

V-1735

Results of Comparison of two
Different Side Impact Dummies

- US SID
- EUROSOD

in Full Scale Tests Acc. FMVSS 214

Testreports:

- FORD TAURUS
- HYUNDAI EXCEL
- CHEVROLET CAVALIER

Dipl.-Ing. K.-P. Glaeser

Cand.-Ing. K. Wichelhaus

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Bundesanstalt für Straßenwesen

Introduction

This report describes the comparison of two different side impact dummies US-SID and EUROSID tested in vehicle side impacts according the FMVSS 214. The original tests with the US-SID were carried out at Calspan Corporation for the NHTSA Contract No DTRS-57-87-C-00047 and are documented under:

CAL REPORT No 7654 - 9 Ford Taurus
CAL REPORT No 7654 -11 Hyundai Excel
CAL REPORT No 7654 - 7 Chevrolet Cavalier

The tests with EUROSID (arms downwards) with the same testcars under the same testconditions were carried out at the BAST test facility in Summer 1991. This report gives the full documentation of the testresults of the crashtests with the three above mentioned cars without interpretation of the results. The work was carried out in the framework of EEVC WG 9, "Side Impact Test Procedure" activities.

	US-SID	EUROSID
Head	3-axial (a_x, a_y, a_z)	3-axial (a_x, a_y, a_z)
Thorax		
Spine		
- upper	lateral (a_y)	3-axial (a_x, a_y, a_z)
- lower	lateral (a_y)	
Ribs		
- upper	lateral (a_y)	lateral (a_y, s_y)
- middle	lateral (s_y)	lateral (a_y, s_y)
- lower	lateral (a_y)	lateral (a_y, s_y)
Abdomen		3 x F_y
Pelvis	lateral (a_y)	3-axial (a_x, a_y, a_z)
Symphyse		(F_y)

Transducers in different dummies

	NHTSA	BAST
<u>Cameras</u>	9	6
<u>Accelerometers</u>		
Car	11	8
Barrier	5	5
Dummy (front)	11 (3 redundant)	13
Dummy (rear)	11 (3 redundant)	13
<u>Displacement Transducers</u>		
Dummy (front)	1	3
Dummy (rear)	1	3
<u>Force Transducers</u>		
Dummy (front)		4
Dummy (rear)		4

Transducers Installed

HYUNDAI EXCEL

Hyundai Excel

<u>Cars</u>	NHTSA	BAST
Year	1/1988	1/1988
Odometer reading	50,2 km	46713,8 km
Test weight:		
front axle	652,5 kg	653,7 kg
rear axle	570,9 kg	572,0 kg
total	1223,4 kg	1225,7 kg
<u>Car characteristics</u>		
Dist. axles	2376 mm	2376 mm
tyres	P155/80R13	P155/80R13
tyres pressure		
front	2,06 bar	2,06 bar
rear	2,06 bar	2,08 bar
fuel (H ₂ O)	39 l (93 %)	39 l (93 %)
	P205/70R14	P205/70R14
<u>Dummies*</u>		
front left	US-SID (P1)	EUROSID (P1)
rear left	US-SID (P4)	EUROSID (P3)
seat back ang. front	25°	25°
body angle	23°	23°
seat adj. length	157,5 mm	157,5 mm
window right	open	open
left	closed	closed
<u>Barrier</u>		
weight	1368,8 kg	1369 kg
impact angle	90°	90°
moving direction	26°	27°
velocity	55,0 km/h	53,8 km/h
impact point	248,9 mm	248,9 mm
MDB shield	HONEYCOMB	HONEYCOMB

Test Parameters

* Arms of EUROSID downwards parallel to the thorax

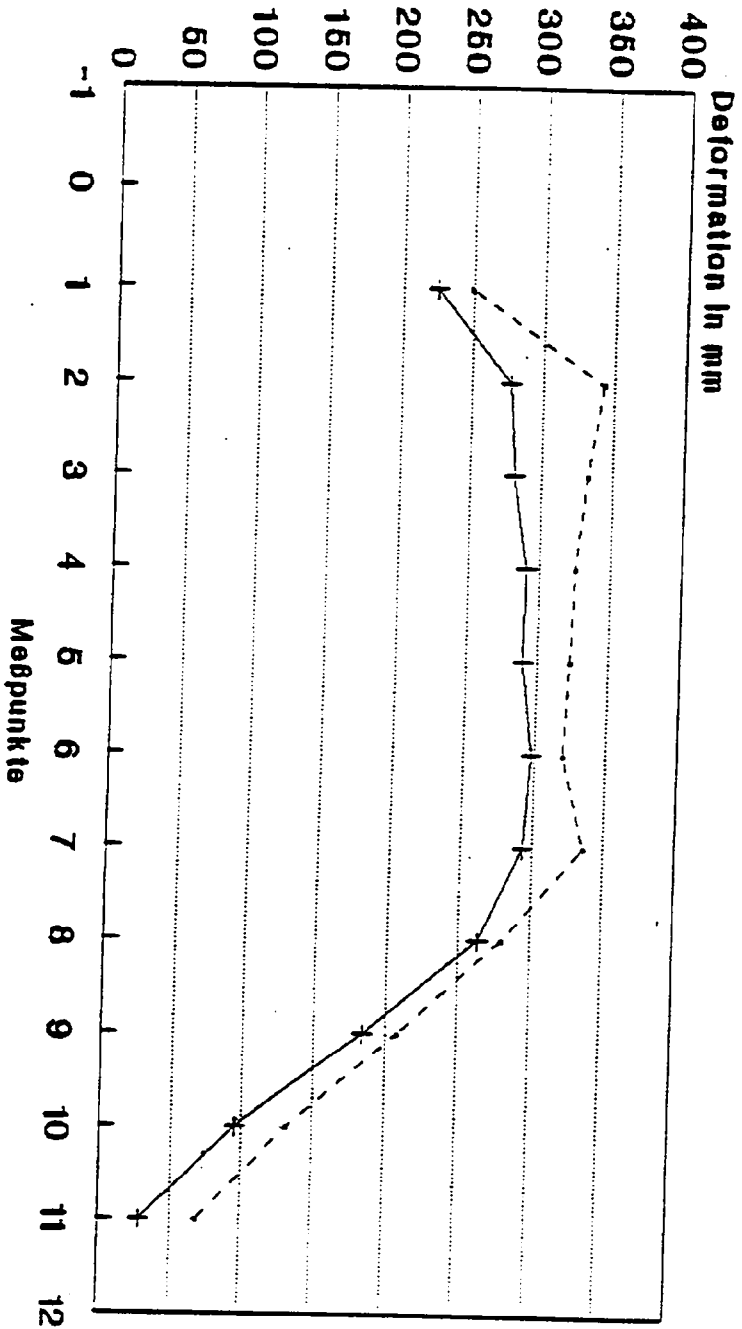
NHTSA-Test "Hyundai Excel" Car-Deformation																
	- 11	01	11	21	31	41	51	61	71	81	91	101	111	121		
	LEVEL 1 (266.7 mm)															
post	714	846	836	829	826	823	838	782	711	635	572					
pre	465	503	503	503	503	503	503	503	503	503	503					
Difference	249	343	333	325	323	320	335	279	208	132	69					
	LEVEL 2 (502.9 mm)															
post	775	818	813	836	843	851	851	843	861	856	843	508				
pre	417	414	414	414	414	414	414	414	414	414	414	417	419			
Difference	358	404	399	422	429	437	437	429	447	442	429	89				
	LEVEL 3 (604.5 mm)															
post	660	724	744	757	770	782	793	800	818	818	810	800	737			
pre	424	424	424	424	424	424	424	424	424	424	429	432	434			
Difference	236	300	320	333	346	358	369	376	394	394	381	368	303			
	LEVEL 4 (881.4 mm)															
post	566	580	610	693	732	744	747	757	762	800	798	795	798	673		
pre	490	483	475	498	490	490	488	488	485	483	483	480	480	480		
Difference	76	97	135	195	242	254	259	269	277	317	315	315	318	193		
	LEVEL 5 (1295.4 mm)															
post										640	663	673	683	765	709	655
pre										691	693	696	688	699	699	699
Difference										- 51	- 30	- 23	- 5	66	10	- 44
	NHTSA-Test "Hyundai Excel"; Barrier-Deformation															
	- 81	- 71	- 61	- 51	- 41	- 31	- 21	- 11	01	11	21	31	41	51	61	71
	LEVEL 1 (431.8 mm)															
Difference	311	151	31	- 31	01	31	01	01	01	01	01	31	31	51	181	251
	LEVEL 2 (588.8 mm)															
Difference	101	- 31	- 51	- 51	- 51	- 51	- 51	- 31	- 31	- 31	01	01	01	01	31	51
	LEVEL 3 (812.8 mm)															
Difference	581	81	51	51	51	81	101	181	101	101	131	181	201	311	691	1091

NHTSA-Test "Hyundai Excel", Deformation

BAST-Test "Hyundai Excel" Car-Deformation																
	- 11	01	11	21	31	41	51	61	71	81	91	101	111	121	131	141
LEVEL 1 (266.7 mm)																
post	742	812	812	812	812	812	812	812	812	812	812	812	812	812	812	812
pre	517	535	531	527	525	522	519	517	516	515	514	513	512	511	510	509
Difference	225	277	281	291	291	290	298	293	293	293	293	293	293	293	293	293
LEVEL 2 (502.9 mm)																
post	778	797	812	825	844	846	843	859	880	878	870	870	870	870	870	870
pre	463	462	460	456	453	452	449	445	446	450	449	447	447	447	447	447
Difference	315	335	352	369	391	394	394	414	434	428	421	421	421	421	421	421
LEVEL 3 (604.5 mm)																
post	655	708	722	733	745	757	768	782	822	814	803	793	724	457	448	448
pre	470	471	467	465	462	460	457	455	453	452	451	450	450	440	436	436
Difference	185	237	255	268	283	297	311	327	369	362	352	343	274	17	12	12
LEVEL 4 (881.4 mm)																
post	547	566	608	662	700	720	728	738	753	805	805	805	802	673	560	520
pre	534	526	520	529	530	526	524	520	519	518	514	510	504	503	500	492
Difference	13	40	88	136	170	194	204	218	234	297	291	295	298	170	60	28
LEVEL 5 (1295.4 mm)																
post																
pre																
Difference																
BAST-Test "Hyundai Excel": Barrier-Deformation																
	- 81	- 71	- 61	- 51	- 41	- 31	- 21	- 11	01	11	21	31	41	51	61	71
LEVEL 1 (431.8 mm)																
Difference	281	181	111	111	101	101	91	101	101	101	101	101	101	101	121	201
LEVEL 2 (588.8 mm)																
Difference	151	151	21	01	01	01	01	21	21	21	21	21	21	21	31	231
LEVEL 3 (812.3 mm)																
Difference	321	01	- 11	- 11	- 11	11	41	21	21	21	51	61	71	301	64	961

BAST-Test "Hyundai Excel", Deformation

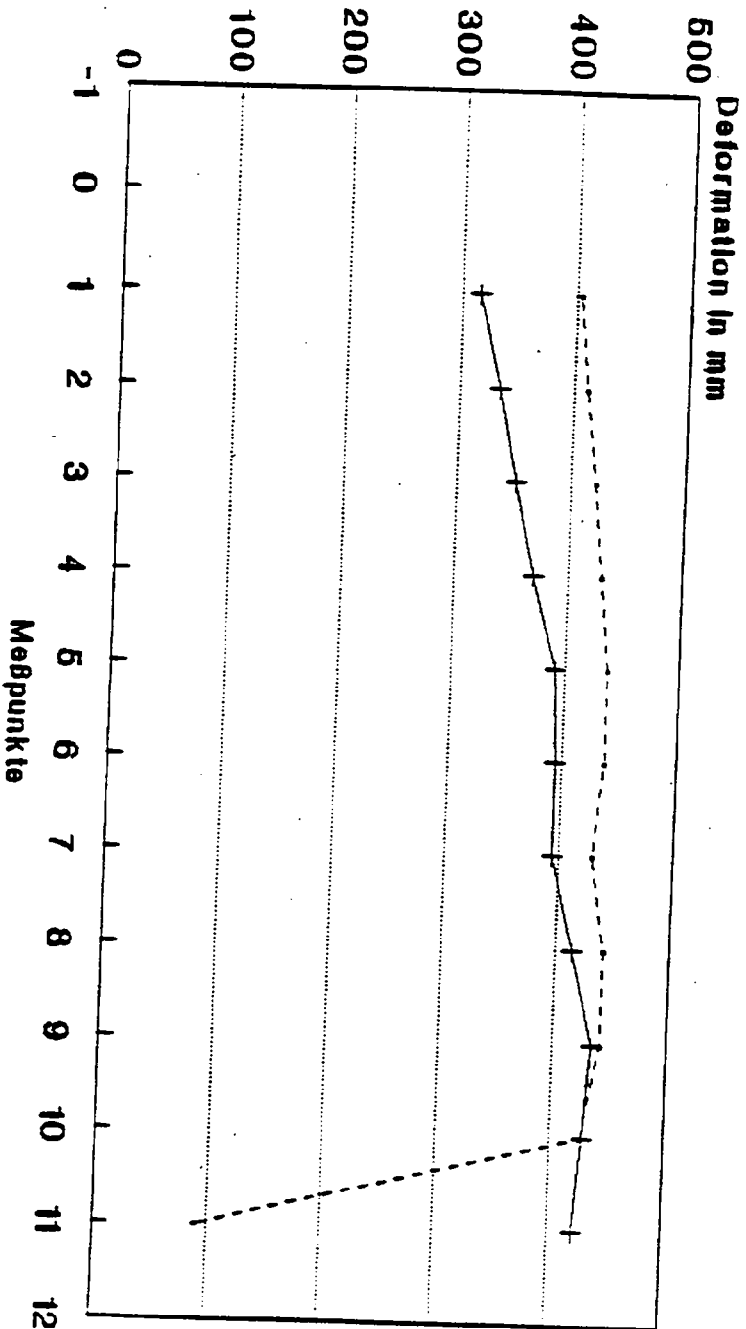
Hyundai Excel Level 1 (266 mm)



--- NHTSA-Test —|— BASI-Test

Car-Deformation "Hyundai Excel", Level 1

Hyundai Excel Level 2 (503 mm)

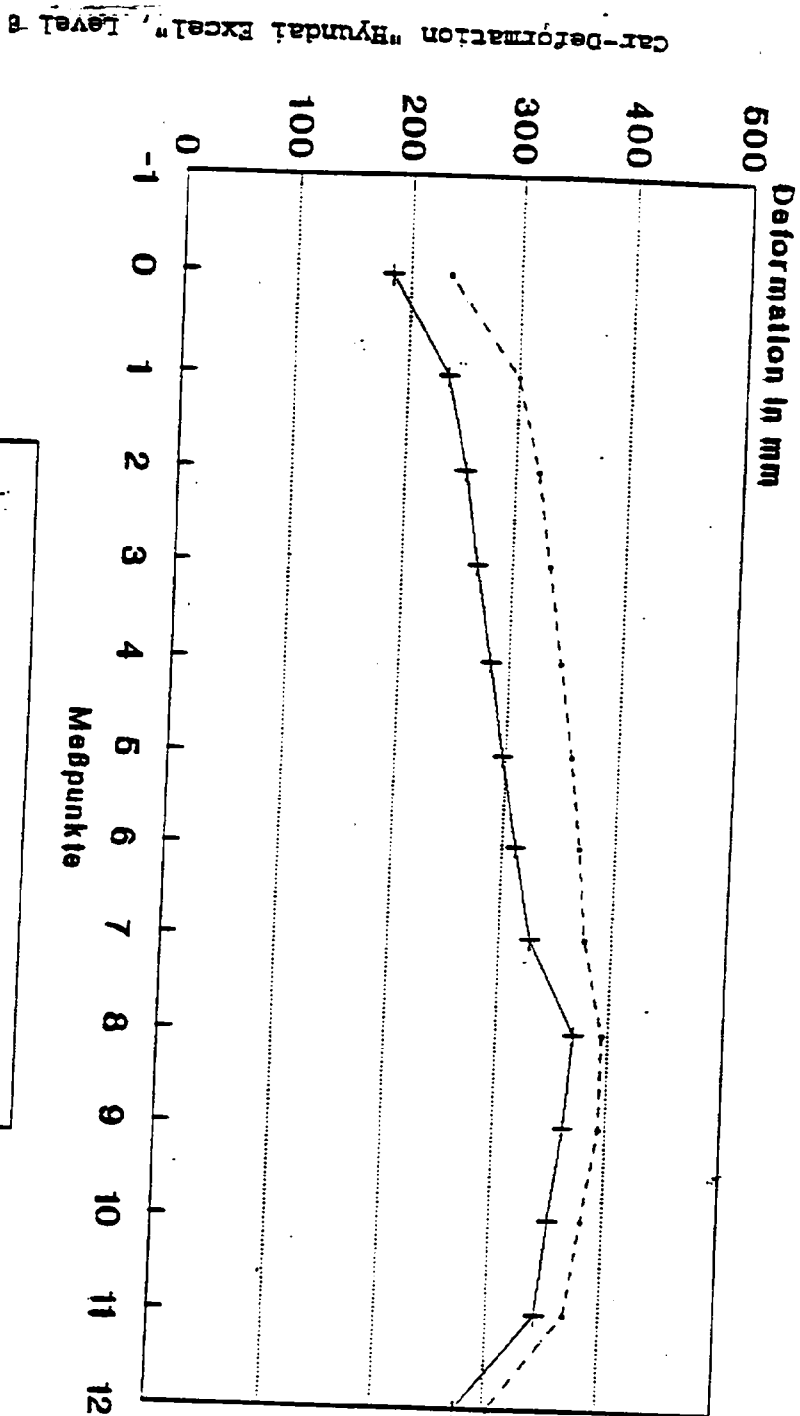


H-Punkt an Meßstelle 6

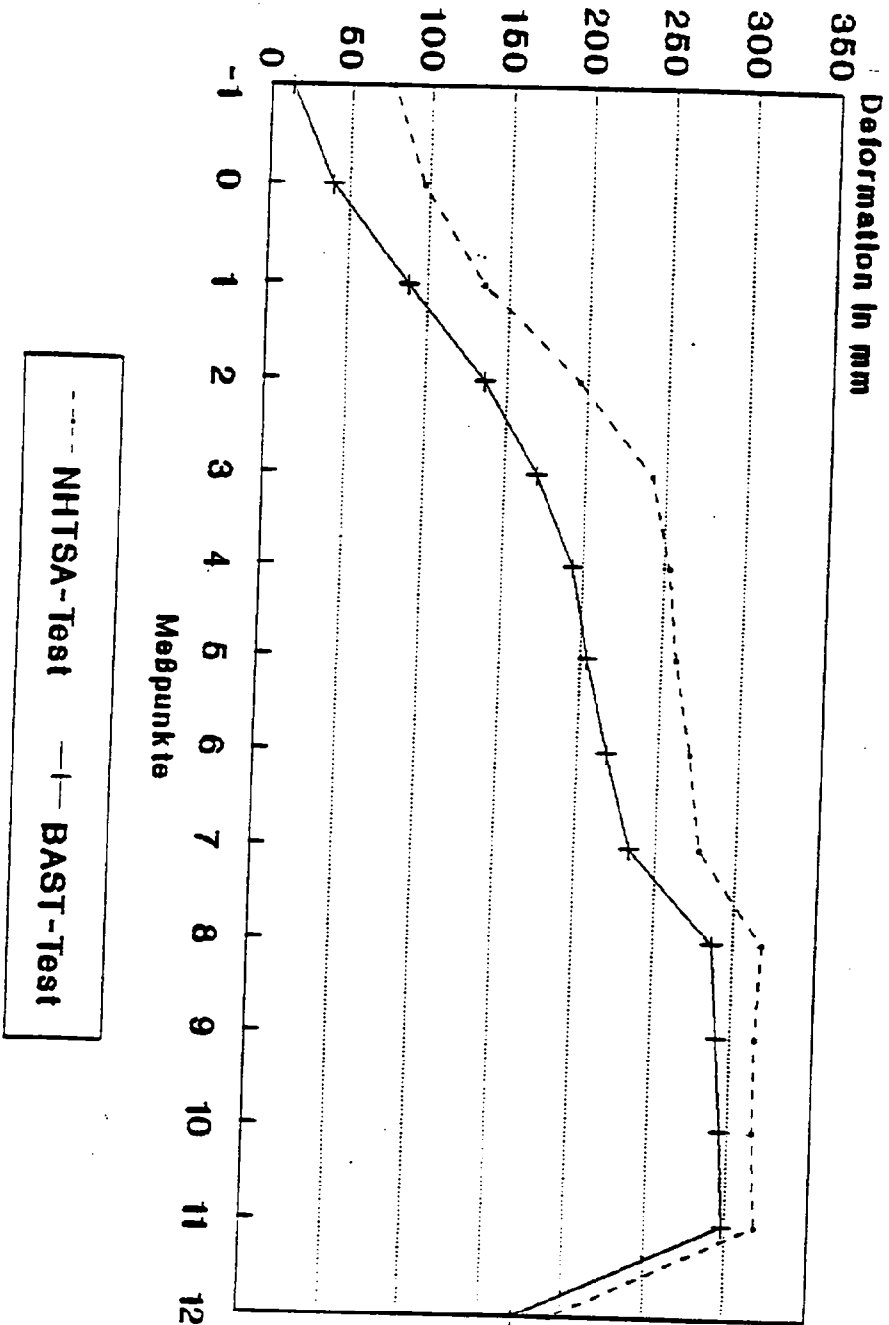
----- NHTSA-Test —|— BAST-Test

Car-Deformation "Hyundai Excel", Level 2

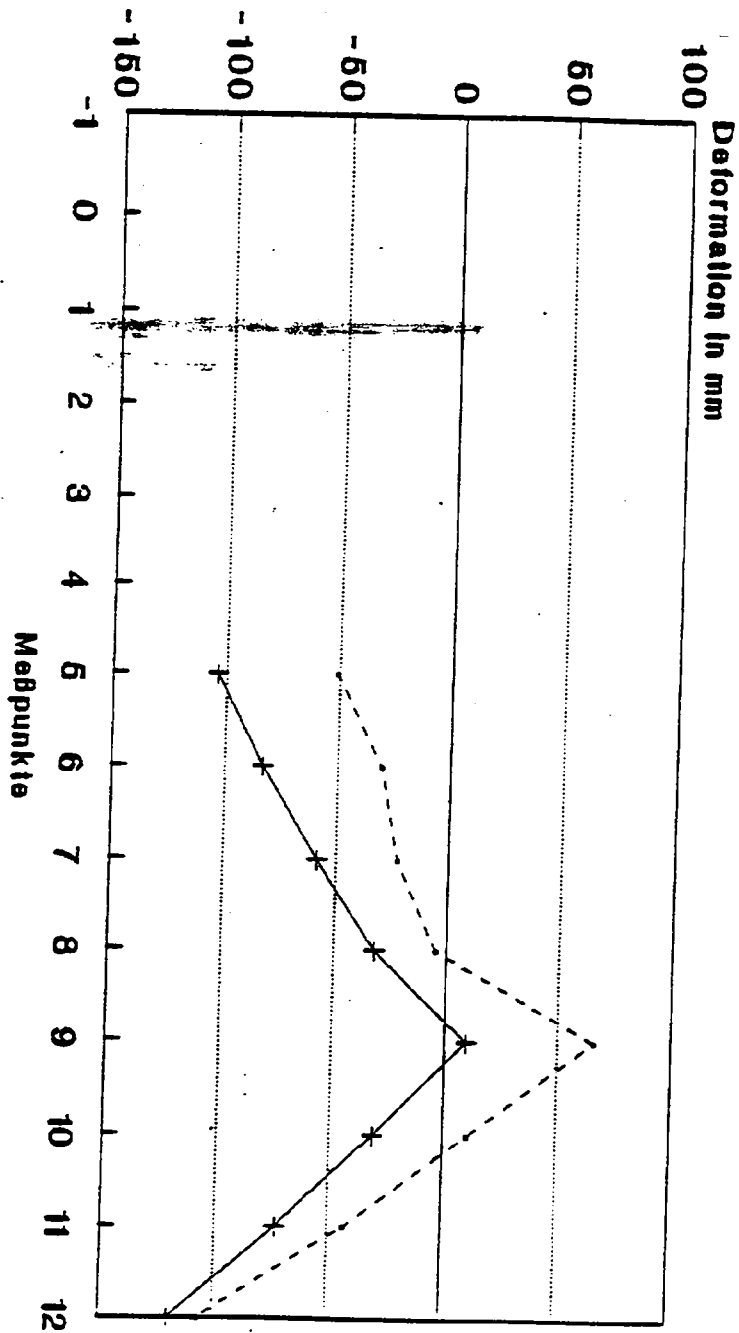
Hyundai Excel Level 3 (605 mm)



Hyundai Excel Level 4 (881 mm)



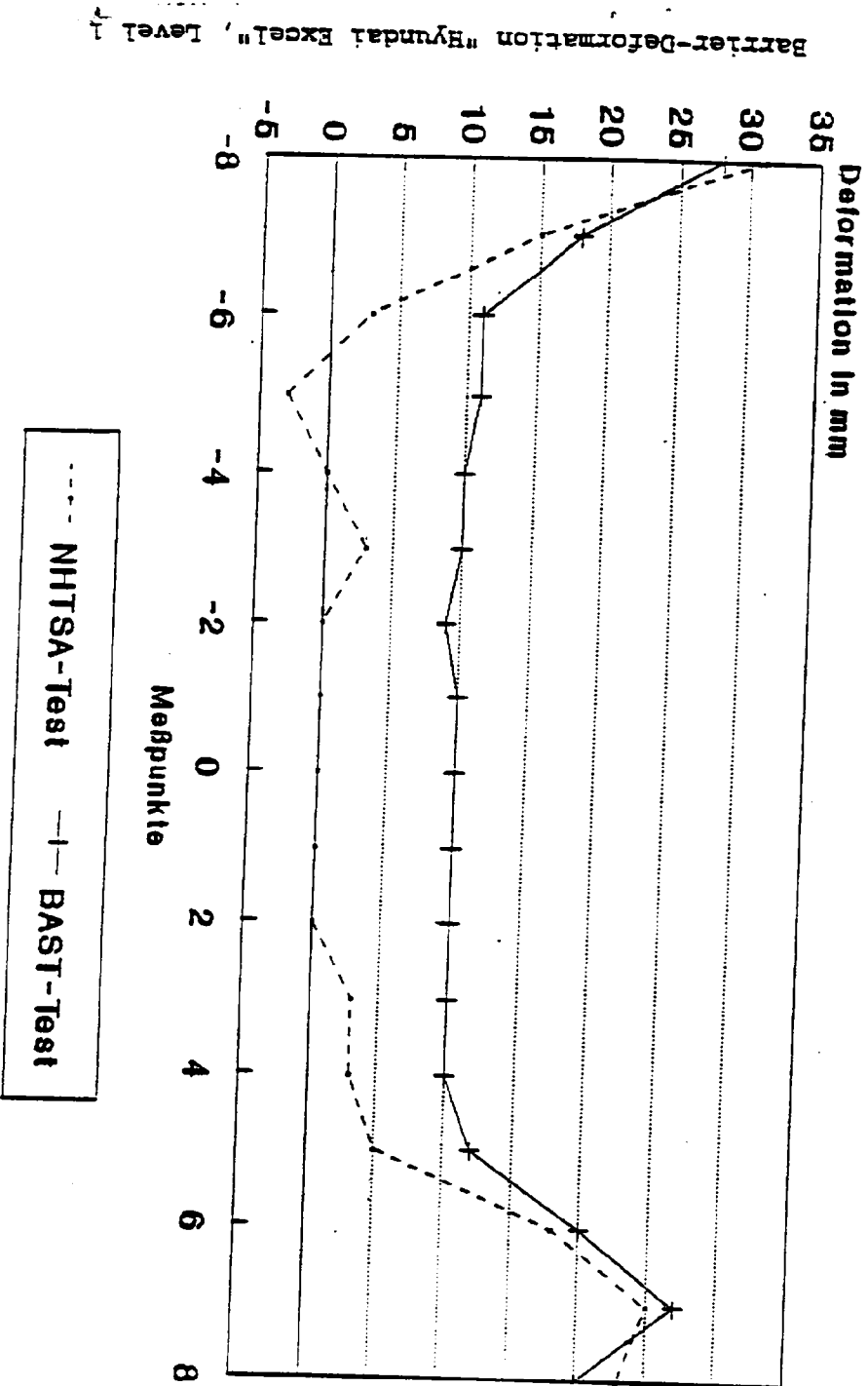
Hyundai Excel Level 5 (1295 mm)



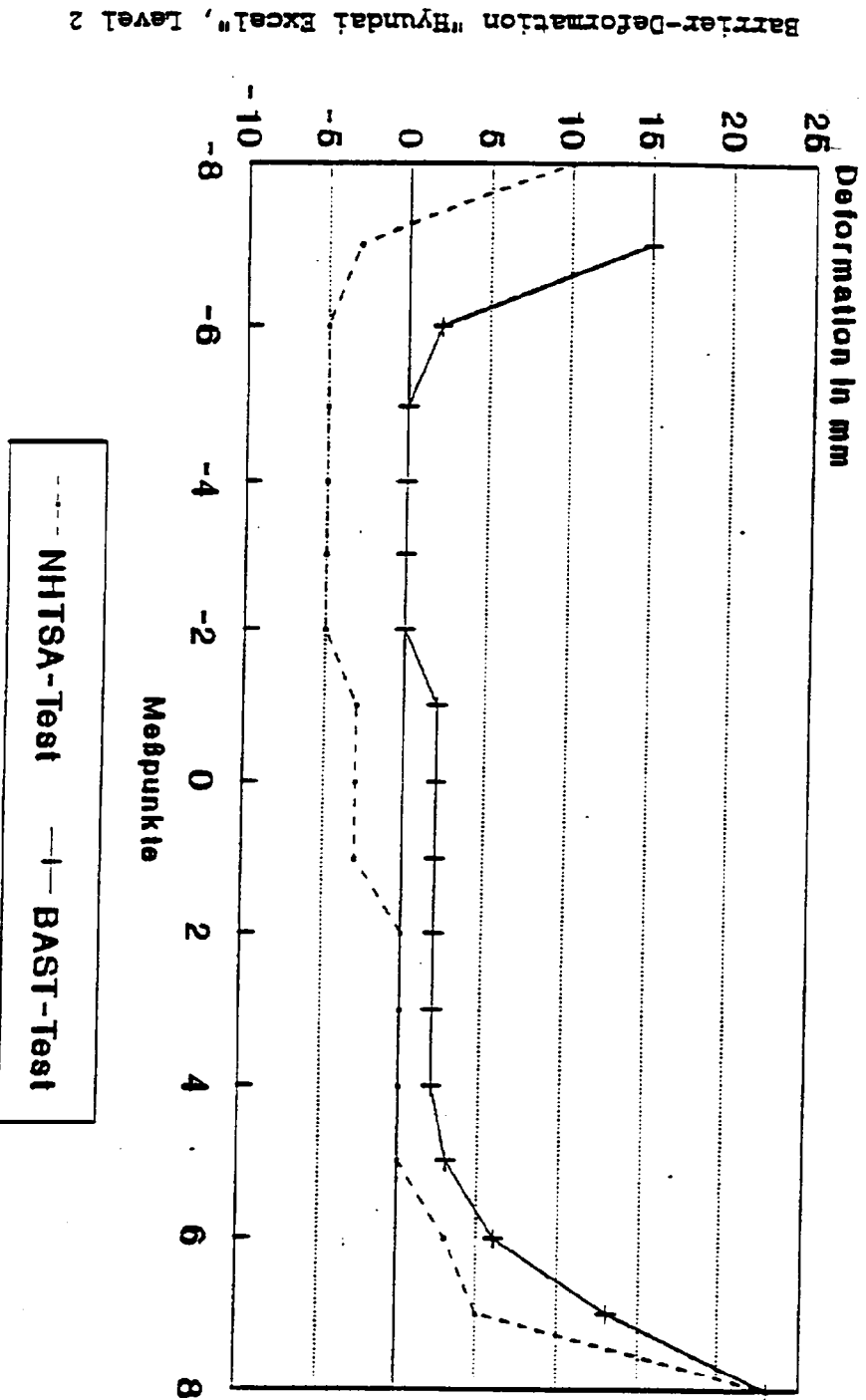
--- NHTSA-Test — BAST-Test

Car-Deformation "Hyundai Excel", Level 5

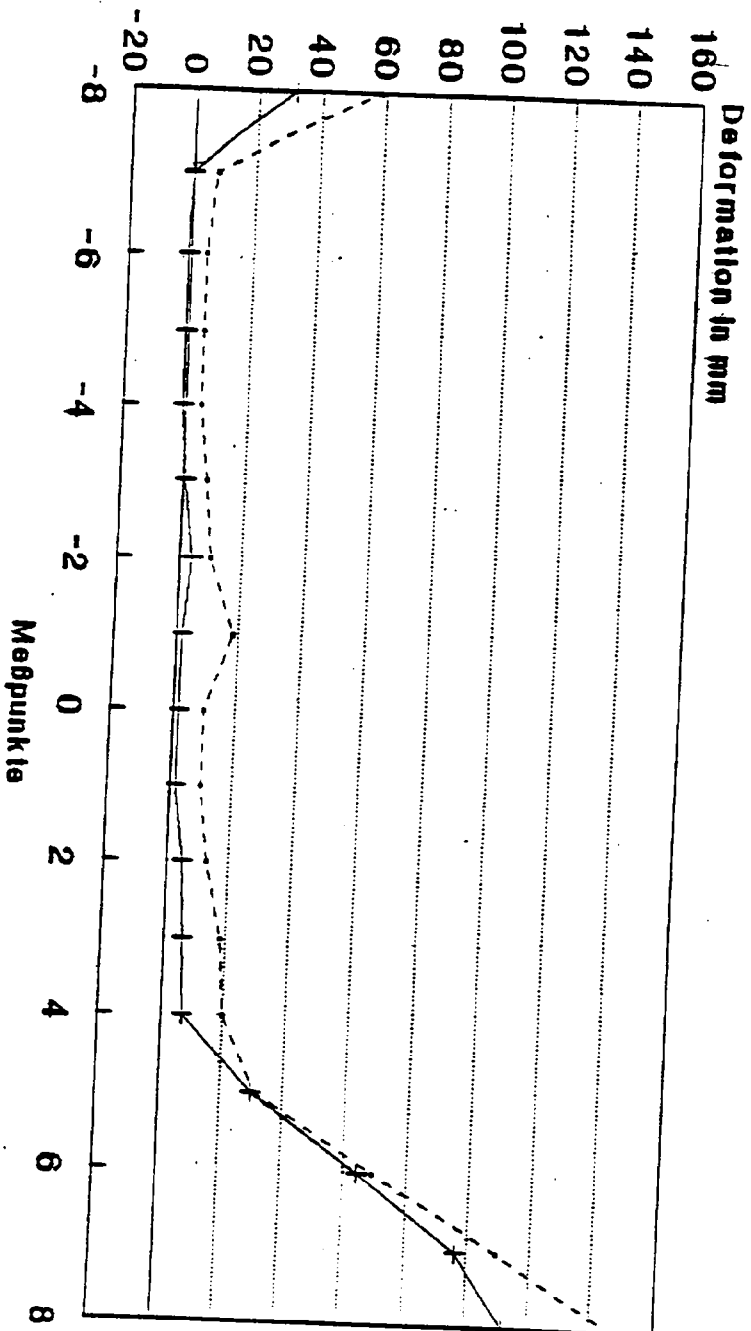
Barrier-Deformation (Hyundai Excel) Level 1 (432 mm)



Barrier-Deformation (Hyundai Excel) Level 2 (559 mm)



Barrier-Deformation (Hyundai Excel) Level 3 (813 mm)



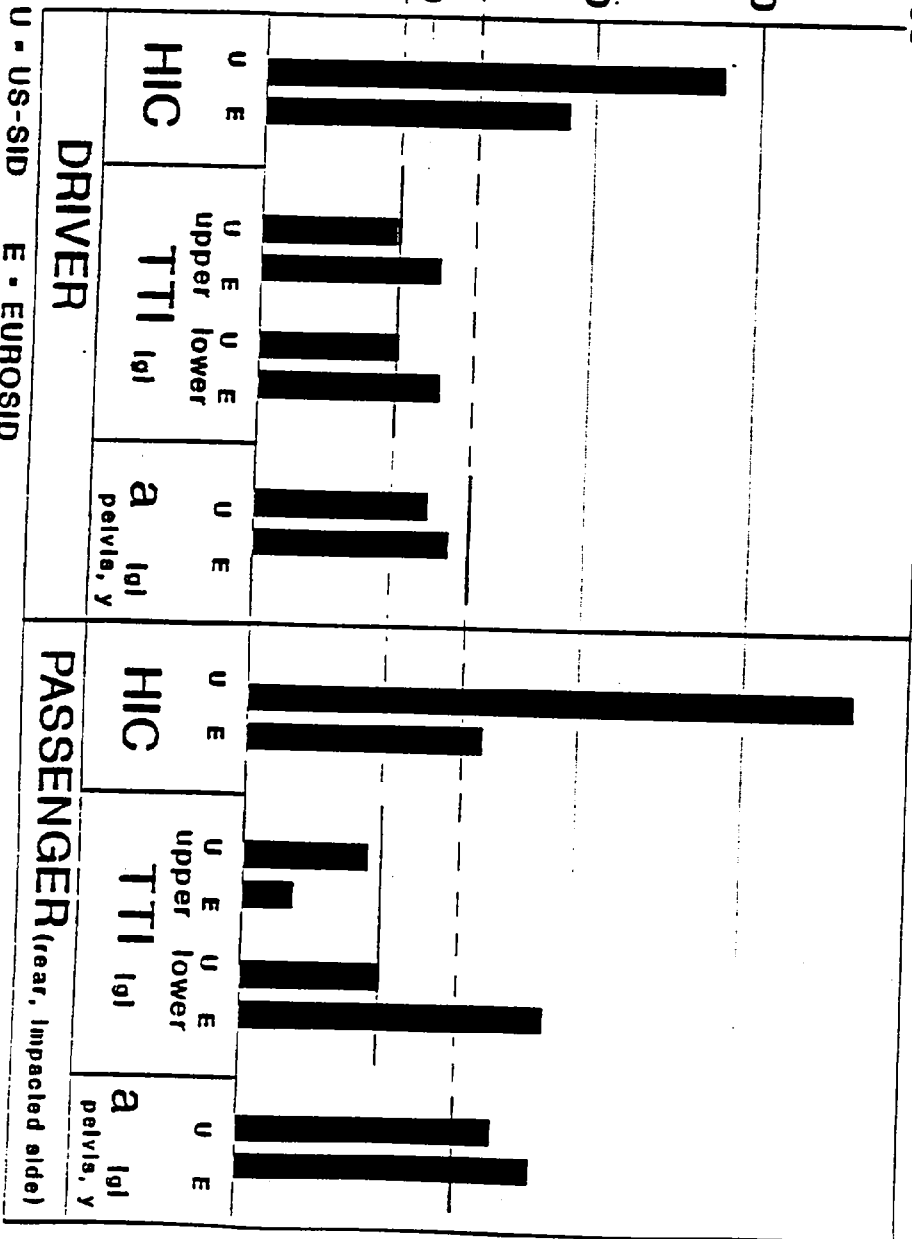
Barrier-Deformation "Hyundai Excel", Level 3

HYUNDAI EXCEL

COMPARISON OF TWO DIFFERENT SIDE IMPACT DUMMIES (US-SID, EUROSID)

TOLERANCE LEVEL 400
HIC : 1000

a pelvis, y : 130 g
TTI : 85 g



BAST

Main Testresults

Position 1: NHTSA-Test HIC = 277,9
(Fahrer) (US-SID) TTI = 81,8 (oben)
TTI = 85,1 (unten)
 a_{By} = 105,0 g

BAST-Test HIC = 184,5
(EUROSID) TTI = 108,8 (oben)
TTI = 118,8 (mitte)
TTI = 110,1 (unten)
 a_{By} = 118,1 g

Position 3/4: NHTSA-Test HIC = 365,8
(stoßseitig, Fond) (US-SID) TTI = 75,2 (oben)
TTI = 81,9 (unten)
 a_{By} = 154,2 g

BAST-Test HIC = 142,7
(EUROSID) TTI = 30,4 (oben)
TTI = 75,1 (mitte)
~~TTI = 100,1 (unten)~~
 ~~a_{By} = 170,1 g~~

ANNEX

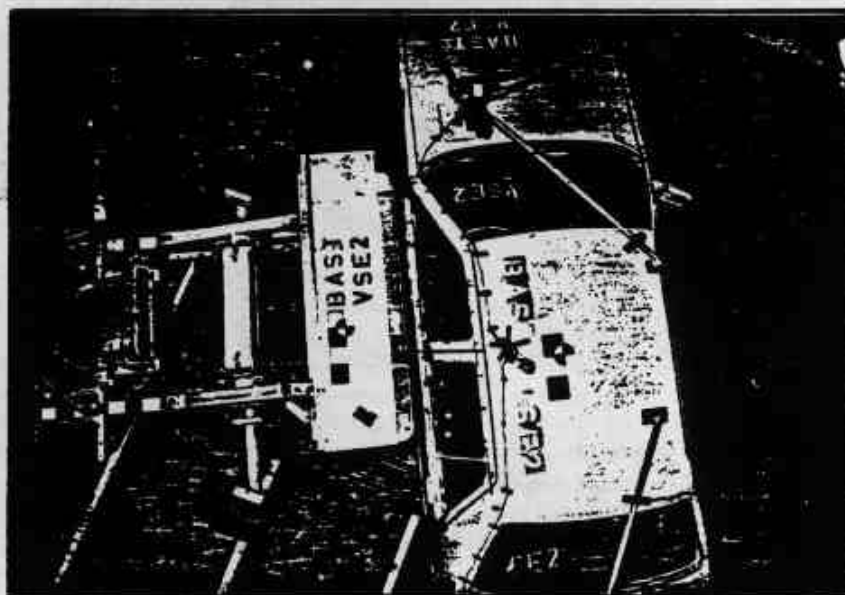
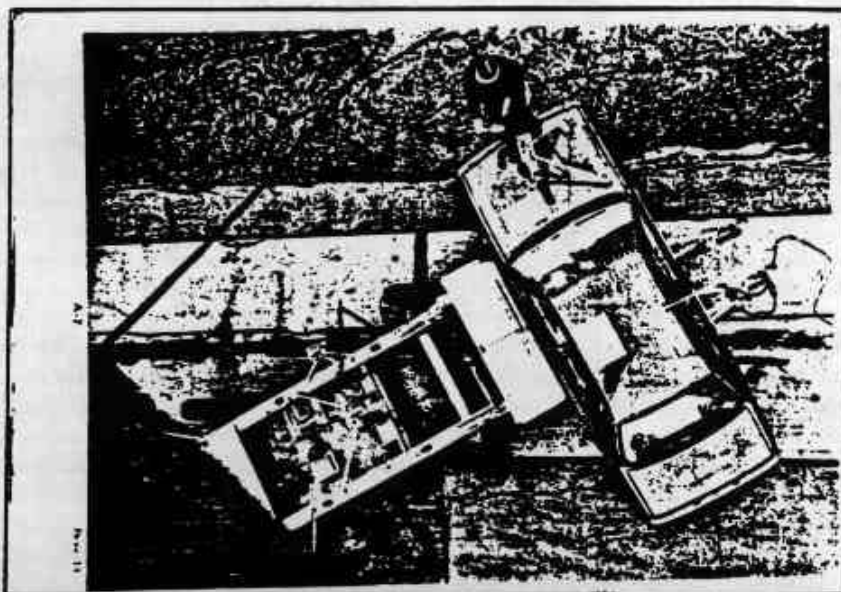
A 1 Photo Documentation

A 2 Summary of Testresults

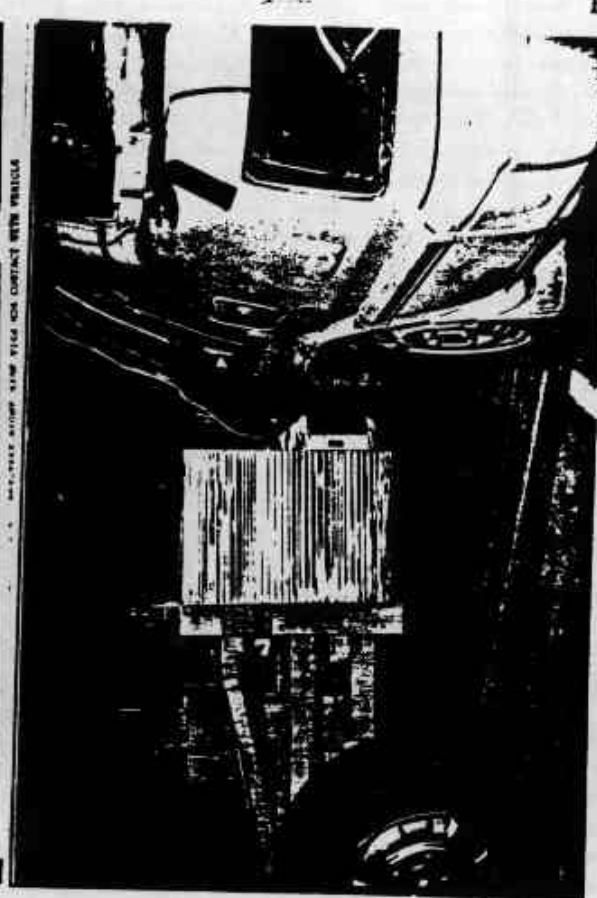
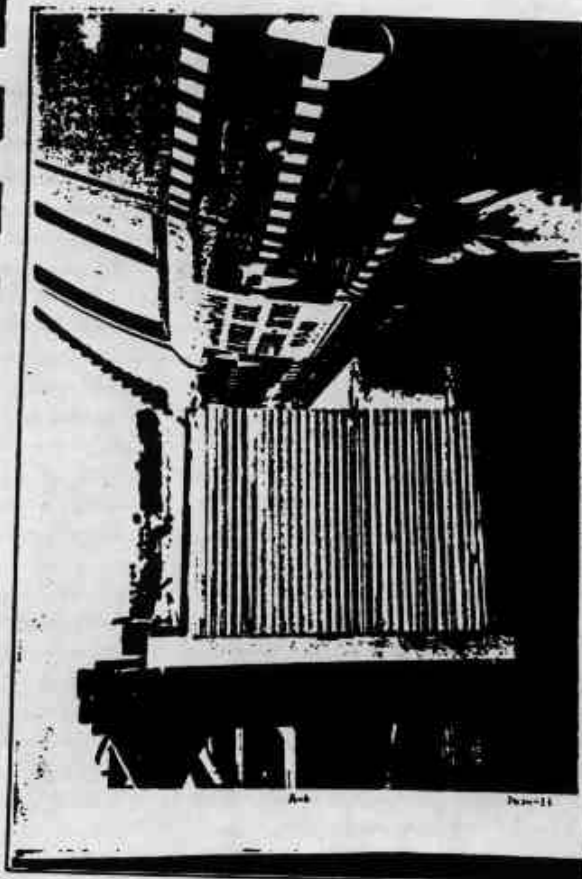
A 3 Computerplots

A 1 PHOTO DOCUMENTATION

In the following a comparison is made between the NHTSA-test and the EAST-test by photographing the same crash - situations or car parts. The upper photo schows the NHTSA, the lower the EAST test.



