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1989



U.S. Department  
of Transportation  
**National Highway  
Traffic Safety  
Administration**



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DOT HS 807 440

May 1989

Final Report

# **Final Report of 270° Contoured Moving Barrier Impact into a 1985 Chevrolet Celebrity 4-Door Sedan in Support of Crash III Damage Algorithm Reformation**

The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear only because they are considered essential to the object of this report.

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16. Abstract																									
<p>Three 270° contoured moving barrier impact tests were conducted for research and development in support of the crash III damage algorithm reformulation. These tests were conducted on a 1985 Chevrolet Celebrity 4-door sedan, VIN 1G1AW19W0F6163763, at the Transportation Research Center of Ohio. The following three tests were conducted on one vehicle:</p> <table border="1"> <thead> <tr> <th>TEST NO.</th> <th>DATE</th> <th>TIME</th> <th>SPEED (mph)</th> <th>AVERAGE CUMULATIVE CRUSH</th> </tr> </thead> <tbody> <tr> <td>890413-1</td> <td>4/13/89</td> <td>1130</td> <td>20.3</td> <td>6.1</td> </tr> <tr> <td>890413-2</td> <td>4/13/89</td> <td>1319</td> <td>30.1</td> <td>13.6</td> </tr> <tr> <td>890413-3</td> <td>4/13/89</td> <td>1450</td> <td>30.3</td> <td>16.5</td> </tr> </tbody> </table>						TEST NO.	DATE	TIME	SPEED (mph)	AVERAGE CUMULATIVE CRUSH	890413-1	4/13/89	1130	20.3	6.1	890413-2	4/13/89	1319	30.1	13.6	890413-3	4/13/89	1450	30.3	16.5
TEST NO.	DATE	TIME	SPEED (mph)	AVERAGE CUMULATIVE CRUSH																					
890413-1	4/13/89	1130	20.3	6.1																					
890413-2	4/13/89	1319	30.1	13.6																					
890413-3	4/13/89	1450	30.3	16.5																					
17. Key Words 270° Contoured Moving Barrier Impact Crash III Damage Algorithm Reformulation.			18. Distribution Statement Document is available to the public from the National Technical Information Service, Springfield, VA 22161																						
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TABLE OF CONTENTS

SECTION	TITLE	PAGE
1.0	PURPOSE AND TEST SUMMMARY	1-1
2.0	VEHICLE AND TEST DATA	2-1
3.0	TEST #890413-1 SUMMARY	3-1
4.0	TEST #890413-2 SUMMARY	4-1
5.0	TEST #890413-3 SUMMARY	5-1
APPENDIX A	PHOTOGRAPHS	A-1
APPENDIX B	DATA PLOTS	B-1



SECTION 1.0  
PURPOSE AND TEST SUMMARY

The purpose of the three 270° contoured moving barrier impact tests was for research and development in support of the CRASH III damage algorithm reformulation.

The 1985 Chevrolet Celebrity was equipped a 2.8 liter, 6-cylinder, transverse, gas engine with a 3-speed automatic transmission. The intended total test weight of the vehicle was 2774 pounds. The actual weight was 2774 pounds.

The contoured moving barrier actual weight was 2786 pounds, frontal width was 62.5 inches, hood height was 30.0 inches, bumper width was 6.0 inches and centerline bumper height to ground was 17.0 inches. The contoured moving barrier was intended to impact the driver's side of the vehicle at 270°. The leading edge of the contact was to be 23.5 inches forward of the vehicle's center of gravity.

The crash event was recorded by three (3) high-speed cameras.

## DEFINITION OF MEASUREMENTS

C1, C2, C3, C4, C5, C6 = crush at 6 points for major (bumper height) penetration.

S1, S2, S3, S4, S5, S6 = crush at 6 points for stiffer member (sill height) penetration.

F = free space distance, measured on the undeformed side of the car, between the surface at major penetration (bumper height) and minor penetration (sill height) locations.

X1, X2 = distances between points C1 and C6, respectively and the vertical plane passing through points at the extreme ends of the car which lay in the plane of the car side before deformation.

B1 = the offset of the trunk centerline from the original body center line.

B2 = the offset of the hood centerline from the original body center line.

If a door hinge or latch or pillar did not fail then:

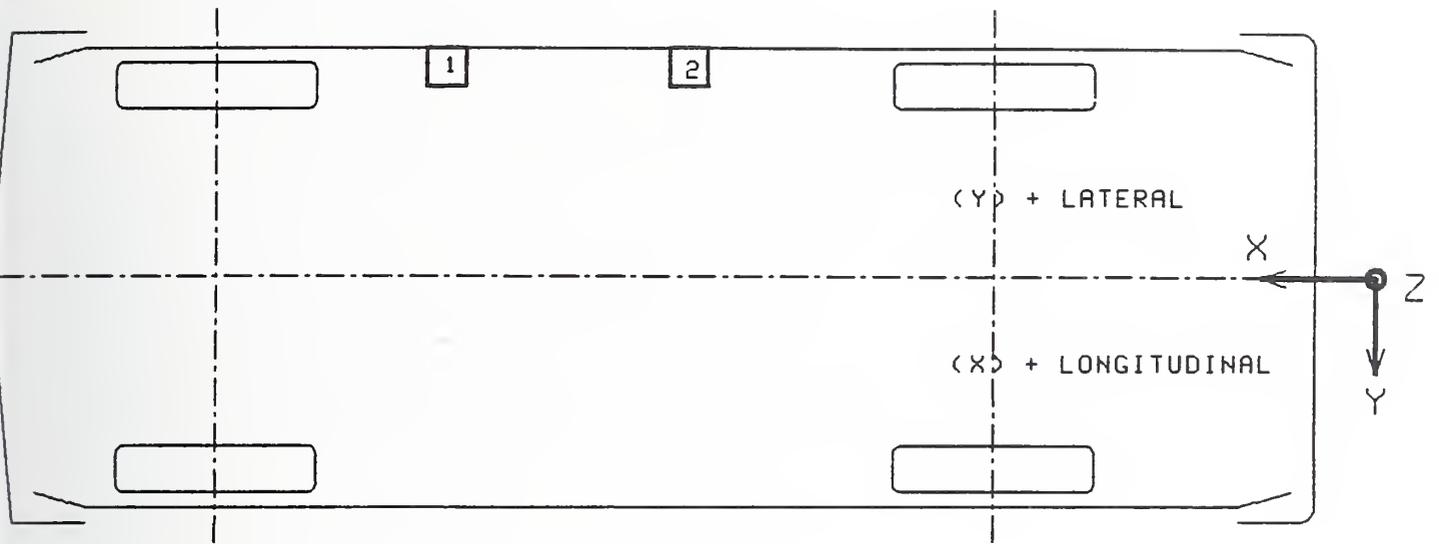
$$\text{Average crush} = \text{Bumper height crush} + \frac{X1 + X2}{2}$$

If a door hinge or latch or pillar did fail then:

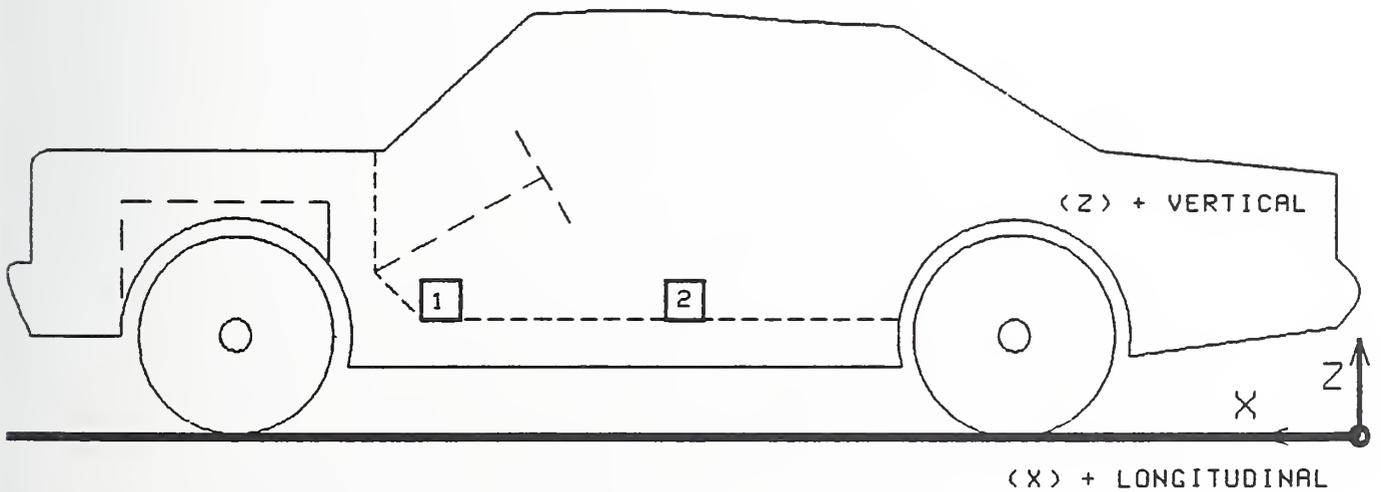
$$\text{Average crush} = \frac{\text{Bumper height crush} + \text{sill height crush as corrected} + X1 + X2}{2}$$

Sill height crush as corrected = sill height crush as measured - free space.

# VEHICLE ACCELEROMETER PLACEMENT

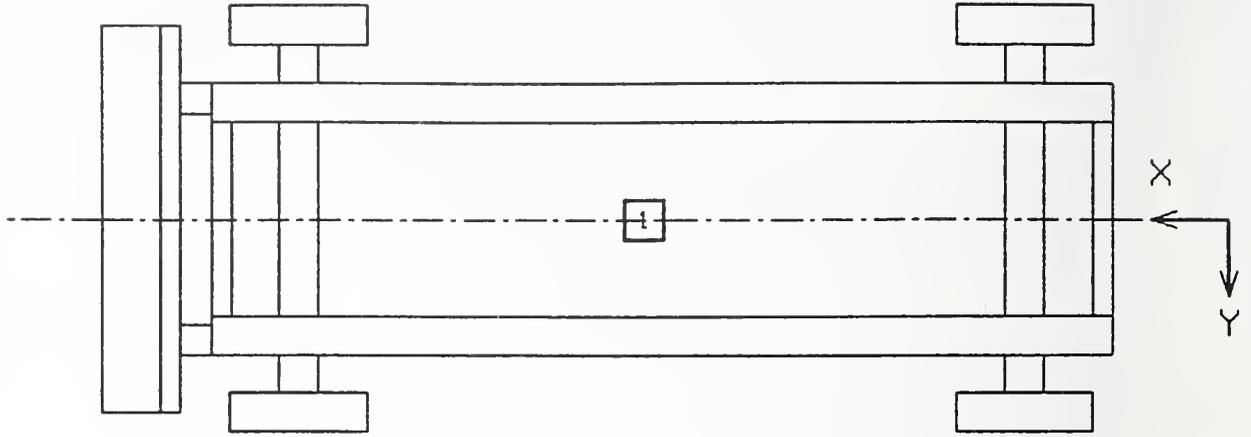


TOP VIEW

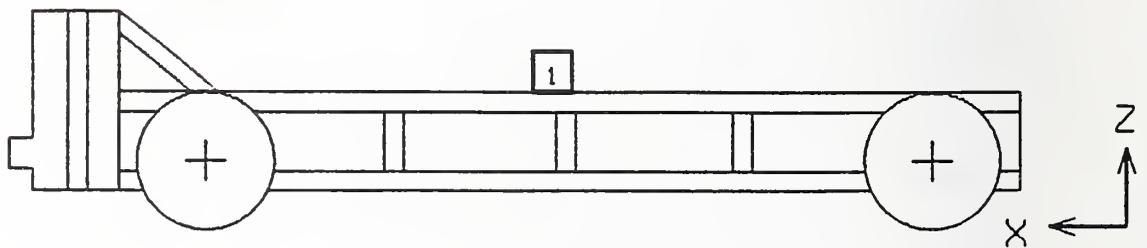


SIDE VIEW

MOVING BARRIER  
ACCELEROMETER PLACEMENT



TOP VIEW



SIDE VIEW

SECTION 2.0  
VEHICLE INFORMATION



TEST VEHICLE INFORMATION, CONT'D

WHEELBASE: 104.5

MAXIMUM WIDTH: 69.0

WEIGHT OF TEST VEHICLE WITH REQUIRED OCCUPANTS AND LUGGAGE:

RIGHT FRONT	852 LBS.	RIGHT REAR	501 LBS.
LEFT FRONT	933 LBS.	LEFT REAR	488 LBS.
TOTAL FRONT WEIGHT	1785 LBS.	(64.4% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	989 LBS.	(35.6% OF TOTAL VEHICLE WEIGHT)	
TOTAL TEST WEIGHT	2774 LBS.		

WEIGHT OF BALLAST SECURED IN VEHICLE TRUNK AREA: 0 LBS.

VEHICLE TIRE DATA:

TIRES ON VEHICLE (MFR. & LINE, SIZE): Uniroyal Tiger Paws P185/75R14 M&S

RECOMMENDED COLD TIRE PRESSURE: FRONT: 35 psi; REAR: 35 psi

SIDEWALL PLY RATING: 1 ply

BIAS PLY, BELTED OR RADIAL? Radial

IS SPARE TIRE "SPACE SAVER"? Yes

IS SPARE TIRE STANDARD EQUIPMENT? Yes

VEHICLE ATTITUDES:

DELIVERED:	LF: 26.4;	RF: 26.1;	LR: 25.8;	RR: 25.6
PRE-TEST:	LF: 27.1;	RF: 26.6;	LR: 26.2;	RR: 25.6
POST-TEST:	LF: 26.4;	RF: 26.3;	LR: 26.6;	RR: 25.0

ALL DISTANCE MEASUREMENTS ARE IN INCHES.



SECTION 3.0

TEST #890413-1 SUMMARY

TEST CONDITIONS:

TEST NUMBER: 890413-1

DATE OF TEST: 4/13/89

TIME OF TEST: 1130

AMBIENT TEMPERATURE AT IMPACT AREA: 40° F

SUBJECT VEHICLE DATA:

	<u>ACTUAL</u>	<u>INTENDED</u>
VEHICLE WEIGHT (lbs.)	2774	2774
VEHICLE ORIENTATION (deg.)	270	270
MOVING BARRIER VELOCITY (mph.)	20.3	20.0
BARRIER WEIGHT (lbs.)	2786	2786
MAXIMUM CUMULATIVE CRUSH BUMPER HEIGHT (in.)	7.5	
AVERAGE CUMULATIVE CRUSH (in.) = $\frac{\{C1+C6+C2+C3+C4+C5\}}{5}$	6.1	

TEST NUMBER 890413-1

VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

No.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION		NEGATIVE DIRECTION	
					MAX G	MSEC	MAX G	MSEC
1	SILL RIGHT FRONT LATERAL	84.5	-26.8	12.2	4.5	74.8	18.8	11.0
2	SILL RIGHT REAR LATERAL	72.5	-26.5	12.2	4.5	75.1	20.2	11.1

\* ALL MEASUREMENTS OF ACCELEROMETER LOCATIONS ARE IN INCHES.

REFERENCE: X: FORWARD FROM REAR AXLE  
 Y: LEFTWARD FROM VEHICLE CENTERLINE  
 Z: UPWARD FROM GROUND LEVEL

TEST NUMBER 890413-1

MOVING BARRIER ACCELEROMETER LOCATIONS AND DATA SUMMARY

No.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION		NEGATIVE DIRECTION	
					MAX G	MSEC	MAX G	MSEC
1	BARRIER CG LONGITUDINAL	75.0	0.0	10.5	0.2	142.3	12.8	40.5

\* ALL MEASUREMENTS OF ACCELEROMETER LOCATIONS ARE IN INCHES.

REFERENCE: X: + FORWARD FROM REAR BUMPER  
 Y: + LEFTWARD FROM VEHICLE CENTERLINE  
 Z: + UPWARD FROM GROUND LEVEL

TEST #890413-1

CONTACT SWITCH LOCATIONS AND DATA SUMMARY

LOCATION	SEPARATION TIME (MSEC)
VEHICLE CONTACT SWITCH - FRONT	167.1
VEHICLE CONTACT SWITCH - REAR	91.1
BARRIER CONTACT SWITCH - LEFT	98.5
BARRIER CONTACT SWITCH - RIGHT	100.4

TEST #890413-1

National Accident Sampling System - Continuous Sampling Subsystem: Vehicle Data

FIELD MEASUREMENTS

Complete When Applicable

<p style="text-align: center;">End Damage</p> <p>Undeformed end width _____</p> <p>Corner shift: A1 _____</p> <p style="padding-left: 100px;">A2 _____</p> <p>End shift at frame (CDC)        (check one)</p> <p style="padding-left: 40px;">&lt;4 inches <u>X</u> _____</p> <p style="padding-left: 40px;">≥4 inches _____</p>	<p style="text-align: center;">Side Damage</p> <p>Bowing: B1 <u>0</u> X1 <u>0</u></p> <p style="padding-left: 100px;">B2 <u>0</u> X2 <u>0</u></p> <p>Bowing constant</p> <p style="text-align: center;"><math>\frac{X1 + X2}{2} = \frac{0}{2}</math></p>
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NOTE: Measure C1 to C6 from Driver to Passenger side in Front or Rear impacts - Rear to Front in Side impacts.

Specific Impact Number	Plane* of C-Measurements	Direct Damage		Field L**	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	C <sub>5</sub>	C <sub>6</sub>	±D
		Width** (CDC)	Max*** Crush								
	Bumper height as measured				0.0	7.0	7.5	7.5	6.2	0.0	
	Bumper height as corrected				0.0	7.6	8.1	8.1	6.8	0.0	
	Sill height as measured				0.0	4.5	6.7	6.0	5.0	0.0	
	Sill height as corrected				0.0	-0.8	1.4	0.8	-0.2	0.0	
	Average Crush			101.4	0.0	7.6	8.1	8.1	6.8	0.0	-12.3
	Bumper free space = -0.6 inches										
	Sill free space = 5.2 inches										
	Door latch, hinge, or pillar did not fail (See Page 1-2).										

\*Identify the plane at which the C-measurements are taken (e.g., at bumper, at sill, above sill, at beltline, etc.) or label adjustments (e.g., free space).

Free space value is defined as the distance between the baseline and the original body contour taken at the individual C locations. This may include the following: bumper lead, bumper taper, side protrusion, side taper, etc. Record the value for each C-measurement and maximum crush.

\*\*Measure and document on the vehicle diagram the beginning or end of the direct damage width and field L (e.g., side damage with respect to undamaged axle.)

\*\*\*Measure and document on the vehicle diagram the location of the maximum crush.

NOTE: Use as many lines/columns as necessary to describe each damage profile.

TEST #890413-1

CAMERA INFORMATION

CAMERA NO.	LOCATION	TYPE	LENS (mm)	SPEED (fps)	PURPOSE OF CAMERA DATA
1	Right side	Photosonic 1B	25	502	Impact overall
2	Overhead wide	Photosonic 1B	13	500	Impact wide
3	Overhead tight	Photosonic 1B	25	500	Impact closeup



SECTION 4.0

TEST #890413-2 SUMMARY

TEST CONDITIONS:

TEST NUMBER: 890413-2

DATE OF TEST: 4/13/89

TIME OF TEST: 1319

AMBIENT TEMPERATURE AT IMPACT AREA: 45° F

SUBJECT VEHICLE DATA:

	<u>ACTUAL</u>	<u>INTENDED</u>
VEHICLE WEIGHT (lbs.)	2774	2774
VEHICLE ORIENTATION (deg.)	270	270
MOVING BARRIER VELOCITY (mph.)	30.1	30.0
BARRIER WEIGHT (lbs.)	2786	2786
MAXIMUM CUMULATIVE CRUSH BUMPER HEIGHT (in.)	17.0	
AVERAGE CUMULATIVE CRUSH (in.) = $\frac{\{C1+C6+C2+C3+C4+C5\}}{5}$	13.6	

VEHICLE ATTITUDES:

POST-TEST: LF: 25.5 RF: 24.1 LR: 25.8 RR: 24.4

TEST NUMBER 890413-2

VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

No.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION		NEGATIVE DIRECTION	
					MAX G	MSEC	MAX G	MSEC
1	SILL RIGHT FRONT LATERAL	84.5	-26.8	12.2	2.5	70.9	45.9	9.4
2	SILL RIGHT REAR LATERAL	72.5	-26.5	12.2	3.3	56.5	41.6	9.3

\* ALL MEASUREMENTS OF ACCELEROMETER LOCATIONS ARE IN INCHES.

REFERENCE: X: FORWARD FROM REAR AXLE  
 Y: LEFTWARD FROM VEHICLE CENTERLINE  
 Z: UPWARD FROM GROUND LEVEL

TEST NUMBER 890413-2

MOVING BARRIER ACCELEROMETER LOCATIONS AND DATA SUMMARY

No.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION		NEGATIVE DIRECTION	
					MAX G	MSEC	MAX G	MSEC
1	BARRIER CG LONGITUDINAL	75.0	0.0	10.5	0.2	138.0	67.7	20.4

\* ALL MEASUREMENTS OF ACCELEROMETER LOCATIONS ARE IN INCHES.

REFERENCE: X: + FORWARD FROM REAR BUMPER  
 Y: + LEFTWARD FROM VEHICLE CENTERLINE  
 Z: + UPWARD FROM GROUND LEVEL

TEST #890413-2

CONTACT SWITCH LOCATIONS AND DATA SUMMARY

LOCATION	SEPARATION TIME (MSEC)
VEHICLE CONTACT SWITCH - FRONT	121.1
VEHICLE CONTACT SWITCH - REAR	112.8
BARRIER CONTACT SWITCH - LEFT	117.6
BARRIER CONTACT SWITCH - RIGHT	100.1

TEST #890413-2

National Accident Sampling System - Continuous Sampling Subsystem: Vehicle Data

FIELD MEASUREMENTS

Complete When Applicable

<p>End Damage</p> <p>Undeformed end width _____</p> <p>Corner shift: A1 _____</p> <p style="padding-left: 100px;">A2 _____</p> <p>End shift at frame (CDC) (check one)</p> <p>&lt;4 inches <u>X</u> _____</p> <p>&gt;4 inches _____</p>	<p>Side Damage</p> <p>Bowing: B1 <u>0</u> X1 <u>1.5</u></p> <p style="padding-left: 100px;">B2 <u>7.0</u> X2 <u>1.2</u></p> <p>Bowing constant</p> <p style="text-align: center;"><math>\frac{X1 + X2}{2} = \underline{1.4}</math></p>
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NOTE: Measure C1 to C6 from Driver to Passenger side in Front or Rear impacts - Rear to Front in Side impacts.

Specific Impact Number	Plane* of C-Measurements	Direct Damage		Field L**	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	C <sub>5</sub>	C <sub>6</sub>	±D
		Width** (CDC)	Max*** Crush								
	Bumper height as measured				0.0	13.4	14.2	14.2	17.0	0.0	
	Bumper height as corrected				0.0	14.0	14.8	14.8	17.6	0.0	
	Sill height as measured				0.0	19.2	12.2	12.4	7.9	0.0	
	Sill height as corrected				0.0	14.0	7.0	7.2	2.6	0.0	
	Average Crush			107.0	1.4	15.4	16.2	16.2	19.0	1.4	-5.8
	Bumper free space = -0.6 inches										
	Sill free space = 5.2 inches										
	Door latch, hinge, or pillar did not fail (See Page 1-2).										

\*Identify the plane at which the C-measurements are taken (e.g., at bumper, at sill, above sill, at beltline, etc.) or label adjustments (e.g., free space).

Free space value is defined as the distance between the baseline and the original body contour taken at the individual C locations. This may include the following: bumper lead, bumper taper, side protrusion, side taper, etc. Record the value for each C-measurement and maximum crush.

\*\*Measure and document on the vehicle diagram the beginning or end of the direct damage width and field L (e.g., side damage with respect to undamaged axle.)

\*\*\*Measure and document on the vehicle diagram the location of the maximum crush.

NOTE: Use as many lines/columns as necessary to describe each damage profile.

TEST #890413-2

CAMERA INFORMATION

<u>CAMERA NO.</u>	<u>LOCATION</u>	<u>TYPE</u>	<u>LENS (mm)</u>	<u>SPEED (fps)</u>	<u>PURPOSE OF CAMERA DATA</u>
1	Right side	Photosonic 1B	25	502	Impact overall
2	Overhead wide	Photosonic 1B	13	498	Impact wide
3	Overhead tight	Photosonic 1B	25	507	Impact closeup



SECTION 5.0

TEST #890413-3 SUMMARY

TEST CONDITIONS:

TEST NUMBER: 890413-3

DATE OF TEST: 4/13/89

TIME OF TEST: 1450

AMBIENT TEMPERATURE AT IMPACT AREA: 50° F

SUBJECT VEHICLE DATA:

	<u>ACTUAL</u>	<u>INTENDED</u>
VEHICLE WEIGHT (lbs.)	2774	2774
VEHICLE ORIENTATION (deg.)	270	270
MOVING BARRIER VELOCITY (mph.)	30.3	30.0
BARRIER WEIGHT (lbs.)	2786	2786
MAXIMUM CUMULATIVE CRUSH BUMPER HEIGHT (in.)	26.4	
AVERAGE CUMULATIVE CRUSH (in.) = $\frac{\{C1+C6+C2+C3+C4+C5\}}{5}$	16.5	

VEHICLE ATTITUDES:

POST-TEST: LF: 24.9 RF: 24.0 LR: 26.0 RR: 24.1

TEST NUMBER 890413-3

VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

No.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION		NEGATIVE DIRECTION	
					MAX G	MSEC	MAX G	MSEC
1	SILL RIGHT FRONT LATERAL	84.5	-26.8	12.2	4.7	93.1	34.0	14.6
2	SILL RIGHT REAR LATERAL	72.5	-26.5	12.2	5.4	102.6	28.1	15.4

\* ALL MEASUREMENTS OF ACCELEROMETER LOCATIONS ARE IN INCHES.

