

CALSPAN ADVANCED TECHNOLOGY CENTER

IMPROVED LIGHTWEIGHT SUBCOMPACT SIDE STRUCTURE TEST REPORT

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Calspan Report No. 6225-V-8

Prepared For:

**THE BUDD COMPANY
TECHNICAL CENTER
FORT WASHINGTON, PA. 19034**

PURCHASE ORDER NO. TC-14436

TEST:	TEST NO. 7
TYPE OF TEST:	CAR-TO-CAR FRONT TO SIDE OBLIQUE
TEST DATE:	14 JULY 1978

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TEST OBJECTIVE

The test objective was to obtain performance data on the side structure of a 1976 VW Rabbit modified by the Budd Company. The test, a 30 mph car-to-car front-to-side oblique impact, involved a 1978 Chevrolet Impala striking the side of the VW Rabbit and is a repeat of Test No. 5. (Calspan Report No. 6225-V-6). The side structure of the test vehicle for this report had additional modifications to the (10 lb) modification tested before. The test program is part of the National Highway Traffic Safety Administration (NHTSA) Contract DOT-HS-7-01588 to improve subcompact side structures.

PRESENTATION OF RESULTS

This test report presents all the test results obtained from this car-to-car, front-to-side impact. Included in this document are still photographs, all vehicle and dummy response data in plotted form, vehicle interior and exterior damage sketches, figures of pre- and post-test vehicle side intrusion measurements and instrumentation identification. High-speed motion pictures and color slides of pre- and post-test conditions were obtained and have been submitted to the sponsor. Included in the vehicle response data, in plotted form, are dynamic intrusion measurements which were obtained by a Calspan designed linear displacement transducer.

Calspan Report No. ZP-6144-V-1, Baseline Crash Test No. 1, of the Improved Lightweight Subcompact Side Structure Contract, Appendix A contains information on the crash test facility and supporting equipment at Calspan.

TABLE 1

CRASH TEST SUMMARY

TEST NO. 7 PROJECT Improved Lightweight Subcompact Side Structure

DATE July 14, 1978 TIME 11:15am TEMP. 77°F

TEST CONDITION Car-to-Car, 60° Side Oblique

VEHICLE NO. 1 1978 Chevrolet Impala (4-door Sedan) ****

VEHICLE NO. 2 1976 Volkswagen Rabbit

	VEH. NO. 1	VEH. NO. 2
TEST WEIGHT (lbs)	<u>Curb Weight + 2 Dummies</u>	<u>Curb Weight + 2 Dummies</u>
IMPACT ANGLE (deg) *	<u>60</u>	<u>0</u>
IMPACT VELOCITY (mph) **	<u>29.69 mph</u>	<u>0</u>
MAX. CRUSH (in)	<u>See Figure 11</u>	<u>15.75</u>
MAX. INTRUSION (in)	<u>--</u>	<u>14.75</u>
DUMMIES	VEH. NO. 1	VEH. NO. 2
TYPE	<u>Hybrid II Part 572</u>	<u>Hybrid II Part 572</u>
LOCATION	<u>LF (1), RF2</u>	<u>LF (1), RF(2)</u>
RESTRAINT	<u>Production 3-point System</u>	<u>Unrestrained Dummies ***</u>
NUMBER OF DATA CHANNELS	<u>63</u>	
NUMBER OF HIGH SPEED CAMERAS	<u>10</u>	

* WITH RESPECT TO TOW TRACK CENTERLINE

** SPEED TRAP MEASUREMENT ($\pm 0.5\%$ ACCURACY)

***The dummies were restrained with Production shoulder and lap belts inadvertently and the test was performed with belted dummies.

****Vehicle No. 1 was used as the impacting vehicle for Test No. 6 and repaired for this test.

OBSERVATIONS (VEHICLE NO. 1) 1978 Chevrolet Impala

GLAZING Undamaged

DOORS Undamaged

SEAT ANCHORAGES Intact

RESTRAINTS Intact

OBSERVATIONS (VEHICLE NO. 2) 1976 Volkswagen Rabbit

GLAZING Windshield was cracked; driver's door and rear side window were broken. Driver's door window was down for test.

DOORS Passenger door was operable.

SEAT ANCHORAGES Driver's seat was crushed

RESTRAINTS Intact

GENERAL COMMENTS o All cameras operated properly

o On Car No. 1 - Firewall X-component of acceleration is questionable due to noise riding on signal at beginning of trace. Probable cause an intermittent open cable.

o On Car No. 2 - Side intrusion measurements are incorrect because of the way the rods bent during the test.

o On Car No. 2 - R.F. Dummy head y acceleration signal had intermittent spikes which made the resultant head acceleration and severity index head data questionable.

TABLE 2

VEHICLE TEST WEIGHTS

CAR NO. 1 - BULLET VEHICLE - 1978 CHEVROLET IMPALA

Left Front	<u>1080</u> lbs.	Left Rear	<u>810</u> lbs.
Right Front	<u>1090</u> lbs.	Right Rear	<u>830</u> lbs.
Total Front	<u>2170</u> lbs.	Total Rear	<u>1640</u> lbs.
Total Weight = <u>2170</u> lbs. + <u>1640</u> lbs. = <u>3810</u> lbs.			
Wheel Base	<u>116.5</u> inches		
Cg _{FW} =	<u>1640</u> lbs.	<u>116.5</u> inches	- <u>50.14</u> inches
	<u>3810</u> lbs.		

CAR NO. 2 - TARGET VEHICLE - 1976 VOLKSWAGEN RABBIT

Left Front	<u>640</u> lbs.	Left Rear	<u>450</u> lbs.
Right Front	<u>720</u> lbs.	Right Rear	<u>470</u> lbs.
Total Front	<u>1360</u> lbs.	Total Rear	<u>920</u> lbs.
Total Weight = <u>1360</u> lbs. + <u>920</u> lbs. = <u>2280</u> lbs.			
Wheel Base	<u>94.5</u> inches		
Cg _{FW} =	<u>920</u> lbs.	<u>94.5</u> inches	= <u>38.10</u> inches
	<u>2280</u> lbs.		

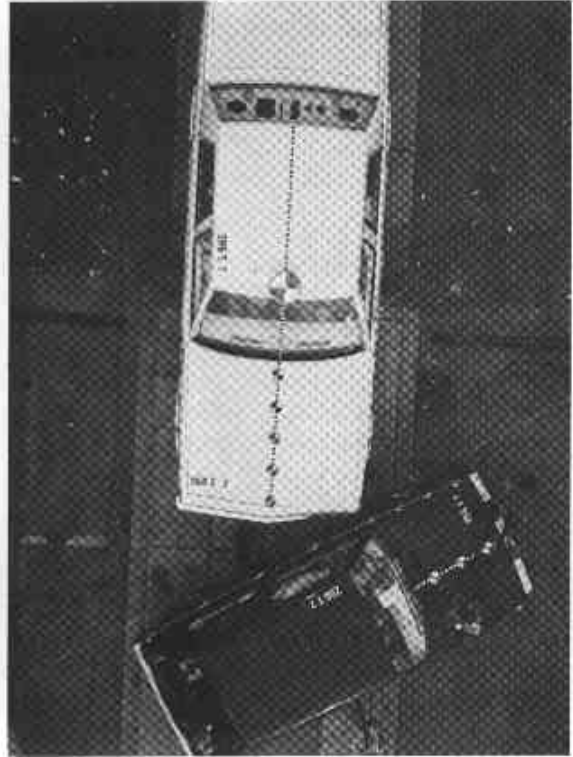
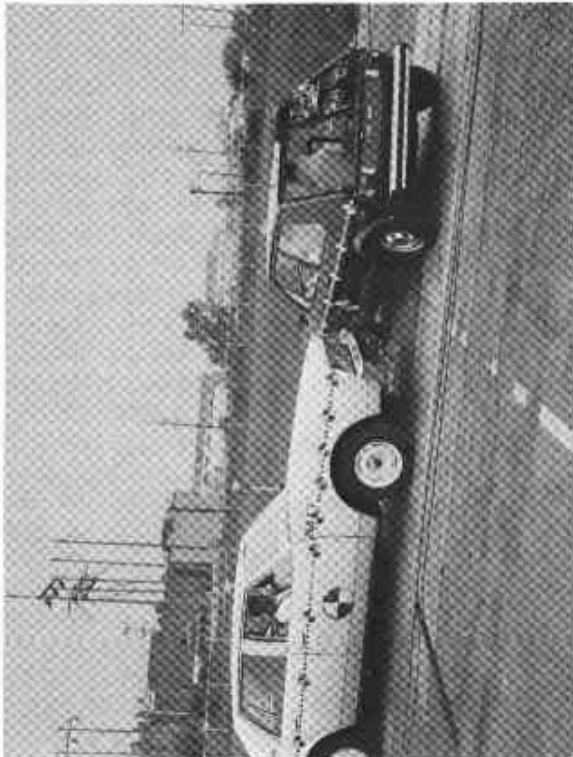
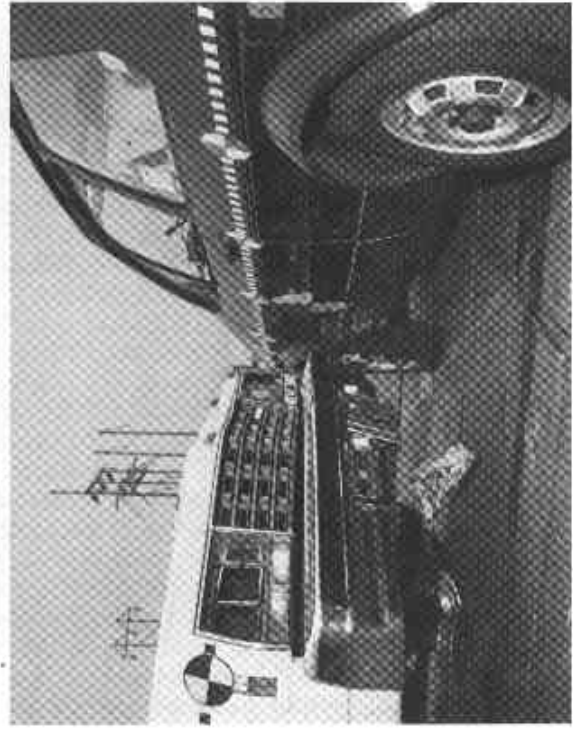


Figure 1 PRE-TEST NO. 7 - VEHICLE IMPACT CONFIGURATION

6225-V-8

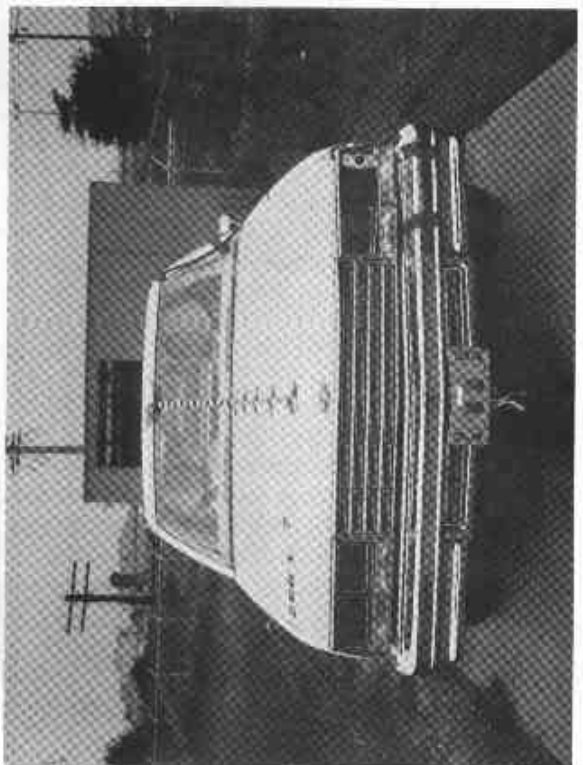
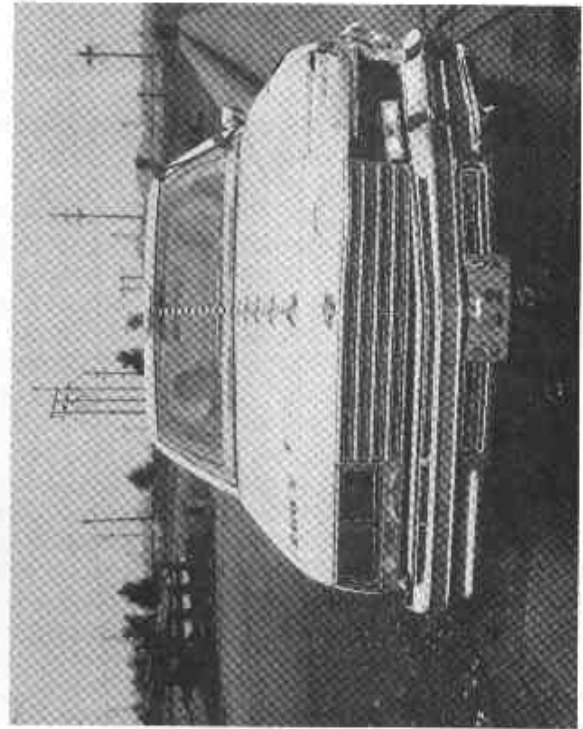
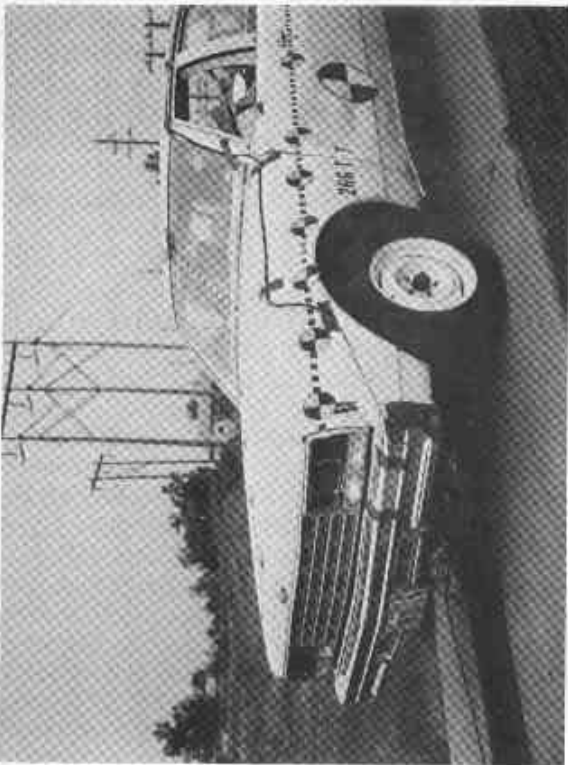
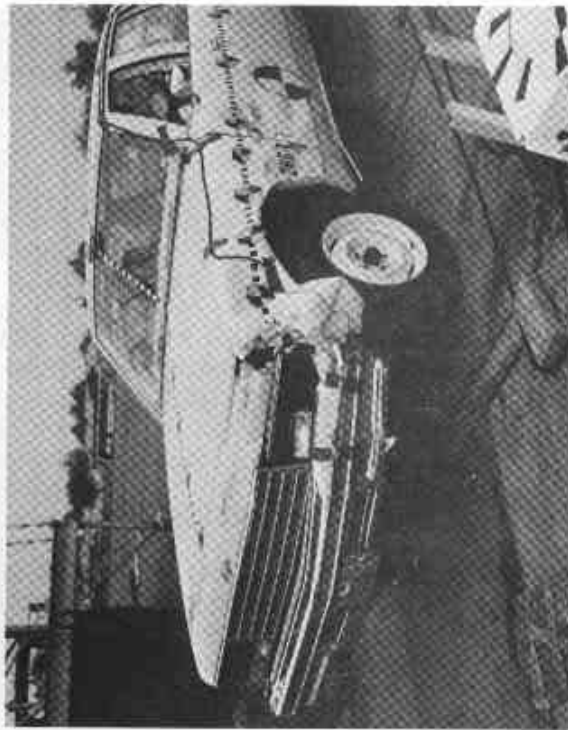


Figure 2 PRE-AND POST-TEST NO. 7 - CAR 1, 1978 CHEVROLET IMPALA

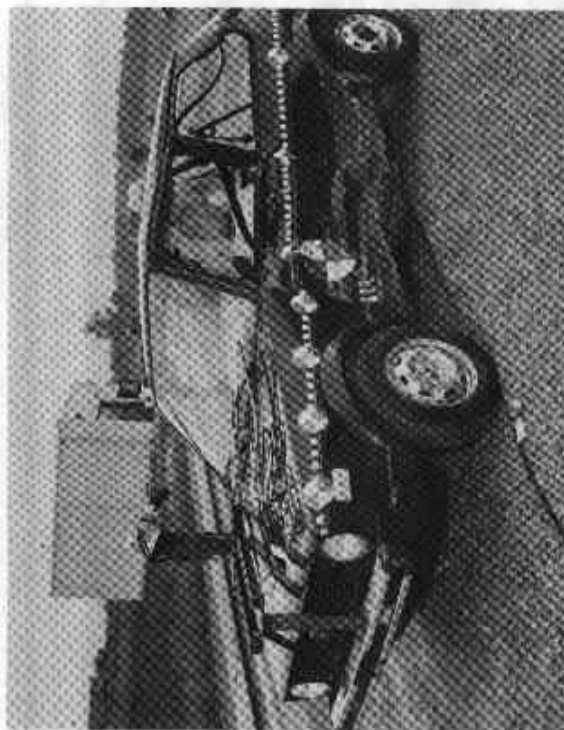
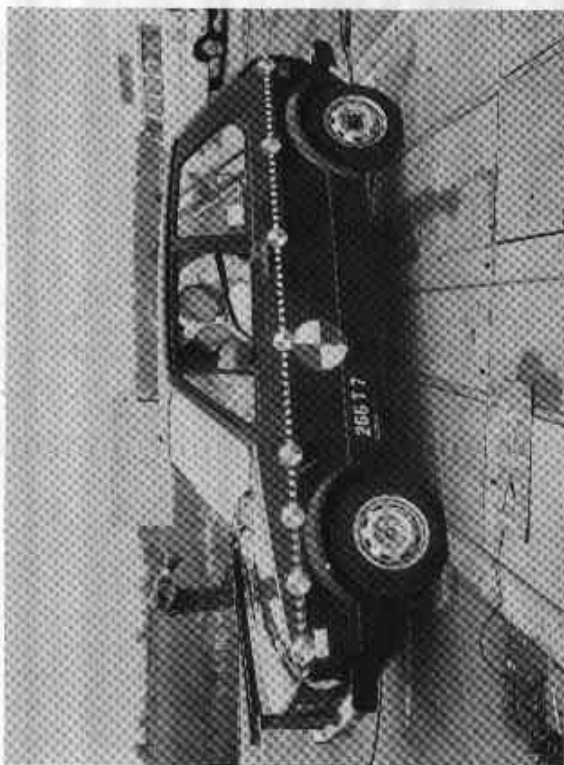


Figure 3 PRE- AND POST-TEST NO. 7 - CAR 2, 1976 VW RABBIT



Figure 4 PRE- AND POST-TEST NO. 7 - CAR 2, 1978 CHEVROLET IMPALA INTERIOR

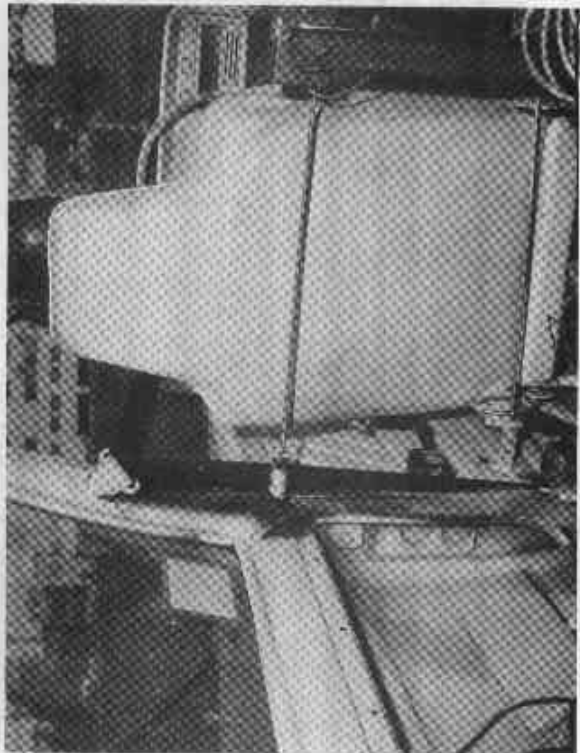
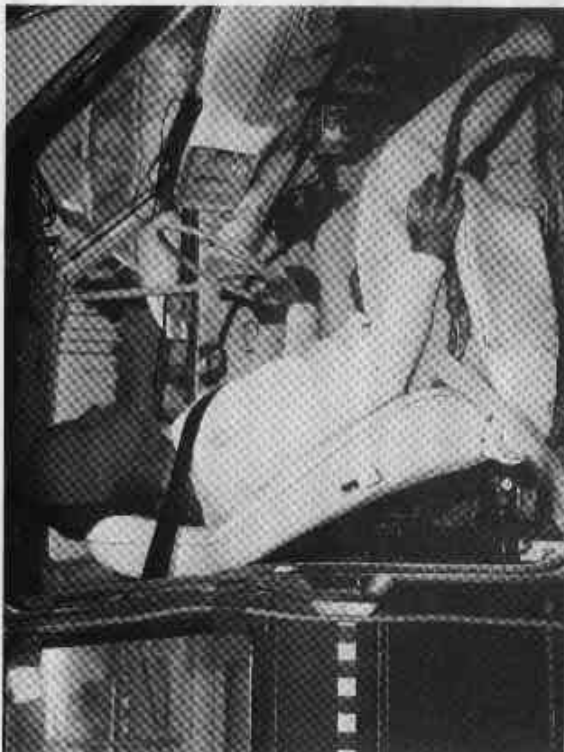
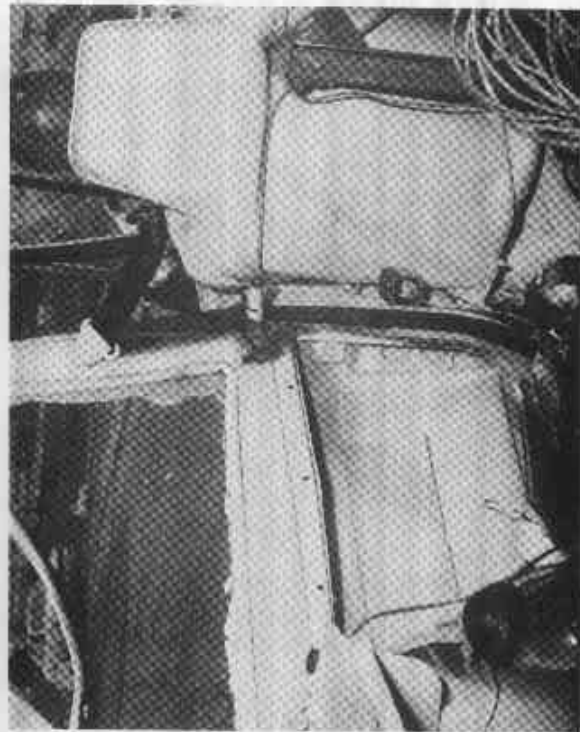
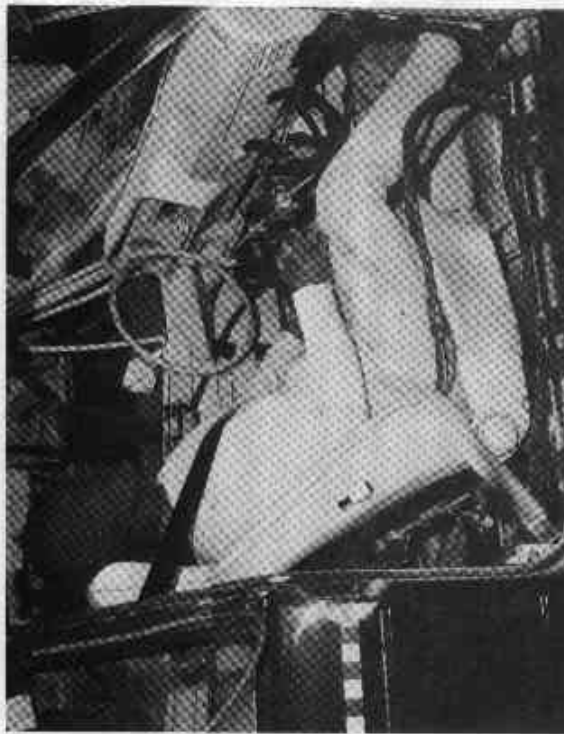
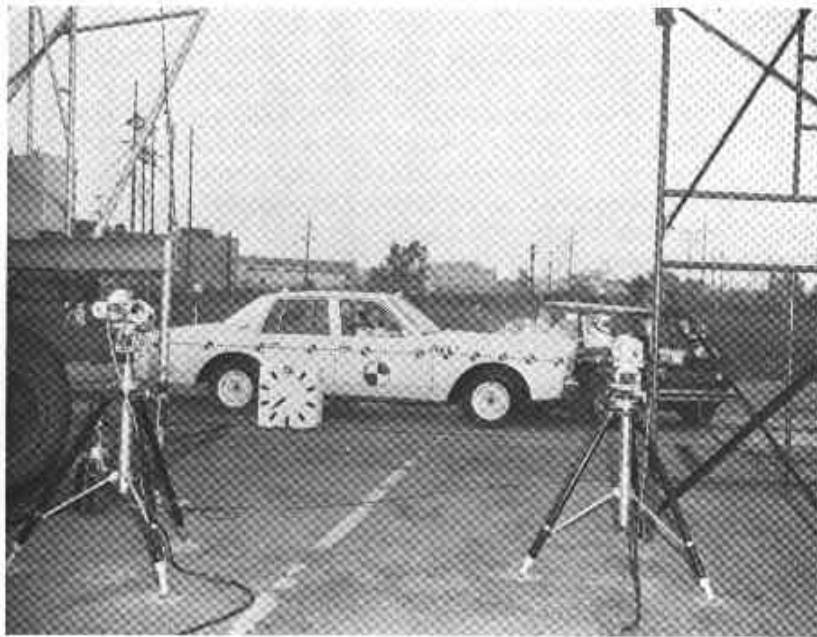


Figure 5 PRE- AND POST-TEST NO. 7 - CAR 2, 1976 VW RABBIT INTERIOR



CRASH EVENT



SIDE DAMAGE OF VW RABBIT

Figure 6 IMPACT AND POST IMPACT OF VW RABBIT

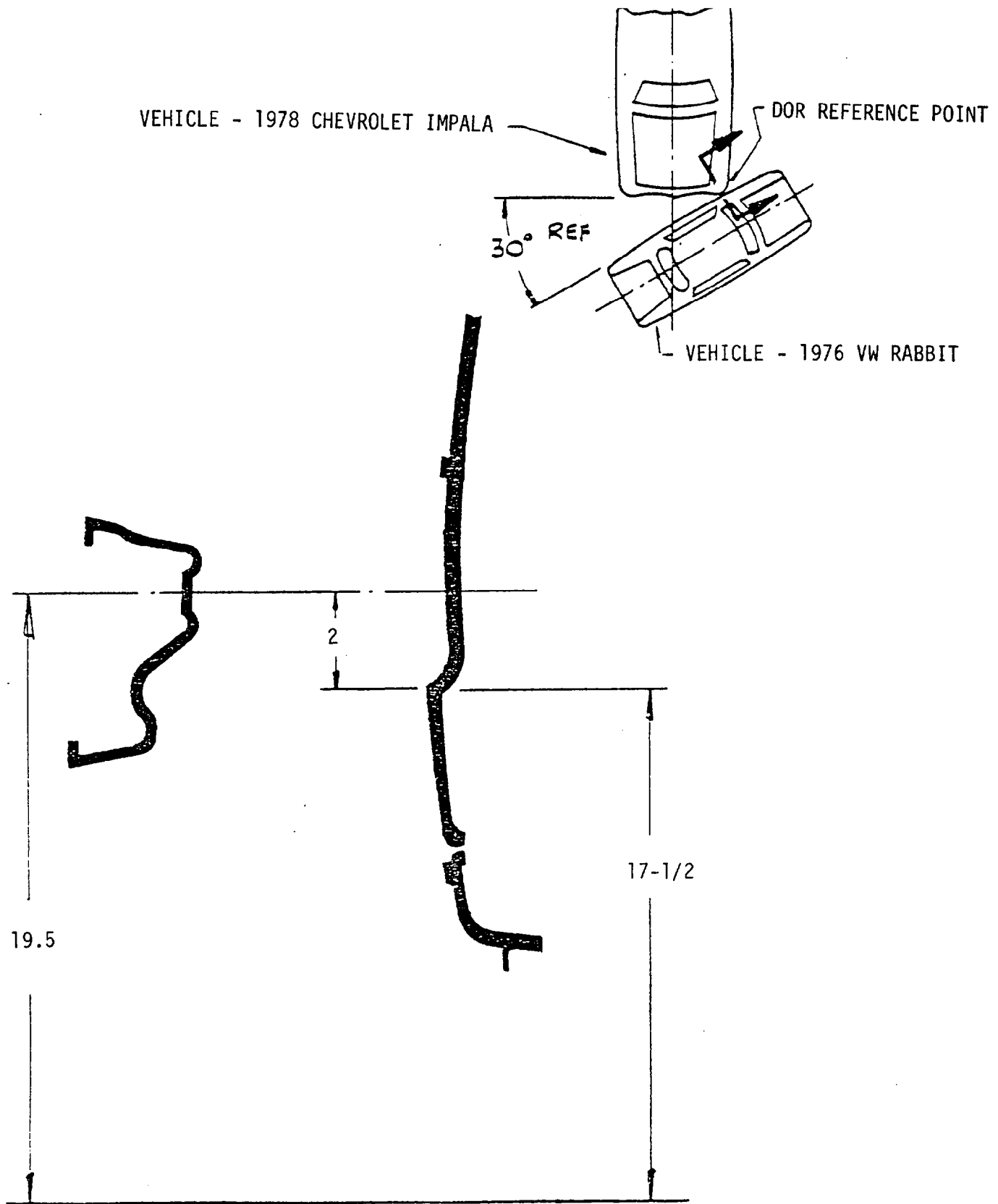
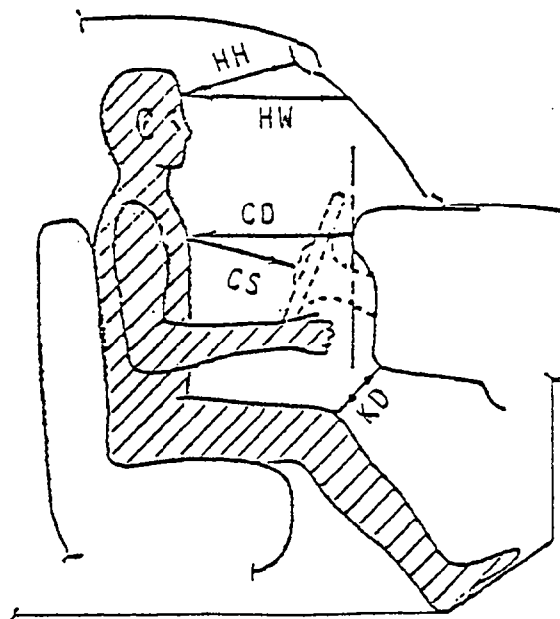
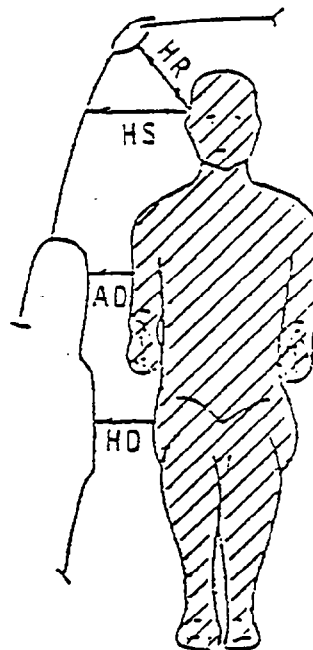


FIGURE 7 VEHICLE CRASH ATTITUDE



HH	21-3/4
HW	25-1/4
CD	25
CS	16-1/4
KD	10



HR	7
HS	9.25
AD	4
HD	6.5

FIGURE 8 OCCUPANT CLEARANCE DIMENSIONS

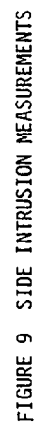
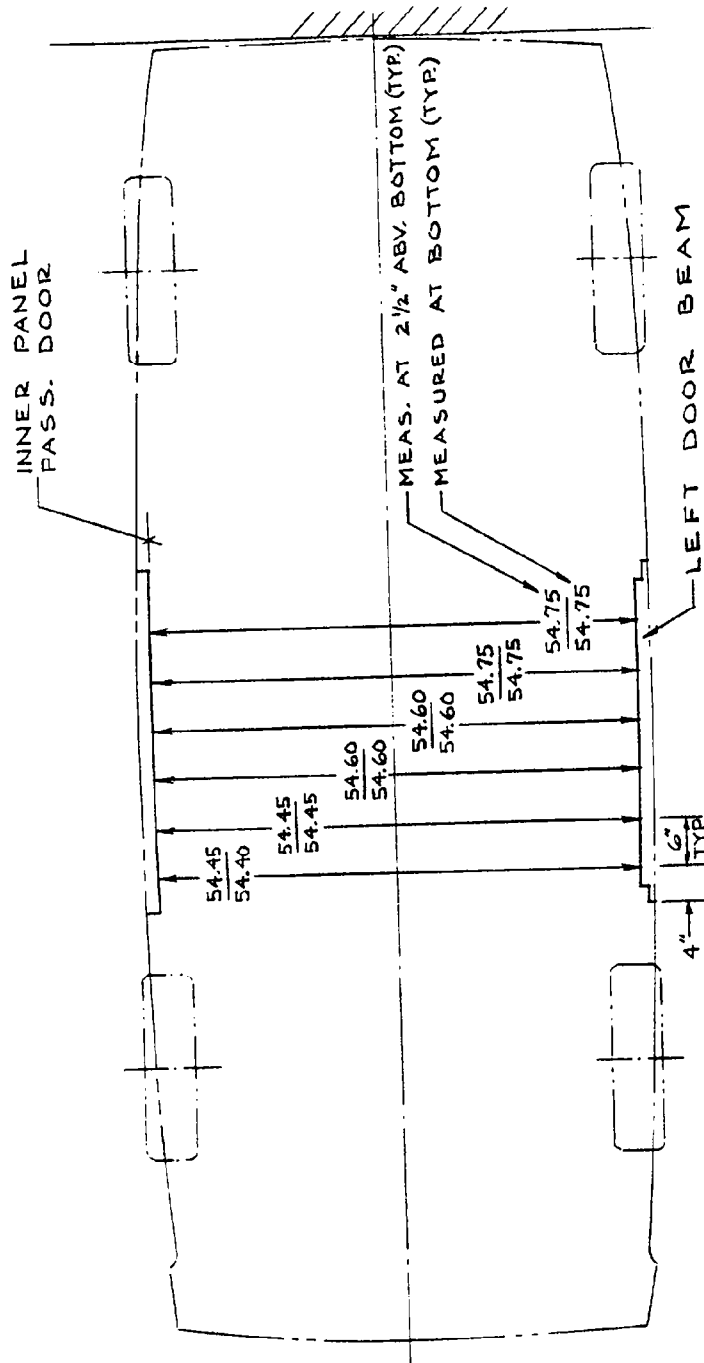


Table 3

SIDE INTRUSION MEASUREMENTS

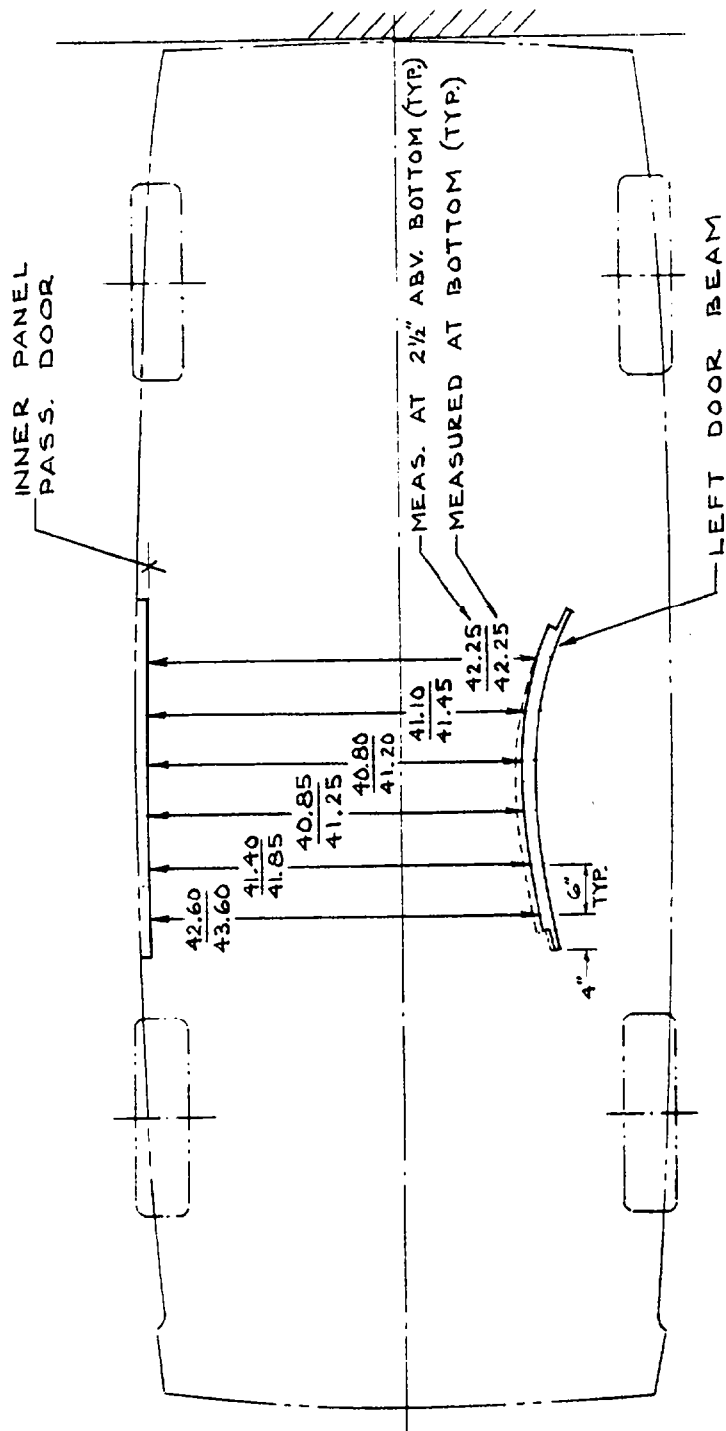
DIMENSIONS LISTED BELOW ARE FROM POINTS SHOWN ON FIGURE 9 TO REF. PLANES LOCATED PARALLEL TO AND OUTBOARD FROM ϕ OF VEHICLE (L. SIDE 34" R. SIDE 34").