B1/1 PRE-TEST OVERHEAD OVERALL VIEW



B1/3 PRE-TEST RIGHT SIDE VIEW MD8 CONTACT WITH VEHICLE



B1/2 PRE-TEST LEFT SIDE VIEW MD8 CONTACT WITH VEHICLE

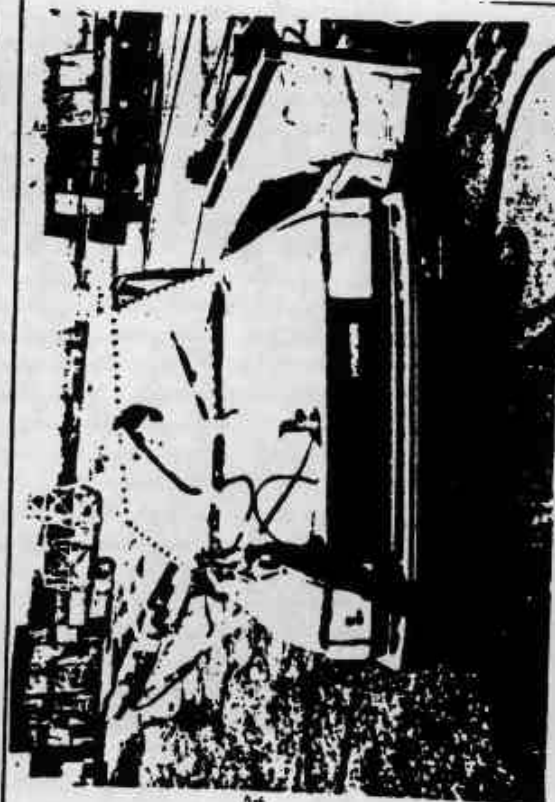


Figure A-3 PRE-TEST FRONT VIEW

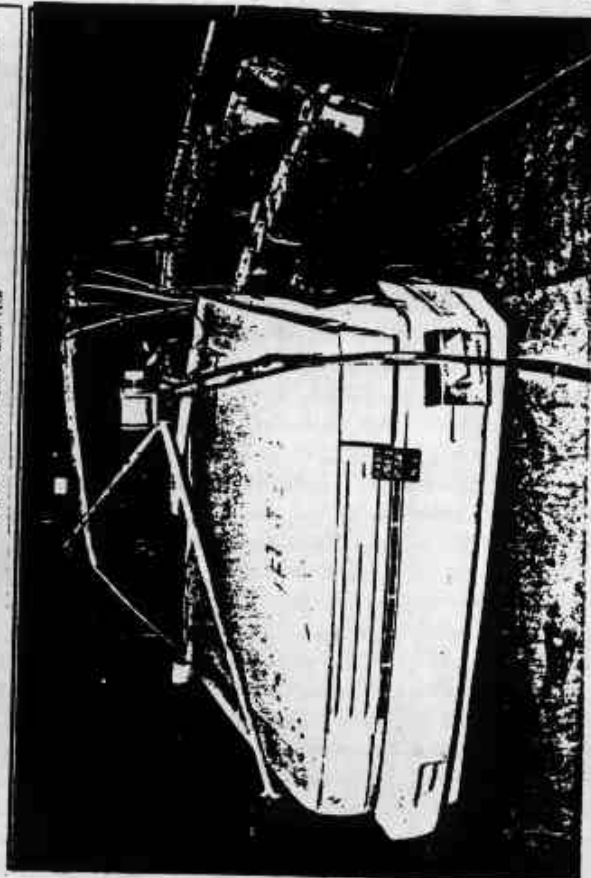


Figure A-4 POST-TEST FRONT VIEW

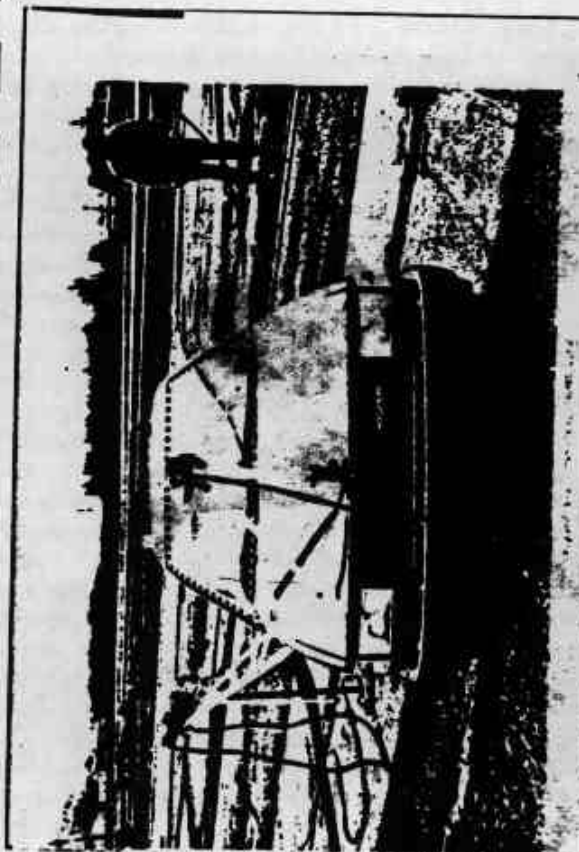
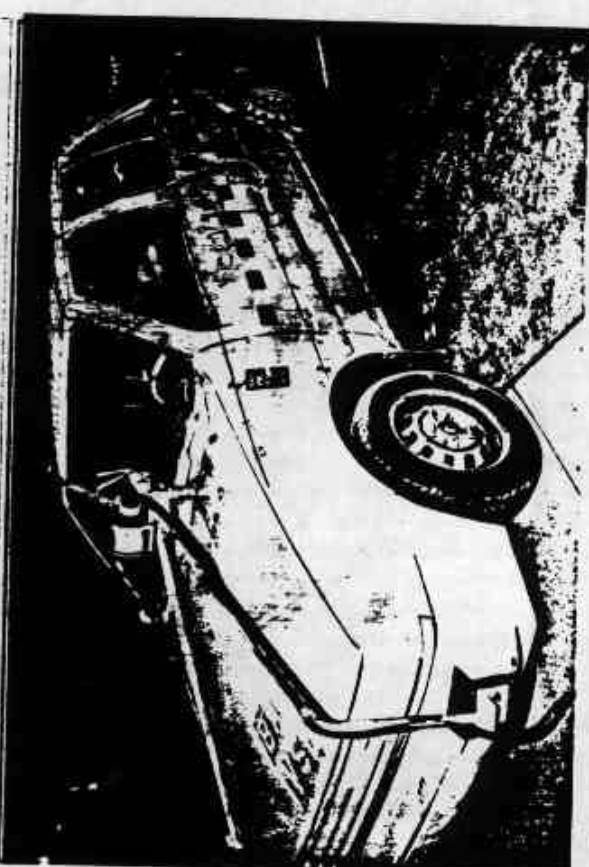
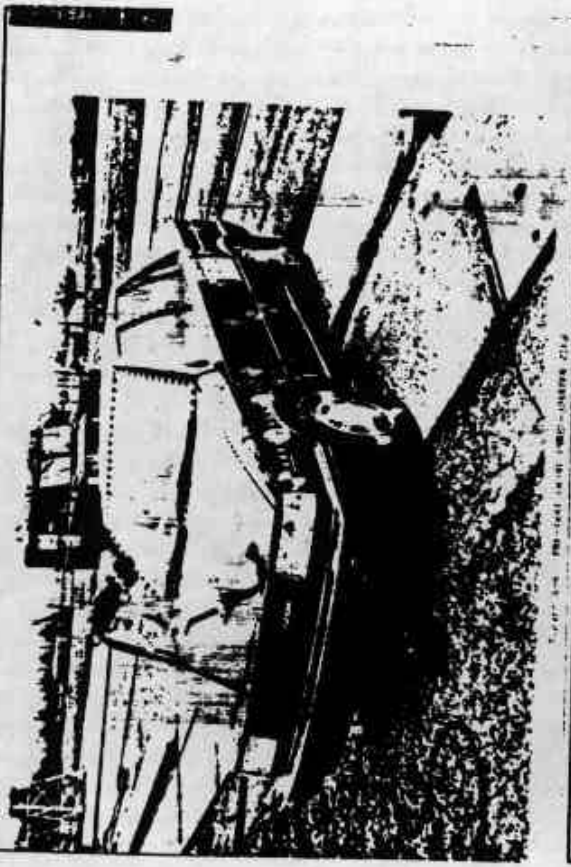
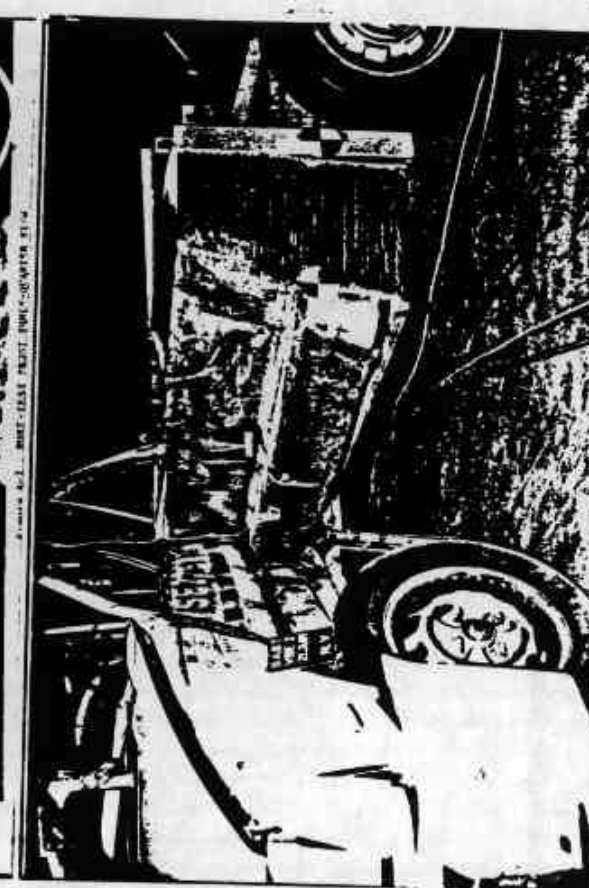
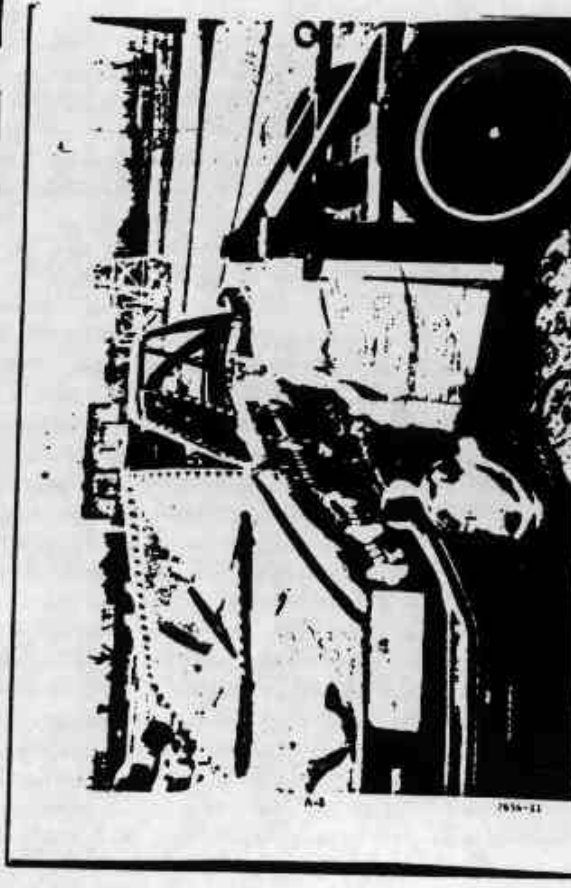


Figure A-5 POST-TEST FRONT VIEW



B1/6 PRE-TEST FRONT THREE-QUARTER VIEW



B1/7 POST-TEST FRONT THREE-QUARTER VIEW

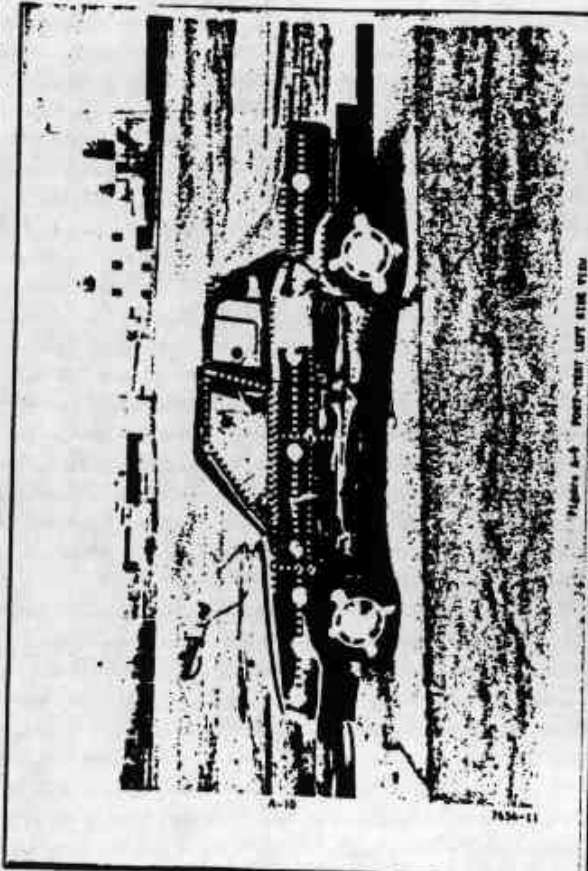


Figure A-10 POST-TEST LEFT SIDE VIEW

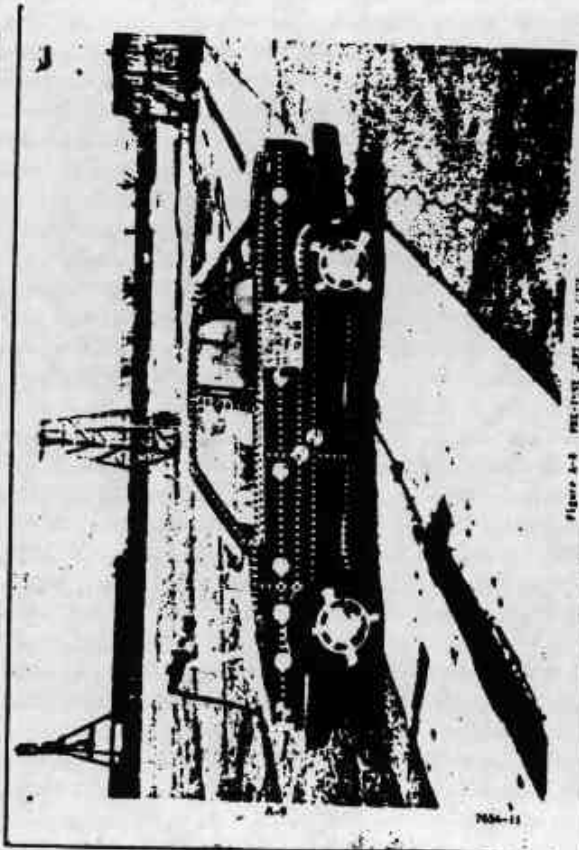
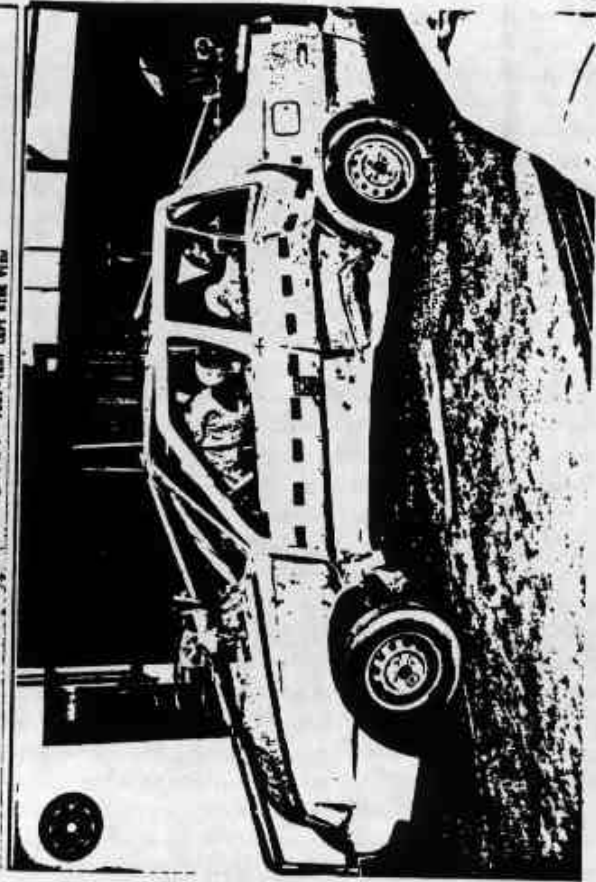
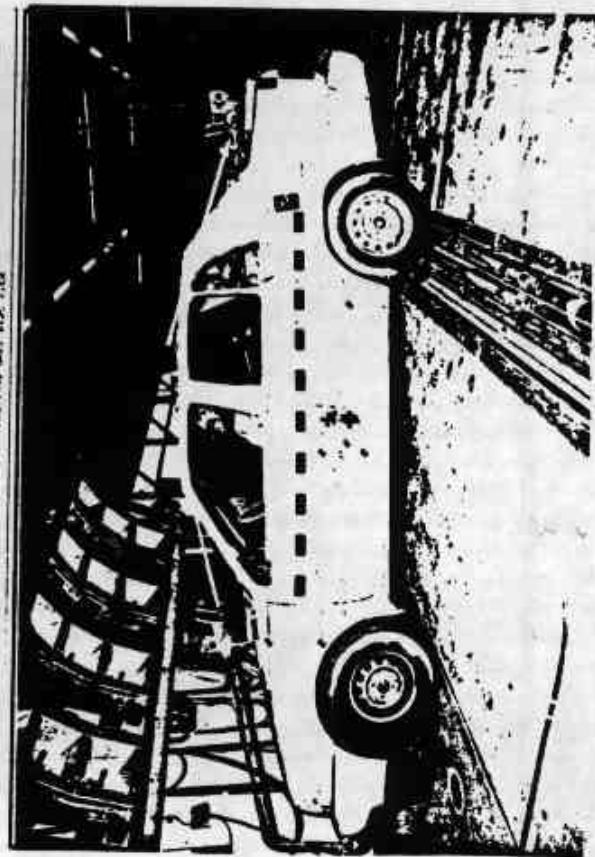
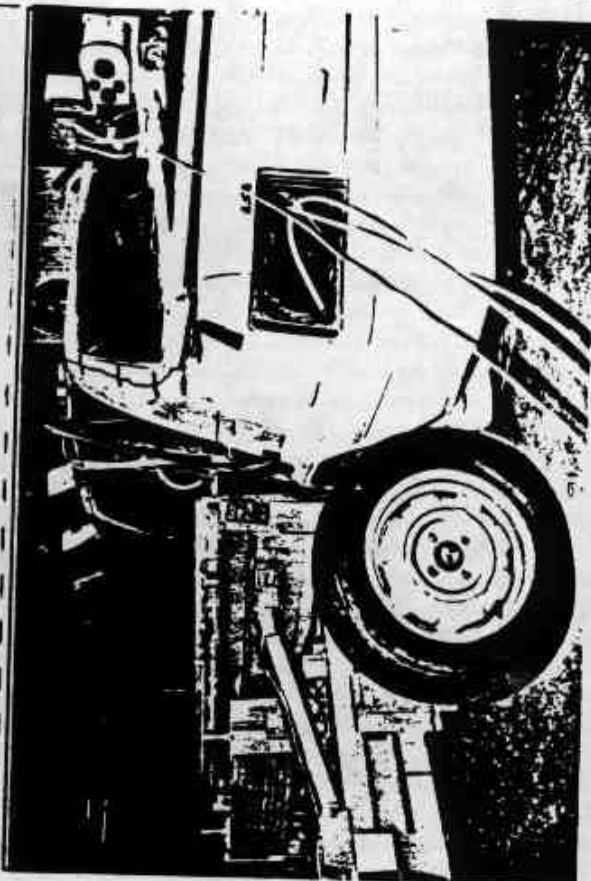
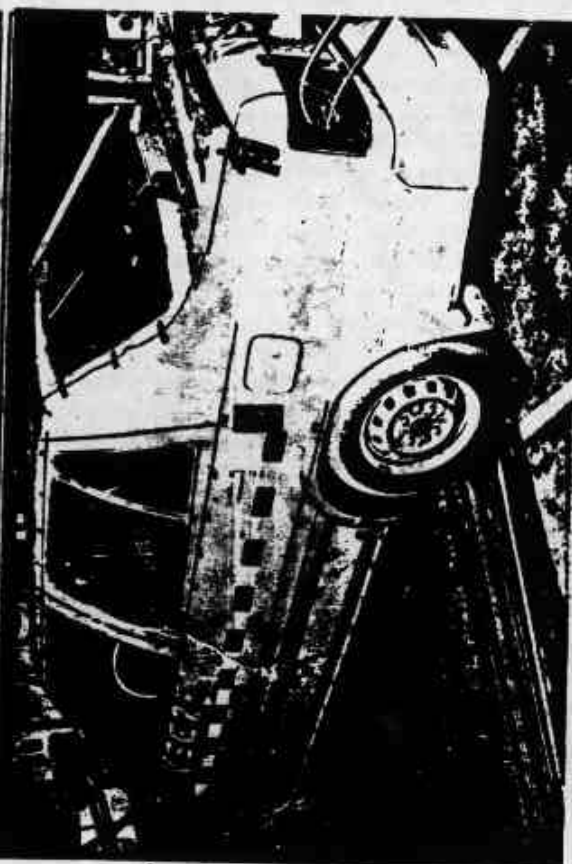


Figure A-9 PRE-TEST LEFT SIDE VIEW





B1/1 POST-TEST REAR THREE-QUARTER VIEW



B1/2 PRE-TEST REAR THREE-QUARTER VIEW

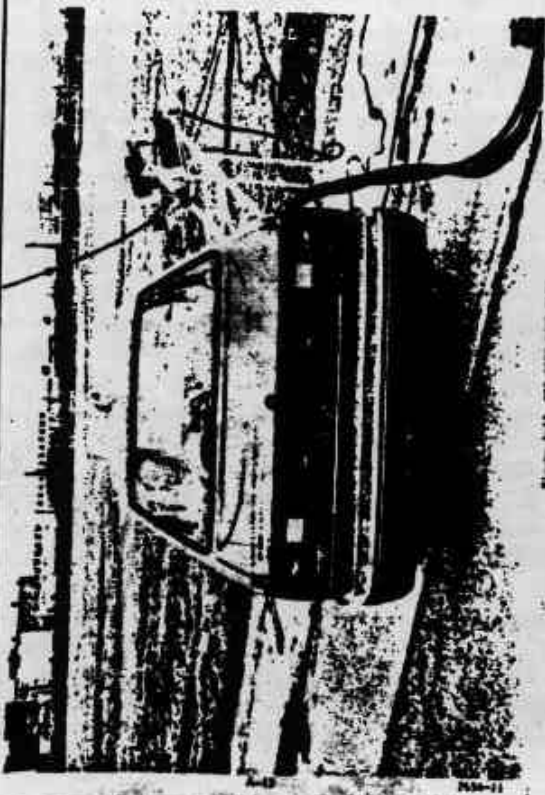
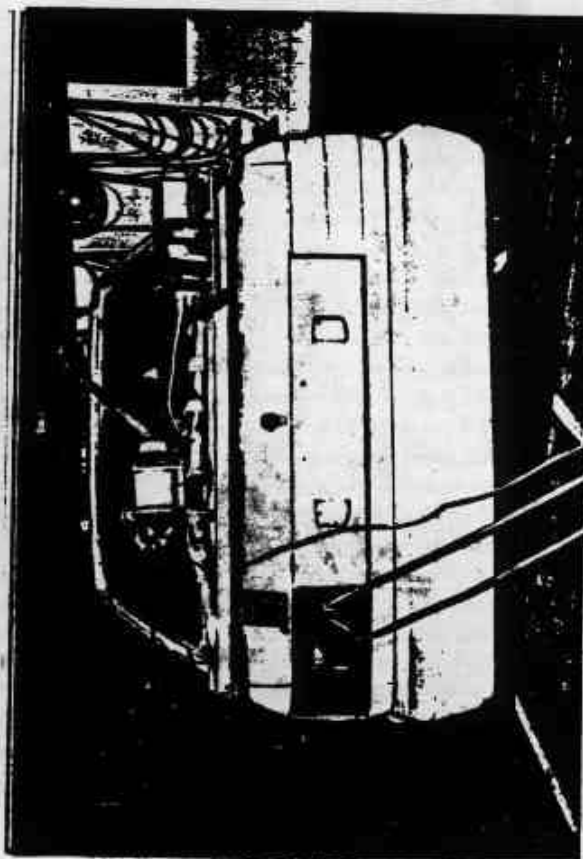
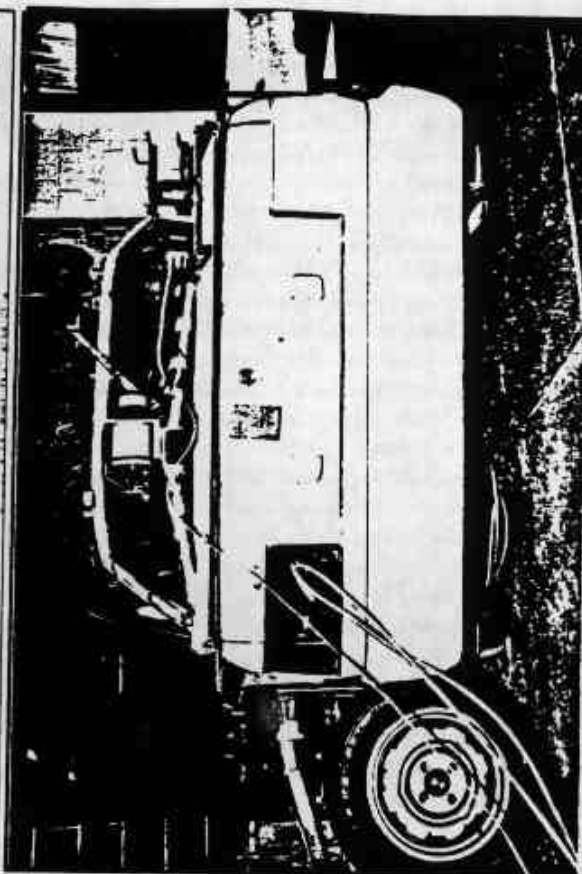
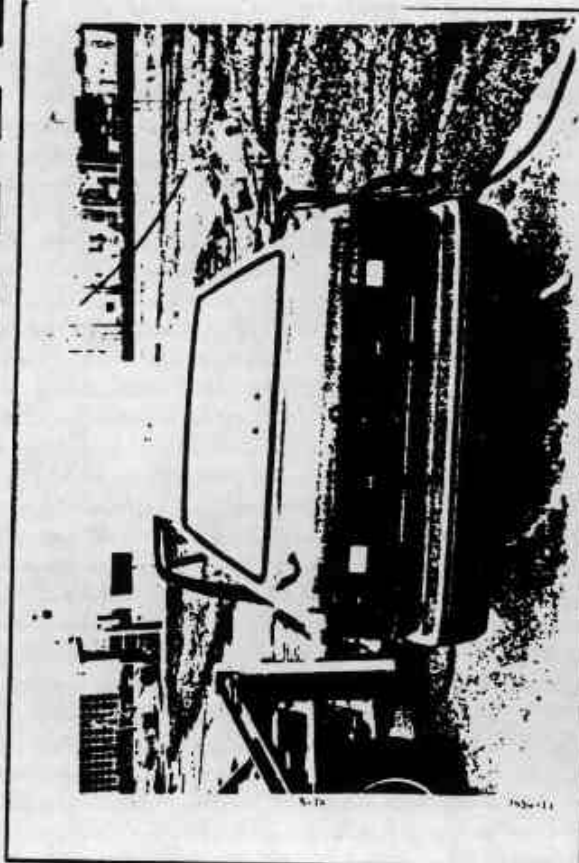


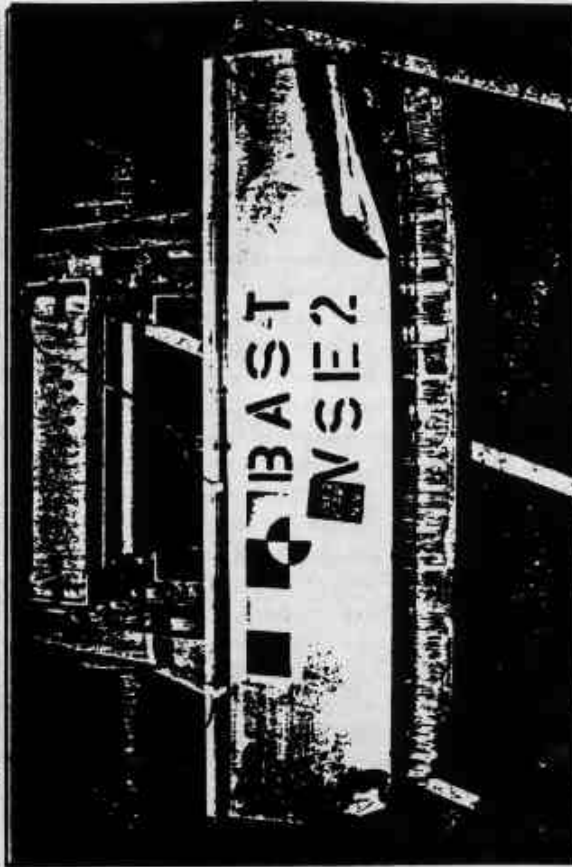
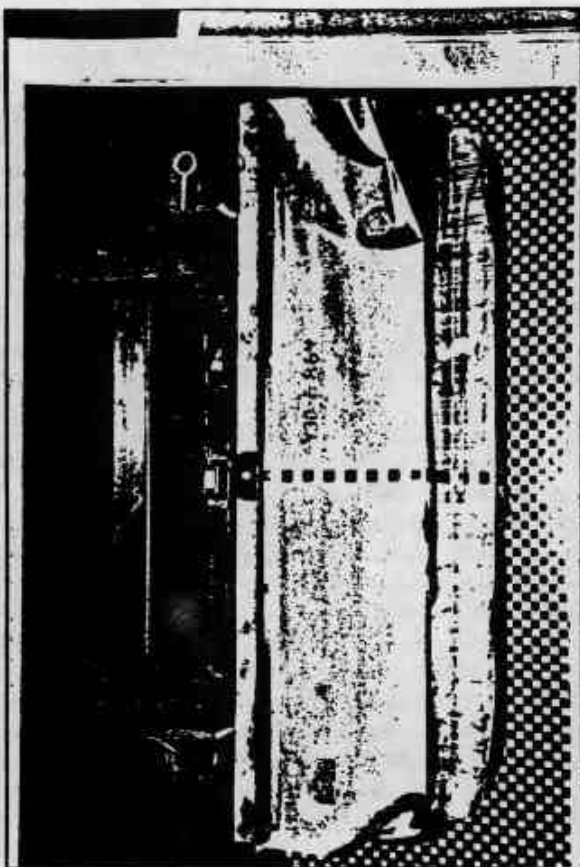
Figure 401 PRE-TEST REAR VIEW



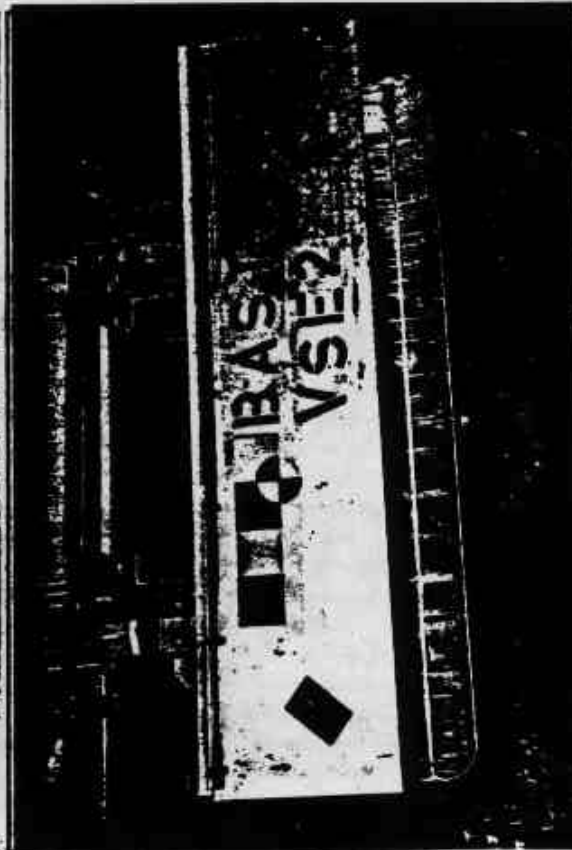
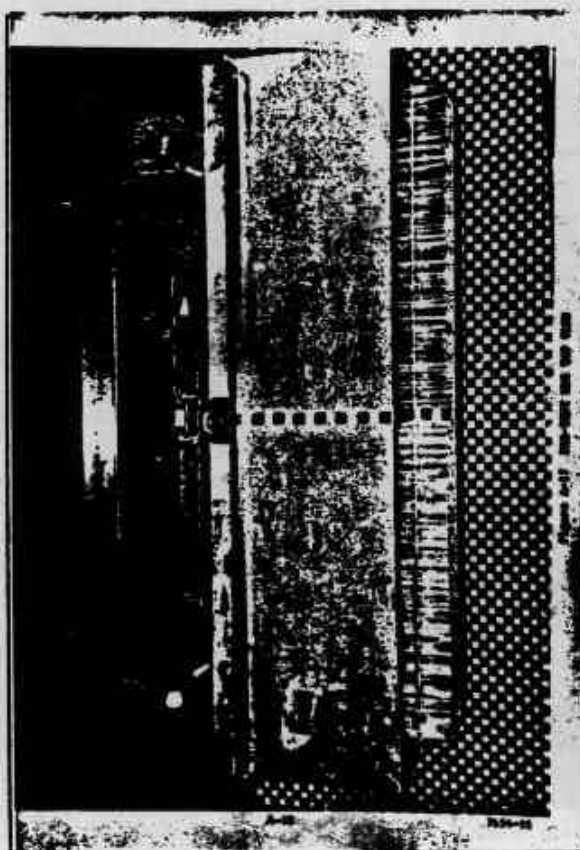
B1/2 PRE-TEST REAR VIEW



B1/3 POST-TEST REAR VIEW



B1/5 POST-TEST MDS TOP VIEW



B1/6 PRE-TEST MDS TOP VIEW

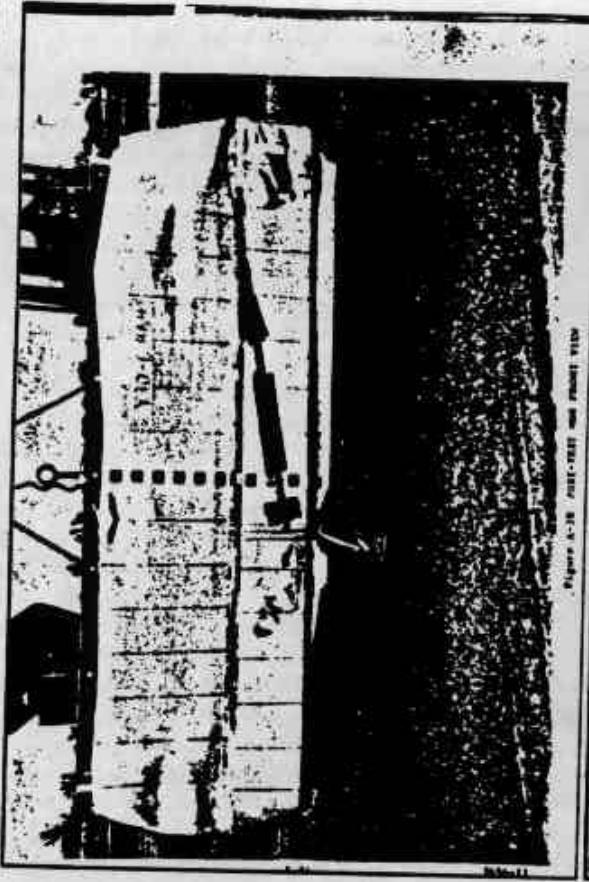


Figure A-18 Port-Test and Front View



Figure A-17 Port-Test and Front View



Figure A-16 Port-Test and Front View



Figure A-15 Port-Test and Front View

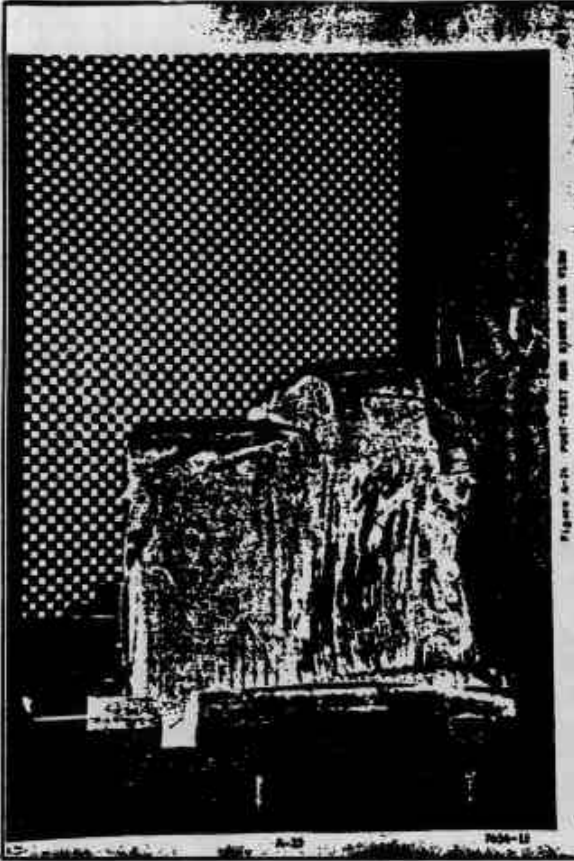


Figure 8-19 Post-test view of the right side of the vehicle

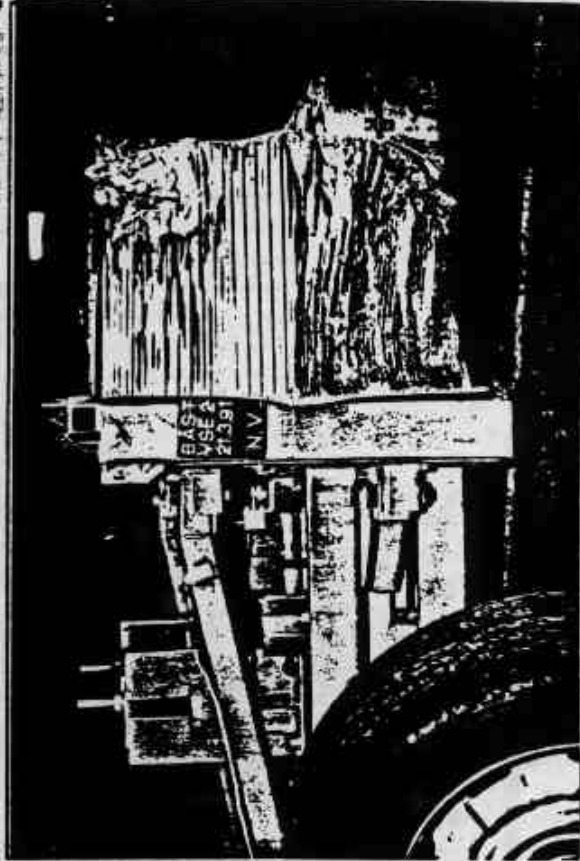


Figure 8-20 Post-test view of the right side of the vehicle

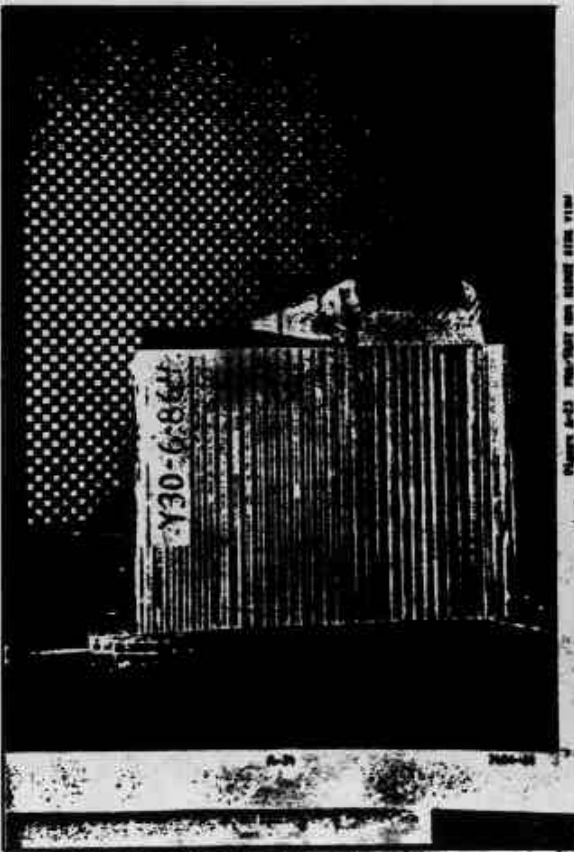


Figure 8-21 Post-test view of the right side of the vehicle

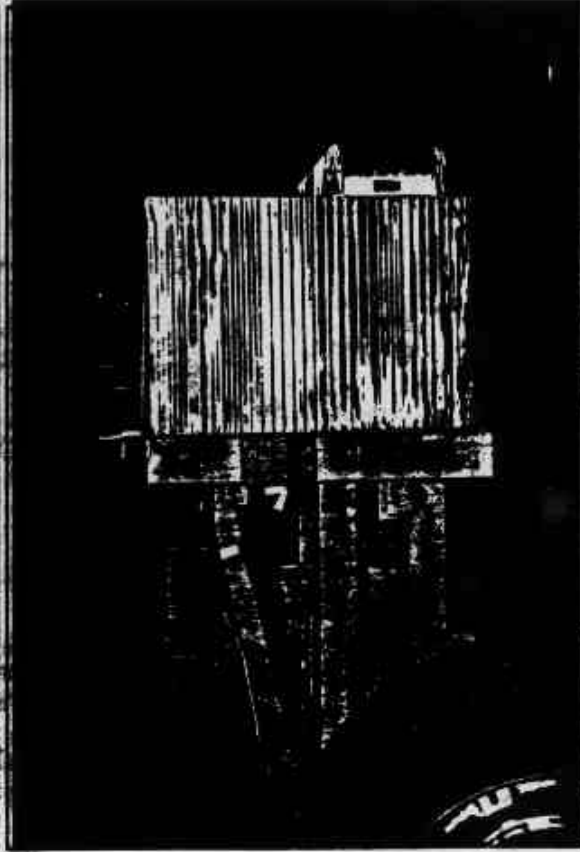


Figure 8-22 Post-test view of the right side of the vehicle

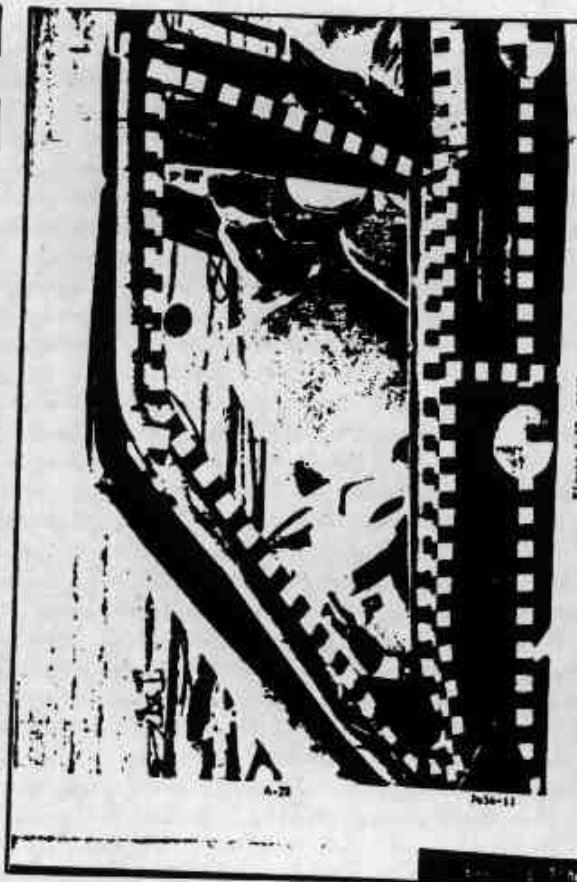


Figure 4-37 Post-test driver position



Figure 4-38 Post-test driver position



Figure 4-39 Post-test driver position



Figure 4-40 Post-test driver position



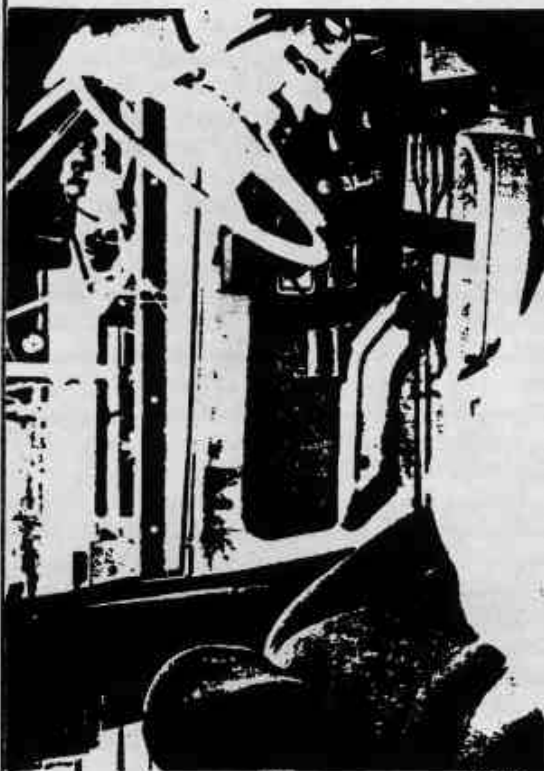
A-19

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Figure A-19 PRE-TEST GEAR POSITIONING AND VEHICLE INTERIOR



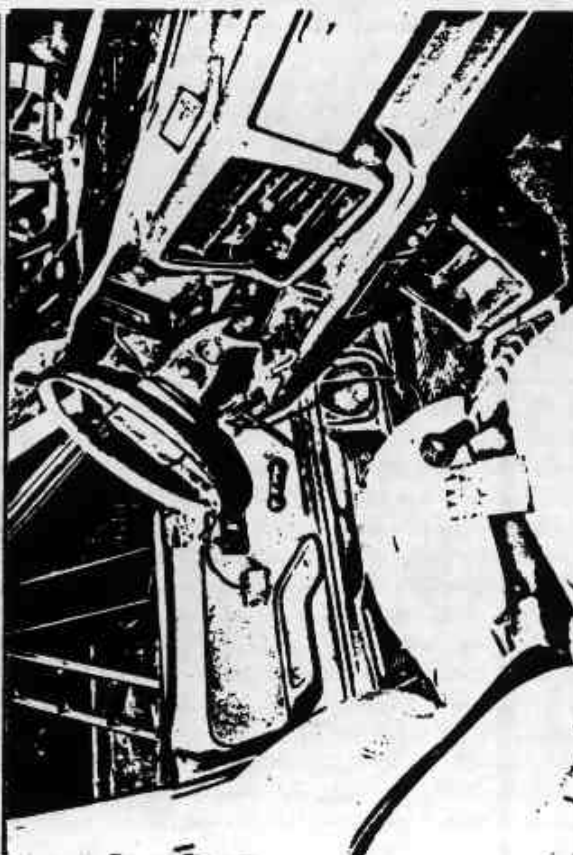
B1/23 PRE-TEST REAR PASSENGER POSITION AND VEHICLE INTERIOR



A-20

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Figure A-20 POST-TEST DRIVER POSITION AND VEHICLE INTERIOR



B1/22 POST-TEST DRIVER CONTACT POINTS WITH LEFT FRONT DOOR

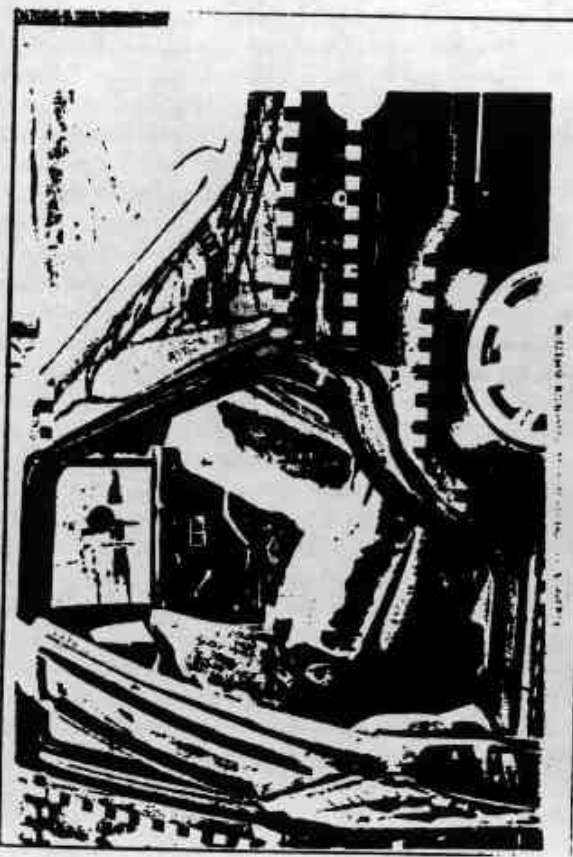


Figure A-32 PRE-TEST REAR PASSENGER POSITION



A-32

CALSPAN
88 HYUNDAI ENT
- MFH - 261

Figure A-33 POST-TEST REAR PASSENGER POSITION



Figure A-34 PRE-TEST REAR PASSENGER POSITION



Figure A-35 POST-TEST REAR PASSENGER POSITION



B1/26 POST-TEST REAR PASSENGER CONTACT POINTS



B1/27 POST-TEST LEFT REAR DOOR AND FLOOR SILL



B1/26 POST-TEST REAR PASSENGER CONTACT POINTS



B1/27 POST-TEST LEFT REAR DOOR AND FLOOR SILL

A 2 SUMMARY OF TESTRESULTS

In the following the Min. and Max.-values (and the time) are summarized for comparison of the testresults. Regrettable these tables are in German, but the computer plots in chapter A 3 can also be used. These plots are also assorted in the way that the upper plot is from the NHTSA test and the lower plot is from the BAST test. The same filter classes are used in both tests. Plots, which are related only to EUROSID-values (abdomin. force FAB (Y,R=result.) (V=front, M=middle, H=rear) or pubis symphysis force FPUY) are plotted in full size. The Dummyposition in the car is driver P1 and rear passenger impacted side P3 (NHTSA) or P4 (BAST).

