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DOT HS 807 438

May 1989

Final Report

Final Report of 270° Contoured Moving Barrier Impact into a 1983 Ford Tempo 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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15. Supplementory Notes

16. Abstroct

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 1983 Ford Tempo 4-door sedan, VIN 2FABP21R2EB119435, at the Transportation Research Center of Ohio. The following three tests were conducted on one vehicle:

TEST NO.	DATE	TIME	SPEED (mph)	AVERAGE CUMULATIVE CRUSH
890424-1	4/24/89	1108	18.7	6.4
890424-2	4/24/89	1320	37.6	18.1
890424-3	4/24/89	1421	37.9	23.8

17. Key Words	18. Distribution Stotement
270° Contoured Moving Barrier Impact Crash III Damage Algorithm Reformulation.	Document is available to the public from the National Technical Information Service, Springfield, VA 22161

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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 1983 Ford Tempo was equipped with a 2.3 liter, 4-cylinder, transverse, gas engine with a 5-speed manual transmission. The intended total test weight of the vehicle was 2367 pounds. The actual weight was 2367 pounds.

The contoured moving barrier actual weight was 2673 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 28.8 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, repectively 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:

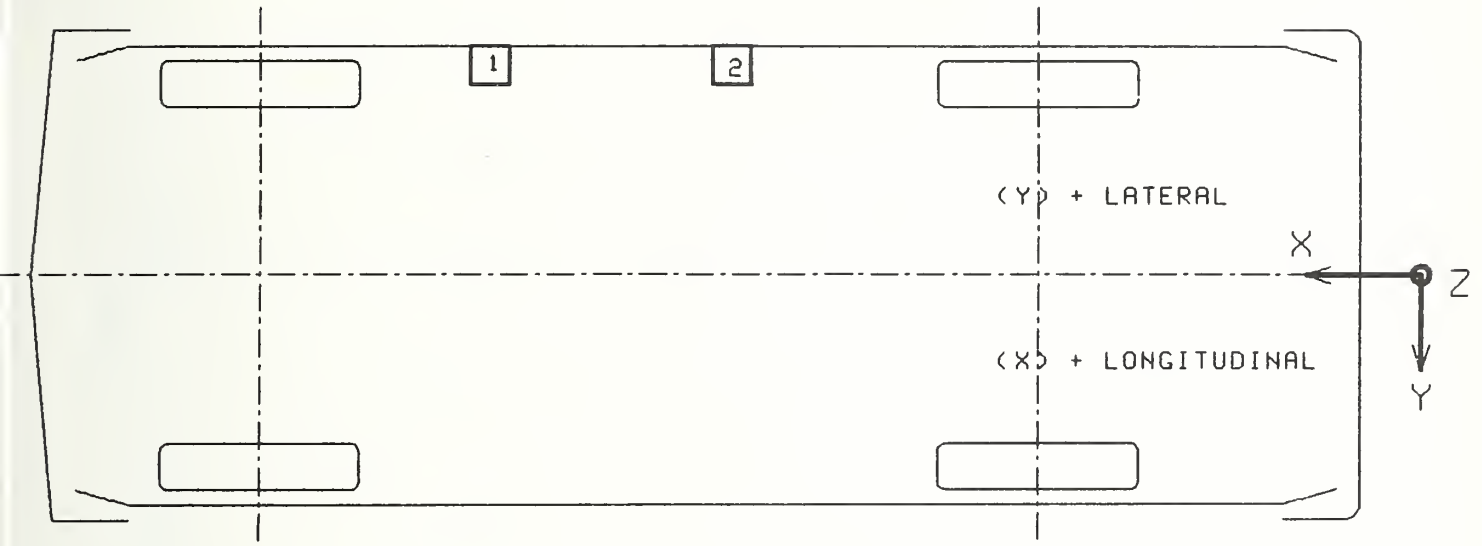
$$\text{Average crush} = \text{Bumper height crush} + \frac{X1 + X2}{2}$$

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

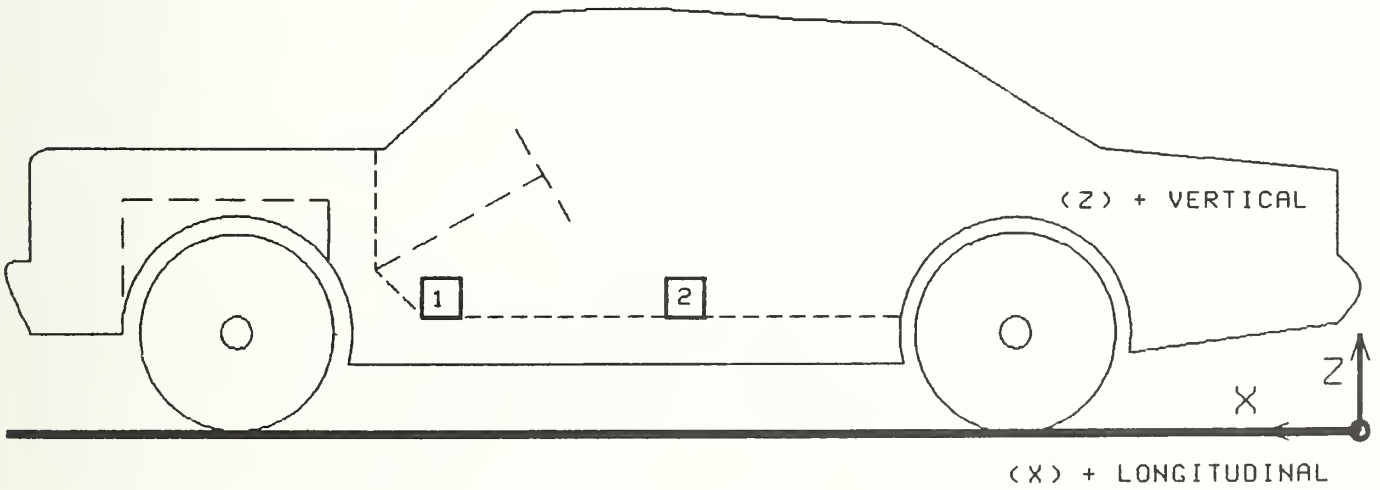
$$\text{Average crush} = \frac{\text{Bumper height crush} + \text{sill height crush as corrected}}{2} + \frac{X1 + X2}{2}$$

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

VEHICLE ACCELEROMETER PLACEMENT

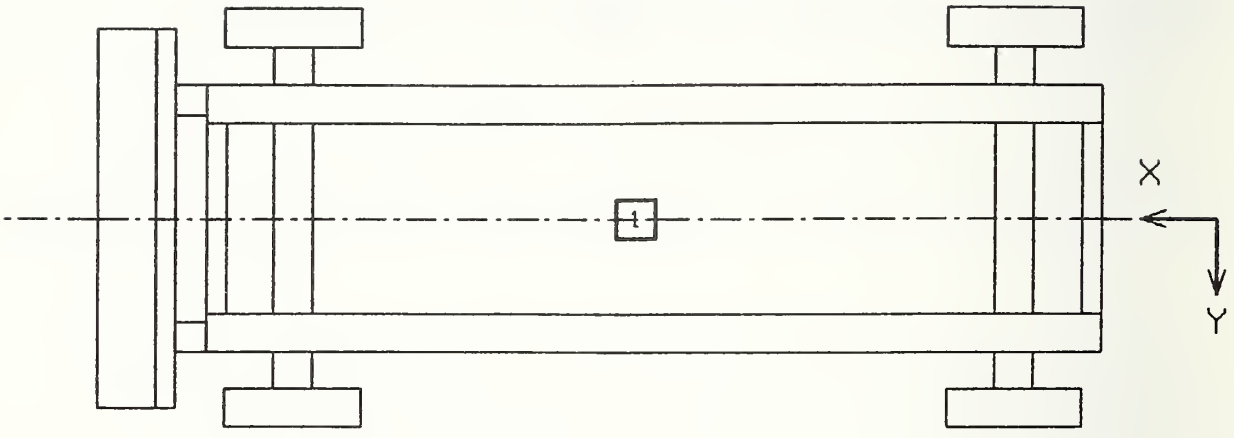


TOP VIEW

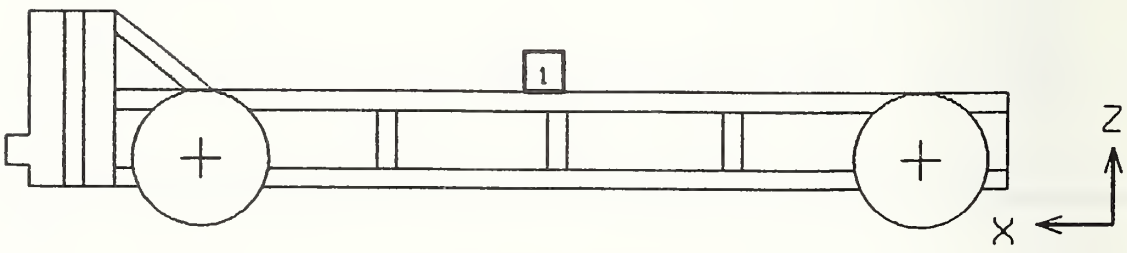


SIDE VIEW

MOVING BARRIER
ACCELEROMETER PLACEMENT



TOP VIEW



SIDE VIEW

SECTION 2.0
VEHICLE INFORMATION

TEST VEHICLE INFORMATION

VEHICLE MANUFACTURER: Ford Motor Company VIN: 2FABP21R2EB119435

MAKE/MODEL: Ford Tempo MODEL YEAR: 1983

BODY STYLE: 4-door sedan COLOR: Navy blue

ENGINE DATA: TYPE: transverse CYLINDERS: 4 DISPLACEMENT: 2.3 liter

_X_GAS, ___DIESEL, ___TURBOCHARGE

TRANSMISSION DATA: _5_SPEED, _X_MANUAL, ___AUTOMATIC, _X_FWD, ___RWD, ___4WD

DATE VEHICLE RECEIVED: 4/18/89 ODOMETER READING: NA

DEALER'S NAME AND ADDRESS: NA

ACCESSORIES:

POWER STEERING	Yes	AUTOMATIC TRANSMISSION	No
POWER BRAKES	Yes	AUTOMATIC SPEED CONTROL	No
POWER SEATS	No	TILTING STEERING WHEEL	No
POWER WINDOWS	No	TELESCOPING STEERING WHEEL	No
TINTED GLASS	Yes	AIR CONDITIONING	No
RADIO	Yes	ANTI-SKID BRAKE	No
CLOCK	Yes	REAR WINDOW DEFROSTER	Yes
OTHER	None		

DATA FROM CERTIFICATION LABEL ON LEFT DOOR FACE OR "B" POST:

VEHICLE MANUFACTURED BY: Ford Motor Company

DATE OF MANUFACTURE: 5/83

GVWR: 3460 LBS.

GAWR: FRONT 1984 LBS.; REAR 1787 LBS.

TEST VEHICLE INFORMATION, CONT'D

WHEELBASE: 99.9

MAXIMUM WIDTH: 68.6

WEIGHT OF TEST VEHICLE WITH REQUIRED OCCUPANTS AND LUGGAGE:

RIGHT FRONT	710 LBS.	RIGHT REAR	462 LBS.
LEFT FRONT	744 LBS.	LEFT REAR	451 LBS.
TOTAL FRONT WEIGHT	1454 LBS.	(61.4% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	913 LBS.	(38.6% OF TOTAL VEHICLE WEIGHT)	
TOTAL TEST WEIGHT	2367 LBS.		

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

VEHICLE TIRE DATA:

TIRES ON VEHICLE (MFR. & LINE, SIZE): Michelin All Season P175/80R13

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:	26.0;	RF:	26.3;	LR:	24.9;	RR: 25.4
PRE-TEST:	LF:	26.5;	RF:	26.8;	LR:	24.9;	RR: 25.1
POST-TEST:	LF:	26.5;	RF:	27.1;	LR:	24.8;	RR: 24.2

ALL DISTANCE MEASUREMENTS ARE IN INCHES.

TEST ANOMALIES

Noise in the form of spikes was observed in the plots for the contact switch OTH2 vehicle contact switch, rear. The switch was used to record the time of vehicle contact with the moving barrier, as well as the time of vehicle separation from the barrier. The switch was damaged by the crush of the moving contoured barrier against the vehicle. The switch was replaced following each test which contained spikes. This is not the standard use of such switches.

SECTION 3.0

TEST #890424-1 SUMMARY

TEST CONDITIONS:

TEST NUMBER: 890424-1

DATE OF TEST: 4/24/89

TIME OF TEST: 1108

AMBIENT TEMPERATURE AT IMPACT AREA: 53° F

SUBJECT VEHICLE DATA:

	ACTUAL	INTENDED
VEHICLE WEIGHT (lbs.)	2367	2367
VEHICLE ORIENTATION (deg.)	270	270
MOVING BARRIER VELOCITY (mph.)	18.7	18.8
BARRIER WEIGHT (lbs.)	2673	2673
MAXIMUM CUMULATIVE CRUSH BUMPER HEIGHT (in.)	8.2	
AVERAGE CUMULATIVE CRUSH (in.) = $\{\frac{C1+C6}{2}+C2+C3+C4+C5\}/5$	6.4	

TEST NUMBER 890424-1

VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

No.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION MAX G	POSITIVE DIRECTION MSEC	NEGATIVE DIRECTION MAX G	NEGATIVE DIRECTION MSEC
1	SILL RIGHT FRONT LATERAL	116.1	-24.5	13.2	3.3	140.4	26.9	8.6
2	SILL RIGHT REAR LATERAL	104.1	-24.6	12.3	3.2	140.8	25.9	8.9

* 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 890424-1

MOVING BARRIER ACCELEROMETER LOCATIONS AND DATA SUMMARY

No.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION MAX G	POSITIVE DIRECTION MSEC	NEGATIVE DIRECTION MAX G	NEGATIVE DIRECTION MSEC
1	BARRIER CG LONGITUDINAL	75.0	0.0	10.5	0.2	121.0	10.7	39.6

* 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 #890424-1

CONTACT SWITCH LOCATIONS AND DATA SUMMARY

LOCATION	SEPARATION TIME (MSEC)
VEHICLE CONTACT SWITCH - FRONT	7.5
VEHICLE CONTACT SWITCH - REAR	73.5 γ
BARRIER CONTACT SWITCH - LEFT	73.5
BARRIER CONTACT SWITCH - RIGHT	94.5

γ See TEST ANOMALIES

PSU/Case Number_____
Vehicle Number_____

TEST #890424-1

National Accident Sampling System - Continuous Sampling Subsystem: Vehicle Data

FIELD MEASUREMENTS

Complete When Applicable

End Damage

Undeformed end width_____

Corner shift: A1_____

A2_____

End shift at frame (CDC)
(check one)

<4 inches X

≥4 inches_____

Side Damage

Bowing: B1 0 X1 0

B2 1.5 X2 0

Bowing constant

$\frac{X1 + X2}{2} = 0$

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 Width** (CDC)	Direct Damage Max*** Crush	Field L**	C_1	C_2	C_3	C_4	C_5	C_6	±D
	Bumper height as measured				0.0	7.2	8.2	7.5	5.0	0.0	
	Bumper height as corrected				0.0	8.2	9.2	8.5	6.0	0.0	
	Sill height as measured				0.0	5.8	6.2	6.0	4.0	0.0	
	Sill height as corrected				0.0	2.3	2.7	2.5	0.5	0.0	
	Average Crush			102.0	0.0	8.2	9.2	8.5	6.0	0.0	-10.6

Bumper free space = -1.0 inches
Sill free space = 3.5 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 #890424-1

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	500	Impact wide
3	Overhead tight	Photosonic 1B	25	495	Impact closeup

SECTION 4.0

TEST #890424-2 SUMMARY

TEST CONDITIONS:

TEST NUMBER: 890424-2

DATE OF TEST: 4/24/89

TIME OF TEST: 1320

AMBIENT TEMPERATURE AT IMPACT AREA: 59° F

SUBJECT VEHICLE DATA:

	ACTUAL	INTENDED
VEHICLE WEIGHT (lbs.)	2367	2367
VEHICLE ORIENTATION (deg.)	270	270
MOVING BARRIER VELOCITY (mph.)	37.6	37.7
BARRIER WEIGHT (lbs.)	2673	2673
MAXIMUM CUMULATIVE CRUSH BUMPER HEIGHT (in.)	22.2	
AVERAGE CUMULATIVE CRUSH (in.) = $\{\frac{C1+C6}{2}+C2+C3+C4+C5\}/5$	18.1	

VEHICLE ATTITUDES:

POST-TEST: LF: 24.1 RF: 23.1 LR: 23.1 RR: 22.1

TEST NUMBER 890424-2

VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

No.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION MAX G	POSITIVE DIRECTION MSEC	NEGATIVE DIRECTION MAX G	NEGATIVE DIRECTION MSEC
1	SILL RIGHT FRONT LATERAL	116.1	-24.5	13.2	2.5	73.5	63.6	7.3
2	SILL RIGHT REAR LATERAL	104.1	-24.6	12.3	2.0	0.9	61.1	7.8

* 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 890424-2

MOVING BARRIER ACCELEROMETER LOCATIONS AND DATA SUMMARY

No.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION MAX G	POSITIVE DIRECTION MSEC	NEGATIVE DIRECTION MAX G	NEGATIVE DIRECTION MSEC
1	BARRIER CG	75.0	0.0	10.5				
	LONGITUDINAL				0.5	256.0	26.8	4.6

* 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 #890424-2

CONTACT SWITCH LOCATIONS AND DATA SUMMARY

LOCATION	SEPARATION TIME (MSEC)
VEHICLE CONTACT SWITCH - FRONT	123.0
VEHICLE CONTACT SWITCH - REAR	142.6 ϒ
BARRIER CONTACT SWITCH - LEFT	103.5
BARRIER CONTACT SWITCH - RIGHT	137.1

ϒ See TEST ANOMALIES

PSU/Case Number_____
Vehicle Number_____

TEST #890424-2

National Accident Sampling System - Continuous Sampling Subsystem: Vehicle Data

FIELD MEASUREMENTS

Complete When Applicable

End Damage

Undeformed end width_____

Corner shift: A1_____

A2_____

End shift at frame (CDC)
(check one)

<4 inches_____

>4 inches X

Side Damage

Bowing: B1 1.5 X1 1.0

B2 9.0 X2 1.8

Bowing constant

$\frac{X1 + X2}{2}$ = 1.4

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 Width** (CDC)	Direct Damage Max*** Crush	Field L**	C_1	C_2	C_3	C_4	C_5	C_6	±D
	Bumper height as measured				0.0	21.0	22.2	21.5	15.0	0.0	
	Bumper height as corrected				0.0	22.0	23.2	22.5	16.0	0.0	
	Sill height as measured				0.0	20.0	19.0	18.6	11.9	0.0	
	Sill height as corrected				0.0	16.5	15.5	15.1	8.4	0.0	
	Average Crush			113.0	1.4	23.4	24.6	23.9	17.4	1.4	-10.2

Bumper height free space = -1.0 inches
Sill height free space = 3.5 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 #890424-2

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	499	Impact wide
3	Overhead tight	Photosonic 1B	25	495	Impact closeup

SECTION 5.0

TEST #890424-3 SUMMARY

TEST CONDITIONS:

TEST NUMBER: 890424-3

DATE OF TEST: 4/24/89

TIME OF TEST: 1421

AMBIENT TEMPERATURE AT IMPACT AREA: 65° F

SUBJECT VEHICLE DATA:

	ACTUAL	INTENDED
VEHICLE WEIGHT (lbs.)	2367	2367
VEHICLE ORIENTATION (deg.)	270	270
MOVING BARRIER VELOCITY (mph.)	37.9	37.7
BARRIER WEIGHT (lbs.)	2673	2673
MAXIMUM CUMULATIVE CRUSH BUMPER HEIGHT (in.)	38.0	
AVERAGE CUMULATIVE CRUSH (in.) = $\{\frac{C1+C6}{2}+C2+C3+C4+C5\}/5$	23.8	

VEHICLE ATTITUDES:

POST-TEST: LF: 22.7 RF: 23.9 LR: 24.3 RR: 25.2

TEST NUMBER 890424-3

VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

No.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION MAX G	POSITIVE DIRECTION MSEC	NEGATIVE DIRECTION MAX G	NEGATIVE DIRECTION MSEC
1	SILL RIGHT FRONT LATERAL	116.1	-24.5	13.2	4.8	98.8	27.4	32.9
2	SILL RIGHT REAR LATERAL	104.1	-24.6	12.3	6.3	100.1	28.2	32.5

* 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 890424-3

MOVING BARRIER ACCELEROMETER LOCATIONS AND DATA SUMMARY

No.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION MAX G	POSITIVE DIRECTION MSEC	NEGATIVE DIRECTION MAX G	NEGATIVE DIRECTION MSEC
1	BARRIER CG	75.0	0.0	10.5				
	LONGITUDINAL				1.1	249.1	21.2	25.1

