FCC PART 15 SUBPART C

EMI MEASUREMENT AND TEST REPORT

For

Unical Enterprises, Inc.

16960 Gale Avenue,
City of Industry, CA 91745

FCC ID: LZX-MCD4300BT

November 30, 2001

This Report Concerns:	**Equipment Type:**
☒ Original Report	Cordless Phone

Test Engineer:	Jeff Lee
Test Date:	November 27, 2001
Reviewed By:	John Y. Chan – Engineering Manager
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1 - GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

The Unical Enterprises, Inc.'s MCD4300BT or the "EUT" as referred to in this report is a cordless telephone, which measures 2.0" (L) x 1.75" (W) x 7.6" (H).

The EUT provides the following features:

- Small size, light weight and low cost
- Contact from SPST-NO is mass production
- No influence from dust, humidity, gases etc. by employment of sealed reed switch
- Wide range from Open Frame type to Encapsulated type with Magnetic Shield case

Note: The test data was only good for the test sample. It may have deviation for other test sample

1.2 Objective

This type approval report is prepared on behalf of *Unical Enterprises, Inc*. in accordance with Part 2, Subpart J, Part 15, Subparts A, B and C of the Federal Communication Commissions rules.

The objective of the manufacturer is to demonstrate compliance with FCC rules for Output Power, Antenna Requirement, Hopping Channel Separation, Number of Hopping Frequency Used, 20 dB Bandwidth, Dwell Time on Each Channel, 100 kHz Bandwidth of Band Edges Measurement, Conducted and Spurious Radiated Emission.

1.3 Related Submittal(s)/Grant(s)

No Related Submittal(s).

1.4 Test Methodology

All measurements contained in this report were conducted with ANSI C63.4 –1992, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz. All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory Corporation. The radiated testing was performed at an antenna-to-EUT distance of 3 Meters.

1.5 Test Facility

The Open Area Test site used by Bay Area Compliance Laboratory Corporation to collect radiated and conducted emission measurement data is located in the back parking lot of the building at 230 Commercial Street, Suite 2, Sunnyvale, California, USA.

Test site at Bay Area Compliance Laboratory Corporation has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI).

The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on

December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-1992.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC file 31040/SIT 1300F2 and VCCI Registration No.: C-1298 and R-1234. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, Bay Area Compliance Laboratory Corporation is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (NVLAP). The scope of the accreditation covers the FCC Method - 47 CFR Part 15 - Digital Devices,

IEC/CISPR 22: 1998, and AS/NZS 3548: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment test methods under NVLAP Lab Code 200167-0.

1.6 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Due Date
HP	Spectrum Analyzer	8568B	2610A02165	12/6/02
HP	Spectrum Analyzer	8593B	2919A00242	12/20/02
HP	Amplifier	8349B	2644A02662	12/20/02
HP	Quasi-Peak Adapter	85650A	917059	12/6/02
HP	Amplifier	8447E	1937A01046	12/6/02
A.H. System	Horn Antenna	SAS0200/571	261	12/27/02
Com-Power	Log Periodic Antenna	AL-100	16005	11/2/02
Com-Power	Biconical Antenna	AB-100	14012	11/2/02
Solar Electronics	LISN	8012-50-R-24-BNC	968447	12/28/02
Com-Power	LISN	LI-200	12208	12/20/02
Com-Power	LISN	LI-200	12005	12/20/02
BACL	Data Entry Software	DES1	0001	12/20/02

***Statement of Traceabillity: Bay Area Compliance Laboratory Corp.** certifies that all calibration has been performed using suitable standards traceable to the NATONAL INSITUTE OF STANDARDS AND TECHNOLOGY (NIST)

1.7 Equipment Under Test (EUT)

Manufacturer	Description	Model	Serial Number	FCC ID
Unical Enterprises	Cordless Phone	MCD4300BT	None	LZX-MCD4300BT

1.8 Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number	FCC ID
Panasonics	Phone Set	A348AL	CS6500U51A	DOC
TELTONE	Simulator	TLS-3B-01	80071	DOC

1.9 External I/O Cabling List and Details

Cable Description	Length (M)	Port/From	To
Unshielded RJ11 Cable	1.5	Line/EUT	Simulator
Unshielded RJ11 Cable	1.5	Phone Set/Panasonic Phone	Simulator

2 - SYSTEM TEST CONFIGURATION

2.1 Description of Test Configuration

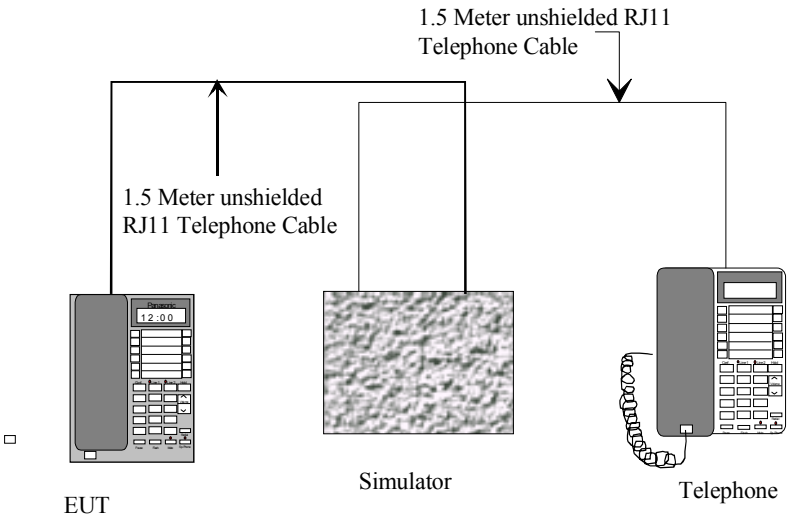
The EUT was configured for testing in a typical fashion (as normally used by a typical user).

The EUT, cordless telephone, Model MCD4300BT was placed on the wooden table axis with the simulator and the telephone on its right in order. The EUT was investigated for emissions while off hook. The radiated data was taken in this mode of operation. All initial and final investigations were performed with the EMI receiver in manual mode scanning the frequency range continuously. The cables were bundled and routed as shown in the 2.3.

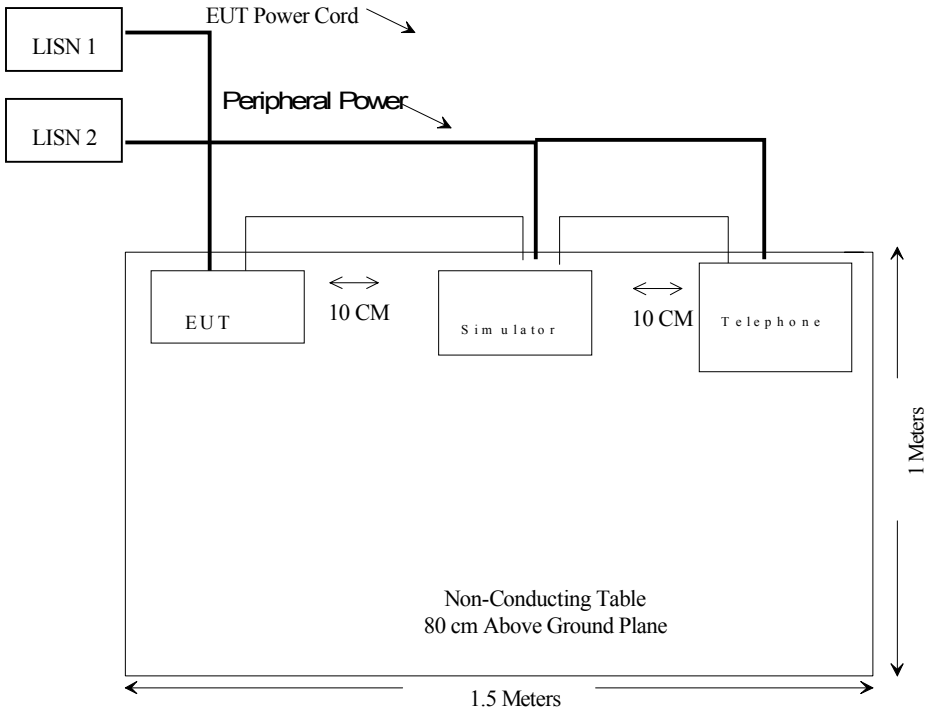
2.2 Equipment Modifications

No modification(s) to the EUT were made to comply with the applicable limits.

2.3 Configuration of Test System



2.4 Test Setup Block Diagram



3 - SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT
§15.207 (a)	Conducted Emission	Pass
§15.209 (a)	Radiated Emission	Pass
§15.203	Antenna Requirement	Pass
§15.247 (a) (1)	Hopping Channel Separation	Pass
§15.247 (a) (1) (i)	Number of Hopping Frequencies Used	Pass
§15.247 (a) (1) (i)	Hopping Channel Bandwidth	Pass
§15.247 (a) (1) (i)	Dwell Time of Each Frequency within a 10 Second Period	Pass
§15.247 (b) (2)	Output Power	Pass
§ 15.247 (c)	100 kHz Bandwidth of Frequency Band Edges	Pass
§ 2.1091	RF Safety Requirements	Pass
§ 15.205	Restricted Bands	Pass

4 - Conducted Output Power Measurement

4.1 Standard Applicable

According to §15.247(b) (2), the maximum peak output power of the intentional radiator shall not exceed 1 Watt.

4.2 Measurement Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.

4.3 Measurement Result

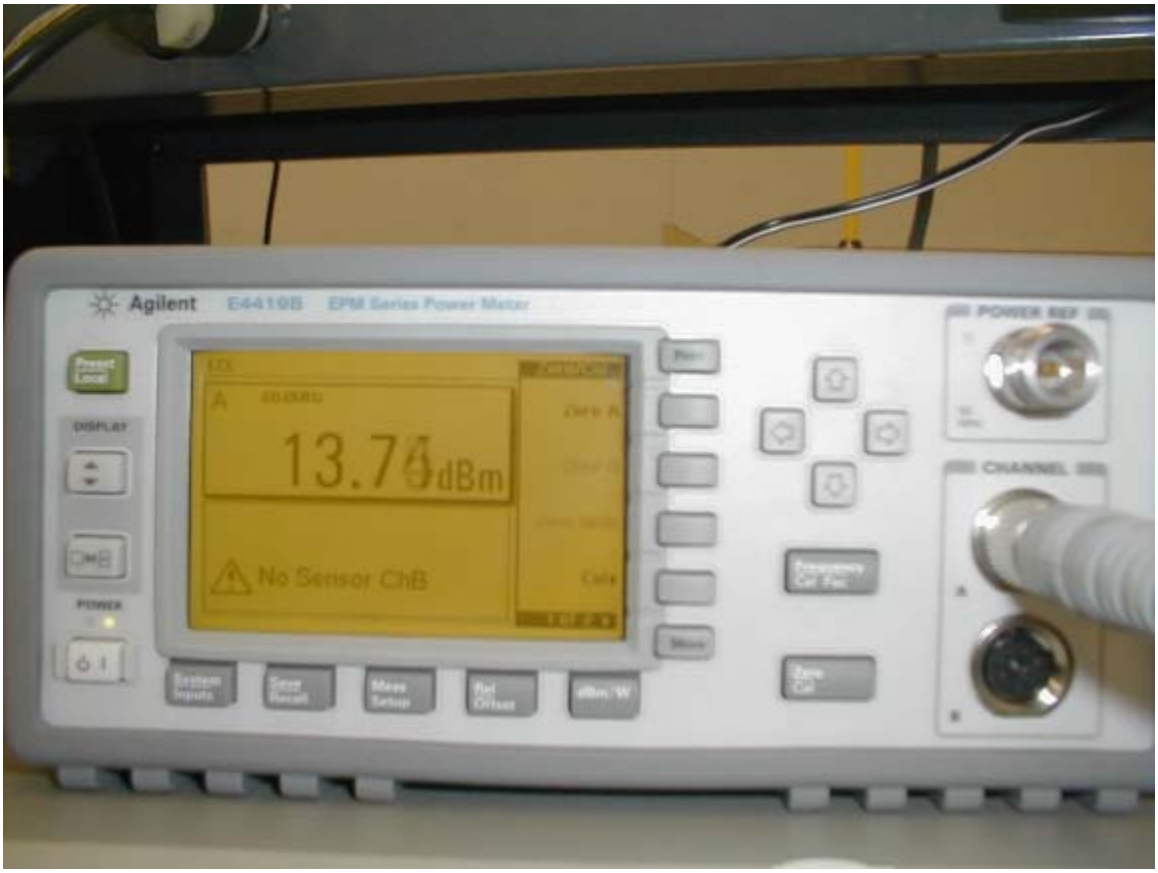
Refer to the attached to the following plots:

Peak Output Power	Page Reference	Test Result
Base Low Channel	11	Passed
Base Middle Channel	12	Passed
Base High Channel	13	Passed
Handset Low Channel	14	Passed
Handset Middle Channel	15	Passed
Handset High Channel	16	Passed

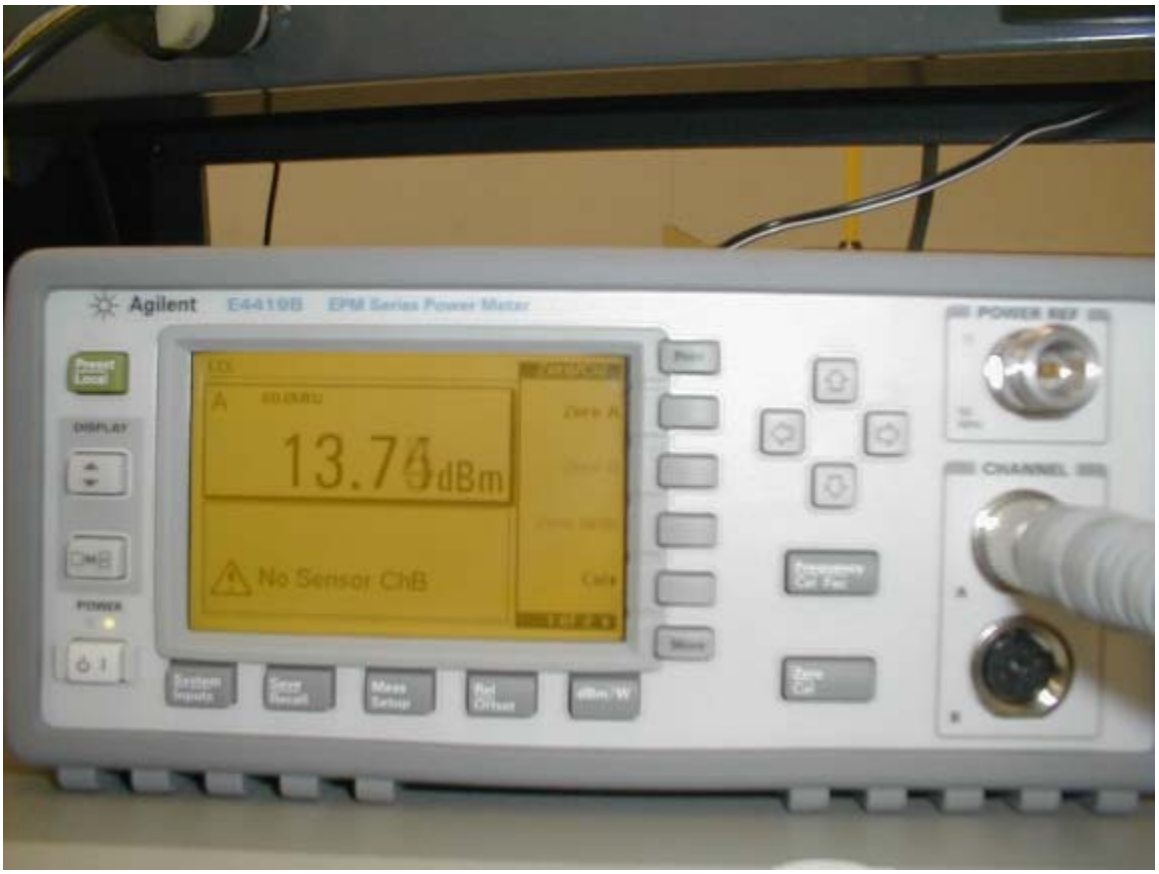
4.4 Test Equipment

Manufacturer	Model No.	Serial No.	Calibration Due Date
Agilent	E4419B	GB40202891	4/8/02
Agilent	E4412A	US38486529	4/8/02

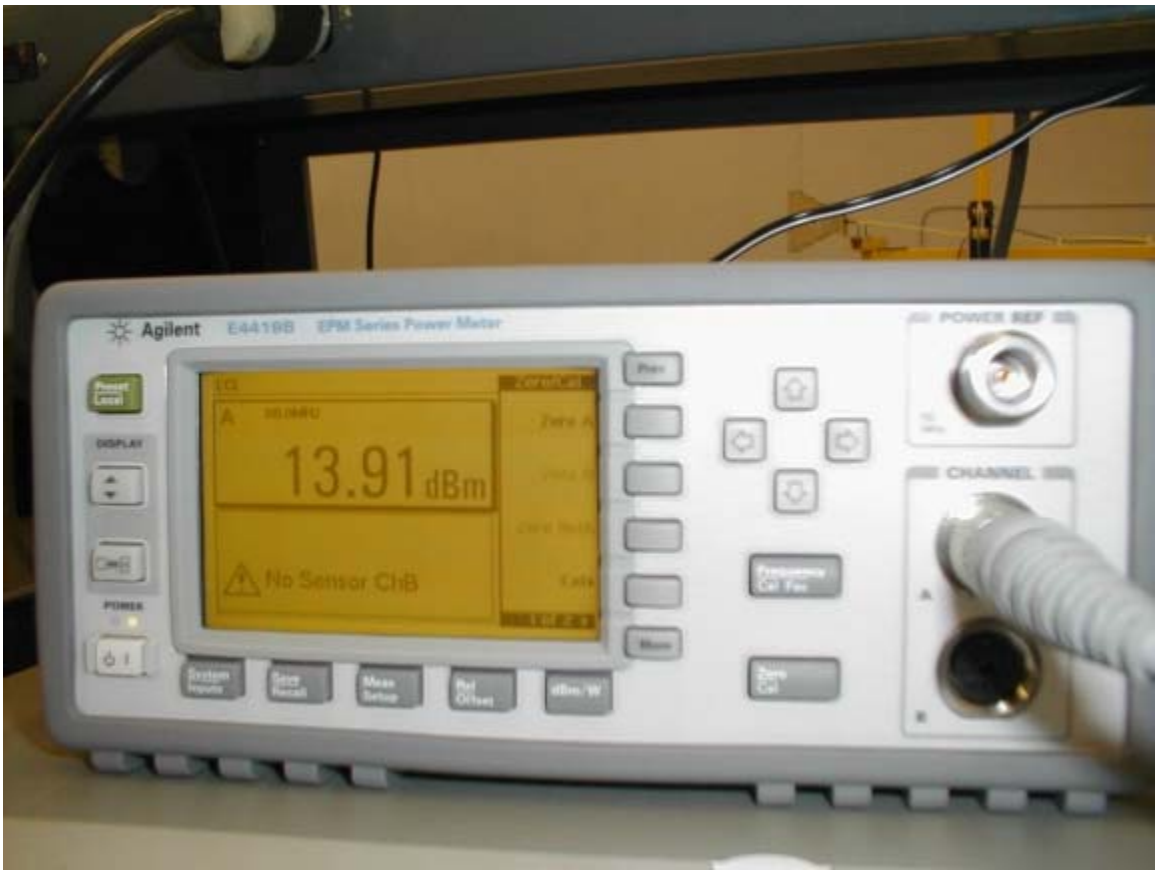
Base Low Channel



Base Middle Channel



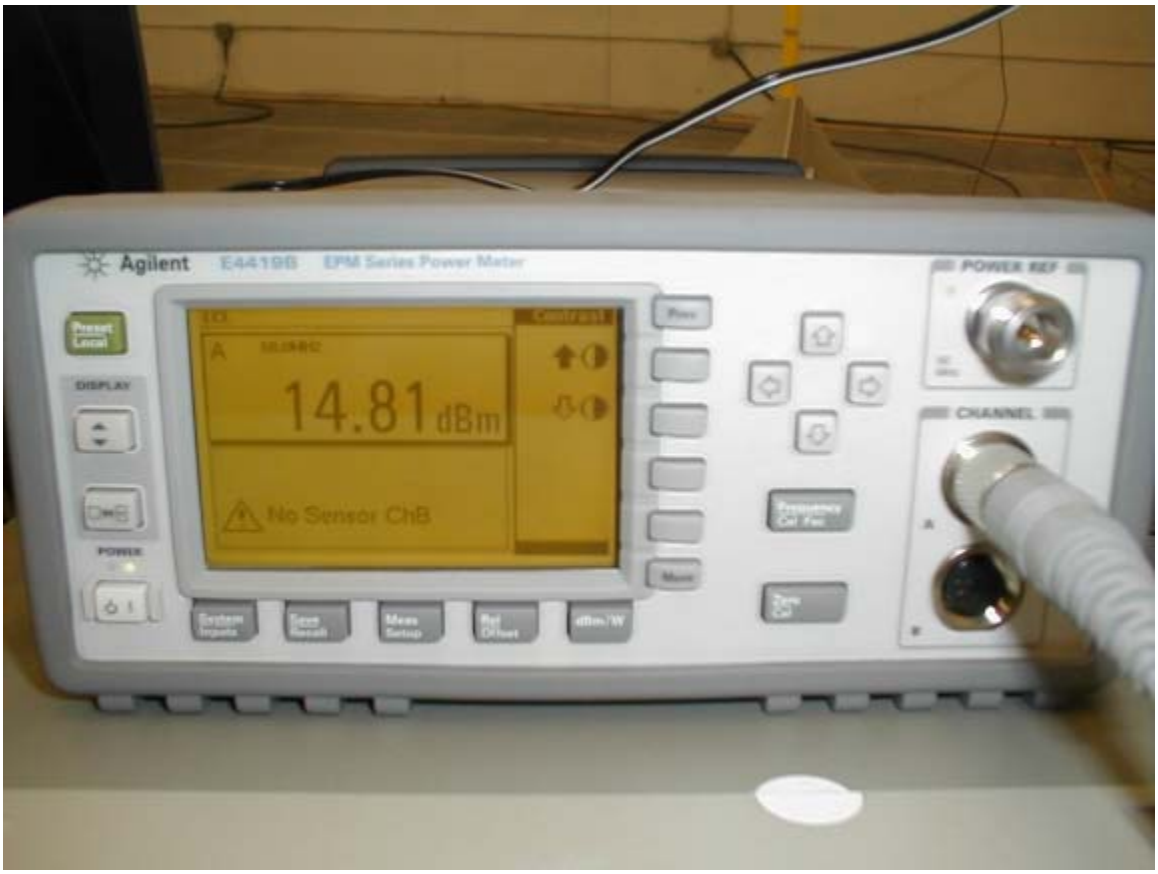
Base High Channel



Handset Low Channel

Handset Middle Channel

Handset High Channel



5 – SPURIOUS EMISSION

5.1 Standard Applicable

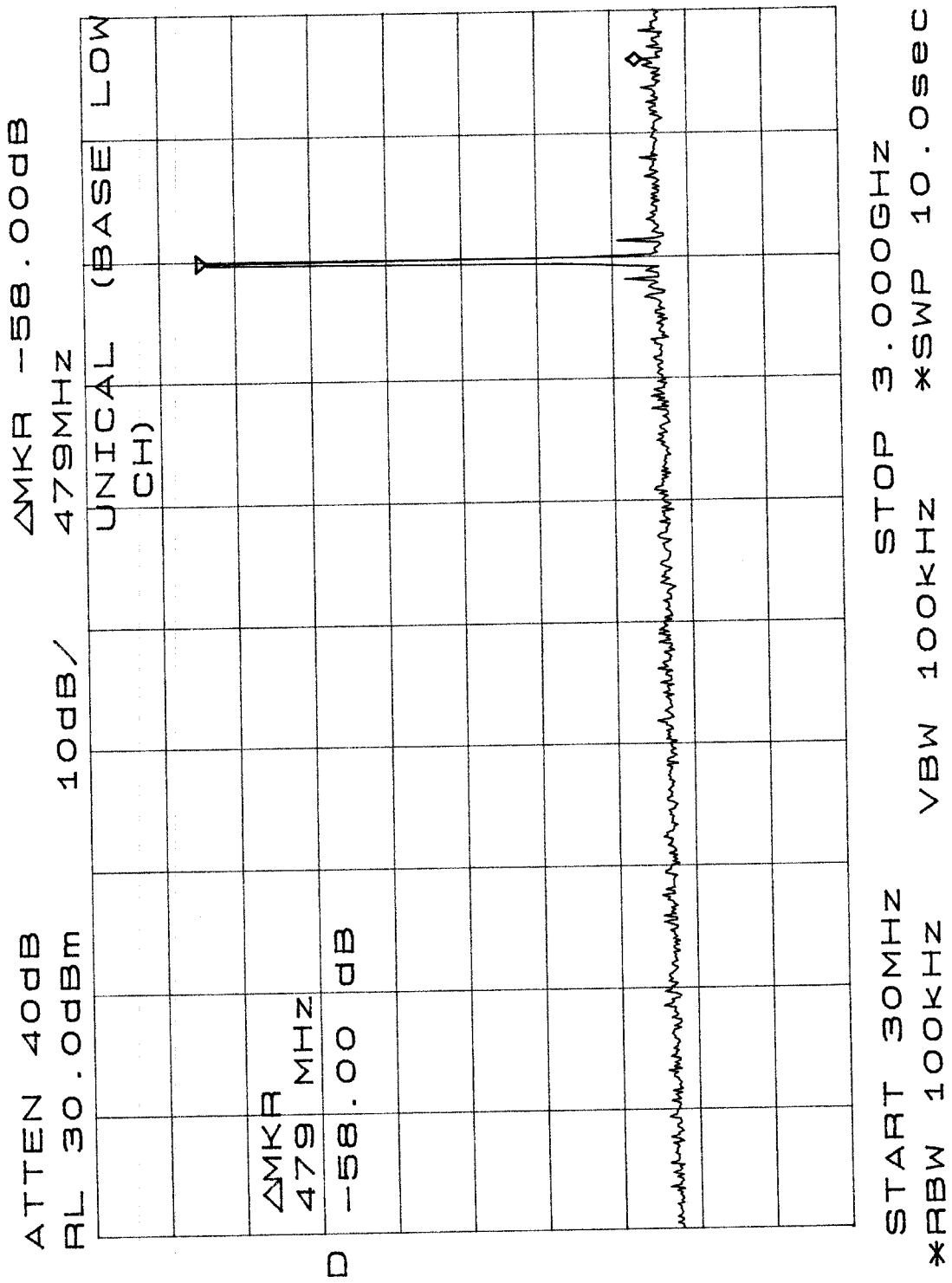
According to §15.209 (f) and §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation f a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit.

