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Attack and Release Characteristics of Compression Hearing Aids

Edwin D. Burnett and Martin A. Bassin

Institute for Basic Standards
National Bureau of Standards
Washington, D. C. 20234

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Department of Medicine and Surgery
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U.S. DEPARTMENT OF COMMERCE, Elliot L. Richardson, *Secretary*

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ABSTRACT

The attack and release time characteristics of 81 compression hearing aids are presented. The input signal used was that specified in the standard, ANSI S3.22.

INTRODUCTION

The attack and release time characteristics of compression hearing aids were recorded by NBS and incorporated for the first time as part of the regular testing of FY-76 hearing aids for the Veterans Administration. This report describes the method used to obtain the results and presents oscilloscope recordings of the envelopes of the attack and release intervals. The actual attack and release times can be obtained from these recordings using the definitions given in Figure 1.

METHOD

To determine the attack and release times of hearing aids tested by NBS the envelope input signal shown in the top of Figure 1 is used. This is the signal specified in the standard, ANSI S3.22 (1). The carrier frequency of this signal is 2 kHz. The amplitude of the input signal corresponds to a sound pressure level (SPL) of either 55 or 80 dB re 20 μPa. To determine the attack time of the hearing aid the SPL is increased abruptly from a SPL of 55 dB to one of 80 dB. The release time is determined by abruptly reducing the SPL from 80 dB to 55 dB. An idealized envelope of the output signal from the hearing aid is shown in the bottom of Figure 1. Although one burst of the 2 kHz signal shown in the top of Figure 1 would be sufficient for the measurement, in practice it is convenient to have this signal repeat itself a sufficient number of times so that adjustments to signal level into the oscilloscope can be made prior to taking the permanent recording of the output signal. The duration of the signal at each of the two SPLs is not critical; however, it must be somewhat longer than the time required for the hearing aid output to reach steady-state conditions after

the level is changed. A duration of 200 ms for each of the signal levels has been found sufficient for most hearing aids.

To minimize the occurrence of spurious transients in the input signal envelope, the abrupt changes in the levels are made at a time corresponding to a zero voltage crossing of the input carrier signal.

The test is performed in a free field. The hearing aid volume control is turned to its maximum setting and its receiver is coupled to a Zwislocki coupler having a type HA-2 adaptor. This adaptor is used even for high-pass hearing aids which are normally tested for their other characteristics on an open coupler.

The coupler's microphone output voltage is displayed on a large-screen (15 x 20 cm) oscilloscope. A total sweep time of 0.5 seconds is used so that the entire duration of the high and low amplitude portions of the signal are displayed. The vertical amplitude control on the oscilloscope is adjusted so the initial overshoot during the attack portion of the signal goes beyond maximum limits of the screen. This permits one to obtain a recording with higher amplitude resolution for those portions of the signal that are used to determine the attack and release times. A second oscilloscope recording is made usually with a total sweep time of 0.05 seconds, with the amplitude attenuated such that the entire overshoot region can be seen.

On each of the figures depicting the envelope of the output signal of the hearing aid are three labels. The first label indicates the alphanumeric code corresponding to hearing aid manufacturer and model number which are given in Table 1. The second label denotes the total duration in seconds

of the sweep of the horizontal axis. This axis is linear so that half the length of the axis corresponds to half the total duration, and so on. The third label indicates the amount of attenuation of the signal relative to that used to obtain the preceding record of the attack and release portions of the same hearing aid. For some of the hearing aids a number is shown above the high-level portion of the signal. This number is the steady-state output SPL at 2 kHz for an input SPL of 80 dB.

Figures 2 and 3 show the output of the "1/2 inch" reference microphone. The minor irregularities in the steady-state portion of the signal are caused by low frequency acoustic noise. These components do not affect the test results since they fall below the frequency region passed by the hearing aids. Figure 3 shows that a time interval of 3 msec (6 cycles of the 2-kHz signal) is required for the acoustical signal to reach steady-state conditions. The peak value of the first cycle of the high amplitude portion of the signal is approximately 1.75 dB below the steady-state peak value.

REFERENCE

1. ANSI S3.22 (1976), "Specification of Hearing Aid Characteristics," American National Standards Institute, New York, N.Y.

TABLE I

Hearing Aid Codes, Manufacturers, and Models

Code	Manufacturer	Model
AT310-AT312	Audiotone	A24 Compression
DA217-DA219	Dahlberg	HT1233 Compression
DX145-DX147	Danavox	745 AGC
DX148-DX150	Danavox	745 DAGC
DY001-DY003	Dynatone	500 P
FI229-FI231	Fidelity	F34
FI232-FI234	Fidelity	F52Bicros
FI238-FI240	Fidelity	F58D
HC019-HC021	HC Electronics	HC527LW
HC022-HC024	HC Electronics	HC527SEW
HC025-HC027	HC Electronics	HC801AGC
LE127-LE129	Lehr	Star 6DRC
NO166-NO168	Norelco	HP8234AGC
NO172-NO174	Norelco	HP8274 Lim, Time, TC
OI214-OI216	Oticon	E14C
QU259-QU261	Qualitone	CNE
RA256-RA258	Radioear	1063
SI157-SI159	Siemens	24PP-AGC-I
ST004-ST007	Starkey	4112
TE301-TE303	Telex	336DC
UN001-UN003	Unitron	295T
UN007-UN009	Unitron	695H
UN013-UN015	Viennatone	88AMA-D
UN019-UN021	Viennatone	90/AOC-PC
WI109-WI111	Widex	A1T
WI121-WI123	Widex	A6T
ZE307-ZE310	Zenith	Command 100D

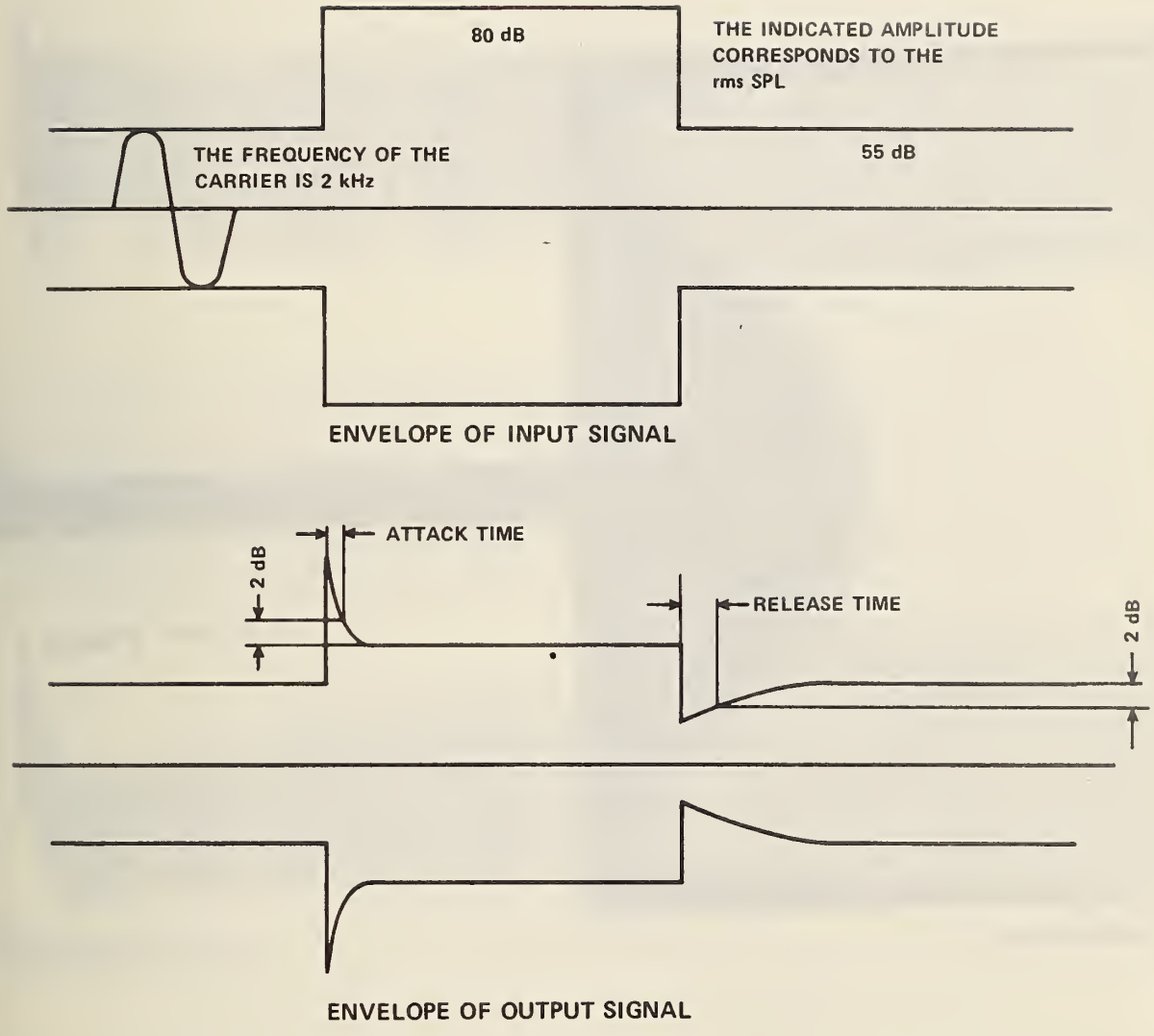


Fig. 1. Idealized envelopes of hearing aid input and output signals.

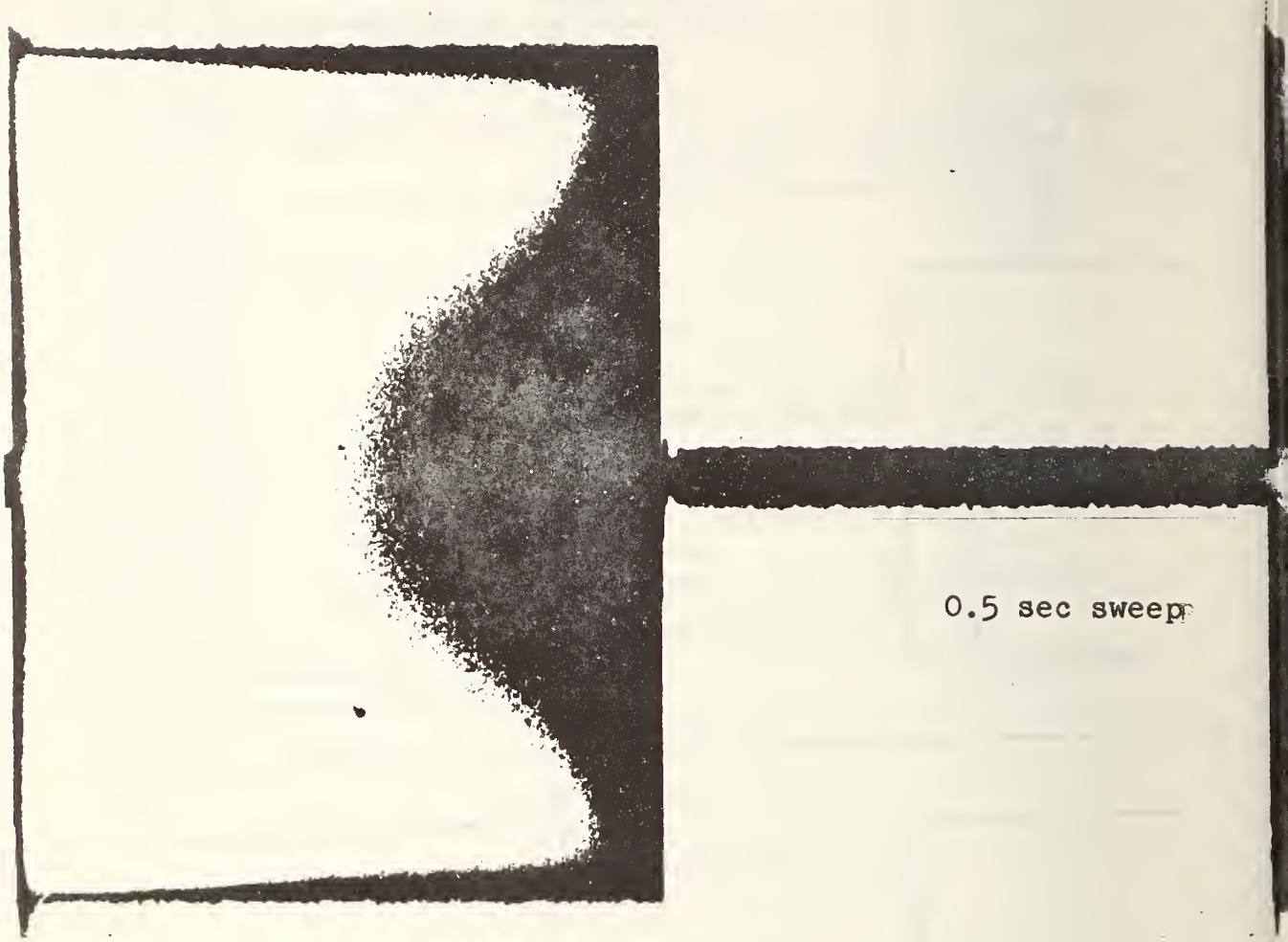


Fig 2 Voltage output from the reference microphone.

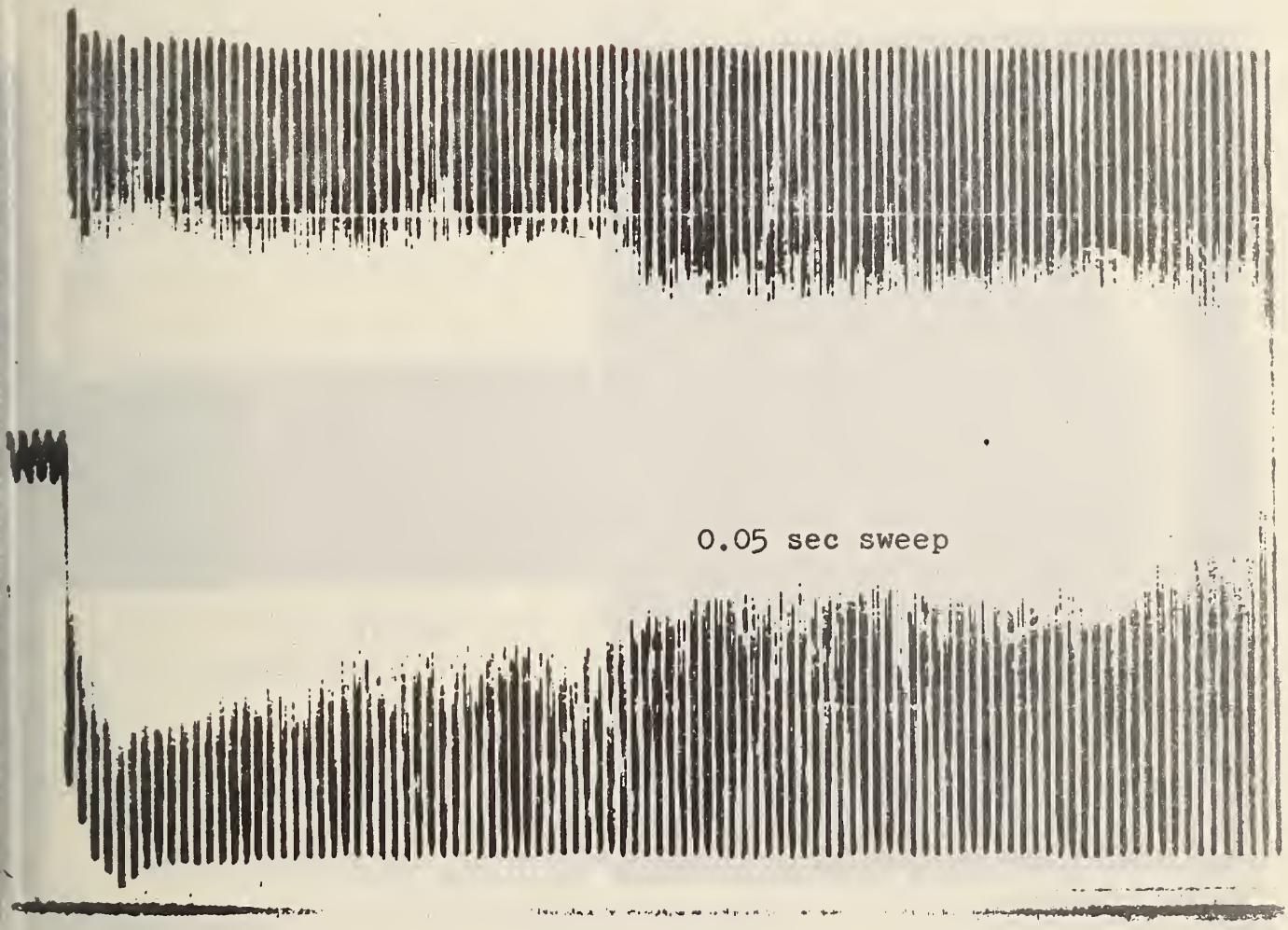
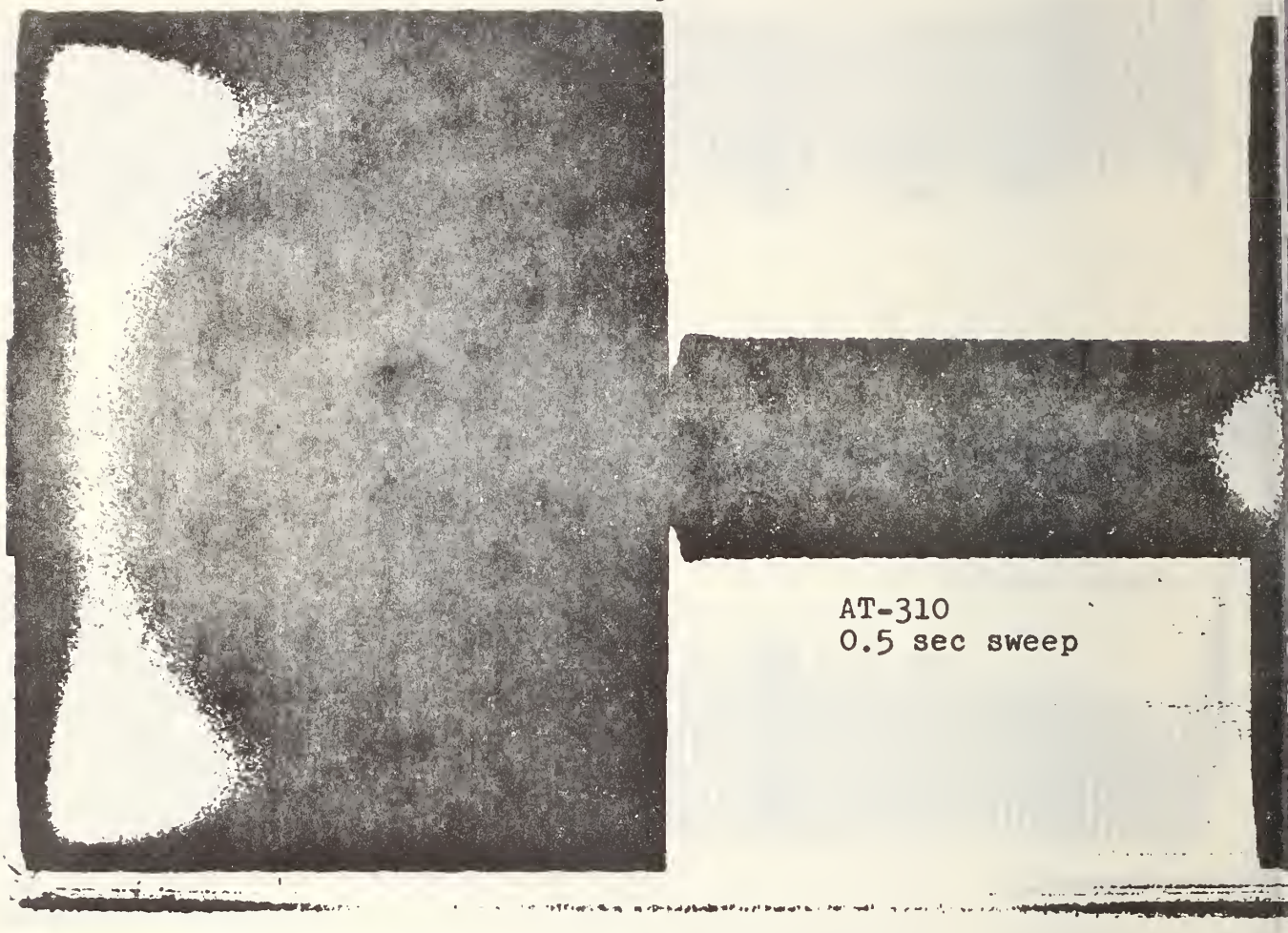


Fig. 3 Voltage output from the reference microphone viewed with an expanded time scale.

