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HELICOPTER FLYING QUALITIES CHARACTERISTICS-CH-46E VOLUME 3

BOEING VERTOL CO.
Boeing Center, P.O. Box 16858
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3 OCTOBER 1983

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Program Element No. 62241N
Work Unit No. 41400

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Warminster, PA 18974

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This document defines the flying qualities characteristics of the CH-46E helicopter. The data are representative of both the metal-bladed and composite-bladed versions. Analytically computed static trim data are presented for a wide range of configurations (gross weight, c.g.) and flight conditions (airspeed, altitude, sideslip, climb, autorotation). Correlation of trim data with available flight test data is provided for validation. (see next page)		

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20. ABSTRACT (continued)

Analytically computed static stability and control derivatives are compiled for significant combinations of configuration and flight condition. Time history data relating to dynamic stability, control response and SAS failures are extracted from flight test records obtained during the Contractor's CH-46E SLEP II flight test program.

VOLUME 3
CH-46E SLEP II TIME-HISTORY DATA

This Volume contains transient time-history data extracted from the CH-46E SLEP II flight test program conducted at the Boeing Vertol flight test facility at Wilmington, Delaware from 20 June to 31 October 1977. A catalog of the time-histories available is given on Page 2. Four general types of data record are presented:

- Dynamic stability (longitudinal pulse response);
- Control responses (longitudinal, lateral and directional step response);
- SAS failure (longitudinal, lateral and directional hard-over SAS input);
- Engine failure (single engine step reduction to ground idle)

In each record, the response of the helicopter in the axis of disturbance (control input, SAS failure, etc.) is thoroughly described by time-histories of six to eight relevant parameters in that axis, while interaxis coupling is assessed by a sampling of four parameters from each of the remaining axes.

The number of time-history plots presented herein is less than the total number of such records obtained by telemetry during the actual flight test program. Due to a built-in 3 to 5 sec delay between the pilot "record-on" command and the start of the aircraft tape record, the initial part of some maneuvers was not recorded on the aircraft tape. These records are therefore omitted from this report.



AI

CATALOG OF TRANSIENT TIME-HISTORIES
CH-46E SLEP II FLIGHT TEST

GW = 24300 lb

CG = 6 in. fwd

<u>DYNAMIC STABILITY</u>			<u>Page</u>
Figure 1	Fwd Pulse	Hover, IGE	4
Figure 2	Aft Pulse		12
Figure 3	Fwd Pulse	119 kt, 3200 ft	20
Figure 4	Aft Pulse		28

<u>CONTROL RESPONSE</u>			
Figure 5	Fwd Stick Step	Hover, IGE	36
Figure 6	Aft Stick Step		44
Figure 7	Fwd Stick Step	116 kt, 4500 ft	52
Figure 8	Aft Stick Step		60
Figure 9	Right Stick Step	Hover, IGE	68
Figure 10	Right Stick Step	118 kt, 4860 ft	75
Figure 11	Left Stick Step		82
Figure 12	Right Pedal Step	Hover, IGE	89
Figure 13	Left Pedal Step		96
Figure 14	Left Pedal Step	104 kt, 4570 ft	103

<u>SAS FAILURE (DUAL-TO-SINGLE)</u>			
Figure 15	Nose Down Failure	134 kt, 3290 ft	110
Figure 16	Nose Up Failure		118
Figure 17	Roll Left Failure	136 kt, 3080 ft	126
Figure 18	Yaw Right Failure	132 kt, 3240 ft	133
Figure 19	Yaw Left Failure		140

SAS FAILURE (SINGLE-TO-NONE)

Page

Figure 20	Nose Down Failure	115 kt, 3140 ft	147
Figure 21	Nose Up Failure		155
Figure 22	Roll Right Failure	117 kt, 3200 ft	163
Figure 23	Roll Left Failure		170
Figure 24	Yaw Right Failure	112 kt, 3100 ft	177

ENGINE FAILURE (DUAL-TO-SINGLE)

Figure 25	No. 1 Engine Failure	137 kt, 3090 ft	184
Figure 26	No. 1 Engine Failure		194

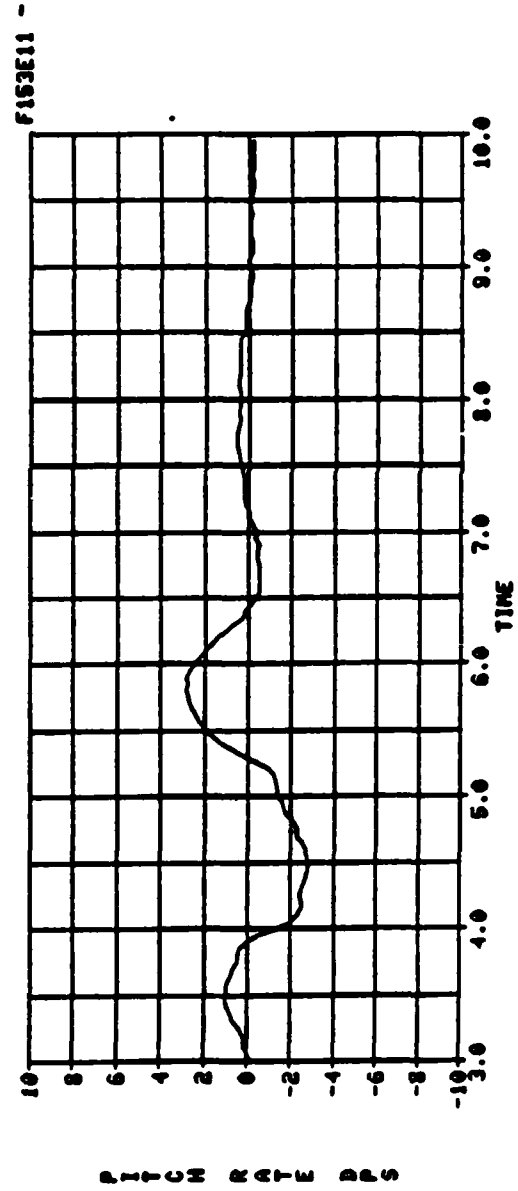
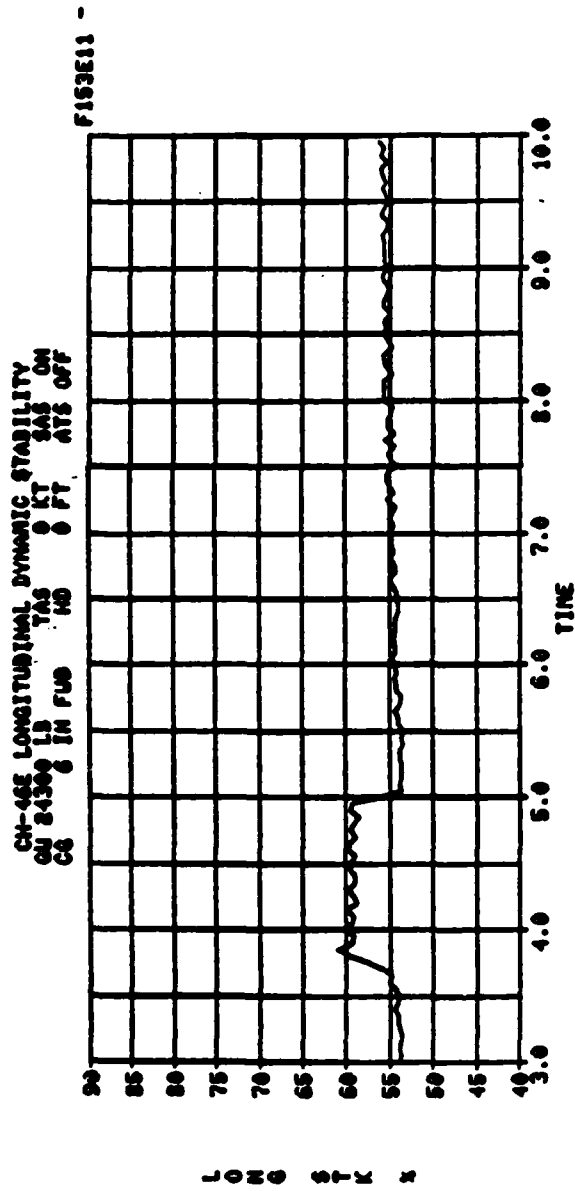


FIGURE 1A

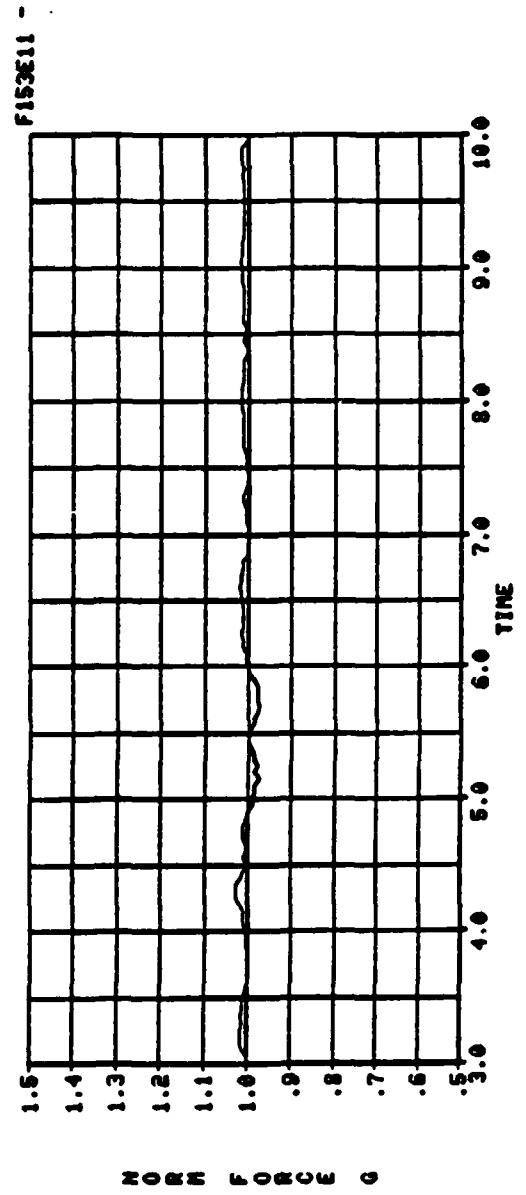
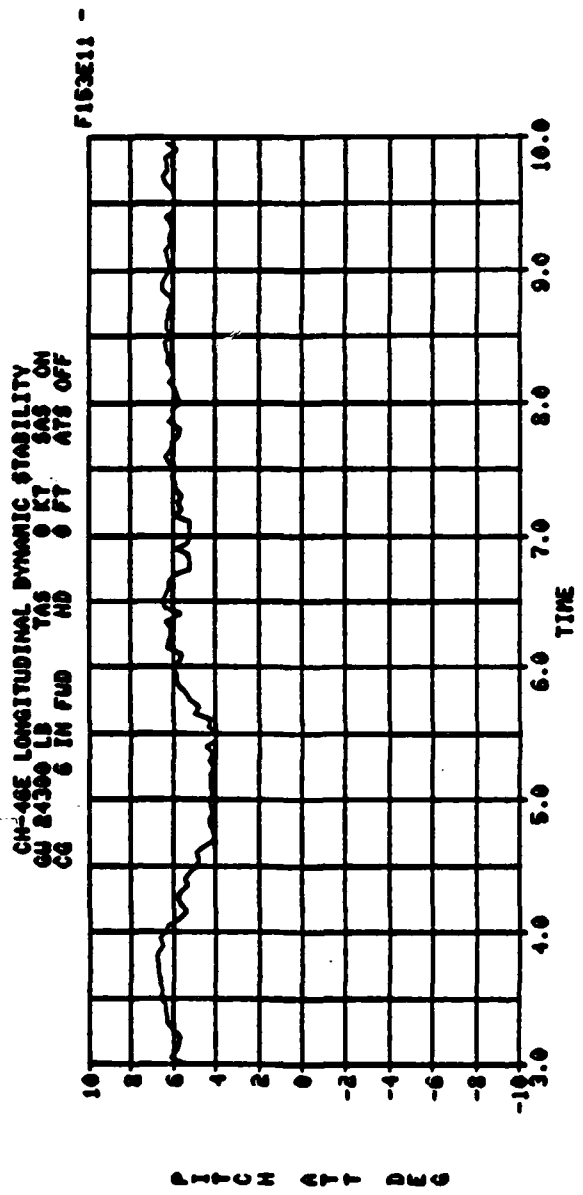


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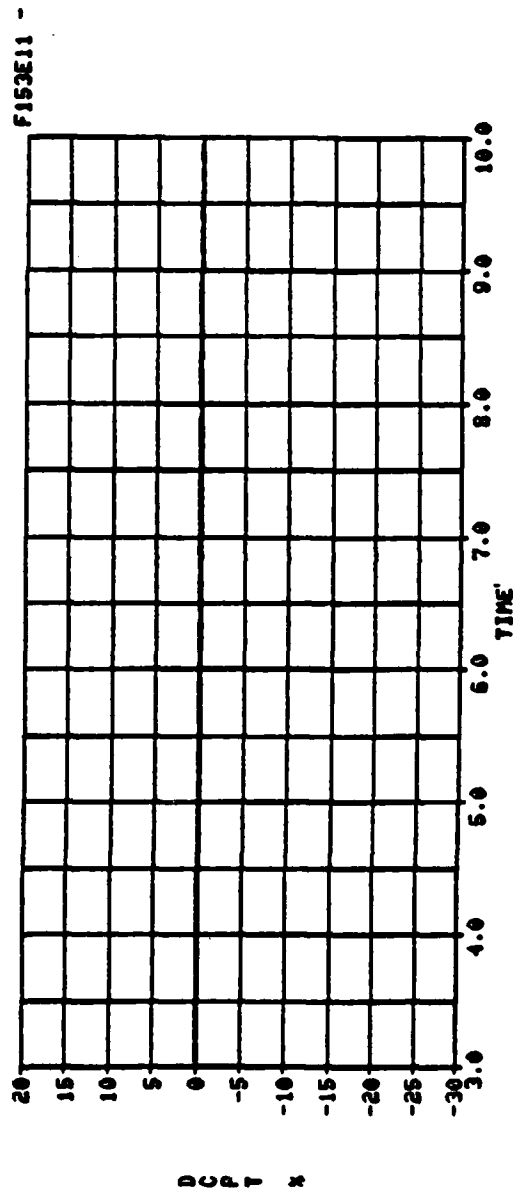
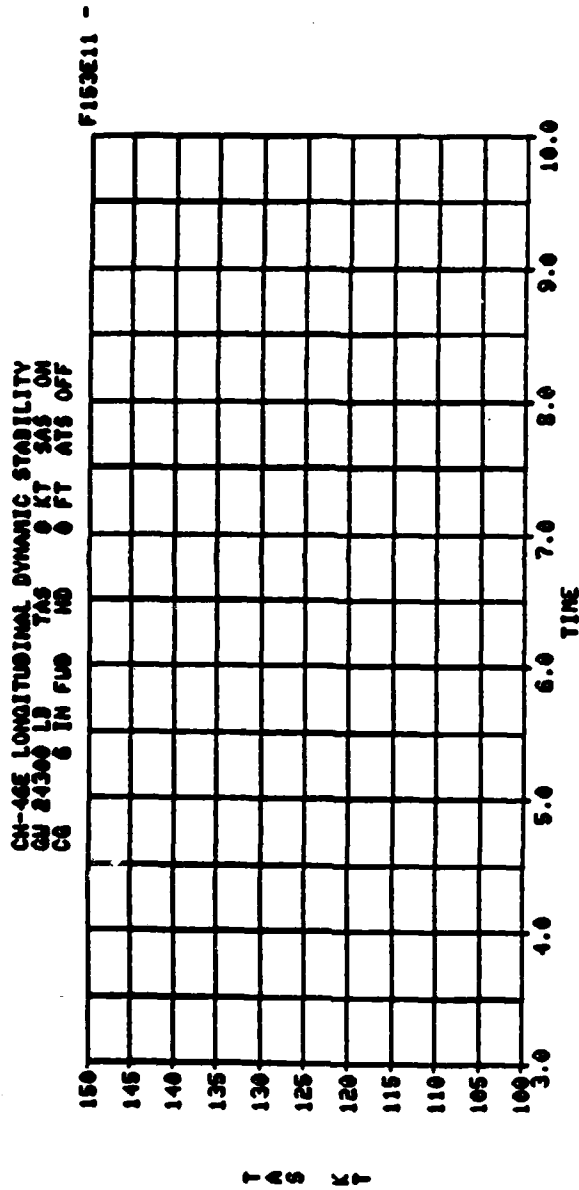


FIGURE 1C

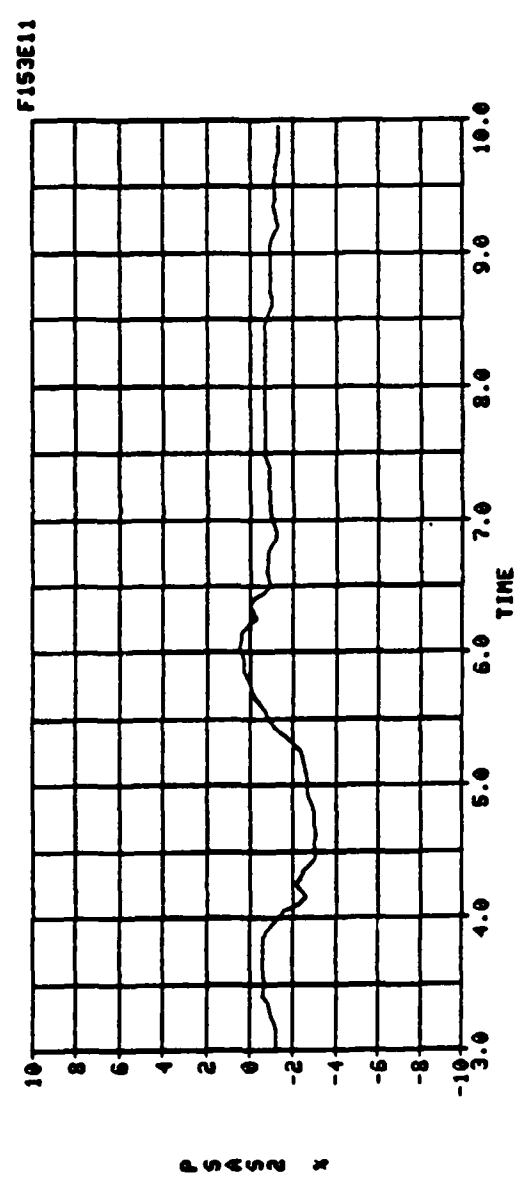
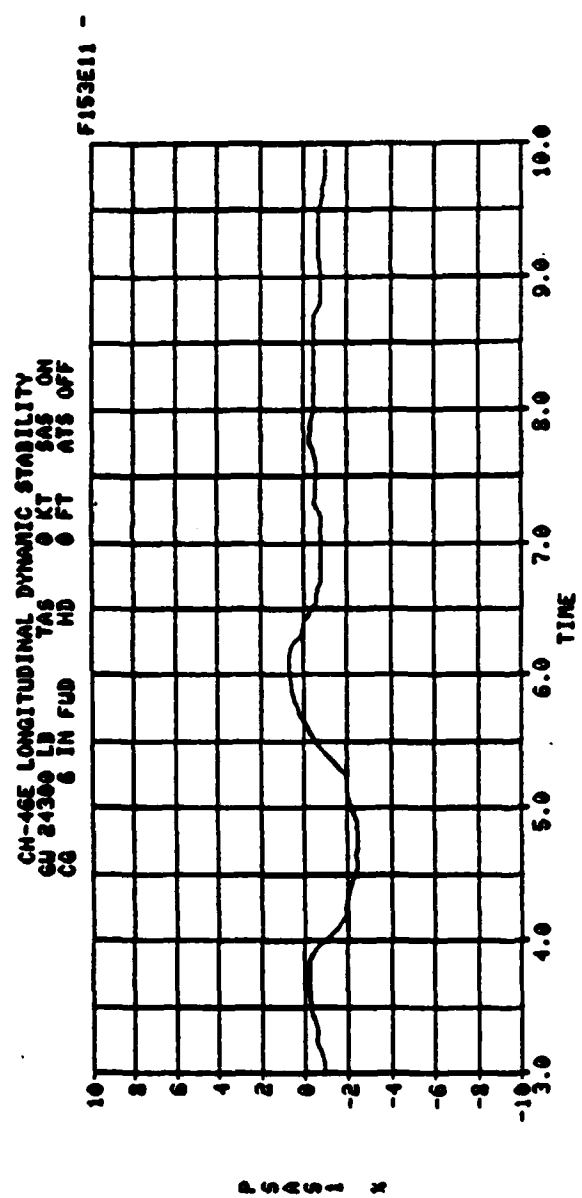


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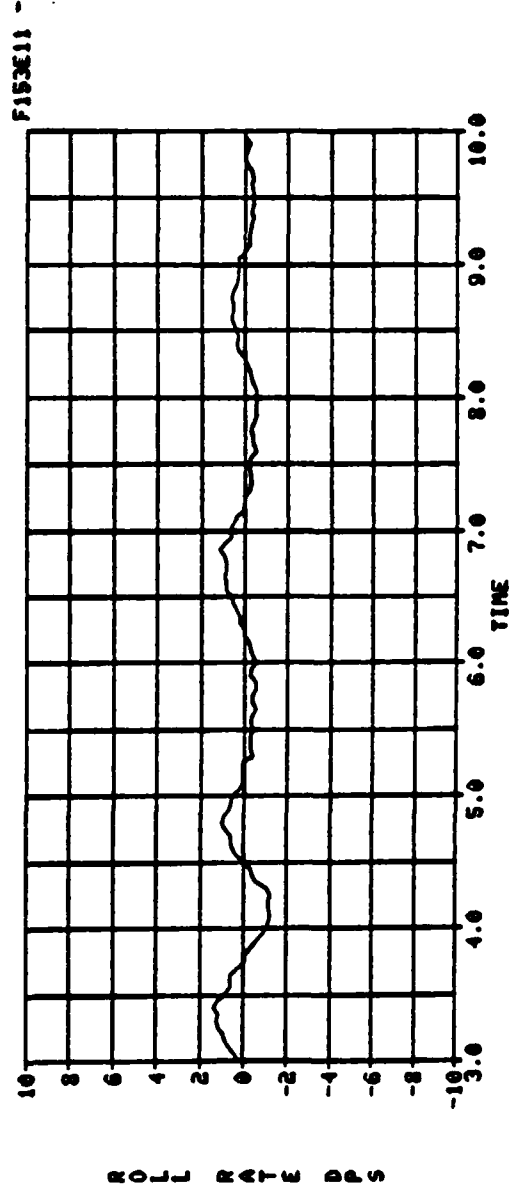
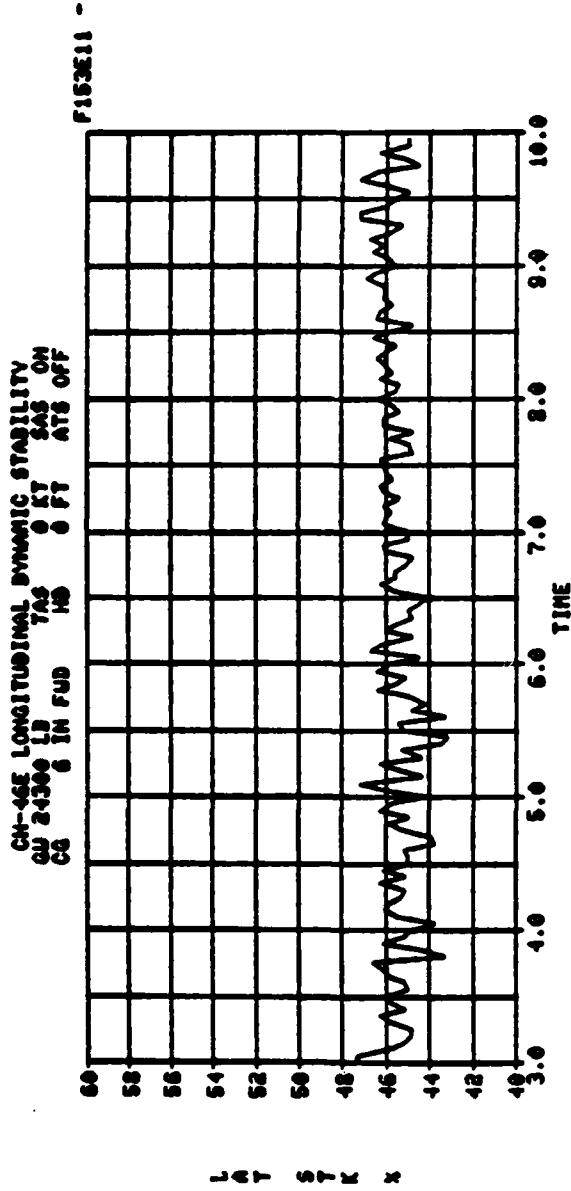


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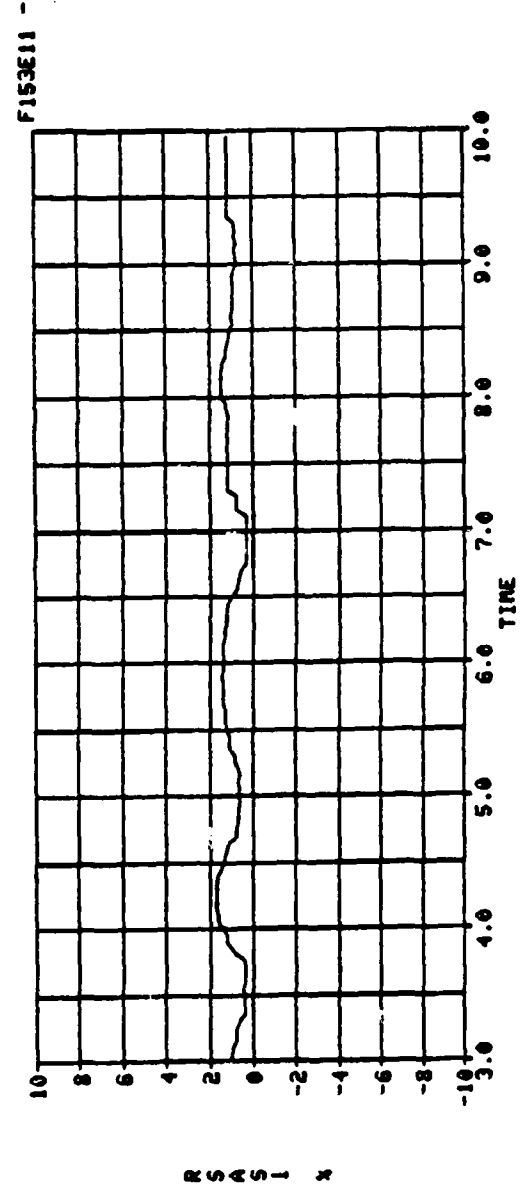
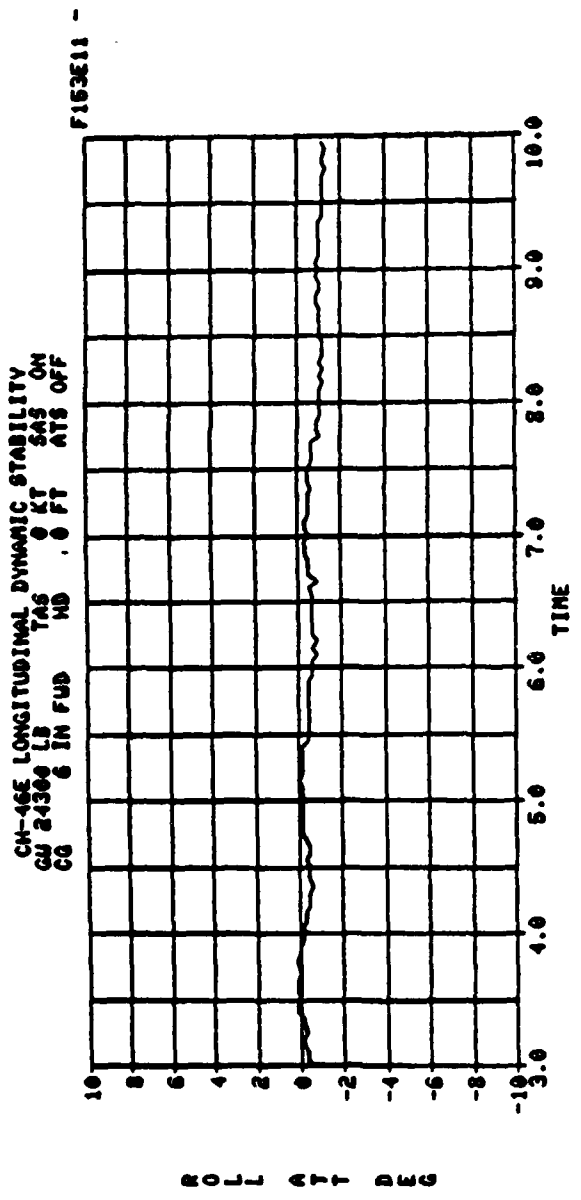


FIGURE 1F

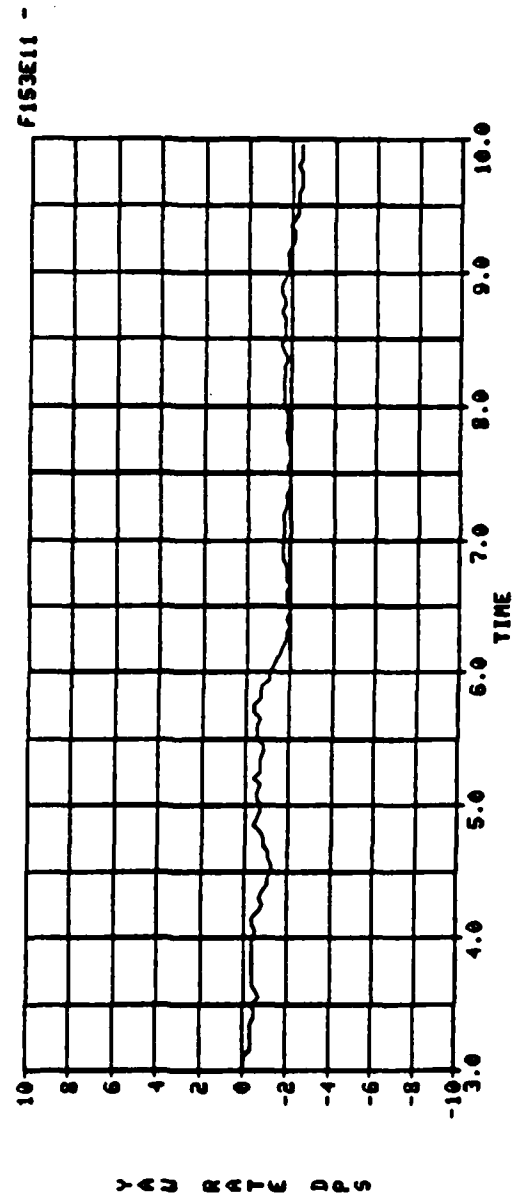
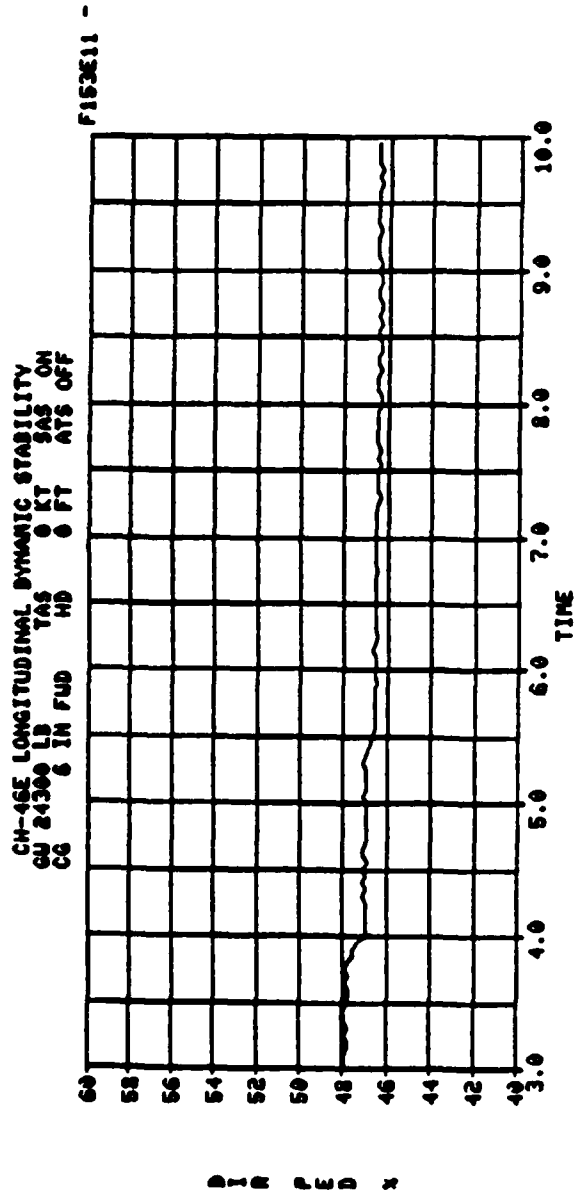


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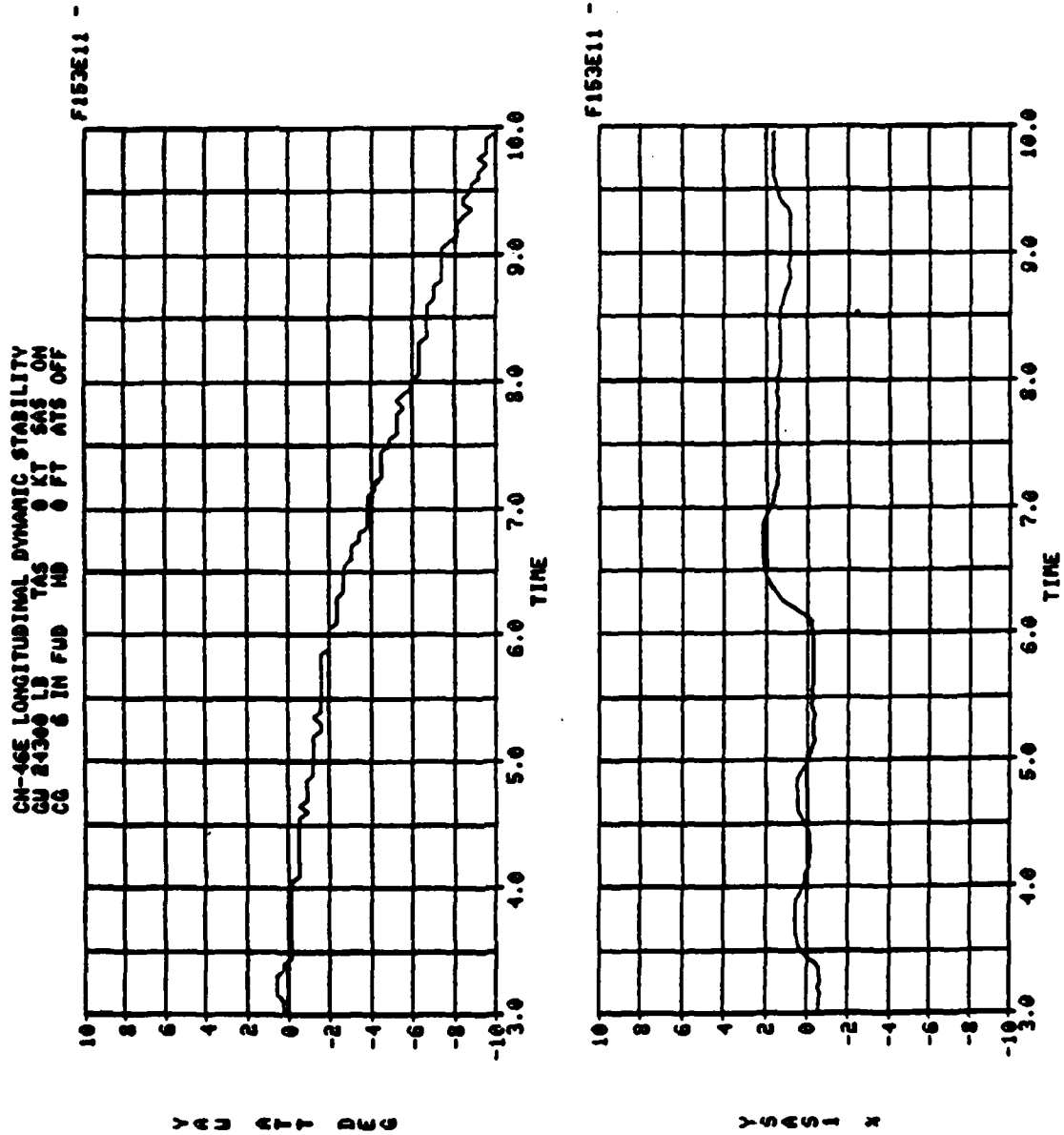


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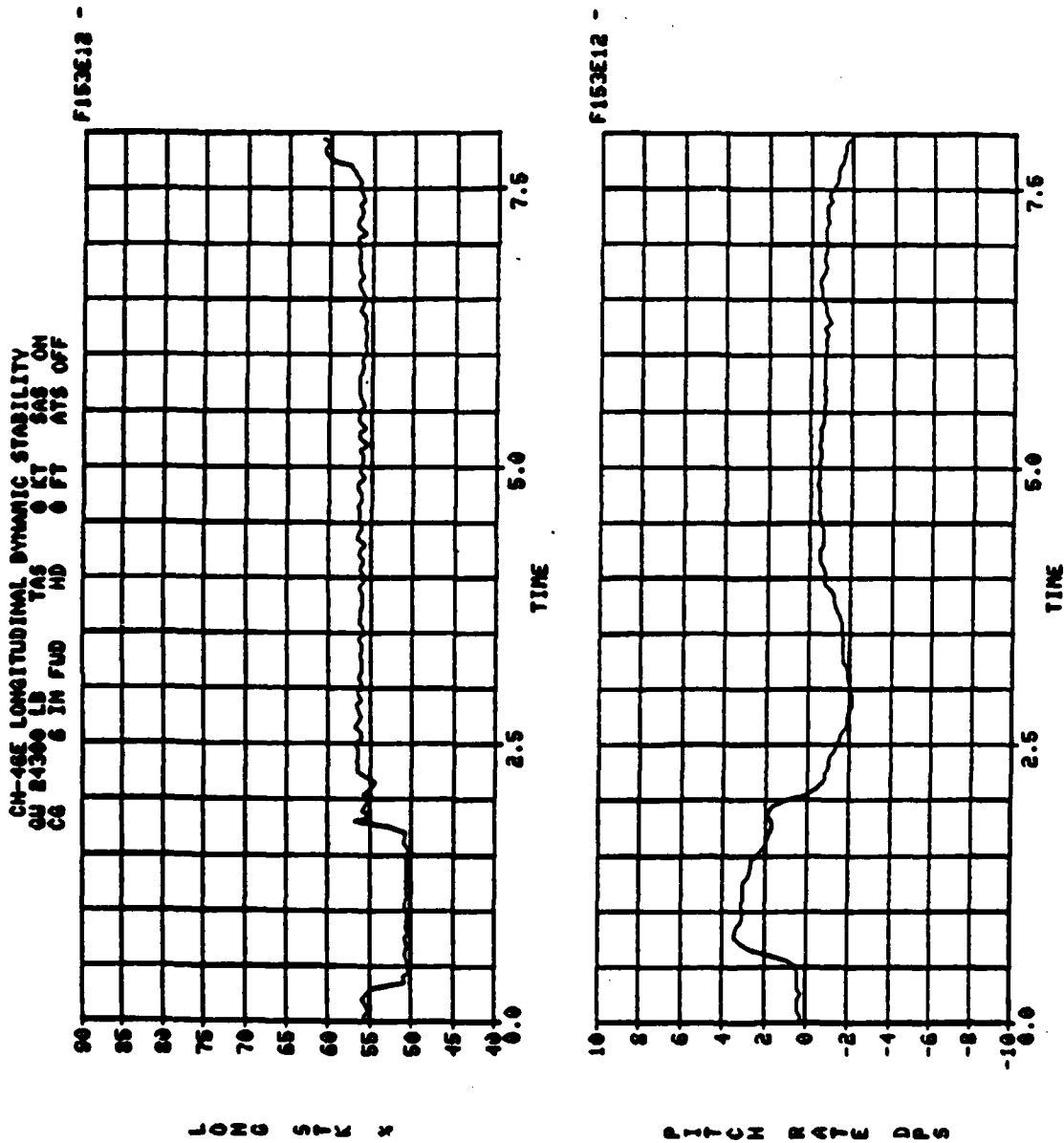


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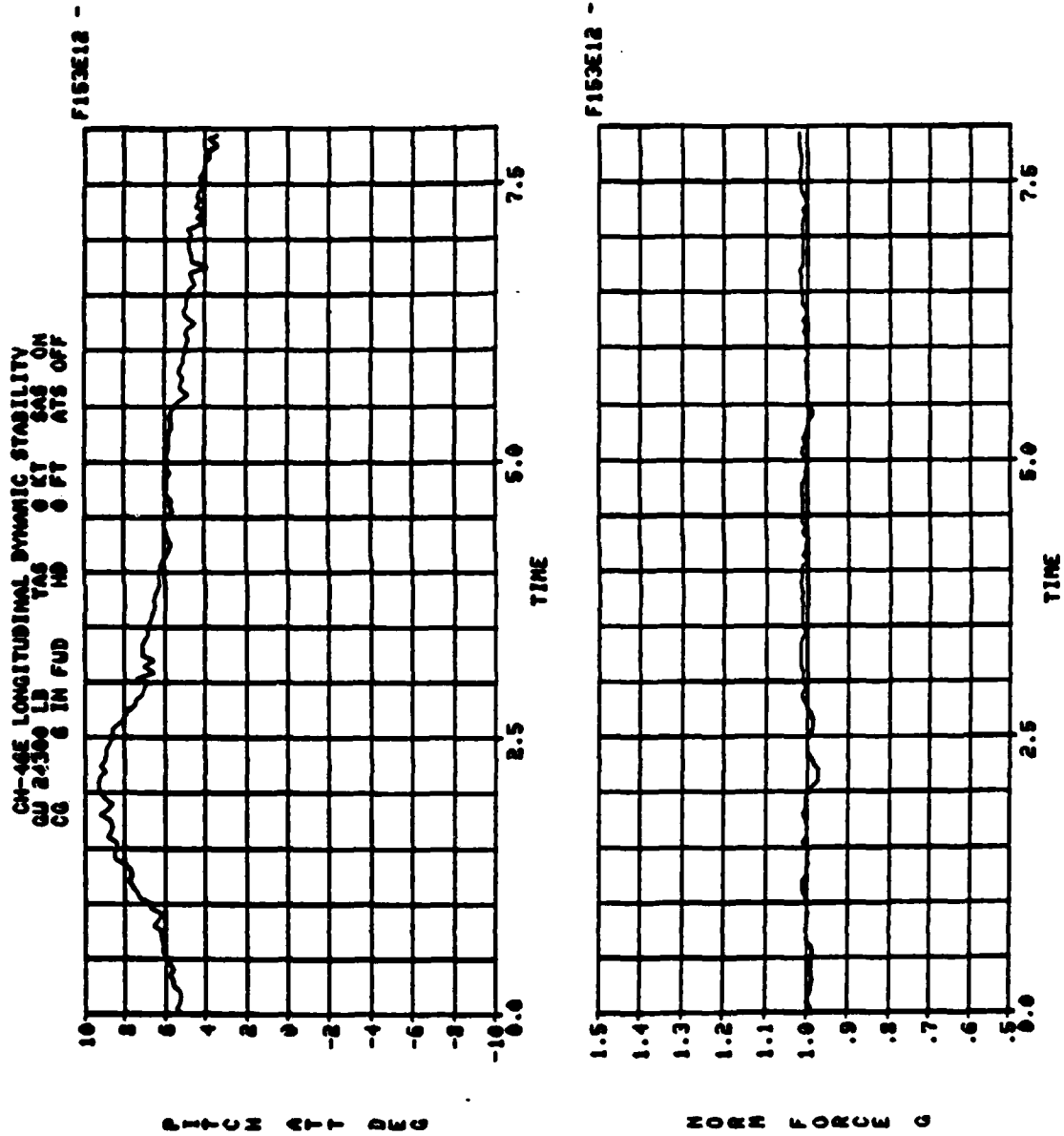


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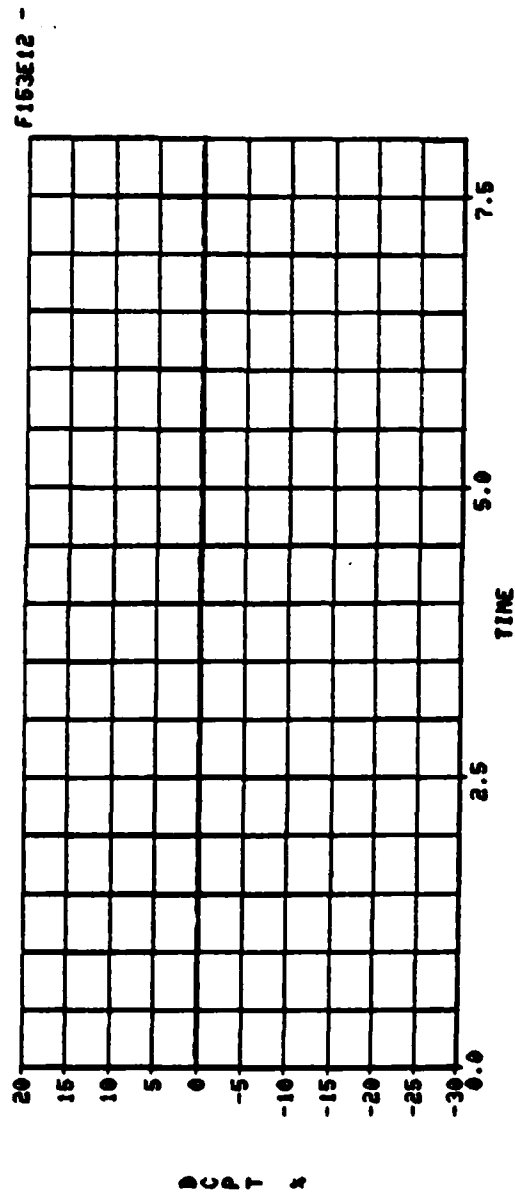
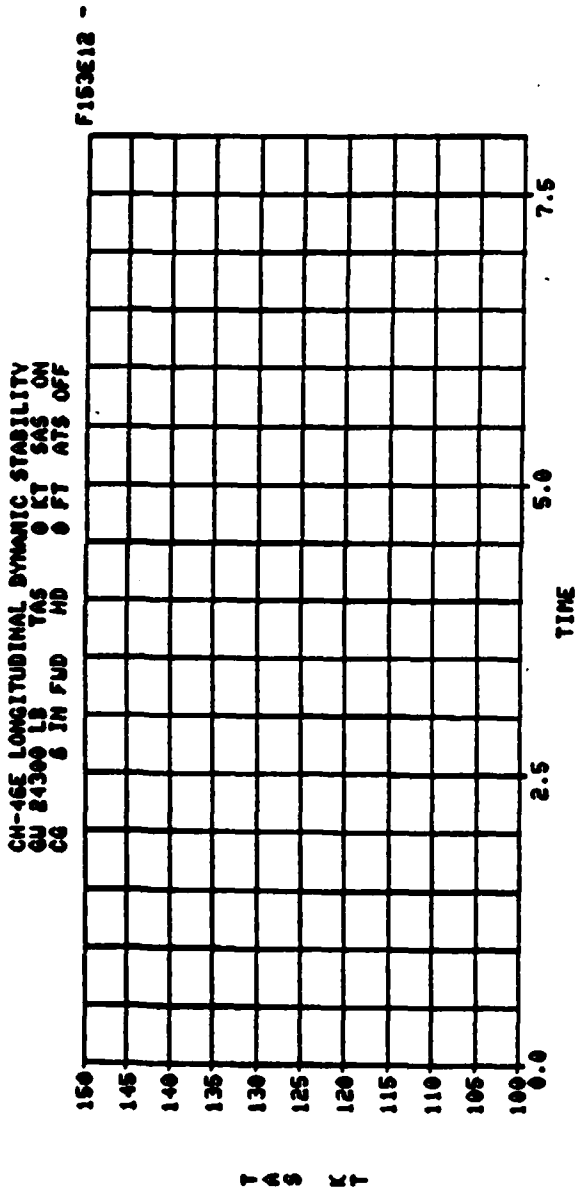


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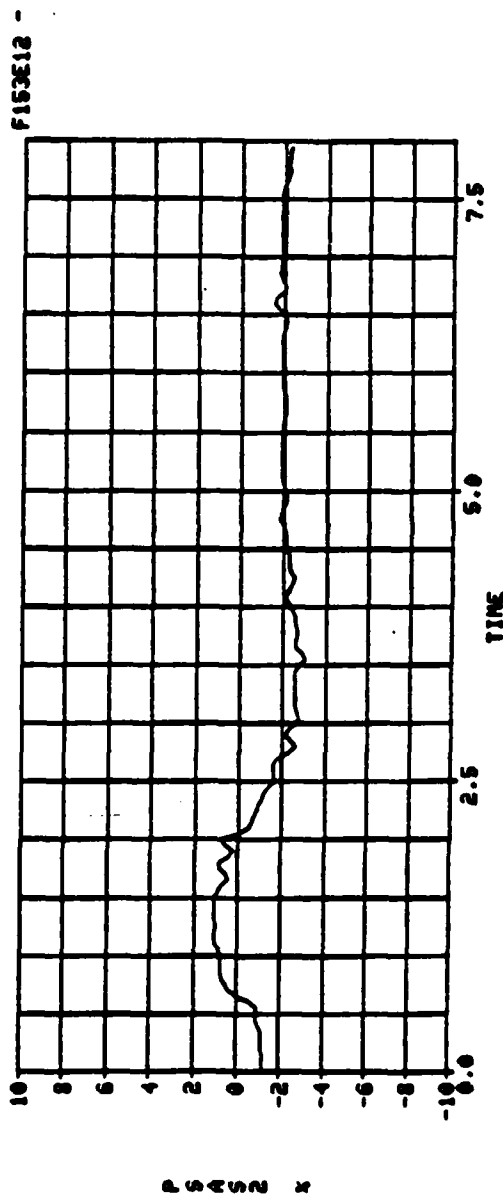
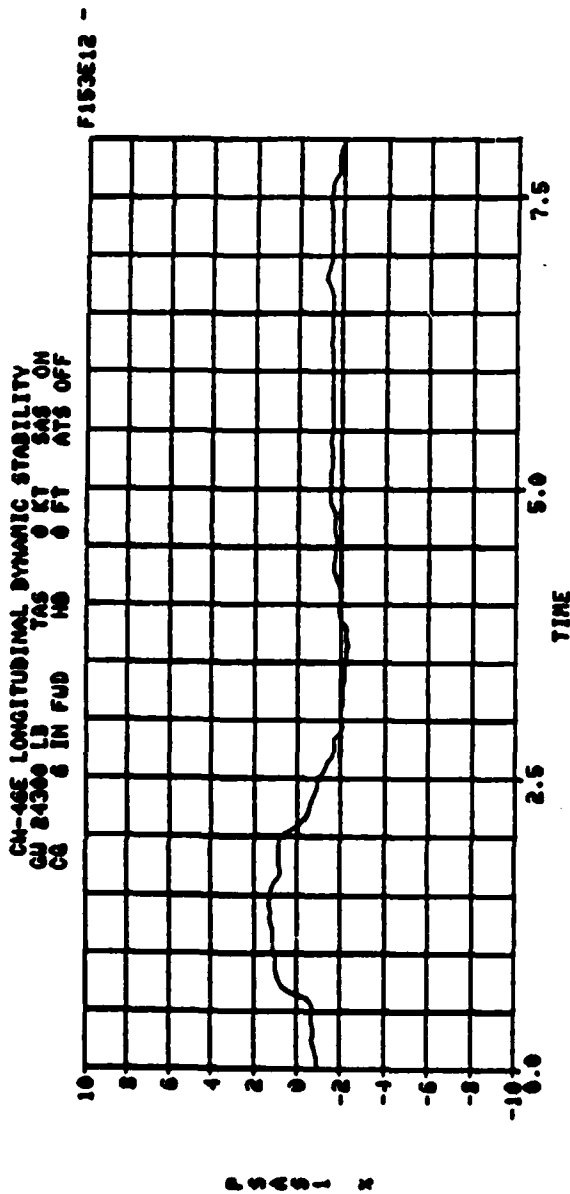


FIGURE 20

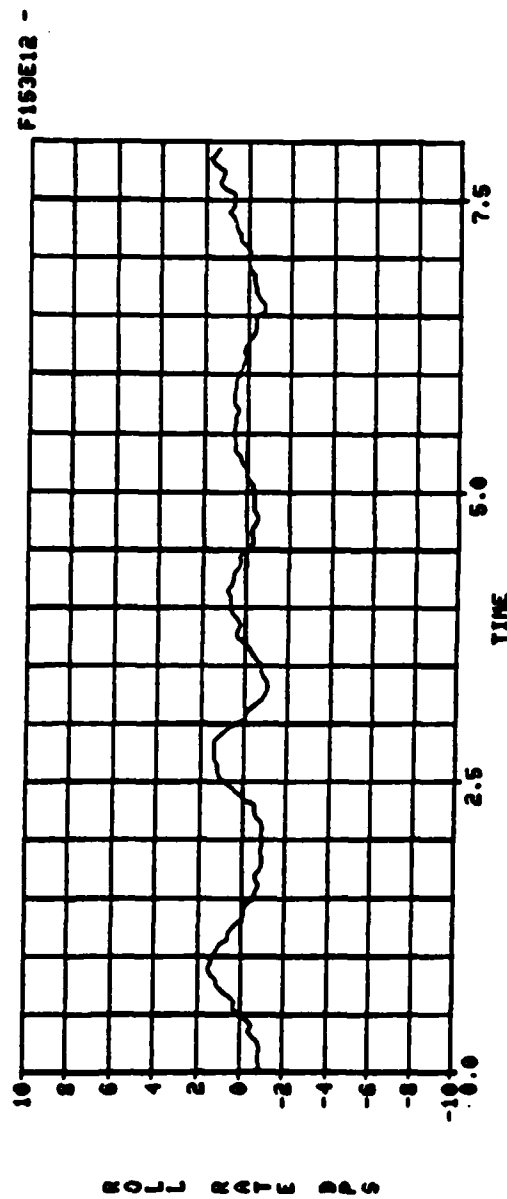
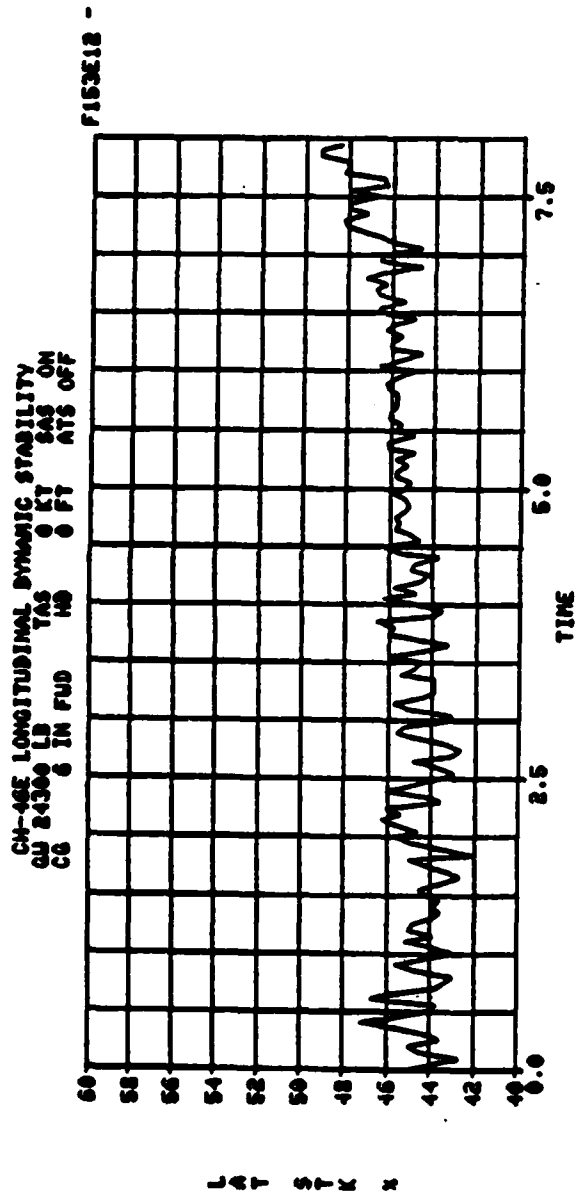


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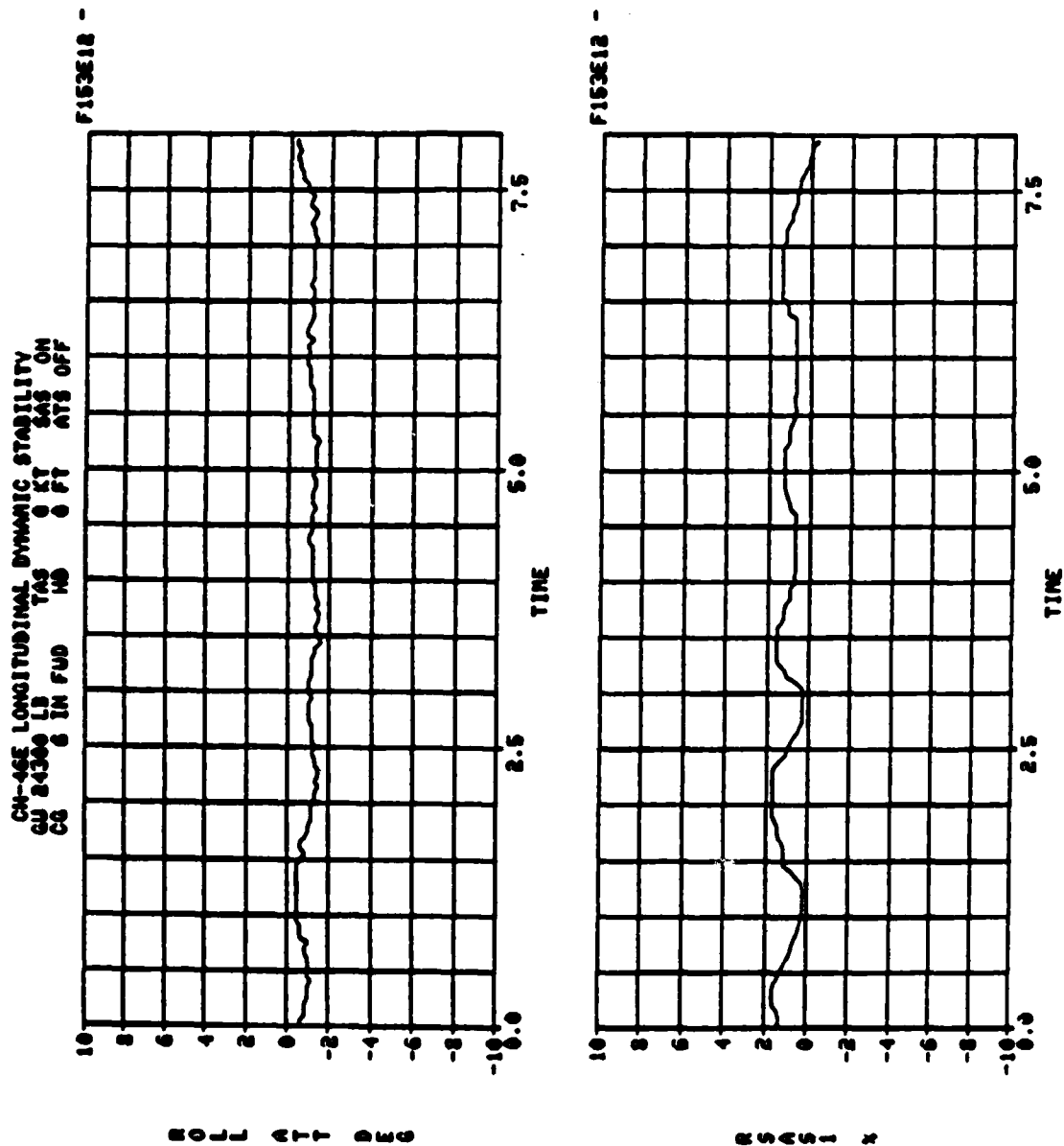


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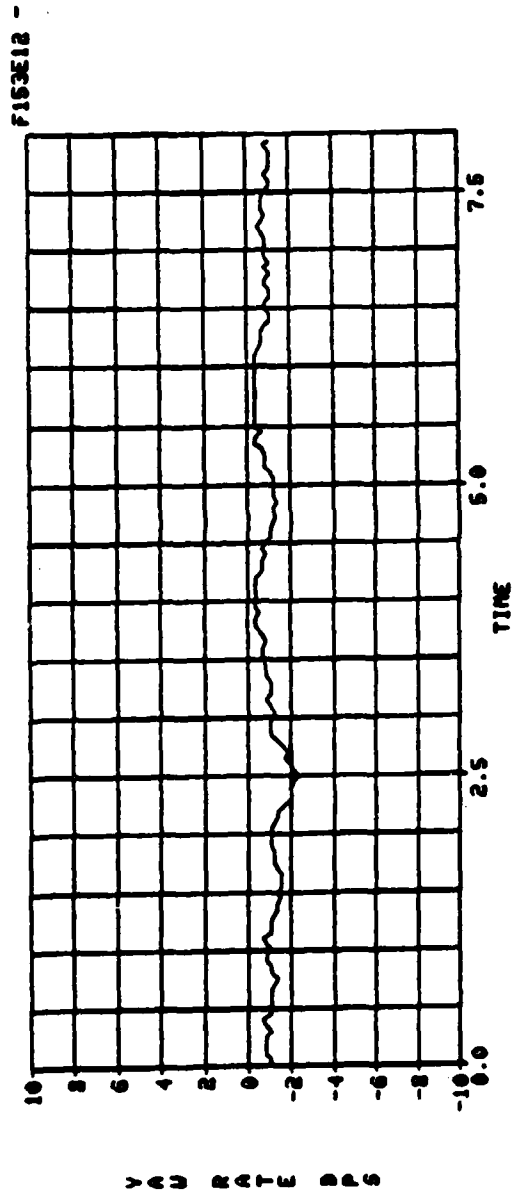
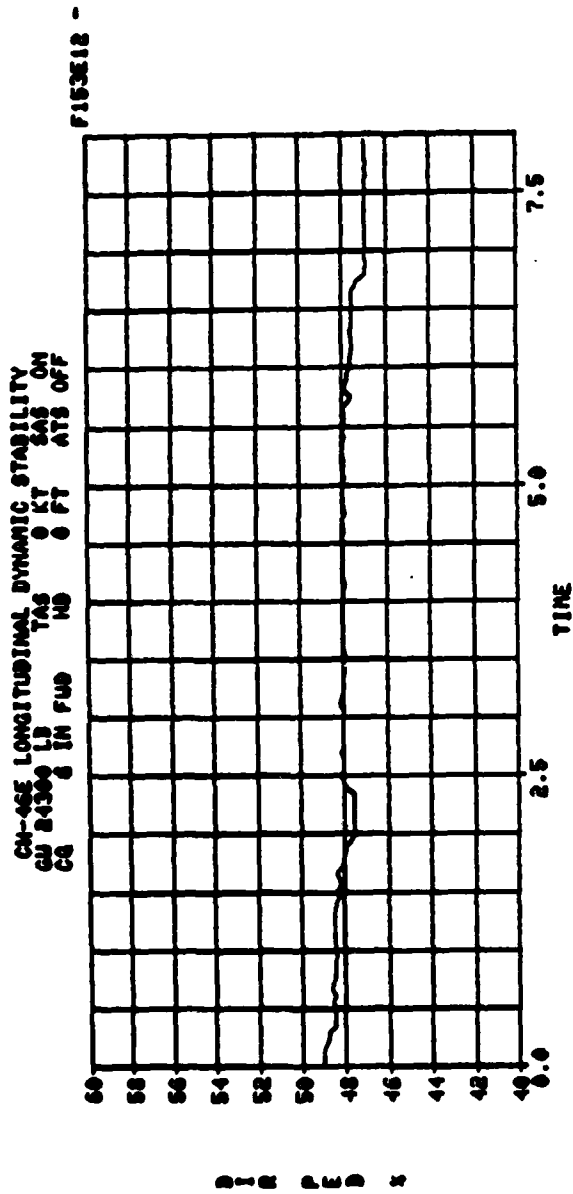


