

Dynamic Science Report No. 3154-83-042/2100

DOT 0602

AIR BAG FLEET RETROFIT PROGRAM
CRASH TESTS

TEST NO. 3154-2
1982 FORD LTD
4-DOOR SEDAN

Prepared by:

DYNAMIC SCIENCE, INC.
An Exodyne Company
1850 West Pinnacle Peak Road
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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 Carn

Approved by Rod Carn

Date 9-21-83

Report Accepted by:

Contract Technical Manager
Office of Vehicle Safety Compliance

Date

TECHNICAL REPORT STANDARD TITLE PAGE

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16. Abstract <p>The objective of this program is to obtain performance data on a driver air bag restraint system retrofitted in police vehicles.</p> <p>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.</p> <p>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 9, 1983. Impact speed was 30.33 mph.</p>			
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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	acres	0.4	hectares	ha
MASS (weight)				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons	0.9	metric ton	t
	(2000 lb)			
VOLUME				
1sp	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	2.5	acres	
	(10 000 m ²)			
MASS (weight)				
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	metric ton	1.1	short tons	
	(1000 kg)			
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

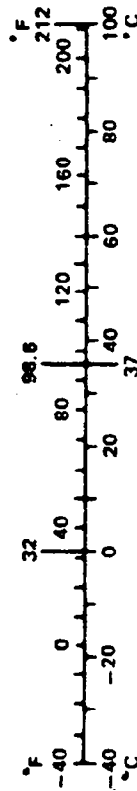


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1.0 PURPOSE AND TEST PROCEDURE

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 9, 1983. Impact speed was 30.33 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. 1346 Color: White

DATA FROM CERTIFICATION LABEL

Vehicle Manufacturer: Ford Motor Company of Canada Ltd
Date of Manufacture: March 1982; VIN: 2FABP31G8CB157432
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: Standard
P225/70R15
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: 9/1/83; Odometer 124
Dealer Name & Address: Furnished by Romeo Kojyo Company Ltd

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

Right Front 1147 lb Right Rear = 852 lb
Left Front = 1120 lb Left Rear = 860 lb
TOTAL FRONT WEIGHT = 2267 lb (57 % of Total Vehicle Weight)
TOTAL REAR WEIGHT = 1712 lb (43 % of Total Vehicle Weight)
TOTAL DELV. WEIGHT = 3979 lb

TARGET WEIGHT = UDW + 170 lbs Cargo + 164 lb Dummy = 4313 lb

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

Right Front = 1180 lb Right Rear = 950 lb
Left Front = 1204 lb Left Rear = 980 lb
TOTAL FRONT WEIGHT = 2384 lb (55 % of Total Vehicle Weight)
TOTAL REAR WEIGHT = 1930 lb (45 % of Total Vehicle Weight)
TOTAL TEST WEIGHT = 4314 lb

Weight of ballast secured in vehicle trunk area = 0 lb

VEHICLE ATTITUDE: (inches)

Delivered Attitude: RF 32.0 LF 32.0 RR 32.0 LR 32.0
Test Attitude: RF 31.8 LF 31.6 RR 31.5 LR 31.1

REMARKS: Vehicle equipped with driver side air cushion re-
straint 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: 9/9/83 Time: 1426 Temperature 104°F
 Required Impact Velocity Range: 28.5 to 30.5 mph
 Impact Velocity: Primary = 30.33 mph Secondary = 30.39 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	<u>210.0</u>	C	<u>209.3</u>	L	<u>210.0</u>
	Post-test = R	<u>186.3</u>	C	<u>186.3</u>	L	<u>187.0</u>
	Crush = R	<u>23.7</u>	C	<u>23.0</u>	L	<u>23.0</u>

Distance from front of test vehicle to point of impact:

	R	<u>27.5</u>	C	<u>26.3</u>	L	<u>26.0</u>
--	---	-------------	---	-------------	---	-------------

VISIBLE DUMMY CONTACT POINTS

	<u>Driver</u>	<u>Passenger</u>
Head	<u>Air bag</u>	<u></u>
Chest	<u>Air bag</u>	<u></u>
Abdomen	<u>Air bag, steering wheel</u>	<u></u>
Left Knee	<u>Knee bolster</u>	<u></u>
Right Knee	<u>Knee bolster</u>	<u></u>

DOOR OPENING

	<u>Front</u>		<u>Rear</u>	
	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
	<u>Difficult</u>	<u>Difficult</u>	<u></u>	<u></u>

SEAT MOVEMENT

Seat Back Failure	<u>None</u>	<u>None</u>	<u></u>	<u></u>
Seat Shift (in.)	<u>None</u>	<u>None</u>	<u></u>	<u></u>

GLAZING DAMAGE

Backlight/Windshield Majority of windshield damage on driver side due to force from air bag contact.
All other windows intact.

OTHER NOTABLE IMPACT EFFECTS: _____

PART 572 DUMMY IN-VEHICLE POSITION RECORDING SHEET

PRE-IMPACT DATA

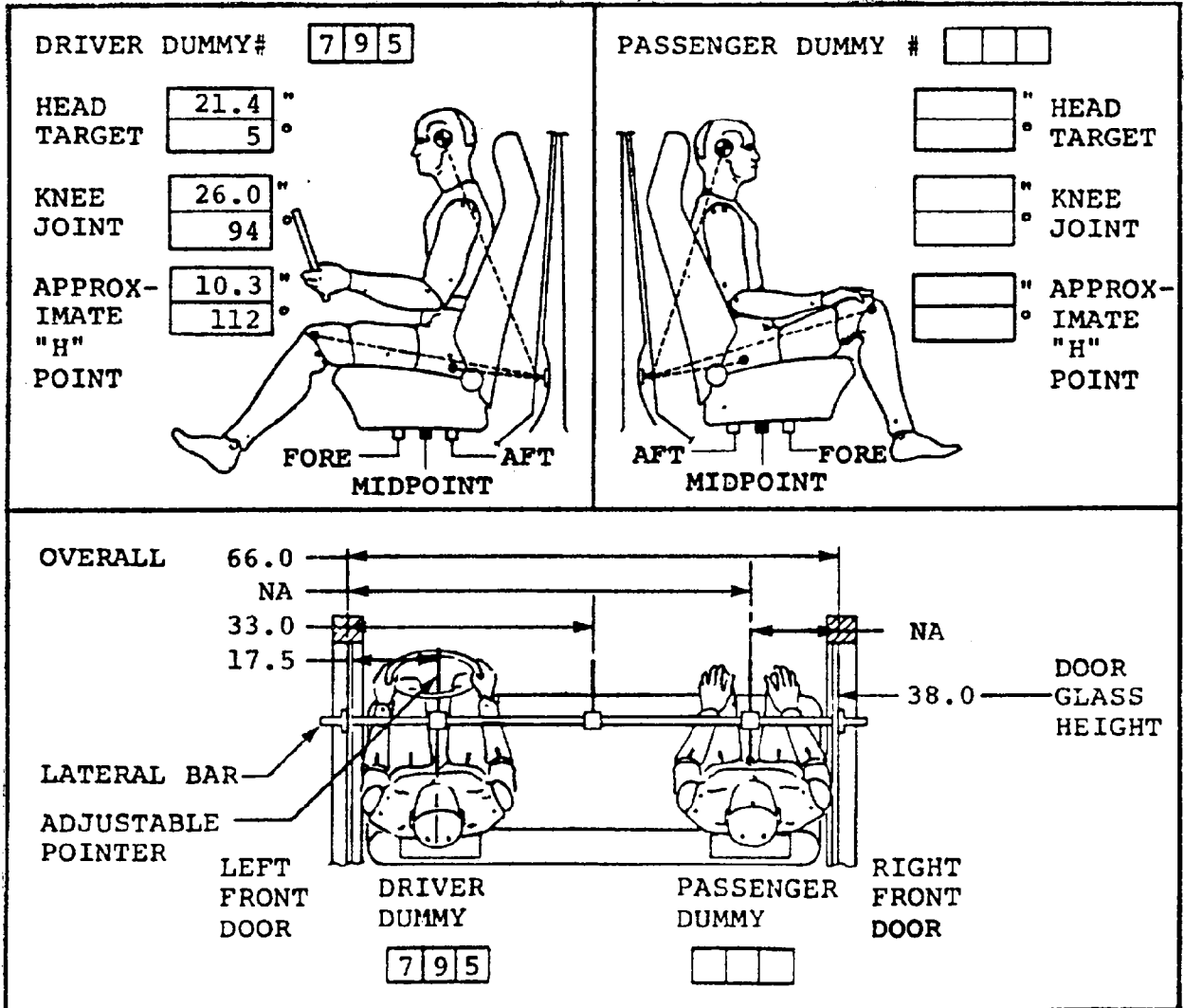
Make/Model: Ford LTD
 Body Style: 4-Door Sedan (Police) Model Year: 1982
 NHTSA No. NA DSI No. 1346 Color: White

DATA FROM CERTIFICATION LABEL

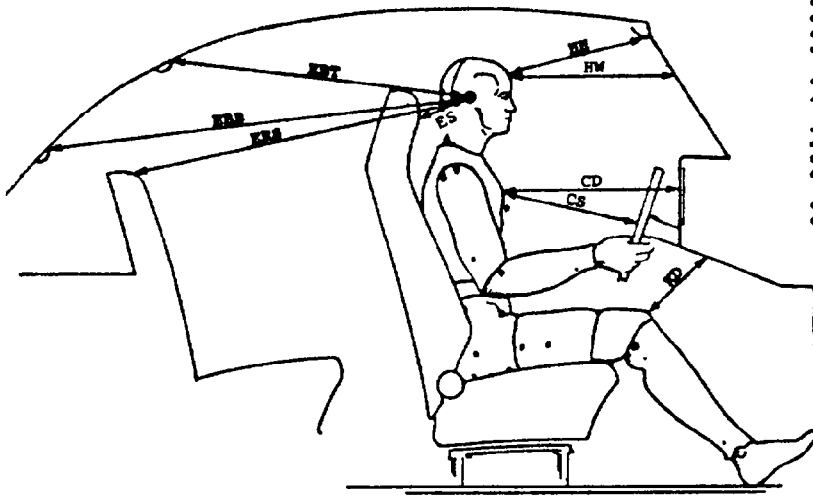
Vehicle Manufacturer: Ford Motor Company of Canada Ltd
 Date of Manufacture: 3/82; VIN: 2FABP31G8CB157432
 GVWR: 5346 lb; GAWR: Front = 2680 lb; Rear = 2716 lb

POST-IMPACT DATA

Type of Test: Frontal (0°) Impact
 Date of Test: 9/9/83 Time: 1426 Temperature 104 °F
 Required Impact Velocity Range: 28.5 to 30.5 mph
 Impact Velocity: Primary = 30.33 mph Secondary = 30.39 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

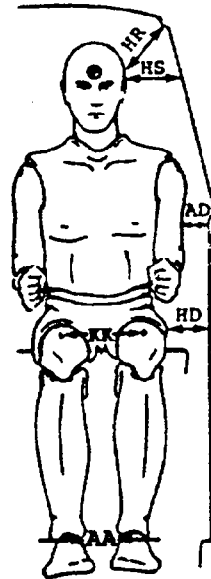


00 8314 40 00302

	Driver	Passenger
HH	14.5	
HW	19.5	
CD	20.5	
CS	10.0	
KD L	4.3	
KD R	4.0	
Torso		Torso
Angle	26°	Angle °
Seat Back		Seat Back
Angle	25°	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.



00 8314 40 00303

	Driver	Passenger
HR	5.5	
HS	9.0	
AD	6.0	
HD	8.5	
KK	9.0	
AA	7.0	

SUMMARY OF VEHICLE ACCELEROMETER DATA

Vehicle: 1982 Ford LTD 4-Door Sedan Test Date: 9/9/83
 Test No.: 3154-2 Test Speed: 30.33 mph

Accelerometer		Maximum Acceleration				
No.	Location	Scale	+A (g)	T (msec)	-A (g)	T (msec)
1X	Left front air bag sensor	±250g	65.8	46.4	117.9	29.5
1Y	Left front air bag sensor	±250g	42.7	25.8	38.7	61.8
2X	Right front air bag sensor	±250g	40.4	42.0	95.5	27.1
2Y	Right front air bag sensor	±250g	29.6	27.4	61.4	19.1
3X	Diagnostic module	±250g	23.6	91.0	57.3	82.5
4X	Driver side B-pillar	±250g	2.3	172.1	32.0	79.0

$\Delta V = 33.1 \text{ mph @ } 157.5 \text{ msec}$

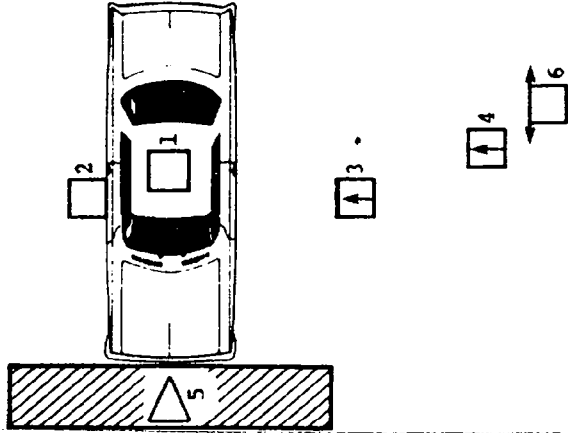
Positive Direction: X = Forward, Y = Rightward, Z = Downward

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	56.2	219.0	55.2	108.0				
Lateral	15.0	111.6	22.1	220.6				
Vertical	35.5	108.0	15.0	151.0				
Resultant	65.2	108.0	-	-				
HIC 476.1 between 92.8 and 123.1 msec								
Chest Acceleration								
Longitudinal	14.7	191.3	48.5	111.6				
Lateral	4.3	31.8	6.4	135.8				
Vertical	18.0	102.5	13.6	148.1				
Resultant (Max)	49.0	111.6						
Resultant (clip)	47.7	-						
TIME > 60 G 0 msec								
SEVERITY INDEX 346.5 @ 320 msec								
	Peak (lb)	Time (msec)	Peak (lb)	Time (msec)	Peak (lb)	Time (msec)	Peak (lb)	Time (msec)
Femur Loads								
Left	132.3	120.5	1754.7	85.0				
Right	57.6	133.0	1356.4	90.5				
Belt Loads								
Lap	Not instrumented							
Torso								
Vehicle Impact Speed (mph): <u>30.33</u>								
$\Delta V = 33.1$ mph								
*Longitudinal:	Forward				**Longitudinal:	Rearward		
Lateral:	Rightward				Lateral:	Leftward		
Vertical:	Downward				Vertical:	Upward		

CAMERA LOCATIONS

Test No: 3154-2 Test Date: 9/9/83
 Test Type: 90° Frontal Barrier
 Vehicle A (Away): 1982 Ford LTD 4-Door Sedan
 Vehicle B (Barrier):
 Comments: Air Bag Test

