FCC Part 15
EMI TEST REPORT

of

E.U.T. ：Bluetooth Car Kit
Model ：50236
FCC ID. ：O3OBT600

for

APPLICANT ： TOPCELL TECHNOLOGY CO., LTD.
ADDRESS ： NO. 403, JUNG MIN ROAD, CHUNGLI,
TAOYUAN HSIEN, TAIWAN, R.O.C

Test Performed by

ELECTRONICS TESTING CENTER, TAIWAN
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Report Number : ET93R-02-078-04

TEST REPORT CERTIFICATION

Applicant : TOPCELL TECHNOLOGY CO., LTD.
: NO. 403, JUNG MIN ROAD, CHUNGLI, TAOYUAN HSIEN, TAIWAN, R.O.C.

Applicant : TOPCELL TECHNOLOGY CO., LTD.
: NO. 403, JUNG MIN ROAD, CHUNGLI, TAOYUAN HSIEN, TAIWAN, R.O.C.

Description of EUT :

a) Type of EUT : Bluetooth Car Kit
b) Trade Name : CCM
c) Model No. : 50236
d) Power Supply : 12Vdc

Regulation Applied : FCC Rules and Regulations Part 15 Subpart B & C (2003)

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 : Mar. 24, 2004

Test Engineer : Jiapeng Chen.
(Jiapeng Chen)

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 Car Kit
b) Trade Name : CCM
c) Model No. : 50236
d) Power Supply : 12Vdc

1.2 Characteristics of Device

The hands free Car Kit with Bluetooth Wireless connection and to be used in the car.

1.3 Test Methodology

For Bluetooth Car Kit, both conducted and radiated emissions were performed according to the procedures illustrated in ANSI C63.4 (2001) 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 as shown in paragraphs (b) and (c) of this section, for an intentional radiator 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 30 MHz shall not exceed the limits in the following table, as measured using a 50µH/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 boundary between the frequency ranges.

Frequency MHz	Quasi Peak dBµV	Average dBµV
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

For intentional device, according to §15.207(a) Line Conducted Emission Limits is same as above table.

(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 dBµV/m	Radiated µV/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 within a 30-second period

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 Car Kit *	Topcell Technology Co., Ltd.	50236 /O3OBT600	----
Mobil Phone	ERICSSON	T39mc	----

Remark "*" means equipment under test.

4 RADIATED EMISSION MEASUREMENT

4.1 Applicable Standard

For periodic operation intentional radiator, the radiated emission shall comply with §15.231(b).

4.2 Measurement Procedure

1. Setup the configuration per figure 5 and 6 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.

   Note : A band 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

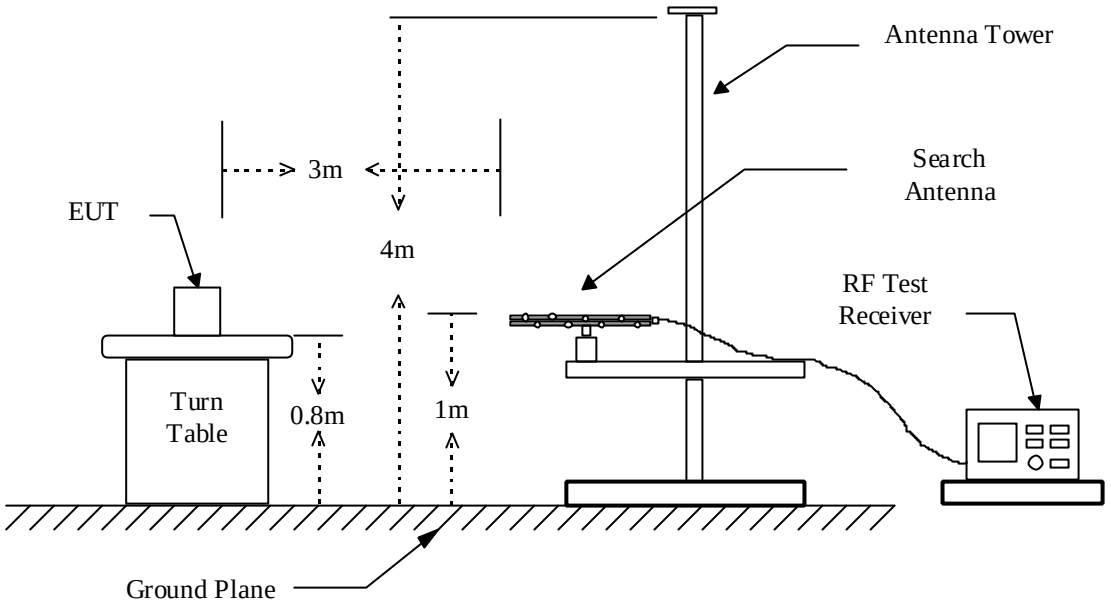
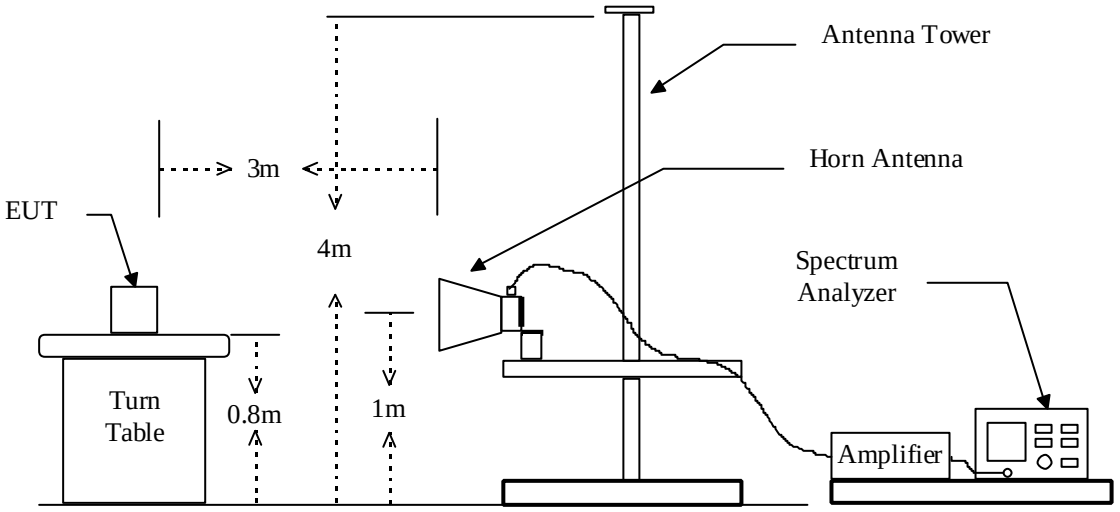


Figure 2 : Frequencies measured above 1 GHz configuration



4.3 Measuring Instrument

The following instrument are used for radiated emissions measurement:

Equipment	Manufacturer	Model No.	Next Cal. Due
RF Test Receiver	Rohde & Schwarz	ESVS 30	08/09/2004
RF Test Receiver	Rohde & Schwarz	ESBI	05/31/2004
Horn Antenna	EMCO	3115	08/12/2004
Log periodic Antenna	EMCO	3146	12/22/2004
Biconical Antenna	EMCO	3110B	11/04/2004
Horn Antenna	EMCO	3116	03/10/2005
Preamplifier	Hewlett-Packard	8449B	06/30/2004
Preamplifier	Hewlett-Packard	8447D	10/12/2004
Spectrum Analyzer	Hewlett-Packard	8564E	08/14/2004

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	10 Hz

4.4 Radiated Emission Data

4.4.1 Fundatmental and Harmonics

Operation Mode : Receiving / Transmitting

Fundamental Frequency : 2402 MHz (Local Frequency : 2400.612 MHz)

Test Date : Feb. 27, 2004 Temperature : 23 ℃ Humidity : 62 %

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)
*2400.612	---	---	42.5	33.8	-3.1	39.4	30.7	74.0	54.0	-23.3	10.0	1.0
*4801.224	---	---	---	---	2.5	---	---	74.0	54.0	---	---	---
*7201.836	---	---	---	---	5.7	---	---	74.0	54.0	---	---	---
*9602.448	---	---	---	---	7.2	---	---	74.0	54.0	---	---	---
*12003.060	---	---	---	---	9.2	---	---	74.0	54.0	---	---	---
4804.037	---	---	---	---	2.5	---	---	74.0	54.0	---	---	---
7206.055	---	---	---	---	5.7	---	---	74.0	54.0	---	---	---
9608.073	---	---	---	---	7.2	---	---	74.0	54.0	---	---	---
12010.091	---	---	---	---	9.2	---	---	74.0	54.0	---	---	---
14412.109	---	---	---	---	11.5	---	---	74.0	54.0	---	---	---
16814.127	---	---	---	---	11.8	---	---	74.0	54.0	---	---	---
19216.145	---	---	---	---	8.9	---	---	74.0	54.0	---	---	---
21618.163	---	---	---	---	9.7	---	---	74.0	54.0	---	---	---
24020.181	---	---	---	---	10.3	---	---	74.0	54.0	---	---	---

Note :

1. Remark "*" means local oscillation frequency.
2. The receiving local oscillation frequency and the harmonics are too low to be measured.
3. Remark "---" means that the emission level is too low to be measured (a pre-amplifier of about 35 dB is used).
4. 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.
5. The expanded uncertainty of the radiated emission tests is 3.53 dB.