<u>Beschleunigungs- aufnehmer (P1)</u>	NHTSA		BAST	
	min	max	min	max
Kopf:				
x-Richtung	-32,5 g 46,6 ms	34,7 g 59,8 ms	-16,5 g 55,3 ms	21,7 g 49,1 ms
y-Richtung	-14,6 g 51,5 ms	83,9 g 93,5 ms	-10,2 g 62,7 ms	72,3 g 49,2 ms
z-Richtung	-6,9 g 46,0 ms	45,2 g 69,1 ms	-30,0 g 61,4 ms	12,8 g 35,9 ms
Brust:				
x-Richtung			-2,9 g 213,1 ms	12,8 g 63,5 ms
y-Richtung			-7,8 g 71,7 ms	87,0 g 41,1 ms
z-Richtung			-13,1 g 33,8 ms	5,0 g 76,4 ms
Rippen:				
obere	-13,7 g 75,0 ms	73,8 g 26,9 ms	-14,2 g 52,3 ms	116,5 g 29,8 ms
(redundant)	-16,0 g 160,6 ms	84,8 g 26,9 ms		
mittlere			-42,4 g 33,6 ms	116,5 g 38,0 ms
untere	-14,2 g 61,9 ms	73,2 g 35,0 ms	-27,8 g 33,0 ms	120,3 g 37,9 ms
(redundant)	-13,6 g 161,3 ms	84,8 g 26,9 ms		

Tabelle B2a Gegenüberstellung der Dummy-Maßwerte (P1)

<u>Beschleunigungs- aufnehmer (P1)</u>	NHTSA		BAST	
	min	max	min	max
Wirbelsäule:				
obere				
x-Richtung			-10,2 g	6,8 g
			47,7 ms	35,9 ms
y-Richtung	-43,9 g	77,4 g	-8,4 g	109,0 g
	65,0 ms	36,7 ms	59,2 ms	38,0 ms
z-Richtung			-4,4 g	20,6 g
			76,4 ms	37,3 ms
untere	-26,2 g	103,2 g		
	65,6 ms	34,4 ms		
(redundant)	-24,5 g	101,0 g		
	65,6 ms	33,8 ms		
Becken:				
x-Richtung			-34,6 g	30,4 g
			36,3 ms	45,1 ms
y-Richtung	-10,5 g	105,0 g	-10,6 g	118,1 ms
	42,5 ms	28,1 ms	47,3 ms	34,8 ms
z-Richtung			-3,1 g	23,8 g
			77,8 ms	40,0 ms
<u>Wegaufnehmer</u>				
Brust	-1,8 mm	54,4 mm		
	157,6 ms	97,7 ms		
Rippen:				
obere			-0,1 mm	35,5 mm
			25,1 ms	48,0 ms
mittlere			-0,6 mm	34,1 mm
			71,2 ms	47,5 ms
untere			-0,1 mm	29,6 mm
			226,5 ms	52,6 ms
<u>Kraftaufnehmer</u>				
Bauch:				
vorderer			0 kN	0,3 kN
			73,6 ms	42,4 ms
mittlerer			0 kN	1,6 kN
			77,8 ms	31,8 ms
hinterer			0 kN	2,2 kN
			16,0 ms	38,2 ms
Schambeinfuge			-0,7 kN	5,2 kN
			63,9 ms	37,5 ms

Forts. Tabelle B2a

Gegenüberstellung der Dummy-
Meßwerte (P1)

<u>Beschleunigungs- aufnehmer (P3/P4)</u>	NHTSA		BAST	
	min	max	min	max
Kopf:				
x-Richtung	-17,5 g	10,8 g	-25,6 g	6,1 g
y-Richtung	68,8 ms	237,2 ms	57,3 ms	117,6 ms
z-Richtung	-8,7 g	60,5 g	-4,9 g	46,9 g
	247,9 ms	53,7 ms	94,0 ms	38,8 ms
Brust:	-62,1 g	28,1 g	-26,0 g	24,6 g
	56,5 ms	38,2 ms	38,7 ms	54,9 ms
Rippen:			-5,3 g	60,8 g
obere			74,8 ms	45,4 ms
(redundant)	-14,7 g	79,4 g	-0,3 g	0,1 g
mittlere	62,5 ms	39,4 ms	49,6 ms	94,0 ms
untere	-14,9 g	75,2 g		
(redundant)	81,3 ms	39,4 ms	-3,1 g	90,8 g
Wirbelsäule:			60,4 ms	41,1 ms
obere	-22,3 g	92,8 g	-308,8 g	294,7 g
untere	66,9 ms	35,6 ms	99,4 ms	39,1 ms
(redundant)	-26,0 g	88,6 g		
	66,9 ms	35,6 ms		
			ausgefallen	
obere	-17,0 g	71,0 g		
untere	63,1 ms	42,5 ms		
(redundant)	-38,4 g	88,2 g		
	61,9 ms	35,6 ms		
	-36,8 g	86,4 g		
	61,3 ms	38,8 ms		
Becken:	-26,4 g	145,2 g	-19,6 g	130,1 g
	42,5 ms	31,3 ms	41,7 ms	34,8 ms
<u>Wegaufnehmer</u>				
Brust	0 mm	96,0 mm		
	-0,7 ms	57,5 ms		
Rippen:			-0,6 mm	9,0 mm
obere			99,6 ms	61,9 ms
mittlere			-0,3 mm	35,1 mm
untere			95,1 ms	62,8 ms
			-0,3 mm	41,3 mm
			93,7 ms	54,8 ms

Tabelle B2b

Gegenüberstellung der Dummy-
Meßwerte (P3/P4))

<u>Kraftaufnehmer</u> (P4)	NHTSA		BAST	
	min	max	min	max
Bauch:				
vorderer			0 kN	2,1 kN
			195,4 ms	39,6 ms
mittlerer			0 kN	2,2 kN
			76,3 ms	39,2 ms
hinterer			0 kN	0,8 kN
			179,5 ms	37,8 ms
Schambeinfuge			-0,4 kN	5,0 kN
			59,0 ms	39,2 ms

Forts. Tabelle B2b

Gegenüberstellung der Dummy-Meßwerte (P3/P4)

<u>Beschleunigungs-</u> <u>aufnehmer</u> (Fahrzeug)	NHTSA		BAST	
	min	max	min	max
Schweller (vorne rechts)				
x-Richtung	-6,9 g	1,3 g	-7,1 g	2,5 g
	14,9 ms	99,6 ms	14,4 ms	98,0 ms
y-Richtung	-3,0 g	25,1 g	-3,3 g	19,6 g
	98,9 ms	12,9 ms	162,4 ms	17,5 ms
z-Richtung	-7,5 g	3,9 g	-5,1 g	3,9 g
	10,7 ms	79,9 ms	55,8 ms	13,5 ms
Schweller (hinten rechts)				
x-Richtung	-7,1 g	1,8 g	-2,7 g	7,1 g
	14,1 ms	52,7 ms	60,1 ms	14,7 ms
y-Richtung	-2,3 g	19,0 g	-2,4 g	26,2 g
	259,5 ms	17,6 ms	163,0 ms	26,7 ms
z-Richtung	-5,9 g	7,5 g	-5,2 g	4,2 g
	44,3 ms	20,6 ms	53,0 ms	21,1 ms

Tabelle B2c

Gegenüberstellung der Fahrzeugmeßwerte

<u>Beschleunigungs- aufnehmer</u>	NHTSA		BAST	
	min	max	min	max
Schweller (vorne links)	-88,4 g 10,0 ms	131,5 g 2,9 ms	-51,0 g 33,5 ms	64,7 g 12,2 ms
Schweller (hinten links)	-31,6 g 26,0 ms	126,7 g 9,7 ms	-9,4 g 37,9 ms	31,5 g 18,4 ms
Fronttüre (links, Mitte)	-99,5 g 26,0 ms	126,7 g 9,7 ms	-155,2 g 31,8 ms	132,7 g 39,3 ms
Fronttüre (links, Oben)	-148,3 g 28,1 ms	169,4 g 17,3 ms	-111,6 g 30,4 ms	168,6 g 23,1 ms
Fondtüre (links, Mitte)	-70,7 g 27,6 ms	84,6 g 19,7 ms	-84,4 g 31,9 ms	141,6 g 26,1 ms
Fondtüre (links, Oben)	-90,0 g 30,9 ms	168,0 g 20,9 ms	-103,7 g 34,0 ms	170,2 g 27,1 ms
Bodengruppe (hinten, Mitte)				
x-Richtung	-7,4 g 11,7 ms	3,1 g 27,2 ms		
y-Richtung	-2,9 g 209,0 ms	17,2 g 10,2 ms		
z-Richtung	-9,1 g 28,4 ms	9,6 g 12,8 ms		
Bodengruppe (Mitte)	-101,7 g 25,7 ms	149,4 g 8,4 ms		
Fahrgastraum (hinten, rechts)	-24,2 g 16,4 ms	1,6 g 170,4 ms		

Forts. Tabelle B2c

Gegenüberstellung der Fahrzeug-
Meßwerte

<u>Beschleunigungs- aufnehmer</u> (Barrieren)	NHTSA		BAST	
	min	max	min	max
Schwerpunkt				
x-Richtung	-14,4 g 33,6 ms	-0,2 g -6,6 ms	-15,0 g 35,0 ms	1,1 g 166,6 ms
y-Richtung	-6,2 g 25,6 ms	1,3 g 50,4 ms	-8,4 g 25,1 ms	1,8 g 52,5 ms
z-Richtung	-16,1 g 28,1 ms	12,9 g 41,2 ms	-4,4 g 13,3 ms	6,8 g 22,4 ms
Rahmen (vorne, Mitte)	-15,4 g 32,3 ms	0,3 g -20,5 ms	-14,1 g 33,4 ms	1,1 g 169,7 ms
Rahmen (hinten, Mitte)	-16,5 g 35,0 ms	2,0 g 214,1 ms	-16,1 g 34,0 ms	1,7 g 164,3 ms

Tabelle B2d Gegenüberstellung der Barrieren-Meßwerte

Anhang B3 (Hyundai Excel)

Graphische Auswertung der Ergebnisse

Acceleration [g]

B3-1

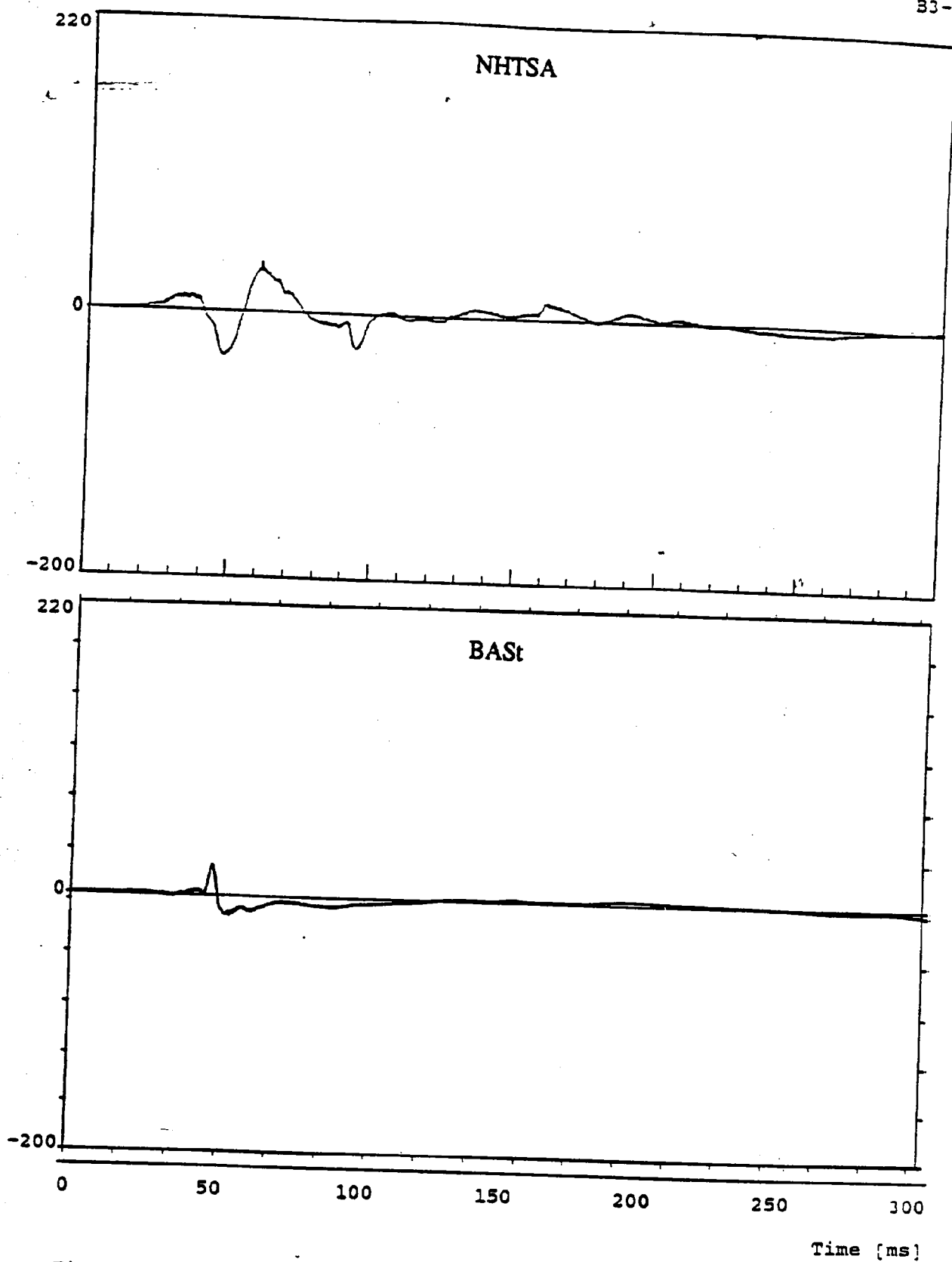


Figure B3/1

ACCELERATION HEAD X AXIS (P1)

Acceleration [g]

B3-2

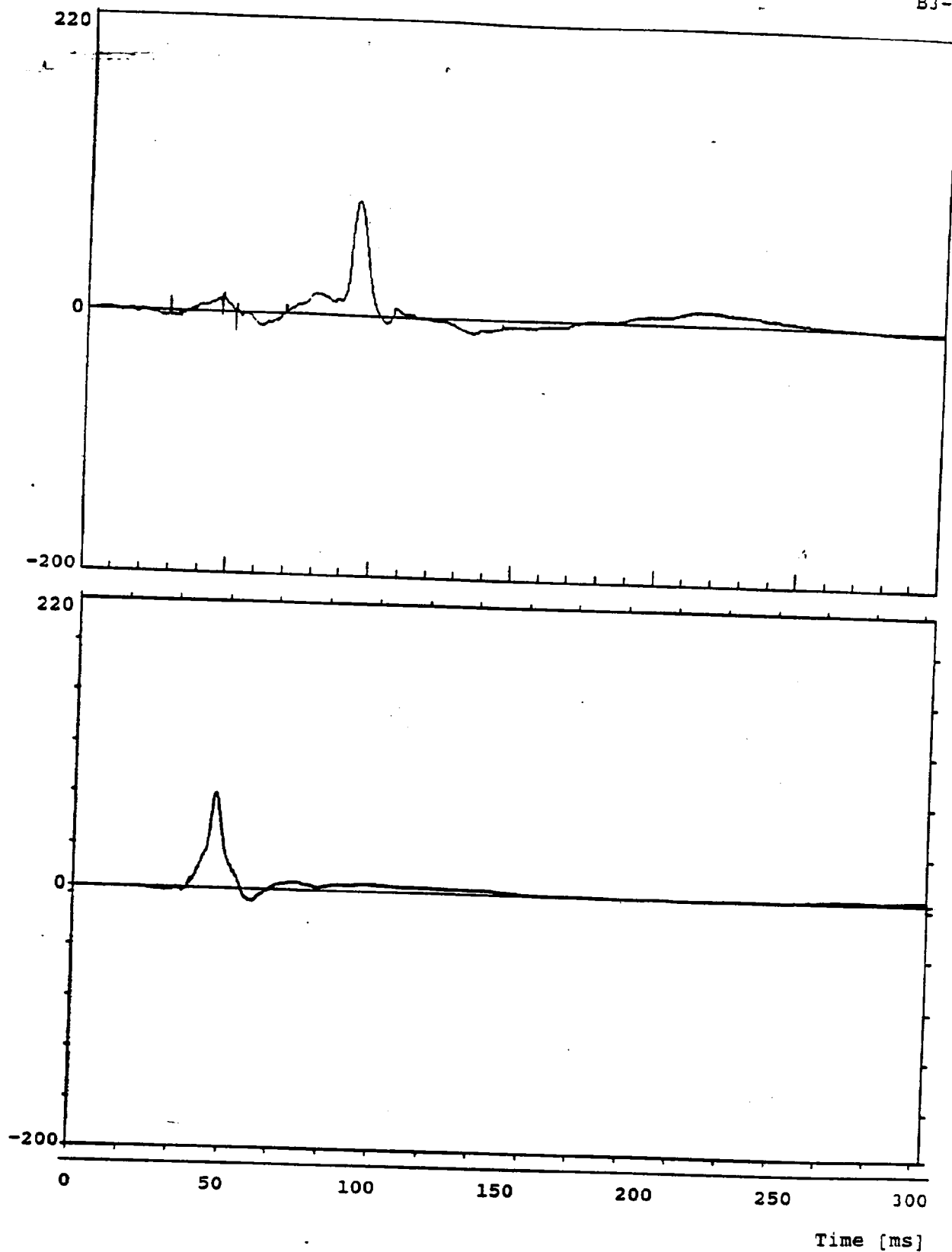


Figure B3/2

ACCELERATION HEAD Y AXIS (P1)

Acceleration [g]

B3-3

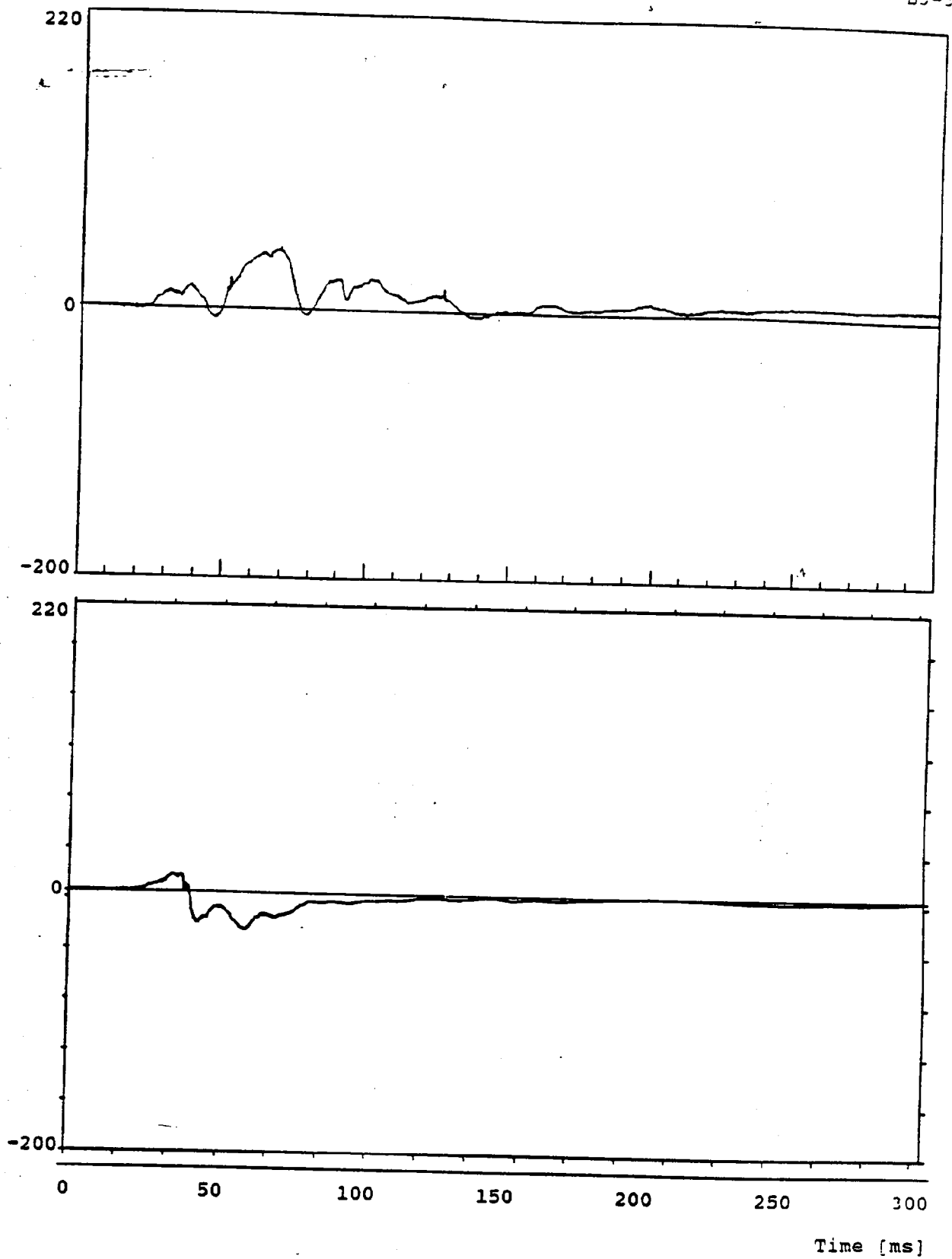


Figure B3/3 ACCELERATION HEAD Z AXIS (P1)

Acceleration [g] (computed)

B3-4

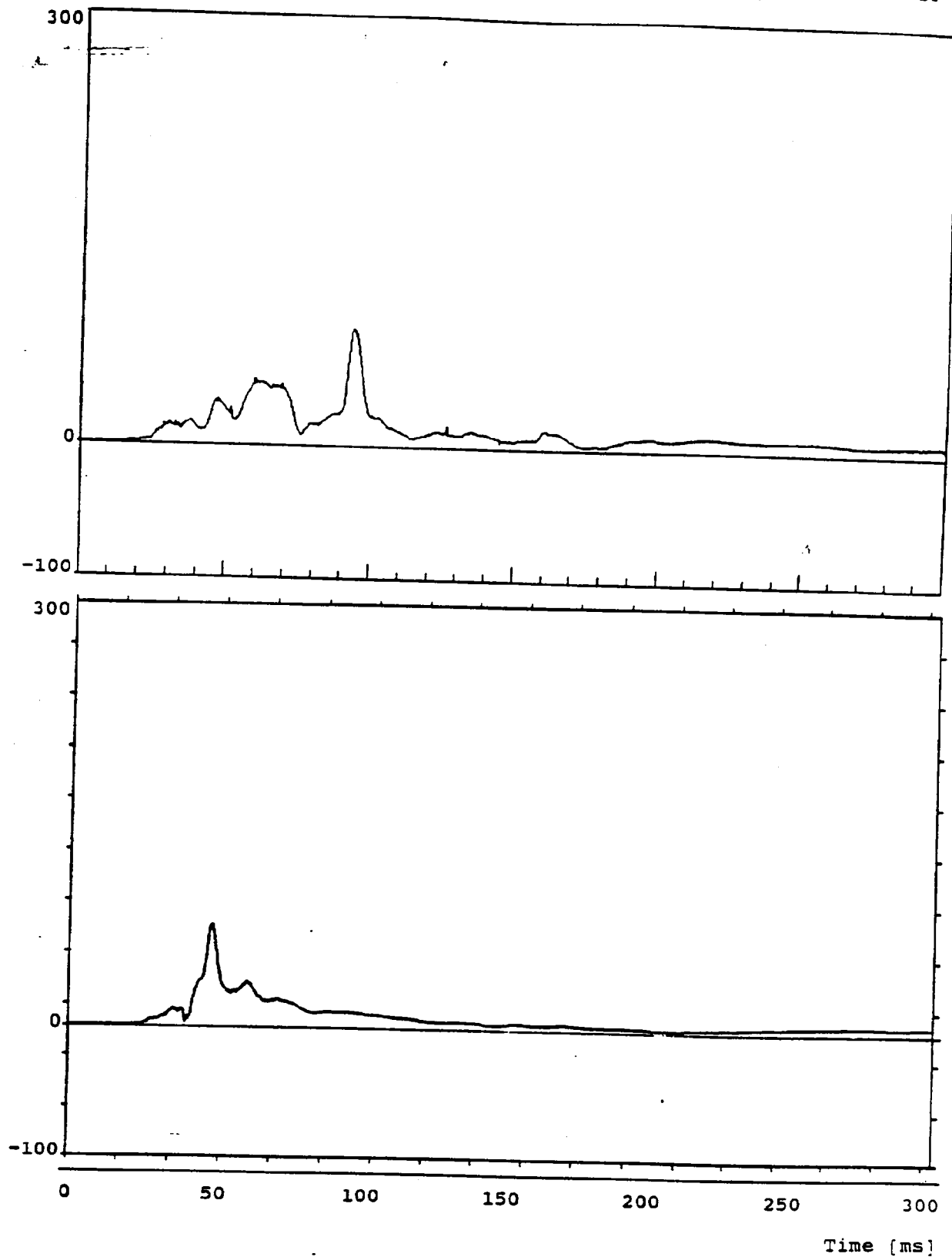


Figure B3/4 ACCELERATION HEAD RS AXIS (P1)

Acceleration [g]

B3-5

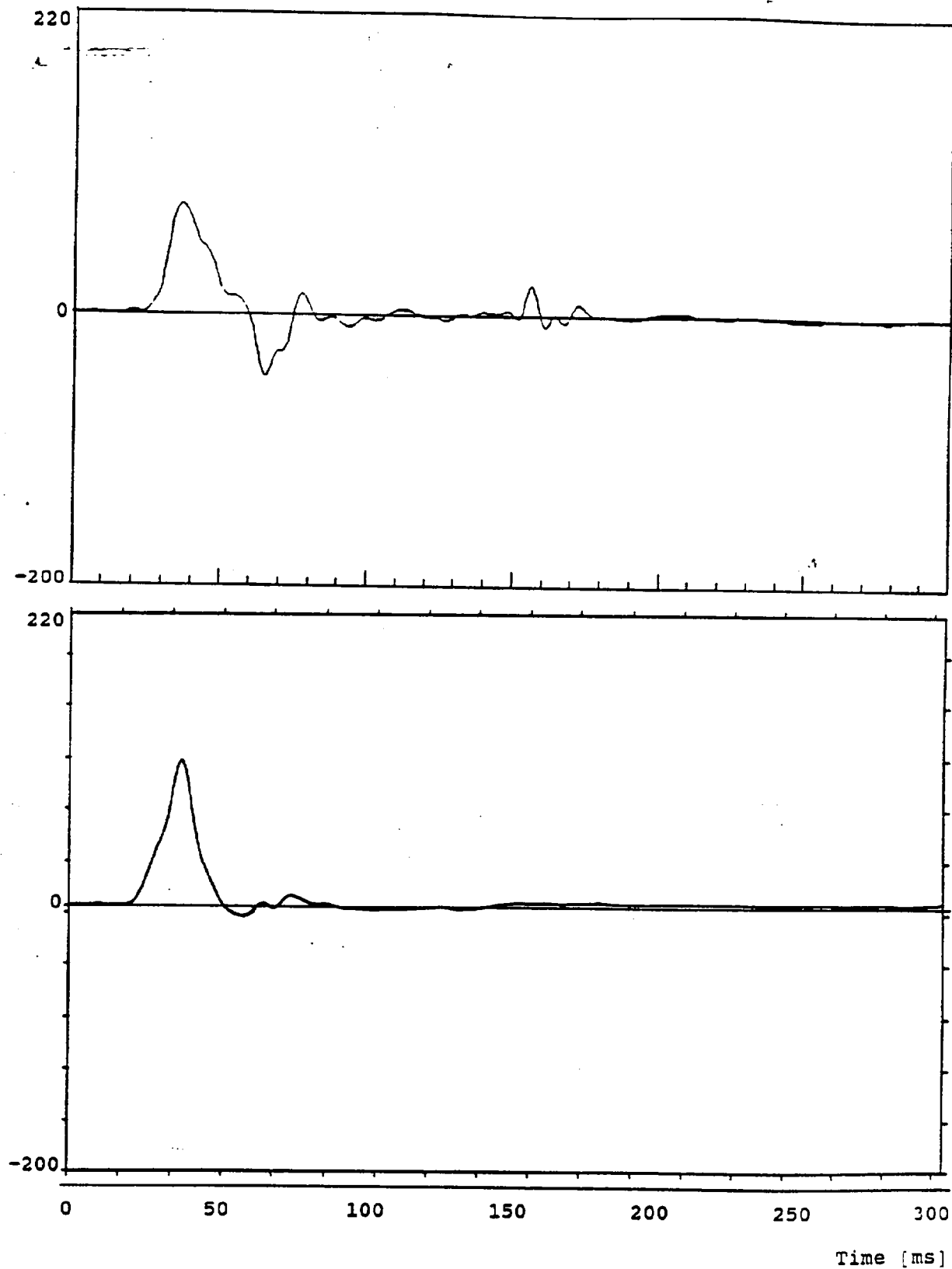


Figure B3/5

ACCELERATION SPINE Y AXIS (P1)

Acceleration [g]

B3-6

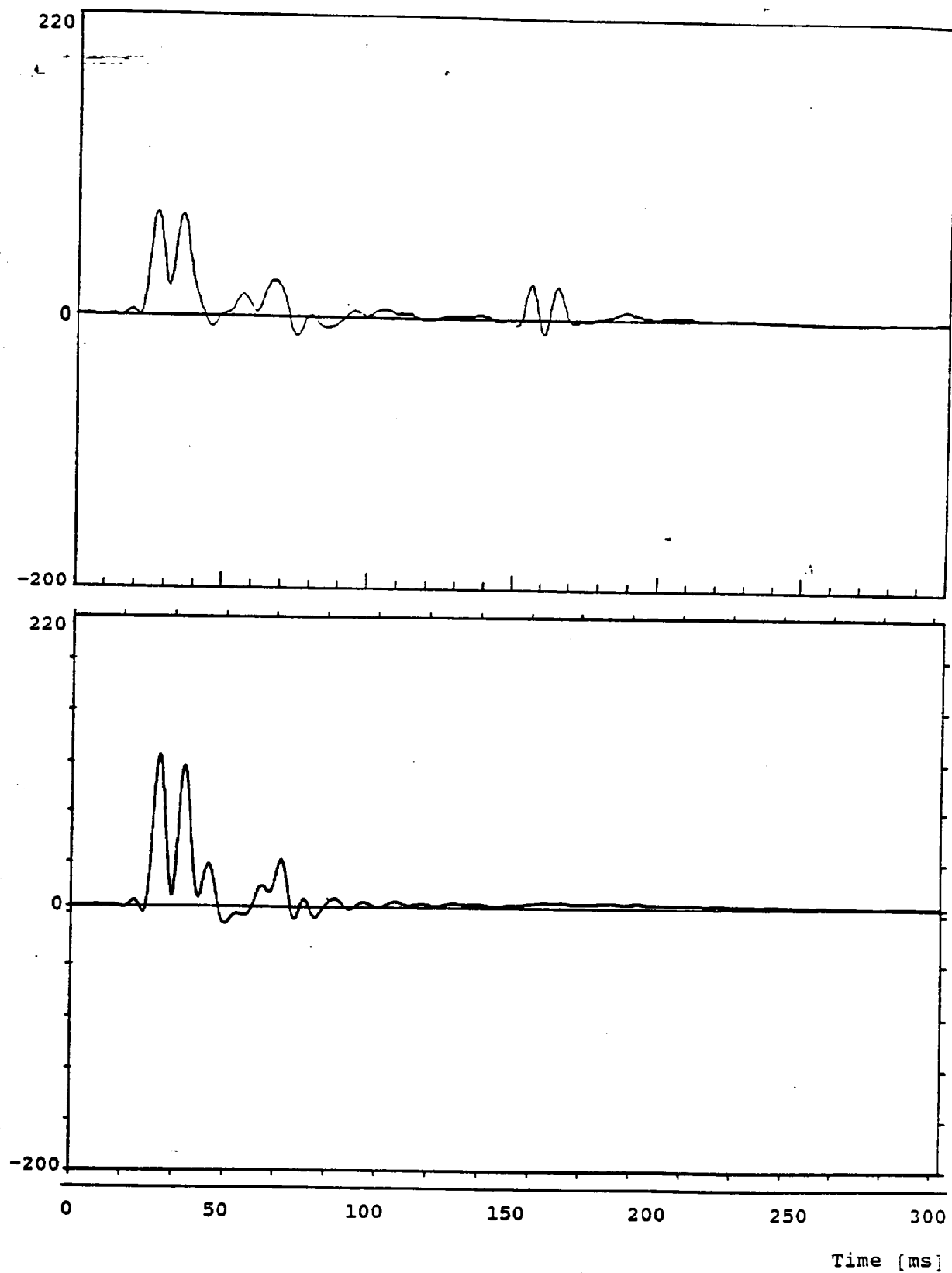


Figure B3/6 ACCELERATION UPPER RIB Y AXIS (P1)

Acceleration [g]

B3-7

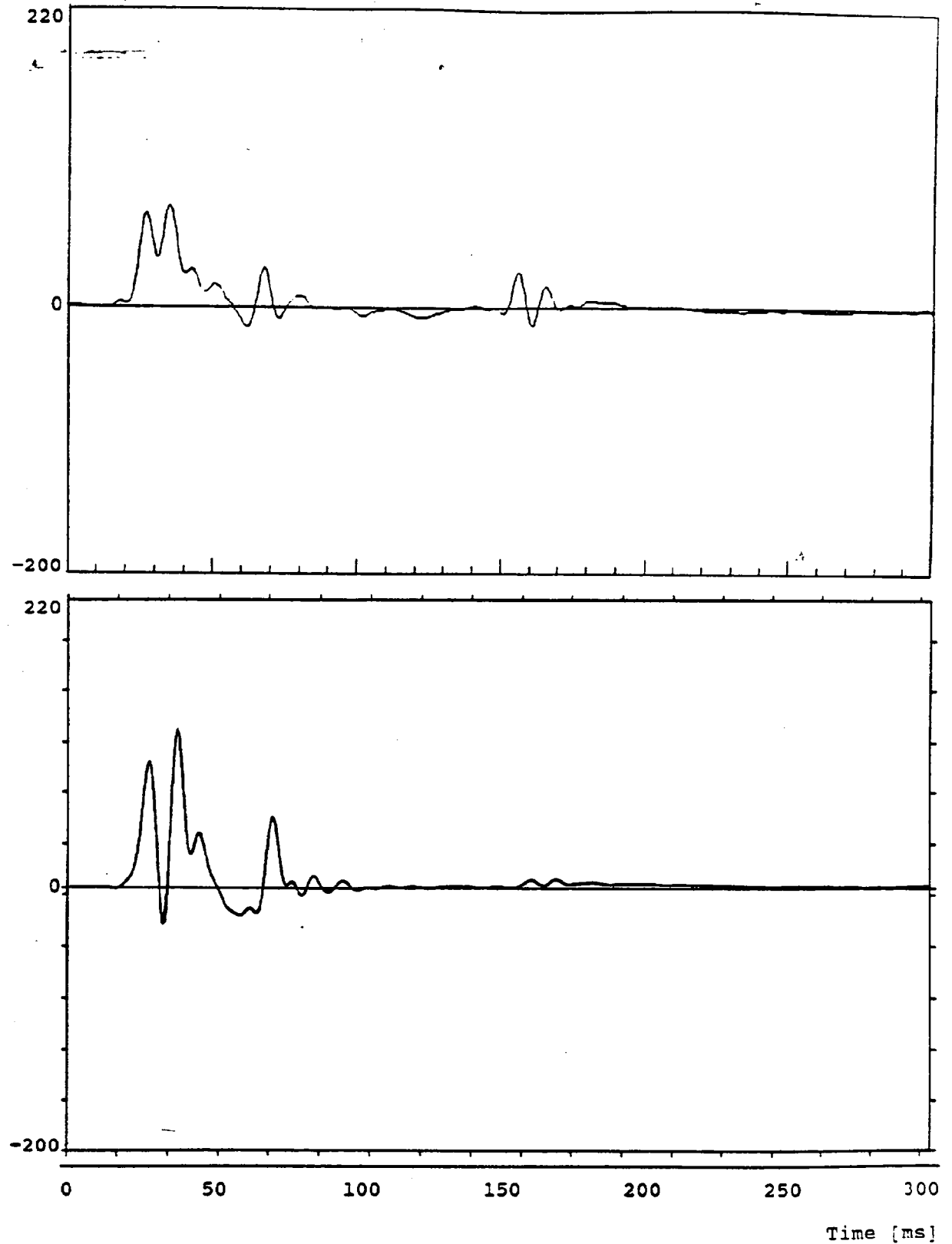


Figure B3/7

ACCELERATION LOWER RIB Y AXIS (P1)

Acceleration [g]

B3-2

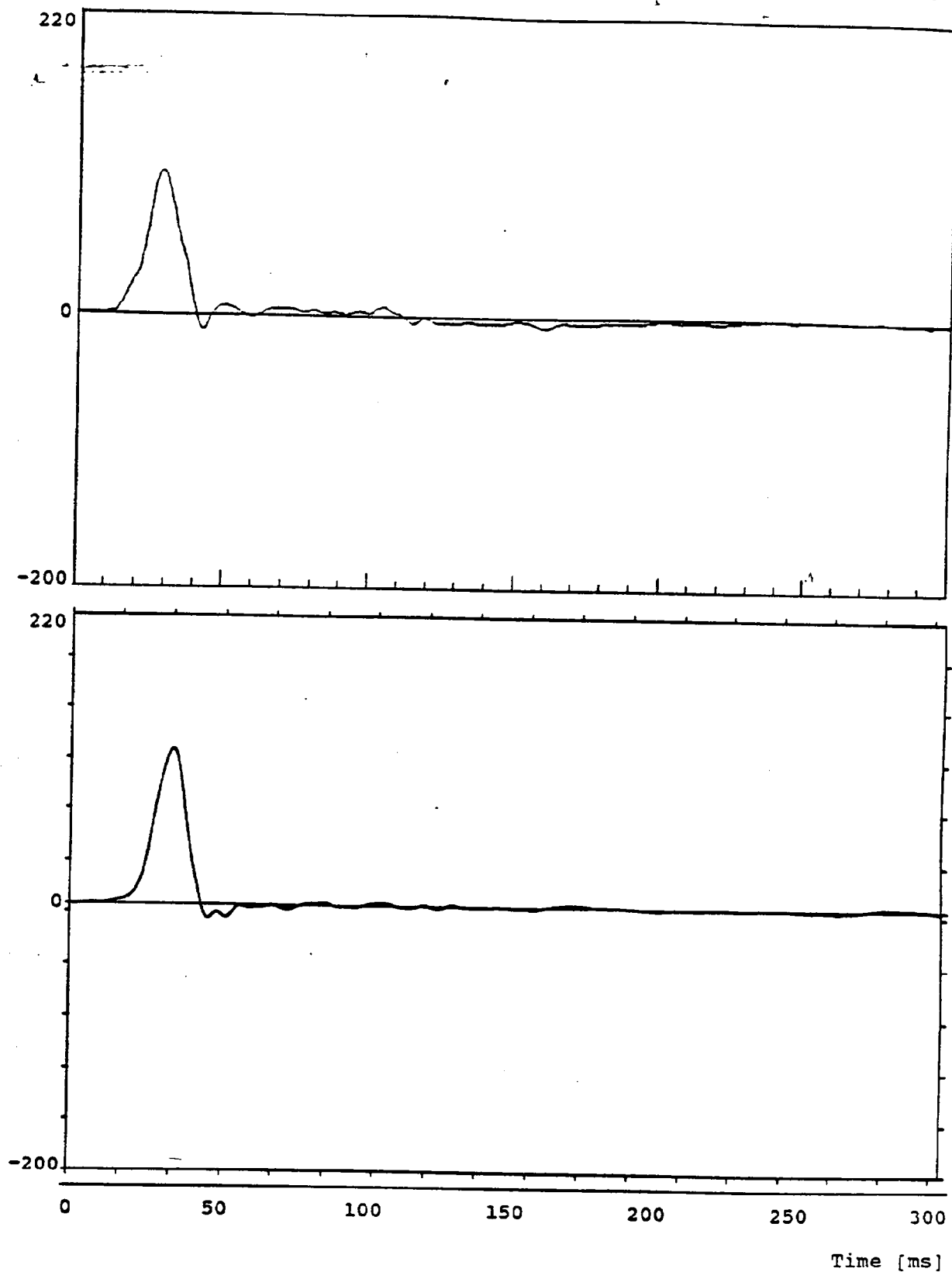


Figure B3/8 ACCELERATION PELVIC Y AXIS (P1)

Displacement [mm]

B3-9

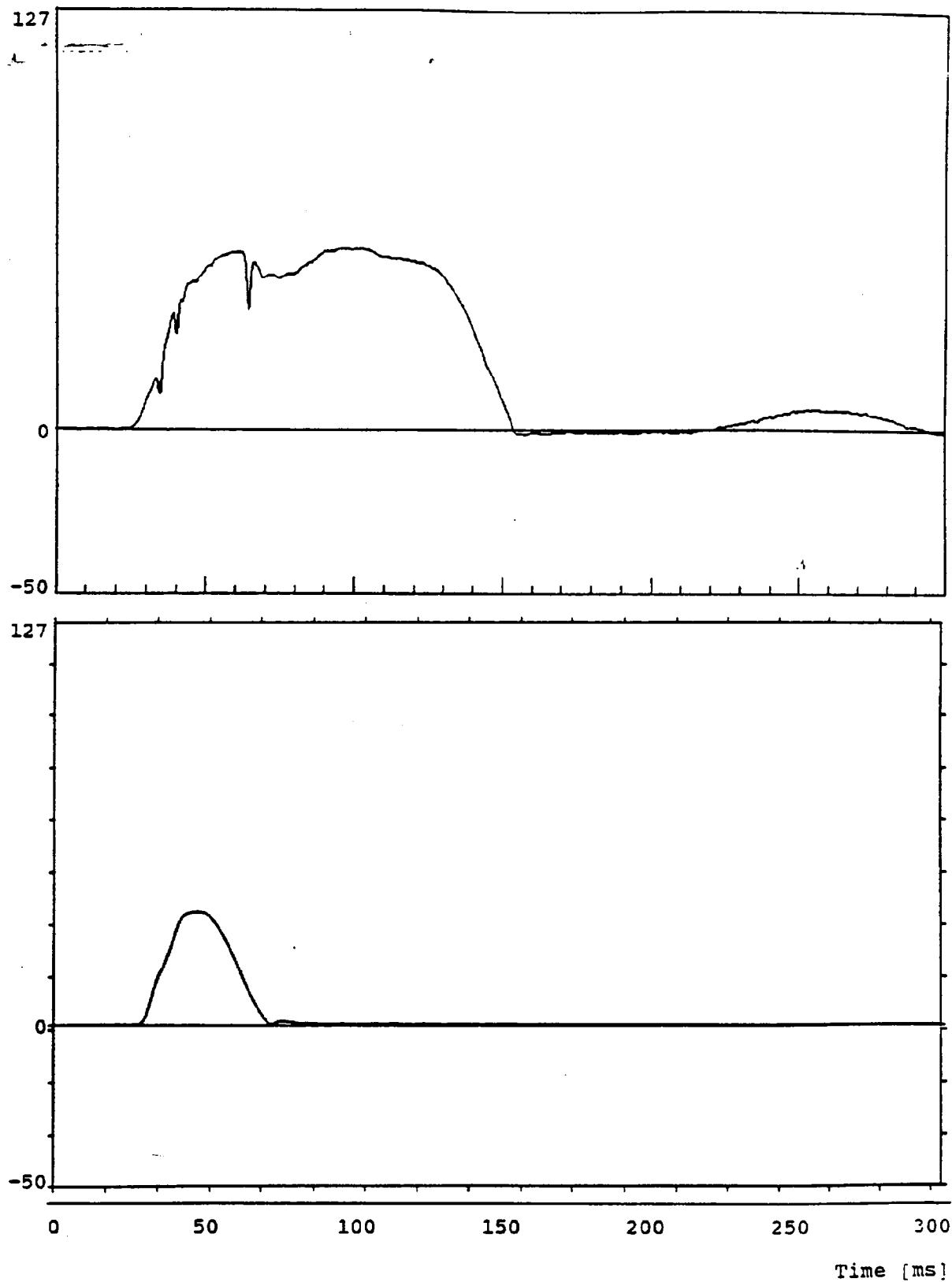


Figure B3/9 DISPLACEMENT CHEST/UPPER RIB (P1)

Displacement [mm]

B3-10

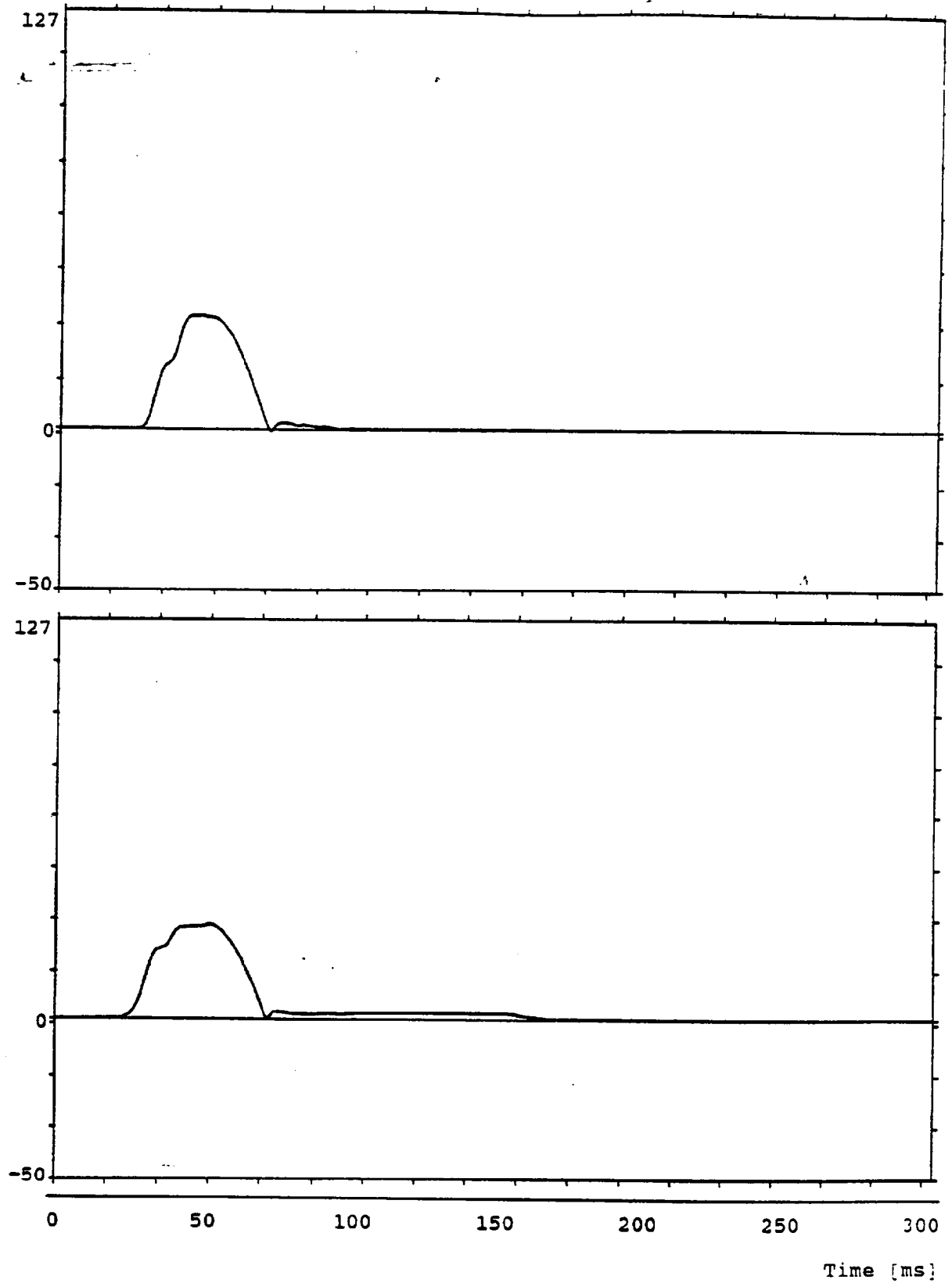


Figure B3/10

DISPLACEMENT MIDDLE RIB/LOWER RIB (P1) BAST

Acceleration [g]

B3-11

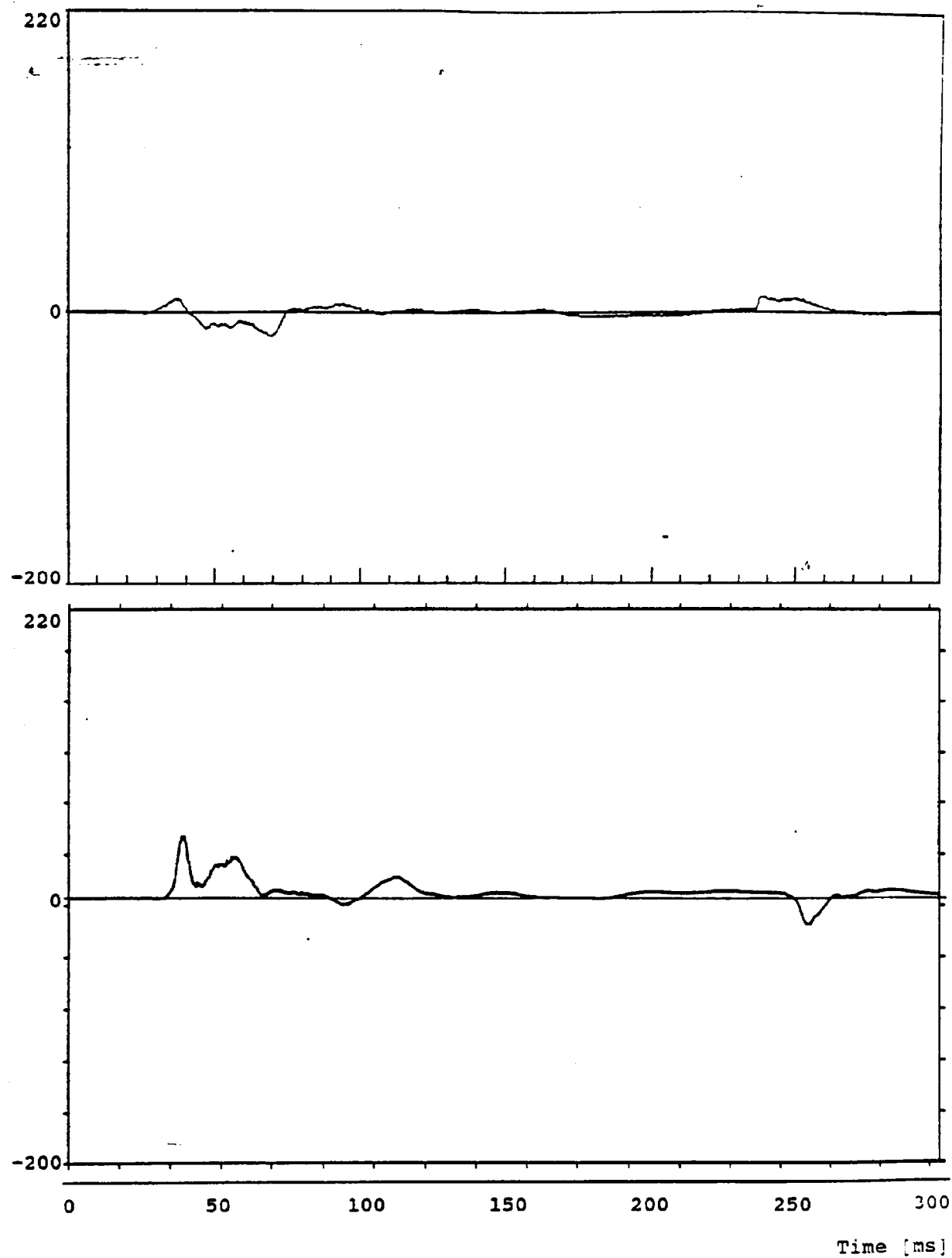


Figure B3/11

ACCELERATION HEAD X AXIS (P3/4)

Acceleration [g]

B3-12

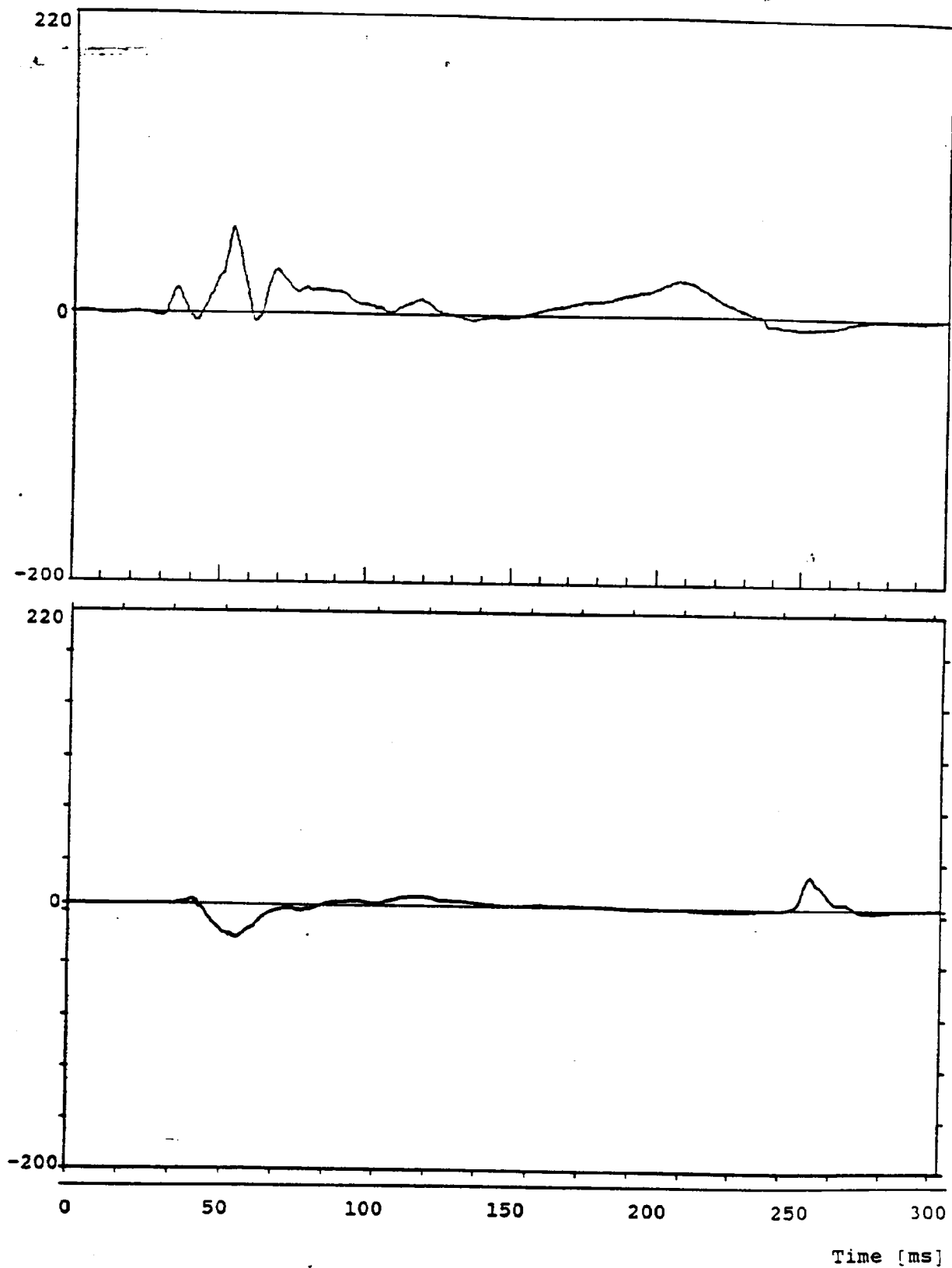


Figure B3/12

ACCELERATION HEAD Y AXIS (P3/4)

Acceleration [g]

B3-12

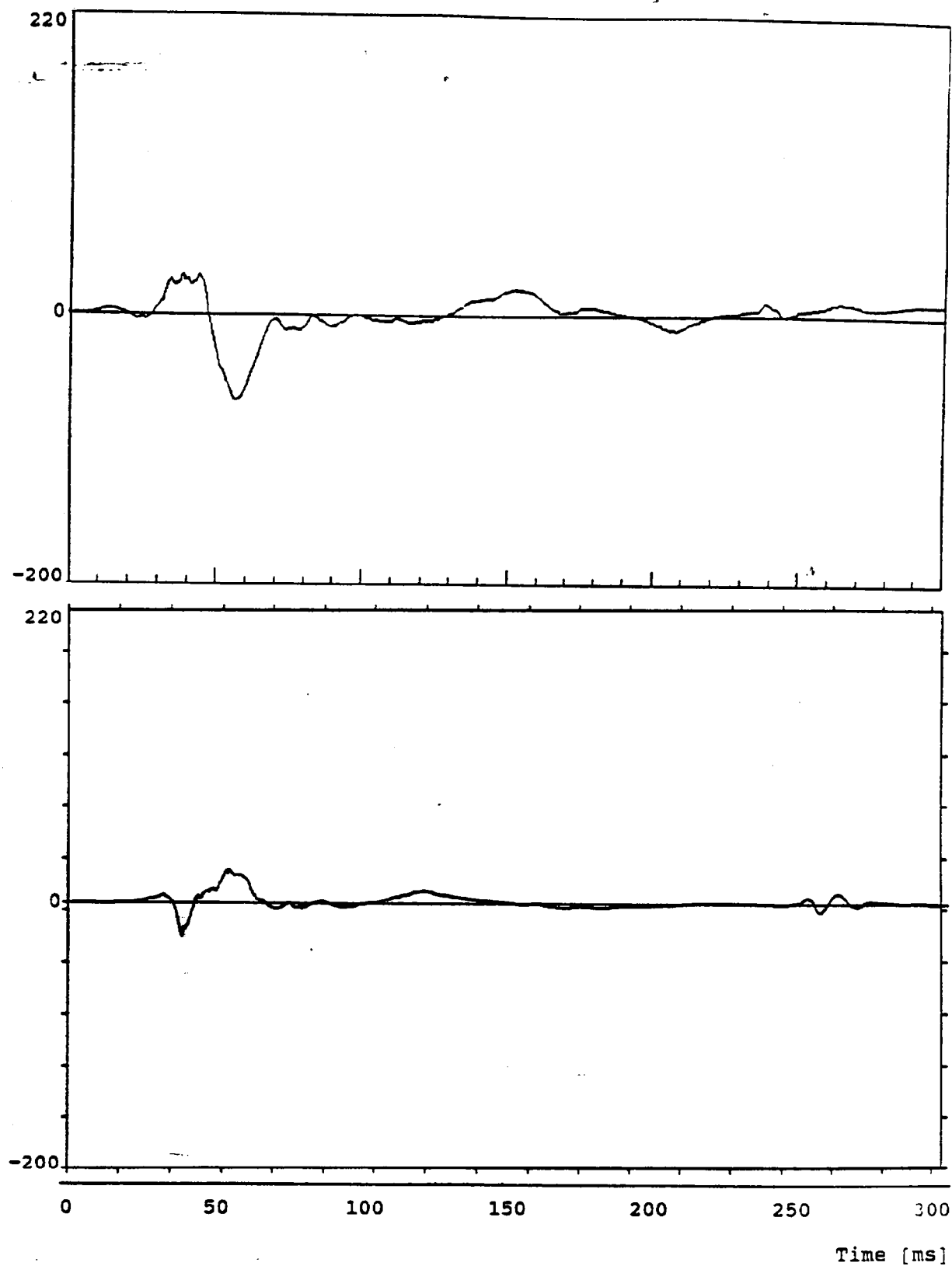


Figure B3/13

ACCELERATION HEAD Z AXIS (P3/4)

