

DOT 462

CALSPAN ADVANCED TECHNOLOGY CENTER



technical report

CALSPAN ADVANCED TECHNOLOGY CENTER

IMPROVED LIGHTWEIGHT SUBCOMPACT SIDE STRUCTURE CRASH TEST REPORT

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Calspan Report No. 6225-V-13

Prepared For:

THE BUDD COMPANY
TECHNICAL CENTER
FORT WASHINGTON, PA 19034

PURCHASE ORDER NO. TC 14436

TEST:	TEST NO. 11
TYPE OF TEST:	CAR-TO-CAR FRONT-TO-SIDE OBLIQUE
TEST DATE:	12 OCTOBER 1978

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TEST OBJECTIVE

The test objective was to obtain performance data on the side structure of a 1976 Volkswagen Rabbit modified by the Budd Company. The vehicle had a mid-weight modification (30 lbs) to one side of the vehicle. The test, a 30 mph car-to-car front-to-side oblique impact, involved a 1978 Chevrolet Impala striking the modified side of the VW Rabbit and is a repeat of a previous test. That test revealed a defect in the floor structure at the B-Pillar that required a modification to the original design be made.

This 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.

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. 11 PROJECT IMPROVED LIGHTWEIGHT SUBCOMPACT
SIDE STRUCTURE

DATE 10/12/78 TIME 11:35 TEMP. 65°F

TEST CONDITION Car-to-Car, Side Oblique

VEHICLE NO. 1 1978 Chevrolet Impala

VEHICLE NO. 2 1976 Volkswagen Rabbit

	VEH. NO. 1	VEH. NO. 2
TEST WEIGHT (lbs)	<u>3780</u>	<u>2370</u>
IMPACT ANGLE (deg)*	<u>60</u>	<u>0</u>
IMPACT VELOCITY (mph)**	<u>29.83</u>	<u>0</u>
MAX. CRUSH (in)	<u>See Fig. 11</u>	<u>12-7/16</u>
MAX. INTRUSION (in)	<u>---</u>	<u>10-15/16</u>

	VEH. NO. 1	VEH. NO. 2
DUMMIES		
TYPE	<u>Part 572 (LF) - 6-Yr Old (RF)</u>	<u>Hybrid II - Part 572</u>
LOCATION	<u>Driver (LF) Passenger (RF)</u>	<u>Driver (LF) - Passenger (RF)</u>
RESTRAINT	<u>Production 3-Point System on Driver Only</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)

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 cracked and some separation at A-Pillar.
Driver's door window was broken and rear side window came out of frame.

DOORS Passenger door was operable.

SEAT ANCHORAGES Driver's seat was crushed but not as extensive as in previous tests.

RESTRAINTS Intact

GENERAL COMMENTS

- All cameras operated properly.
- Car No. 1 and Car No. 2 dummy data has noise spikes on data which make the data difficult to read. The cause was found to be a bad electrical connection to the battery power and has been corrected.

TABLE 2

VEHICLE TEST WEIGHTS

CAR NO. 1 - BULLET VEHICLE - 1978 CHEVROLET IMPALA

Left Front	<u>1060</u> lbs.	Left Rear	<u>830</u> lbs.
Right Front	<u>1050</u> lbs.	Right Rear	<u>840</u> lbs.
Total Front	<u>2110</u> lbs.	Total Rear	<u>1670</u> lbs.
Total Weight = <u>2110</u> lbs. + <u>1670</u> lbs. = <u>3780</u> lbs.			
Wheel Base	<u>116.5</u> inches		
Cg _{FW}	<u>1670 lbs. 116.5 inches</u> <u>3780 lbs.</u> = <u>51.47</u> inches		

CAR NO. 2 - TARGET VEHICLE - 1976 VOLKSWAGEN RABBIT

Left Front	<u>730</u> lbs.	Left Rear	<u>440</u> lbs.
Right Front	<u>730</u> lbs.	Right Rear	<u>470</u> lbs.
Total Front	<u>1460</u> lbs.	Total Rear	<u>910</u> lbs.
Total Weight = <u>1460</u> lbs. + <u>910</u> lbs. = <u>2370</u> lbs.			
Wheel Base	<u>94.5</u> inches		
C _{GFW}	$= \frac{910 \text{ lbs.} \times 94.5 \text{ inches}}{2370 \text{ lbs.}} = \underline{36.28 \text{ inches}}$		

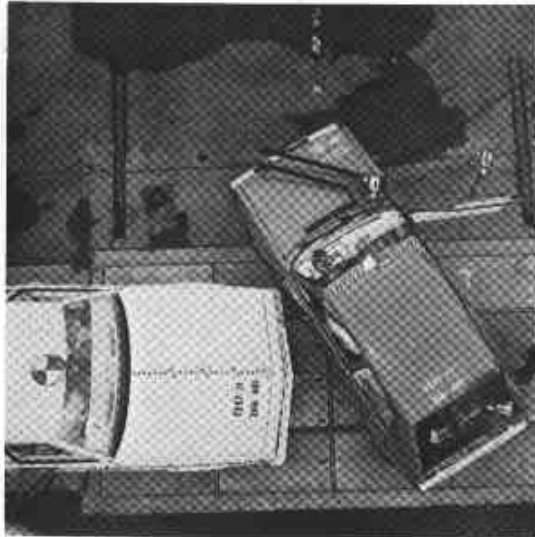


Figure 1 PRE-TEST NO. 11 – VEHICLE IMPACT CONFIGURATION



Figure 2 PRE- AND POST-TEST NO. 11 – 1978 CHEVROLET IMPALA EXTERIOR

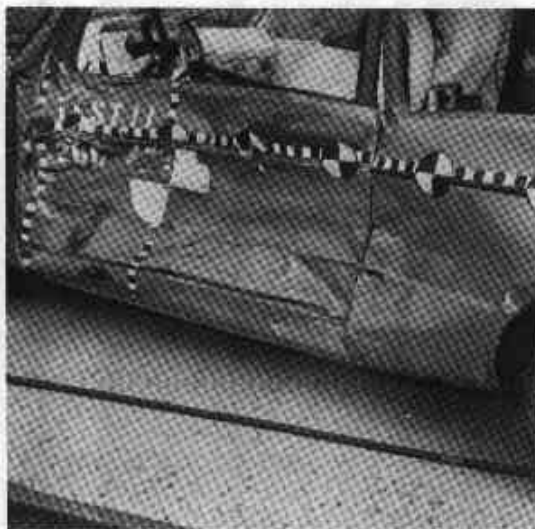


Figure 3 PRE- AND POST-TEST NO. 11 – 1976 V.W. RABBIT EXTERIOR



Figure 4 PRE- AND POST-TEST NO. 11 — 1978 CHEVROLET IMPALA INTERIOR

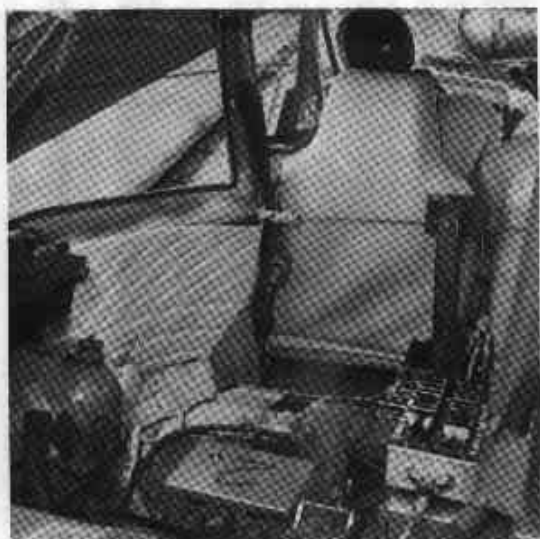


Figure 5 POST-TEST NO. 11 – CAR 2, 1976 V.W. RABBIT INTERIOR

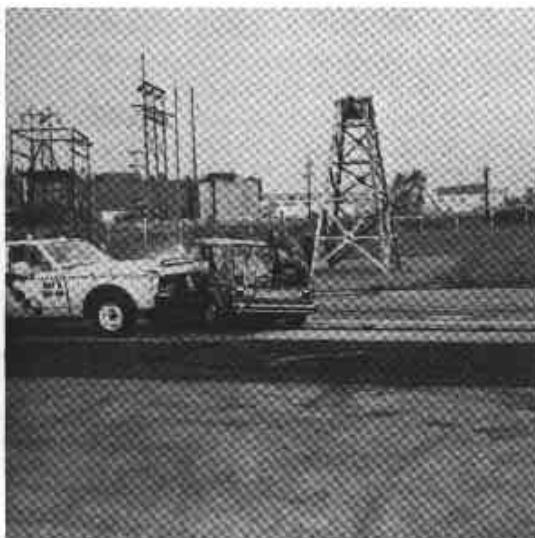


Figure 6 IMPACT AND POST IMPACT OF V.W. RABBIT

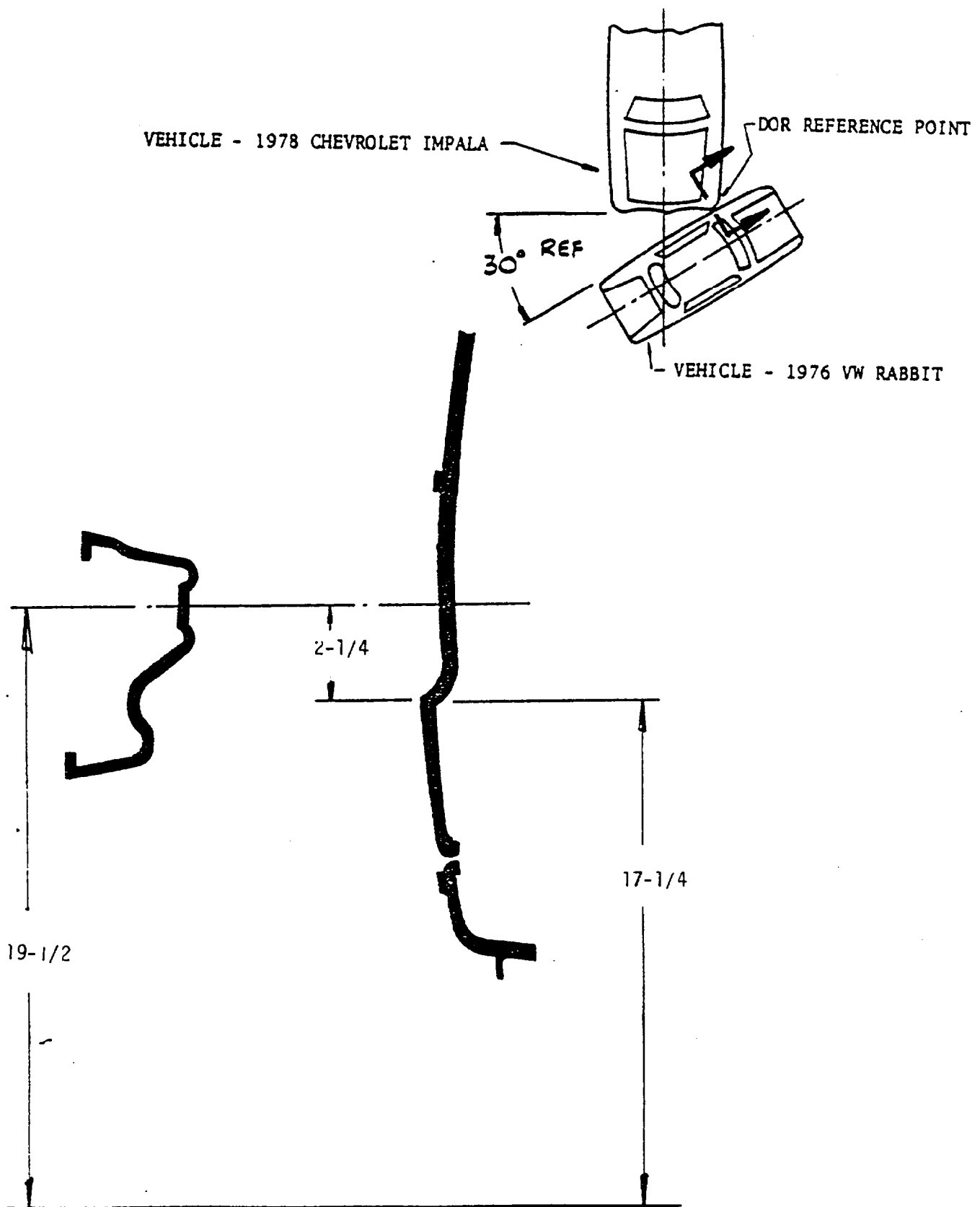
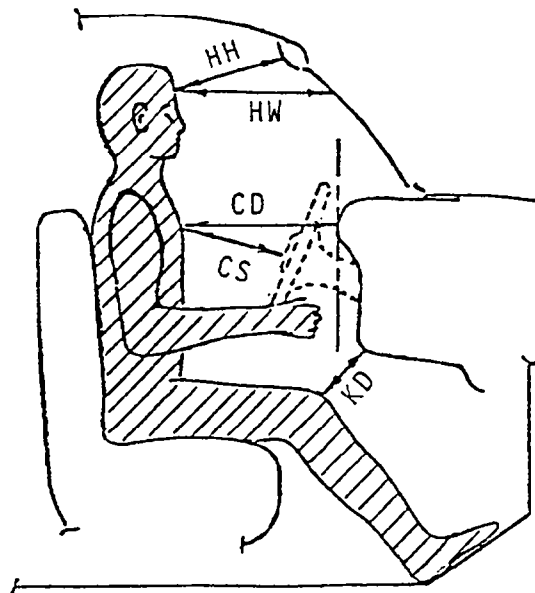
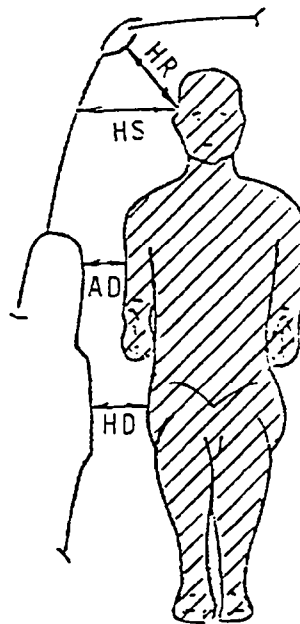


FIGURE 7 VEHICLE CRASH ATTITUDE

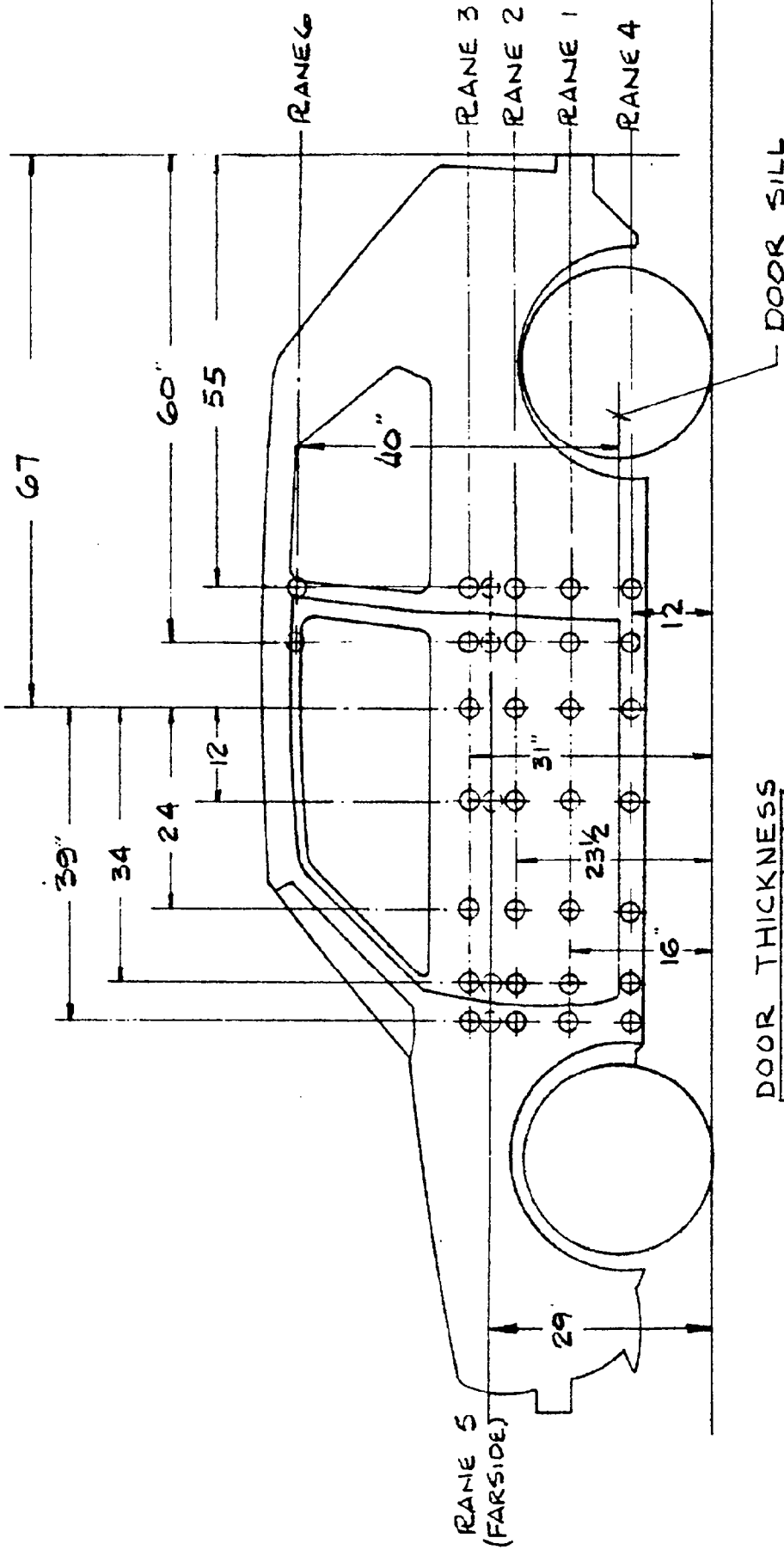


HH	19
HW	23-3/4
CD	21-1/2
CS	14-1/4
KD	8-1/2



HR	6.5
HS	8.5
AD	4.5
HD	7.0

Figure 8 OCCUPANT CLEARANCE DIMENSIONS



DOOR THICKNESS

ROW	THICKNESS	UNIT
3	1 3/4	3
4	1 1/2	2 7/8
5	1 1/4	1 3/8
6	1 1/8	1 7/8
7	1	1

FIGURE 9 SIDE INTRUSION MEASUREMENTS

PRE-TEST LOCATION MEASUREMENTS

1976 V.W. RABBIT

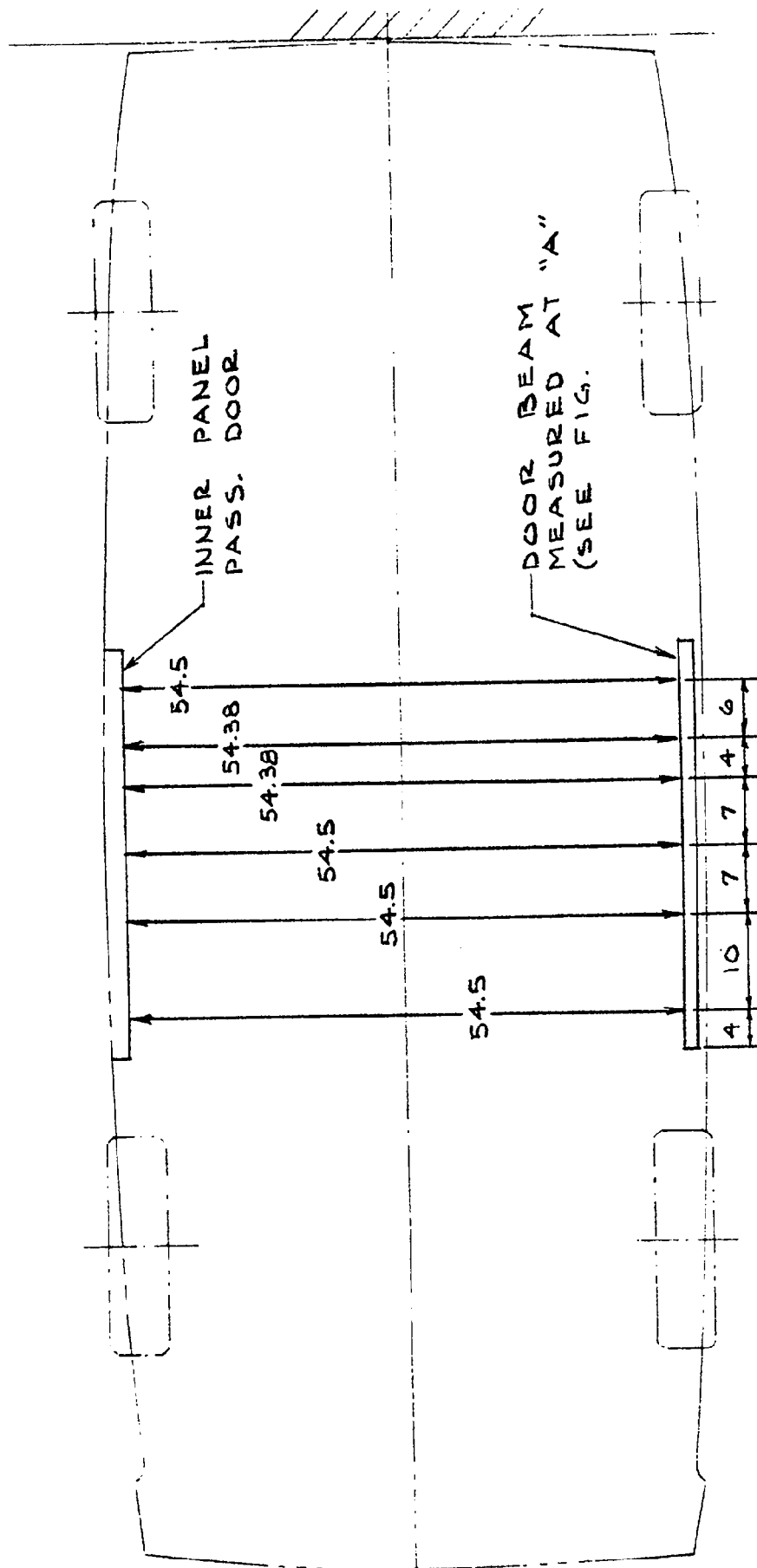
TABLE 3
SIDE INTRUSION MEASUREMENTS

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

PLANE NO.	DIMENSIONS (INCHES)						
	ROW						
	1	2	3	4	5	6	7
PRE	4-1/4	4-7/16	4-7/16	4-11/16	4-5/8	4-11/16	4-7/8
1 POST	5-3/4	7-1/4	10	11-3/4	11-1/2	11-11/16	10-1/8
DIFF.	1-1/2	2-13/16	5-9/16	7-1/16	6-7/8	7	5-1/4
PRE	3-11/16	3-7/8	3-3/4	3-11/16	3-3/4	3-3/4	3-7/8
2 POST	5-3/8	10-3/8	14-1/16	15-5/8	14-9/16	13-5/16	12-11/16
DIFF.	1-11/16	6-1/2	10-5/16	11-15/16	10-13/16	9-9/16	9-13/16
PRE	4-3/8	4-1/4	4-1/16	3-7/8	3-15/16	3-15/16	4
3 POST	5-3/4	9-5/16	14-1/2	16-5/16	13-1/2	13-3/4	12-1/2
DIFF.	1-3/8	5-1/16	10-7/16	12-7/16	9-9/16	9-13/16	8-1/2
PRE	5-5/8	5-3/4	5-3/4	5-15/16	6-1/8	6-1/4	6-7/16
4 POST	6-15/16	7-3/4	8-1/4	9	9-1/2	9-3/4	8-7/8
DIFF.	1-5/16	2	2-1/2	3-1/16	3-3/8	3-1/2	2-7/16
PRE	3-5/8	3-5/8		3-7/16	3-1/2	3-5/8	3-11/16
5 POST	2-3/4	2-5/8		2-5/8	2-3/4	2-7/8	3-1/16
DIFF.	7/8	1		13/16	3/4	3/4	5/8
PRE						11-7/8	11-7/8
6 POST						12-7/16	13-3/4
DIFF.						- 9/16	1-7/8
PRE							
7 POST							
DIFF.							

1976 VW RABBIT

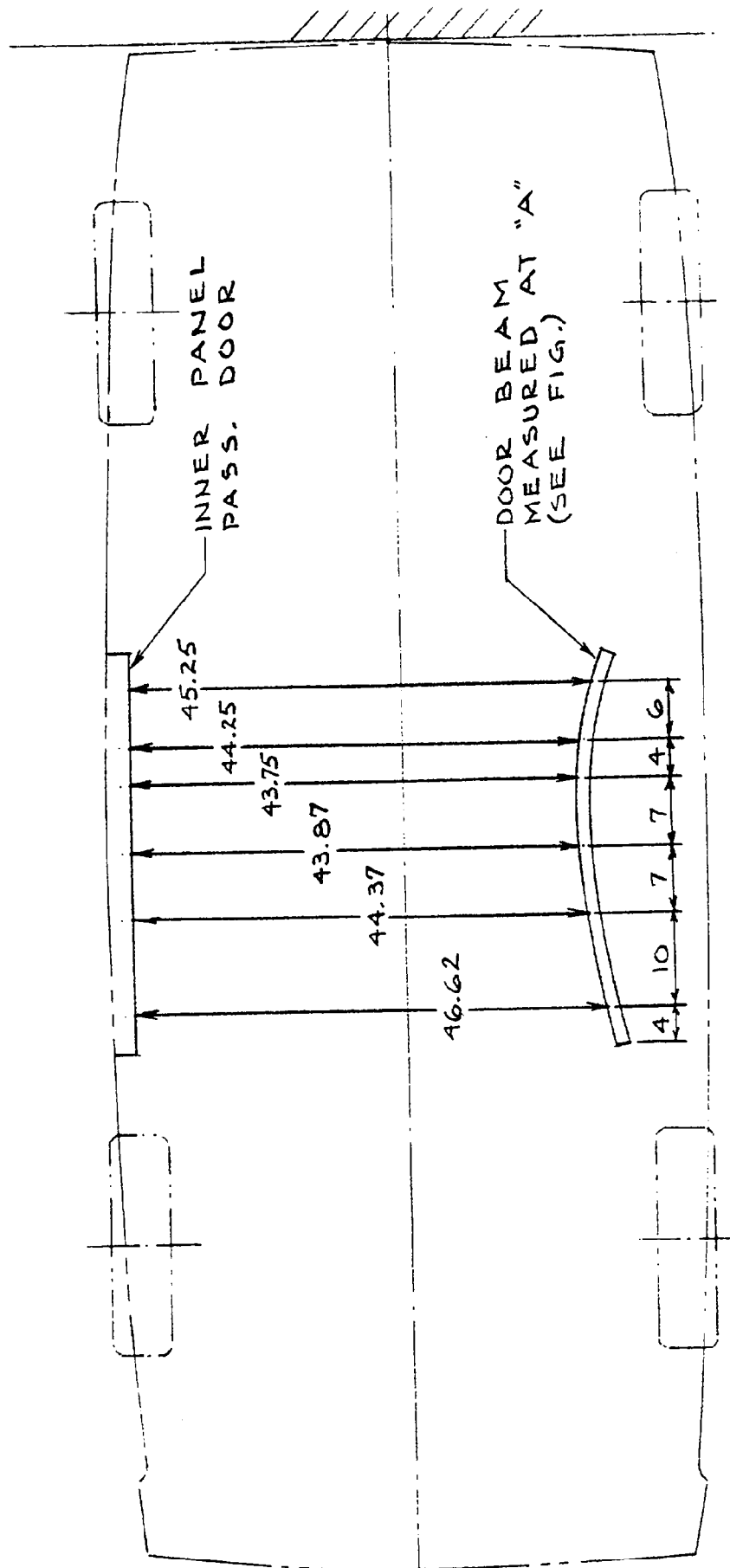
BUDD DYNAMIC TEST NO. 11



PLANE "A"

Figure 10A PRE-TEST DOOR BEAM INTRUSION MEASUREMENTS

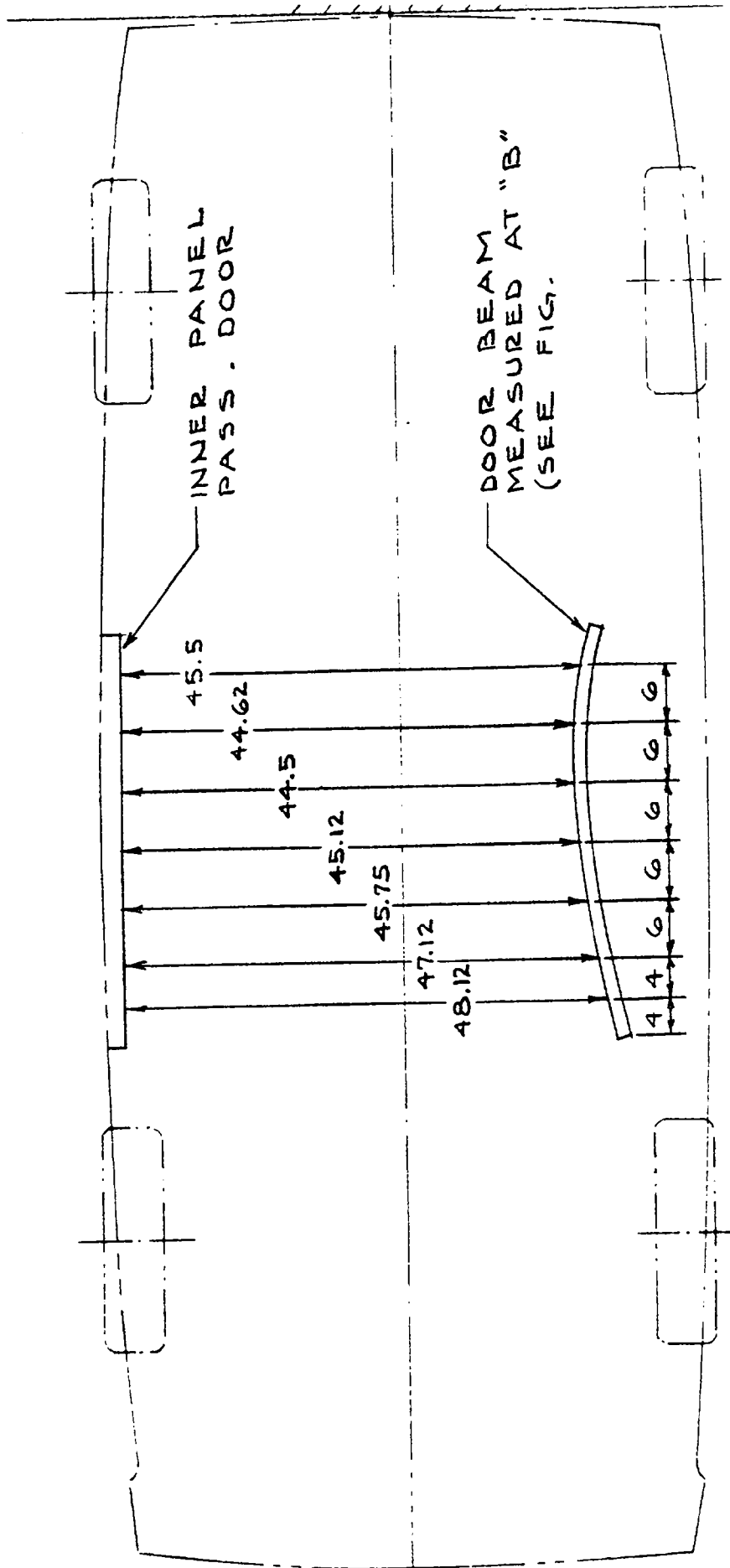
1976 VW RABBIT
SCALE .06" = 1



1976 VW RABBIT
SCALE .06" = 1"

PLANE "A" TEST

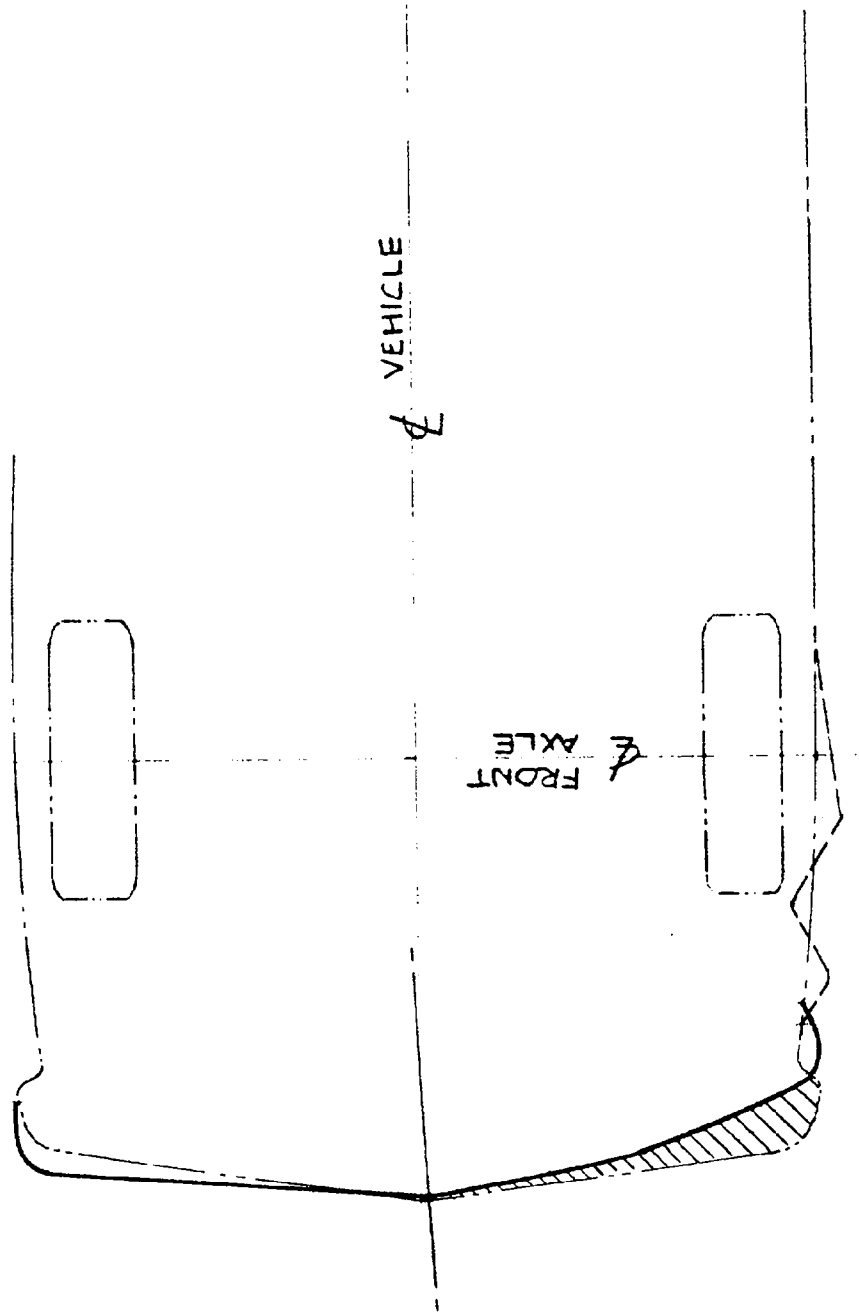
Figure 10C POST-TEST DOOR BEAM INTRUSION MEASUREMENTS



1976 VW RABBIT
SCALE .06" = 1"

PLANE "B" TEST

Figure 10D POST-TEST DOOR BEAM INTRUSION MEASUREMENTS



0 3 6 9 12
SCALE - (Inches)

Figure 11 PRE- AND POST-TEST DEFORMATION - CAR NO. 1 - 1978 CHEVROLET IMPALA

TABLE 4
ELECTRONIC INSTRUMENTATION TEST NO. 11
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 of 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. 11
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 of 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

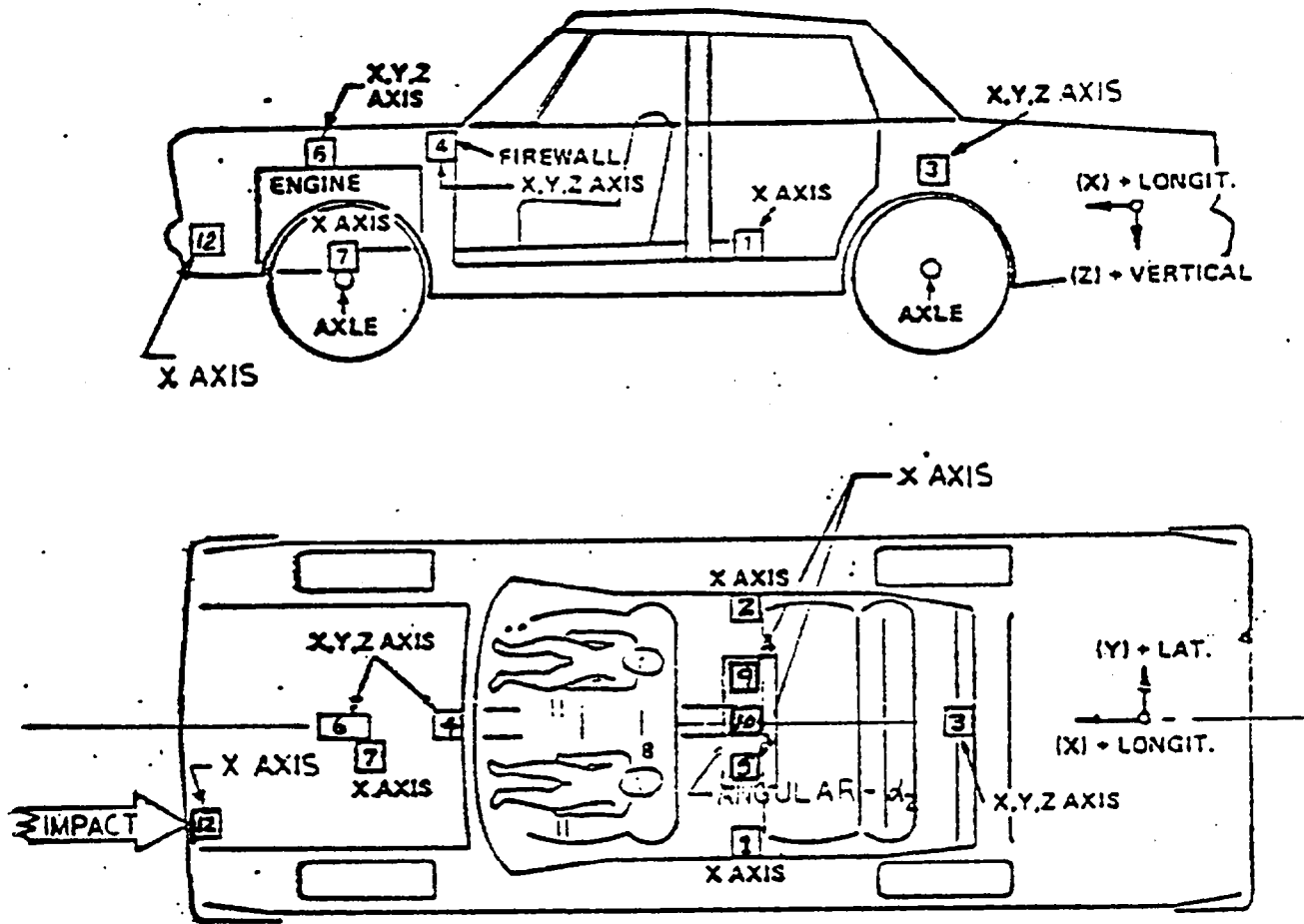
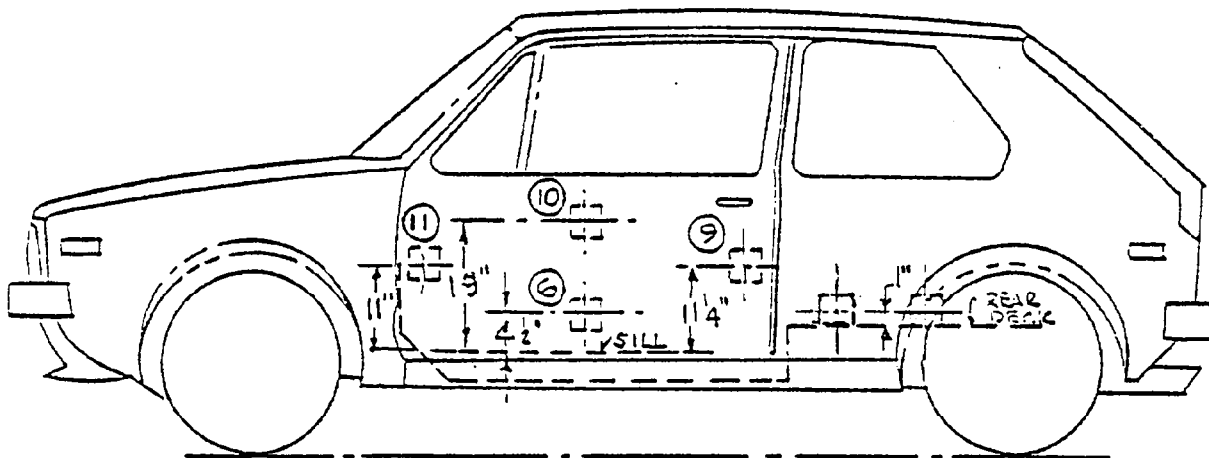
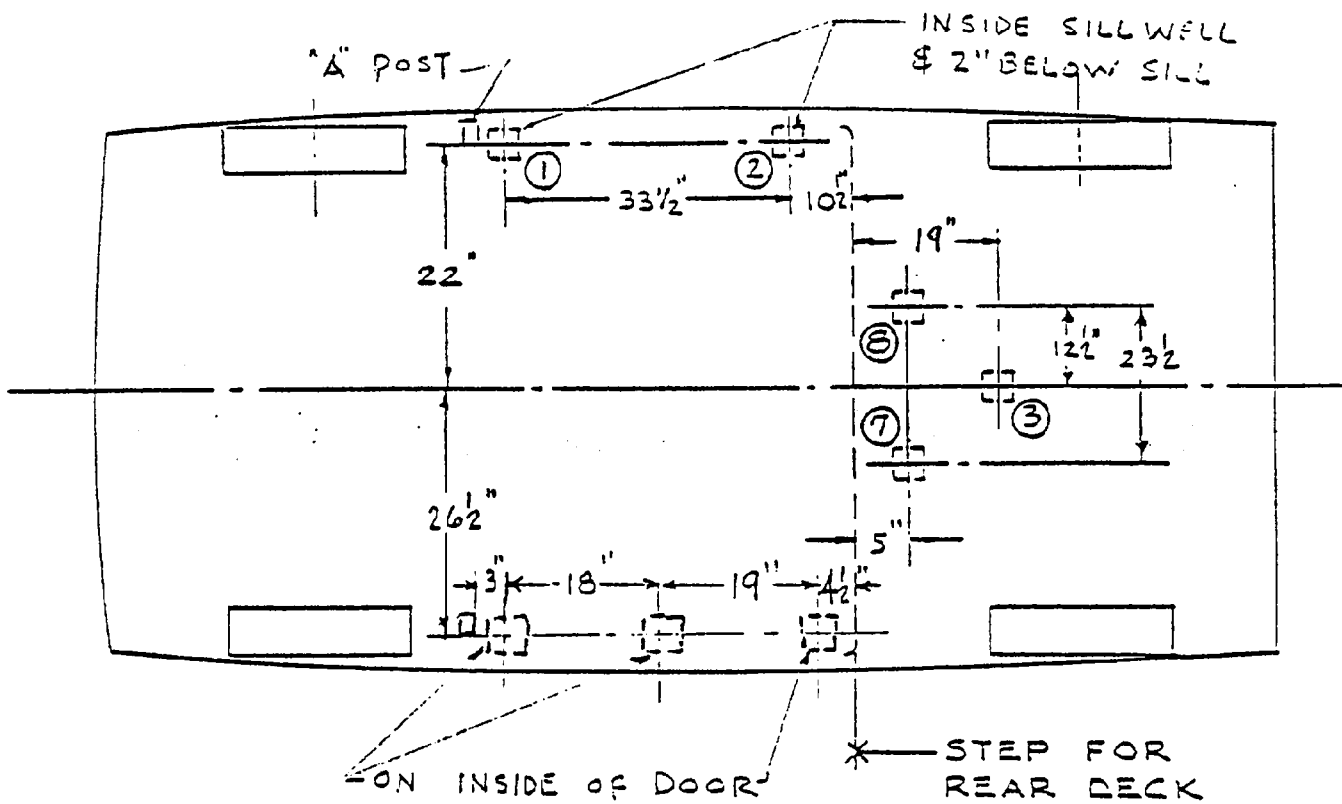


FIGURE 12 - VEHICLE ACCELEROMETER LOCATIONS



CAR NO. 2 - TARGET VEHICLE - 1976 VOLKSWAGEN RABBIT

Figure 13 VEHICLE ACCELEROMETER LOCATIONS

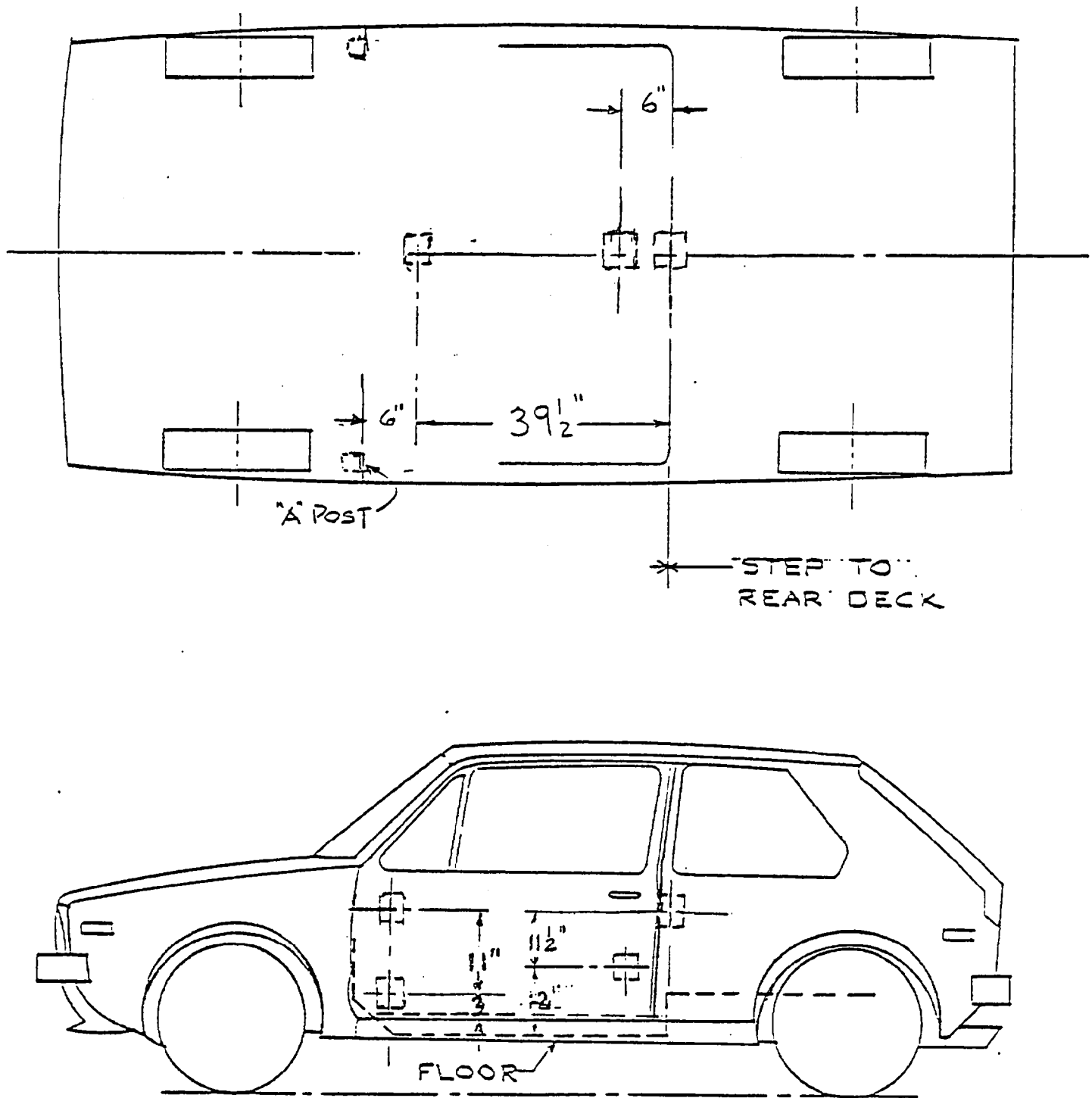


Figure 14 VEHICLE POTENTIOMETER LOCATIONS

TABLE 6

HIGH SPEED CAMERA INFORMATION (TEST No. 11)

CAMERA NO.	LOCATION	TYPE	LENS (mm)	SPEED (fps)
1) SOUTH WIDE	A = 23 ft. B = 2 ft. 10 in.	Photosonics	13	850
2) SOUTH CLOSE	C = 24 ft. 10 in. D = 5 ft.	Photosonics	25	775
3) TOWER SOUTH	L = 25 ft. M = 12 ft.	Photosonics	13	650
4) NORTH WIDE	E = 26 ft. F = 14 ft.	Photosonics	13	650
5) NORTH CLOSE	G = 26 ft. 8 in. H = 19 ft.	Photosonics	25	775
6) TOWER 45°	J = 21 ft. 7 in. K = 11 ft.	Photosonics	13	900
7) TOWER	31 ft. 6 in.	Photosonics	13	650
8) HOOD	On-board	Stalex	8	1000
9) PASSENGER DOOR	On-board	Stalex	8	1500
10) REAR	On-board	Stalex	8	950

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.