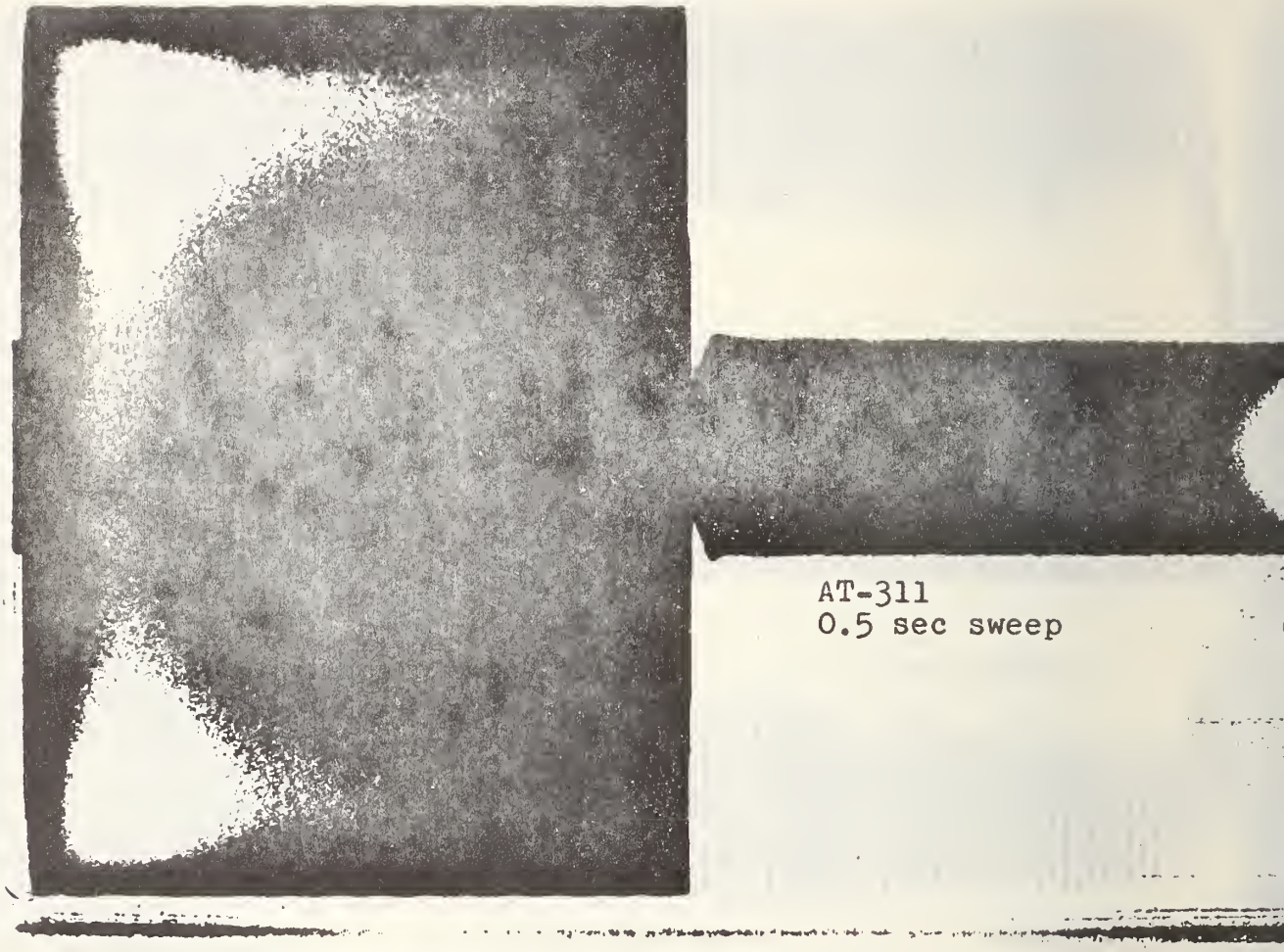
116.5



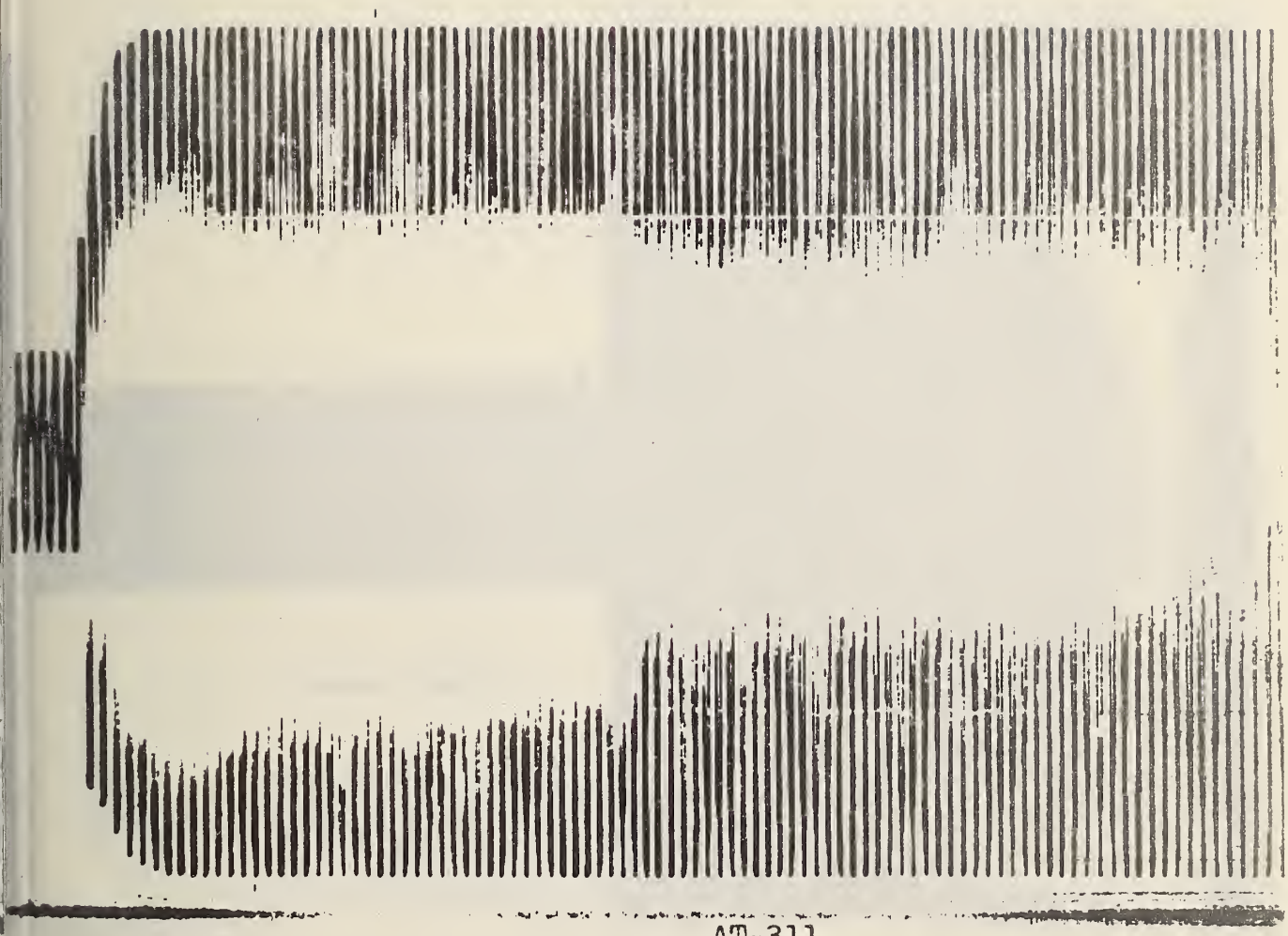
AT-310
0.5 sec sweep

AT-310
0.05 sec sweep
0 dB

116.5

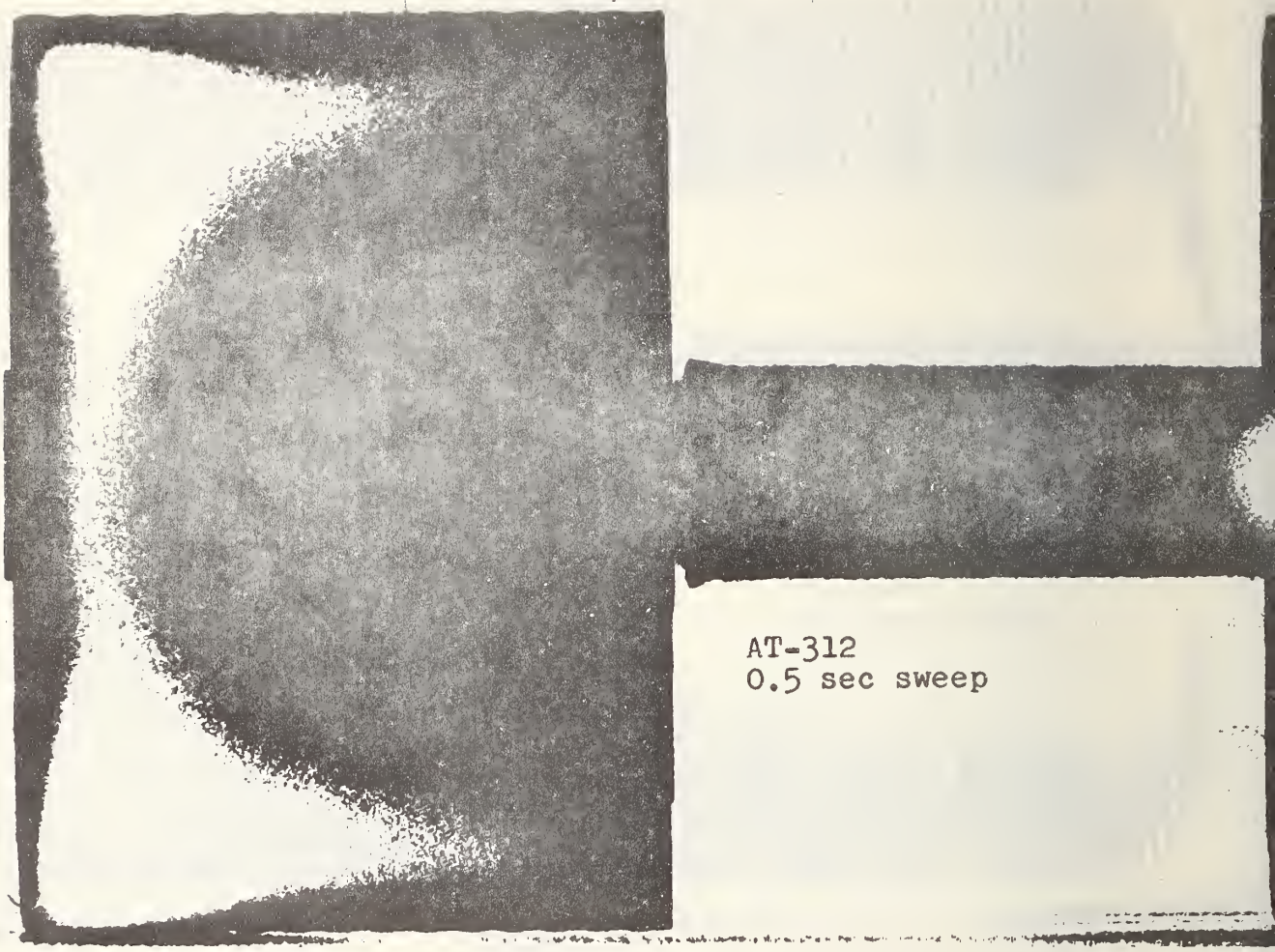


AT-311
0.5 sec sweep



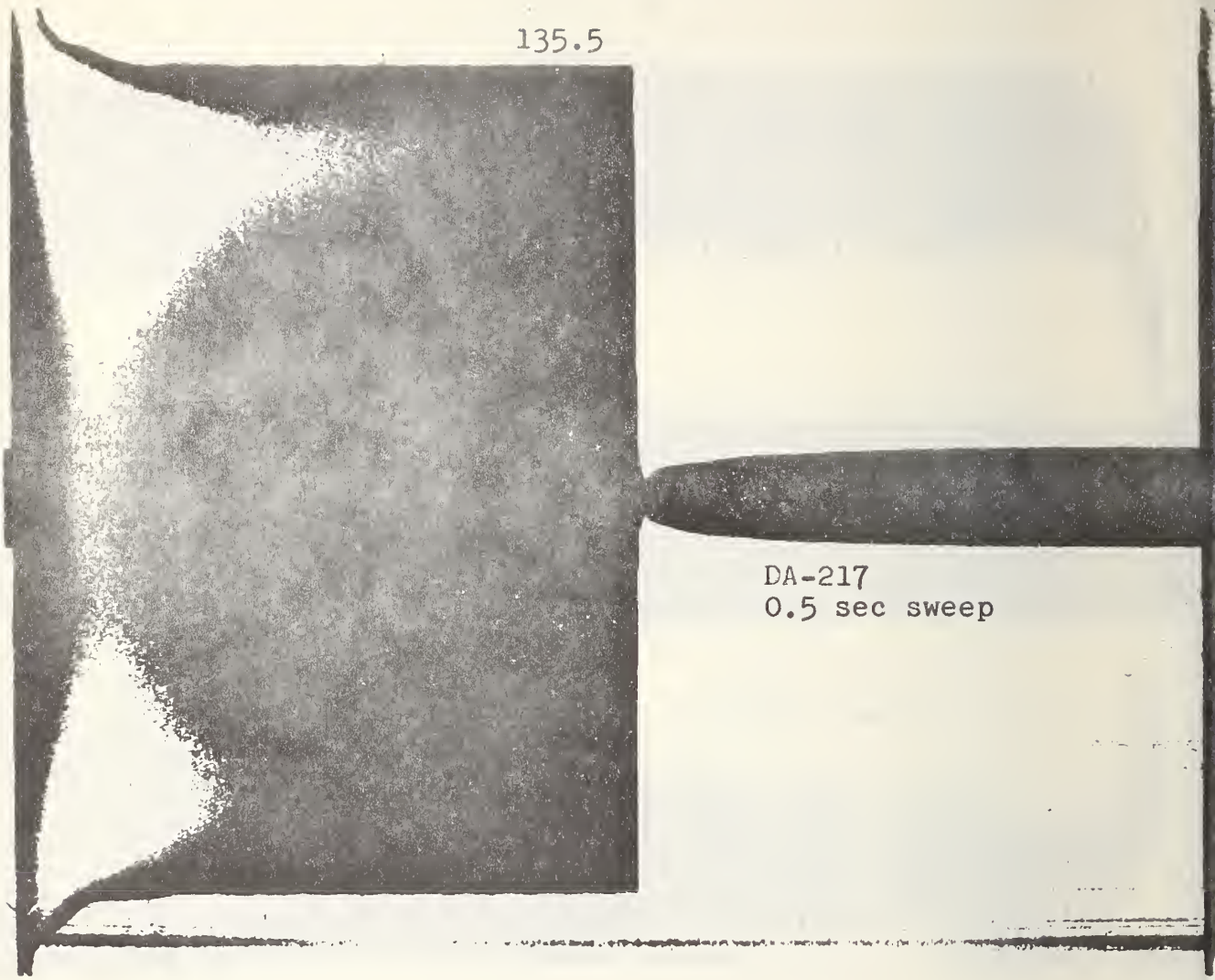
AT-311
0.05 sec sweep
0 dB

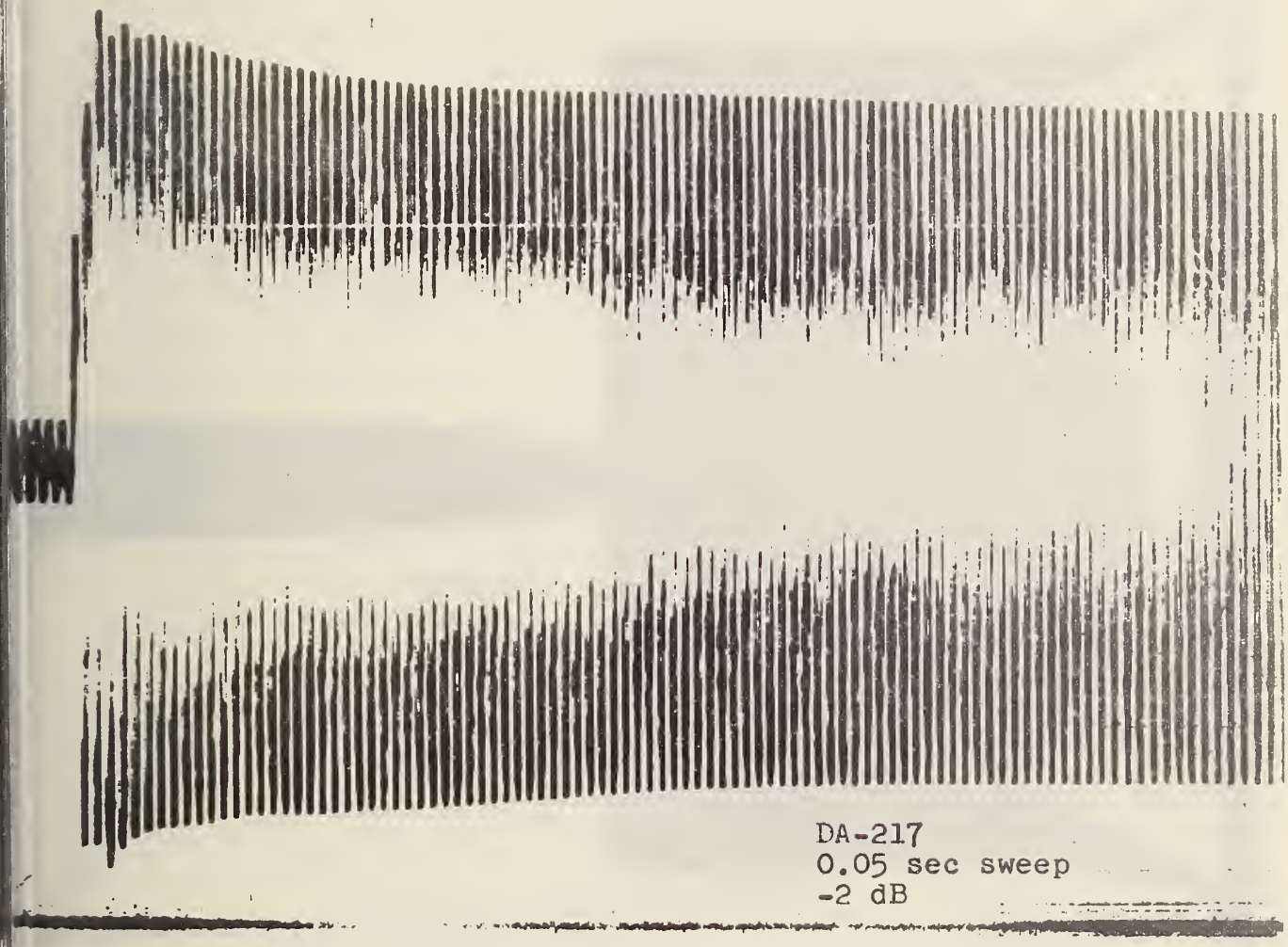
117

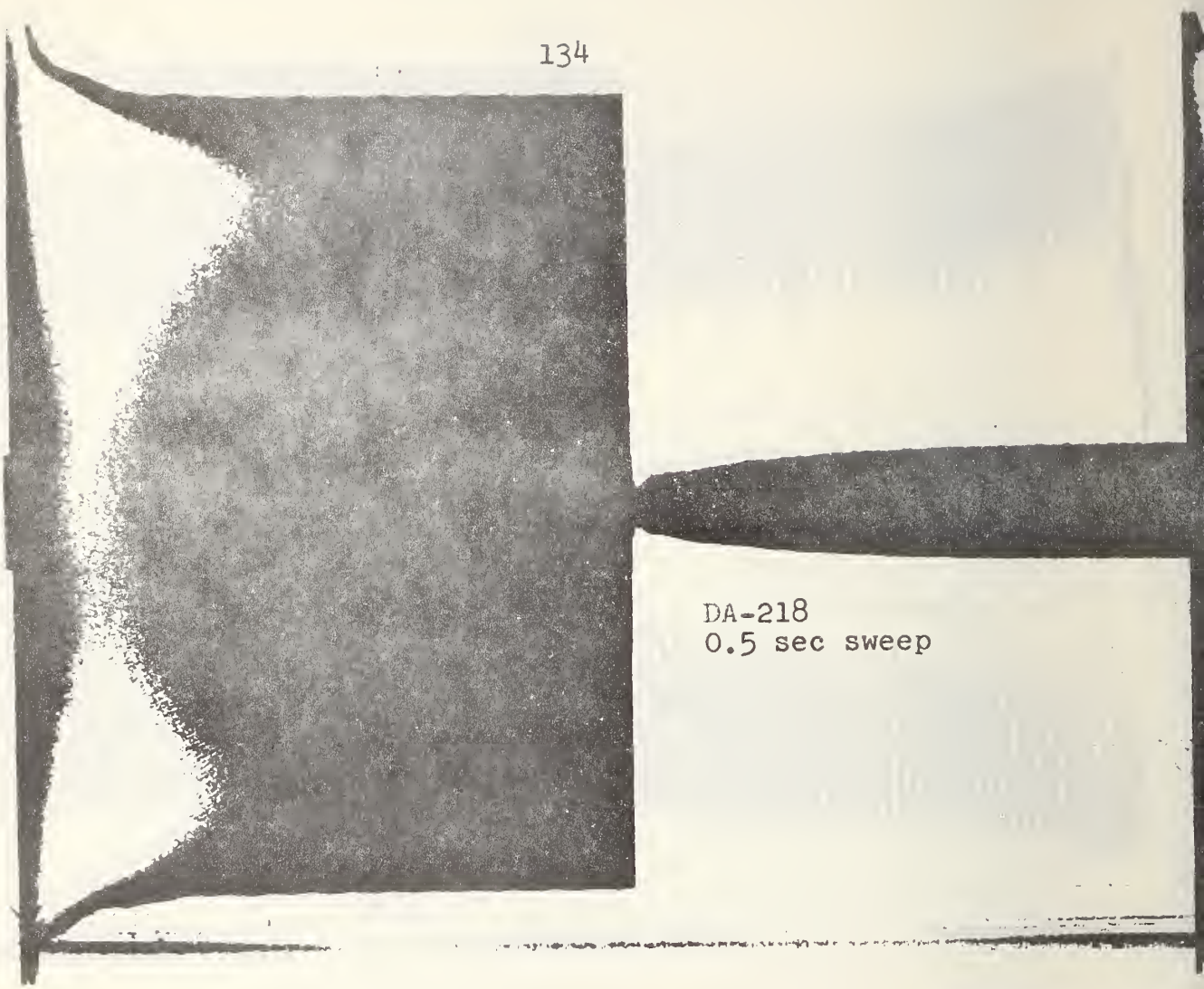


AT-312
0.5 sec sweep

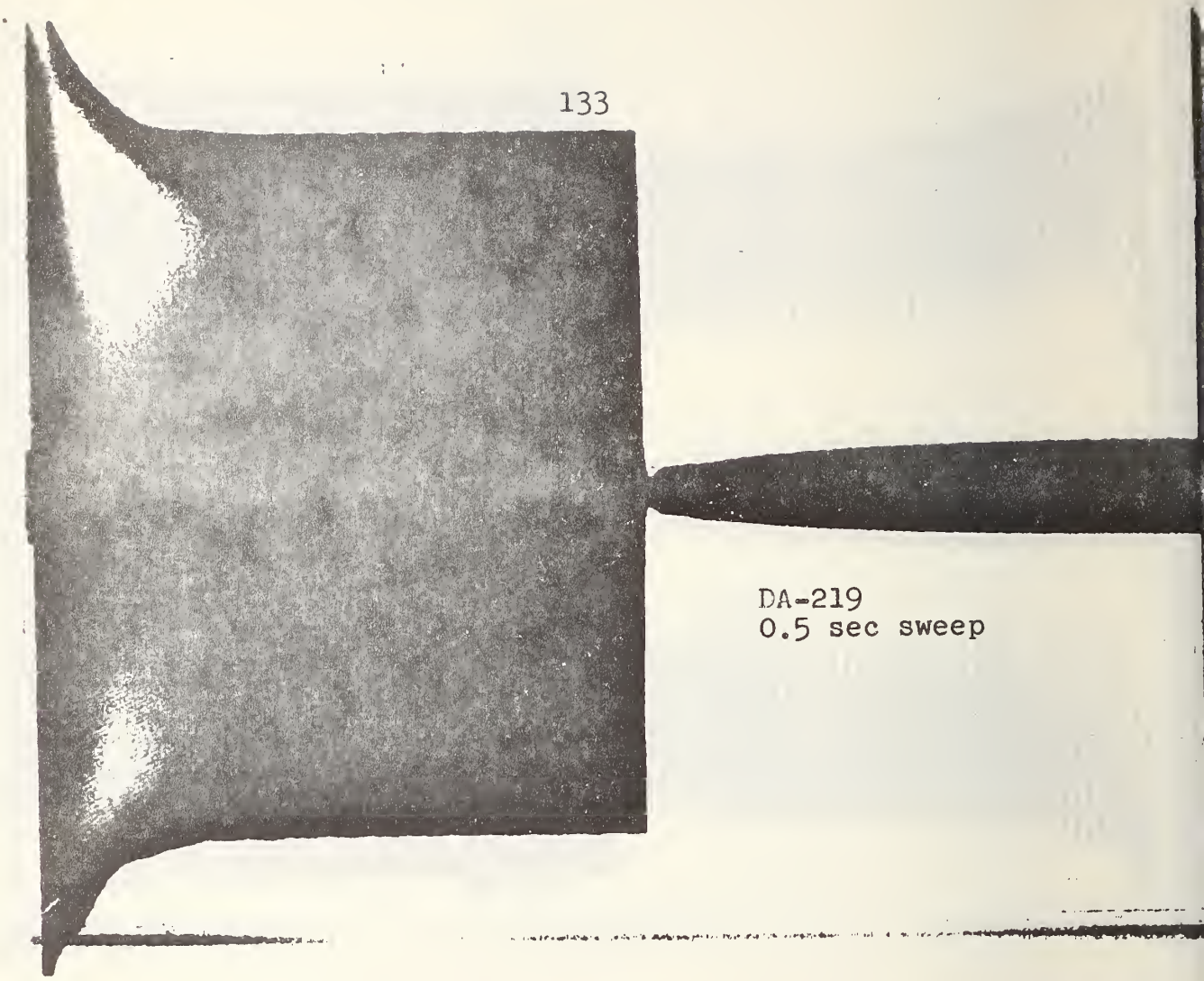

AT-312
0.05 sec sweep
0 dB


135.5
DA-217
0.5 sec sweep

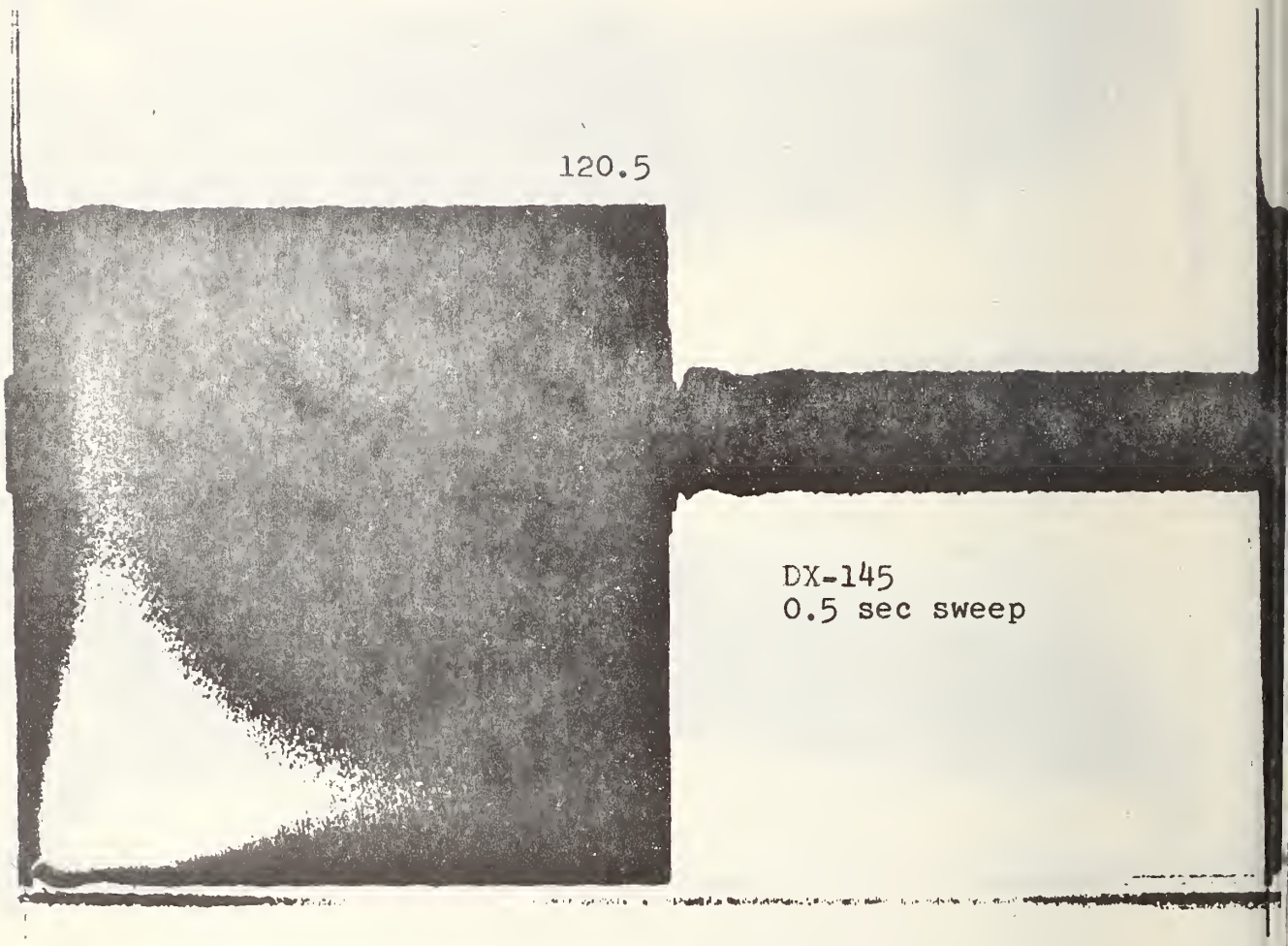

DA-217
0.05 sec sweep
-2 dB

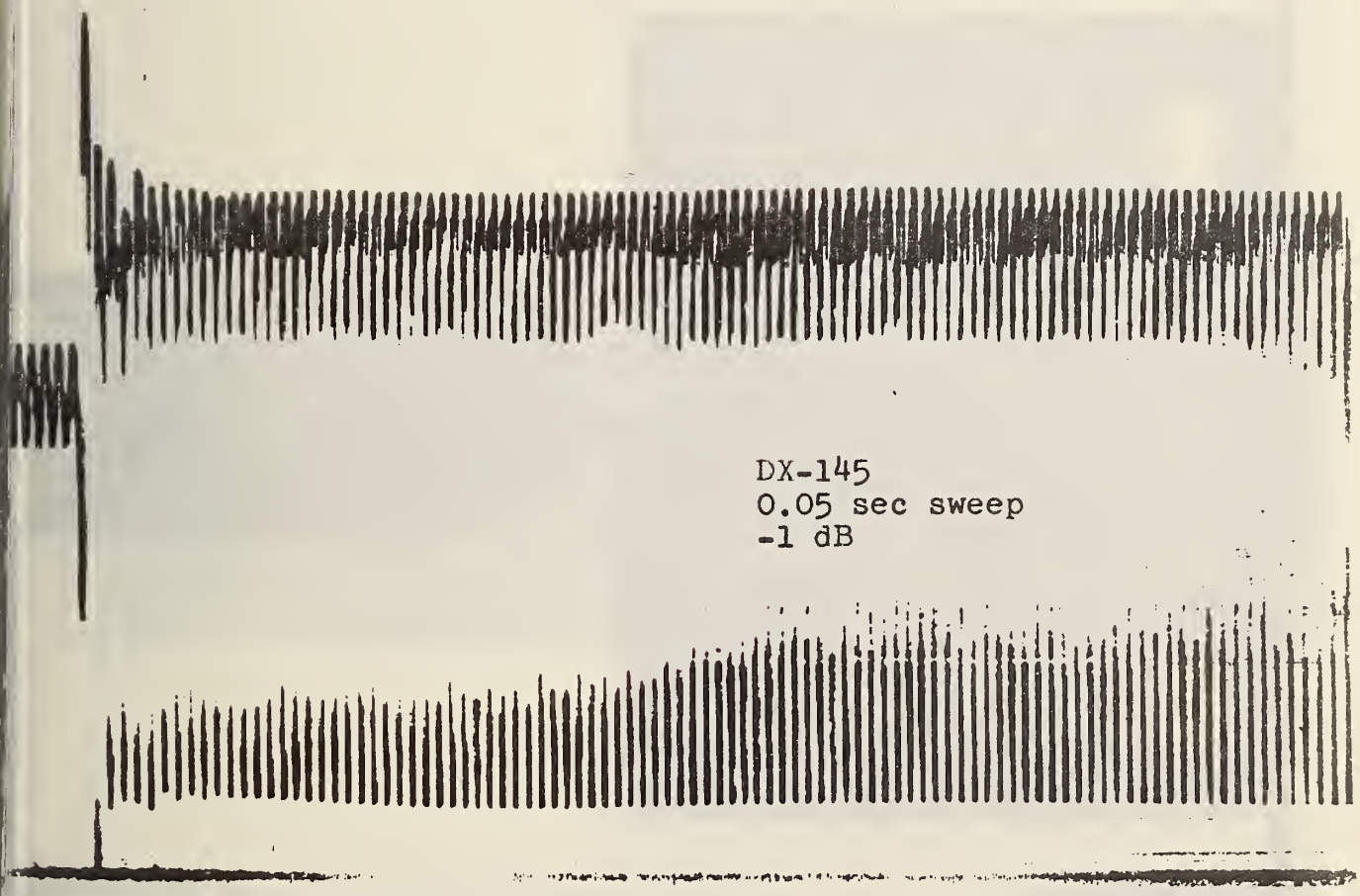

134
DA-218
0.5 sec sweep

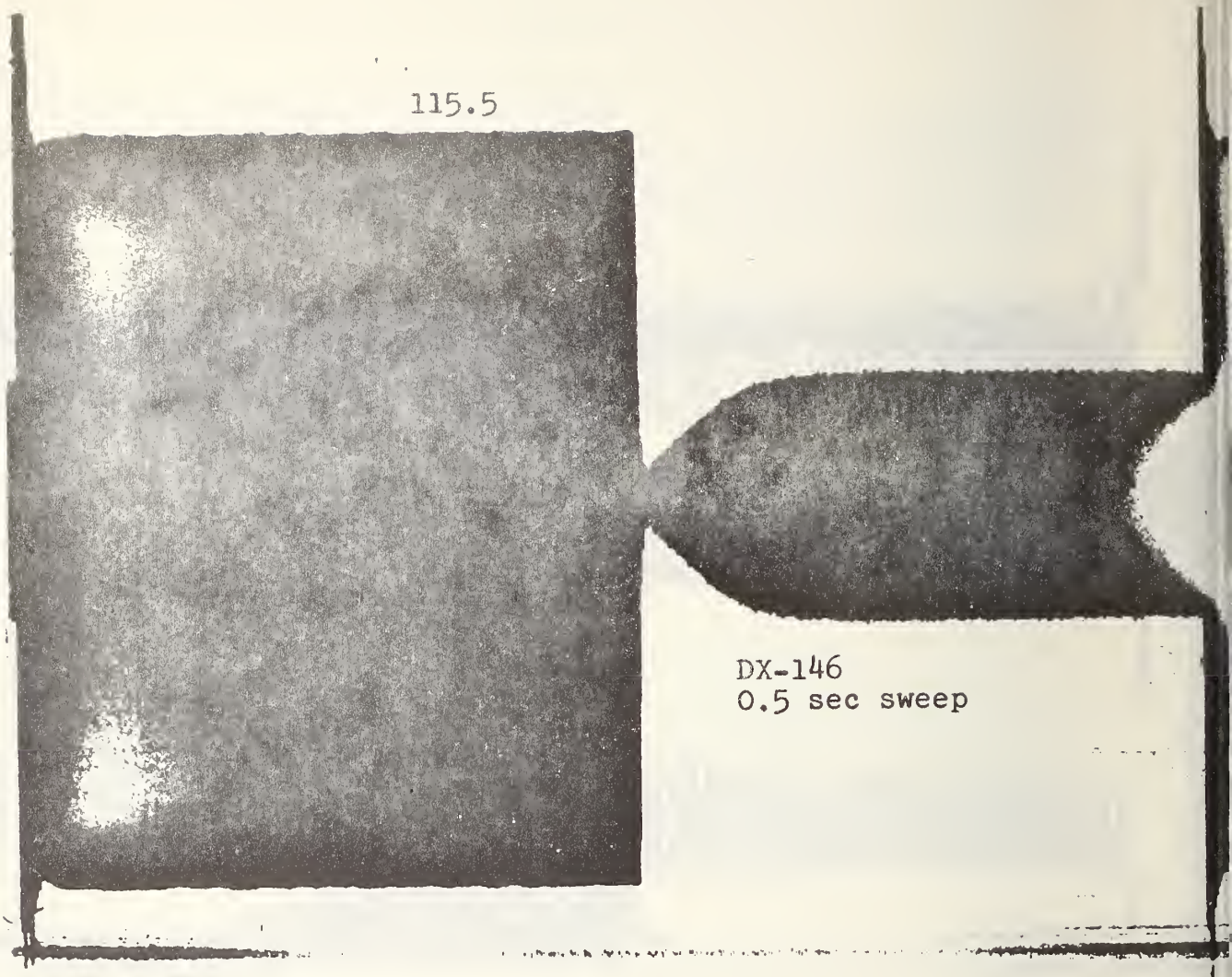

DA-218
0.05 sec sweep
-2 dB

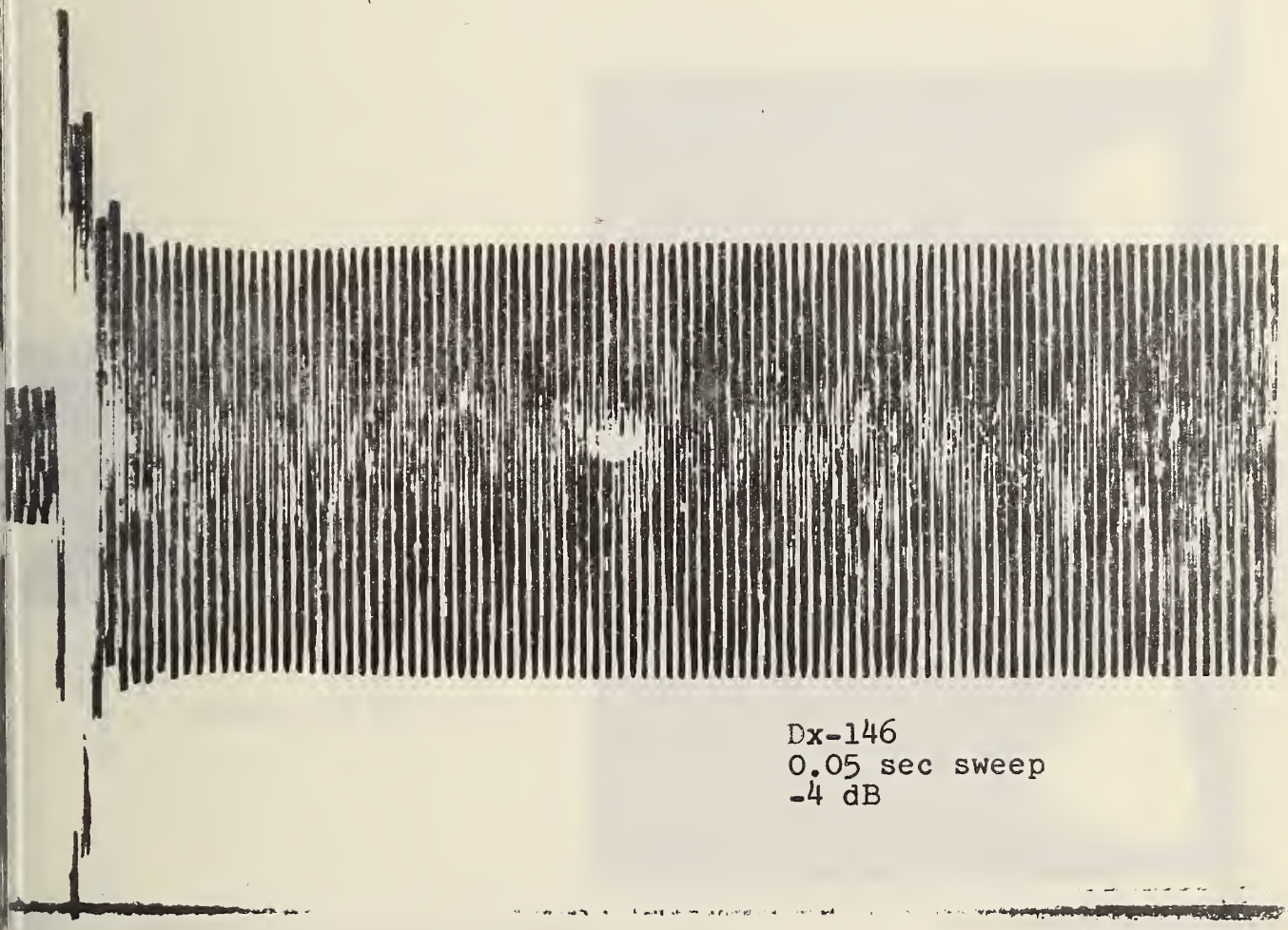

133
DA-219
0.5 sec sweep


DA-219
0.05 sec sweep
-2 dB

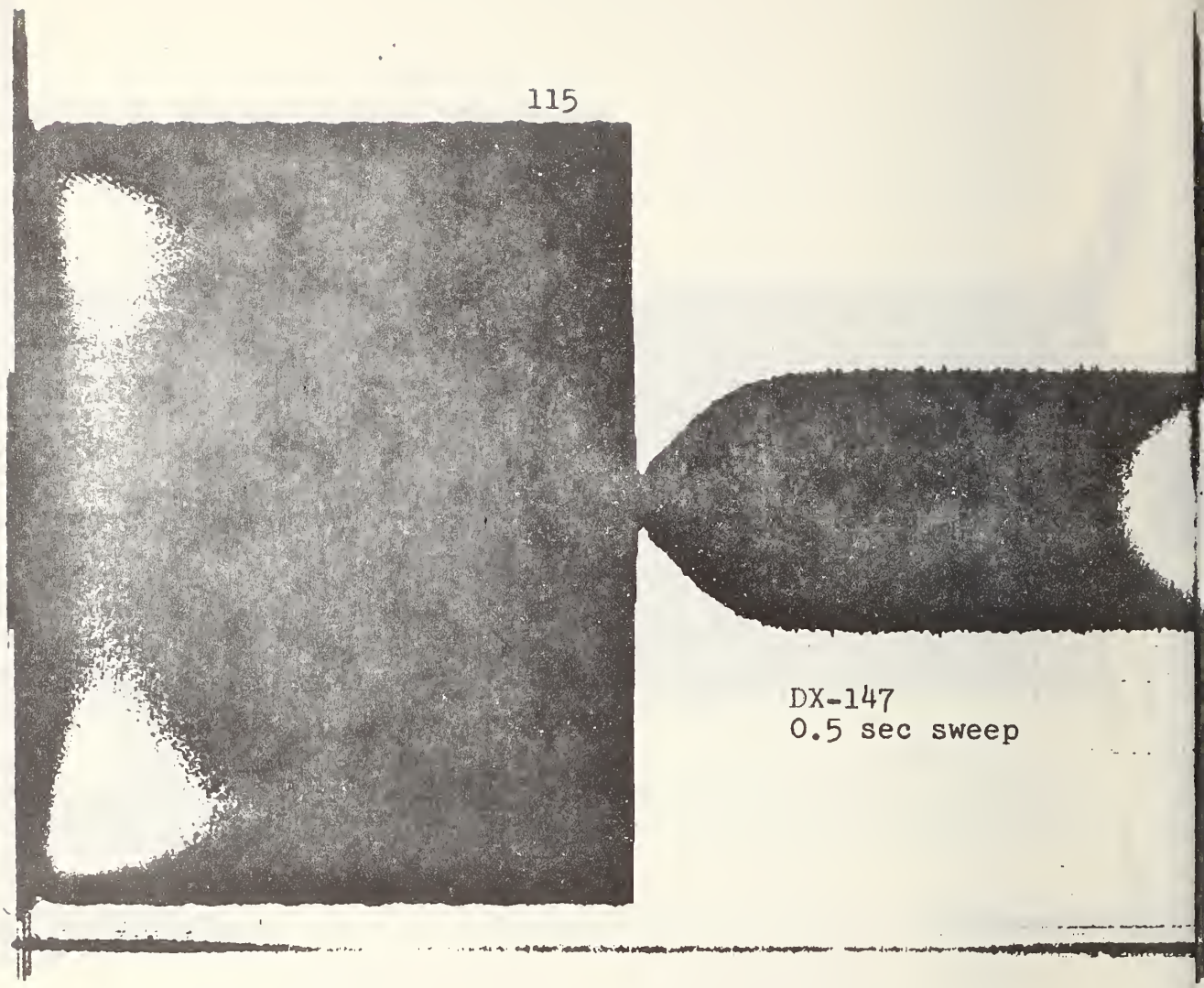

120.5
DX-145
0.5 sec sweep


DX-145
0.05 sec sweep
-1 dB


115.5
DX-146
0.5 sec sweep

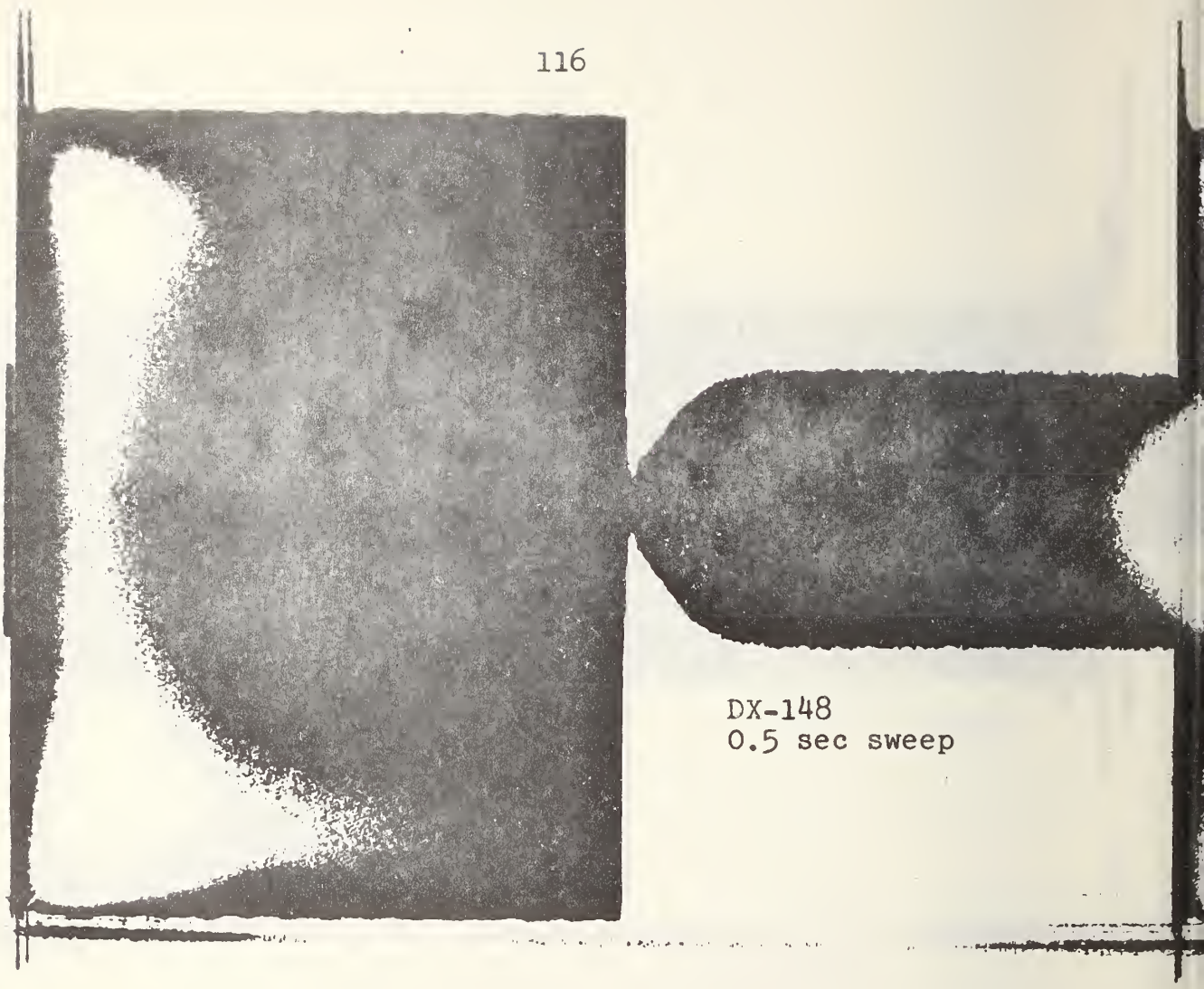


Dx-146
0.05 sec sweep
-4 dB


115
DX-147
0.5 sec sweep

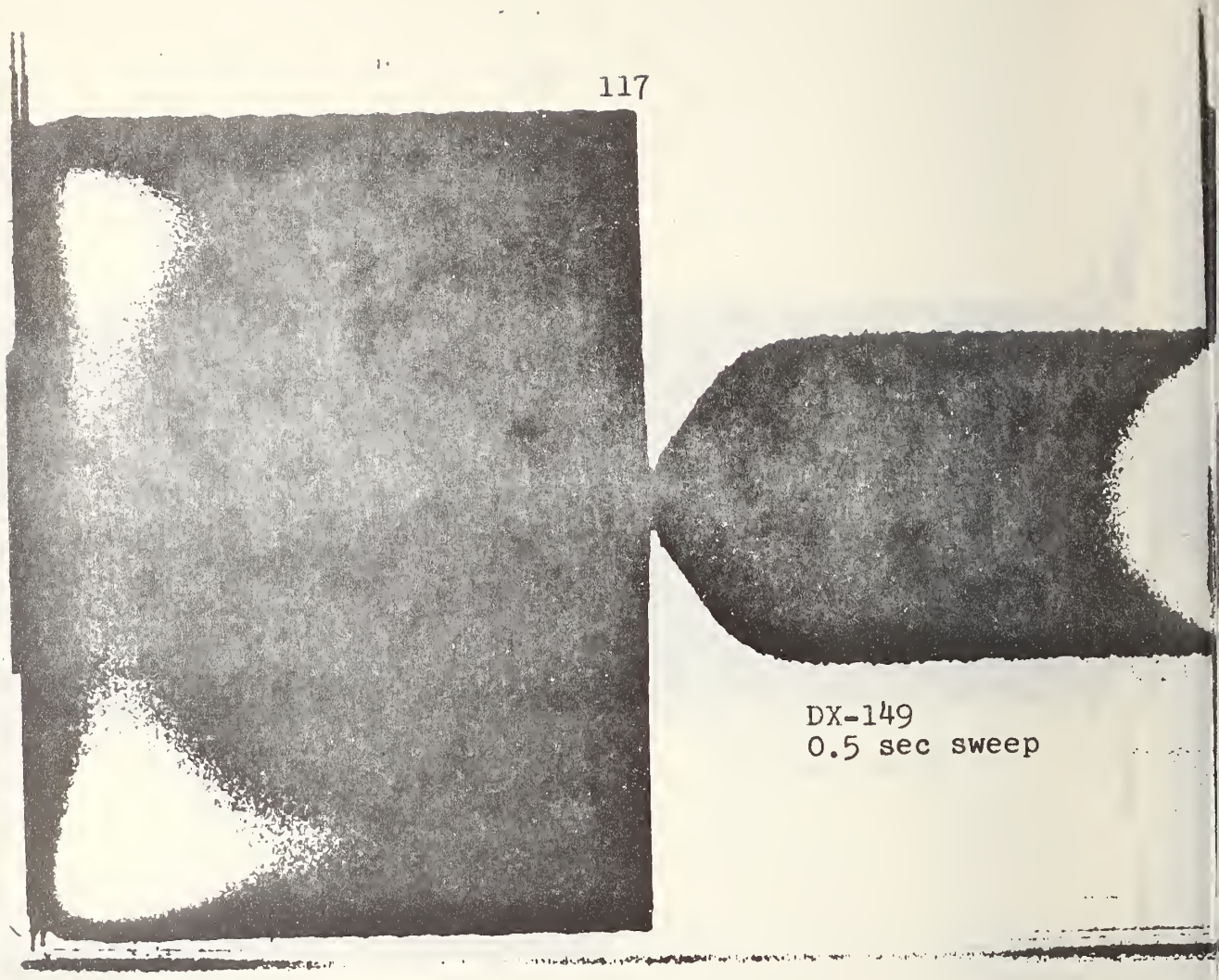
DX-147
0.05 sec sweep
-6 dB

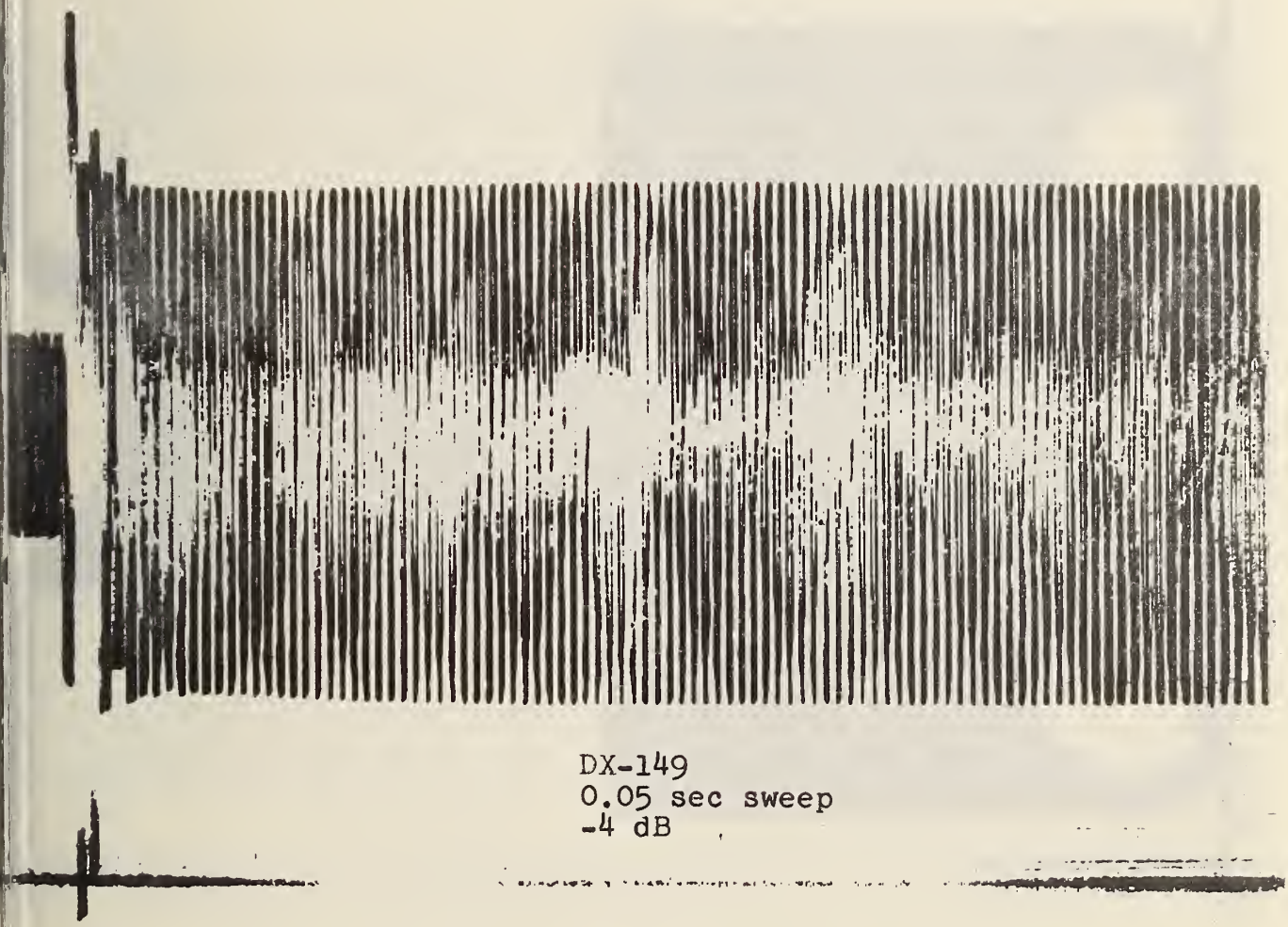
116



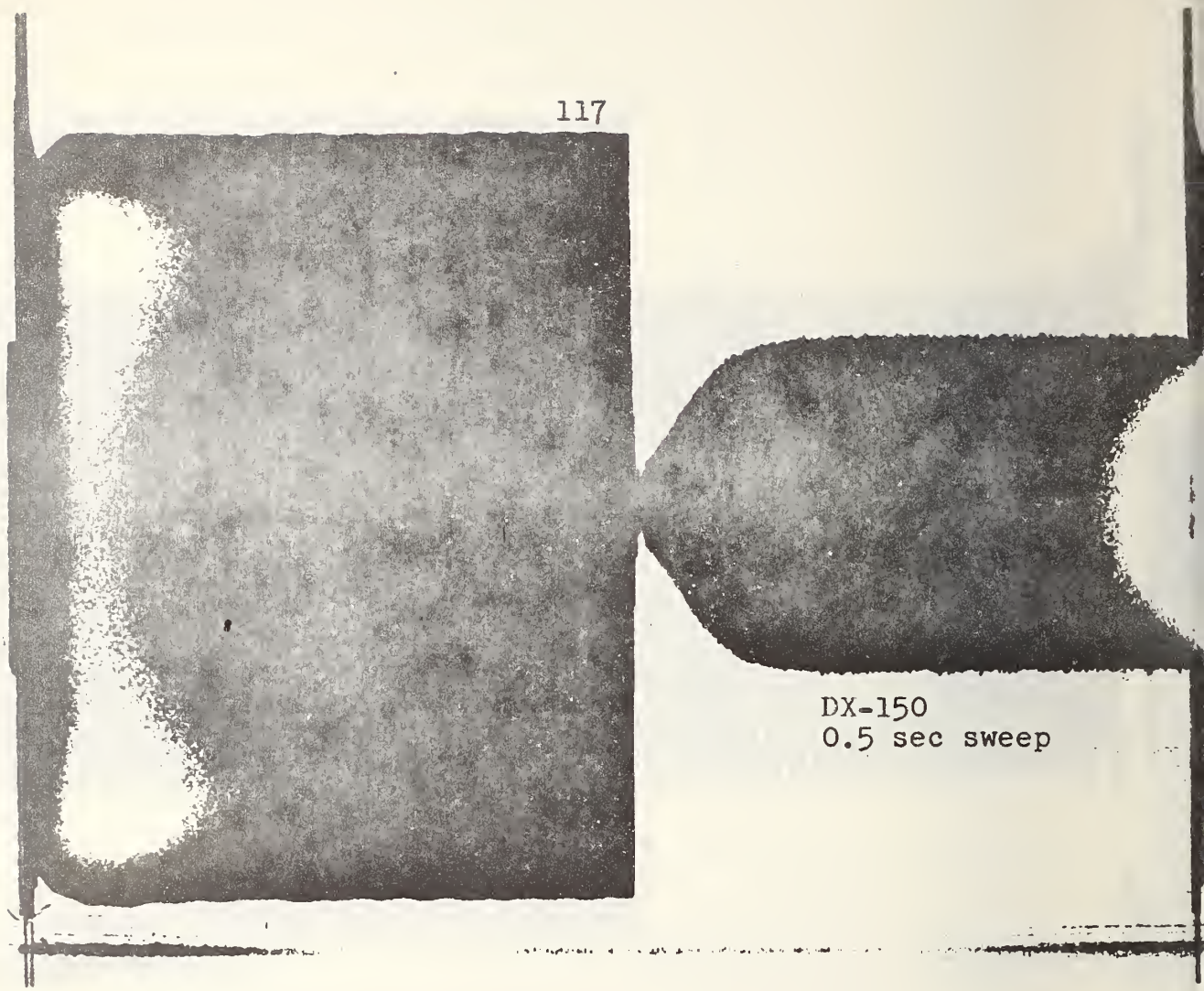
DX-148
0.5 sec sweep

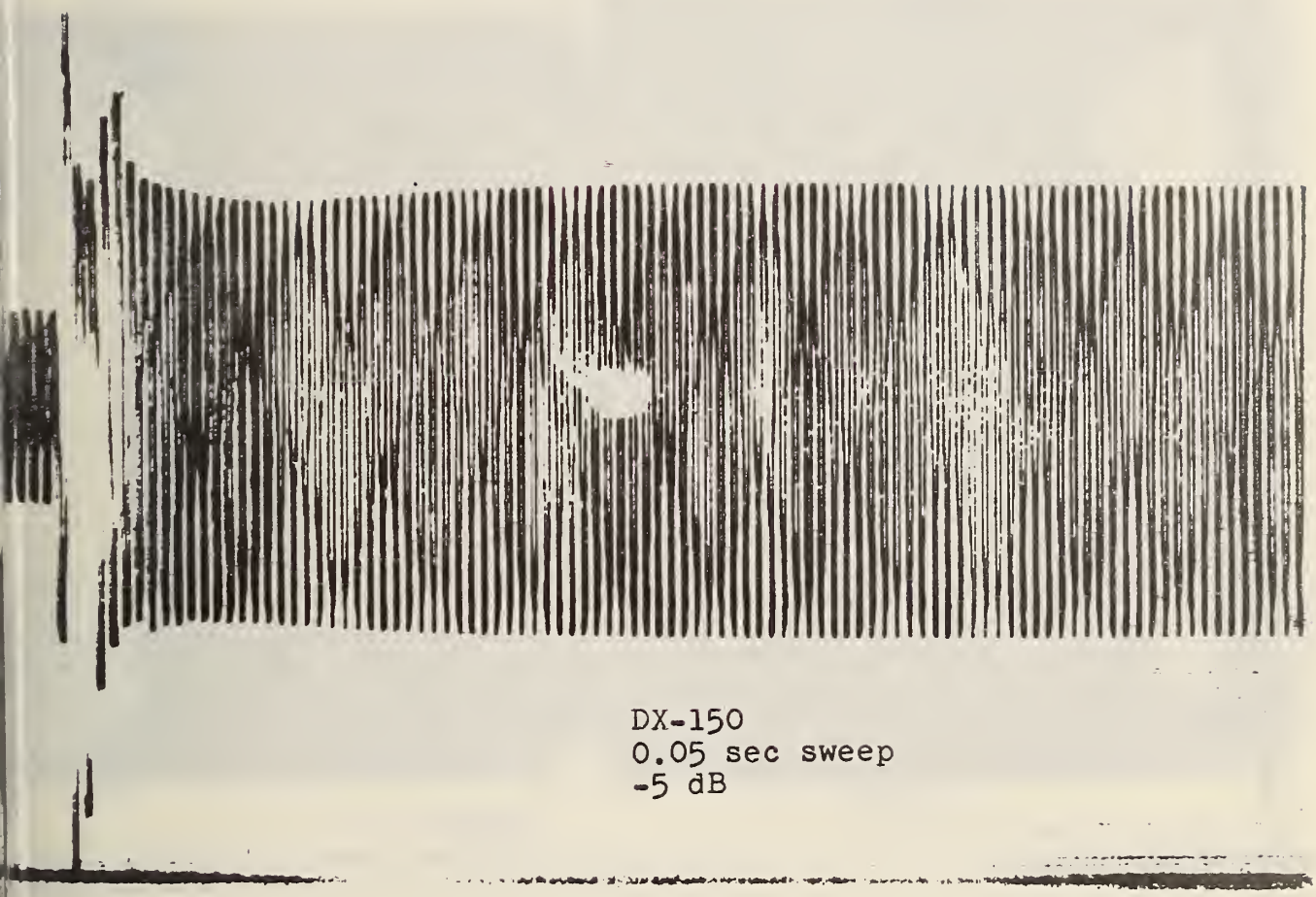
DX-148
0.05 sec sweep
-6 dB


117
DX-149
0.5 sec sweep

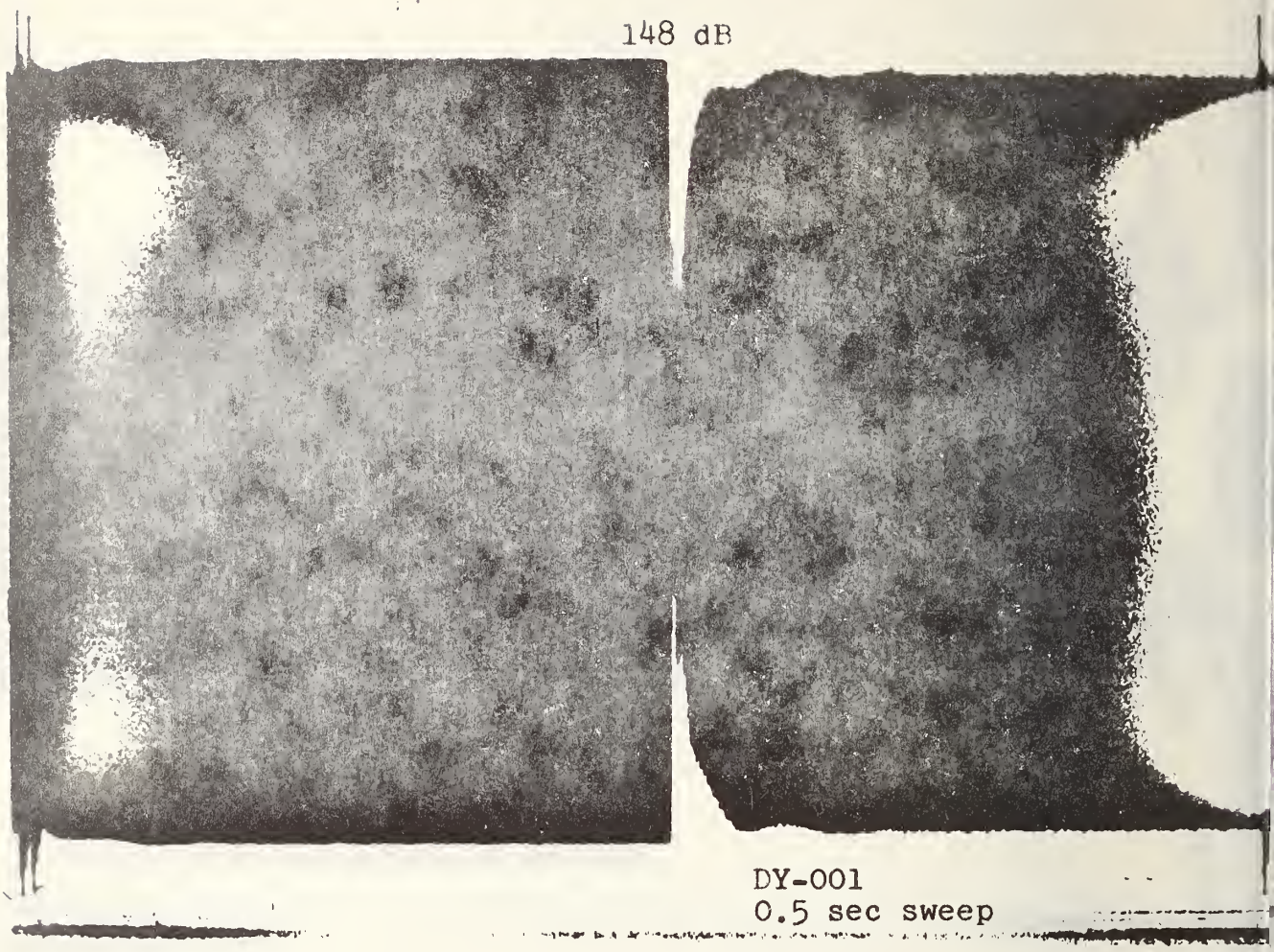


DX-149
0.05 sec sweep
-4 dB


117
DX-150
0.5 sec sweep

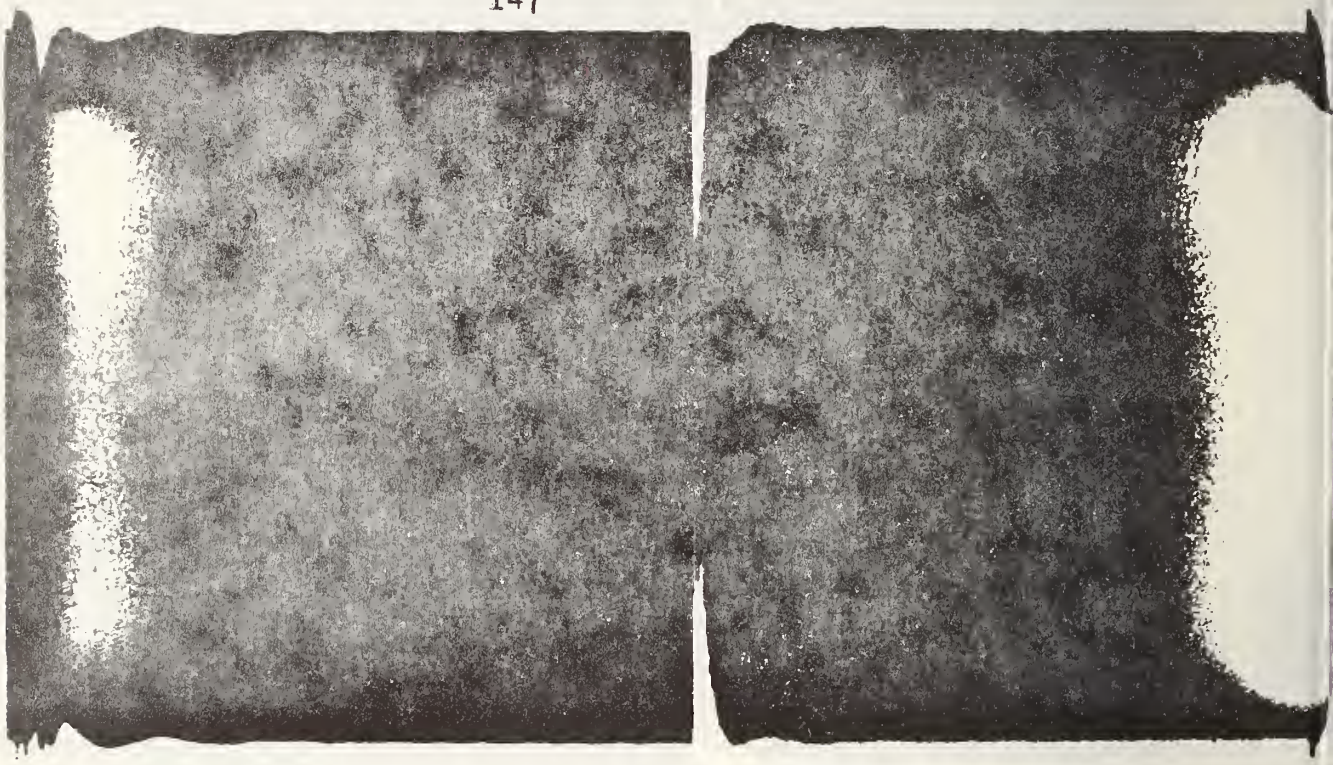


DX-150
0.05 sec sweep
-5 dB

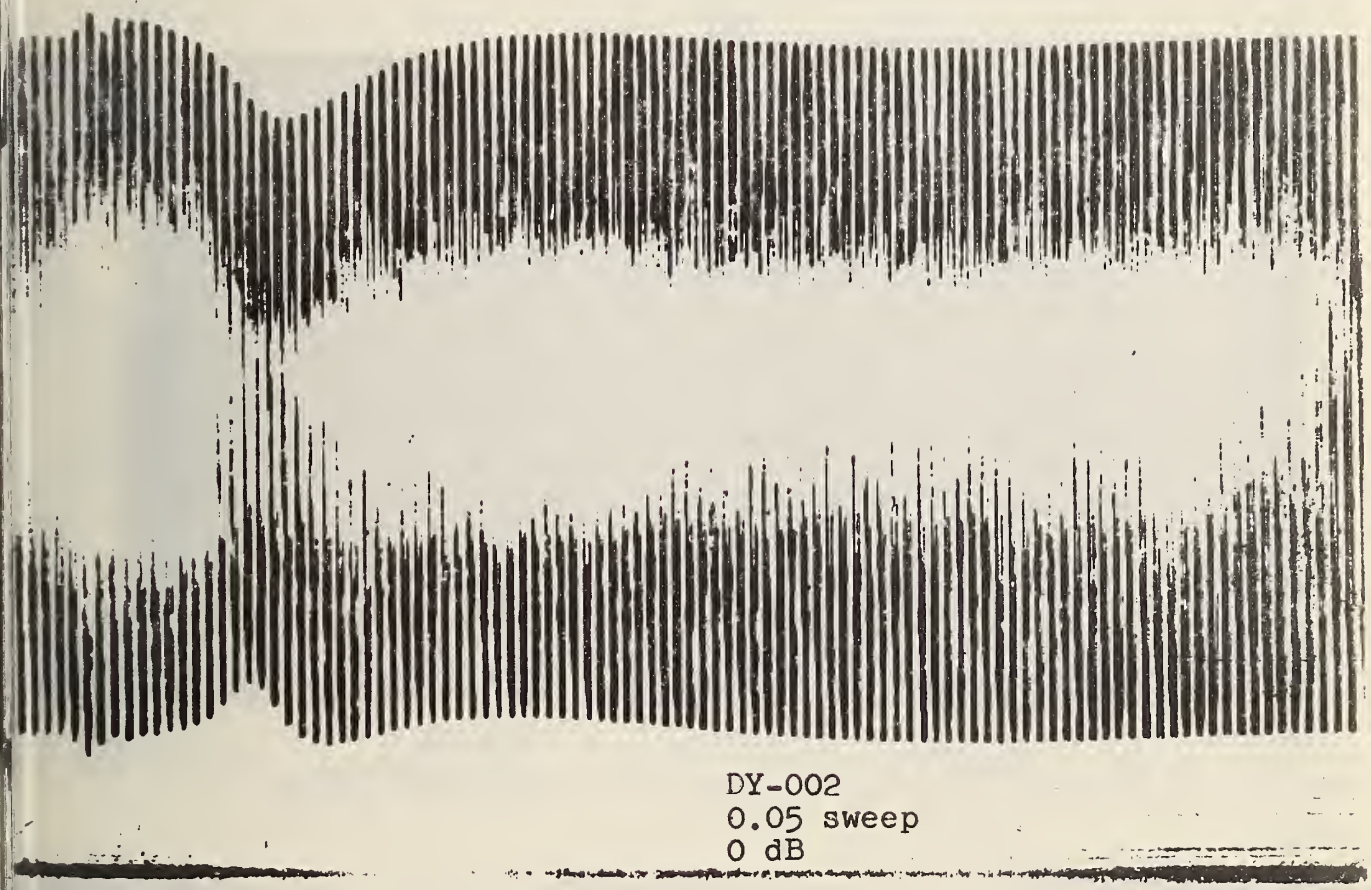

148 dB
DY-001
0.5 sec sweep