PLANE NO.	DIMENSIONS (INCHES)							
	1	2	3	4	5	6	7	8
1	PRE	4.25	4.40	4.35	4.50	4.50	4.70	4.75
	POST	8.85	13.25	18.85	17.05	15.75	14.85	11.25
	DIFF.	4.60	8.85	14.50	12.55	11.25	10.15	6.50
2	PRE	3.75	3.85	3.65	3.70	3.75	3.85	3.90
	POST	8.25	15.40	19.40	17.60	16.35	15.35	12.15
	DIFF.	4.50	11.55	15.75	13.90	12.60	11.50	8.25
3	PRE	4.40	4.40	4.25	4.10	4.25	4.25	4.25
	POST	8.00	14.25	18.10	18.85	16.00	14.00	11.25
	DIFF.	3.60	9.85	13.85	14.75	11.75	9.75	7.00
4	PRE	5.50	5.75	5.60	5.60	5.75	5.85	5.85
	POST	9.25	13.25	14.75	16.00	16.60	13.25	10.00
	DIFF.	3.75	7.50	9.15	10.40	9.40	7.40	4.15
5	PRE	4.00	4.00	3.75	3.75	3.90	3.90	—
	POST	2.25	2.25	2.25	2.25	2.70	3.00	—
	DIFF.	1.75	1.75	1.50	1.50	1.20	0.90	—
6	PRE	—	—	—	—	11.85	11.85	—
	POST	—	—	—	—	13.00	14.00	—
	DIFF.	—	—	—	—	1.15	2.15	—
7	PRE	—	—	—	—	—	—	—
	POST	—	—	—	—	—	—	—
	DIFF.	—	—	—	—	—	—	—



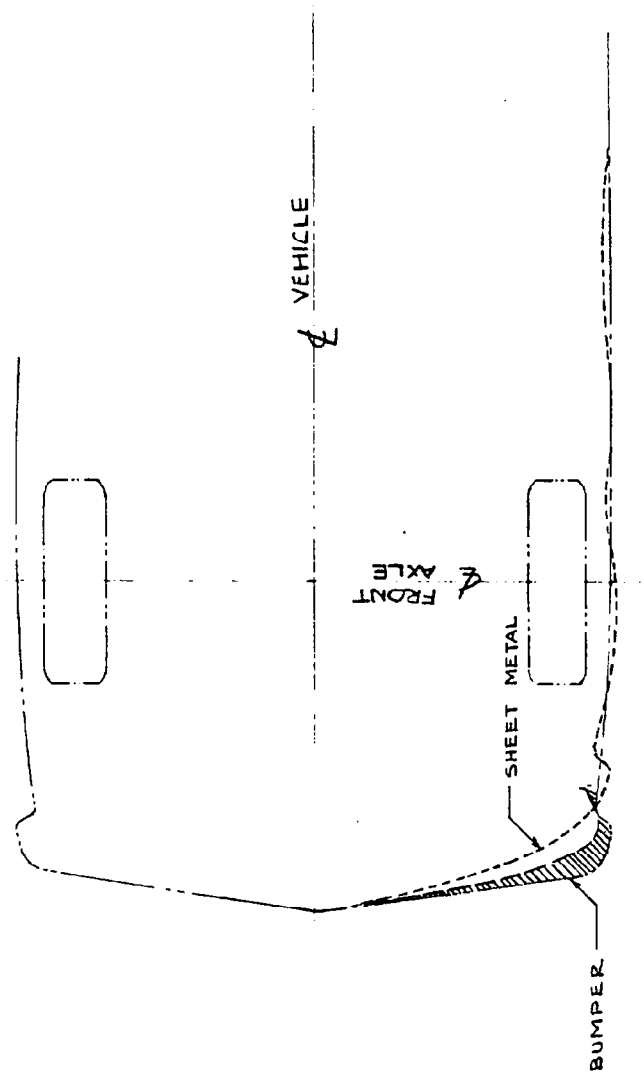
1976 VOLKSWAGEN RABBIT
SCALE 1/16" = 1"

FIGURE 10-1 PRE-TEST DOOR BEAM INTRUSION MEASUREMENTS



1976 VOLKSWAGEN RABBIT
scale .06" = 1"

FIGURE 10-2 POST-TEST DOOR BEAM INTRUSION MEASUREMENTS



0 3 6 9 12
SCALE - (INCHES)

FIGURE 11 PRE- AND POST-TEST DEFORMATION - CAR 1, 1978 CHEVROLET IMPALA

TABLE 4

ELECTRONIC INSTRUMENTATION TEST No. 7
Car 1 - Bullet Vehicle - 1978 Chevrolet Impala

TRANSDUCER DESCRIPTION OR ACCELEROMETER LOCATION *	DIRECTION OF PARAMETER BEING MEASURED	LOCATION ON VEHICLE	DESCRIPTION LISTED ON DATA PLOTS
<u>VEHICLE ACCELEROMETER</u>			
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	Rear Compartment	Left Rear Compartment - Angular X
6	X,Y,Z	Top Engine, Carburetor	Engine
7	X	Front Crossmember	Front Crossmember
9	X	Rear Compartment	Right Rear Compartment - Angular X
<u>DUMMY</u>			
LF Head (Dummy (1))	X,Y,Z	Left Front Seat	Dummy (LF) Head
LF Chest "	X,Y,Z	Left Front Seat	Dummy (LF) Chest
LF Femurs "	R,L **	Left Front Seat	Dummy (LF) Femurs
LF Belts "	U,R,L ***	Left Front Seat	Self-explanatory
<u>MISCELLANEOUS</u>			
10	Yaw Rate	Centerline behind Front Seats	Tunnel Yaw Rate
12	X-Accel.	Bumper (rear face)	Bumper

* See Accelerometer Layout Diagram Figure 12

** Right & Left Forces

*** Upper, Lower Belt Forces

TABLE 5

ELECTRONIC INSTRUMENTATION TEST No. 7

Car 2 - Target Vehicle - 1976 Volkswagen Rabbit

TRANSDUCER DESCRIPTION OR ACCELEROMETER LOCATION *	DIRECTION OF PARAMETER BEING MEASURED	LOCATION ON VEHICLE	DESCRIPTION LISTED ON DATA PLOTS
<u>VEHICLE ACCELEROMETER</u>			
1	X, Y, Z	Right Sill next to Front Seat	Right Front Compartment
2	X, Y, Z	Right Sill next to Rear Seat	Right Rear Compartment
3	X, Y, Z	Deck over Rear Axle	Rear Deck
6	Y	Lower Left Door Centerline	Lower Door Center
7	X	Rear Compartment	Left Compartment - Angular X
8	X	Rear Compartment	Right Compartment - Angular X
9	Y	Mid-rear of Left Door	Mid-aft of Door
10	Y	Upper Left Door Centerline	Upper Door Center
11	Y	Mid-Front of Left Door	Mid-front Door
<u>DUMMY</u>			
LF Head (Dummy (1))	X, Y, Z	Left Front Seat	Dummy (LF) Head
LF Chest (Dummy (1))	X, Y, Z	Left Front Seat	Dummy (LF) Chest
LF Pelvis (Dummy (1))	X, Y	Left Front Seat	Dummy (LF) Pelvis
RF Head (Dummy (2))	X, Y, Z	Right Front Seat	Dummy (RF) Head
RF Chest (Dummy (2))	X, Y, Z	Right Front Seat	Dummy (RF) Chest
RF Pelvis (Dummy (2))	X, Y	Right Front Seat	Dummy (RF) Pelvis
<u>MISCELLANEOUS</u>			
12	Yaw Rate	Centerline behind Front Seats	Tunnel Yaw Rate
13 - 16	Side Intrusion	Side Intrusion (Driver Side)	Side Intrusion

*See Accelerometer Layout Diagram Figure 13

CAR 1 - BULLET VEHICLE - 1978 CHEVROLET IMPALA

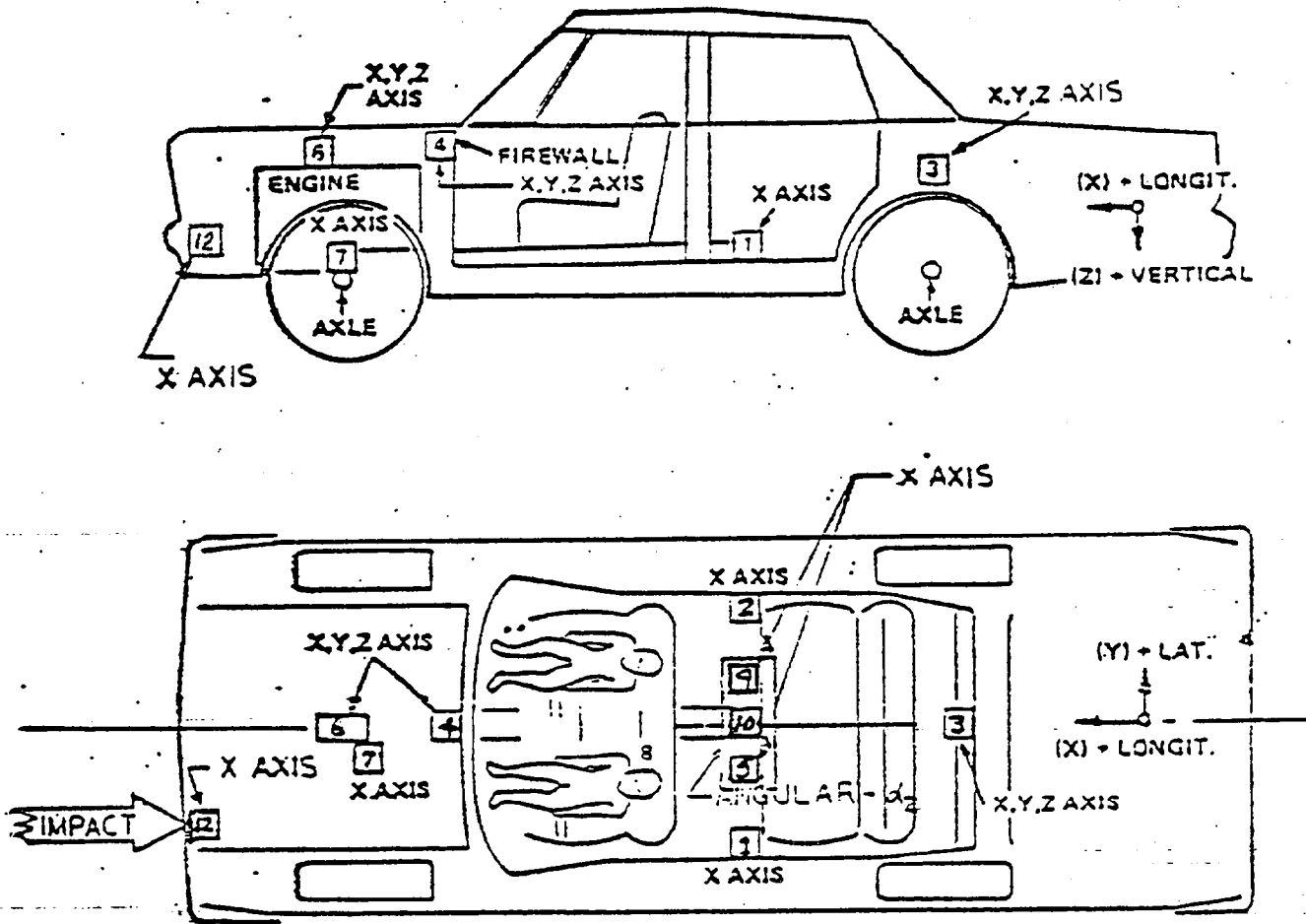


FIGURE 12 VEHICLE ACCELEROMETER LOCATIONS

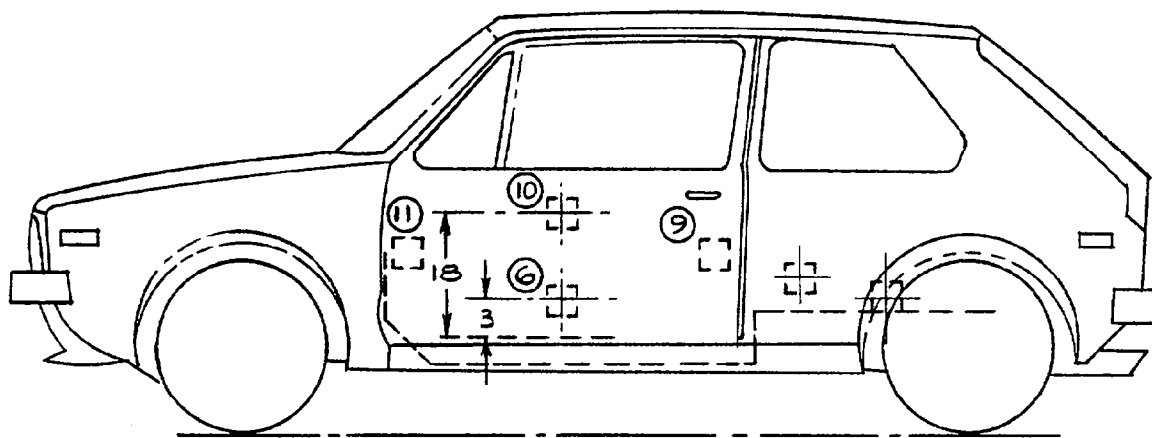
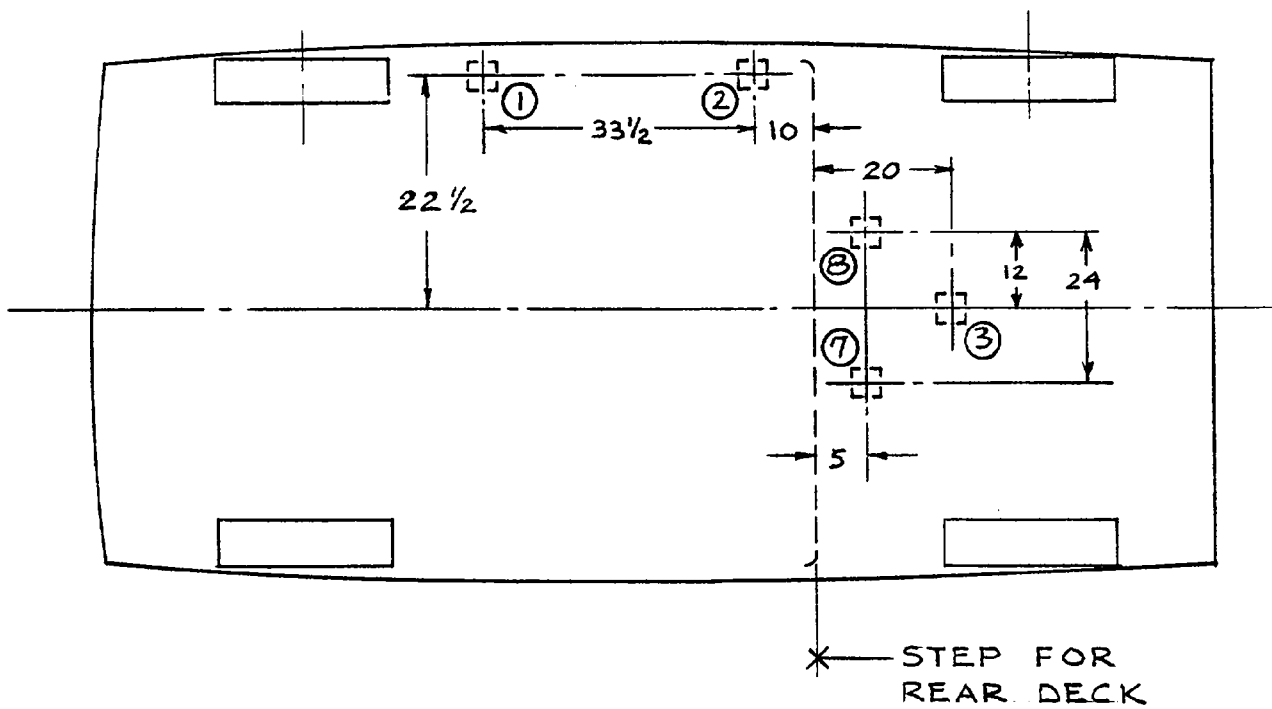


FIGURE 13 VEHICLE ACCELERATION LOCATIONS

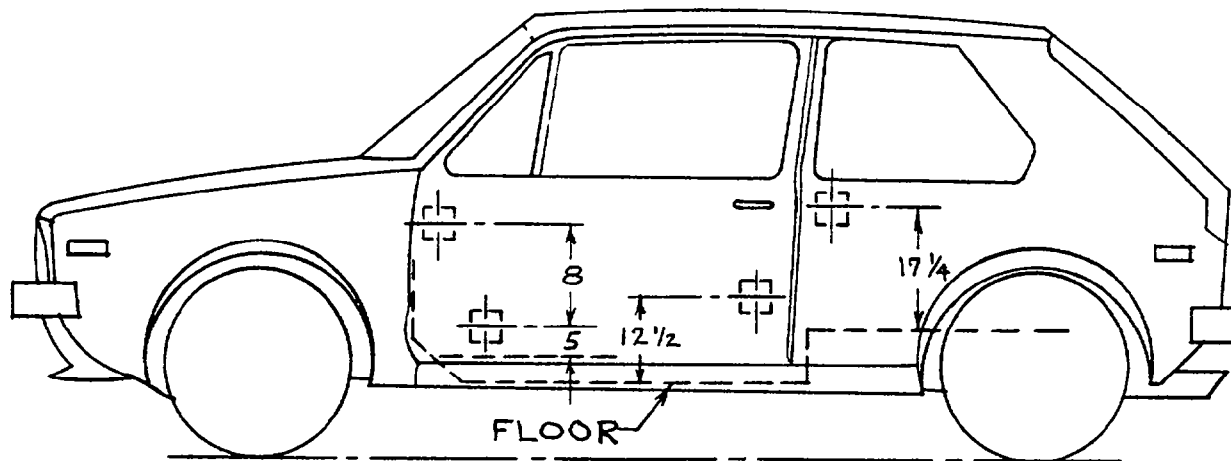
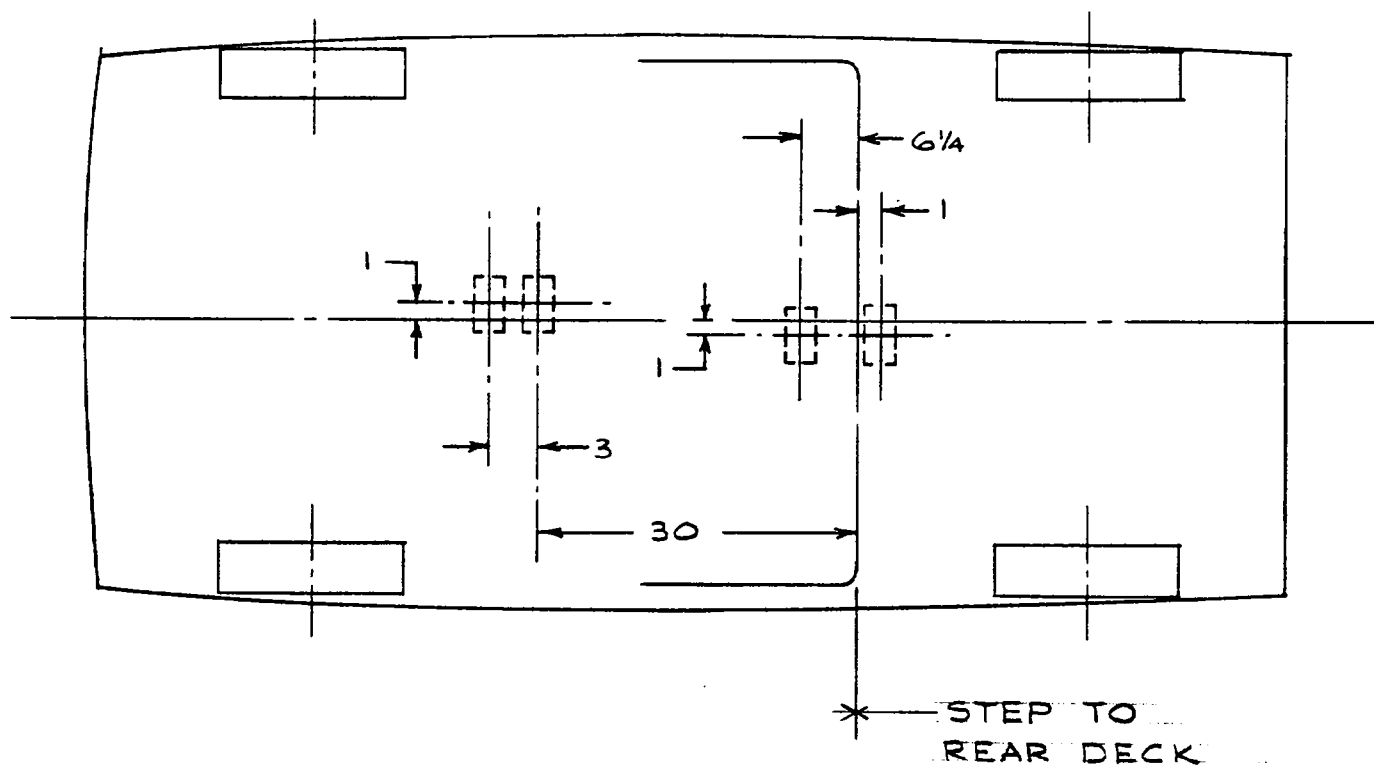


FIGURE 14 VEHICLE POTENTIOMETER LOCATIONS

TABLE 6

HIGH SPEED CAMERA INFORMATION (TEST No. 7)

CAMERA NO.	LOCATION	TYPE	LENS (mm)	SPEED (fps)
1) South Wide	A = 23 ft. B = 2 ft. 10 in.	Photosonics	13	870
2) South Close	C = 24 ft. 10 in. D = 5 ft.	Photosonics	25	850
3) Tower South	L = 25 ft. M = 12 ft.	Photosonics	13	770
4) North Wide	E = 26 ft. F = 14 ft.	Photosonics	13	550
5) North Close	G = 26 ft. 8 in. H = 19 ft.	Photosonics	25	550
6) Tower 45°	J = 21 ft. 7 in. K = 11 ft.	Photosonics	13	800
7) Tower	31 ft. 6 in.	Photosonics	13	750
8) Hood	On-board	Stalex	8	1350
9) Passenger Door	On-board	Stalex	8	1500
10) Rear	On-board	Stalex	8	1400

NOTE: CAMERAS ARE NUMBERED ACCORDING TO SPLICING SEQUENCE OF FILM.

(24 fps) REAL TIME MOVIE FILM COVERAGE OF PRE-CRASH, POST-CRASH
AND CRASH EVENT SPLICED AT START AND END OF FILM.

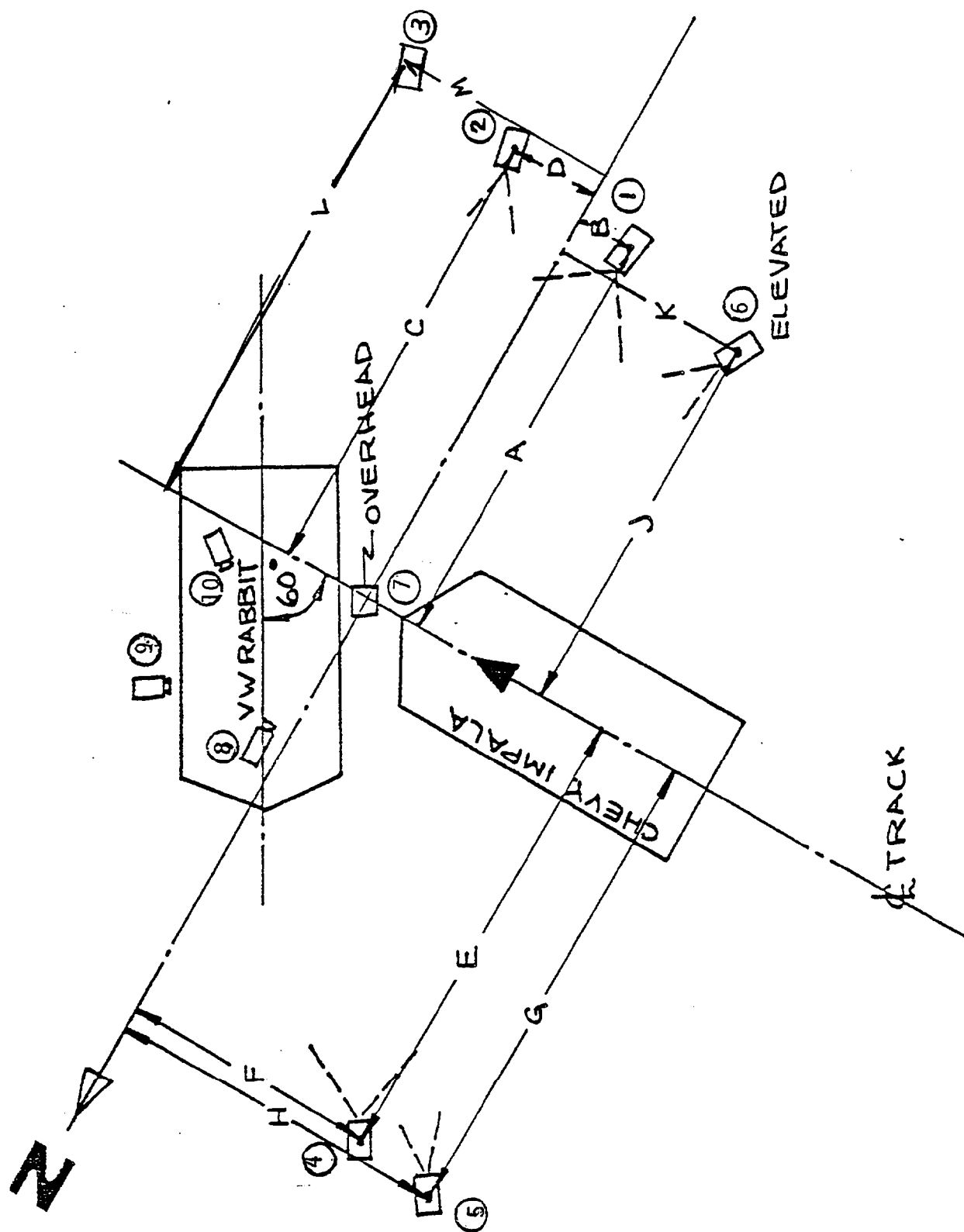


FIGURE 15 HIGH-SPEED CAMERA LOCATIONS

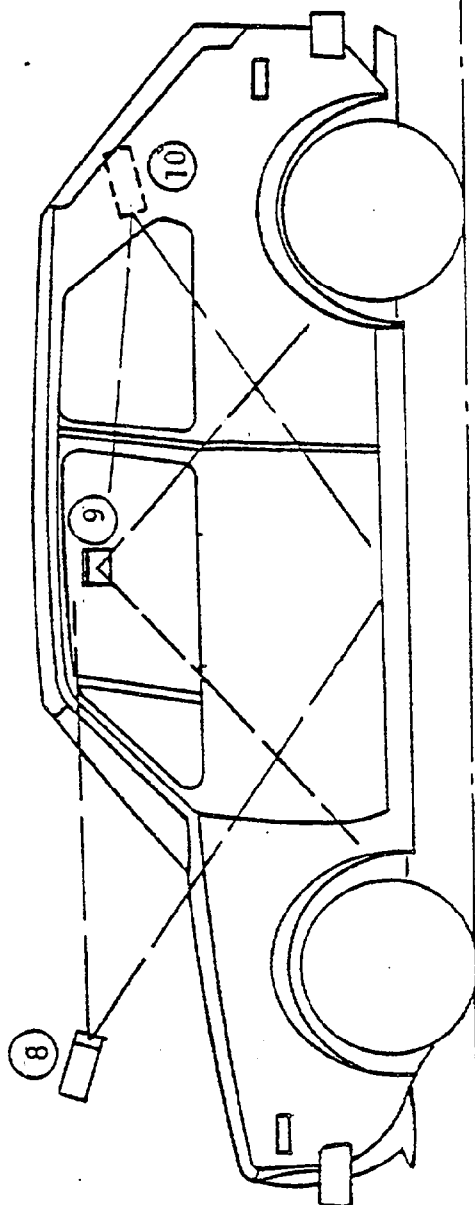


FIGURE 16 ON-BOARD HIGH-SPEED CAMERA LOCATIONS

DUMMY INJURY CRITERIA VALUES

CAR 1 - STRIKING VEHICLE

1978 Chevrolet Impala

	MAXIMUM ACCELERATION ("G") *											
	HEAD				CHEST				PELVIS			
	X	Y	Z	R	X	Y	Z	R	X	Y	Z	R
DUMMY (1)	-11	-2	10	15	-10	1	-2	10.8				
DUMMY (2)												
DUMMY (3)												
DUMMY (4)												

	MAXIMUM FORCE-FEMUR LOAD (LBS)	
	RIGHT FEMUR	LEFT FEMUR
DUMMY (1)	150	130
DUMMY (2)		
DUMMY (3)		
DUMMY (4)		

	MAXIMUM FORCE-SEAT BELTS LOADS (LBS)		
	SHOULDER STRAP UPPER BELT LOAD	LAP STRAP RIGHT BELT LOAD	LAP STRAP LEFT BELT LOAD
DUMMY (1)	650	850	220
DUMMY (2)			
DUMMY (3)			
DUMMY (4)			

	HEAD INJURY CRITERIA**				SEVERITY INDEX	
	HIC	t ₁ (SEC)	t ₂ (SEC)	AVE. ACC. (g) t ₁ TO t ₂	HEAD	CHEST
DUMMY (1)	33.3	.091	.163	11.6	40.9	15
DUMMY (2)						
DUMMY (3)						
DUMMY (4)						

*DEFINED AS EXCEEDING 0.003 SEC. DURATION

**AS DEFINED IN FMVSS NO. 208

TABLE 8

DUMMY INJURY CRITERIA VALUES

CAR 2 - STRUCK VEHICLE

1976 VOLKSWAGEN RABBIT

	MAXIMUM ACCELERATION ("G") *											
	HEAD				CHEST				PELVIS			
	X	Y	Z	R	X	Y	Z	R	X	Y	Z	R
DUMMY (1)	-20	34	60	65	-23	60	-11	65	-32	75		
DUMMY (2)	-13	49	50	56	7.5	110	6	110	-20	40		
DUMMY (3)												
DUMMY (4)												

	MAXIMUM FORCE-FEMUR LOAD (LBS)		DUMMY LOCATION
	RIGHT FEMUR	LEFT FEMUR	
DUMMY (1)			Left Front Passenger
DUMMY (2)			Right Front Passenger
DUMMY (3)			
DUMMY (4)			

	MAXIMUM FORCE-SEAT BELTS LOADS (LBS)		
	SHOULDER STRAP UPPER BELT LOAD	LAP STRAP RIGHT BELT LOAD	LAP STRAP LEFT BELT LOAD
DUMMY (1)			
DUMMY (2)			
DUMMY (3)			
DUMMY (4)			

	HEAD INJURY CRITERIA**				SEVERITY INDEX	
	HIC	t ₁ (SEC)	t ₂ (SEC)	AVE. ACC. (g) t ₁ TO t ₂	HEAD	CHEST
DUMMY (1)	504.2	.062	.111	40.4	711.5	560
DUMMY (2)	321.1	.083	.142	31.3	779.2	1100
DUMMY (3)						
DUMMY (4)						

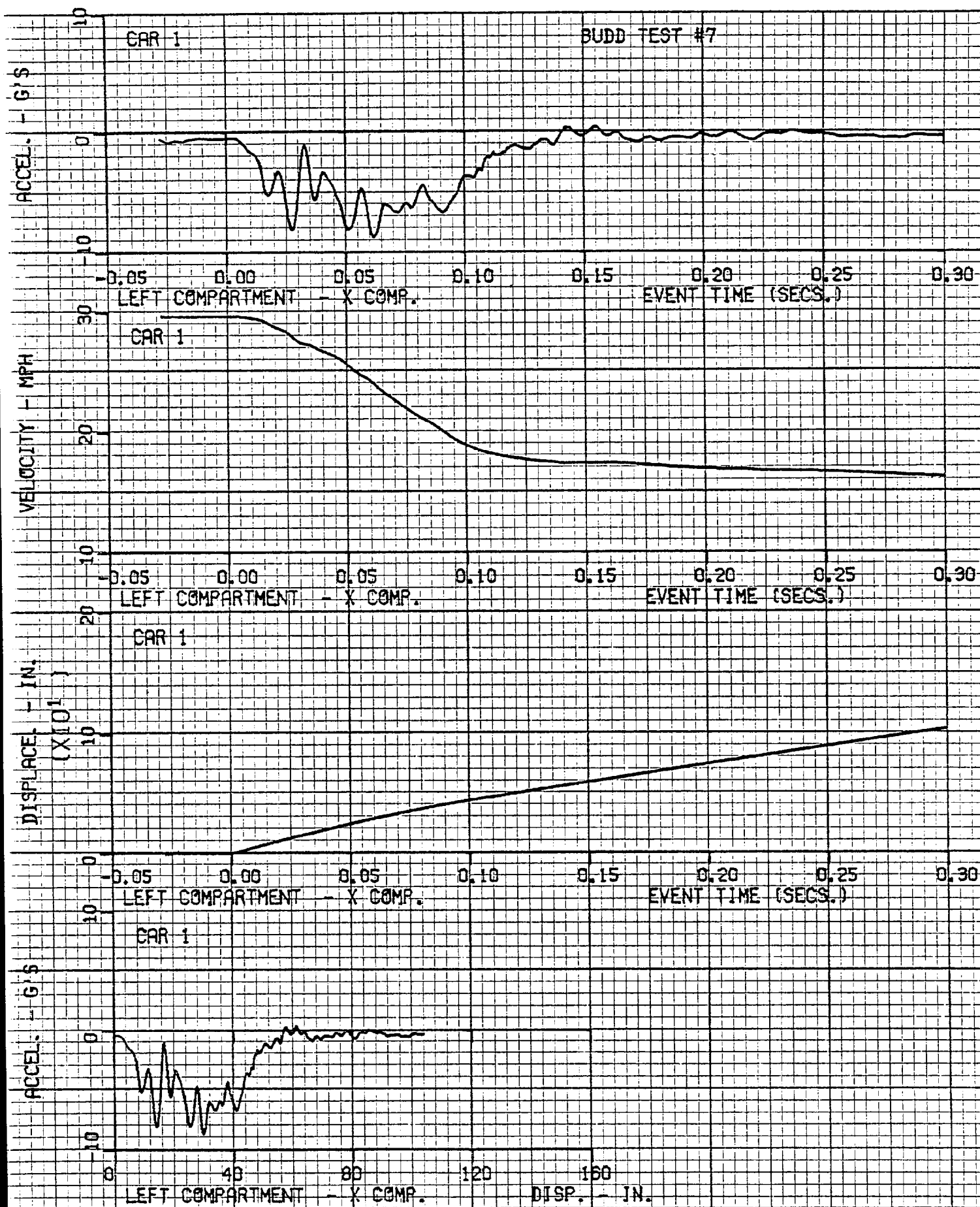
*DEFINED AS EXCEEDING 0.003 SEC. DURATION