REFERENCE: X: FORWARD FROM REAR AXLE  
 Y: LEFTWARD FROM VEHICLE CENTERLINE  
 Z: UPWARD FROM GROUND LEVEL

TEST NUMBER 890413-3

MOVING BARRIER ACCELEROMETER LOCATIONS AND DATA SUMMARY

No.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION		NEGATIVE DIRECTION	
					MAX G	MSEC	MAX G	MSEC
1	BARRIER CG LONGITUDINAL	75.0	0.0	10.5	1.0	208.0	19.2	17.1

\* ALL MEASUREMENTS OF ACCELEROMETER LOCATIONS ARE IN INCHES.

REFERENCE: X: + FORWARD FROM REAR BUMPER  
 Y: + LEFTWARD FROM VEHICLE CENTERLINE  
 Z: + UPWARD FROM GROUND LEVEL

TEST #890413-3

CONTACT SWITCH LOCATIONS AND DATA SUMMARY

LOCATION	SEPARATION TIME (MSEC)
VEHICLE CONTACT SWITCH - FRONT	118.4
VEHICLE CONTACT SWITCH - REAR	117.1
BARRIER CONTACT SWITCH - LEFT	197.1
BARRIER CONTACT SWITCH - RIGHT	102.8

TEST #890413-3

National Accident Sampling System - Continuous Sampling Subsystem: Vehicle Data

FIELD MEASUREMENTS

Complete When Applicable

<p>End Damage</p> <p>Undeformed end width _____</p> <p>Corner shift: A1 _____</p> <p style="padding-left: 100px;">A2 _____</p> <p>End shift at frame (CDC) (check one)</p> <p style="padding-left: 40px;">&lt;4 inches _____</p> <p style="padding-left: 40px;">&gt;4 inches <u>X</u> _____</p>	<p>Side Damage</p> <p>Bowing: B1 <u>1</u> X1 <u>1</u></p> <p style="padding-left: 100px;">B2 <u>11.5</u> X2 <u>5.5</u></p> <p>Bowing constant</p> <p style="text-align: center;"><math>\frac{X1 + X2}{2} = \frac{3.2}{2}</math></p>
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NOTE: Measure C1 to C6 from Driver to Passenger side in Front or Rear impacts - Rear to Front in Side impacts.

Specific Impact Number	Plane* of C-Measurements	Direct Damage		Field L**	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	C <sub>5</sub>	C <sub>6</sub>	±D
		Width** (CDC)	Max*** Crush								
	Bumper height as measured				0.0	23.0	24.1	26.4	7.5	0.0	
	Bumper height as corrected				0.0	23.6	24.7	27.0	8.1	0.0	
	Sill height as measured				0.0	22.4	19.5	14.8	13.4	0.0	
	Sill height as corrected				0.0	17.2	14.3	9.6	8.2	0.0	
	Average Crush			110.6	3.2	23.6	22.7	21.5	11.4	3.2	-13.7
	Bumper free space = -0.6 inches										
	Sill free space = 5.2 inches										
	Failure occurs (See Page 1-2).										

\*Identify the plane at which the C-measurements are taken (e.g., at bumper, at sill, above sill, at beltline, etc.) or label adjustments (e.g., free space).

Free space value is defined as the distance between the baseline and the original body contour taken at the individual C locations. This may include the following: bumper lead, bumper taper, side protrusion, side taper, etc. Record the value for each C-measurement and maximum crush.

\*\*Measure and document on the vehicle diagram the beginning or end of the direct damage width and field L (e.g., side damage with respect to undamaged axle.)

\*\*\*Measure and document on the vehicle diagram the location of the maximum crush.

NOTE: Use as many lines/columns as necessary to describe each damage profile.

TEST #890413-3

CAMERA INFORMATION

CAMERA NO.	LOCATION	TYPE	LENS (mm)	SPEED (fps)	PURPOSE OF CAMERA DATA
1	Right side	Photosonic 1B	25	505	Impact overall
2	Overhead wide	Photosonic 1B	13	505	Impact wide
3	Overhead tight	Photosonic 1B	25	502	Impact closeup



APPENDIX A  
PHOTOGRAPHS

LIST OF PHOTOGRAPHS

1. PRE-TEST OVERALL FRONT VIEW
2. POST-TEST OVERALL FRONT VIEW
3. PRE-TEST OVERALL LEFT SIDE - VIEW 1
4. POST-TEST OVERALL LEFT SIDE - VIEW 1
5. PRE-TEST OVERALL LEFT SIDE - VIEW 2
6. POST-TEST OVERALL LEFT SIDE - VIEW 2
7. PRE-TEST OVERALL REAR VIEW
8. POST-TEST OVERALL REAR VIEW
9. PRE-TEST OVERALL RIGHT SIDE VIEW
10. POST-TEST OVERALL RIGHT SIDE VIEW
11. PRE-TEST LEFT FRONT THREE-QUARTER VIEW
12. POST-TEST LEFT FRONT THREE-QUARTER VIEW
13. PRE-TEST LEFT REAR THREE-QUARTER VIEW
14. POST-TEST LEFT REAR THREE-QUARTER VIEW
15. PRE-TEST CLOSE-UP LEFT FRONT VIEW
16. POST-TEST CLOSE-UP LEFT FRONT VIEW
17. PRE-TEST CLOSE-UP LEFT REAR VIEW
18. POST-TEST CLOSE-UP LEFT REAR VIEW
19. POST-TEST BARRIER FACE VIEW
20. POST-TEST BARRIER SIDE VIEW