* 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 #890424-3

CONTACT SWITCH LOCATIONS AND DATA SUMMARY

LOCATION	SEPARATION TIME (MSEC)
VEHICLE CONTACT SWITCH - FRONT	37.5
VEHICLE CONTACT SWITCH - REAR	8.2
BARRIER CONTACT SWITCH - LEFT	10.5
BARRIER CONTACT SWITCH - RIGHT	155.8

PSU/Case Number_____
Vehicle Number_____

TEST #890424-3
National Accident Sampling System - Continuous Sampling Subsystem: Vehicle Data

FIELD MEASUREMENTS

Complete When Applicable

End Damage

Undeformed end width_____

Corner shift: A1_____

A2_____

End shift at frame (CDC)
(check one)
<4 inches_____
≥4 inches X

Side Damage

Bowing: B1 1.5 X1 0.0

B2 13.5 X2 0.0

Bowing constant

$\frac{X1 + X2}{2}$ = 0.0

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 Width** (CDC)	Direct Damage Max*** Crush	Field L**	C_1	C_2	C_3	C_4	C_5	C_6	±D
	Bumper height as measured				0.0	26.5	36.8	38.0	28.0	0.0	
	Bumper height as corrected				0.0	27.5	37.8	39.0	29.0	0.0	
	Sill height as measured				0.0	26.5	33.4	26.0	32.5	0.0	
	Sill height as corrected				0.0	23.0	29.9	22.5	29.0	0.0	
	Average Crush			139.0	0.0	25.3	33.9	30.8	29.0	0.0	-19.2

Bumper height free space = -1.0 inches
Sill height free space = 3.5 inches
Door latch, hinge, or pillar did 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 #890424-3

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	498	Impact wide
3	Overhead tight	Photosonic 1B	25	498	Impact closeup

APPENDIX A

PHOTOGRAPHS

TEST #890424-1

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 LEFT SIDE CLOSE-UP VIEW
20. PRE-TEST BARRIER FACE - VIEW 1
21. PRE-TEST BARRIER FACE - VIEW 2
22. PRE-TEST BARRIER FACE - VIEW 3

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

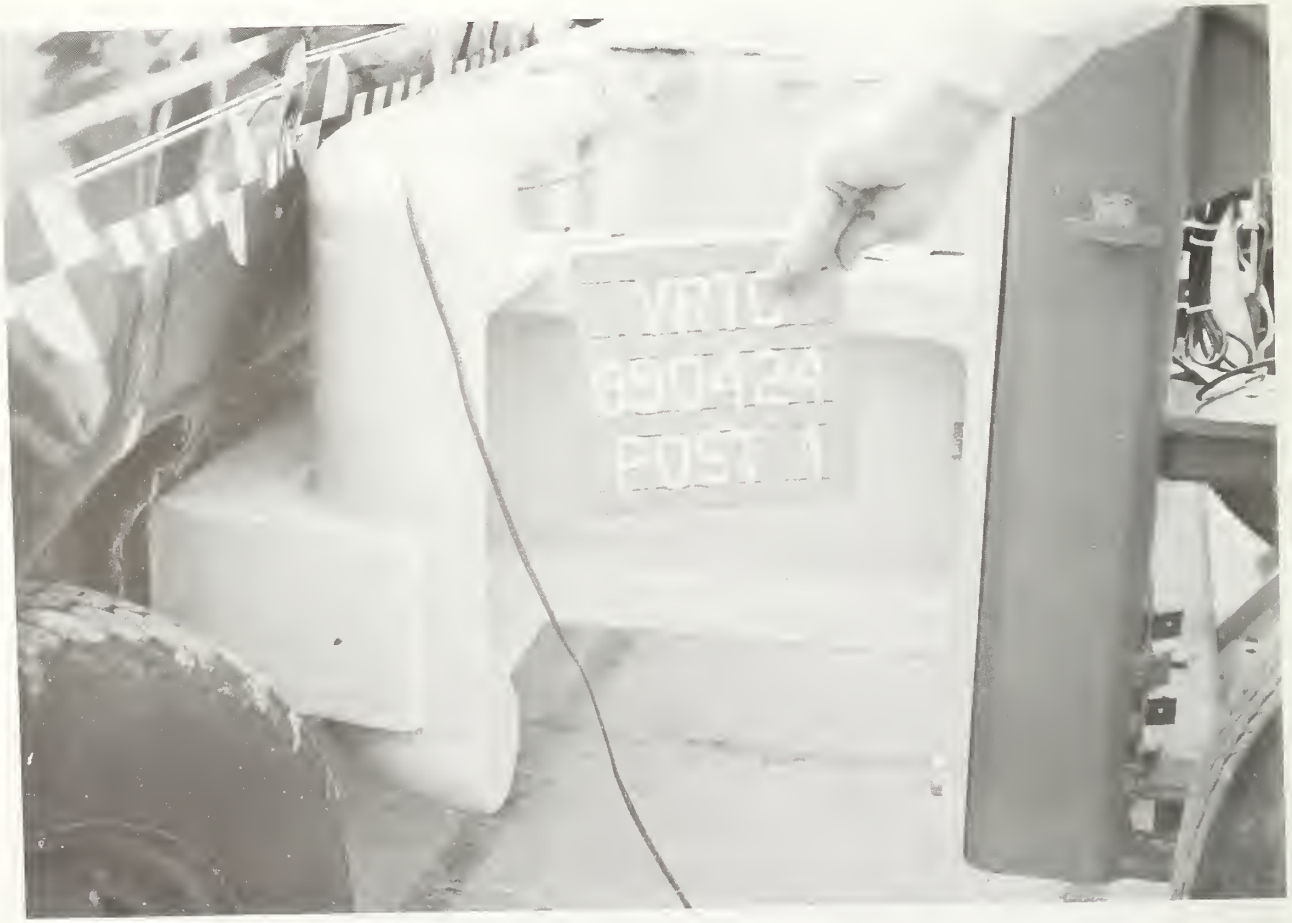


Figure A-16. POST-TEST CLOSE-UP LEFT FRONT VIEW

Figure A-17. PRE-TEST CLOSE-UP LEFT REAR VIEW

Figure A-18. POST-TEST CLOSE-UP LEFT REAR VIEW

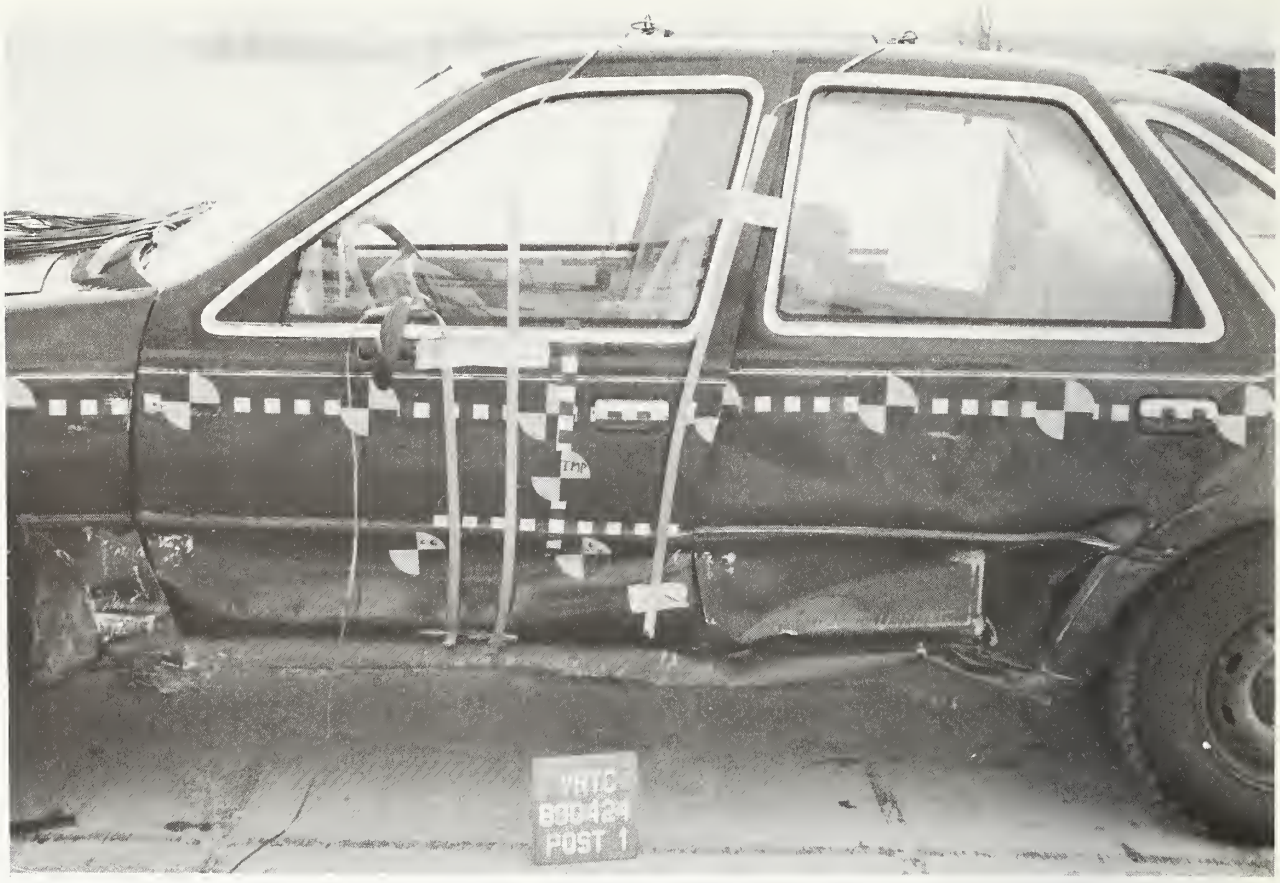


Figure A-19. POST-TEST LEFT SIDE CLOSE-UP VIEW

Figure A-20. PRE-TEST BARRIER FACE - VIEW 1

Figure A-21. PRE-TEST BARRIER FACE - VIEW 2

Figure A-22. PRE-TEST BARRIER FACE - VIEW 3

TEST #890424-2

LIST OF PHOTOGRAPHS

23. POST-TEST OVERALL FRONT VIEW
24. POST-TEST OVERALL LEFT SIDE - VIEW 1
25. POST-TEST OVERALL LEFT SIDE - VIEW 2
26. POST-TEST OVERALL LEFT SIDE - VIEW 3
27. POST-TEST OVERALL LEFT SIDE - VIEW 4
28. POST-TEST OVERALL REAR VIEW
29. POST-TEST OVERALL RIGHT SIDE VIEW
30. POST-TEST LEFT FRONT THREE-QUARTER VIEW
31. POST-TEST LEFT REAR THREE-QUARTER VIEW
32. POST-TEST CLOSE-UP LEFT FRONT VIEW
33. POST-TEST CLOSE-UP LEFT REAR VIEW

Figure A-23. POST-TEST OVERALL FRONT VIEW

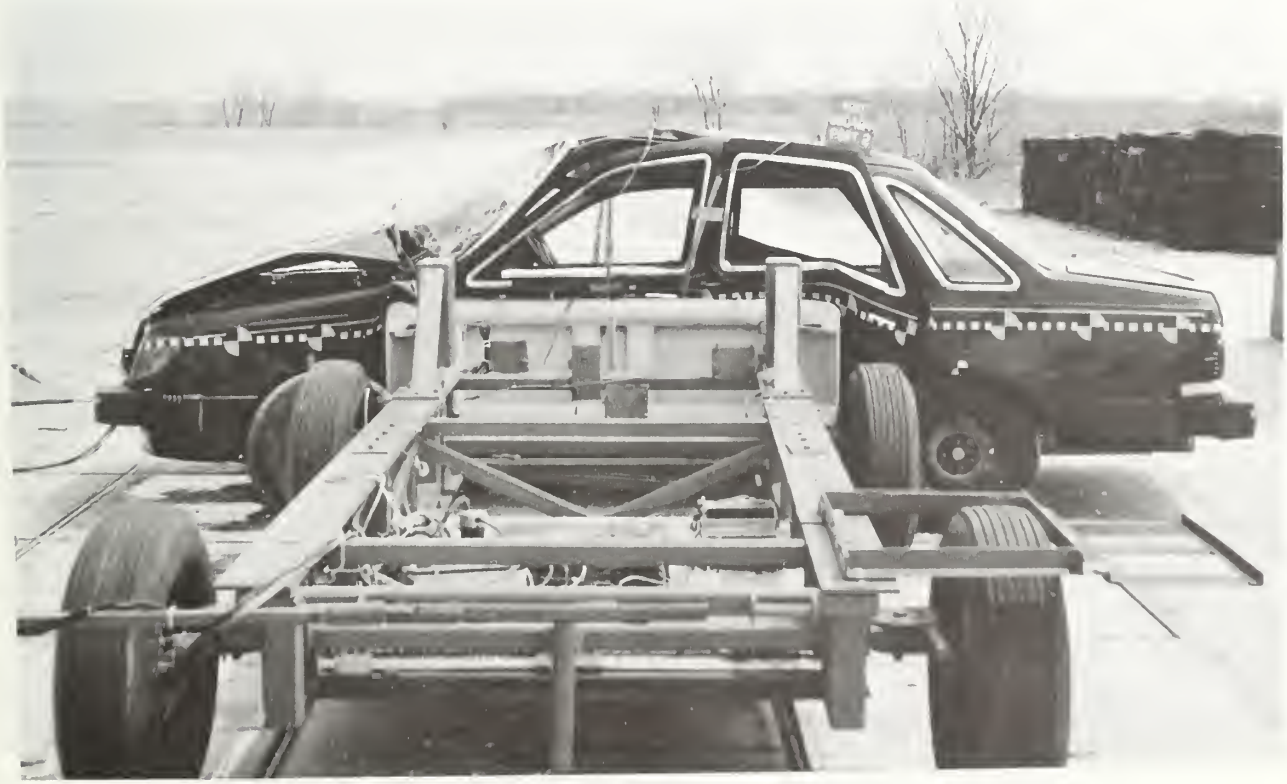


Figure A-24. POST-TEST OVERALL LEFT SIDE - VIEW 1

Figure A-25. POST-TEST OVERALL LEFT SIDE - VIEW 2

Figure A-26. POST-TEST OVERALL LEFT SIDE - VIEW 3

Figure A-27. POST-TEST OVERALL LEFT SIDE - VIEW 4

Figure A-28. POST-TEST OVERALL REAR VIEW

Figure A-29. POST-TEST OVERALL RIGHT SIDE VIEW

Figure A-30. POST-TEST LEFT FRONT THREE-QUARTER VIEW

Figure A-31. POST-TEST LEFT REAR THREE-QUARTER VIEW

Figure A-32. POST-TEST CLOSE-UP LEFT FRONT VIEW

Figure A-33. POST-TEST CLOSE-UP LEFT REAR VIEW

TEST #890424-3

LIST OF PHOTOGRAPHS

34. POST-TEST OVERALL FRONT VIEW
35. POST-TEST OVERALL LEFT SIDE - VIEW 1
36. POST-TEST OVERALL LEFT SIDE - VIEW 2
37. POST-TEST OVERALL REAR VIEW
38. POST-TEST OVERALL RIGHT SIDE VIEW
39. POST-TEST LEFT FRONT THREE-QUARTER VIEW
40. POST-TEST LEFT REAR THREE-QUARTER VIEW
41. POST-TEST CLOSE-UP LEFT FRONT VIEW
42. POST-TEST CLOSE-UP LEFT REAR VIEW
43. POST-TEST LEFT SIDE CLOSE-UP - VIEW 1
44. POST-TEST LEFT SIDE CLOSE-UP - VIEW 2