Operation Mode : Receiving / Transmitting

Fundamental Frequency : 2441 MHz (Local Frequency : 2439.713 MHz)

Test Date : Feb. 27, 2004 Temperature : 23 ℃ Humidity : 62 %

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)
*2439.713	---	---	42.3	32.8	-2.9	39.4	29.9	74.0	54.0	-24.1	20.0	1.0
*4879.426	---	---	---	---	2.7	---	---	74.0	54.0	---	---	---
*7319.139	---	---	---	---	5.9	---	---	74.0	54.0	---	---	---
*9758.852	---	---	---	---	7.3	---	---	74.0	54.0	---	---	---
*12198.565	---	---	---	---	9.3	---	---	74.0	54.0	---	---	---
4882.134	---	---	---	---	2.7	---	---	74.0	54.0	---	---	---
7323.201	---	---	---	---	5.9	---	---	74.0	54.0	---	---	---
9764.268	---	---	---	---	7.3	---	---	74.0	54.0	---	---	---
12205.335	---	---	---	---	9.3	---	---	74.0	54.0	---	---	---
14646.402	---	---	---	---	11.6	---	---	74.0	54.0	---	---	---
17087.469	---	---	---	---	13.3	---	---	74.0	54.0	---	---	---
19528.536	---	---	---	---	8.5	---	---	74.0	54.0	---	---	---
21969.603	---	---	---	---	9.9	---	---	74.0	54.0	---	---	---
24410.670	---	---	---	---	10.7	---	---	74.0	54.0	---	---	---

Note :

1. Remark "*" means local oscillation frequency.
2. The receiving local oscillation frequency and the harmonics are too low to be measured.
3. Remark "---" means that the emission level is too low to be measured (a pre-amplifier of about 35 dB is used).
4. 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.
5. The expanded uncertainty of the radiated emission tests is 3.53 dB.

Operation Mode : Receiving / Transmitting

Fundamental Frequency : 2480 MHz (Local Frequency : 2478.412 MHz)

Test Date : Feb. 27, 2004 Temperature : 23 ℃ Humidity : 62 %

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)
*2478.412	---	---	44.0	35.0	-2.8	41.2	32.2	74.0	54.0	-21.8	25.0	1.0
*4956.824	---	---	---	---	2.8	---	---	74.0	54.0	---	---	---
*7435.236	---	---	---	---	6.1	---	---	74.0	54.0	---	---	---
*9913.647	---	---	---	---	7.4	---	---	74.0	54.0	---	---	---
*12392.059	---	---	---	---	9.4	---	---	74.0	54.0	---	---	---
4960.812	---	---	---	---	2.8	---	---	74.0	54.0	---	---	---
7441.218	---	---	---	---	6.1	---	---	74.0	54.0	---	---	---
9921.624	---	---	---	---	7.4	---	---	74.0	54.0	---	---	---
12402.030	---	---	---	---	9.4	---	---	74.0	54.0	---	---	---
14882.436	---	---	---	---	11.5	---	---	74.0	54.0	---	---	---
17362.842	---	---	---	---	15.2	---	---	74.0	54.0	---	---	---
19843.248	---	---	---	---	8.6	---	---	74.0	54.0	---	---	---
22323.654	---	---	---	---	10.2	---	---	74.0	54.0	---	---	---
24804.060	---	---	---	---	11.0	---	---	74.0	54.0	---	---	---

Note :

1. Remark "*" means local oscillation frequency.
2. The receiving local oscillation frequency and the harmonics are too low to be measured.
3. Remark "---" means that the emission level is too low to be measured (a pre-amplifier of about 35 dB is used).
4. 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.
5. The expanded uncertainty of the radiated emission tests is 3.53 dB.

4.4.2 Radiated Emissions in Restricted Bands

Operation Mode : Receiving /Transmitting

Test Date : Feb. 27, 2004 Temperature : 23 ℃ Humidity : 62 %

Operation Mode : TX : 2402 MHz Restricted Frequency band : 2310MHz-2390MHz

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)
2320.900	40.3	28.1	39.1	26.3	-3.4	36.9	24.7	74.0	54.0	-29.3	0	1.0
2385.000	41.2	29.7	38.5	27.1	-3.1	38.1	26.6	74.0	54.0	-27.4	0	1.0

Operation Mode : TX : 2480 MHz Restricted Frequency band : 2483.5MHz-2500MHz

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)
2486.500	40.7	29.6	40.1	27.1	-2.8	37.9	26.8	74.0	54.0	-27.2	0	1.0
2495.700	41.5	30.2	39.9	27.2	-2.7	38.8	27.5	74.0	54.0	-26.5	0	1.0

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.

4.4.3 Other Emissions

a) Emission frequencies below 1 GHz

Operation Mode : Receiving / Transmitting

Test Date : Feb. 27, 2004 Temperature : 23 ℃ Humidity : 62 %

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)
176.610	H	34.9	-9.1	25.8	43.5	-17.7	0	2.0
221.970	H	31.3	-5.7	25.6	46.0	-20.4	70	3.0
227.910	H	30.6	-5.2	25.4	46.0	-20.6	215	1.0
825.700	V	23.2	1.5	24.7	46.0	-21.3	160	3.0
920.900	V	23.7	2.4	26.1	46.0	-19.9	70	2.0
963.600	H	23.3	3.3	26.6	54.0	-27.4	110	1.5

b) Emission frequencies above 1 GHz

Radiated emission frequencies above 1 GHz to 25 GHz were too low to be measured with a pre-amplifier of 35 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 - Amplifier Gain

4.6 Photos of Radiation Measuring Setup

Please See Exhibits F-Test_Setup_Photos

5 CONDUCTED EMISSION MEASUREMENT

5.1 Description

This EUT is excused from investigation of conducted emission, for it is powered by DC Battery only. According to §15.207 (d), measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.

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 is integrated on the main PCB. No consideration of replacement. Please see construction Photos of Exhibit B for details.

7 HOPPING CHANNEL SEPARATION

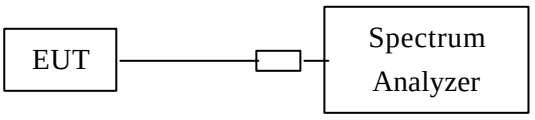
7.1 Standard Applicable

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	04/14/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

7.4 Measurement Data

Test Date : Feb. 27, 2004 Temperature : 23 ℃ Humidity : 62 %

1) 2402 MHz : Adjacent Hopping Channel Separation is 997 kHz
2) 2441 MHz : Adjacent Hopping Channel Separation is 997 kHz
3) 2480 MHz : Adjacent Hopping Channel Separation is 997 kHz

Note : 1. Please see appendix 1 for Plotted Data
2. The expanded uncertainty of the hopping channel separation tests is 2dB.

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	04/14/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

8.4 Measurement Data

Test Date : Feb. 27, 2004 Temperature : 23 ℃ Humidity : 62 %

There are 79 hopping frequencies in a hopping sequence.

Note : 1. Please see appendix 2 for Plotted Data
2. The expanded uncertainty of umber of hopping frequency used tests is 2dB.

9 CHANNEL BANDWIDTH

9.1 Standard Applicable

According to 15.247(a)(1)(ii), for frequency hopping system operating in the 2400-2483.5 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	04/14/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

9.4 Measurement Data

Test Date : Feb. 27, 2004 Temperature : 23 ℃ Humidity : 62 %

1) 2402 MHz : Channel Bandwidth is 837 kHz
2) 2441 MHz : Channel Bandwidth is 863 kHz
3) 2480 MHz : Channel Bandwidth is 830 kHz

Note : 1. Please see appendix 3 for Plotted Data
2. The expanded uncertainty ofchannel bandwidth tests is 2dB.

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	04/14/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

10.4 Measurement Data

Test Date : Feb. 27, 2004 Temperature : 23 ℃ Humidity : 62 %

1) 2402 MHz : the dwell time is 101×3.16×600μs=0.1915 sec
2) 2441 MHz : the dwell time is 101×3.16×600μs=0.1915 sec
3) 2480 MHz : the dwell time is 101×3.16×600μs=0.1915 sec

The maximum time of occupancy for a particular channel is 191.5 msec in any 31.6 second period, which is less than the 400 msec allowed by the rules; therefore, it meets the requirements of this section.

Note : 1. Please see appendix 4 for Plotted Data
2. The expanded uncertainty of dwell time on each channel tests is 2dB.

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	04/14/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

11.4 Measurement Data

Test Date : Feb. 27, 2004 Temperature : 23 ℃ Humidity : 62 %

1) 2402 MHz : Output Peak Power is –2.33 dBm = **0.58479**mW
2) 2441 MHz : Output Peak Power is –0.67 dBm = **0.85704**mW
3) 2480 MHz : Output Peak Power is –0.67 dBm = **0.85704**mW

Note : 1. Please see appendix 5 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	04/14/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

12.4 Measurement Data

Test Date : Feb. 27, 2004 Temperature : 23 ℃ Humidity : 62 %

a) Lower Band Edge : All emissions in this 100kHz bandwidth are attenuated more than 20dB from the carrier.

b) Upper Band Edge : All emissions in this 100kHz bandwidth are attenuated more than 20dB from the carrier.

