Dynamic Science Report No. 3154-83-040/2098

DOT ØGØ1

AIR BAG FLEET RETROFIT PROGRAM
CRASH TESTS

TEST NO. 3154-1
1982 FORD LTD
4-DOOR SEDAN

Prepared by:

DYNAMIC SCIENCE, INC.
An Exodyne Company
1850 West Pinnacle Peak Road
Phoenix, Arizona 85027

September 1983

TEST REPORT

Prepared for:

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
400 SEVENTH STREET, S.W.
WASHINGTON, D.C. 20590

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Prepared by Rod D. Garn

Approved by Rod Garn

Date 9-19-83

Report Accepted by:

_____

Contract Technical Manager
Office of Vehicle Safety Compliance

_____

Date

TECHNICAL REPORT STANDARD TITLE PAGE

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AIR BAG FLEET RETROFIT PROGRAM CRASH TEST - TEST NO. 3154-1 - 1982 FORD LTD 4-DOOR SEDAN

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United States Department of Transportation
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15. Supplementary Notes

16. Abstract

The objective of this program is to obtain performance data on a driver air bag restraint system retrofitted in police vehicles.

One calibrated 50th percentile Part 572 dummy was utilized to obtain occupant response data relative to FMVSS 208 requirements. Various vehicle mounted accelerometers were utilized to monitor vehicle response to the impact environment. Air bag crash sensor actuation, firing squib current, and diagnostic system power source were electronically monitored throughout the impact event.

This report contains results of all electronic data obtained during frontal barrier crash testing of a 1982 Ford LTD, 4-Door Sedan, at Dynamic Science on September 1, 1983. Impact speed was 29.69 mph.

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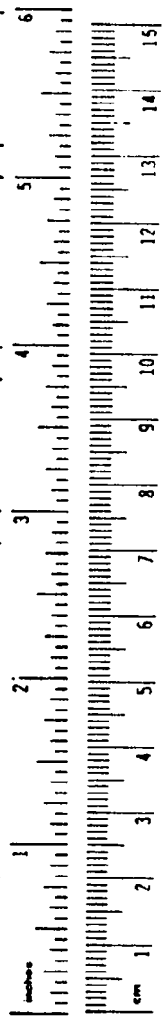
Form DOT F 1700.7 (8-69)

METRIC CONVERSION FACTORS

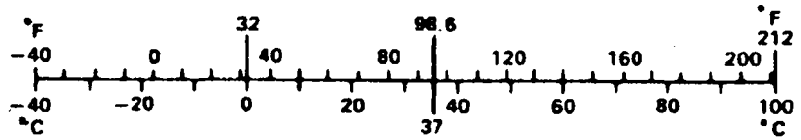
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	metric ton	t
	VOLUME			
tsp	teaspoons	5	milliliters	mL
Tbsp	tablespoons	15	milliliters	mL
in^3	cubic inches	16	milliliters	mL
fl oz	fluid ounces	30	milliliters	mL
c	cups	0.24	liters	L
pt	pints	0.47	liters	L
qt	quarts	0.95	liters	L
gal	gallons	3.8	liters	L
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	degrees Fahrenheit	5/9 (after subtracting 32)	degrees Celsius	°C



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10 000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	metric ton (1000 kg)	1.1	short tons	
	VOLUME			
mL	milliliters	0.03	fluid ounces	fl oz
mL	milliliters	0.06	cubic inches	in^3
L	liters	2.1	pints	pt
L	liters	1.06	quarts	qt
L	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	degrees Celsius	9/5 (then add 32)	degrees Fahrenheit	°F



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1.0 PURPOSE AND TEST PROCEDURE

1.1 PURPOSE

A series of six tests is planned for inclusion in this program; the objective of each being to obtain performance data on a driver air bag restraint system retrofitted into selected police vehicles. Five of the planned tests will be 90° flat frontal barrier impacts, with the remaining test being a 12-inch diameter pole barrier impact.

1.2 TEST PROCEDURE

One complete air bag restraint system, including steering wheel, inflator, air bag, and auxiliary knee bolster will be retrofitted into each candidate vehicle. Installation will be accomplished in conjunction with, and under the direction of, the air bag system development contractor, Romeo Kojyo Company Ltd.

One 50th percentile Part 572 dummy will be utilized in each test to obtain occupant response data relative to FMVSS 208 requirements. Various vehicle mounted accelerometers will be utilized to monitor vehicle response to the impact environment. Air bag crash sensor actuation, firing squib current, and diagnostic system power source will be electronically monitored throughout the impact event.

Actual test procedures utilized will be in general accordance with NHTSA Laboratory Procedure TP-219-02 with modifications and substitutions as directed by the Statement of Work for Contract No. DTNH22-82-A-17148 and the designated NHTSA Contract Technical Monitor.

2.0 REPORT ORGANIZATION

This report contains results of all electronic data obtained during frontal barrier crash testing of a 1982 Ford LTD, 4-Door Sedan, at Dynamic Science, Inc. on September 1, 1983. Impact speed was 29.69 mph.

Summary results are presented in tabulated format in the following data sheets:

- General Test and Vehicle Parameter Data
- Part 572 Dummy In-Vehicle Position Recording Sheet
- Summary of Vehicle Accelerometer Data
- FMVSS 208 Dummy Data Summary
- Camera Locations

Calcomp plots of electronic data from the entire impact event are included in Appendix A. Selected pre- and post-test photographs are presented in Appendix B.

GENERAL TEST AND VEHICLE PARAMETER DATA

PRE-IMPACT DATA

Make/Model: Ford LTD

Body Style: 4-Door Sedan (Police) Model Year 1982

NHTSA No. NA DSI No. 1345 Color: White

DATA FROM CERTIFICATION LABEL

Vehicle Manufacturer: Ford Motor Company of Canada Ltd

Date of Manufacture: March 1982 ; VIN: 2FABP31G9CB157326

GVWR: 5346 lb; GAWR: Front = 2680 lb; Rear = 2716 lb

DATA FROM "RECOMMENDED TIRE PRESSURE" LABEL

Vehicle Capacity:	FRONT	REAR	RECOMMENDED	LOAD RANGE:
Tire Pressure:	32 psi	32 psi	TIRE SIZE: P225/70R15	Standard

Designated Seating: 3 Front 3 Rear 6 Total

Cargo load = 200 lb Is Spare Tire: Space Saver? No

TOTAL =1100 lb Standard Equipment? Yes

Engine: 351 CID V8

Transmission: 4-Speed Automatic Rear Wheel Drive

Date Vehicle Received by Laboratory: 8/23/83 ; Odometer 984

Dealer Name & Address: Furnished by Romeo Kojyo Company Ltd

WEIGHT (LB) OF TEST VEHICLE AS RECEIVED (WITH MAX. FLUIDS) = UDW

Right Front 1186 lb Right Rear = 851 lb

Left Front = 1161 lb Left Rear = 851 lb

TOTAL FRONT WEIGHT = 2347 lb (58 % of Total Vehicle Weight)

TOTAL REAR WEIGHT = 1702 lb (42 % of Total Vehicle Weight)

TOTAL DELV. WEIGHT = 4049 lb

TARGET WEIGHT = UDW + 100 lbs Cargo + 164 lb Dummy = 4313 lb

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND 0 LB CARGO:

Right Front = 1190 lb Right Rear = 943 lb

Left Front = 1215 lb Left Rear = 968 lb

TOTAL FRONT WEIGHT = 2405 lb (56 % of Total Vehicle Weight)

TOTAL REAR WEIGHT = 1911 lb (44 % of Total Vehicle Weight)

TOTAL TEST WEIGHT = 4316 lb

Weight of ballast secured in vehicle trunk area = 0 lb

VEHICLE ATTITUDE: (inches)

	RF	LF	RR	LR
Delivered Attitude:	33.0	33.0	33.0	33.0
Test Attitude:	32.8	32.8	32.4	32.0

REMARKS: Vehicle equipped with driver side air cushion restraint and auxiliary knee bolster. Auxiliary push bumper installed on front of vehicle.

GENERAL TEST AND VEHICLE PARAMETER DATA (CONT)

POST-IMPACT DATA

Type of Test: Frontal (0°) Impact

Date of Test: 9/1/83 Time: 1502 Temperature 106°F

Required Impact Velocity Range: 28.5 to 30.5 mph

Impact Velocity: Primary = 29.69 mph Secondary = NA mph

Distance from the vehicle's front bumper to barrier face entering the vehicle velocity measurement device is 5.0 feet and distance exiting the vehicle velocity measurement device is 1.0 foot.

VEHICLE REBOUND AND CRUSH (in.)

Vehicle Length:	Pre-test =	R	210.0	℄	209.5	L 210.0
	Post-test =	R	188.8	℄	190.3	L 189.0
	Crush =	R	21.2	℄	19.2	L 21.0

Distance from front of test vehicle to point of impact:

R 25.8 ℄ 25.1 L 25.0

VISIBLE DUMMY CONTACT POINTS

	Driver	Passenger
Head	Steering wheel, instrument panel, windshield	
Chest	Steering wheel & hub	
Abdomen	Steering wheel	
Left Knee	Knee bolster	
Right Knee	Knee bolster	

DOOR OPENING	Front		Rear	
	Left	Right	Left	Right
	Difficult	Difficult		

SEAT MOVEMENT				
Seat Back Failure	None	None		
Seat Shift (in.)	None	None		

GLAZING DAMAGE

Backlight/Windshield: Majority of windshield damage (cracking) on driver side due to dummy contact. All other windows intact.

OTHER NOTABLE IMPACT EFFECTS: Steering wheel mounted air bag unit failed to deploy during the impact event.

PART 572 DUMMY IN-VEHICLE POSITION RECORDING SHEET

PRE-IMPACT DATA

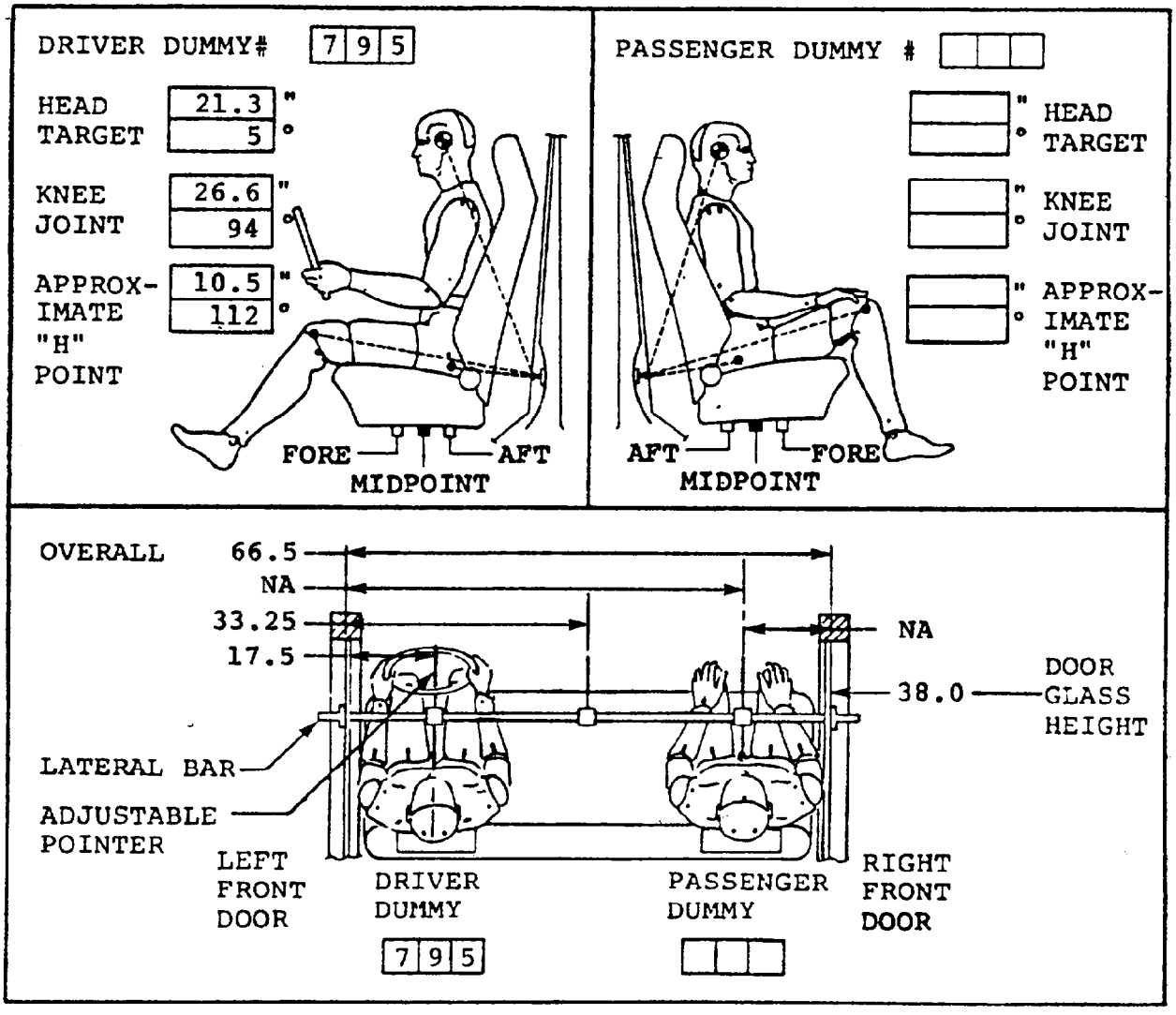
Make/Model: Ford LTD
Body Style: 4-Door Sedan (Police) Model Year: 1982
NHTSA No. NA DSI No. 1345 Color: White

DATA FROM CERTIFICATION LABEL

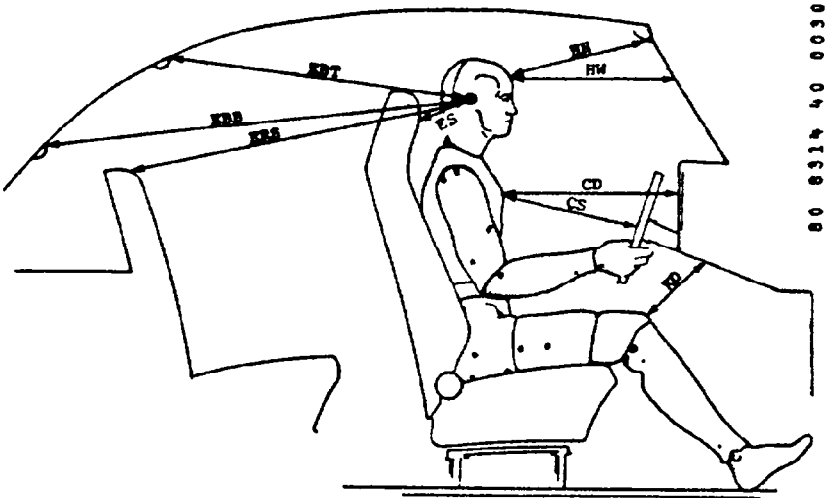
Vehicle Manufacturer: Ford Motor Company of Canada Ltd
Date of Manufacture: 3/82 ; VIN: 2FABP31G9CB157326
GVWR: 5346 lb; GAWR: Front = 2680 lb; Rear = 2716 lb

POST-IMPACT DATA

Type of Test: Frontal (0°) Impact
Date of Test: 9/1/83 Time: 1502 Temperature 106 °F
Required Impact Velocity Range: 28.5 to 30.5 mph
Impact Velocity: Primary = 29.69 mph Secondary = NA mph
Seat Type: Split back bench Adjuster Type: 10 position manual
Bucket Seat Type Back: Low back with adjustable head rest
Technicians: R. Garn, D. Romeo



PART 572 DUMMY IN-VEHICLE POSITION RECORDING SHEET



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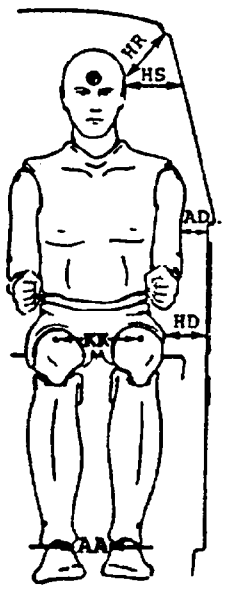
	Driver	Passenger
HH	12.75	
HW	18.5	
CD	20.25	
CS	9.25	
KD L	4.75	
KD R	4.5	
Torso Angle	26°	Torso Angle °
Seat Back Angle	25°	Seat Back Angle °

HH = Head to Windshield Header
HW = Head to Windshield
CD = Chest to Dash
CS = Chest to Steering Wheel
KD = Knees to Dash
HR = Head to Side Roof
HS = Head to Side Window
AD = Arm to Door
HD = Hip to Door
KK - Knee to Knee
Torso and seat back angles are relative to vertical.

REMARKS: Dummies positioned according to OVSC recommended procedure for positioning Part 572 dummies in test vehicle.



80 8314 40 00303

	Driver	Passenger
HR	5.25	
HS	8.5	
AD	5.5	
HD	8.5	
KK	9.0	
AA	7.0	

SUMMARY OF VEHICLE ACCELEROMETER DATA

Vehicle: 1982 Ford LTD 4-Door Sedan Test Date: 9/1/83

Test No.: 3154-1 Test Speed: 29.69 mph

Accelerometer		Maximum Acceleration				
No.	Location	Scale	+A (g)	T (msec)	-A (g)	T (msec)
1X	Left front air bag sensor	±250g	98.3	33.4	104.6	37.3
1Y	Left front air bag sensor	±250g	49.1	28.5	50.7	33.9
1Z	Left front air bag sensor	±250g	219.3	70.3	91.6	45.4
2X	Right front air bag sensor	±250g	119.3	33.0	176.0	38.3
2Y	Right front air bag sensor	±250g	30.9	55.5	50.5	38.0
2Z	Right front air bag sensor	±250g	38.1	24.1	56.6	29.6
3X	Diagnostic module	±250g	28.4	89.9	69.2	86.0
3Y	Diagnostic module	±250g	21.9	68.3	19.8	52.4
3Z	Diagnostic module	±250g	35.4	90.4	34.2	86.1
4X	Driver side B-pillar	±250g	2.2	160.4	31.7	31.1
4Y	Driver side B-pillar	±250g	6.5	36.3	6.6	91.8
4Z	Driver side B-pillar	±250g	27.0	46.1	15.0	78.1

ΔV = 33.8 mph @ 140.9 msec

Positive Direction: X = Forward, Y = Rightward, Z = Downward

FMVSS 208 DUMMY DATA SUMMARY

	Driver Dummy				Passenger Dummy			
	Positive Direction*		Negative Direction**		Positive Direction*		Negative Direction**	
	Peak (G)	Time (msec)	Peak (G)	Time (msec)	Peak (G)	Time (msec)	Peak (G)	Time (msec)
Head Acceleration								
Longitudinal	22.6	104.6	85.0	102.0				
Lateral	23.6	101.6	53.4	102.0				
Vertical	63.3	117.9	16.6	102.4				
Resultant	103.9	102.0						
HIC	821.3 between 84.9 and 139.6 msec							
Chest Acceleration								
Longitudinal	4.5	268.4	57.5	88.0				
Lateral	6.8	117.8	4.5	95.1				
Vertical	18.0	114.4	2.6	126.9				
Resultant (Max)	58.2	88.0						
Resultant (clip)	53.8	-						
TIME > 60 G	0 msec							
SEVERITY INDEX	369.9 @ 320 msec							
	Peak (lb)	Time (msec)	Peak (lb)	Time (msec)	Peak (lb)	Time (msec)	Peak (lb)	Time (msec)
Femur Loads								
Left	63.4	129.5	1447.7	85.0				
Right	76.9	131.5	1484.3	84.0				
Belt Loads								
Lap	Not instrumented							
Torso								

Vehicle Impact Speed (mph): 29.69

ΔV = 33.8 mph

*Longitudinal:	Forward	**Longitudinal:	Rearward
Lateral:	Rightward	Lateral:	Leftward
Vertical:	Downward	Vertical:	Upward

