DOT ϕ 100

INTERIOR DOOR BEHAVIOR IN A LATERAL COLLISION

Contract Number: DOT-HS-8-01943
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M. Alan Aylor
Eugene N. Jones
Frank J. Jancar

GENERAL ENVIRONMENTS CORPORATION
HARTWOOD, VIRGINIA 22471

July 1980

FINAL REPORT

PREPARED FOR

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

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Prepared by: Eugene N. Jones
Special Services Engineer

Approved by: M. Alan Aylor
M. Alan Aylor
Manager, Automotive Dynamic Laboratory

Date: 24 July 1980

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Contract Technical Manager
Office of Vehicle Safety Research

Date

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15. SUPPLEMENTARY NOTES

16. ABSTRACT

A 90 degree side (right) impact test of a 1973 Ford LTD, 4-door sedan was performed at the General Environments Corporation, Automotive Dynamics Laboratory. The impacting vehicle was a 1974 Ford LTD, 4-door hardtop. The impact speed was 29.28 mph. Maximum passenger compartment intrusion was 13.81 inches. Maximum vehicle exterior crush (right side) was 16.37 inches.

17. KEY WORDS	18. DISTRIBUTION STATEMENT
Side Impact Passenger Compartment Intrusion	

19. SECURITY CLASSIFICATION (OF THIS REPORT)	20. SECURITY CLASSIFICATION (OF THIS PAGE)	21. NO. OF PAGES	22. PRICE
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1. INTRODUCTION

General Environments Corporation under contract to the National Highway Traffic Safety Administration (NHTSA), Department of Transportation (DOT) conducted an intervehicular, 90 degree side impact collision on 27 December 1979. Vehicles used in the test were a 1974, 4-door hardtop Ford LTD and a 1973, 4-door Ford LTD sedan. The 1974 Ford LTD served as the bullet vehicle and the 1973 Ford LTD as the target vehicle. The bullet vehicle impacted the passenger (right) side of the target vehicle at a velocity of 29.28 mph. Impact forces on both the bullet and target vehicles were measured by on board accelerometers. The crash event was documented photographically with high-speed 16mm color motion film.

2. PURPOSE

The purpose of the test was to reconstruct a 30 mph, 90 degree side impact, originally conducted in 1974 with occupants in the target vehicle, with no occupants in the target vehicle. The Calspan Corporation Advanced Technology Center conducted the original test under Contract No. DOT-HS-4-00922. The test, referred to as Calspan Test One, disclosed at about 30 msec. into the crash event forces build up on the interior door.

3. CRASH TEST SUMMARY

A 1973, 4-door Ford LTD sedan was laterally impacted by a 1974, 4-door Ford LTD at a velocity of 29.28 mph. The angle of impact was 90 degrees. The bullet vehicle (1974 Ford) impacted the passenger (right) side of the target vehicle (1973 Ford) such that the passenger (right) side edge of the bullet vehicle passed through the D.O.R. point of the target vehicle. Test weights of the bullet and target vehicles were 4,510 pounds and 4,660 pounds, respectively. Relevant crash test information is listed in Table 1. Vehicle descriptive data for the test vehicles is presented in Tables 2 and 3. Pre-test and post test photographs of the vehicles are presented in Appendix A.

Maximum intrusion into the passenger compartment of the target vehicle was 13.81 inches. Maximum exterior crush on the passenger (right) side of the target vehicle was 16.37 inches. A general exterior crush contour for the passenger side of the target vehicle is shown on Figure 1. Maximum longitudinal crush on the bullet vehicle was 5.19 inches.

4. INSTRUMENTATION

The test vehicles were instrumented with accelerometers at locations specified in the Statement of Work with one exception. Accelerometers designated as numbers 13 and 14 in the Statement of Work were omitted from the target vehicle per clearance from the CTM. Tables 4 and 5 list the accelerometer locations on the bullet and target vehicles, respectively.

5. TEST RESULTS

All accelerometer data were processed and filtered in accordance with the requirements contained in the Statement of Work. Complete data in final form for the crash test performed are contained in Appendix B.

Immediately following the crash event a "quick look" analysis of data obtained disclosed that data was not obtained from four (4) target vehicle channels and nine (9) bullet vehicle channels. Preliminary analysis of the data collection malfunction was traced to one of the two FM magnetic tape recorders used in the test. The faulty recorder was determined to have been operating normally until approximately fifty (50) feet before impact, at which time it had a recording malfunction. Follow-on partial disassembly and inspection of the recorder revealed the bias oscillator pin (number 8) female contacts were spread apart. A lack of connection at this point could not be proven; however, no output from the bias oscillator would cause a failure to record on all channels and give results identical to those experienced.

TABLE 1

CRASH TEST SUMMARY

Test No. 80-015 Project Task 2

Date 27 December 1979 Time Not recorded Temp. 46°F

Test Condition Front-to-Side, 90° angle

Vehicle No. 1 1974 Ford LTD

Vehicle No. 2 1973 Ford LTD

	Veh. No. 1	Veh. No. 2
Test Weight (lbs.)	4510	4660
Impact Angle (deg.)*	0	90
Impact Velocity (mph)	29.28	0
Max. Crush (in.)	5.19	16.37
Max. Intrusion (in.)	N/A	13.81

Dummies	Veh. No. 1	Veh. No. 2
Type	N/A	N/A
Location		
Restraint		

Number of Data Channels 27
Number of High Speed Cameras 5

*With respect to tow track centerline

TABLE 2
1974 Ford LTD Bullet Vehicle

VEHICLE DESCRIPTION

VEHICLE MAKE Ford YEAR AND MODEL 1974 LTD

ASSIGNED TEST NO. FL4-901 VIN 4E64S127777

TEST LABORATORY Automotive Dynamics Laboratory/General Environments Corporation

ODOMETER READING 41,448.8

Brakes Power: Yes X No ____
Front: Drum ____ Disc X Rear: Drum X Disc ____

Seats Power: Yes ____ No X
Front: Bench X Bucket ____ Split bench ____
Rear: Bench X Bucket ____ Split bench ____

Bumpers Optional: Front ____ Rear ____
Bumper guards: Front X Rear X
Rub strips: Front ____ Rear ____

Windows Power: Yes ____ No X Tinted: Yes X No ____

Rear Window Defroster: Yes X No ____

Radio Yes X No ____ AM ____ AM/FM X

Steering Power: Yes X No ____ Tilt steering wheel: Yes ____ No X

Air Conditioning Yes X No ____

Transmission Auto X Manual ____ No. of forward speeds 3
Cruise control: Yes ____ No X Shifter: Floor ____ Column X

Tires Size: HR78-15 Whitewall: Yes X No ____
Type: Bias ply ____ Belted X Radial X
Manufacturer: General

Vehicle Weight Gross (GVWR) N/A Unloaded (Curb) N/A

Date of Manufacture: ____

Engine: No. of cylinders 8 HP ____
Total Displacement 400 (CC ____) (CID ____)

Bumper system description: ____

TABLE 3
1973 Ford LTD Target Vehicle
VEHICLE DESCRIPTION

VEHICLE MAKE Ford YEAR AND MODEL 1973 LTD

ASSIGNED TEST NO. FL3-902 VIN 3E63H168910

TEST LABORATORY Automotive Dynamics Laboratory/General Environments Corporation

ODOMETER READING 79,240

Brakes Power: Yes X No ____
Front: Drum ____ Disc X Rear: Drum X Disc ____

Seats Power: Yes ____ No X
Front: Bench X Bucket ____ Split bench ____
Rear: Bench X Bucket ____ Split bench ____

Bumpers Optional: Front ____ Rear ____
Bumper guards: Front X Rear X
Rub strips: Front ____ Rear ____

Windows Power: Yes ____ No X Tinted: Yes X No ____

Rear Window Defroster: Yes ____ No X

Radio Yes X No ____ AM X AM/FM ____

Steering Power: Yes X No ____ Tilt steering wheel: Yes ____ No X

Air Conditioning Yes X No ____

Transmission Auto X Manual ____ No. of forward speeds 3
Cruise control: Yes ____ No ____ Shifter: Floor ____ Column X

Tires Size: H78-15 Whitewall: Yes ____ No X
Type: Bias ply X Belted ____ Radial ____
Manufacturer: ____

Vehicle Weight Gross (GVWR) 5587 Unloaded (Curb) ____

Date of Manufacture: 11/72

Engine: No. of cylinders 8 HP ____
Total Displacement 351 (CC ____) (CID X)

Bumper system description: ____

TABLE 4

ELECTRONIC INSTRUMENTATION

Car 1 - Bullet Vehicle - 1974 4-door Ford LTD

Transducer or Description Accelerometer Location	Direction of Parameter Being Measured	Location on Vehicle	Description Listed on Data Points
VEHICLE ACCELEROMETER			
1	X	Left Sill next to rear seat	Left Compartment
2	X	Right Sill next to rear seat	Right Compartment
3	X, Y, Z	Deck over rear Axle	Rear Deck
4	X, Y. Z	Firewall	Firewall
5	X-Accel.	Bumper (rear face)	Bumper

TABLE 5

ELECTRONIC INSTRUMENTATION

Car 2 - Target Vehicle - 1973 4-door Ford LTD

Transducer or Description Accelerometer Location	Direction of Parameter Being Measured	Location on Vehicle	Description Listed on Data Plots
1	X, Y, Z	Left Sill next to Front Seat	Left Front Compartment
2	X, Y, Z	Left Sill next to Rear Seat	Left Rear Compartment
3	X, Y, Z	Deck over Rear Axle	Rear Deck
4	Y	Lower Right Door Centerline	Lower Right Door Center
5	Y	Mid-rear of Right Door	Mid-aft of Right Door
6	Y	Upper Right Door Centerline - 6 inches below windowsill	Upper Right Door Center
7	Y	Mid-Front of Right Door	Mid-Front of Right Door
8	Y	Upper Left Door Centerline - 6 inches below windowsill	Upper Left Door Center
9	Y	Front Seat Frame Base, at Right end, on support Plate for Back Rest	Right Front Seat
10	Y	Front Seat Frame Base, at Left end, on Support Plate for Back Rest	Left Front Seat
11	Y	Left Rear Door at Upper Door Centerline - 6 inches below windowsill	Left Rear Door
12	Y	Right Rear Door at Upper Door Centerline - 6 inches below Windowsill	Right Rear Door

TABLE 6

TARGET VEHICLE
PASSENGER COMPARTMENT INTRUSION

	Sidewall Lateral Intrusion (in.)	
	Roof Level	Mid-Level
A-Pillar Region	0.25	-
Front Door ℄	4.88	13.81
B-Pillar	0.75	-
Rear Door ℄	4.56	9.56
C-Pillar Region	0	-

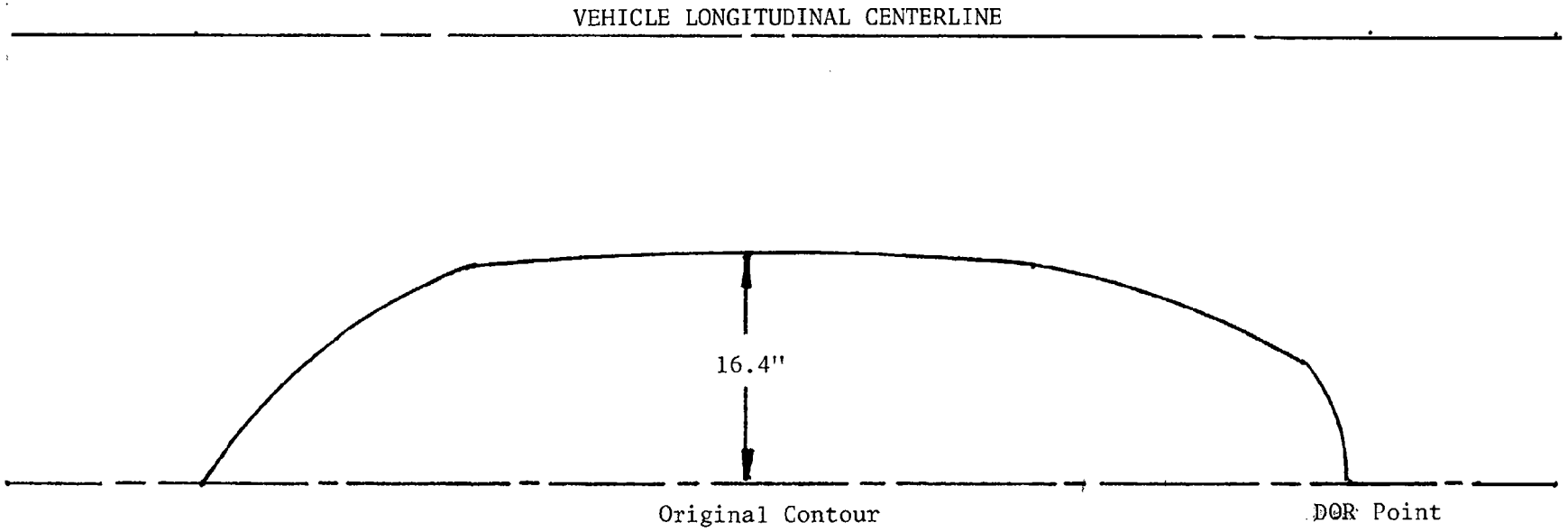
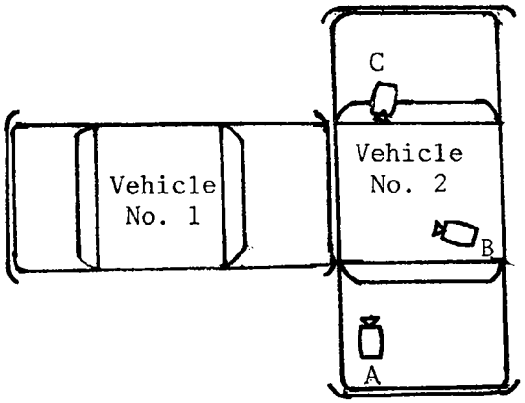


FIGURE 1
POST TEST EXTERNAL CRUSH CONTOUR
RIGHT SIDE, TARGET VEHICLE



CAMERA LEGEND

A - Photosonics 1B, 17mm lens
1000 FPS, Hood Mounted
B - Photosonics 1B, 13mm Lens
1000 FPS, Roof Mounted
C - Photosonics 1B, 13mm Lens
1000 FPS, Rear Shelf Mounted
D - Locam, 25mm Lens, 500 FPS
E - Locam, 25mm Lens, 500 FPS

FIGURE 2
CAMERA SCHEMATIC

APPENDIX A

VEHICLE PHOTOGRAPHS

FIGURE A-1 PRE- AND POST TEST FRONT AND REAR VIEWS, TARGET VEHICLE

FIGURE A-2 PRE- AND POST TEST SIDE VIEWS, TARGET VEHICLE

FIGURE A-3 PRE- AND POST TEST FRONT AND REAR VIEWS, BULLET VEHICLE

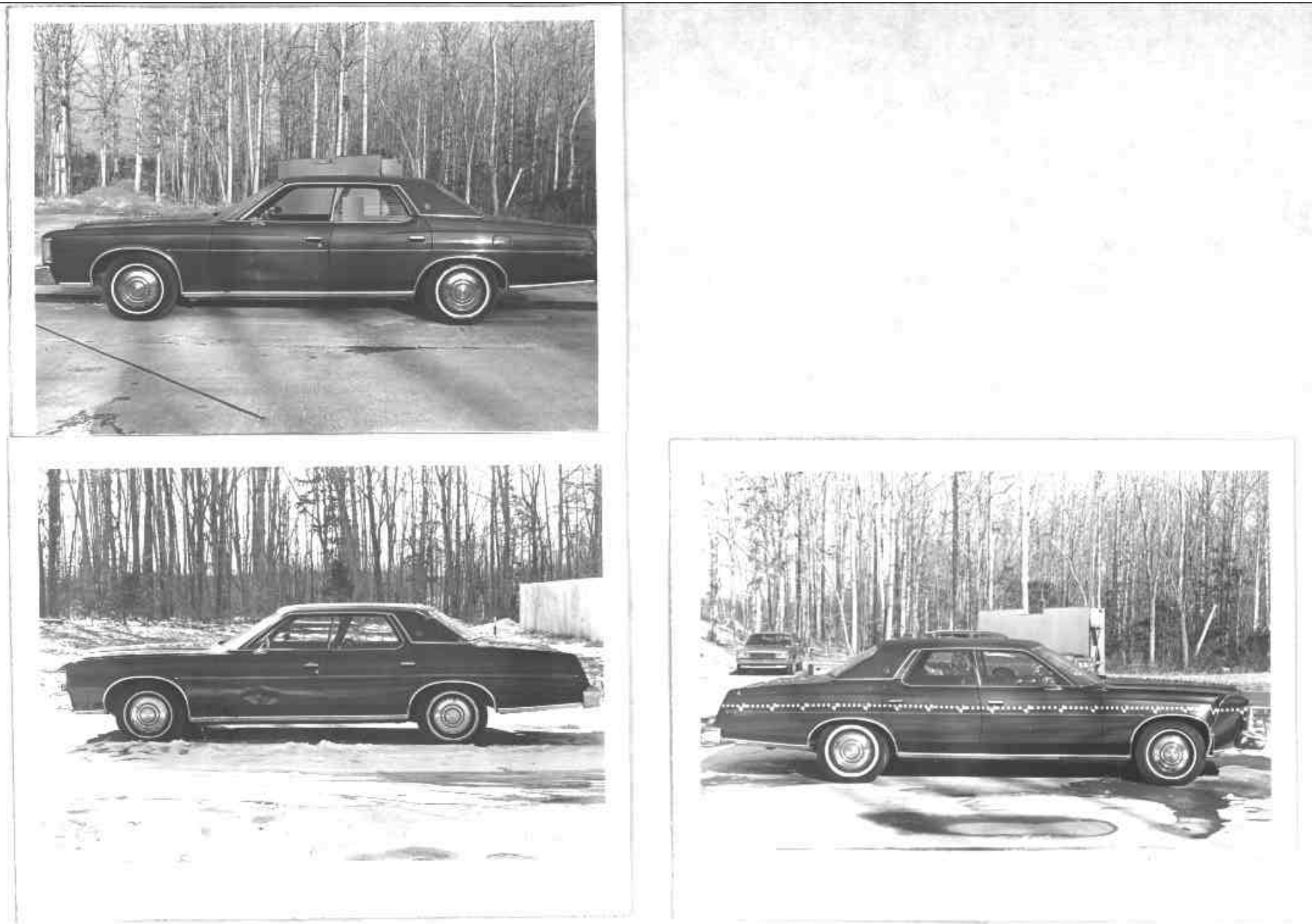
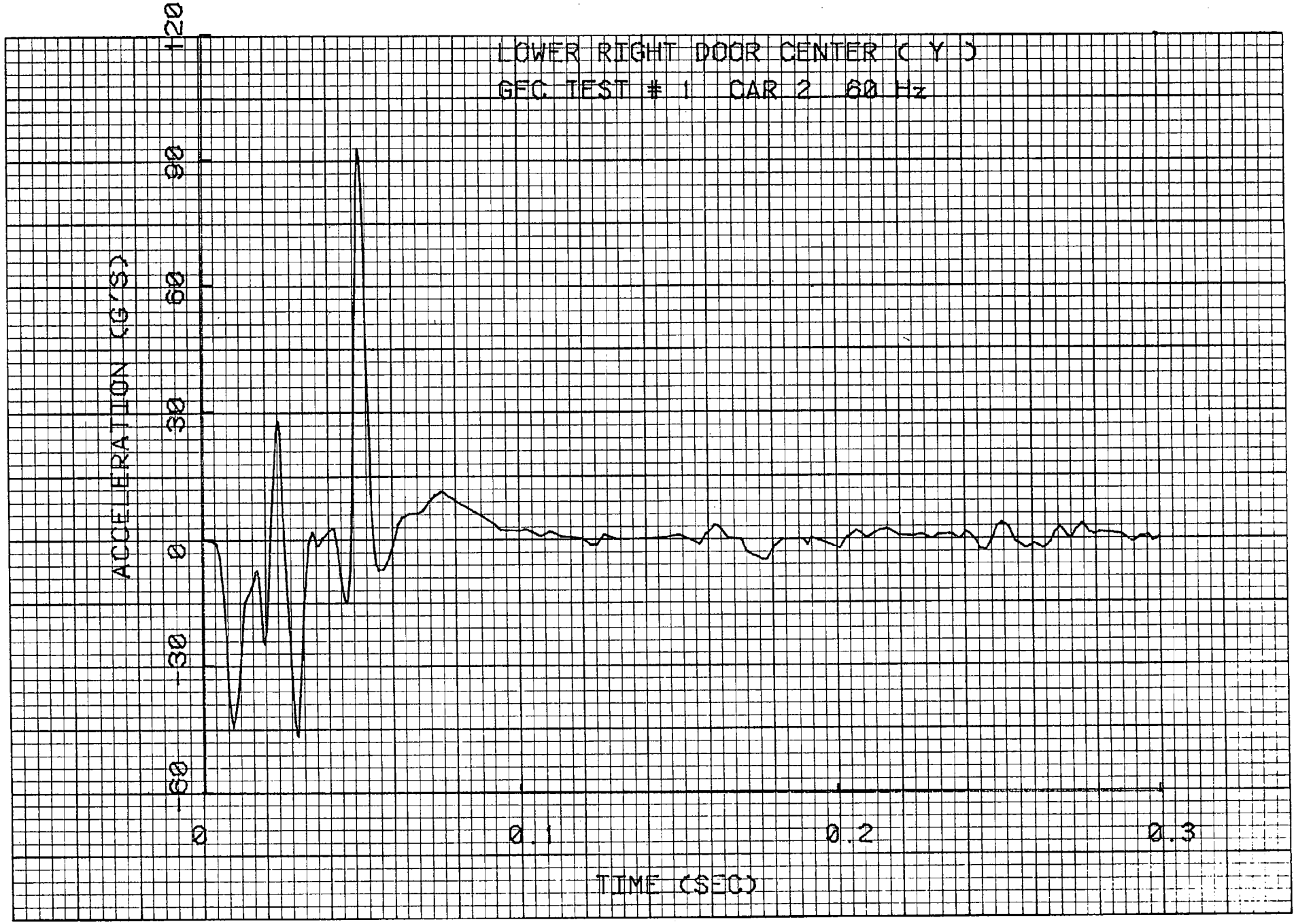


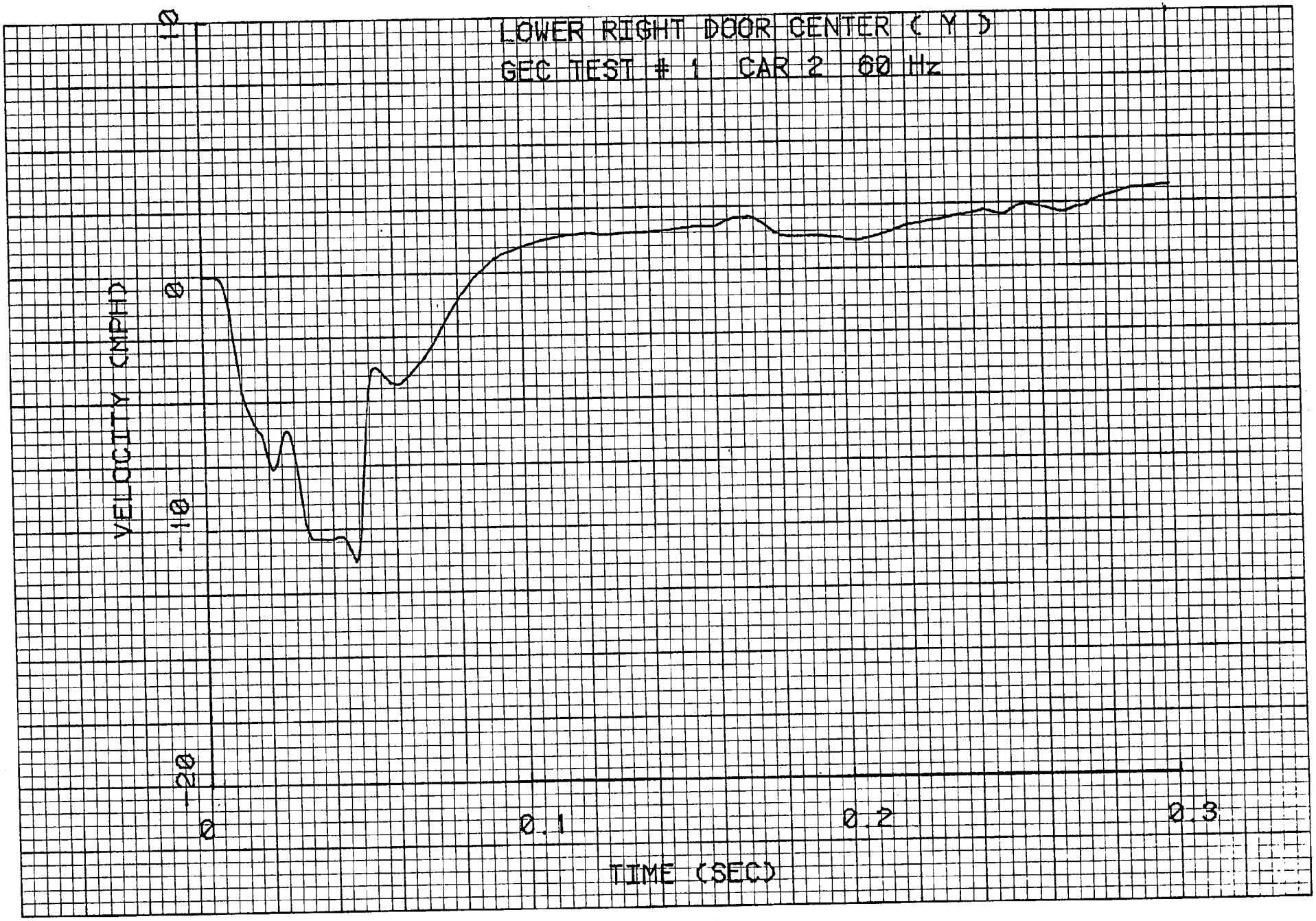
FIGURE A-4 PRE- AND POST TEST SIDE VIEWS, BULLET VEHICLE

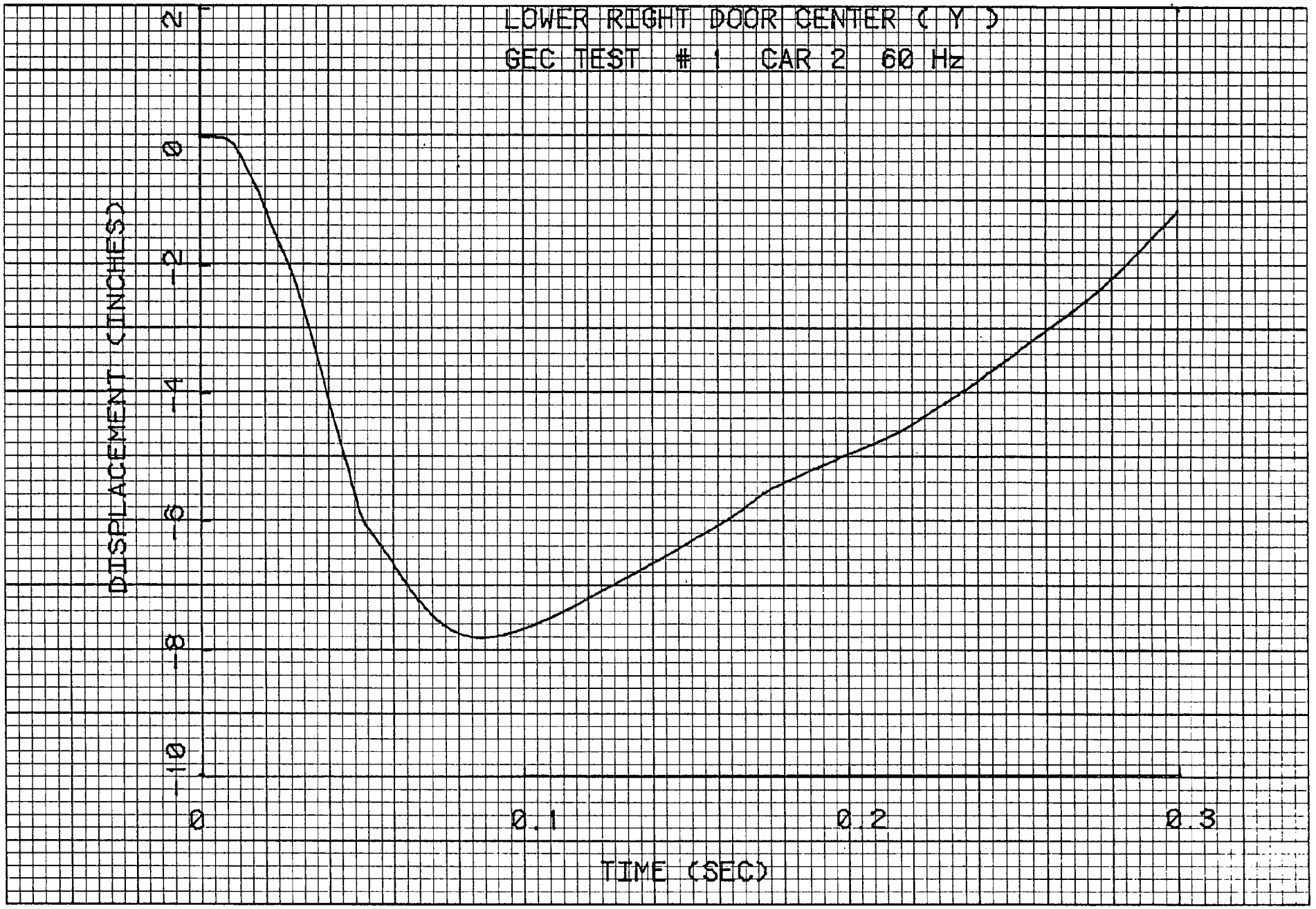
APPENDIX B

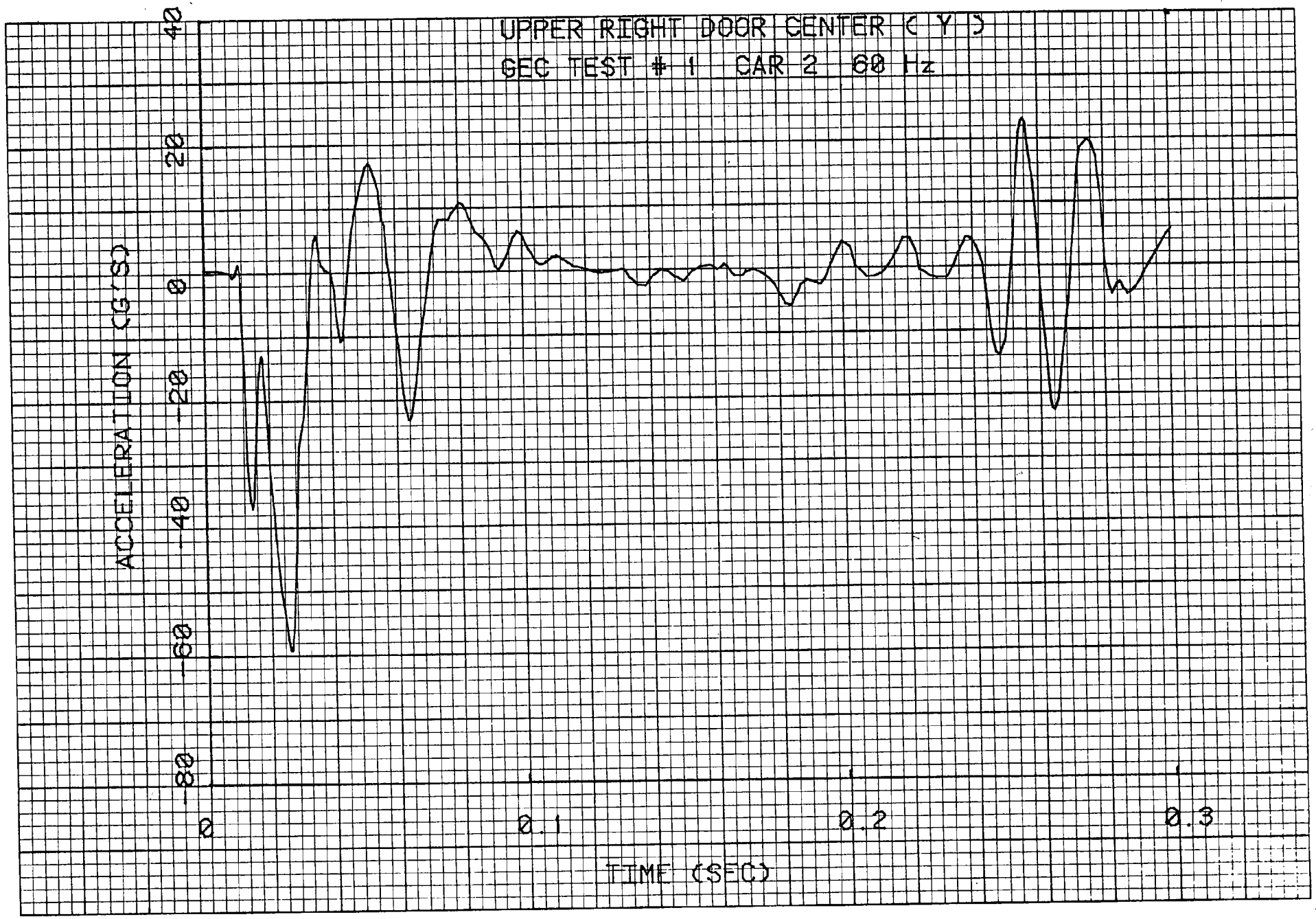
TARGET VEHICLE RESPONSE DATA

1973 Ford LTD
Filter Class Channels
15 Hz and 60 Hz


LOWER RIGHT DOOR CENTER (Y)
GEC TEST # 1 CAR 2 60 Hz
+120
90
60
30
0
-30
-60
ACCELERATION (G'S)
0
0.1
0.2
0.3
TIME (SEC)






