COMPLEMENTARY ACCEPTANCE and DESIGN TEST REPORT (CADTR)

MEASUREMENT OF THE UNWANTED RF EMISSIONS

FOR THE AHV1600 TRANSCEIVER

CONTRACT N° [contract number]

CDRL N° [CDRL number]

Prepared for:
[Contracting Agency Name, department code]

Prepared by:
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EVOLUTIONS

REV	DESCRIPTION
- -	First issue
- A	Amended further FCC comments "Correspondence Reference Number: 38124, Form 731 Confirmation Number: EA494543, Date of Original E-mail: 09/24/2009" : Quote : "2) The Test Report appears to have only radiated emissions data. Send in a Test Report with the transmitter data." Unquote
- B	
- C	
- D	
- E	
- F	

Ind.	- -	- A	- B	- C	- D	- E	- F
Date	2008/03/13	2008/09/28					
Written by	A. JAMET	S. TALLET					
Verified by	D. DOS SANTOS	S. TALLET					
Approved by	E. CARDONE	C. MICHEL					

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1. SCOPE

1.1 IDENTIFICATION

This document concerns Hardware Test Report of the measurement of the unwanted emissions for the prototype of the AHV1600 Transceiver:

- Name: AHV1600
- P/N: 61778974xx-yy

Note: the functional indices (xx) are not included in the equipment identification (P/N) to ease document configuration management.

Note: the prototype standard indices (yy) are not included in the equipment identification (P/N) to ease document configuration management..

1.2 DOCUMENT OVERVIEW

This document reports the results of the measurement of the unwanted emissions for the prototype of the AHV1600 Transceiver.

The results of the Complementary Acceptance and Design Test Procedure [3] shall be consigned in this document.

1.3 APPLICATION FIELD

This document is applied only to the prototype of the AHV1600 Transceiver.

2. DOCUMENTS

2.1 APPLICABLES DOCUMENTS

Document's Identifier	*Document's Title*
[1] ITU (International Telecommunication Union) Radio Regulations ; Edition 2004	Appendix 3 (Rev. WRC-03) Tables of maximum permitted power levels for spurious or spurious domain emissions
[2] E-CFR (Electronics Code of Federal Regulations) ; December 2007	Title 47 : Telecommunications ; Chapter I : Federal Communications Commission ; Part 87 : Aviation Services § 87.135 : Bandwidth of emission § 87.139 : Emission limitations
[3] CADTP n°62 134 086-206	Complementary Acceptance and Design Test Procedure of the Measurement of the Unwanted RF Emissions for the AHV1600 Transceiver
[4] Huber+Suhner Data Sheet	Between Series Adapter: 34_MMBX-TNC-50-1/1-2_N

2.2 REFERENCED DOCUMENTS

Document's Identifier	*Document's Title*
[5] TCF,QE/MOD_073/--/en	Document template

3. TYPICAL INFORMATIONS

3.1 PROTOTYPE EQUIPMENT IDENTIFICATION

Name	**AHV1600**
Manufacturer name	**THALES**
Manufacturer code	**F0057**
Part Number	61778974AA
Serial Number	00004
Amendment label	-
Date of manufacture	-

3.2 BENCH TEST

Name	*Part Number*	*Serial Number*	*Amendment*
BTE PILOTAGE DISCRET	61 491 331 AA	00100	-

3.3 IDENTIFICATION OF APPLICABLE PROCEDURE

Document title	*Identification*	*Edition date*	*Index*
HTD	62 134 086-206	2008/03/11	--
HTR	62 134 087-279	2008/03/13	--

3.4 ACCEPTANCE

	Name	*Date*	*Signature*
Operator name	A. JAMET	2008/04/07	
Person in charge of quality			

3.5 COMMENTS

Deviations:

Measurement are done only in the frequency band 9kHz-50GHz because of:

- *Spectrum analyzer frequency band*
- *Characteristics of equipment connector TX and RX (DC-5GHz, cf. [4])*
- *Level of harmonics (harmonics upper the harmonic 2 have a very low level and are embedded in the noise floor)*

Remarks

Measurement upper 50GHz will be not significant

4. TRANSCEIVER CHARACTERISTICS

4.1 POWER AT CONNECTOR TX

The maximum power level of the AHV1600 radio altimeter is:

P_{TXMax}=19dBm=79.4mW

4.2 FREQUENCY BANDWIDTH

According to the ITU [1] and e-CFR [2], the allocated band for radio altimeters is 4200MHz-4400MHz and is reserved exclusively for radio altimeters.

The bandwidth of emissions of the AHV1600 transceiver is:

B=[4240-4363]MHz

Δf=123MHz

4.3 MODULATION CHARACTERISTICS

The modulation of the AHV1600 transceiver FM/CW is a linear sawtooth.

5. THEORETICAL UNWANTED DOMAIN EMISSIONS

5.1 ITU (INTERNATIONAL TELECOMMUNICATION UNION)

5.1.1 DEFINITION

Spurious emission:

Emission on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

Out-of-band emission:

Emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions.

Unwanted emissions:

Consist of spurious domain emissions and out-of-band emissions.

5.1.2 UNWANTED EMISSIONS FREQUENCIES AND LEVELS

Spurious domain emission limits

According to the ITU [1], the frequency range of the measurement of spurious domain emissions is from 9kHz to 110GHz or the second harmonic if higher. The spurious domain emission levels are specified in the following reference bandwidths :

1kHz for 9kHz≤f_c≤150kHz

10kHz for 150kHz≤f_c≤30MHz

100kHz for 30MHz≤f_c≤1GHz

1MHz for f_c≥1GHz

Determination of the boundary between the out-of-band and spurious domains

f_c=4300MHz

B_N=200MHz

Using the general separation formula, the out-of-band domain is :

1.5xB_N+100=1.5x200MHz+100MHz=400MHz either side of the centre frequency

The following graphics resumes the spectrum emission:

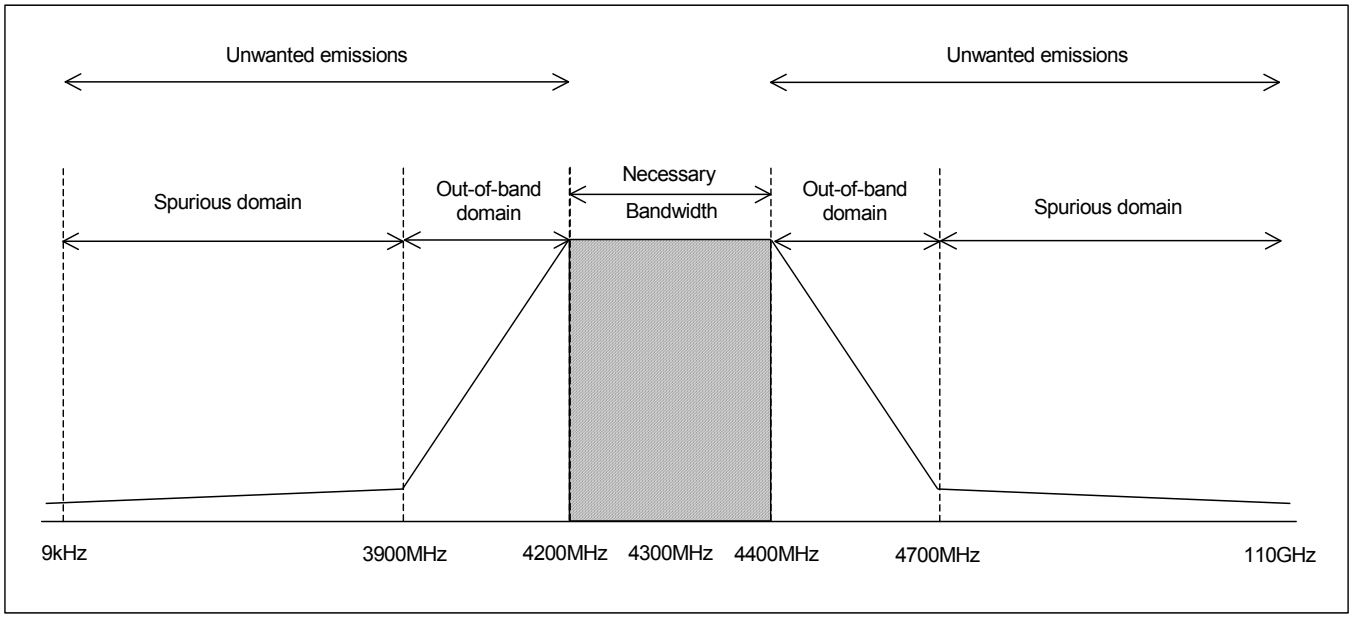


Figure 1: Spectrum emissions

Attenuation value used to calculate maximum permitted spurious domain emission power levels for use with radio equipment is:

A=56+10log(P) or 40dBc whichever is less stringent

Calculated attenuation:

P_{TX}=19dBm=79.4mW=-11dBW

A=56+10log(79.4x10^{-3})=45dBc

45dBc is more stringent than 40dBc so the 40Bc value is used.

Spurious domain emissions (converting to an absolute level) must not exceed –11dBw-40dBc=-51dBW=-21dBm in the reference bandwidth.

For 9kHz≤f_c≤3900MHz and 4700MHz≤f_c≤110GHz, spurious domain emission level shall be ≤ -21dBm in the reference bandwidth.

5.2 E-CFR (ELECTRONICS CODE OF FEDERAL REGULATIONS)

5.2.1 BANDWIDTH OF EMISSION

According to the § 87.135 of e-CFR [2], occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5 percent of the total mean power of a given emission.

$P_{res}=P_{TX}$x0.5%=0.0794x0.5/100=397µW=-4dBm

5.2.2 EMISSION LIMITATIONS

According to the § 87.139 of e-CFR [2], the mean power of any emission must be attenuated below the mean power of the transmitter as follows:

Frequency	Attenuation	Level
4200MHz≤f_c≤4400MHz	-	19dBm
4000MHz≤f_c≤4100MHz 4500MHz≤f_c≤4600MHz	25dB	-6dBm
3900MHz≤f_c≤4000MHz 4600MHz≤f_c≤4700MHz	35dB	-16dBm
fc≤3900MHz fc≥4700MHz	40dB	-21dBm

Table 1: Attenuation level versus frequency bandwidth

5.3 CONCLUSION

The following figure resumes the combination between ITU rules and CFR rule. Reference bandwidth of the ITU will be applied on this document.

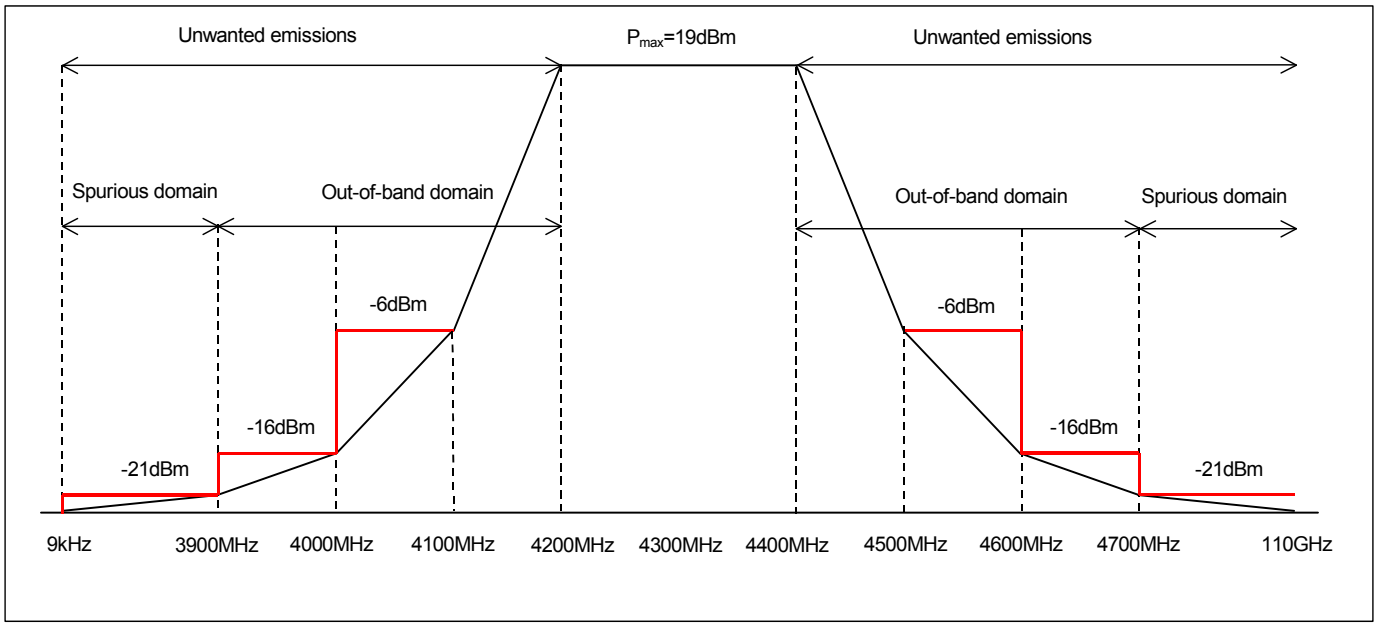


Figure 2: Level of emissions versus frequency

6. PREPARATION OF THE TESTS

6.1 LABORATORY TEST EQUIPMENTS

6.1.1 STANDARD LABORATORY TEST EQUIPMENTS

The standard laboratory test equipments necessary for the progress of the measurement are the following ones:

Name	Manufacturer	Type	Frequency band	Serial Number	Date of validation
Spectrum analyzer	Hewlett Packard	8593E	9kHz-22GHz	-	31/09/2009
Spectrum analyzer	Hewlett Packard	8565E	9kHz-50GHz	-	20/05/2009
Power supply	TTI	EL302D	-	-	-
Adapters	-	TNC M – SMA M	DC-18GHZ	-	-
Load	-	50Ω	DC-18GHZ	-	-

Tableau 2 : Standard laboratory test equipments

6.1.2 SPECIAL LABORATORY TEST EQUIPMENTS

Box test	61 491 331 AA n°: 00100

6.2 LABORATORY TEST ASSEMBLY

See figure 2 in the Complementary Acceptance and Design Test Procedure [3].