CAMERA LOCATIONS

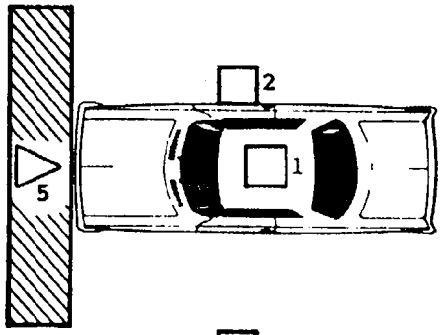
Test No: 3154-1 **Test Date:** 9/1/83

Test Type: 90° Frontal Barrier

Vehicle A: 1982 Ford LTD 4-Door Sedan

Vehicle B

Comments: Air Bag Test



CAMERA	YES
STILLS	
SLIDES	
MOVIE	
POLAROID	
VIDEO	

CAMERA SYMBOLS

- PIT
- GROUND
- BARRIER
- OVERHEAD
- ON-BOARD
- PANNING

FRAME RATE

1. 1000 fr/sec
2. 200 fr/sec
3. Other 24 fr/sec
4. 400 fr/sec
5. 500 fr/sec

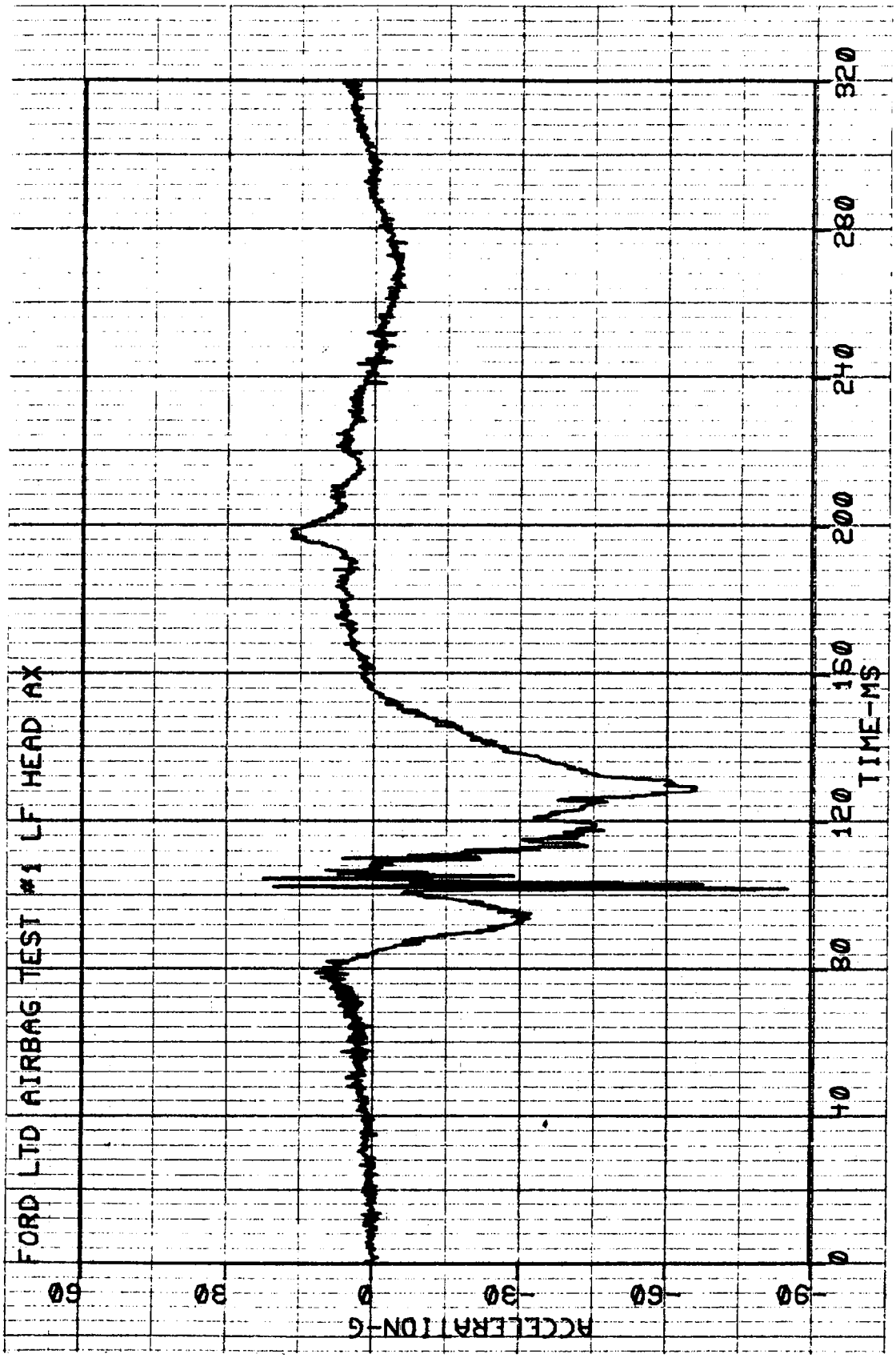
TIMING LIGHT SPEED

1. 100 Hz (10 msec/light)
2. 200 Hz (5 msec/light)
3. Other _____

Loc. No.	Location	Field of View	Lens Size	Frm Rate	Tmng Spd	Ser No	Impact Dist-X	C.L. Dist-Y	CAM Hght-Z
1	On-board vehicle roof	Over driver shoulder - view dummy & air bag	8	4	-	7	NA	NA	NA
2	On-board pass. door	90° view of dummy & air bag deployment	8	4	-	6	NA	NA	NA
3	Left side ground-base	Close-up of dummy through window	16	4	-	M7	11'	9'	6'8"
4	Left side ground-base	Overall of vehicle throughout impact event	16	4	-	M3	9'	36'4"	5'
5	Barrier overhead	View air bag deployment through windshield	10	4	-	M9	-1'	0	9'
6	Ground-based panning	Overall of vehicle throughout impact event	Var.	3	-	-	-	-	-