FIGURE 26

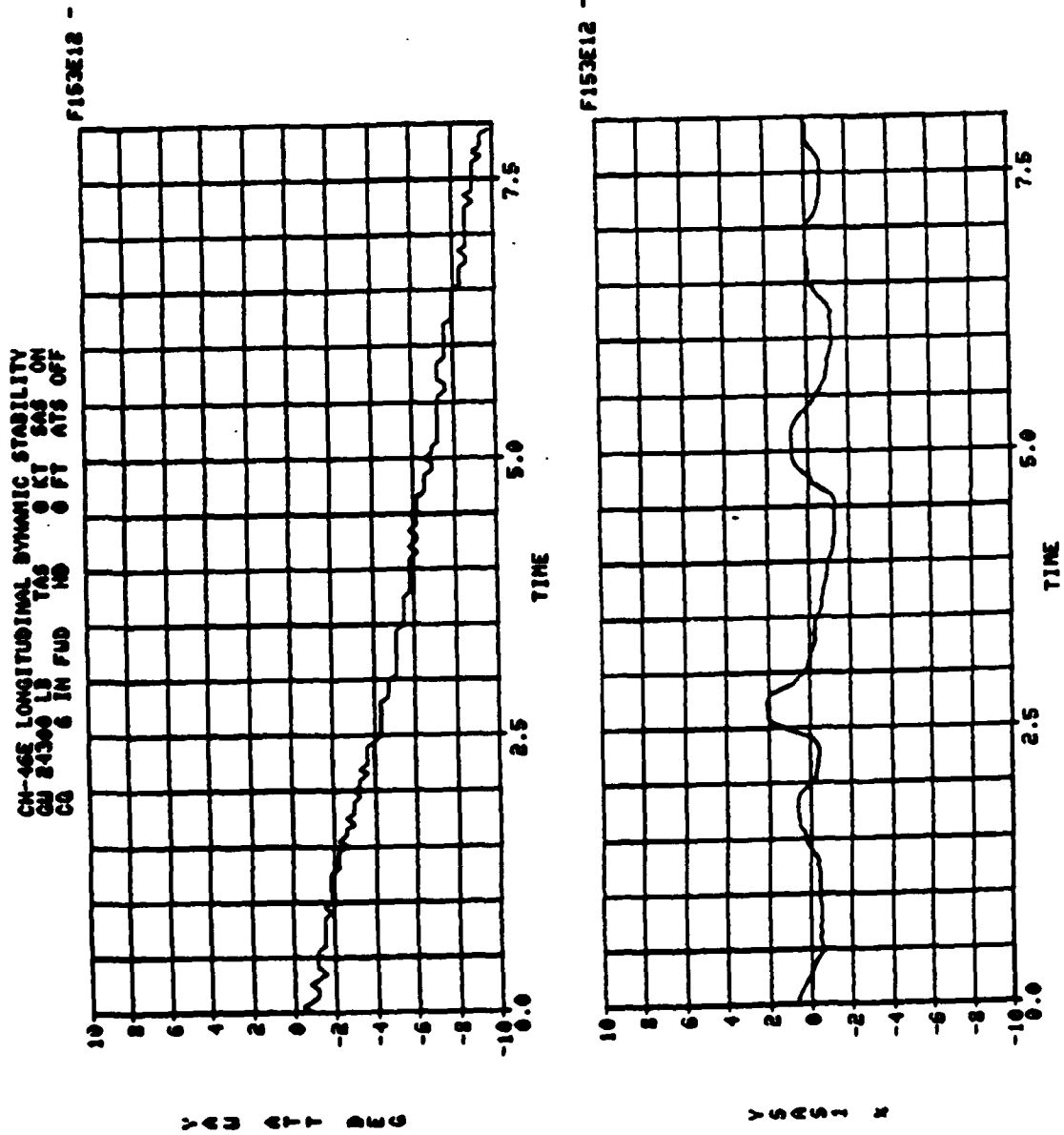


FIGURE 2H

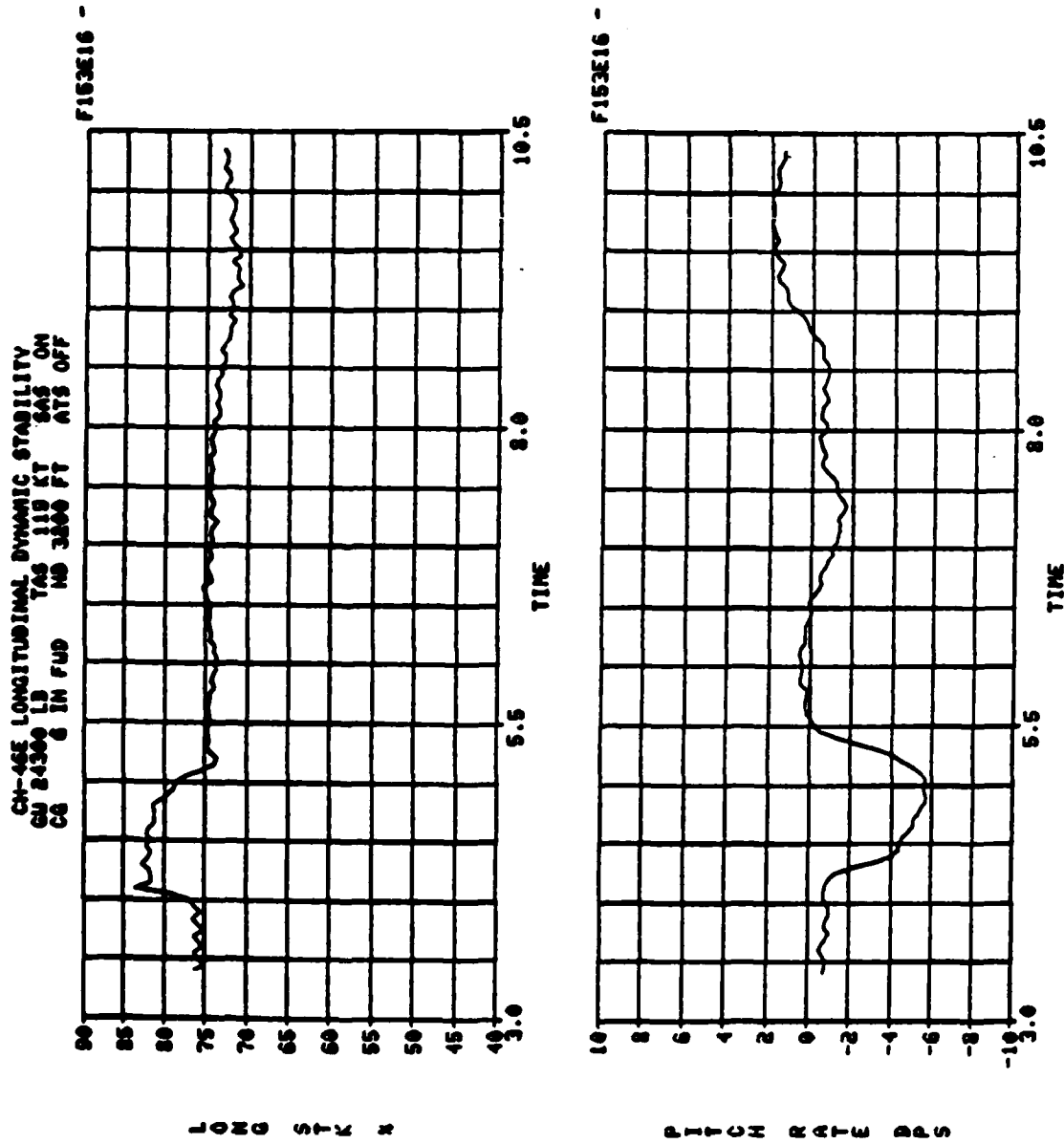


FIGURE 3A

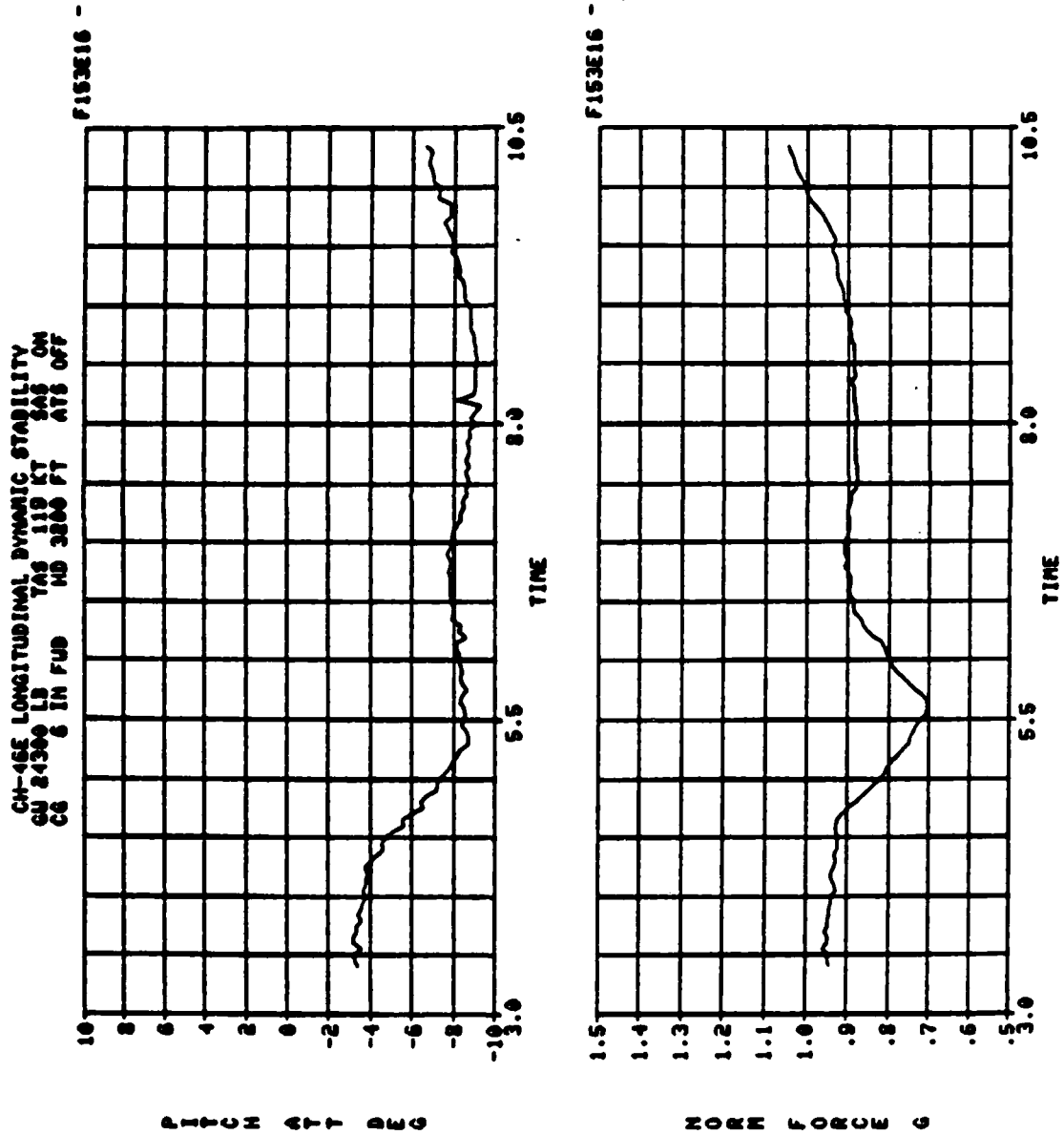


FIGURE 38

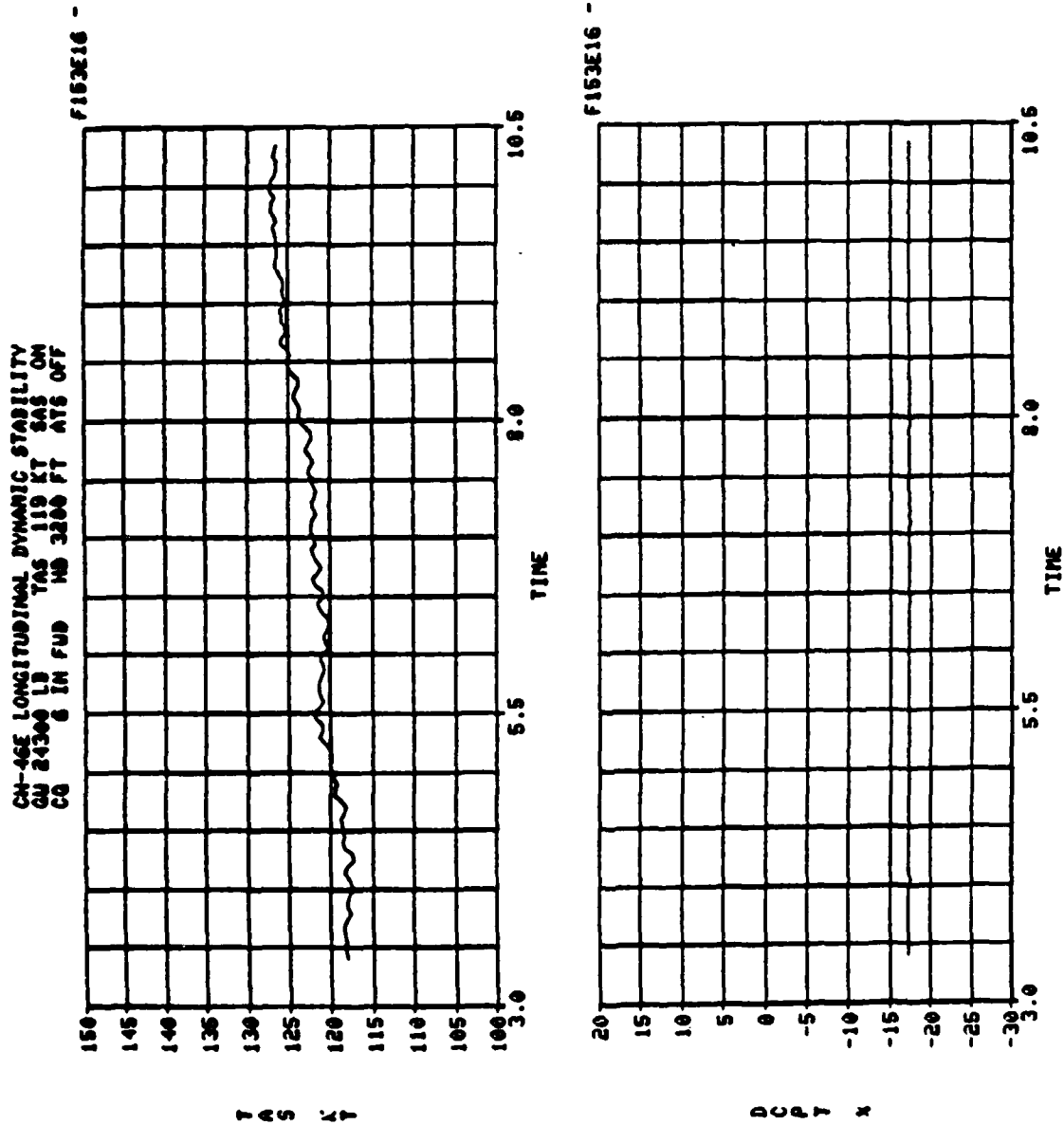


FIGURE 3C

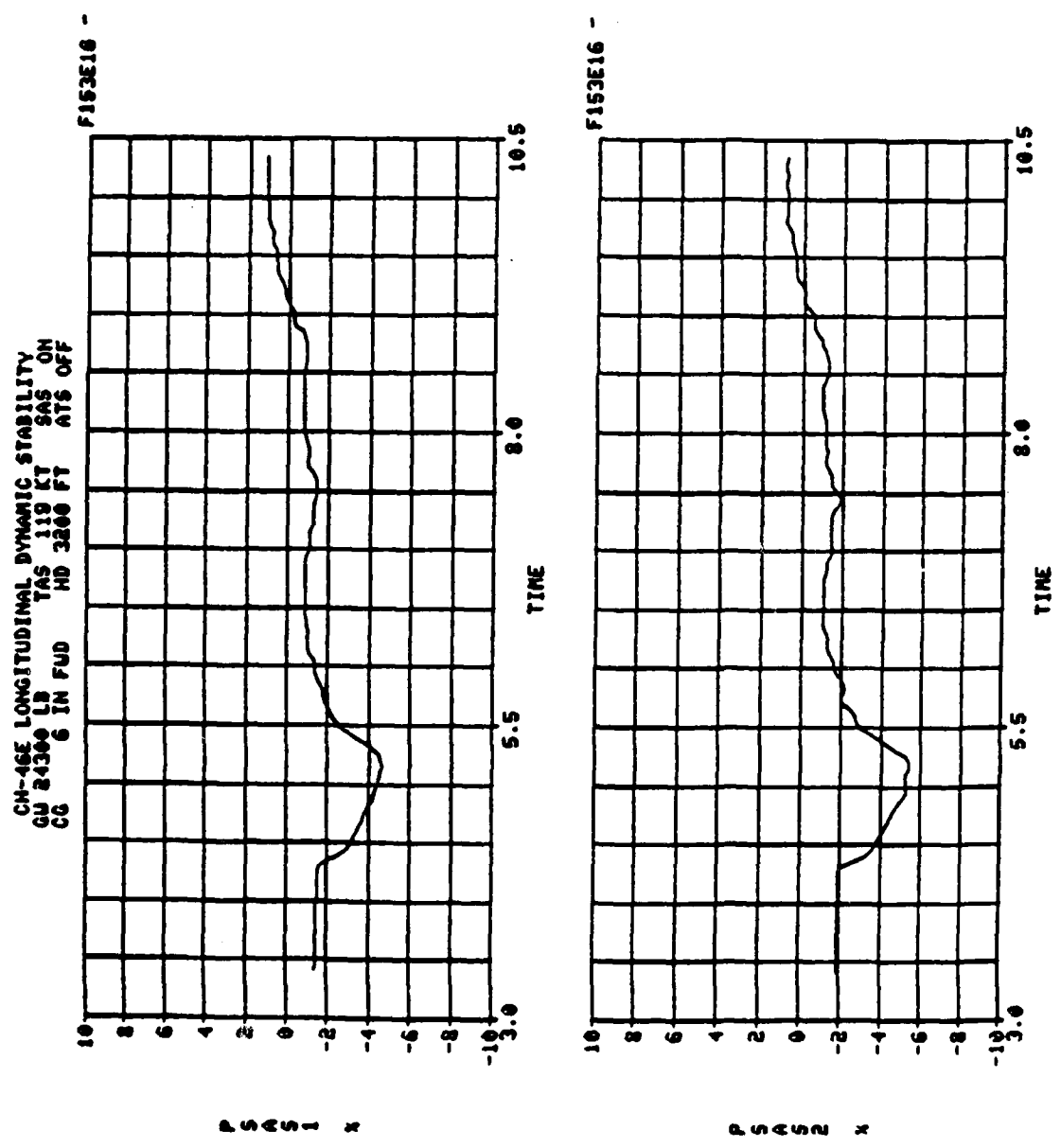


FIGURE 3D

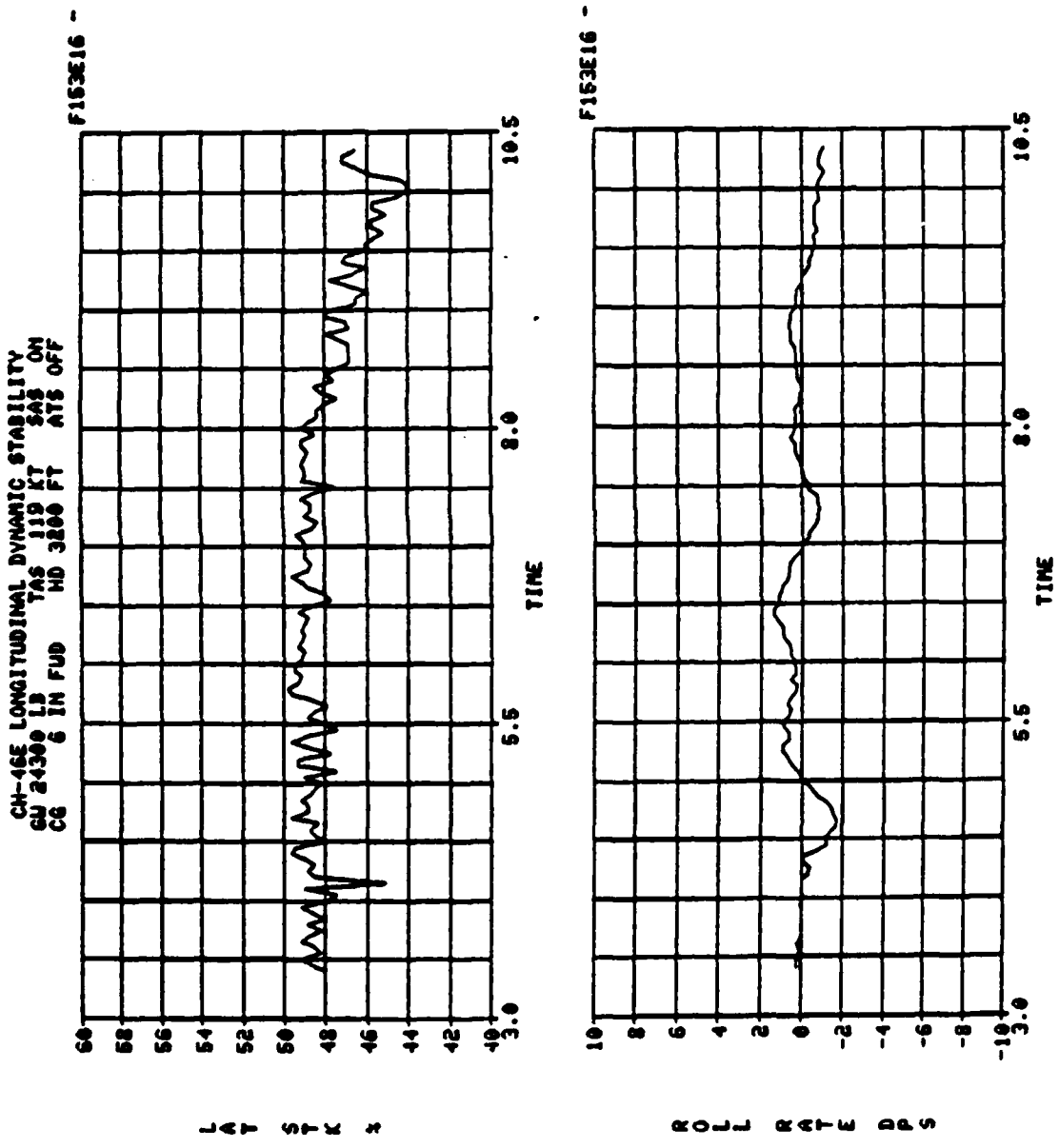


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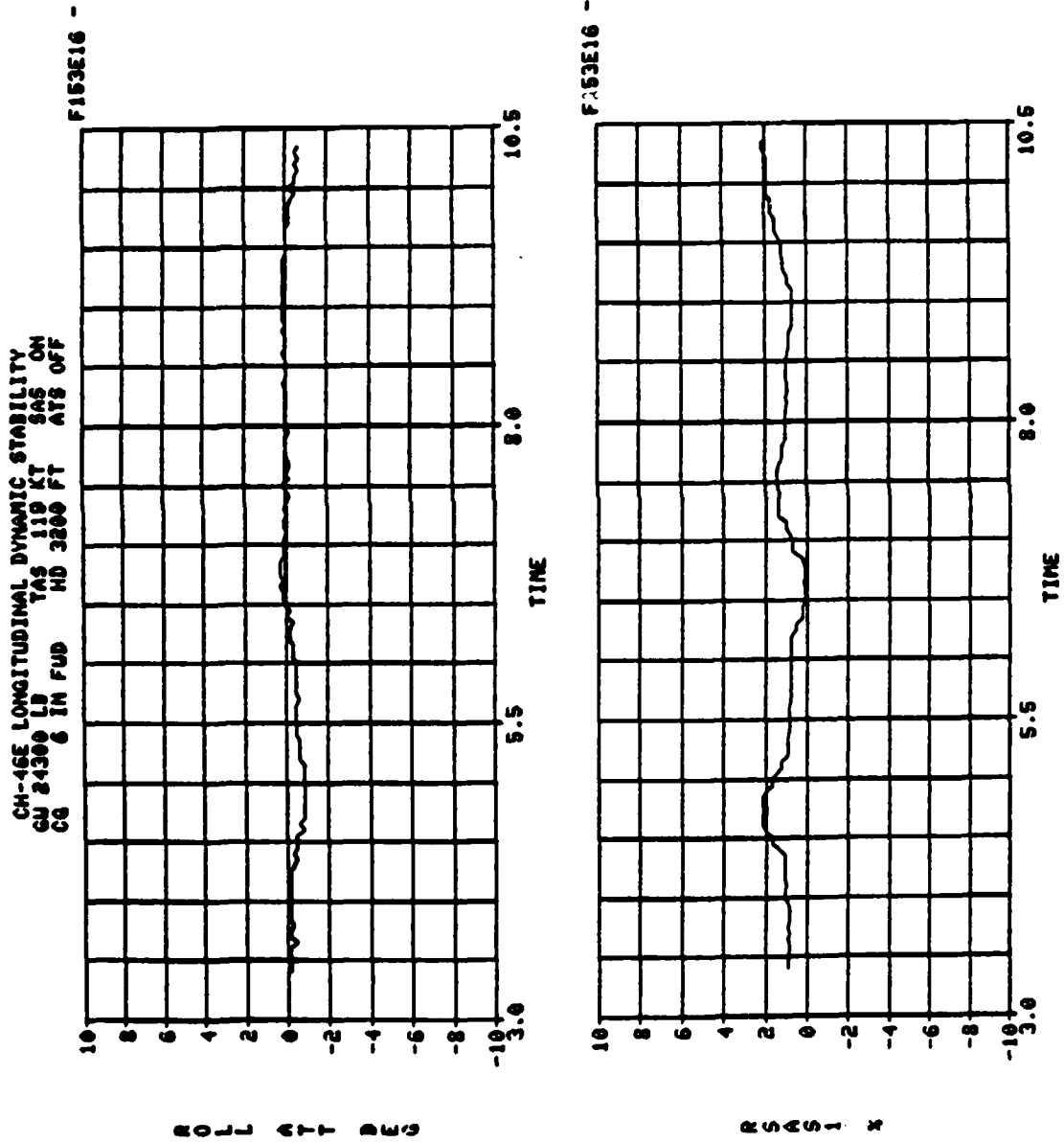


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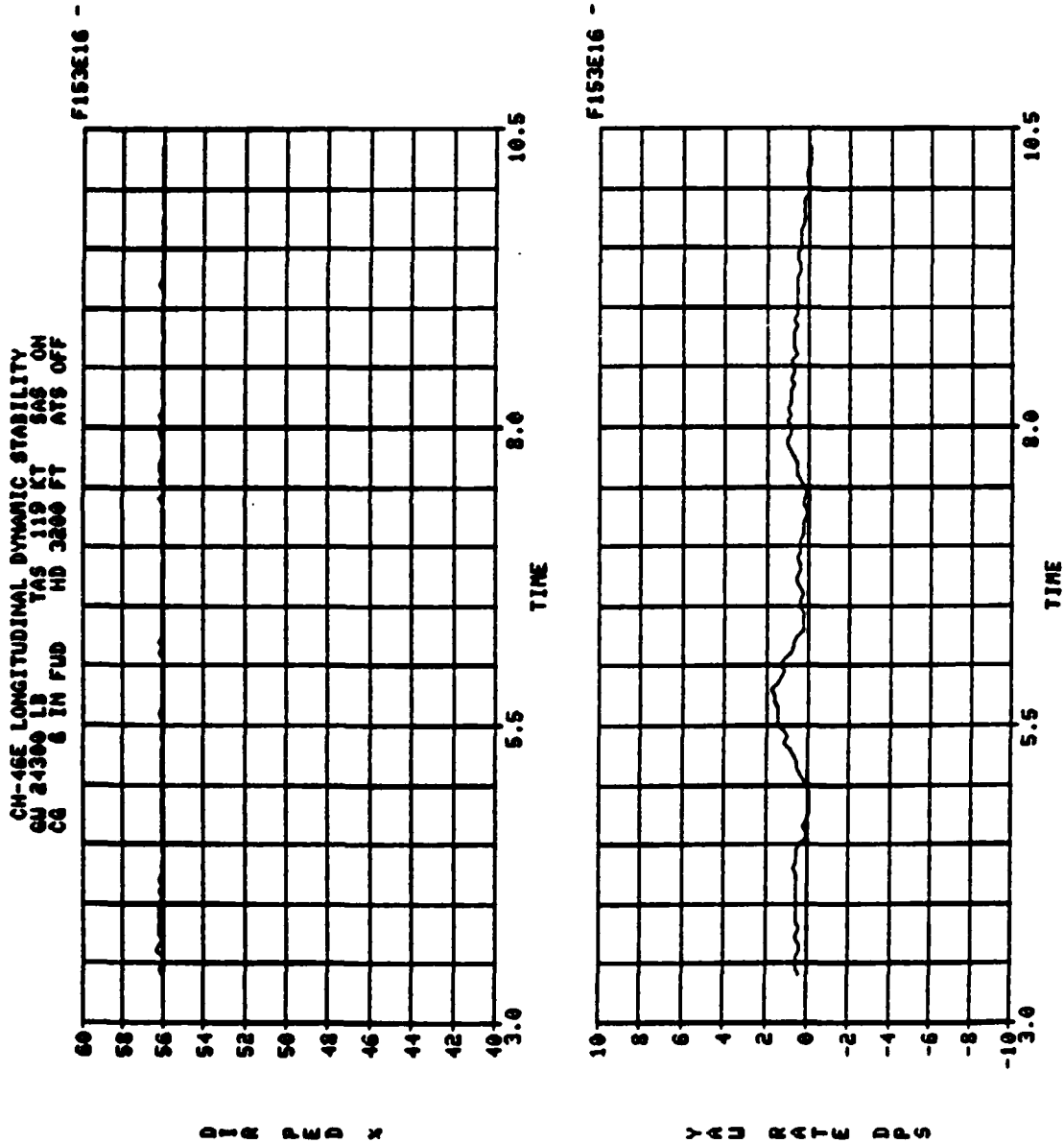


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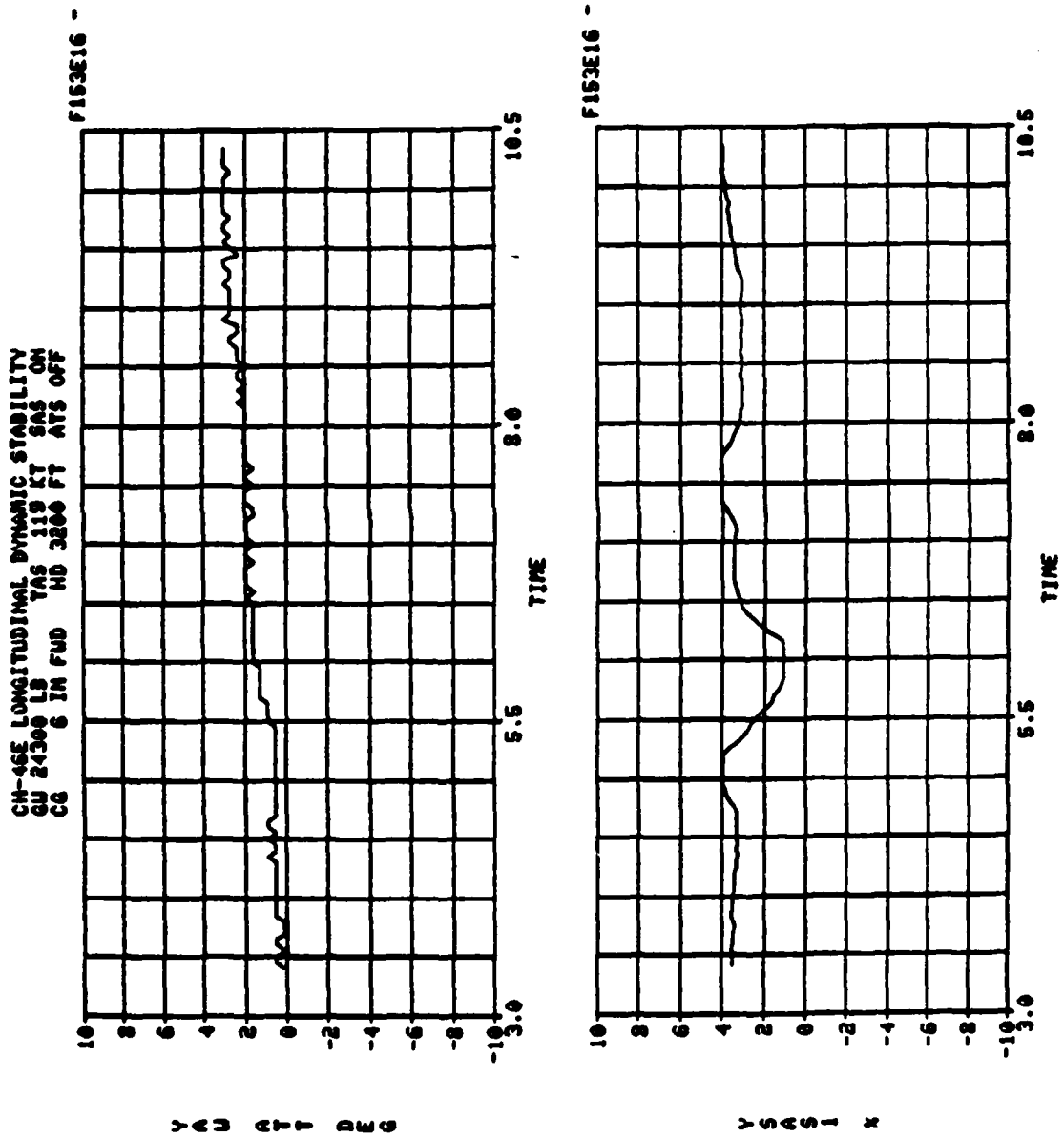


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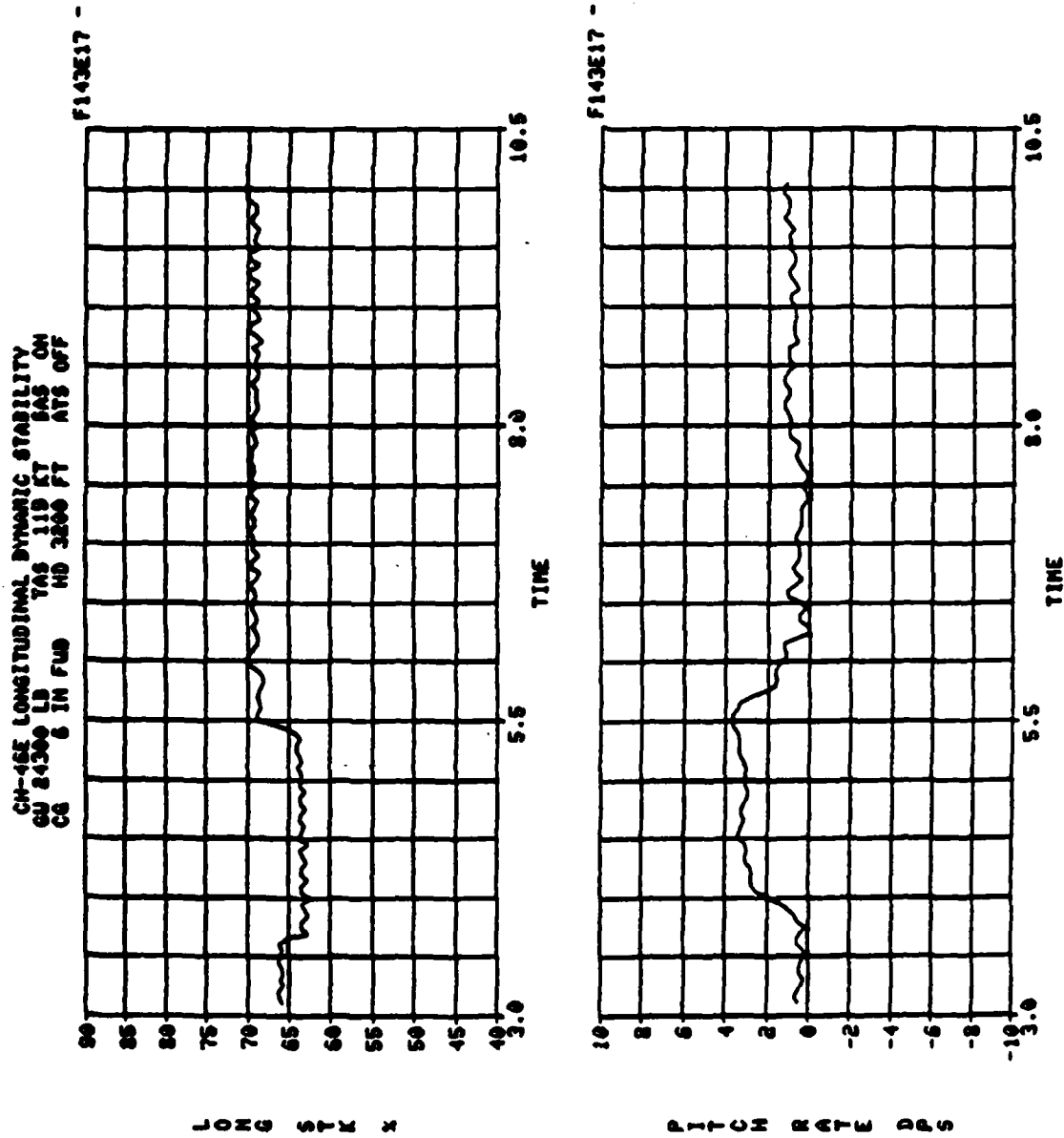


FIGURE 4A

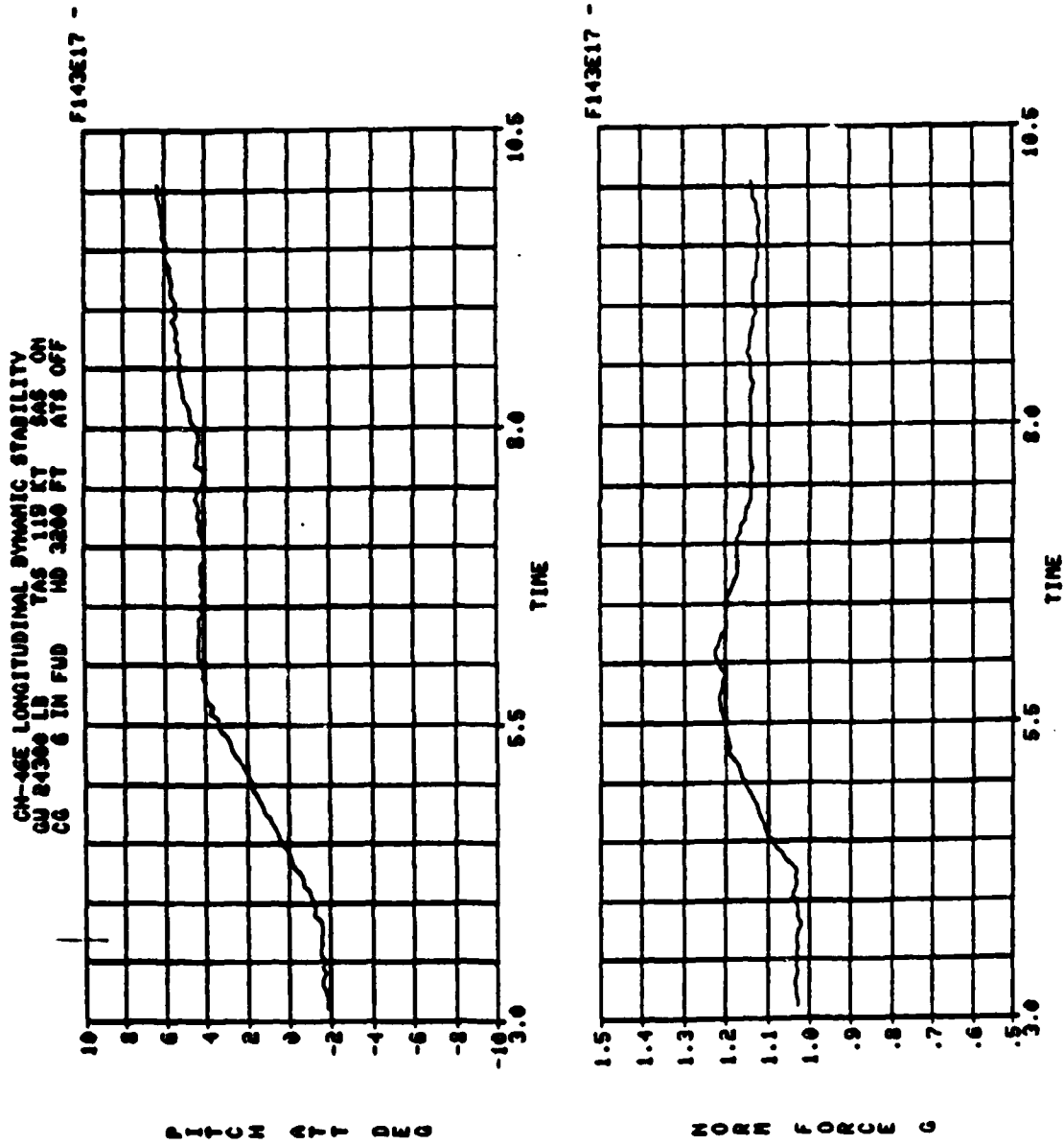


FIGURE 4B

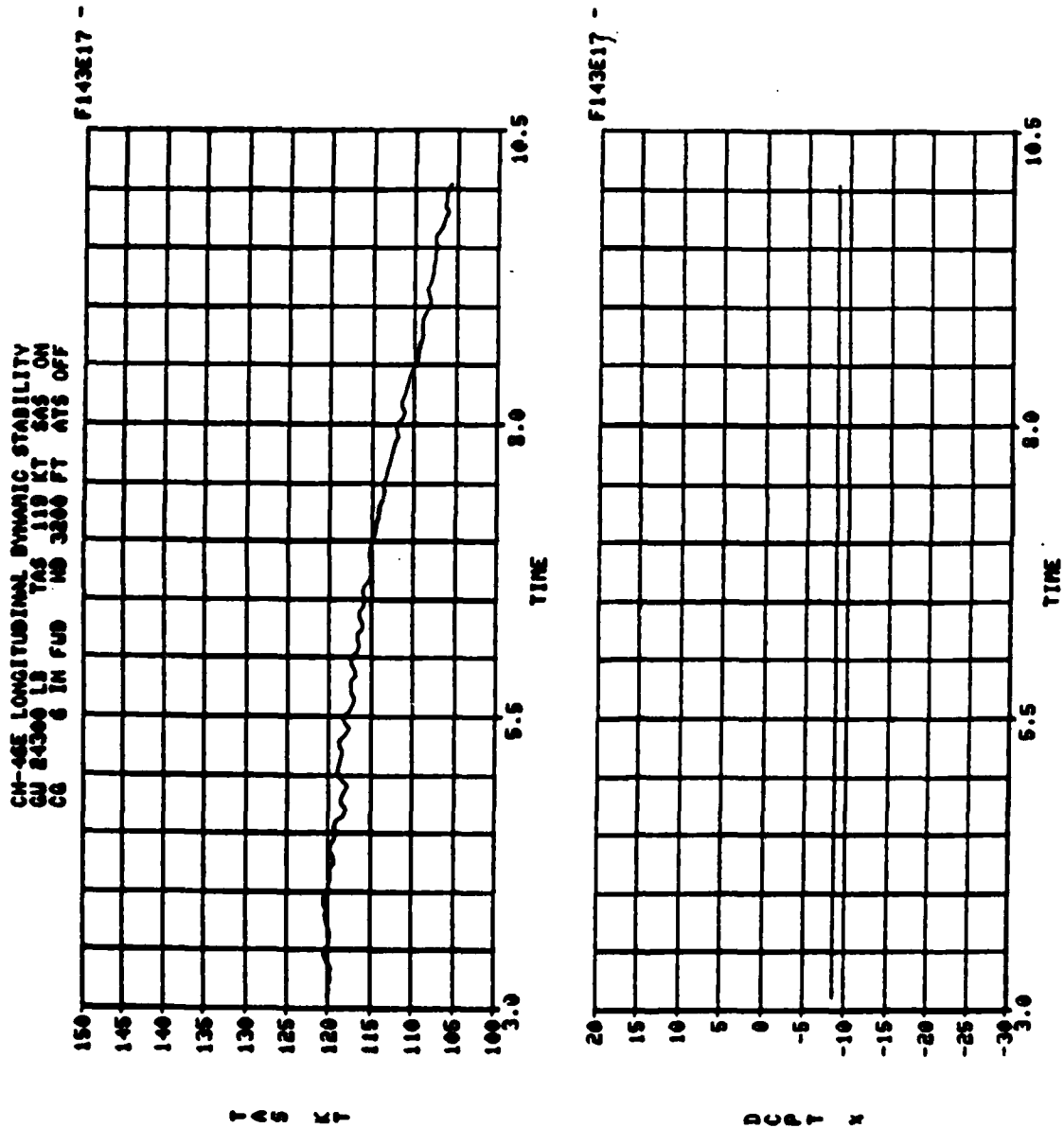


FIGURE 4C

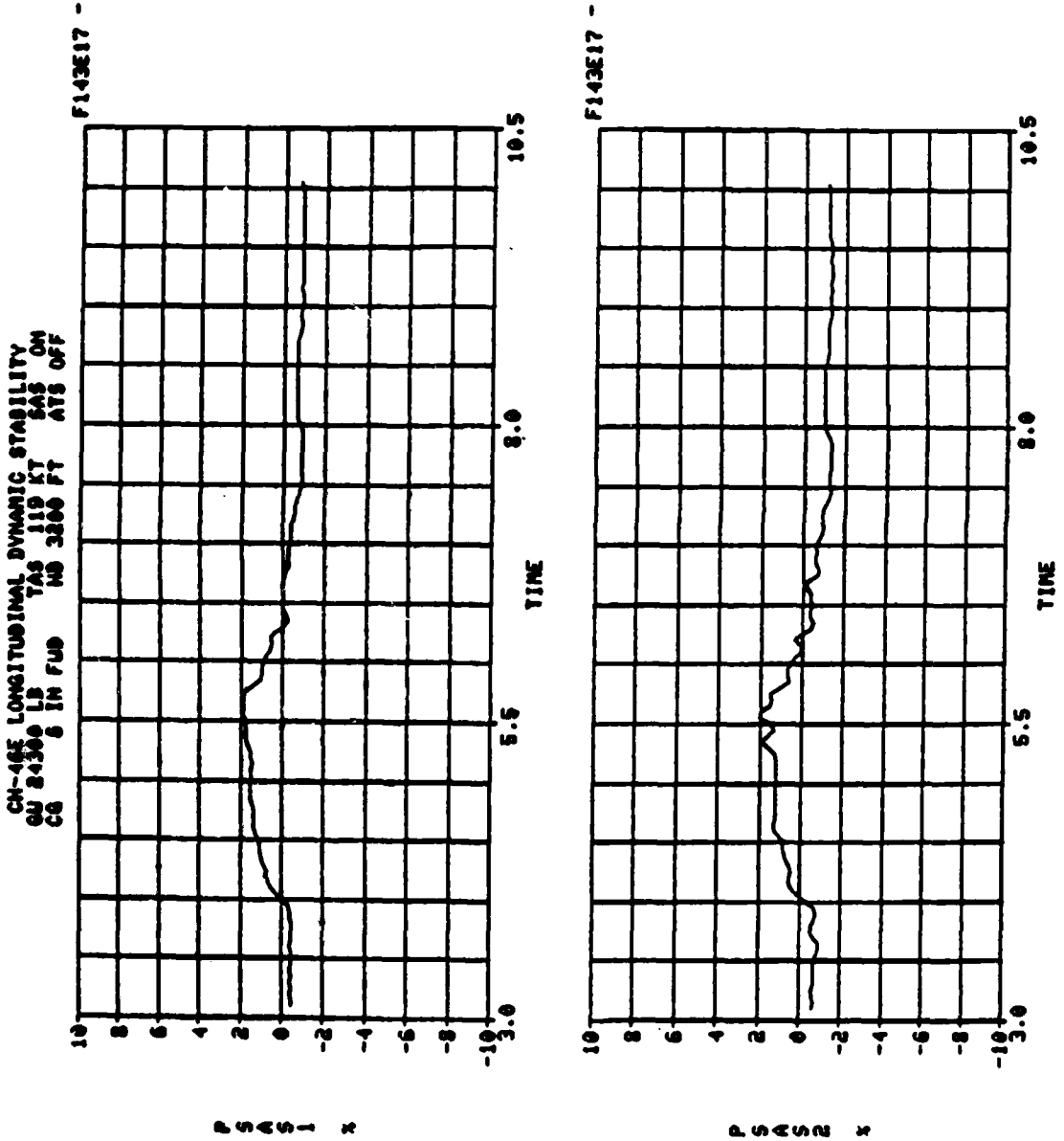


FIGURE 4D

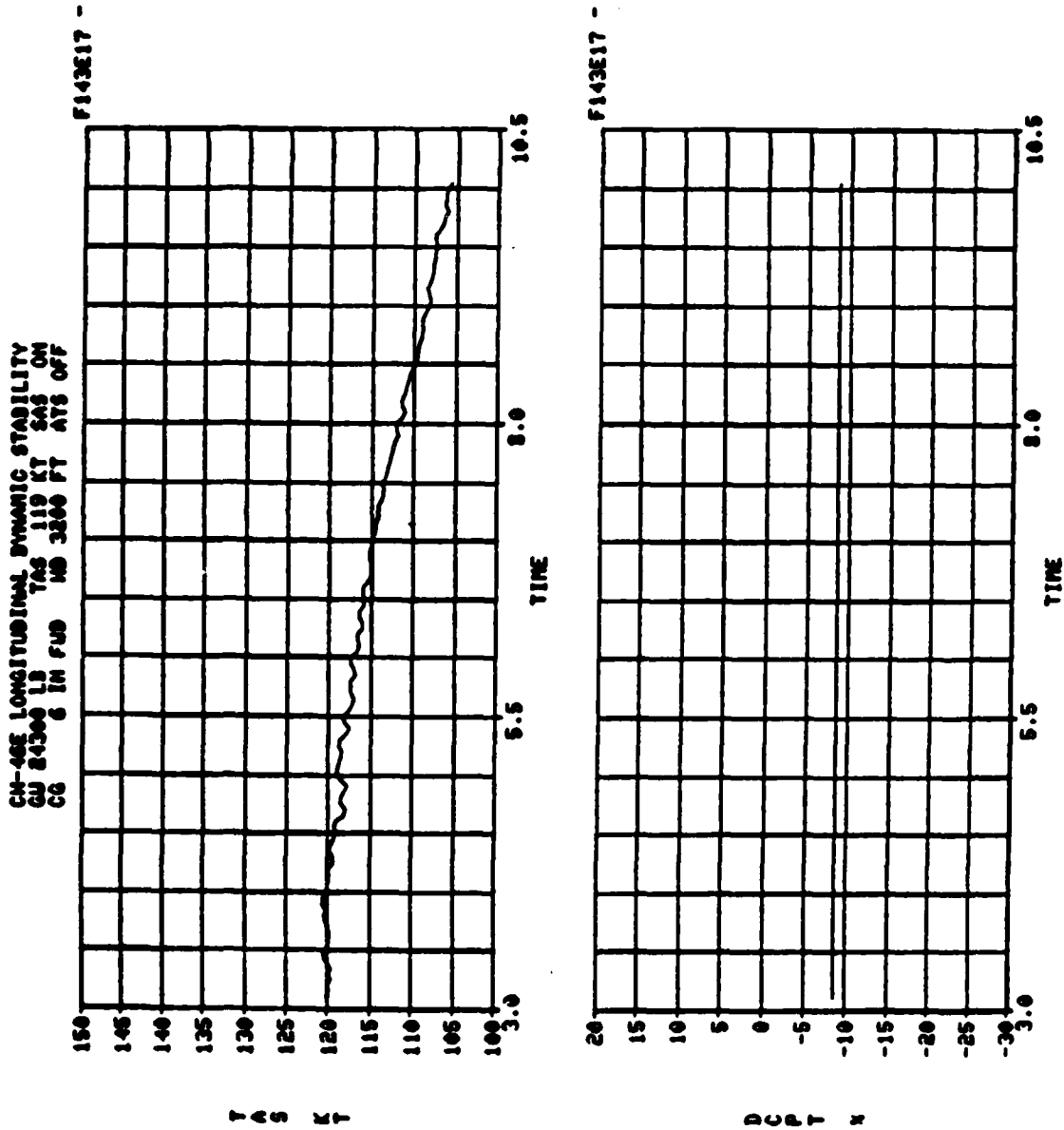


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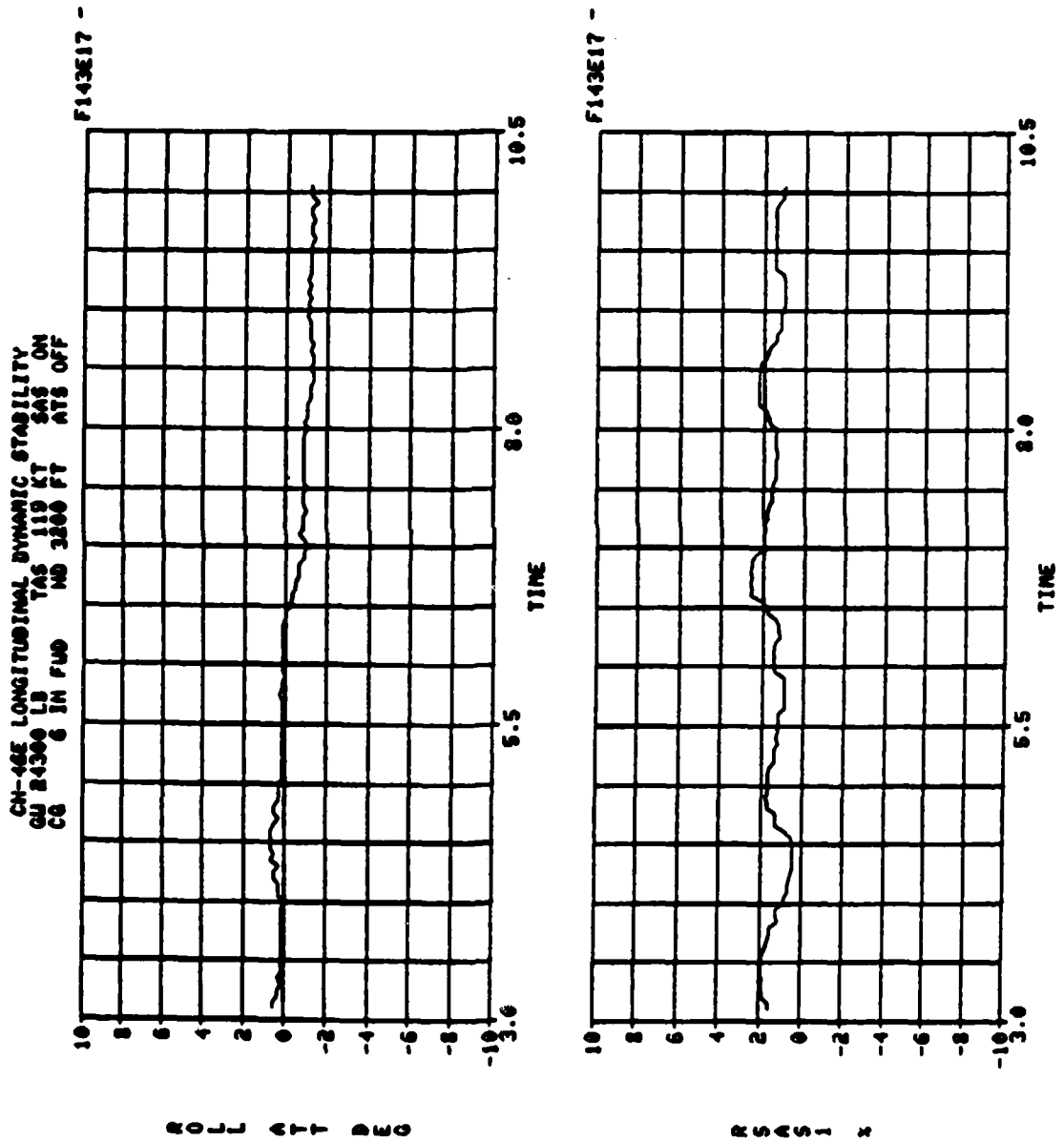


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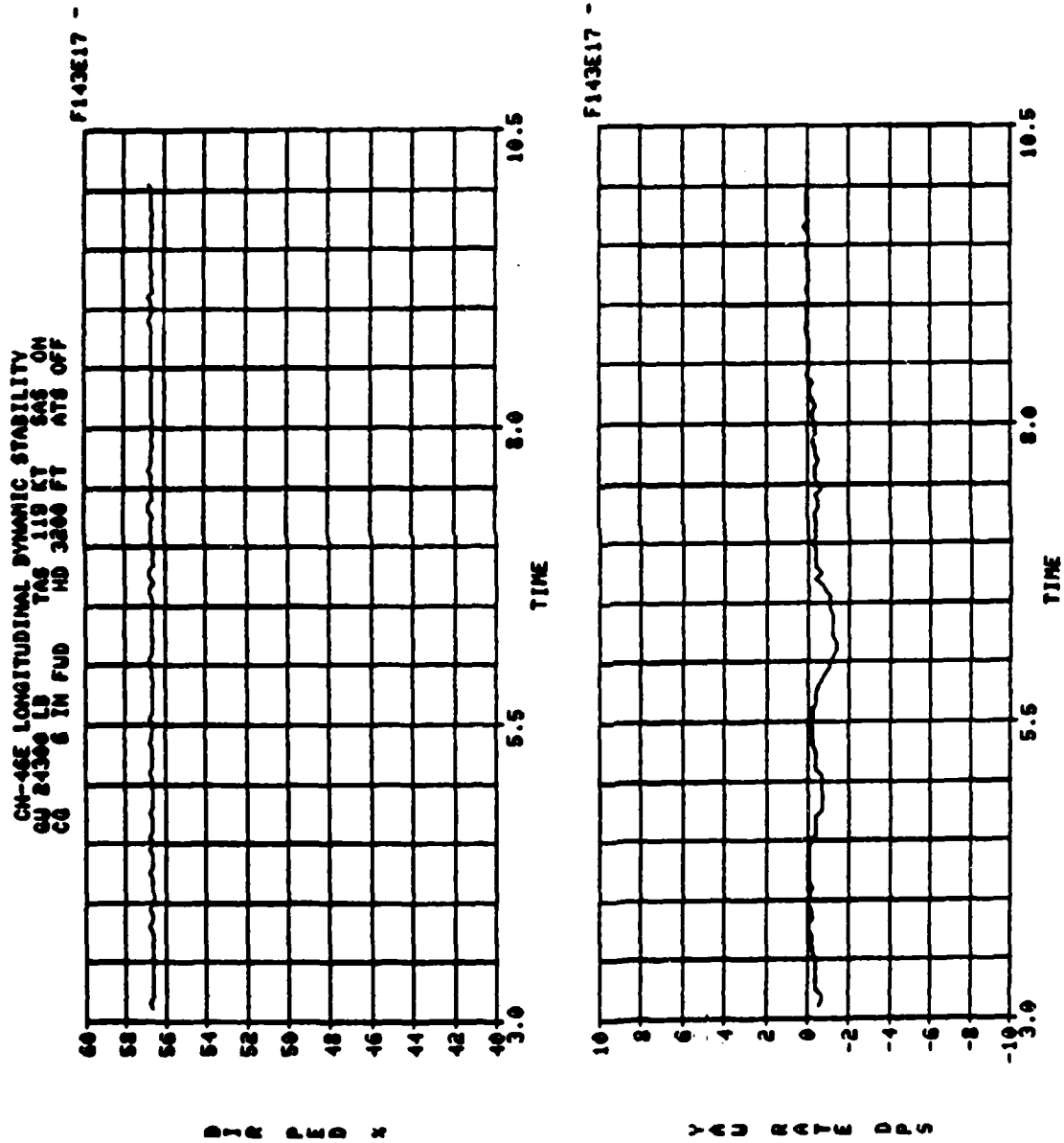


FIGURE 4G

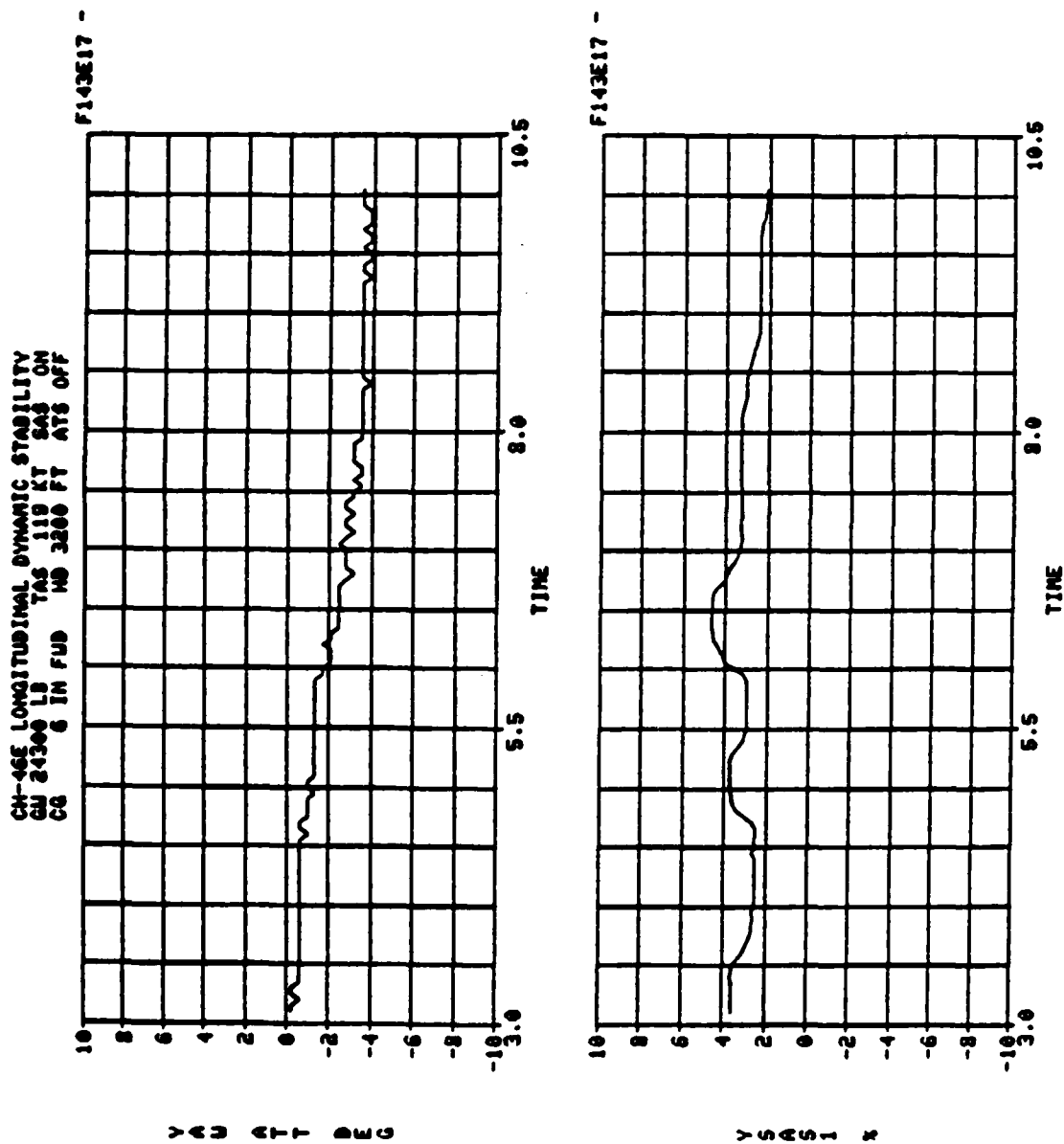


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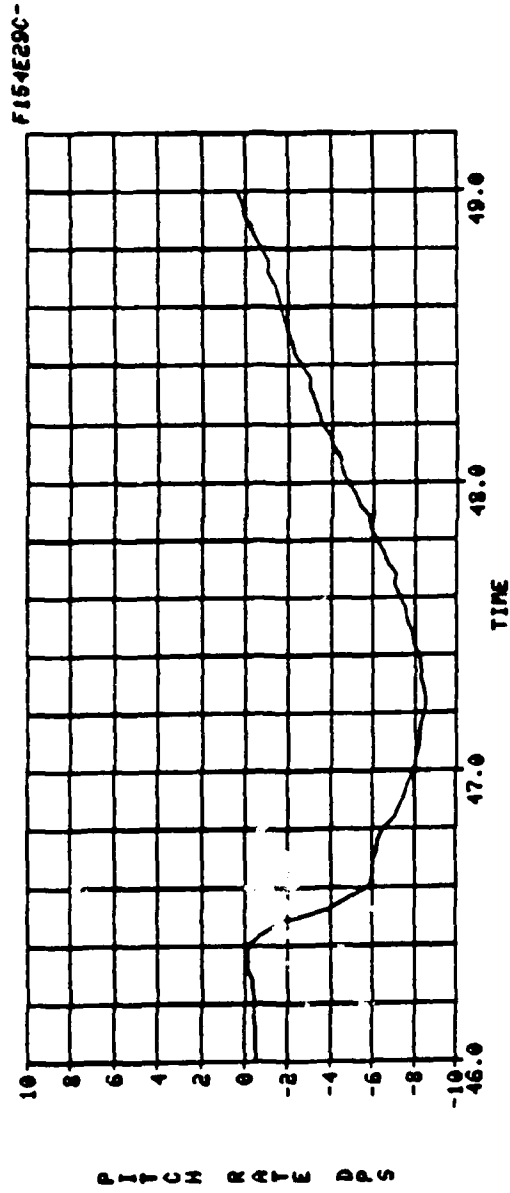
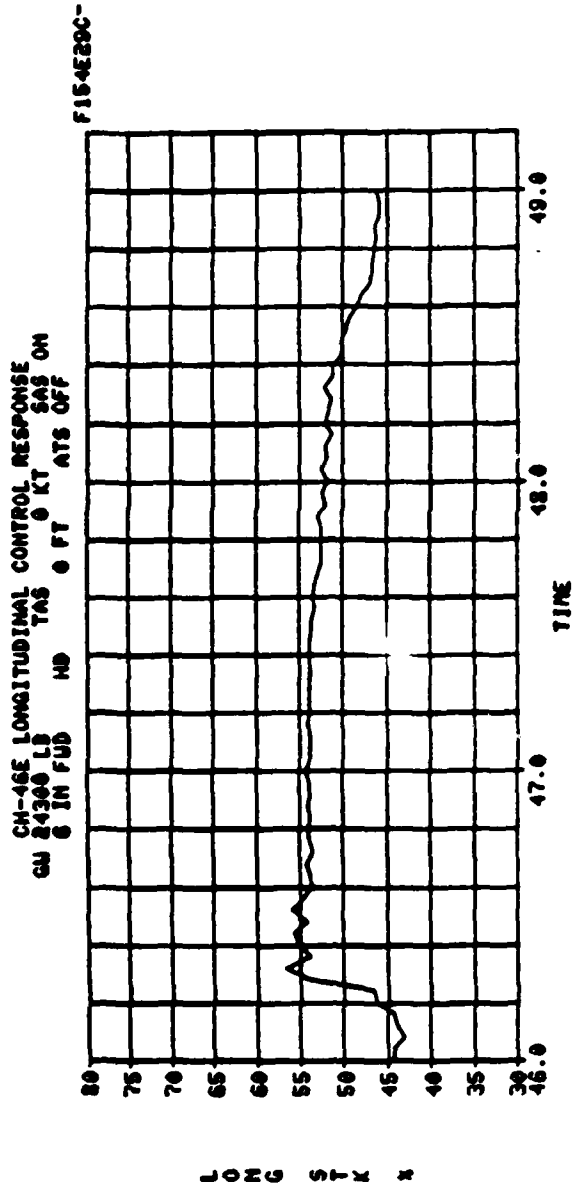


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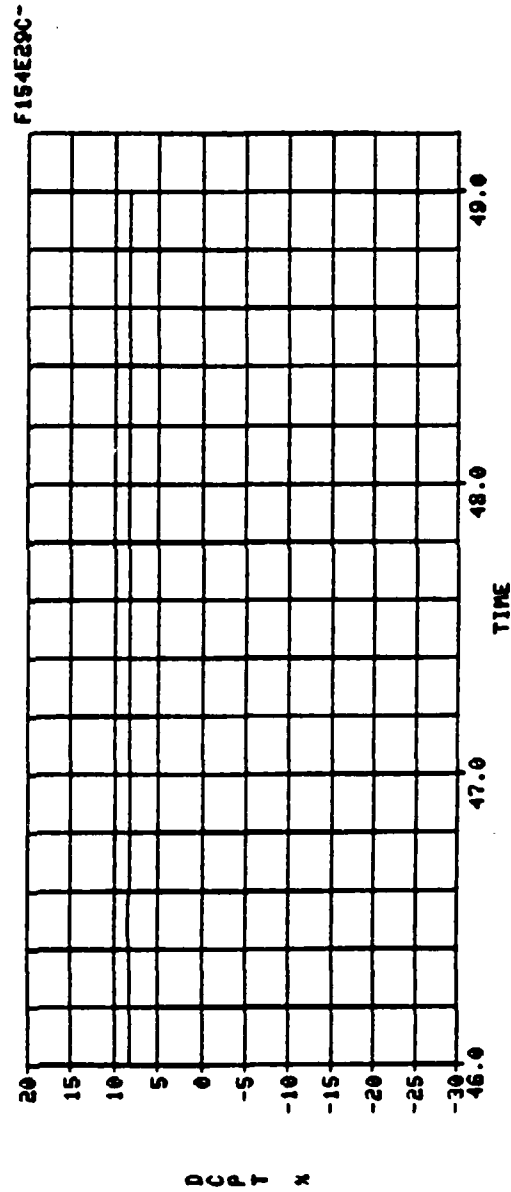
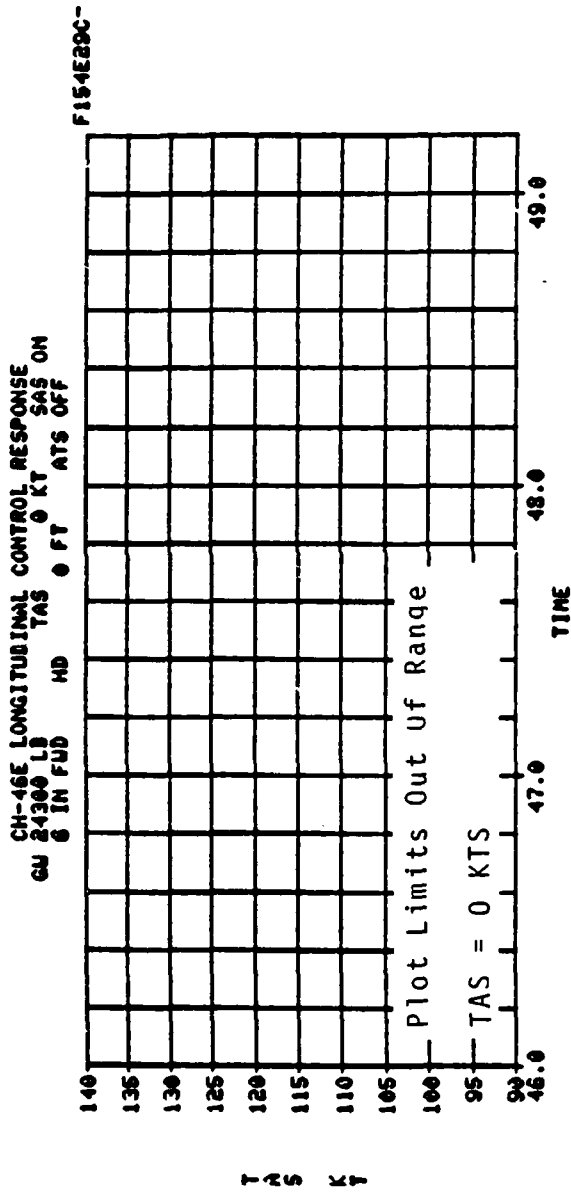