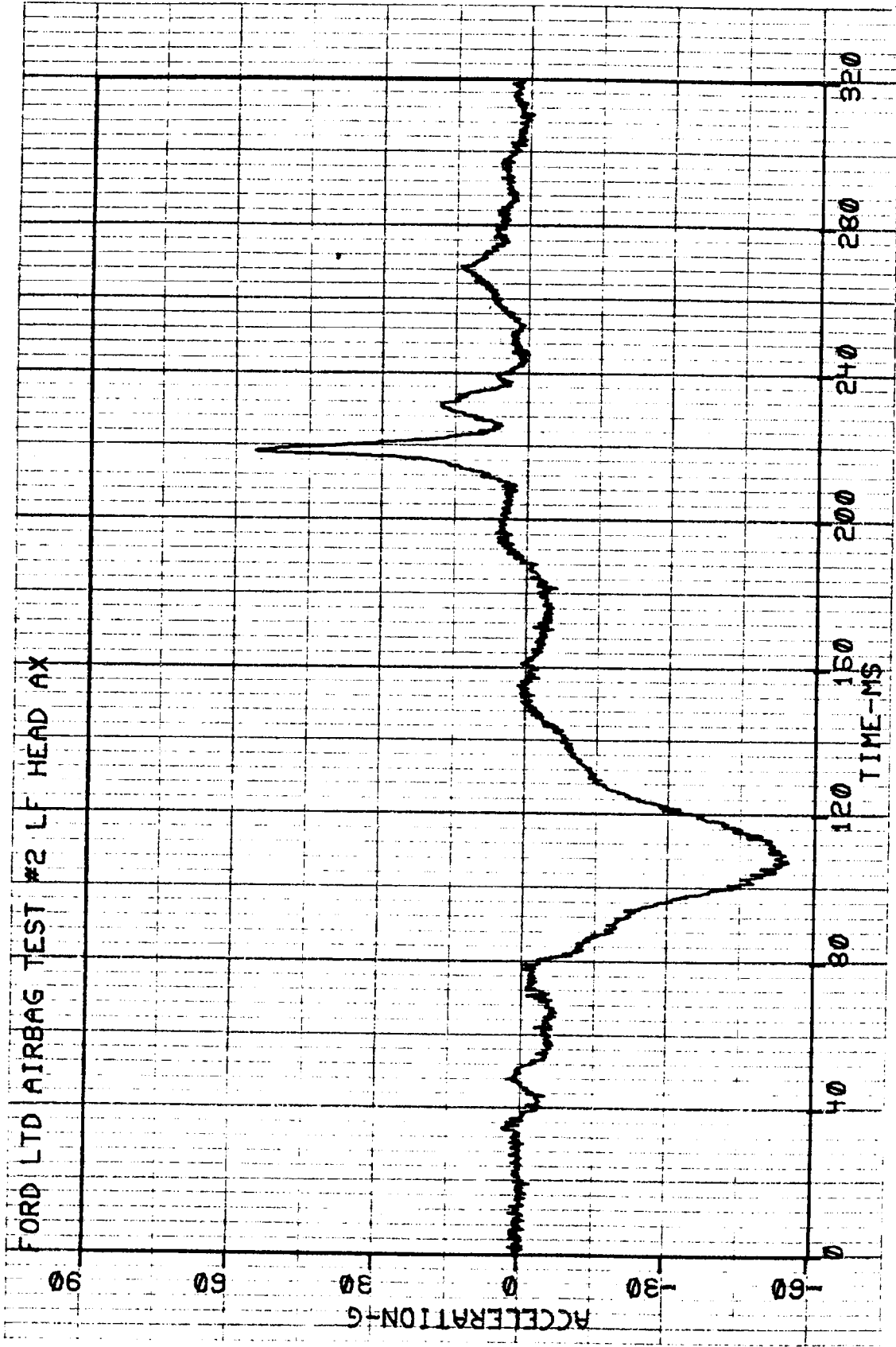


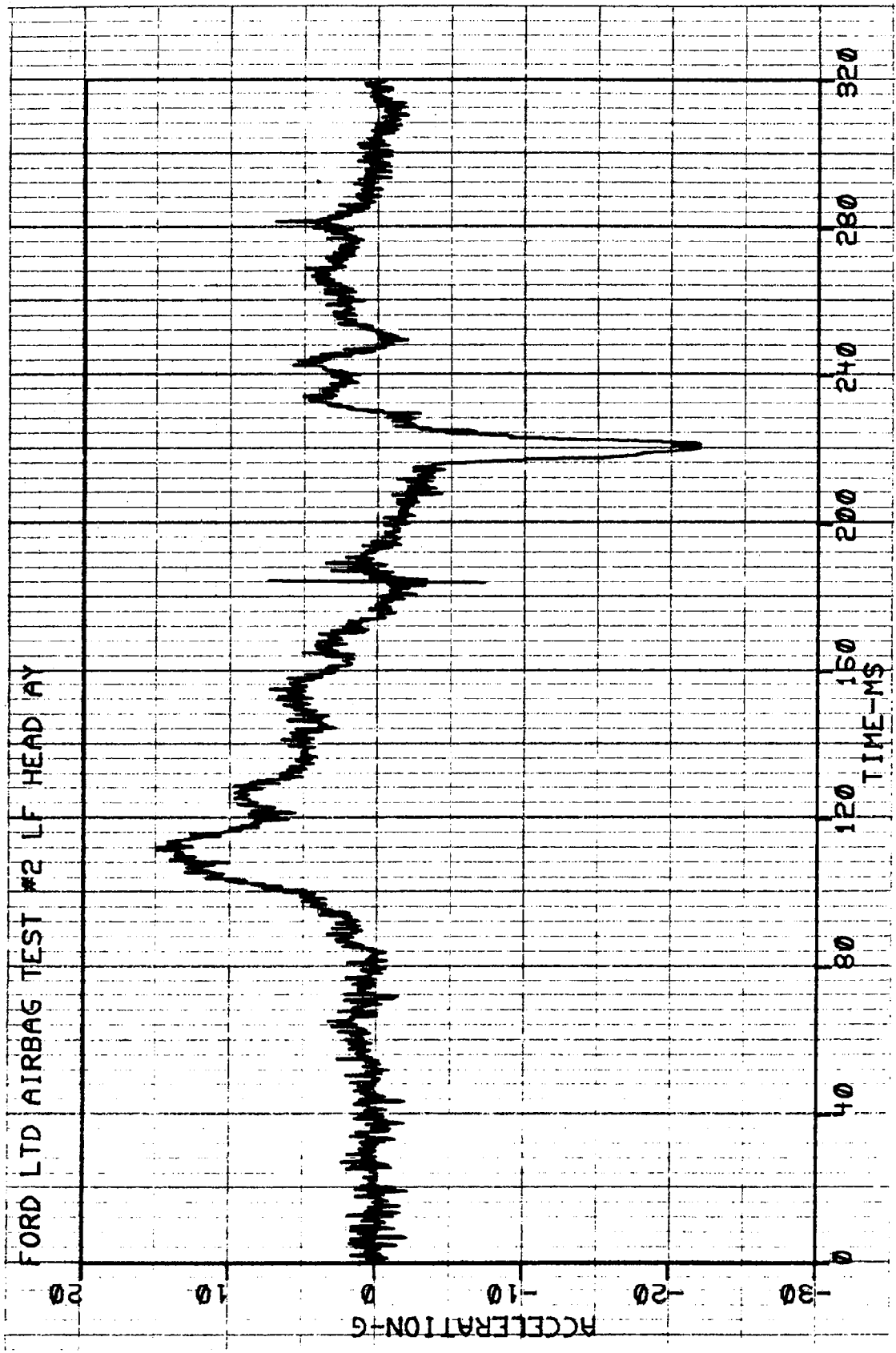
- CAMERA SYMBOLS
- PIT
 - GROUND
 - BARRIER
 - OVERHEAD
 - ON-BOARD
 - PANNING
- FRAME RATE
- 1. 1000 fr/sec
 - 2. 200 fr/sec
 - 3. Other 24 fr/sec
 - 4. 400 fr/sec
 - 5. 500 fr/sec
- TIMING LIGHT SPEED
- 1. 100 Hz (10 msec/light)
 - 2. 200 Hz (5 msec/light)
 - 3. Other

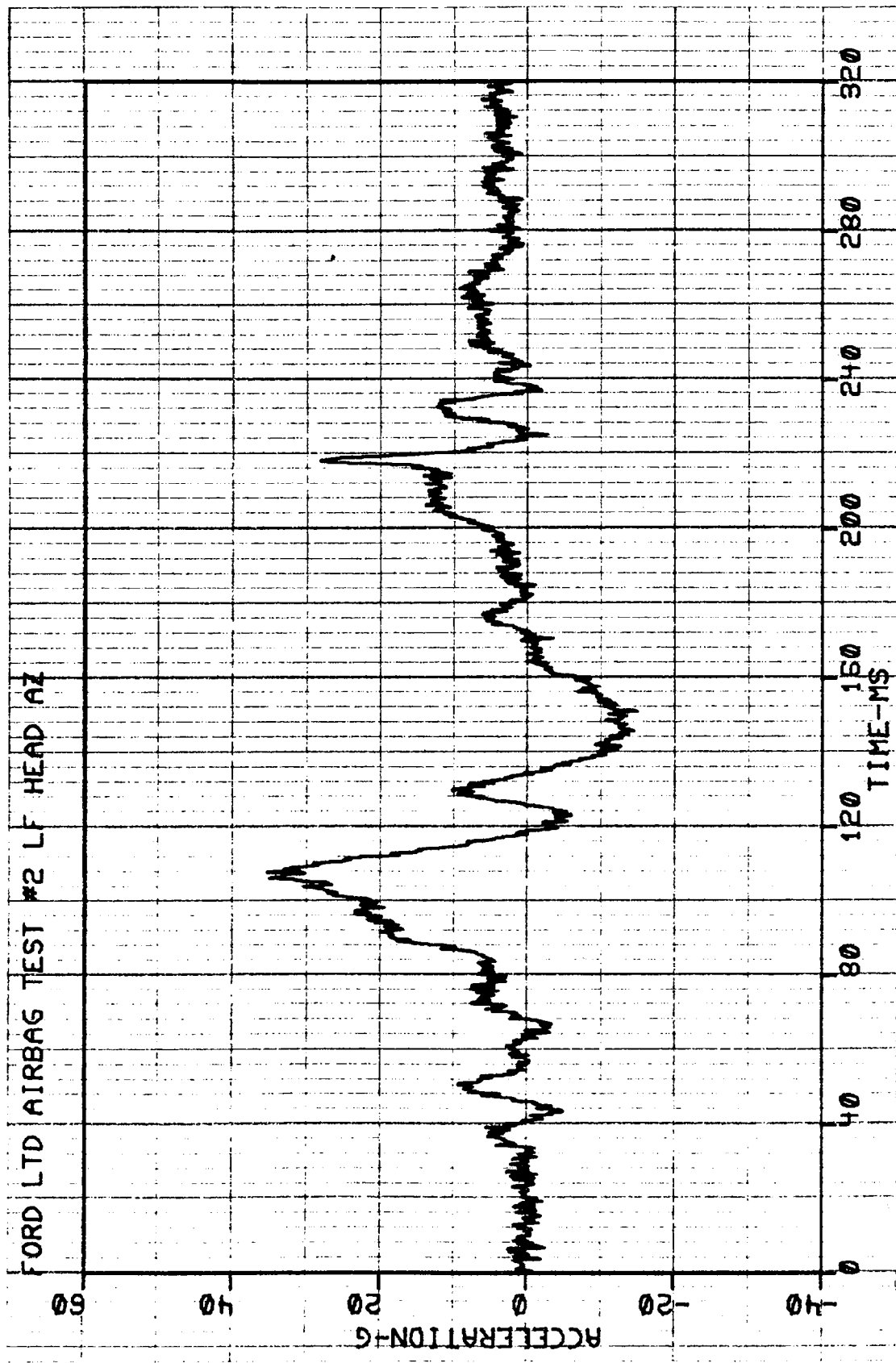
CAMERA	YES
STILLS	
SLIDES	
MOVIE	
POLAROID	
VIDEO	

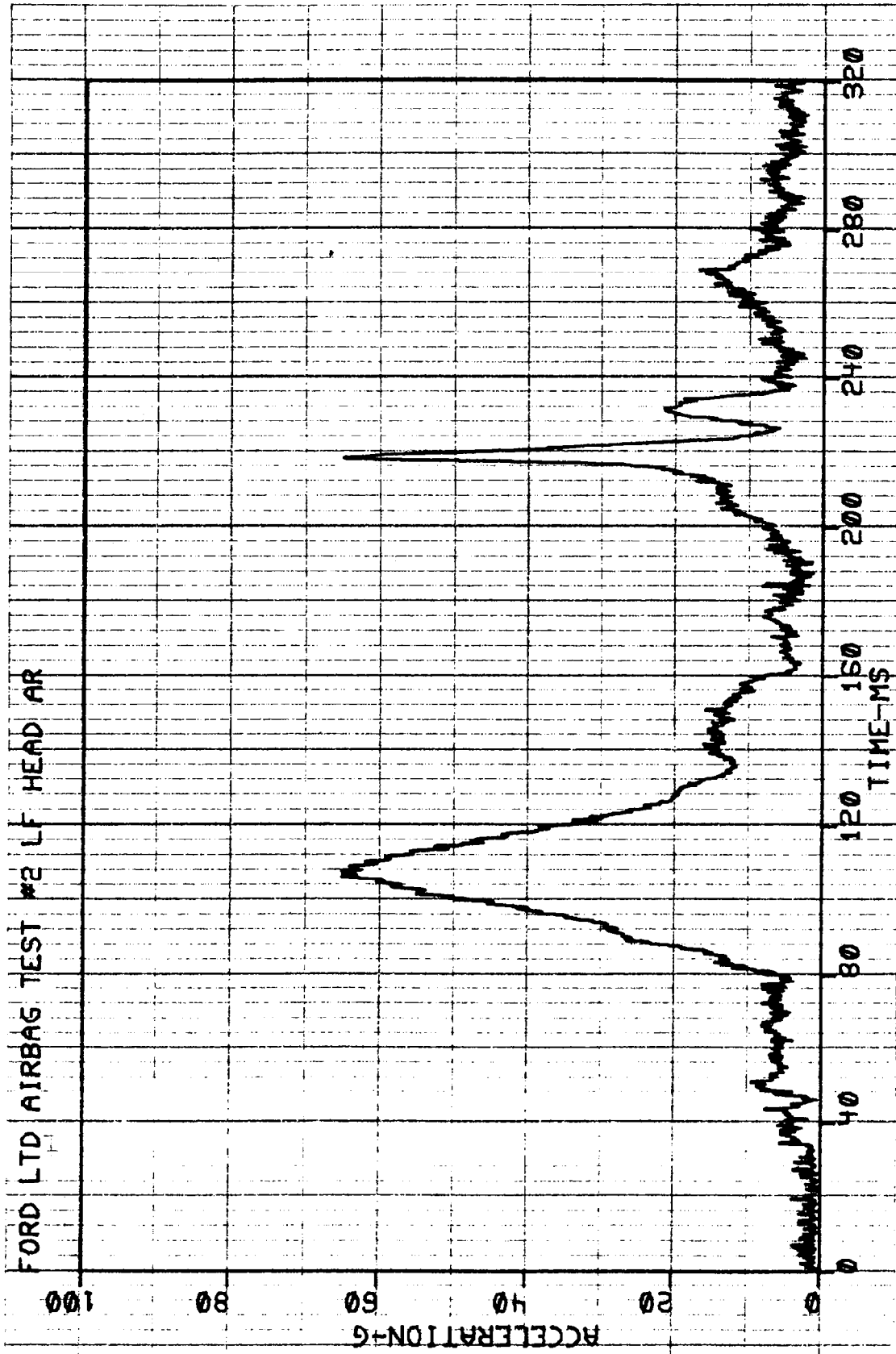
Loc. No.	Location	Field of View	Lens Size	Frm Rate	Tmng Spd	Ser No	Impact Dist-X	C.L. Dist-Y	CAM Hght-Z
1	On-board vehicle roof	Over driver shoulder - view dummy and air bag	8	4	-	7	NA	NA	NA
2	On-board pass. door	90° view of dummy and air bag deployment	8	4	-	6	NA	NA	NA
3	Left side ground-based	Close-up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