APPENDIX A

CALCOMP PLOTS OF ELECTRONIC DATA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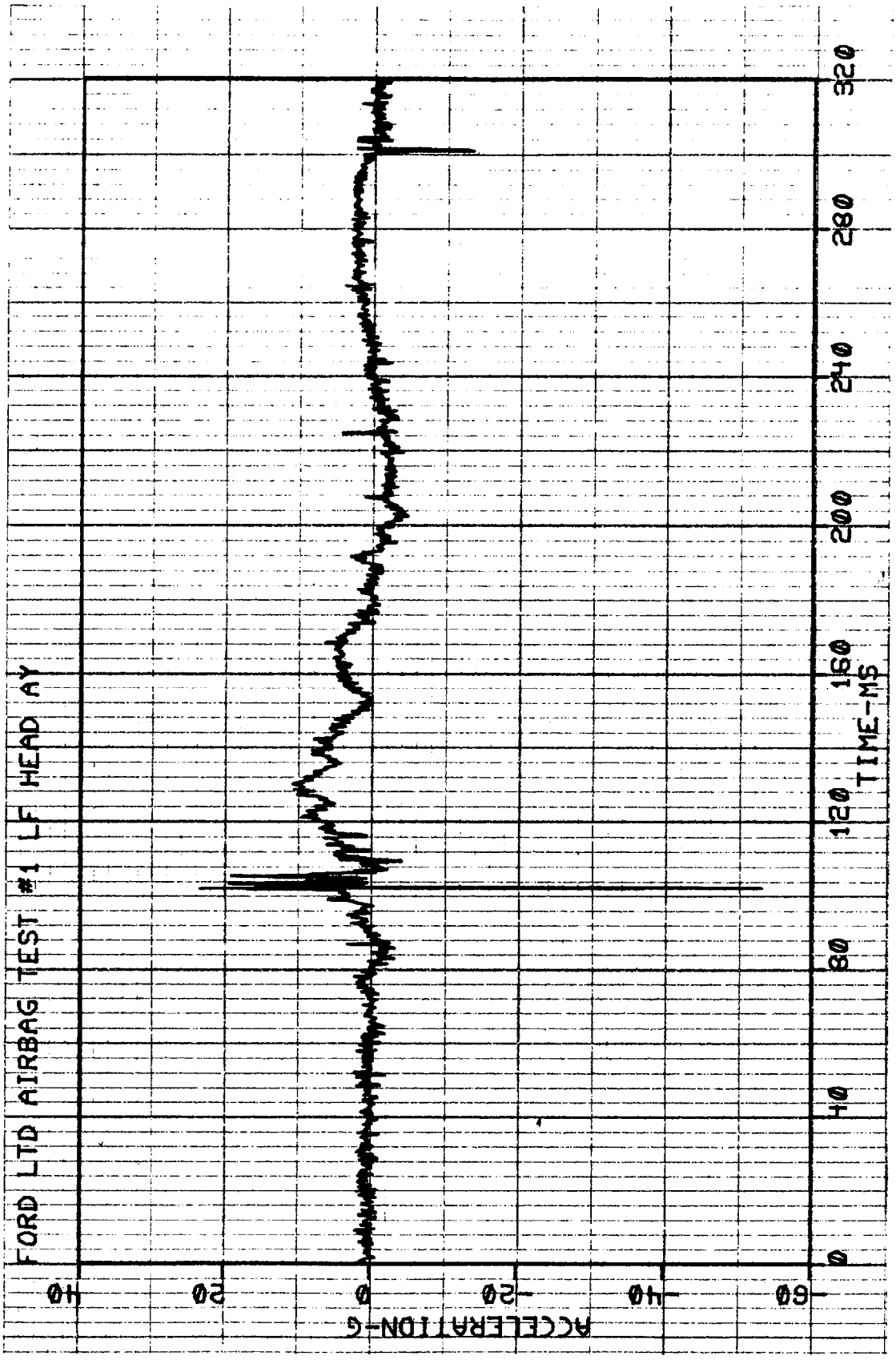
TIME-MS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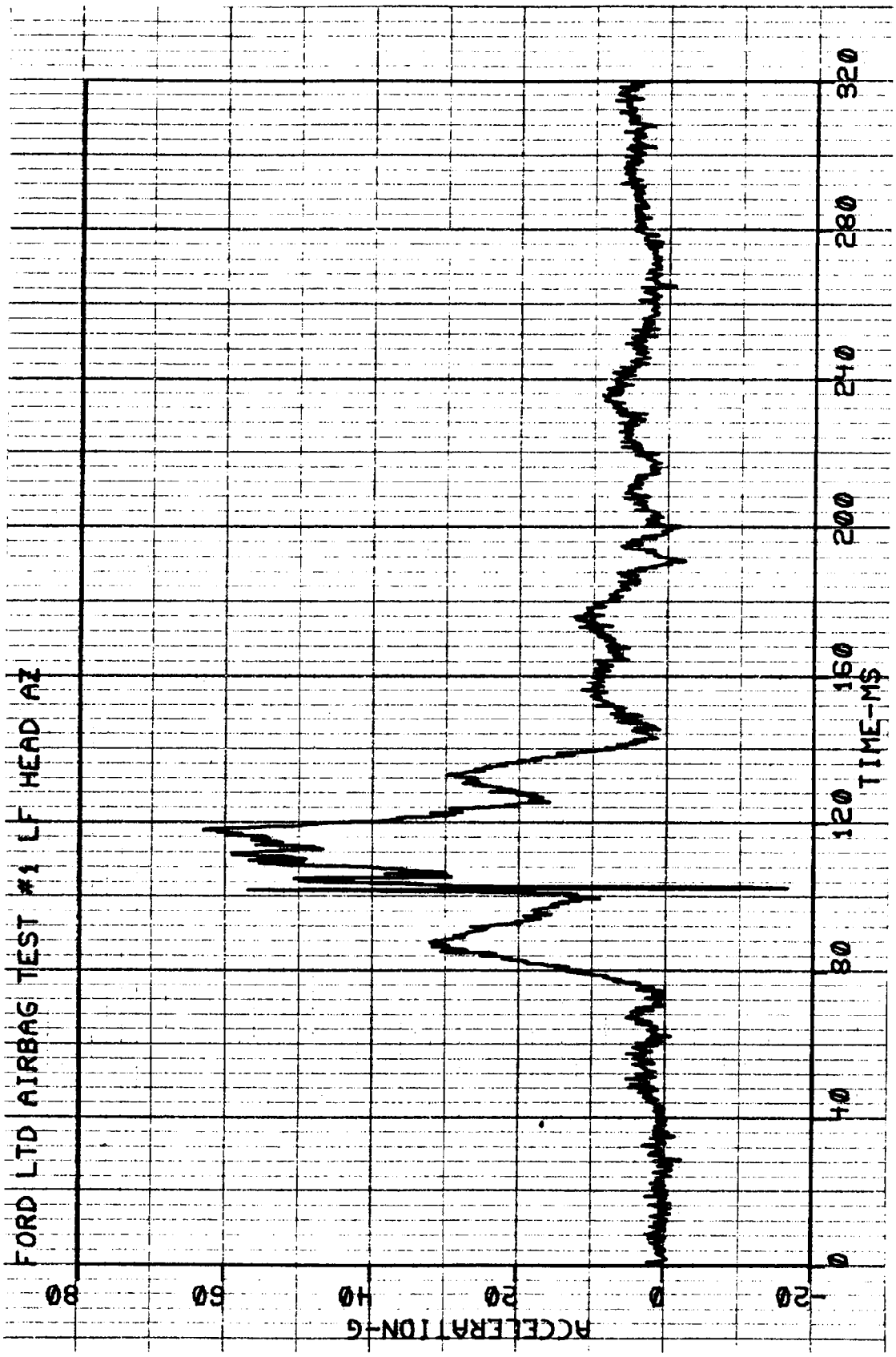
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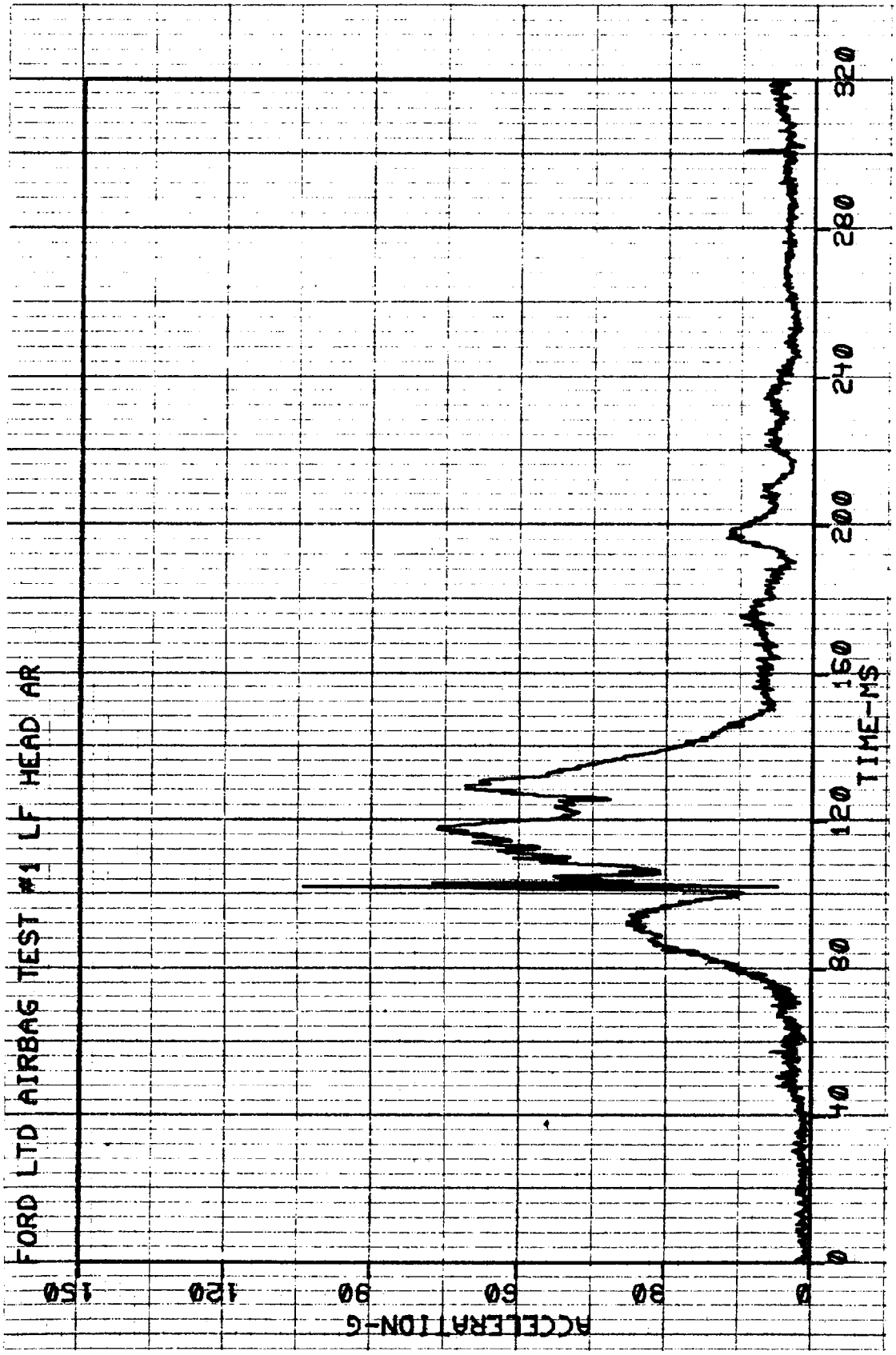
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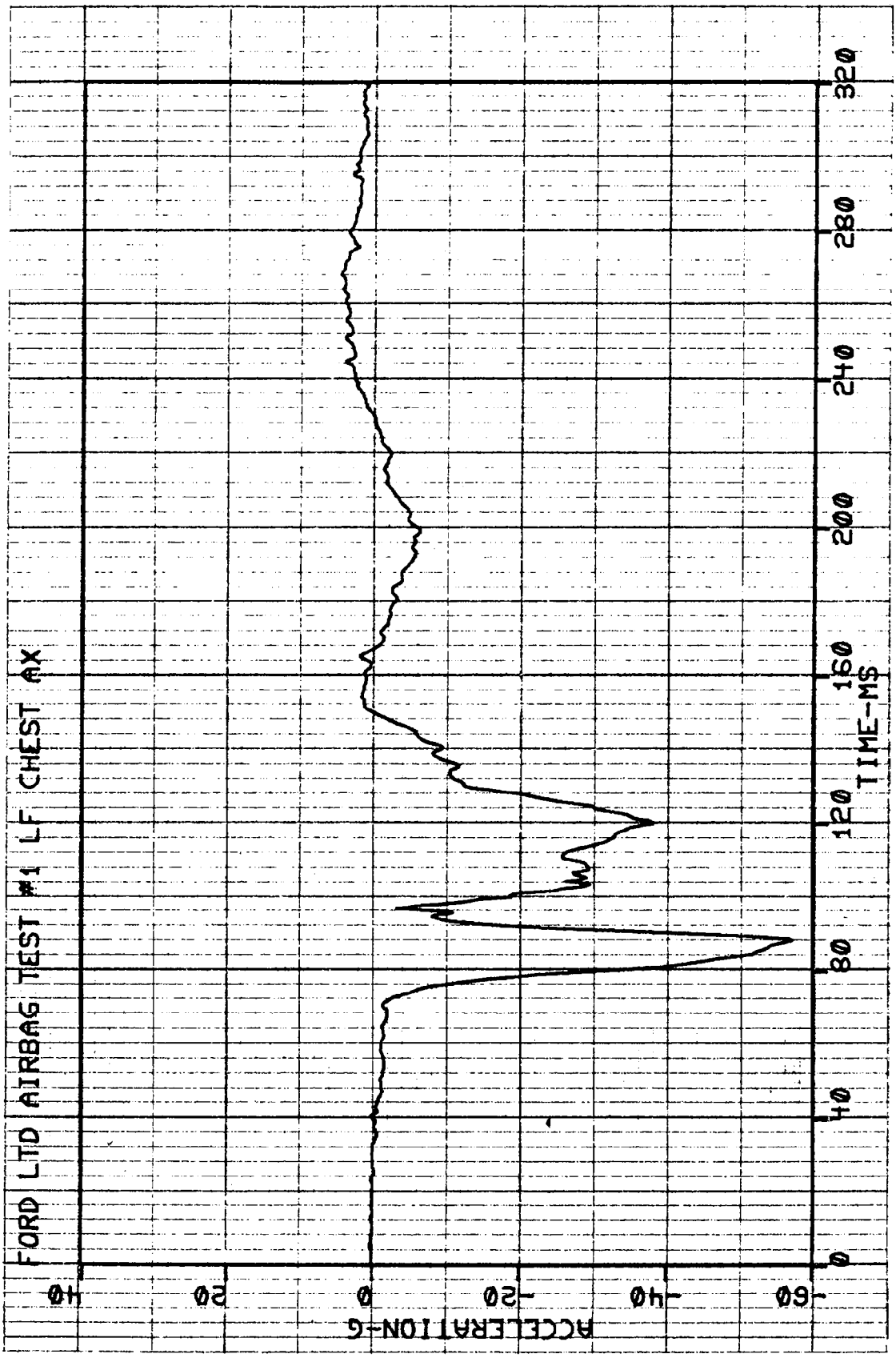
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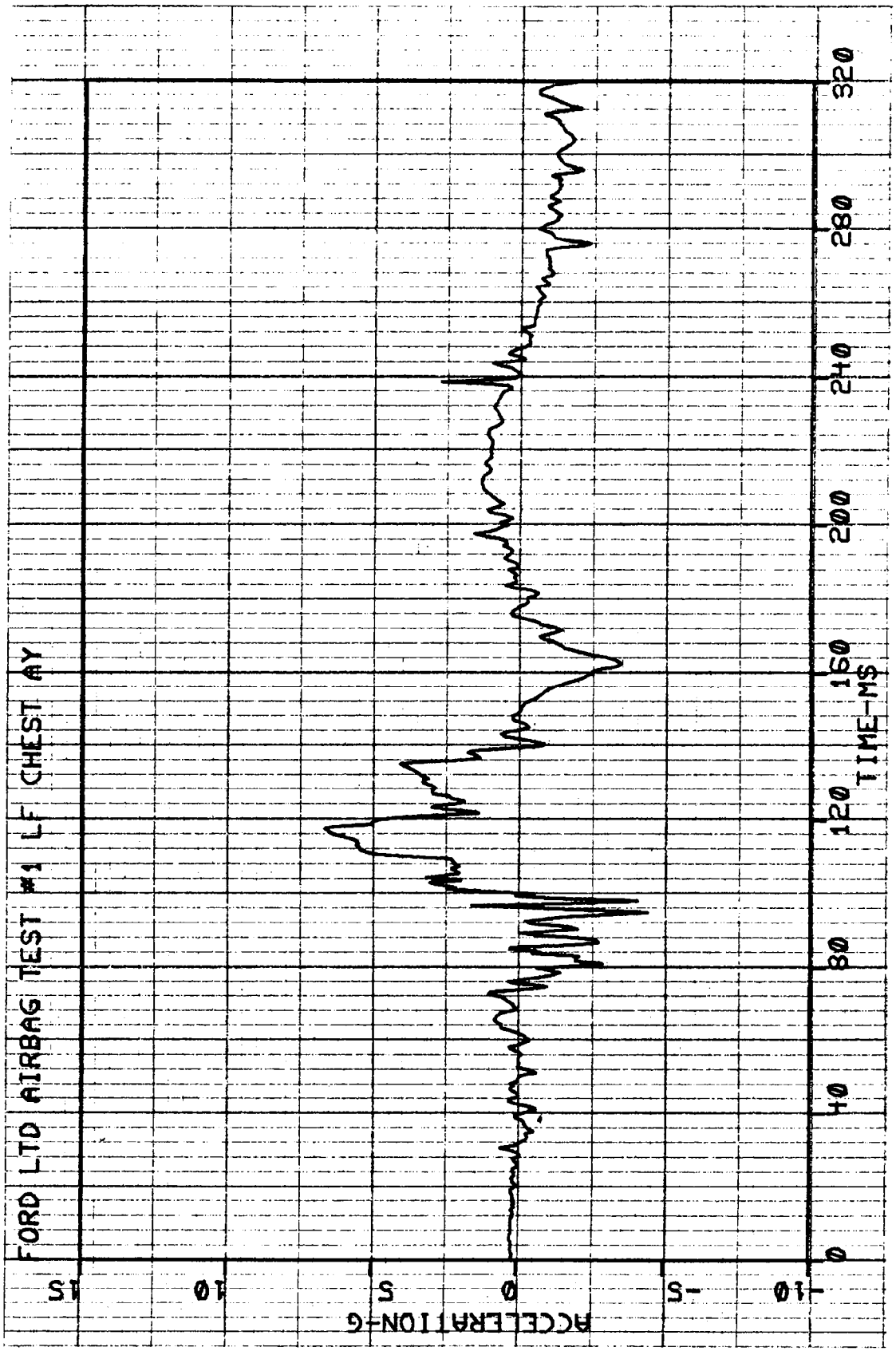
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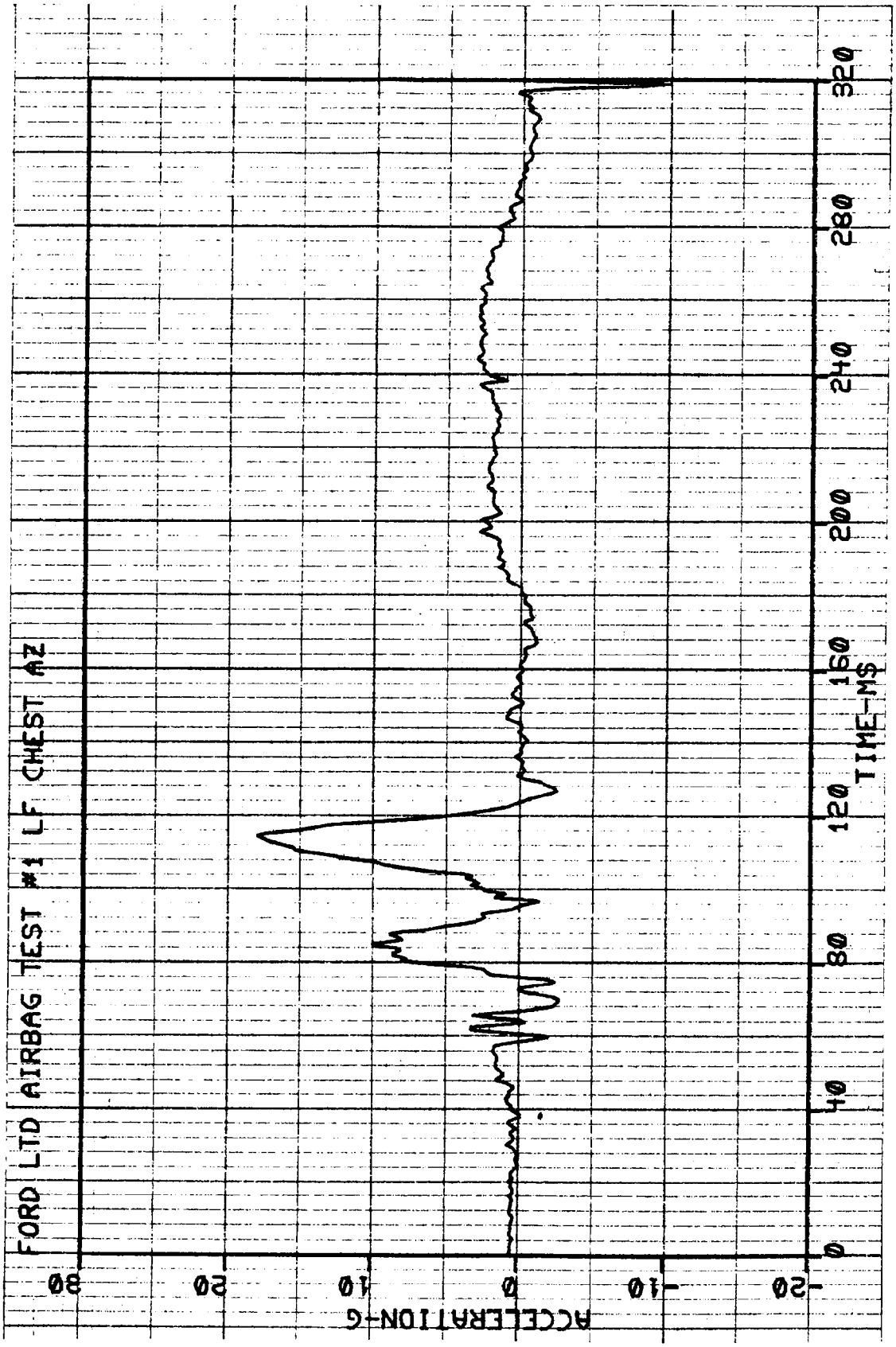
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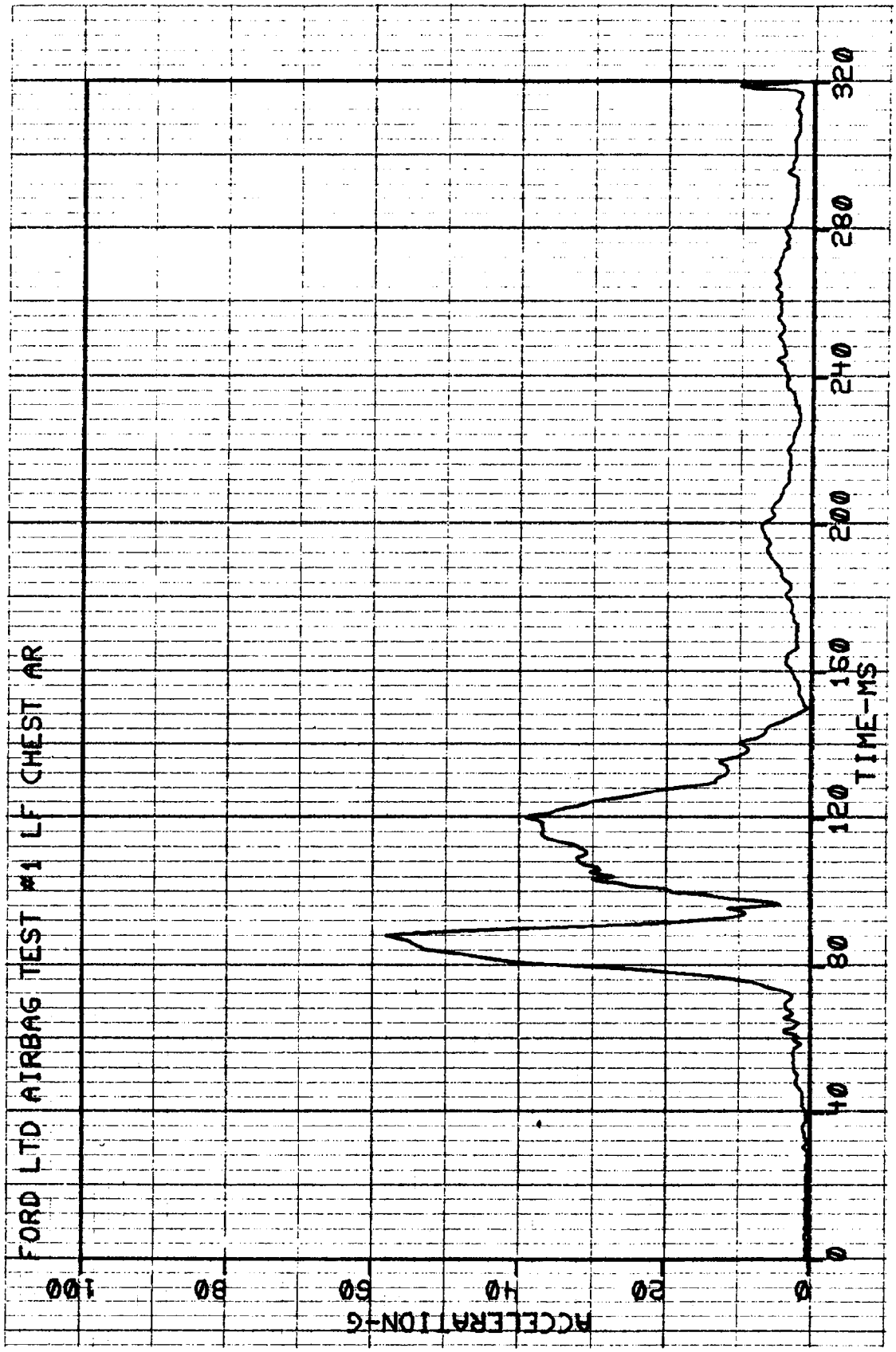