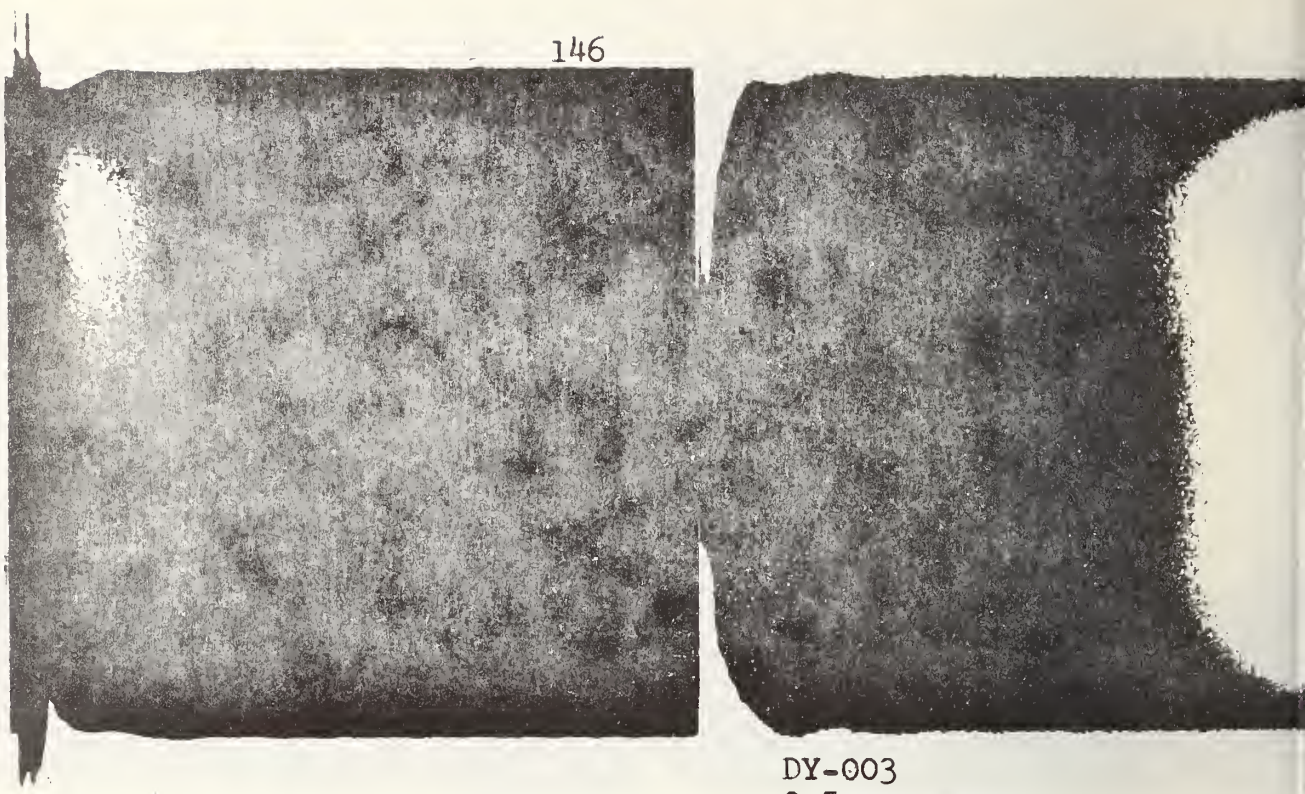

DY-001
0.05 sec sweep 0 dB

147

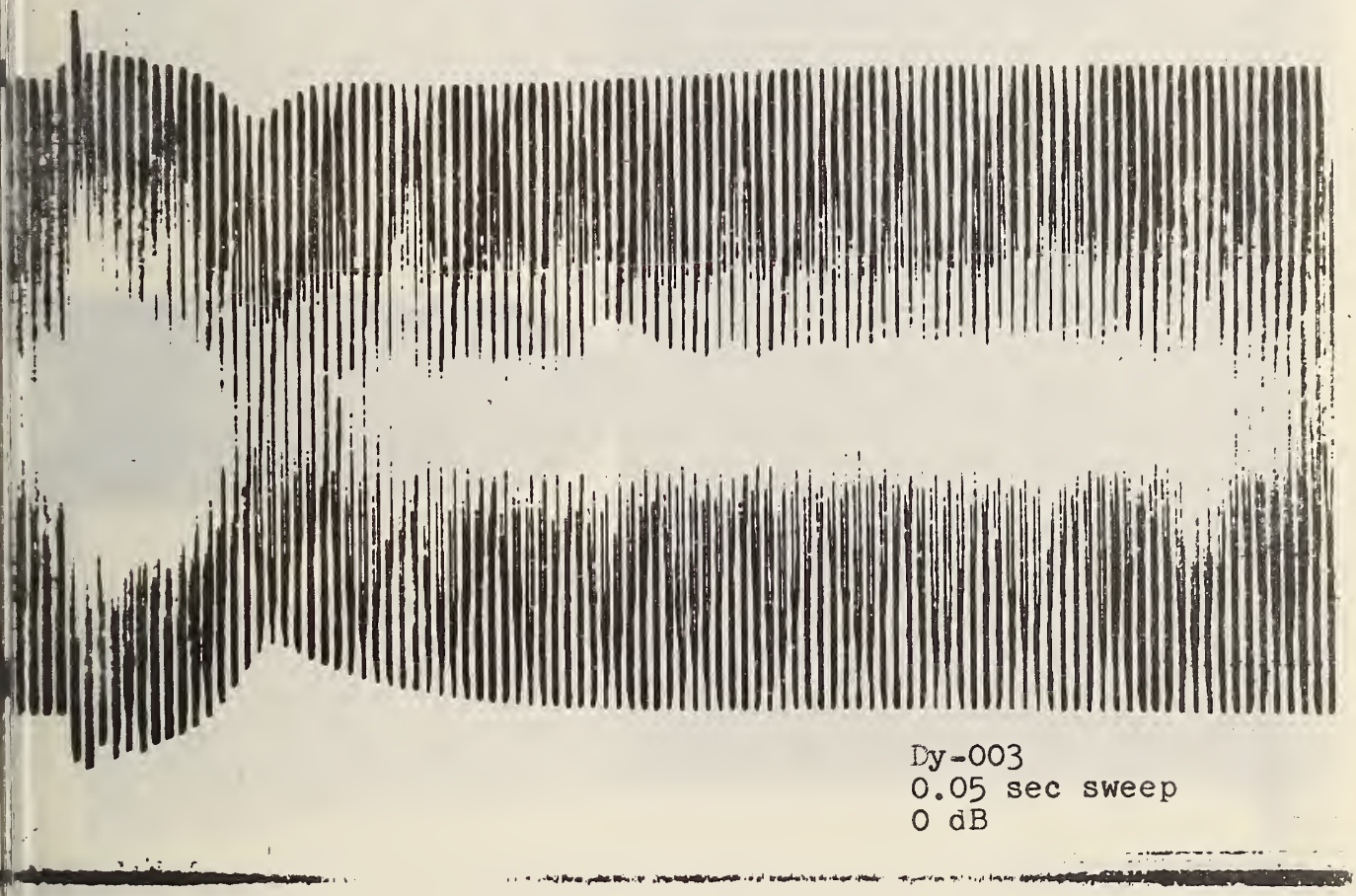


DY-002
0.5 sec sweep

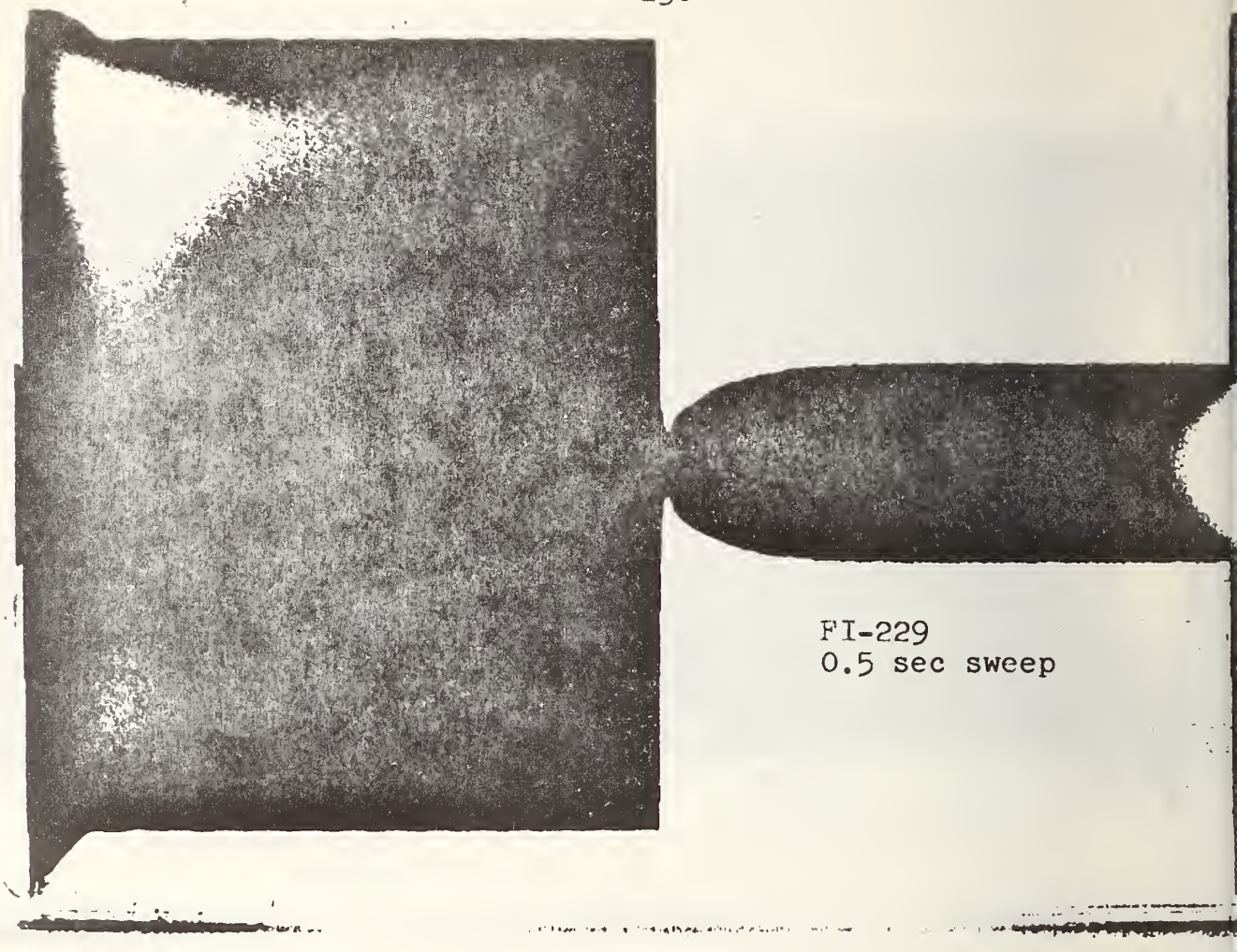

DY-002
0.05 sweep
0 dB



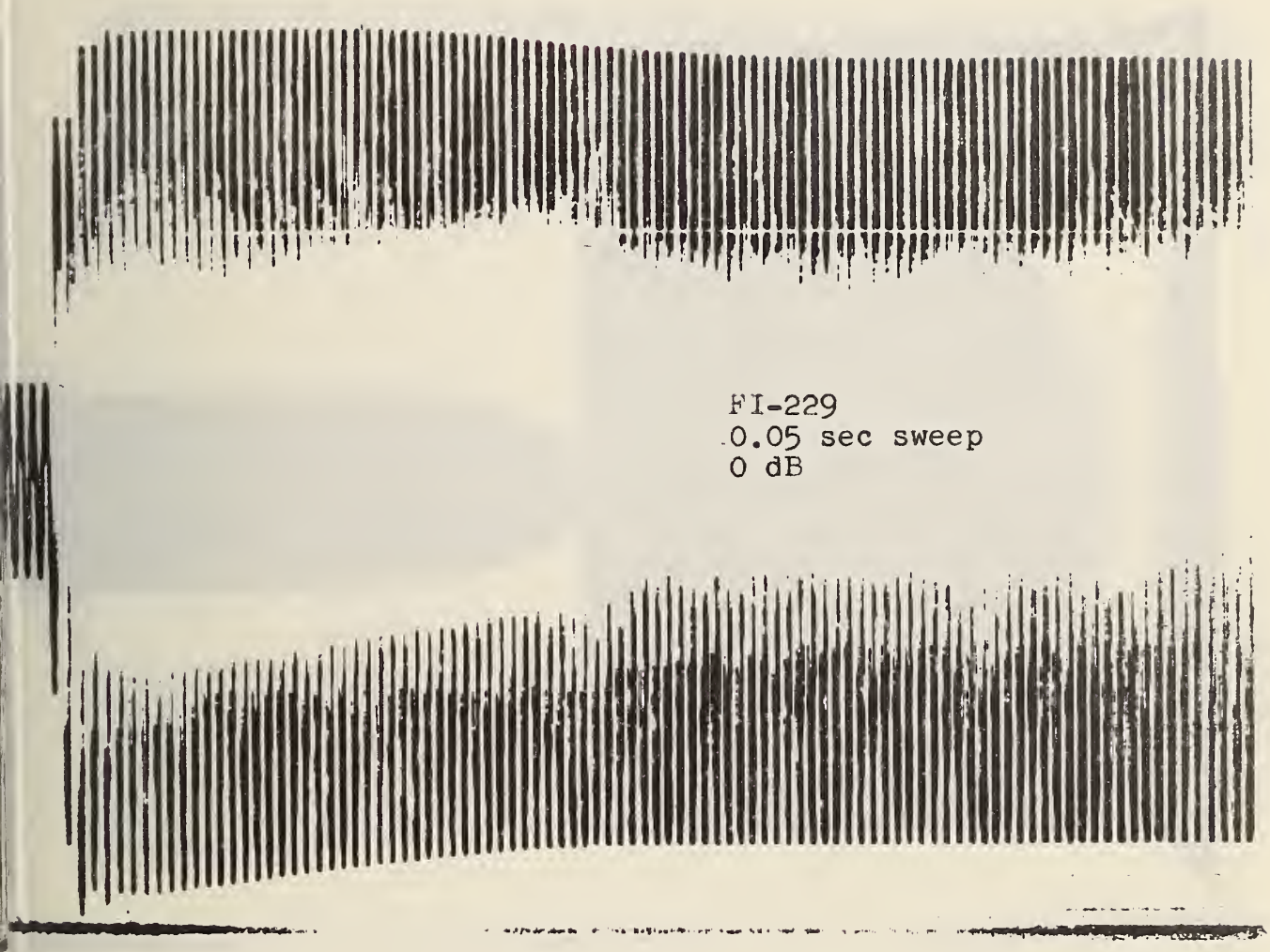
DY-003
0.5 sec sweep


Dy-003
0.05 sec sweep
0 dB

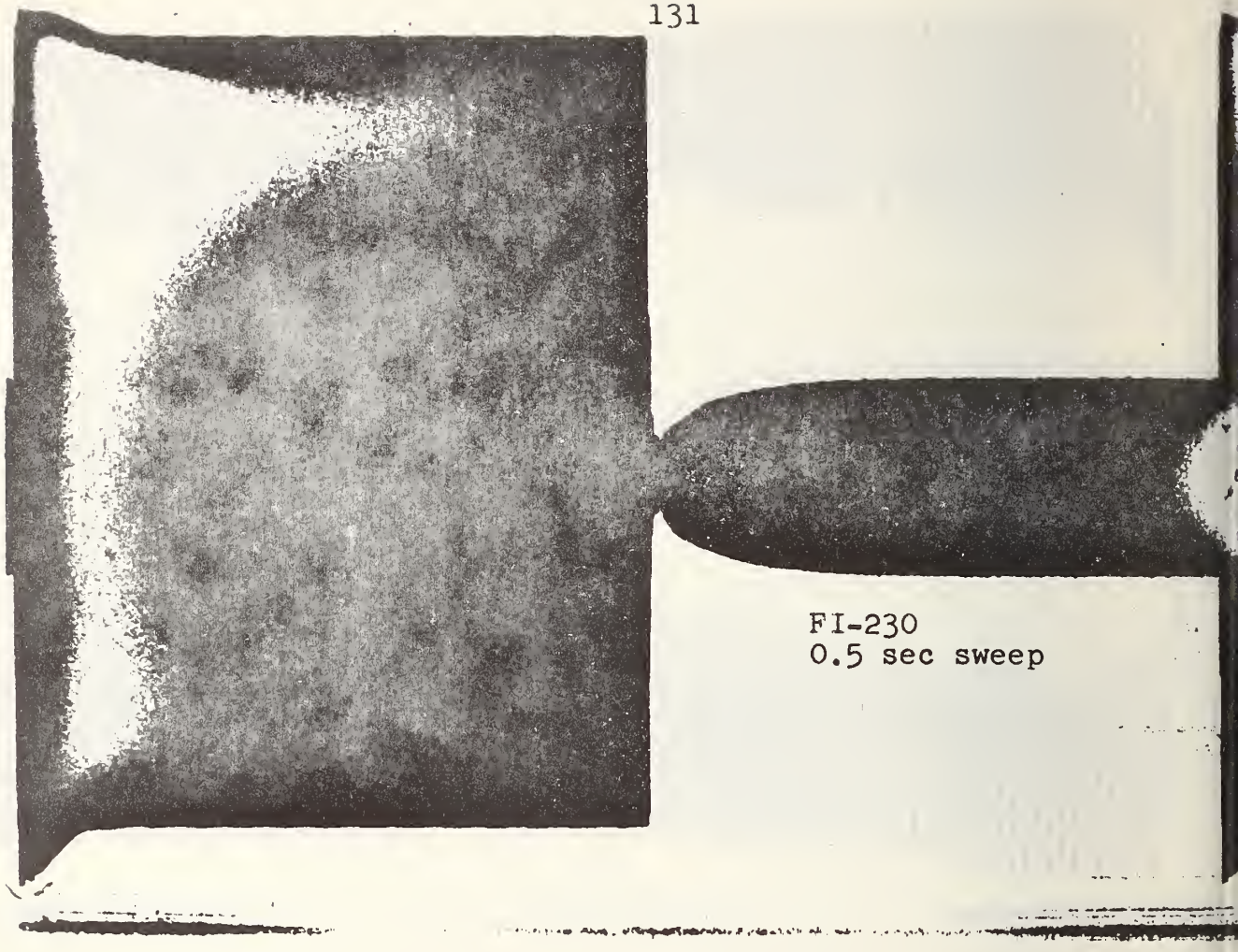
130



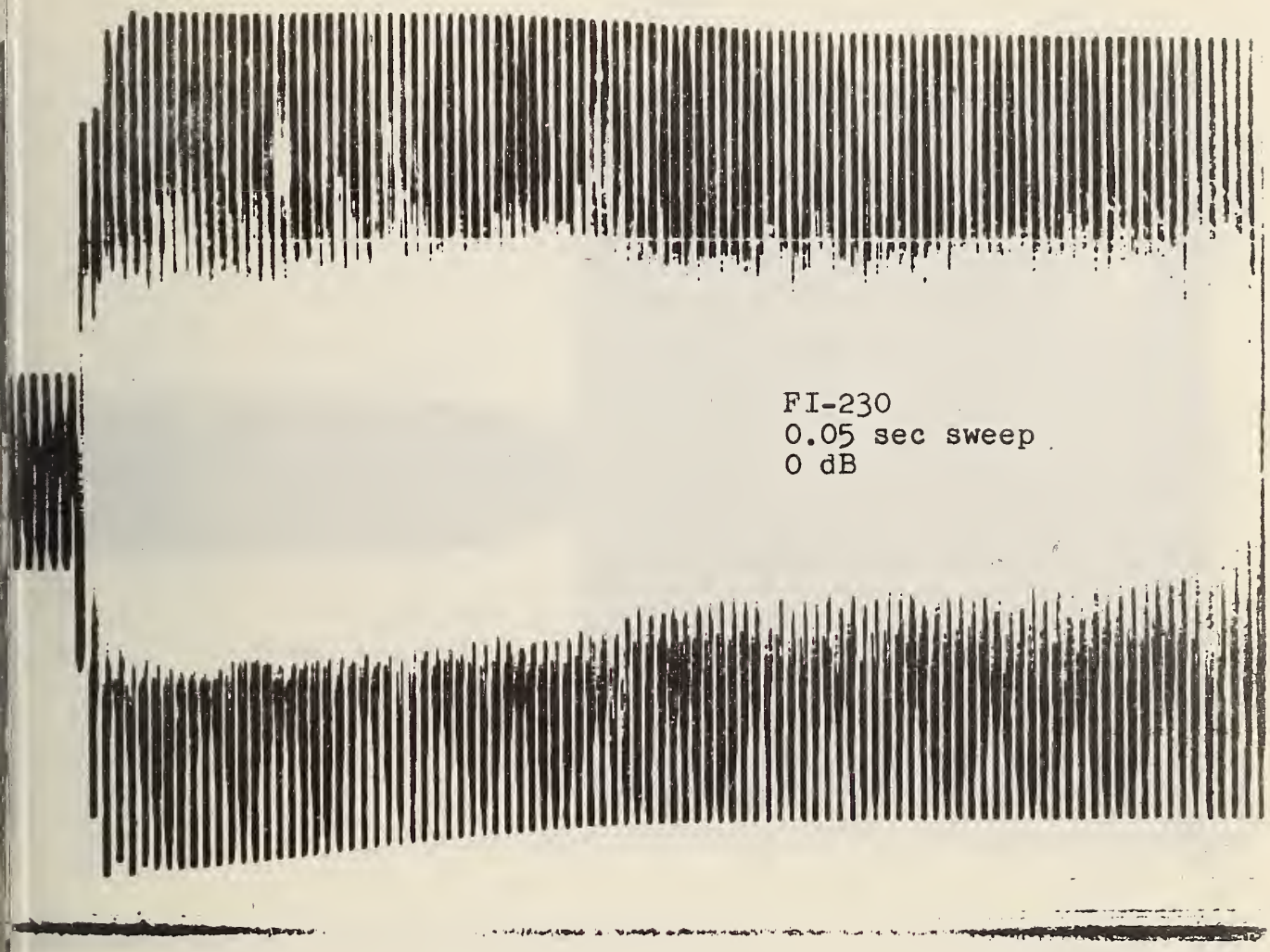
FI-229
0.5 sec sweep

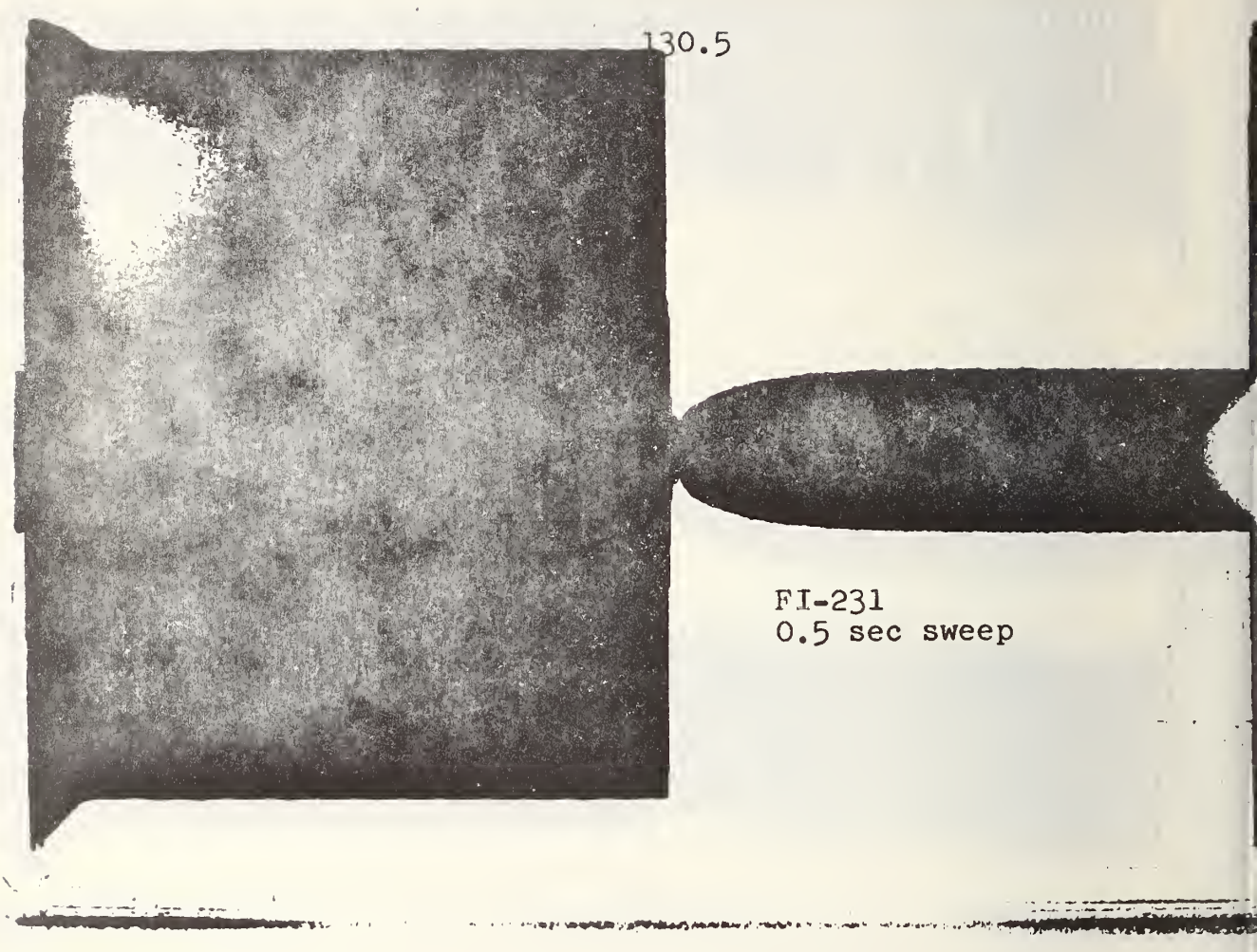

FI-229
0.05 sec sweep
0 dB

131



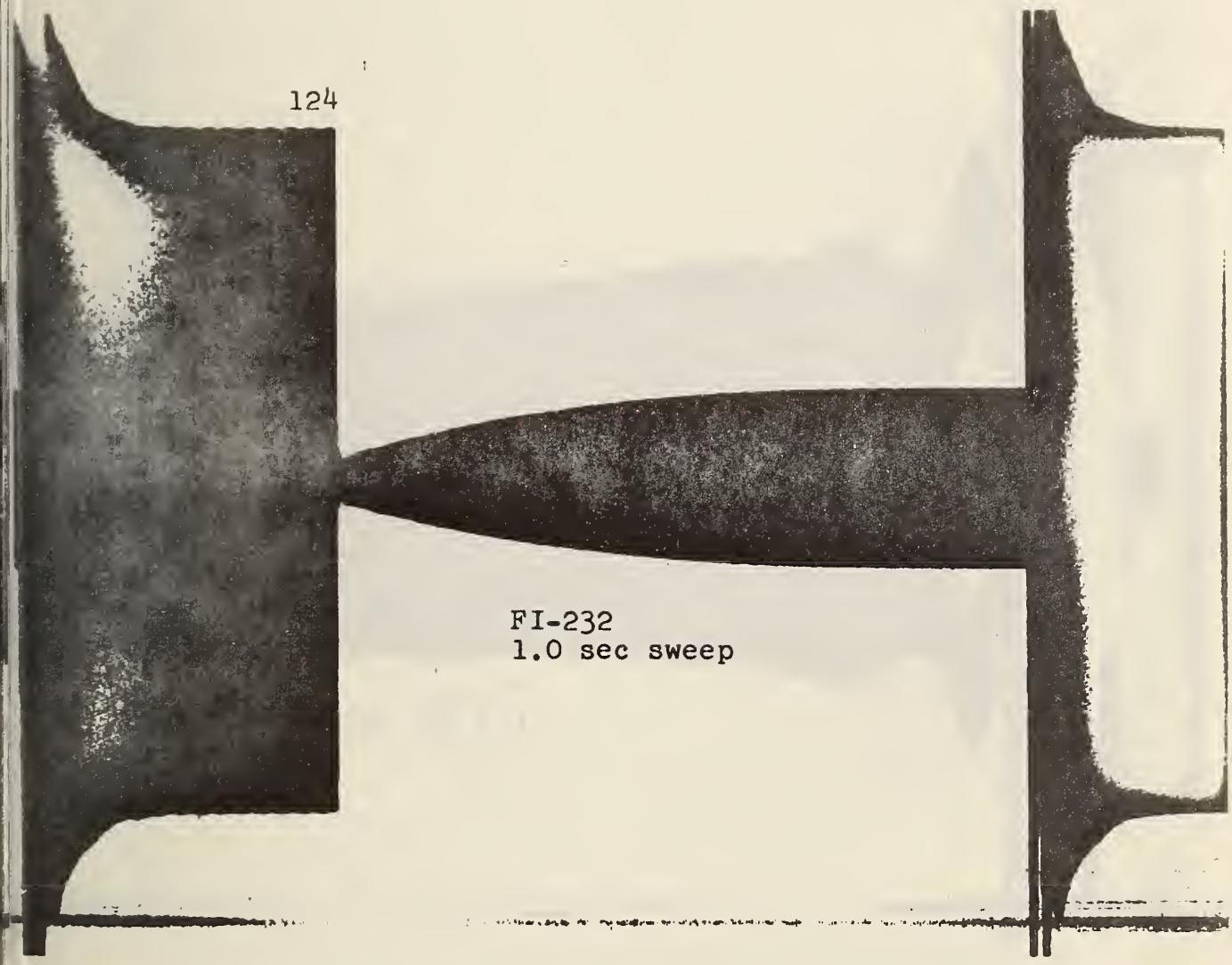
FI-230
0.5 sec sweep

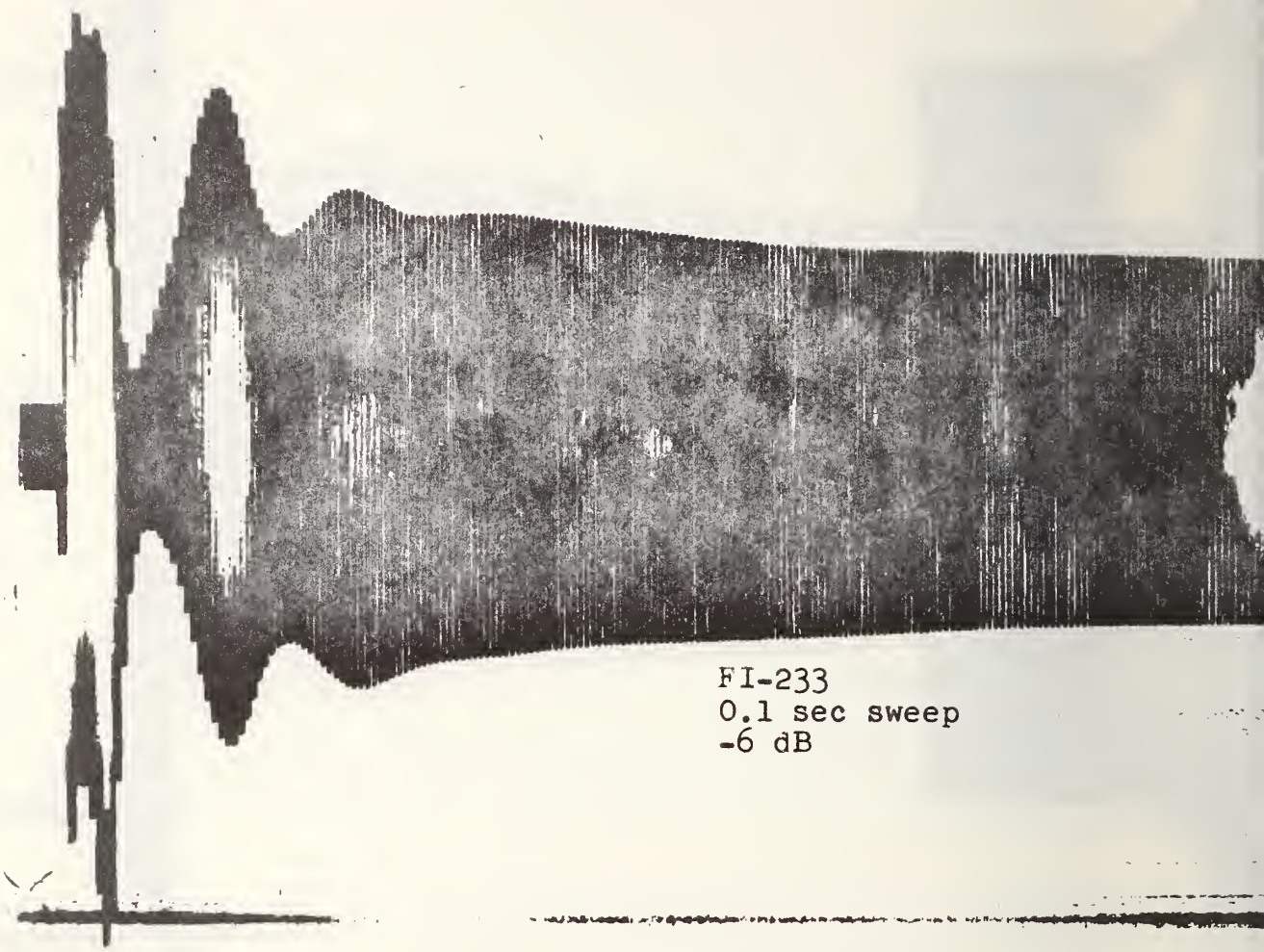

FI-230
0.05 sec sweep
0 dB


130.5
FI-231
0.5 sec sweep

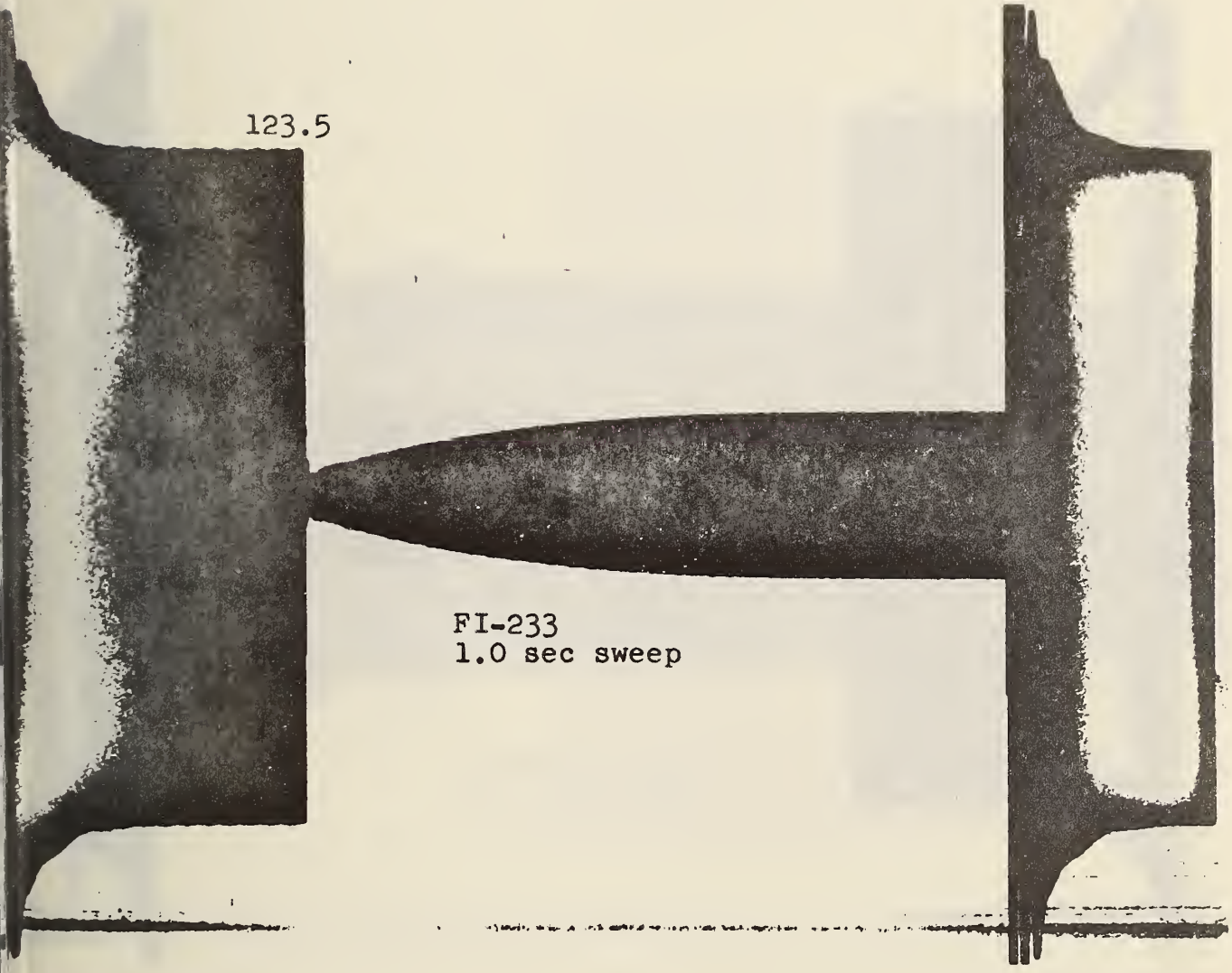

FI-231
0.05 sec sweep
0dB

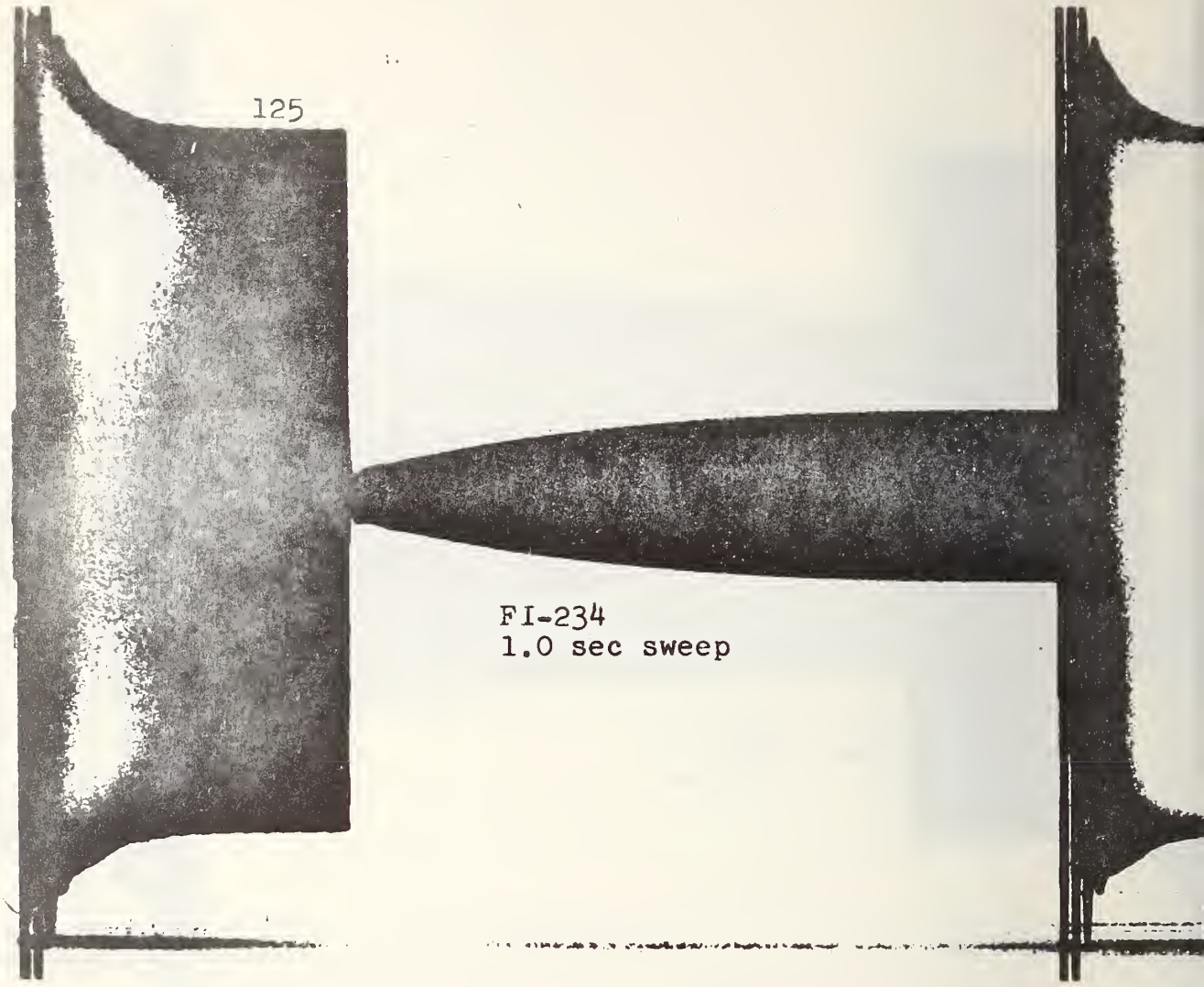

FI-232
0.1 sec sweep
-5 dB


124
FI-232
1.0 sec sweep

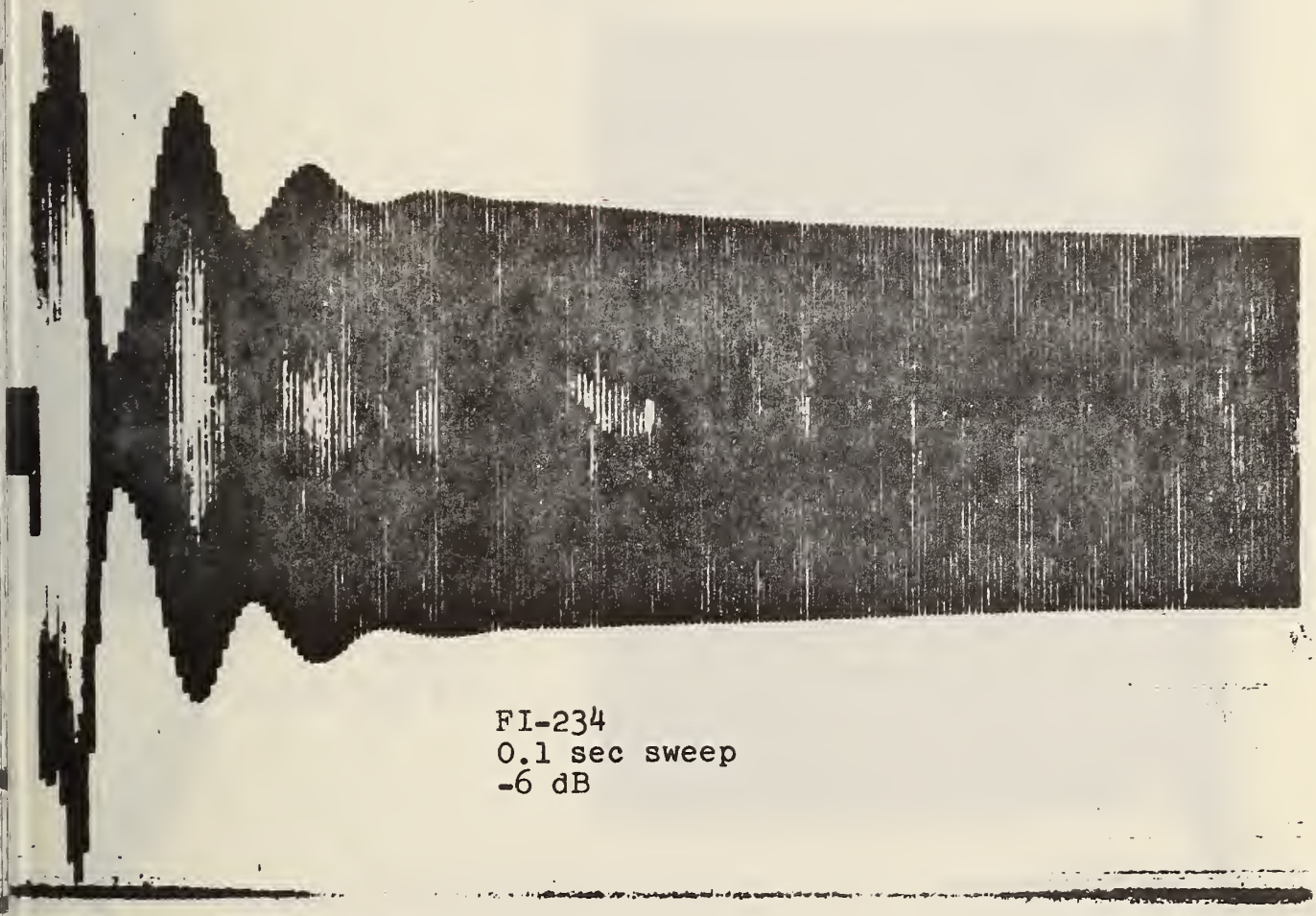


FI-233
0.1 sec sweep
-6 dB

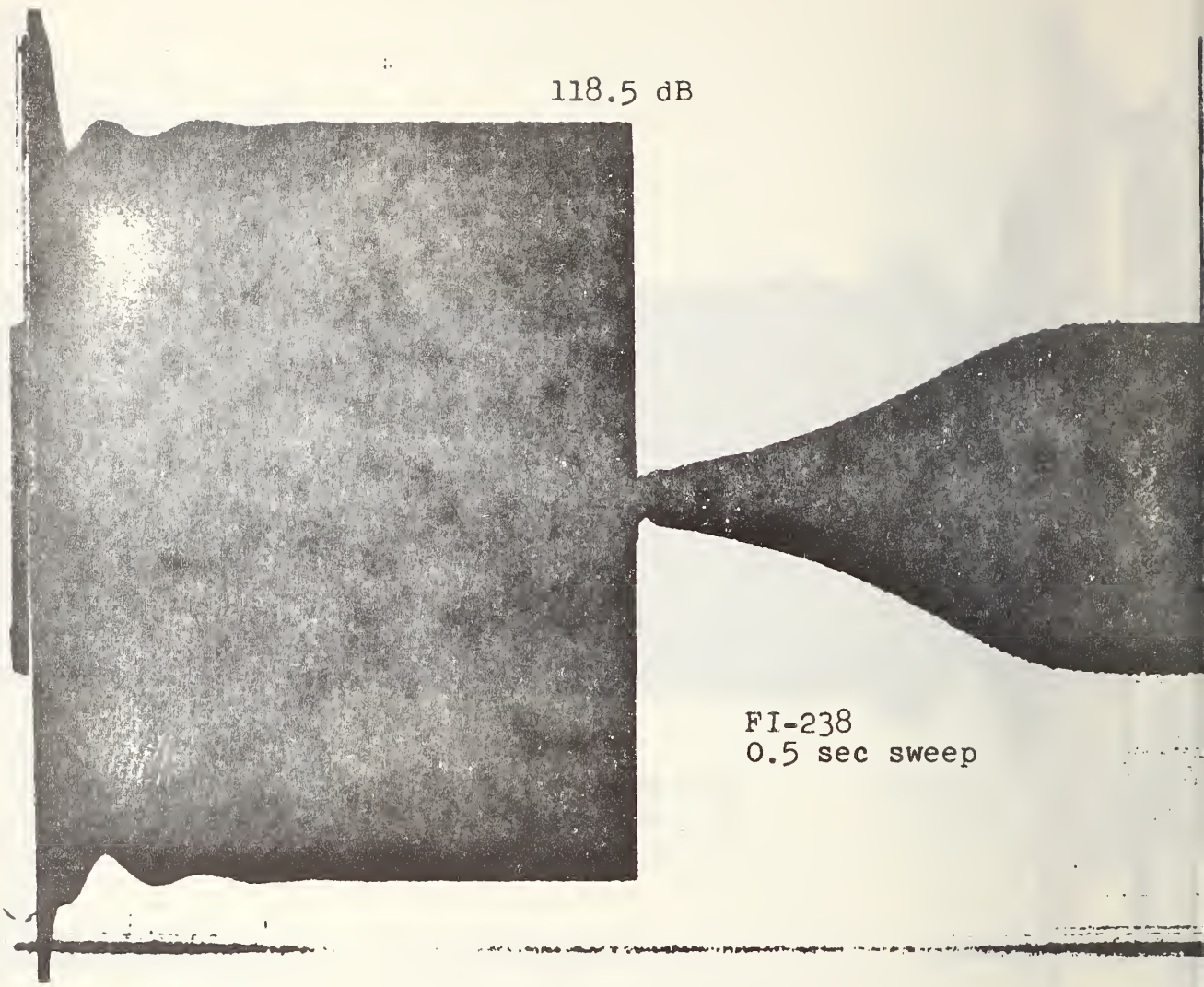

123.5
FI-233
1.0 sec sweep

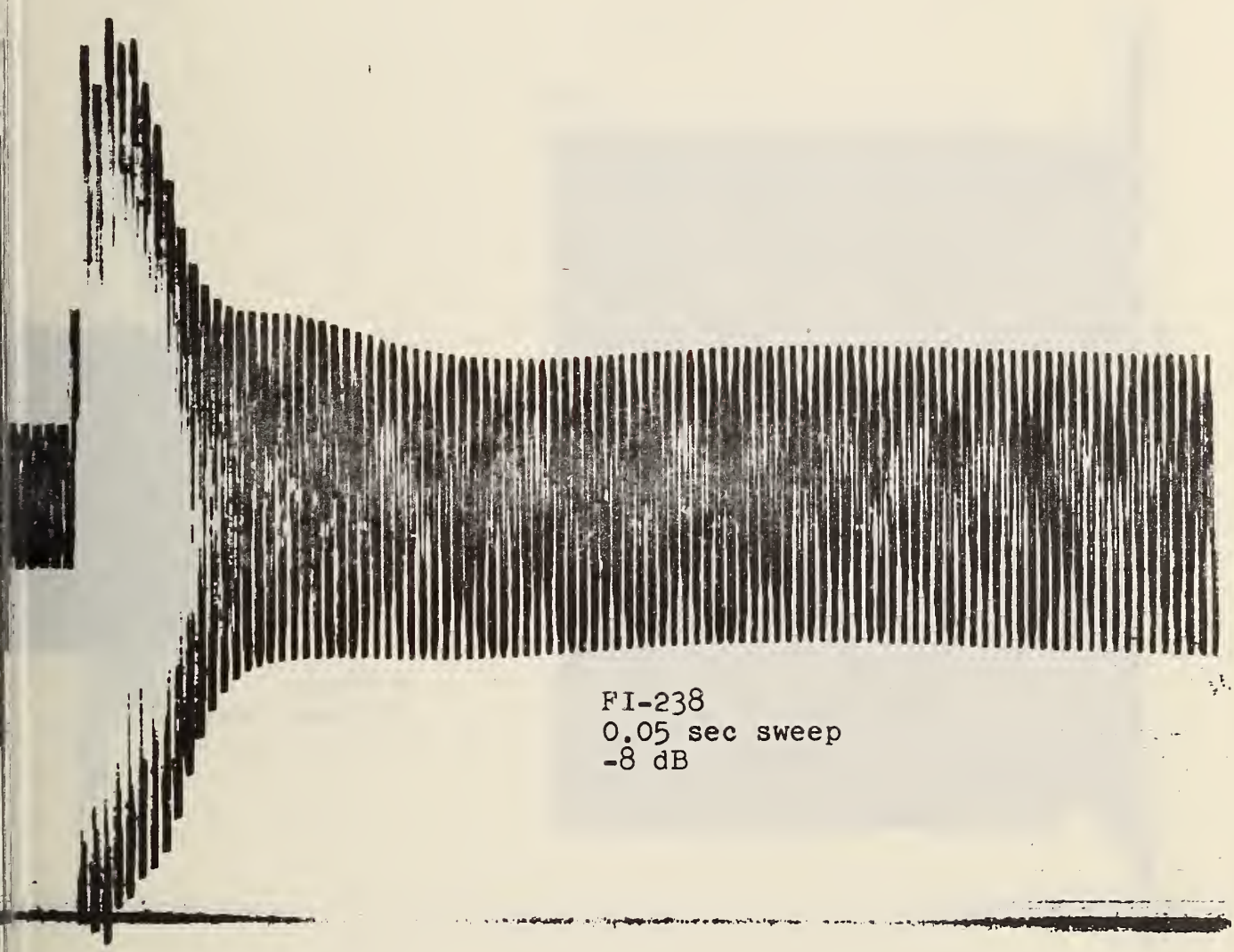


FI-234
1.0 sec sweep

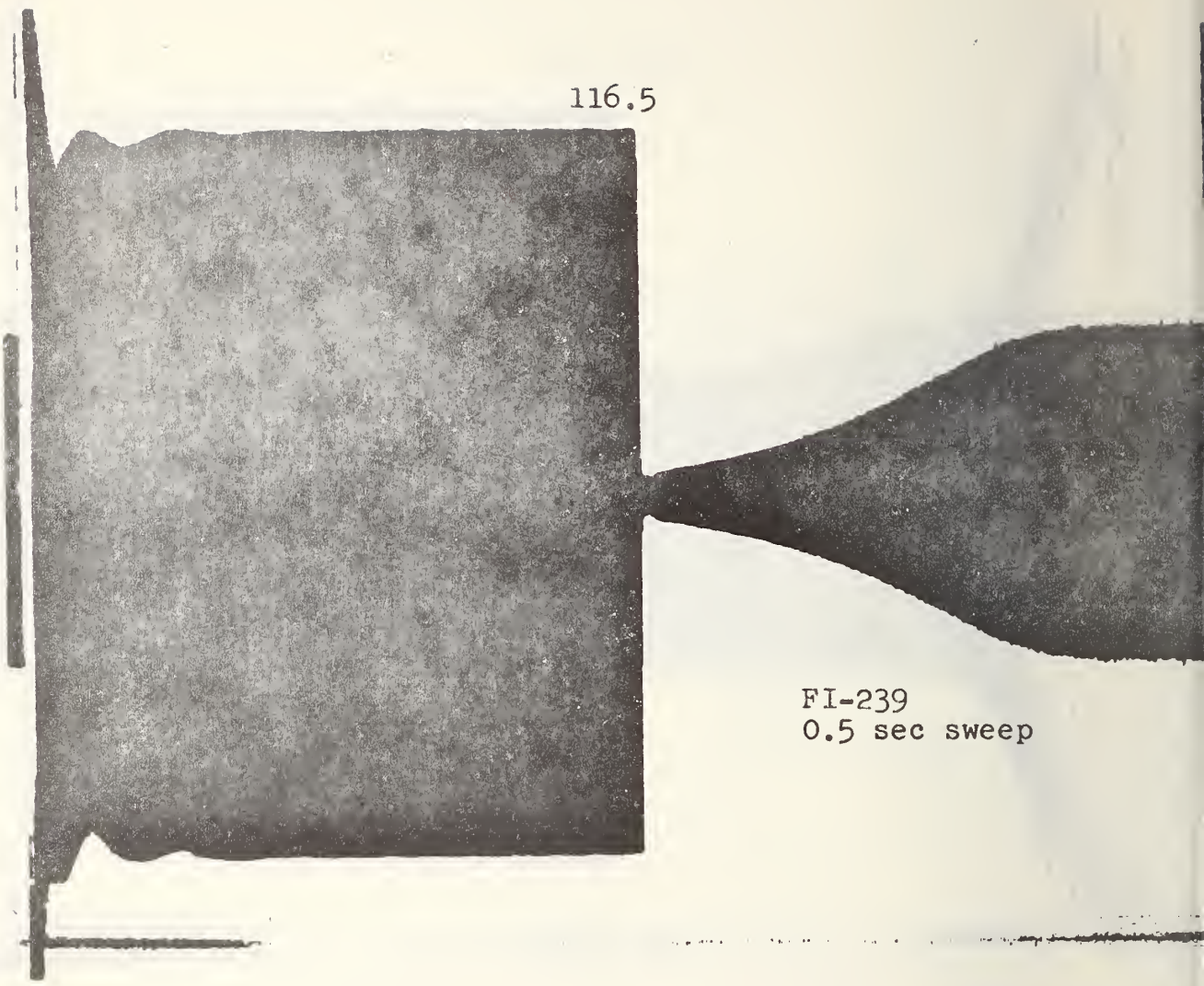


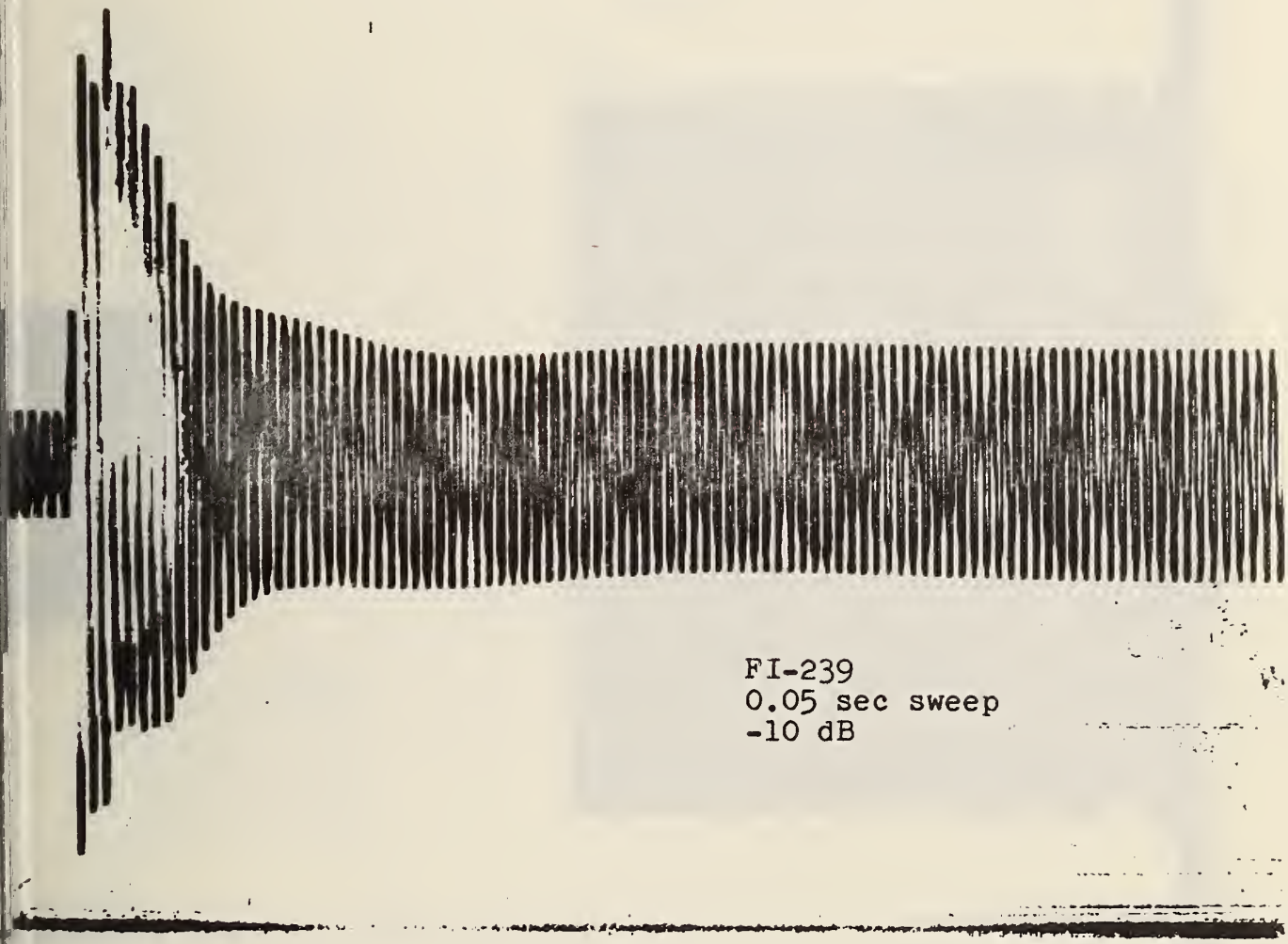
FI-234
0.1 sec sweep
-6 dB

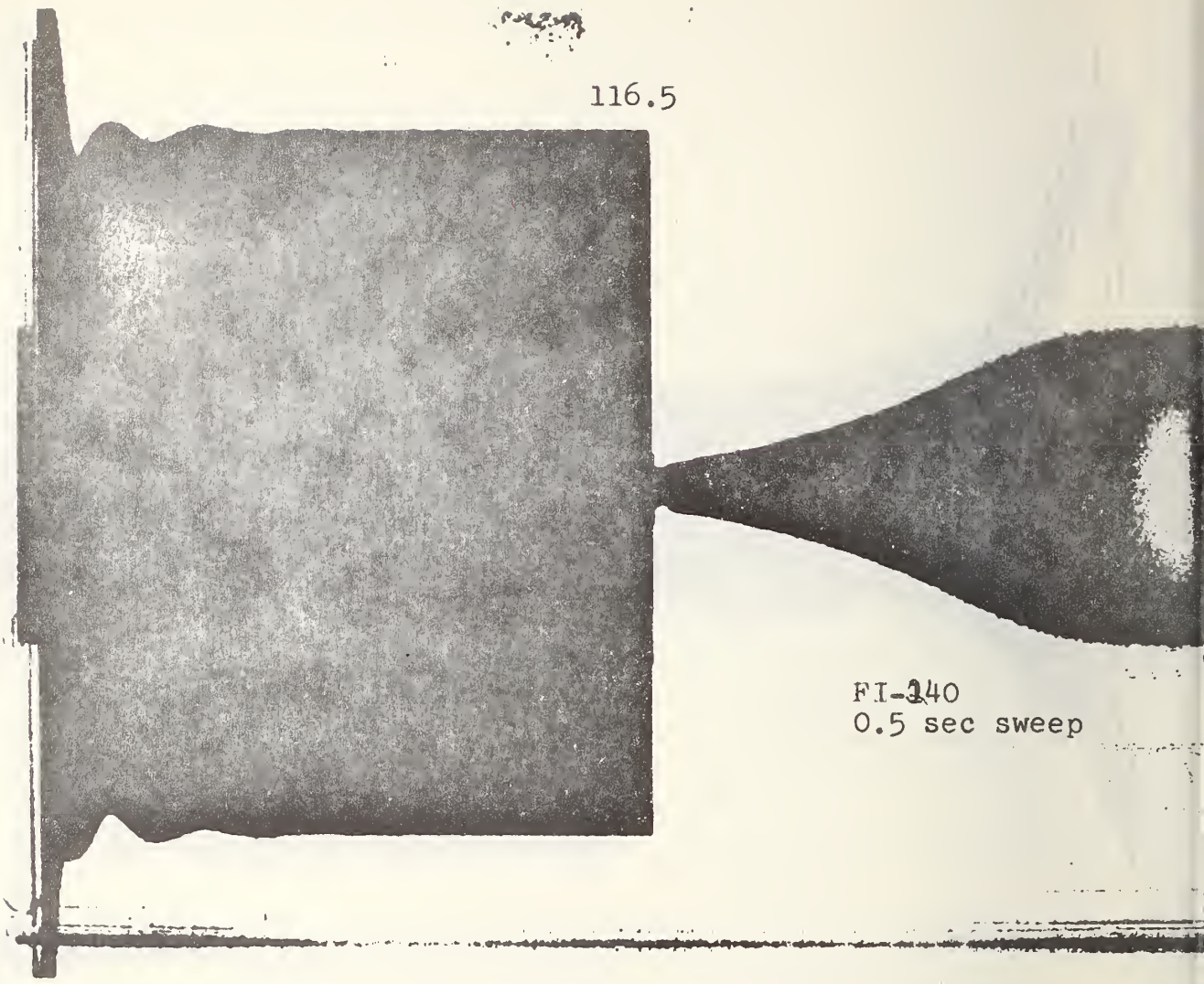

118.5 dB
FI-238
0.5 sec sweep

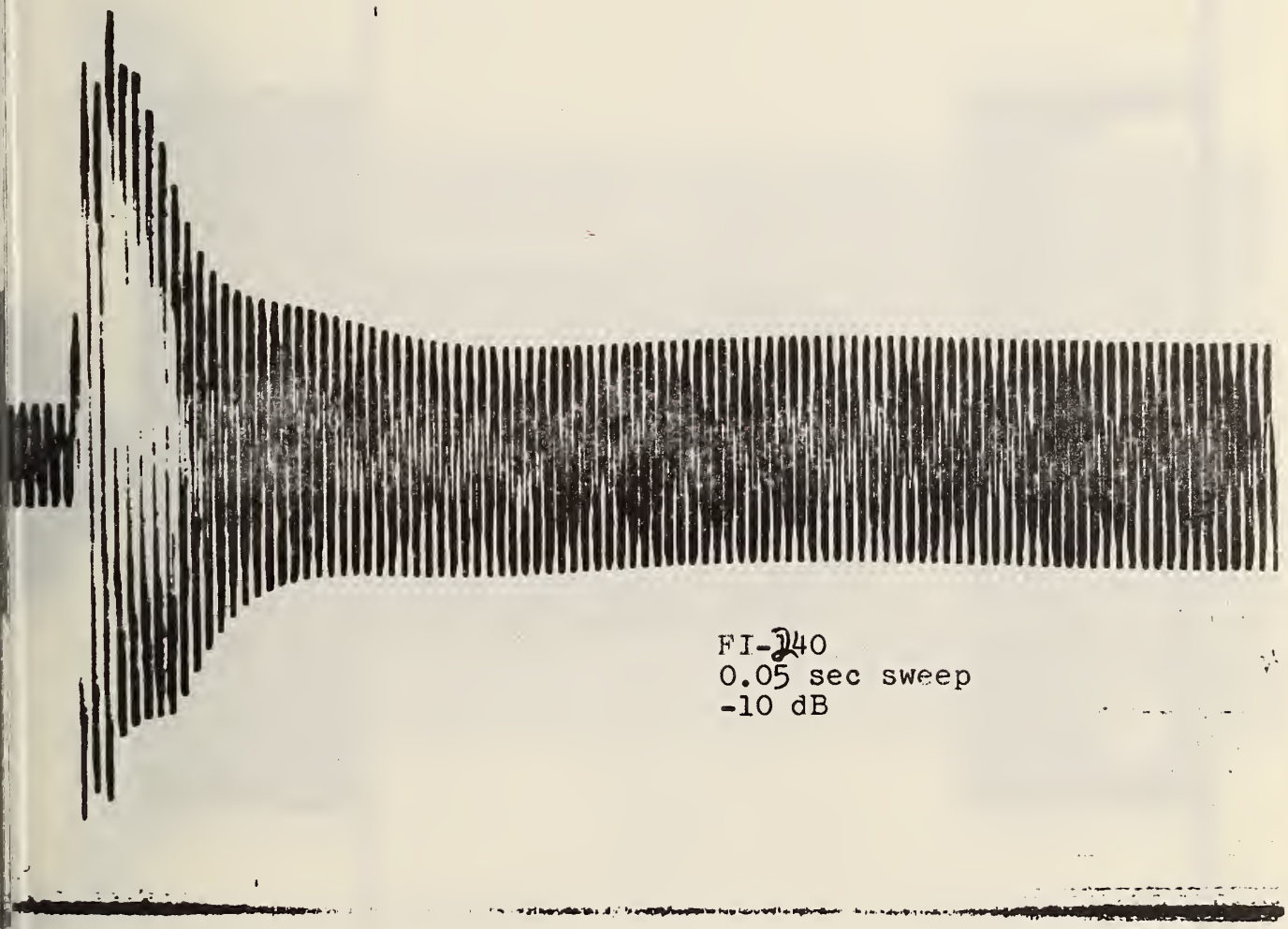


FI-238
0.05 sec sweep
-8 dB

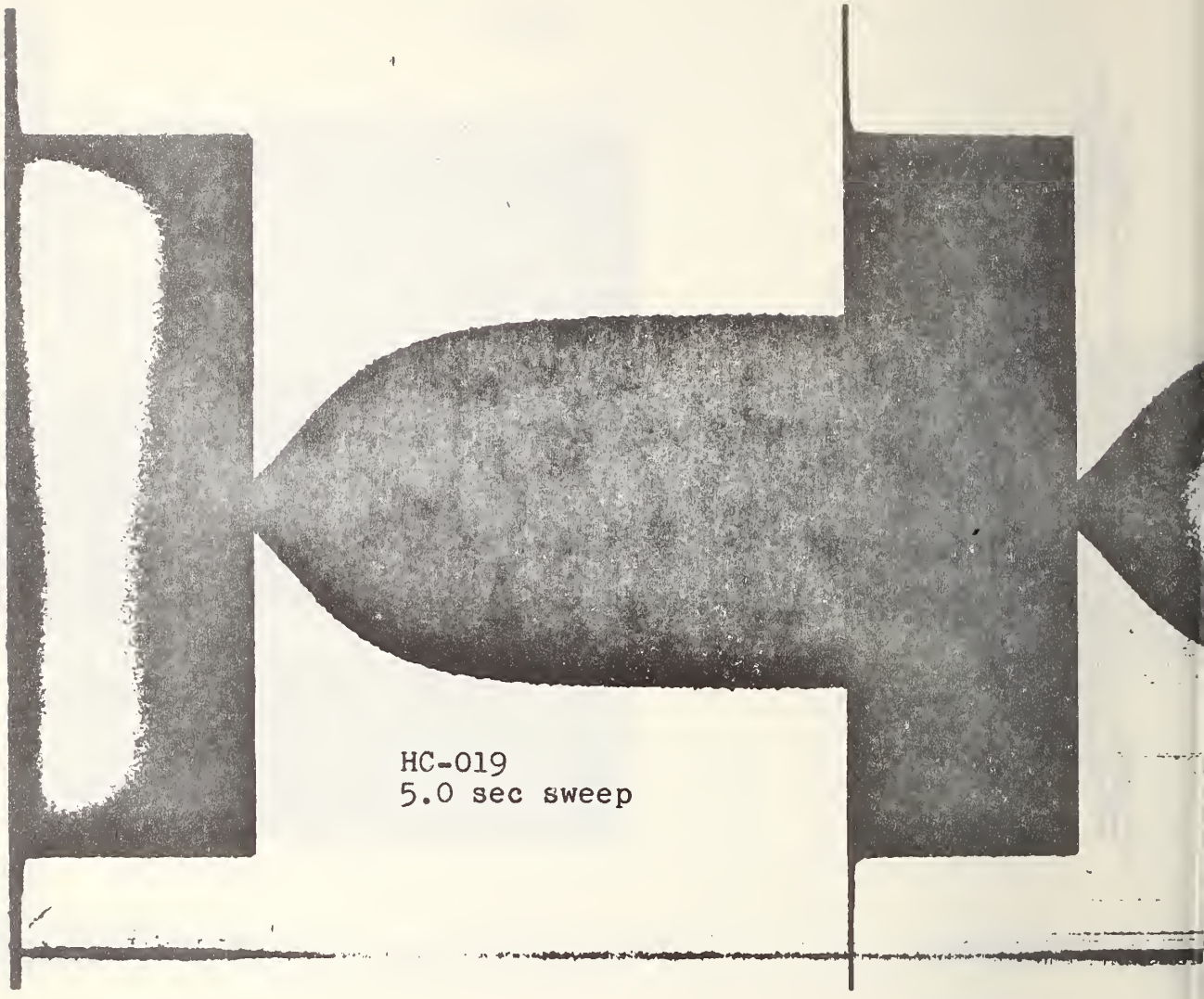

116.5
FI-239
0.5 sec sweep

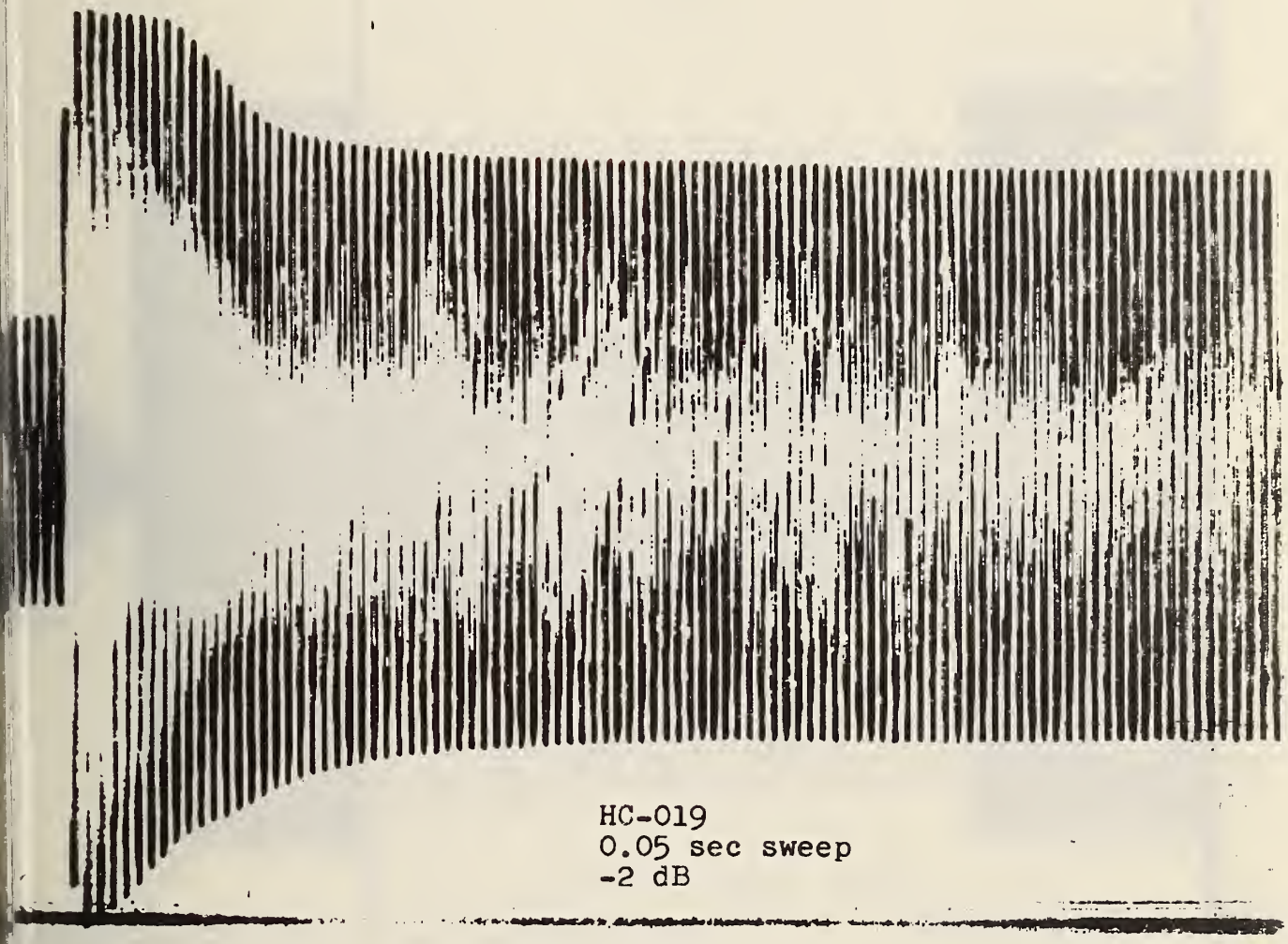

FI-239
0.05 sec sweep
-10 dB

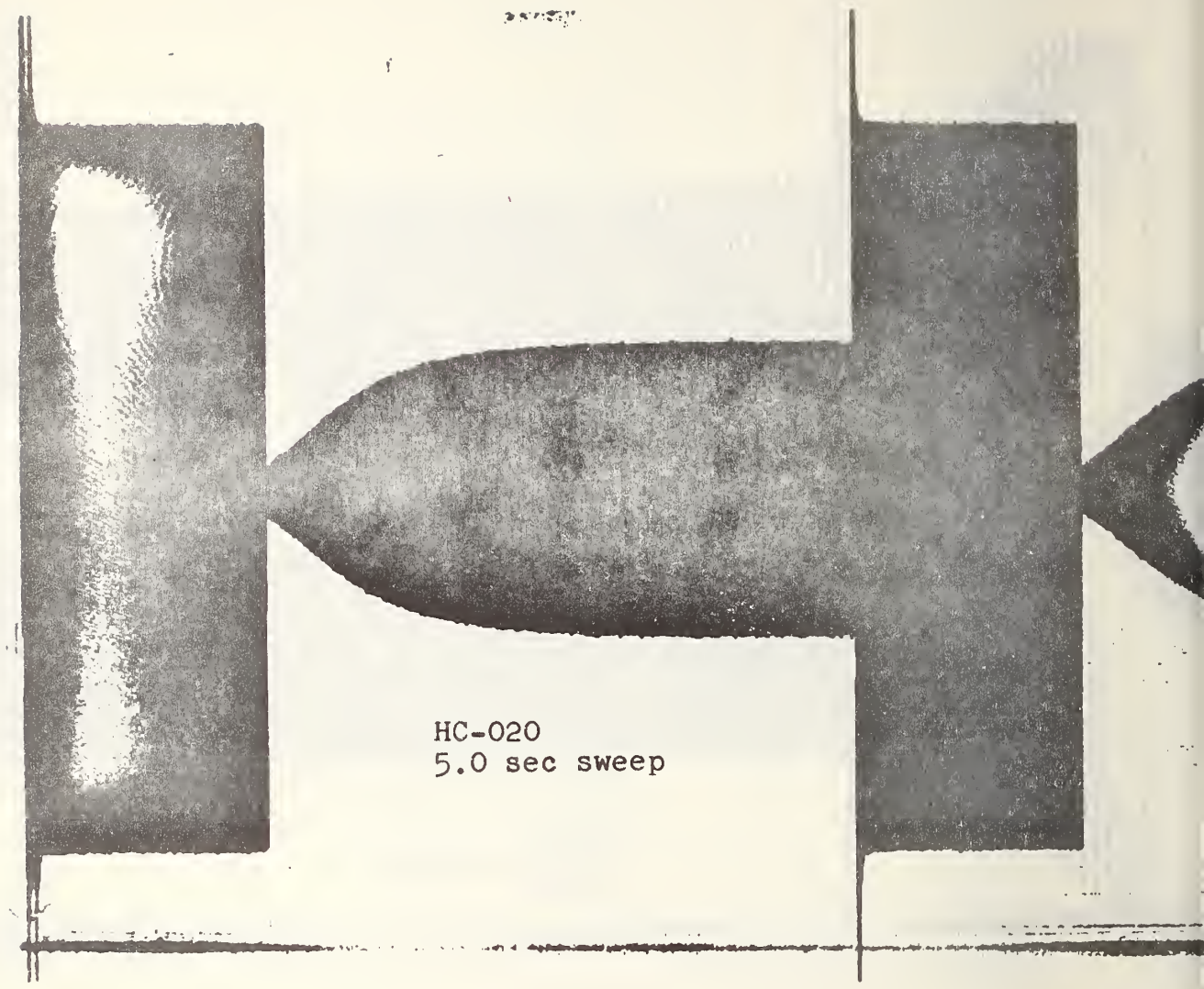

116.5
FI-140
0.5 sec sweep

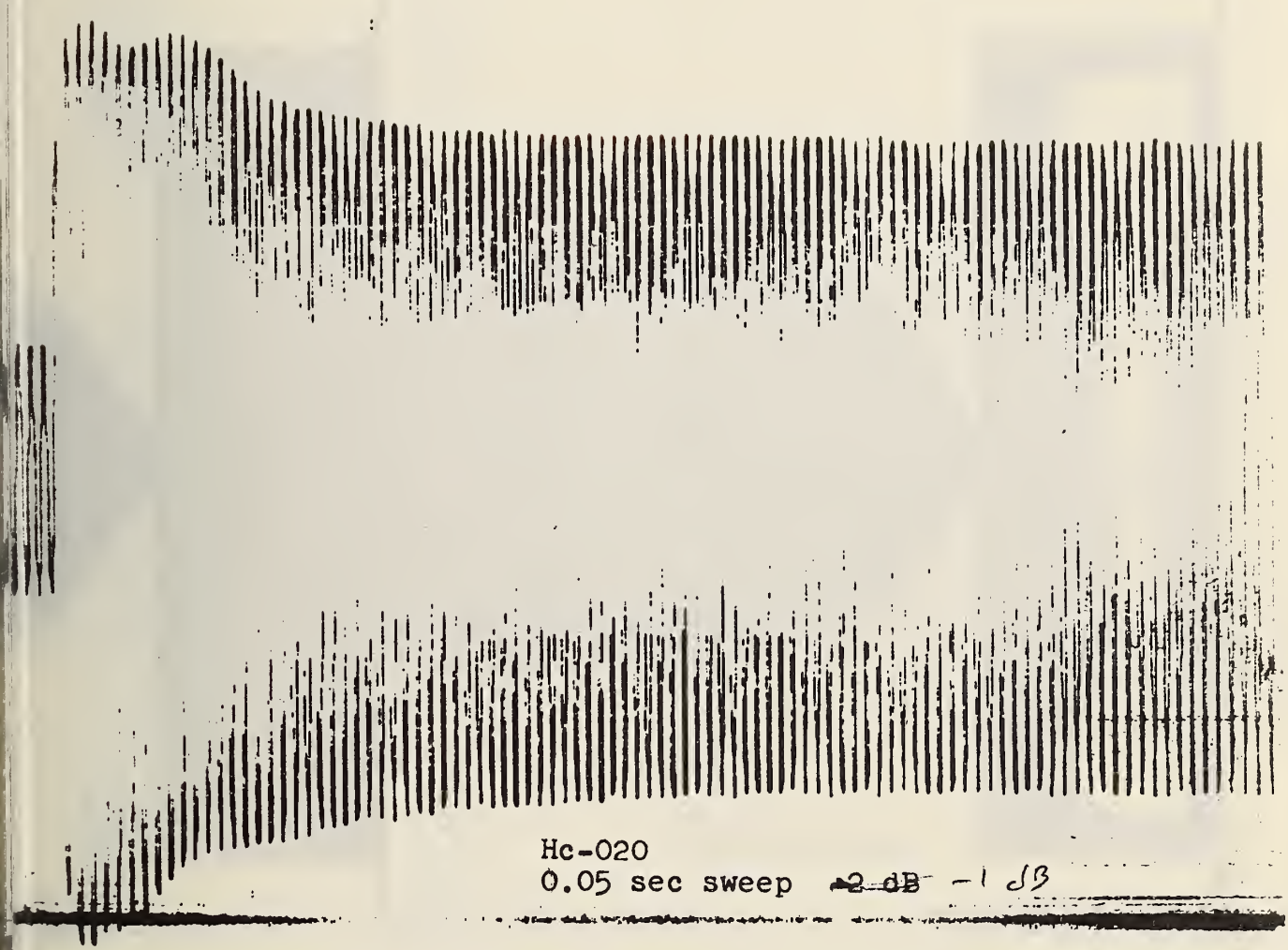


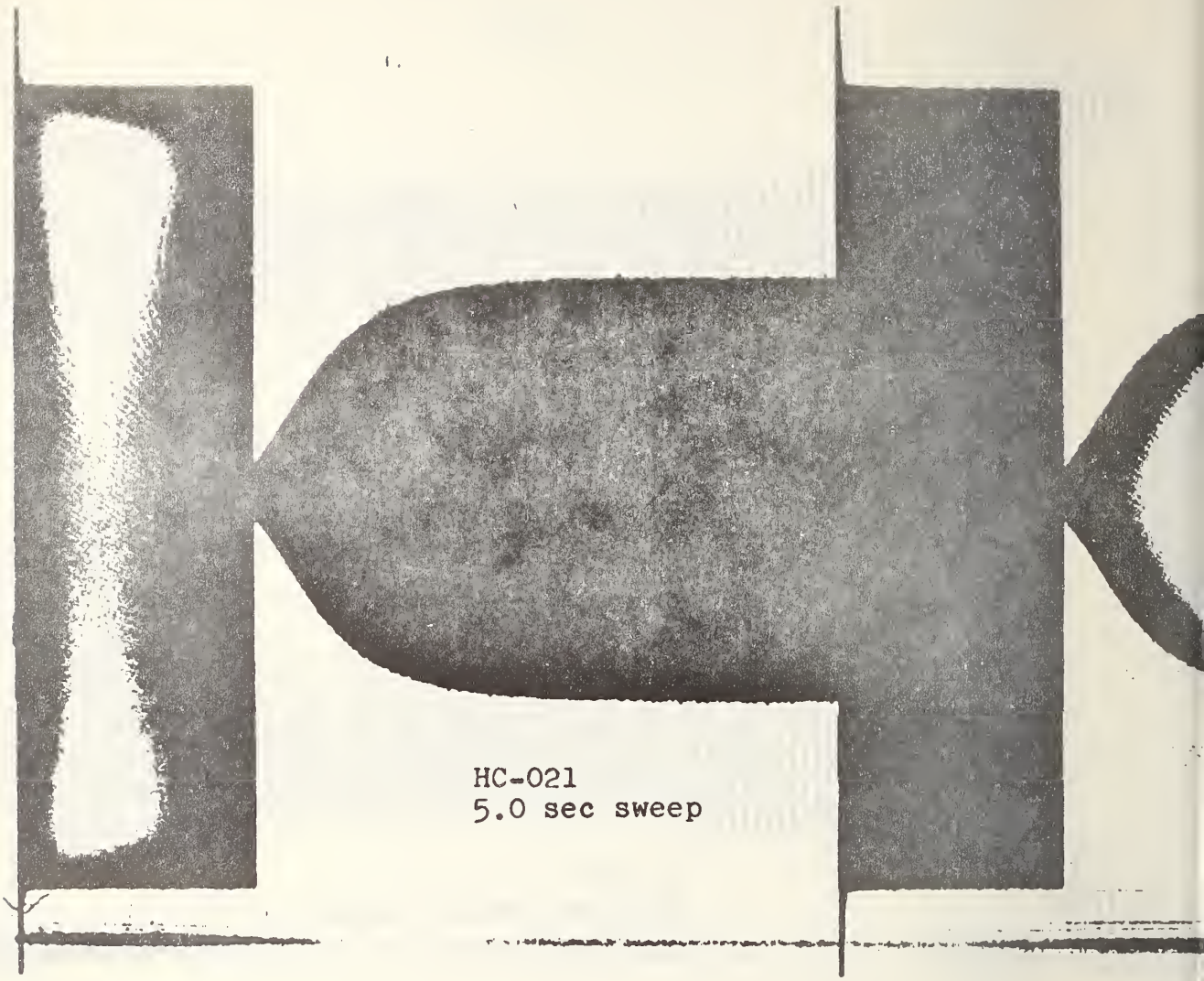