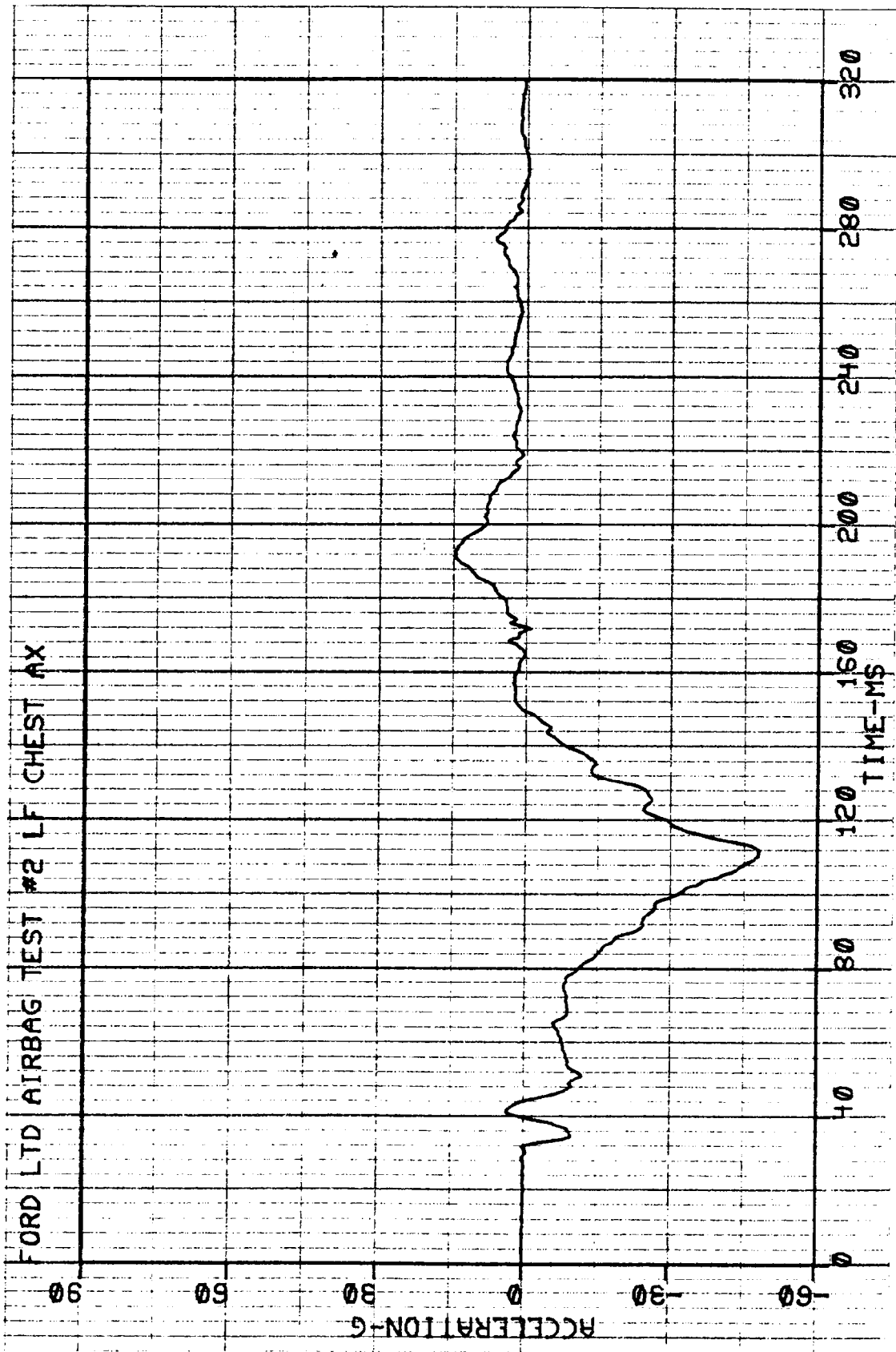
APPENDIX A
CALCOMP PLOTS OF ELECTRONIC DATA