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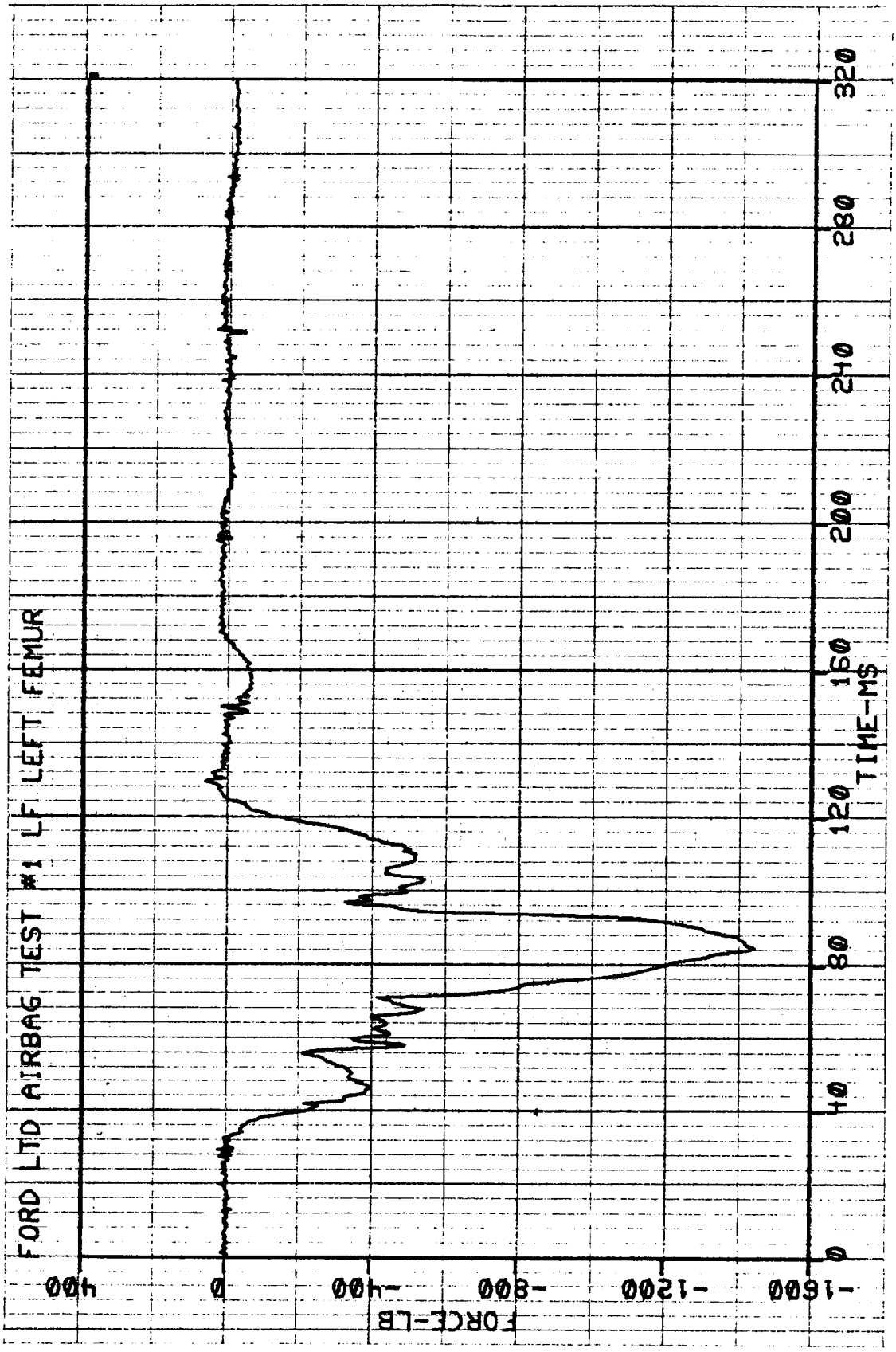
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FORCE-LB
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-400
-800
-1200
-1600
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40
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120
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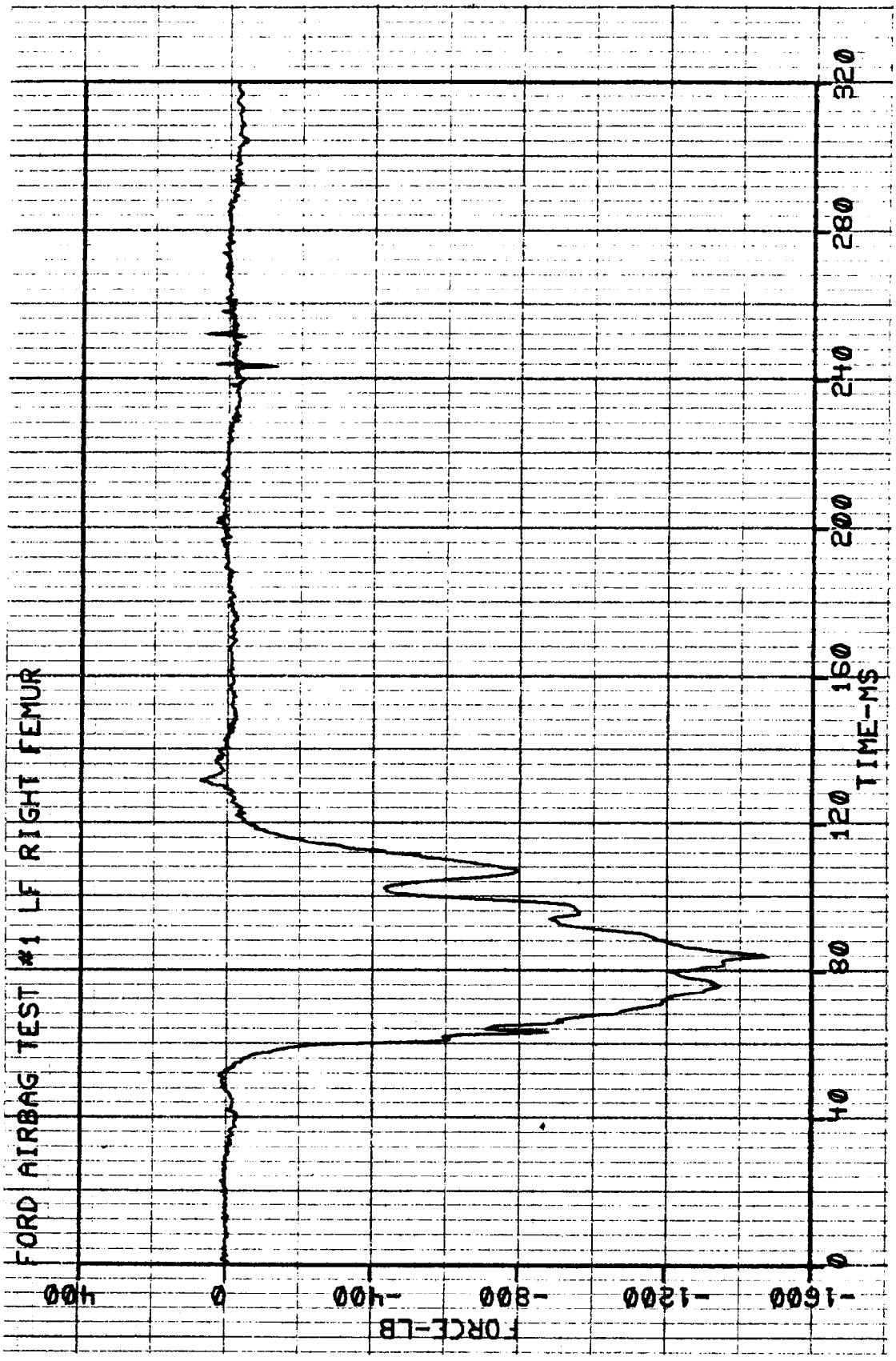
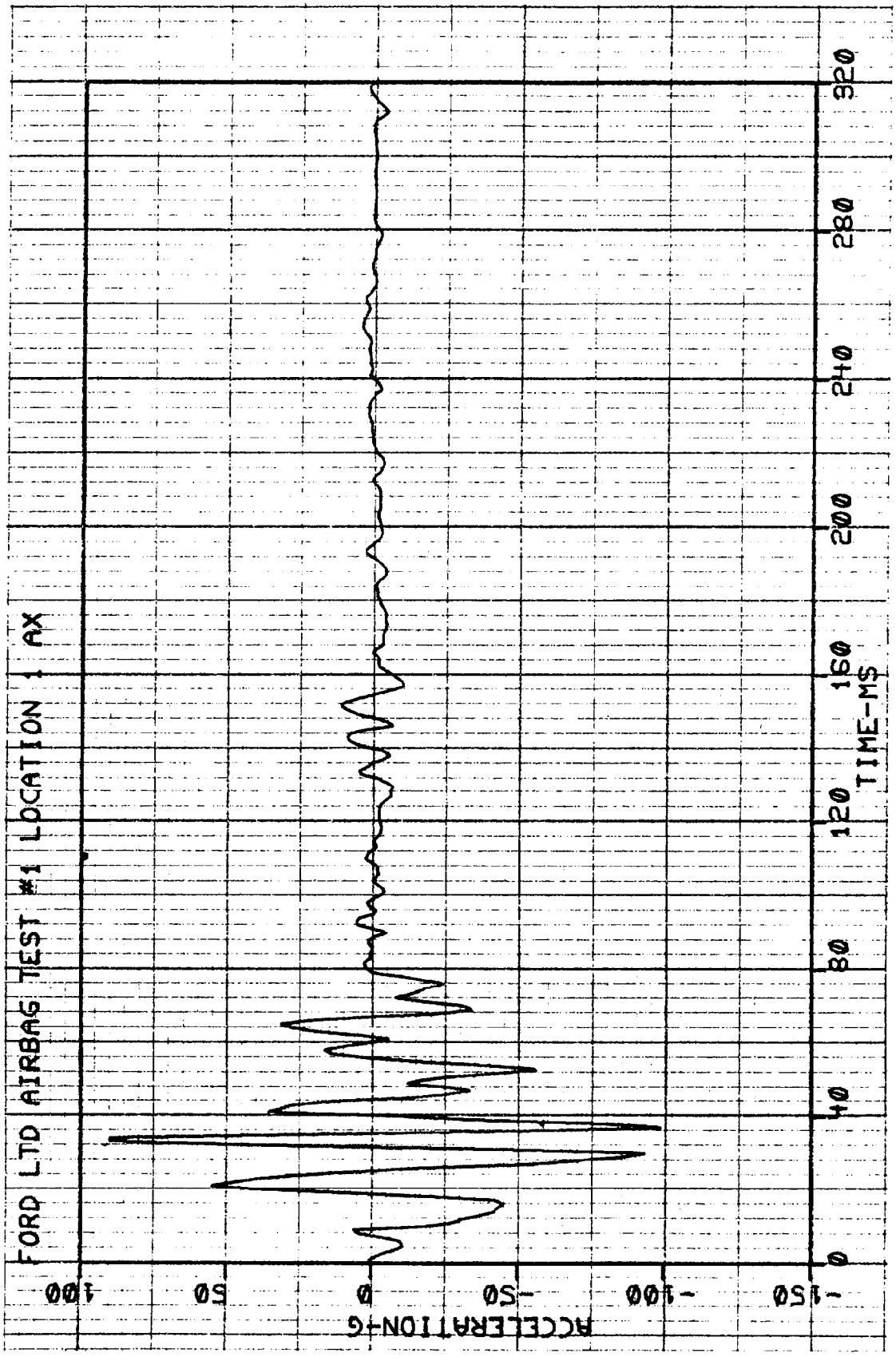
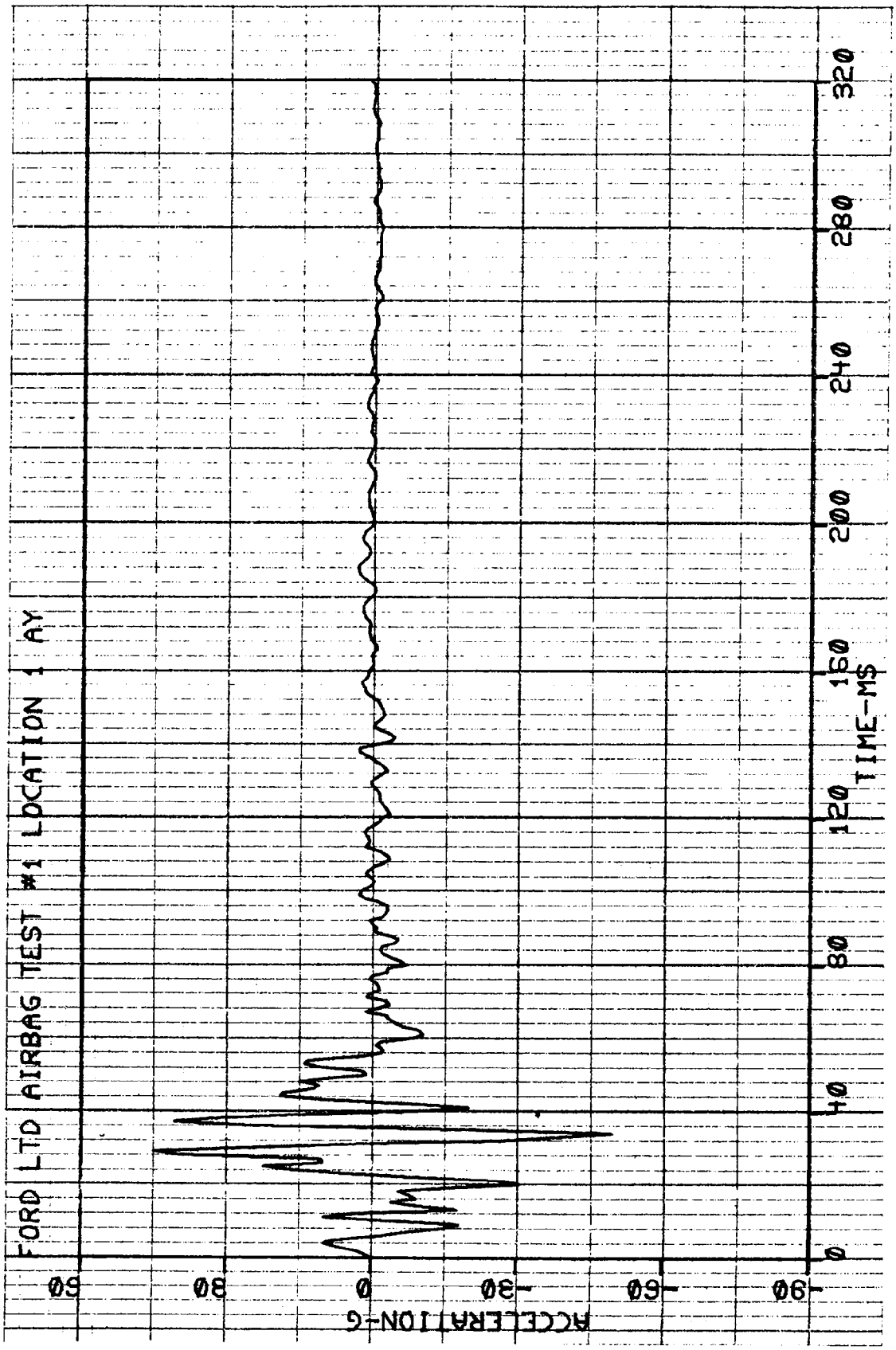
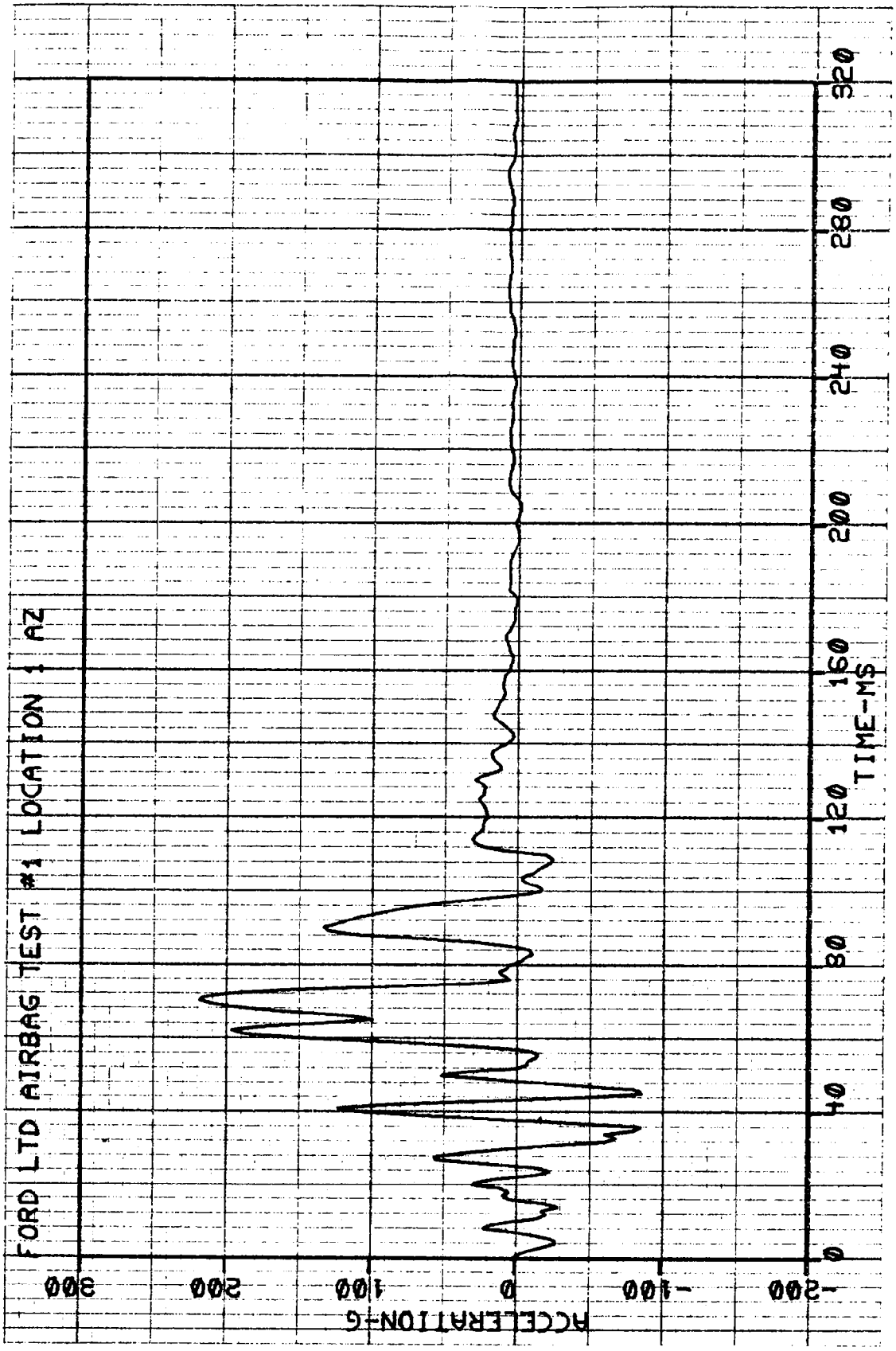
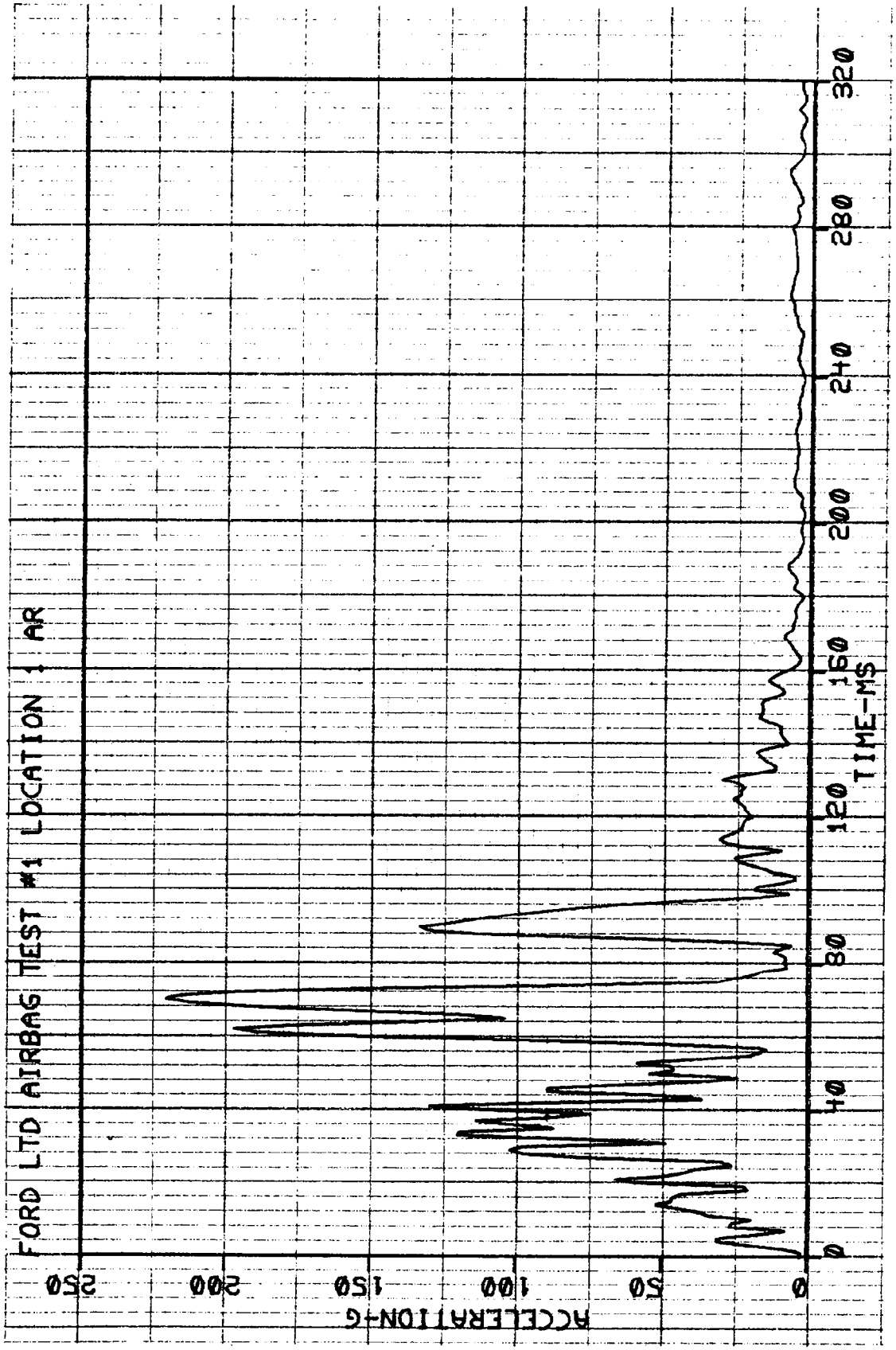
200
240
280
320