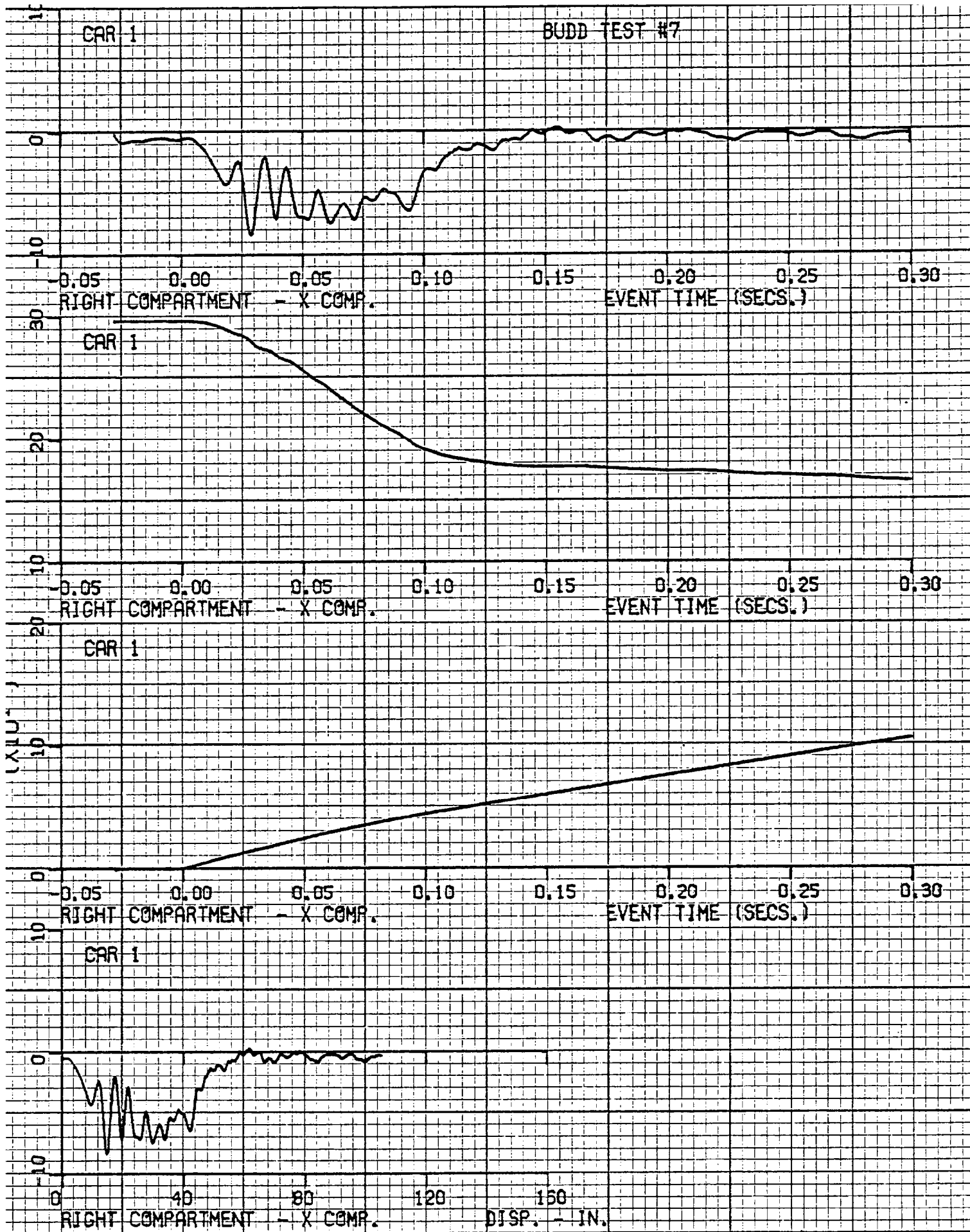
**AS DEFINED IN FMVSS NO. 208

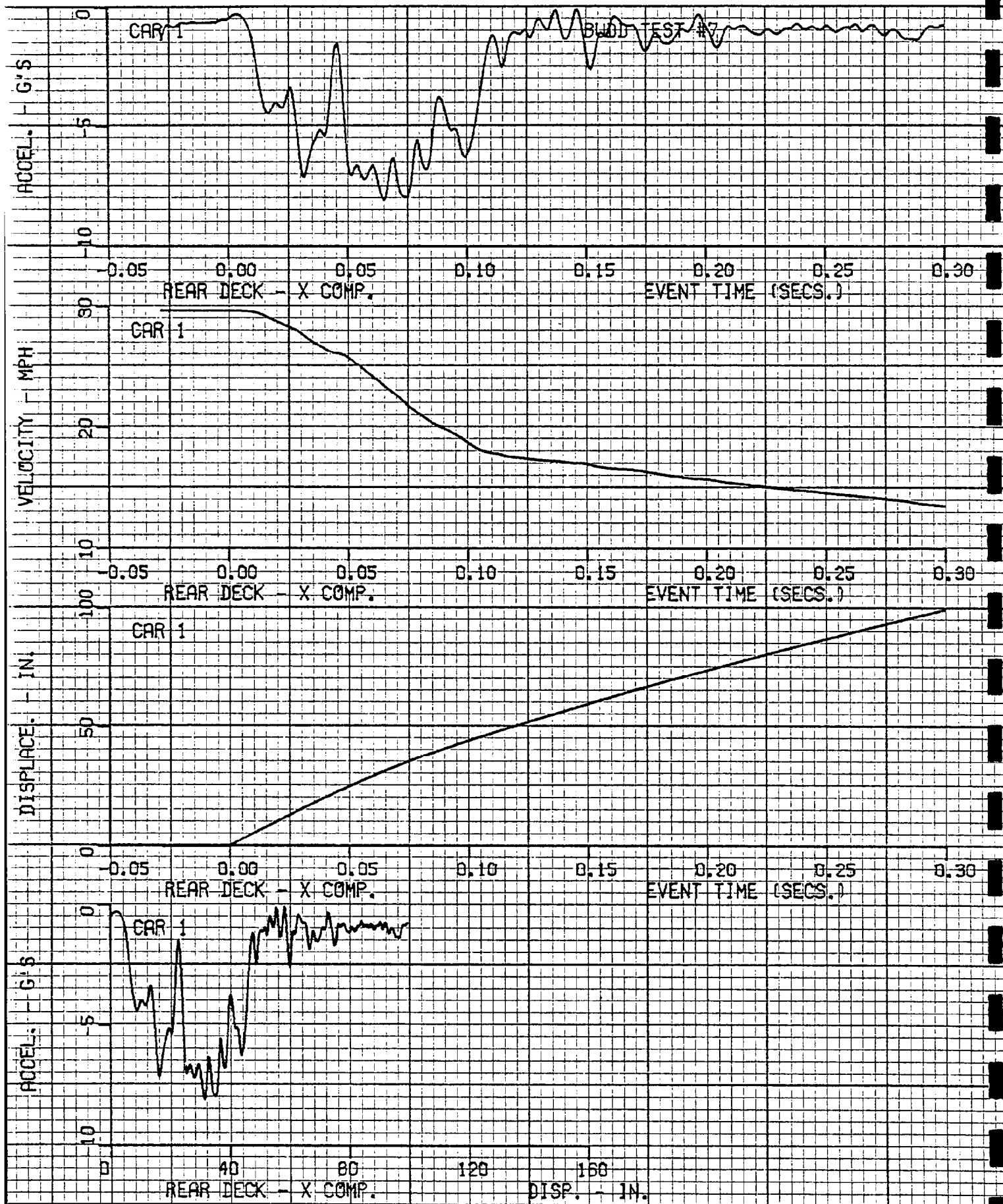
TEST NO. 7

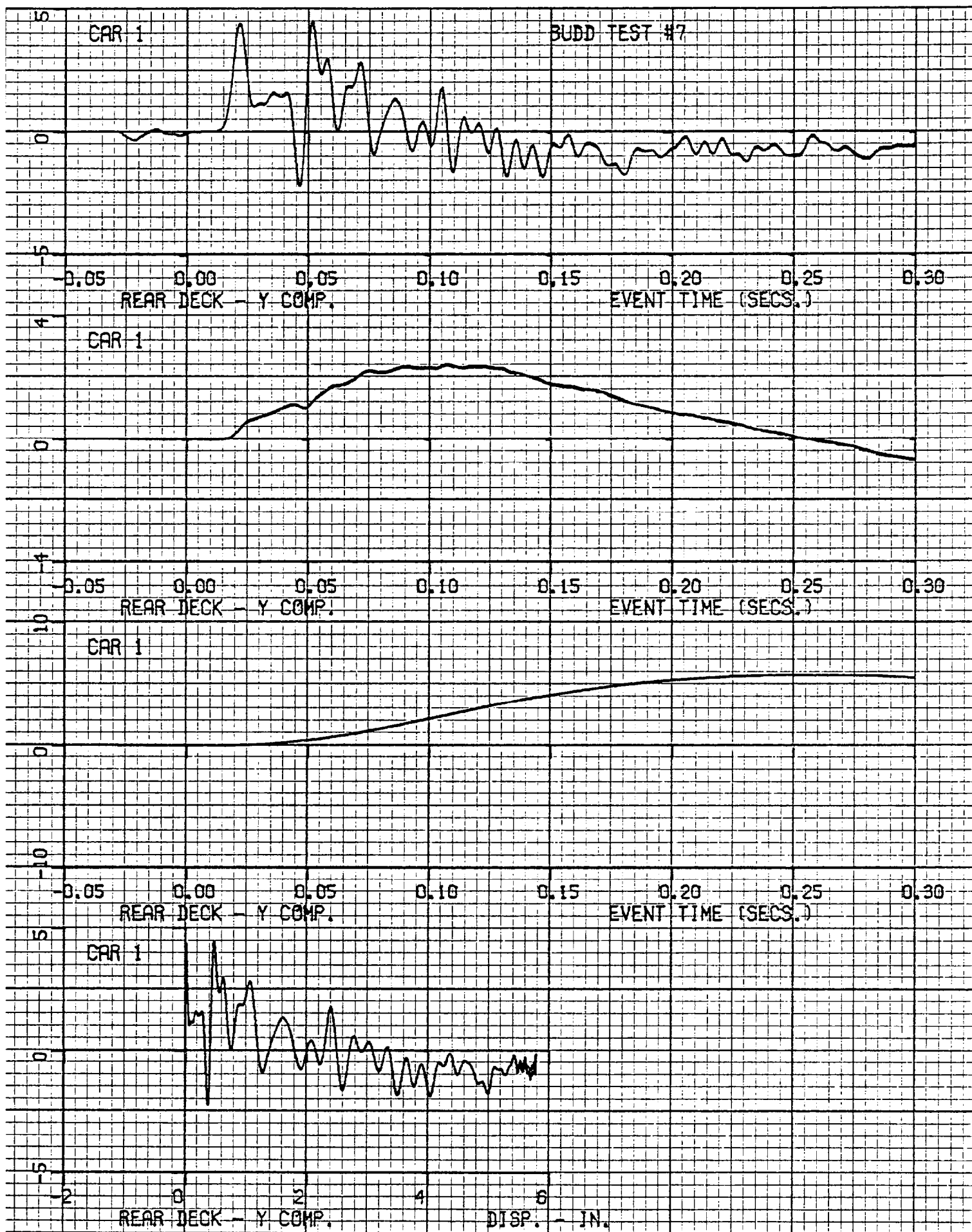
CAR 1 - 1978 CHEVROLET IMPALA

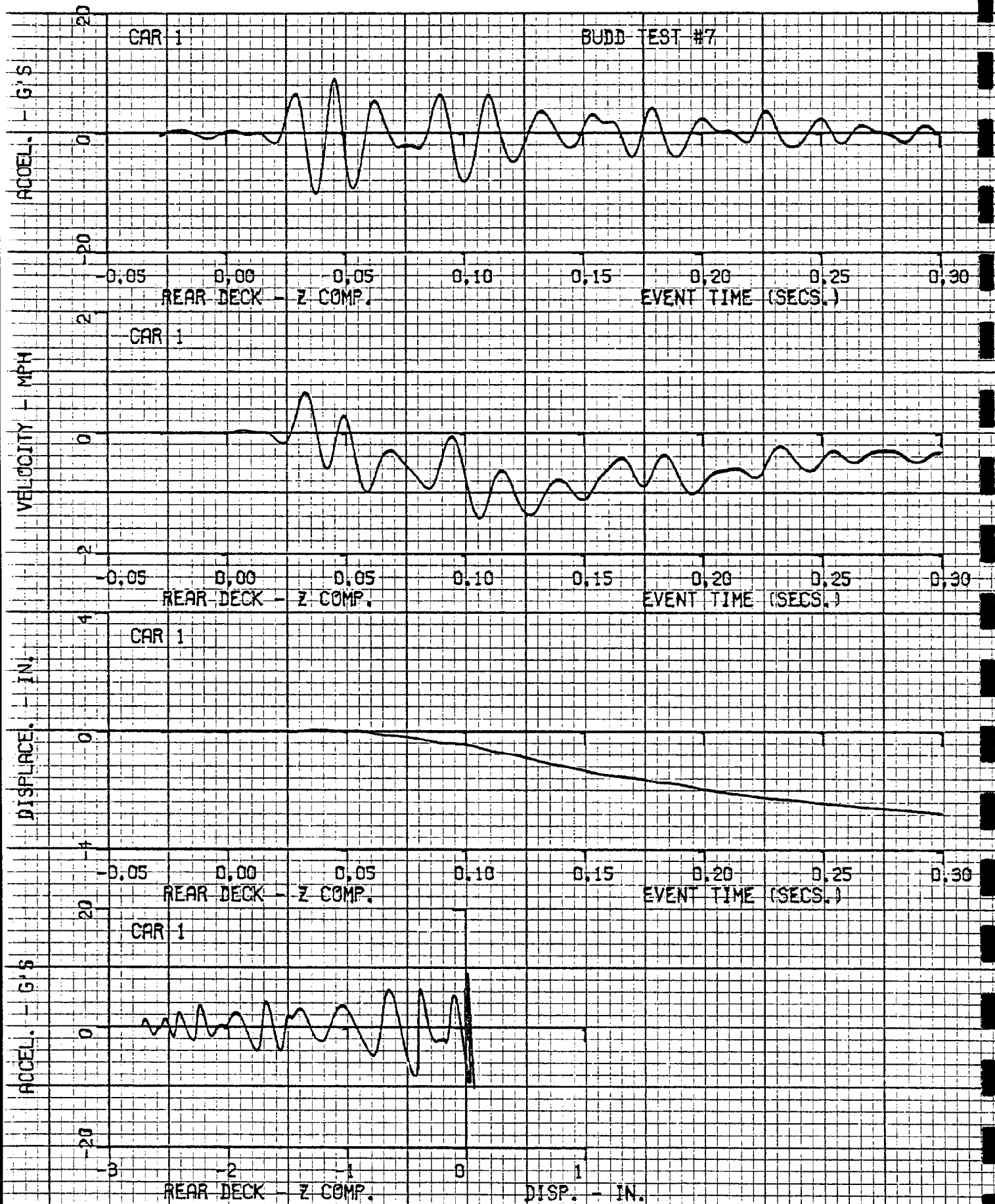
VEHICLE DATA, 60 HZ FILTER

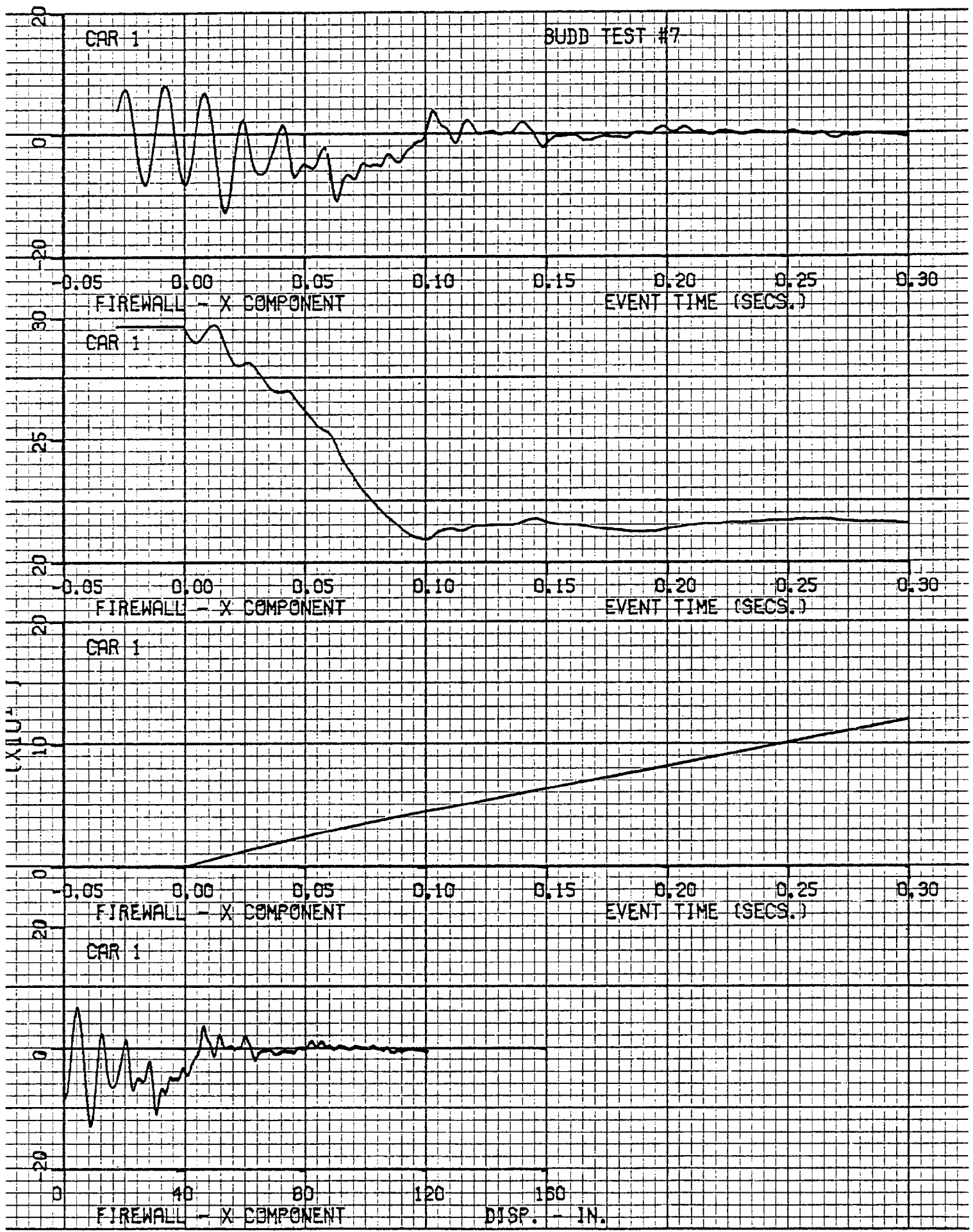


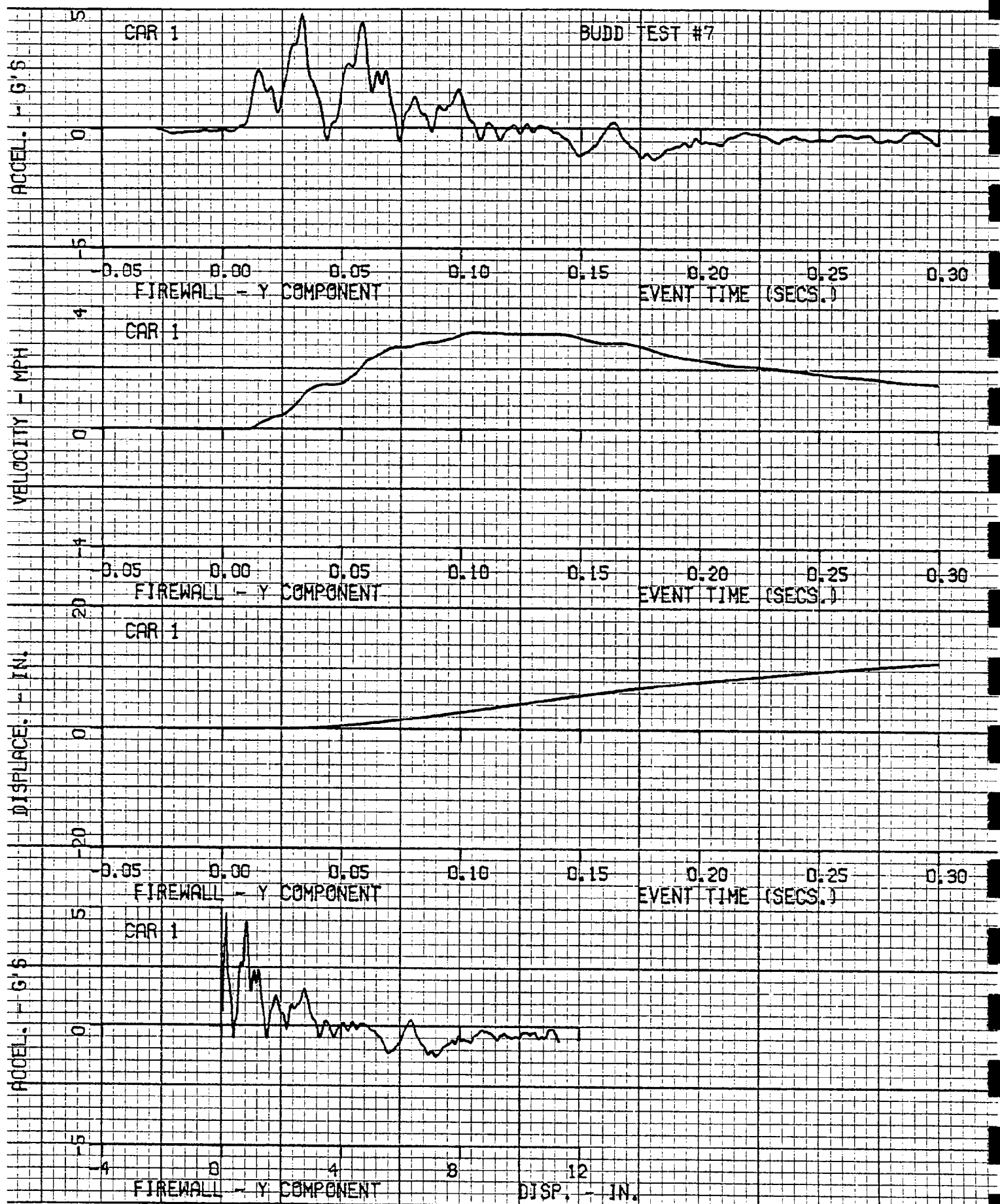


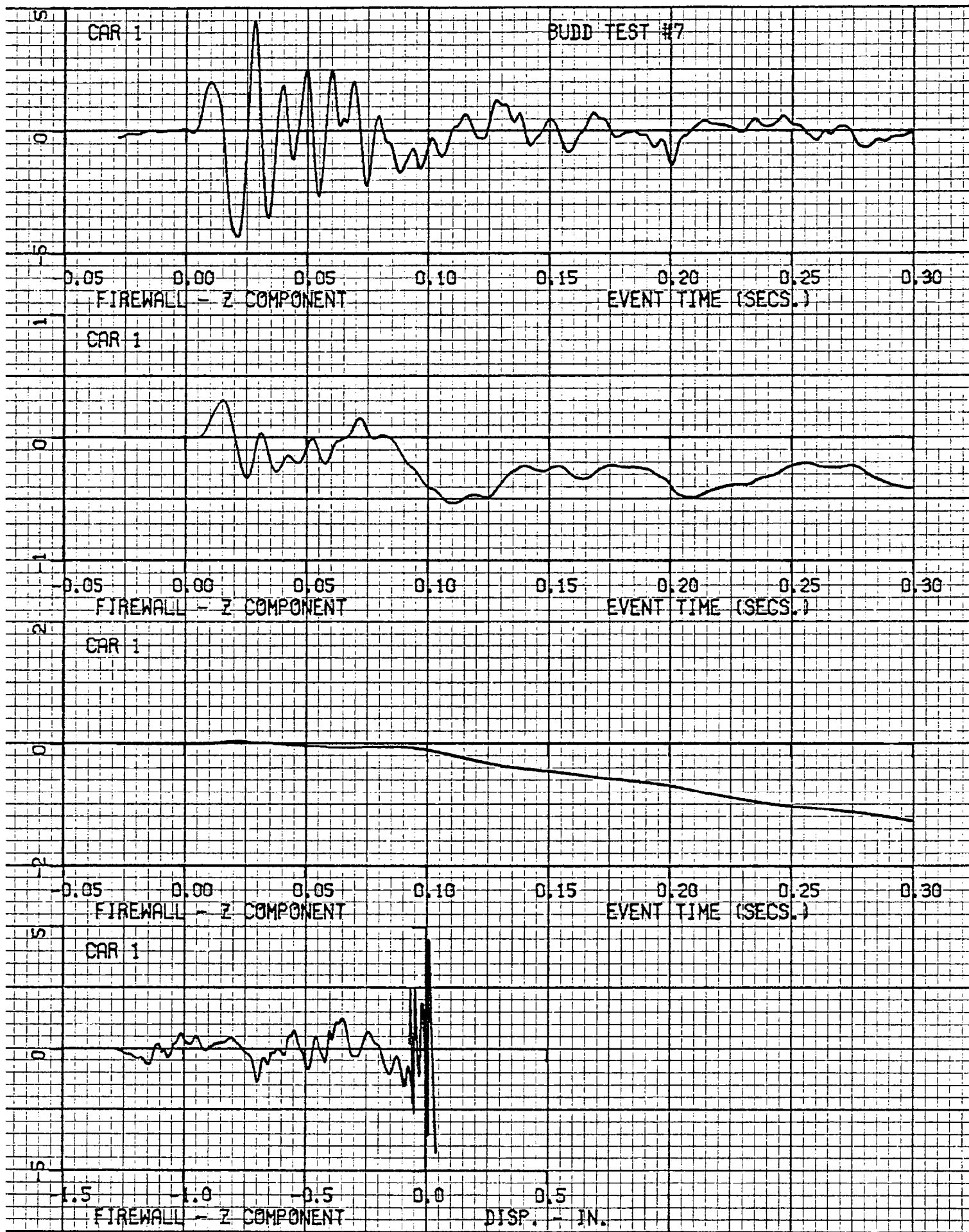


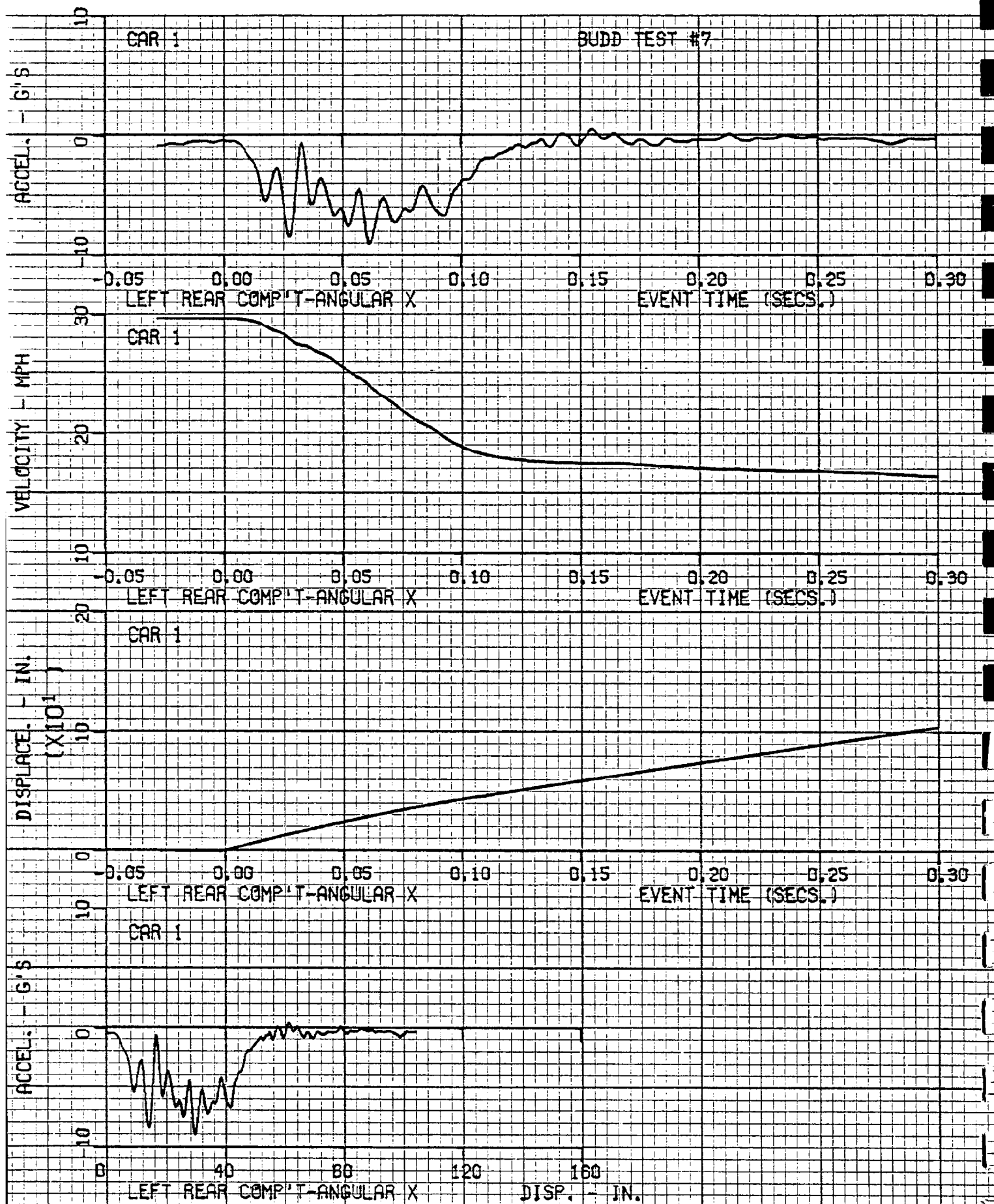


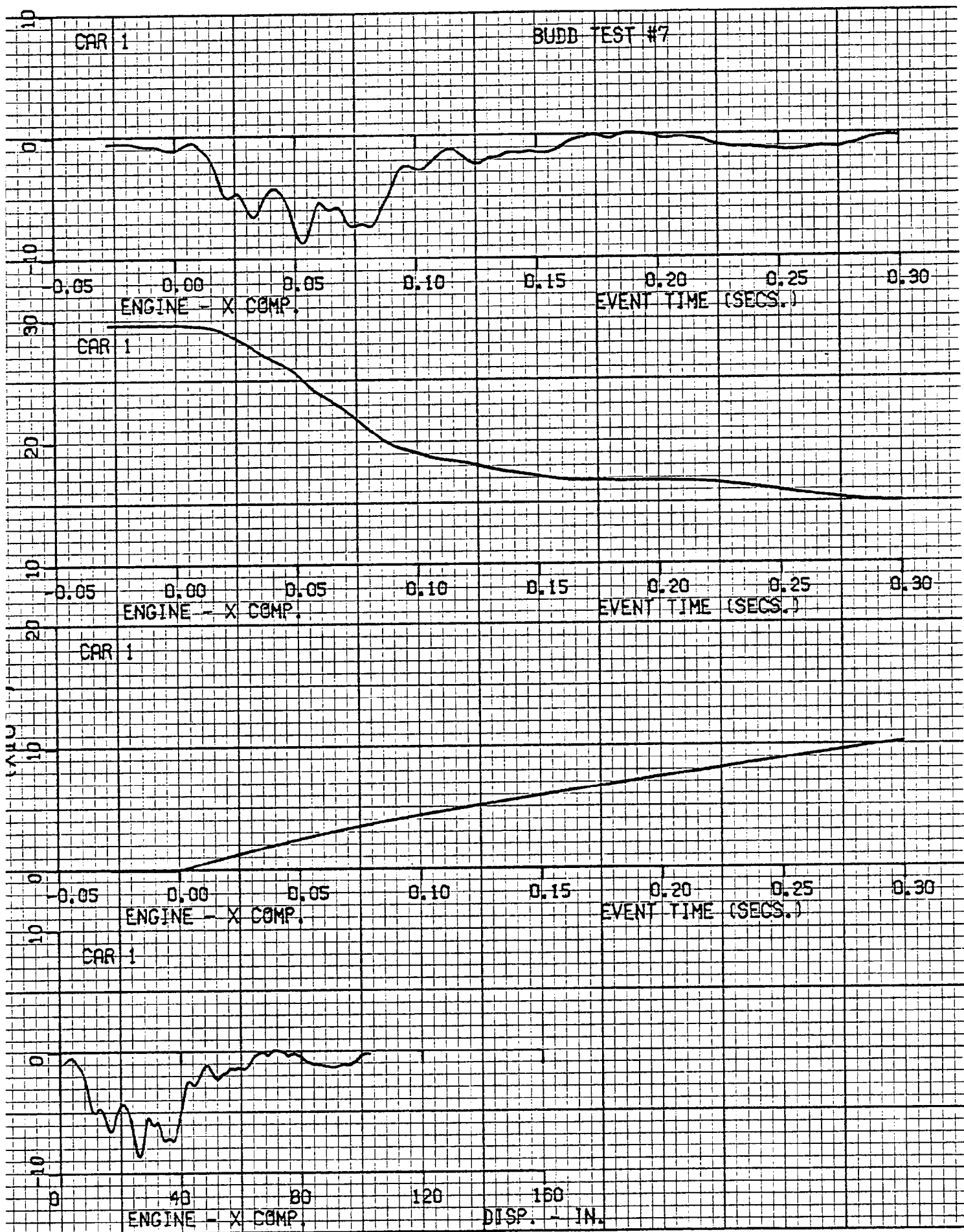


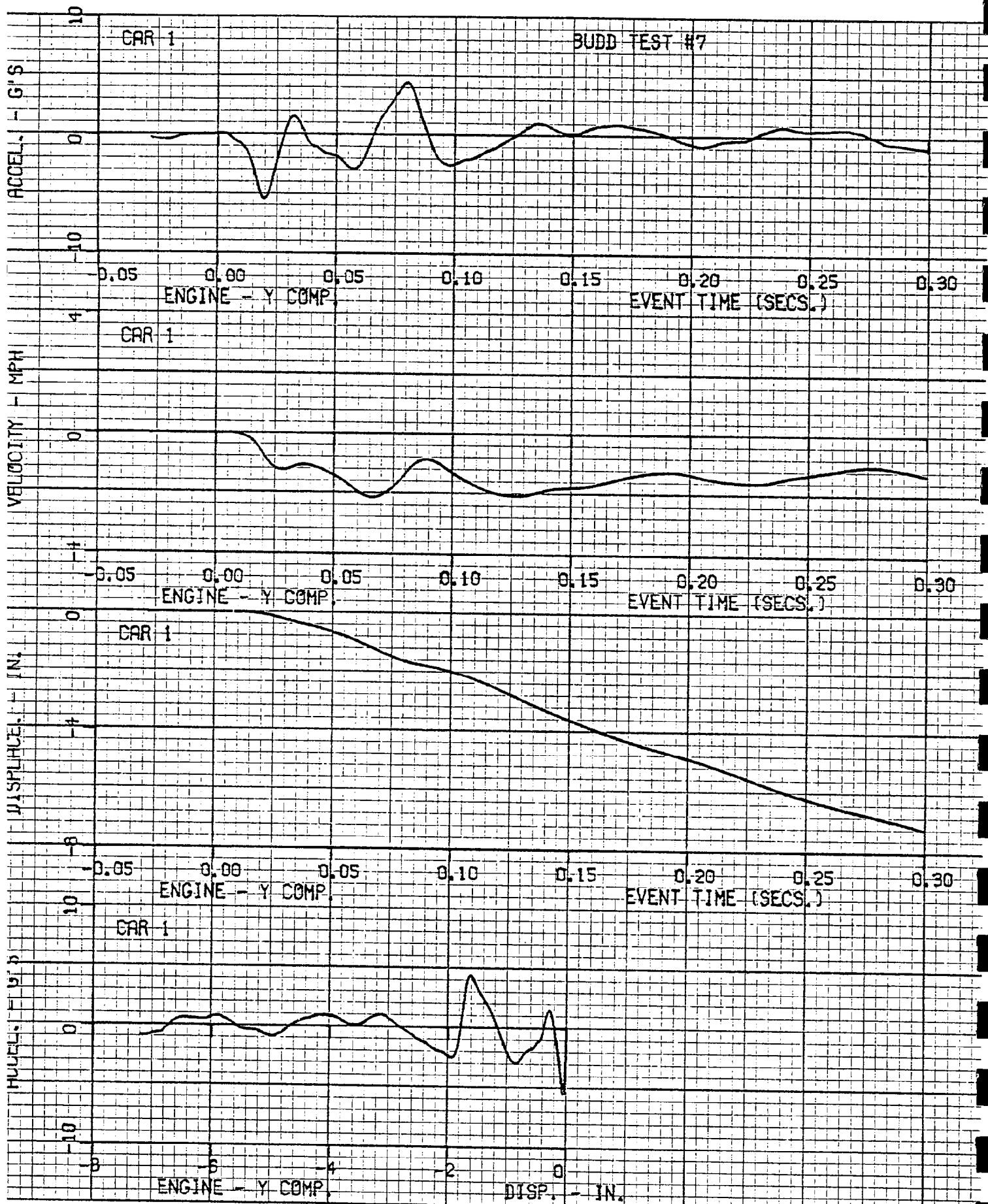


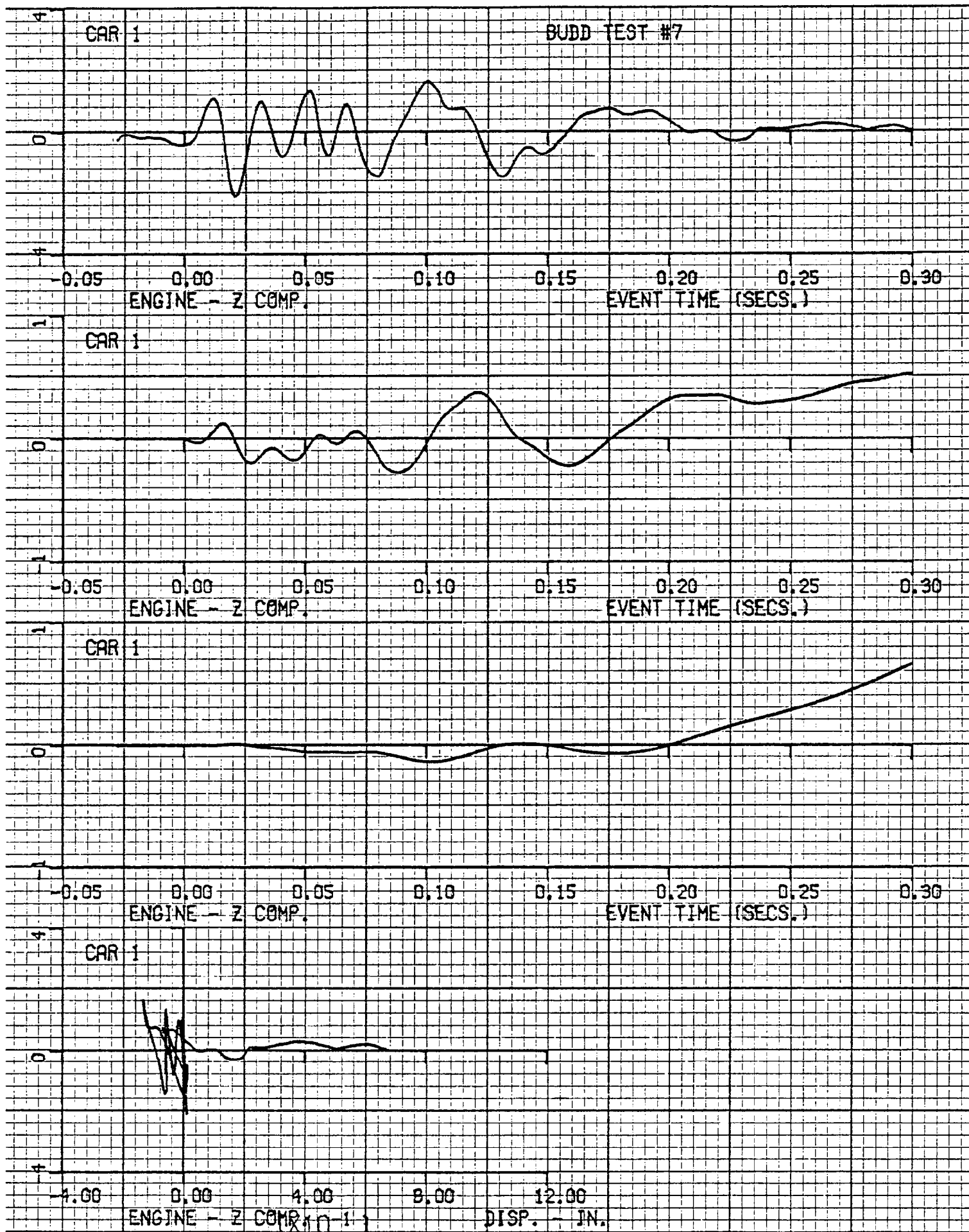


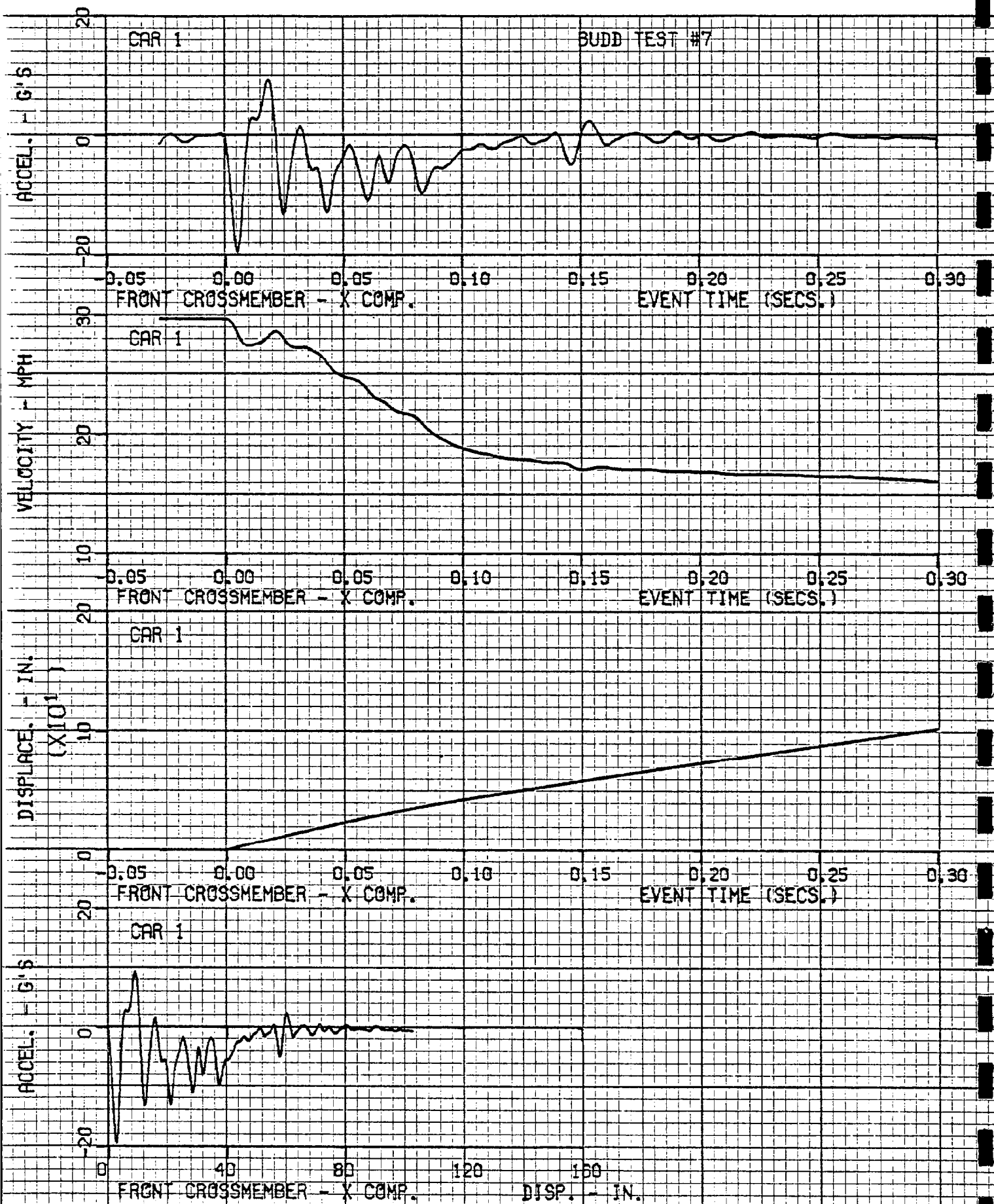


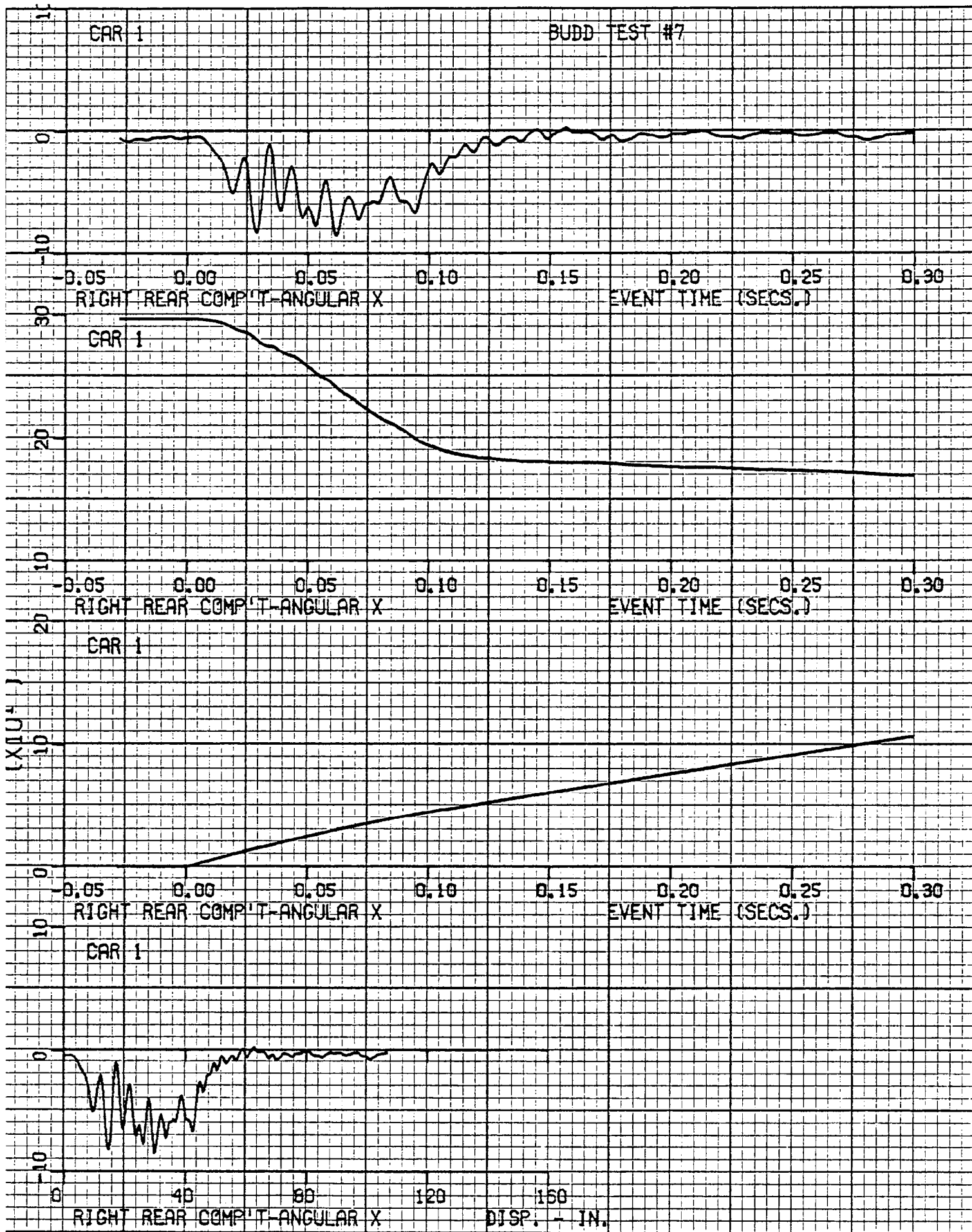


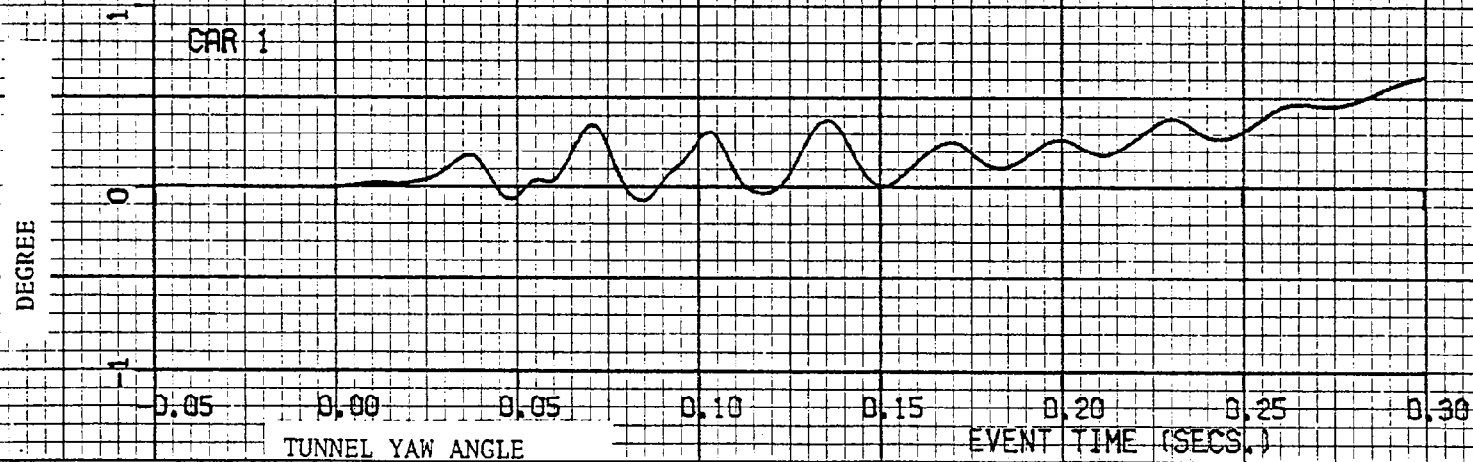
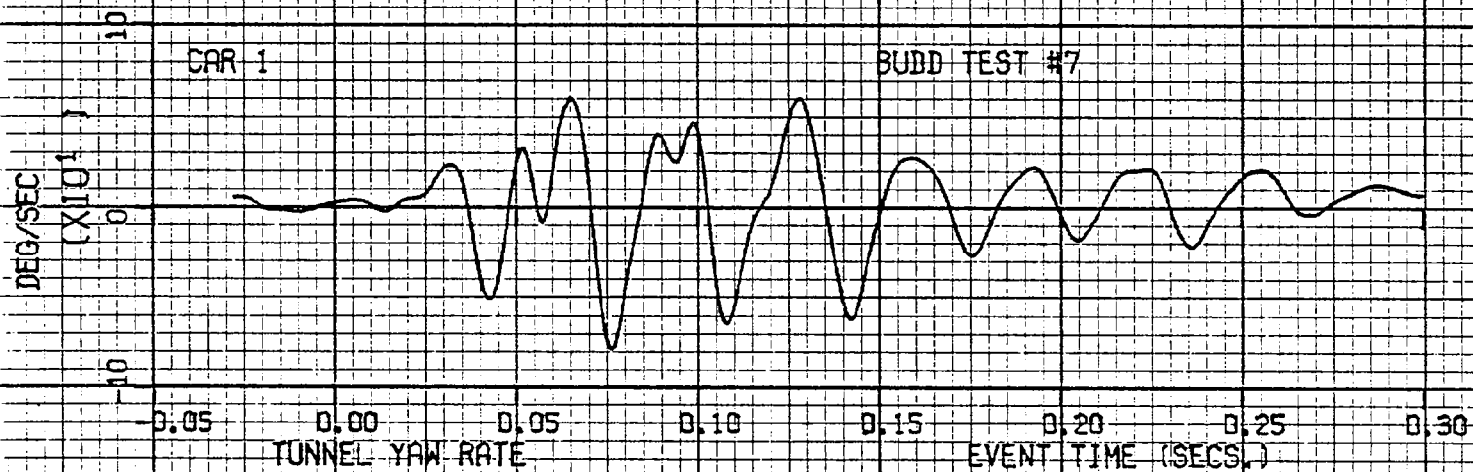