Note : 1. Please see appendix 6 for Plotted Data

2. The expanded uncertainty of the 100 KHz bandwidth of band edges tests is 1000Hz.

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	04/14/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

13.4 Measurement Data

Mode : Low Channel

Test Date : Feb. 27, 2004 Temperature : 23 ℃ Humidity : 62 %

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.

Mode : Mid Channel

Test Date : Feb. 27, 2004 Temperature : 23 ℃ Humidity : 62 %

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.

Mode : Hi Channel

Test Date : Feb. 27, 2004 Temperature : 23 ℃ Humidity : 62 %

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

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	04/14/2004
Attenuator	Weinschel Engineering	1	N/A
Plotter	Hewlett-Packard	7440A	N/A

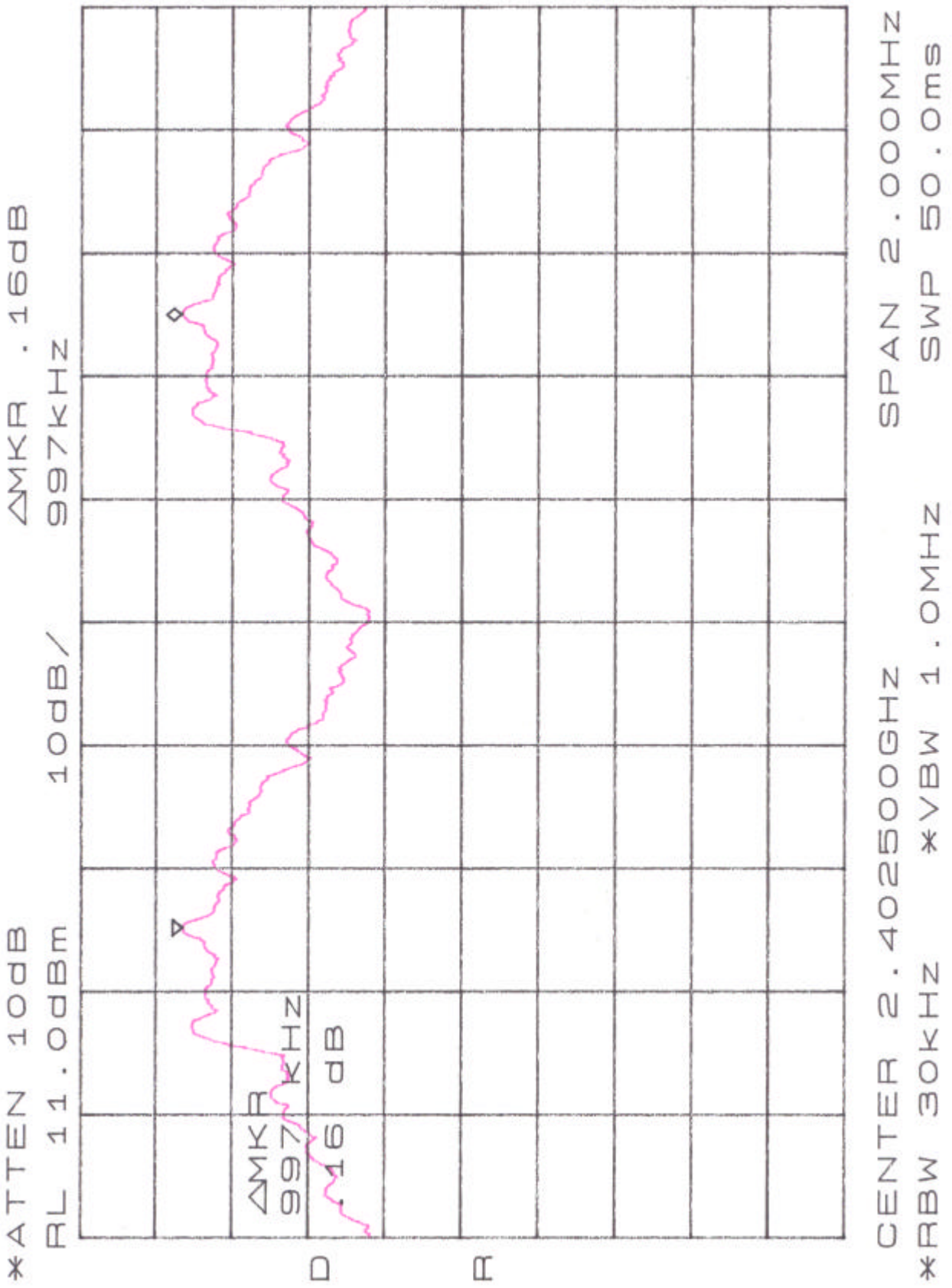
14.4 Measurement Data

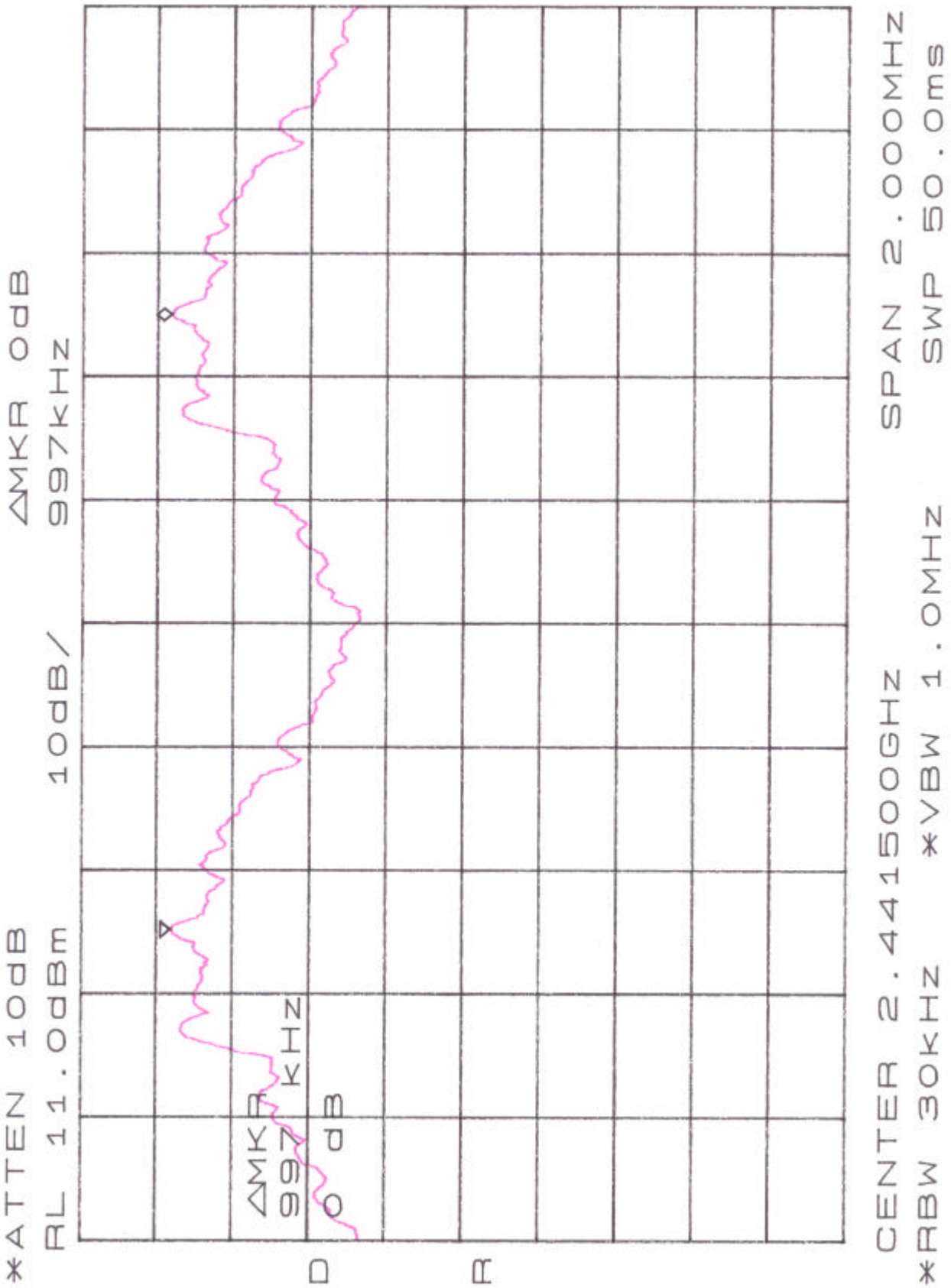
Test Date : Feb. 27, 2004 Temperature : 23 ℃ Humidity : 62 %