Figure A-1. PRE-TEST OVERALL FRONT VIEW



Figure A-2. POST-TEST OVERALL FRONT VIEW



Figure A-3. PRE-TEST OVERALL LEFT SIDE - VIEW 1



Figure A-4. POST-TEST OVERALL LEFT SIDE - VIEW 1

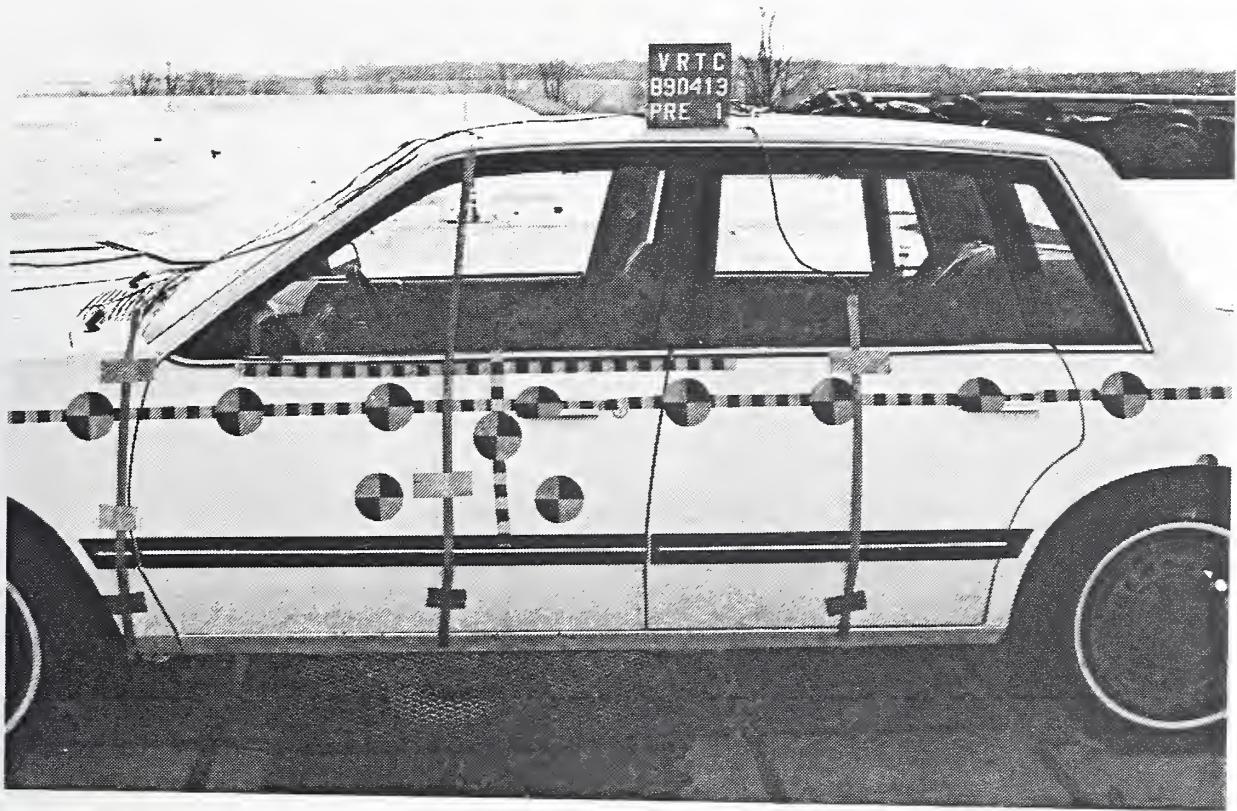


Figure A-5. PRE-TEST OVERALL LEFT SIDE - VIEW 2



Figure A-6. POST-TEST OVERALL LEFT SIDE - VIEW 2



Figure A-7. PRE-TEST OVERALL REAR VIEW



Figure A-8. POST-TEST OVERALL REAR VIEW



Figure A-9. PRE-TEST OVERALL RIGHT SIDE VIEW



Figure A-10. POST-TEST OVERALL RIGHT SIDE VIEW



Figure A-11. PRE-TEST LEFT FRONT THREE-QUARTER VIEW



Figure A-12. POST-TEST LEFT FRONT THREE-QUARTER VIEW



Figure A-13. PRE-TEST LEFT REAR THREE-QUARTER VIEW



Figure A-14. POST-TEST LEFT REAR THREE-QUARTER VIEW

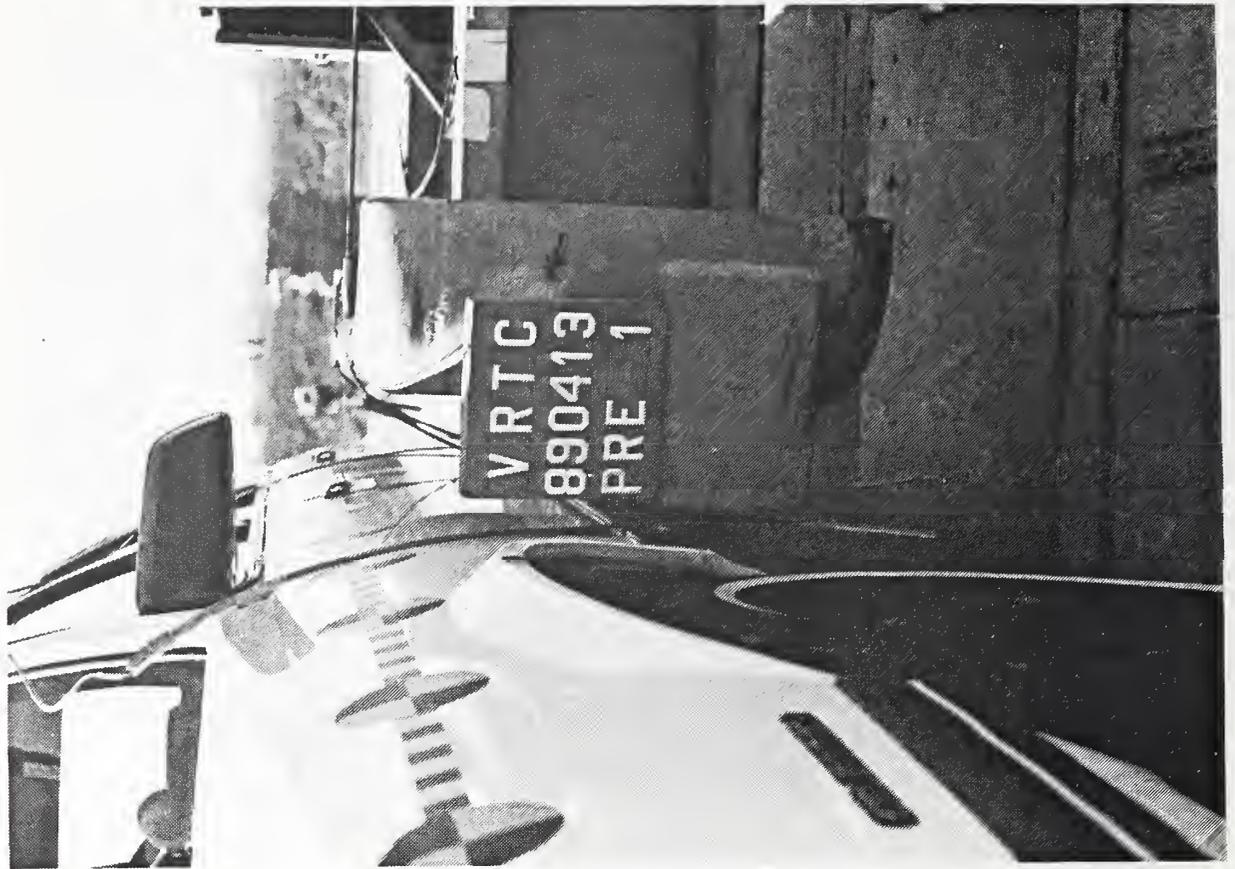


Figure A-15. PRE-TEST CLOSE-UP LEFT FRONT VIEW

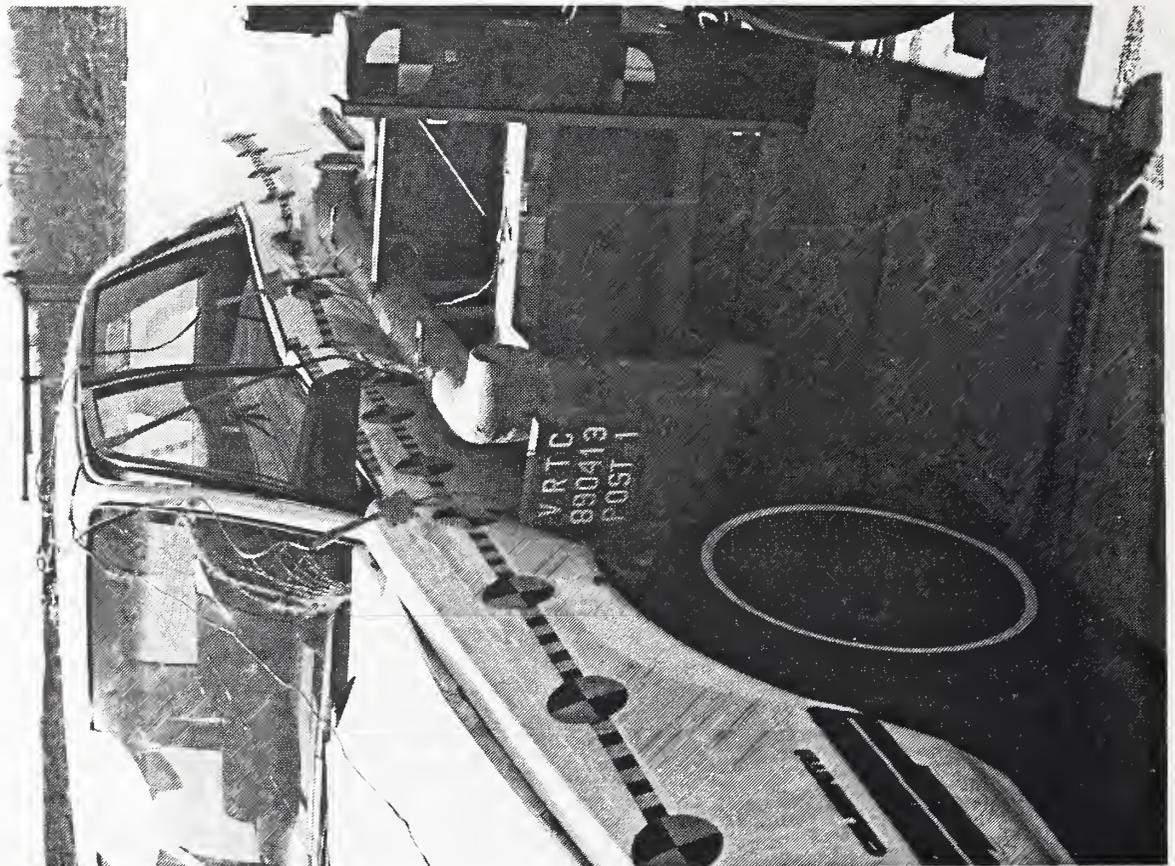


Figure A-16. POST-TEST CLOSE-UP LEFT FRONT VIEW

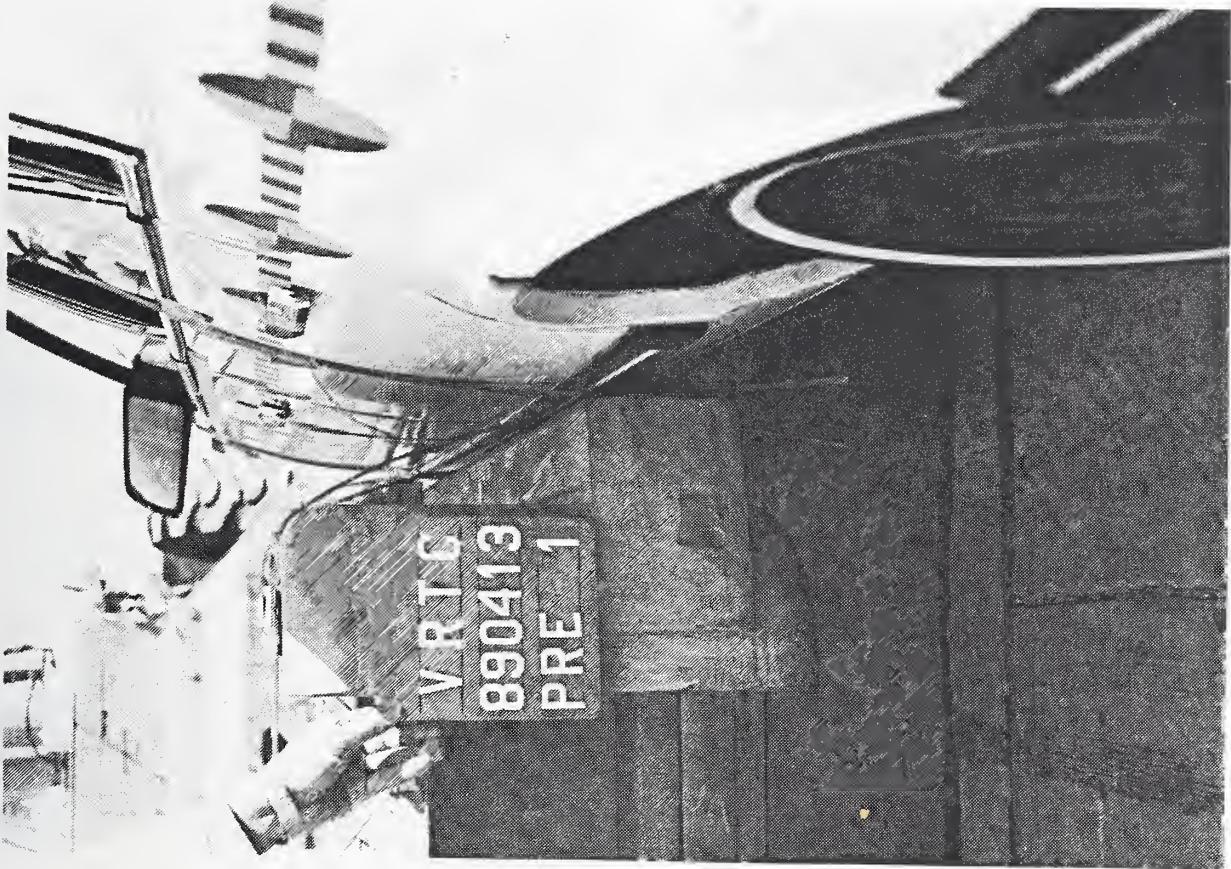


Figure A-17. PRE-TEST CLOSEUP LEFT REAR VIEW

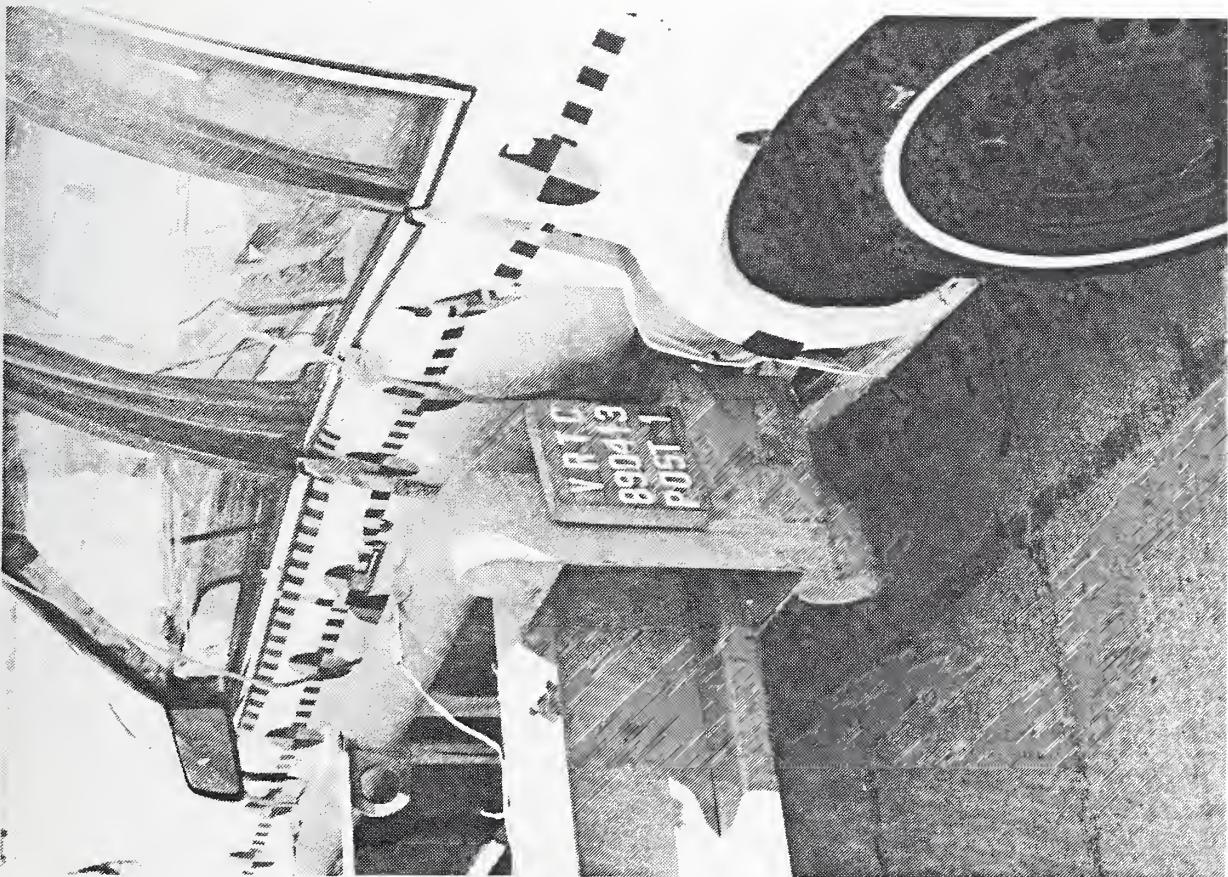


Figure A-18. POST-TEST CLOSEUP LEFT REAR VIEW

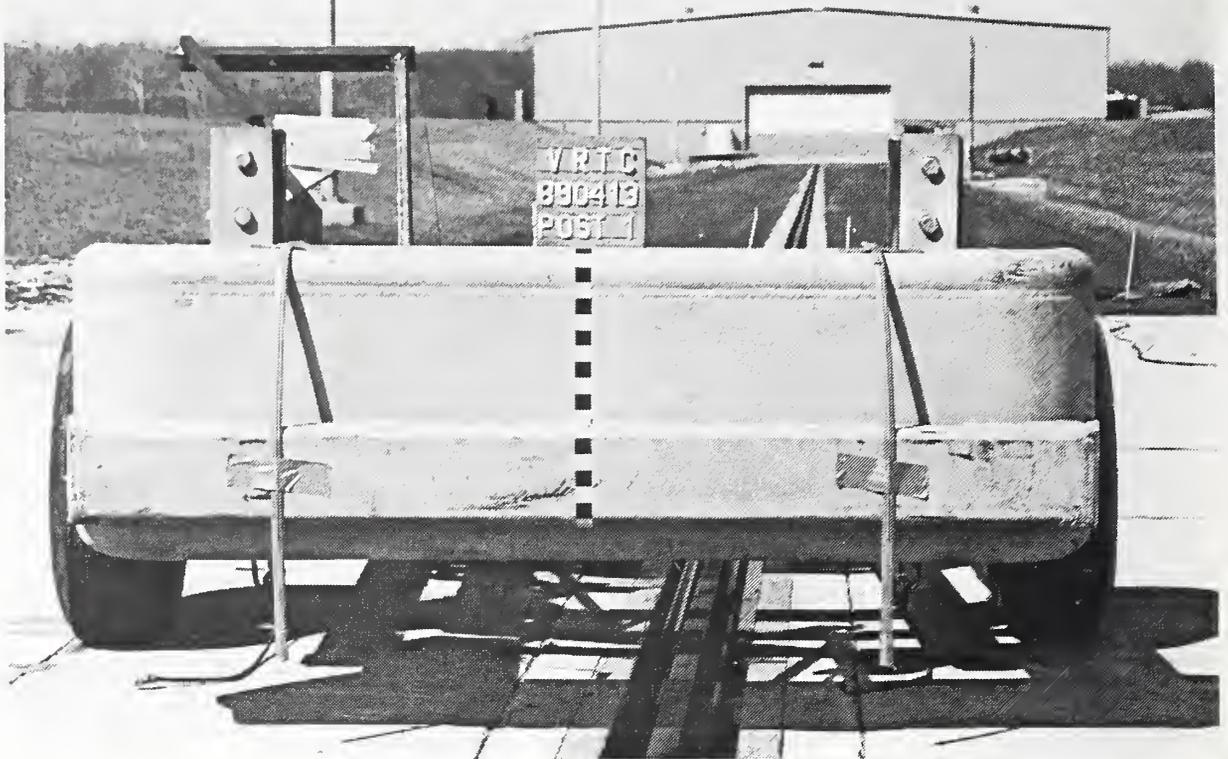


Figure A-19. POST-TEST BARRIER FACE VIEW

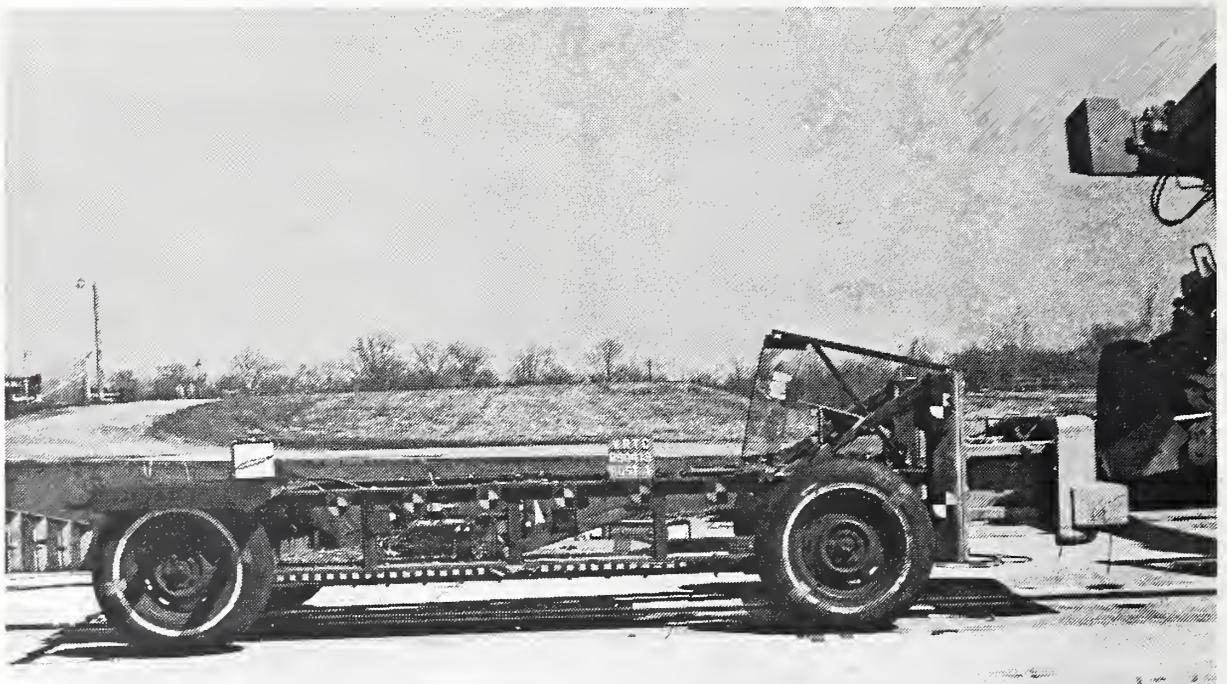


Figure A-20. POST-TEST BARRIER SIDE VIEW

TEST #890413-2

LIST OF PHOTOGRAPHS

21. POST-TEST OVERALL FRONT VIEW
22. POST-TEST OVERALL LEFT SIDE - VIEW 1
23. POST-TEST OVERALL LEFT SIDE - VIEW 2
24. POST-TEST OVERALL REAR VIEW
25. POST-TEST OVERALL RIGHT SIDE VIEW
26. POST-TEST LEFT FRONT THREE-QUARTER VIEW
27. POST-TEST LEFT REAR THREE-QUARTER VIEW
28. POST-TEST CLOSE-UP LEFT FRONT VIEW
29. POST-TEST CLOSE-UP LEFT REAR VIEW





Figure A-21. POST-TEST OVERALL FRONT VIEW



Figure A-22. POST-TEST OVERALL LEFT SIDE VIEW 1



Figure A-23. POST-TEST OVERALL LEFT SIDE - VIEW 2



Figure A-24. POST-TEST OVERALL REAR VIEW



Figure A-25. POST-TEST OVERALL RIGHT SIDE VIEW



Figure A-26. POST-TEST LEFT FRONT THREE-QUARTER VIEW



Figure A-27. POST-TEST LEFT REAR THREE-QUARTER VIEW

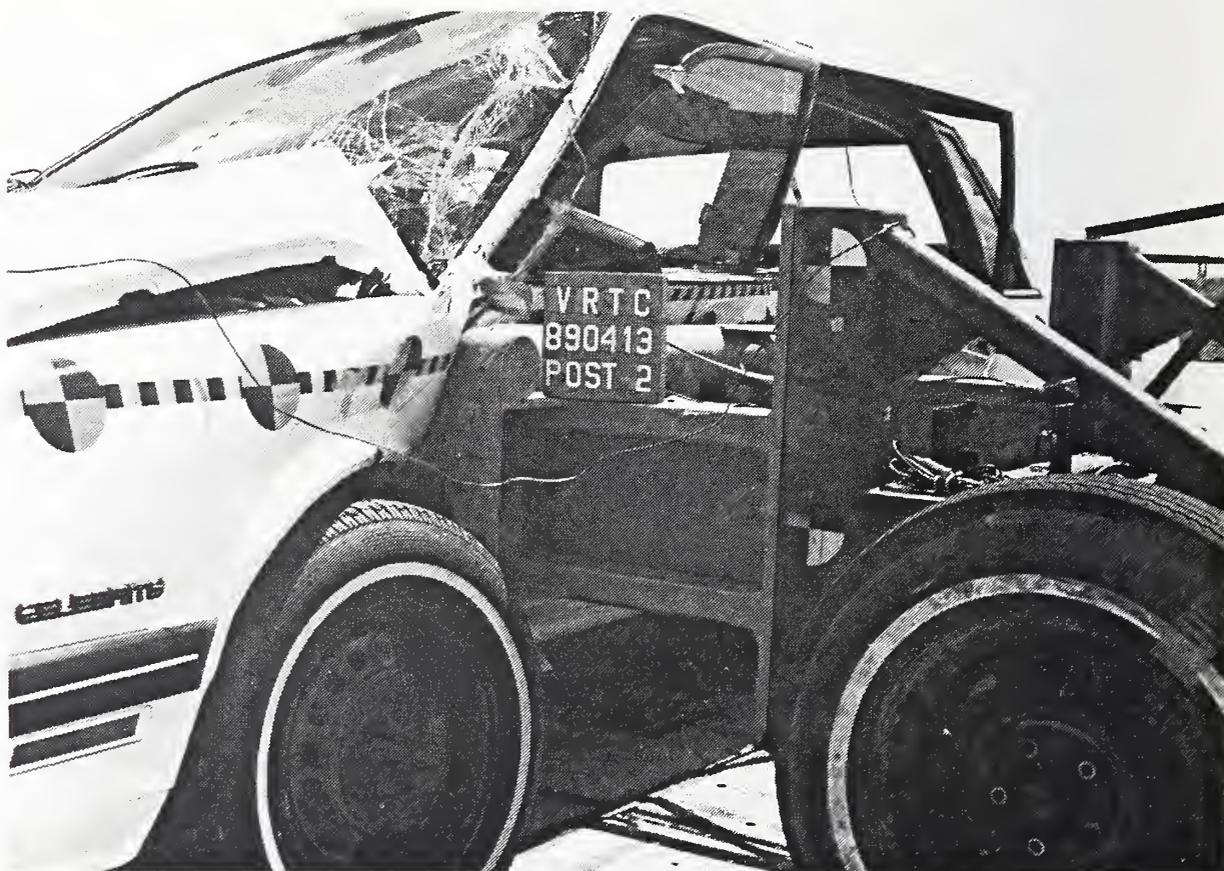


Figure A-28. POST-TEST CLOSE-UP LEFT FRONT VIEW



Figure A-29. POST-TEST CLOSE-UP LEFT REAR VIEW



TEST #890413-3  
LIST OF PHOTOGRAPHS

30. POST-TEST OVERALL FRONT - VIEW 1
31. POST-TEST OVERALL FRONT - VIEW 2
32. POST-TEST OVERALL LEFT SIDE - VIEW 1
33. POST-TEST OVERALL LEFT SIDE - VIEW 2
34. POST-TEST OVERALL REAR VIEW
35. POST-TEST OVERALL RIGHT SIDE VIEW
36. POST-TEST LEFT FRONT THREE-QUARTER VIEW
37. POST-TEST LEFT REAR THREE-QUARTER VIEW
38. POST-TEST CLOSE-UP LEFT FRONT VIEW
39. POST-TEST CLOSE-UP LEFT REAR VIEW
40. POST-TEST LEFT SIDE CLOSE-UP - VIEW 1
41. POST-TEST LEFT SIDE CLOSE-UP - VIEW 2
42. POST-TEST LEFT SIDE CLOSE-UP - VIEW 3
43. POST-TEST INSIDE CLOSE-UP VIEW