Figure A-34. POST-TEST OVERALL FRONT VIEW

Figure A-35. POST-TEST OVERALL LEFT SIDE - VIEW 1

Figure A-36. POST-TEST OVERALL LEFT SIDE - VIEW 2

Figure A-37. POST-TEST OVERALL REAR VIEW

Figure A-38. POST-TEST OVERALL RIGHT SIDE VIEW

Figure A-39. POST-TEST LEFT FRONT THREE-QUARTER VIEW

Figure A-40. POST-TEST LEFT REAR THREE-QUARTER VIEW

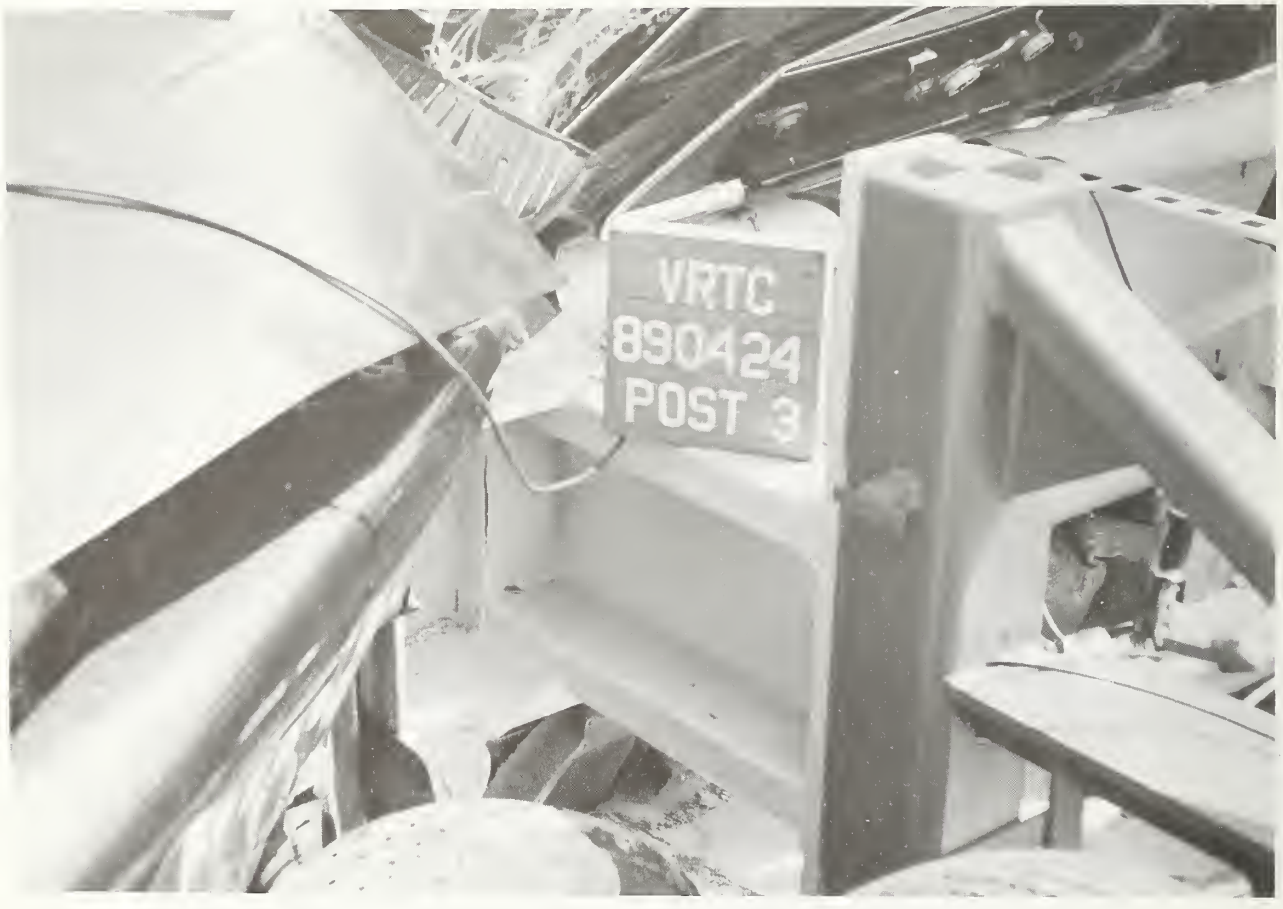


Figure A-41. POST-TEST CLOSE-UP LEFT FRONT VIEW

Figure A-42. POST-TEST CLOSE-UP LEFT REAR VIEW

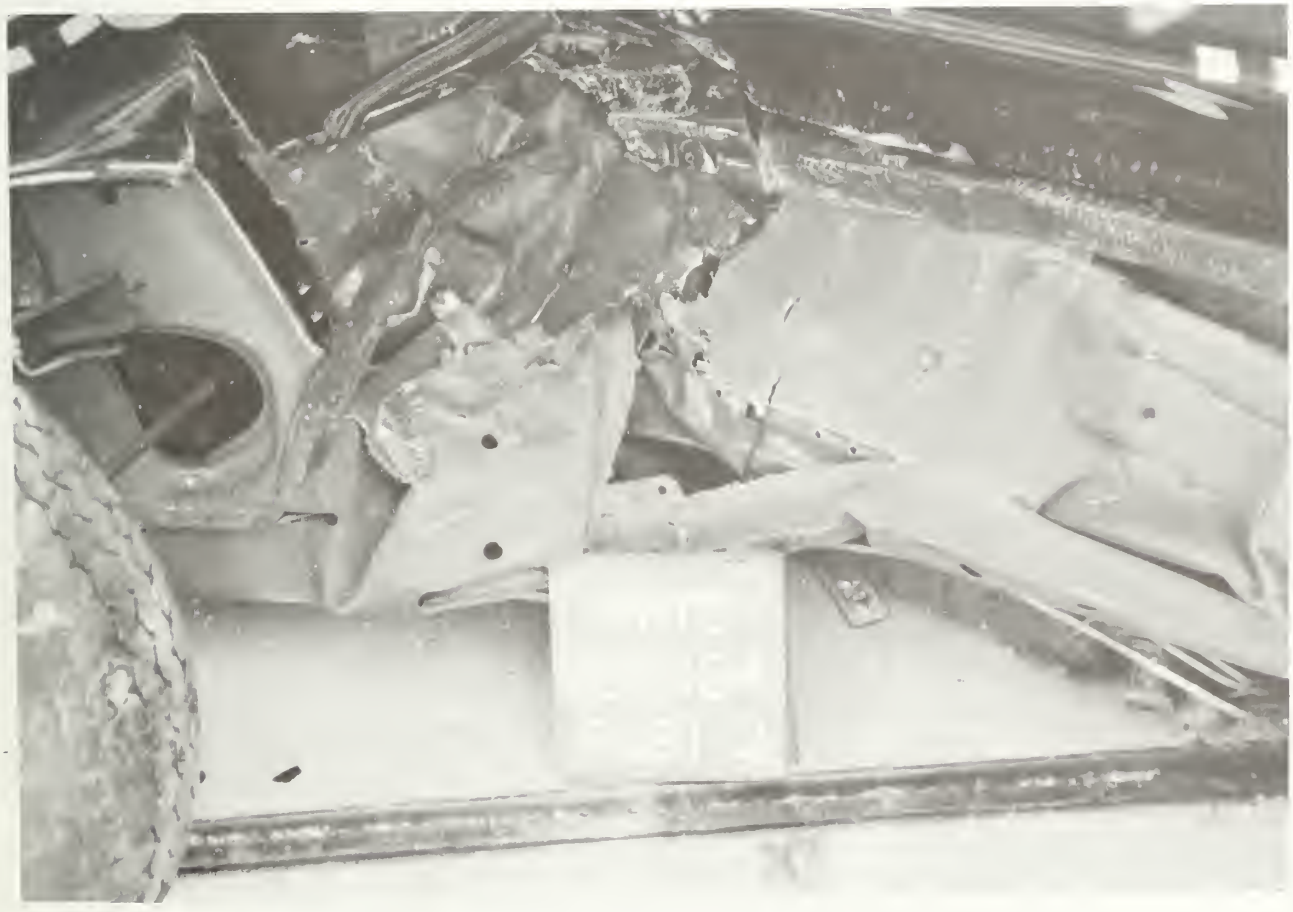


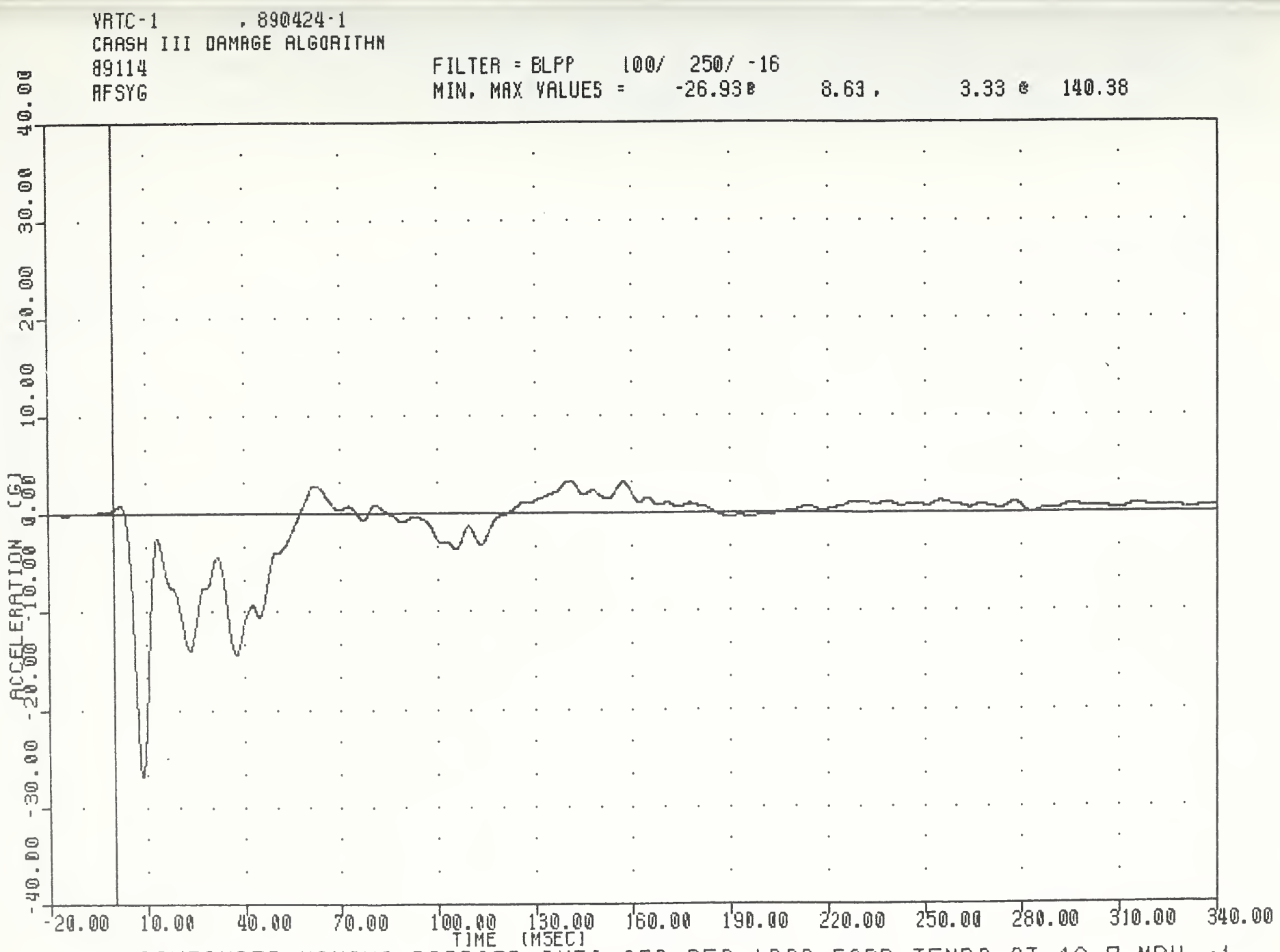
Figure A-43. POST-TEST LEFT SIDE CLOSE-UP - VIEW 1

Figure A-44. POST-TEST LEFT SIDE CLOSE-UP - VIEW 2

APPENDIX B

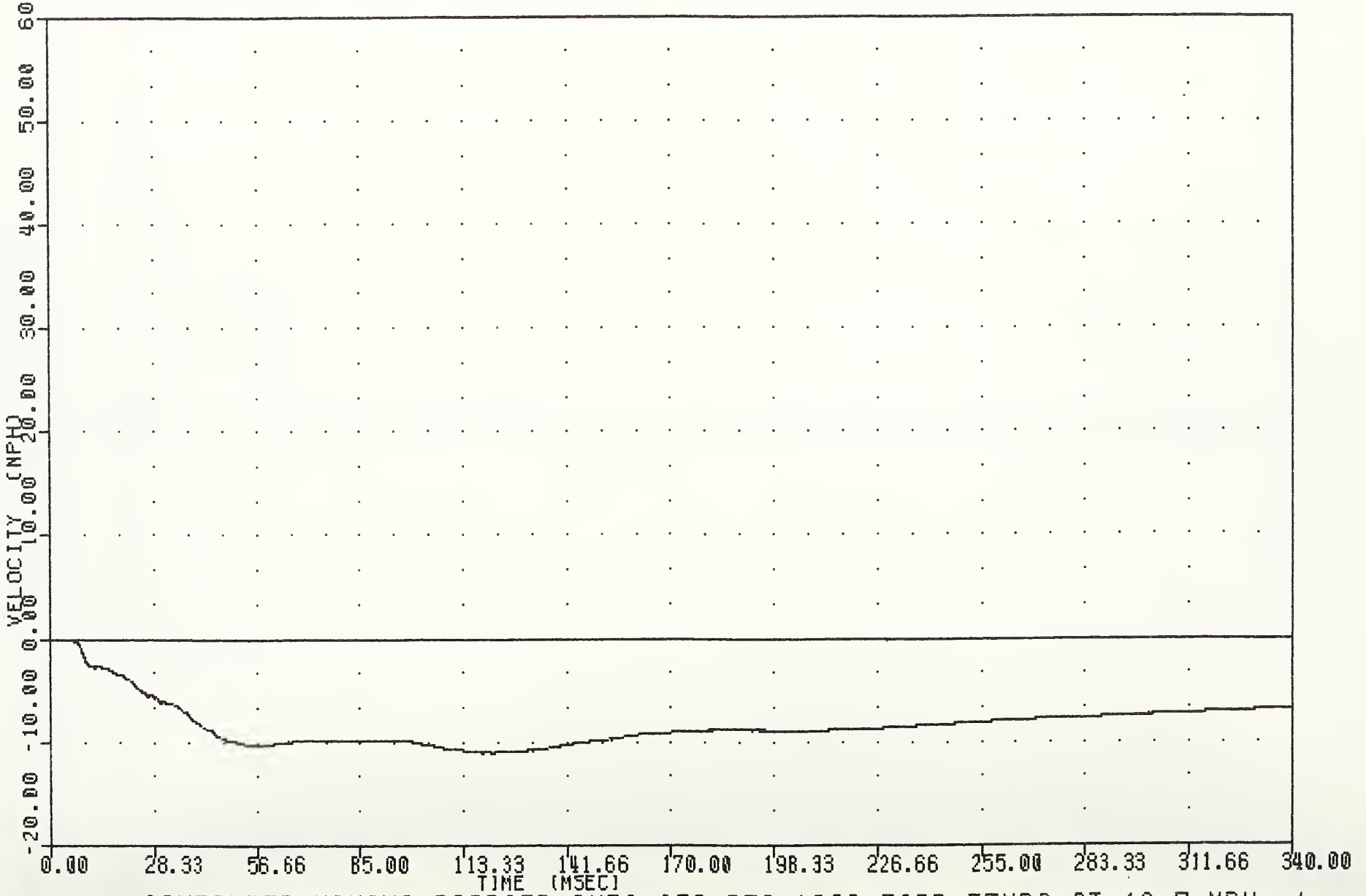
DATA PLOTS

TEST #890424-1



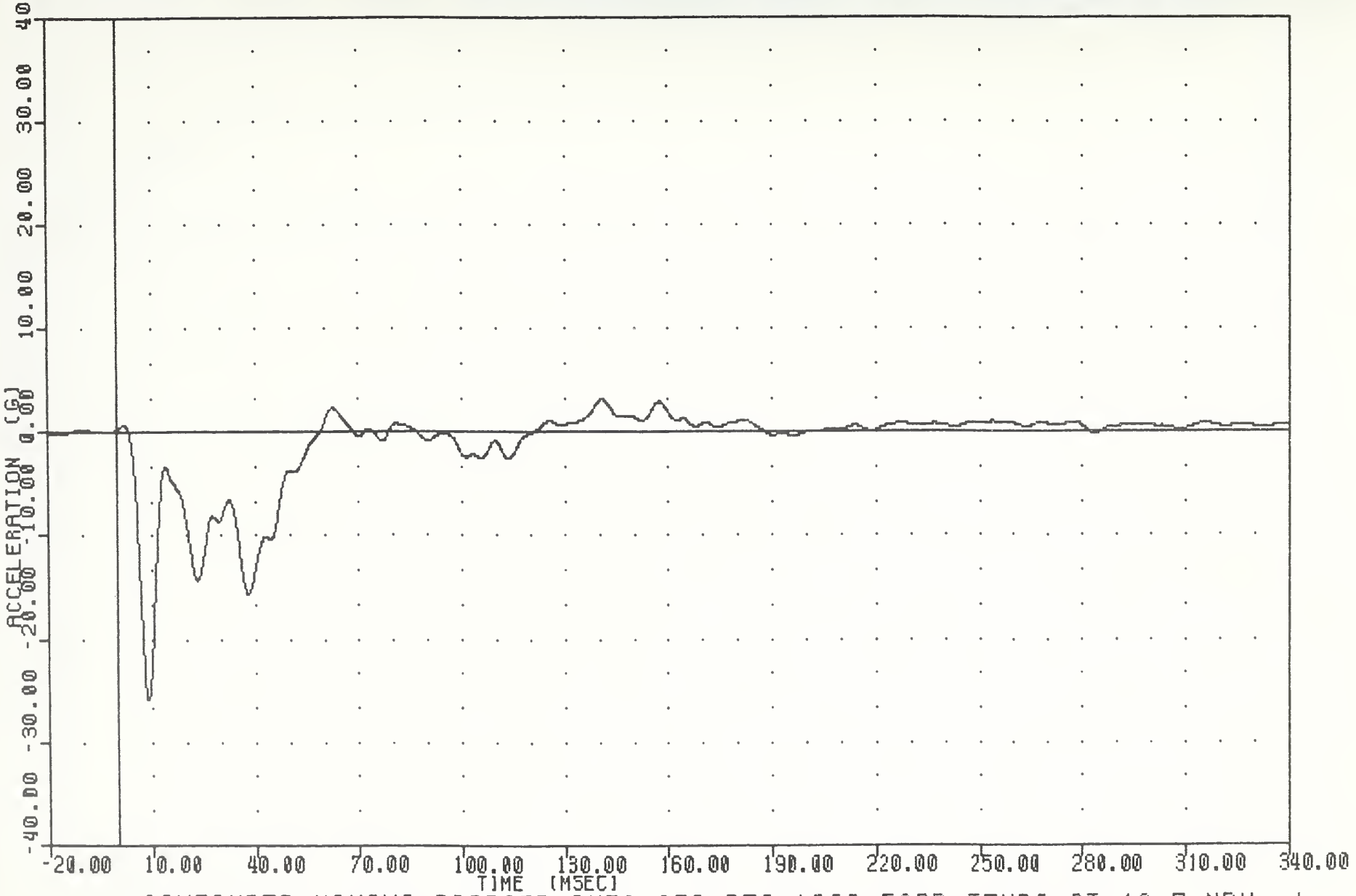
CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 18.7 MPH #1
VEHICLE RIGHT FRONT SILL Y AXIS ACCELERATION

VRTC-1 , 890424-1
CRASH III DAMAGE ALGORITHM
89114 FILTER = ALPF 1650/ 5214/ -40
RFSYV MIN, MAX VALUES = -11.04 @ 121.13 , 0.00 @ 0.38



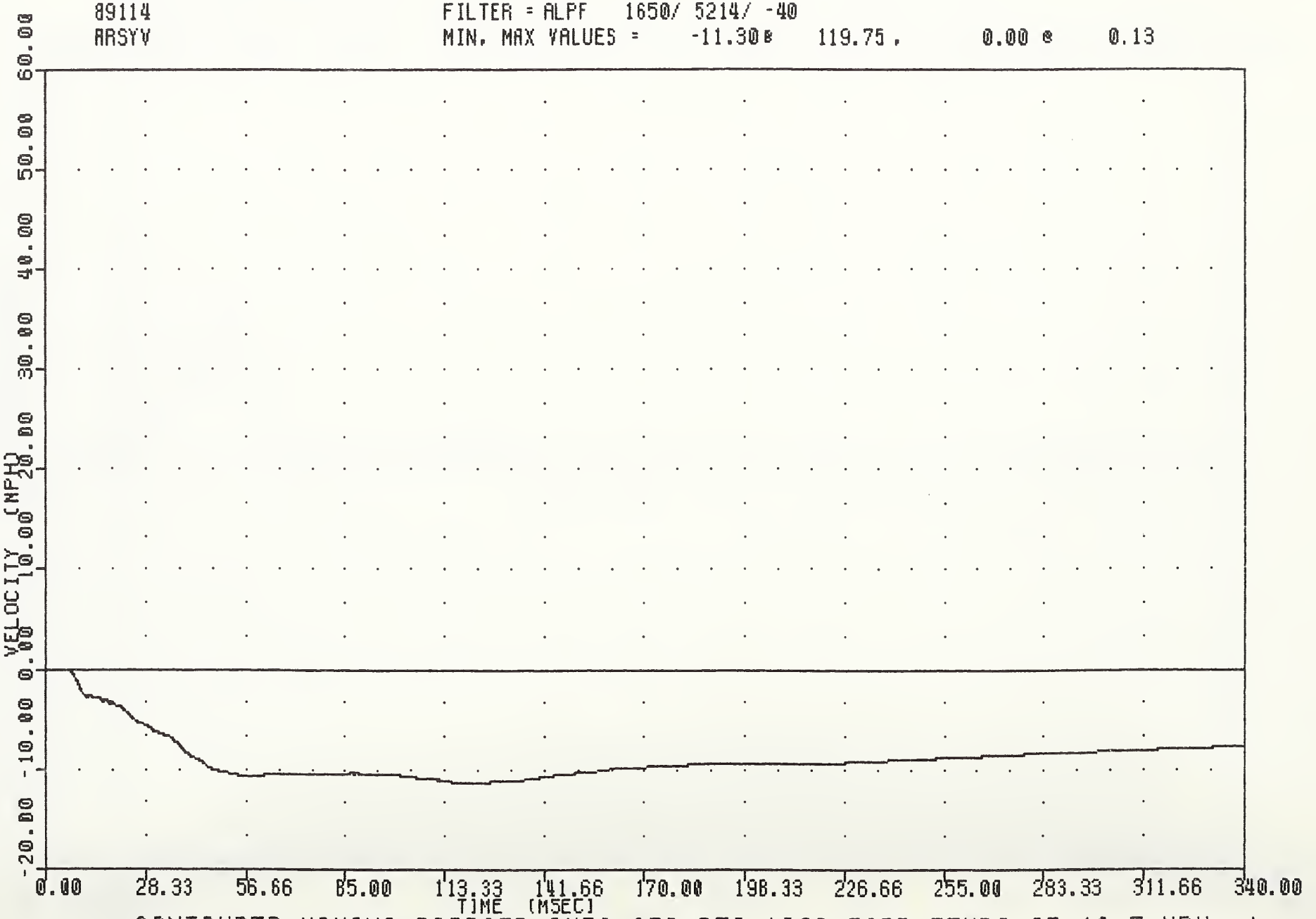
CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 18.7 MPH #1
VEHICLE RIGHT FRONT SILL Y AXIS VELOCITY

VRTC-1 , 890424-1
CRASH III DAMAGE ALGORITHM
89114
ARSYG
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -25.92 @ 8.88 , 3.17 @ 140.75