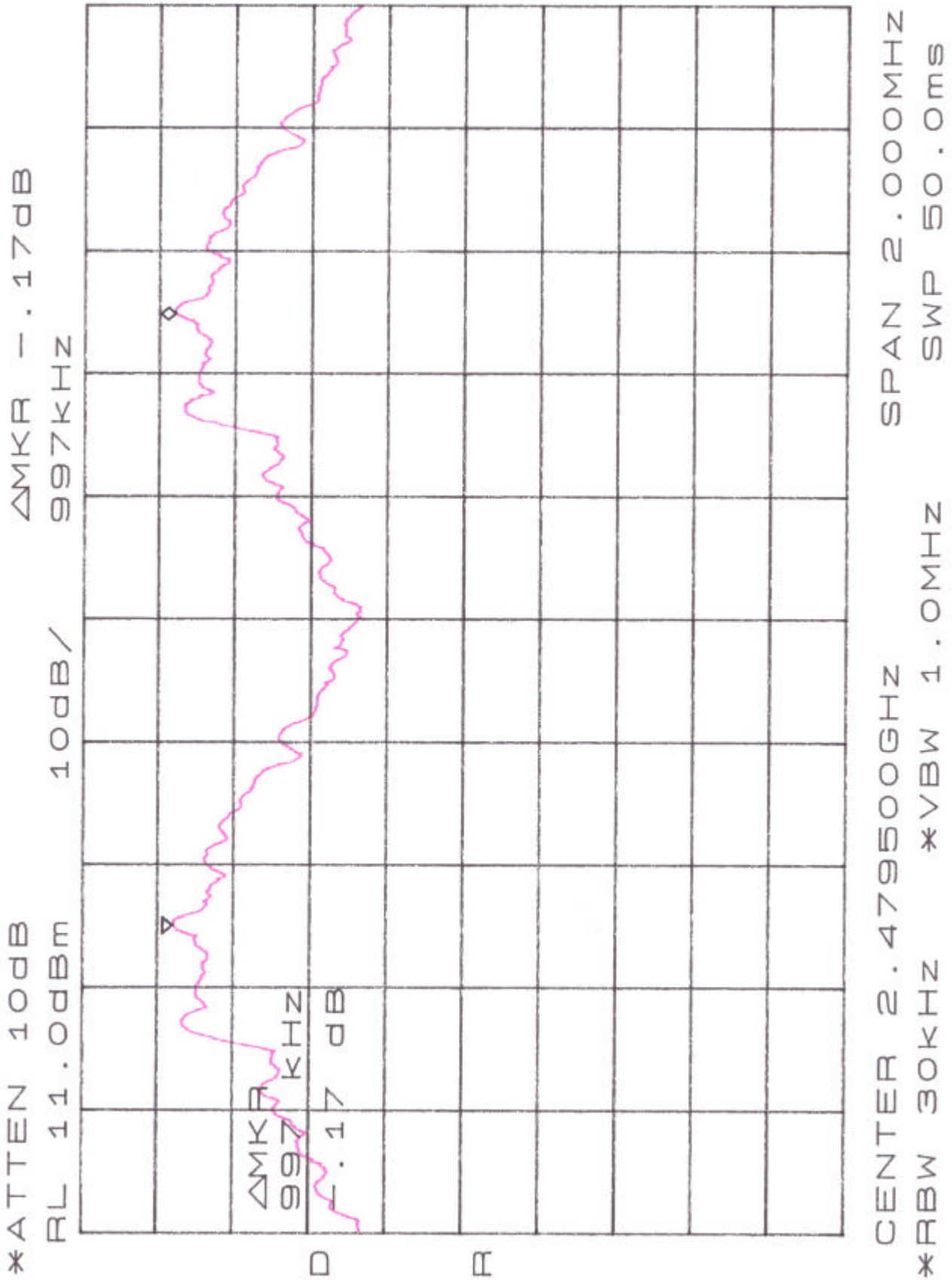
a) 2402MHz : Maximun Power Density of 3 kHz Bandwidth is –12.33dBm
b) 2441MHz : Maximun Power Density of 3 kHz Bandwidth is –11.00dBm
c) 2480MHz : Maximun Power Density of 3 kHz Bandwidth is –11.00dBm

Note : 1. Please see appendix 8 for Plotted Data
2. The expanded uncertainty of the power density tests is 2dB.

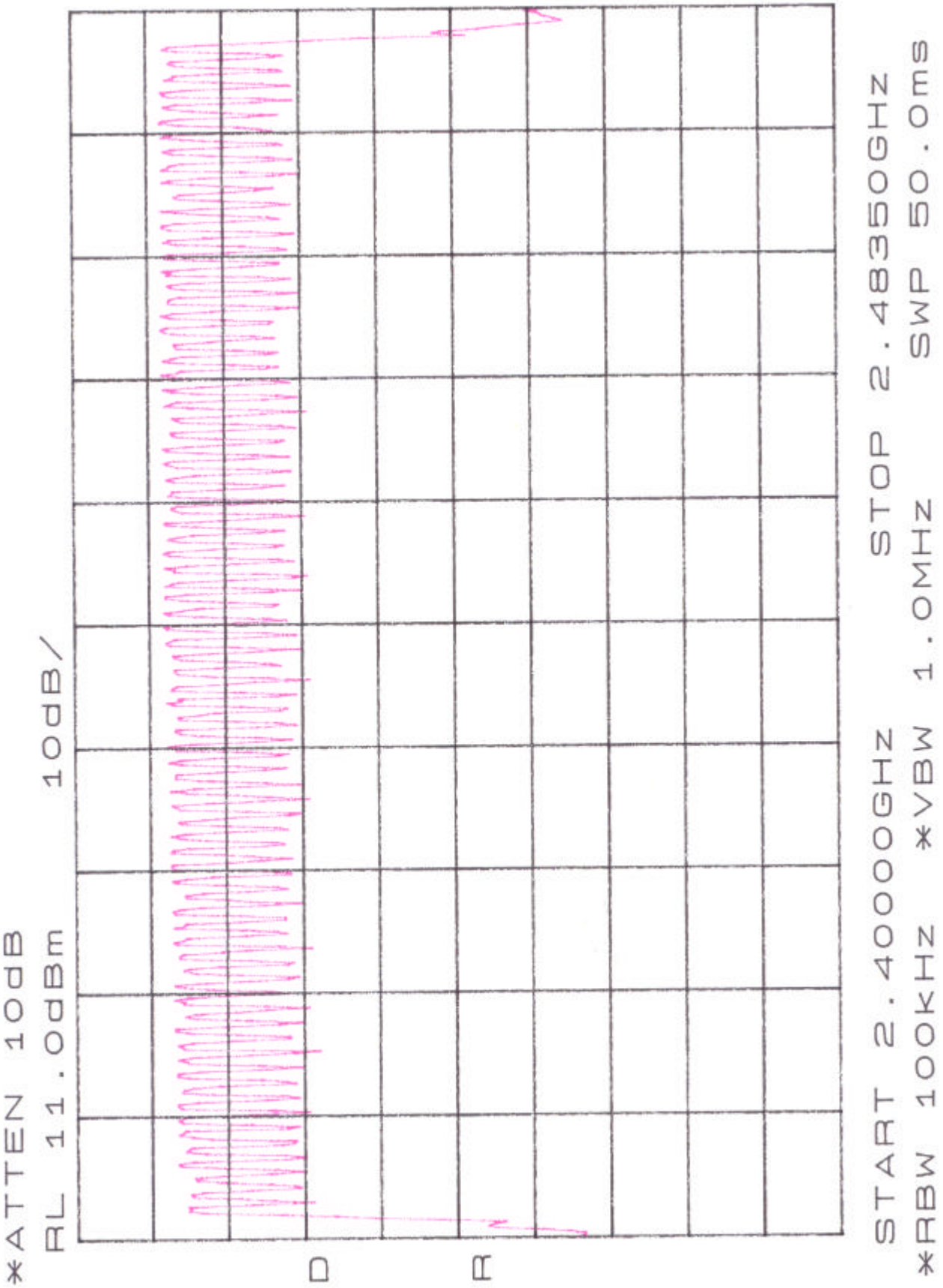
Appendix 1 : Plotted Data for Separation of Adjacent Channel


*ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR .16dB
997kHz
ΔMKR
997 kHz
.16 dB
D
R
CENTER 2.402500GHz
*RBW 30kHz
*VBW 1.0MHz
SPAN 2.000MHz
SWP 50.0ms