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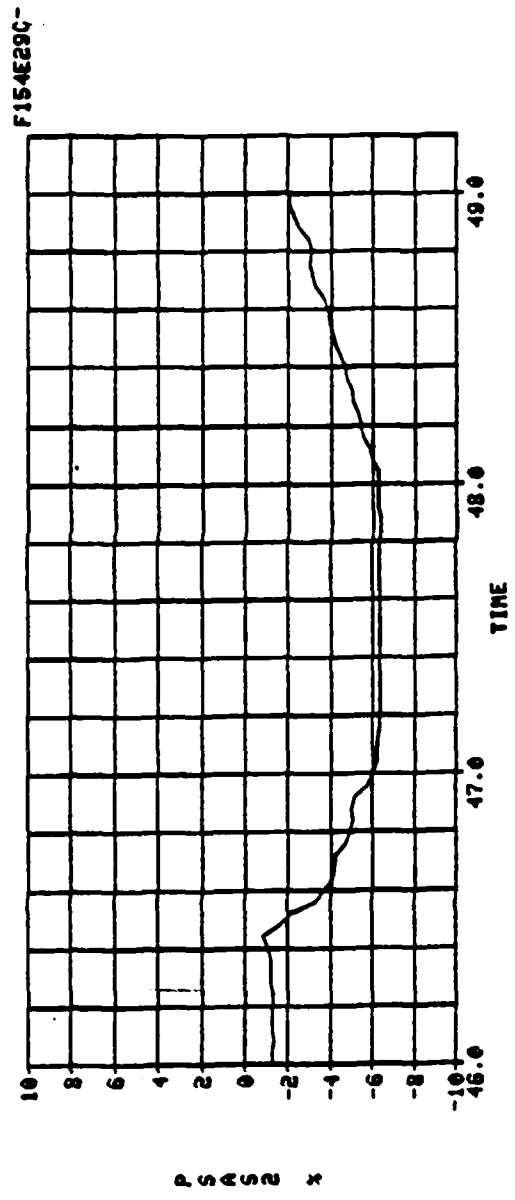
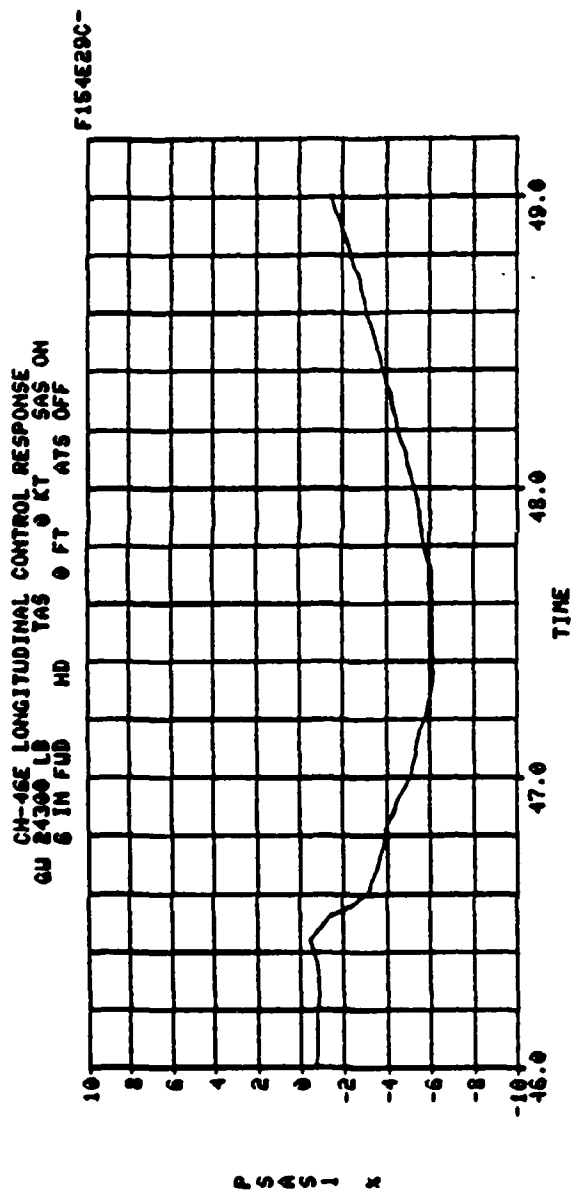


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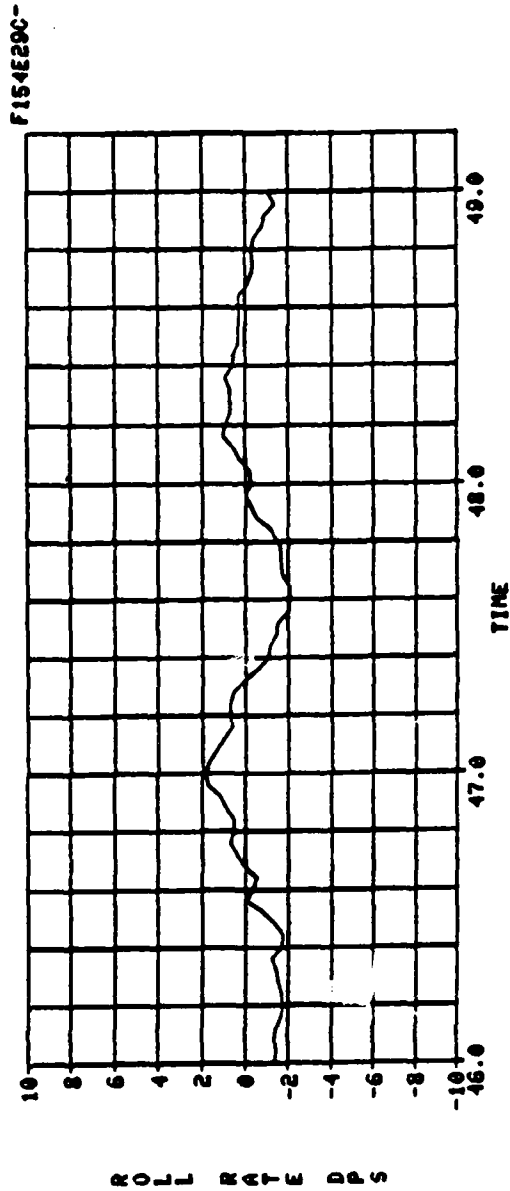
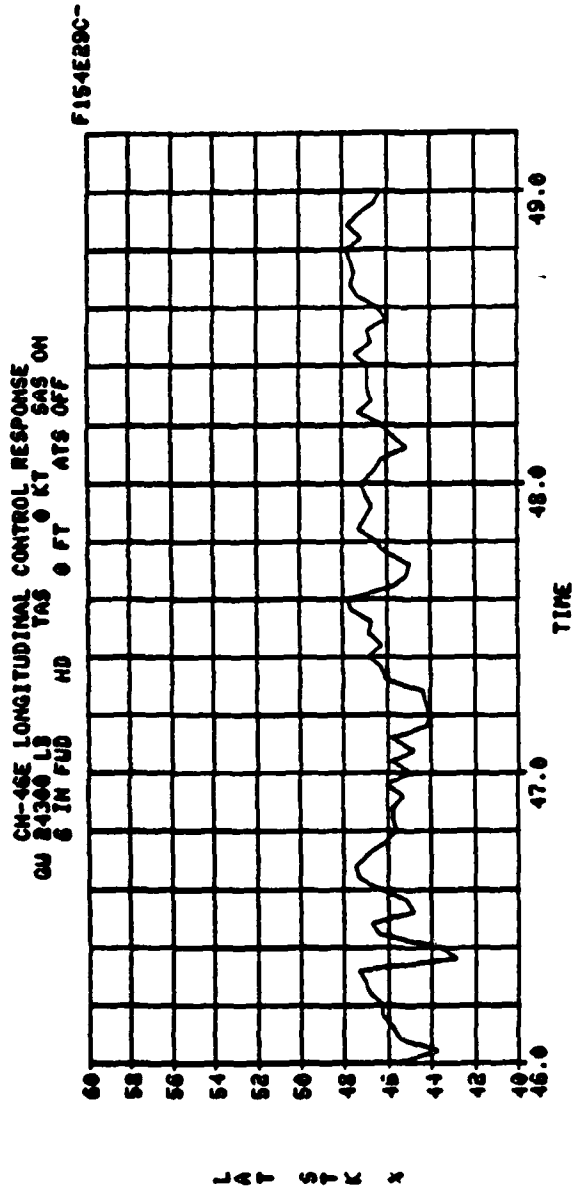


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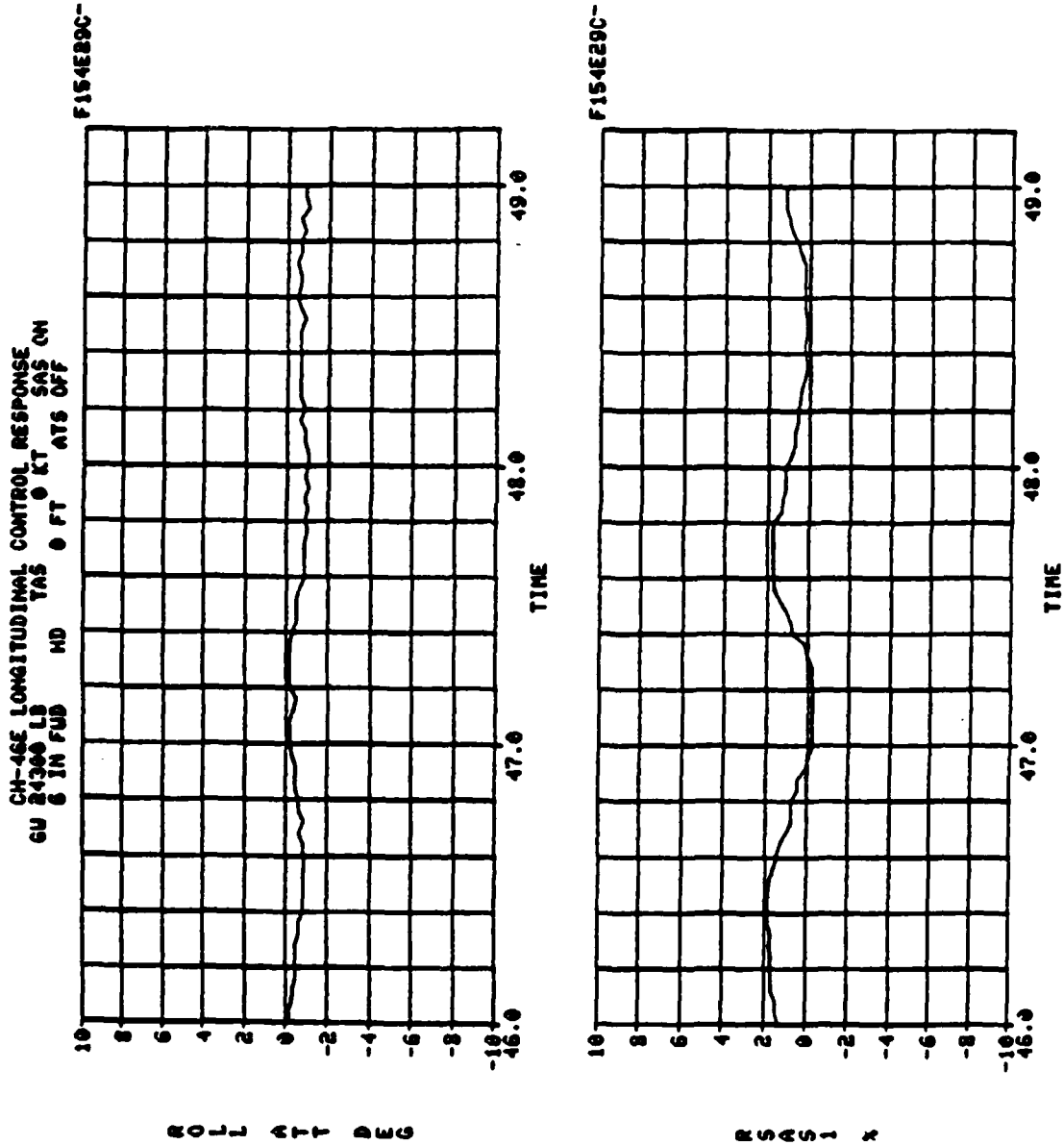


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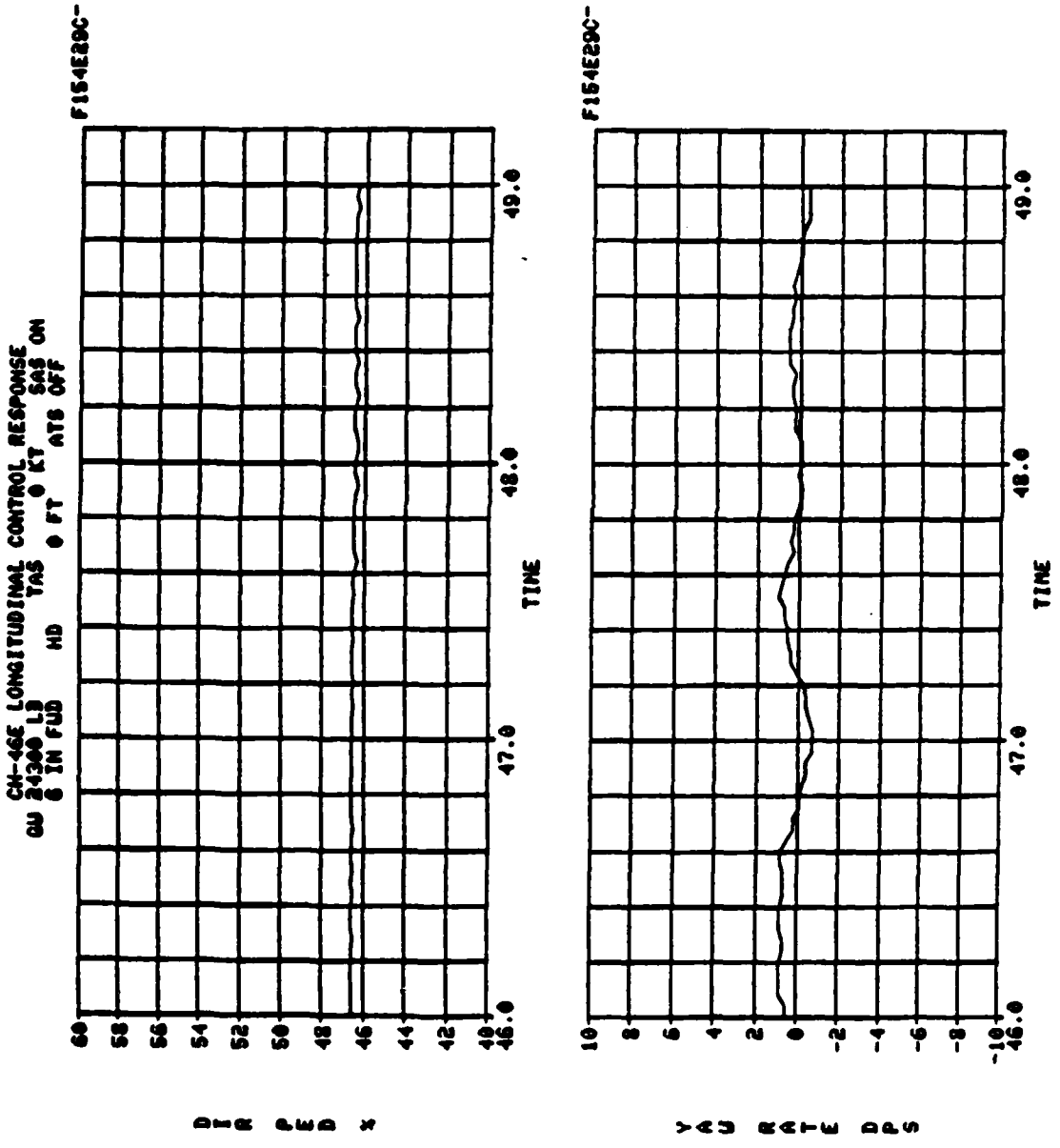


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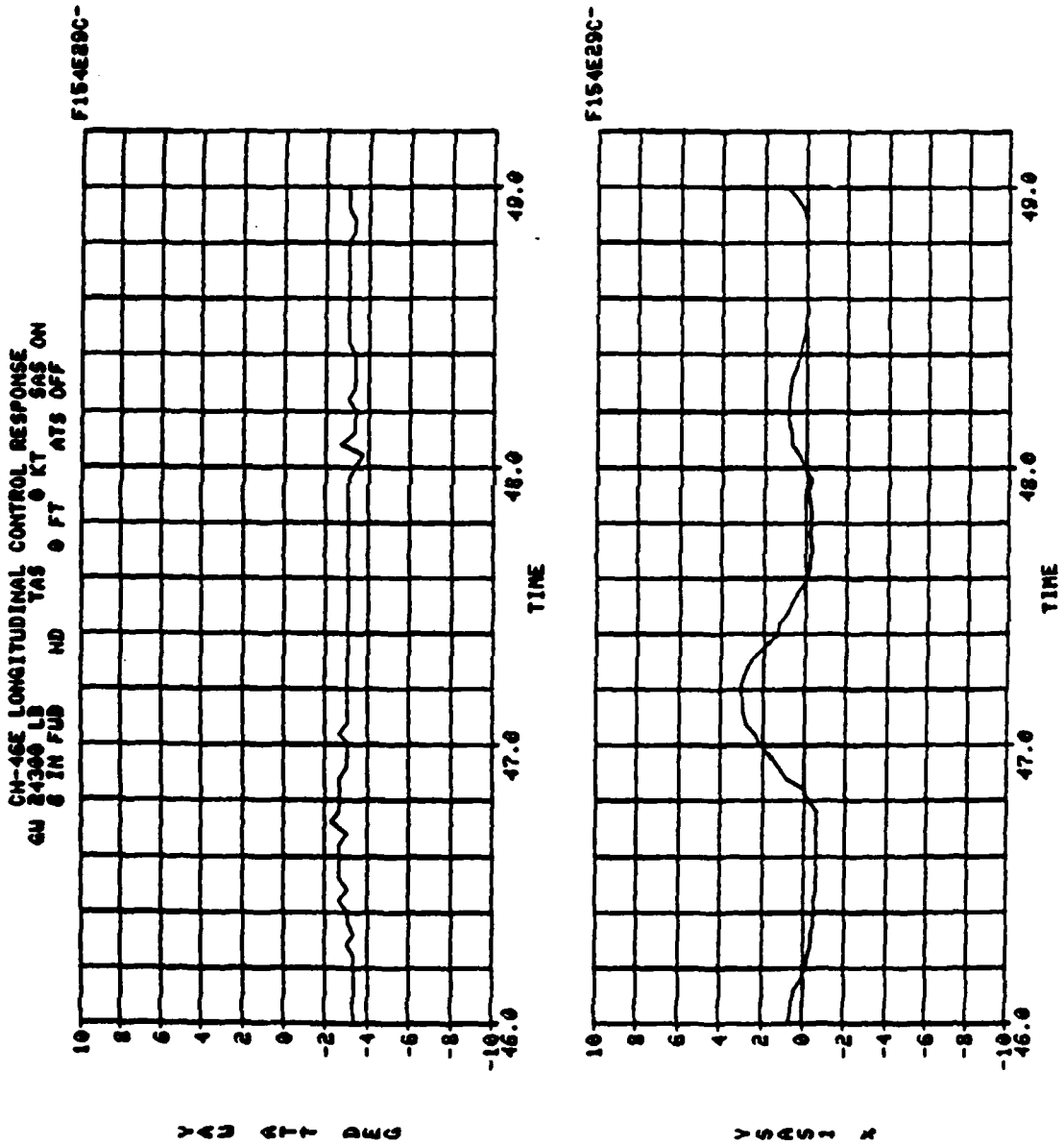


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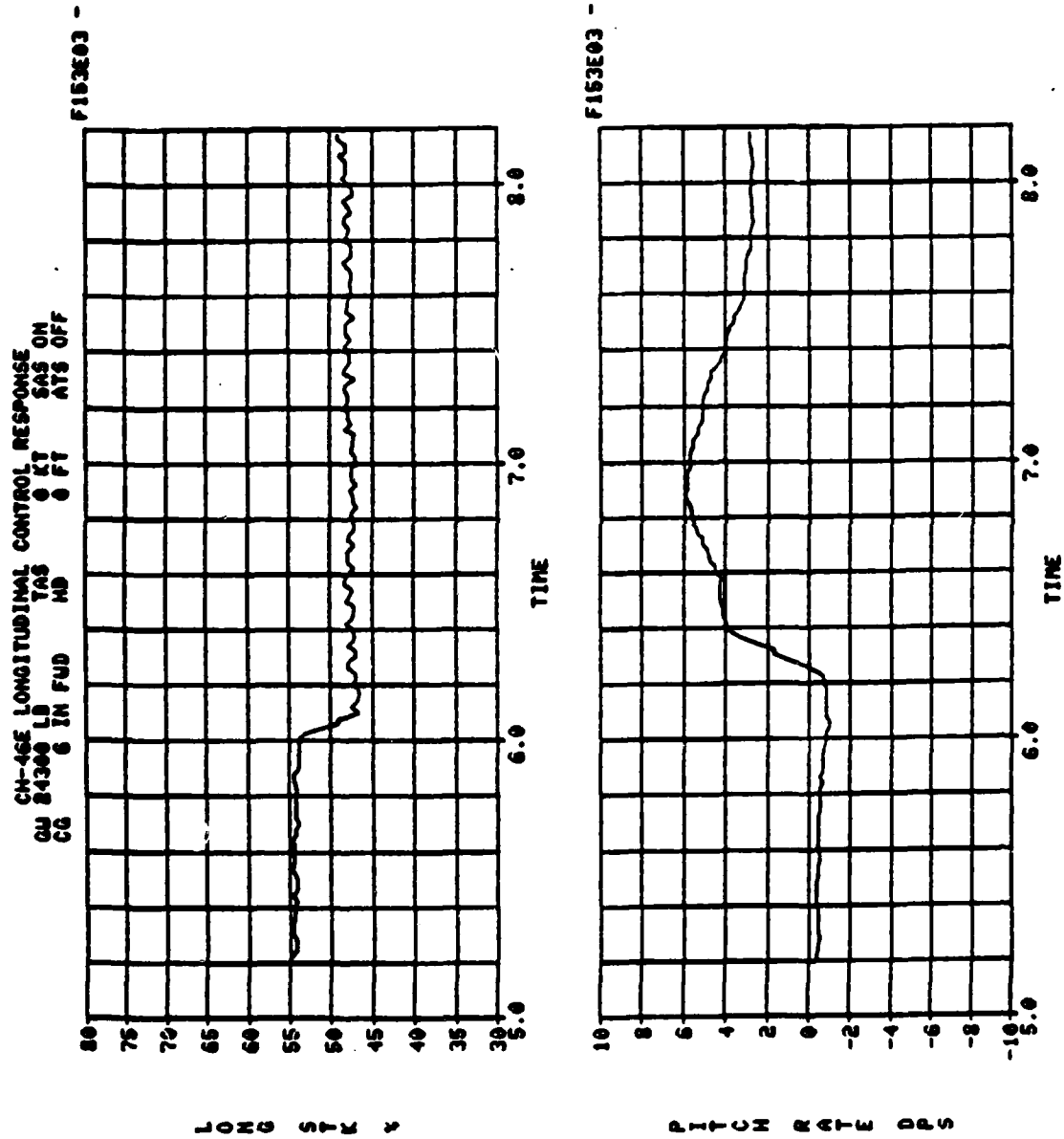


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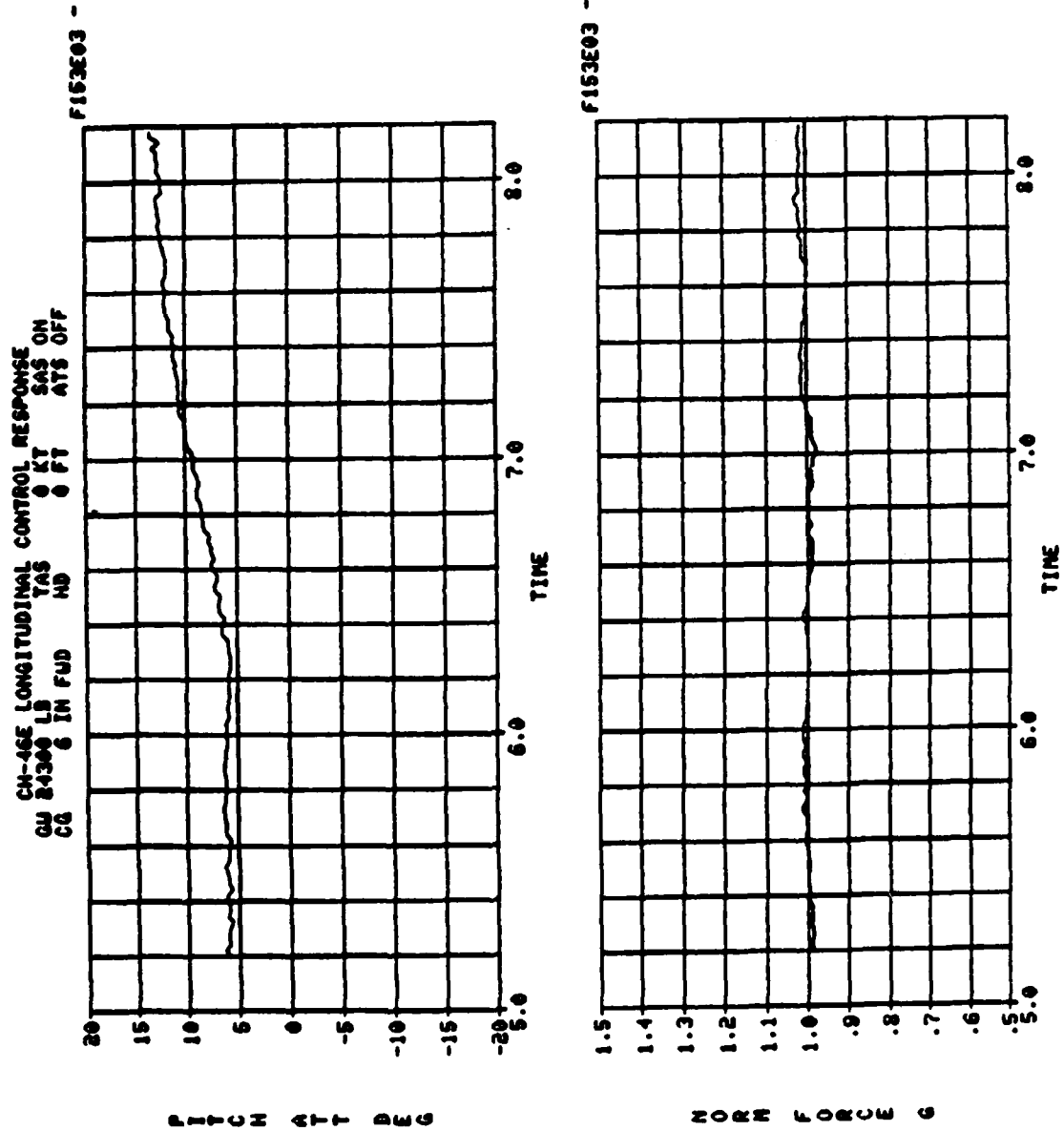


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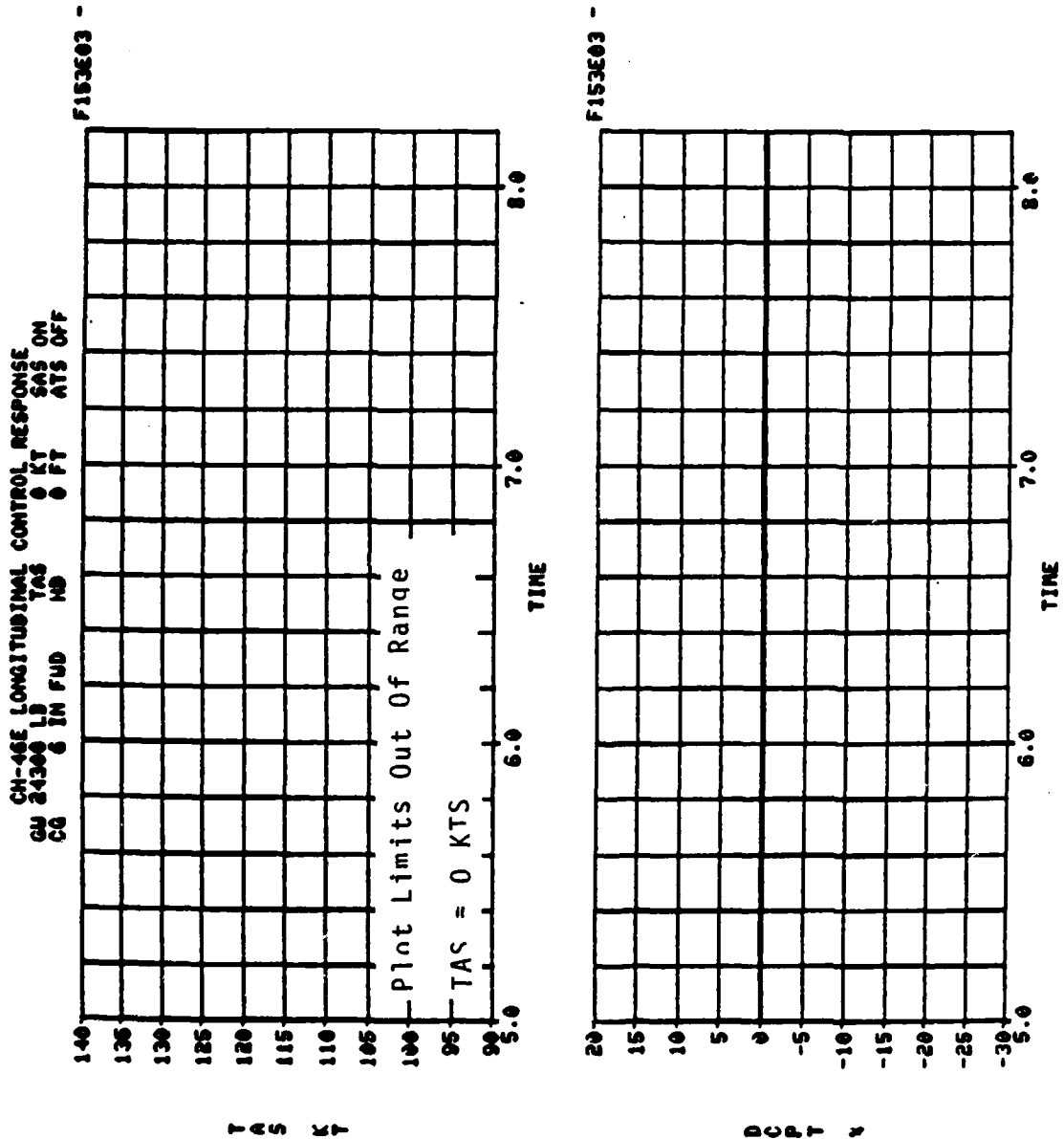


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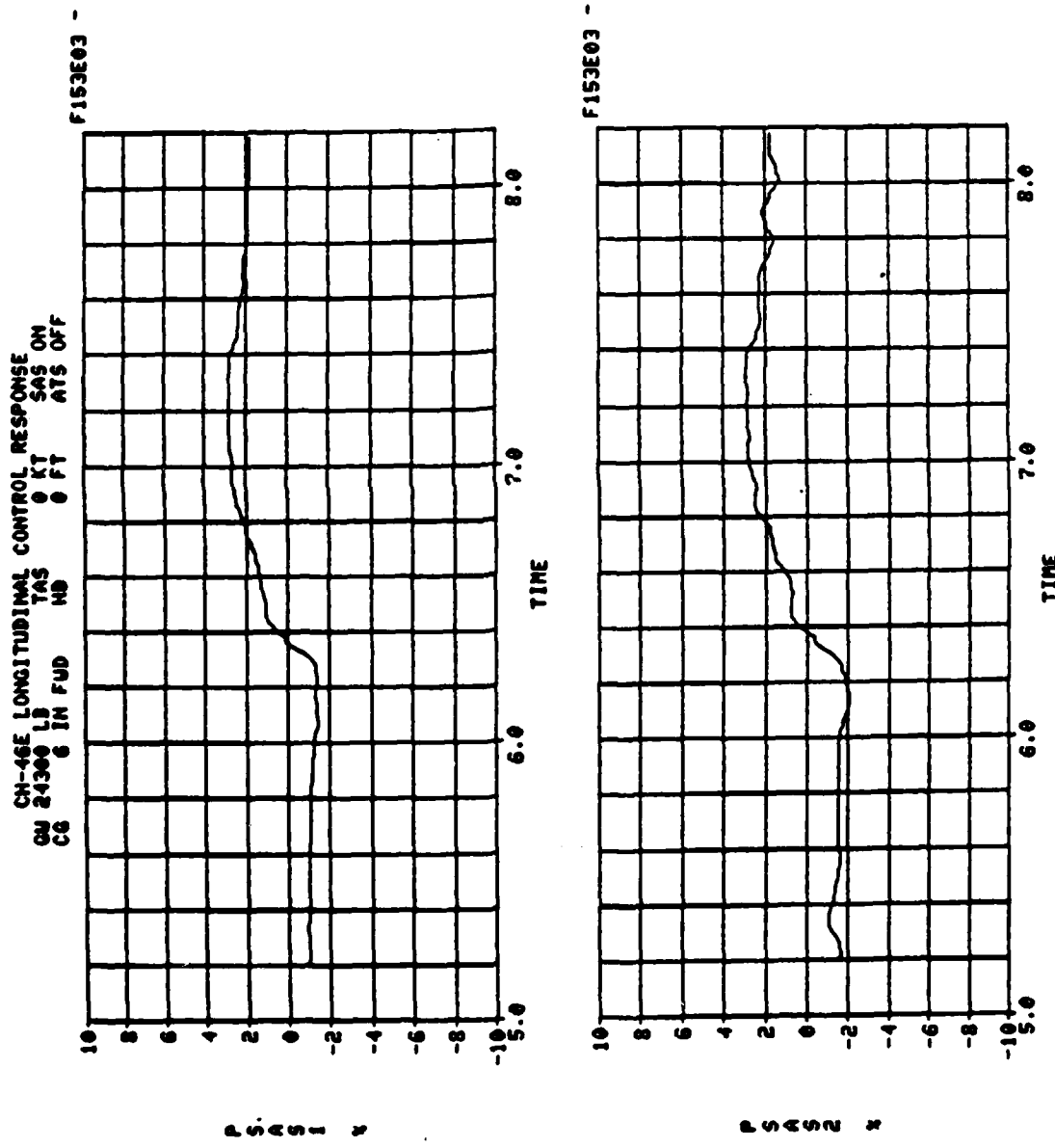


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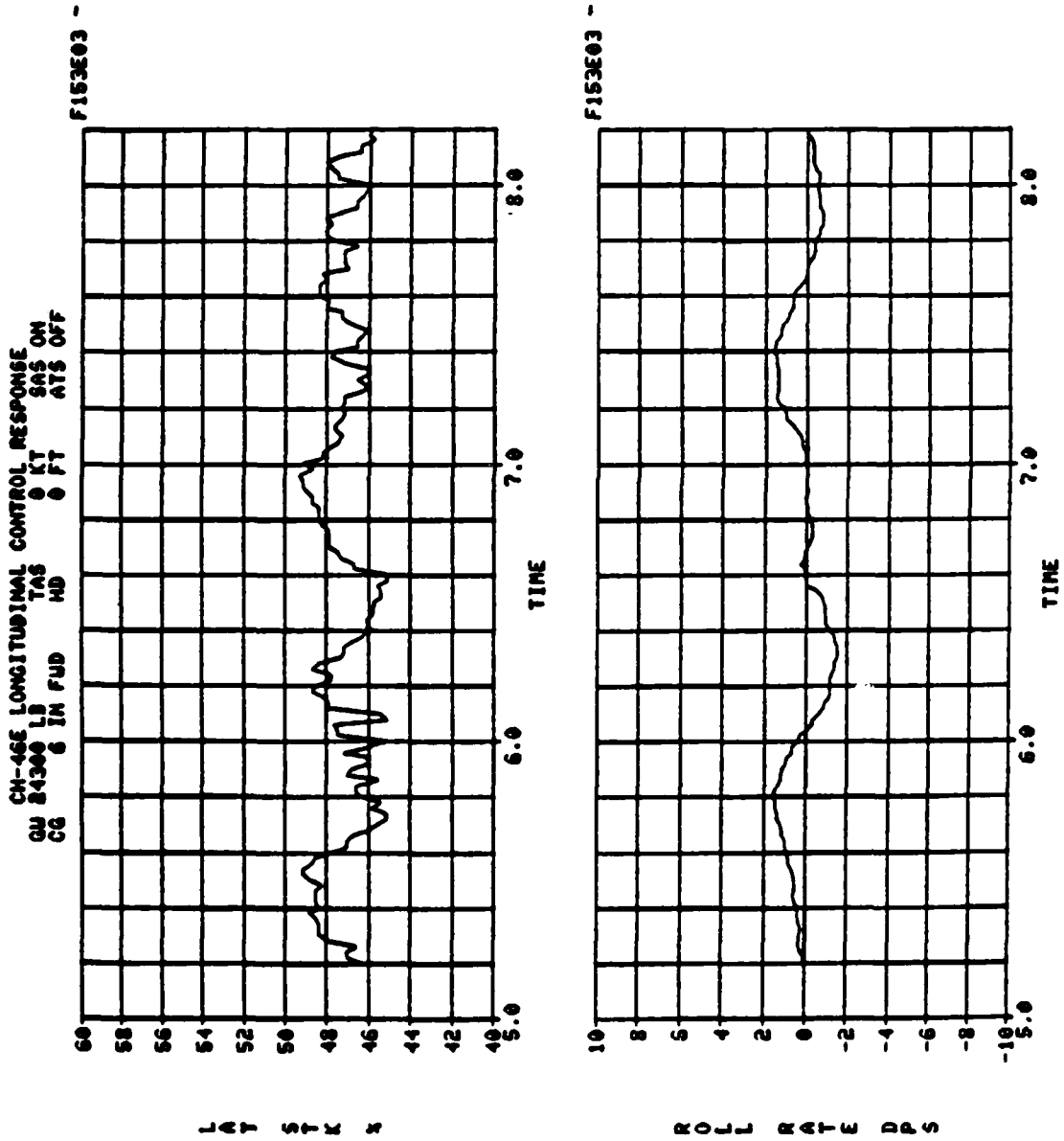


FIGURE 6E

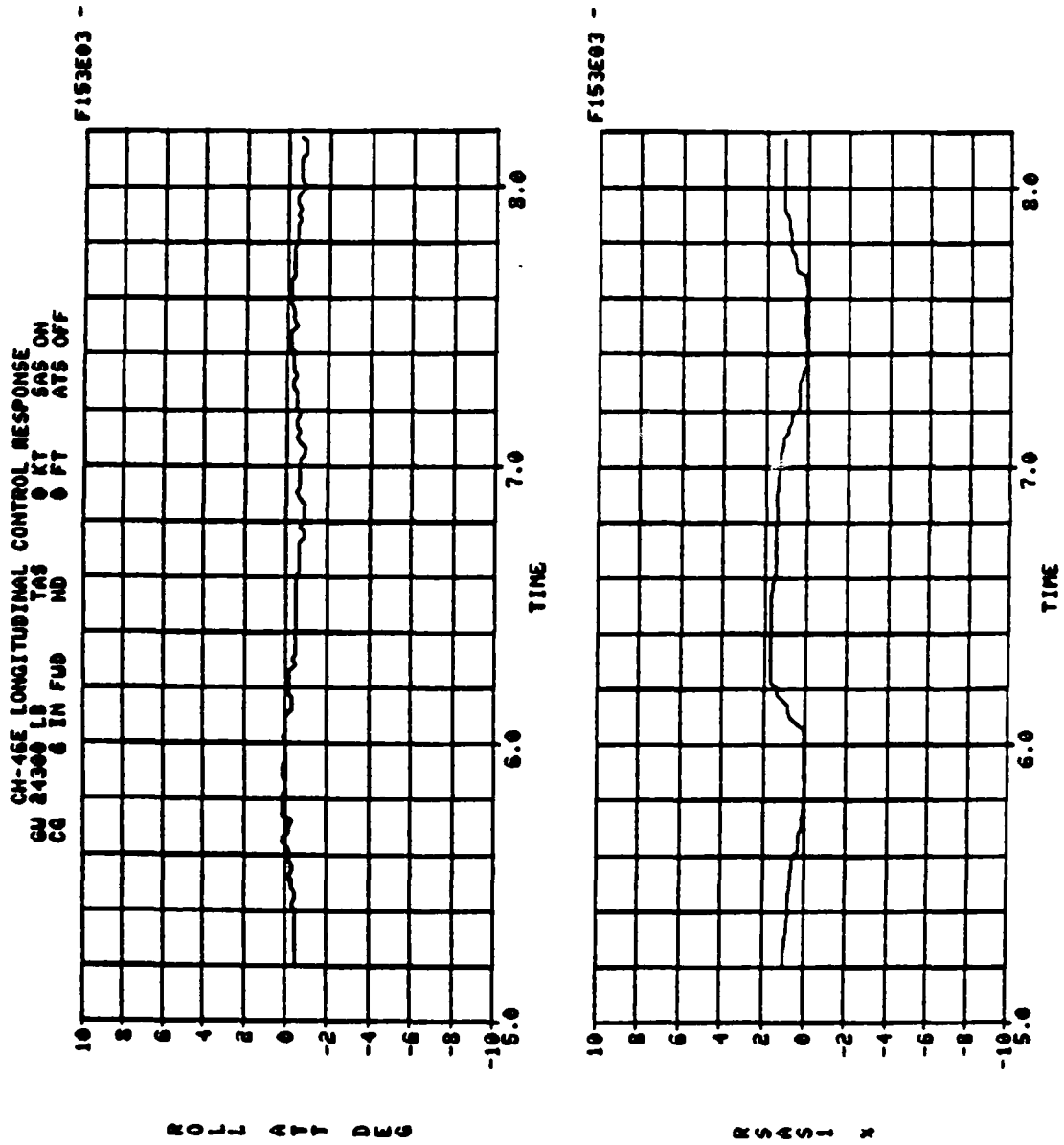


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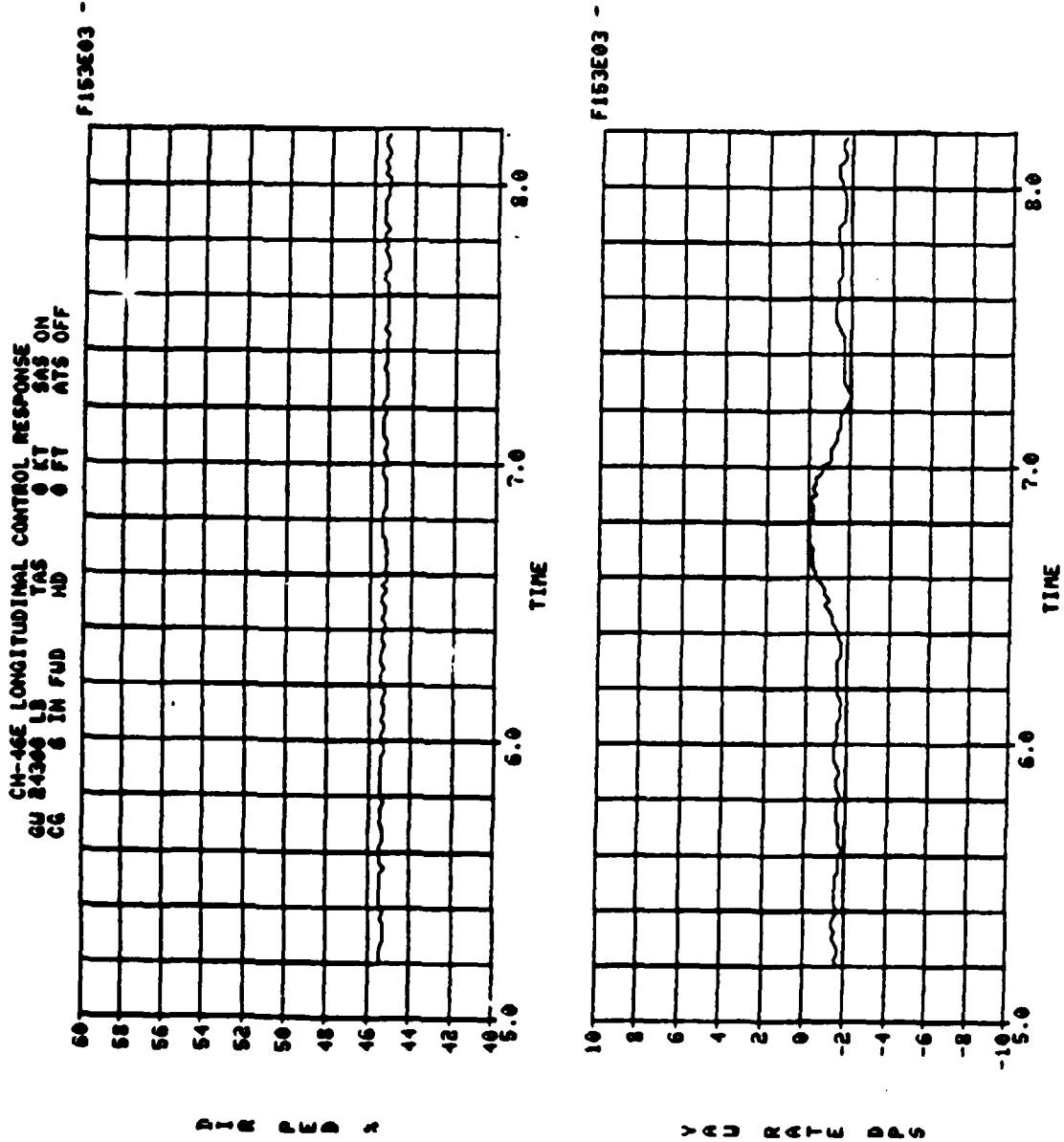


FIGURE 6G

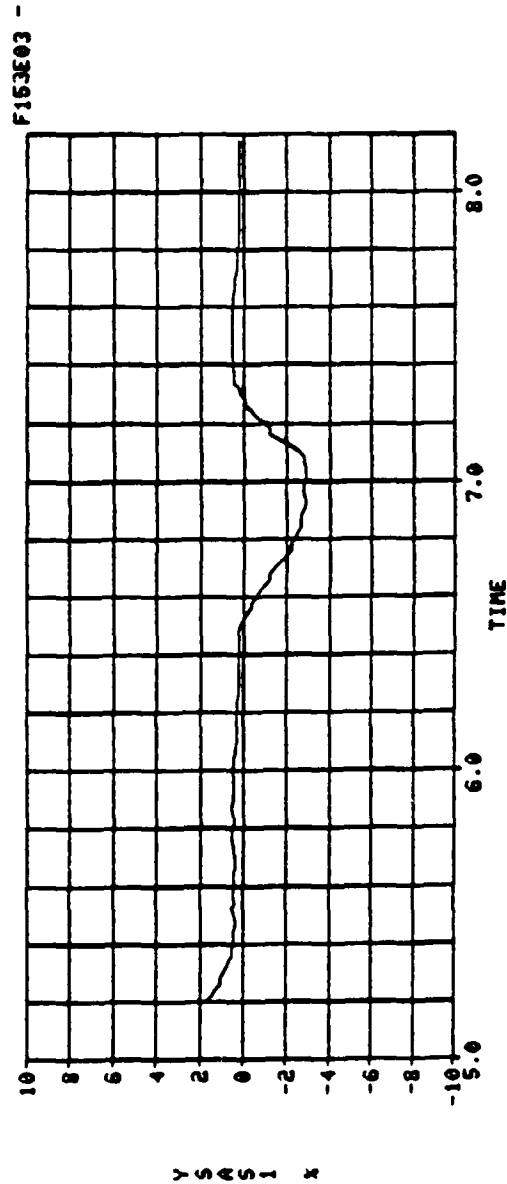
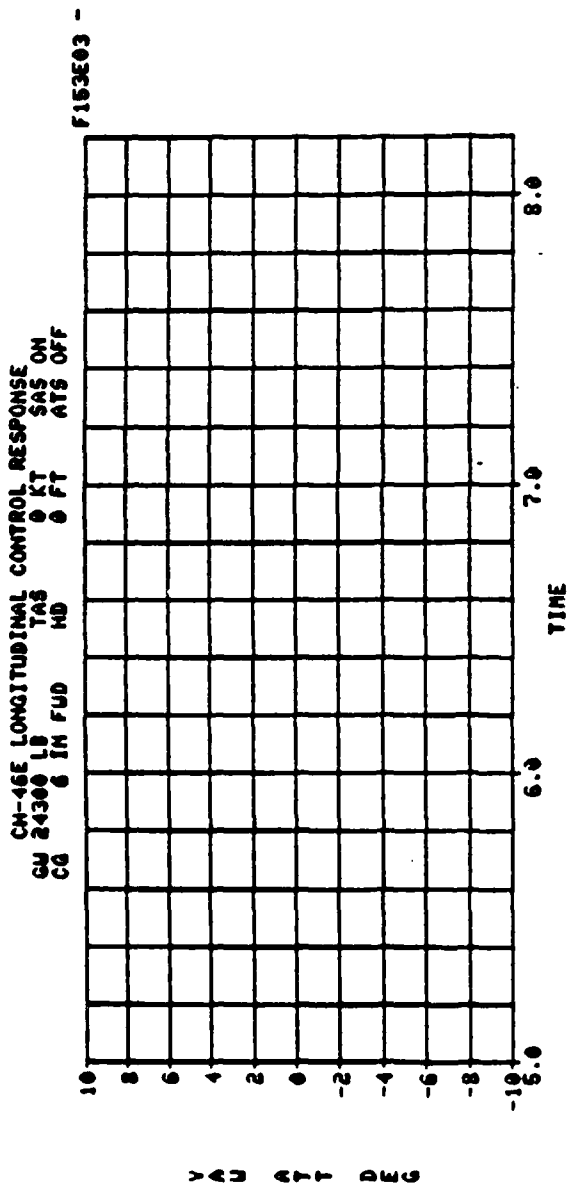


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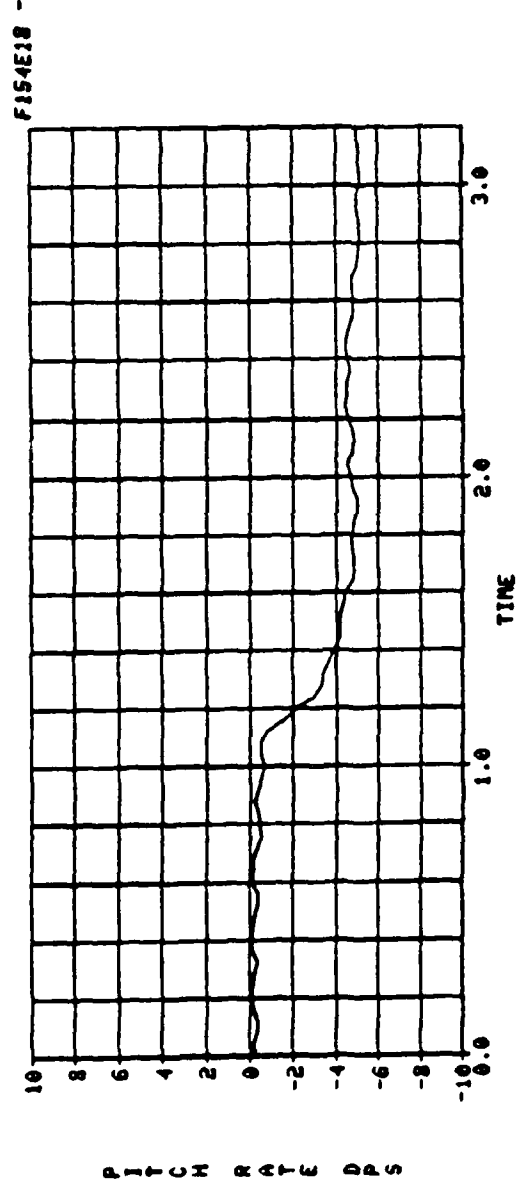
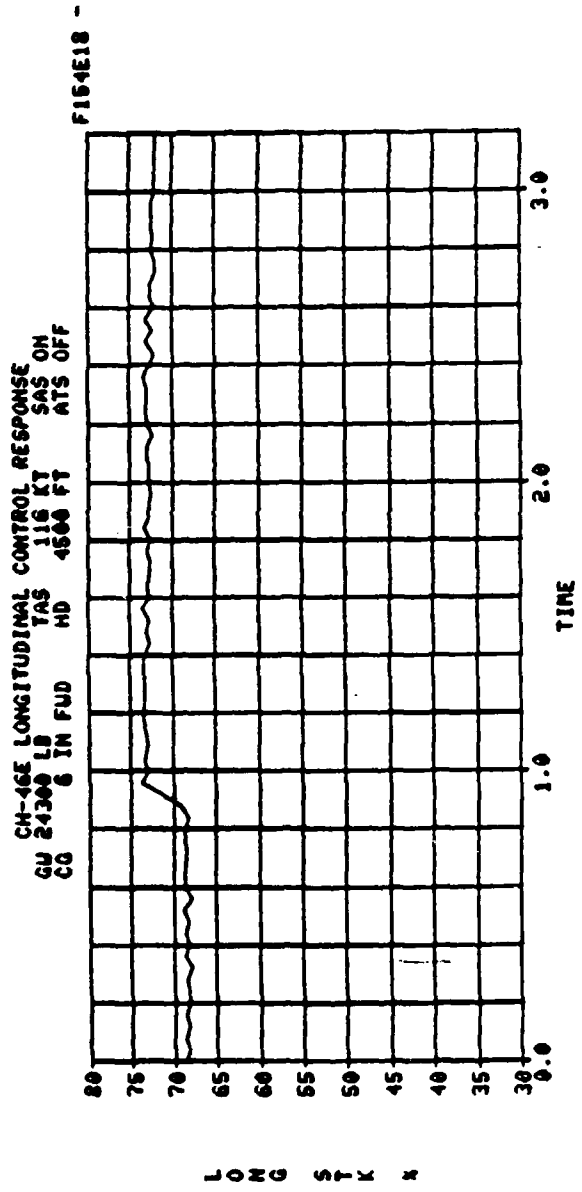


FIGURE 7A

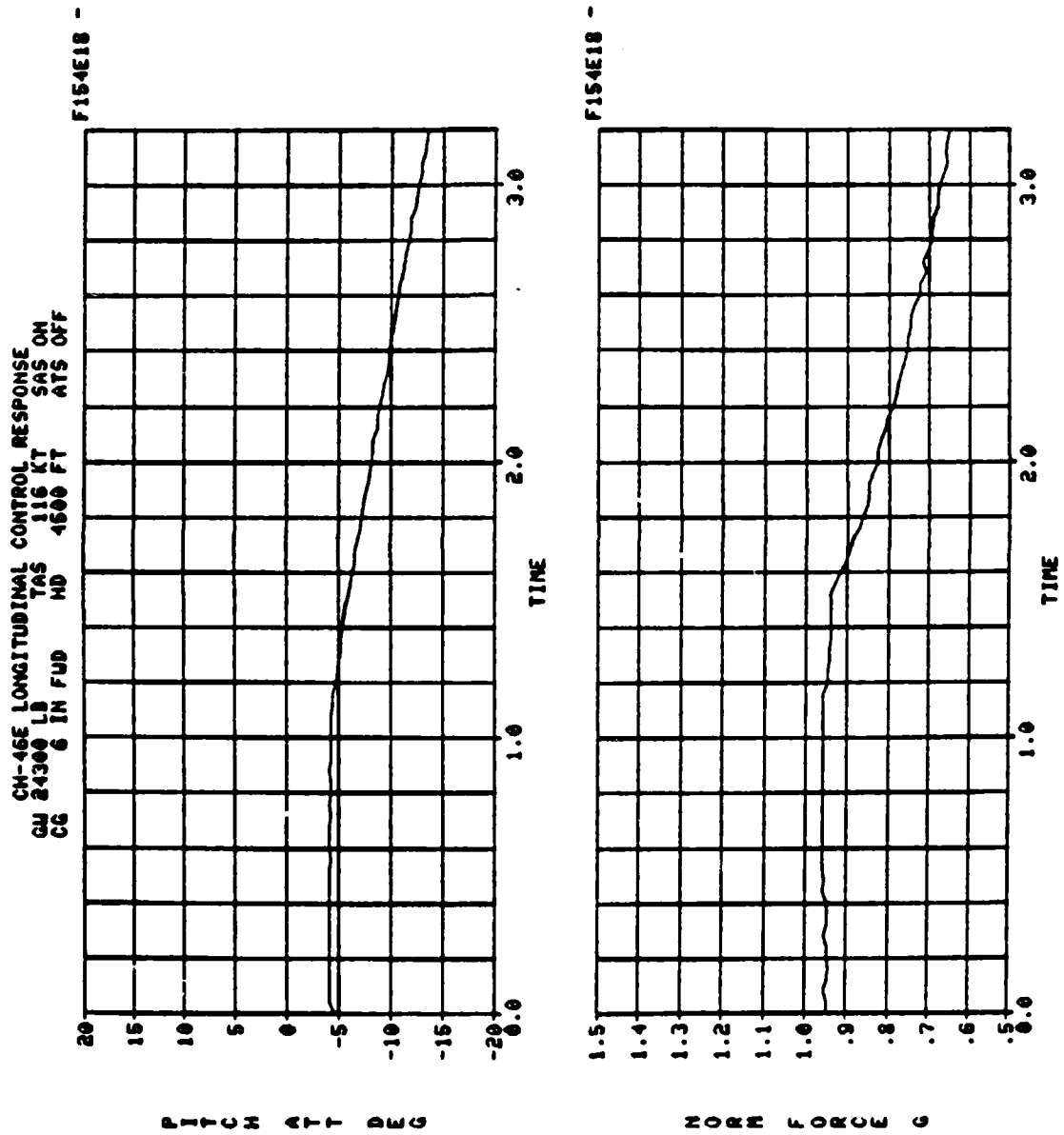


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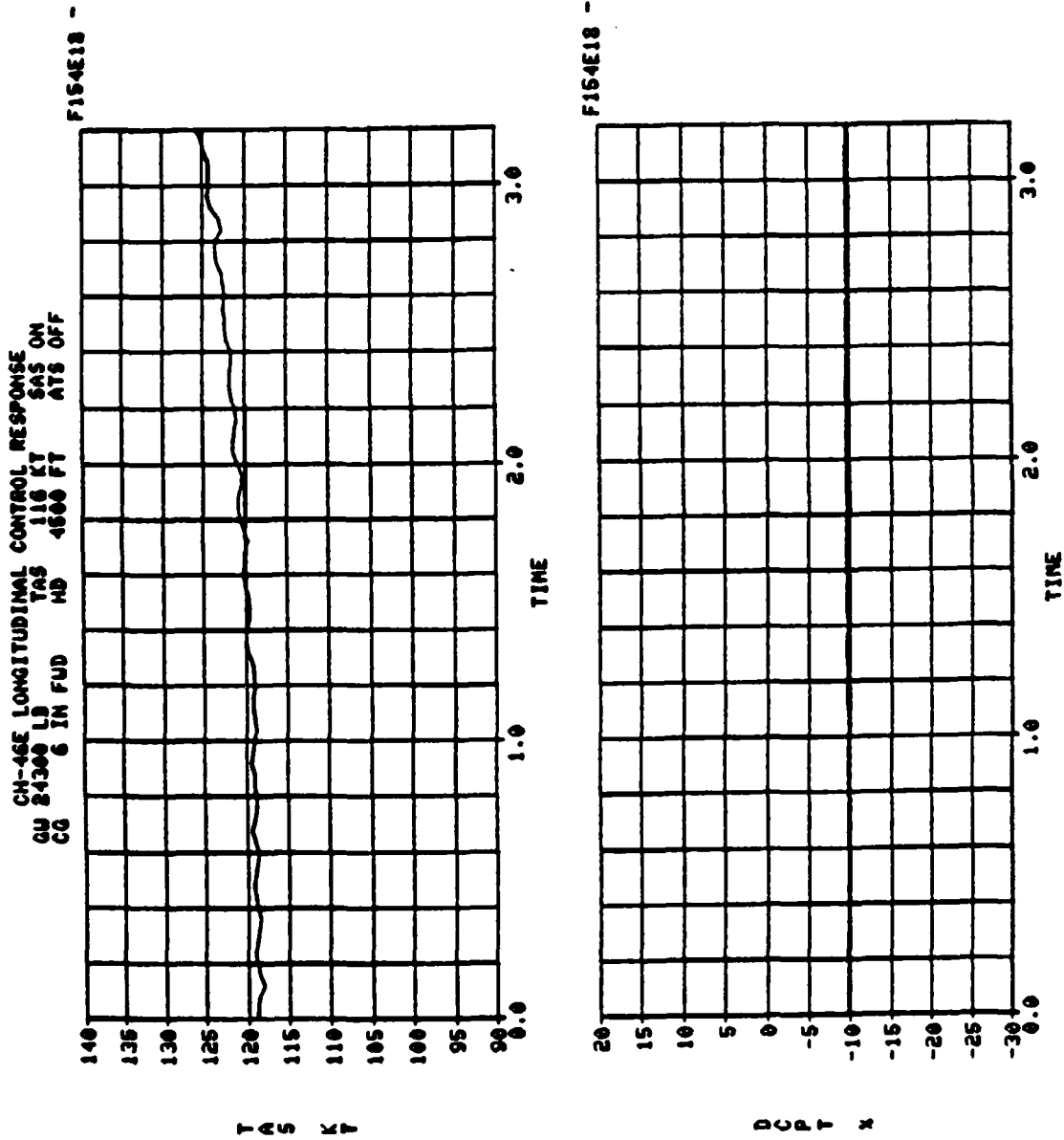


FIGURE 7C

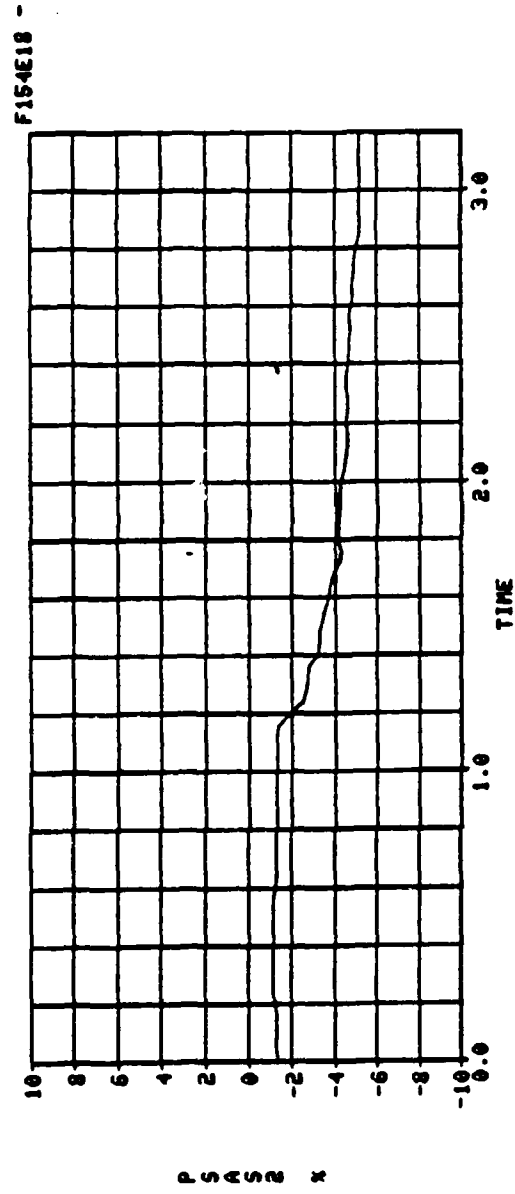
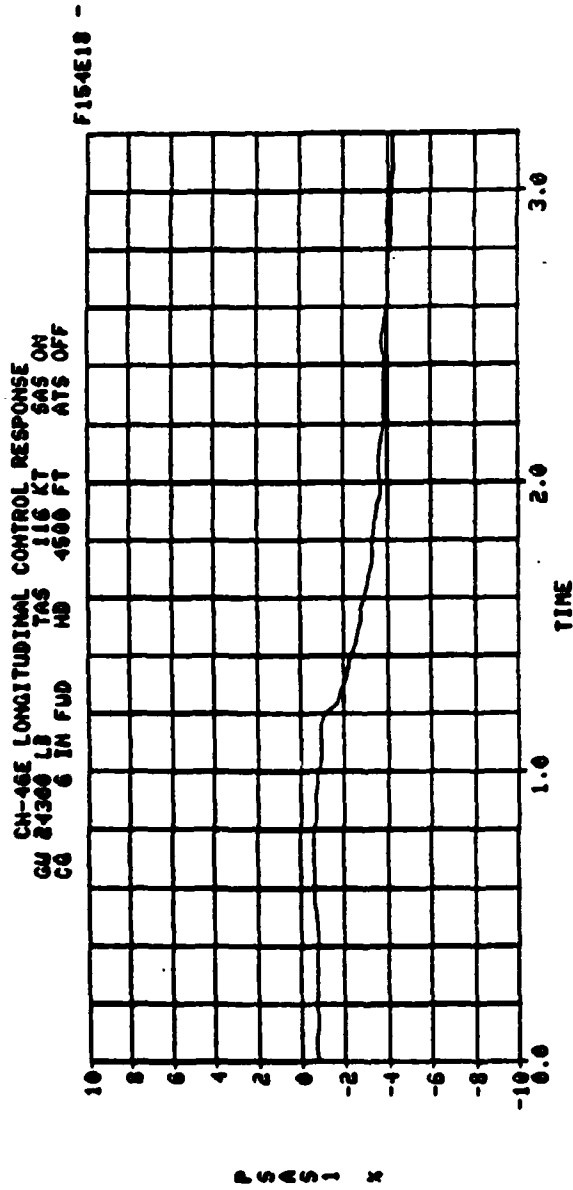


FIGURE 7D

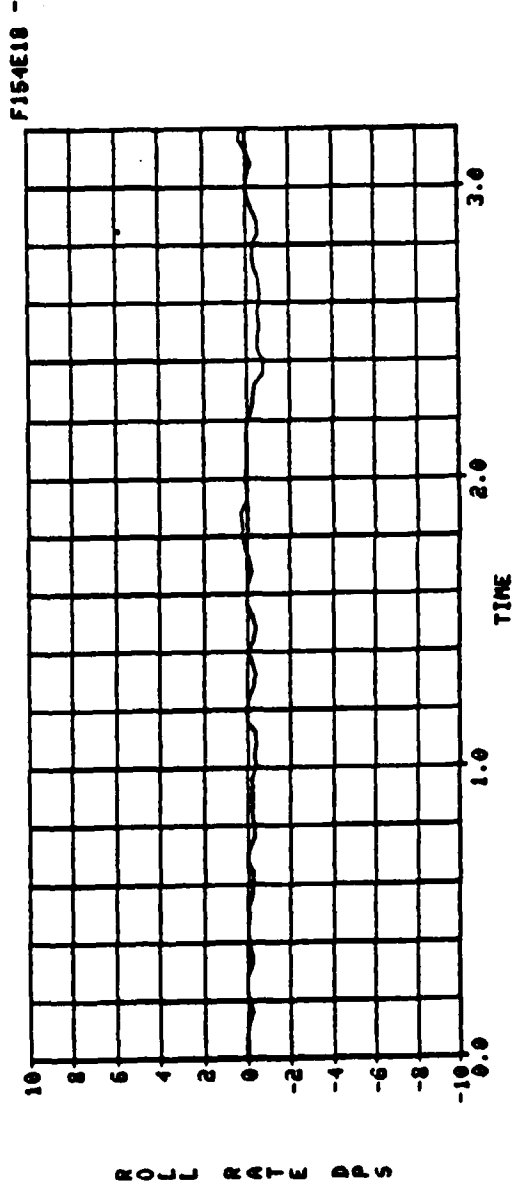
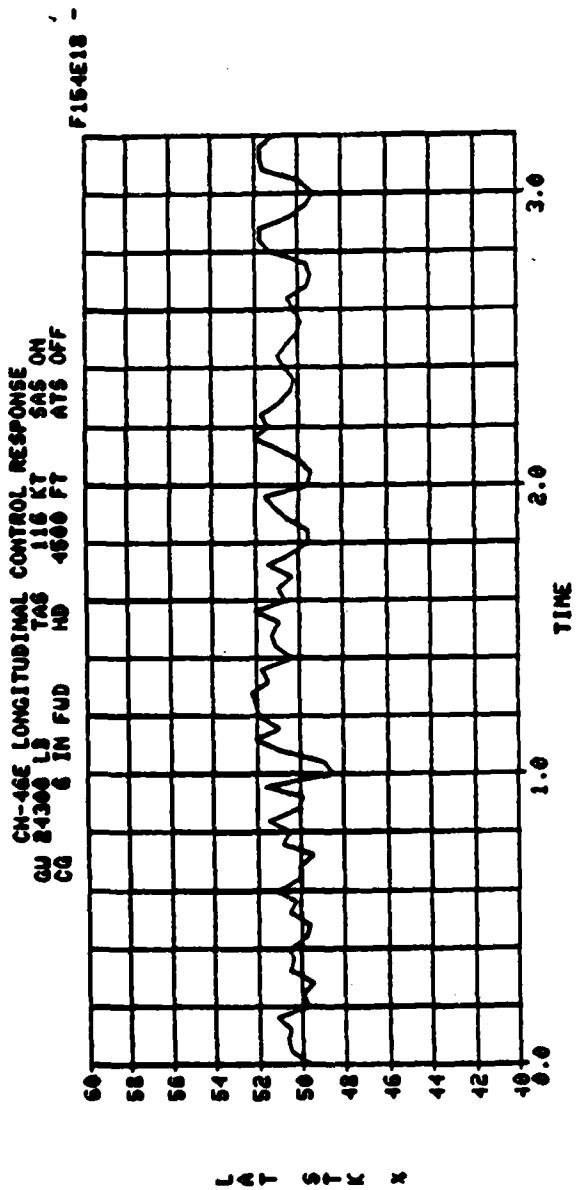