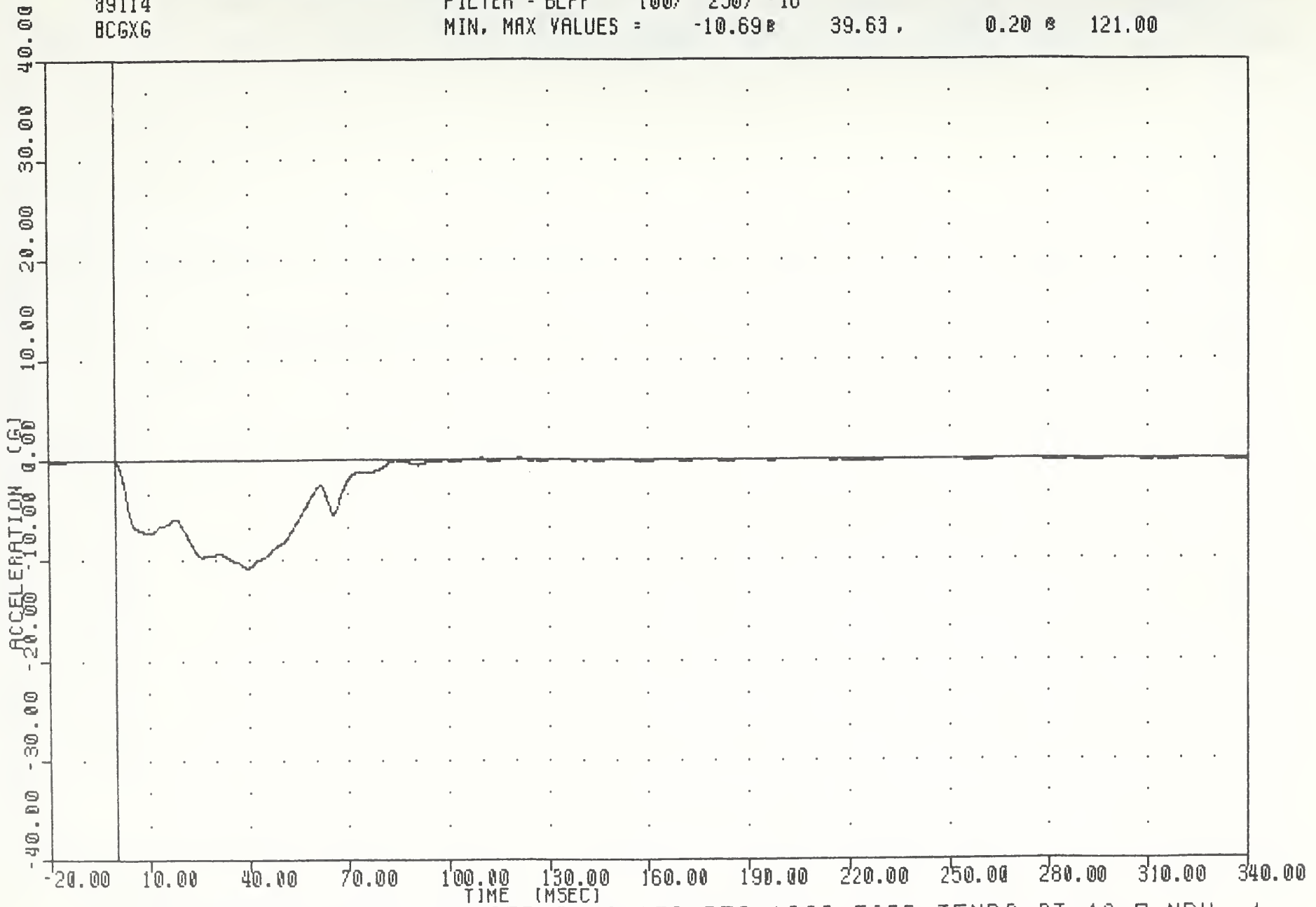
CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 18.7 MPH *1
VEHICLE RIGHT REAR SILL Y AXIS ACCELERATION

VRTC-1 , 890424-1
CRASH III DAMAGE ALGORITHM
89114 FILTER = ALPF 1650/ 5214/ -40
ARSYV MIN, MAX VALUES = -11.30 @ 119.75 , 0.00 @ 0.13



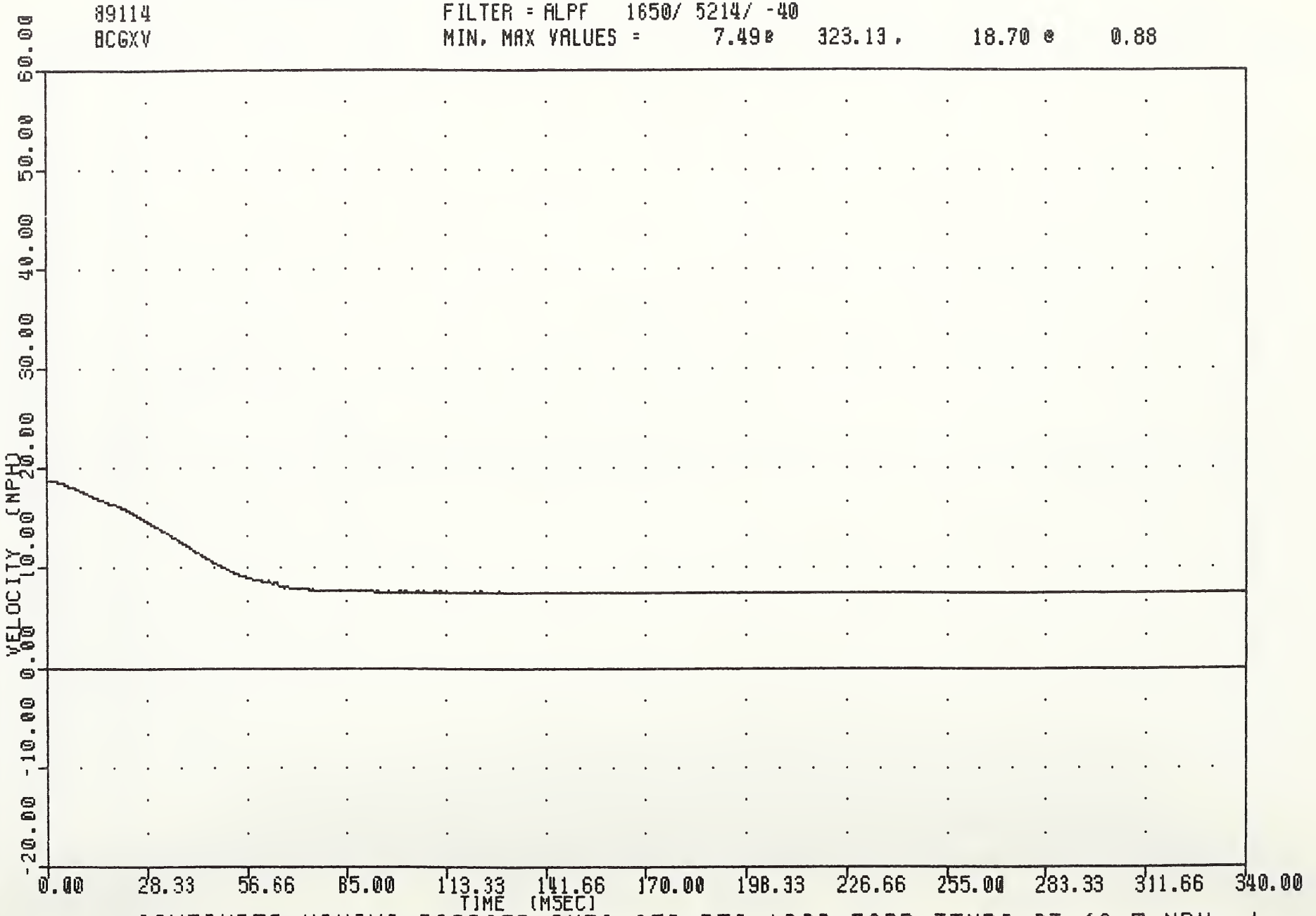
CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 18.7 MPH #1
VEHICLE RIGHT REAR SILL Y AXIS VELOCITY

VRTC-1 , 890424-1
CRASH III DAMAGE ALGORITHM
89114
BCGXG
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -10.69 @ 39.63 , 0.20 @ 121.00

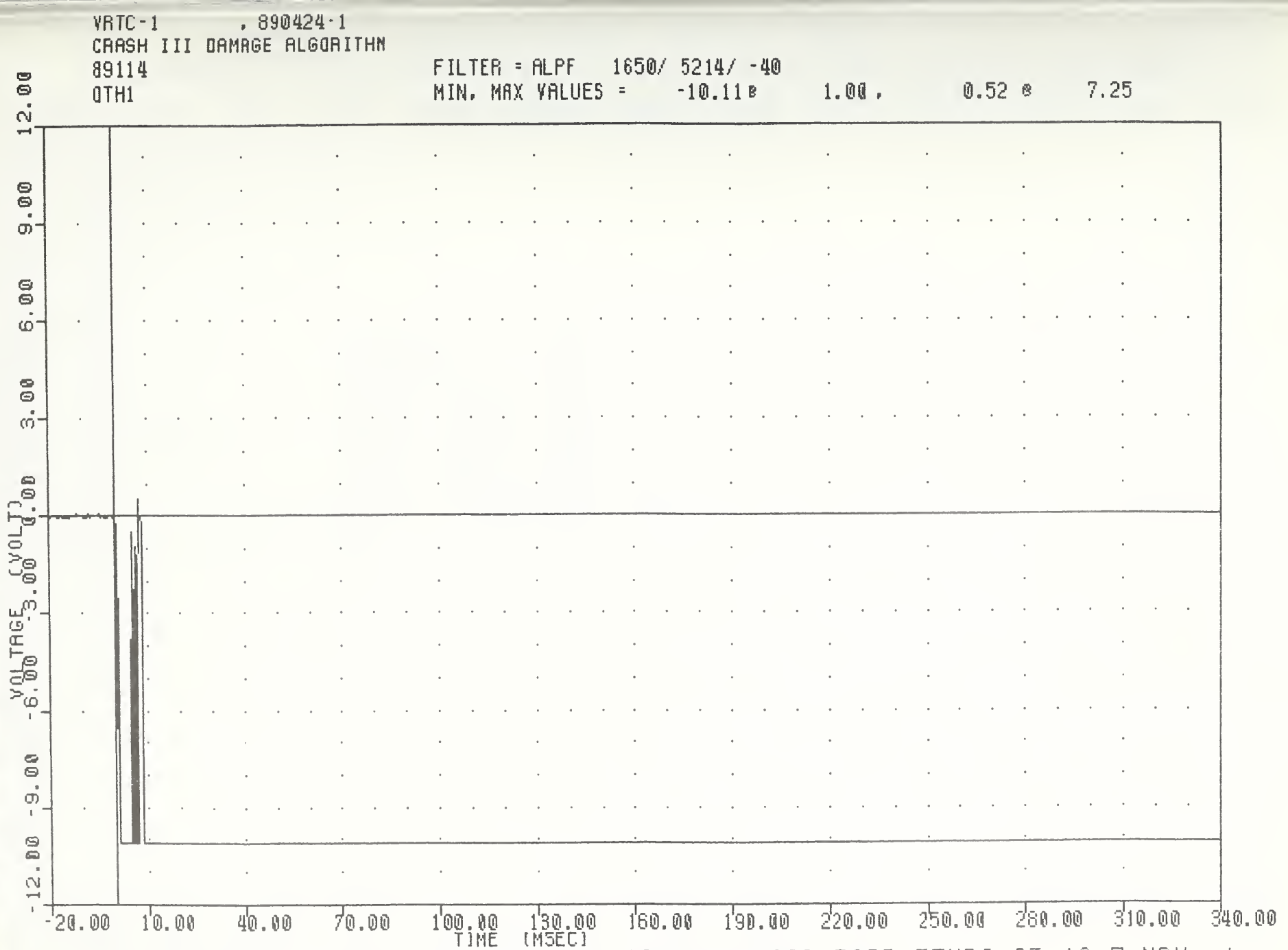


CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 18.7 MPH *1
CONTOURED BARRIER CENTER OF GRAVITY X AXIS ACCELERATION

VRTC-1 , 890424-1
CRASH III DAMAGE ALGORITHM
89114 FILTER = ALPF 1650/ 5214/ -40
BCGXV MIN, MAX VALUES = 7.49@ 323.13, 18.70 @ 0.88

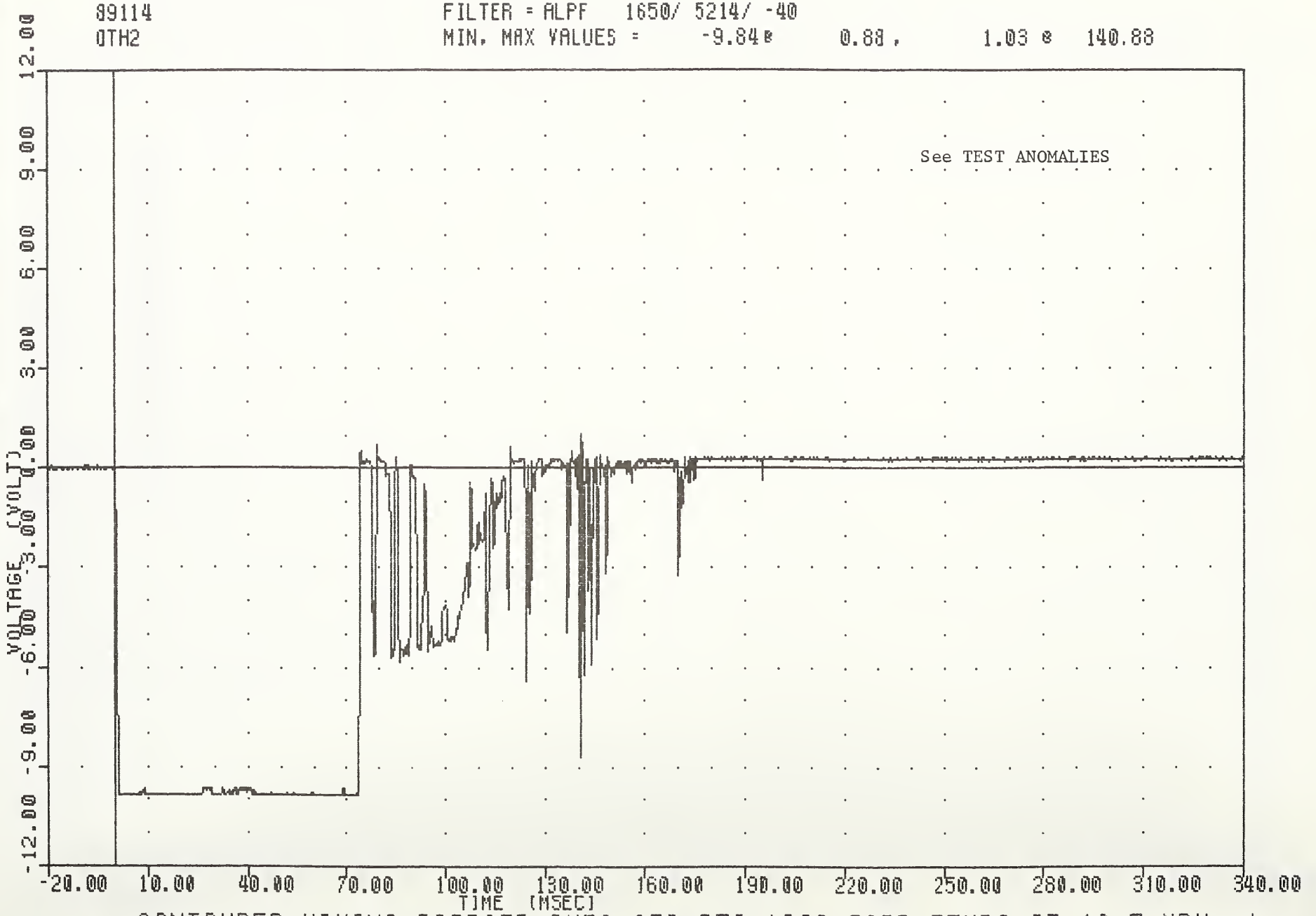


CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 18.7 MPH #1
CONTOURED MOVING BARRIER CENTER OF GRAVITY X AXIS VELOCITY

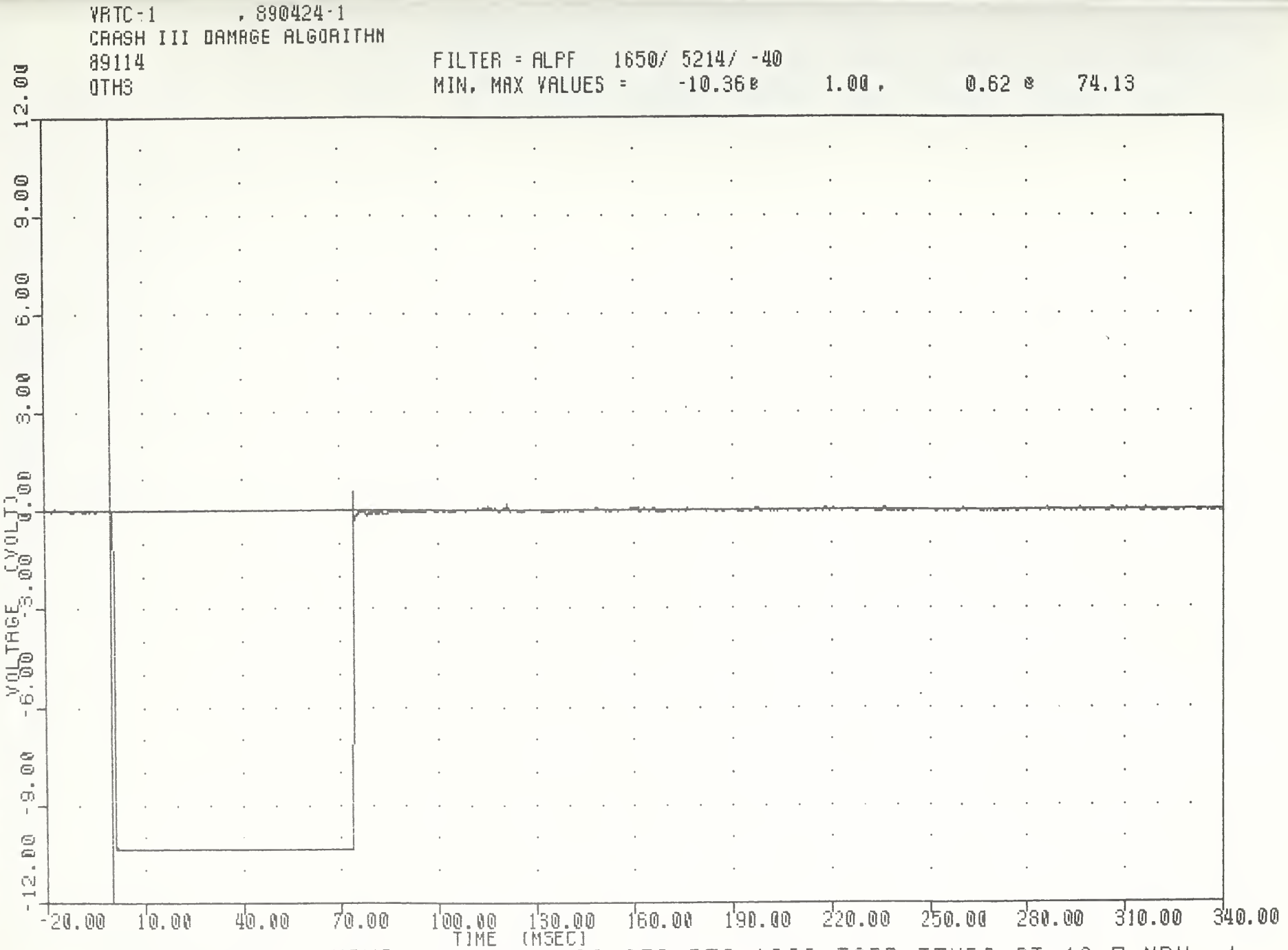


CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 18.7 MPH #1
VEHICLE CONTACT SWITCH - FRONT

VRTC-1 , 890424-1
CRASH III DAMAGE ALGORITHM
89114 FILTER = ALPF 1650/ 5214/ -40
0TH2 MIN, MAX VALUES = -9.84 @ 0.88 , 1.03 @ 140.88



CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 18.7 MPH #1
VEHICLE CONTACT SWITCH - REAR