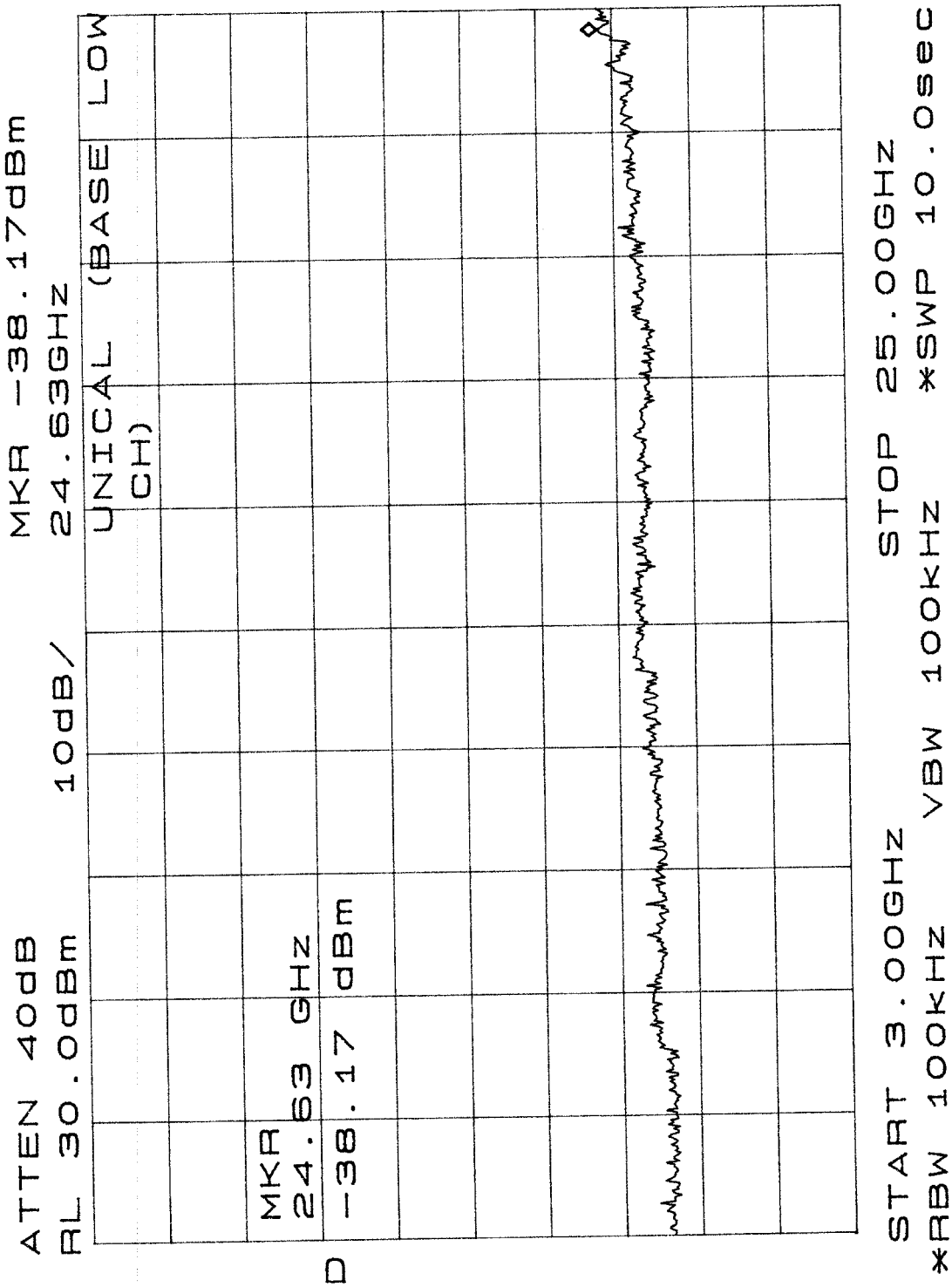
5.2 Measurement Procedure

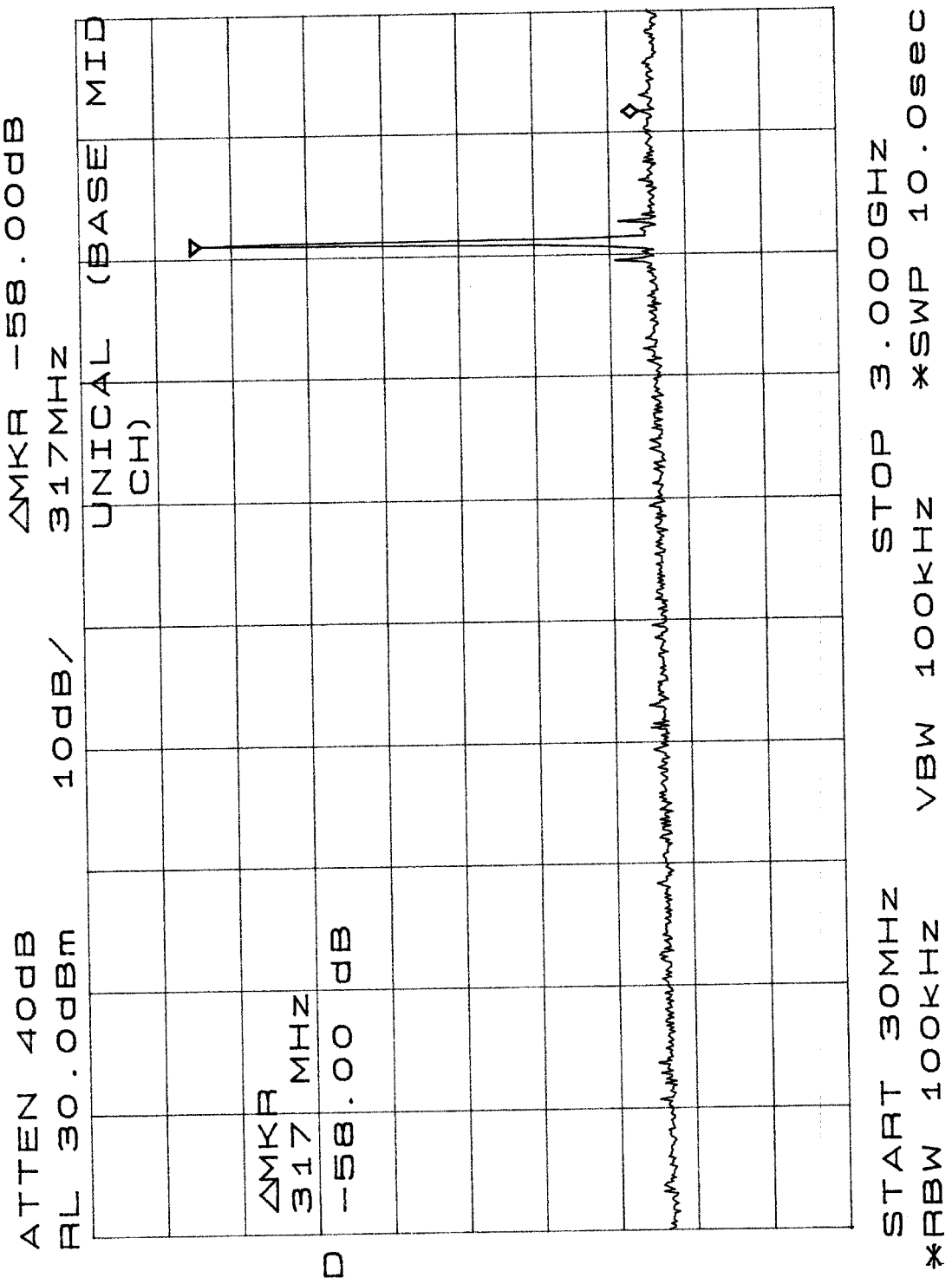
1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument 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. Set the SA on Max-Hold Mode, and then keep the EUT in transmitting mode. Record all the signals from each channel until each one has been recorded.
4. Set the SA on View mode and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

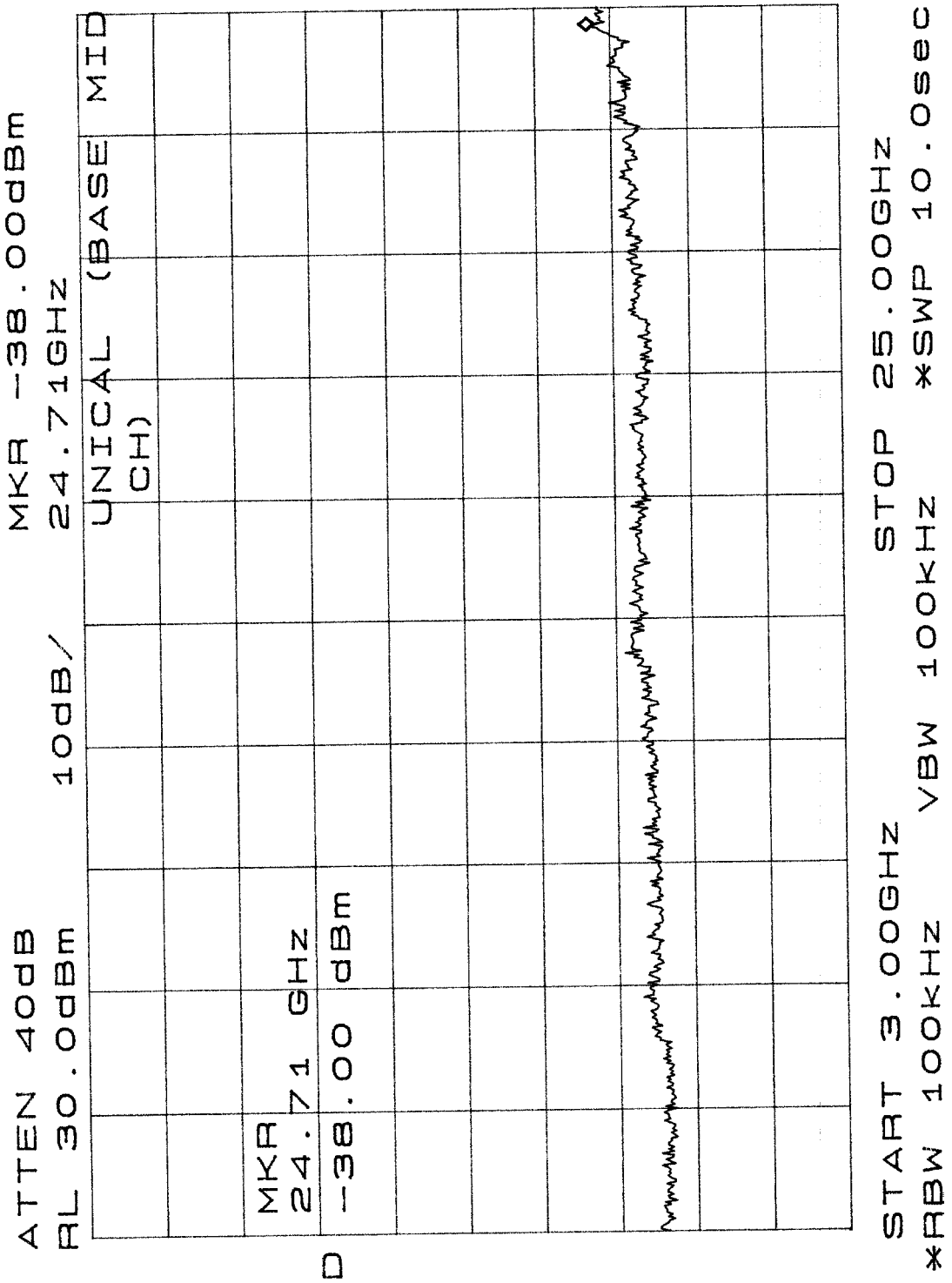
5.3 Measurement Data

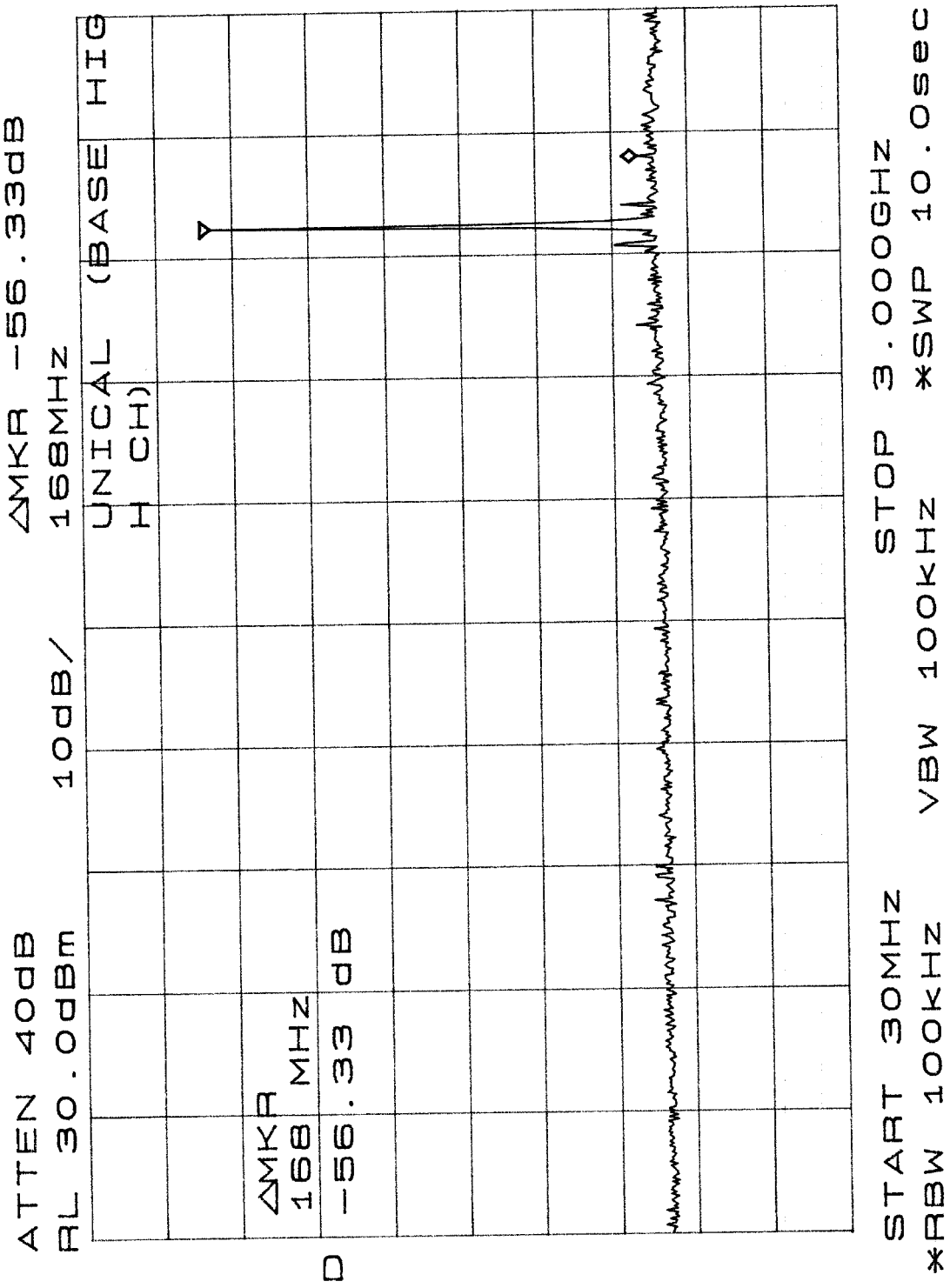
Spurious Emission	Page Reference	Test Results
	18-29	Passed

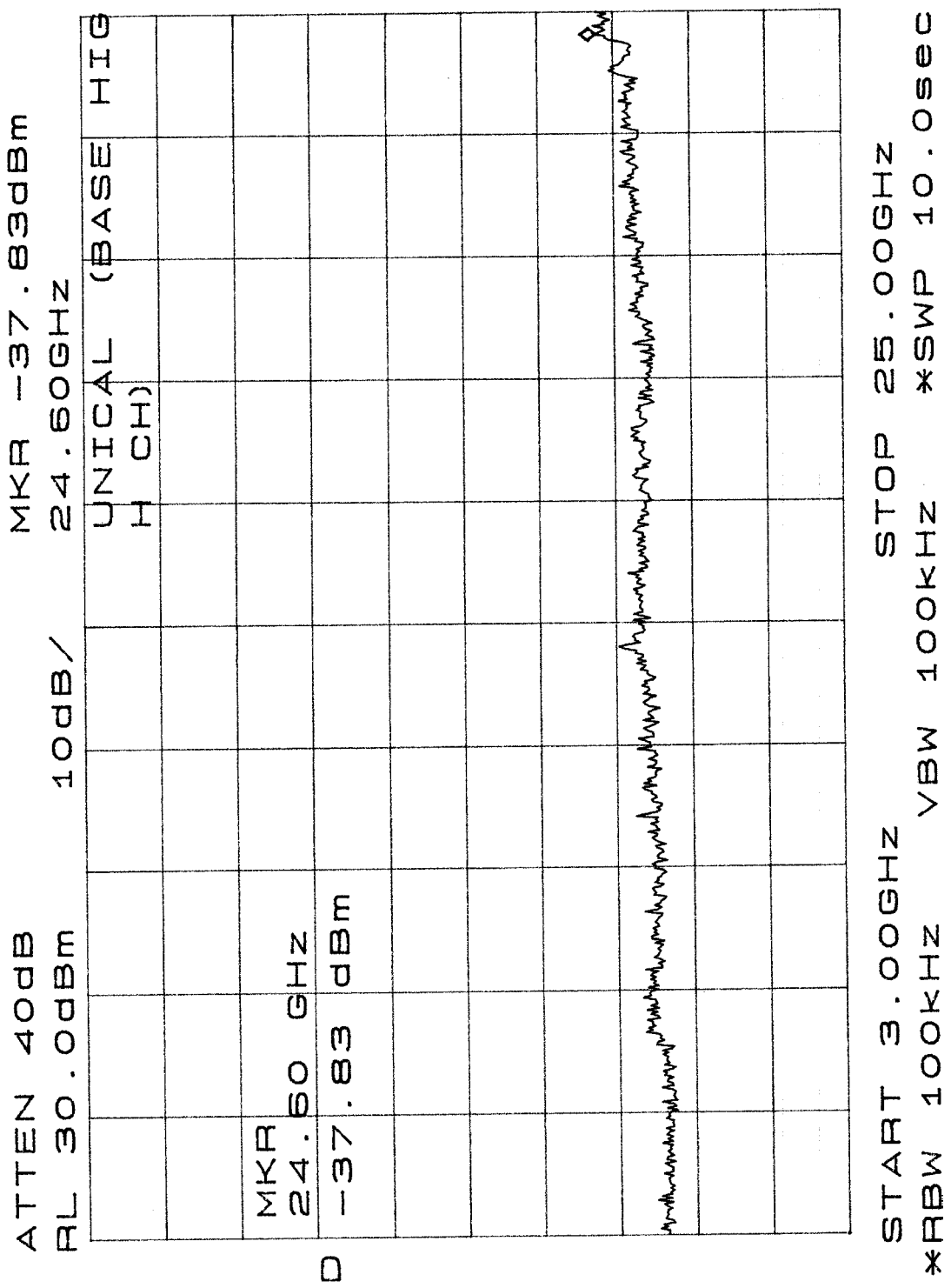

ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR -58.00dB
479MHz
UNICAL (BASE LOW CH)
ΔMKR
479 MHz
-58.00 dB
D
START 30MHz
*RBW 100KHz
VBW 100KHz
STOP 3.000GHz
*SWP 10.0sec

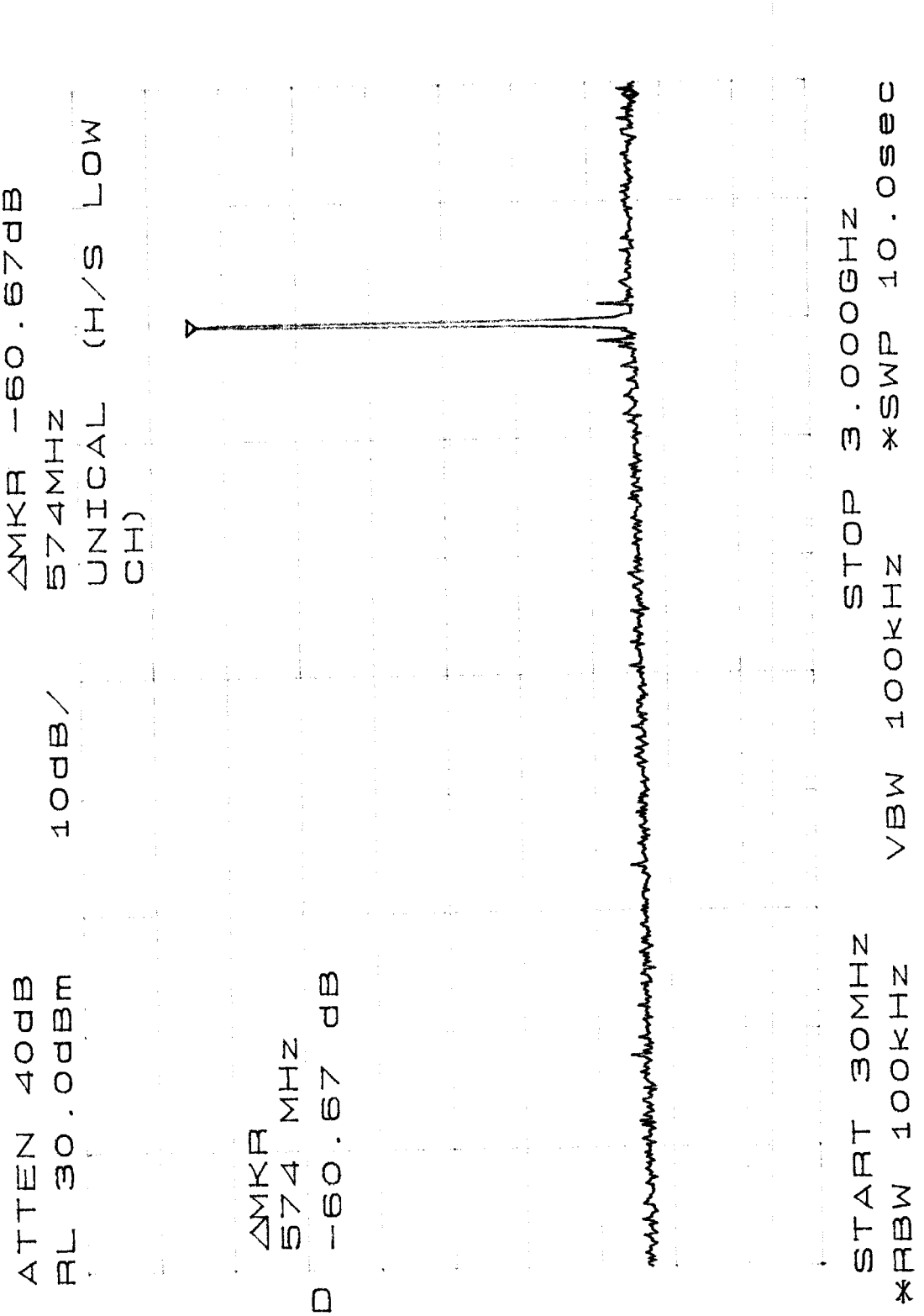

ATTEN 40dB
RL 30.0dBm
10dB/
MKR -38.17dBm
24.63GHz
UNICAL (BASE LOW CH)
MKR
24.63 GHz
-38.17 dBm
D
START 3.00GHz
*RBW 100KHz
VBW 100KHz
STOP 25.00GHz
*SWP 10.0sec

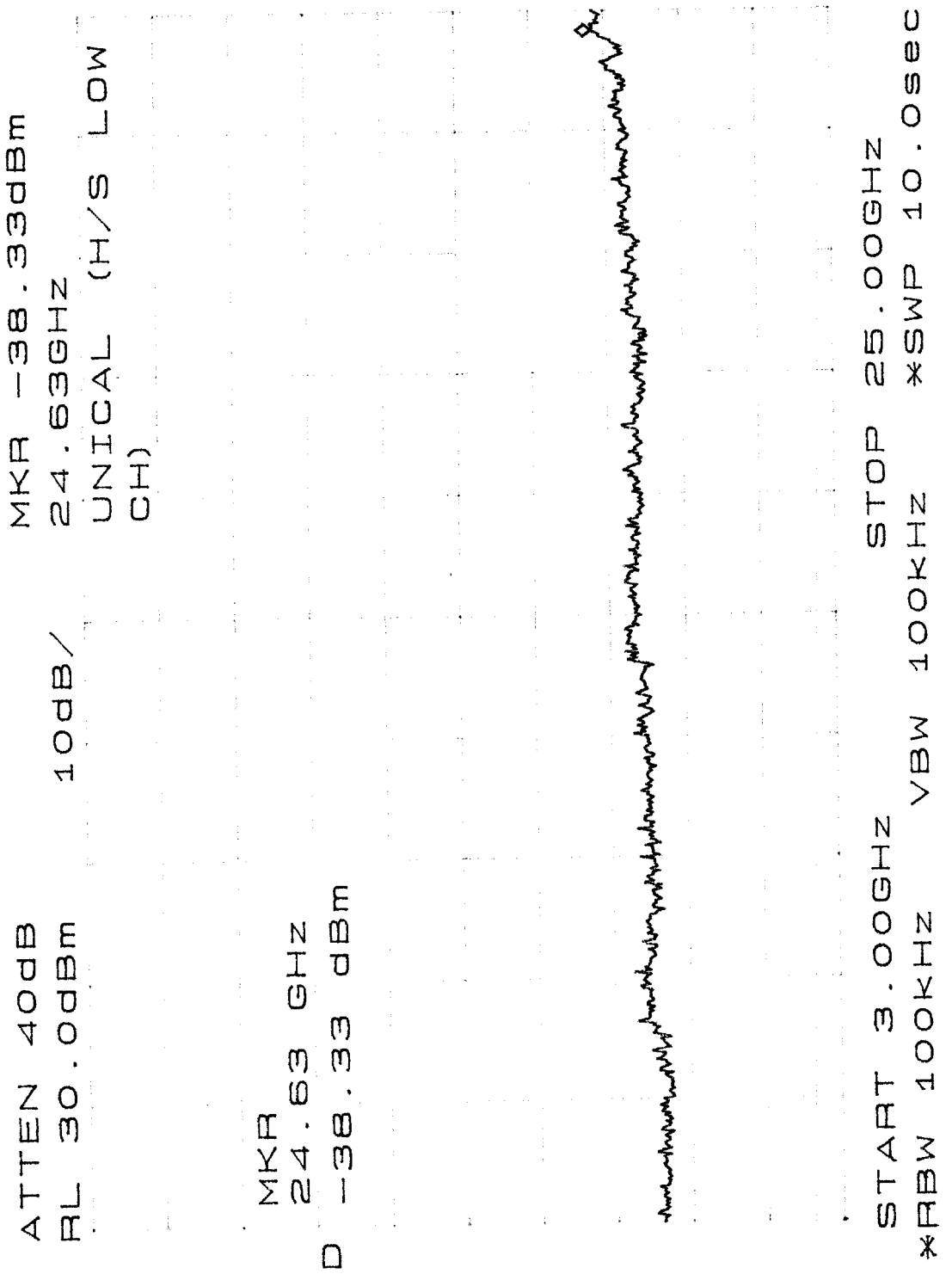

ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR -58.00dB
317MHz
UNICAL (BASE MID CH)
ΔMKR
317 MHz
-58.00 dB
D
START 30MHz
*RBW 100KHz
VBW 100KHz
STOP 3.000GHz
*SWP 10.0sec