UPPER RIGHT DOOR CENTER (Y)
GEC TEST # 1 CAR 2 60 Hz
ACCELERATION (G'S)
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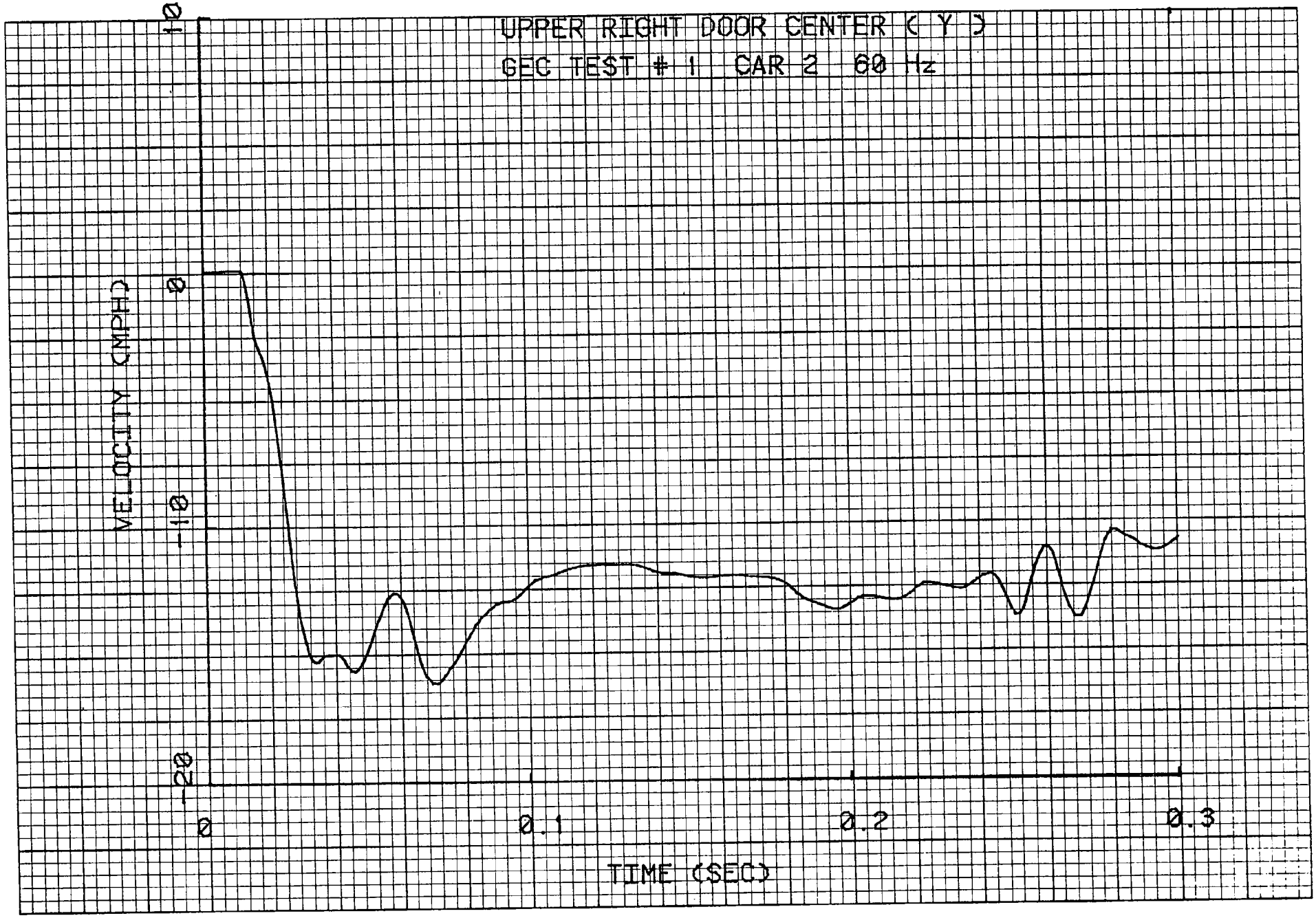
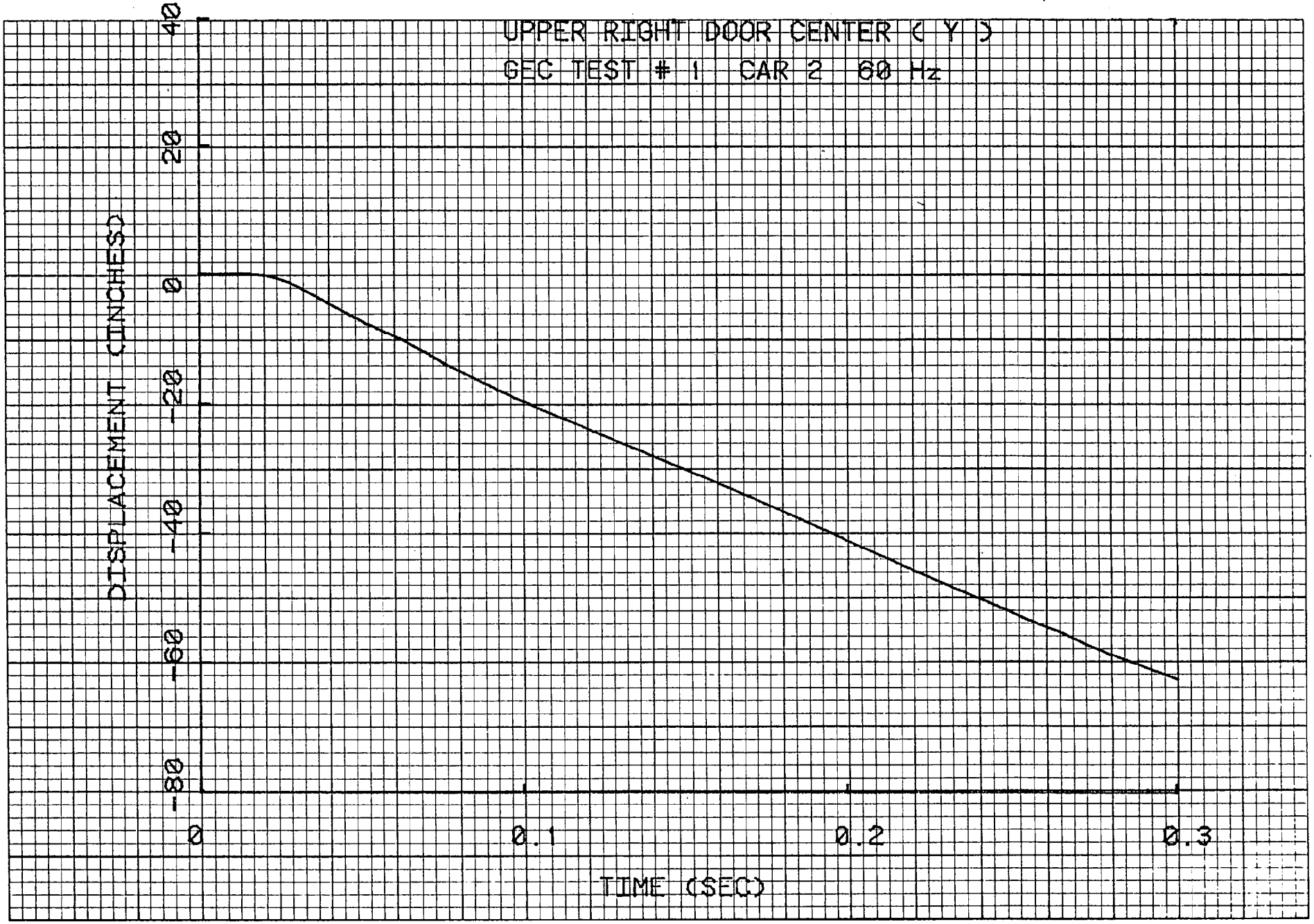
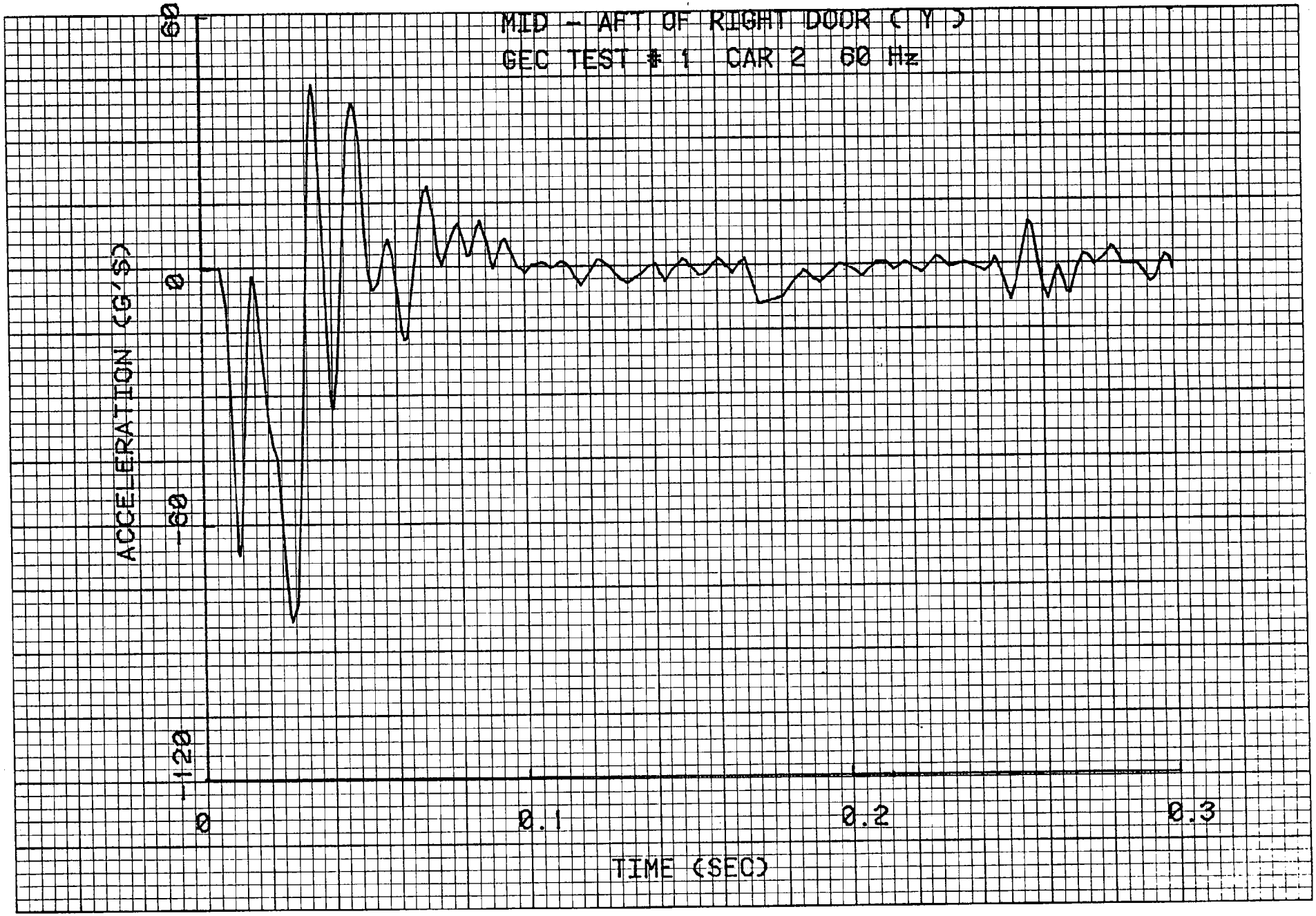
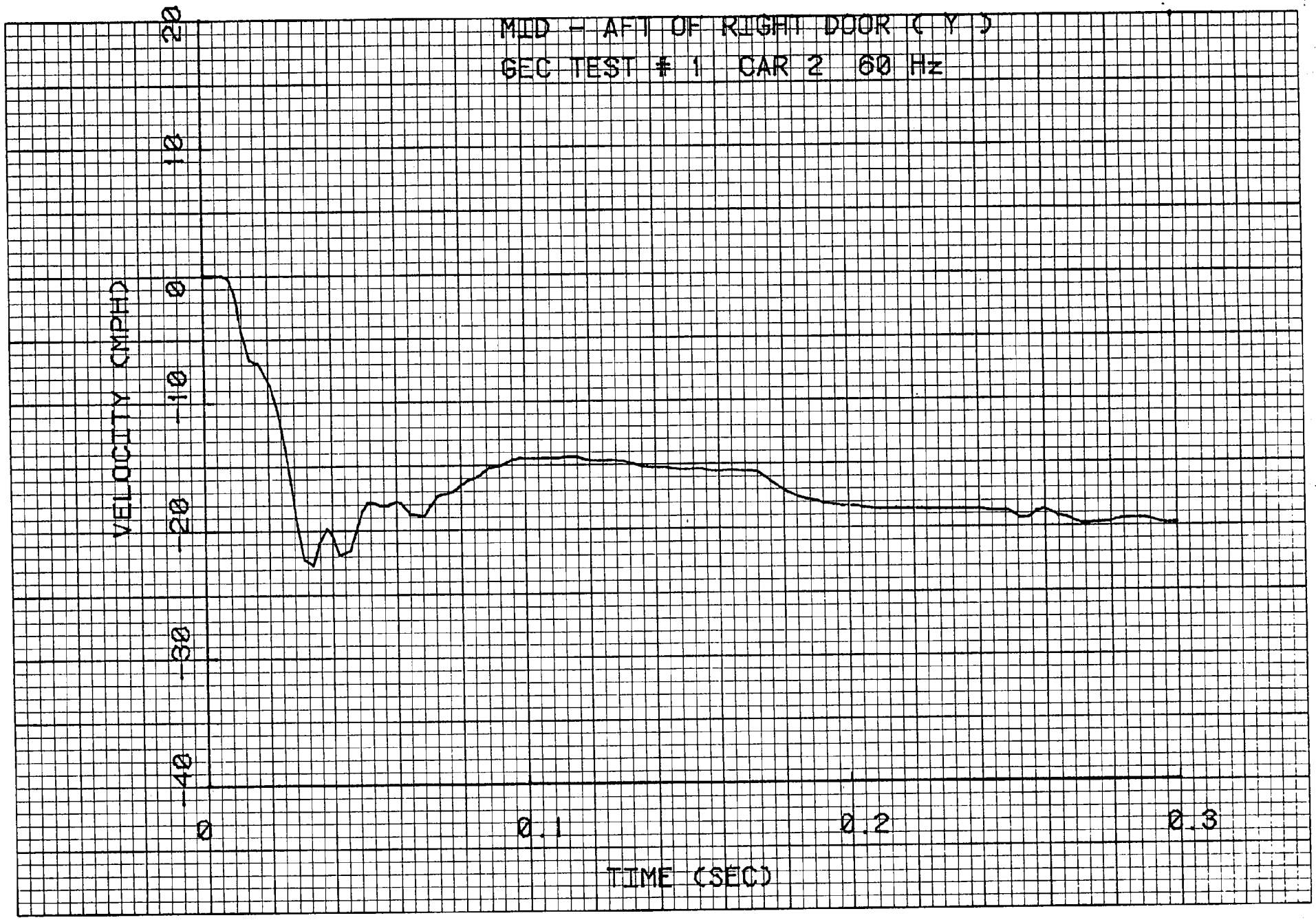
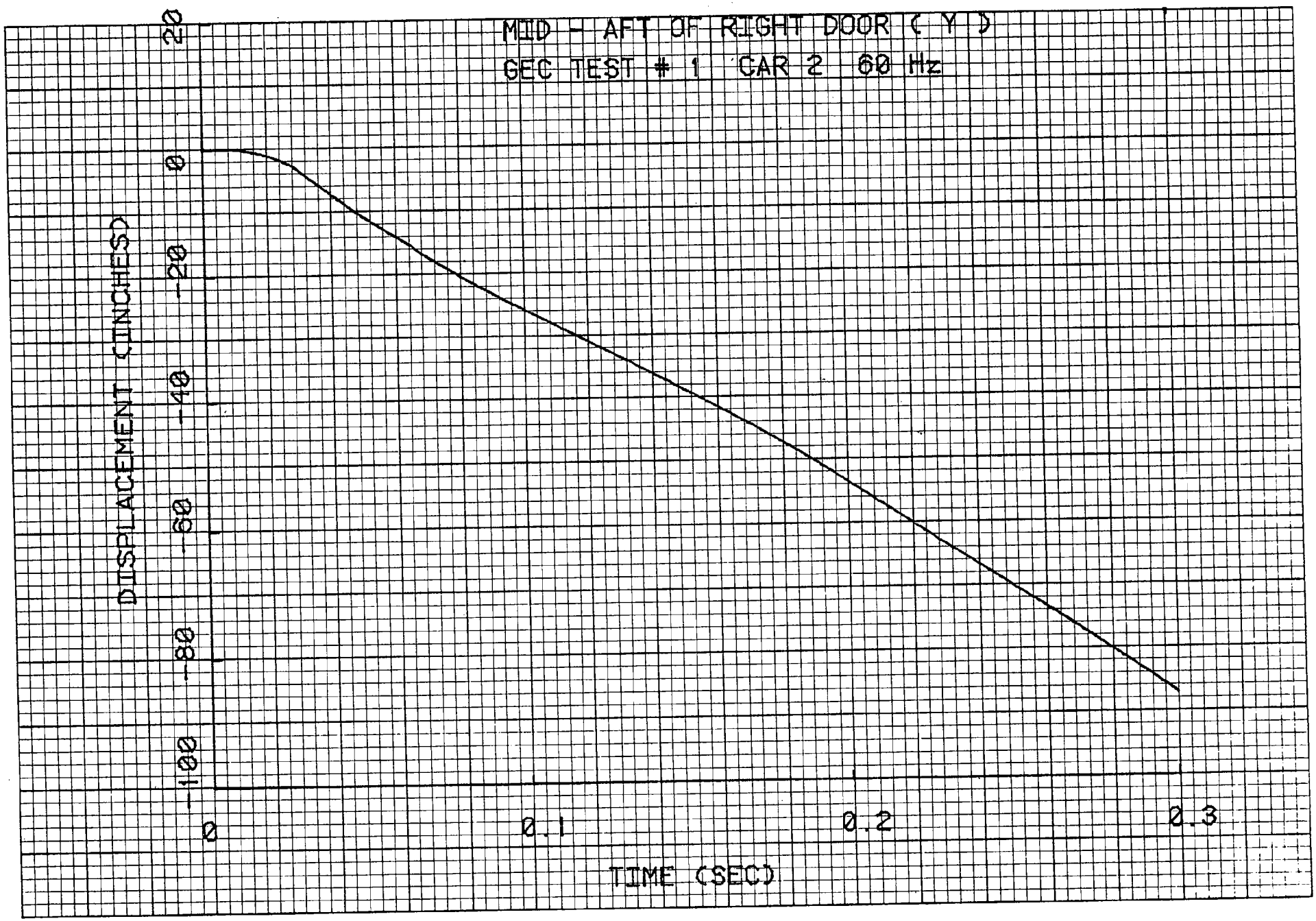
20
0
-20
-40
-60
-80
0
0.1
0.2
0.3
TIME (SEC)








MID - AFT OF RIGHT DOOR (Y)
GEC TEST # 1 CAR 2 60 Hz
VELOCITY (MPH)
20
10
0
-10
-20
-30
-40
0
0.1
0.2
0.3
TIME (SEC)


MID - AFT OF RIGHT DOOR (Y)
GEC TEST # 1 CAR 2 60 Hz
DISPLACEMENT (INCHES)
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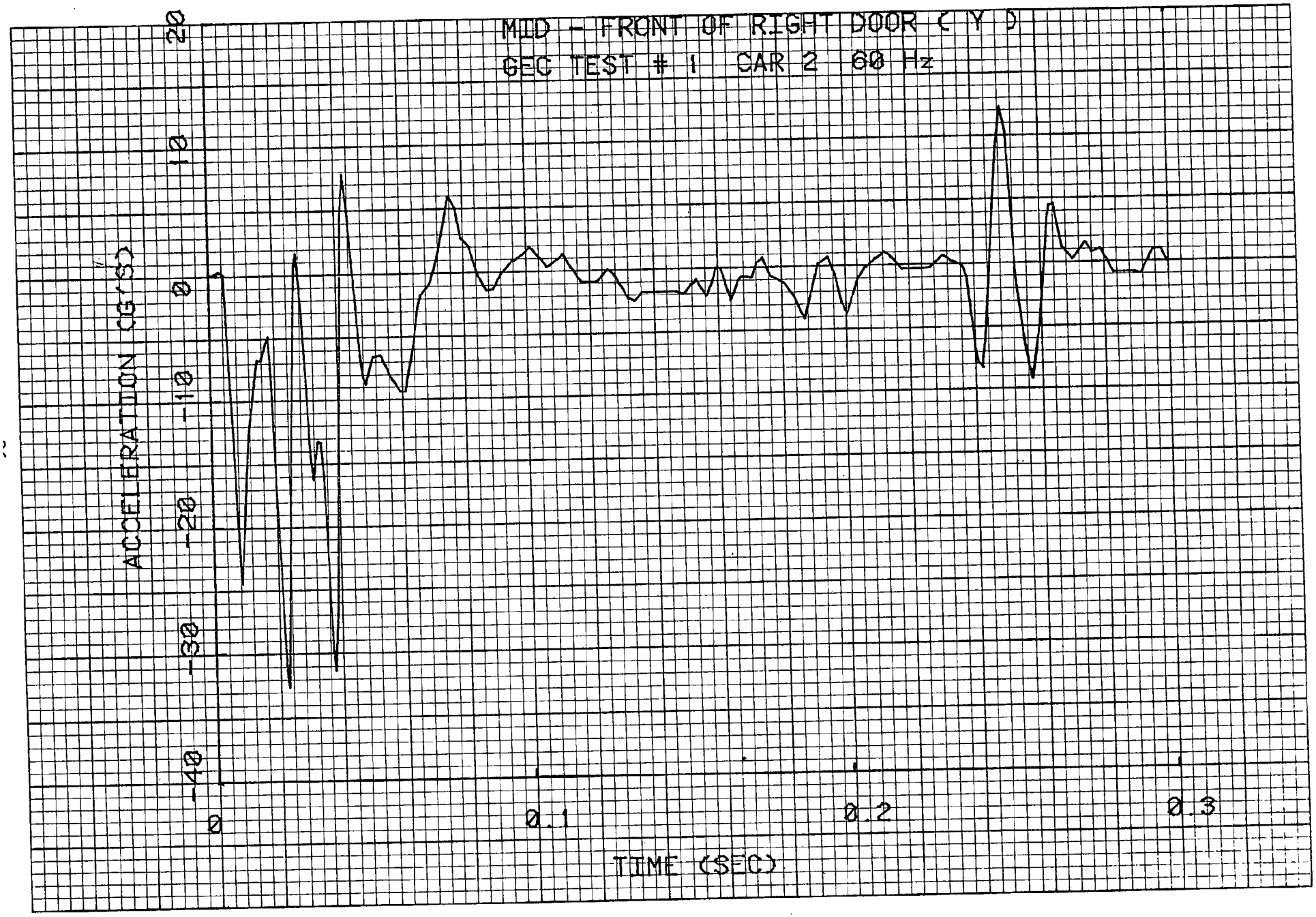
0
-20
-40
-60
-80
-100
0
0.1
0.2
0.3
TIME (SEC)


MID - FRONT OF RIGHT DOOR (Y)
GEC TEST # 1 CAR 2 60 Hz
ACCELERATION (G'S)
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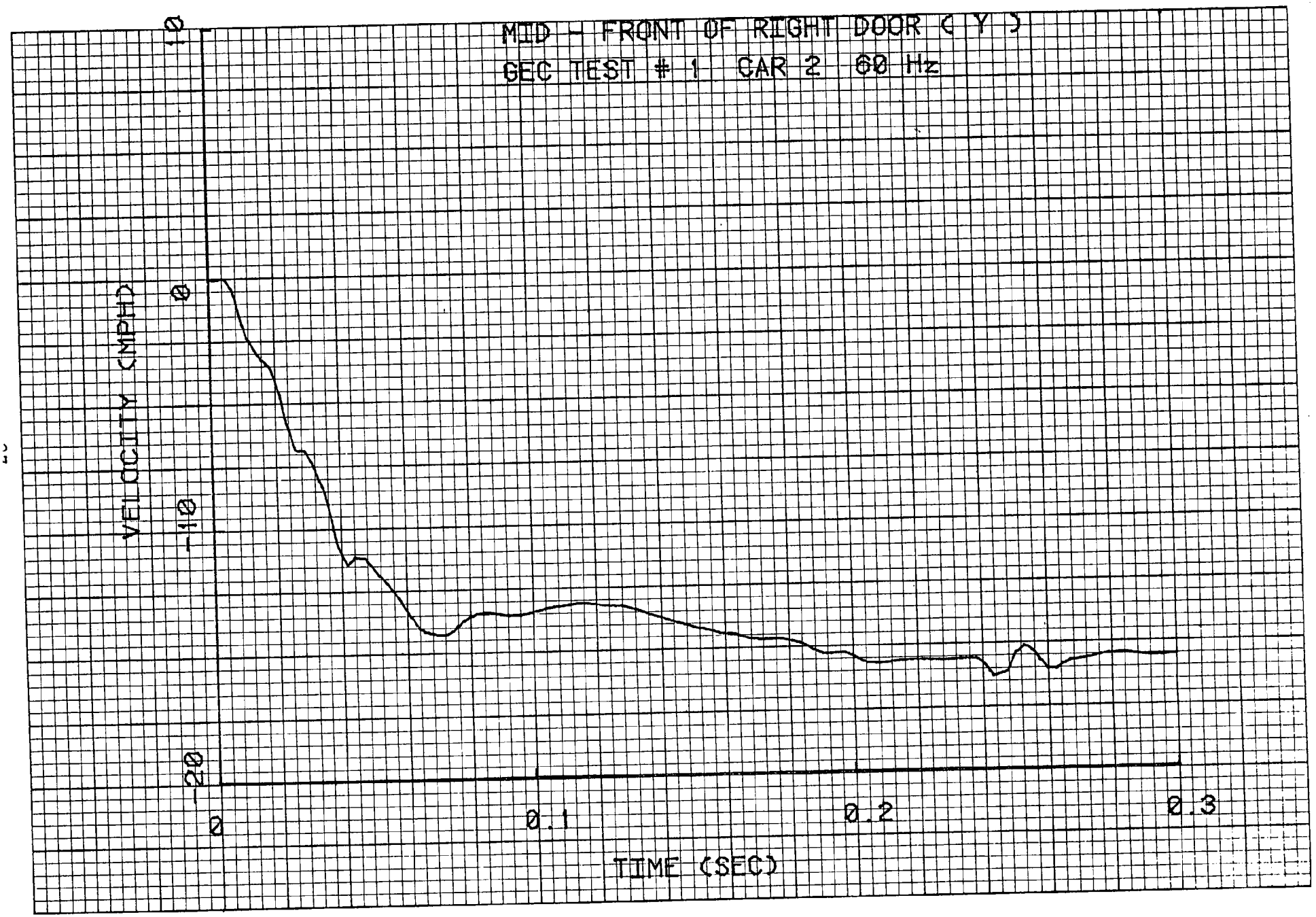
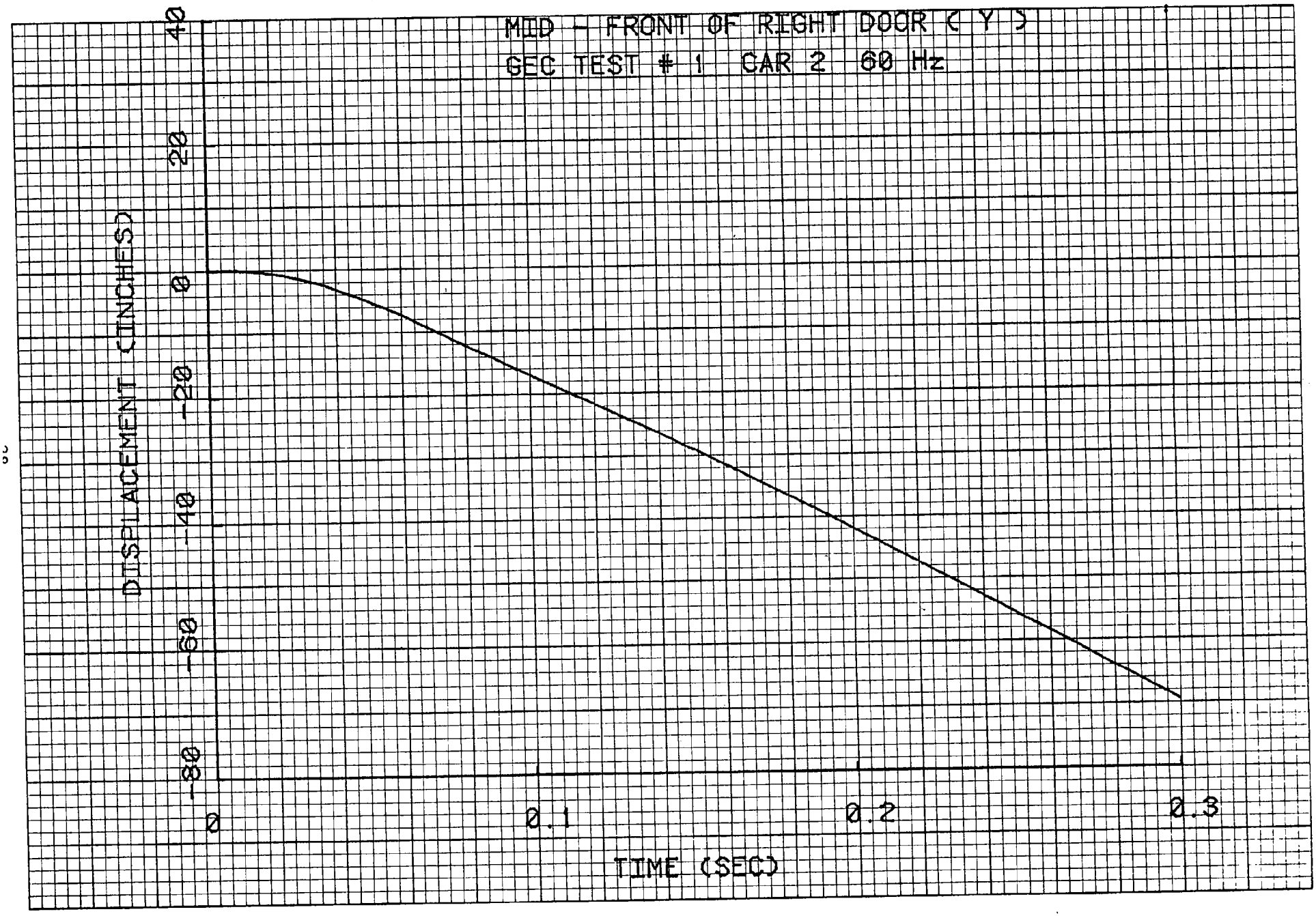
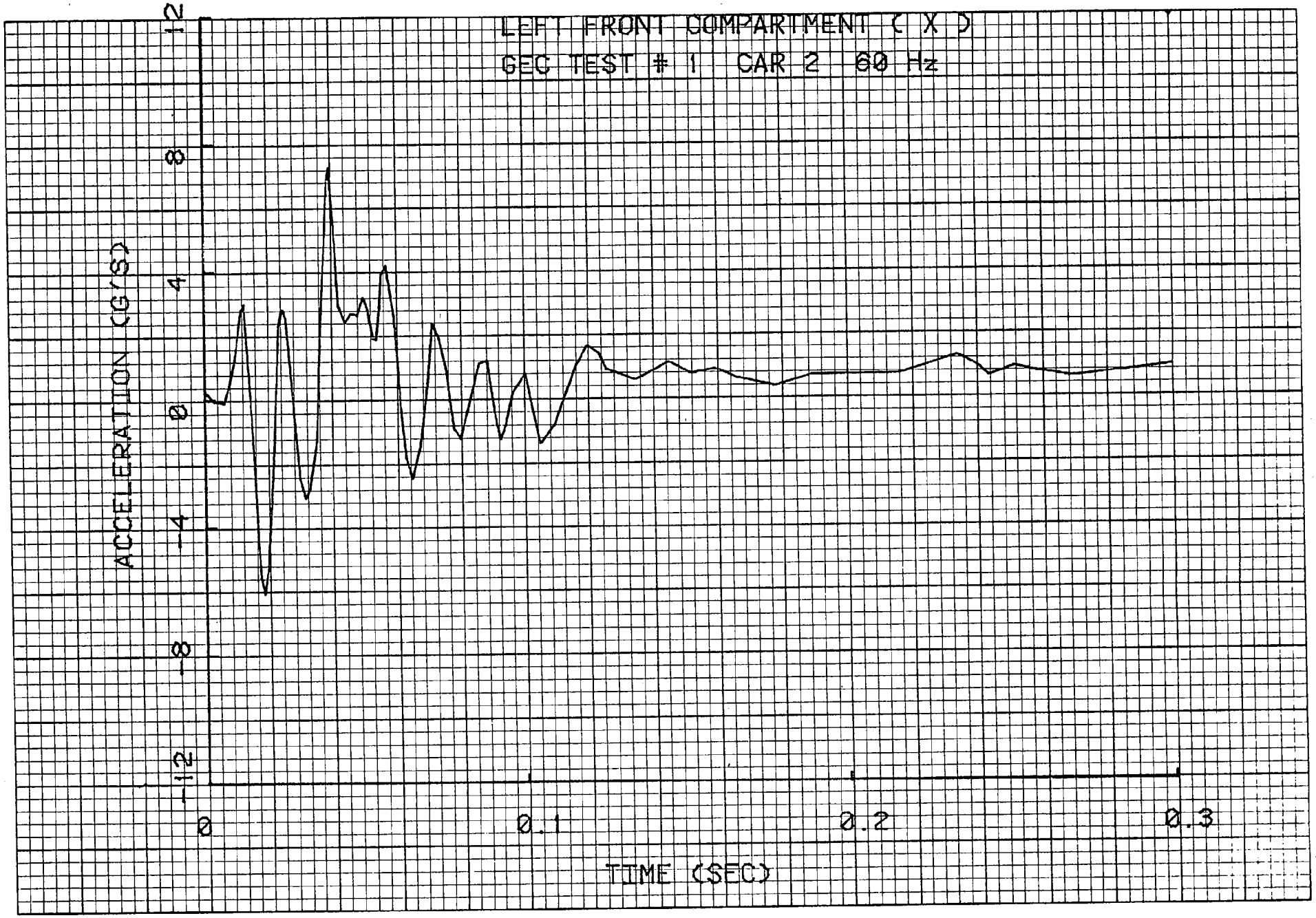
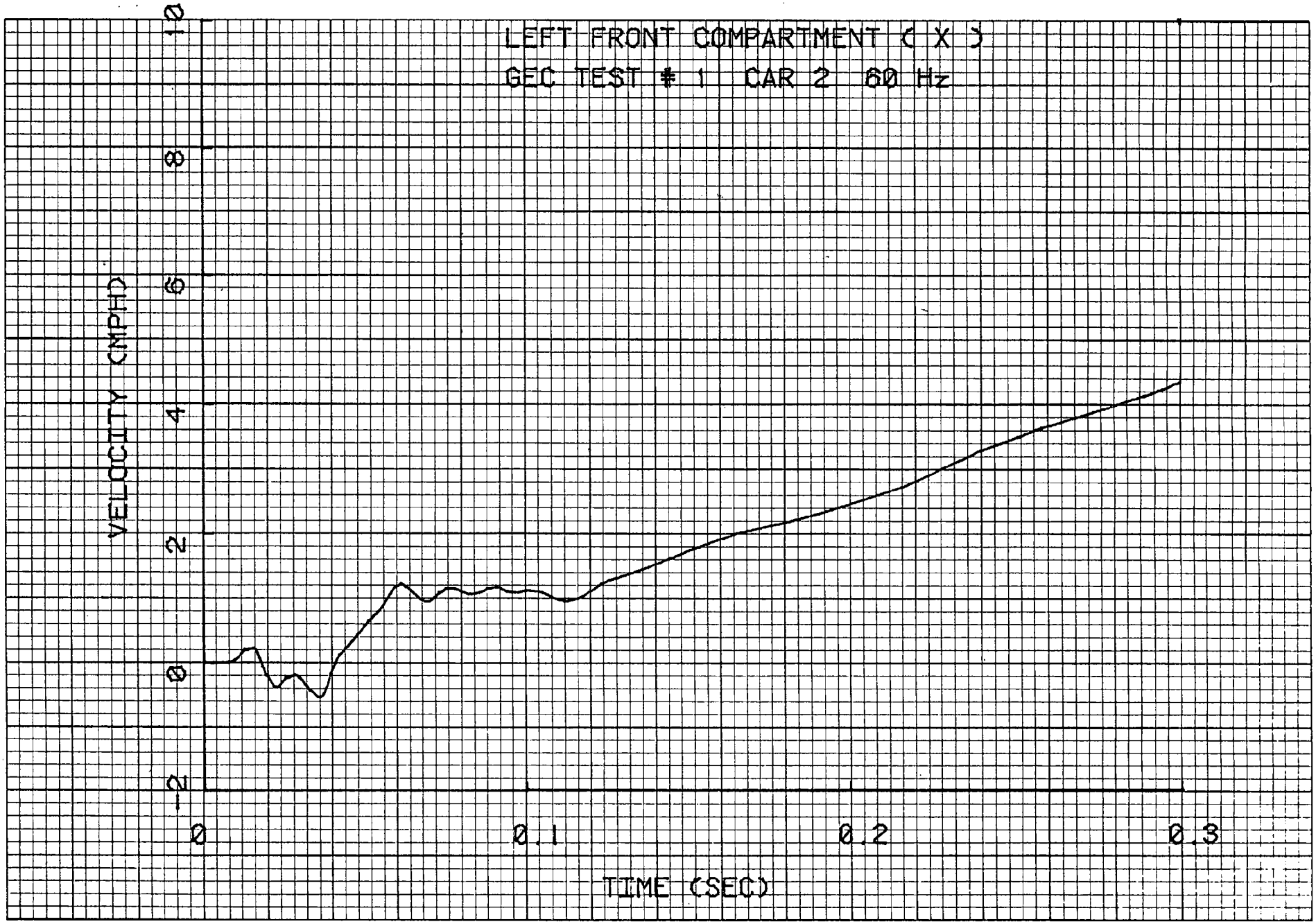
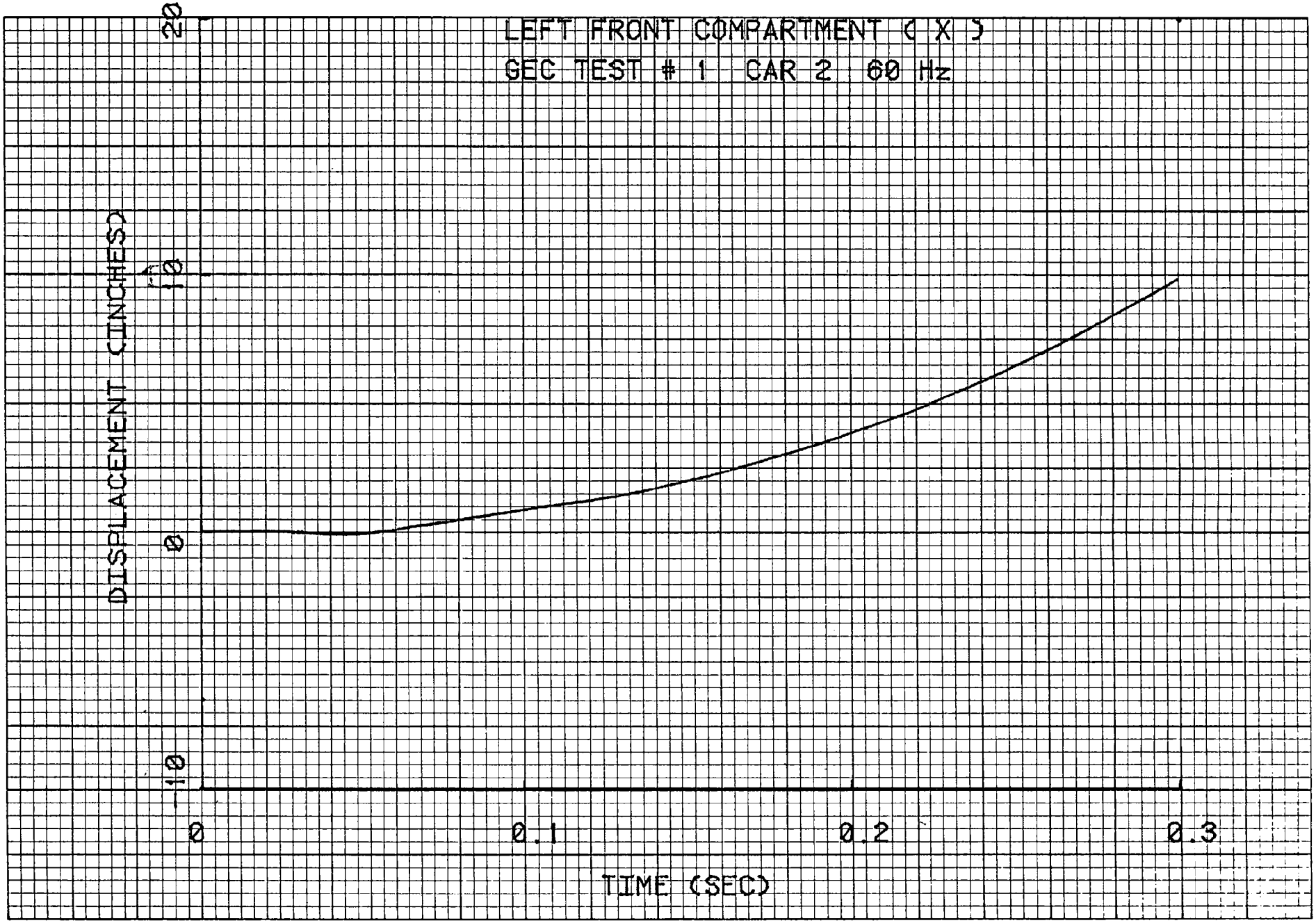
10
0
-10
-20
-30
-40
0
0.1
0.2
0.3
TIME (SEC)