7. TESTS RESULTS

Check	*HTD requirement*	*Result*		*Problem Report*	*ICD requirement*
		PASS	FAILED		
Measure of the out-of-band domain emissions	HTD-AUT-0010	☒	☐		ICD-2520
Measure of the Spurious domain emissions	HTD-AUT-0020	☒	☐		ICD-2525

8. MEASURES

The spectrum diagrams of the measures are done in the appendices of this document.

8.1 TEST N°1: MEASUREMENT OF SPURIOUS DOMAIN EMISSIONS

N°	CHECK	EXPECTED RESULT	RESULT
1	Maximum spectrum level in the bandwidth 3900 to 4000MHz	≤ -16dBm	**-67.8dBm**
2	Maximum spectrum level in the bandwidth 4000 to 4100MHz	≤ -6dBm	**-55.9dBm**
3	Maximum spectrum level in the bandwidth 4100 to 4600MHz	≤ -6dBm	**-57.1dBm**
4	Maximum spectrum level in the bandwidth 4600 to 4700MHz	≤ -16dBm	**-68.4dBm**

8.2 TEST N°2: MEASUREMENT OF SPURIOUS DOMAIN EMISSIONS

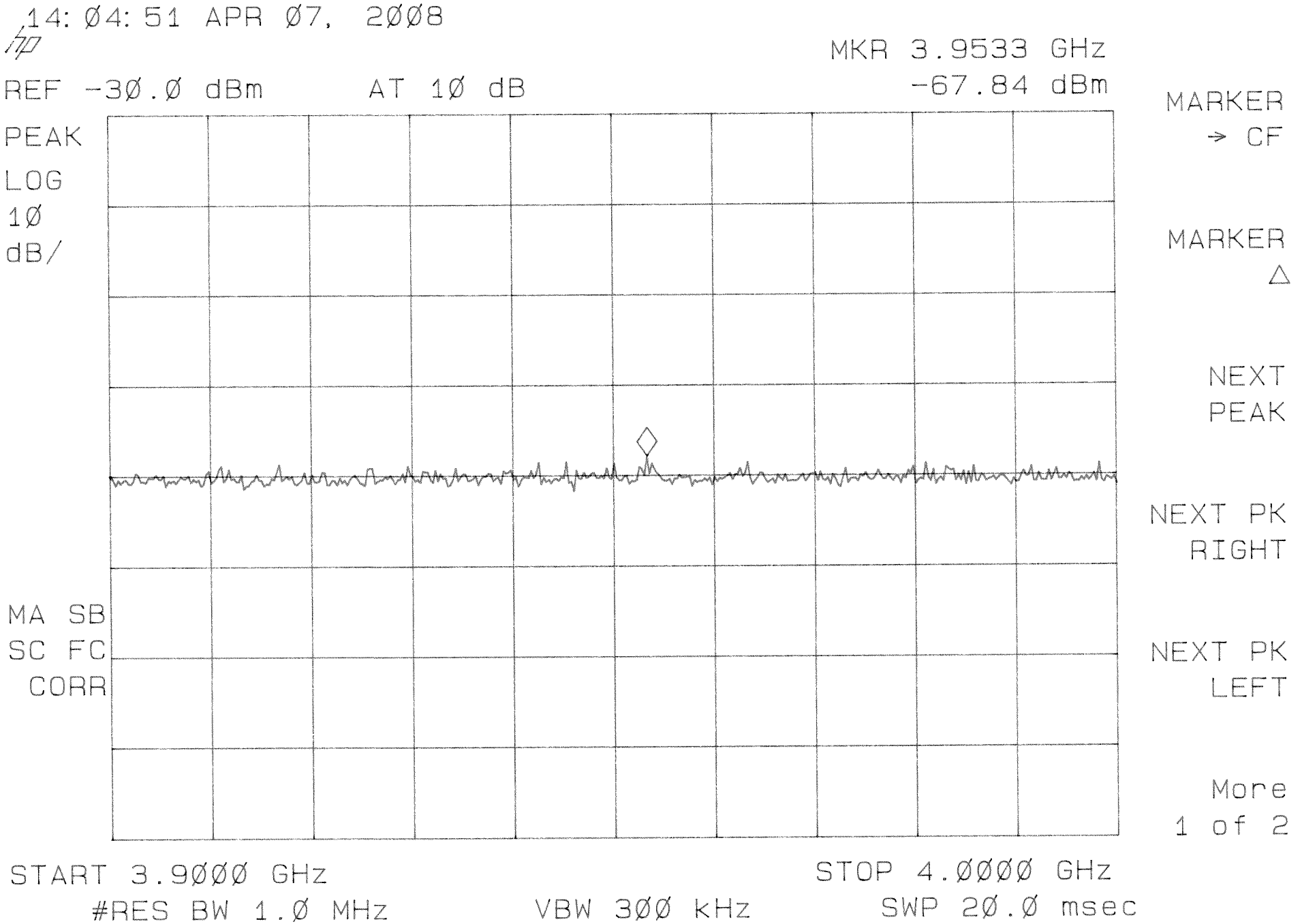
N°	CHECK	EXPECTED RESULT	RESULT
1	Maximum spectrum level in the bandwidth 9kHz to 150kHz	≤ -21dBm	**-69.3dBm**
2	Maximum spectrum level in the bandwidth 150kHz to 30MHz	≤ -21dBm	**-89.3dBm**
3	Maximum spectrum level in the bandwidth 30MHz to 1000MHz	≤ -21dBm	**-78.5dBm**
4	Maximum spectrum level in the bandwidth 1000MHz to 2900MHz	≤ -21dBm	**-57.4dBm**
5	Maximum spectrum level in the bandwidth 2900MHz to 3900MHz	≤ -21dBm	**-64.6dBm**

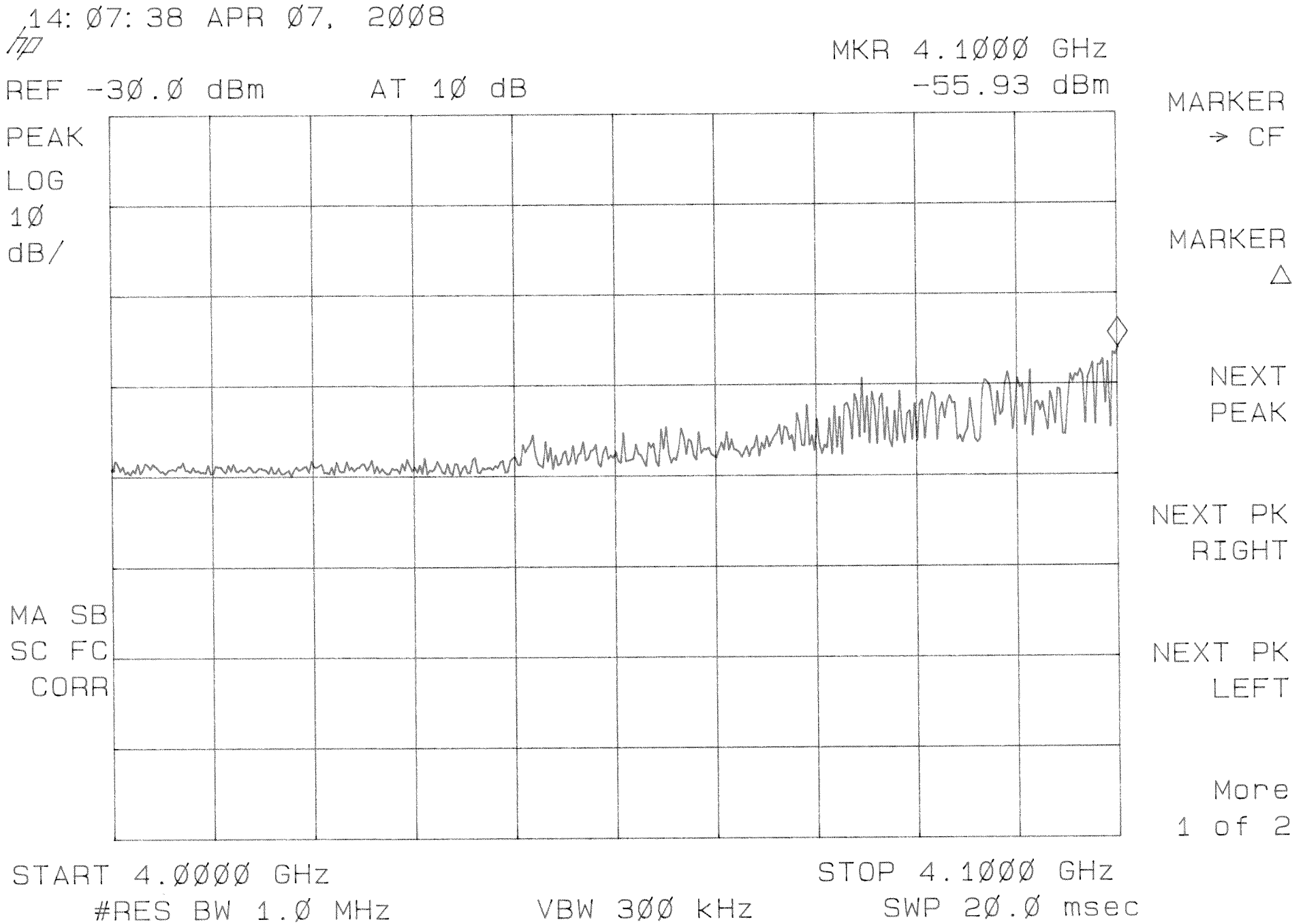
6	Maximum spectrum level in the bandwidth 4700MHz to 8900MHz	≤ -21dBm	**-39.2dBm**
7	Maximum spectrum level in the bandwidth 8900MHz to 11900MHz	≤ -21dBm	**-58.3dBm**
8	Maximum spectrum level in the bandwidth 11900MHz to 14900MHz	≤ -21dBm	**-45.8dBm**
9	Maximum spectrum level in the bandwidth 14900MHz to 18000MHz	≤ -21dBm	**-46.5dBm**
10	Maximum spectrum level in the bandwidth 18000MHz to 22000MHz	≤ -21dBm	**-47.7dBm**
11	Maximum spectrum level in the bandwidth 22000MHz -> 26000MHz	≤ -21dBm	**-56.8dBm**
12	Maximum spectrum level in the bandwidth 26000MHz -> 30000MHz	≤ -21dBm	**-56.1dBm**
13	Maximum spectrum level in the bandwidth 30000MHz -> 34000MHz	≤ -21dBm	**-52.3dBm**
14	Maximum spectrum level in the bandwidth 34000MHz -> 38000MHz	≤ -21dBm	**-54.3dBm**
15	Maximum spectrum level in the bandwidth 38000MHz -> 42000MHz	≤ -21dBm	**-55dBm**
16	Maximum spectrum level in the bandwidth 42000MHz -> 46000MHz	≤ -21dBm	**-53.8dBm**
17	Maximum spectrum level in the bandwidth 46000MHz -> 50000MHz	≤ -21dBm	**-53dBm**
17	Maximum spectrum level in the bandwidth 50000MHz -> 110000MHz	≤ -21dBm	**-**