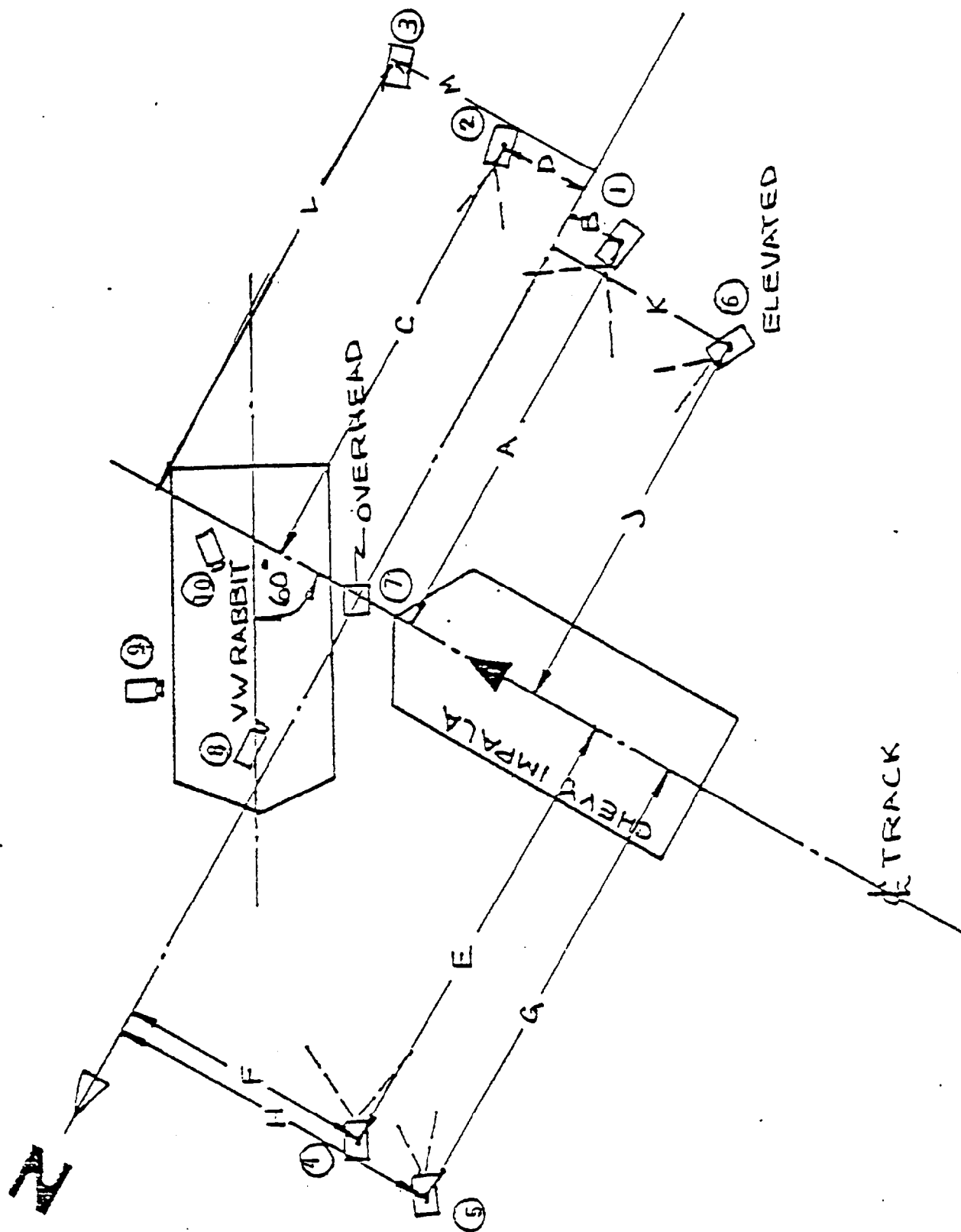


FIGURE 15 HIGH-SPEED CAMERA LOCATIONS

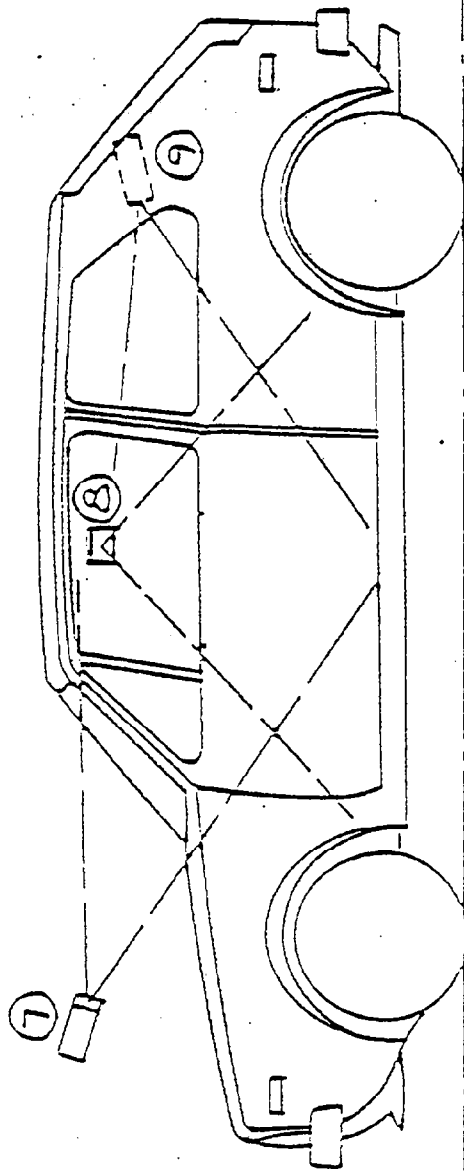


Figure 16 - ON-BOARD HIGH SPEED CAMERA LOCATIONS

TABLE 7

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	8	14	-8	3.5	-4.5	10.5				
DUMMY (2)												
DUMMY (3)												
DUMMY (4)												

	MAXIMUM FORCE-FEMUR LOAD (LBS)	
	RIGHT FEMUR	LEFT FEMUR
DUMMY (1)	----	----
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)	400	450	---
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)	26.2	.099	.164	11.05	48.8	14
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)	-28	26	45	48	-28	50	10	63	-40	98		
DUMMY (2)	5	35	30	40	10	70	4	75	-4.5	60		
DUMMY (3)												
DUMMY (4)												

	MAXIMUM FORCE-FEMUR LOAD (LBS)	
	RIGHT FEMUR	LEFT FEMUR
DUMMY (1)		
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)			
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)	263.63	.060	.104	32.4	398	450
DUMMY (2)	105.03	.080	.122	22.9	165	610
DUMMY (3)						
DUMMY (4)						

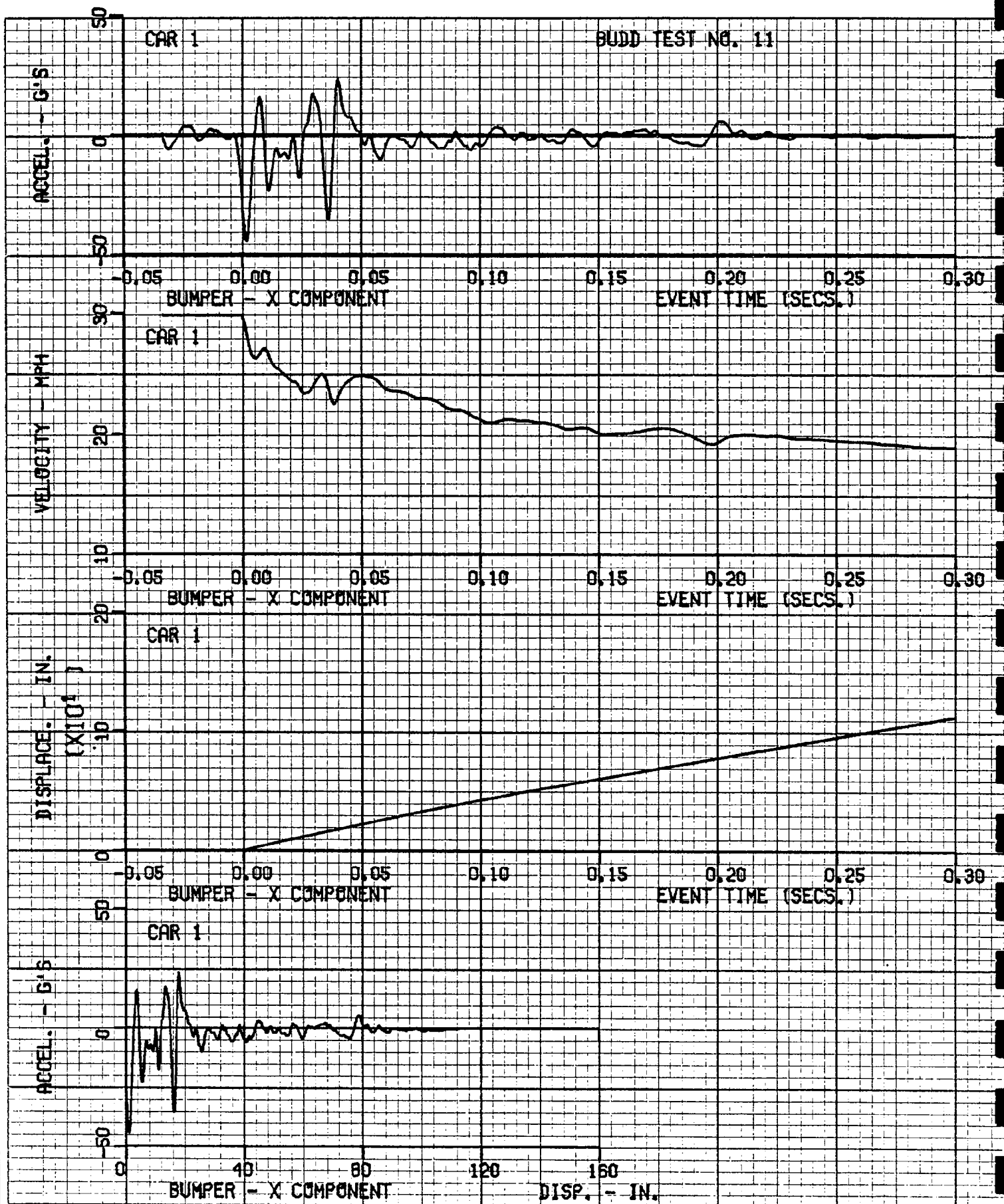
*DEFINED AS EXCEEDING 0.003 SEC. DURATION

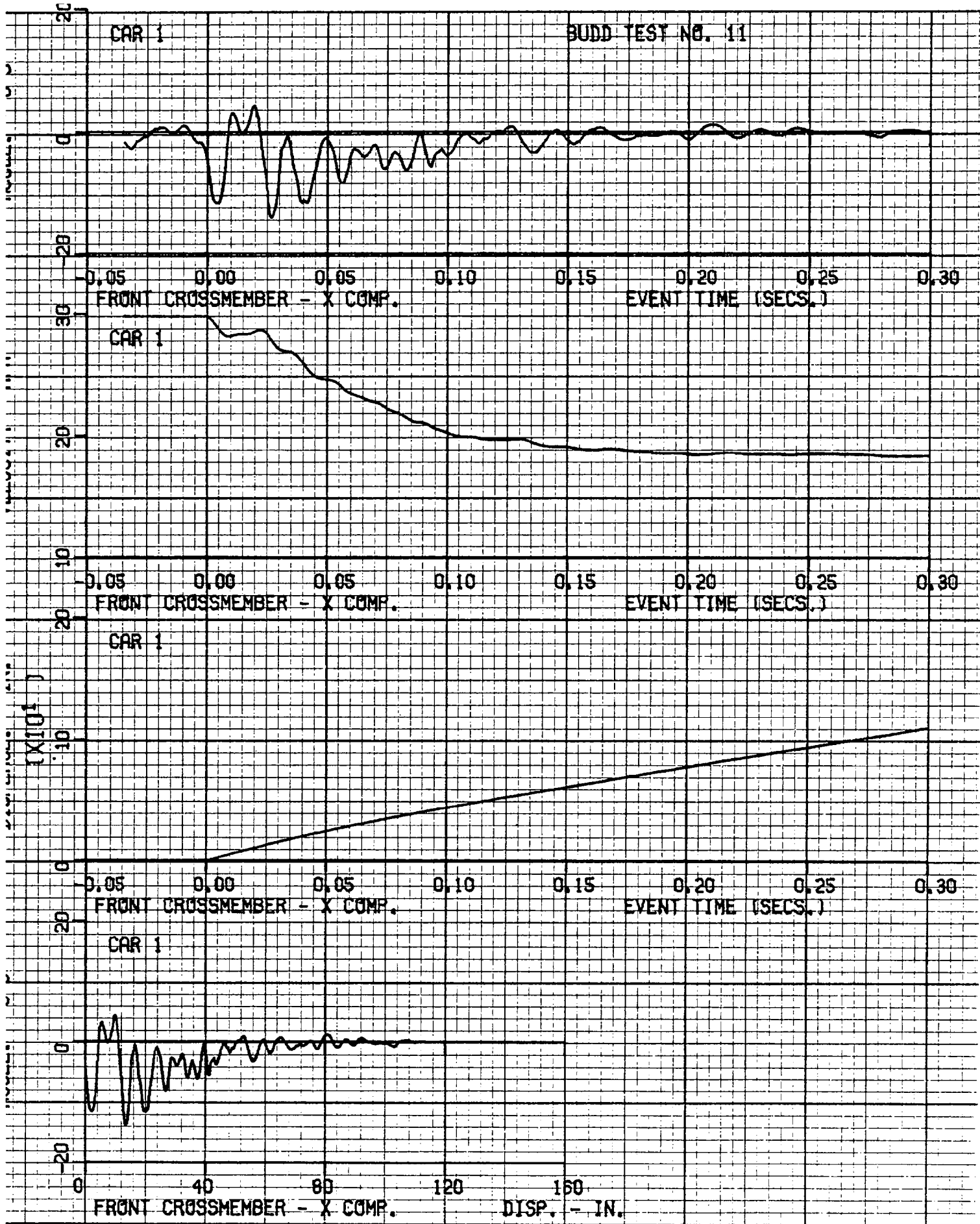
**AS DEFINED IN FMVSS NO. 208

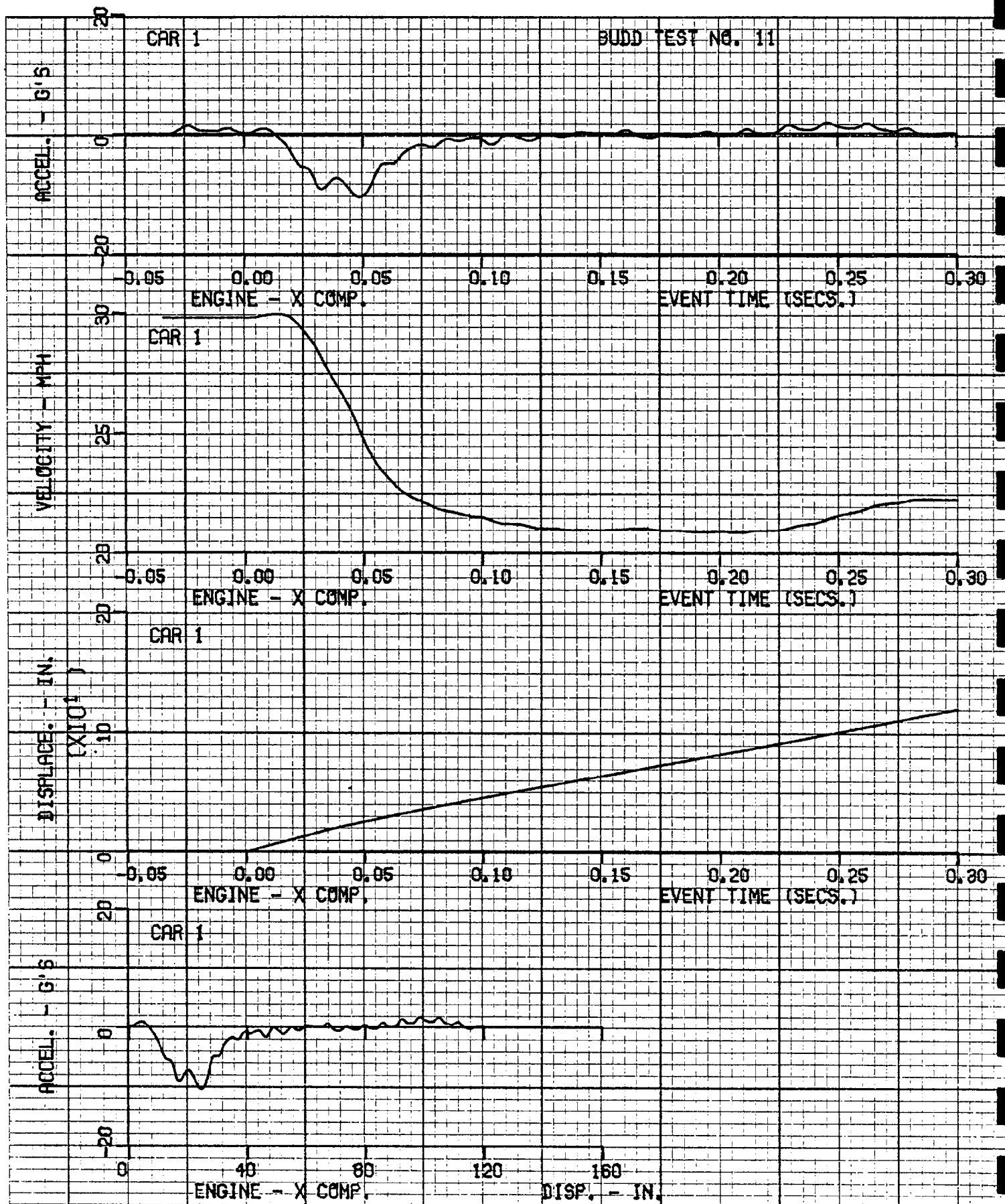
TEST NO. 11

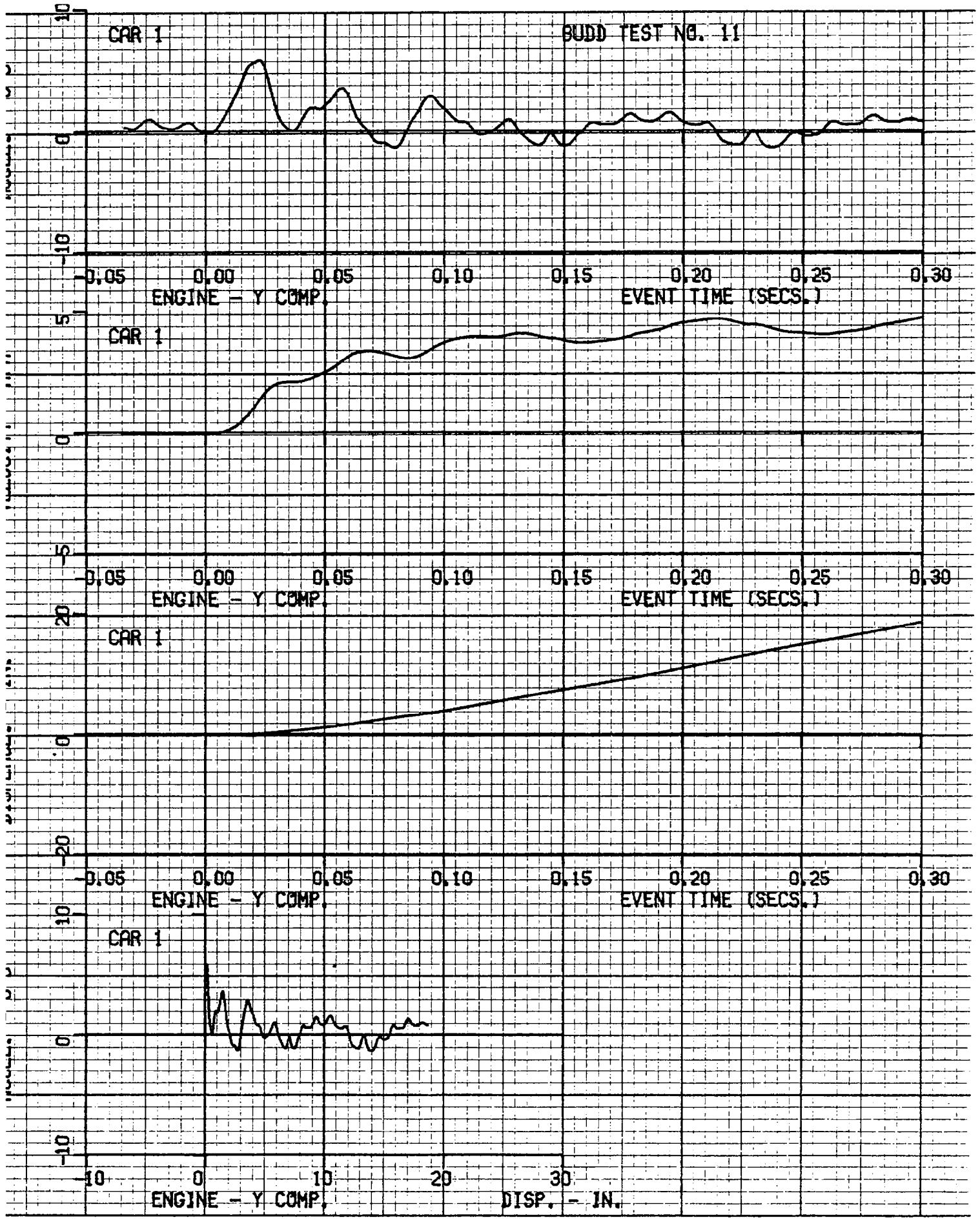
CAR NO. 1 - 1978 CHEVROLET IMPALA

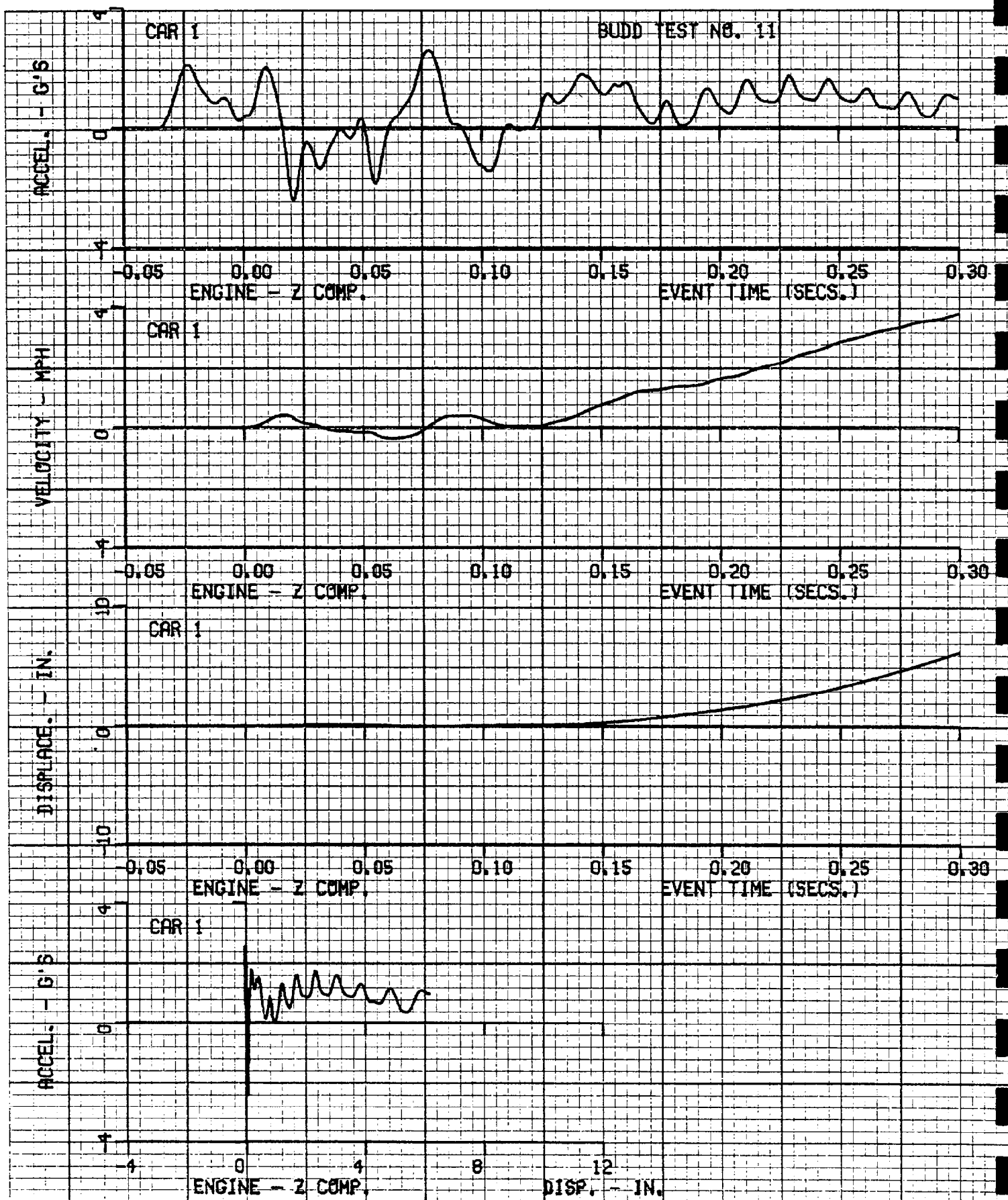
VEHICLE DATA - 60 HZ CHANNEL CLASS

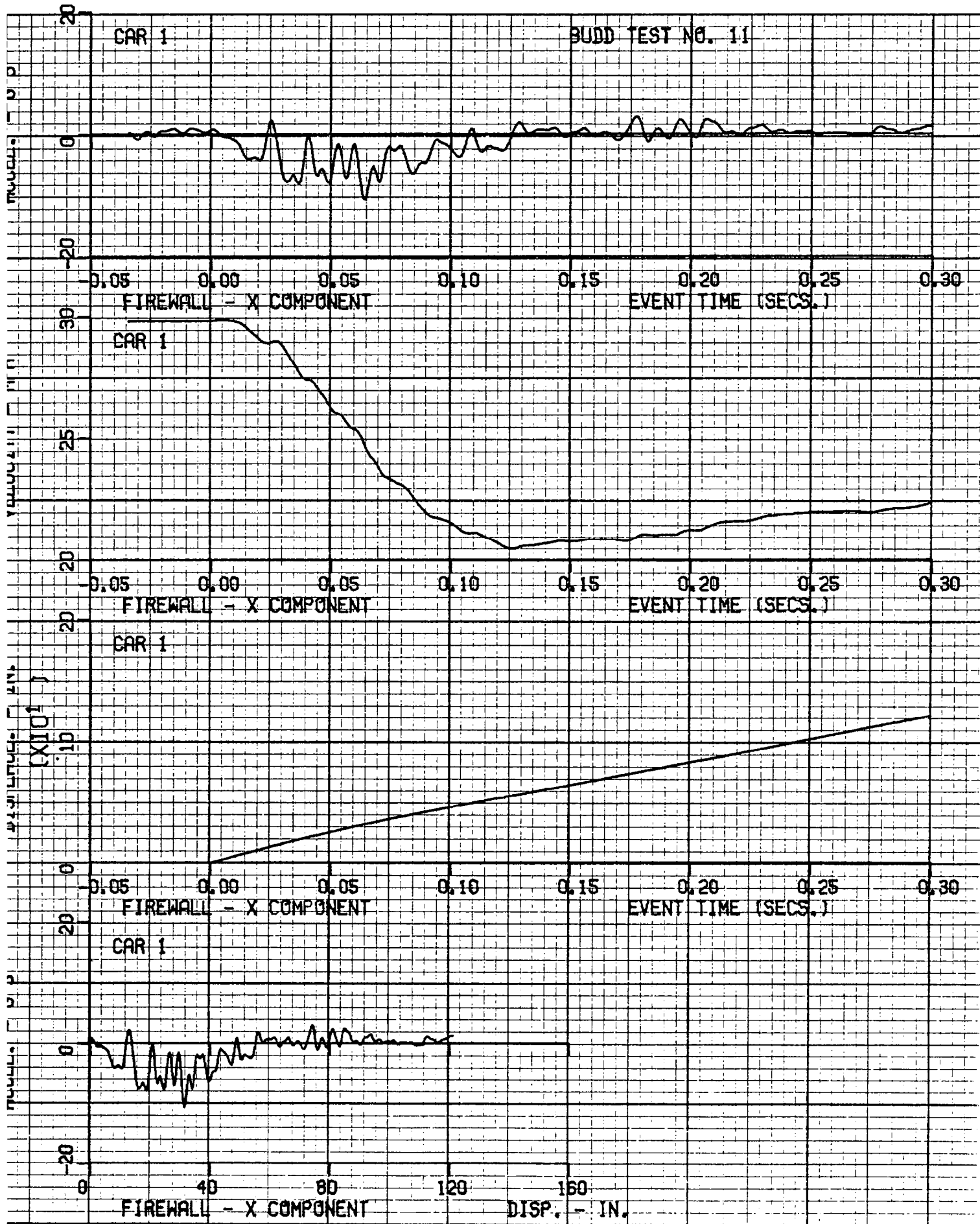


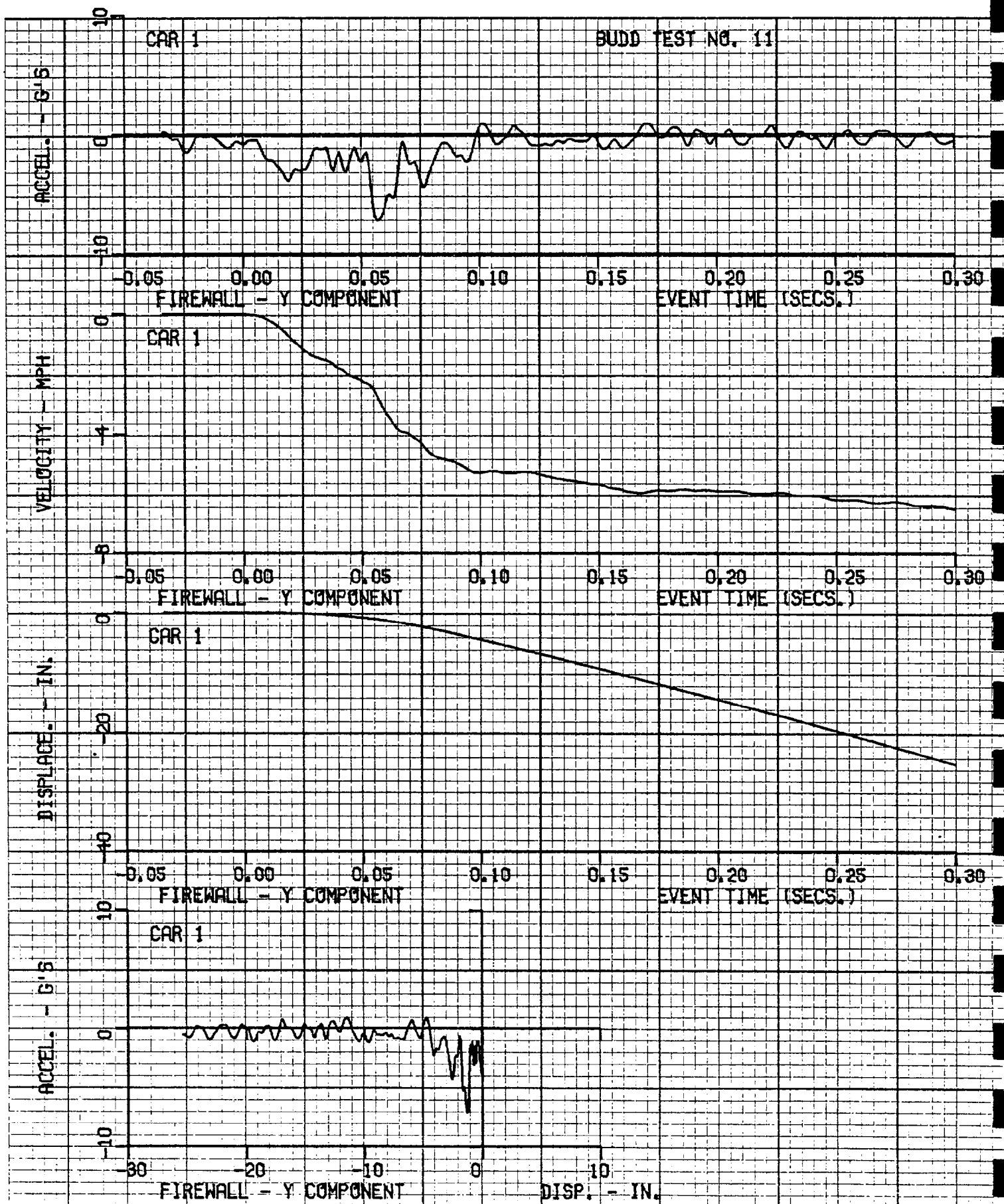


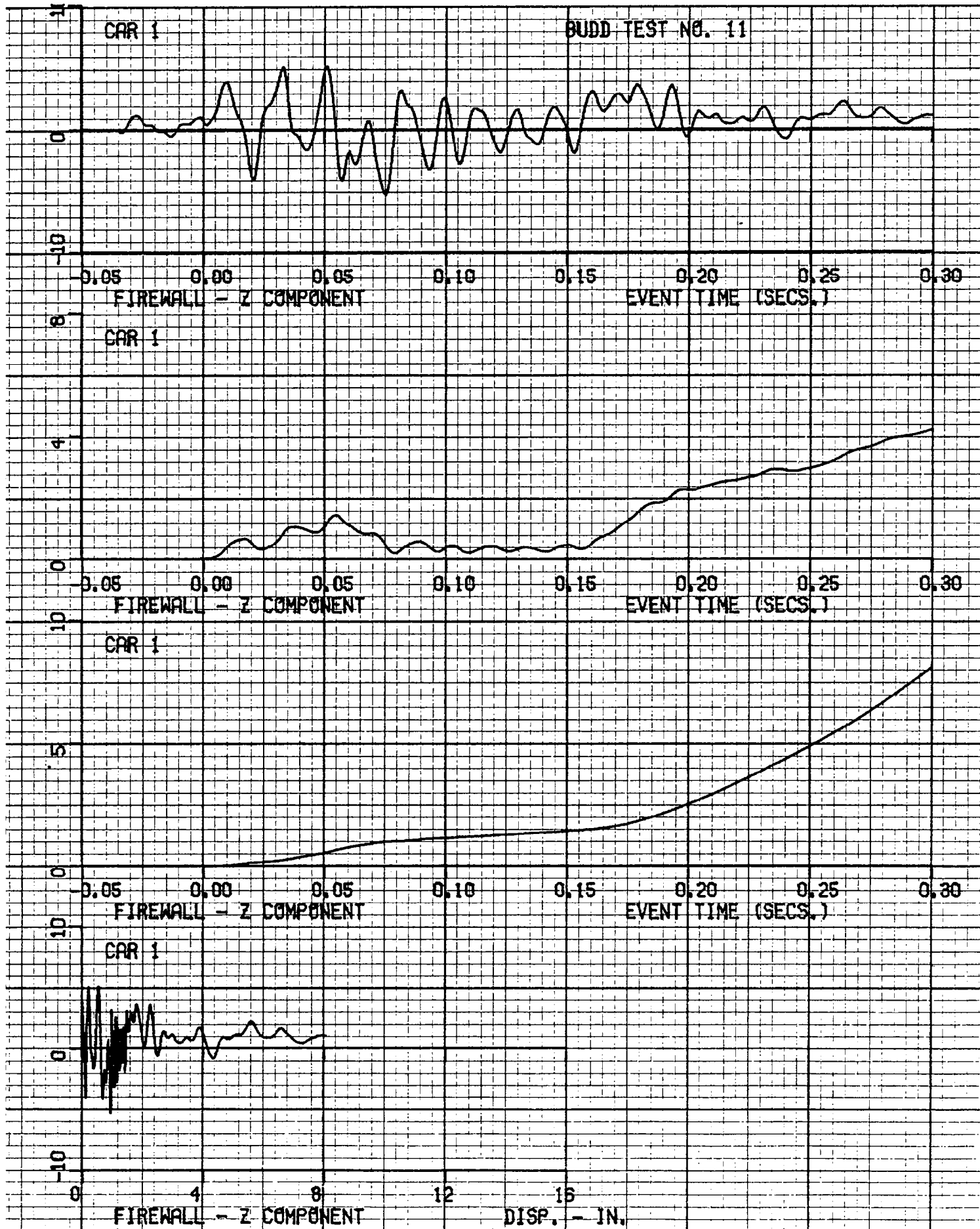


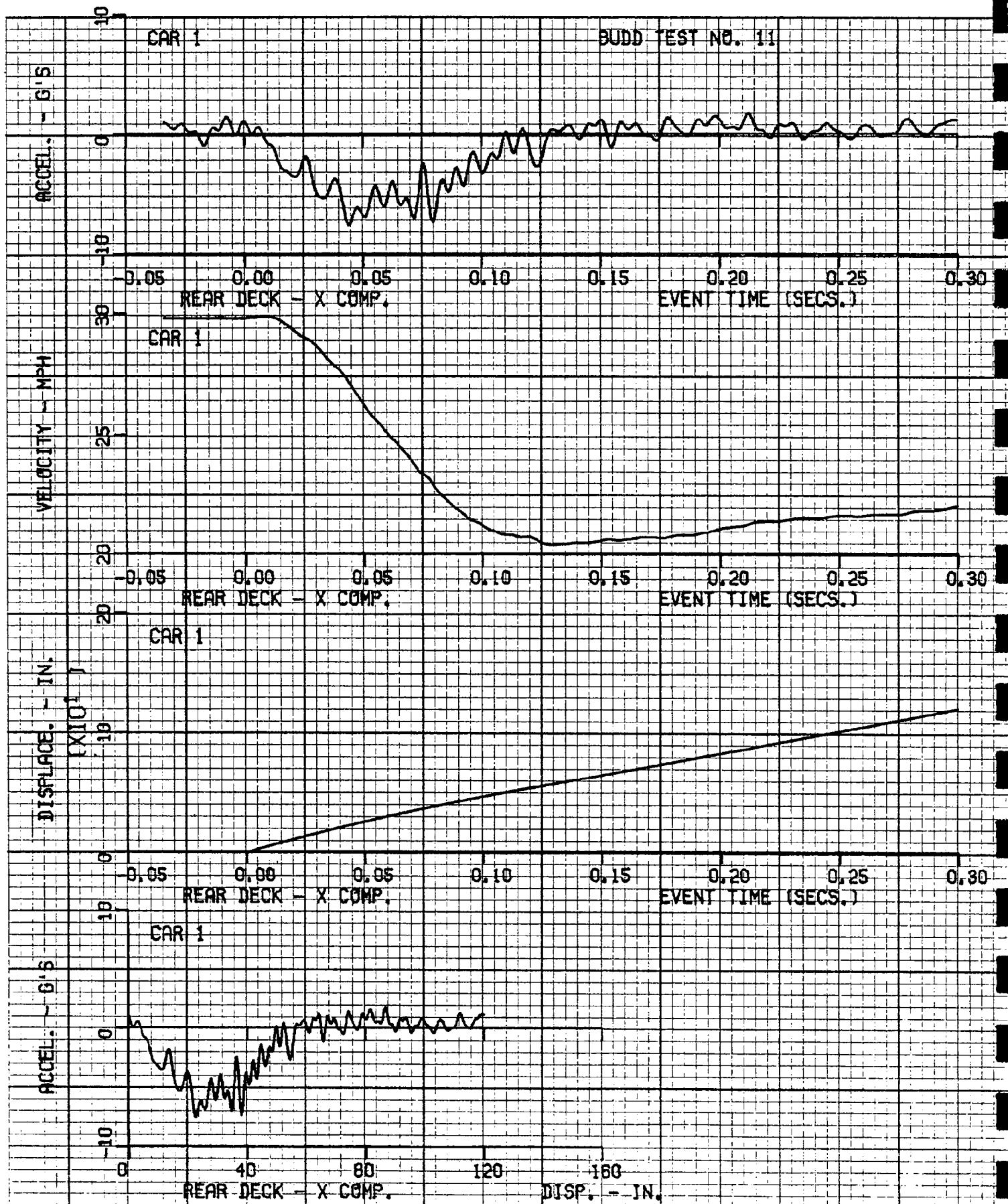




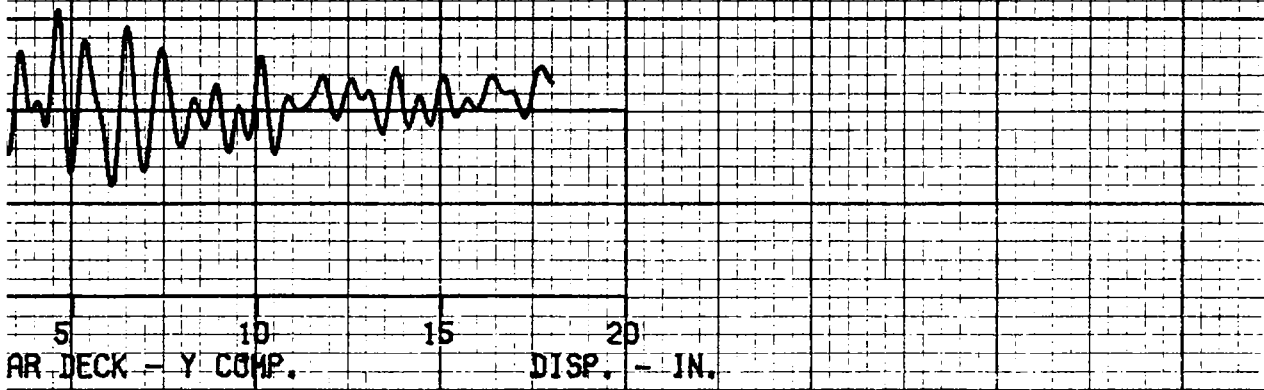
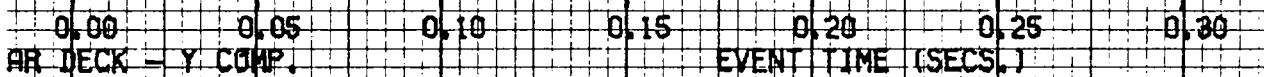
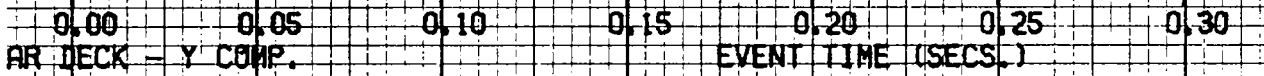
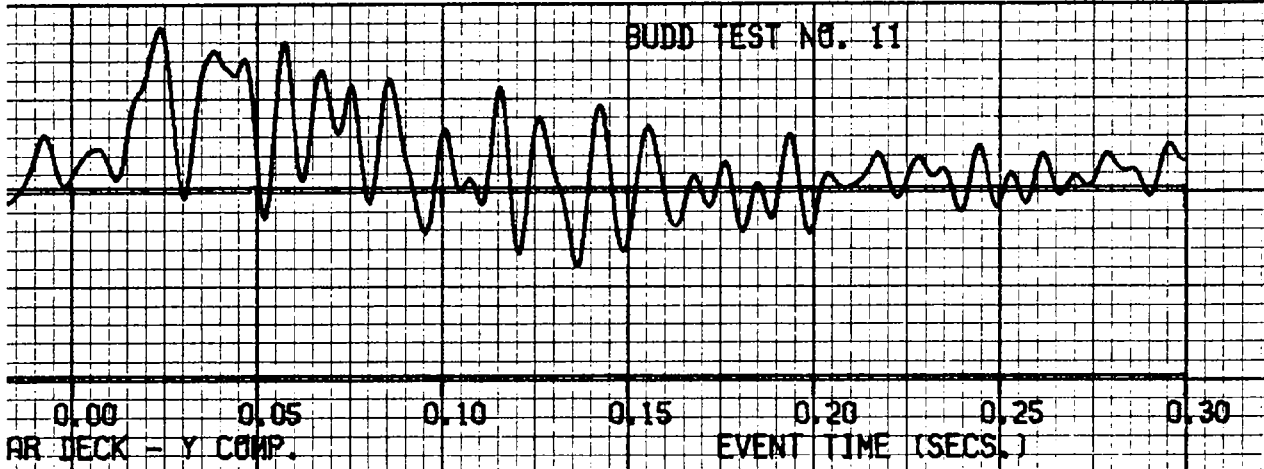