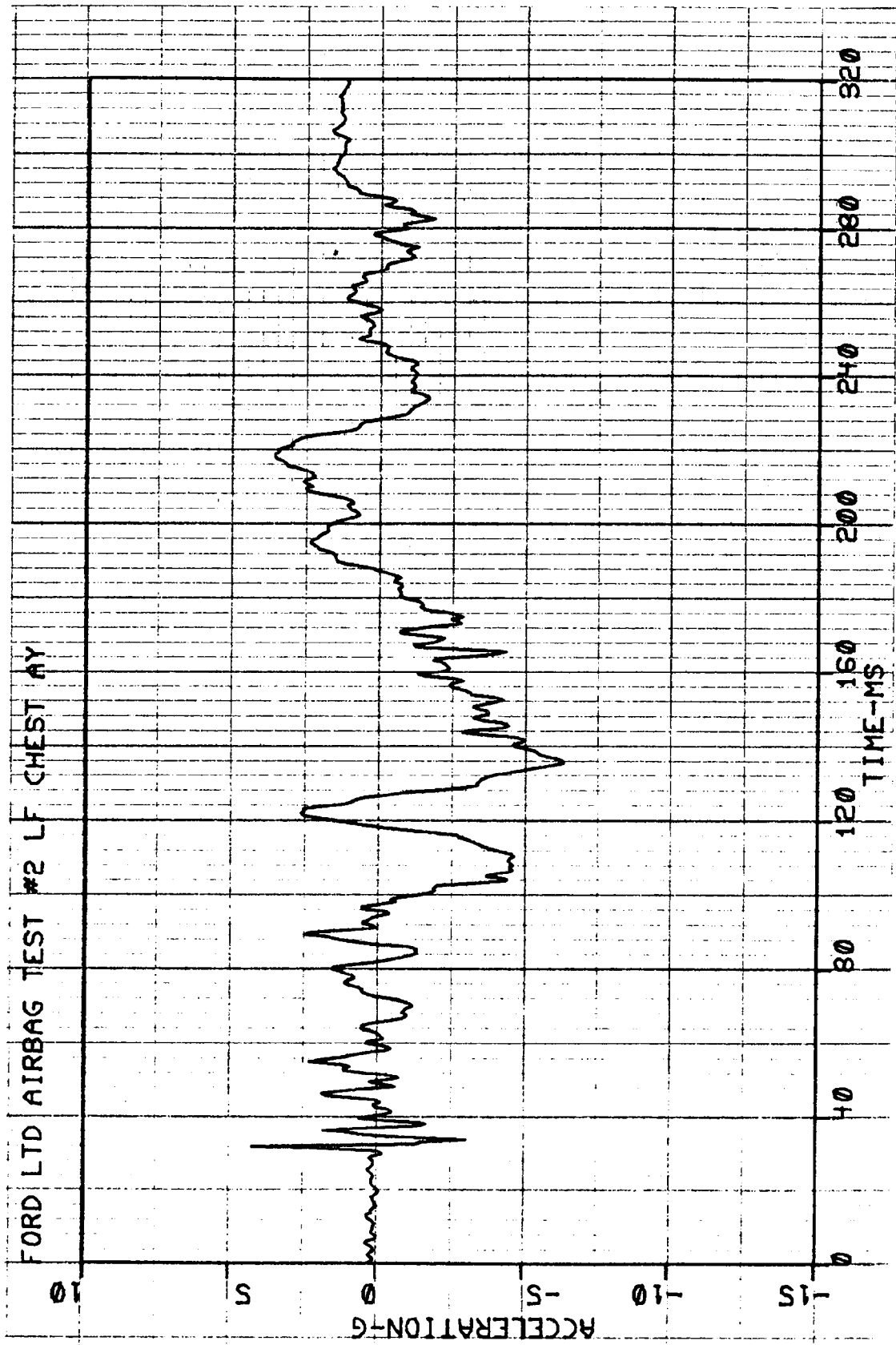


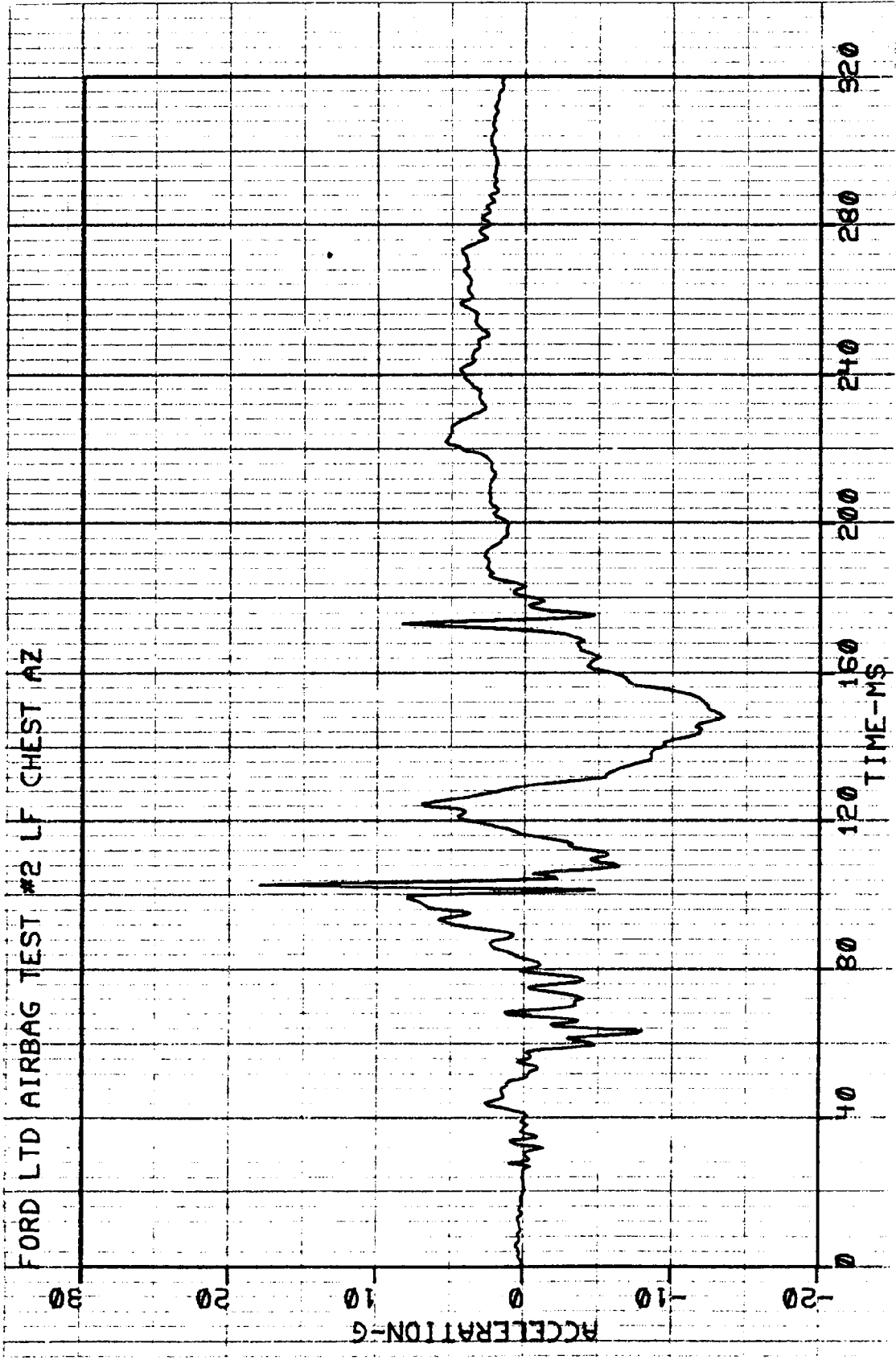


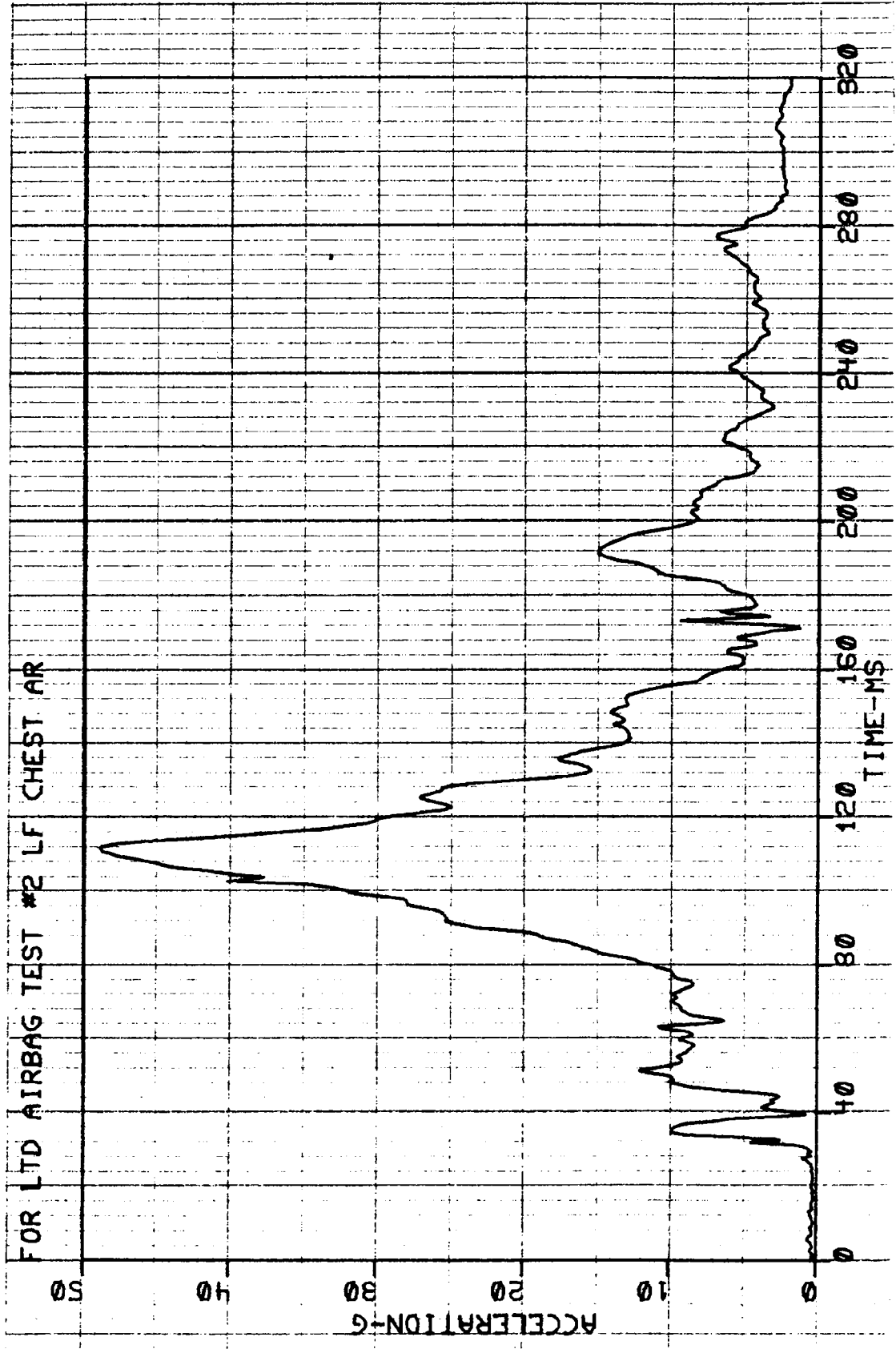


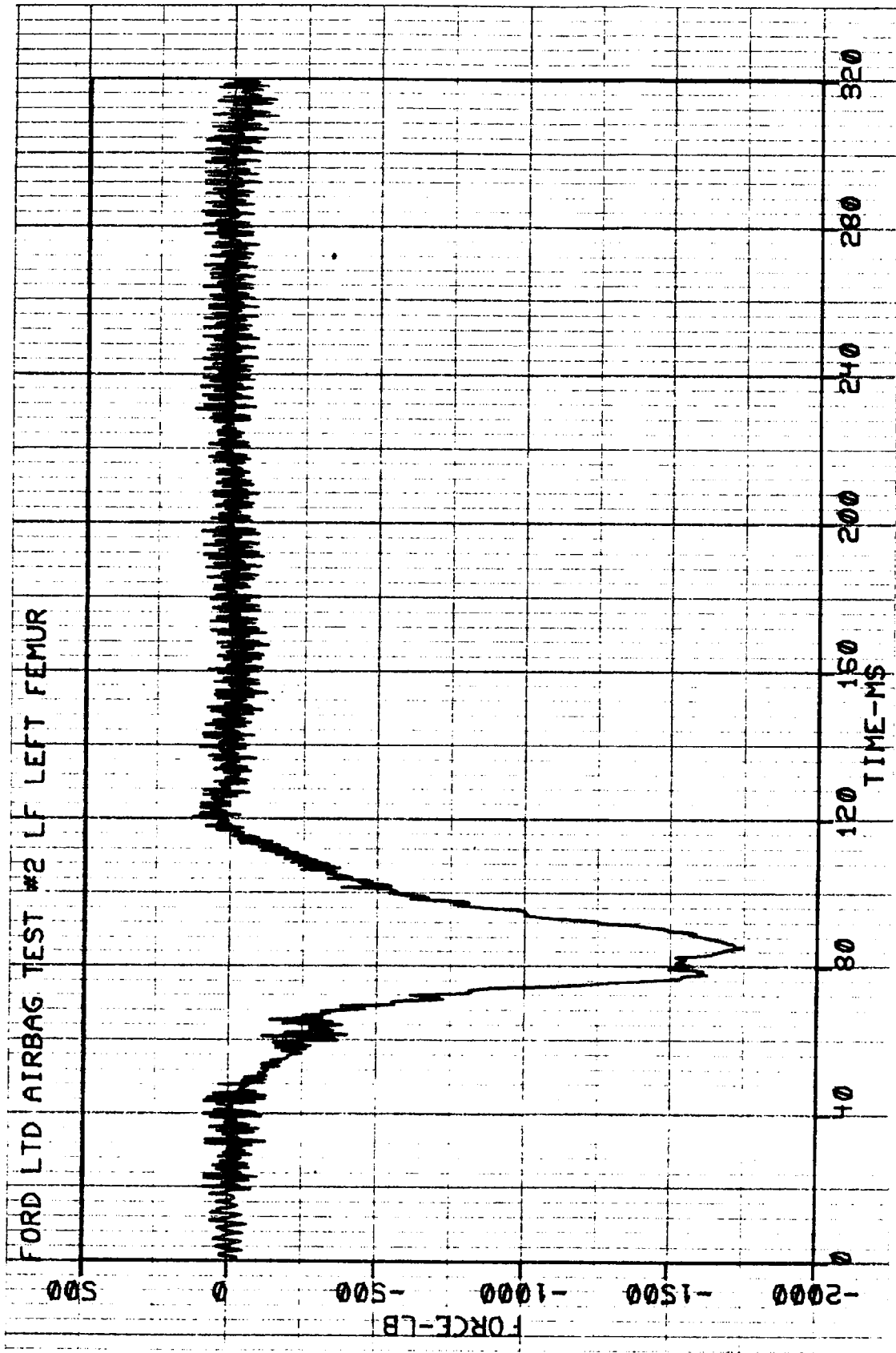


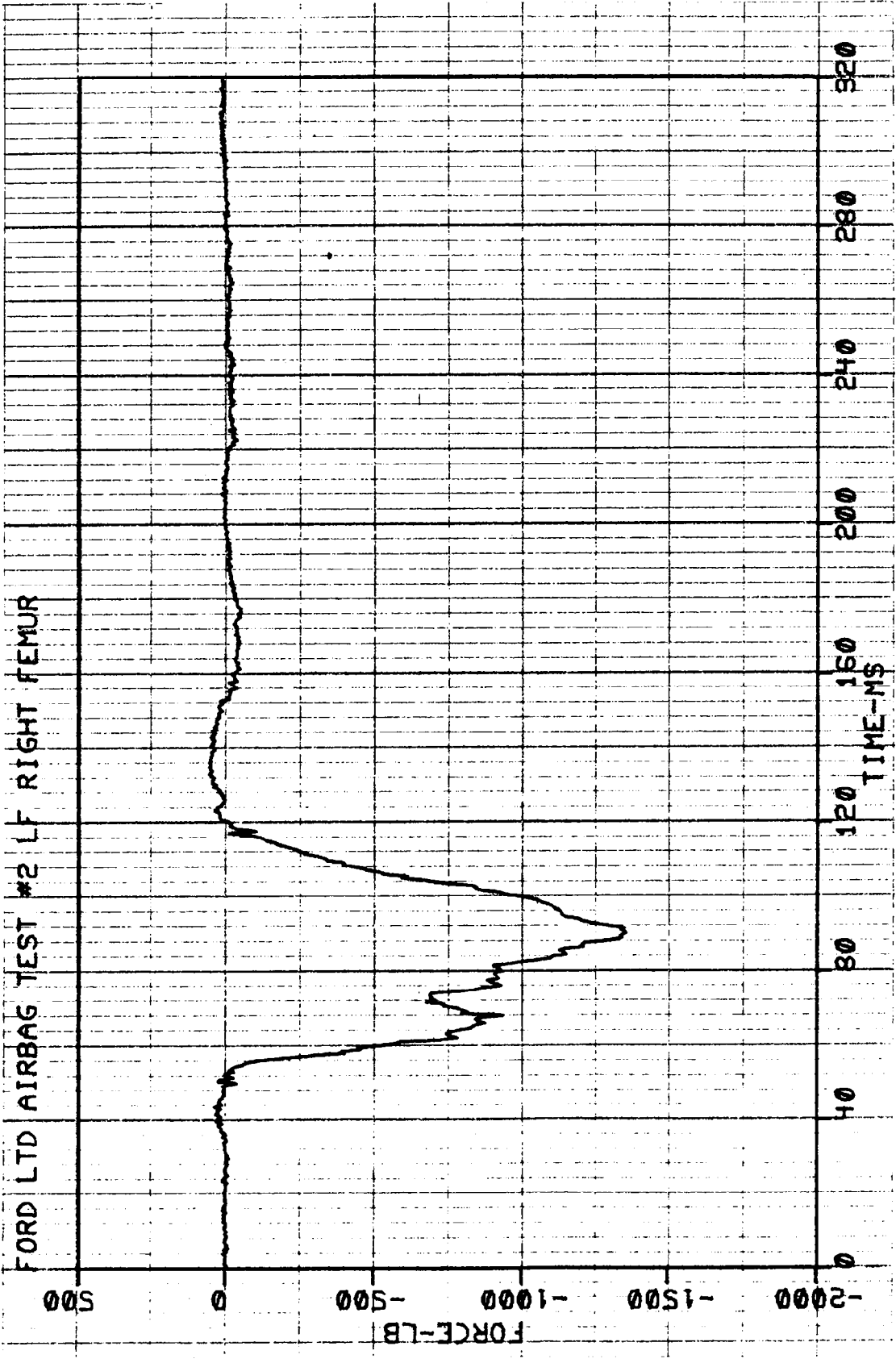


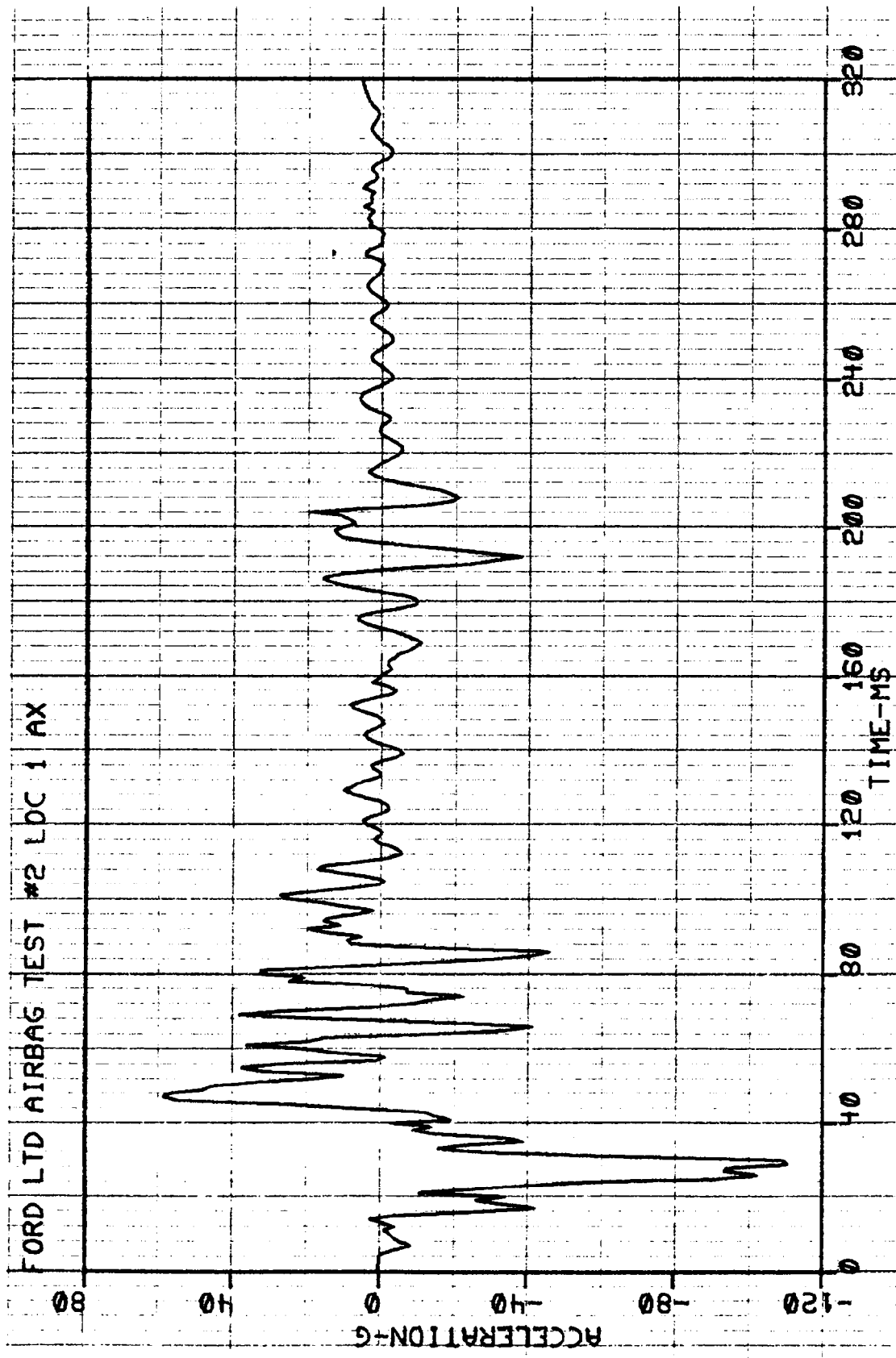