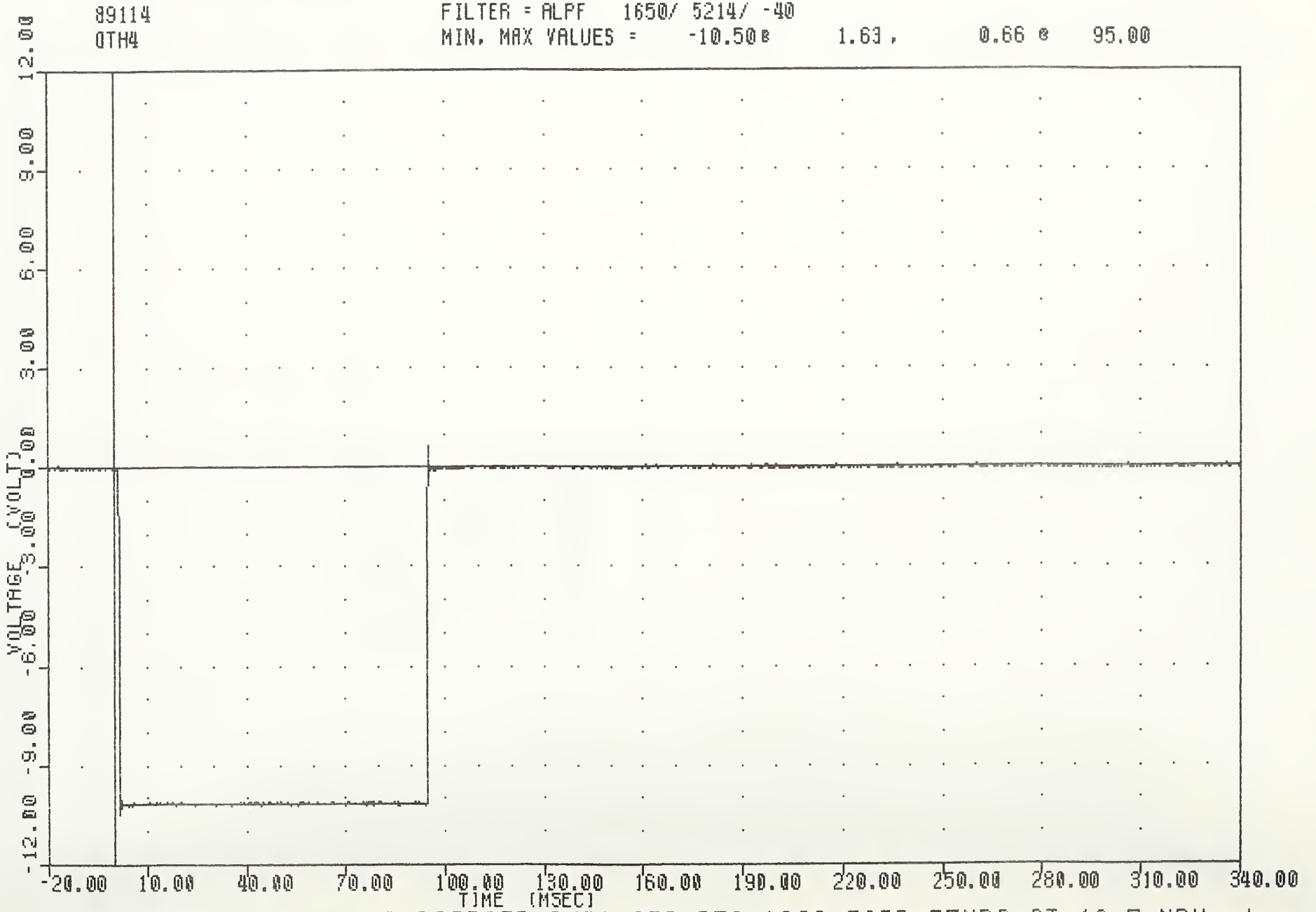


CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 18.7 MPH *1

BARRIER CONTACT SWITCH - RIGHT

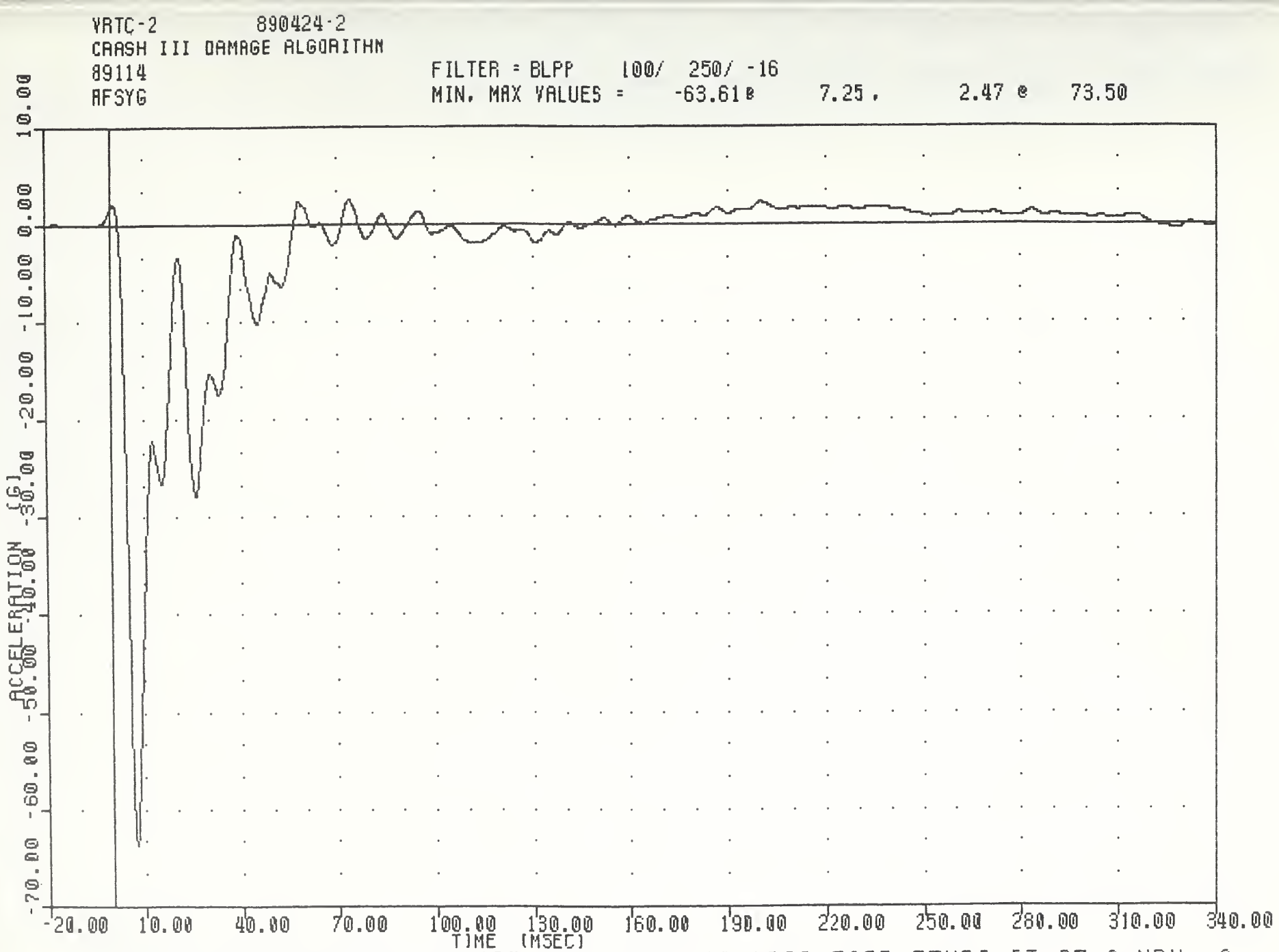
VRTC-1 , 890424-1
CRASH III DAMAGE ALGORITHM
89114
OTH4

FILTER = ALPF 1650/ 5214/ -40
MIN, MAX VALUES = -10.50 @ 1.63 , 0.66 @ 95.00



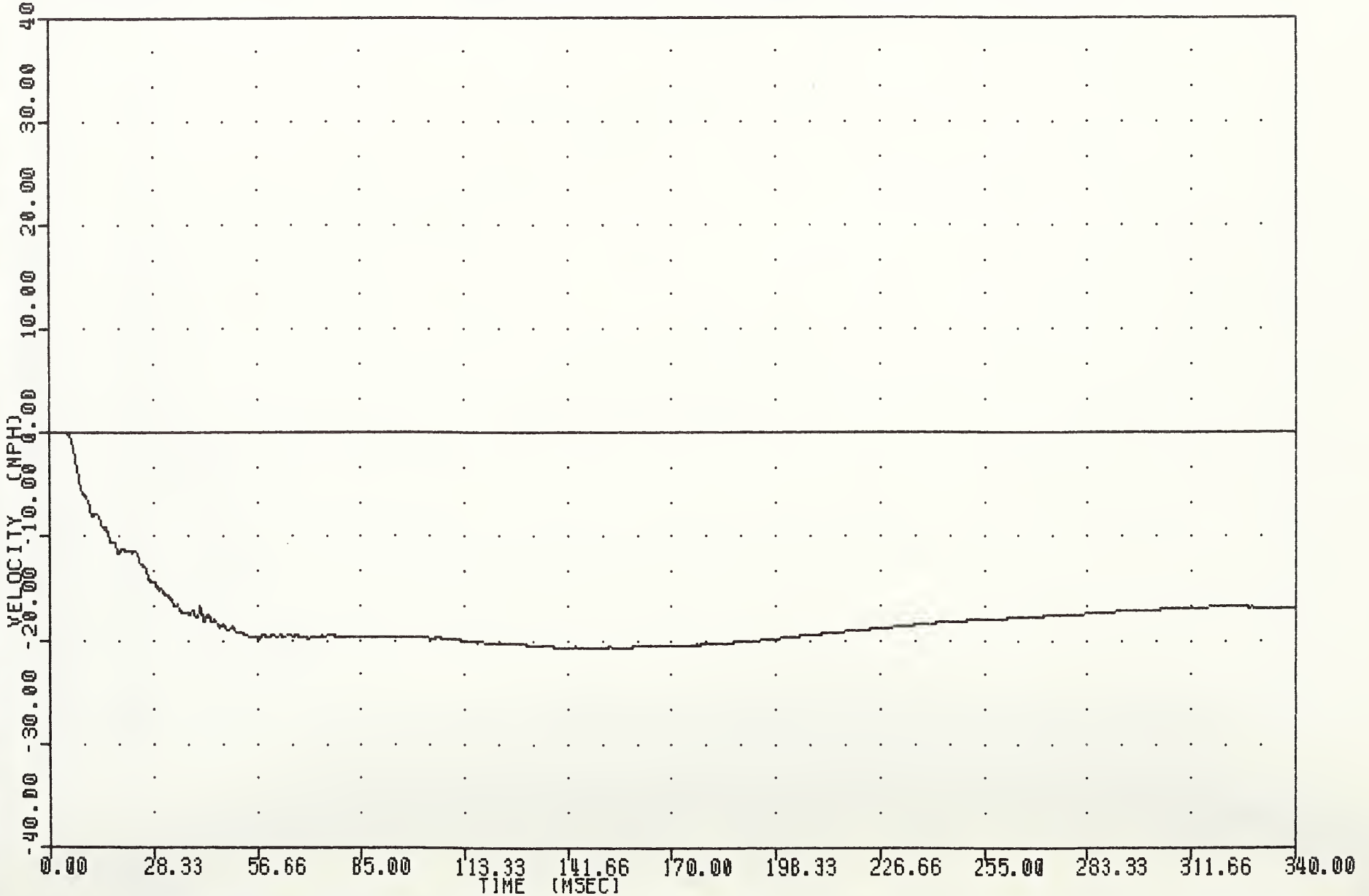
CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 18.7 MPH #1
BARRIER CONTACT SWITCH - LEFT

TEST #890424-2

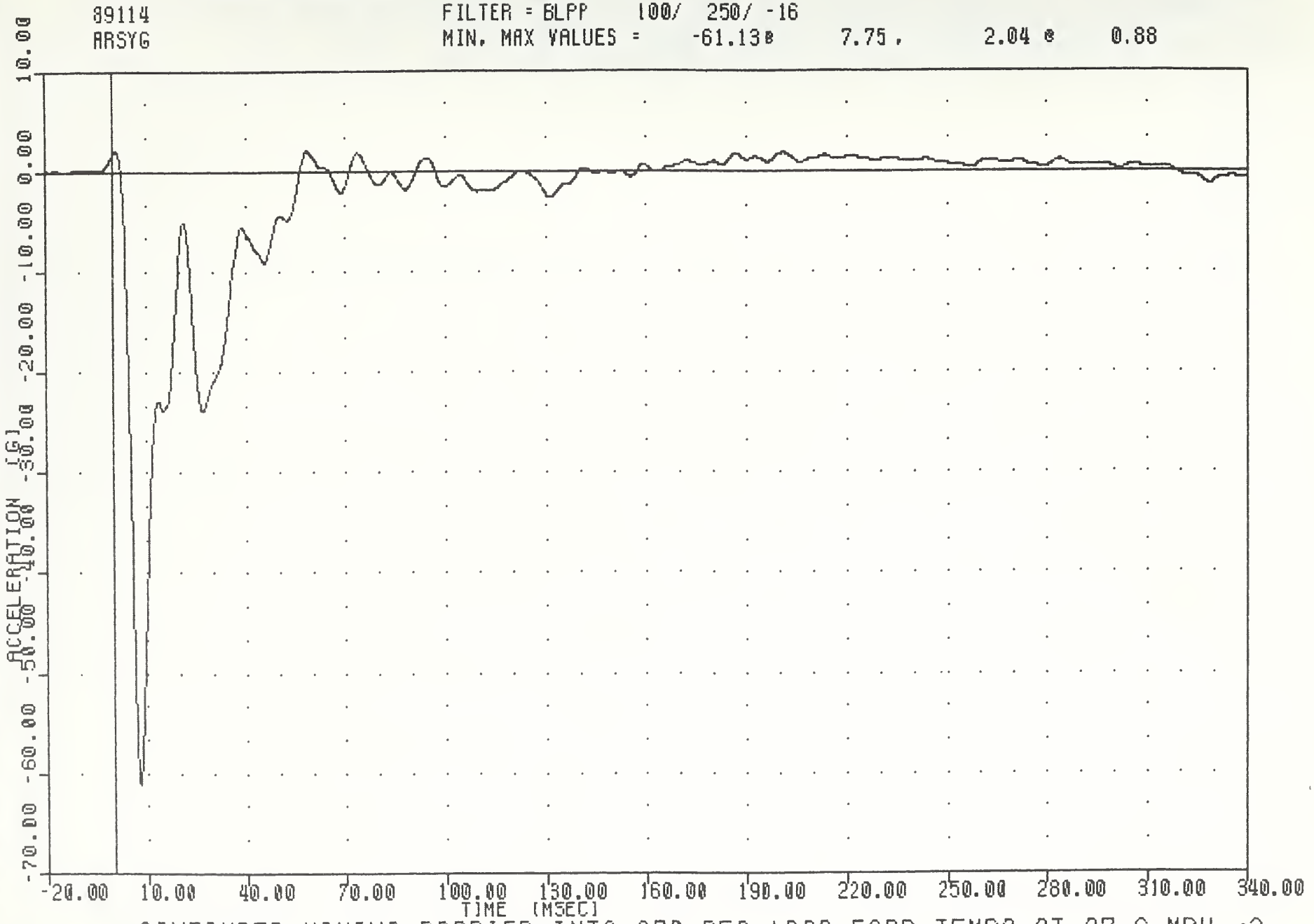


CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.6 MPH *2
VEHICLE RIGHT FRONT SILL Y AXIS ACCELERATION

VRTC-2 , 890424-2
CRASH III DAMAGE ALGORITHM
89114 FILTER = ALPF 1650/ 5214/ -40
RFSYV MIN, MAX VALUES = -20.69 @ 146.38 , 0.00 @ 0.00

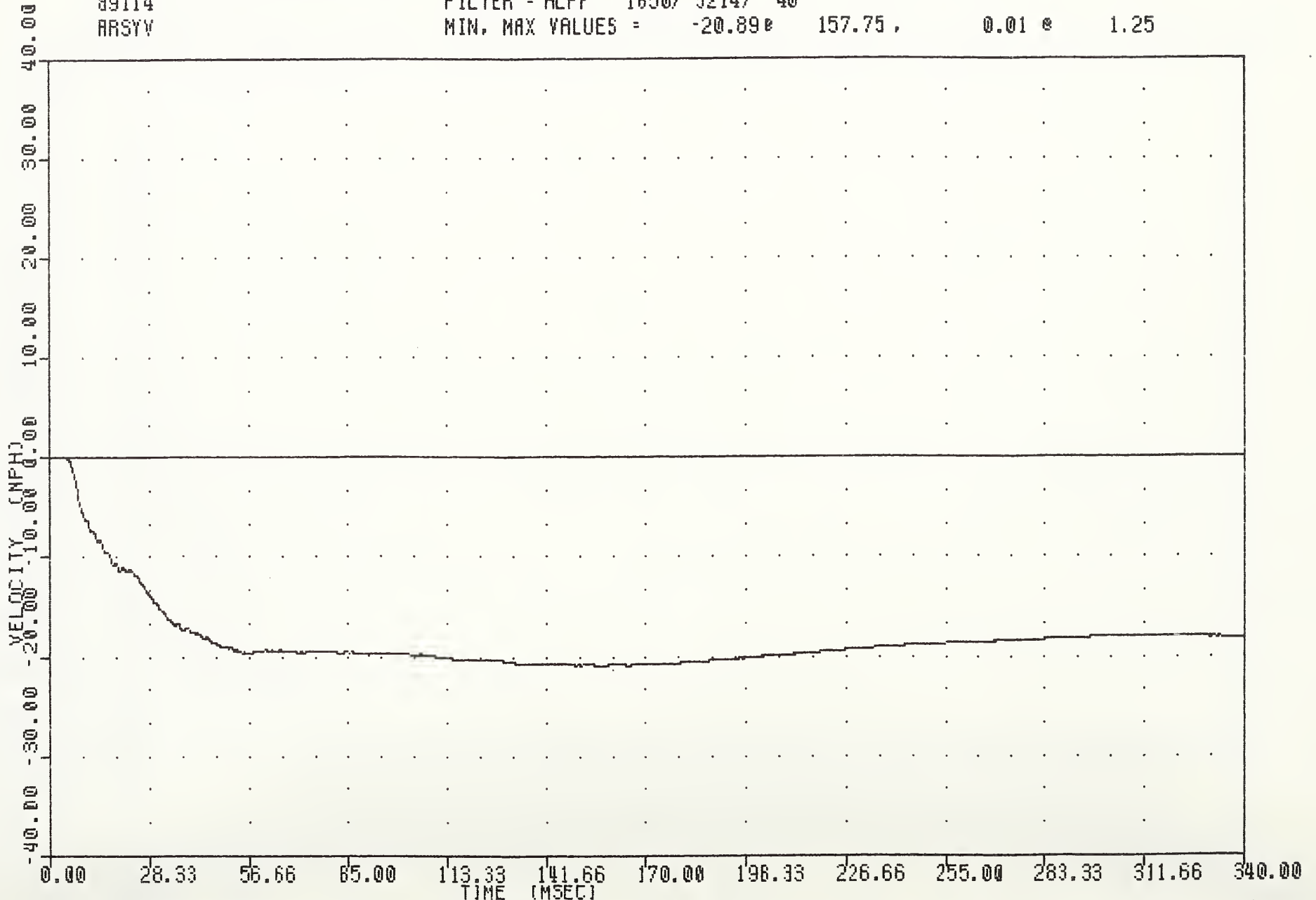


CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.6 MPH #2
VEHICLE RIGHT FRONT SILL Y AXIS VELOCITY

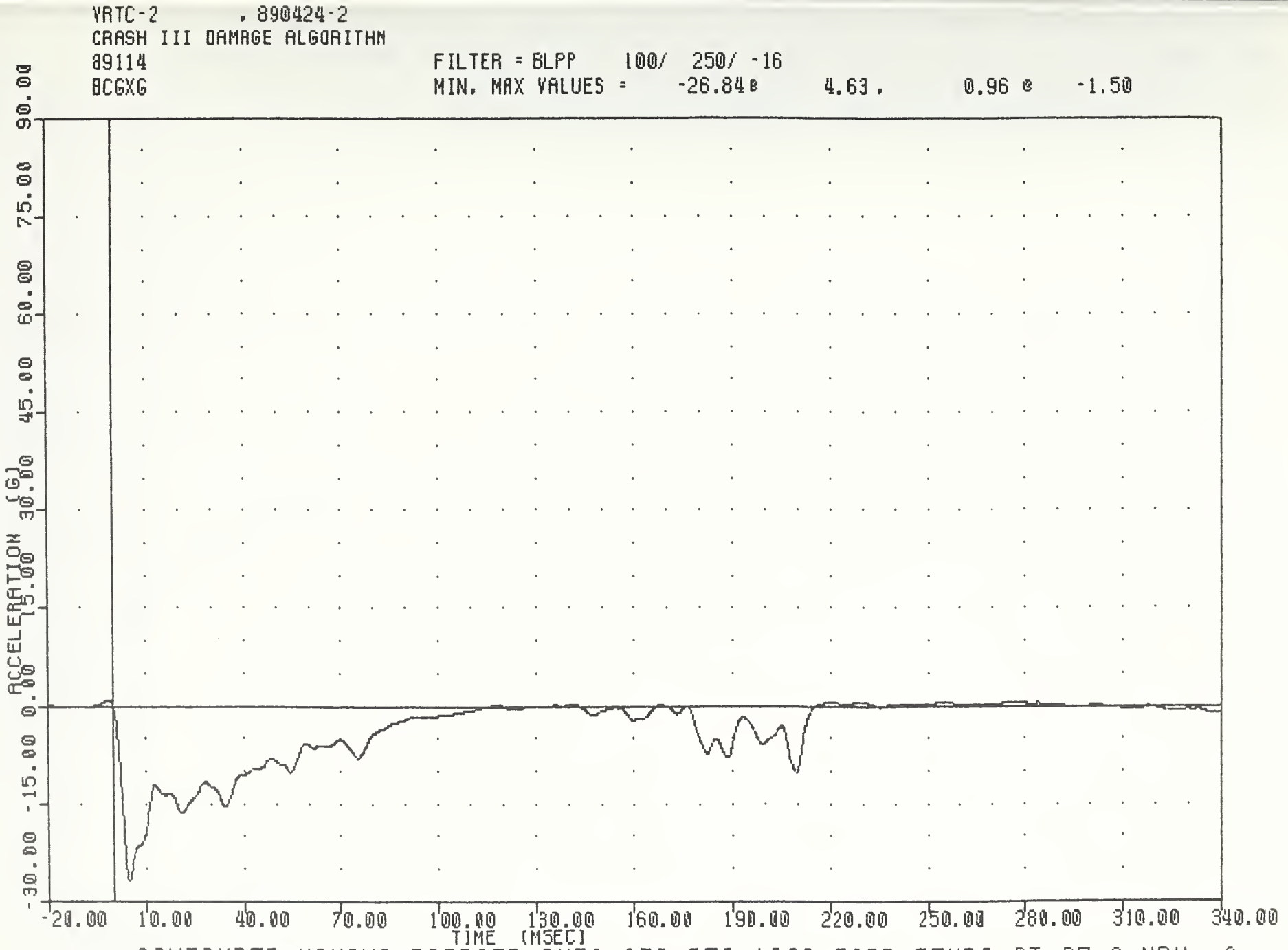


CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.6 MPH #2
VEHICLE RIGHT REAR SILL Y AXIS ACCELERATION

VRTC-2 , 890424-2
CRASH III DAMAGE ALGORITHM
89114 FILTER = ALPF 1650/ 5214/ -40
ARSYV MIN, MAX VALUES = -20.89 @ 157.75 , 0.01 @ 1.25