FIGURE 7E

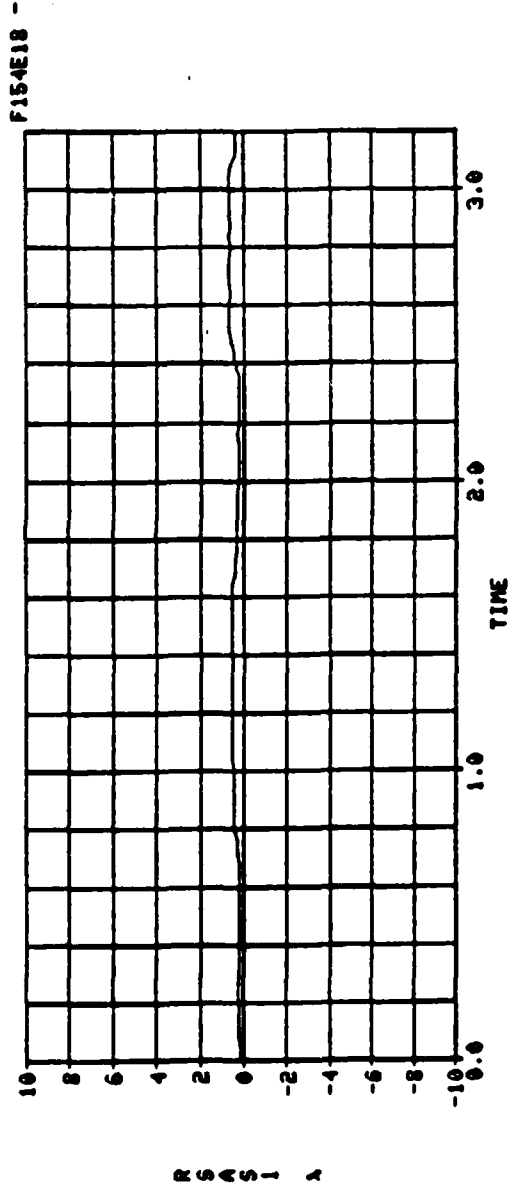
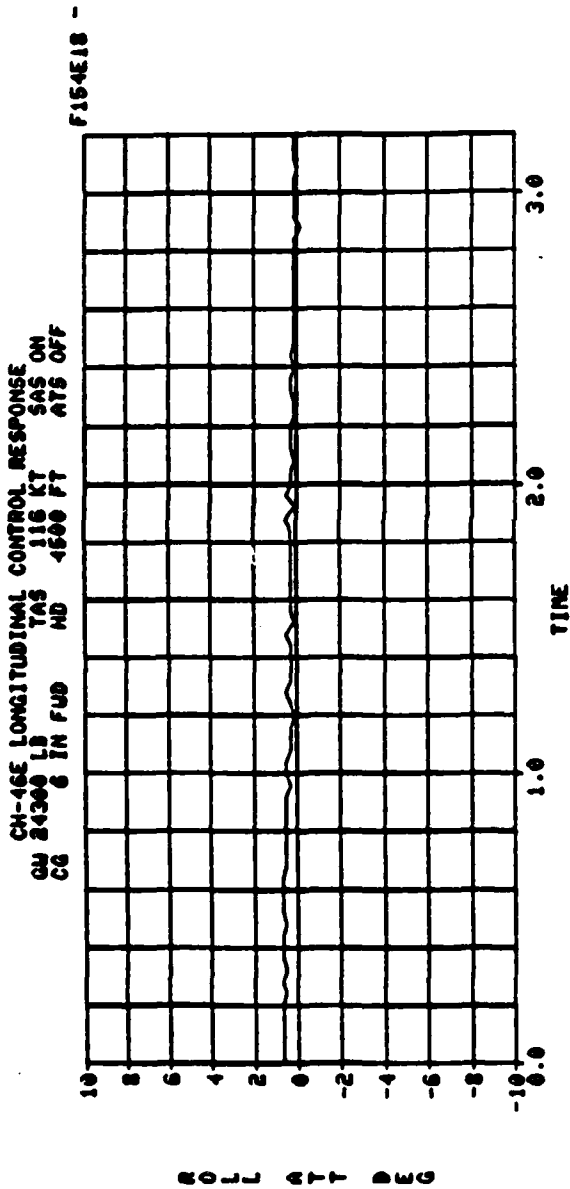


FIGURE 7F

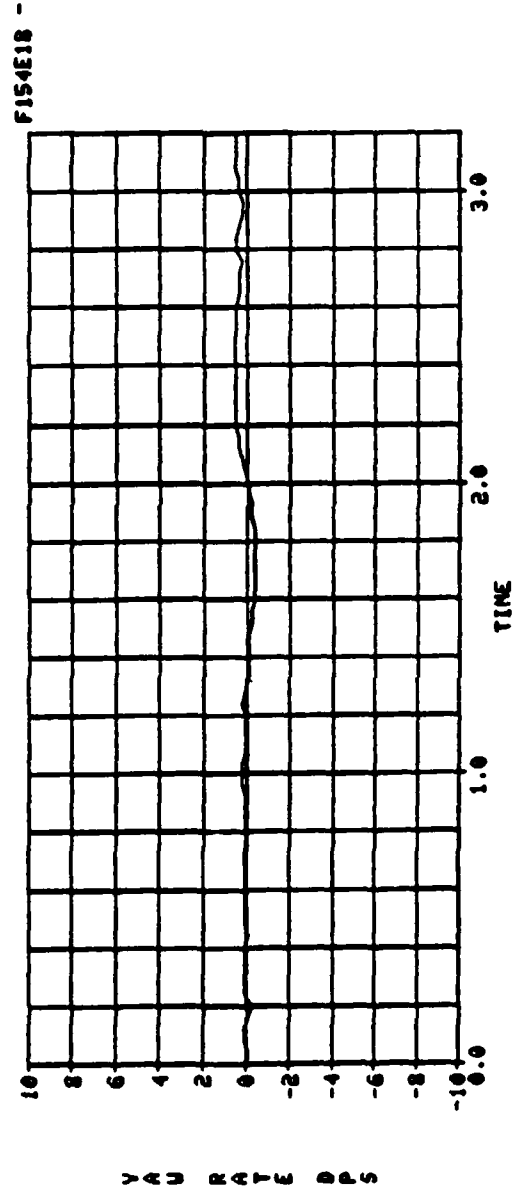
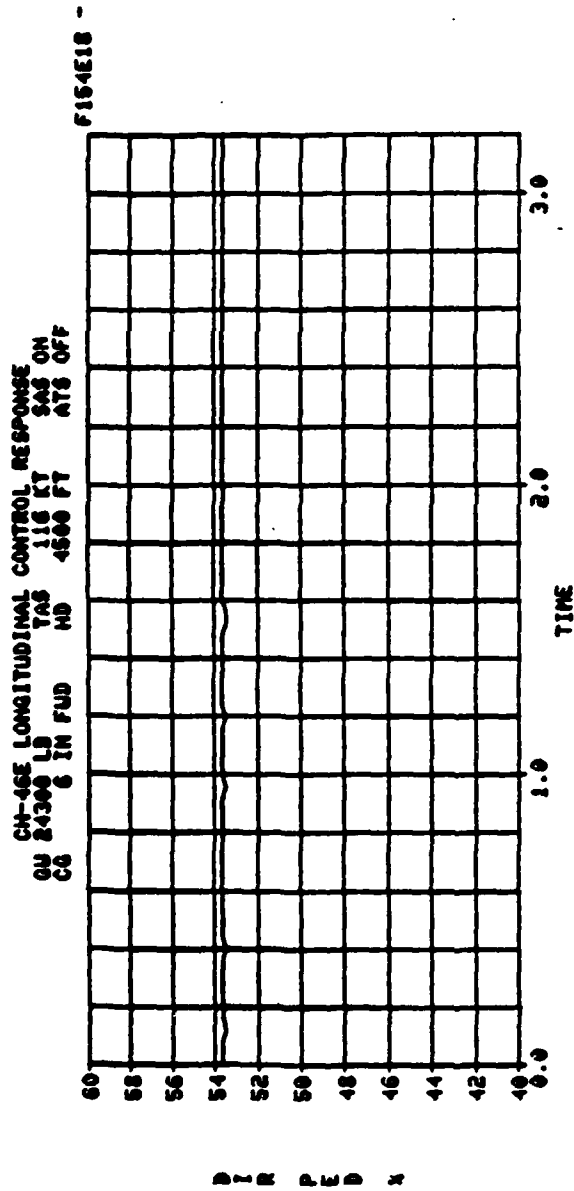


FIGURE 7G

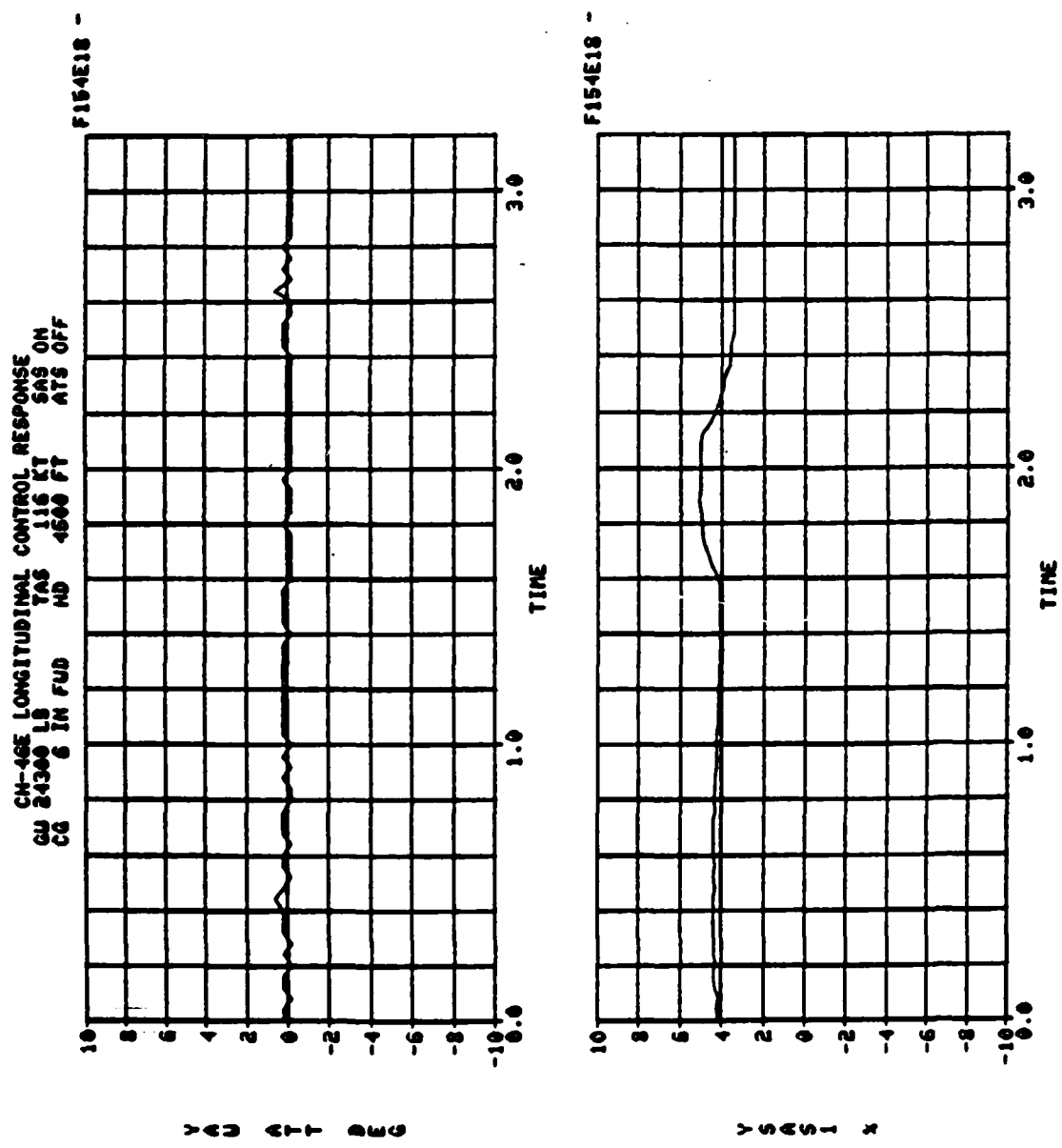


FIGURE 7H

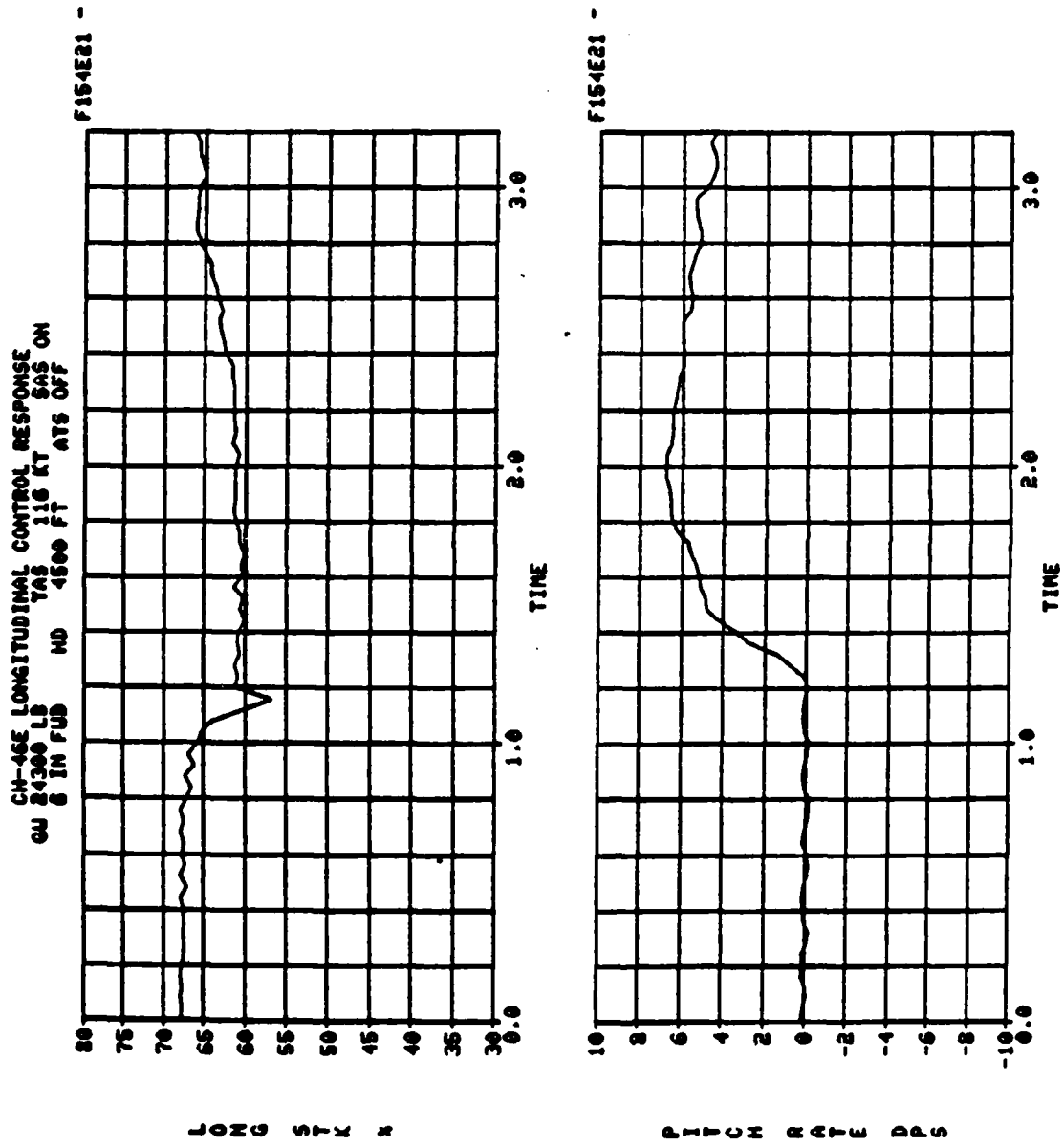


FIGURE 8A

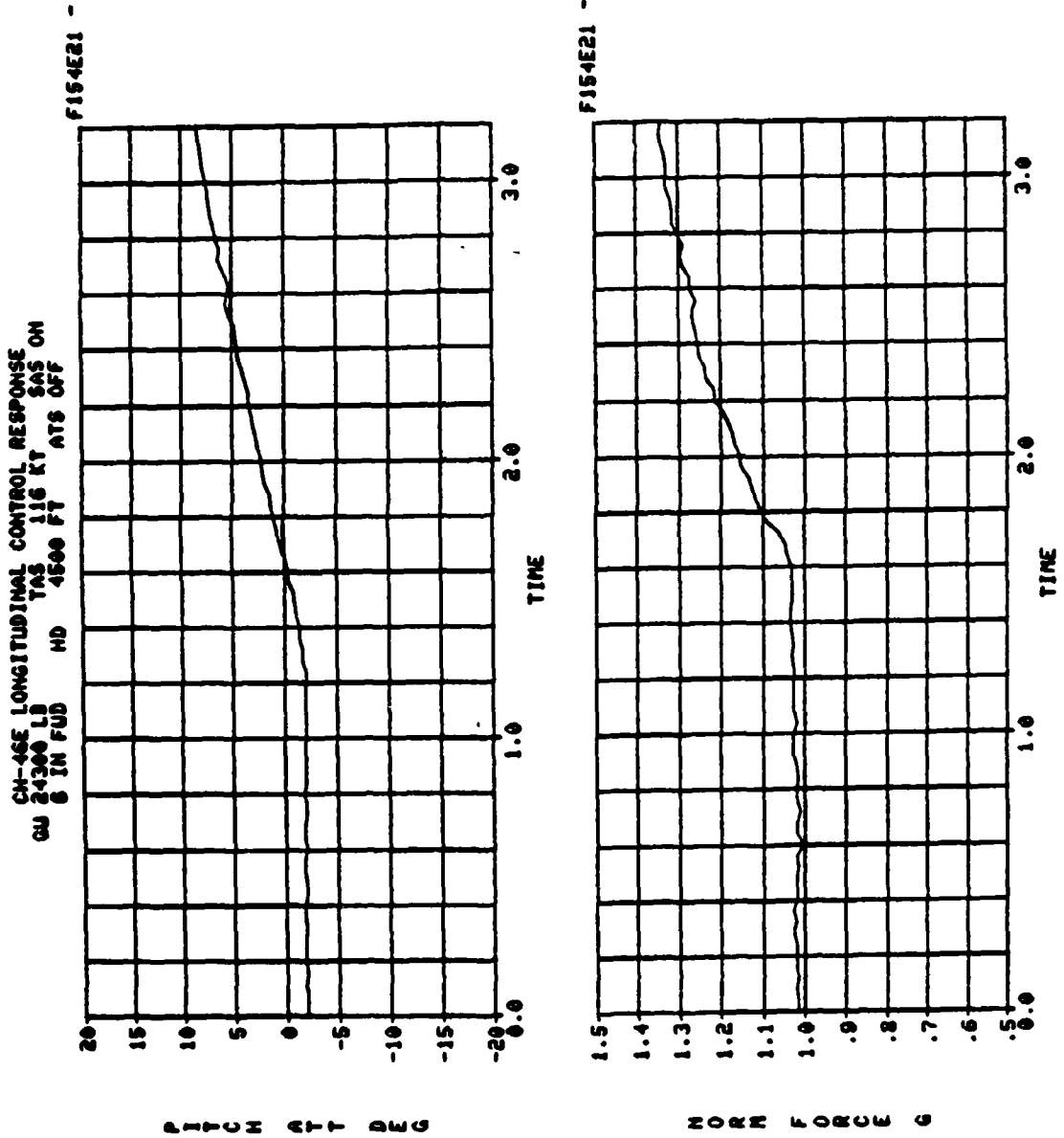


FIGURE 8B

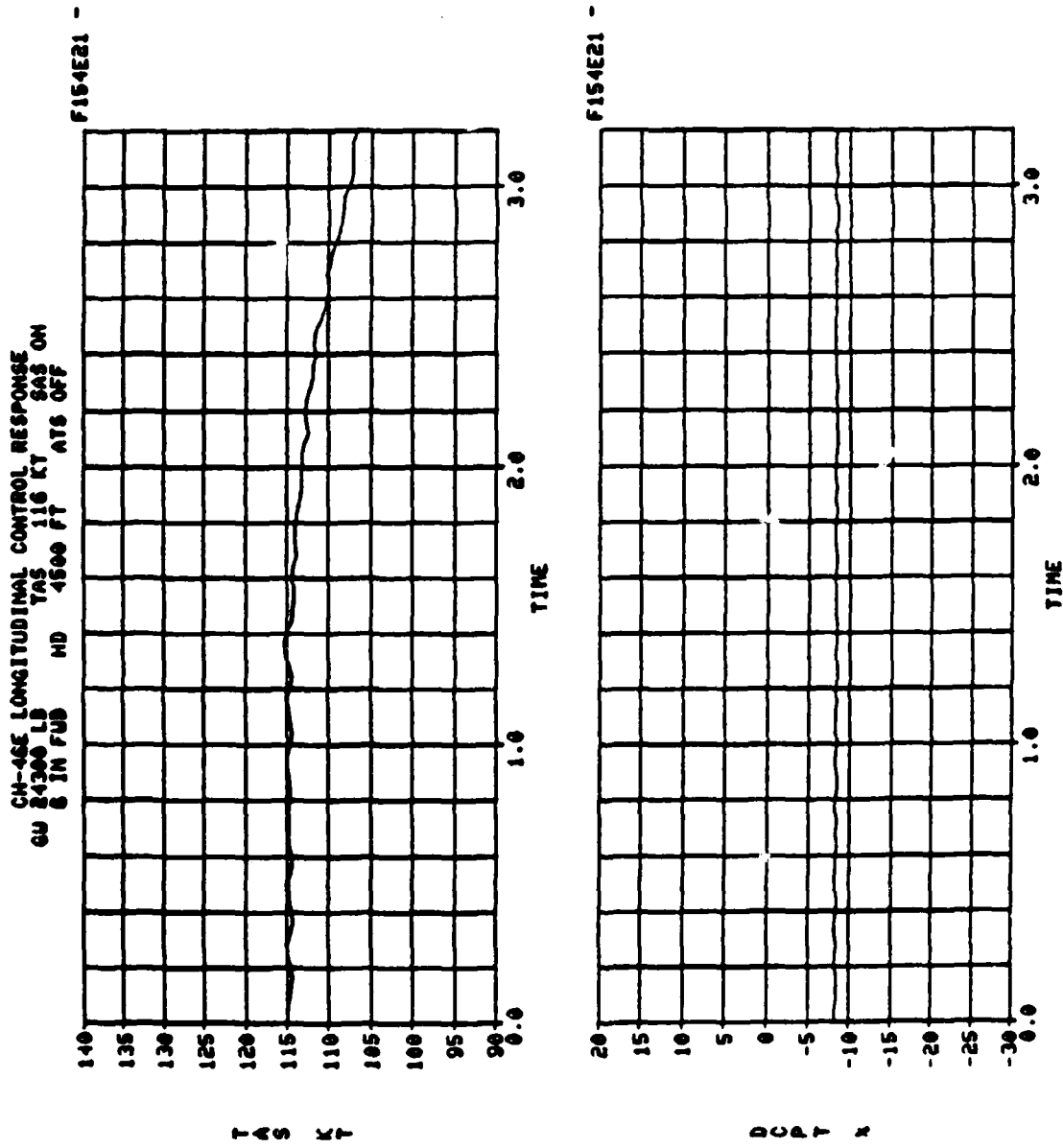


FIGURE 8C

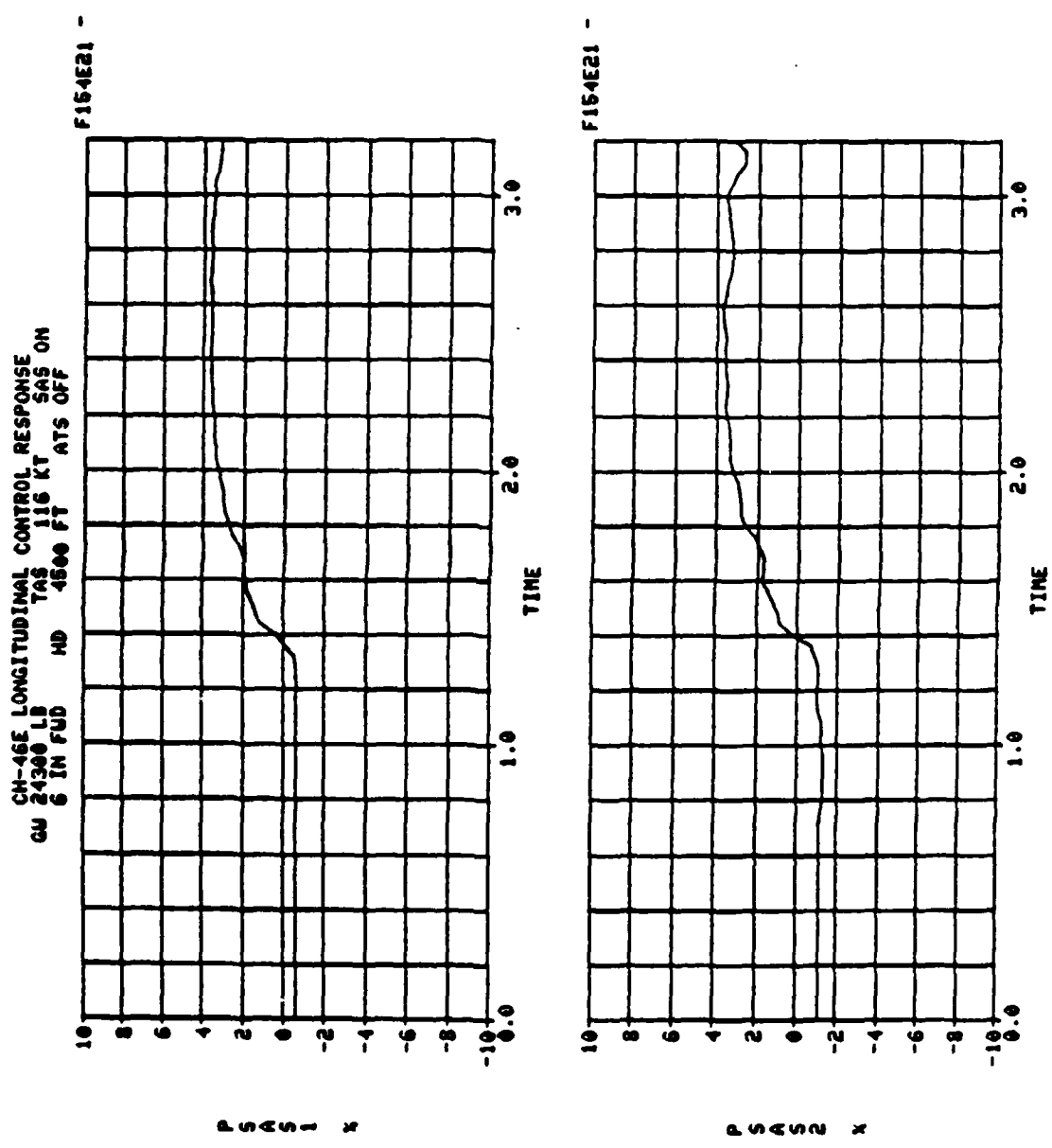


FIGURE 8D

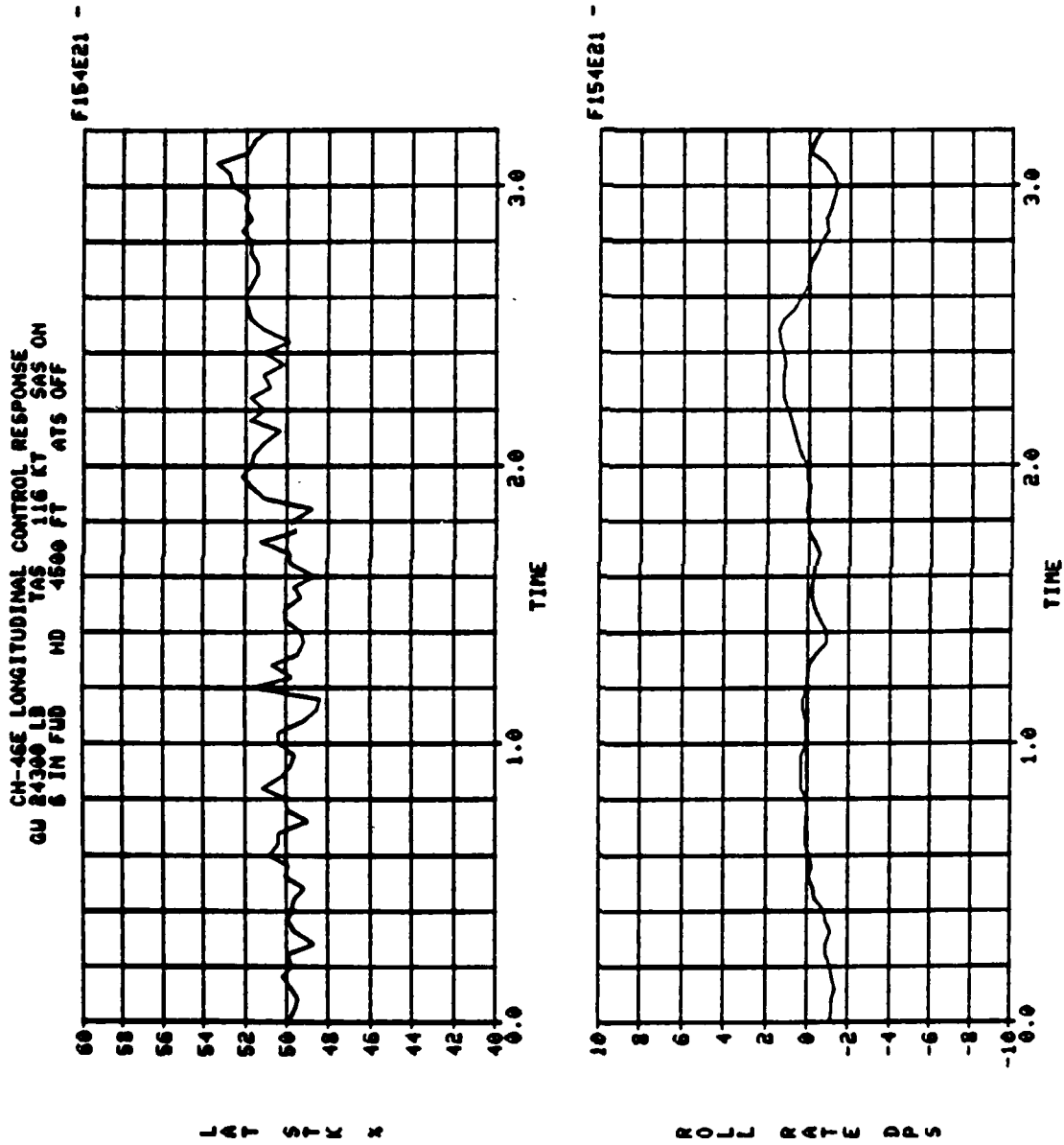


FIGURE 3E

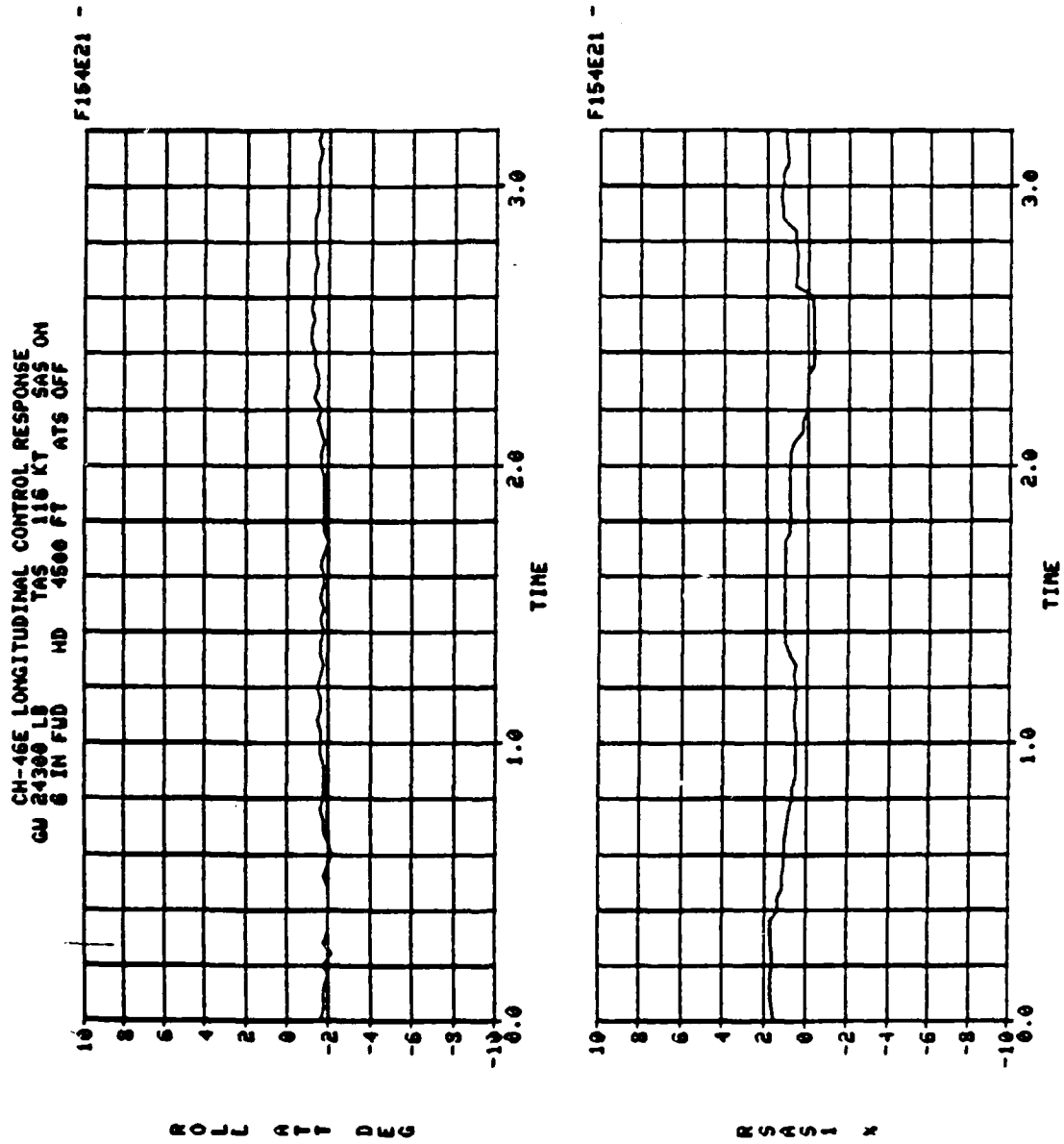


FIGURE 8F

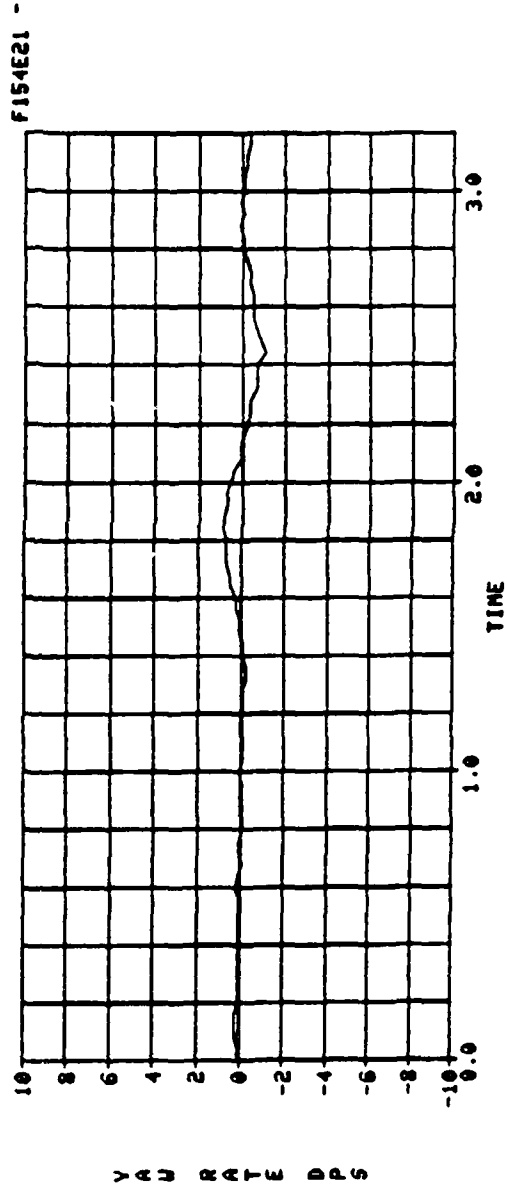
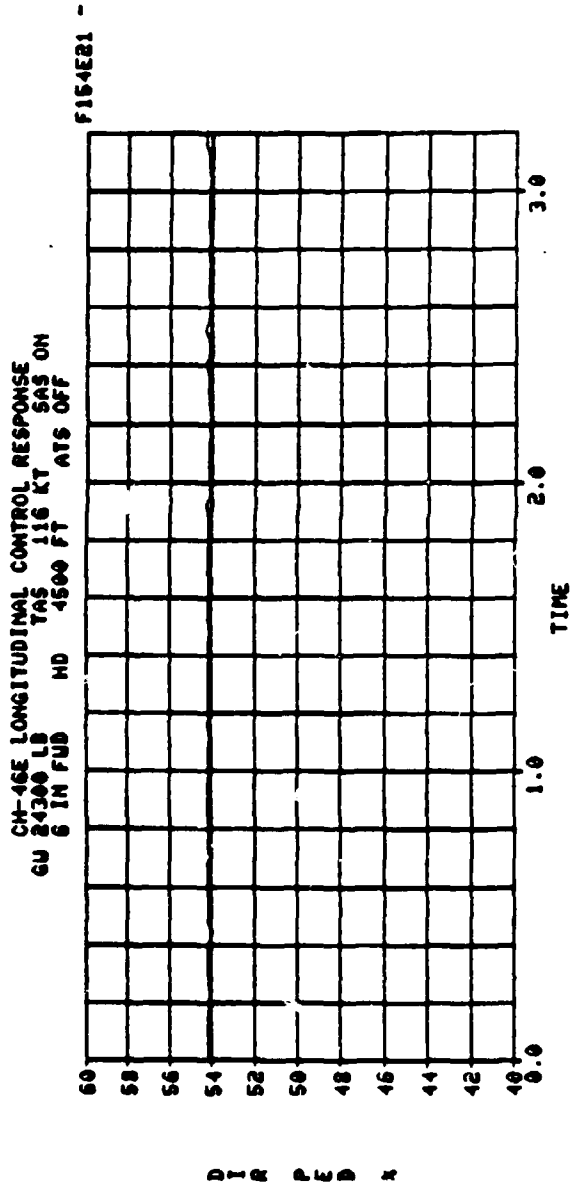


FIGURE 8G

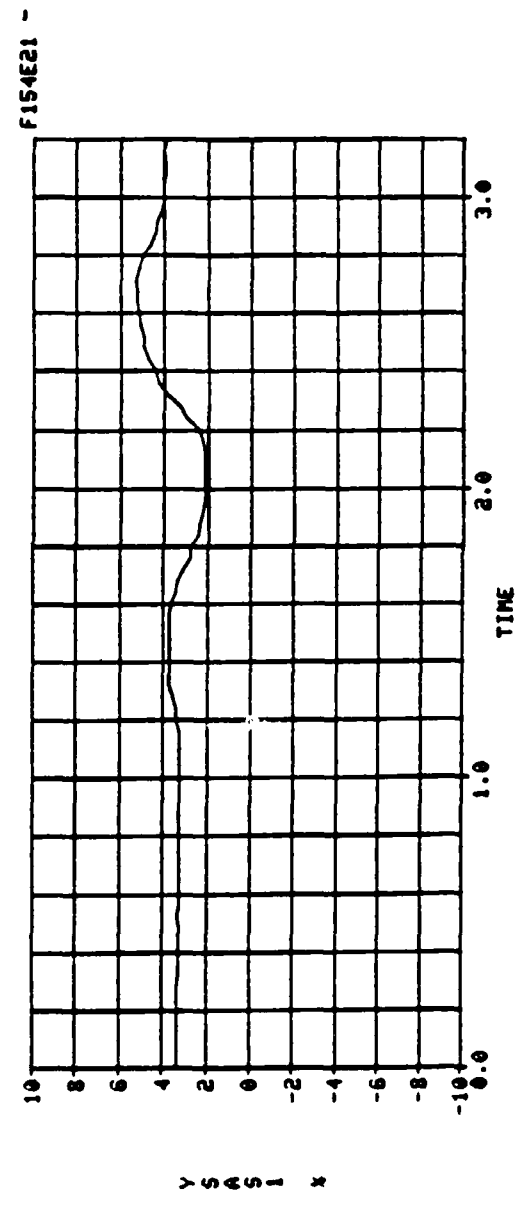
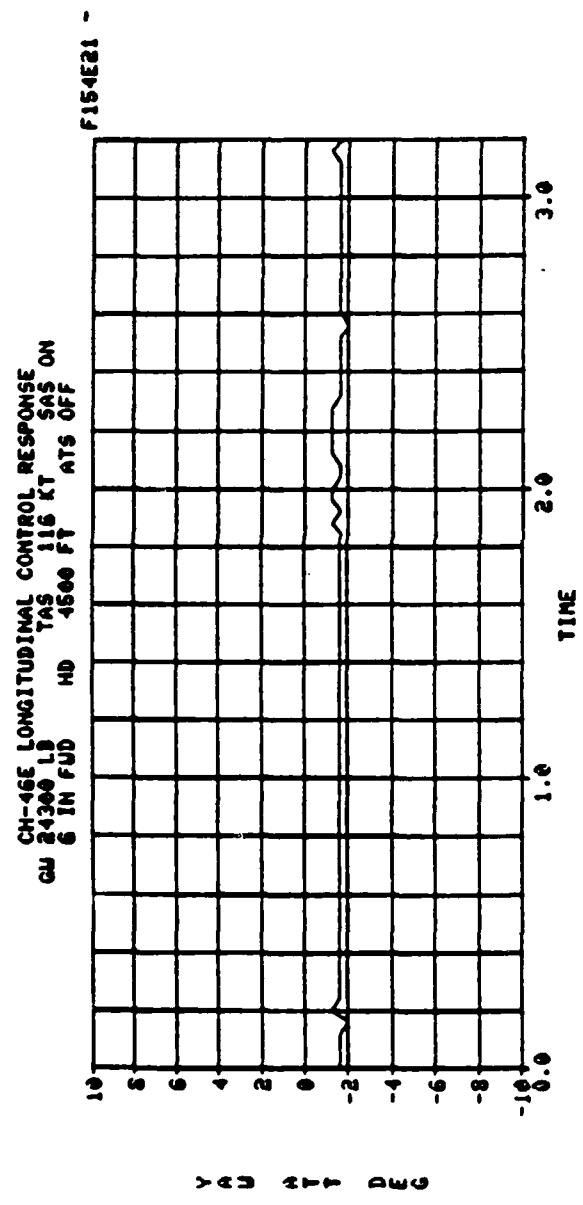


FIGURE 8H

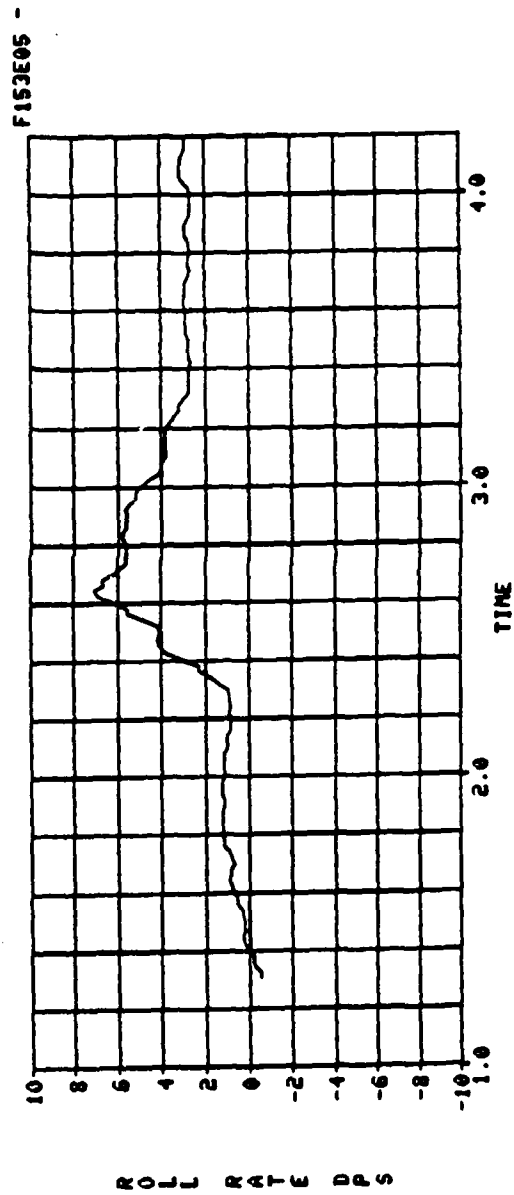
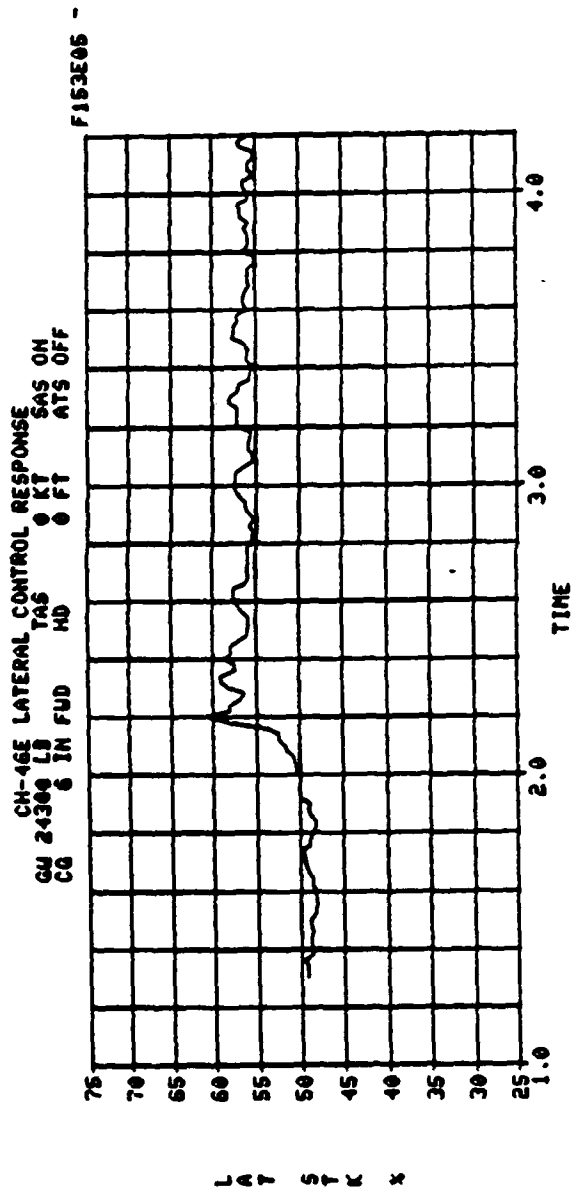


FIGURE 9A

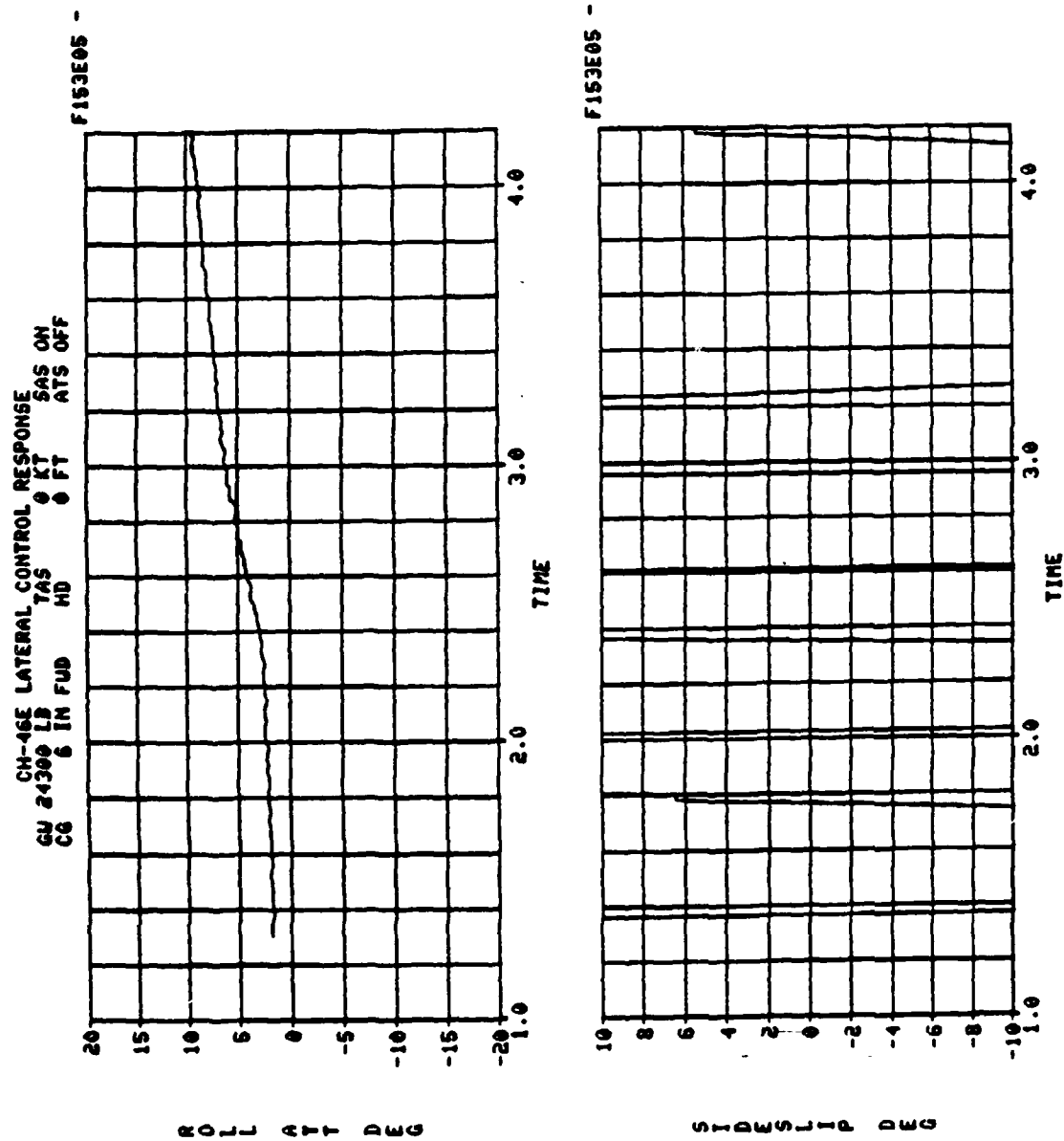


FIGURE 9B

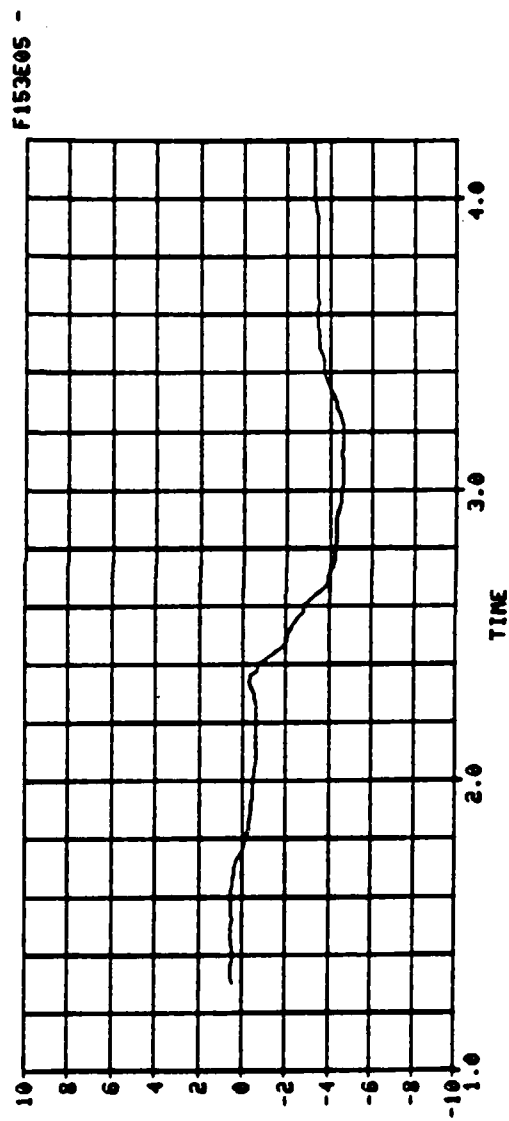
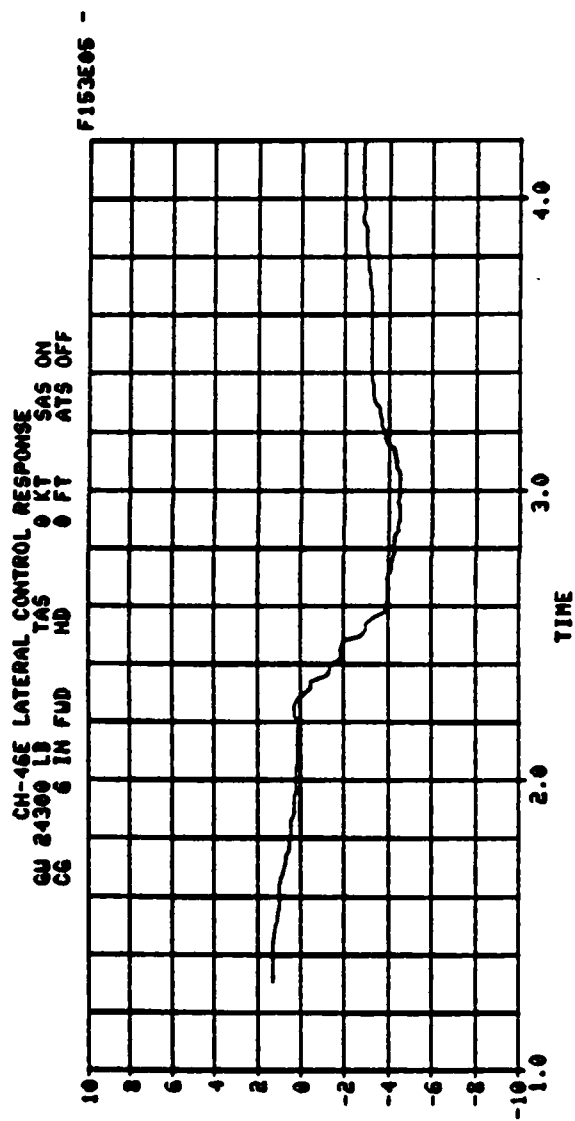


FIGURE 9C

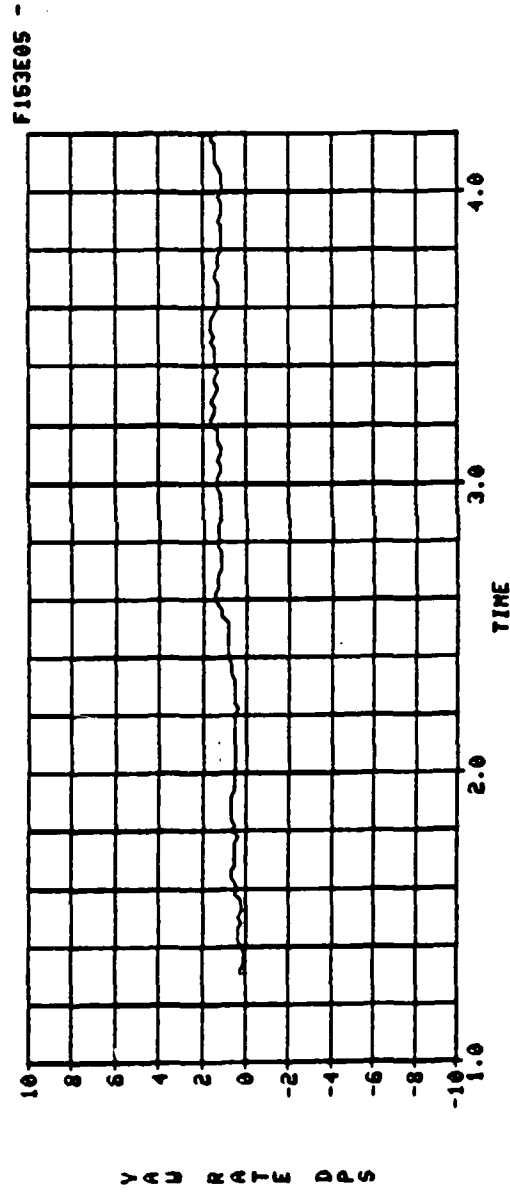
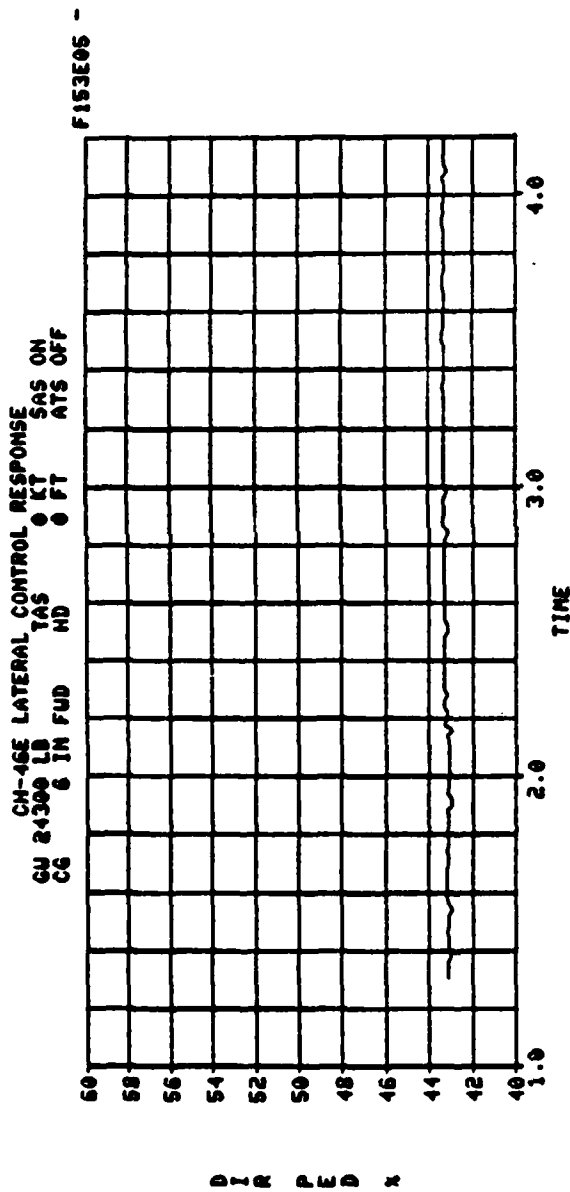


FIGURE 90

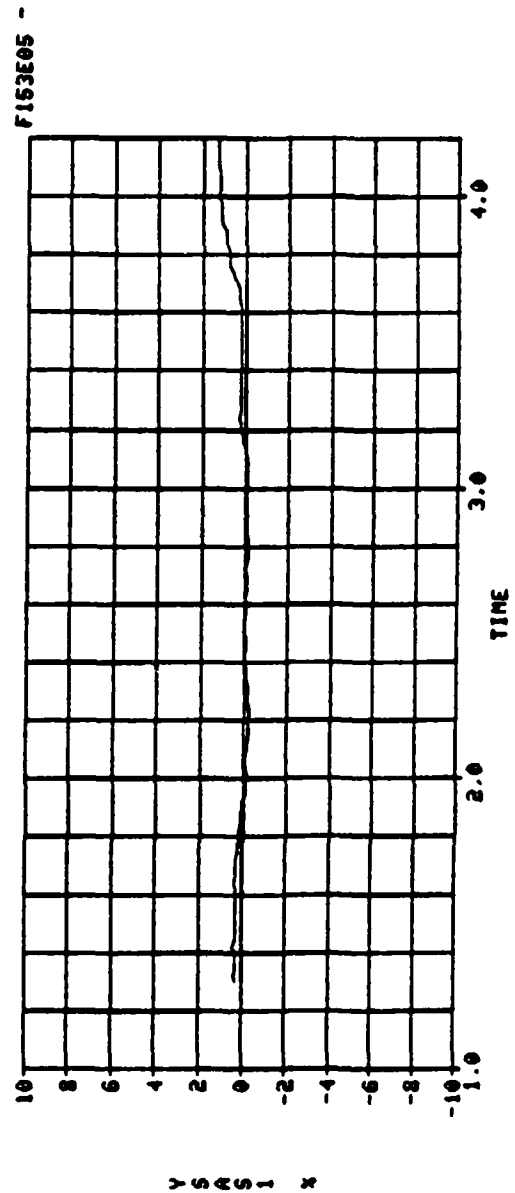
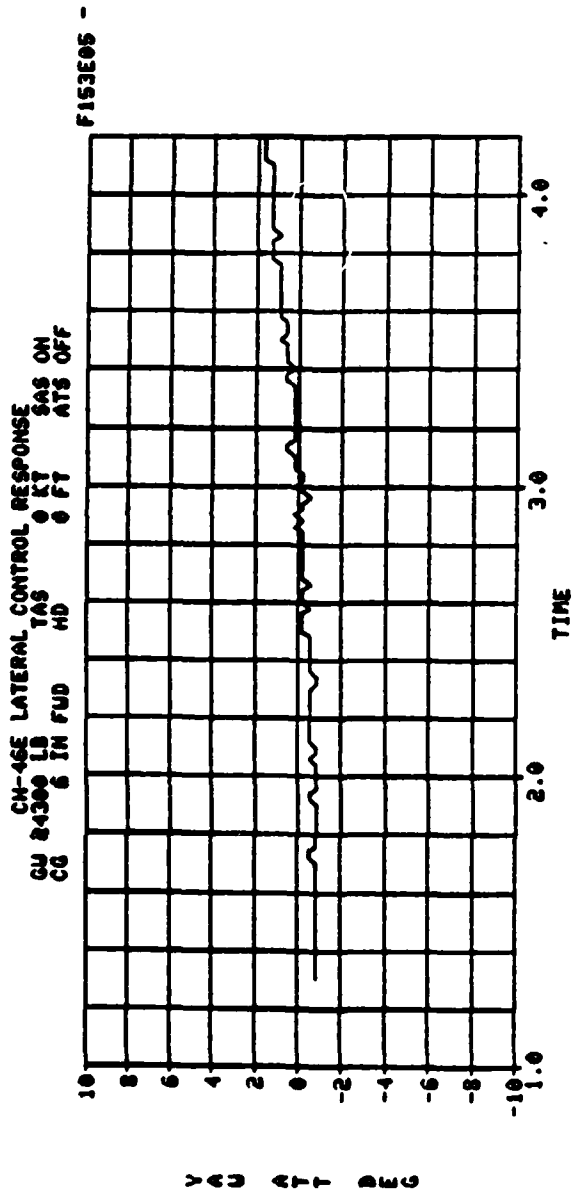


FIGURE 9E

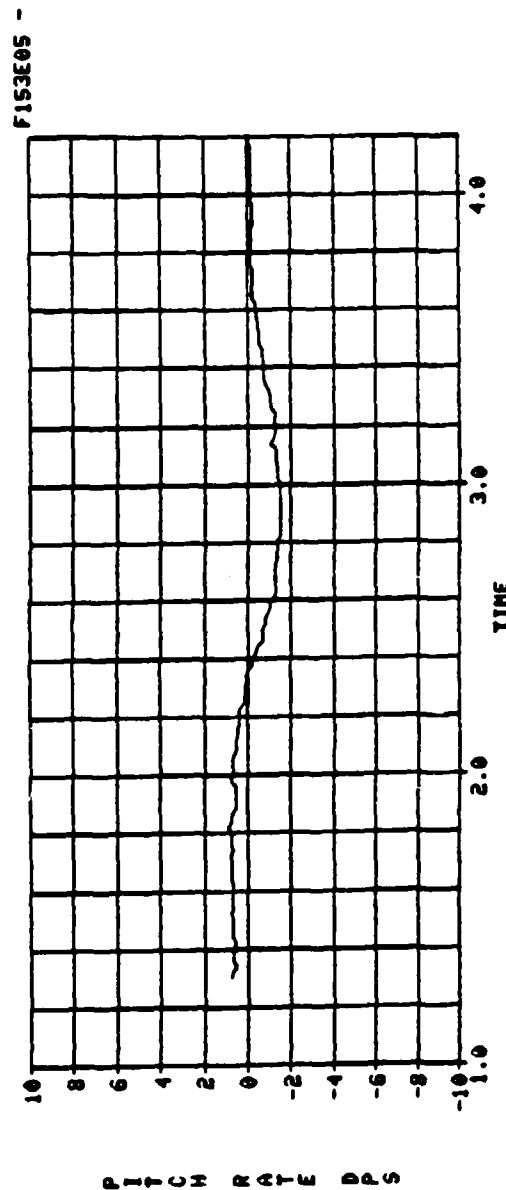
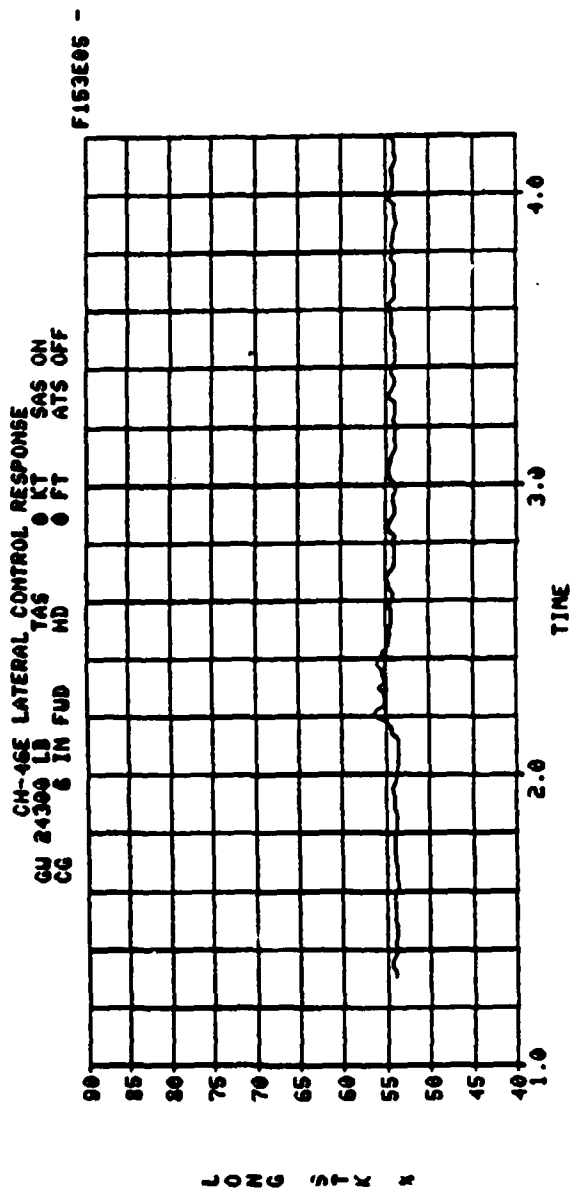


FIGURE 9F

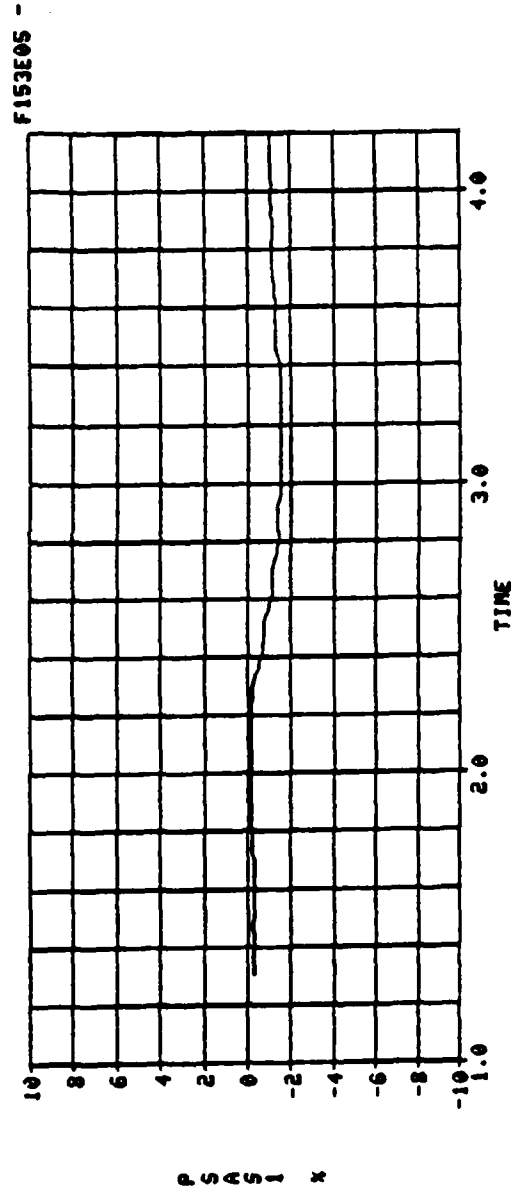
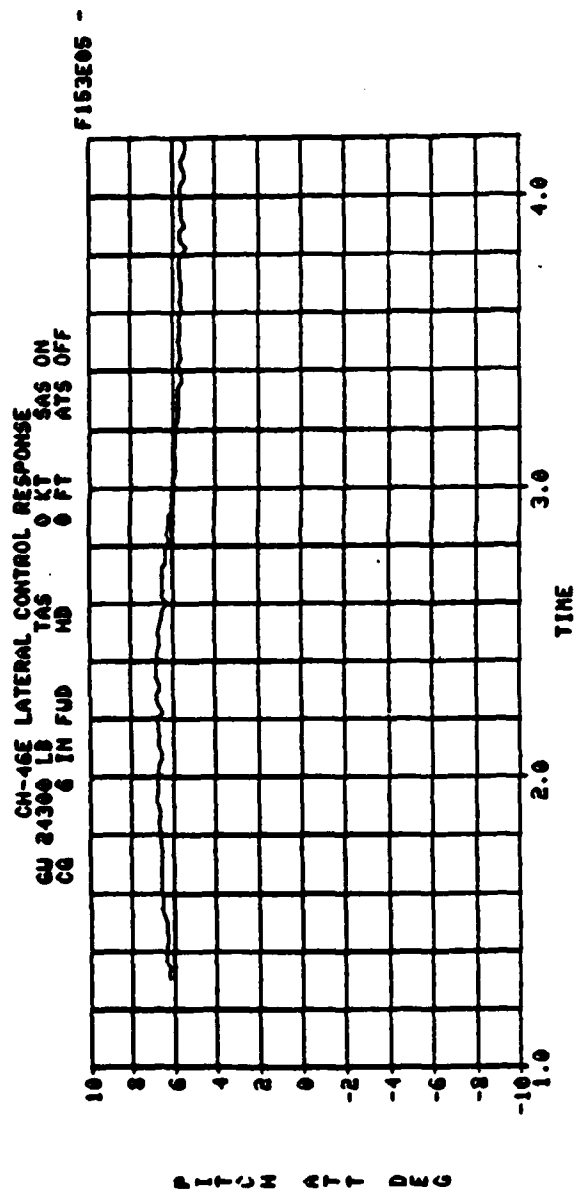