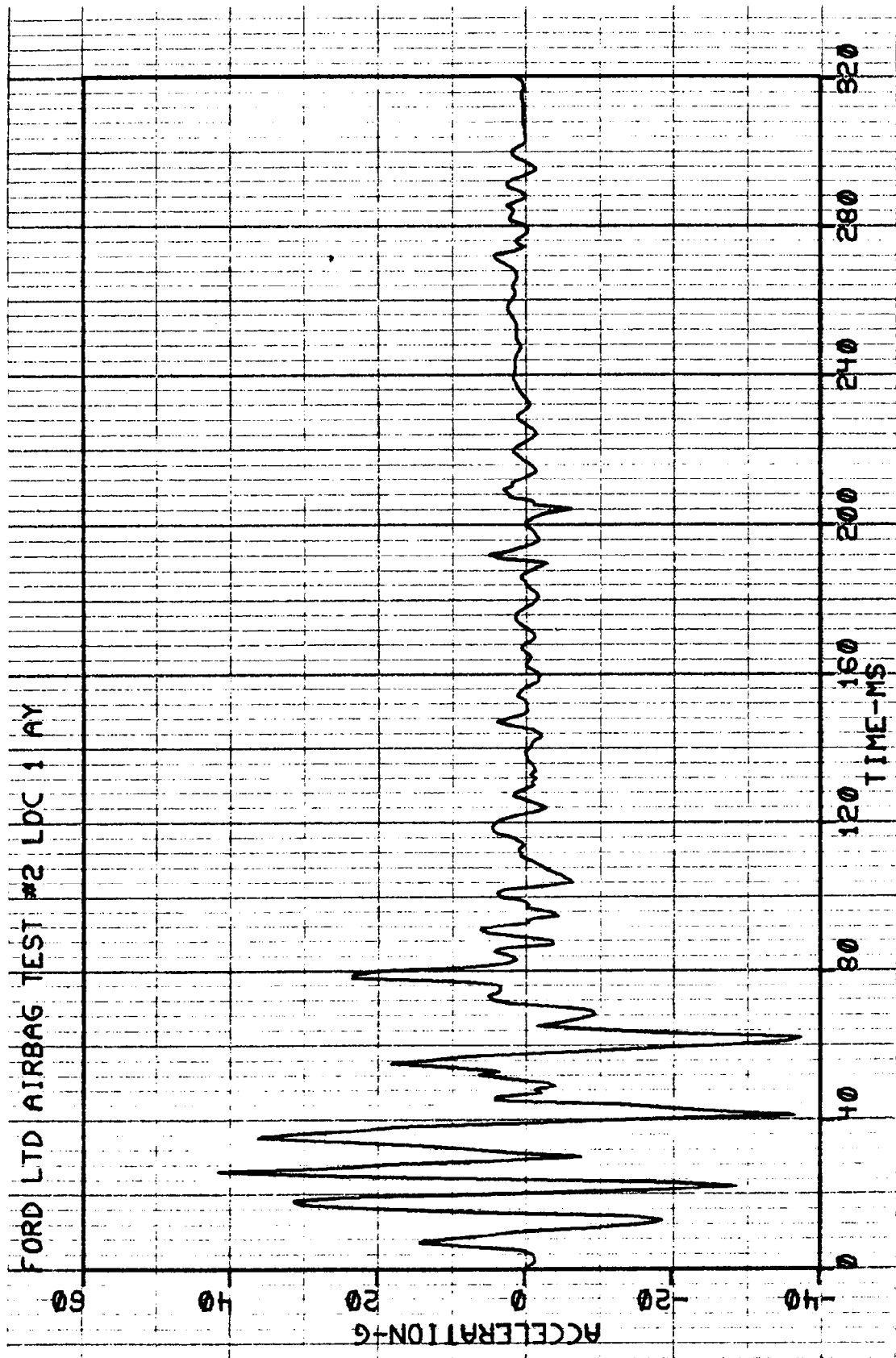


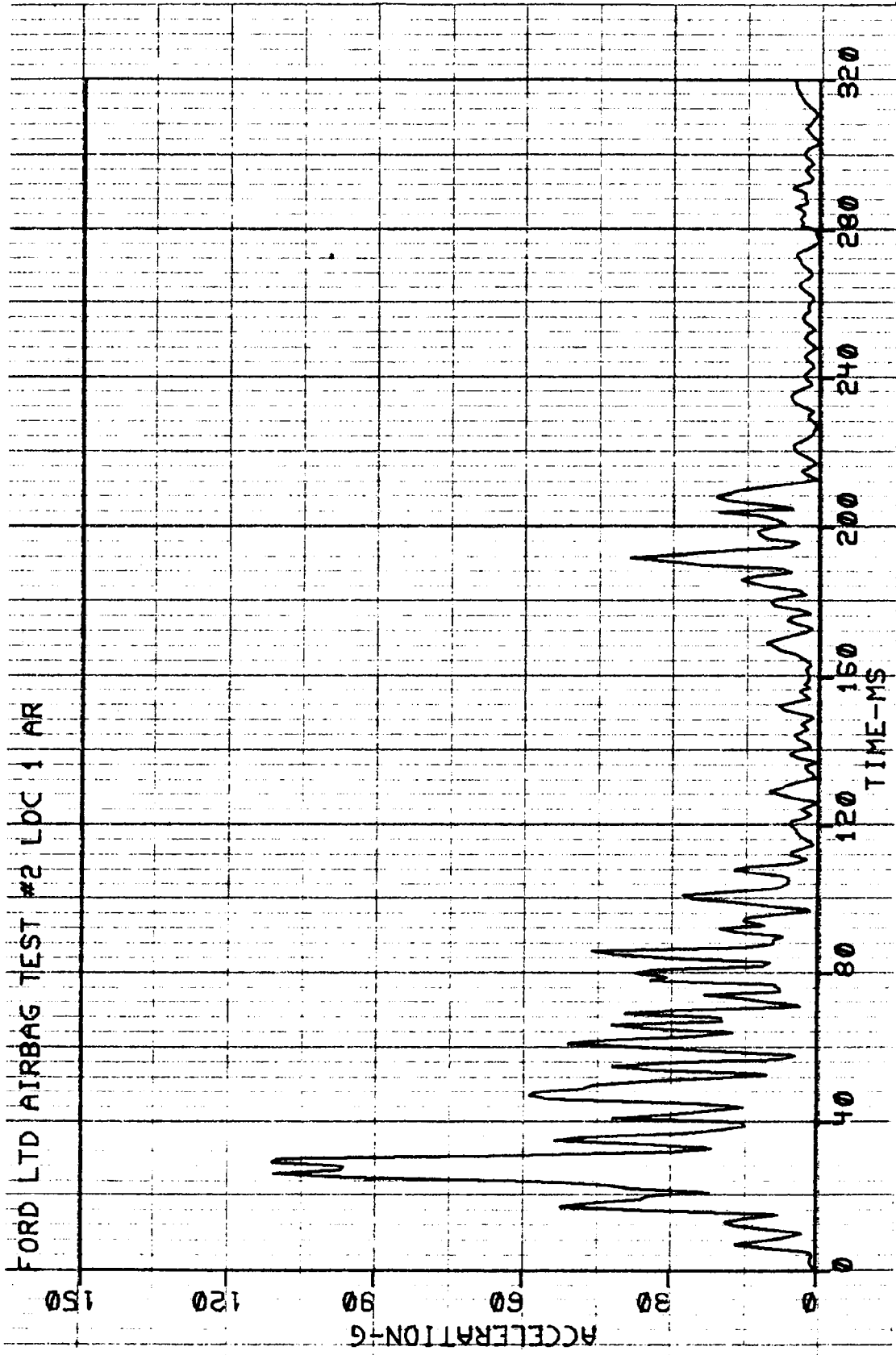


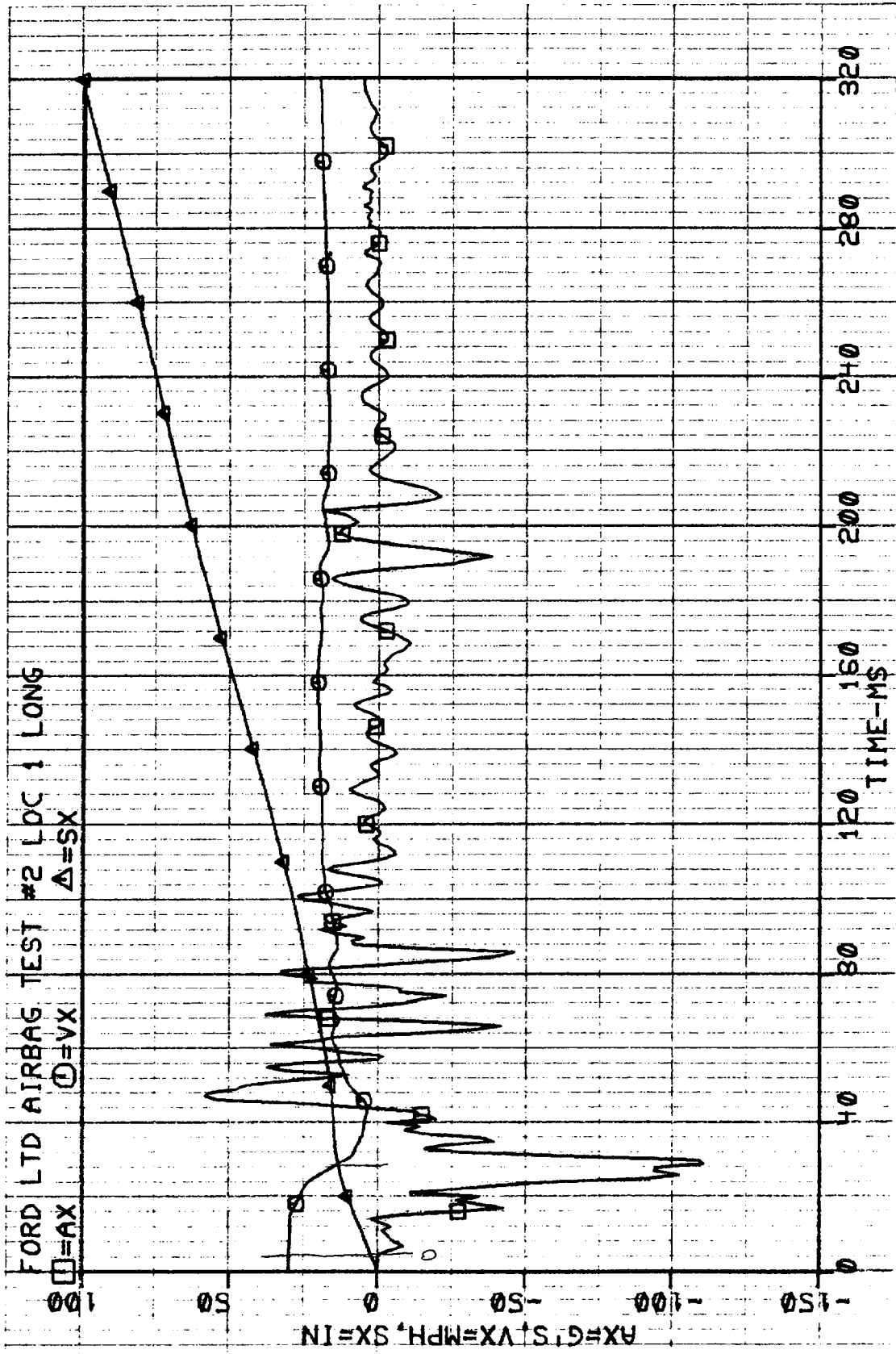


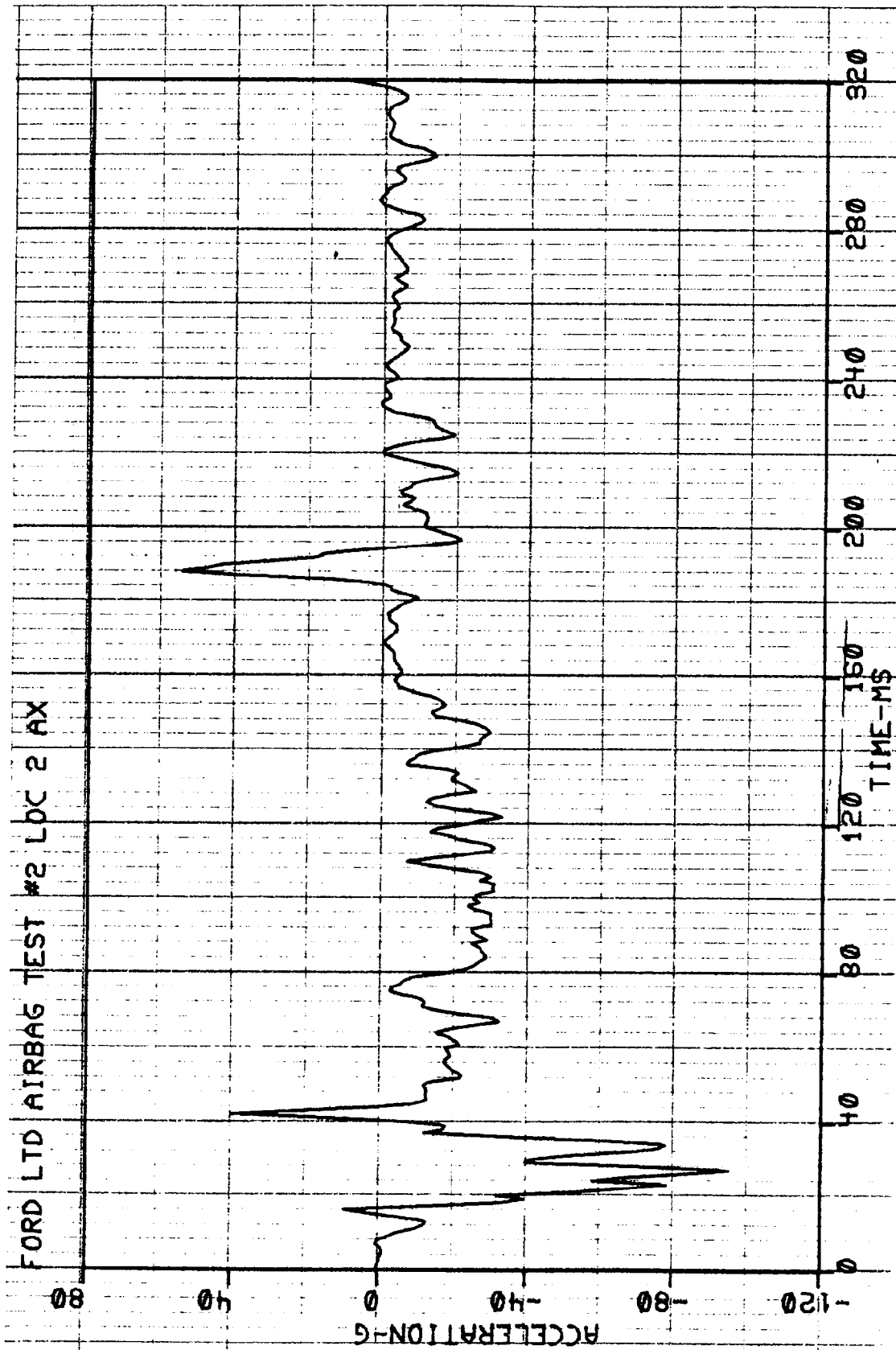


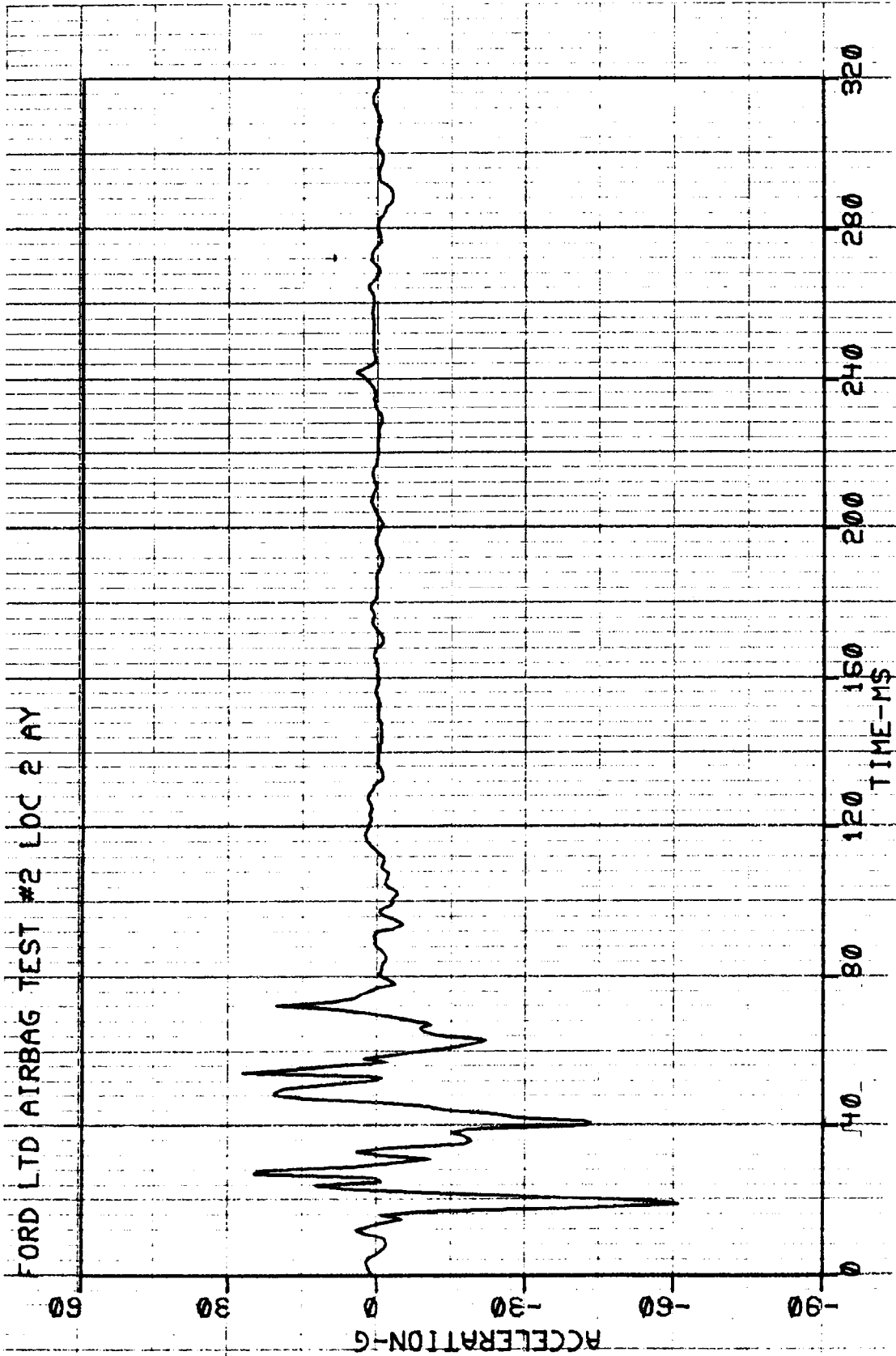


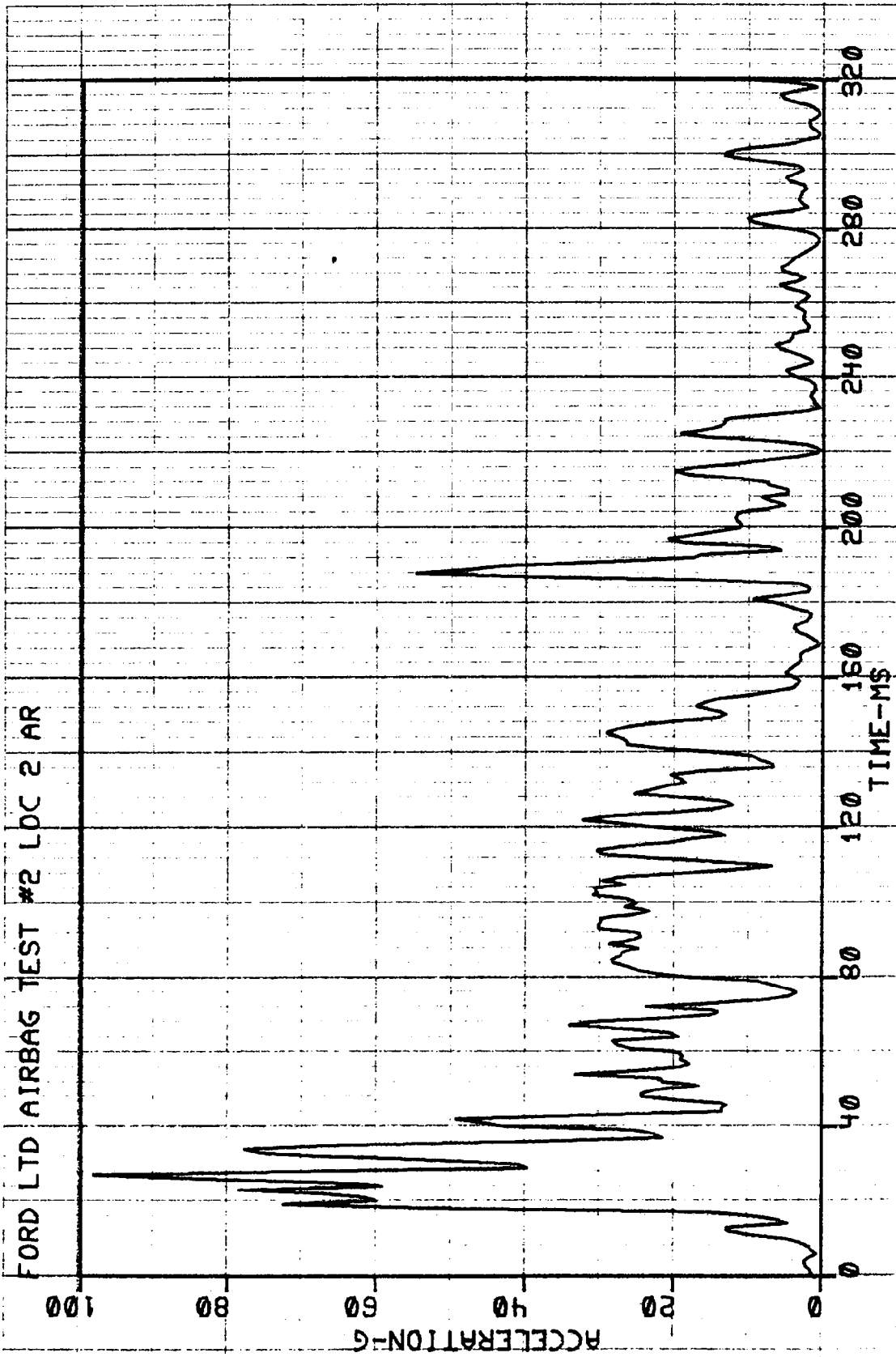


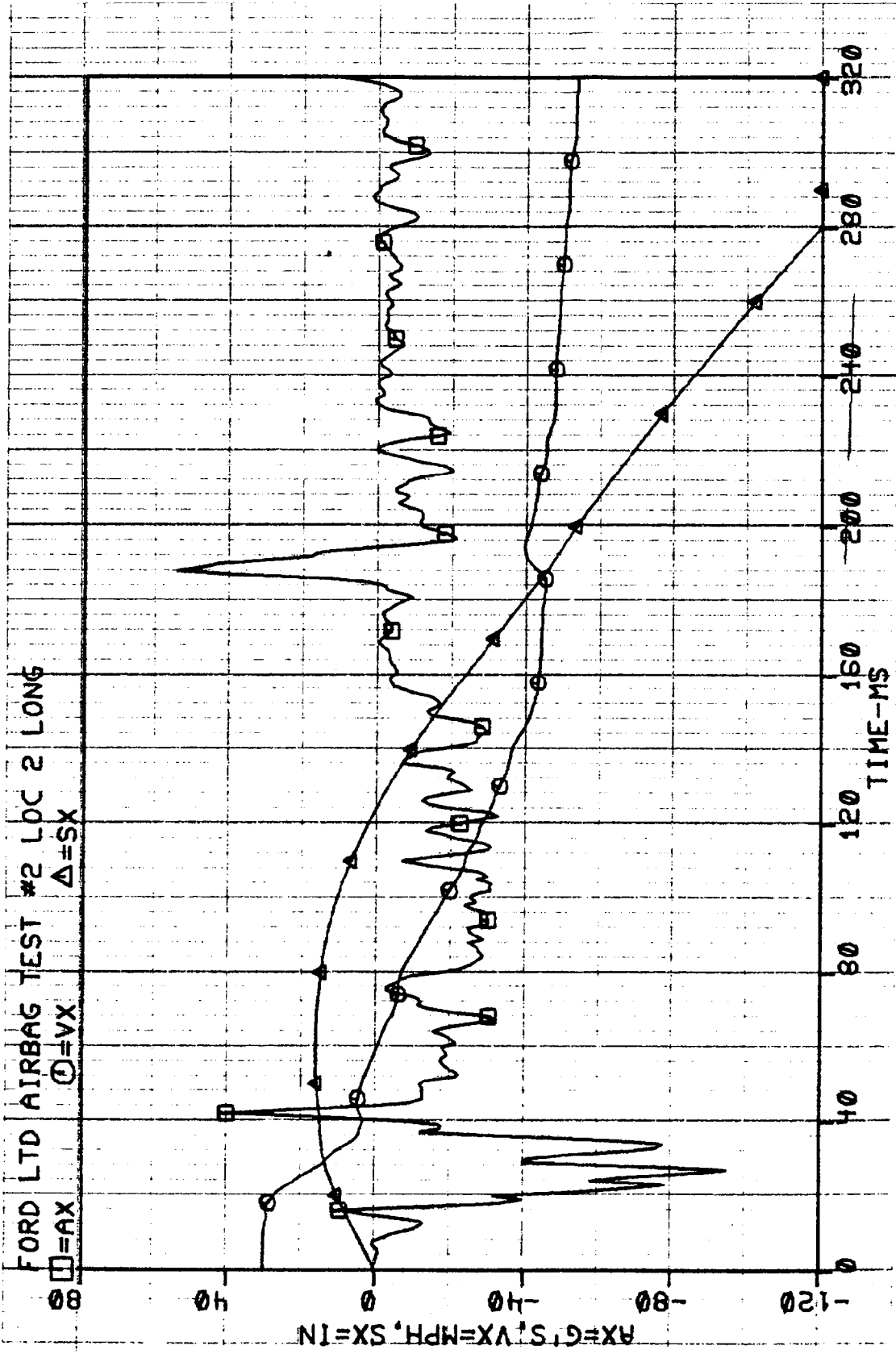