FI-240
0.05 sec sweep
-10 dB


HC-019
5.0 sec sweep


HC-019
0.05 sec sweep
-2 dB

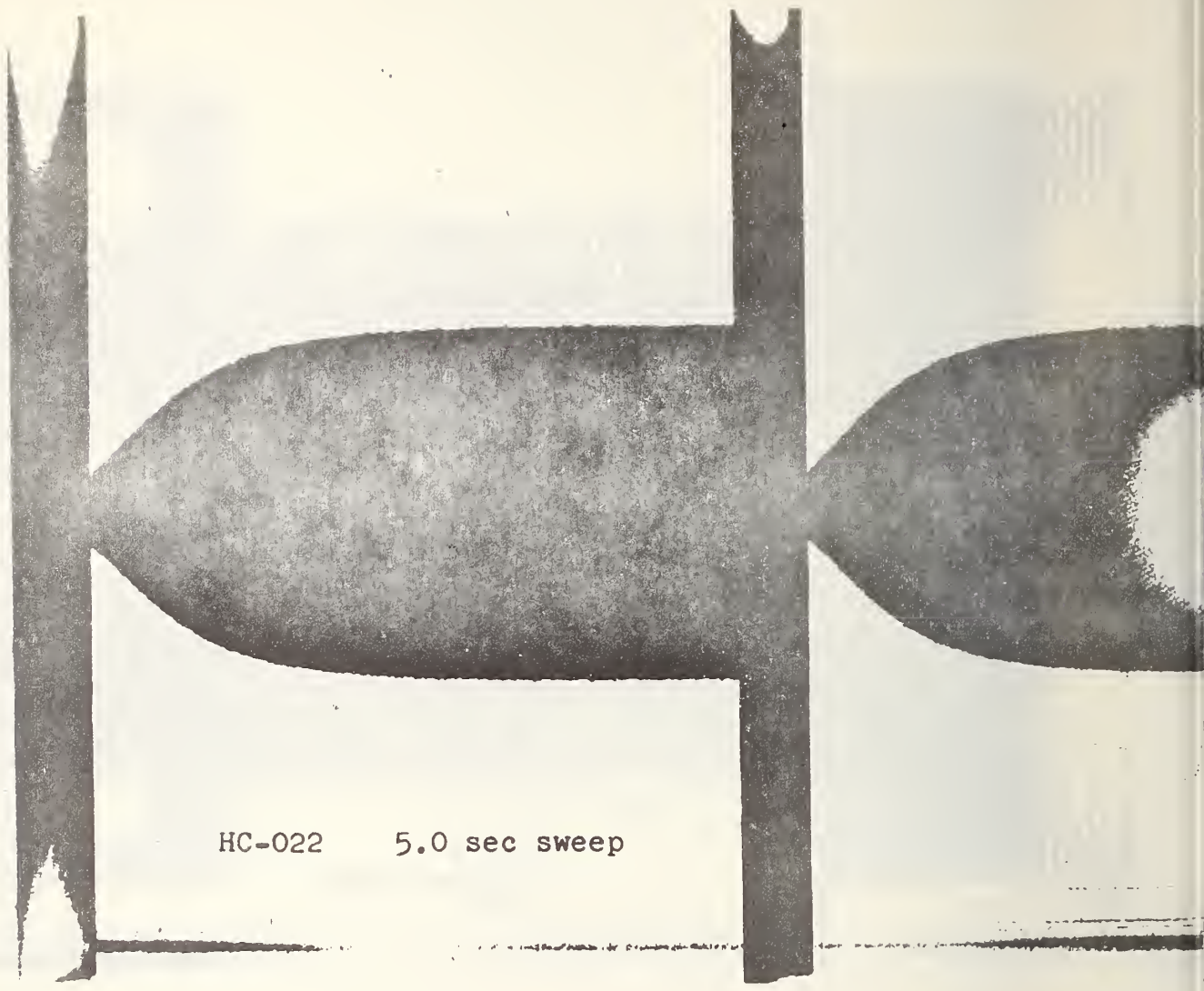

HC-020
5.0 sec sweep


Hc-020
0.05 sec sweep ~~2 dB~~ -1 dB

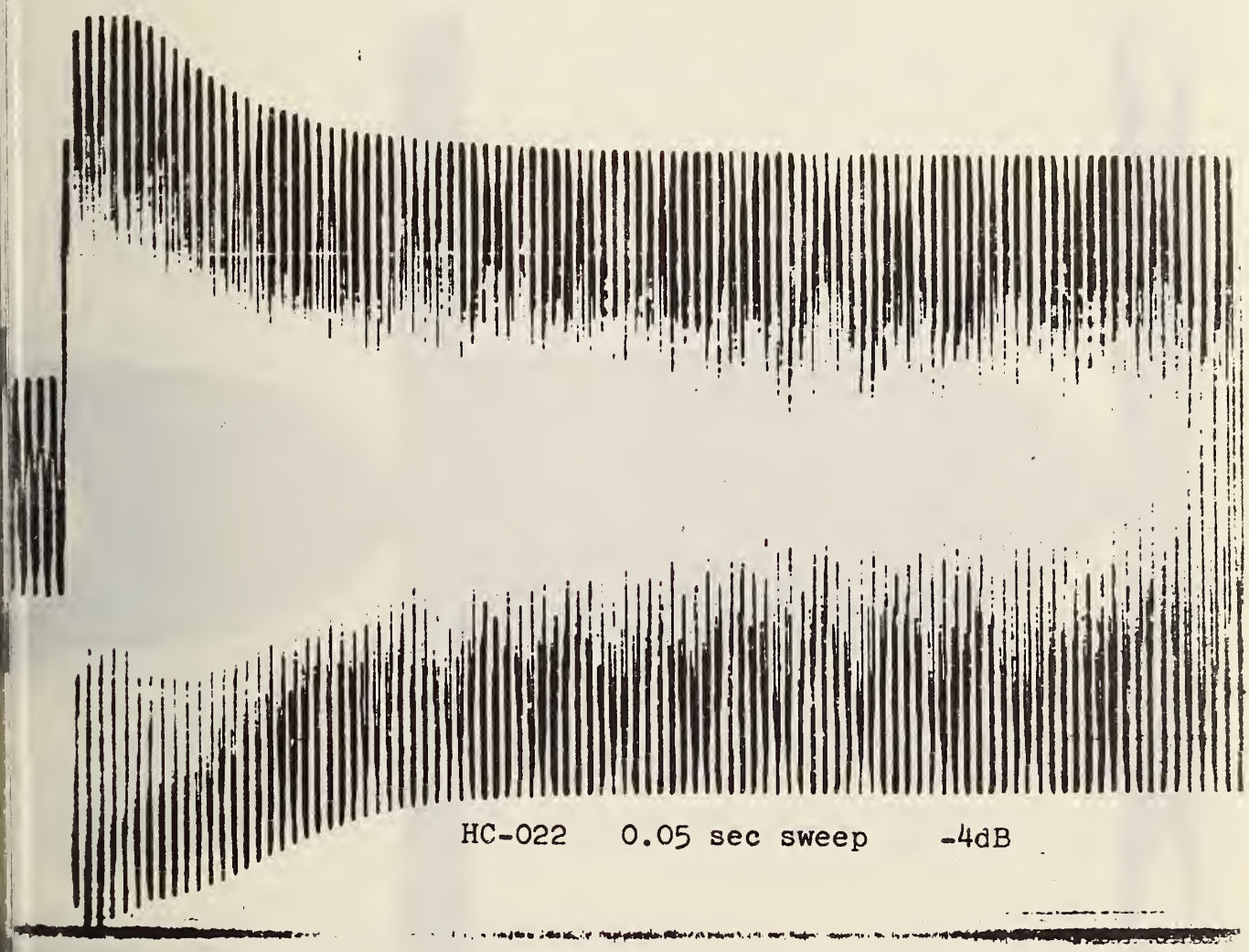


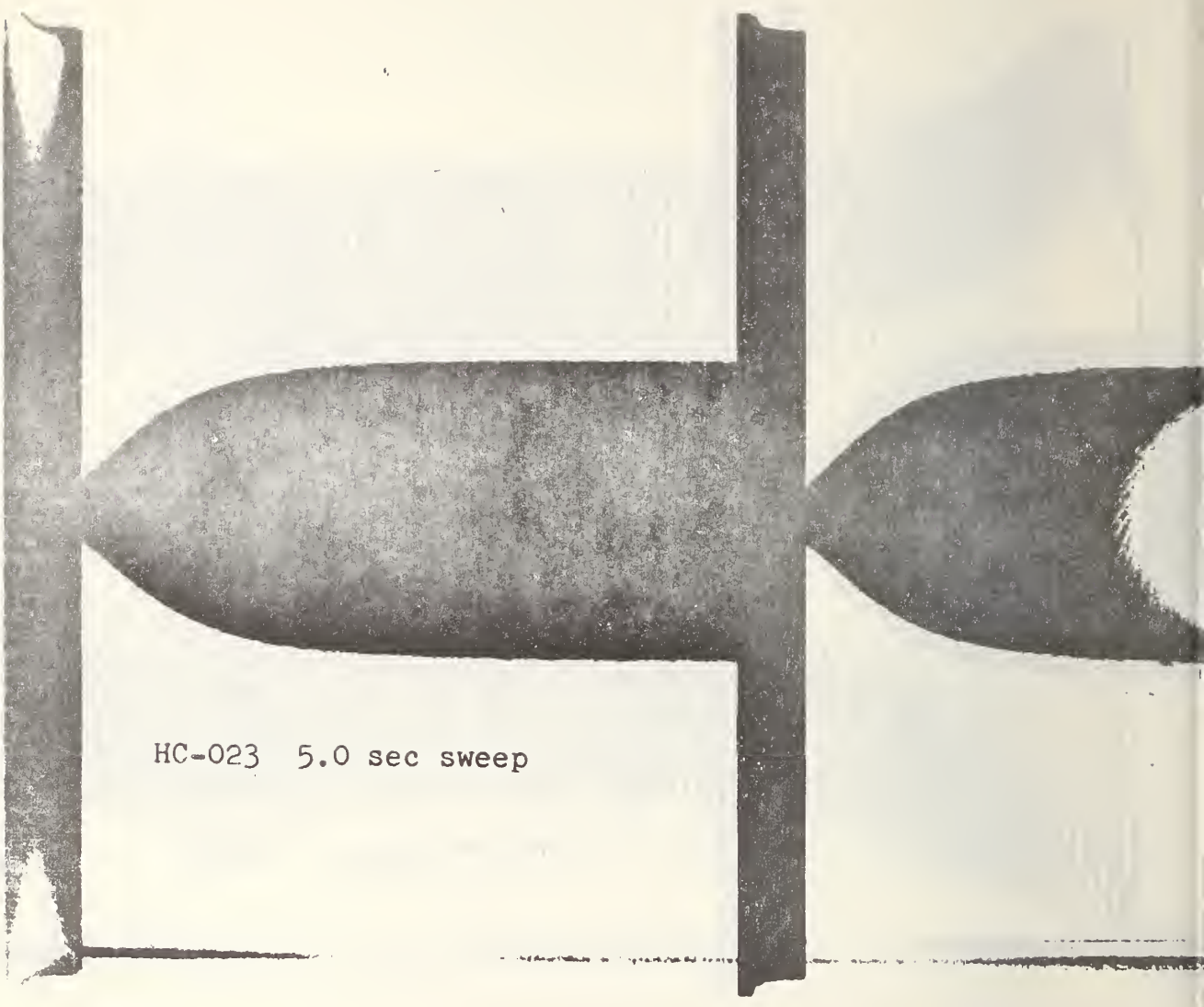
HC-021
5.0 sec sweep

HC-021
0.05 sec sweep
-3 dB



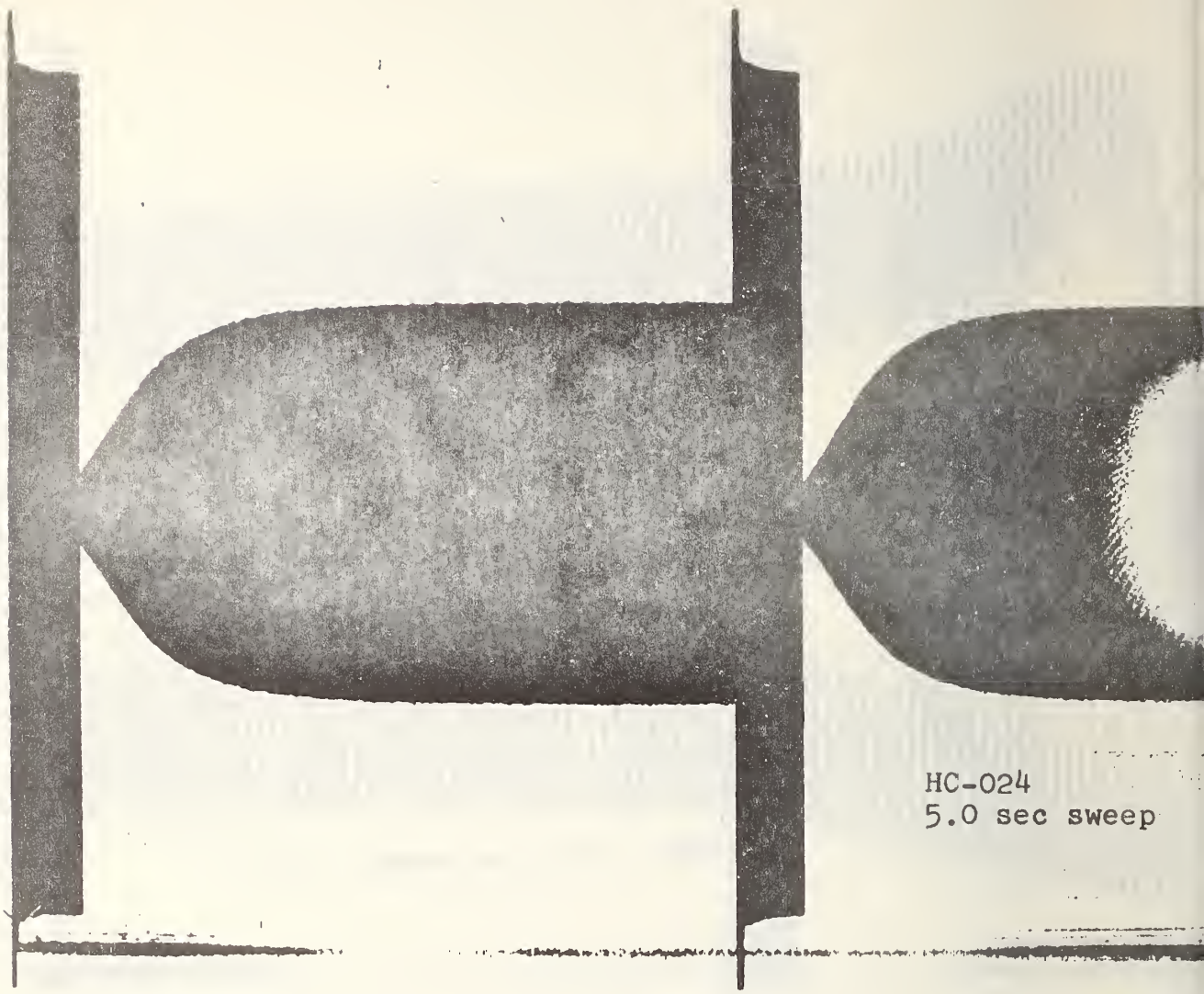
HC-022 5.0 sec sweep

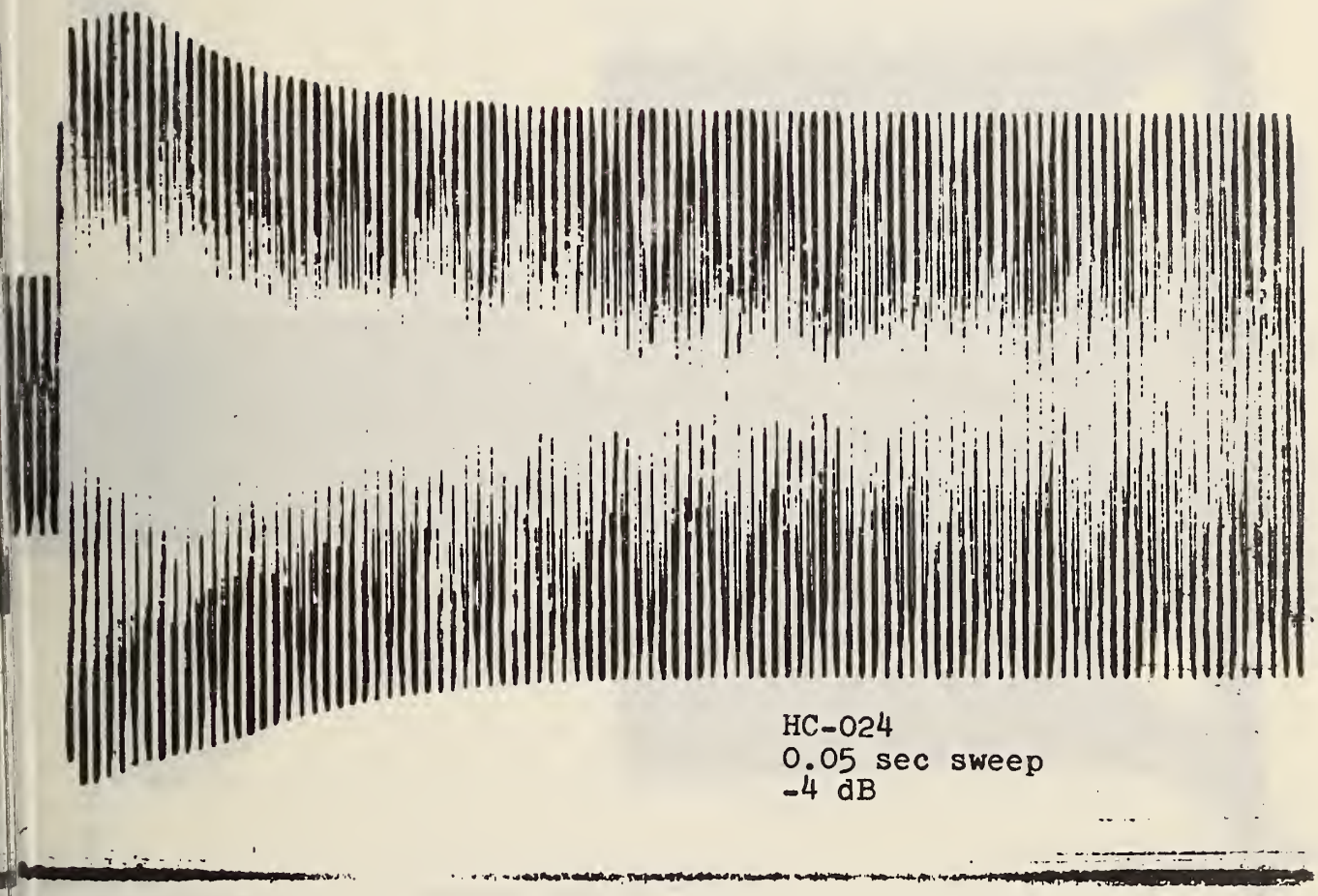

HC-022 0.05 sec sweep -4dB

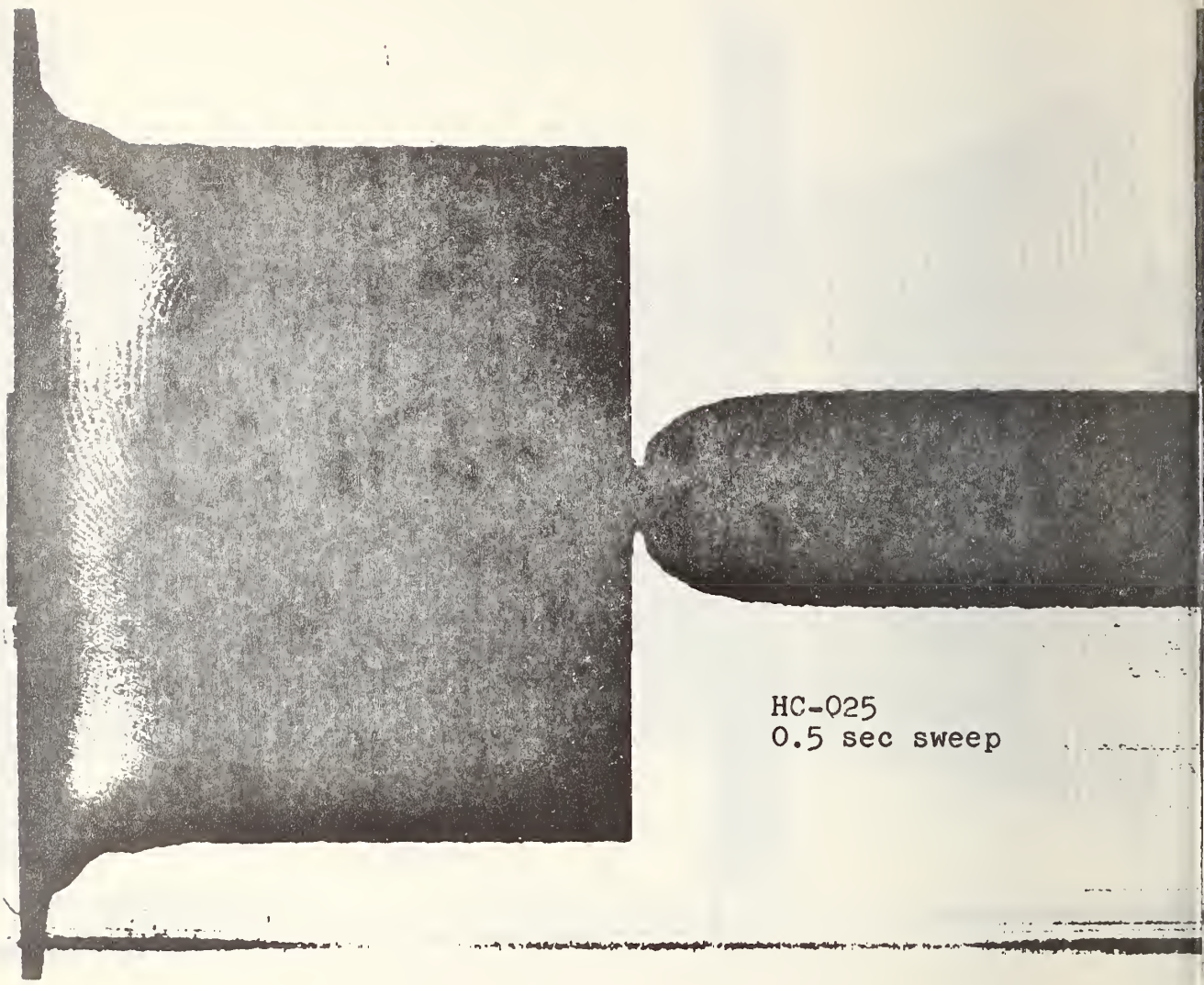


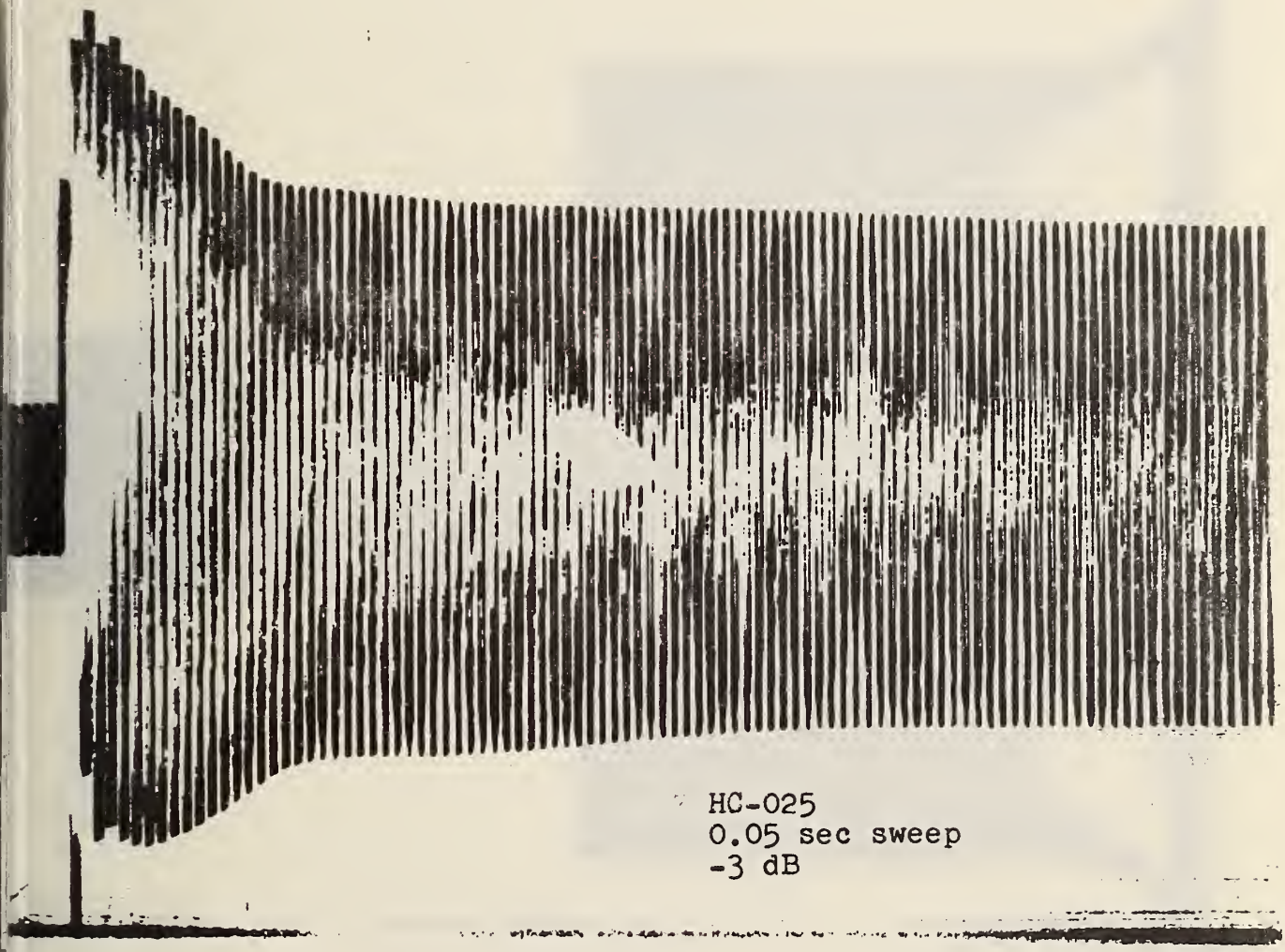
HC-023 5.0 sec sweep

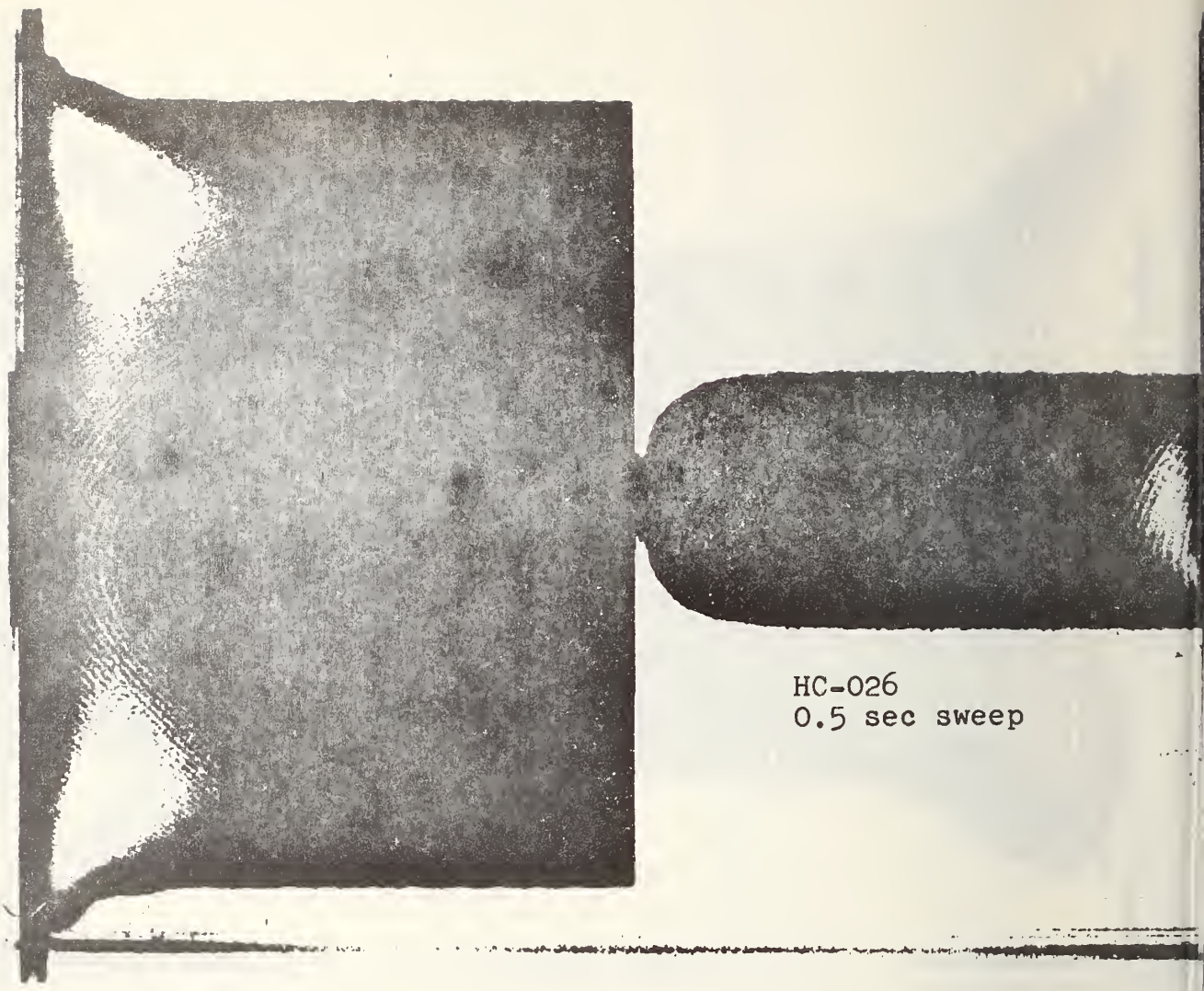

HC-023 0.05 sec sweep -4dB


HC-024
5.0 sec sweep


HC-024
0.05 sec sweep
-4 dB

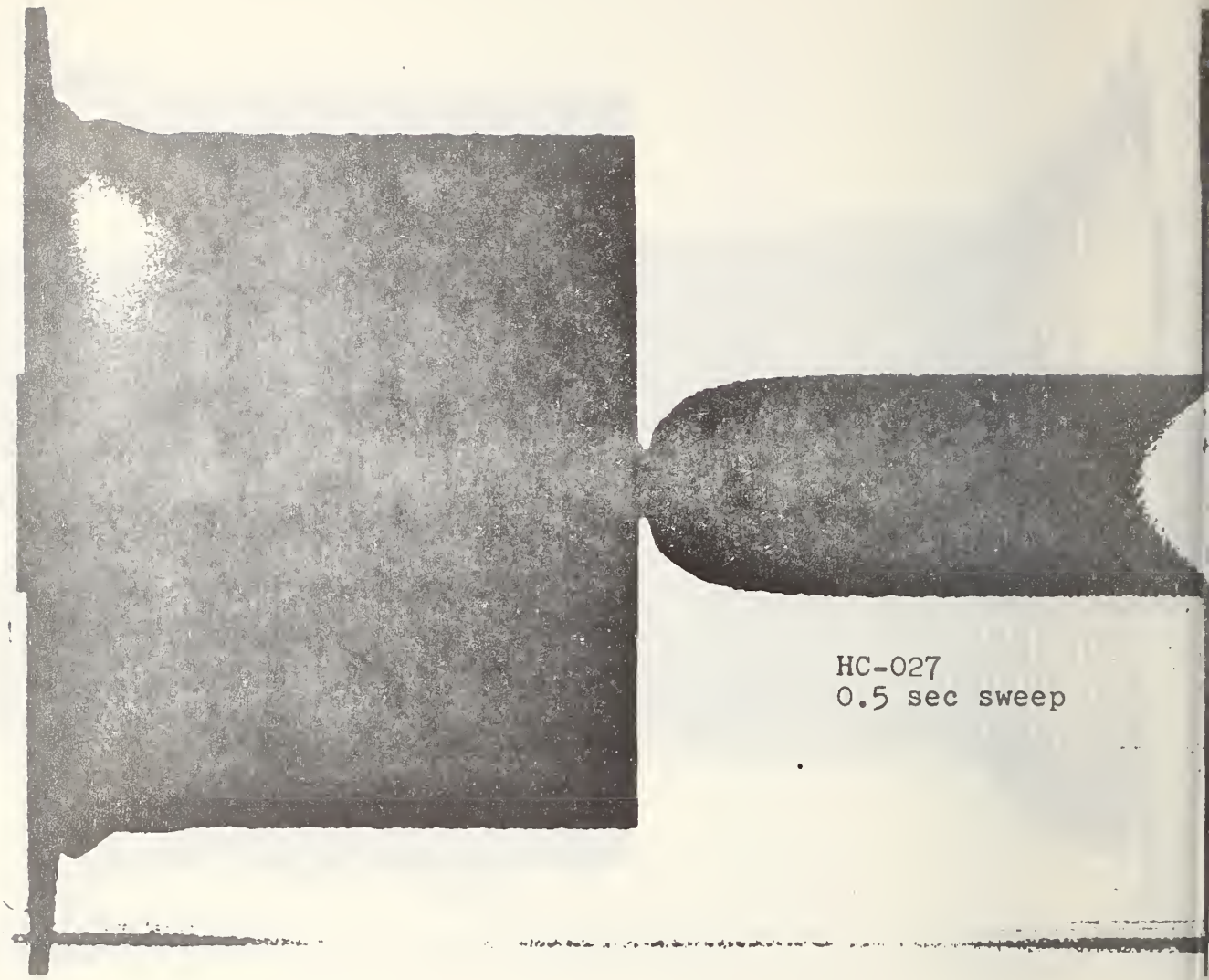

HC-025
0.5 sec sweep

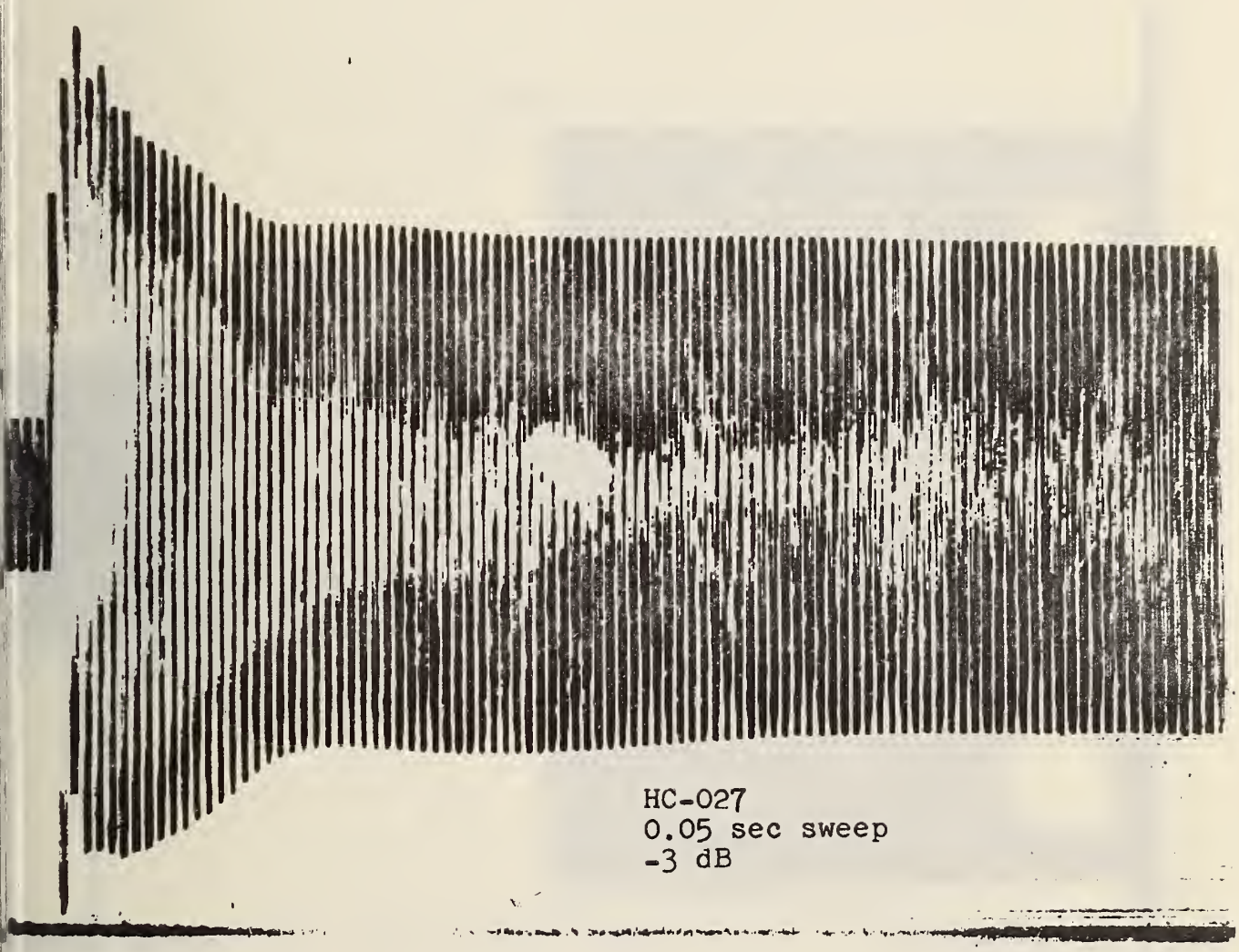

HC-025
0.05 sec sweep
-3 dB



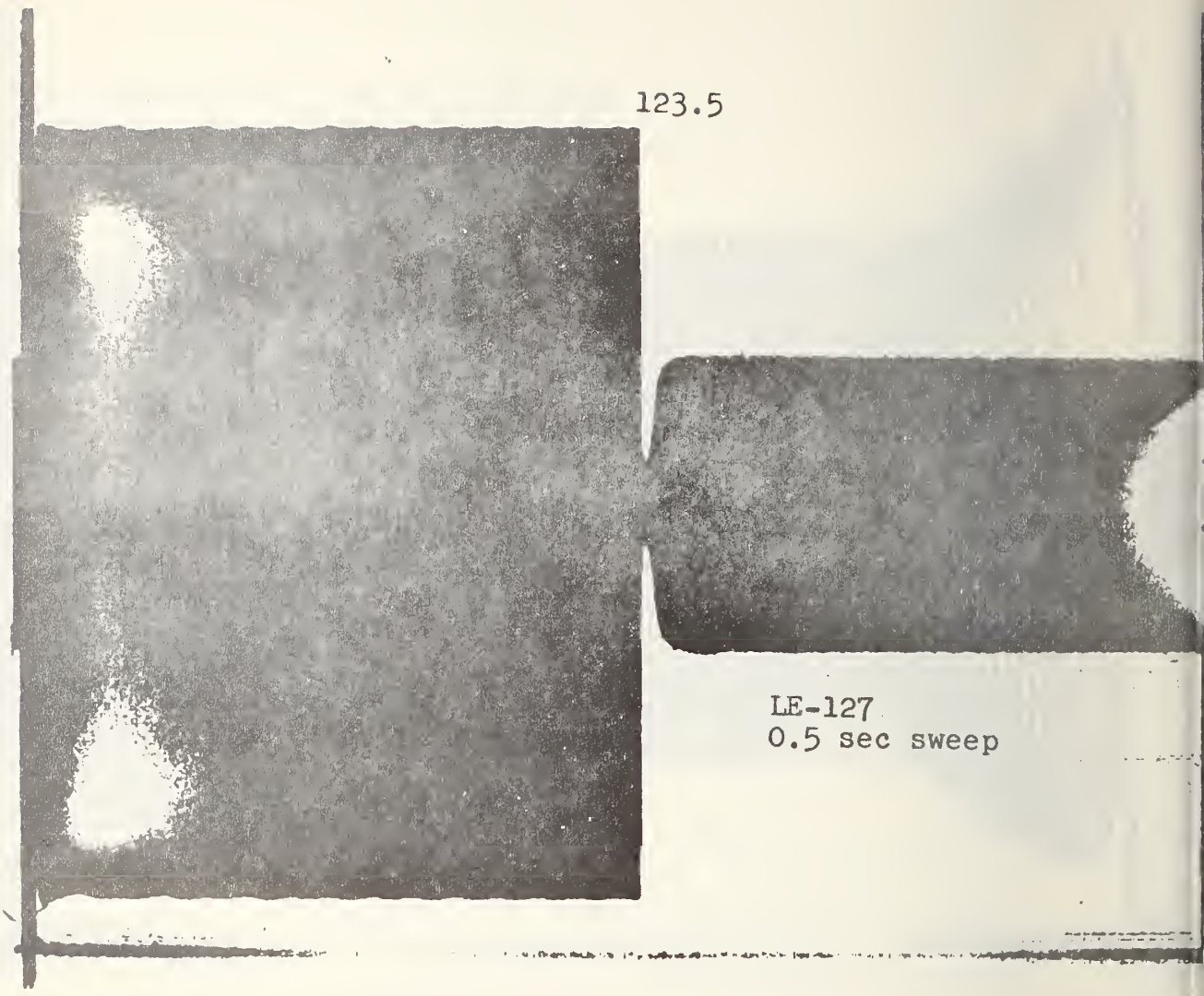
HC-026
0.5 sec sweep

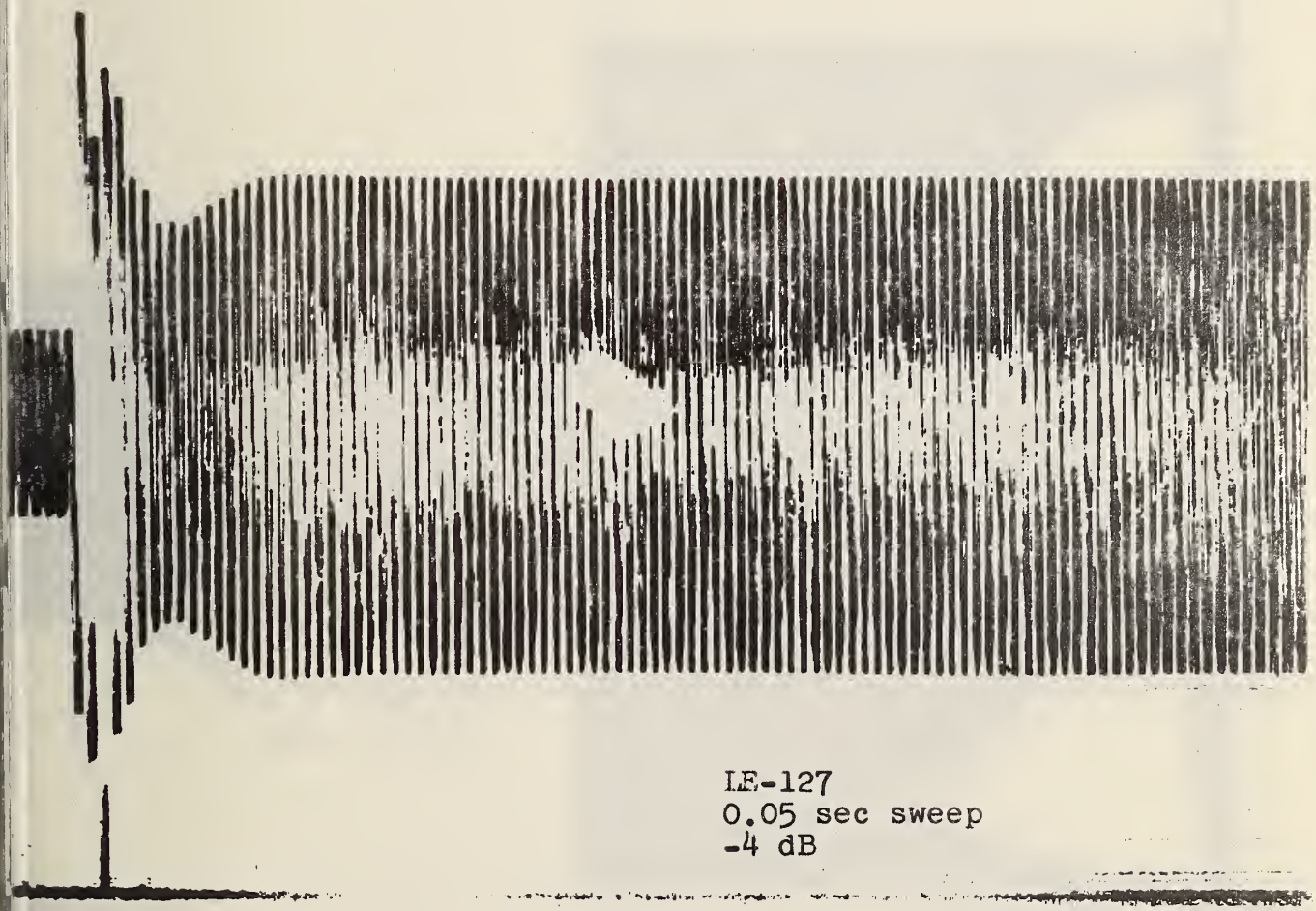
HC-026
0.05 sec sweep
-4 dB


HC-027
0.5 sec sweep

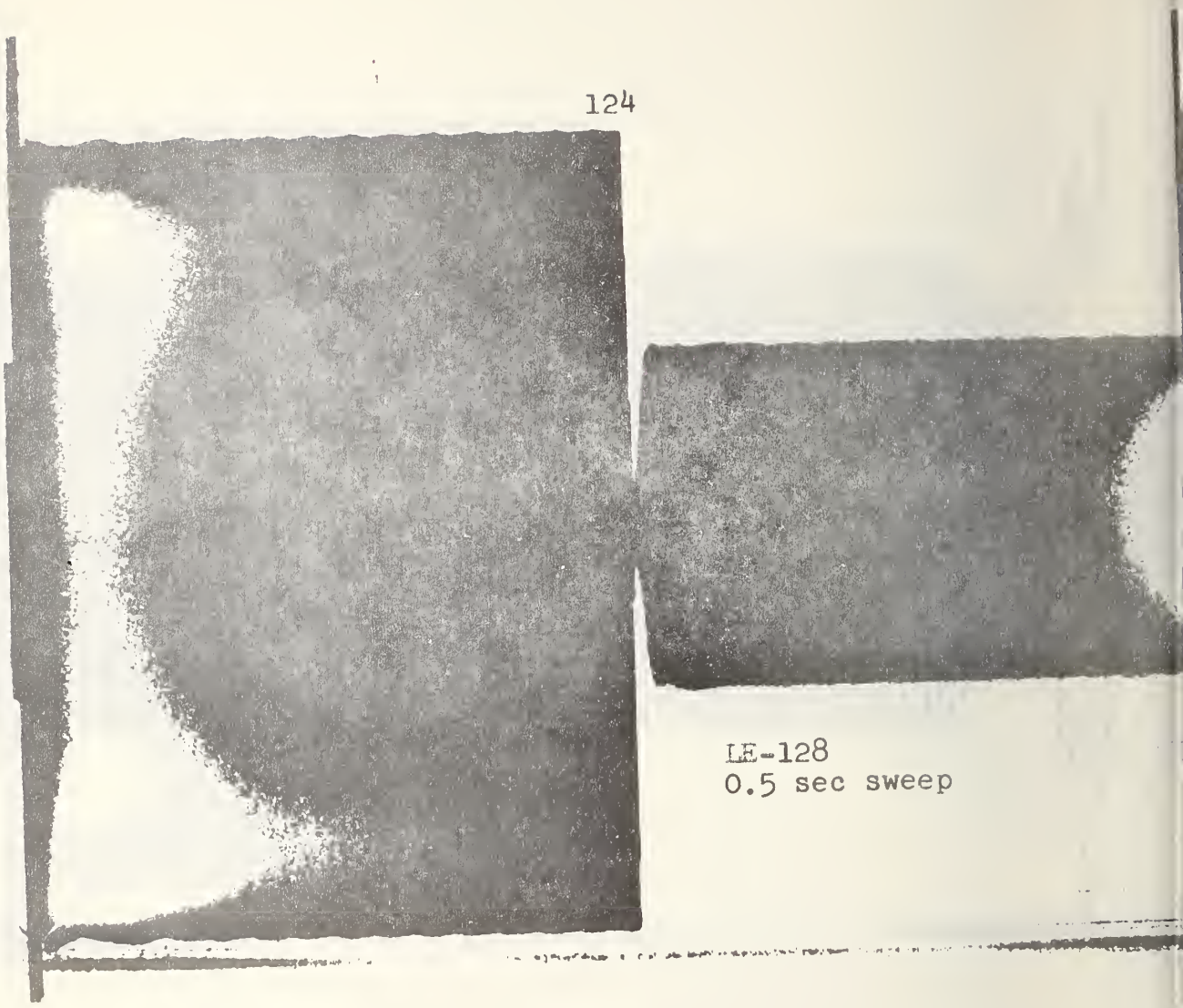


HC-027
0.05 sec sweep
-3 dB

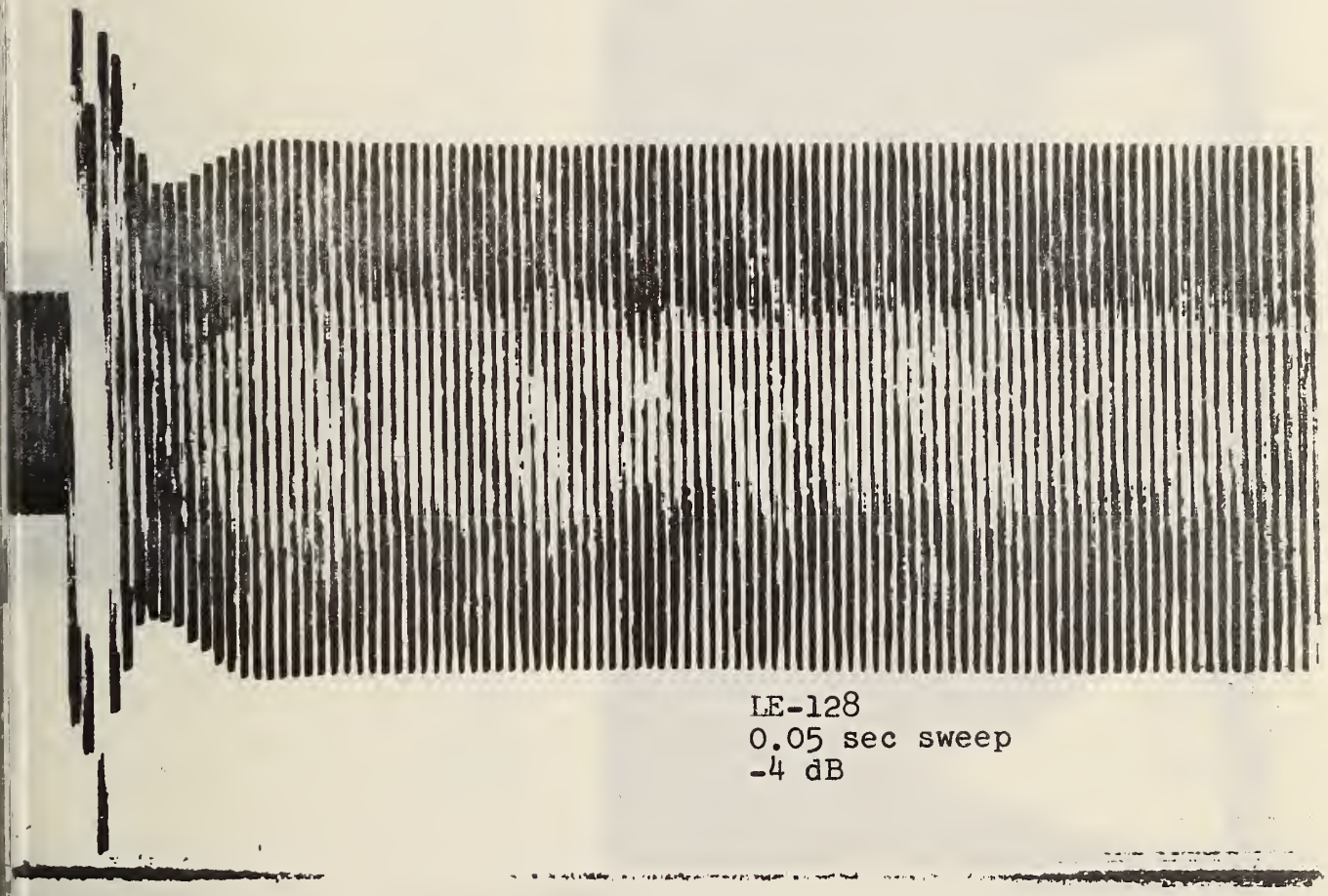

123.5
LE-127
0.5 sec sweep



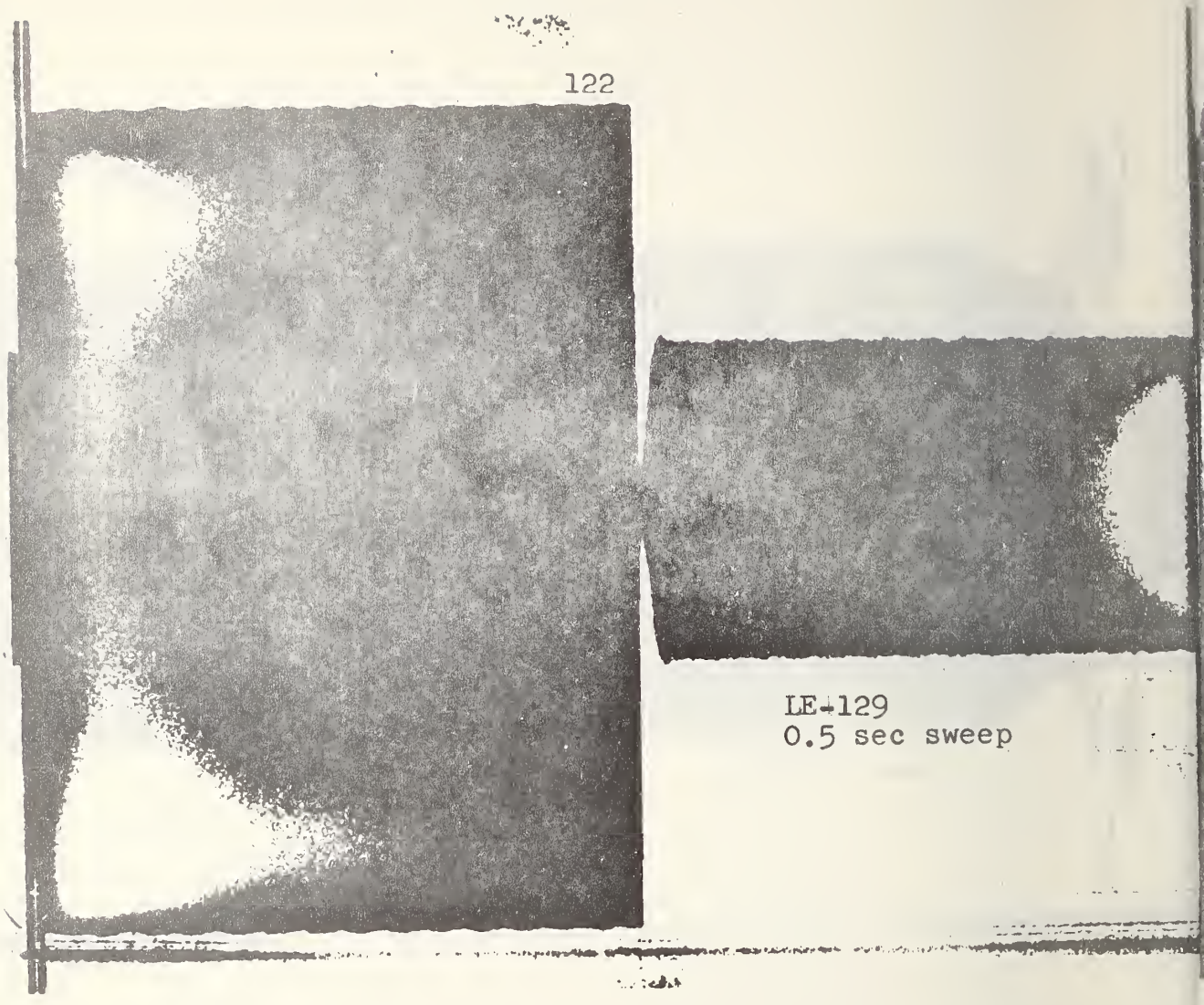
LE-127
0.05 sec sweep
-4 dB

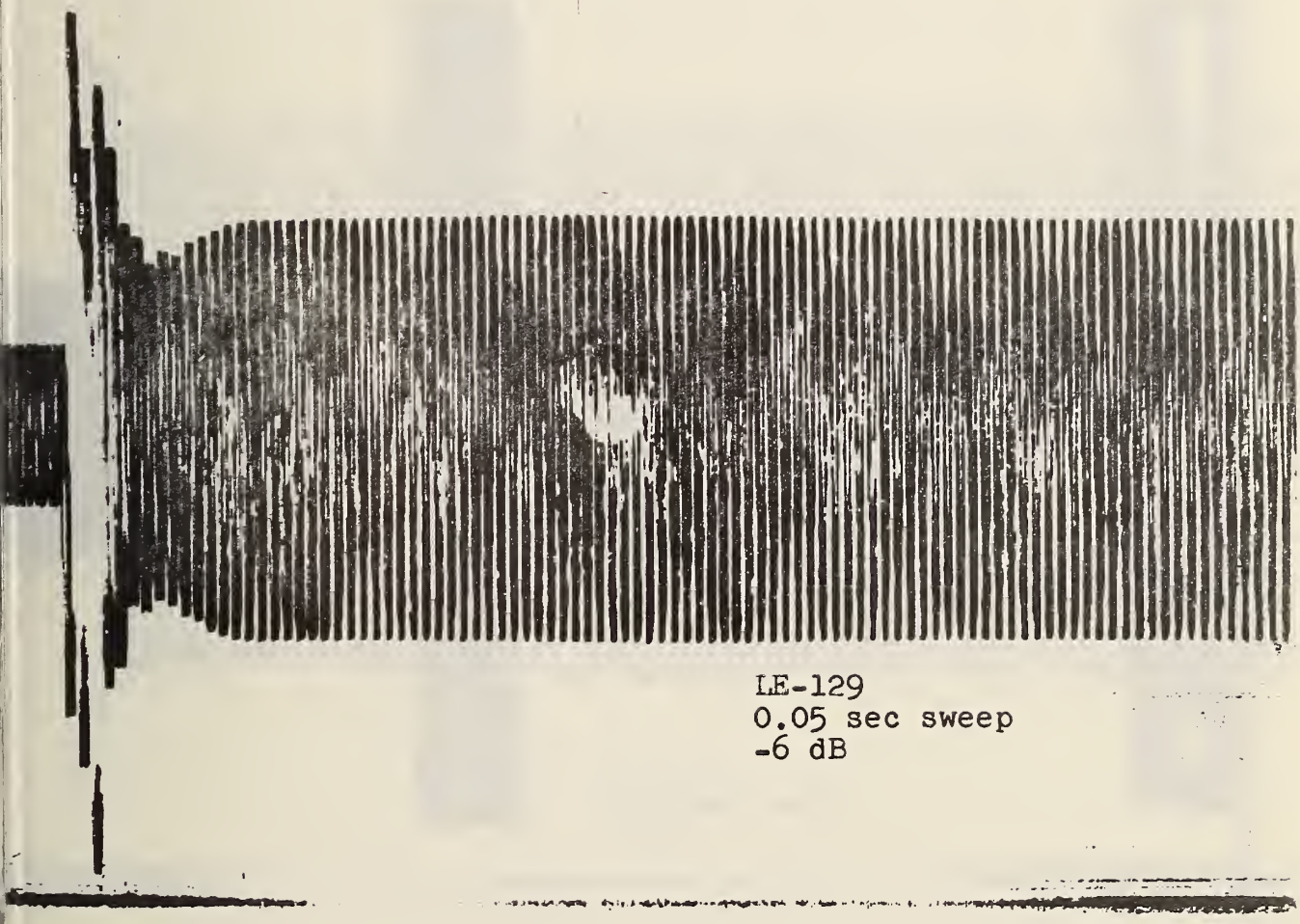


LE-128
0.5 sec sweep

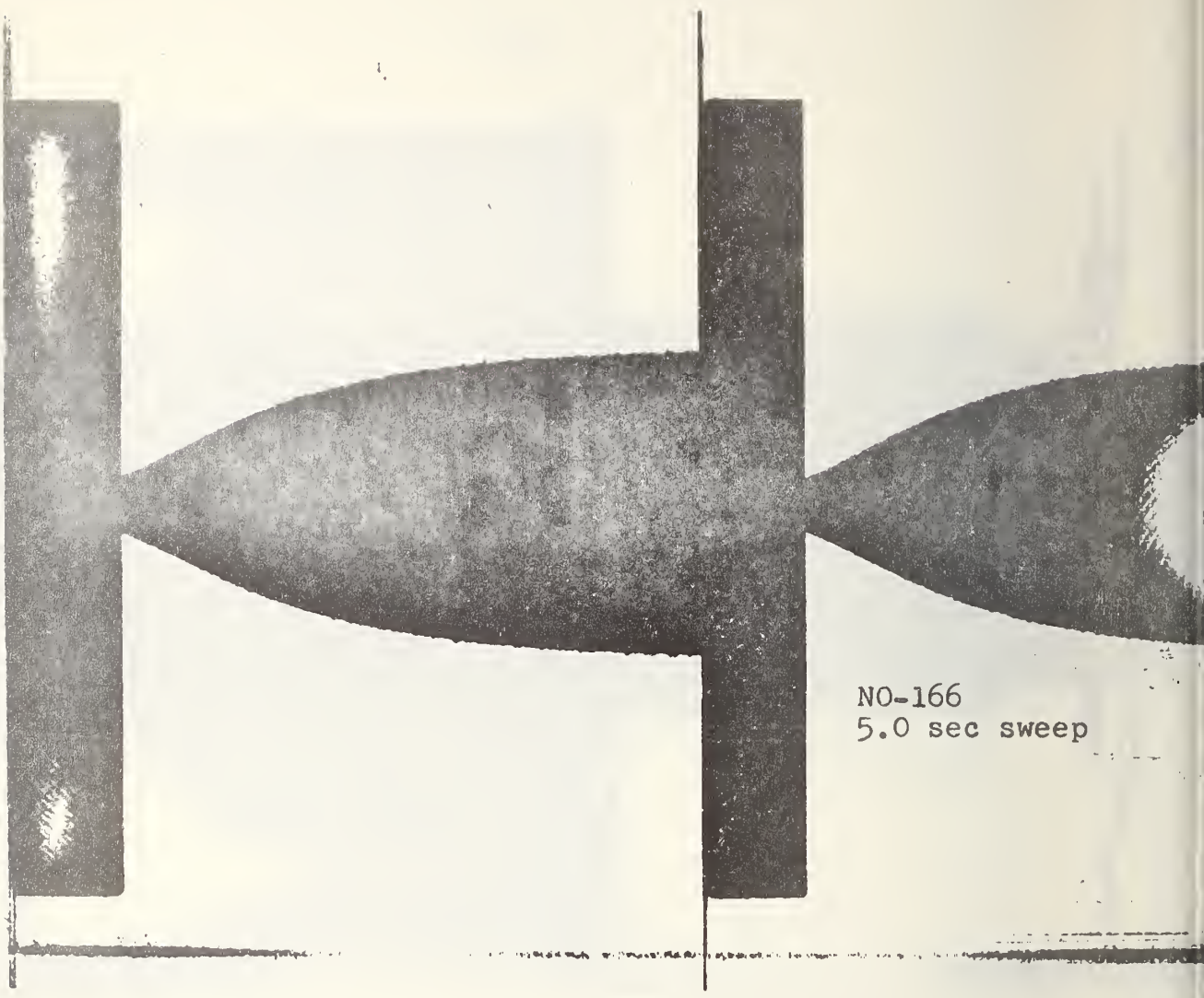


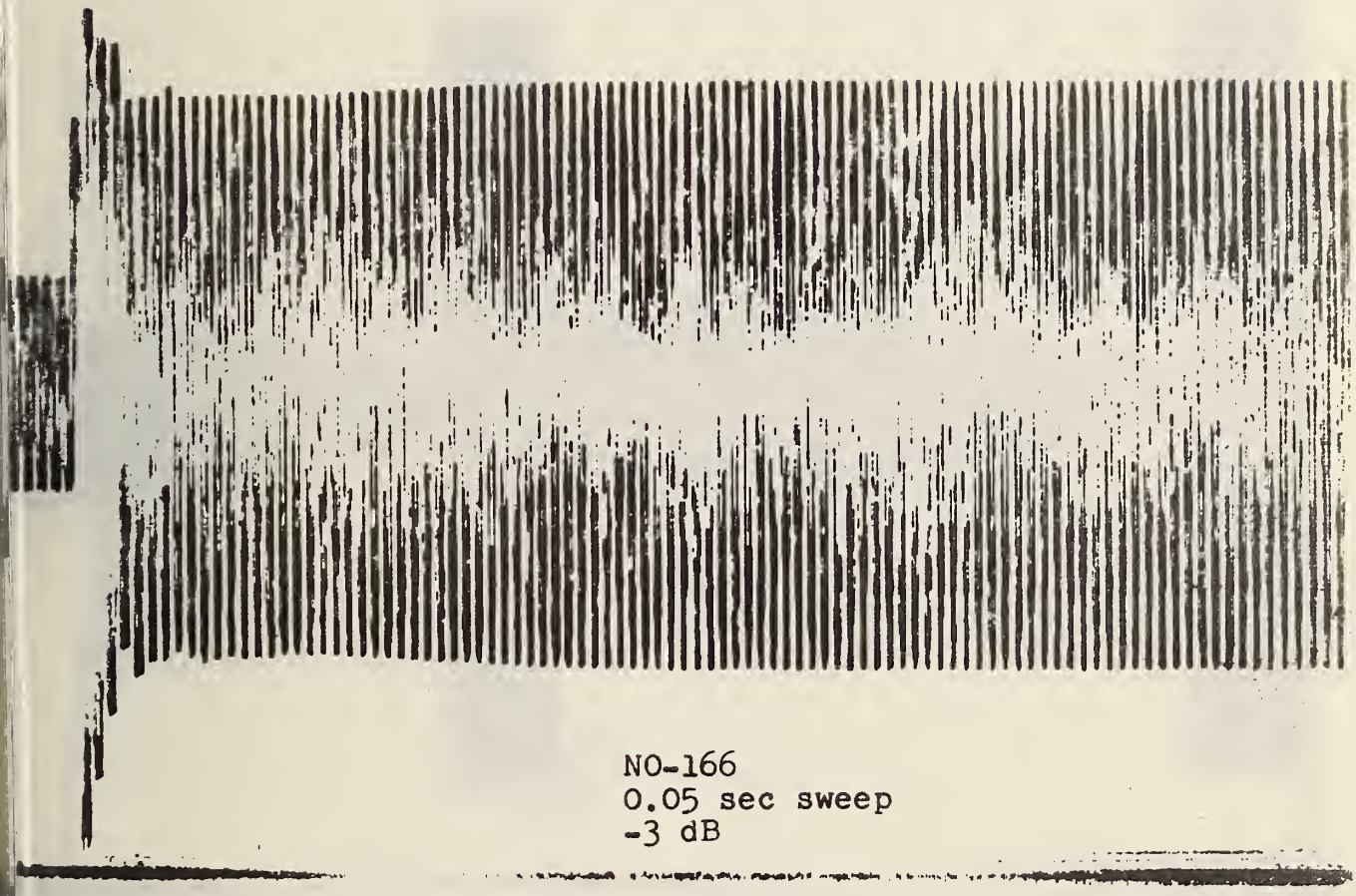
LE-128
0.05 sec sweep
-4 dB


122
LE-129
0.5 sec sweep

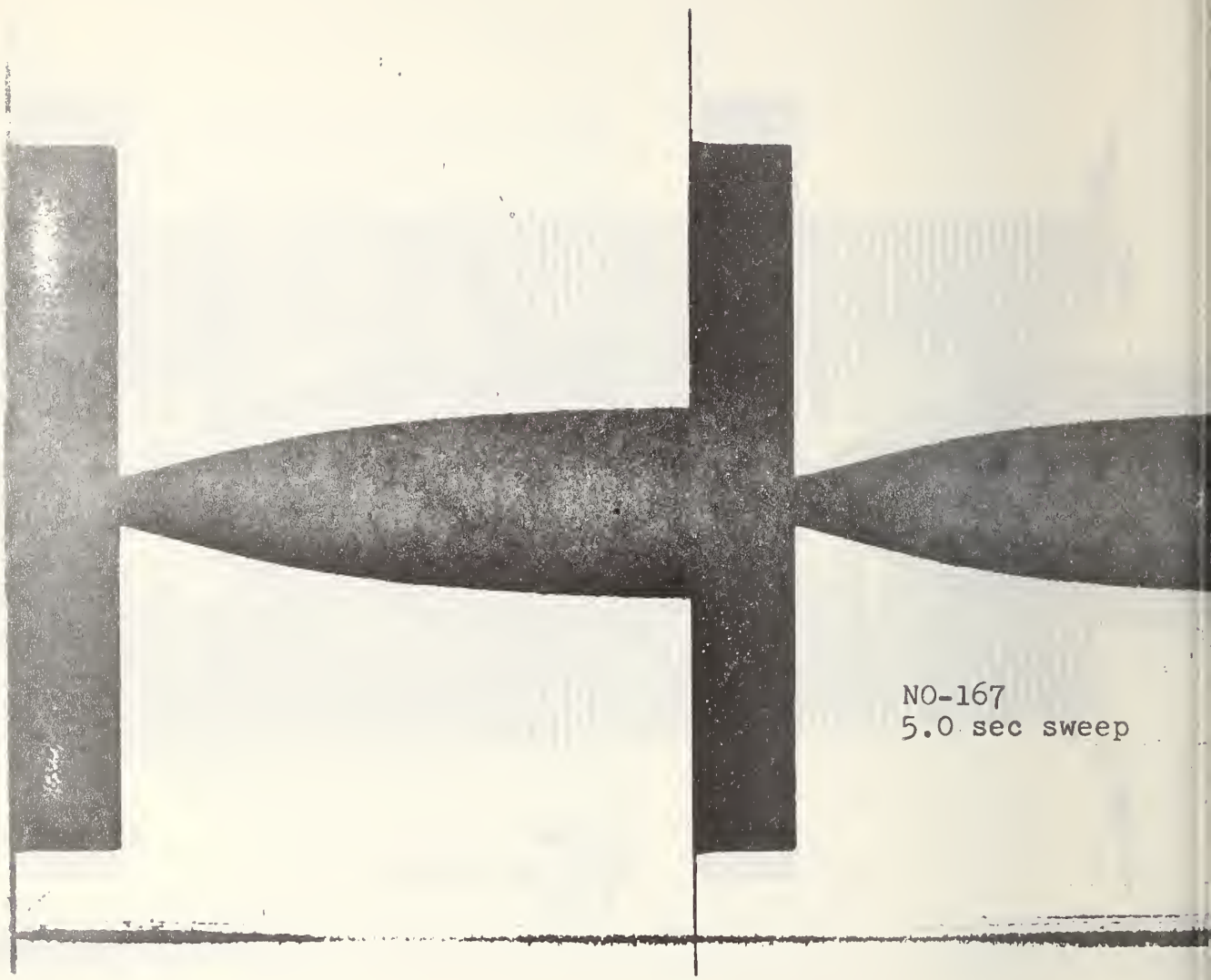


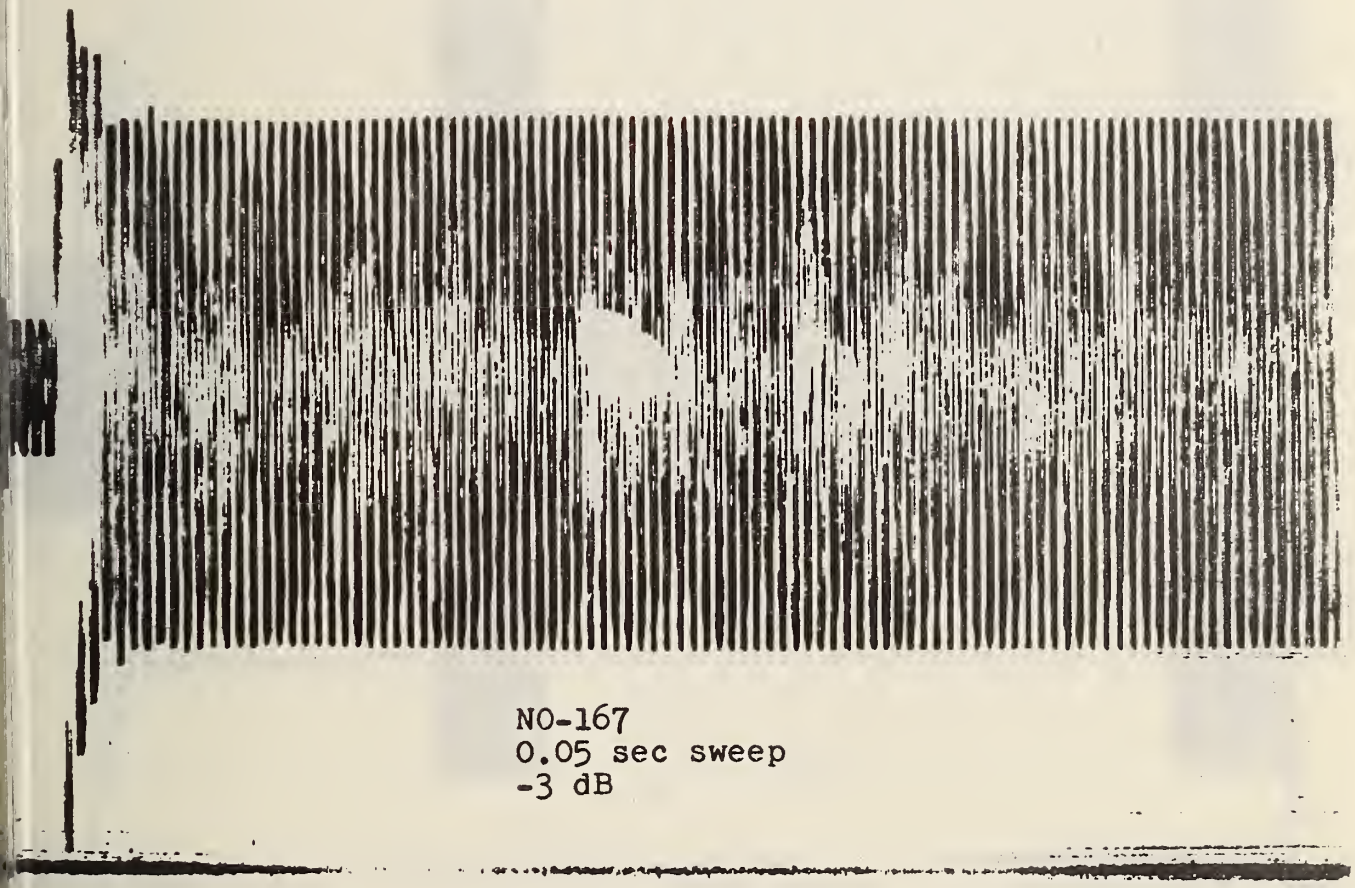
LE-129
0.05 sec sweep
-6 dB


NO-166
5.0 sec sweep