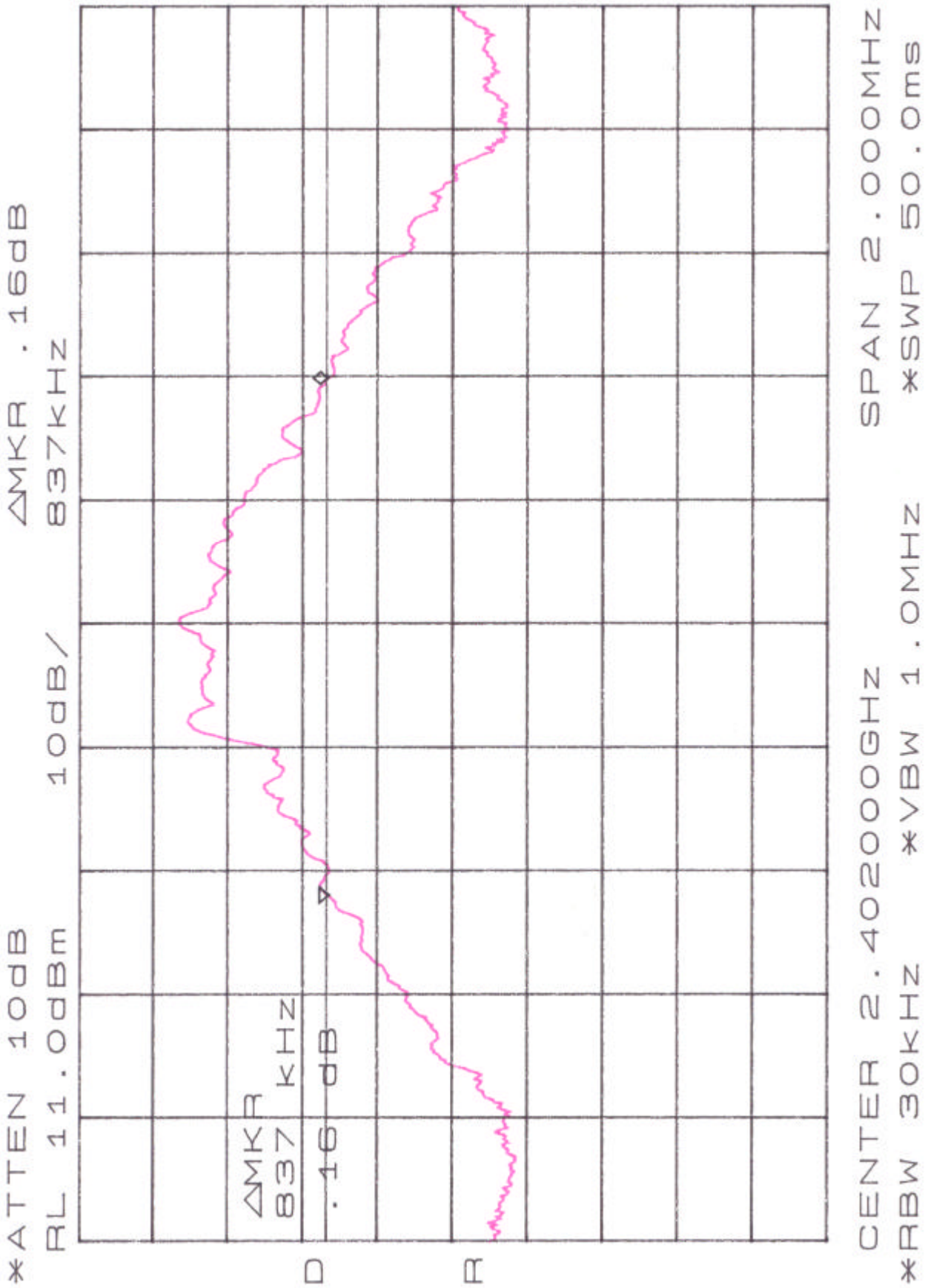

*ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR 0dB
997kHz
ΔMKR
997
kHz
0
dB
D
R
CENTER 2.44150GHz
*RBW 30kHz
*VBW 1.0MHz
SPAN 2.000MHz
SWP 50.0ms

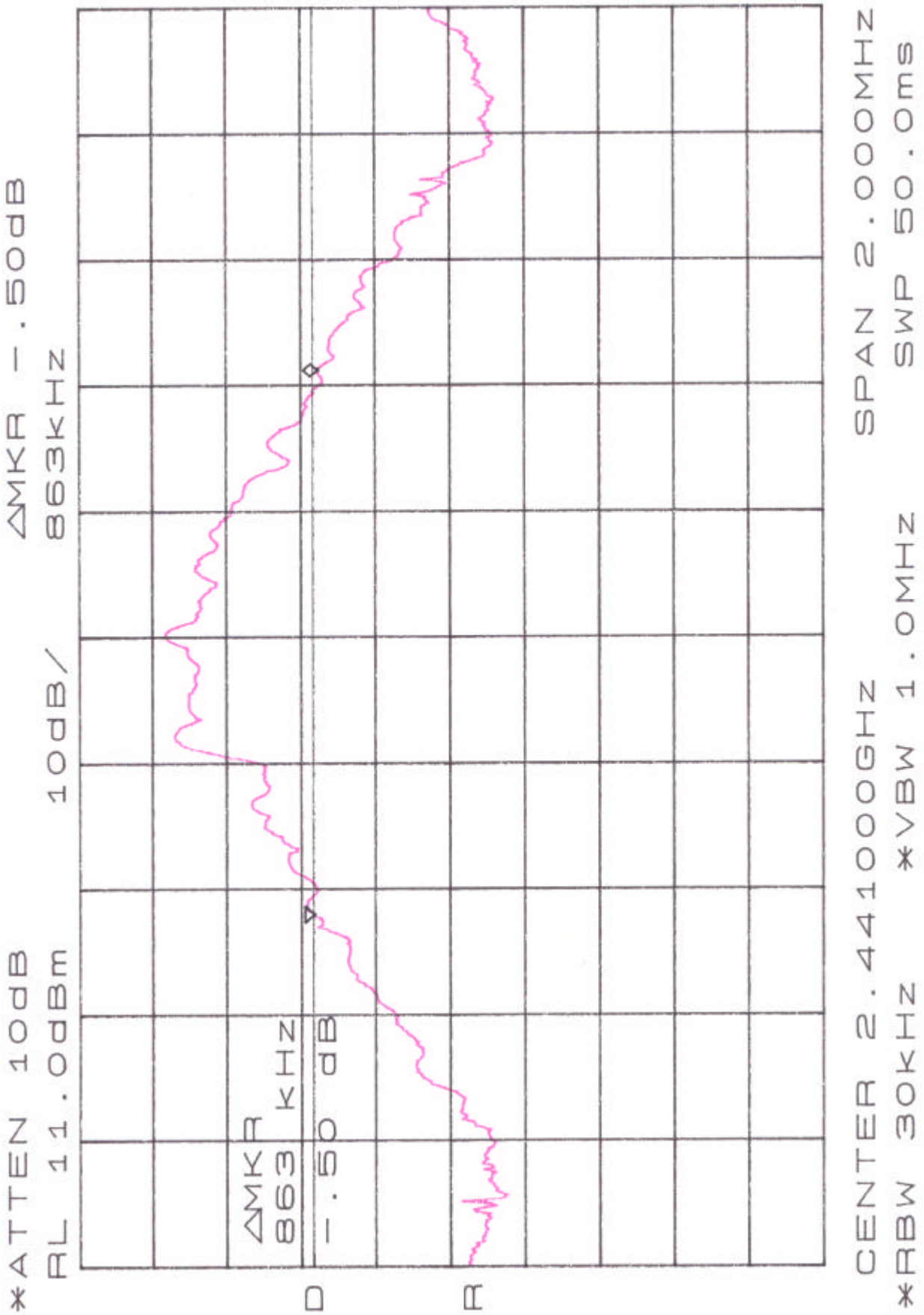

*ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR -.17dB
997kHz
ΔMKR
997 kHz
-.17 dB
D
R
CENTER 2.47950GHz
*RBW 30kHz
*VBW 1.0MHz
SPAN 2.000MHz
SWP 50.0ms

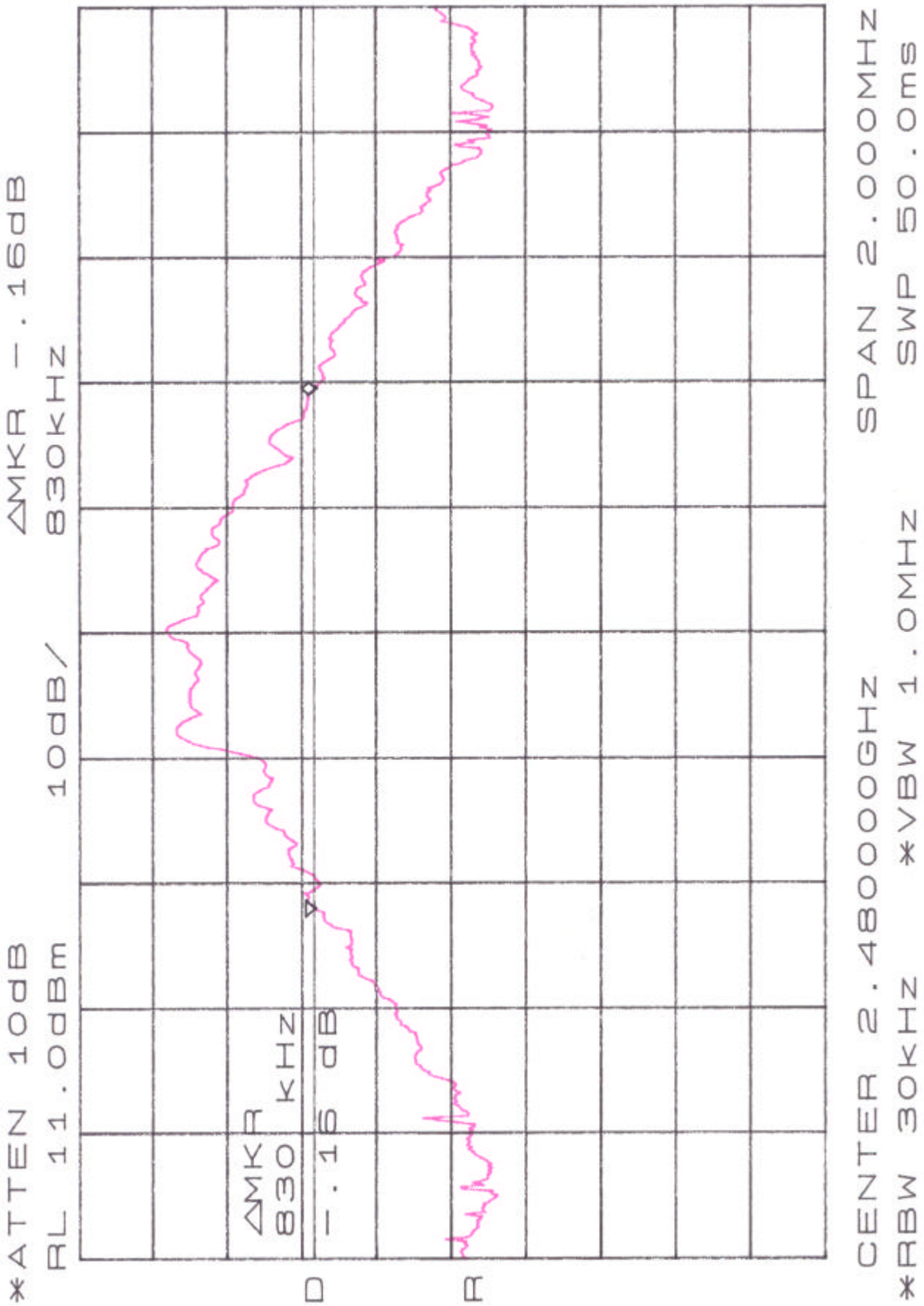
Appendix 2 : Plotted Data for Total Used Hopping Frequencies