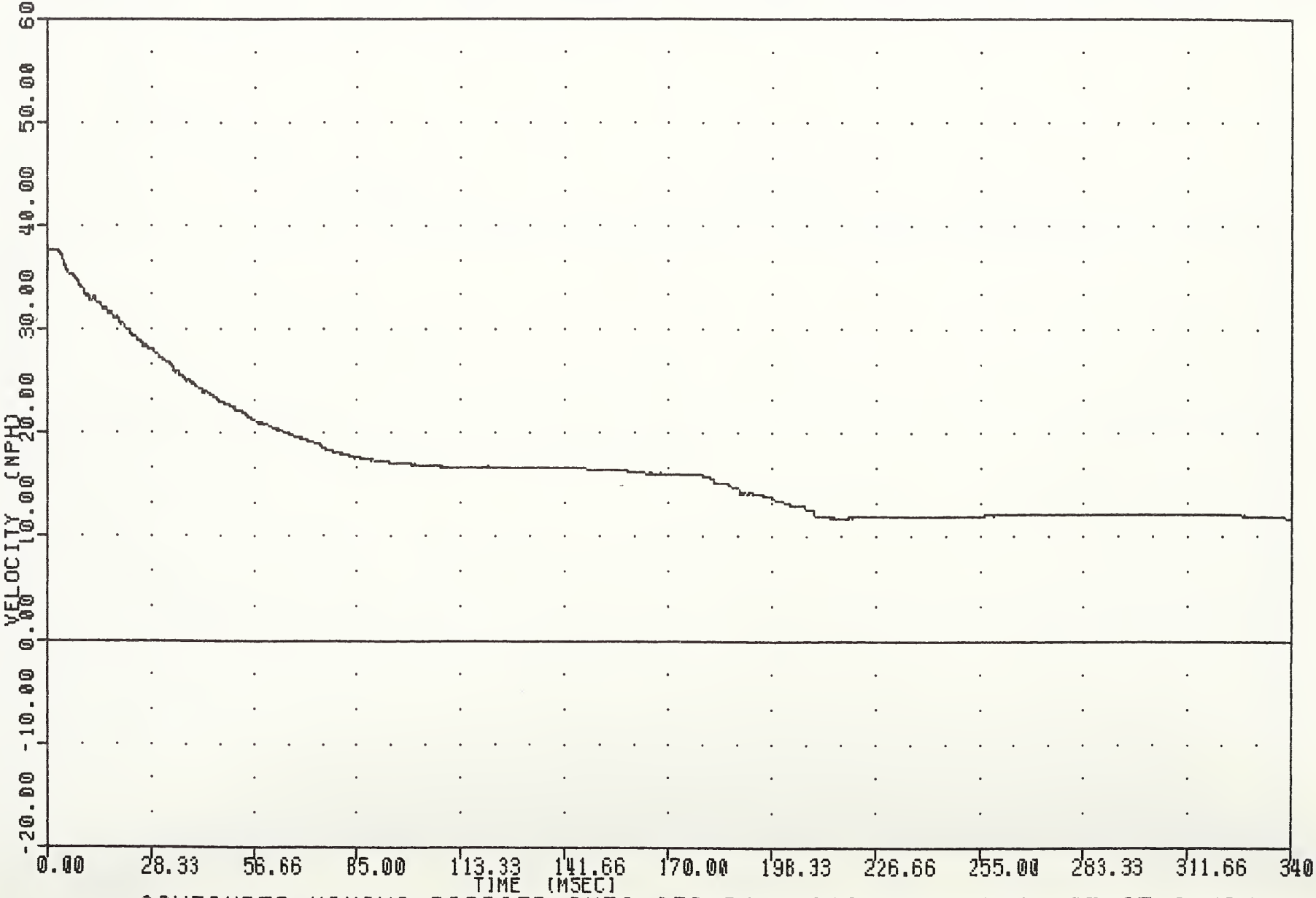
CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.6 MPH #2
VEHICLE RIGHT REAR SILL Y AXIS VELOCITY



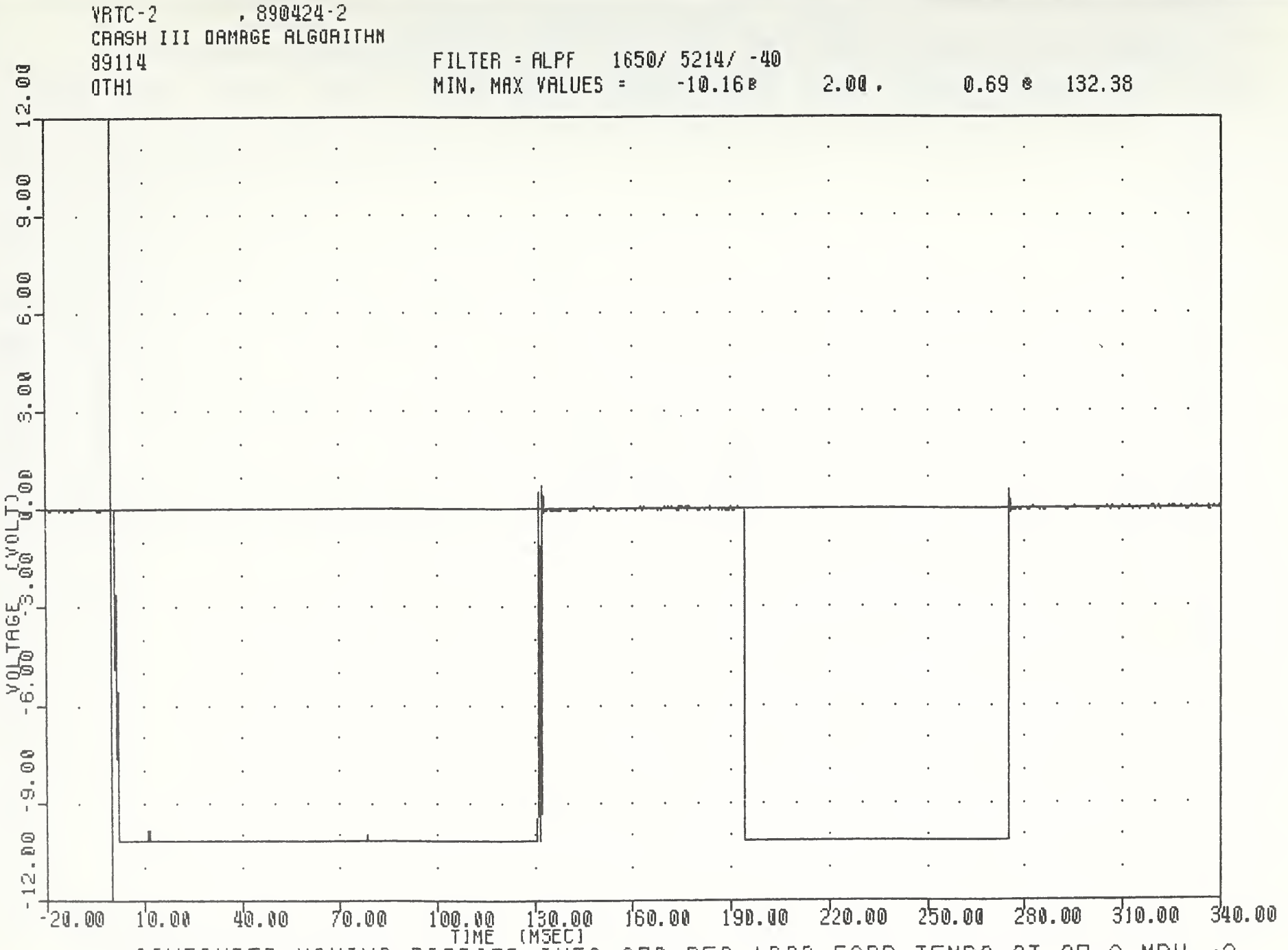
CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.6 MPH *2

CONTOURED MOVING BARRIER CENTER OF GRAVITY X AXIS ACCELERATION

VRTC-2 , 890424-2
CRASH III DAMAGE ALGORITHM
89114 FILTER = ALPF 1650/ 5214/ -40
BCGXV MIN, MAX VALUES = 11.84 @ 340.00 , 37.60 @ 0.00



CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.6 MPH #2
CONTOURED MOVING BARRIER CENTER OF GRAVITY X AXIS VELOCITY

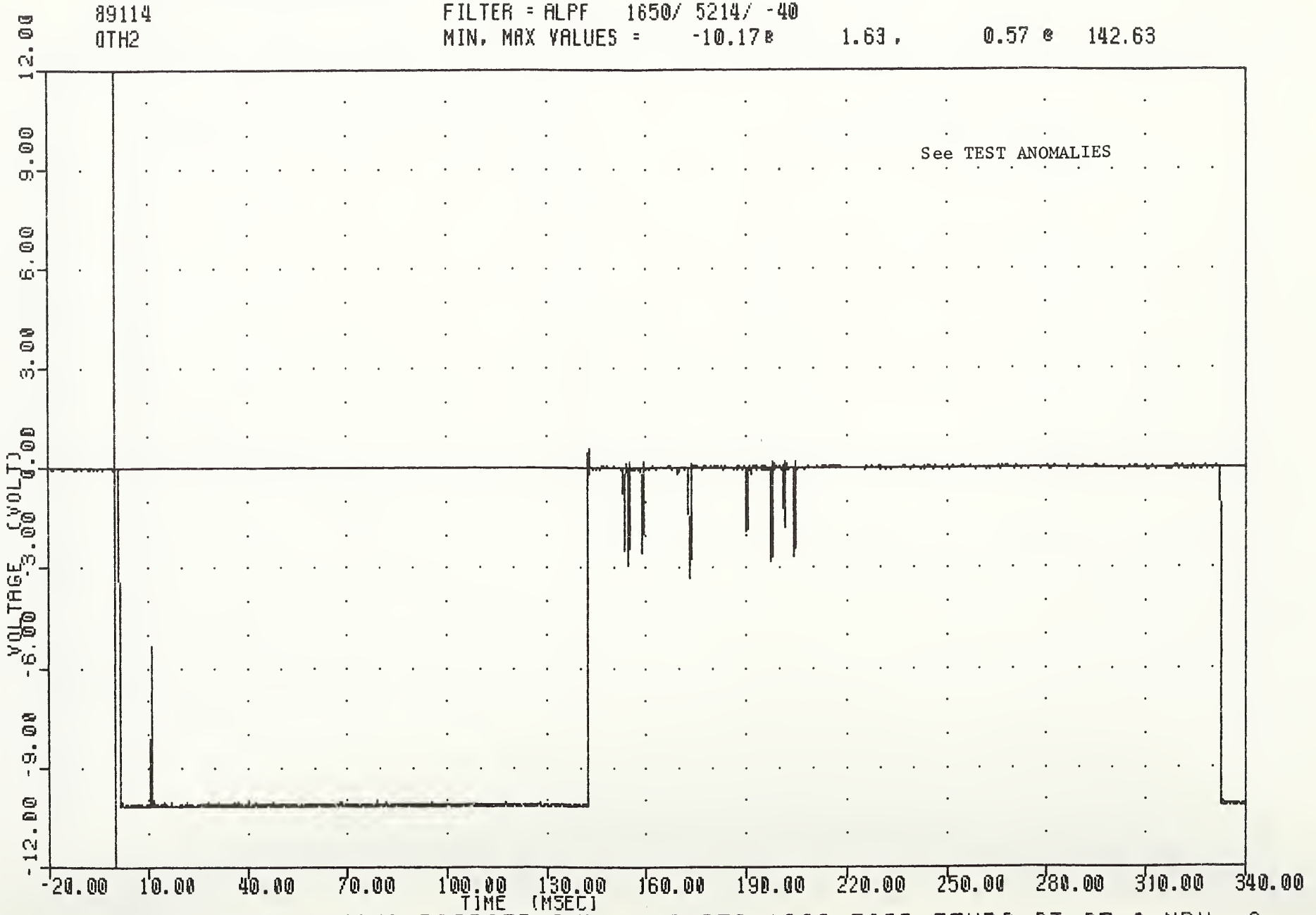


CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.6 MPH *2

VEHICLE CONTACT SWITCH - FRONT

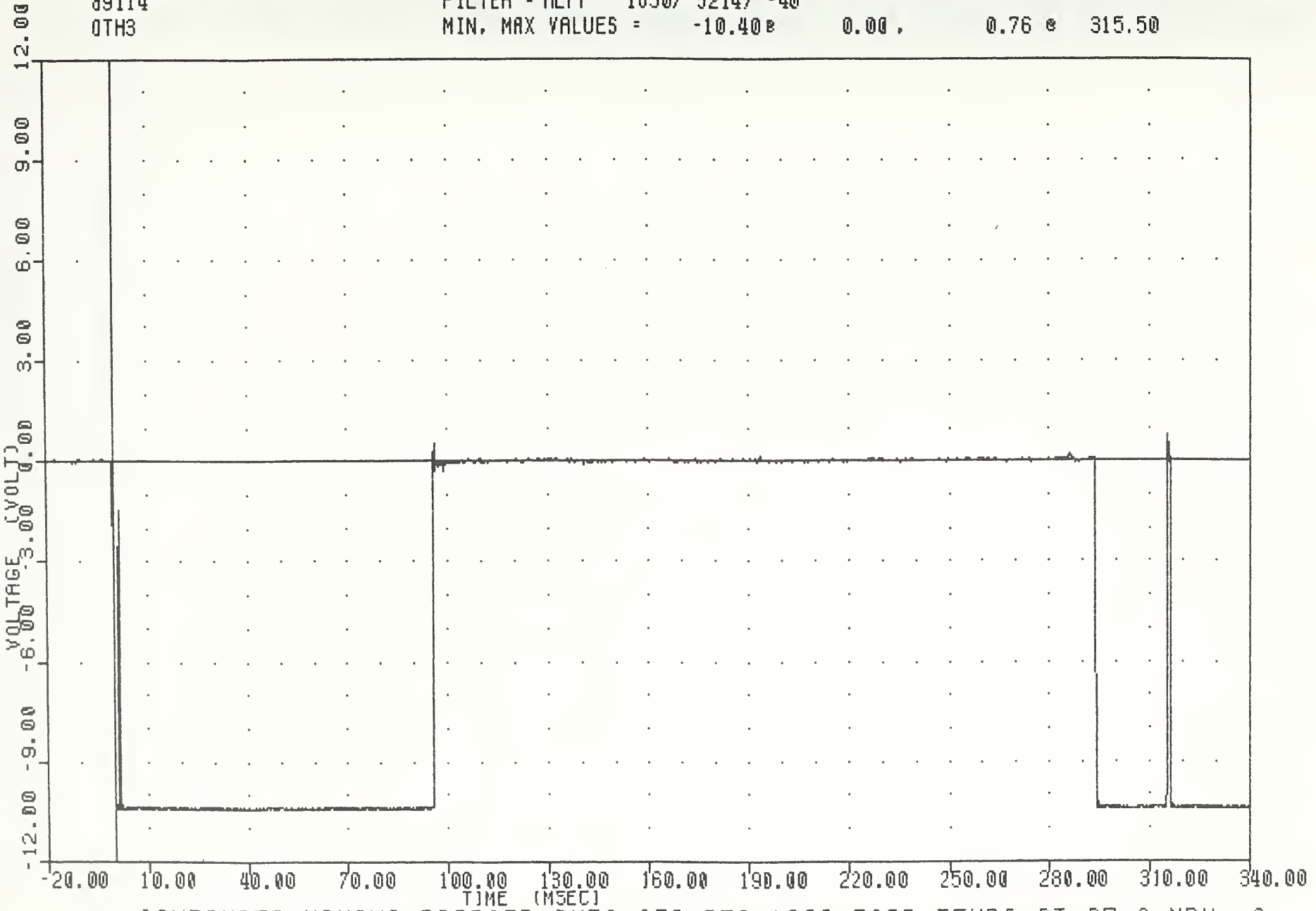
VRTC-2 , 890424-2
CRASH III DAMAGE ALGORITHM
89114
0TH2

FILTER = ALPF 1650/ 5214/ -40
MIN, MAX VALUES = -10.17 @ 1.63 , 0.57 @ 142.63

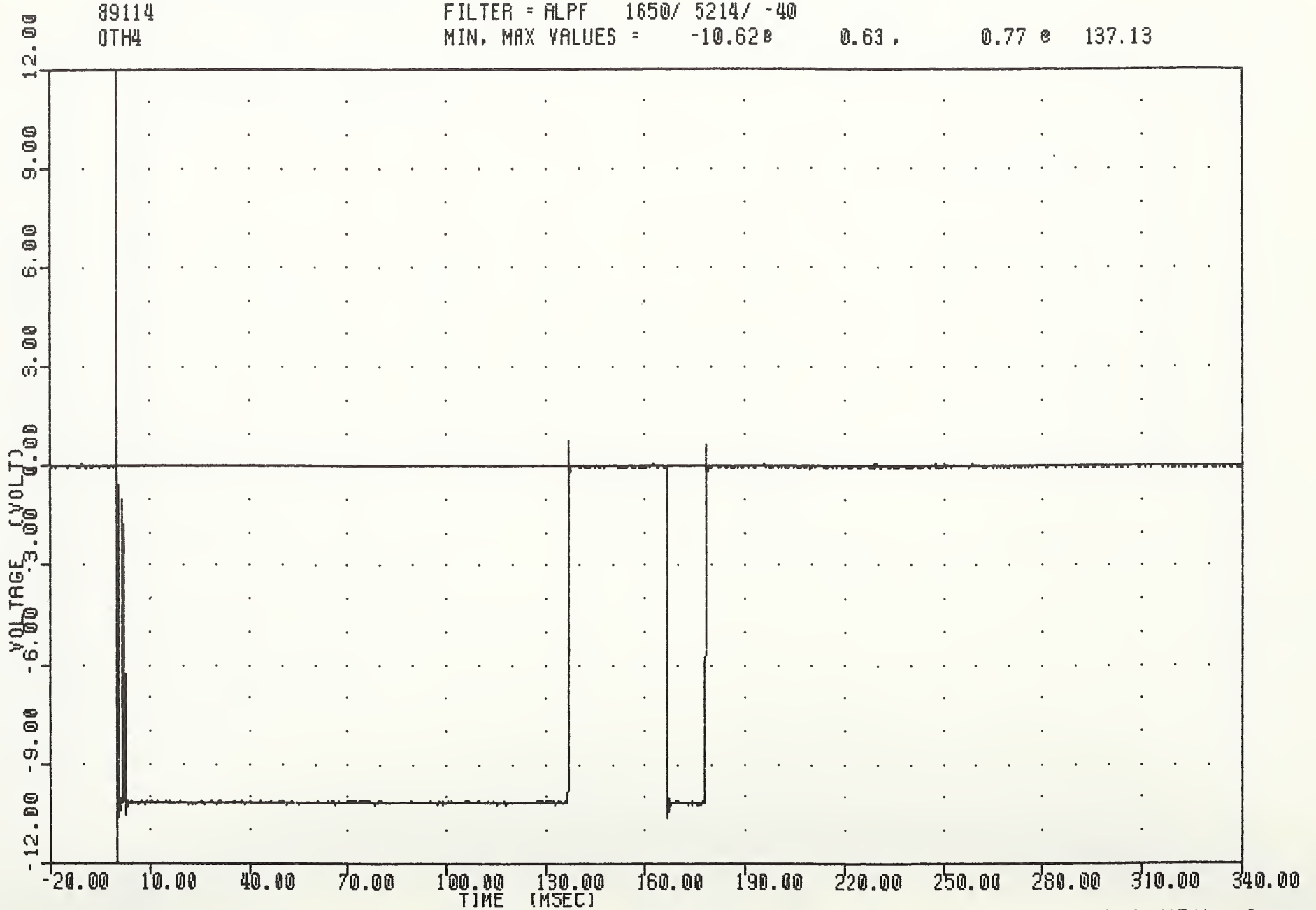


CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.6 MPH #2
VEHICLE CONTACT SWITCH - REAR