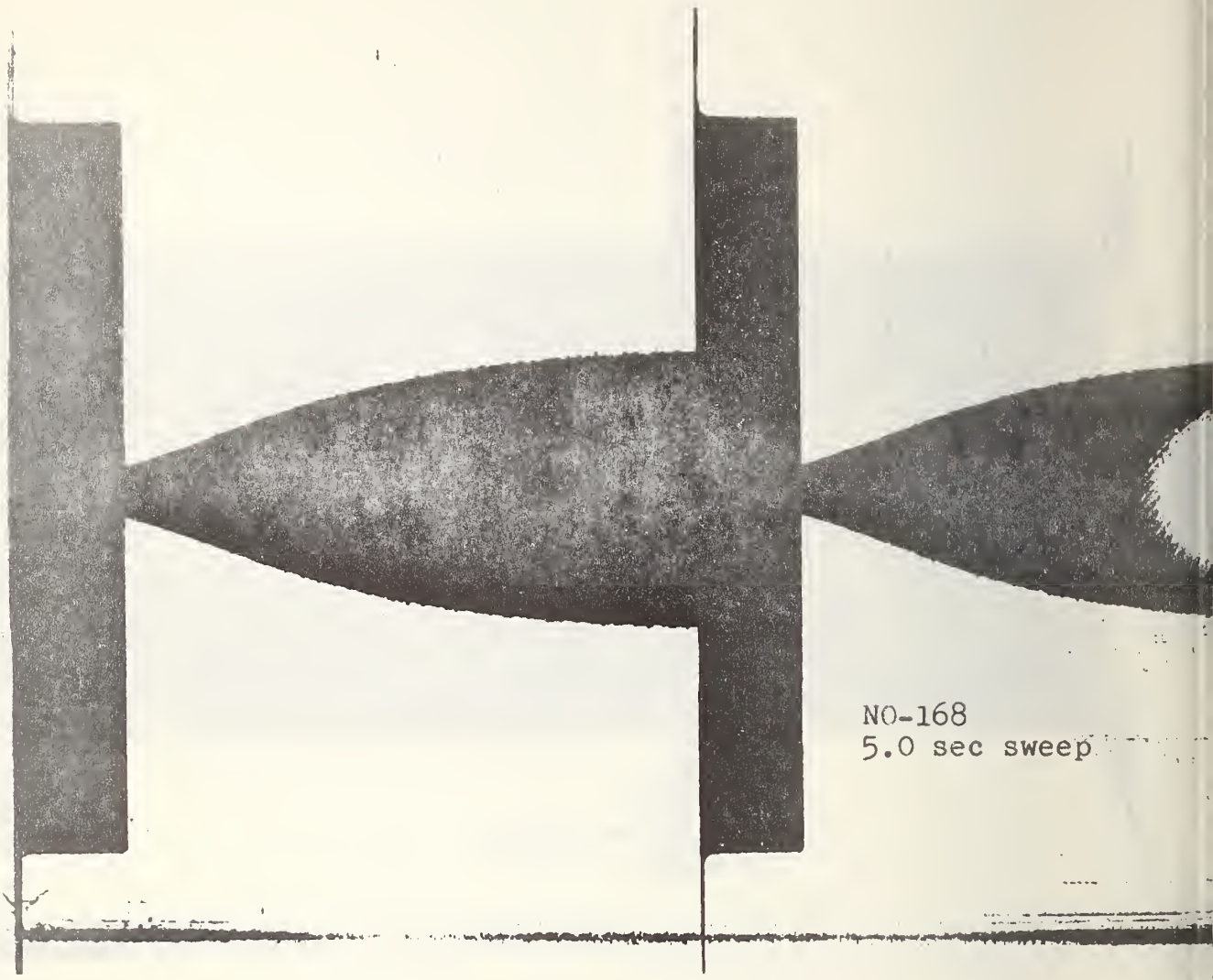


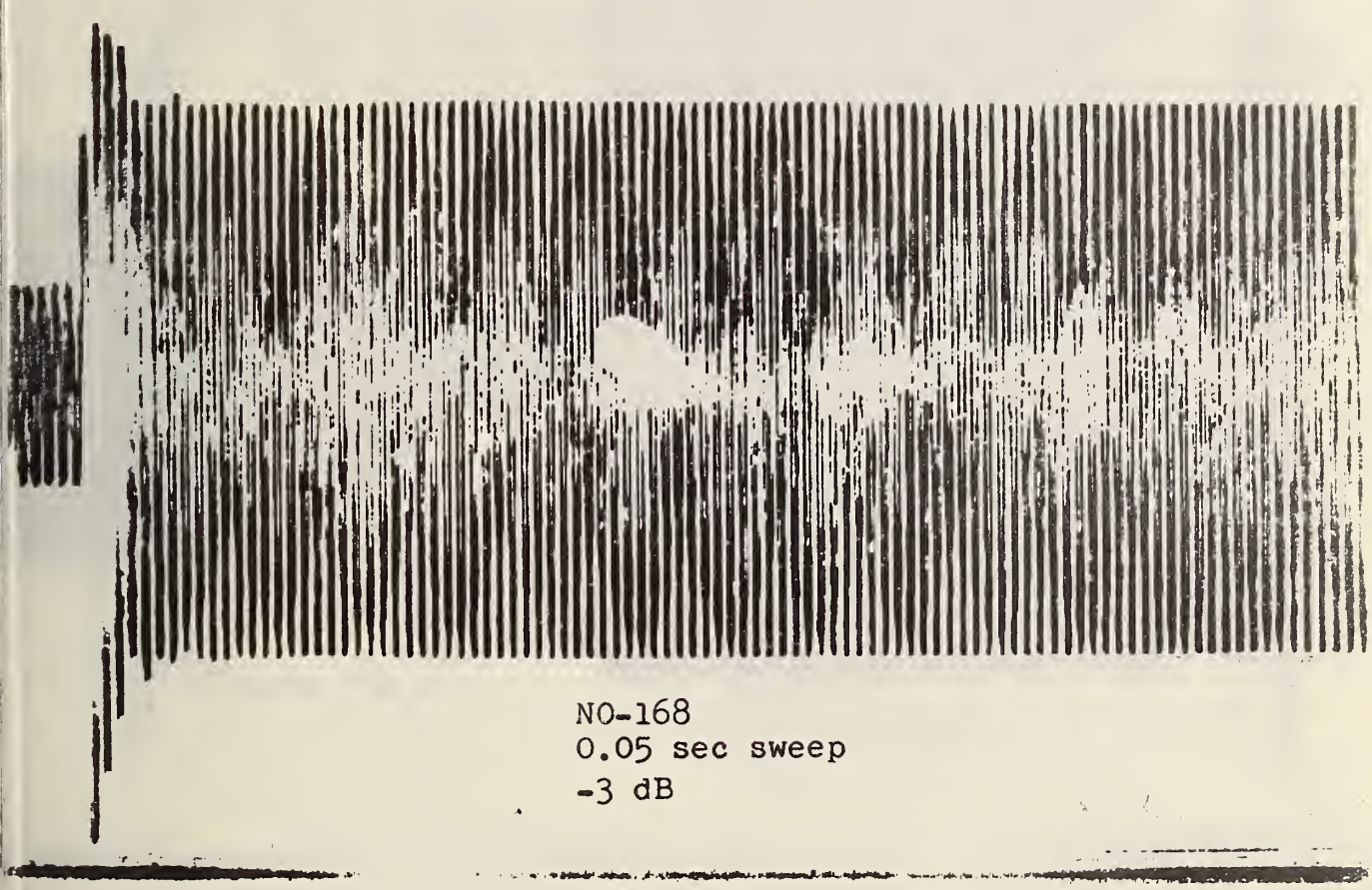
NO-166
0.05 sec sweep
-3 dB


NO-167
5.0 sec sweep

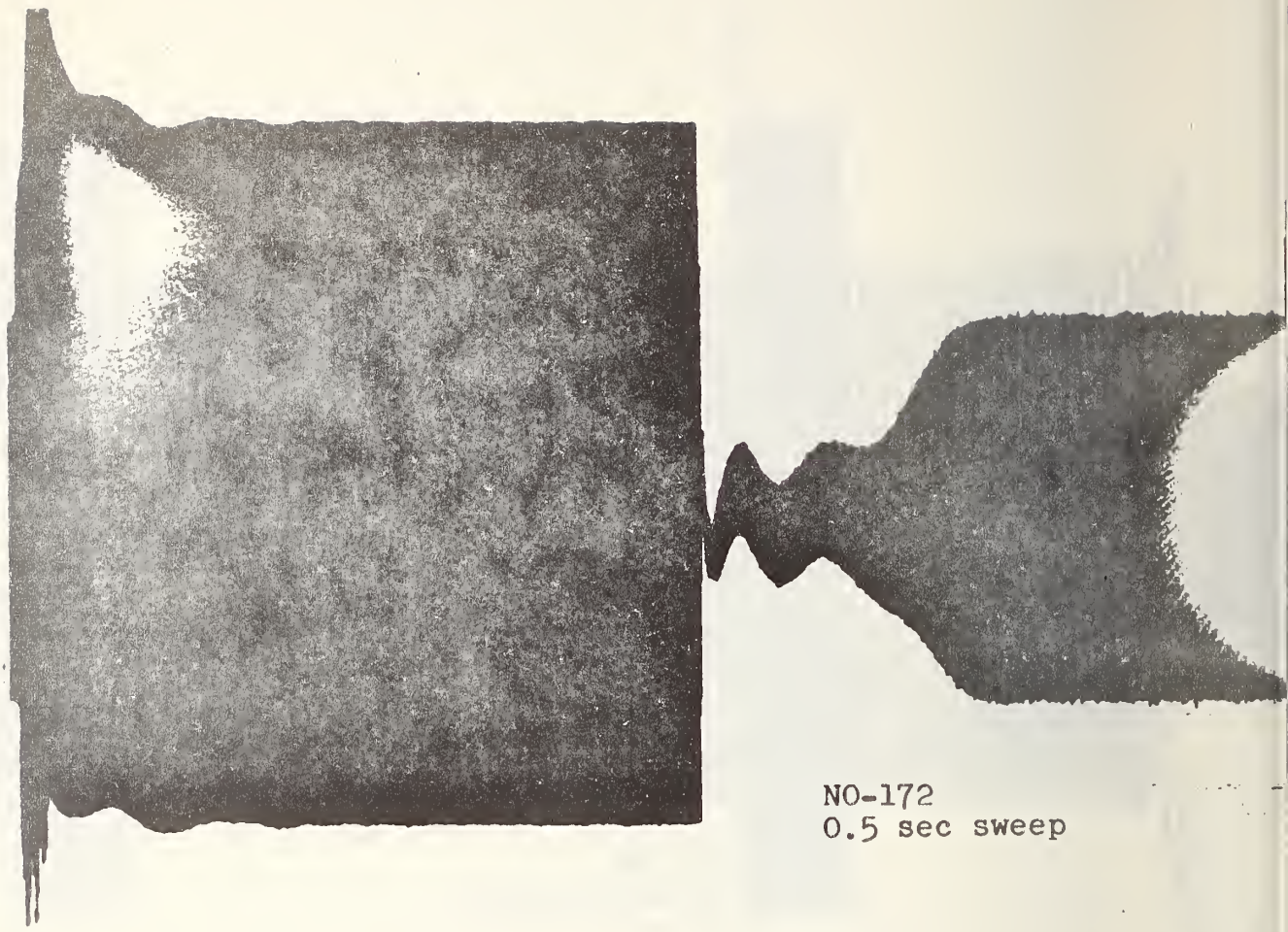


NO-167
0.05 sec sweep
-3 dB

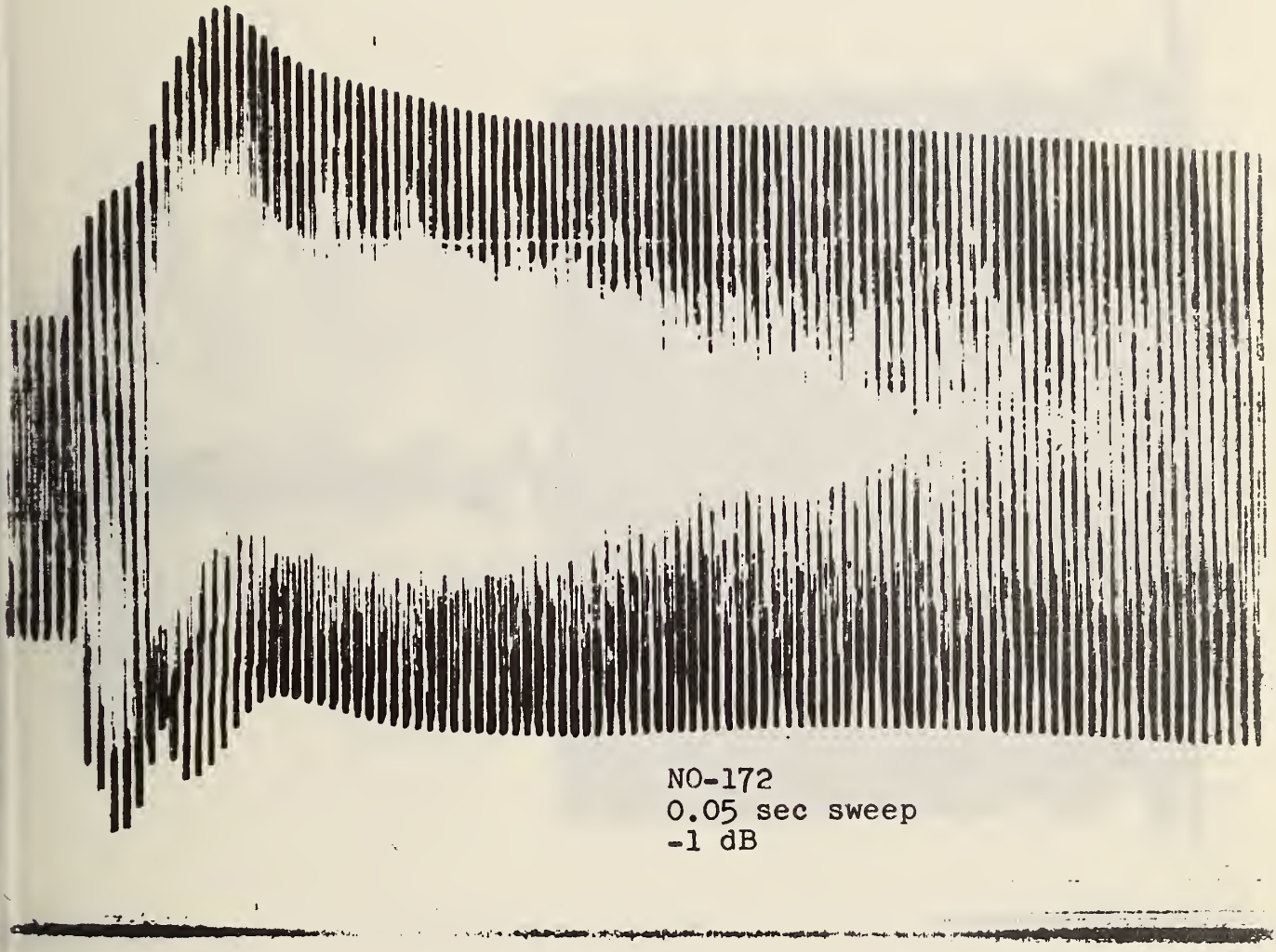

NO-168
5.0 sec sweep



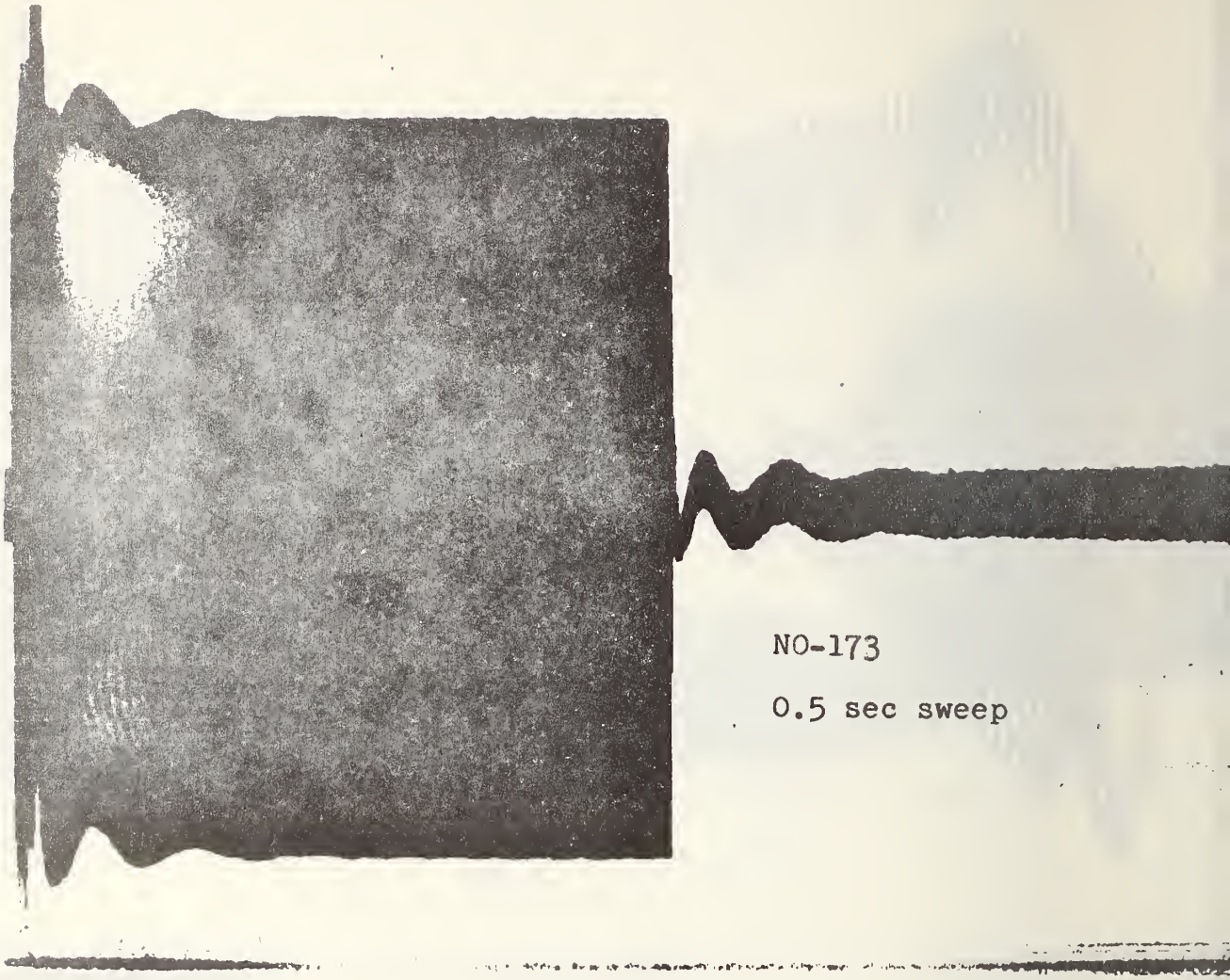
NO-168
0.05 sec sweep
-3 dB



NO-172
0.5 sec sweep

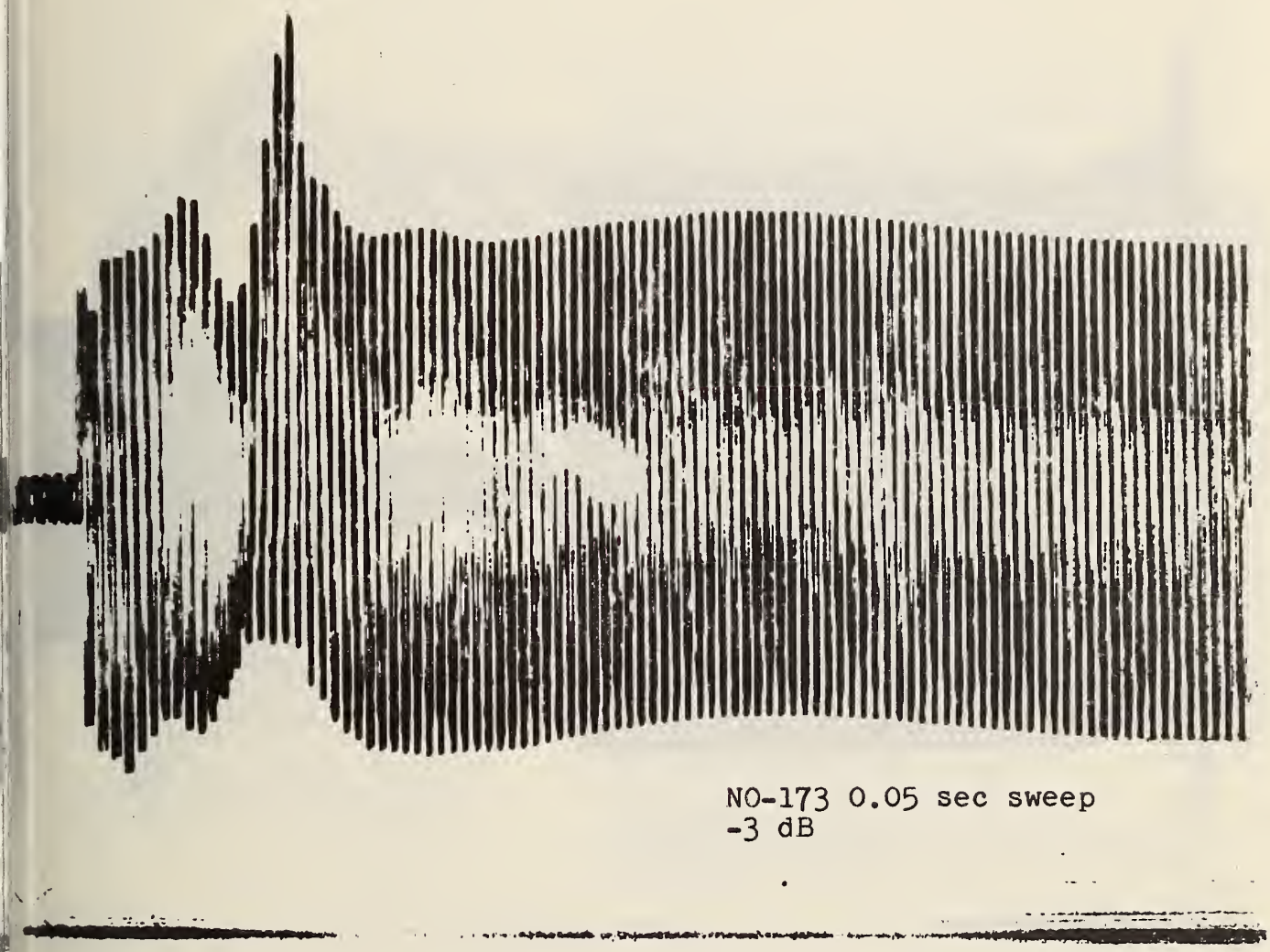


NO-172
0.05 sec sweep
-1 dB

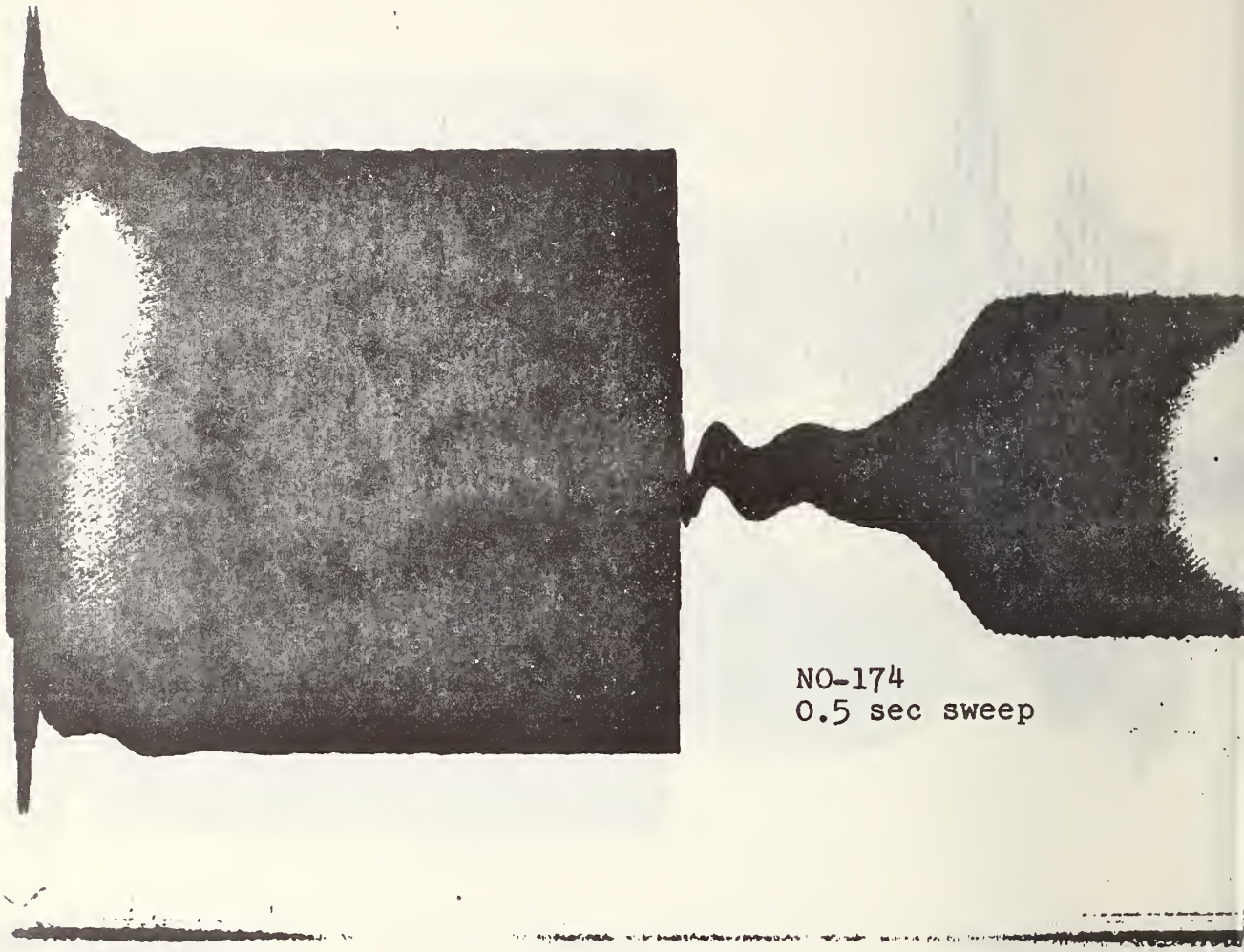


NO-173

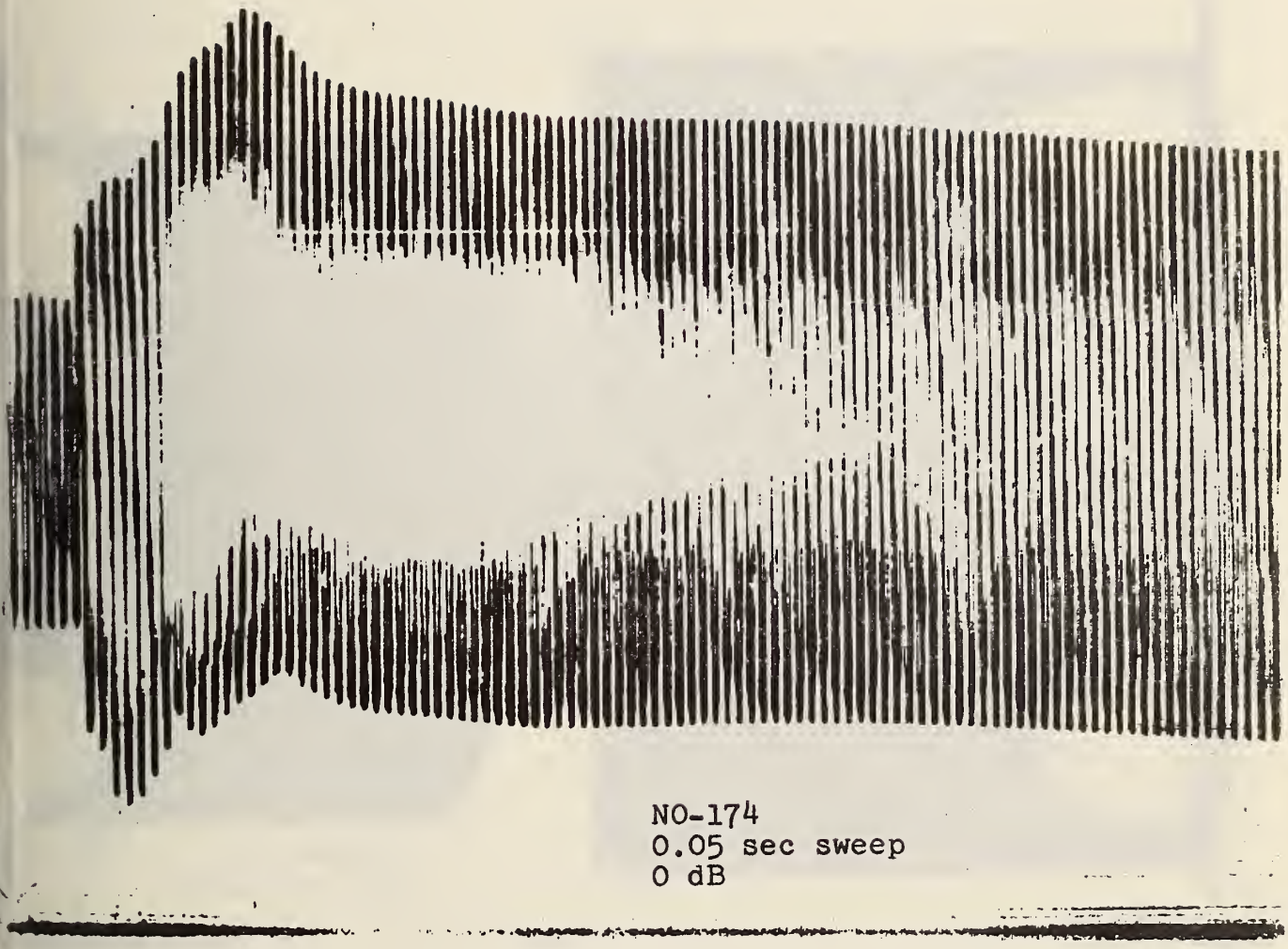
0.5 sec sweep



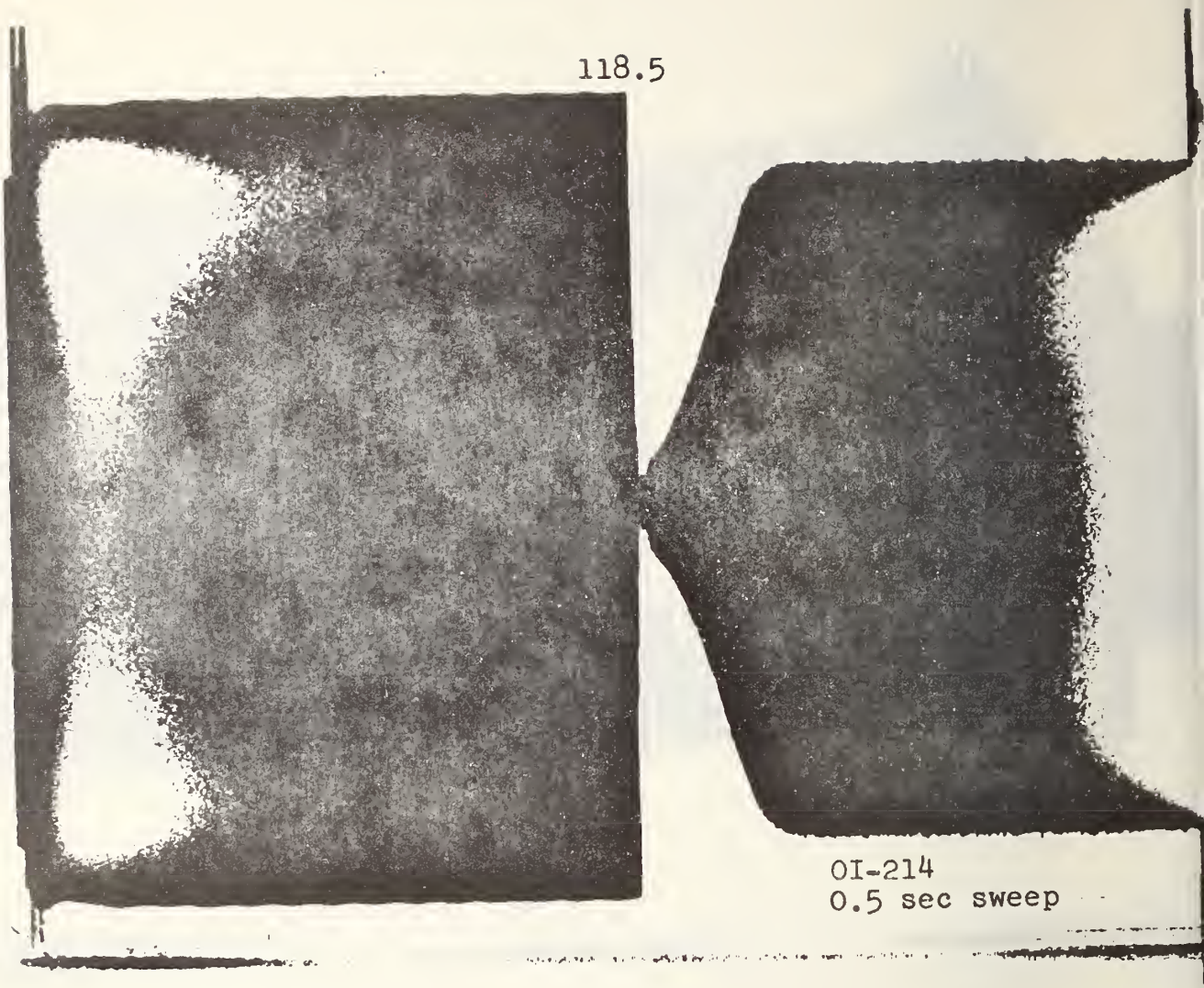
NO-173 0.05 sec sweep
-3 dB



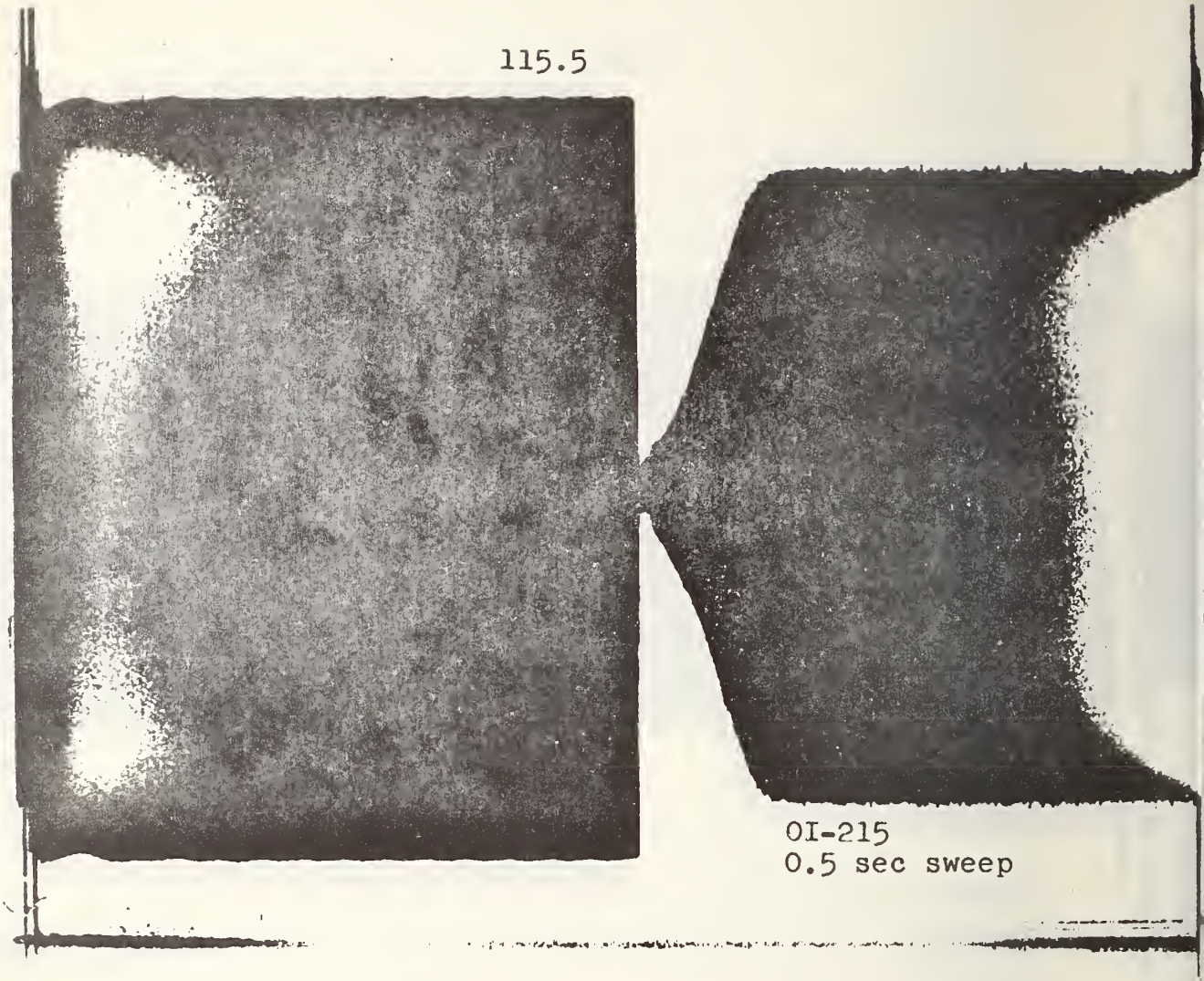
NO-174
0.5 sec sweep

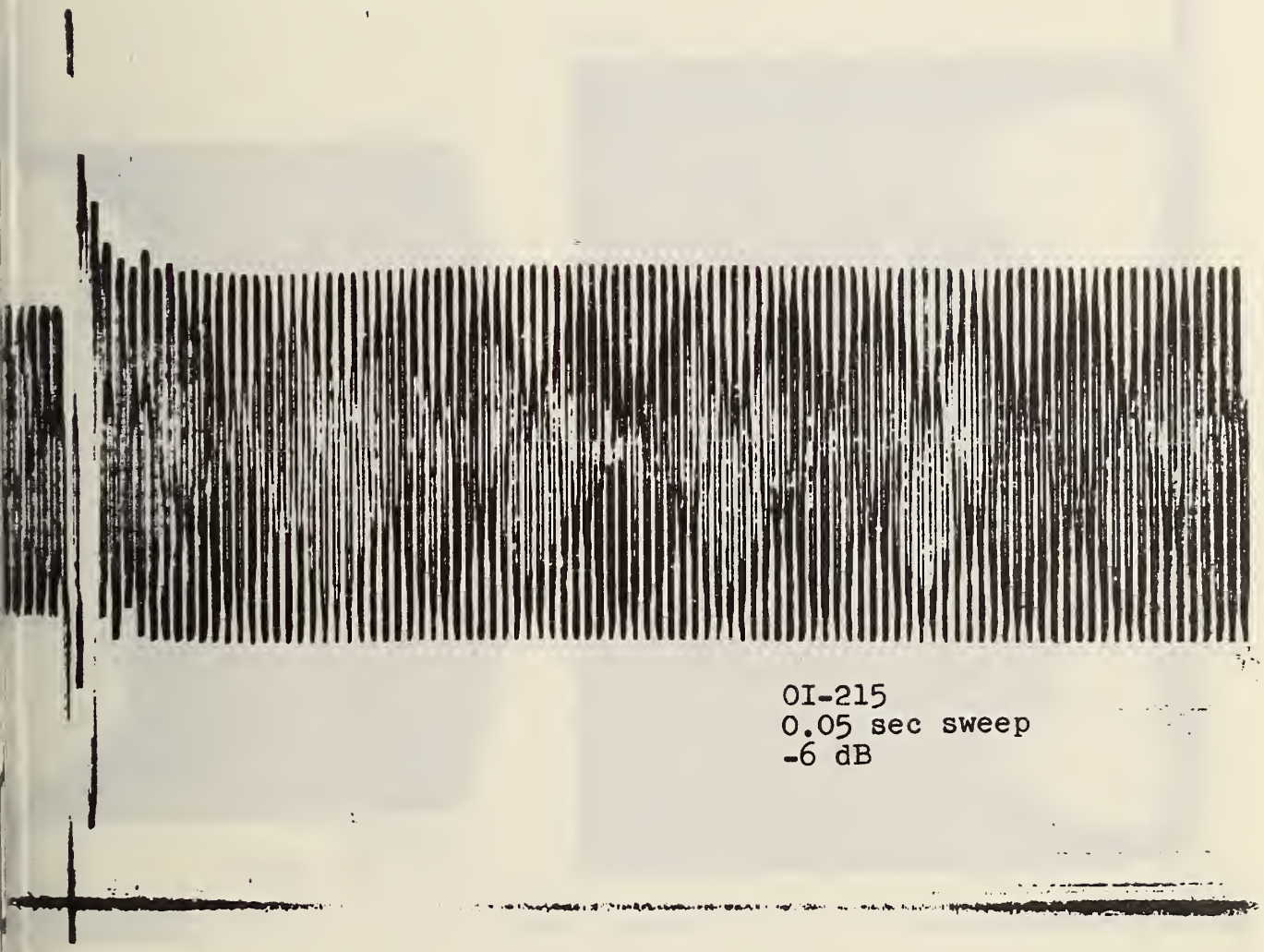


NO-174
0.05 sec sweep
0 dB

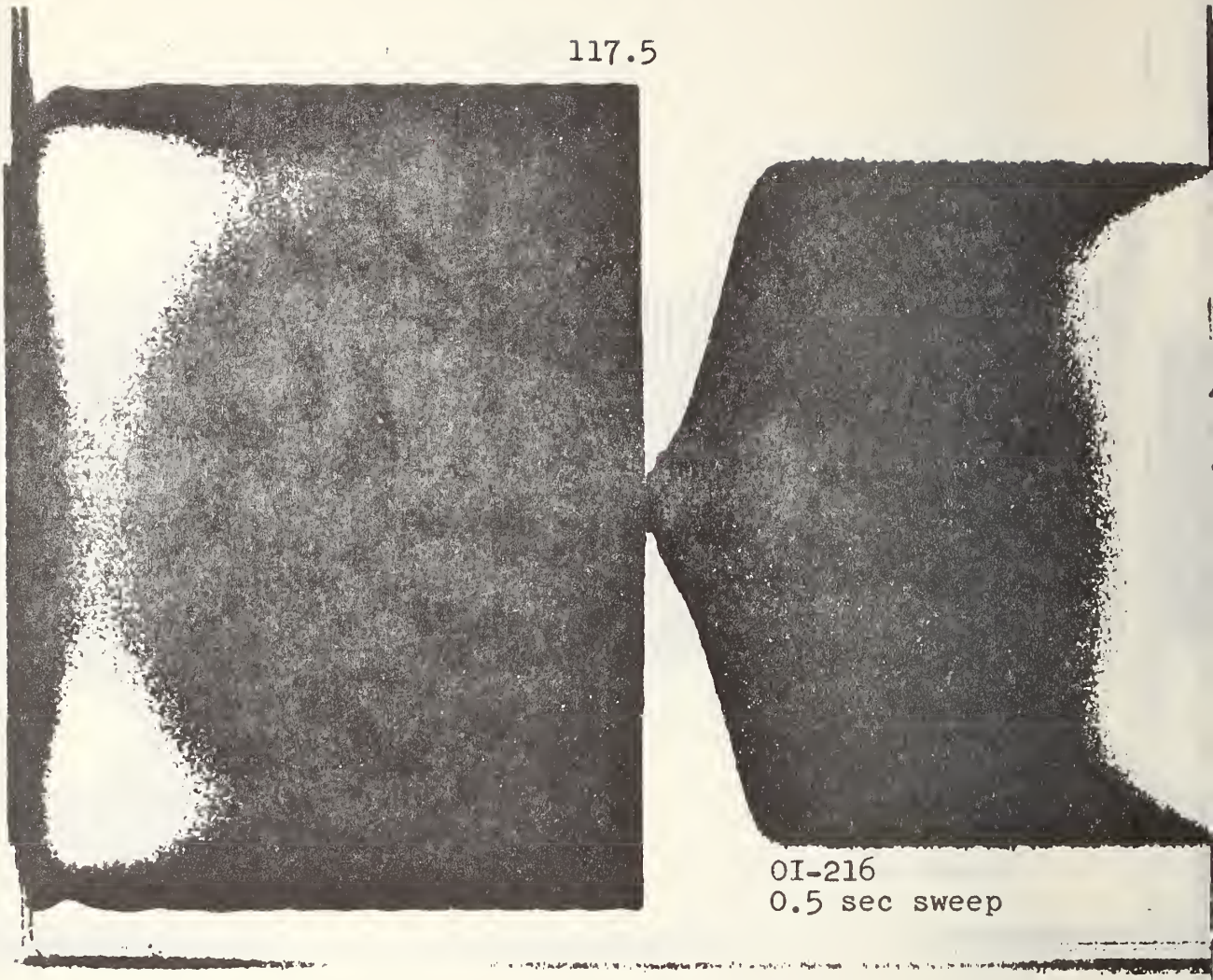

118.5
OI-214
0.5 sec sweep

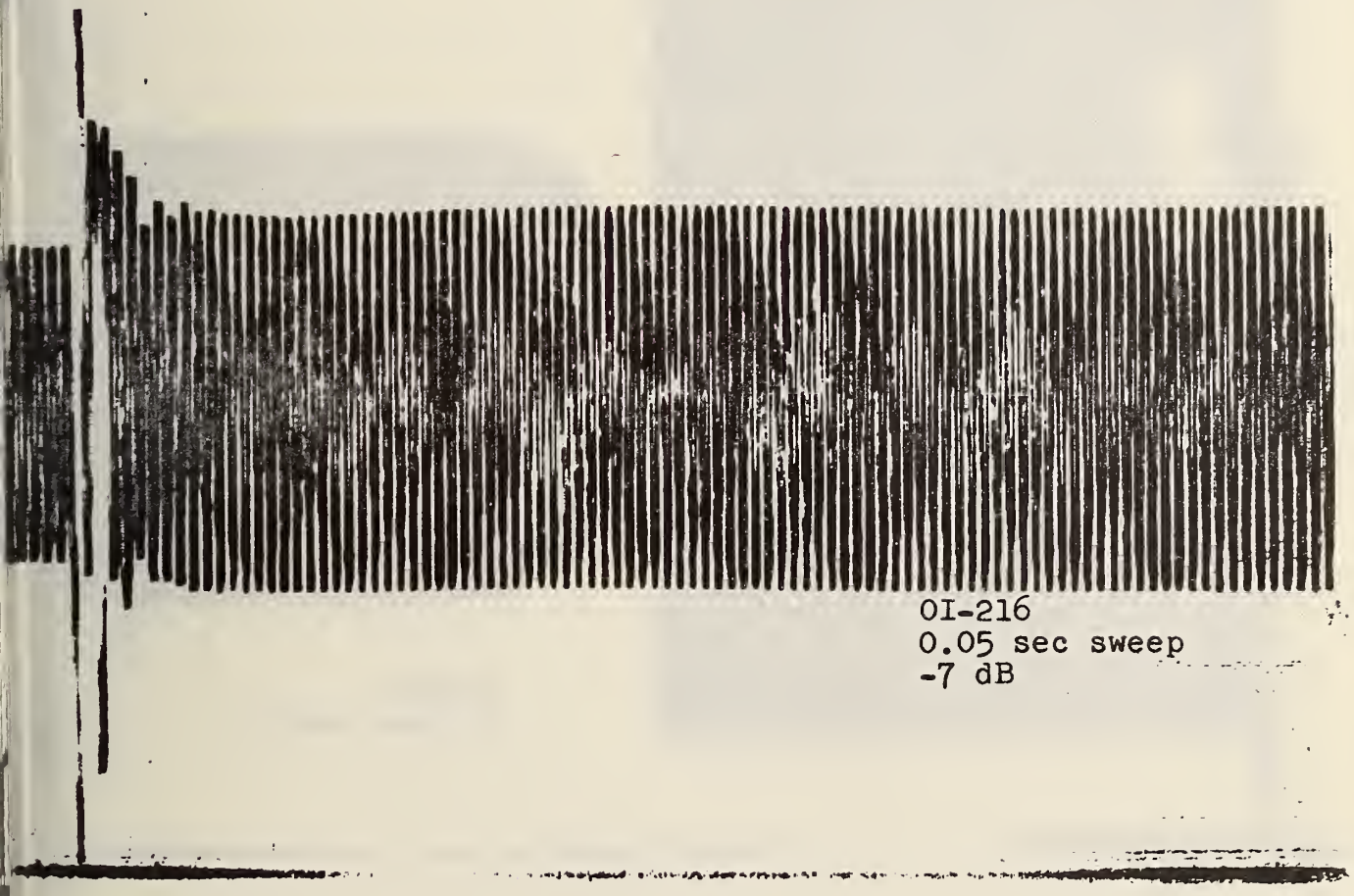
OI-214
0.05 sec sweep
-5 dB

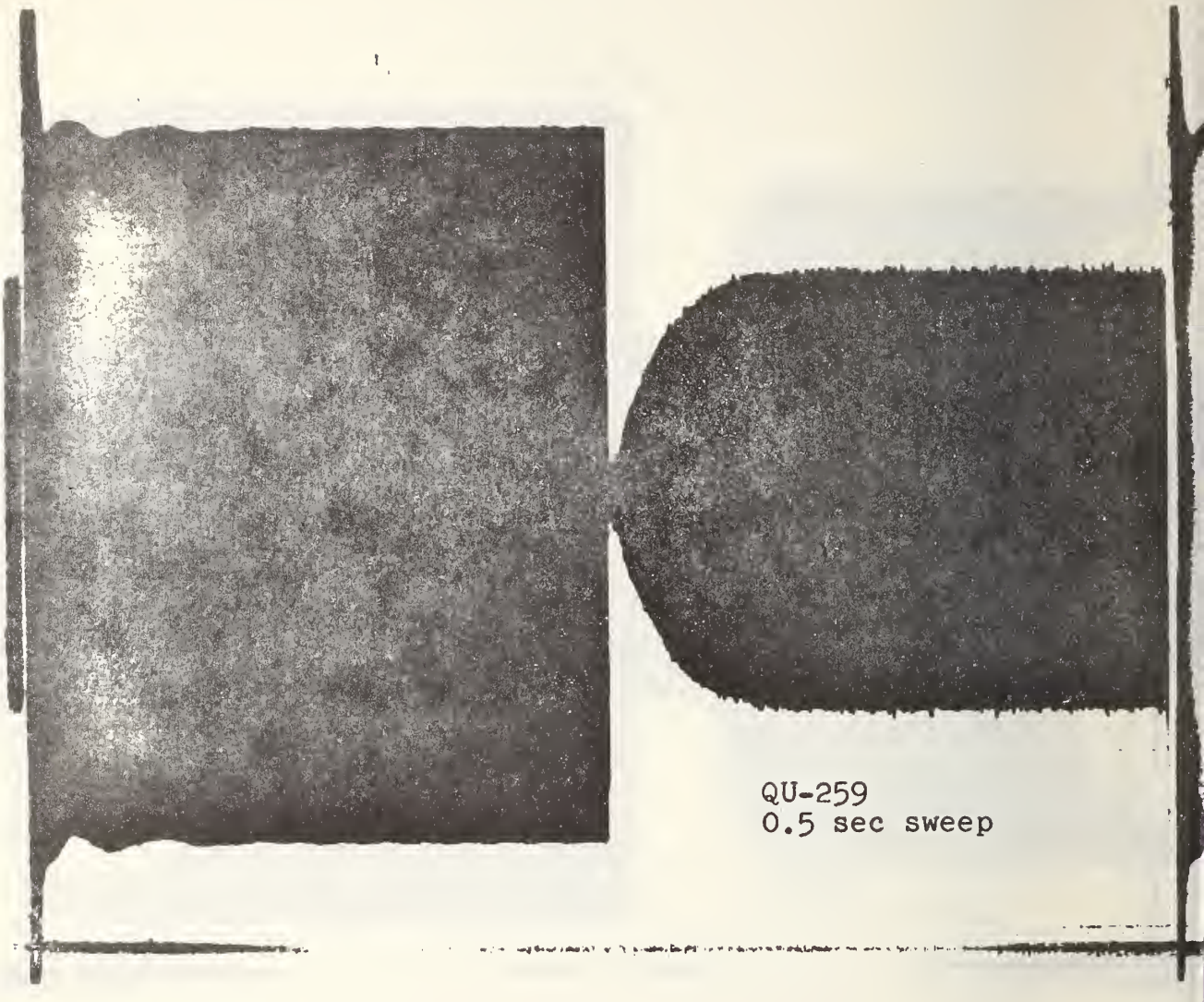

115.5
OI-215
0.5 sec sweep



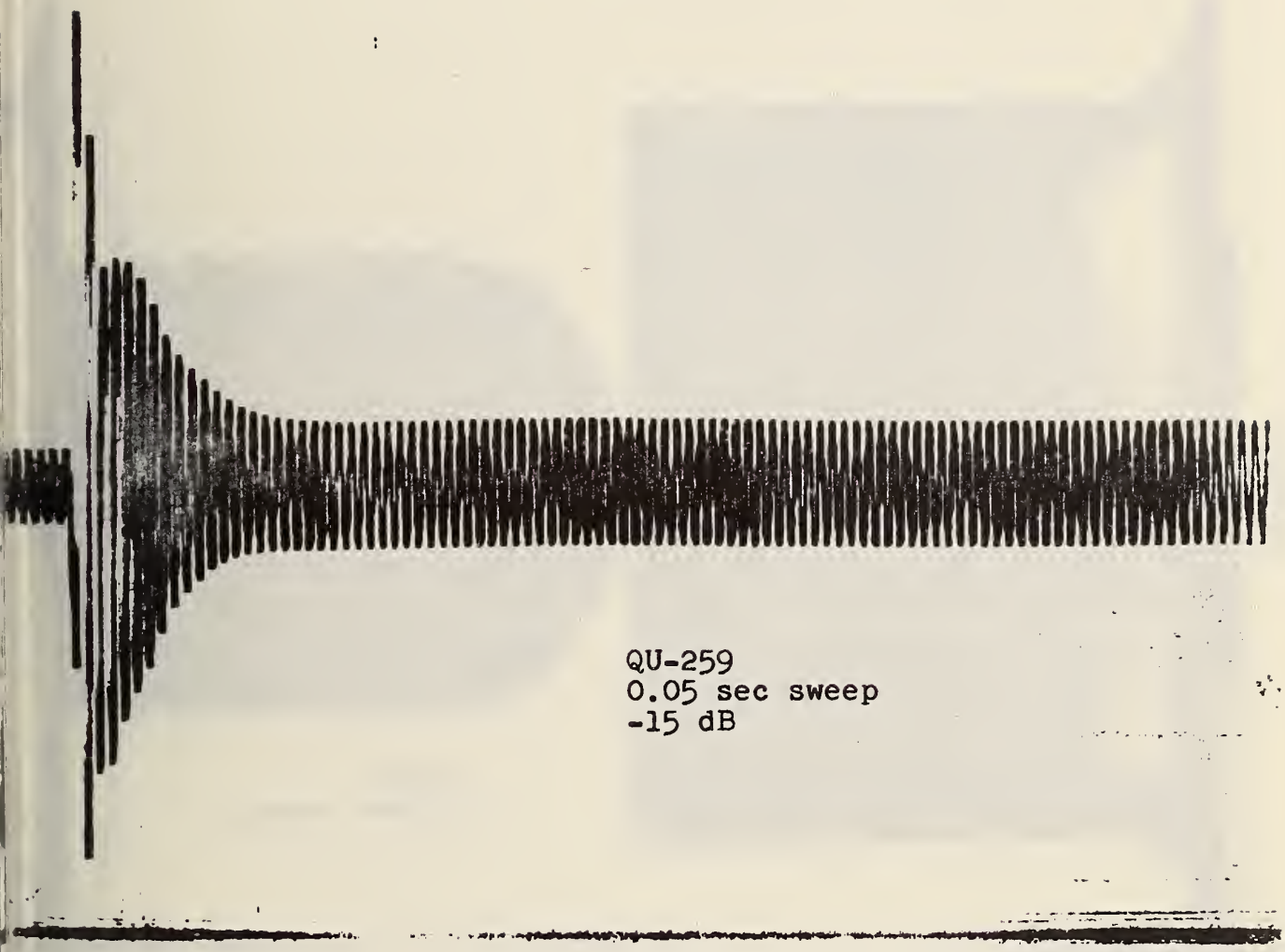
OI-215
0.05 sec sweep
-6 dB


117.5
OI-216
0.5 sec sweep

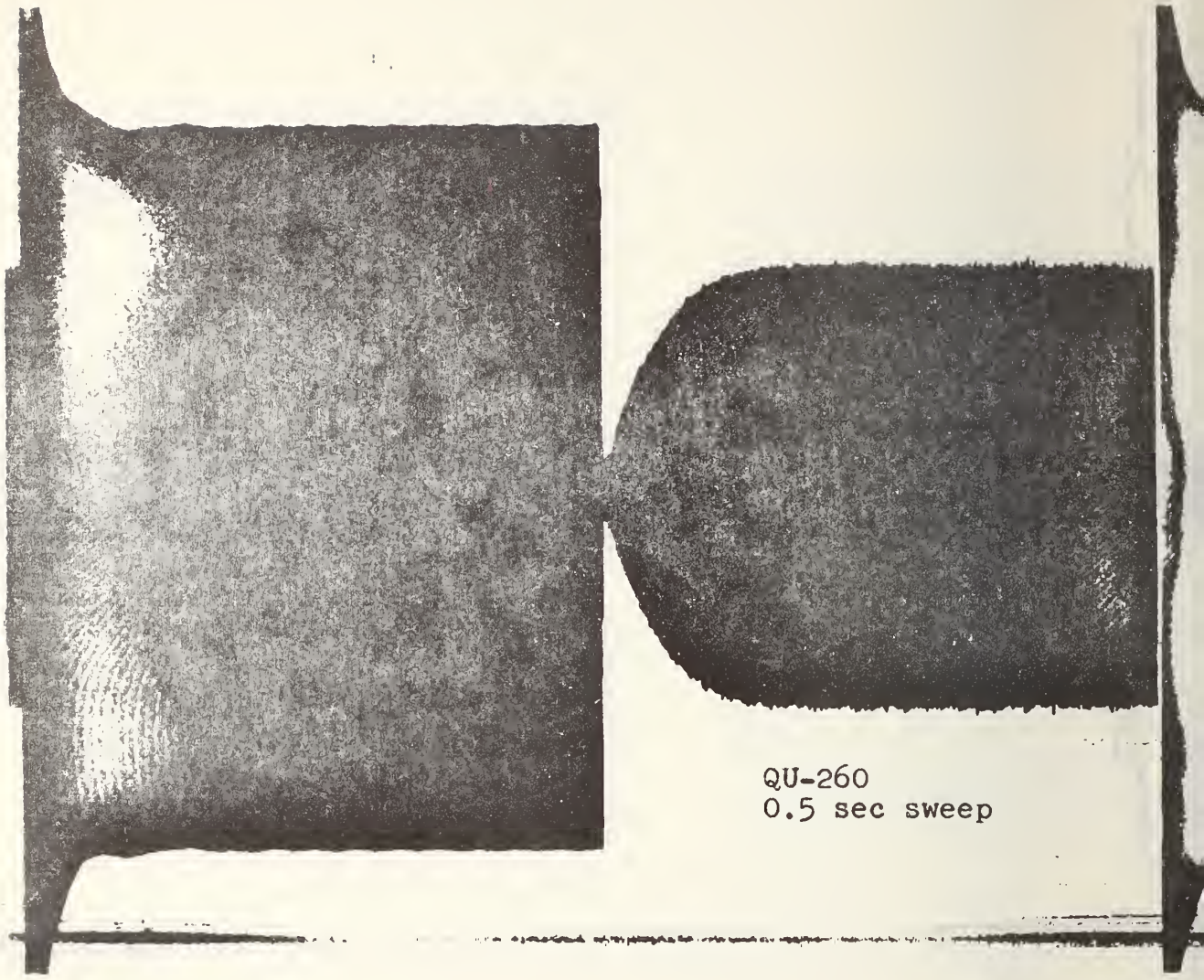

OI-216
0.05 sec sweep
-7 dB



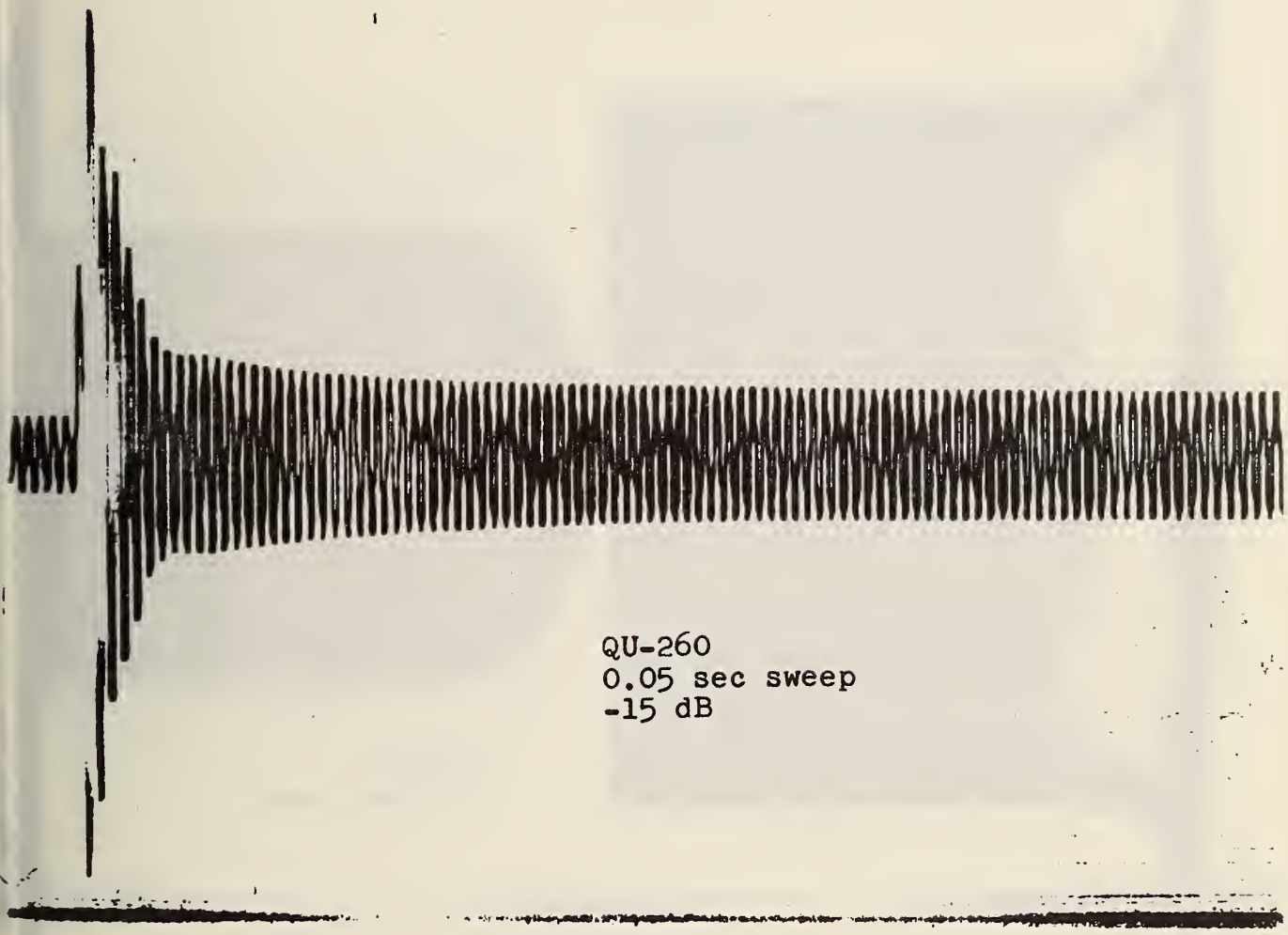
QU-259
0.5 sec sweep



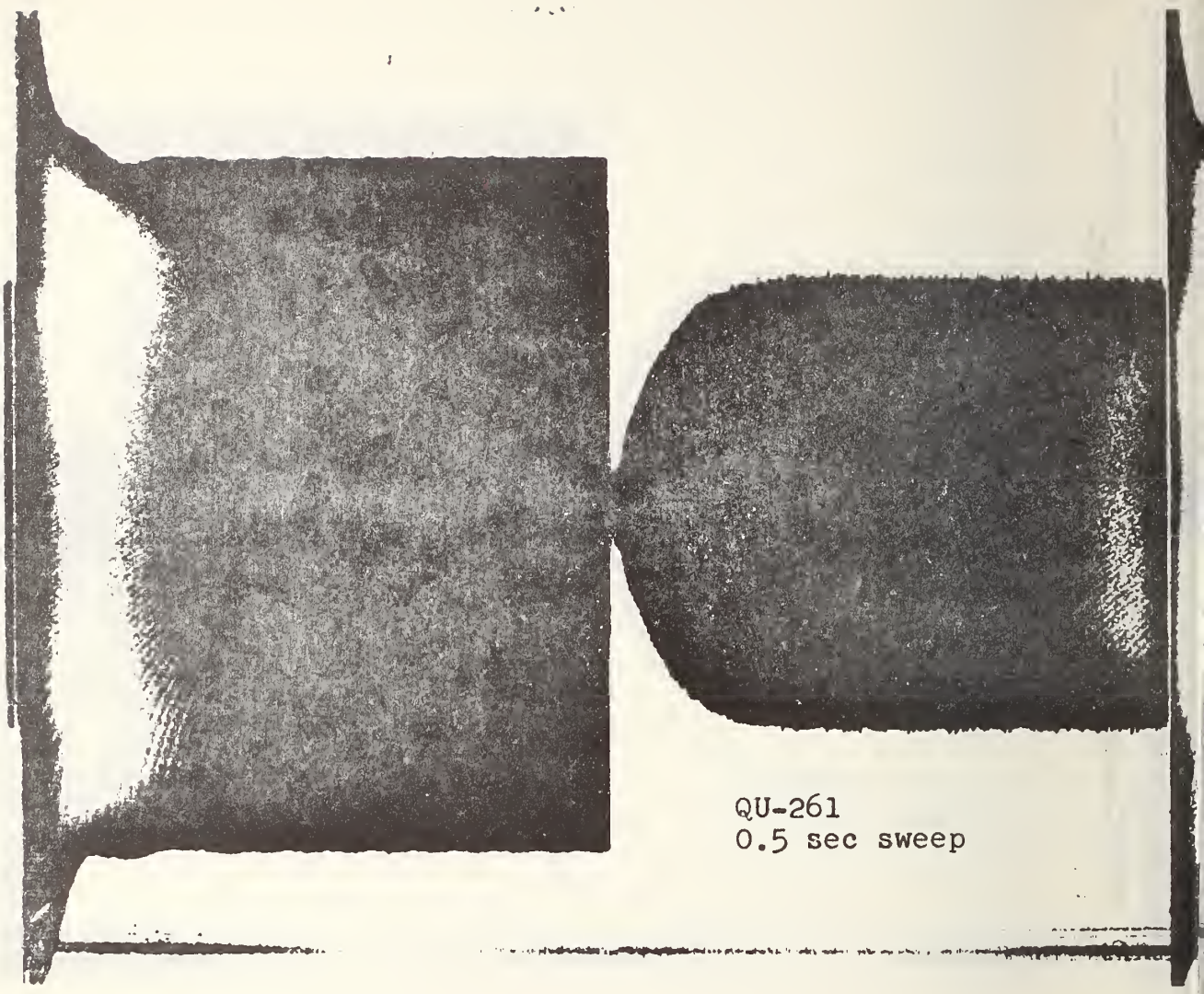
QU-259
0.05 sec sweep
-15 dB



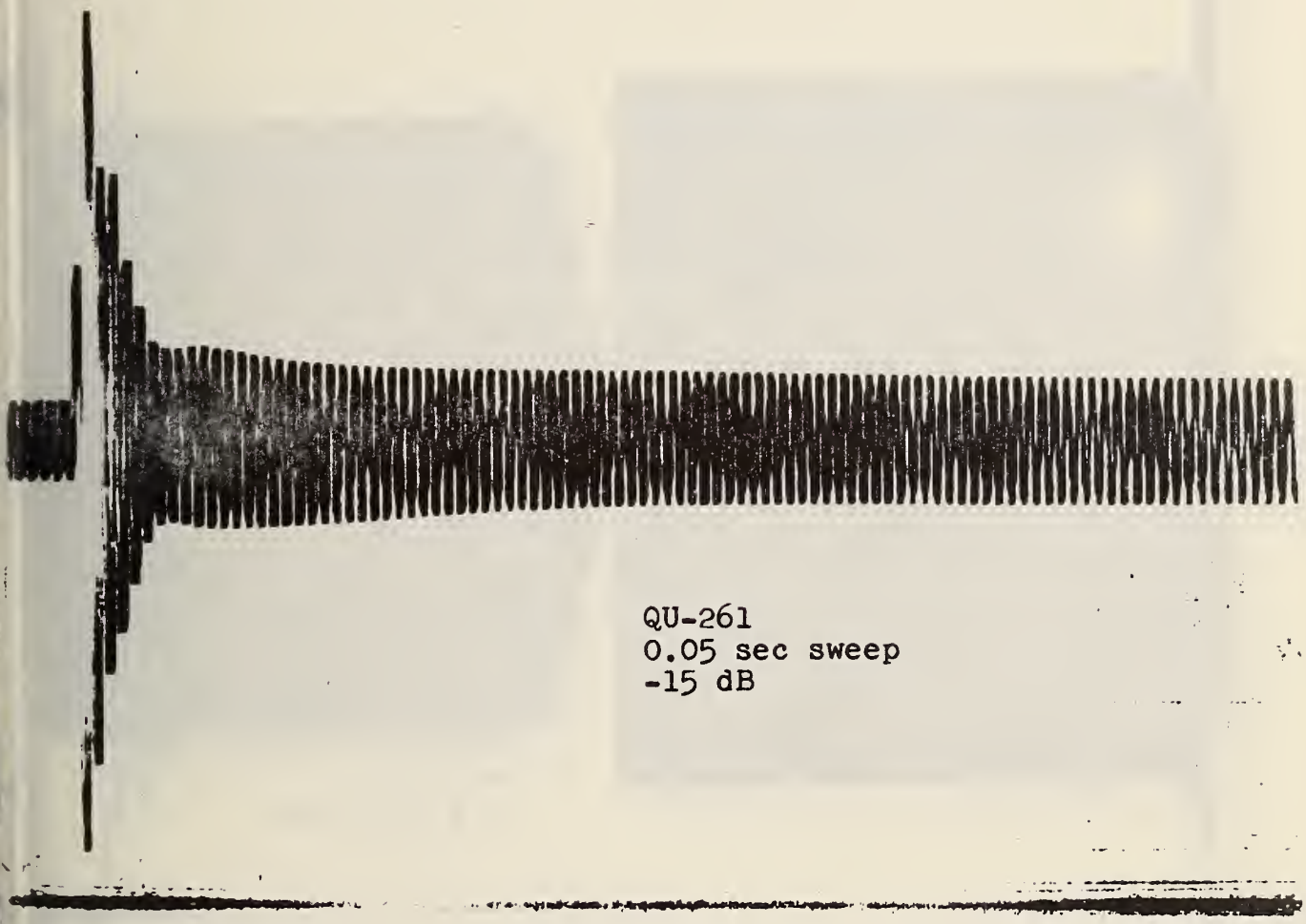
QU-260
0.5 sec sweep



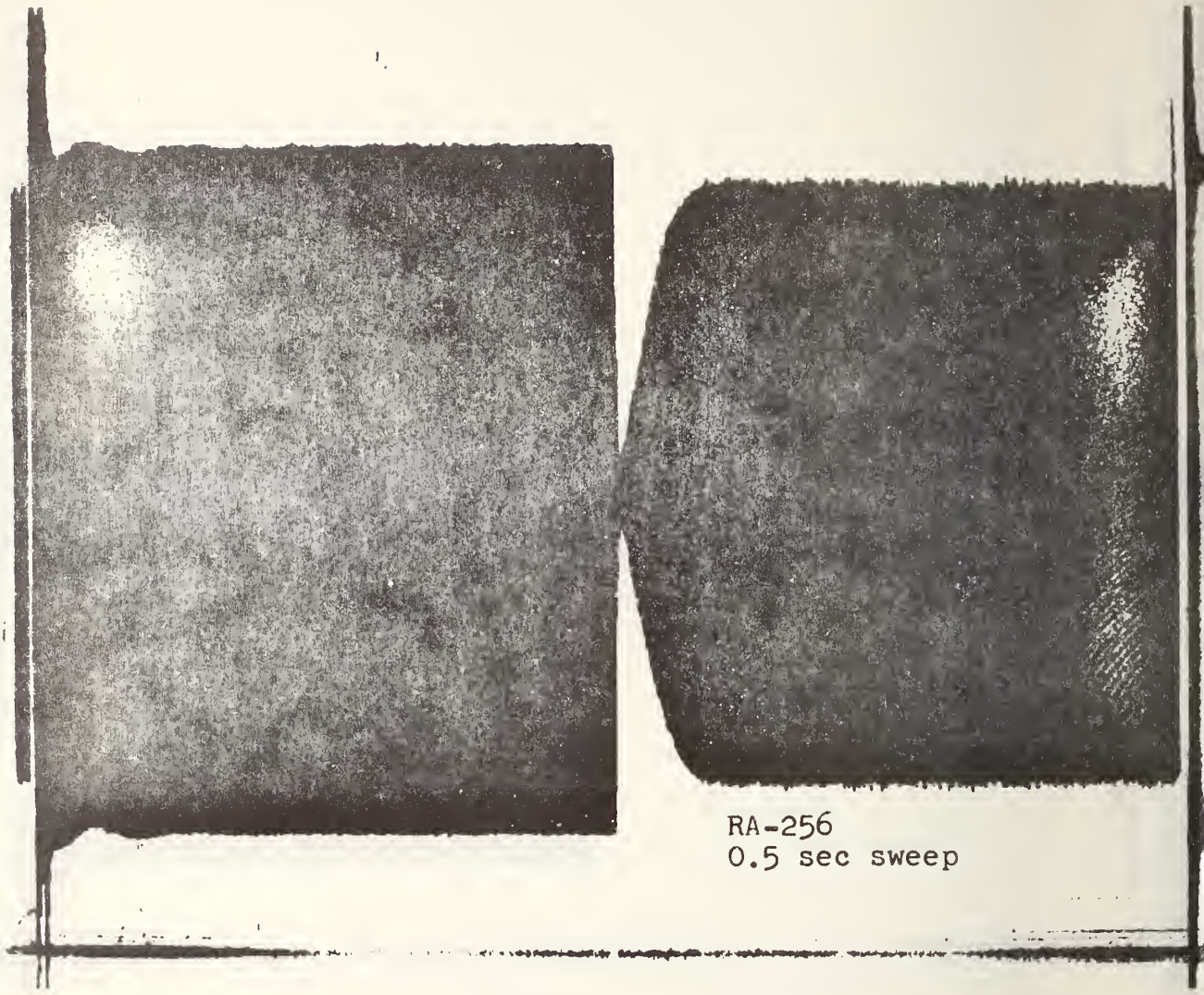
QU-260
0.05 sec sweep
-15 dB



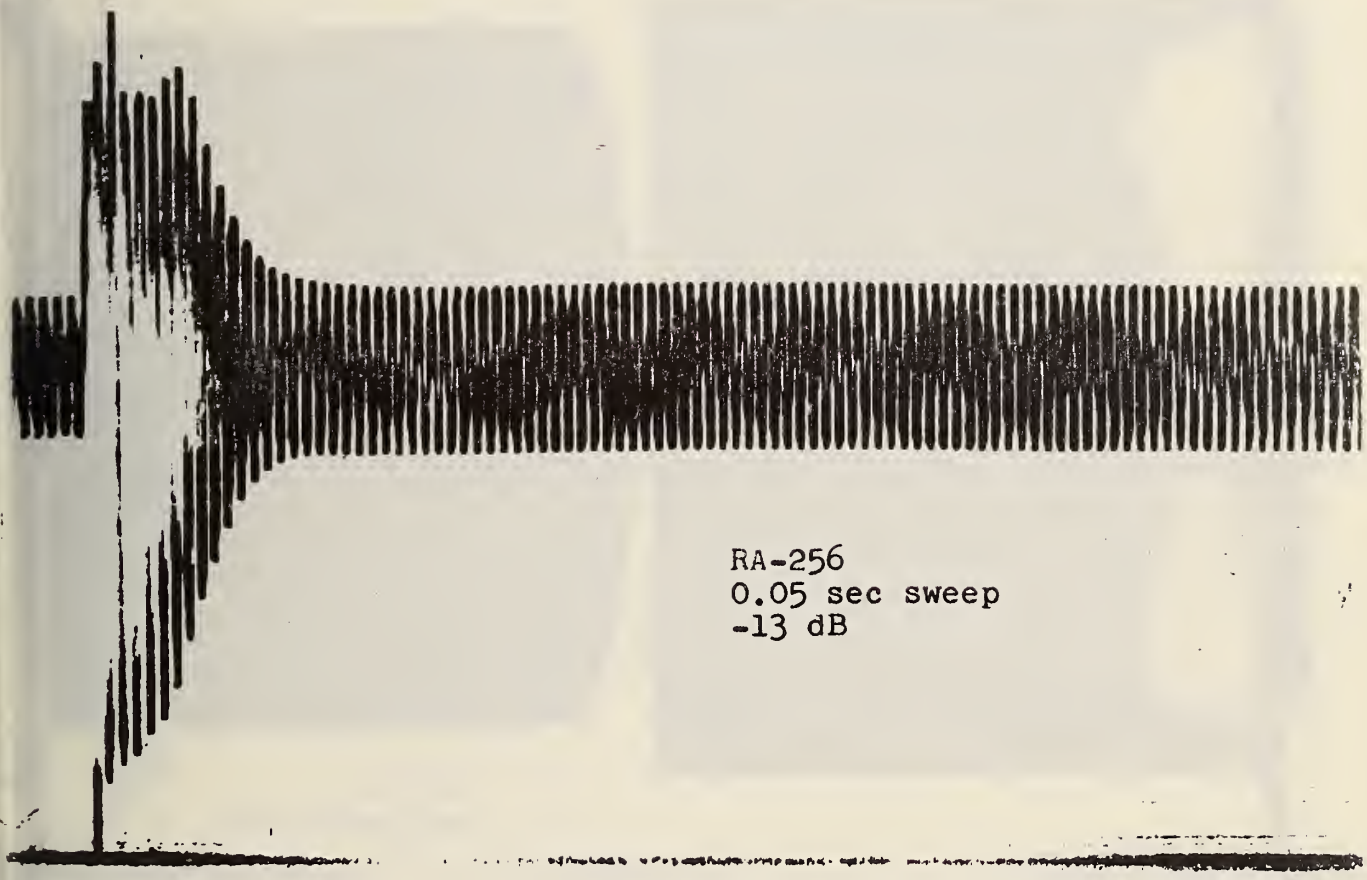
QU-261
0.5 sec sweep

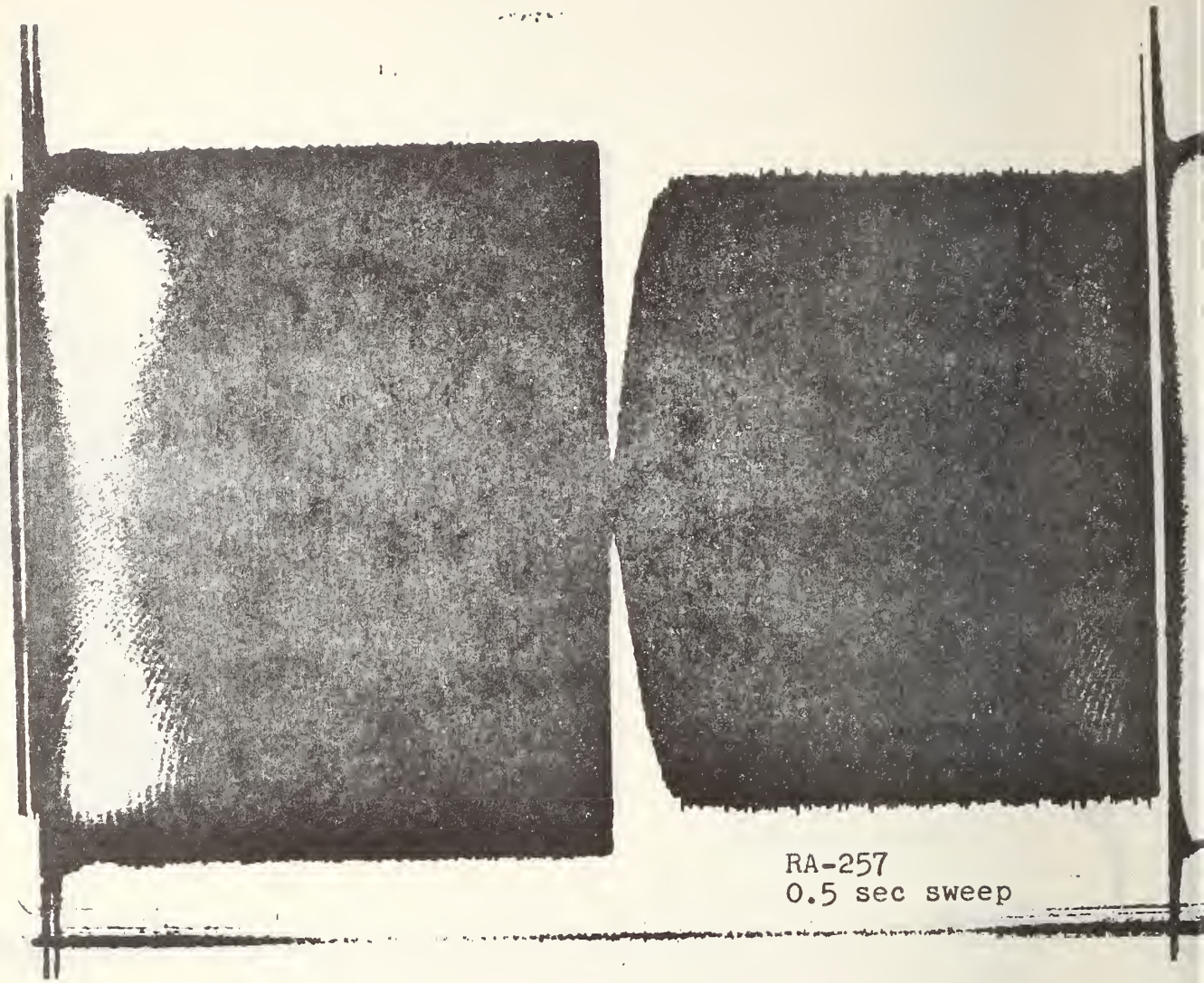


QU-261
0.05 sec sweep
-15 dB