Acceleration [g] (computed)

B3-14

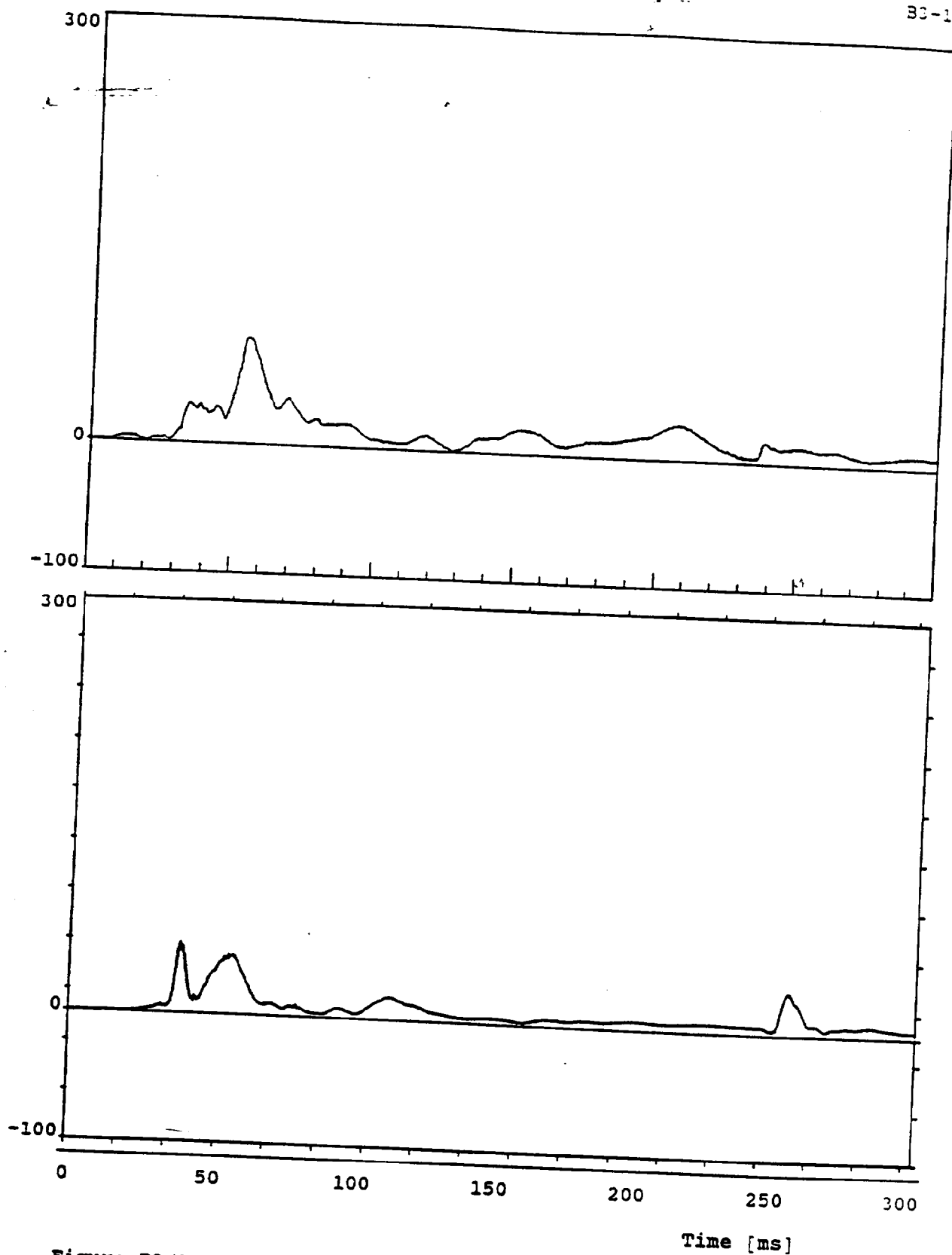


Figure B3/14

ACCELERATION HEAD RS AXIS (P3/4)

Acceleration [g]

B3-15

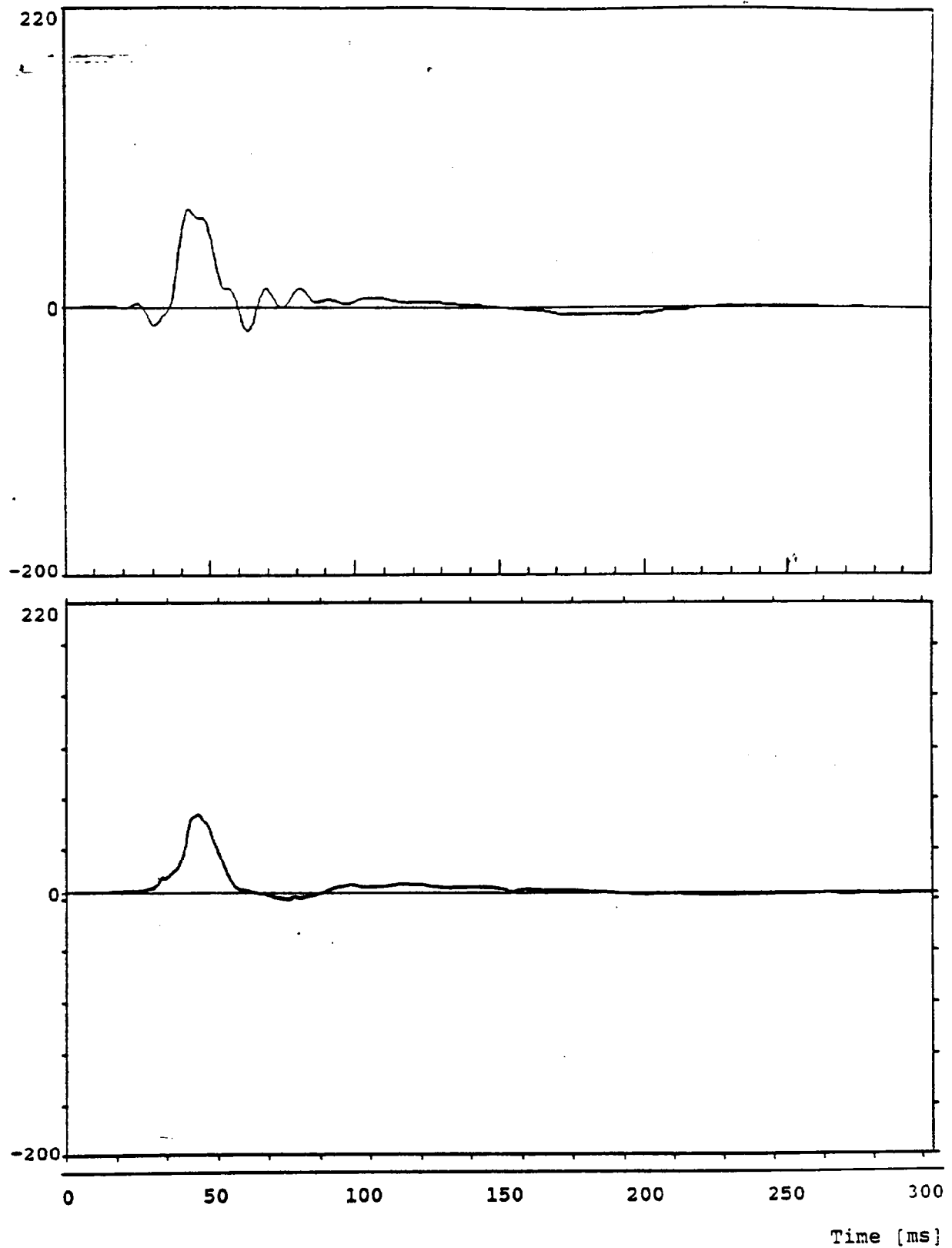


Figure B3/15

ACCELERATION SPINE Y AXIS (P3/4)

Acceleration [g]

B3-16

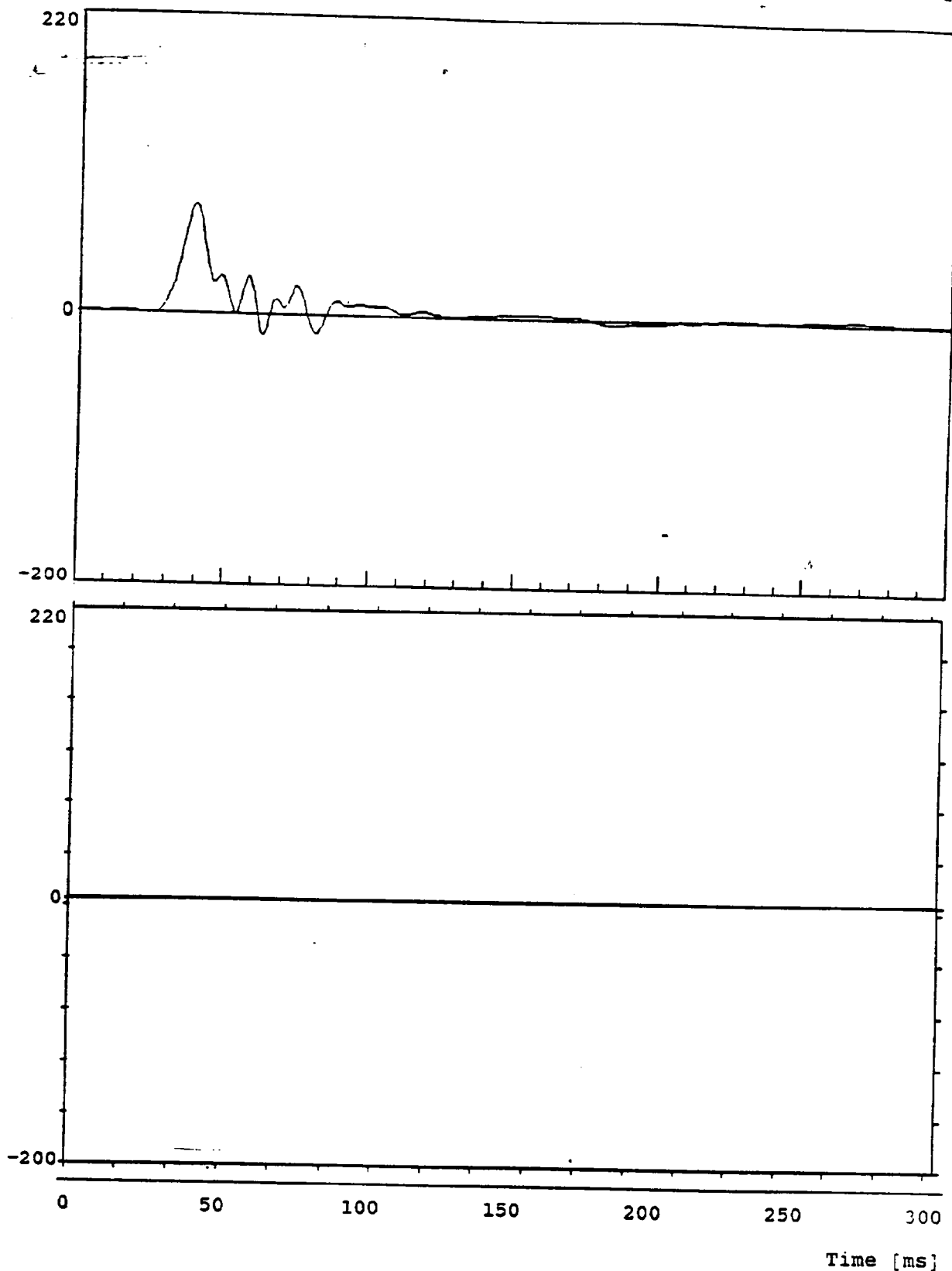


Figure B3/16

ACCELERATION UPPER RIB Y AXIS (P3/4)

Acceleration [g]

B3-17

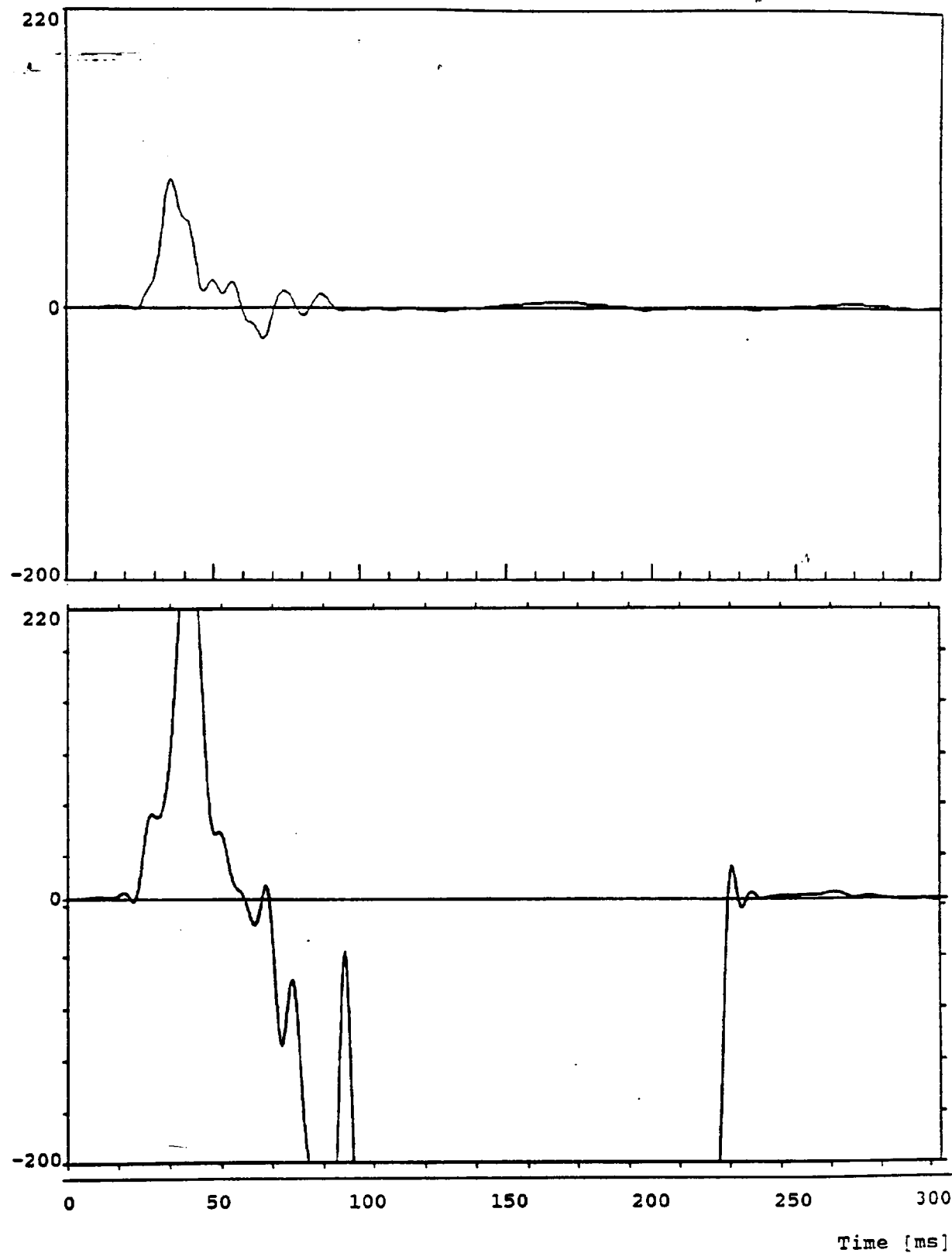


Figure B3/17

ACCELERATION LOWER RIB Y AXIS (P3/4)

Acceleration [g]

B3-18

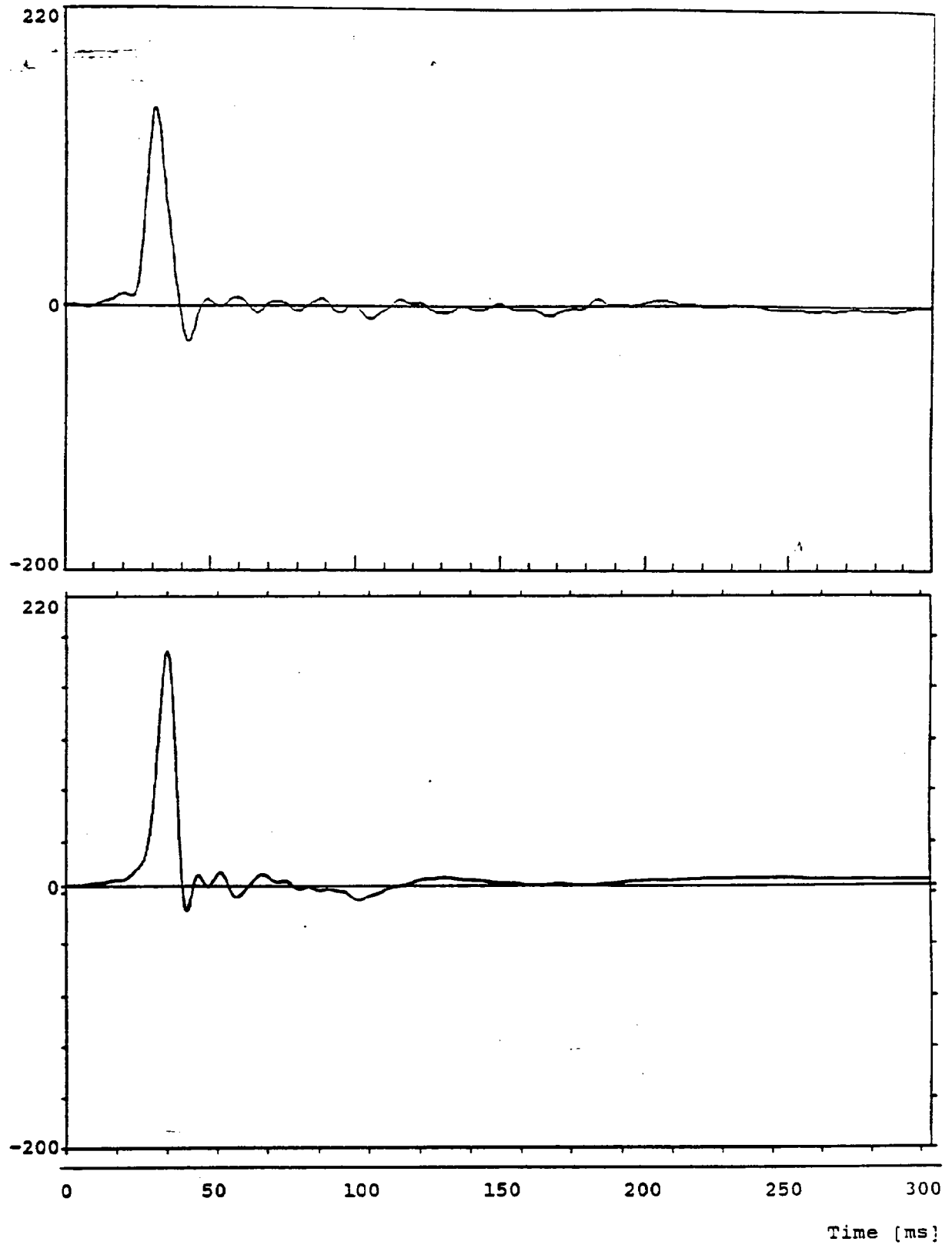


Figure B3/18

ACCELERATION PELVIC Y AXIS (P3/4)

Displacement [mm]

B3-19

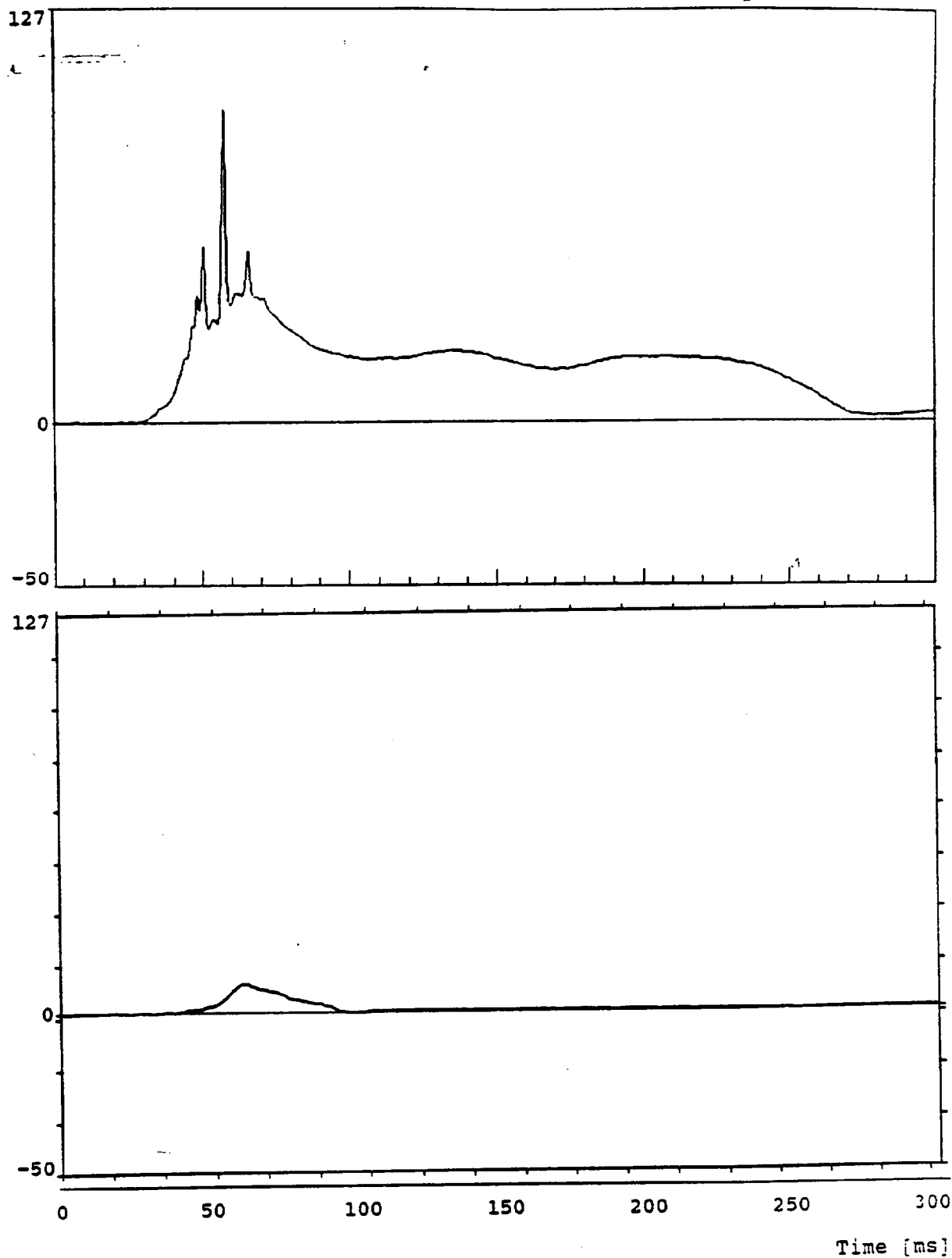


Figure B3/19

DISPLACEMENT CHEST/UPPER RIB (P3/4)

Displacement [mm]

B3-20

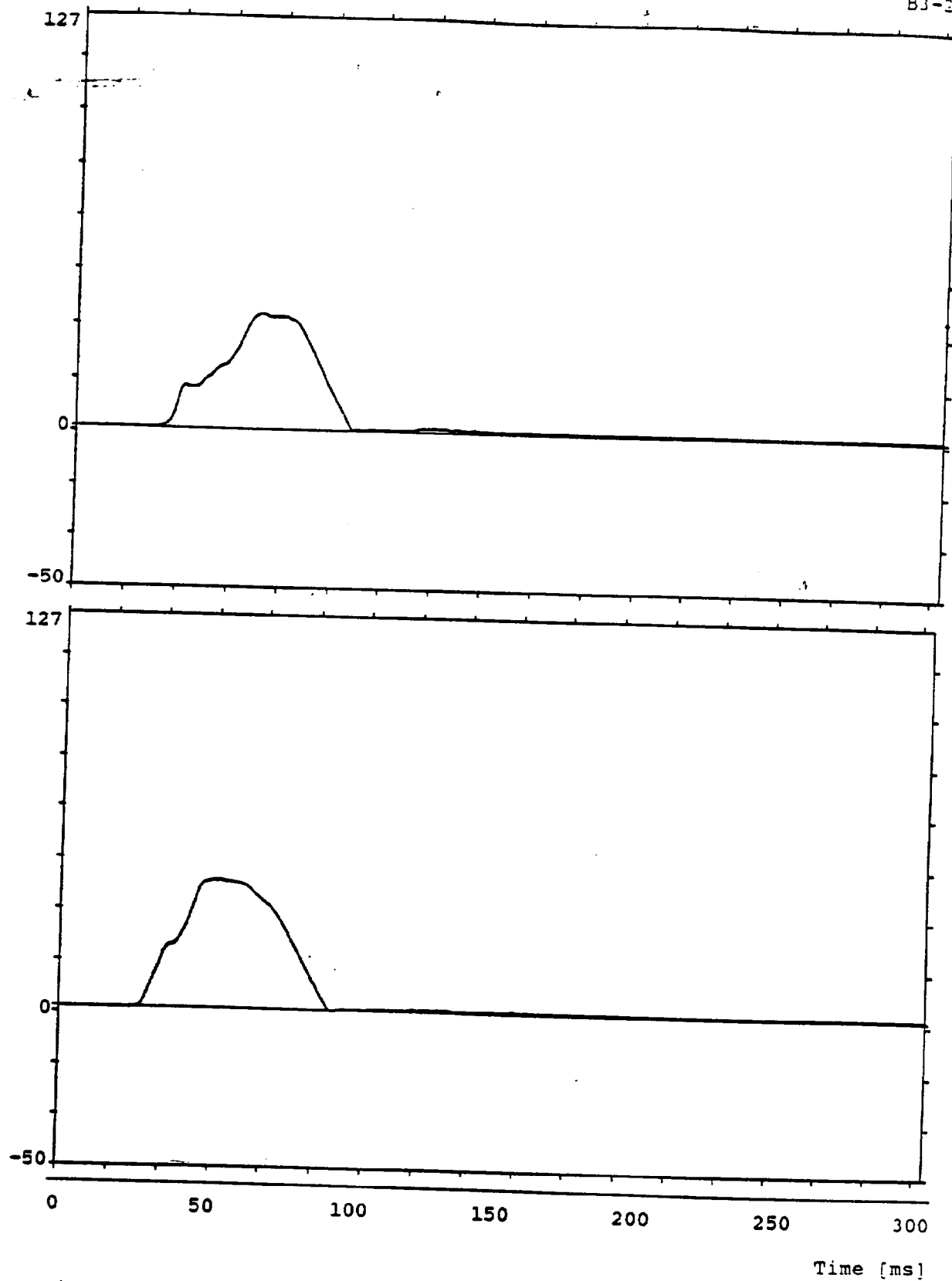


Figure B3/20

DISPLACEMENT MIDDLE RIB/LOWER RIB (P3/4) BAST

Acceleration [g]

B3-21

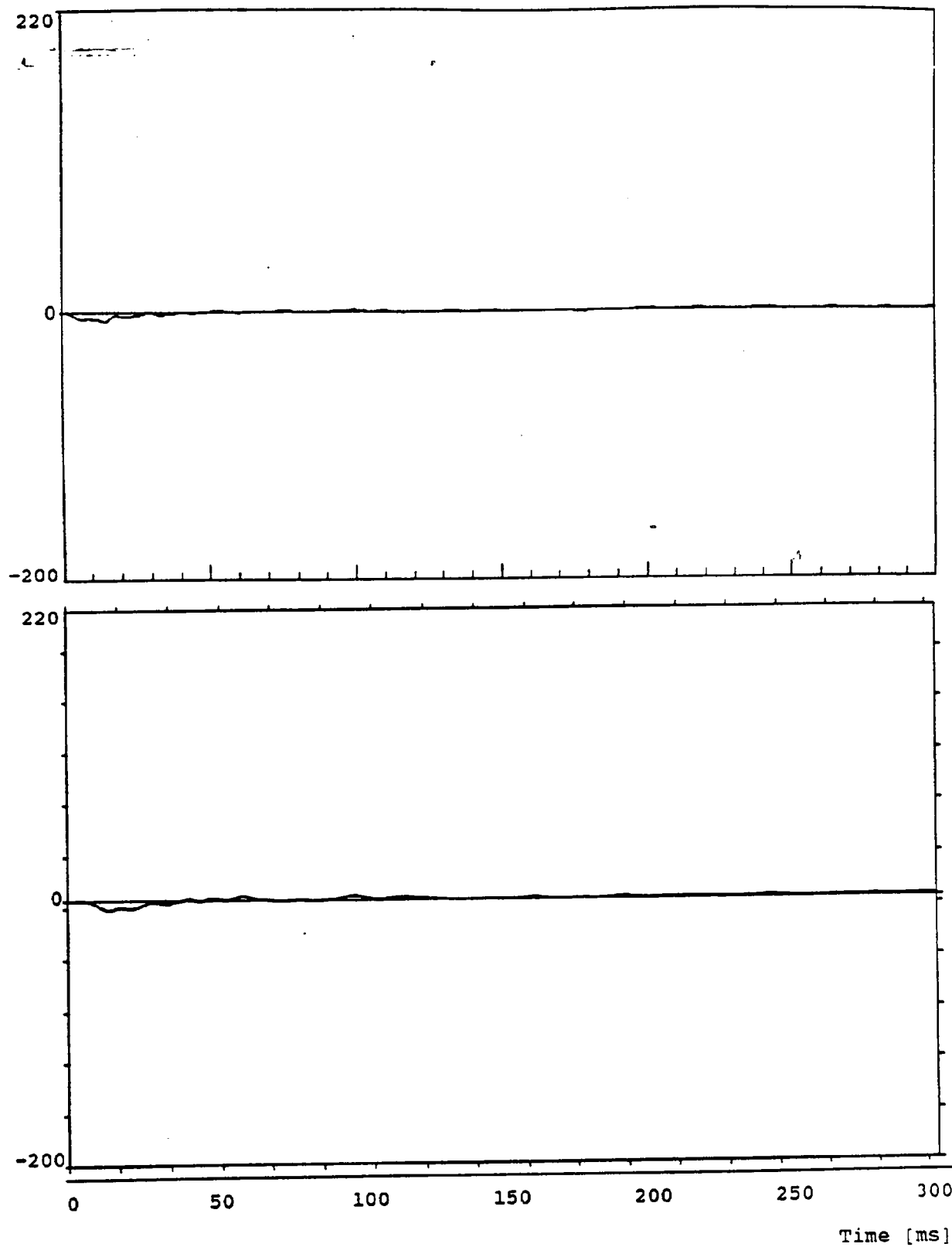


Figure B3/21

ACCELERATION DOOR SILL RIGHT FRONT X AXIS (CAR)

Acceleration [g]

B3-22

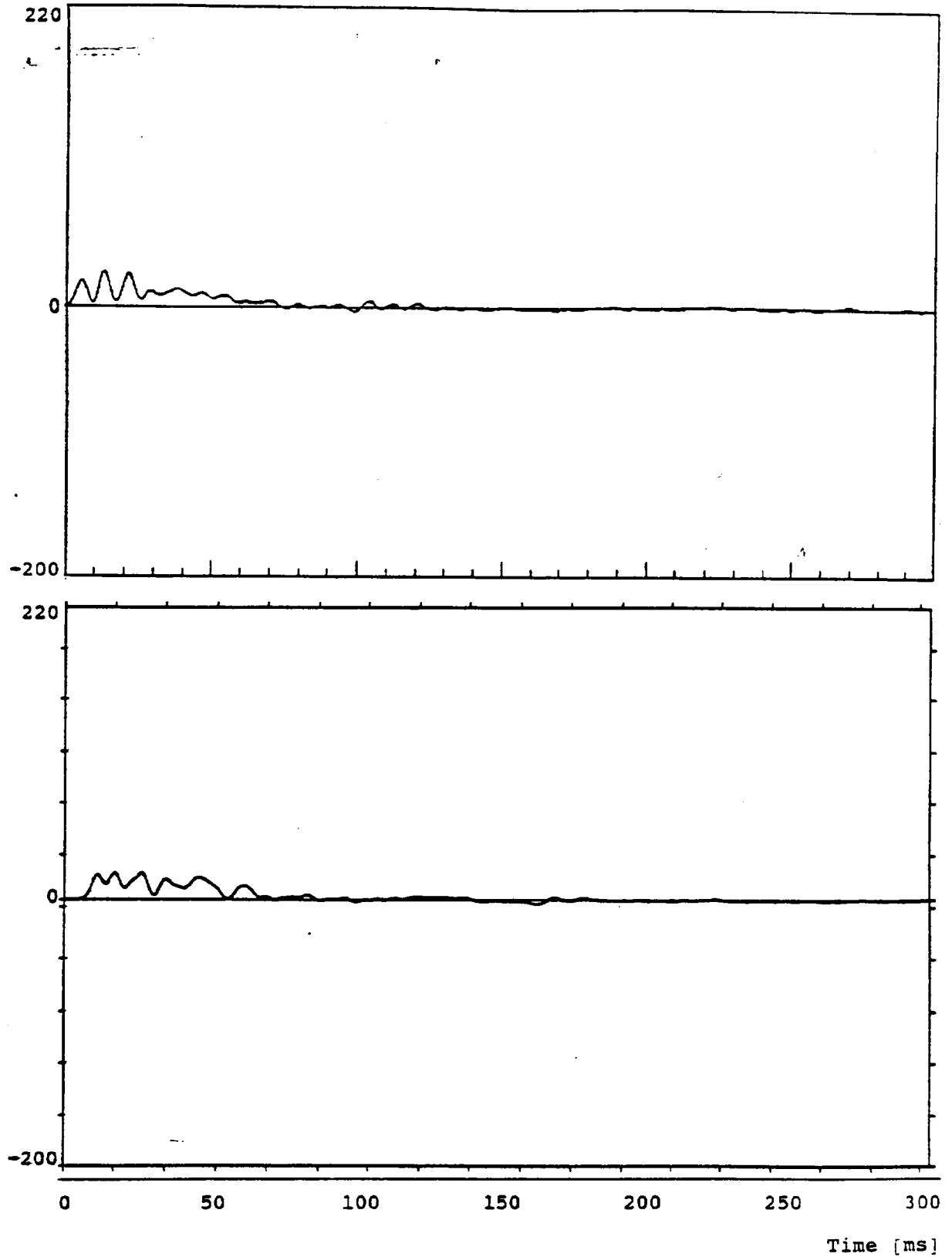


Figure B3/22

ACCELERATION DOOR SILL RIGHT FRONT Y AXIS (CAR)

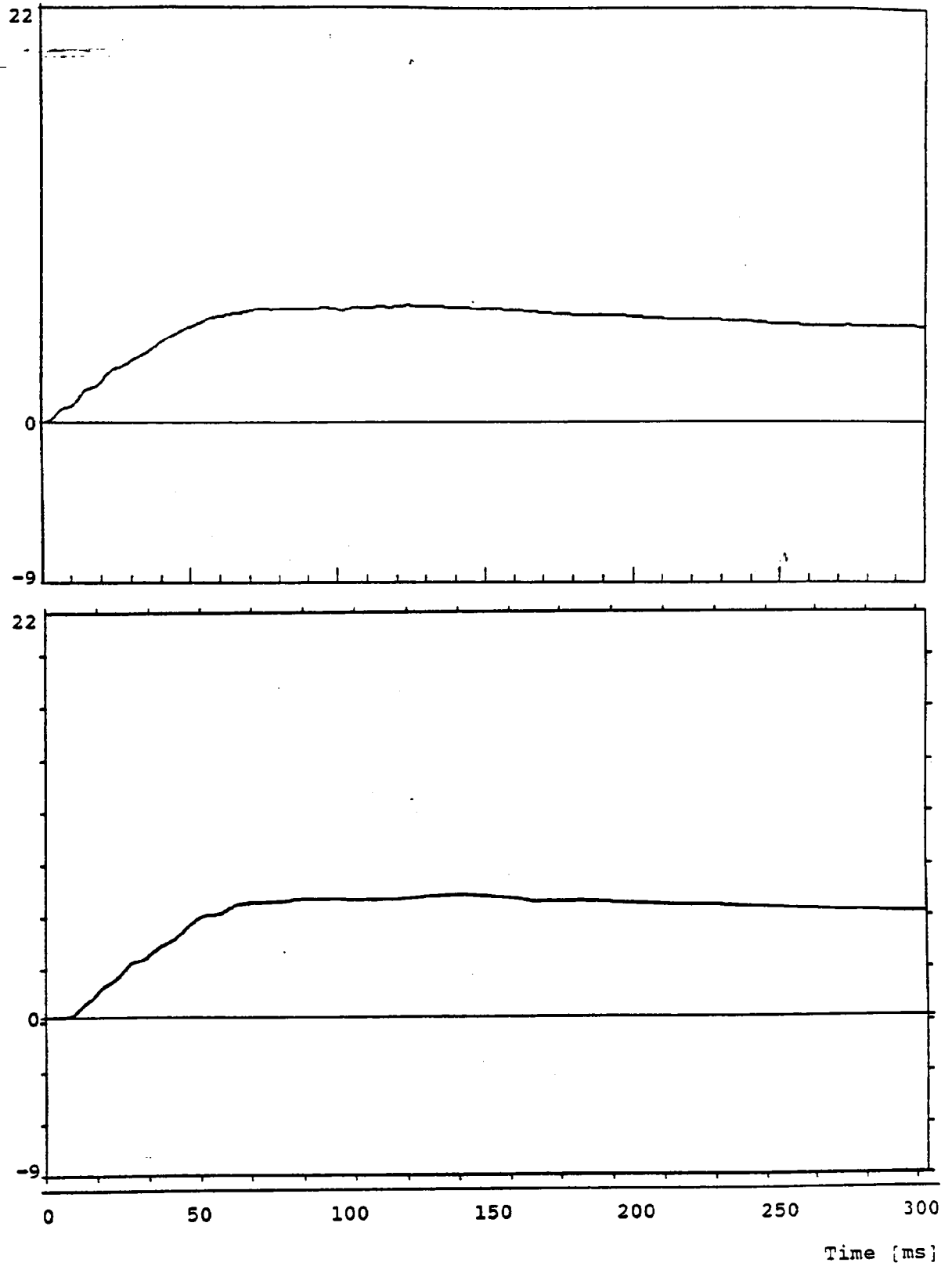


Figure B3/23

VELOCITY DOOR SILL RIGHT FRONT Y AXIS (CAR)

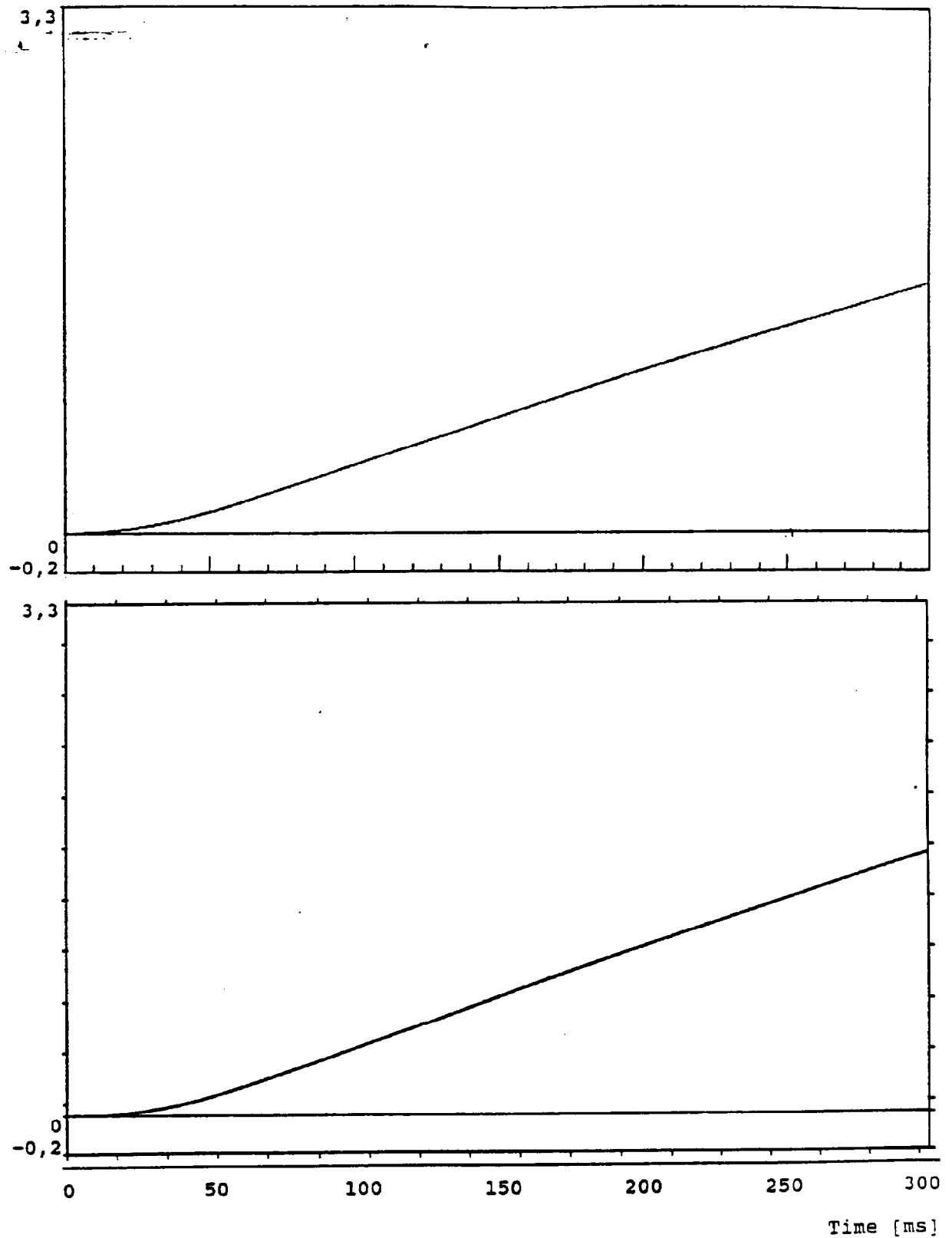


Figure B3/24

DISPLACEMENT DOOR SILL RIGHT FRONT Y AXIS (CAR)

Acceleration [g]

B3-25

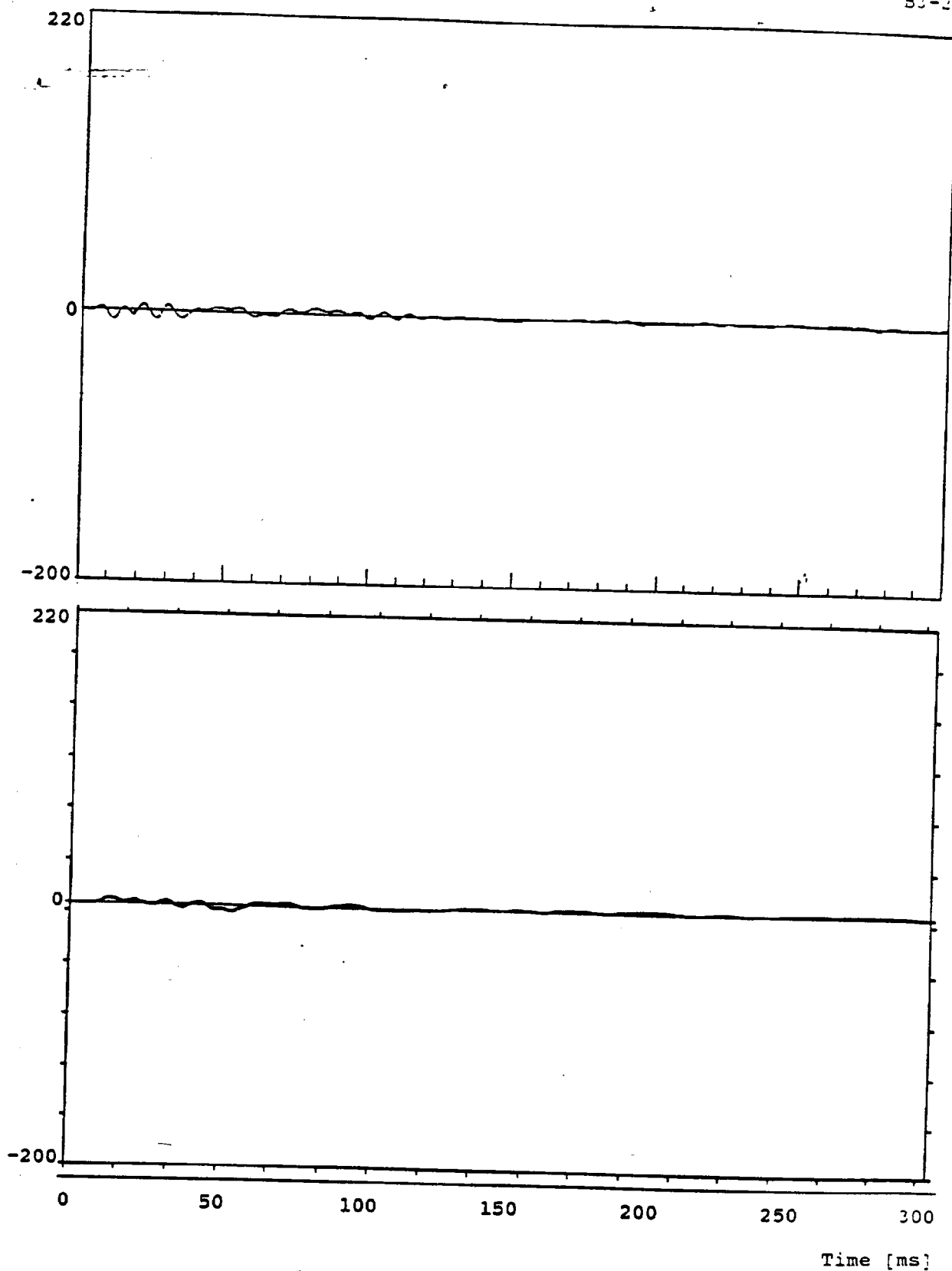


Figure B3/25

ACCELERATION DOOR SILL RIGHT FRONT Z AXIS (CAR)

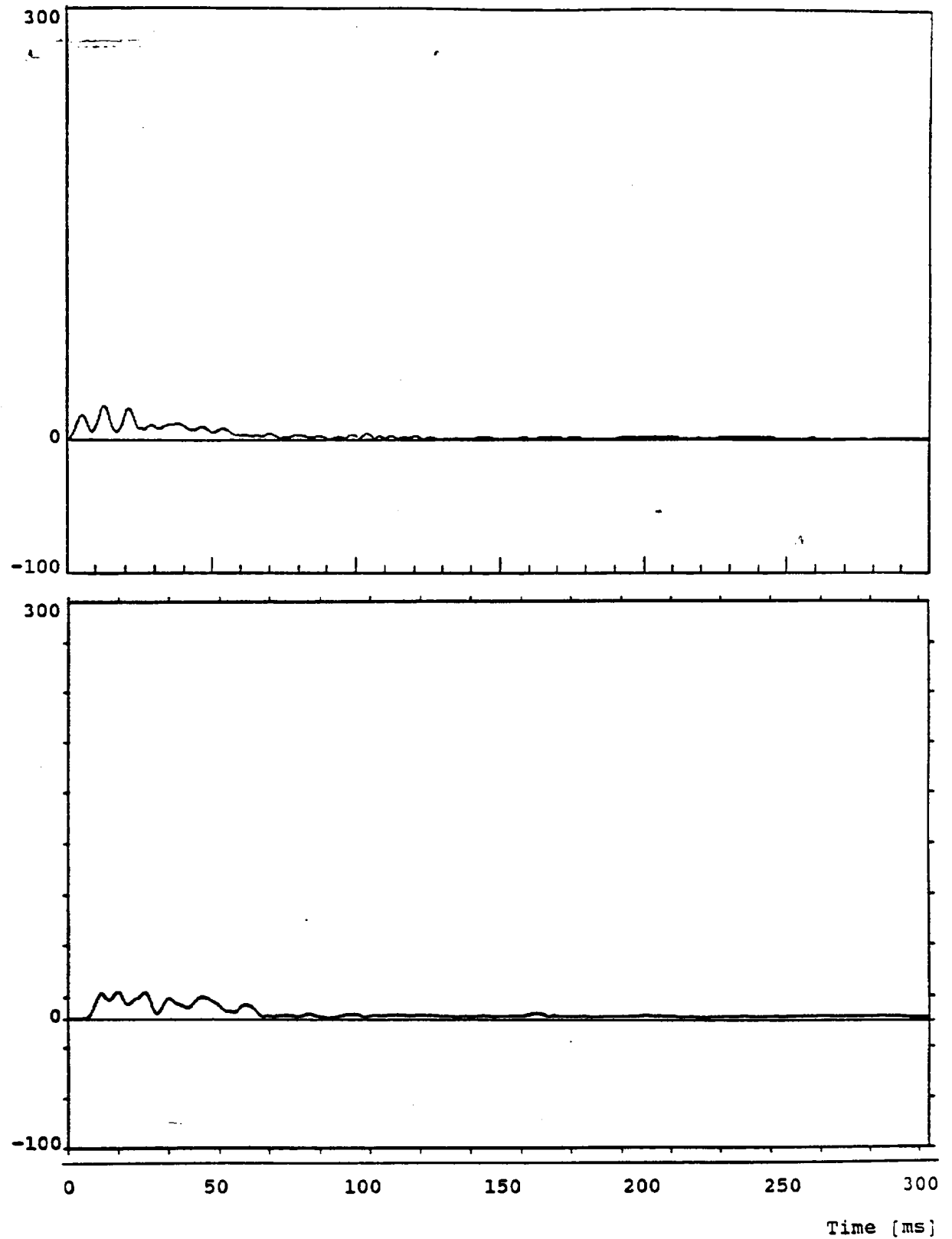


Figure B3/26

ACCELERATION DOOR SILL RIGHT FRONT RS AXIS (CAR)

Acceleration [g]