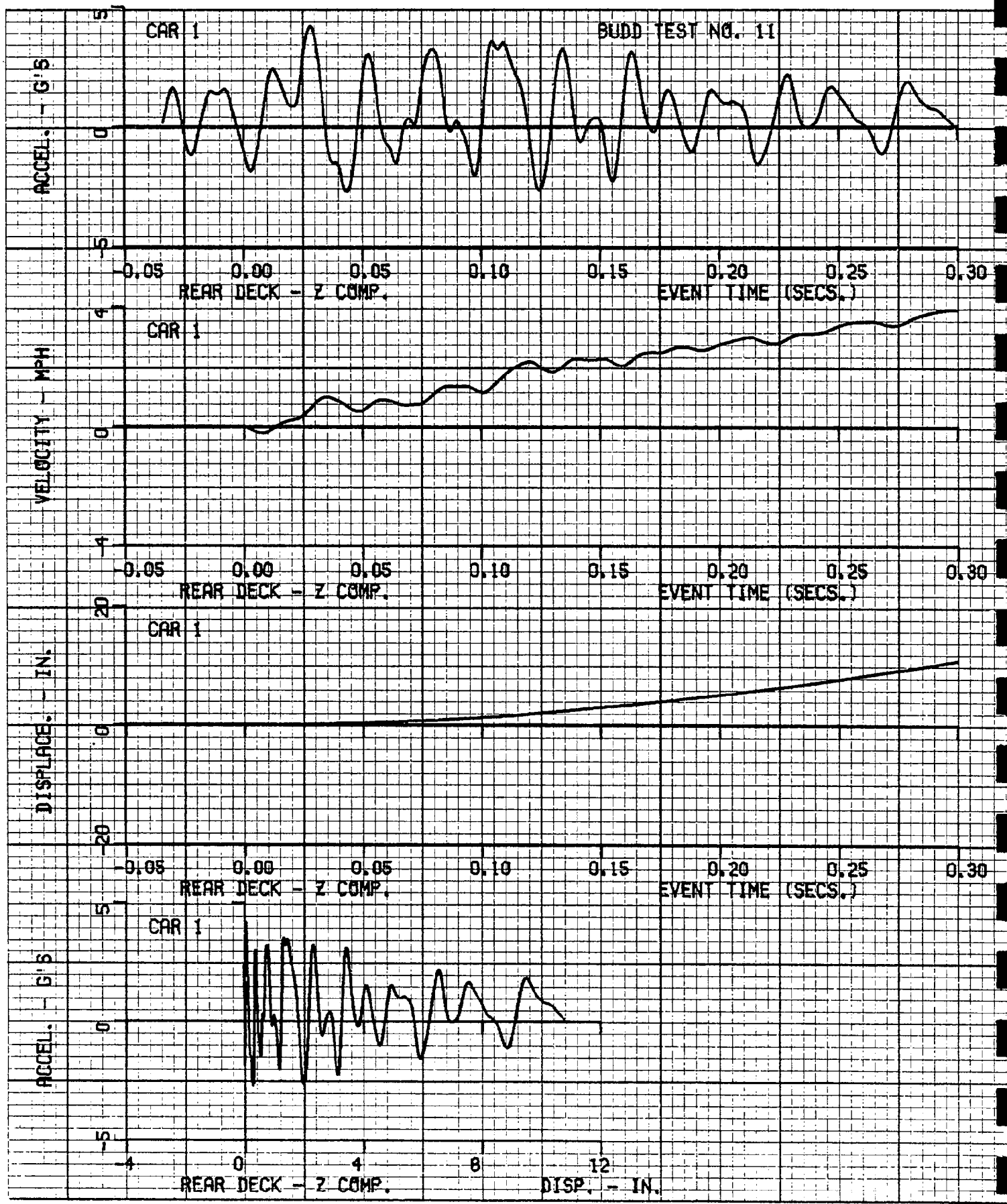


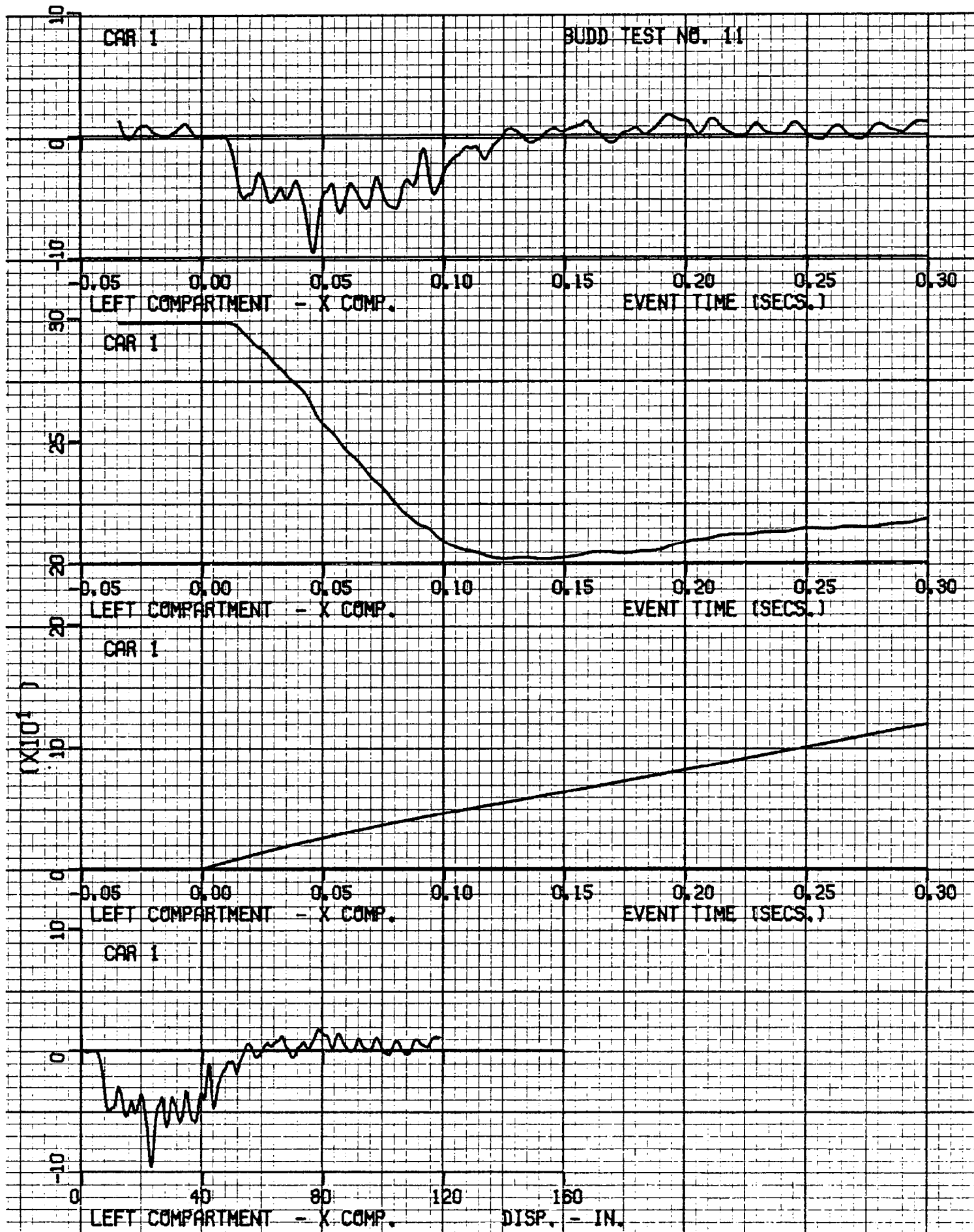


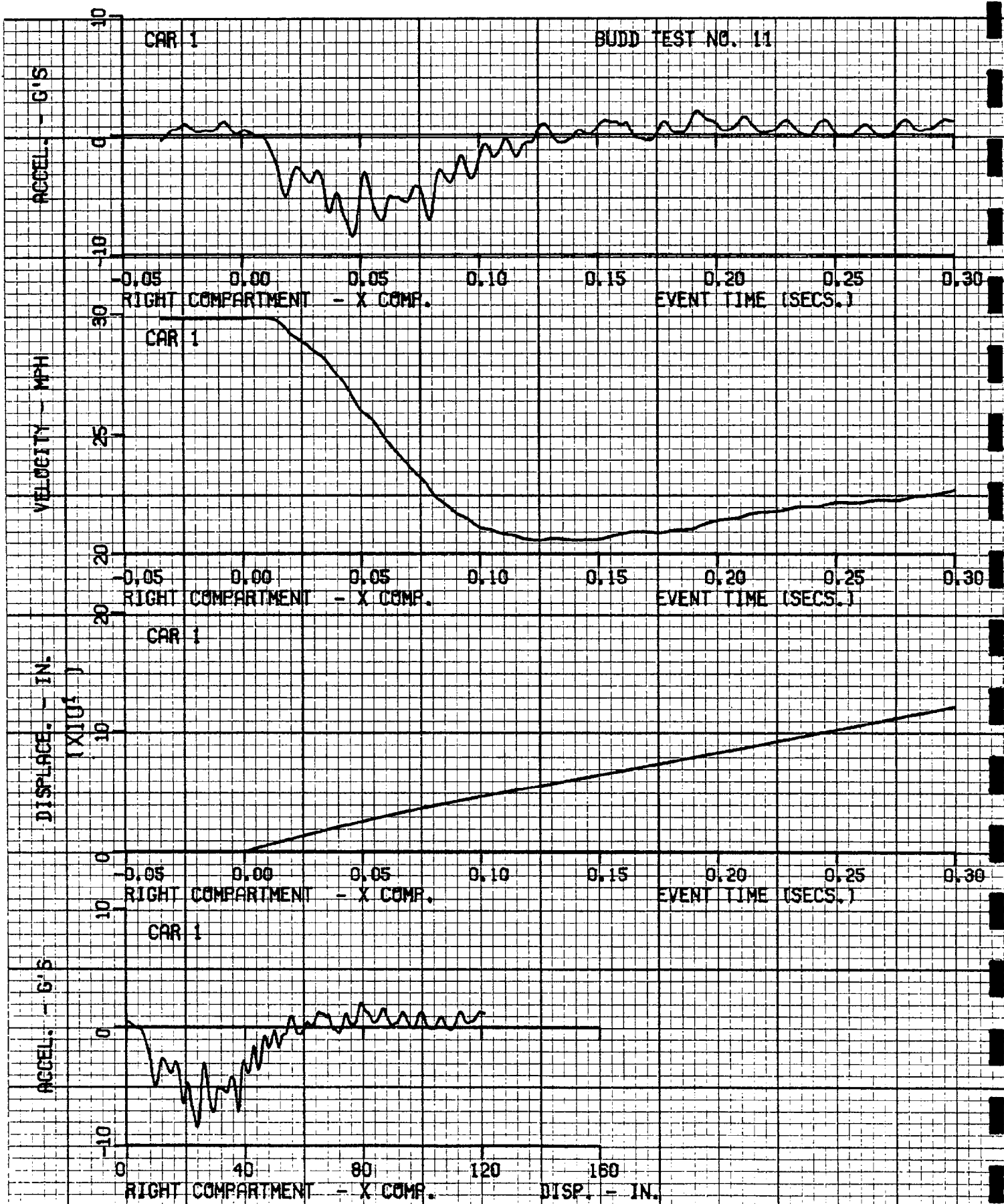


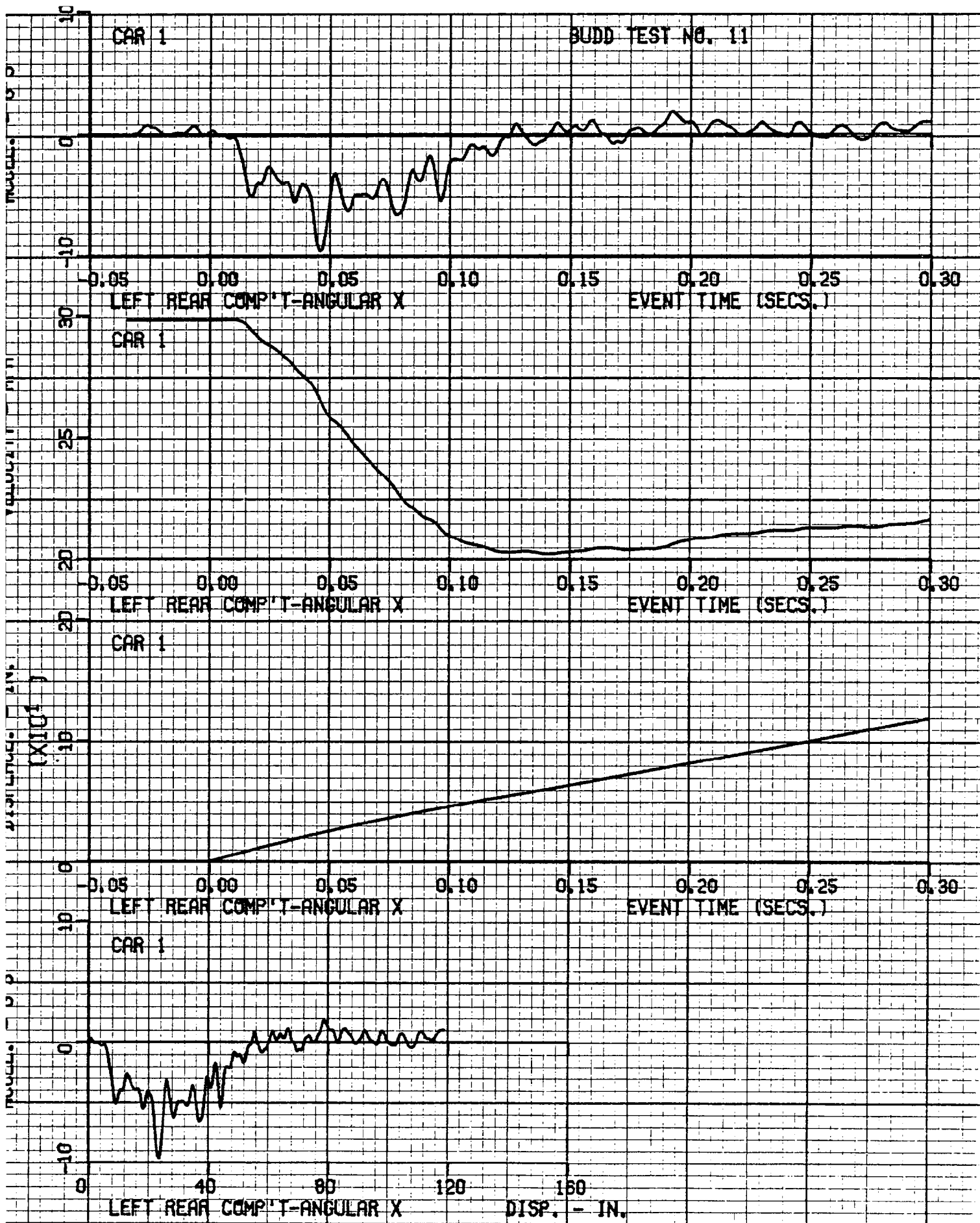
BUDD TEST NO. 11

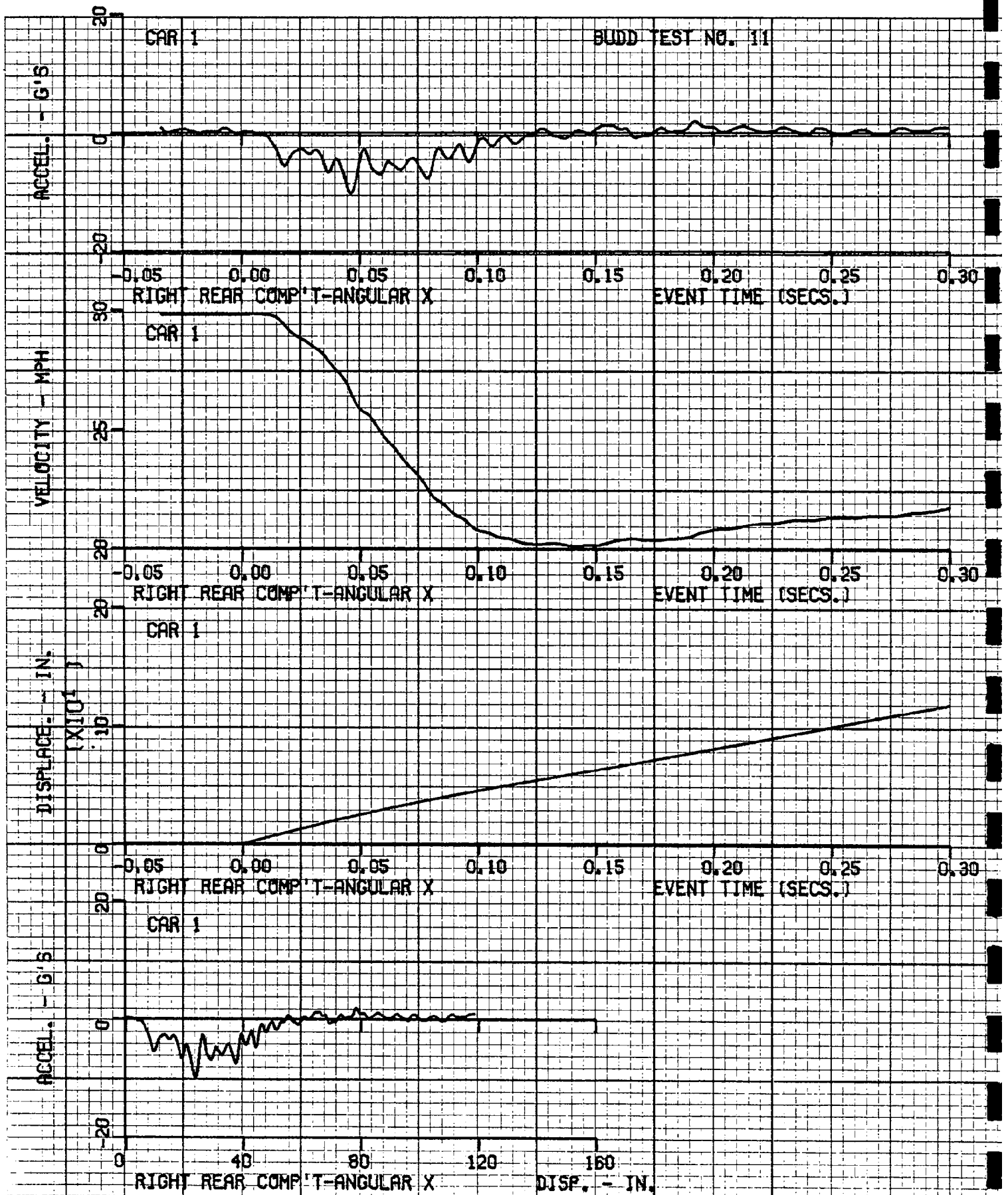


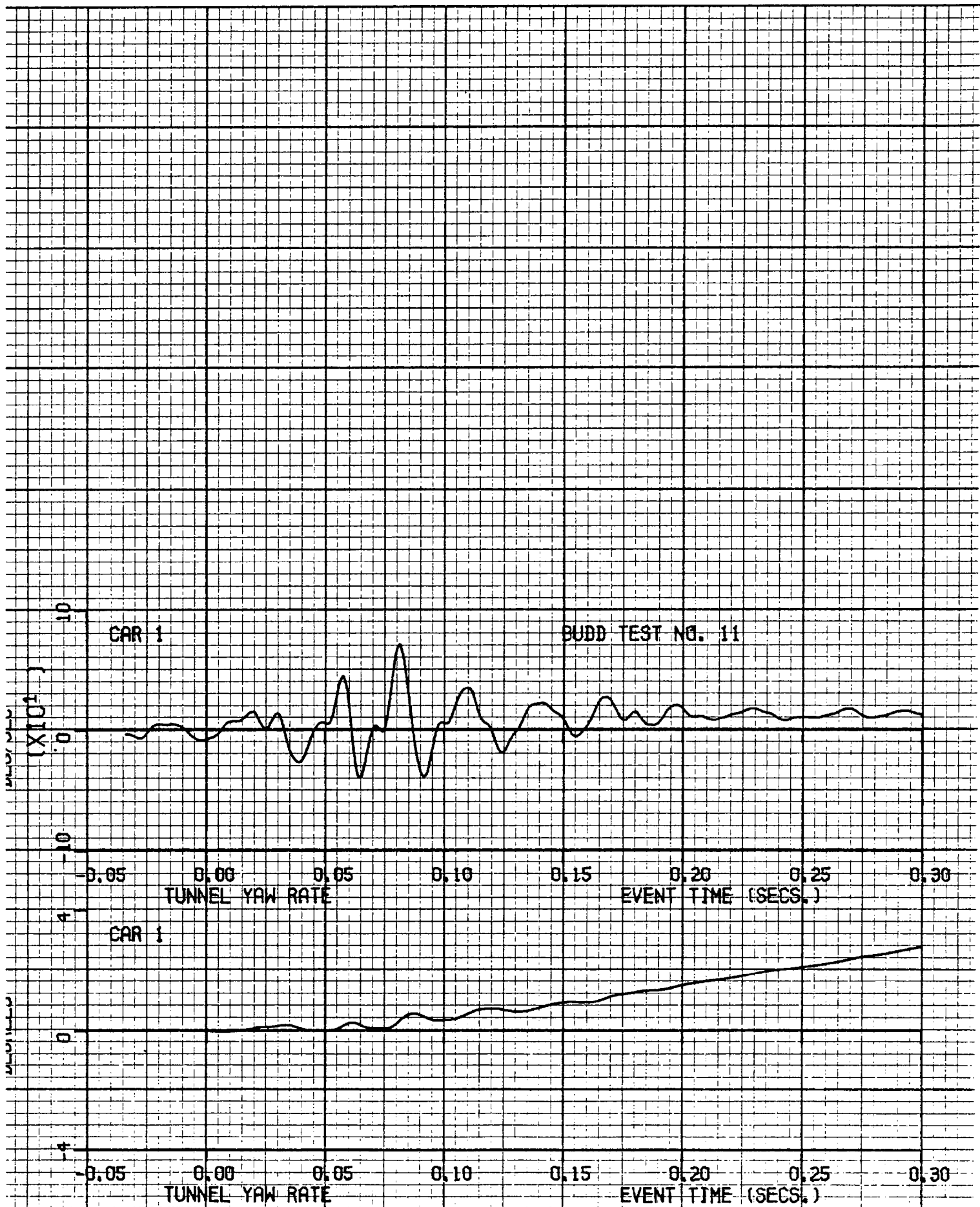








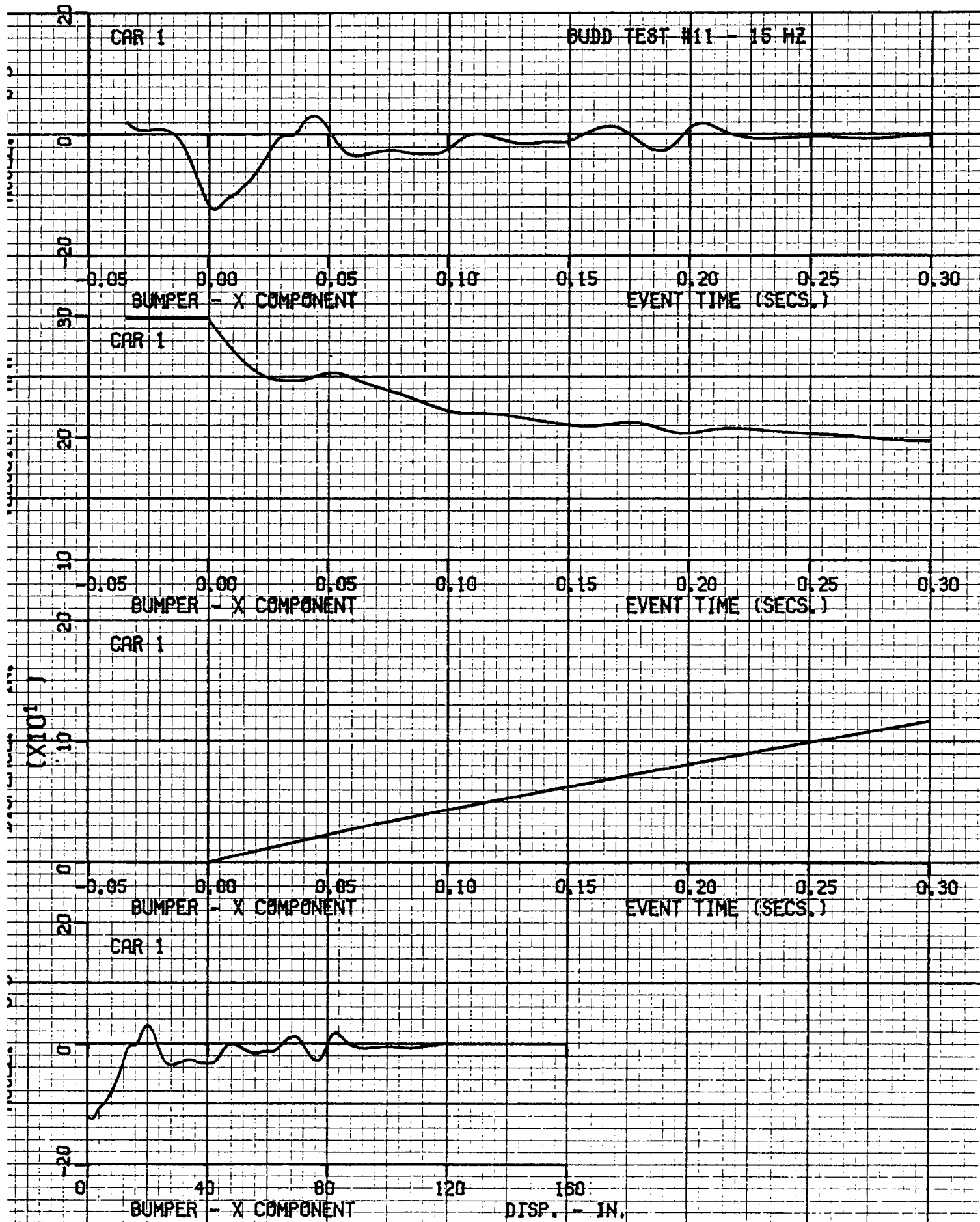


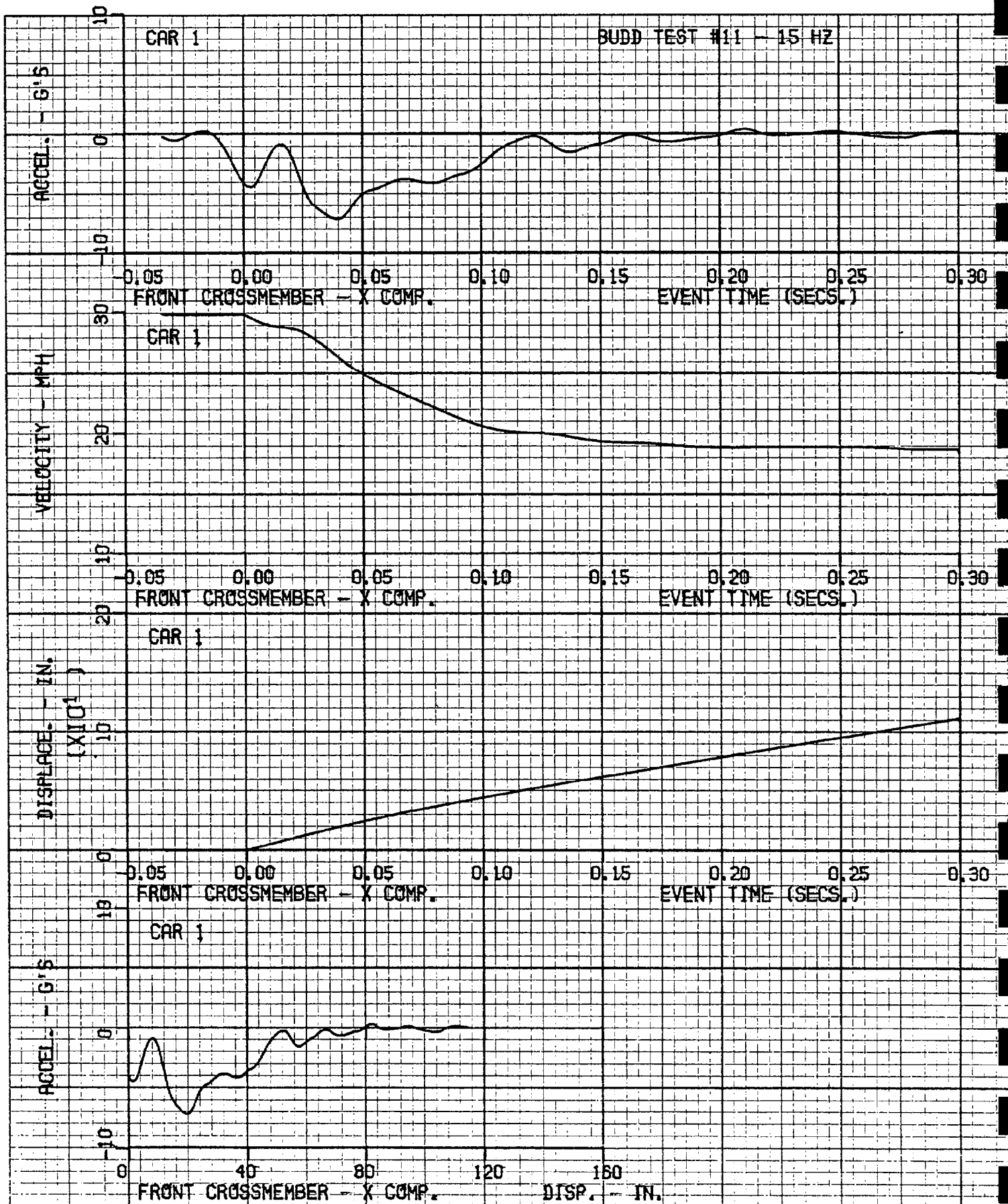


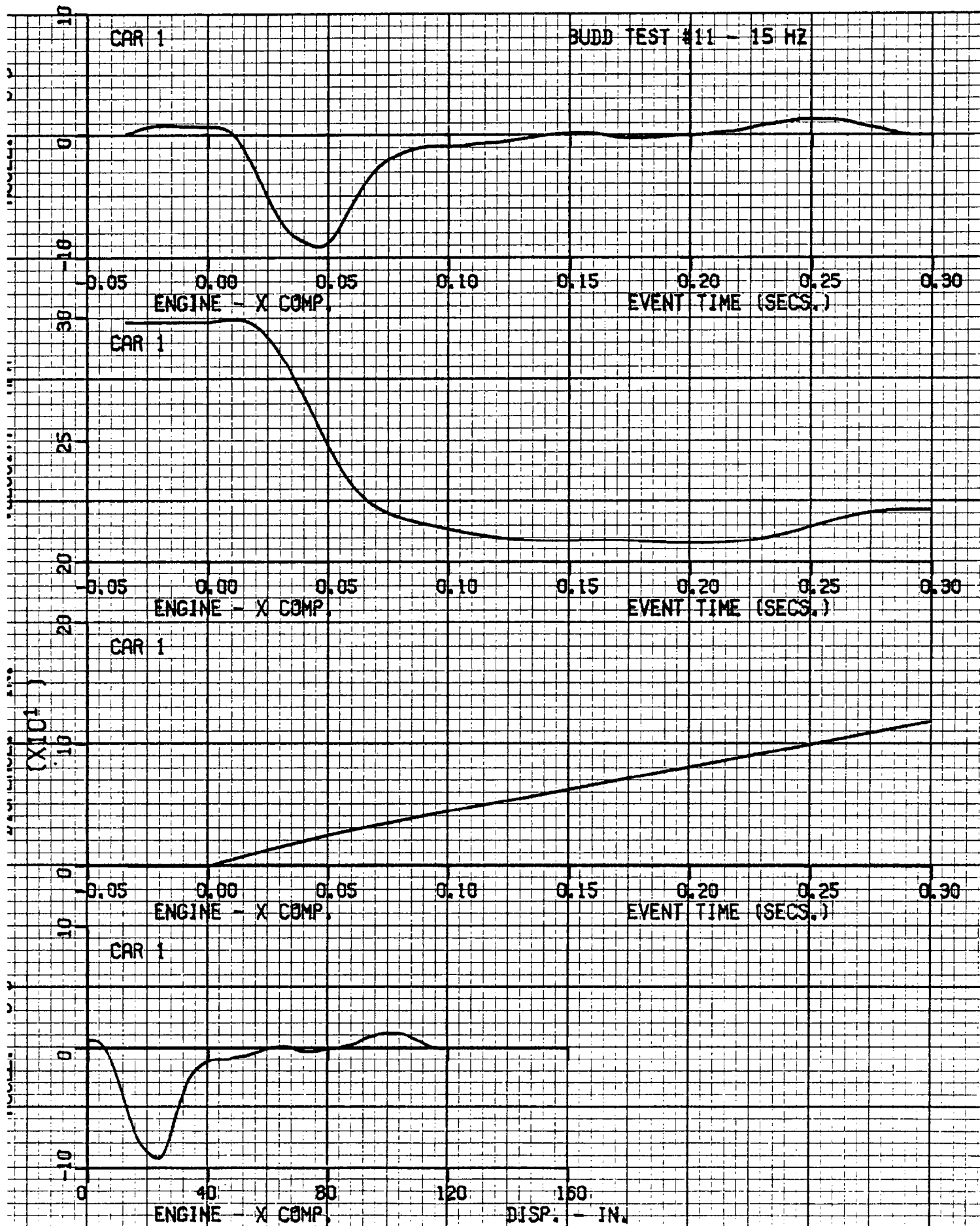
TEST NO. 11

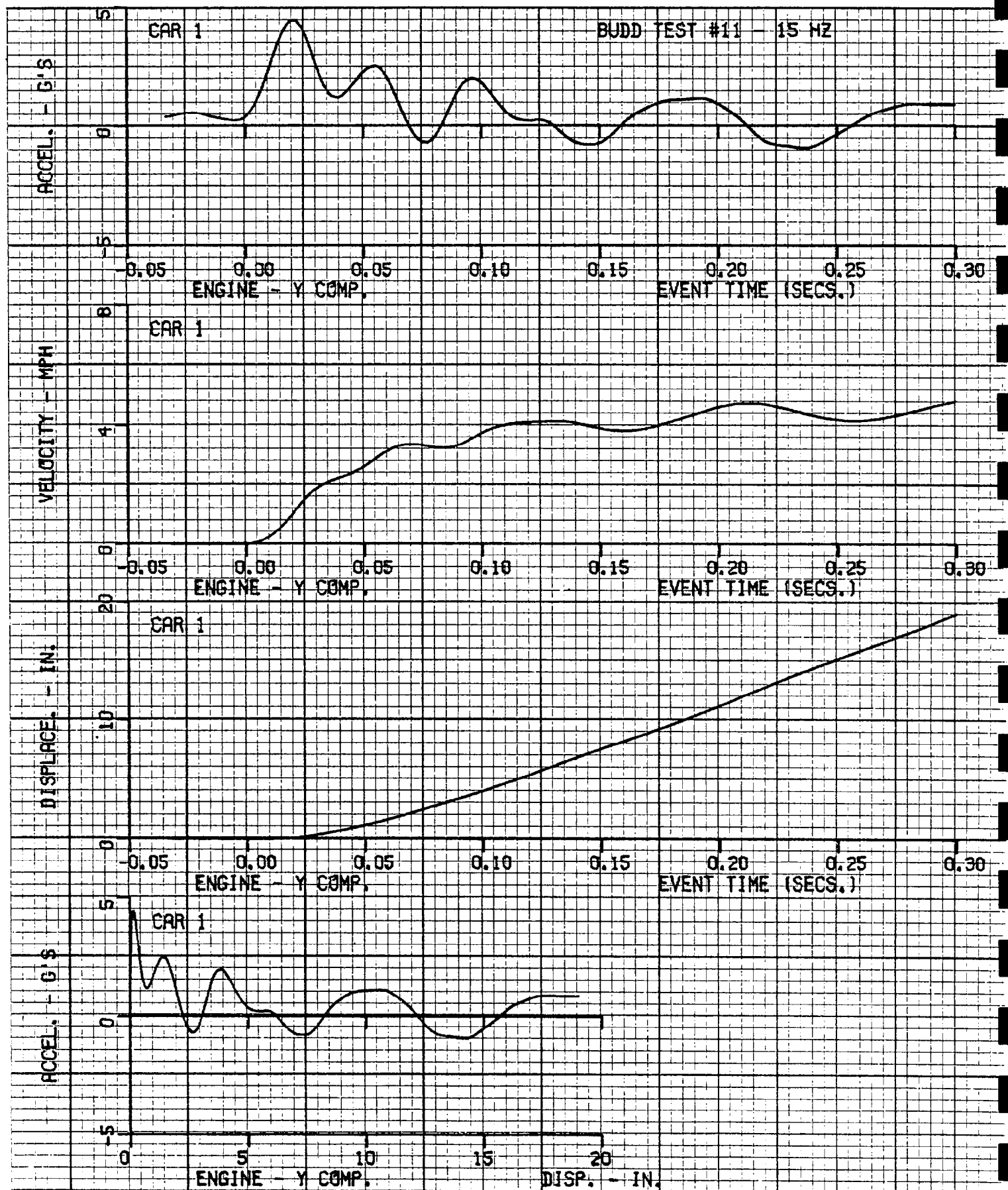
CAR NO. 1 - 1978 CHEVROLET IMPALA

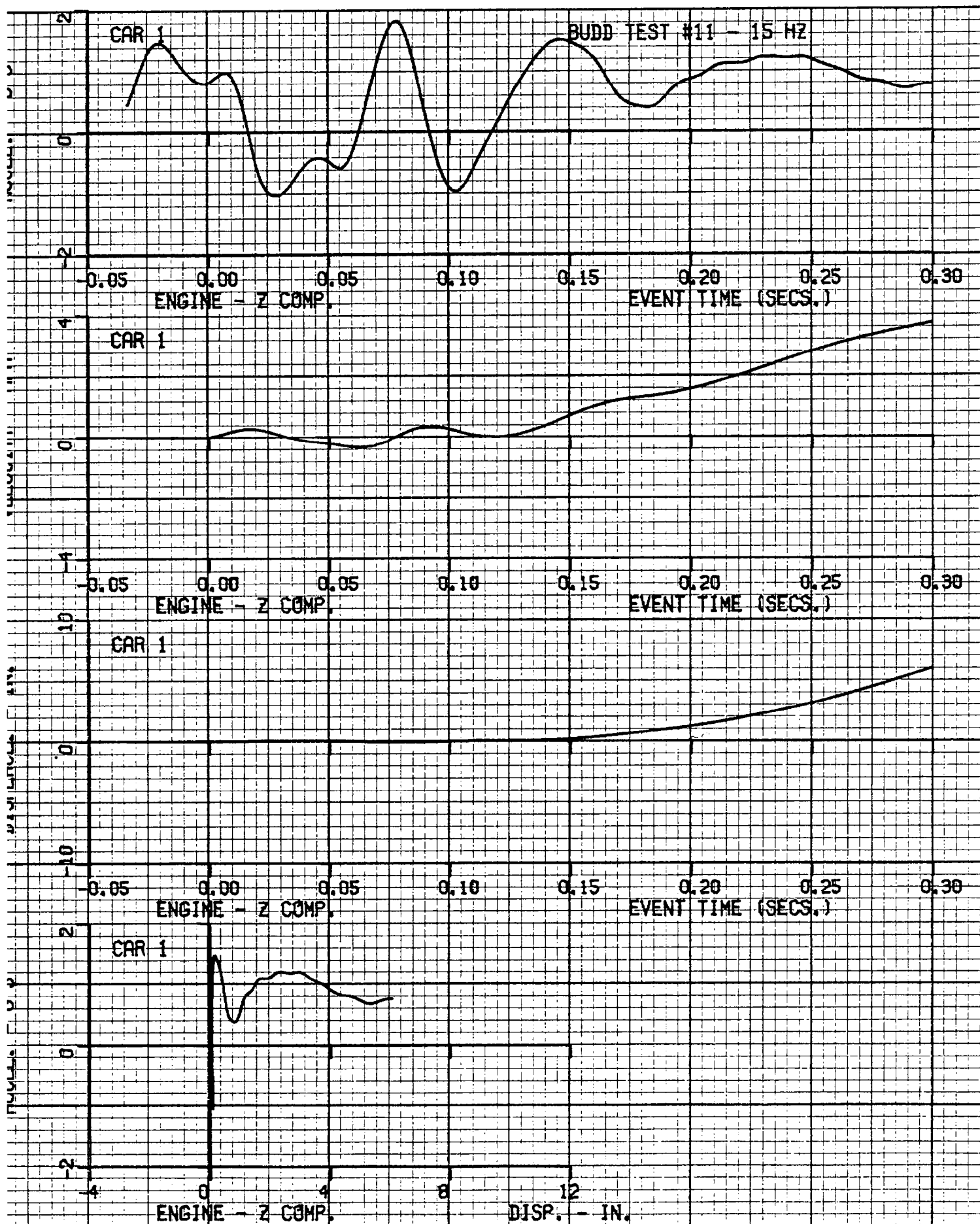
VEHICLE DATA - 15 HZ CHANNEL CLASS

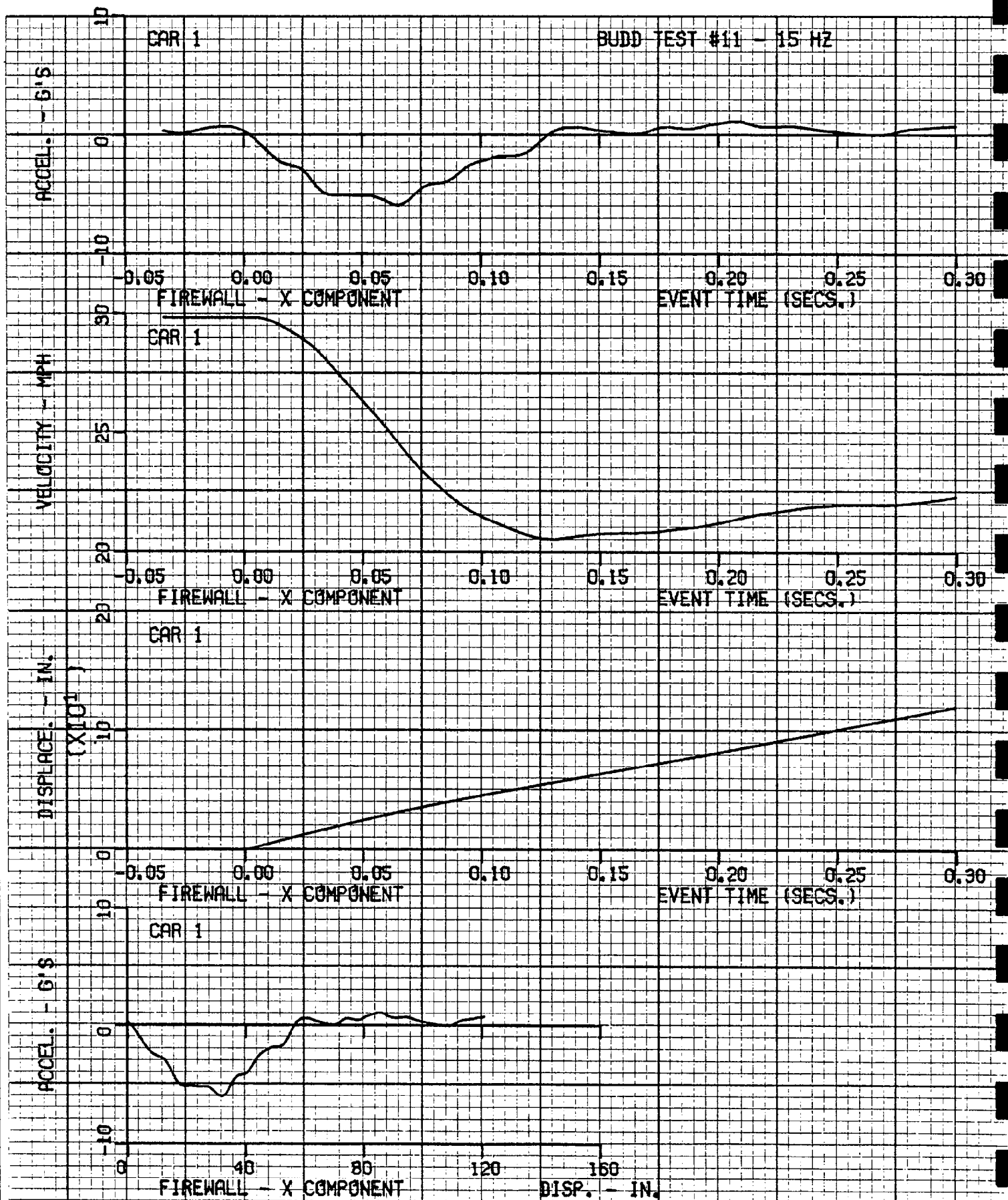


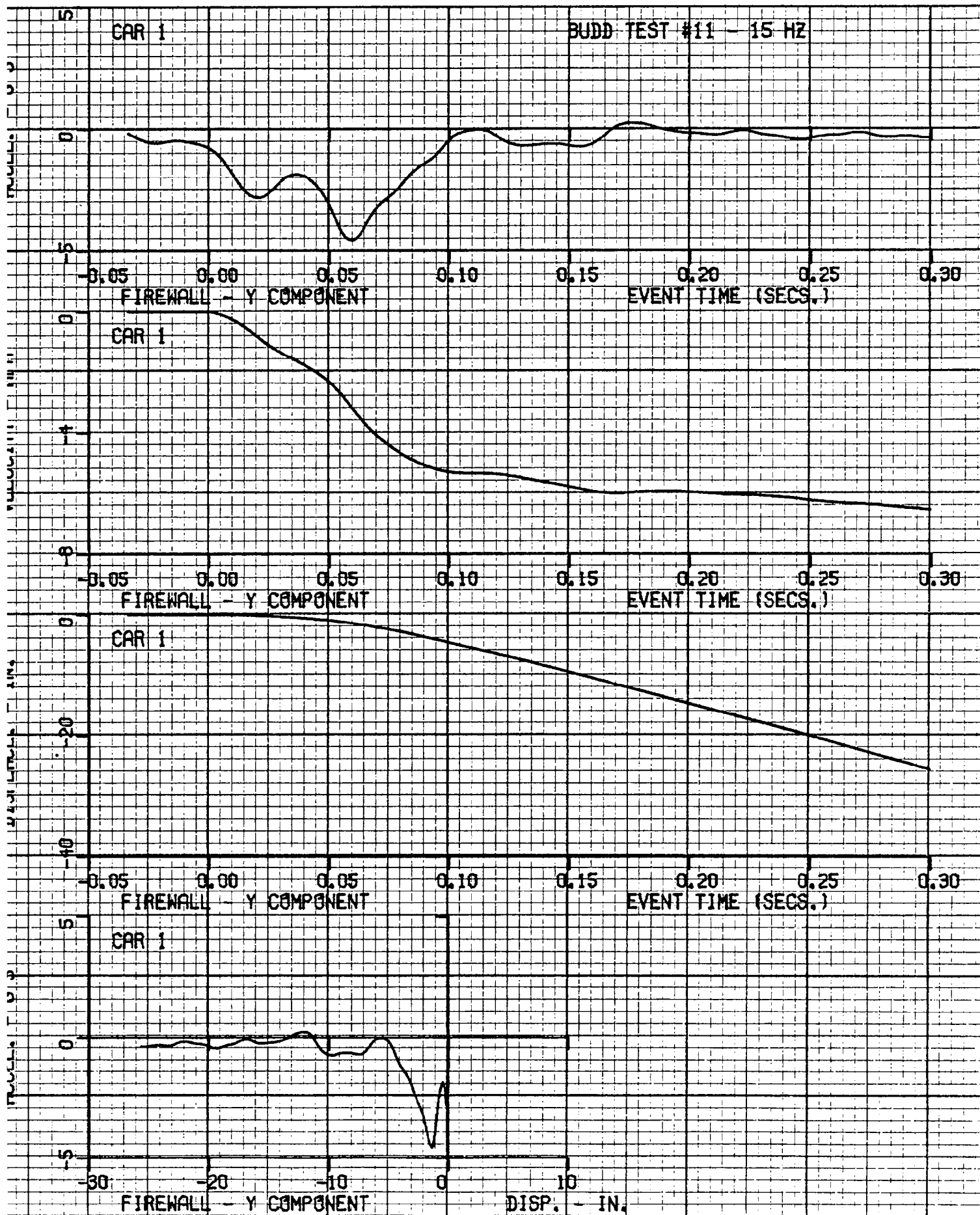