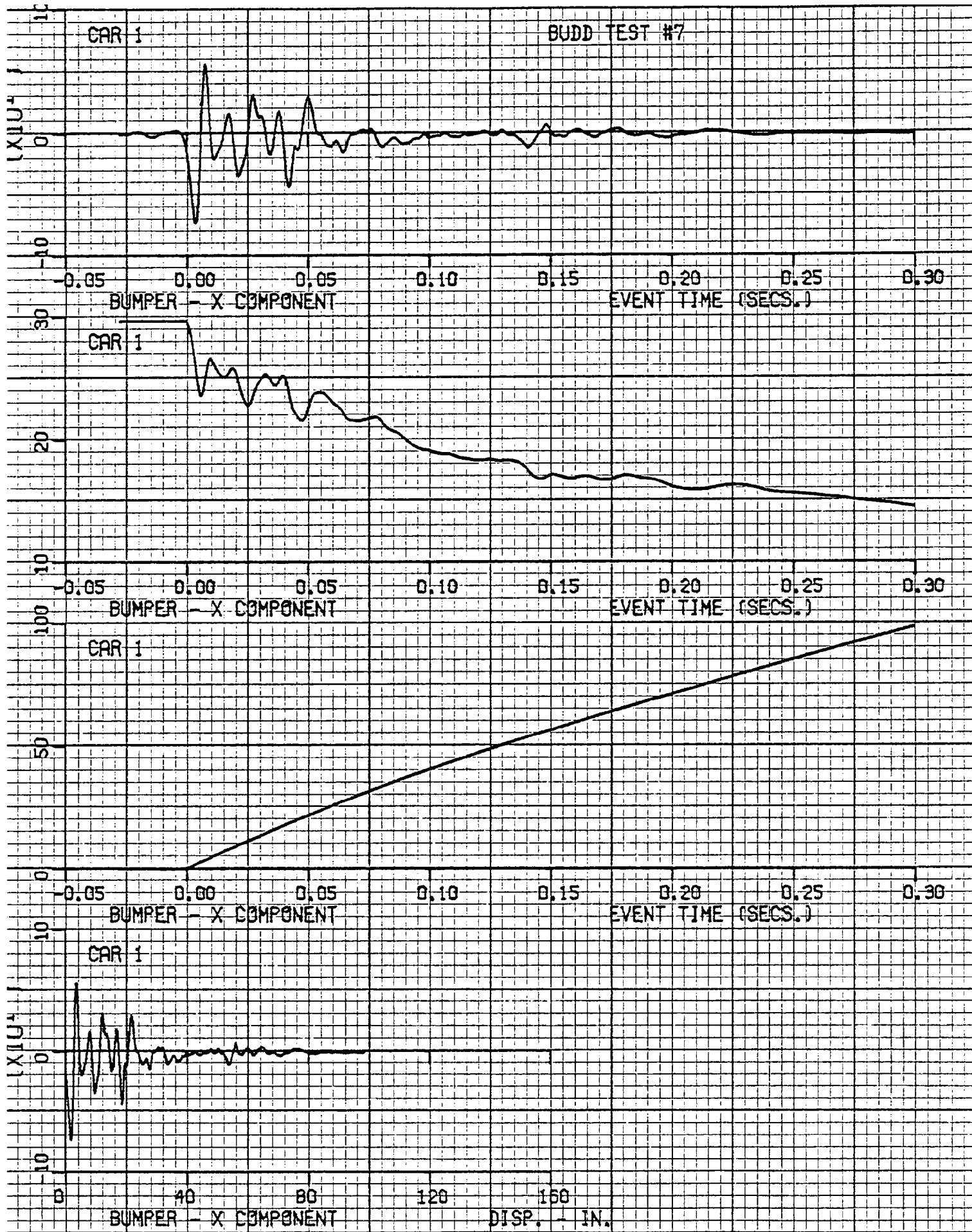








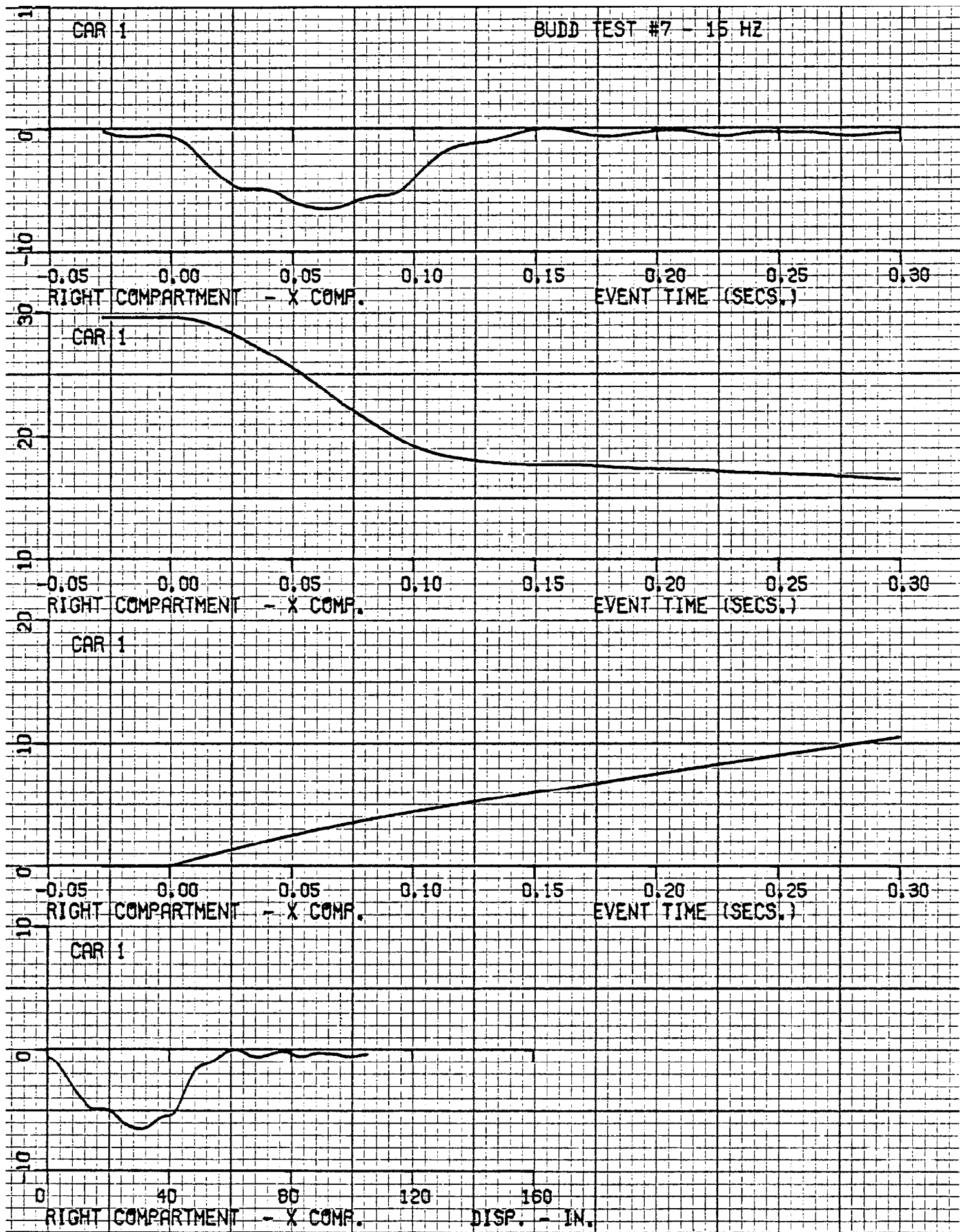


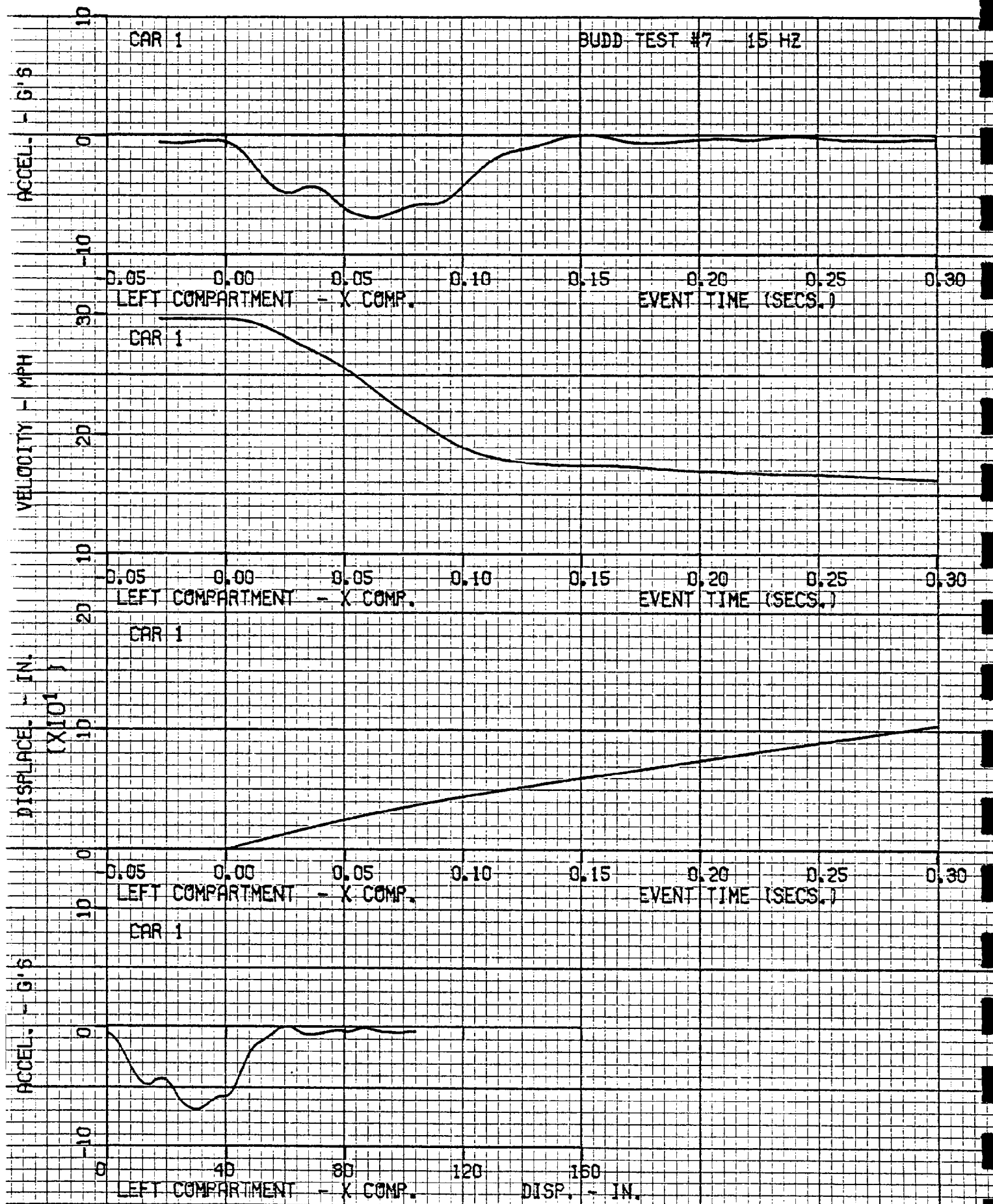


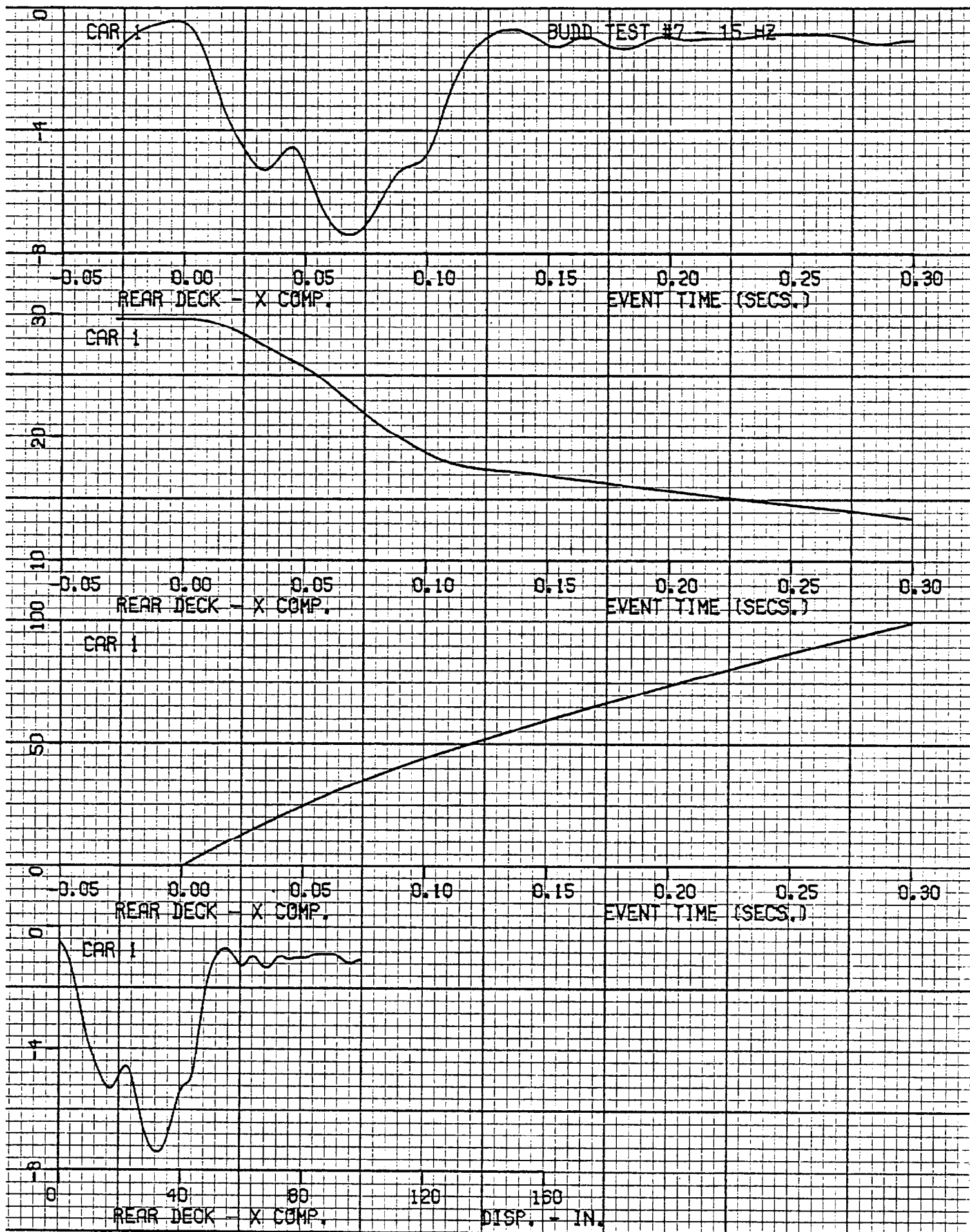
TEST NO. 7

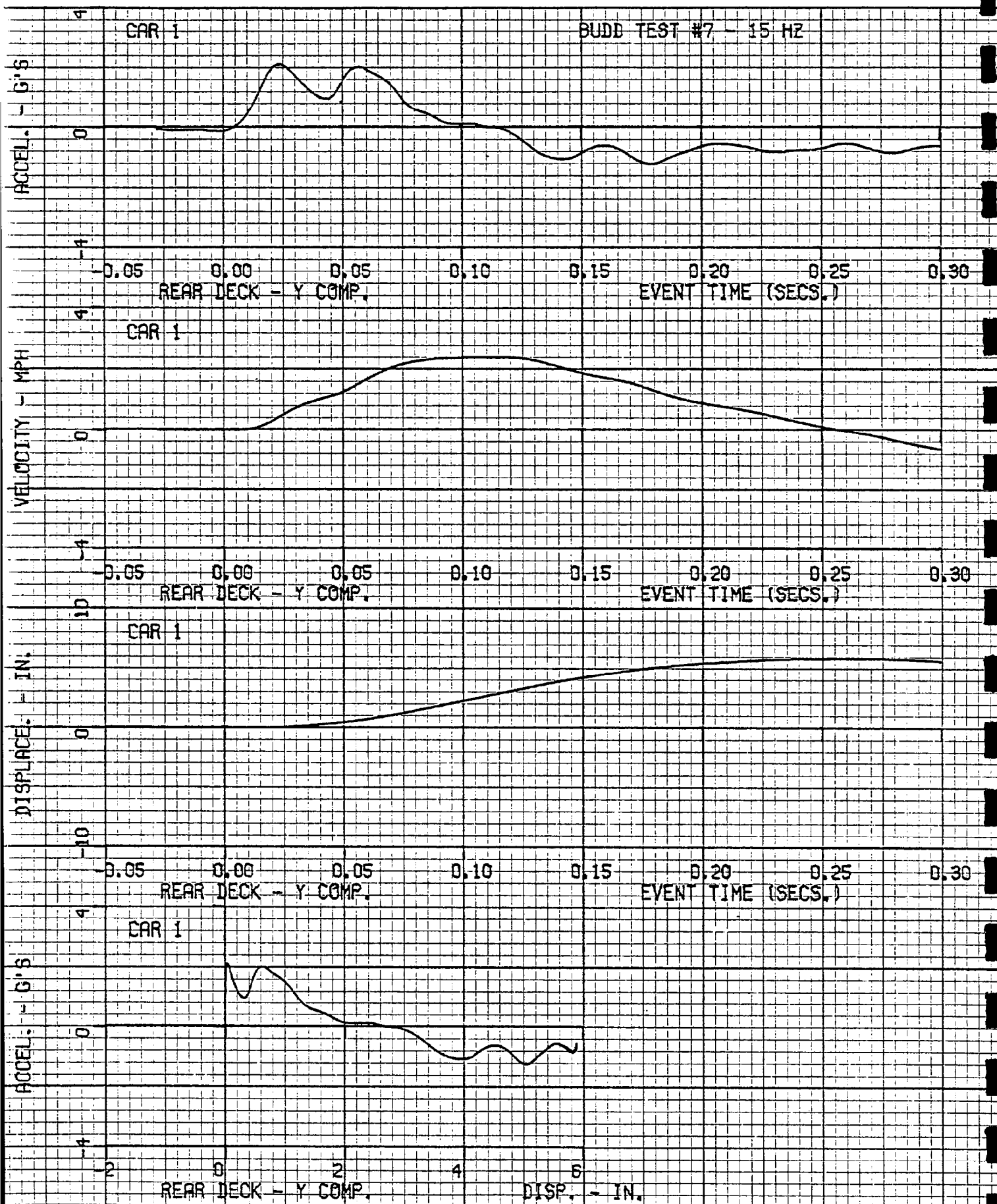
CAR 1 - 1978 CHEVROLET IMPALA

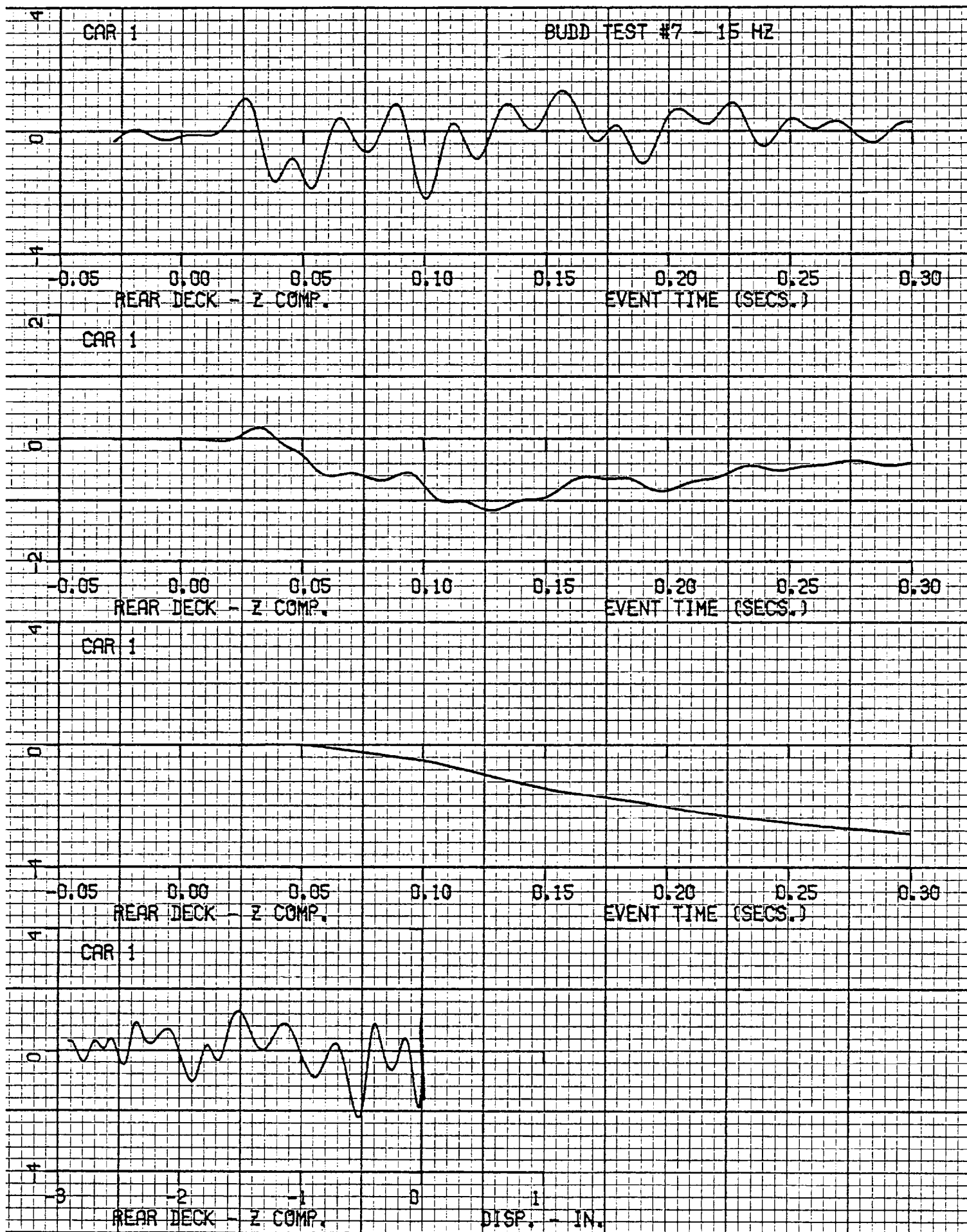
VEHICLE DATA, 15 HZ FILTER

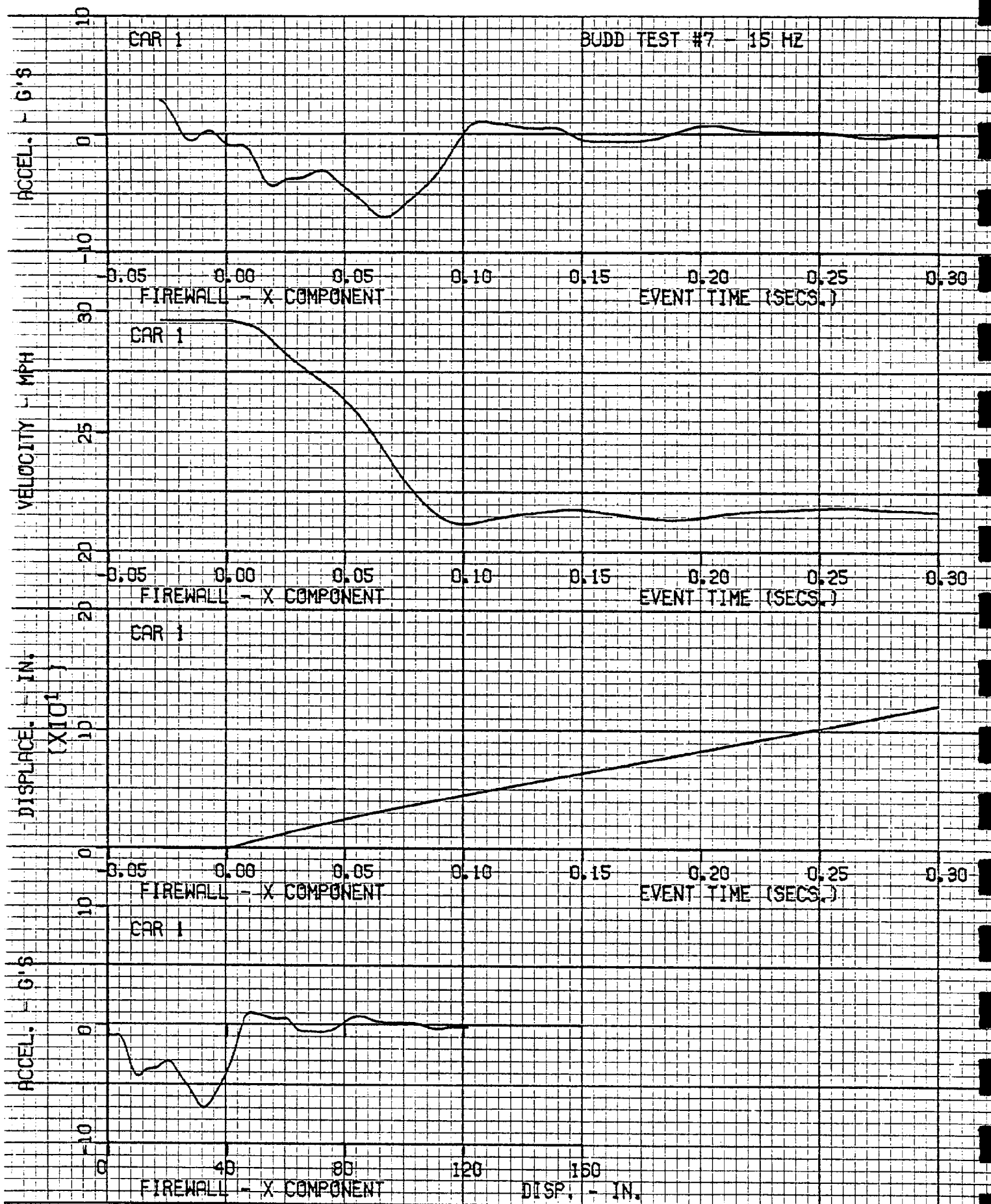


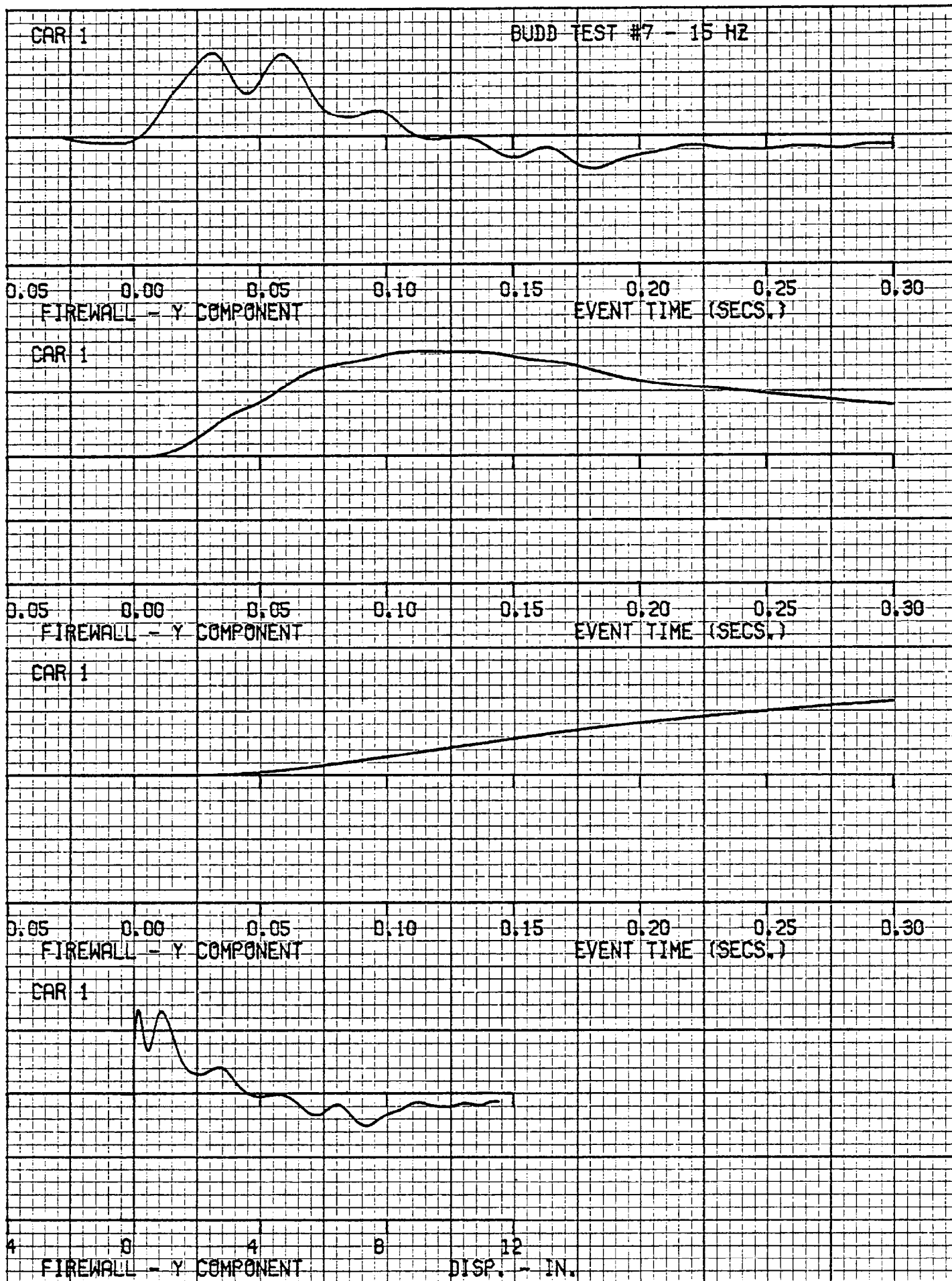


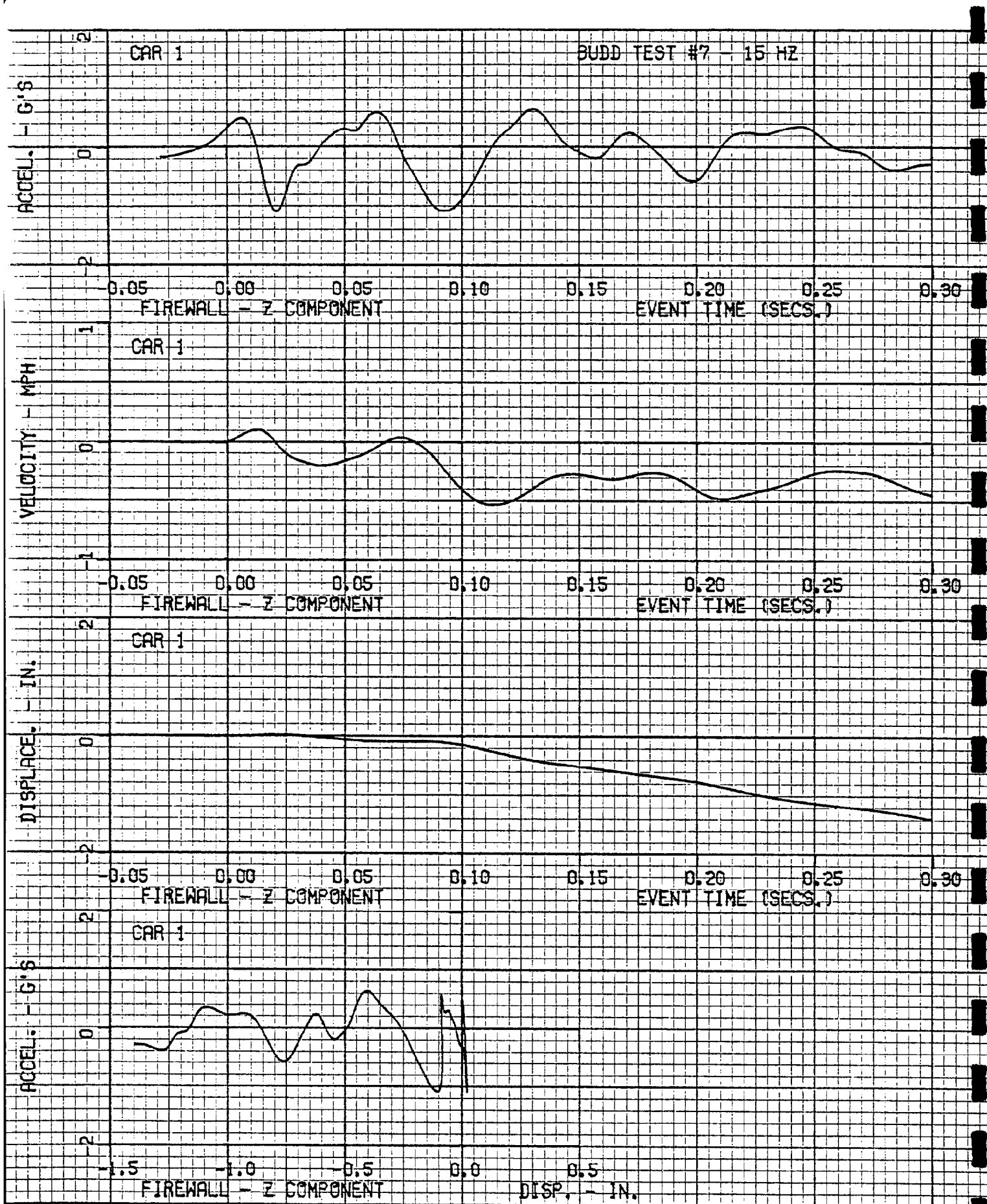


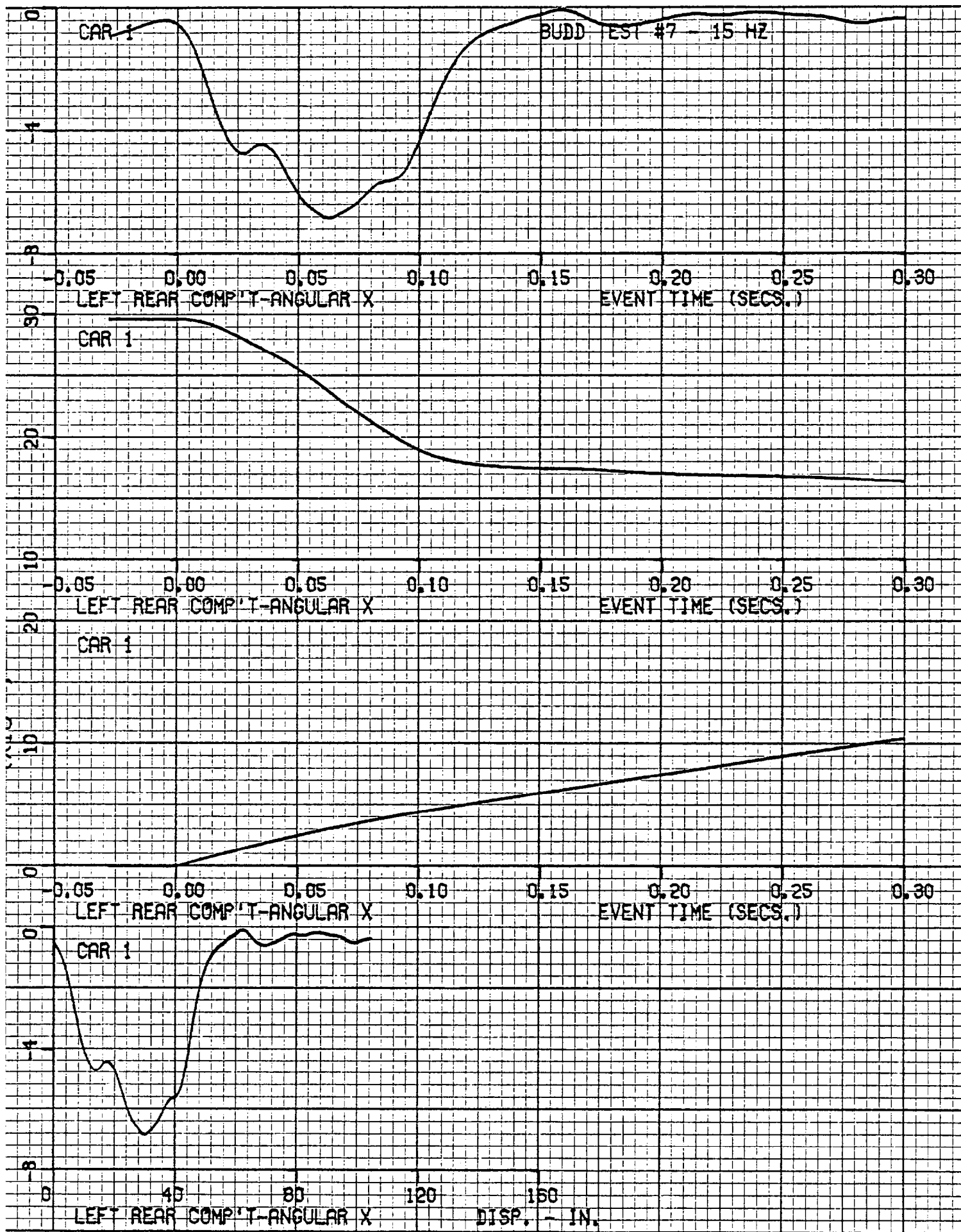


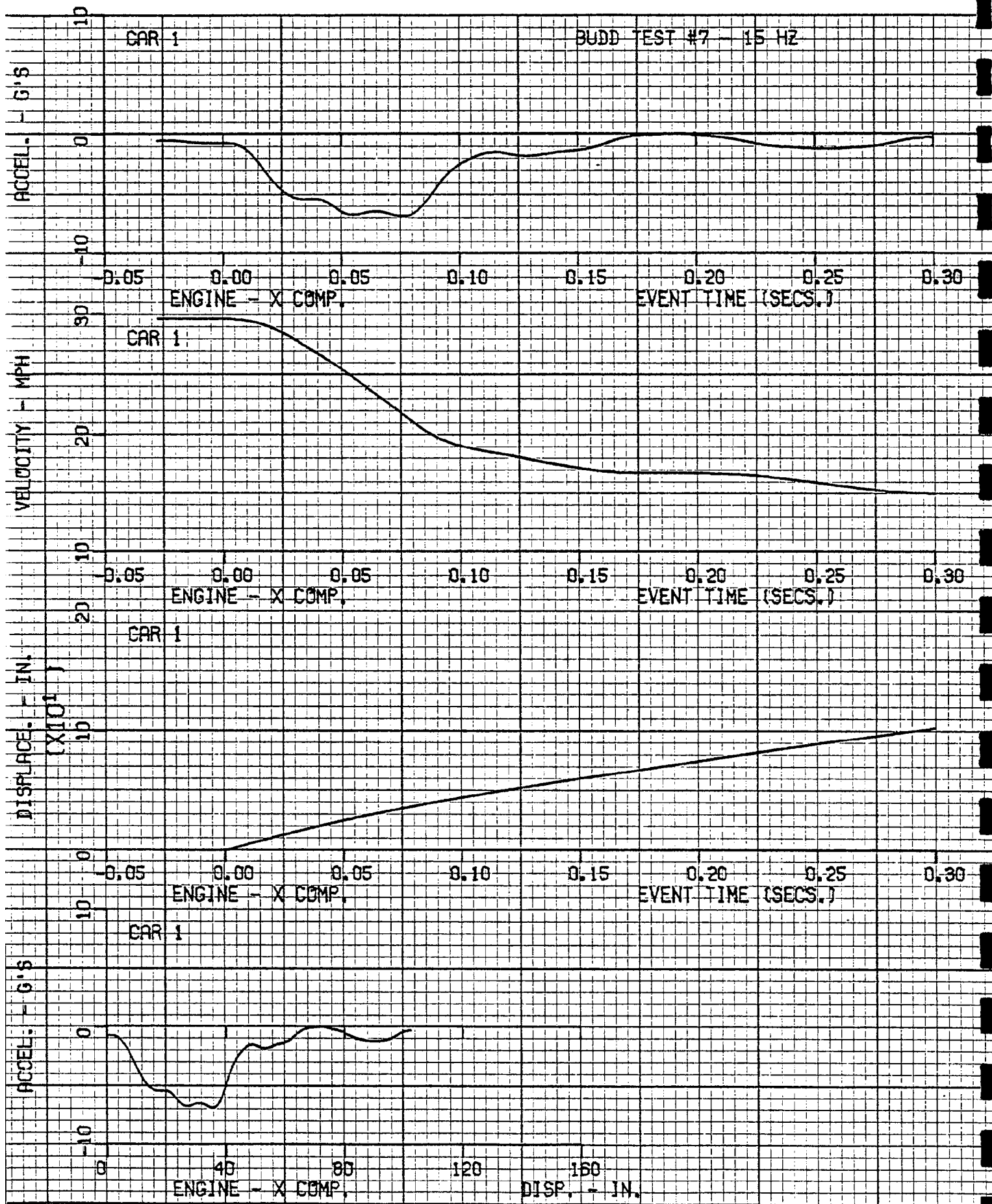




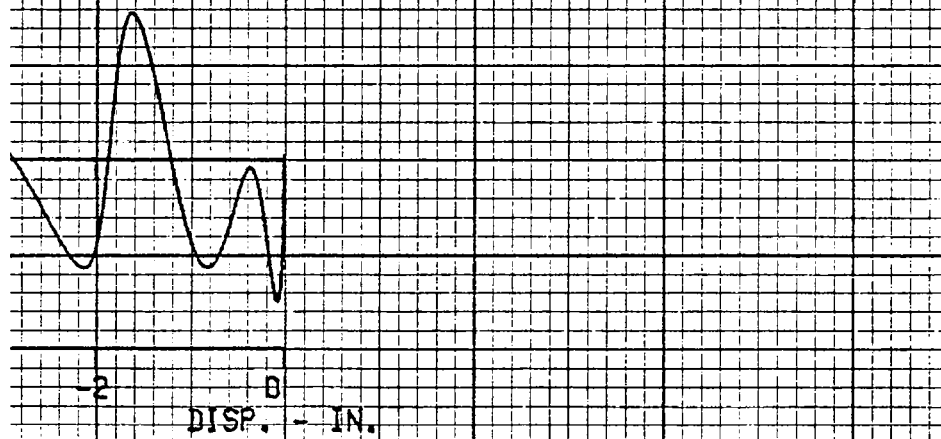
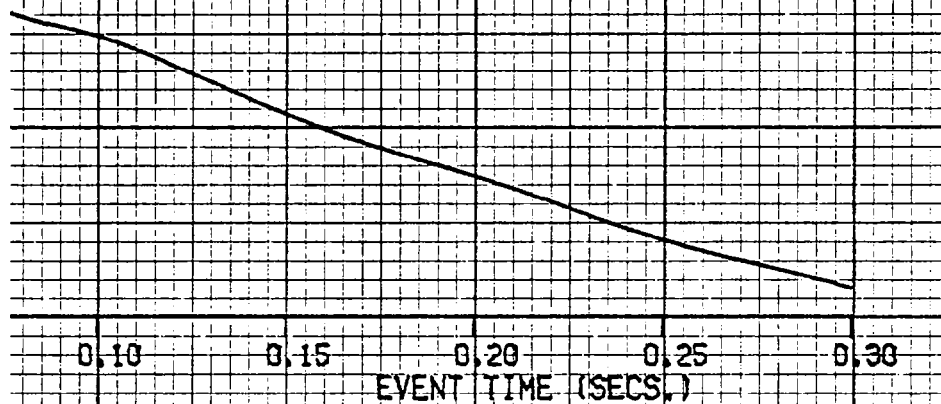
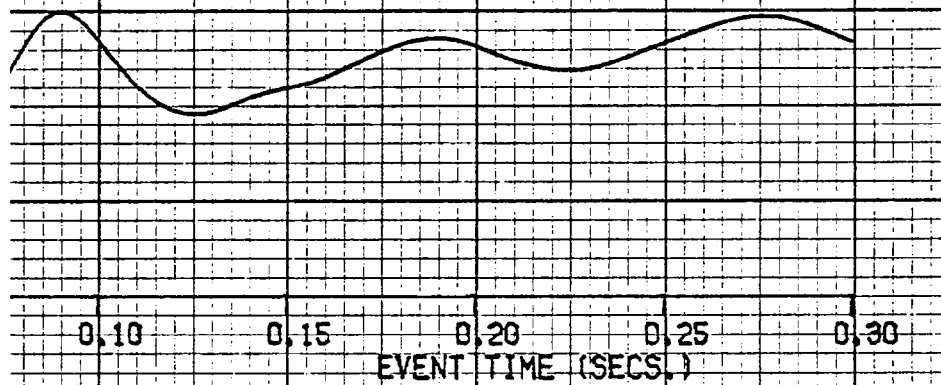
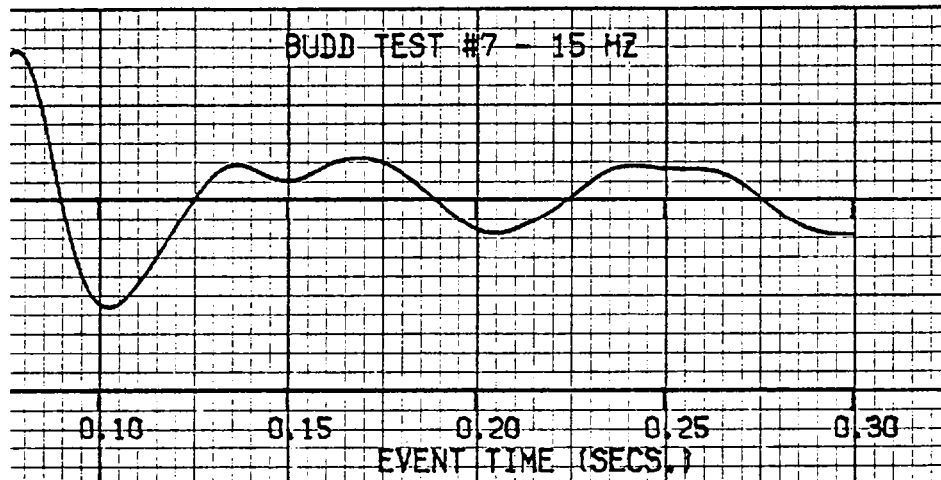