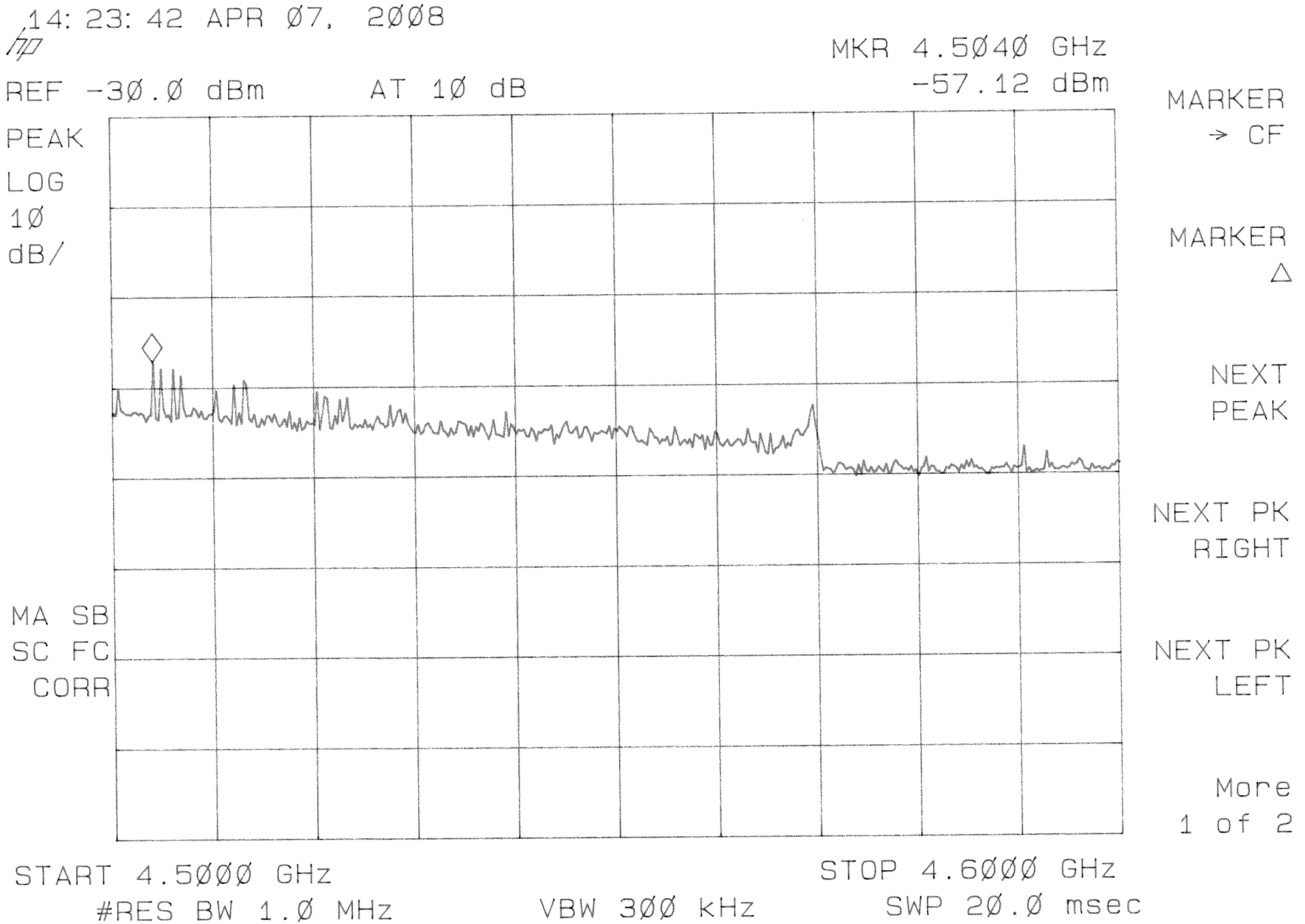
APPENDICES

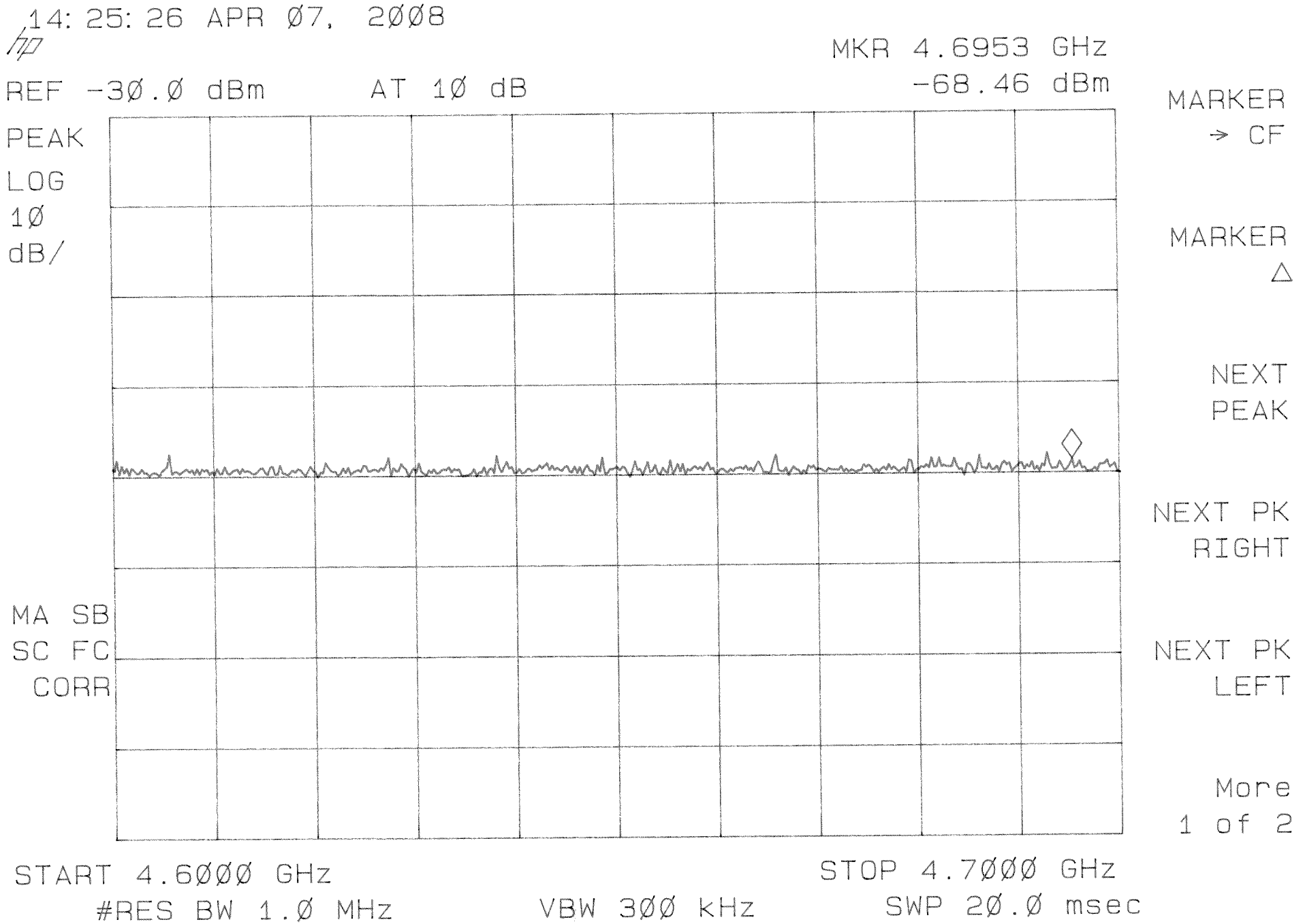
Measures

Out of Band Domain

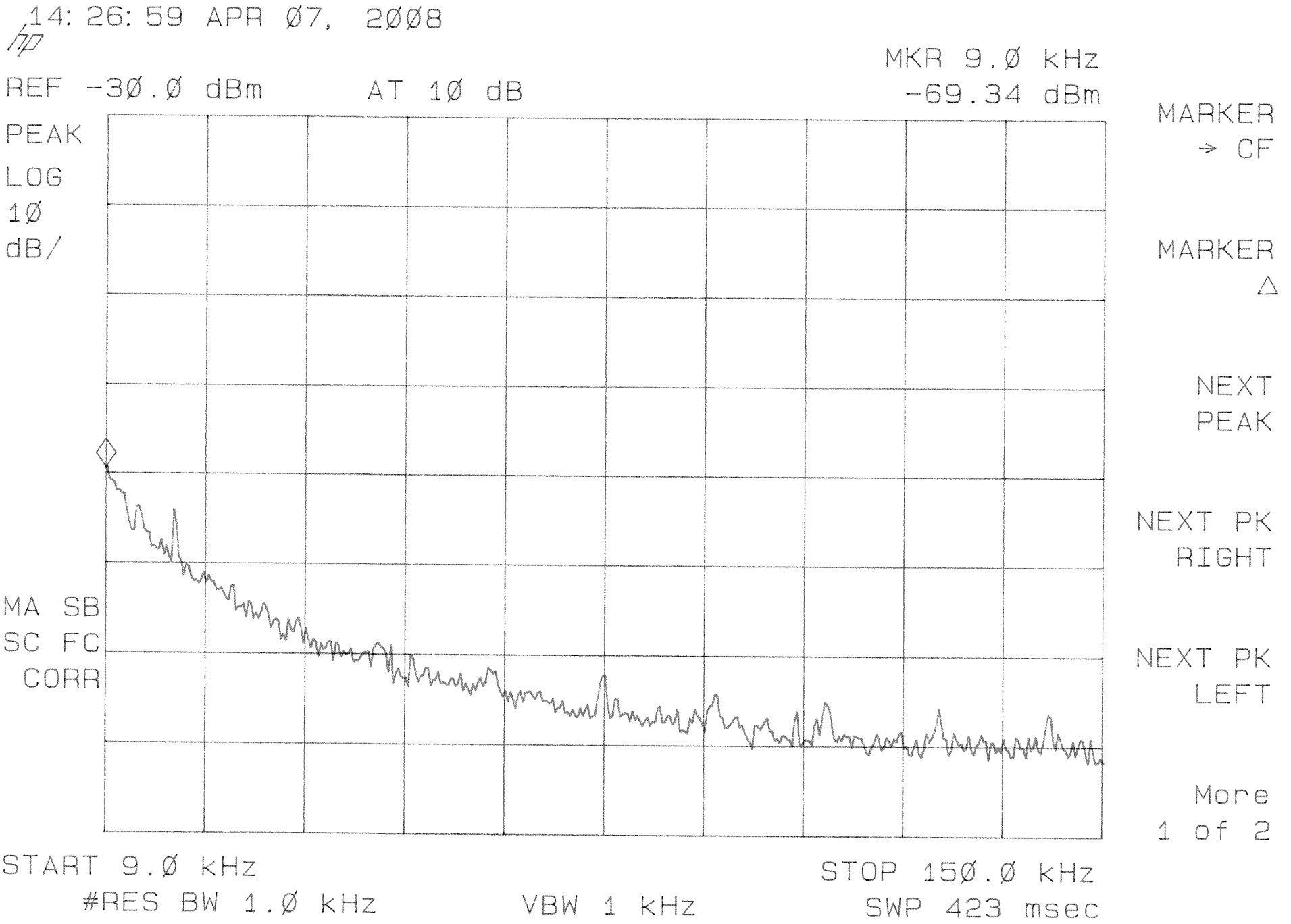

14: Ø4: 51 APR Ø7, 2ØØ8
MKR 3.9533 GHz
REF -3Ø.Ø dBm
AT 1Ø dB
-67.84 dBm
PEAK
LOG
1Ø
dB/
MARKER
→ CF
MARKER
△
NEXT
PEAK
NEXT PK
RIGHT
MA SB
SC FC
CORR
NEXT PK
LEFT
More
1 of 2
START 3.9ØØØ GHz
STOP 4.ØØØØ GHz
#RES BW 1.Ø MHz
VBW 3ØØ kHz
SWP 2Ø.Ø msec

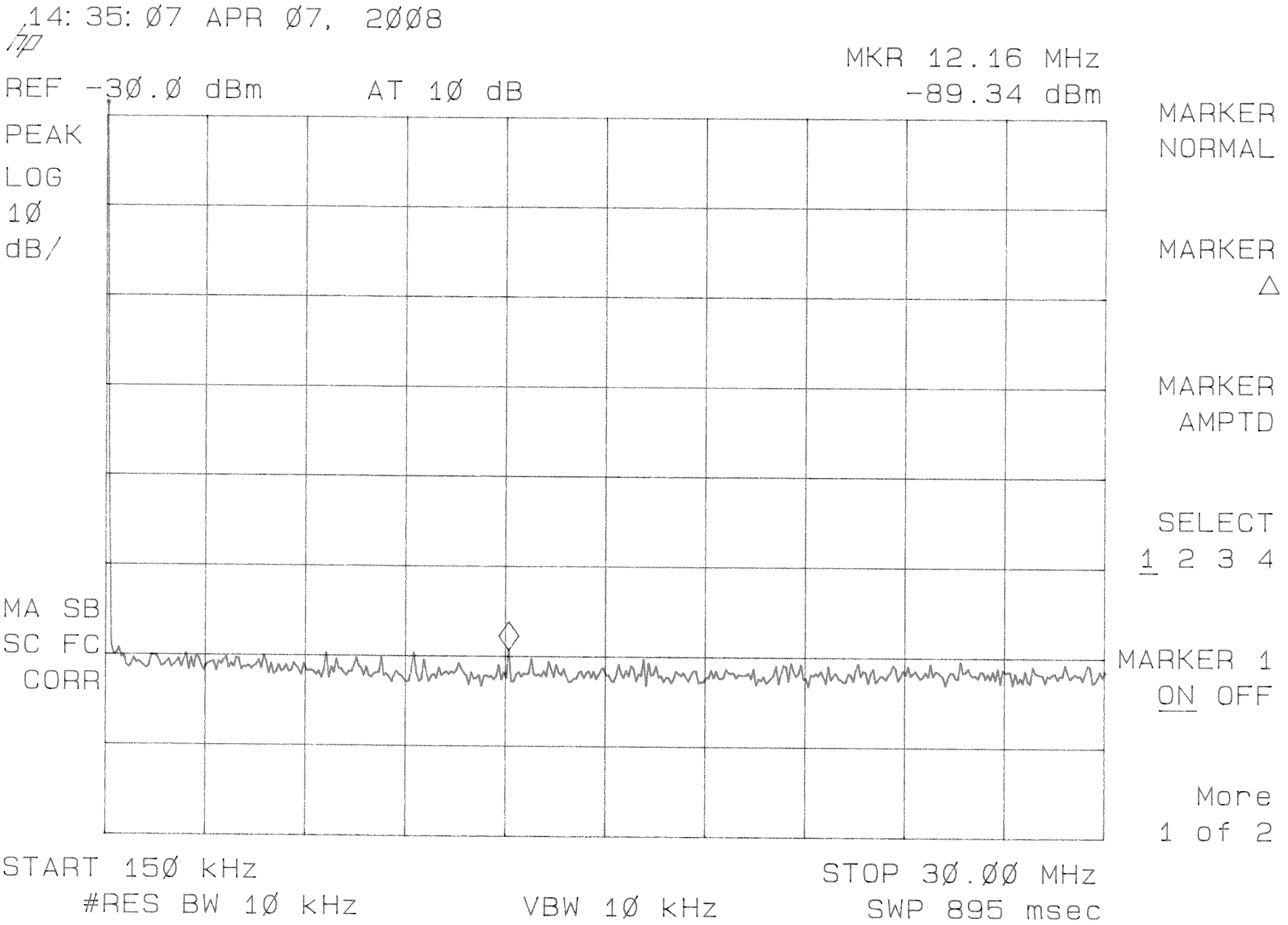

14: 07: 38 APR 07, 2008
MKR 4.100Ø GHz
REF -30.Ø dBm
AT 1Ø dB
-55.93 dBm
PEAK
LOG
1Ø
dB/
MARKER
→ CF
MARKER
△
NEXT
PEAK
NEXT PK
RIGHT
MA SB
SC FC
CORR
NEXT PK
LEFT
More
1 of 2
START 4.ØØØØ GHz
STOP 4.1ØØØ GHz
#RES BW 1.Ø MHz
VBW 3ØØ kHz
SWP 2Ø.Ø msec