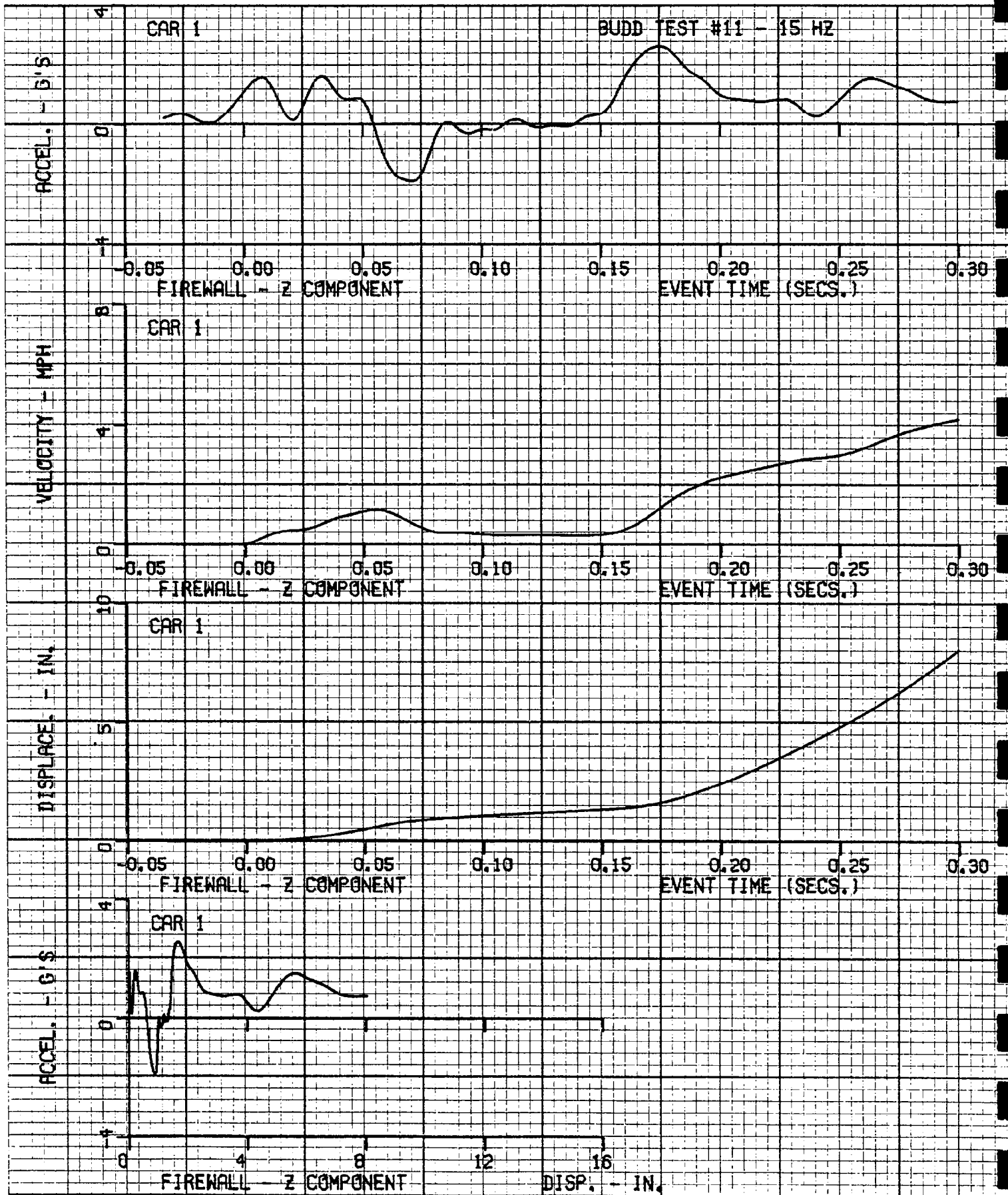


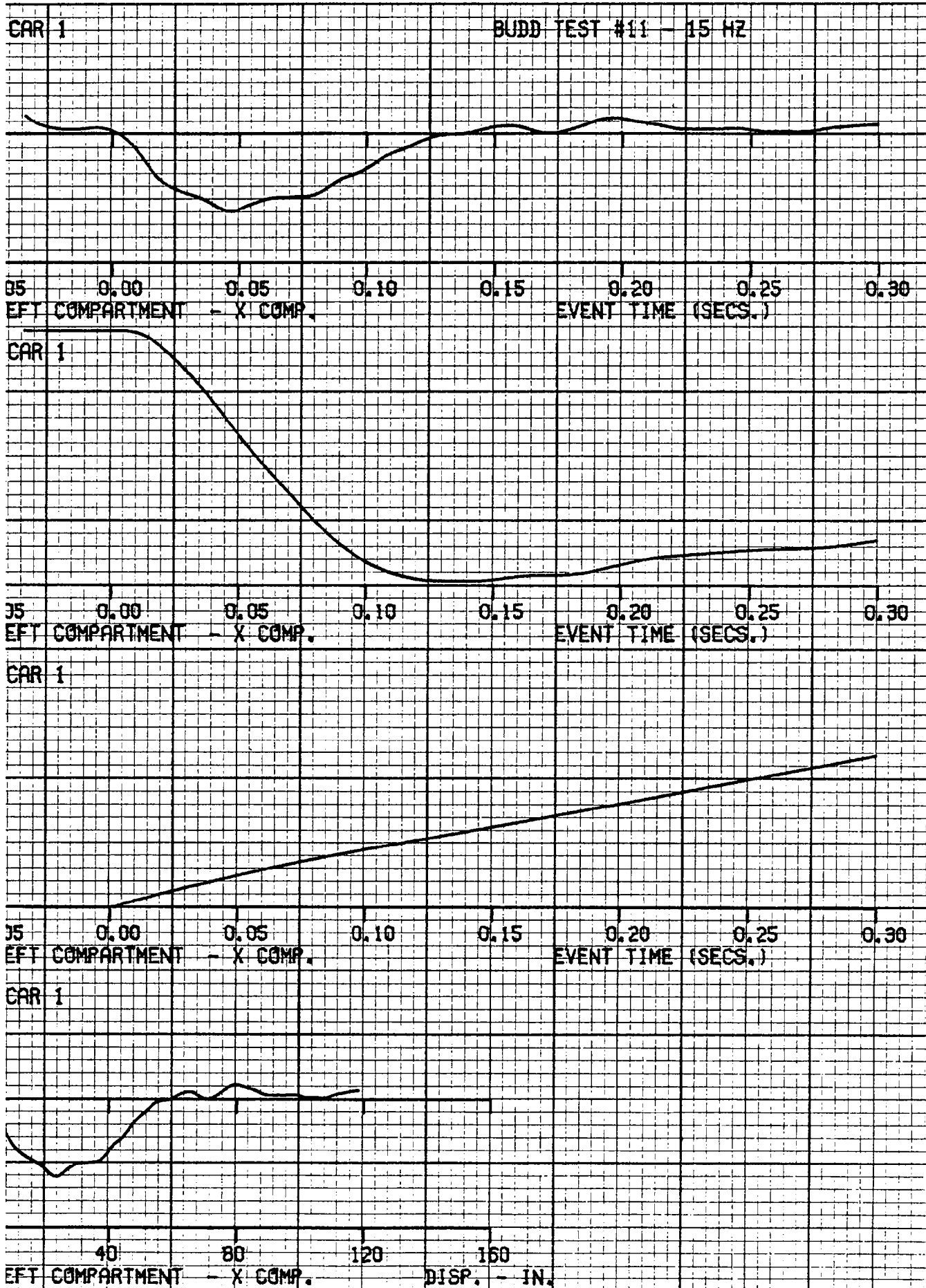


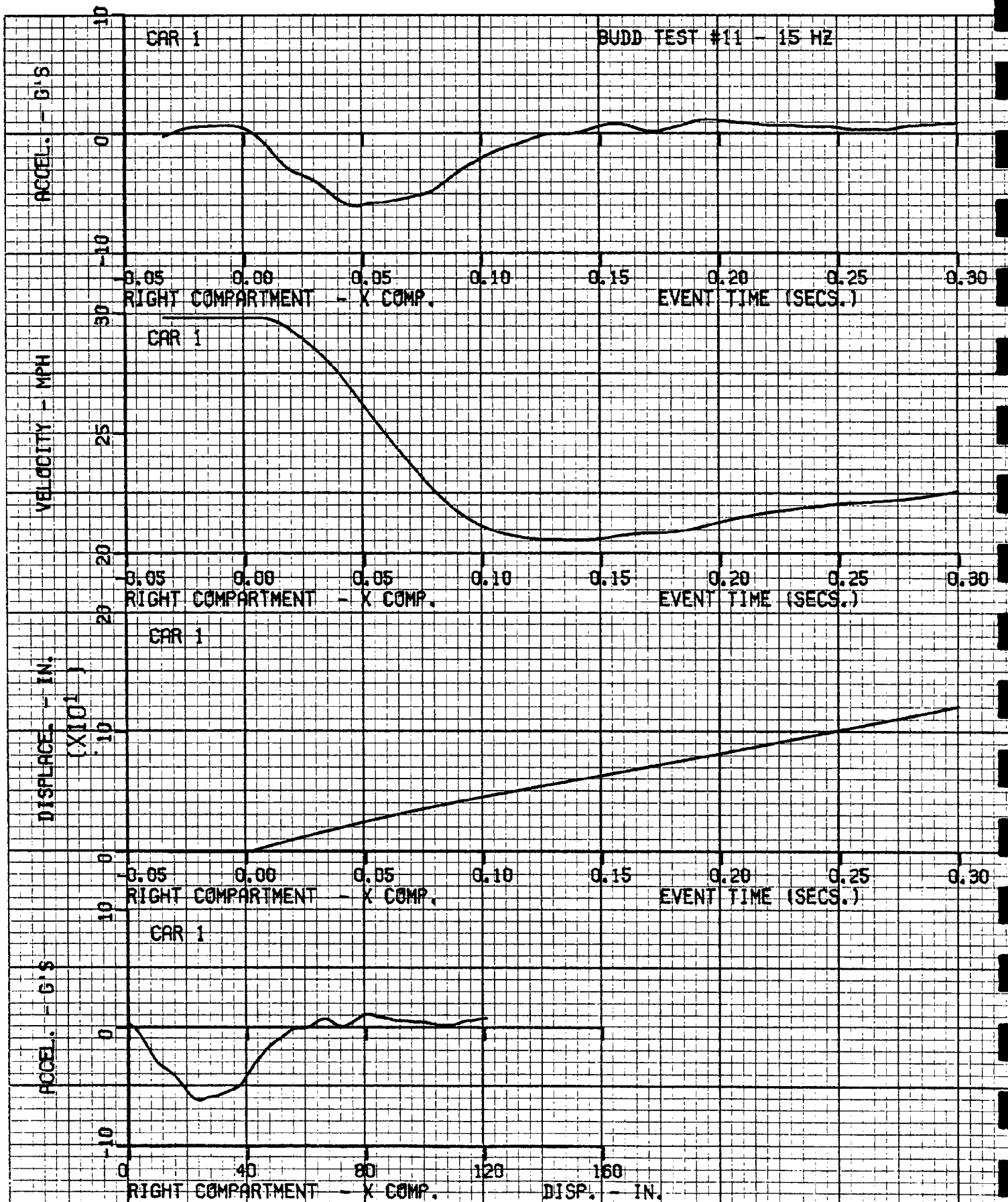


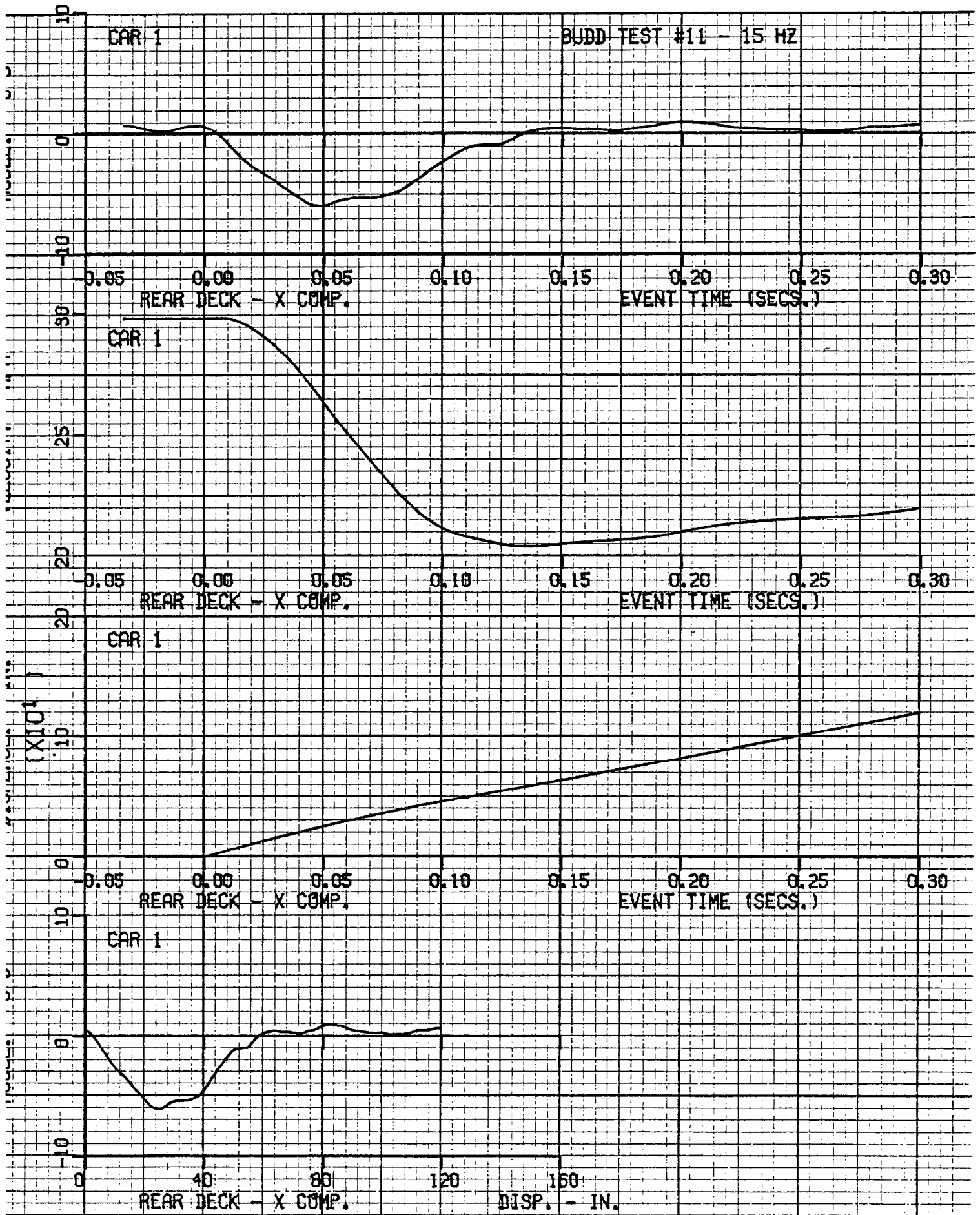


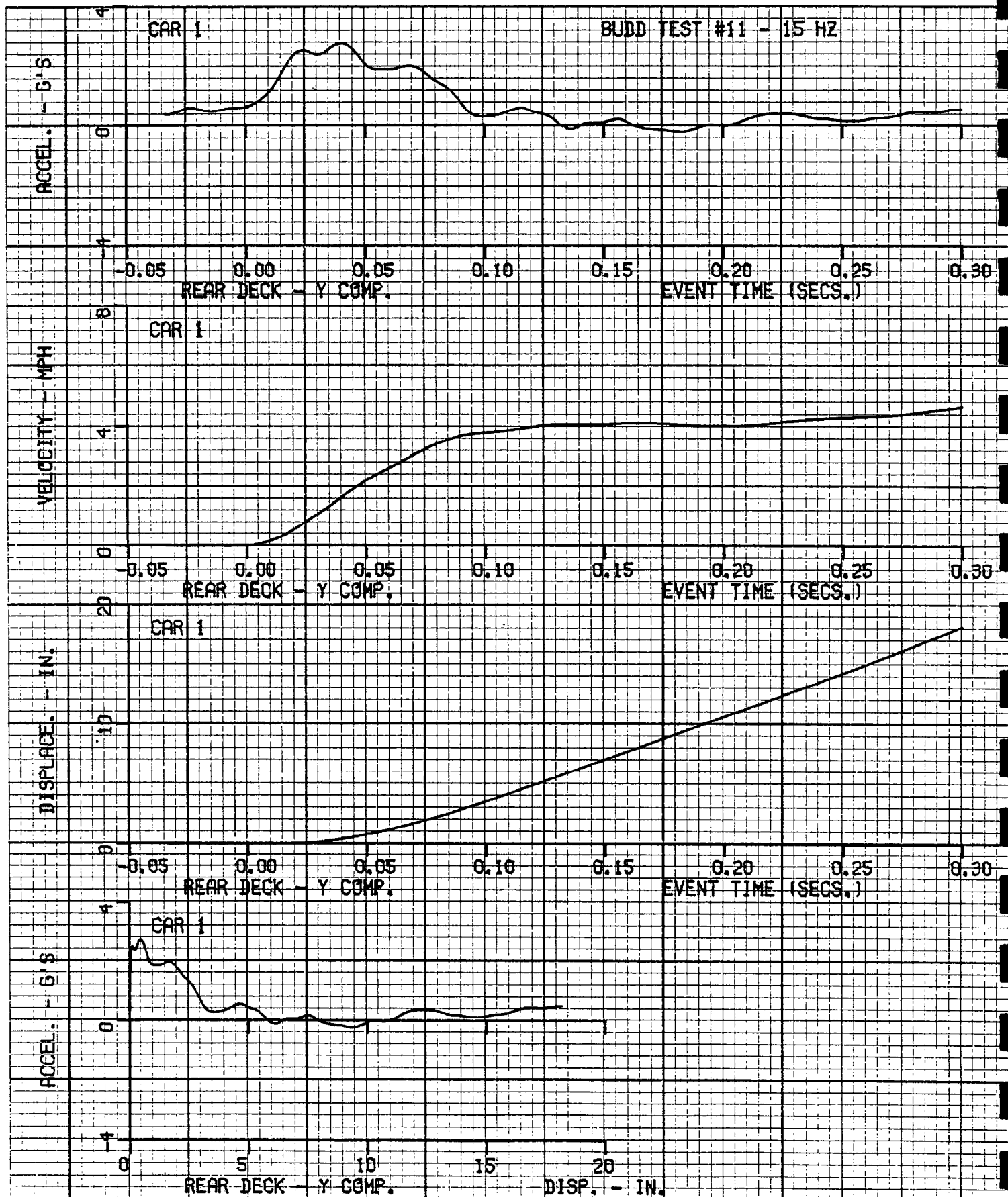


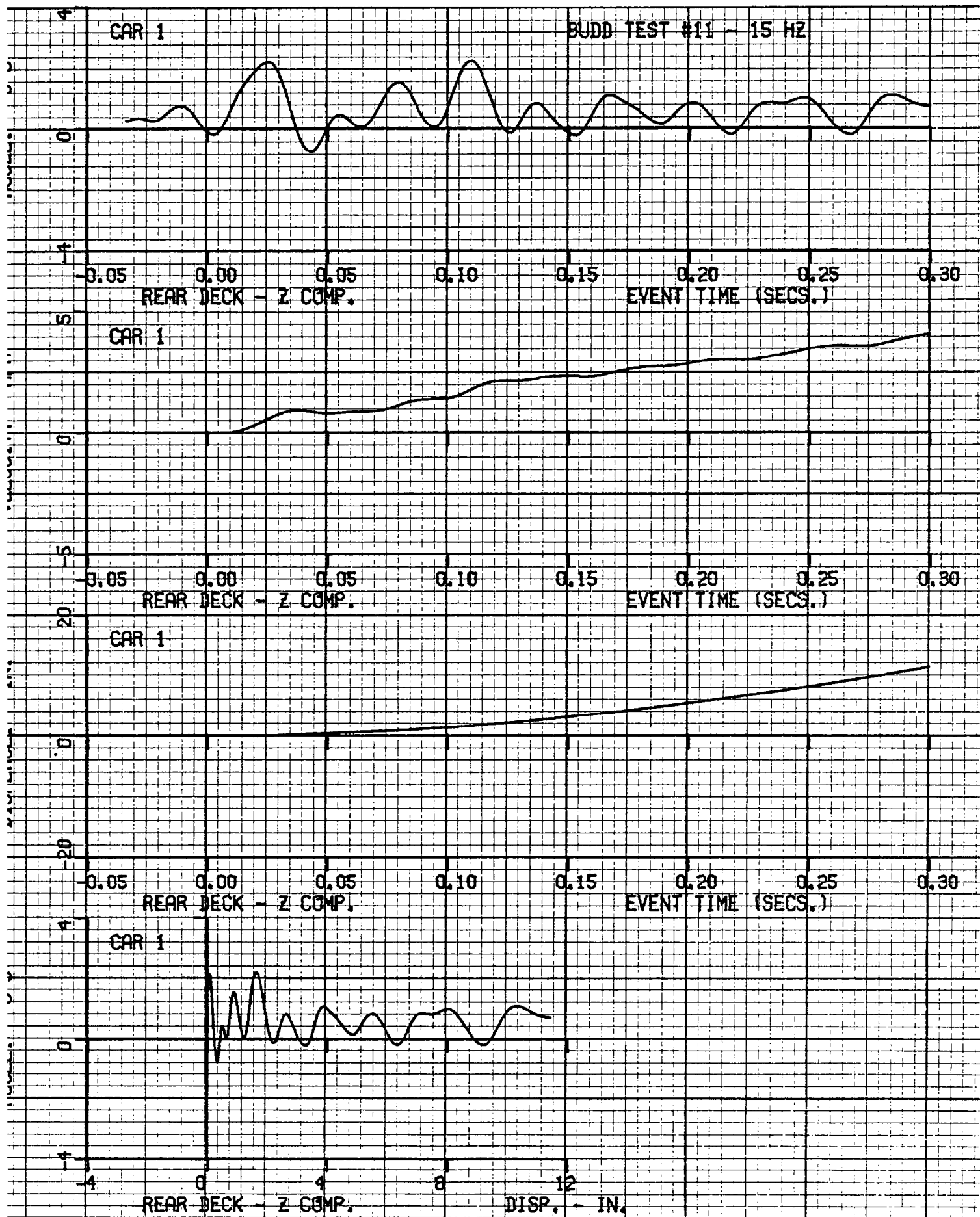


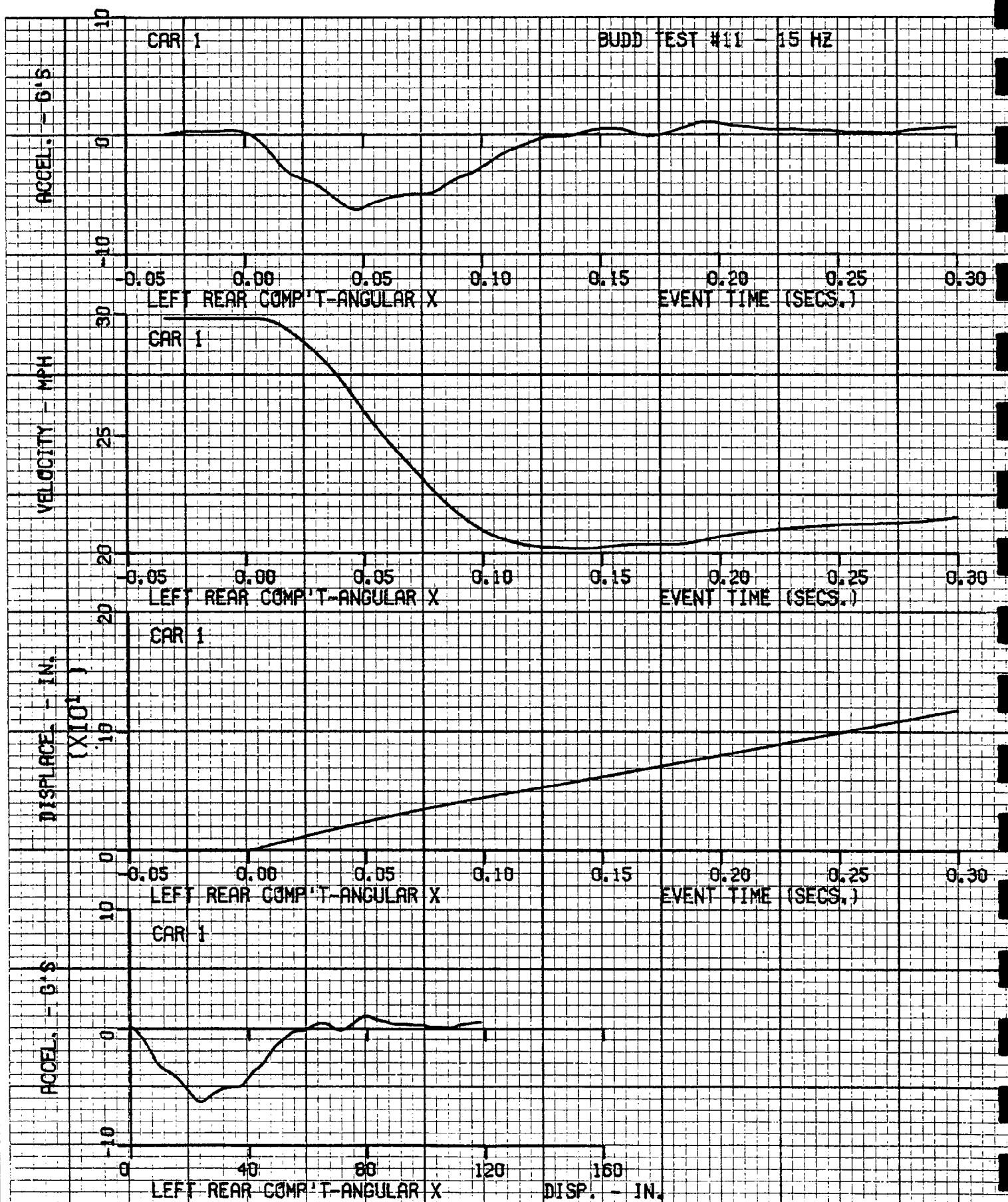


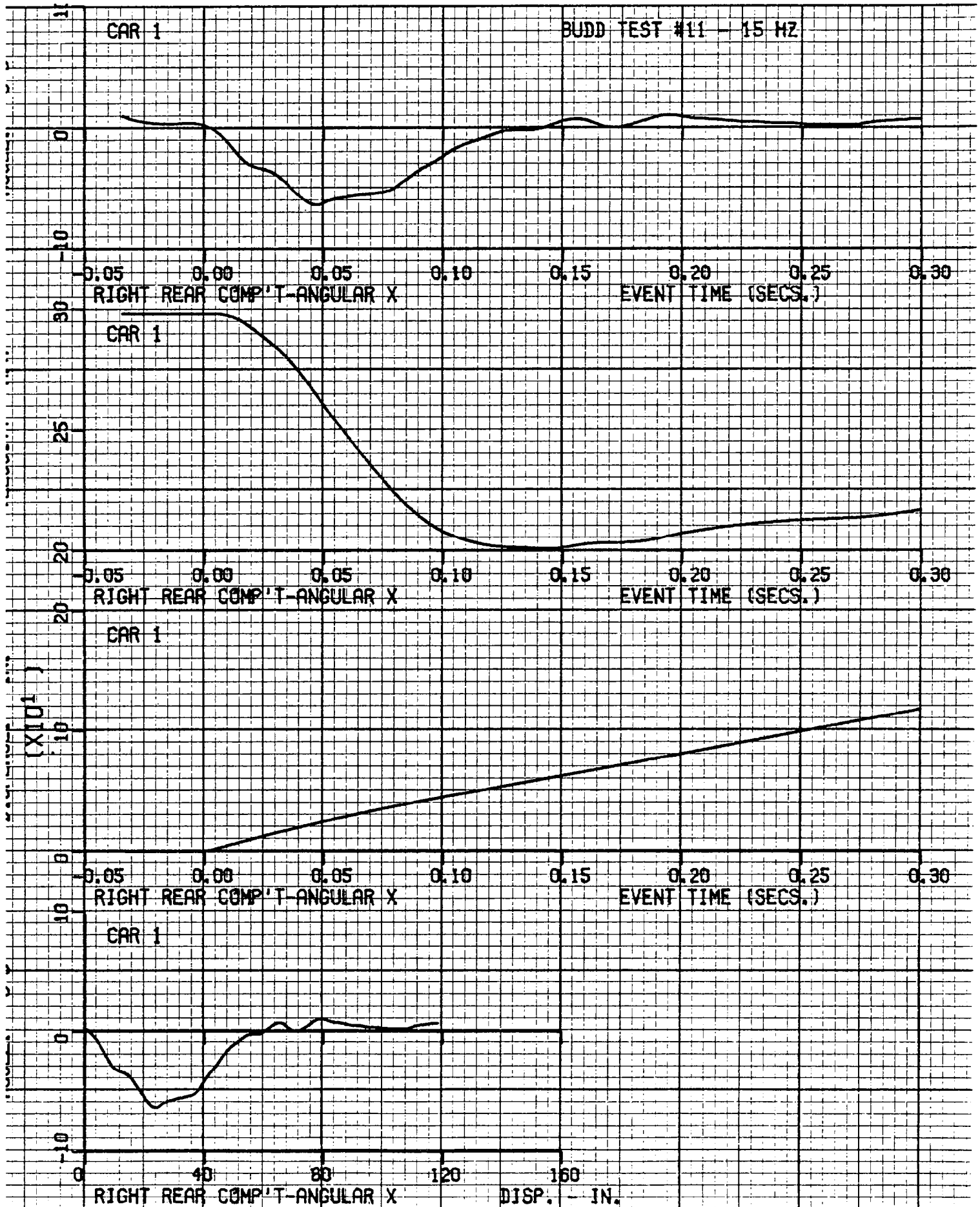


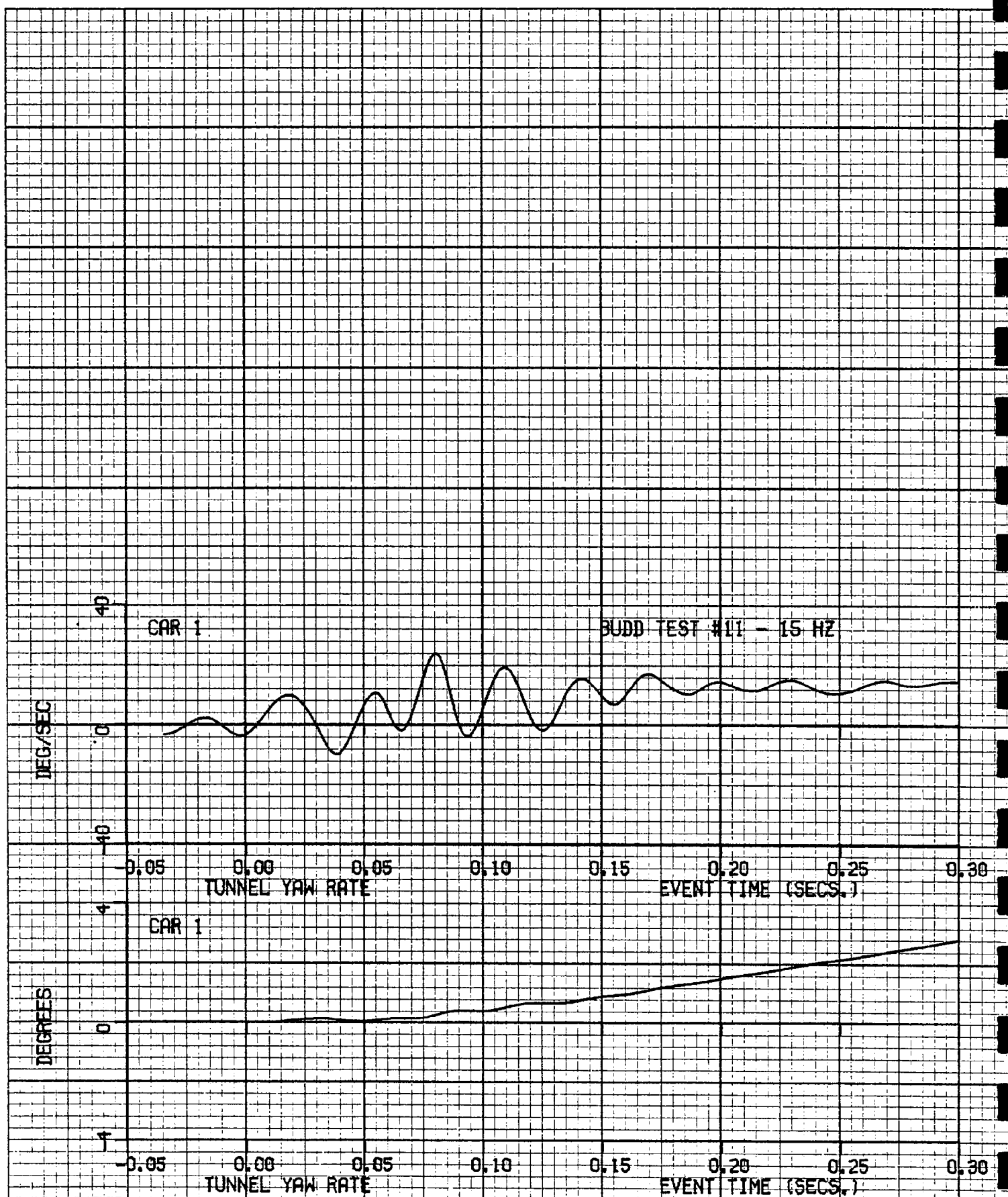










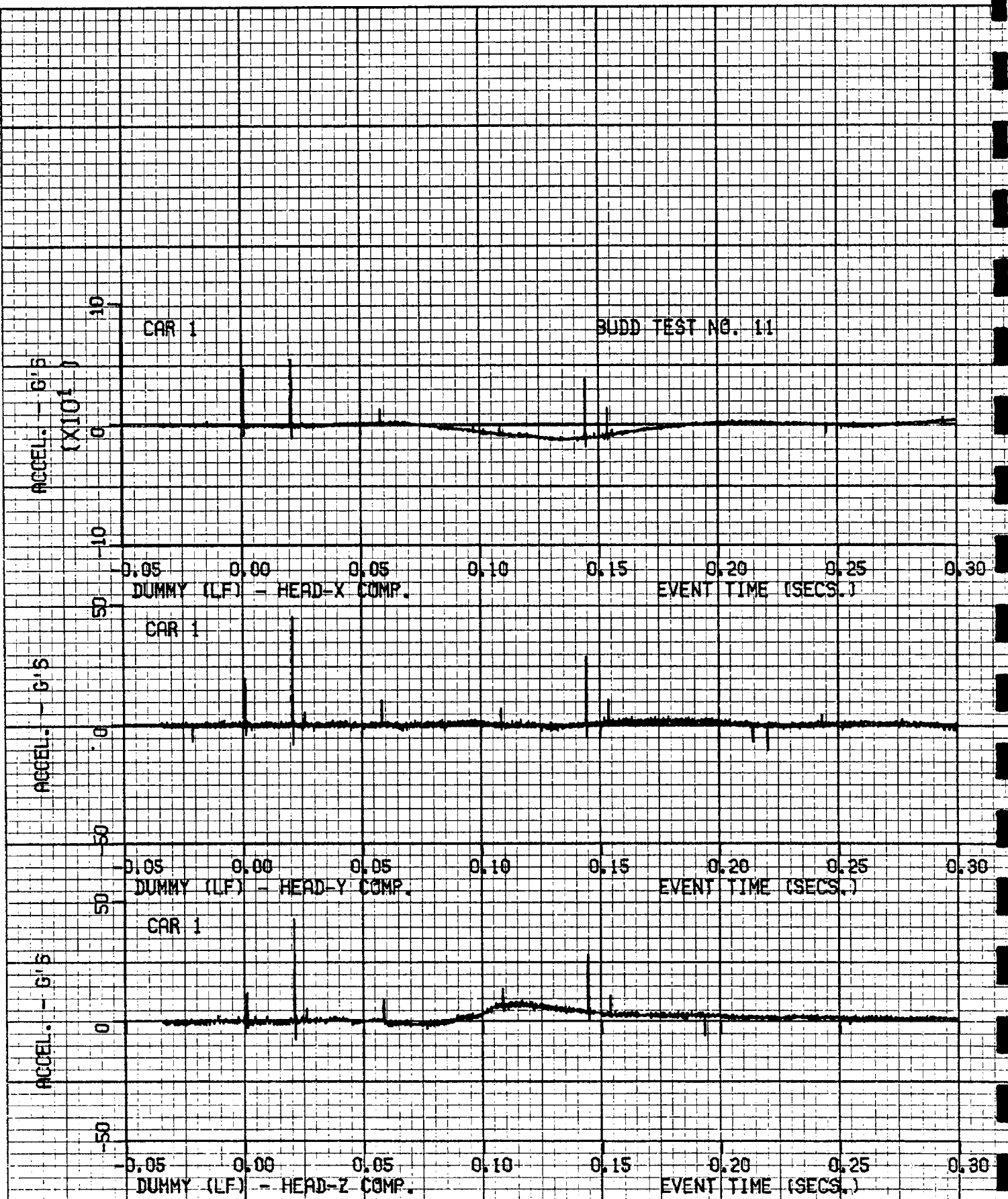


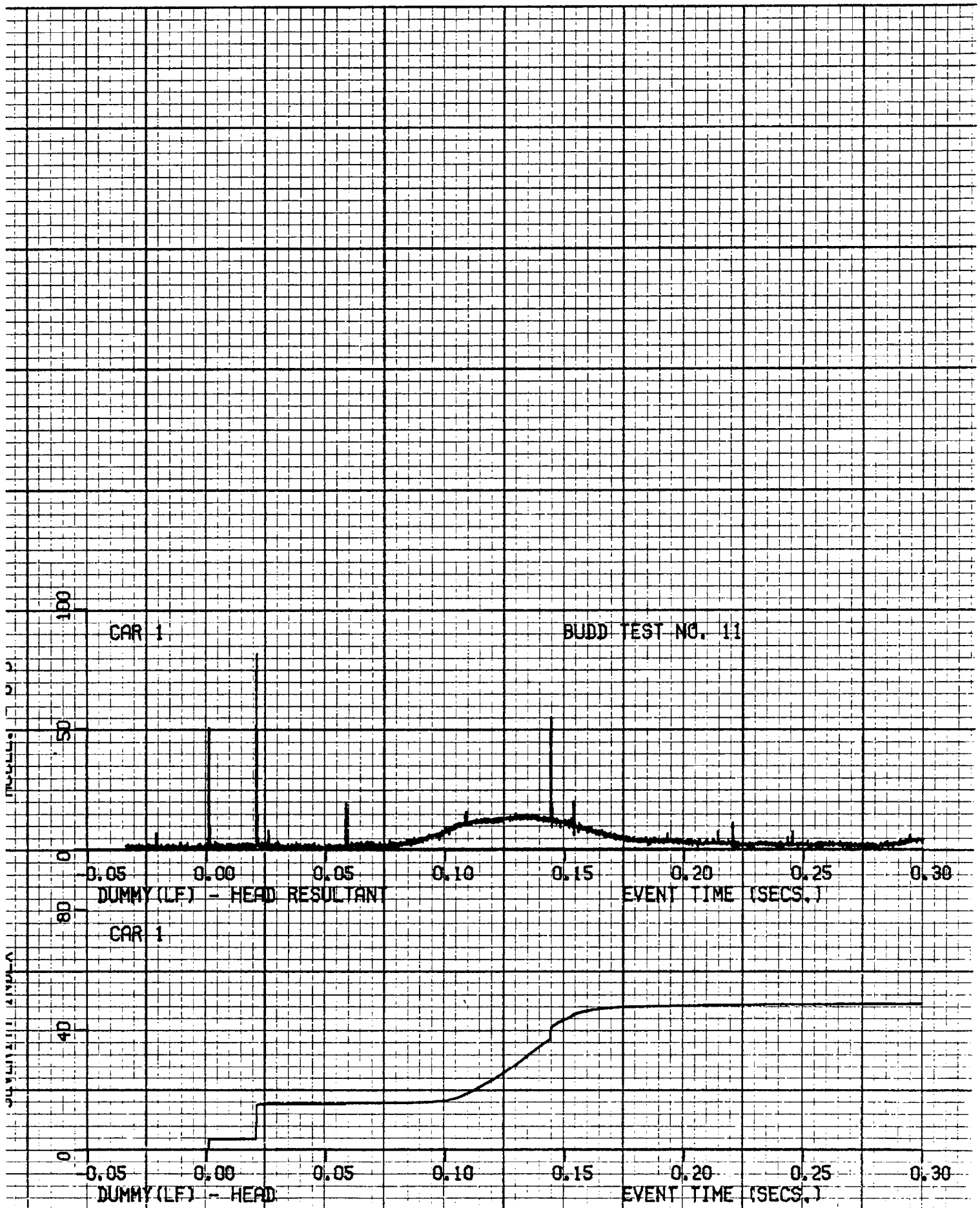
TEST NO. 11

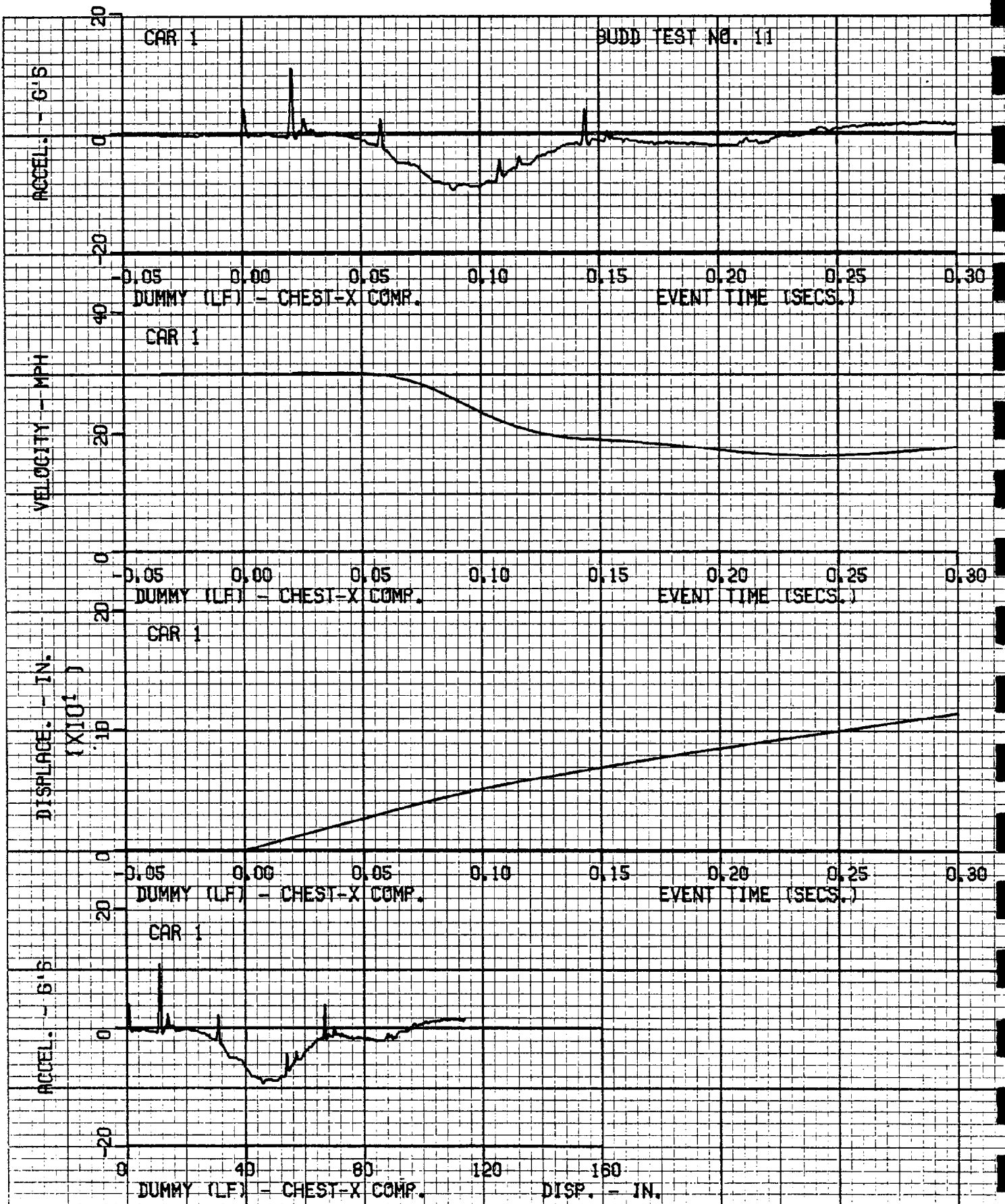
CAR NO. 1 - 1978 CHEVROLET IMPALA

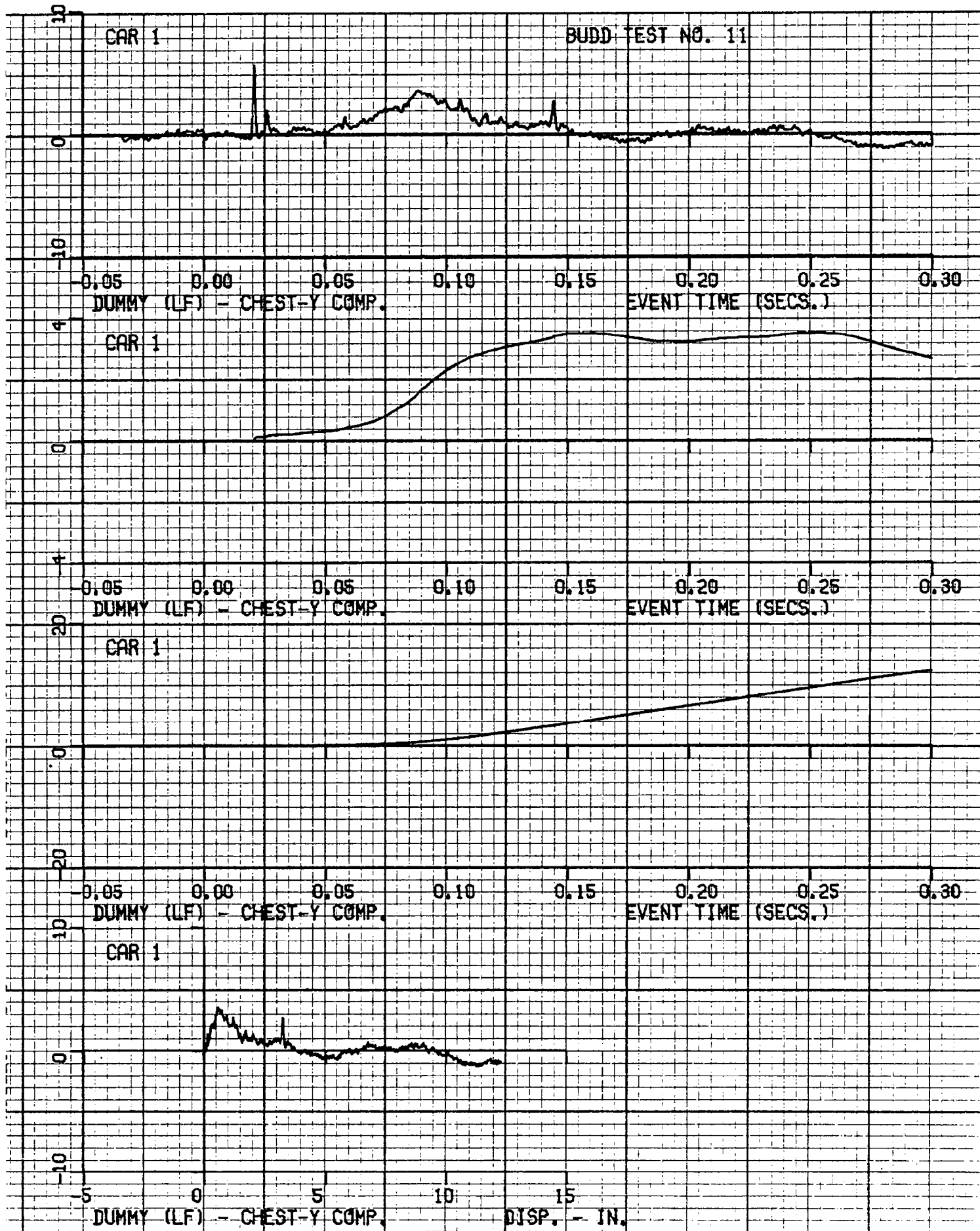
DUMMY DATA