B3-27

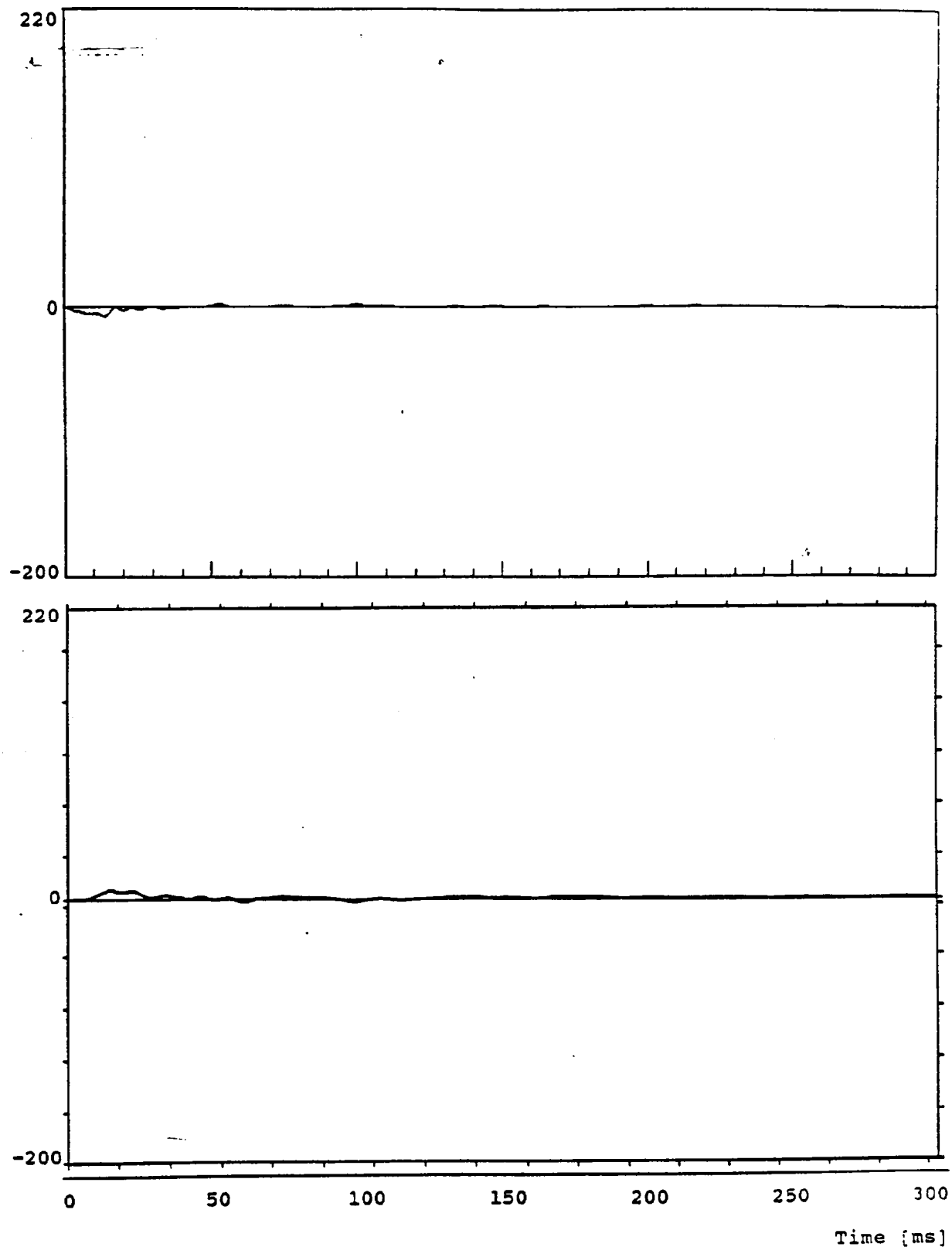


Figure B3/27

ACCELERATION DOOR SILL RIGHT REAR X AXIS (CAR)

Acceleration [g]

B3-23

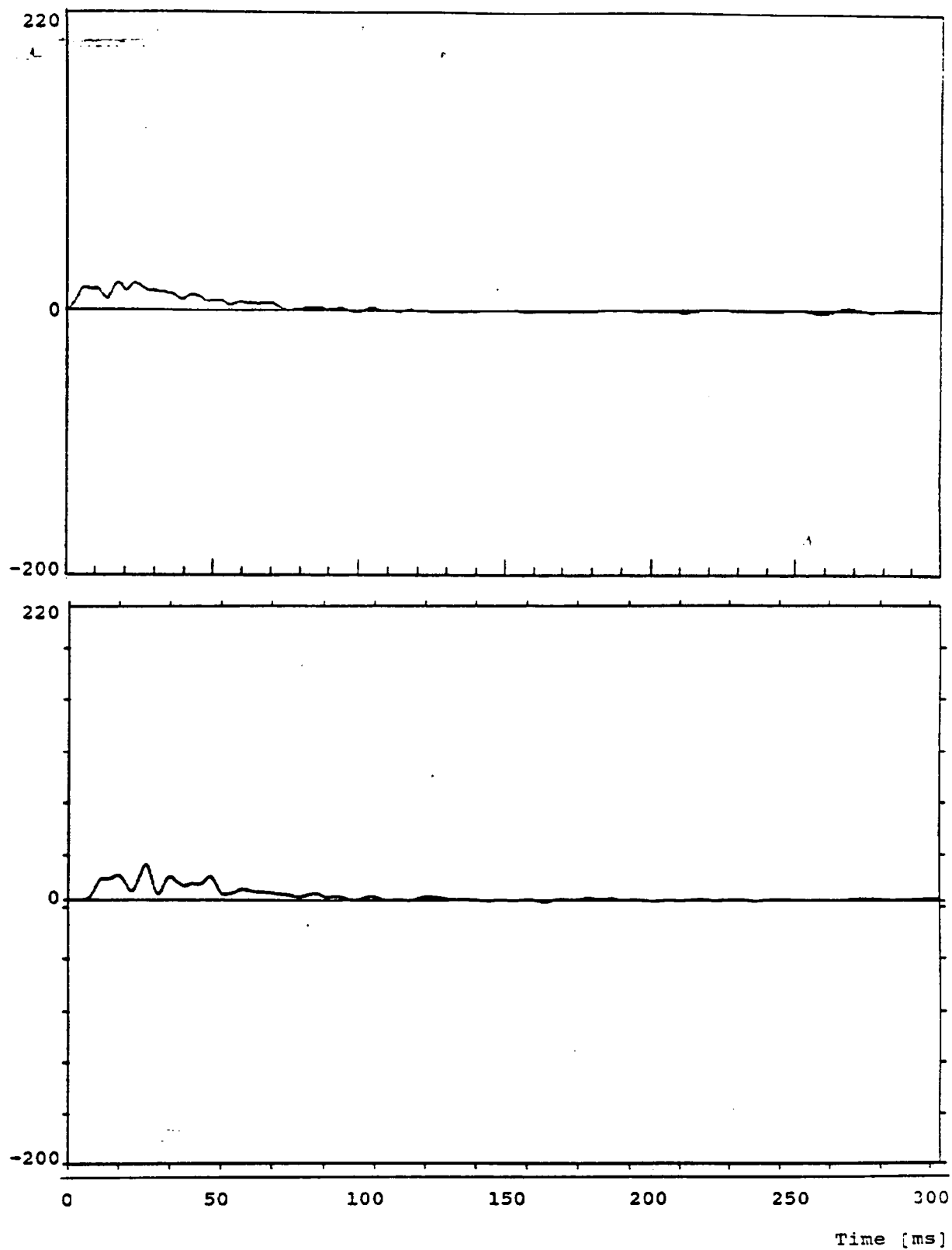


Figure B3/28

ACCELERATION DOOR SILL RIGHT REAR Y AXIS (CAR)

Velocity [m/s] (computed)

B3-29

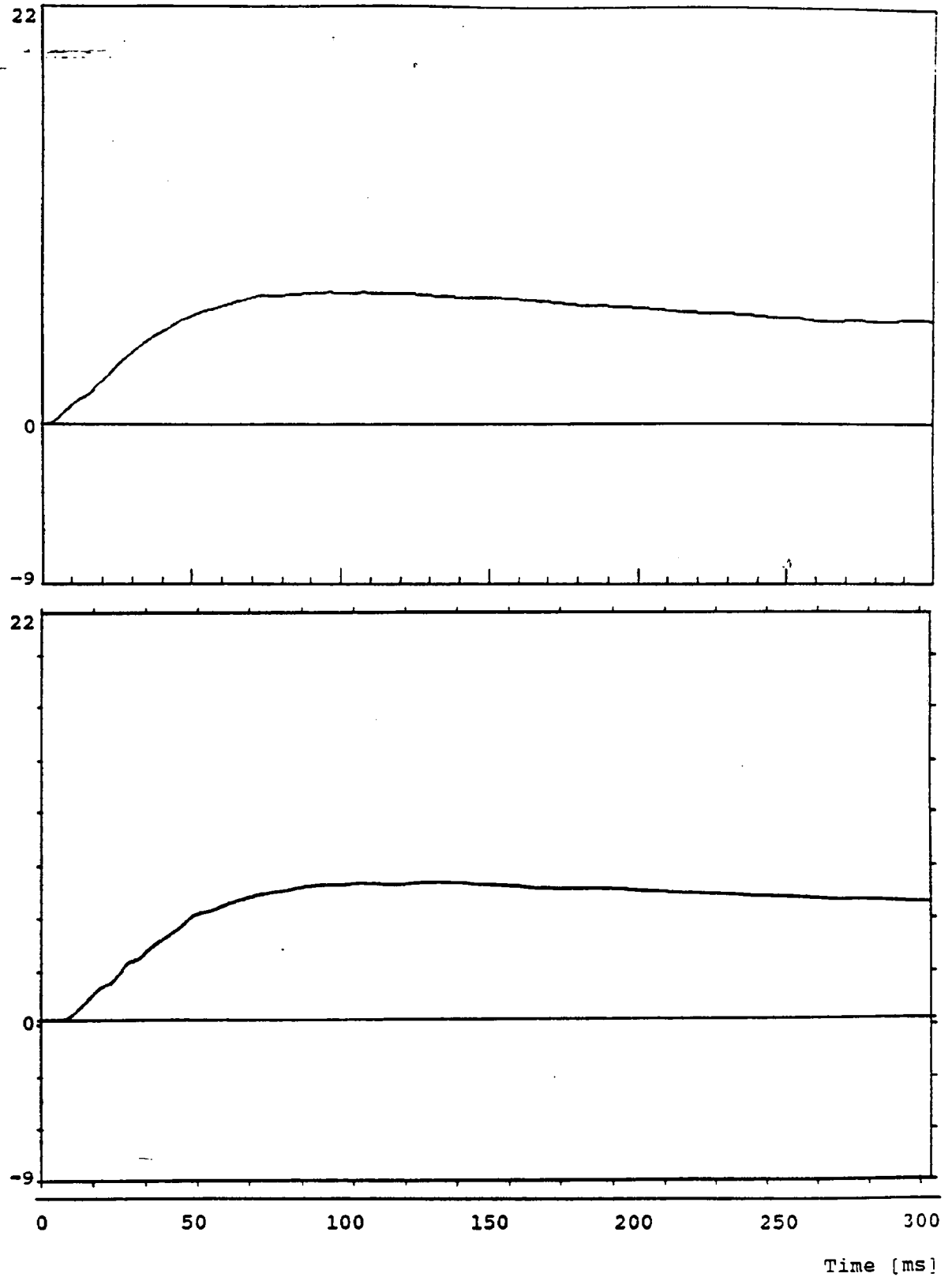


Figure B3/29

VELOCITY DOOR SILL RIGHT REAR Y AXIS (CAR)

Displacement [m] (computed)

B3-30

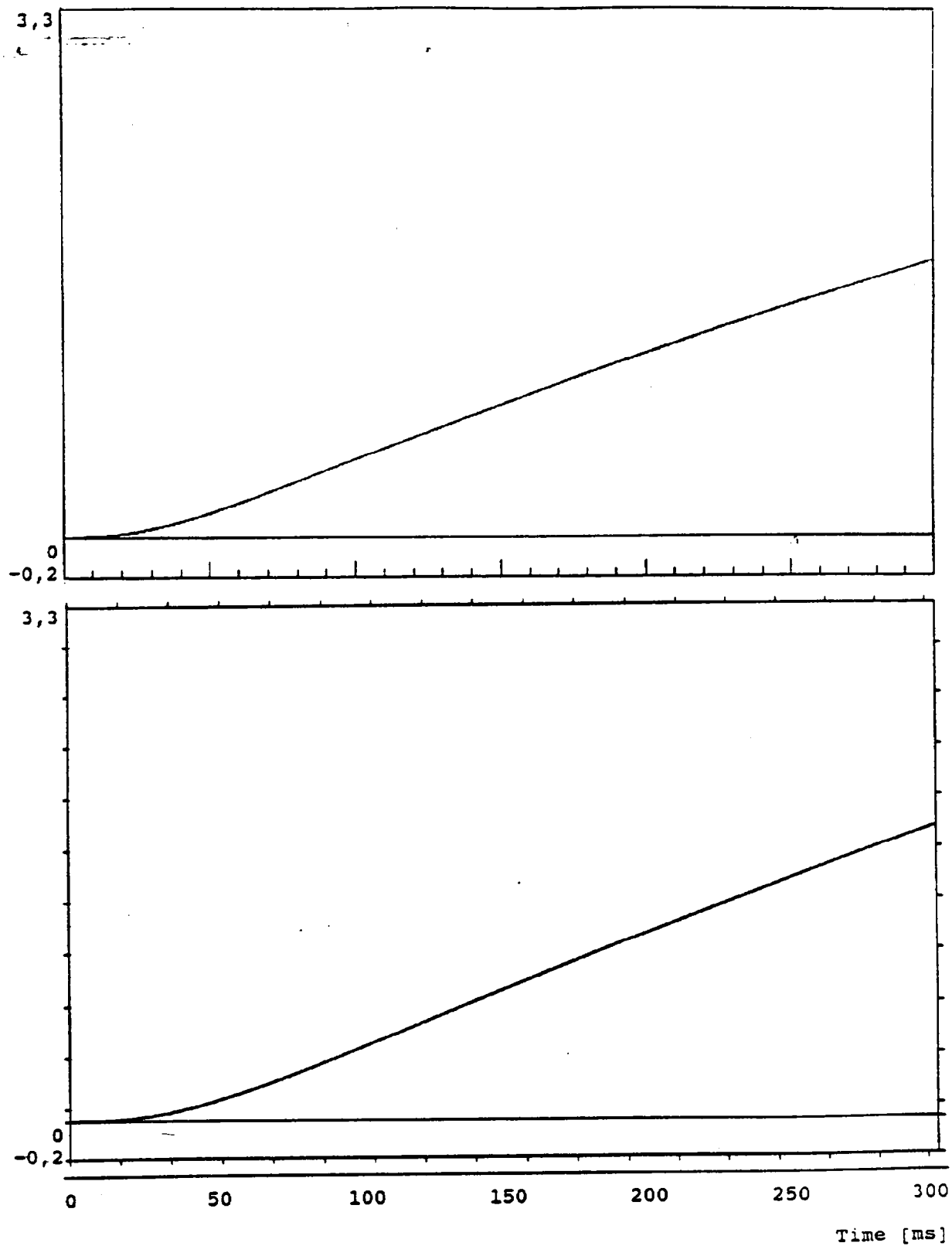


Figure B3/30

DISPLACEMENT DOOR SILL RIGHT REAR Y AXIS (CAR)

Acceleration [g]

B3-31

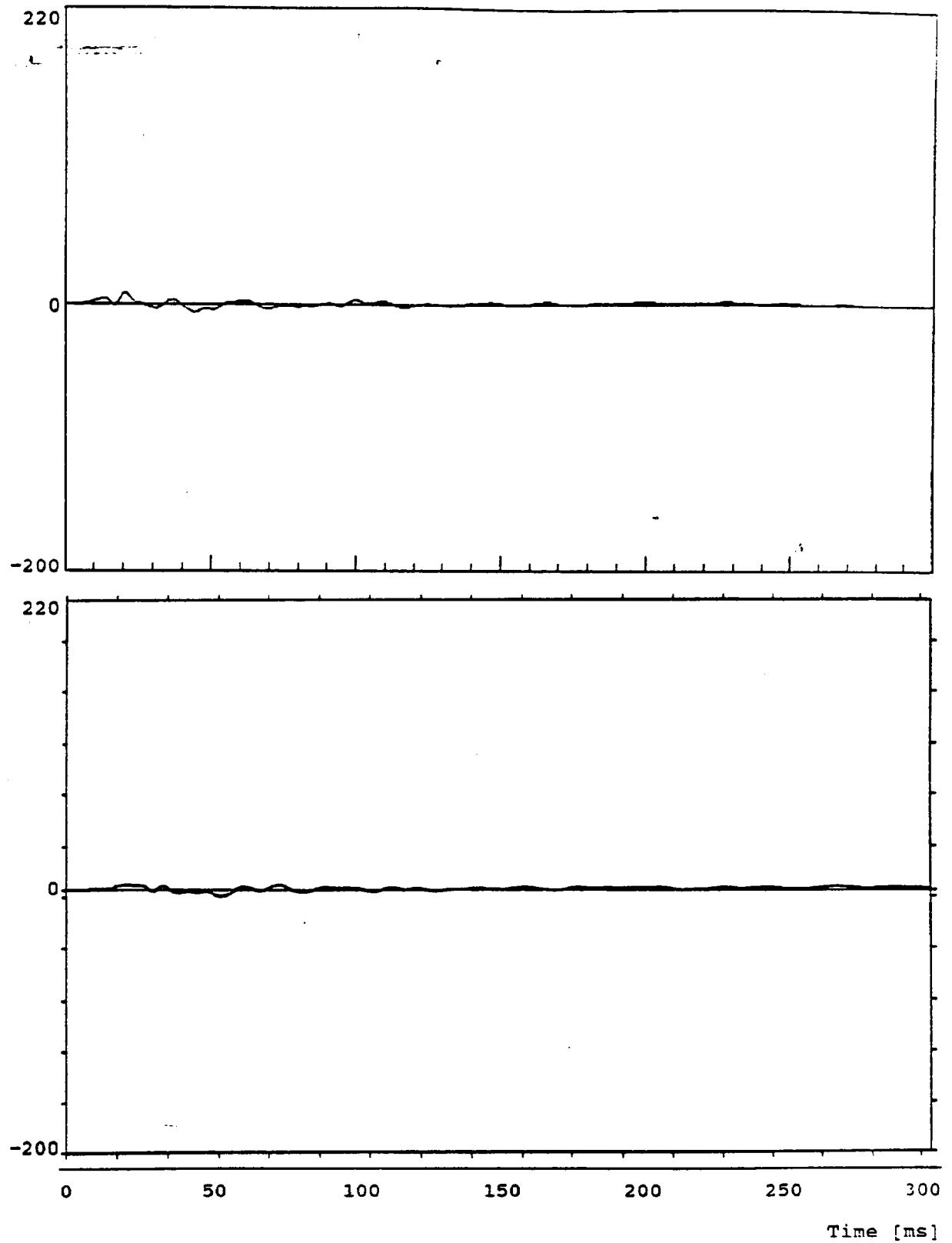


Figure B3/31

ACCELERATION DOOR SILL RIGHT REAR Z AXIS (CAR)

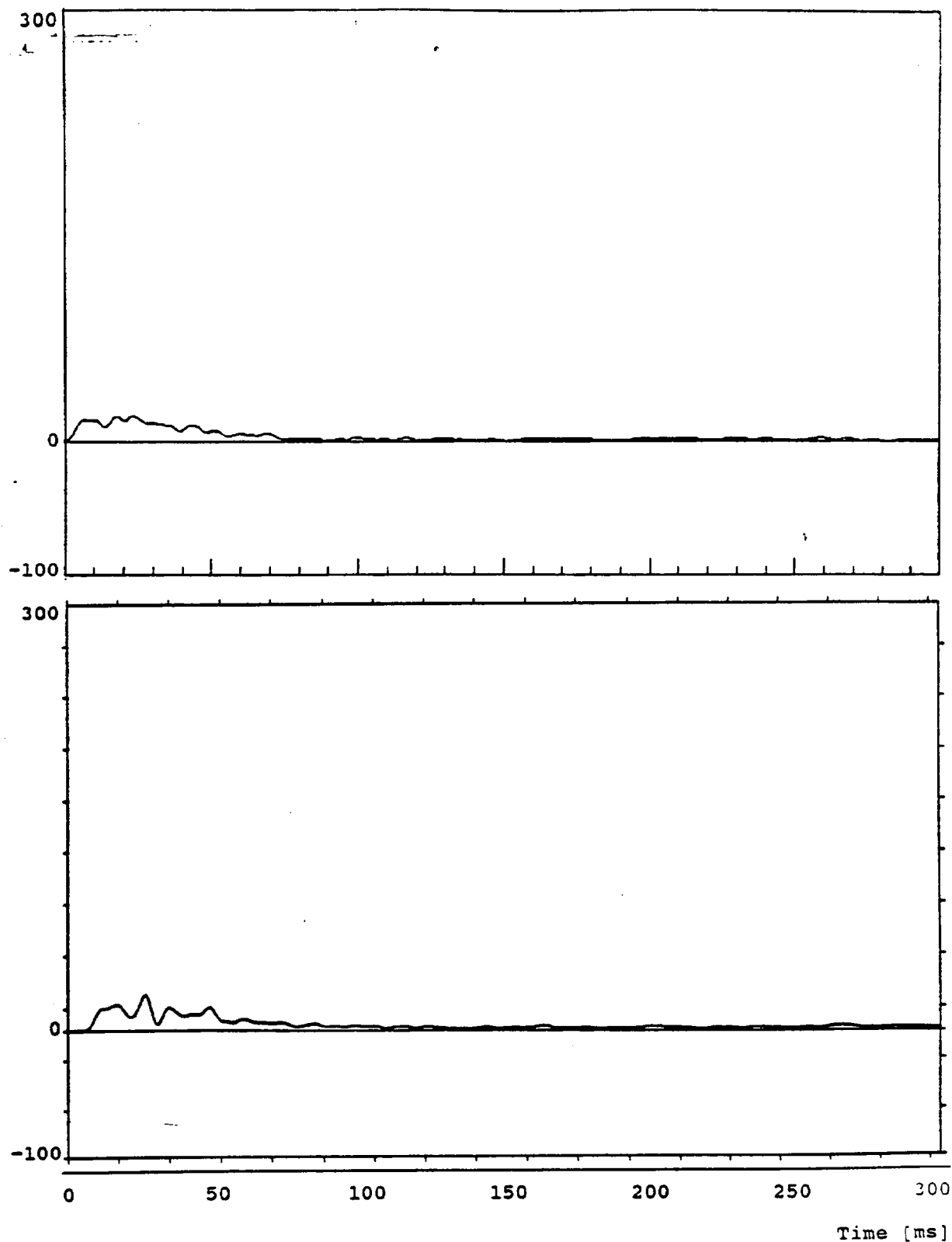


Figure B3/32

ACCELERATION DOOR SILL RIGHT REAR RS AXIS (CAR)

Acceleration [g]

B3-33

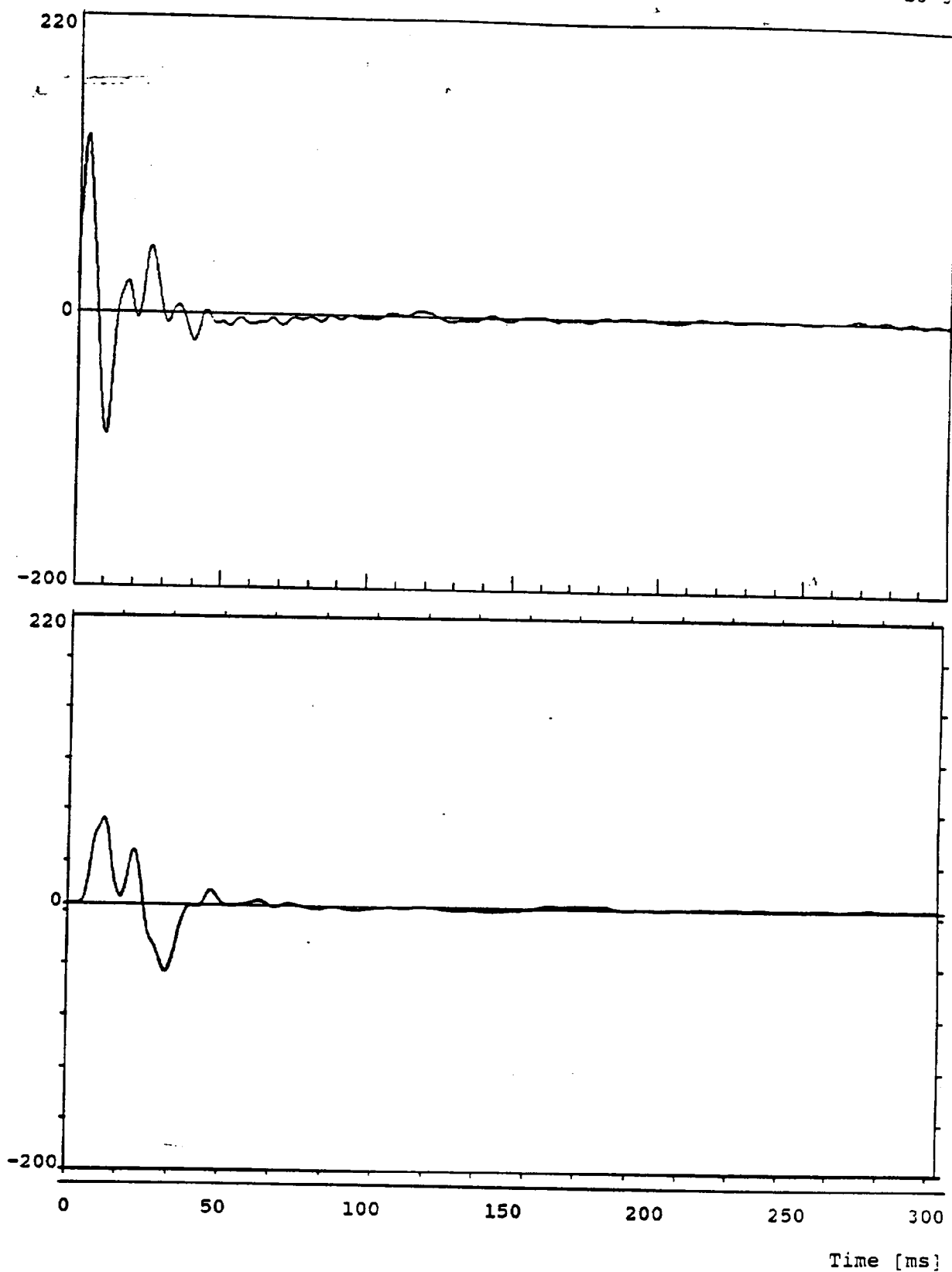


Figure B3/33

ACCELERATION DOOR SILL LEFT FRONT Y AXIS (CAR)

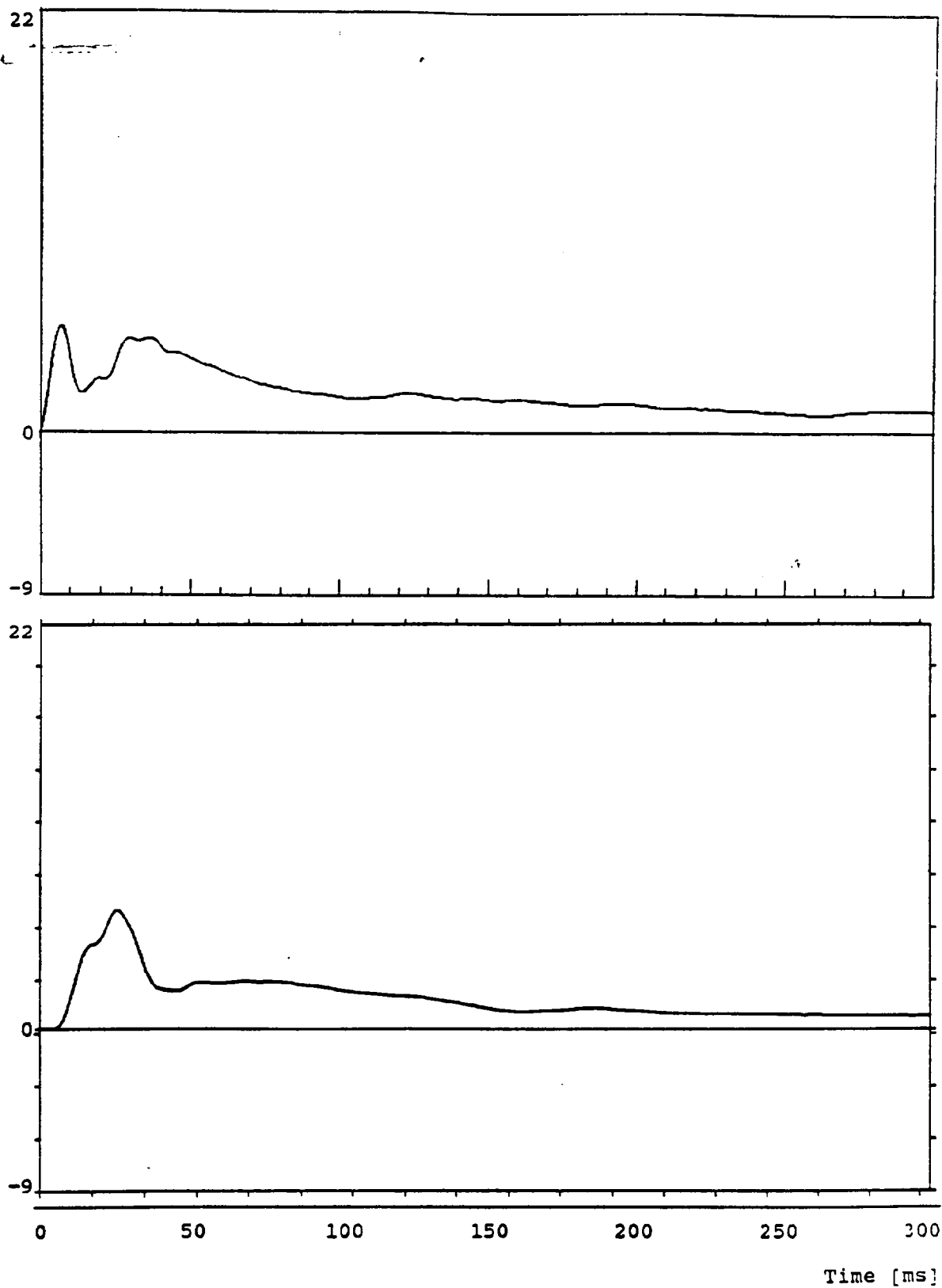


Figure B3/34

VELOCITY DOOR SILL LEFT FRONT Y AXIS (CAR)

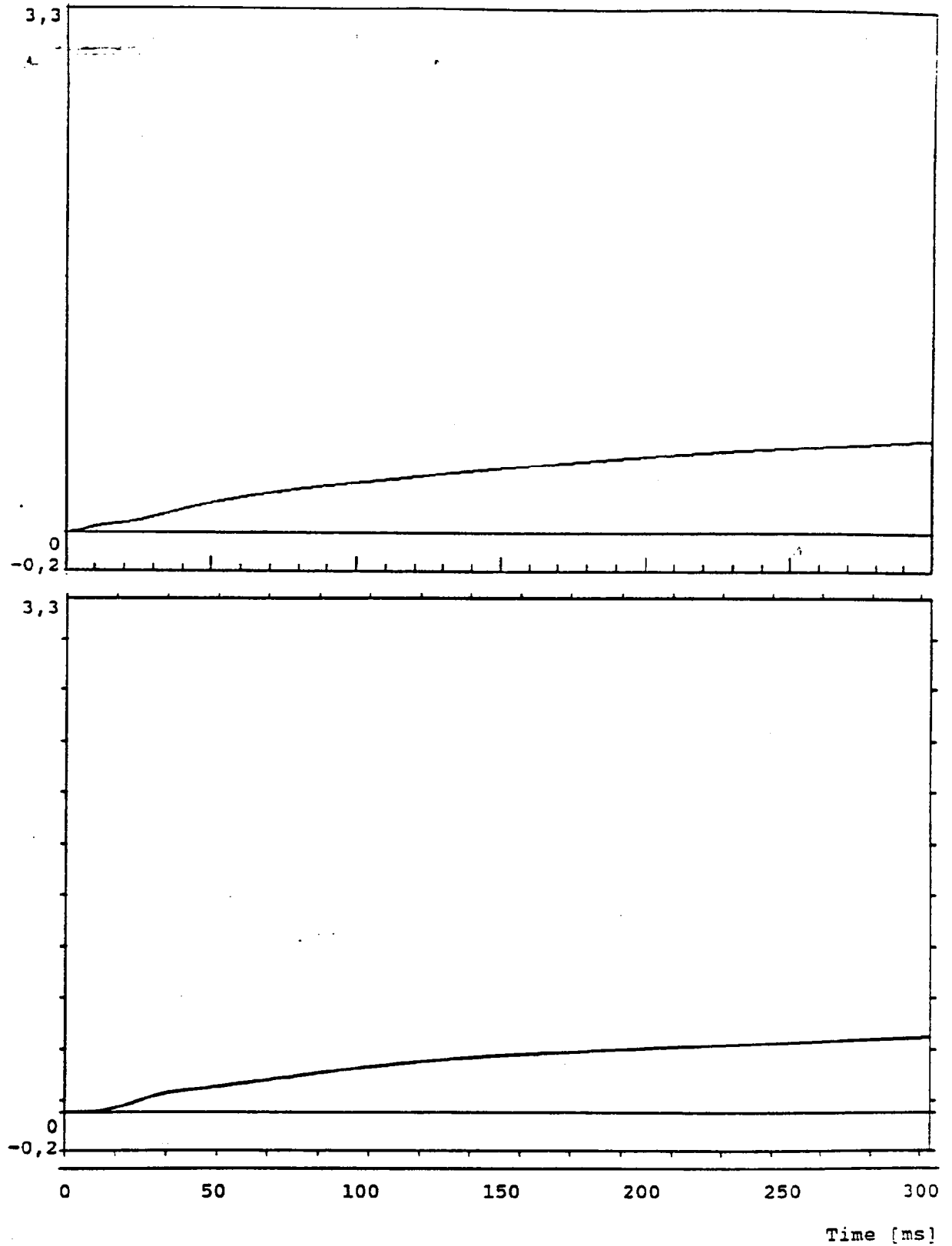


Figure B3/35

DISPLACEMENT DOOR SILL LEFT FRONT Y AXIS (CAR)

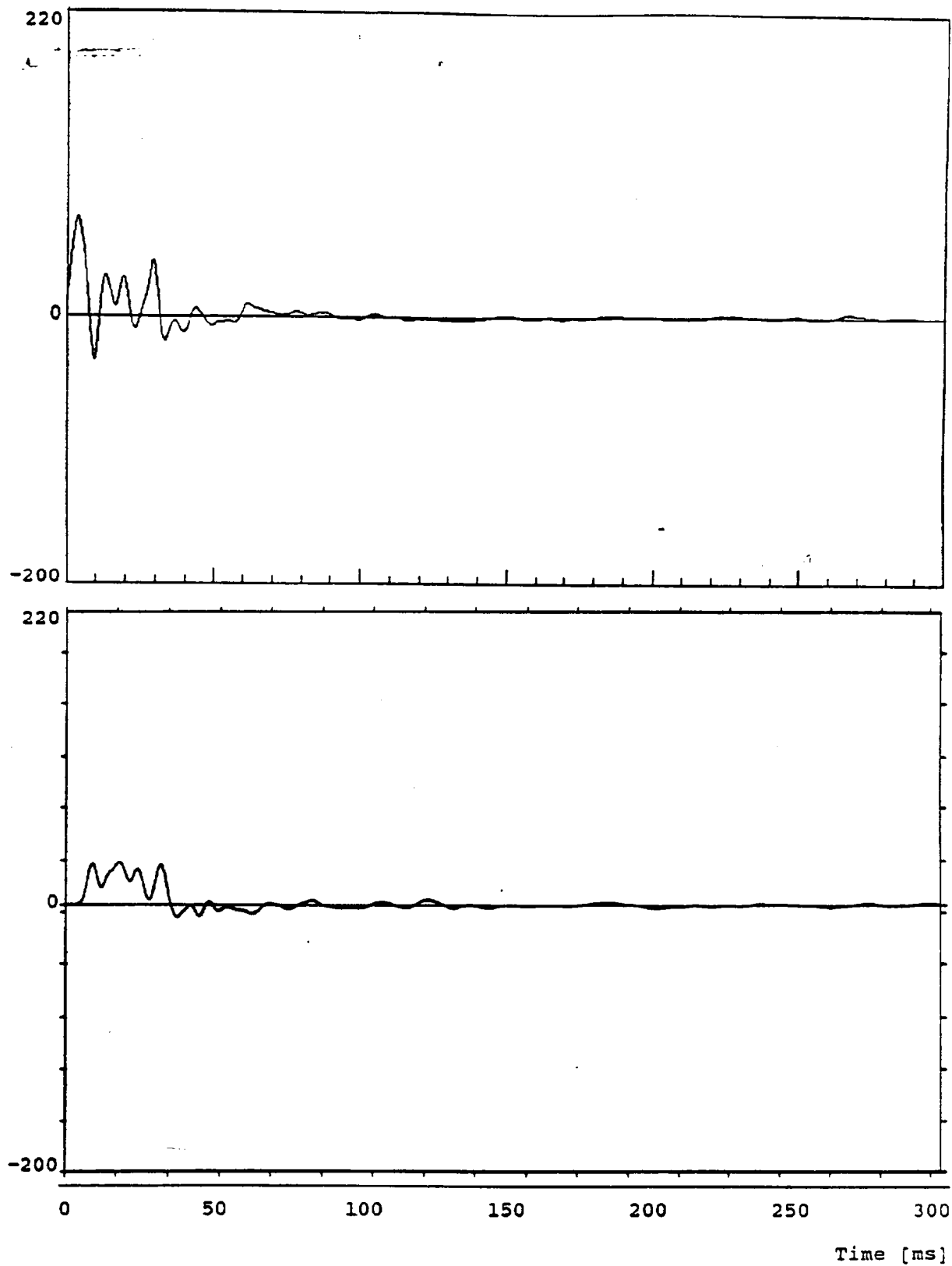


Figure B3/36

ACCELERATION DOOR SILL LEFT REAR Y AXIS (CAR)

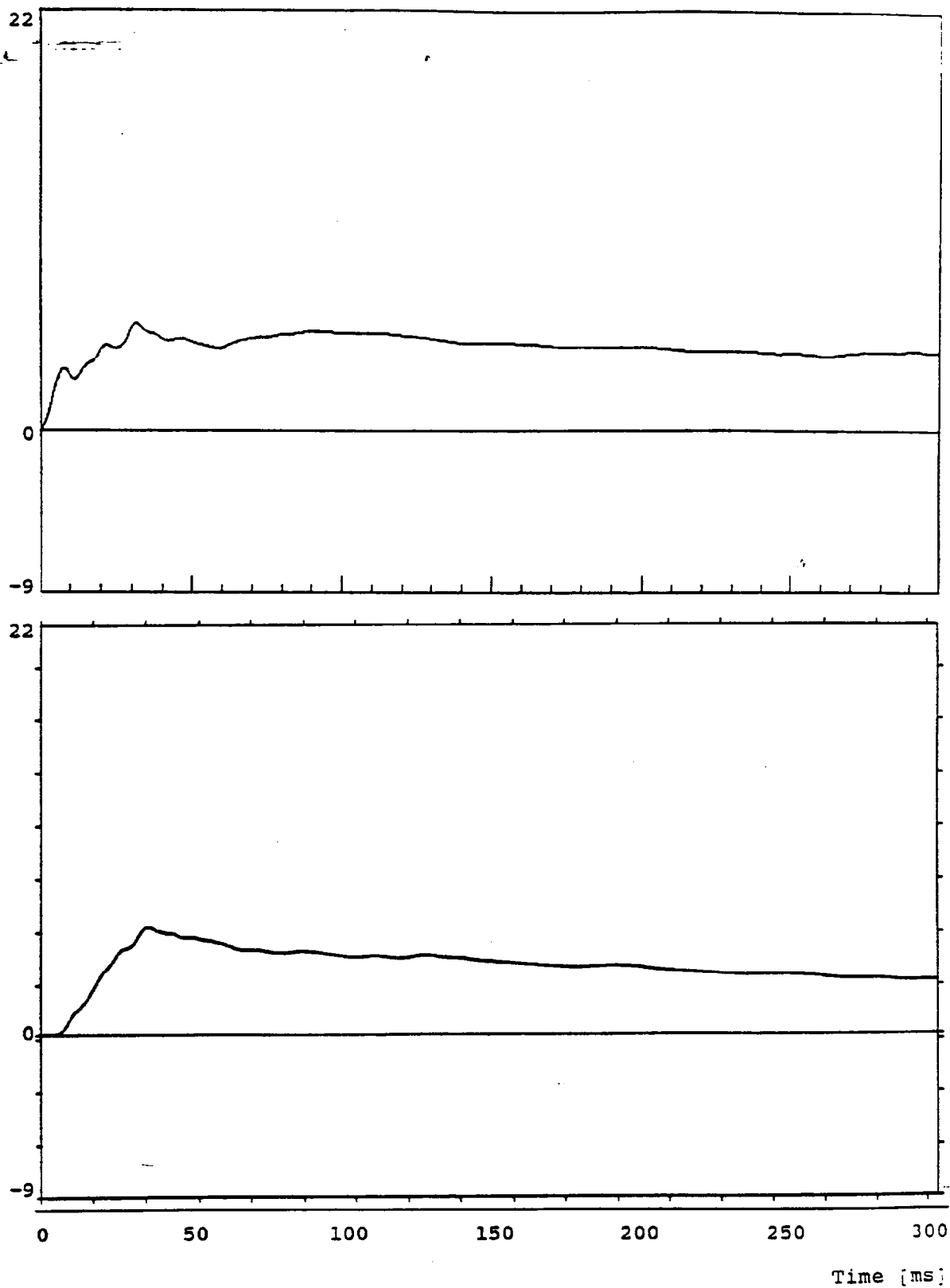


Figure B3/37

VELOCITY DOOR SILL LEFT REAR Y AXIS (CAR)

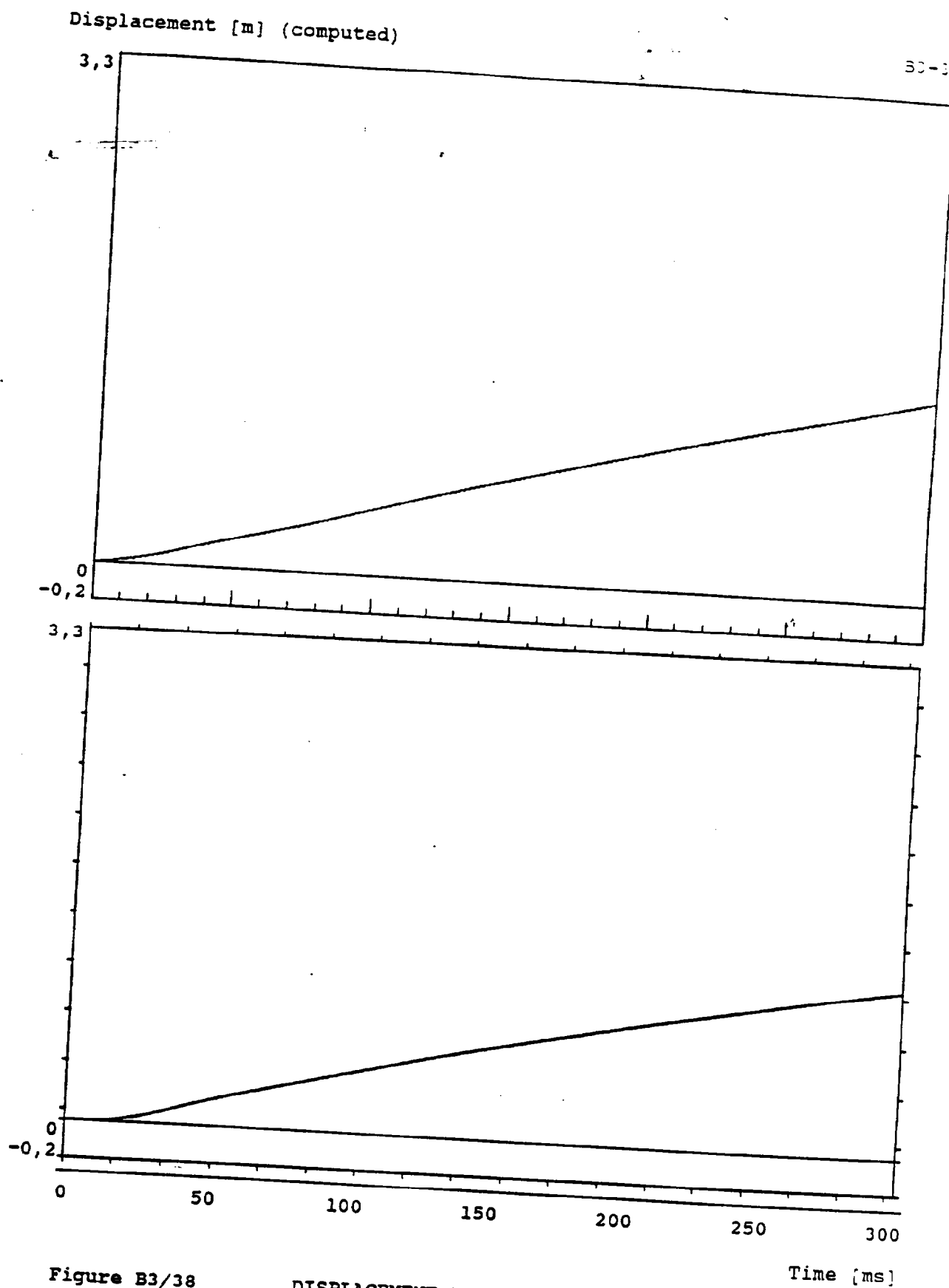


Figure B3/38

DISPLACEMENT DOOR SILL LEFT REAR Y AXIS (CAR)

Acceleration [g]

B3-39

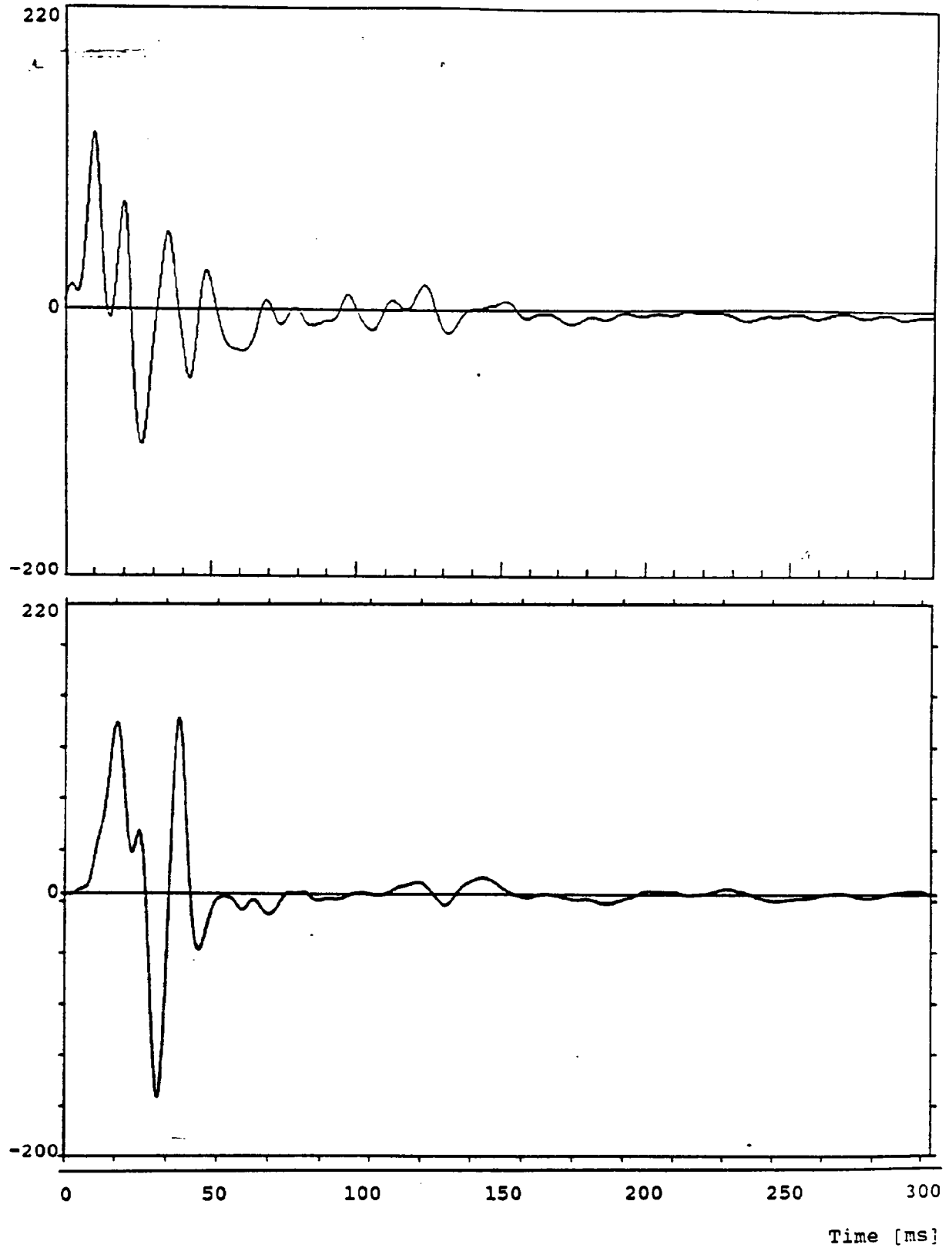


Figure B3/39

ACCELERATION LEFT FRONT DOOR MID Y AXIS (CAR)

Velocity [m/s] (computed)

B3-40

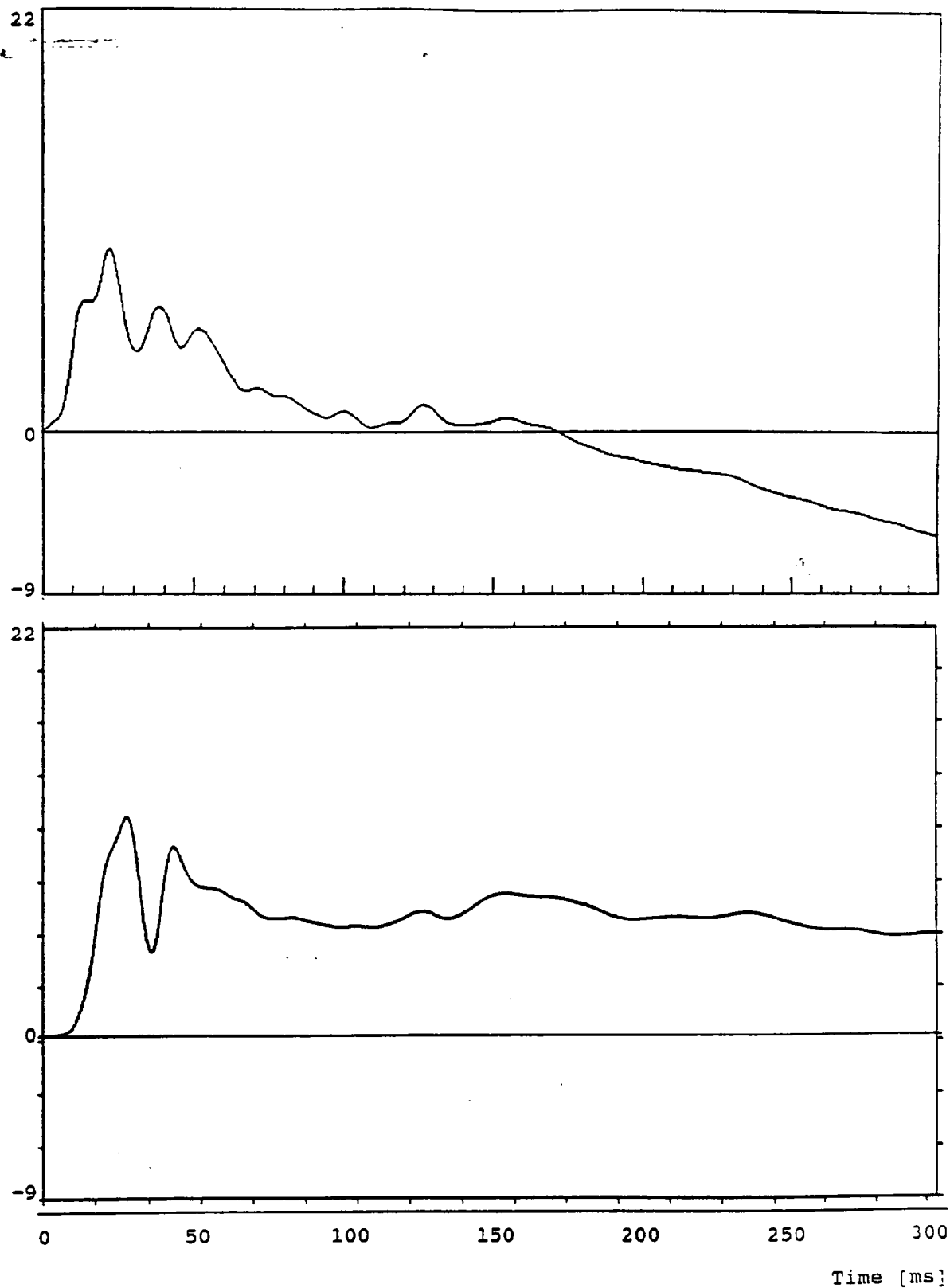


Figure B3/40

VELOCITY LEFT FRONT DOOR MID Y AXIS (CAR)

Displacement [m] (computed)