FIGURE 9G

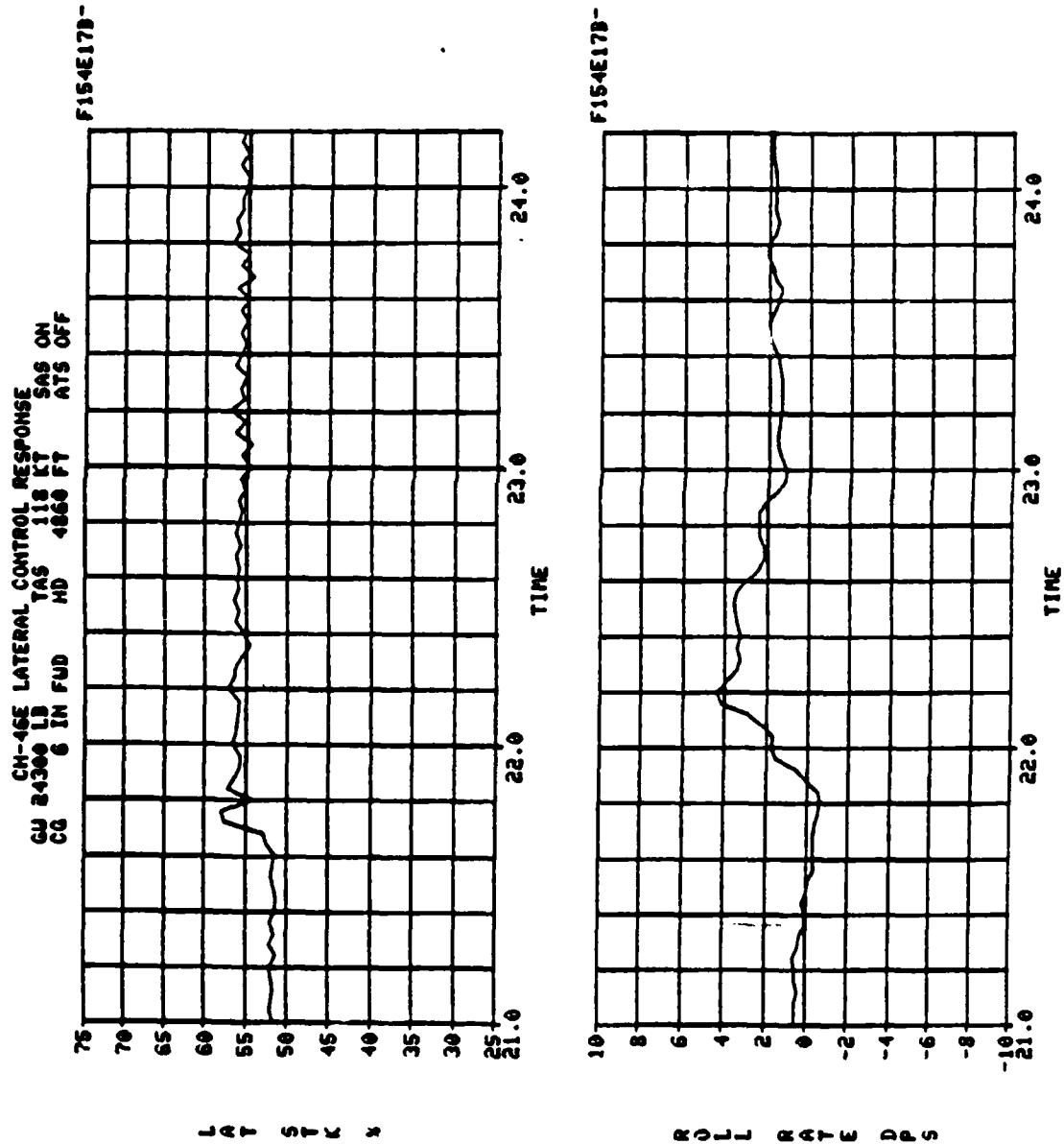


FIGURE 10A

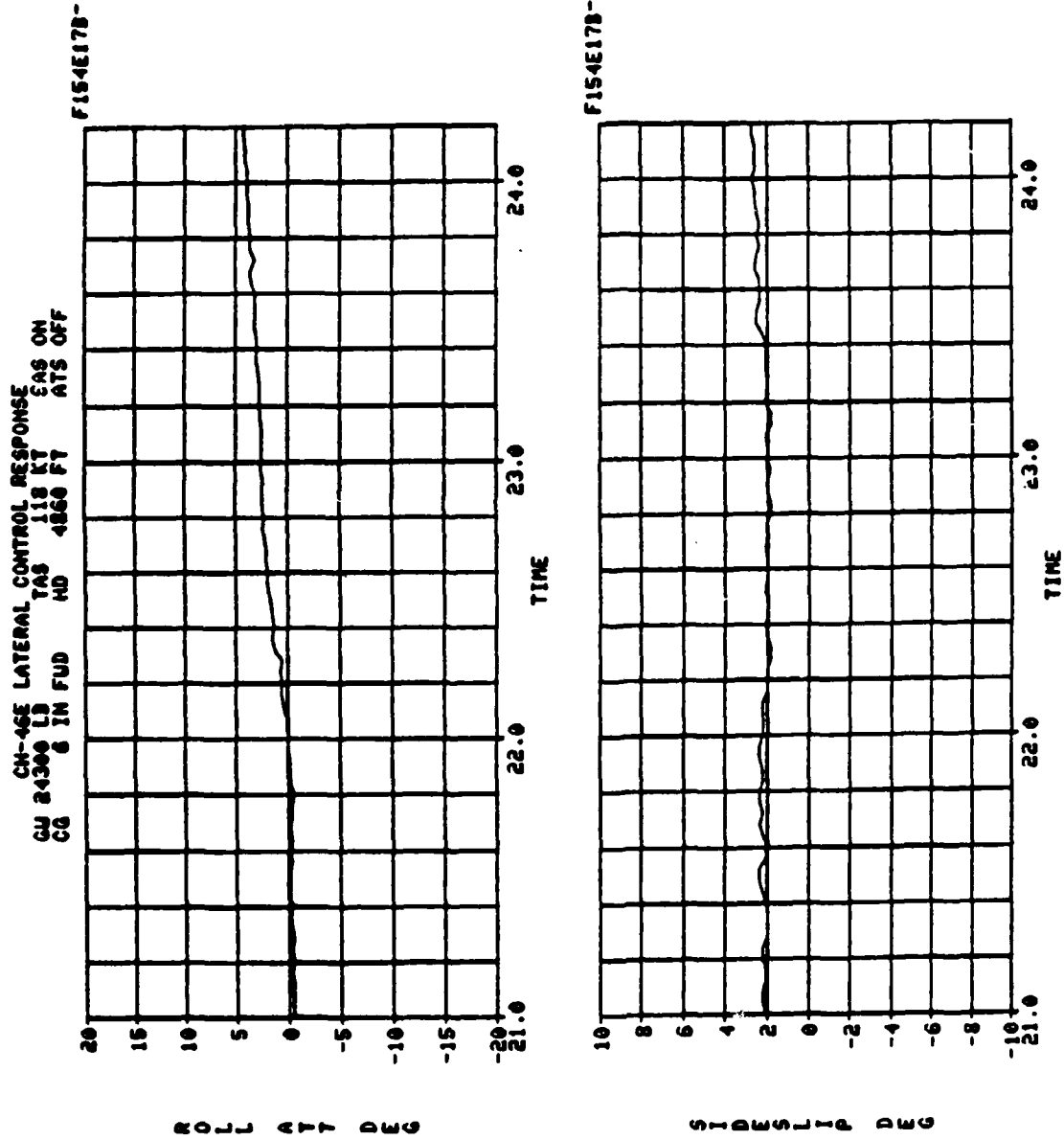


FIGURE 10B

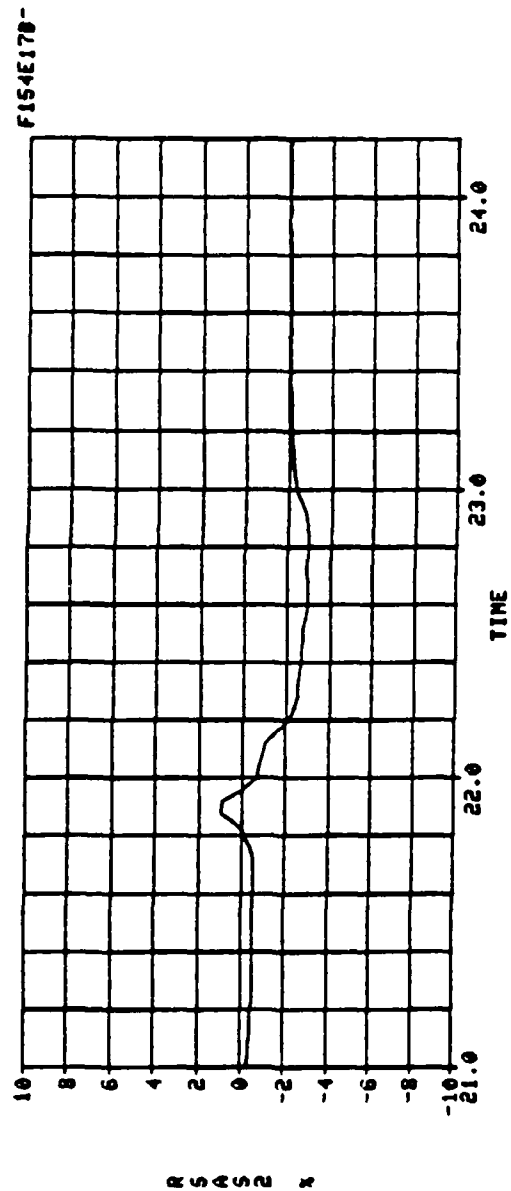
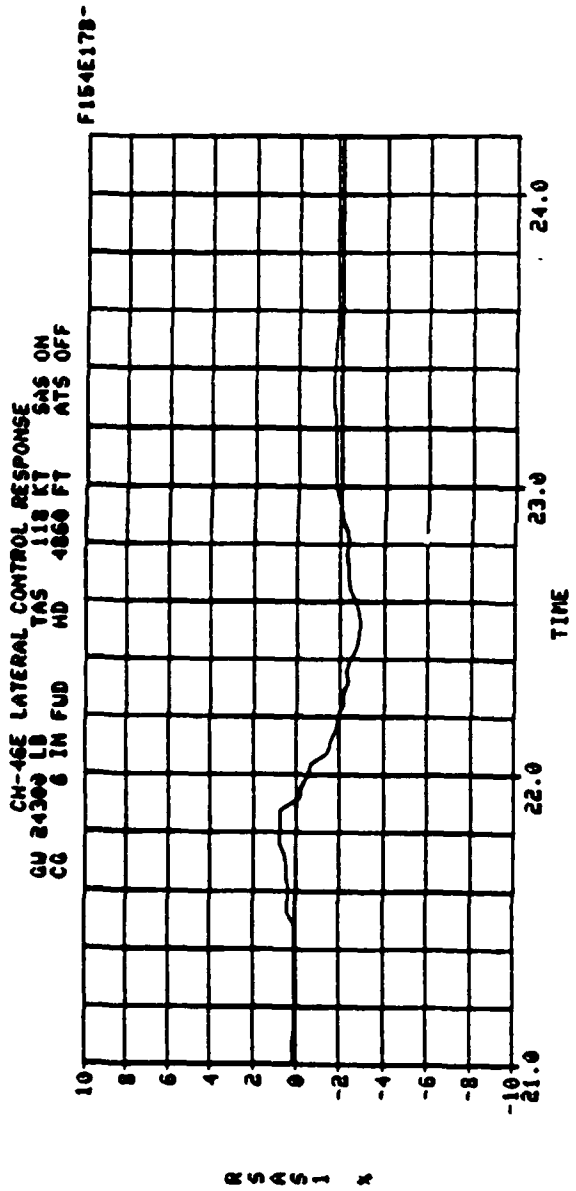


FIGURE 10C

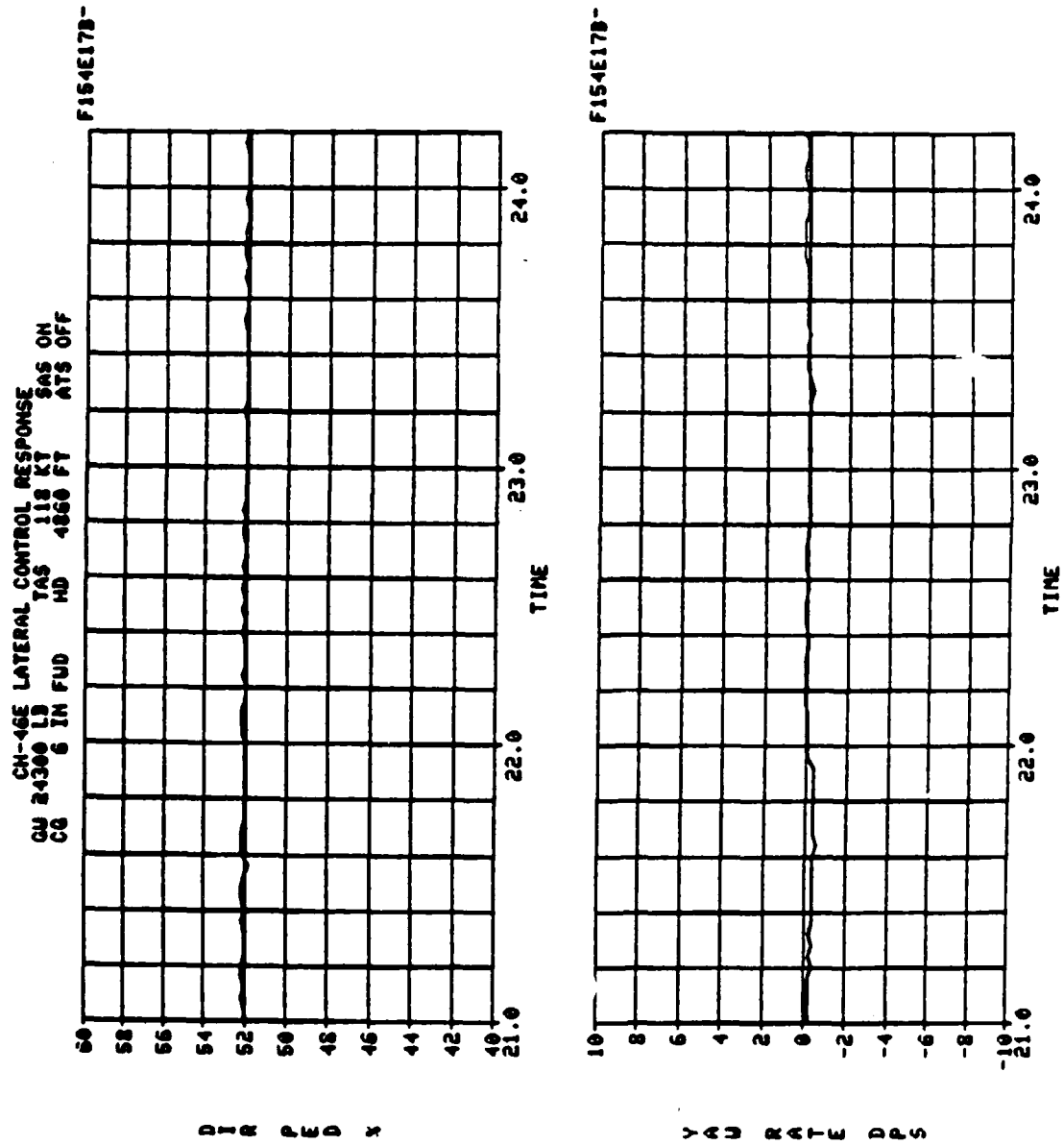


FIGURE 10D

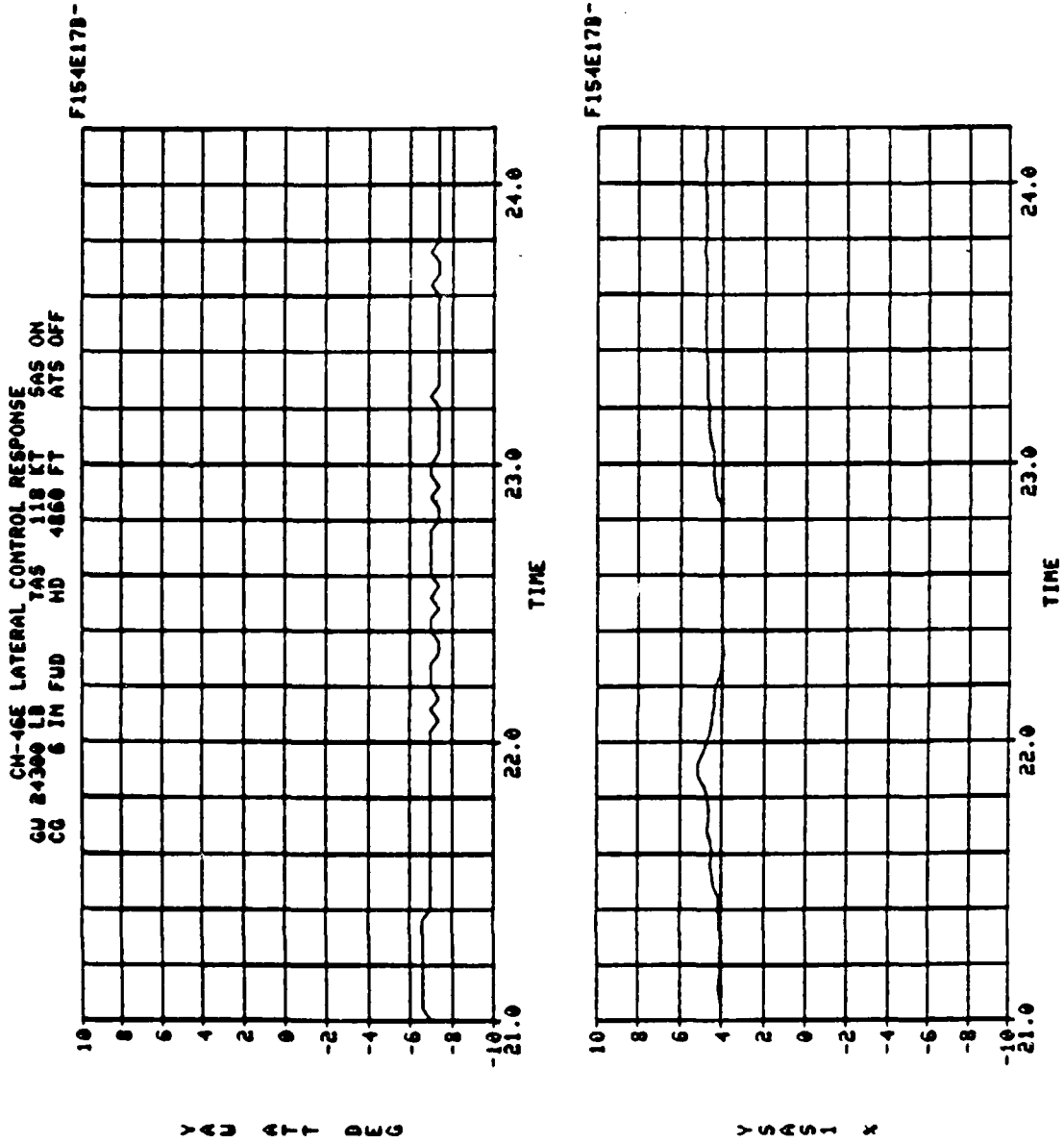


FIGURE 10E

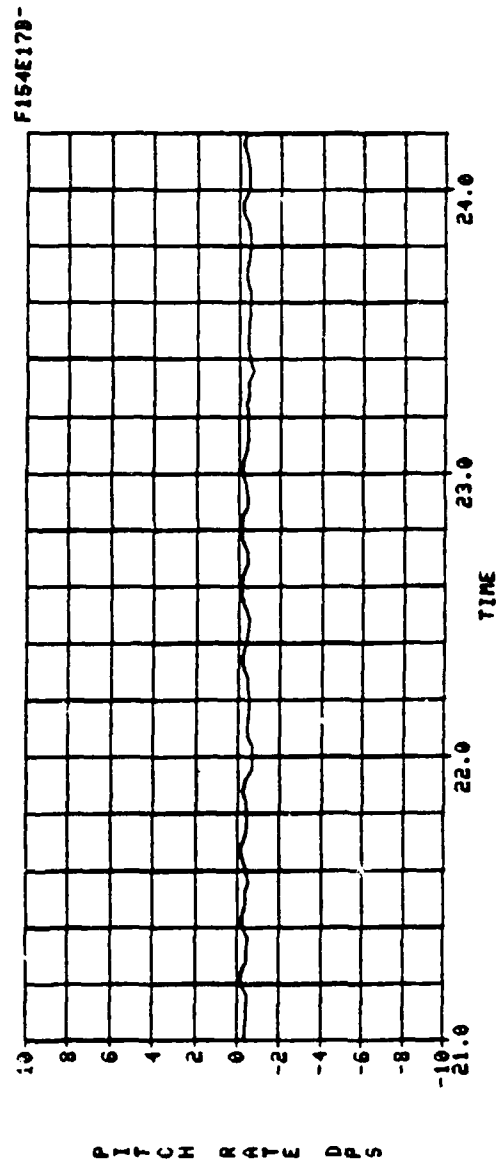
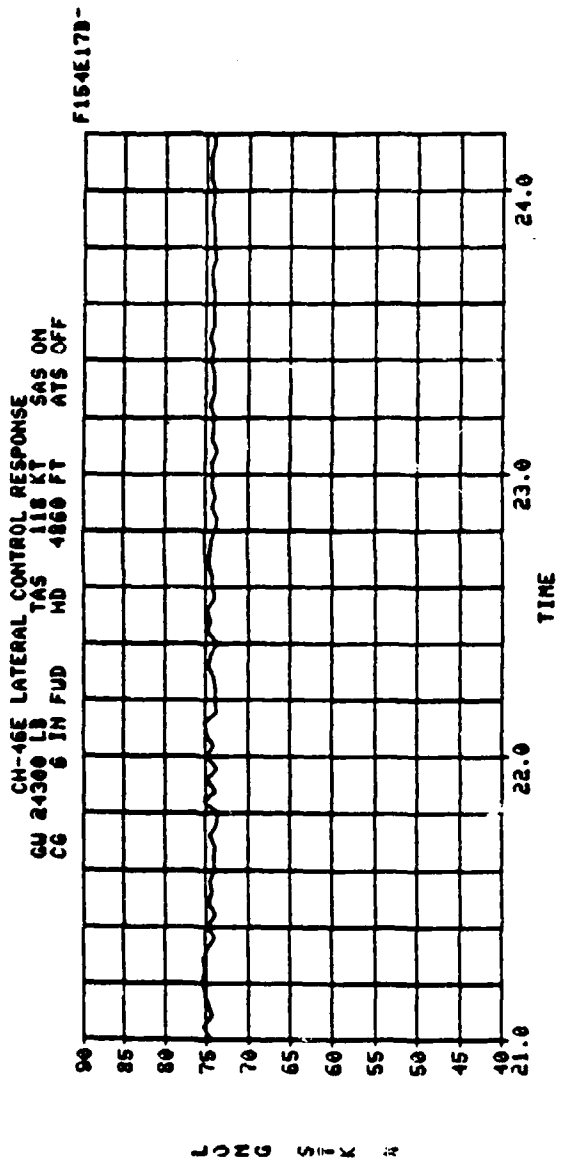


FIGURE 10F

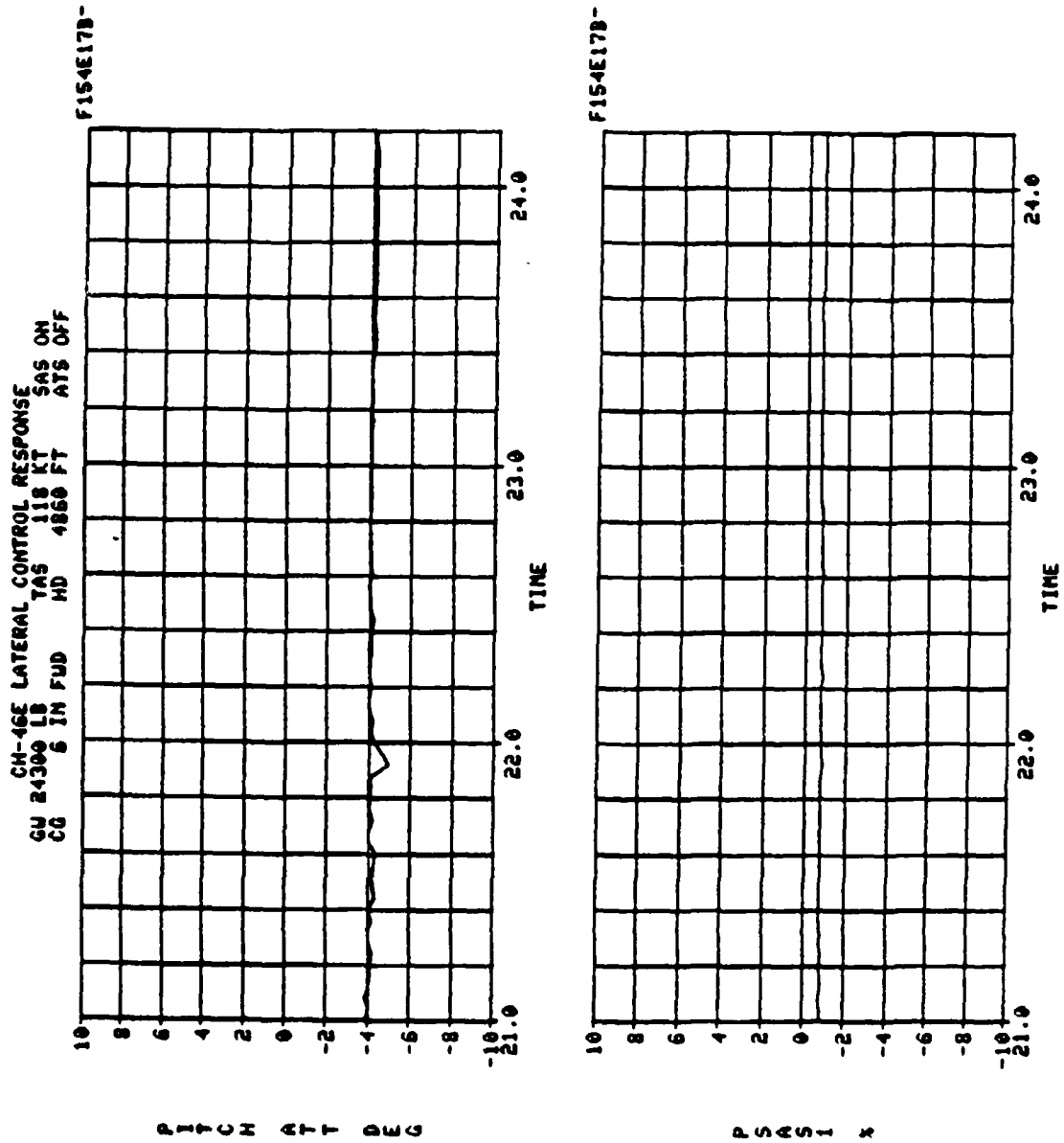


FIGURE 10G

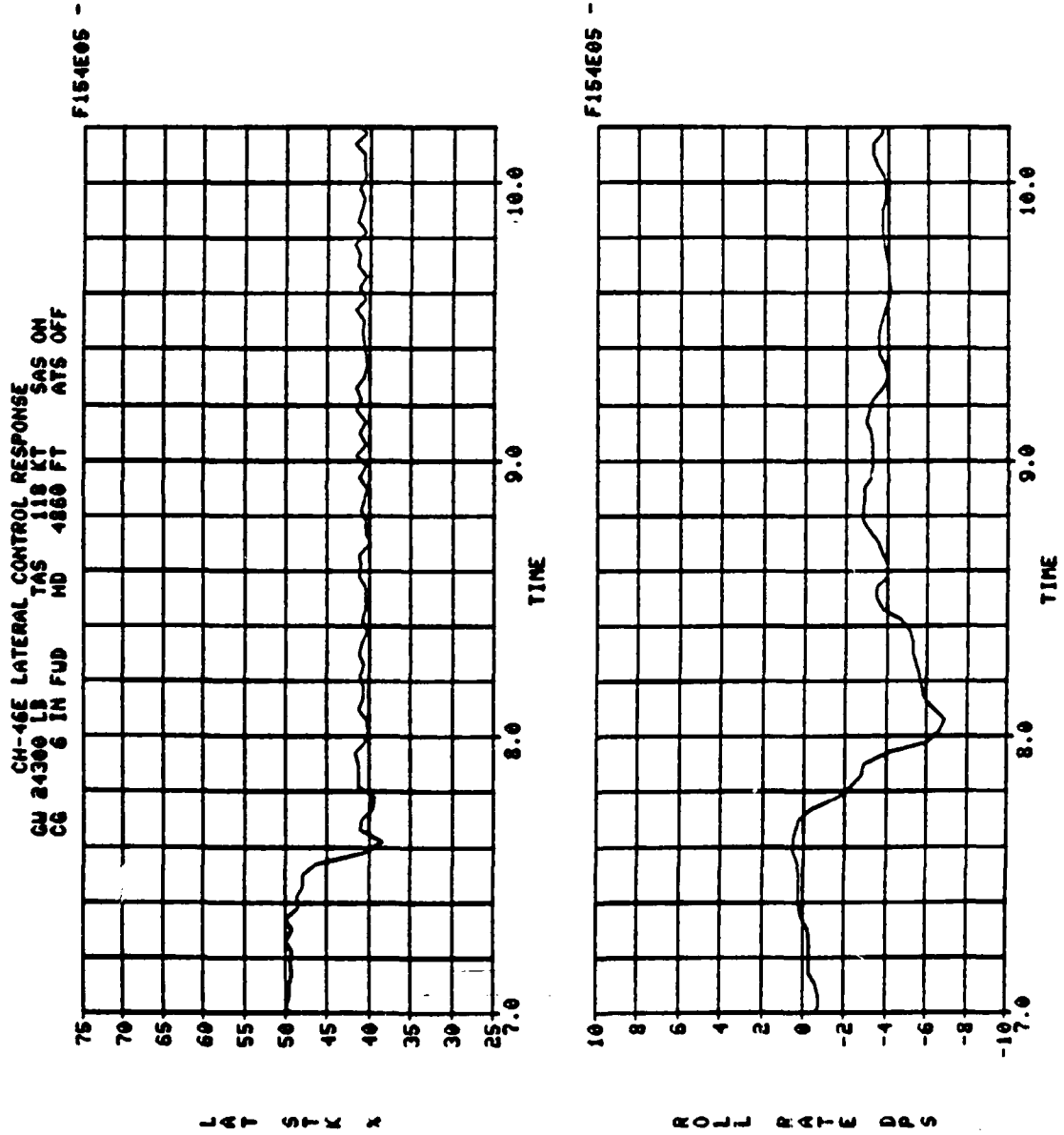


FIGURE 11A

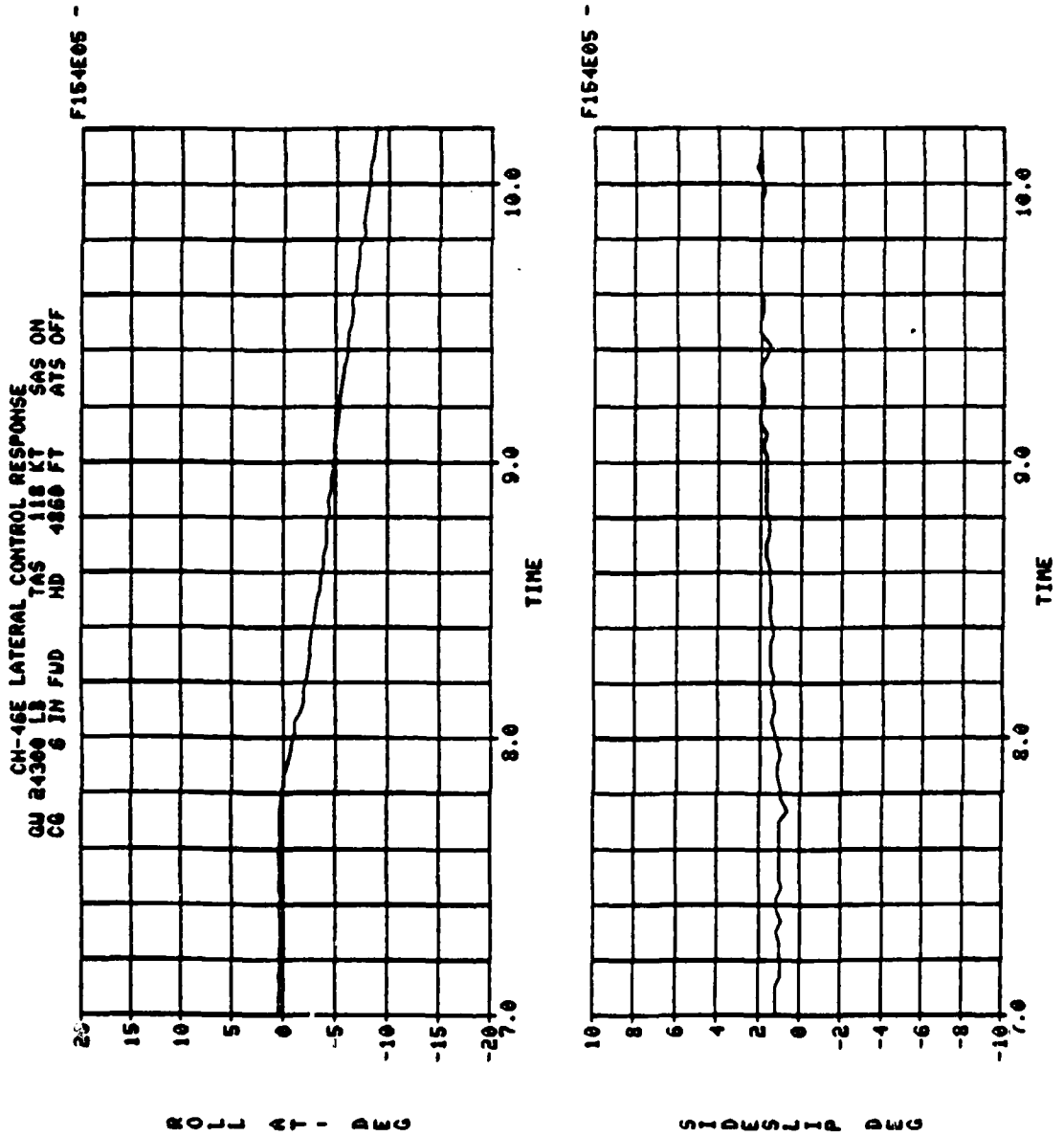


FIGURE 11B

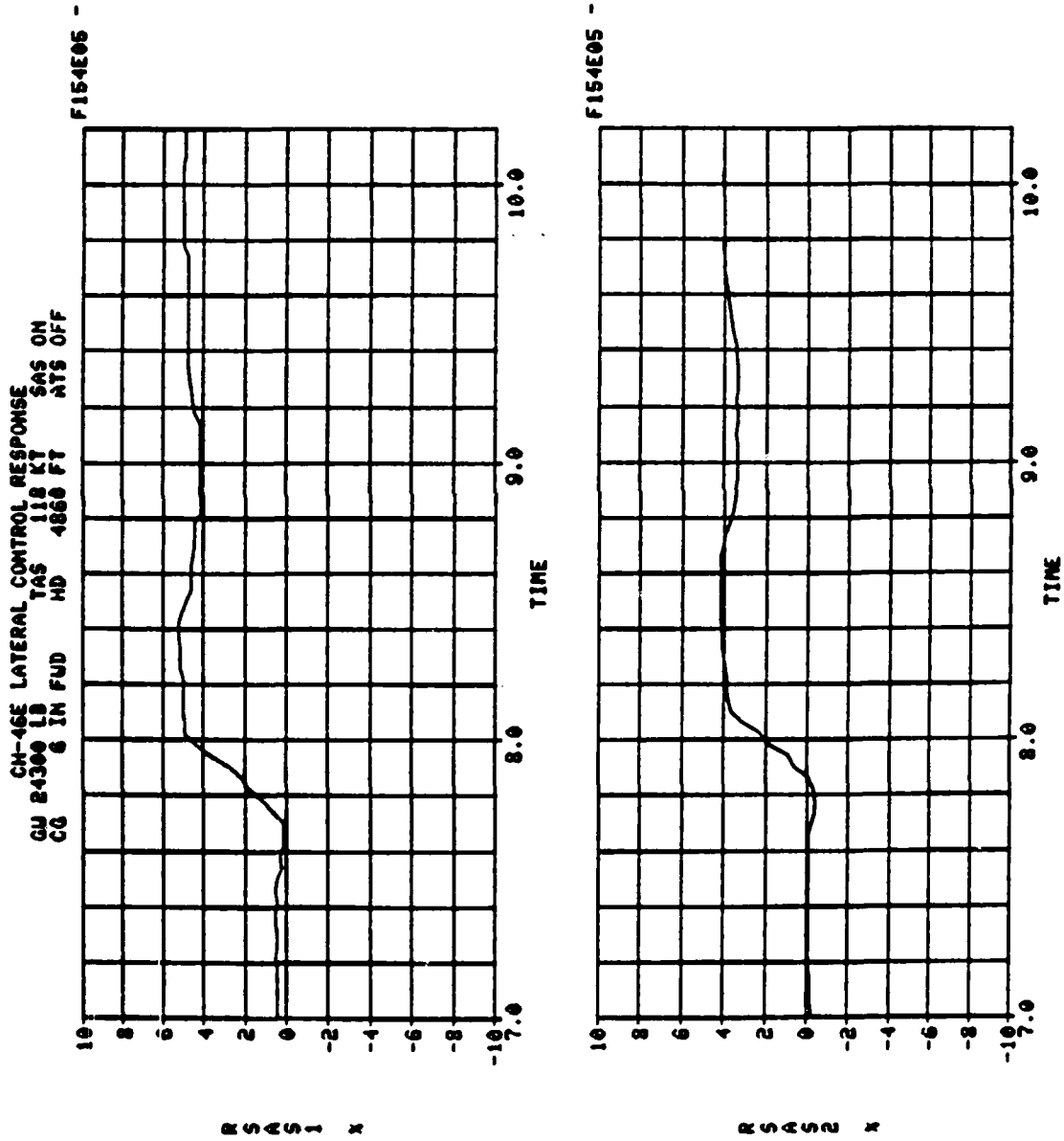


FIGURE 11C

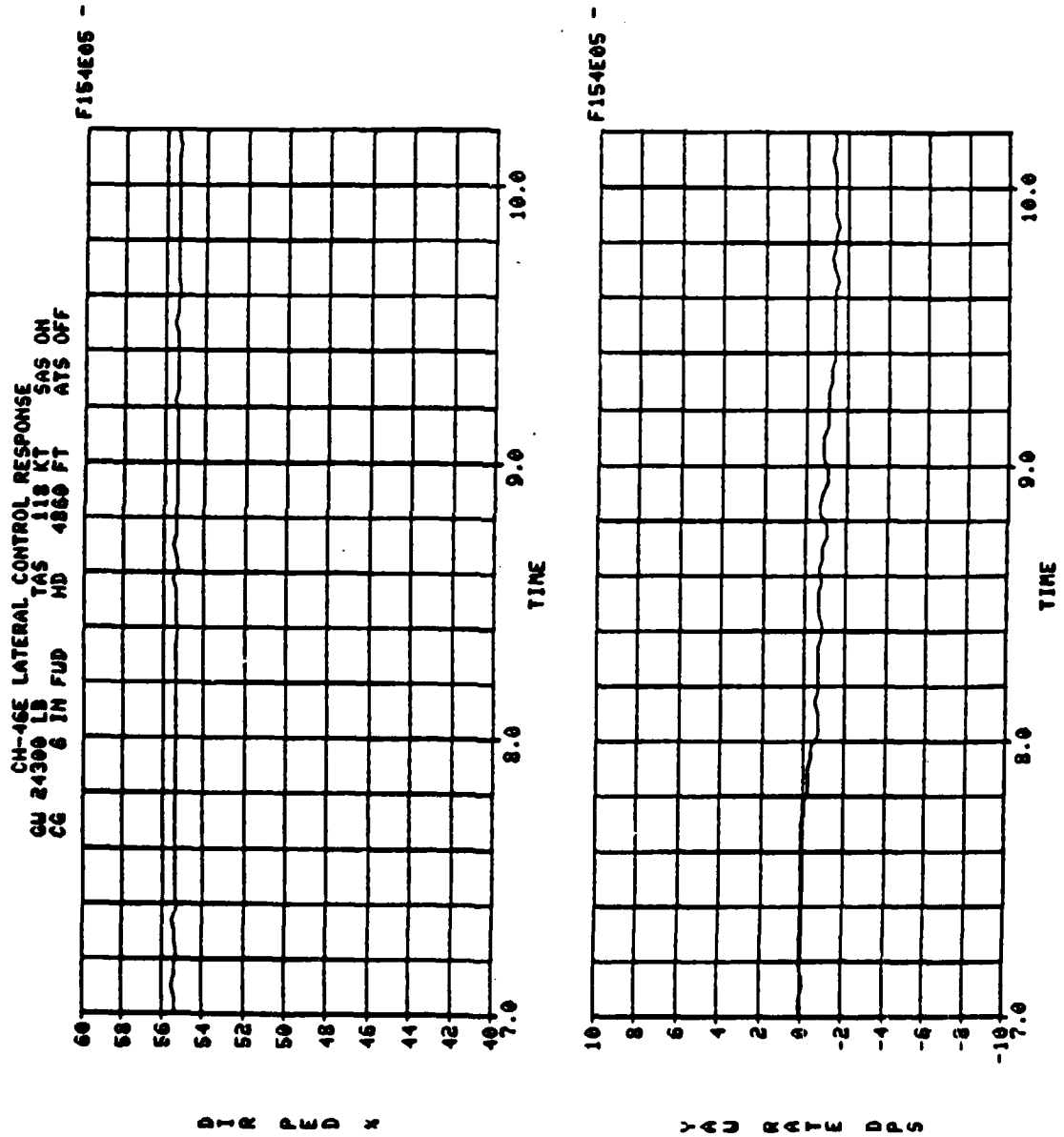


FIGURE 11D

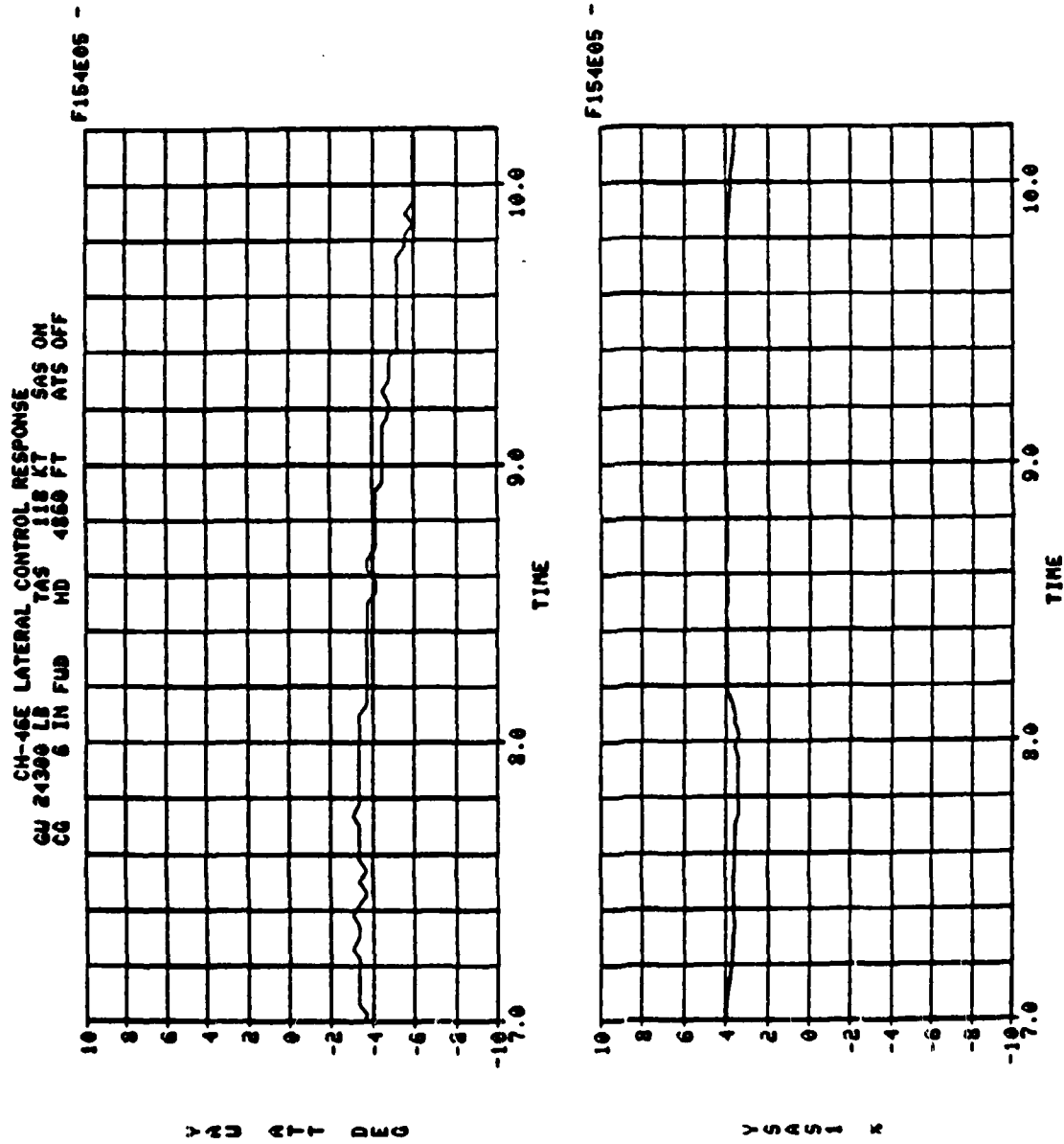


FIGURE 11E

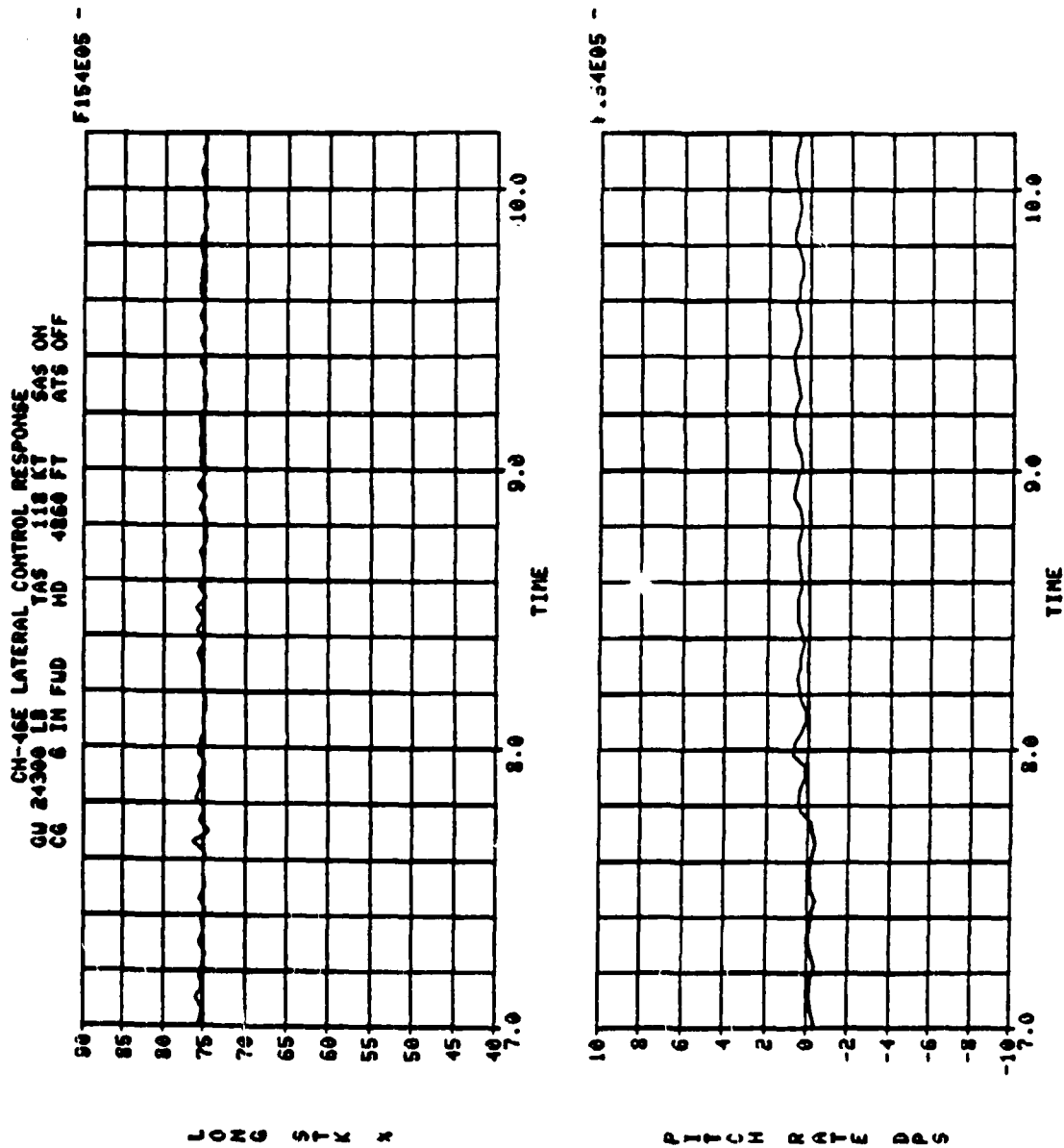


FIGURE 11F

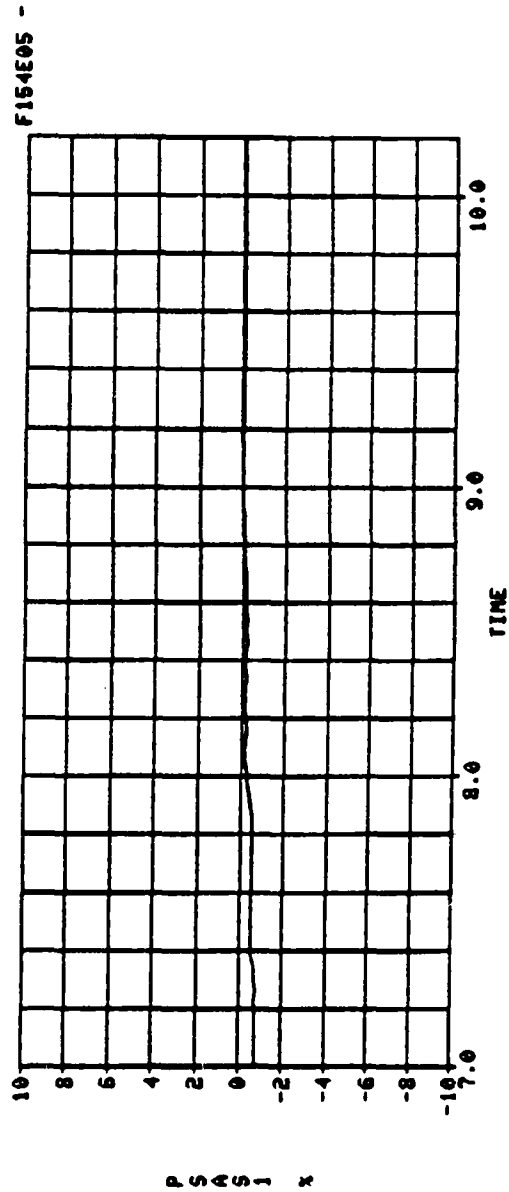
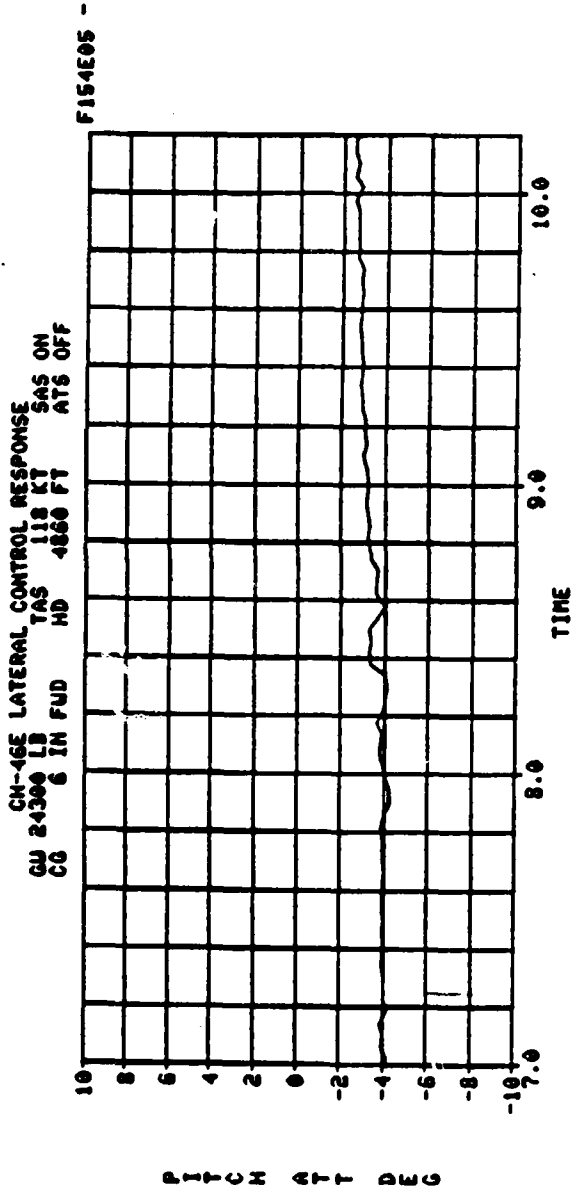


FIGURE 11G

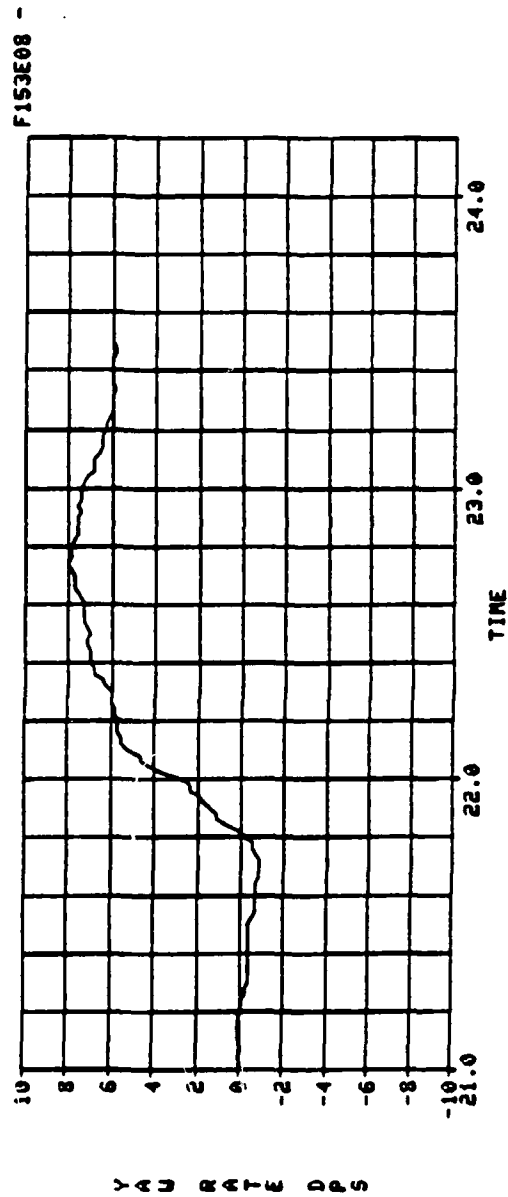
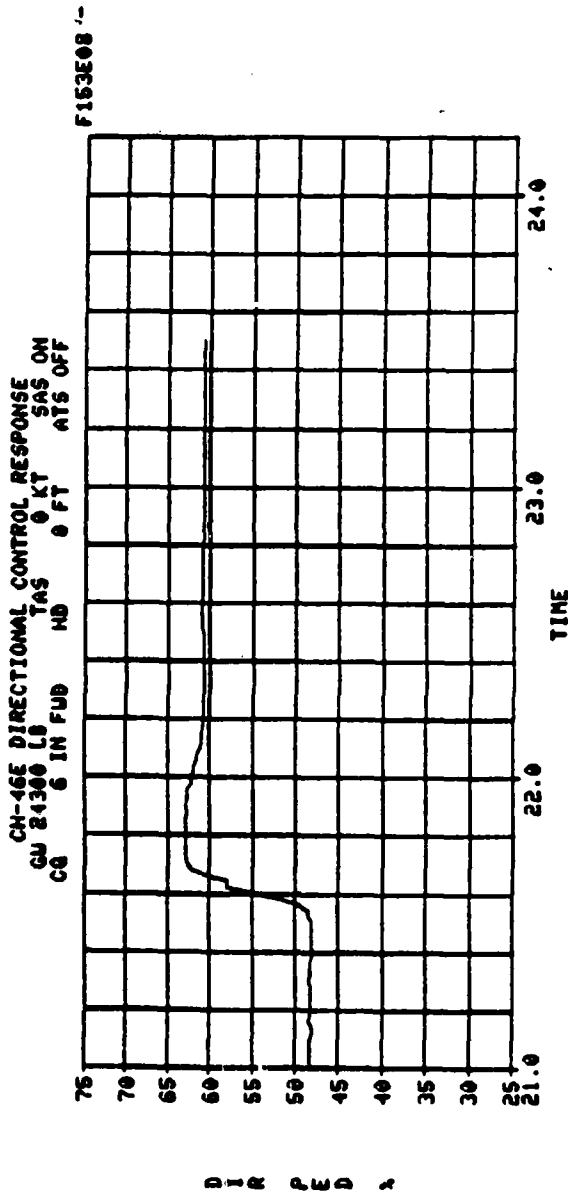


FIGURE 12A

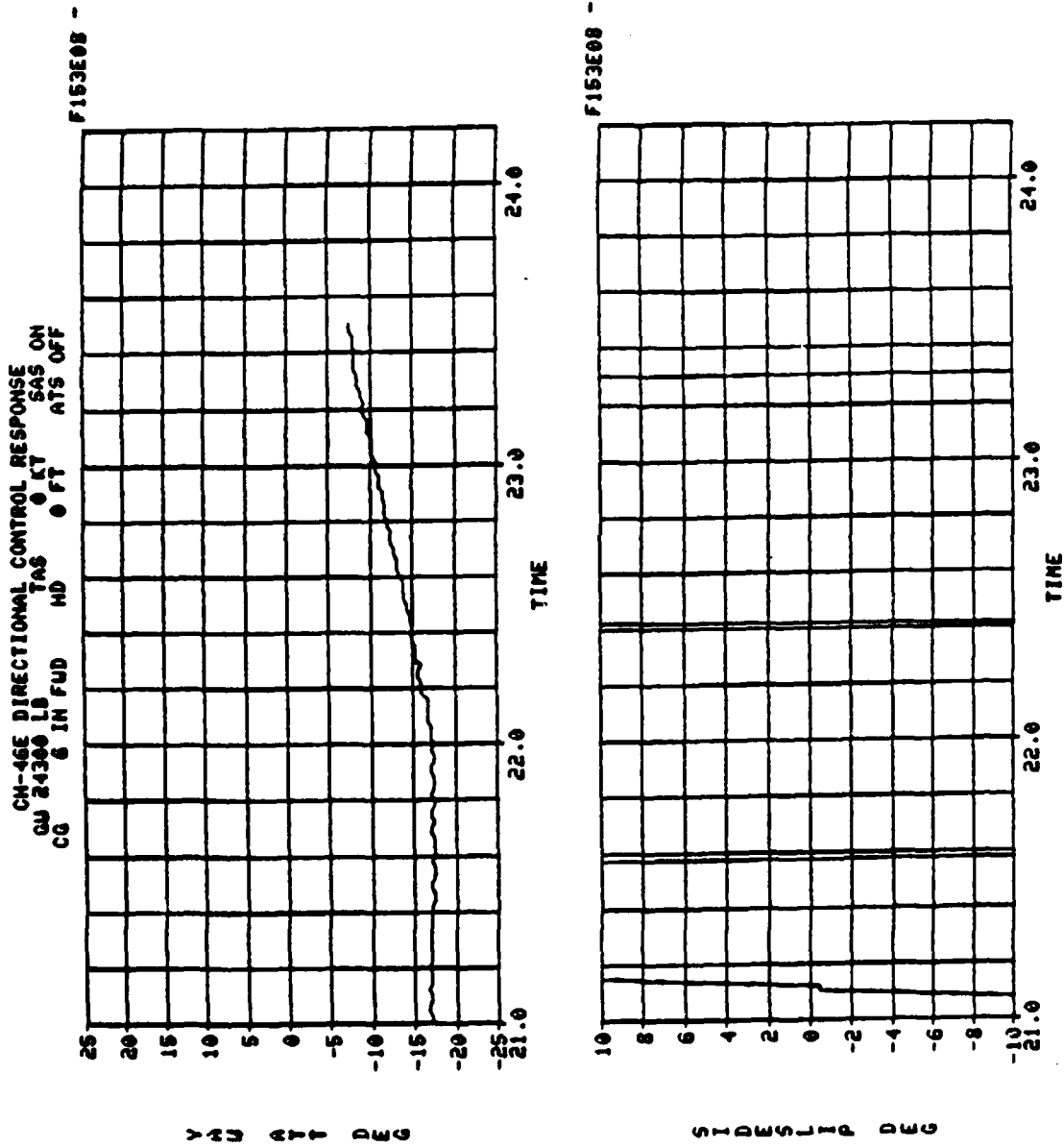


FIGURE 12B

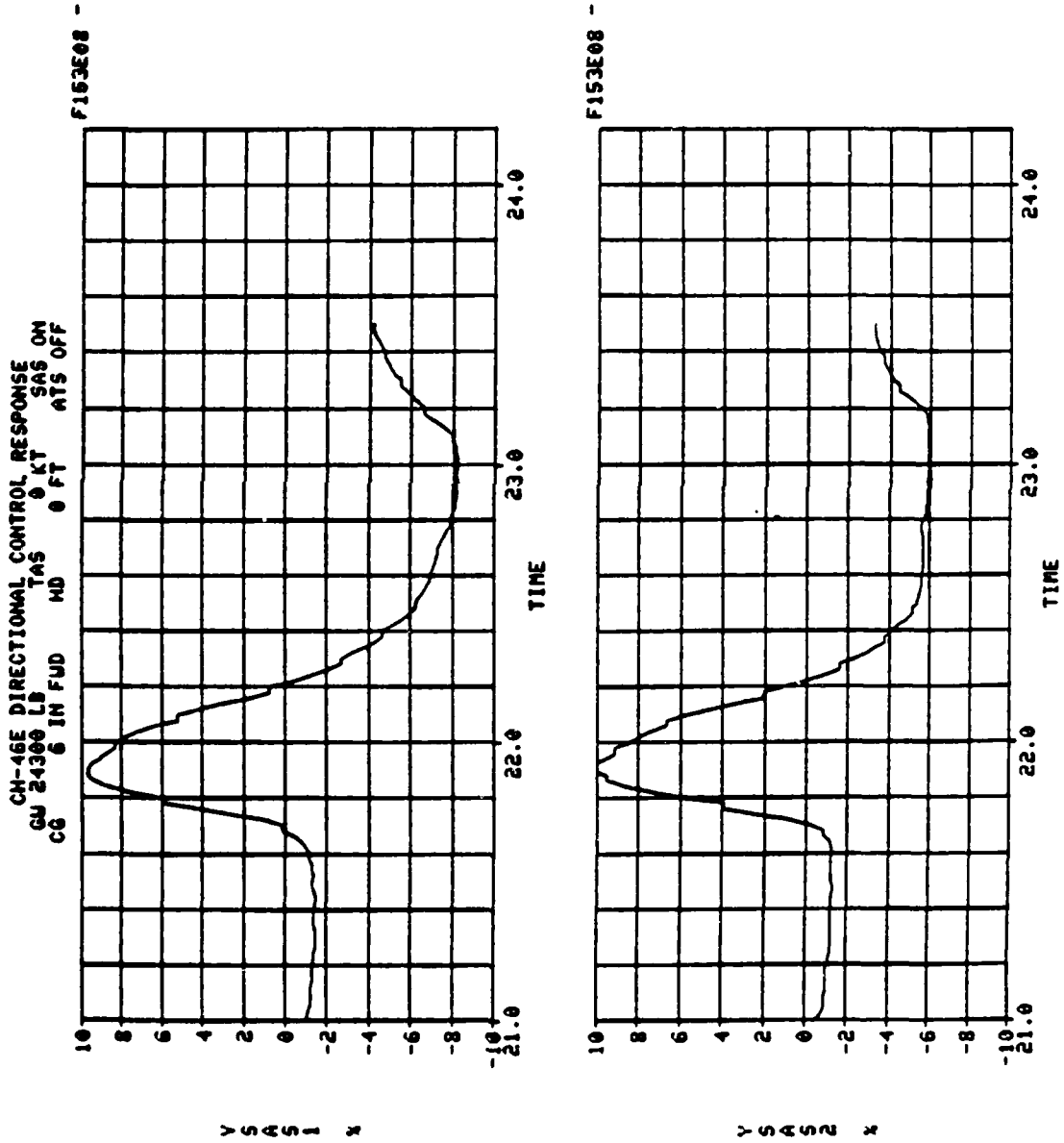


FIGURE 12C

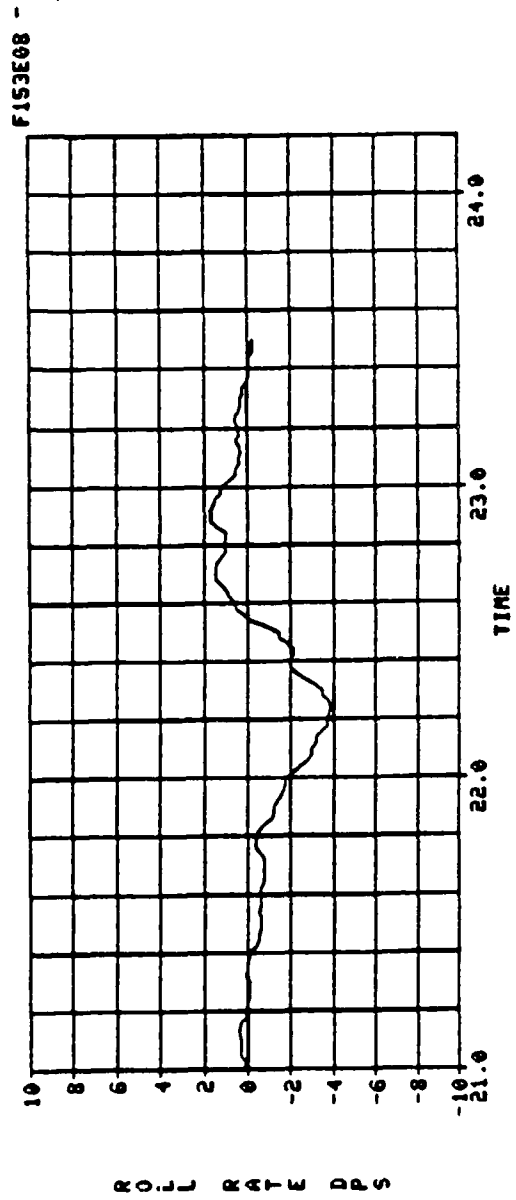
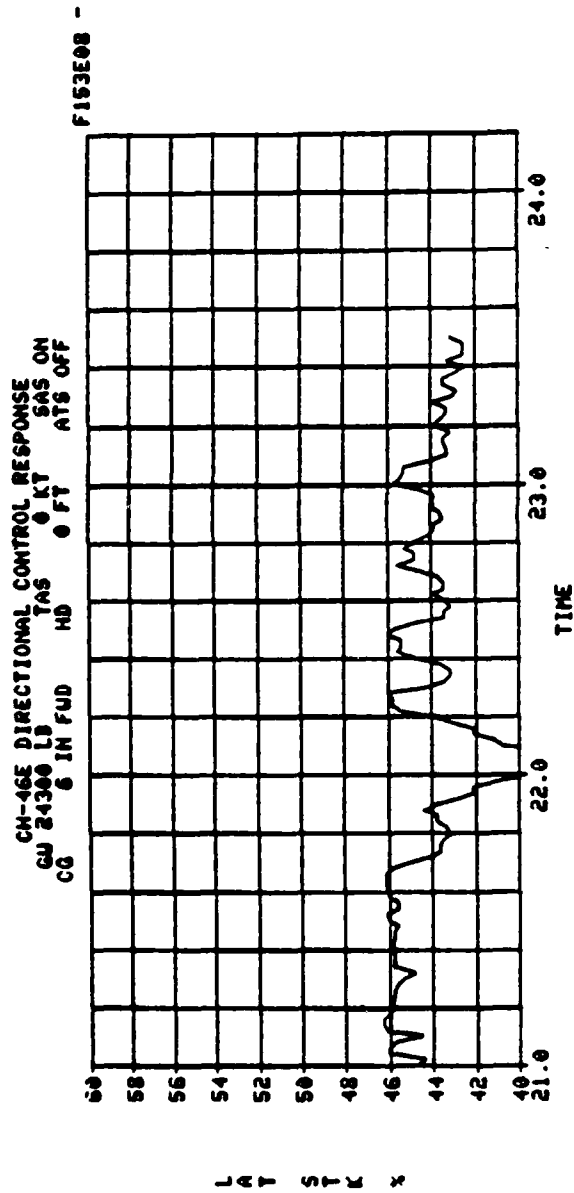