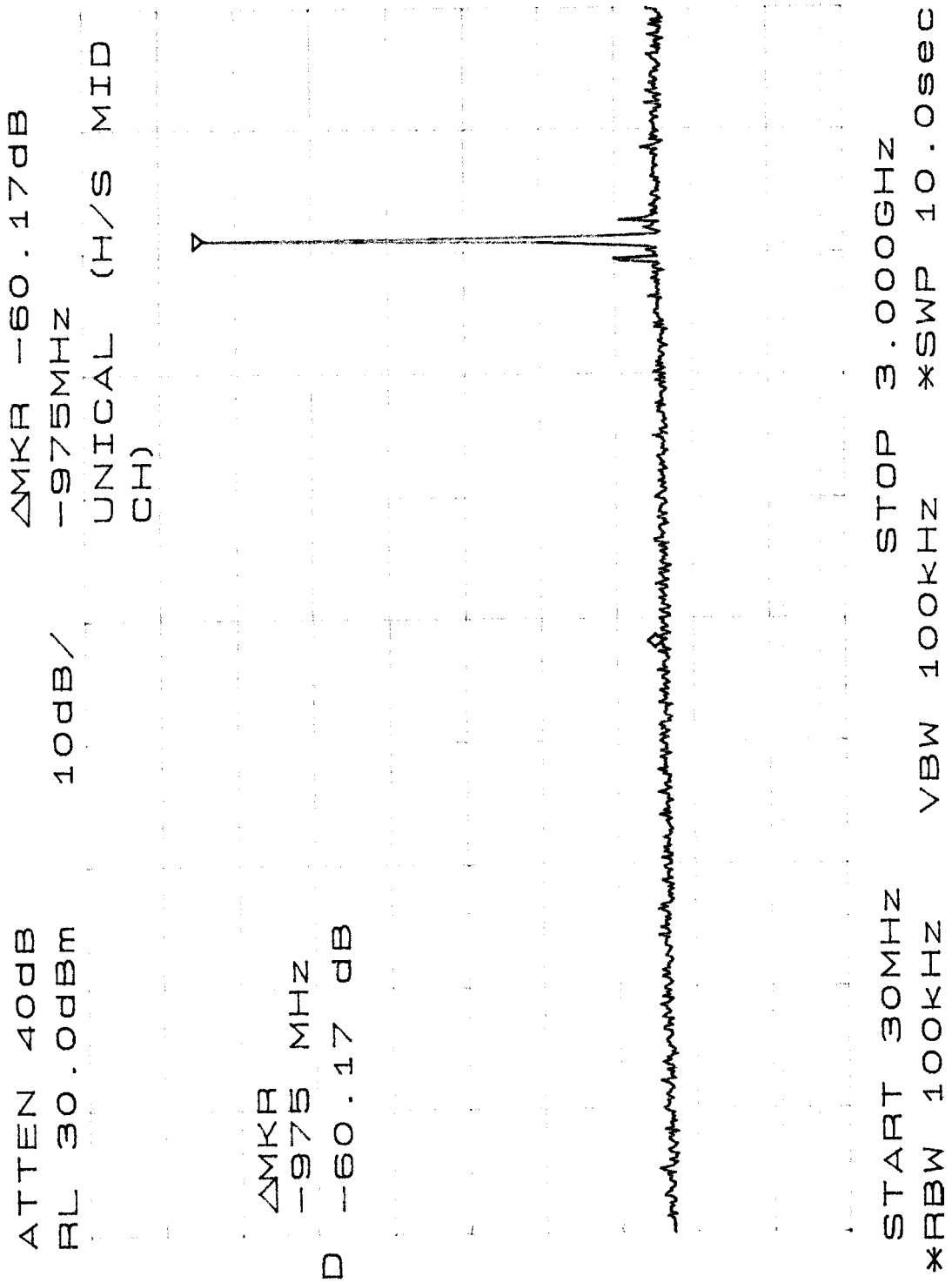

MKR -38.00dBm
24.71GHz
UNICAL (BASE MID CH)
ATTEN 40dB
RL 30.0dBm
10dB/
MKR 24.71 GHz
-38.00 dBm
START 3.00GHz
*RBW 100kHz
VBW 100kHz
STOP 25.00GHz
*SWP 10.0sec

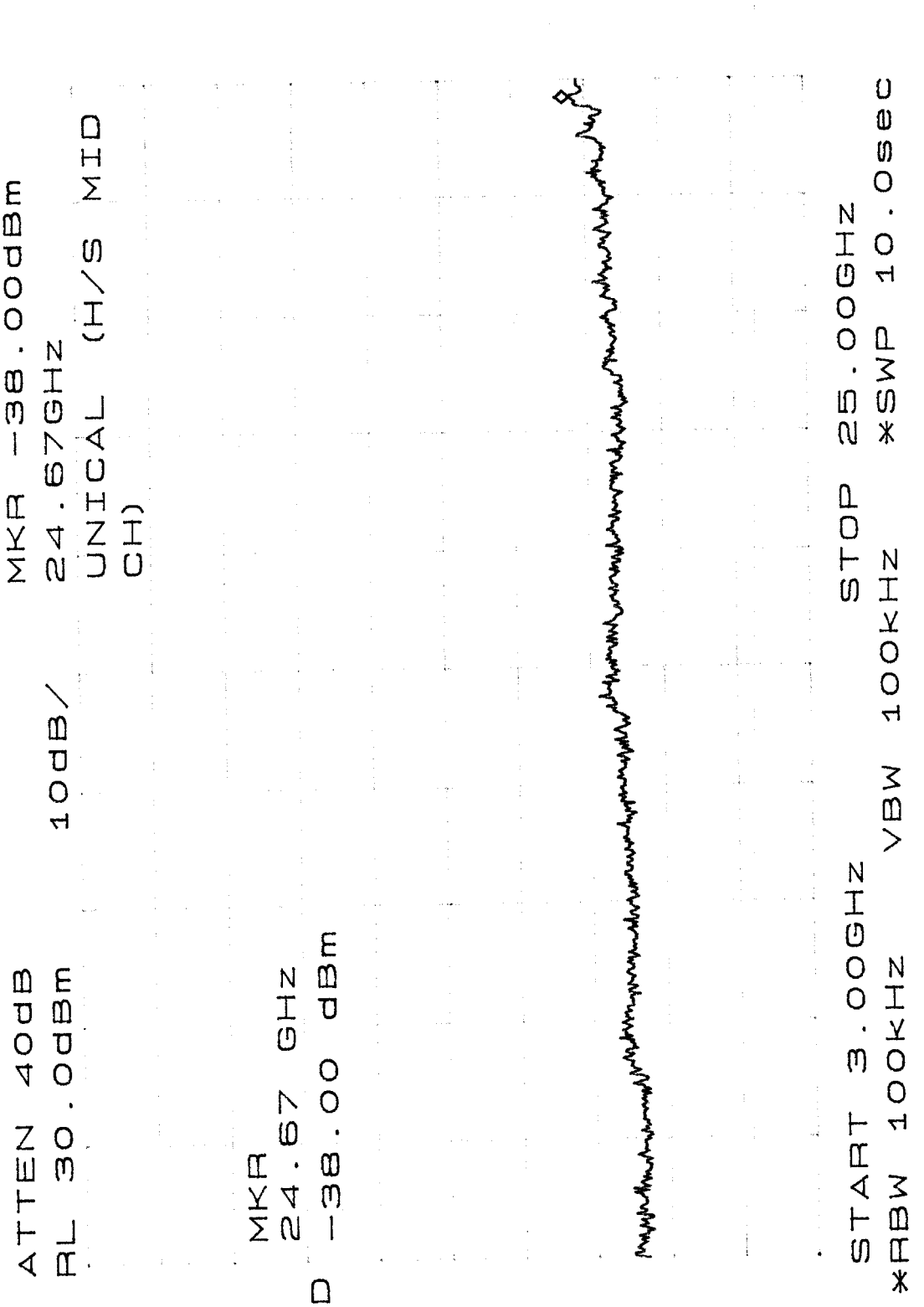

ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR -56.33dB
168MHz
UNICAL (BASE HIG
H CH)
ΔMKR
168 MHz
-56.33 dB
D
START 30MHz
*RBW 100kHz
VBW 100kHz
STOP 3.000GHz
*SWP 10.0sec

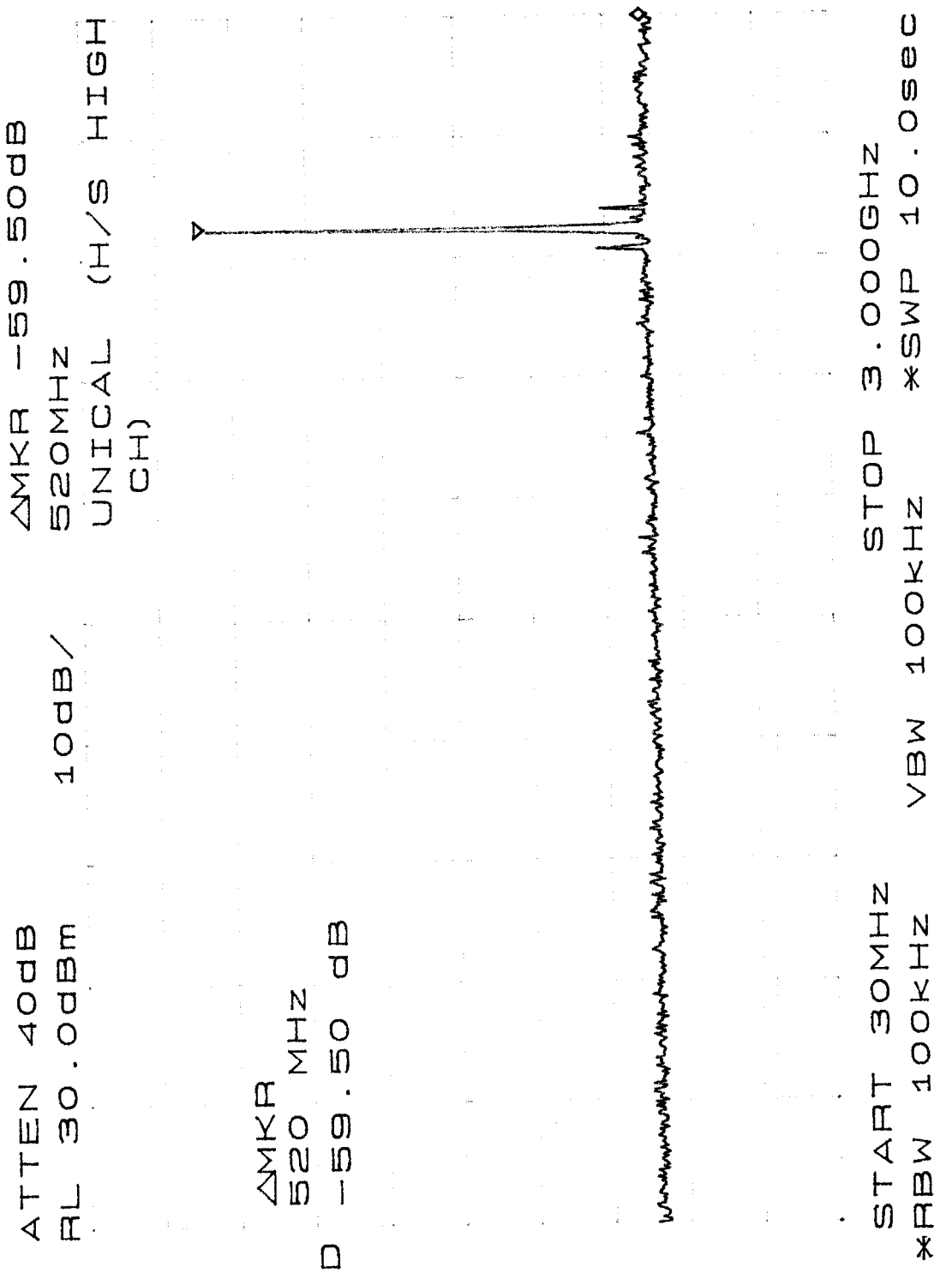

ATTEN 40dB
RL 30.0dBm
10dB/
MKR -37.83dBm
24.60GHz
UNICAL (BASE HIG
H CH)
MKR
24.60 GHz
-37.83 dBm
D
START 3.00GHz
*RBW 100KHz
VBW 100KHz
STOP 25.00GHz
*SWP 10.0sec

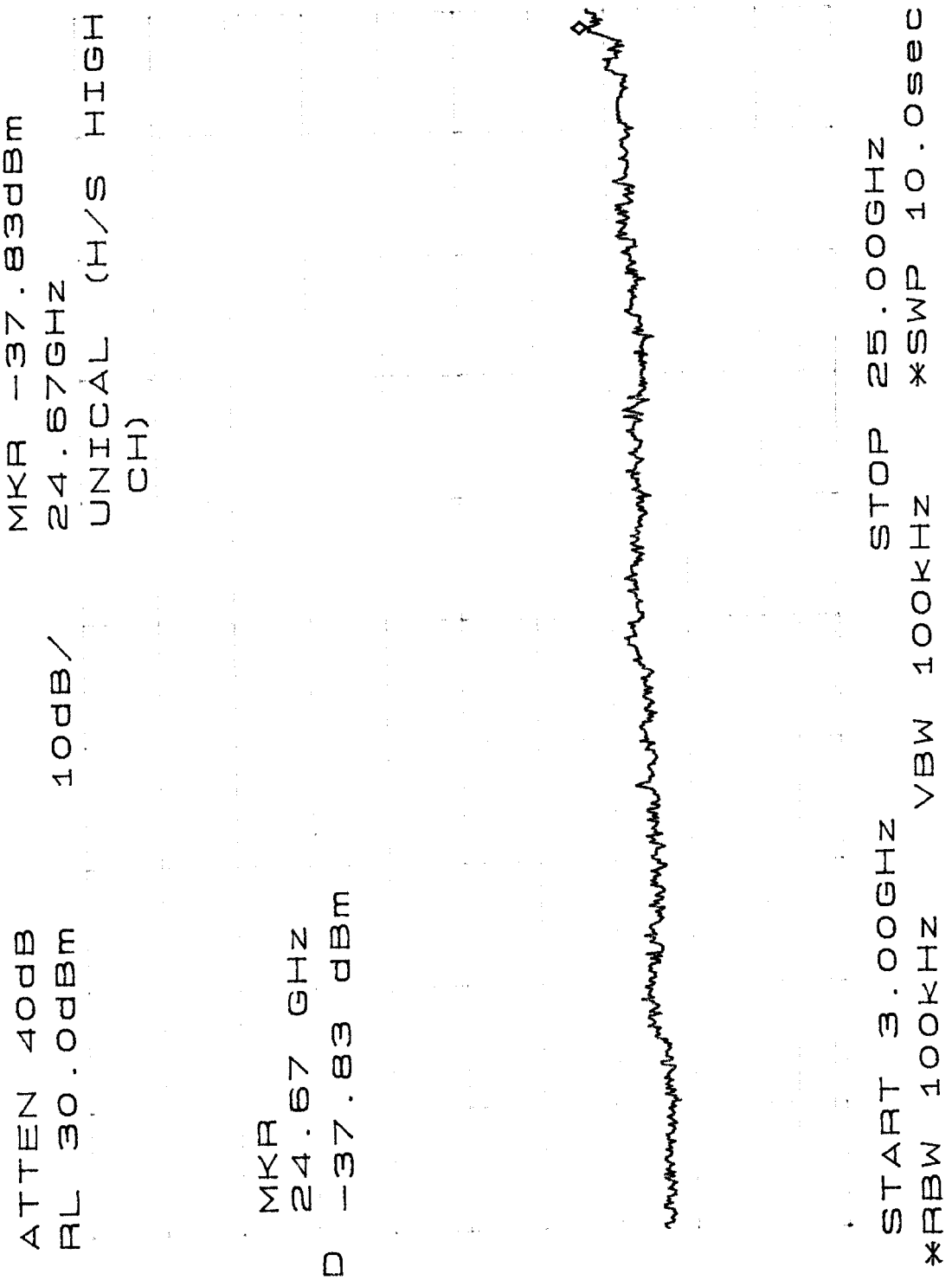

ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR -60.67dB
574MHz
UNICAL (H/S LOW CH)
ΔMKR
574 MHz
D -60.67 dB
START 30MHz
*RBW 100KHz
VBW 100KHz
STOP 3.000GHz
*SWP 10.0sec


ATTEN 40dB
RL 30.0dBm
10dB/
MKR -38.33dBm
24.63GHz
UNICAL (H/S LOW CH)
MKR
24.63 GHz
D -38.33 dBm
START 3.00GHz
*RBW 100KHz
VBW 100KHz
STOP 25.00GHz
*SWP 10.0sec


ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR -60.17dB
-975MHz
UNICAL (H/S MID CH)
ΔMKR
-975 MHz
D -60.17 dB
START 30MHz
*RBW 100kHz
VBW 100kHz
STOP 3.000GHz
*SWP 10.0sec


ATTEN 40dB
RL 30.0dBm
10dB/
MKR -38.00dBm
24.67GHz
UNICAL (H/S MID CH)
MKR
24.67 GHz
D -38.00 dBm
START 3.00GHz
*RBW 100KHz
VBW 100KHz
STOP 25.00GHz
*SWP 10.0sec


ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR -59.50dB
520MHz
UNICAL (H/S HIGH CH)
ΔMKR
520 MHz
D -59.50 dB
START 30MHz
*RBW 100KHz
VBW 100KHz
STOP 3.000GHz
*SWP 10.0sec


ATTEN 40dB
RL 30.0dBm
10dB/
MKR -37.83dBm
24.67GHz
UNICAL (H/S HIGH CH)
MKR
24.67 GHz
D -37.83 dBm
START 3.00GHz
*RBW 100kHz
VBW 100kHz
STOP 25.00GHz
*SWP 10.0sec

6 – 20 dB BANDWIDTH

6.1 Standard Applicable

According to §15.247(a)(1)(ii), for frequency hopping systems operating in the 2400-2483.5 MHz, the maximum 20 dB bandwidth of the hopping channel is 1MHz.

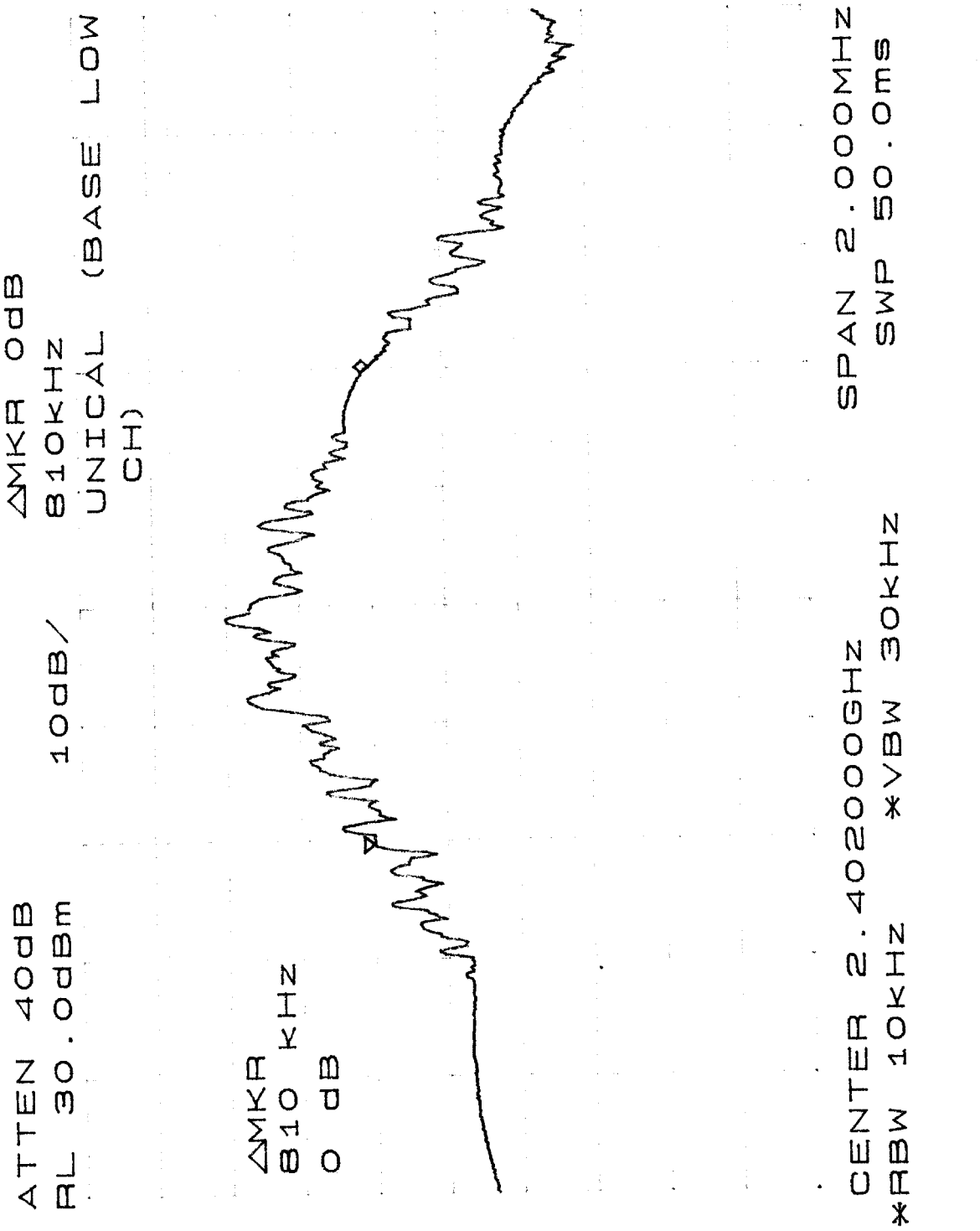
6.2 Measurement Procedure

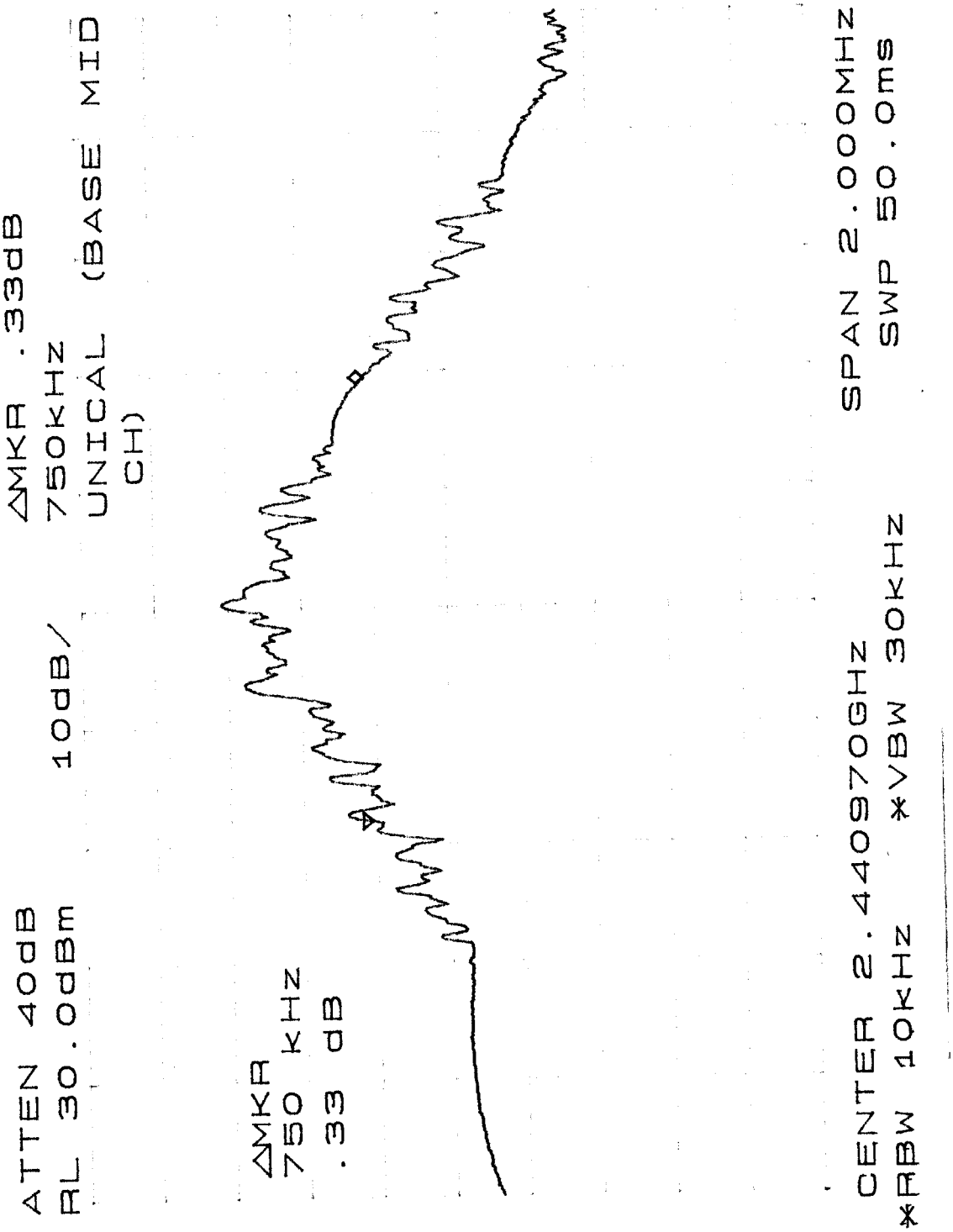
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

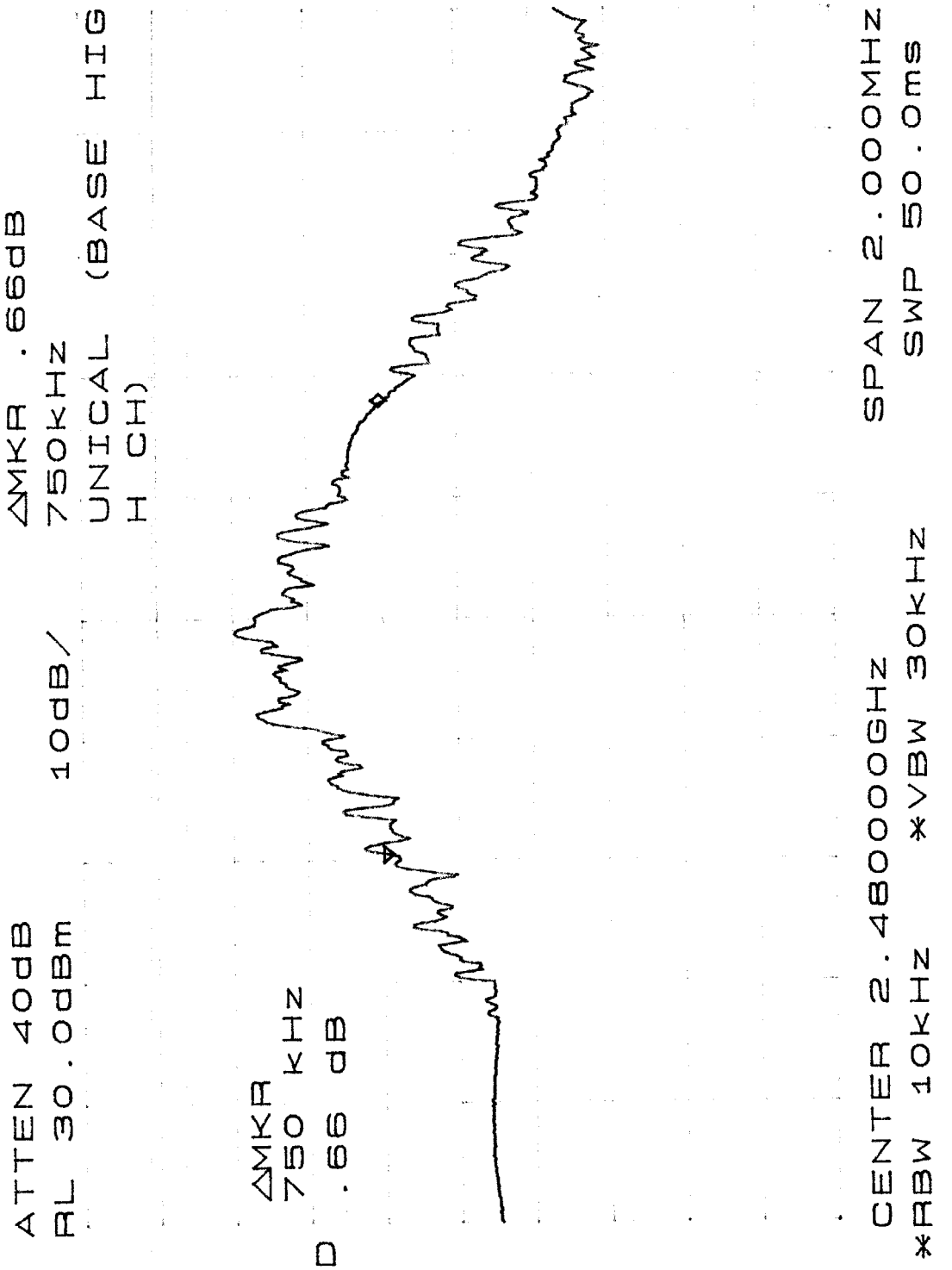
6.3 Measurement Data

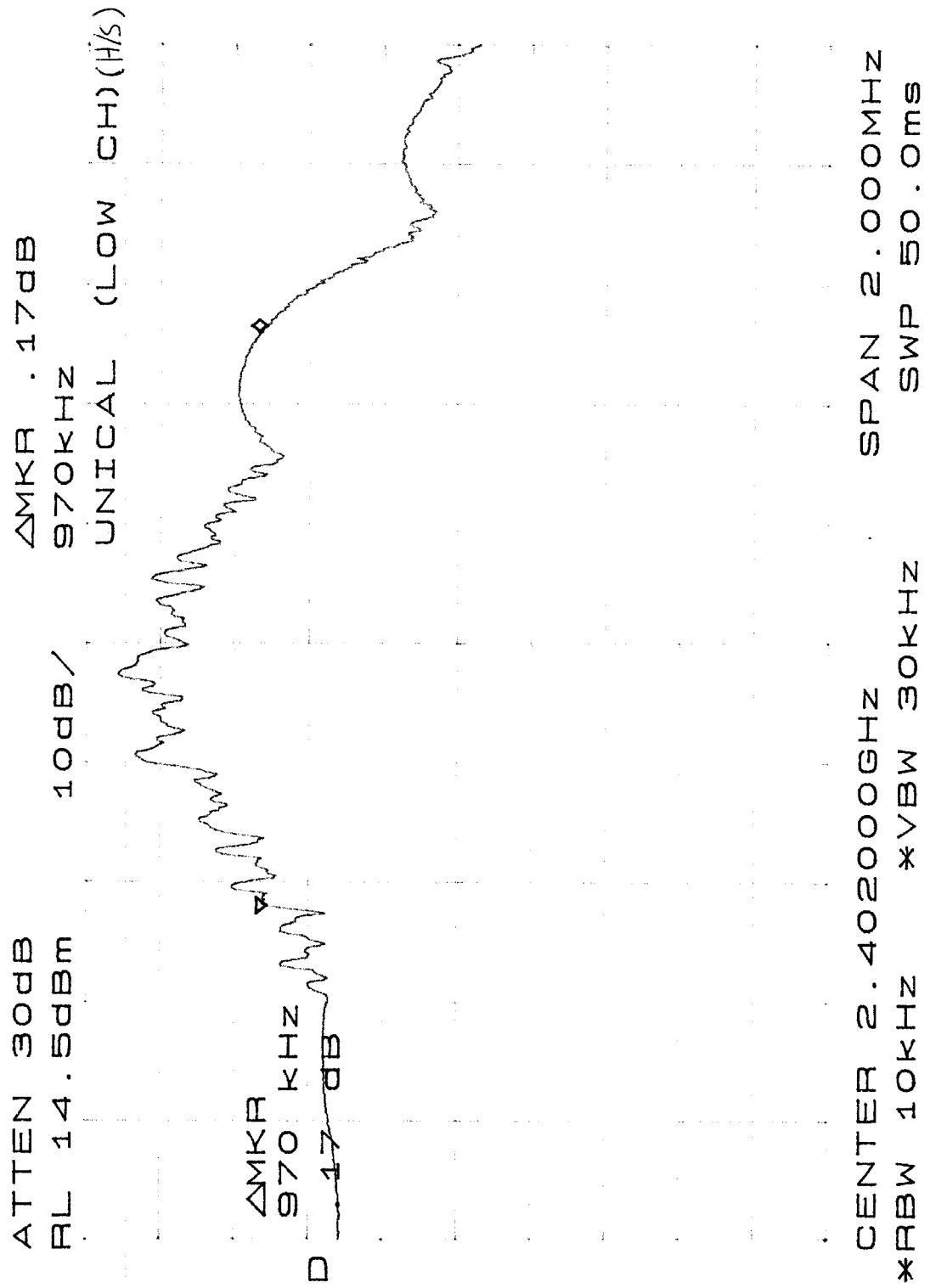
The following are plots of Hopping Channel Bandwidth for low, middle and high channel.