B3-41

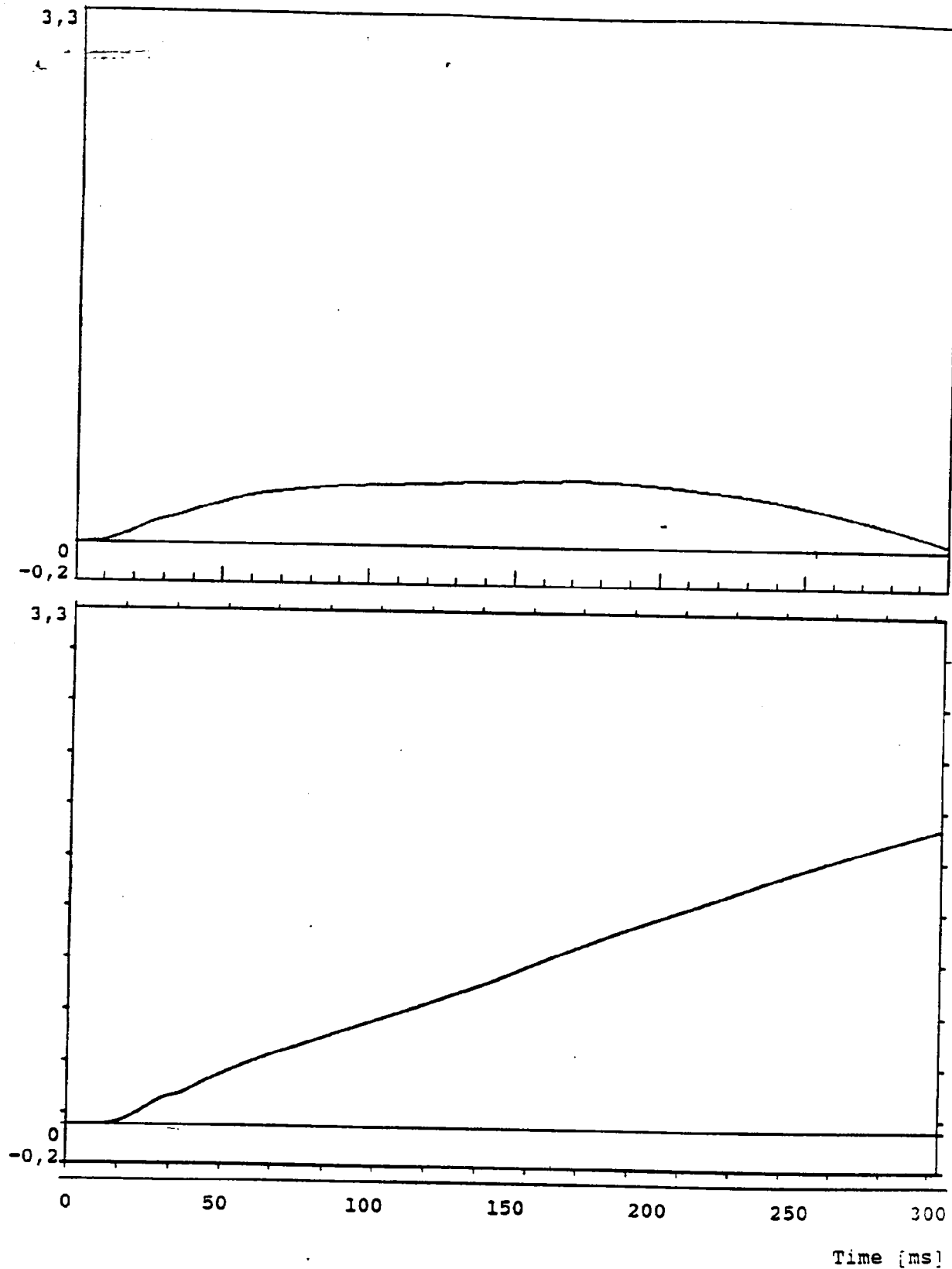


Figure B3/41

DISPLACEMENT LEFT FRONT DOOR MID Y AXIS (CAR)

Acceleration [g]

B3-42

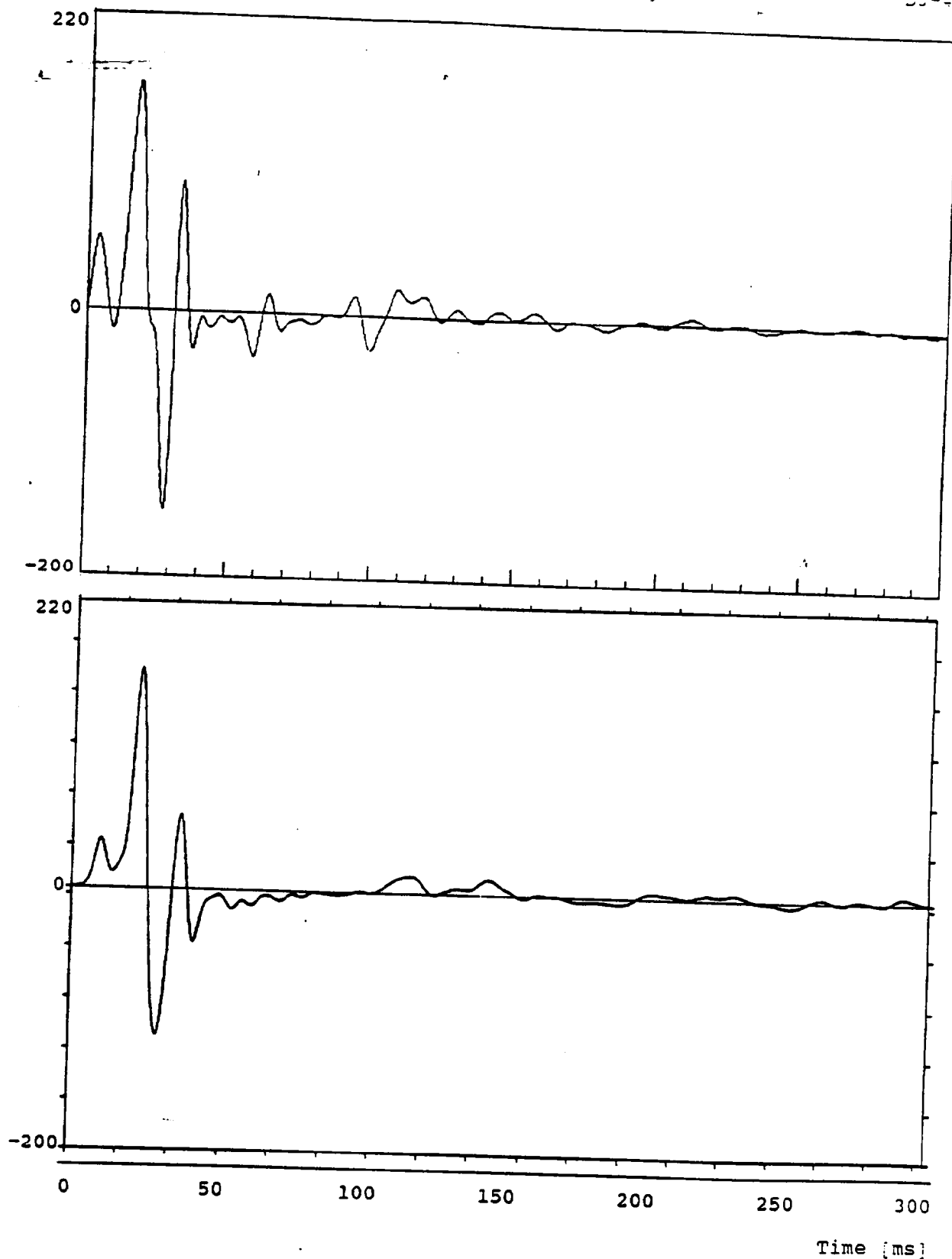


Figure B3/42

ACCELERATION LEFT UPPER FRONT DOOR Y AXIS (CAR)

Velocity [m/s] (computed)

B3-43

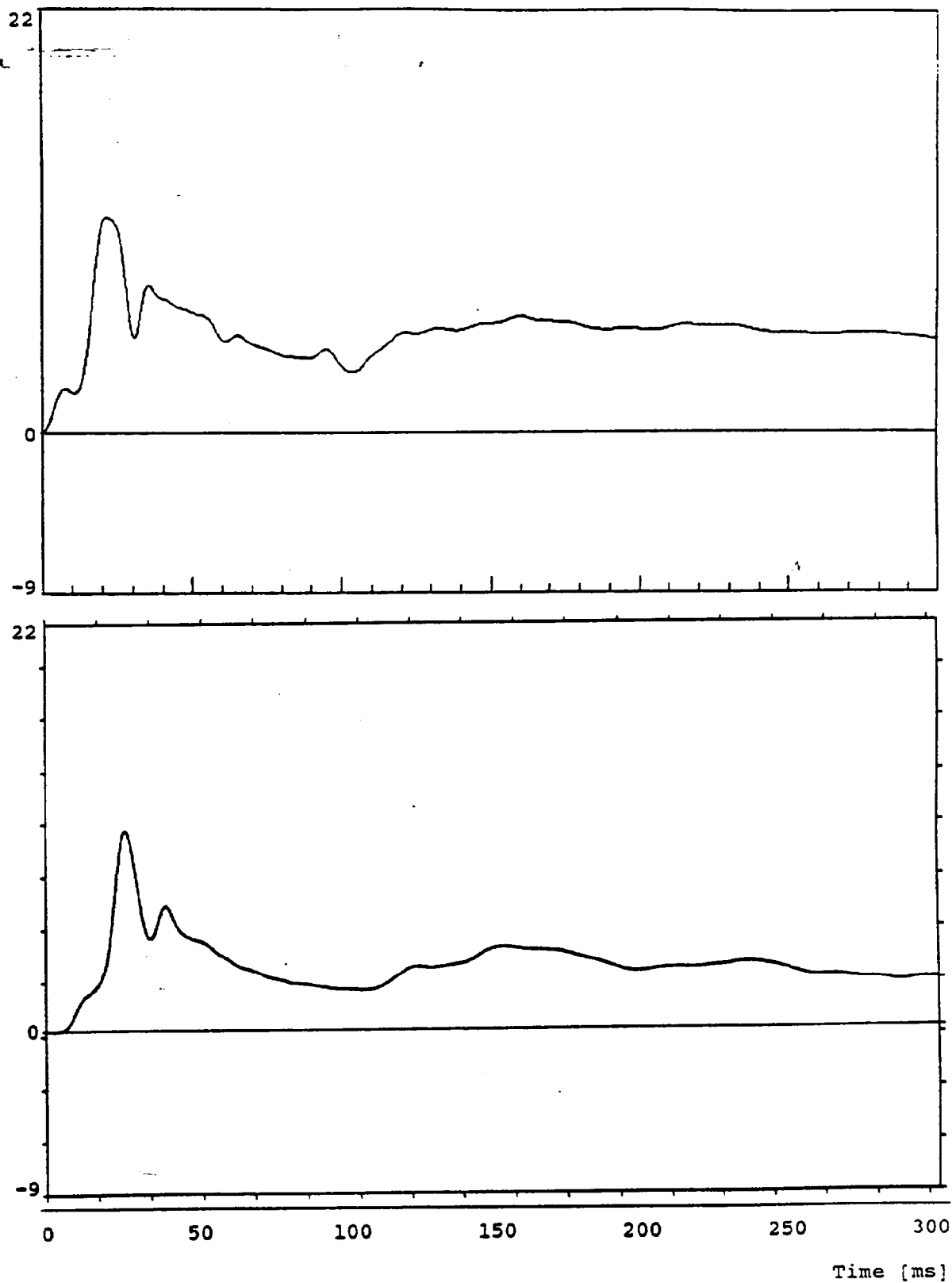


Figure B3/43

VELOCITY LEFT UPPER FRONT DOOR Y AXIS (CAR)

Displacement [m] (computed)

B3-44

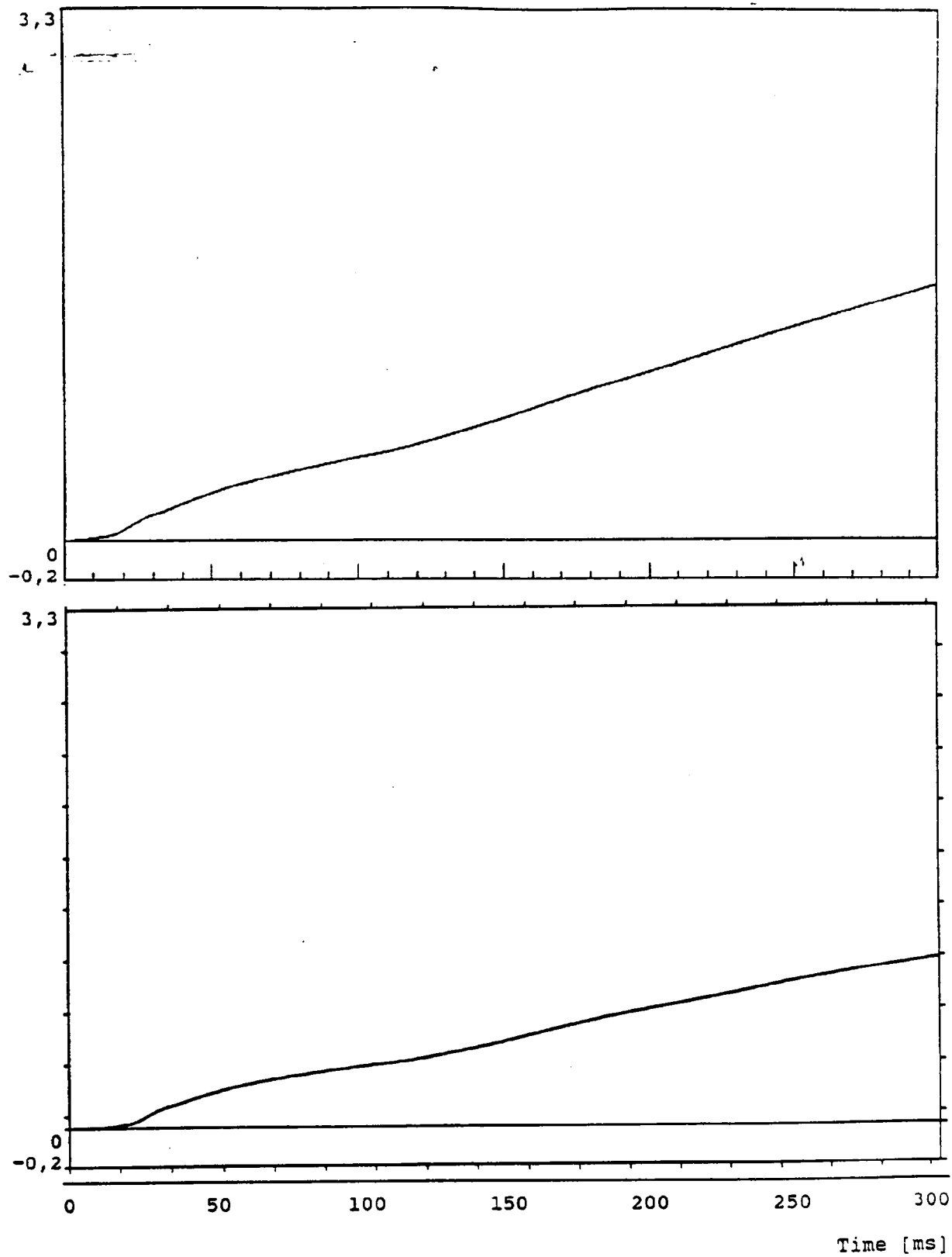


Figure B3/44

DISPLACEMENT LEFT UPPER FRONT DOOR Y AXIS (CAR)

Acceleration [g]

B3-45

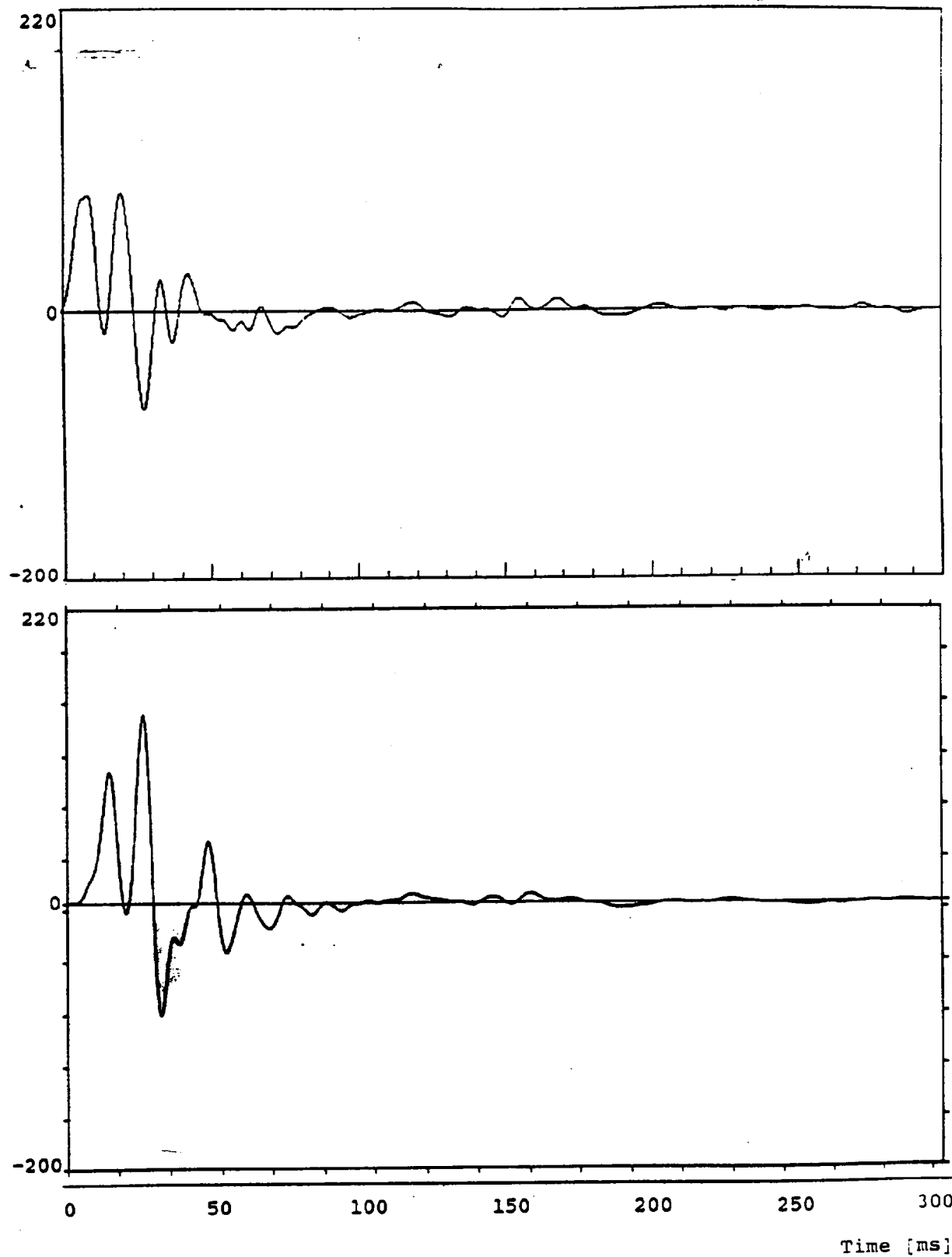


Figure B3/45

ACCELERATION LEFT REAR DOOR MID Y AXIS (CAR)

Velocity [m/s] (computed)

B3-46

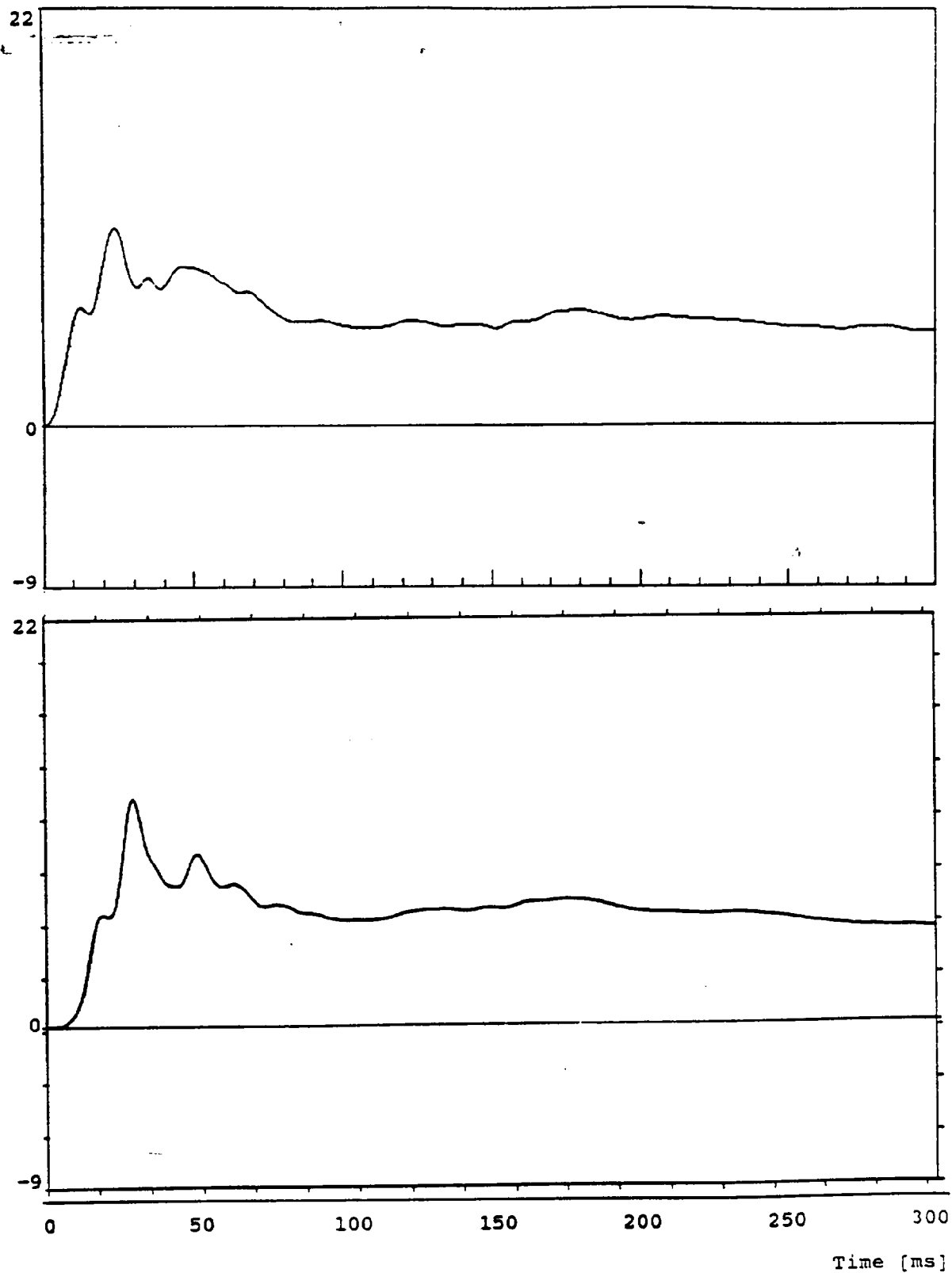


Figure B3/46

VELOCITY LEFT REAR DOOR MID Y AXIS (CAR)

Displacement [m] (computed)

B3-47

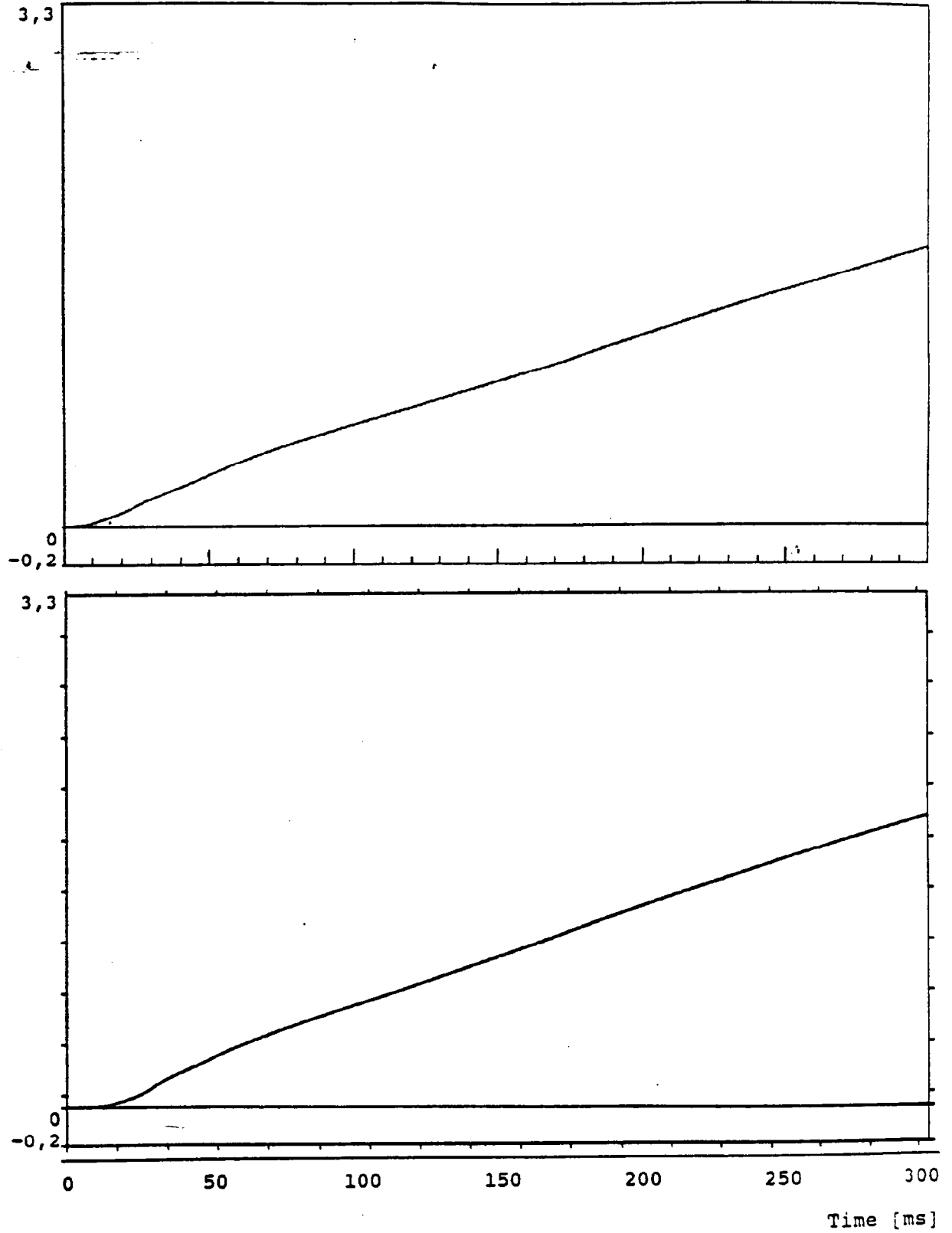


Figure B3/47

DISPLACEMENT LEFT REAR DOOR MID Y AXIS (CAR)

Acceleration [g]

B3-48

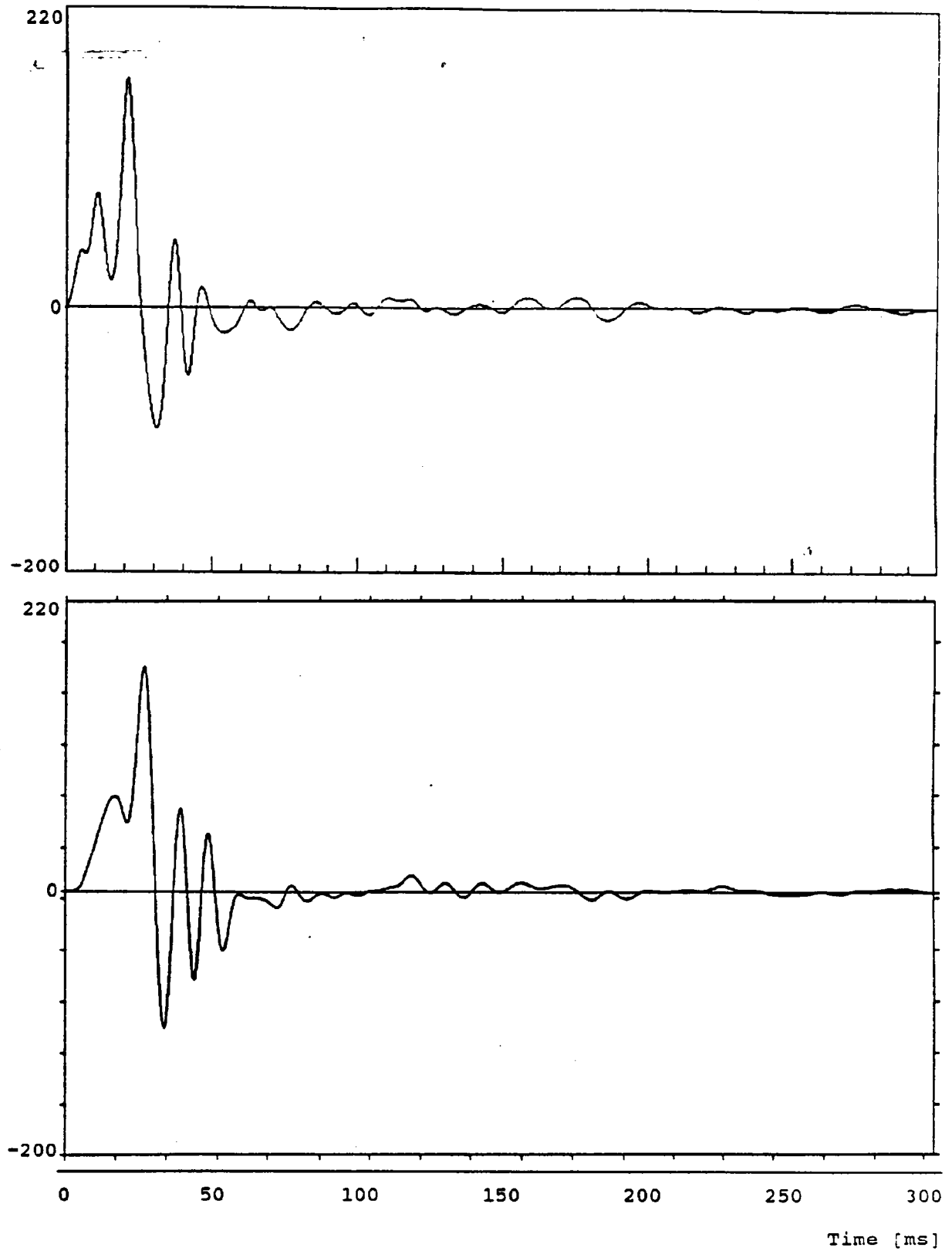


Figure B3/48

ACCELERATION UPPER LEFT REAR DOOR Y AXIS (CAR)

Velocity [m/s] (computed)

B3-49

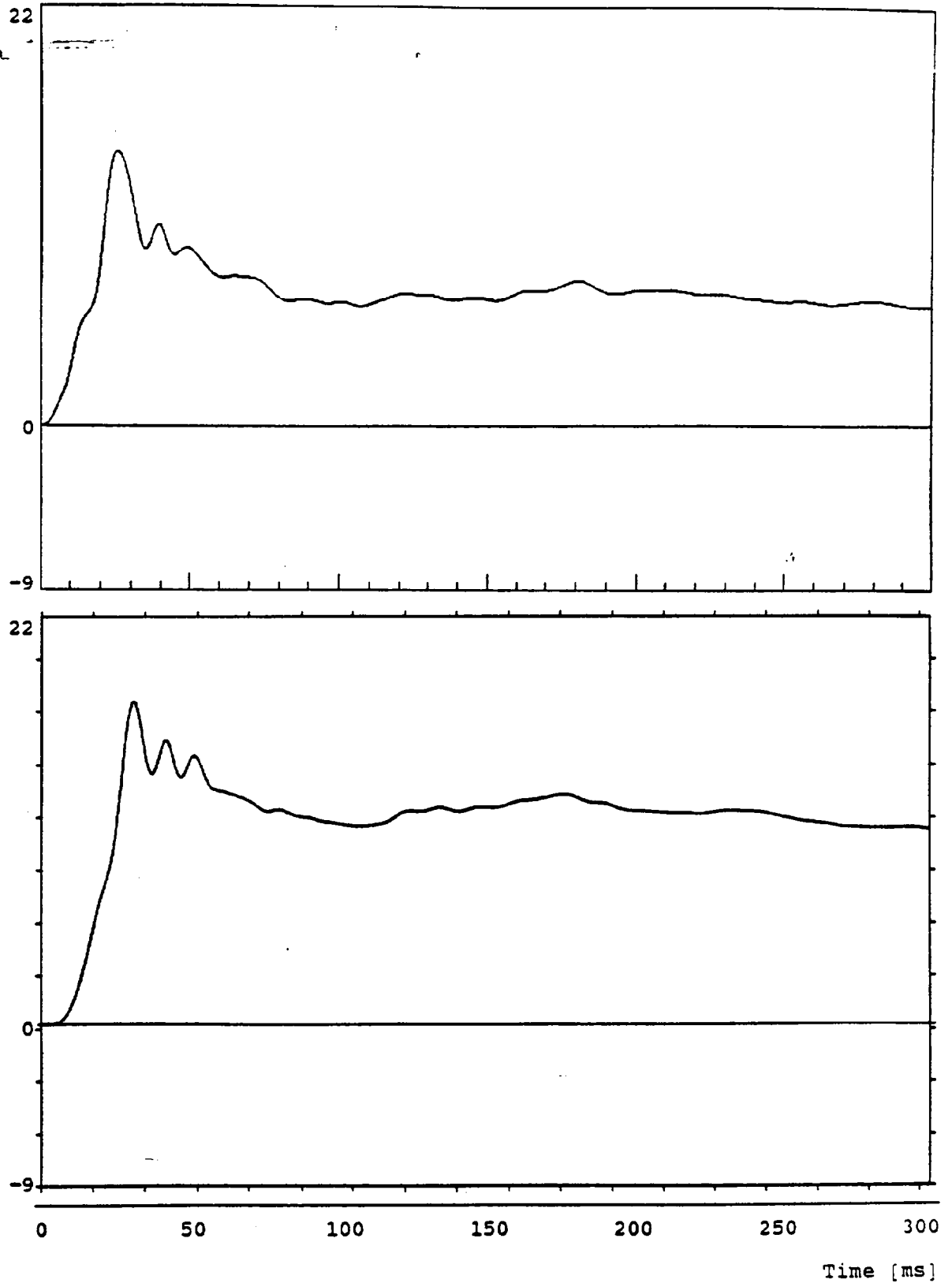


Figure B3/49

VELOCITY UPPER LEFT REAR DOOR Y AXIS (CAR)

Displacement [m] (computed)

B3-50

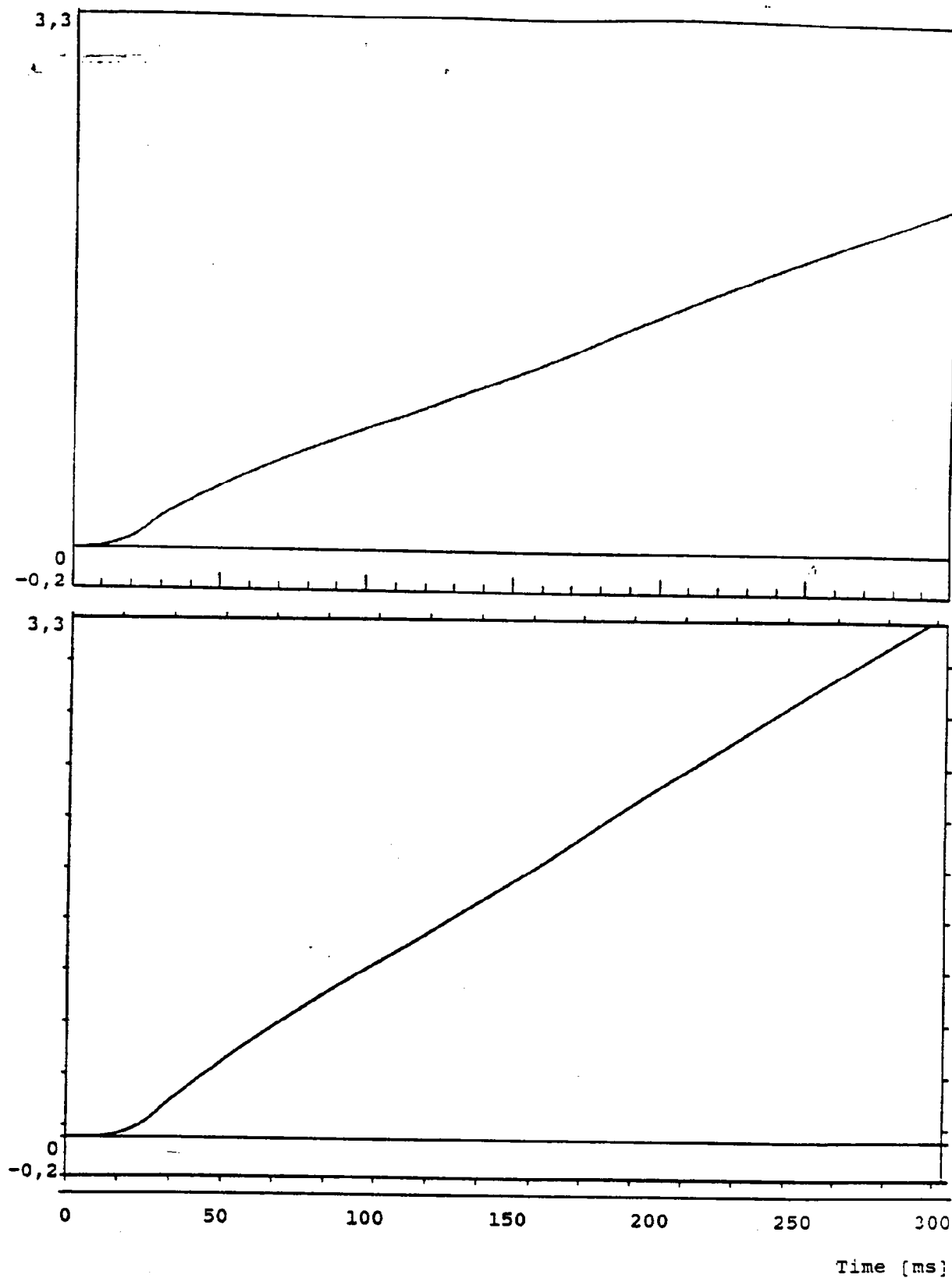


Figure B3/50

DISPLACEMENT UPPER LEFT REAR DOOR Y AXIS (CAR)

Acceleration [g]

B3-51

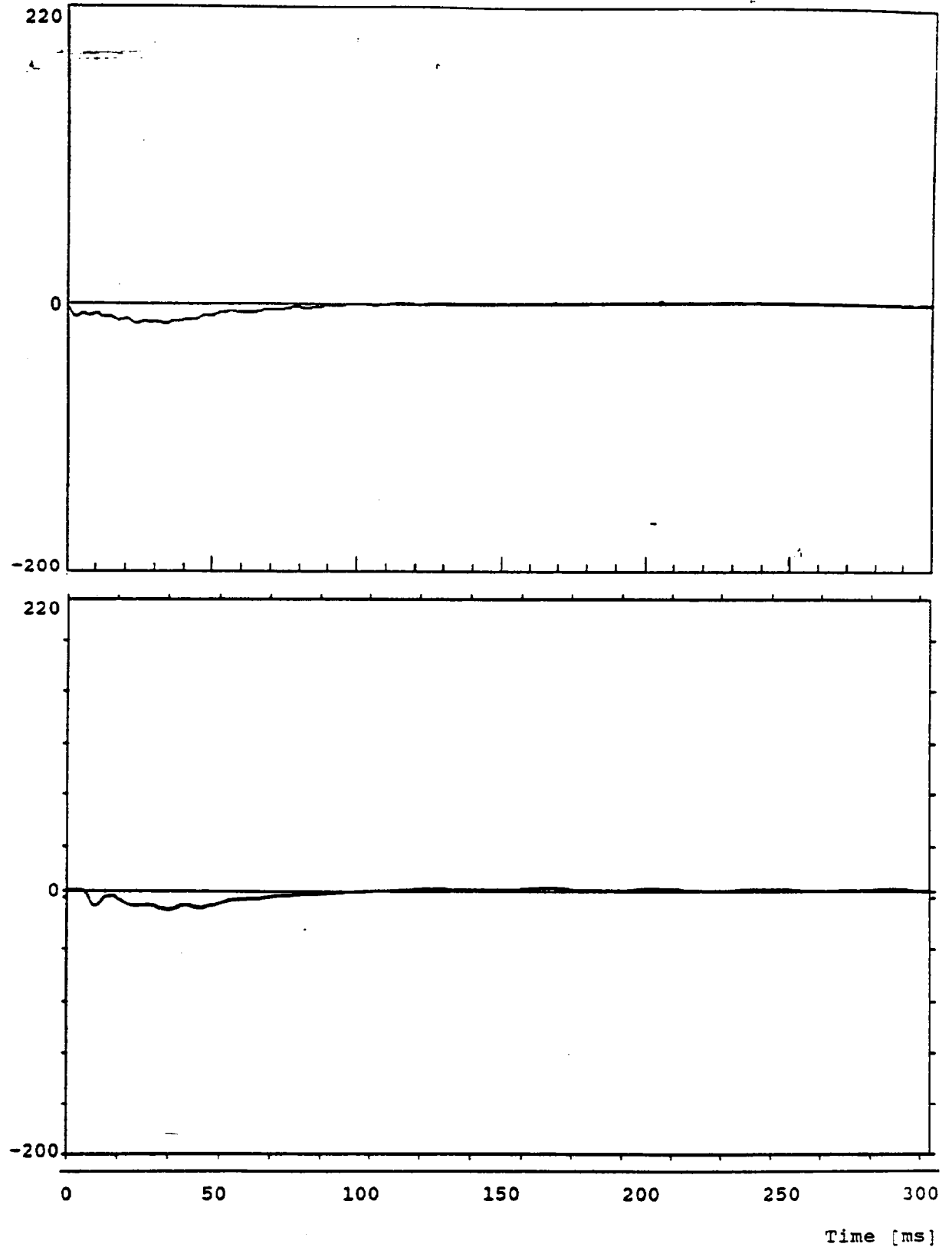


Figure B3/51

ACCELERATION CENTER OF GRAVITY X AXIS (BARRIER)

Velocity [m/s] (computed)

B3-52

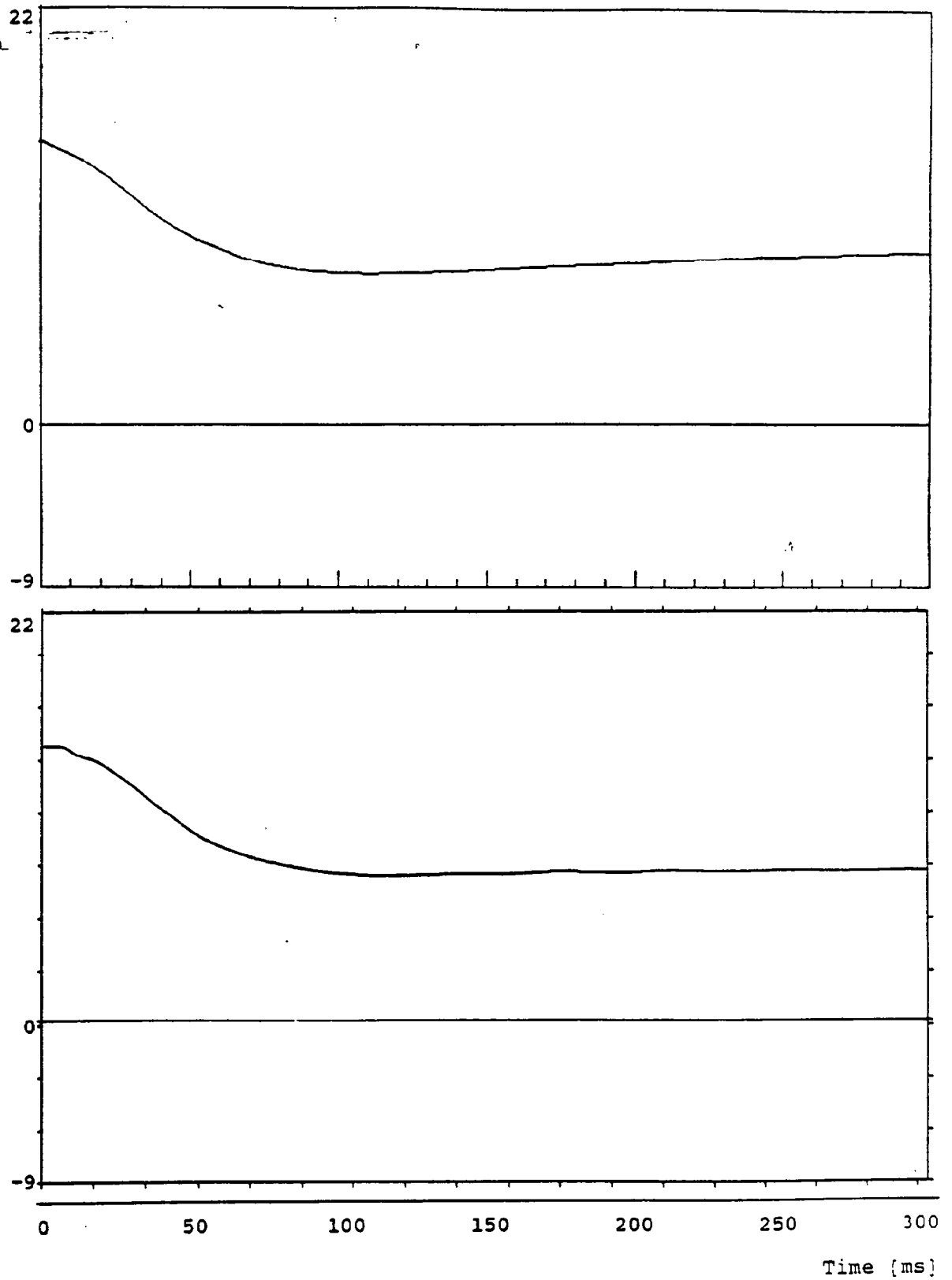


Figure B3/52

VELOCITY CENTER OF GRAVITY X AXIS (BARRIER)

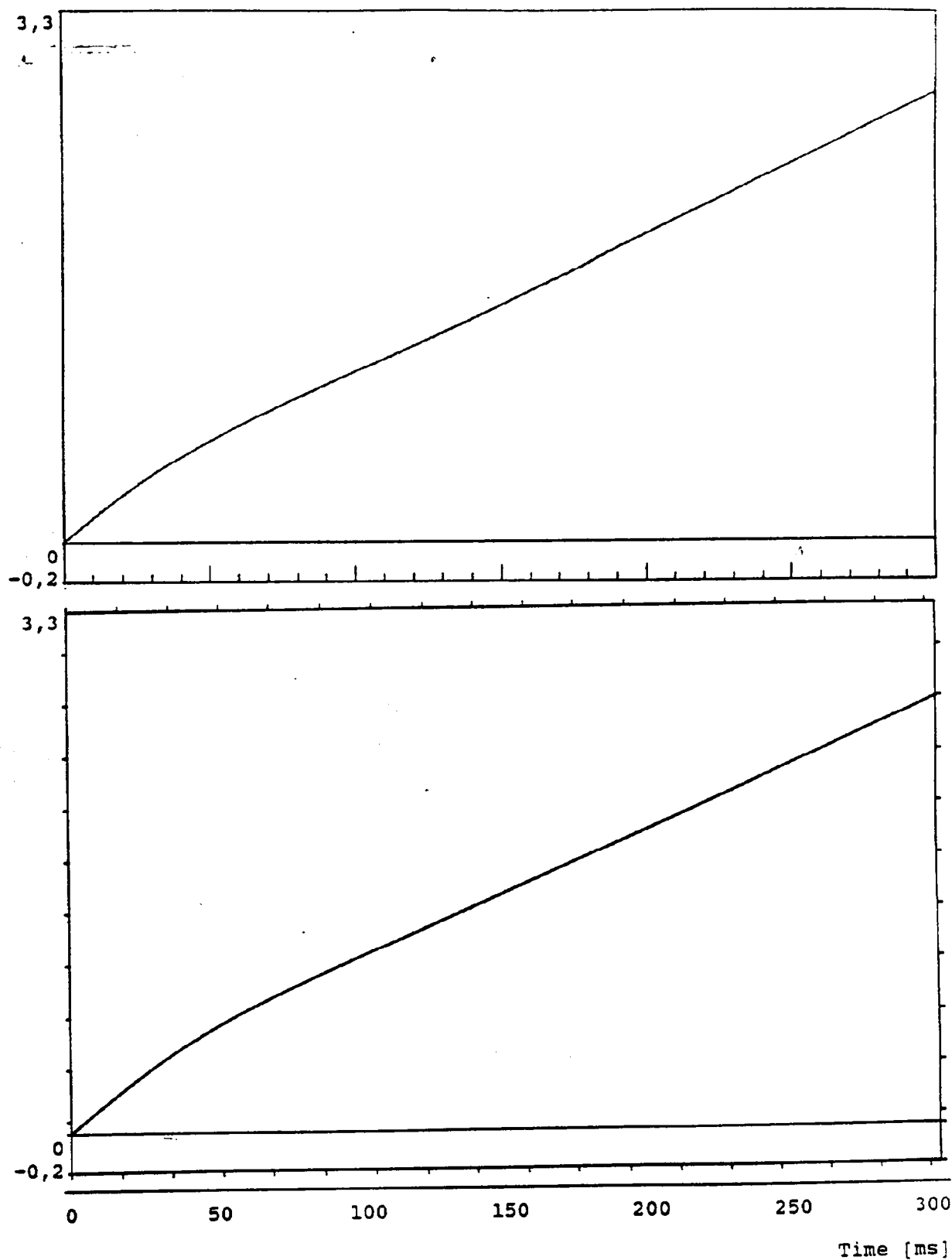


Figure B3/53

DISPLACEMENT CENTER OF GRAVITY X AXIS (BARRIER)

Acceleration [g]

B3-54

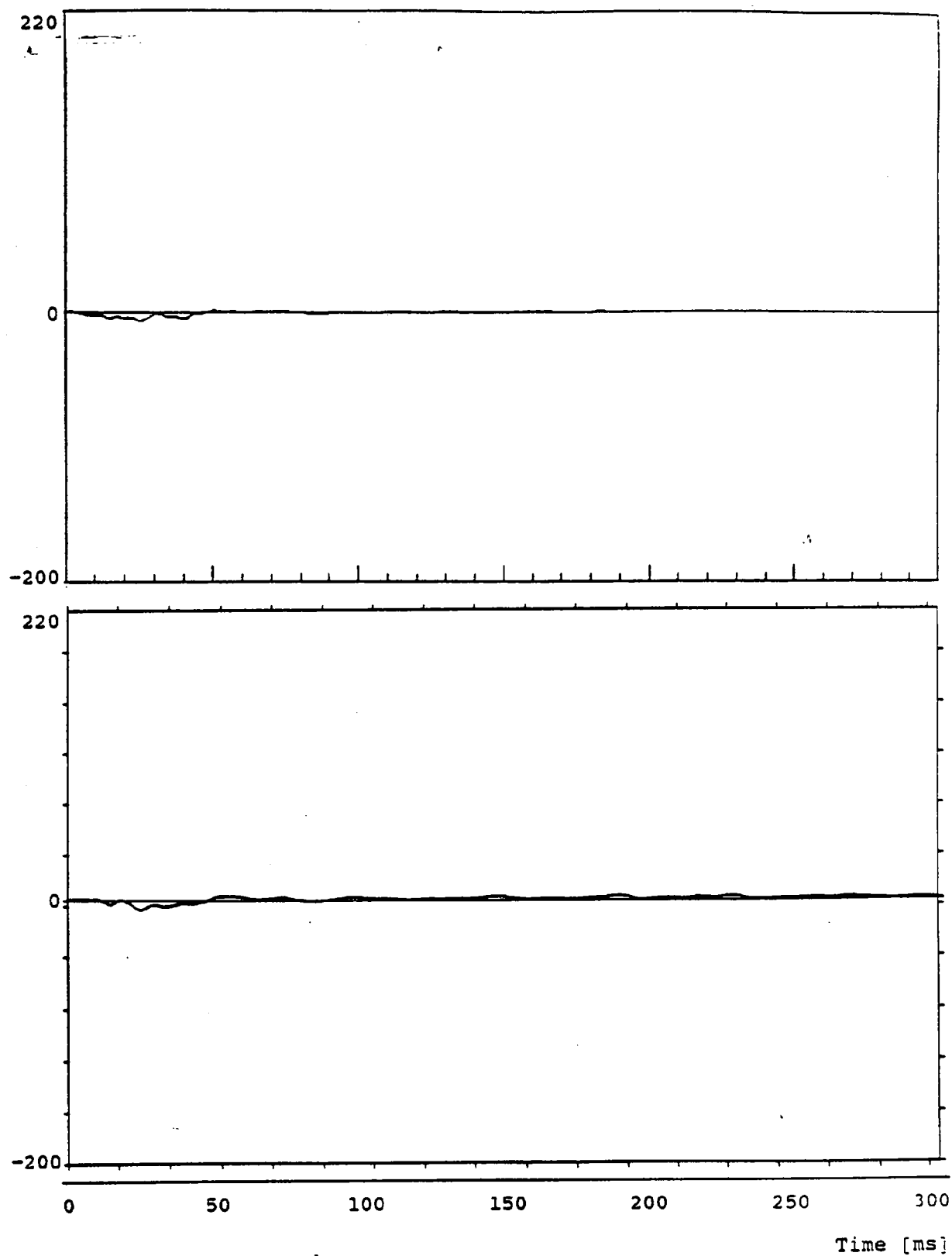


Figure B3/54

ACCELERATION CENTER OF GRAVITY Y AXIS (BARRIER)