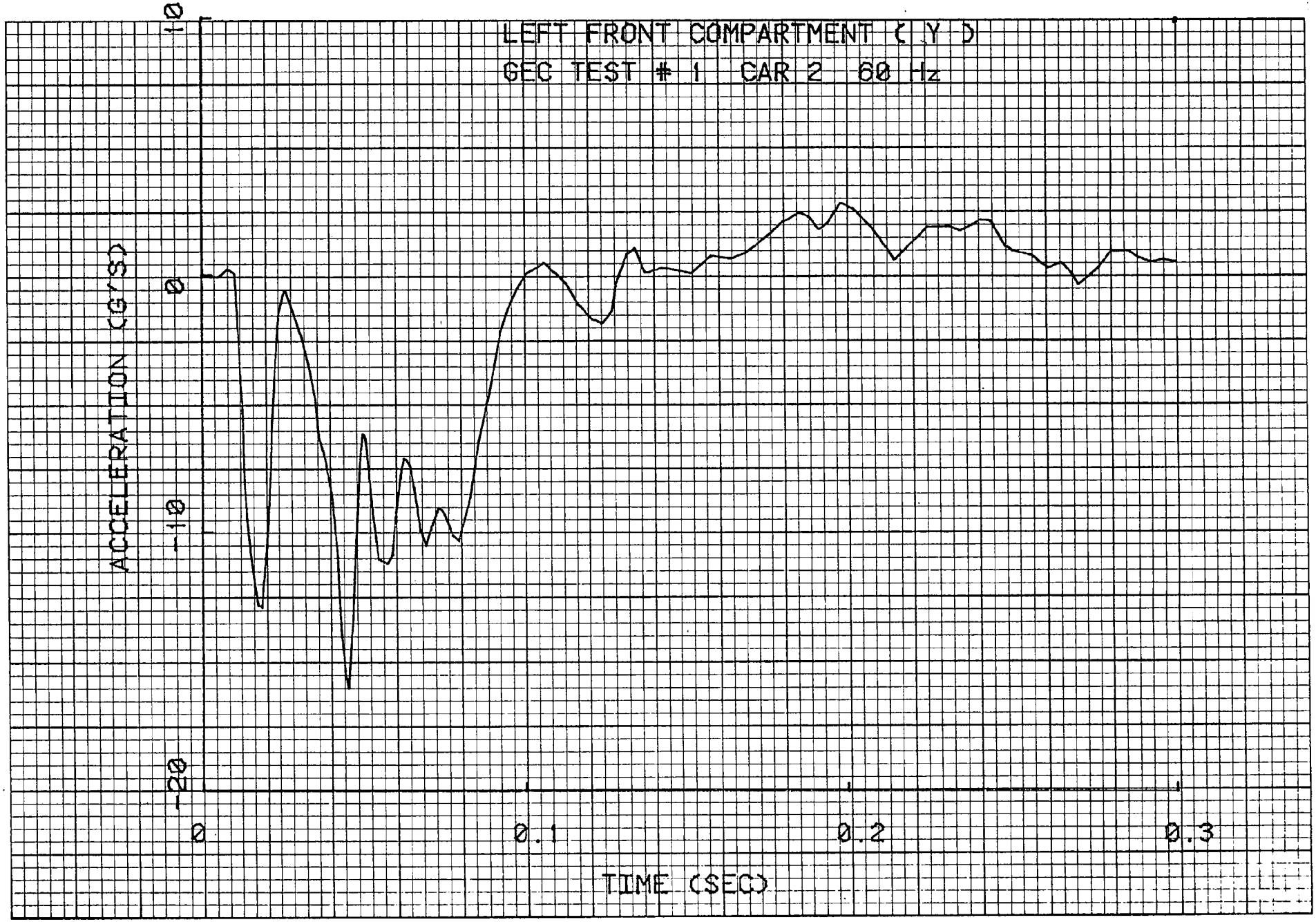


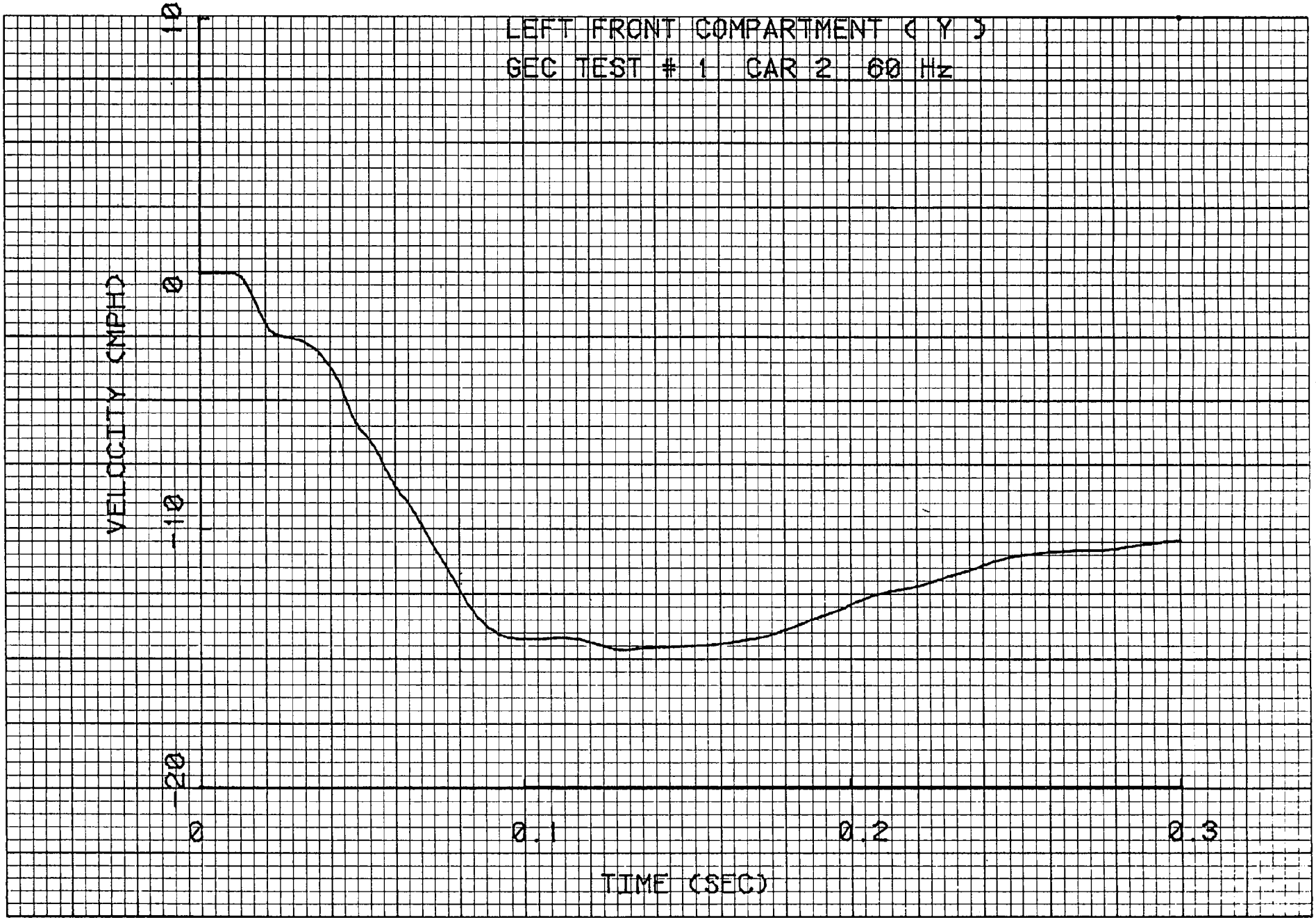


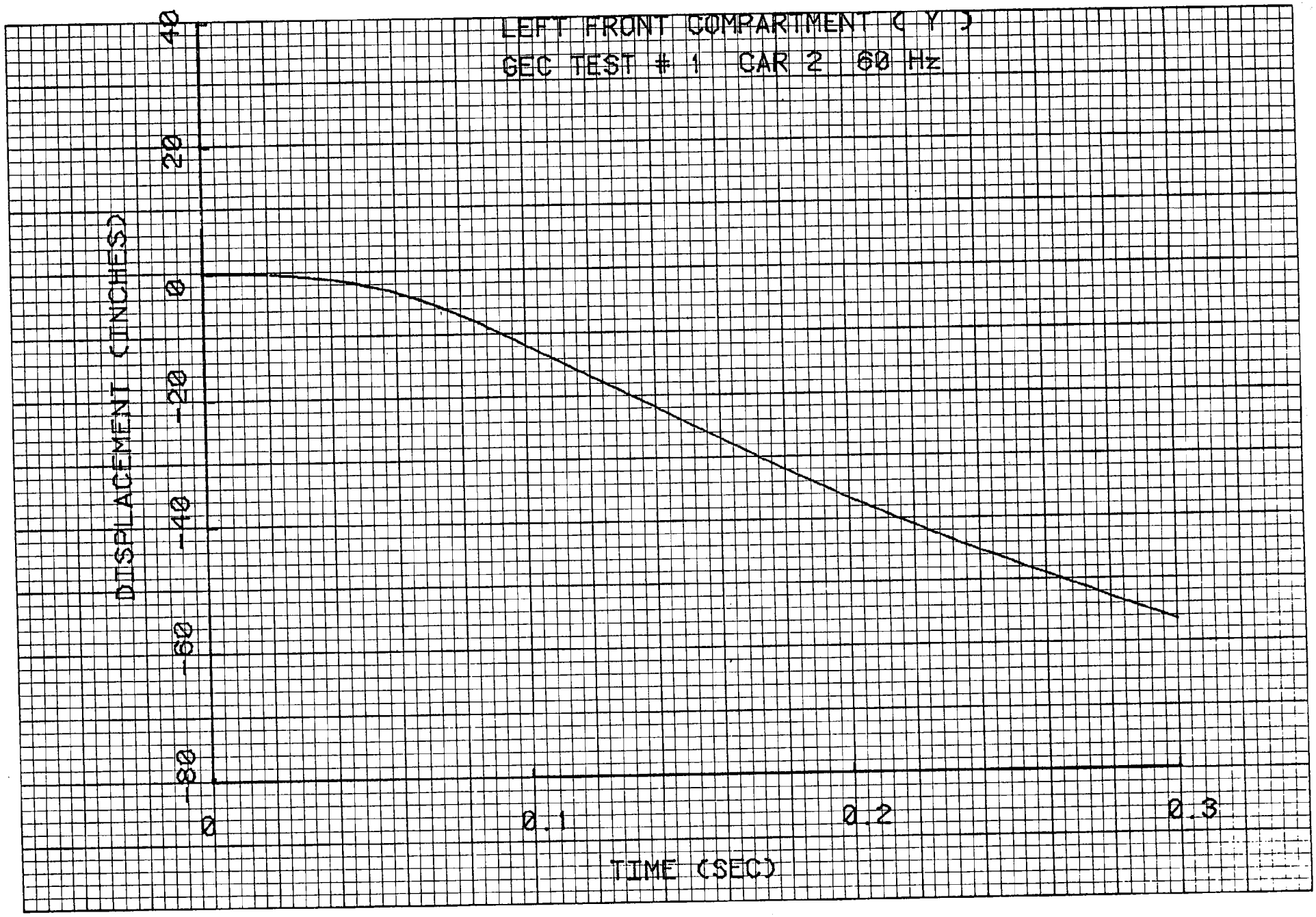

LEFT FRONT COMPARTMENT (X)
GEC TEST # 1 CAR 2 60 Hz
ACCELERATION (G'S)
12
8
4
0
-4
-8
-12
0
0.1
0.2
0.3
TIME (SEC)

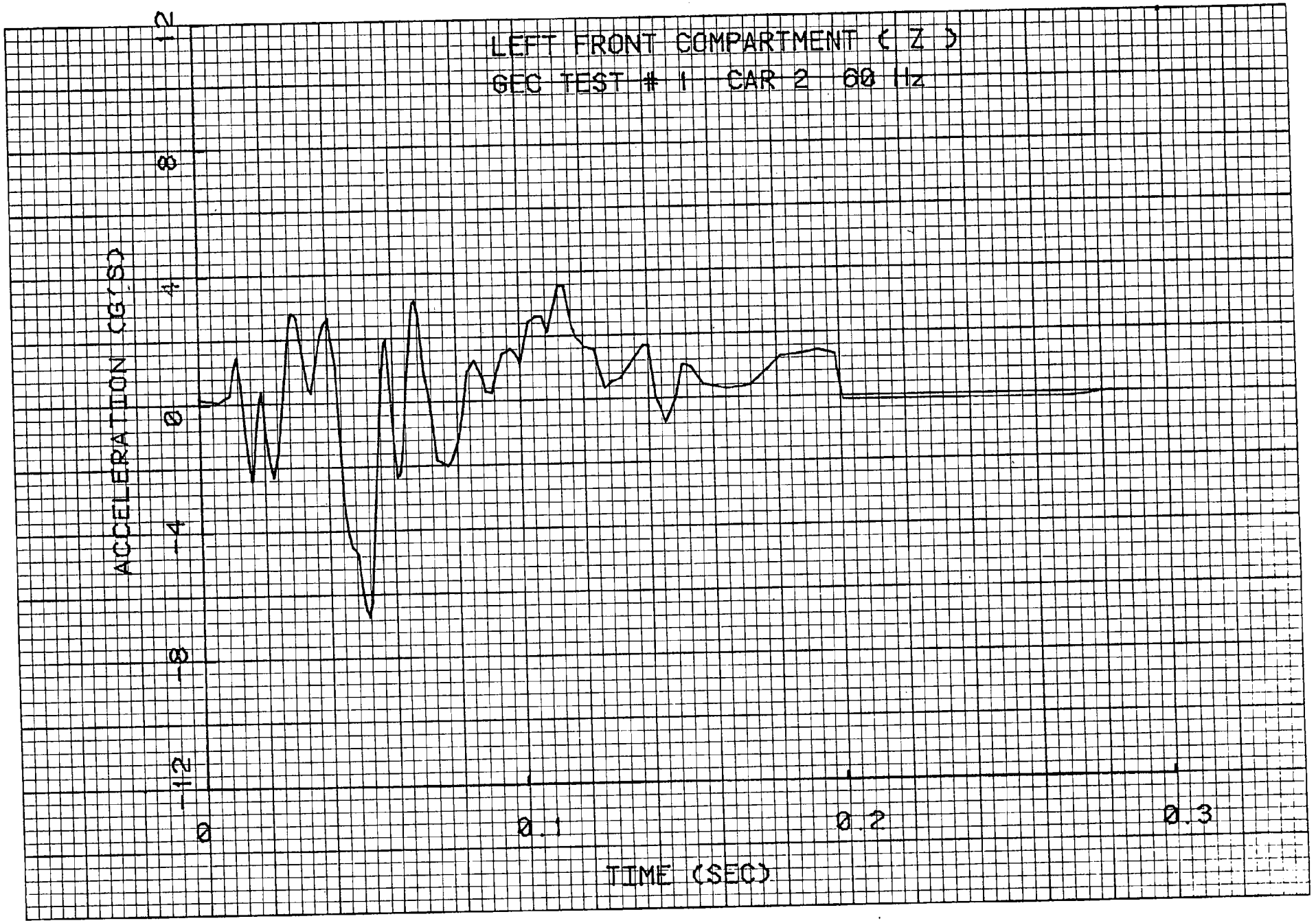


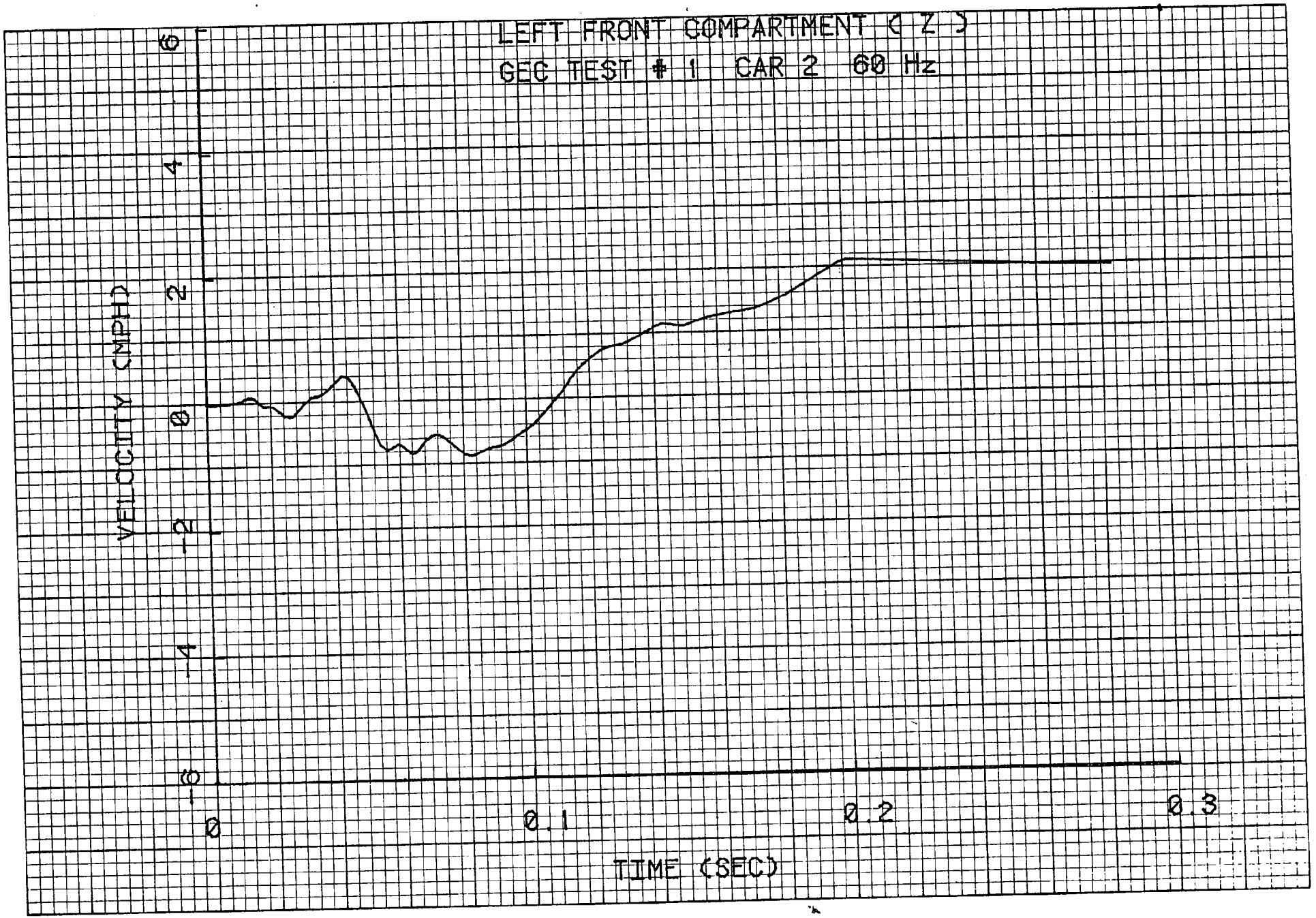


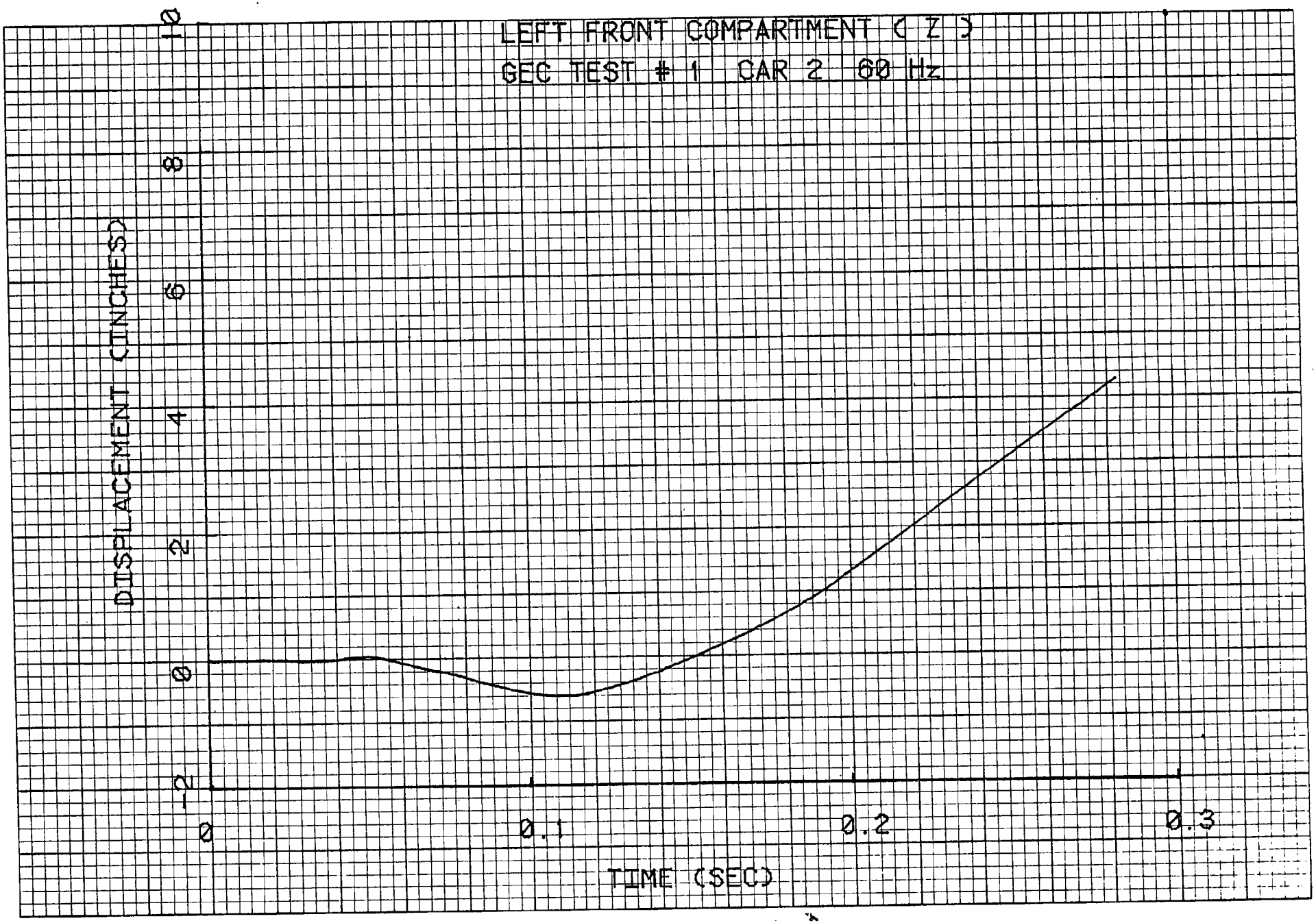

LEFT FRONT COMPARTMENT (Y)
GEC TEST # 1 CAR 2 60 Hz
ACCELERATION (G'S)
10
0
-10
-20
0
0.1
0.2
0.3
TIME (SEC)

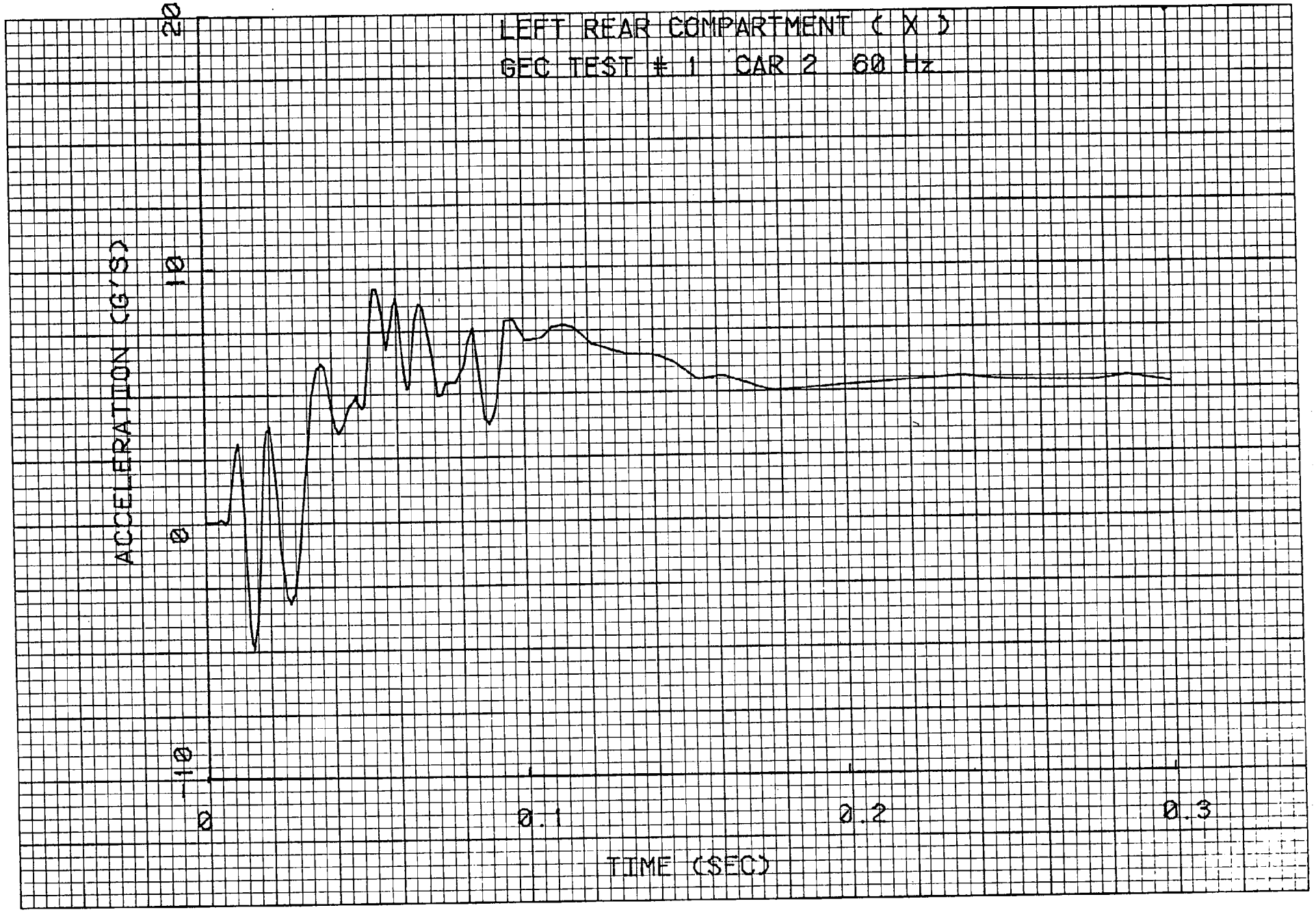


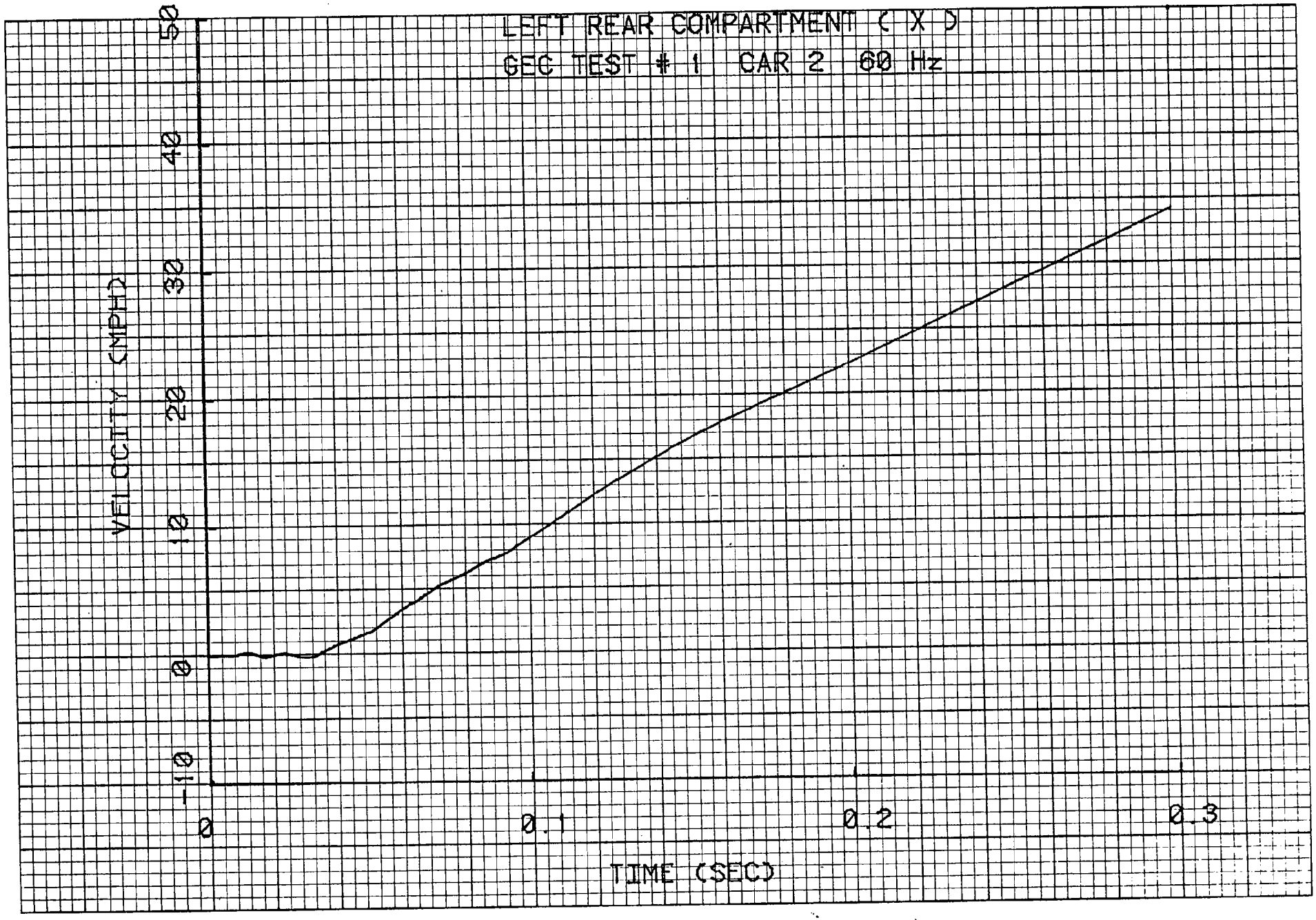

LEFT FRONT COMPARTMENT (Y)
GEC TEST # 1 CAR 2 60 Hz
DISPLACEMENT (INCHES)
40
20
0
-20
-40
-60
-80
0
0.1
0.2
0.3
TIME (SEC)