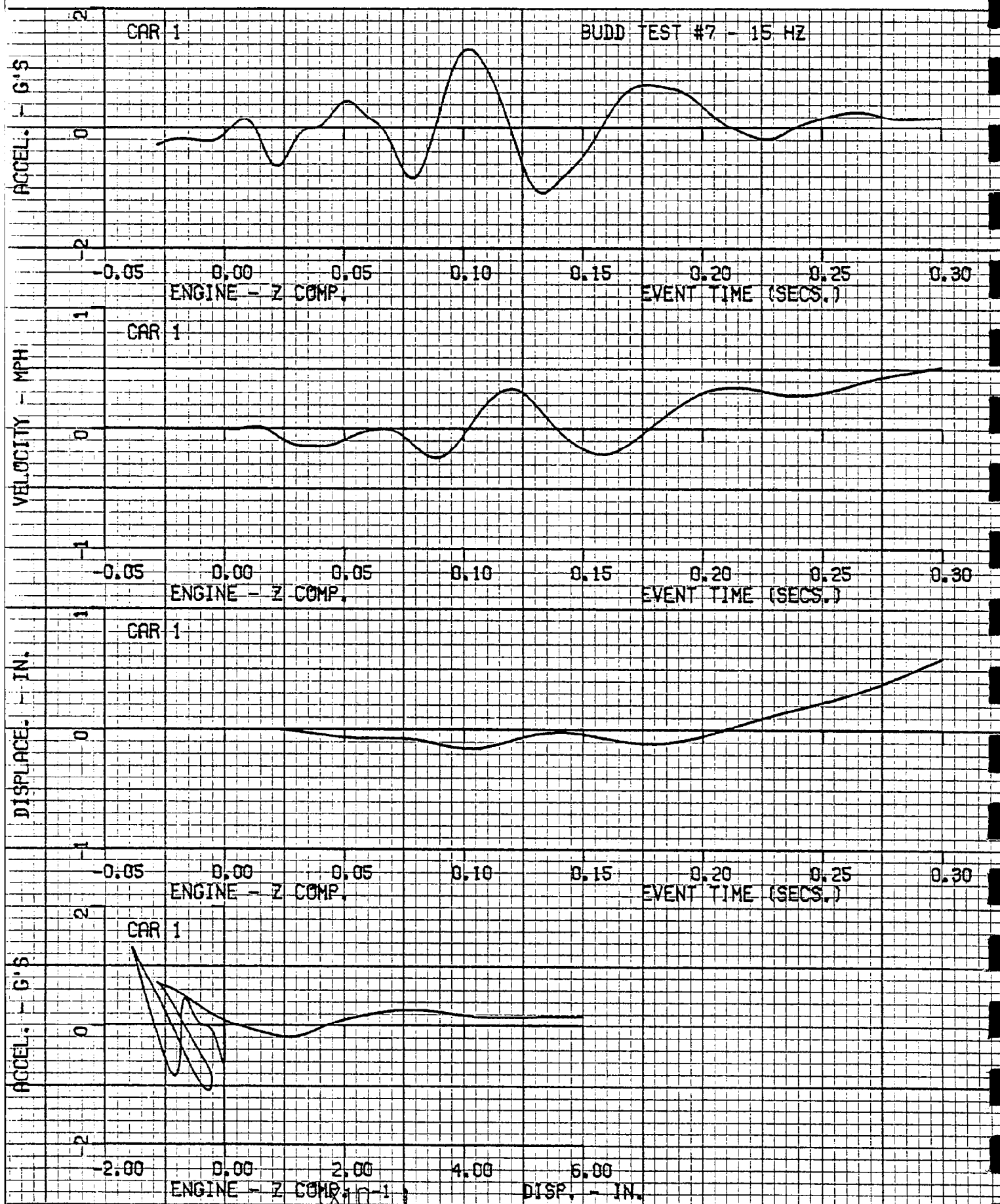


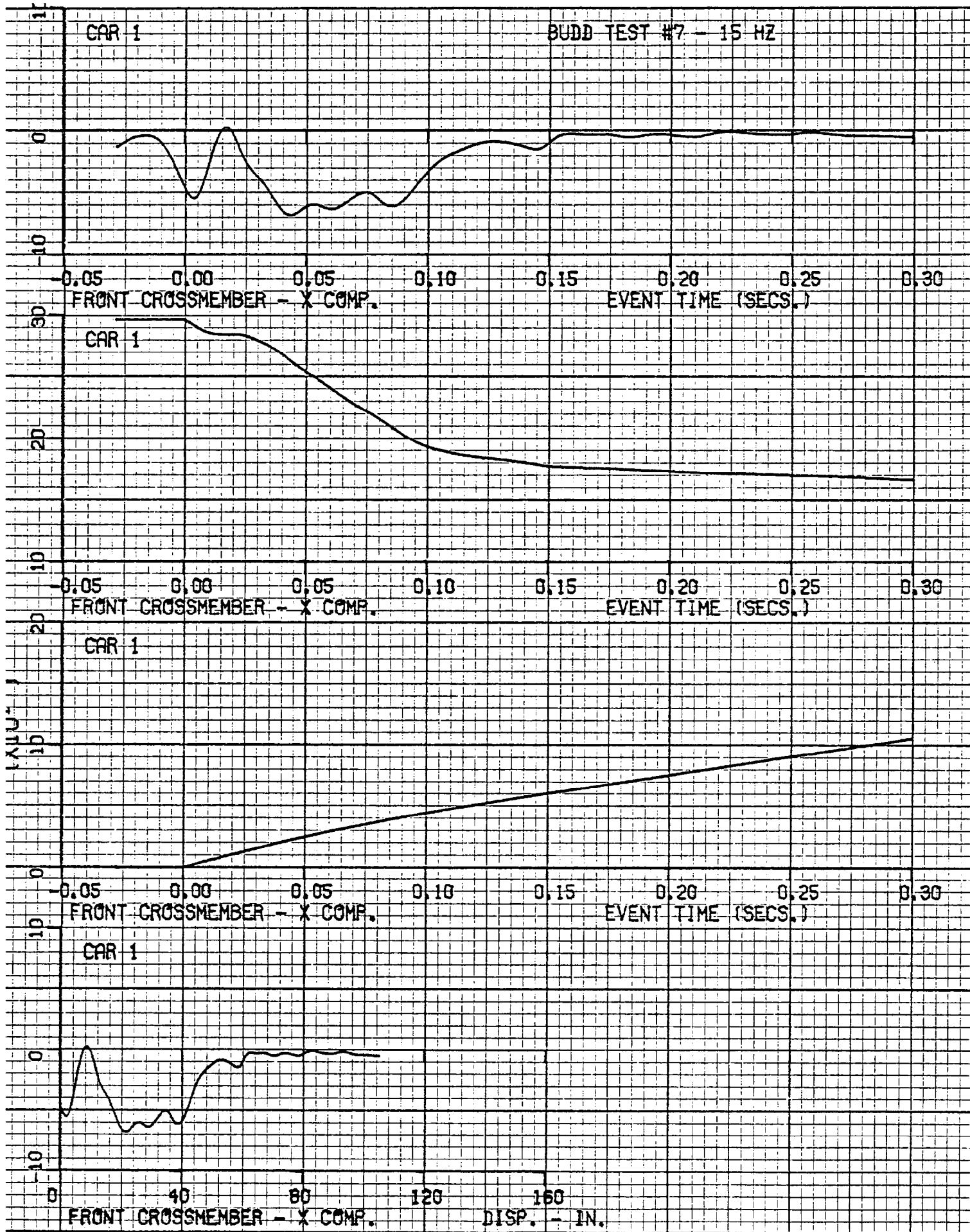


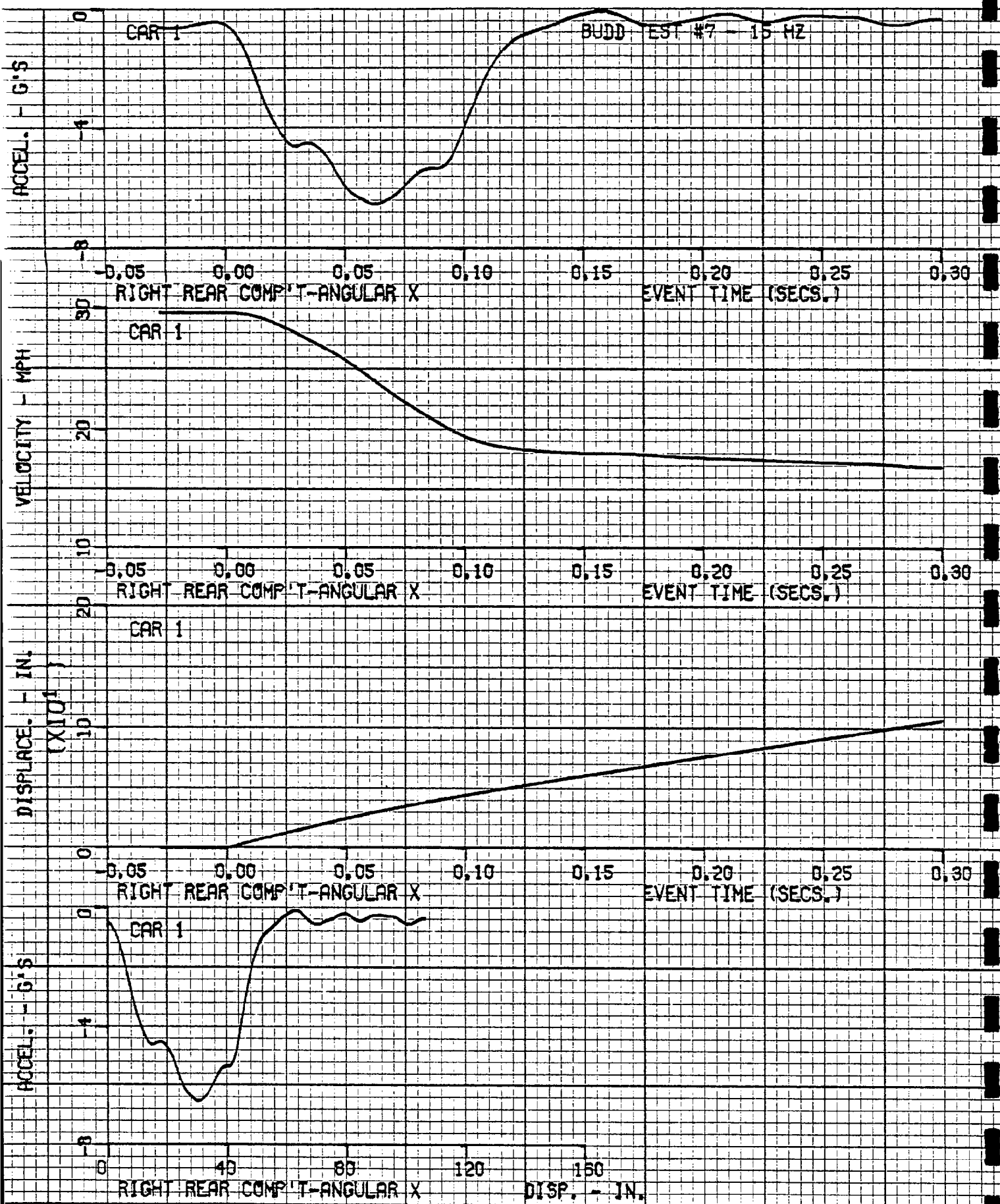


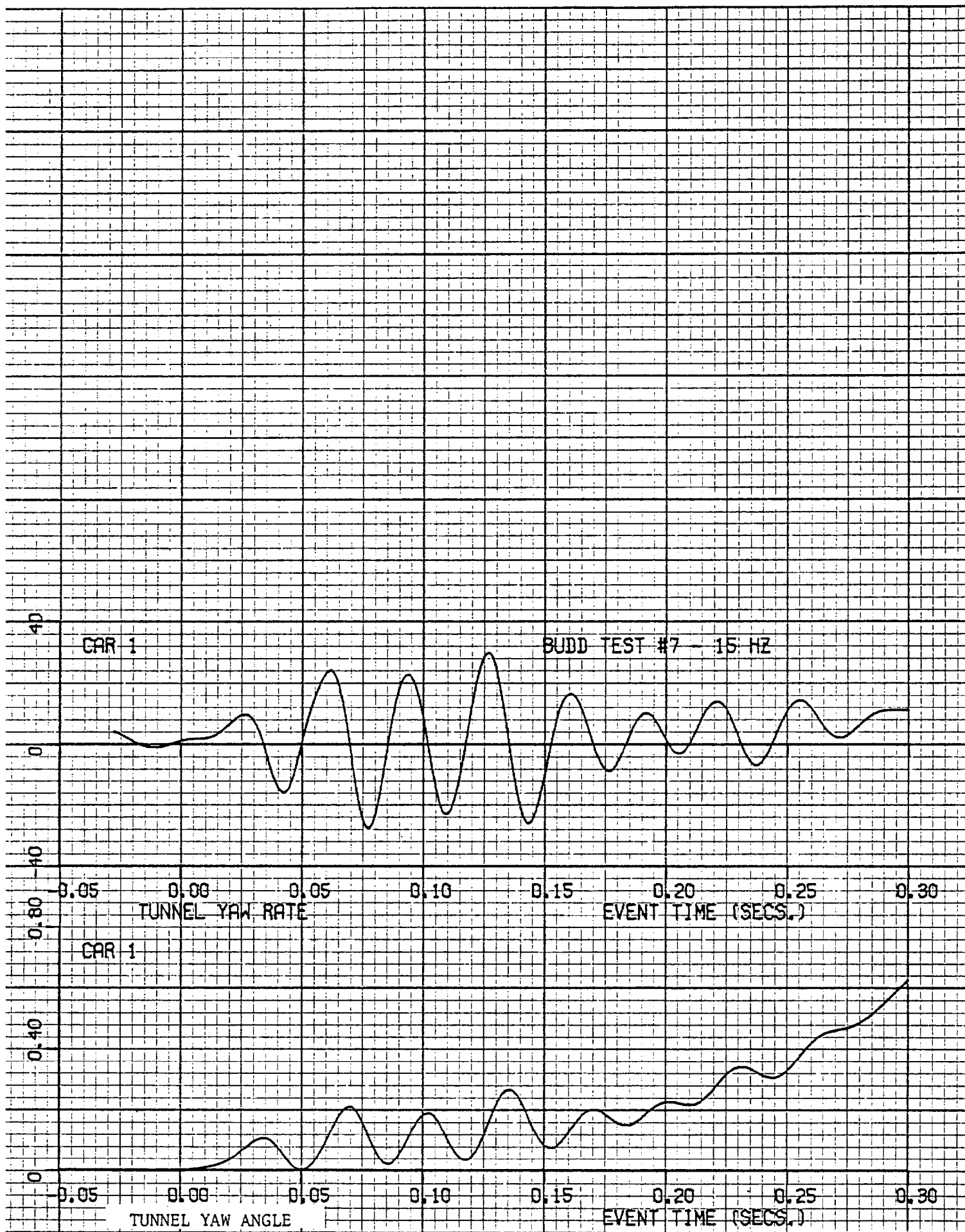
BUDD TEST #7 - 15 HZ

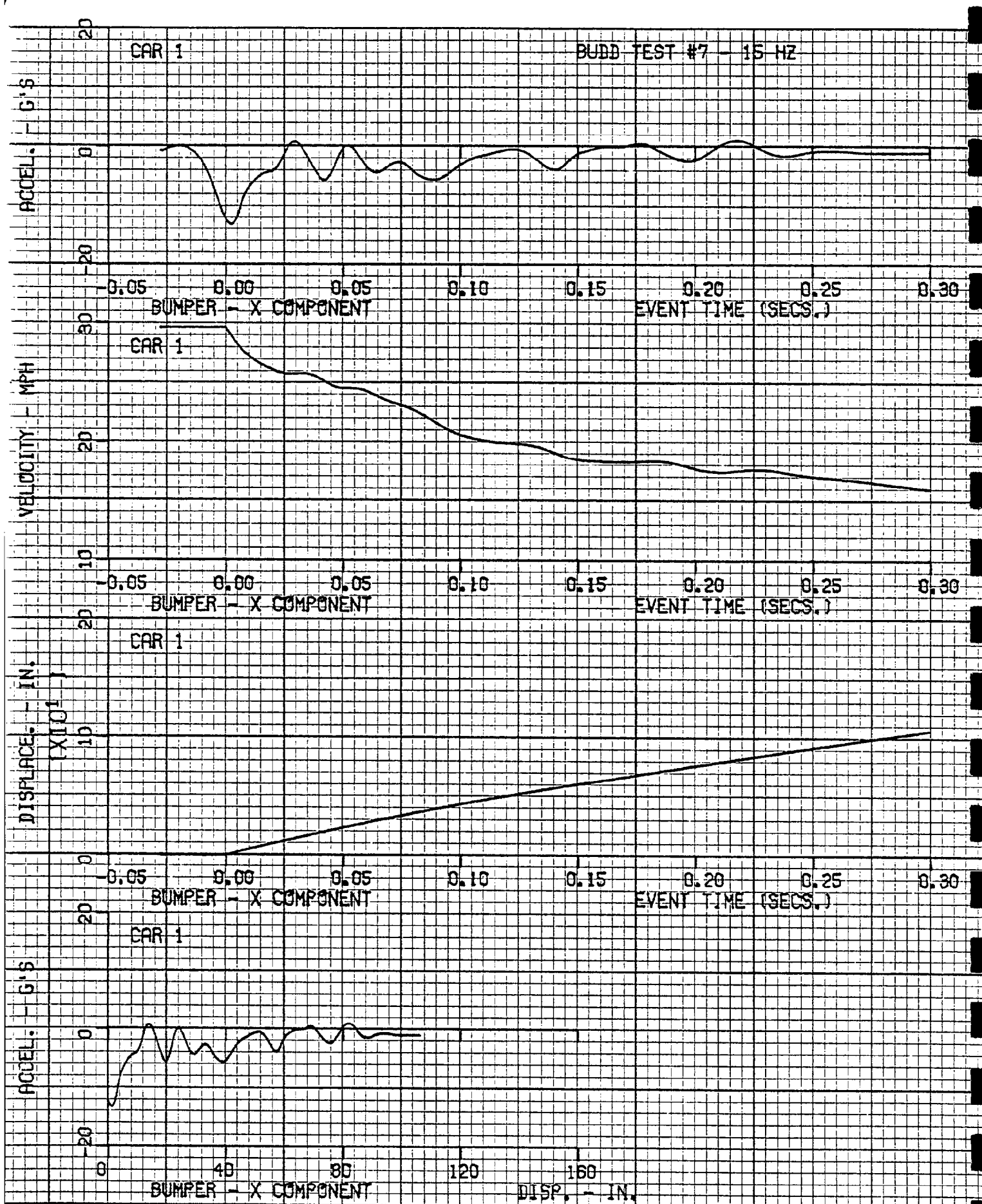












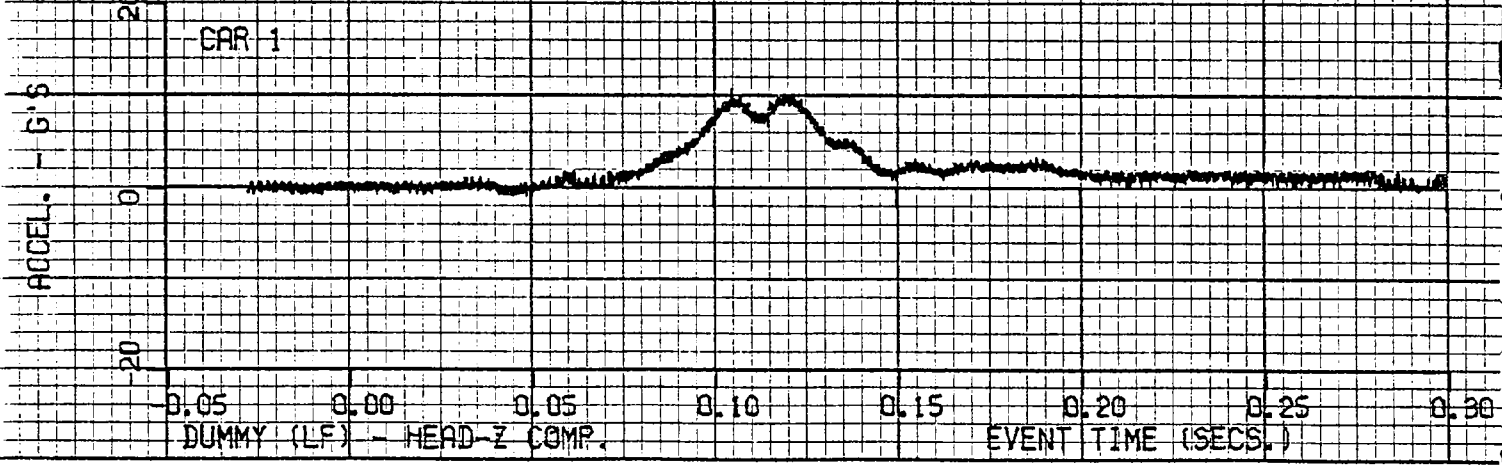
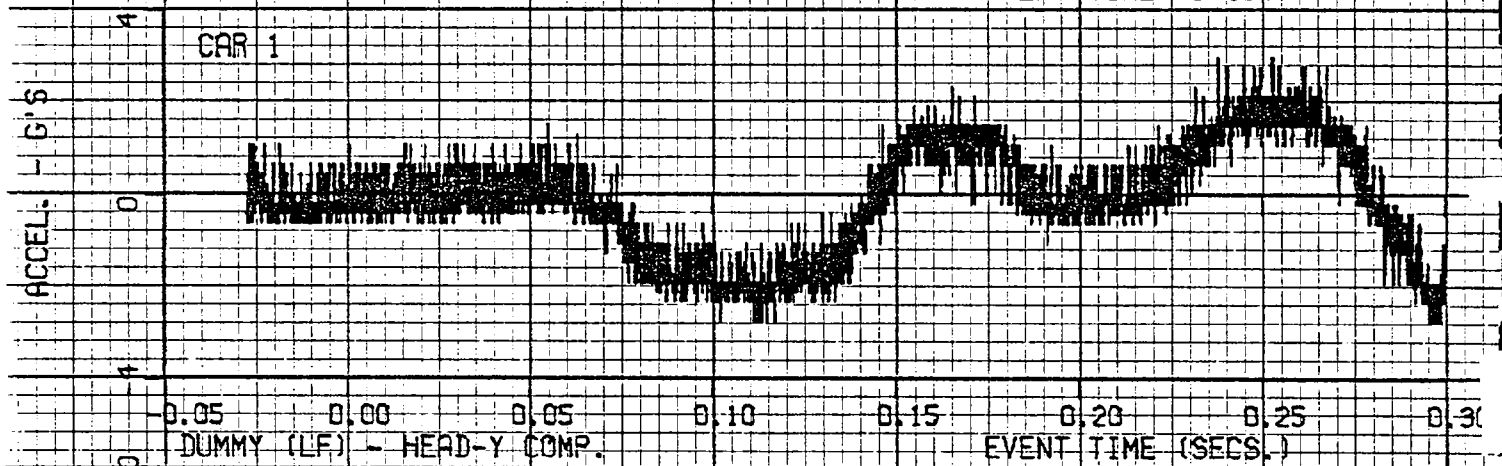
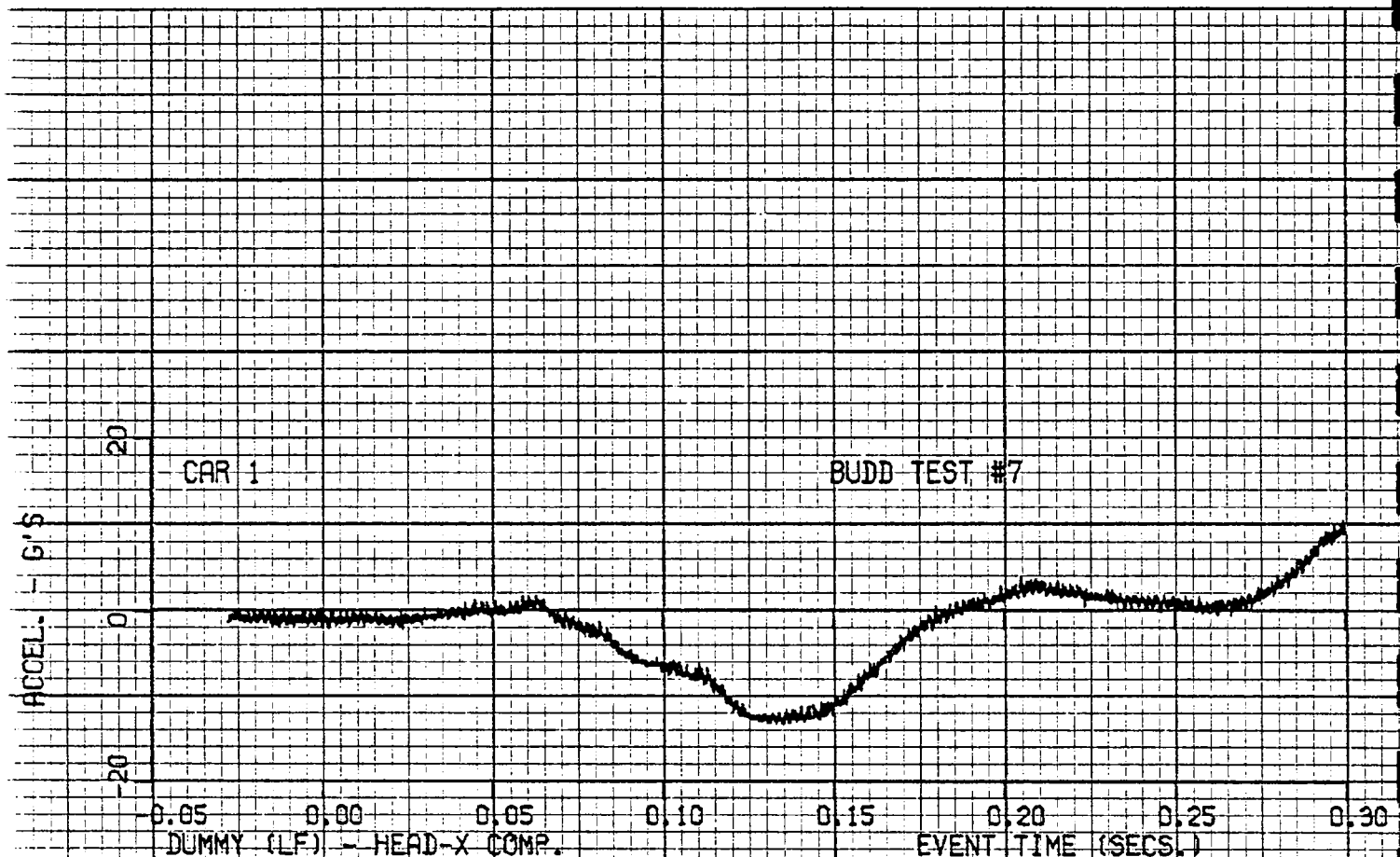
TEST NO. 7

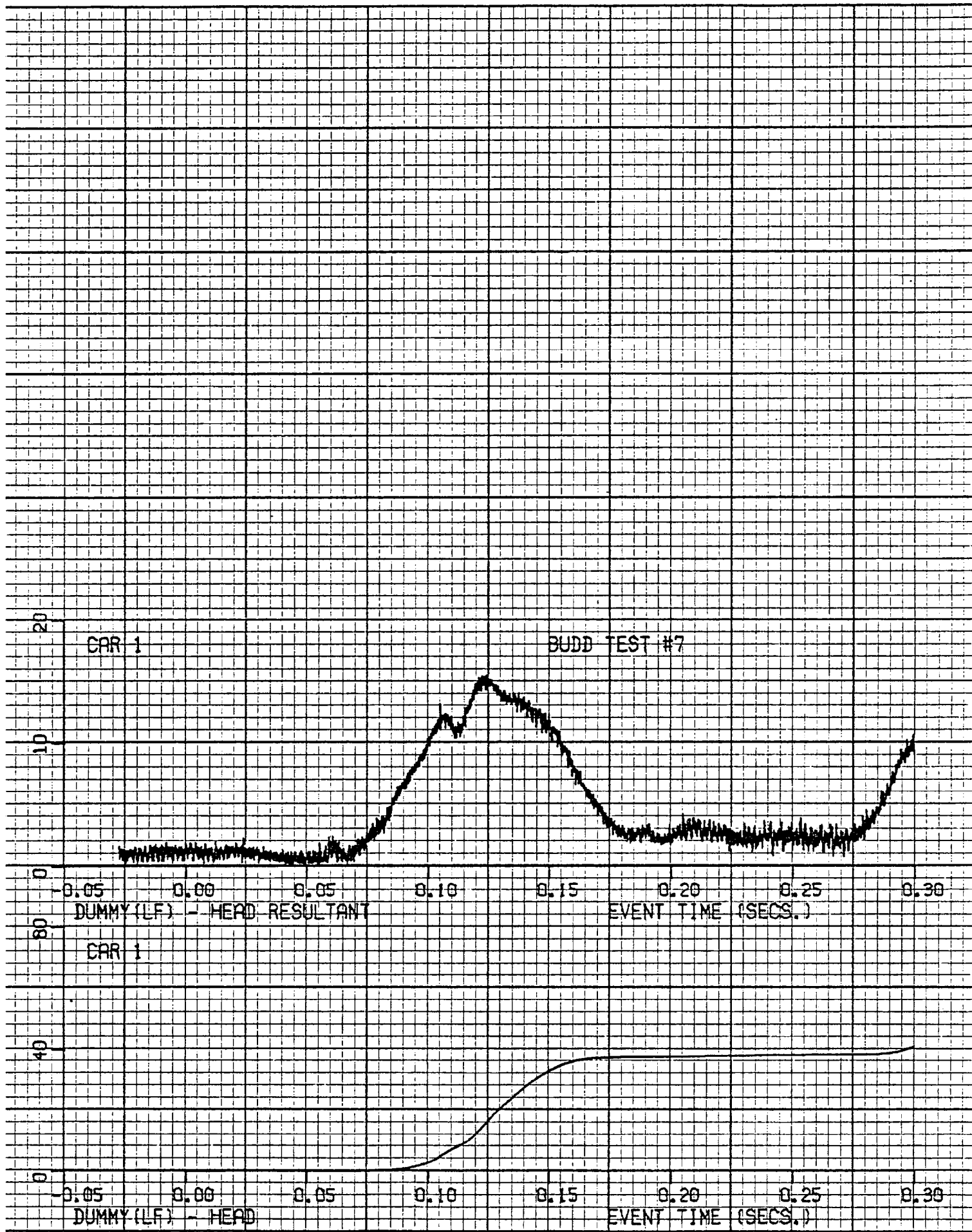
CAR 1 - 1978 CHEVROLET IMPALA

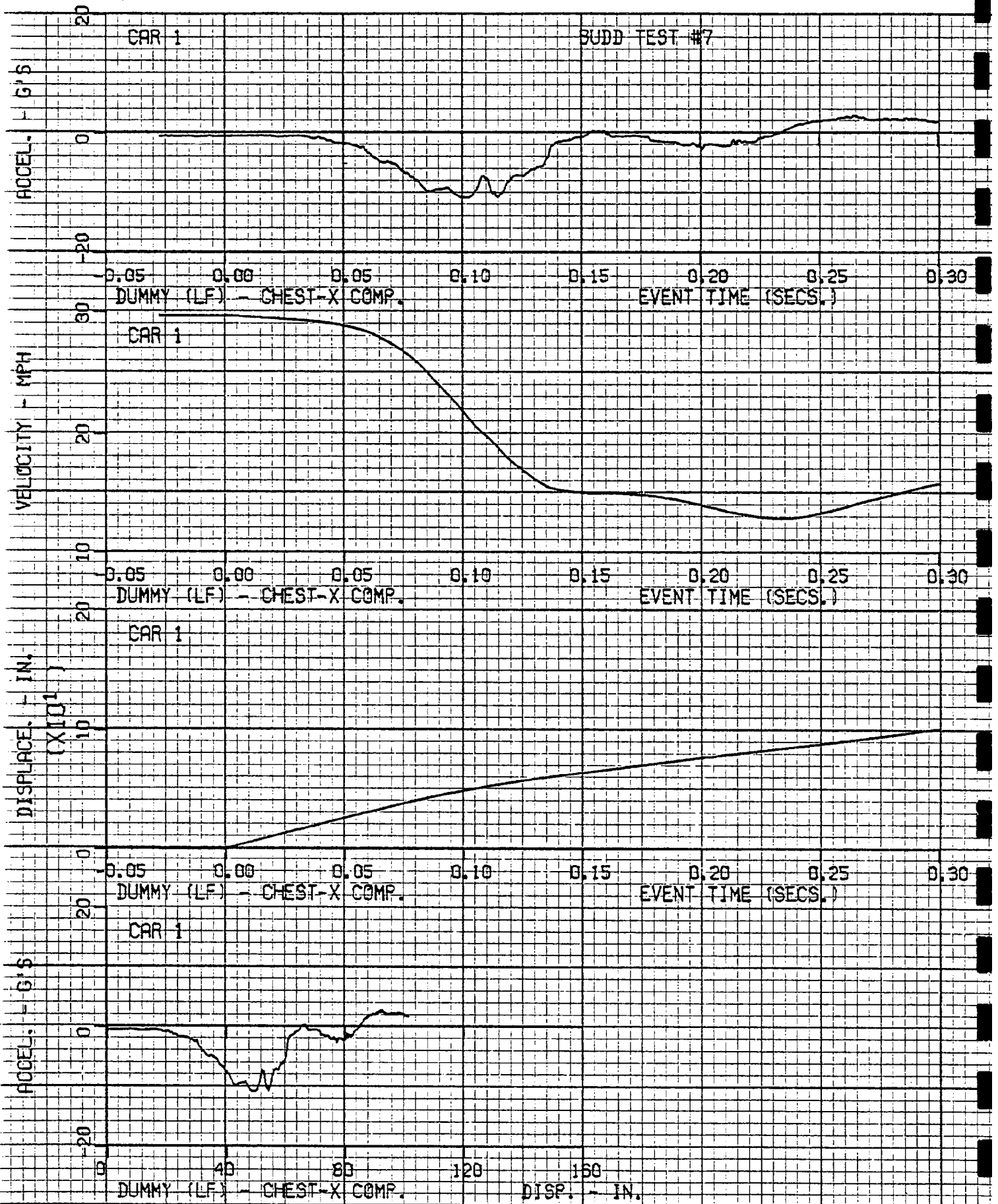
DUMMY DATA

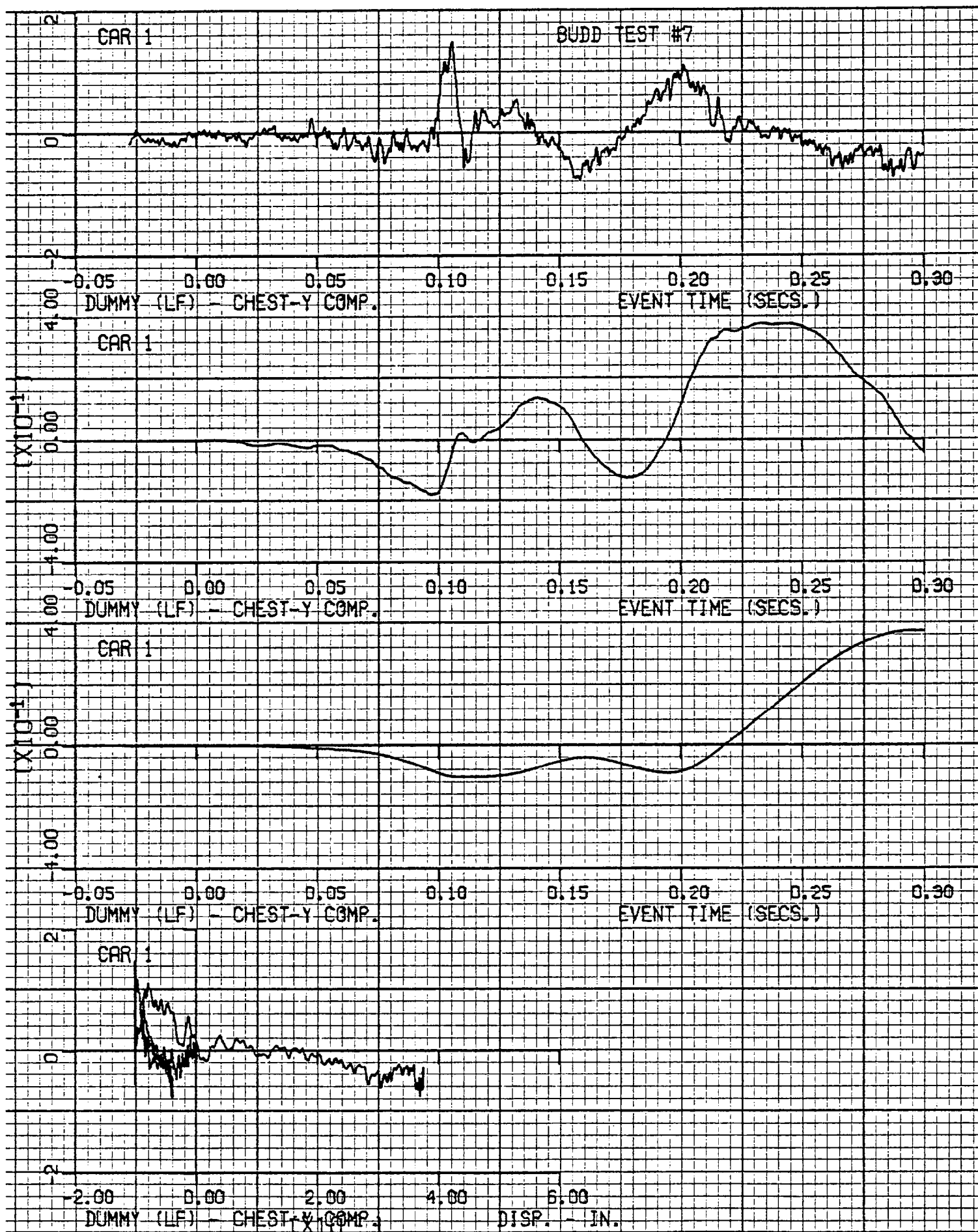
FILTER CHANNEL CLASS

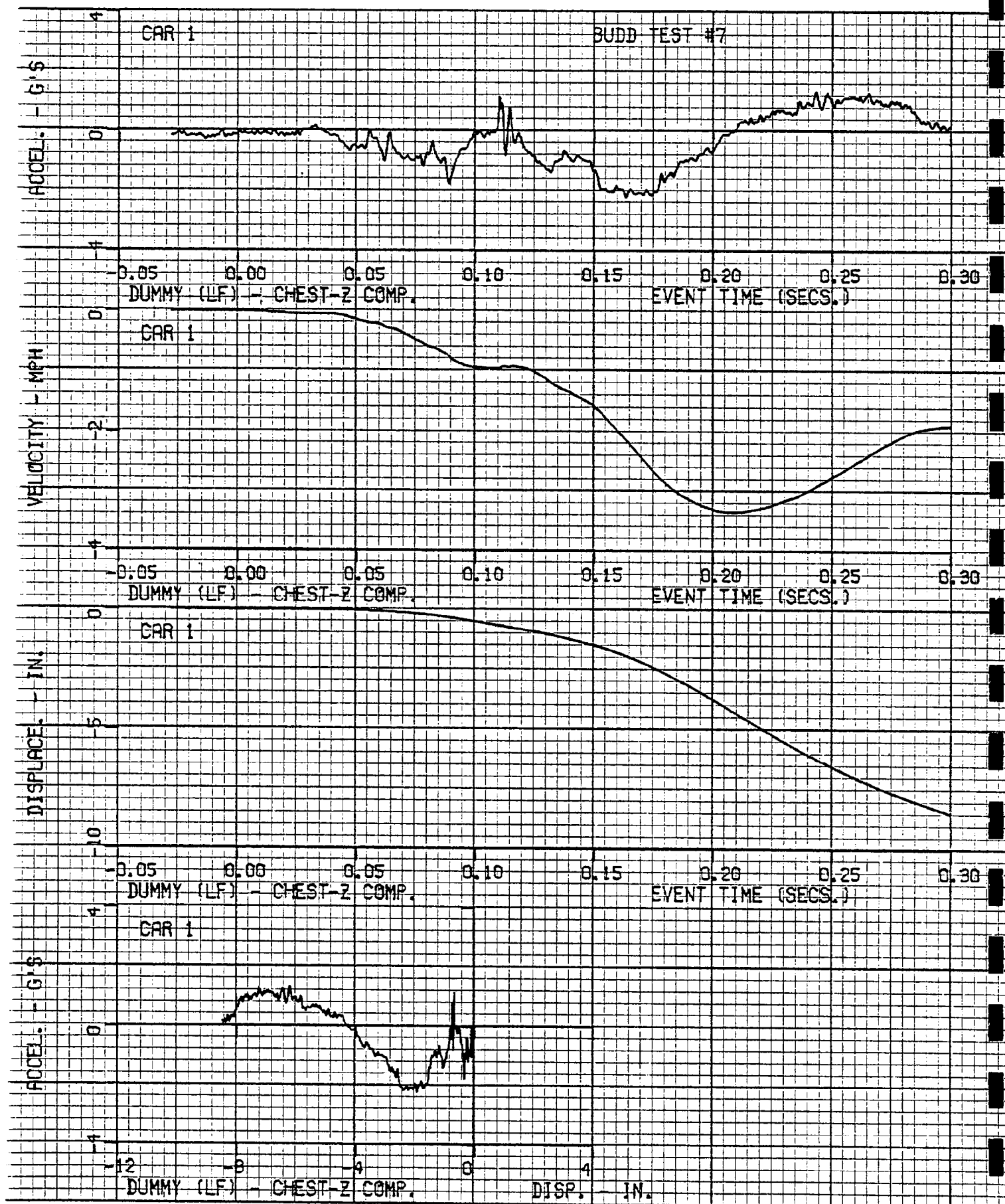
Head Acceleration	1000
Chest Acceleration	180
Femur Forces	600
Belt Loads	60

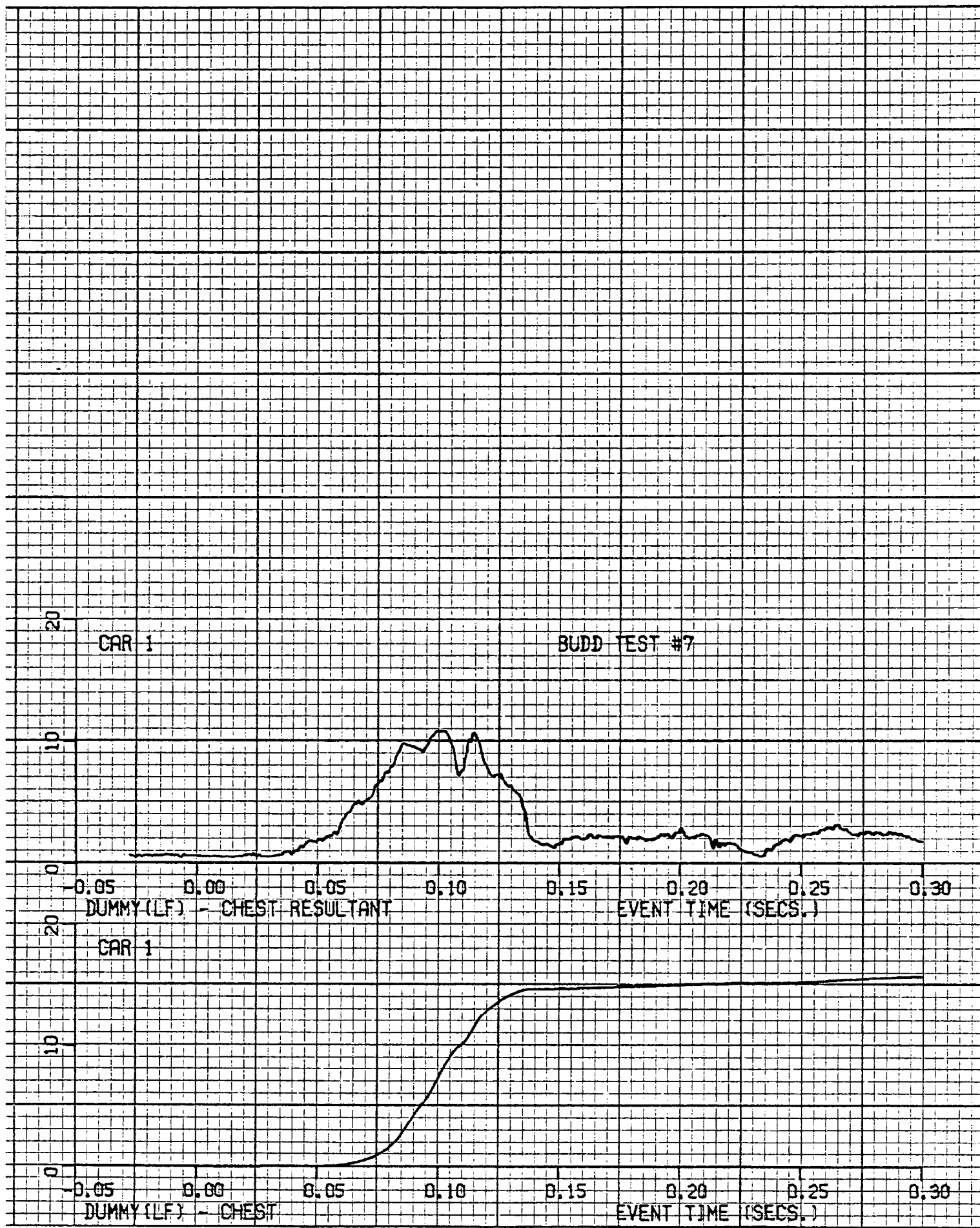


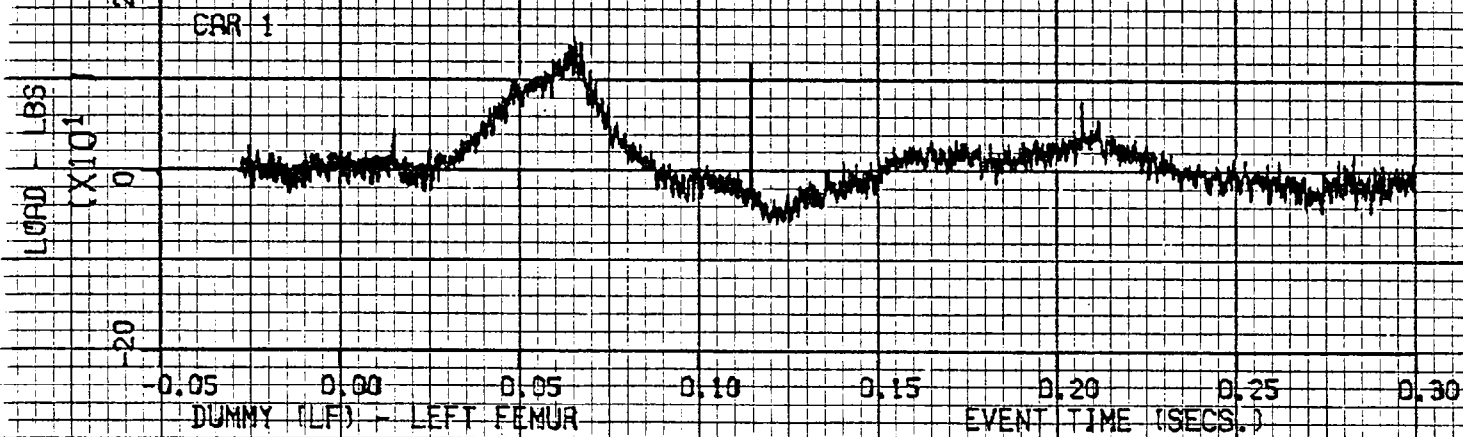
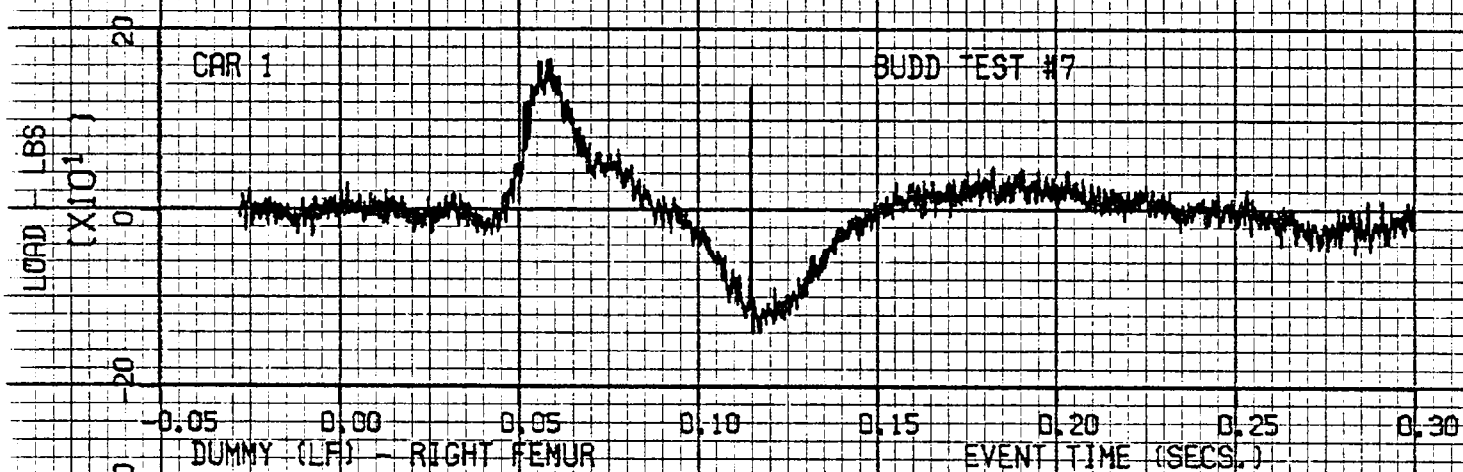