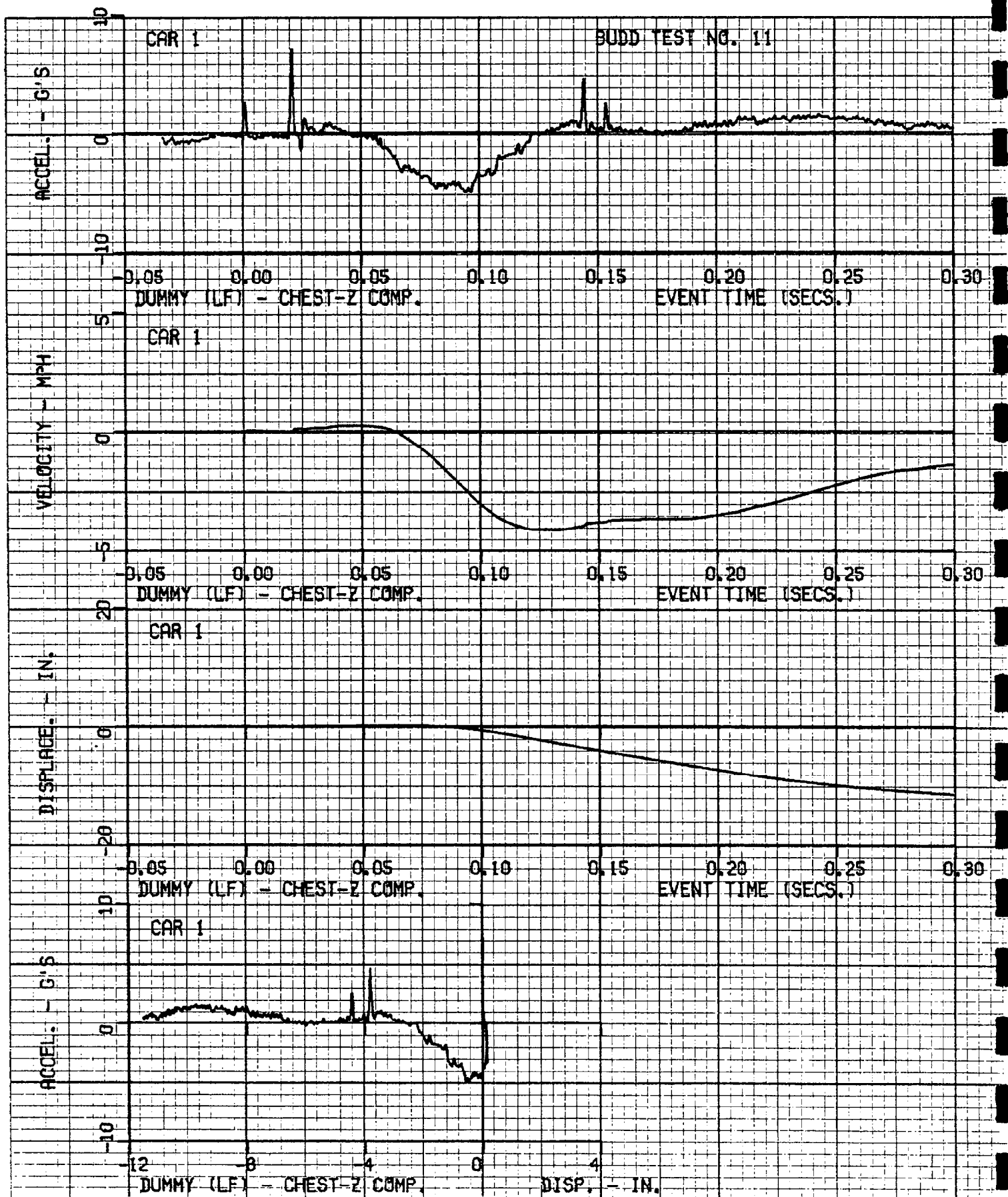
	<u>Filter Channel Class</u>
Head Acceleration	1000
Chest Acceleration	180
Femur Forces	600
Belt Loads	60



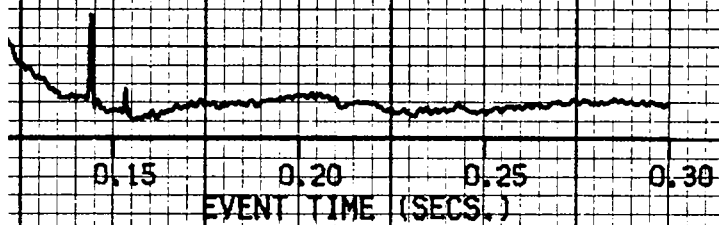




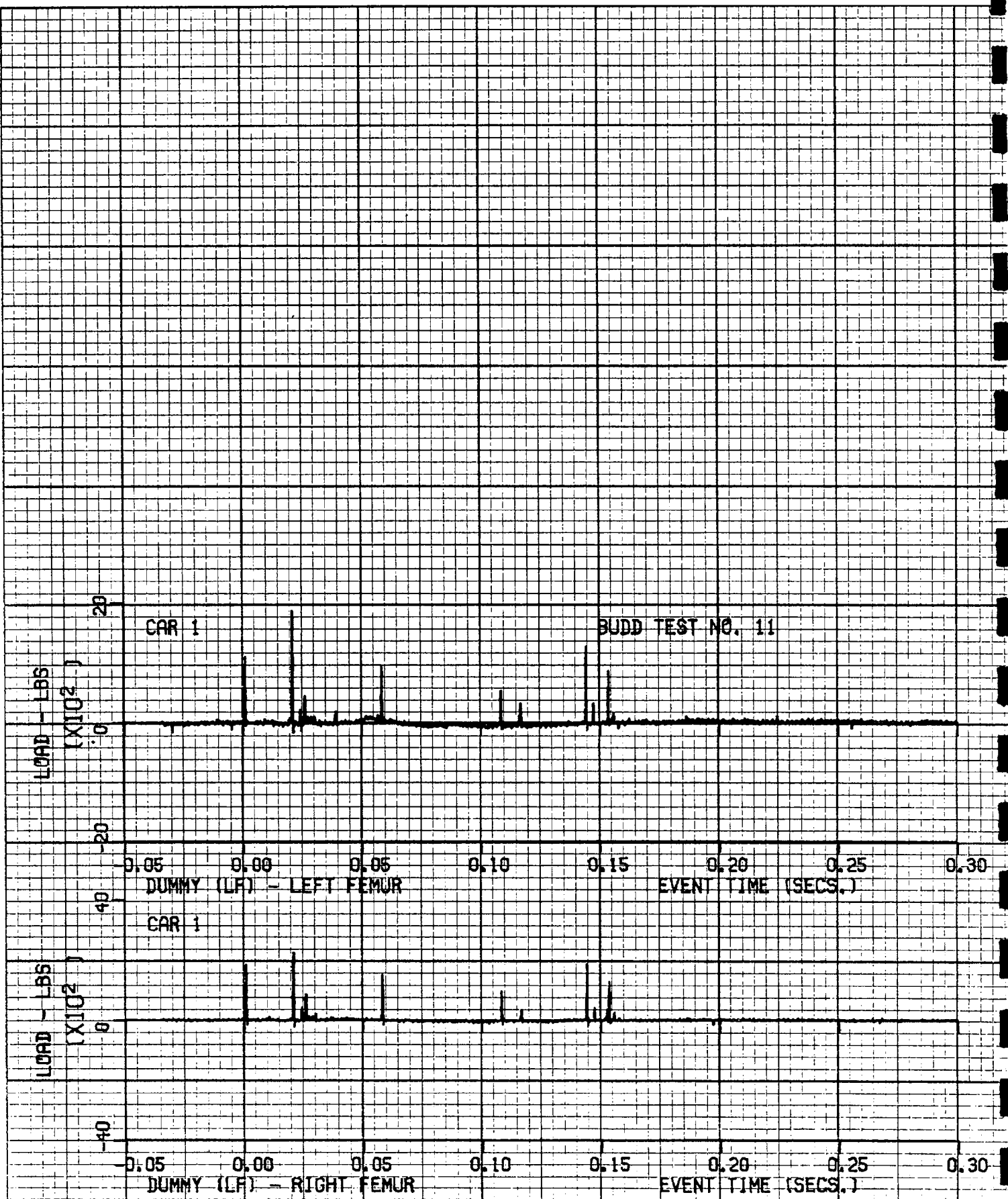


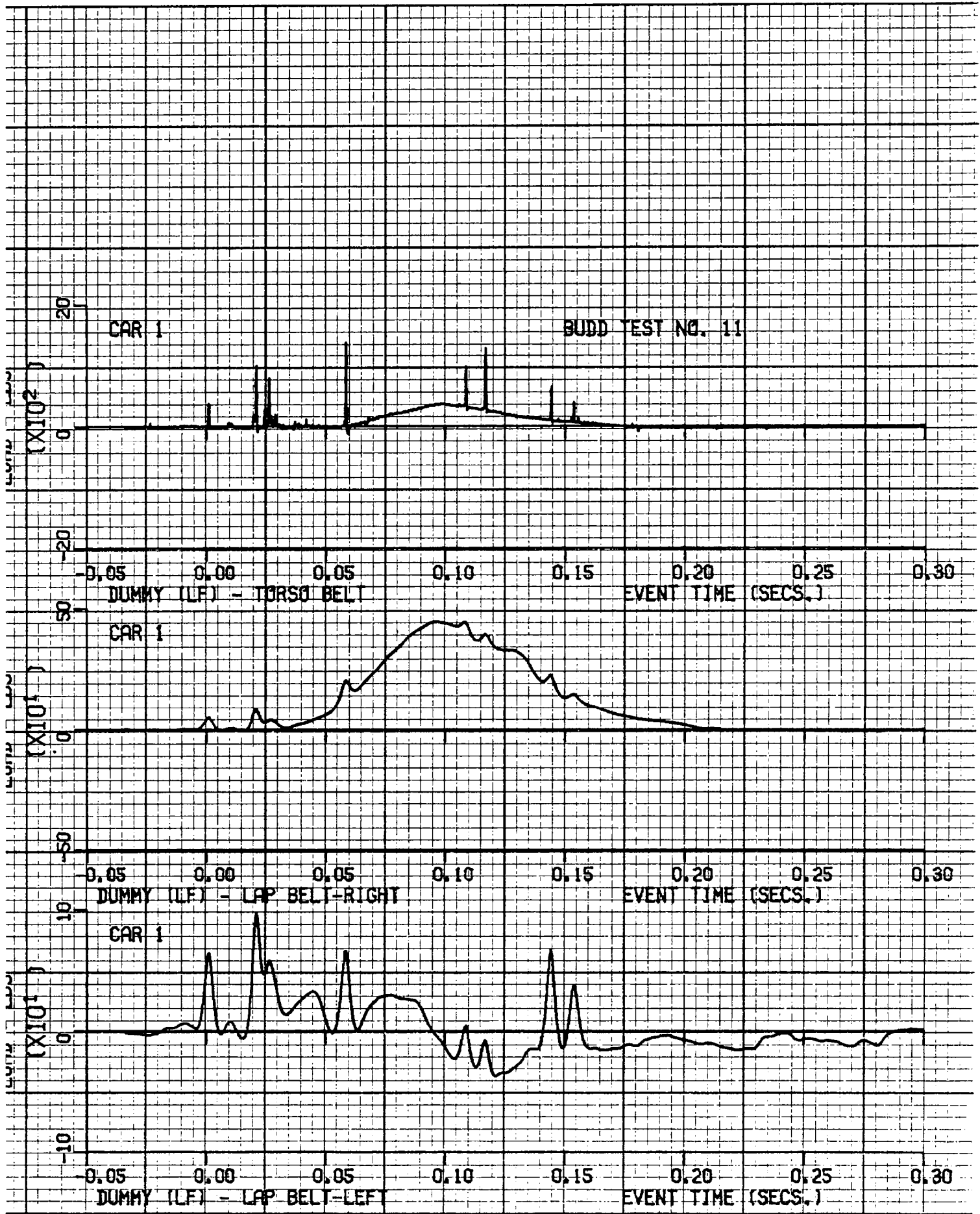


BUDD TEST NO. 11



0.15 0.20 0.25 0.30
EVENT TIME (SECS.)

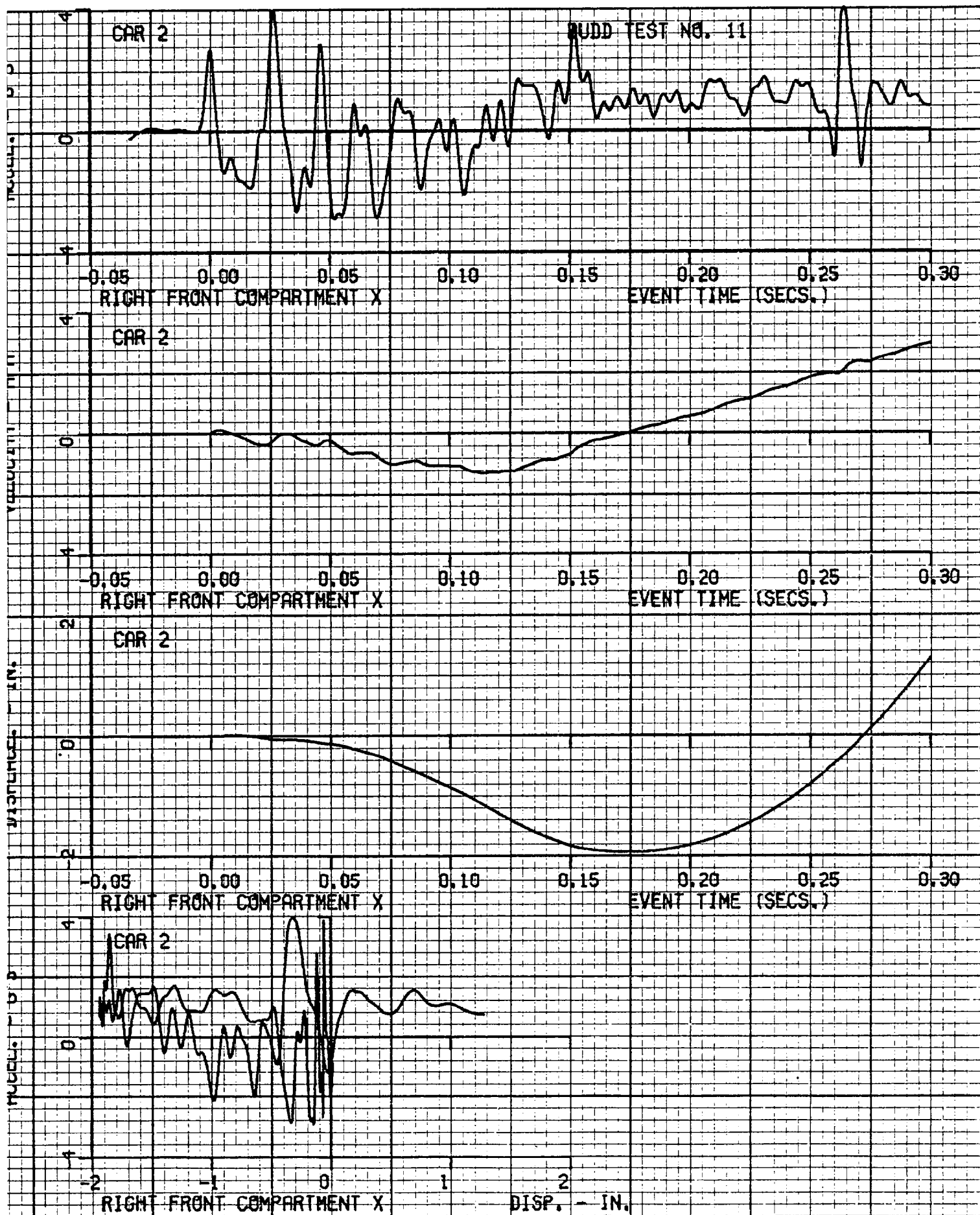


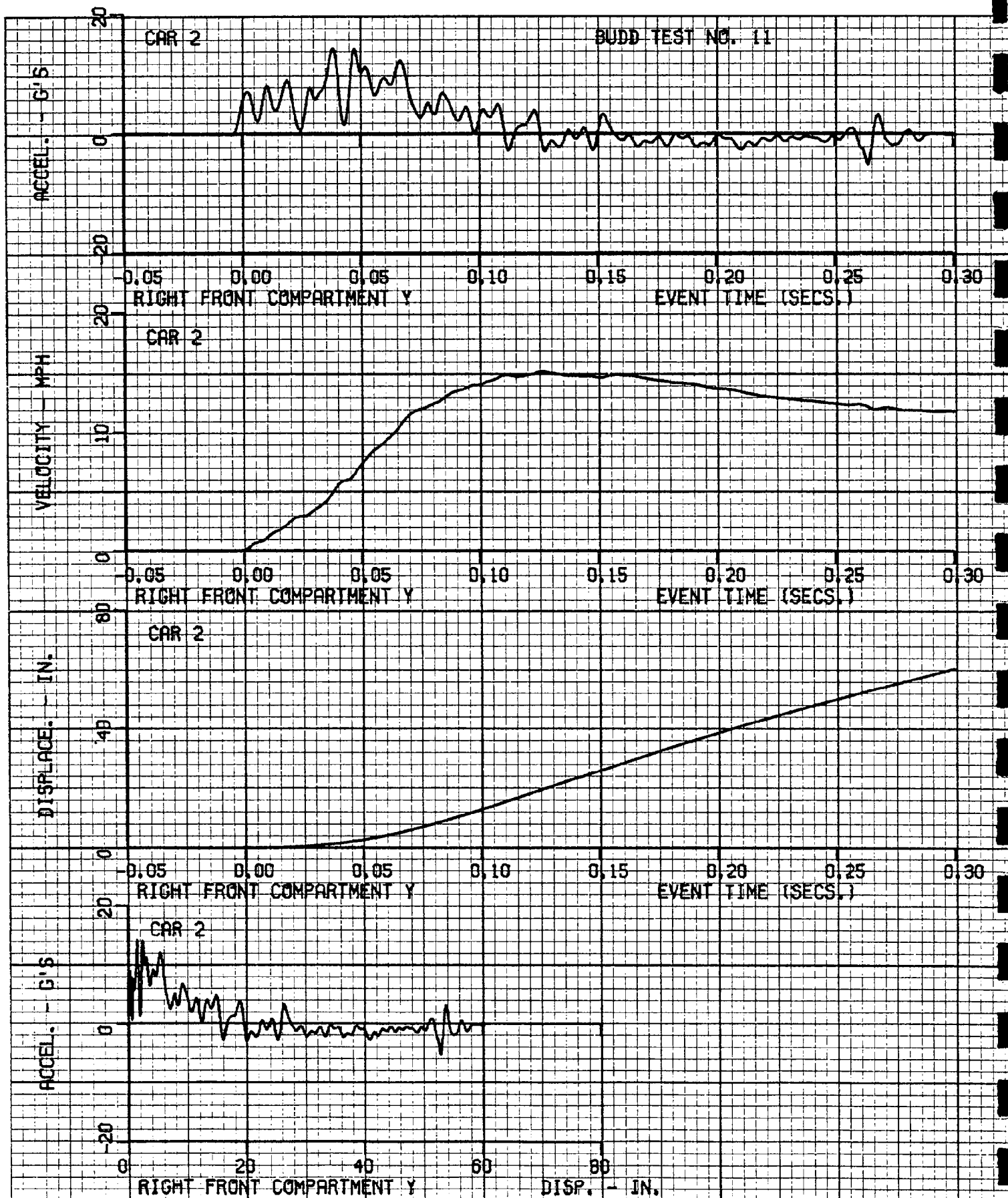


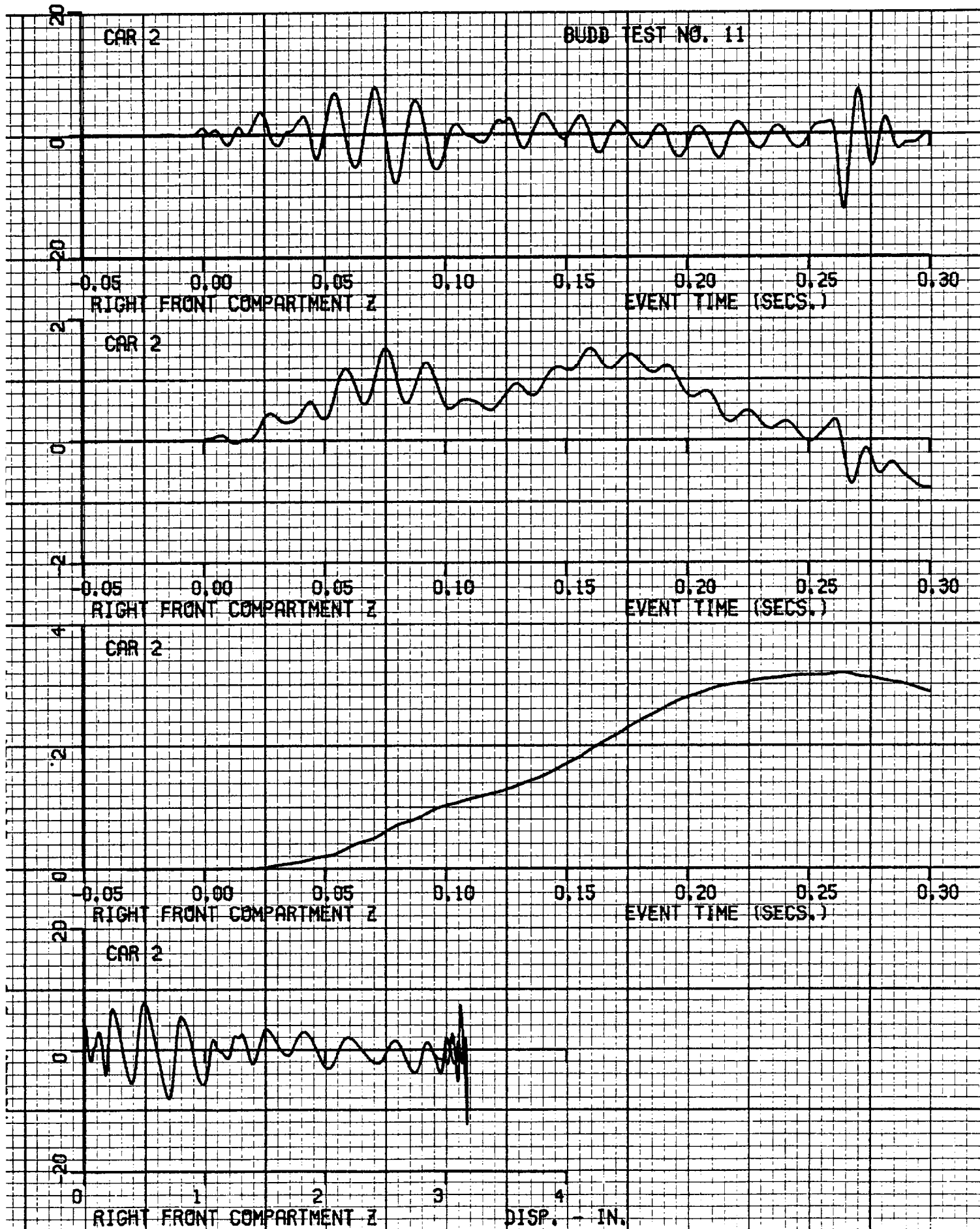
TEST NO. 11

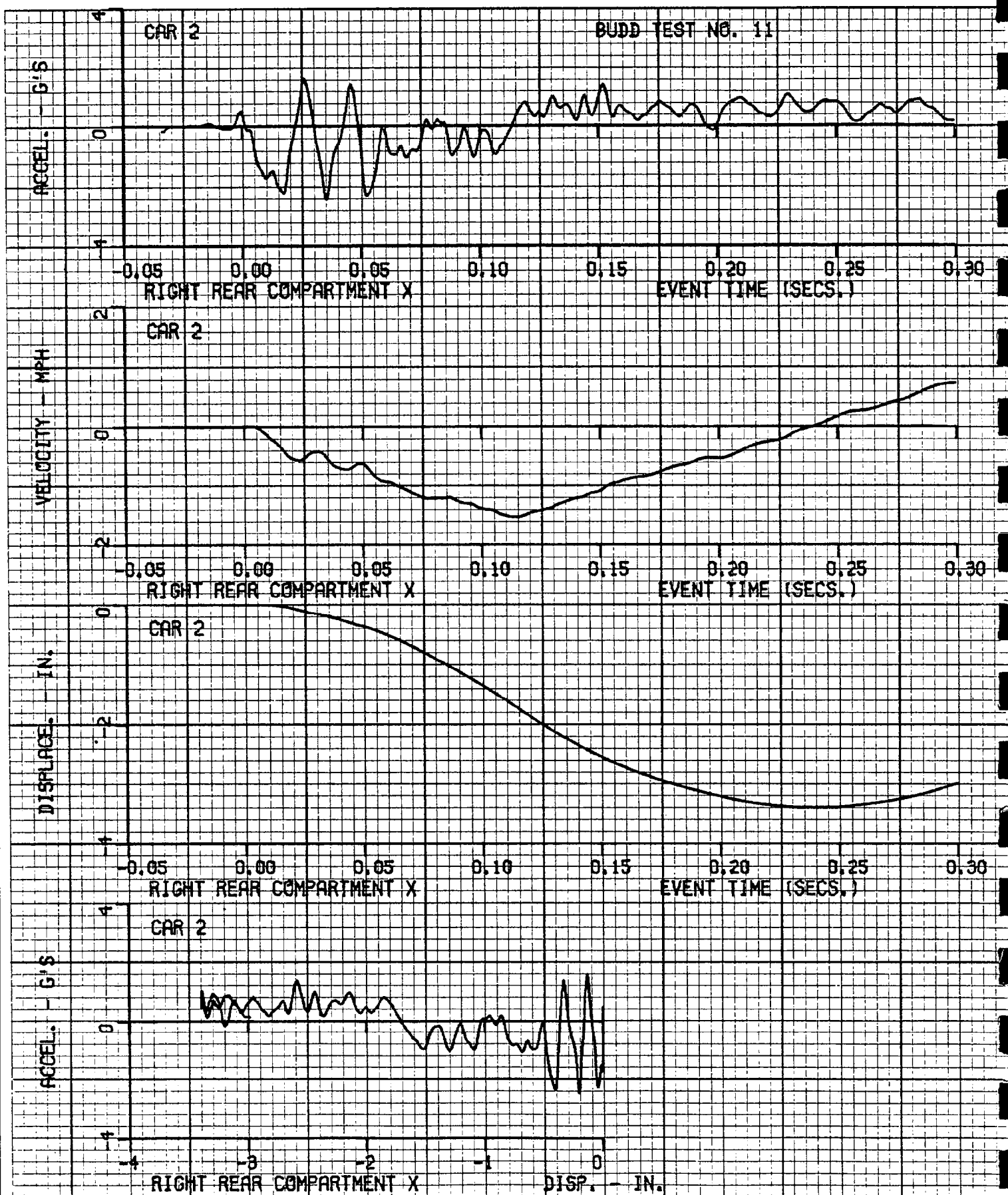
CAR NO. 2 - 1976 VOLKSWAGEN RABBIT

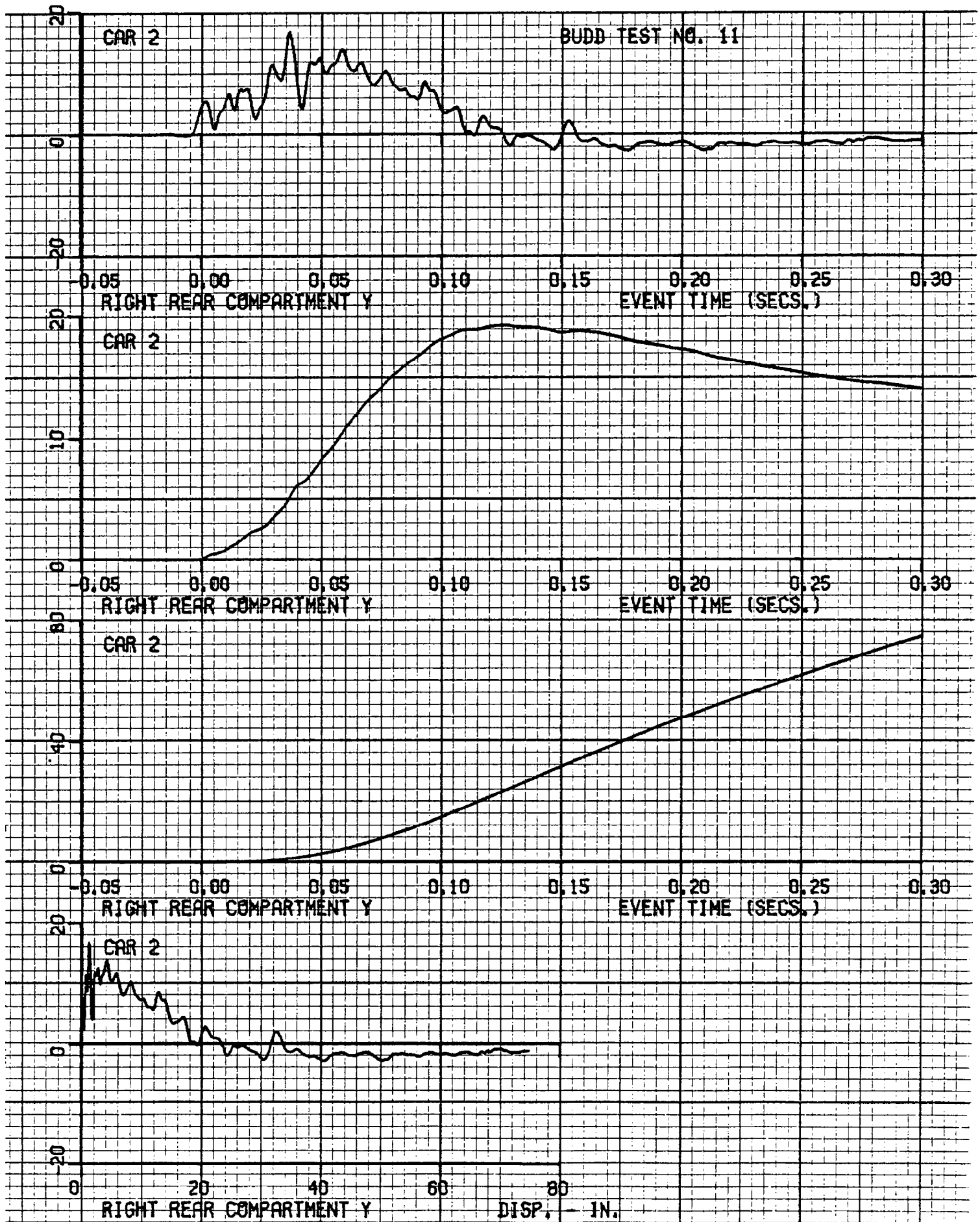
	<u>Filter Channel Class</u>
Vehicle Data	60
Side Intrusion	1000