Acceleration [g]

B3-55

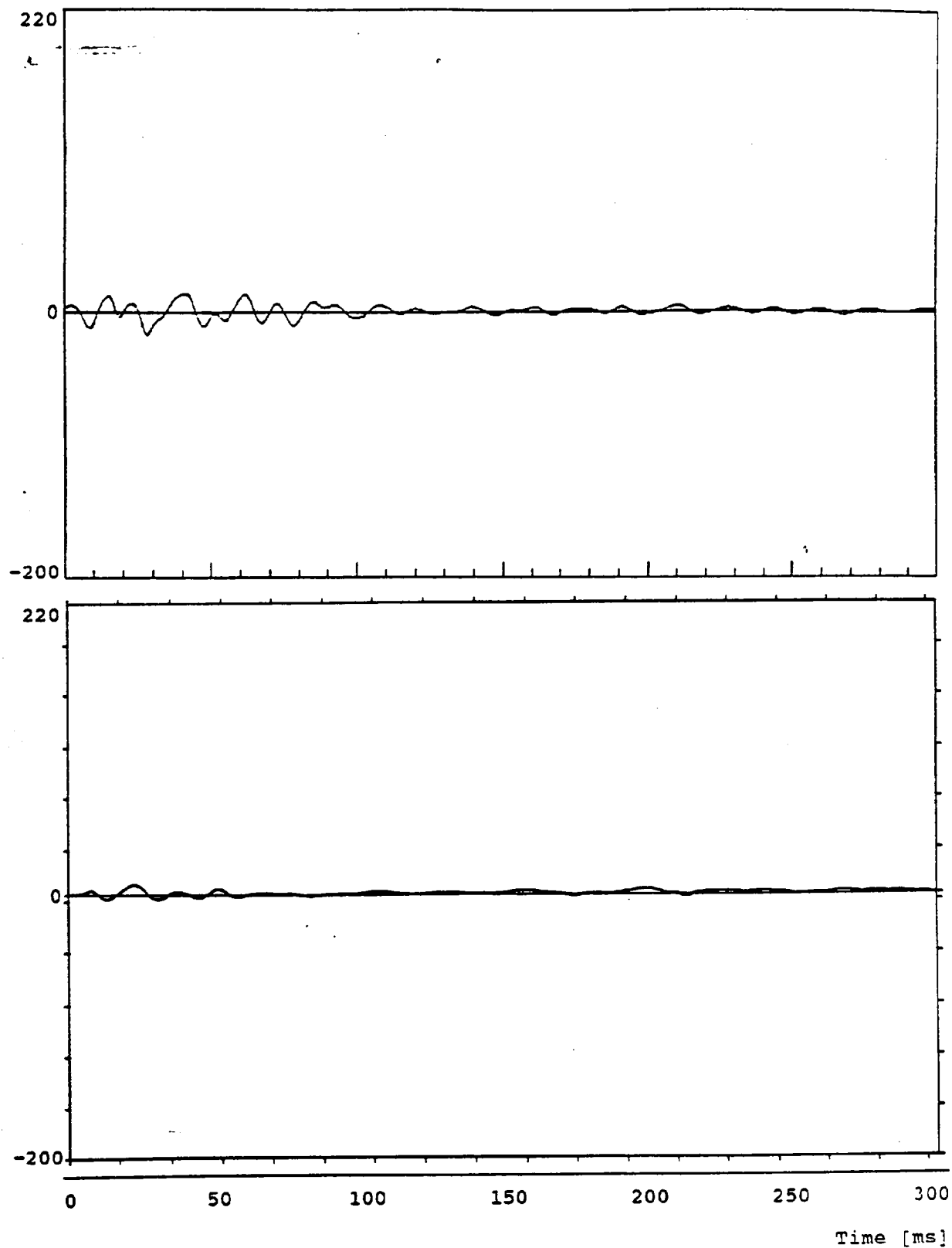


Figure B3/55

ACCELERATION CENTER OF GRAVITY Z AXIS (BARRIER)

Acceleration [g] (computed)

B3-56

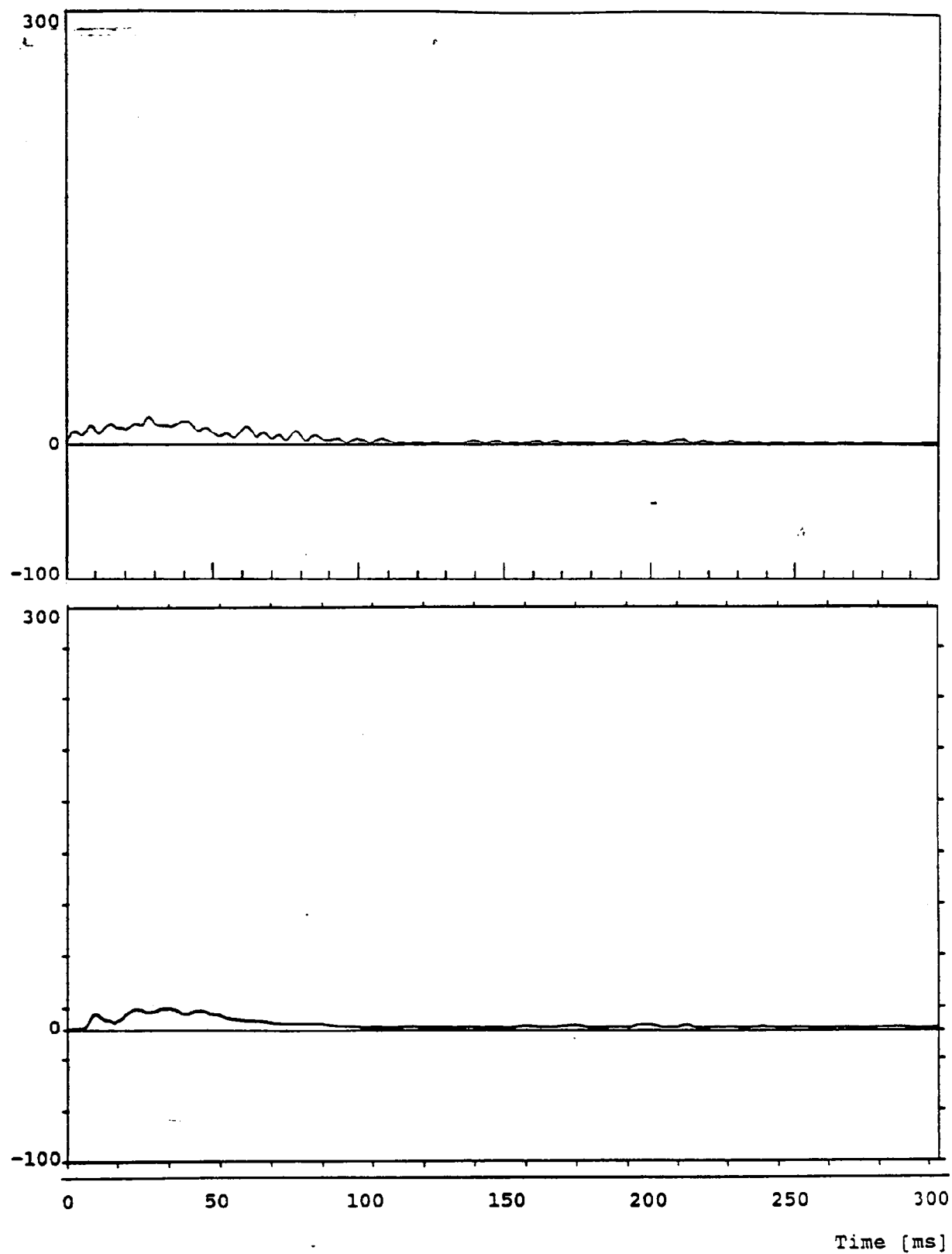


Figure B3/56

ACCELERATION CENTER OF GRAVITY RS AXIS (BARRIER)

Acceleration [g]

B3-57

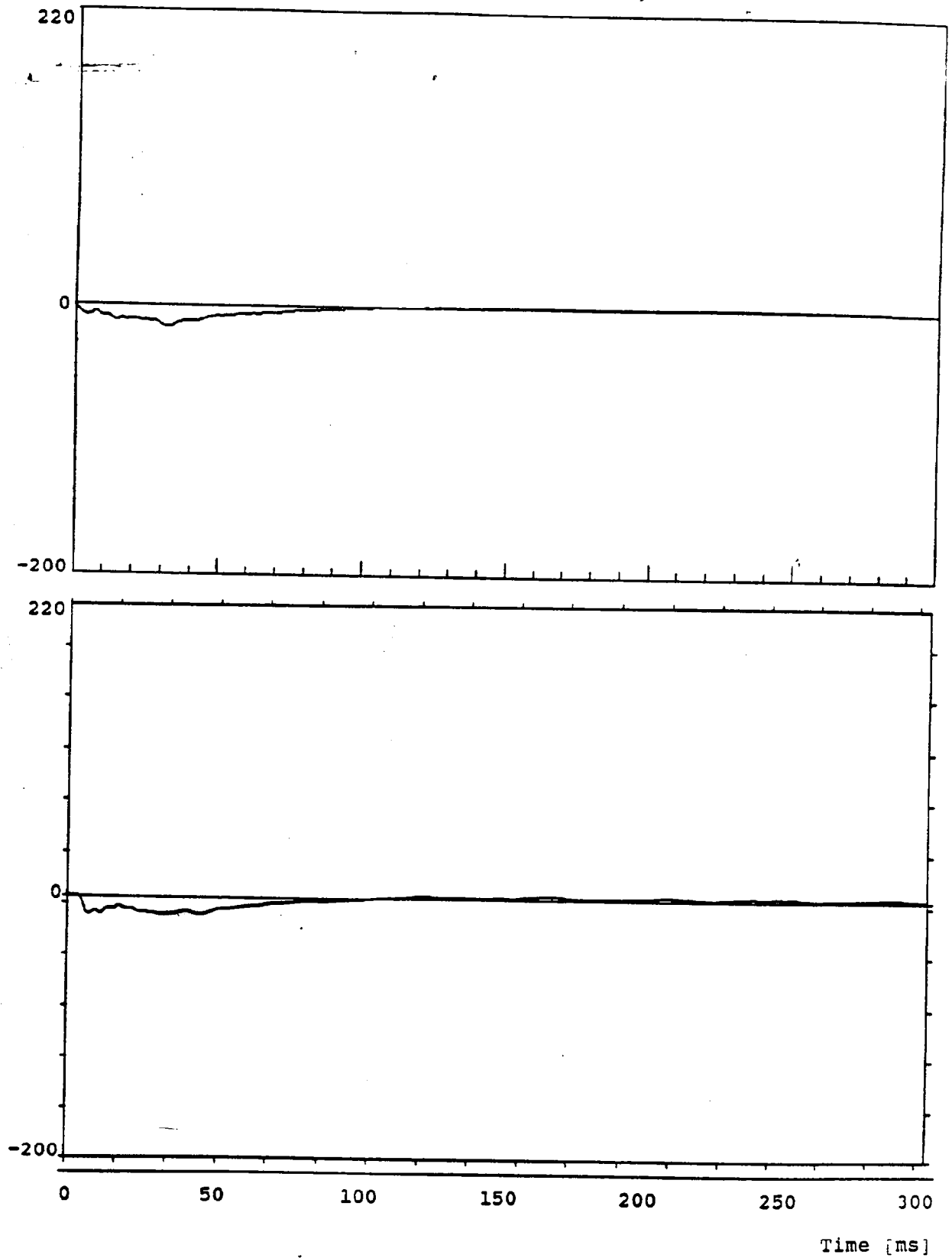


Figure B3/57

ACCELERATION FRONT FRAME CL X AXIS (BARRIER)

Velocity [m/s] (computed)

B3-53

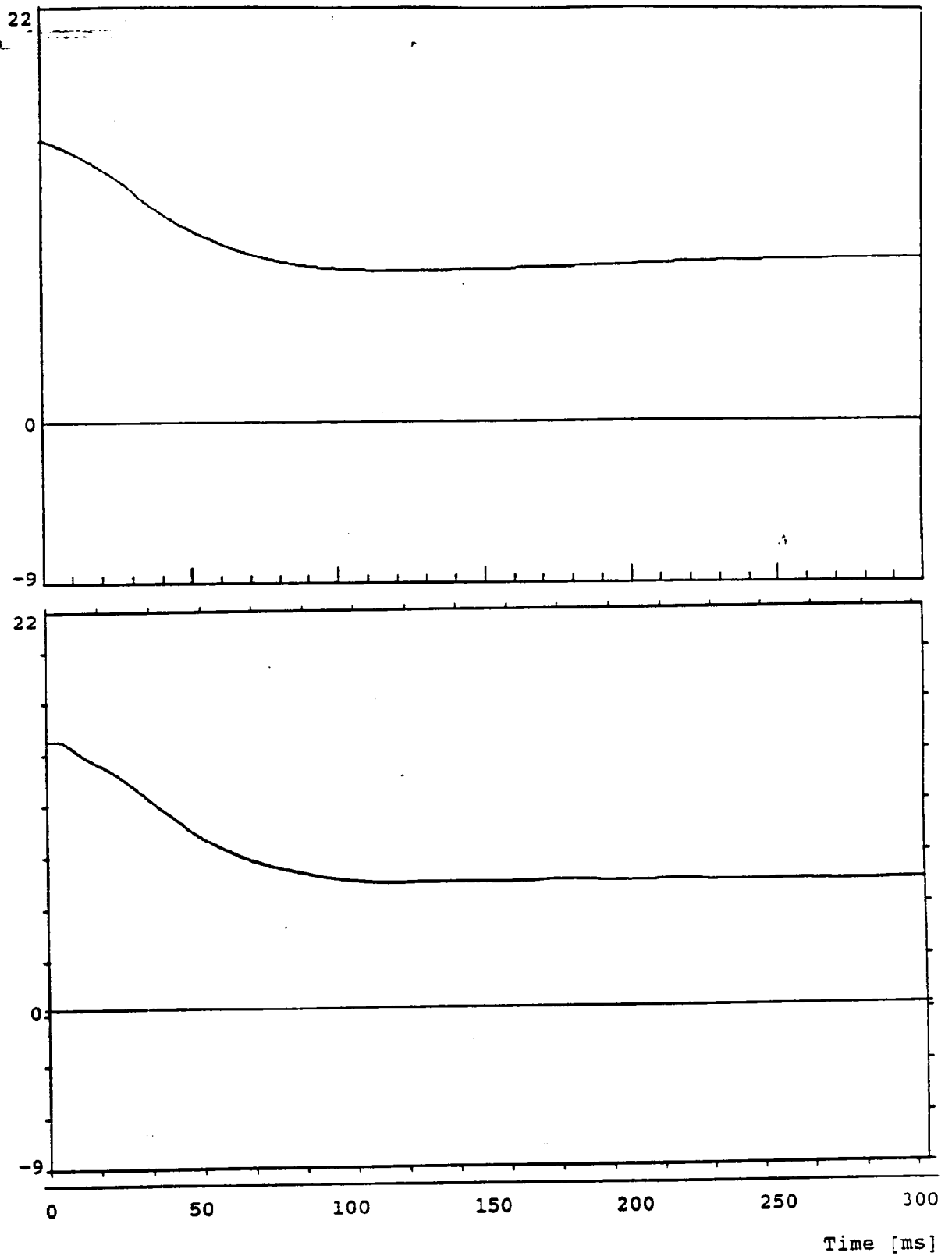


Figure B3/58

VELOCITY FRONT FRAME CL X AXIS (BARRIER)

Displacement [m] (computed)

B3-59

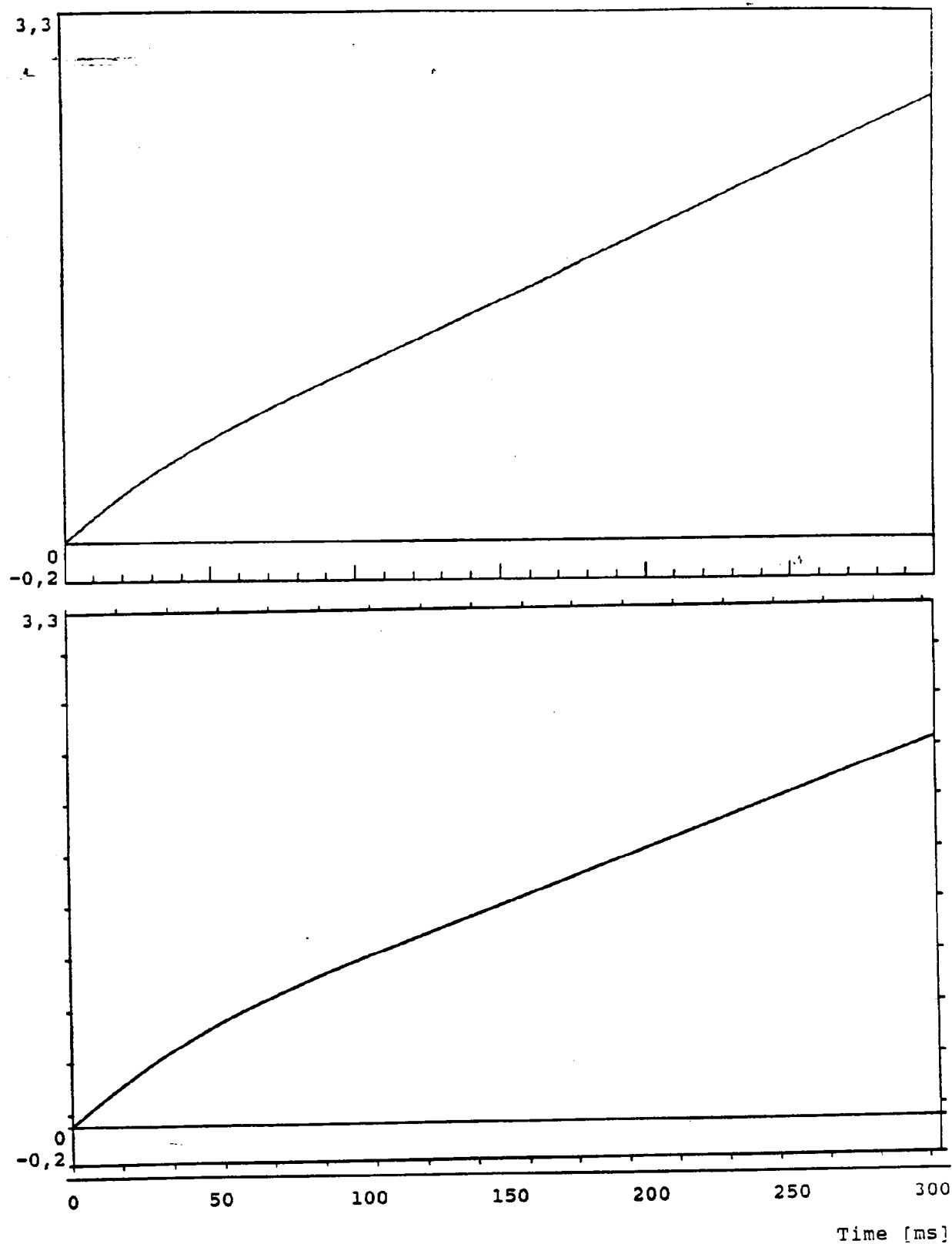
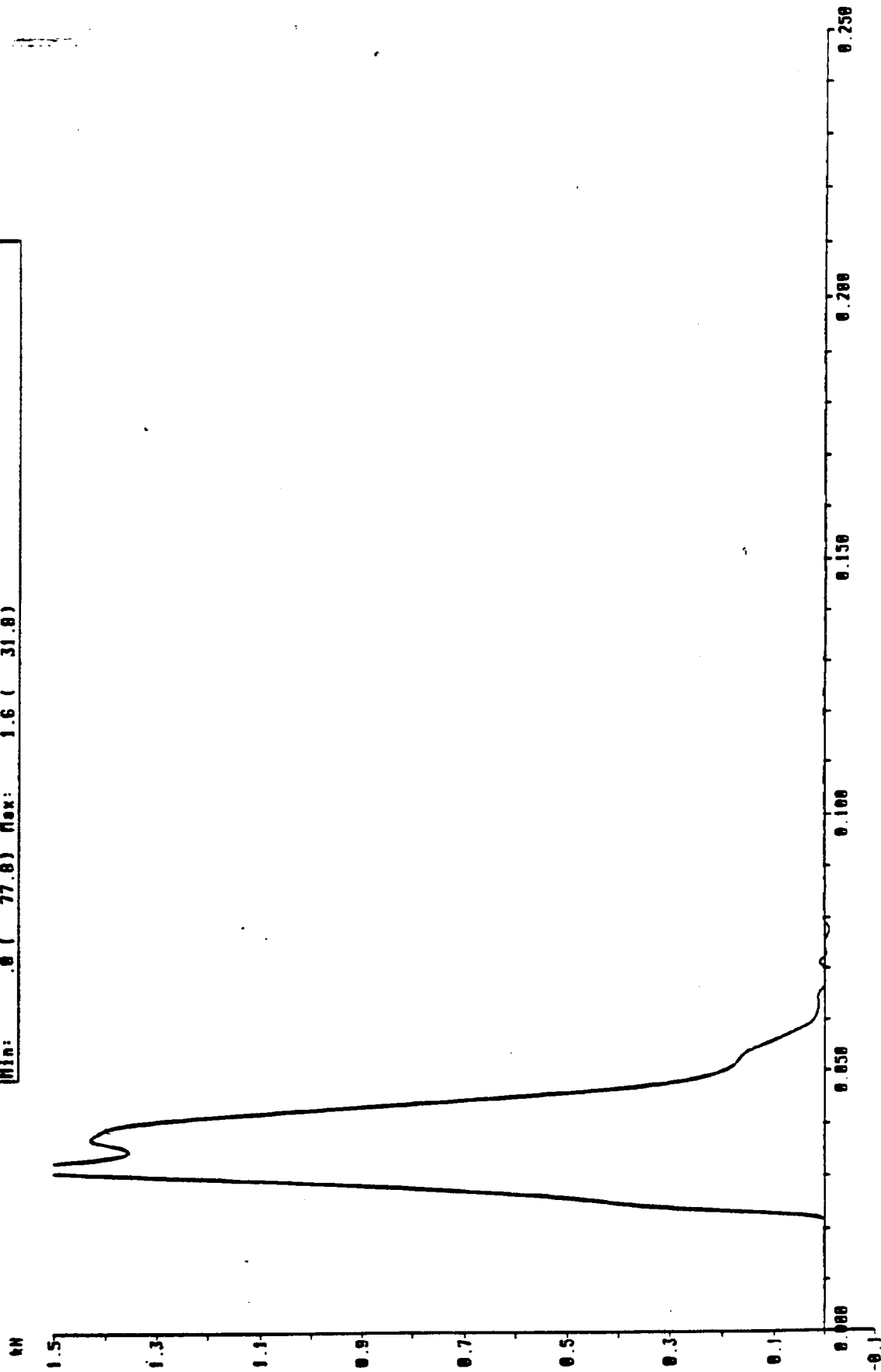


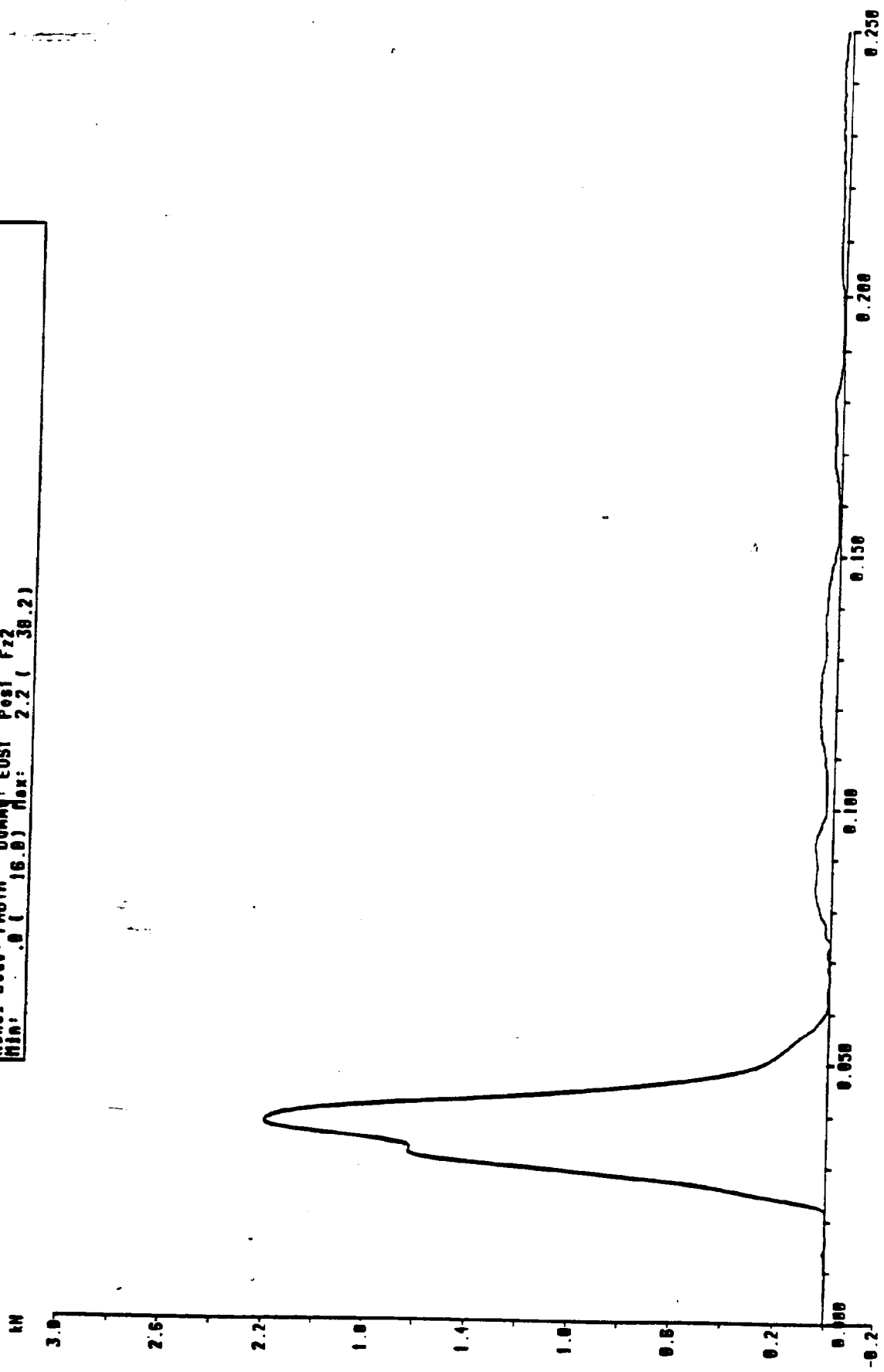
Figure B3/59

DISPLACEMENT FRONT FRAME CL X AXIS (BARRIER)

BASt Unfallforschung UVH 25.03.1991
Versuch: VSE02 vom: 21.03.91
Kennel-Code: FABVH Dummy: EUS1 Pos1 Fz2
Min: 0 (77.8) Max: 1.6 (31.8)

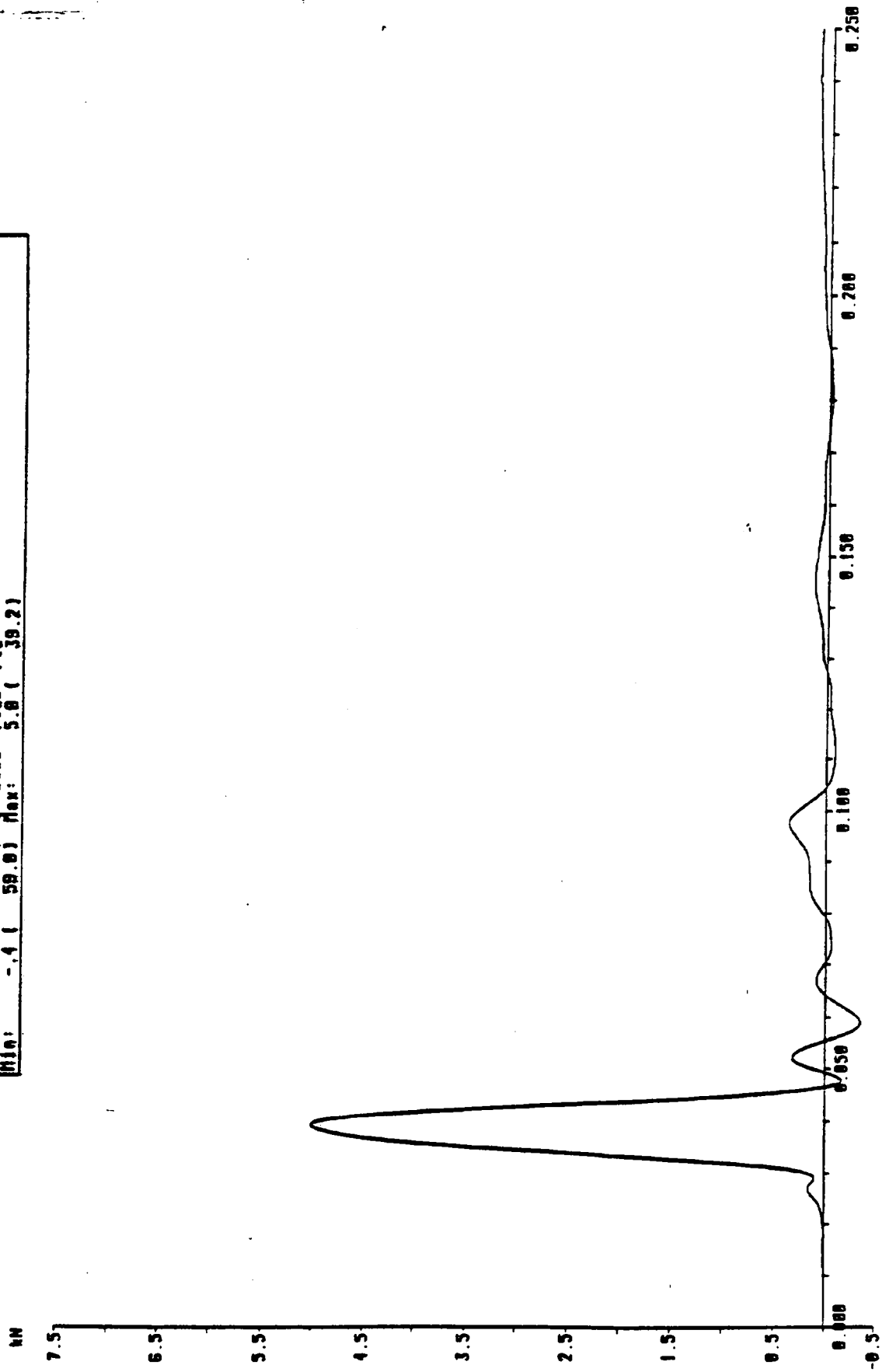


BAST Unfallforschung UVH
Versuch: VSE02 vom: 21.03.91 25.03.1991
Kanal-Code: FABYH Datum: EUSI Post Fz2
Min: .0 (16.0) Max: 2.2 (38.2)



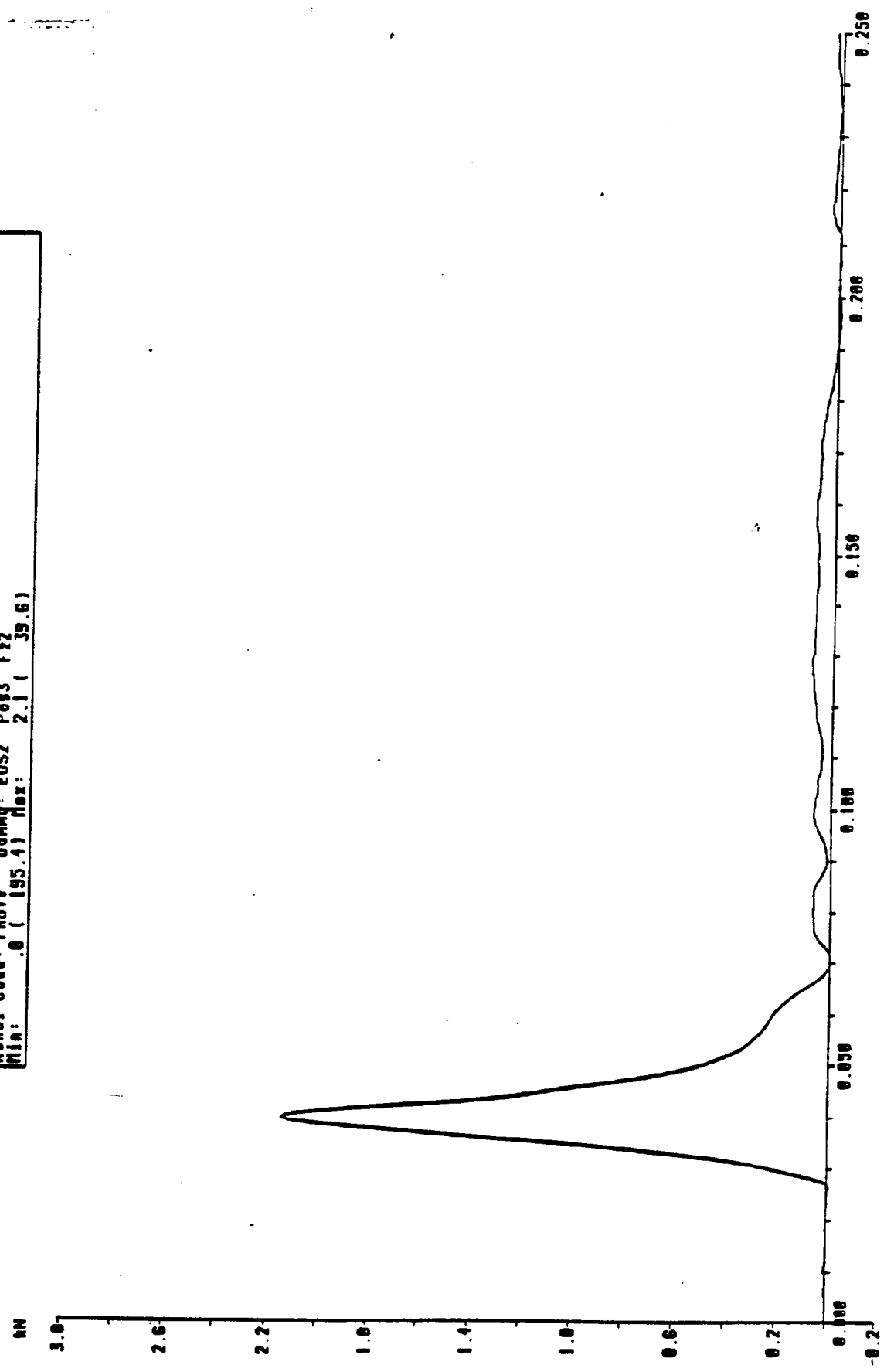
BAST Unfallforschung UVM
Versuch: VSEB2 vom: 21.03.91
Kanal-Code: FPUY Dummy: EUS2 Pos3 F72
Min: -4 (59.8) Max: 5.8 (39.2)

25.03.1991



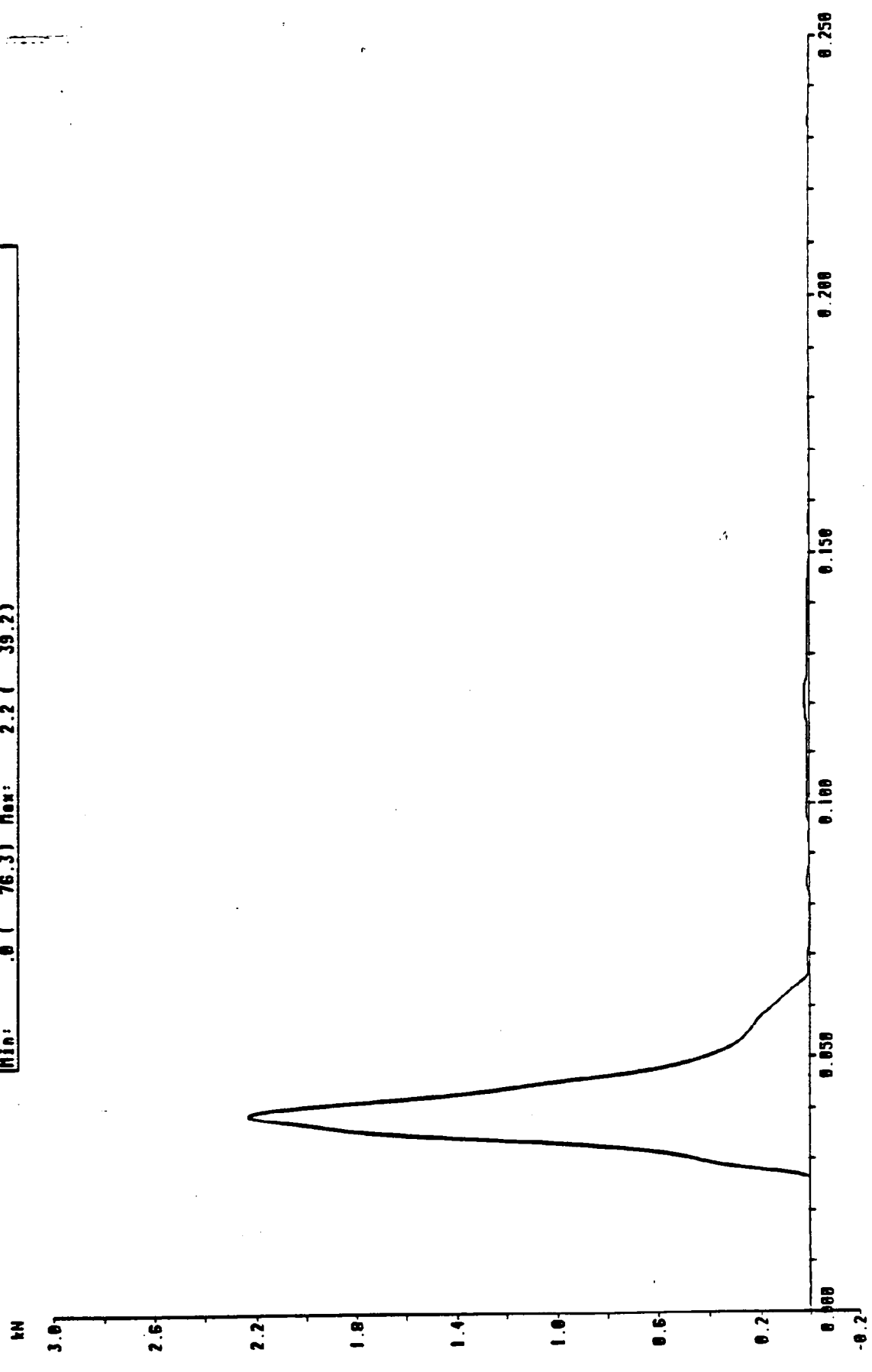
BAST Unfallforschung UVH
Versuch: YSE02 vom: 21.03.91
Kanal-Code: FABVY Datum: EUS2 Pos3 Fz2
Min: .0 (195.4) Max: 2.1 (39.6)

25.03.1991

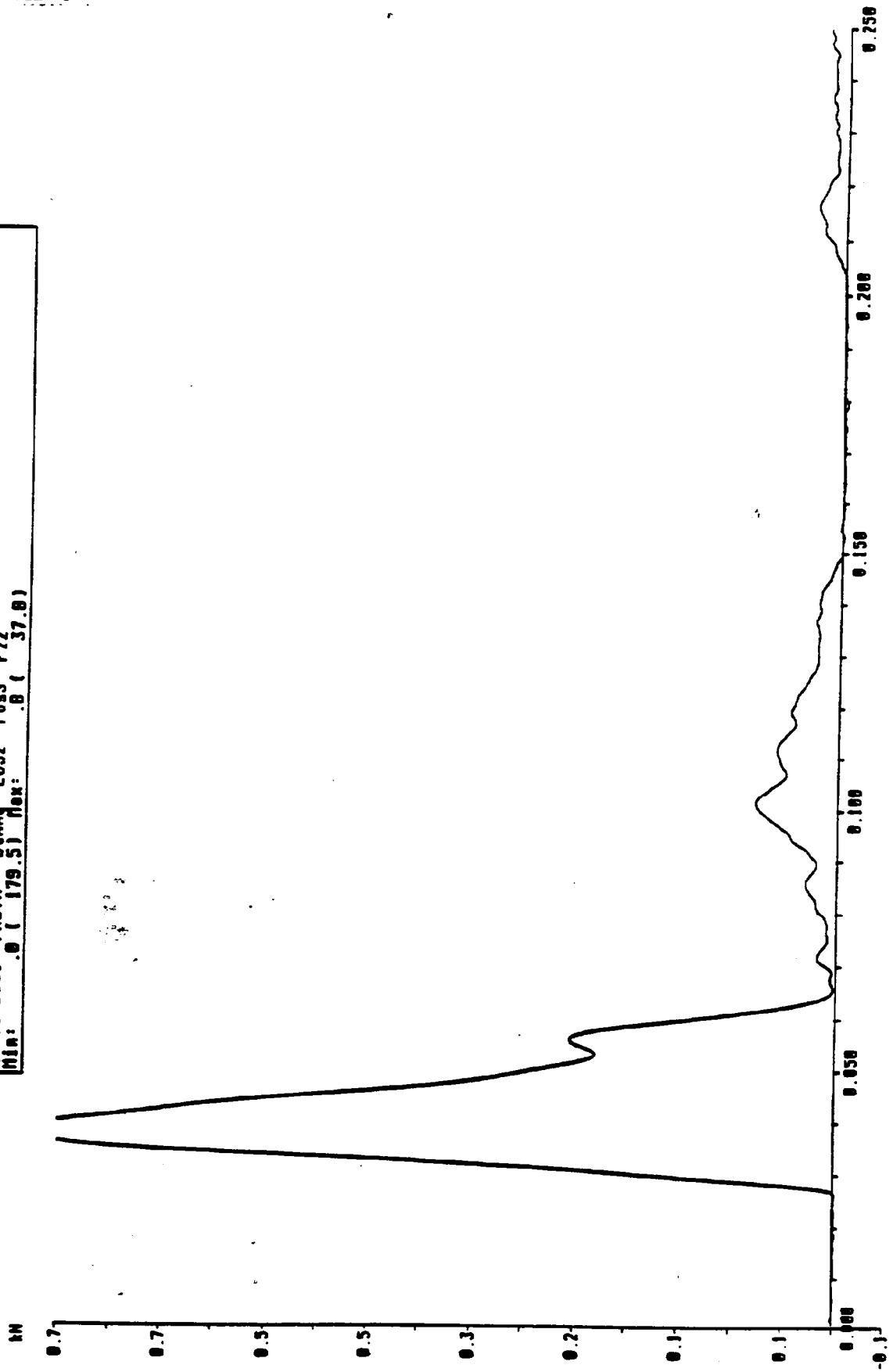


BASt Unfallforschung UVH
Versuch: VSE02 vom: 21.03.91
Kanal-Code: FABYM Dummy: EUS2 Pos3 F12
Min: .0 (76.3) Max: 2.2 (39.2)

25.03.1991



BAST Unfallforschung UVM
Versuch: VSE02 vom: 21.03.91
Kanal-Code: FABYH Dummy: EUS2 Pos3 Fz2
Min: 0 (179.5) Max: 0 (37.0)



Acceleration [g]

B3-60

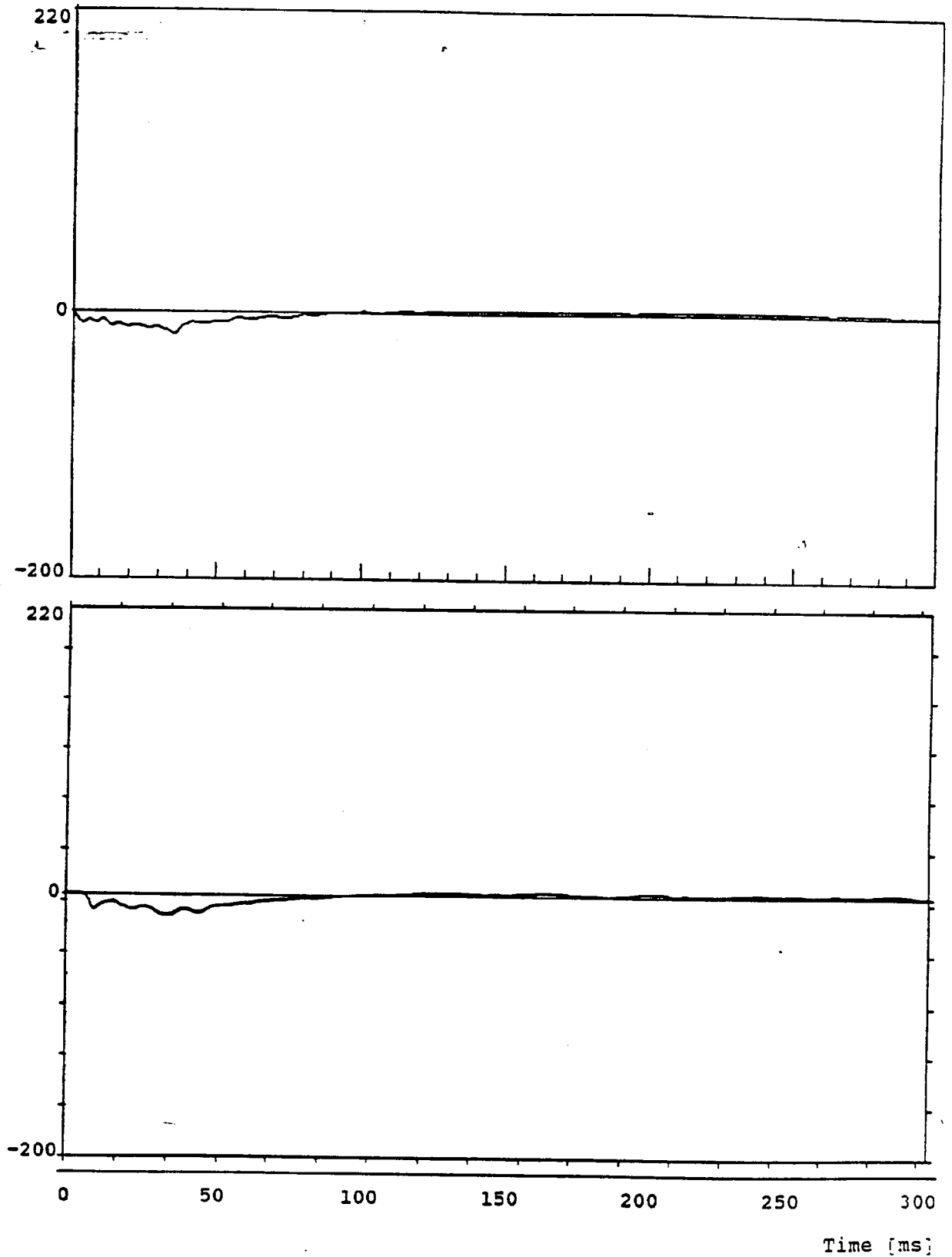


Figure B3/60

ACCELERATION REAR FRAME CL X AXIS (BARRIER)

Velocity [m/s] (computed)

B3-61

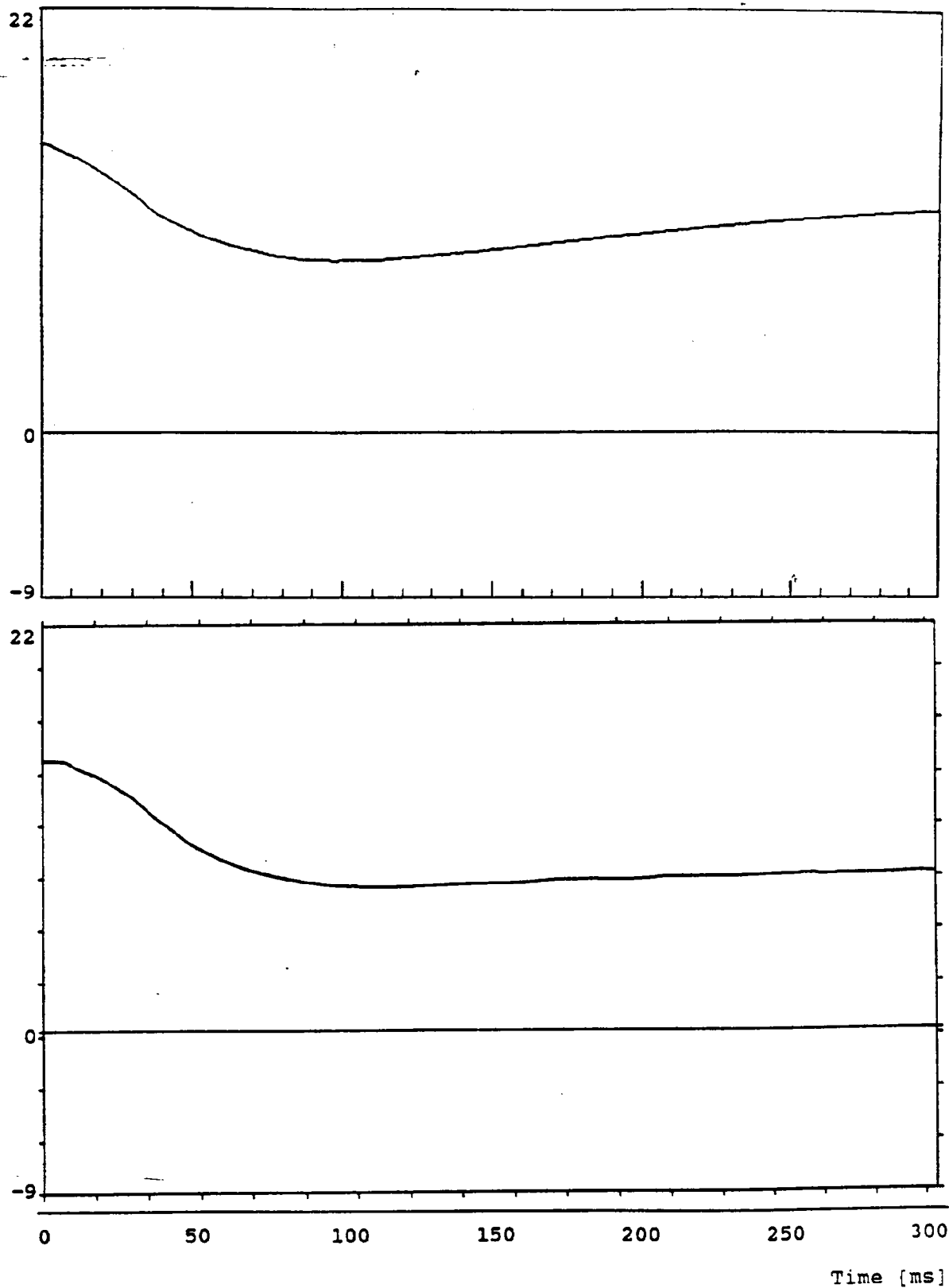


Figure B3/61

VELOCITY REAR FRAME CL X AXIS (BARRIER)

Displacement [m] (computed)