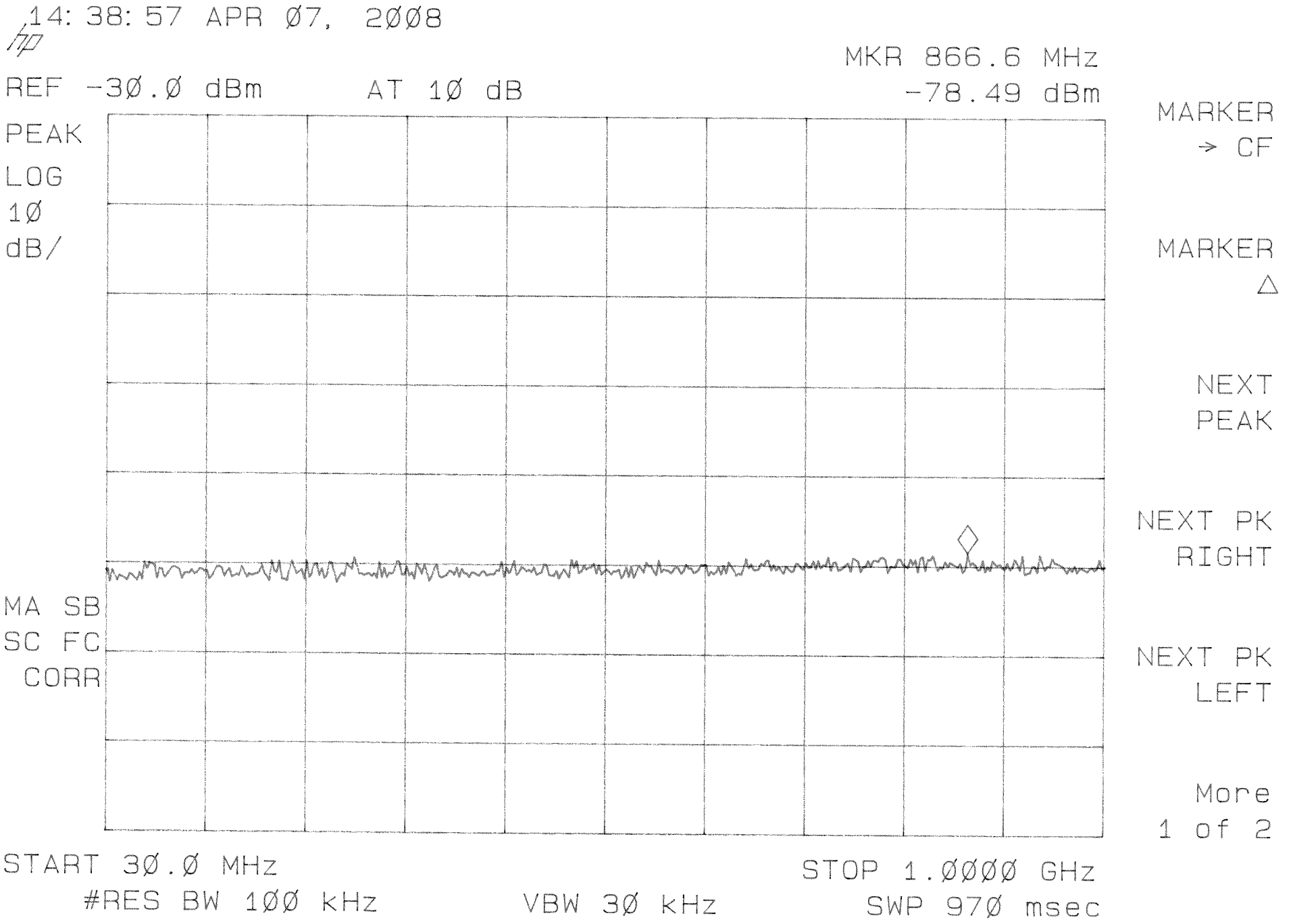

14: 23: 42 APR Ø7, 2ØØ8
MKR 4.5Ø4Ø GHz
-57.12 dBm
REF -3Ø.Ø dBm
AT 1Ø dB
PEAK
LOG
1Ø
dB/
MARKER
→ CF
MARKER
△
NEXT
PEAK
NEXT PK
RIGHT
NEXT PK
LEFT
More
1 of 2
MA SB
SC FC
CORR
START 4.5ØØØ GHz
#RES BW 1.Ø MHz
VBW 3ØØ kHz
STOP 4.6ØØØ GHz
SWP 2Ø.Ø msec

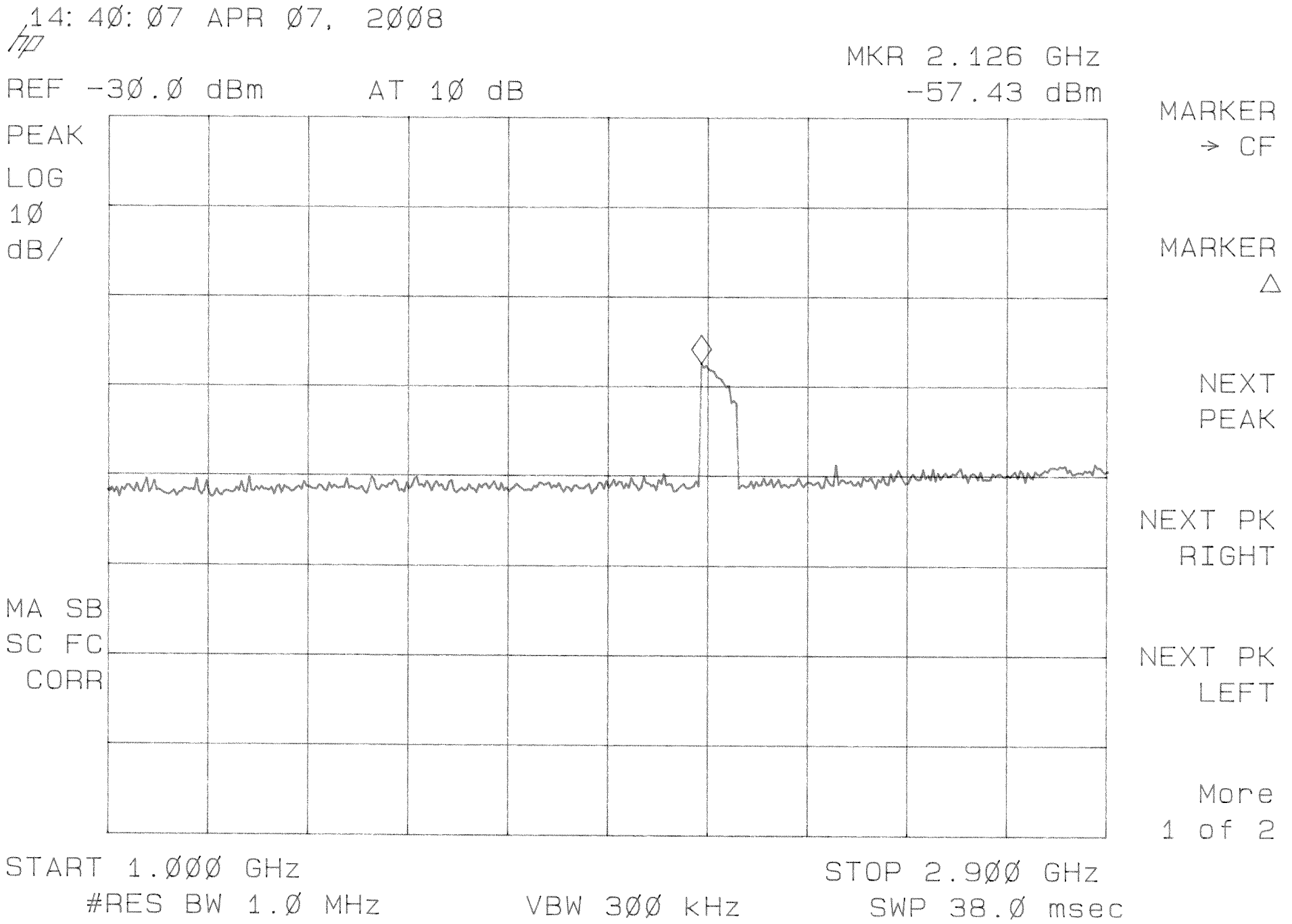

14: 25: 26 APR Ø7, 2ØØ8
MKR 4.6953 GHz
-68.46 dBm
REF -3Ø.Ø dBm
AT 1Ø dB
PEAK
LOG
1Ø
dB/
MARKER
→ CF
MARKER
△
NEXT
PEAK
NEXT PK
RIGHT
MA SB
SC FC
CORR
NEXT PK
LEFT
More
1 of 2
START 4.6ØØØ GHz
STOP 4.7ØØØ GHz
#RES BW 1.Ø MHz
VBW 3ØØ kHz
SWP 2Ø.Ø msec