*ATTEN 10dB
RL 11.0dBm 10dB/
D
R
START 2.40000GHz STOP 2.48350GHz
*RBW 100kHz *VBW 1.0MHz SWP 50.0ms

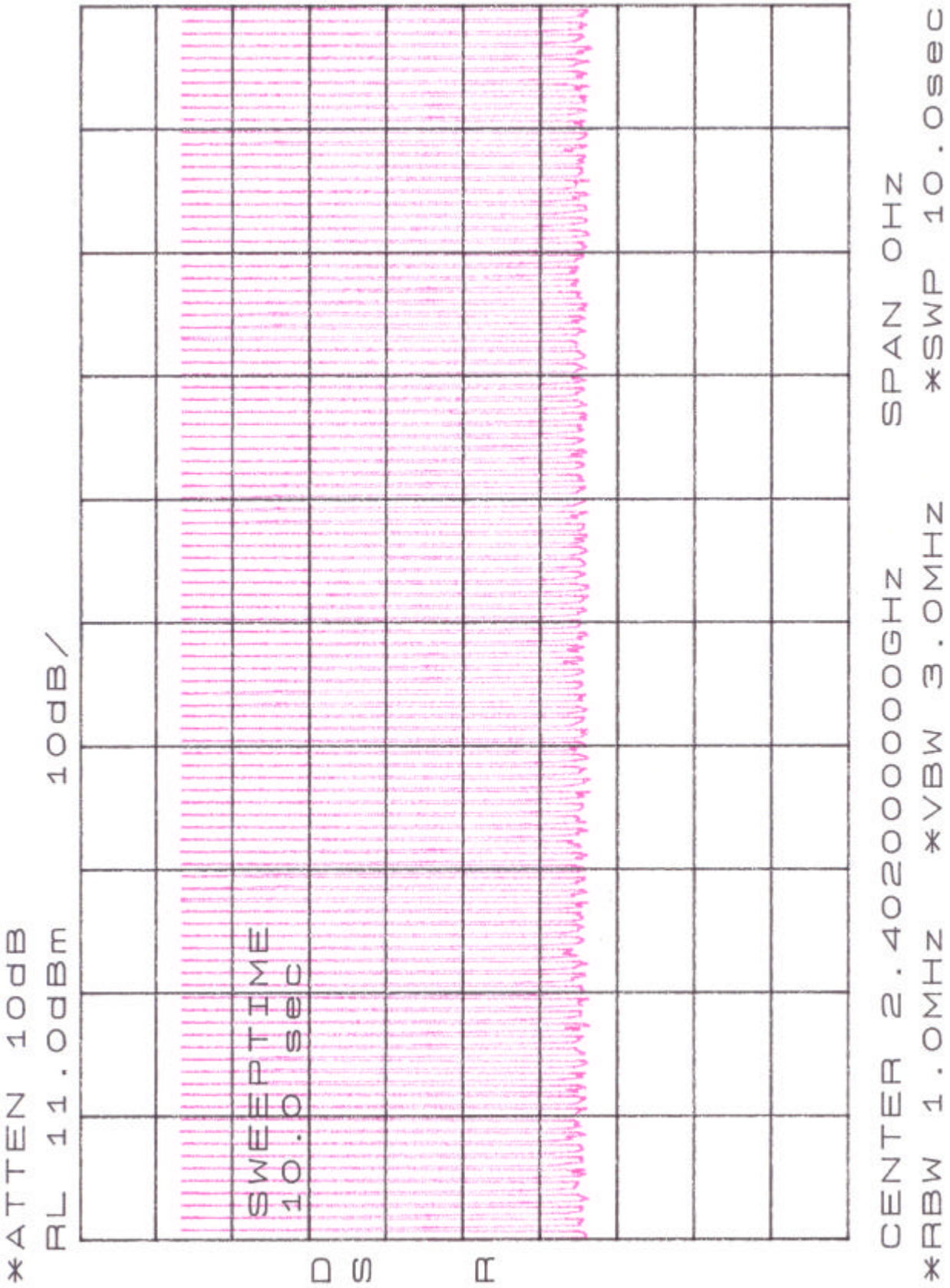
Appendix 3 : Plotted Data for Channel Bandwidth

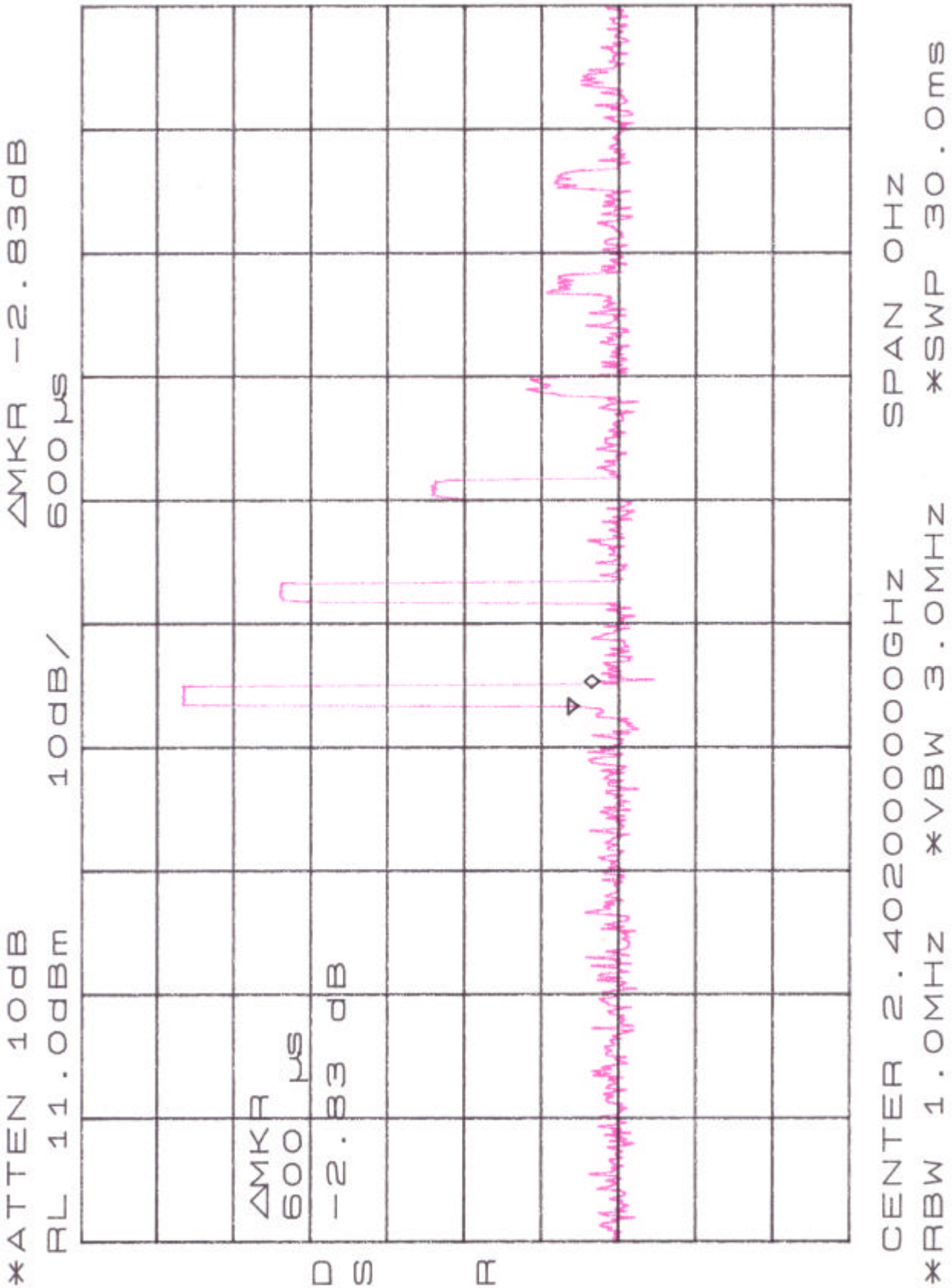

*ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR .16dB
837kHz
ΔMKR
837 kHz
.16 dB
D
R
CENTER 2.40200GHz
*RBW 30kHz
*VBW 1.0MHz
SPAN 2.000MHz
*SWP 50.0ms