VRTC-2 , 890424-2
CRASH III DAMAGE ALGORITHM
89114
OTH3
FILTER = ALPF 1650/ 5214/ -40
MIN, MAX VALUES = -10.40 @ 0.00 , 0.76 @ 315.50



CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.6 MPH #2
BARRIER CONTACT SWITCH - RIGHT

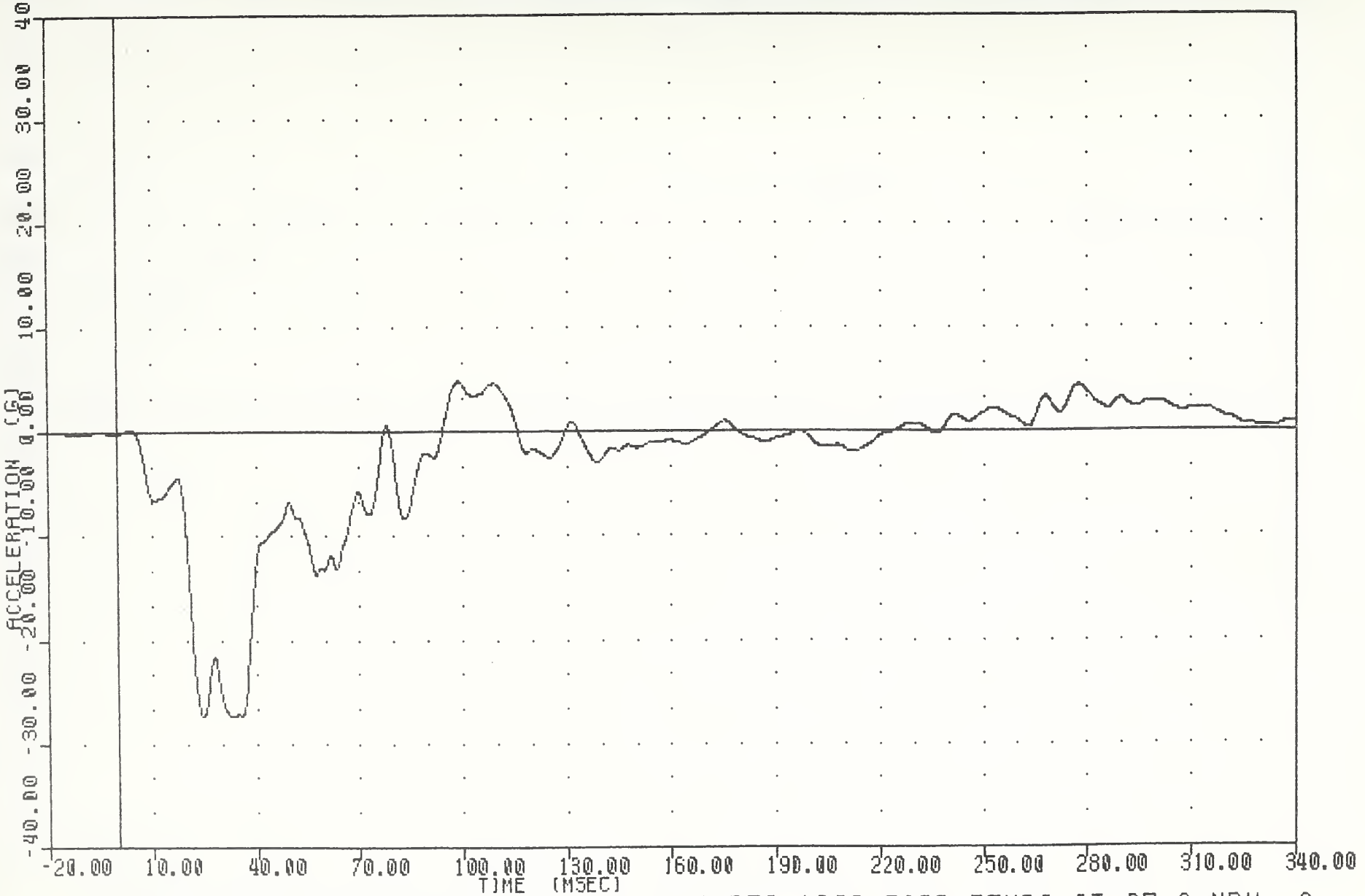


CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.6 MPH #2
BARRIER CONTACT SWITCH - LEFT

TEST #890424-3

VRTC-3 , 890424-3
CRASH III DAMAGE ALGORITHM
89114
RFSYG

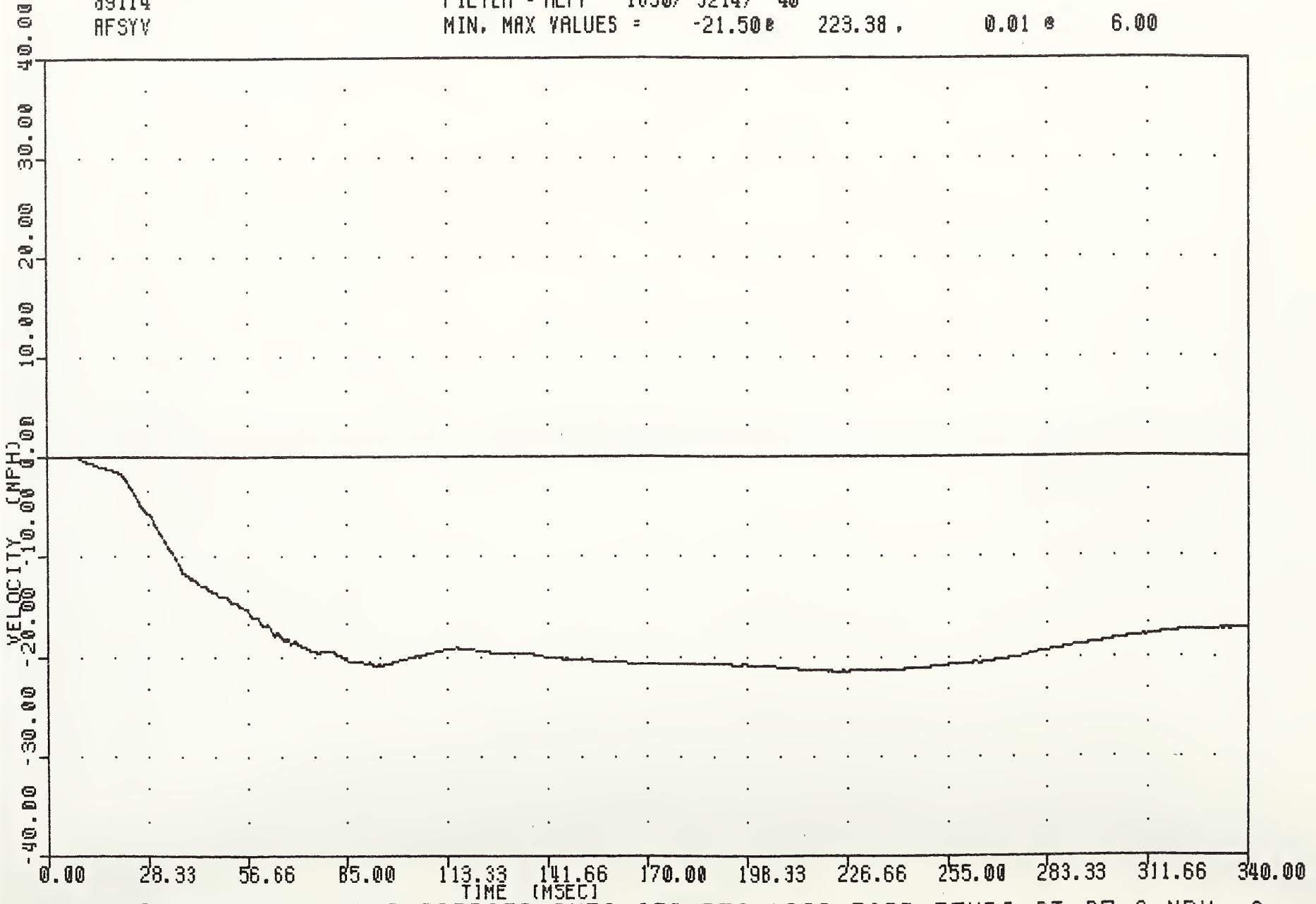
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -27.41 @ 32.88 , 4.83 @ 98.75



CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.9 MPH #3
VEHICLE RIGHT FRONT SILL Y AXIS ACCELERATION

VRTC-3 , 890424-3
CRASH III DAMAGE ALGORITHM
89114
RFSYV

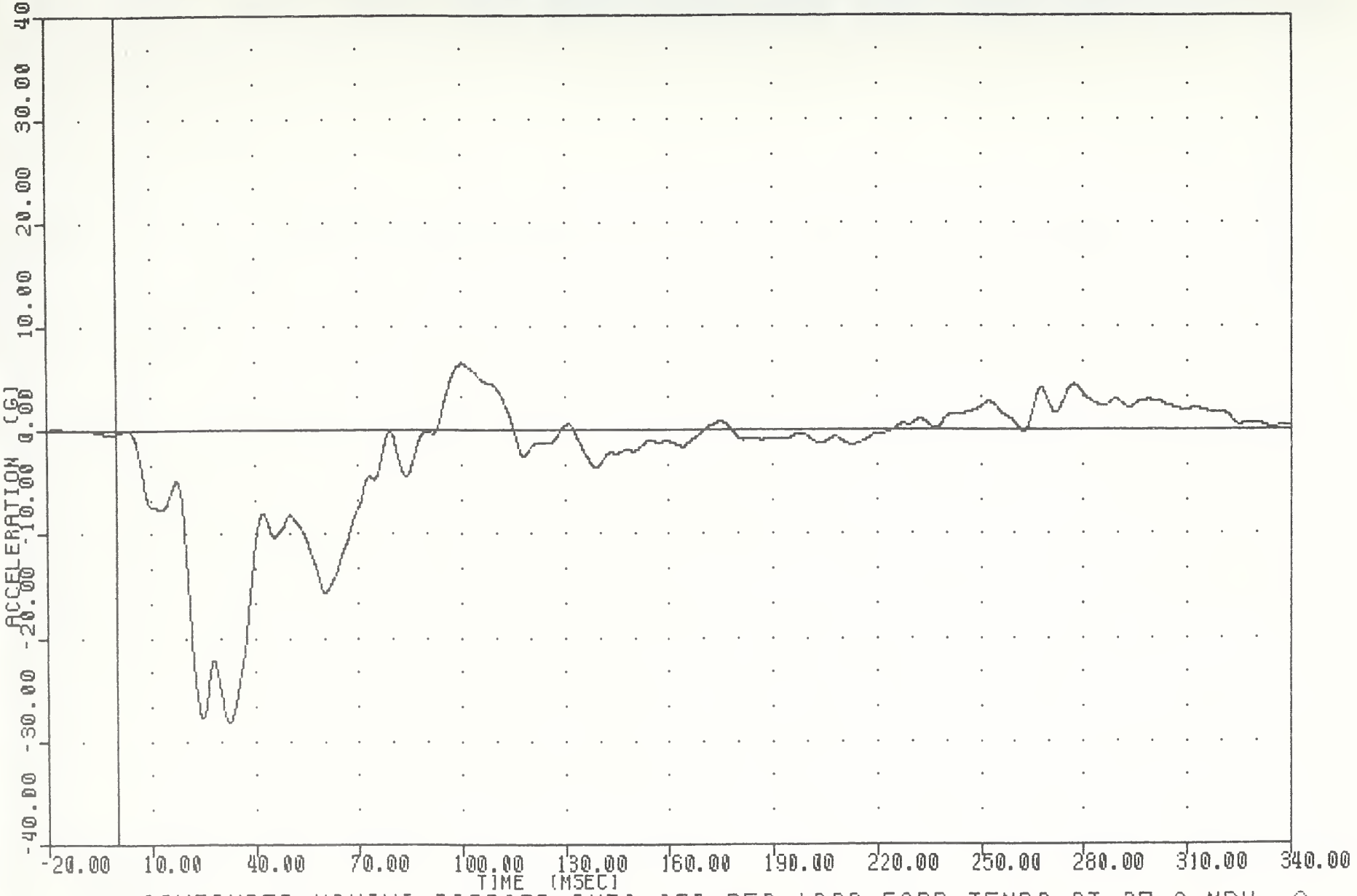
FILTER = RLPF 1650/ 5214/ -40
MIN, MAX VALUES = -21.50 @ 223.38 , 0.01 @ 6.00



CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.9 MPH #3
VEHICLE RIGHT FRONT SILL Y AXIS VELOCITY

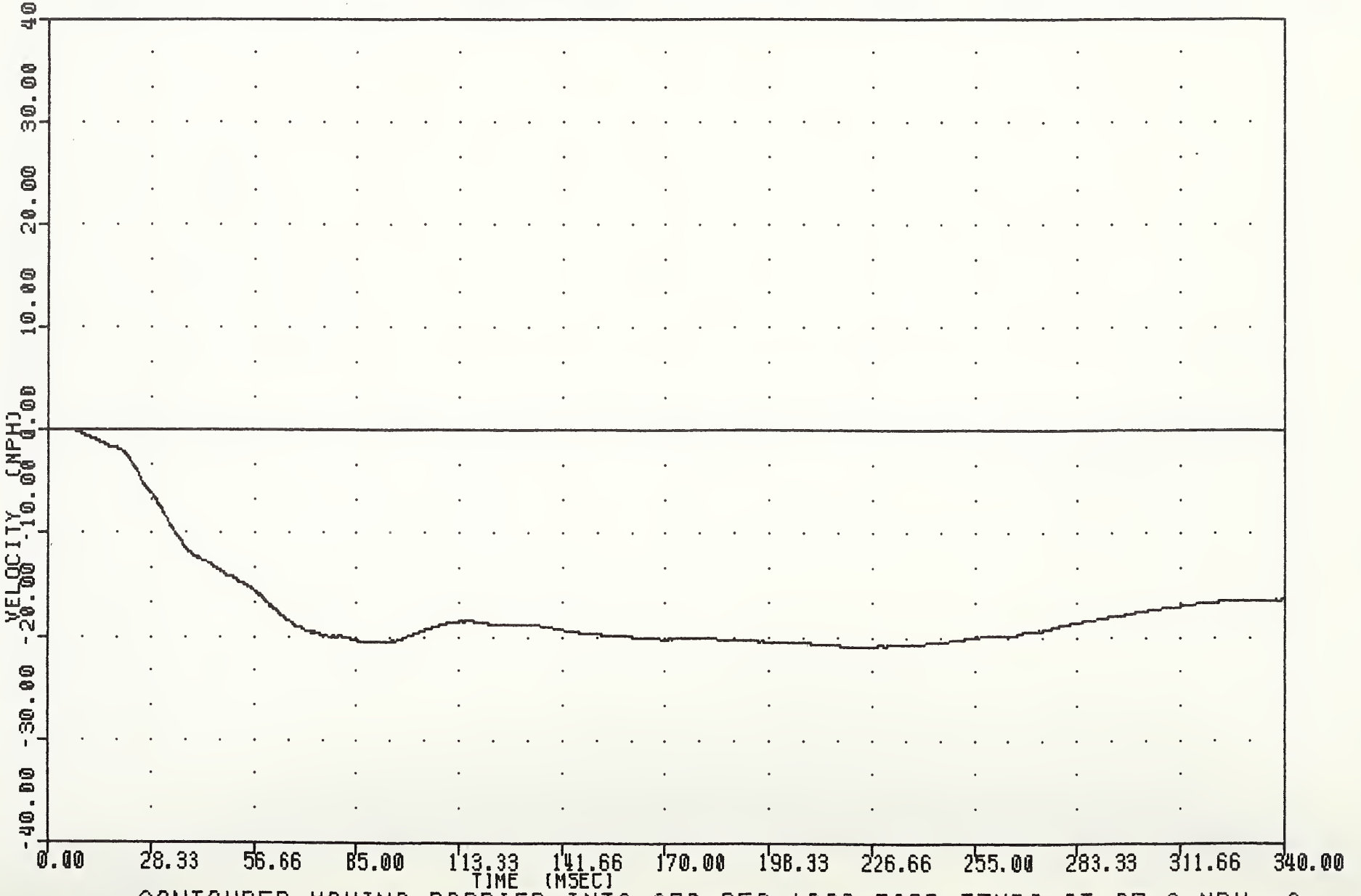
VRTC-3 , 890424-3
CRASH III DAMAGE ALGORITHM
89114
ARSYG

FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -28.25 @ 32.50 , 6.34 @ 100.13



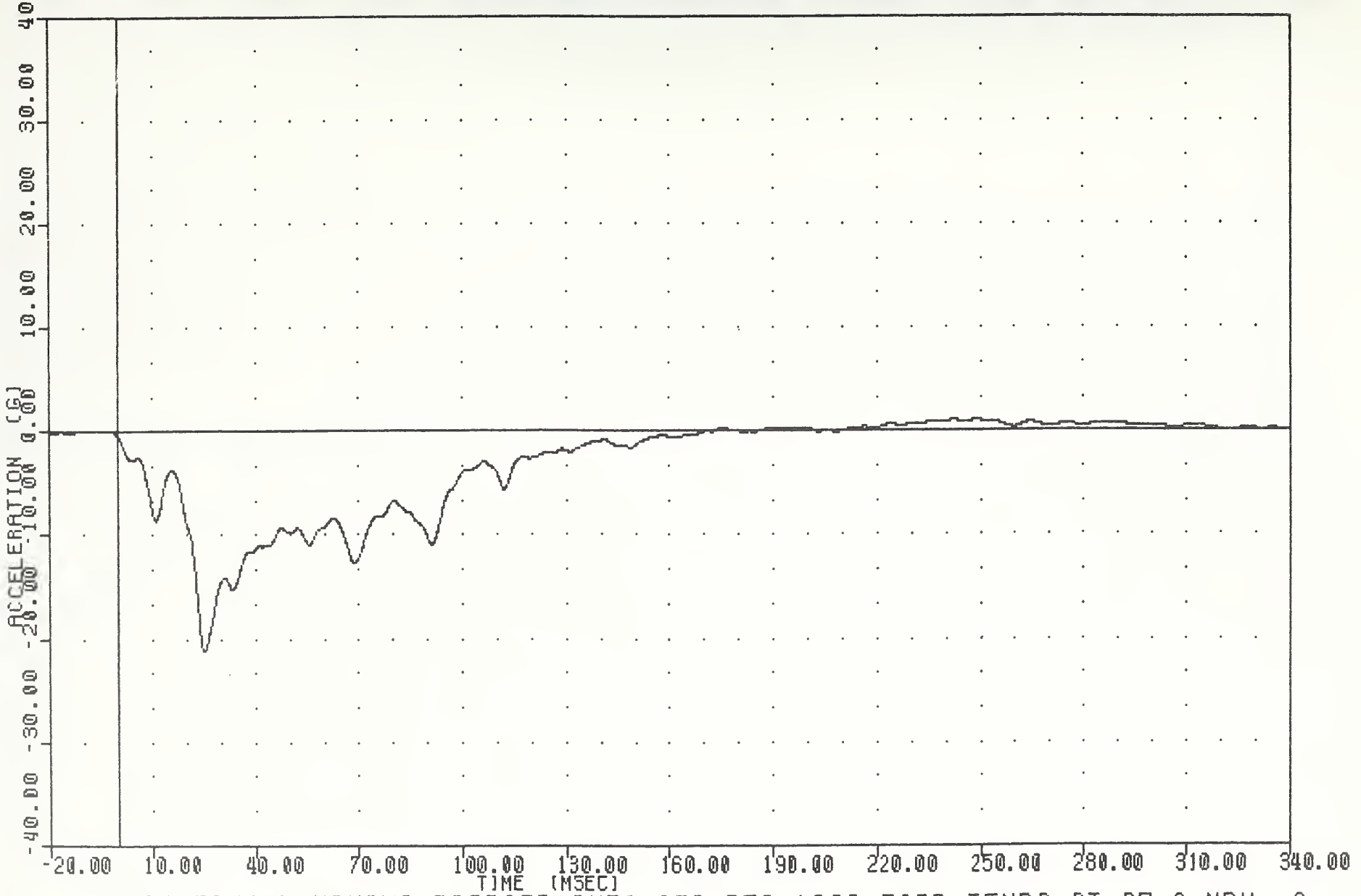
CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.9 MPH #3
VEHICLE RIGHT REAR SILL Y AXIS ACCELERATION