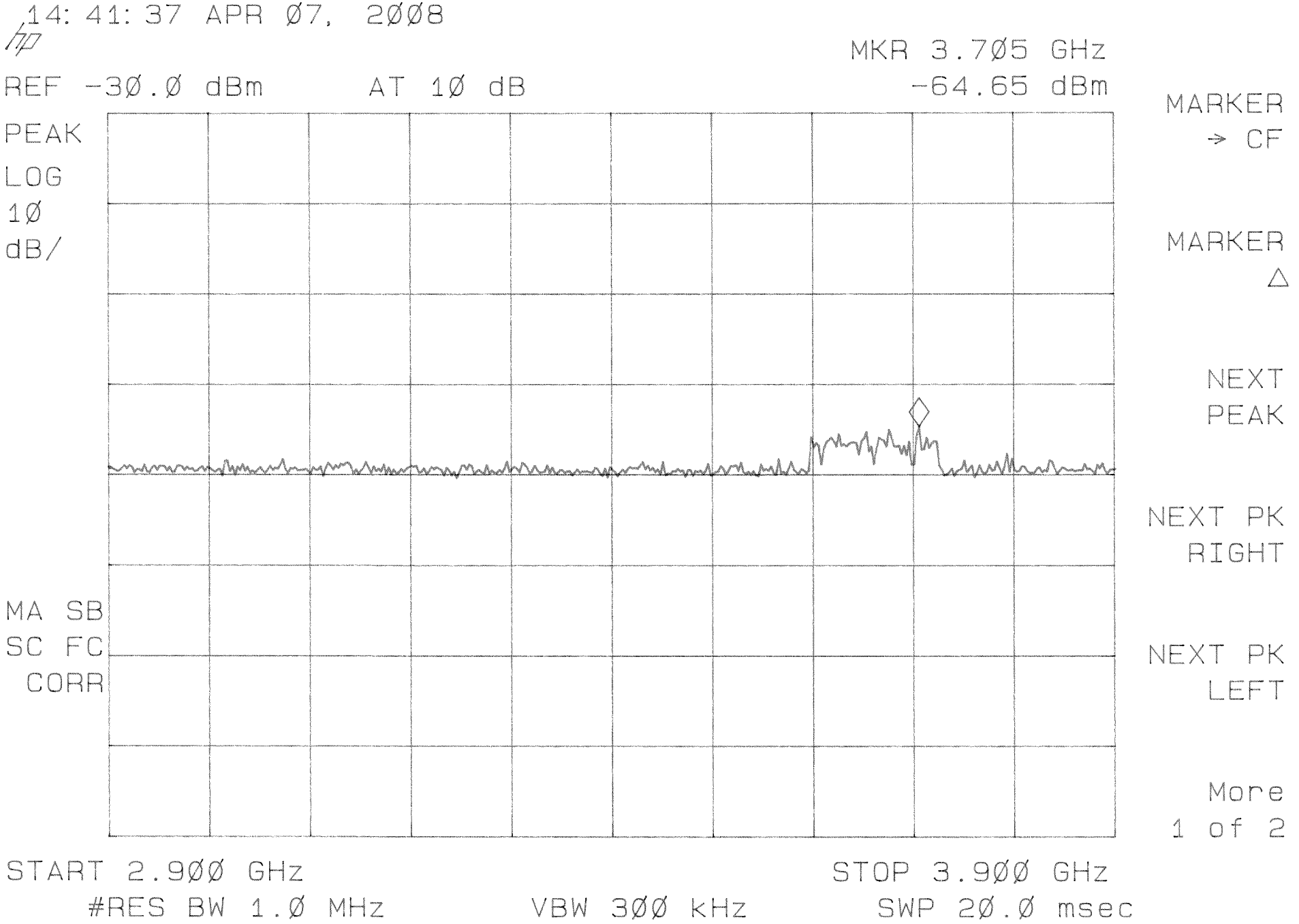
Spurious Emission

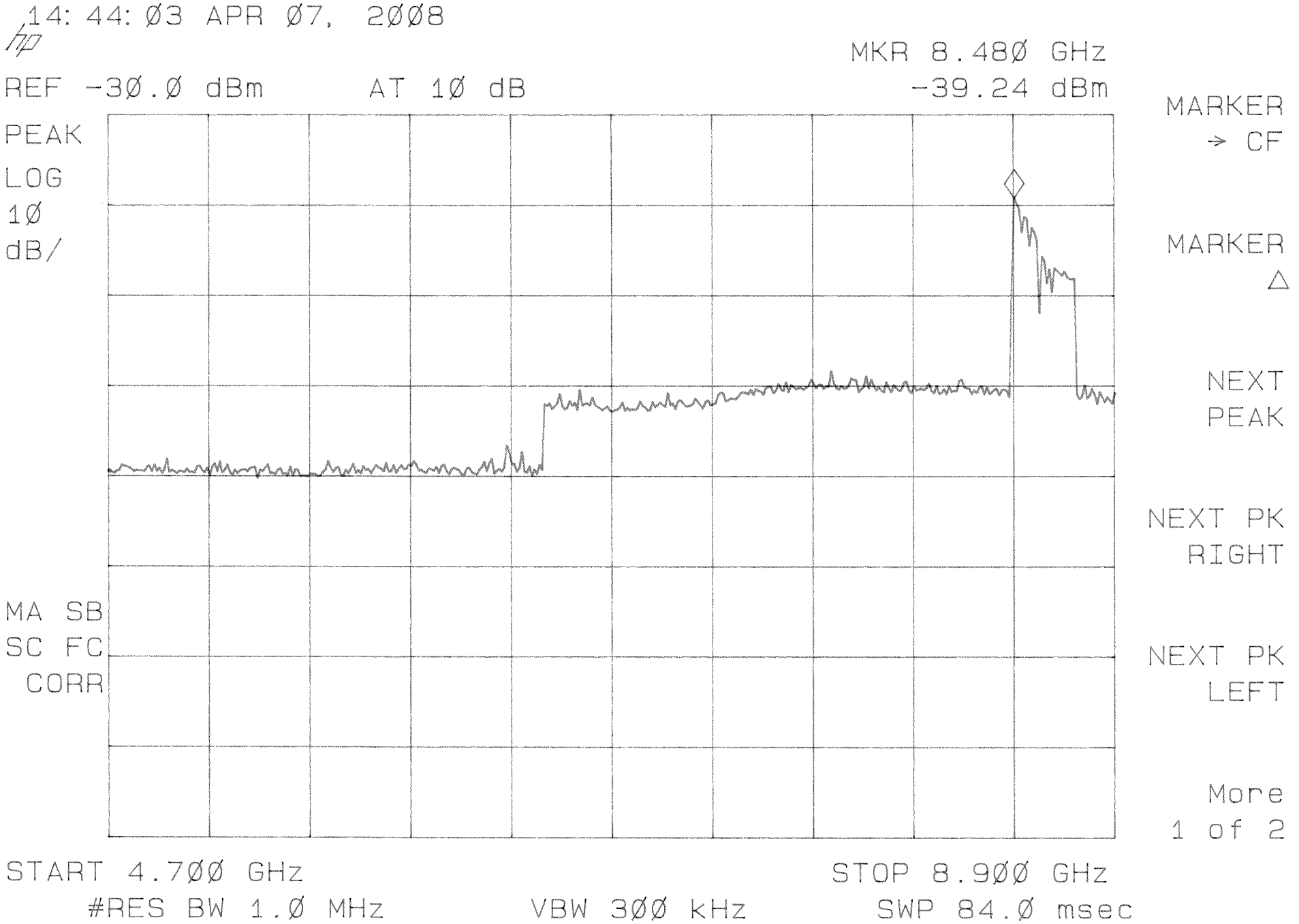

14: 26: 59 APR Ø7, 2ØØ8
MKR 9.Ø kHz
REF -3Ø.Ø dBm
AT 1Ø dB
-69.34 dBm
PEAK
LOG
1Ø
dB/
MARKER
→ CF
MARKER
△
NEXT
PEAK
NEXT PK
RIGHT
MA SB
SC FC
CORR
NEXT PK
LEFT
More
1 of 2
START 9.Ø kHz
STOP 15Ø.Ø kHz
#RES BW 1.Ø kHz
VBW 1 kHz
SWP 423 msec

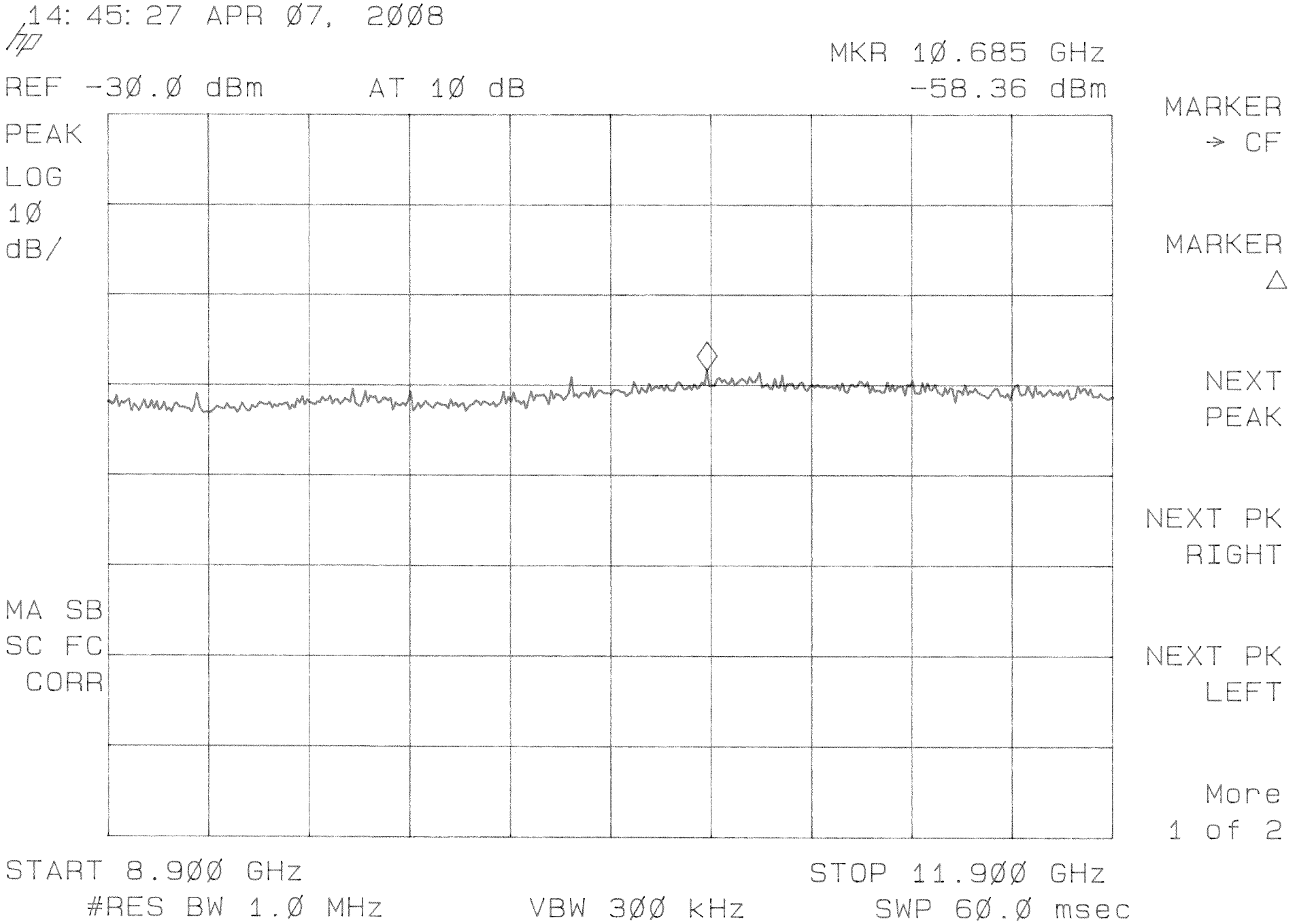

14: 35: Ø7 APR Ø7, 2ØØ8
MKR 12.16 MHz
-89.34 dBm
REF -3Ø.Ø dBm
AT 1Ø dB
PEAK
LOG
1Ø
dB/
MARKER
NORMAL
MARKER
△
MARKER
AMPTD
SELECT
1 2 3 4
MA SB
SC FC
CORR
MARKER 1
ON OFF
More
1 of 2
START 15Ø kHz
#RES BW 1Ø kHz
VBW 1Ø kHz
STOP 3Ø.ØØ MHz
SWP 895 msec

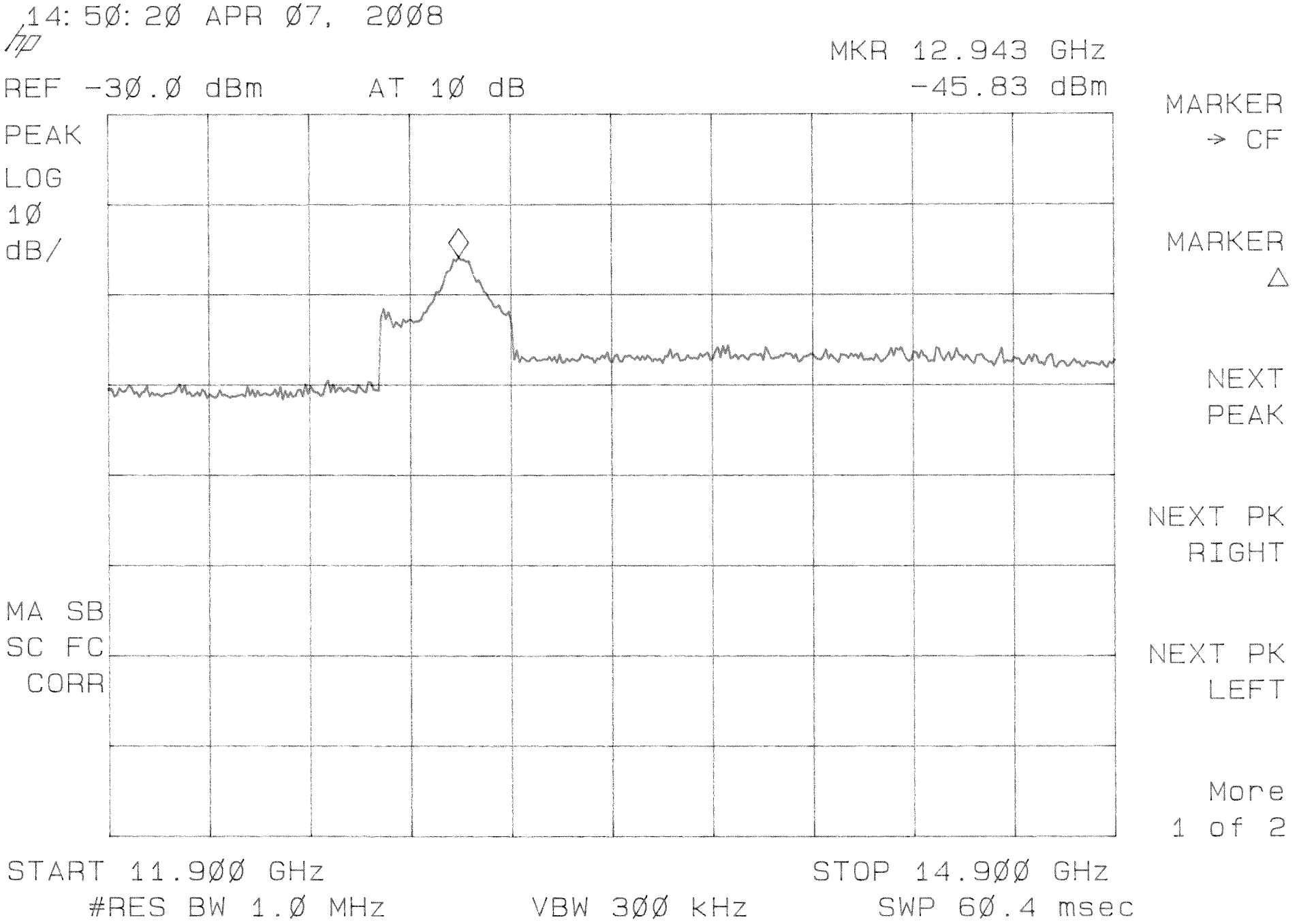

14: 38: 57 APR Ø7, 2ØØ8
MKR 866.6 MHz
REF -3Ø.Ø dBm
AT 1Ø dB
-78.49 dBm
PEAK
LOG
1Ø
dB/
MARKER
→ CF
MARKER
△
NEXT
PEAK
NEXT PK
RIGHT
MA SB
SC FC
CORR
NEXT PK
LEFT
More
1 of 2
START 3Ø.Ø MHz
STOP 1.ØØØØ GHz
#RES BW 1ØØ kHz
VBW 3Ø kHz
SWP 97Ø msec