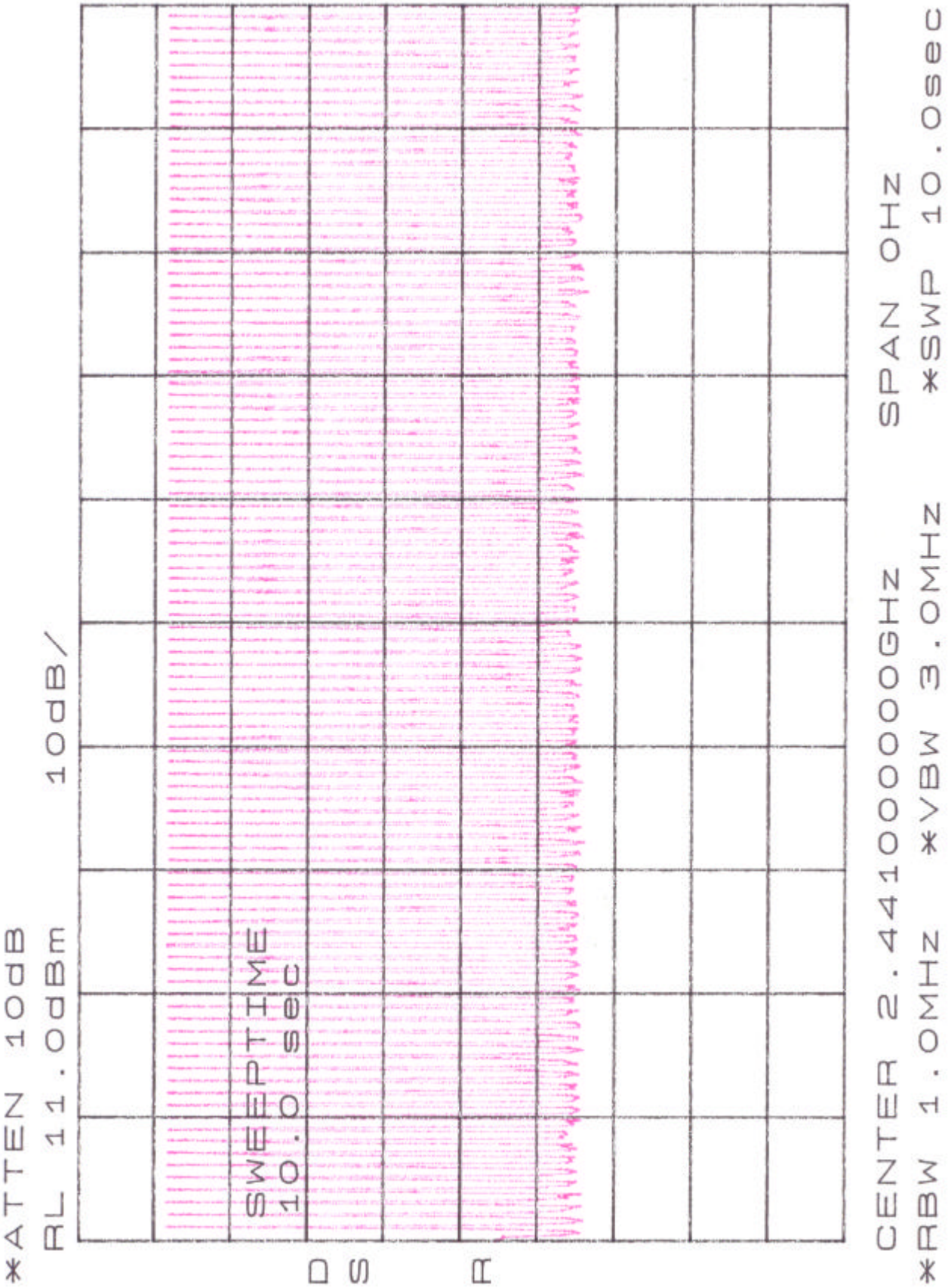

*ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR -.50dB
863KHZ
ΔMKR
863 KHZ
-.50 dB
D
R
CENTER 2.44100GHZ
*RBW 30KHZ
*VBW 1.0MHZ
SPAN 2.000MHZ
SWP 50.0ms

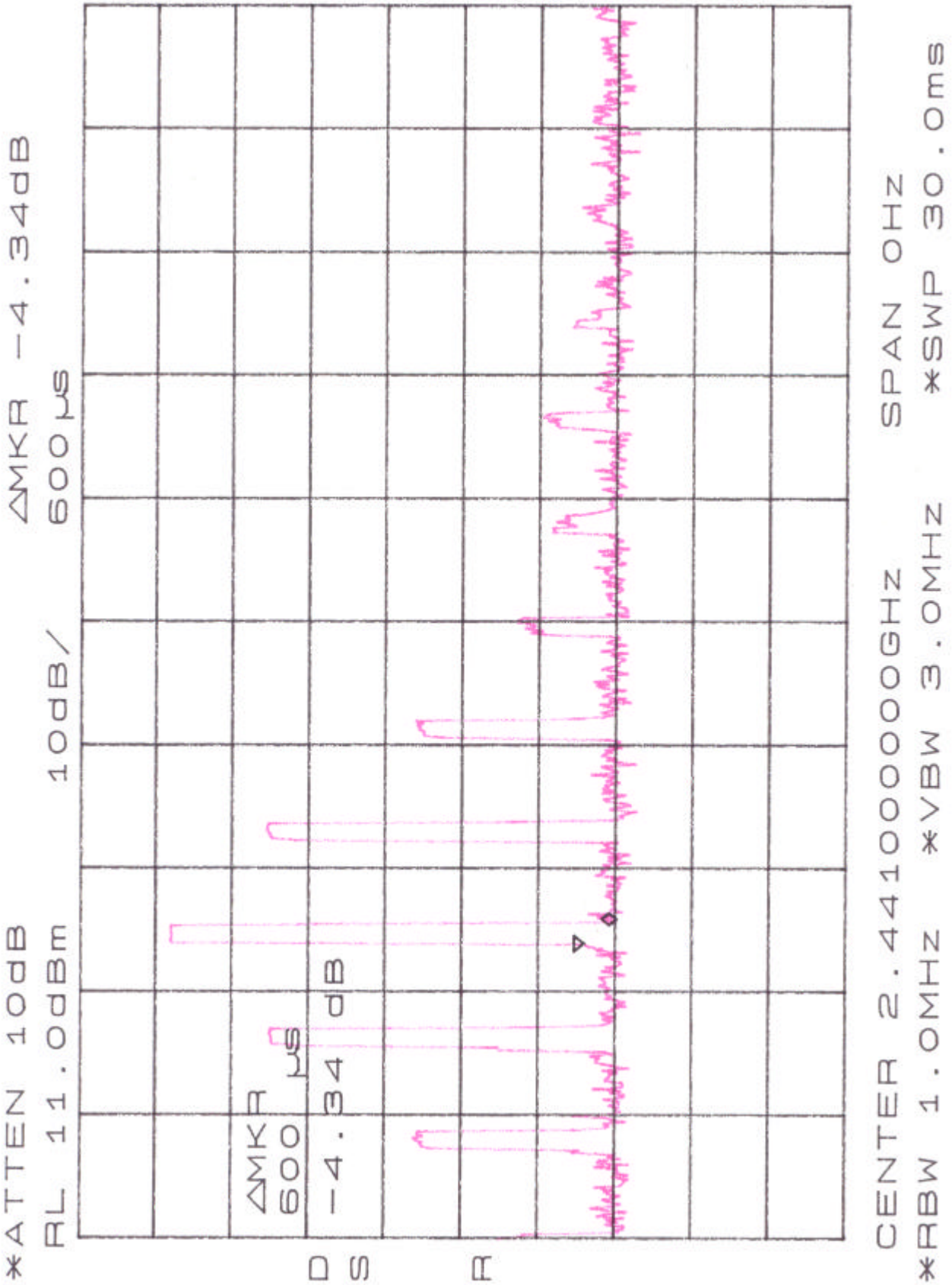

*ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR -.16dB
830kHz
ΔMKR
830 kHz
-.16 dB
D
R
CENTER 2.48000GHz
*RBW 30kHz
*VBW 1.0MHz
SPAN 2.000MHz
SWP 50.0ms