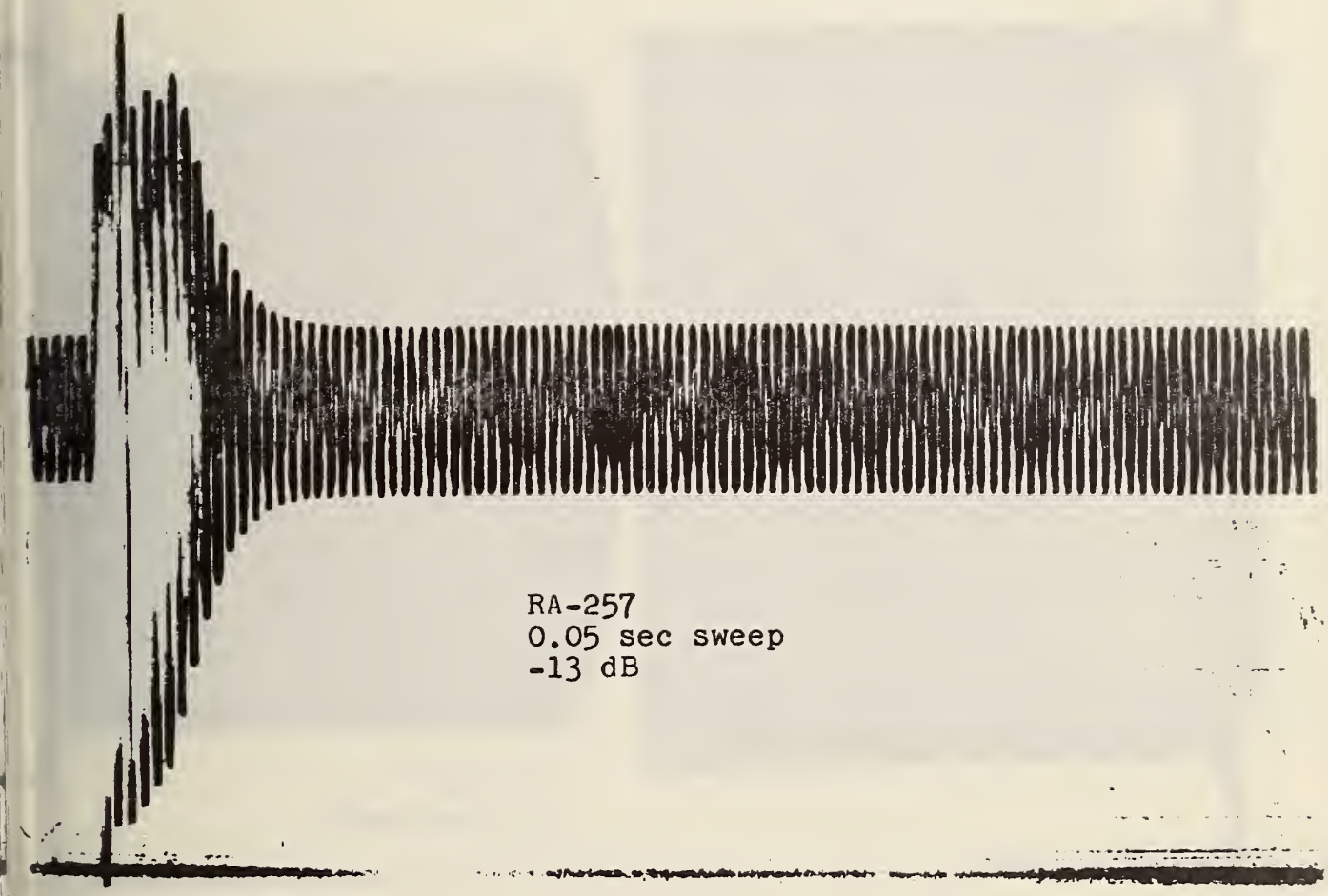


RA-256
0.5 sec sweep

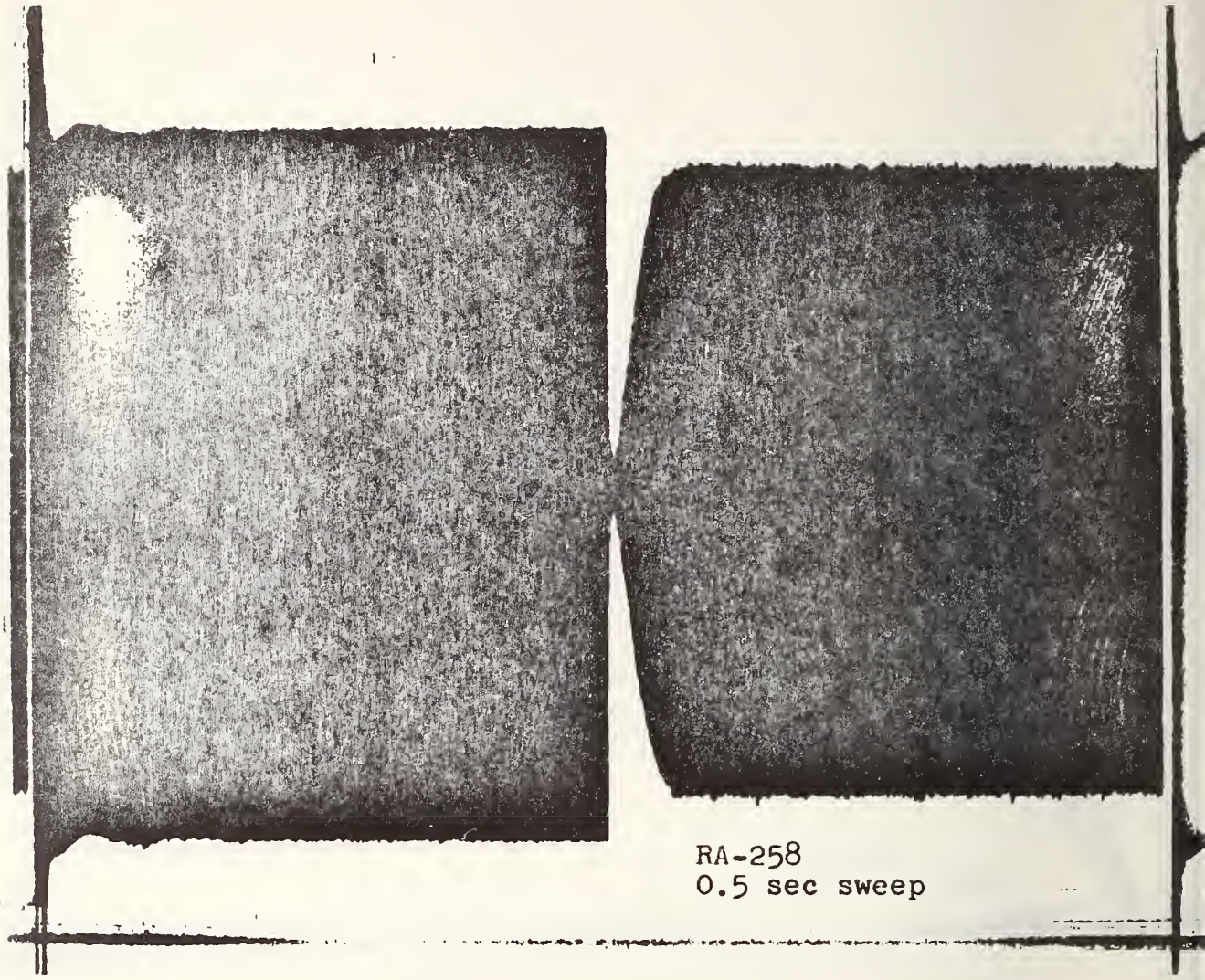

RA-256
0.05 sec sweep
-13 dB



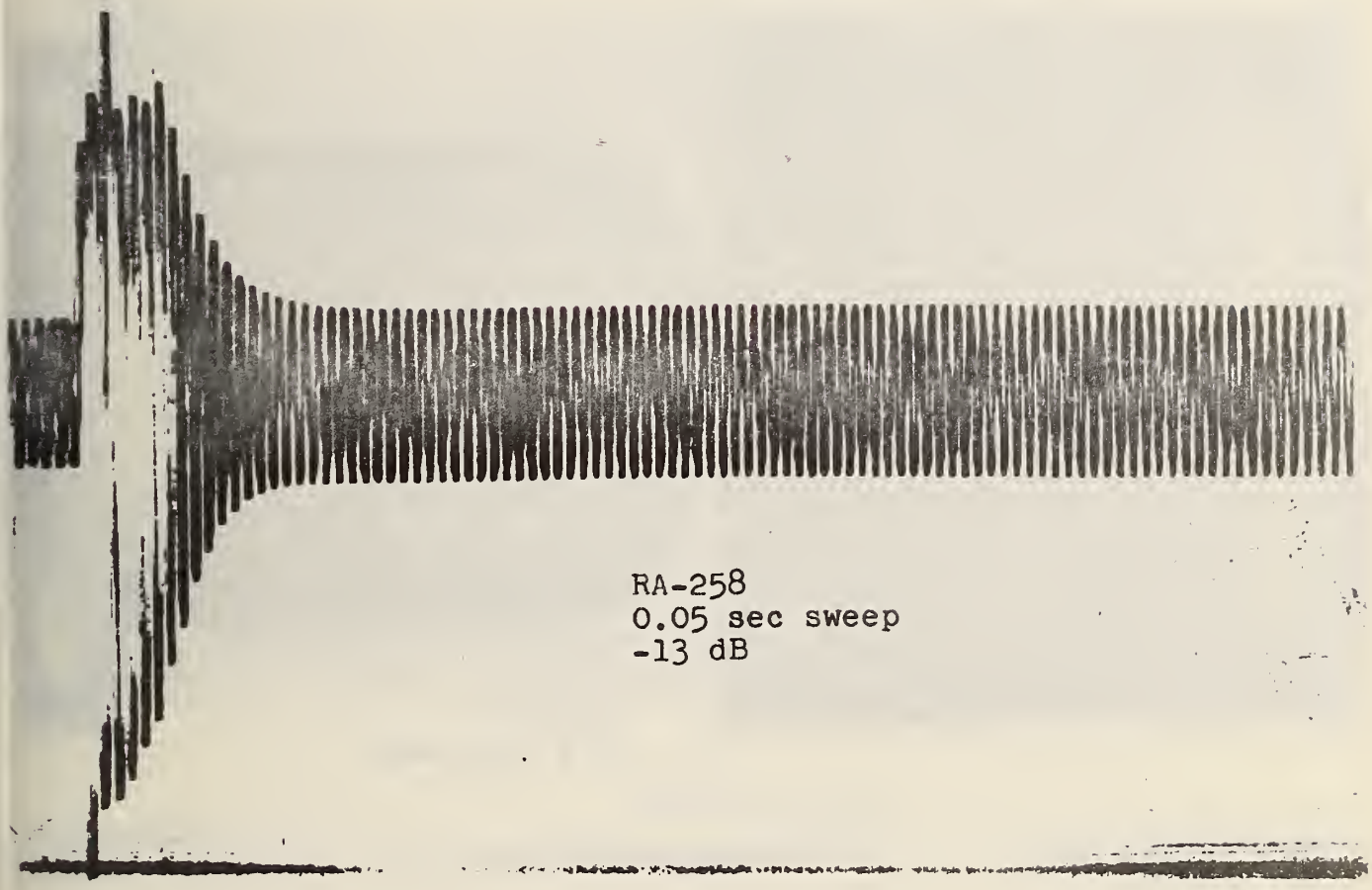
RA-257
0.5 sec sweep

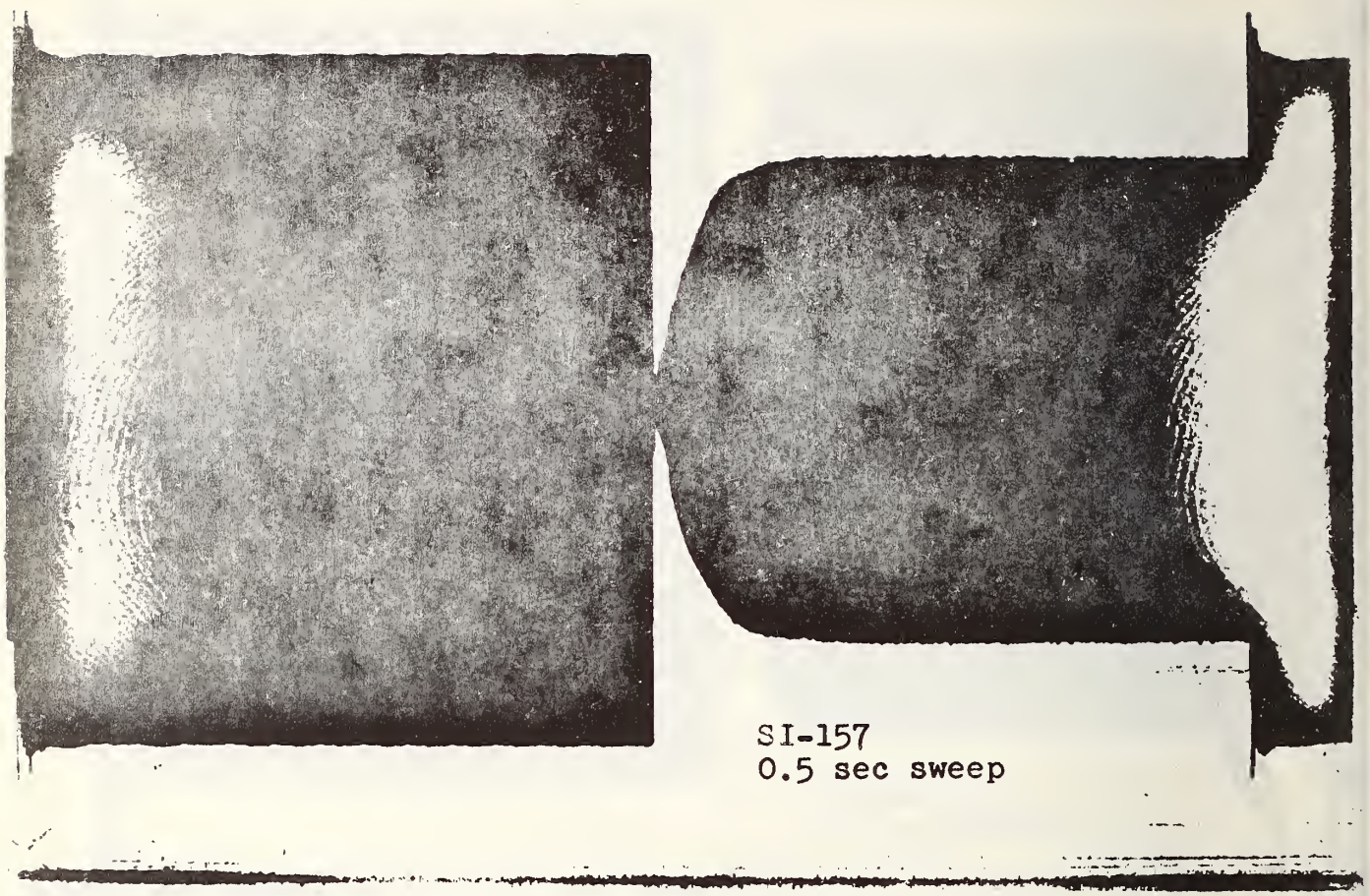


RA-257
0.05 sec sweep
-13 dB

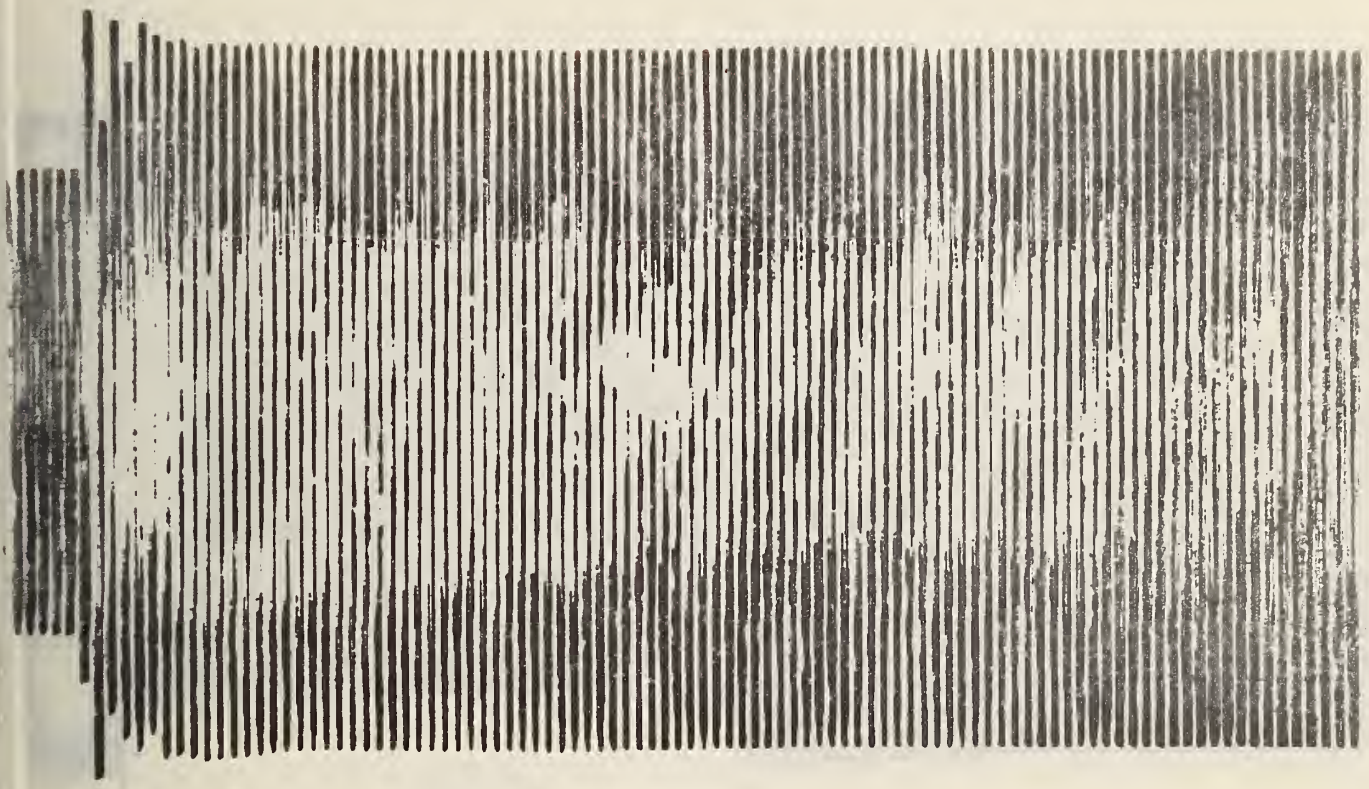


RA-258
0.5 sec sweep

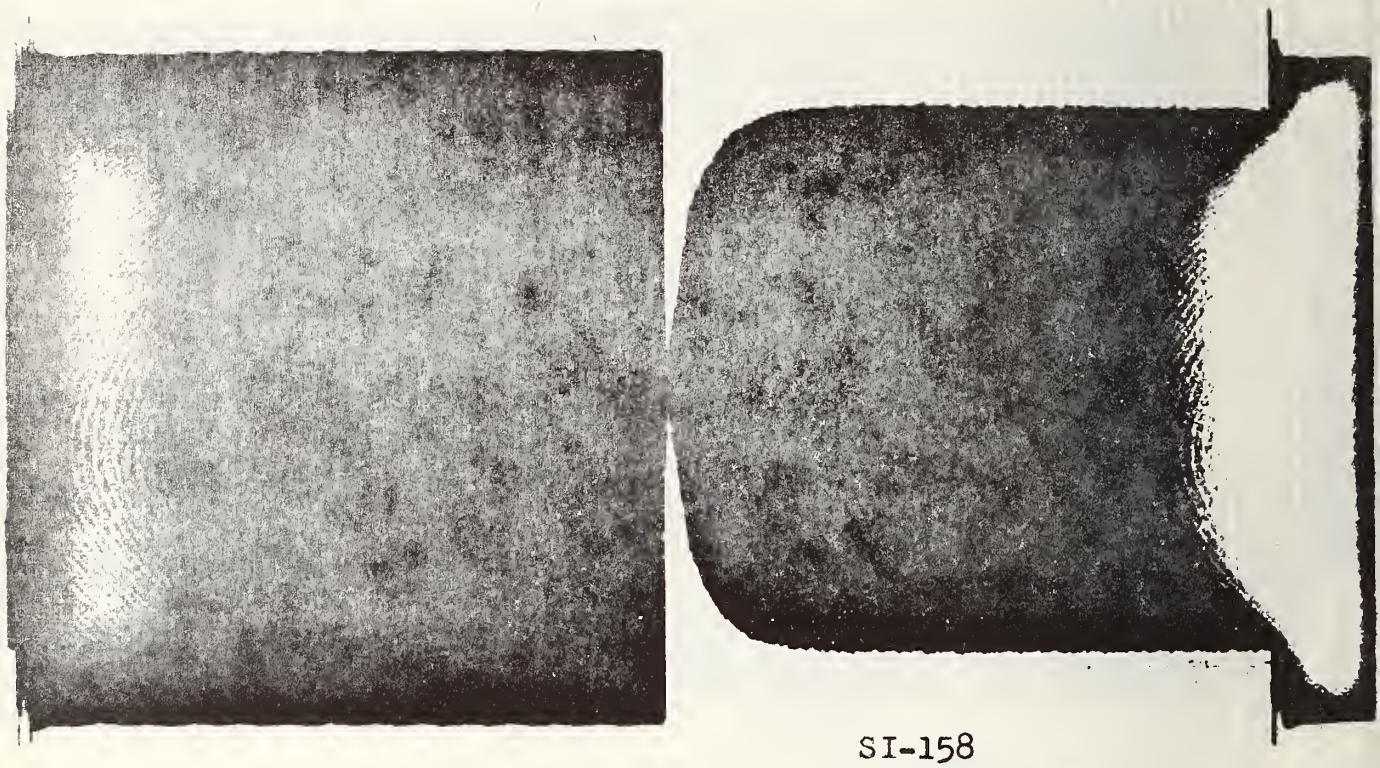

RA-258
0.05 sec sweep
-13 dB



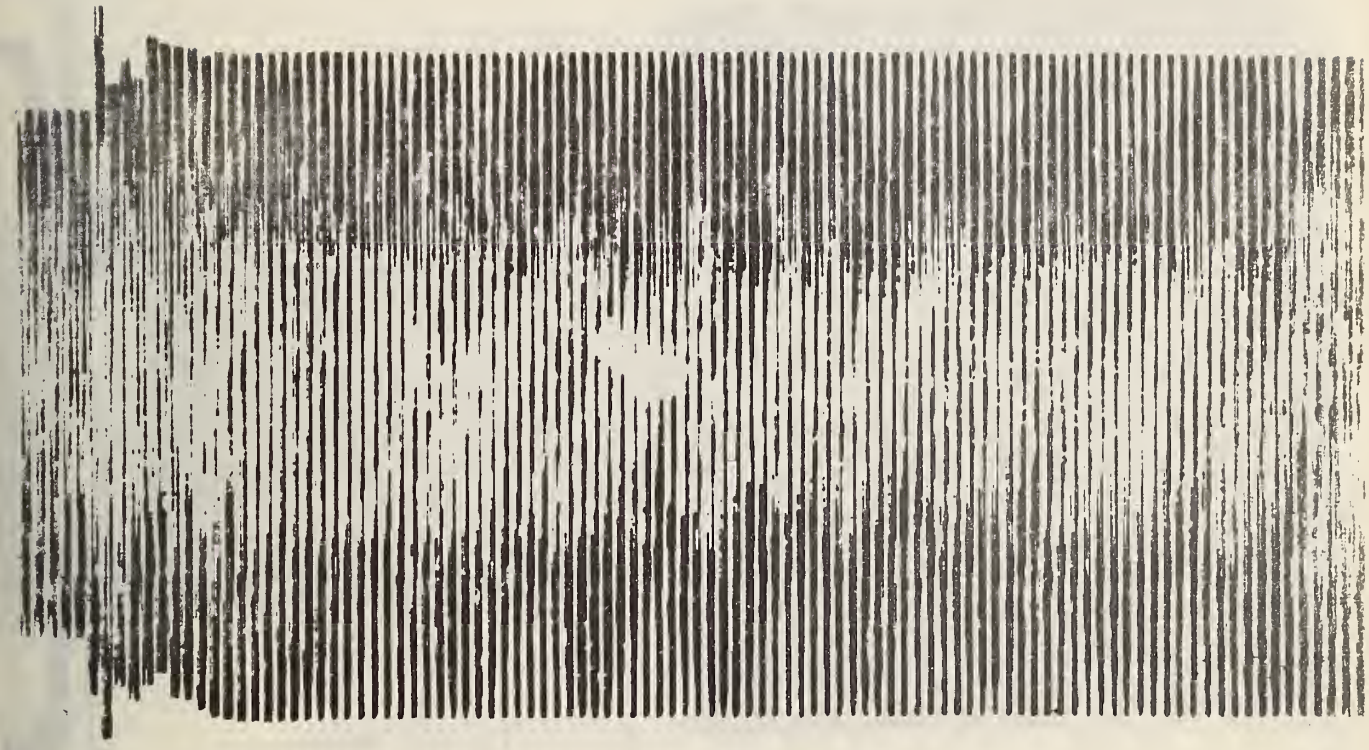
SI-157
0.5 sec sweep



SI-157
0.05 sec sweep

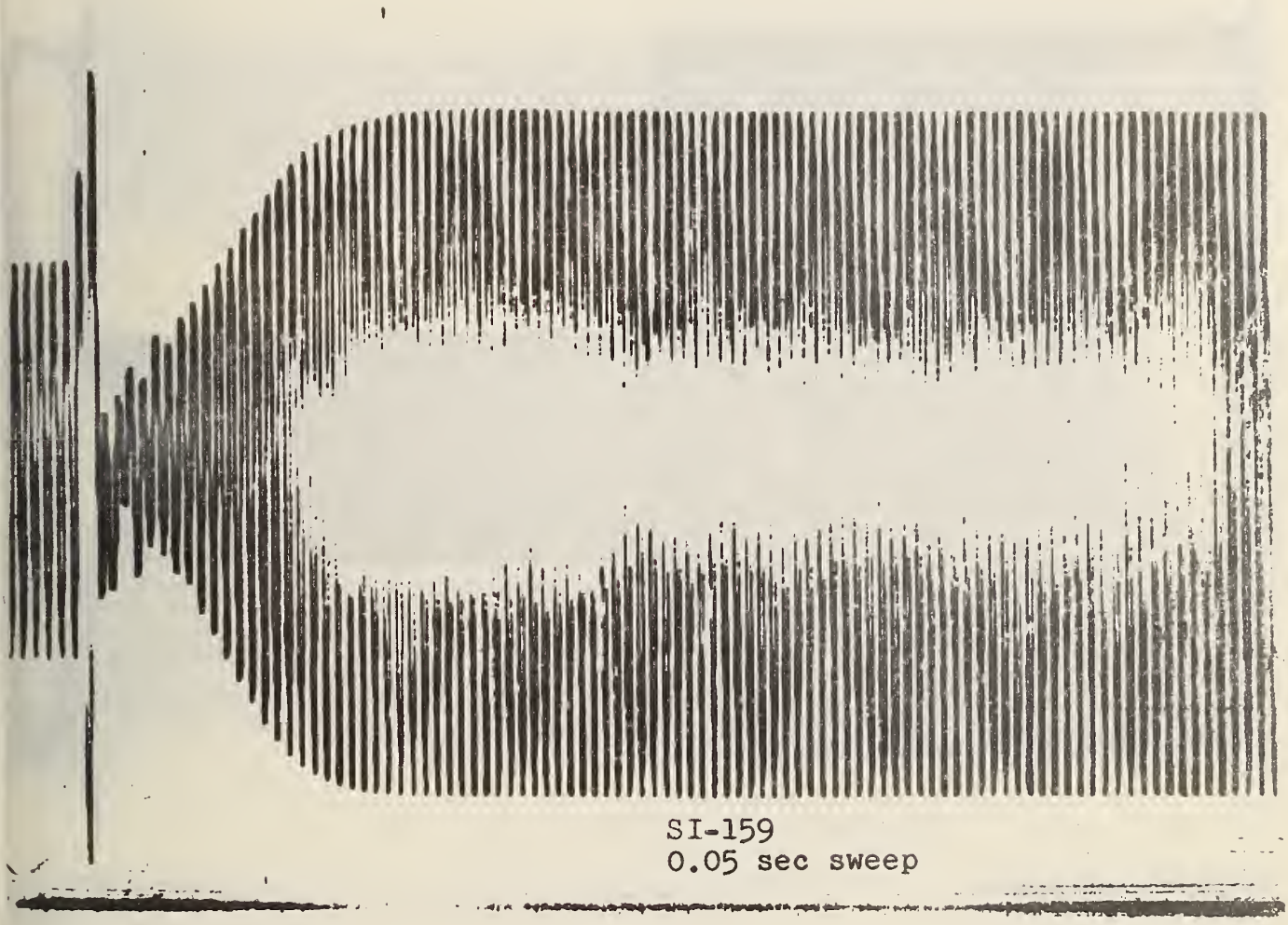


SI-158
0.5 sec sweep

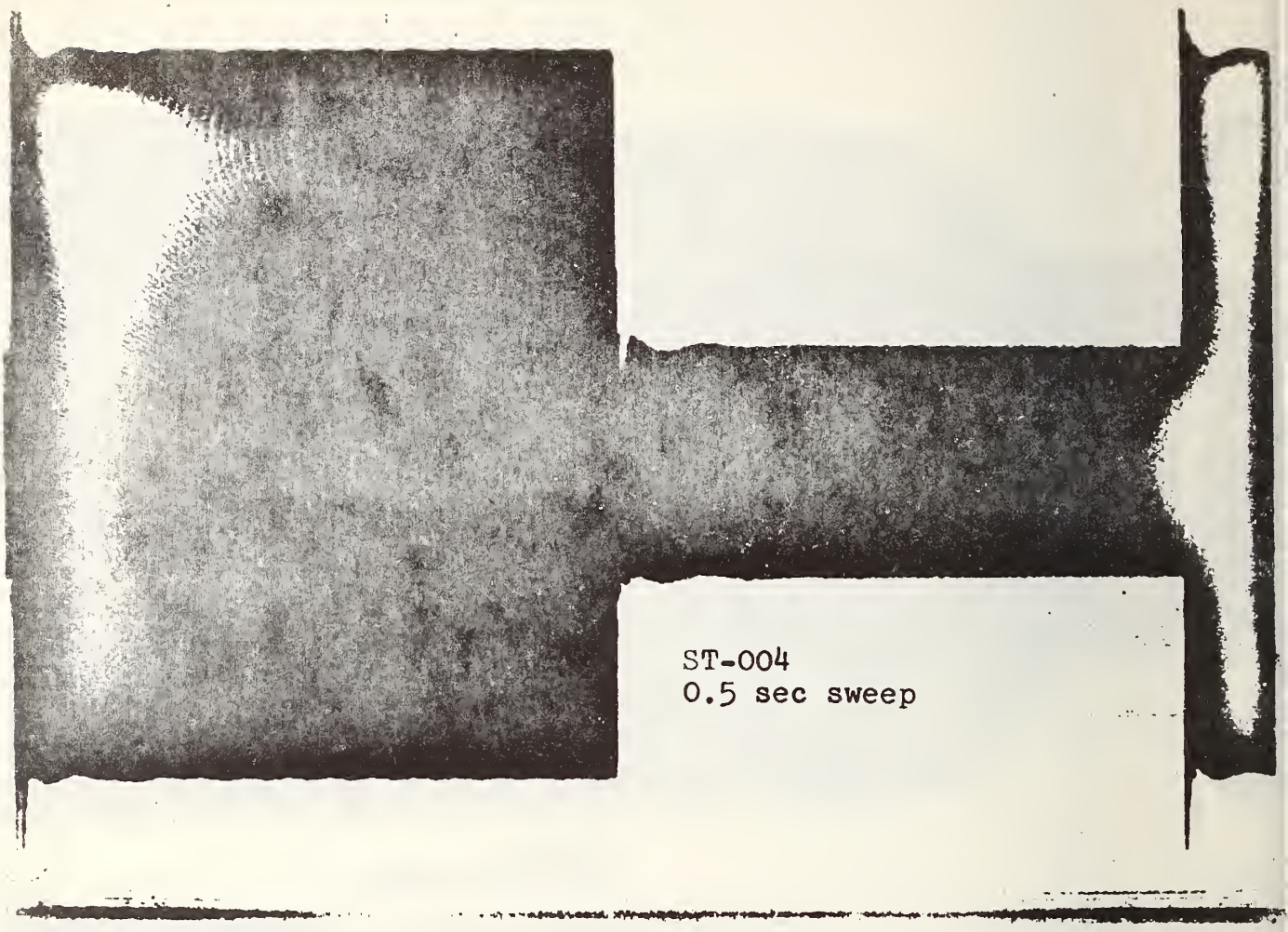


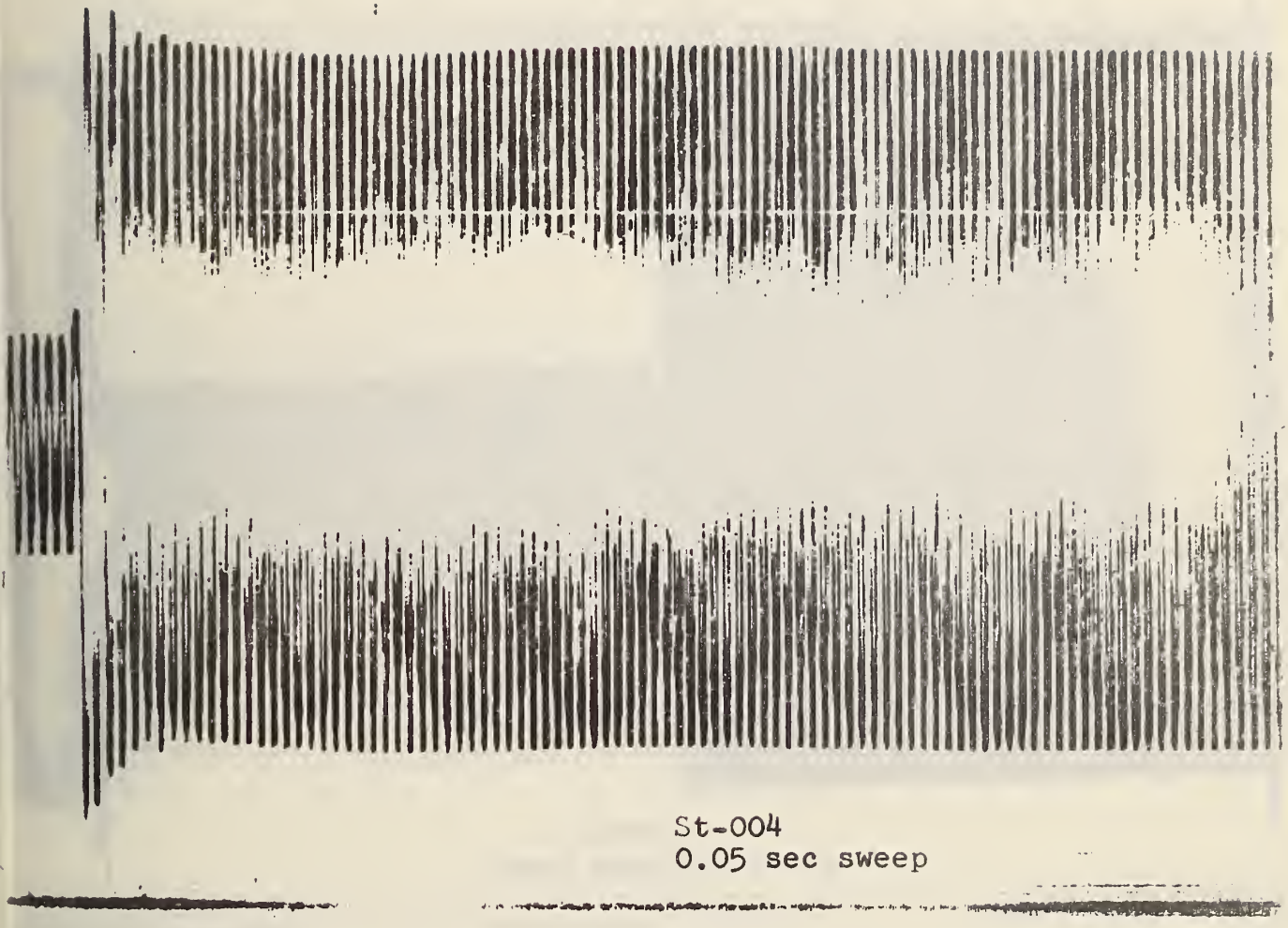
SI-158
0.05 sec sweep

SI-159
0.5 sec sweep

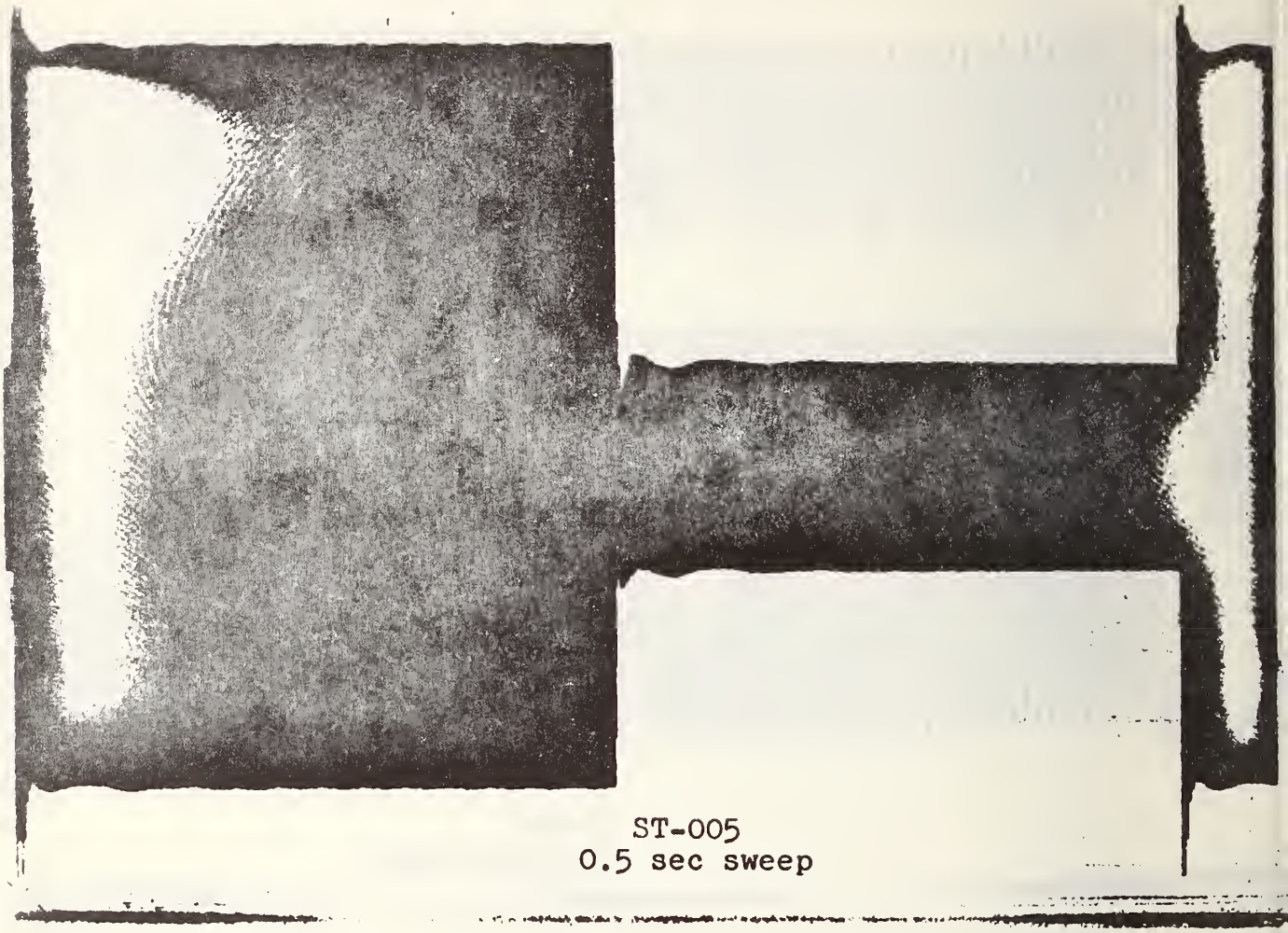


SI-159
0.05 sec sweep

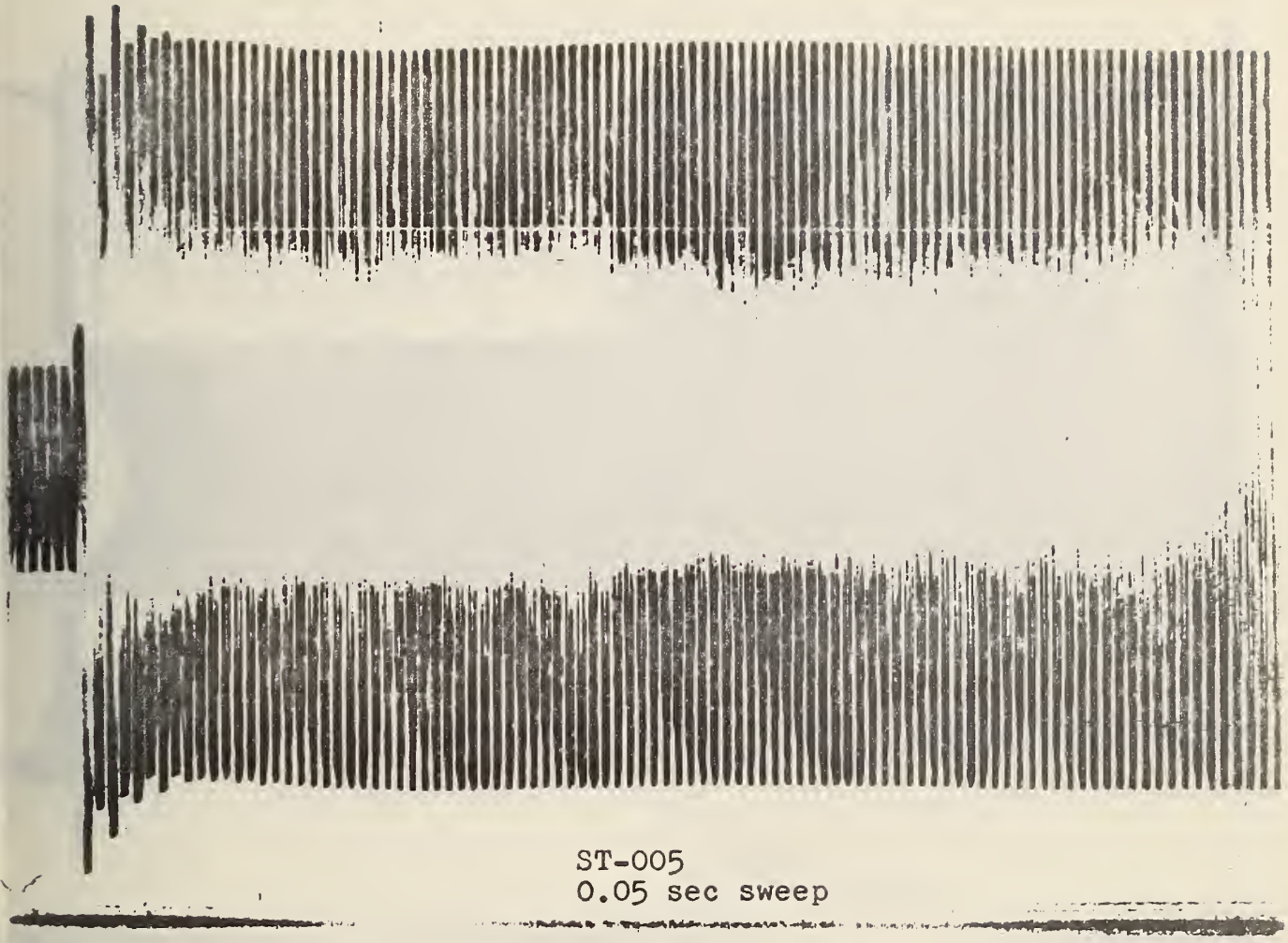

ST-004
0.5 sec sweep



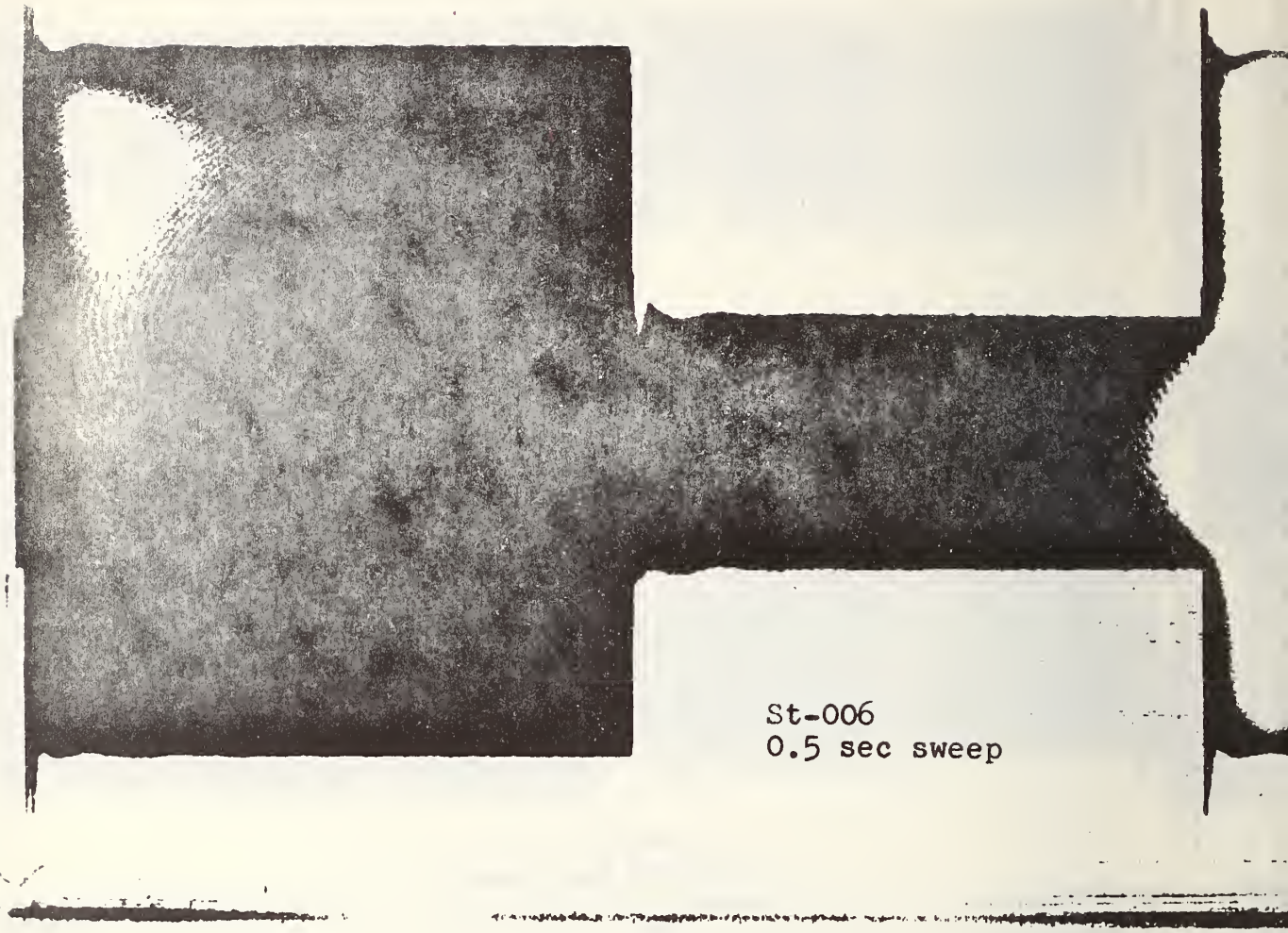
St-004
0.05 sec sweep

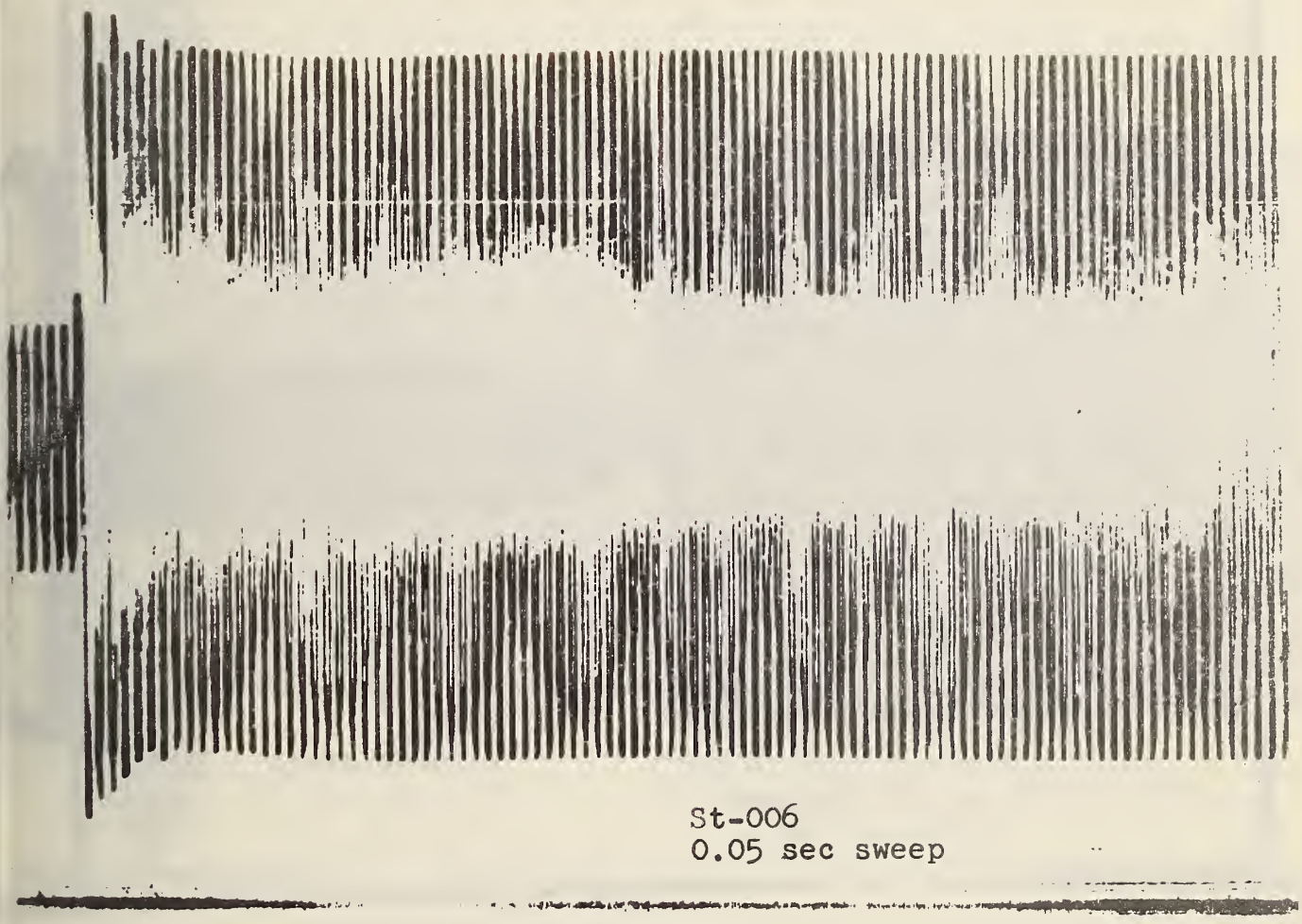


ST-005
0.5 sec sweep

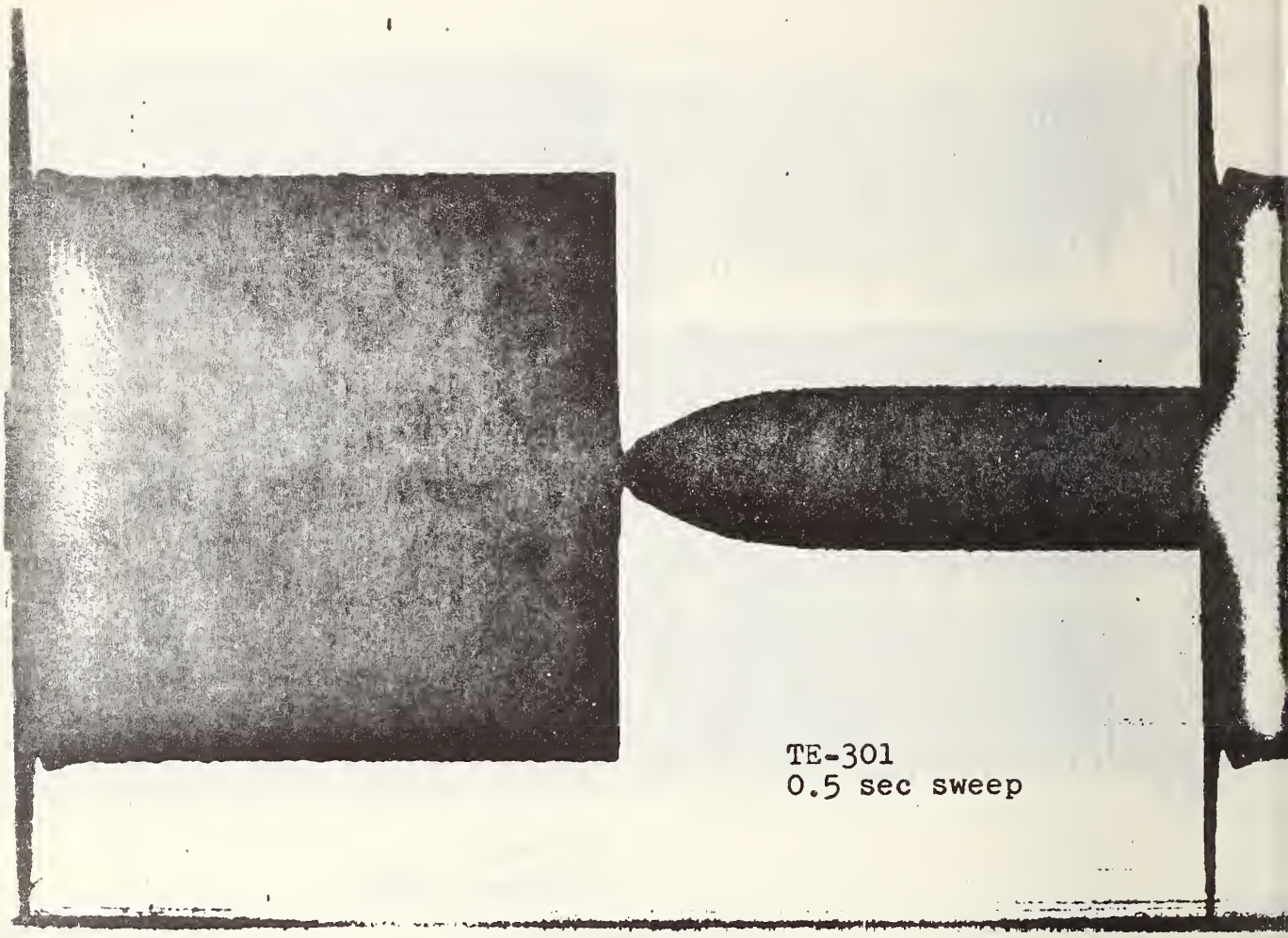


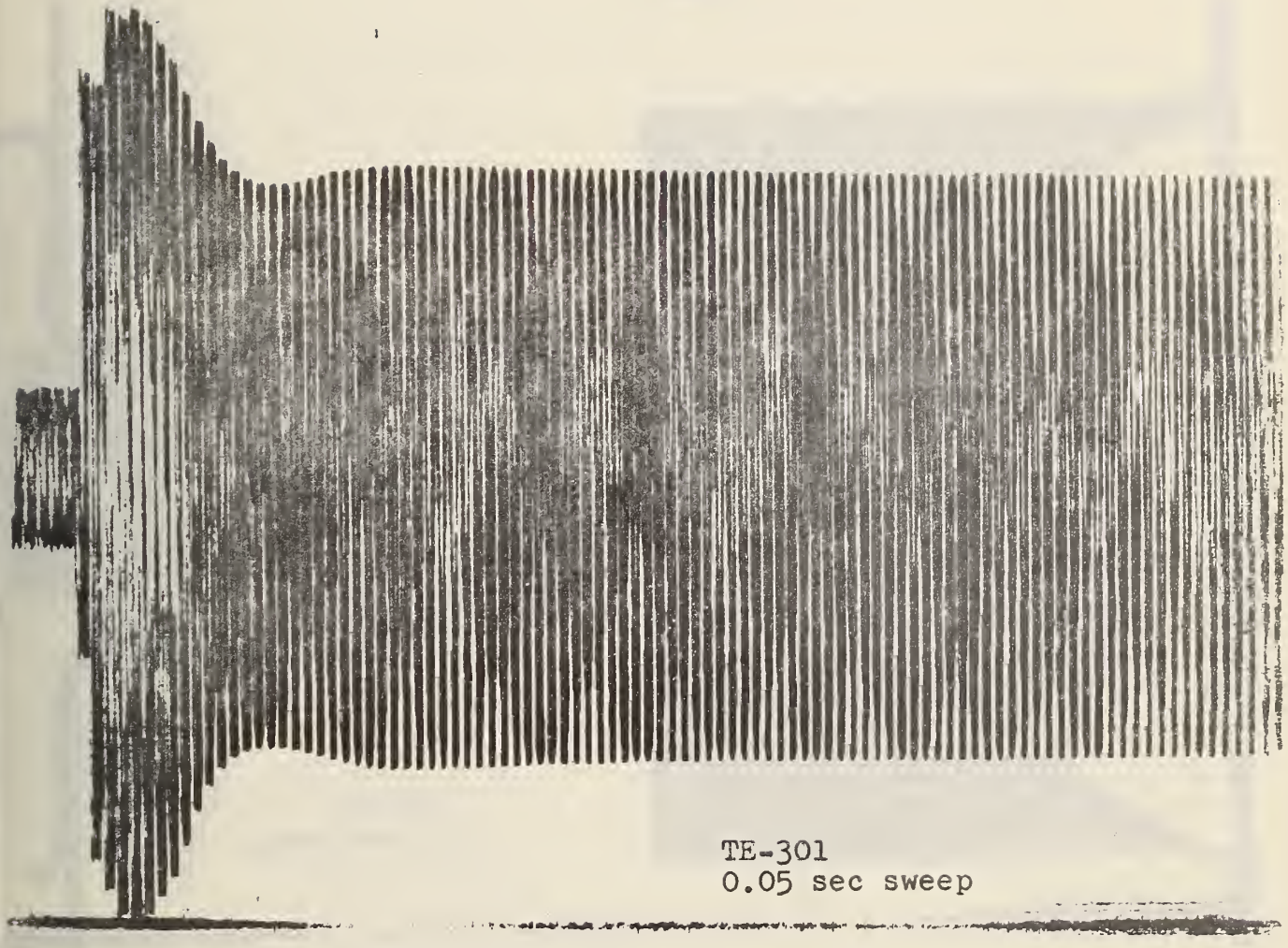
ST-005
0.05 sec sweep


St-006
0.5 sec sweep

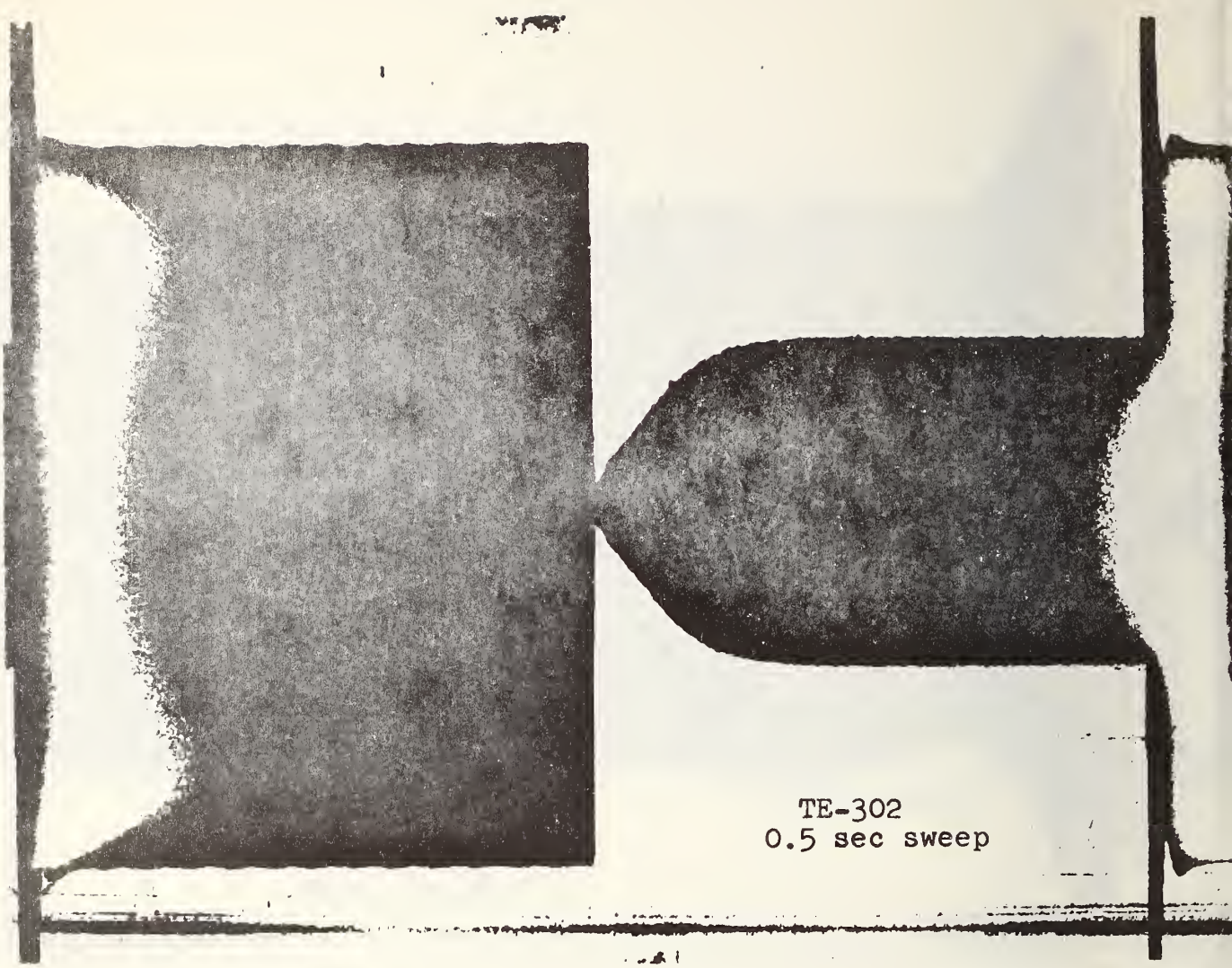


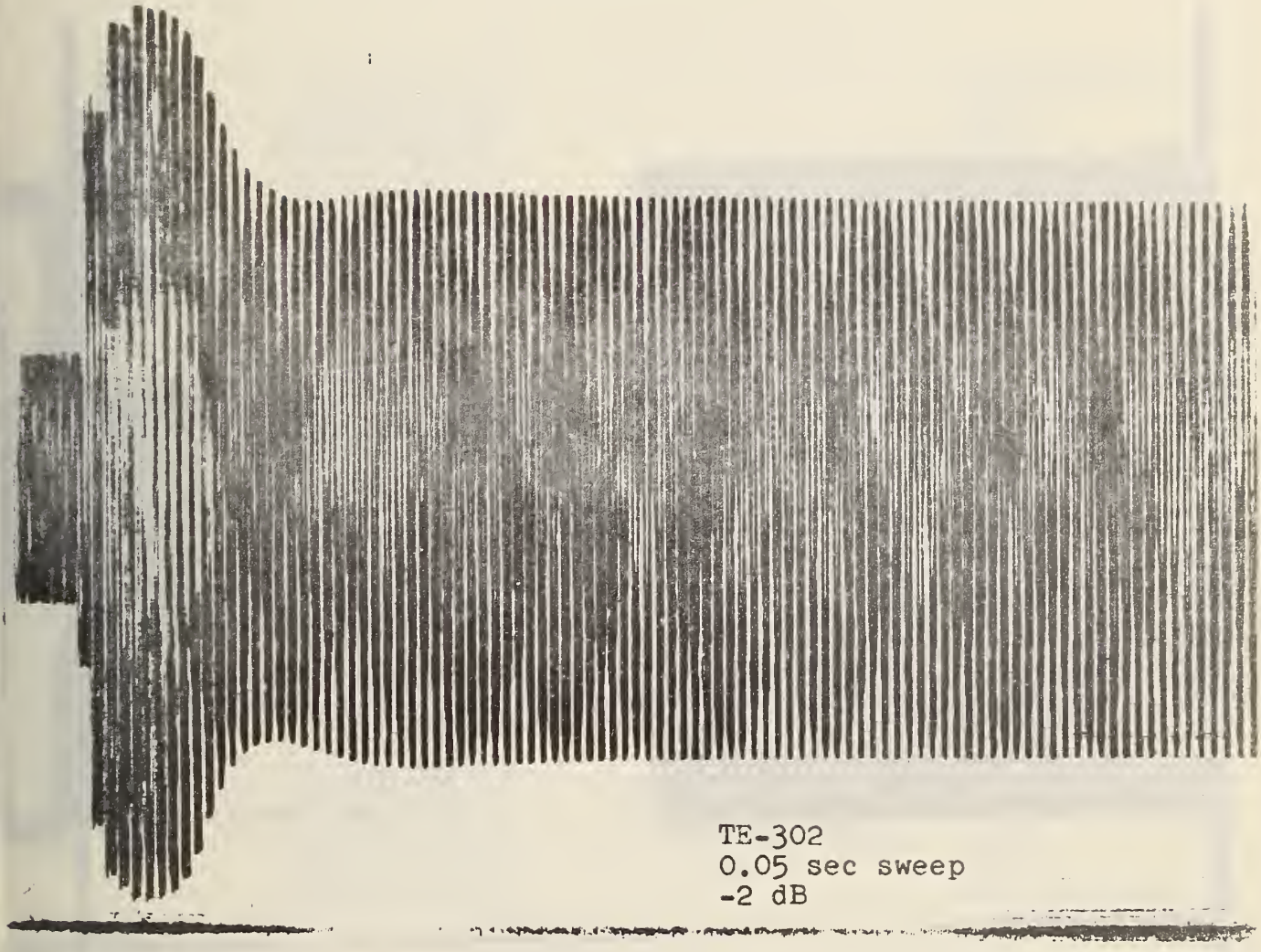
St-006
0.05 sec sweep

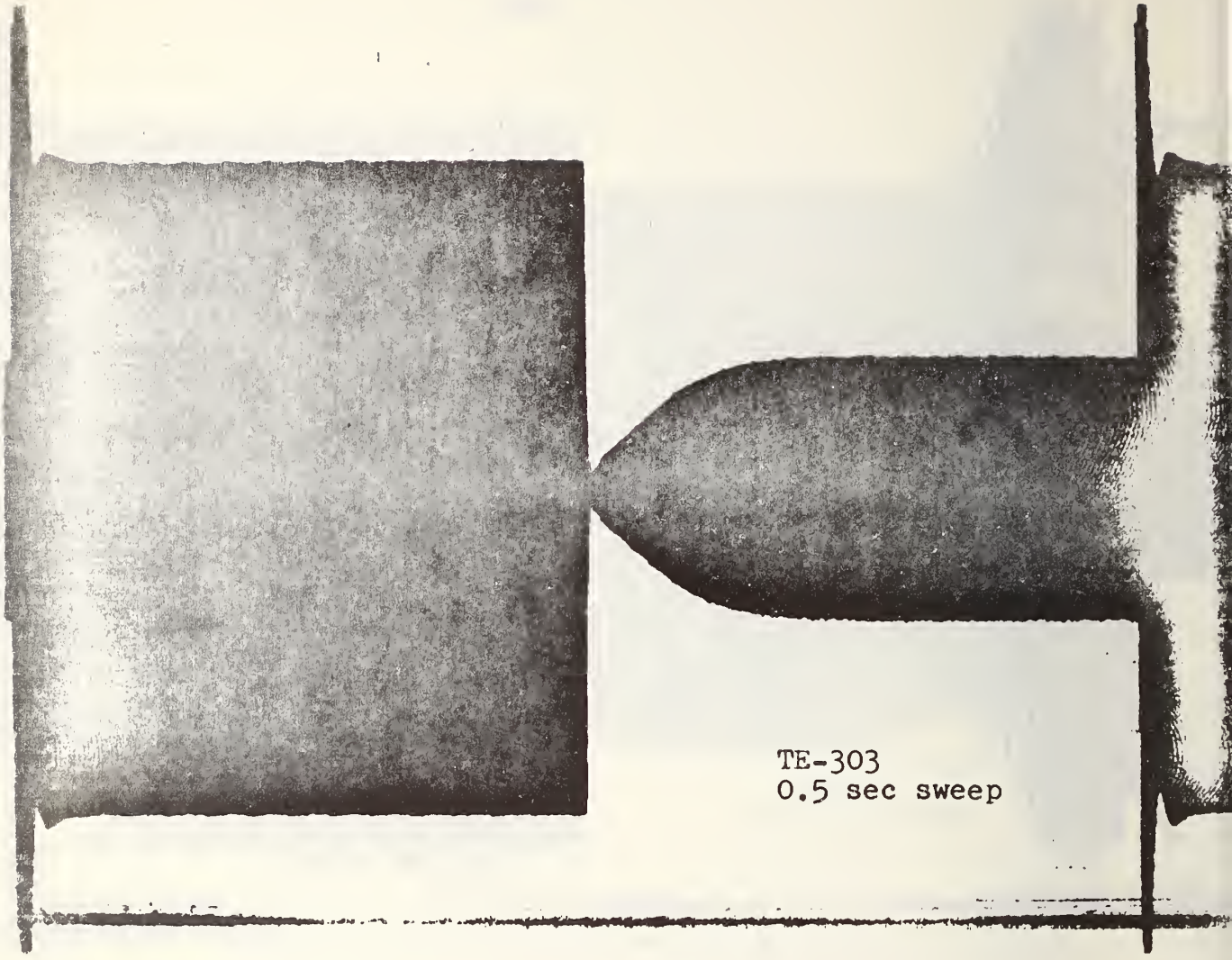

TE-301
0.5 sec sweep

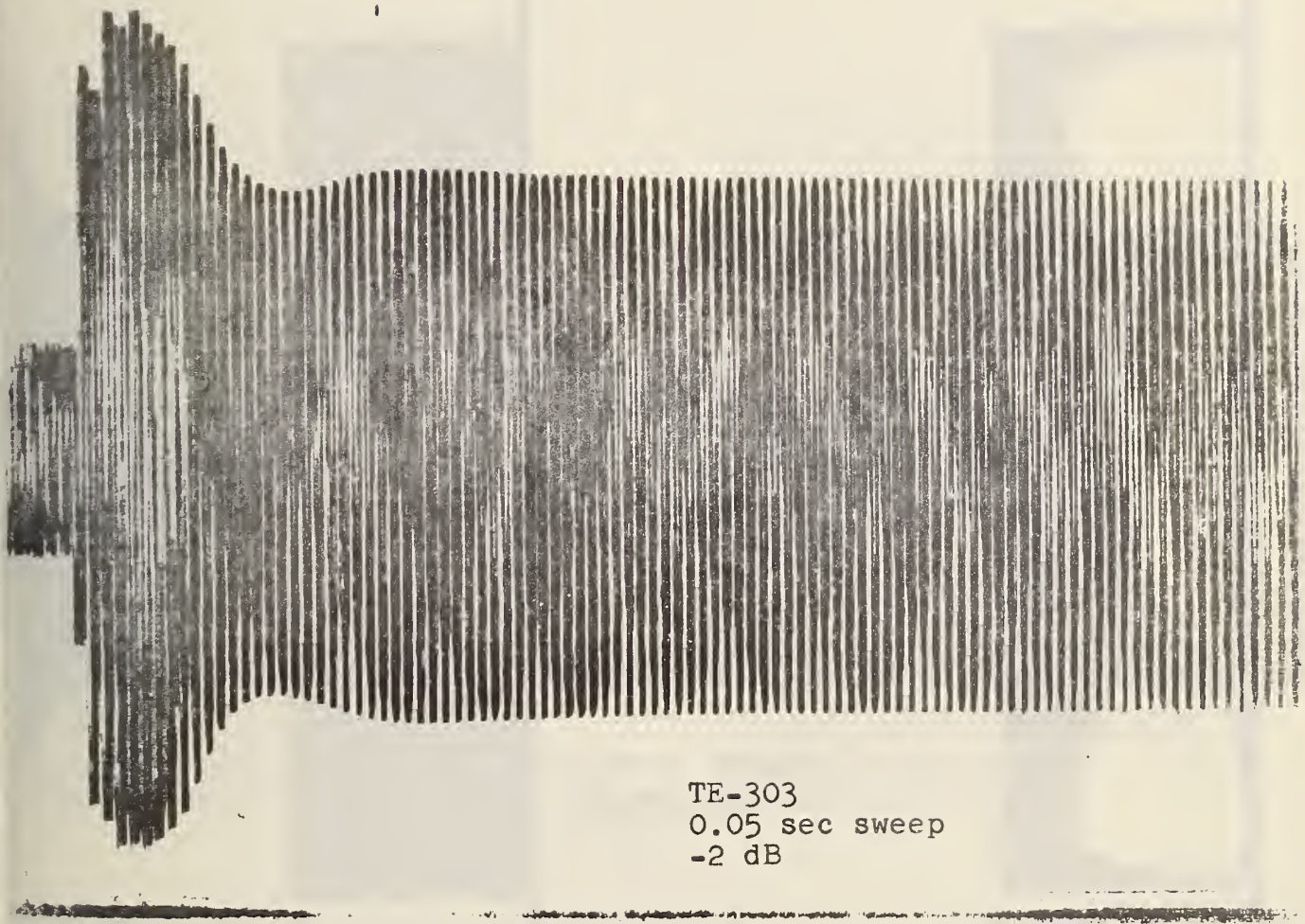


TE-301
0.05 sec sweep

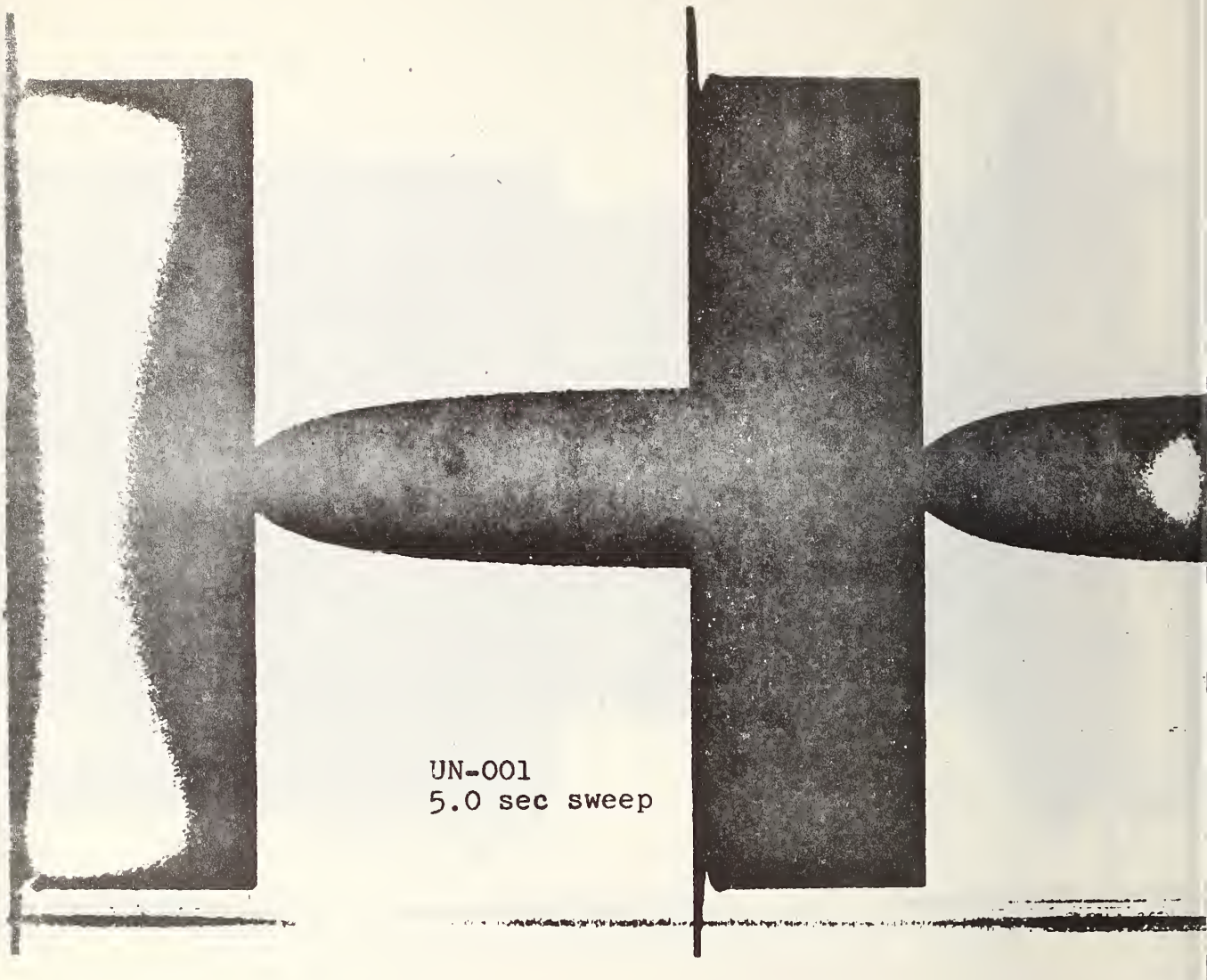

TE-302
0.5 sec sweep

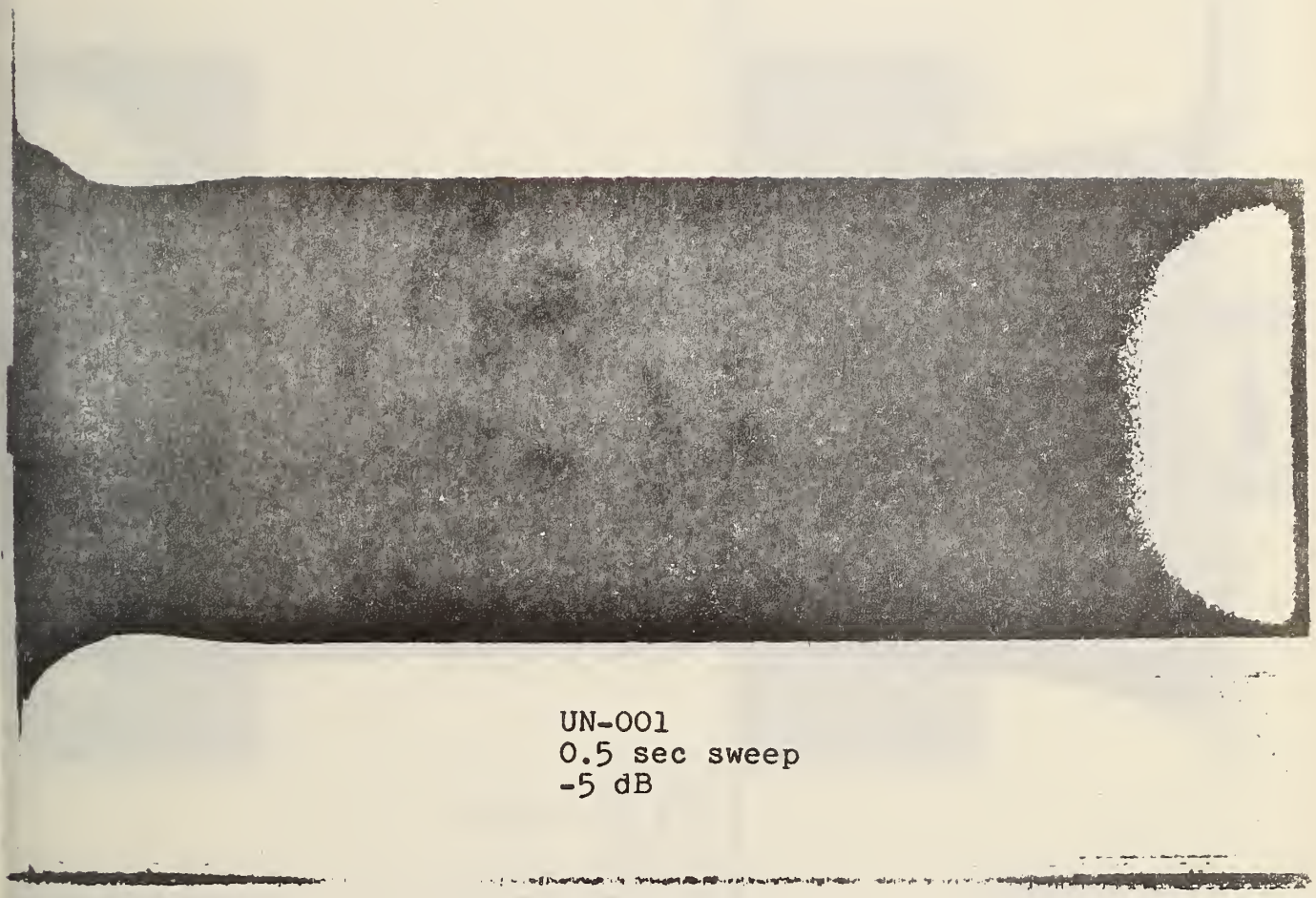

TE-302
0.05 sec sweep
-2 dB


TE-303
0.5 sec sweep

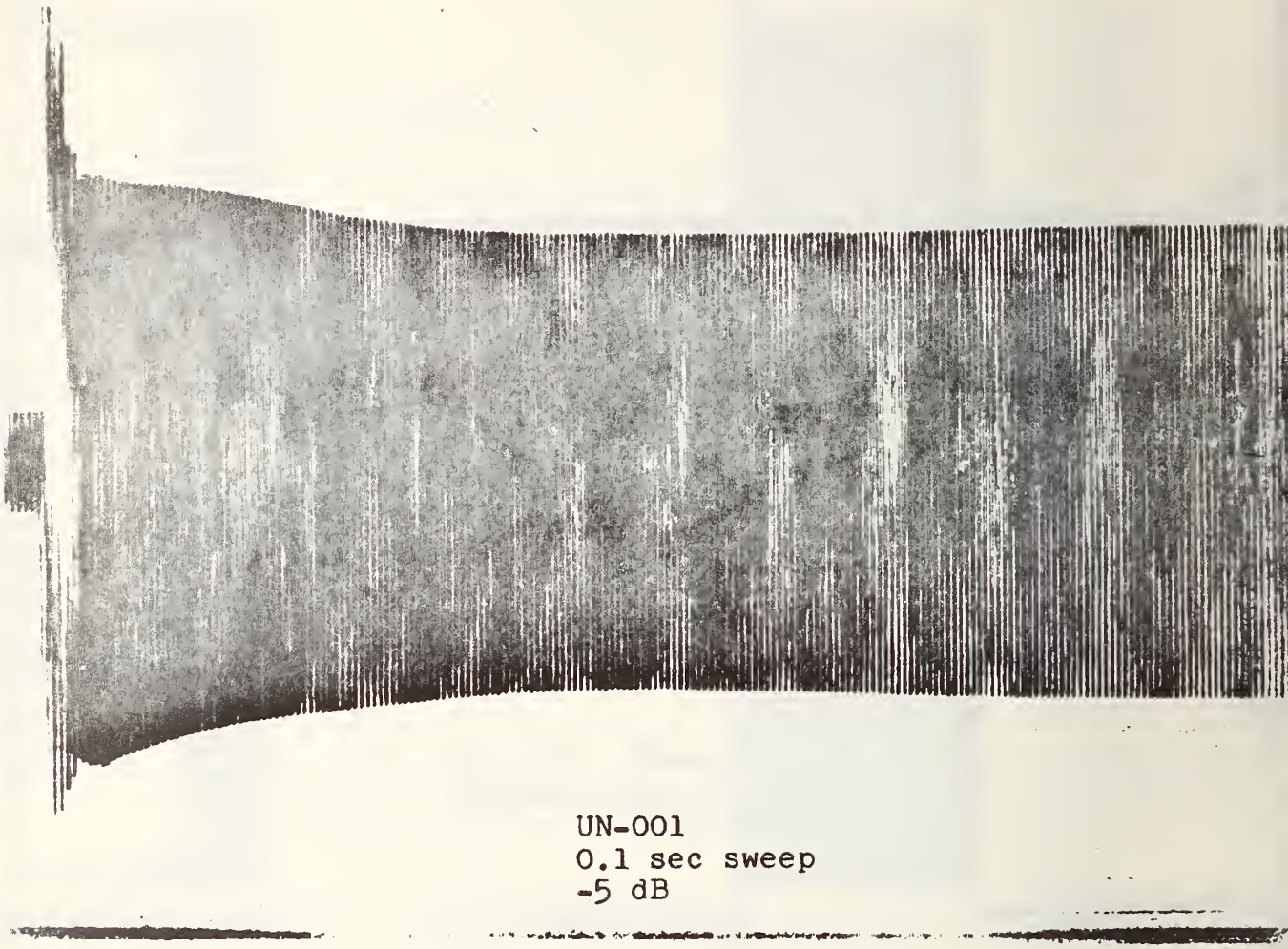


TE-303
0.05 sec sweep
-2 dB

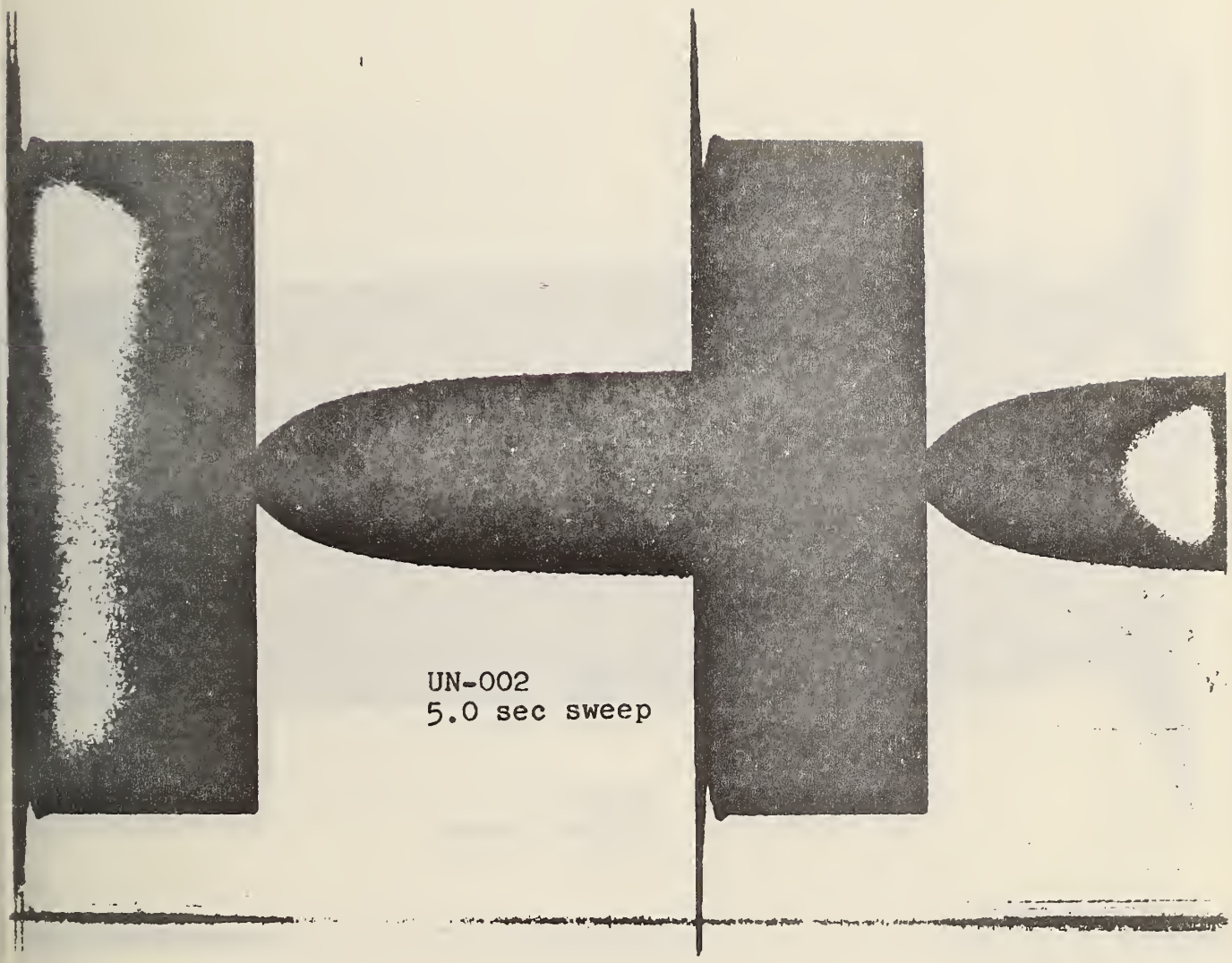