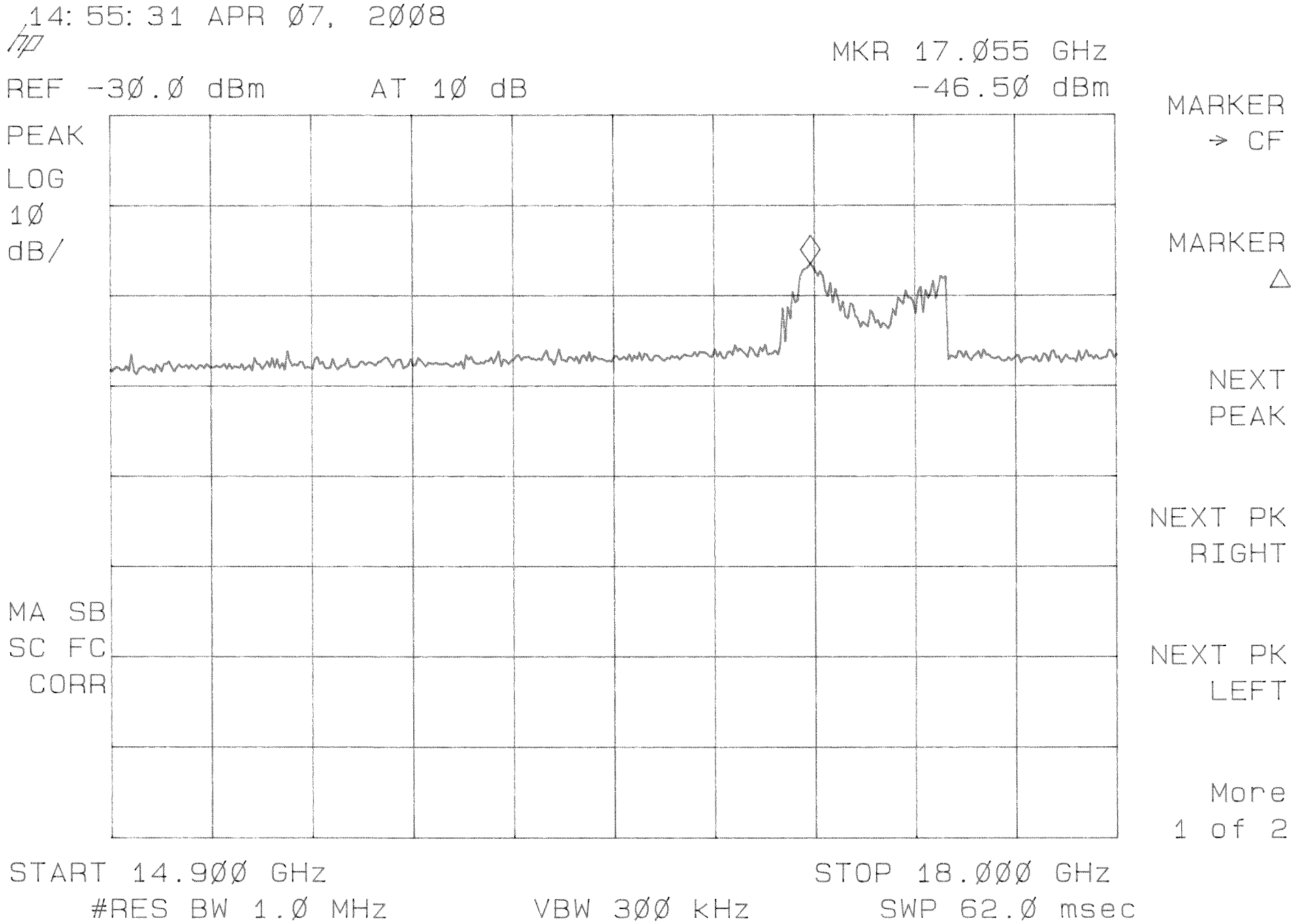

14: 4Ø: Ø7 APR Ø7, 2ØØ8
MKR 2.126 GHz
-57.43 dBm
REF -3Ø.Ø dBm
AT 1Ø dB
PEAK
LOG
1Ø
dB/
MARKER
→ CF
MARKER
△
NEXT
PEAK
NEXT PK
RIGHT
NEXT PK
LEFT
More
1 of 2
MA SB
SC FC
CORR
START 1.ØØØ GHz
#RES BW 1.Ø MHz
VBW 3ØØ kHz
STOP 2.9ØØ GHz
SWP 38.Ø msec

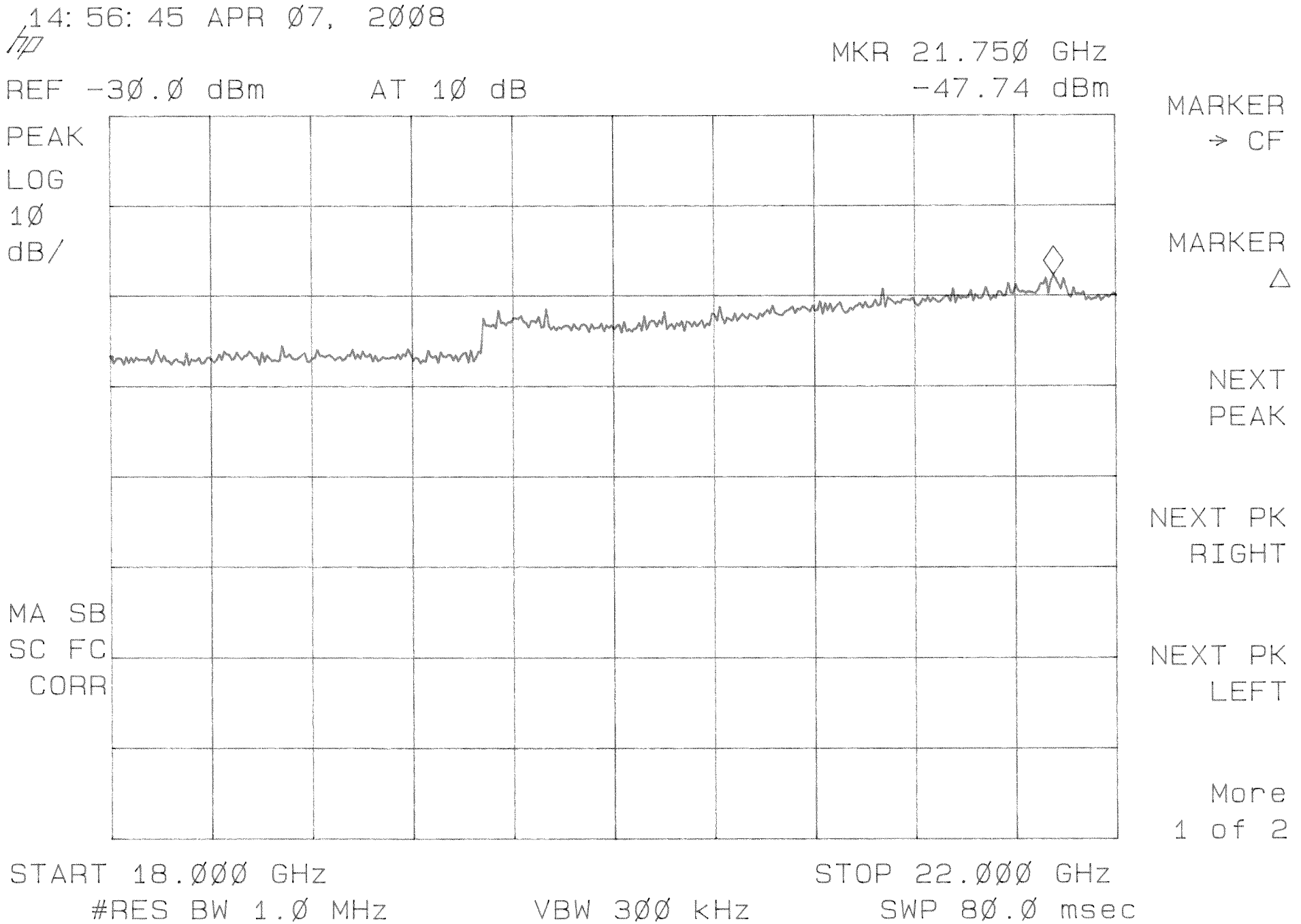

14: 41: 37 APR Ø7, 2ØØ8
MKR 3.7Ø5 GHz
REF -3Ø.Ø dBm
AT 1Ø dB
-64.65 dBm
PEAK
LOG
1Ø
dB/
MARKER
→ CF
MARKER
△
NEXT
PEAK
NEXT PK
RIGHT
MA SB
SC FC
CORR
NEXT PK
LEFT
More
1 of 2
START 2.9ØØ GHz
STOP 3.9ØØ GHz
#RES BW 1.Ø MHz
VBW 3ØØ kHz
SWP 2Ø.Ø msec

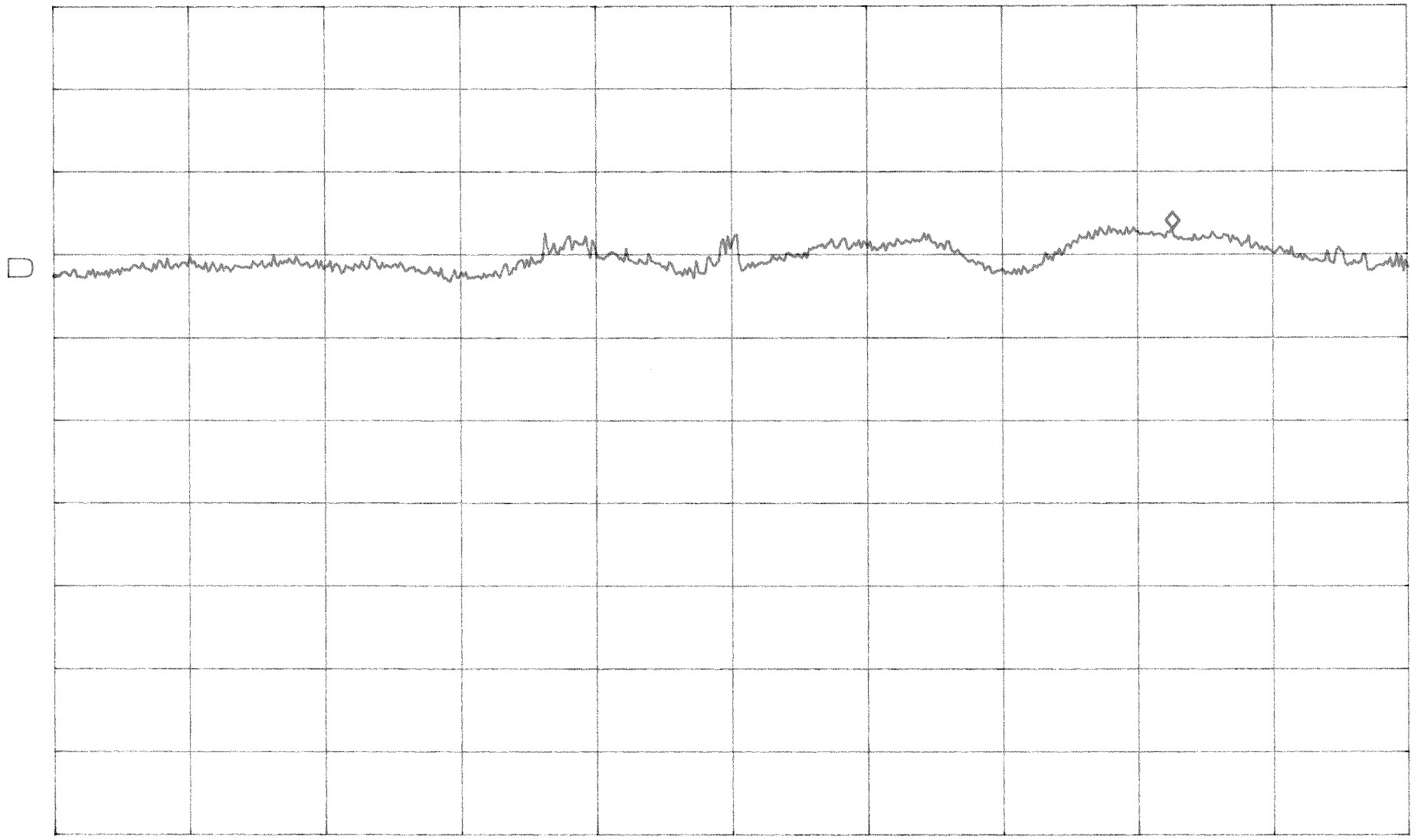

14: 44: Ø3 APR Ø7, 2ØØ8
MKR 8.48Ø GHz
REF -3Ø.Ø dBm
AT 1Ø dB
-39.24 dBm
PEAK
LOG
1Ø
dB/
MARKER
→ CF
MARKER
△
NEXT
PEAK
NEXT PK
RIGHT
MA SB
SC FC
CORR
NEXT PK
LEFT
More
1 of 2
START 4.7ØØ GHz
STOP 8.9ØØ GHz
#RES BW 1.Ø MHz
VBW 3ØØ kHz
SWP 84.Ø msec