FIGURE 12D

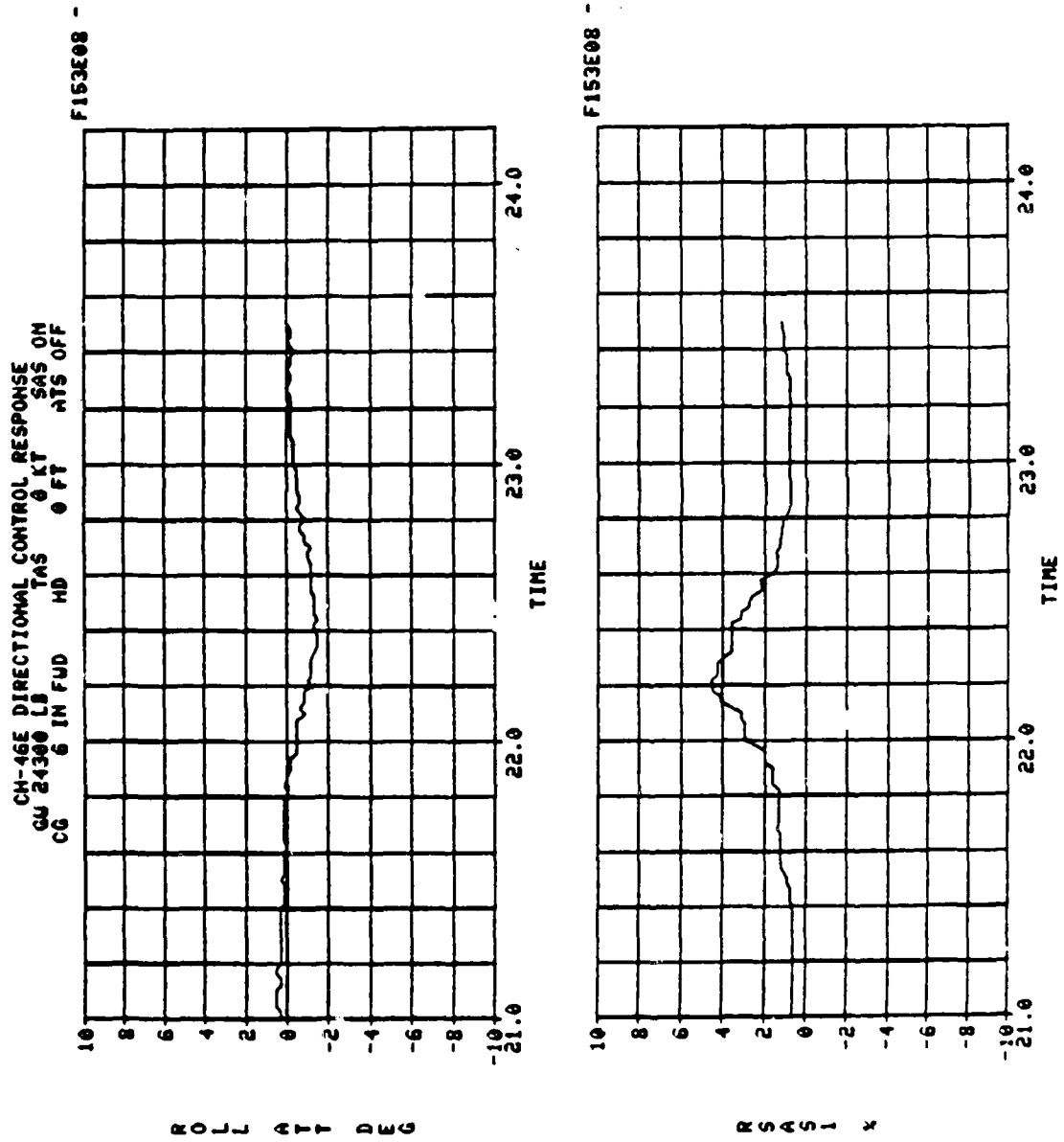
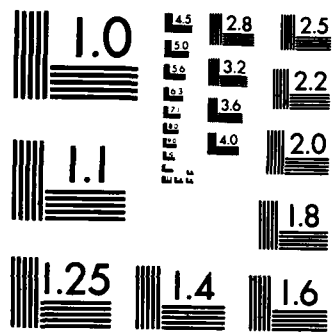


FIGURE 12E



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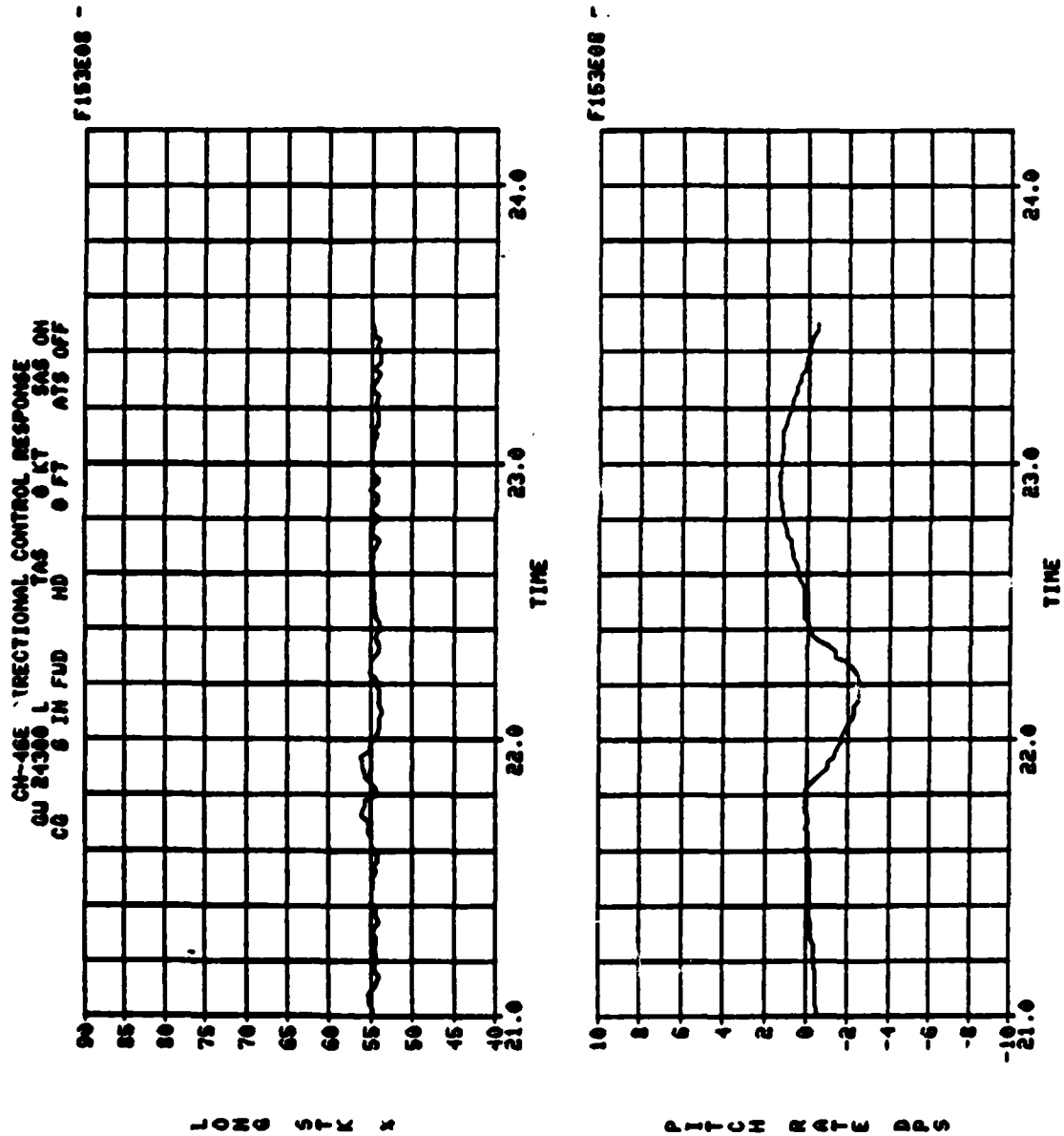


FIGURE 12F

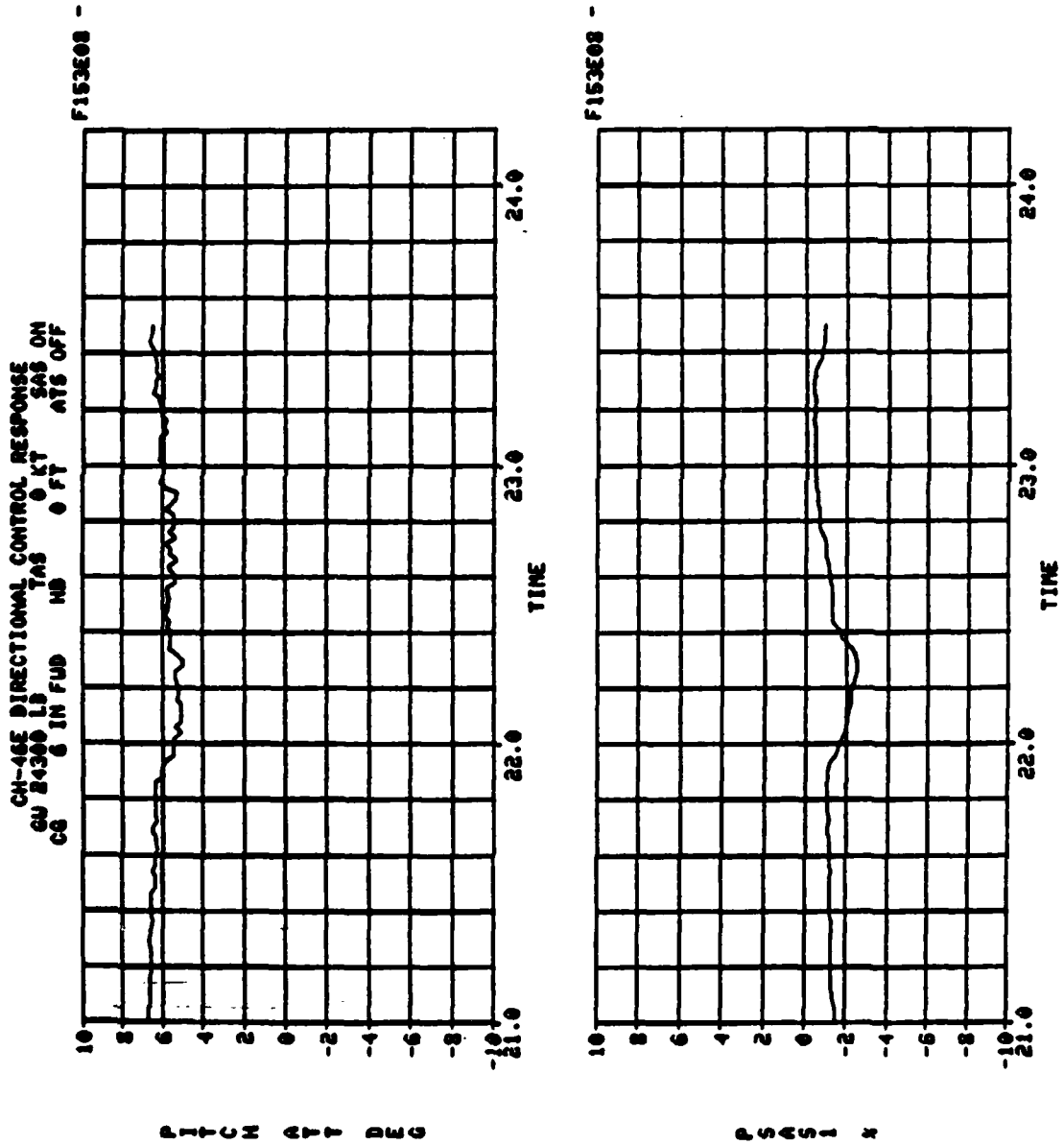


FIGURE 12G

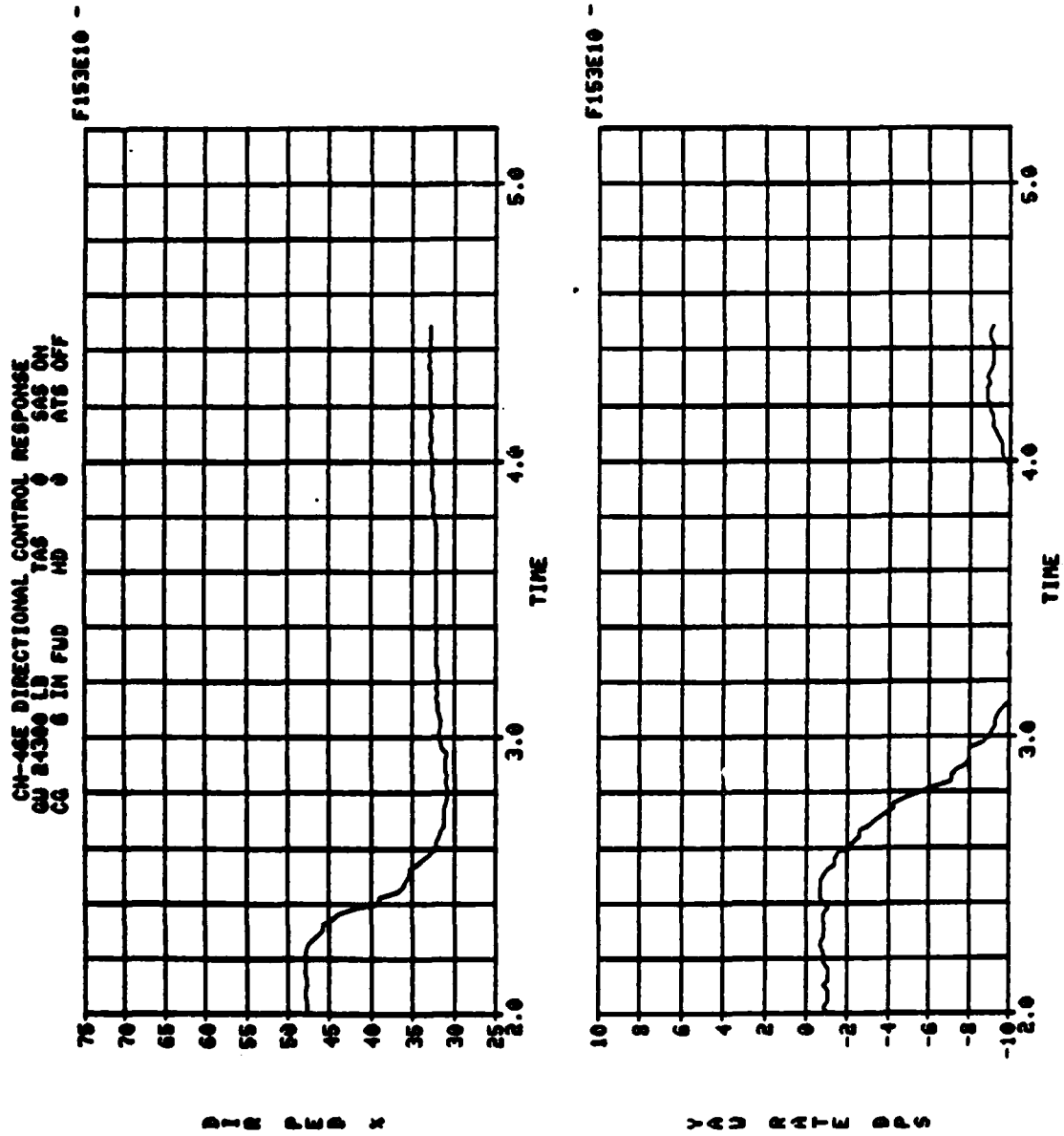


FIGURE 13A

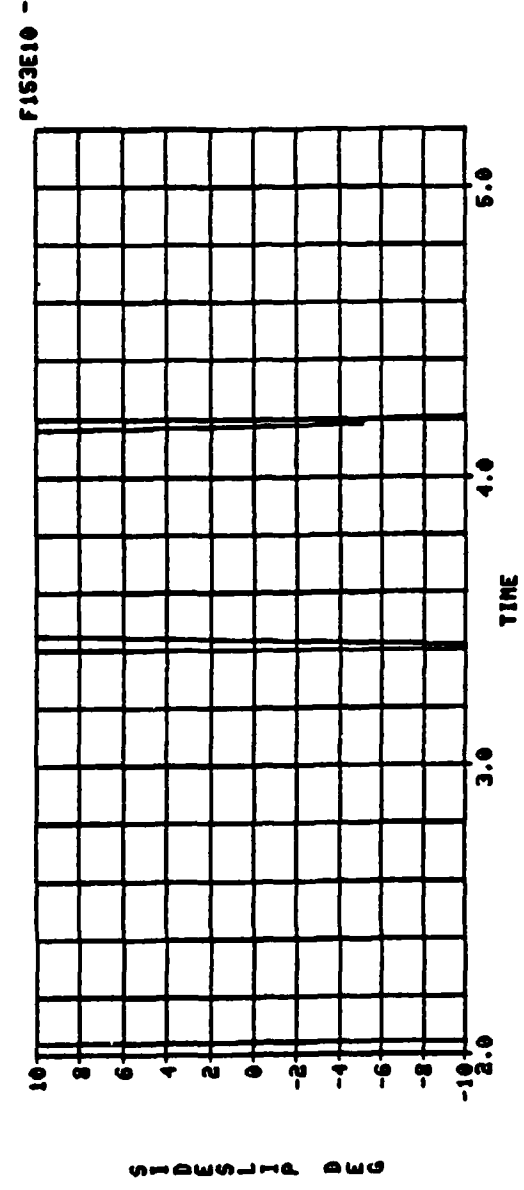
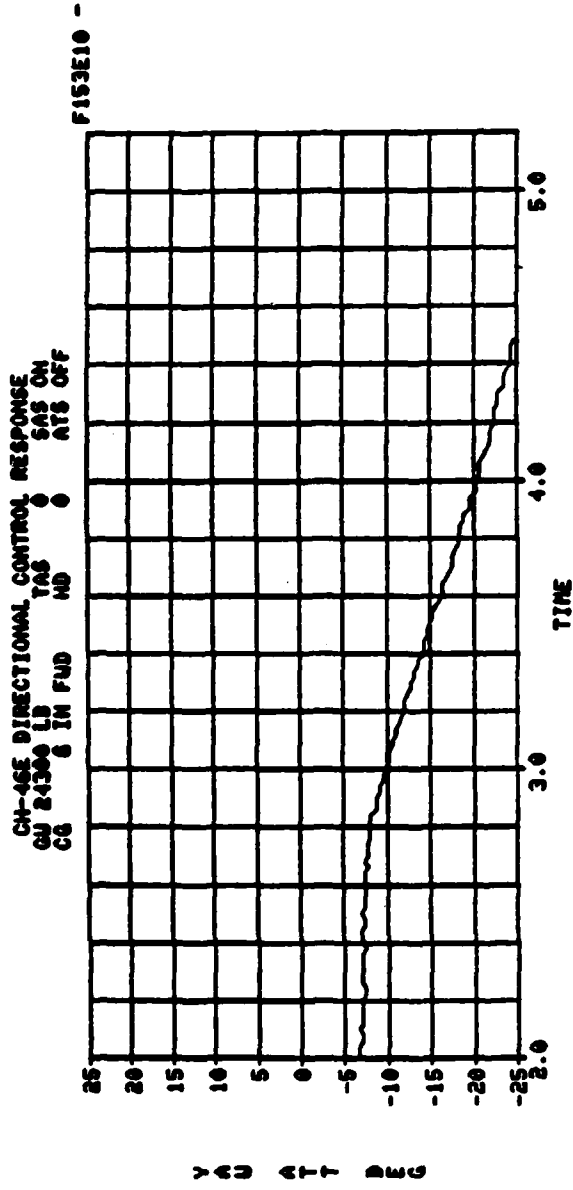


FIGURE 13B

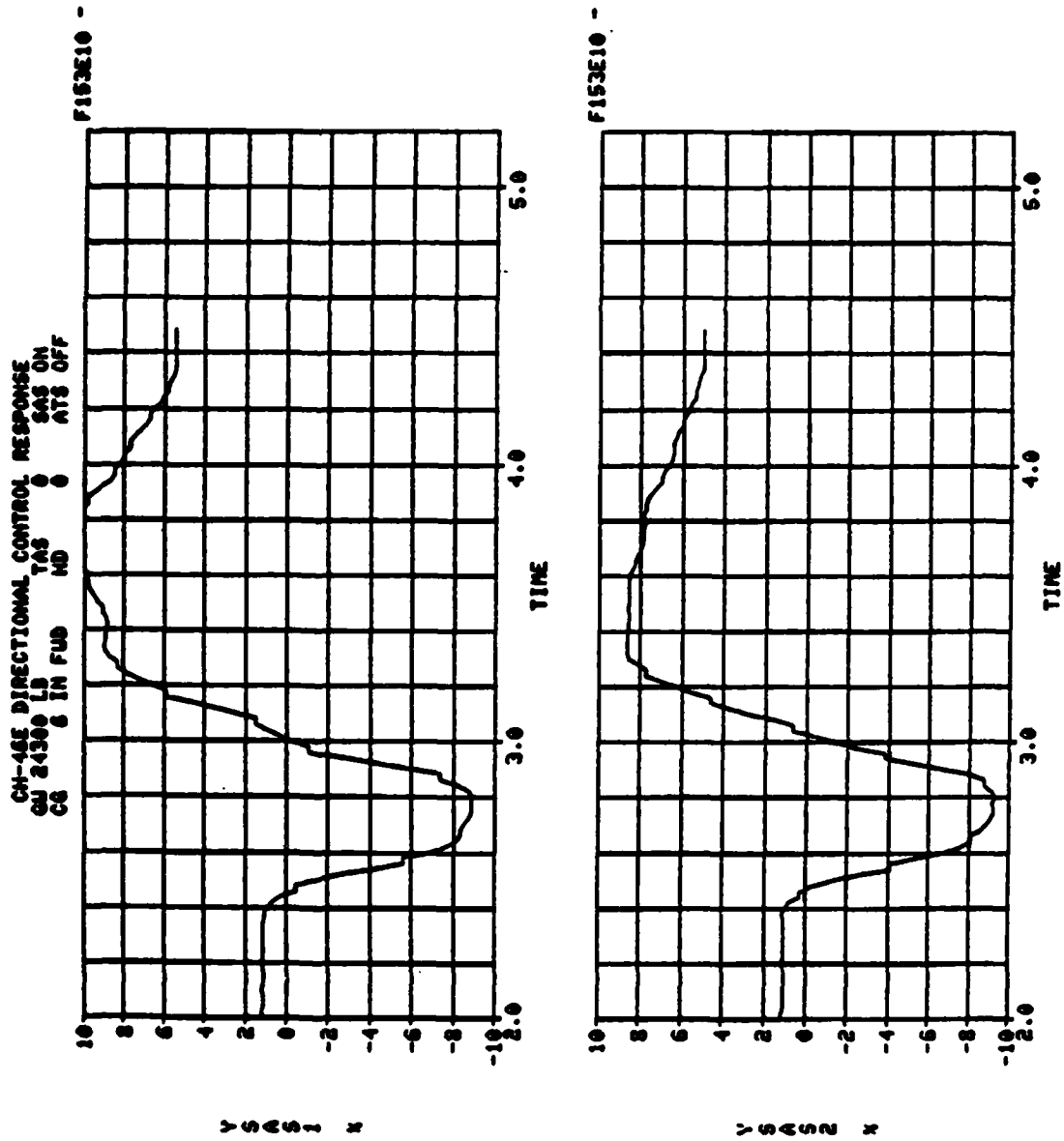


FIGURE 13C

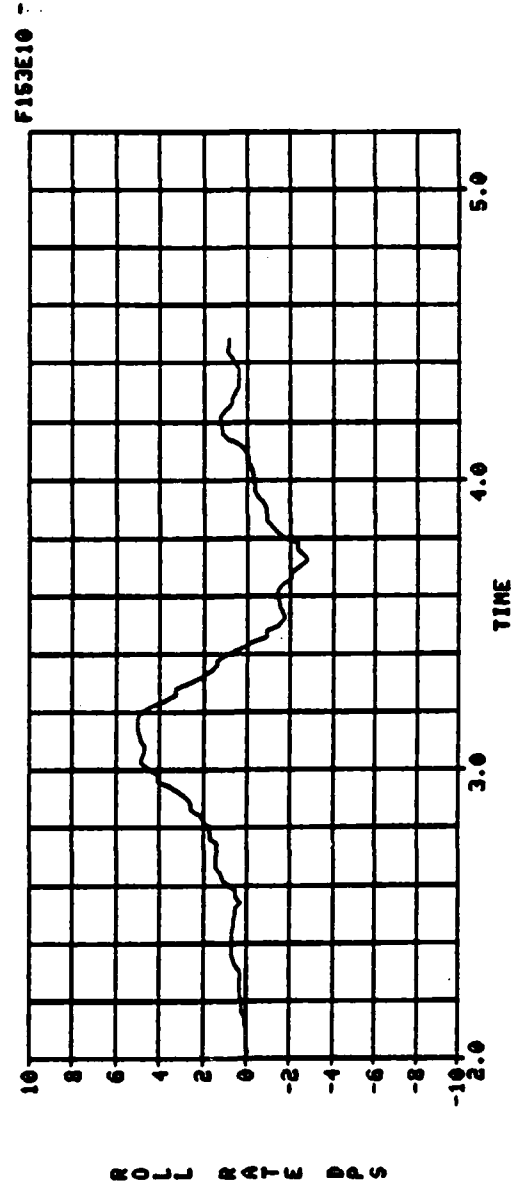
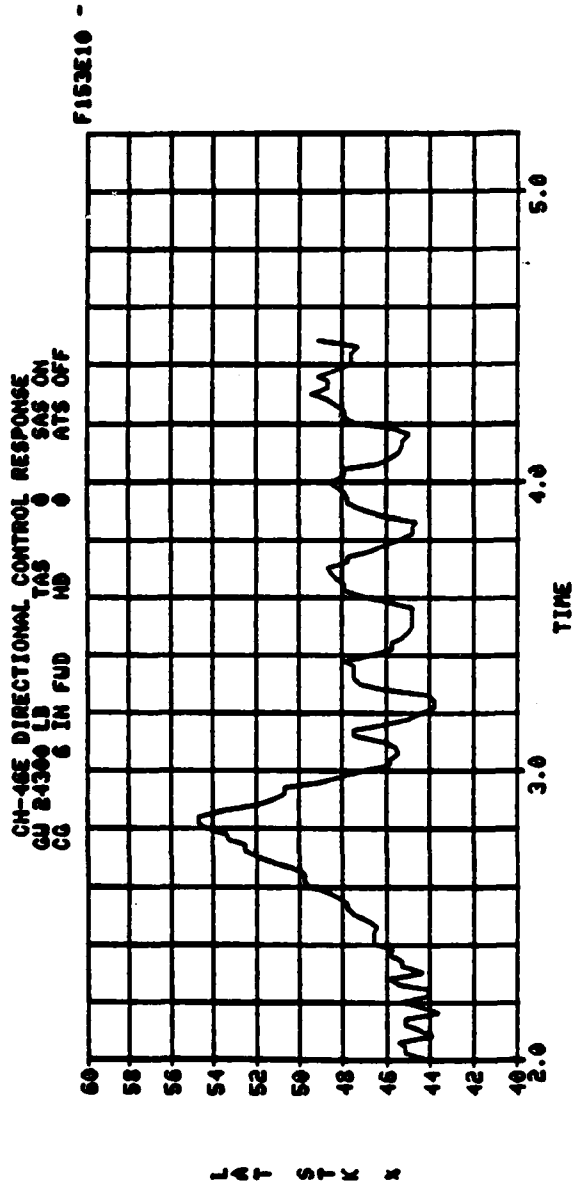


FIGURE 13D

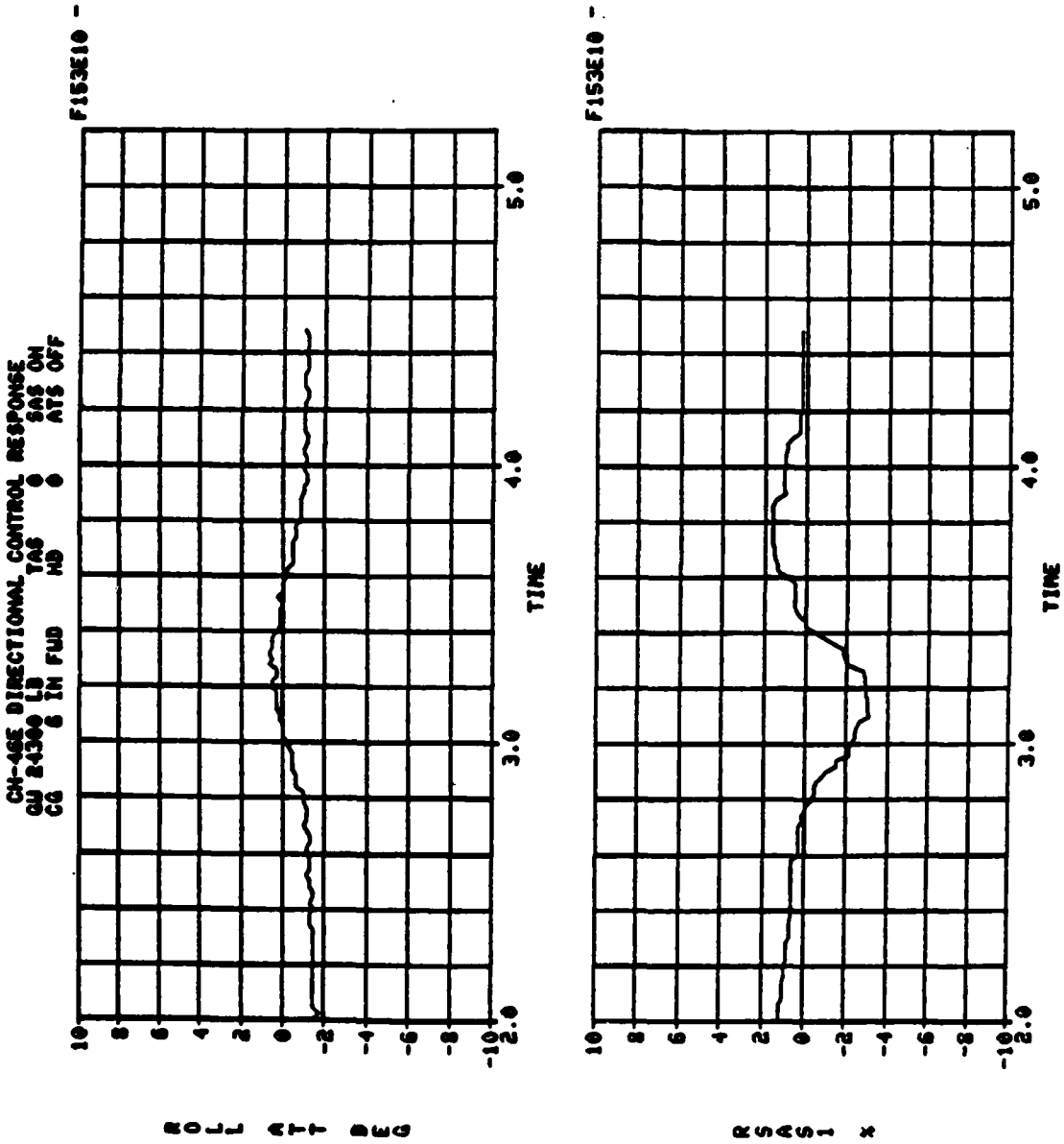


FIGURE 13E

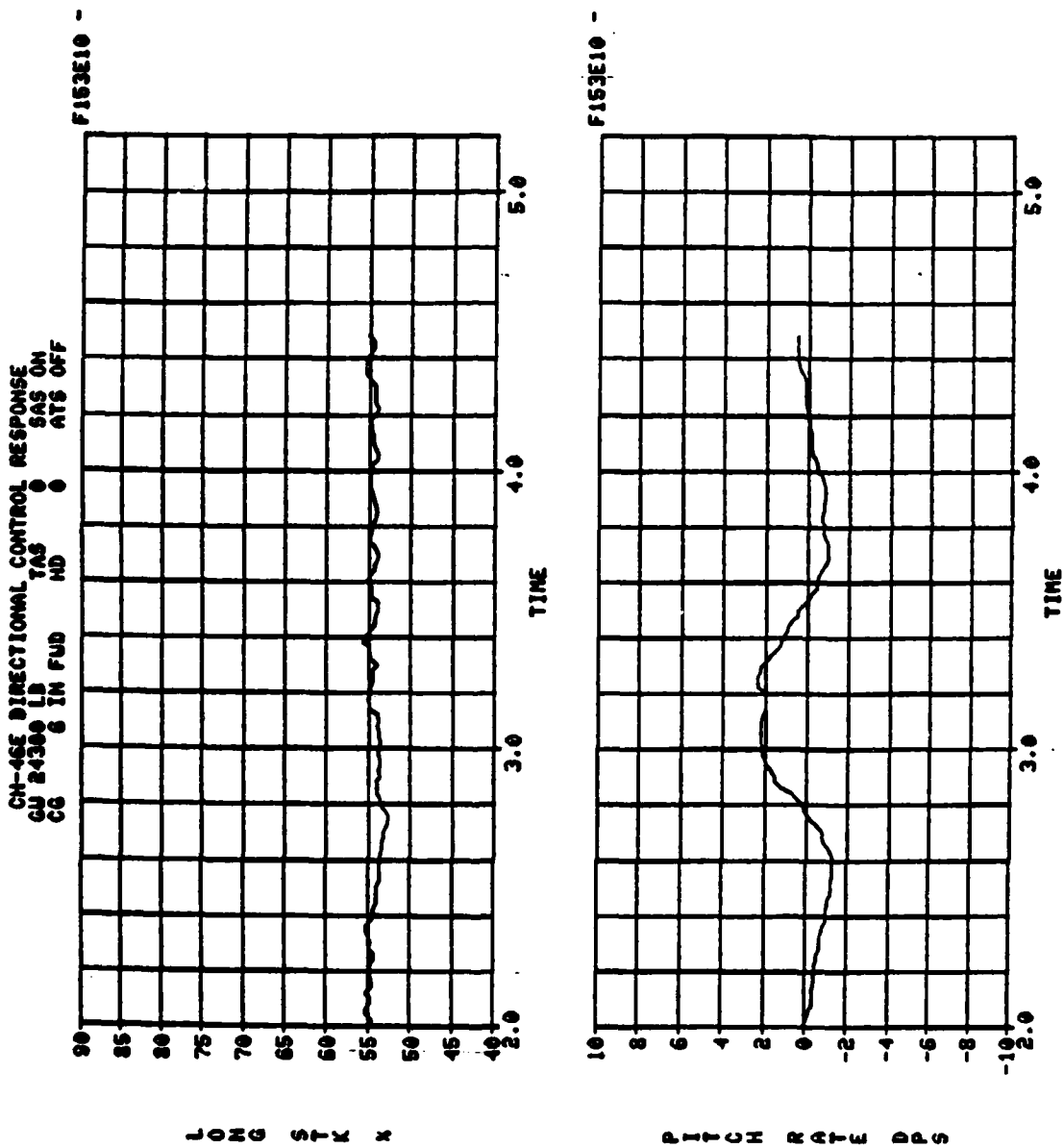


FIGURE 13F

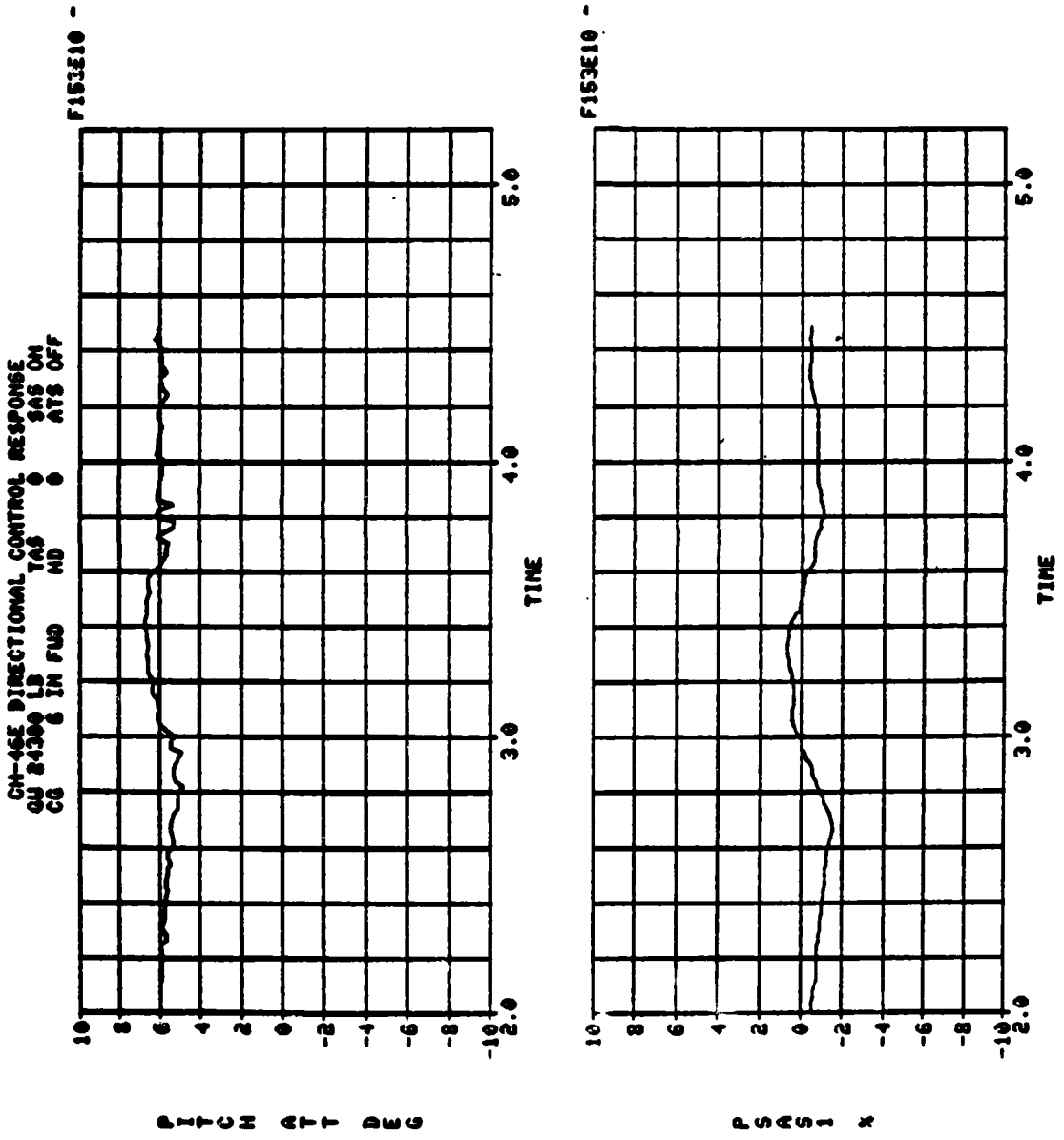


FIGURE 13G

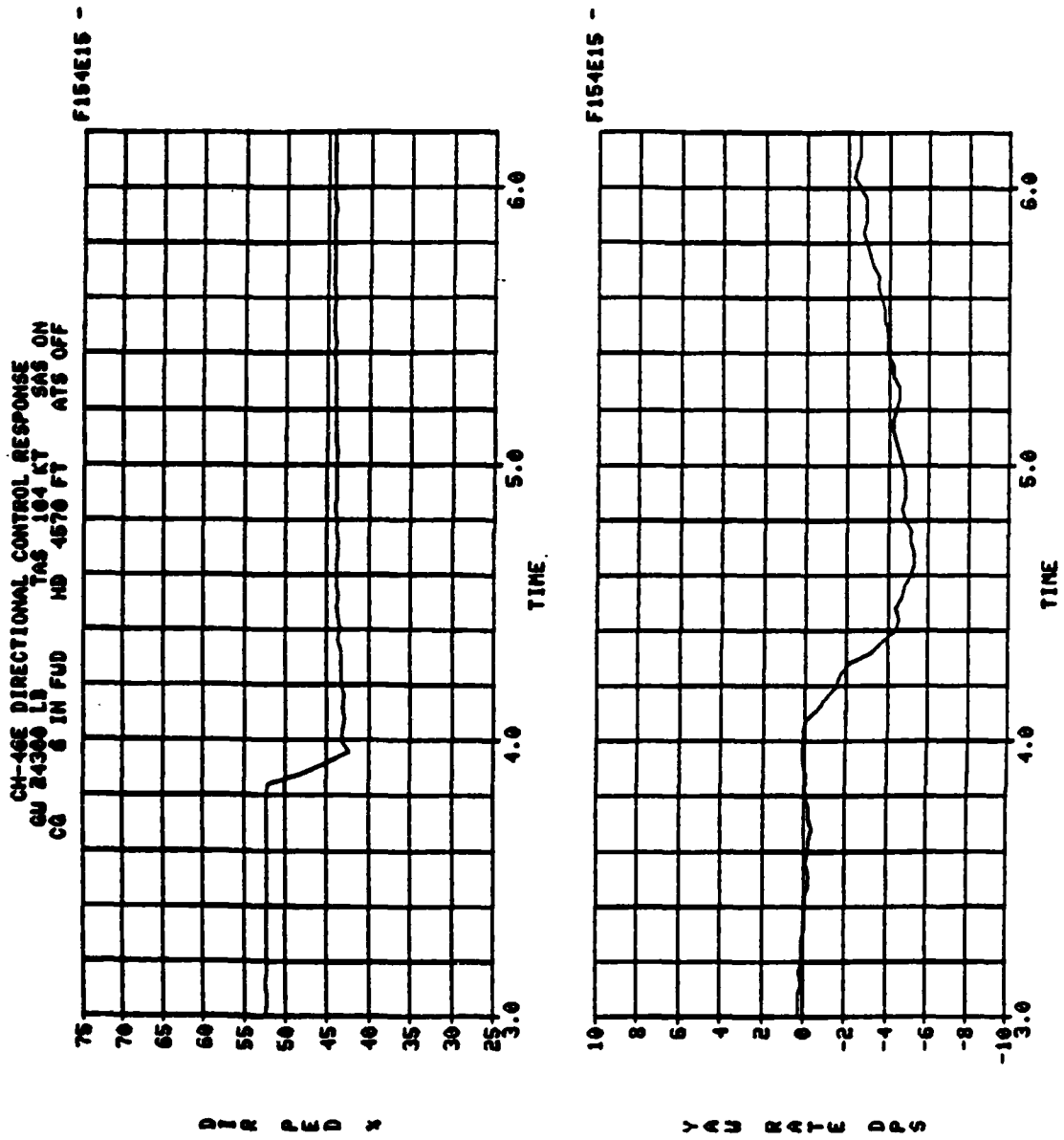


FIGURE 14A

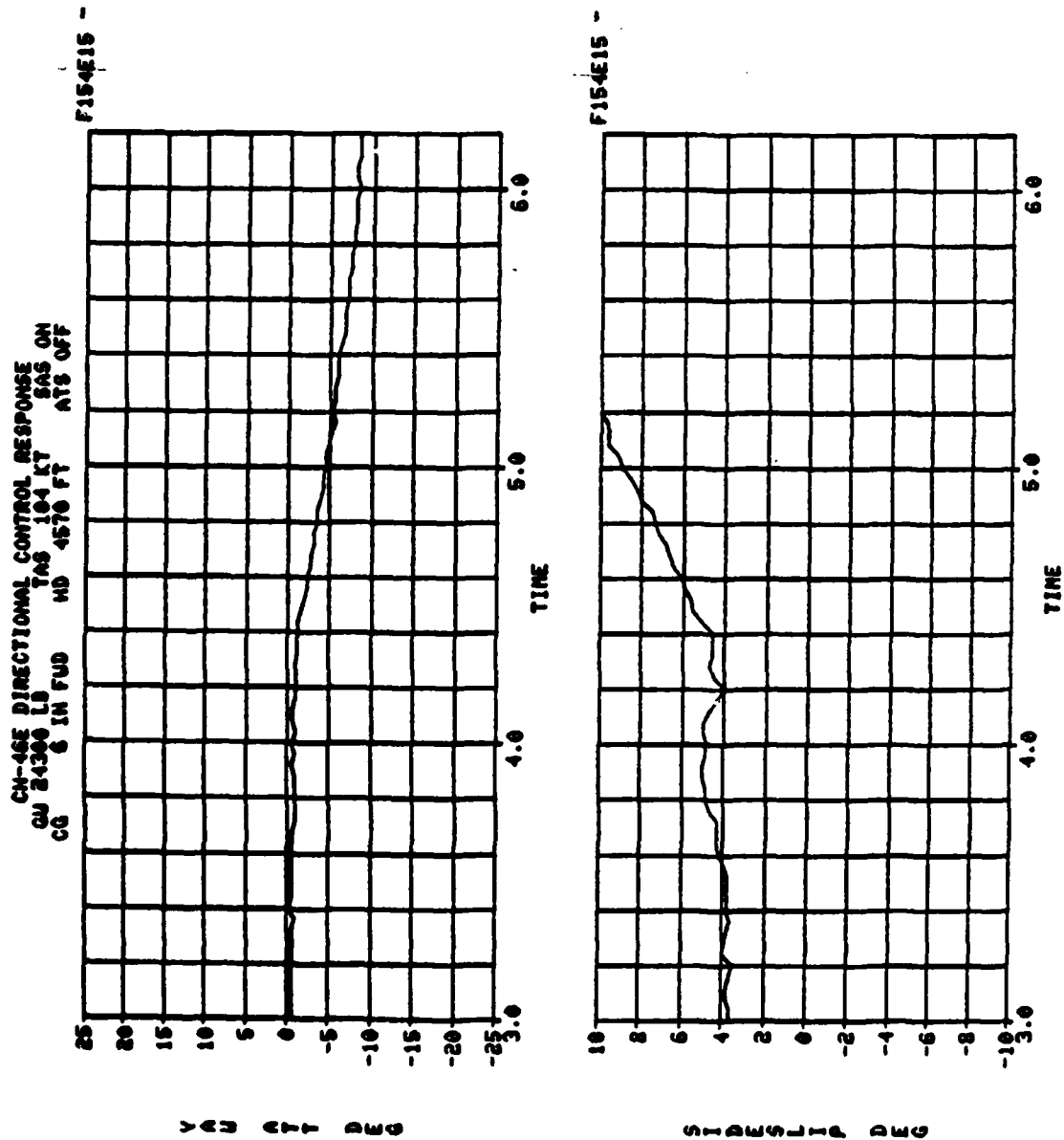


FIGURE 14B

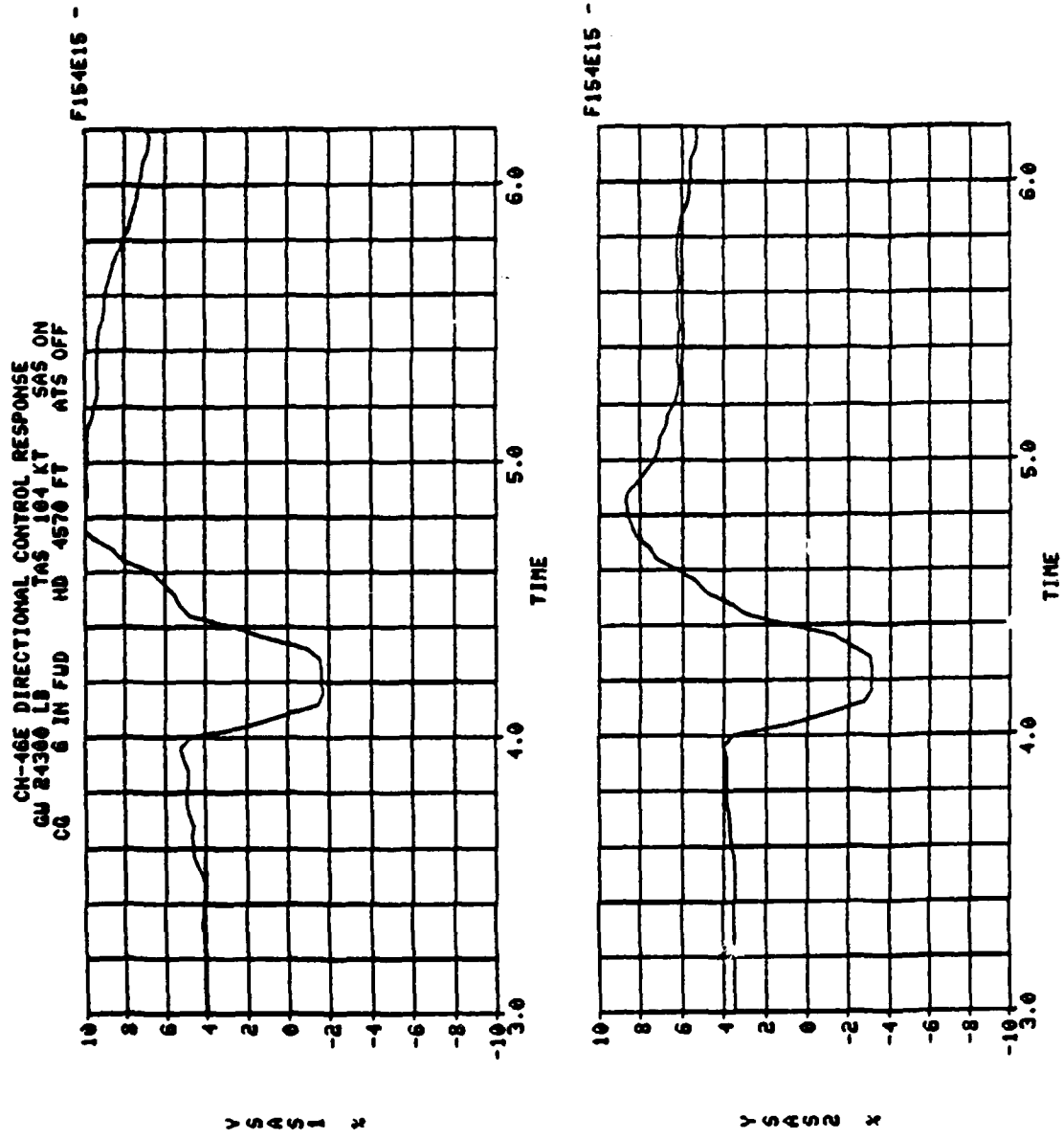


FIGURE 14C

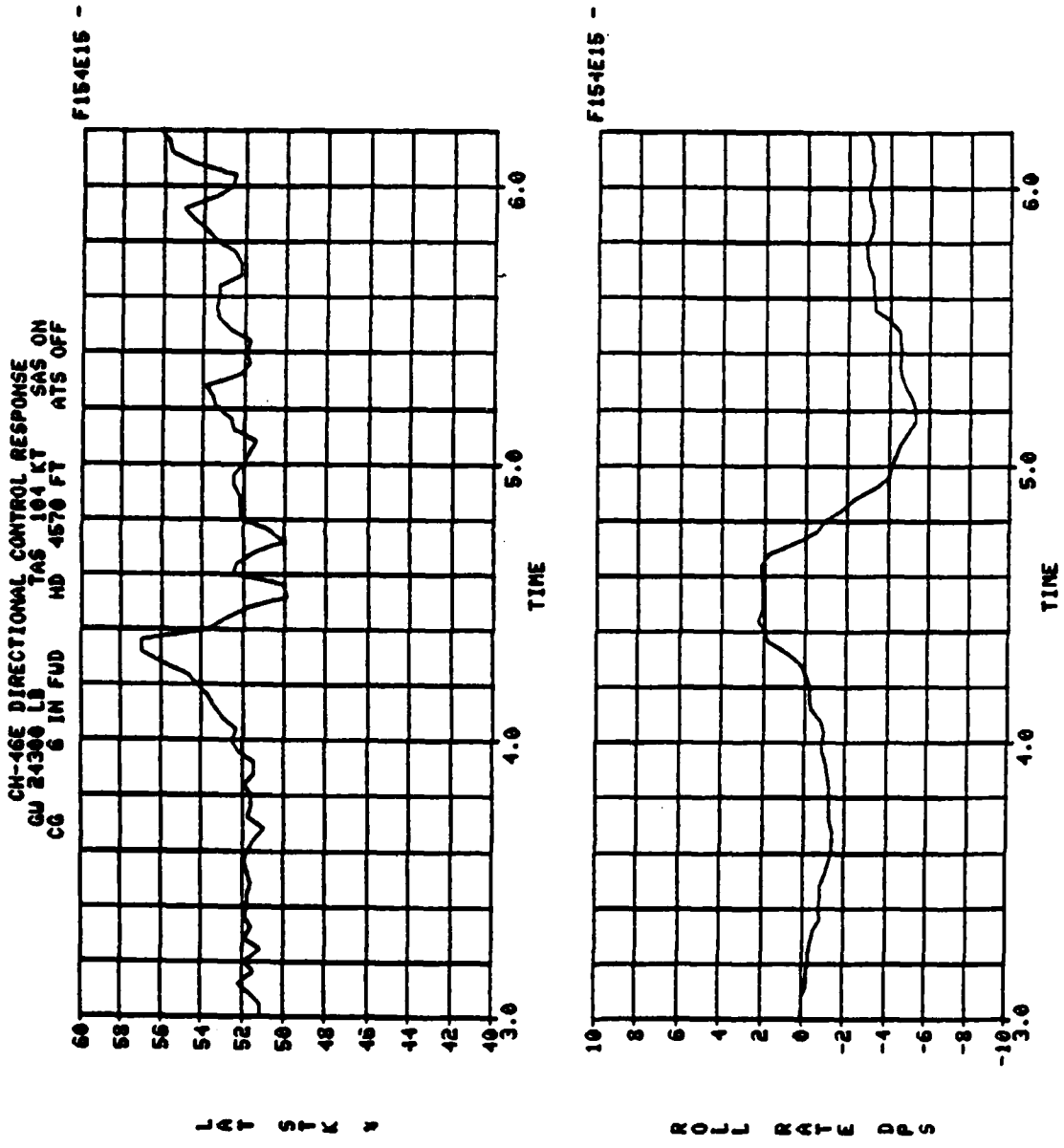
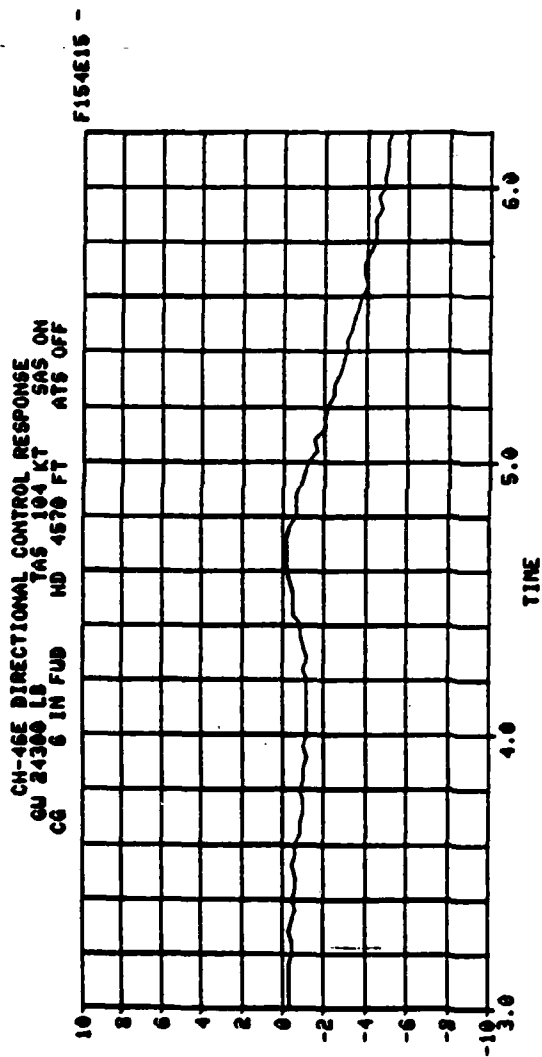
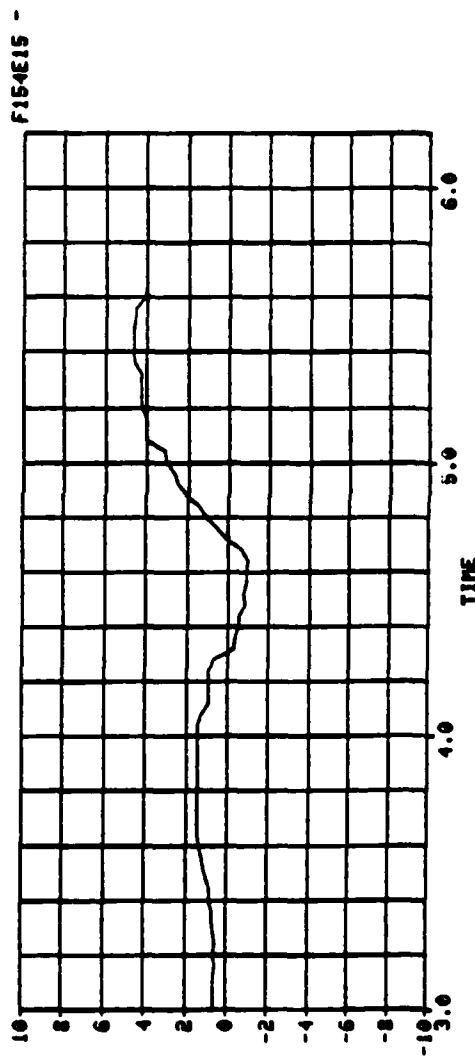