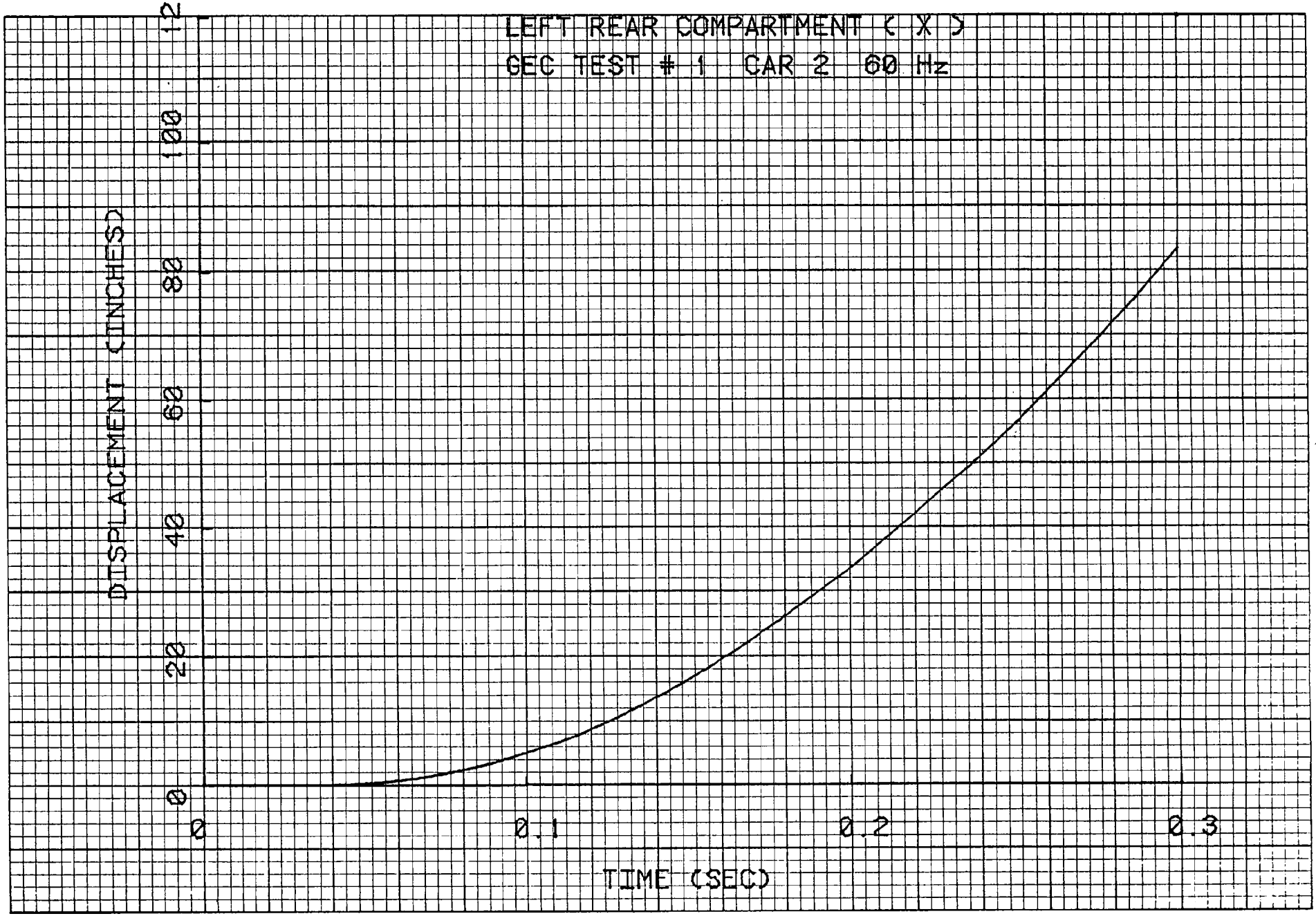


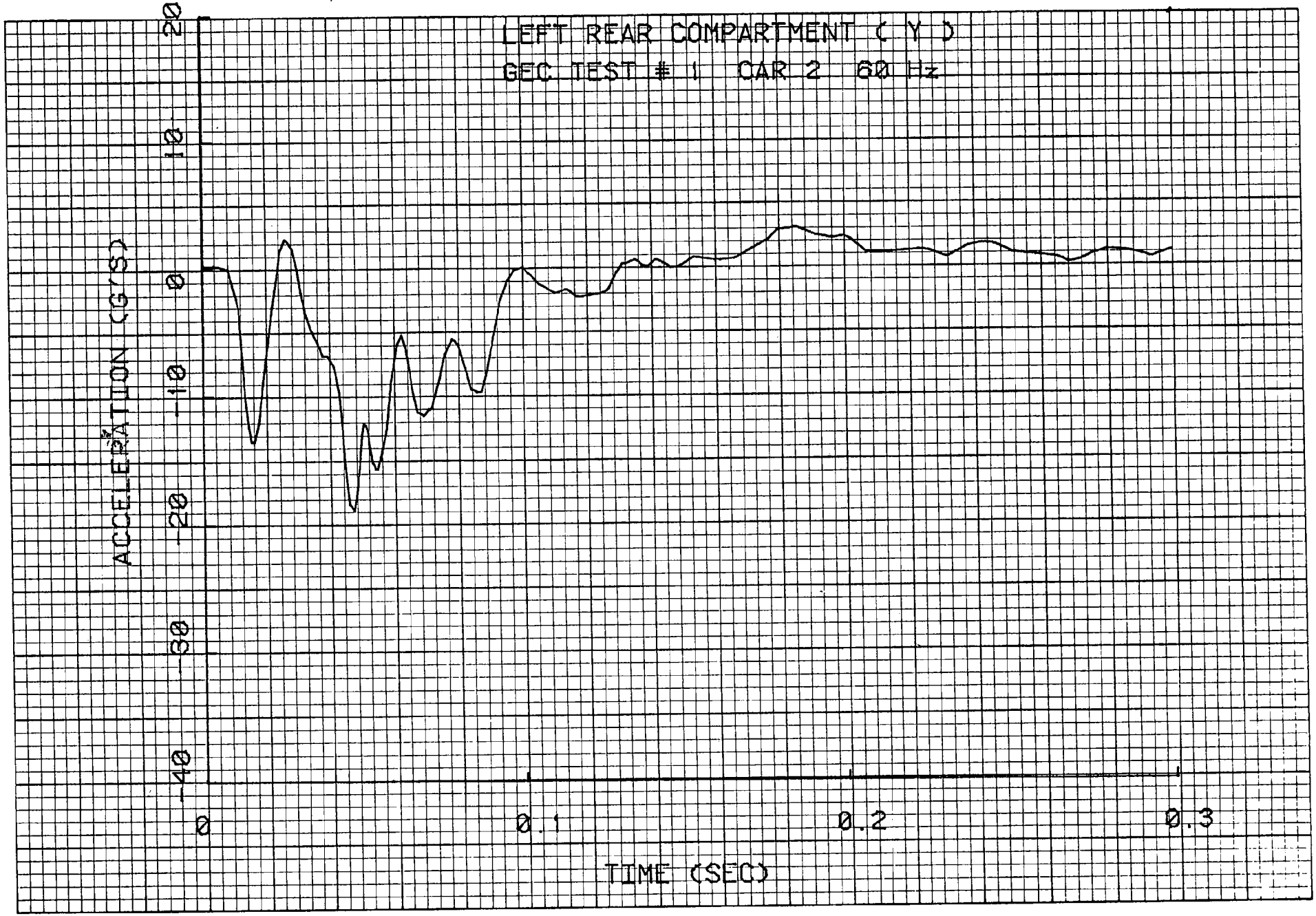


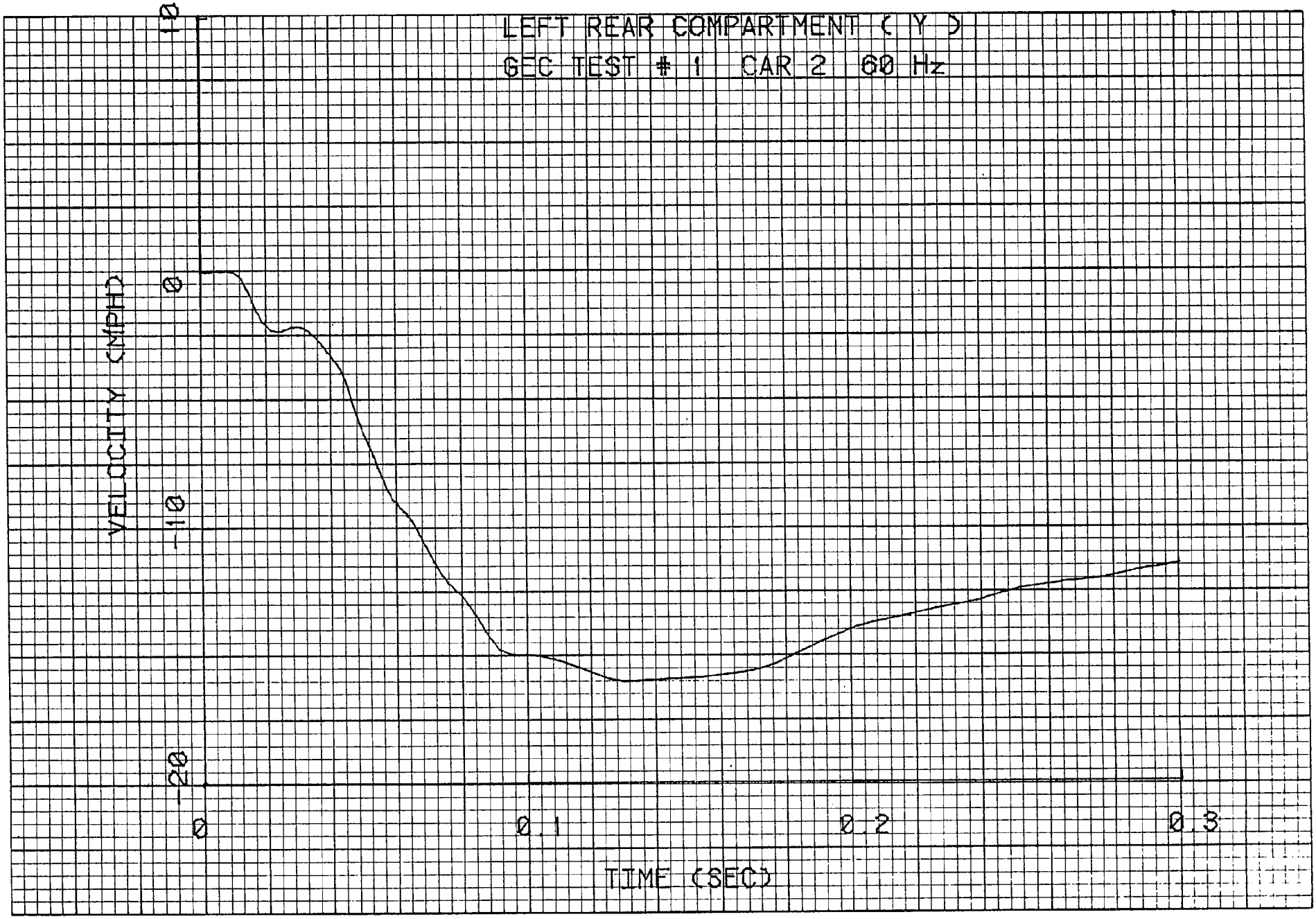


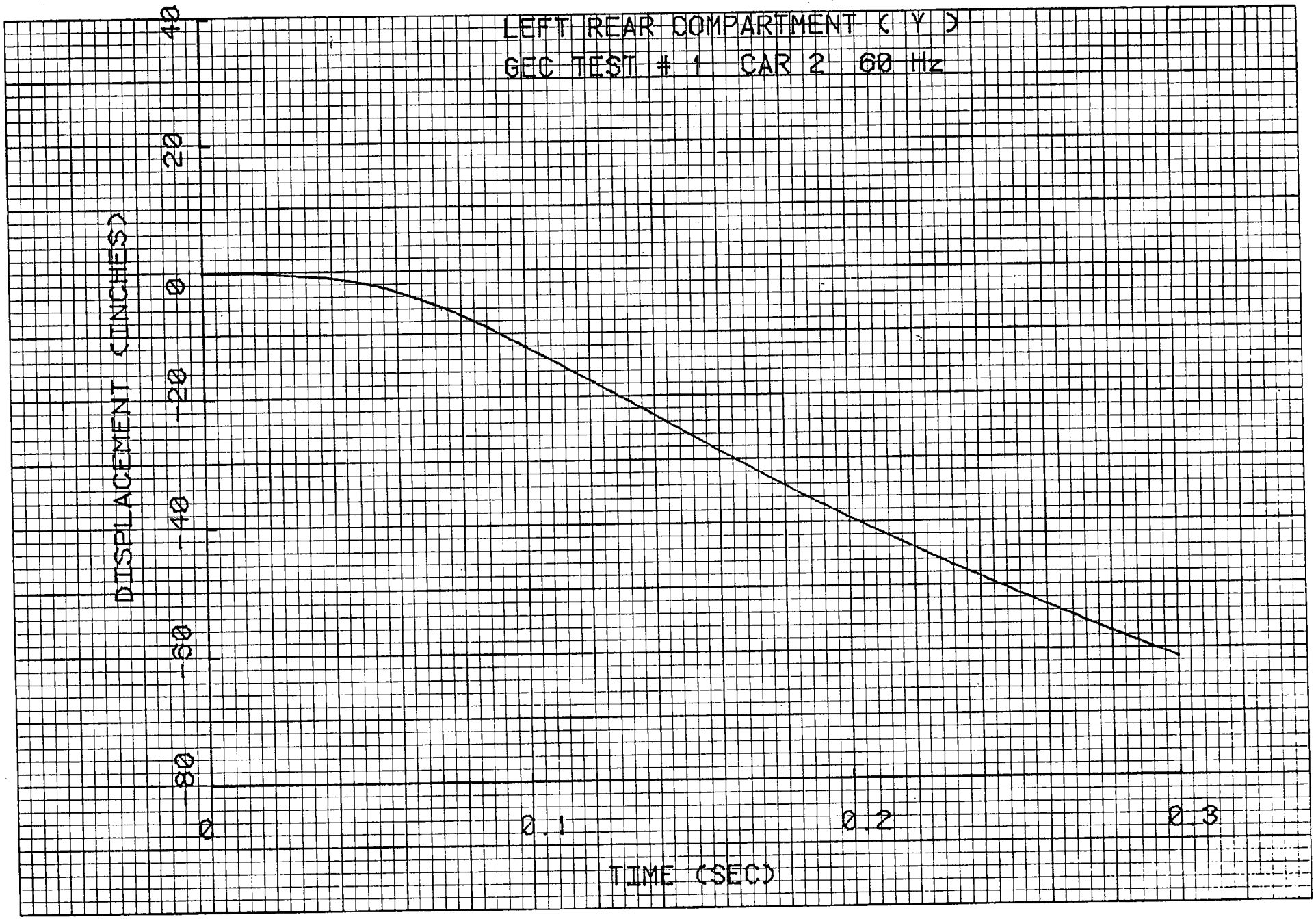


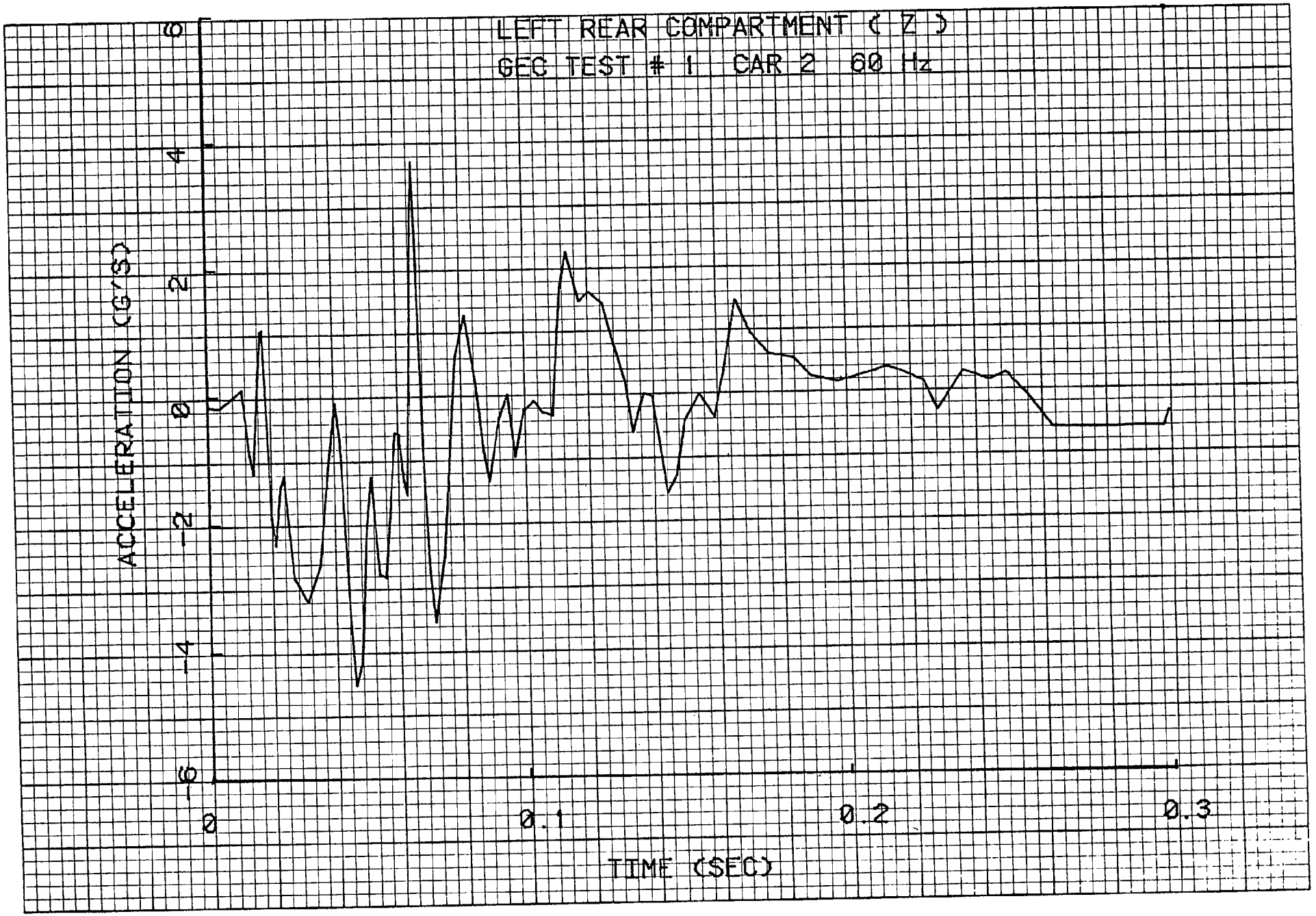


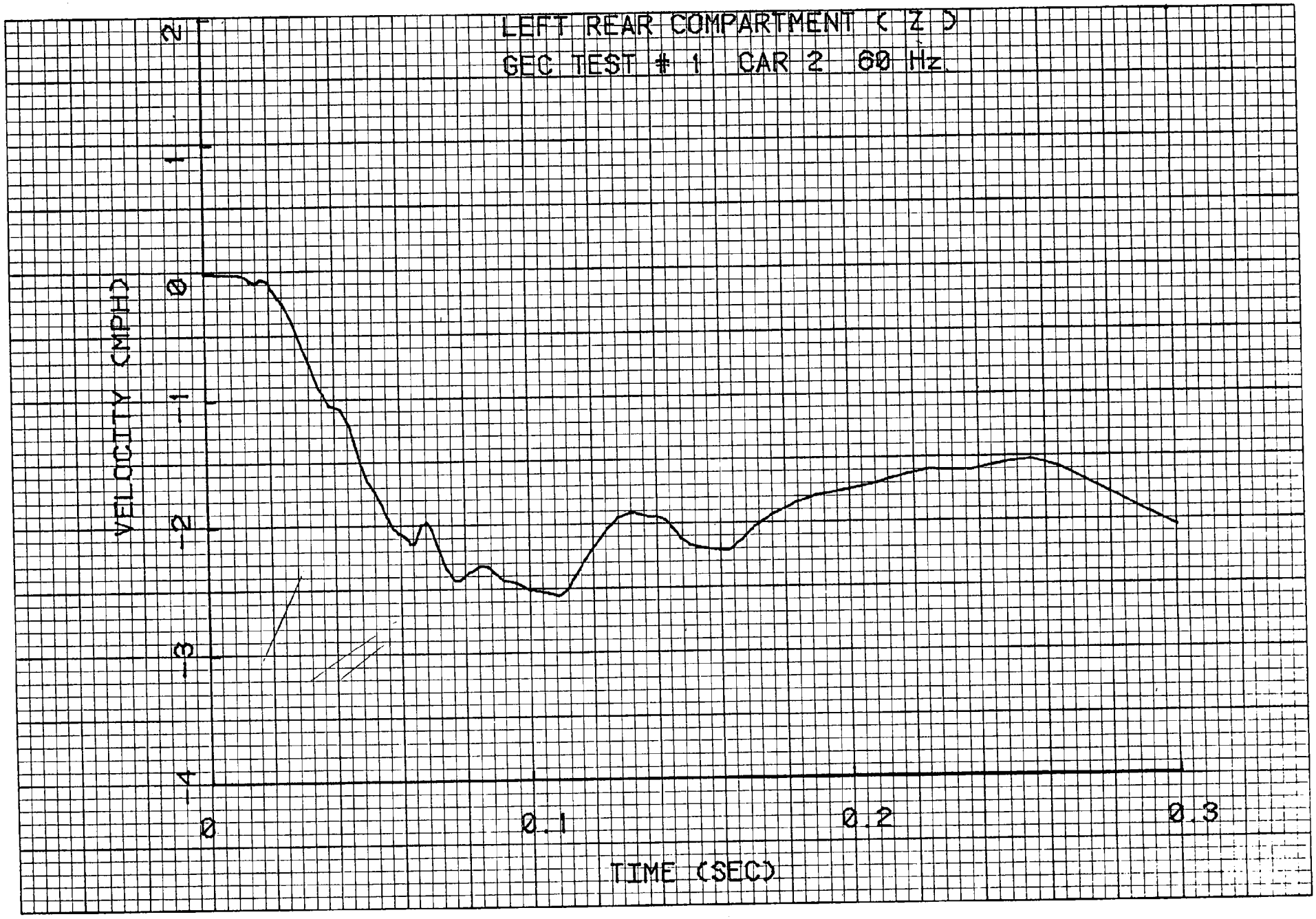


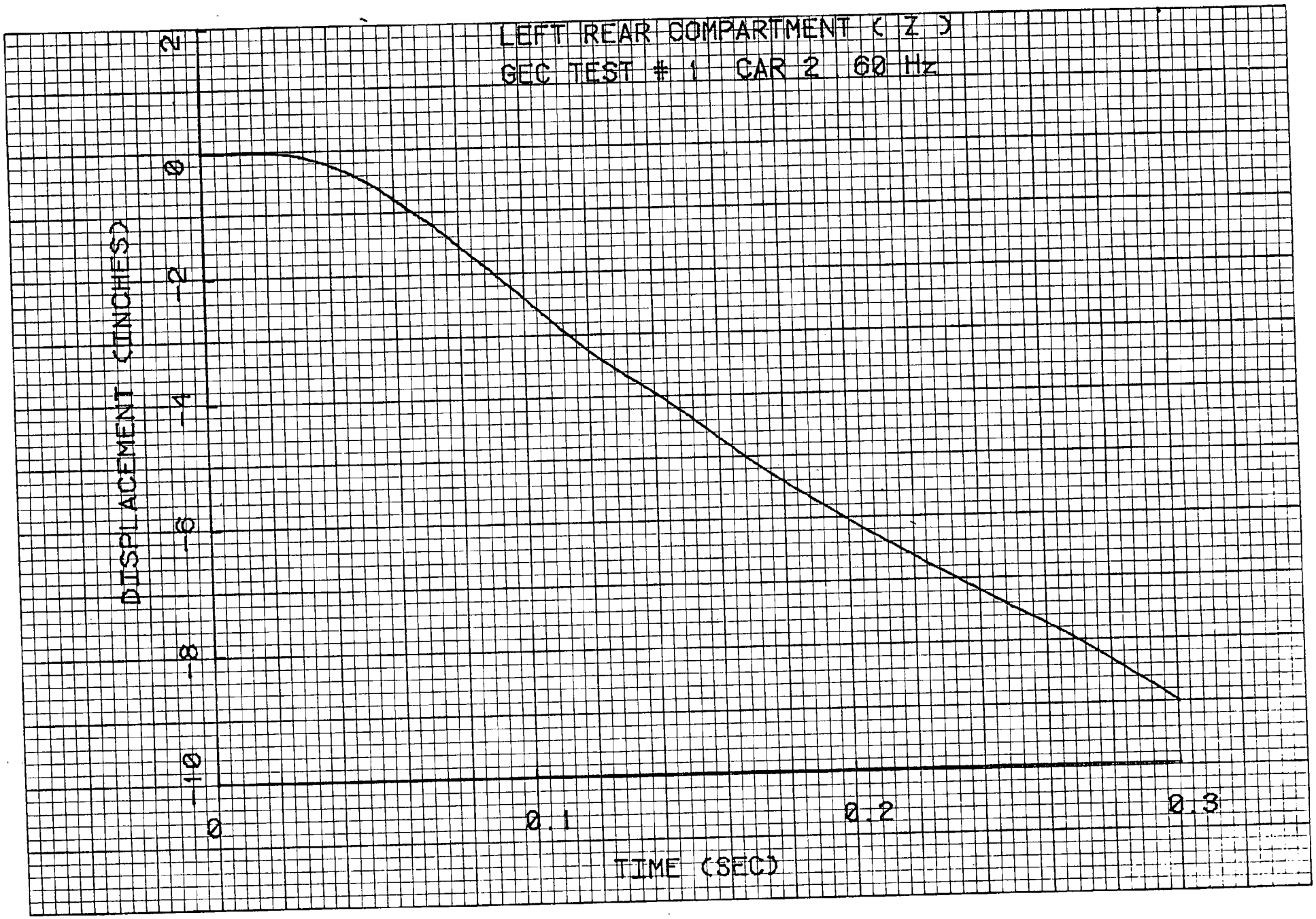

LEFT REAR COMPARTMENT (Y)
GEC TEST # 1 CAR 2 60 Hz
ACCELERATION (G'S)
20
10
0
-10
-20
-30
-40
0
0.1
0.2
0.3
TIME (SEC)

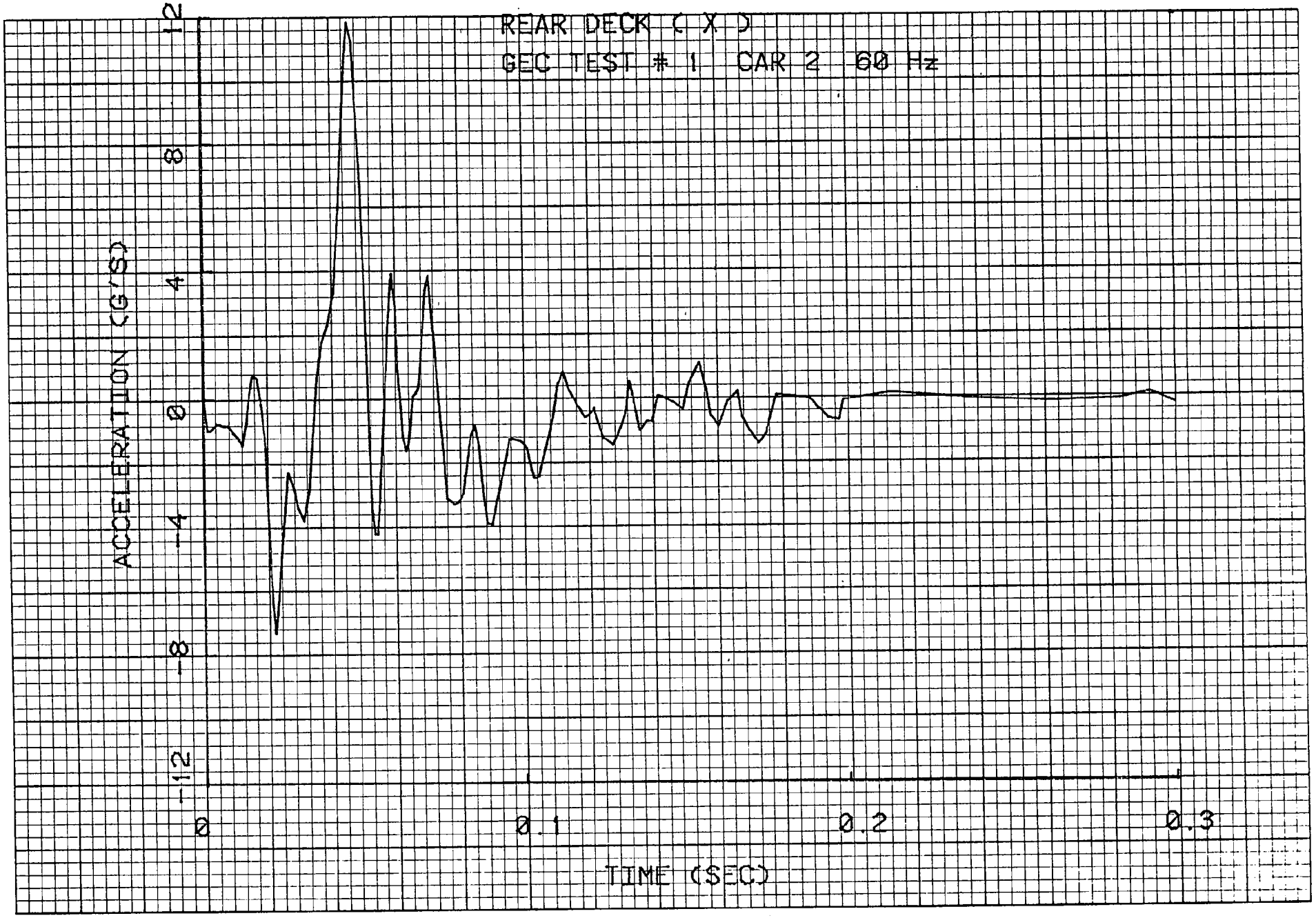

LEFT REAR COMPARTMENT (Y)
GEC TEST # 1 CAR 2 60 Hz
10
0
-10
-20
VELOCITY (MPH)
0
0.1
0.2
0.3
TIME (SEC)

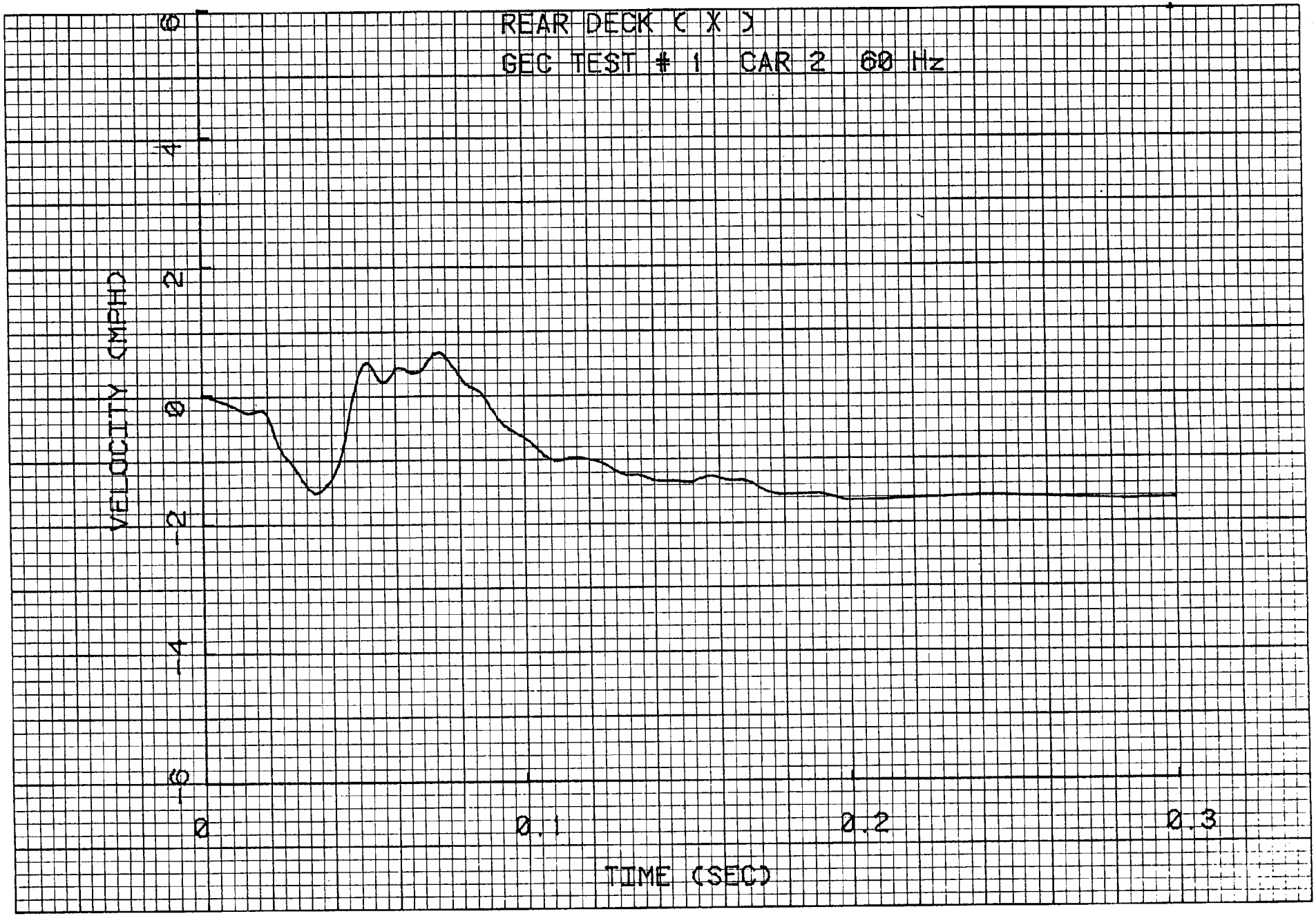

LEFT REAR COMPARTMENT (Y)
GEC TEST # 1 CAR 2 60 Hz
DISPLACEMENT (INCHES)
40
20
0
-20
-40
-60
-80
0
0.1
0.2
0.3
TIME (SEC)

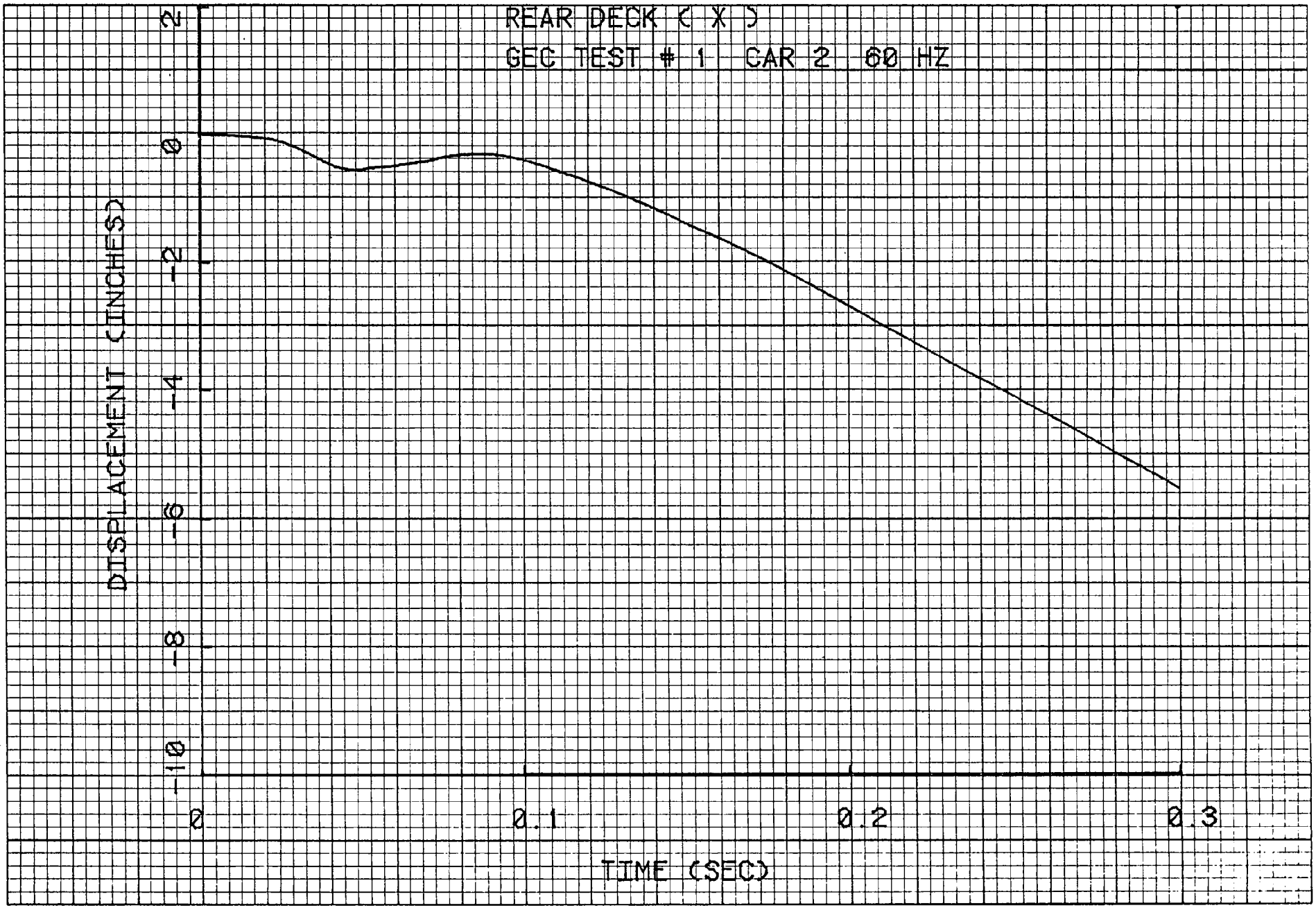

LEFT REAR COMPARTMENT (Z)
GEC TEST # 1 CAR 2 60 Hz
ACCELERATION (G'S)
6
4
2
0
-2
-4
-6
0
0.1
0.2
0.3
TIME (SEC)

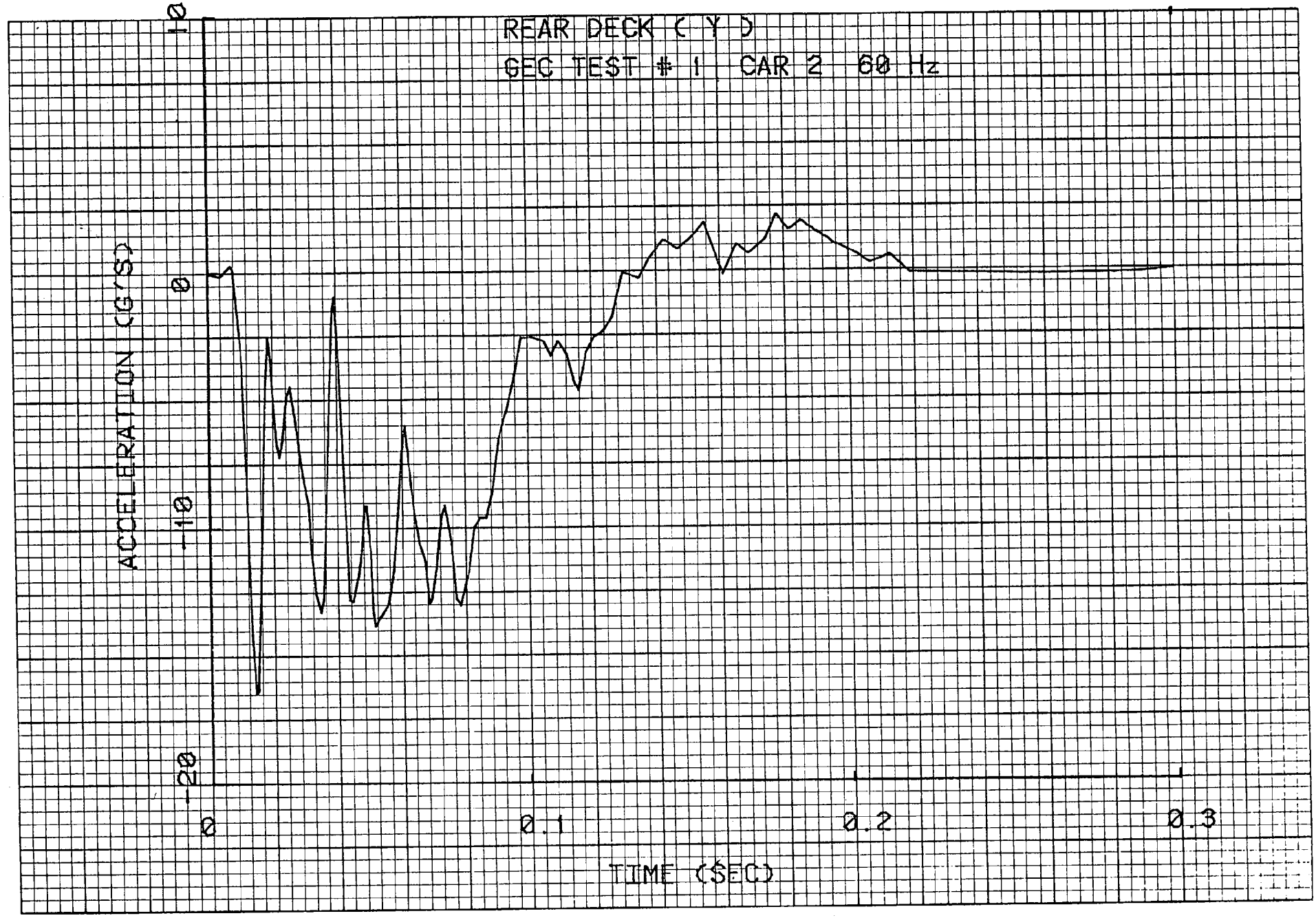

LEFT REAR COMPARTMENT (Z)
GEC TEST # 1 CAR 2 60 Hz.
VELOCITY (MPH)
2
1
0
-1
-2
-3
-4
0
0.1
0.2
0.3
TIME (SEC)