Figure A-30. POST-TEST OVERALL FRONT - VIEW 1



Figure A-31. POST-TEST OVERALL FRONT - VIEW 2

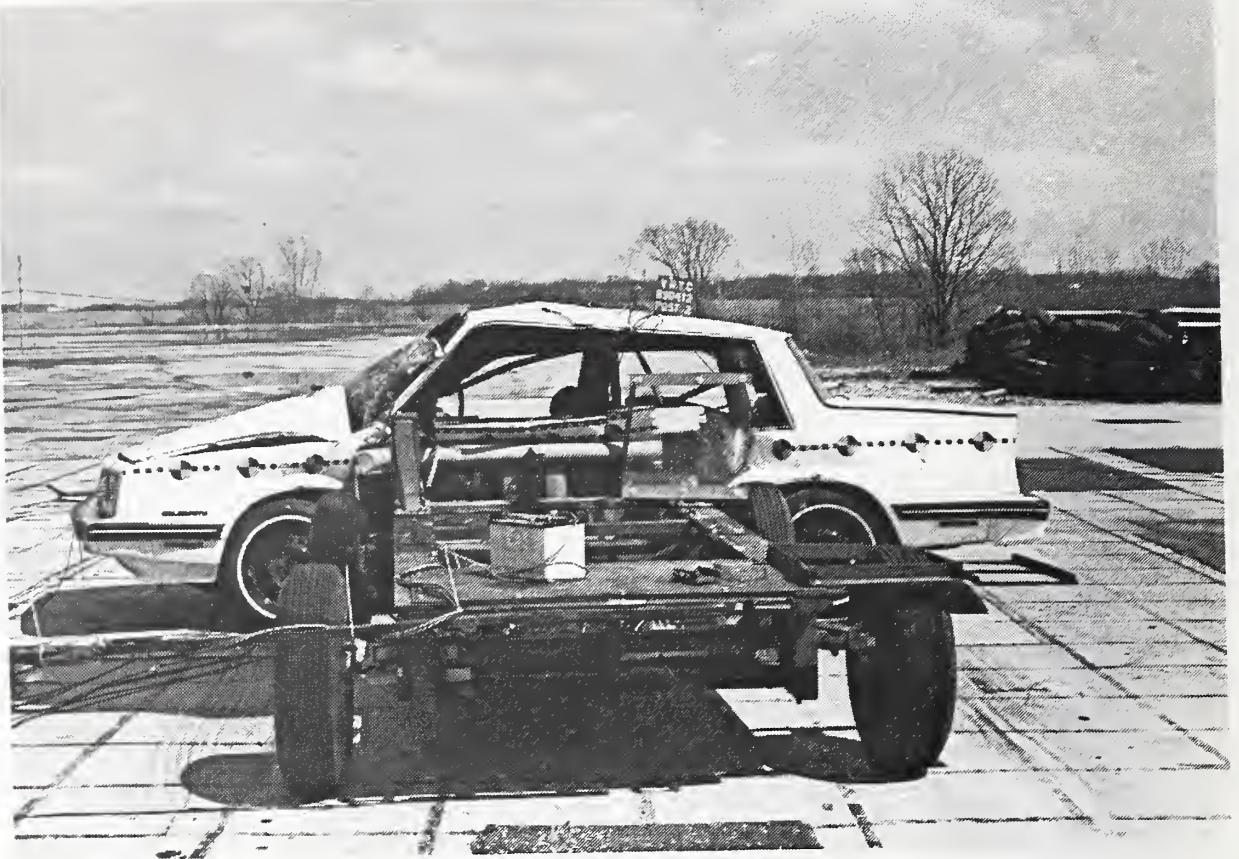


Figure A-32. POST-TEST OVERALL LEFT SIDE - VIEW 1



Figure A-33. PRE-TEST OVERALL LEFT SIDE - VIEW 2



Figure A-34. POST-TEST OVERALL REAR VIEW



Figure A-35. POST-TEST OVERALL RIGHT SIDE VIEW



Figure A-36. POST-TEST LEFT FRONT THREE-QUARTER VIEW

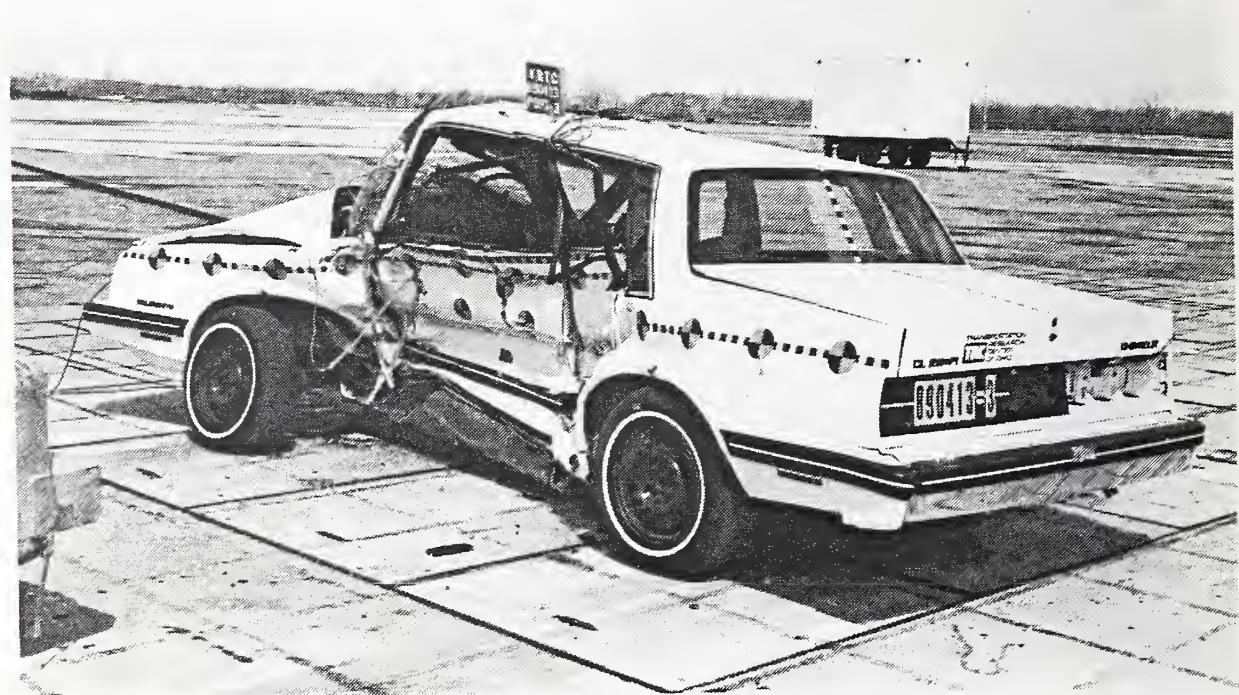


Figure A-37. PRE-TEST LEFT REAR THREE-QUARTER VIEW

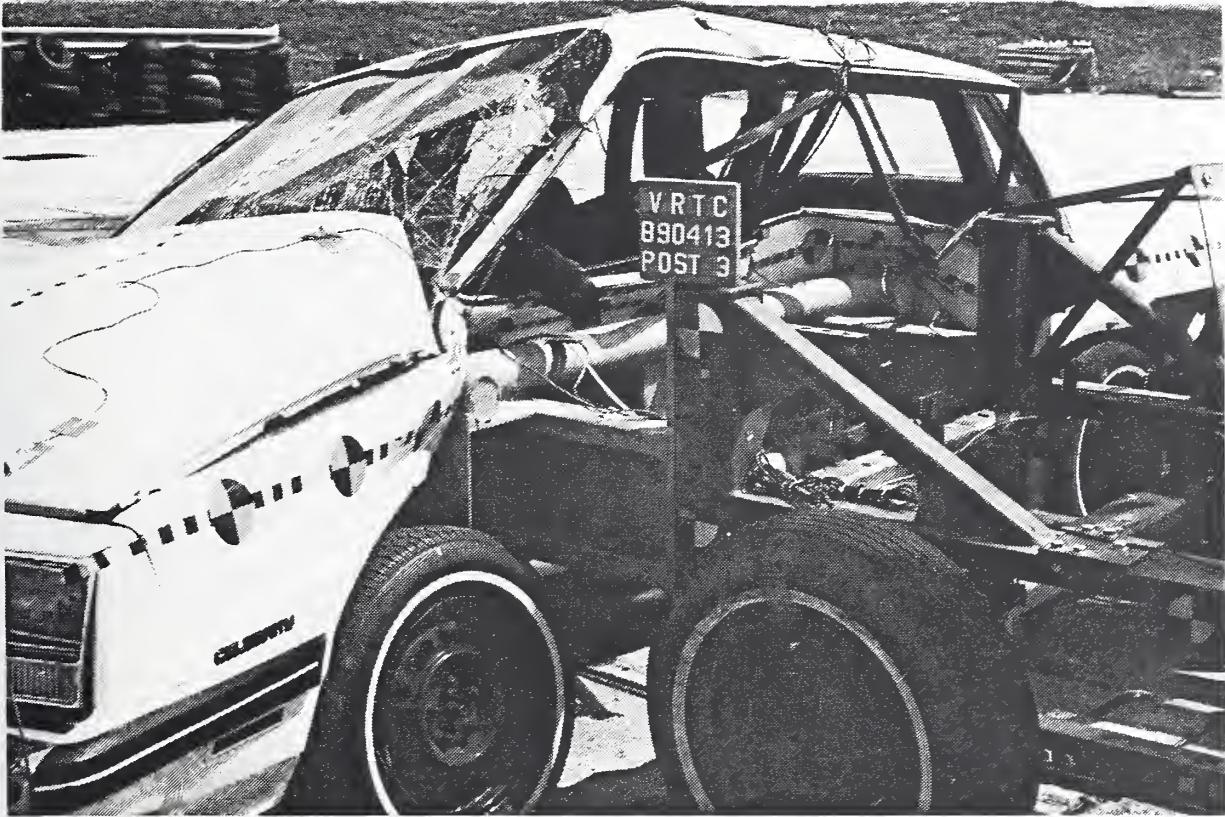


Figure A-38. POST-TEST CLOSE-UP LEFT FRONT VIEW



Figure A-39. POST-TEST CLOSE-UP LEFT REAR VIEW



Figure A-40. POST-TEST LEFT SIDE CLOSE-UP - VIEW 1



Figure A-41. POST-TEST LEFT SIDE CLOSE-UP - VIEW 2

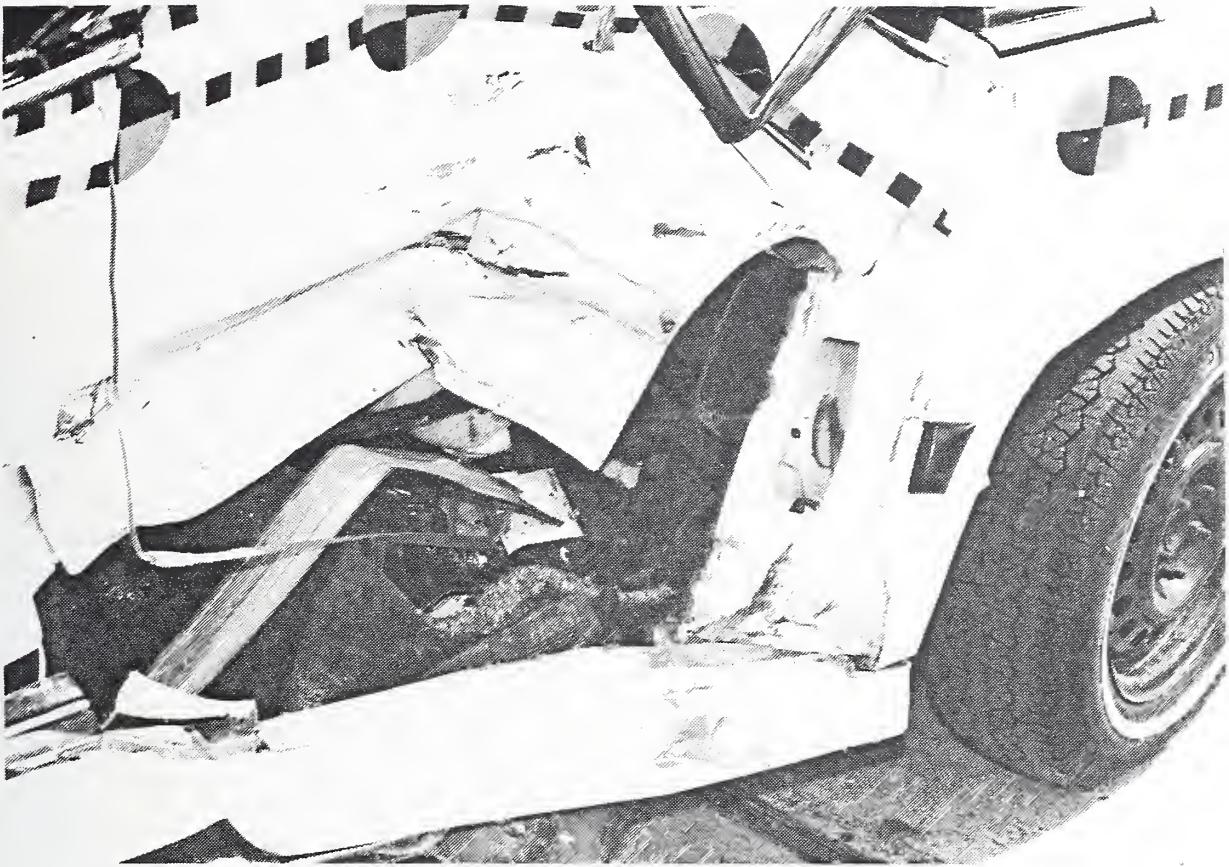


Figure A-42. POST-TEST LEFT SIDE CLOSE-UP - VIEW 3

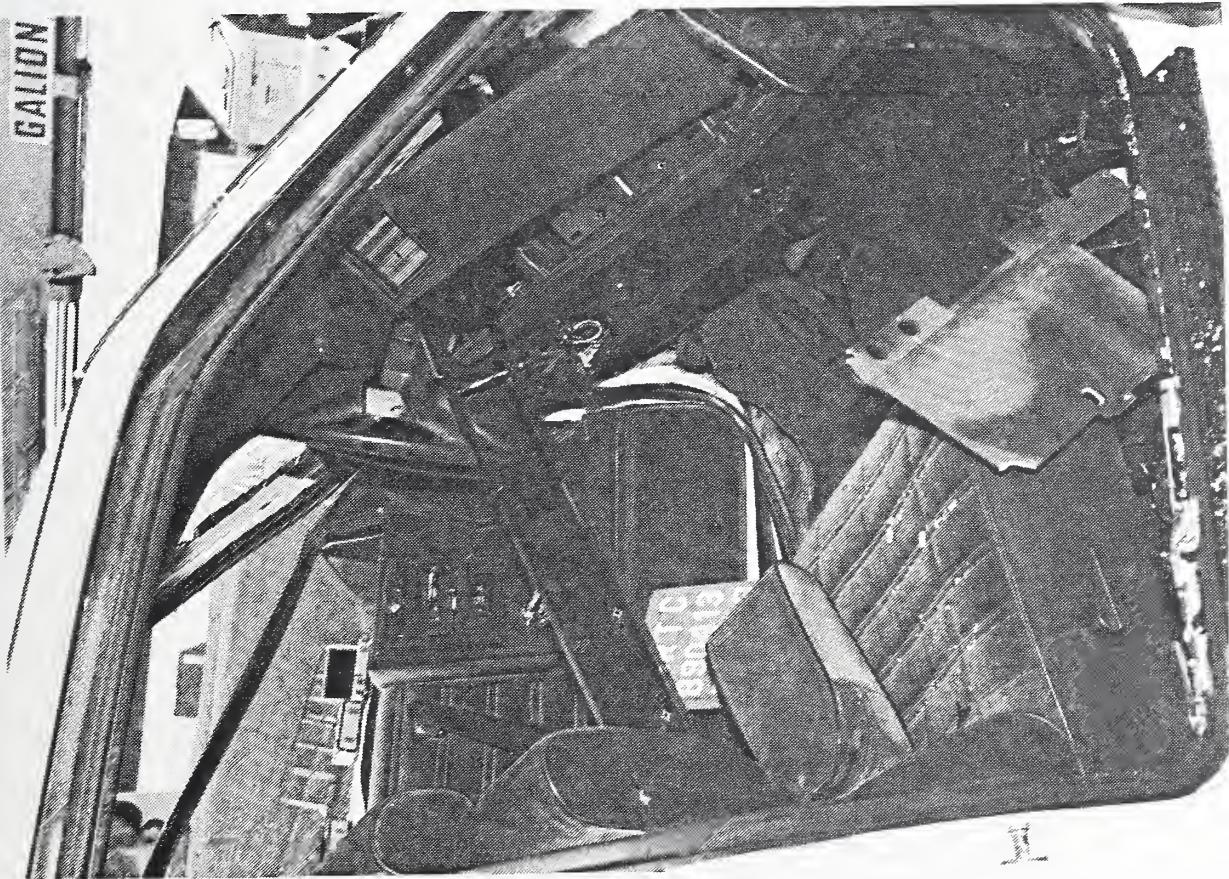


Figure A-43. POST-TEST INSIDE CLOSE-UP VIEW

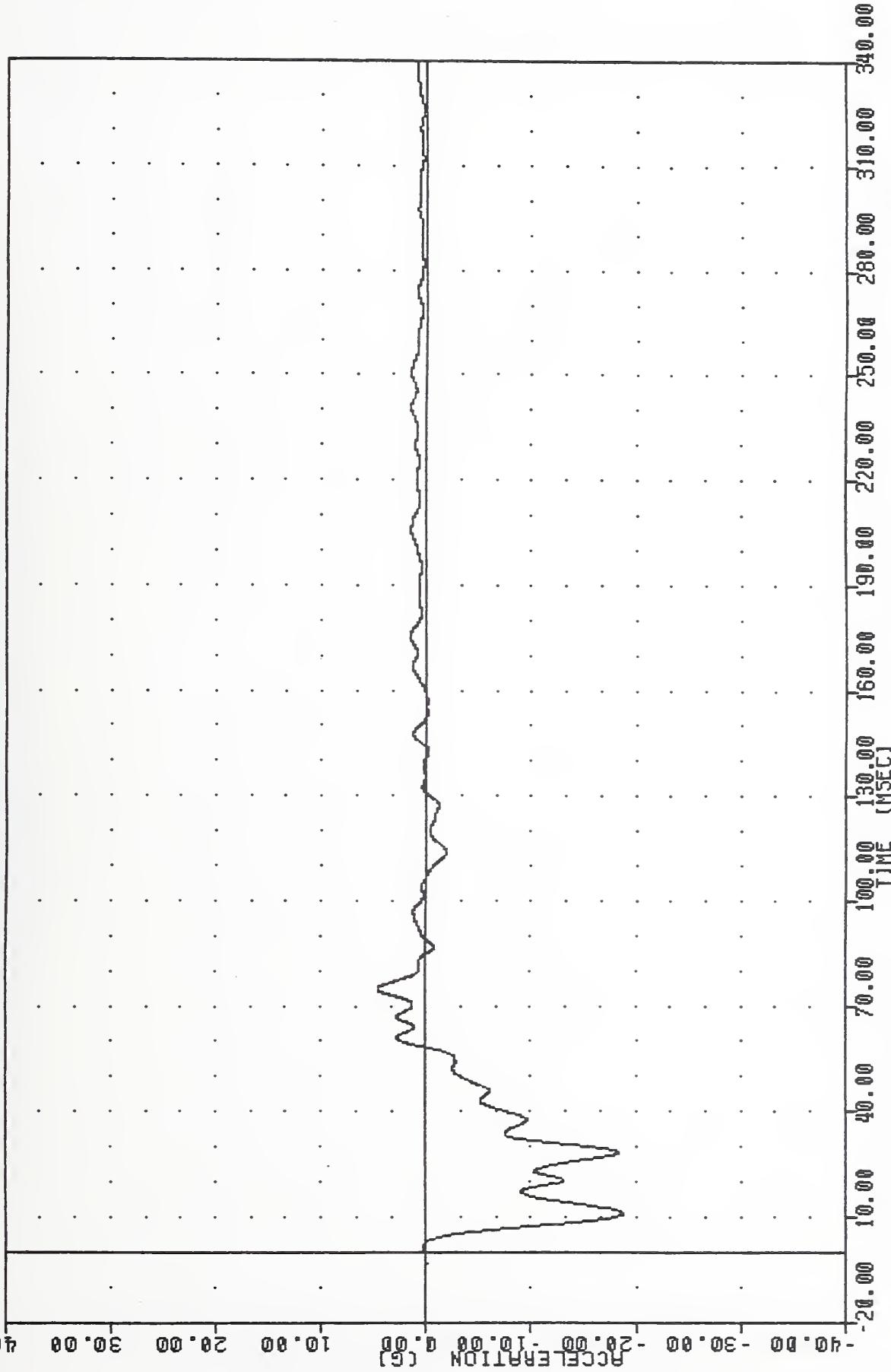


APPENDIX B  
DATA PLOTS

TEST #890413-1

VRTC-1  
 CRASH III DAMAGE ALGORITHM  
 89103  
 RFSYG

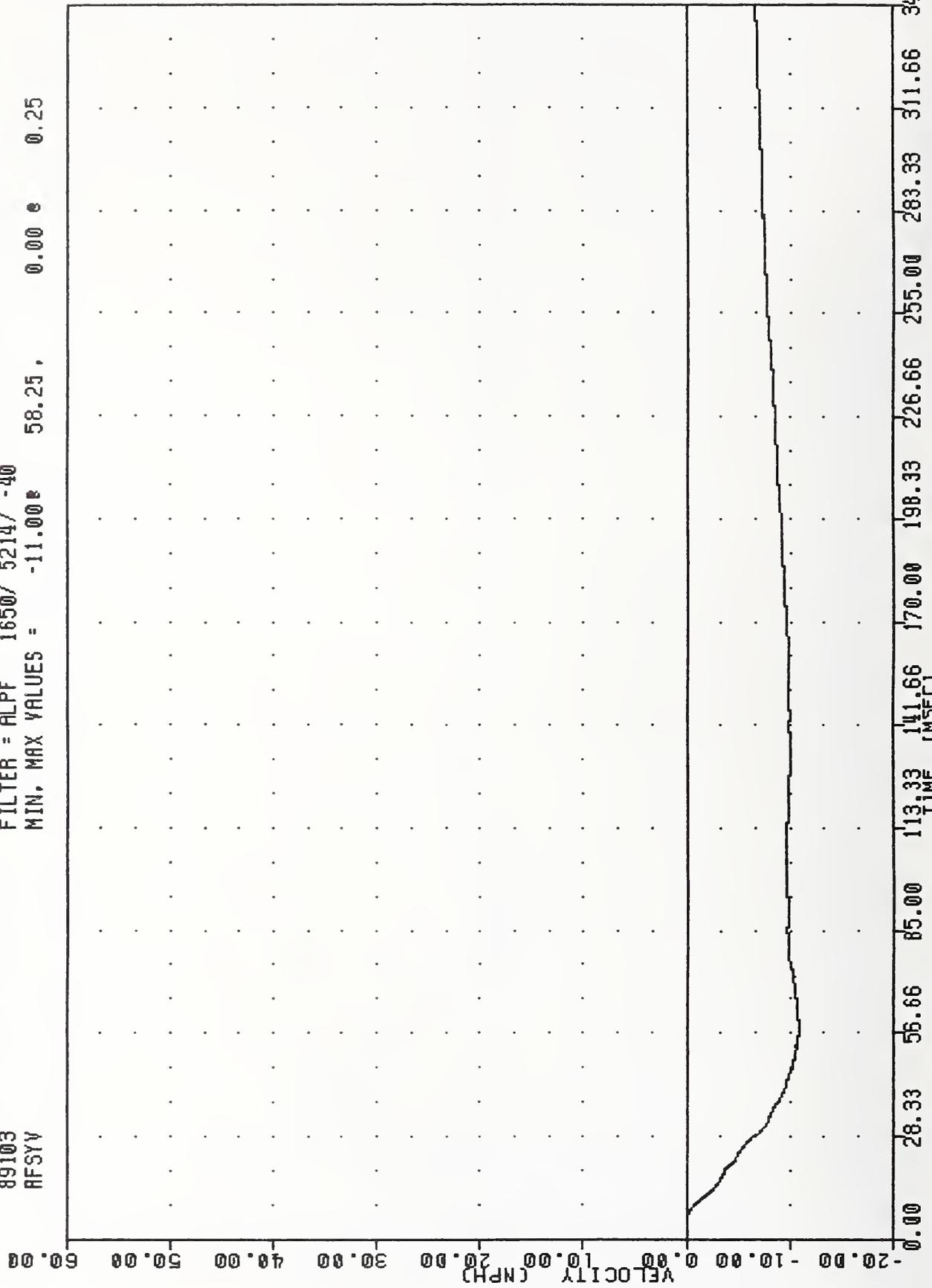
FILTER = BLPP 100/ 250/ -16  
 MIN, MAX VALUES = -18.76 11.00 4.55 e. 74.75



CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 20.3 MPH #1  
 VEHICLE RIGHT FRONT SILL Y AXIS ACCELERATION

VRTC-1 , 890413-1  
 CRASH III DAMAGE ALGORITHM  
 89103  
 AFSYV

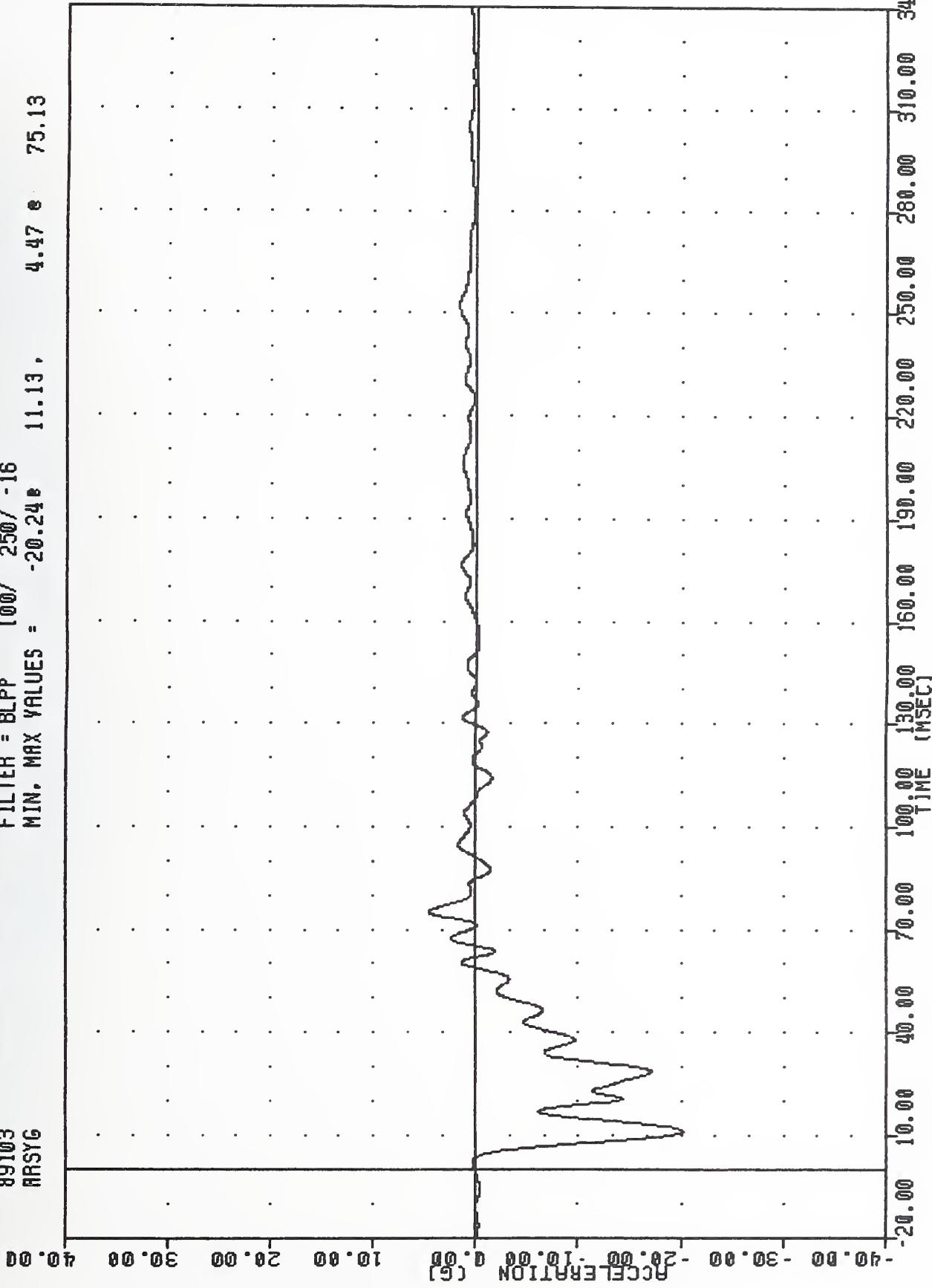
FILTER = ALPF 1650/ 5214/ -40  
 MIN. MAX VALUES = -11.00e 58.25 , 0.00 e 0.25



CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 20.3 MPH #1  
 VEHICLE RIGHT FRONT SILL Y AXIS VELOCITY

VRTC-1 , 890413-1  
CRASH III DAMAGE ALGORITHM  
89103  
ARSYG

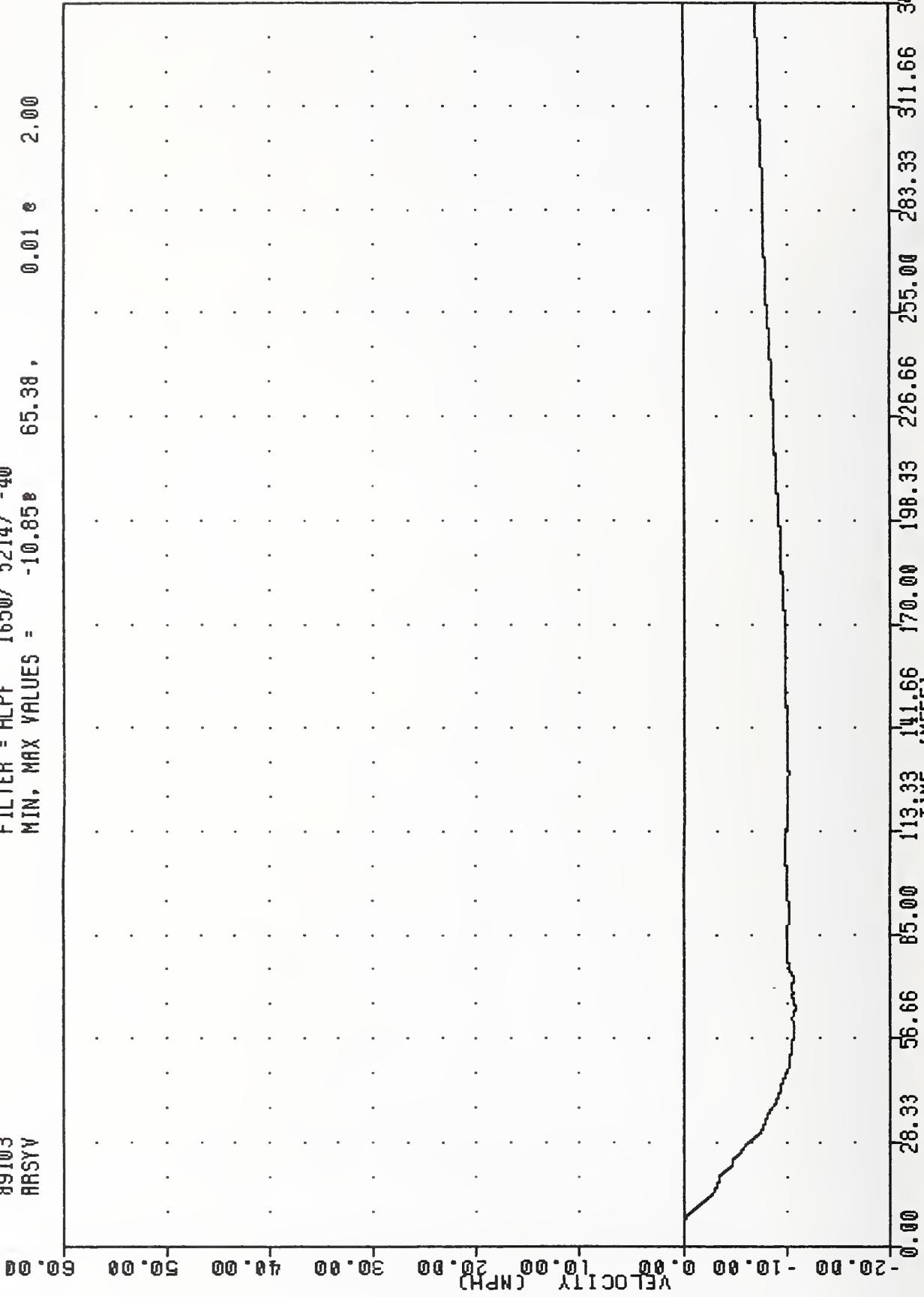
FILTER = BLPP 100/ 250/ -16  
MIN. MAX VALUES = -20.24e 11.13, 4.47 e 75.13



CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 20.3 MPH #1  
VEHICLE RIGHT REAR SILL Y AXIS ACCELERATION

VRTC-1 , 890413-1  
 CRASH III DAMAGE ALGORITHM  
 89103  
 ARSYV

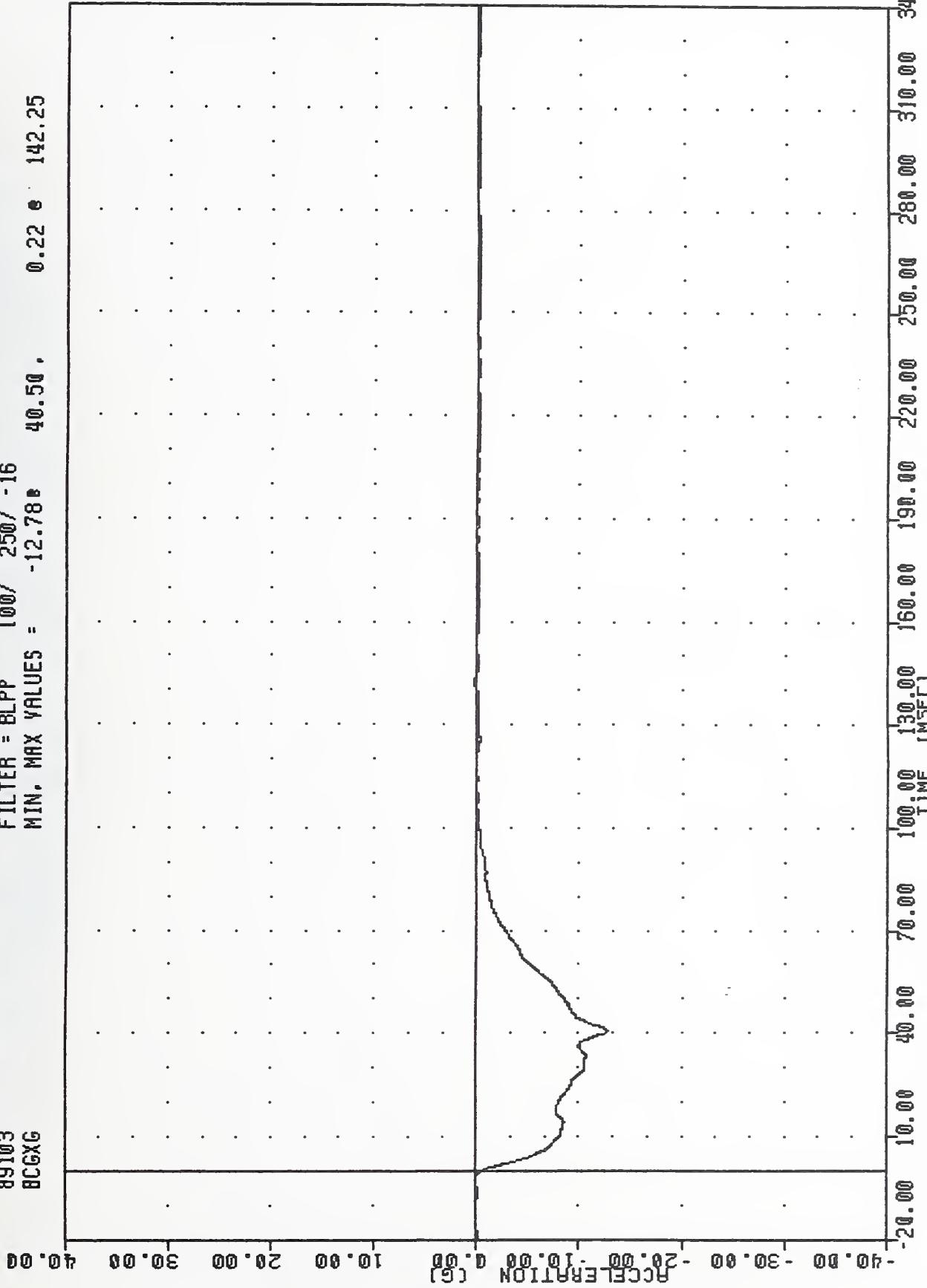
FILTER = ALPF 1650/ 5214/ -40  
 MIN, MAX VALUES = -10.85e 65.38 , 0.01 e 2.00



CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 20.3 MPH #1  
 VEHICLE RIGHT REAR SILL Y AXIS VELOCITY

VRTC-1 , 890413-1  
CRASH III DAMAGE ALGORITHM  
89103  
BCGXC

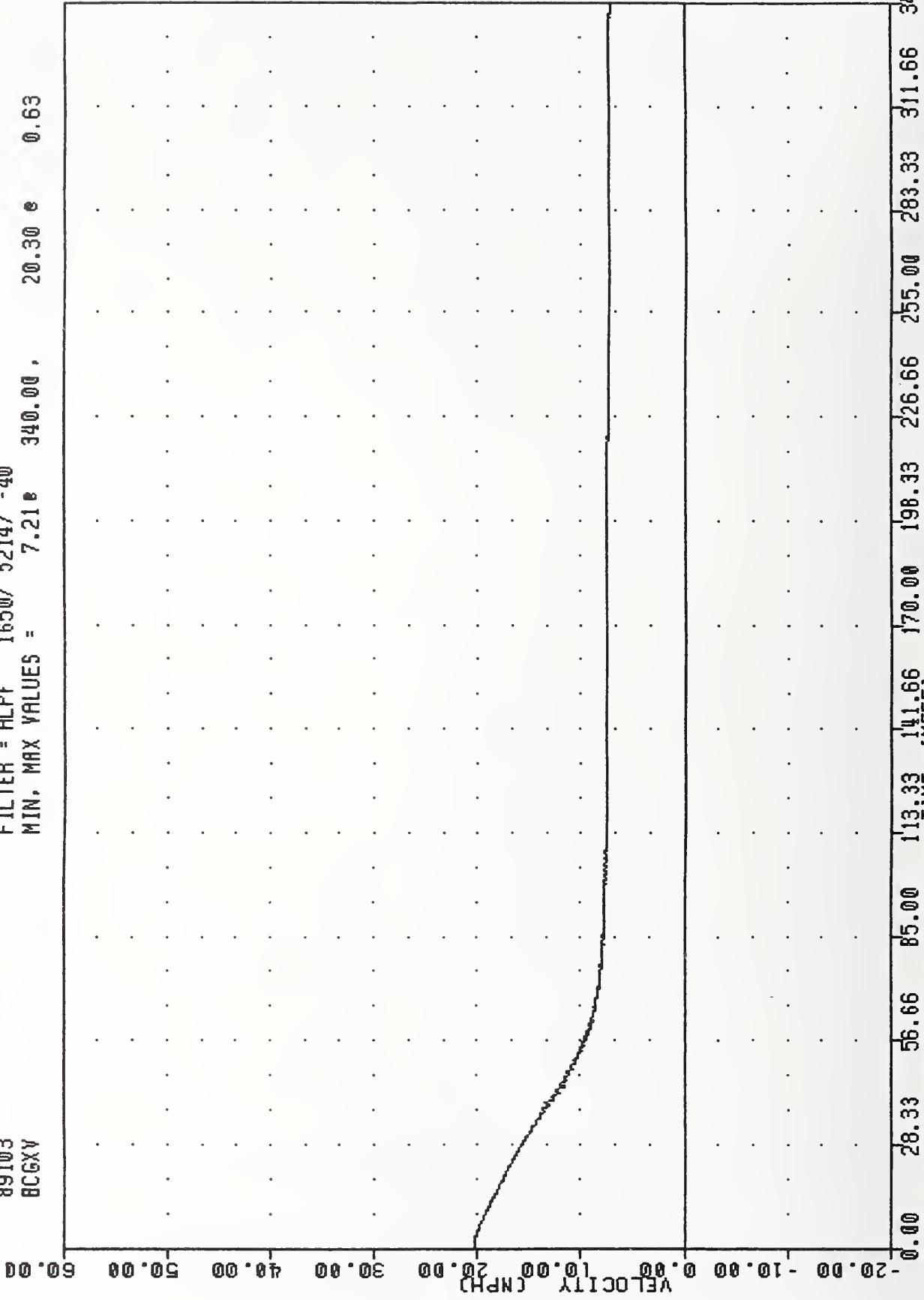
FILTER = BLPP 100/ 250/ -16  
MIN. MAX VALUES = -12.78 40.50 0.22 142.25



CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 20.3 MPH #1  
CONTOURED BARRIER CENTER OF GRAVITY X AXIS ACCELERATION

YATC-1 , 890413-1  
 CRASH III DAMAGE ALGORITHM  
 89103  
 BCGXY

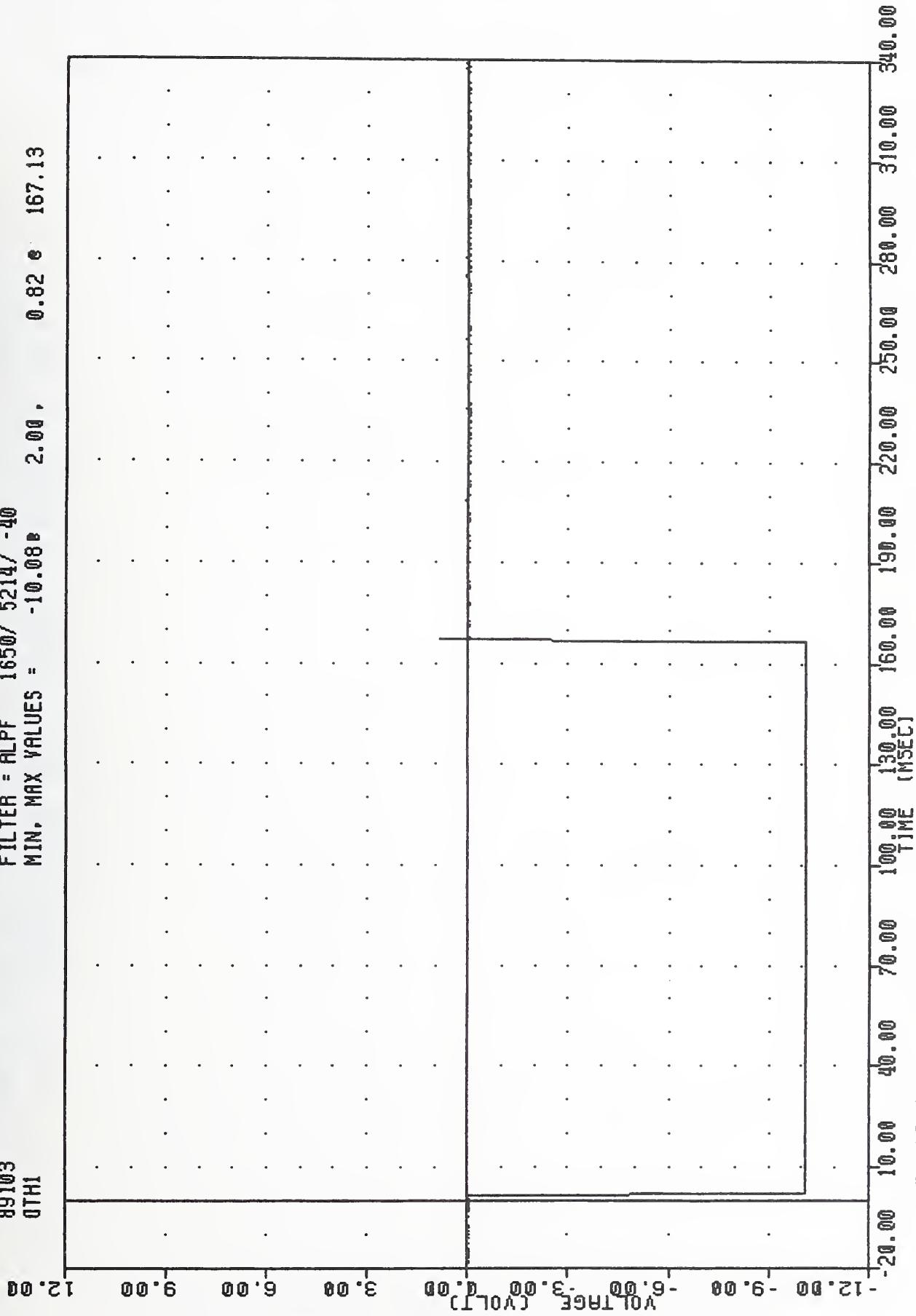
FILTER = ALPF 1650/ 5214/ -40  
 MIN, MAX VALUES = 7.21e 340.00, 20.30 e 0.63



0.00 28.33 56.66 85.00 113.33 141.66 170.00 198.33 226.66 255.00 283.33 311.66 340.00  
 CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 20.3 MPH #1  
 CONTOURED MOVING BARRIER CENTER OF GRAVITY X AXIS VELOCITY

YRTC-1 , 890413-1  
 CRASH III DAMAGE ALGORITHM  
 89103  
 0TH1

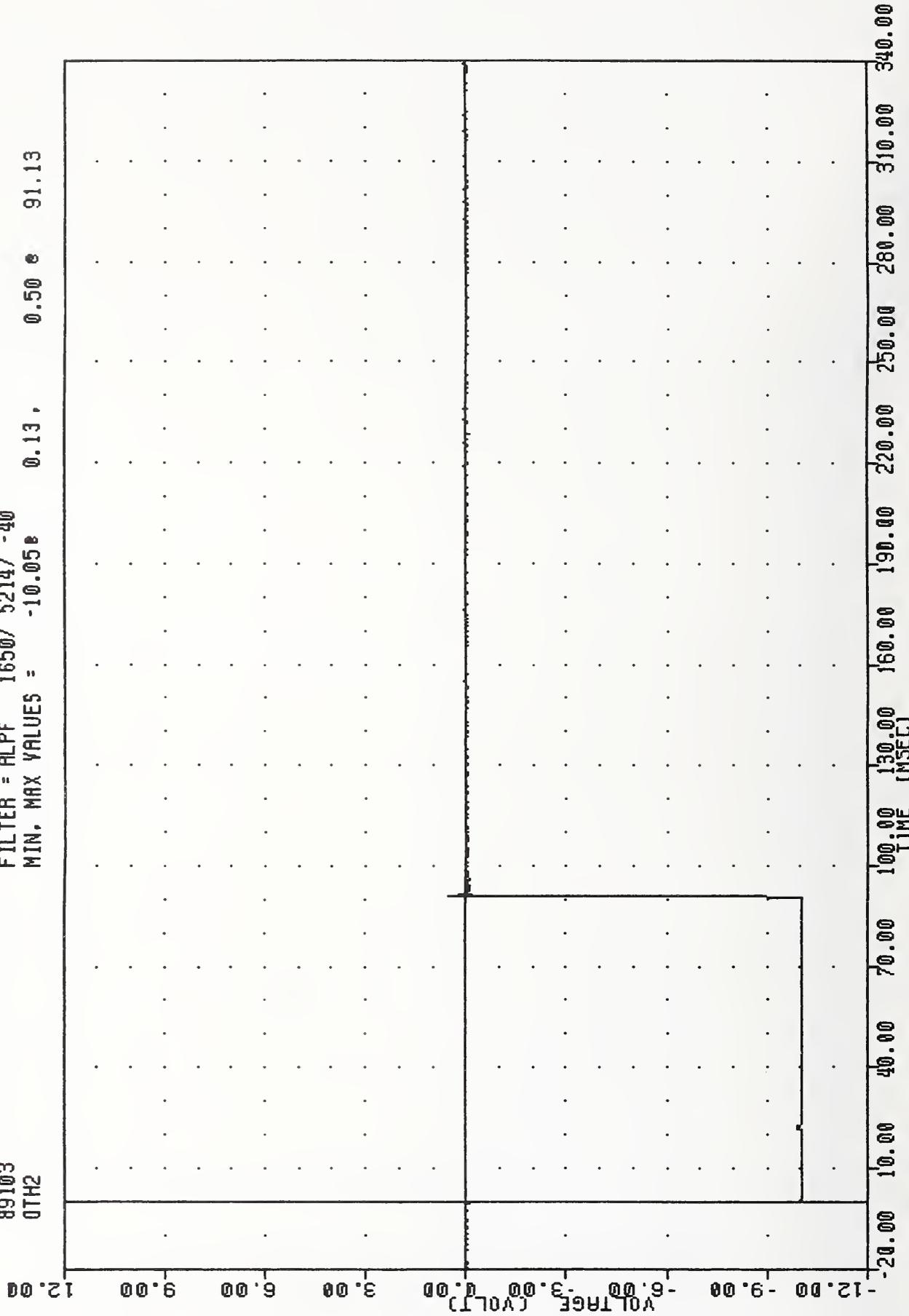
FILTER = ALPF 1650/ 5214/ -40  
 MIN. MAX VALUES = -10.08 e 2.00 , 0.82 e 167.13



CONToured BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 20.3 MPH #1  
 VEHICLE CONTACT SWITCH - FRONT

VRTC-1 , 890413-1  
 CRASH III DAMAGE ALGORITHM  
 89103  
 0TH2

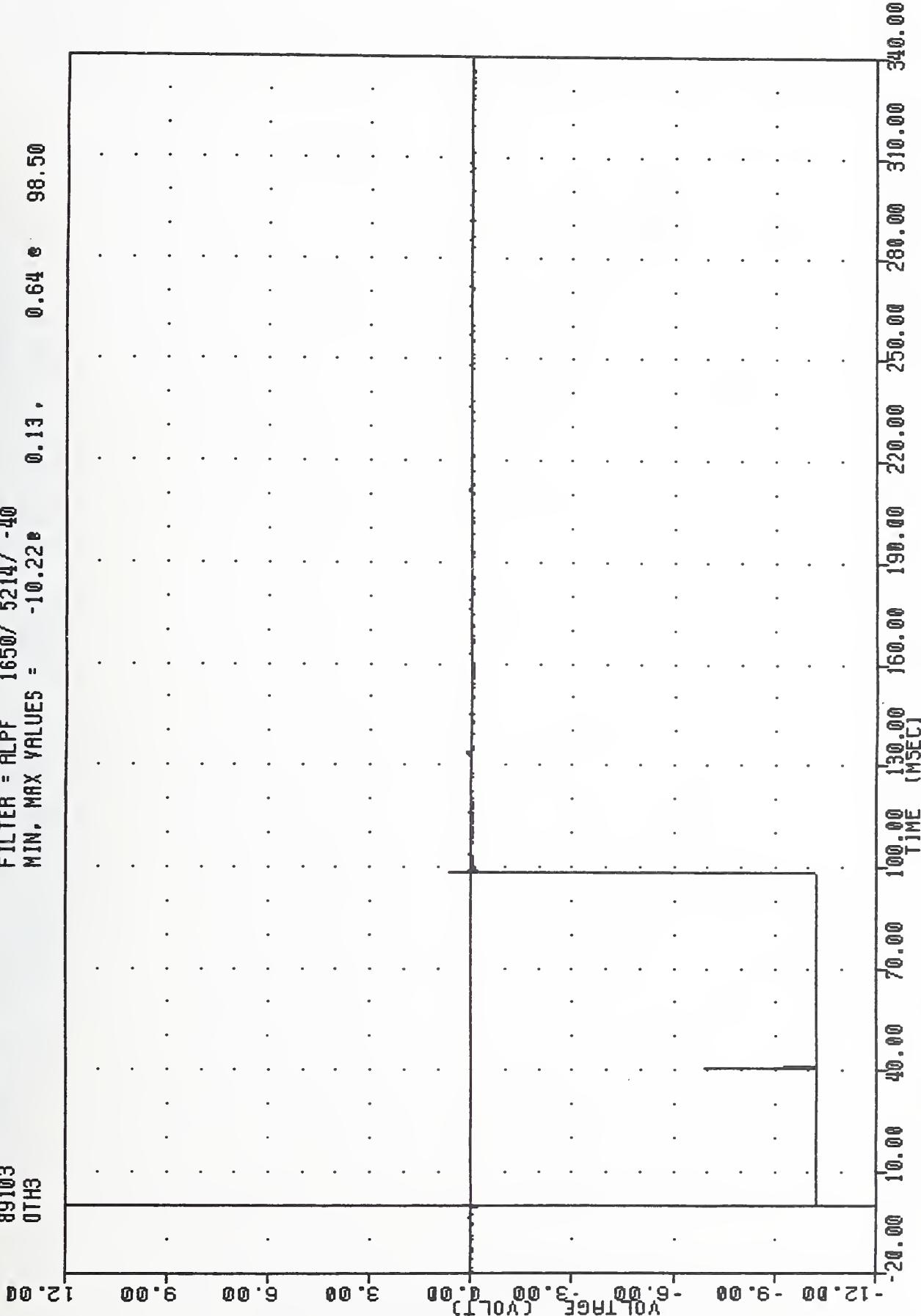
FILTER = ALPF 1650/ 5214/ -40  
 MIN, MAX VALUES = -10.05e 0.13, 0.50 e 91.13



CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 20.3 MPH #1  
 VEHICLE CONTACT SWITCH - REAR

YRTC-1 , 890413-1  
 CRASH III DAMAGE ALGORITHM  
 89103  
 OTHS

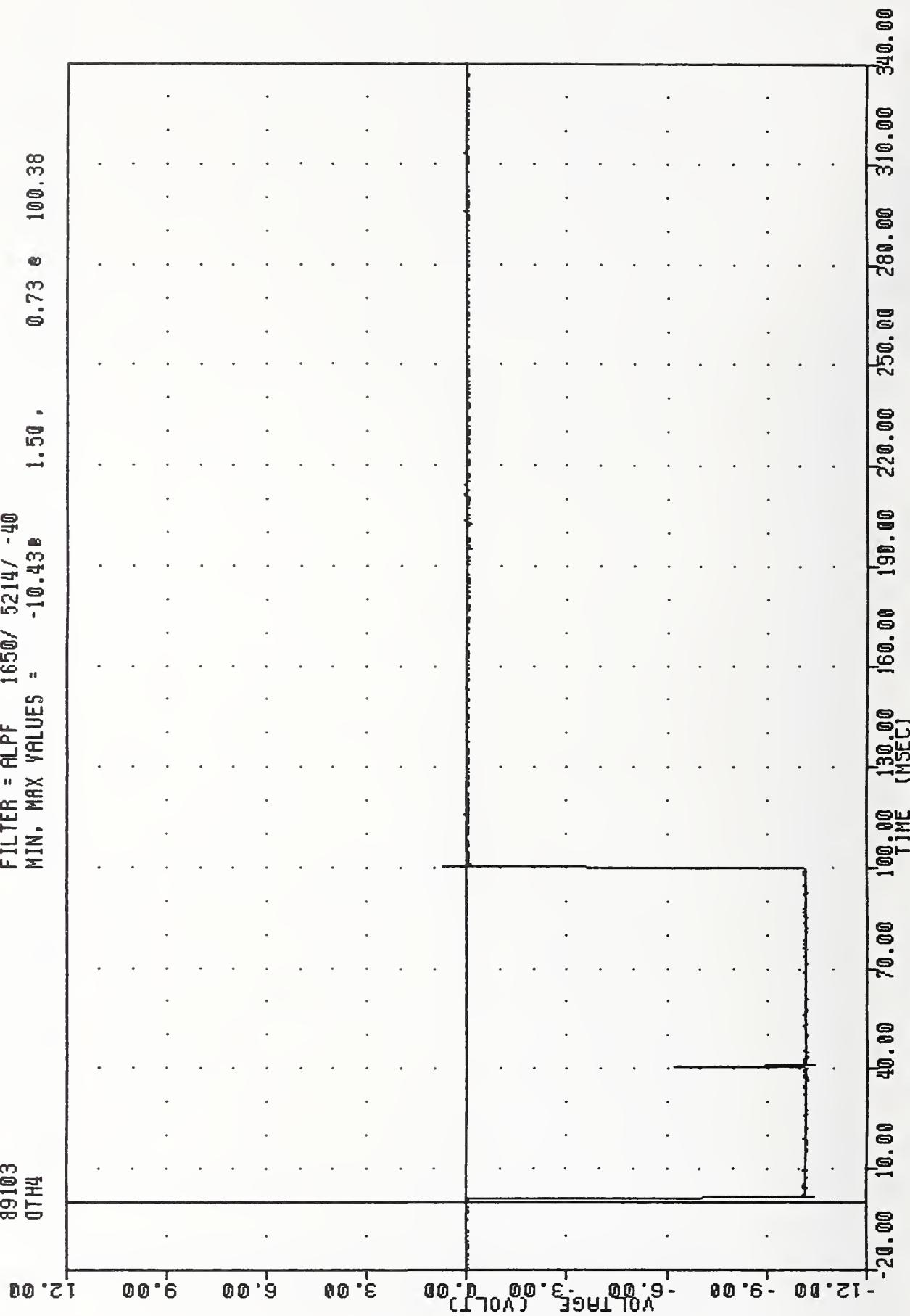
FILTER = ALPF 1650/ 5214/ -40  
 MIN. MAX VALUES = -10.22e 0.13 , 0.64 e 98.50



CONToured BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 20.3 MPH #1  
 BARRIER CONTACT SWITCH - RIGHT

VRTC-1 , 890413-1  
CRASH III DAMAGE ALGORITHM  
89103  
0TH4

FILTER = ALPF 1650/ 5214/ -40  
MIN, MAX VALUES = -10.43e 1.50, 0.73 e 100.38



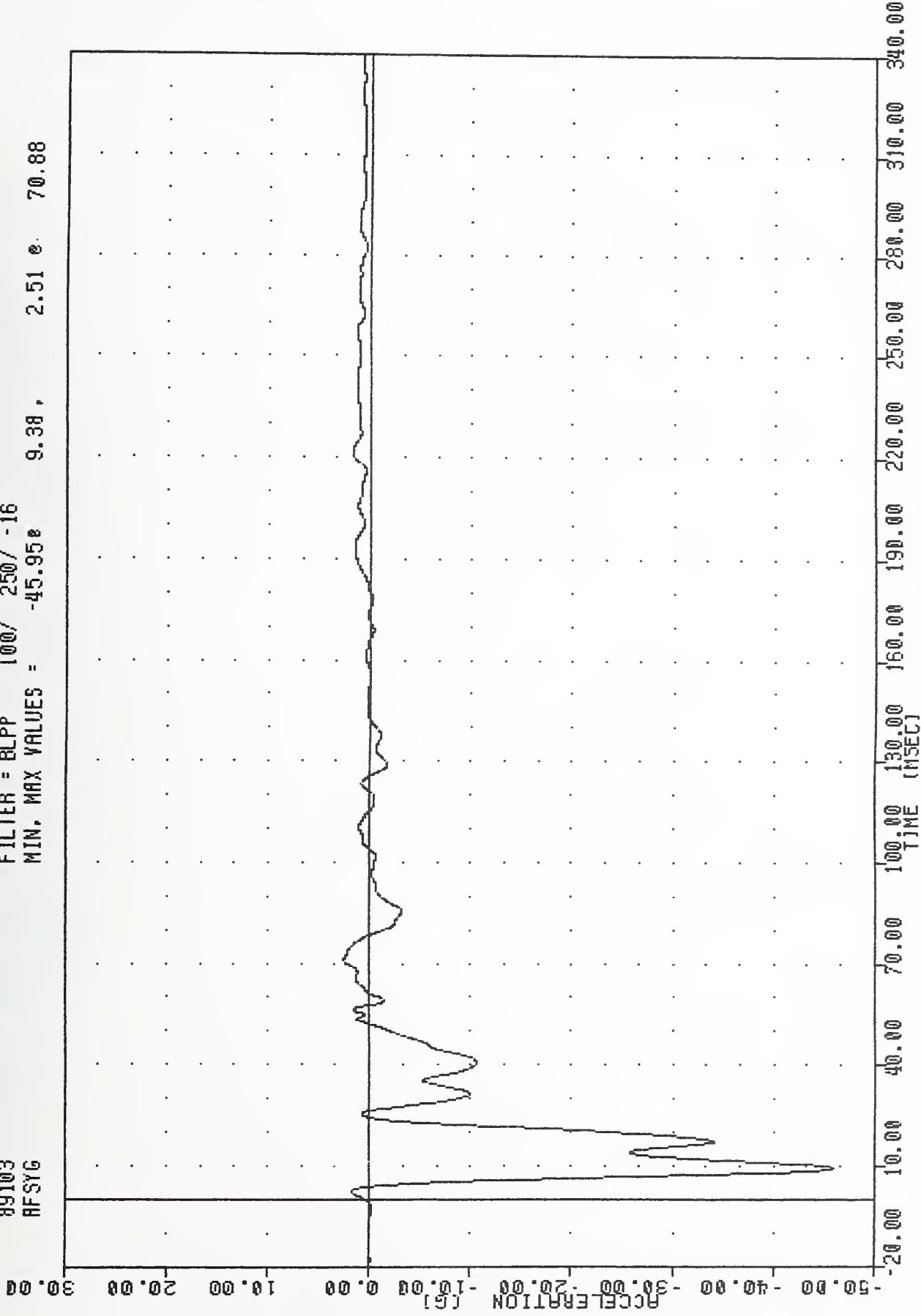
CONTOURED BARRIER INTO 90 DEG CHEVROLET CELEBRITY AT 20.3 MPH #1  
BARRIER CONTACT SWITCH - LEFT

TEST #890413-2



VRTC-2 , 890413-2  
CRASH III DAMAGE ALGORITHM  
89103  
RFSYG

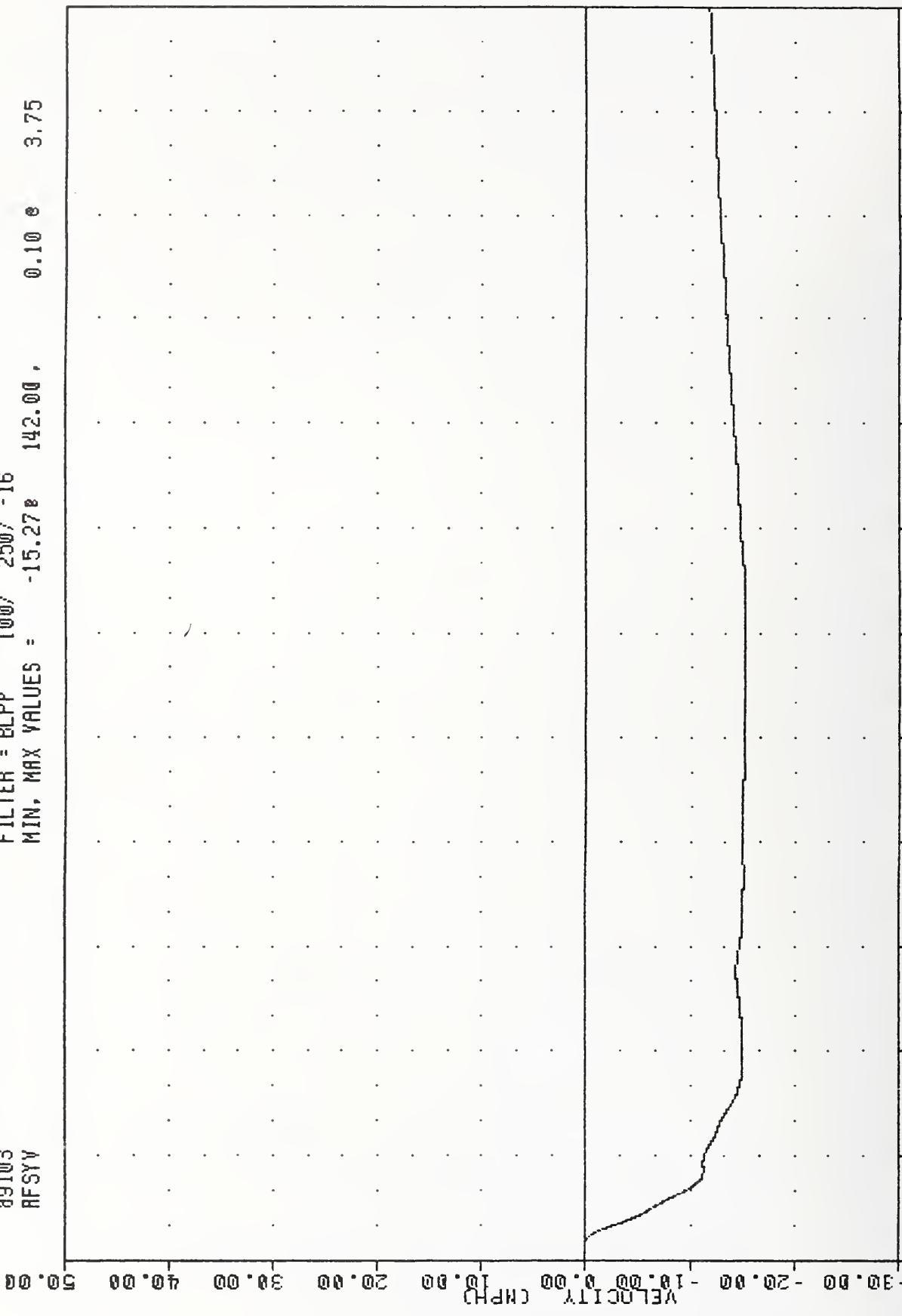
FILTER = BLPP 100/ 250/ -16  
MIN, MAX VALUES = -45.95e 9.38 , 2.51 e 70.88



CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 30.1 MPH #2  
VEHICLE RIGHT FRONT SILL Y AXIS ACCELERATION

YRTC-2 , 890413-2  
 CRASH III DAMAGE ALGORITHM  
 89103  
 RFSYV

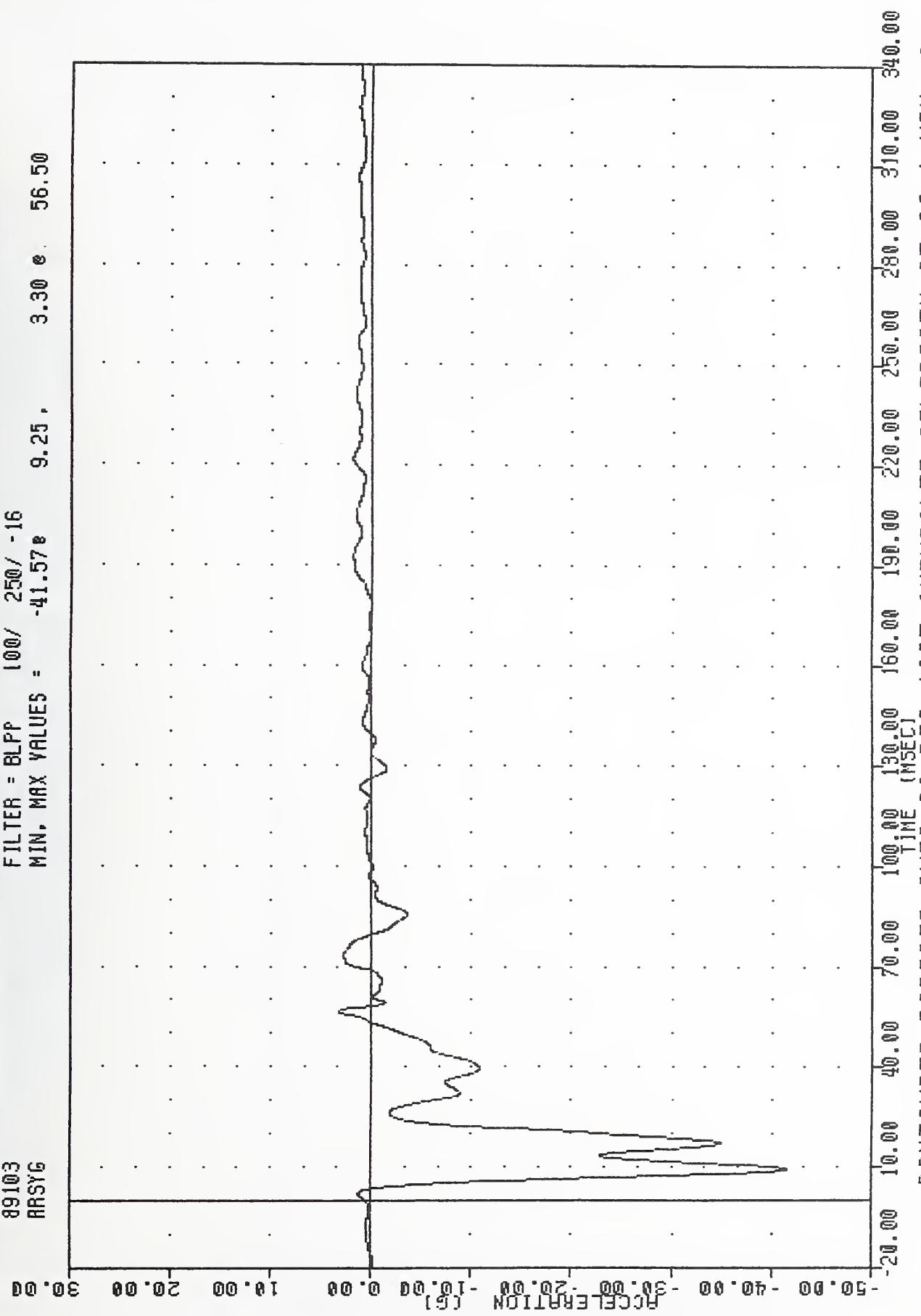
FILTER = BLPP 100/ 250/ -16  
 MIN, MAX VALUES = -15.278 142.00 , 0.10 e 3.75



0.00 28.33 56.66 85.00 113.33 141.66 170.00 198.33 226.66 255.00 283.33 311.66 340.00  
 VELOCITY (CMPH)  
 TIME (MSEC)  
 CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 30.1 MPH #2  
 VEHICLE RIGHT FRONT SILL Y AXIS VELOCITY

VRTC-2 , 890413-2  
 CRASH III DAMAGE ALGORITHM  
 89103  
 ARSYG

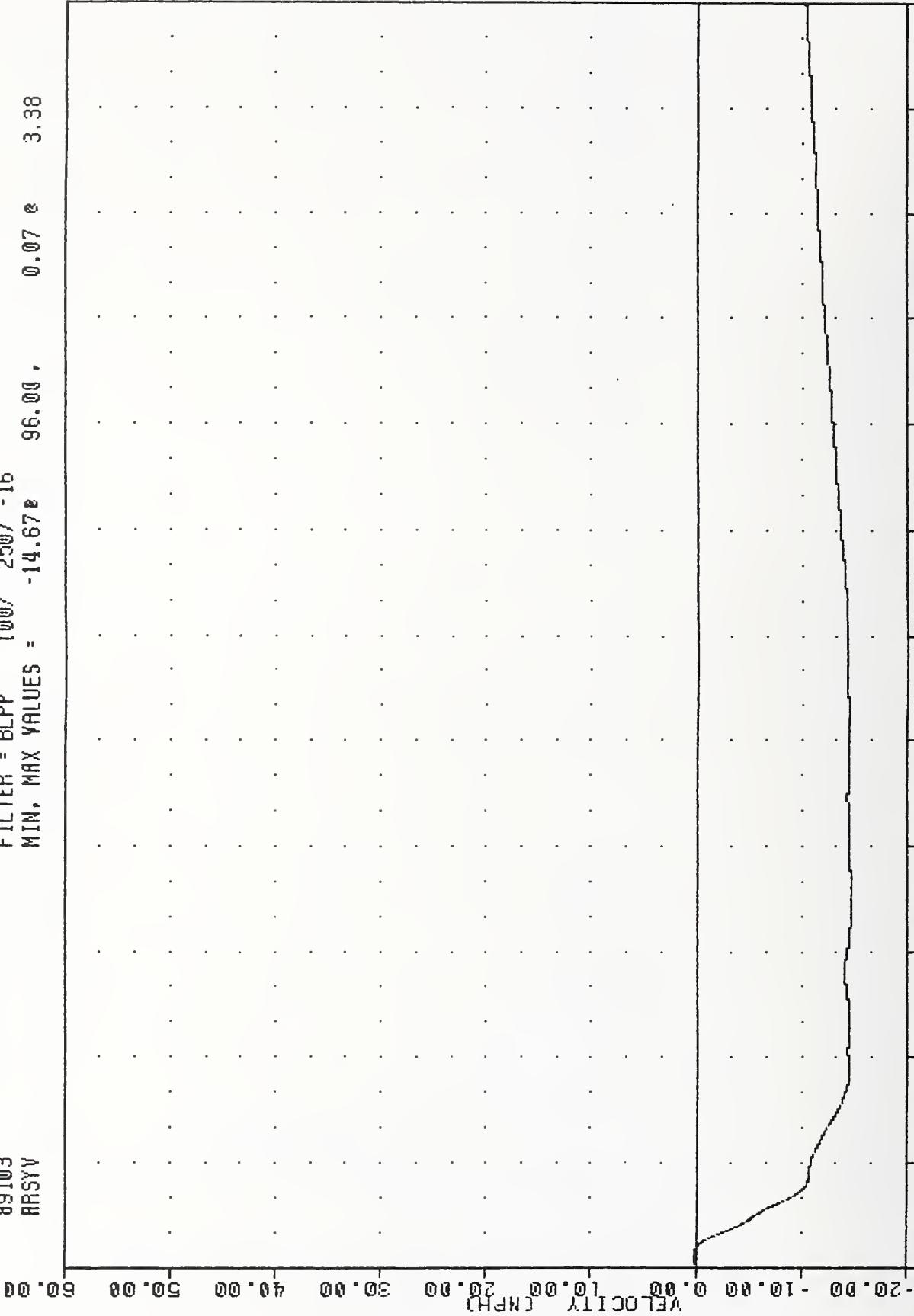
FILTER = BLPP 100/ 250/ -16  
 MIN, MAX VALUES = -41.57 e 9.25 , 3.30 e 56.50



CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 30.1 MPH #2  
 VEHICLE RIGHT REAR SILL Y AXIS ACCELERATION

YRTC-2 , 890413-2  
 CRASH III DAMAGE ALGORITHM  
 89103  
 ARSYV

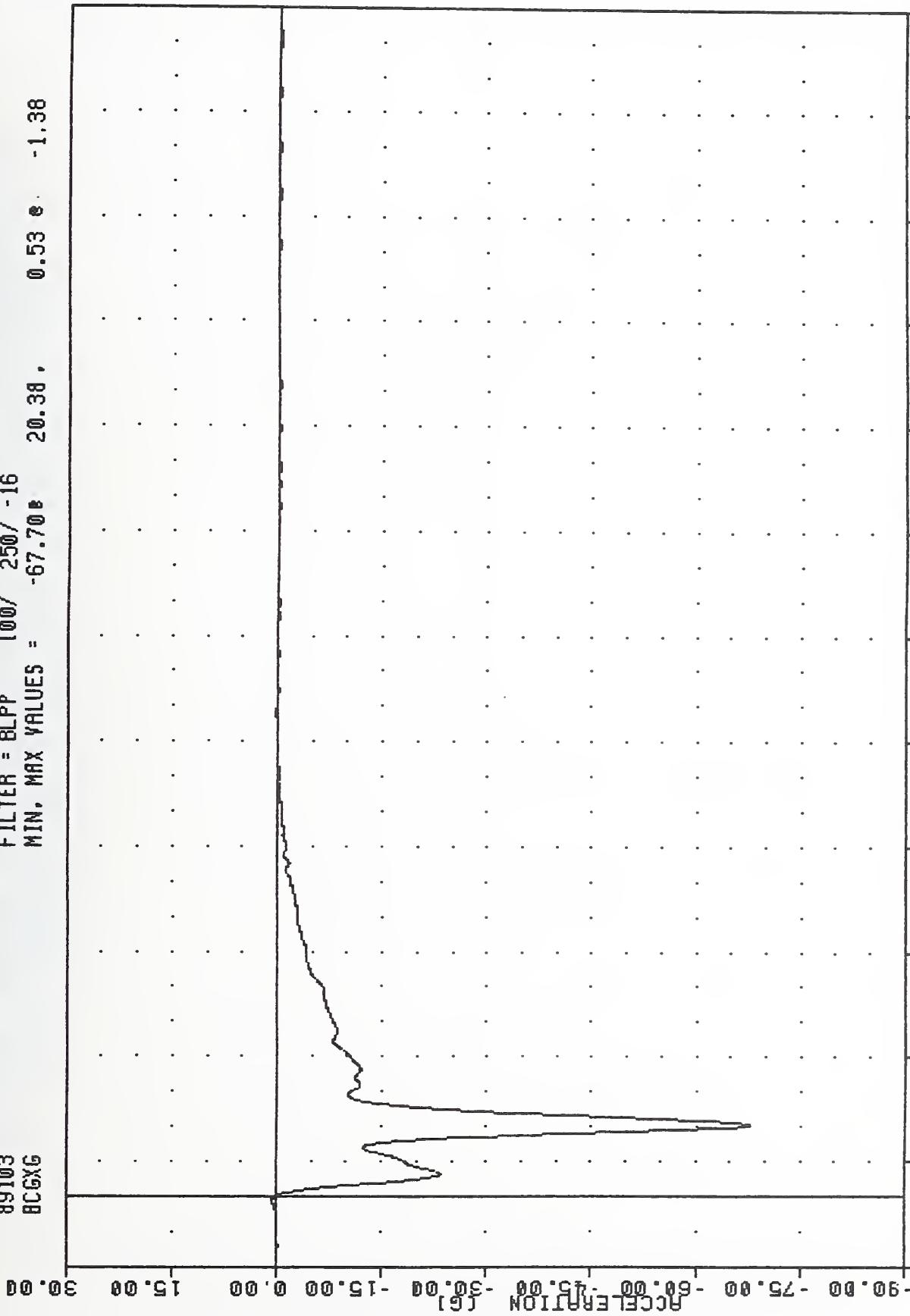
FILTER = BLPP 100/ 250/ -16  
 MIN, MAX VALUES = -14.67e 96.00 , 0.07 e 3.38



0.00 28.33 56.66 85.00 113.33 141.66 170.00 196.33 226.66 255.00 283.33 311.66 340.00  
 TIME (MSEC)  
 CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 30.1 MPH #2  
 VEHICLE RIGHT REAR SILL Y AXIS VELOCITY

VRTC-2 , 890413-2  
 CRASH III DAMAGE ALGORITHM  
 89103  
 BCGXG

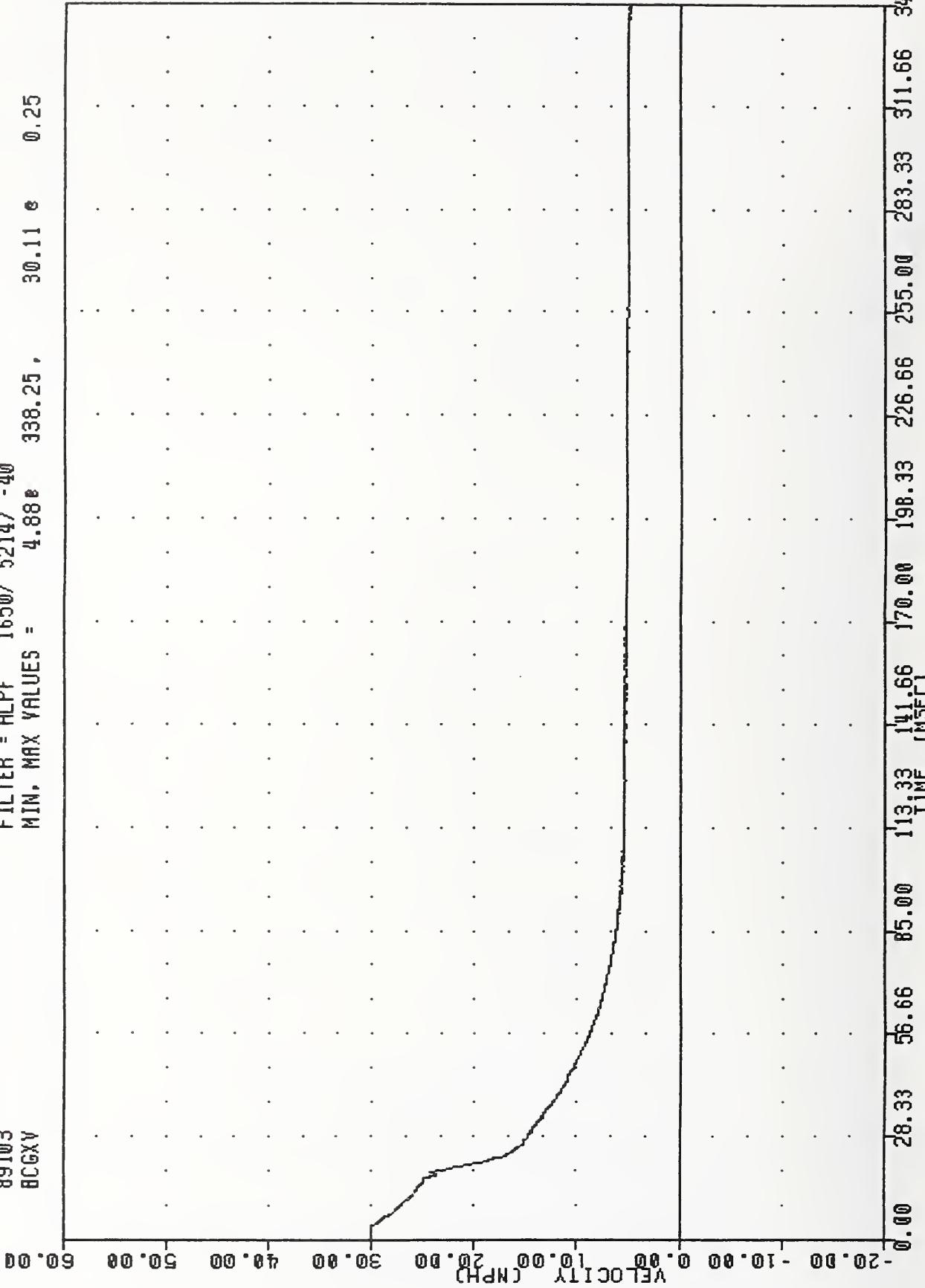
FILTER = BLPP 100/ 250/ -16  
 MIN, MAX VALUES = -67.70 0.53 e. -1.38



CONTOURED BARRIER INTO 90 DEG CHEVROLET CELEBRITY AT 30.1 MPH #2  
 CONTOURED MOVING BARRIER CENTER OF GRAVITY X AXIS ACCELERATION

YRTC-2 , 890413-2  
 CRASH III DAMAGE ALGORITHM  
 89103  
 BCGXY

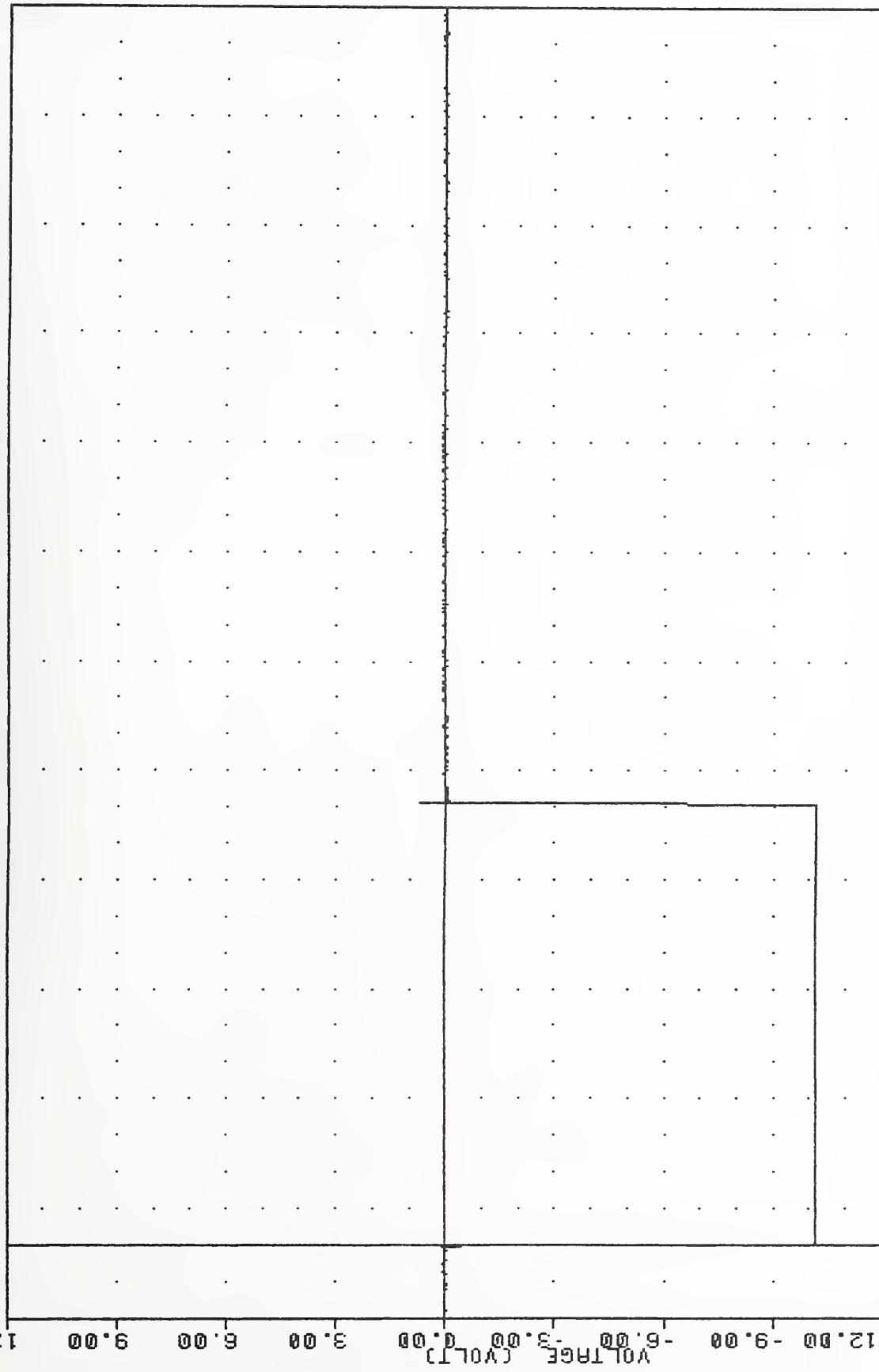
FILTER = ALPF 1650/ 5214/ -40  
 MIN. MAX VALUES = 4.88e 30.11 e 0.25



CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 30.1 MPH #2  
 CONTOURED MOVING BARRIER CENTER OF GRAVITY X AXIS VELOCITY

VRTC-2 , 690413-2  
 CRASH III DAMAGE ALGORITHM  
 89103  
 0TH1

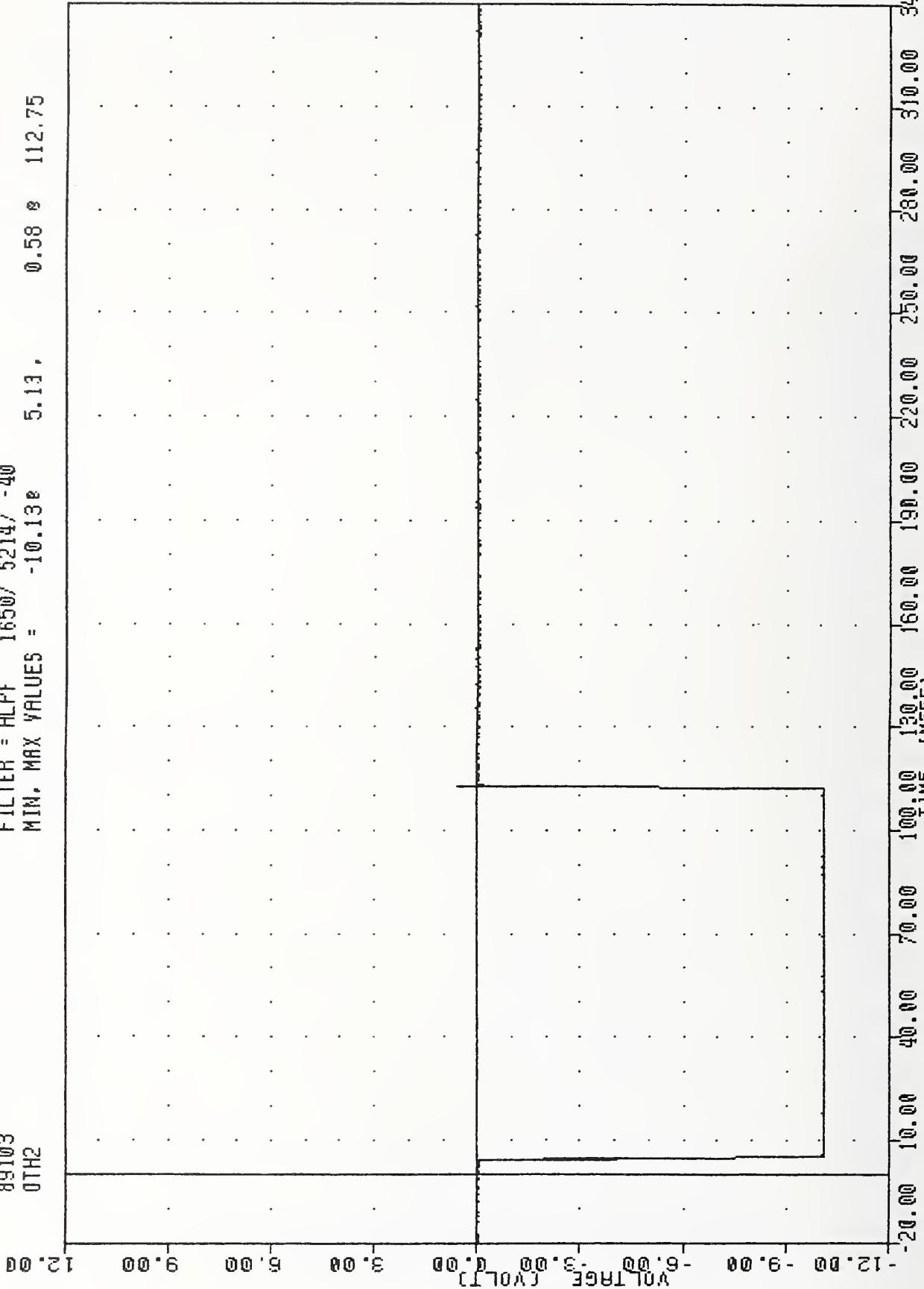
FILTER = ALPF 1650/ 5214/ -40  
 MIN. MAX VALUES = -10.15e 0.13. 0.69 e 121.13