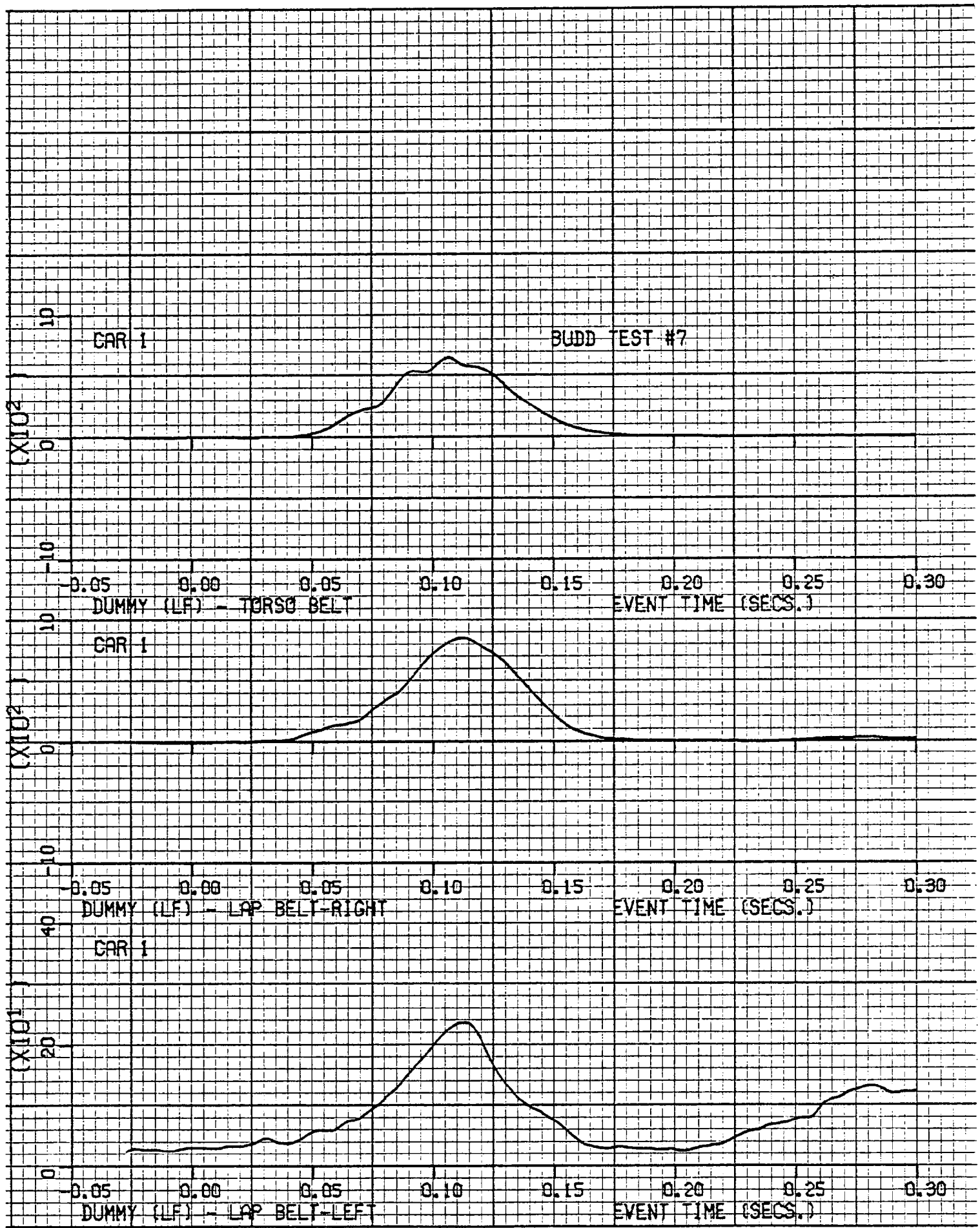










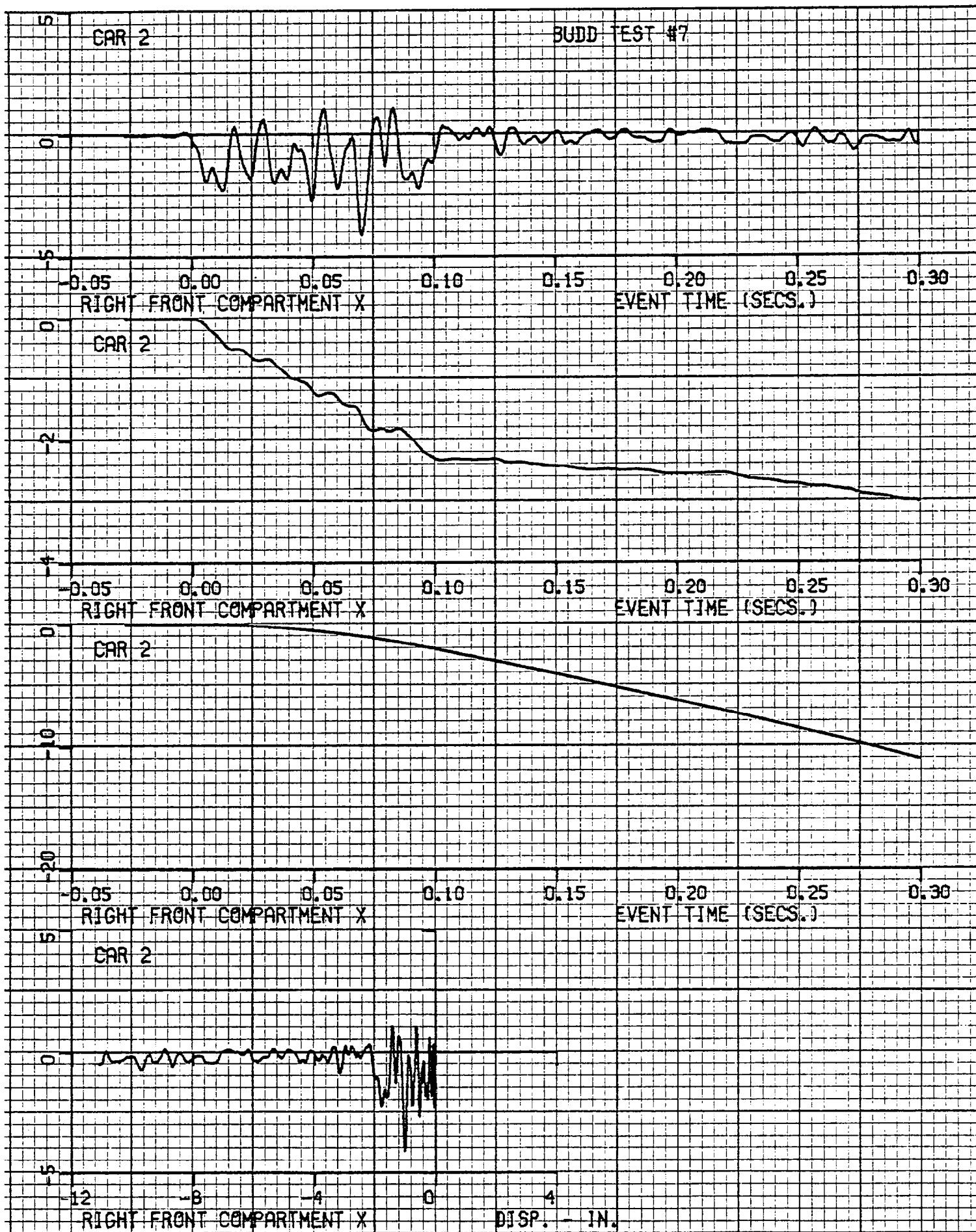


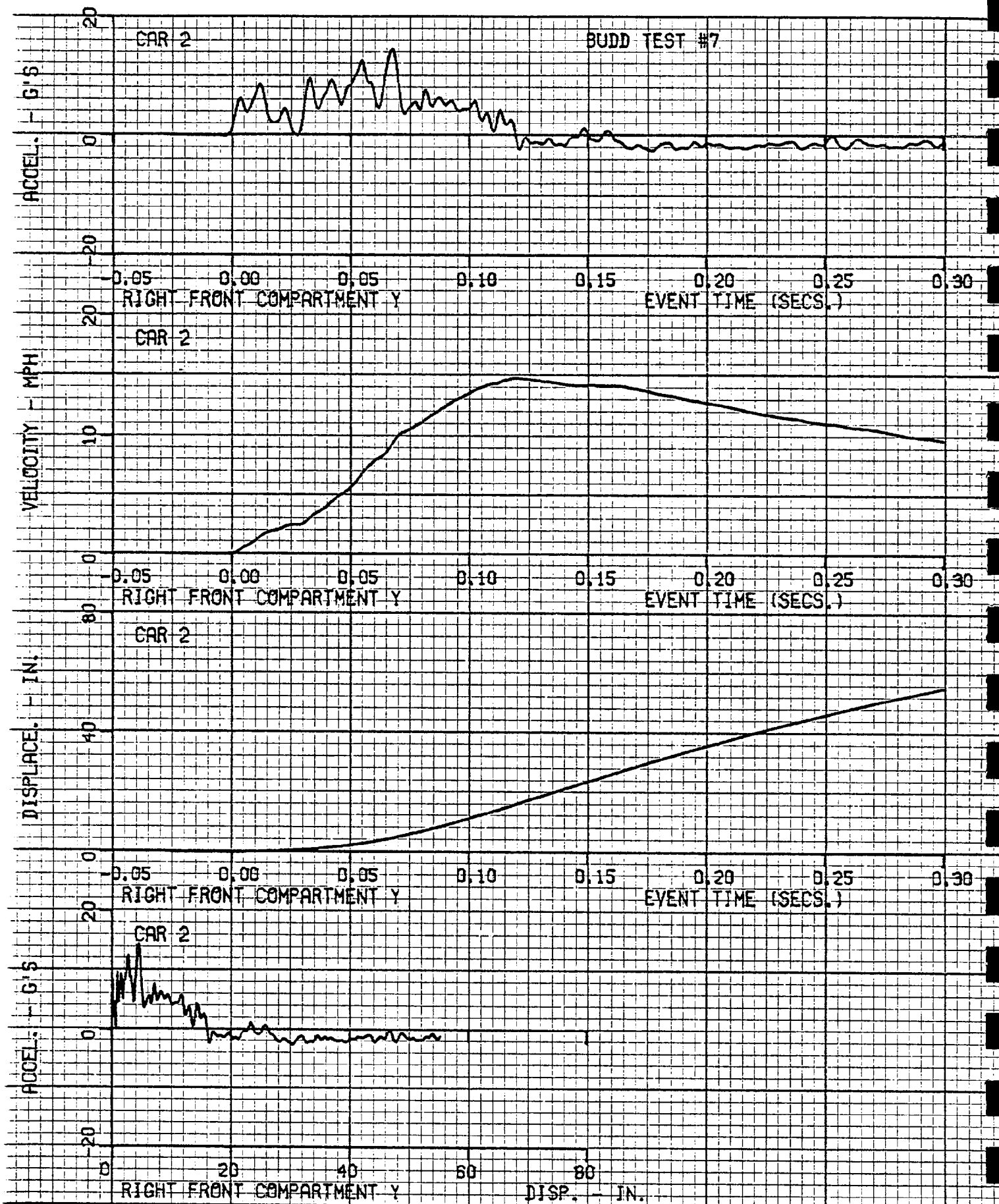
TEST NO. 7

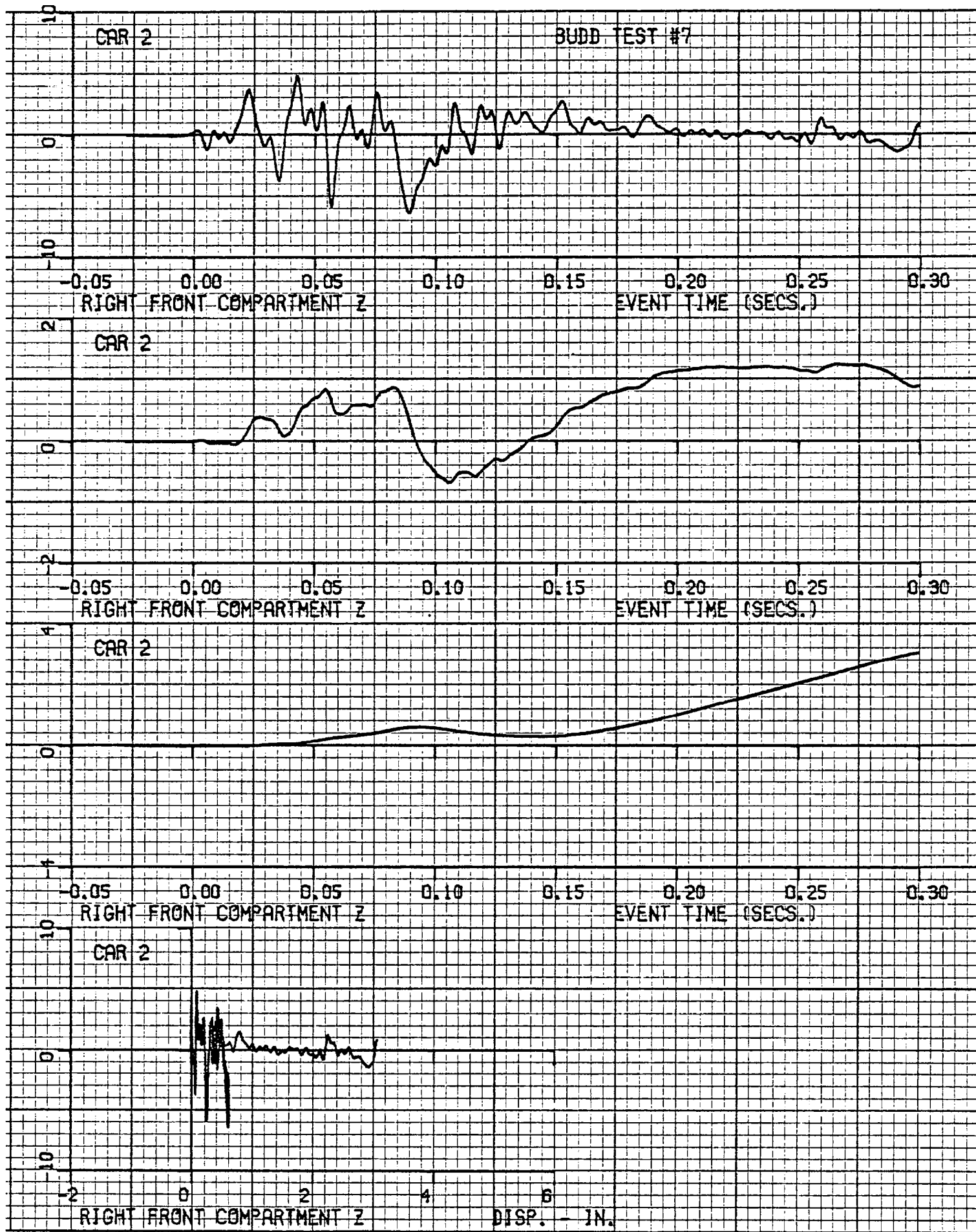
CAR 2 - 1976 VOLKSWAGEN RABBIT

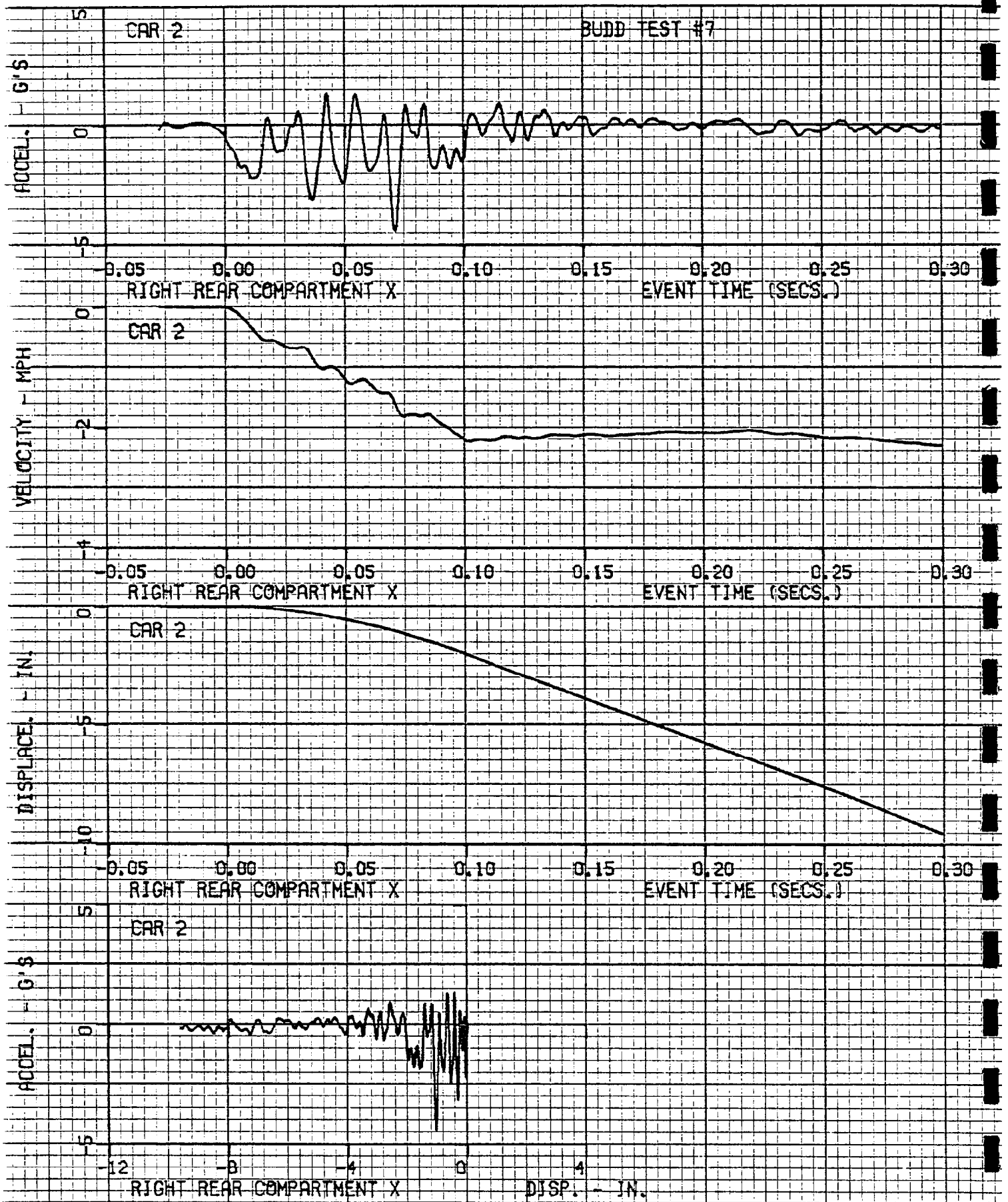
VEHICLE DATA 60 HZ FILTER

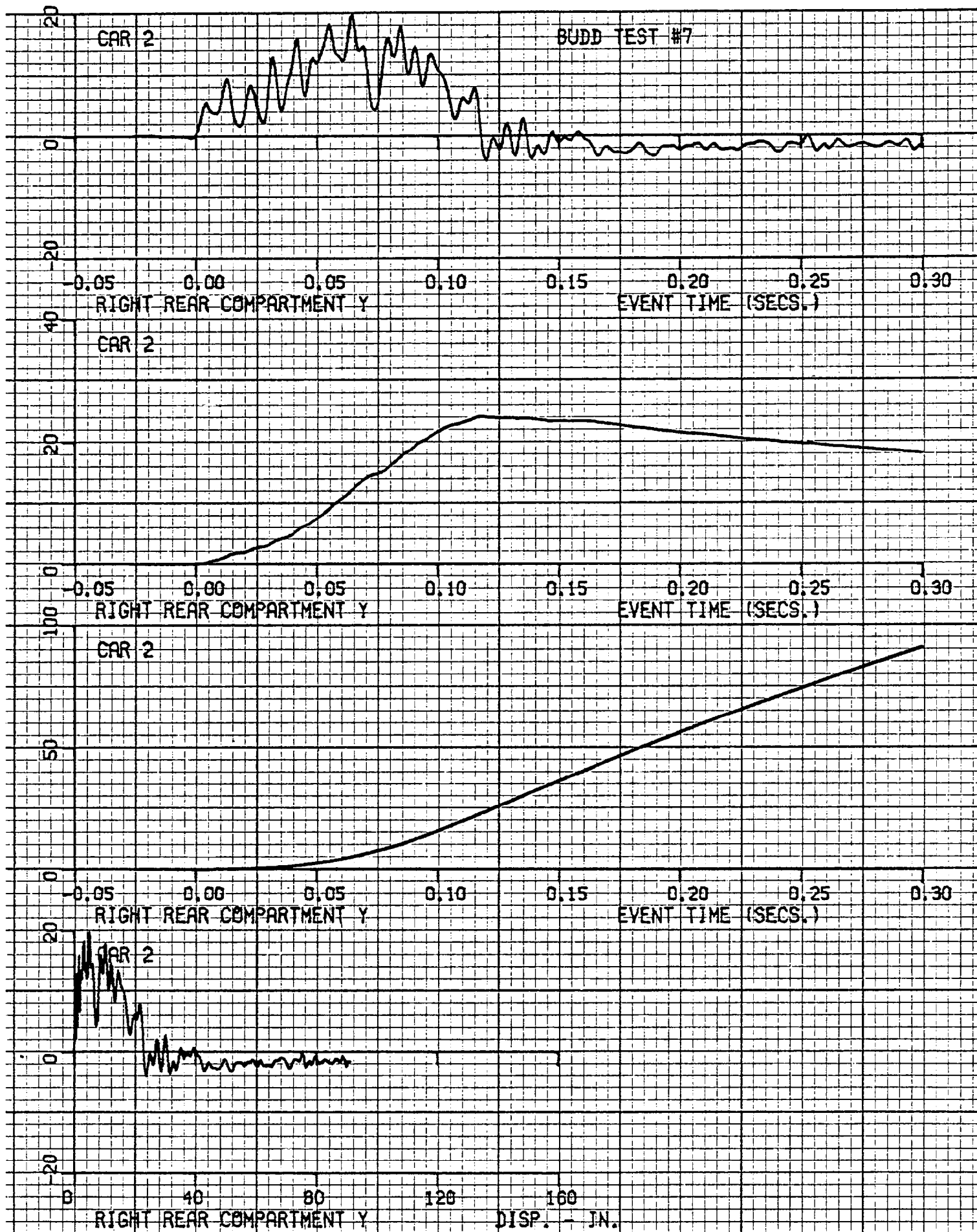
SIDE INTRUSION DATA 1000 HZ FILTER

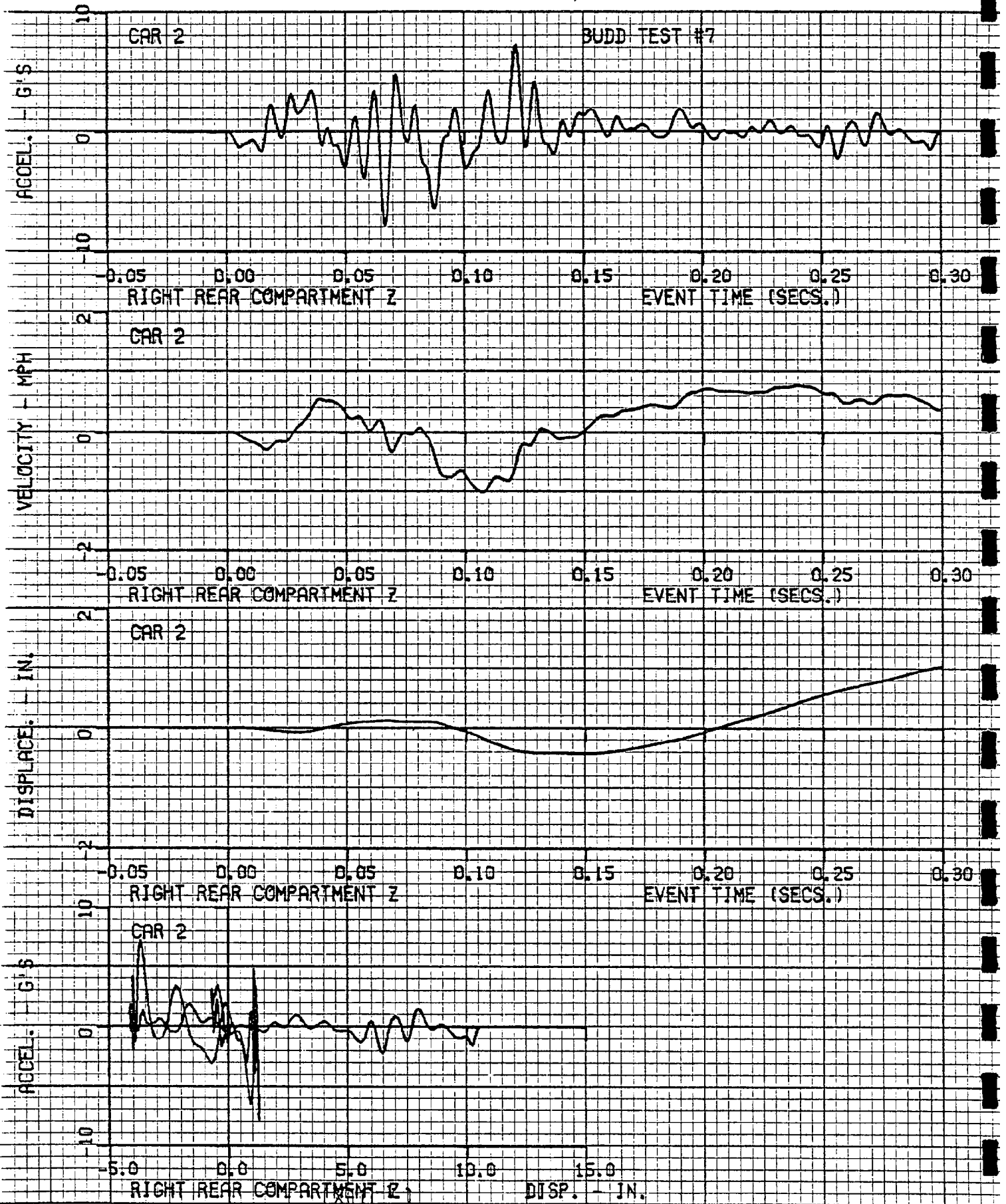






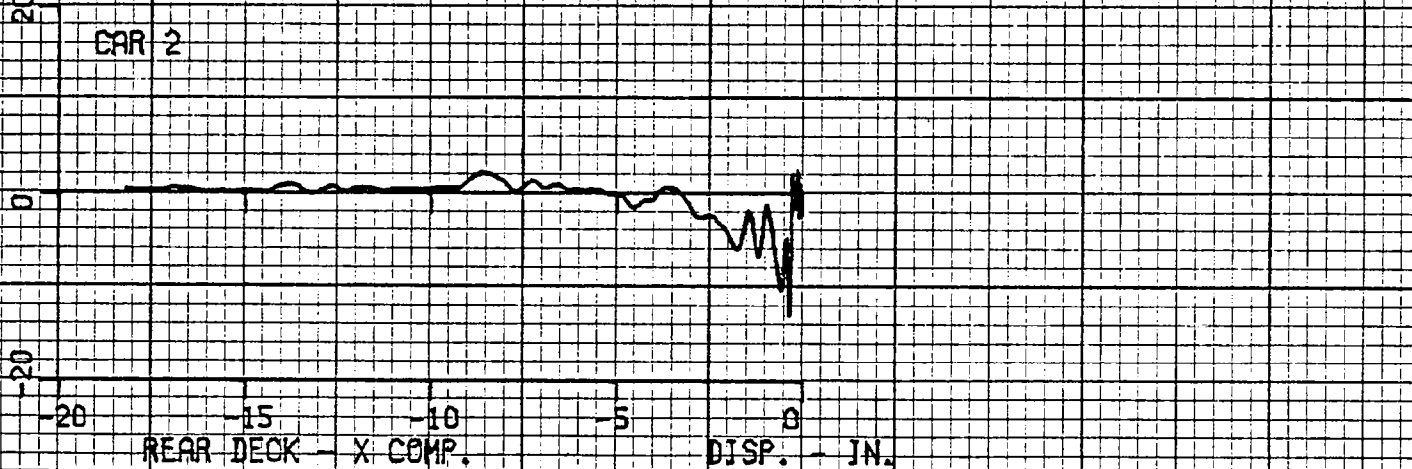
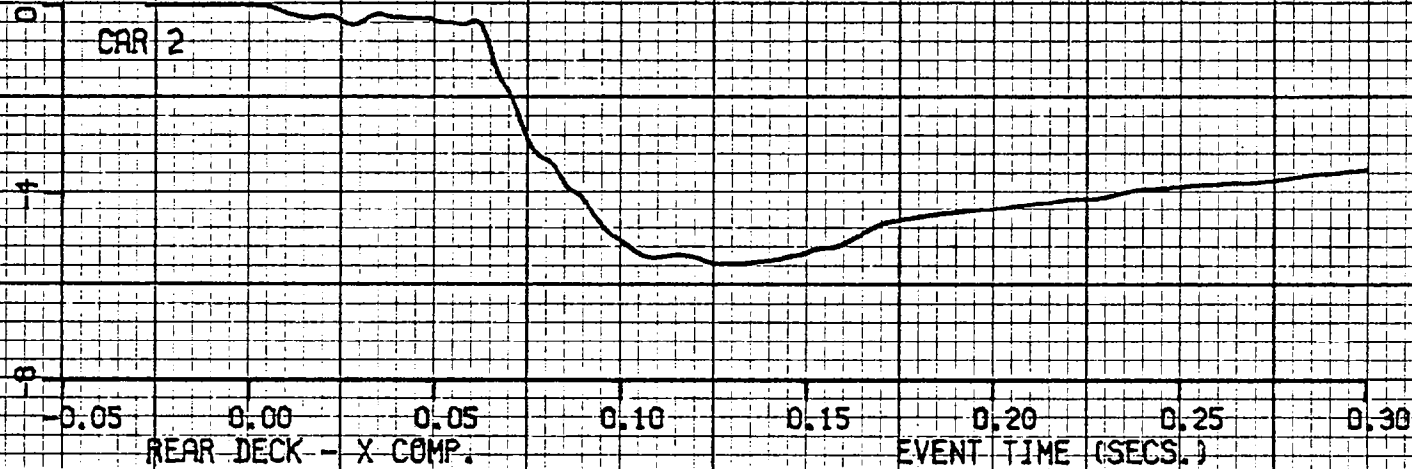
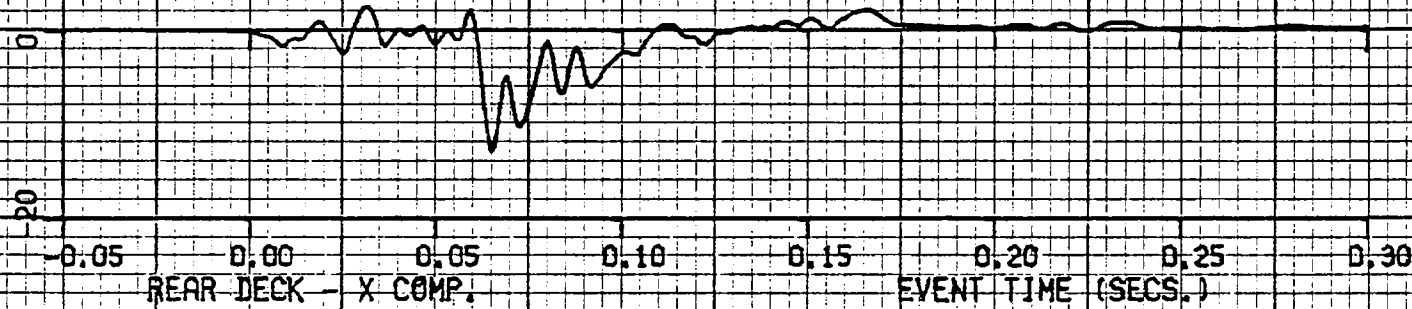