FIGURE 14D



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Y-AXIS

FIGURE 14E

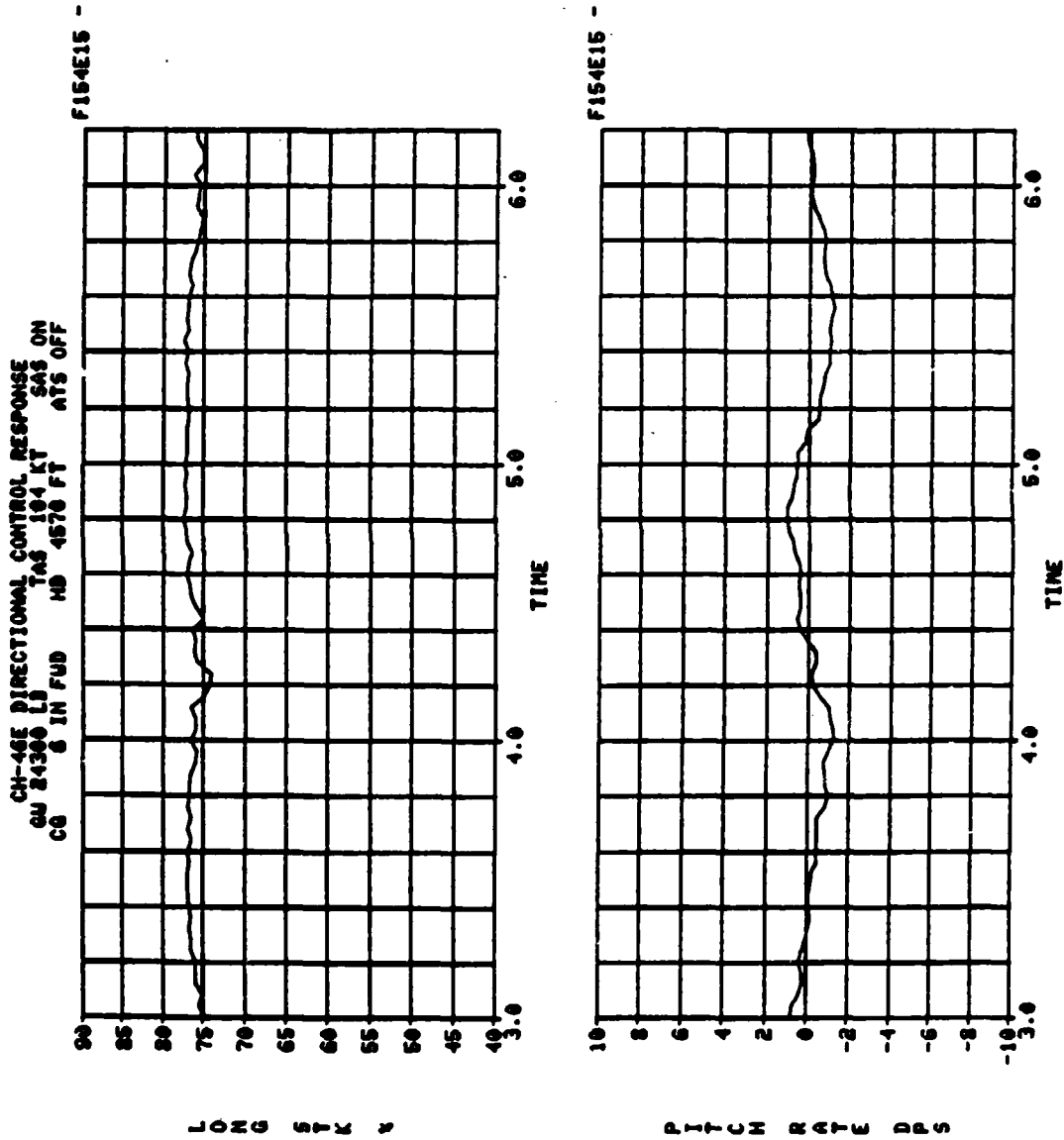


FIGURE 14F

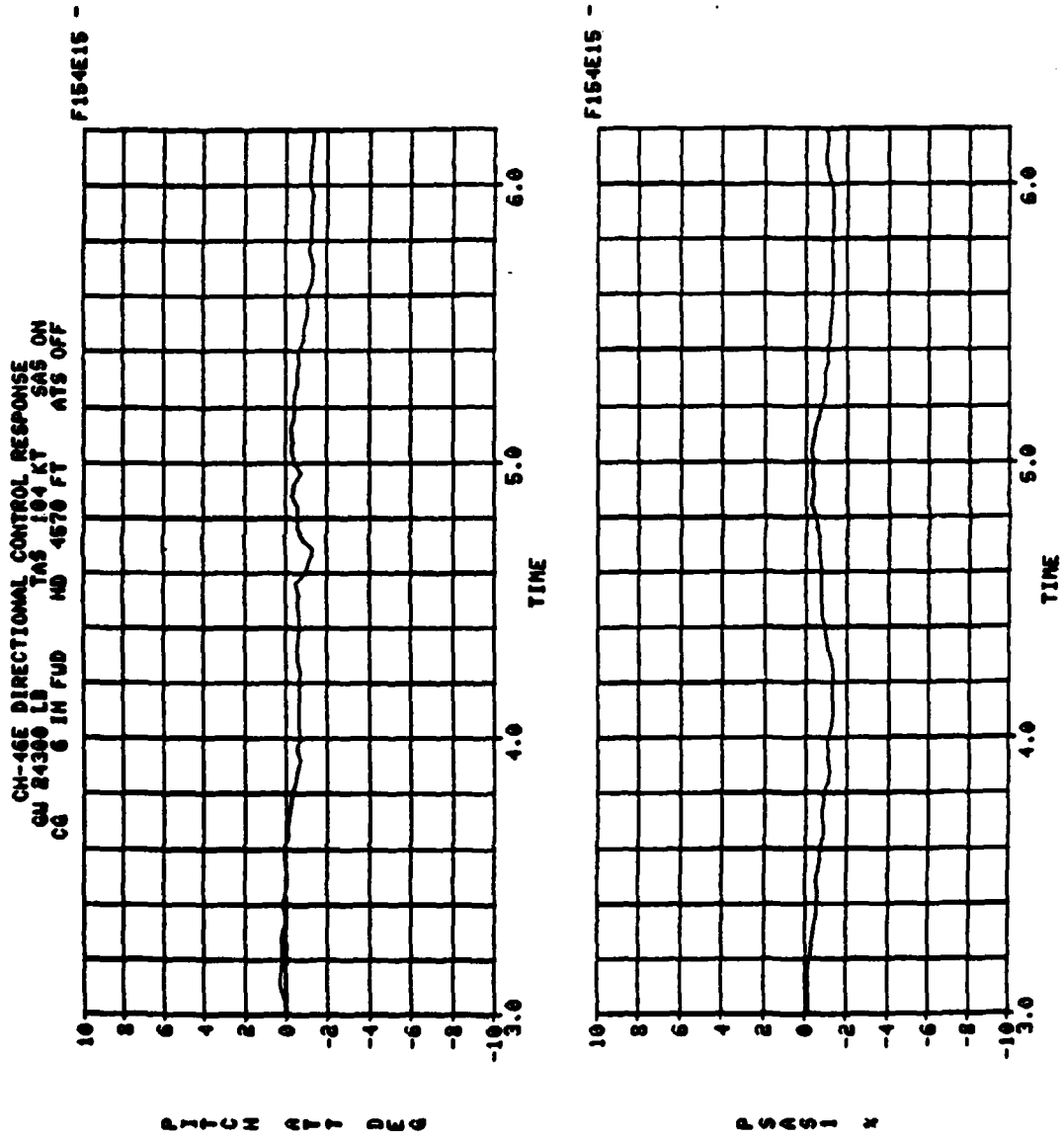


FIGURE 14G

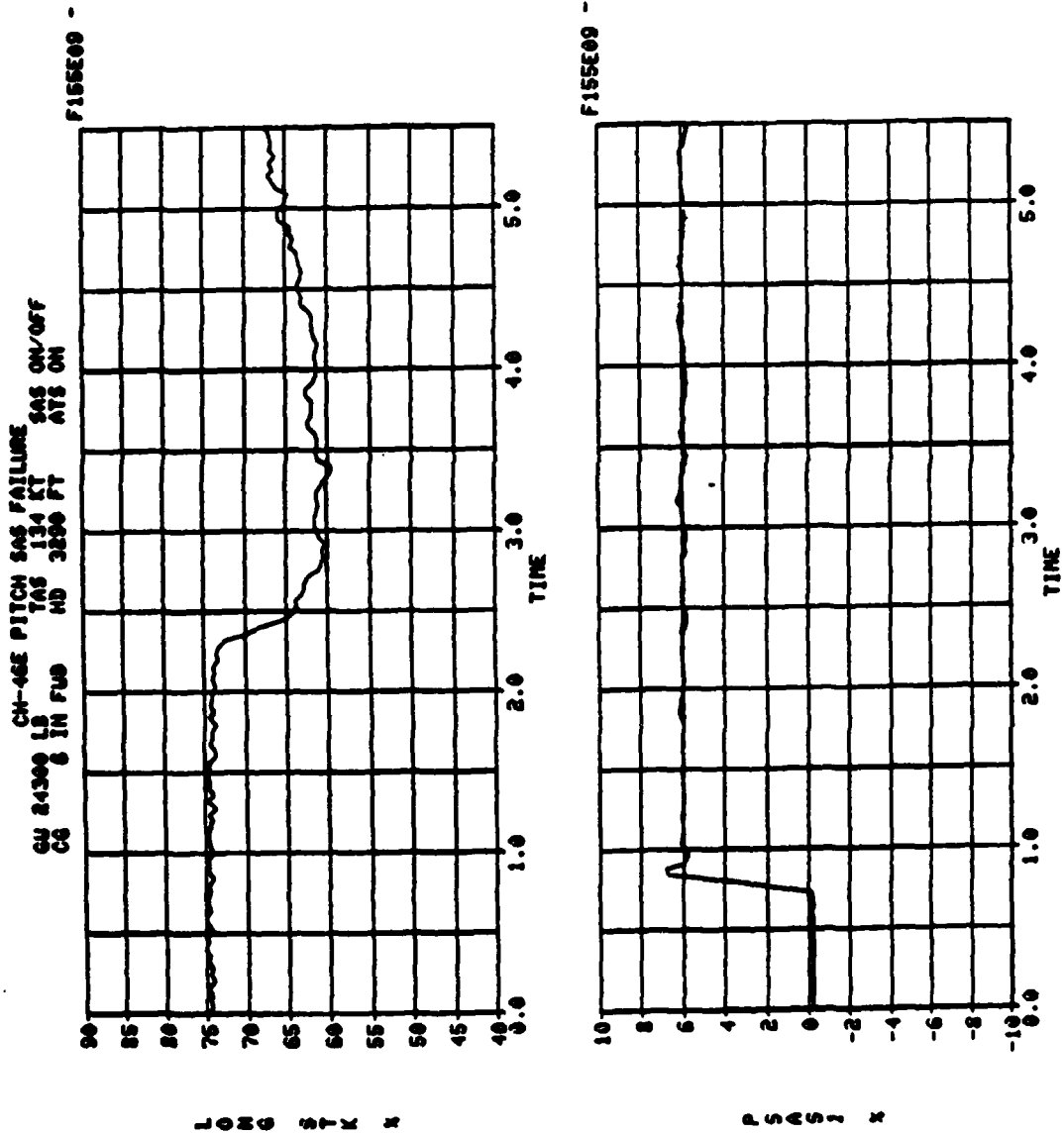


FIGURE 15A

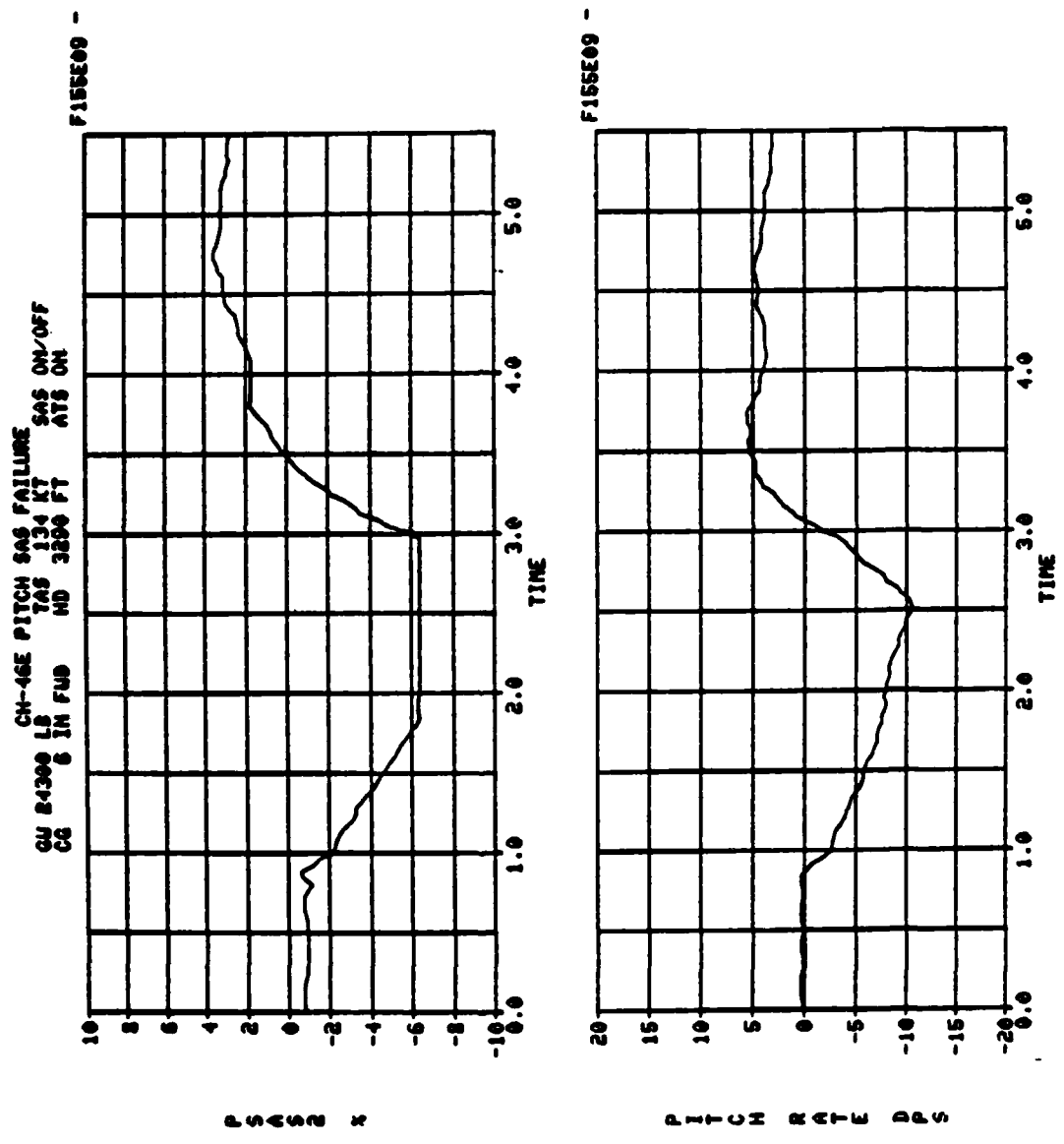


FIGURE 15B

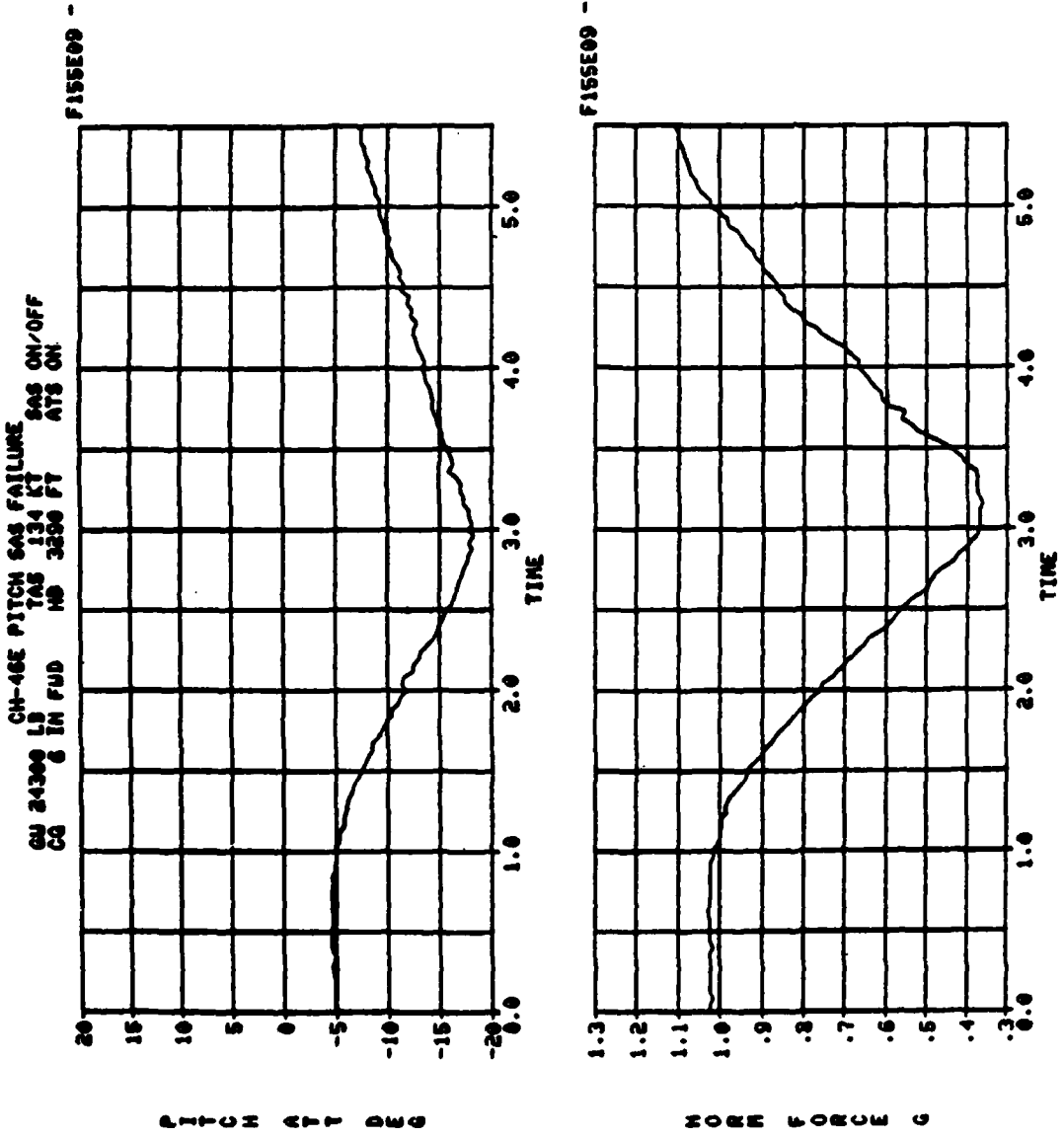


FIGURE 15C

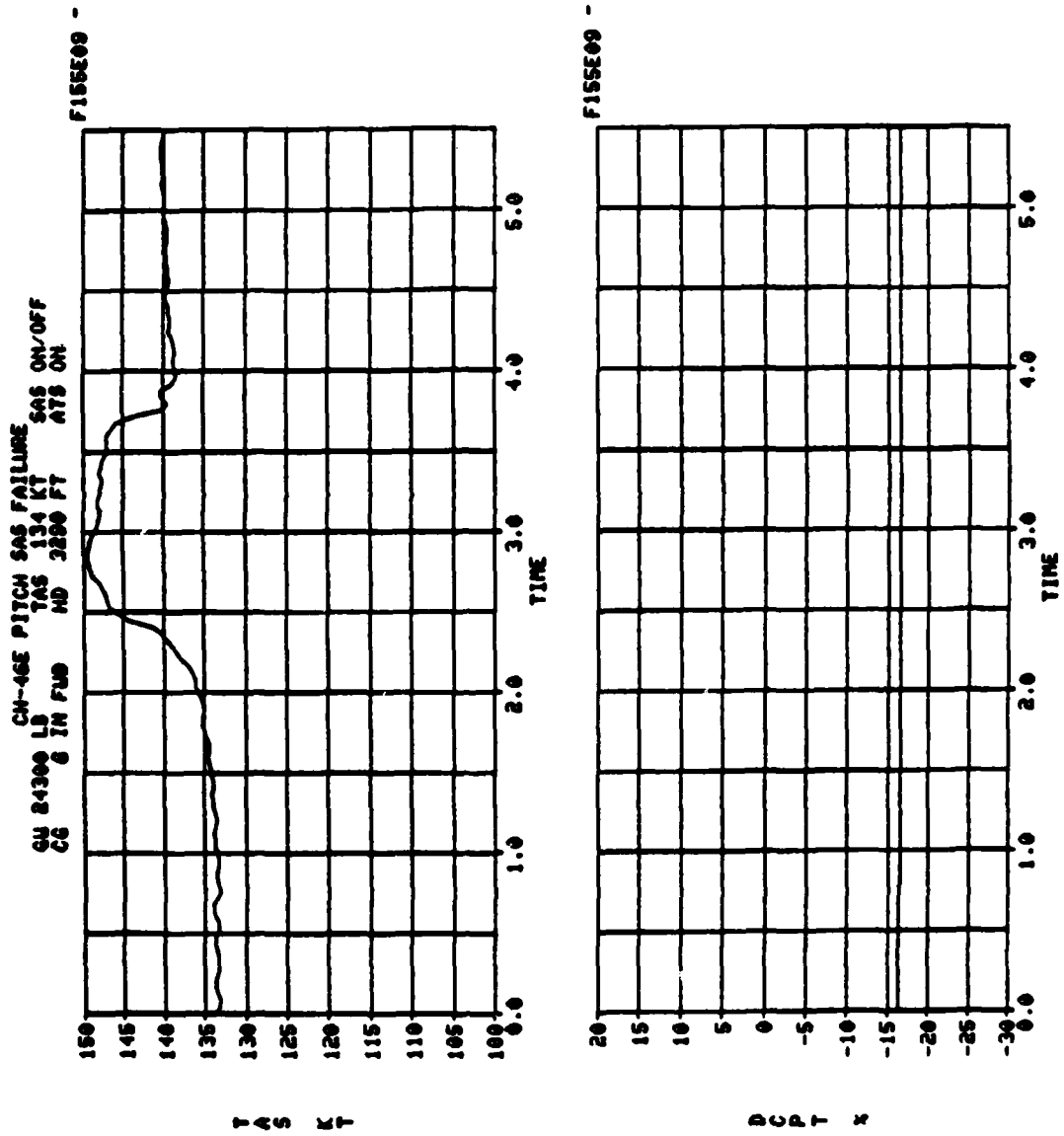


FIGURE 15D

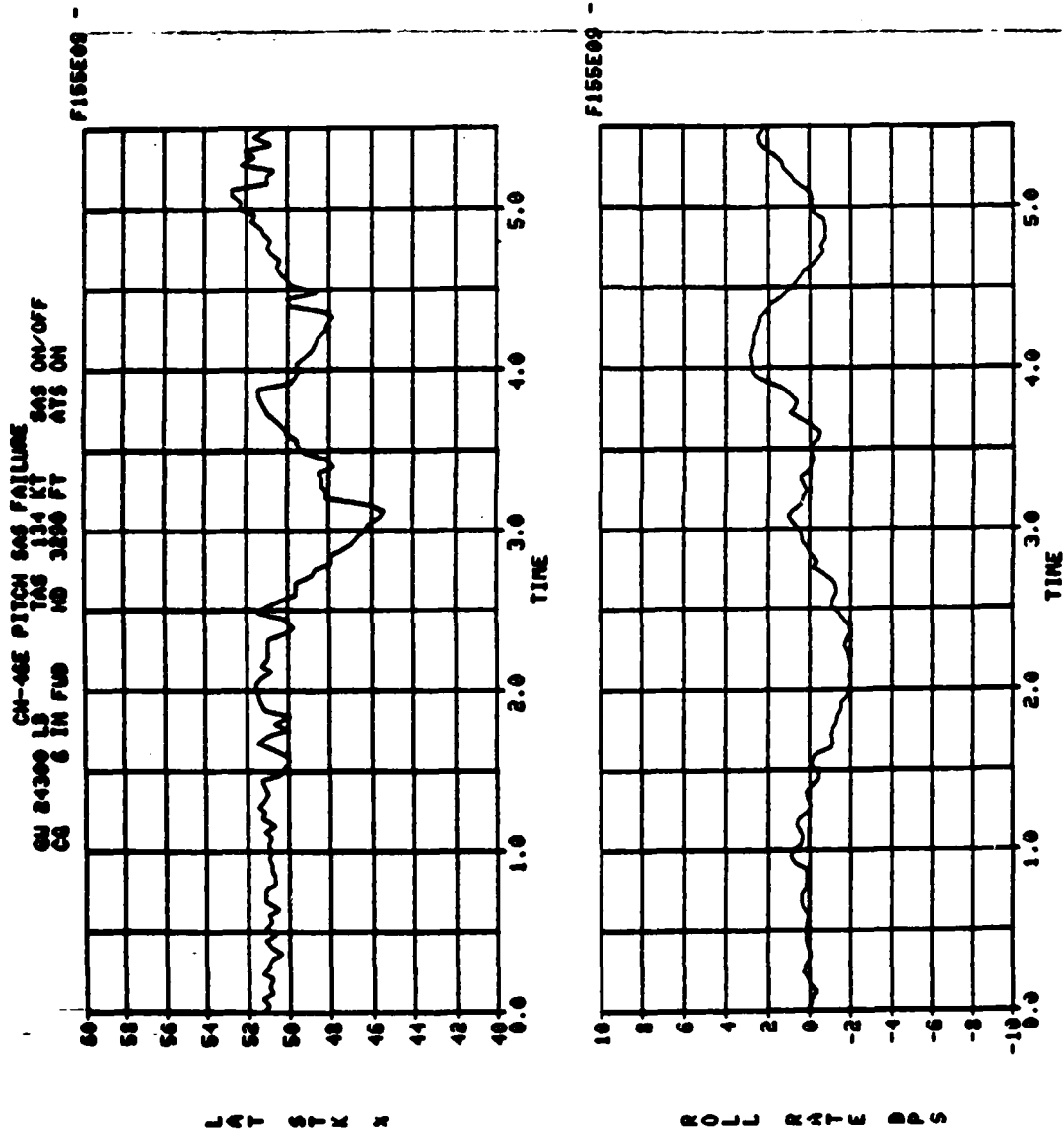


FIGURE 15E

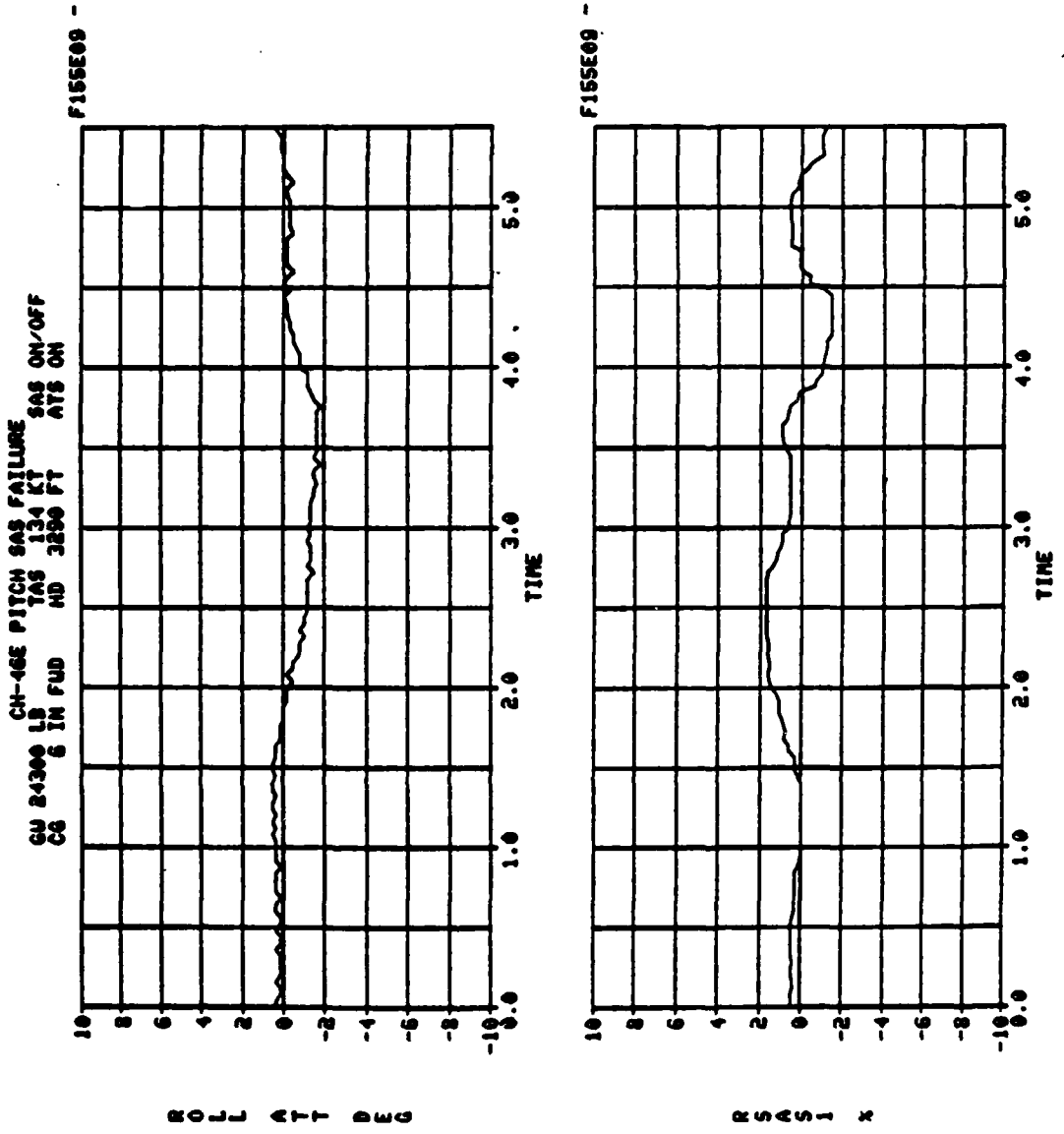


FIGURE 15F

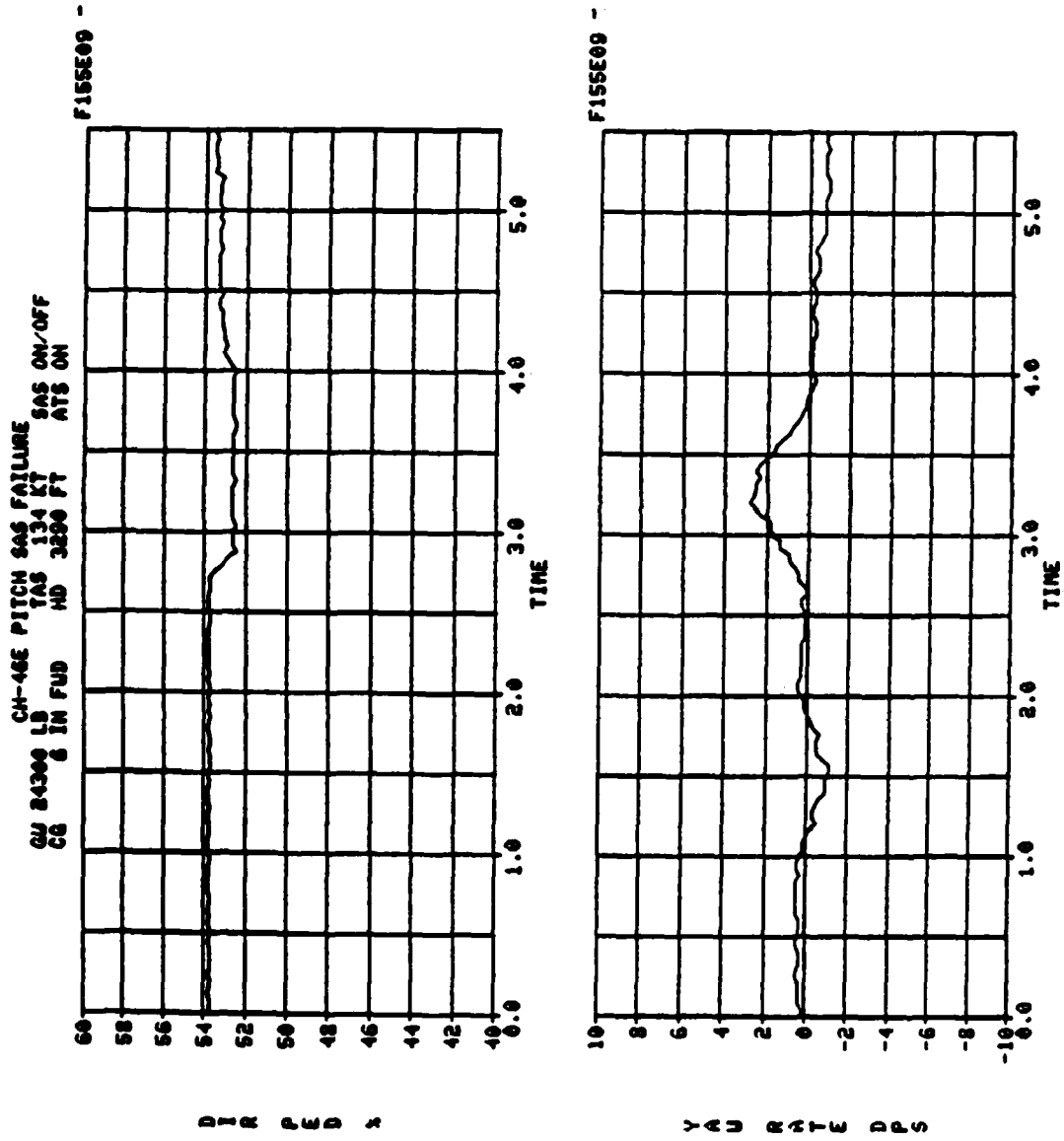


FIGURE 15G

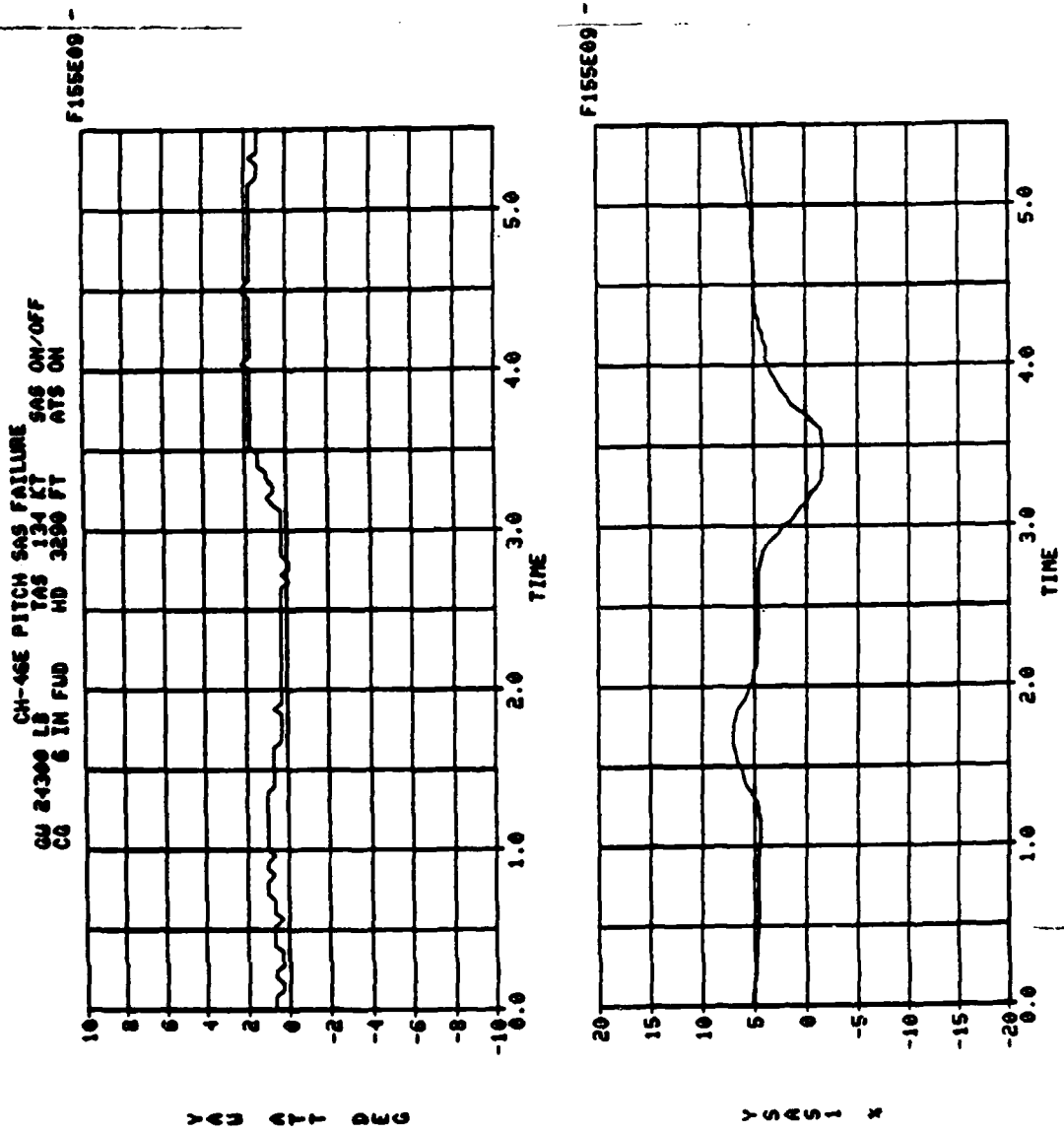


FIGURE 15H

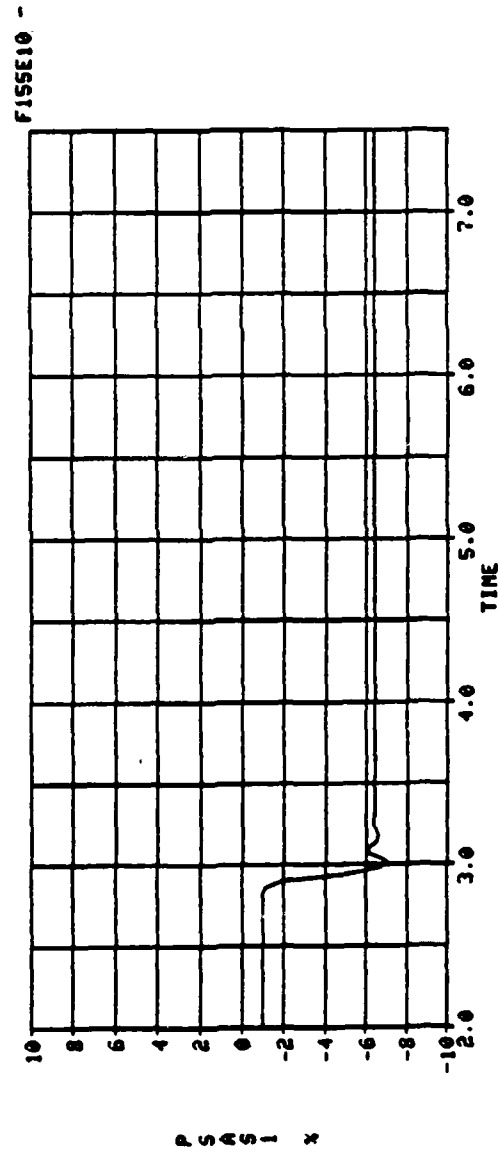
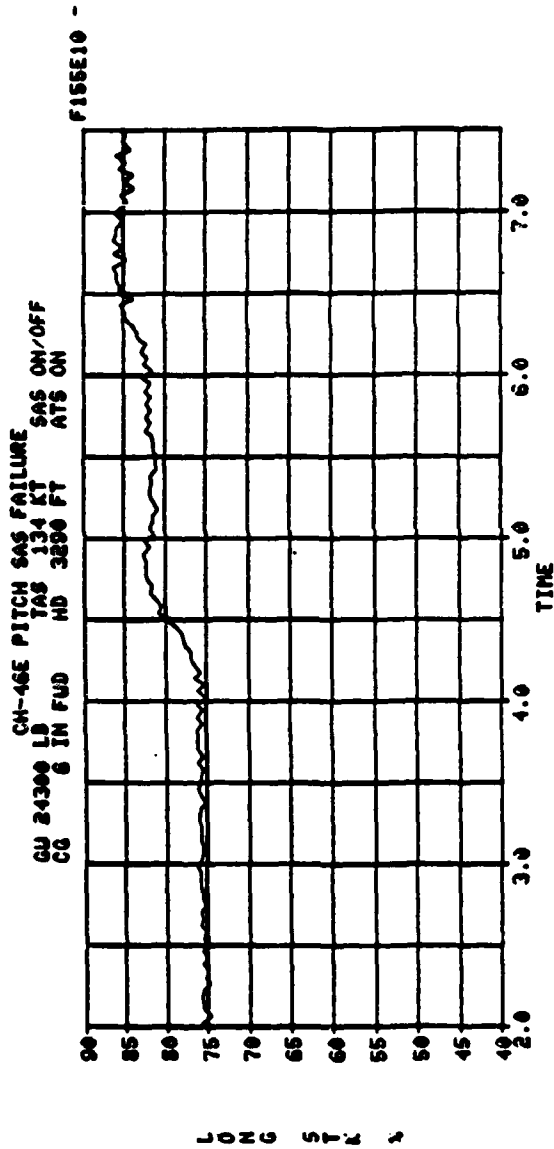


FIGURE 16A

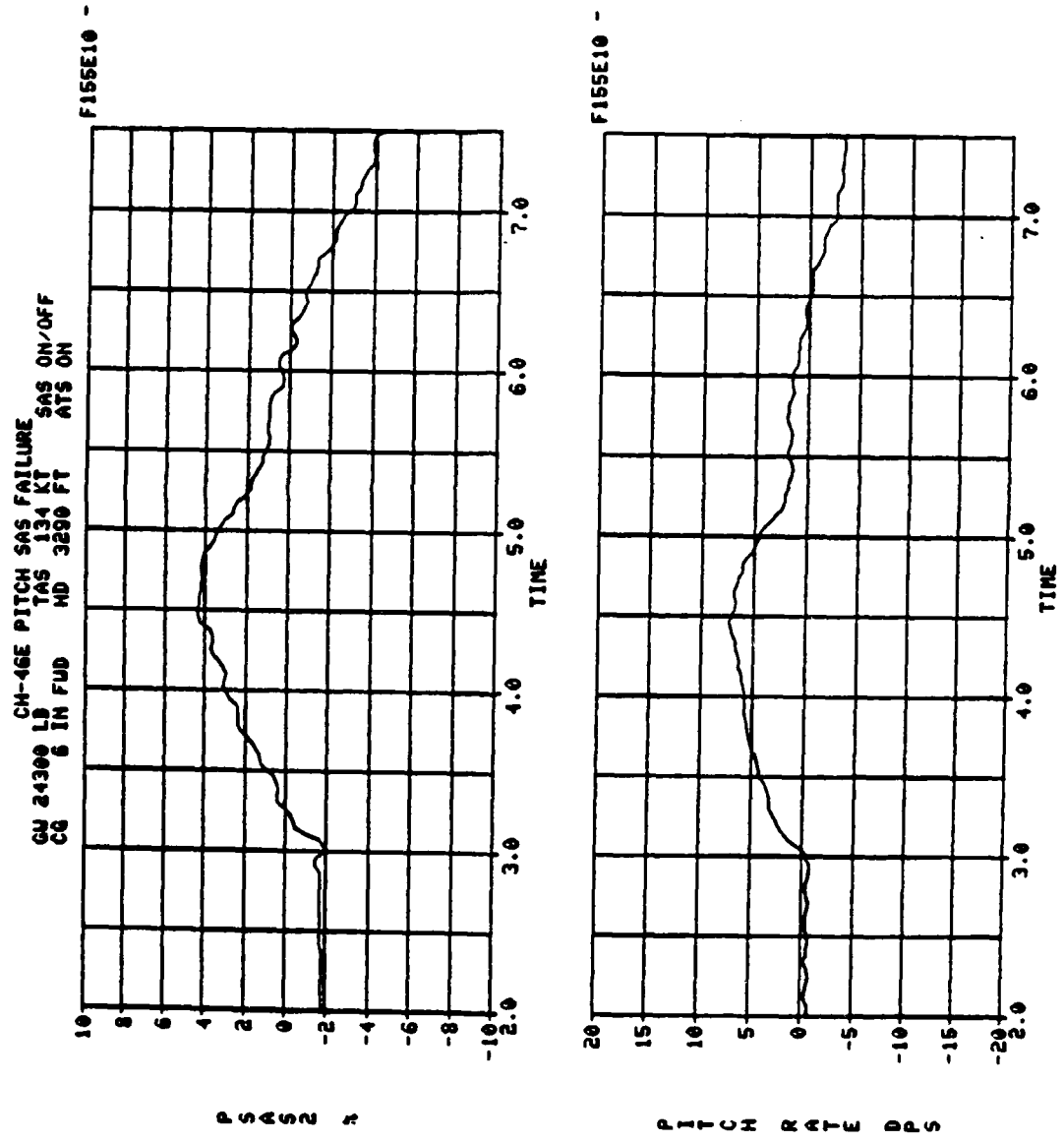


FIGURE 16B

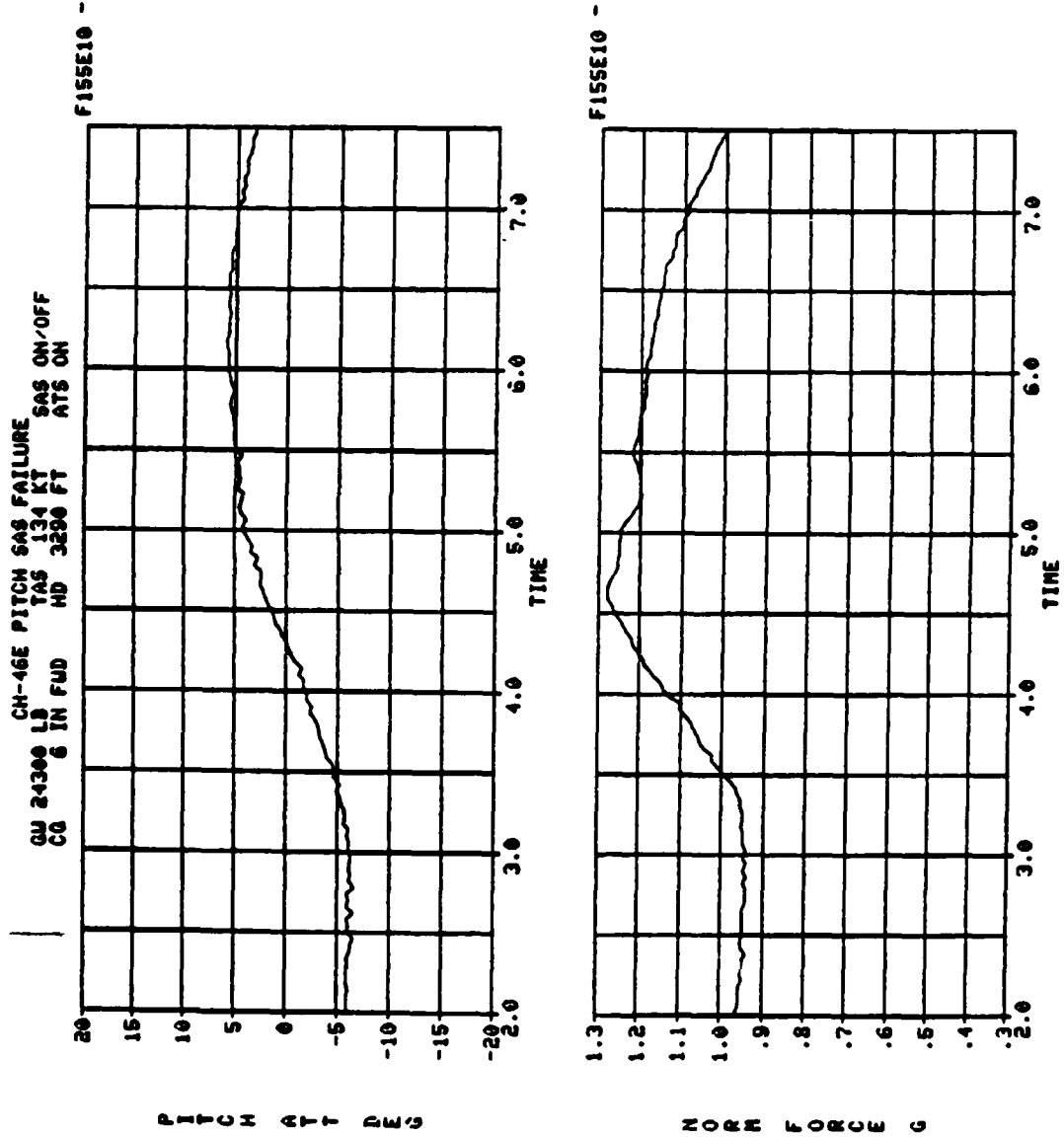


FIGURE 16C

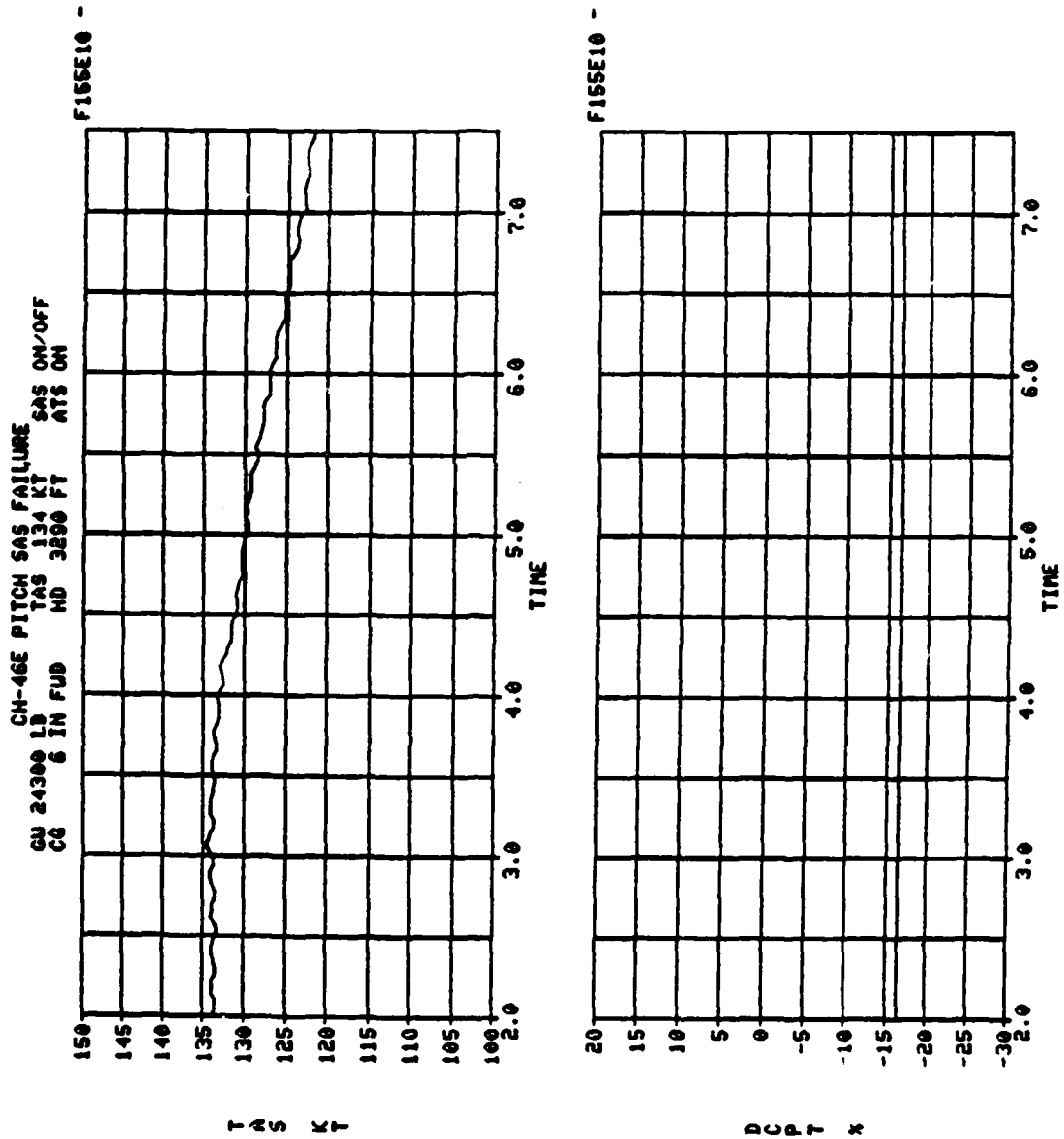


FIGURE 160

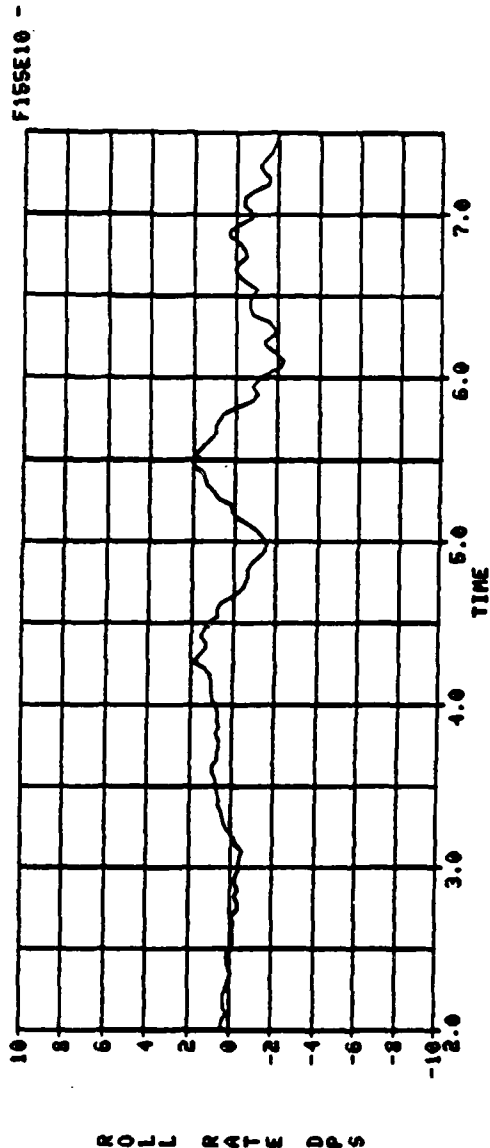
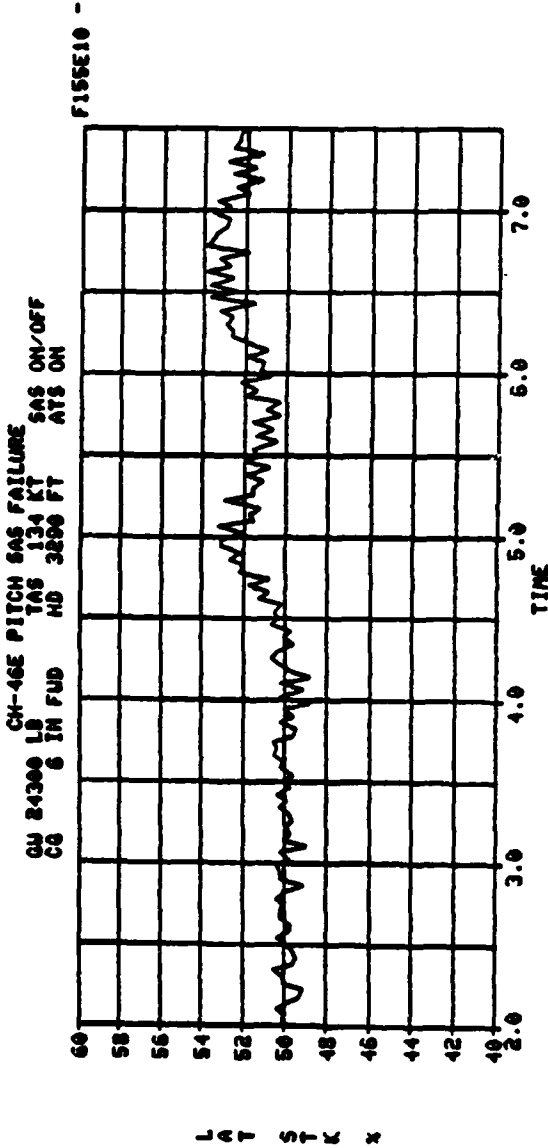


FIGURE 16E

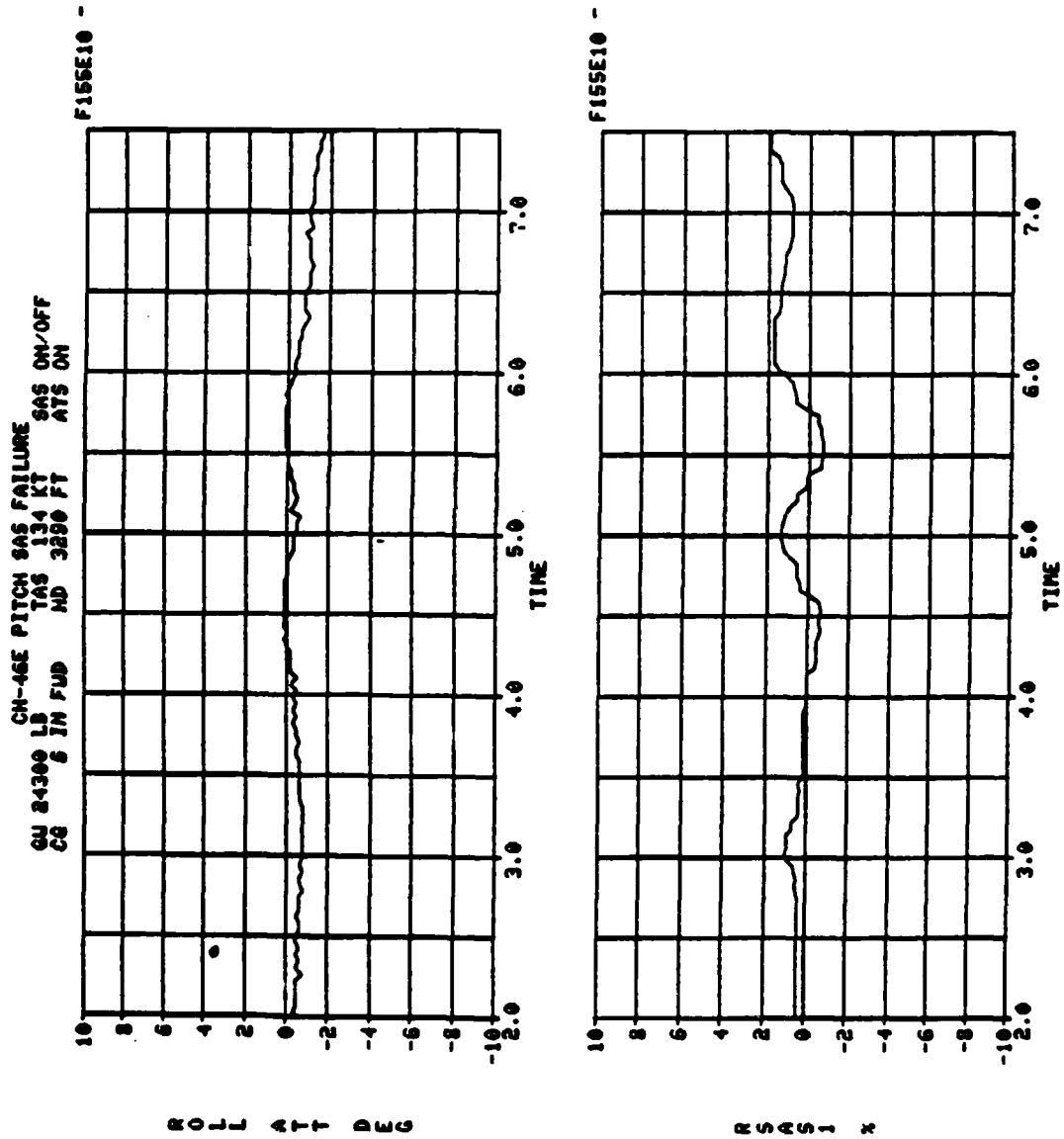


FIGURE 16F

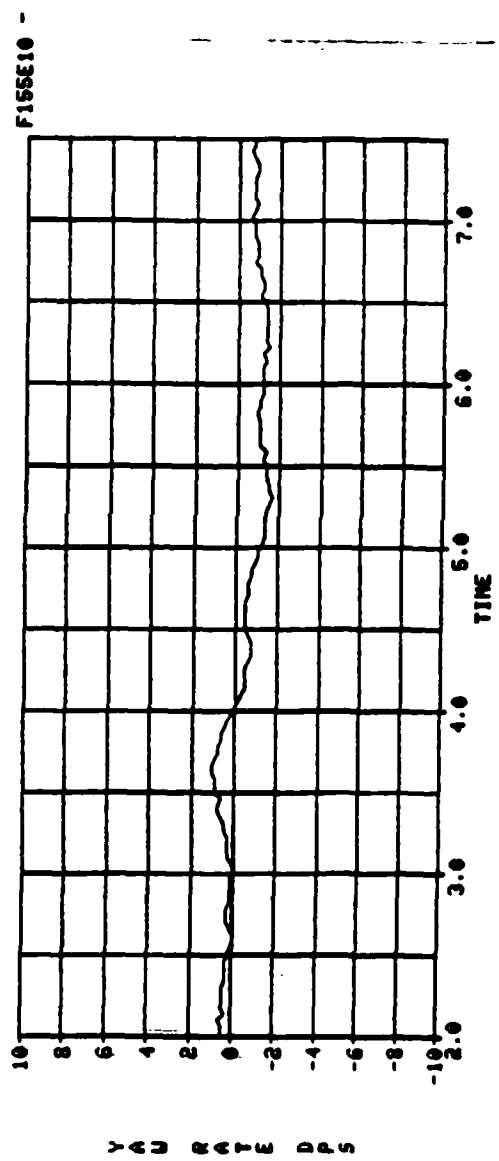
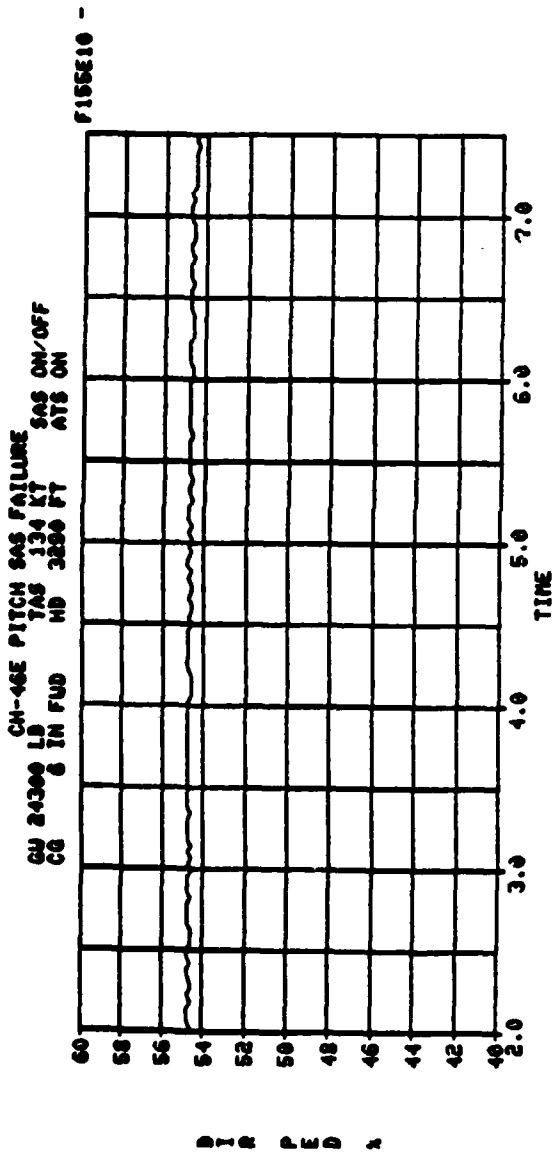


FIGURE 16G

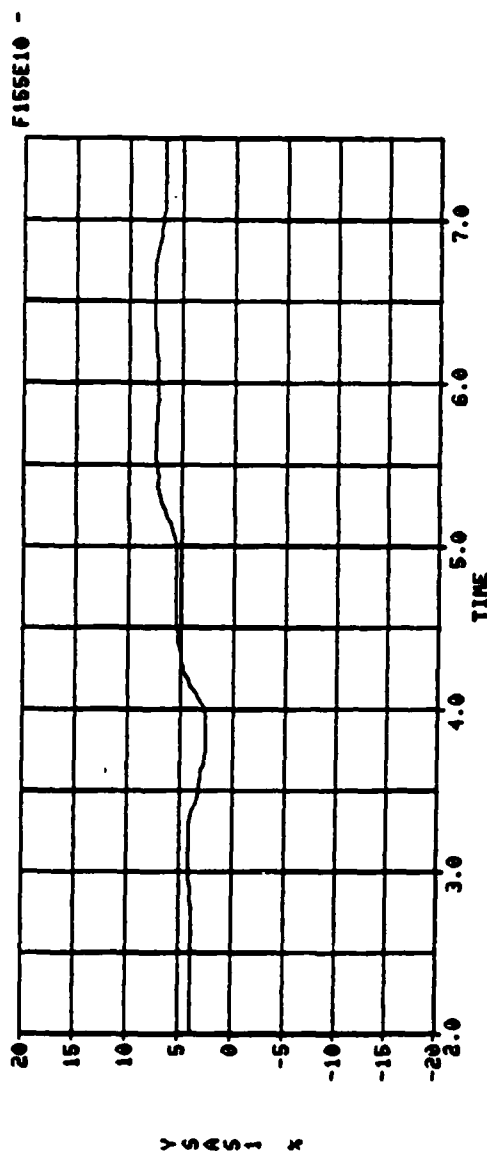
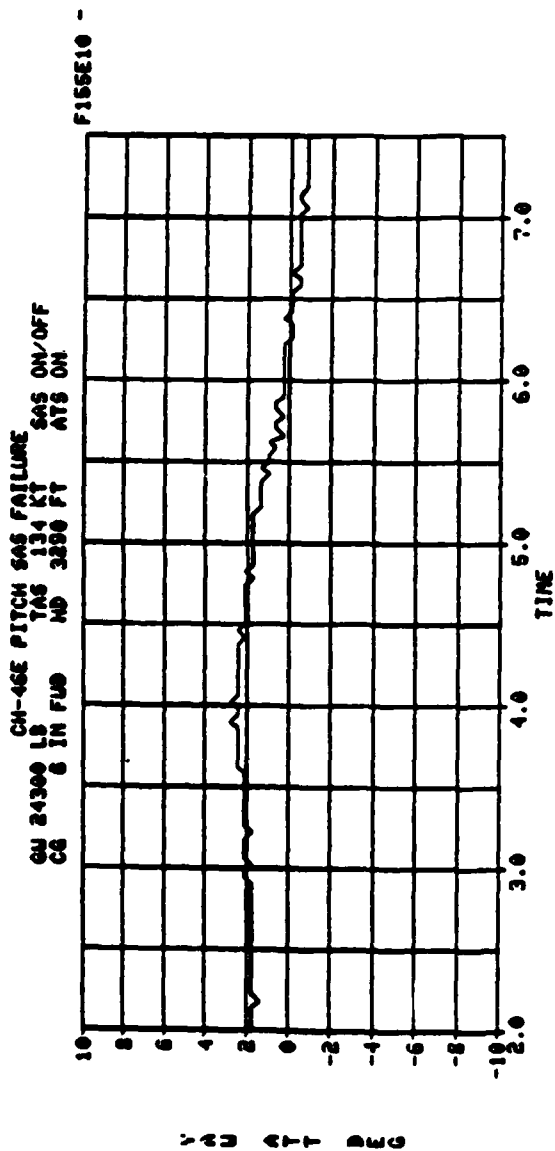


FIGURE 16H

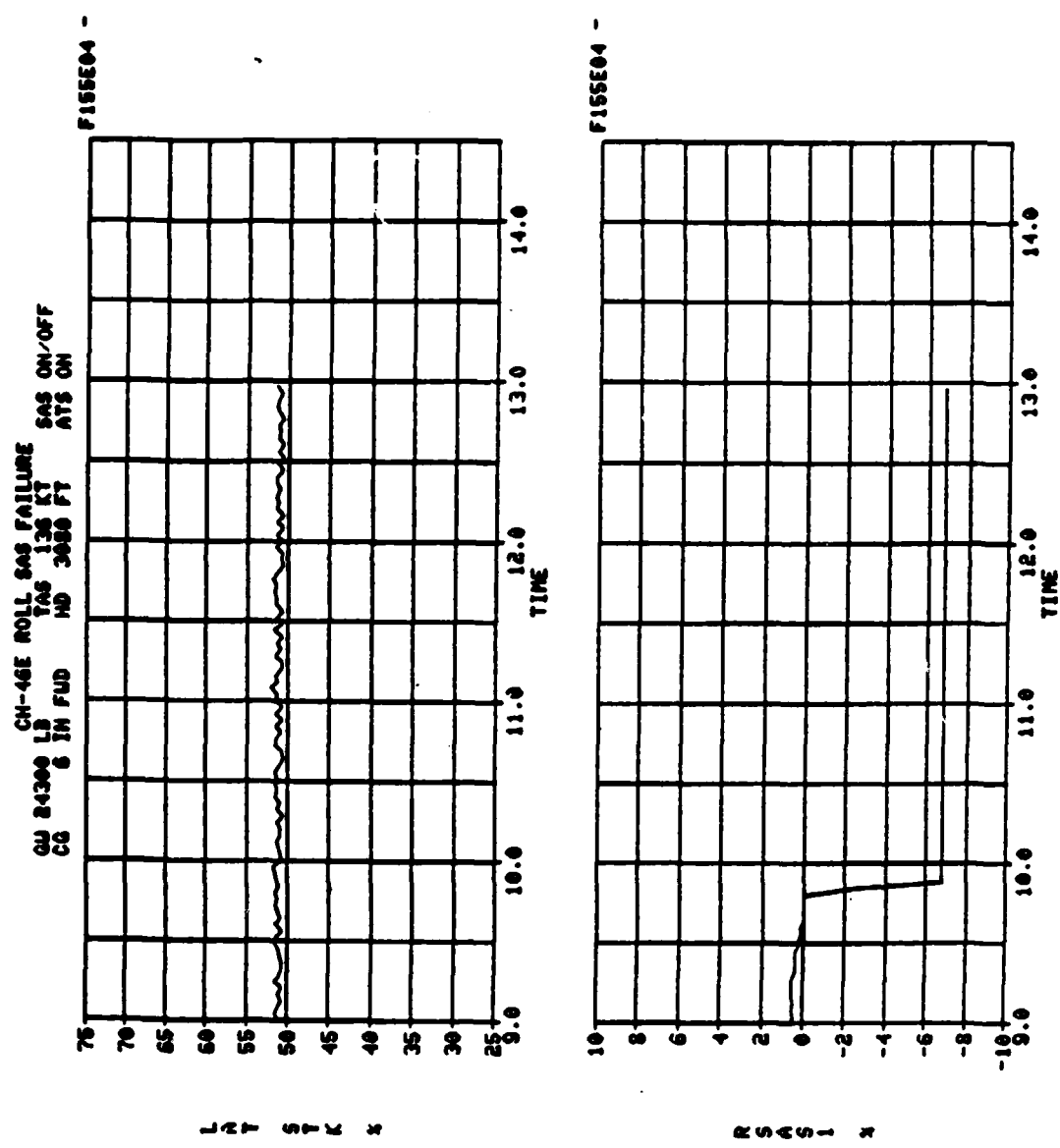


FIGURE 17A

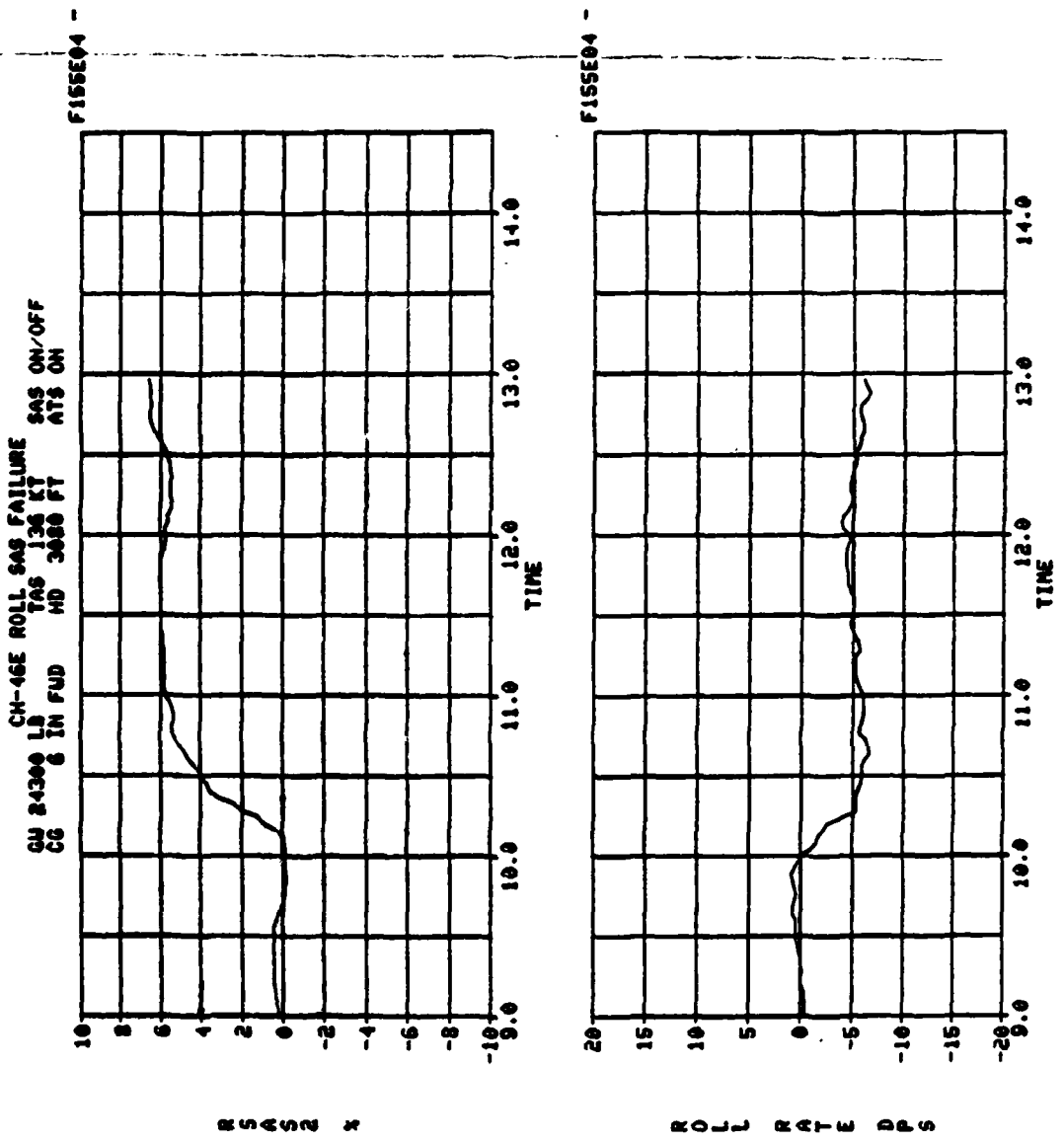


FIGURE 17B

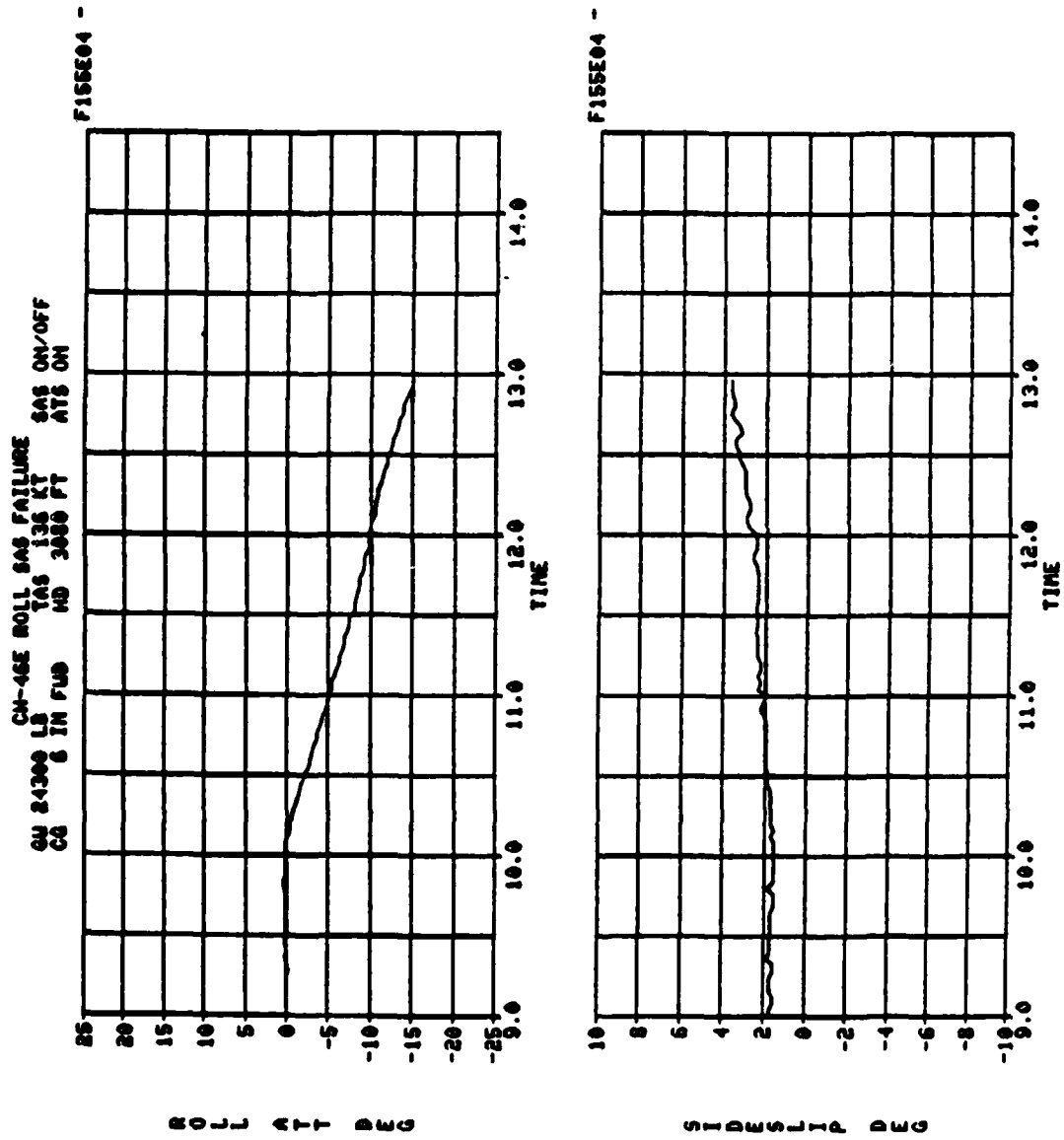


FIGURE 17C

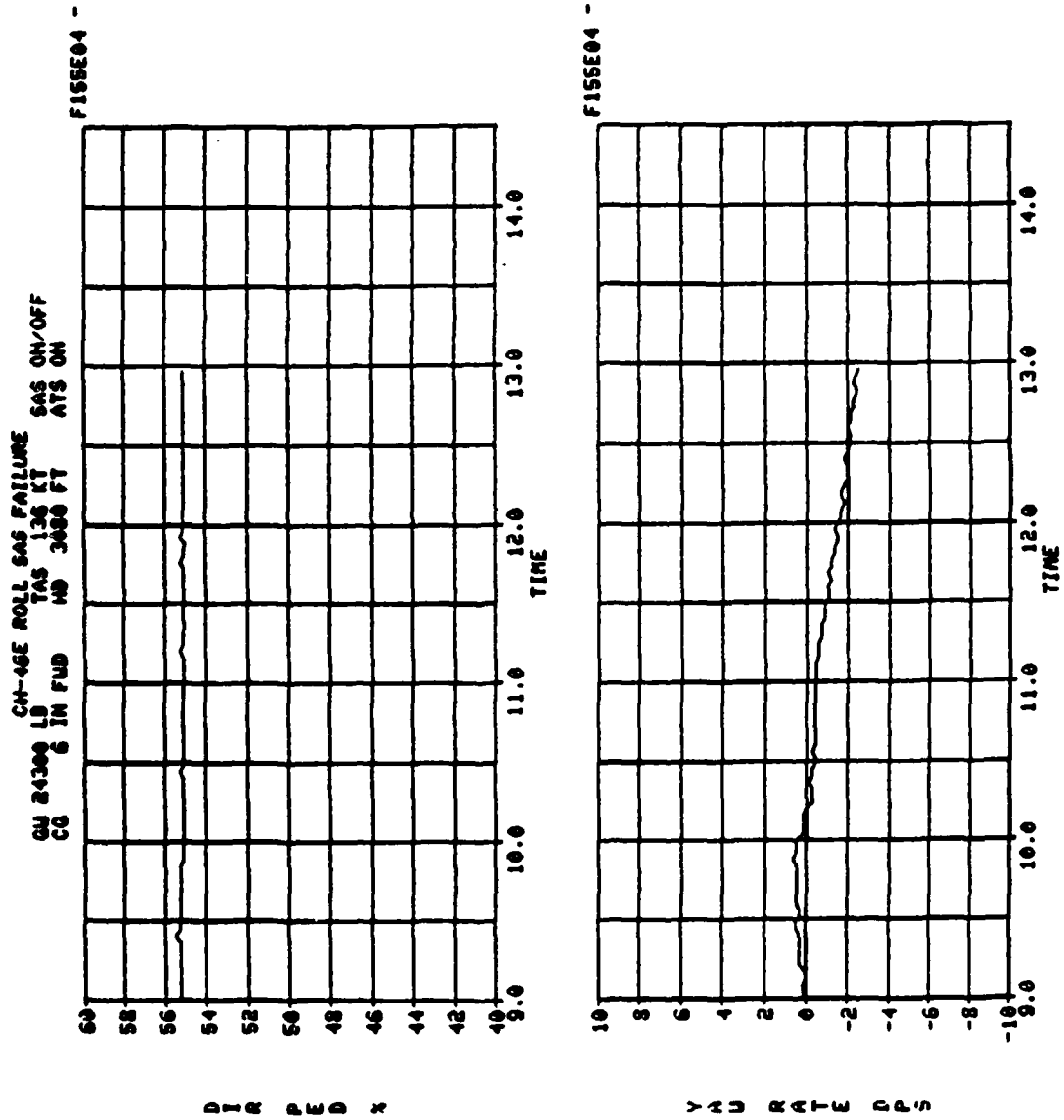


FIGURE 17D

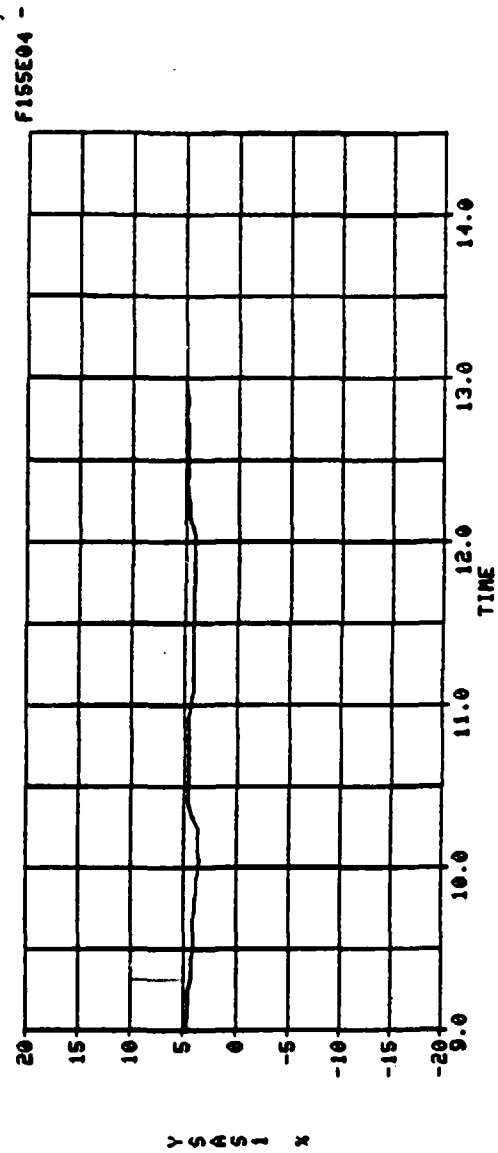
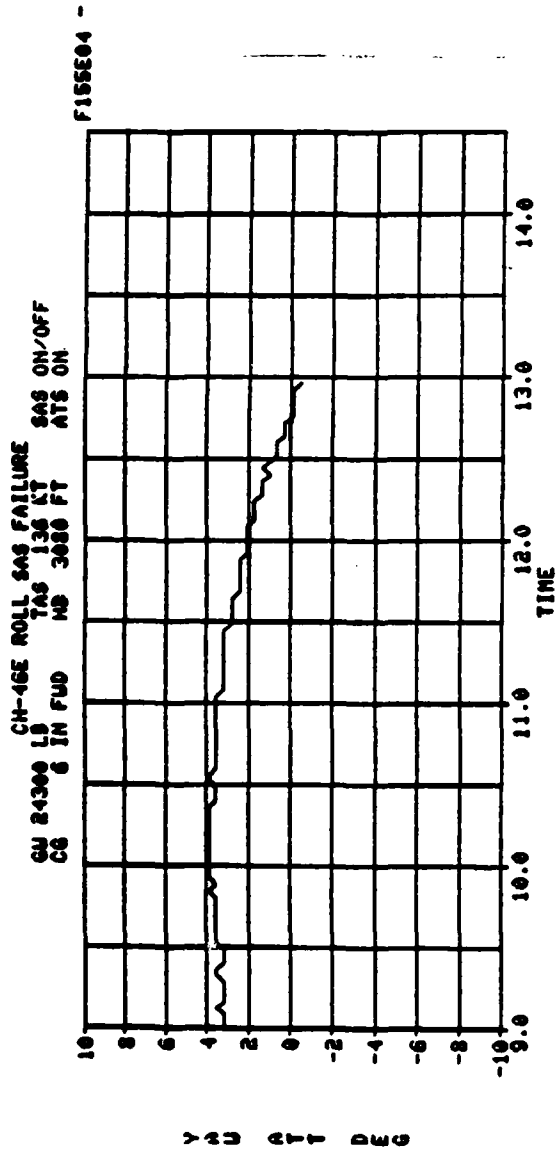