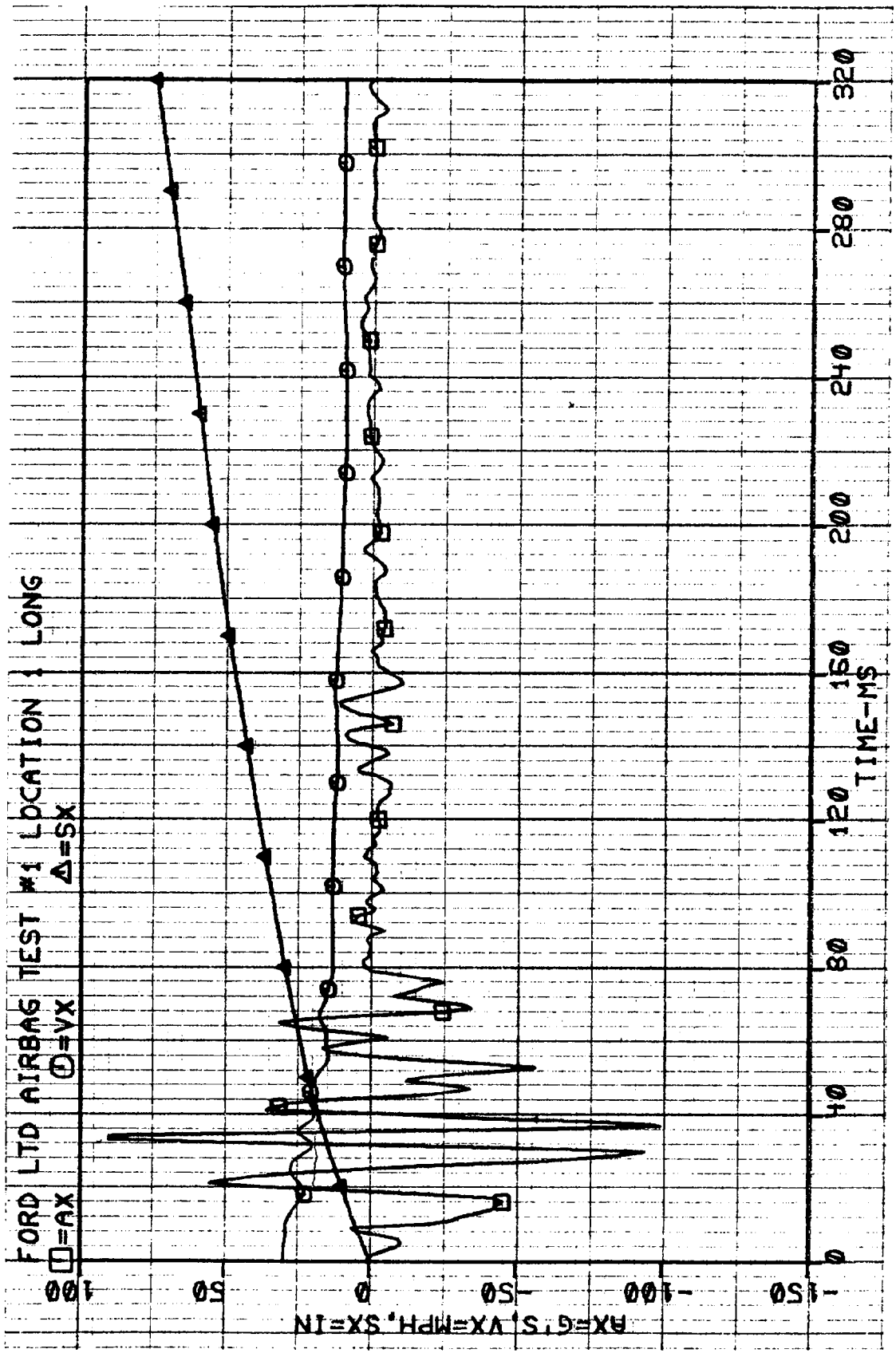

FORD AIRBAG TEST #1 LF RIGHT FEMUR
FORCE-LB
400
0
-400
-800
-1200
-1600
0
40
80
120
160
200
240
280
320
TIME-MS

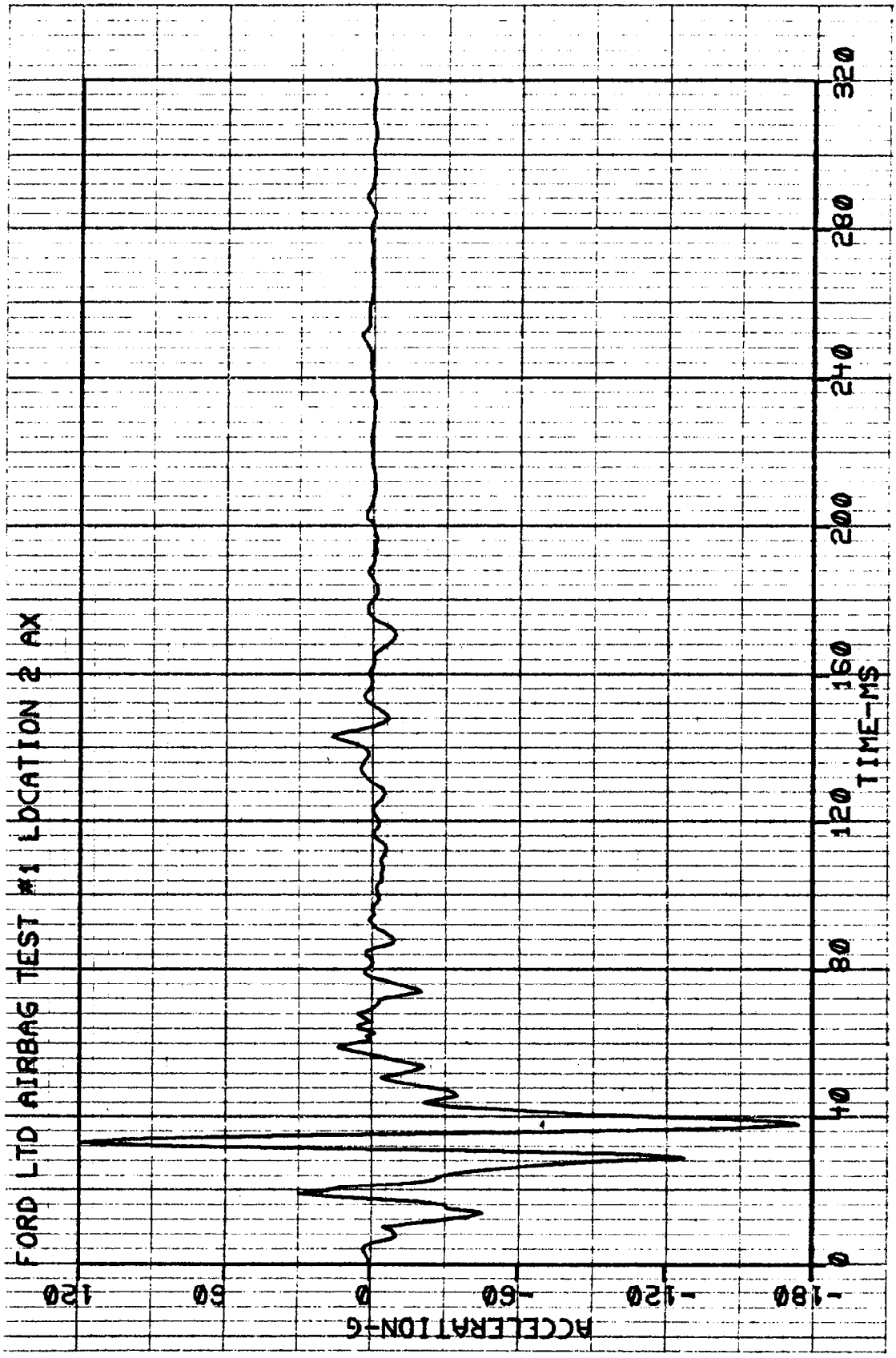

FORD LTD AIRBAG TEST #1 LOCATION 1 AX
ACCELERATION-G
100
50
0
-50
-100
-150
0
40
80
120
160
200
240
280
320
TIME-MS

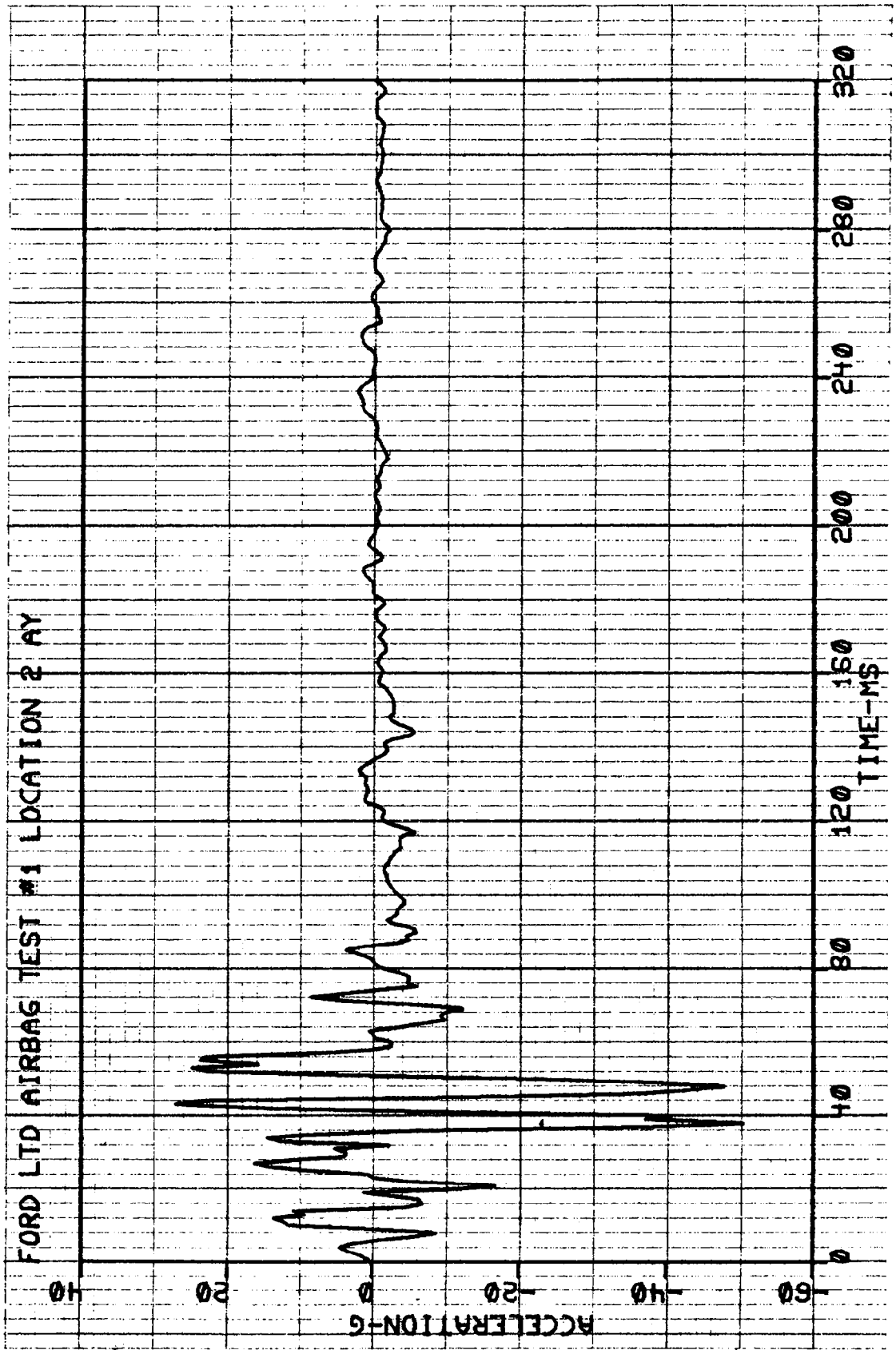

FORD LTD AIRBAG TEST #1 LOCATION 1 AY
ACCELERATION-G
TIME-MS
60
30
0
-30
-60
-90
0
40
80
120
160
200
240
280
320

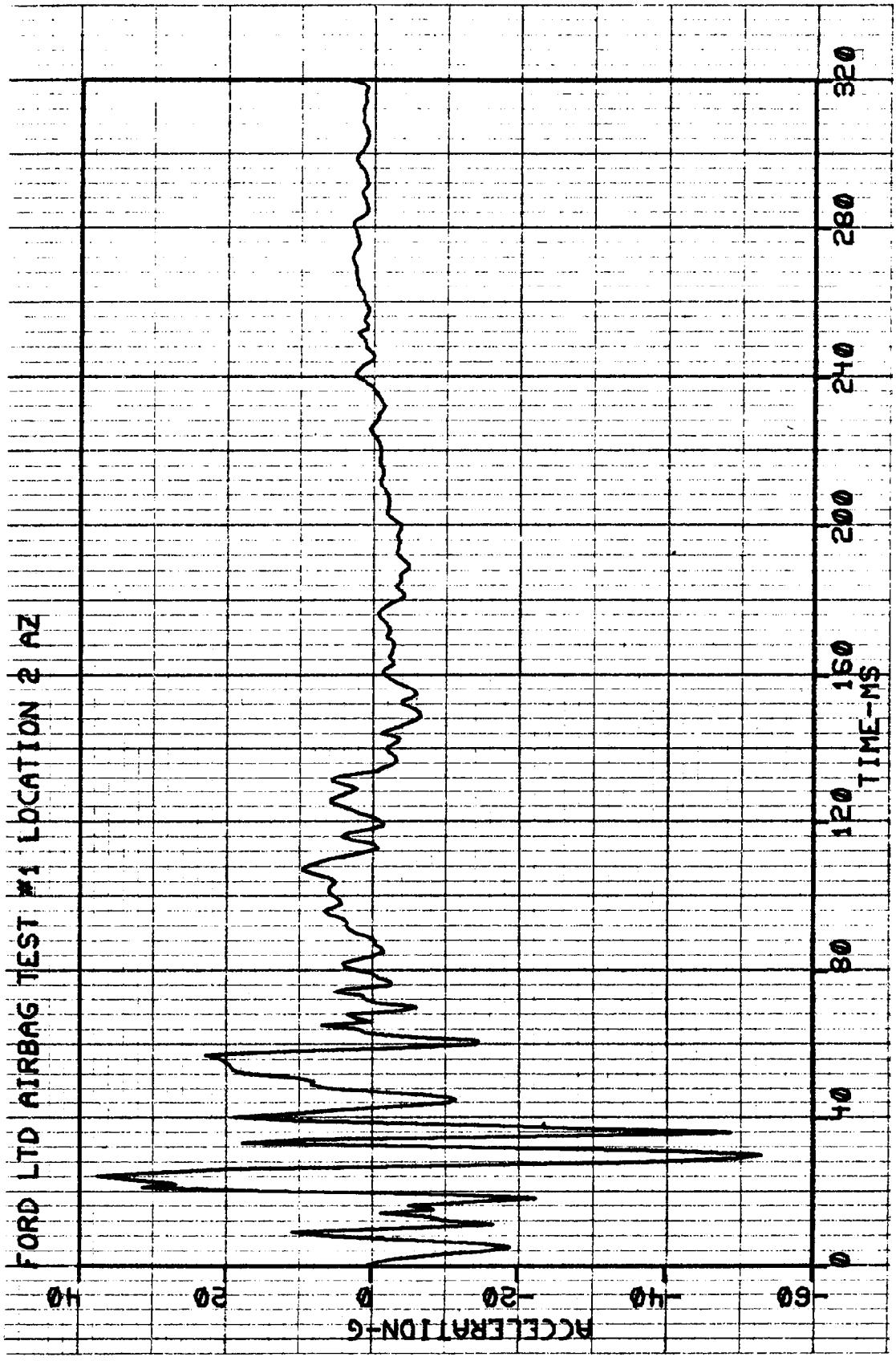

FORD LTD AIRBAG TEST #1 LOCATION 1 AZ
ACCELERATION-G
300
200
100
0
-100
-200
0
40
80
120
160
200
240
280
320
TIME-MS

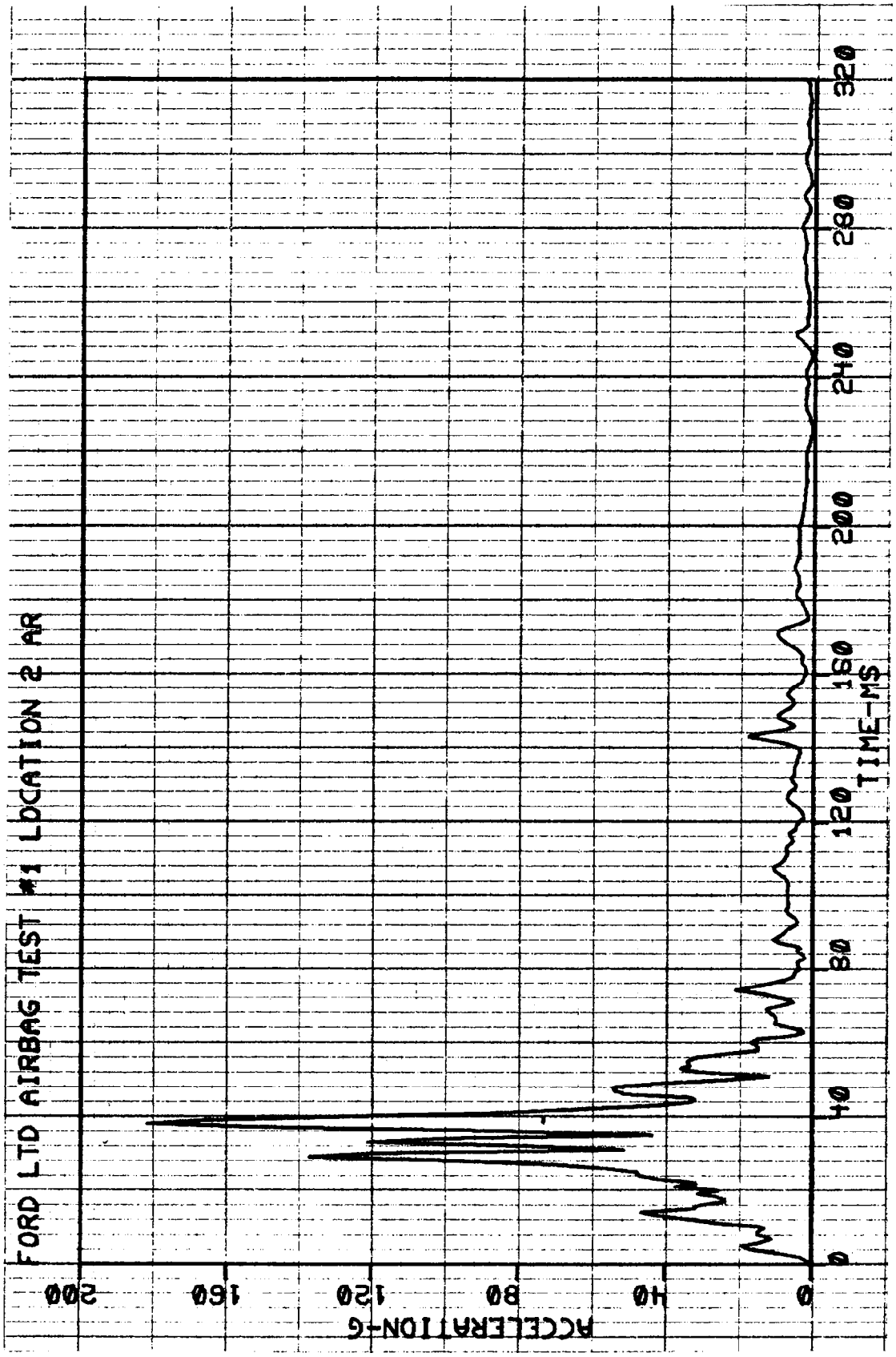

FORD LTD AIRBAG TEST #1 LOCATION 1 AR
ACCELERATION-G
0
50
100
150
200
250
TIME-MS
0
40
80
120
160
200
240
280
320

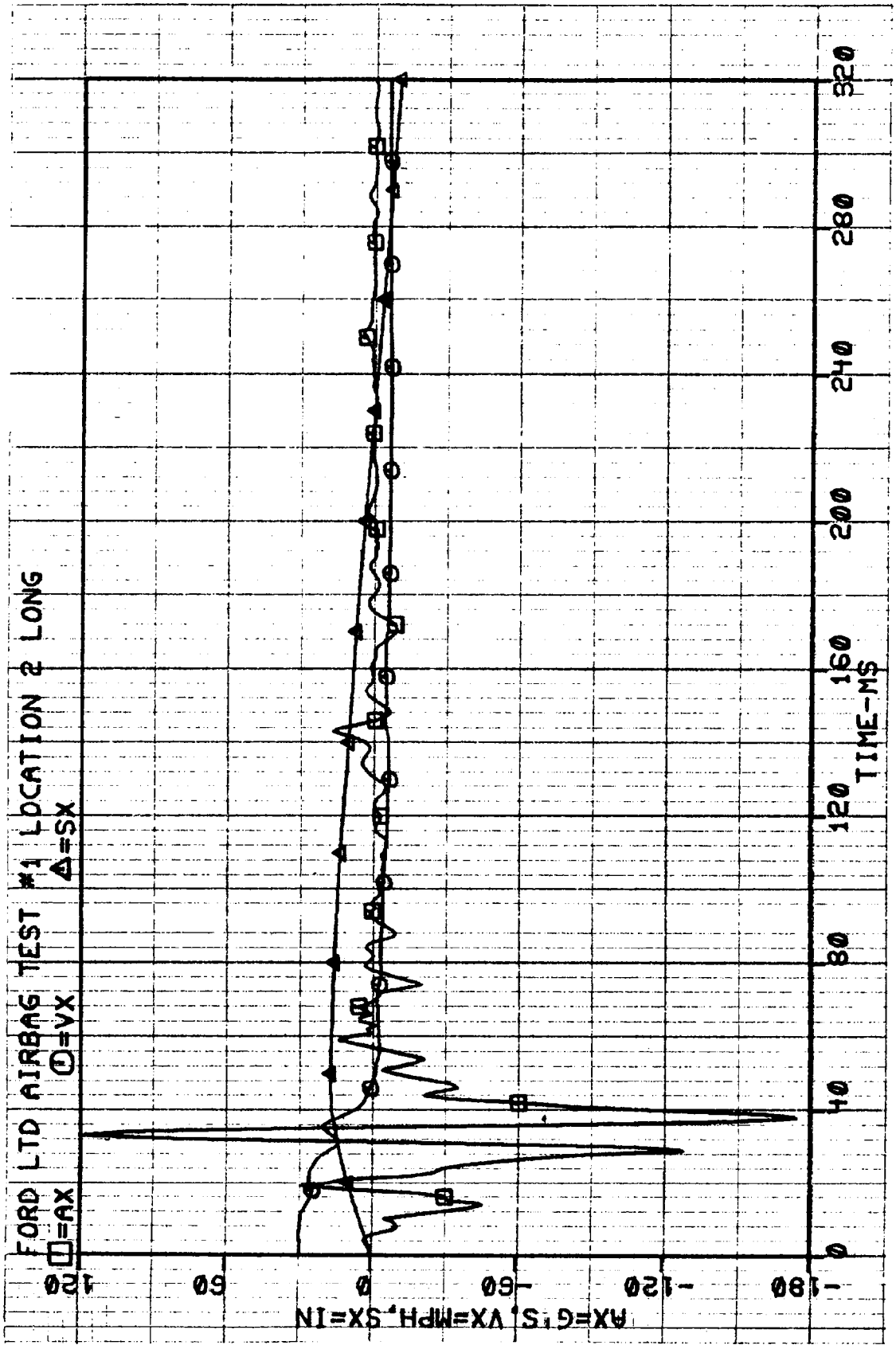

FORD LTD AIRBAG TEST #1 LOCATION 1 LONG
□=AX
○=VX
Δ=SX
AX=G'S, VX=MPH, SX=IN
100
50
0
-50
-100
-150
0
40
80
120
160
200
240
280
320
TIME-MS