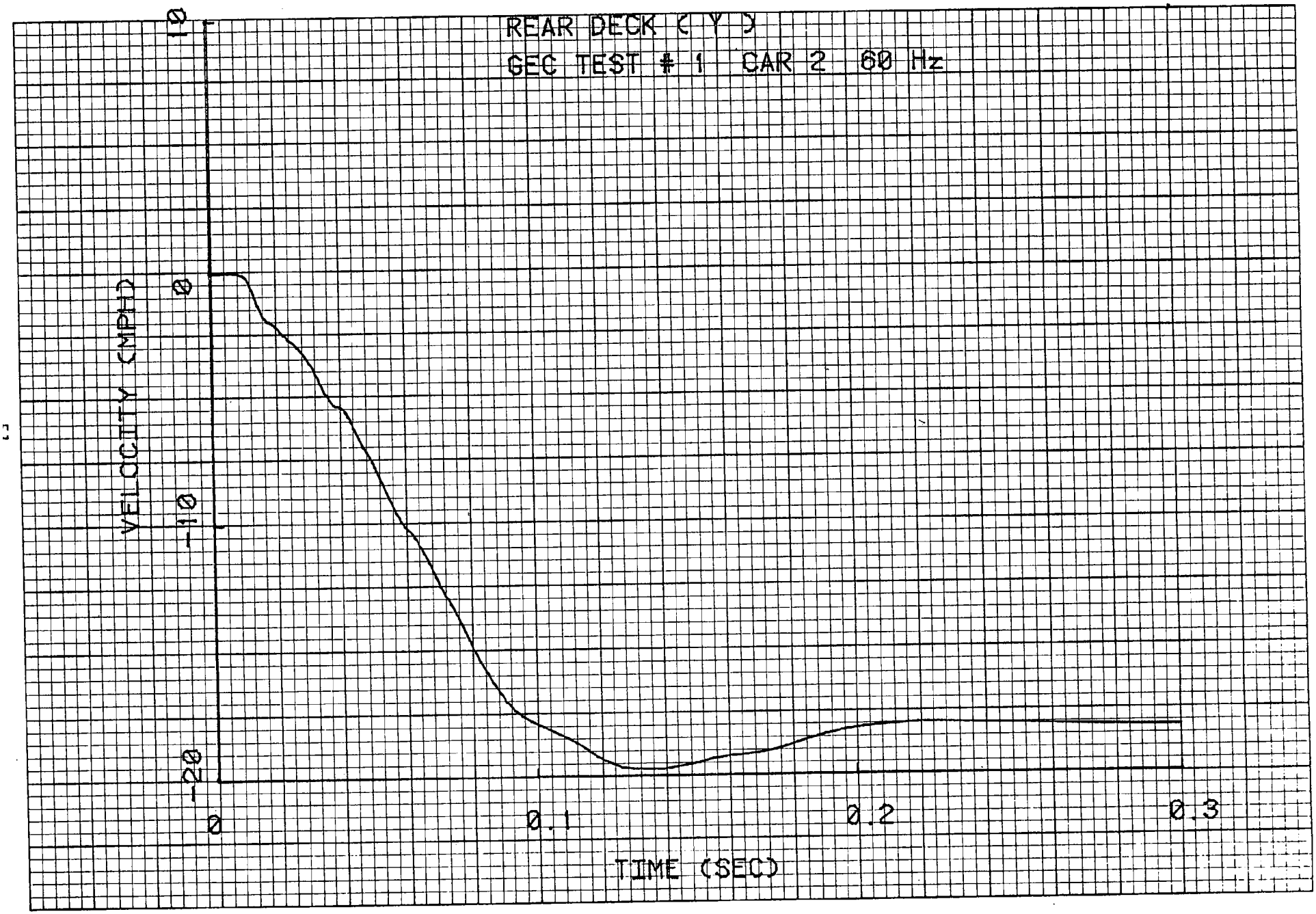


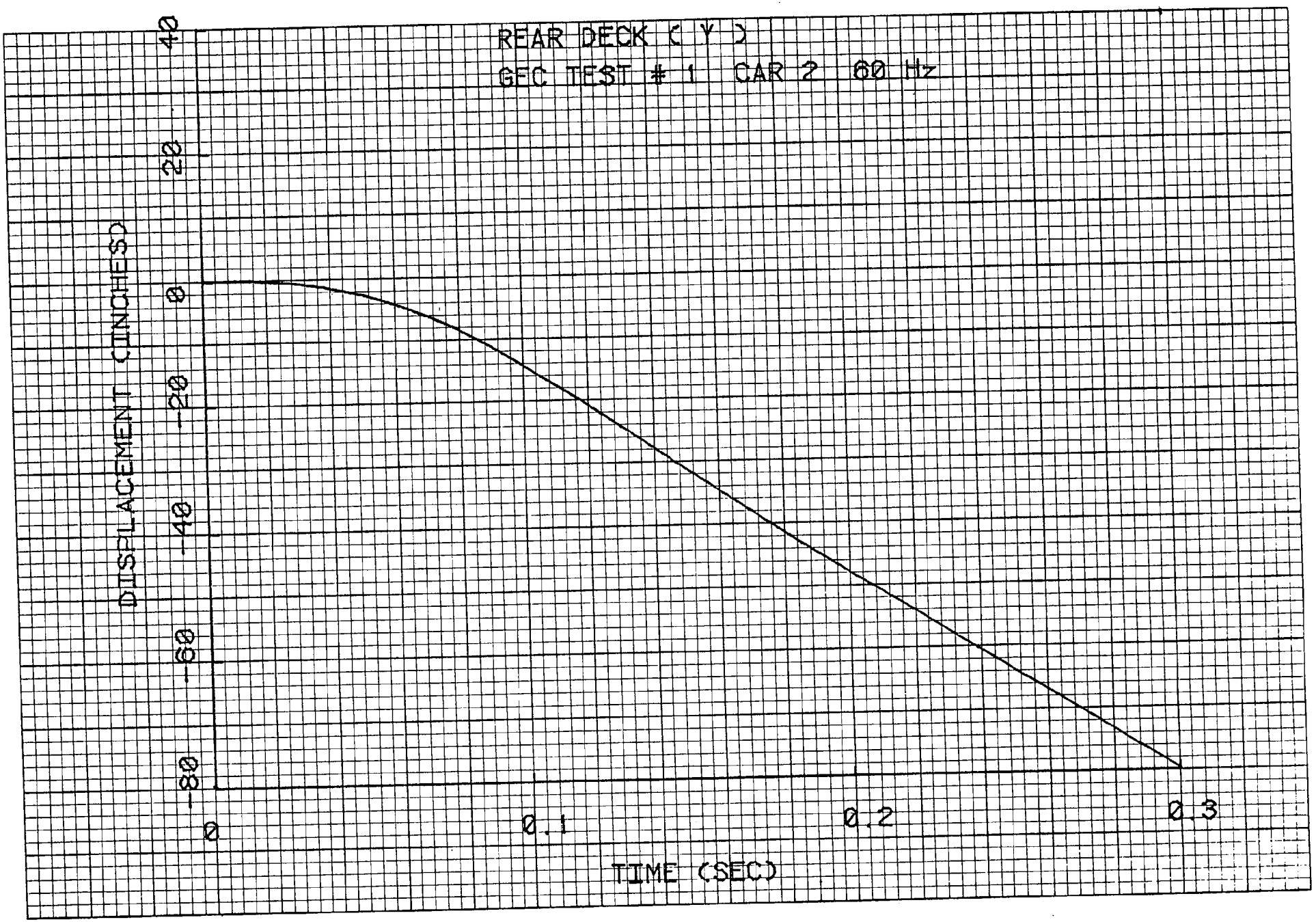


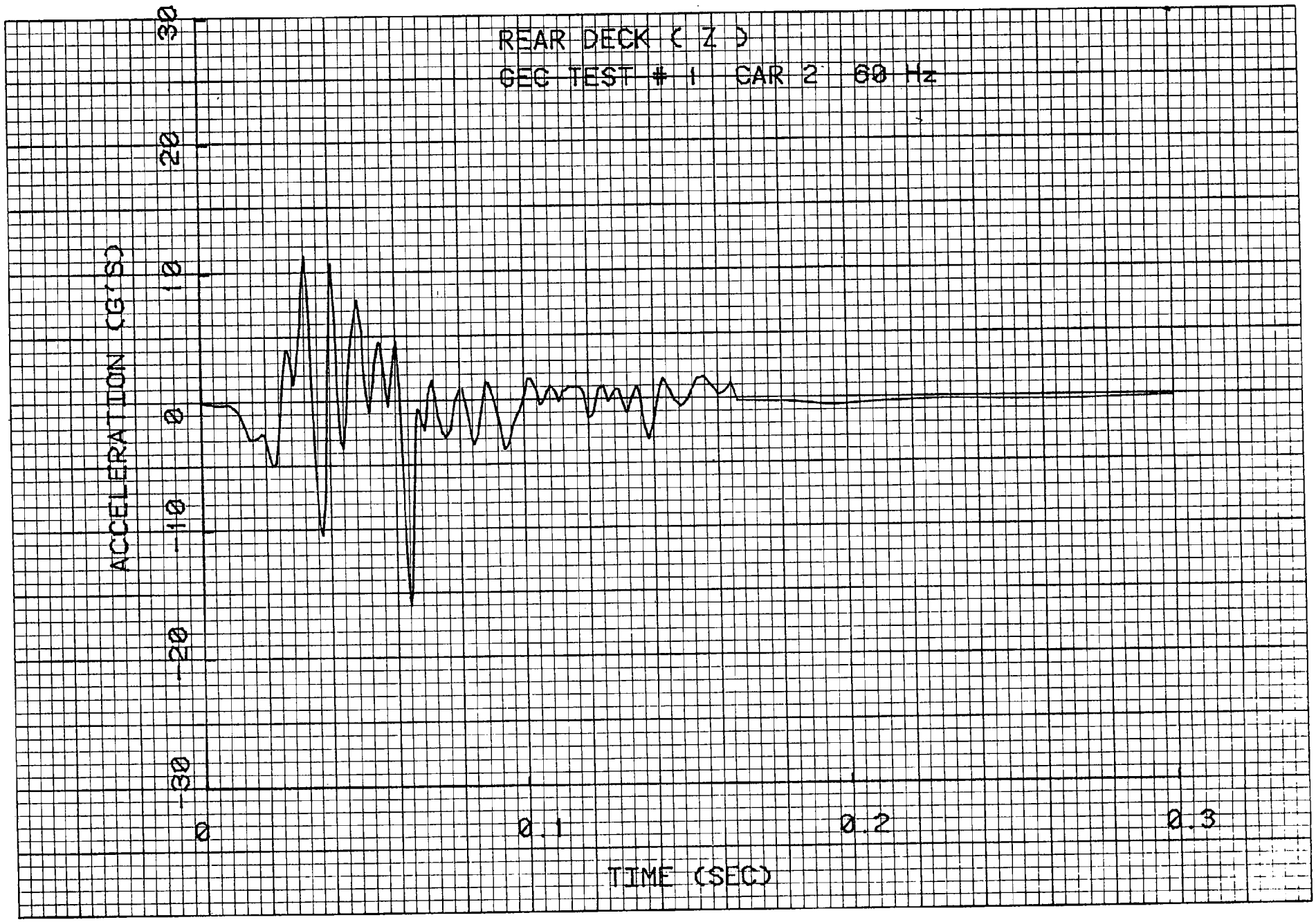


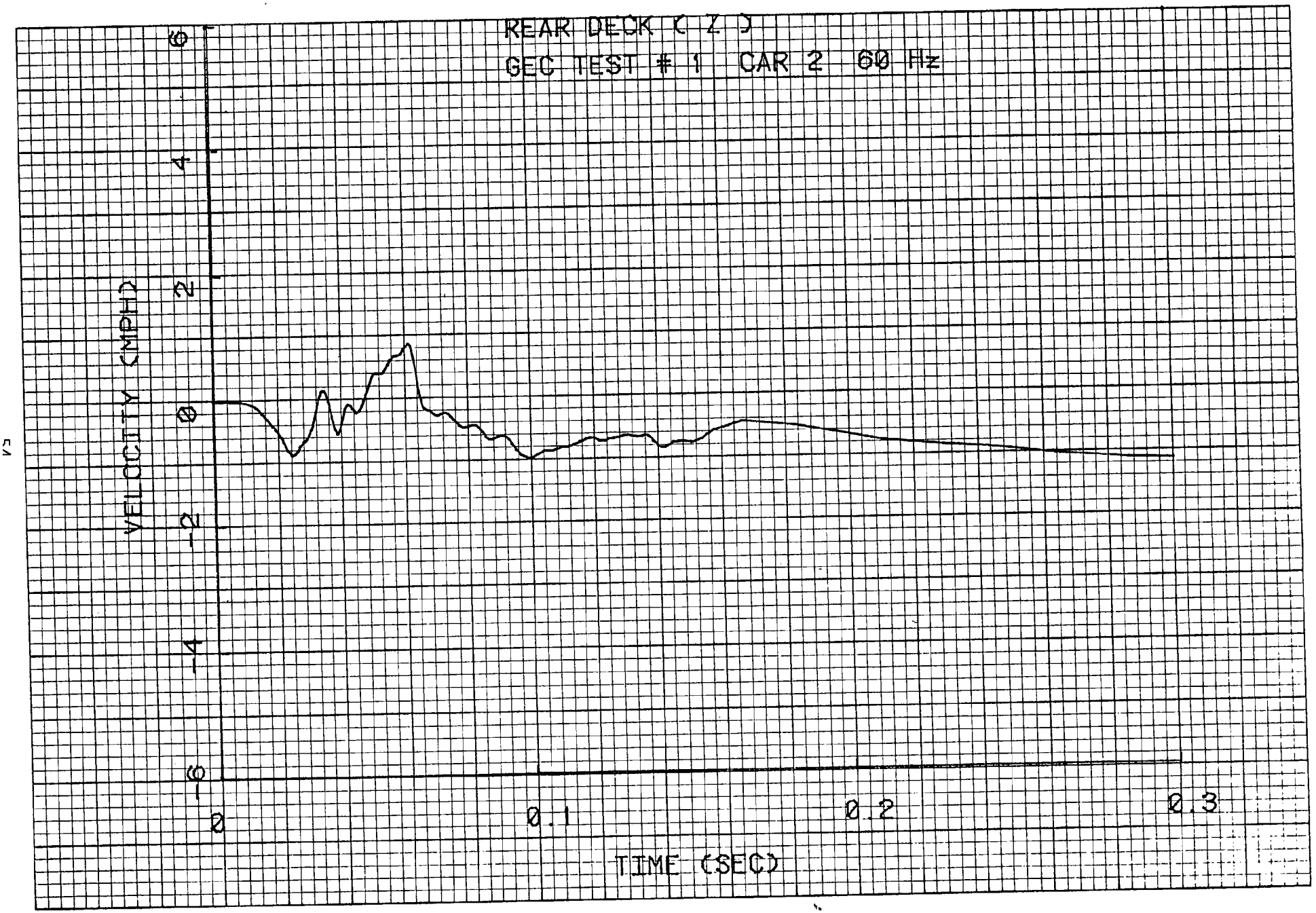


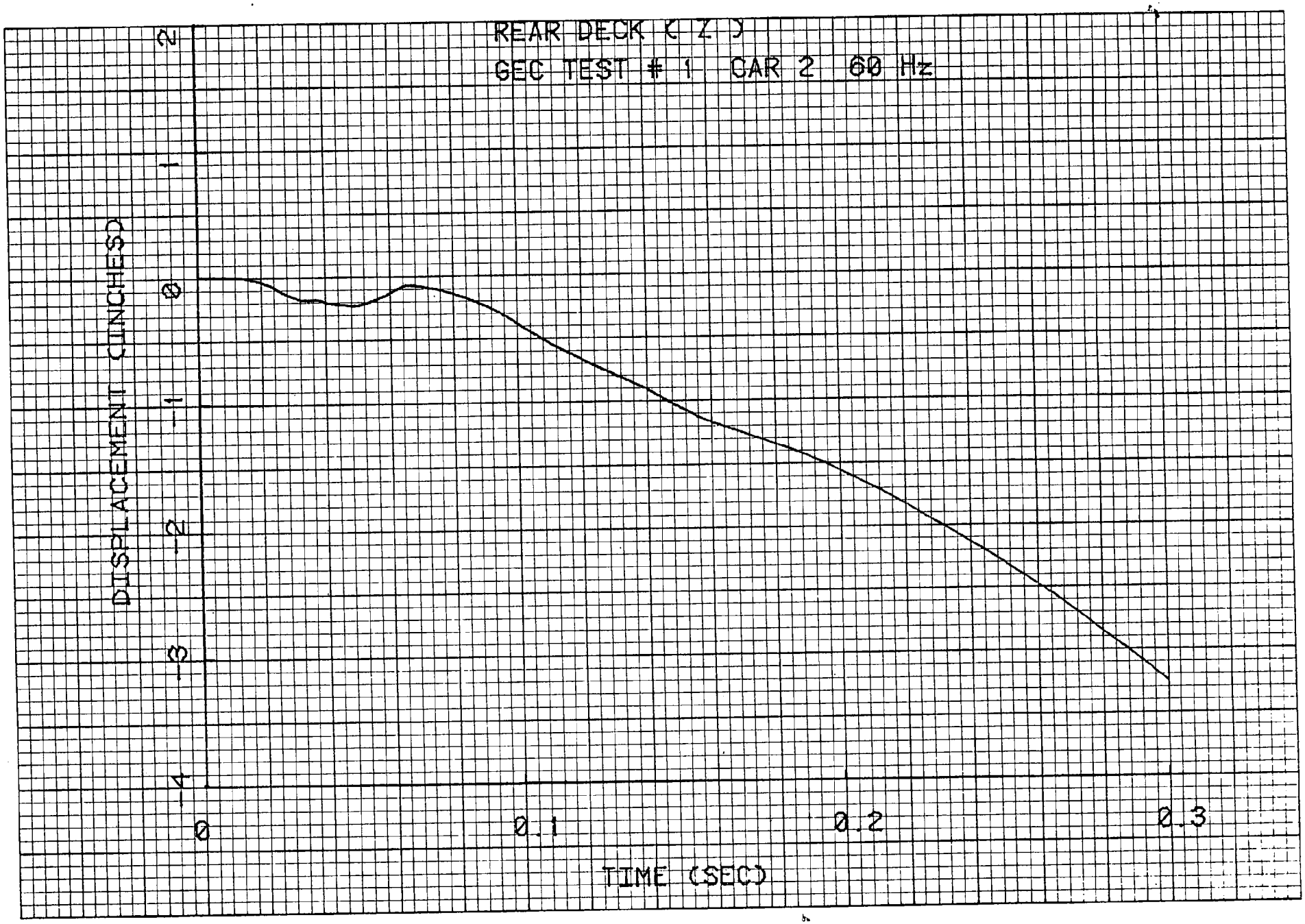

REAR DECK (Y)
GEC TEST # 1 CAR 2 60 Hz
10
0
-10
-20
ACCELERATION (G'S)
0
0.1
0.2
0.3
TIME (SEC)

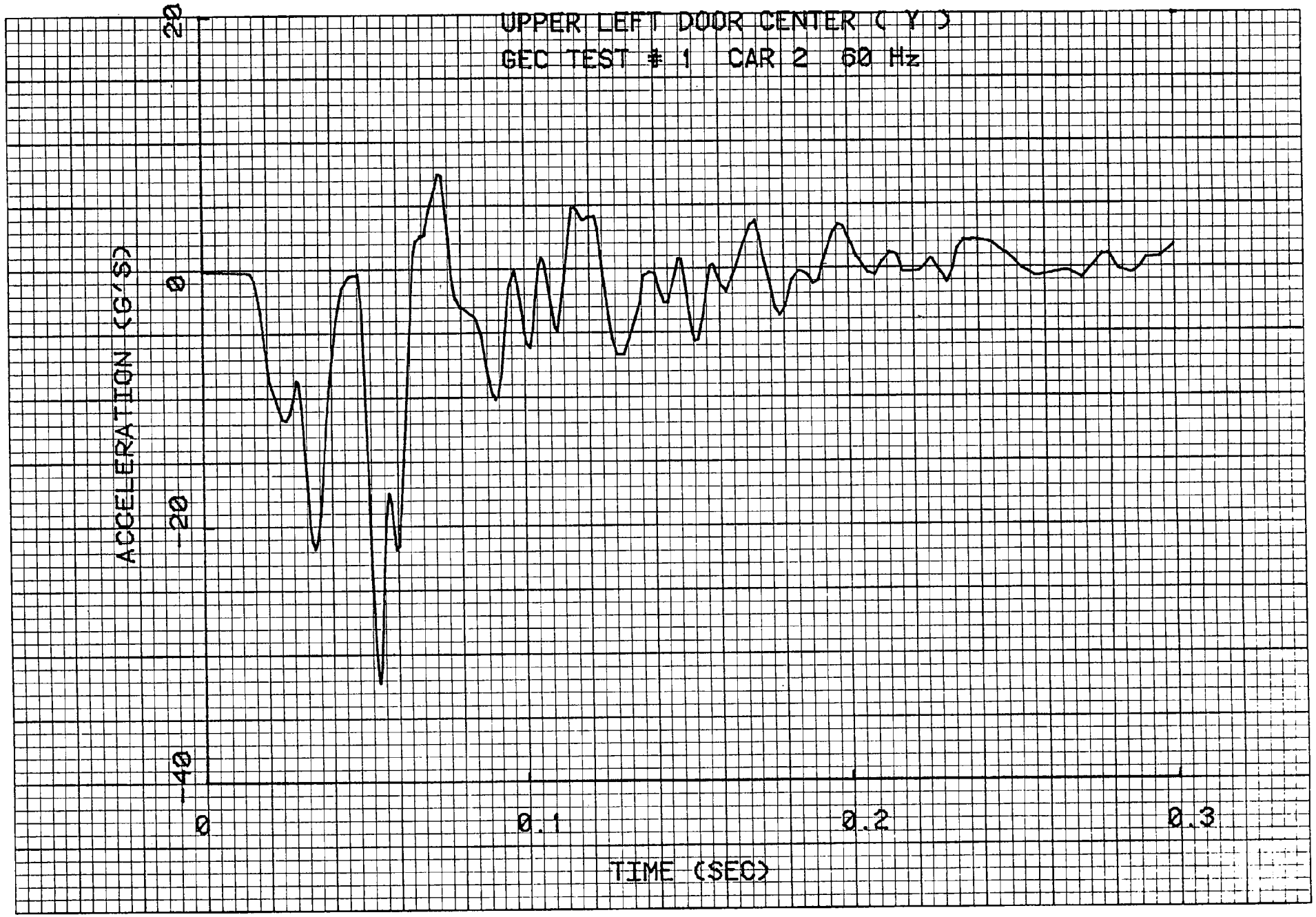


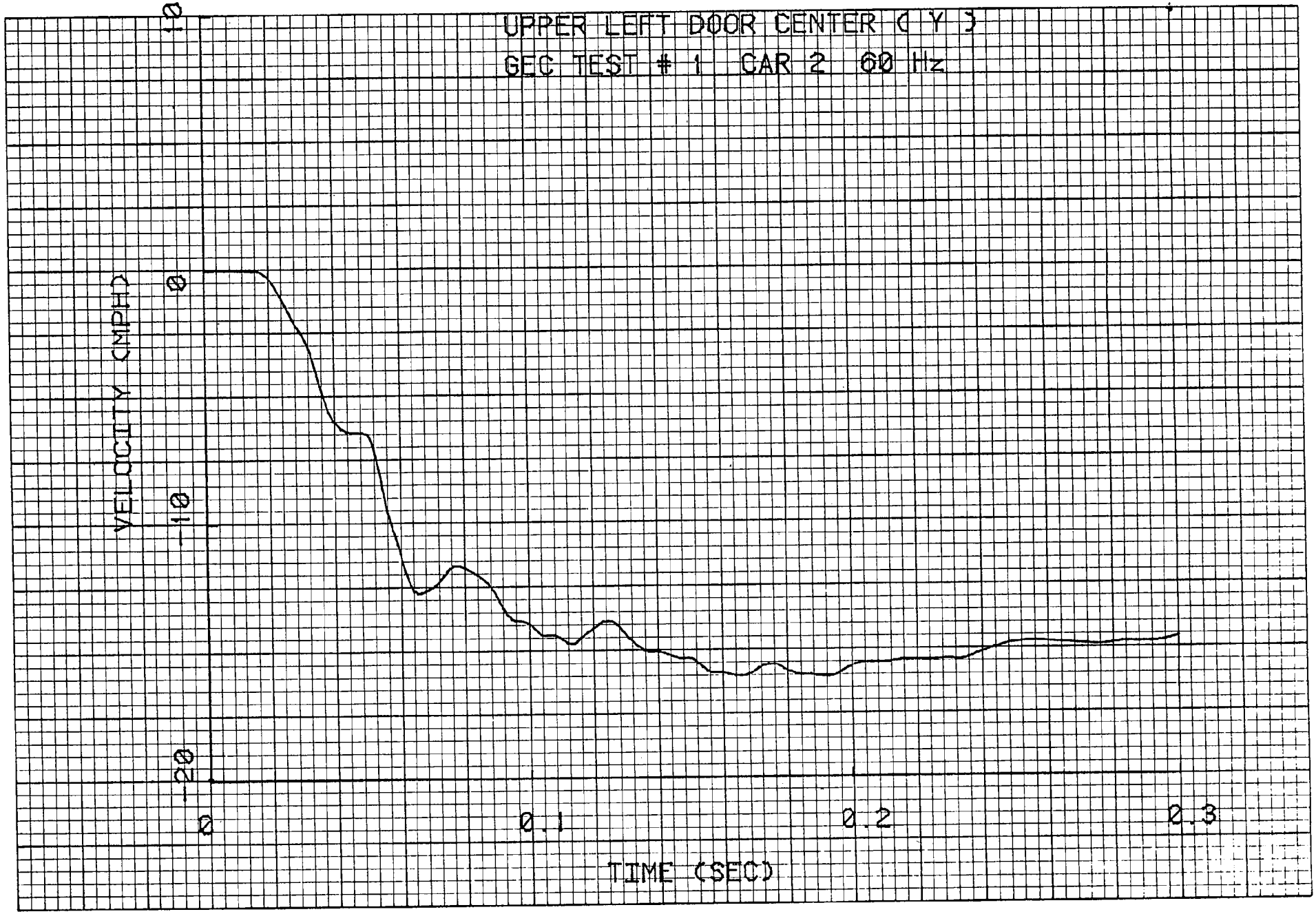

REAR DECK (Y)
GFC TEST # 1 CAR 2 60 Hz
DISPLACEMENT (INCHES)
40
20
0
-20
-40
-60
-80
0
0.1
0.2
0.3
TIME (SEC)