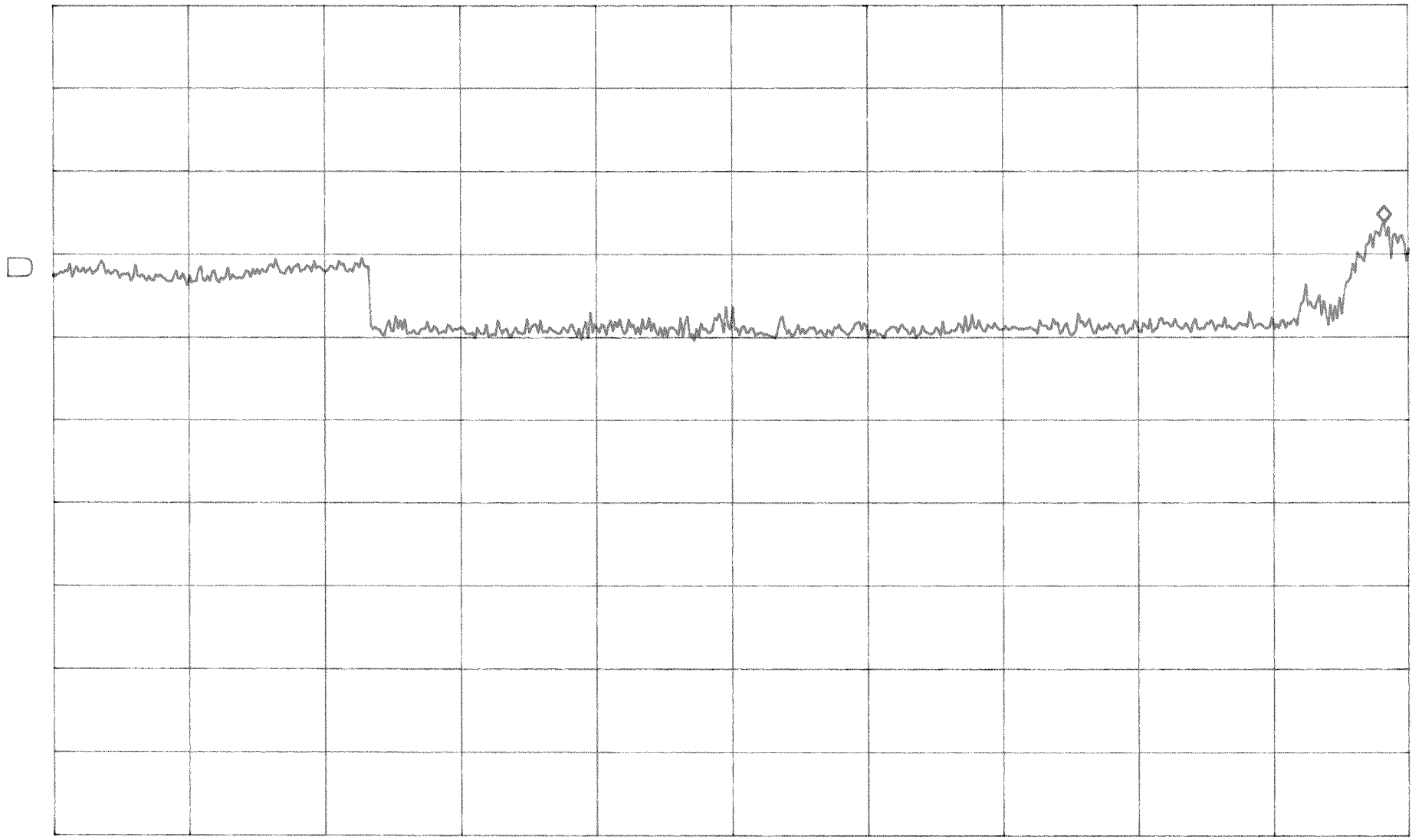

14: 45: 27 APR Ø7, 2ØØ8
MKR 1Ø.685 GHz
REF -3Ø.Ø dBm
AT 1Ø dB
-58.36 dBm
PEAK
LOG
1Ø
dB/
MARKER
→ CF
MARKER
△
NEXT
PEAK
NEXT PK
RIGHT
MA SB
SC FC
CORR
NEXT PK
LEFT
More
1 of 2
START 8.9ØØ GHz
STOP 11.9ØØ GHz
#RES BW 1.Ø MHz
VBW 3ØØ kHz
SWP 6Ø.Ø msec

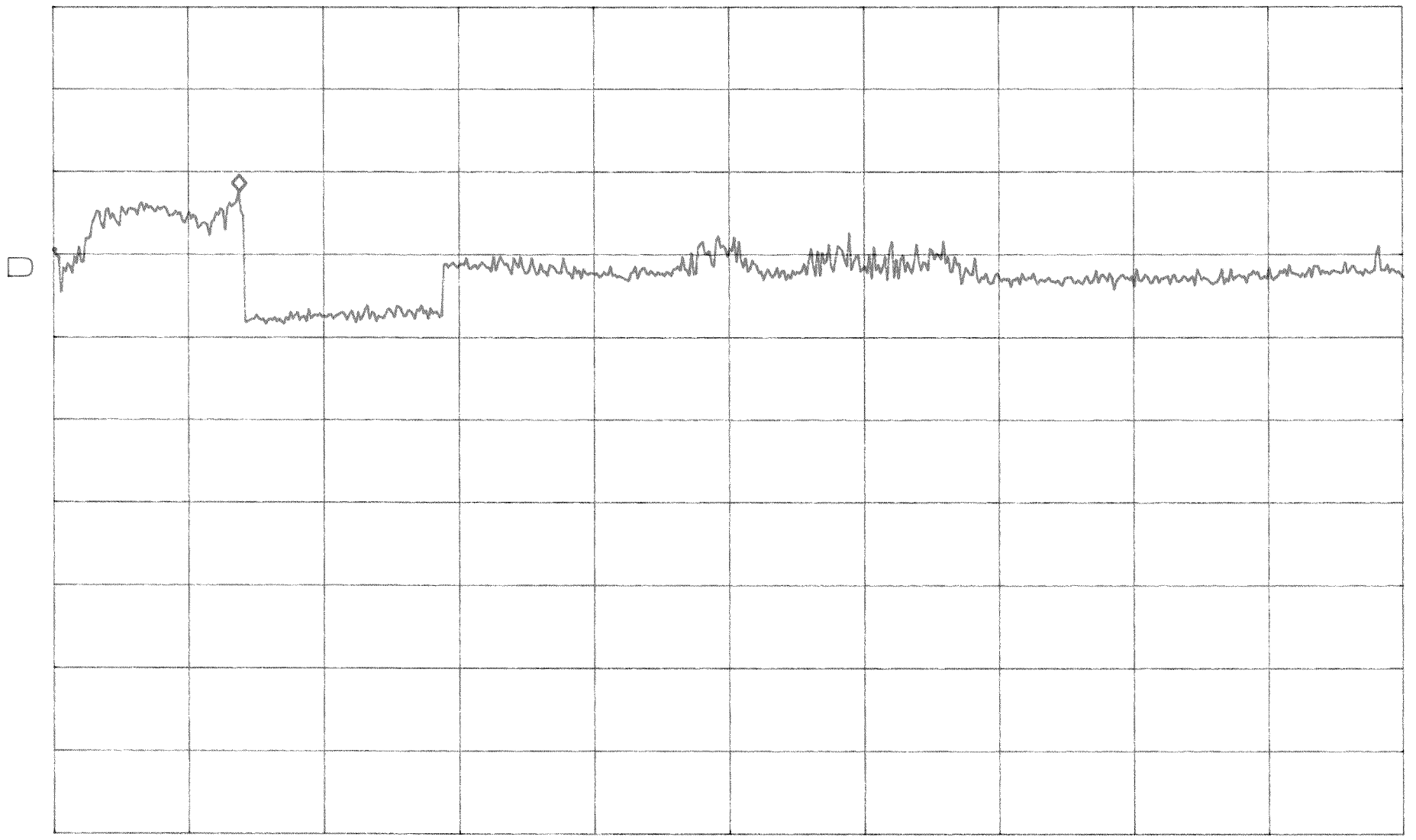

14: 5Ø: 2Ø APR Ø7, 2ØØ8
MKR 12.943 GHz
-45.83 dBm
REF -3Ø.Ø dBm
AT 1Ø dB
PEAK
LOG
1Ø
dB/
MARKER
→ CF
MARKER
△
NEXT
PEAK
NEXT PK
RIGHT
MA SB
SC FC
CORR
NEXT PK
LEFT
More
1 of 2
START 11.9ØØ GHz
STOP 14.9ØØ GHz
#RES BW 1.Ø MHz
VBW 3ØØ kHz
SWP 6Ø.4 msec

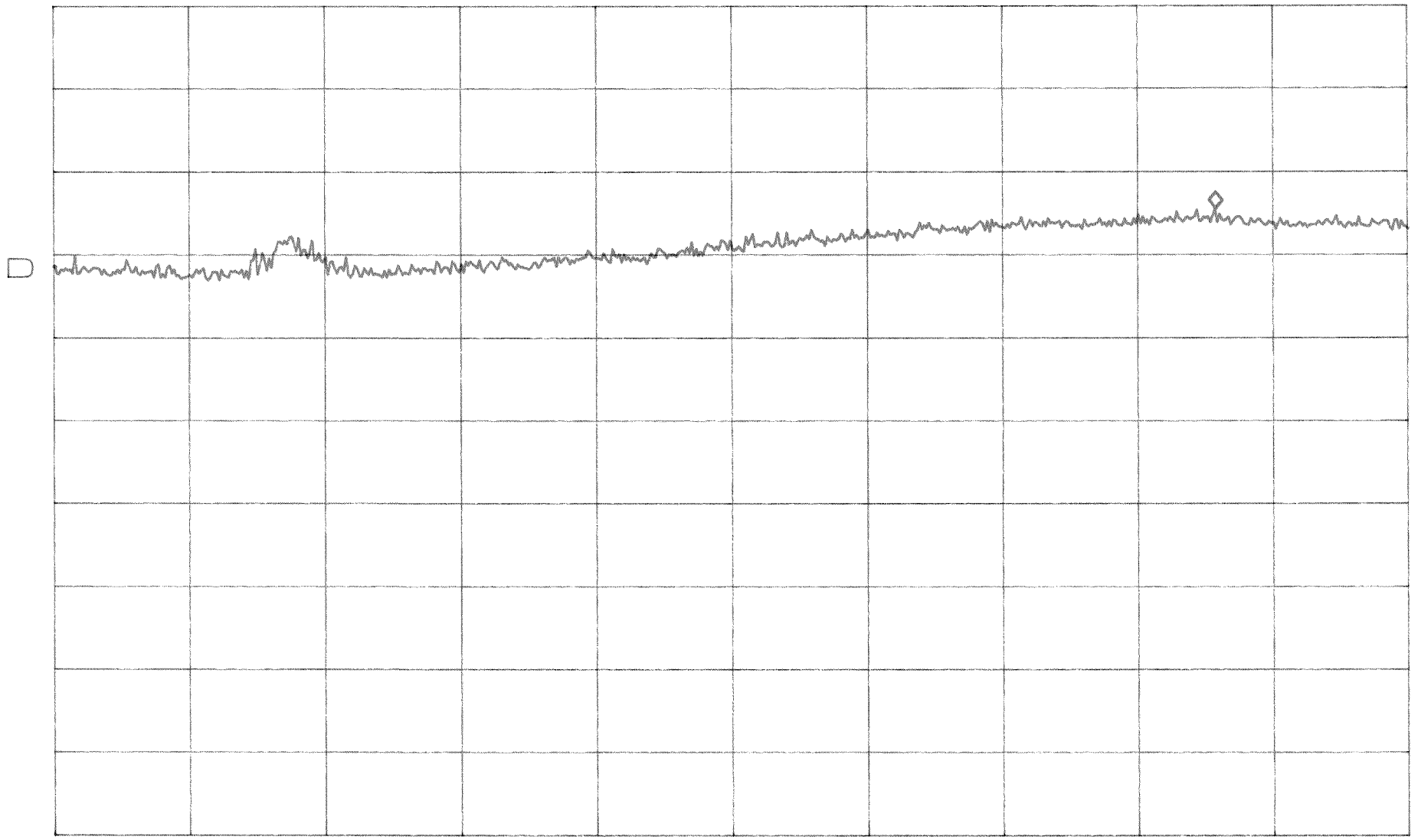

14: 55: 31 APR Ø7, 2ØØ8
MKR 17.Ø55 GHz
-46.5Ø dBm
REF -3Ø.Ø dBm
AT 1Ø dB
PEAK
LOG
1Ø
dB/
MARKER
→ CF
MARKER
△
NEXT
PEAK
NEXT PK
RIGHT
NEXT PK
LEFT
More
1 of 2
MA SB
SC FC
CORR
START 14.9ØØ GHz
STOP 18.ØØØ GHz
#RES BW 1.Ø MHz
VBW 3ØØ kHz
SWP 62.Ø msec