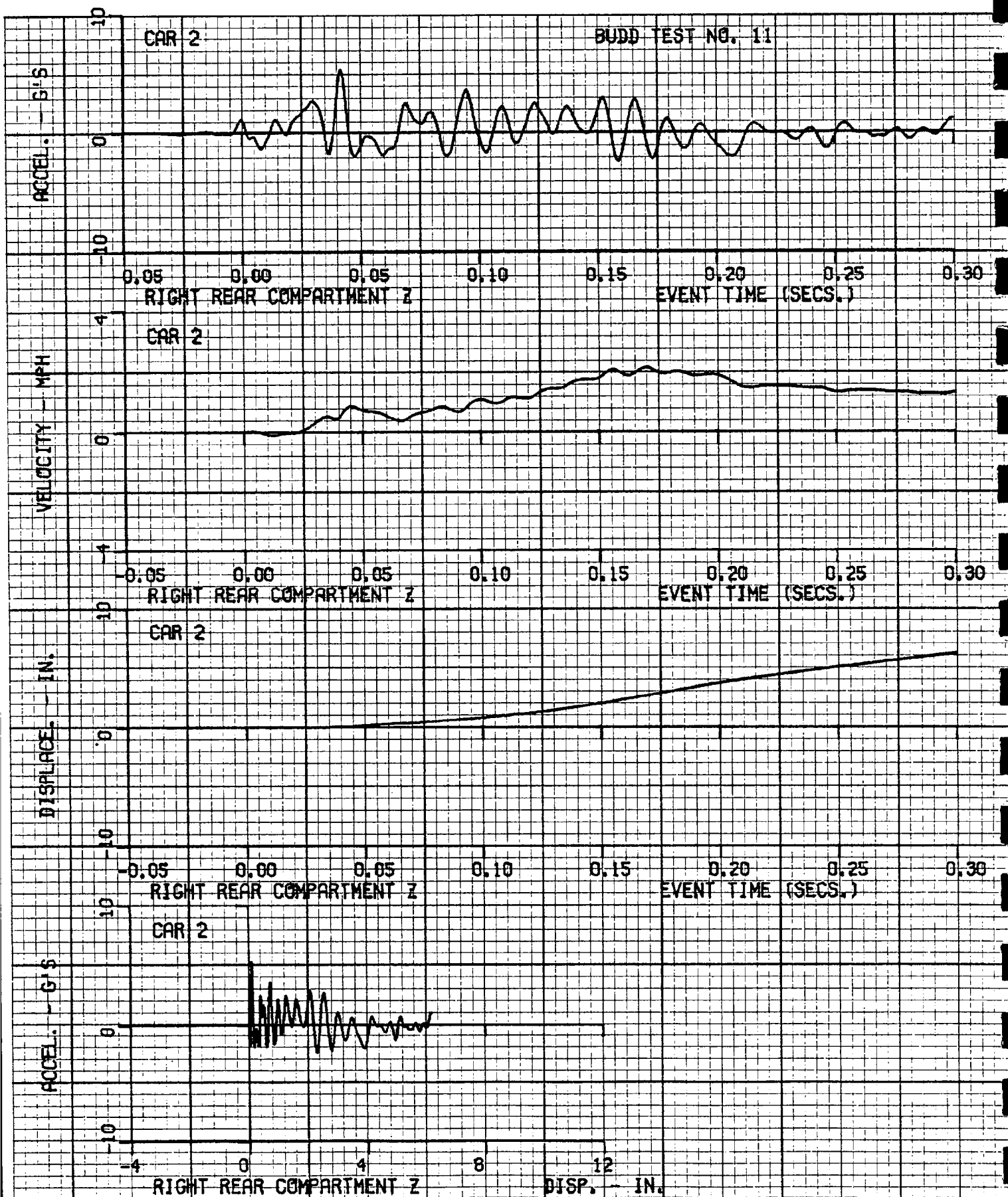


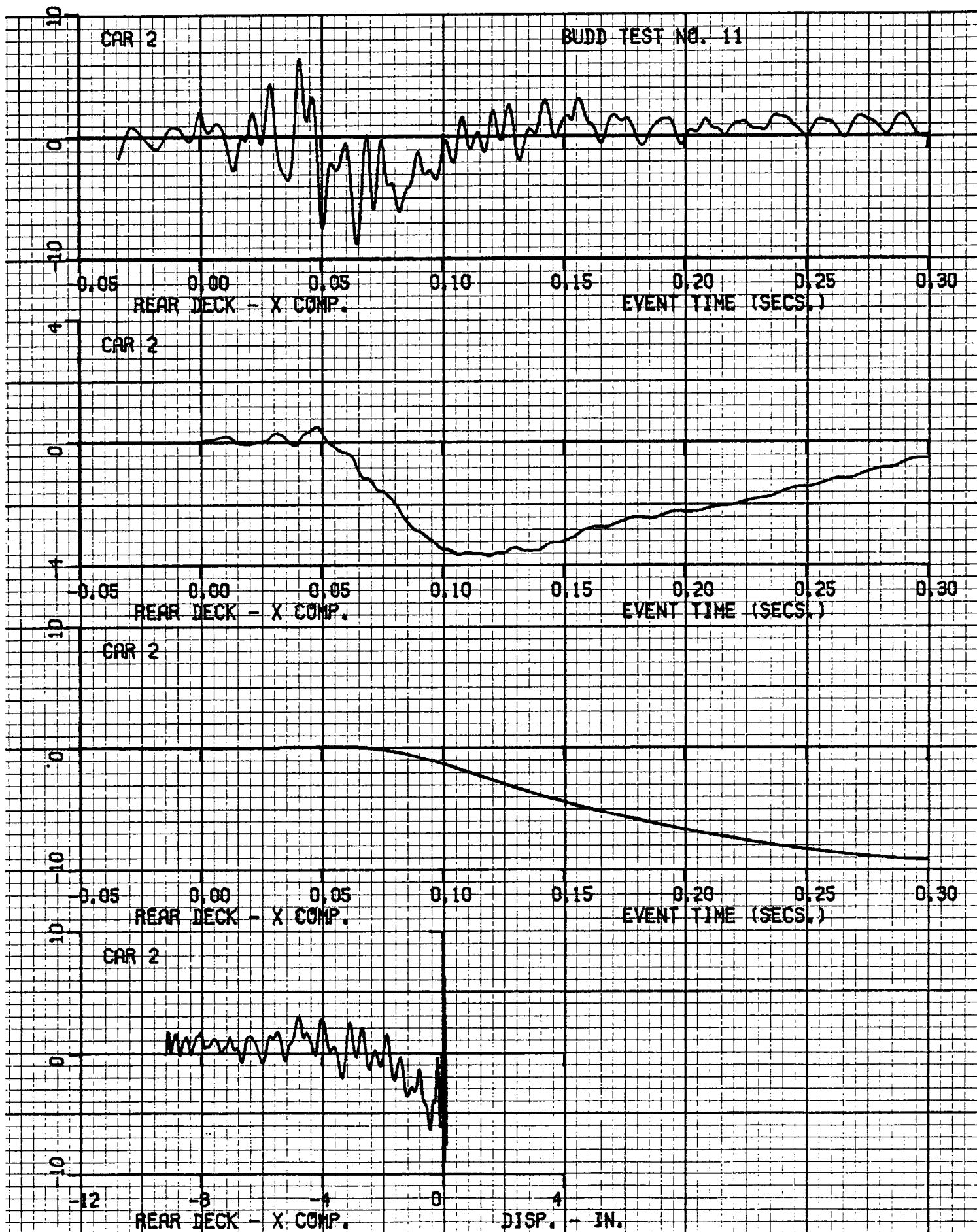


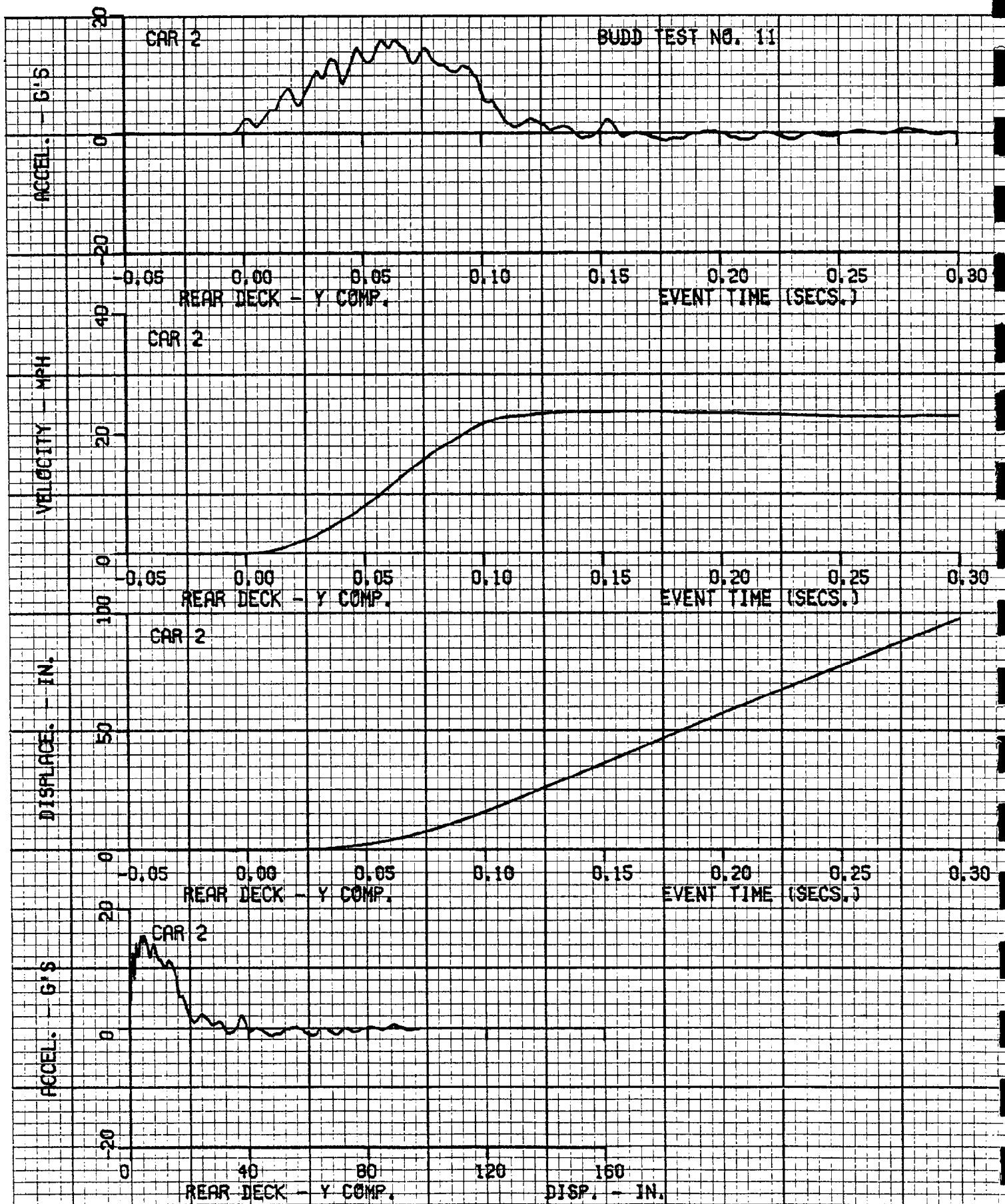


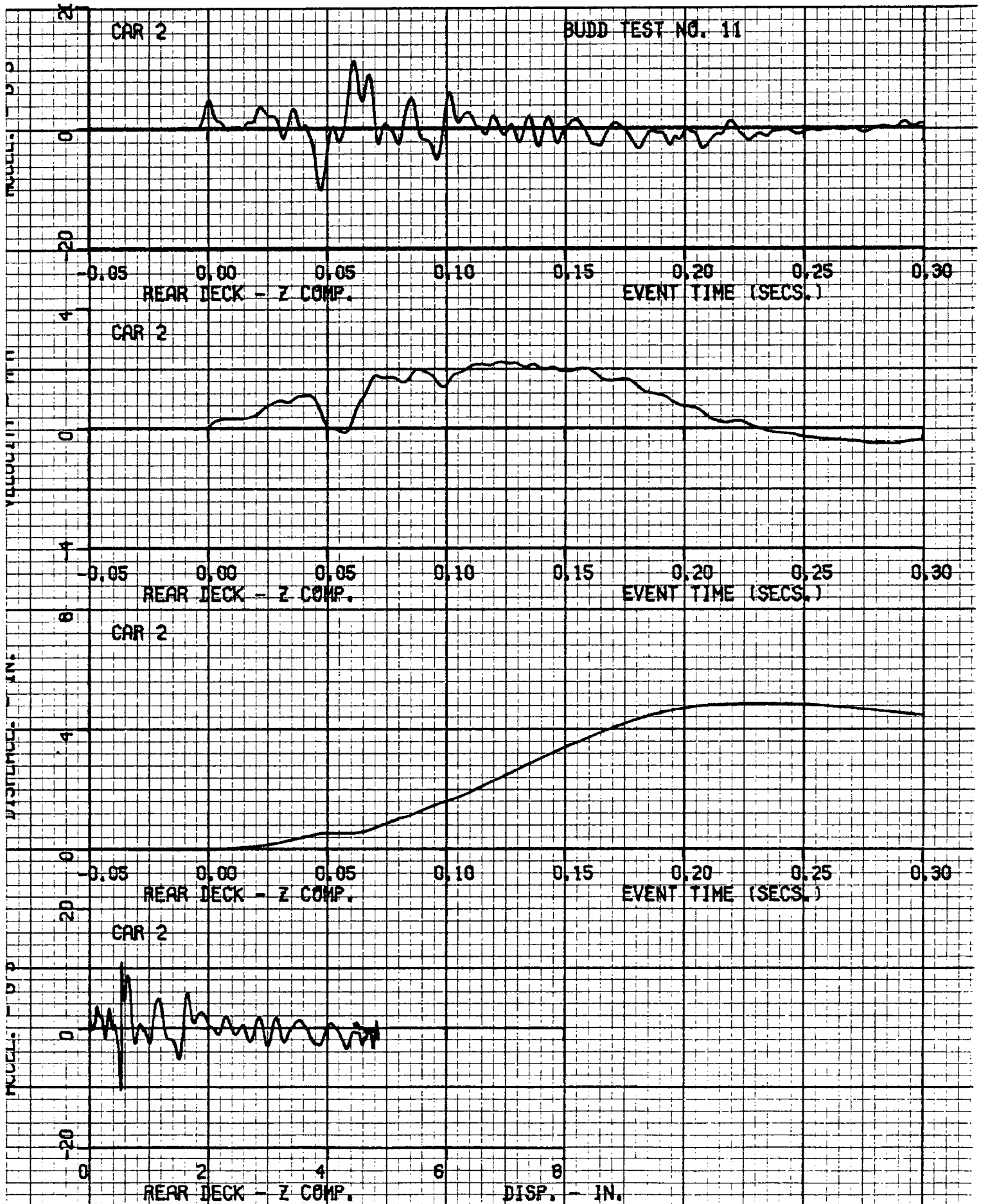


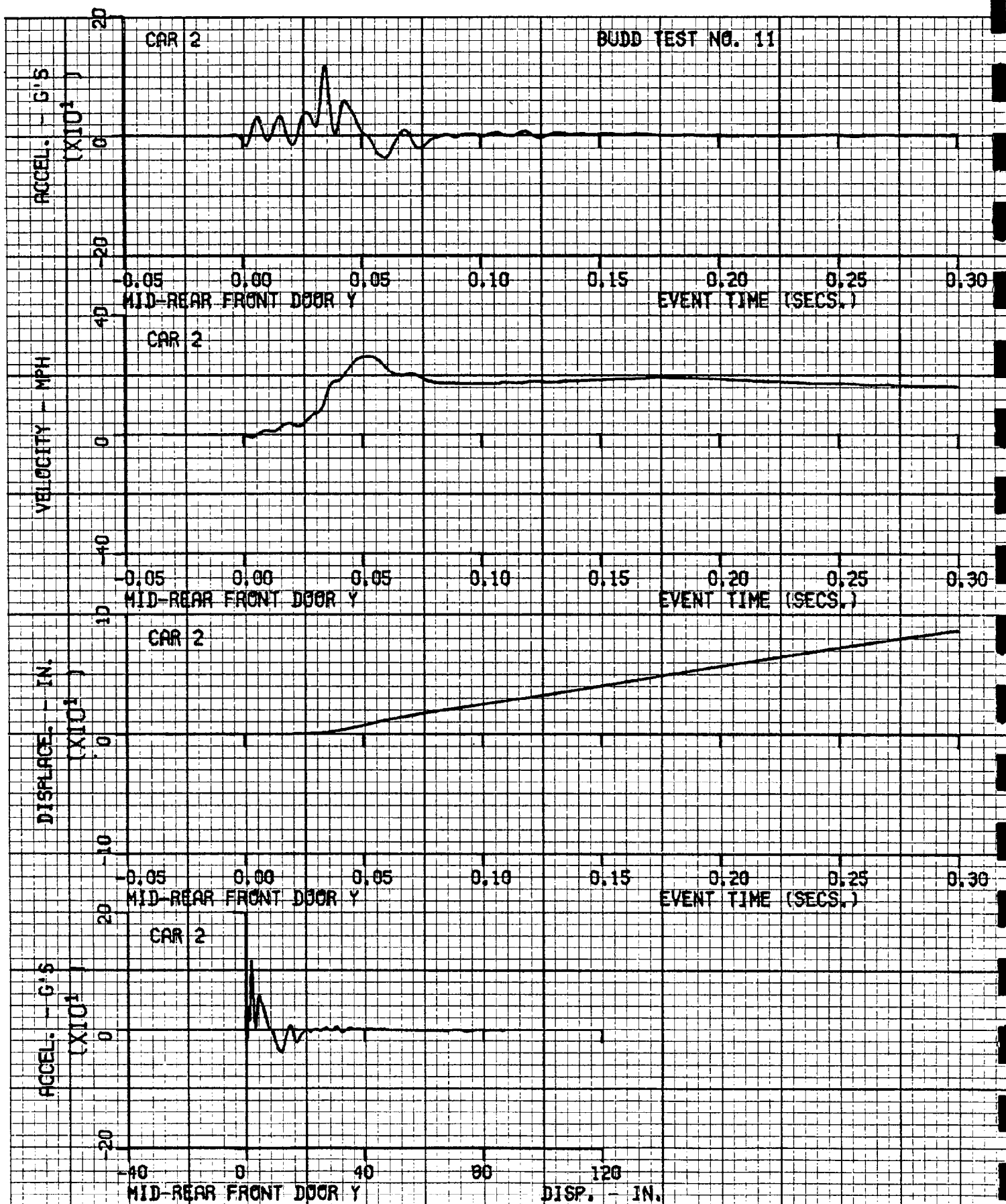


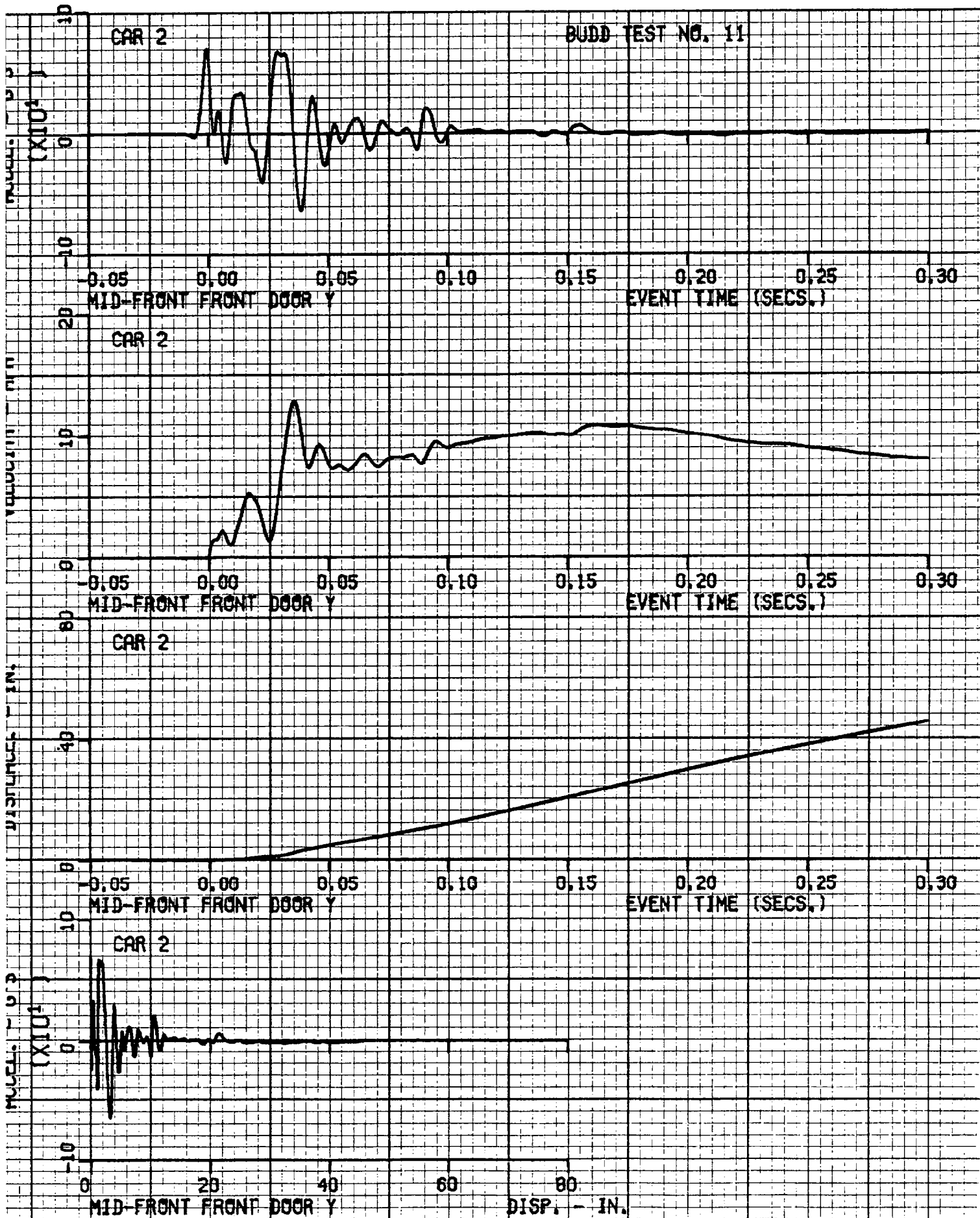


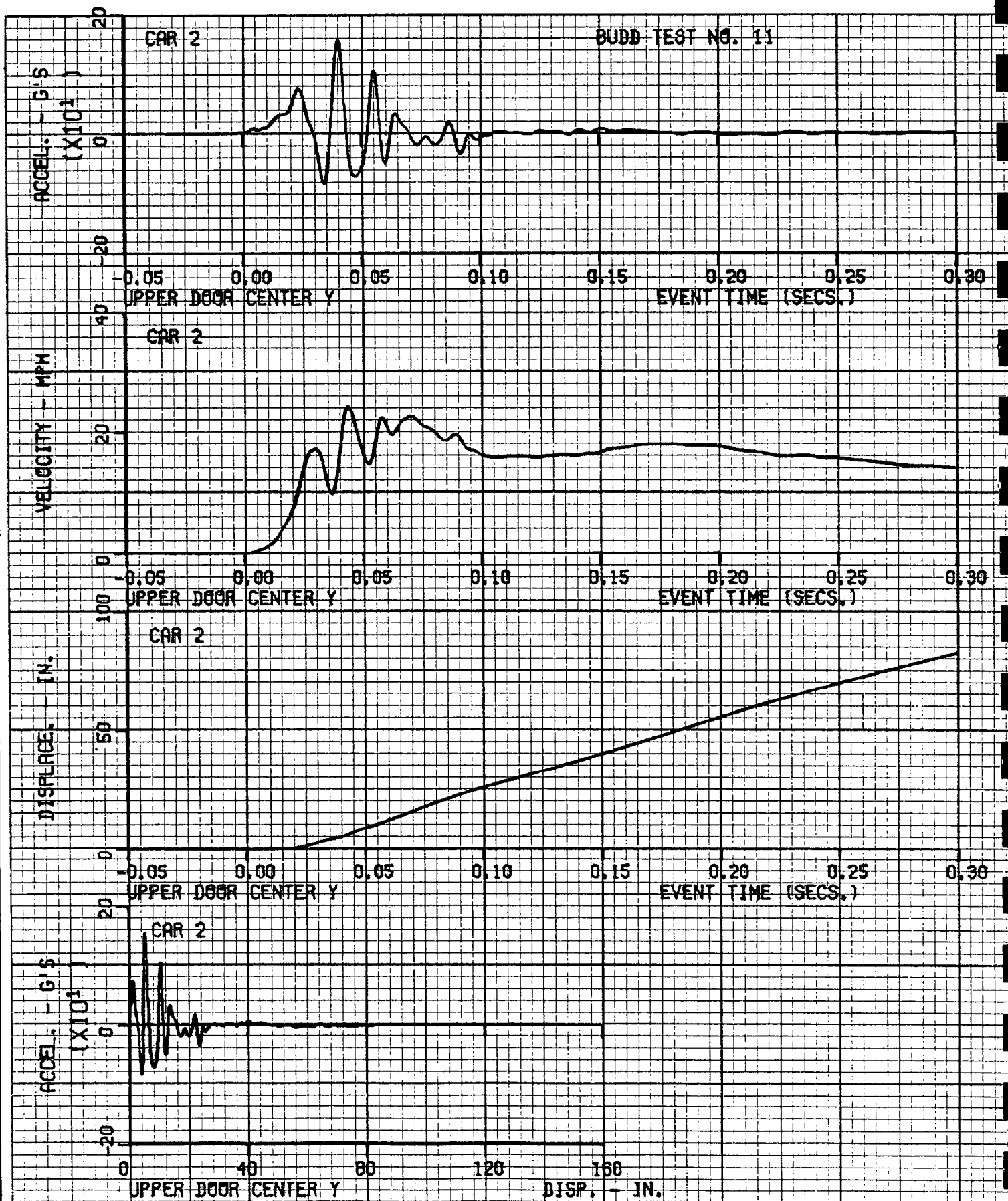












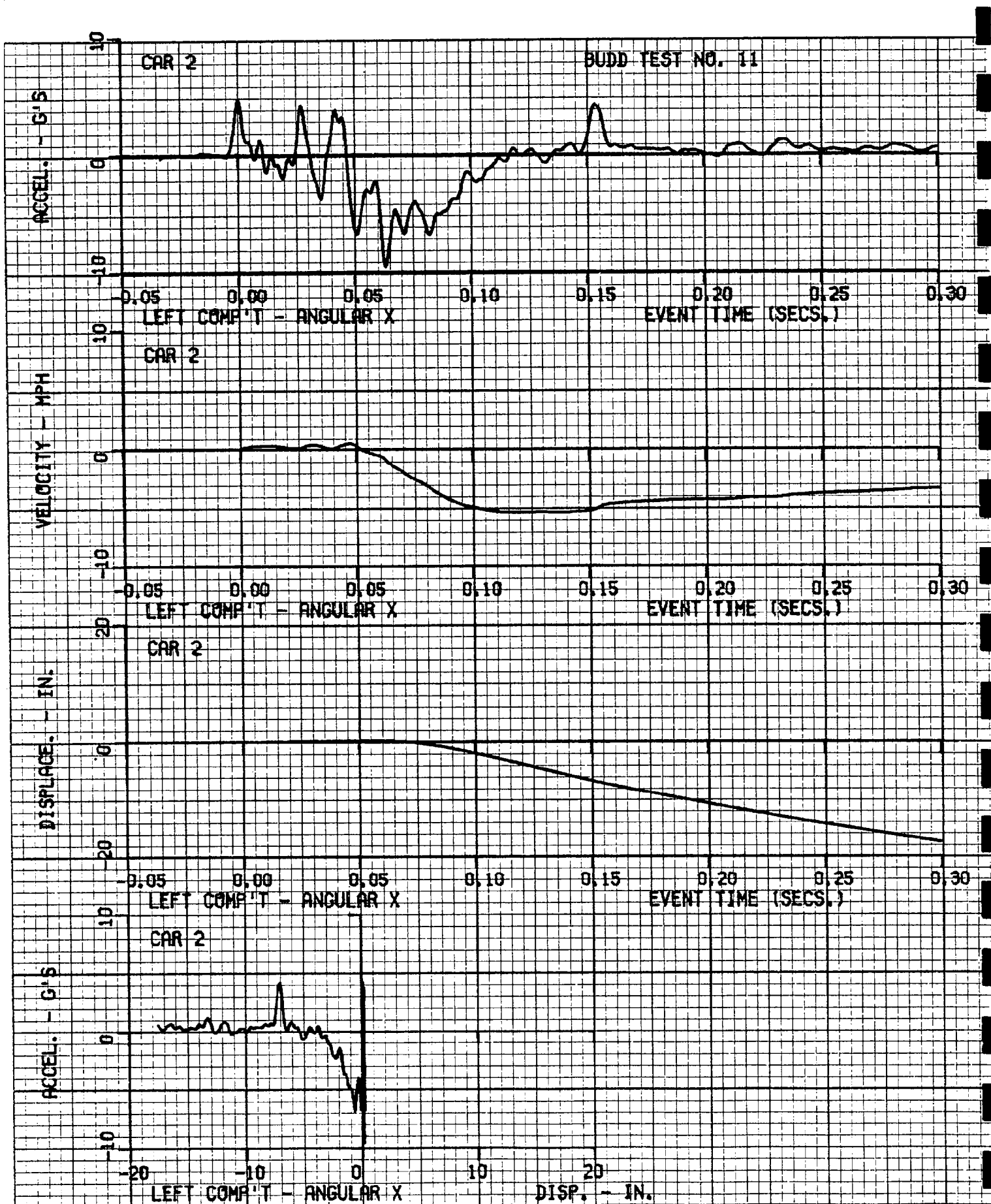
BUDD TEST NO. 11

0.10 0.15 0.20 0.25 0.30
EVENT TIME (SECS.)

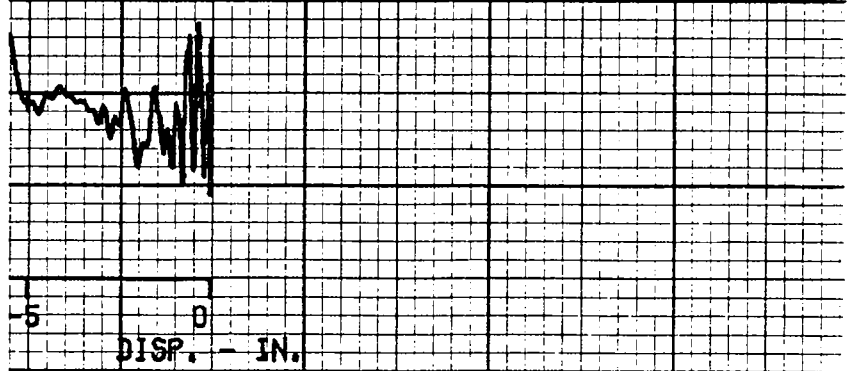
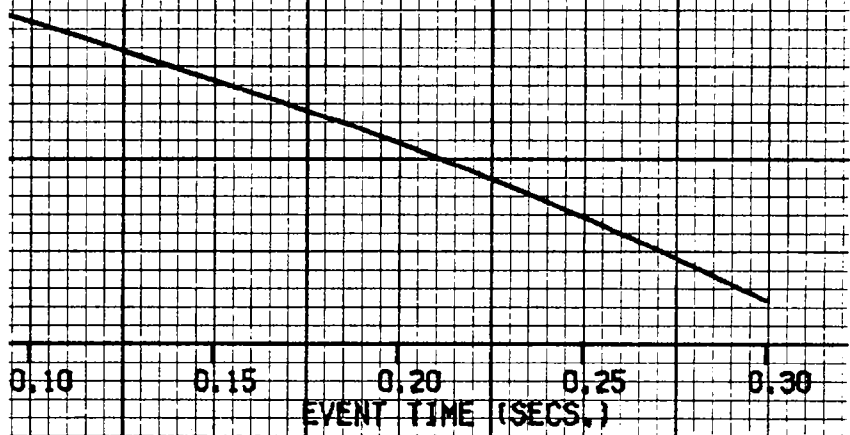
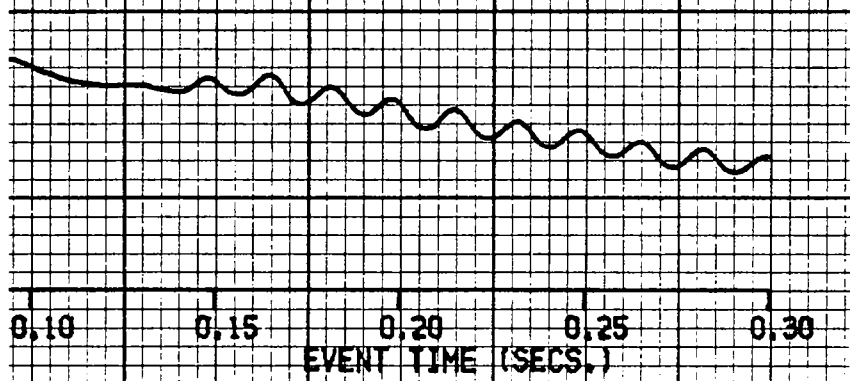
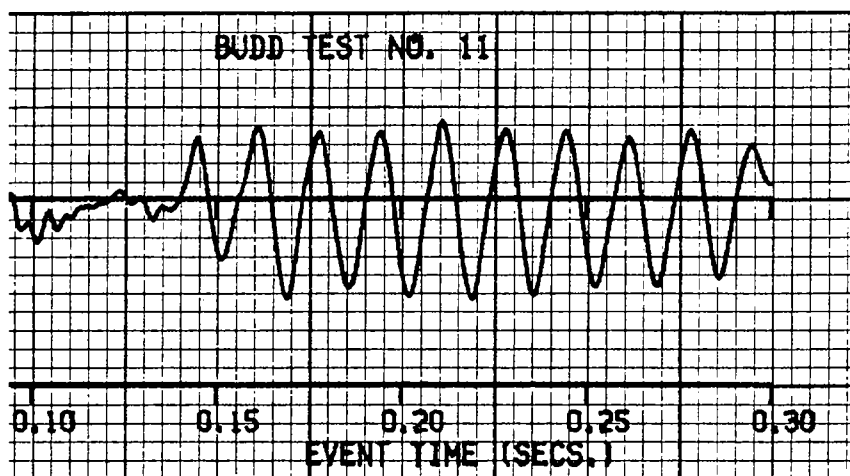
0.10 0.15 0.20 0.25 0.30
EVENT TIME (SECS.)

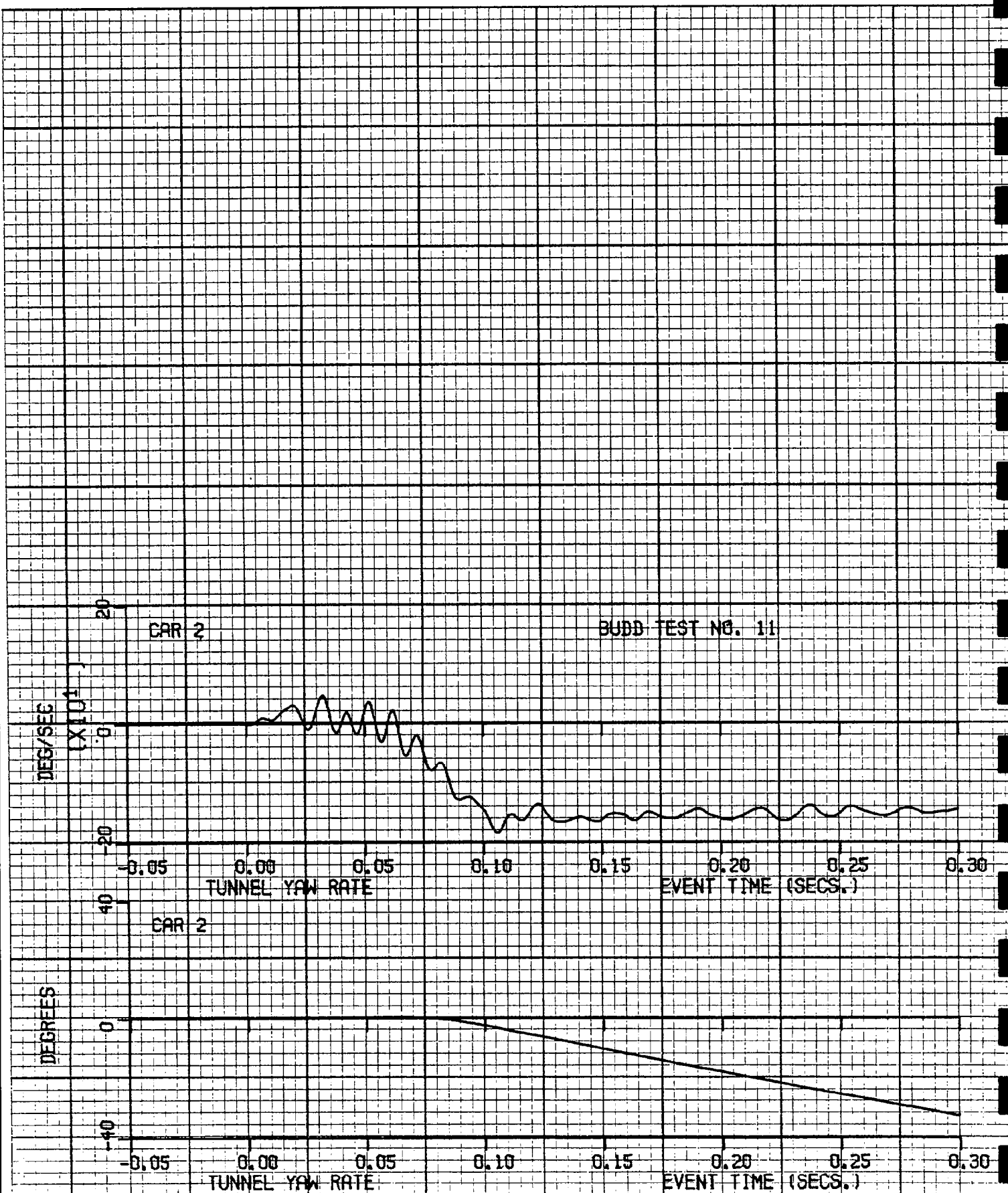
0.10 0.15 0.20 0.25 0.30
EVENT TIME (SECS.)

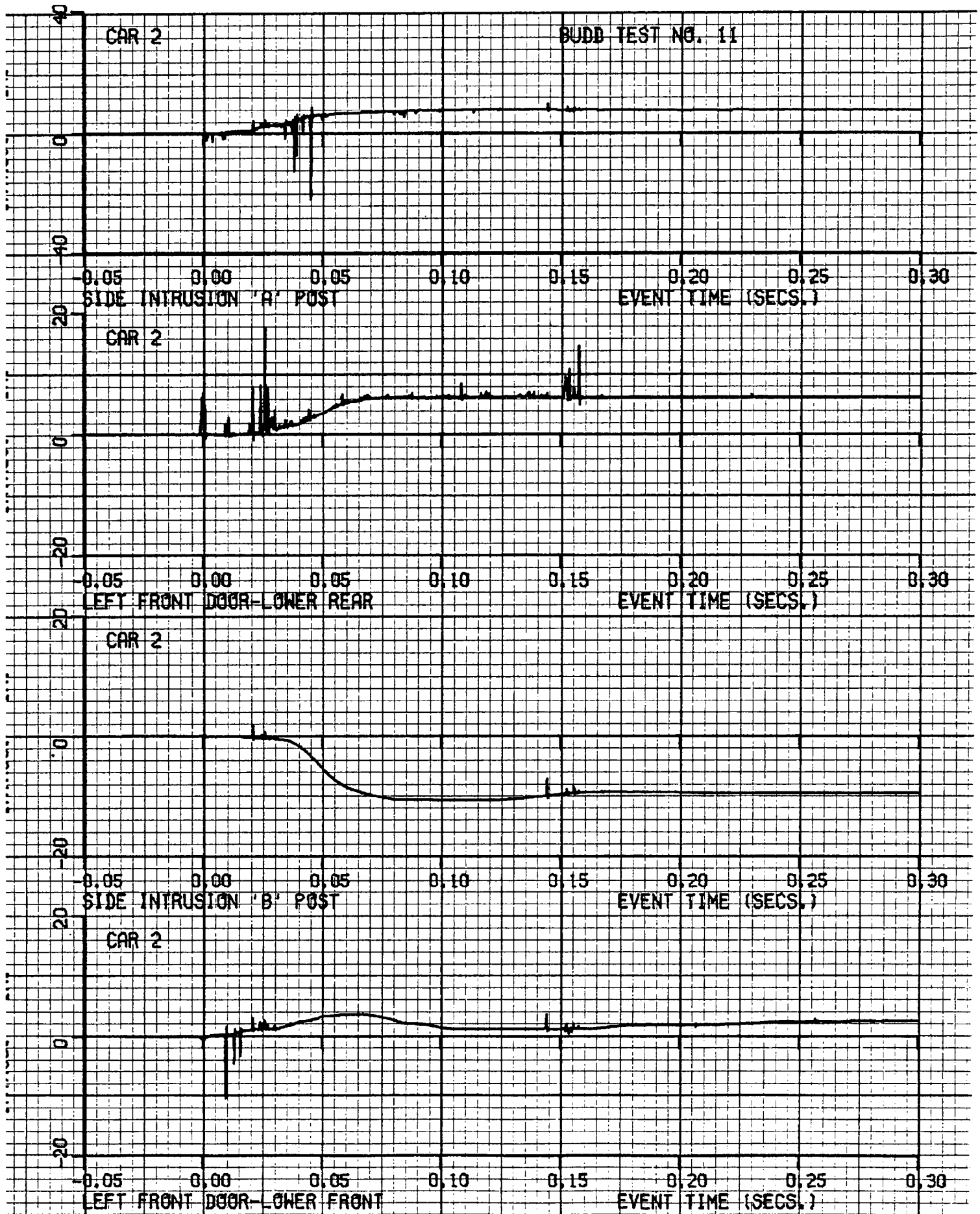
80 120
DISP. - IN.