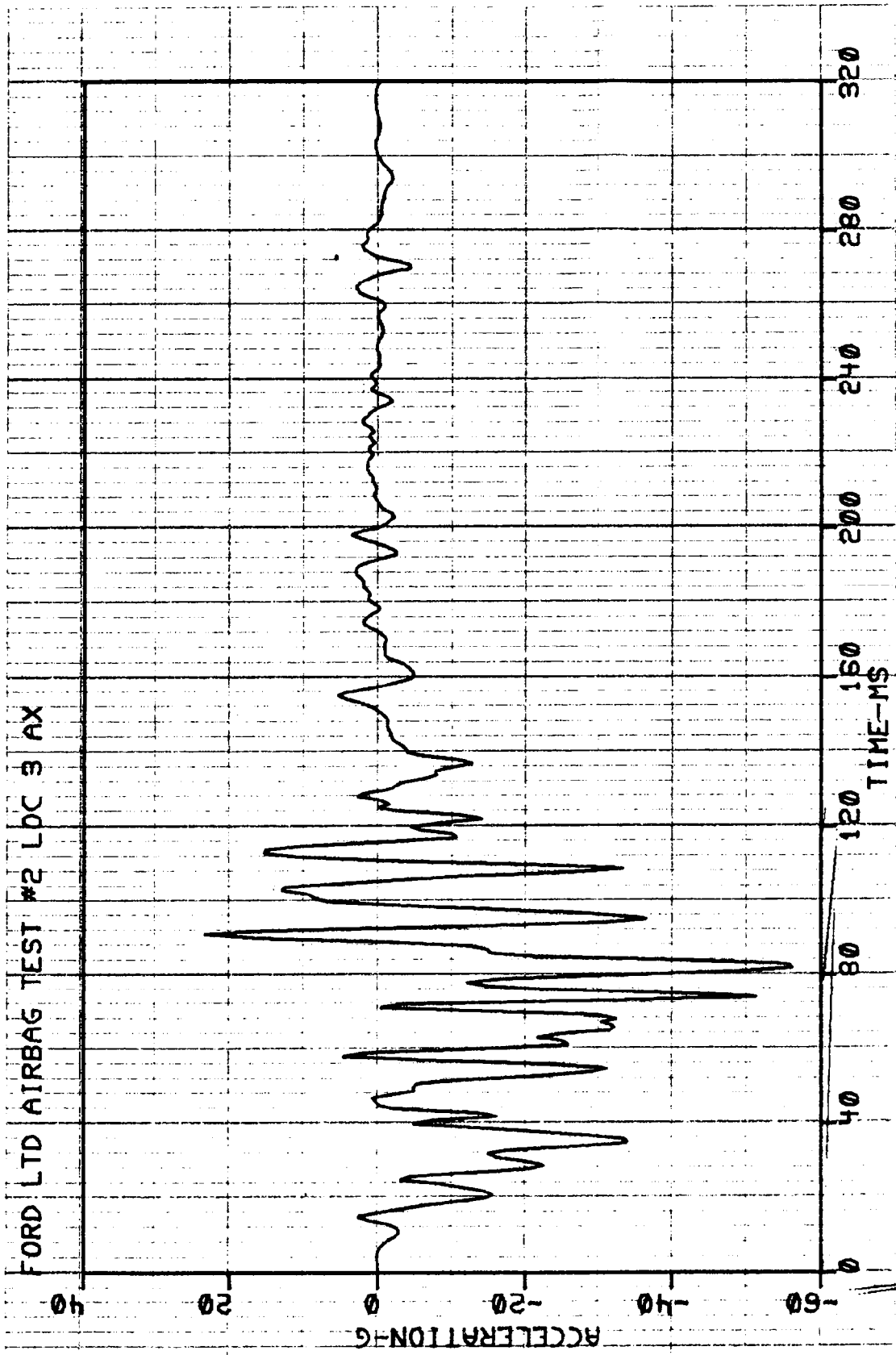


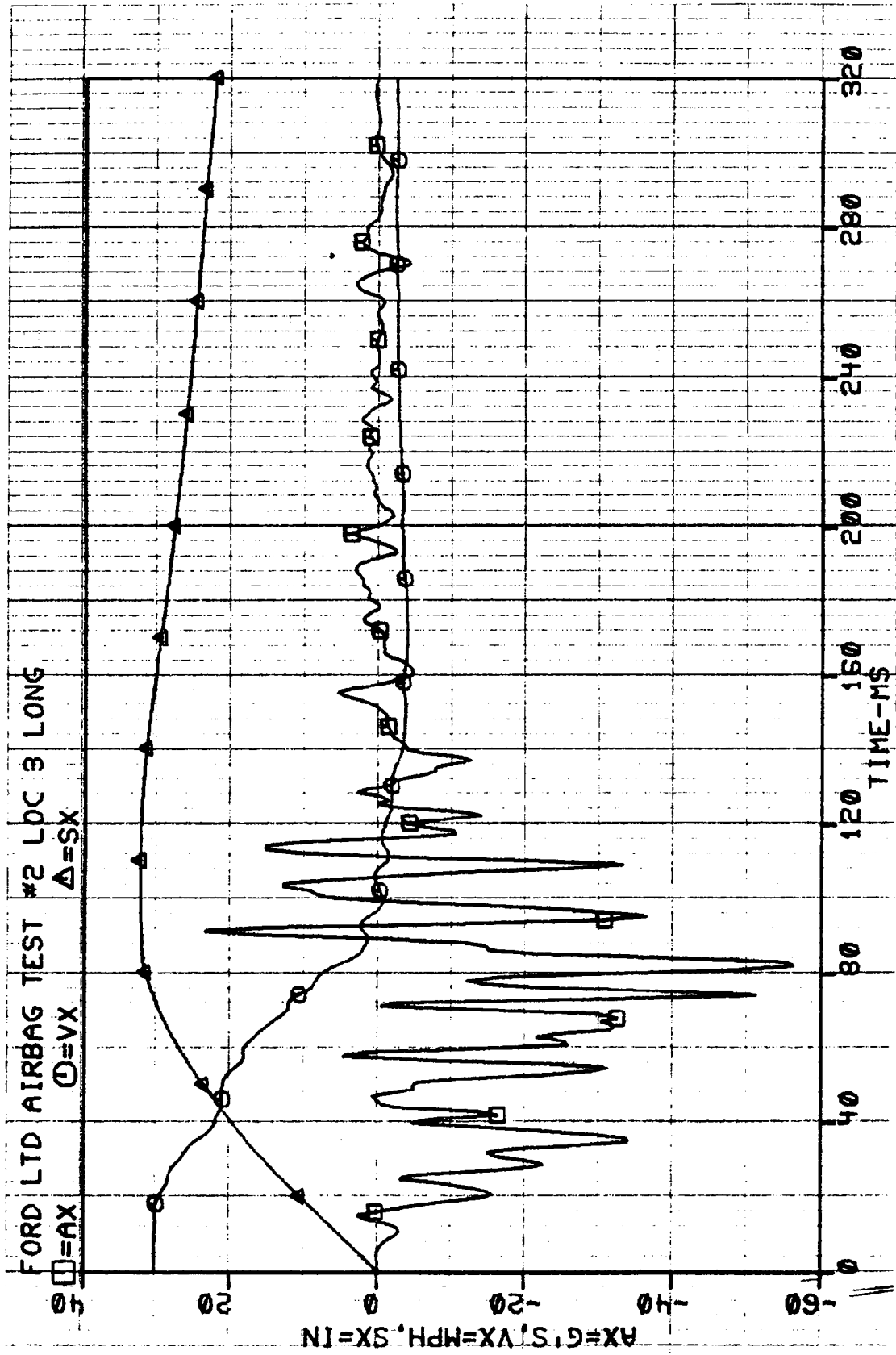


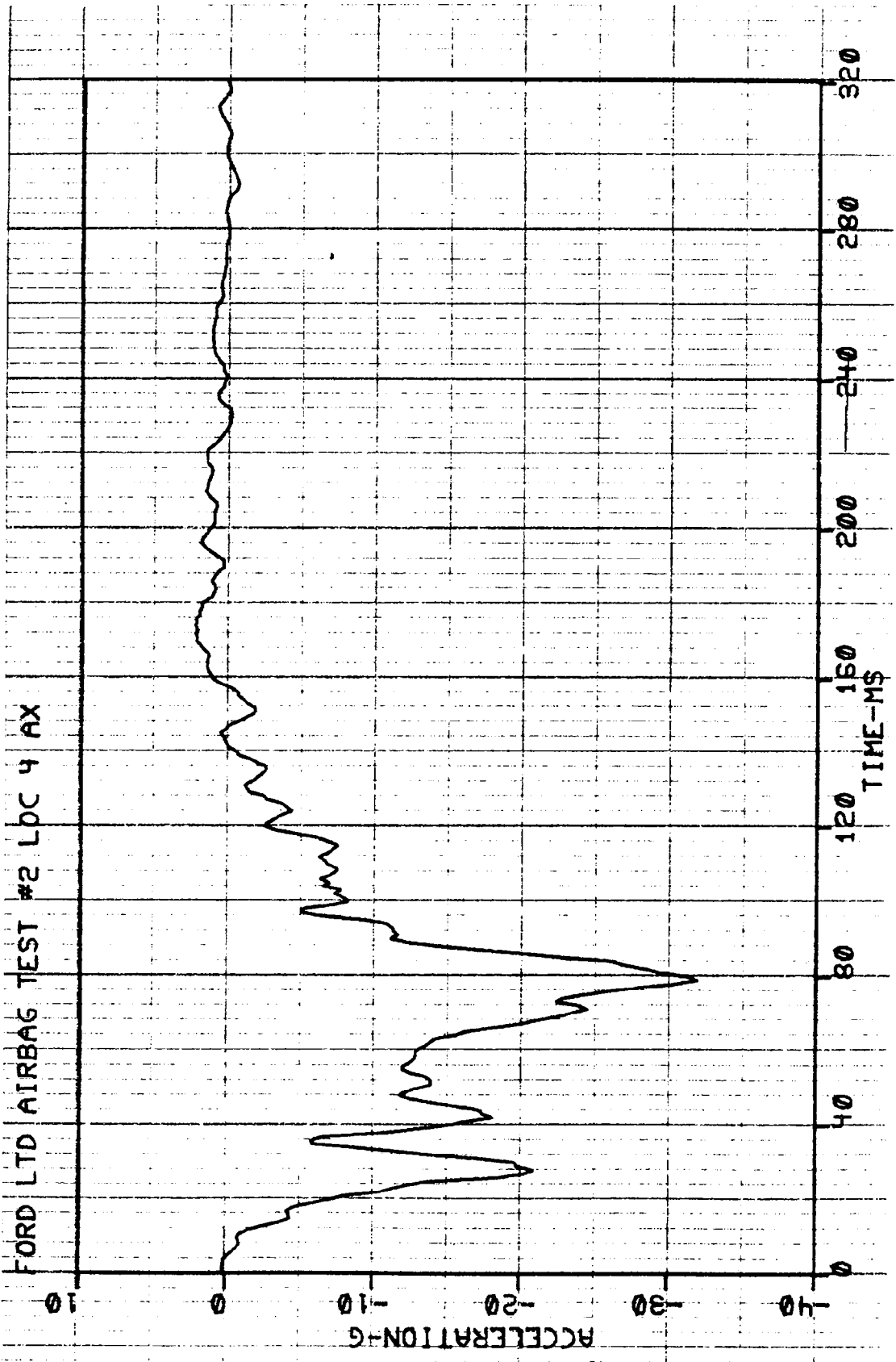


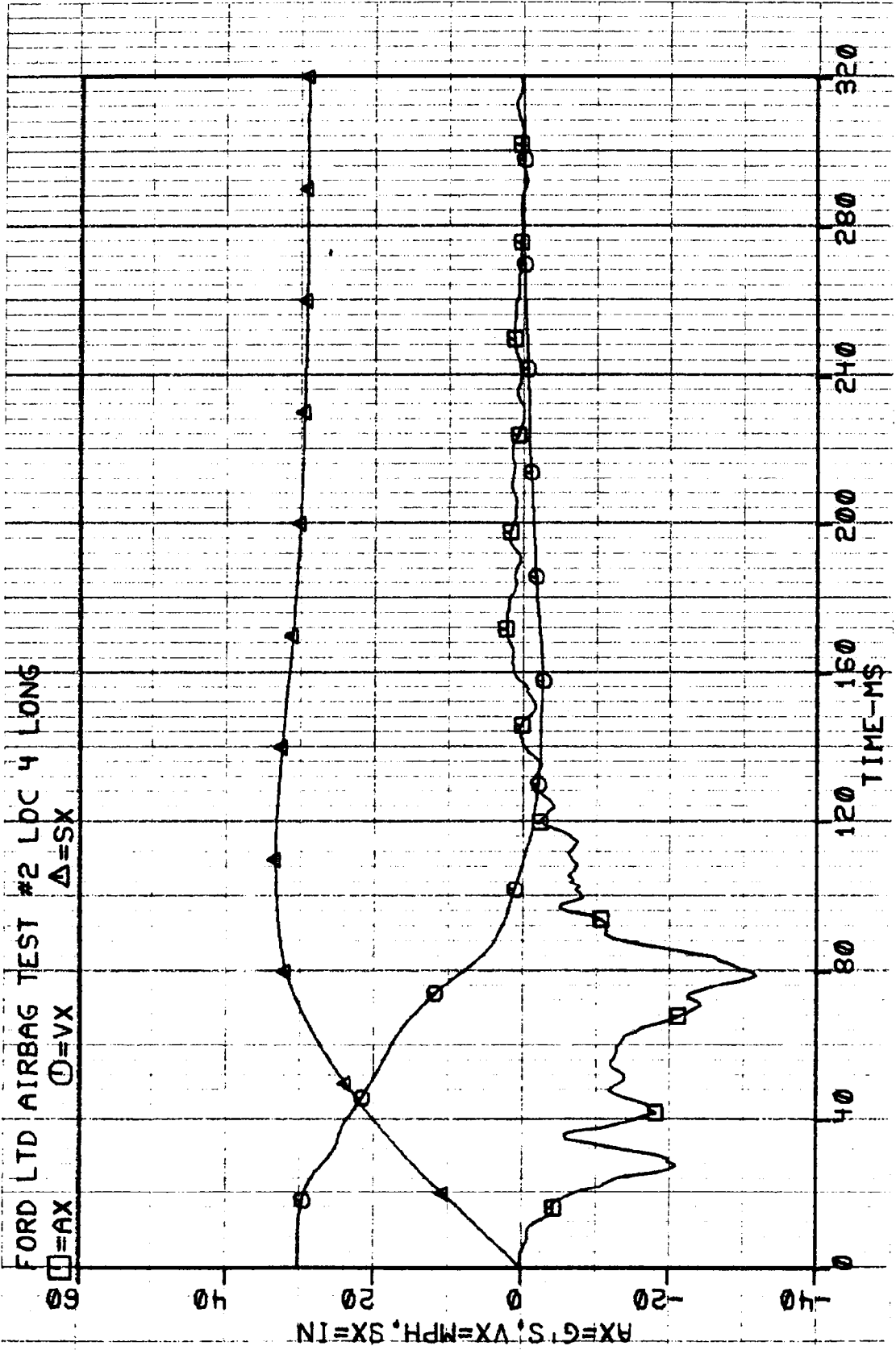


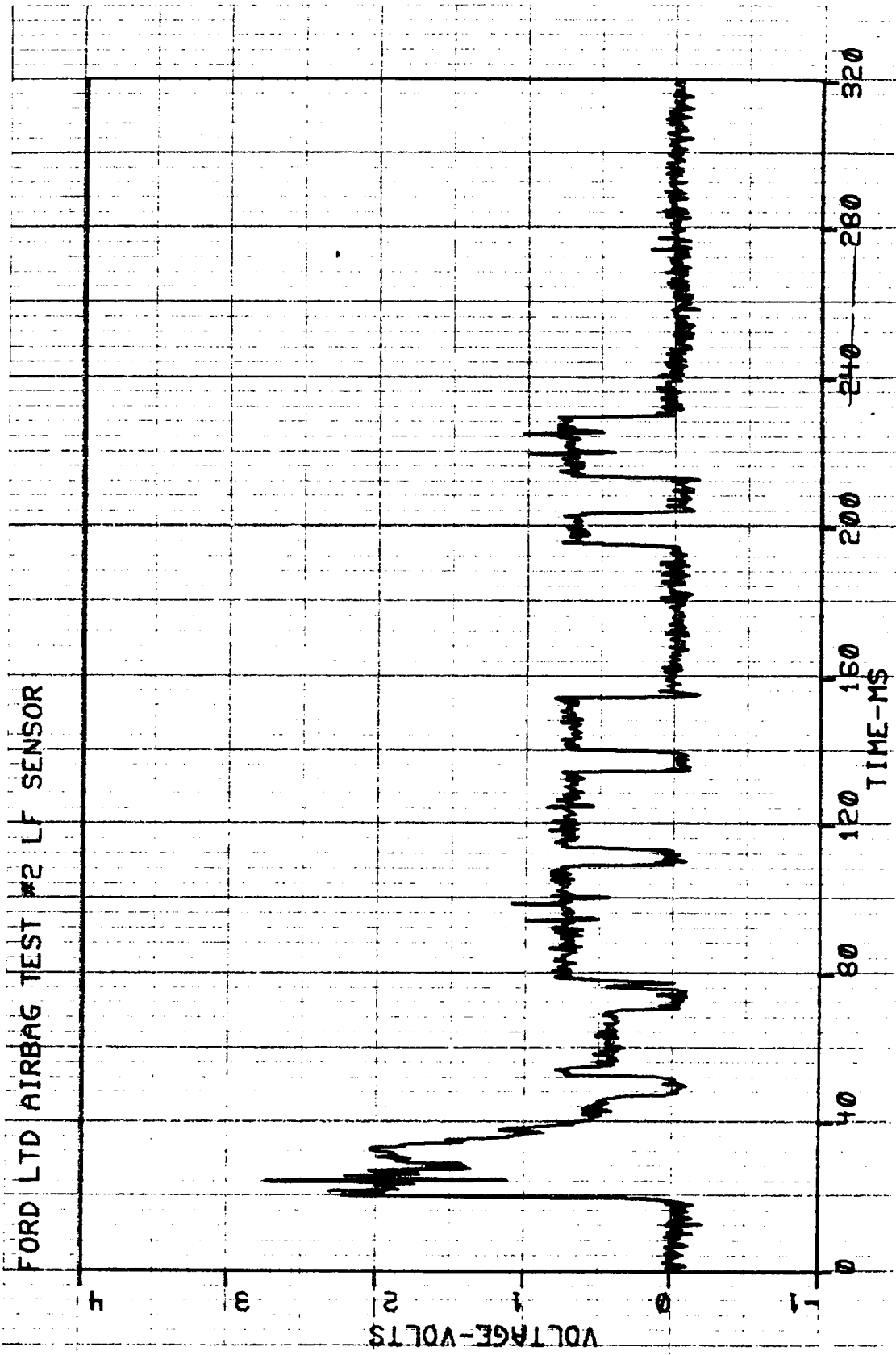


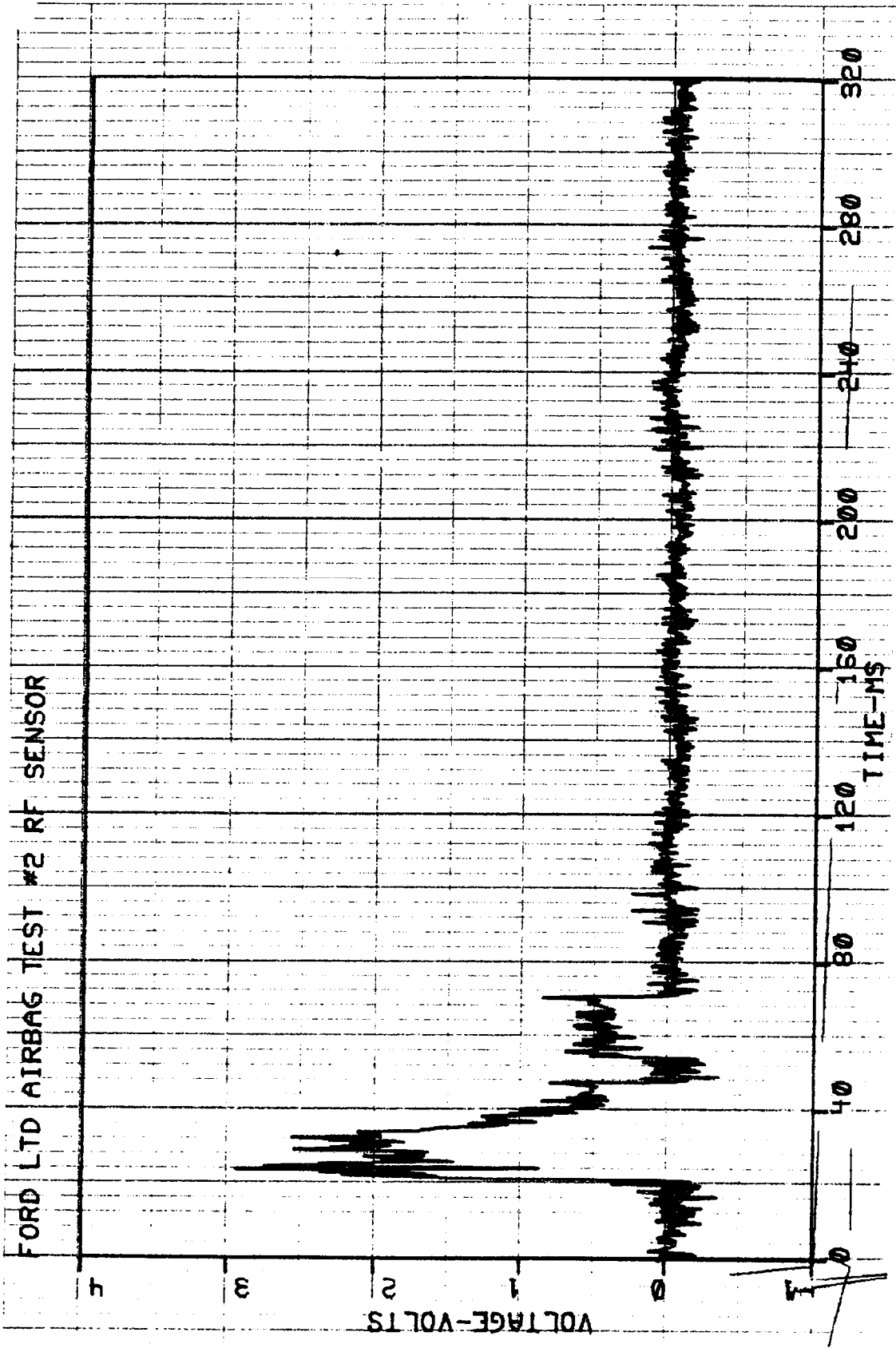