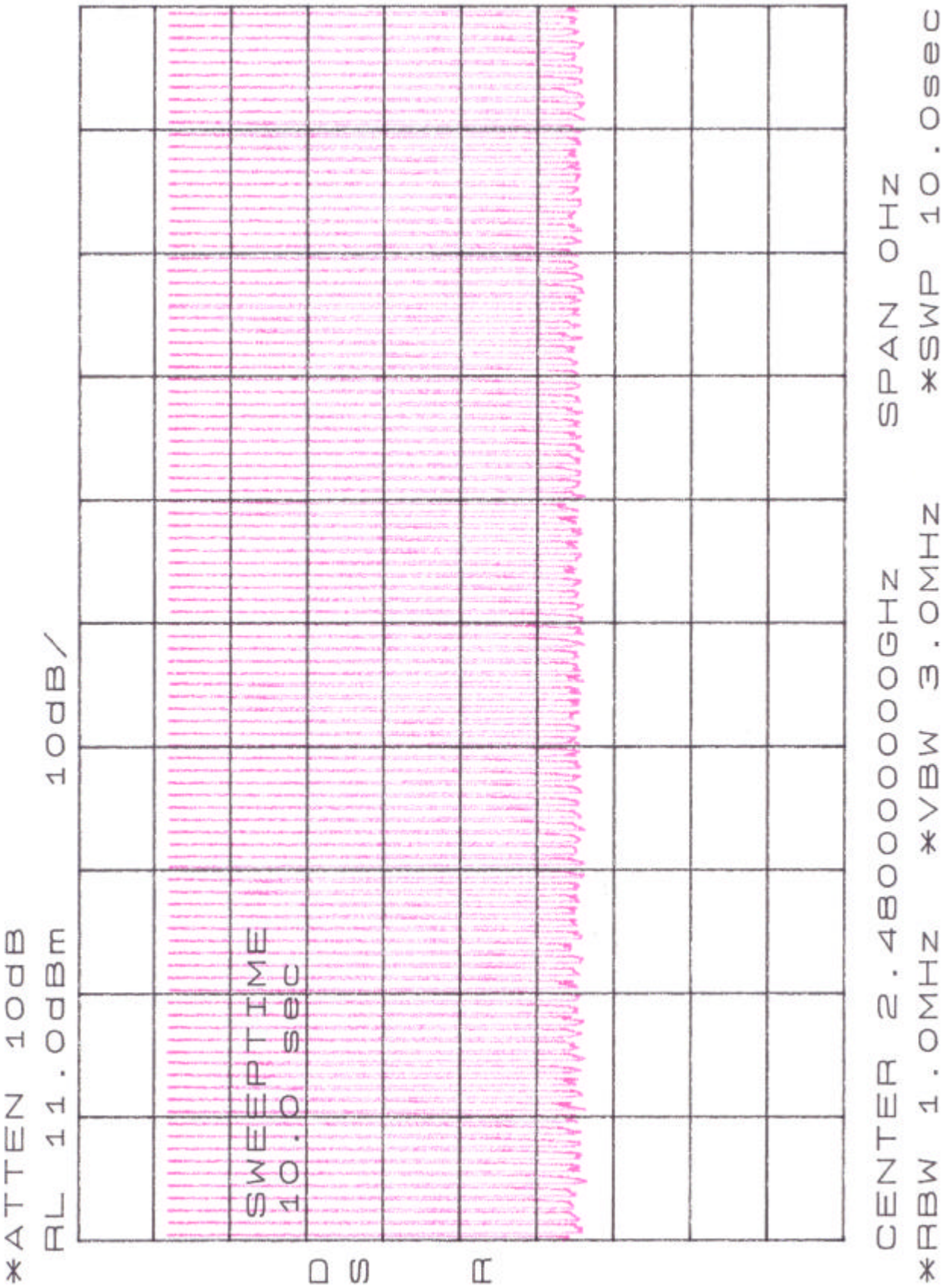
Appendix 4 : Plotted Data for Channel Dwell Time

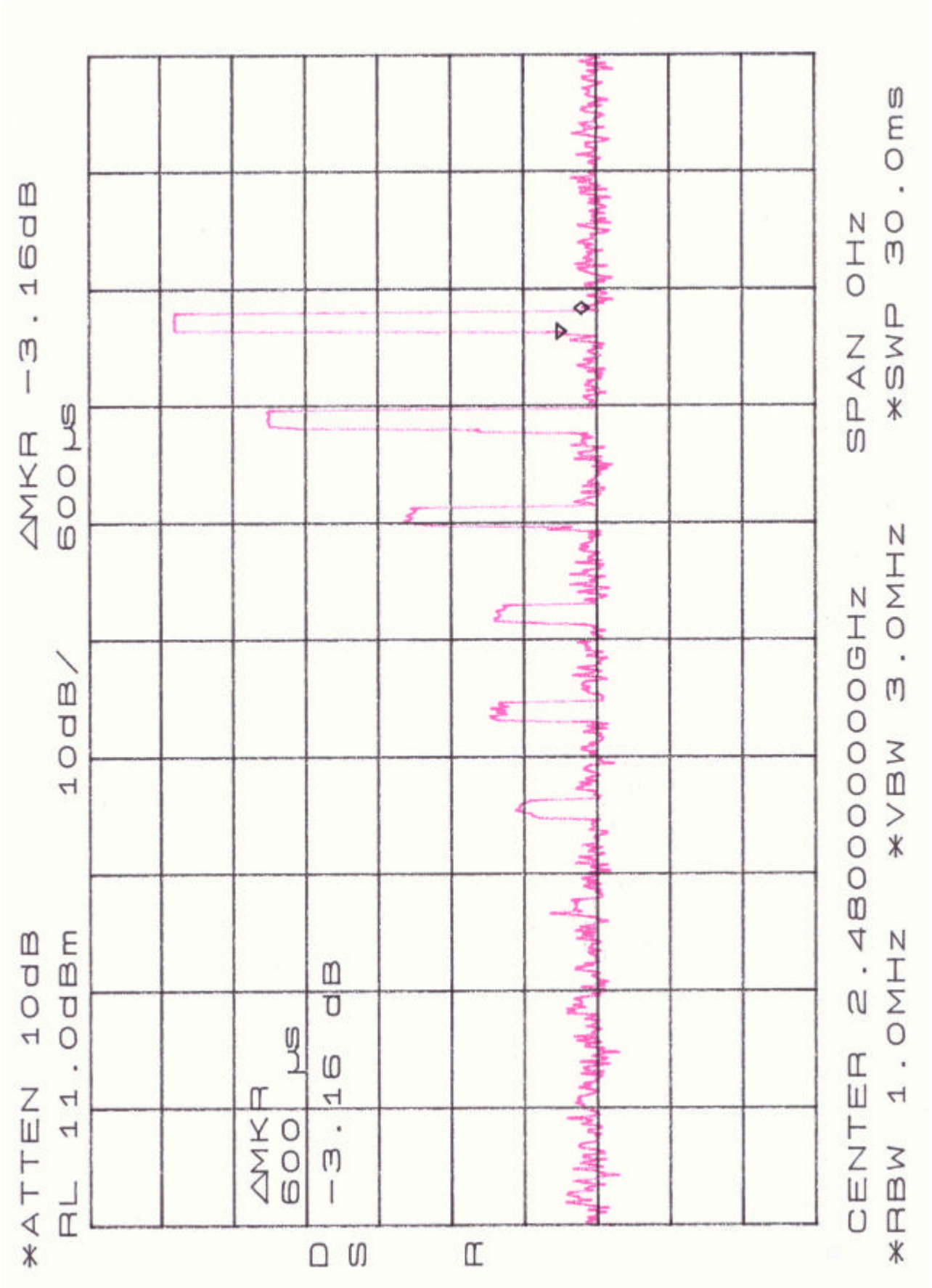

*ATTEN 10dB
RL 11.0dBm 10dB/
SWEEP TIME
10.0 sec
D S
R
CENTER 2.402000000GHz
*RBW 1.0MHz *VBW 3.0MHz
SPAN 0Hz
*SWP 10.0sec


*ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR -2.83dB
600 μs
ΔMKR
600 μs
-2.83 dB
D S
R
CENTER 2.402000000GHz
*RBW 1.0MHz
*VBW 3.0MHz
SPAN 0Hz
*SWP 30.0ms


*ATTEN 10dB
RL 11.0dBm
10dB/
SWEEP TIME
10.0sec
D S
R
CENTER 2.441000000GHz
*RBW 1.0MHz
*VBW 3.0MHz
SPAN 0Hz
*SWP 10.0sec


*ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR -4.34dB
600 μs
ΔMKR
600 μs
-4.34 dB
D S
R
CENTER 2.441000000GHz
*RBW 1.0MHz
*VBW 3.0MHz
SPAN 0Hz
*SWP 30.0ms


*ATTEN 10dB
RL 11.0dBm
10dB/
SWEEP TIME
10.0sec
D S
R
CENTER 2.480000000GHz
*RBW 1.0MHz
*VBW 3.0MHz
SPAN 0Hz
*SWP 10.0sec


*ATTEN 10dB
RL 11.0dBm
10dB/
ΔMKR -3.16dB
600 μs
ΔMKR
600 μs
-3.16 dB
D S
R
CENTER 2.480000000GHz
SPAN 0Hz
*RBW 1.0MHz
*VBW 3.0MHz
*SWP 30.0ms