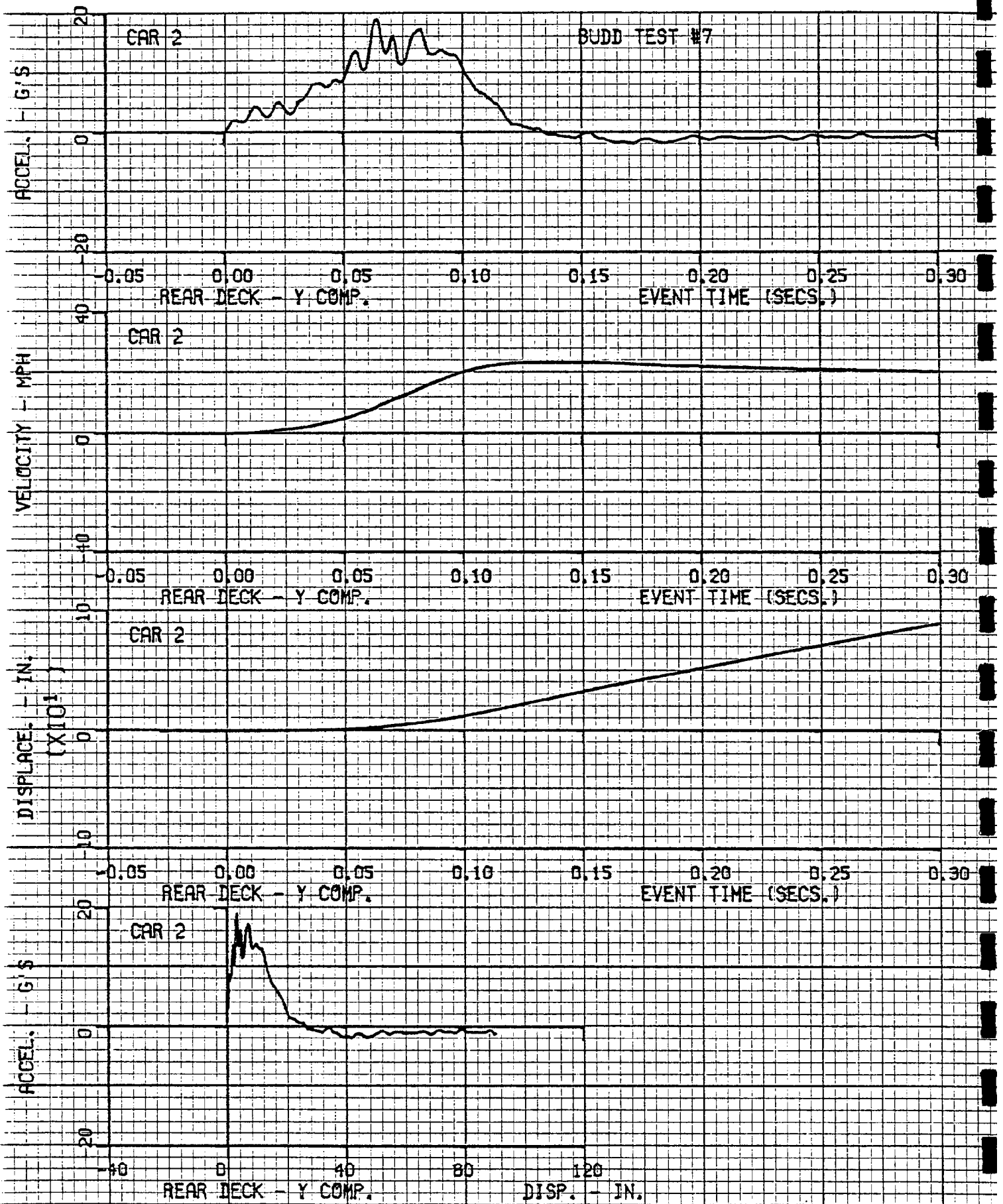


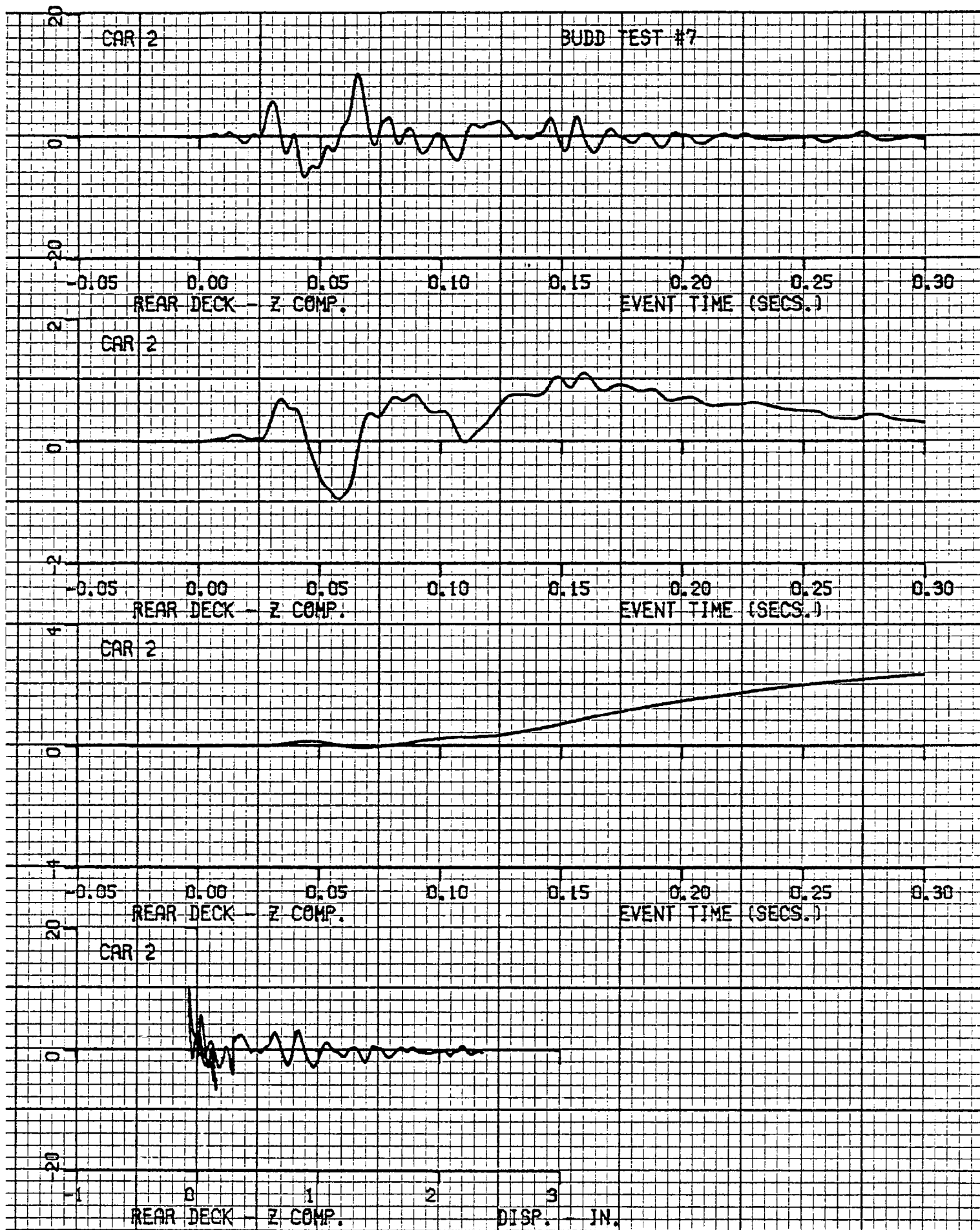


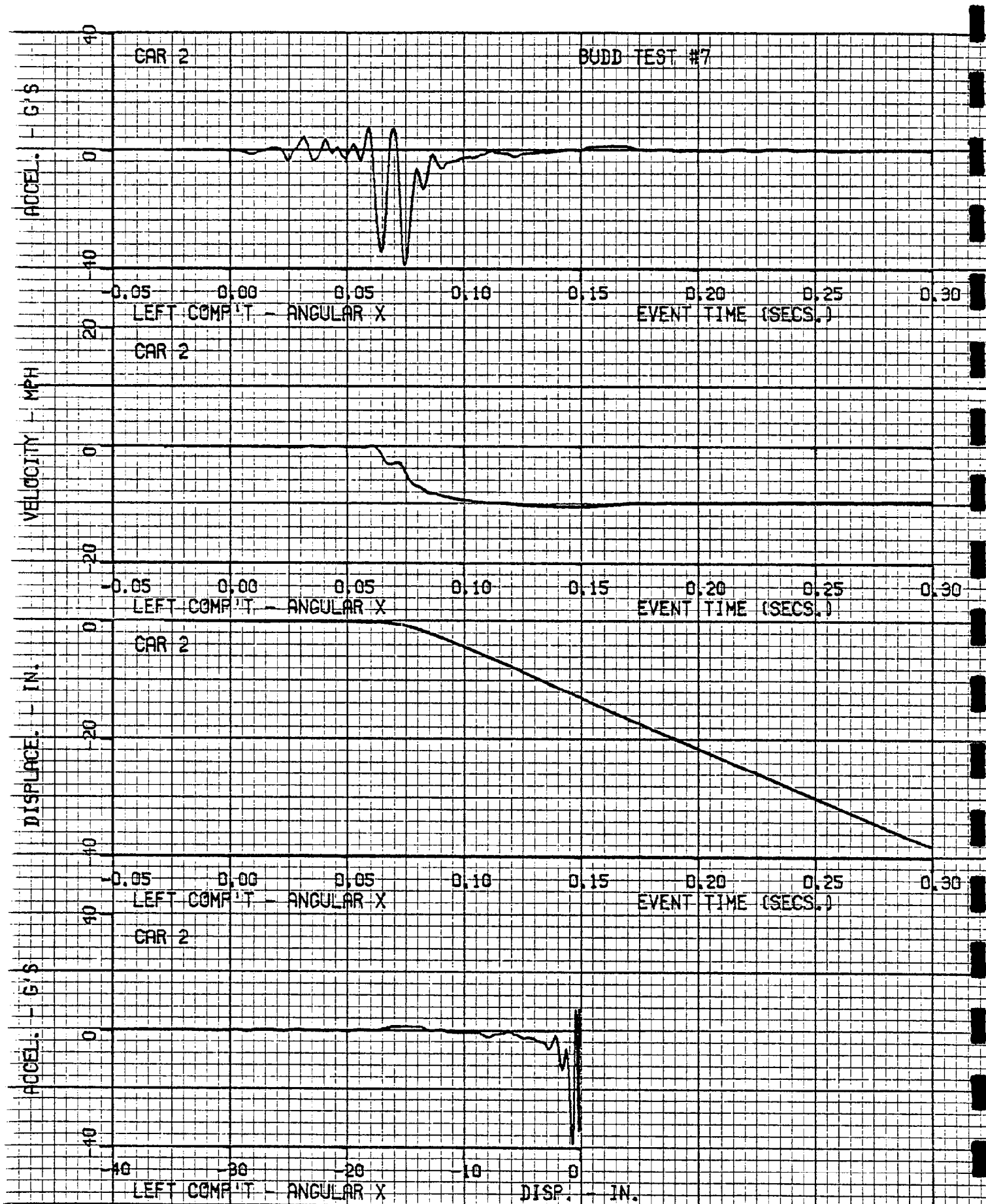
CAR 2

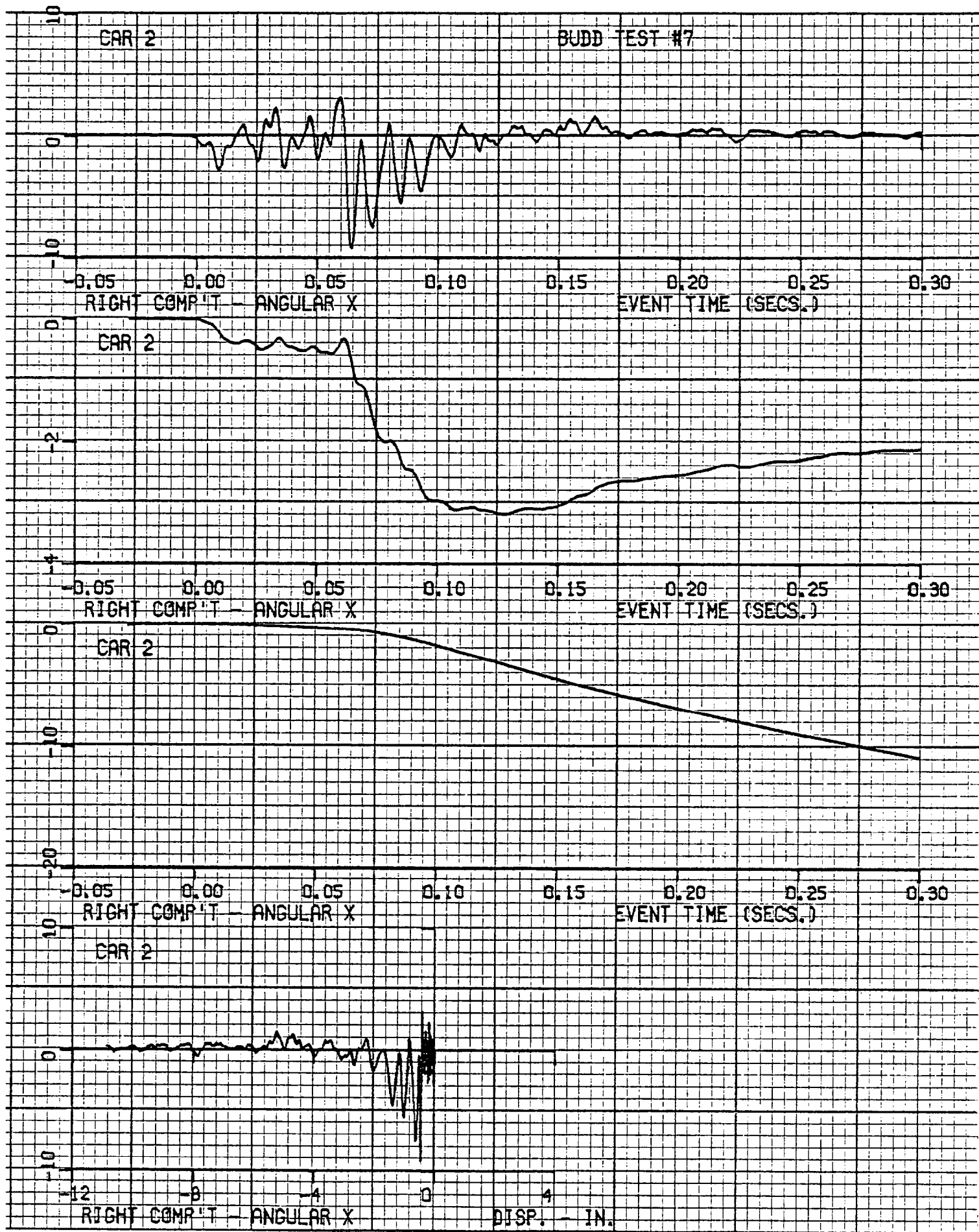
BUDD TEST #7

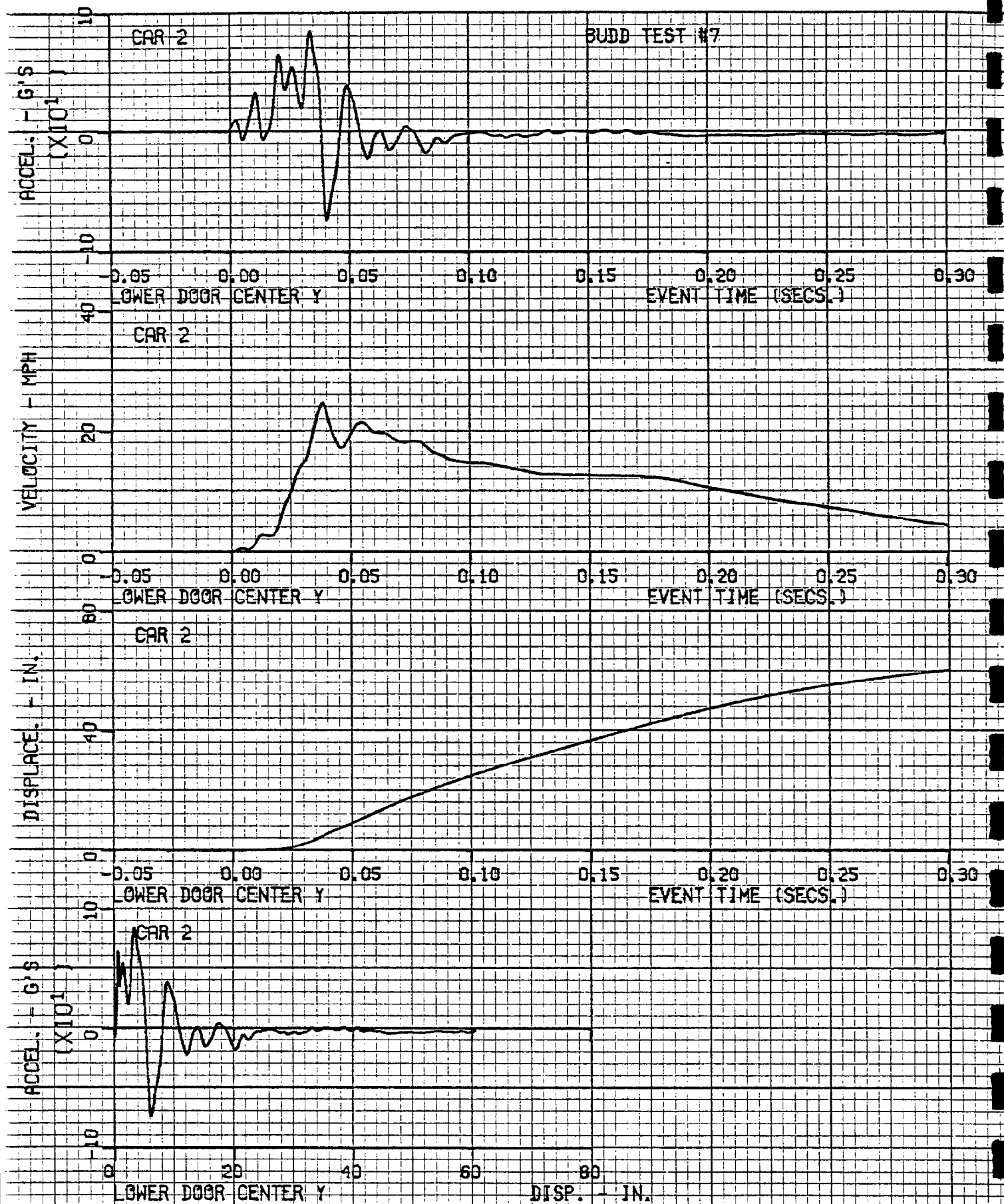


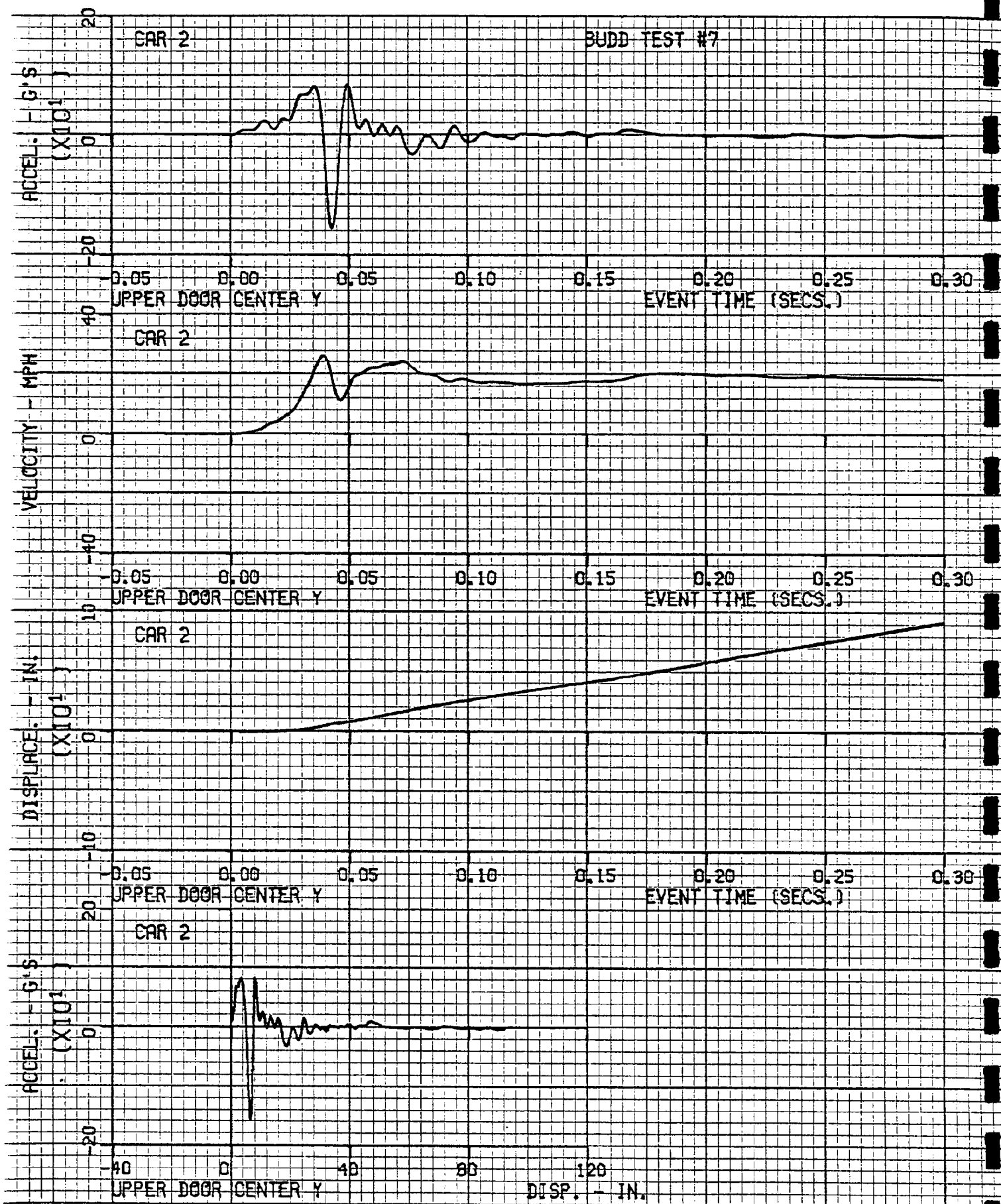


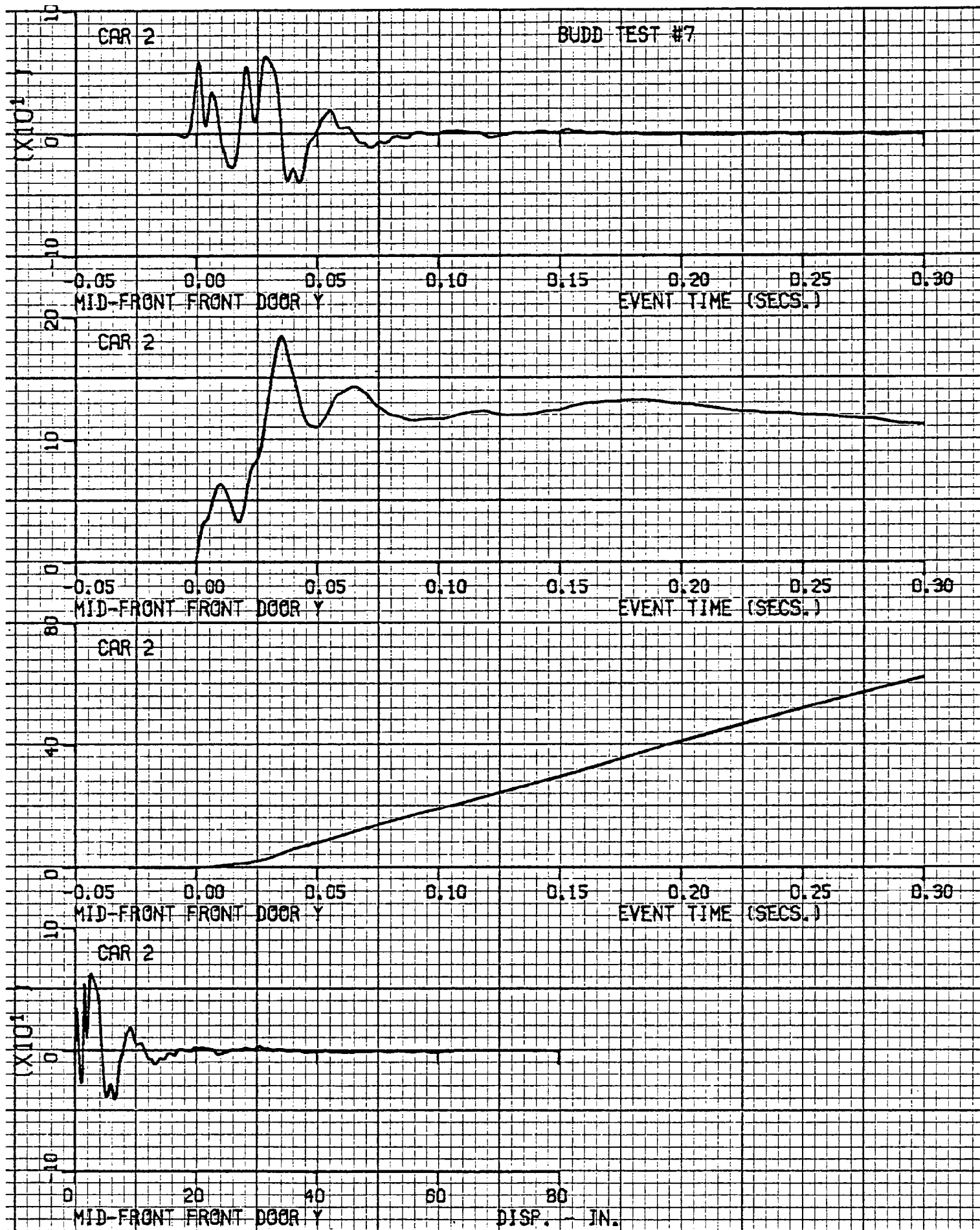


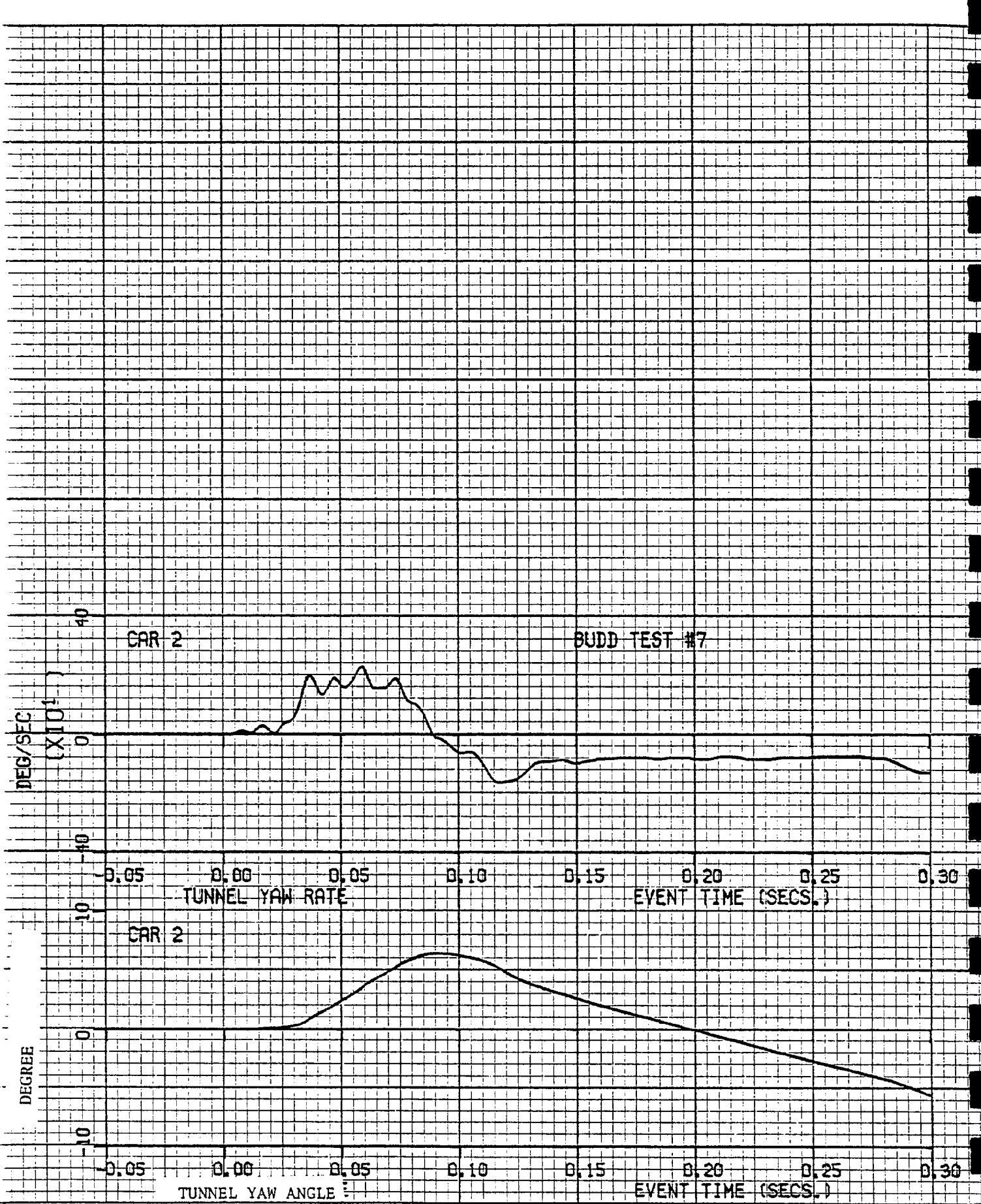


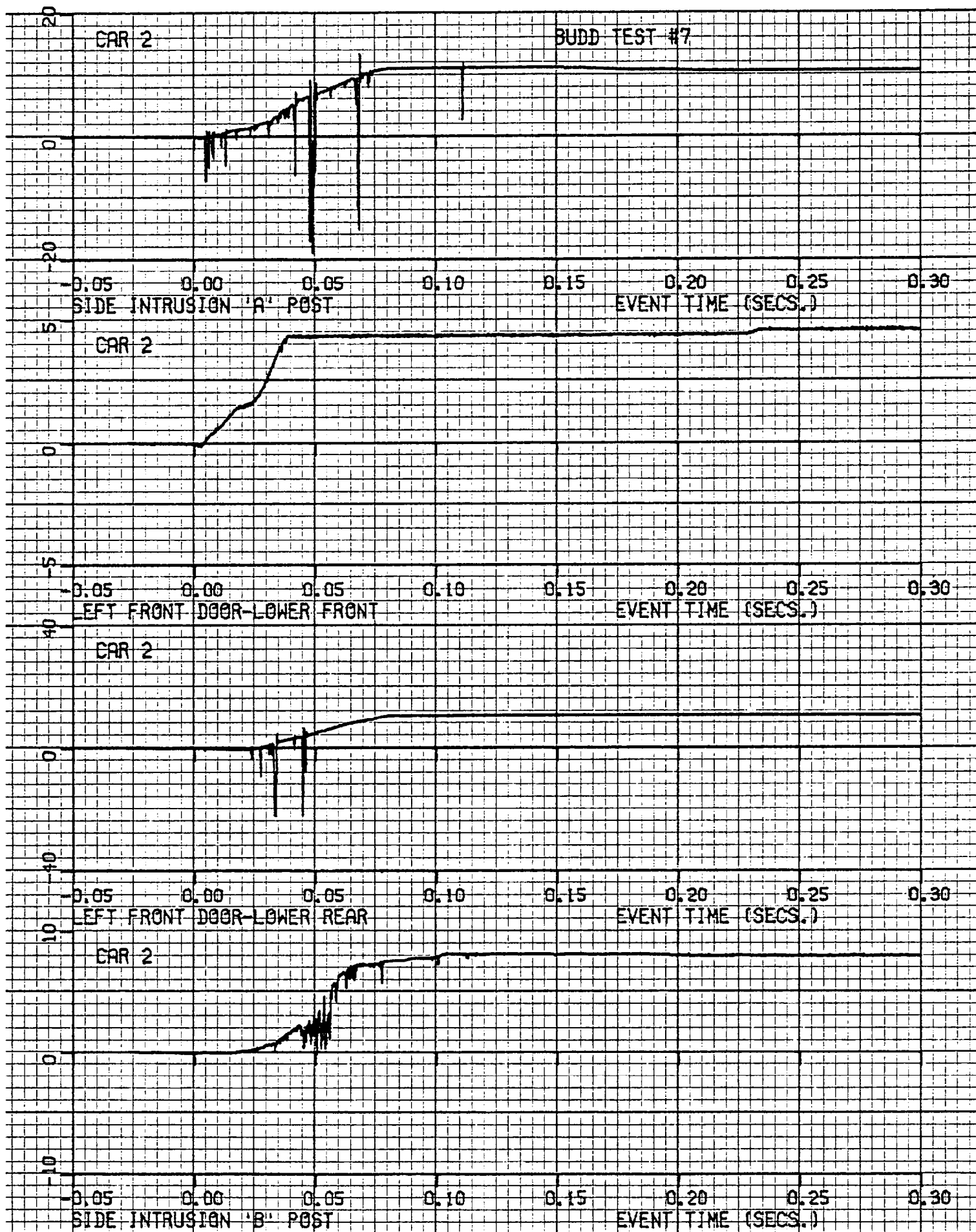








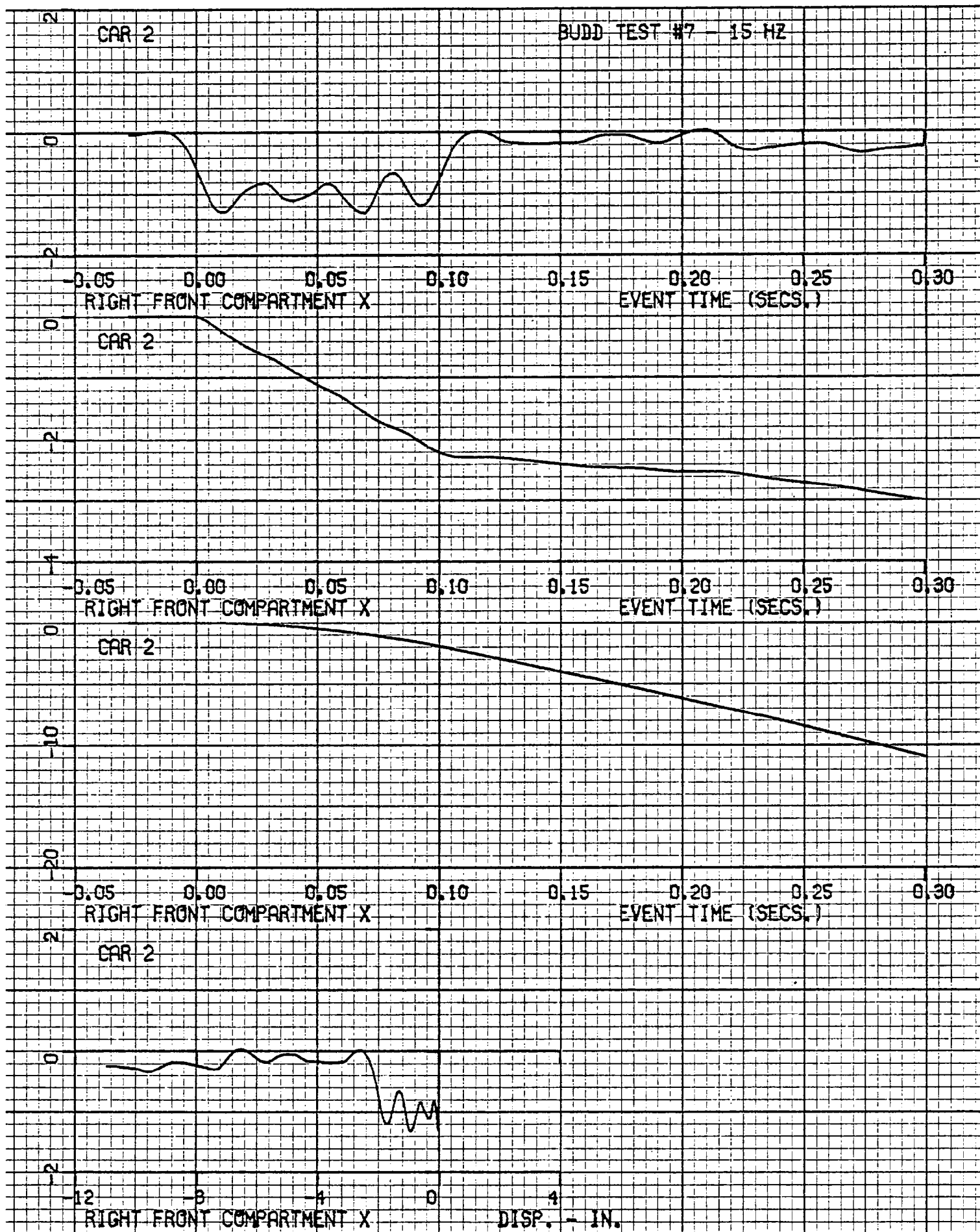


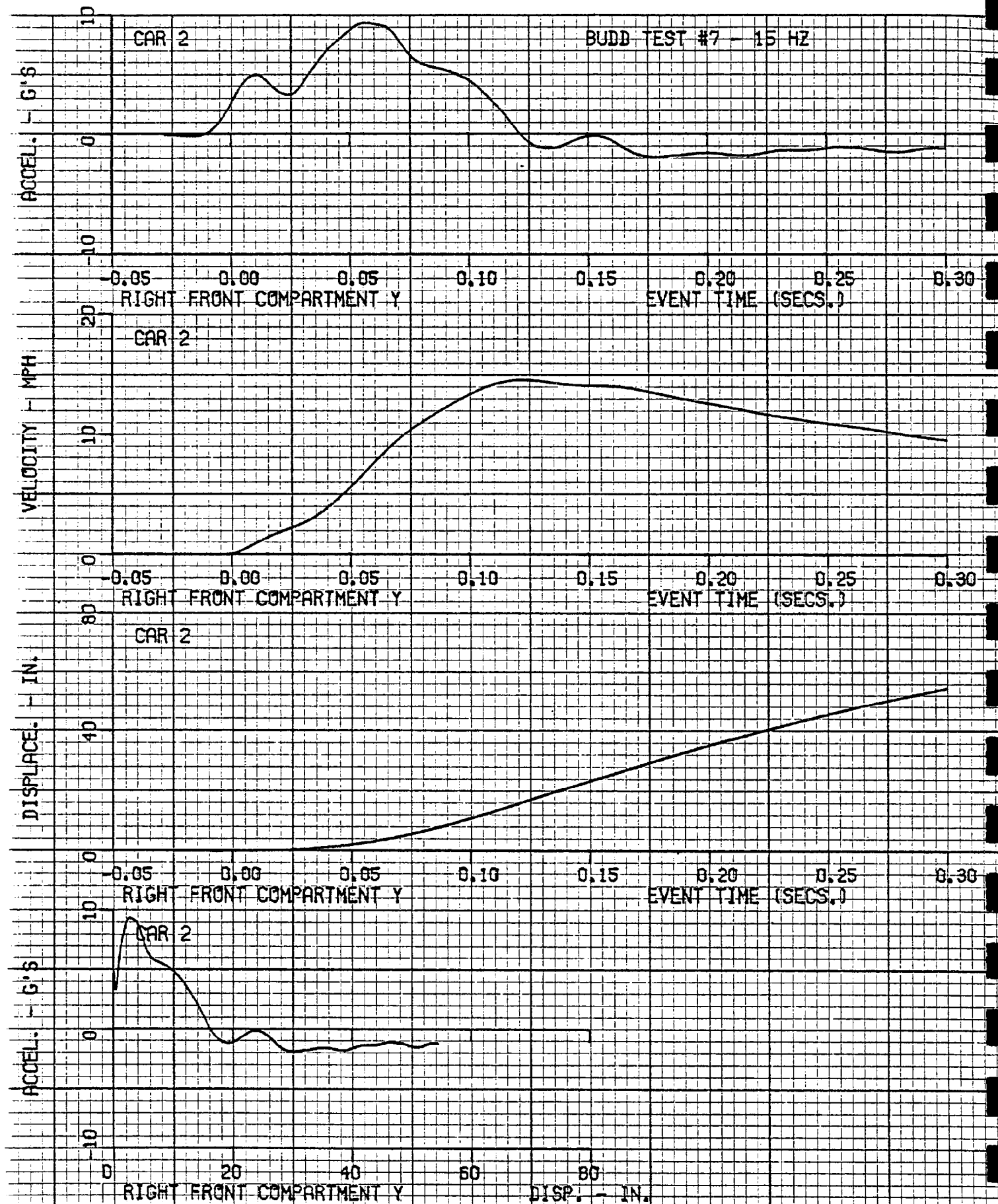


TEST NO. 7

CAR 2 - 1976 VOLKSWAGEN RABBIT

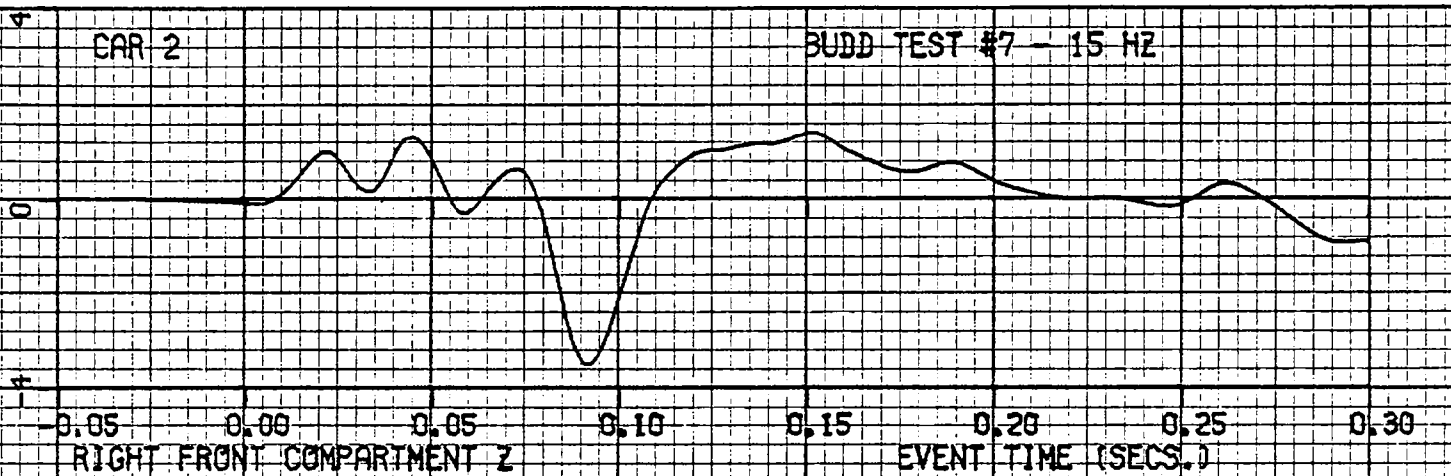
VEHICLE DATA, 15 HZ FILTER



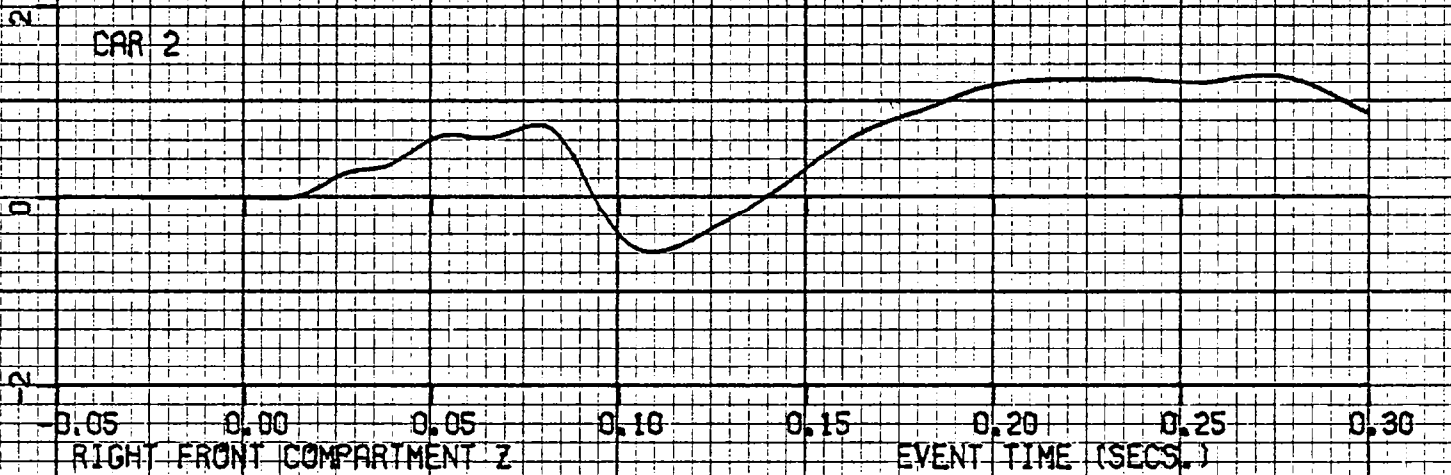


CAR 2

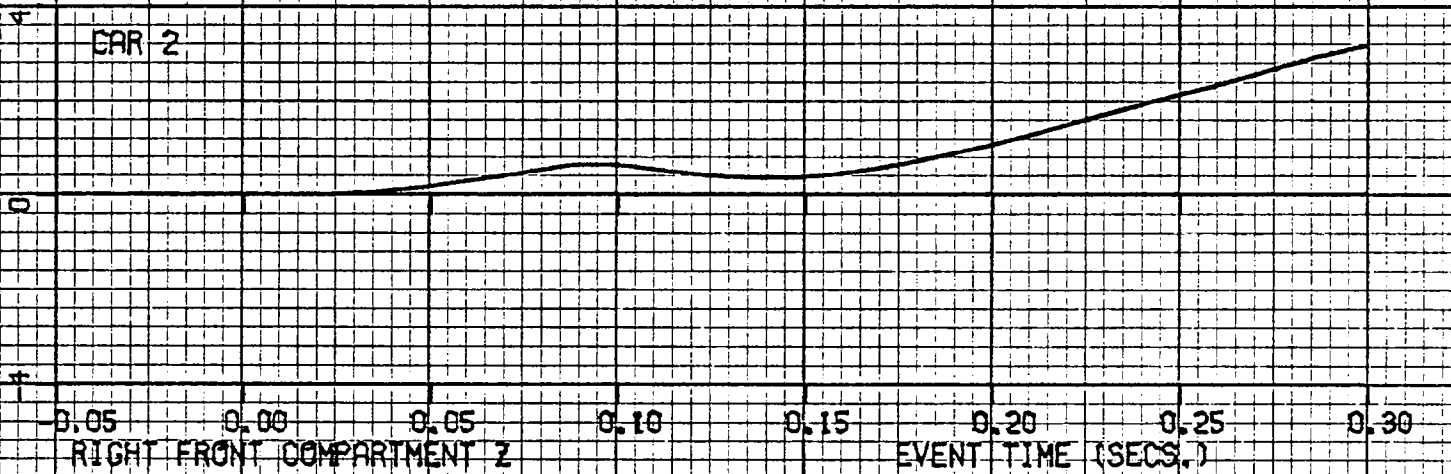
BUDD TEST #7 - 15 HZ



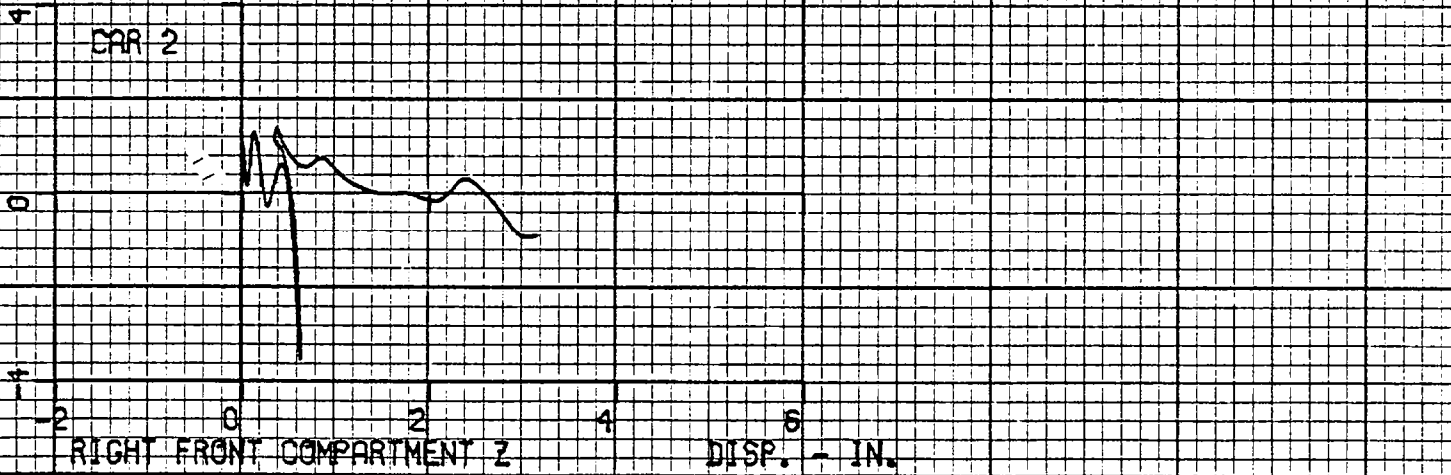
CAR 2



CAR 2