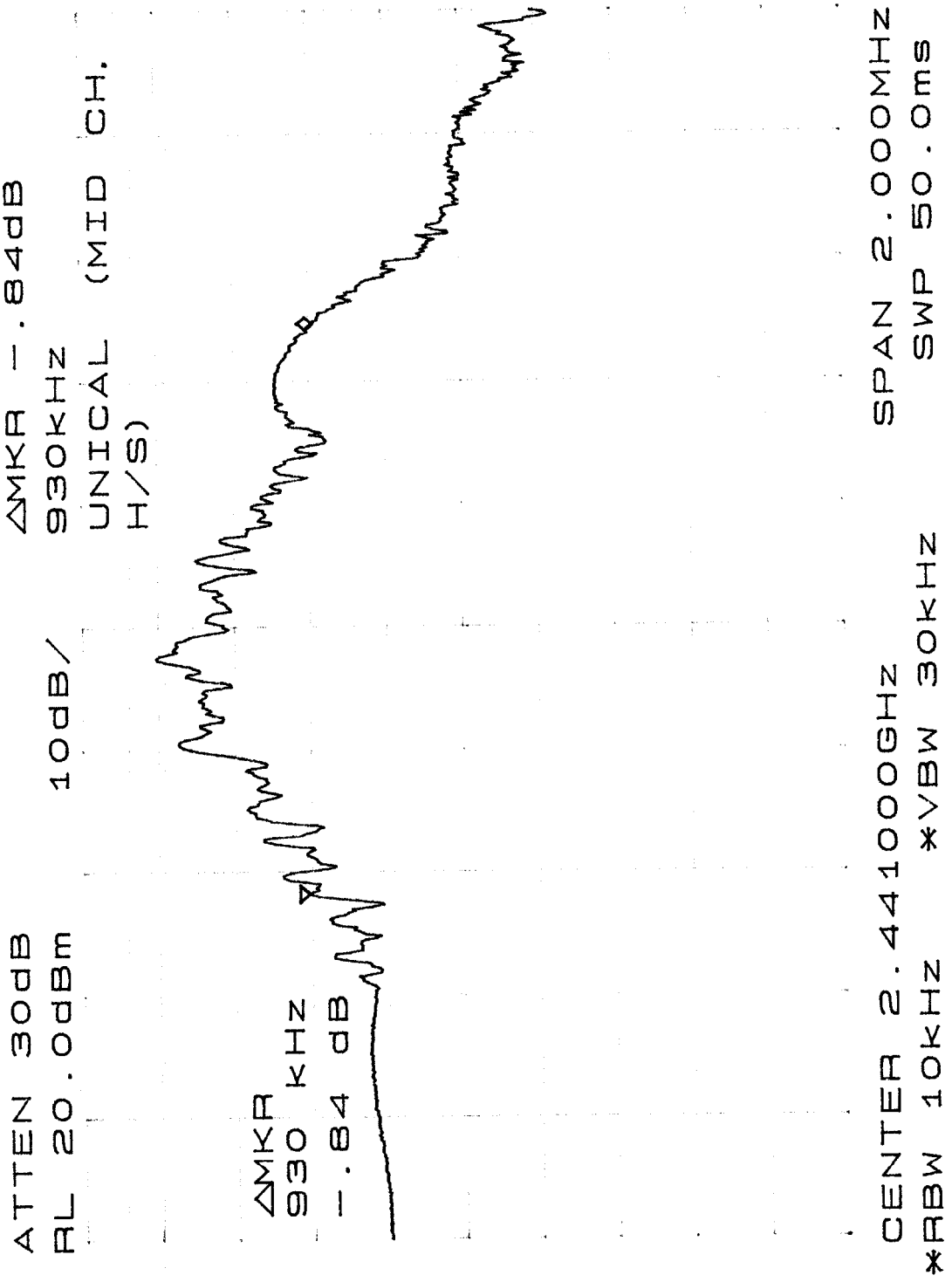
20 dB Channel Bandwidth	Page Reference	Test Result
Base Low Channel	31	Passed
Base Middle Channel	32	Passed
Base High Channel	33	Passed
Handset Low Channel	34	Passed
Handset Middle Channel	35	Passed
Handset High Channel	36	Passed

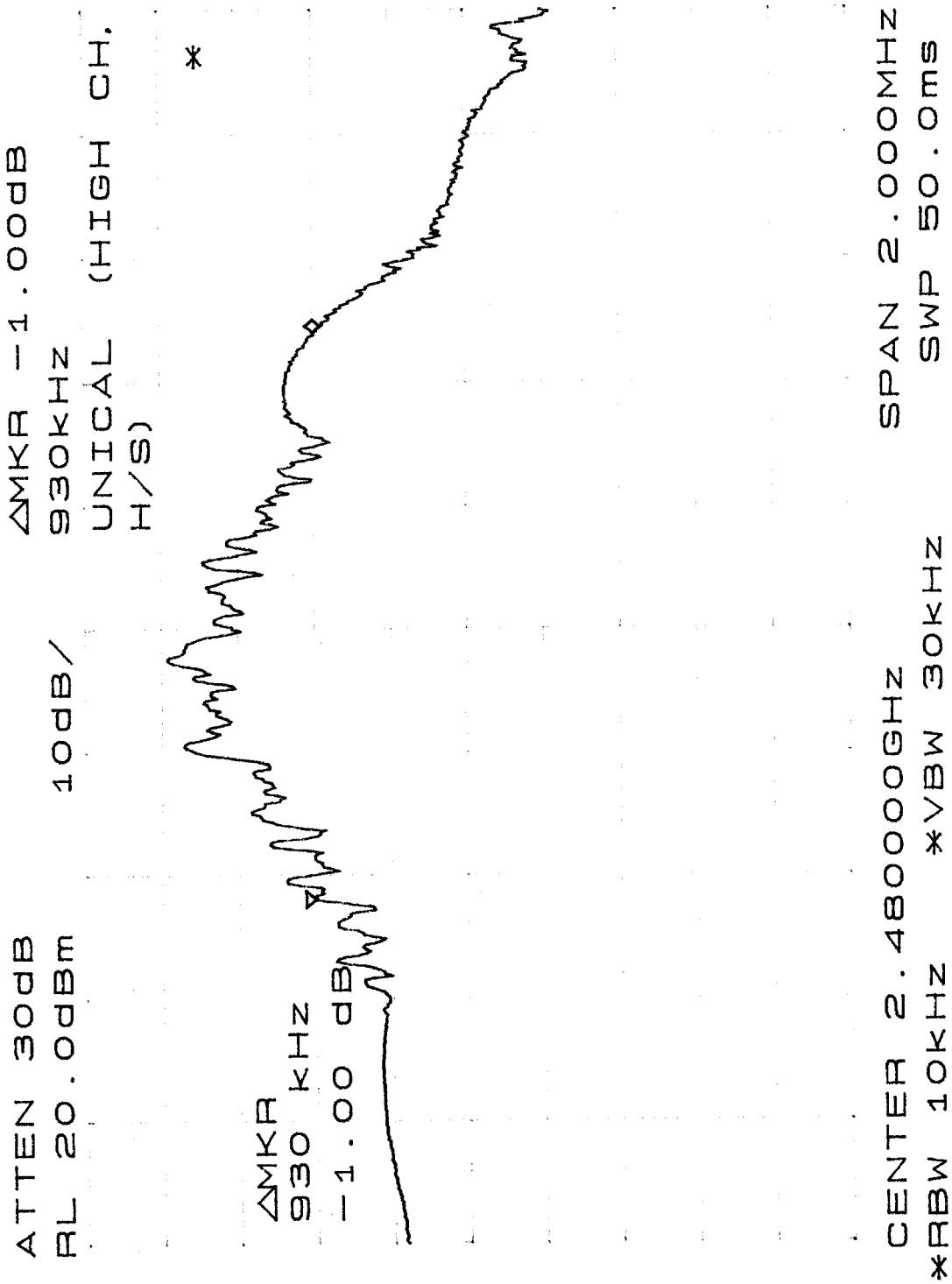

ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR 0dB
810kHz
UNICAL (BASE LOW CH)
ΔMKR
810 kHz
0 dB
CENTER 2.402000GHz
*RBW 10kHz
*VBW 30kHz
SPAN 2.000MHz
SWP 50.0ms


ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR .33dB
750kHz
UNICAL (BASE MID CH)
ΔMKR
750 kHz
.33 dB
CENTER 2.440970GHz
*RBW 10kHz
*VBW 30kHz
SPAN 2.000MHz
SWP 50.0ms


ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR .66dB
750kHz
UNICAL (BASE HIG
H CH)
ΔMKR
750 kHz
D .66 dB
CENTER 2.480000GHz
SPAN 2.000MHz
*RBW 10kHz
*VBW 30kHz
SWP 50.0ms


ATTEN 30dB
RL 14.5dBm
10dB/
ΔMKR .17dB
970kHz
UNICAL (LOW CH)(H/S)
ΔMKR
970 kHz
D -17 dB
CENTER 2.402000GHz
SPAN 2.000MHz
*RBW 10kHz
*VBW 30kHz
SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -.84dB
930kHz
UNICAL (MID CH.
H/S)
ΔMKR
930 kHz
-.84 dB
CENTER 2.441000GHz
*RBW 10kHz
*VBW 30kHz
SPAN 2.000MHz
SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -1.00dB
930kHz
UNICAL (HIGH CH. H/S)
ΔMKR
930 kHz
-1.00 dB
CENTER 2.480000GHz
*RBW 10kHz
*VBW 30kHz
SPAN 2.000MHz
SWP 50.0ms

7-100 kHz BANDWIDTH OF BAND EDGES MEASUREMENT

7.1 Standard Applicable

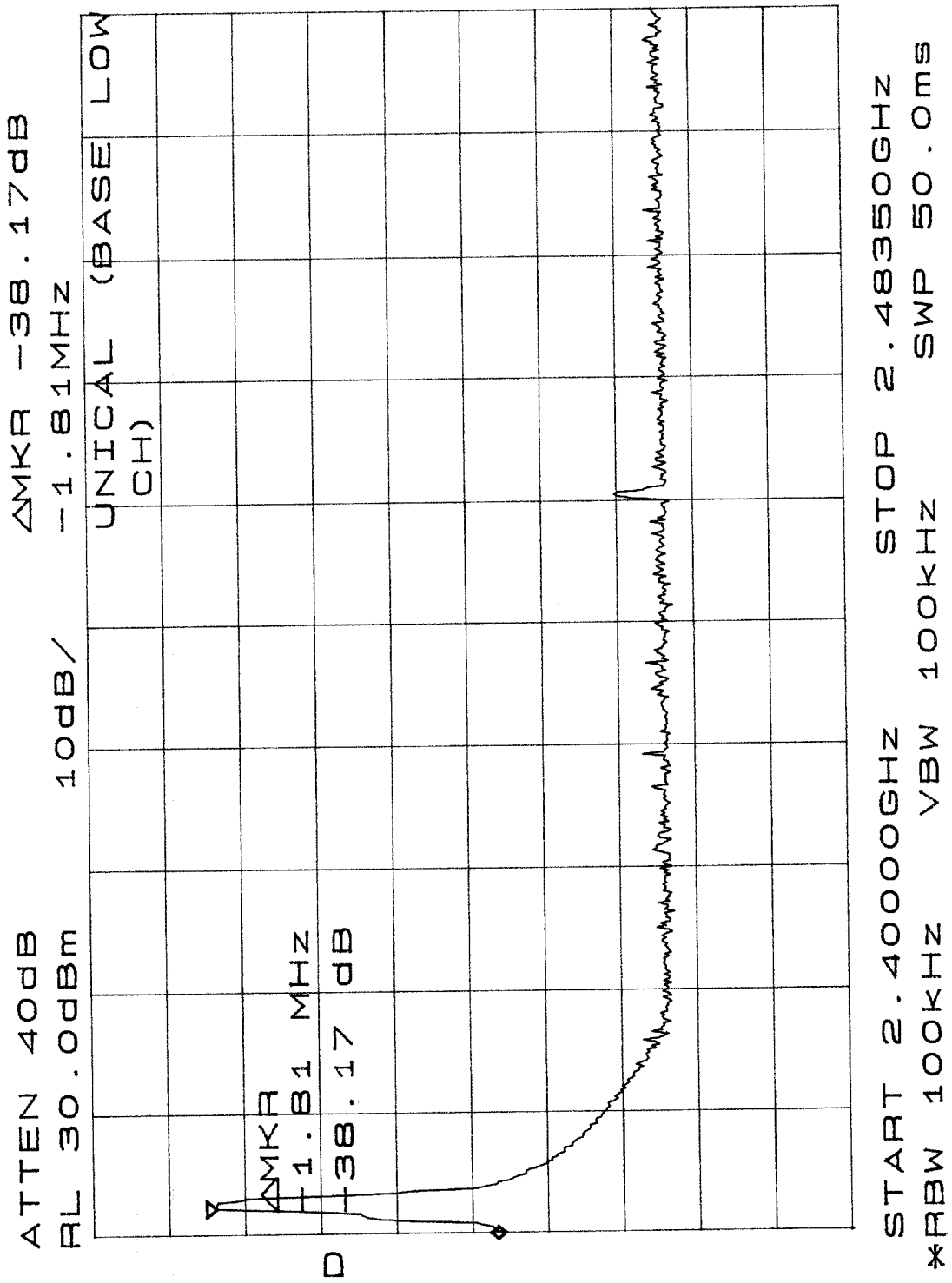
According to §15.247(c), if *any* 100 kHz bandwidth outside these frequency bands, the radio frequency power that is produced by the modulation products of the spreading sequence, the information sequence and the carrier frequency shall be either at least 20 dB below that in any 100 kHz bandwidth within the band that contains the highest level of the desired power or shall not exceed the general levels specified in § 15.209(a), whichever results in the lesser attenuation.

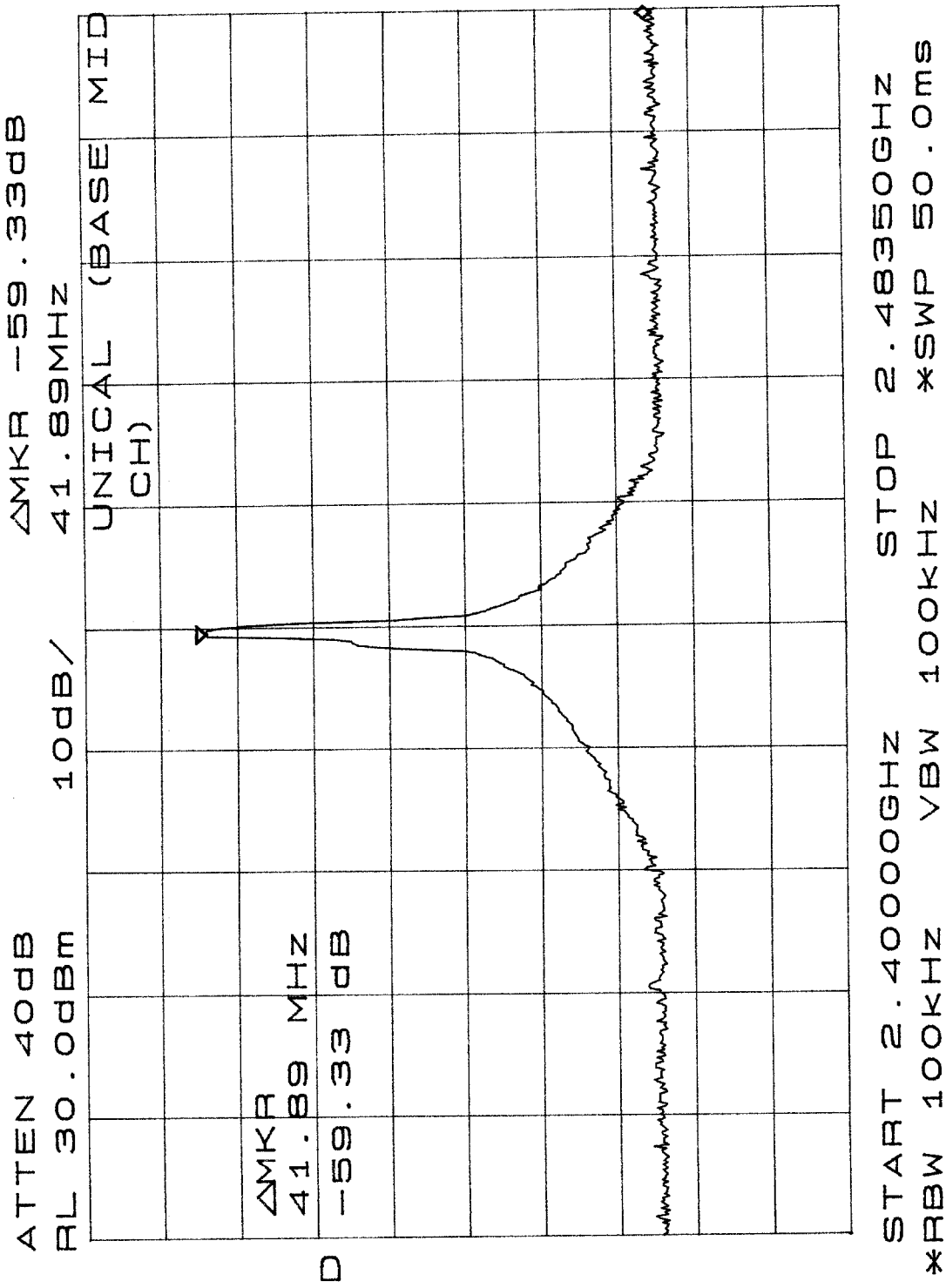
7.2 Measurement Procedure

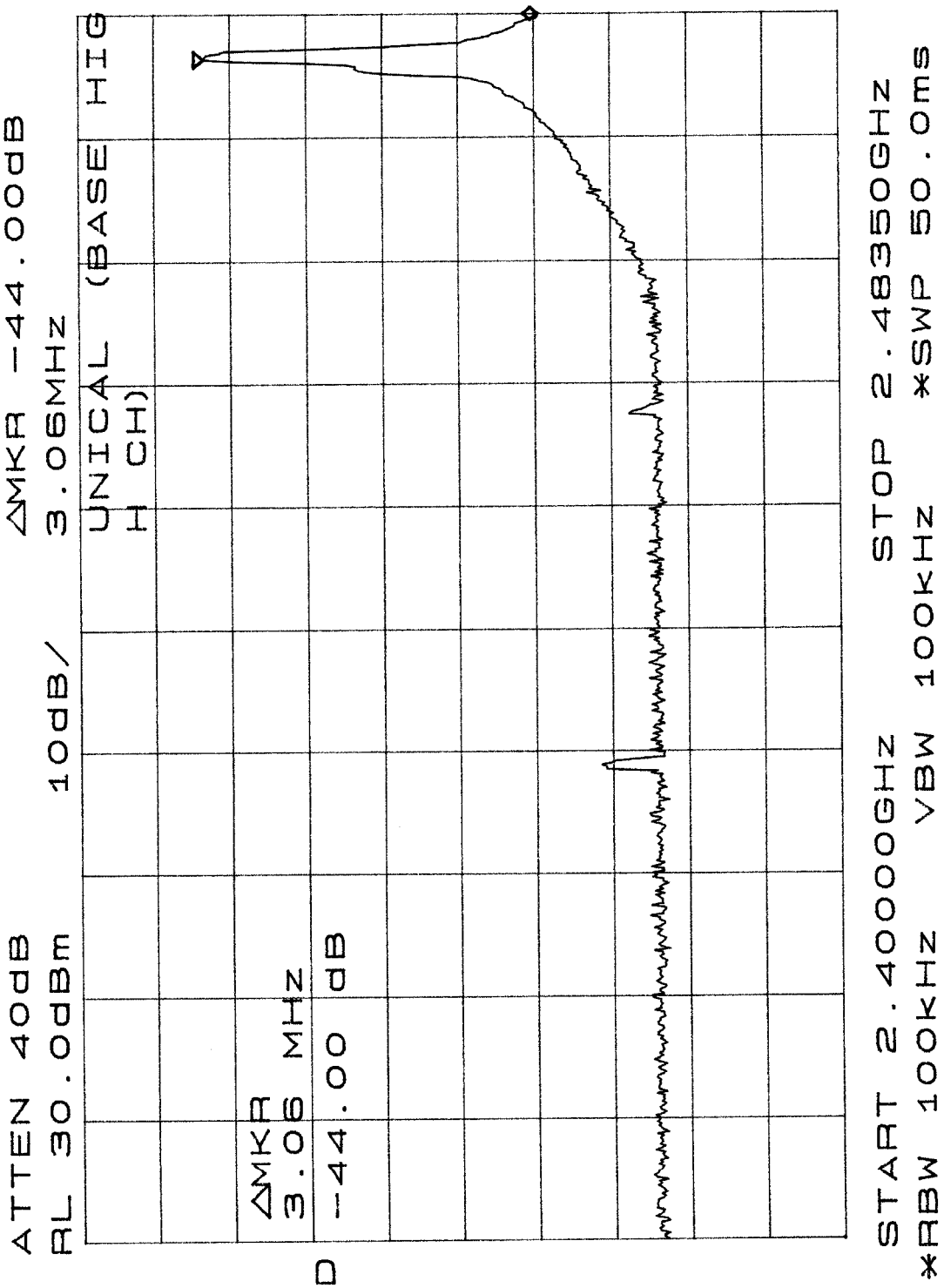
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

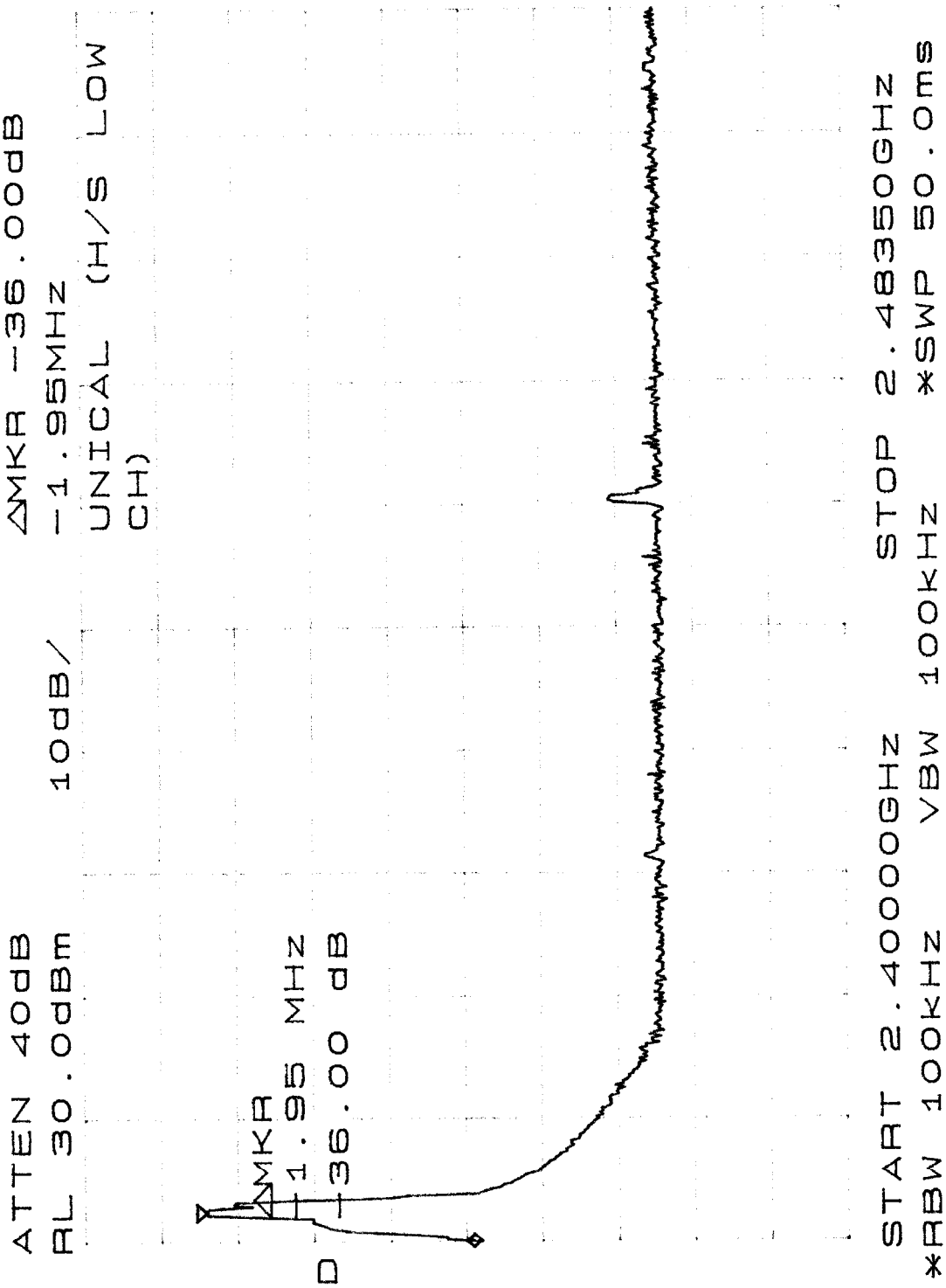
7.3 Test Results

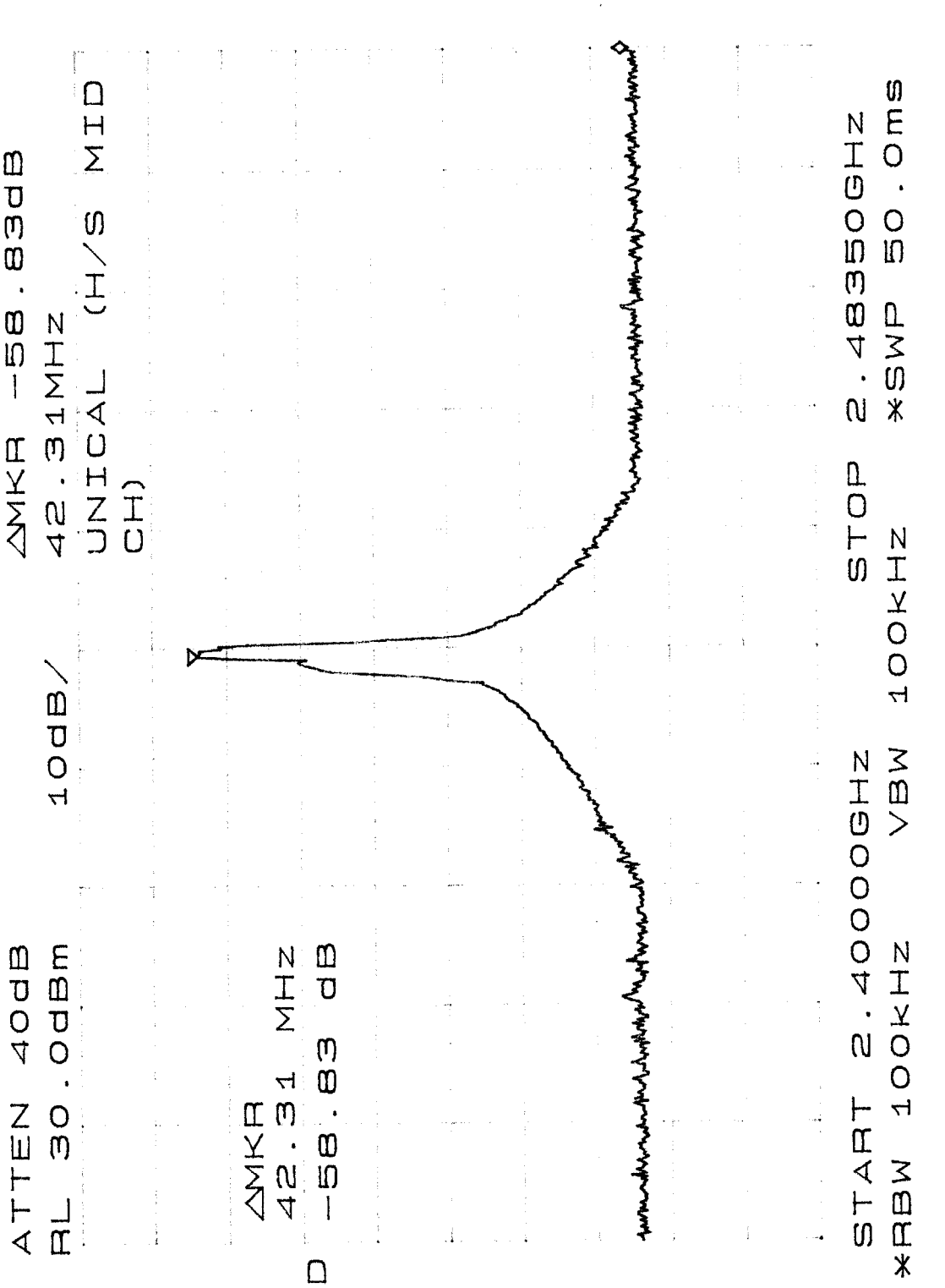
100KHz dB Bandwidth Band Edge	Page Reference	Test Result
Base Low Channel	38	Passed
Base Middle Channel	39	Passed
Base High Channel	40	Passed
Handset Low Channel	41	Passed
Handset Middle Channel	42	Passed
Handset Low Channel	43	Passed