BUDD TEST NO. 11



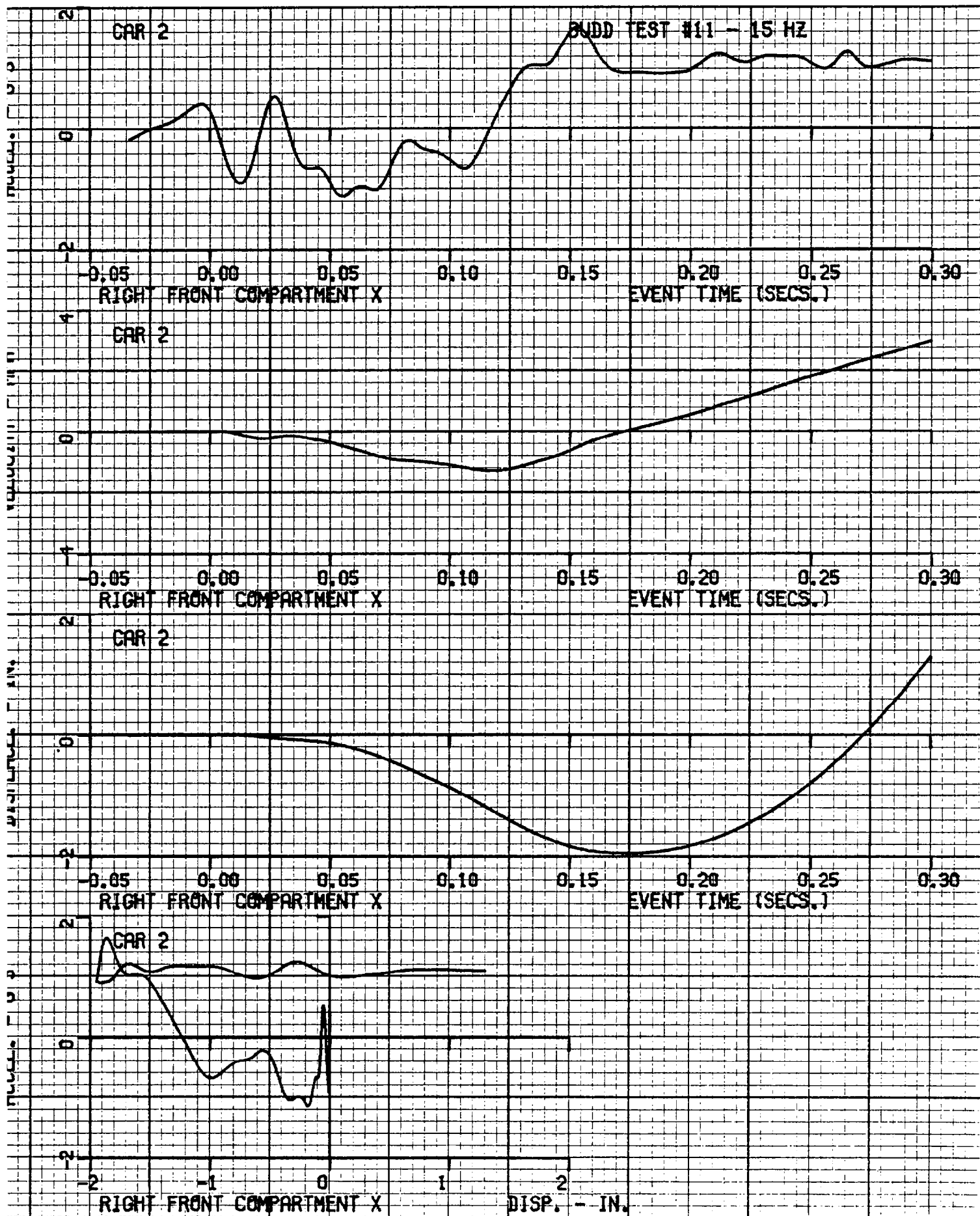


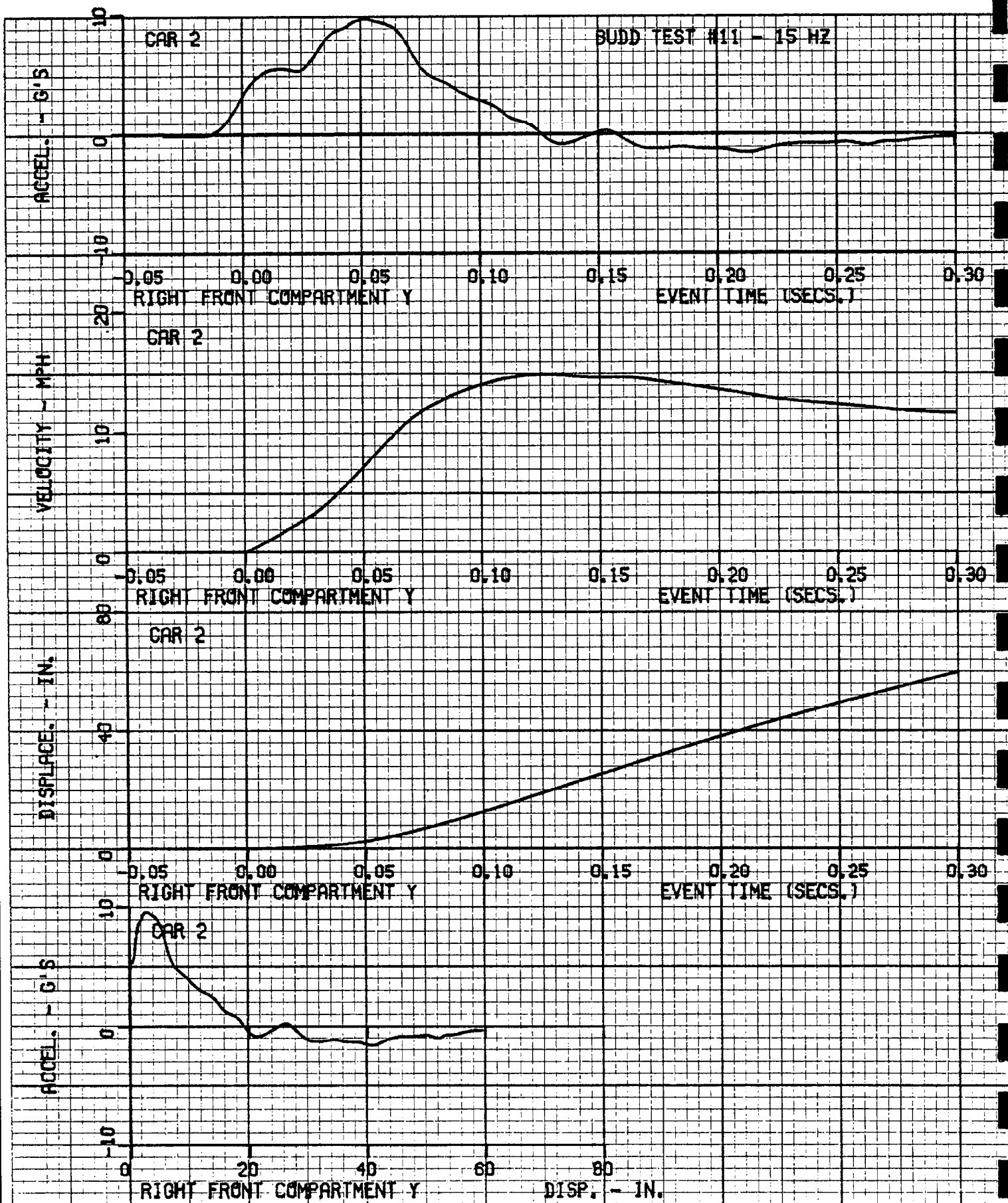


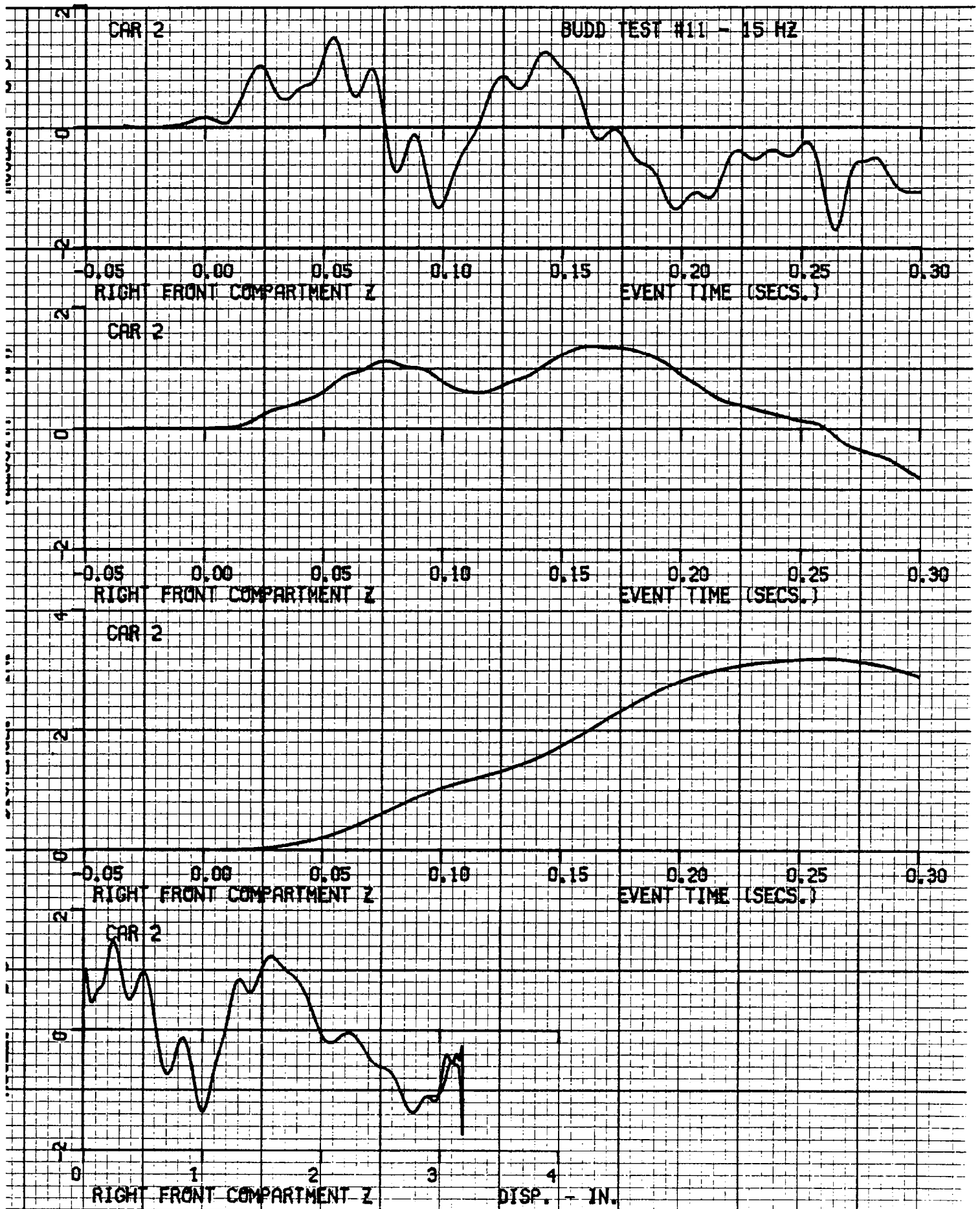
TEST NO. 11

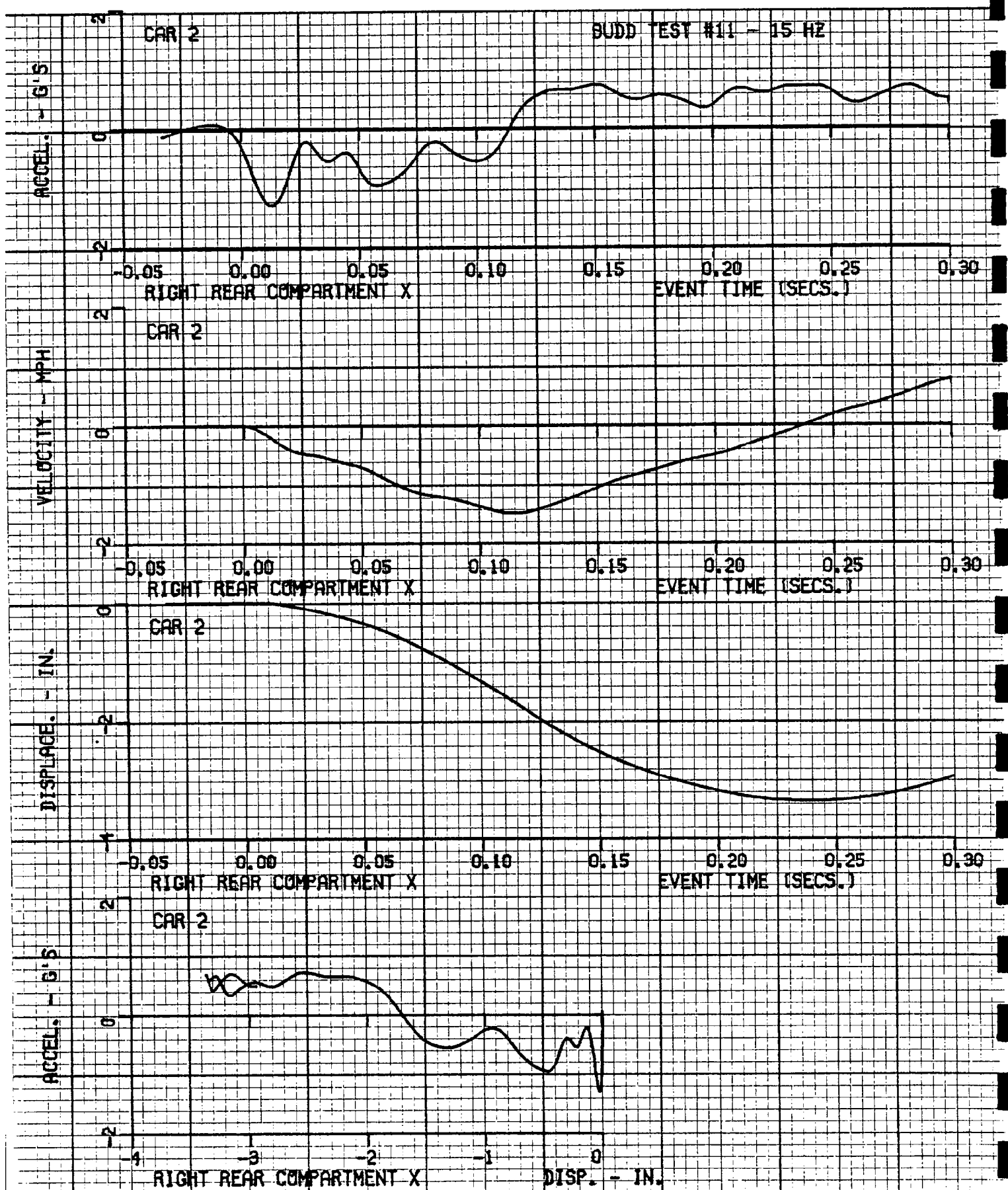
CAR NO. 2 - 1976 VOLKSWAGEN RABBIT

VEHICLE DATA - 15 HZ CHANNEL CLASS









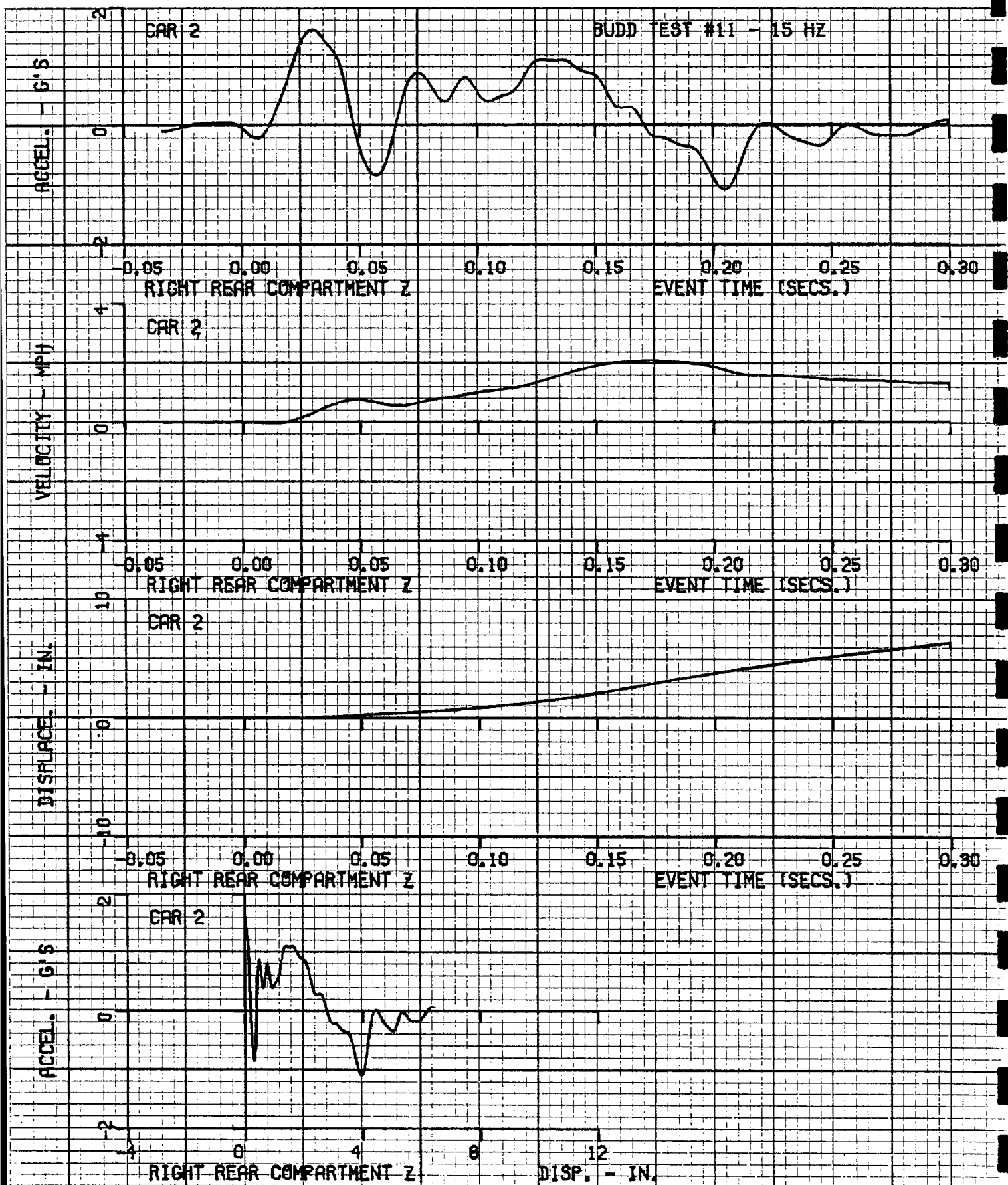
BUDD TEST #11 - 15 HZ

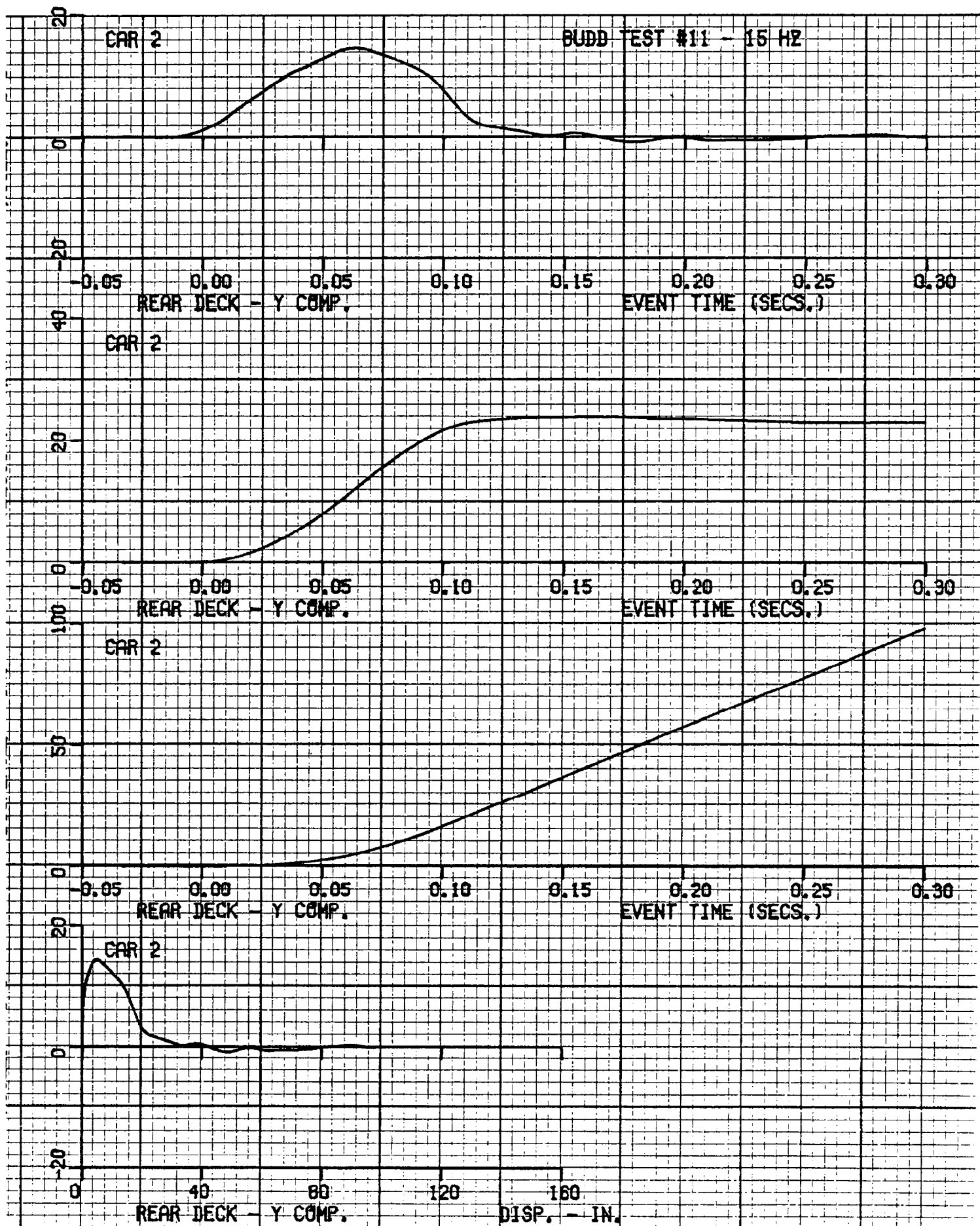
0.05 0.10 0.15 0.20 0.25 0.30
EVENT Y EVENT TIME (SECS.)

0.05 0.10 0.15 0.20 0.25 0.30
EVENT Y EVENT TIME (SECS.)

0.05 0.10 0.15 0.20 0.25 0.30
EVENT Y EVENT TIME (SECS.)

0 80 80
EVENT Y DISP. - IN.





BUDD TEST #11 - 15 HZ

ACCEL. - G'S

CAR 2

REAR DECK - X COMP. EVENT TIME (SECS.)

VELOCITY - MPH

CAR 2

REAR DECK - X COMP. EVENT TIME (SECS.)

DISPLAC. - IN.

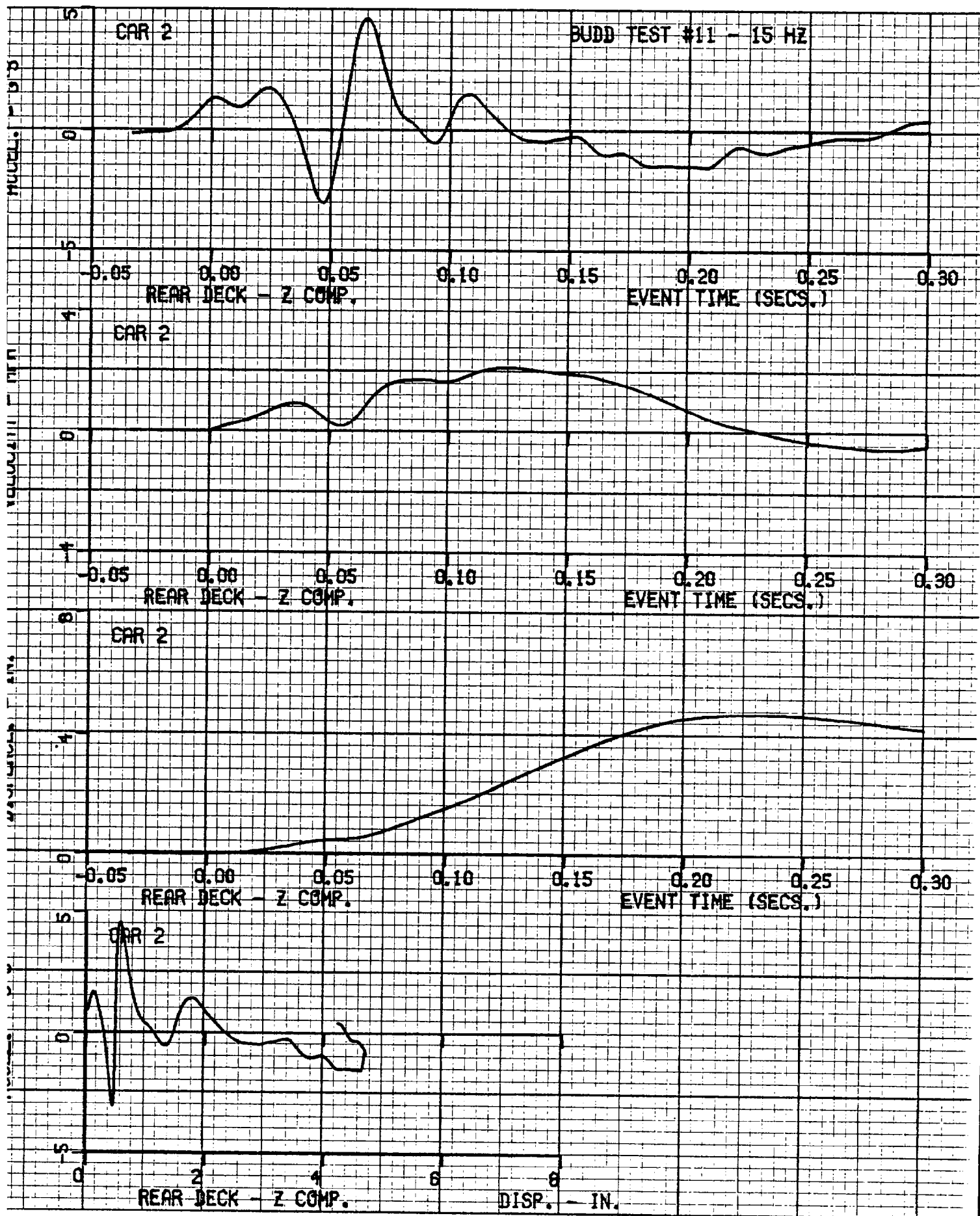
CAR 2

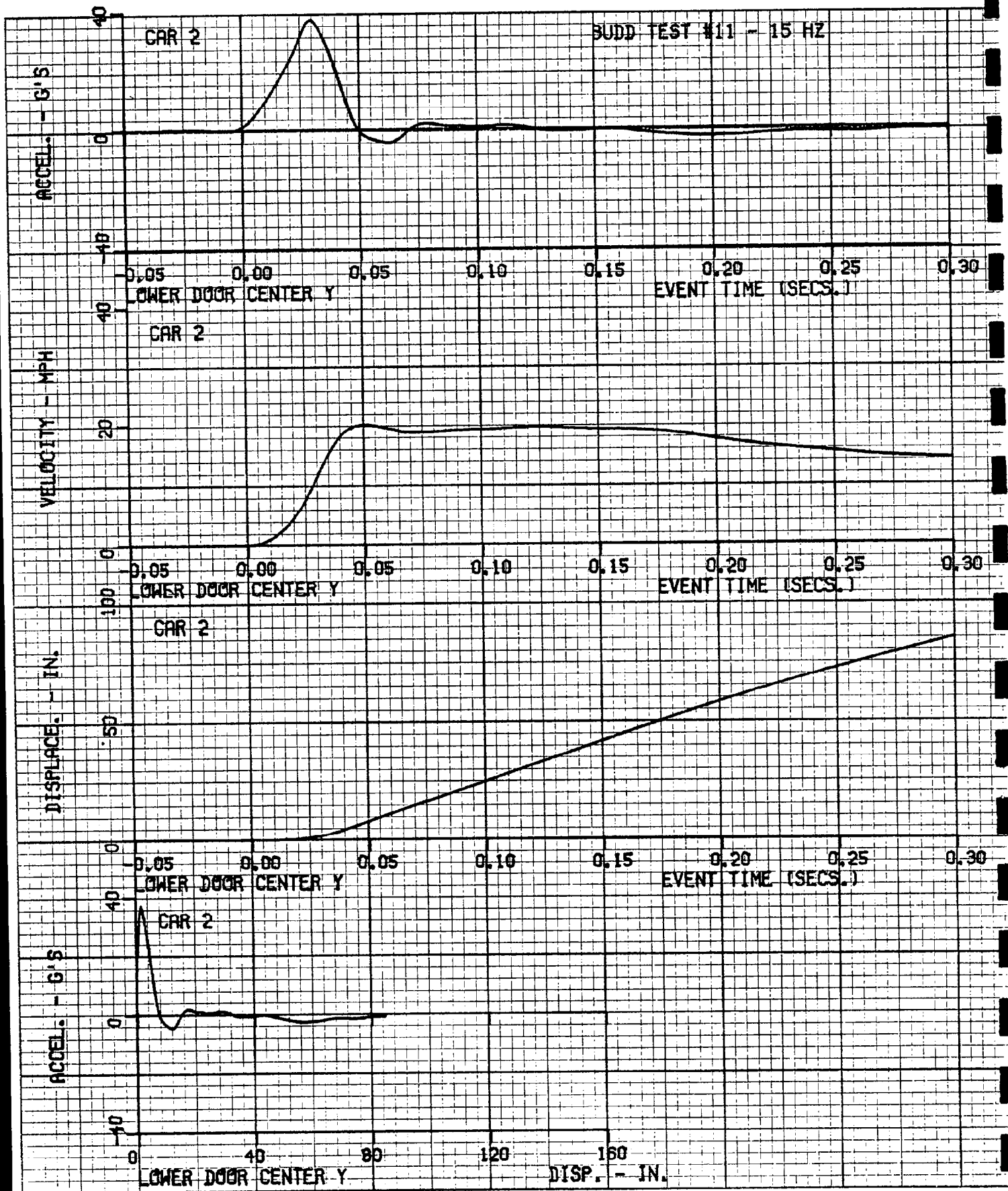
REAR DECK - X COMP. EVENT TIME (SECS.)

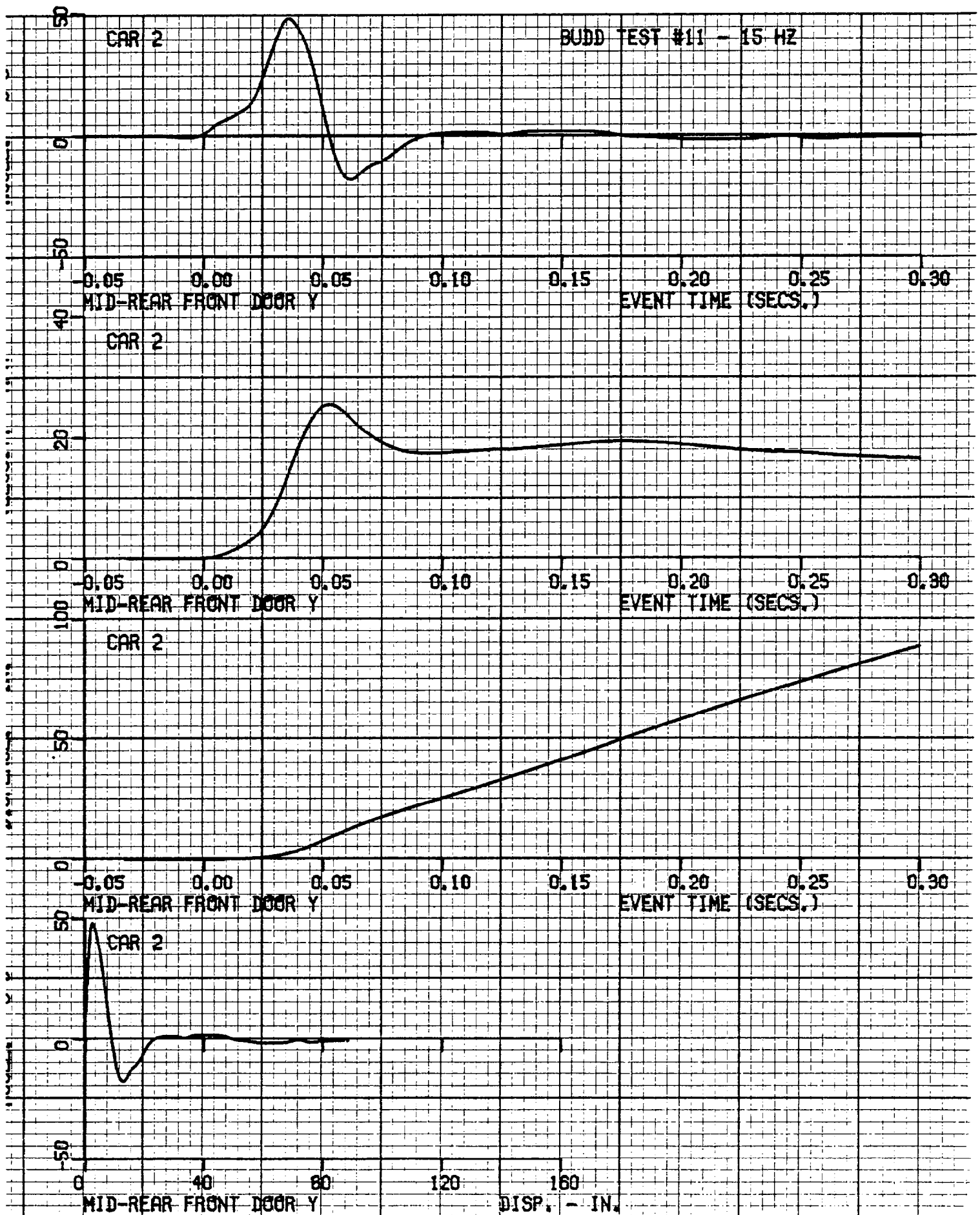
ACCEL. - G'S

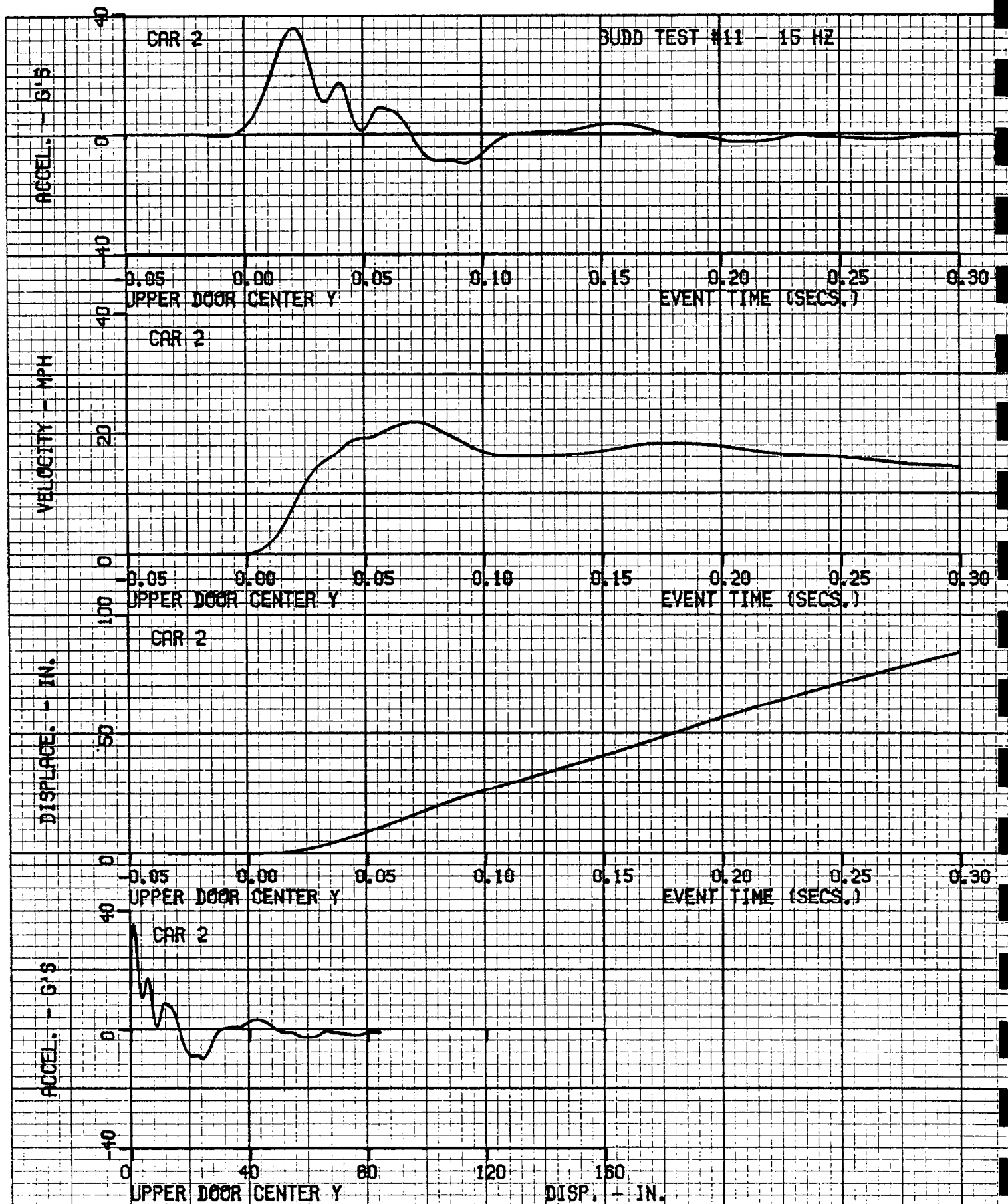
CAR 2

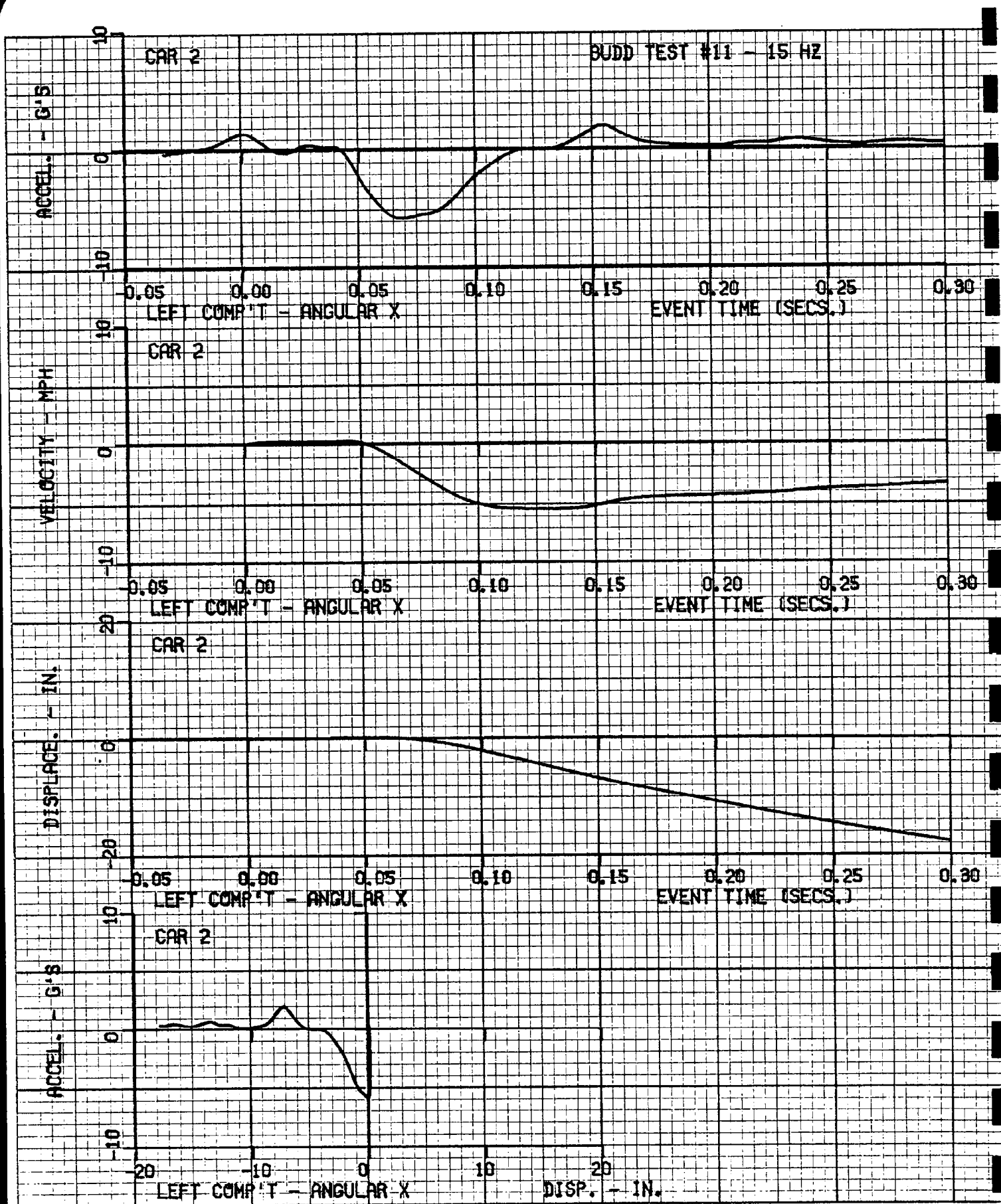
REAR DECK - X COMP. DISP. - IN.



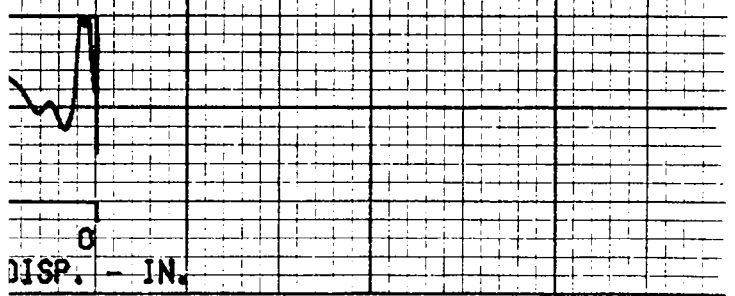
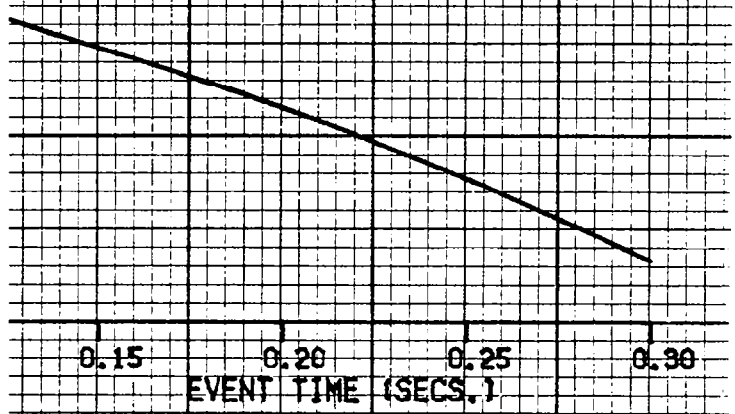
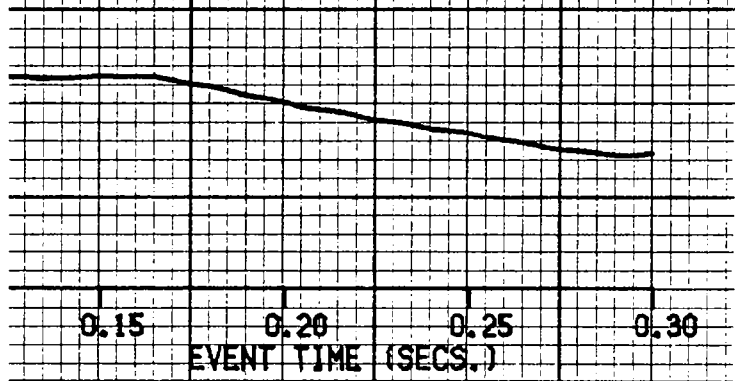
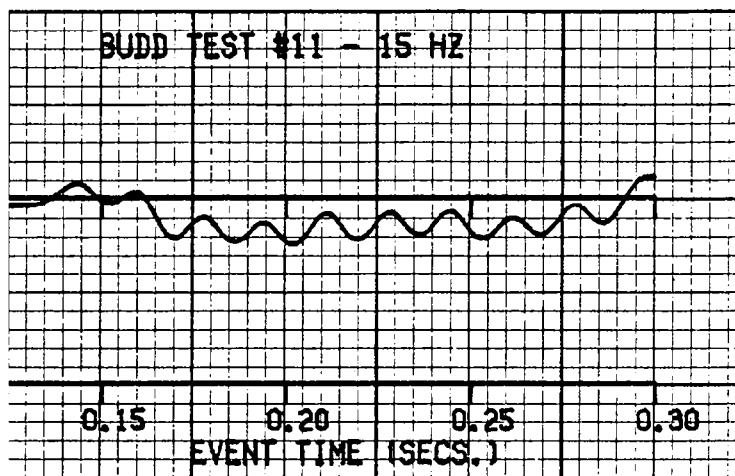