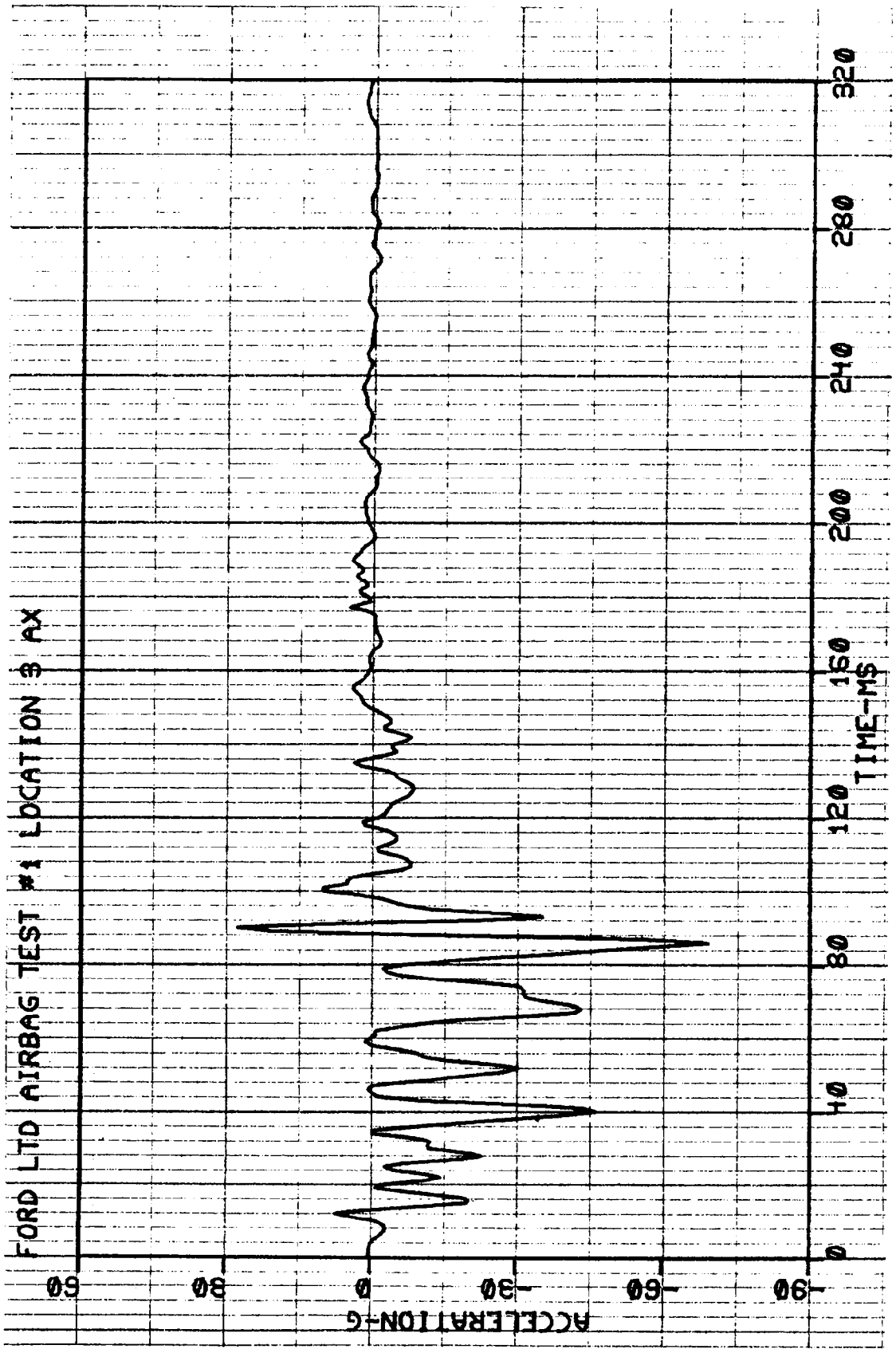

FORD LTD AIRBAG TEST #1 LOCATION 2 AX
ACCELERATION-G
120
60
0
-60
-120
-180
TIME-MS
0
40
80
120
160
200
240
280
320

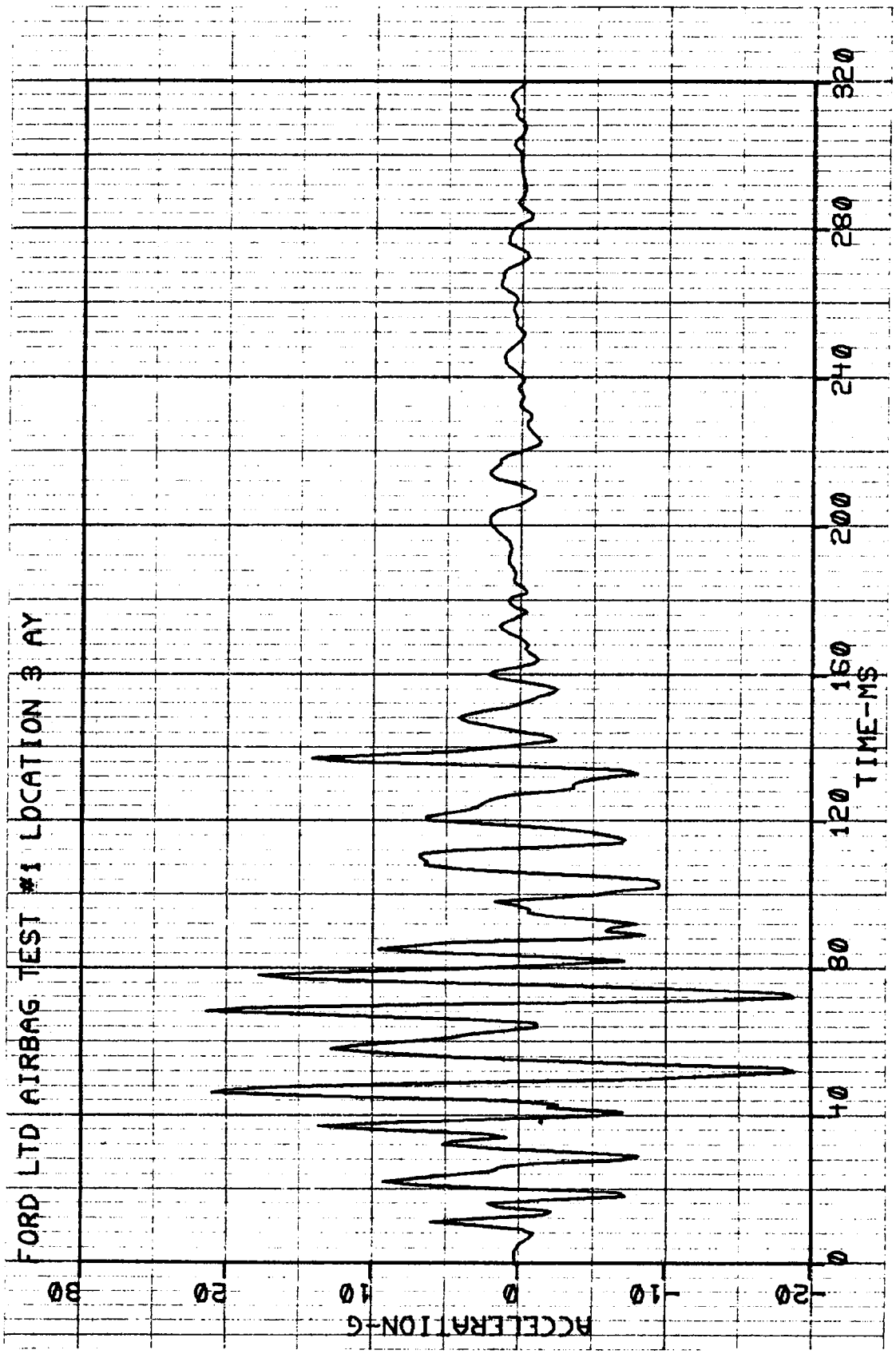

FORD LTD AIRBAG TEST #1 LOCATION 2 AY
ACCELERATION-G
TIME-MS
40
20
0
-20
-40
-60
0
40
80
120
160
200
240
280
320

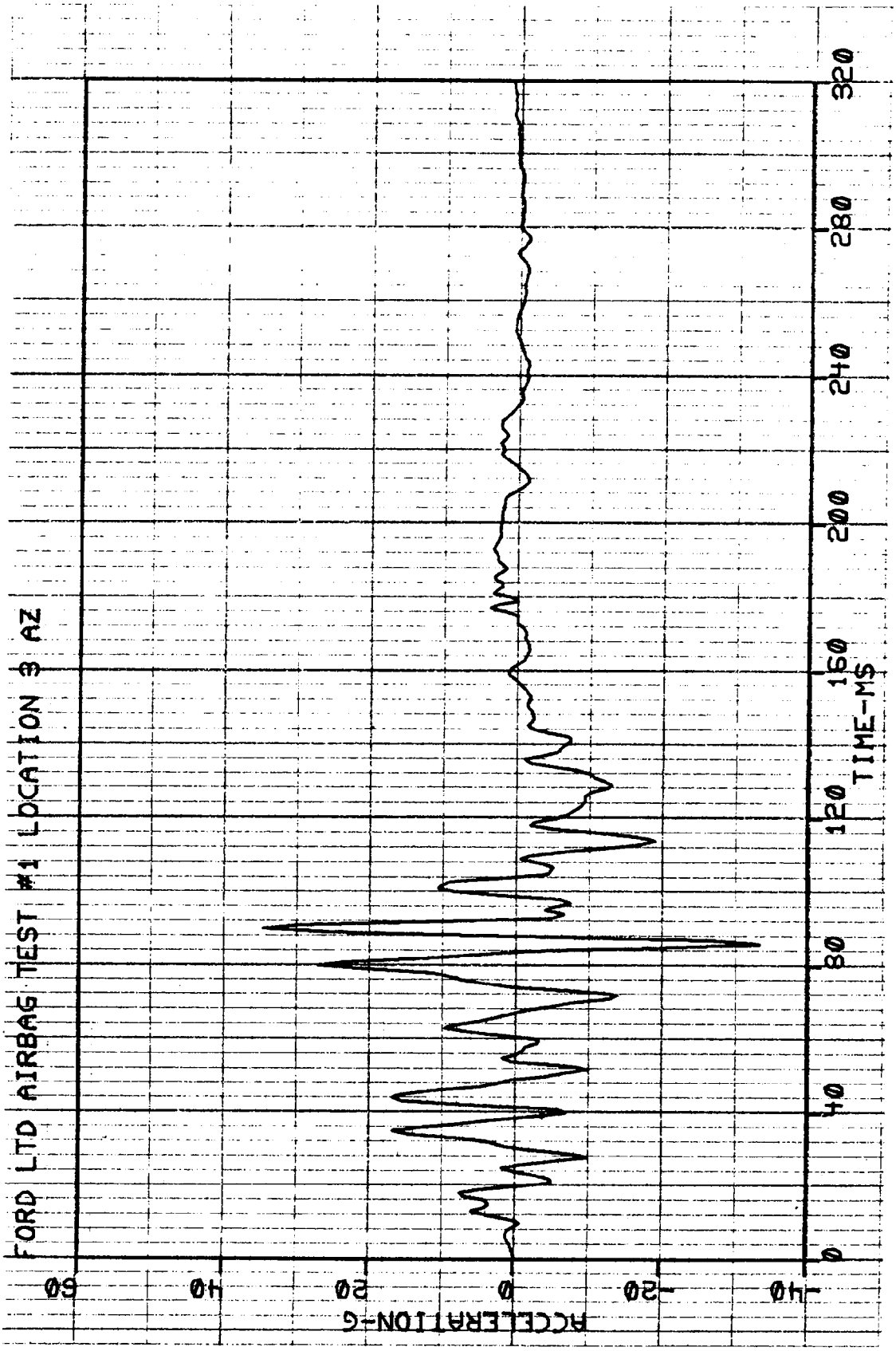

FORD LTD AIRBAG TEST #1 LOCATION 2 AZ
ACCELERATION-G
TIME-MS
40
20
0
-20
-40
-60
0
40
80
120
160
200
240
280
320

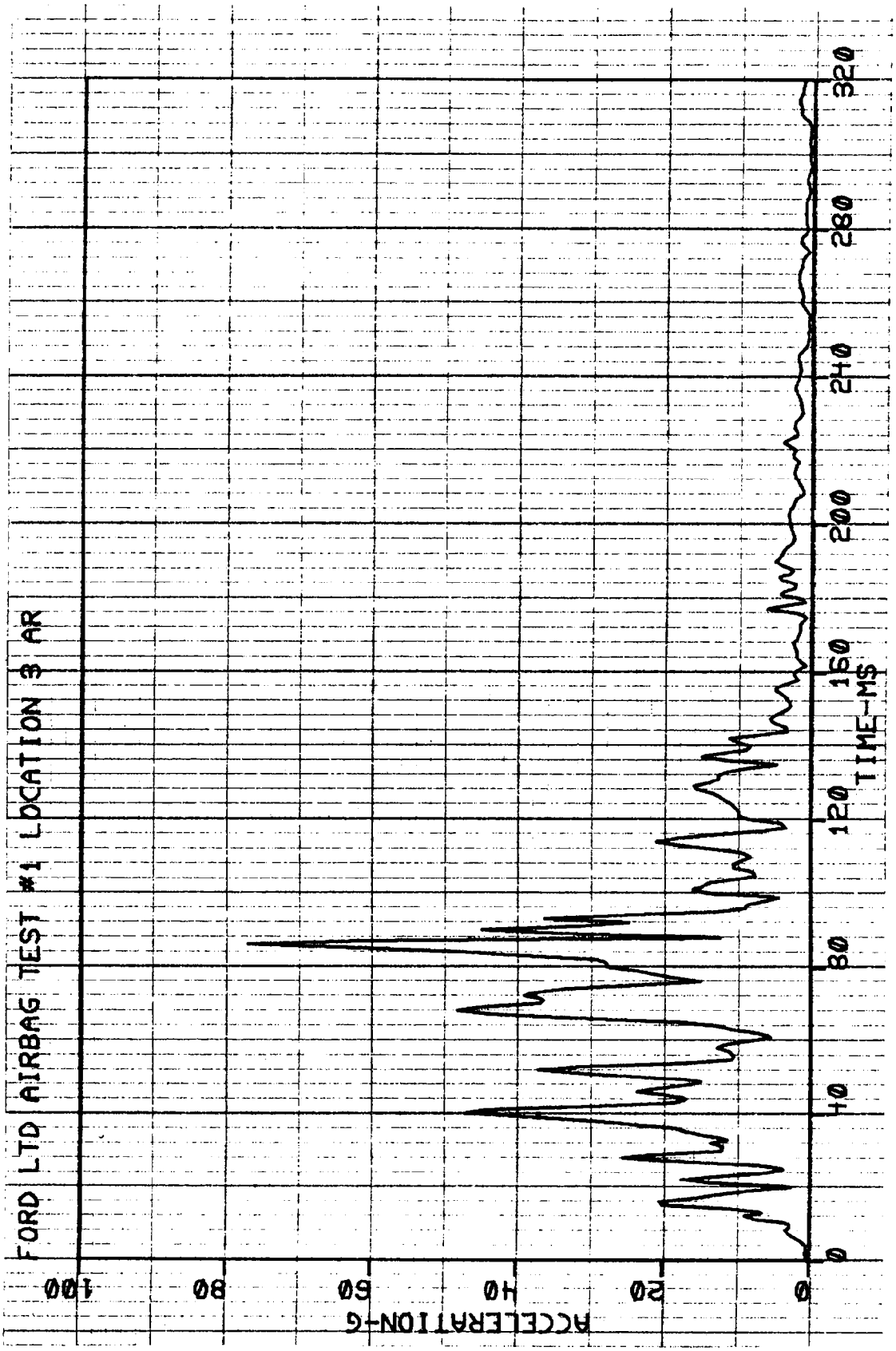

FORD LTD AIRBAG TEST #1 LOCATION 2 AR
ACCELERATION-G
0
40
80
120
160
200
TIME-MS
0
40
80
120
160
200
240
280
320

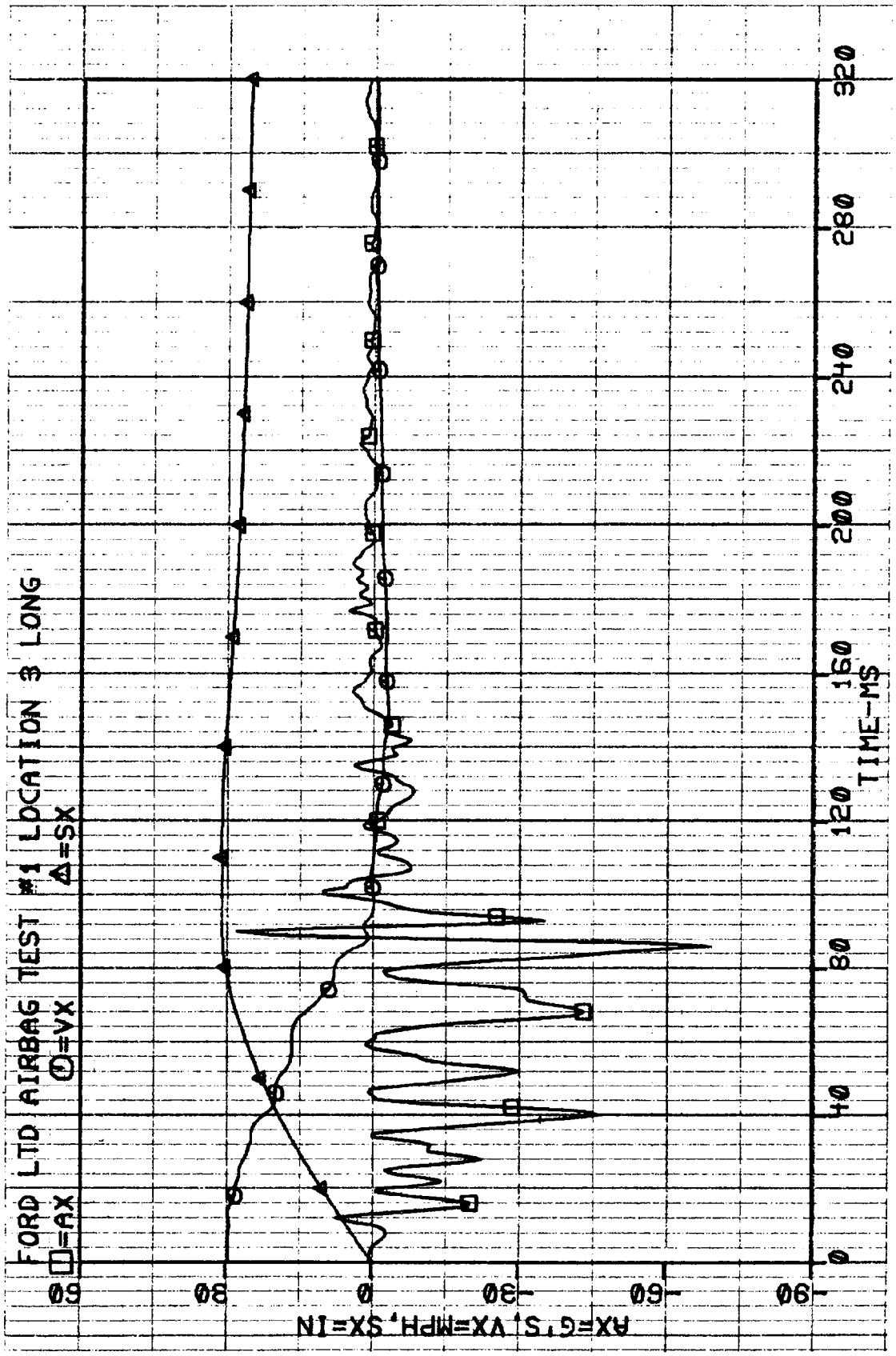

FORD LTD AIRBAG TEST #1 LOCATION 2 LONG
□=AX
○=VX
Δ=SX
AX=G'S, VX=MPH, SX=IN
120
60
0
-60
-120
-180
0
40
80
120
160
200
240
280
320
TIME-MS