VRTC-3 , 890424-3
CRASH III DAMAGE ALGORITHM
89114 FILTER = ALPF 1650/ 5214/ -40
RRSYV MIN, MAX VALUES = -20.90 @ 226.00 , 0.00 @ 0.13



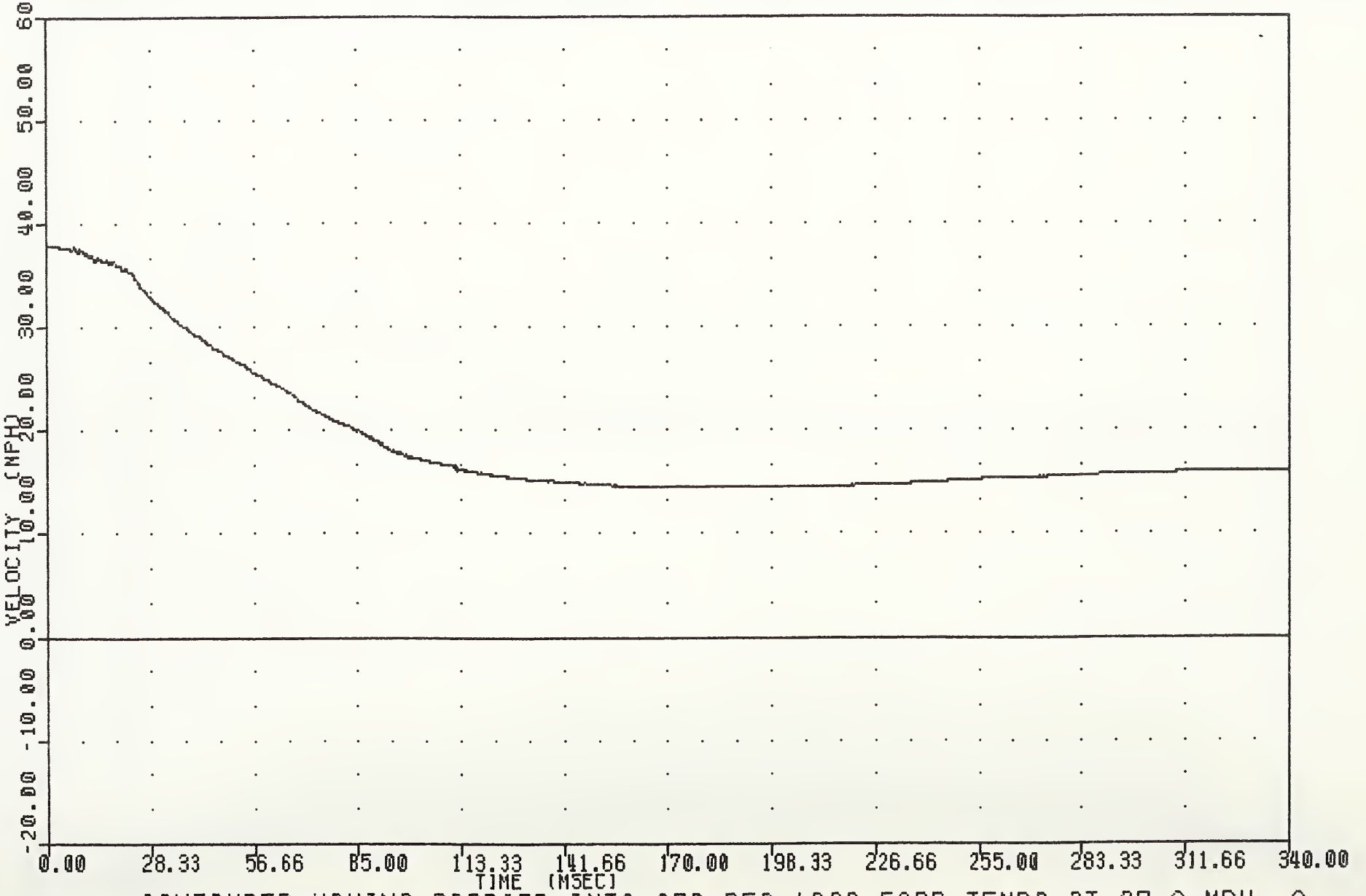
CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.9 MPH #3
VEHICLE RIGHT REAR SILL Y AXIS VELOCITY

YATC-3 , 890424-3
CRASH III DAMAGE ALGORITHN
89114
BCGXG
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -21.24 @ 25.13 , 1.13 @ 249.13



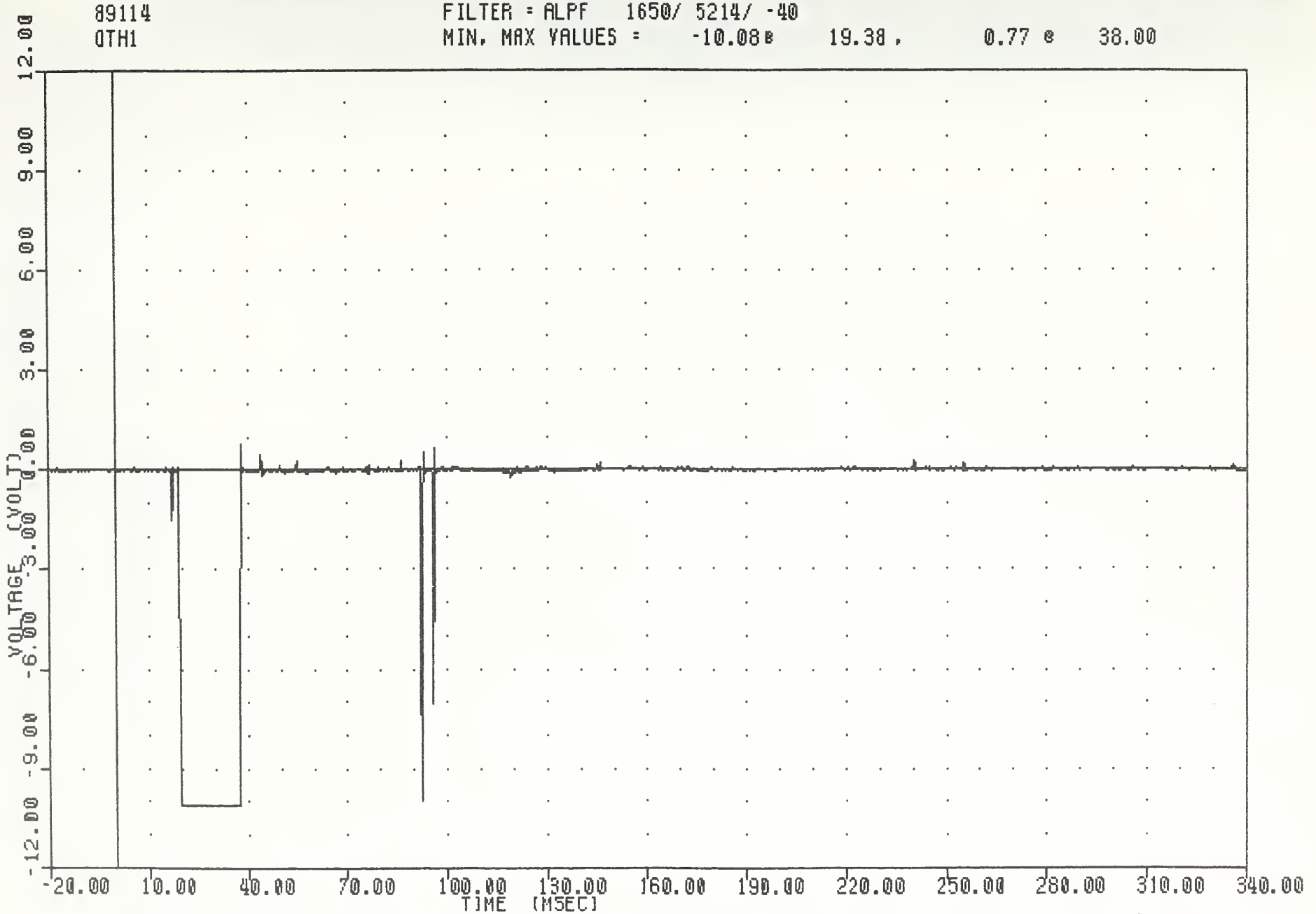
CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.9 MPH #3
CONTOURED MOVING BARRIER CENTER OF GRAVITY X AXIS ACCELERATION

VRTC-3 , 890424-3
CRASH III DAMAGE ALGORITHM
89114 FILTER = ALPF 1650/ 5214/ -40
BCGXV MIN. MAX VALUES = 14.46 @ 188.13 , 37.90 @ 0.25



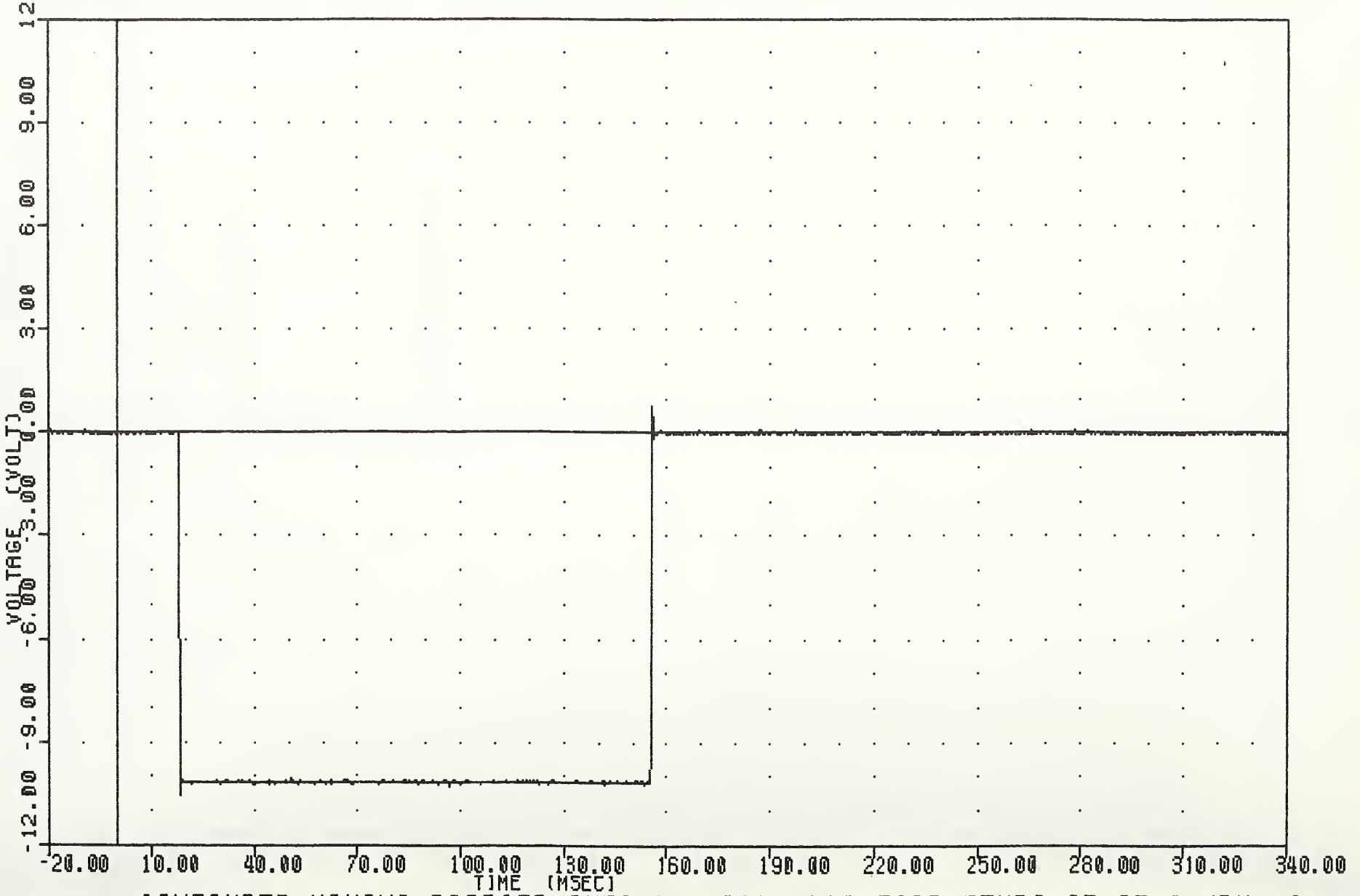
CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.9 MPH #3
CONTOURED MOVING BARRIER CENTER OF GRAVITY X AXIS VELOCITY

VRTC-3 , 890424-3
CRASH III DAMAGE ALGORITHM
89114
OTH1
FILTER = ALPF 1650/ 5214/ -40
MIN, MAX VALUES = -10.08 @ 19.38 , 0.77 @ 38.00

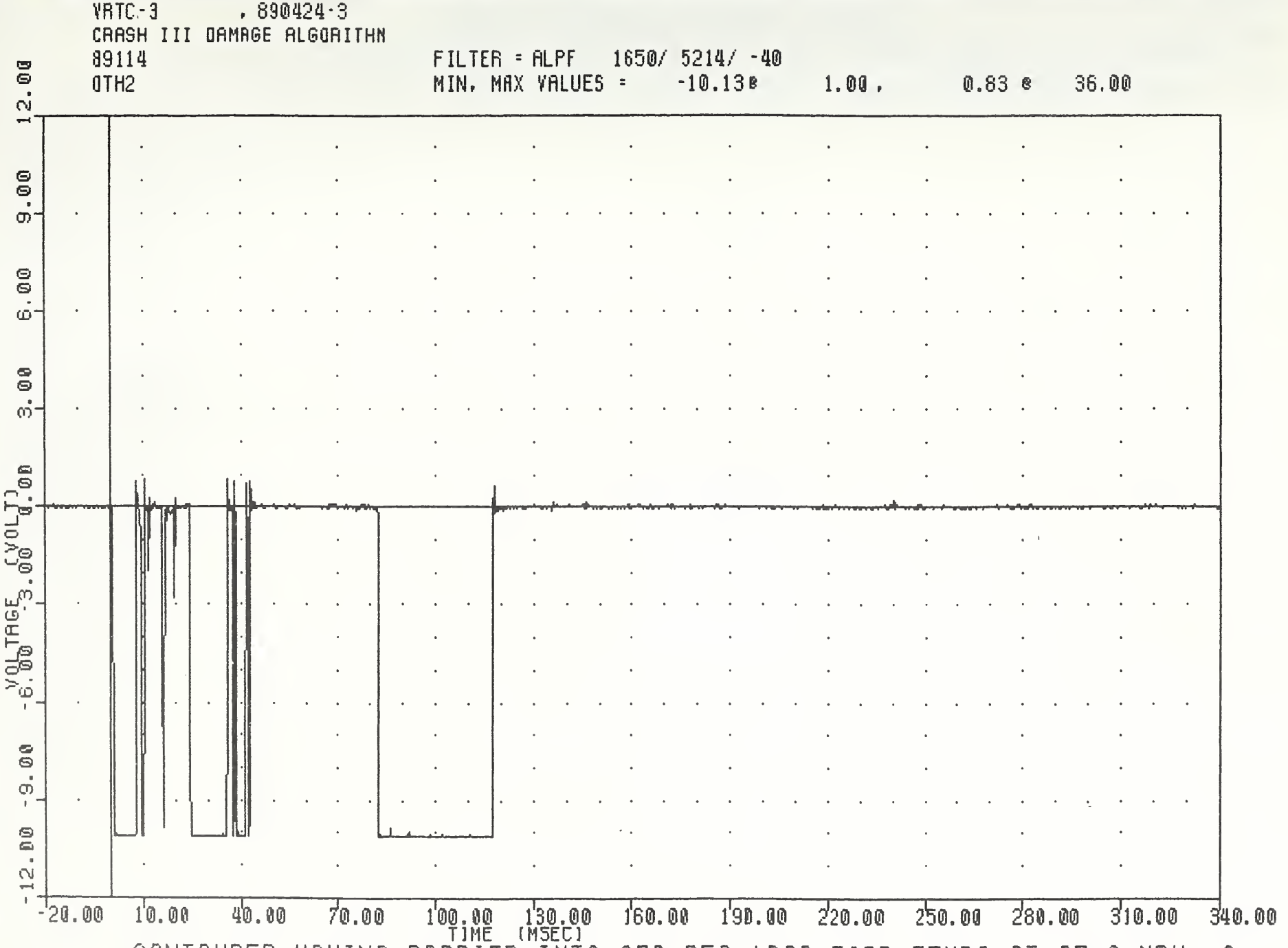


CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.9 MPH #3
VEHICLE CONTACT SWITCH - FRONT

VRTC-3 , 890424-3
CRASH III DAMAGE ALGORITHM
89114 FILTER = ALPF 1650/ 5214/ -40
OTH4 MIN. ,MAX VALUES = -10.55 @ 18.38 , 0.75 @ 155.75

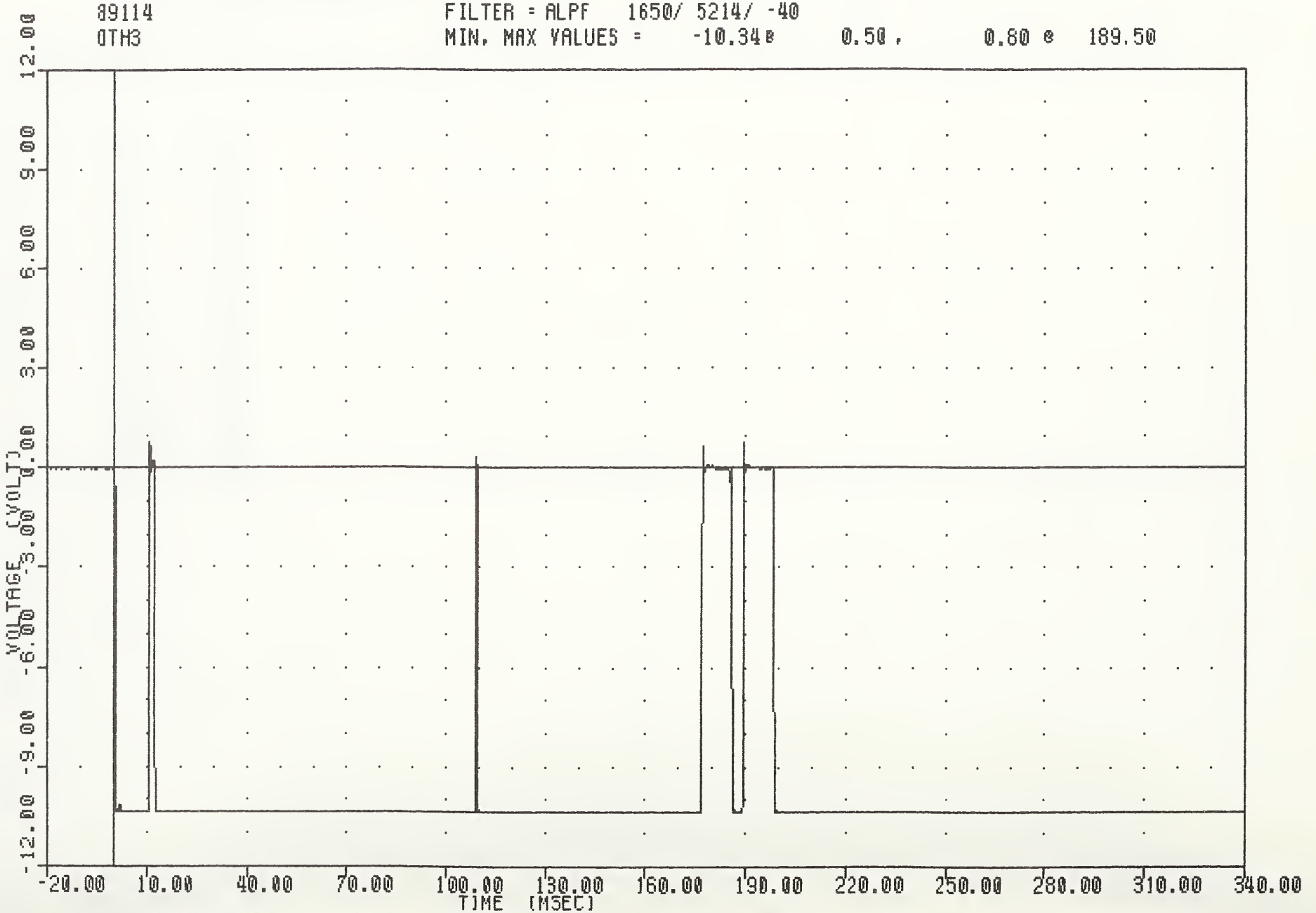


CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.9 MPH #3
BARRIER CONTACT SWITCH - LEFT



CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.9 MPH #3

VEHICLE CONTACT SWITCH - REAR



CONTOURED MOVING BARRIER INTO 270 DEG 1983 FORD TEMPO AT 37.9 MPH #3

BARRIER CONTACT SWITCH - RIGHT