UN-001
5.0 sec sweep

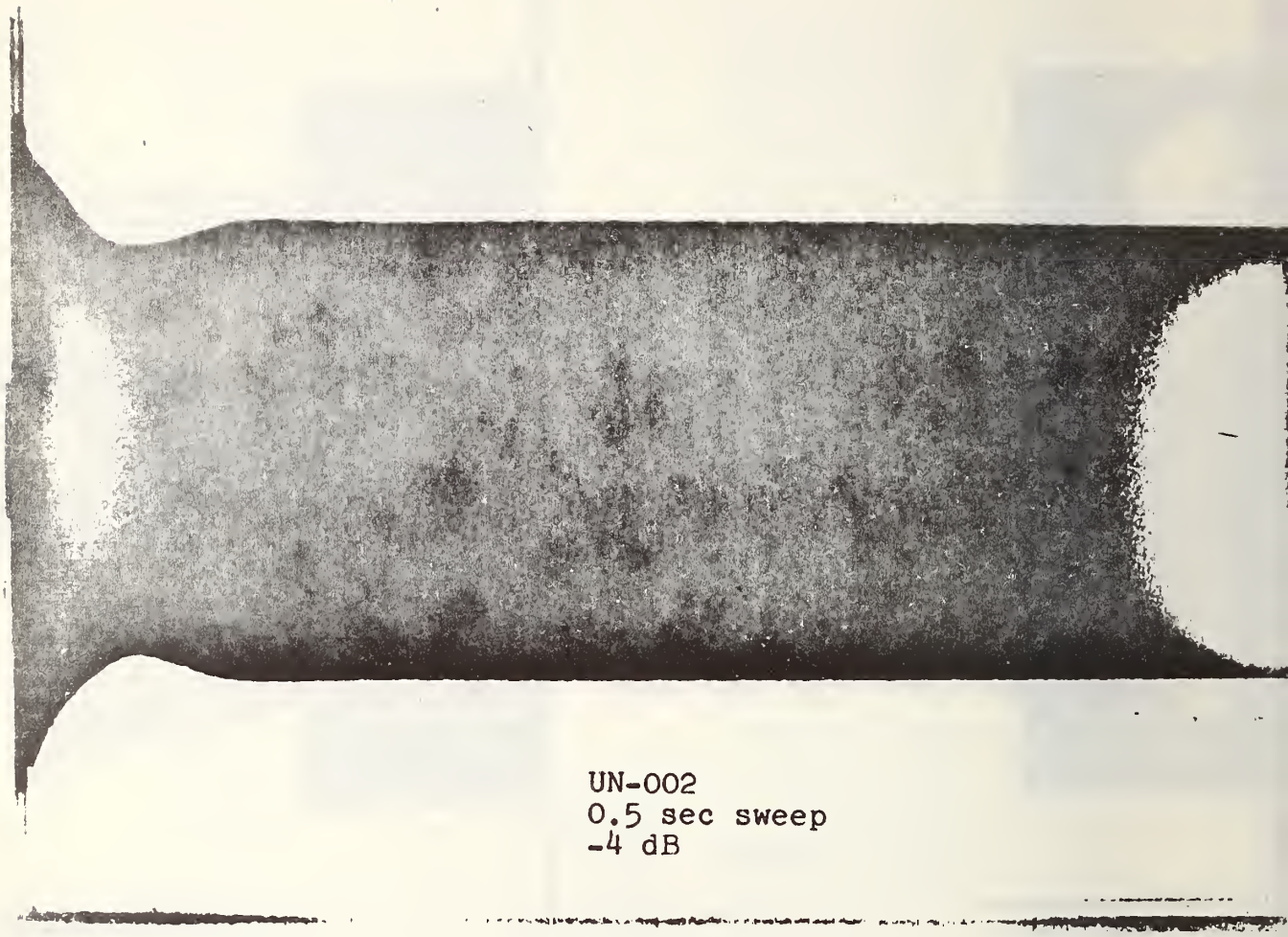


UN-001
0.5 sec sweep
-5 dB

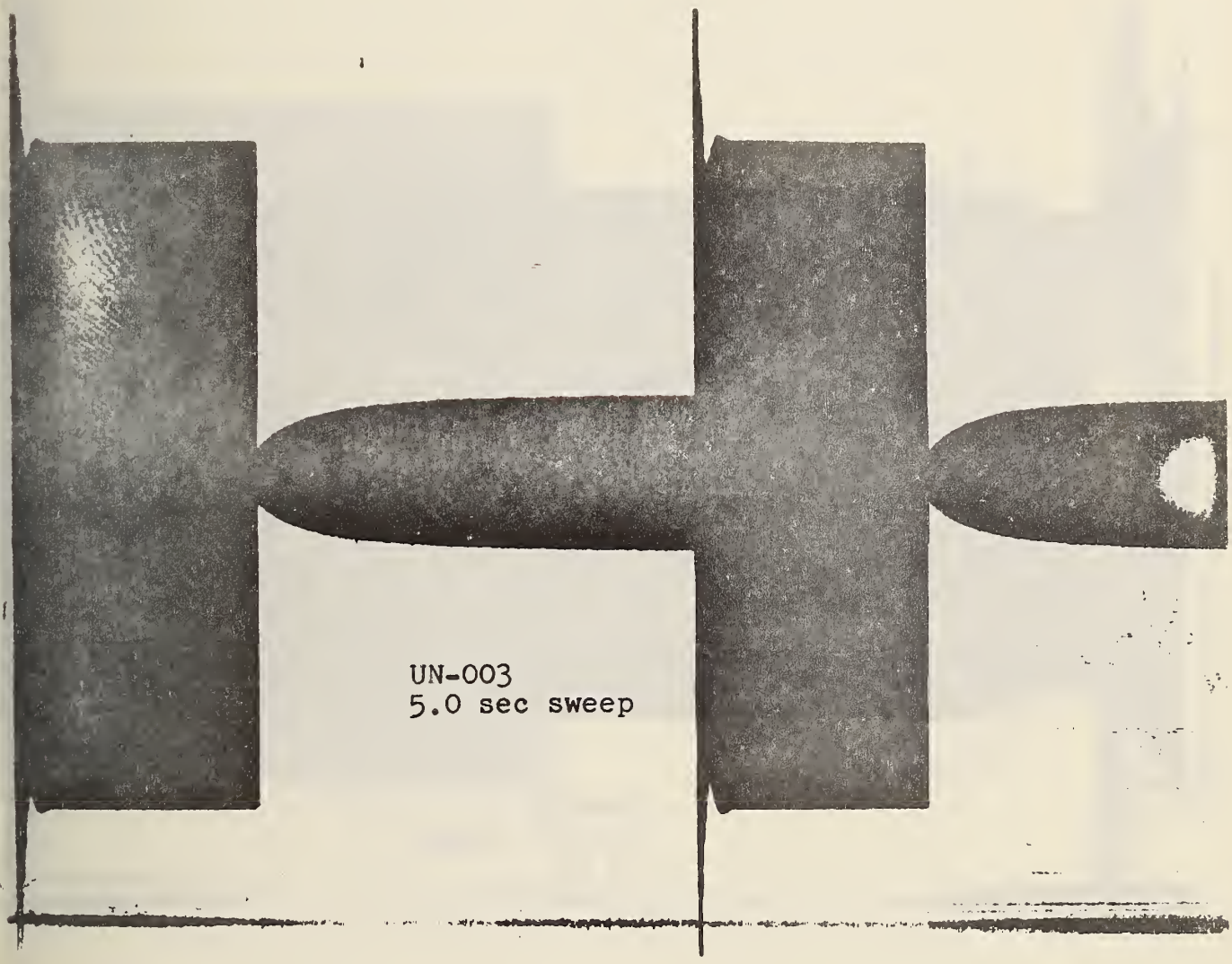


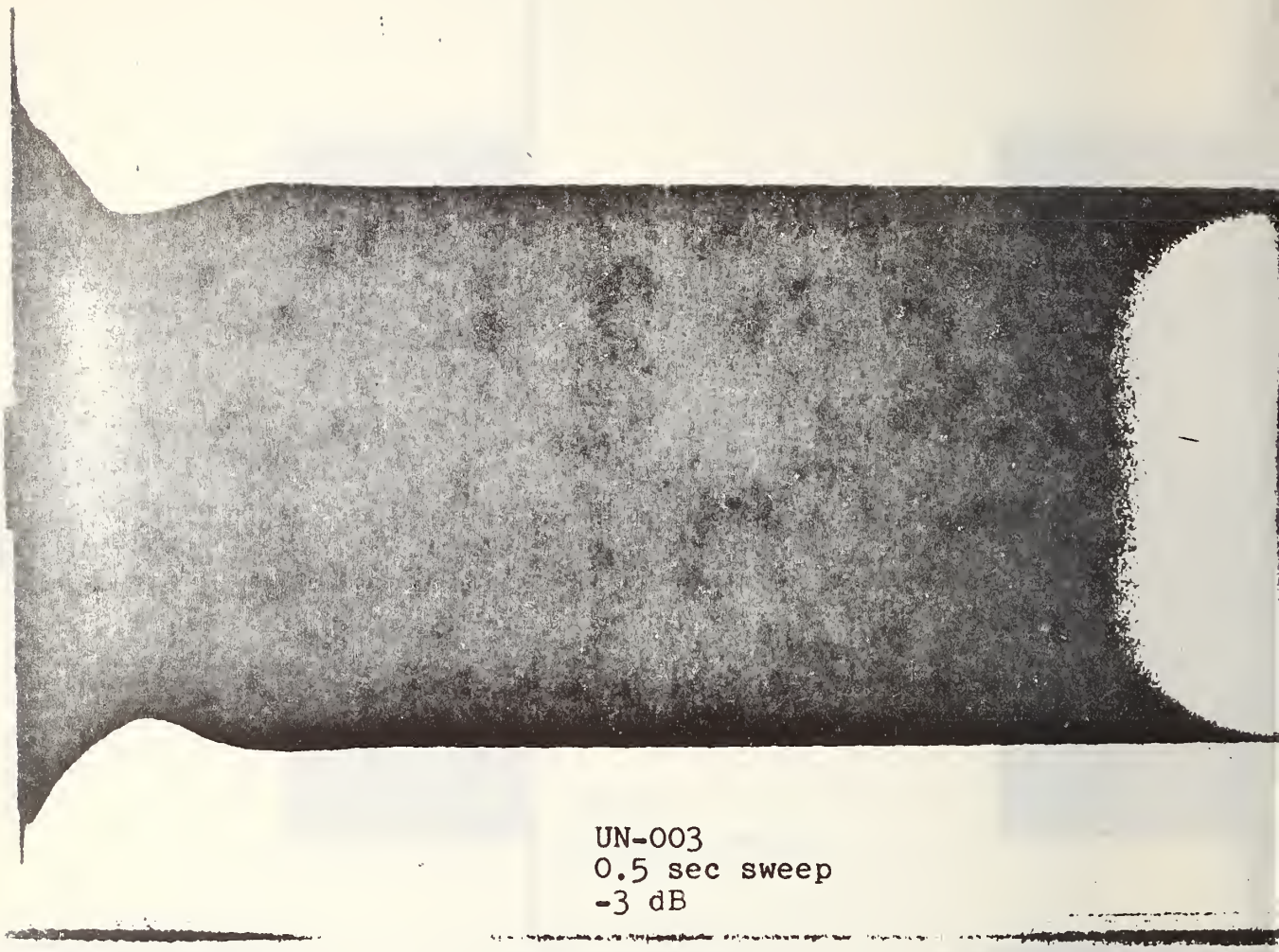
UN-001
0.1 sec sweep
-5 dB


UN-002
5.0 sec sweep

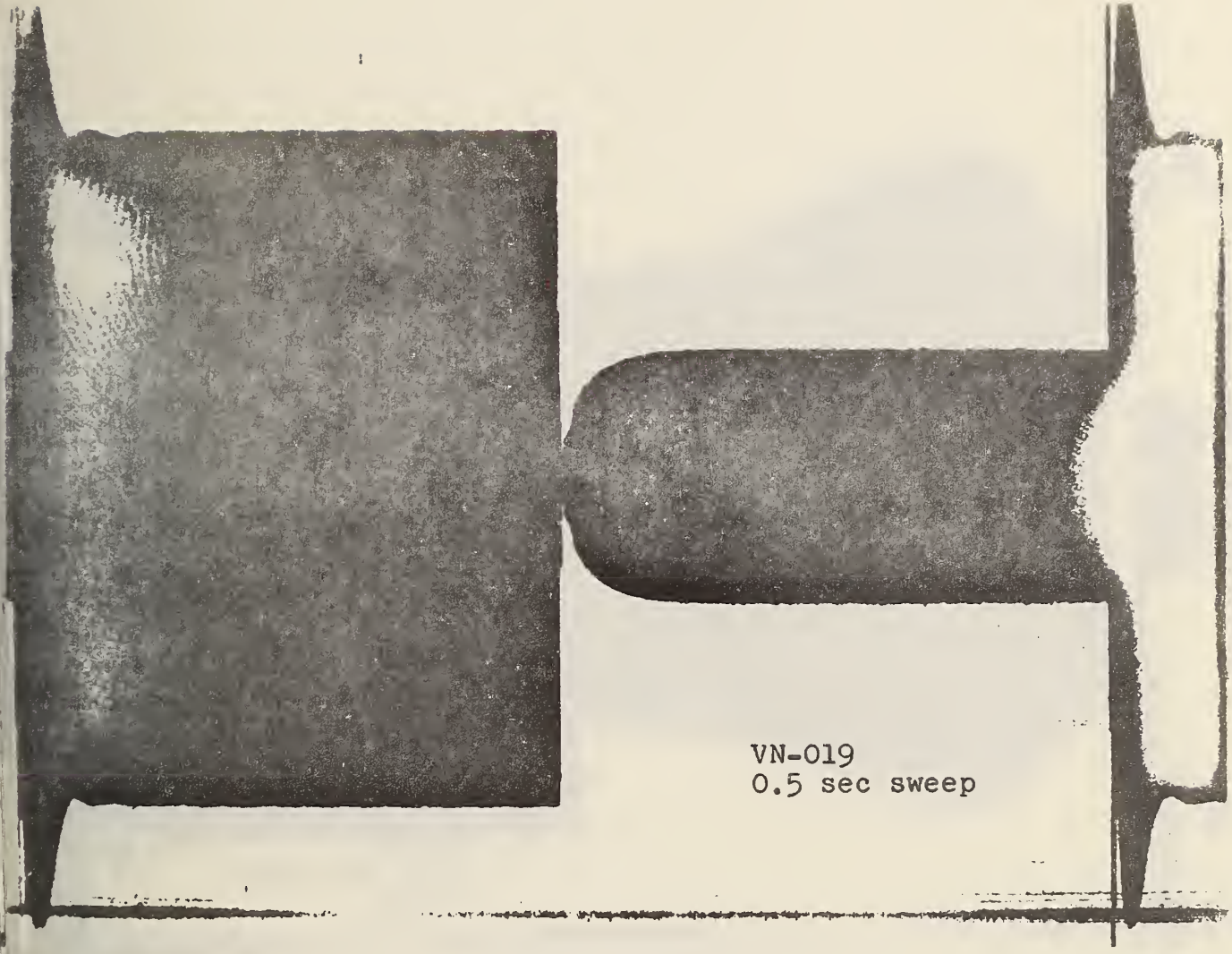


UN-002
0.5 sec sweep
-4 dB

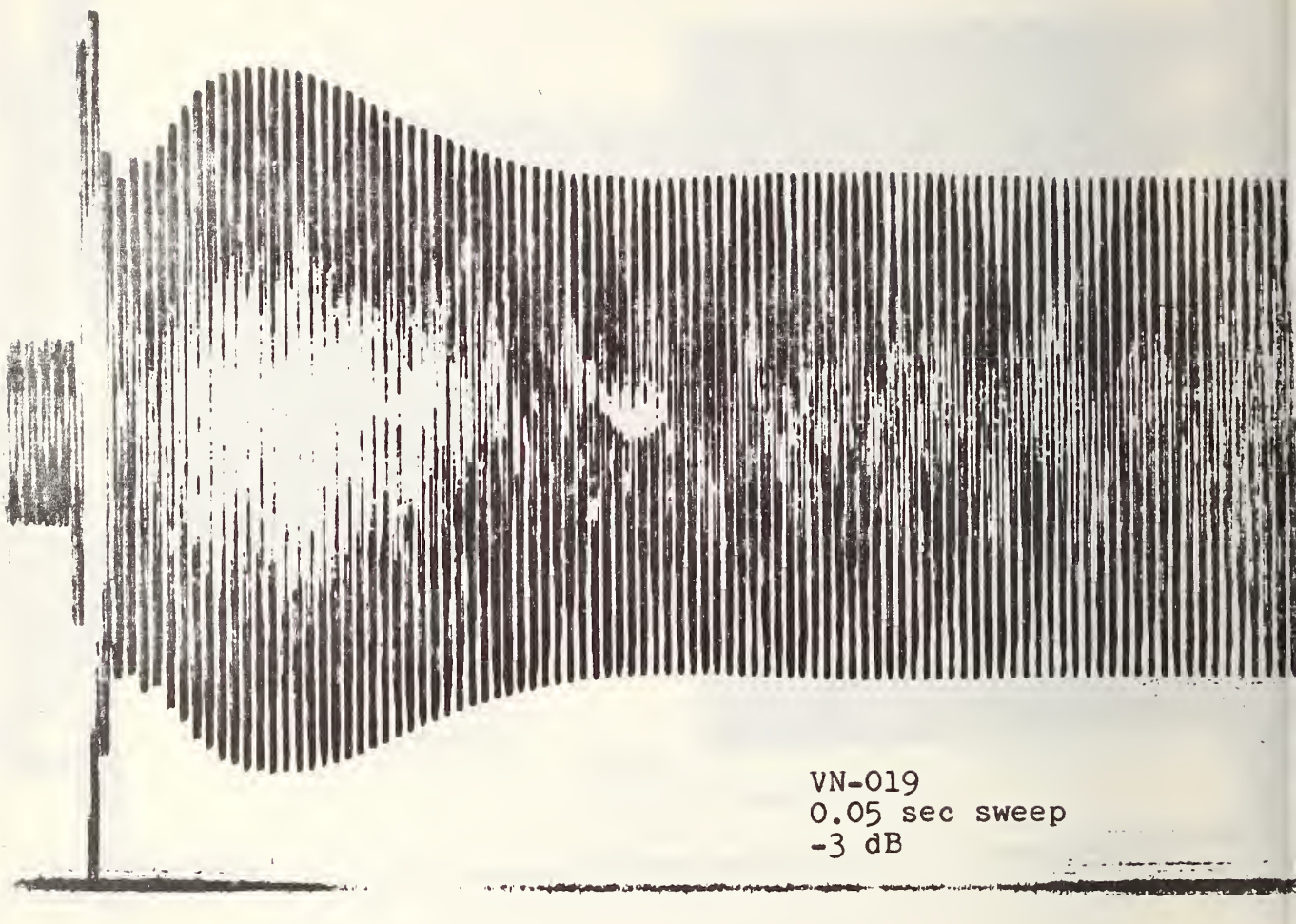

UN-003
5.0 sec sweep

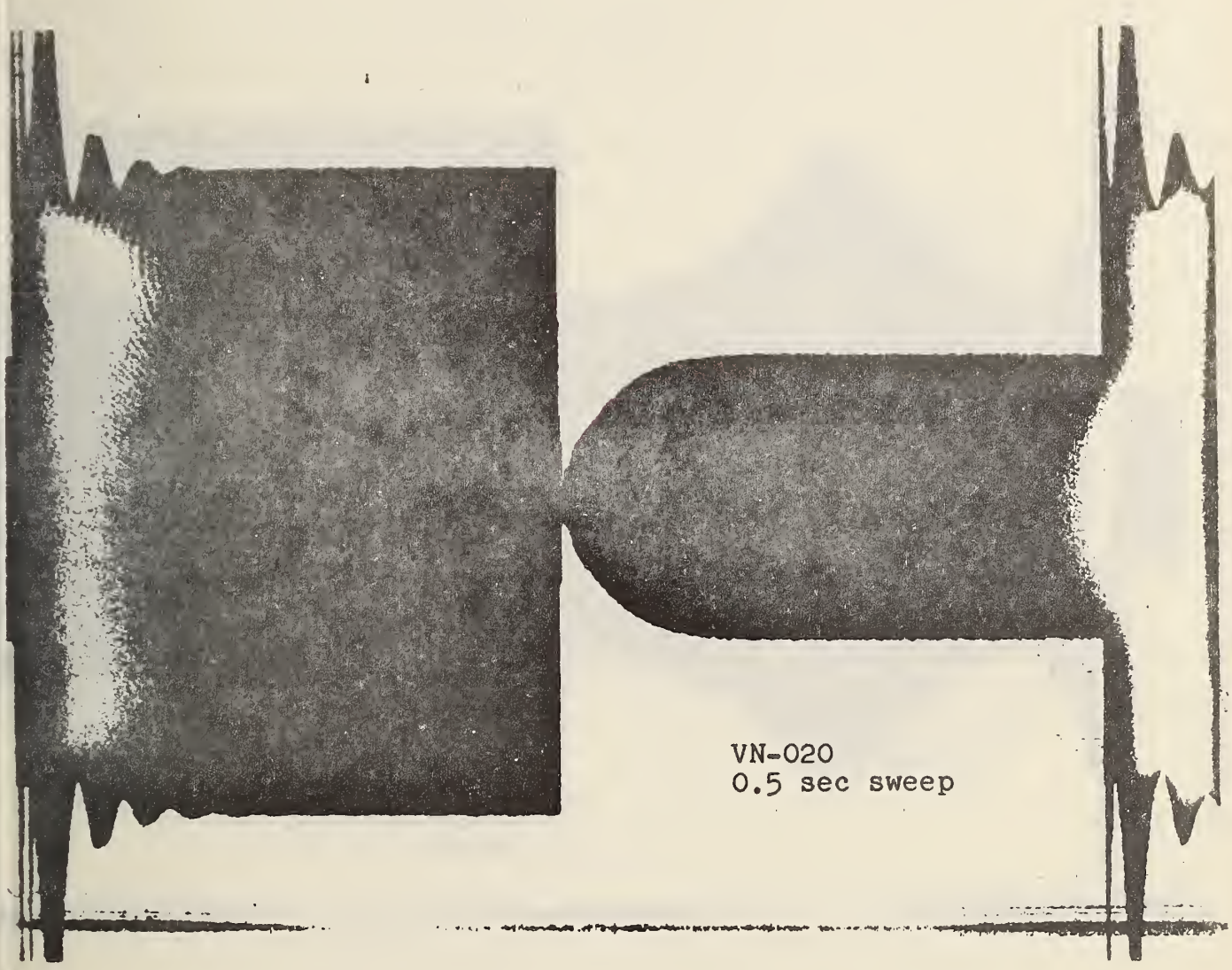


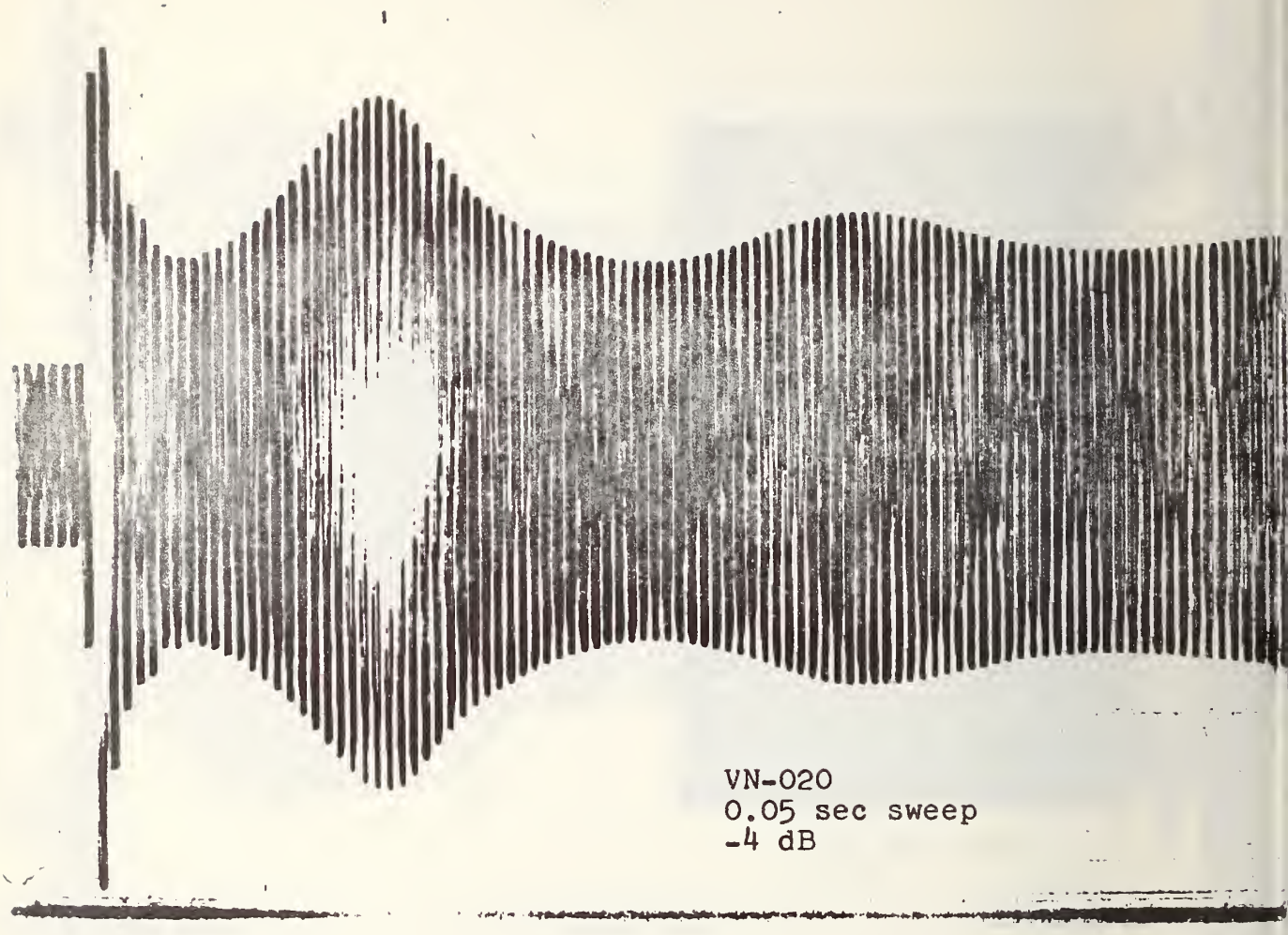
UN-003
0.5 sec sweep
-3 dB

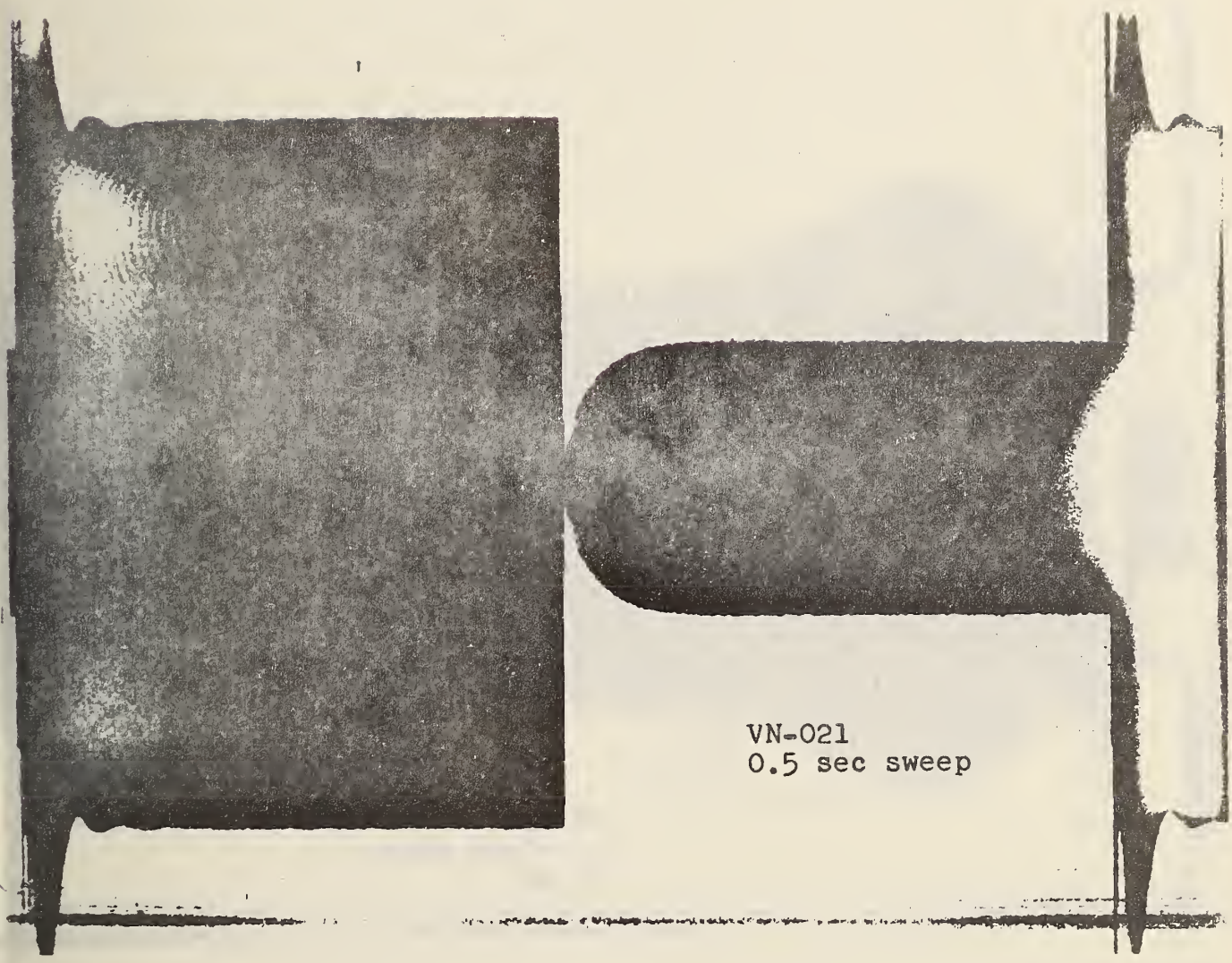


VN-019
0.5 sec sweep

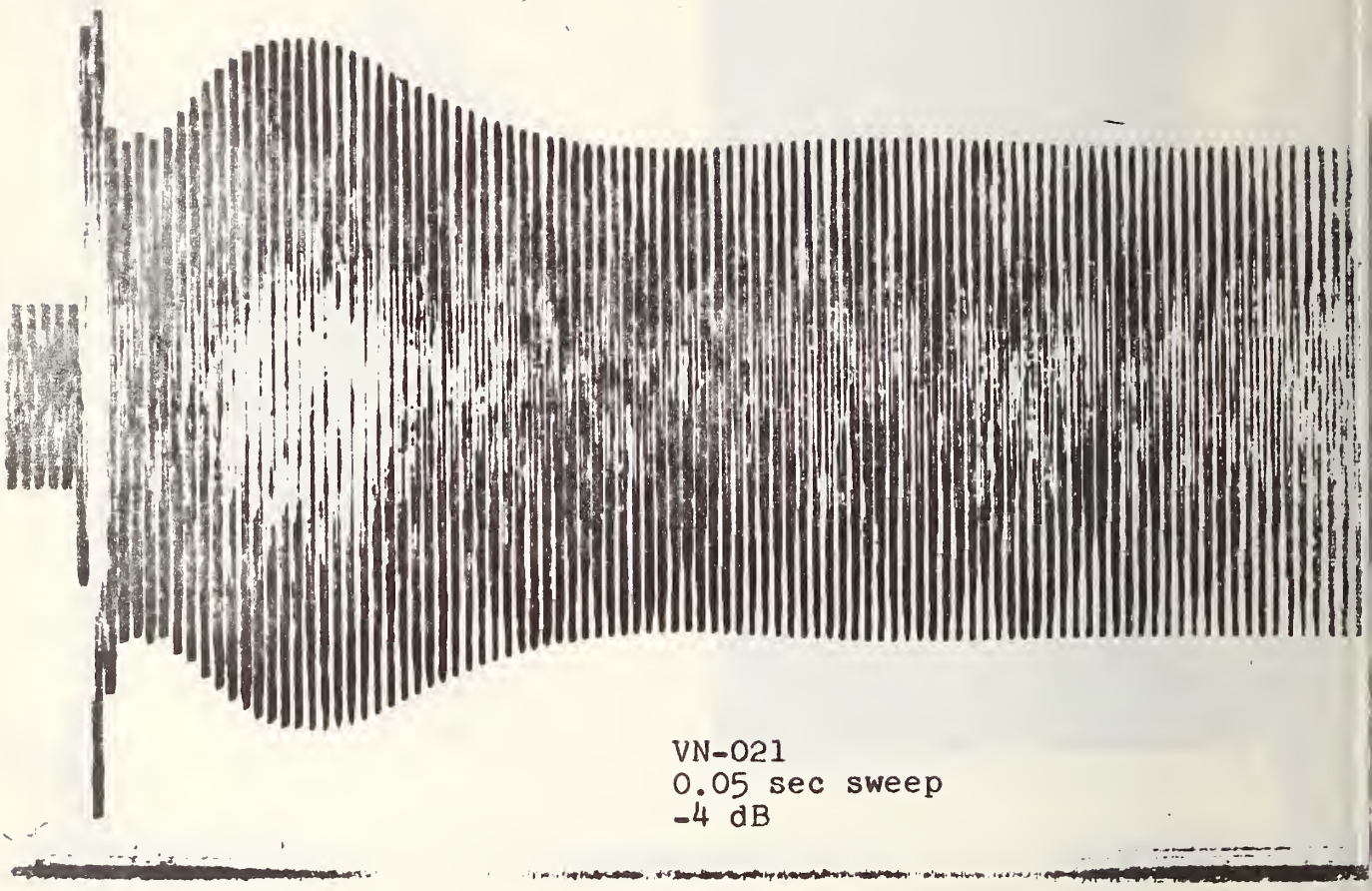

VN-019
0.05 sec sweep
-3 dB

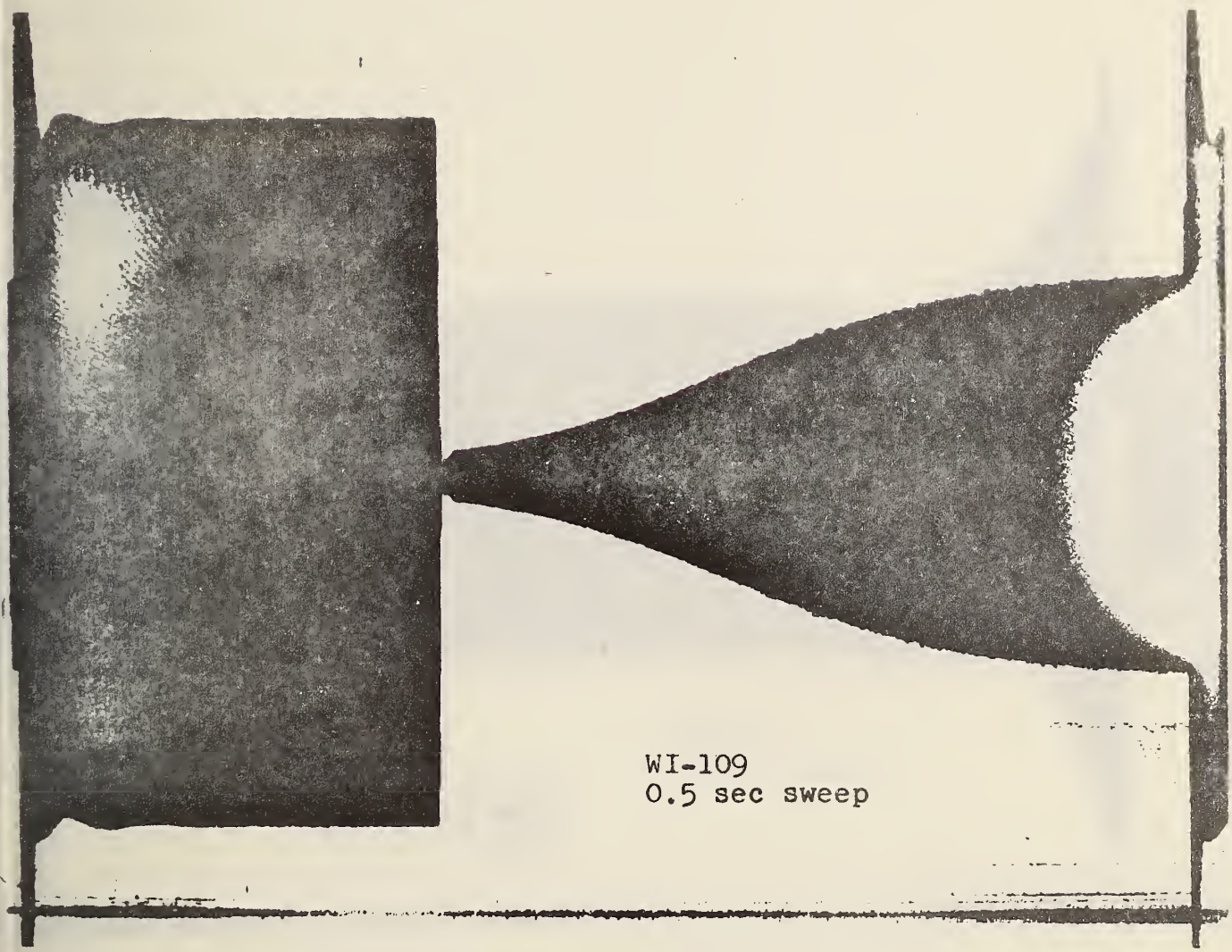

VN-020
0.5 sec sweep


VN-020
0.05 sec sweep
-4 dB

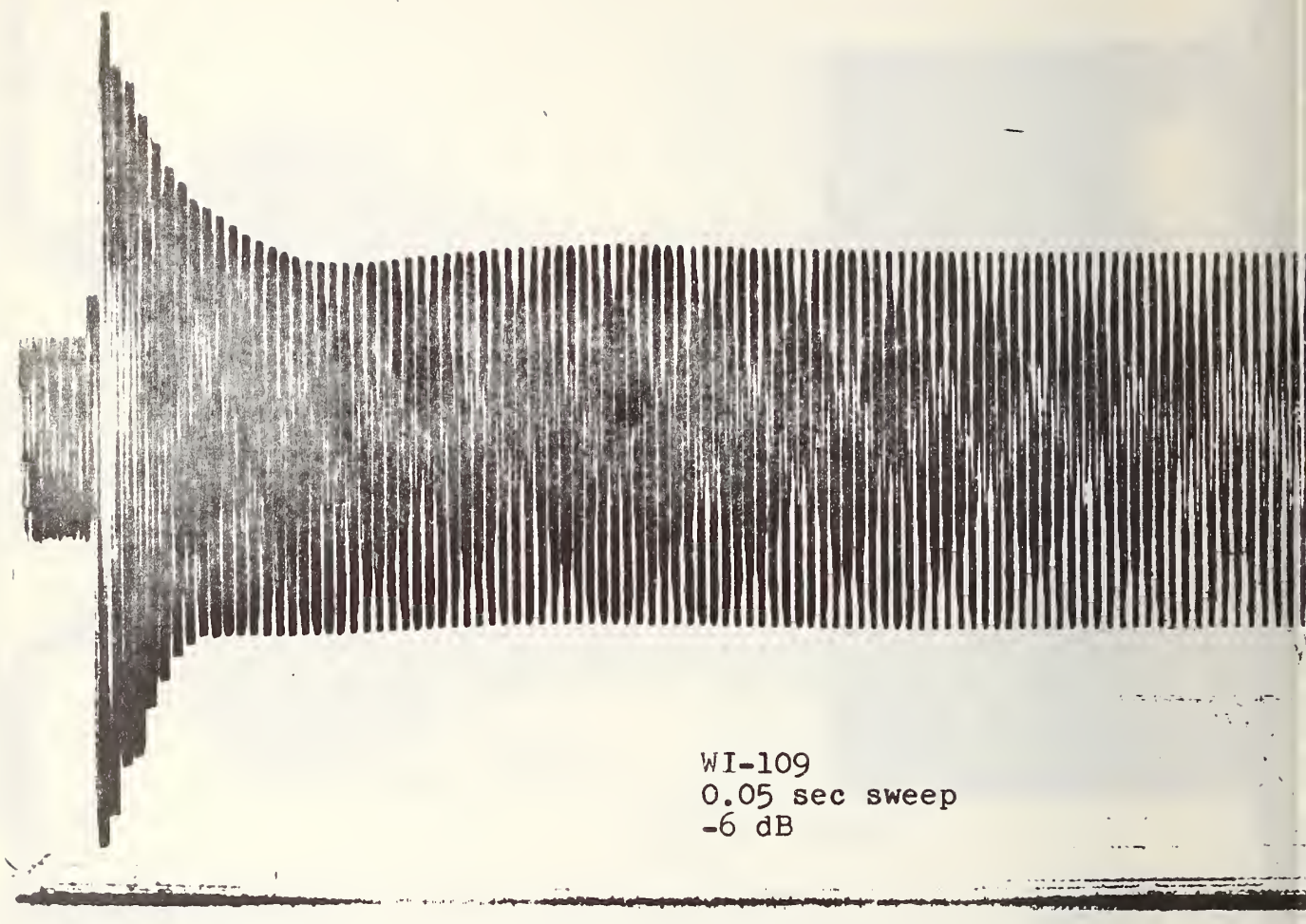


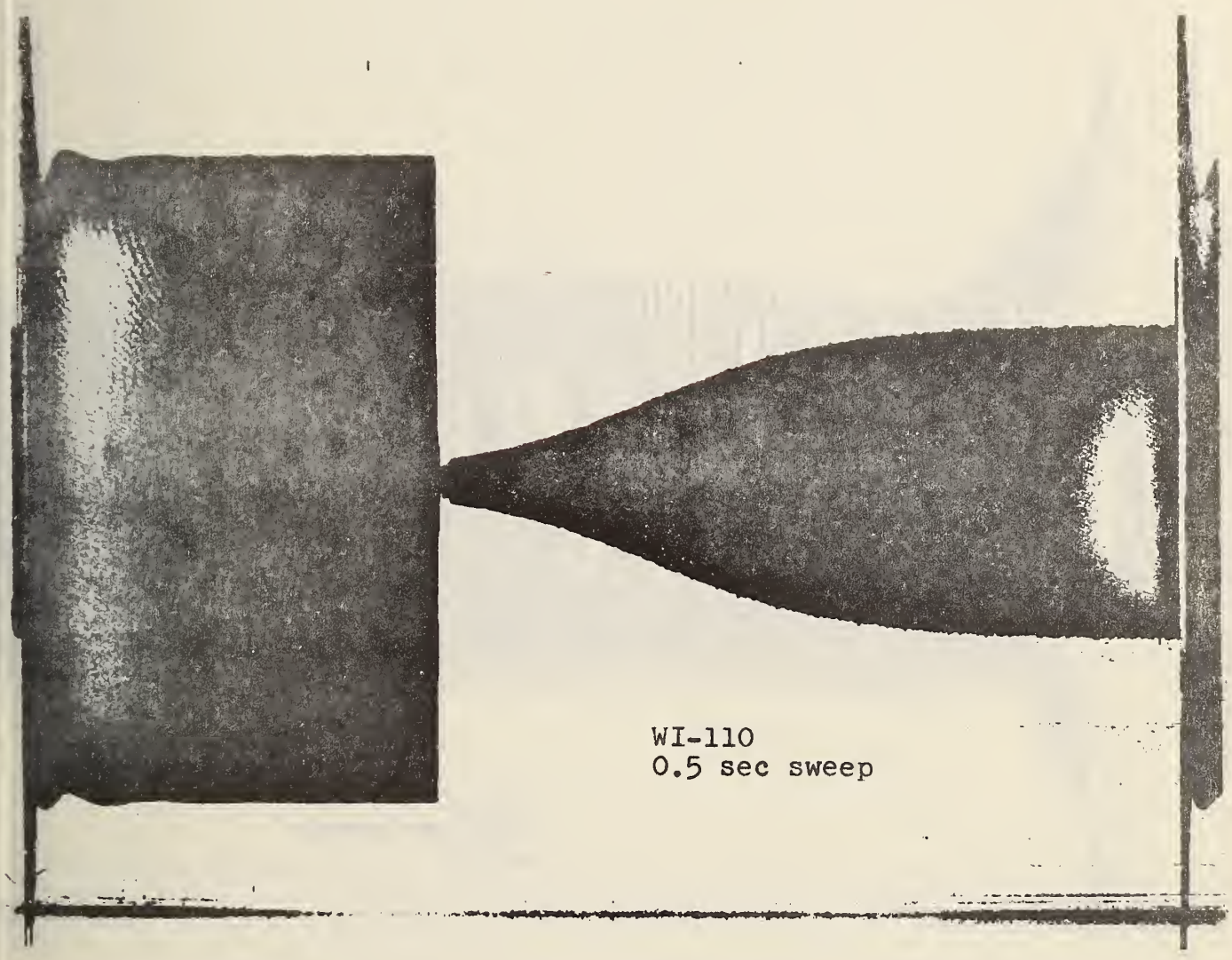
VN-021
0.5 sec sweep


VN-021
0.05 sec sweep
-4 dB

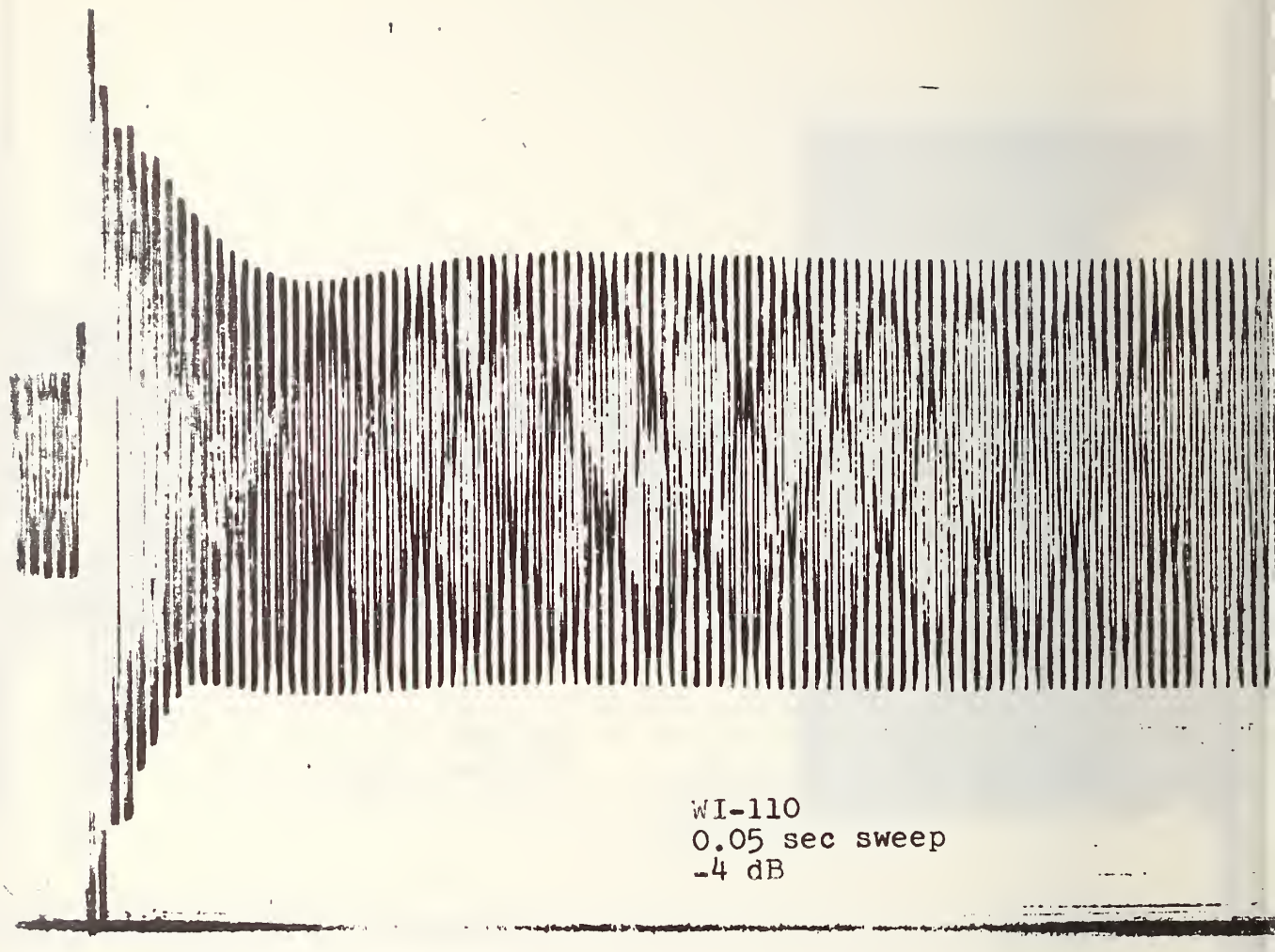


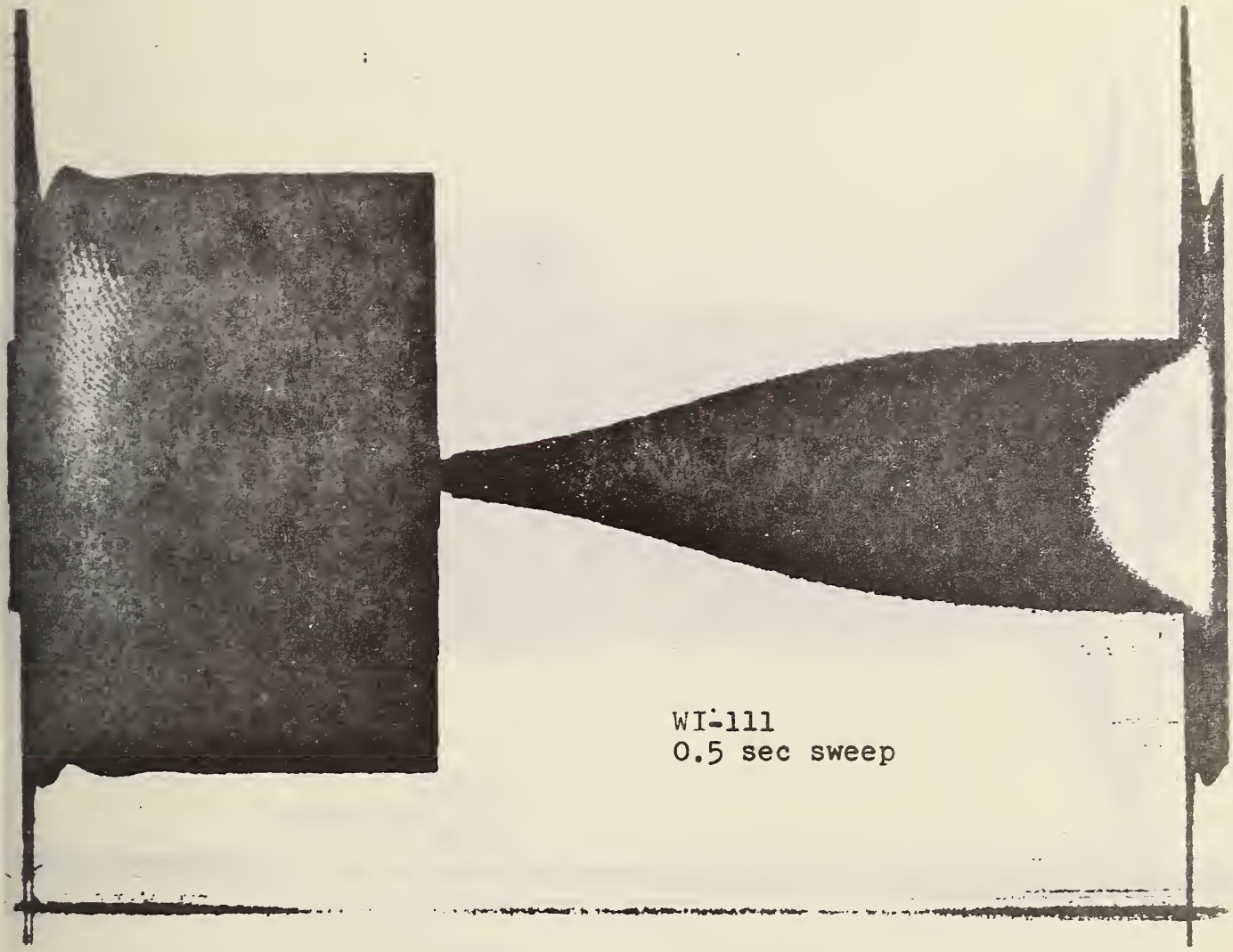
WI-109
0.5 sec sweep


WI-109
0.05 sec sweep
-6 dB

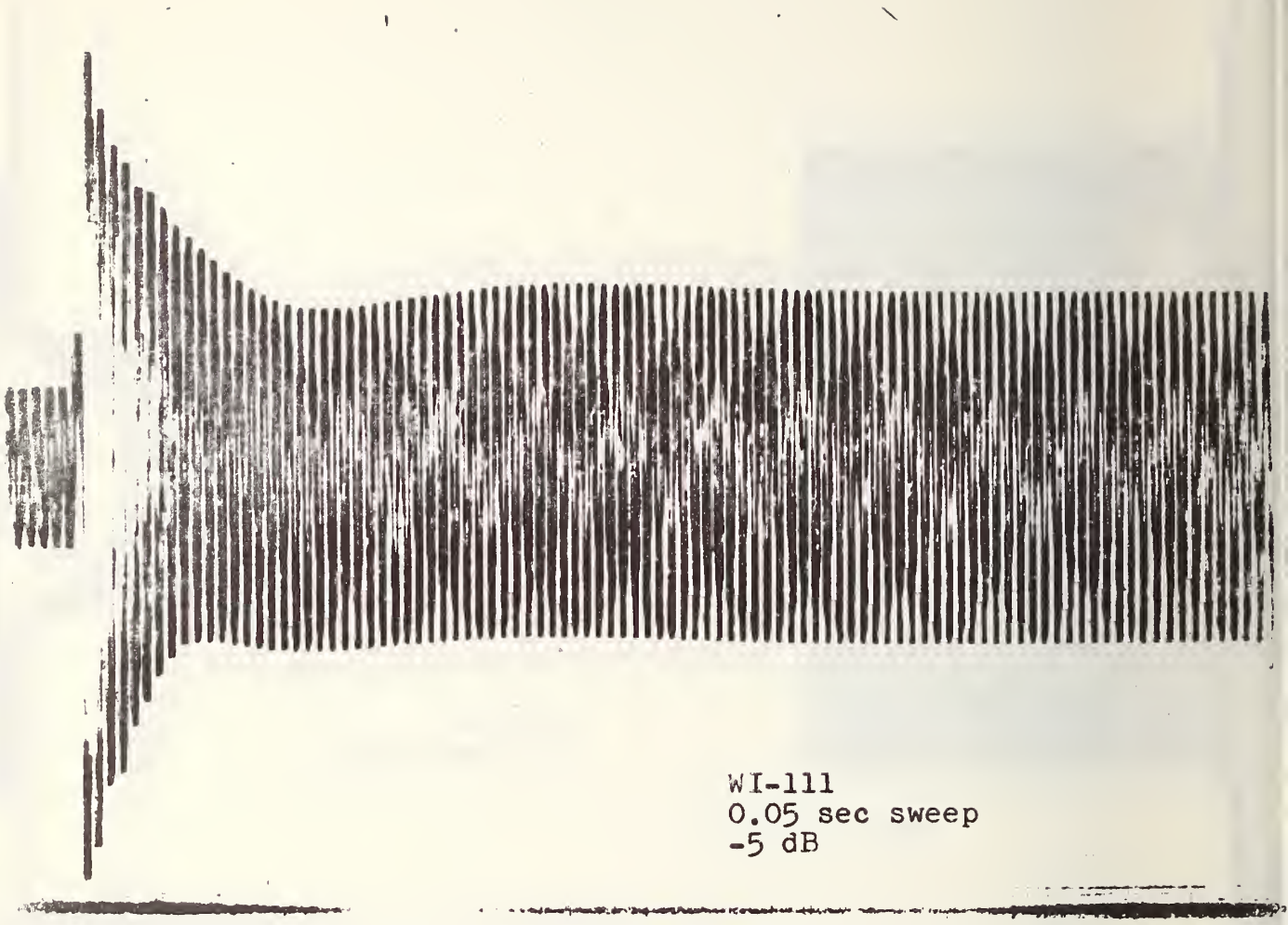


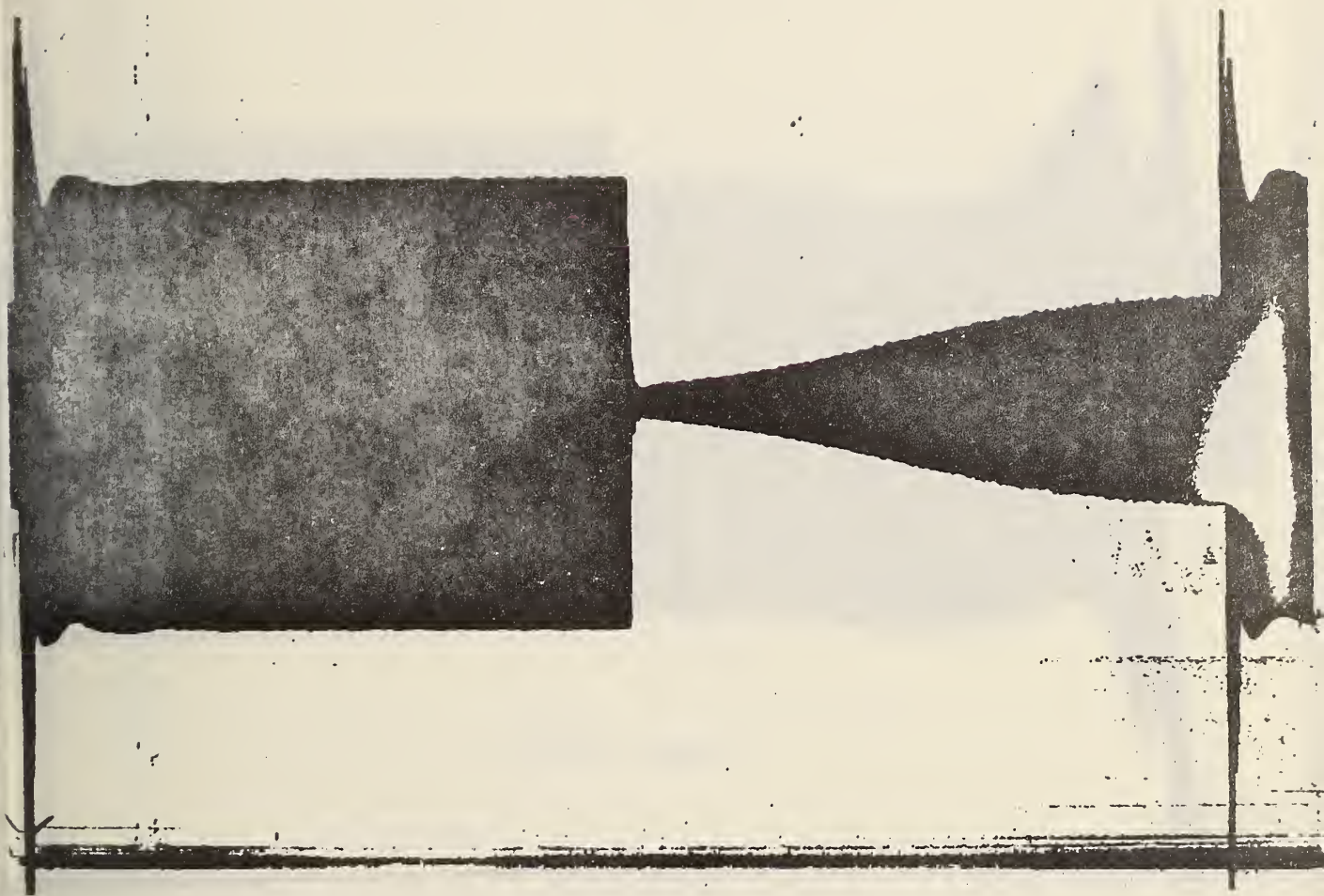
WI-110
0.5 sec sweep


WI-110
0.05 sec sweep
-4 dB

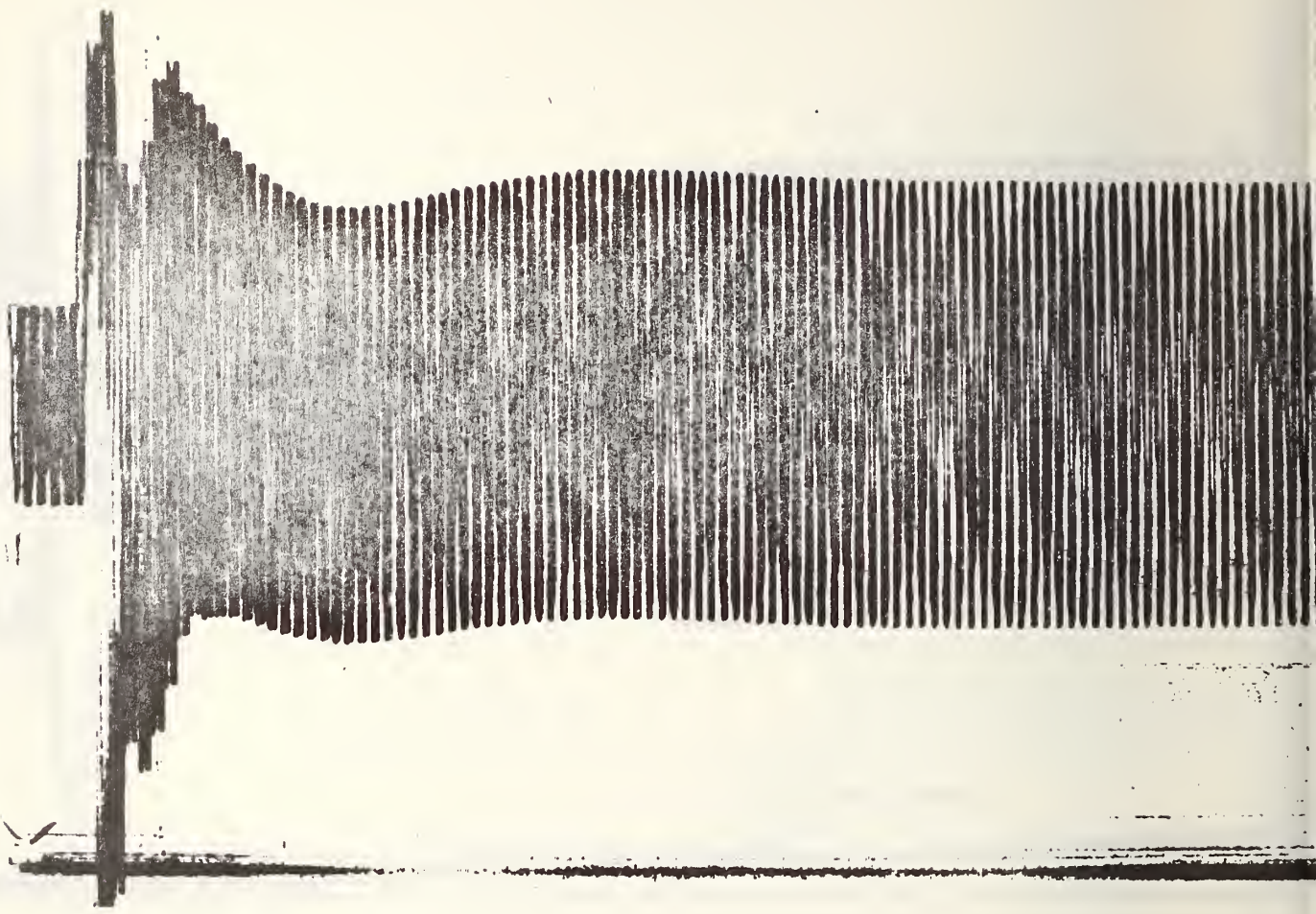


WI-111
0.5 sec sweep

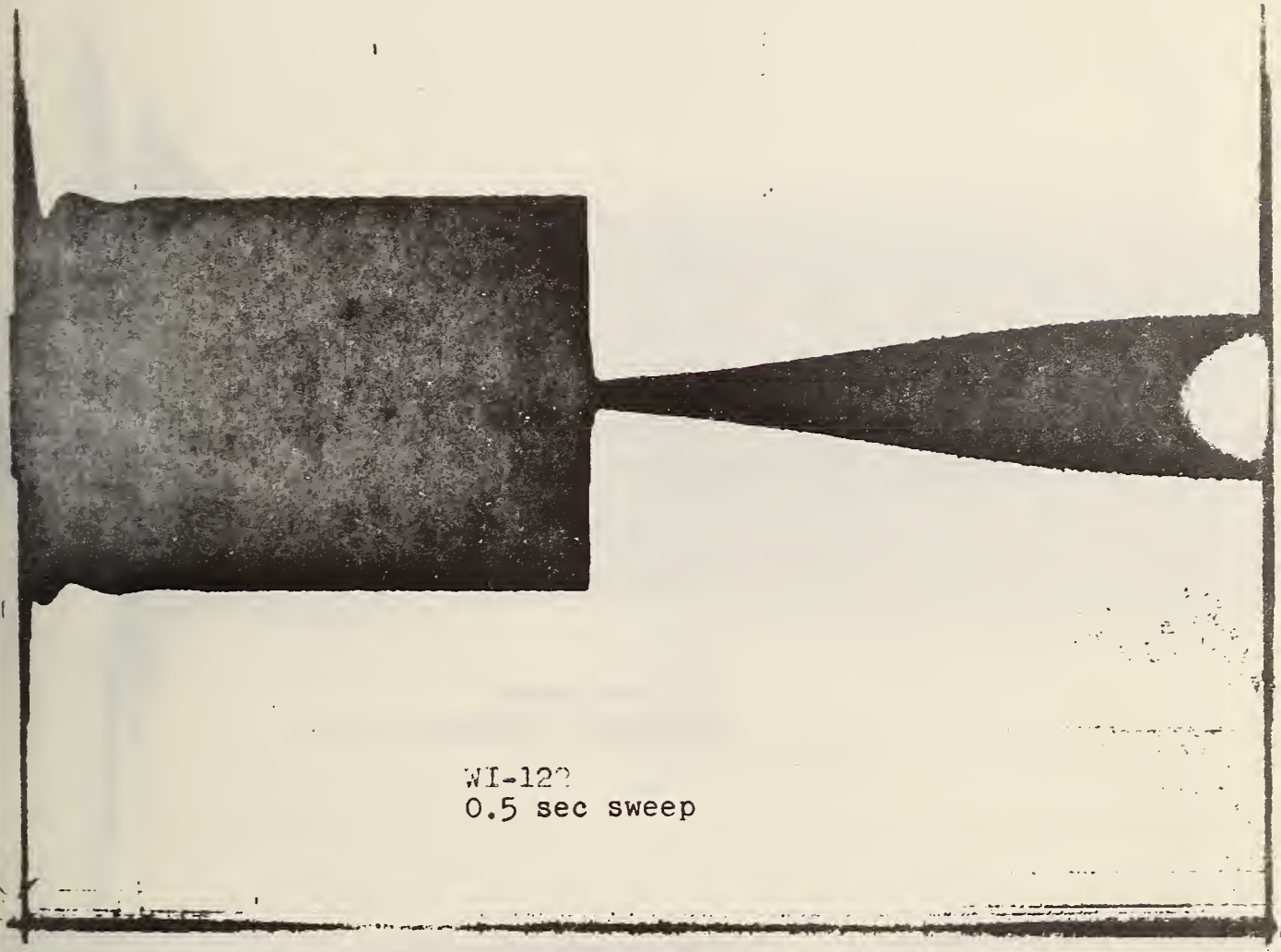

WI-111
0.05 sec sweep
-5 dB



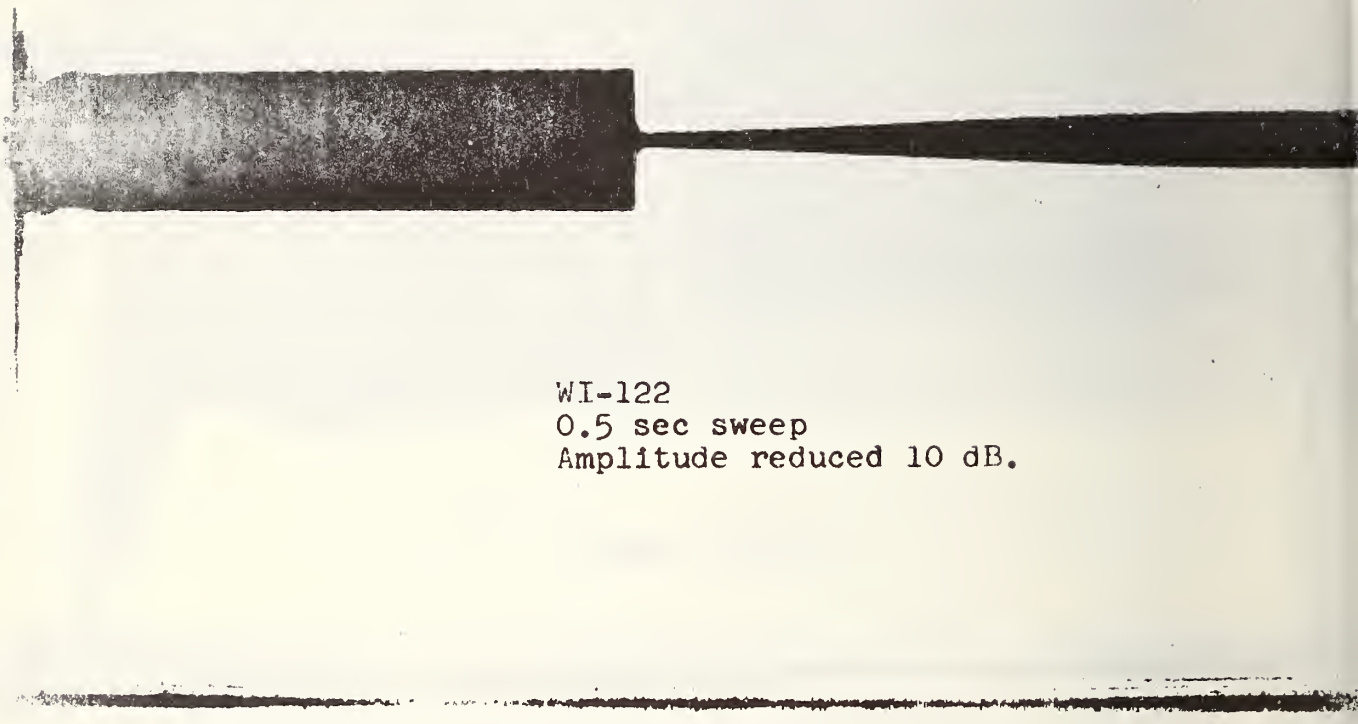
WI-121
0.5 sec sweep



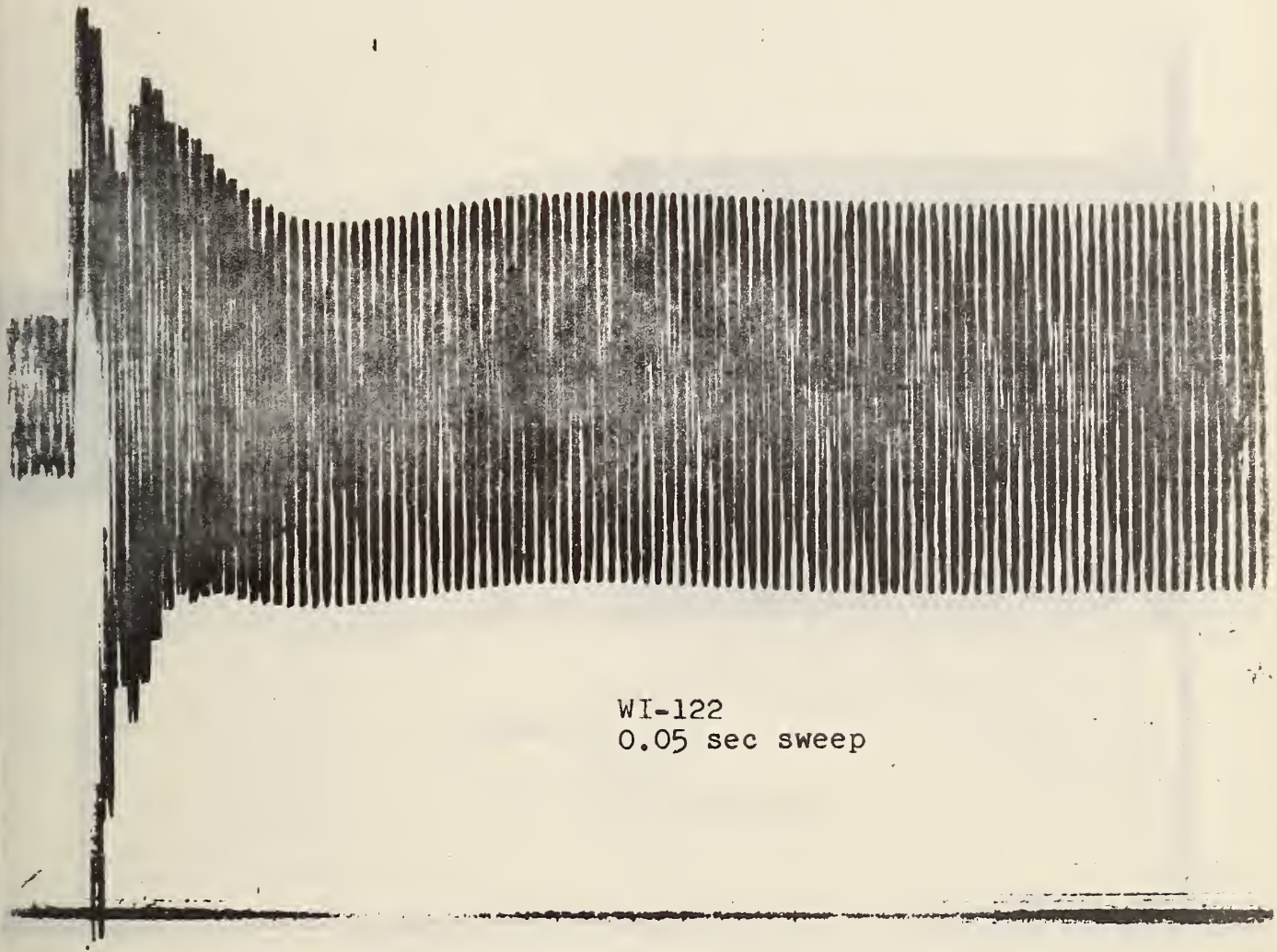
WI-121
0.05 sec sweep



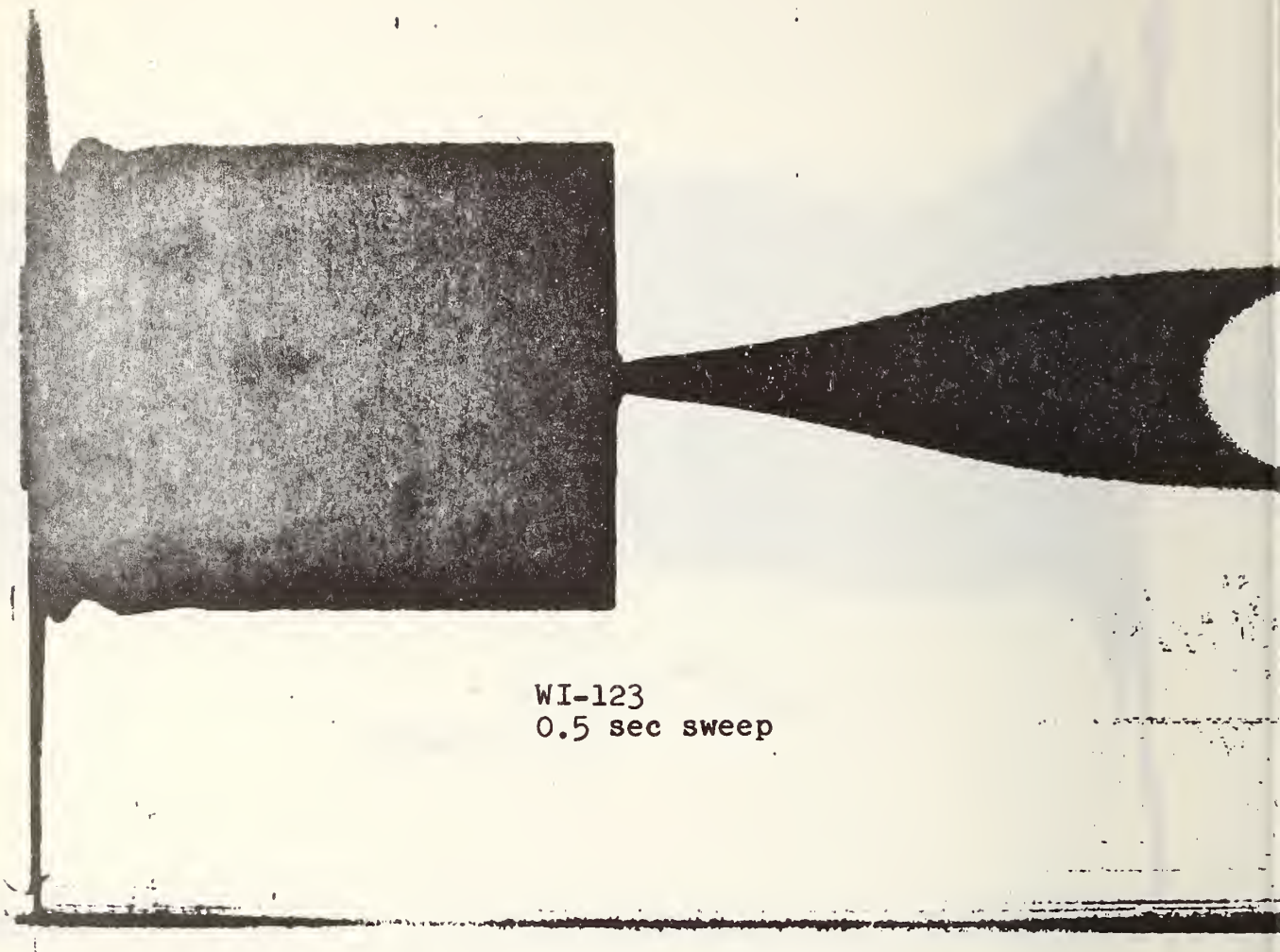
WI-12?
0.5 sec sweep



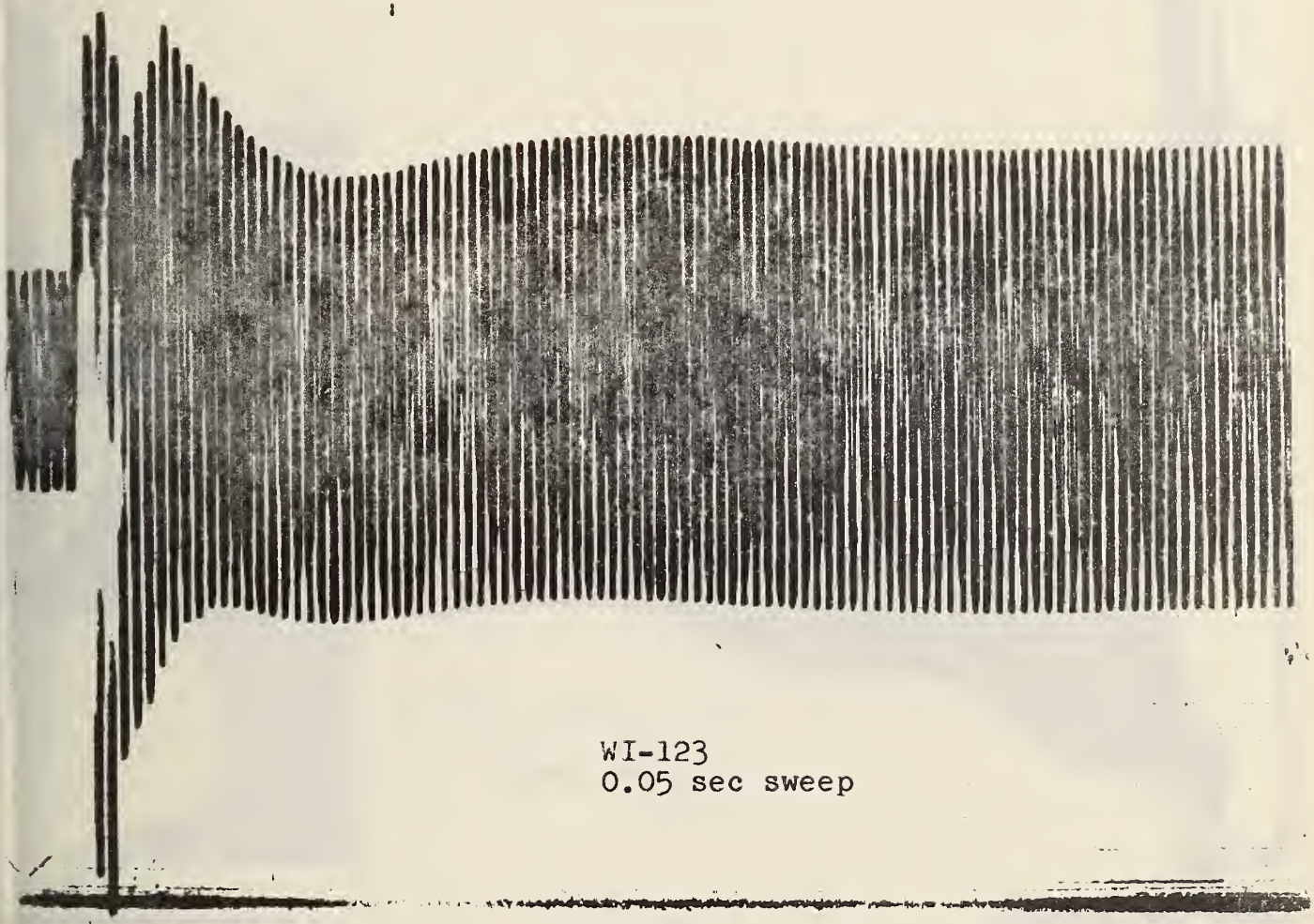
WI-122
0.5 sec sweep
Amplitude reduced 10 dB.