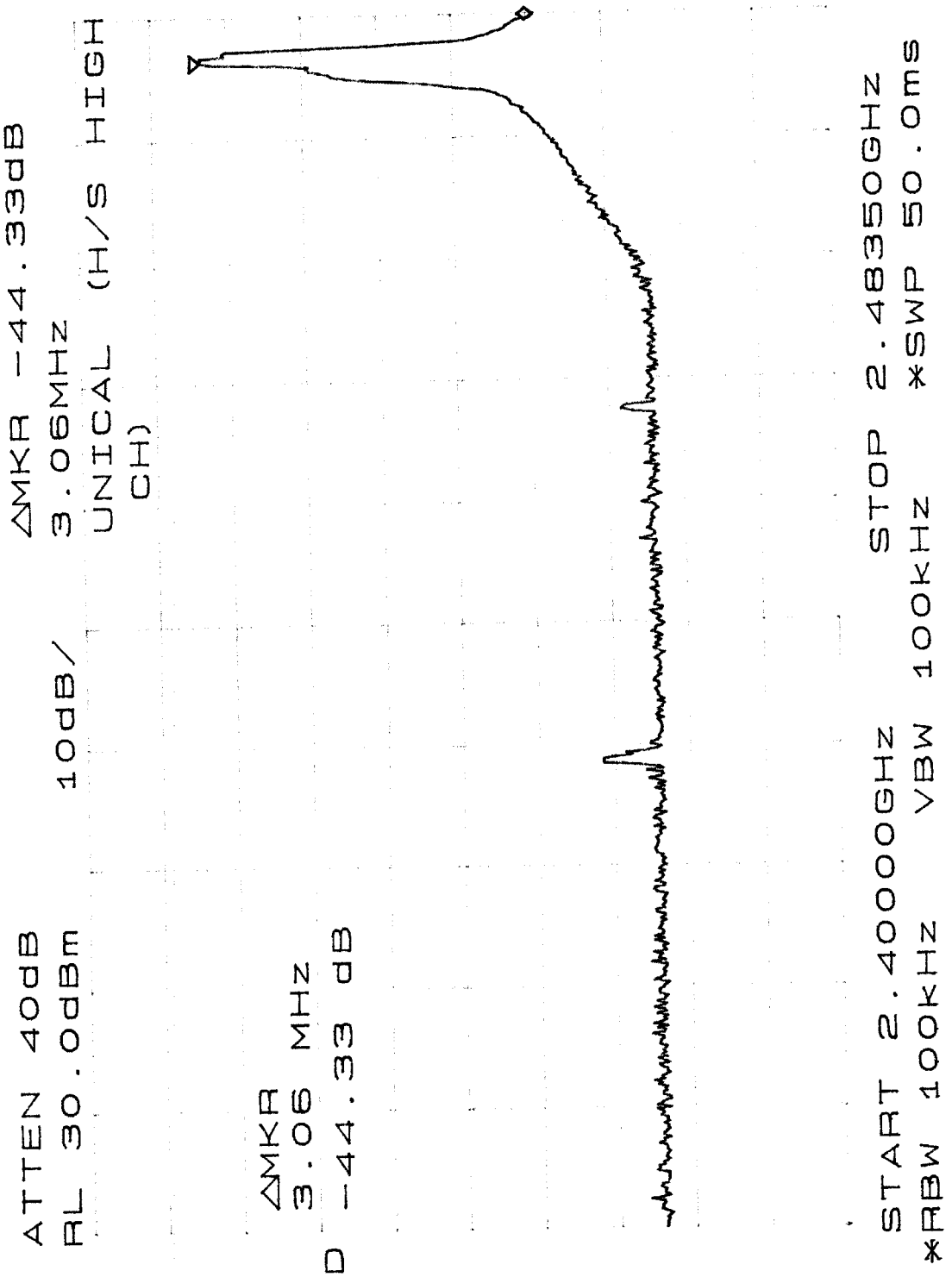

ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR -38.17dB
-1.81MHz
UNICAL (BASE LOW CH)
ΔMKR
1.81 MHz
38.17 dB
START 2.40000GHz
*RBW 100KHz
VBW 100KHz
STOP 2.48350GHz
SWP 50.0ms


ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR -59.33dB
41.89MHz
UNICAL (BASE MID CH)
ΔMKR
41.89 MHz
-59.33 dB
D
START 2.40000GHz
*RBW 100KHz
VBW 100KHz
STOP 2.48350GHz
*SWP 50.0ms


ATTEN 40dB
RL 30.00dBm
10dB/
ΔMKR -44.00dB
3.06MHz
UNICAL (BASE HIG
H CH)
ΔMKR
3.06 MHz
-44.00 dB
D
START 2.40000GHz
*RBW 100KHz
VBW 100KHz
STOP 2.48350GHz
*SWP 50.0ms


ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR -36.00dB
-1.95MHz
UNICAL (H/S LOW CH)
ΔMKR 1.95 MHz
36.00 dB
START 2.40000GHz
*RBW 100KHz
VBW 100KHz
STOP 2.48350GHz
*SWP 50.0ms


ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR -58.83dB
42.31MHz
UNICAL (H/S MID CH)
ΔMKR
42.31 MHz
D -58.83 dB
START 2.40000GHz
*RBW 100KHz
VBW 100KHz
STOP 2.48350GHz
*SWP 50.0ms


ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR -44.33dB
3.06MHz
UNICAL (H/S HIGH CH)
ΔMKR
3.06 MHz
D -44.33 dB
START 2.40000GHz
*RBW 100kHz
VBW 100kHz
STOP 2.48350GHz
*SWP 50.0ms

8 – Hopping Channel

8.1 Standard Applicable

According to §15.247(a)(1)(i), for frequency hopping system operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

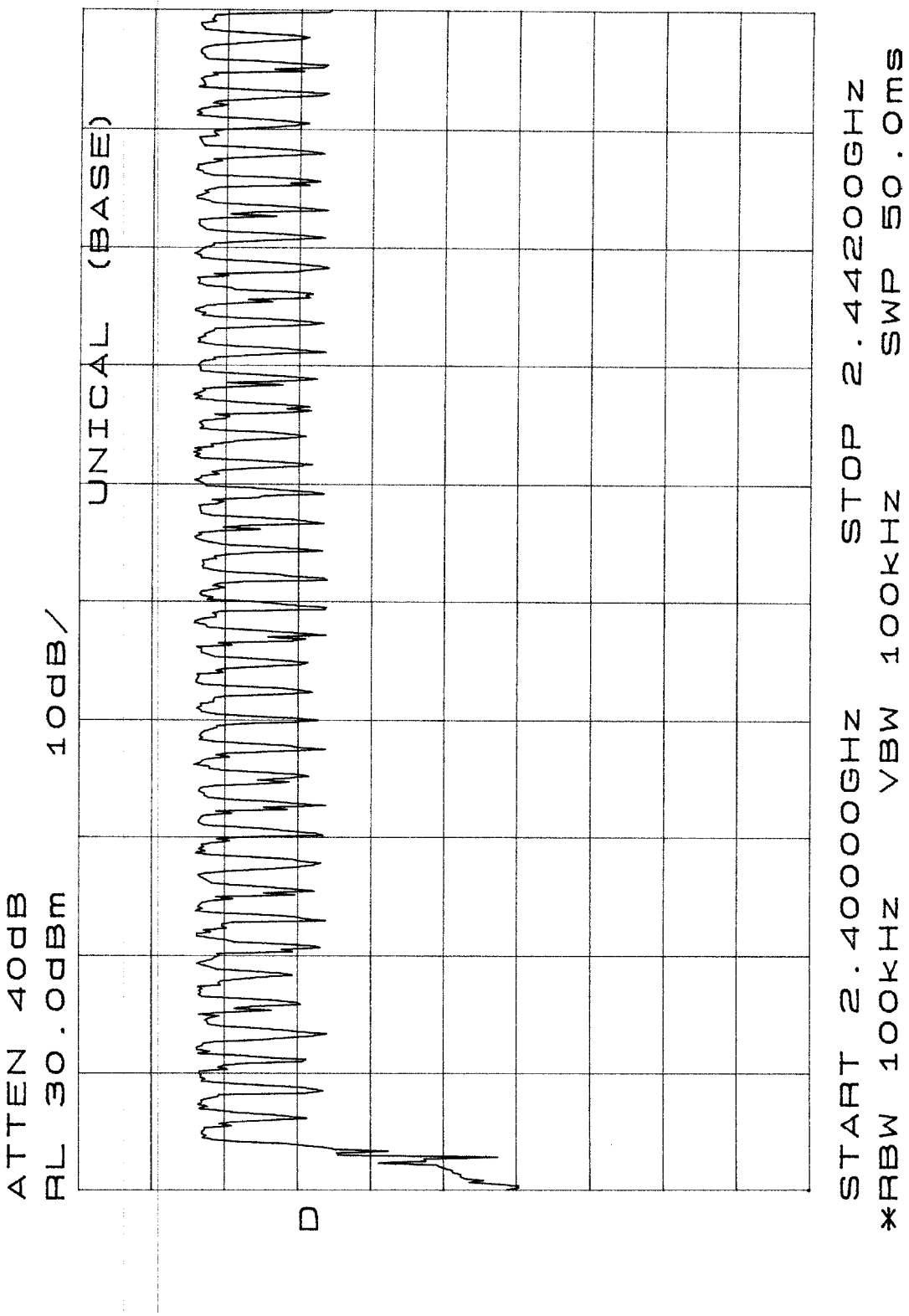
8.2 Measurement Procedure

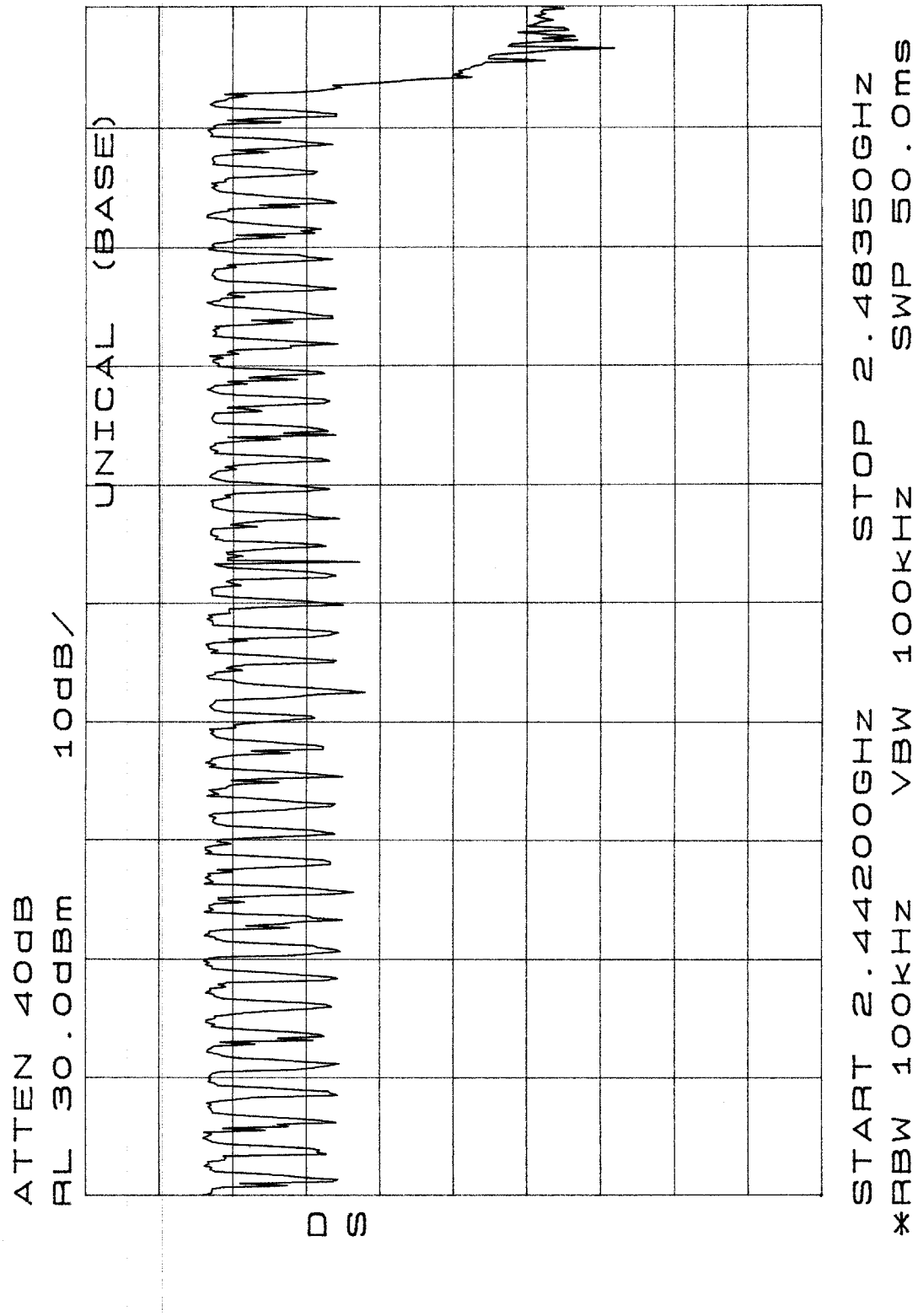
1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2 Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument 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 Set the SA on Max-Hold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
4 Set the SA on View mode and then plot the result on SA screen.
5 Repeat above procedures until all frequencies measured were complete.

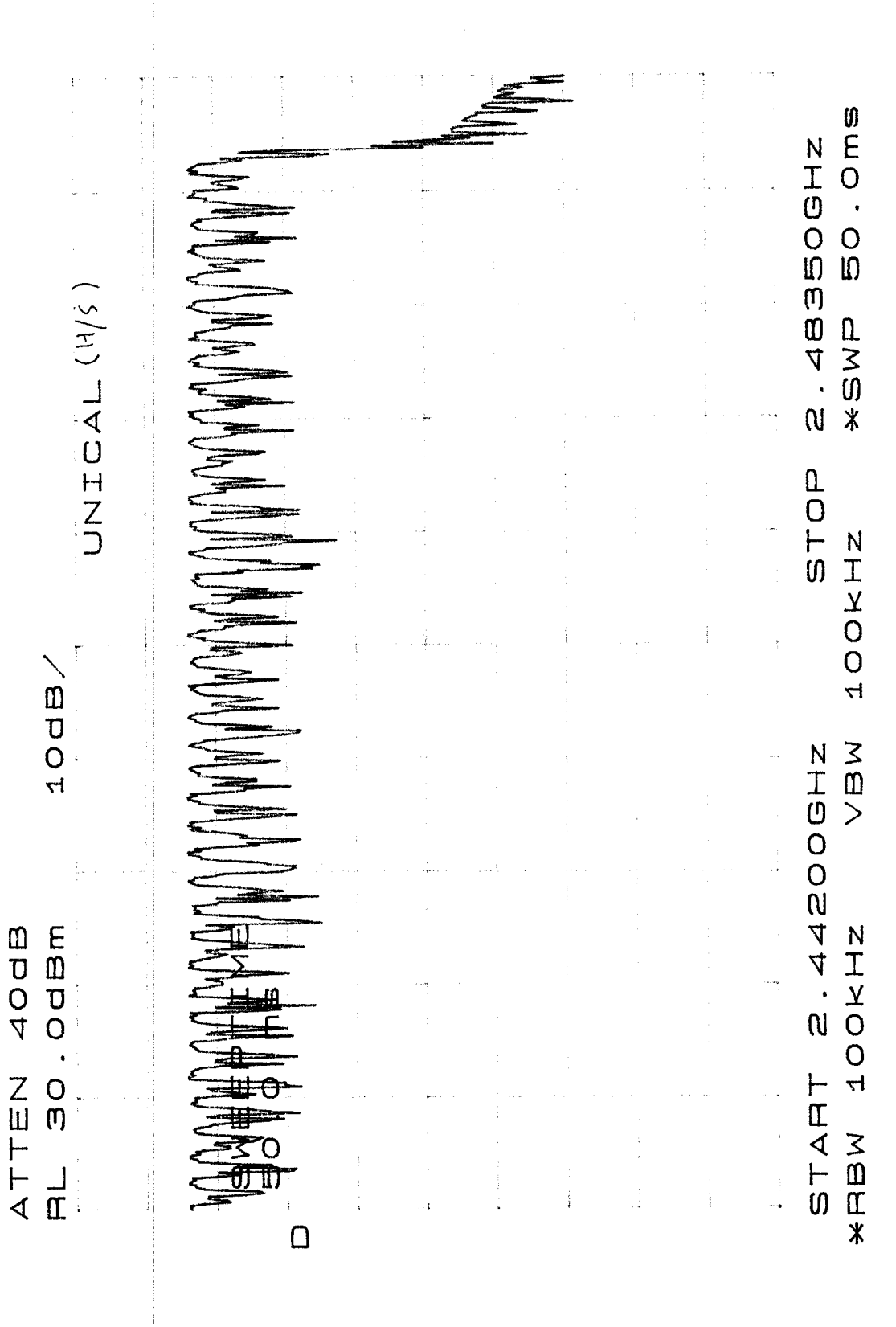
8.3 Test Results

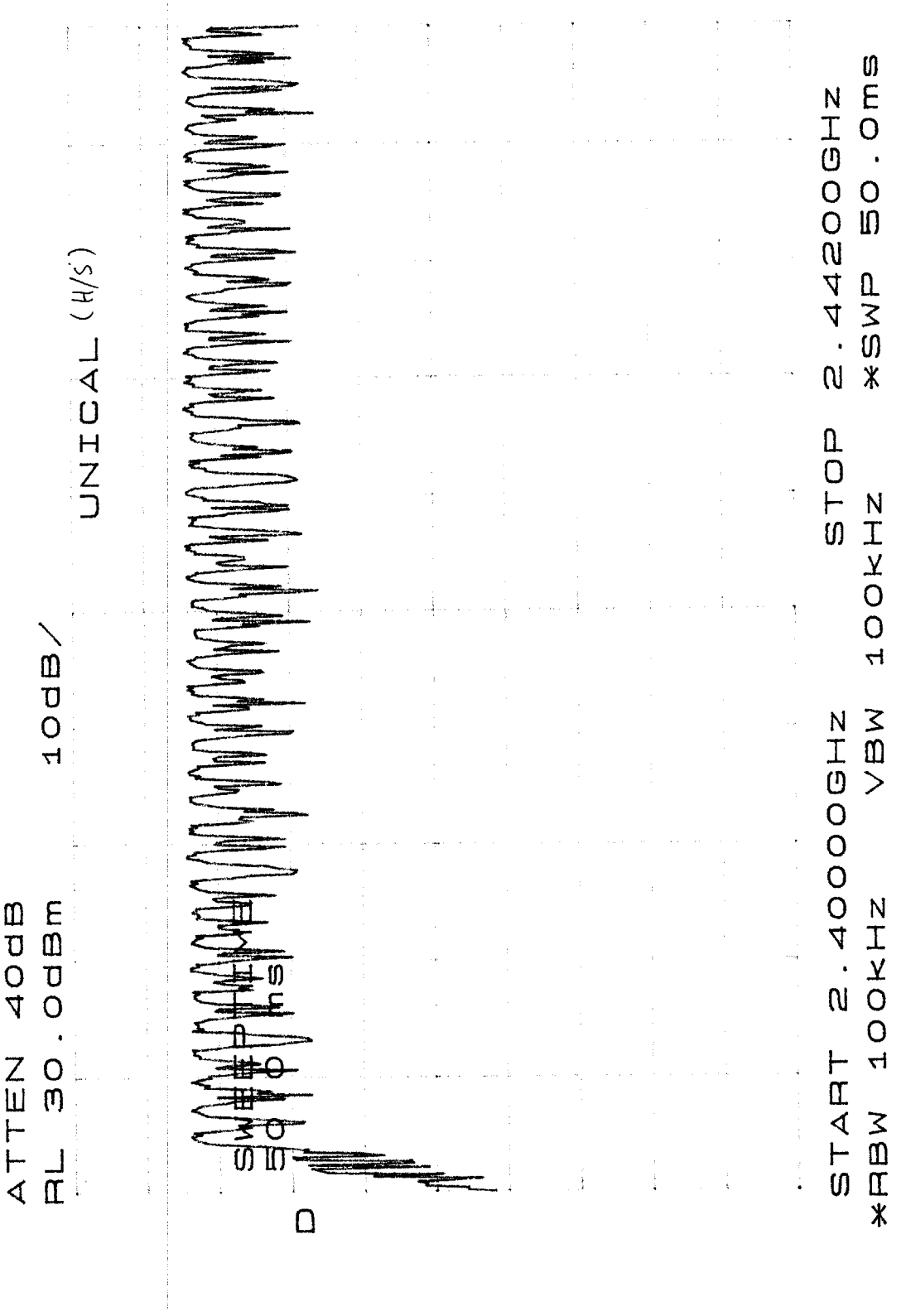
The following are plots of Hopping Channel Bandwidth for low, middle and high channel.

Hopping Frequency	Page Reference	Test Result
Base Unit	45-46	Passed (79 Channels)
Handset Unit	47-48	Passed (79 Channels)


UNICAL (BASE)
ATTEN 40dB
RL 30.0dBm
10dB/
START 2.40000GHz
*RBW 100KHz
VBW 100KHz
STOP 2.44200GHz
SWP 50.0ms
D


UNICAL (BASE)
ATTEN 40dB
RL 30.0dBm
10dB/
D S
START 2.44200GHz
*RBW 100kHz
STOP 2.48350GHz
VBW 100kHz
SWP 50.0ms


ATTEN 40dB
RL 30.0dBm
10dB/
UNICAL (H/S)
D1 WHITE
START 2.44200GHz
*RBW 100KHz
VBW 100KHz
STOP 2.48350GHz
*SWP 50.0ms


ATTEN 40dB
RL 30.0dBm
10dB/
UNICAL (H/S)
SWEEP
D
START 2.40000GHz
*RBW 100kHz
VBW 100kHz
STOP 2.44200GHz
*SWP 50.0ms

9 - DWELL TIME ON EACH CHANNEL

9.1 Standard Applicable

According to §15.247 (a)(1)(i), for frequency hopping system operating in the 902-928 MHz band, if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the average time of occupancy on any frequency shall not be greater than 0.4 second within a 20-second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

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 was set 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. Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
5. Repeat above procedures until all frequencies measured were complete.