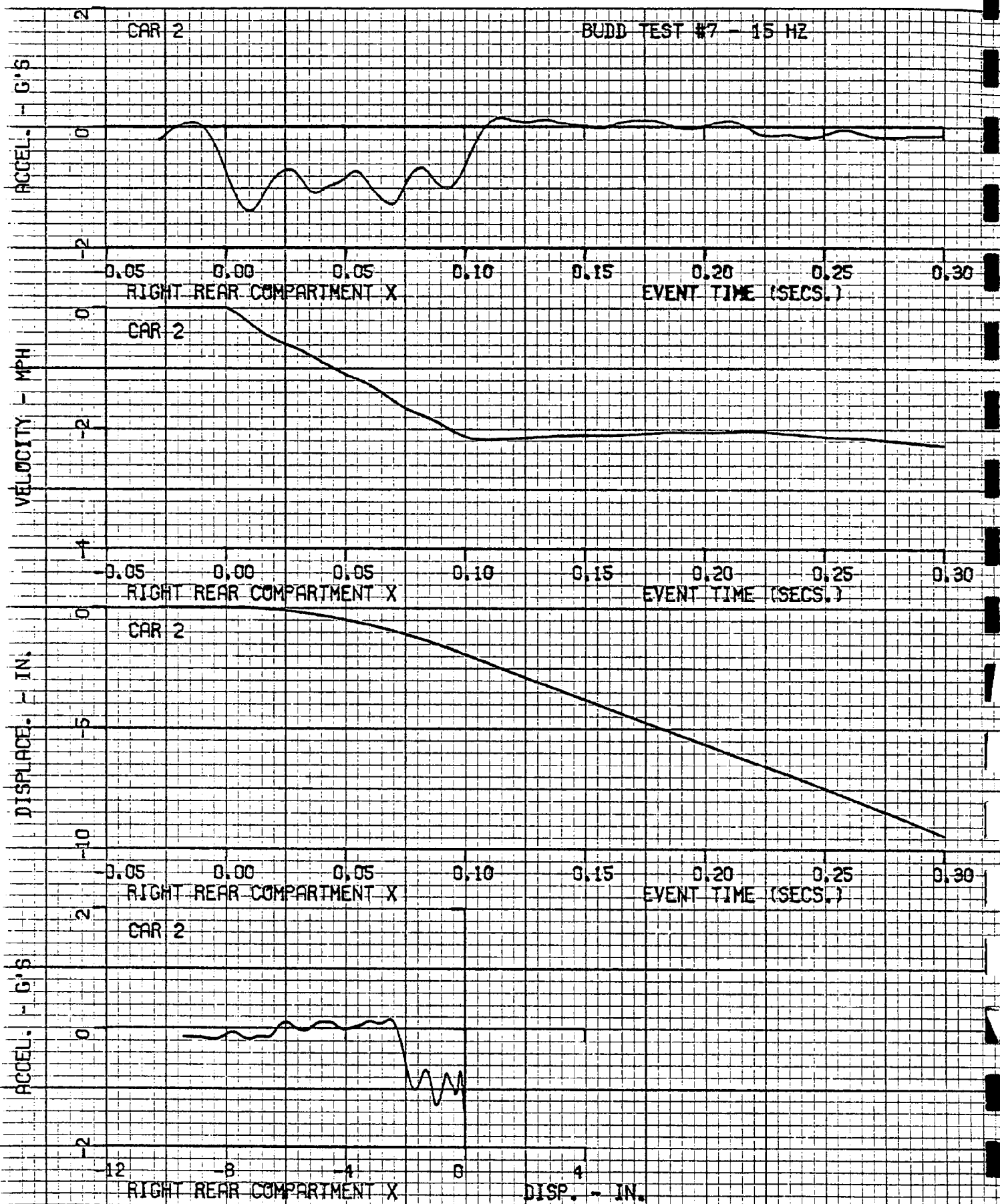


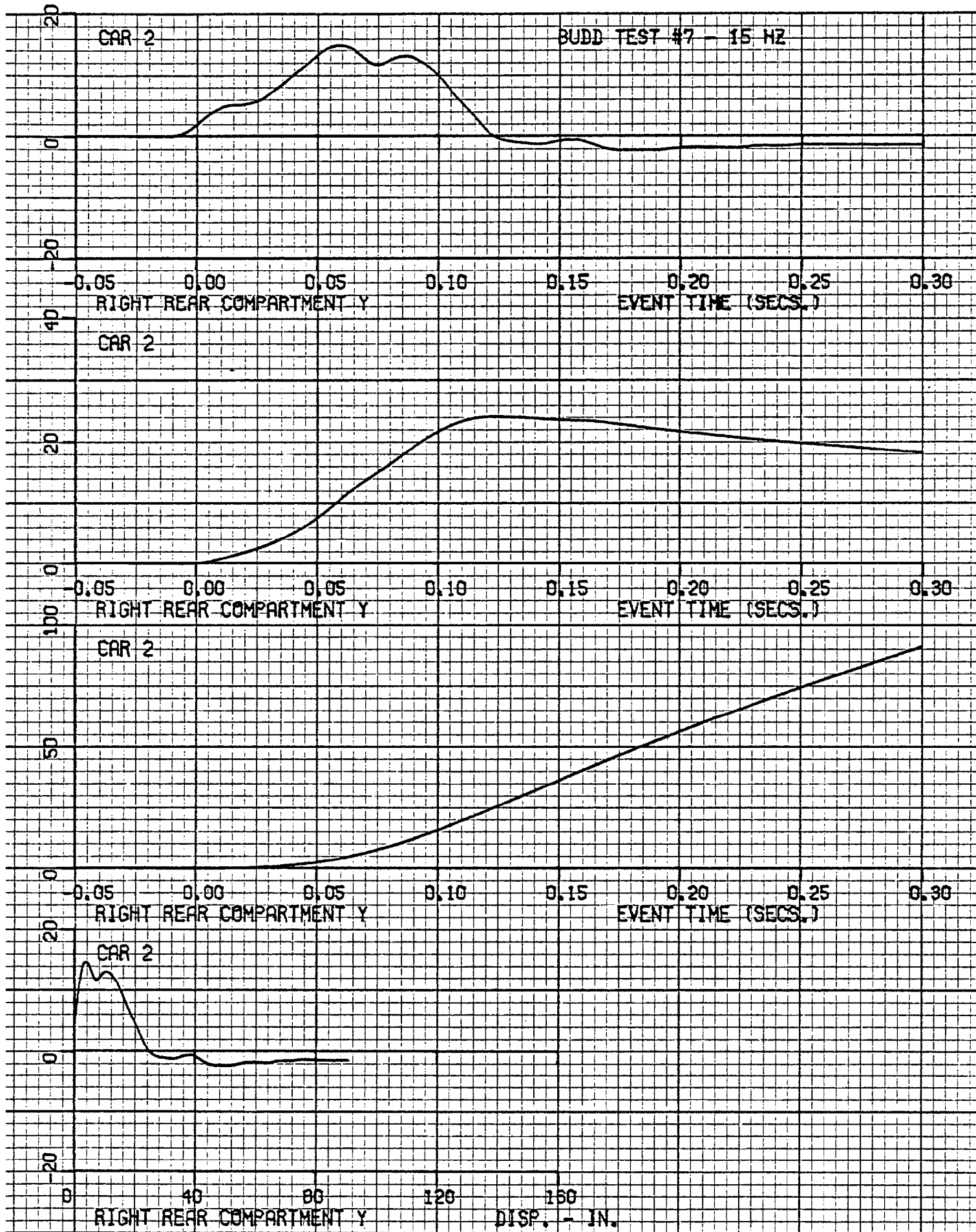
CAR 2

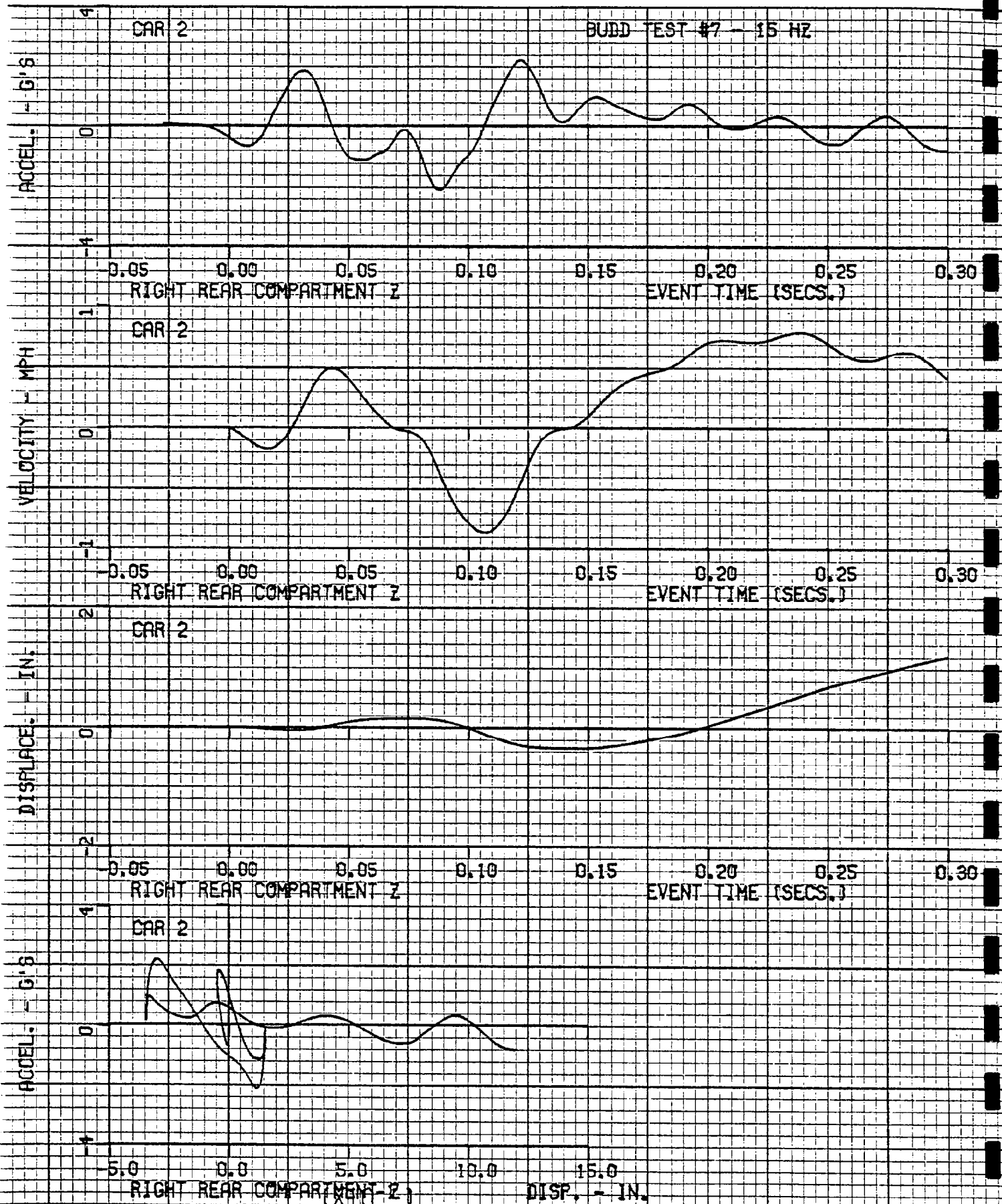


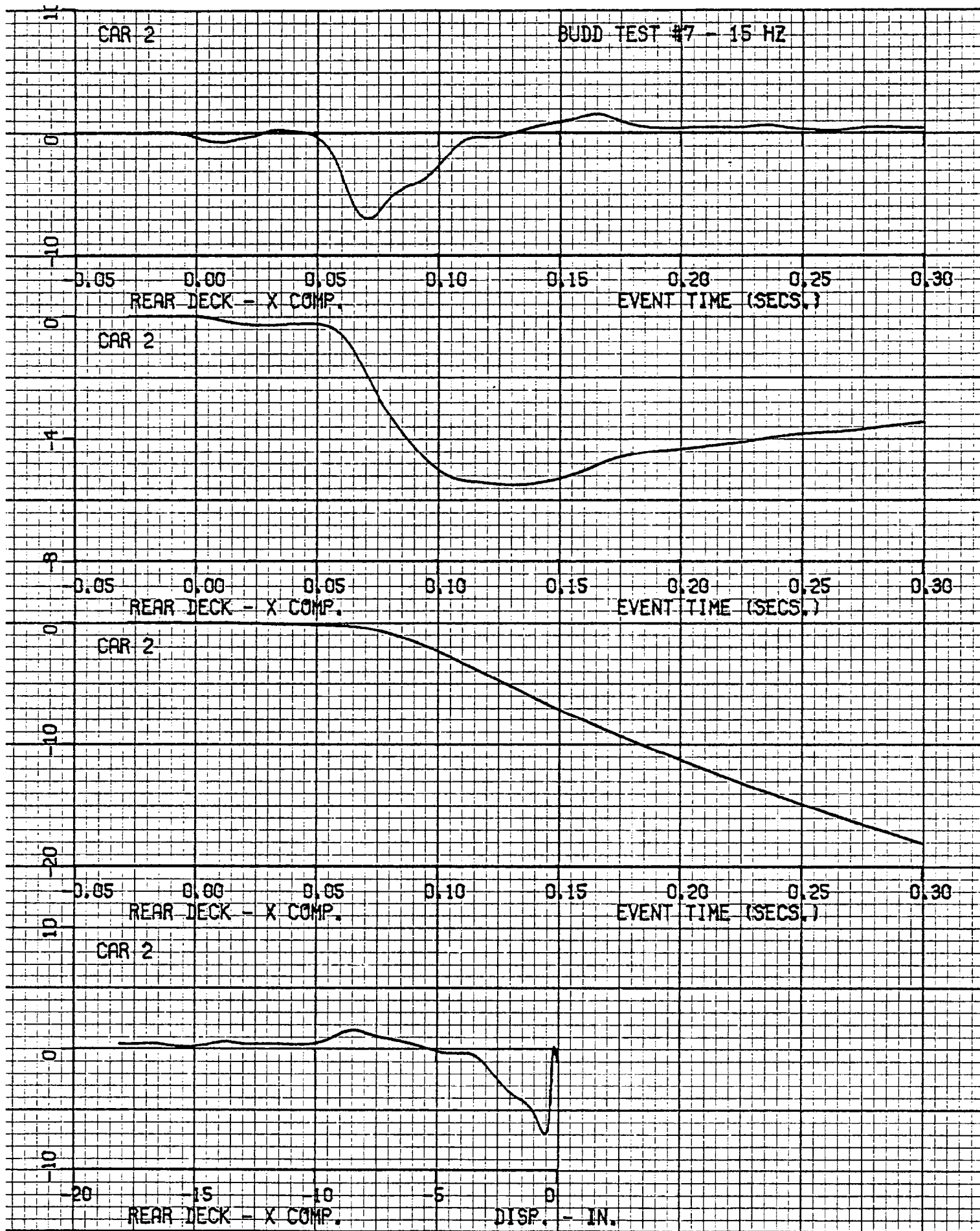
RIGHT FRONT COMPARTMENT Z

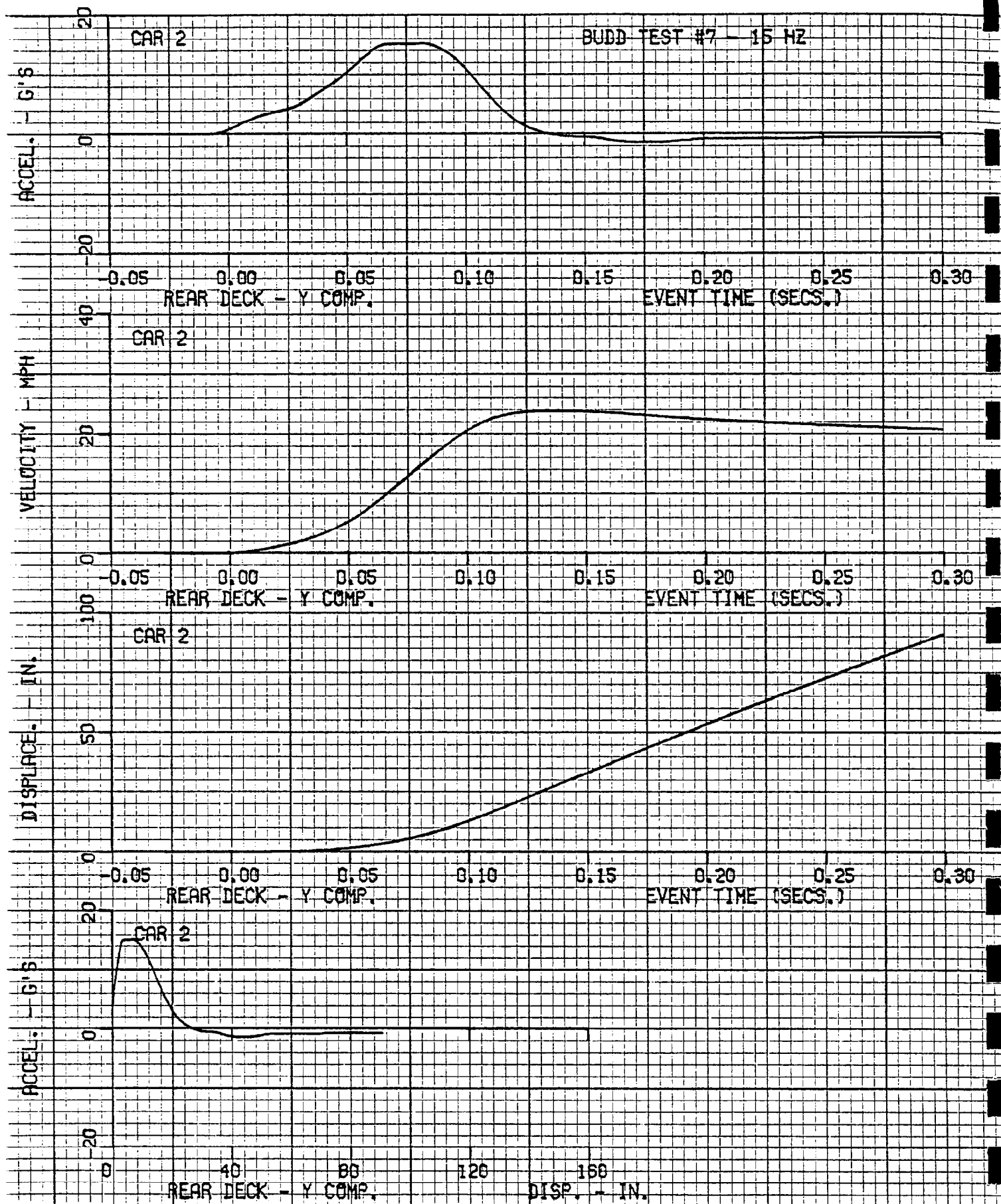
DISP. - IN.

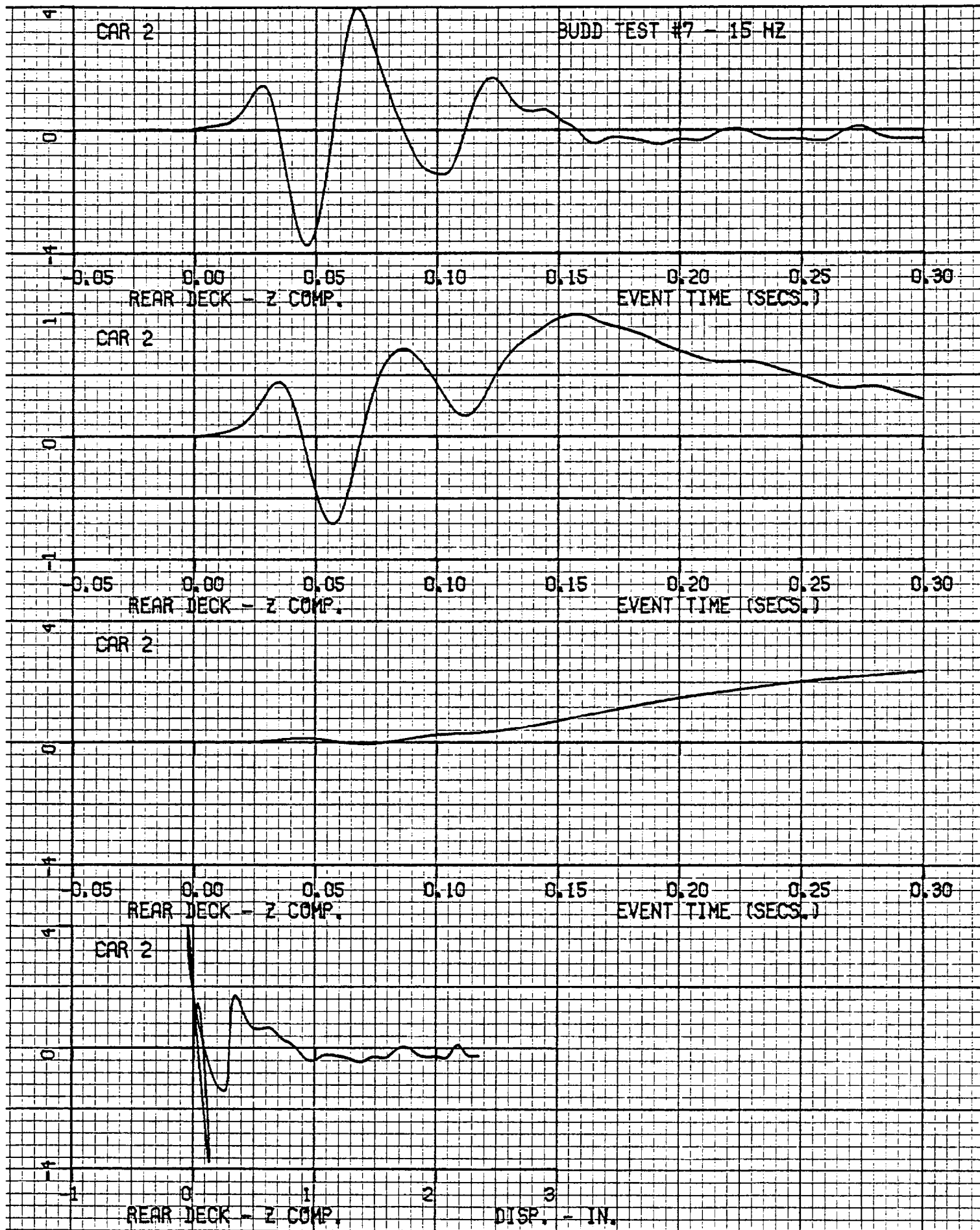


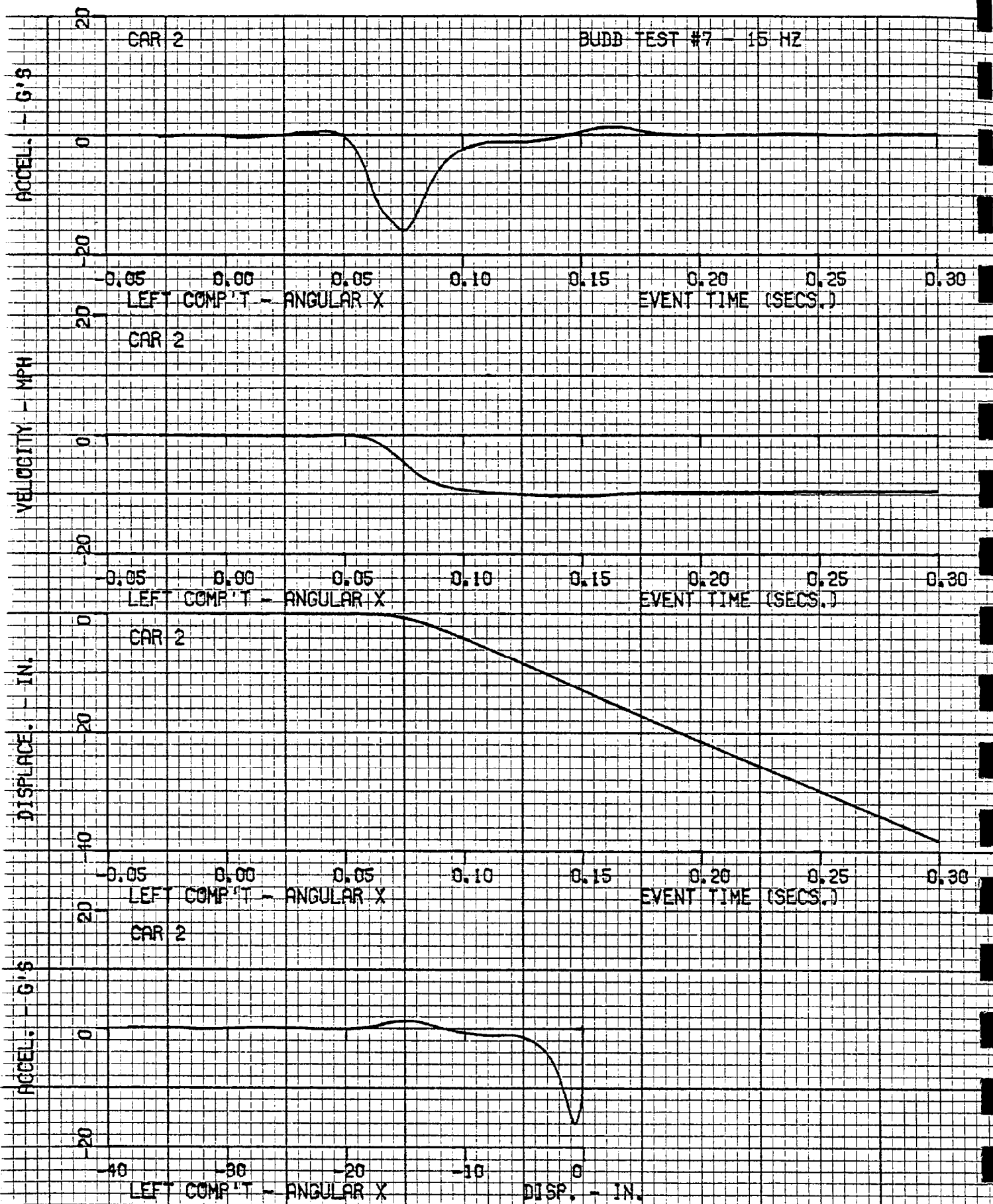


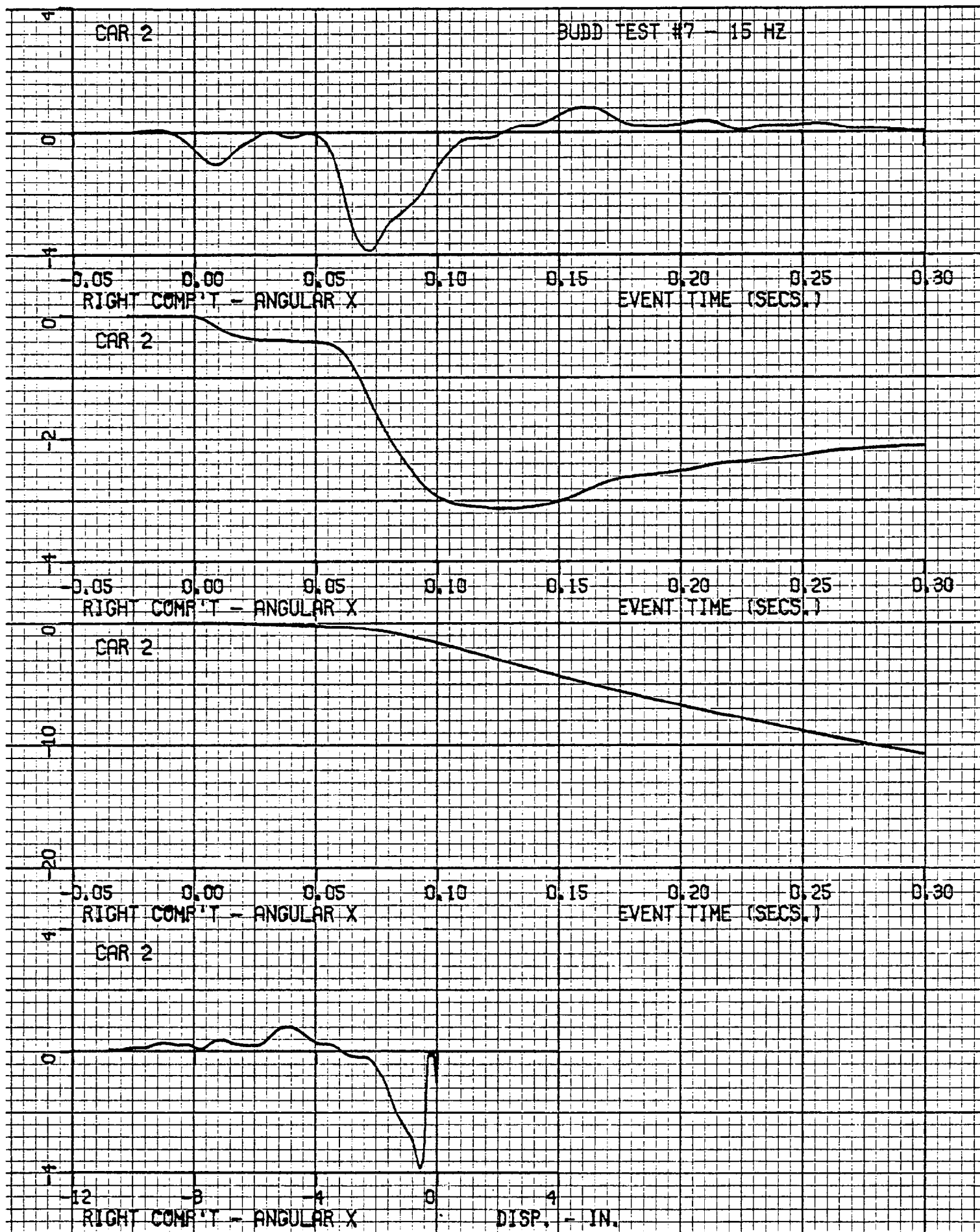


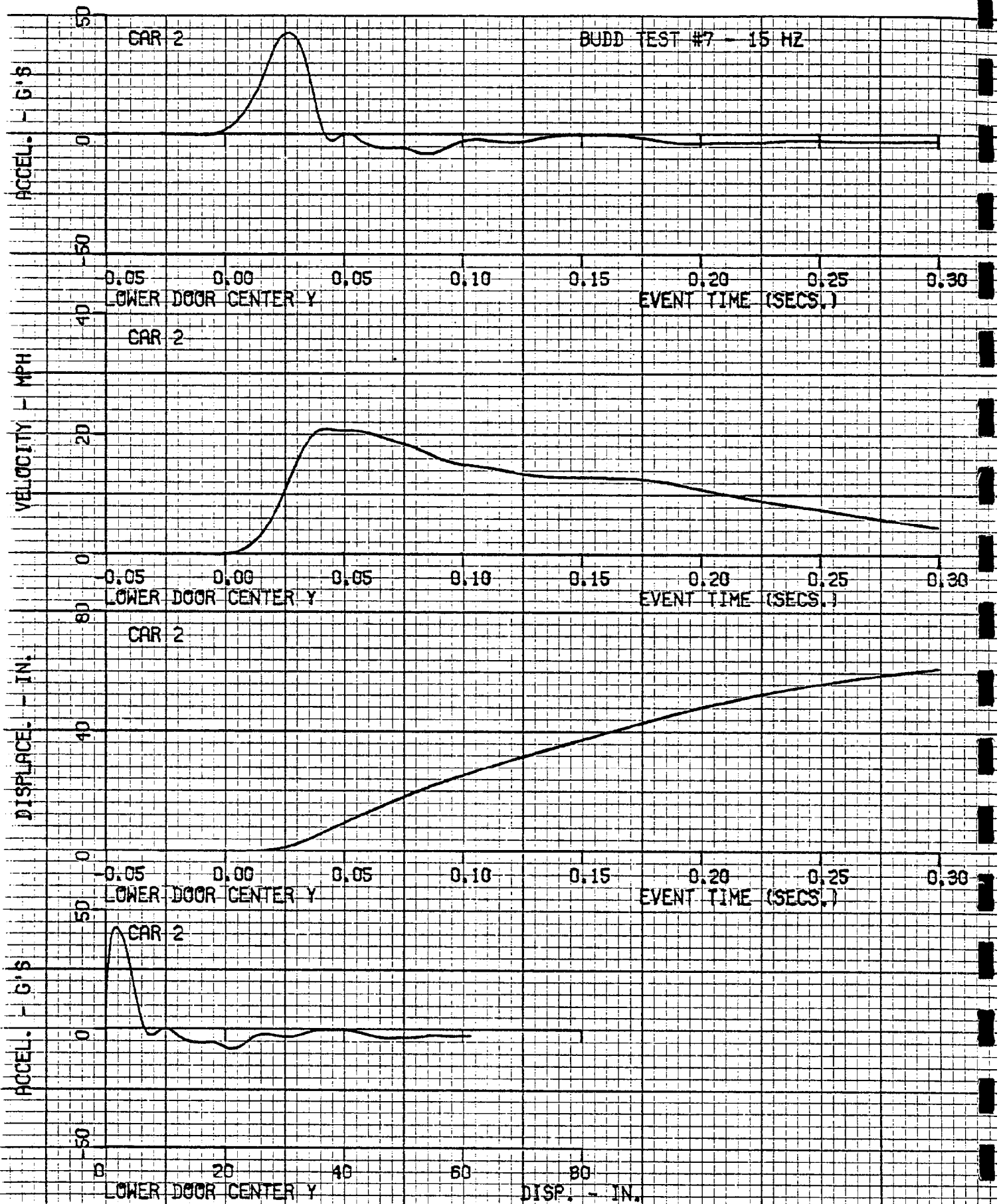


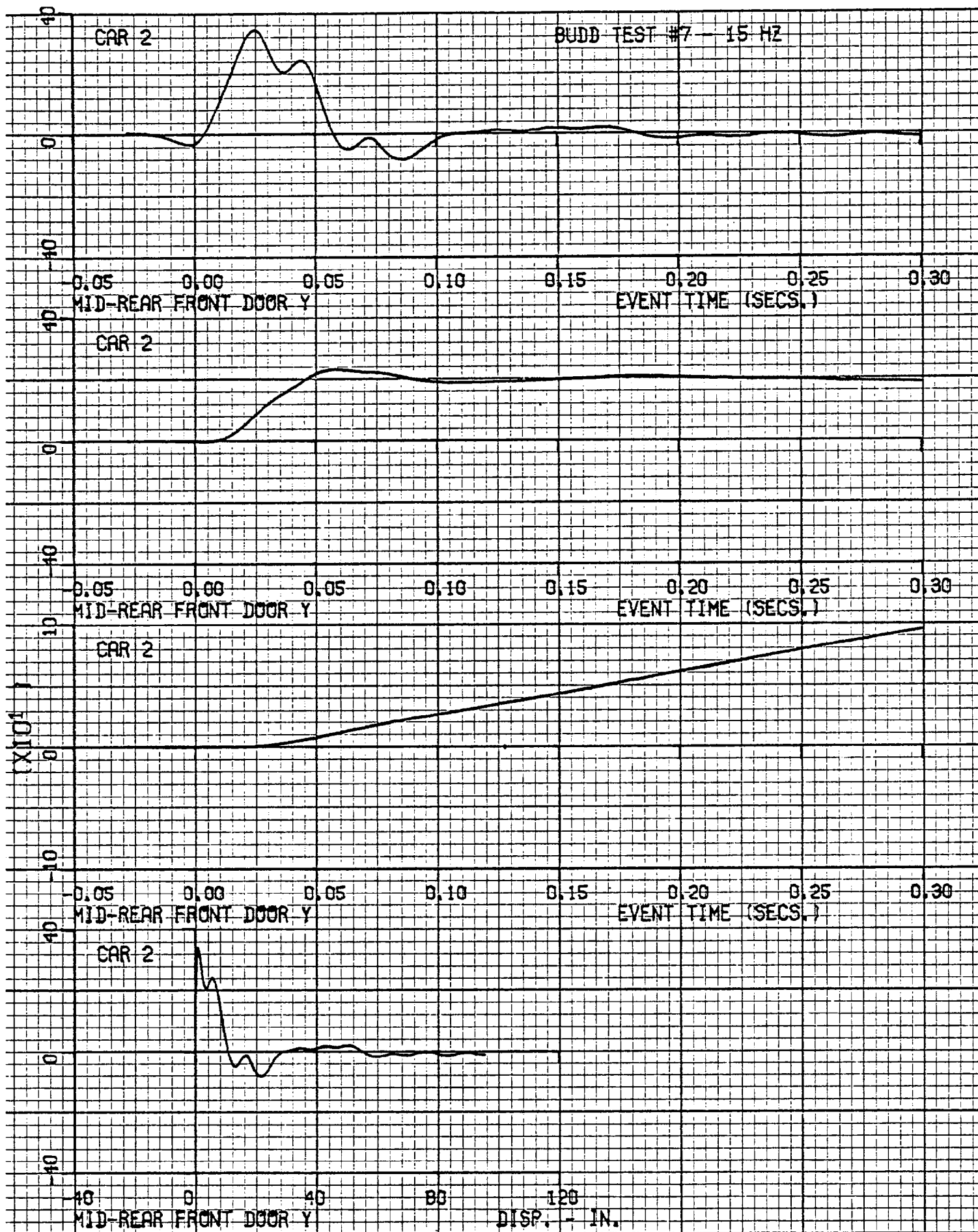


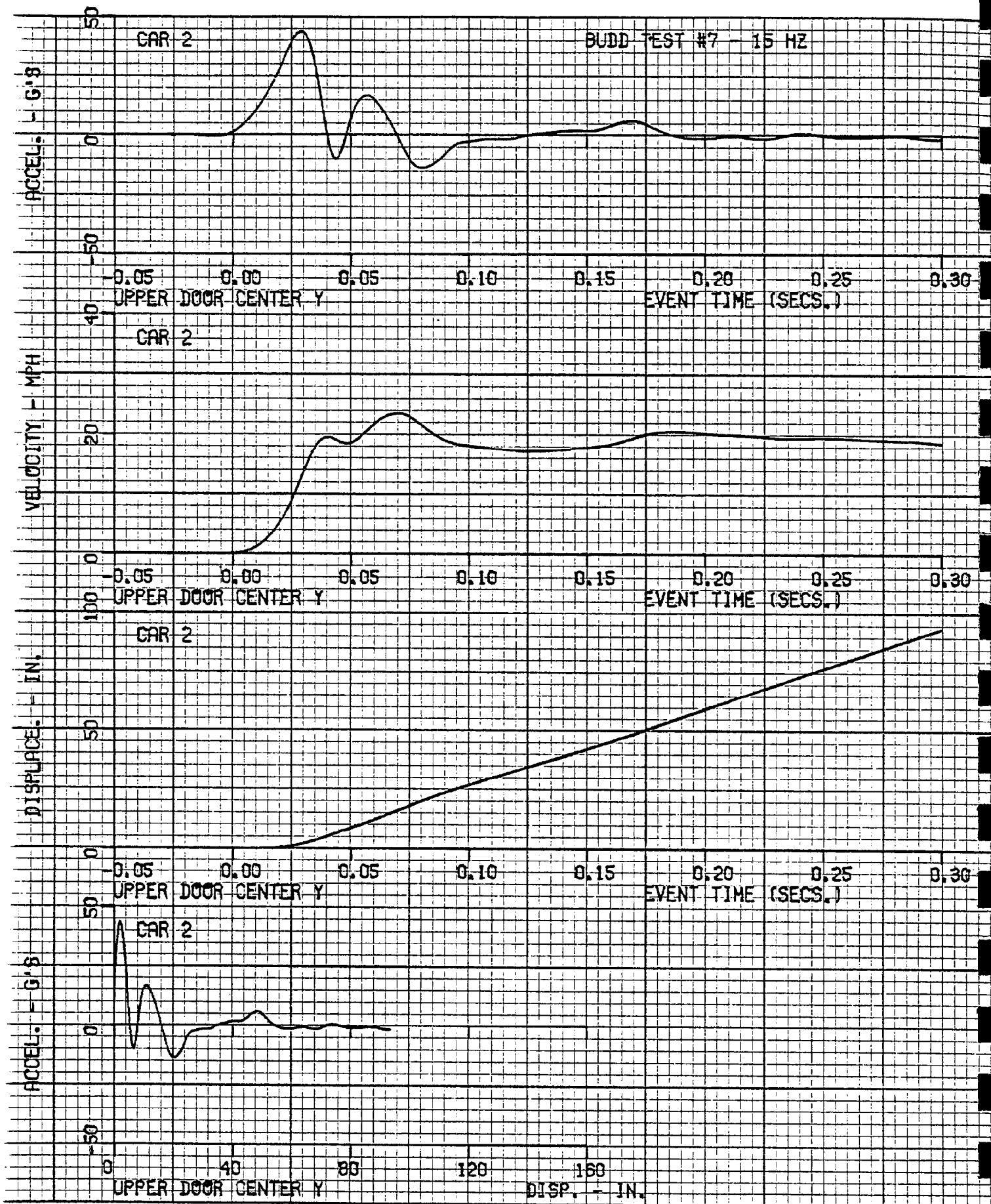


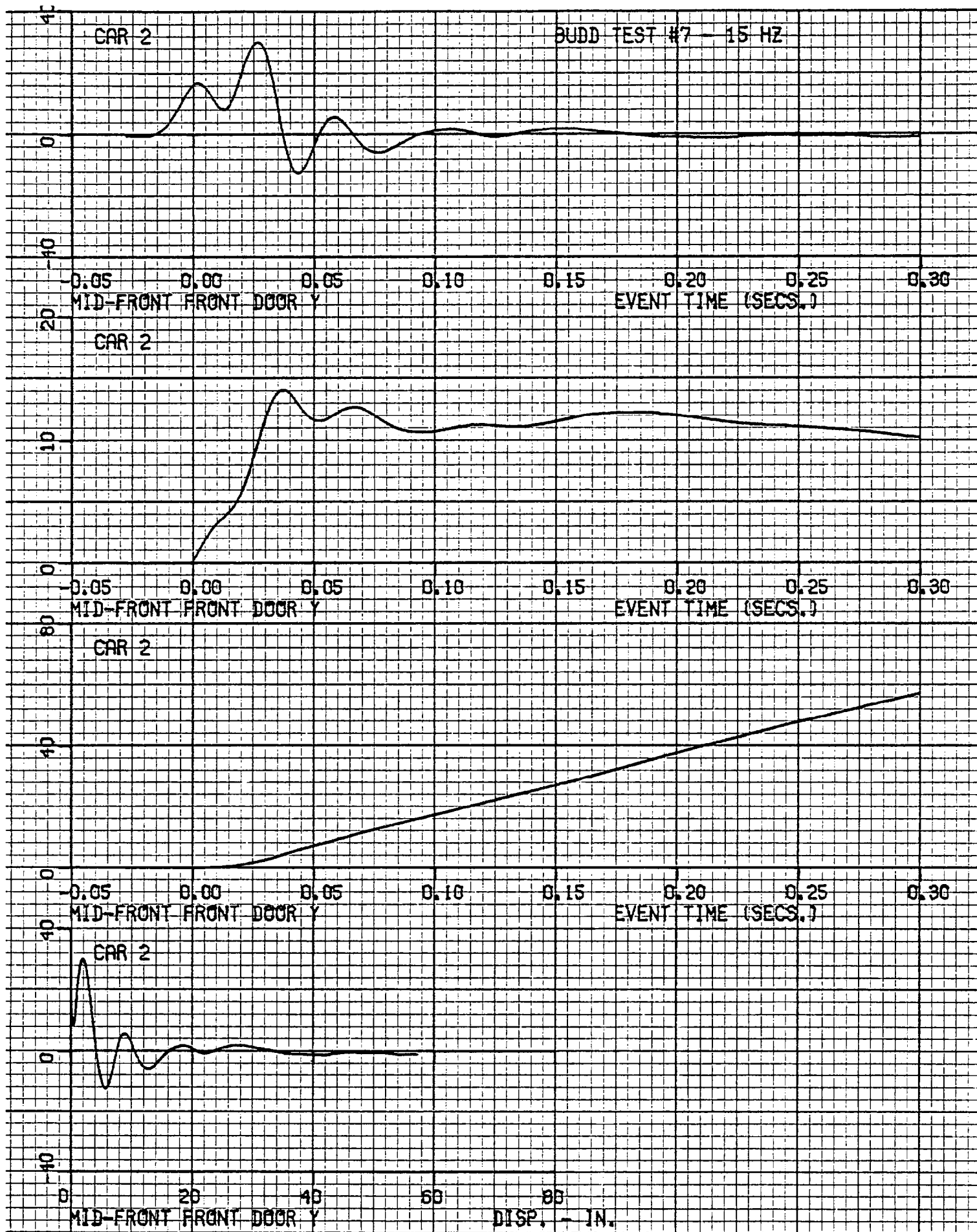


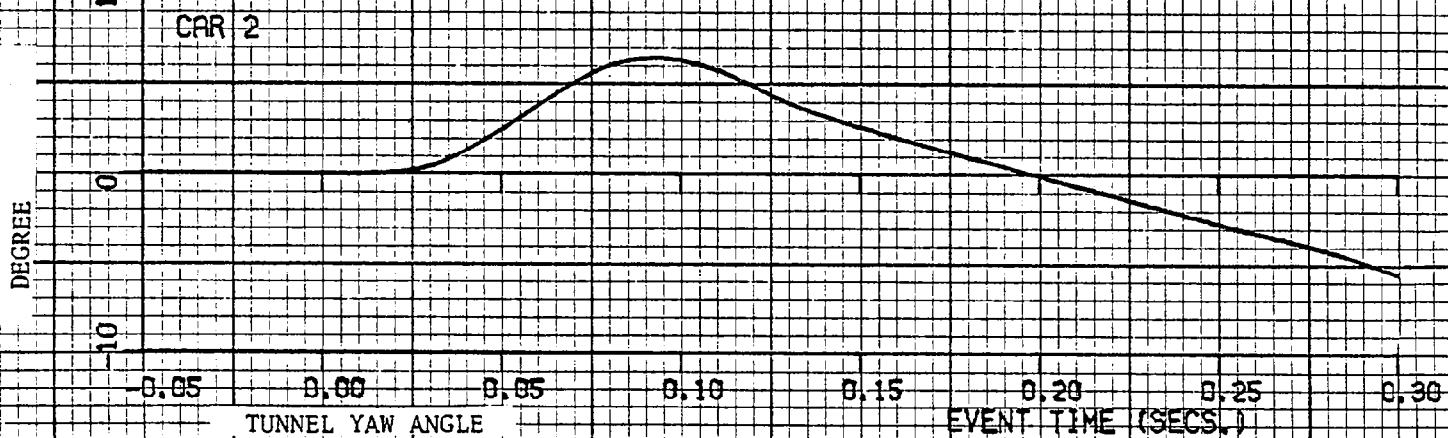
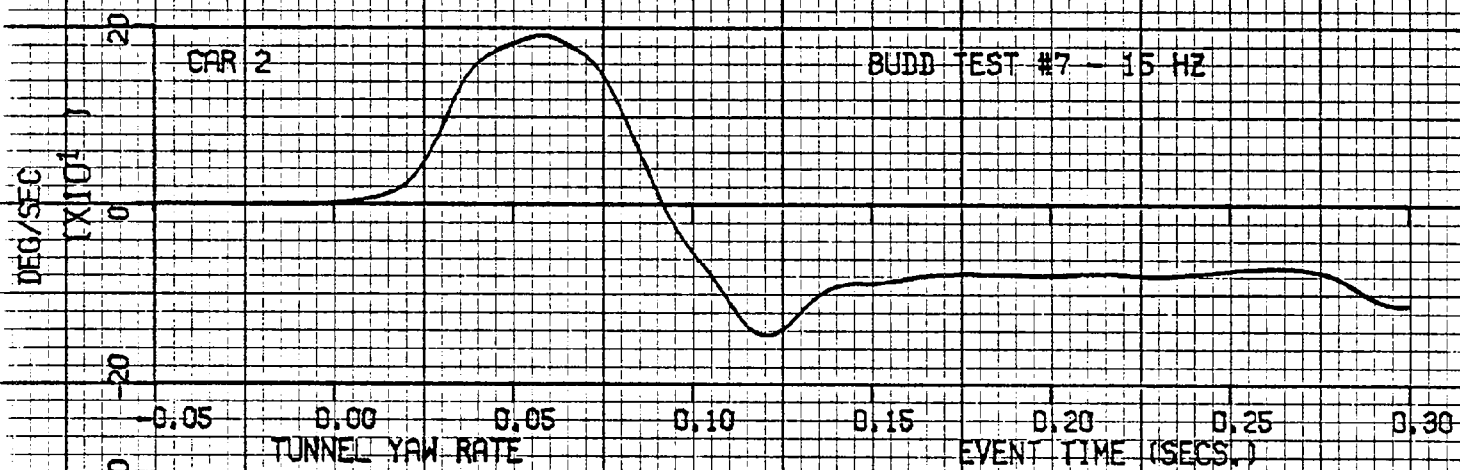












TEST NO. 7

CAR 2 - 1976 VOLKSWAGEN RABBIT

DUMMY DATA

Head Acceleration	1000 HZ
Chest Acceleration	180 HZ
Pelvis Acceleration	180 HZ