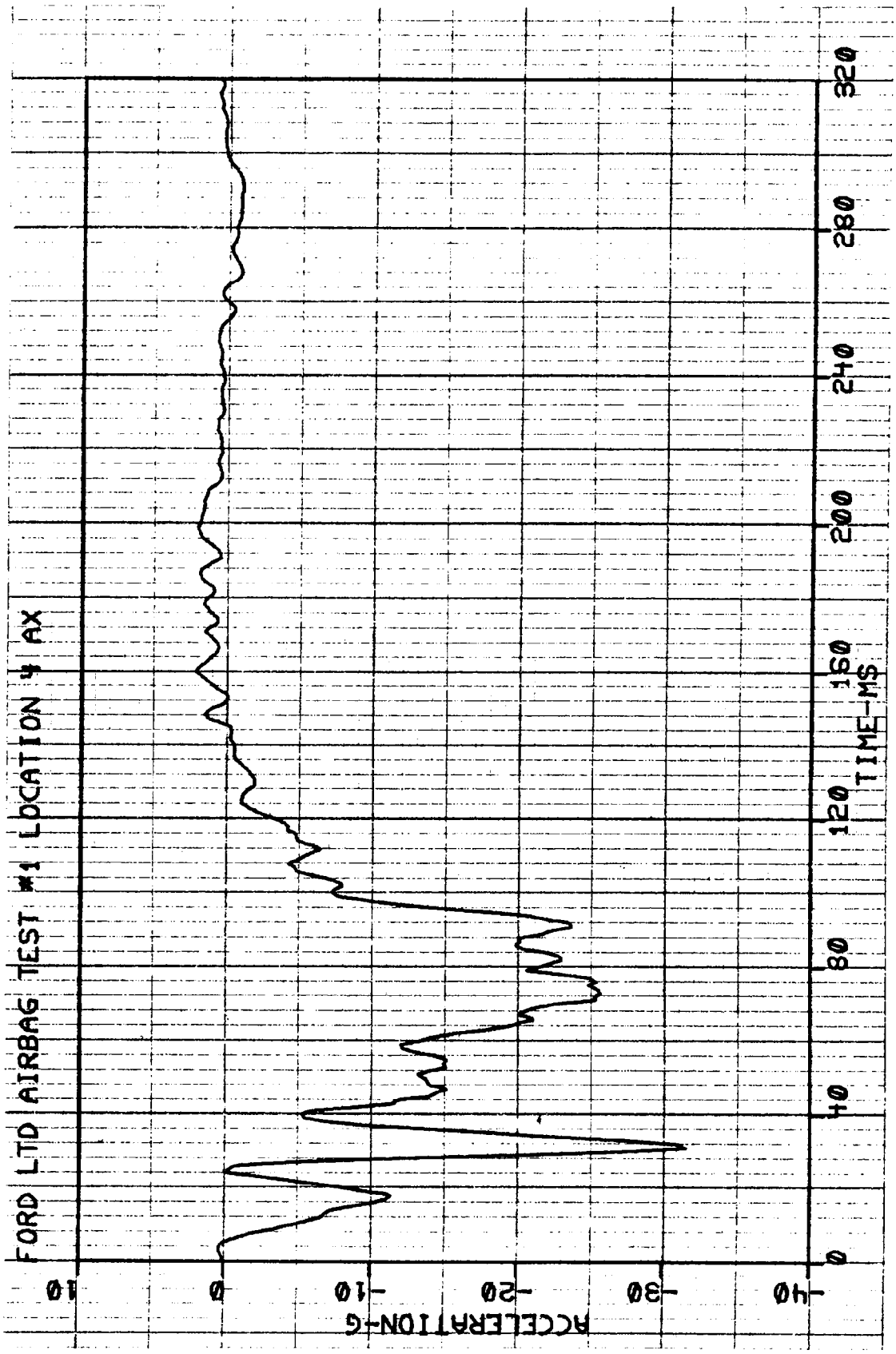

FORD LTD AIRBAG TEST #1 LOCATION 3 AX
ACCELERATION-G
60
30
0
-30
-60
-90
0
40
80
120
160
200
240
280
320
TIME-MS

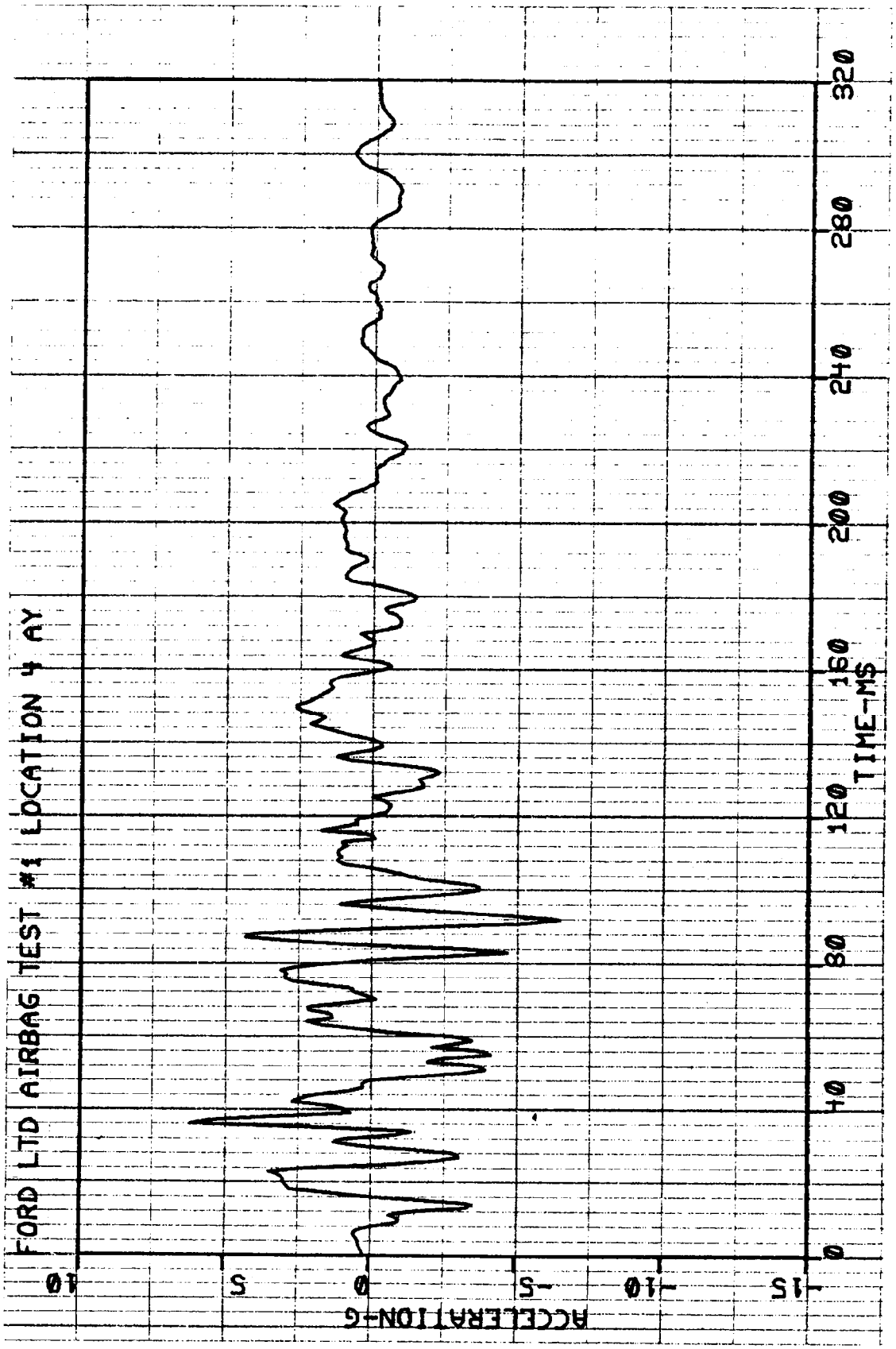

FORD LTD AIRBAG TEST #1 LOCATION 3 AY
ACCELERATION-G
80
20
10
0
10
20
0
40
80
120
160
200
240
280
320
TIME-MS

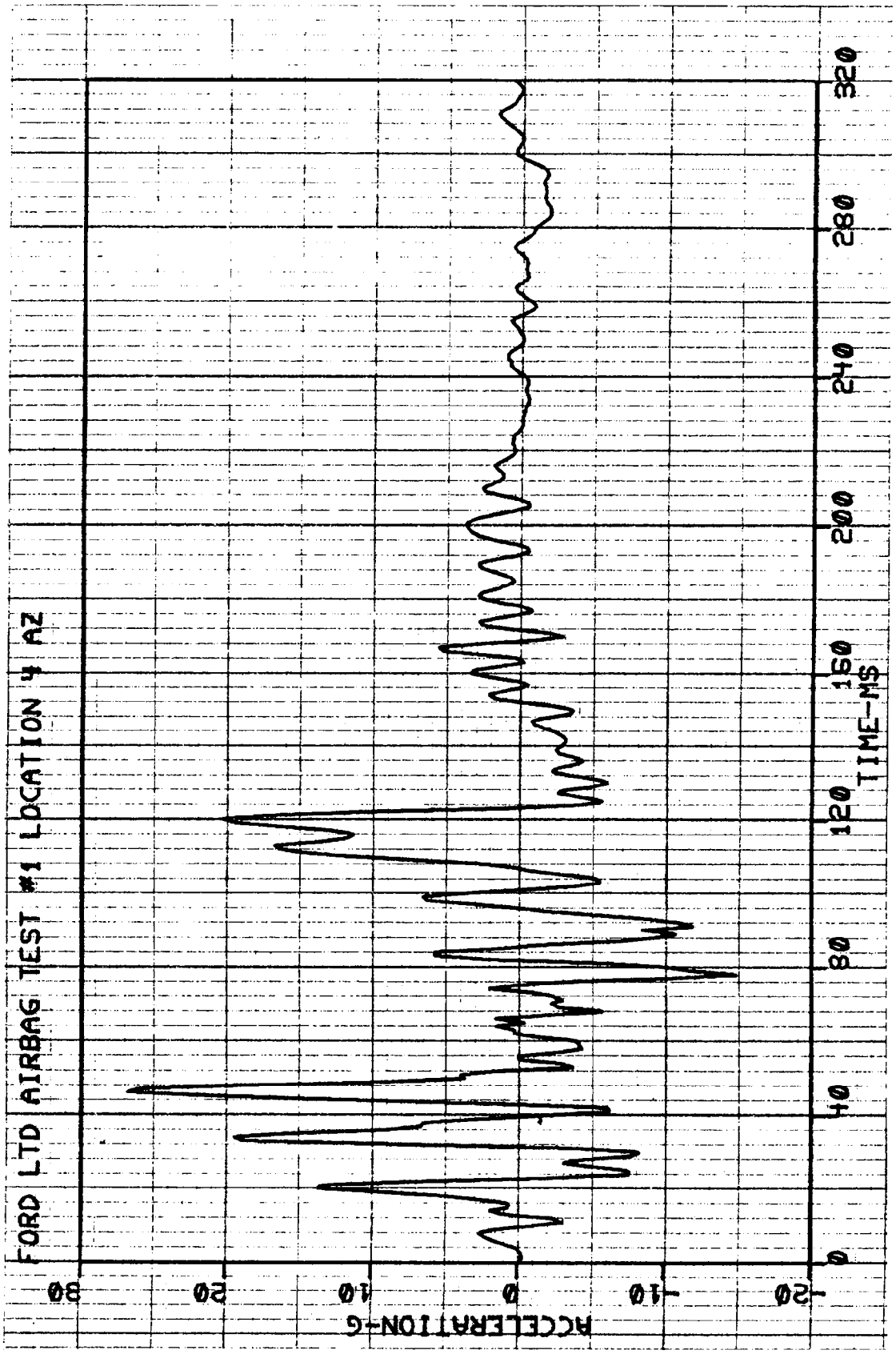

FORD LTD AIRBAG TEST #1 LOCATION 3 AZ
ACCELERATION-G
60
40
20
0
-20
-40
0
40
80
120
160
200
240
280
320
TIME-MS

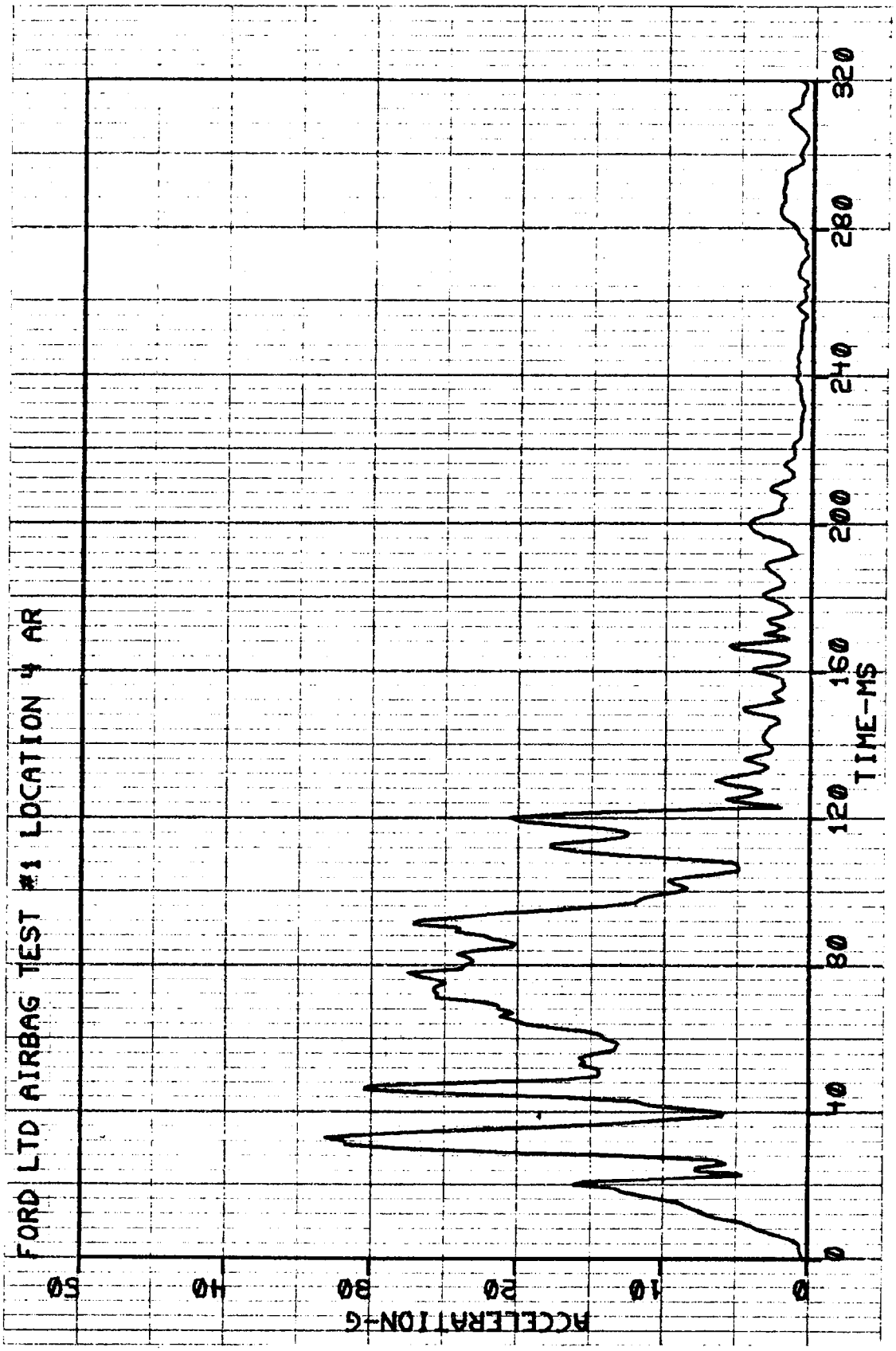

FORD LTD AIRBAG TEST #1 LOCATION 3 AR
ACCELERATION-G
TIME-MS
0
20
40
60
80
100
0
40
80
120
160
200
240
280
320

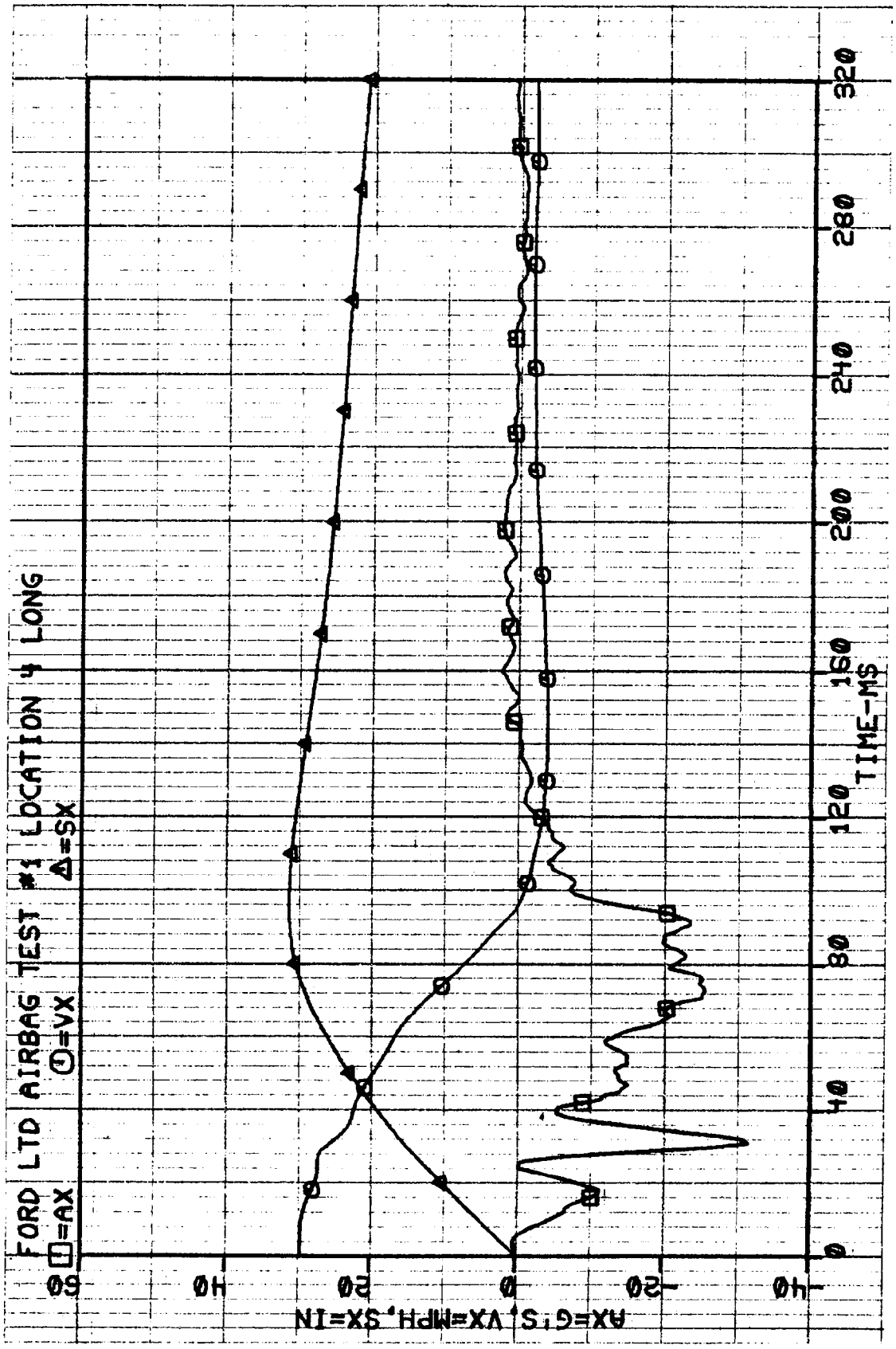

FORD LTD AIRBAG TEST #1 LOCATION 3 LONG
□=AX
O=VX
Δ=SX
AX=G'S, VX=MPH, SX=IN
TIME-MS
60
30
0
-30
-60
-90
0
40
80
120
160
200
240
280
320