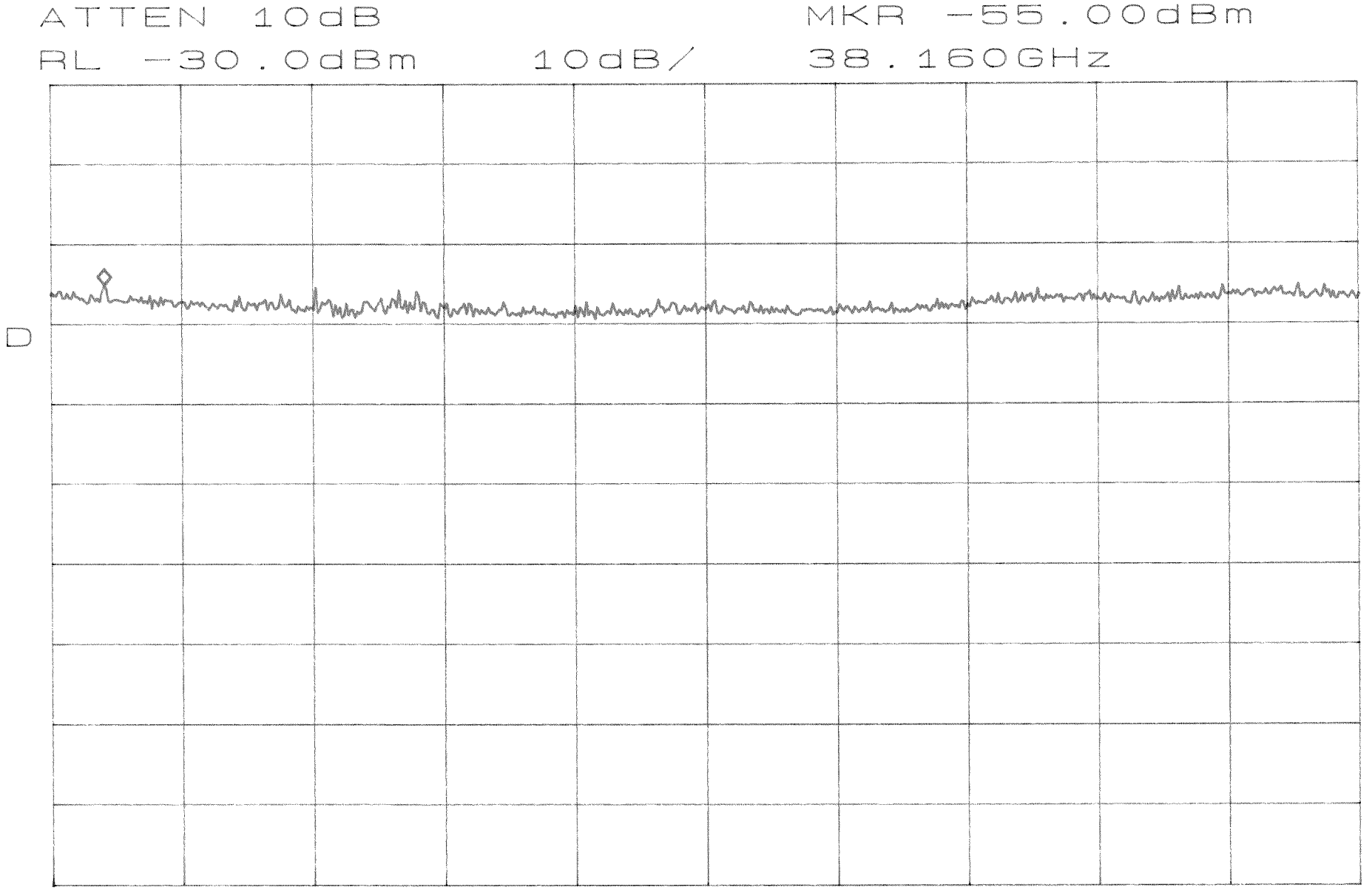

14: 56: 45 APR Ø7, 2ØØ8
MKR 21.75Ø GHz
-47.74 dBm
REF -3Ø.Ø dBm
AT 1Ø dB
PEAK
LOG
1Ø
dB/
MARKER
→ CF
MARKER
△
NEXT
PEAK
NEXT PK
RIGHT
NEXT PK
LEFT
More
1 of 2
MA SB
SC FC
CORR
START 18.ØØØ GHz
STOP 22.ØØØ GHz
#RES BW 1.Ø MHz
VBW 3ØØ kHz
SWP 8Ø.Ø msec

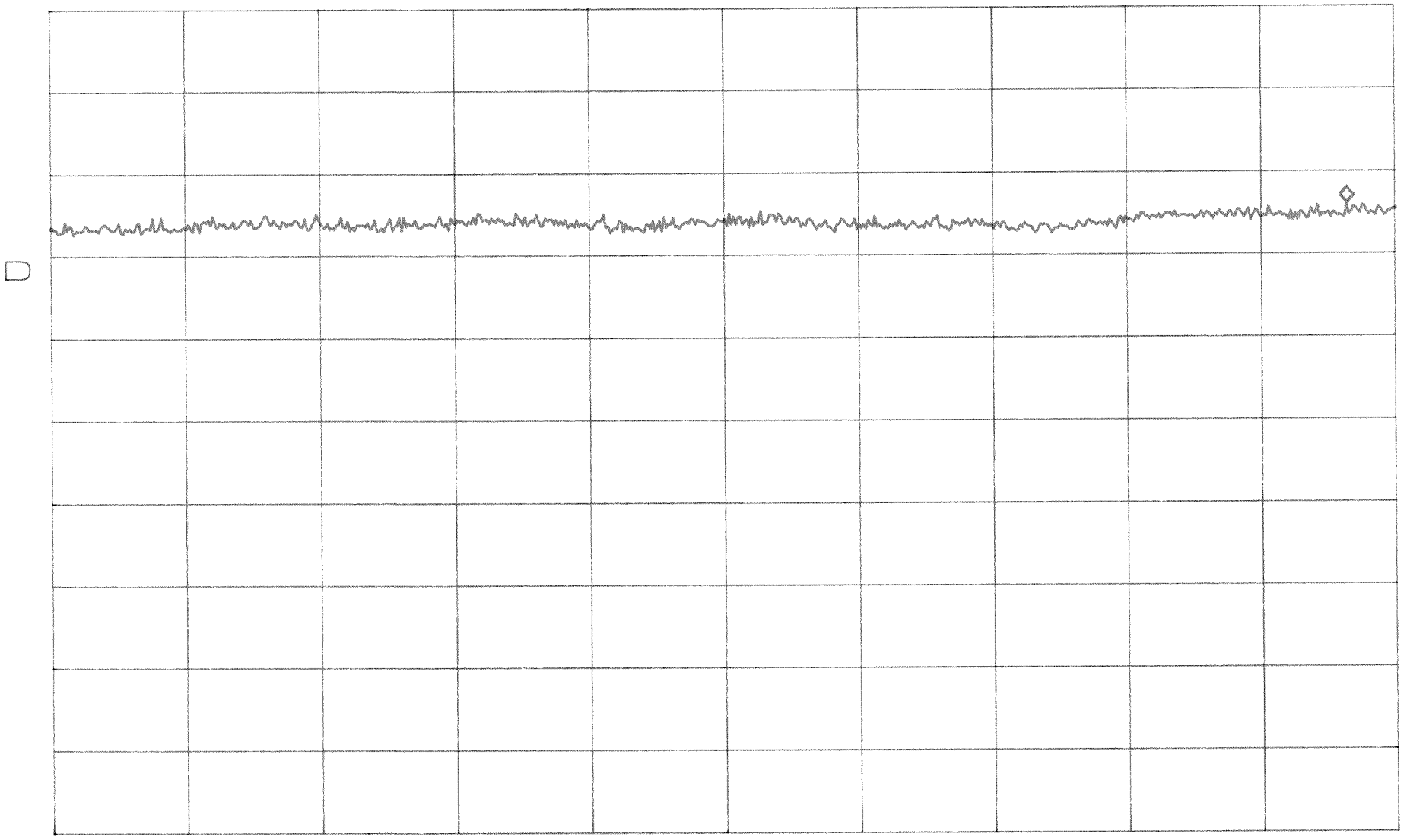

ATTEN 10dB
MKR -56.83dBm
RL -30.0dBm
10dB/
25.300GHz
D
START 22.000GHz
STOP 26.000GHz
*RBW 1.0MHz
VBW 1.0MHz
SWP 80.0ms

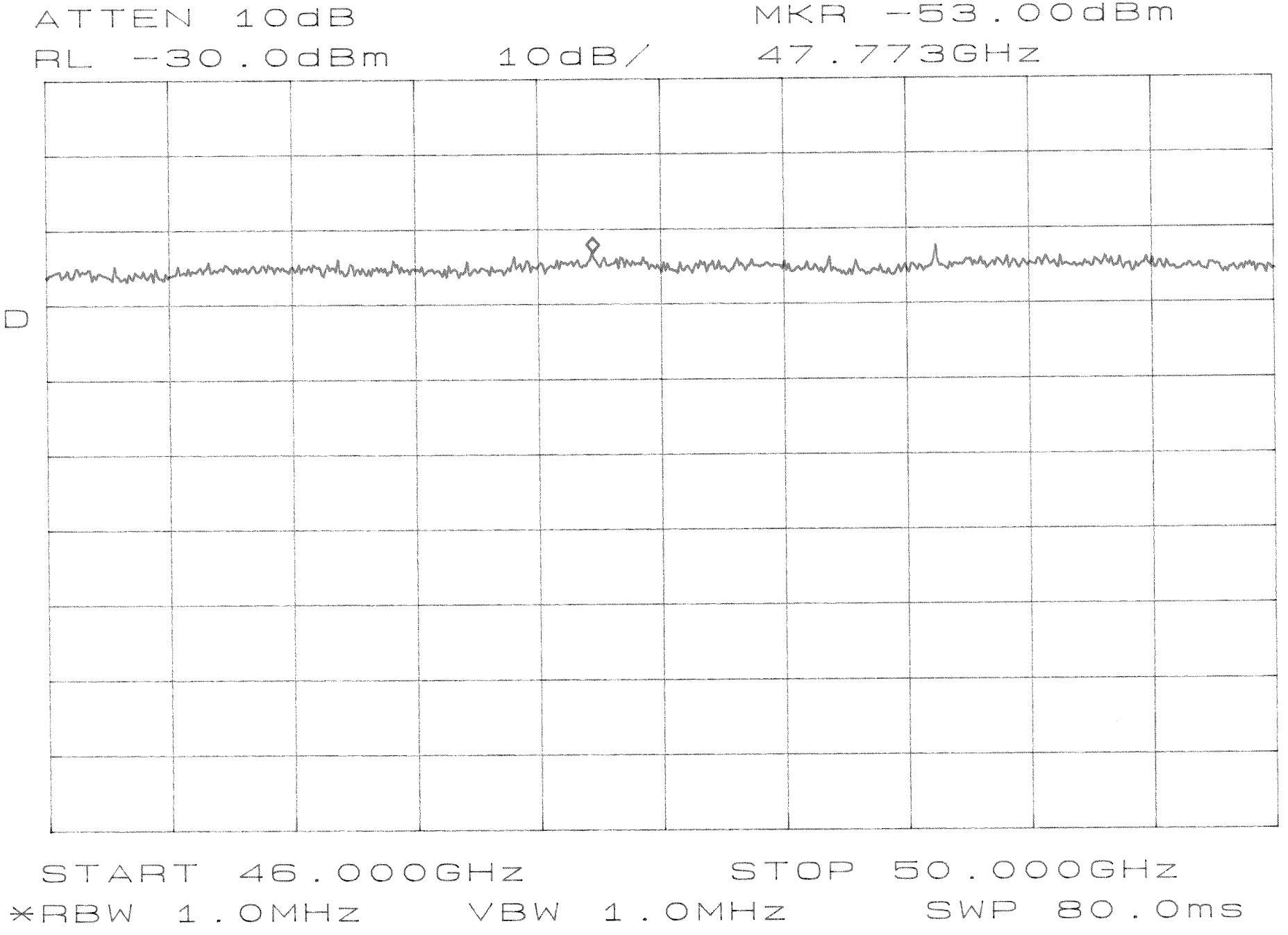

ATTEN 10dB
MKR -56.17dBm
RL -30.0dBm
10dB/
29.927GHz
D
START 26.000GHz
STOP 30.000GHz
*RBW 1.0MHz
VBW 1.0MHz
SWP 80.0ms


ATTEN 10dB
MKR -52.33dBm
RL -30.0dBm
10dB/
30.547GHz
D
START 30.000GHz
STOP 34.000GHz
*RBW 1.0MHz
VBW 1.0MHz
SWP 80.0ms


ATTEN 10dB
MKR -54.33dBm
RL -30.0dBm
10dB/
37.427GHz
D
START 34.000GHz
STOP 38.000GHz
*RBW 1.0MHz
VBW 1.0MHz
SWP 80.0ms


ATTEN 10dB
MKR -55.00dBm
RL -30.0dBm
10dB/
38.160GHz
D
START 38.000GHz
STOP 42.000GHz
*RBW 1.0MHz
VBW 1.0MHz
SWP 80.0ms


ATTEN 10dB
MKR -53.83dBm
RL -30.0dBm
10dB/
45.853GHz
D
START 42.000GHz
STOP 46.000GHz
*RBW 1.0MHz
VBW 1.0MHz
SWP 80.0ms


ATTEN 10dB
MKR -53.00dBm
RL -30.0dBm
10dB/
47.773GHz
D
START 46.000GHz
STOP 50.000GHz
*RBW 1.0MHz
VBW 1.0MHz
SWP 80.0ms