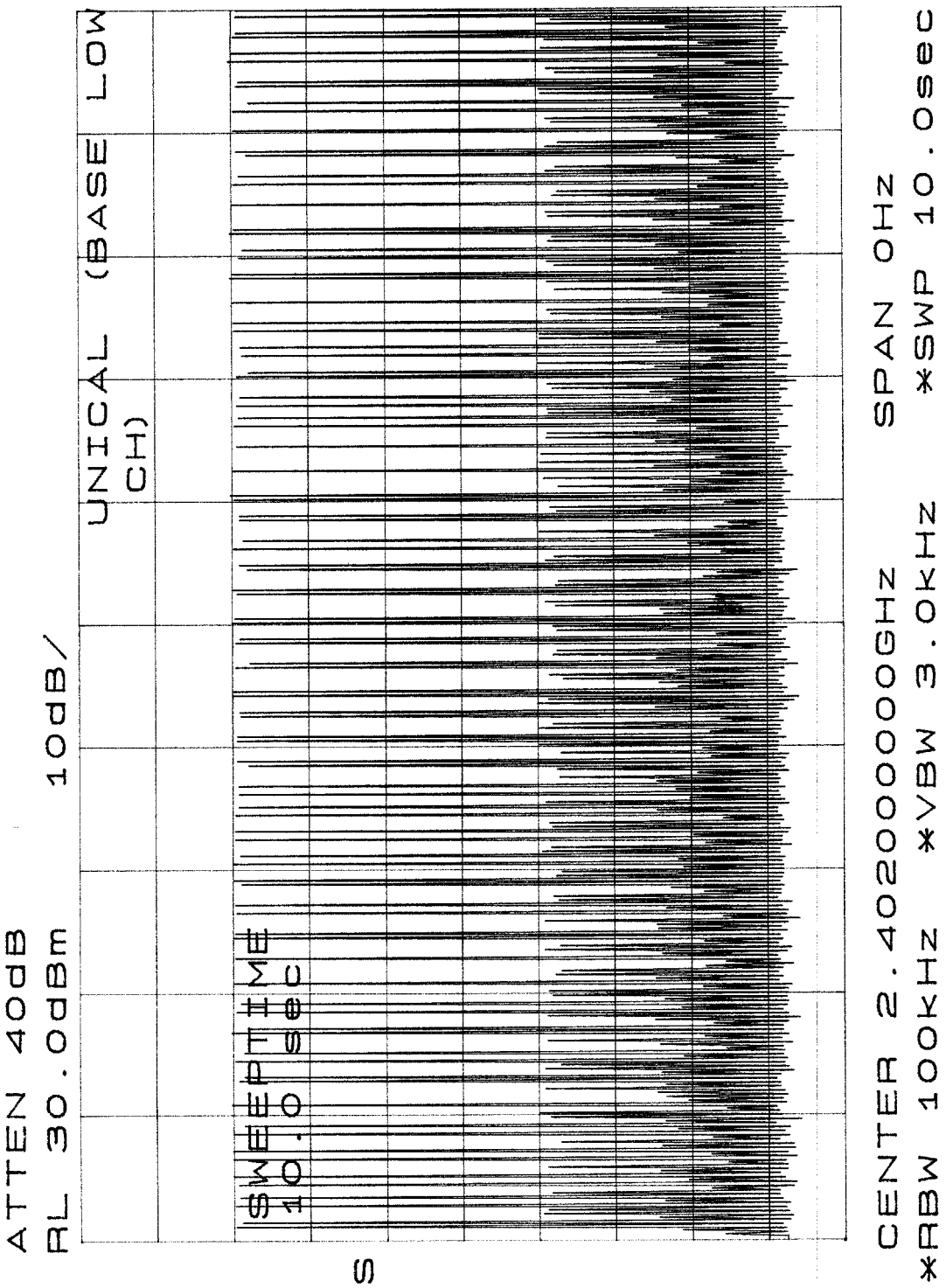
9.3 Test Results

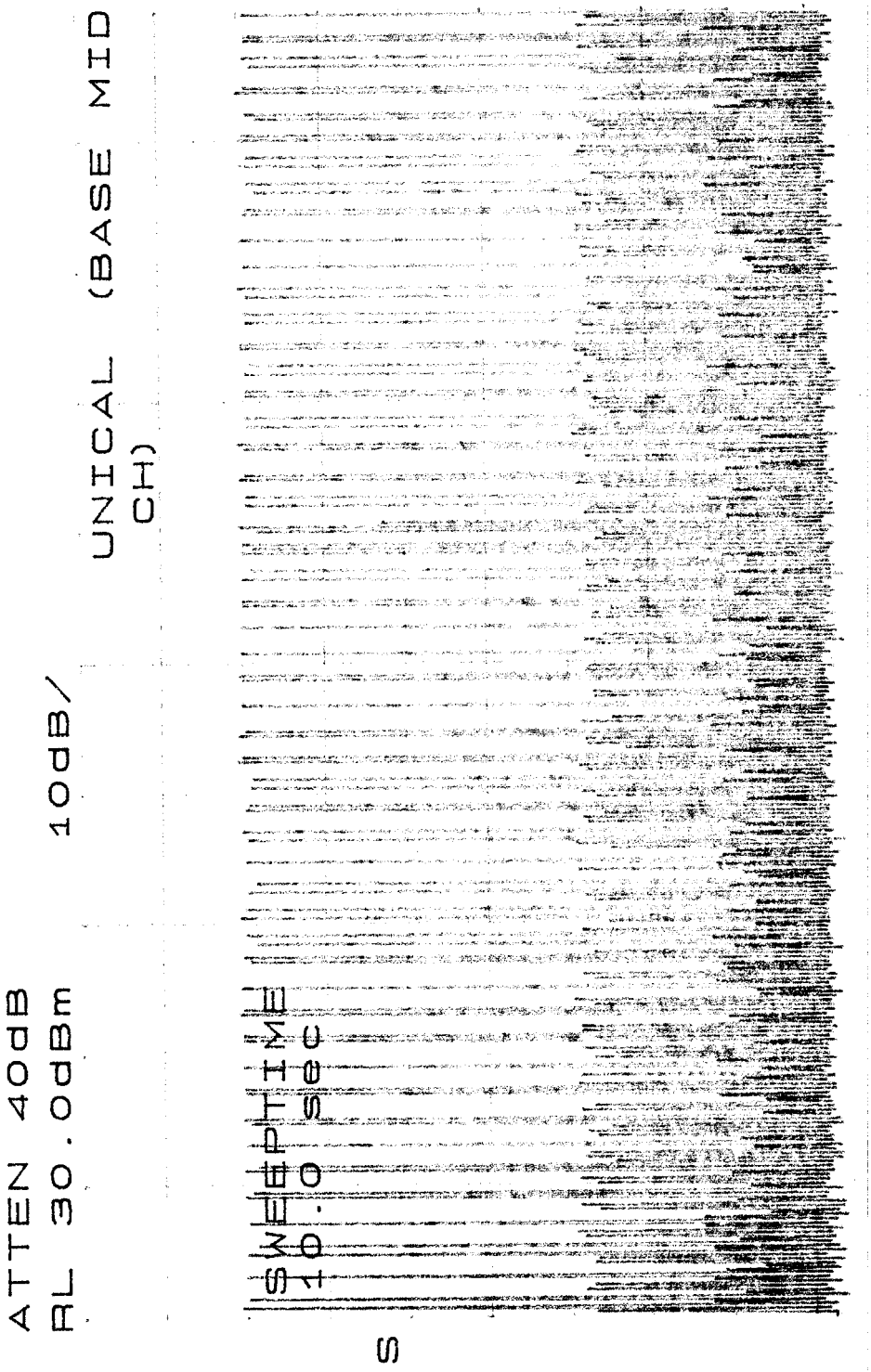
In normal operation, there are 84 transmissions per 10 second. Therefore, the dwell time for each channel is:

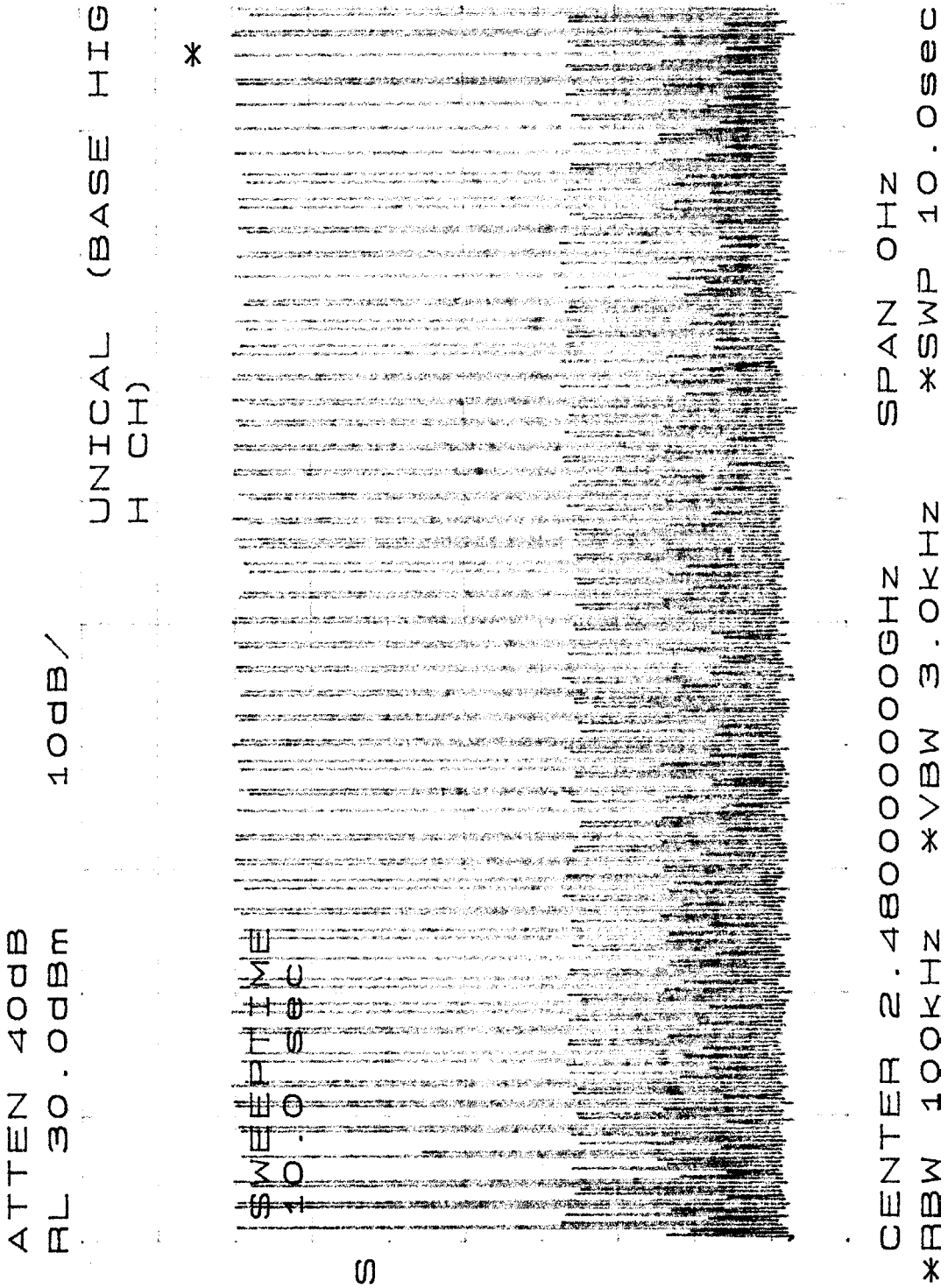
0.4 5 ms x 84 = 37.8 ms < 0.4 s (Passed)

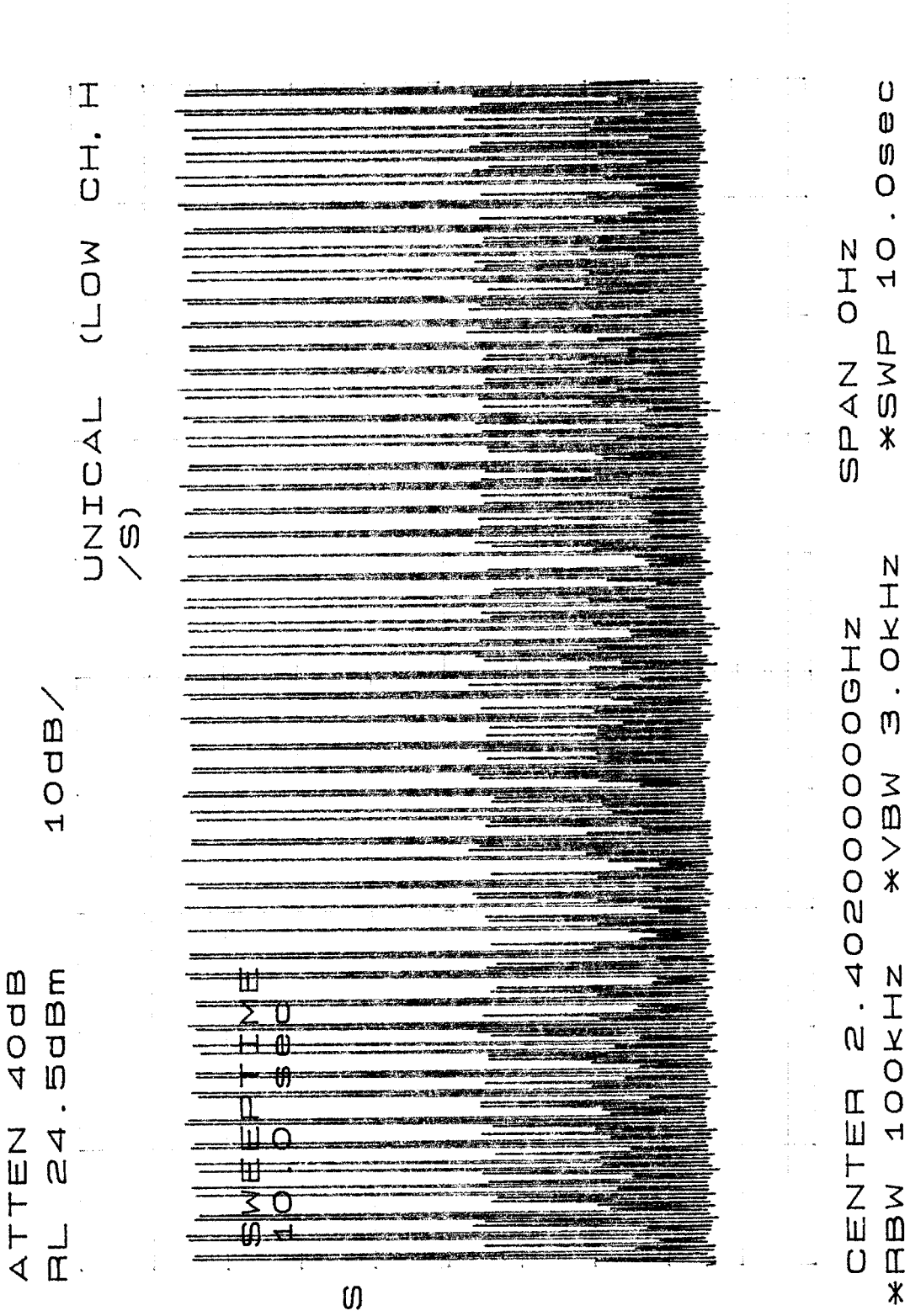
The following are plots of Average Time of Occupancy for low, middle and high channel.

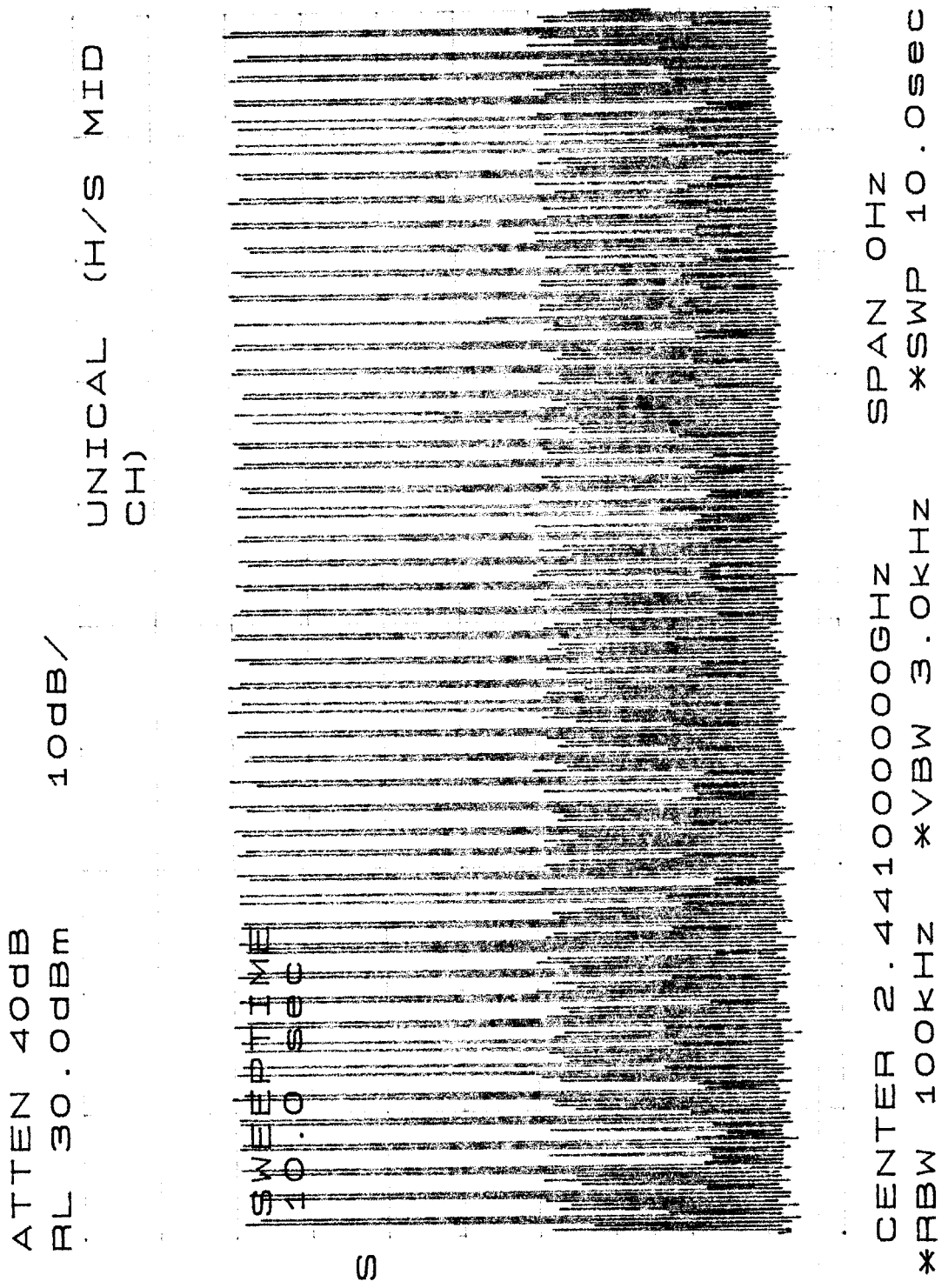
Hopping Frequency	Page Reference	Test Result
Base Low Channel	50	Passed
Base Middle Channel	51	Passed
Base High Channel	52	Passed
Handset Low Channel	53	Passed
Handset Middle Channel	54	Passed
Handset High Channel	55	Passed

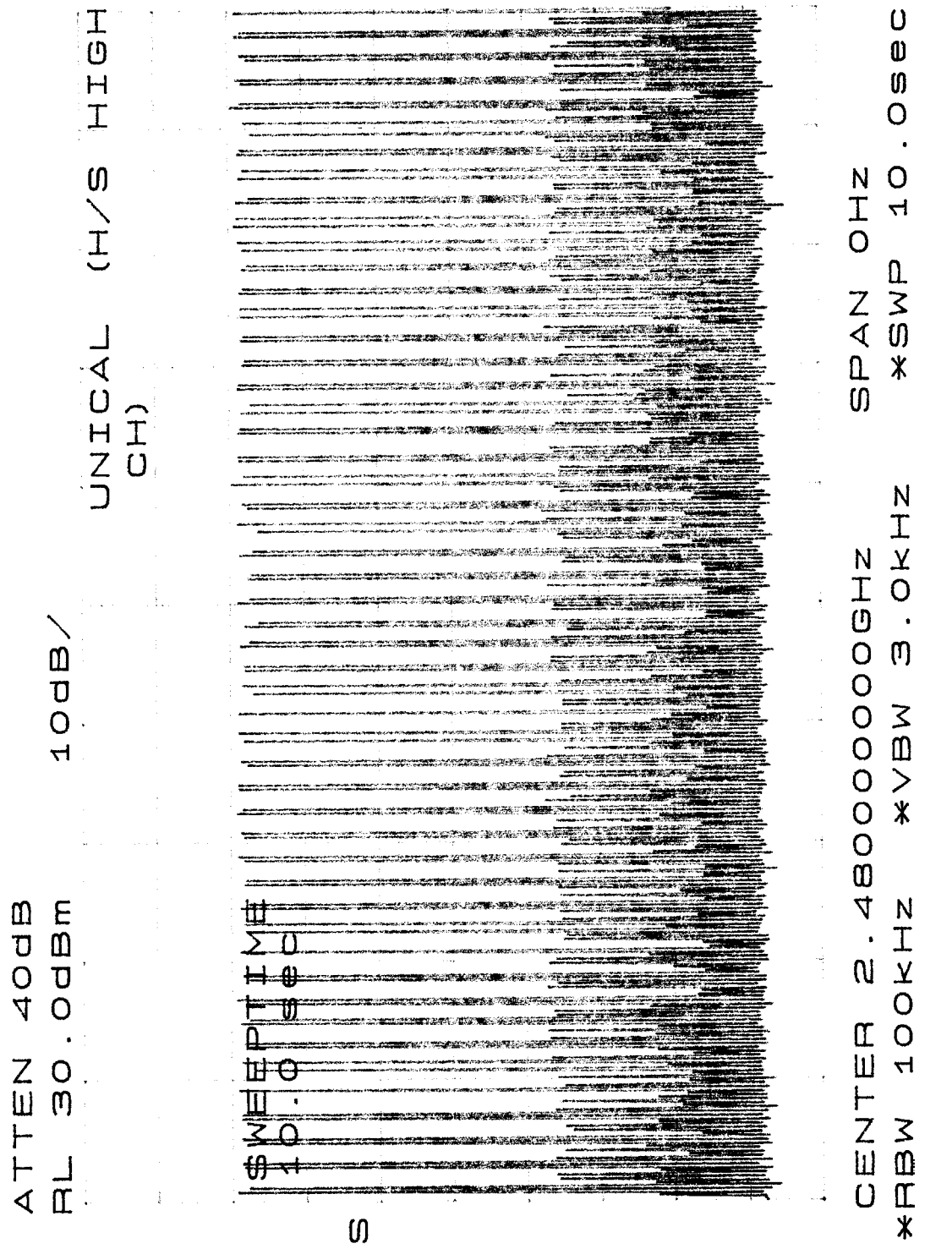

ATTEN 40dB
RL 30.0dBm
10dB/
UNICAL (BASE LOW CH)
SWEEP 10.0sec
CENTER 2.402000000GHz
SPAN 0Hz
*RBW 100kHz
*VBW 3.0kHz
*SWP 10.0sec

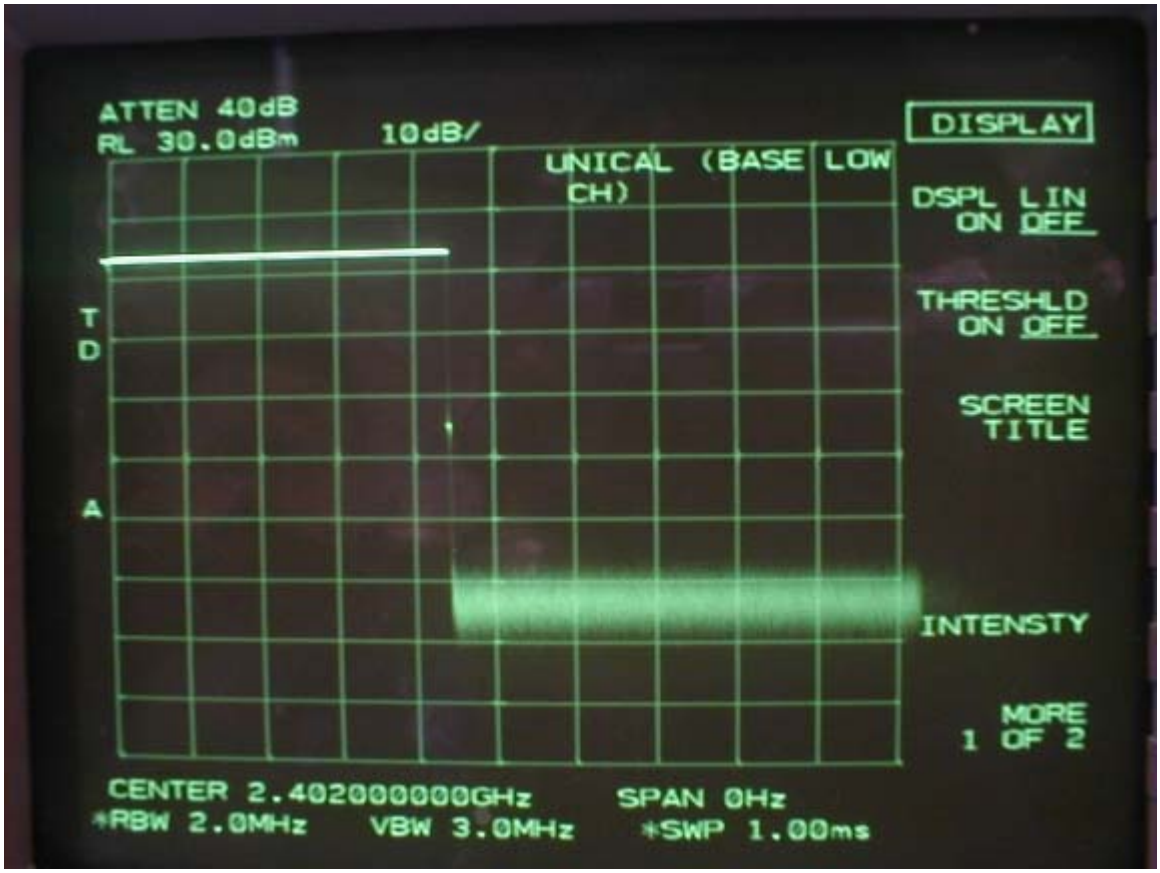

ATTEN 40dB
RL 30.0dBm
10dB/
UNICAL (BASE MID CH)
SWEEP TIME
10.0sec
S
CENTER 2.441000000GHz
*RBW 100KHz
*VBW 3.0KHz
SPAN 0Hz
*SWP 10.0sec

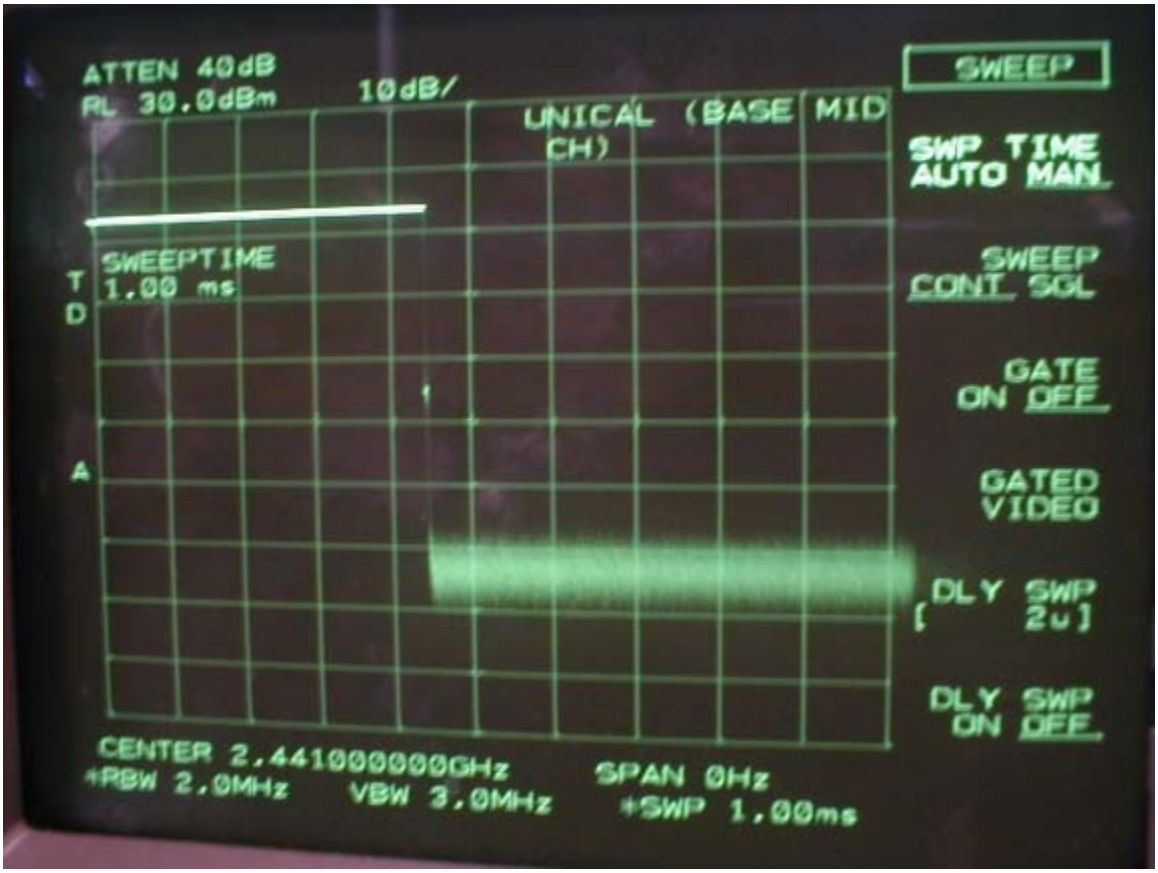

ATTEN 40dB
RL 30.0dBm
10dB/
UNICAL (BASE HIG
H CH)
*
S
SWEEP 10.0sec
CENTER 2.480000000GHz
SPAN 0Hz
*RBW 100KHz
*VBW 3.0KHz
*SWP 10.0sec


