 11.0dBm
10dB/
SWEEP TIME
10.0 sec
S
R
CENTER 2.441000000GHz
*RBW 1.0MHz
*VBW 1.0MHz
SPAN 0Hz
*SWP 10.0sec


ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR -3.33dB
600 µs
ΔMKR
600 µs
-3.33 dB
S
R
CENTER 2.441000000GHz
*RBW 1.0MHz
*VBW 1.0MHz
SPAN 0Hz
*SWP 30.0ms


ATTEN 10dB
RL 11.0dBm 10dB/
SWEEP TIME
10.0 sec
S
R
CENTER 2.402000000GHz SPAN 0Hz
*RBW 1.0MHz *VBW 1.0MHz *SWP 10.0sec


ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR -4.00dB
600 µs
ΔMKR
600 µs
-4.00 dB
S
R
CENTER 2.402000000GHz
*RBW 1.0MHz
*VBW 1.0MHz
SPAN 0Hz
*SWP 30.0ms