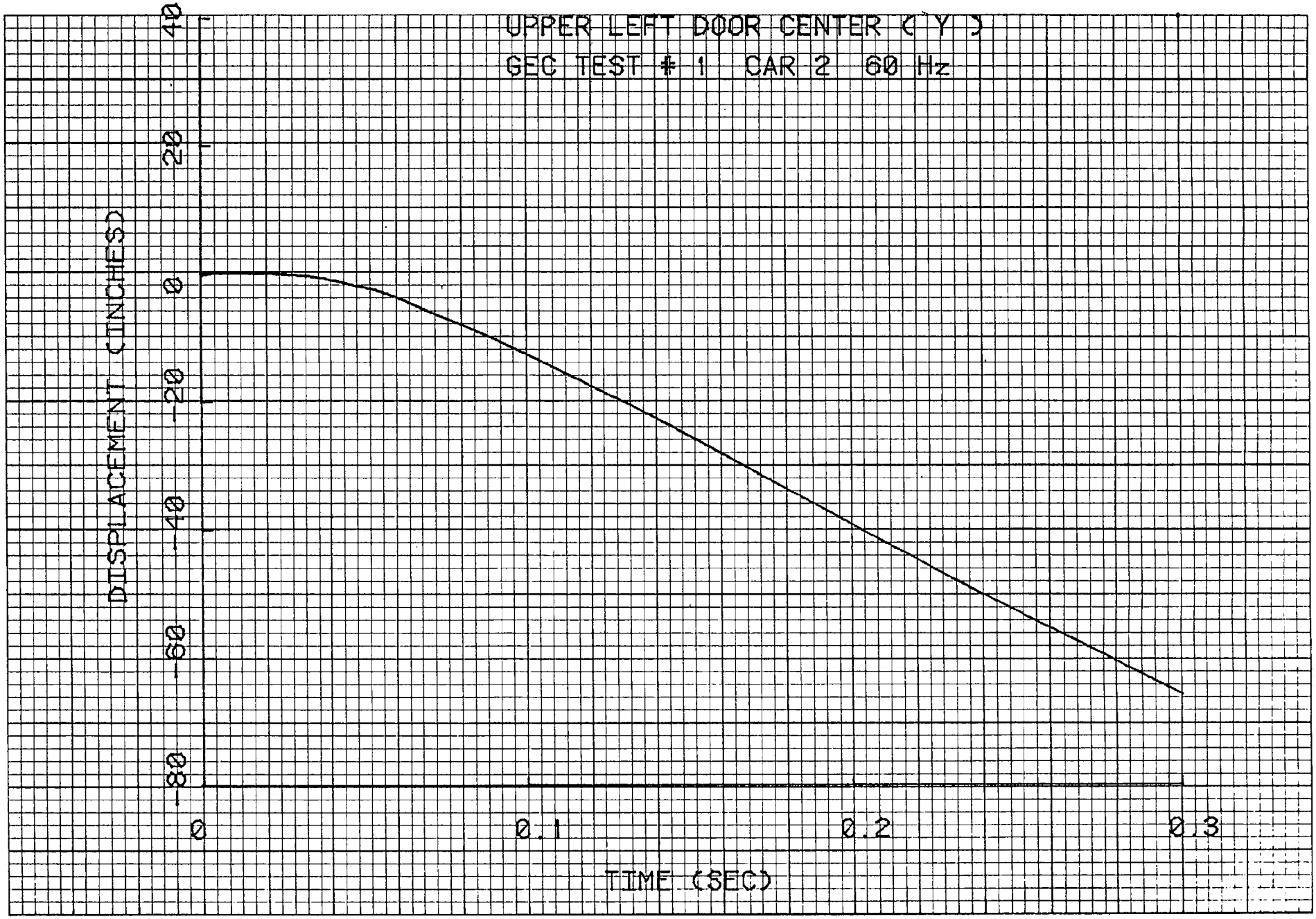


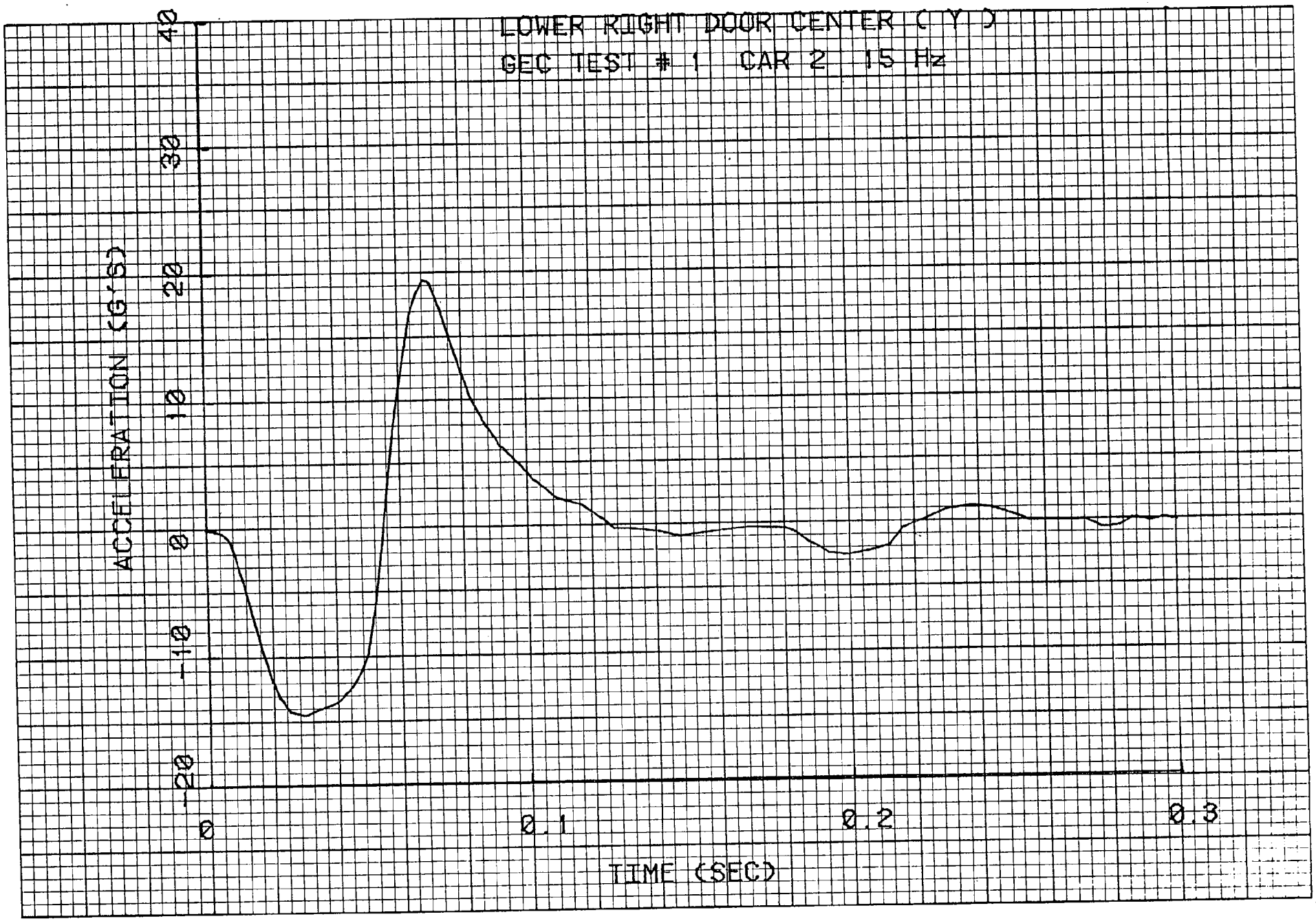


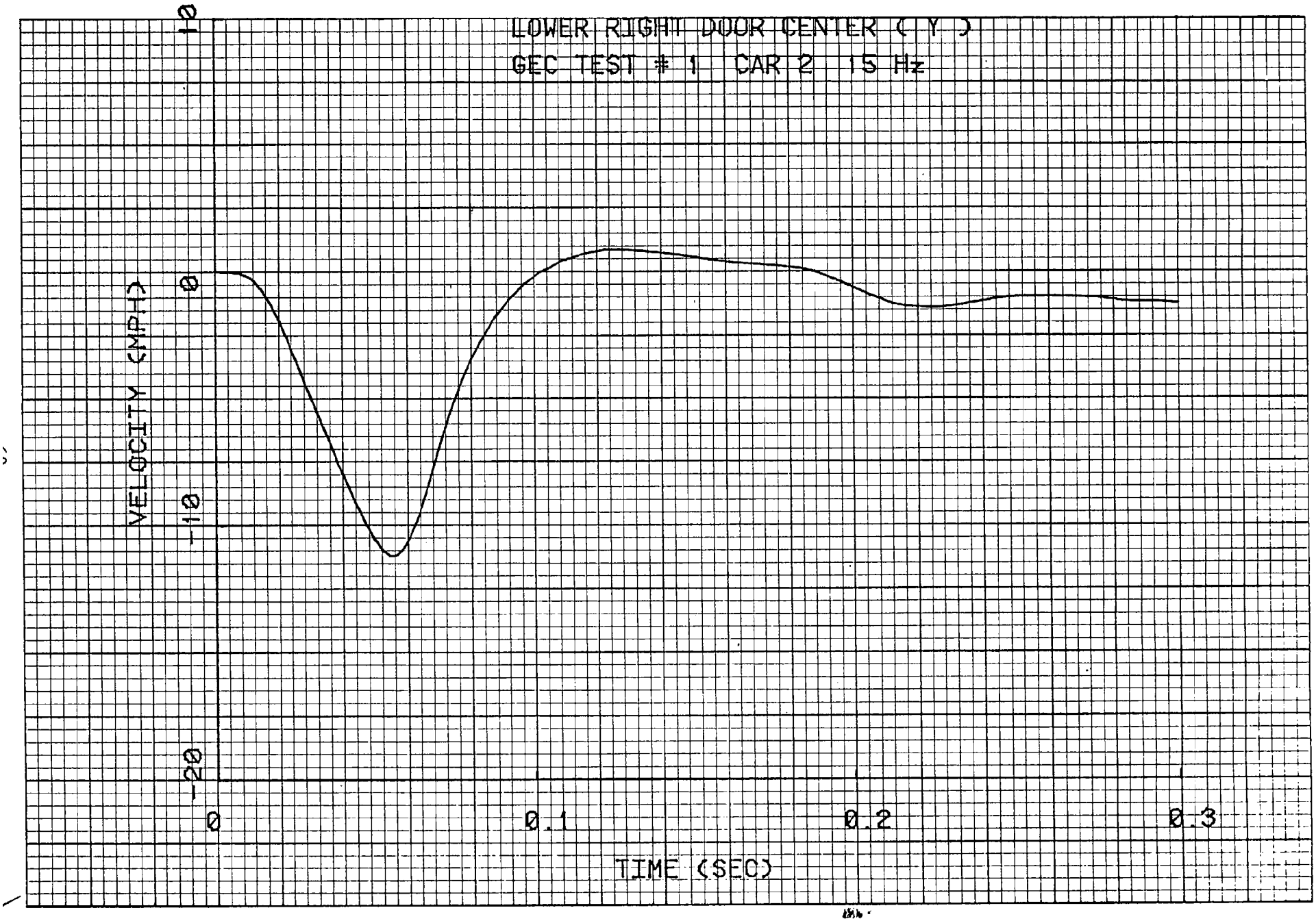


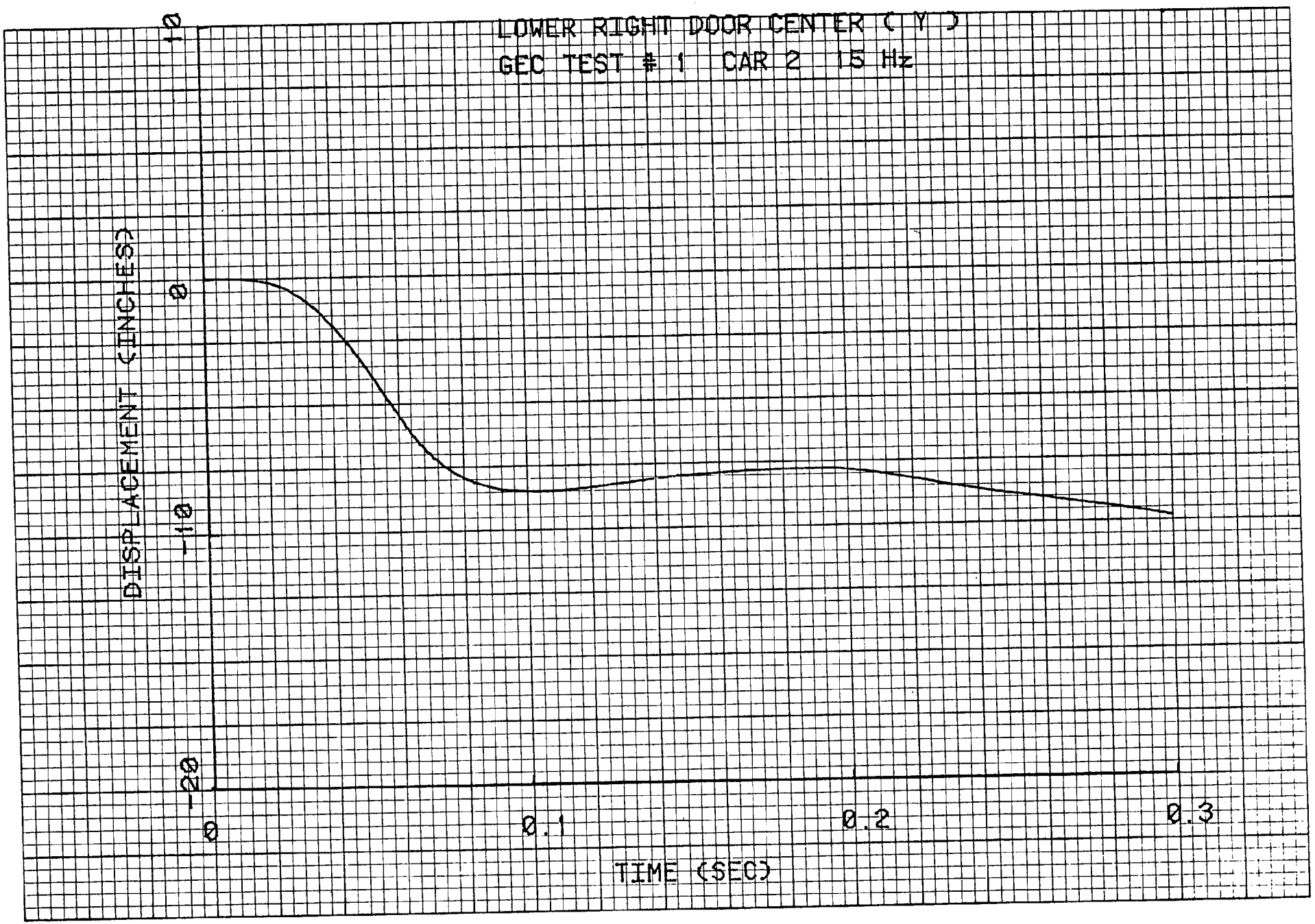


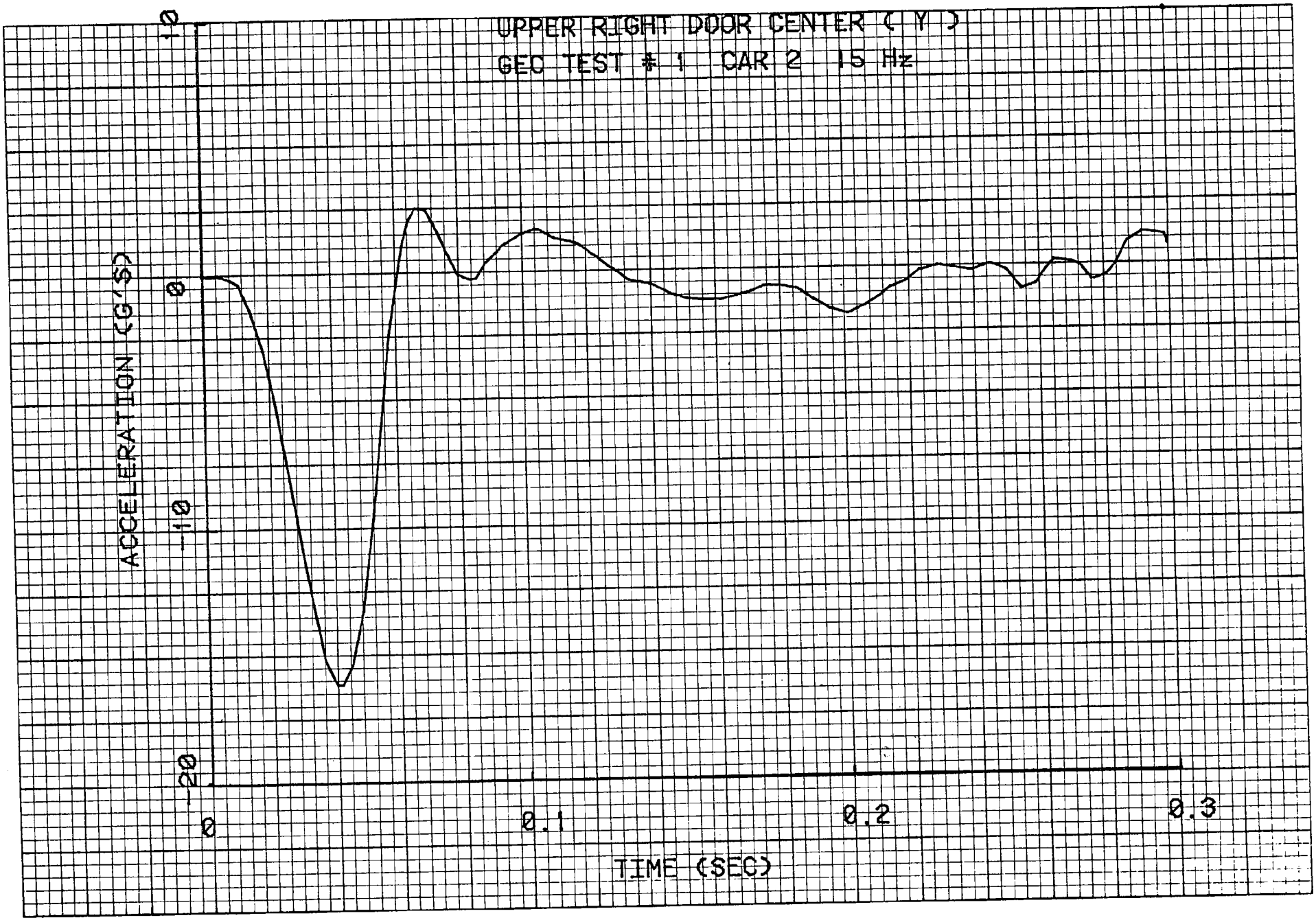

UPPER LEFT DOOR CENTER (Y)
GEC TEST # 1 CAR 2 60 Hz
VELOCITY (MPH)
10
0
-10
-20
0
0.1
0.2
0.3
TIME (SEC)

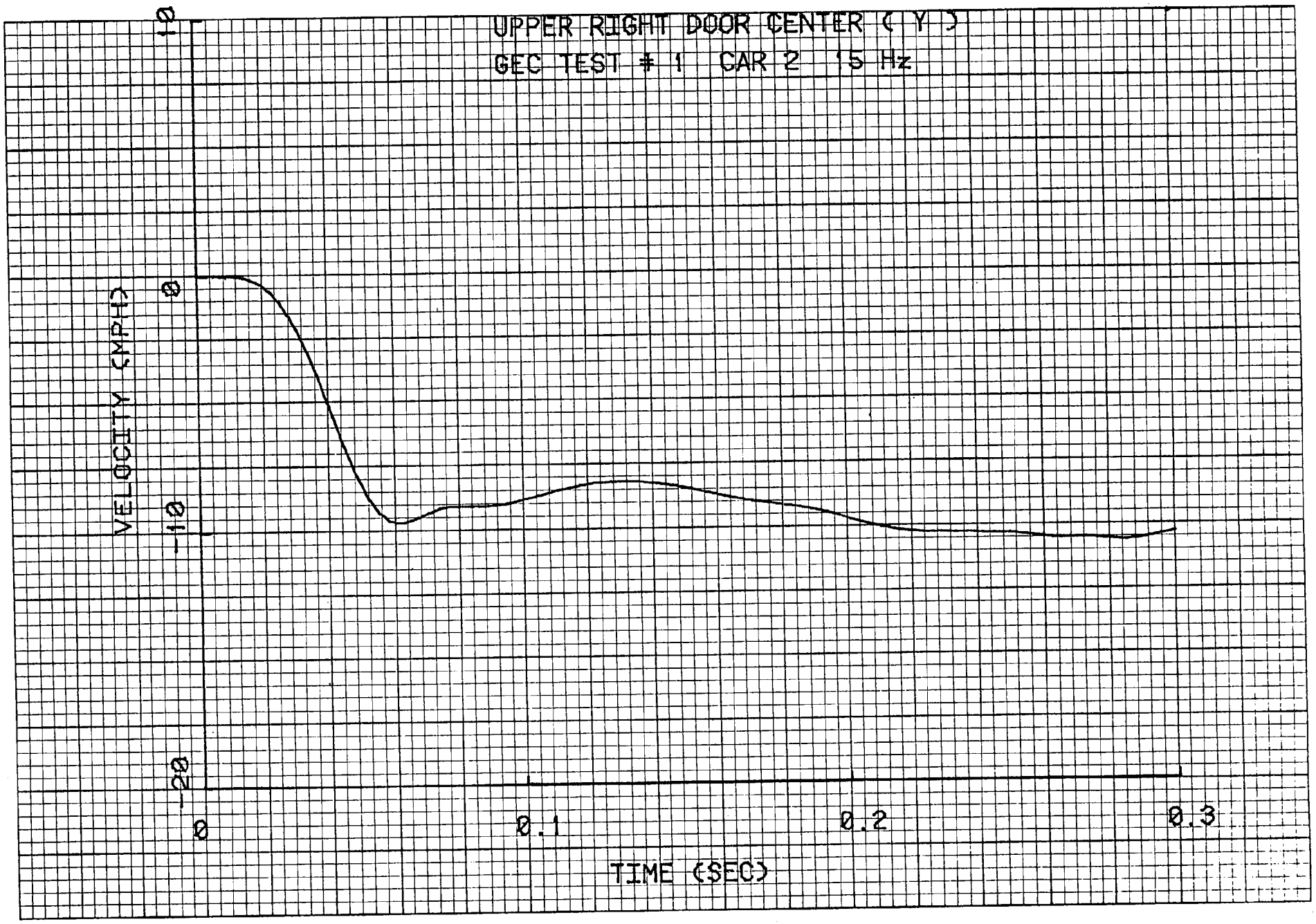


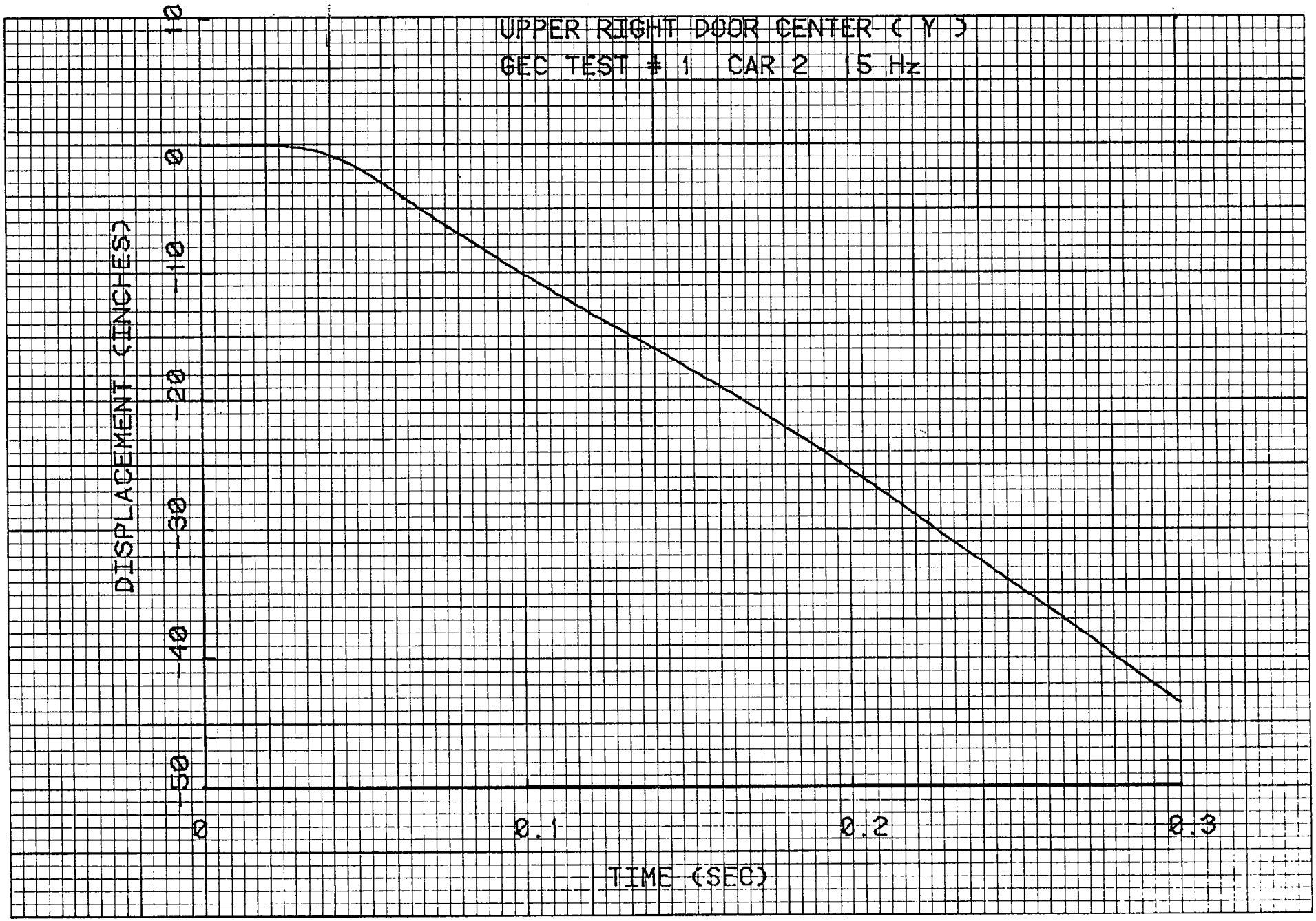

LOWER RIGHT DOOR CENTER (Y)
GEC TEST # 1 CAR 2 15 Hz
ACCELERATION (G'S)
40
30
20
10
0
-10
-20
0
0.1
0.2
0.3
TIME (SEC)

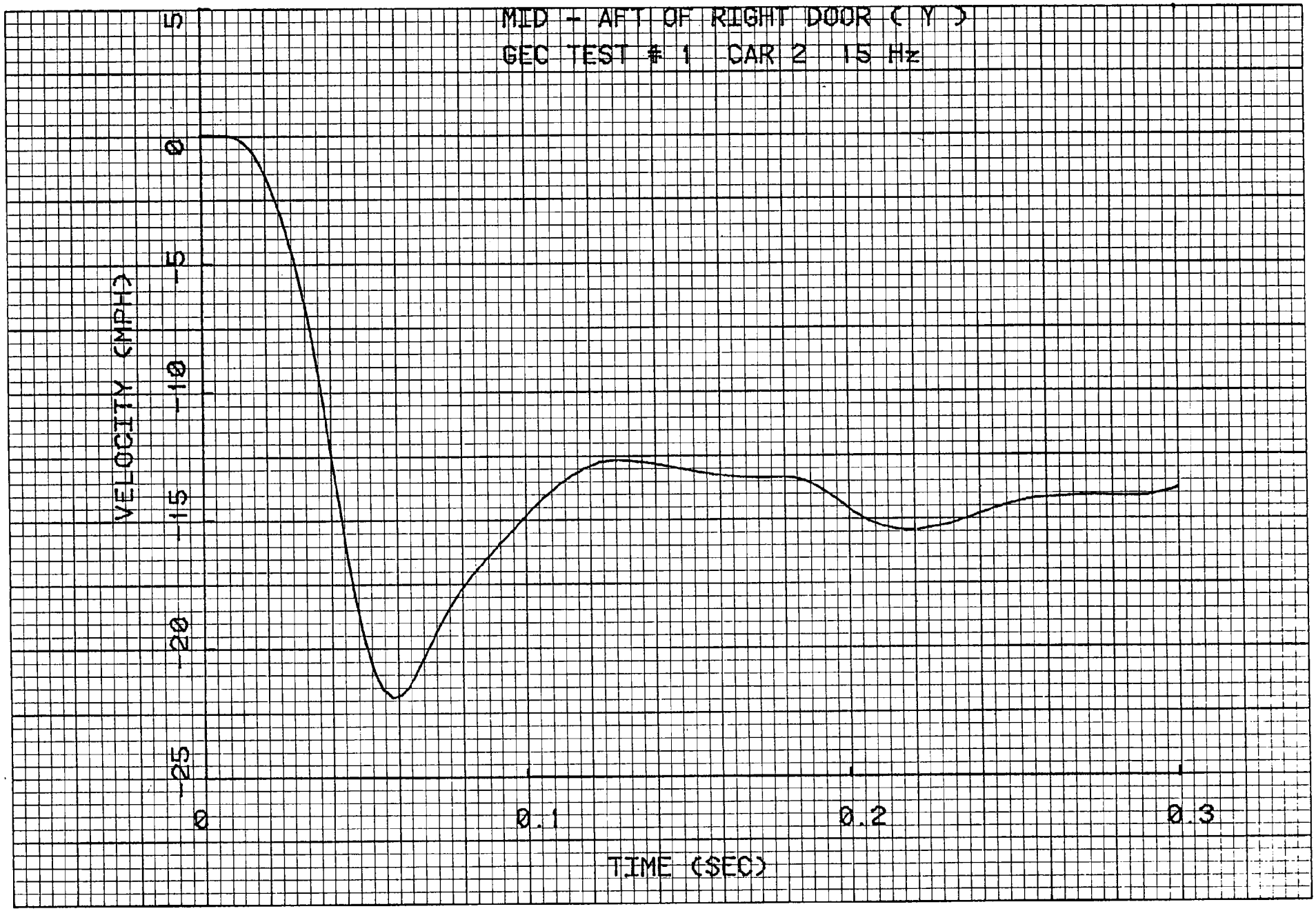


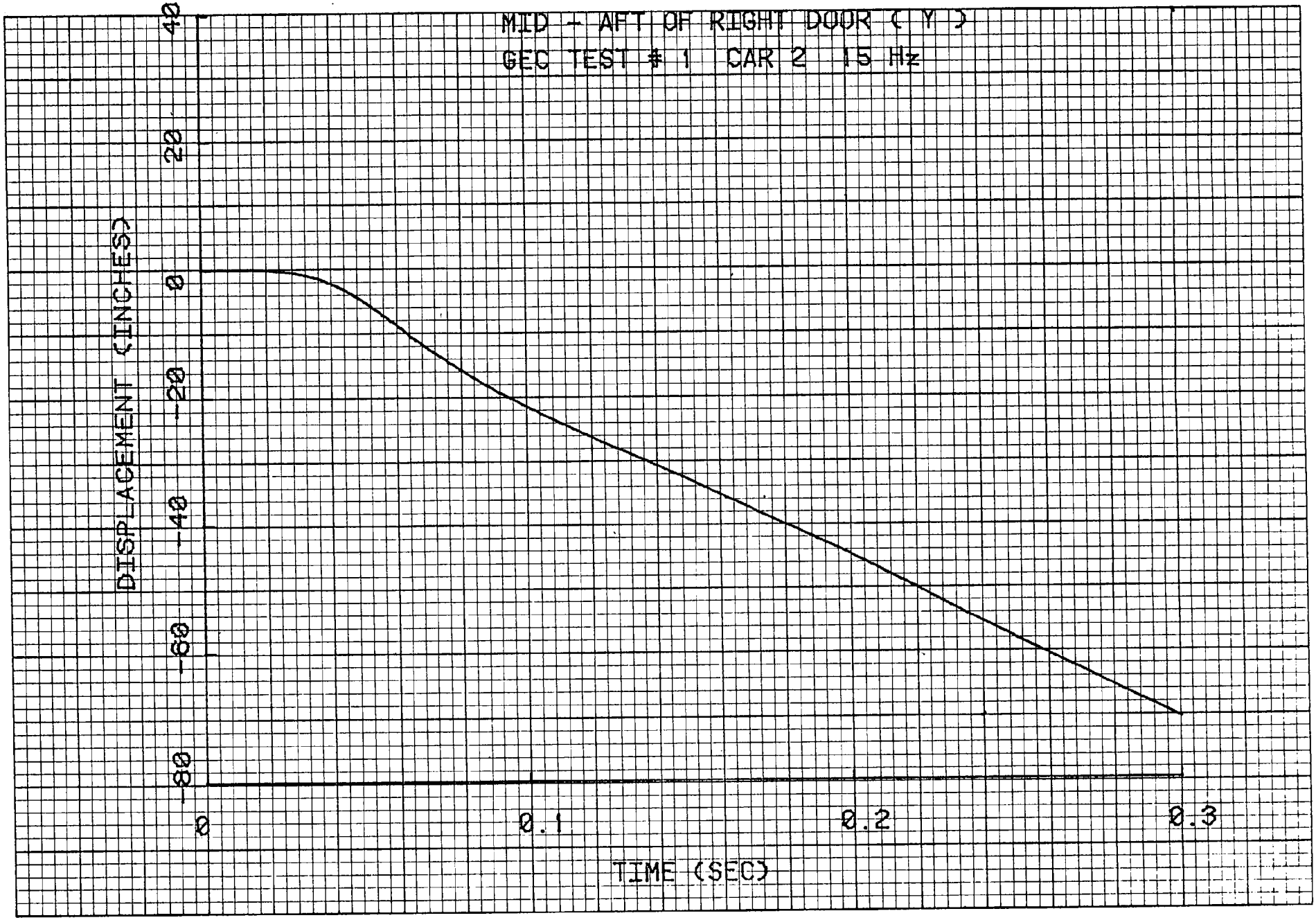


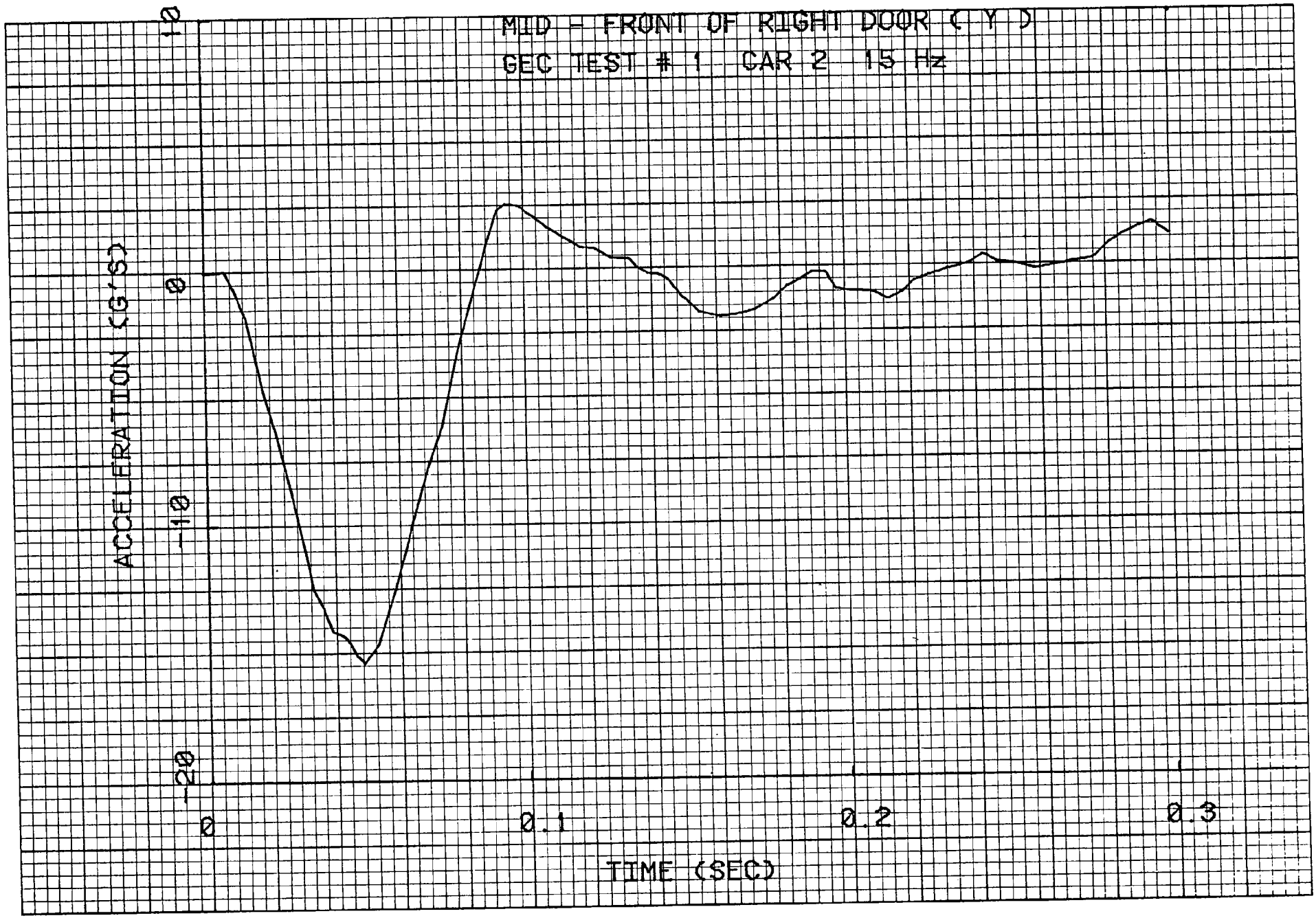


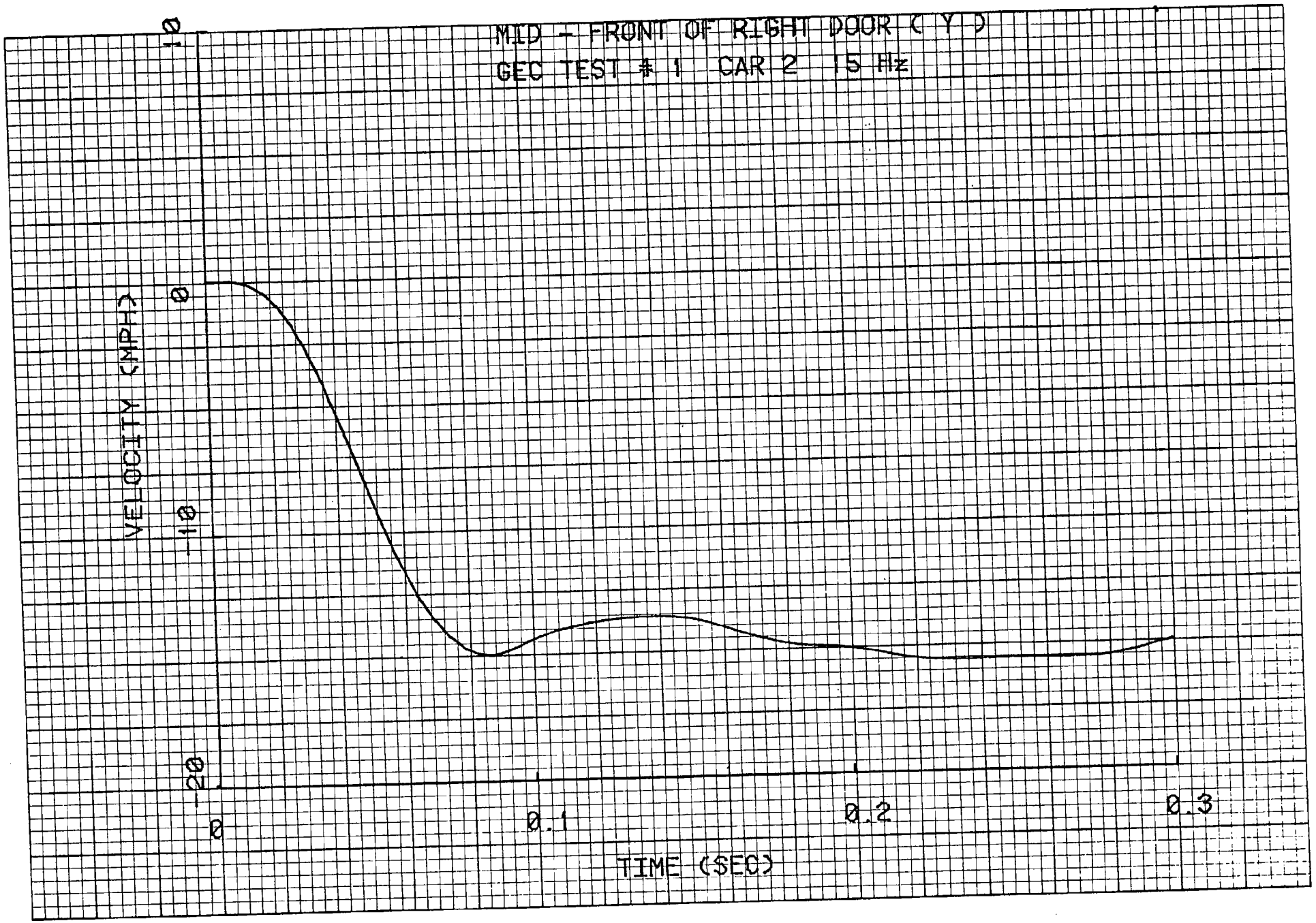


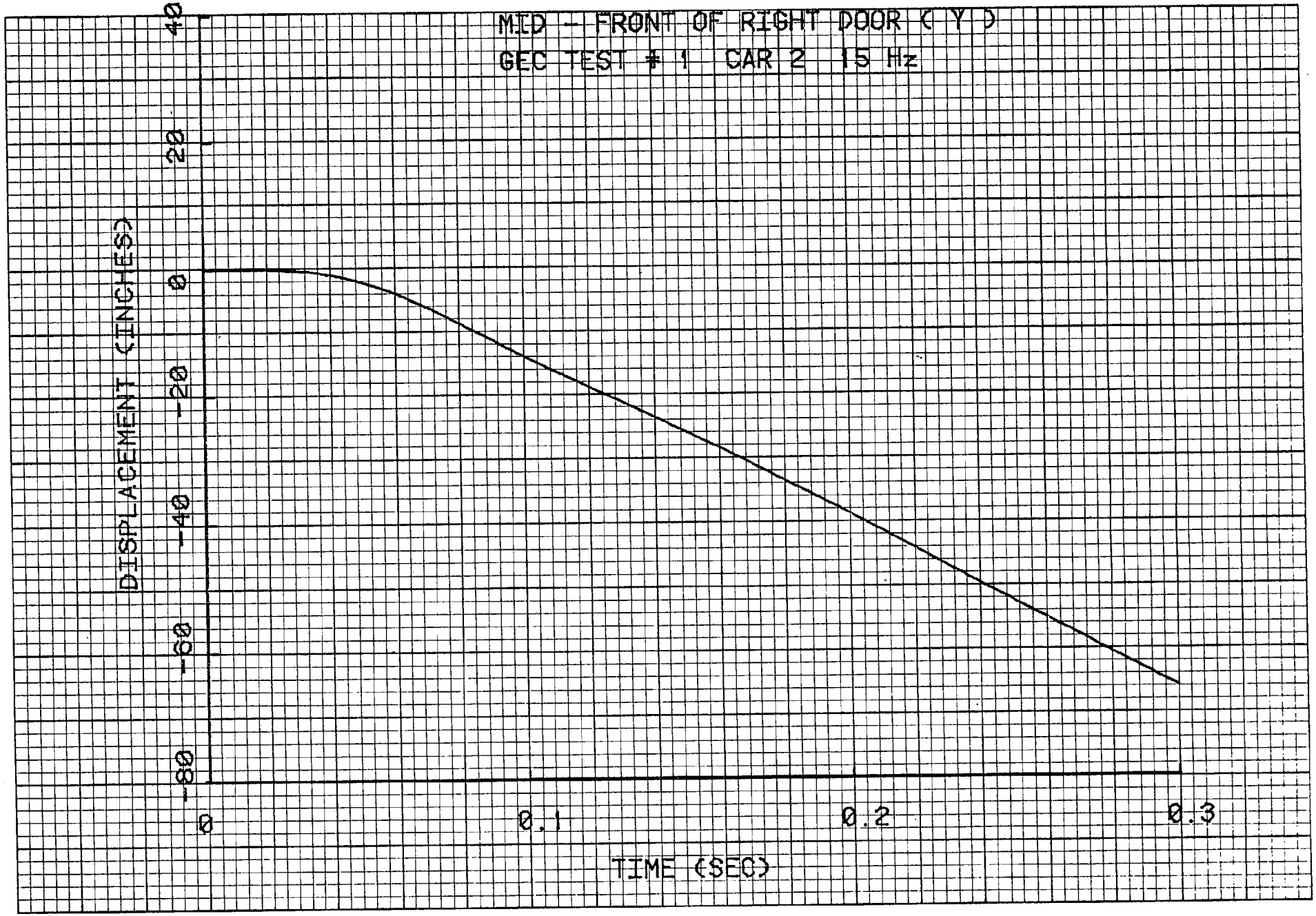


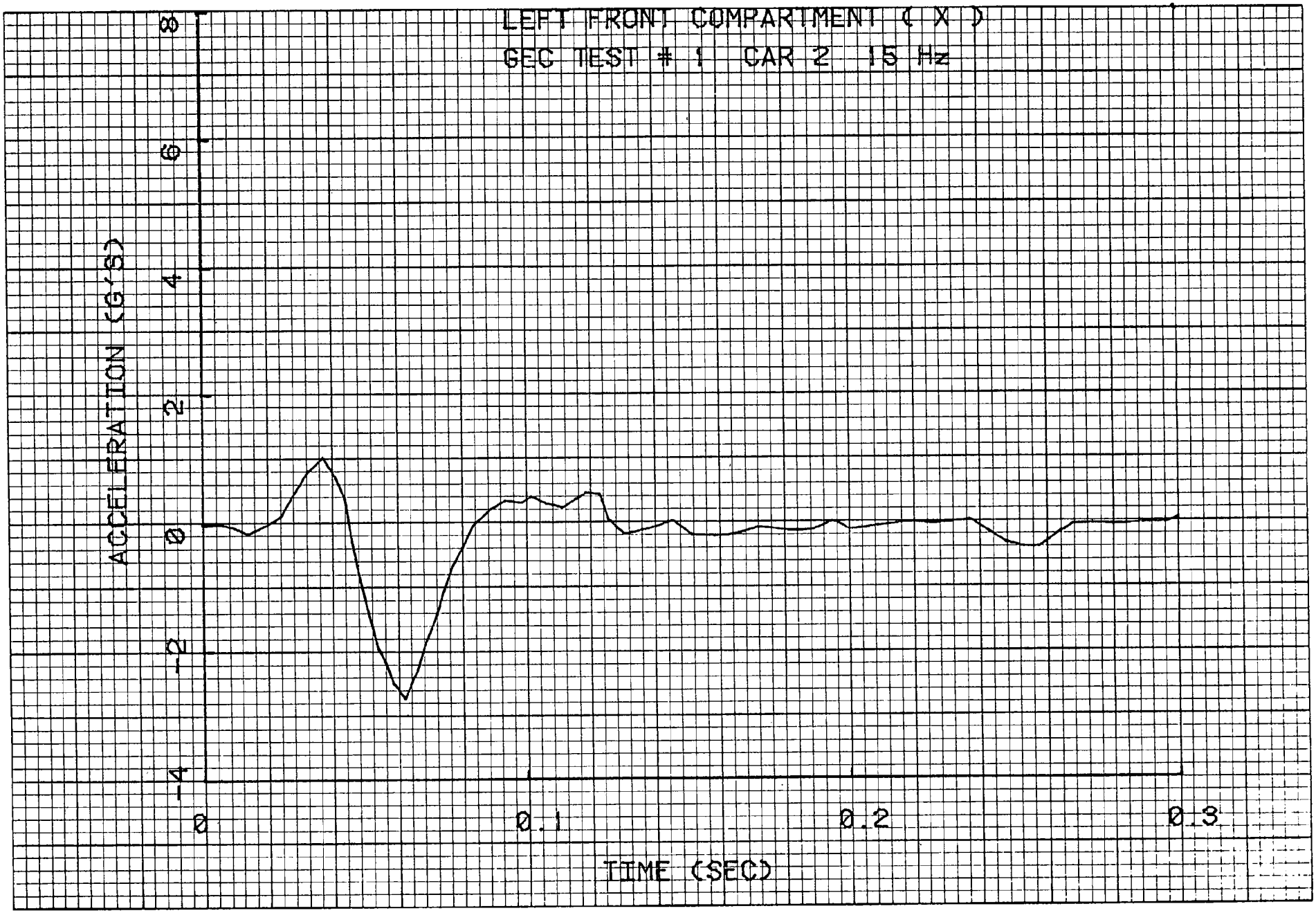

MID - AFT OF RIGHT DOOR (Y)
GEC TEST # 1 CAR 2 15 Hz
VELOCITY (MPH)
5
0
-5
-10
-15
-20
-25
0
0.1
0.2
0.3
TIME (SEC)