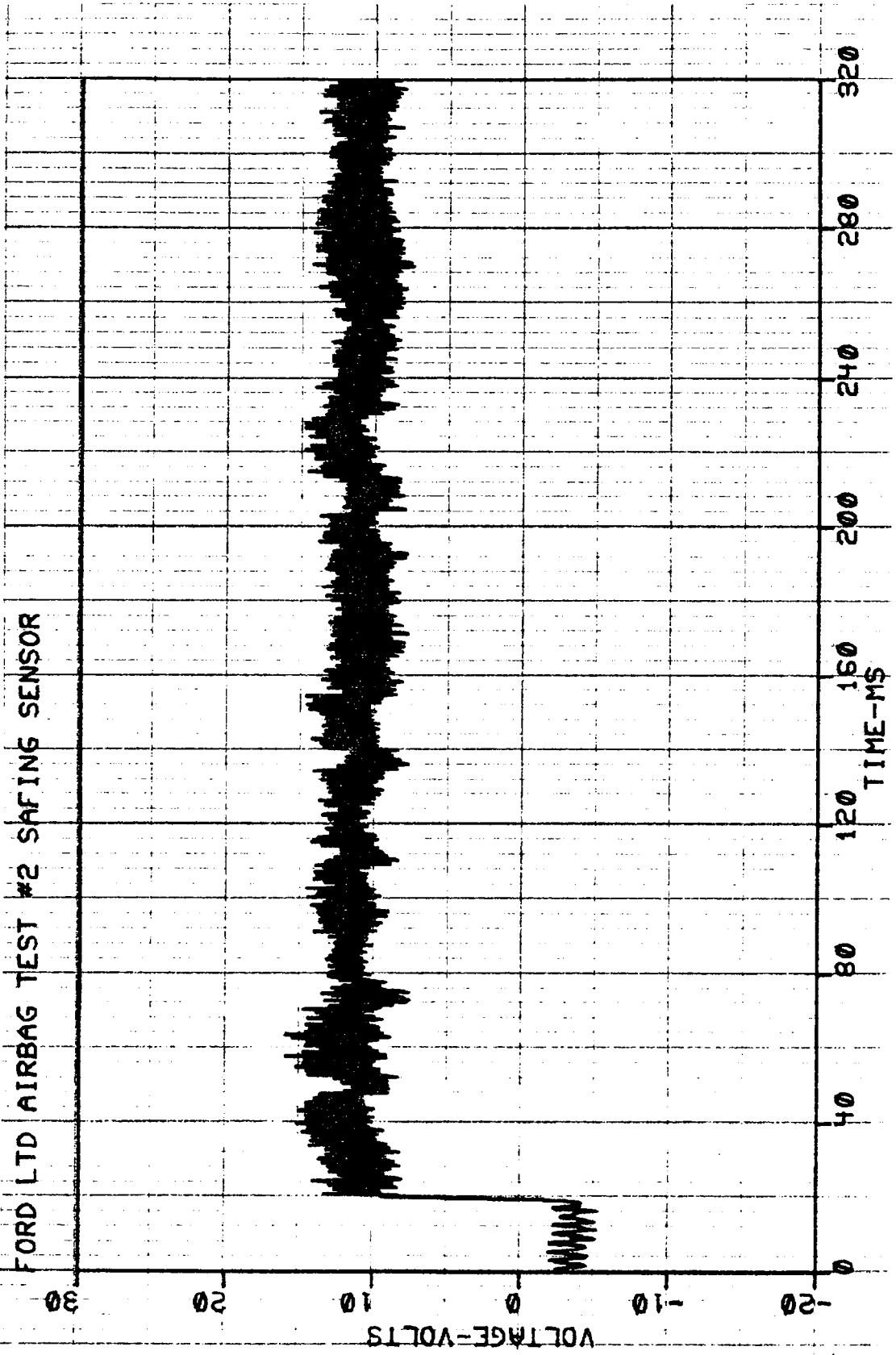


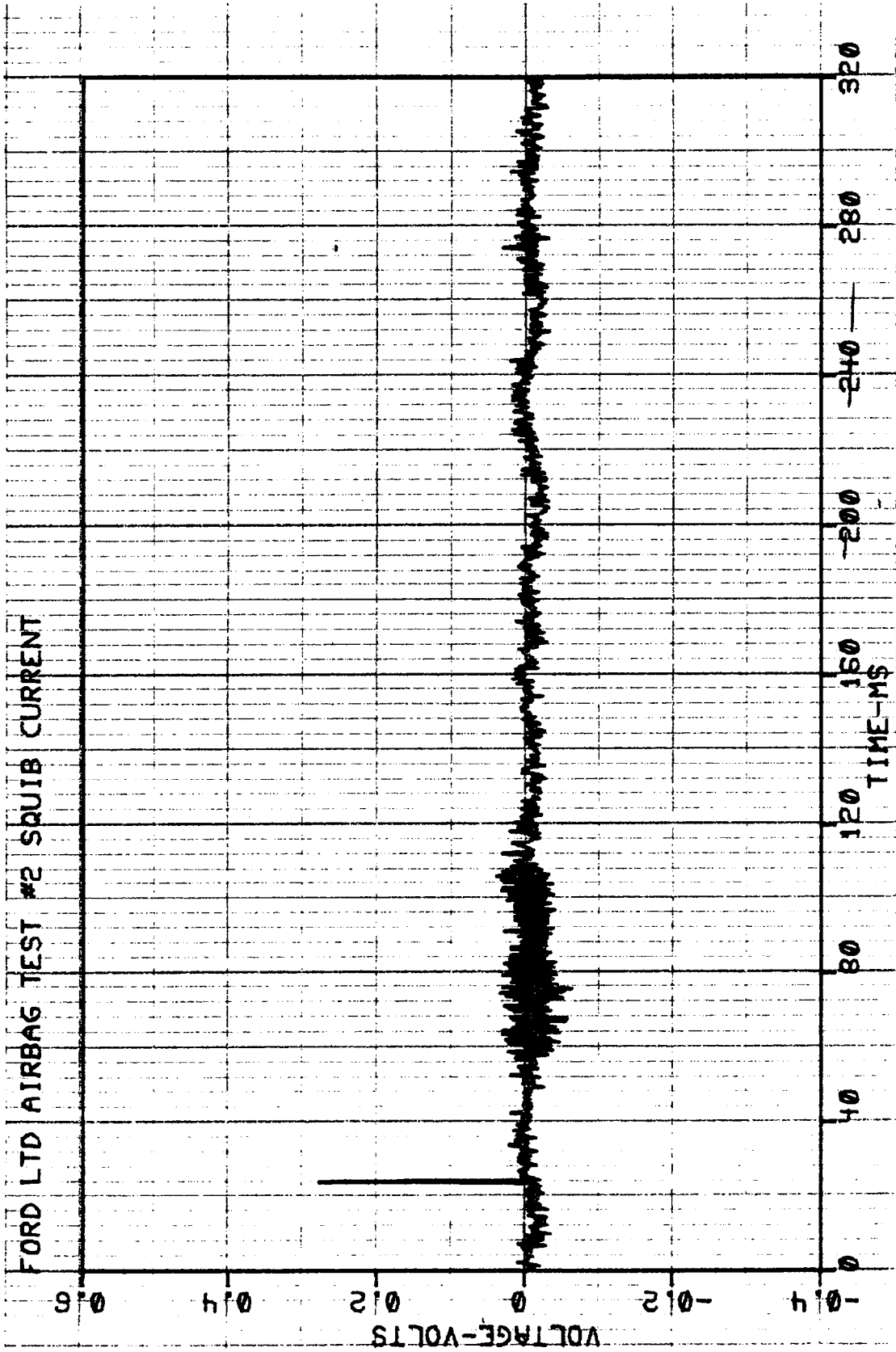












APPENDIX B
PHOTOGRAPHS



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



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



FIGURE B-3. PRE-TEST VIEW OF DRIVER.



FIGURE B-4. PRE-TEST VIEW OF KNEE BOLSTER