ATTEN 40dB
RL 24.5dBm
10dB/
UNICAL (LOW CH. H
/S)
CENTER 2.402000GHz
*RBW 100kHz
*VBW 3.0kHz
SPAN 0Hz
*SWP 10.0sec

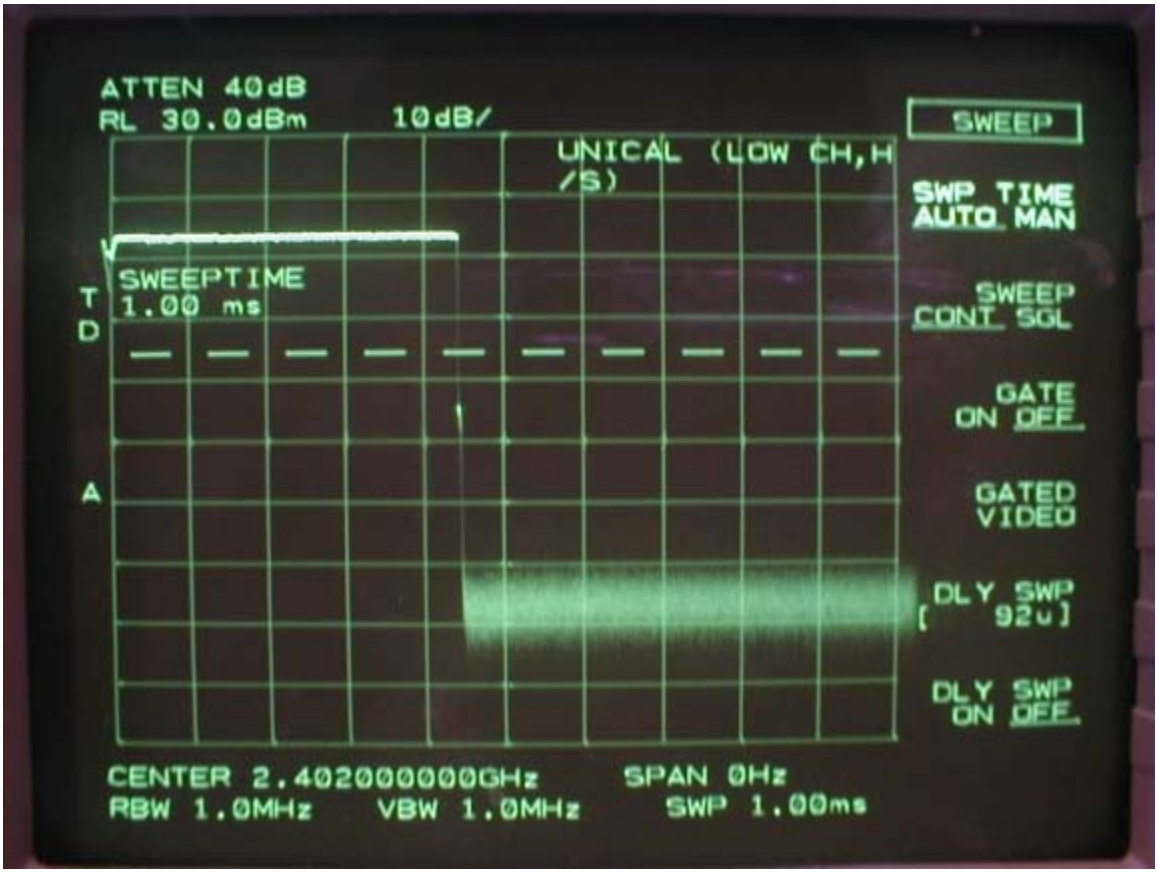

ATTEN 40dB
RL 30.0dBm
10dB/
UNICAL (H/S MID CH)
CENTER 2.441000000GHz
*RBW 100KHz
*VBW 3.0KHz
SPAN 0Hz
*SWP 10.0sec

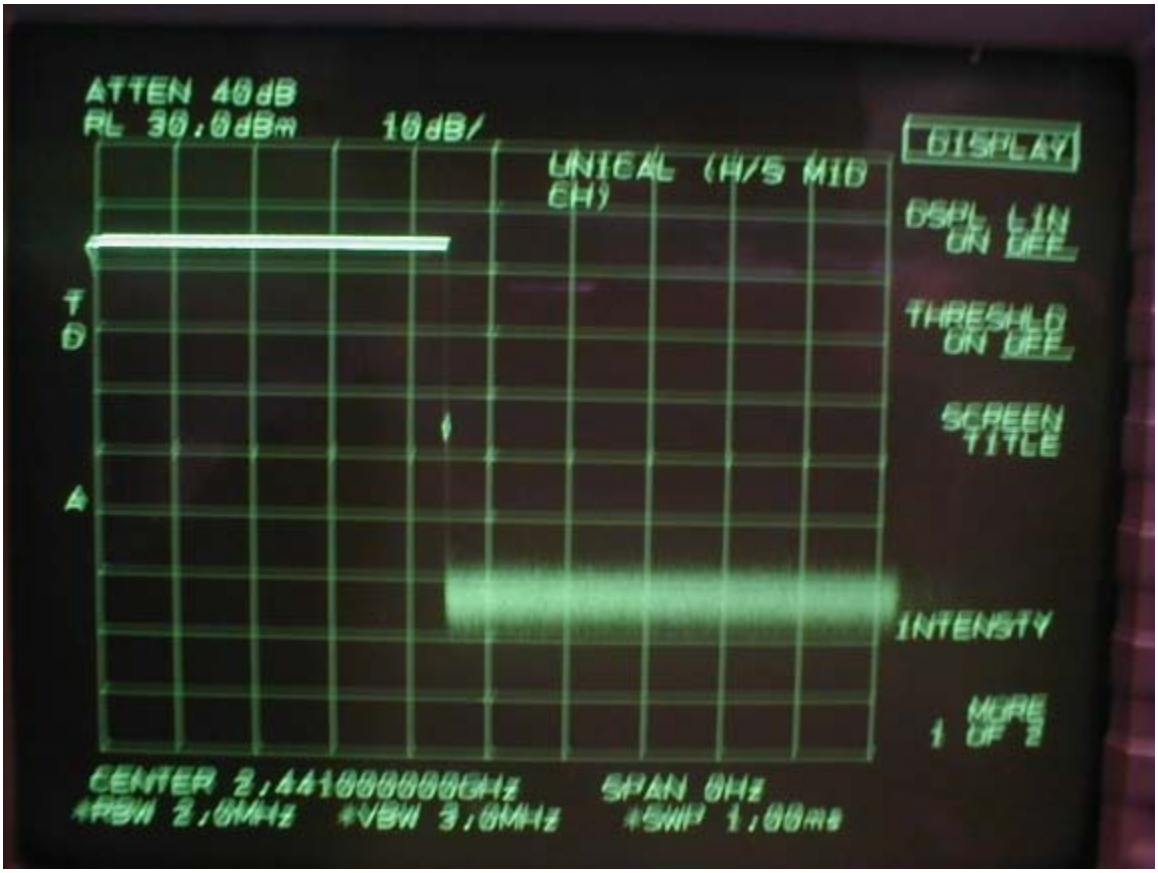

UNICAL (H/S HIGH CH)
ATTEN 40dB
RL 30.0dBm
10dB/
CENTER 2.480000GHz
*RBW 100KHz
*VBW 3.0KHz
SPAN 0Hz
*SWP 10.0sec

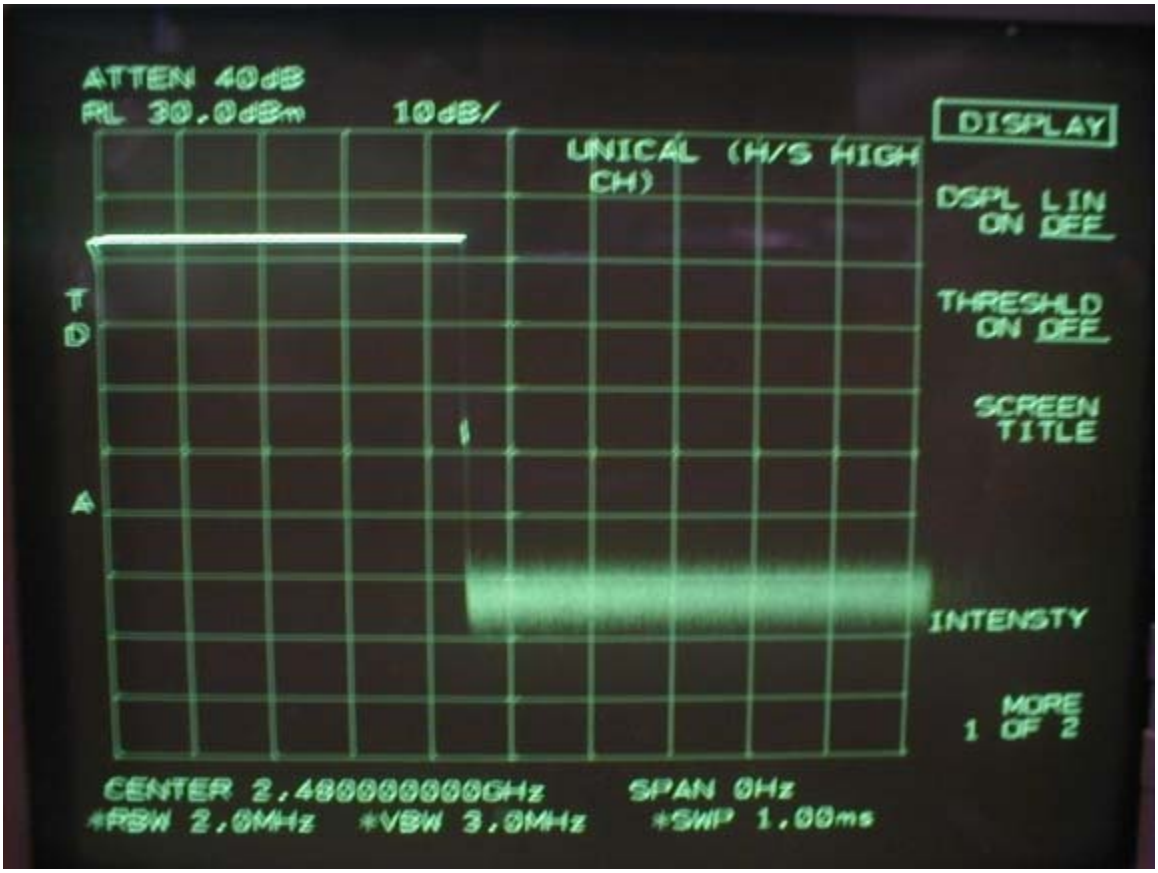

ATTEN 40dB
RL 30.0dBm
10dB/
UNICAL (BASE LOW CH)
DISPLAY
DSPL LIN ON OFF
THRESHLD ON OFF
SCREEN TITLE
INTENSTY
MORE 1 OF 2
T
D
A
CENTER 2.402000000GHz
SPAN 0Hz
*RBW 2.0MHz
VBW 3.0MHz
*SWP 1.00ms


ATTEN 40dB
RL 30.0dBm
10dB/
UNICAL (BASE MID CH)
SWEEP
SWP TIME AUTO MAN
SWEEPTIME 1.00 ms
SWEEP CONT SGL
GATE ON OFF
GATED VIDEO
DLY SWP 2u
DLY SWP ON OFF
CENTER 2.441000000GHz
SPAN 0Hz
#RBW 2.0MHz
VBW 3.0MHz
#SWP 1.00ms


ATTEN 40dB
RL 30.0dBm
10dB/
UNICAL (BASE HIG
H CH)
DISPLAY
DSPL LIN
ON OFF
THRESHLD
ON OFF
SCREEN
TITLE
INTENSTY
MORE
1 OF 2
T
D
A
CENTER 2.480000000GHz
SPAN 0Hz
*RBW 2.0MHz
VBW 3.0MHz
*SWP 1.00ms


ATTEN 40dB
RL 30.0dBm
10dB/
UNICAL (LOW CH,H
/S)
SWEEP
SWP TIME
AUTO MAN
SWEEPTIME
1.00 ms
T
D
SWEEP
CONT SGL
GATE
ON OFF
A
GATED
VIDEO
DLY SWP
[92u]
DLY SWP
ON OFF
CENTER 2.402000000GHz
SPAN 0Hz
RBW 1.0MHz
VBW 1.0MHz
SWP 1.00ms


ATTEN 40dB
RL 30.0dBm
10dB/
UNICAL (H/S MID CH)
DISPLAY
DSPL LIN ON OFF
THRESHLD ON OFF
SCREEN TITLE
INTENSITY
MORE 1 OF 2
CENTER 2.441000000GHz
SPAN 0Hz
#RBW 2.0MHz
#VBW 3.0MHz
#SWP 1.00ms


ATTEN 40dB
RL 30.0dBm
10dB/
UNICAL (H/S HIGH CH)
DISPLAY
DSPL LIN ON OFF
THRESHLD ON OFF
SCREEN TITLE
INTENSTY
MORE 1 OF 2
T
D
A
CENTER 2.480000000GHz
SPAN 0Hz
*RBW 2.0MHz
*VBW 3.0MHz
*SWP 1.00ms

10 – Channel Separation

10.1 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.

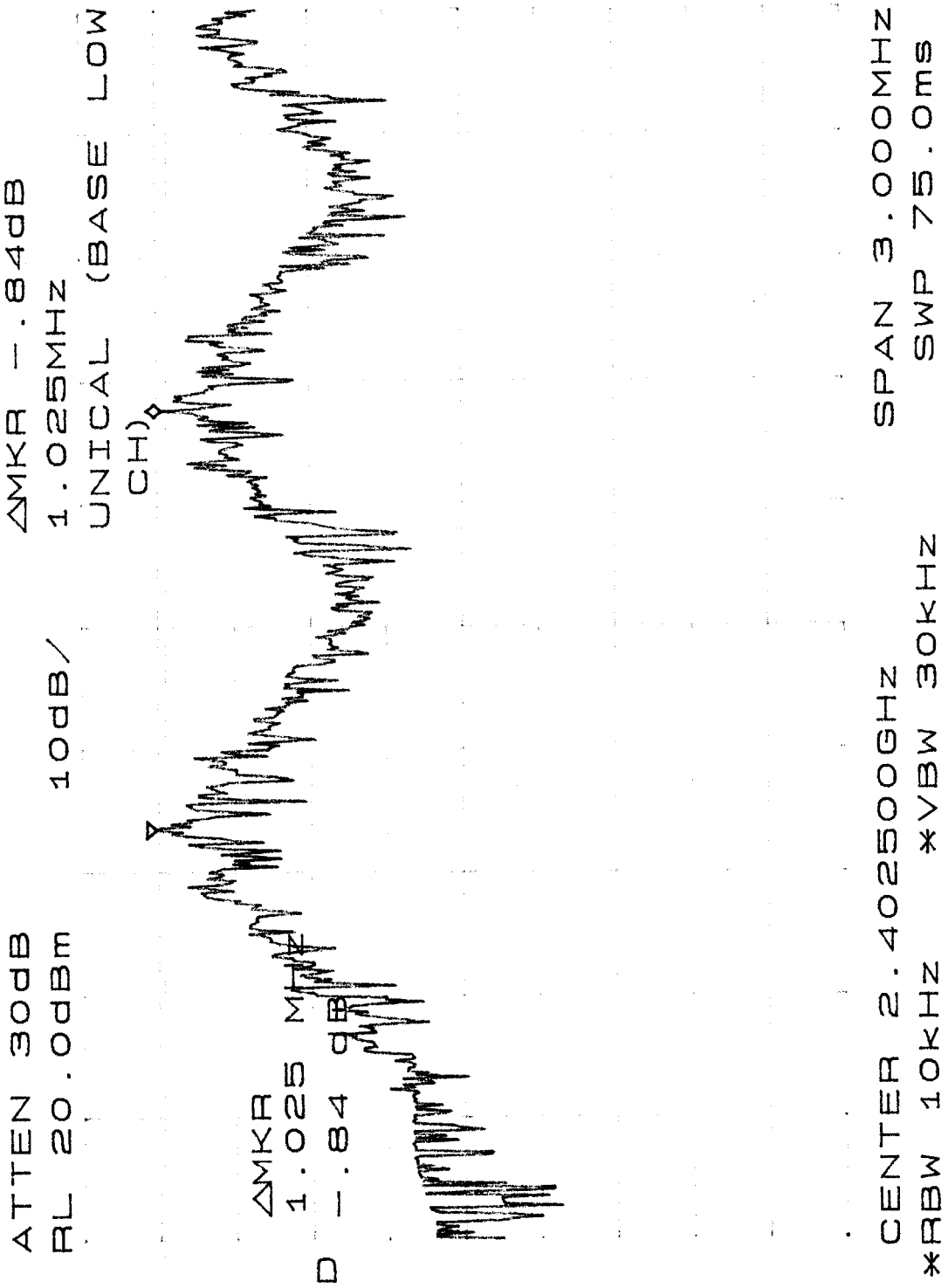
10.2 Measurement Procedure

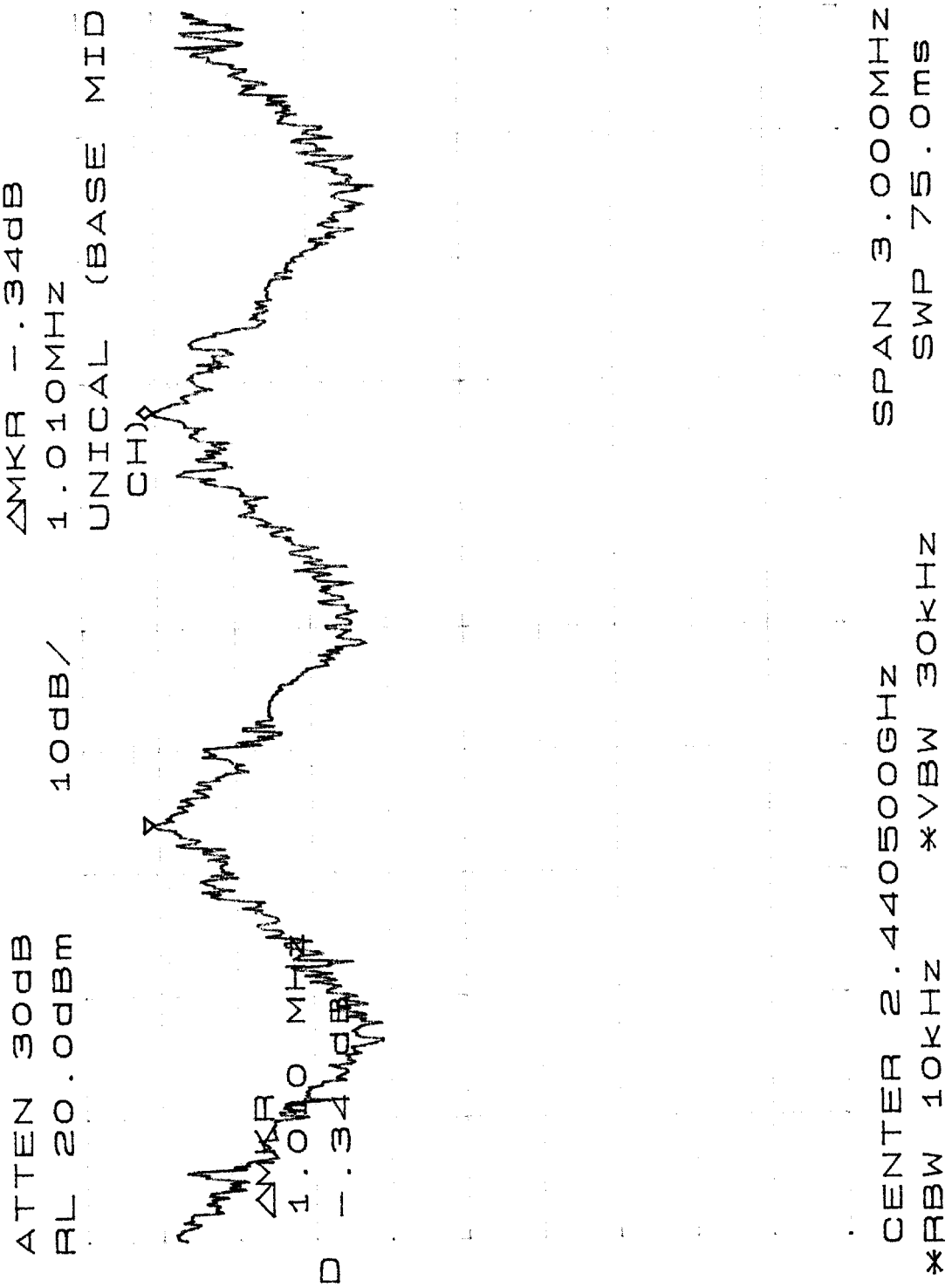
1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
3. By using the Max-Hold function record the separation of two adjacent channels.
4. Measure the frequency difference of these two adjacent channels by SA MARK function, and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

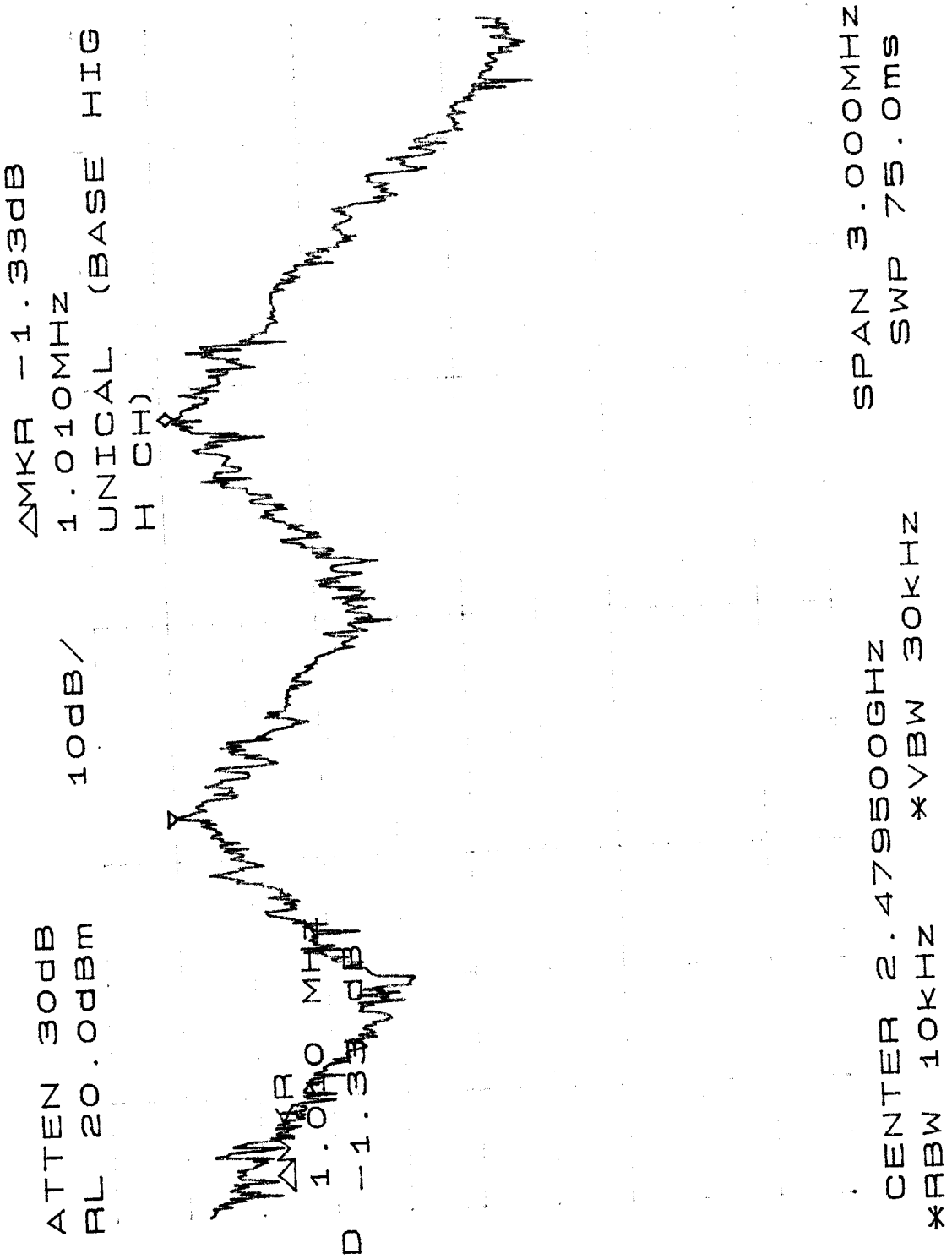
10.3 Test Results

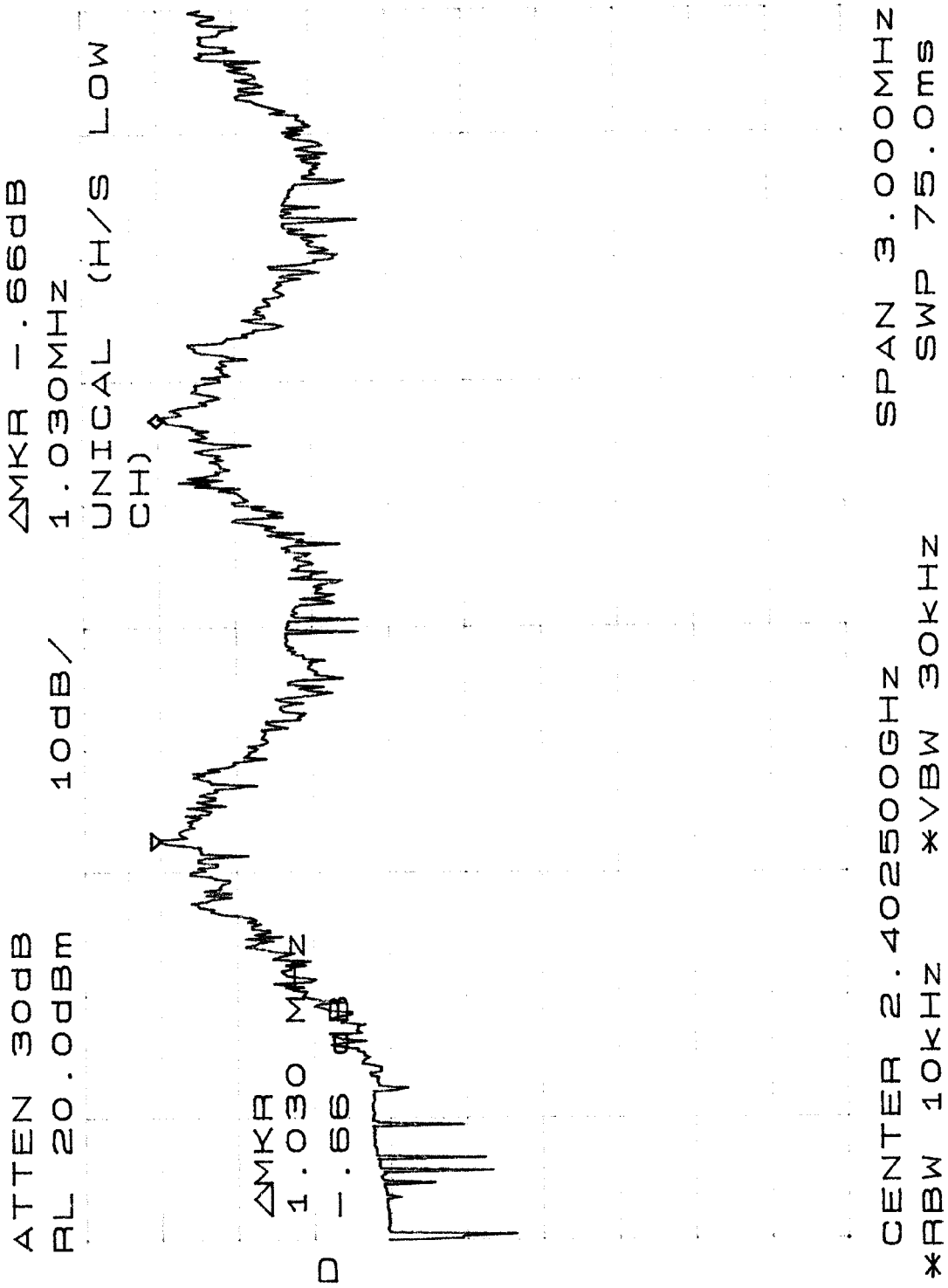
The following are plots of Channel Separation for low, middle and high channel.