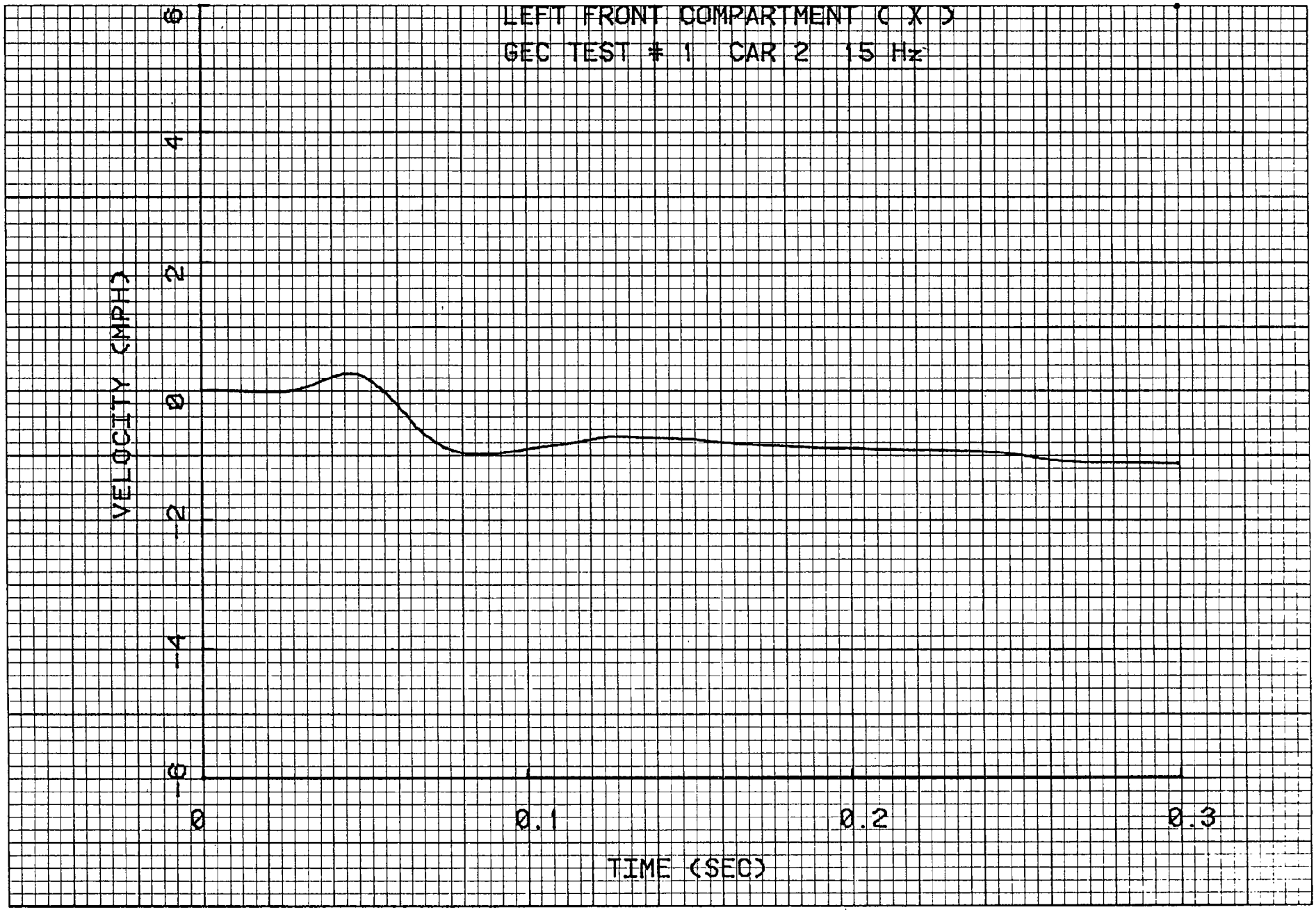

MID - AFT OF RIGHT DOOR (Y)
GEC TEST # 1 CAR 2 15 Hz
DISPLACEMENT (INCHES)
40
20
0
-20
-40
-60
-80
0
0.1
0.2
0.3
TIME (SEC)

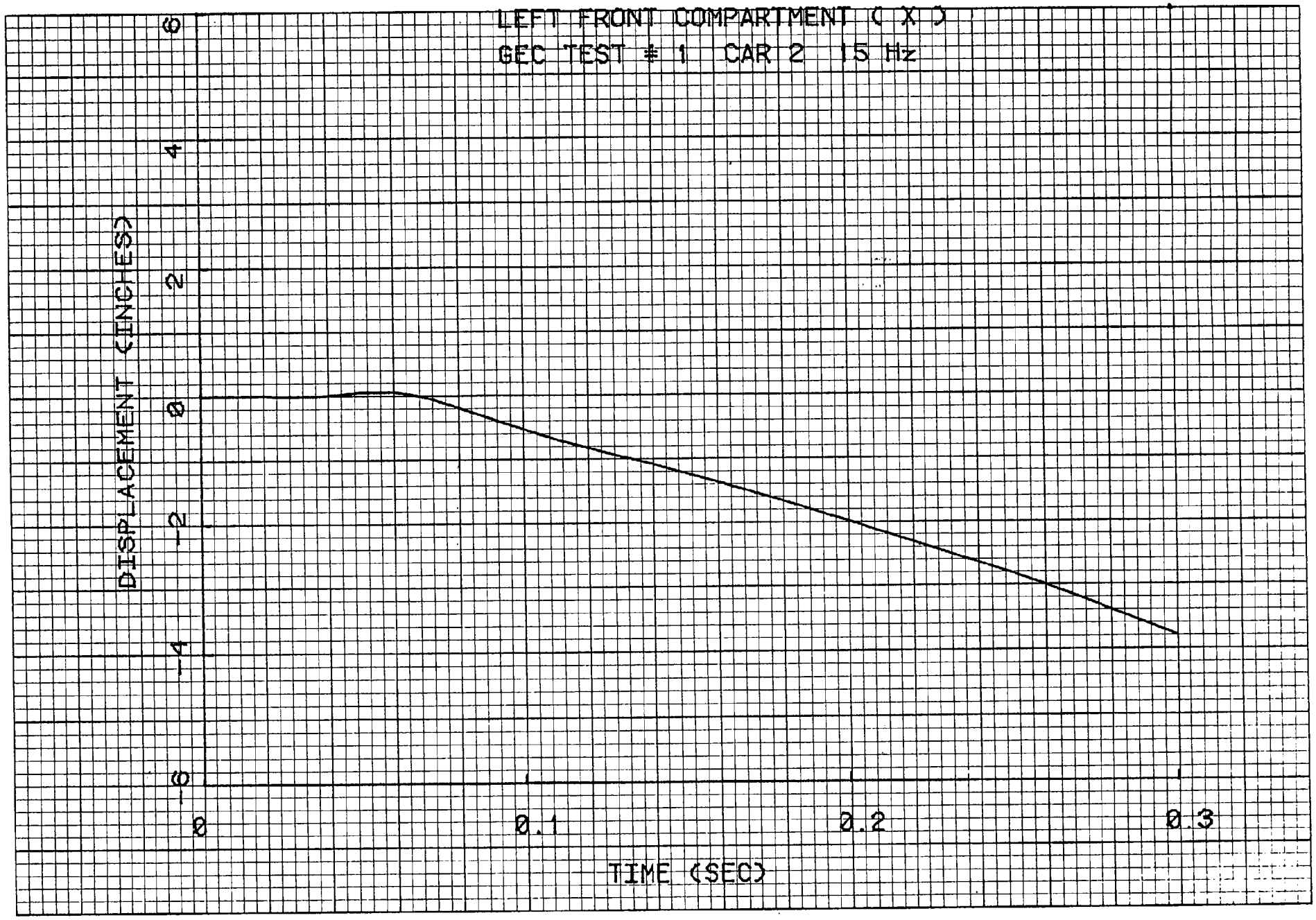


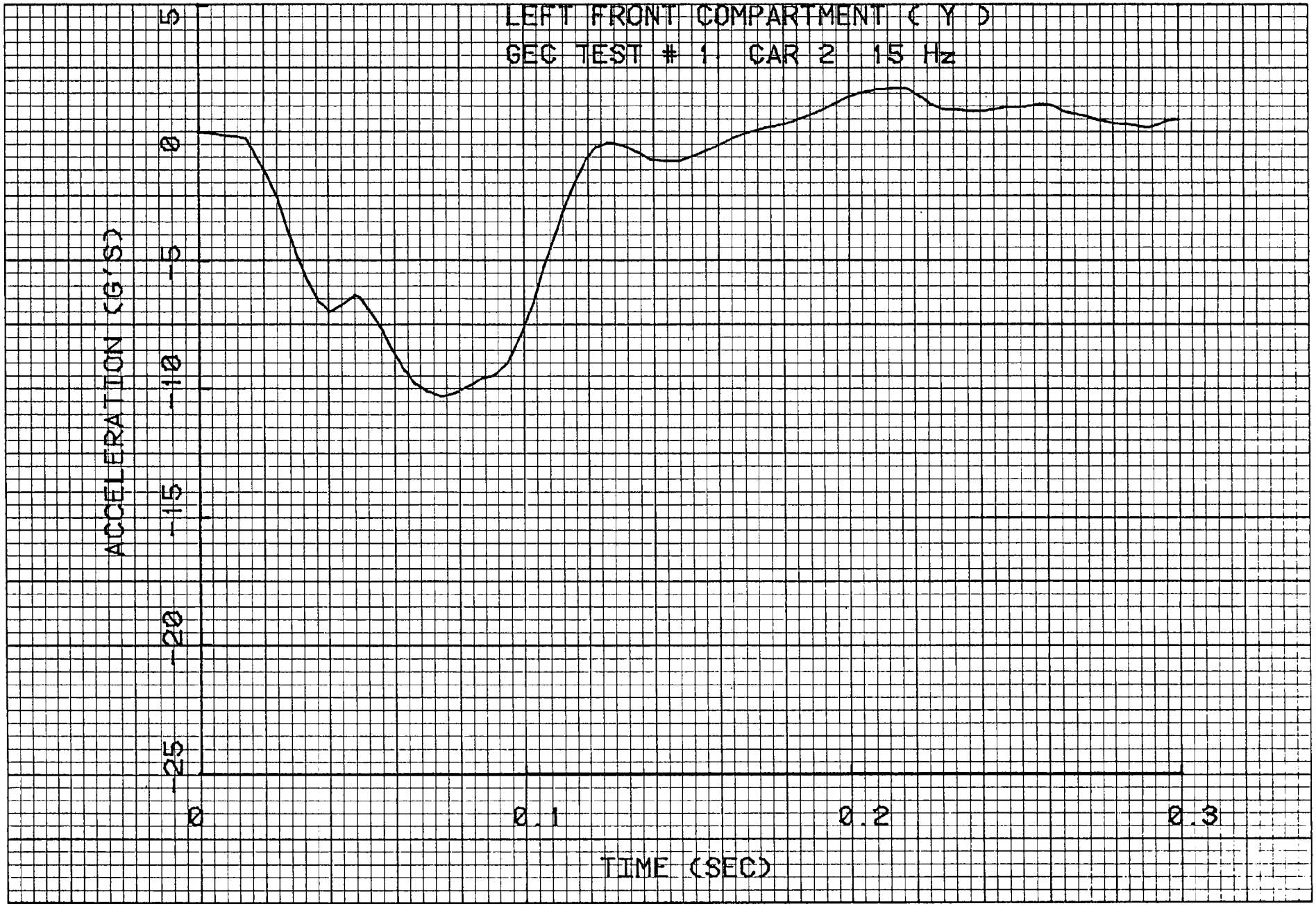


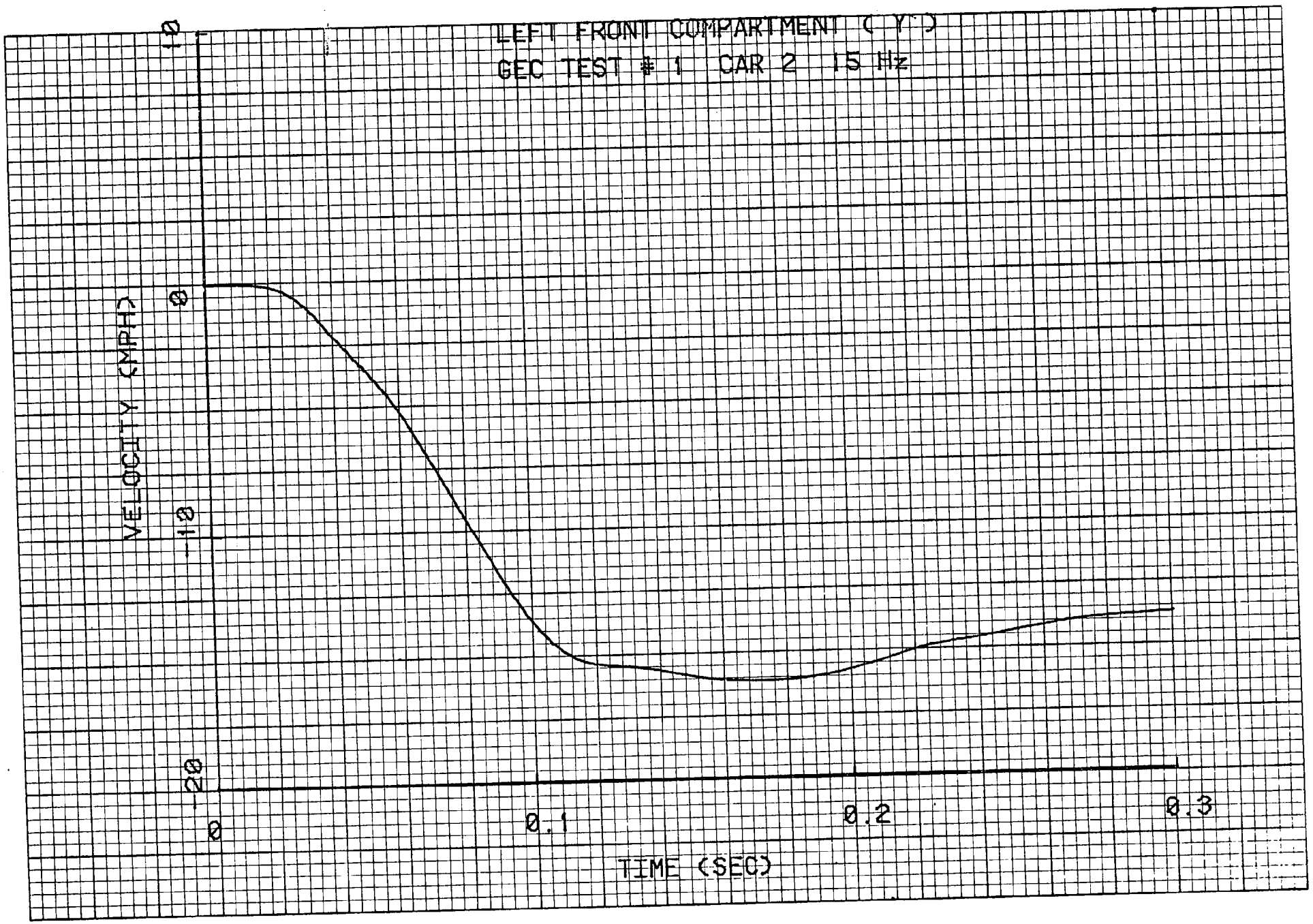

MID - FRONT OF RIGHT DOOR (Y)
GEC TEST # 1 CAR 2 15 Hz
DISPLACEMENT (INCHES)
40
20
0
-20
-40
-60
-80
0
0.1
0.2
0.3
TIME (SEC)

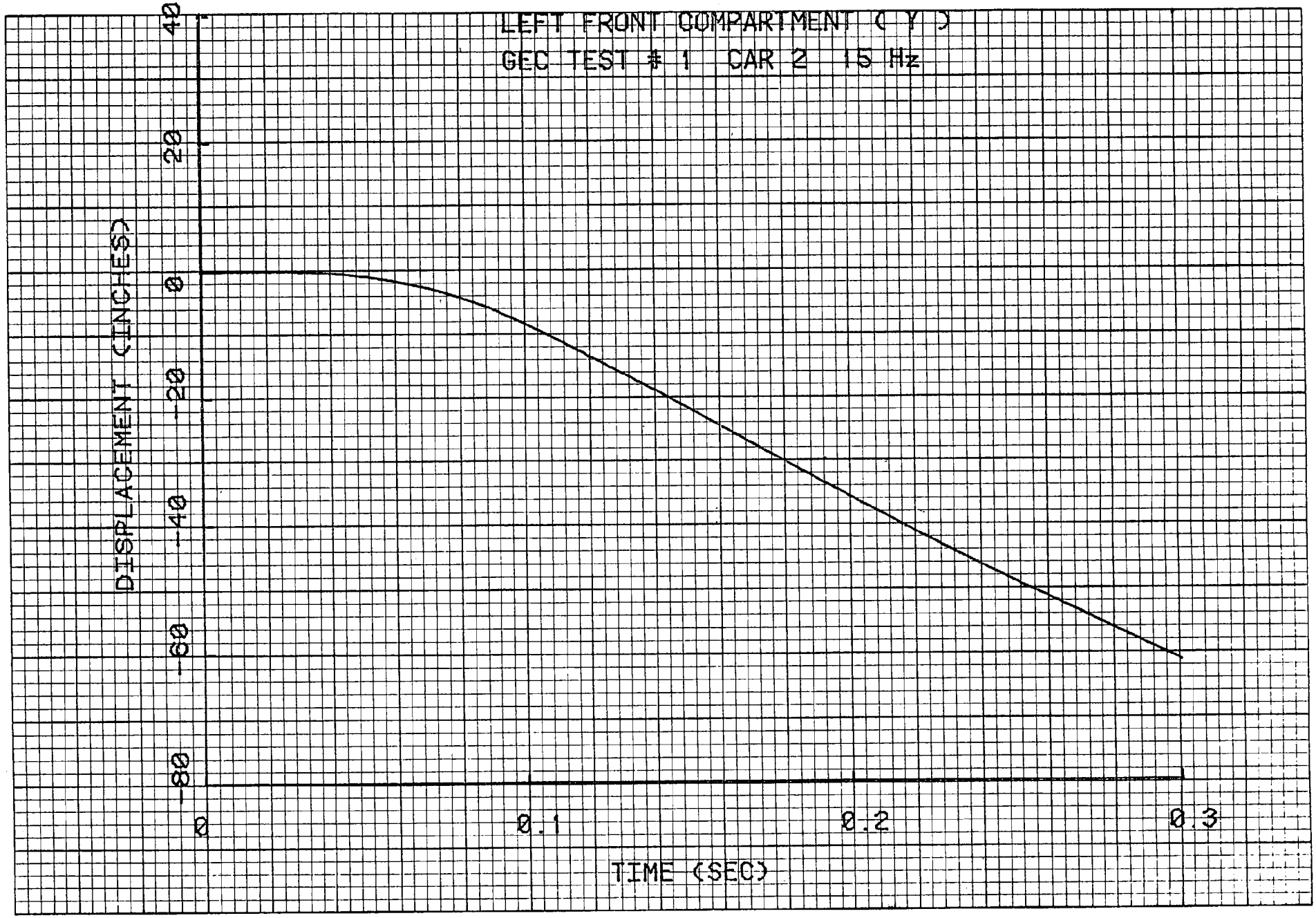


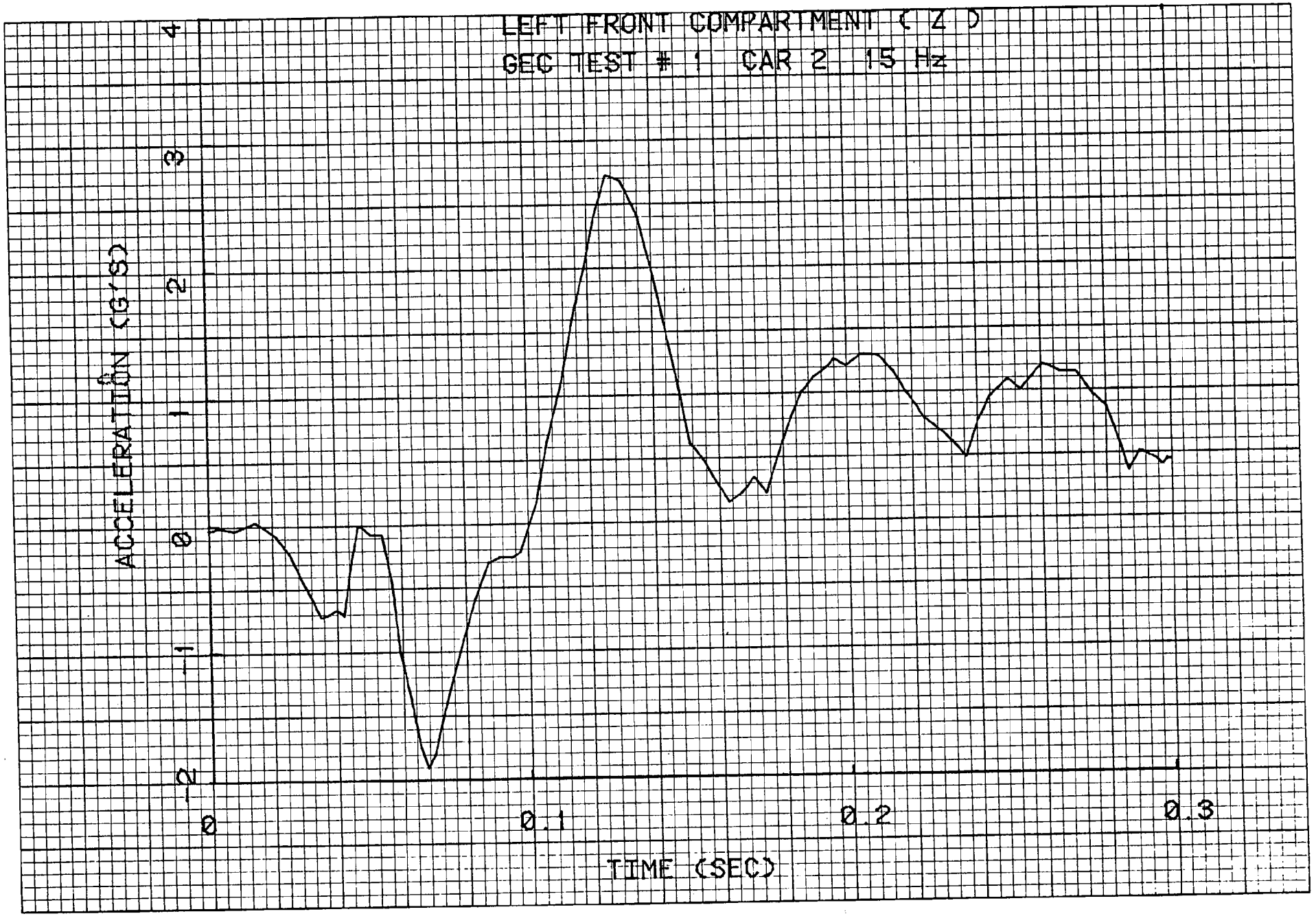

LEFT FRONT COMPARTMENT (X)
GEC TEST # 1 CAR 2 15 Hz
VELOCITY (MPH)
6
4
2
0
-2
-4
-6
0
0.1
0.2
0.3
TIME (SEC)

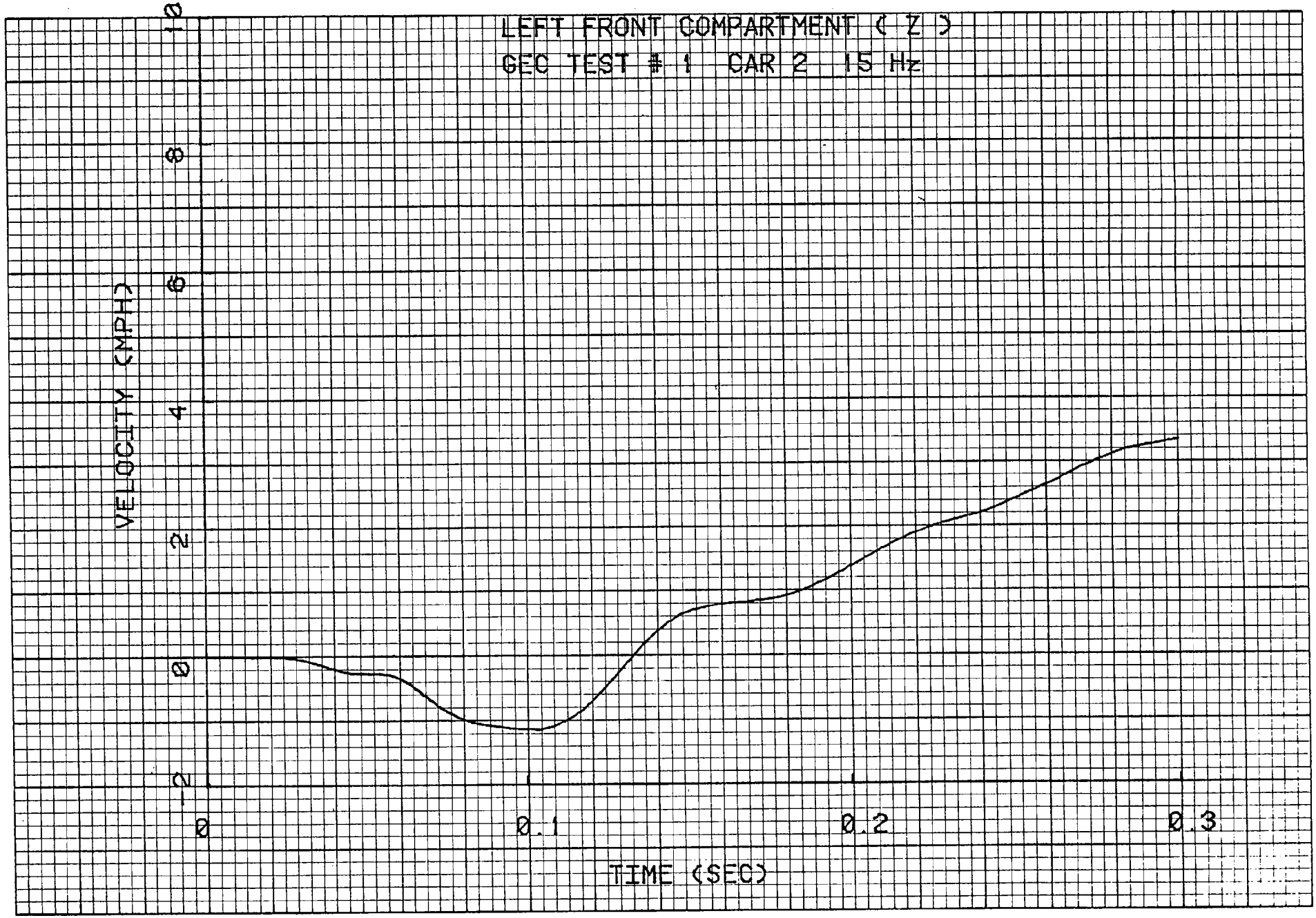


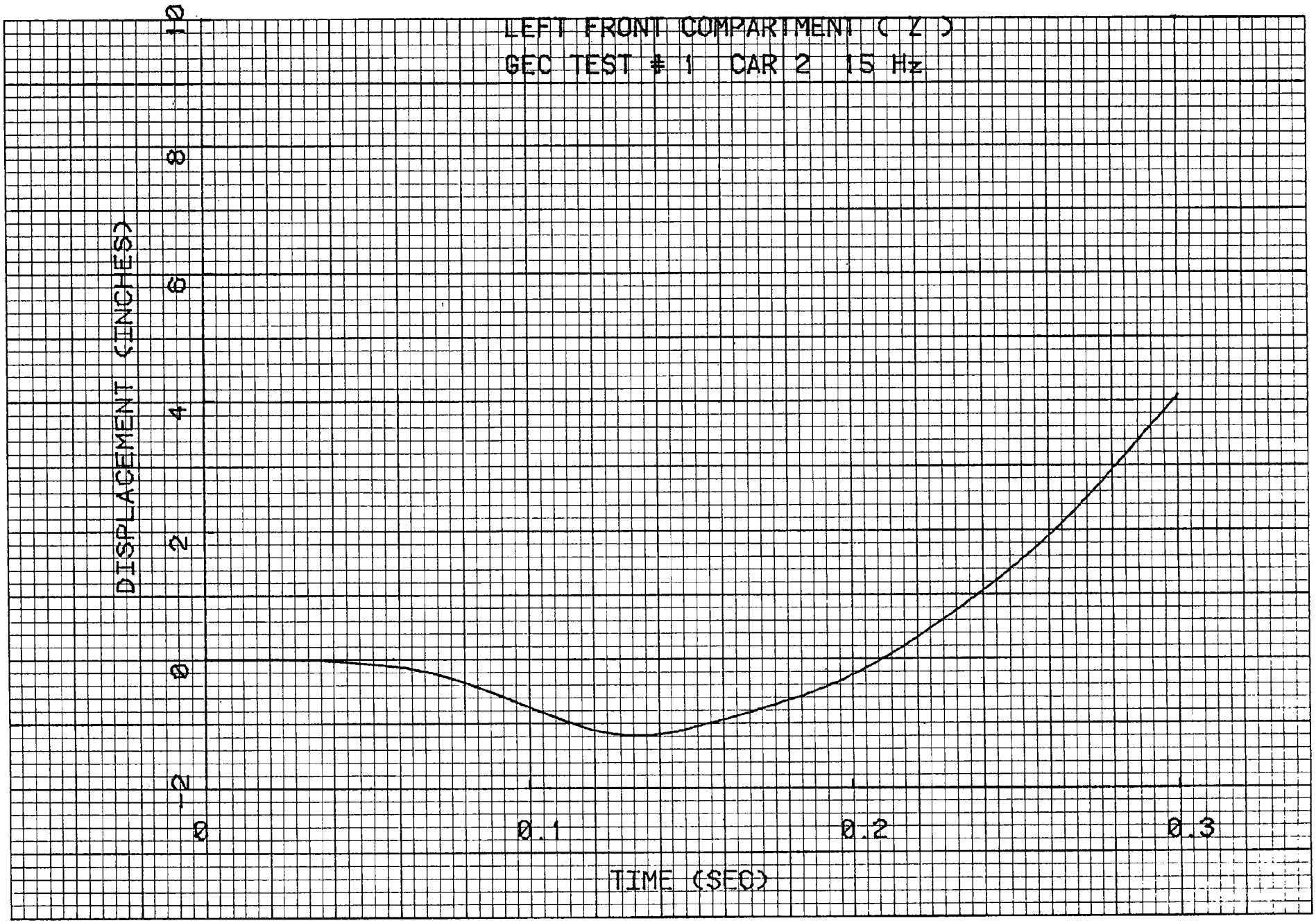

LEFT FRONT COMPARTMENT (Y)
GEC TEST # 1 CAR 2 15 Hz
ACCELERATION (G'S)
5
0
-5
-10
-15
-20
-25
0
0.1
0.2
0.3
TIME (SEC)