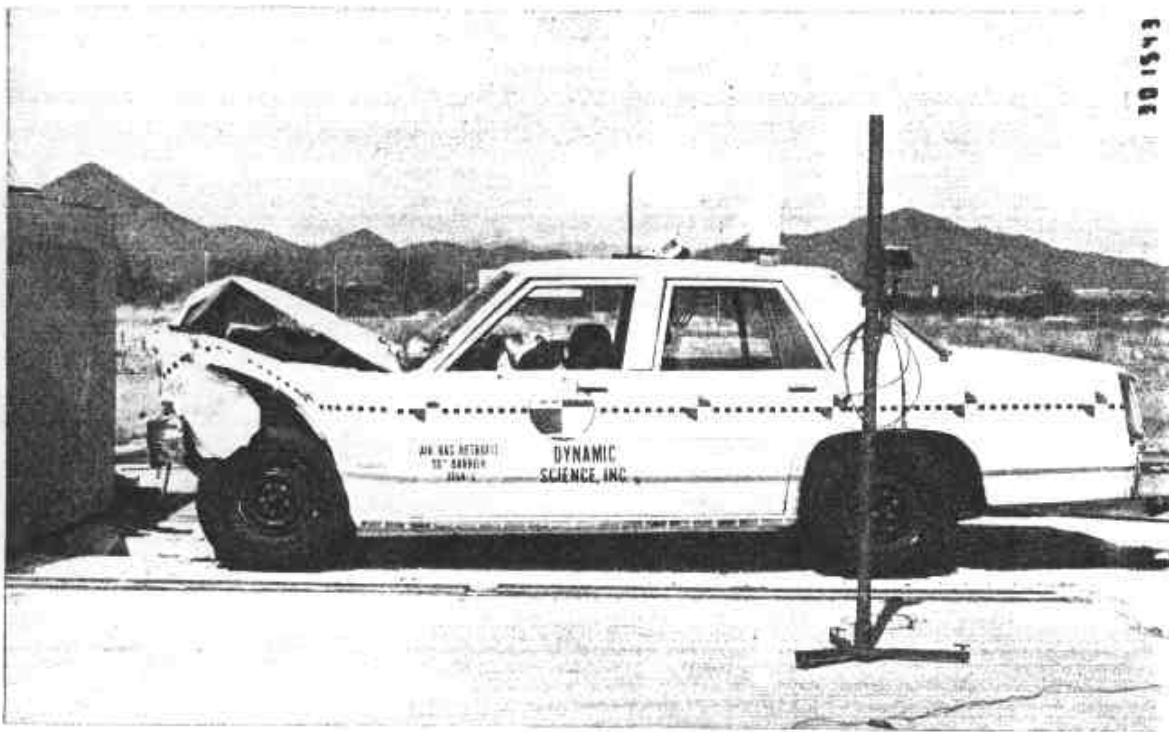


FIGURE B-5. POST-TEST OVERALL VIEW OF VEHICLE.



FIGURE B-6. POST-TEST VIEW OF DRIVER.



FIGURE B-7. POST-TEST VIEW OF DRIVER.

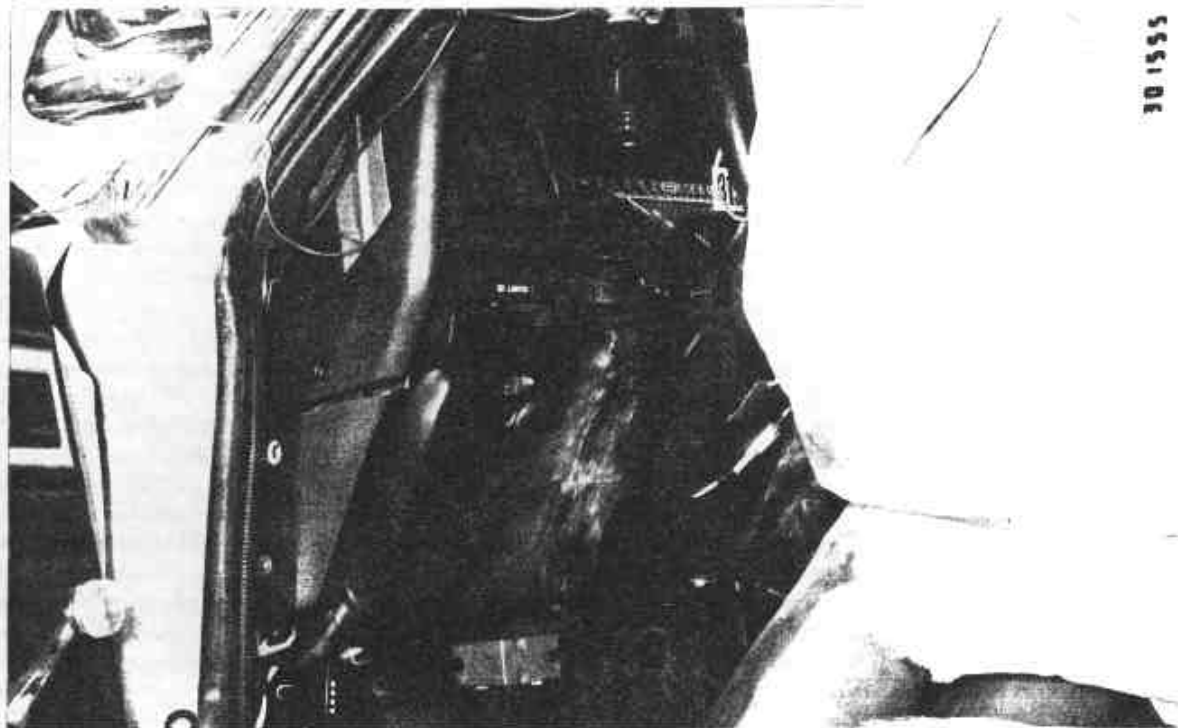


FIGURE B-8. POST-TEST VIEW OF KNEE BOLSTER.