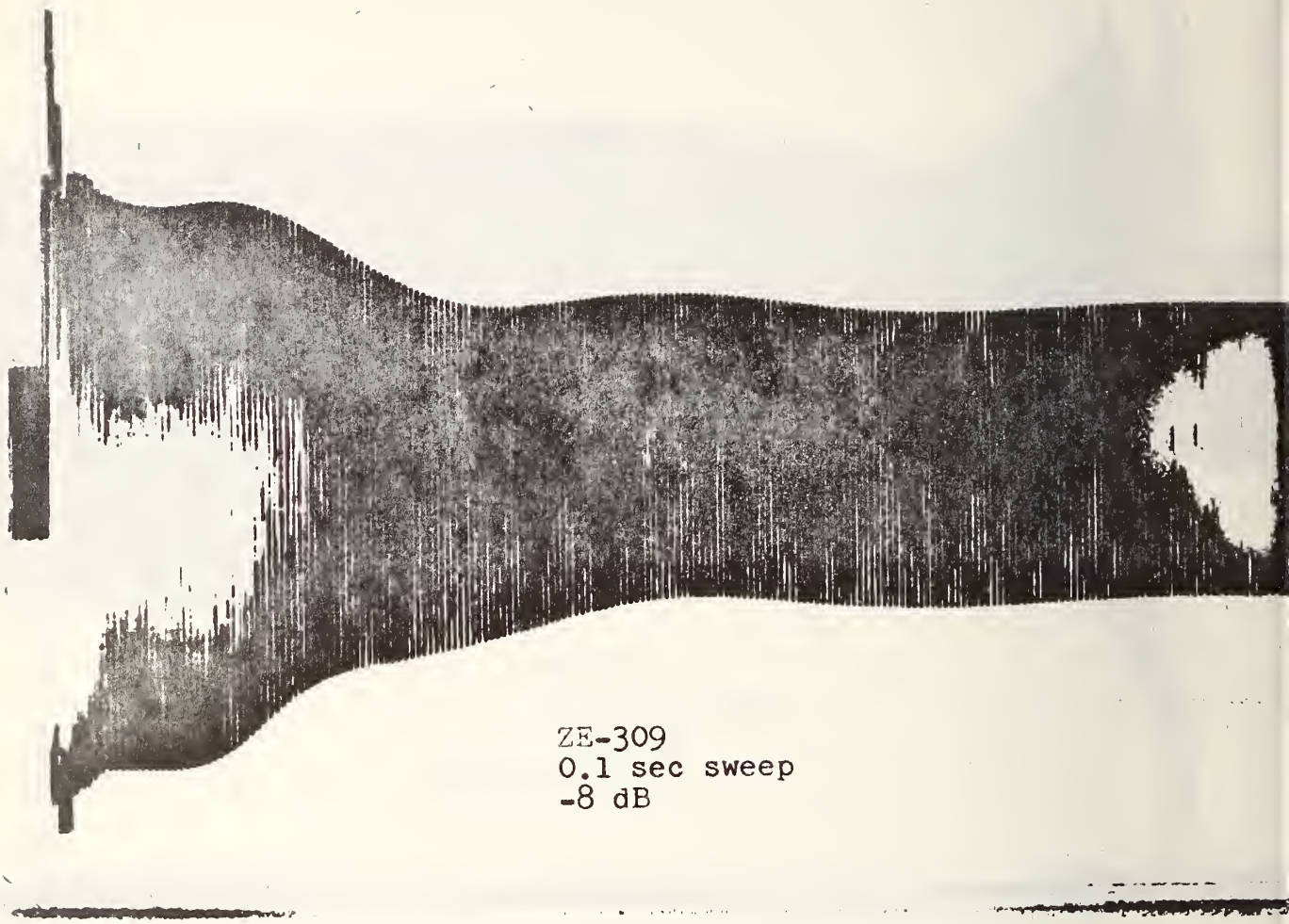
WI-122
0.05 sec sweep



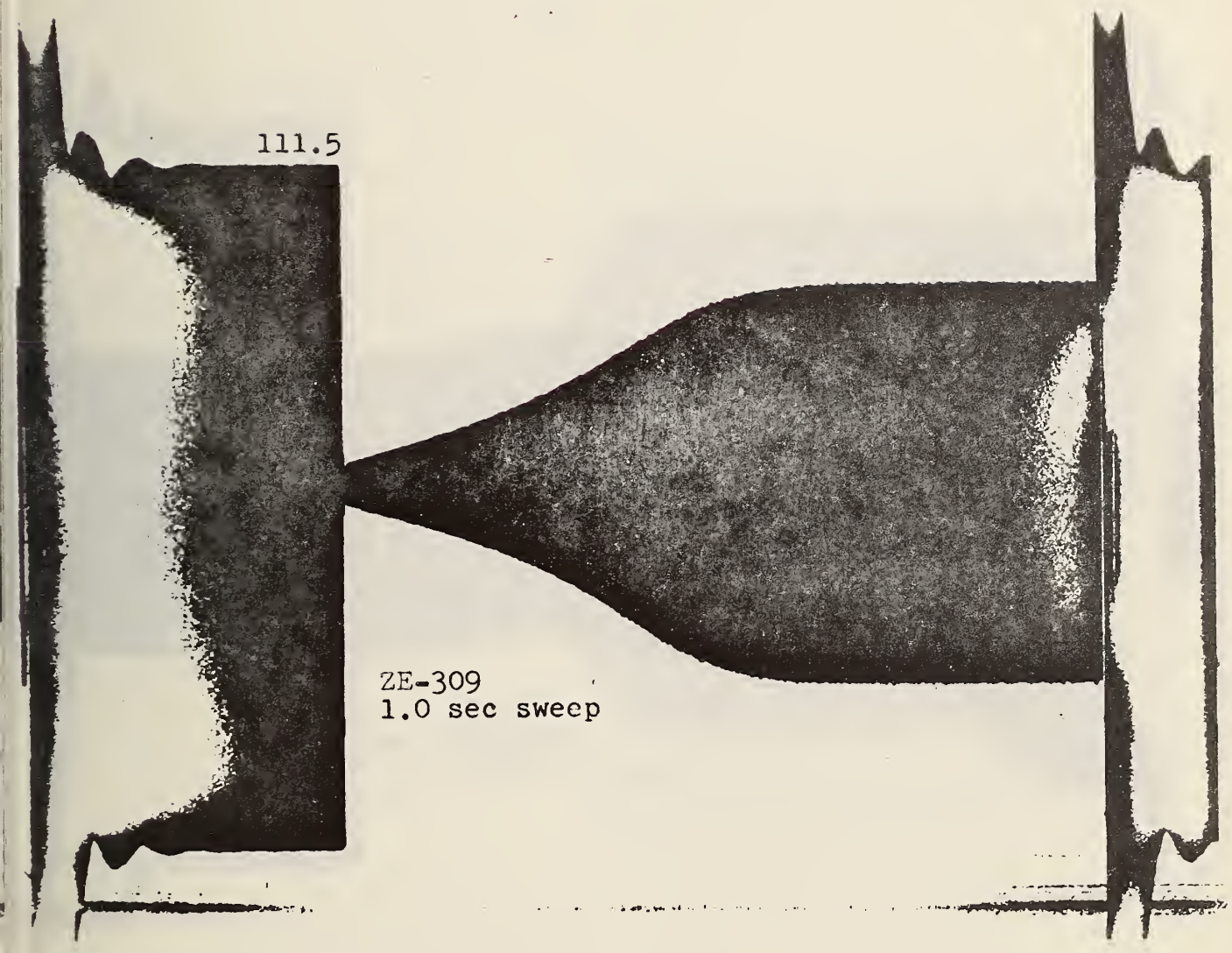
WI-123
0.5 sec sweep

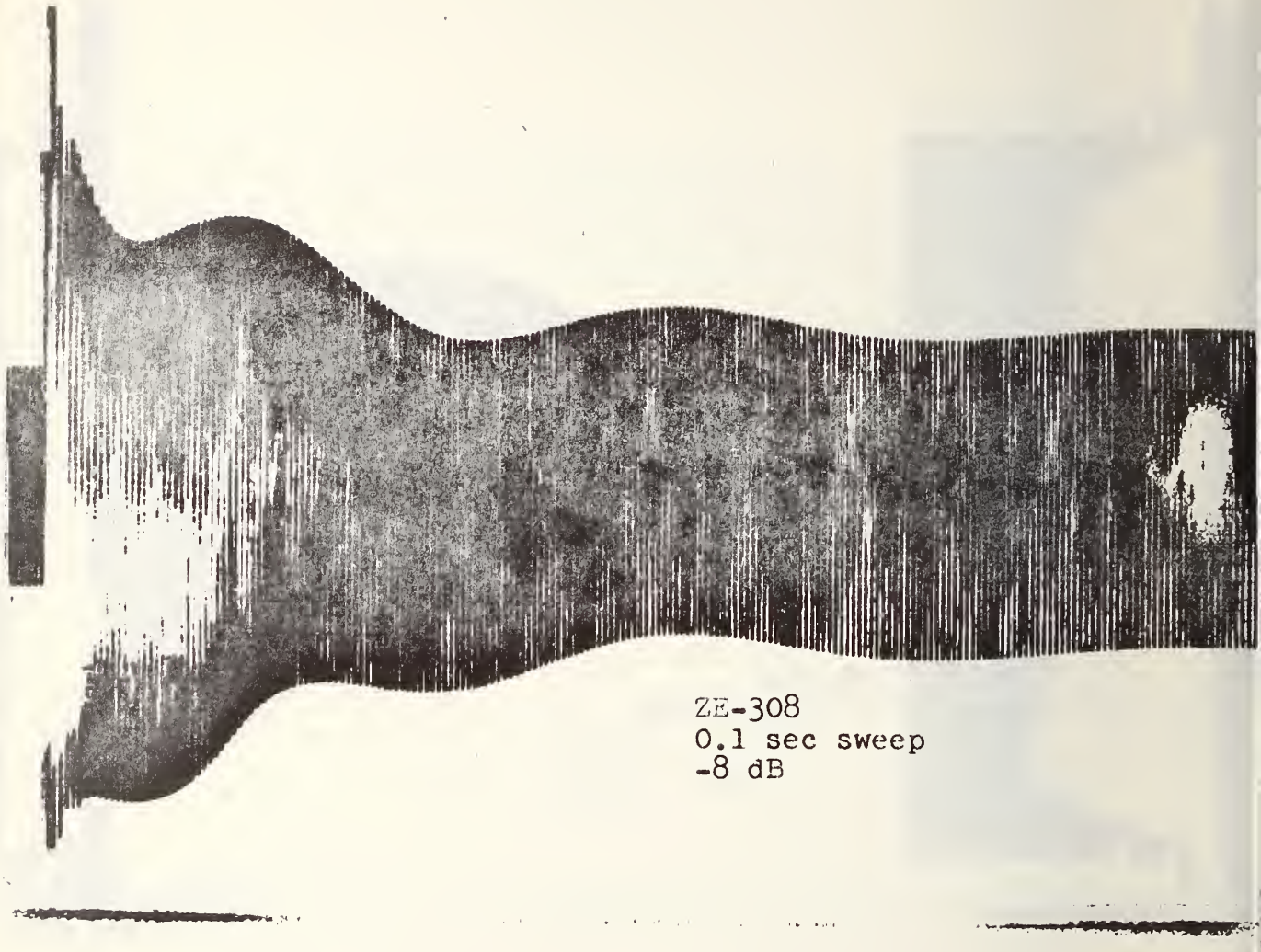


WI-123
0.05 sec sweep

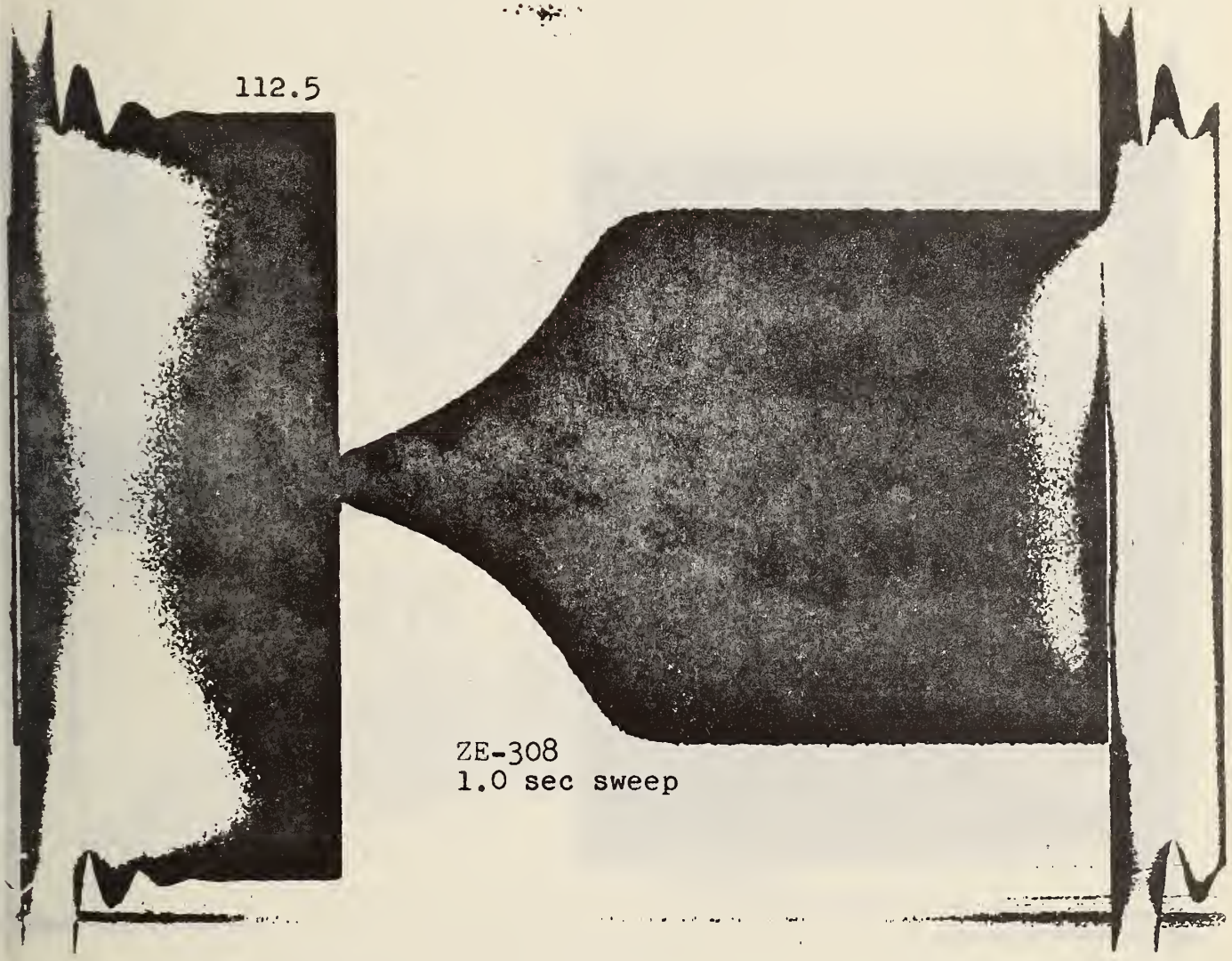


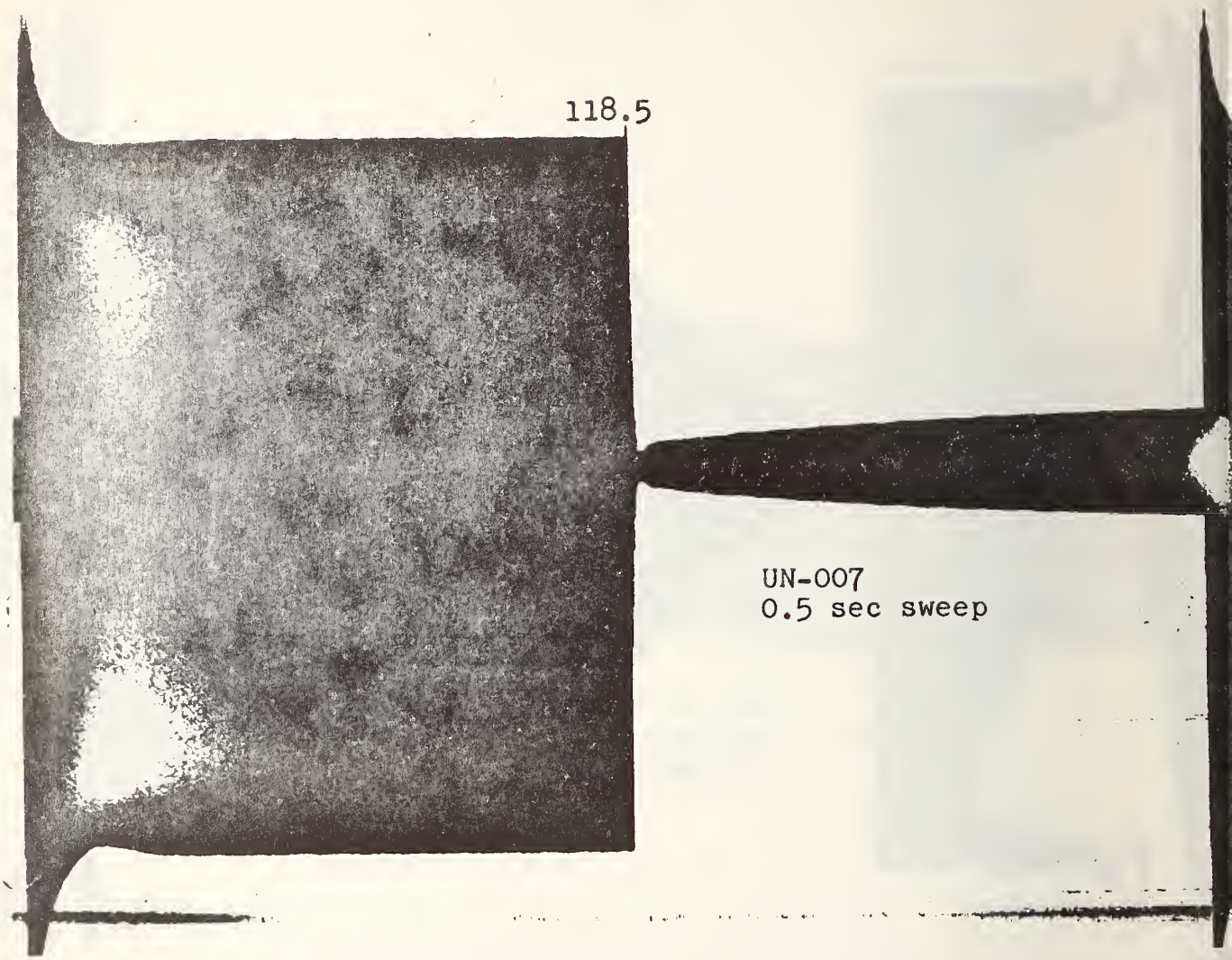
ZE-309
0.1 sec sweep
-8 dB

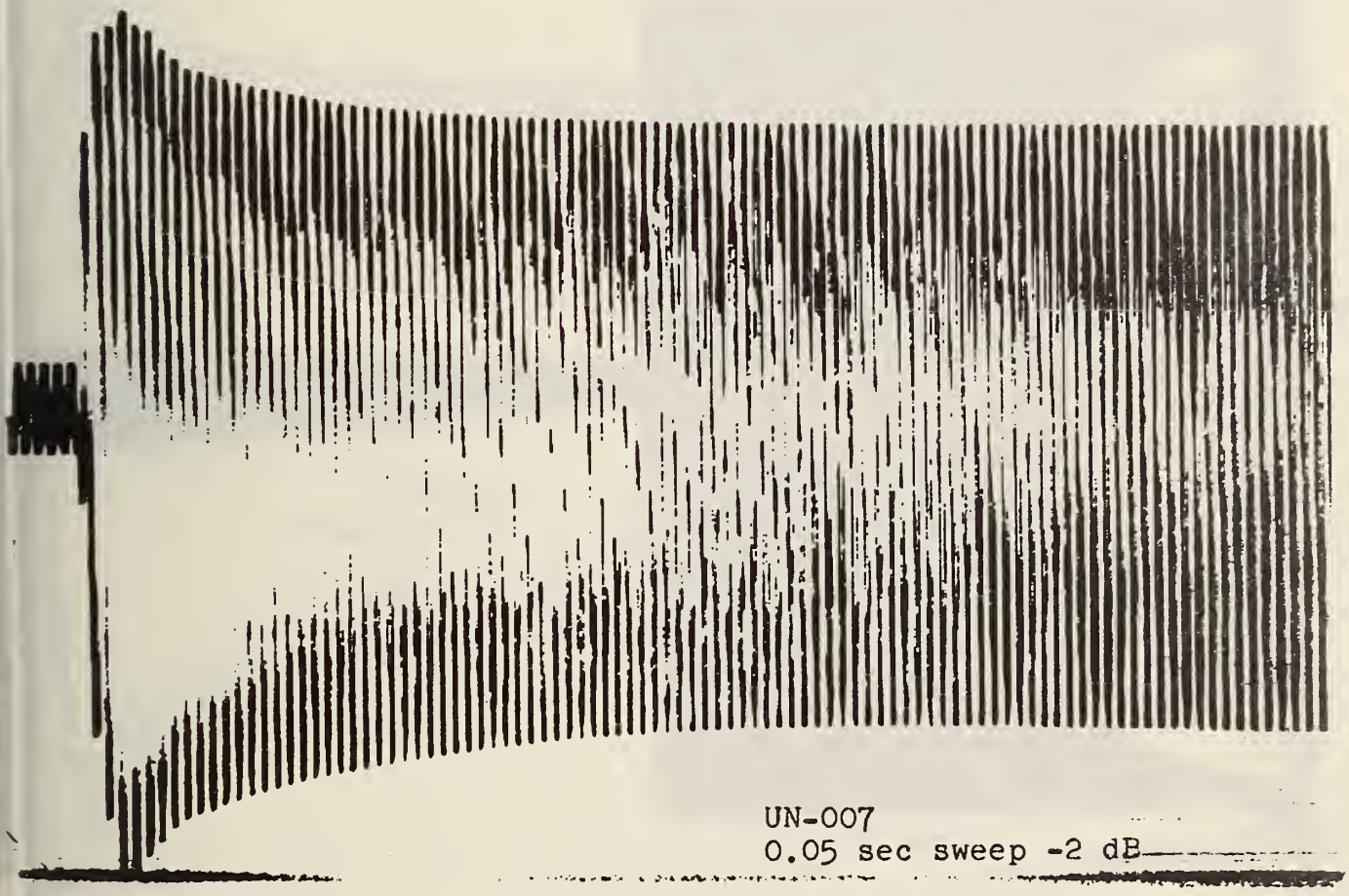

111.5
ZE-309
1.0 sec sweep

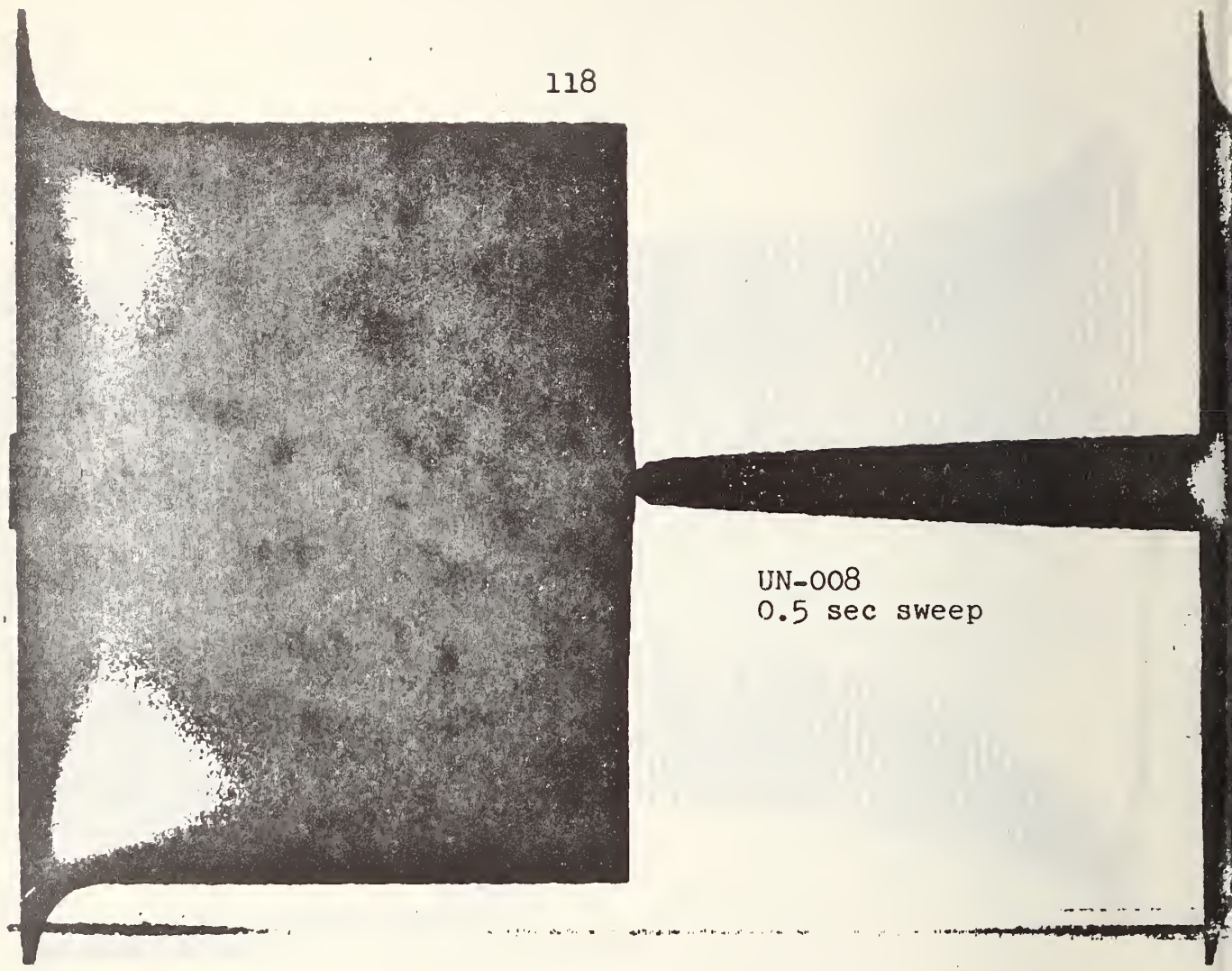


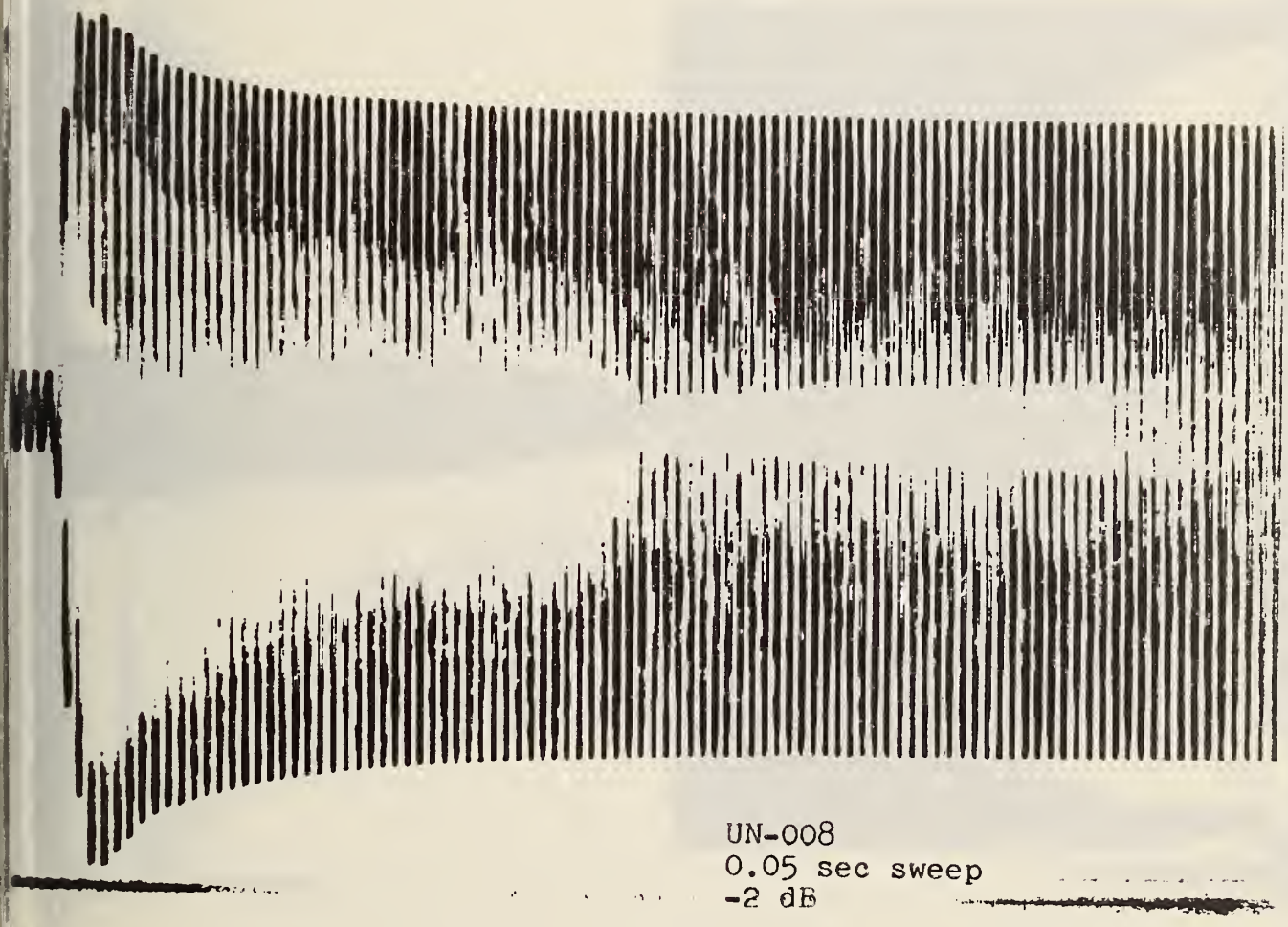
ZE-308
0.1 sec sweep
-8 dB

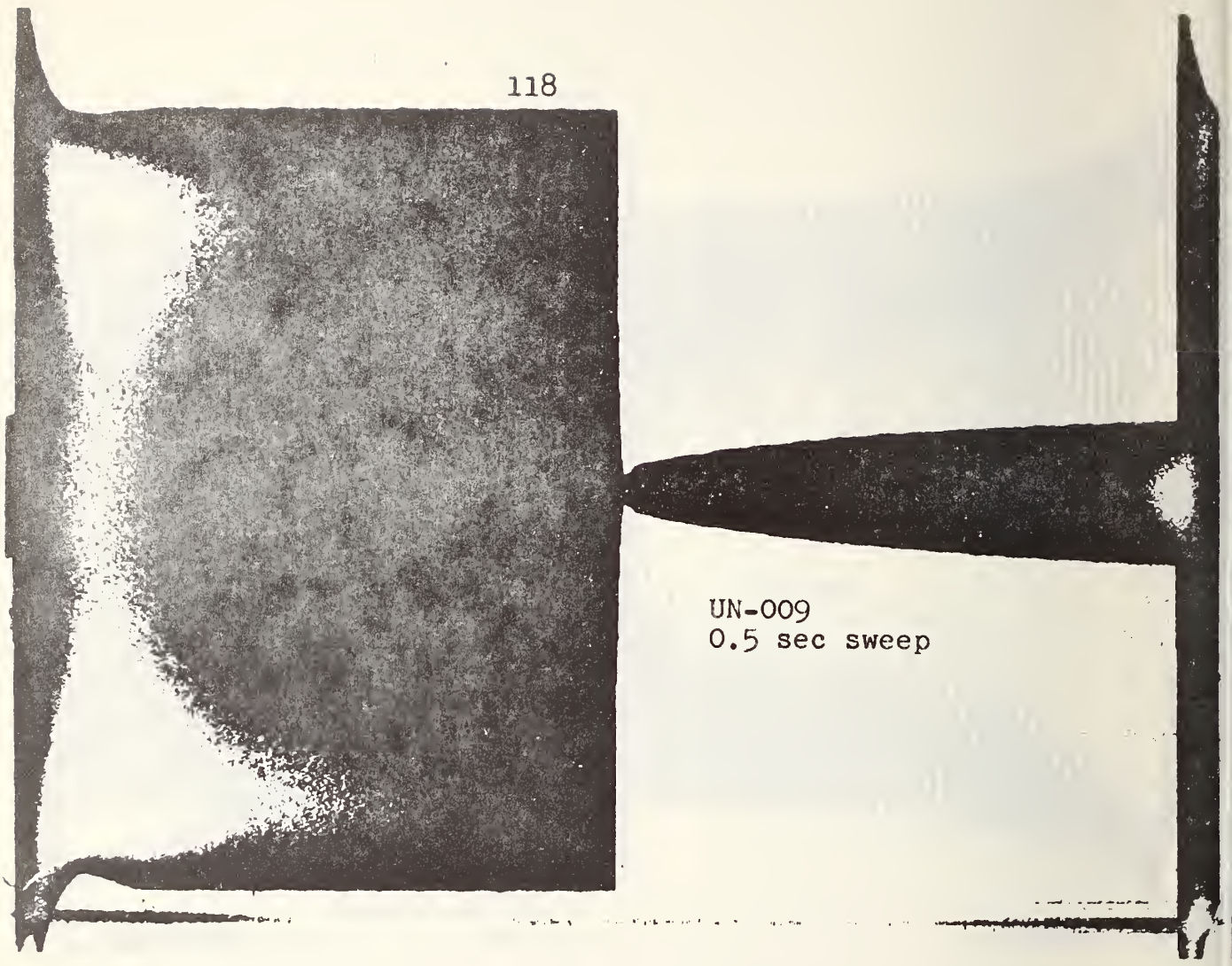

112.5
ZE-308
1.0 sec sweep

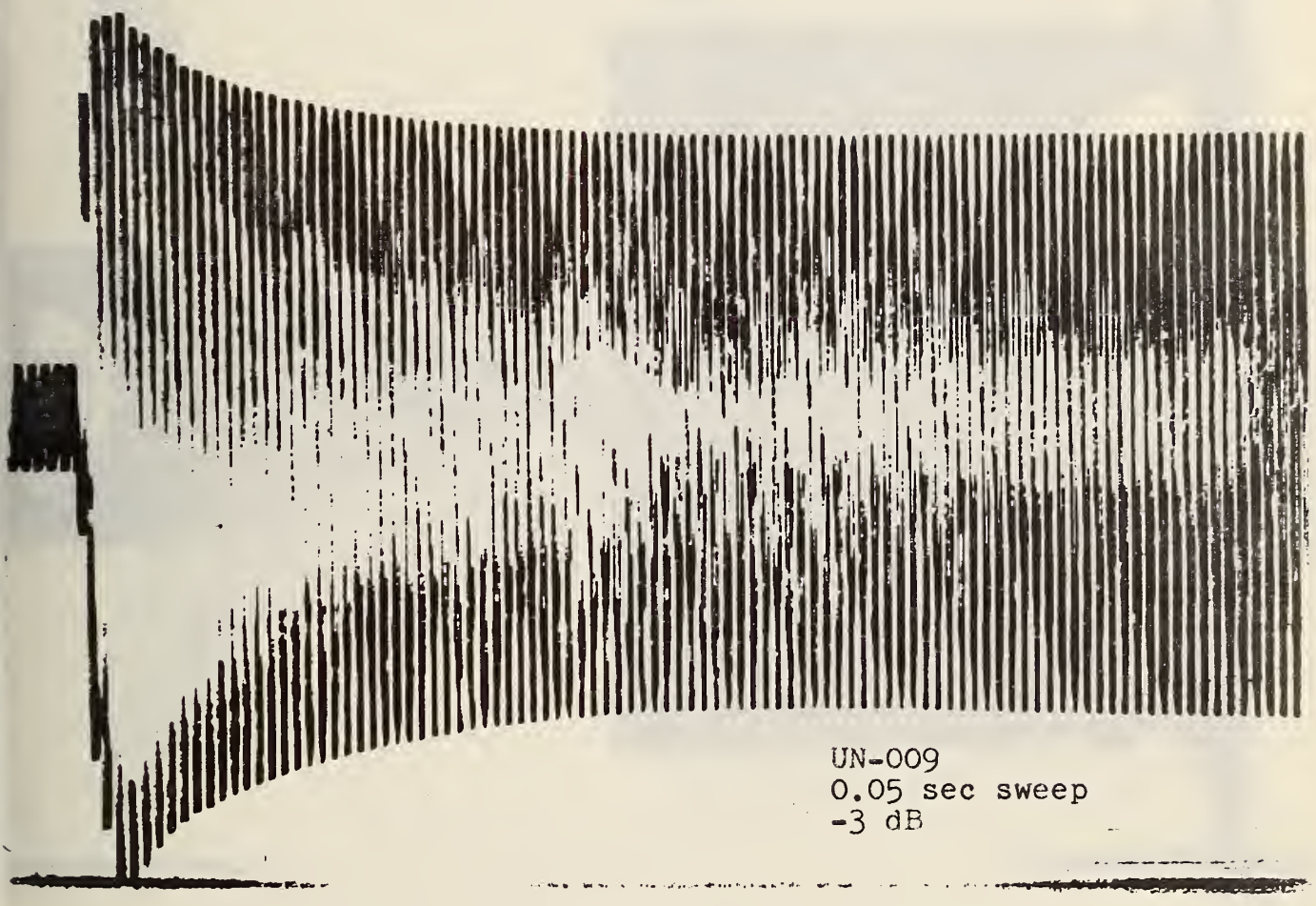

118.5
UN-007
0.5 sec sweep

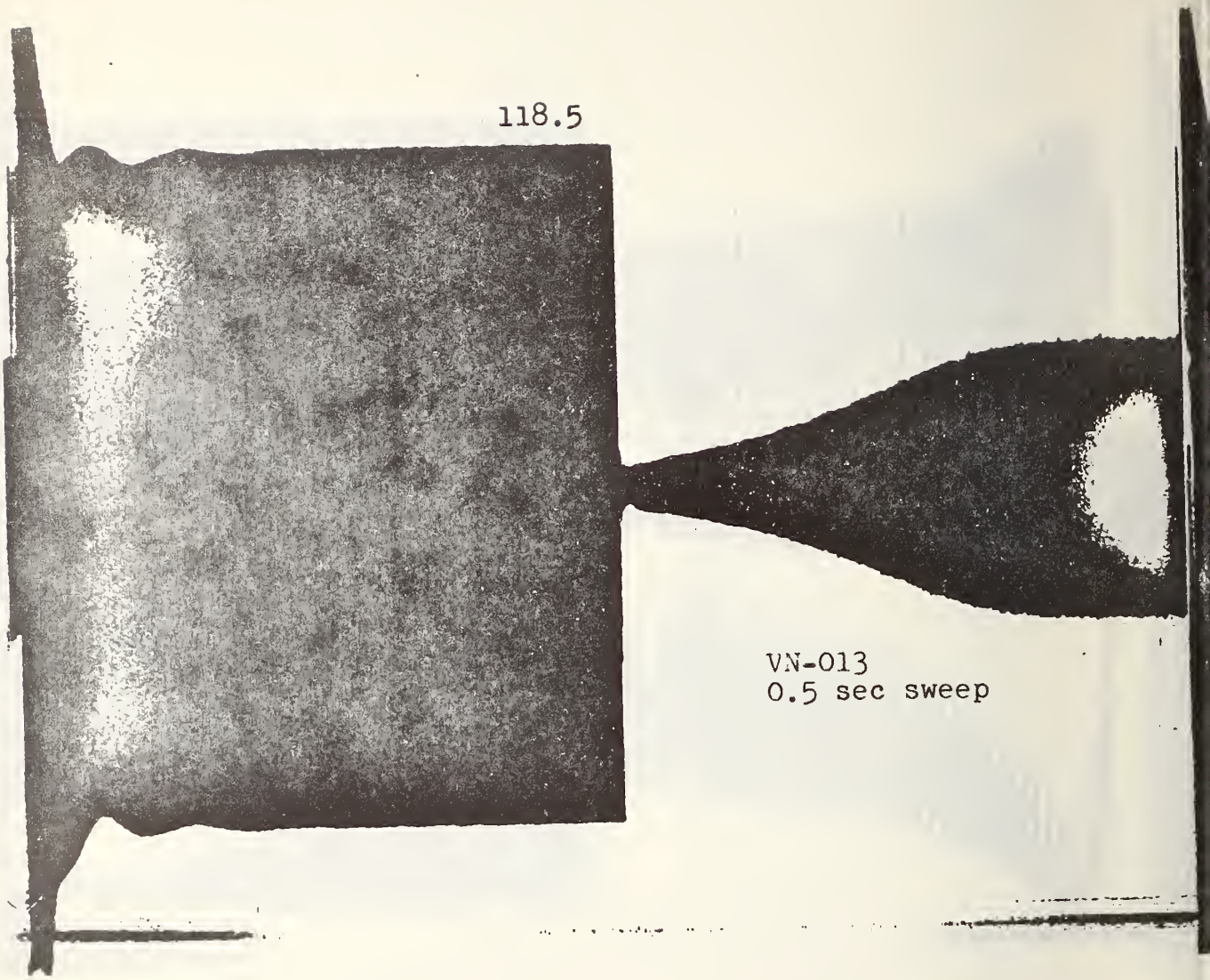

UN-007
0.05 sec sweep -2 dB

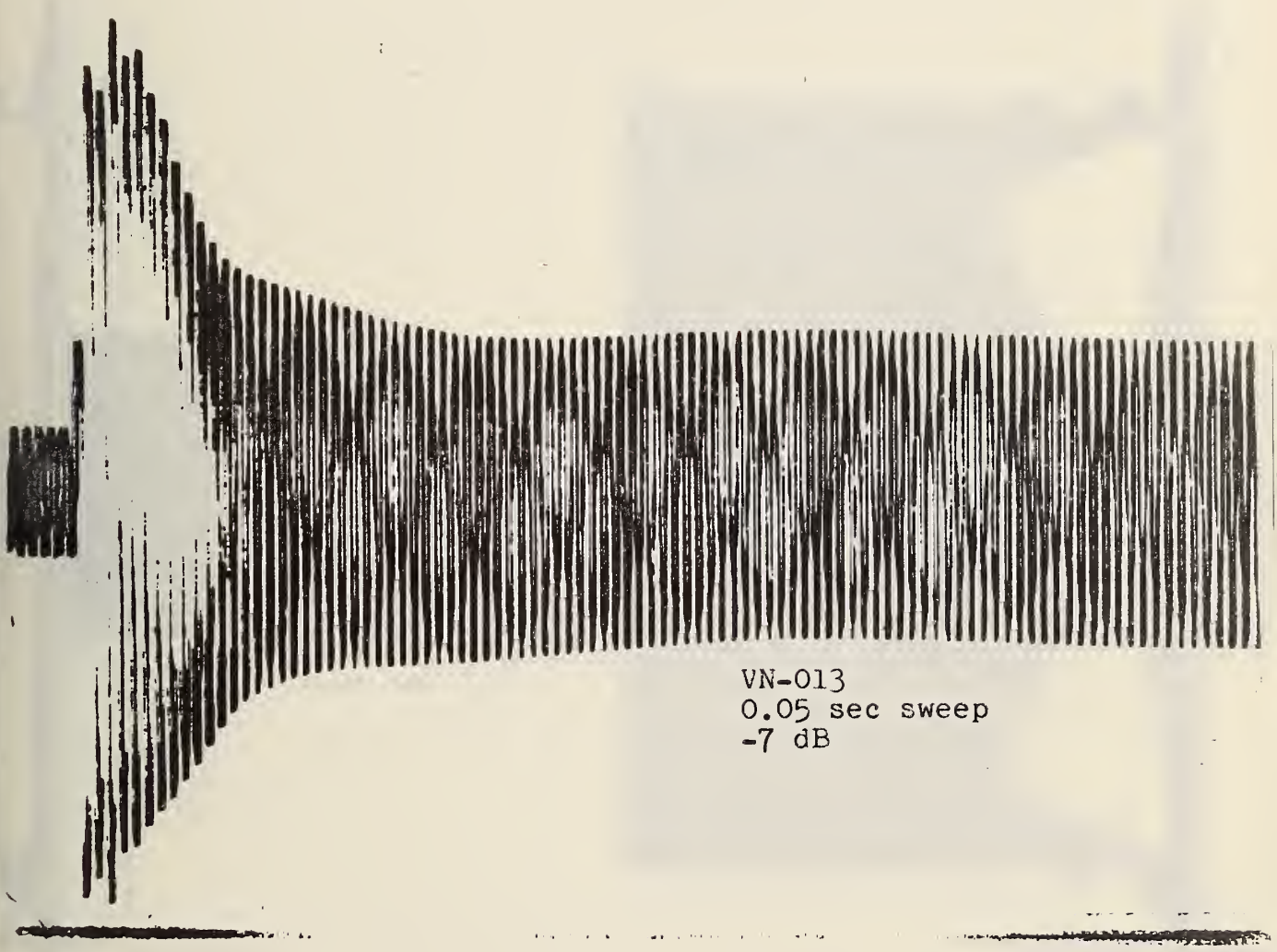

118
UN-008
0.5 sec sweep

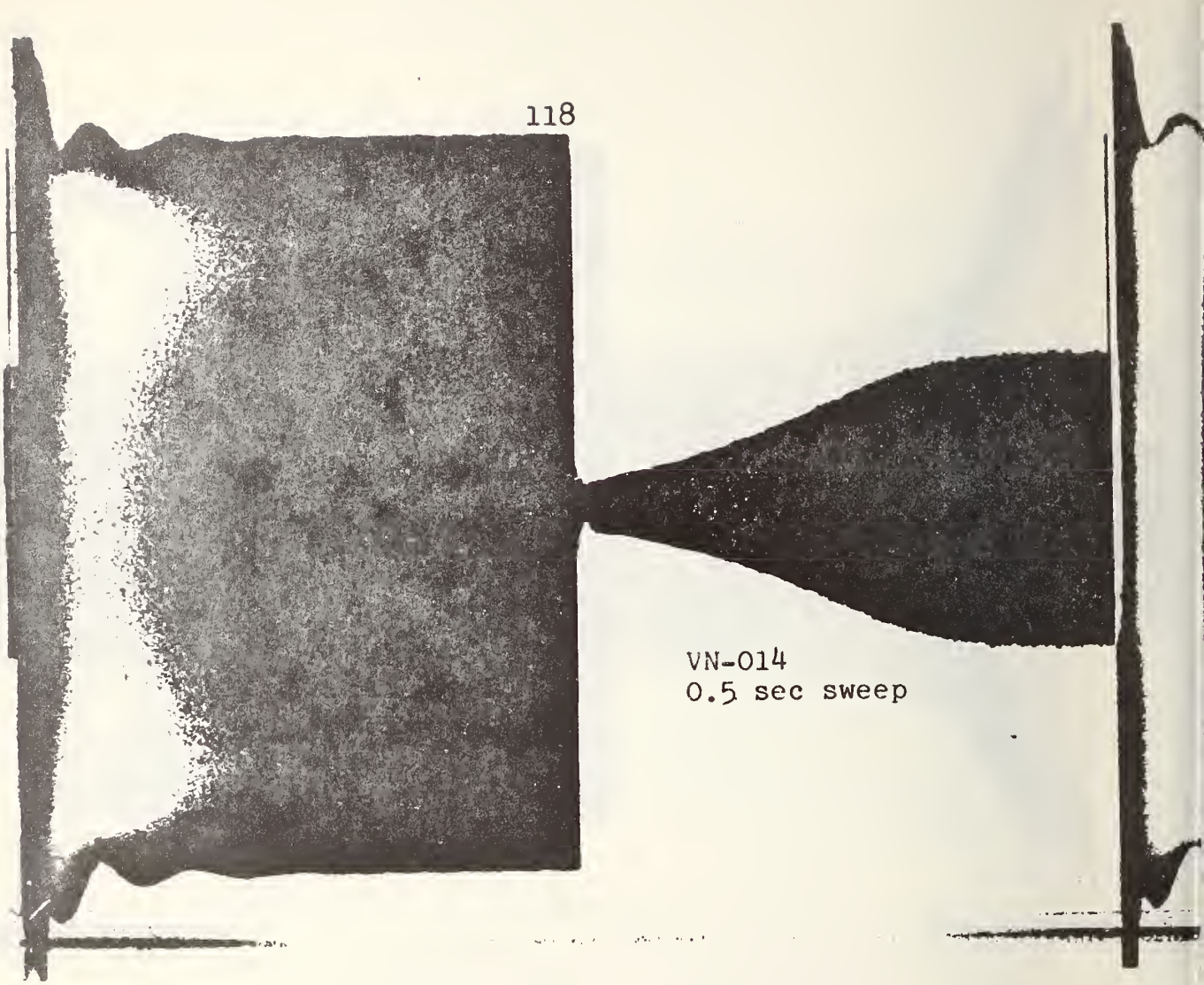

UN-008
0.05 sec sweep
-2 dB

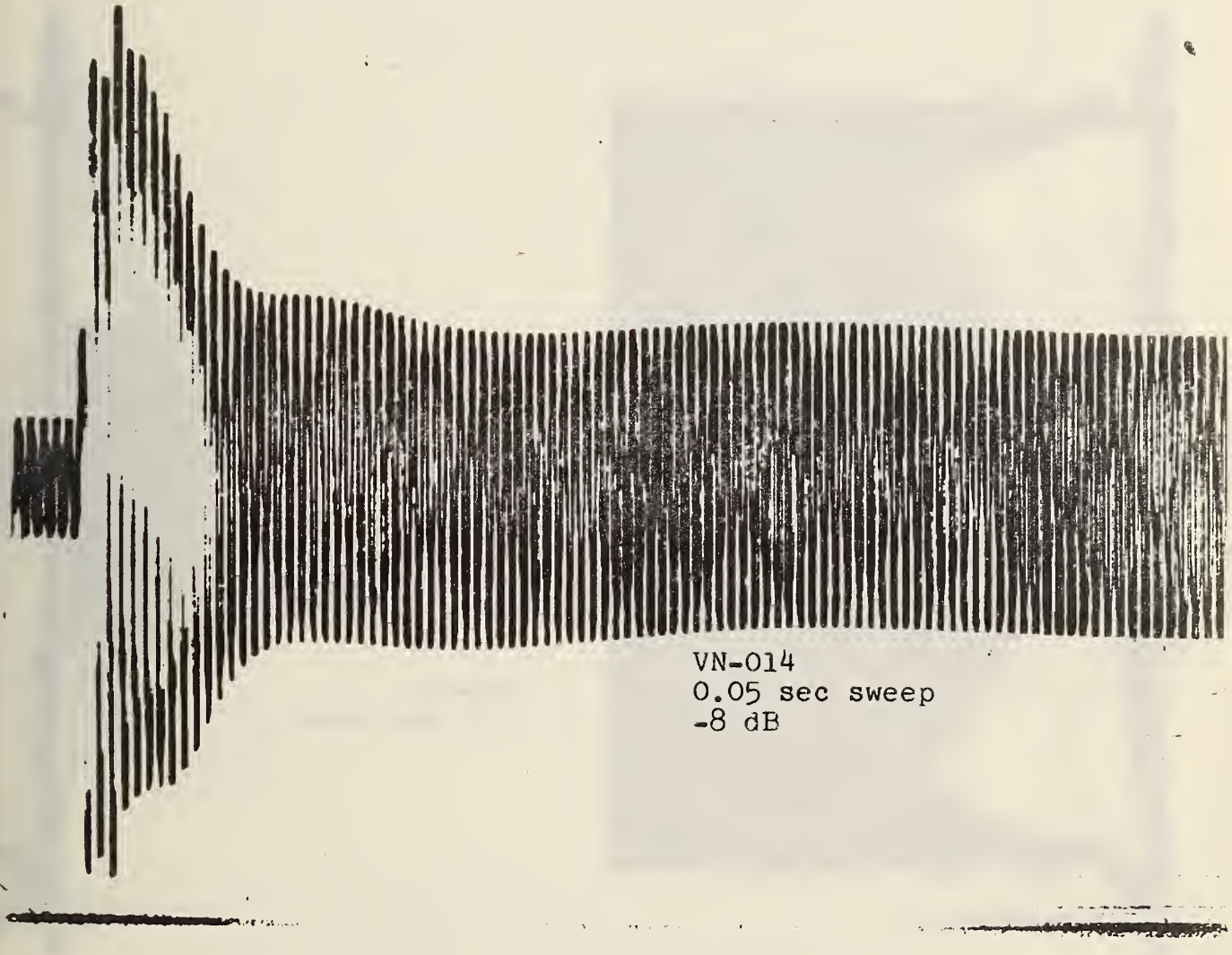

118
UN-009
0.5 sec sweep

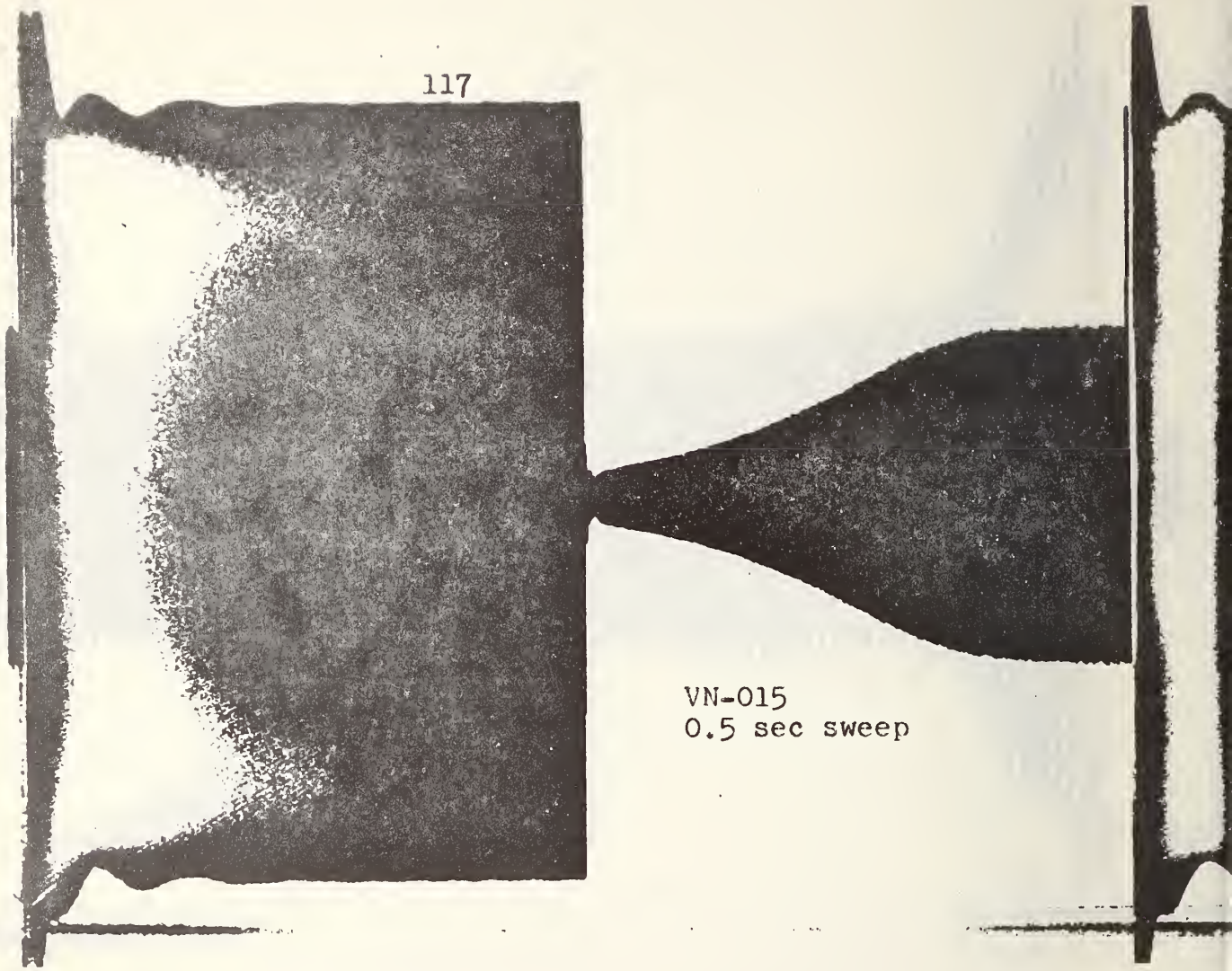

UN-009
0.05 sec sweep
-3 dB

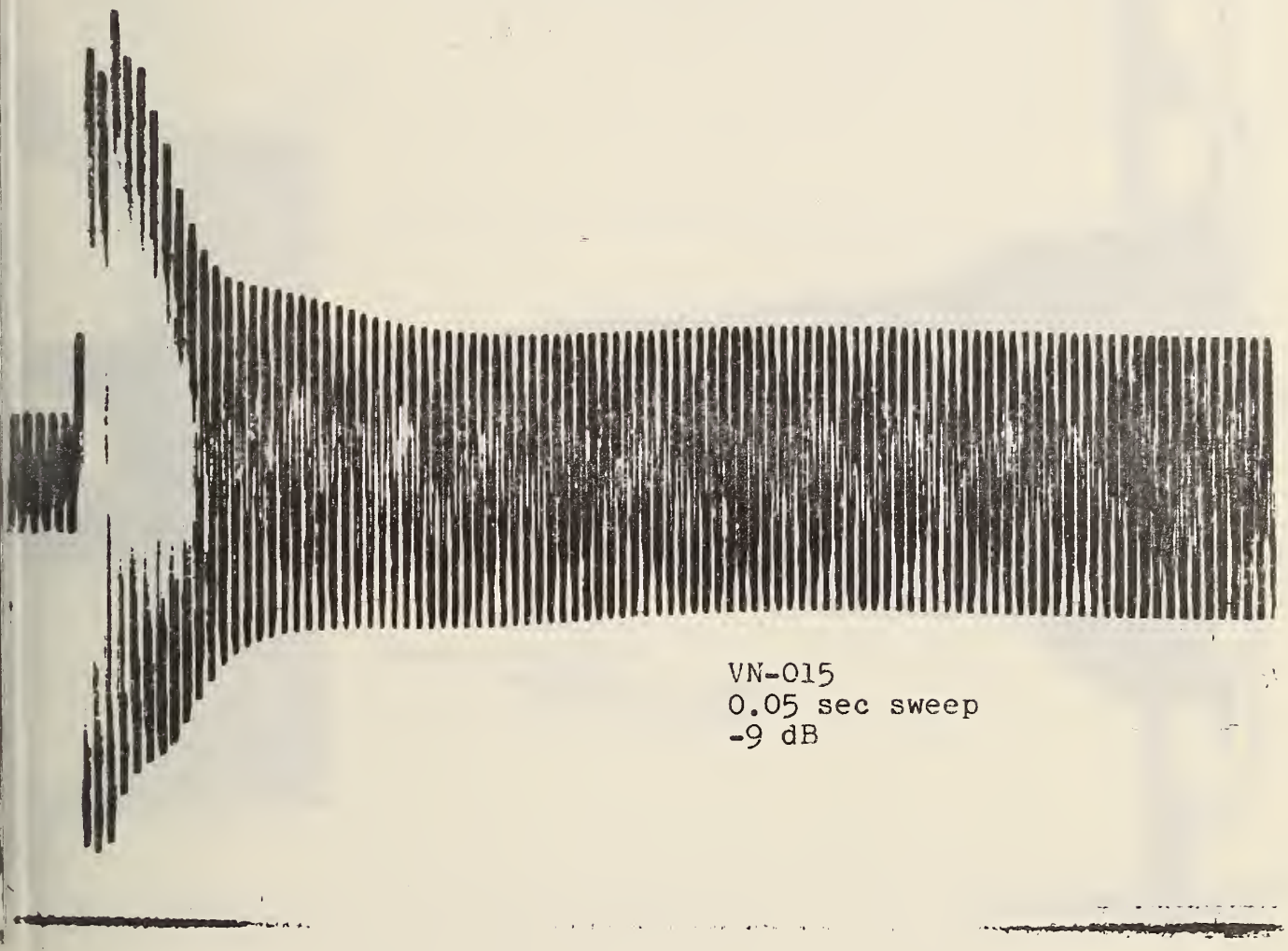

118.5
VN-013
0.5 sec sweep


VN-013
0.05 sec sweep
-7 dB

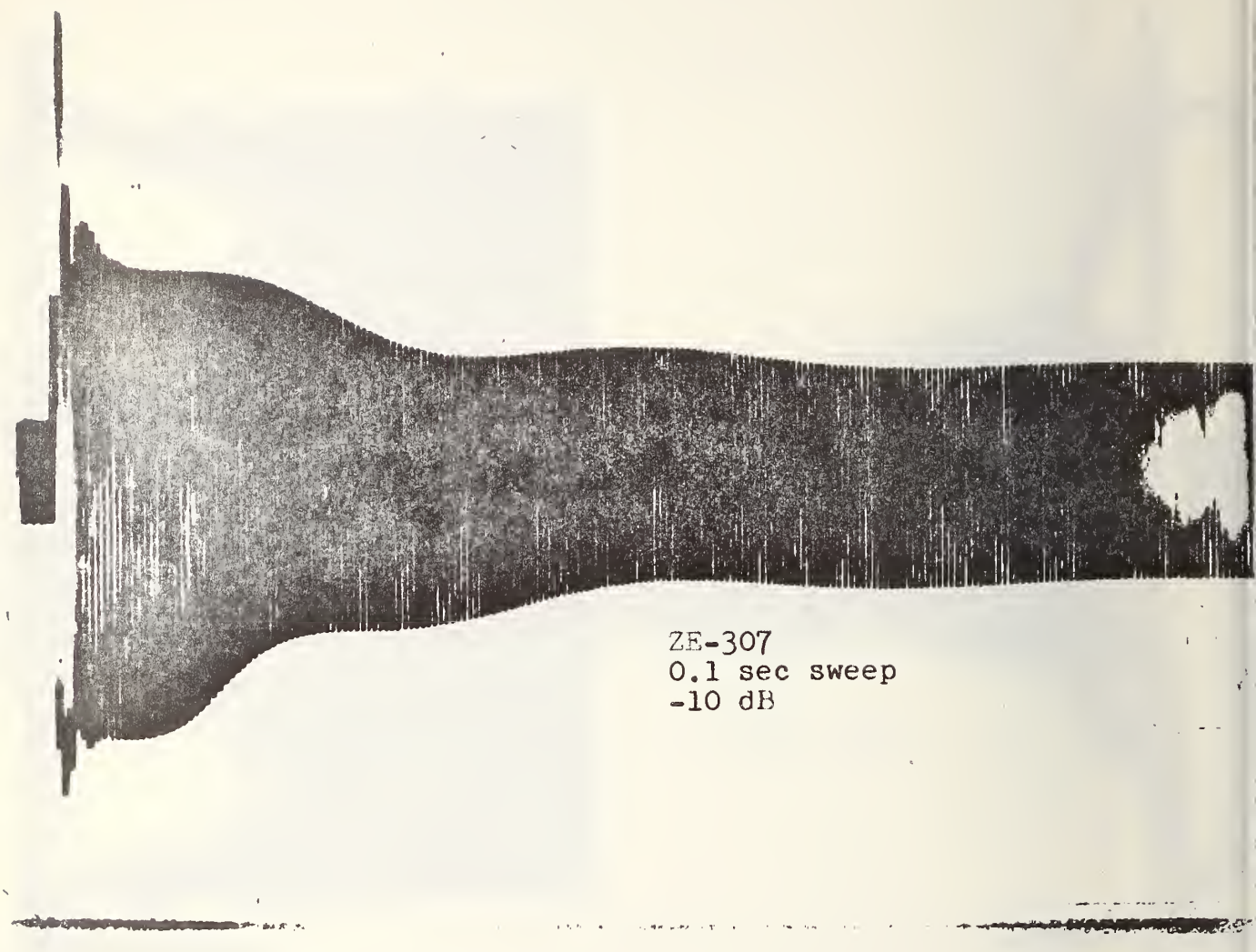

118
VN-014
0.5 sec sweep

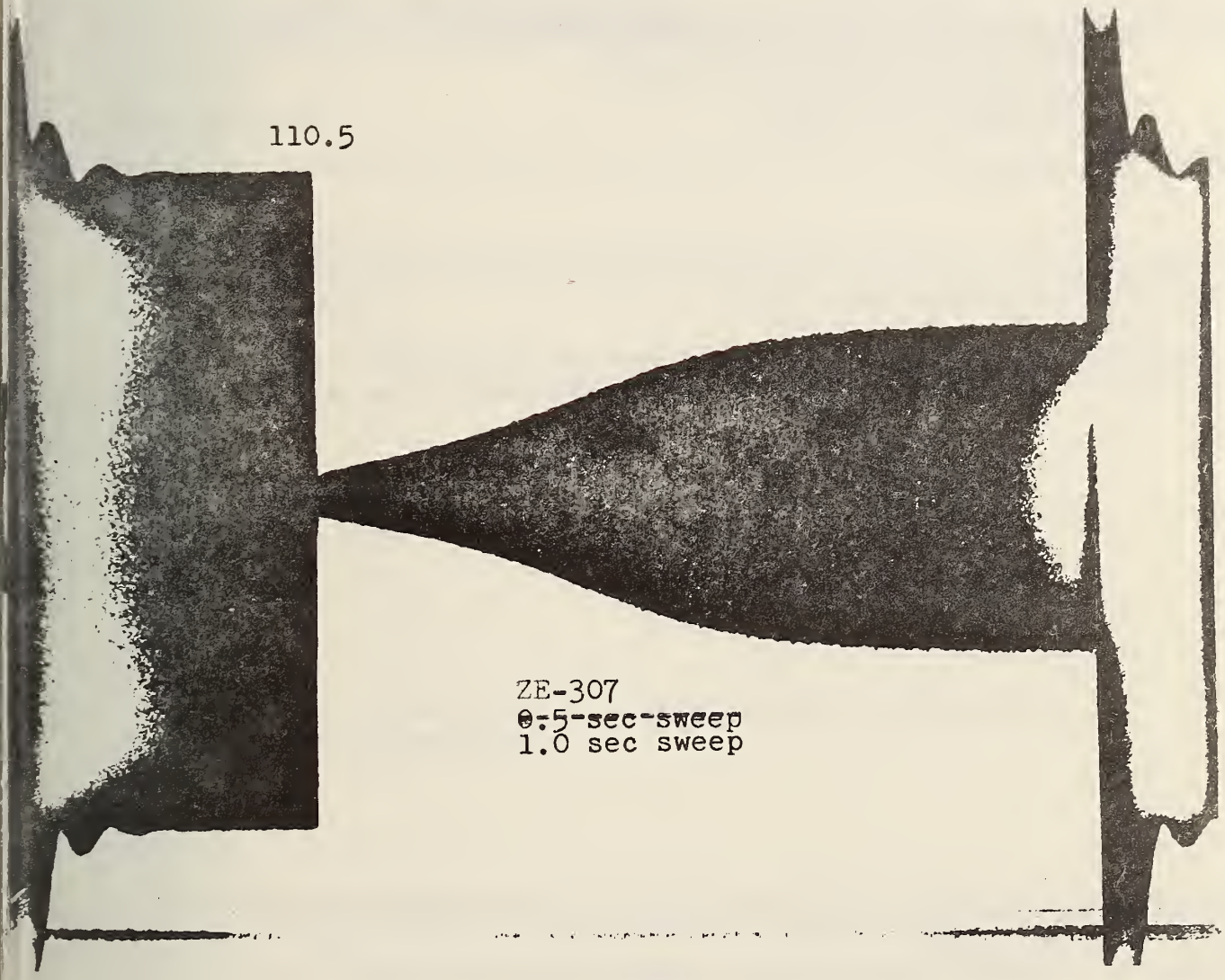

VN-014
0.05 sec sweep
-8 dB


117
VN-015
0.5 sec sweep



VN-015
0.05 sec sweep
-9 dB


ZE-307
0.1 sec sweep
-10 dB


110.5
ZE-307
0.5-sec-sweep
1.0 sec sweep

SHEET	NBSIR 76-1179	

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7. AUTHOR(S): Edwin D. Burnett and Martin A. Bassin

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15. SUPPLEMENTARY NOTES

16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

The attack and release time characteristics of 81 compression hearing aids are presented. The input signal used was that specified in the standard, ANSI S3.22.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

Attack and release characteristics; compression; hearing aids

18. AVAILABILITY

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