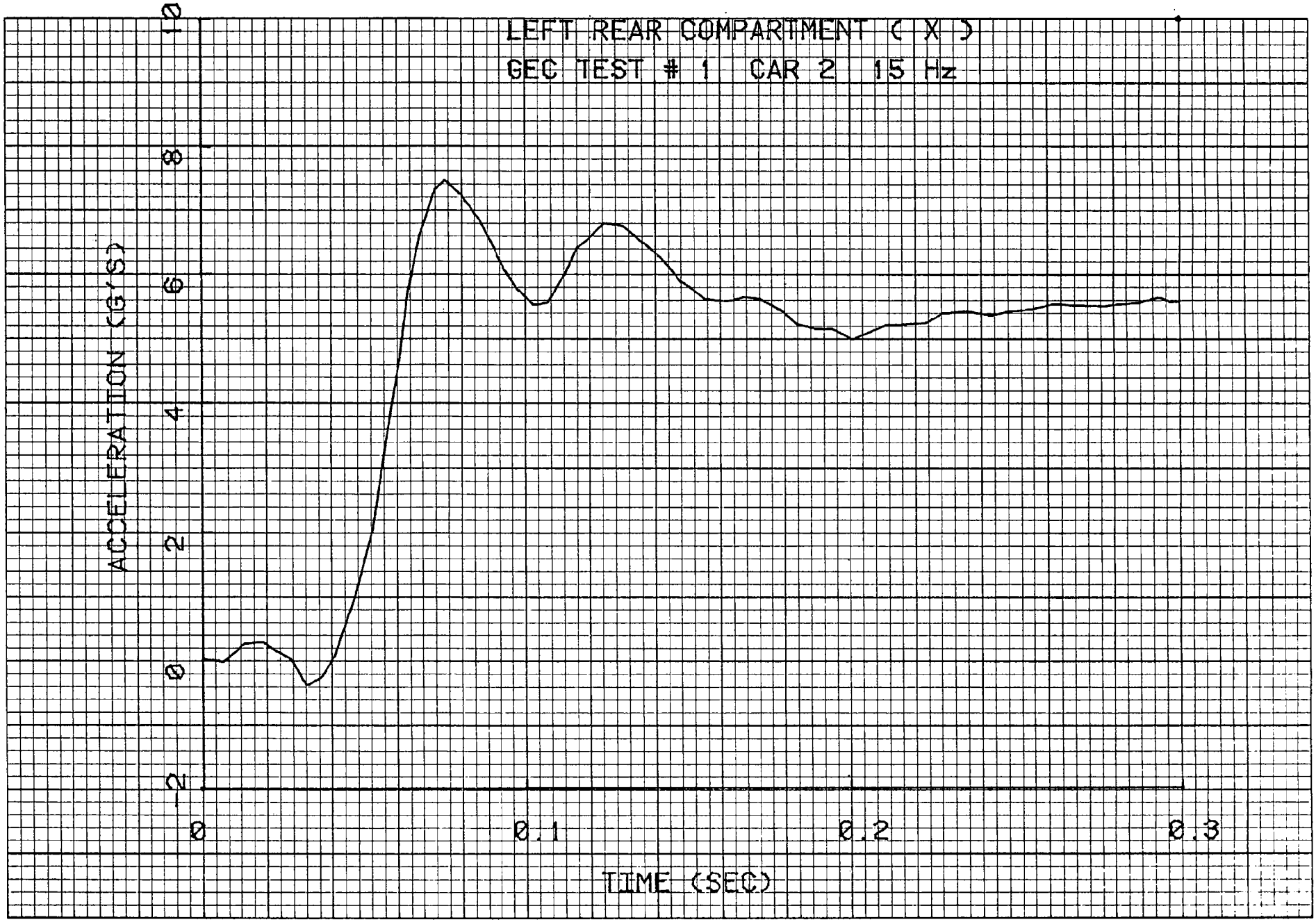


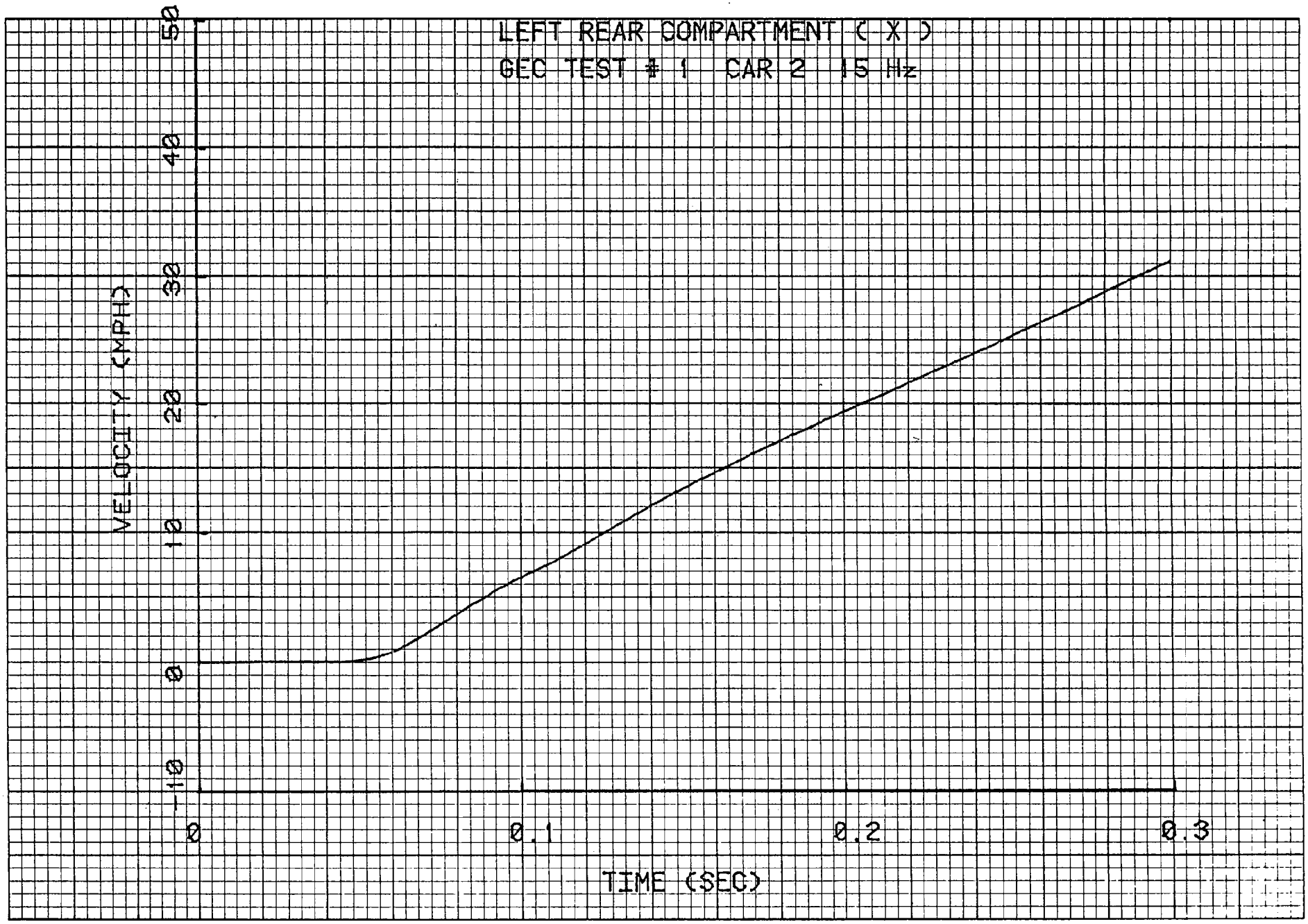


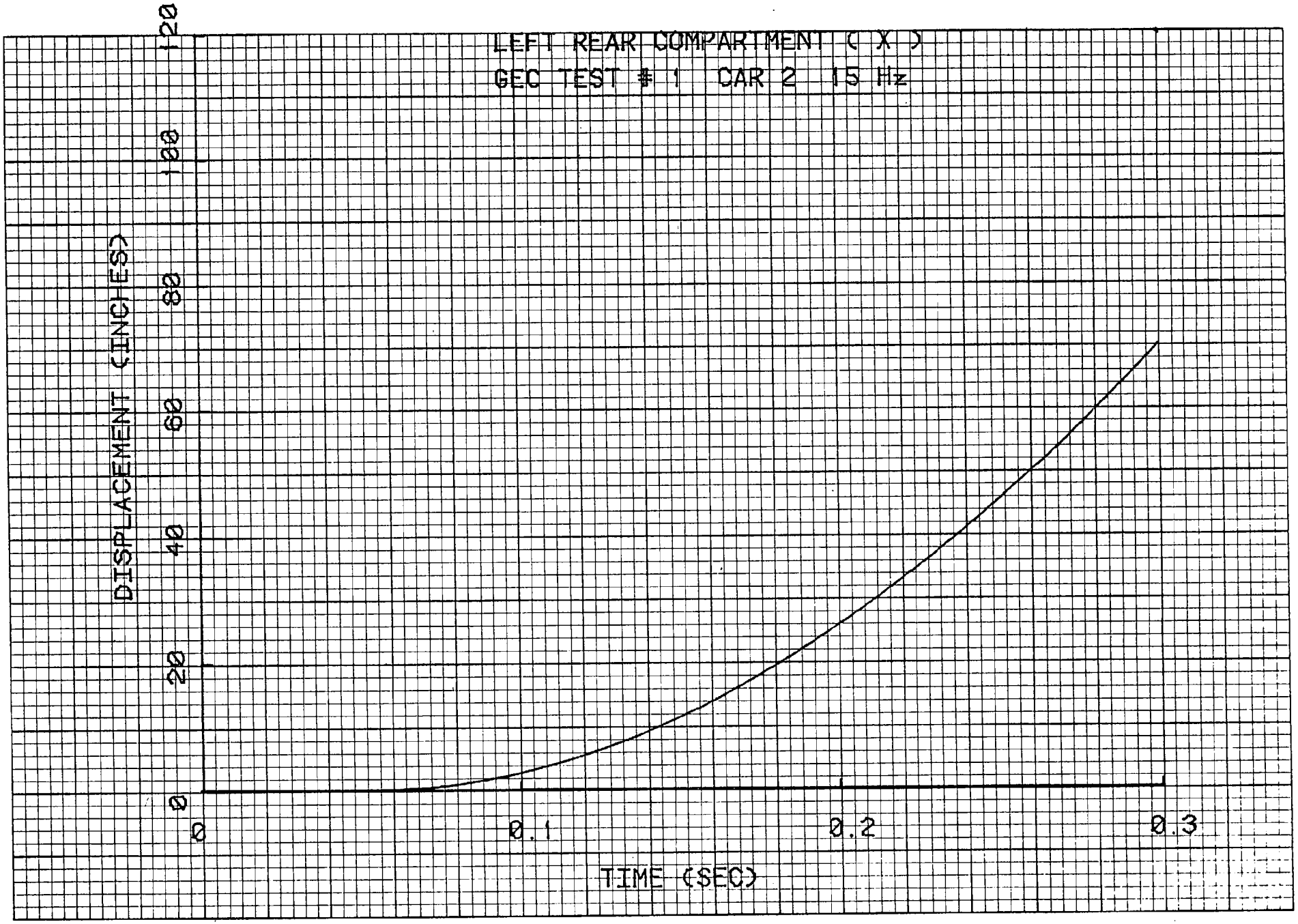


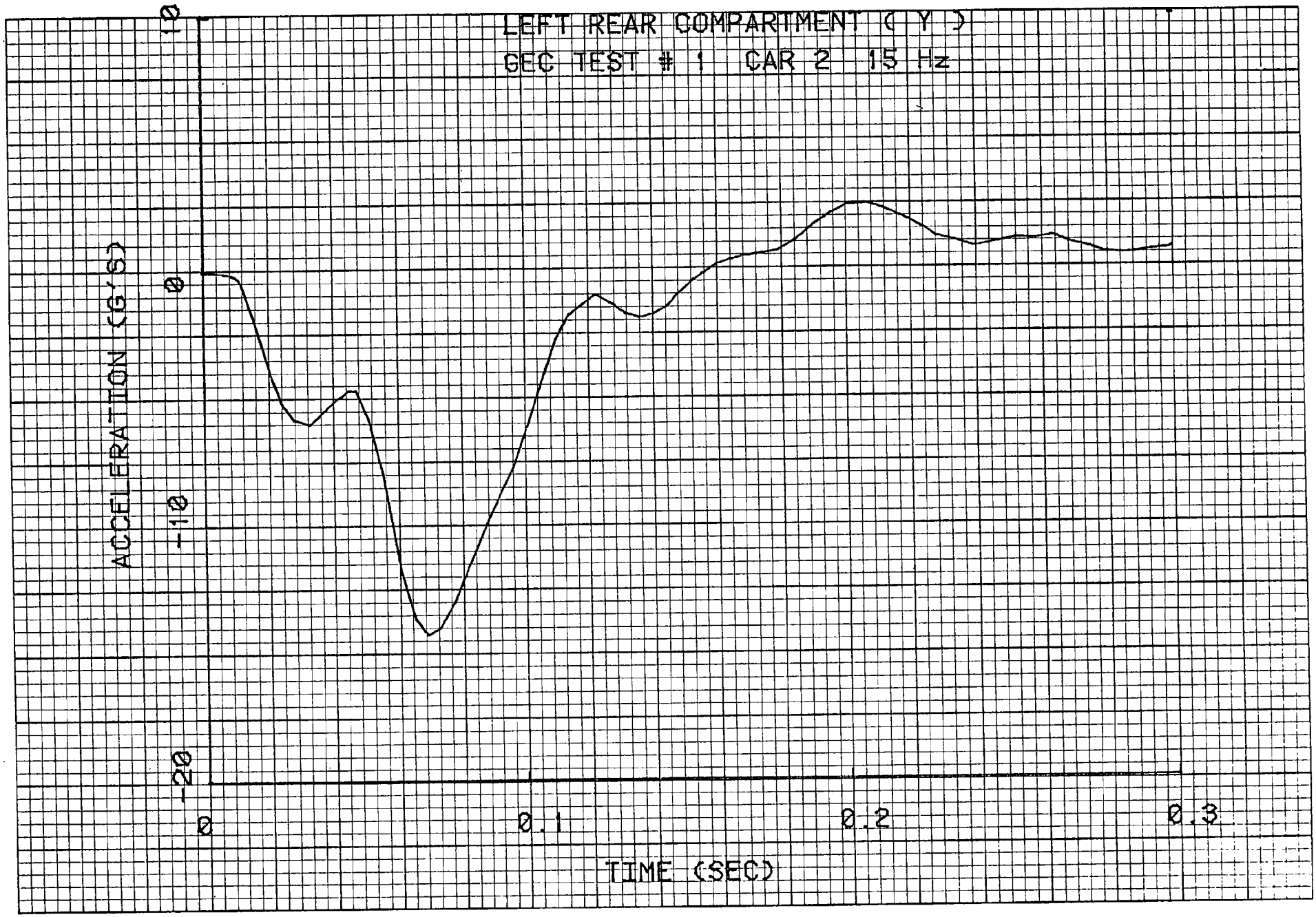


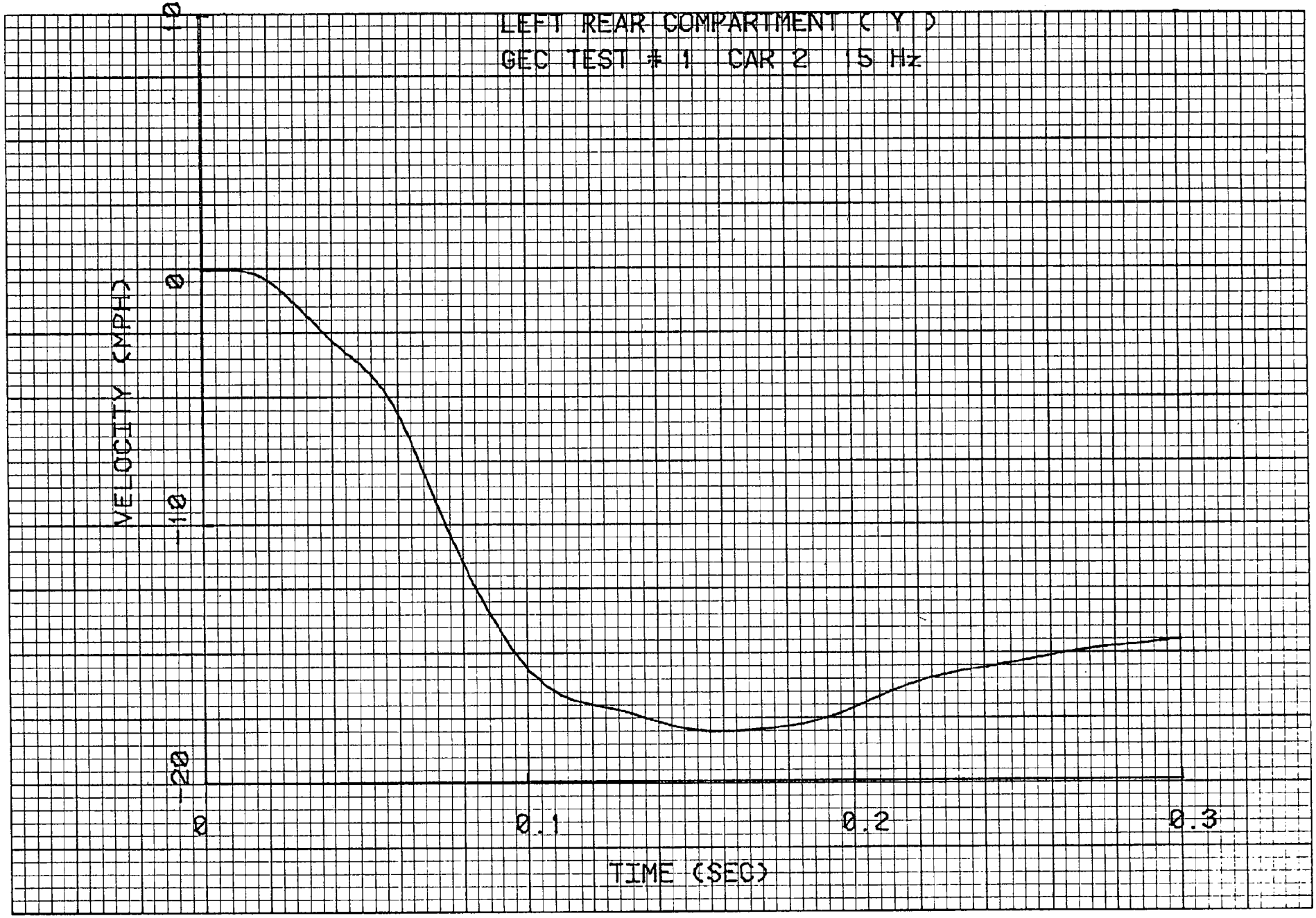


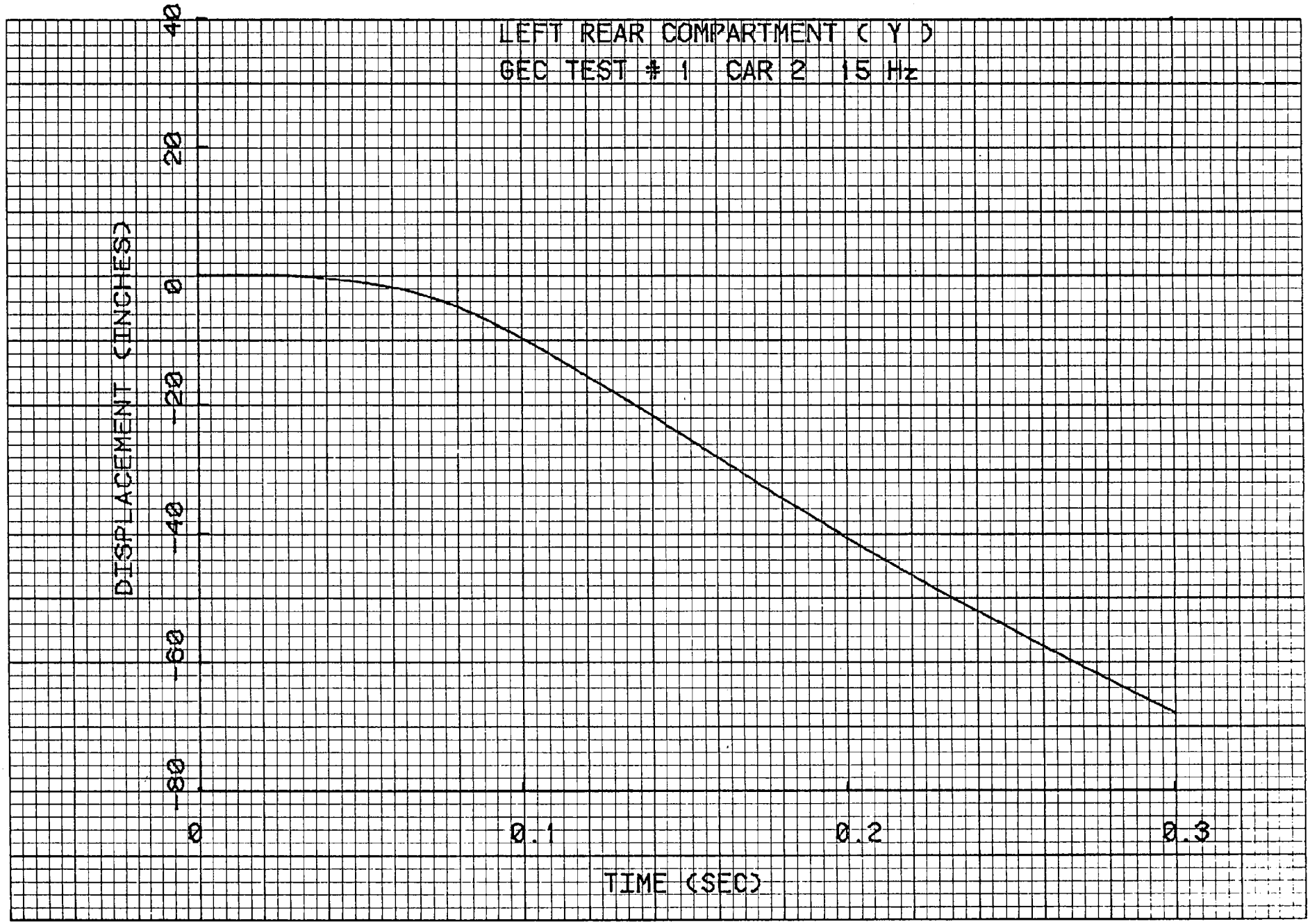


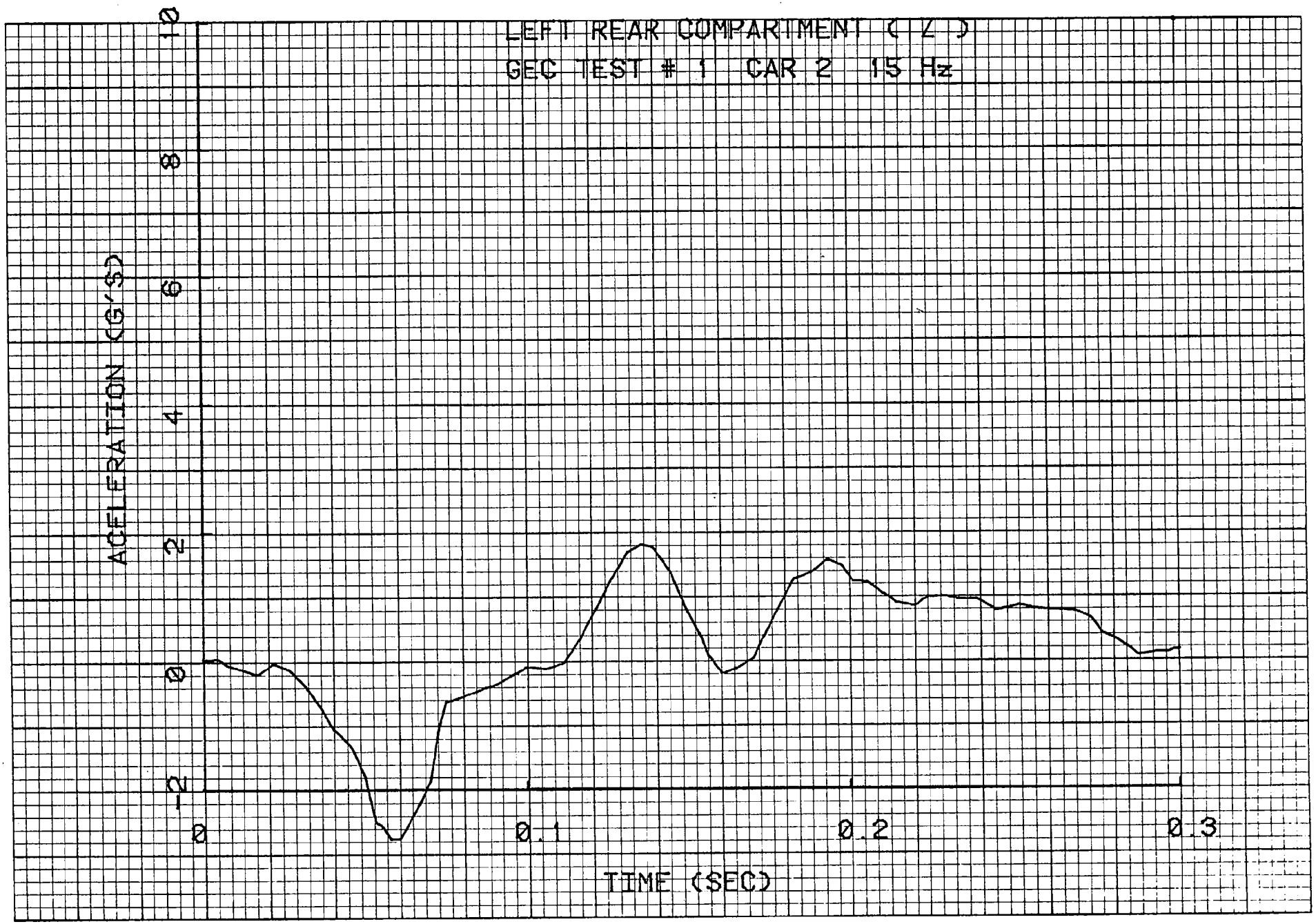

LEFT REAR COMPARTMENT (X)
GEC TEST # 1 CAR 2 15 Hz
VELOCITY (MPH)
50
40
30
20
10
0
-10
0
0.1
0.2
0.3
TIME (SEC)

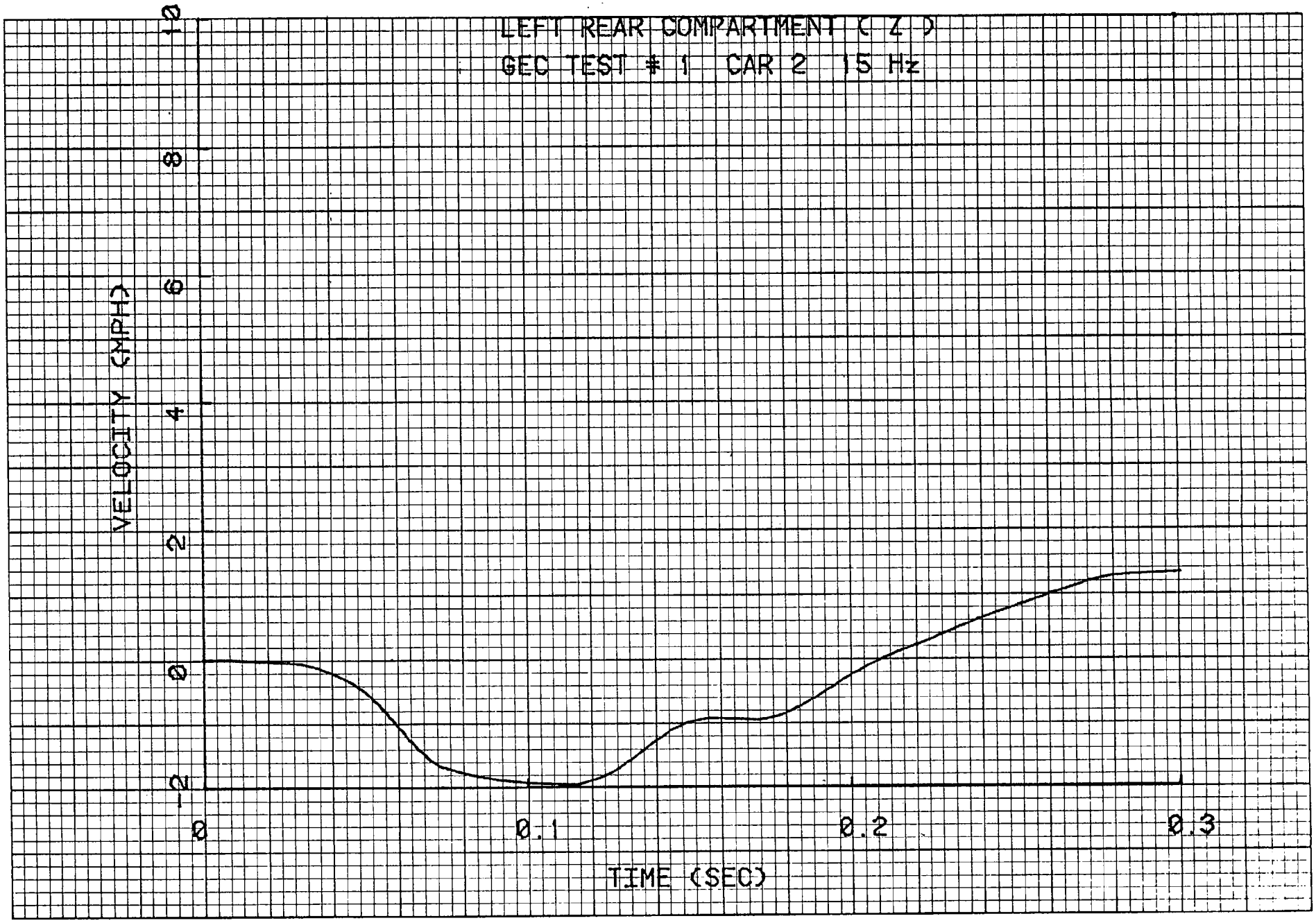

LEFT REAR COMPARTMENT (X)
GEC TEST # 1 CAR 2 15 Hz
DISPLACEMENT (INCHES)
120
100
80
60
40
20
0
0
0.1
0.2
0.3
TIME (SEC)

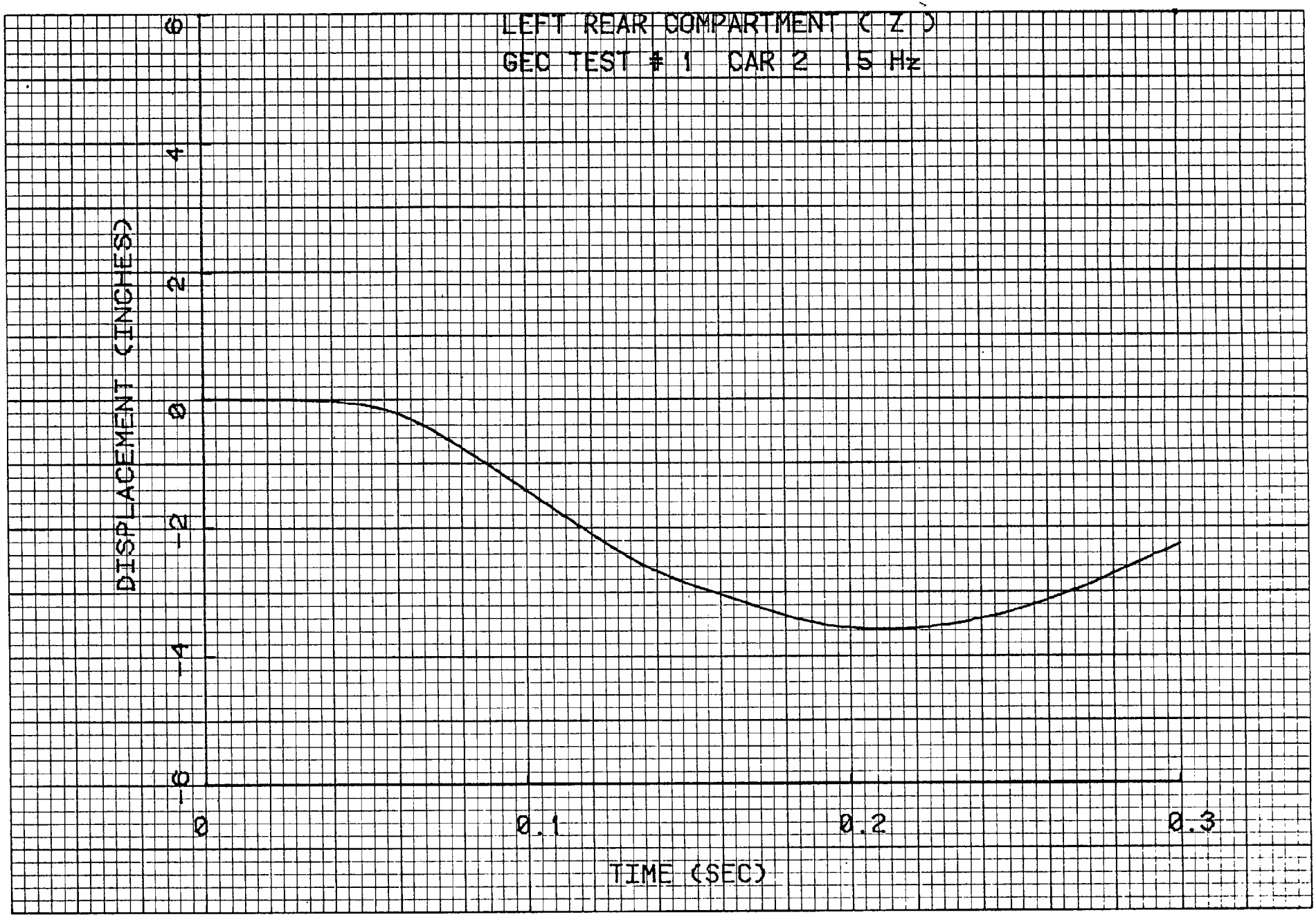


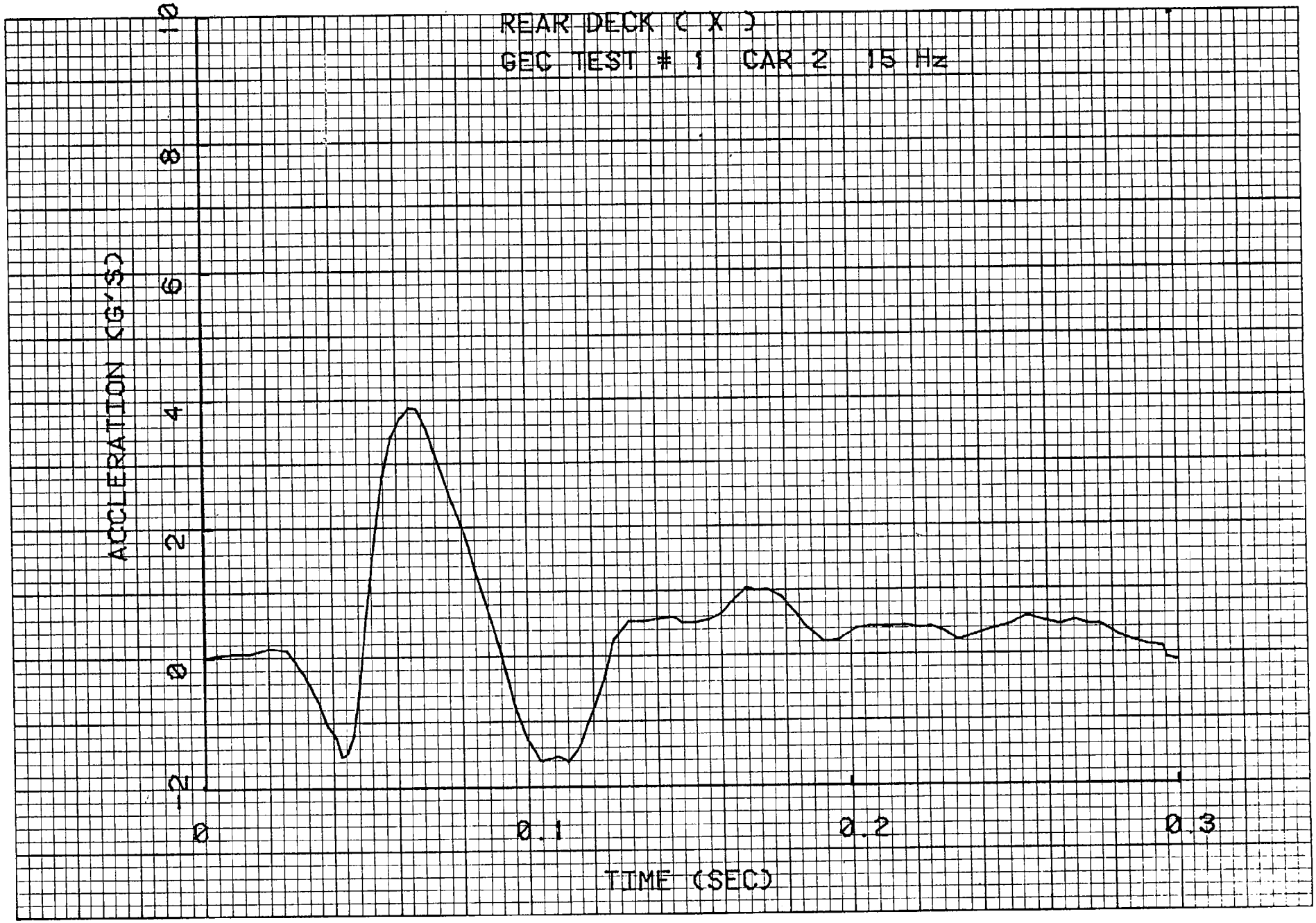


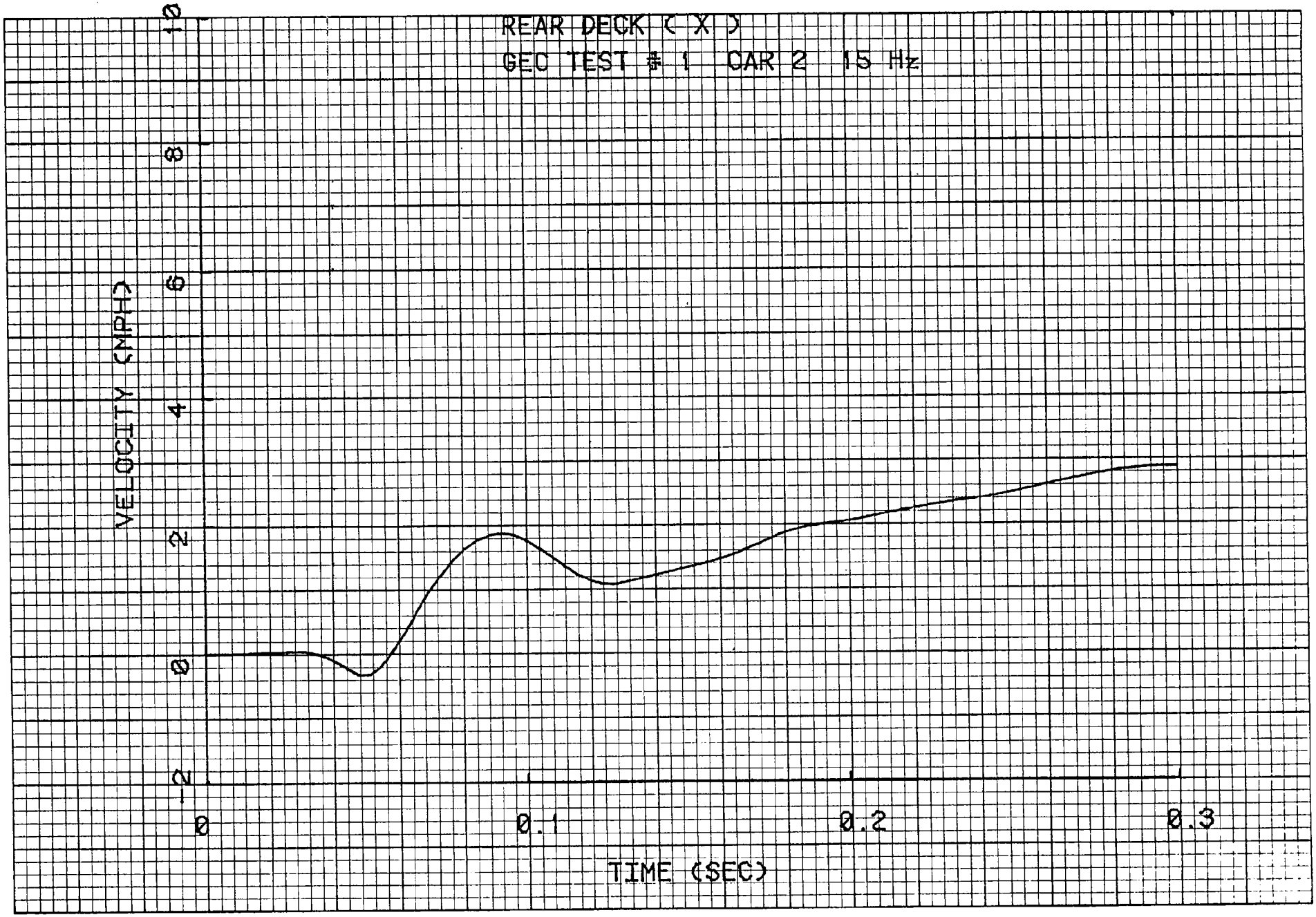





LEFT REAR COMPARTMENT (Z)
GEC TEST # 1 CAR 2 15 Hz
VELOCITY (MPH)
10
8
6
4
2
0
-2
0
0.1
0.2
0.3
TIME (SEC)




REAR DECK (X)
GEC TEST # 1 CAR 2 15 Hz
ACCELERATION (G'S)
10
8
6
4
2
0
-2
0
0.1
0.2
0.3
TIME (SEC)


REAR DECK (X)
GEC TEST # 1 CAR 2 15 Hz
VELOCITY (MPH)
10
8
6
4
2
0
-2
0
0.1
0.2
0.3
TIME (SEC)