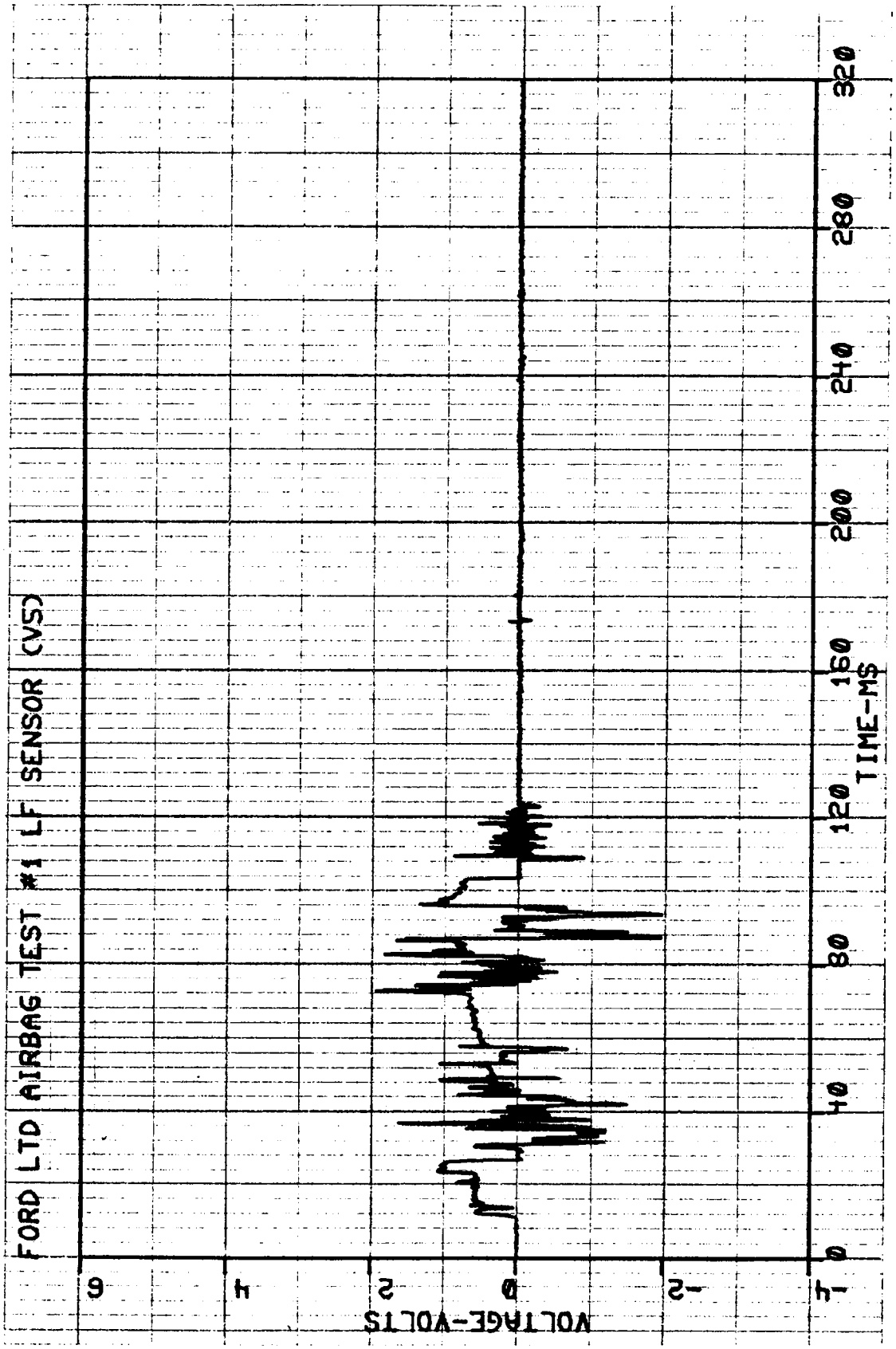

FORD LTD AIRBAG TEST #1 LOCATION 4 AX
ACCELERATION-G
10
0
-10
-20
-30
-40
TIME-MS
0
40
80
120
160
200
240
280
320

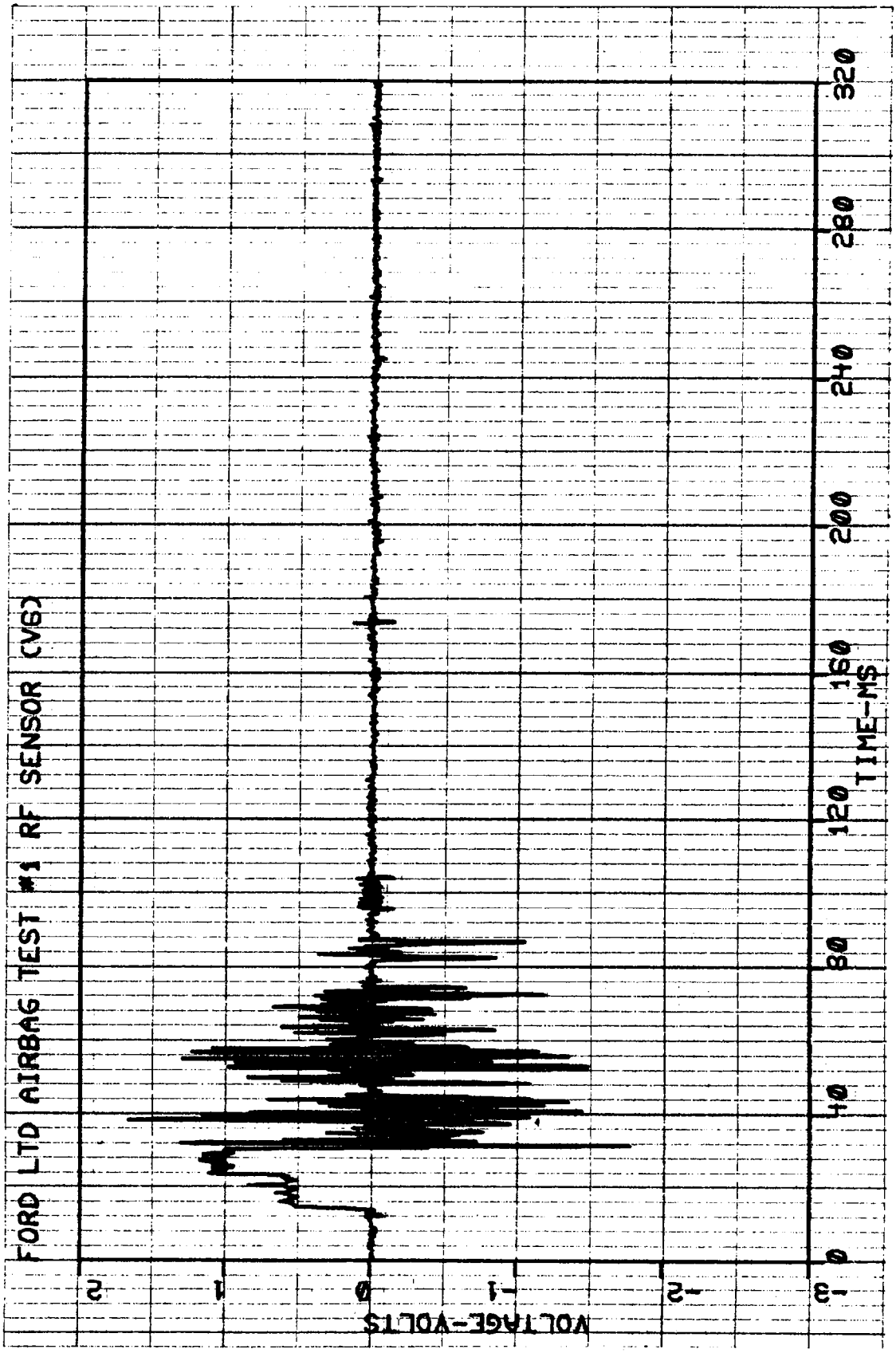

FORD LTD AIRBAG TEST #1 LOCATION 4 AY
ACCELERATION-G
TIME-MS
0
40
80
120
160
200
240
280
320
5
0
-5
-10
-15
10

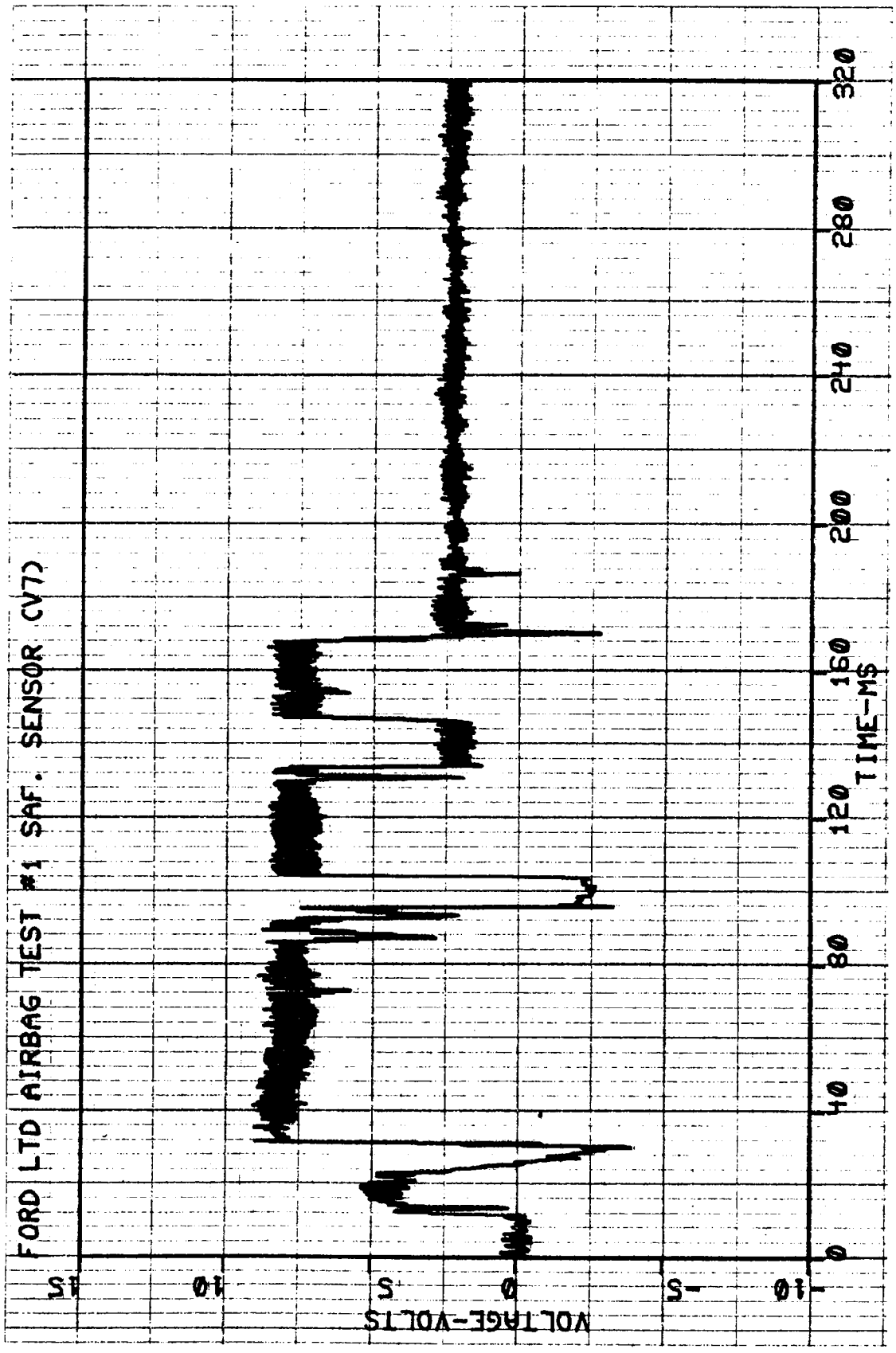

FORD LTD AIRBAG TEST #1 LOCATION 4 AZ
ACCELERATION-G
30
20
10
0
-10
-20
TIME-MS
0
40
80
120
160
200
240
280
320

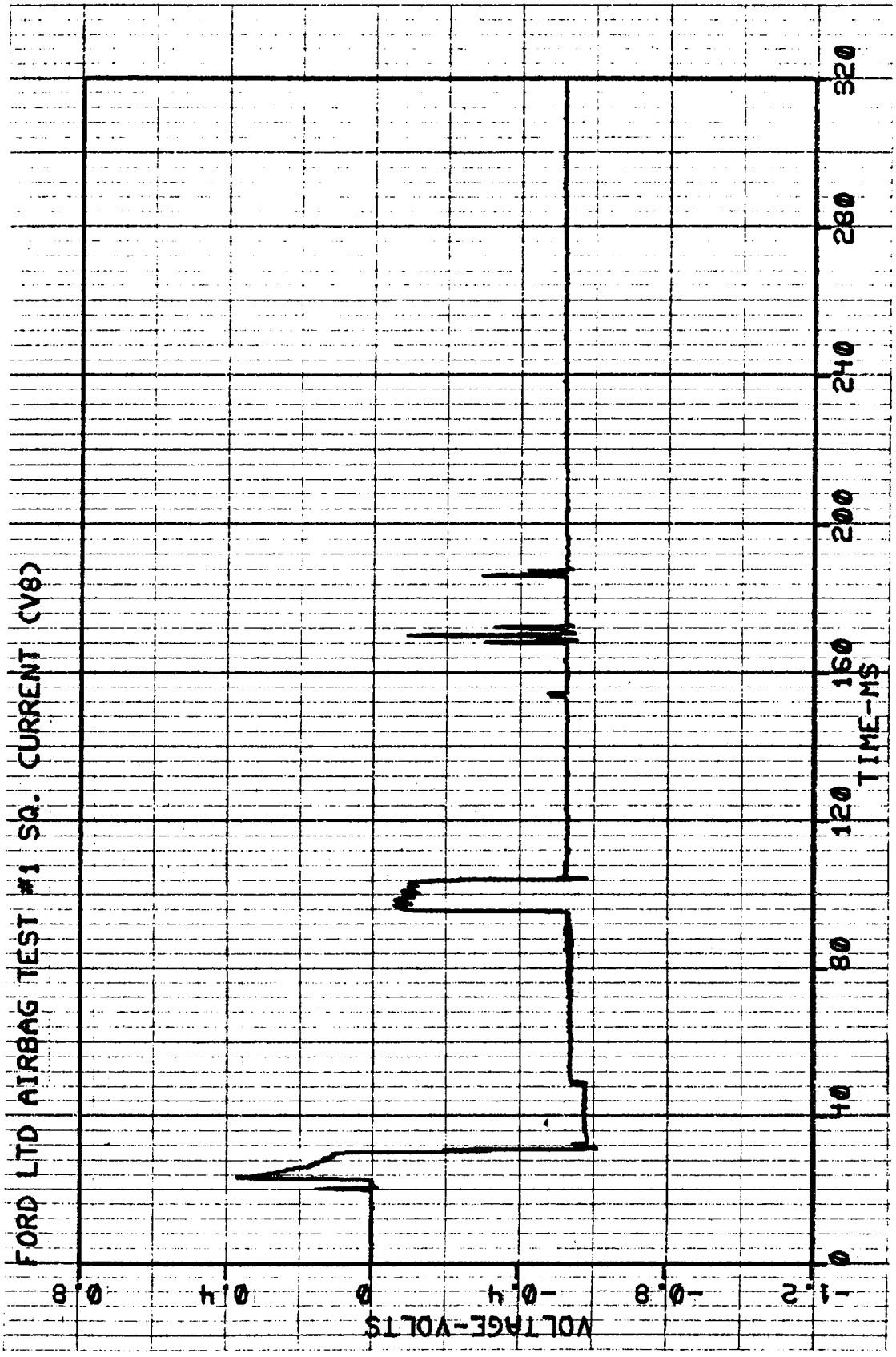

FORD LTD AIRBAG TEST #1 LOCATION 4 AR
ACCELERATION-G
0
10
20
30
40
50
TIME-MS
0
40
80
120
160
200
240
280
320

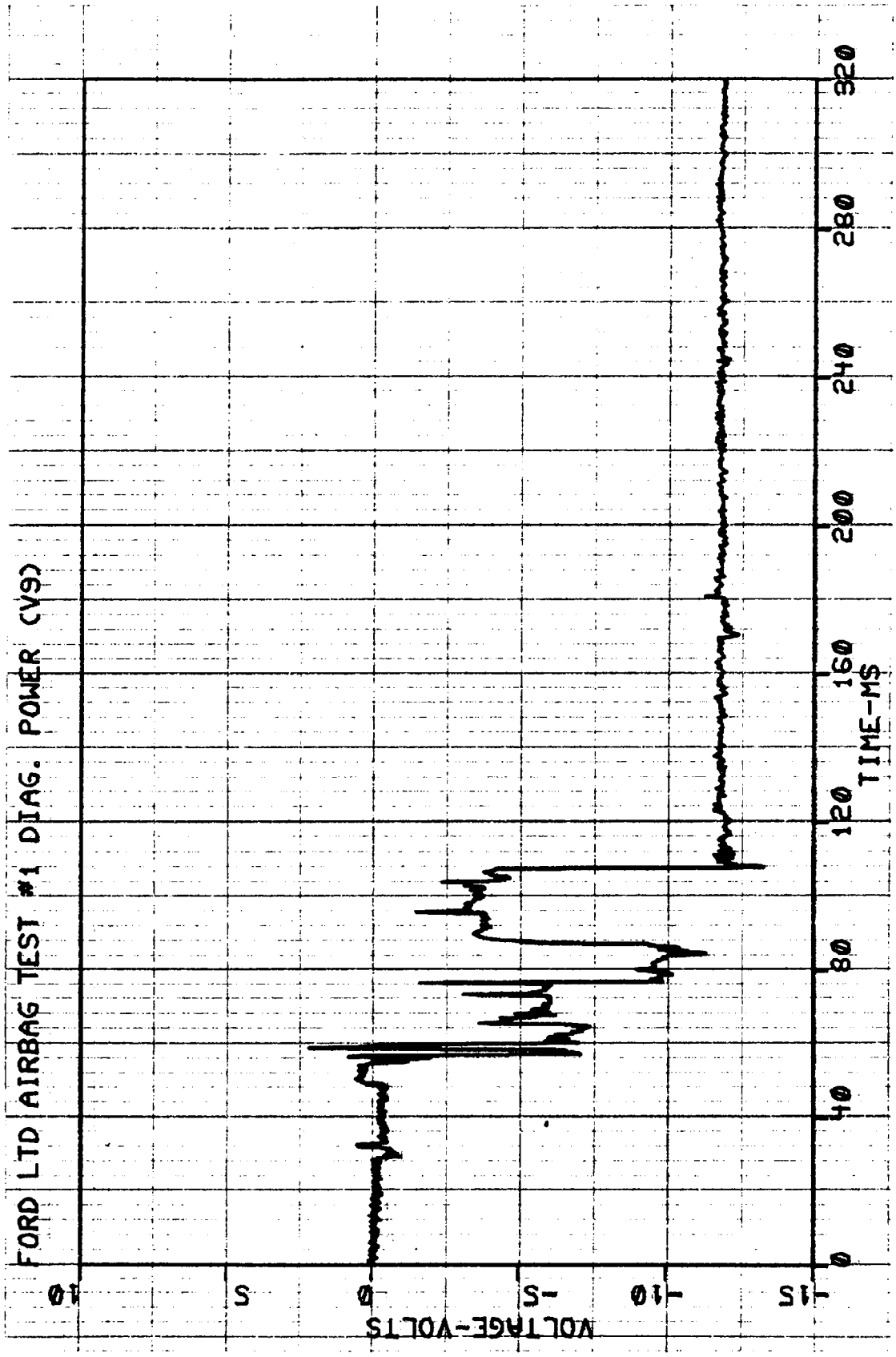

FORD LTD AIRBAG TEST #1 LOCATION 4 LONG
□=AX
○=VX
Δ=SX
AX=G'S, VX=MPH, SX=IN
TIME-MS
-40
-20
0
20
40
0
40
80
120
160
200
240
280
320

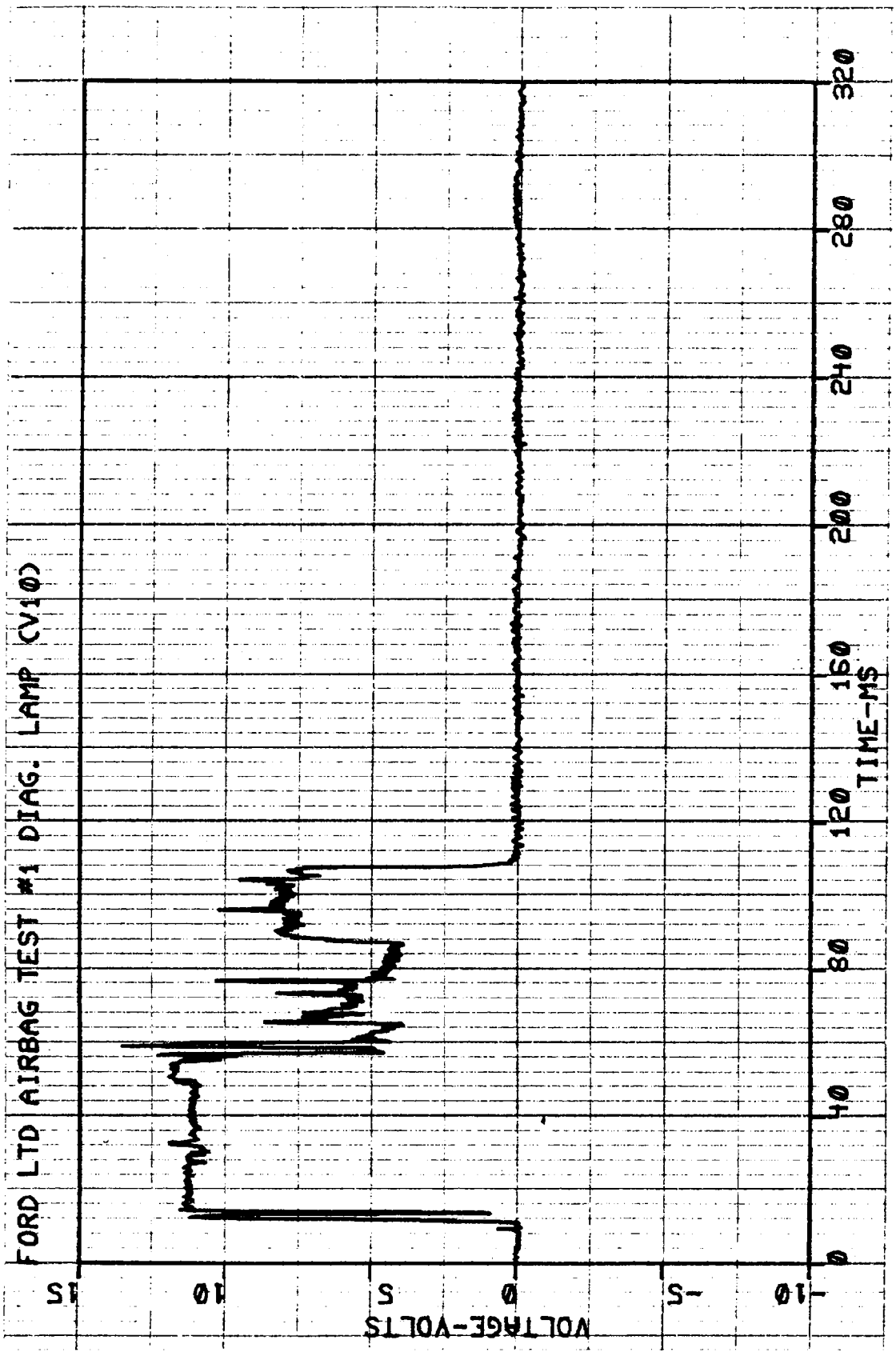

FORD LTD AIRBAG TEST #1 LF SENSOR (VS)
VOLTAGE-VOLTS
TIME-MS
6
4
2
0
-2
-4
0
40
80
120
160
200
240
280
320


FORD LTD AIRBAG TEST #1 RF SENSOR (V6)
VOLTAGE-VOLTS
TIME-MS
2
1
0
-1
-2
-3
0
40
80
120
160
200
240
280
320


FORD LTD AIRBAG TEST #1 SAF. SENSOR (V7)
VOLTAGE-VOLTS
15
10
5
0
-5
-10
TIME-MS
0
40
80
120
160
200
240
280
320


FORD LTD AIRBAG TEST #1 SQ. CURRENT (V8)
VOLTAGE-VOLTS
TIME-MS
0
40
80
120
160
200
240
280
320
.8
.4
0
-.4
-.8
-1.2


FORD LTD AIRBAG TEST #1 DIAG. POWER (V9)
VOLTAGE-VOLTS
TIME-MS
10
5
0
-5
-10
-15
0
40
80
120
160
200
240
280
320


FORD LTD AIRBAG TEST #1 DIAG. LAMP (V10)
TIME-MS
0
40
80
120
160
200
240
280
320
VOLTAGE-VOLTS
15
10
5
0
-5
-10

APPENDIX B

PHOTOGRAPHS

FIGURE B-1. PRE-TEST OVERALL VIEW OF VEHICLE.

FIGURE B-2. PRE-TEST VIEW OF DRIVER.

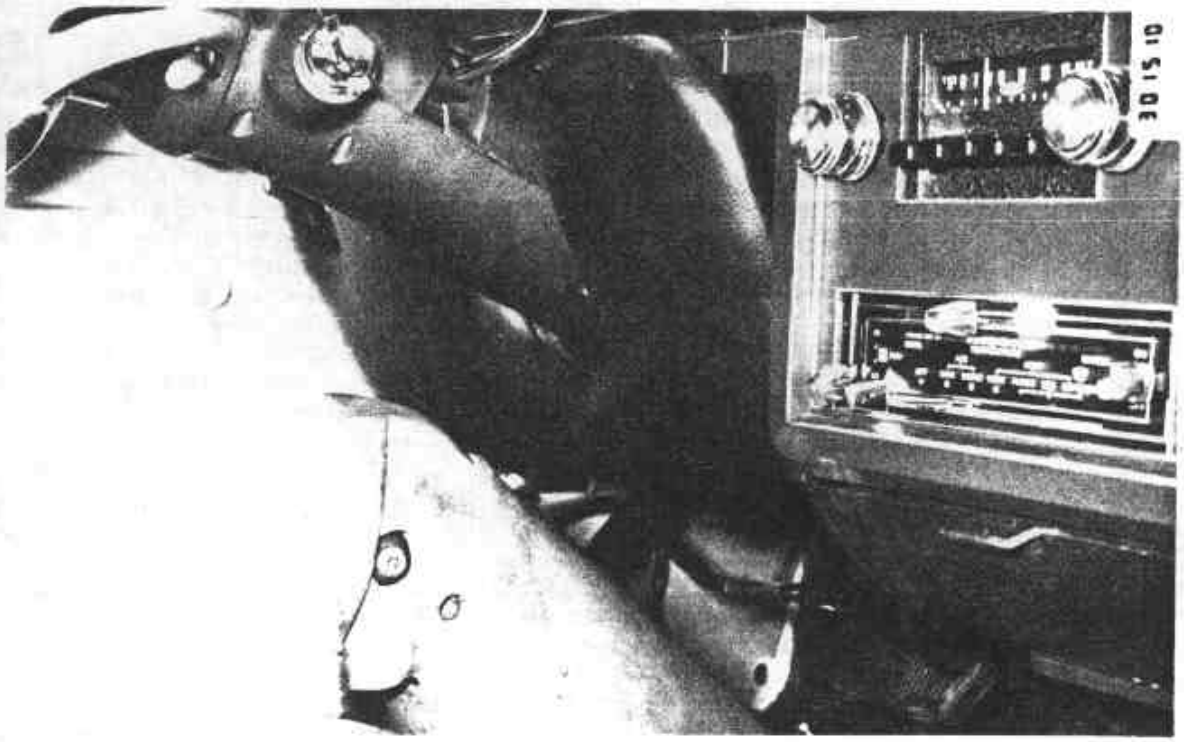


FIGURE B-3. PRE-TEST VIEW OF KNEE BOLSTER.

FIGURE B-4. POST-TEST OVERALL VIEW OF VEHICLE.

FIGURE B-5. POST-TEST VIEW OF DRIVER.