BUDD TEST #11 - 15 HZ



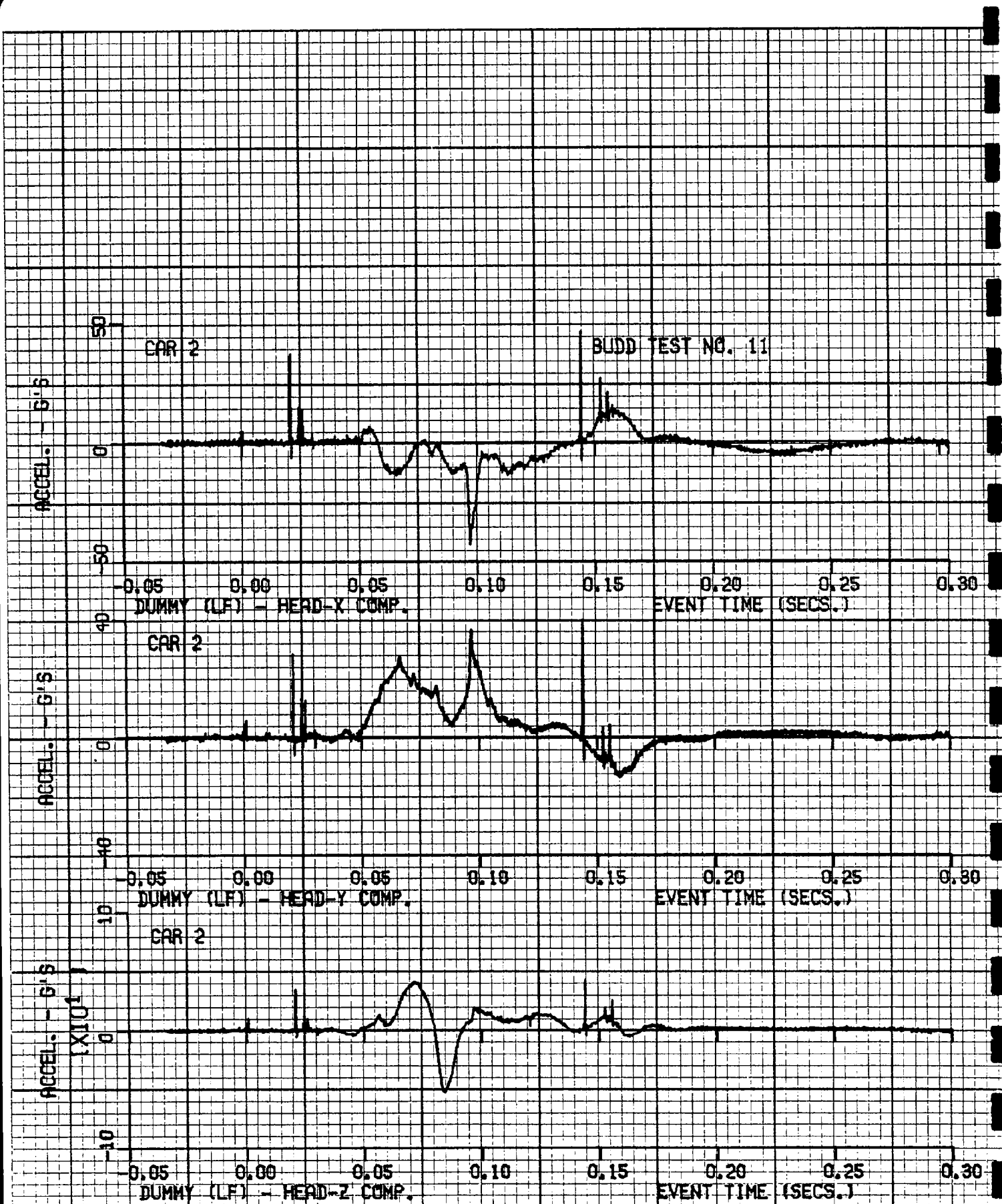


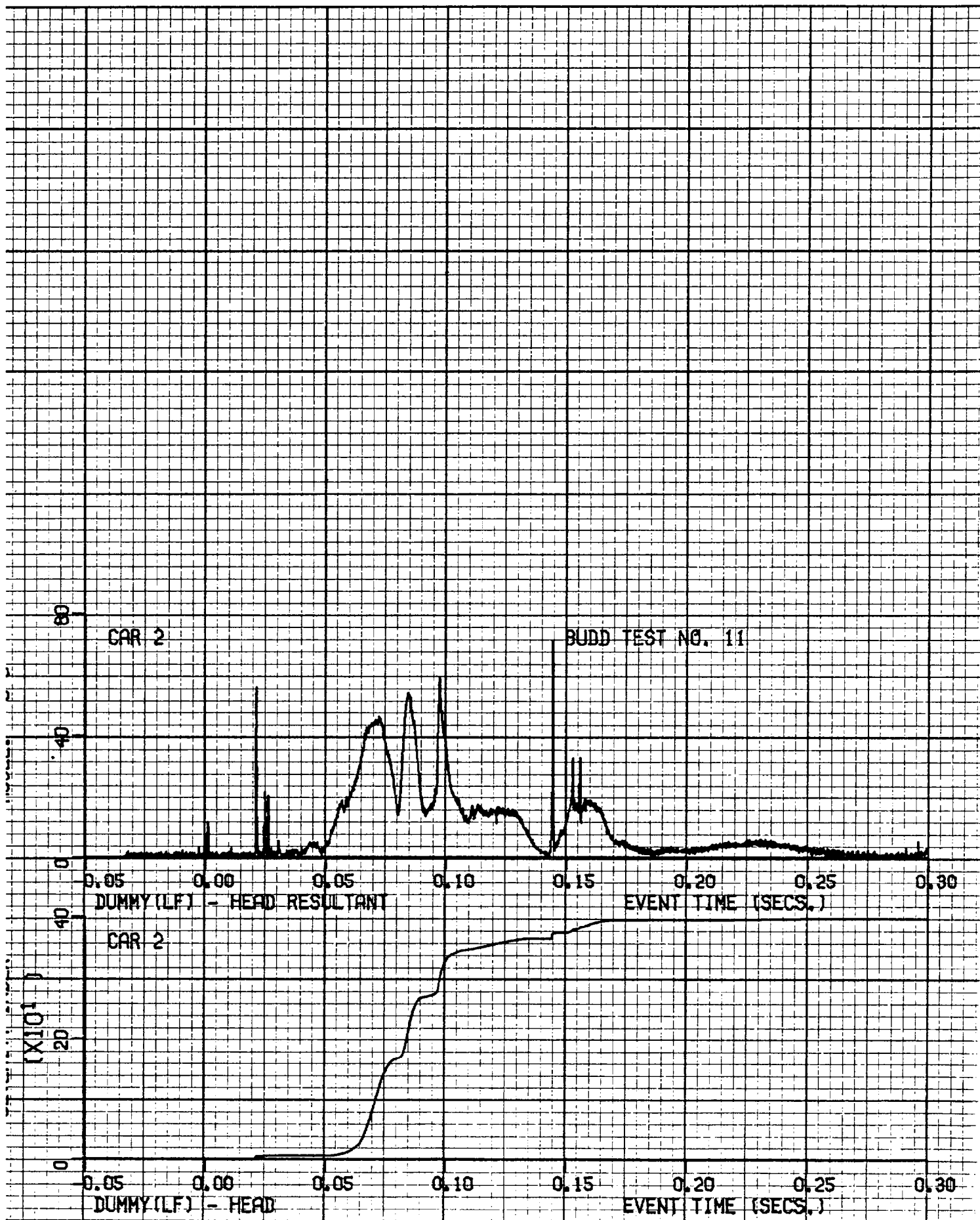
TEST NO. 11

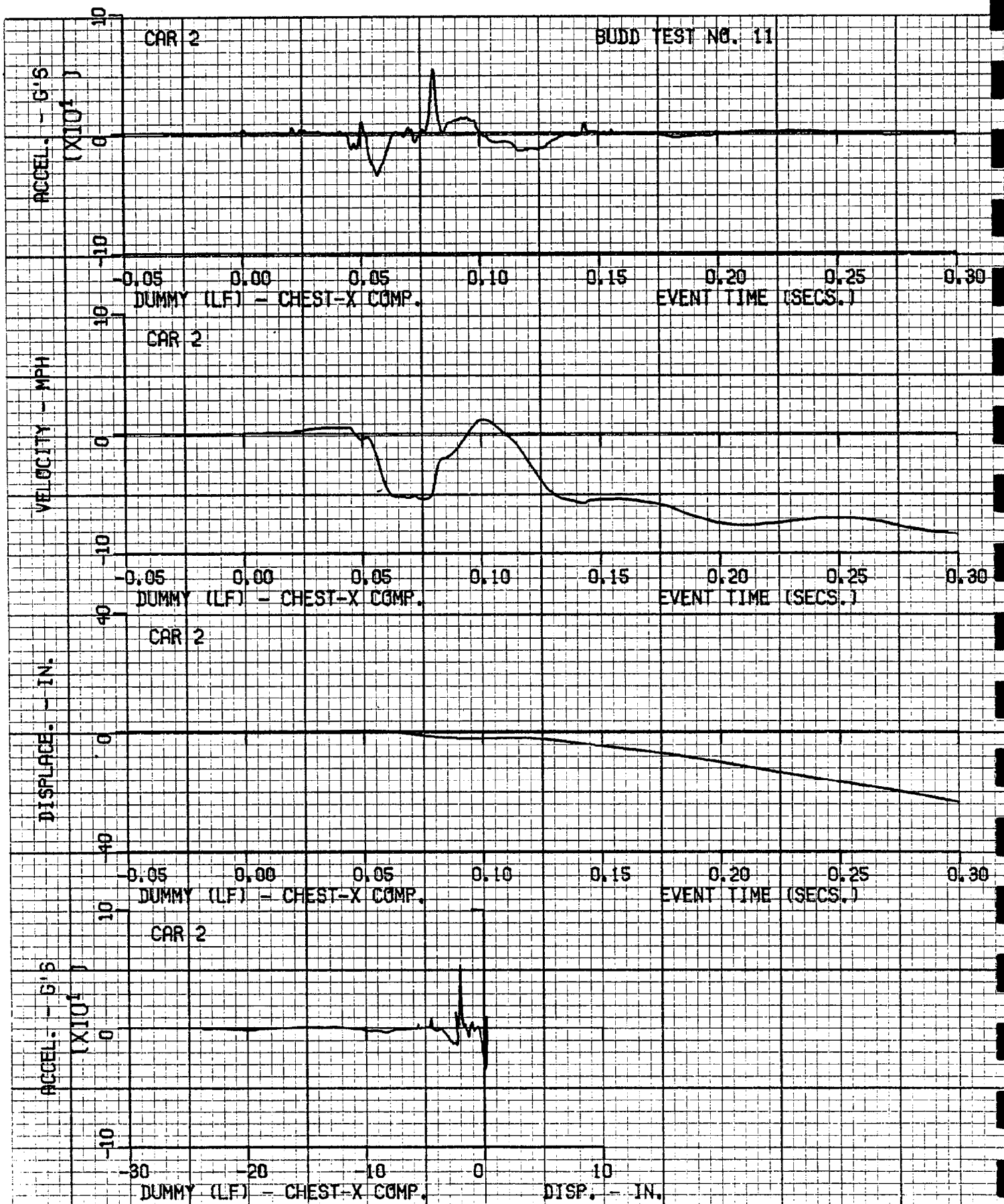
CAR NO. 2 - 1976 VOLKSWAGEN RABBIT

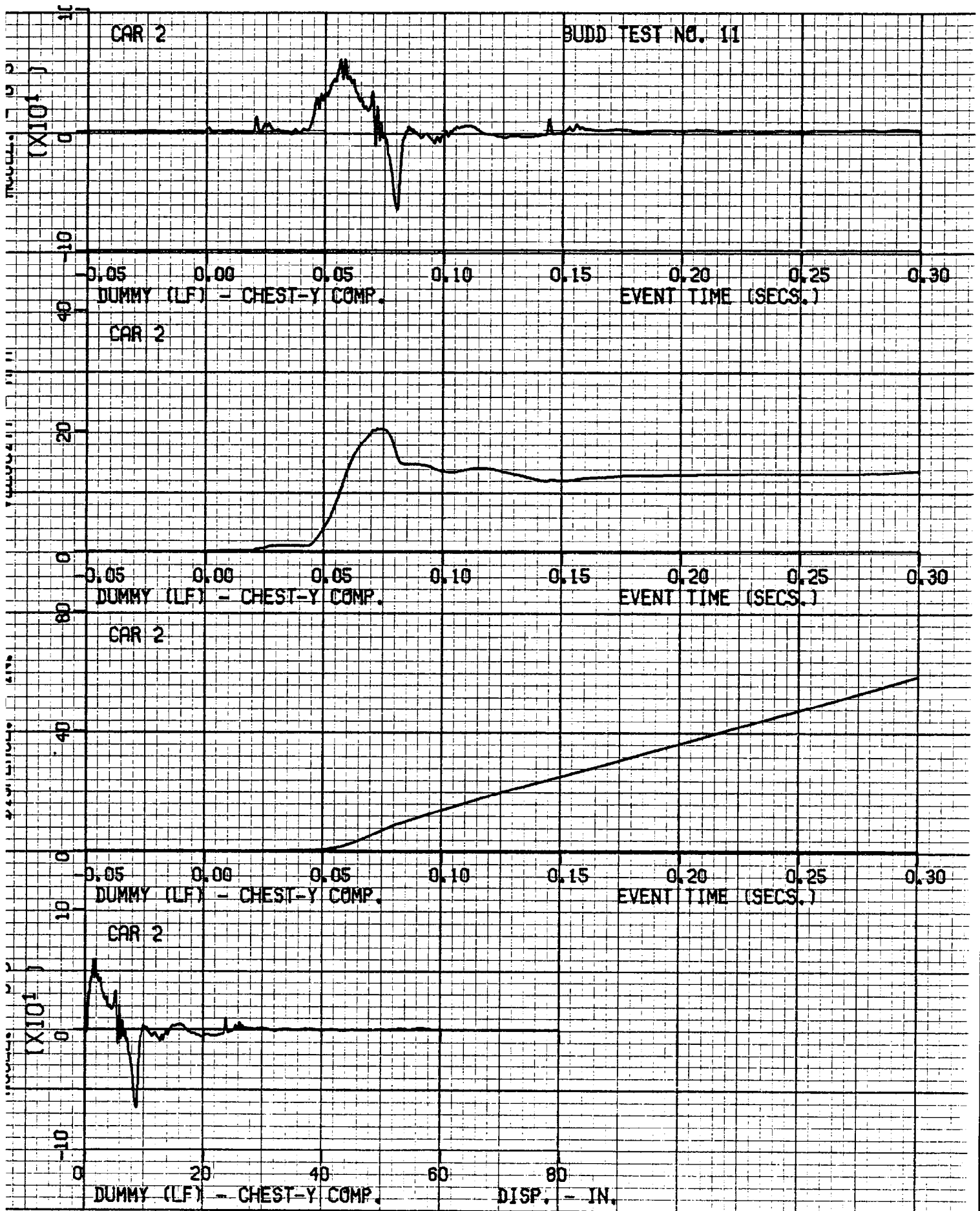
DUMMY DATA

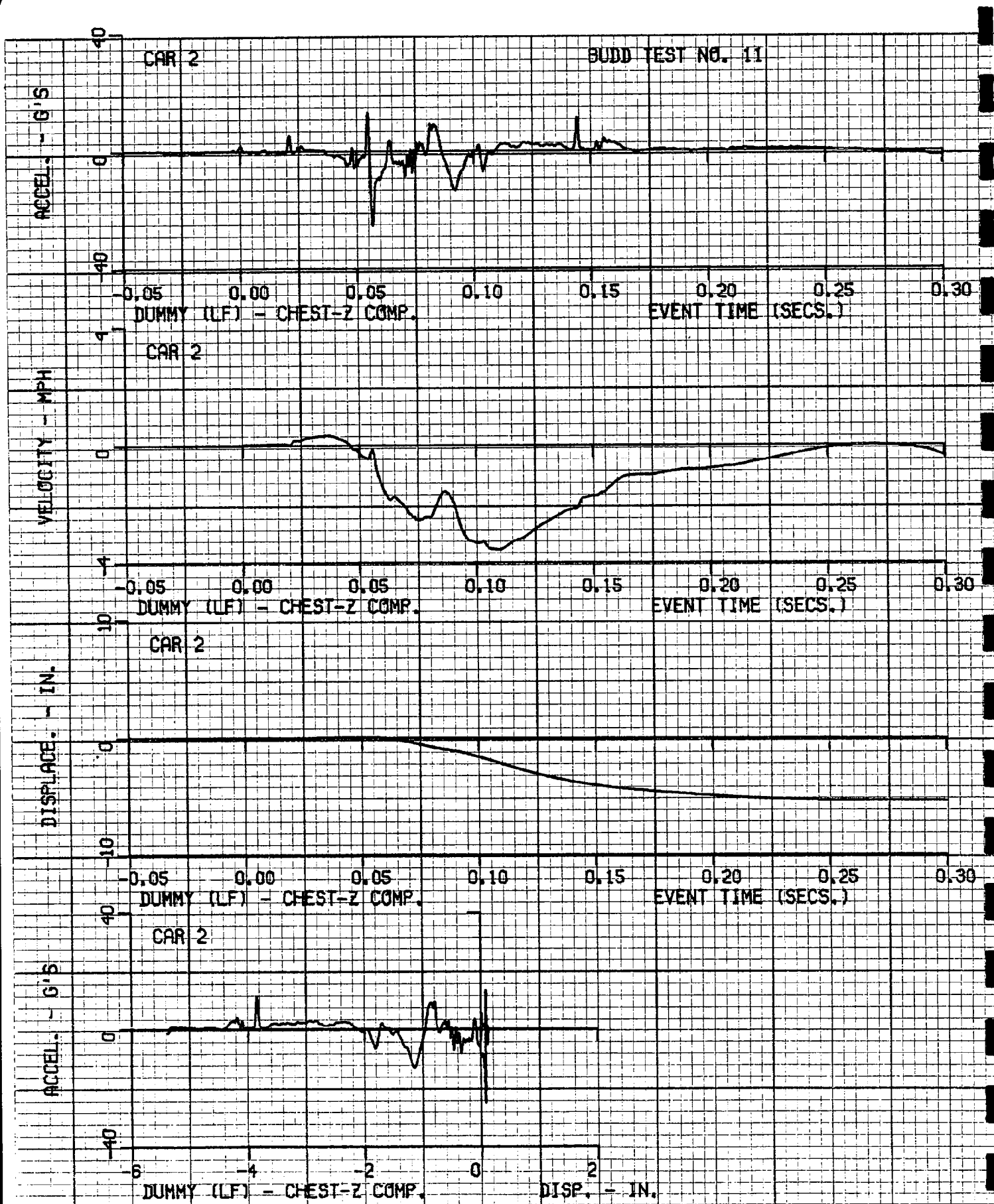
	<u>Filter Channel Class</u>
Head Acceleration	1000
Chest Acceleration	180
Pelvic Acceleration	180

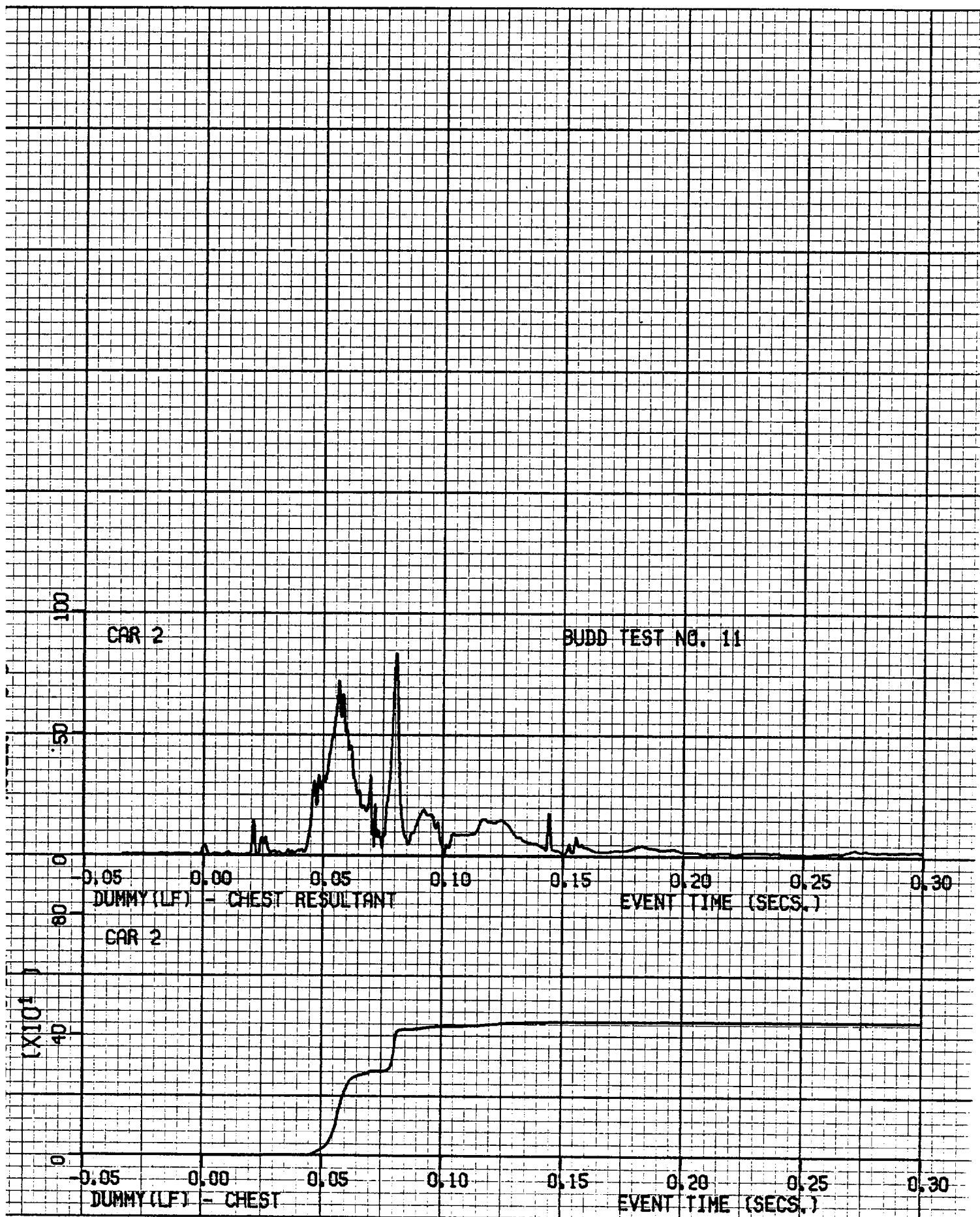


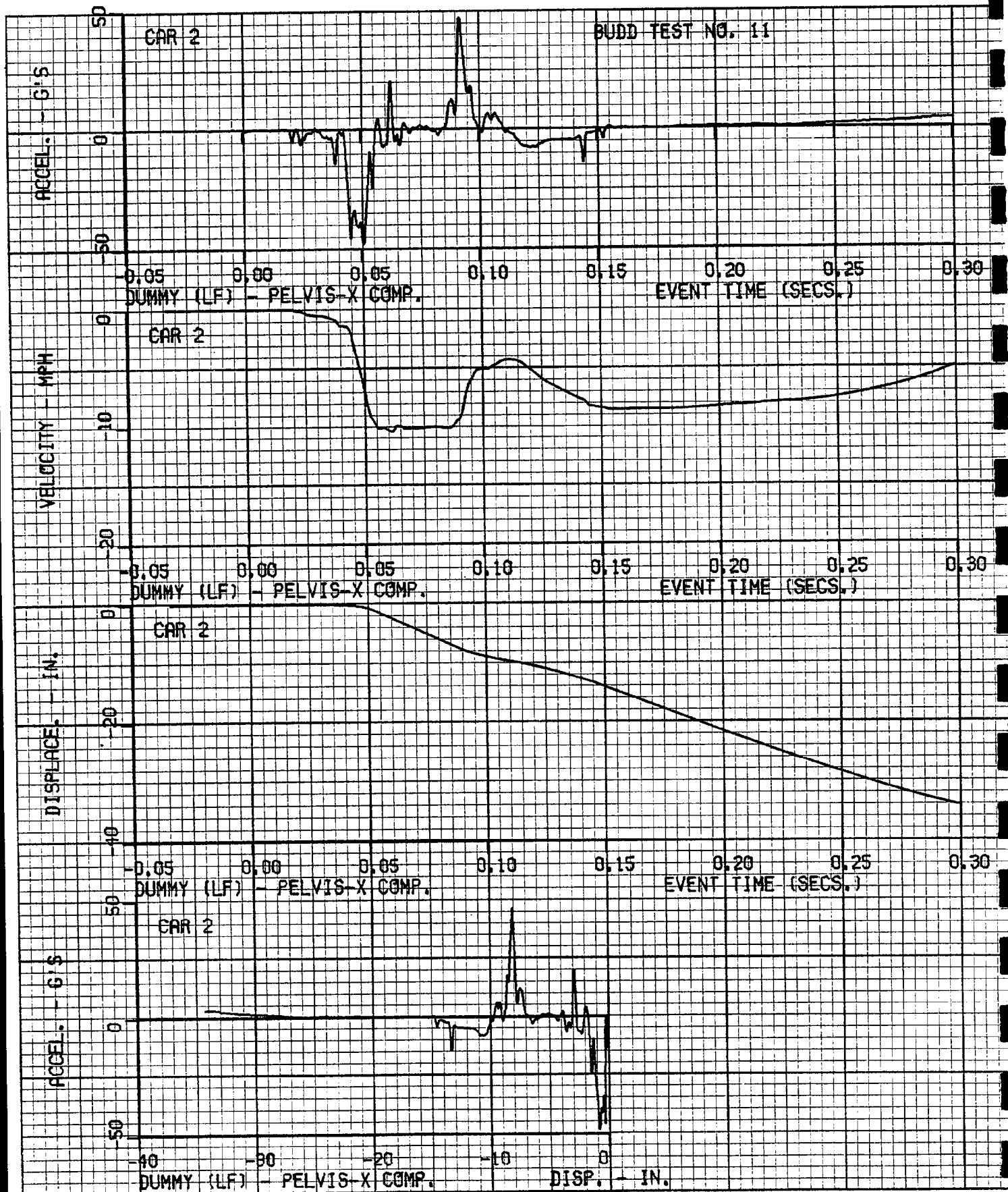


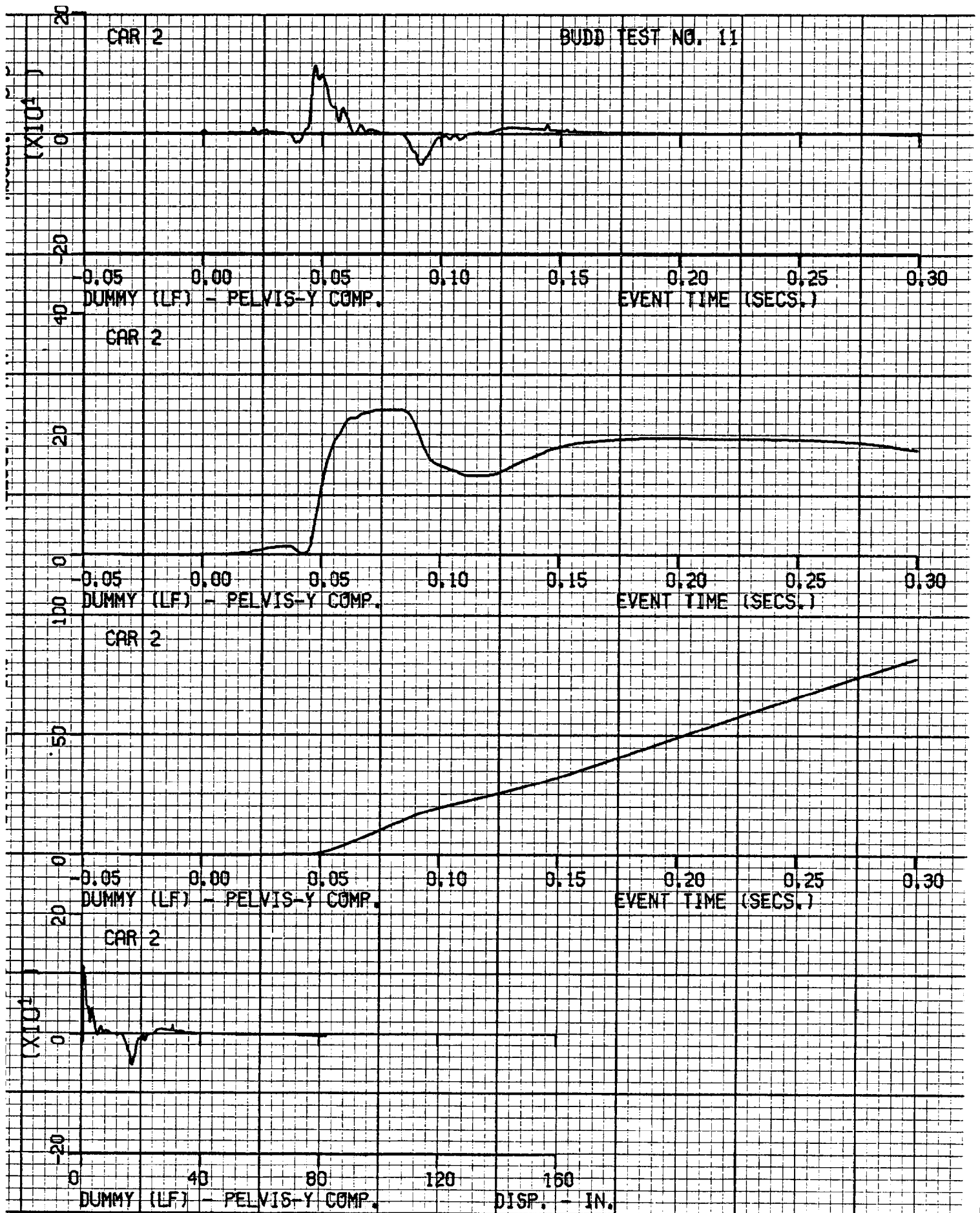


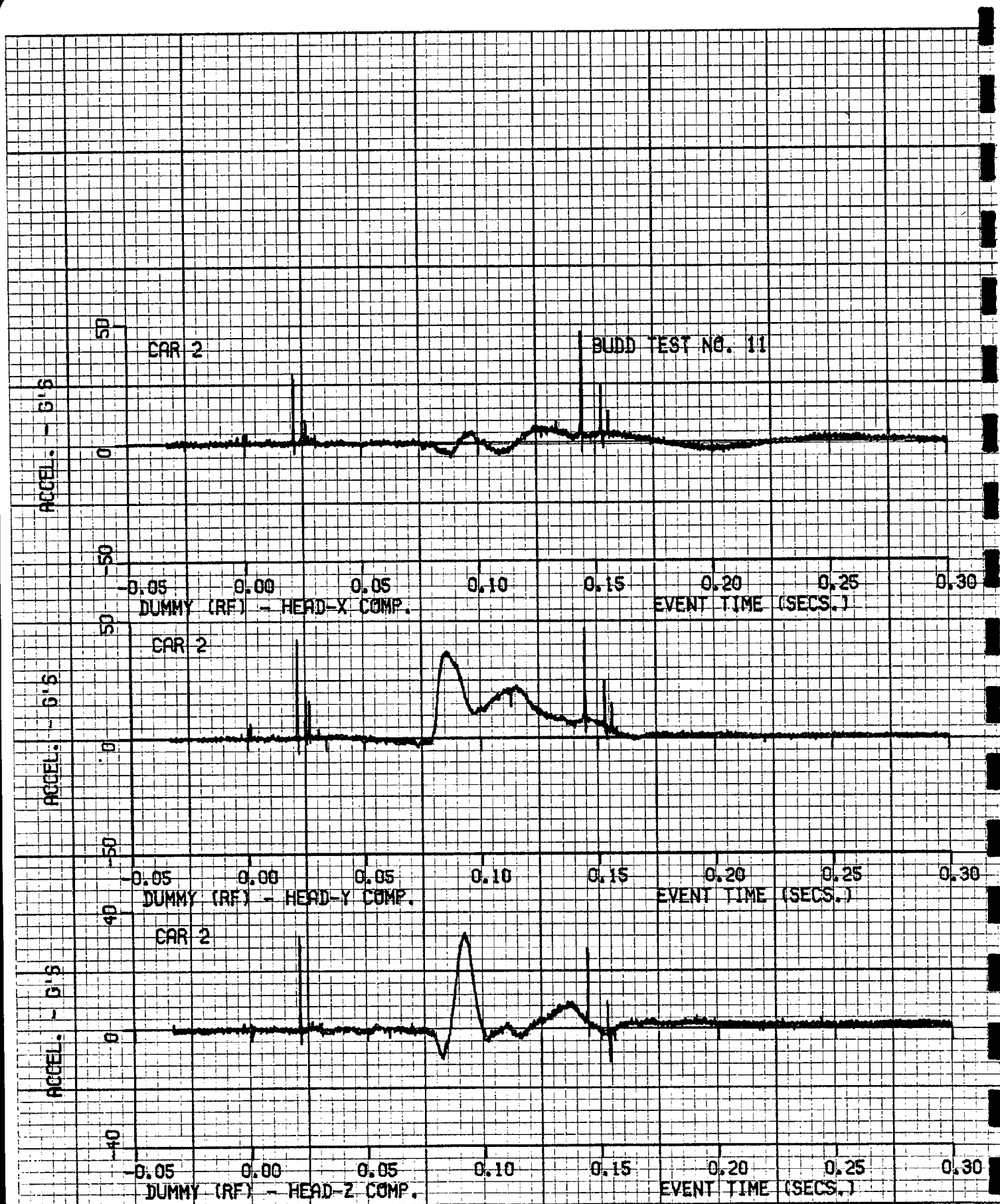


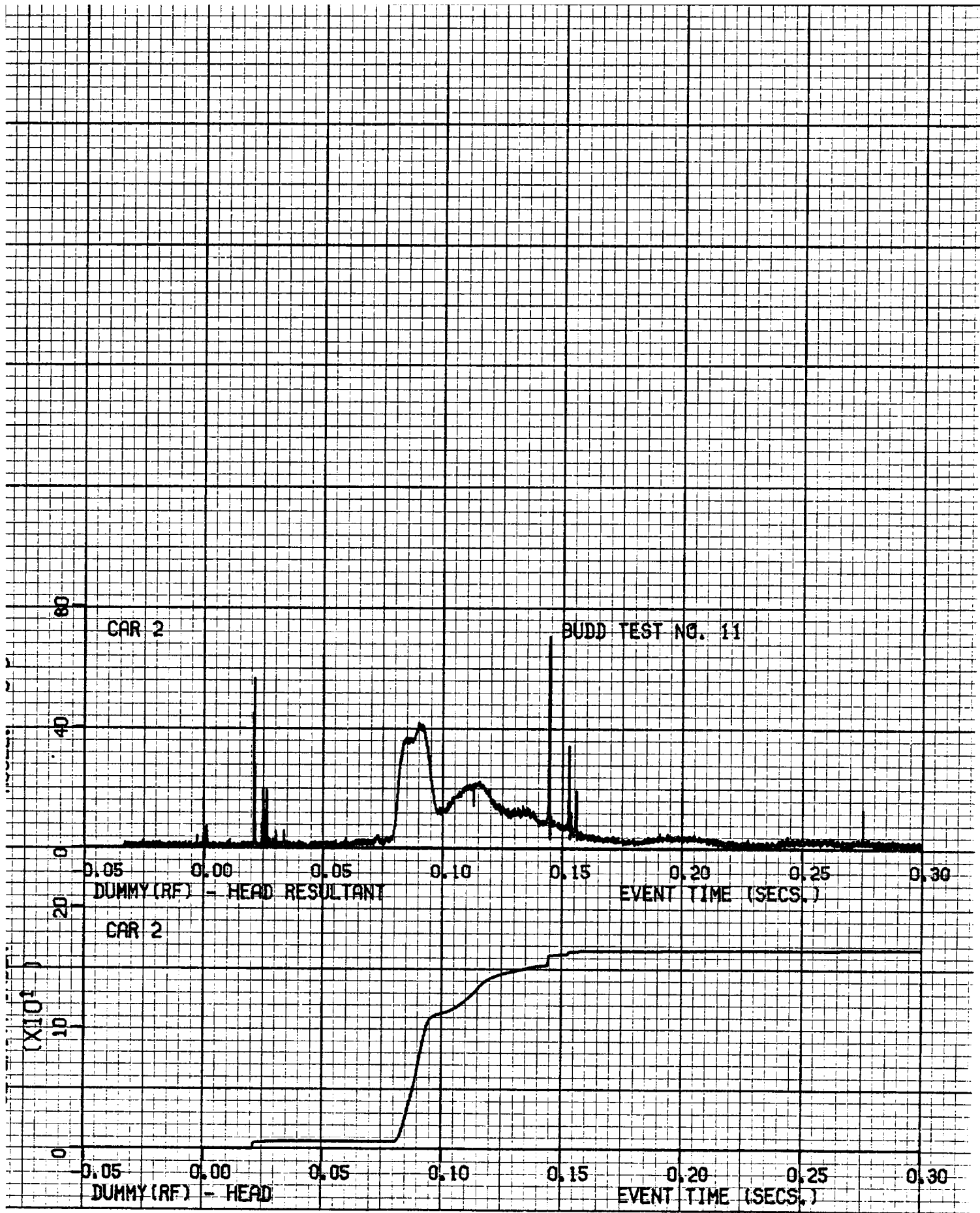


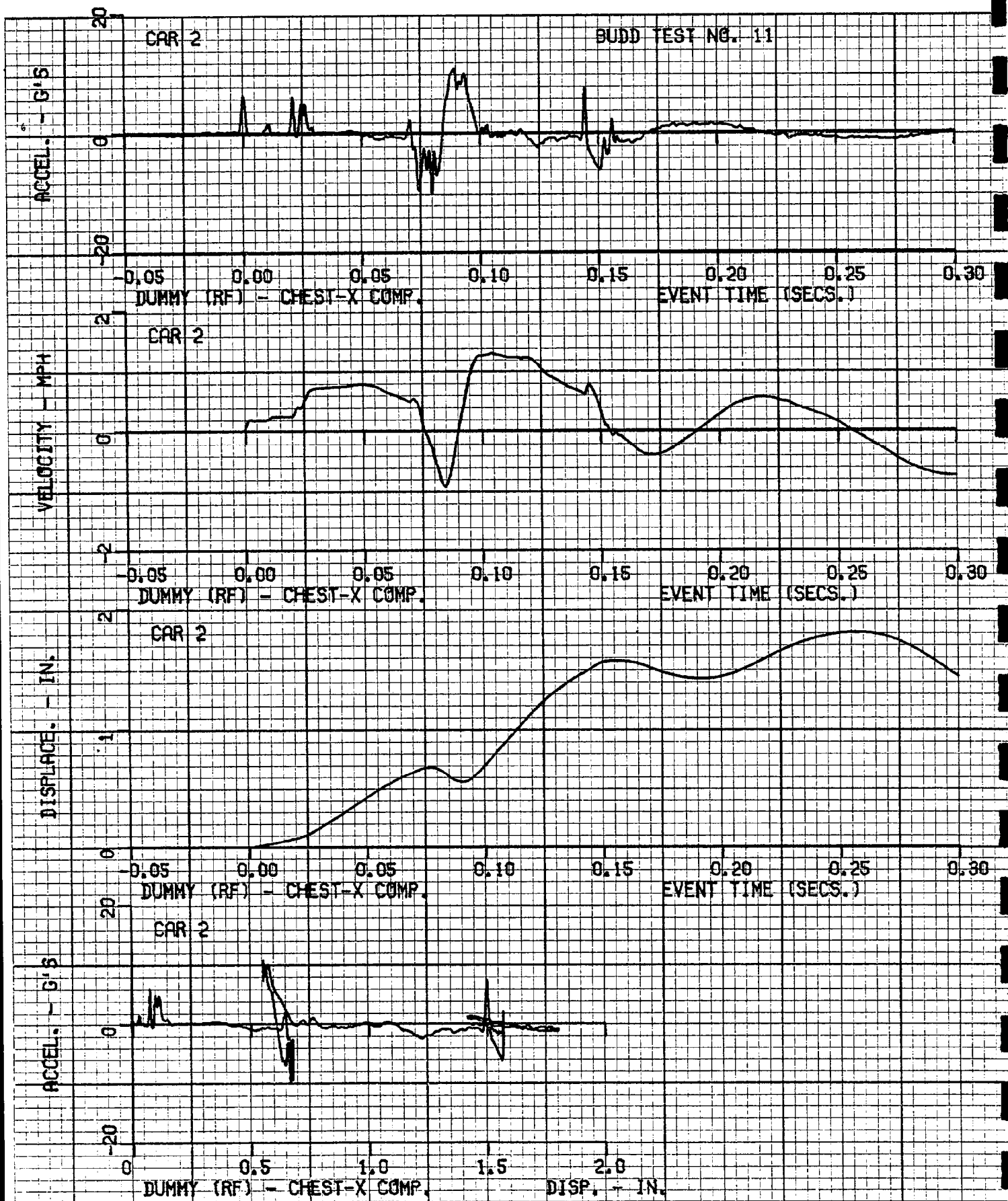


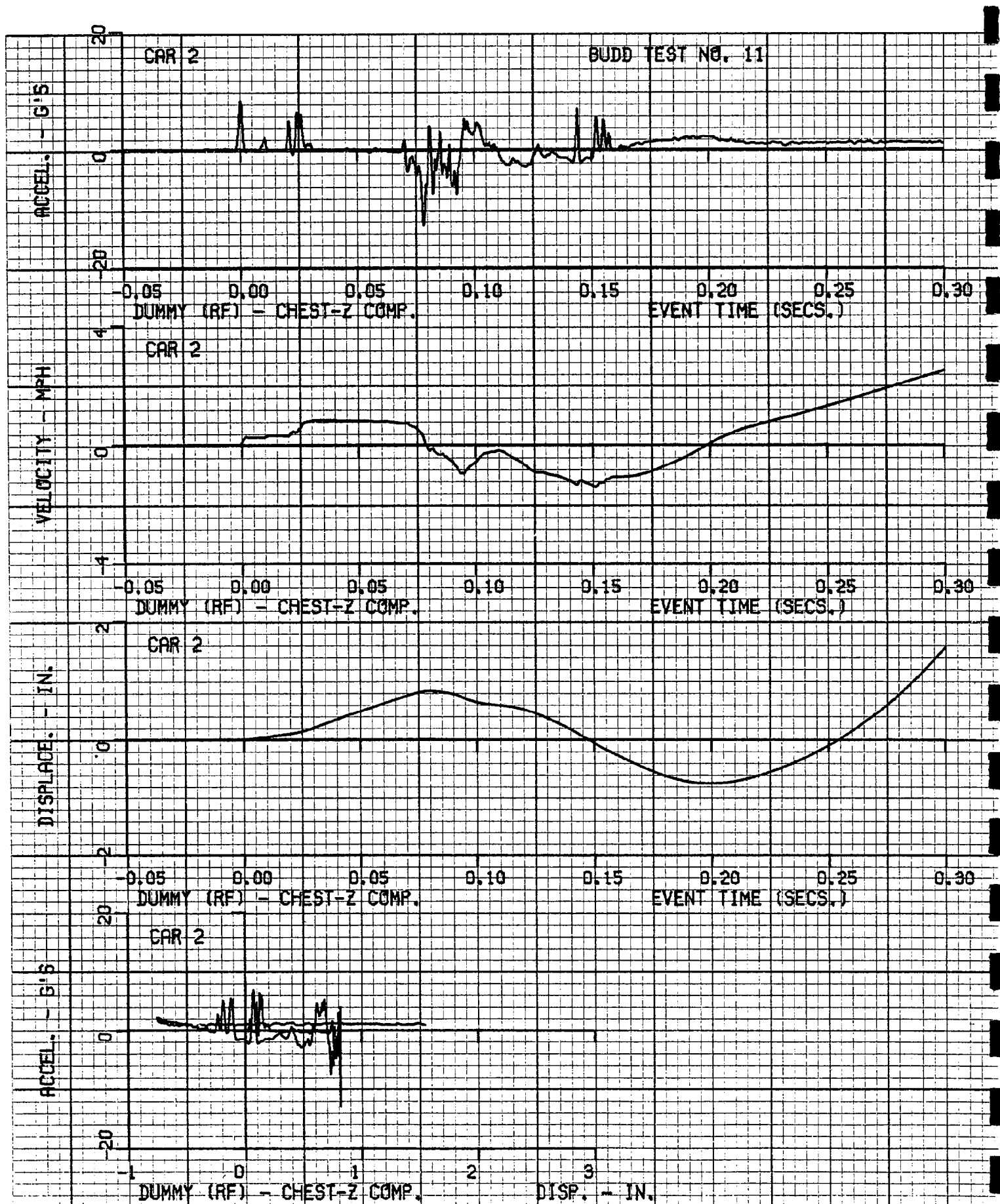


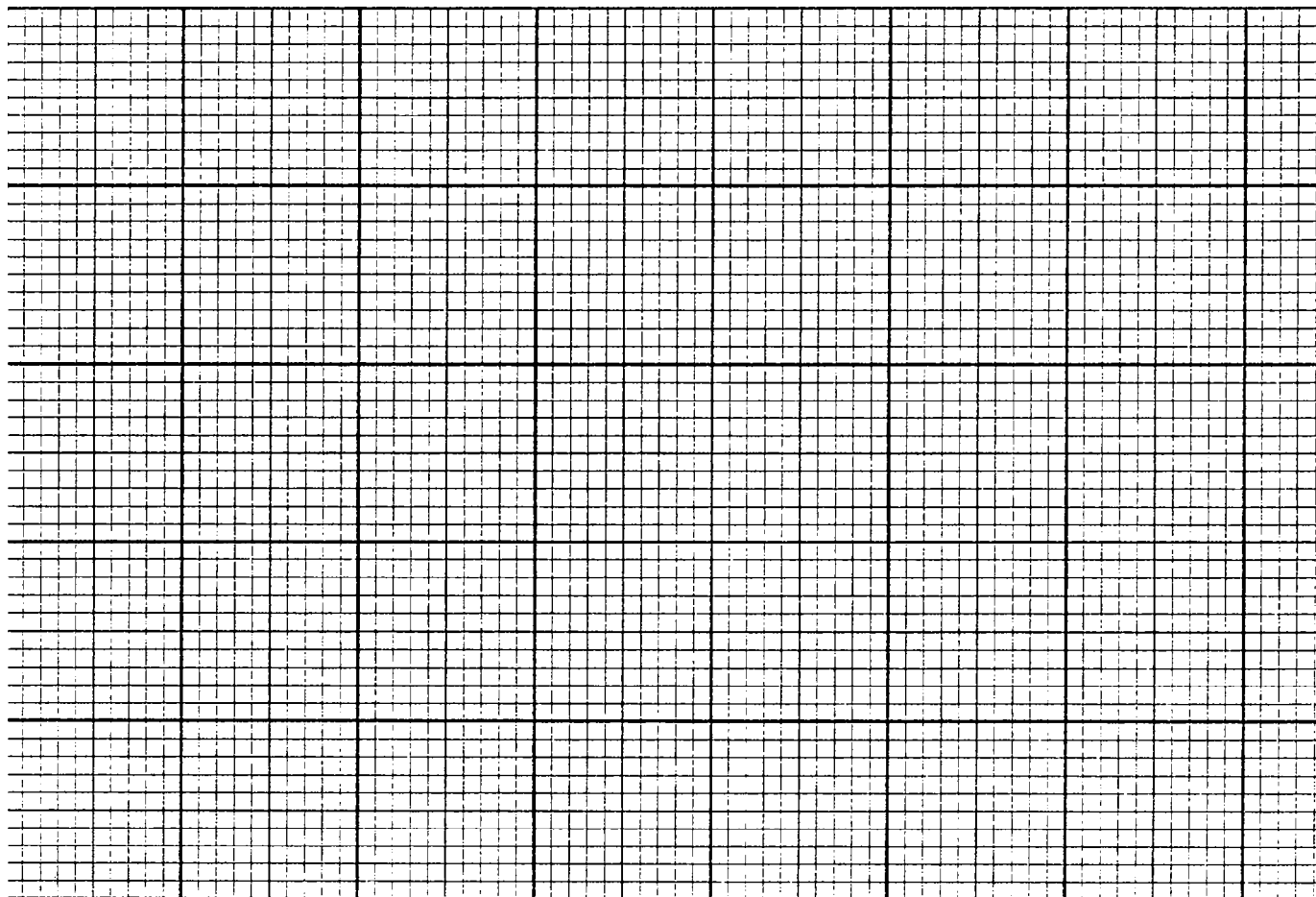






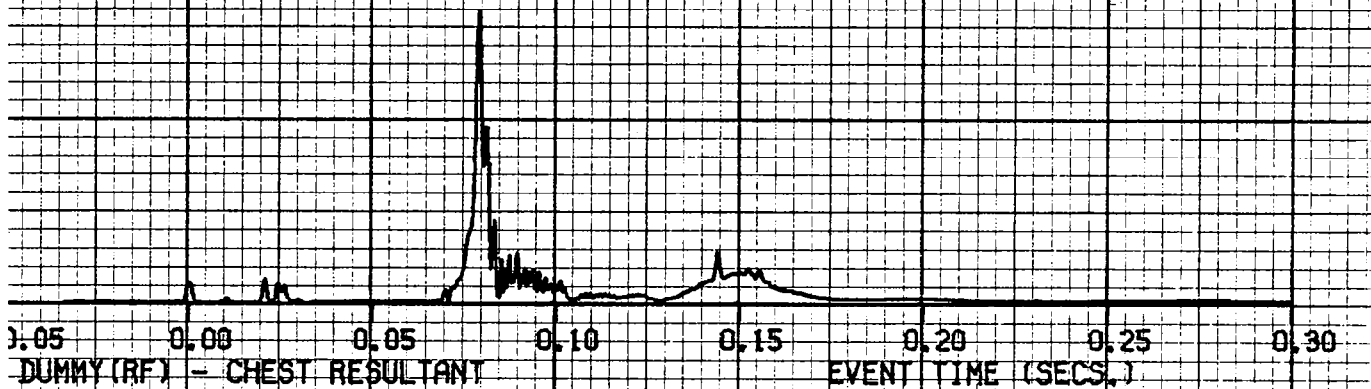




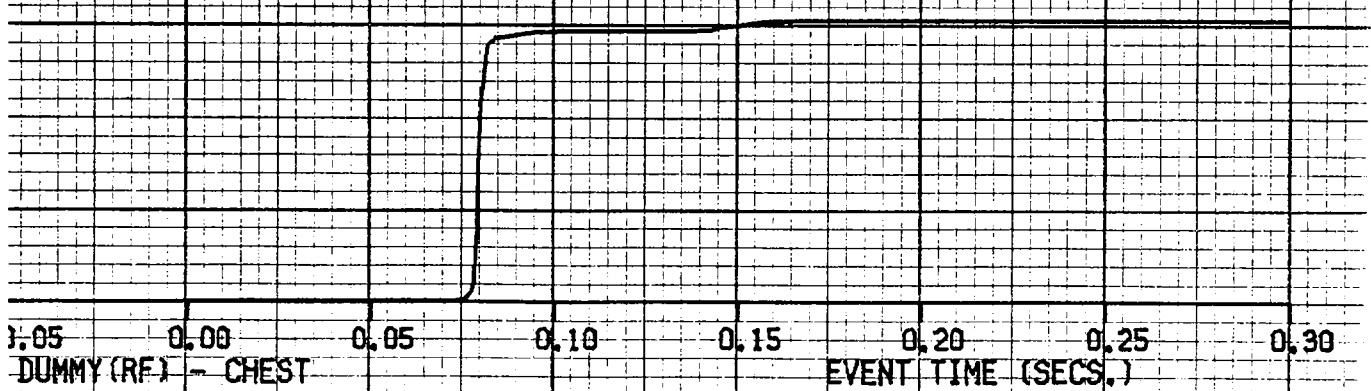


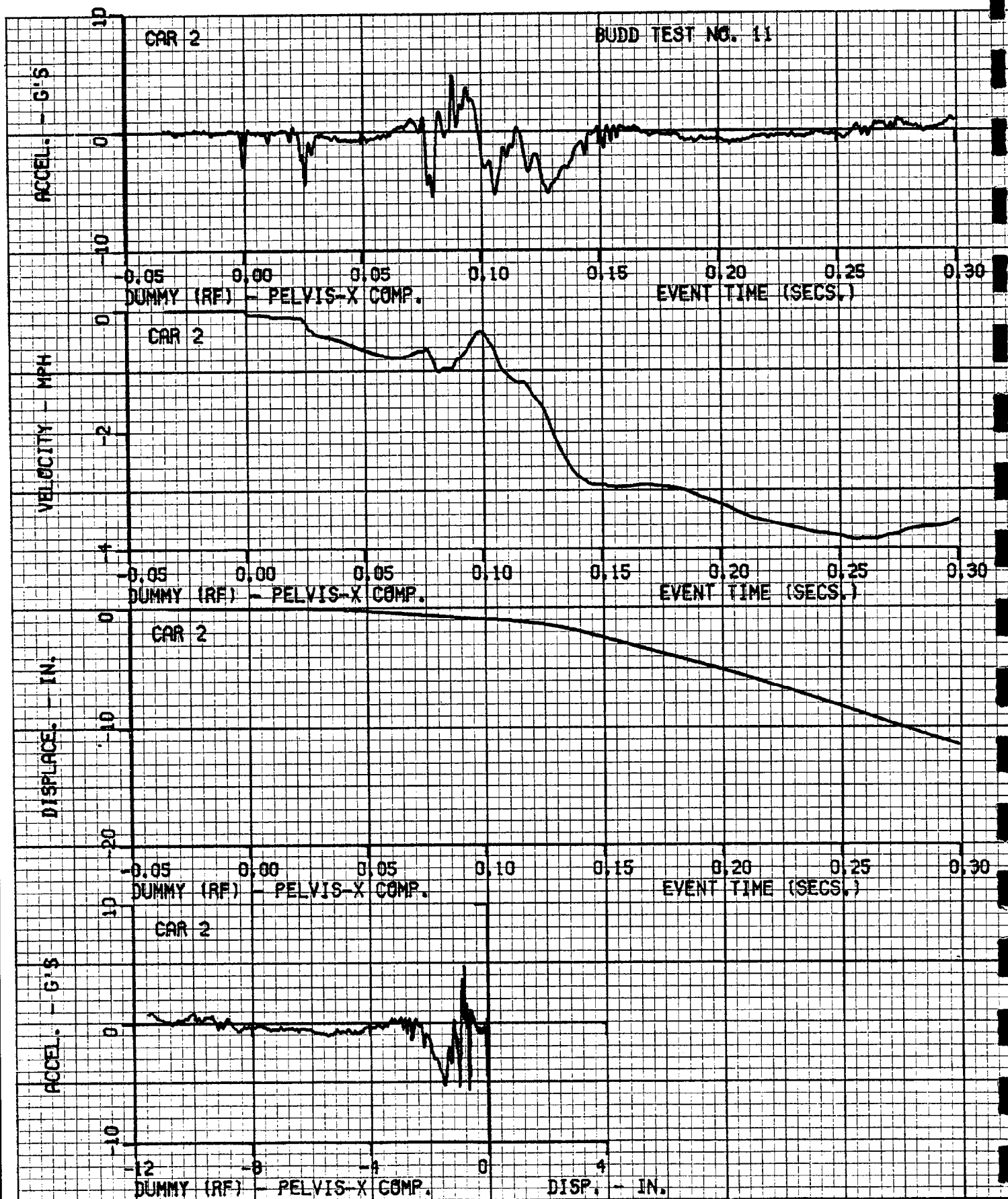
CAR 2

BUDD TEST NO. 11



CAR 2





BUDD TEST NO. 11

0.15 0.20 0.25 0.30
EVENT TIME (SECS.)

0.15 0.20 0.25 0.30
EVENT TIME (SECS.)

0.15 0.20 0.25 0.30
EVENT TIME (SECS.)

120
ISP. - IN.