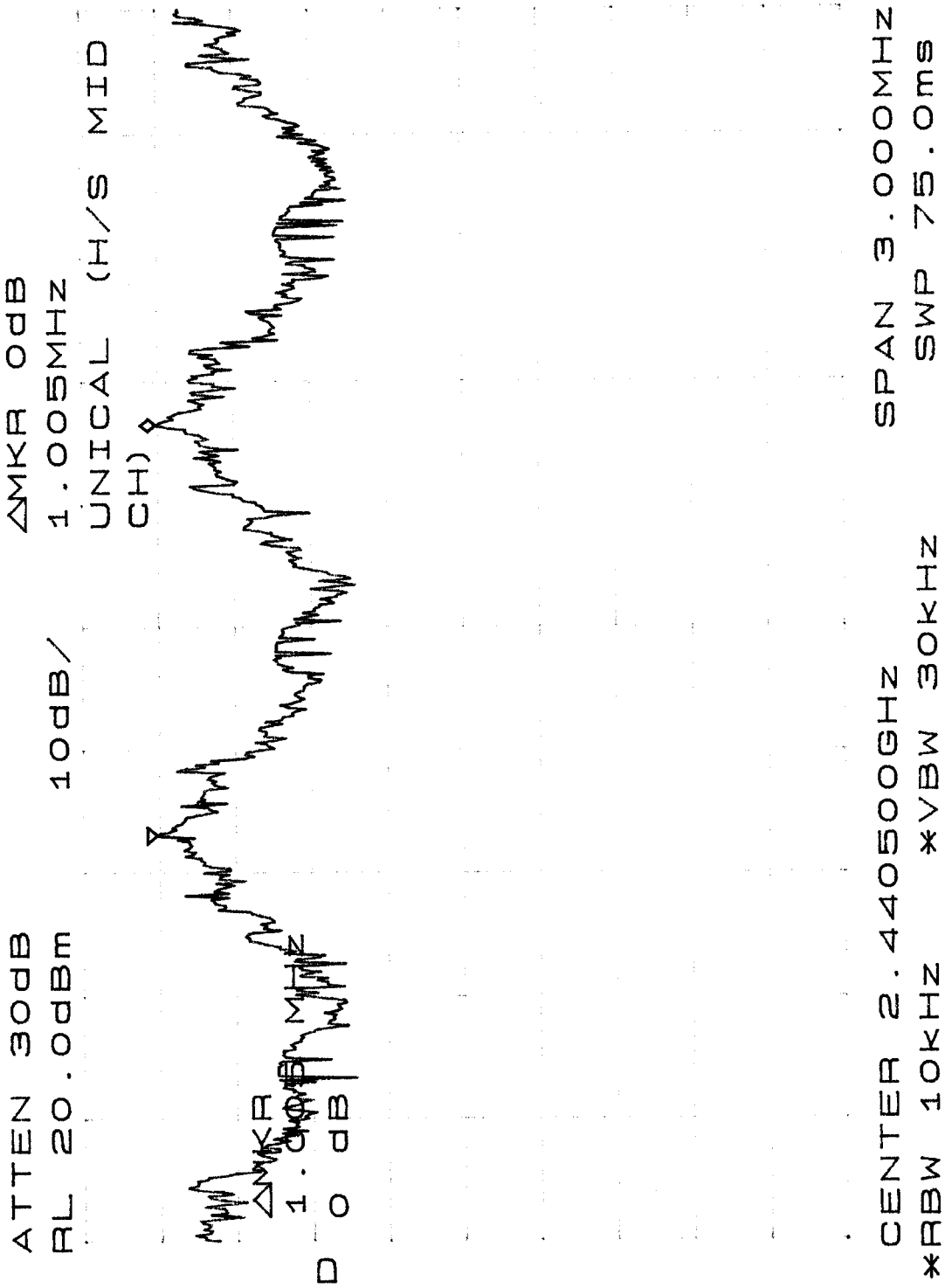
Hopping Frequency	Page Reference	Test Result
Base Low Channel	57	Passed
Base Middle Channel	58	Passed
Base High Channel	59	Passed
Handset Low Channel	60	Passed
Handset Middle Channel	61	Passed
Handset High Channel	62	Passed

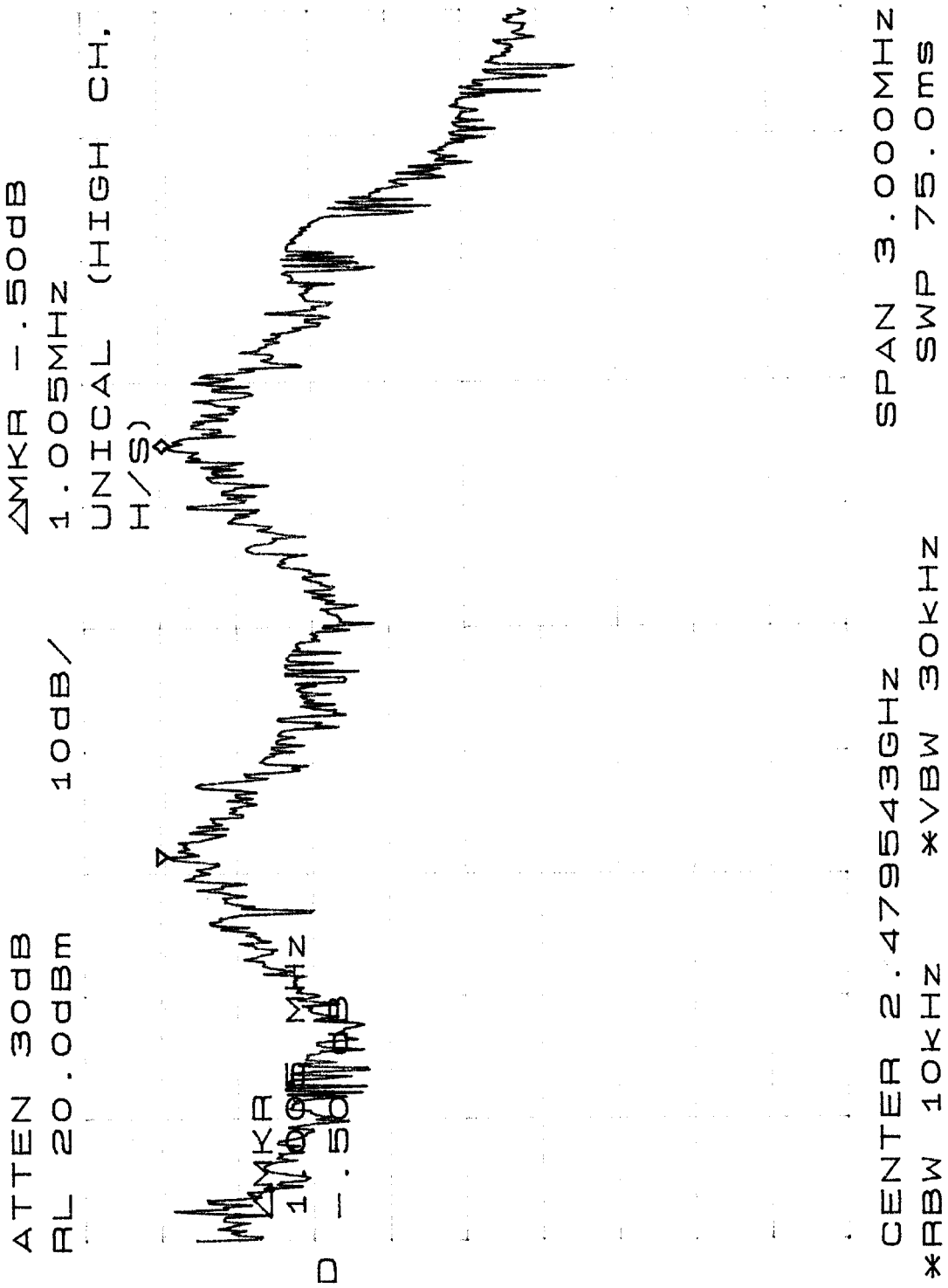

ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -.84dB
1.025MHz
UNICAL (BASE LOW CH)
ΔMKR
1.025 MHz
-.84 dB
D
CENTER 2.402500GHz
*RBW 10KHz
*VBW 30KHz
SPAN 3.000MHz
SWP 75.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -.34dB
1.010MHz
UNICAL (BASE MID CH)
ΔMKR
1.010 MHz
-.34 dB
D
CENTER 2.440500GHz
*RBW 10KHz
*VBW 30KHz
SPAN 3.000MHz
SWP 75.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -1.33dB
1.010MHz
UNICAL (BASE HIG
H CH)
D -1.33dB
ΔMKR 1.010 MHz
CENTER 2.479500GHz
*RBW 10KHz
*VBW 30KHz
SPAN 3.000MHz
SWP 75.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -.66dB
1.030MHz
UNICAL (H/S LOW CH)
ΔMKR
1.030 MHz
D -.66 dB
CENTER 2.402500GHz
*RBW 10kHz
*VBW 30kHz
SPAN 3.000MHz
SWP 75.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR 0dB
1.005MHz
UNICAL (H/S MID CH)
ΔMKR 1.005 MHz
1.00 dB
CENTER 2.440500GHz
*RBW 10KHz
*VBW 30KHz
SPAN 3.000MHz
SWP 75.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -.50dB
1.005MHz
UNICAL (HIGH CH. H/S)
D -.50dB
CENTER 2.479543GHz
SPAN 3.000MHz
*RBW 10KHz
*VBW 30KHz
SWP 75.0ms

11 - ANTENNA REQUIREMENT

11.1 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.

And according to § 15.247 (1), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

11.2 Antenna Connected Construction

The directional gain of antenna used for transmitting is 4.12 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.

12 – RF SAFETY REQUIREMENTS TO 2.1091

According to section 3 of Supplement C to OET Bulleting 65, Part 15 Transmitters are categorically excluded from Routine Environmental Evaluation by measurement or precise computations unless otherwise required by the Commissions.

The unit under evaluation has an external antenna of 4.12 dBi gain with a measured output power of 0.012 Watts at the antenna terminals.

Due to the low power of the EUT, environmental evaluation should be deemed unnecessary since the EUT's operational frequency range is 2.4GHz and the ERP is considerably less than 3 Watts.

A warning statement is also including in the user manual.

13 – SPURIOUS RADIATED EMISSION DATA

13.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement at BACL is $\pm$4.0 dB.

13.2 EUT Setup

The radiated emission tests were performed in the open area 3-meter test site, using the setup in accordance with the ANSI C63.4 - 1992. The specification used was the FCC 15 Subpart C limits.

The simulator was placed at the center back edge of the test table with the EUT on its left and the telephone on it right. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.

The spacing between the peripherals was 10 centimeters.

Input / Output cables were draped along the edge of the test table and bundle when necessary.

The host PC system was connected with 110 Vac/60Hz power source.

13.3 Spectrum Analyzer Setup

According to FCC Rules, 47 CFR §15.33 (a) (1), the system was tested to 25GHz.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

Start Frequency	30 MHz
Stop Frequency	25GHz
Sweep Speed	Auto
IF Bandwidth	1 MHz
Video Bandwidth	1 MHz
Quasi-Peak Adapter Bandwidth	120 kHz
Quasi-Peak Adapter Mode	Normal
Resolution Bandwidth	1MHz

13.4 Test Procedure

For the radiated emissions test, the Host PC system and all support equipment power cords were connected to the AC floor outlet since the power supply used in the EUT did not provide an accessory power outlet.

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations. All data was recorded in the peak detection mode. Quasi-peak readings was performed only when an emission was found to be marginal (within -4 dBμV of specification limits), and are distinguished with a "**Qp**" in the data table.

13.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dBμV means the emission is 7dBμV below the maximum limit for Class B. The equation for margin calculation is as follows:

Margin = Corr. Ampl. - Class B Limit

13.6 Summary of Test Results

According to the data in section 11.7, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.207, and 15.247, and had the worst margin of:

For Base Unit:

-1.7 dBμV at **178.82 MHz** in the **Vertical** polarization, 30 MHz to 1 GHz, **3 meters**

-10.1 dBμV at **4803.97 MHz** in the **Horizontal** polarization, Low Channel, 30 MHz to 1 GHz, **3 meters**

-15.6 dBμV at **488.75 MHz** in the **Vertical** polarization, Middle Channel, 30 MHz to 1 GHz, **3 meters**

-15.3 dBμV at **4959.76 MHz** in the **Horizontal** polarization, High Channel, 30 MHz to 1 GHz, **3 meters**

For Handset Unit:

-2.2 dBμV at **48.02 MHz** in the **Vertical** polarization, 30 MHz to 1 GHz, **3 meters**

-10.4 dBμV at **4803.95 MHz** in the **Horizontal** polarization, Low Channel, 30 MHz to 1 GHz, **3 meters**

-13.4 dBμV at **4881.75 MHz** in the **Horizontal** polarization, Middle Channel, 30 MHz to 1 GHz, **3 meters**

-15.4 dBμV at **4960.10 MHz** in the **Vertical** polarization, High Channel, 30 MHz to 1 GHz, **3 meters**

13.7.a. Final Test Data, Base Unit, 30MHz to 1GHz, 3 meters

INDICATED		TABLE	ANTENNA		CORRECTION FACTOR			CORRECTED AMPLITUDE	FCC 15 Subpart C	
Frequency MHz	Ampl dBµV/m	Angle Degree	Height Meter	Polar H/ V	Antenna dBµV/m	Cable DB	Amp. DB	Corr. Ampl. dBµV/m	Limit dBµV/m	Margin dB
178.82	49.5	180	2.0	V	13.4	3.9	25.0	41.8	43.5	-1.7
49.14	51.3	0	2.1	V	11.3	0.5	25.0	38.1	40.0	-1.9
455.99	47.5	270	2.1	H	17.8	3.2	25.0	43.5	46.0	-2.5
799.73	37.5	90	1.5	H	23.0	3.7	25.0	39.2	46.0	-6.8
432.00	43.5	225	2.1	H	17.5	2.9	25.0	38.9	46.0	-7.1
120.02	44.7	45	1.0	V	12.1	2.2	25.0	34.0	43.5	-9.5
333.32	41.8	270	1.3	H	15.0	2.6	25.0	34.4	46.0	-11.6
122.82	42.5	270	2.0	V	12.1	2.2	25.0	31.8	43.5	-11.7
168.03	40.8	45	1.8	V	13.3	2.1	25.0	31.2	43.5	-12.3
192.03	38.7	45	1.2	V	14.4	2.7	25.0	30.8	43.5	-12.7
269.00	40.0	90	1.2	H	13.3	4.9	25.0	33.2	46.0	-12.8
144.04	41.3	180	1.5	V	13.2	1.0	25.0	30.5	43.5	-13.0
239.97	44.7	270	2.0	H	12.0	1.2	25.0	32.9	46.0	-13.1

13.7.b Final Test Data, Handset Unit, 30MHz to 1GHz, 3 meters

INDICATED		TABLE	ANTENNA		CORRECTION FACTOR			CORRECTED AMPLITUDE	FCC 15 Subpart C	
Frequency MHz	Ampl. DBµV/m	Angle Degree	Height Meter	Polar H/ V	Antenna dBµV/m	Cable dB	Amp. dB	Corr. Ampl. dBµV/m	Limit dBµV/m	Margin dB
48.02	51.0	180	1.5	V	11.3	0.5	25.0	37.8	40.0	-2.2
747.25	43.3	360	1.0	H	22.4	2.9	25.0	43.6	46.0	-2.4
311.99	45.3	180	1.8	H	15.9	3.7	25.0	39.9	46.0	-6.1
959.98	34.3	45	1.2	H	24.7	4.2	25.0	38.2	46.0	-7.8
287.99	39.8	90	1.5	H	14.6	5.8	25.0	35.2	46.0	-10.8
197.75	38.3	315	1.9	V	15.0	3.9	25.0	32.2	43.5	-11.3
305.11	40.0	225	1.4	H	15.1	4.6	25.0	34.7	46.0	-11.3
599.98	36.5	225	1.3	H	20.3	2.7	25.0	34.5	46.0	-11.5
144.03	41.8	315	2.0	V	13.2	1.0	25.0	31.0	43.5	-12.5
239.99	43.0	90	2.0	H	12.0	1.2	25.0	31.2	46.0	-14.8
360.00	35.5	180	1.8	H	15.5	5.2	25.0	31.2	46.0	-14.8
168.04	38.2	0	1.4	V	13.3	2.1	25.0	28.6	43.5	-14.9

13.7.c Final Test Data, Handset Unit, Low Channel, 1GHz to 25GHz, 3 meters

INDICATED		TABLE	ANTENNA		CORRECTION FACTOR			CORRECTED AMPLITUDE	FCC 15 Subpart C	
Frequency MHz	Ampl. DBµV/m	Angle Degree	Height Meter	Polar H/ V	Antenna dBµV/m	Cable dB	Amp. dB	Corr. Ampl. dBµV/m	Limit dBµV/m	Margin dB
2403.95	100.5	270	1.0	H	28.1	3.4	30.0	102.0		
2403.95	104.5	180	1.0	V	28.1	3.4	30.0	106.0		
4803.95	36.2	315	1.3	H	32.5	4.9	30.0	43.6	54.0	-10.4
4803.95	31.3	180	1.6	V	32.5	4.9	30.0	38.7	54.0	-15.3

13.7.d Final Test Data, Handset Unit, Middle Channel, 1GHz to 25GHz, 3 meters

INDICATED		TABLE	ANTENNA		CORRECTION FACTOR			CORRECTED AMPLITUDE	FCC 15 Subpart C	
Frequency MHz	Ampl. DBµV/m	Angle Degree	Height Meter	Polar H/ V	Antenna dBµV/m	Cable dB	Amp. dB	Corr. Ampl. dBµV/m	Limit dBµV/m	Margin dB
2441.08	98.2	180	1.3	V	28.1	3.4	30.0	99.6		
2441.08	104.0	45	2.5	H	28.1	3.4	30.0	105.5		
4881.75	33.2	45	1.0	H	32.5	4.9	30.0	40.6	54.0	-13.4
4881.75	31.2	360	2.0	V	32.5	4.9	30.0	38.6	54.0	-15.4

13.7.e Final Test Data, Handset Unit, High Channel, 1GHz to 25GHz, 3 meters

INDICATED		TABLE	ANTENNA		CORRECTION FACTOR			CORRECTED AMPLITUDE	FCC 15 Subpart C	
Frequency MHz	Ampl. DBµV/m	Angle Degree	Height Meter	Polar H/ V	Antenna dBµV/m	Cable dB	Amp. dB	Corr. Ampl. dBµV/m	Limit dBµV/m	Margin dB
4960.10	31.2	90	2.0	V	32.5	4.9	30.0	38.6	54.0	-15.4
4960.10	29.3	180	1.0	H	32.5	4.9	30.0	36.7	54.0	-17.3
2480.05	104.0	360	1.9	V	28.1	3.4	30.0	105.5		
2480.00	92.3	360	1.8	H	28.1	3.4	30.0	93.8		

13.7.f Final Test Data, Base Unit, Low Channel, 1GHz to 25GHz, 3 meters

INDICATED		TABLE	ANTENNA		CORRECTION FACTOR			CORRECTED AMPLITUDE	FCC 15 Subpart C	
Frequency MHz	Ampl. DBµV/m	Angle Degree	Height Meter	Polar H/ V	Antenna dBµV/m	Cable dB	Amp. dB	Corr. Ampl. dBµV/m	Limit dBµV/m	Margin dB
4803.97	34.5	315	1.2	V	32.5	4.9	30.0	41.9	54.0	-12.1
4803.97	36.5	135	3.0	H	32.5	4.9	30.0	43.9	54.0	-10.1
2402.08	104.7	135	3.0	H	28.1	3.4	30.0	106.1		
2402.08	101.8	45	1.1	V	28.1	3.4	30.0	103.3		

13.7.g Final Test Data, Base Unit, Middle Channel, 1GHz to 25GHz, 3 meters

INDICATED		TABLE	ANTENNA		CORRECTION FACTOR			CORRECTED AMPLITUDE	FCC 15 Subpart C	
Frequency MHz	Ampl. DBµV/m	Angle Degree	Height Meter	Polar H/ V	Antenna dBµV/m	Cable dB	Amp. dB	Corr. Ampl. dBµV/m	Limit dBµV/m	Margin dB
4881.75	30.8	380	1.0	H	32.5	4.9	30.0	38.2	54.0	-15.8
4881.75	31.0	270	1.2	V	32.5	4.9	30.0	38.4	54.0	-15.6
2441.17	100.3	45	1.9	V	28.1	3.4	30.0	101.8		
2441.17	98.8	90	1.0	H	28.1	3.4	30.0	100.3		

13.7.h Final Test Data, Base Unit, High Channel, 1GHz to 25GHz, 3 meters

INDICATED		TABLE	ANTENNA		CORRECTION FACTOR			CORRECTED AMPLITUDE	FCC 15 Subpart C	
Frequency MHz	Ampl. DBµV/m	Angle Degree	Height Meter	Polar H/ V	Antenna dBµV/m	Cable dB	Amp. dB	Corr. Ampl. dBµV/m	Limit dBµV/m	Margin dB
4959.76	29.7	315	1.5	V	32.5	4.9	30.0	37.1	54.0	-16.9
4959.76	31.3	315	2.0	H	32.5	4.9	30.0	38.7	54.0	-15.3
2480.00	94.8	90	1.9	V	28.1	3.4	30.0	96.3		
2480.00	97.3	180	2.2	H	28.1	3.4	30.0	98.8		

14 - CONDUCTED EMISSIONS TEST DATA

14.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, and LISN.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of any conducted emissions measurement at BACL is $\pm$2.4 dB.

14.2 EUT Setup

The measurement was performed at the **O**pen **A**rea **T**est **S**ite, using the same setup per ANSI C63.4 - 1992 measurement procedure. The specification used was FCC 15 Subpart C limits.

The simulator was placed at the center back edge of the test table with the EUT on its left and the telephone on it right. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.

The spacing between the peripherals was 10 centimeters.

Input / Output cables were draped along the edge of the test table and bundle when necessary.

The host PC system was connected with 110 Vac/60Hz power source.

14.3 Spectrum Analyzer Setup

The spectrum analyzer was set with the following configurations during the conduction test:

Start Frequency	450 kHz
Stop Frequency	30 MHz
Sweep Speed	Auto
IF Bandwidth	100 kHz
Video Bandwidth	100 kHz
Quasi-Peak Adapter Bandwidth	9 kHz
Quasi-Peak Adapter Mode	Normal

14.4 Test Procedure

During the conducted emission test, the power cord of the host system was connected to the auxiliary outlet of the first LISN.

Maximizing procedure was performed on the six (6) highest emissions of each modes tested to ensure EUT is compliant with all installation combination.

All data was recorded in the peak detection mode. Quasi-peak readings were only performed when an emission was found to be marginal (within -4 dBμV of specification limits). Quasi-peak readings are distinguished with a "**Qp**".

14.5 Summary of Test Results

According to the data in section 12.6, the EUT complied with the FCC Conducted margin for a Class B device, with the *worst* margin reading of:

-14.8 dBμV at **0.630 MHz** in the **Neutral** mode, Base Unit, 450KHz – 30 MHz.

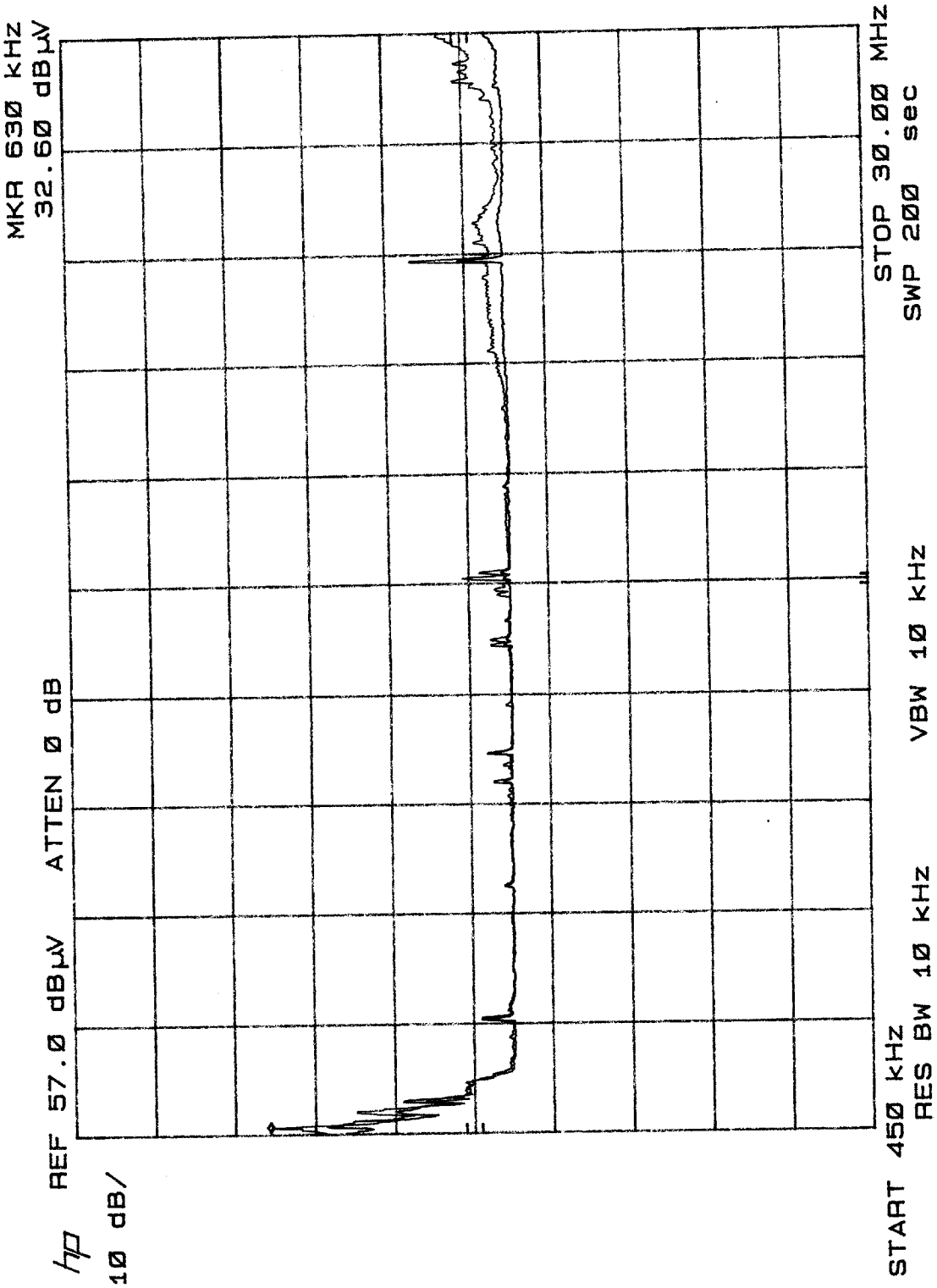
14.6 Conducted Emissions Test Data

14.6.1 Test Data, Base Unit, 0.45 - 30 MHz.

LINE CONDUCTED EMISSIONS				FCC CLASS B	
Frequency	Amplitude	Detector	Phase	Limit	Margin
MHz	dBμV	Qp/Ave/Peak	Line/Neutral	dBμV	dB
0.630	33.2	Peak	Neutral	48	-14.8
0.660	26.2	Peak	Line	48	-21.8
0.800	22.0	Peak	Line	48	-26.0
1.070	21.8	Peak	Neutral	48	-26.2
1.340	16.3	Peak	Line	48	-31.7
3.520	6.1	Peak	Neutral	48	-41.9

14.7 Plot of Conducted Emissions Test Data

Plot(s) of Conducted Emissions Test Data is presented hereinafter as reference.


MKR 630 kHz
32.60 dBµV
REF 57.0 dBµV
ATTEN 0 dB
10 dB/
START 450 kHz
RES BW 10 kHz
VBW 10 kHz
STOP 30.00 MHz
SWP 200 sec