B3-62

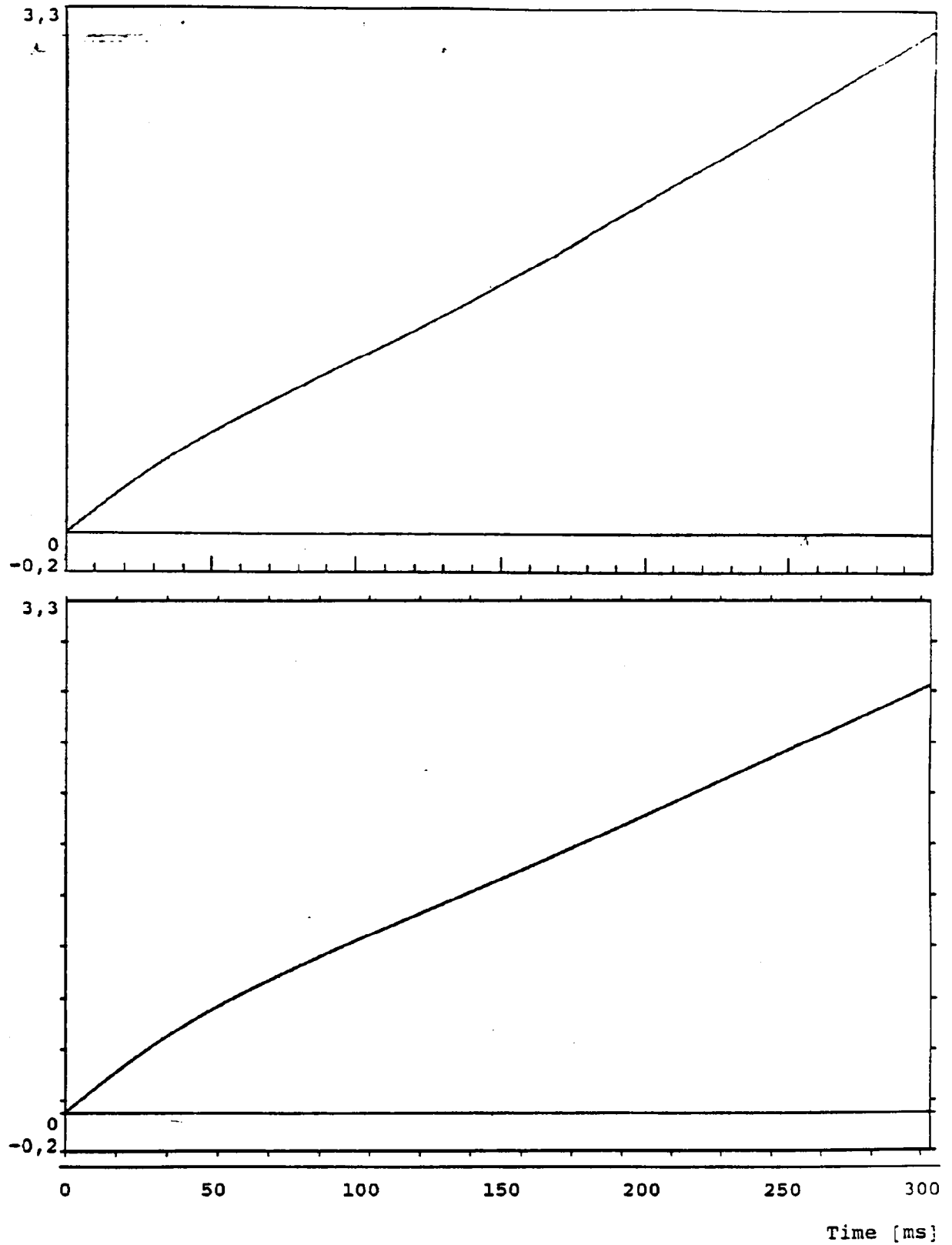
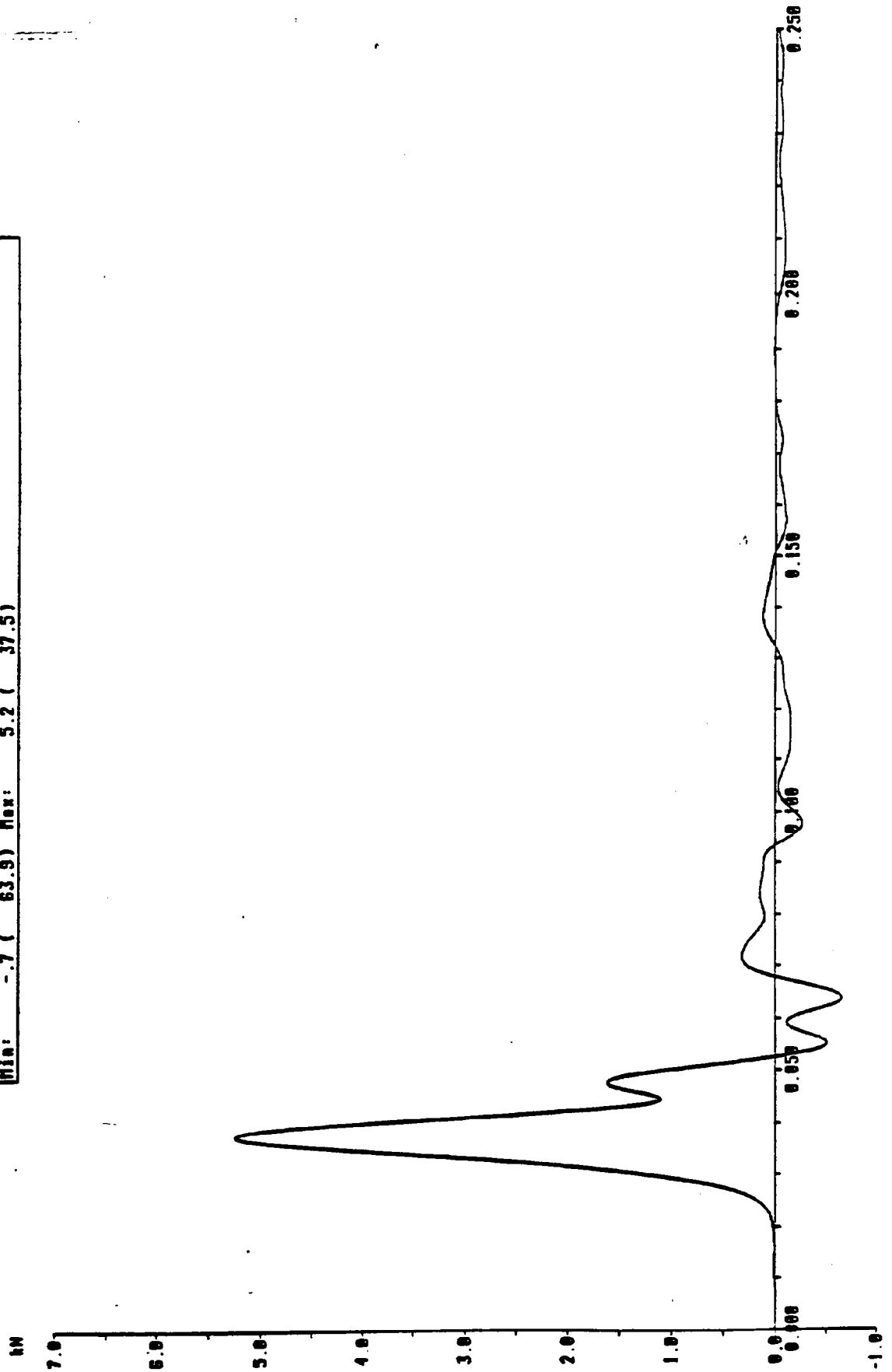


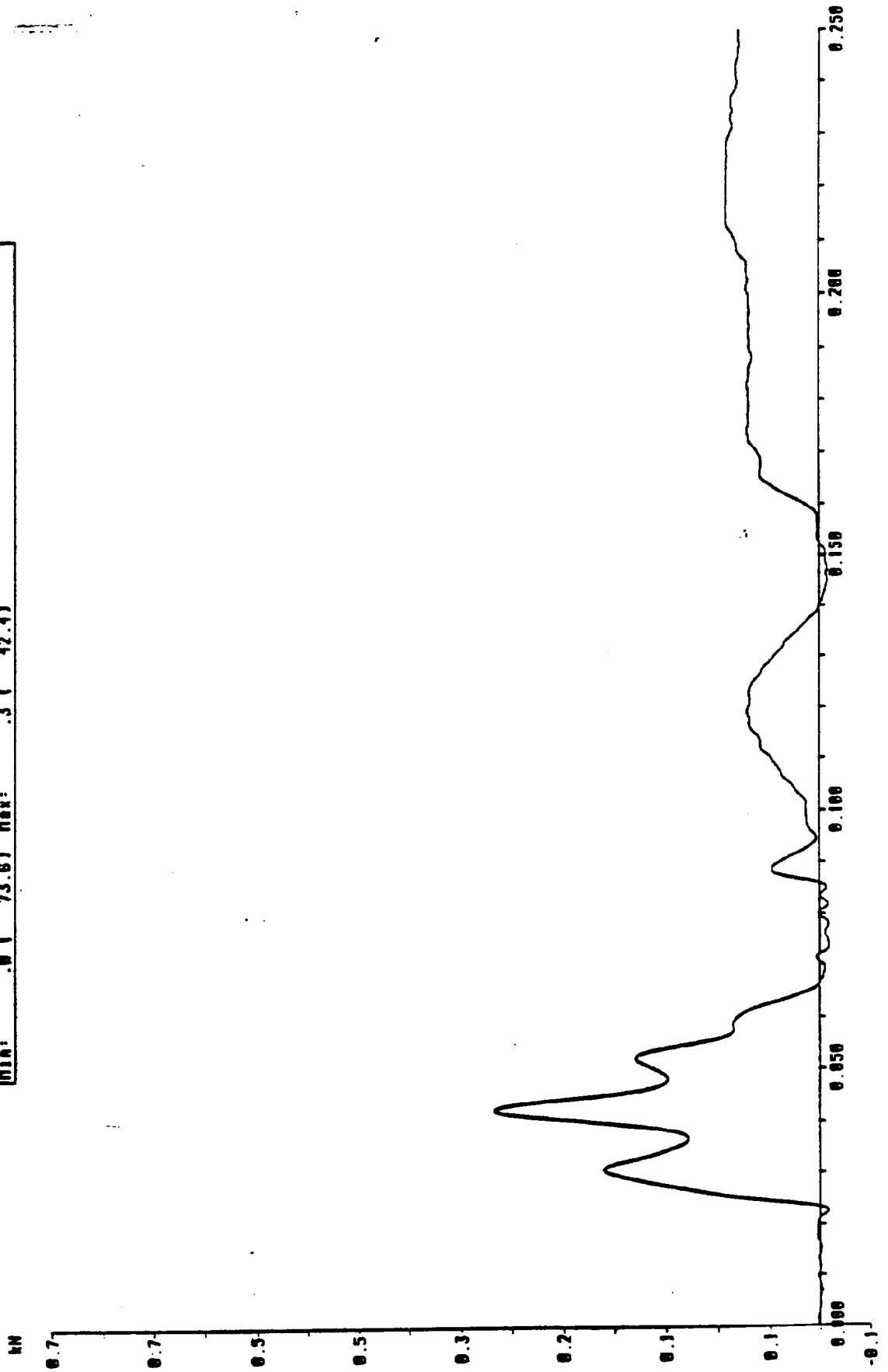
Figure B3/62

DISPLACEMENT REAR FRAME CL X AXIS (BARRIER)

BAST Unfallforschung UVM 25.03.1991
Versuch: VSE02 vom: 21.03.91
Kanal-Code: FPUY Dummy: EUSI Post: F22
Min: -.7 (63.9) Max: 5.2 (37.5)

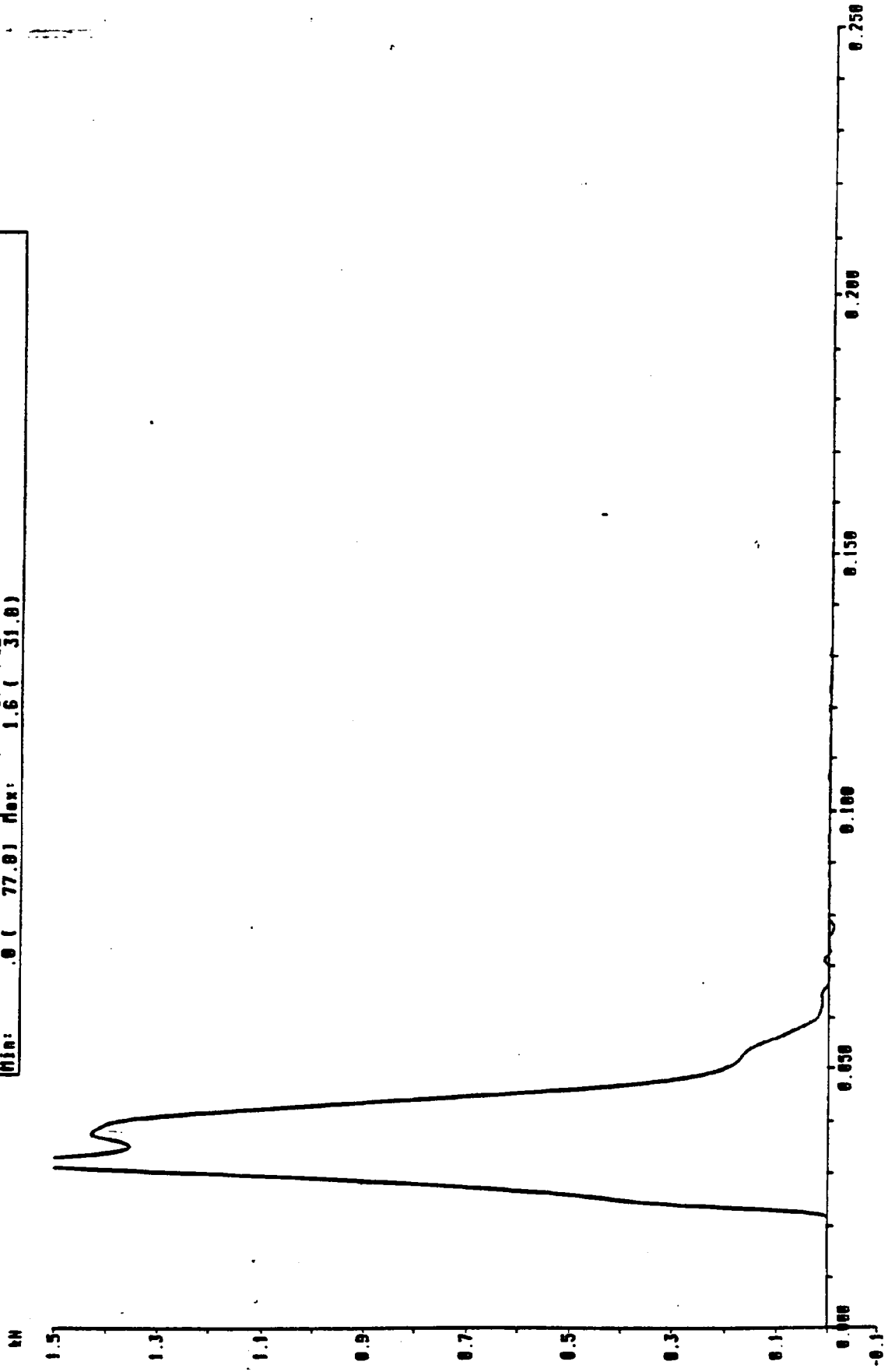


BAST Unfallforschung UVM 25.03.1991
Versuch: VSE02 von: 21.03.91
Kanal-Code: FABV Dummy: EUSI Post Fz2
Min: .0 (73.6) Max: .3 (42.4)

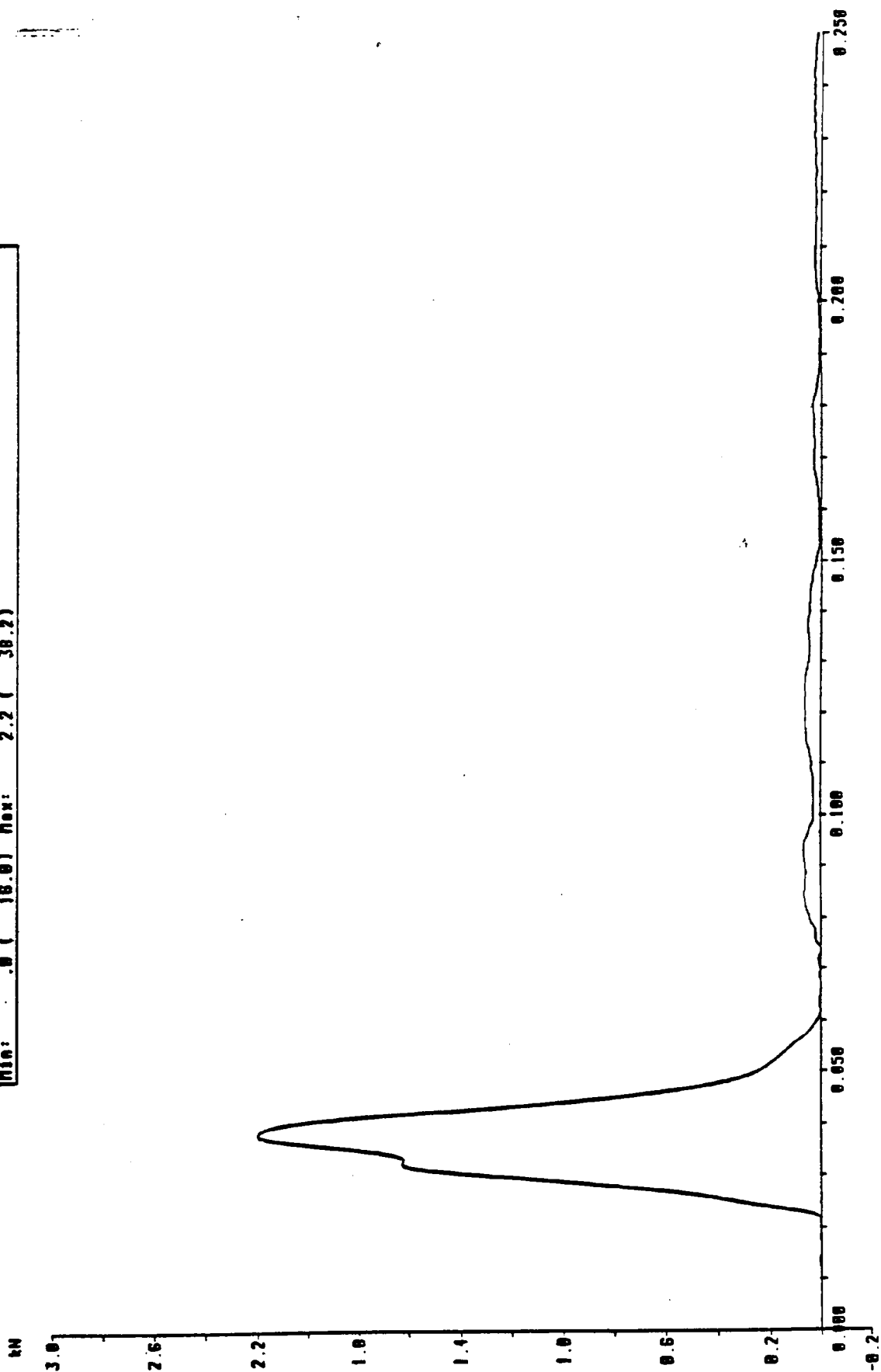


BASt Unfallforschung UVH
Versuch: VSEB2 vom: 21.03.91
Kanal-Codo: FABYM Dummy: EUST Post F12
Min: .0 (77.8) Max: 1.6 (31.8)

25.03.1991

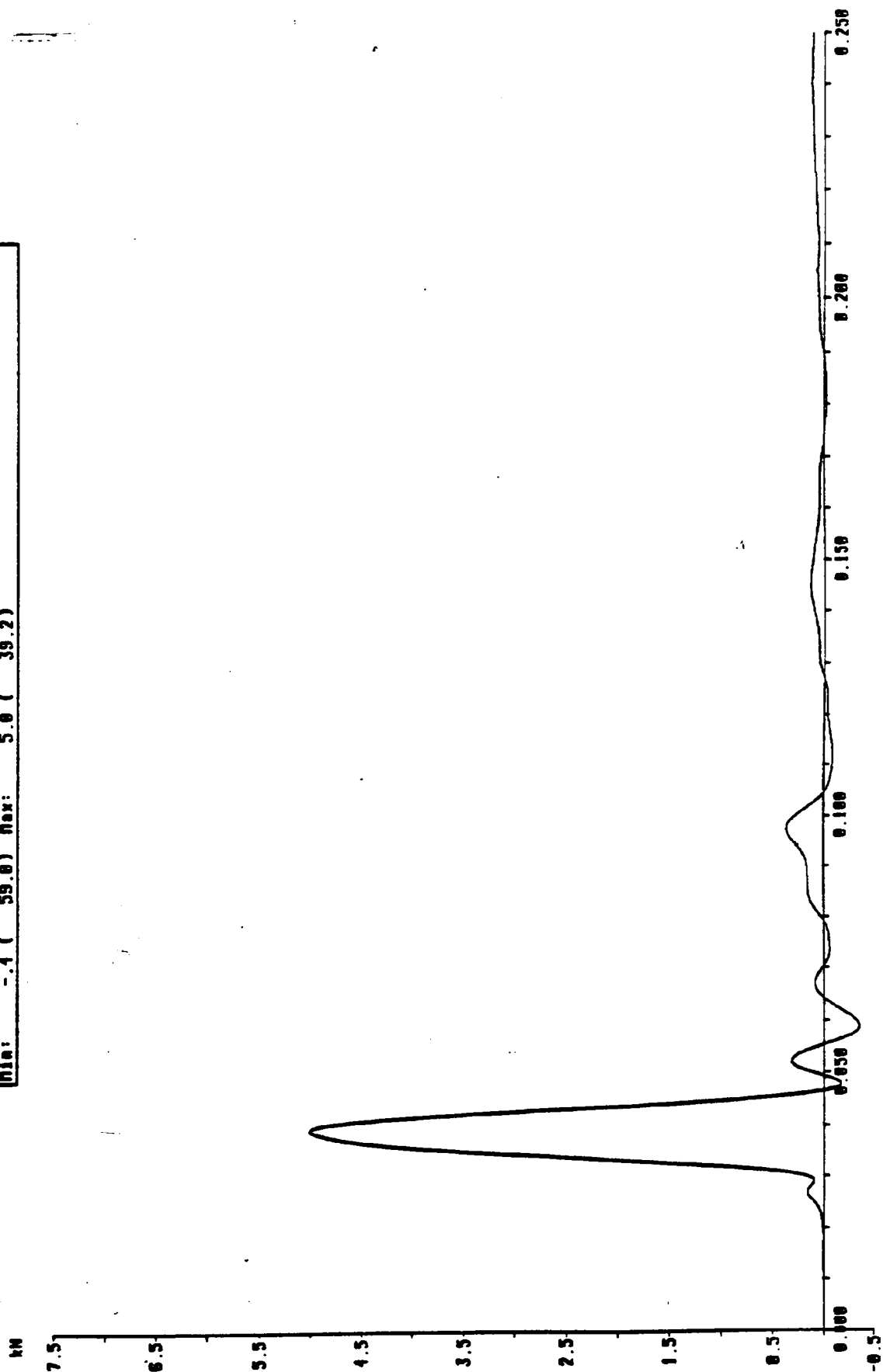


RASt Unfallforschung UVM
Versuch: VSE02 vom: 21.03.91
Kanal-Code: FABYH Dummy: EUS1 Pos1 Fz2
Min: .0 (18.0) Max: 2.2 (30.2)

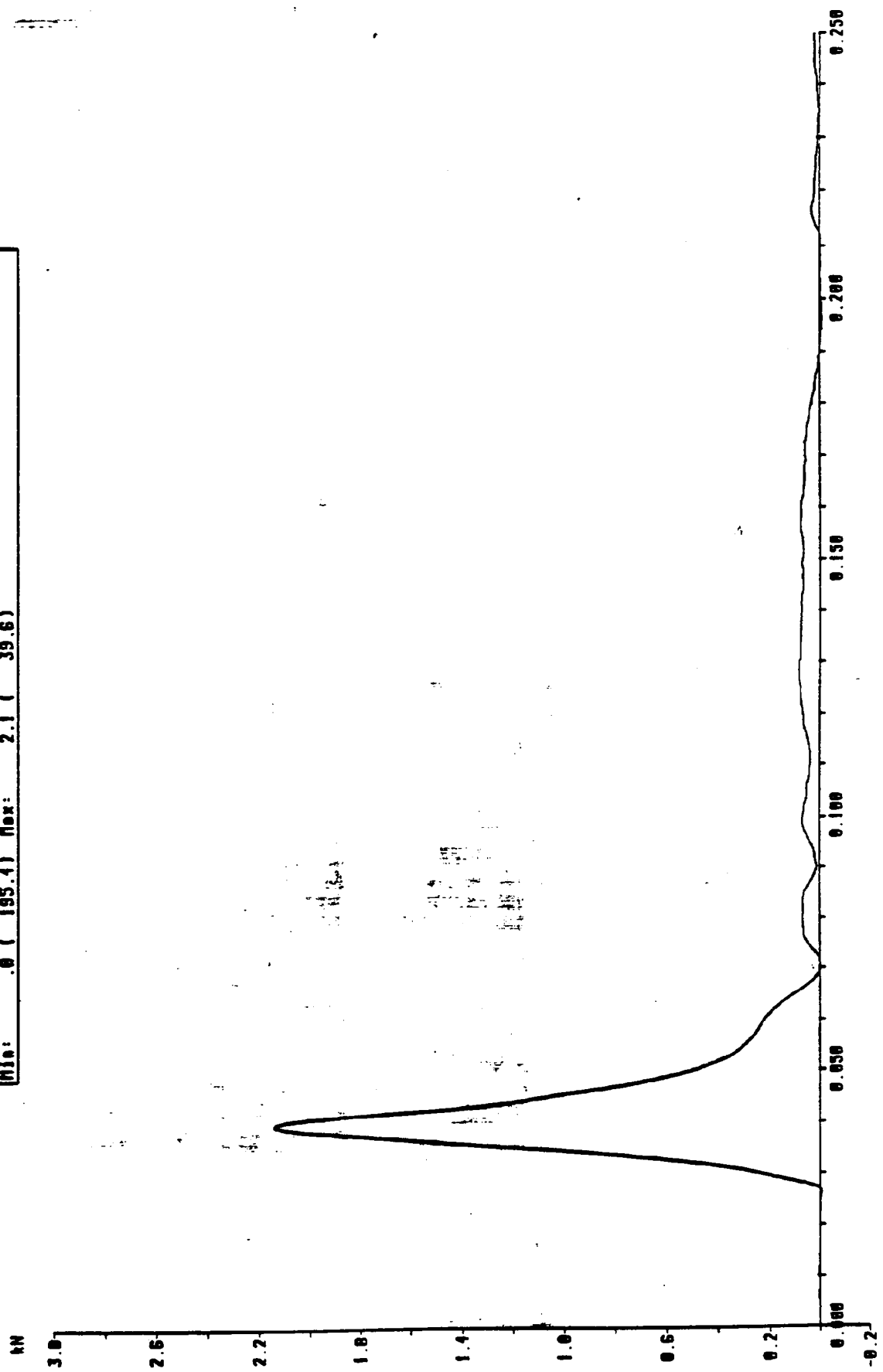


BSt Unfallforschung UVM
Versuch: VSE02 von: 21.03.91
Kanal-Code: FPVY Datum: EUS2 Pos3 Fz2
Min: -4 (59.0) Max: 5.0 (39.2)

25.03.1991

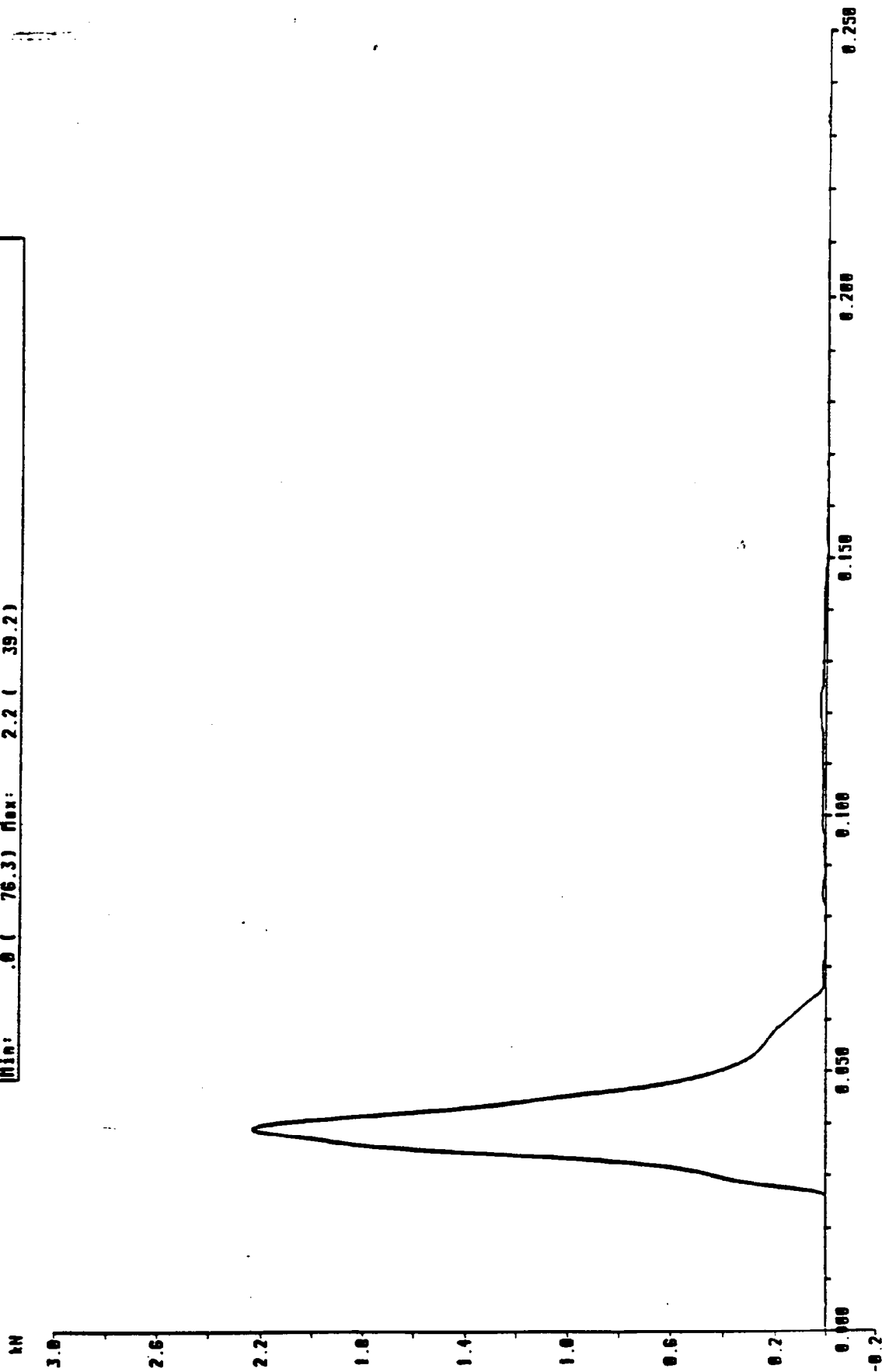


Bst Unfallforschung UVM
 Versuch: VSE02 von: 21.03.91
 Kanal-Code: FABV Dunny: EUS2 Pos3 F12
 Min: 0 (195.4) Max: 2.1 (39.6)

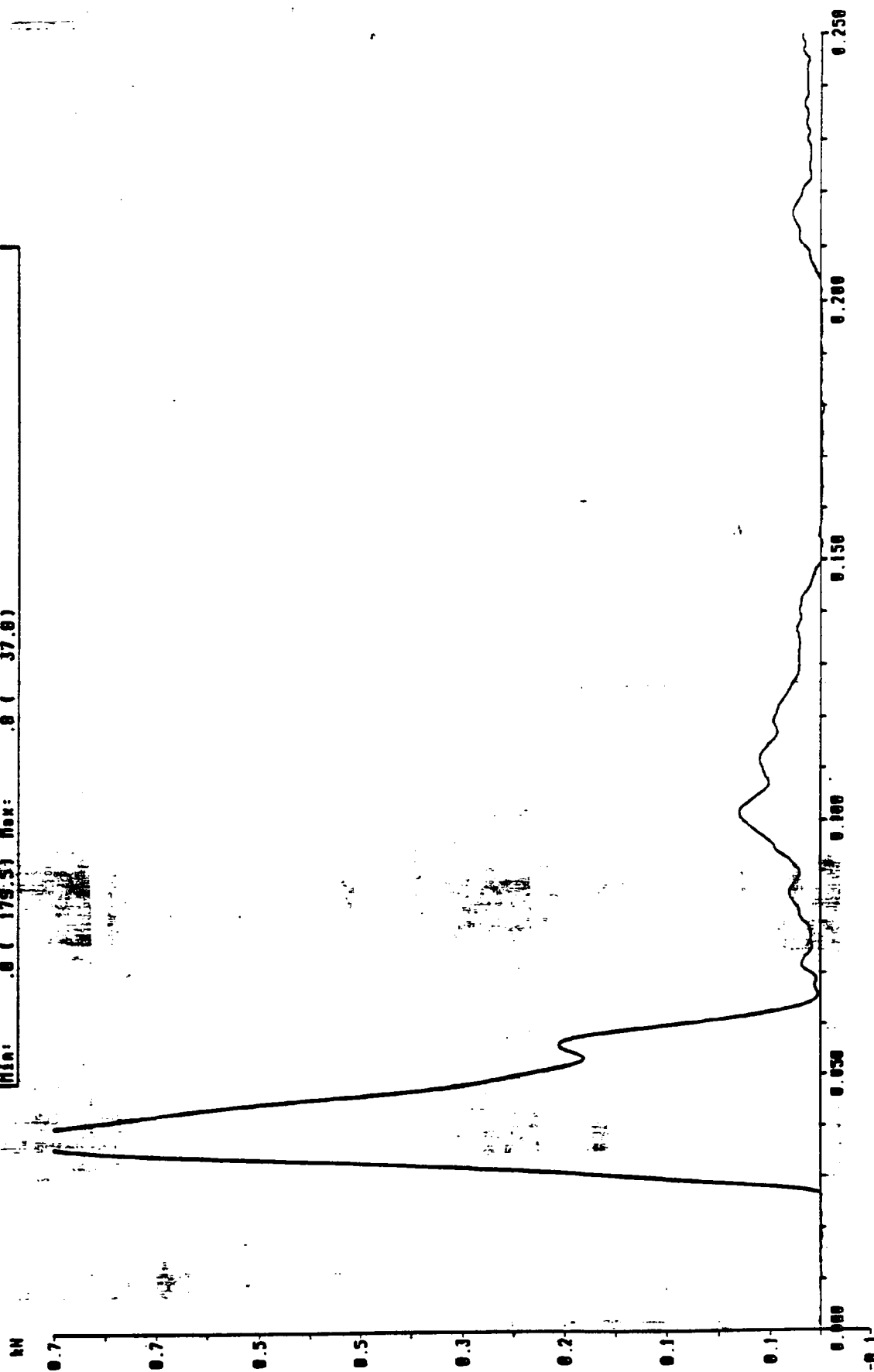


BASf Unfallforschung UVM
Versuch: VSE02 vom: 21.03.91
Kanal-Code: FABYM Dummy: EUS2 Pos3 Fz2
Min: .0 (76.3) Max: 2.2 (39.2)

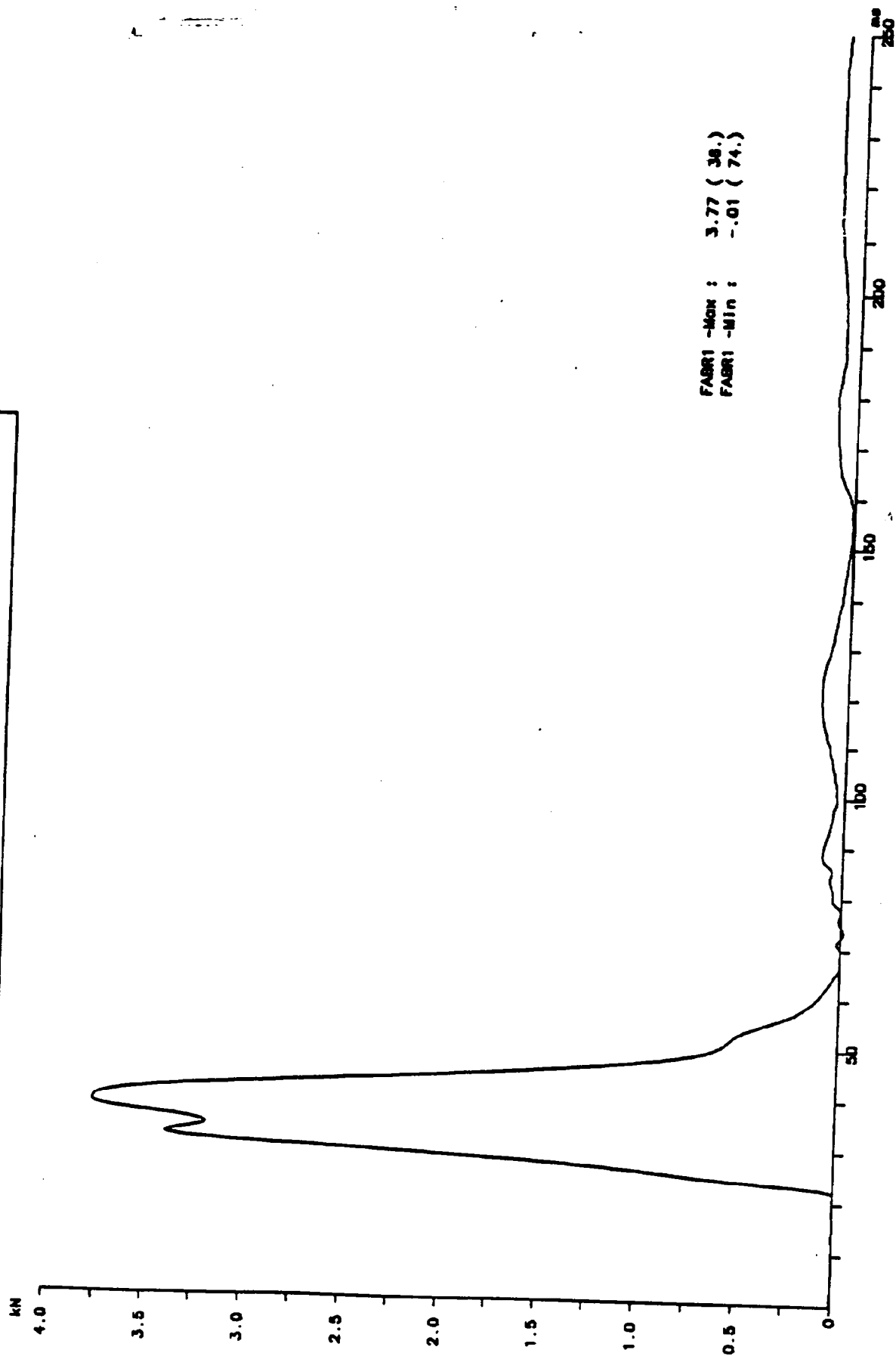
25.03.1991



Bast Unfallforschung UVM 25.03.1991
Versuch: YSE02 von: 21.03.91
Kennel-Code: FABYH Dummy: EUS2 Pos3 Fz2
Min: 0 (175.5) Max: 0 (37.8)

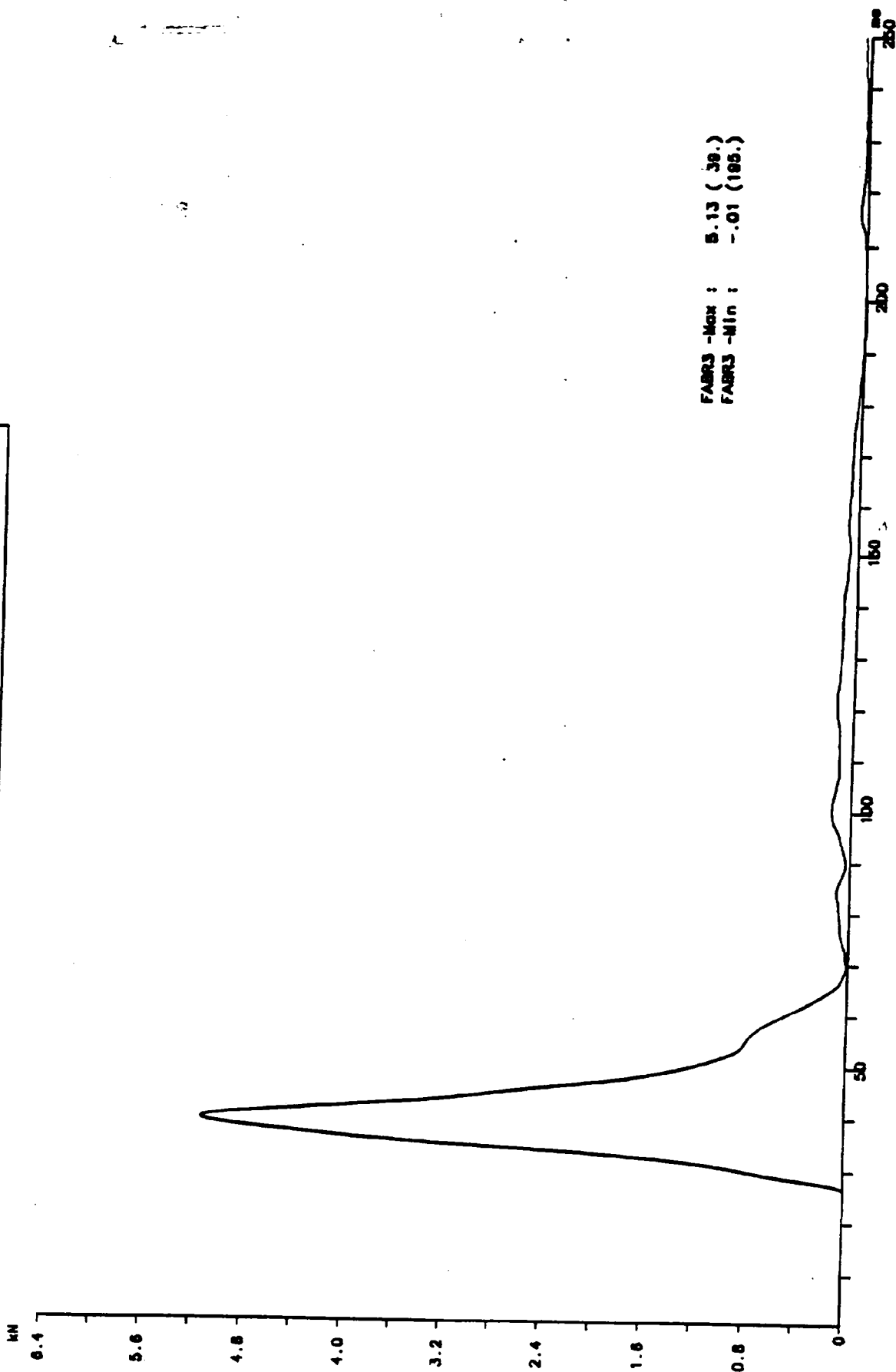


BAST Unfallforschung UVM	09-10-91	Kan.: FARR1
Versuch: VSE02		



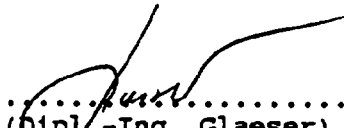
FARR1 -Max : 3.77 (38.)
FARR1 -Min : -0.01 (74.)

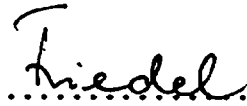
BAST Unfallforschung UVM	08-10-91	Kan.: FABR3
Versuch: VSE02		



FABR3 -Max : 5.13 (38.)
FABR3 -Min : -.01 (185.)

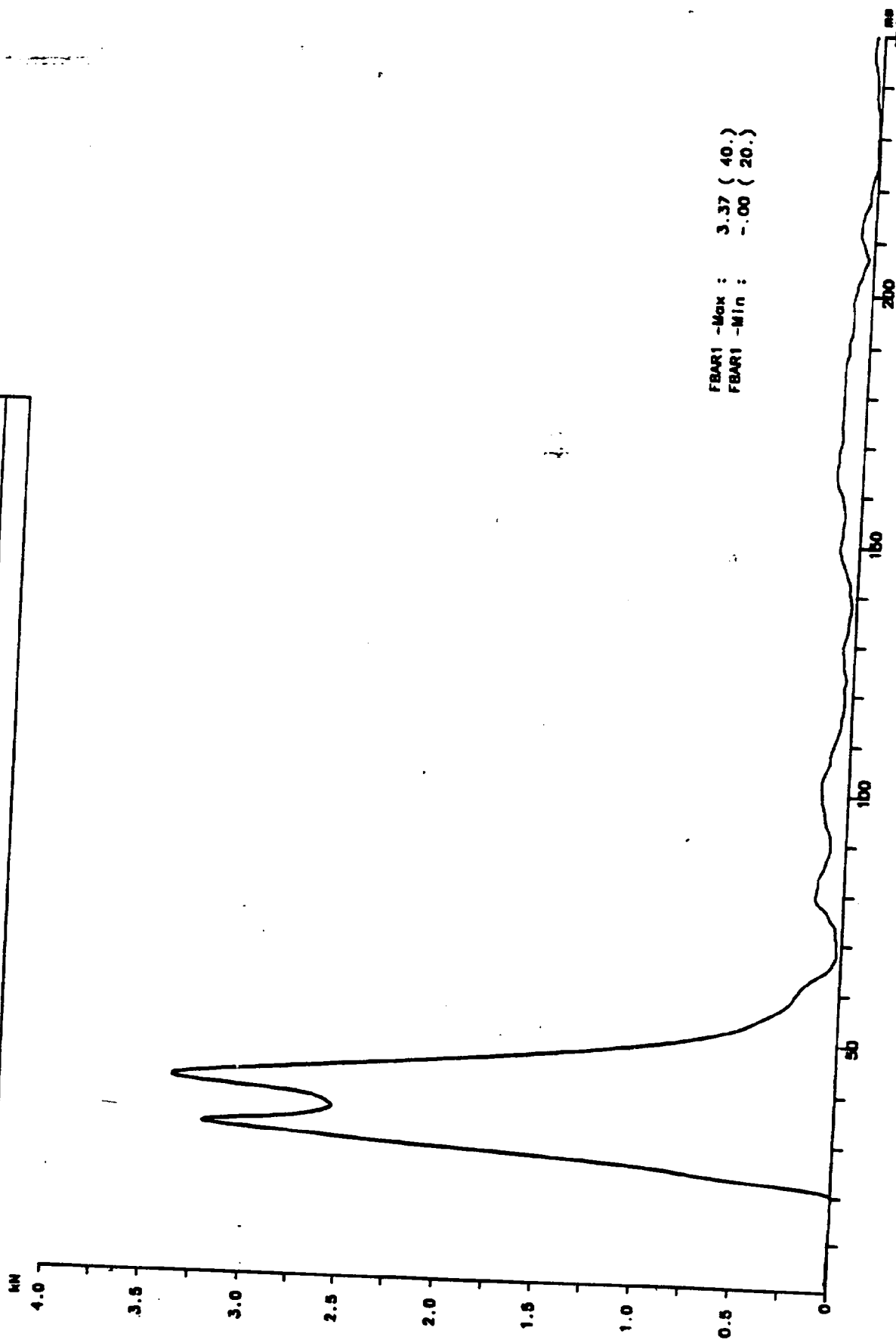
Sachbearbeiter


.....
(Dipl.-Ing. Glaeser)
Oberregierungsrat

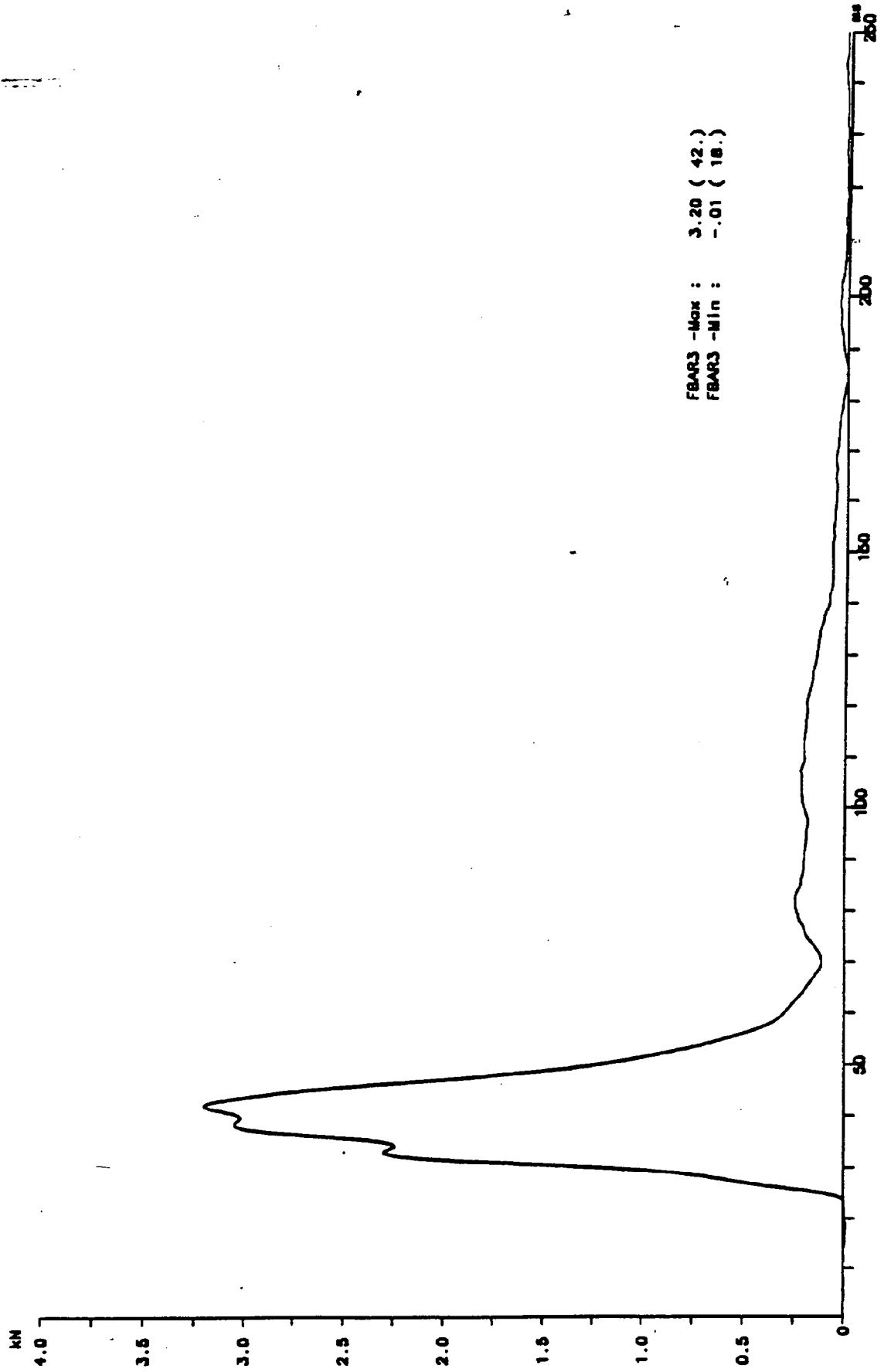

.....
(Dr. med. B. Friedel)
Direktor und Professor
Leiter der Gruppe
Verkehrsmedizin, Unfallmechanik
Biomechanik, Unfallfürsorge

Berg. Gladbach, den 03.03.92

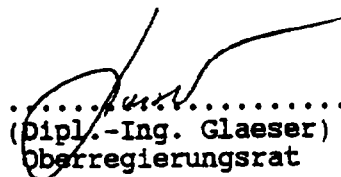
BAST Unfallforschung UVM	09-10-91	Kan.: FBAR1
Versuch: VSE03		



BAST Unfallforschung UVM	09-10-91	Kan.: FBAR3
Versuch: VSE03		



Sachbearbeiter


.....
(Dipl.-Ing. Glaeser)
Oberregierungsrat


.....
(Dr. med. B. Friedel)
Direktor und Professor
Leiter der Gruppe
Verkehrsmedizin, Unfallmechanik
Biomechanik, Unfallfürsorge

Berg. Gladbach, den 03.03.92