-12.00 10.00 40.00 70.00 100.00 130.00 160.00 190.00 220.00 250.00 280.00 310.00 340.00  
 TIME (MSEC)  
 CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 30.1 MPH #2  
 VEHICLE CONTACT SWITCH - FRONT

YRIC-2 , 890413-2  
 CRASH III DAMAGE ALGORITHM  
 89103  
 0TH2

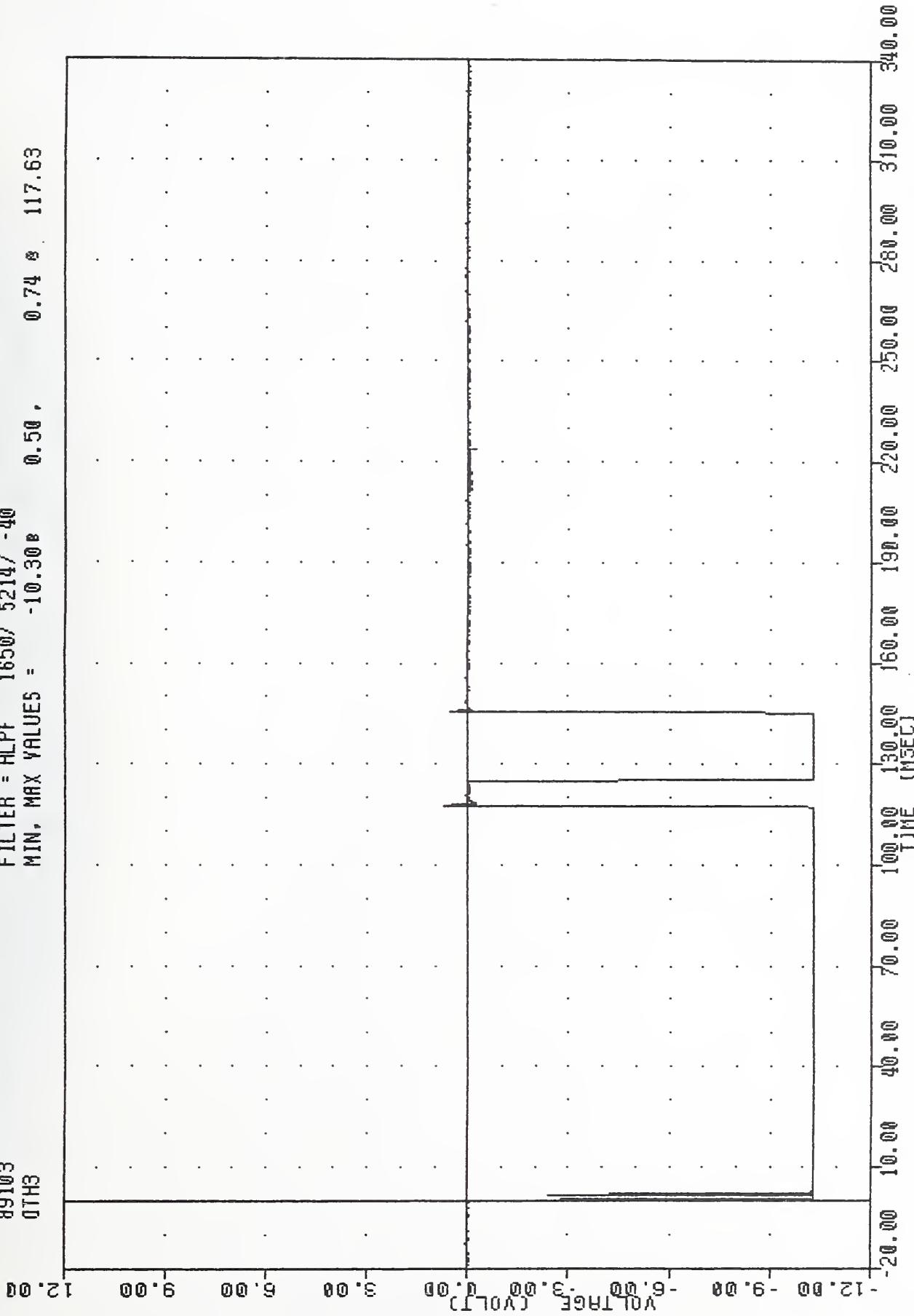
FILTER = ALFF 1650/ 5214/ -40  
 MIN, MAX VALUES = -10.13e 5.13, 0.58 e 112.75



CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 30.1 MPH #2  
 VEHICLE CONTACT SWITCH - REAR

VRTC-2 , 890413-2  
 CRASH III DAMAGE ALGORITHM  
 89103  
 0TH3

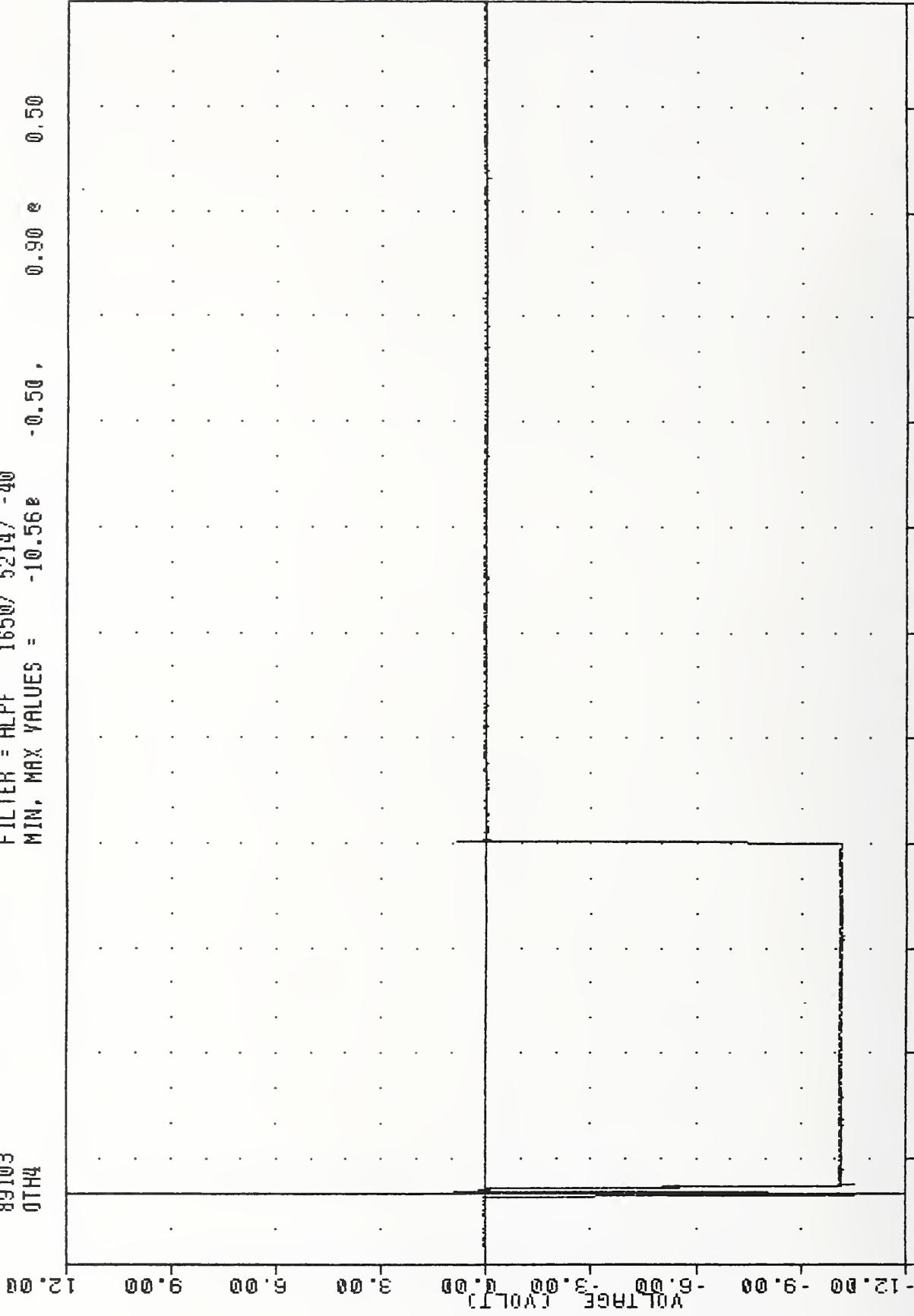
FILTER = ALPF 1650/ 5214/ -40  
 MIN, MAX VALUES = -10.30 0.50 0.74 117.63



CONToured BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 30.1 MPH #2  
 BARRIER CONTACT SWITCH - RIGHT

VRTC-2 , 890413-2  
 CRASH III DAMAGE ALGORITHM  
 89103  
 0TH4

FILTER = ALPF 1650/ 5214/ -40  
 MIN. MAX VALUES = -10.56e -0.50 , 0.90 e 0.50



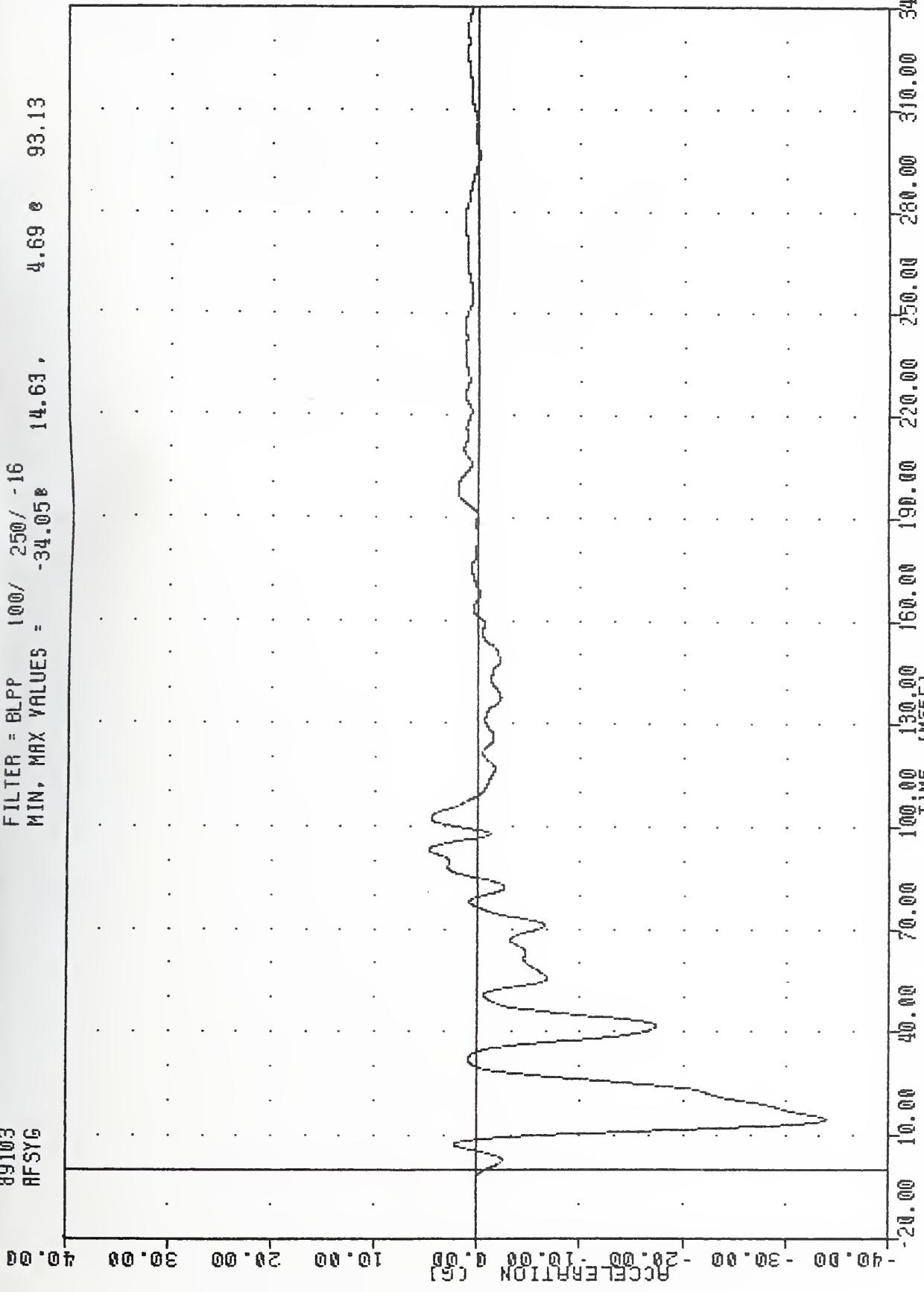
CONTOURED BARRIER INTO 90 DEG CHEVROLET CELEBRITY AT 30.1 MPH #2  
 BARRIER CONTACT SWITCH - LEFT

TEST #890413-3



VIL-3  
 CRASH III DAMAGE ALGORITHM  
 89103  
 RFSYG

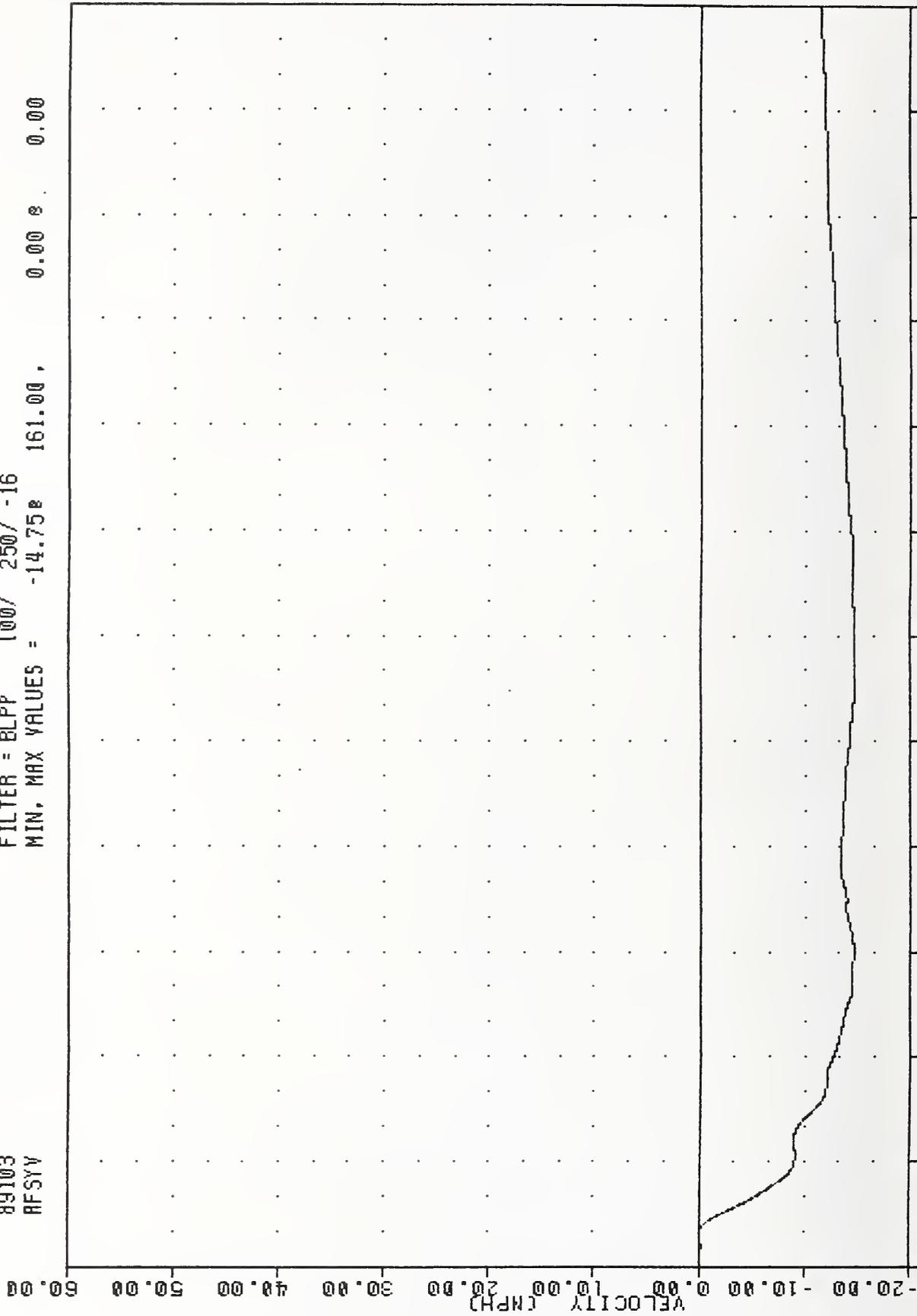
FILTER = BLPP 100/ 250/ -16  
 MIN, MAX VALUES = -34.058 14.63, 4.698 93.13



CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 30.3 MPH #3  
 VEHICLE RIGHT FRONT SILL Y AXIS ACCELERATION

VRTC-3 , 890413-3  
 CRASH III DAMAGE ALGORITHM  
 89103  
 RFSYV

FILTER = BLPP 100/ 250/ -16  
 MIN, MAX VALUES = -14.75e 161.00 , 0.00 e 0.00

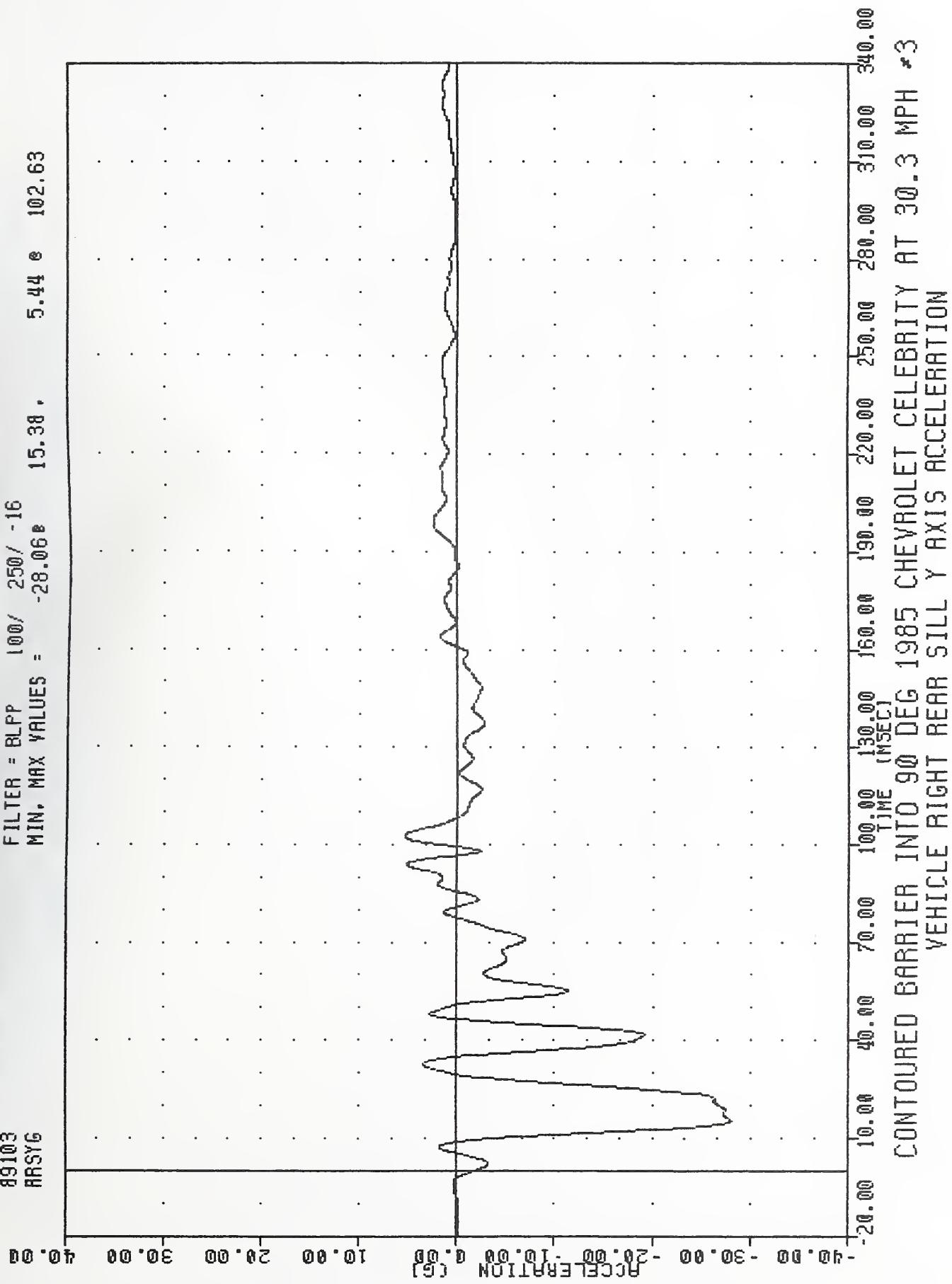


CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 30.3 MPH #3  
 VEHICLE RIGHT FRONT STILL Y OVTC VELOCITY

VHIC-3 , 890413-3  
CRASH III DAMAGE ALGORITHM

89103  
RRSYG

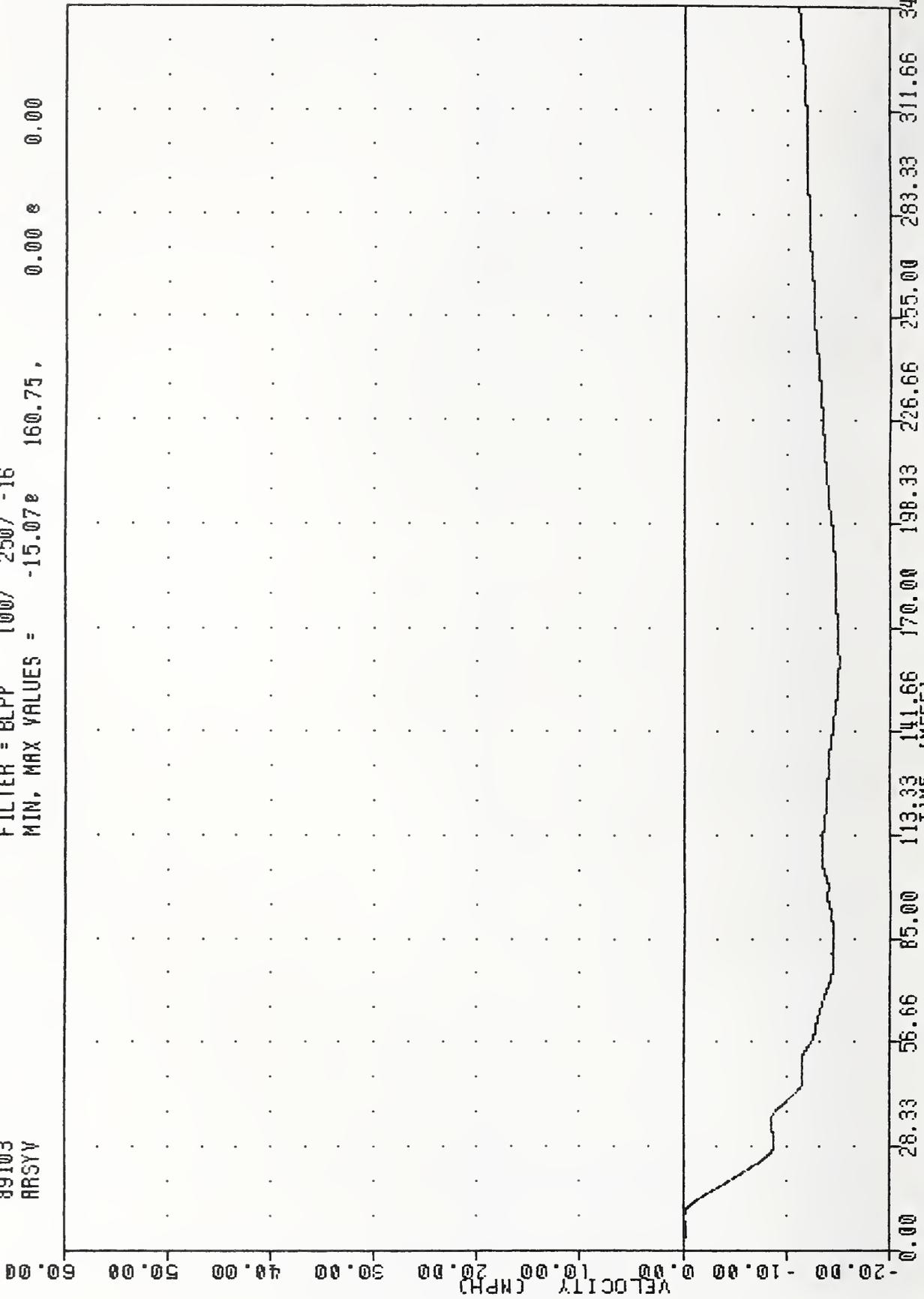
FILTER = BLPP 100/ 250/ -16  
MIN. MAX VALUES = -28.06 15.38 5.44 102.63



CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 30.3 MPH #3  
VEHICLE RIGHT REAR SILL Y AXIS ACCELERATION

VRTC-3 , 890413-3  
 CRASH III DAMAGE ALGORITHM  
 89103  
 ARSYV

FILTER = BLPP 100/ 250/ -16  
 MIN, MAX VALUES = -15.07e 160.75, 0.00 e 0.00

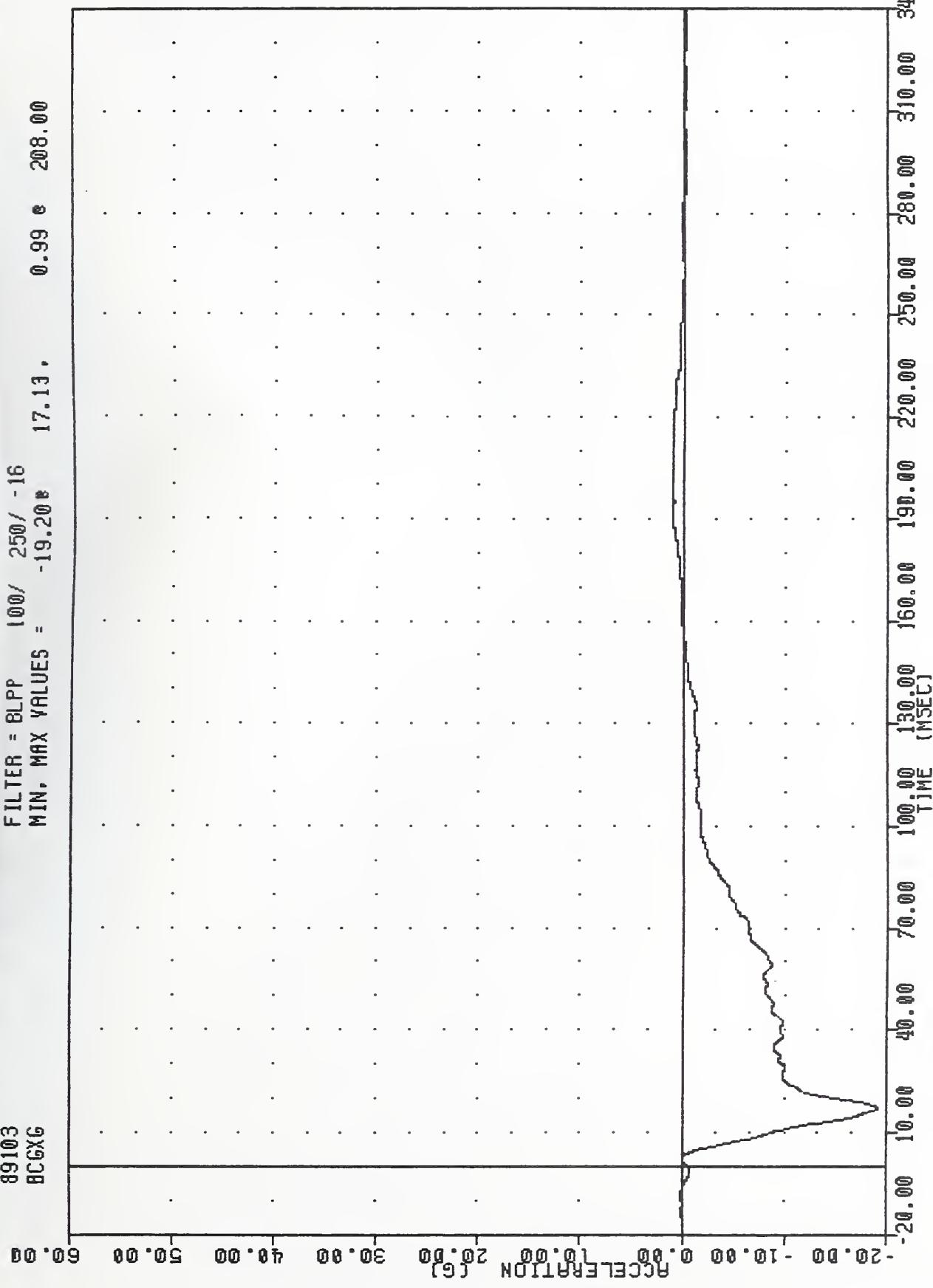


CONToured BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 30.3 MPH #3  
 VEHICLE RIGHT REAR STII Y AYTC VELOCITY

CRASH III DAMAGE ALGORITHM

89103  
BC6XG

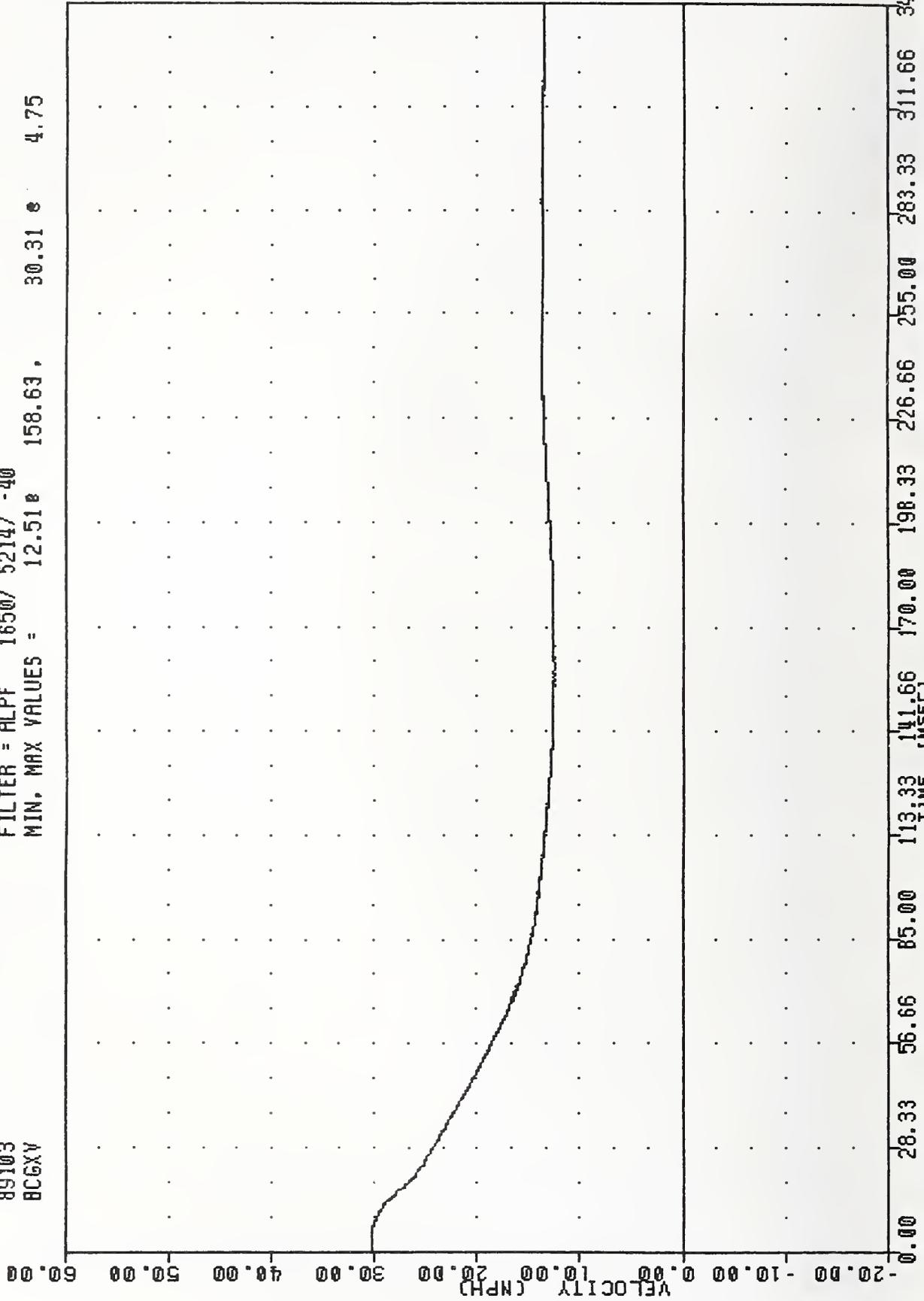
FILTER = BLPP 100/ 250/ -16  
MIN. MAX VALUES = -19.20 17.13 0.99 e 208.00



CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 30.3 MPH #3  
CONTOURED MOVING BARRIER CENTER OF GRAVITY X AXIS ACCELERATION

VRTC-3  
 CRASH III DAMAGE ALGORITHM  
 89103  
 BCGXY

890413-3  
 FILTER = ALPF 1650/ 5214/ -40  
 MIN, MAX VALUES = 12.51e 158.63, 30.31 e 4.75

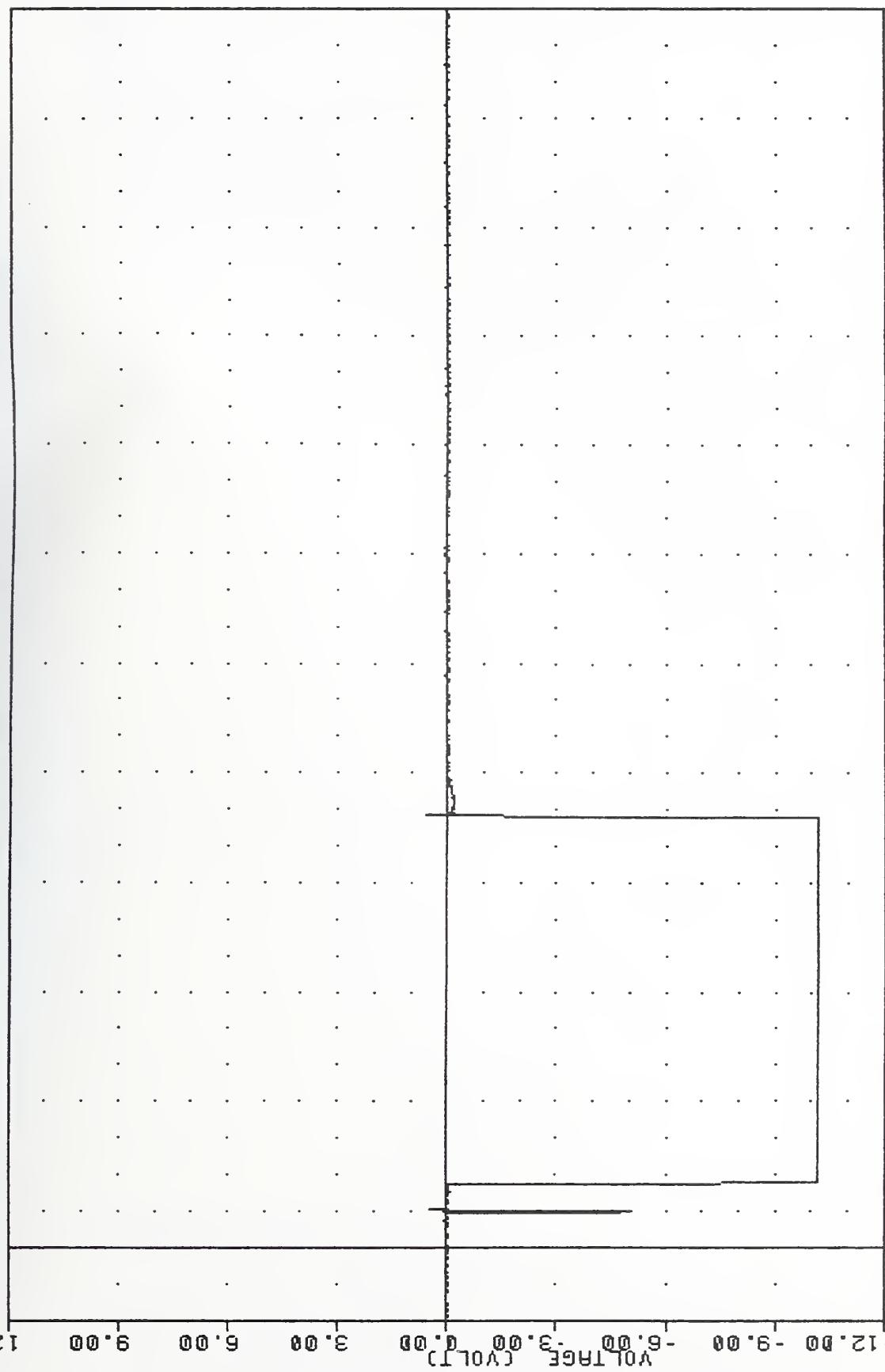


CONTOURED BARRIER INTO 90 DEG 1985 CHEVRON FT CELFRITY AT 90 A UNIT  
 COUNTS WITH UP VELOCITY X BYTS VELOCITY

CRASH III DAMAGE ALGORITHM

89103  
OTH1

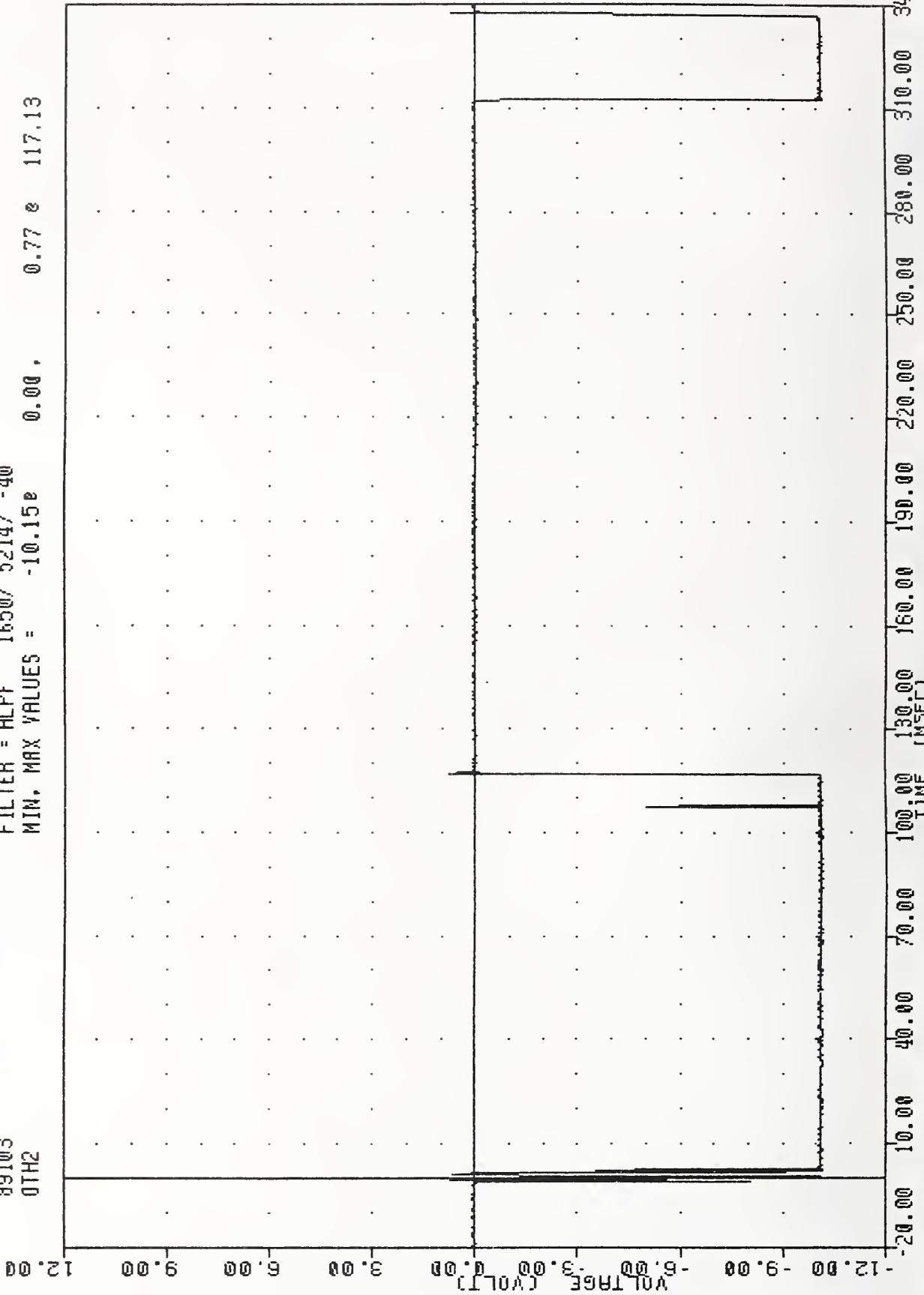
FILTER = ALPF 1650/ 5214/ -40  
MIN. MAX VALUES = -10.17e 17.88, 0.60 e 118.38



-20.00 10.00 40.00 70.00 100.00 130.00 160.00 190.00 220.00 250.00 280.00 310.00 340.00  
TIME (MSEC)  
CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 30.3 MPH #3  
VEHICLE CONTACT SWITCH - FRONT

VRTC-3 , 890413-3  
 CRASH III DAMAGE ALGORITHM  
 89103  
 0TH2

FILTER = ALPF 1650/ 5214/ -40  
 MIN, MAX VALUES = -10.15e 0.00, 0.77 e 117.13



CONToured BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 30.3 MPH #3  
 VEHICLE CONTACT SWITCH - REAR

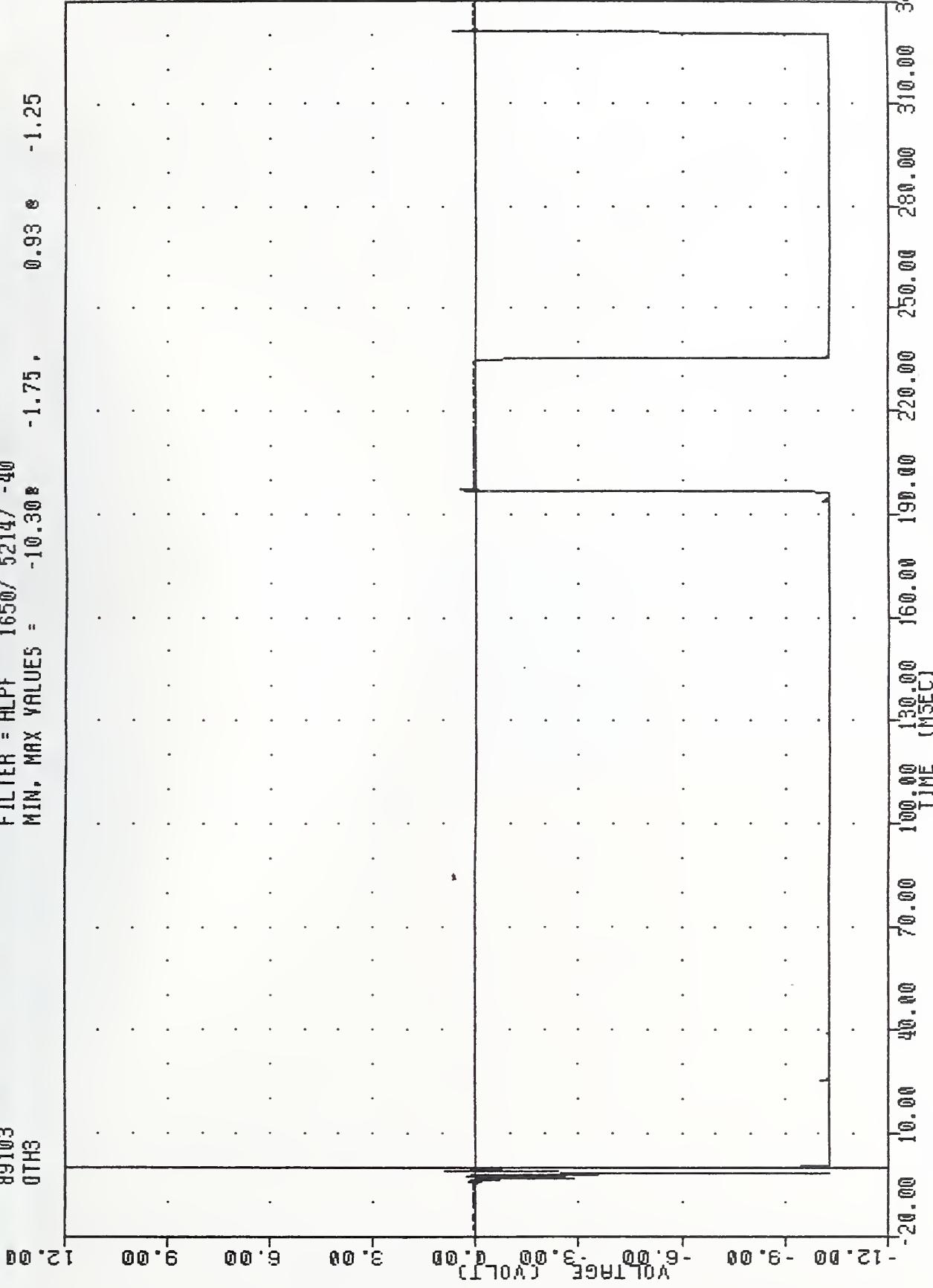
89103

0TH3

FILTER = ALPF 1650/ 5214/ -40

MIN, MAX VALUES = -10.30 0

-1.75, 0.93 e -1.25

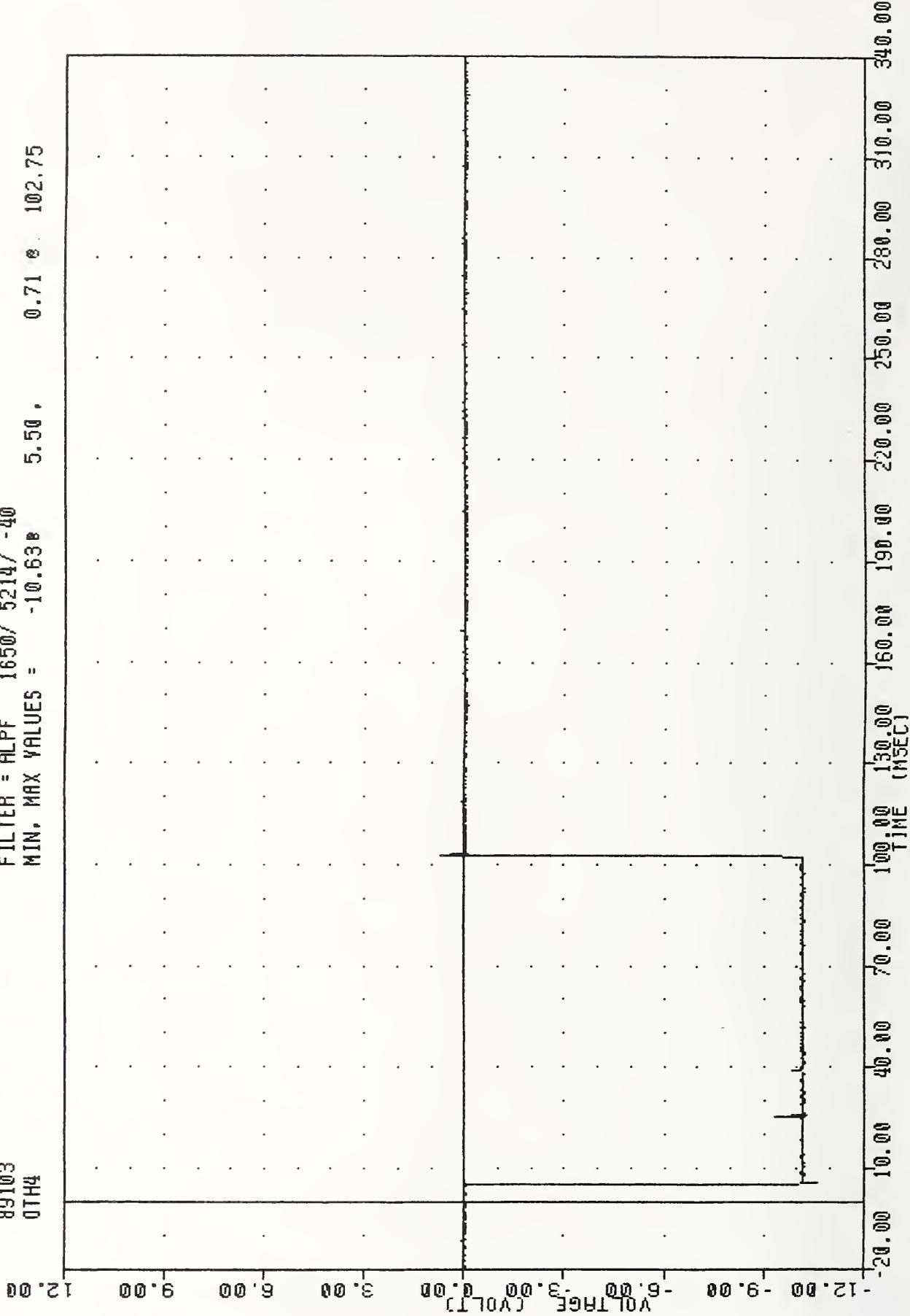


100.00 130.00 160.00 190.00 220.00 250.00 280.00 310.00 340.00  
 TIME (MSEC)

CONTOURED BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 30.3 MPH #3  
 BARRIER CONTACT SWITCH - RIGHT

VRTC-3 , 890413-3  
 CRASH III DAMAGE ALGORITHM  
 89103  
 0TH4

FILTER = ALPF 1650/ 5214/ -40  
 MIN, MAX VALUES = -10.638 5.50 , 0.71 @ 102.75



CONToured BARRIER INTO 90 DEG 1985 CHEVROLET CELEBRITY AT 30.3 MPH #3  
 BARRIER CONTACT SWITCH - LEFT

TI 242 . E6546

M. Habash, M.

Final report  
contoured and

Form DOT F 1720.2  
FORMERLY FORM DOT F 1

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