FIGURE 17E

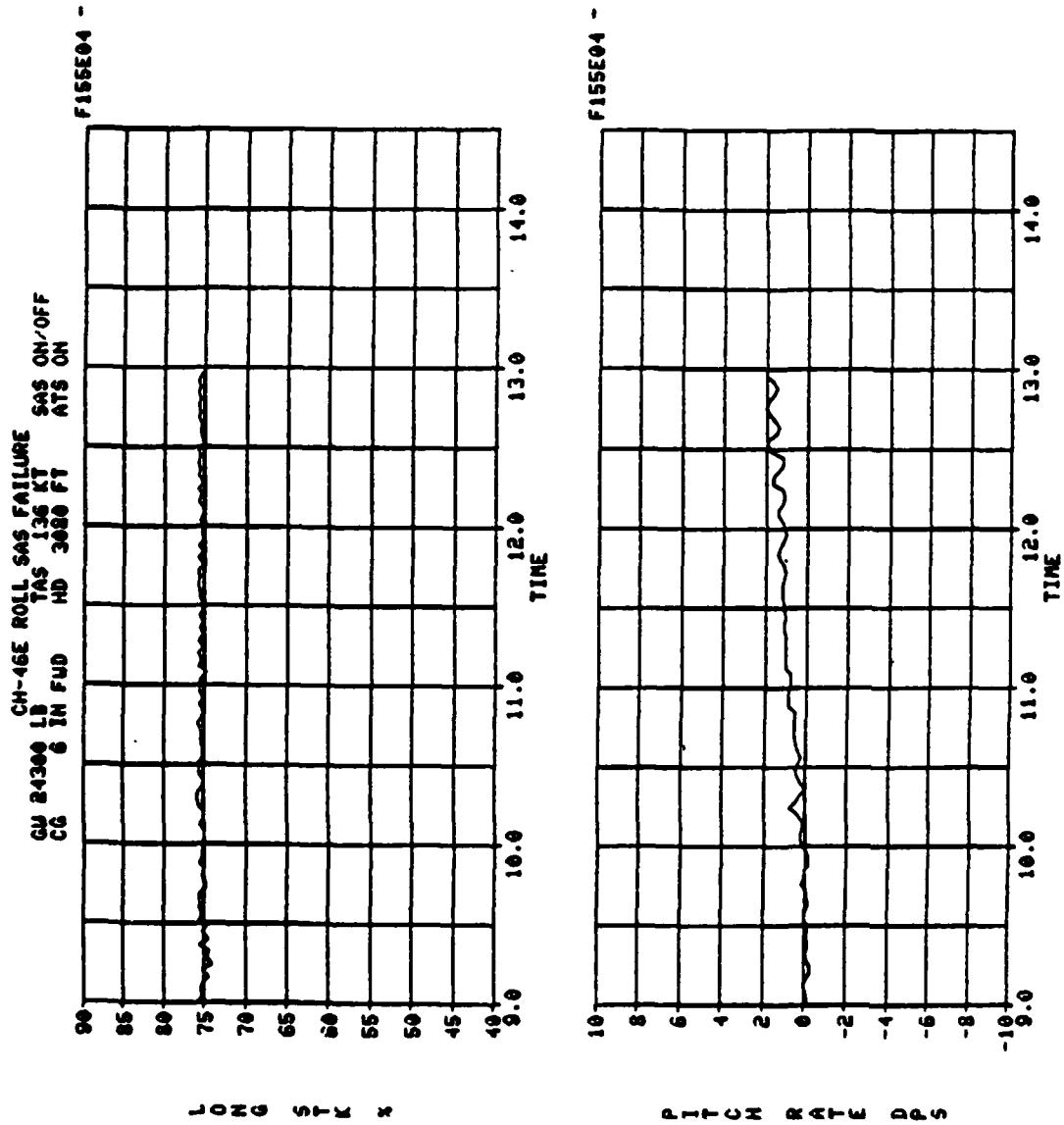


FIGURE 17F

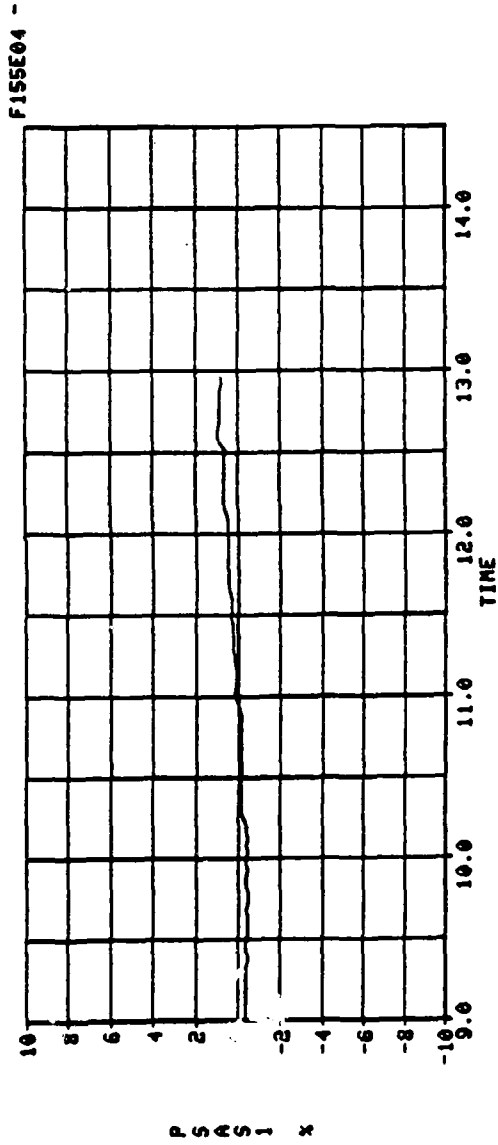
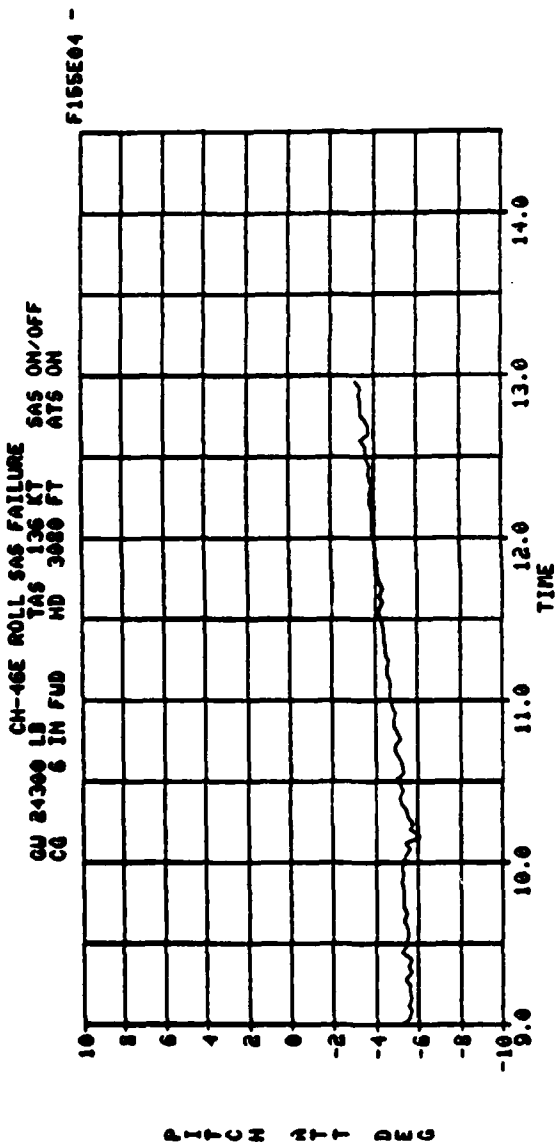


FIGURE 17G

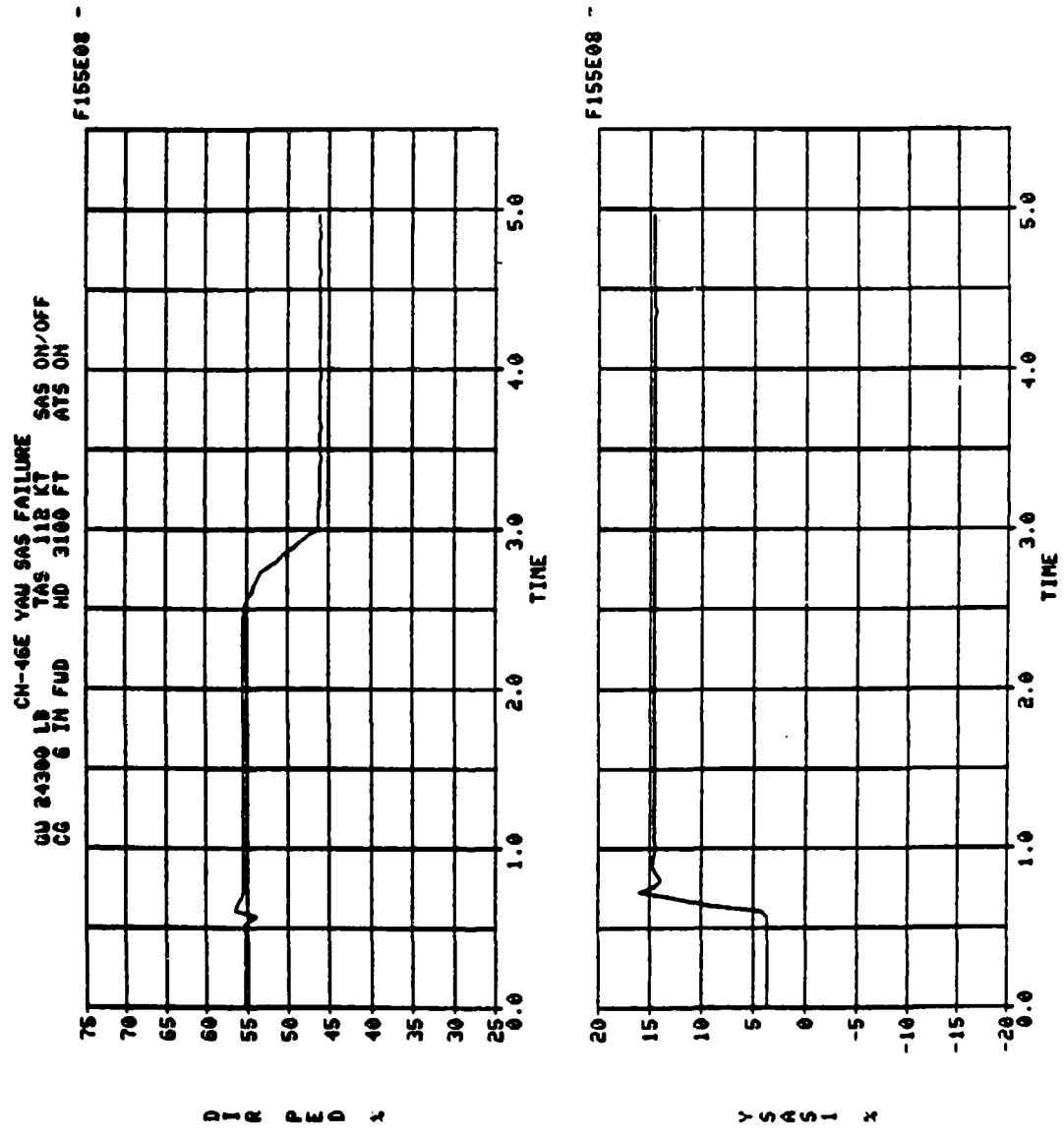


FIGURE 18A

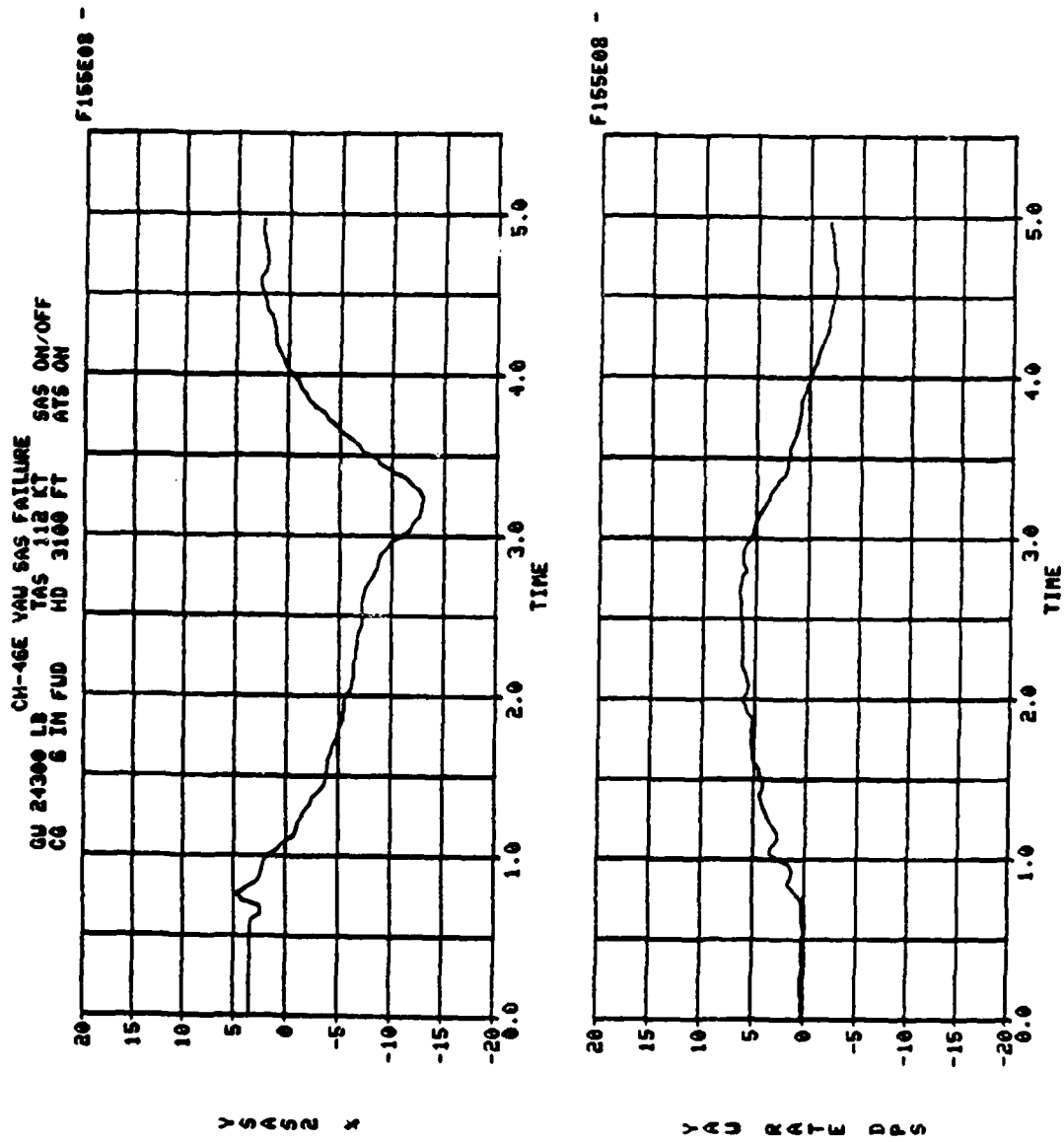


FIGURE 18B

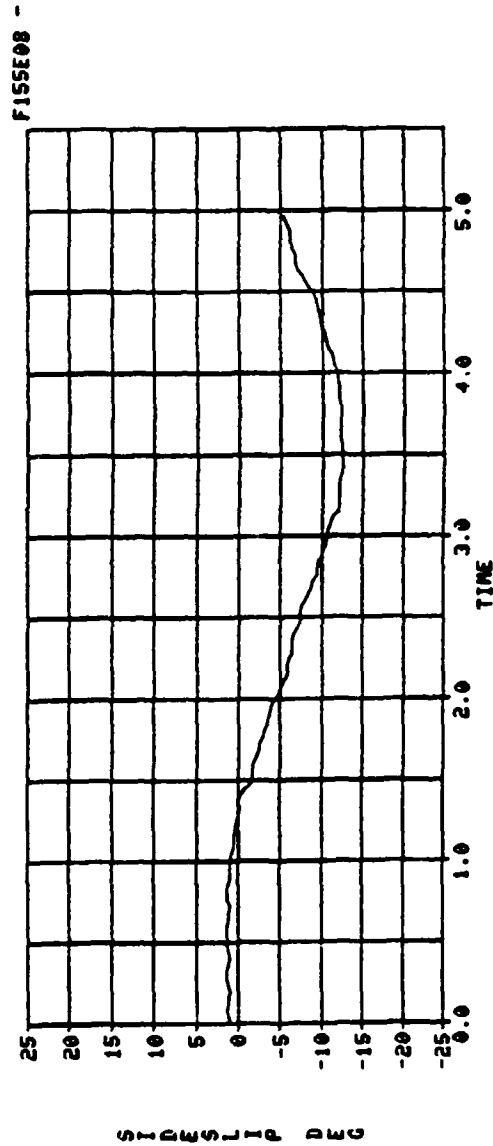
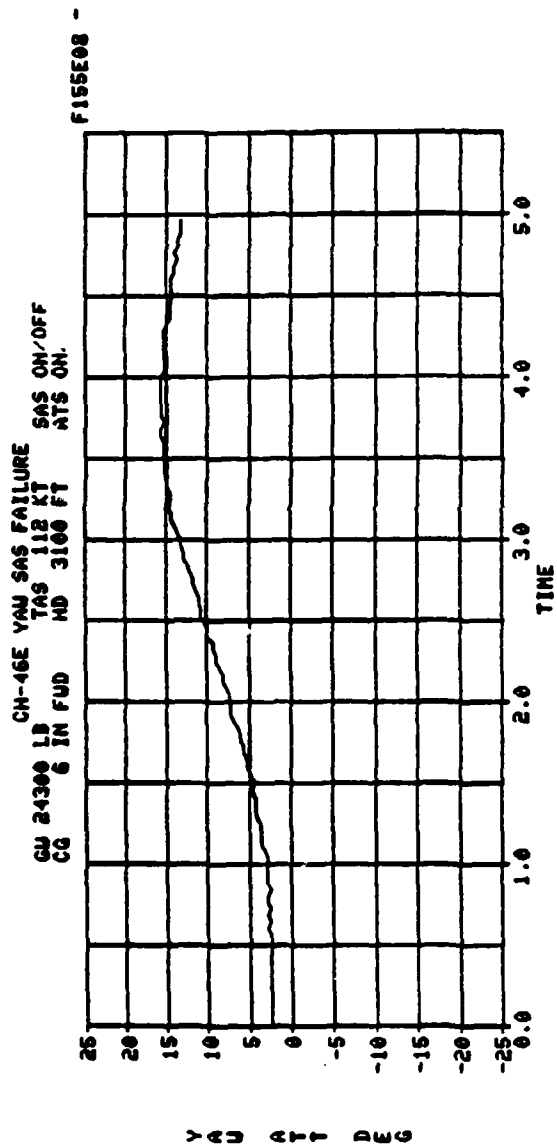


FIGURE 18C

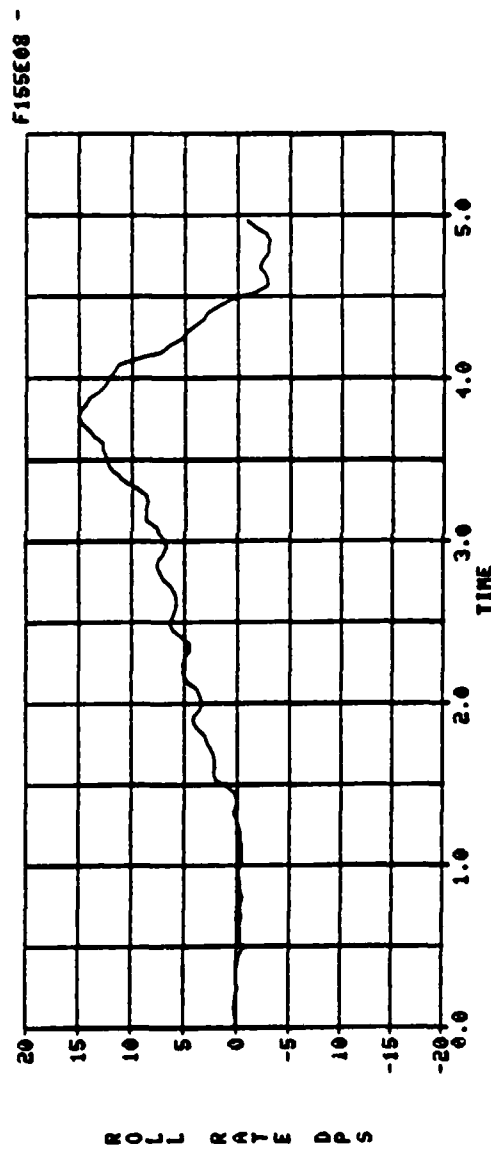
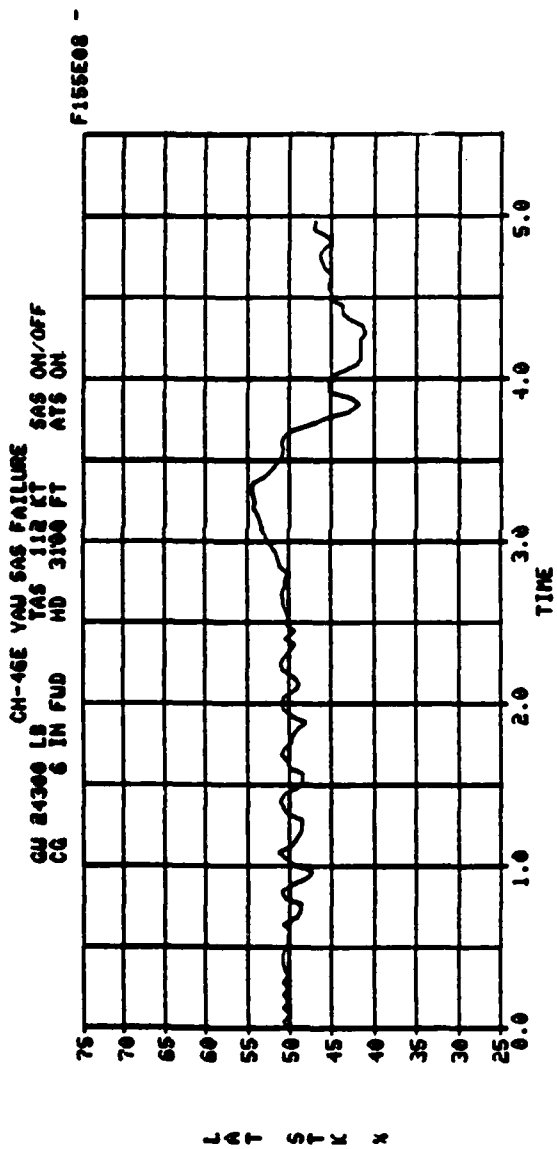


FIGURE 18D

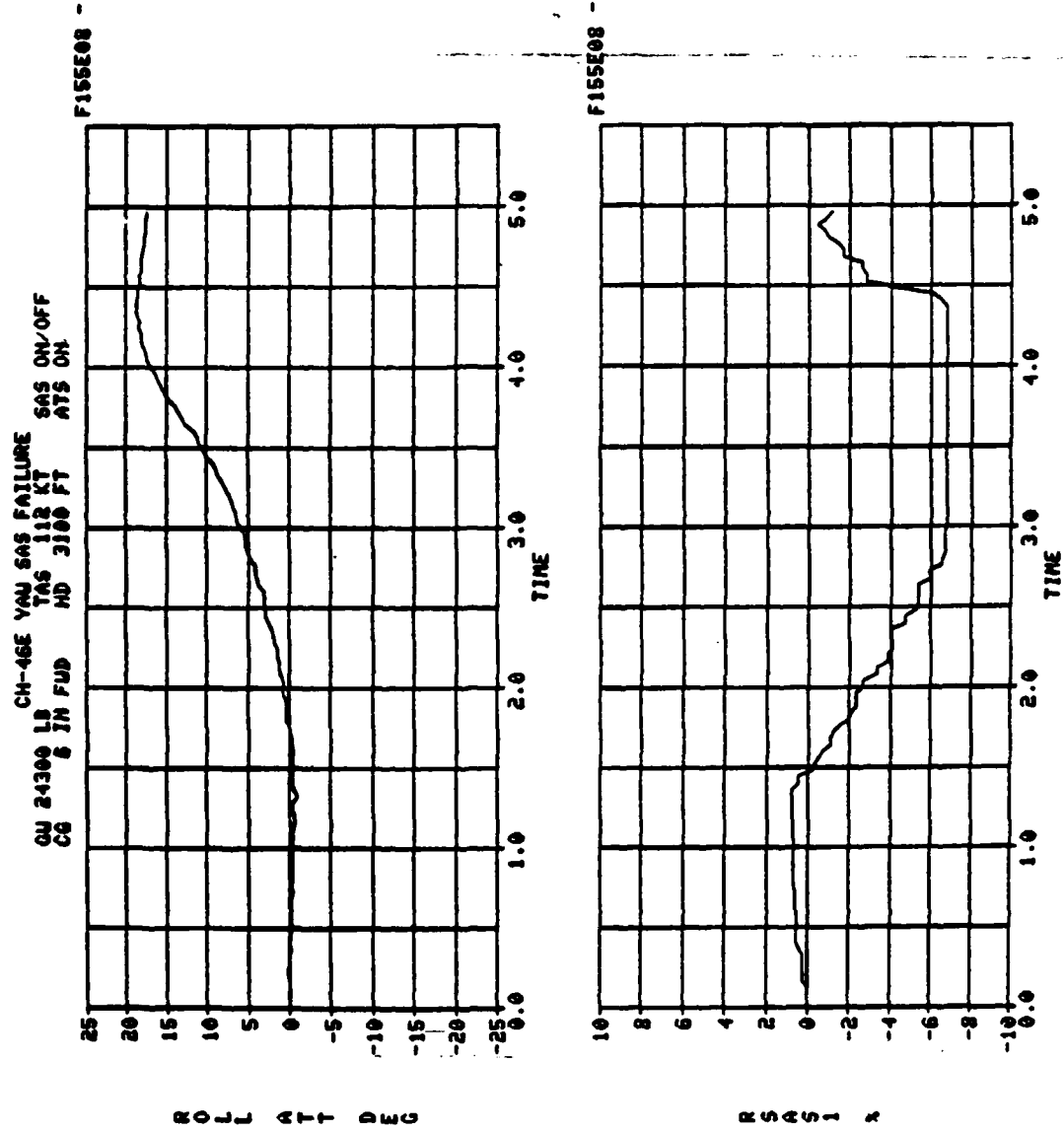


FIGURE 18E

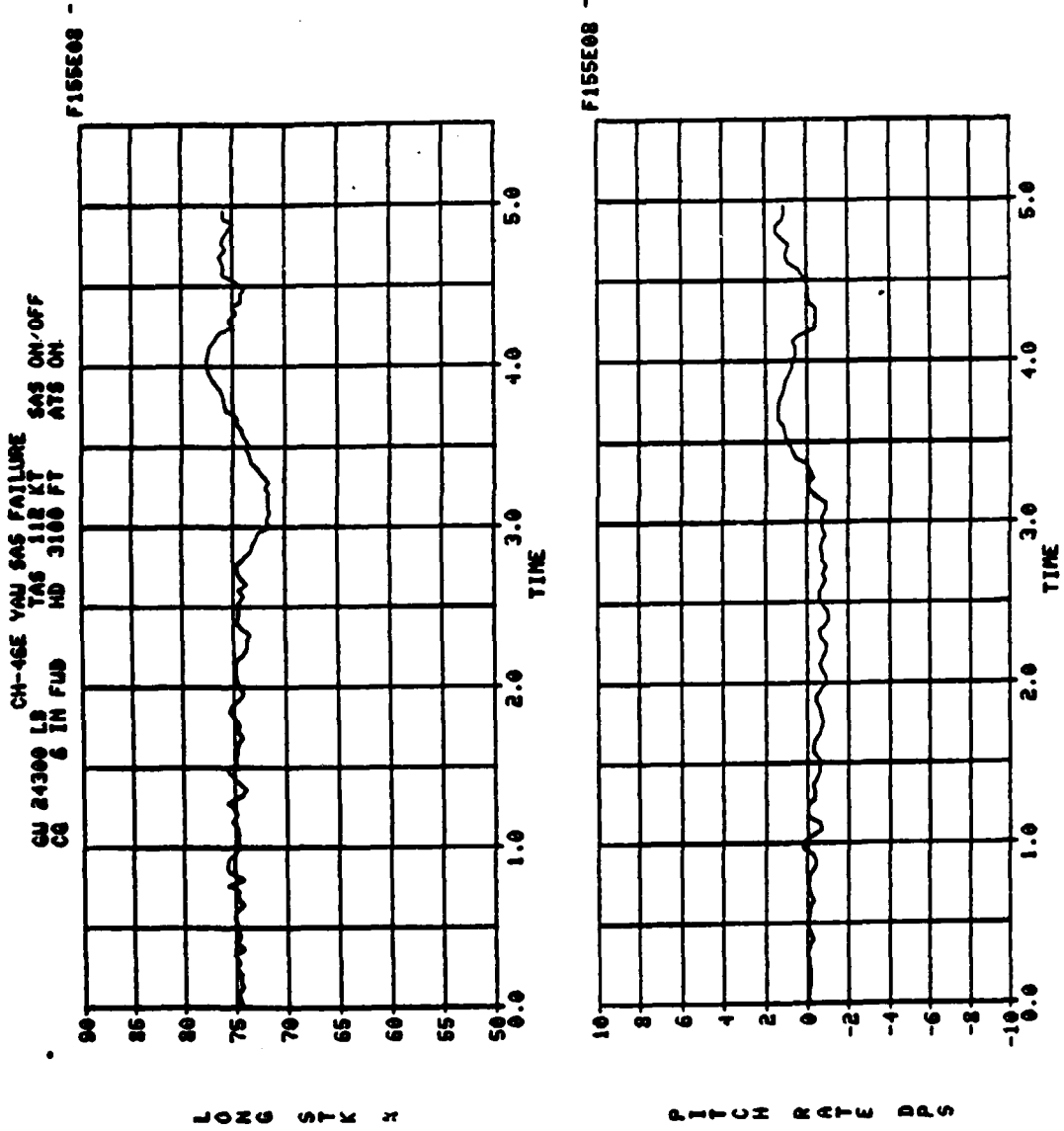


FIGURE 18F

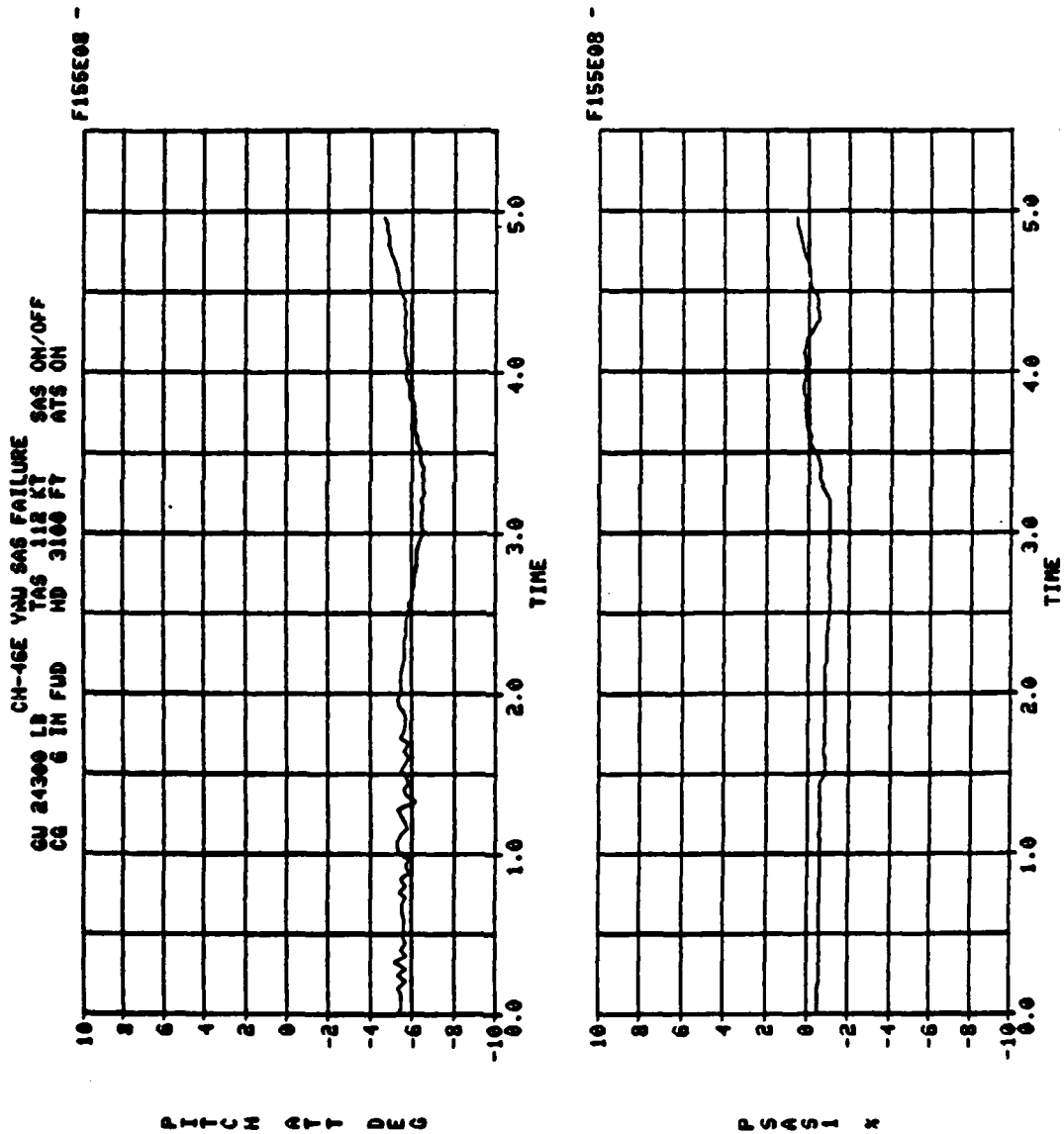


FIGURE 18G

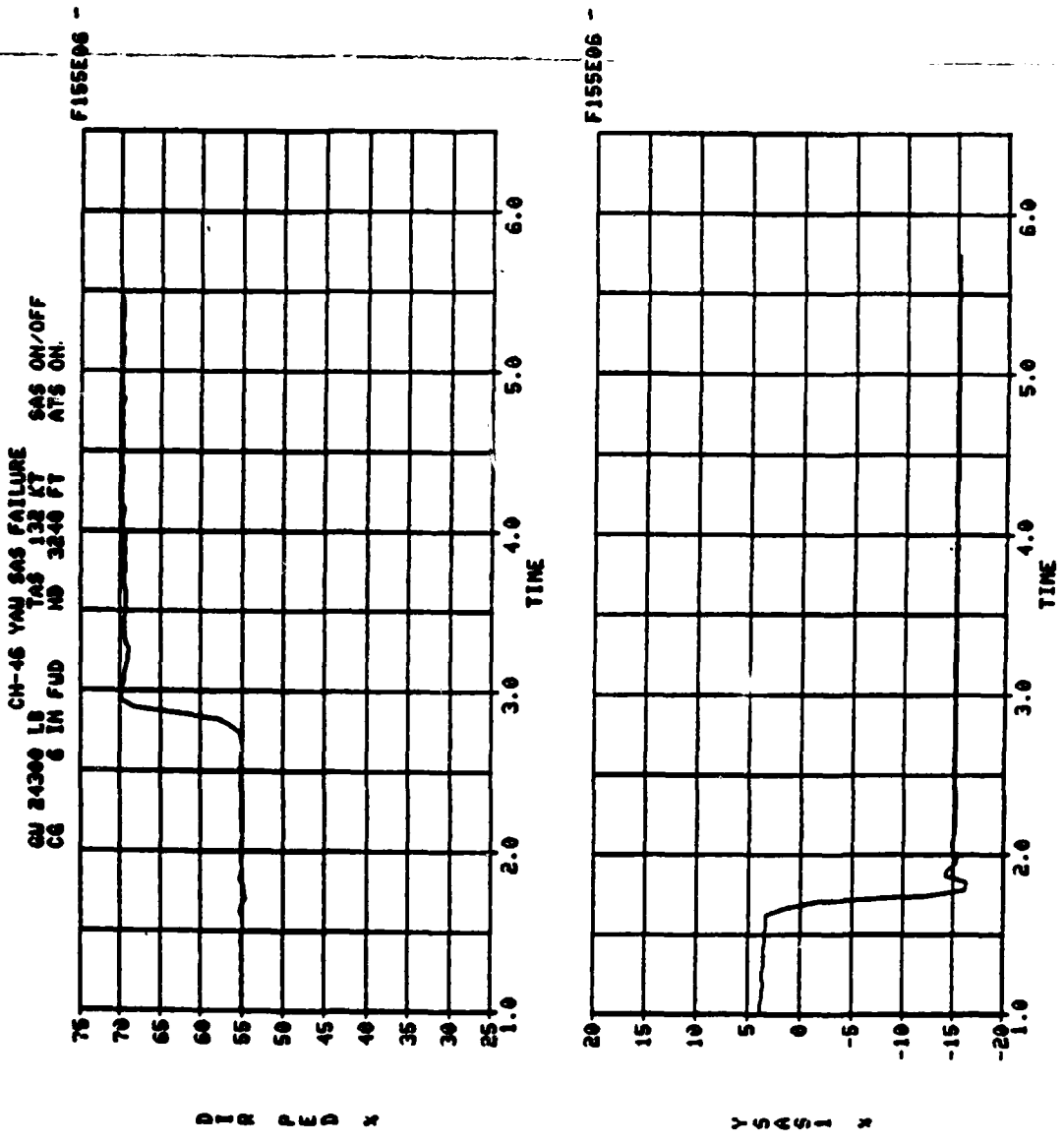


FIGURE 19A

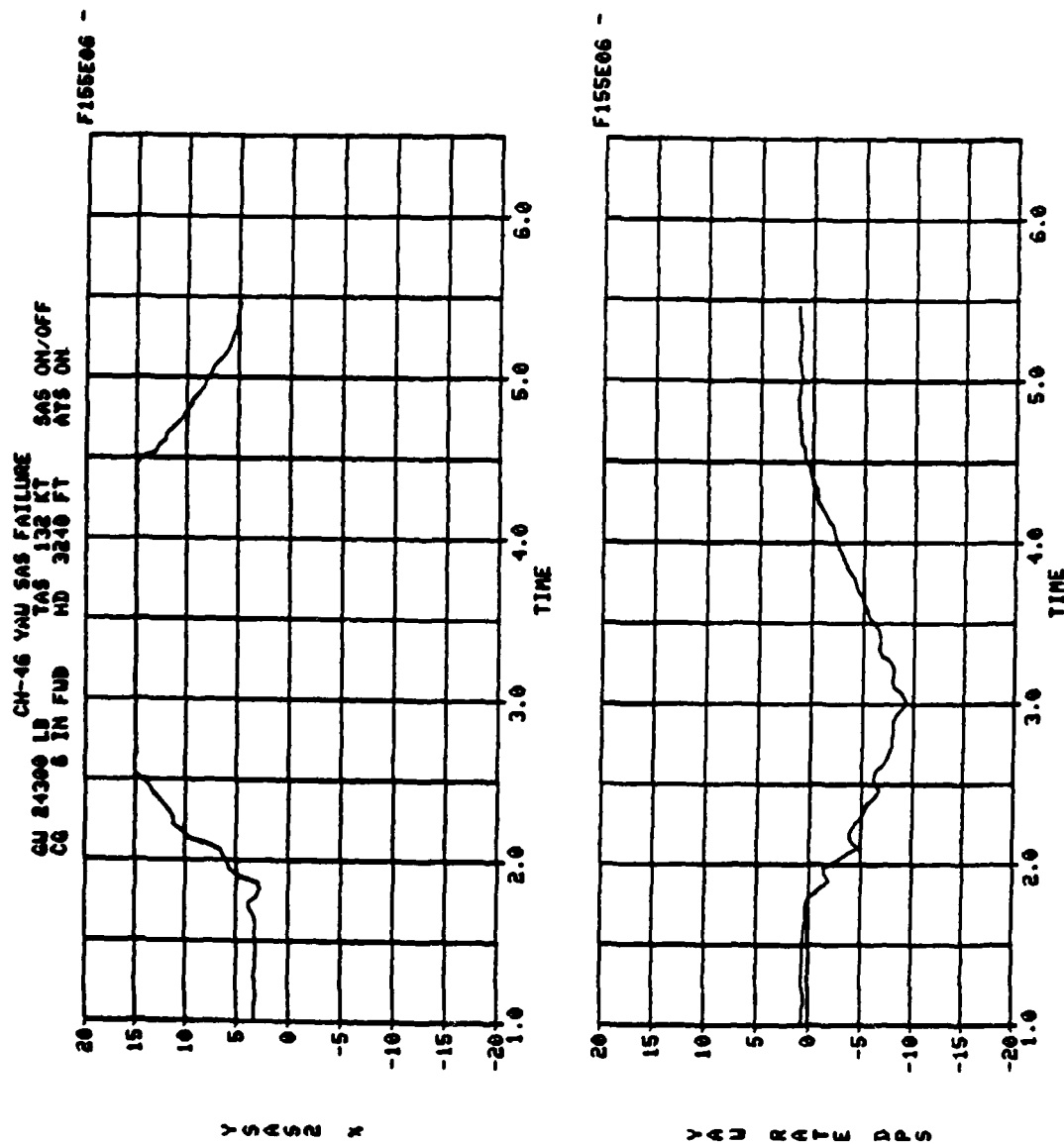


FIGURE 198

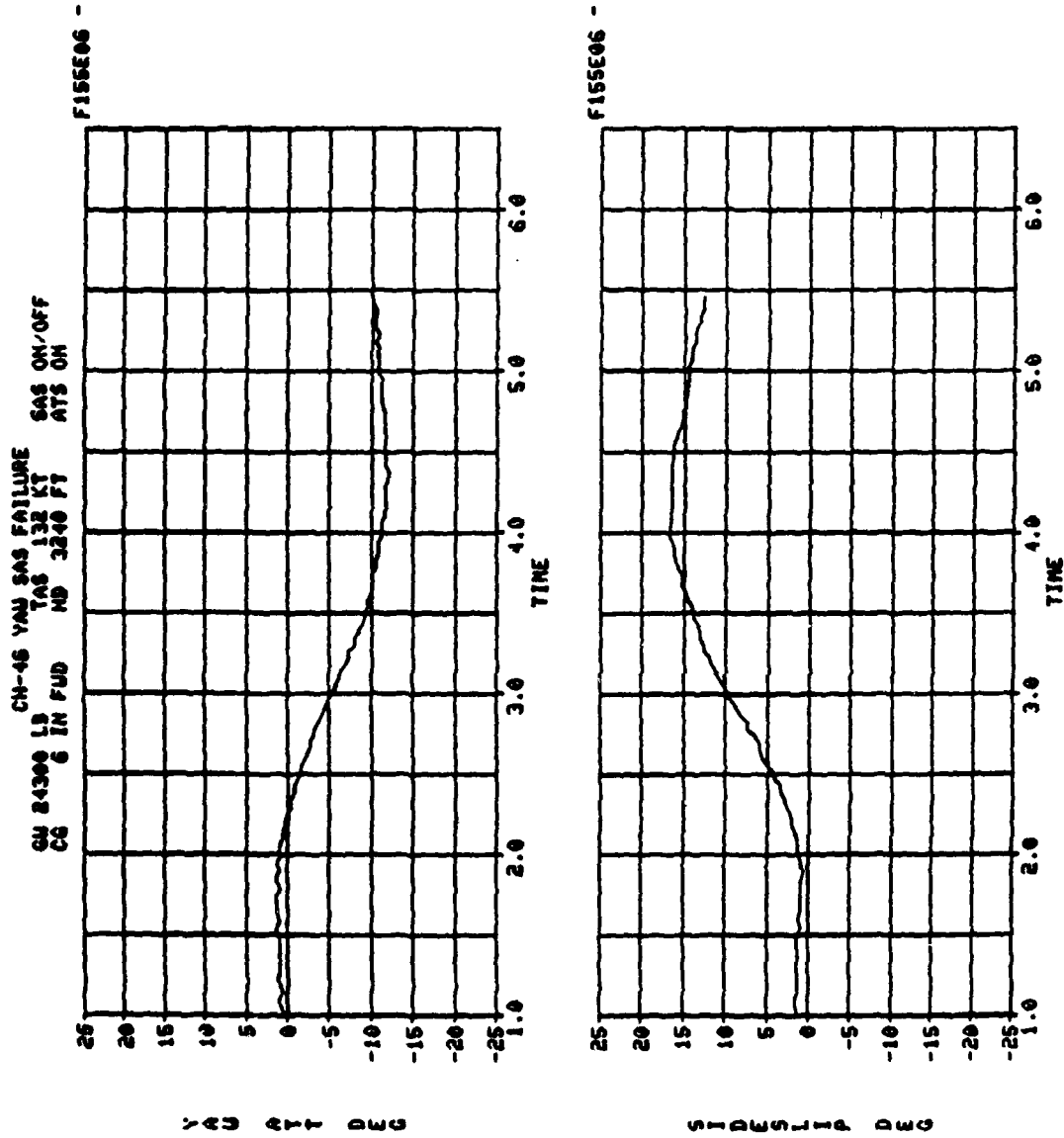


FIGURE 19C

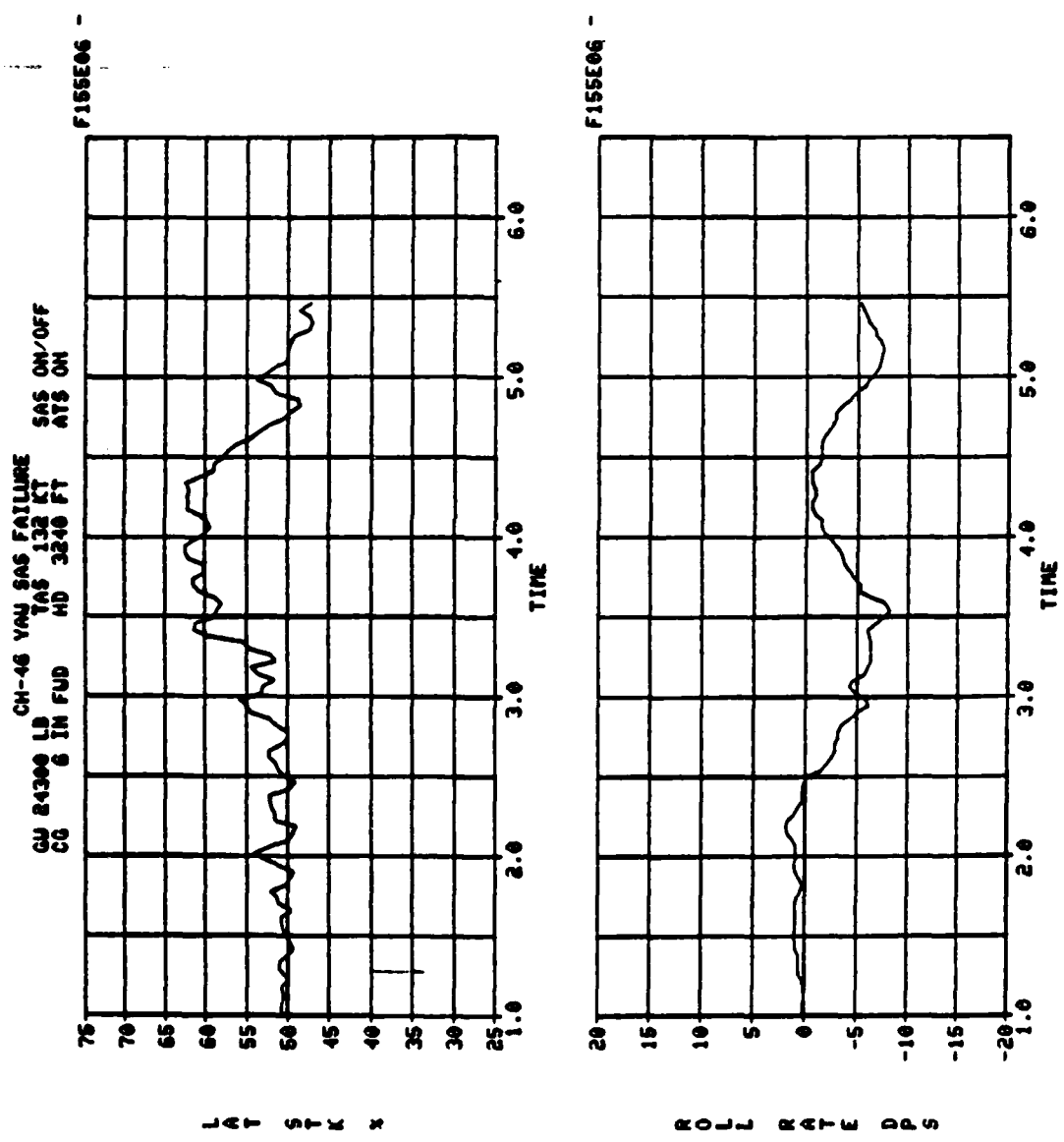


FIGURE 19D

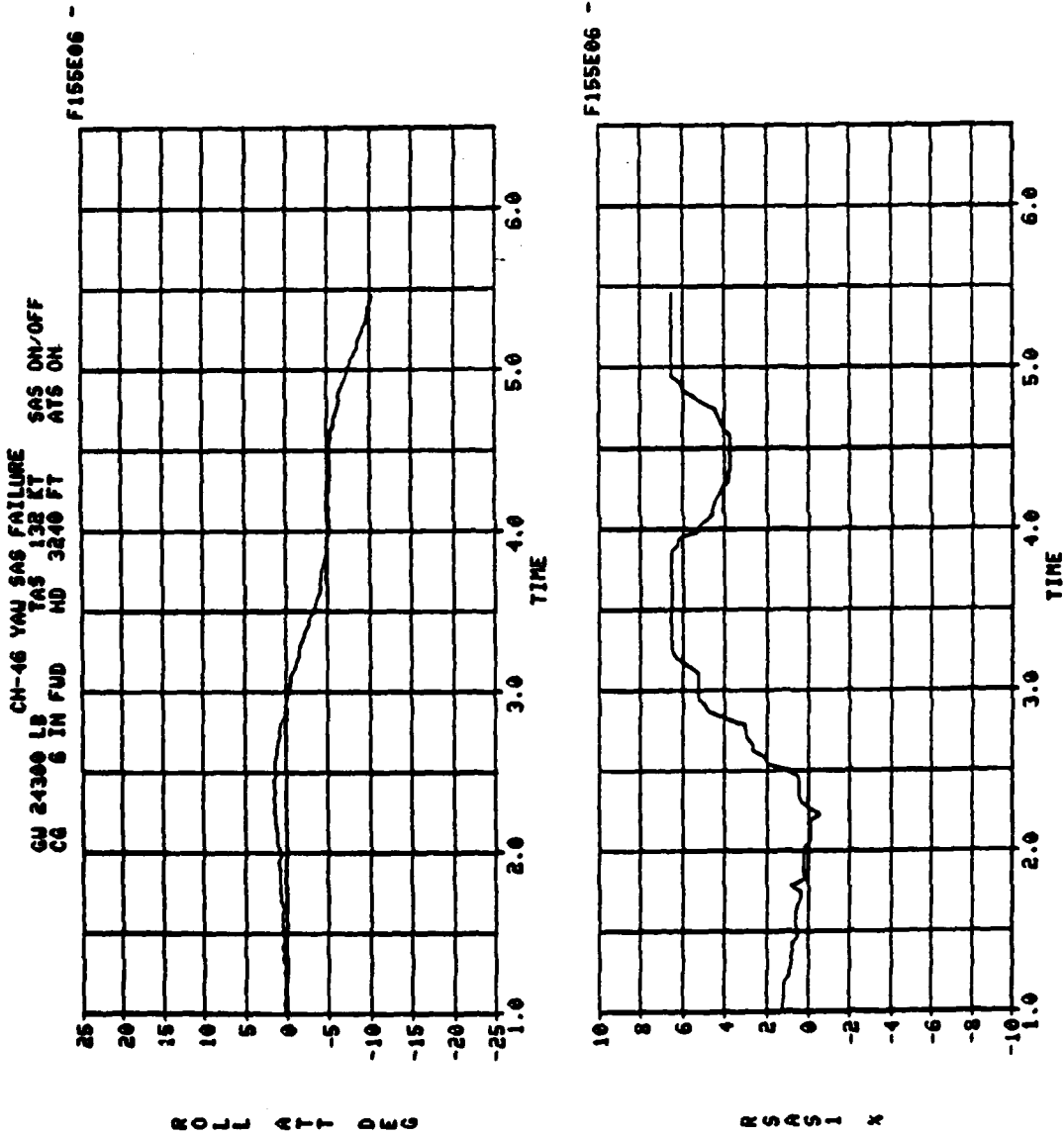


FIGURE 19E

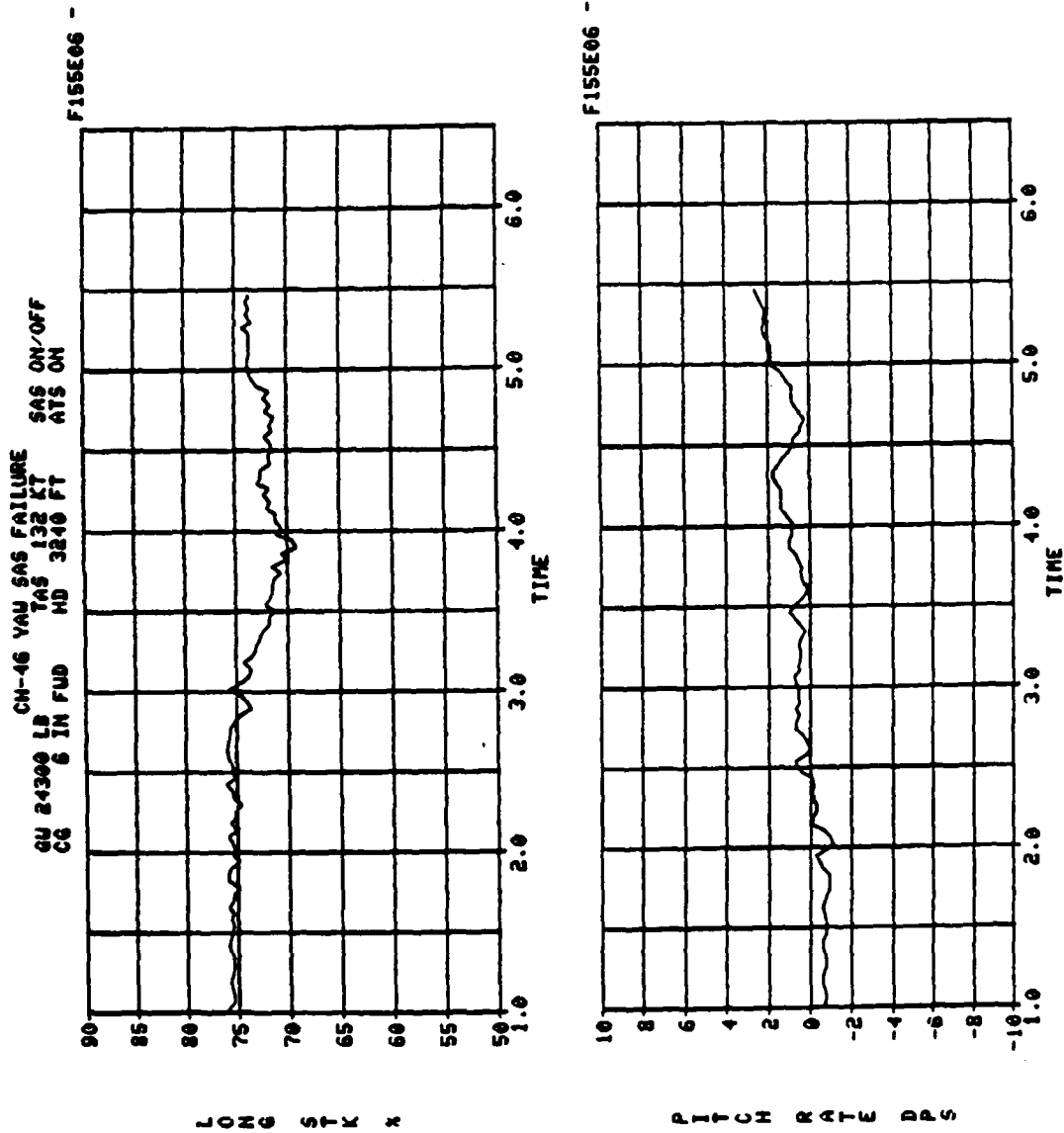


FIGURE 19F

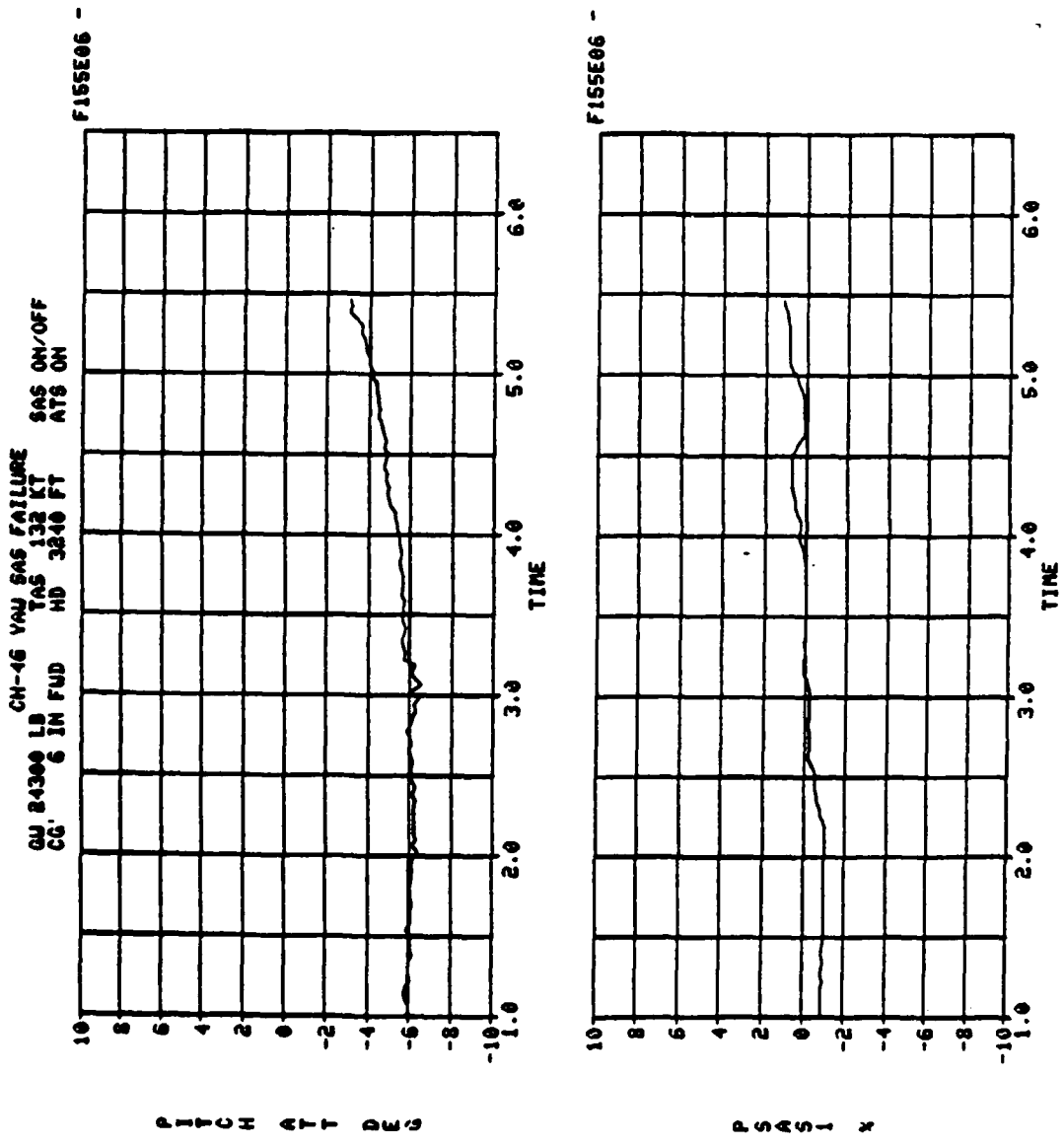


FIGURE 19G

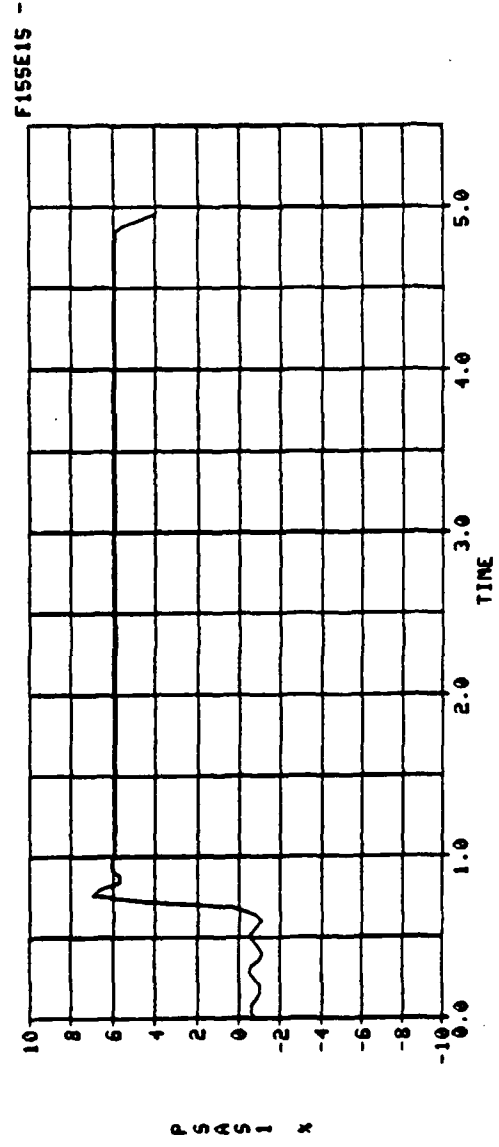
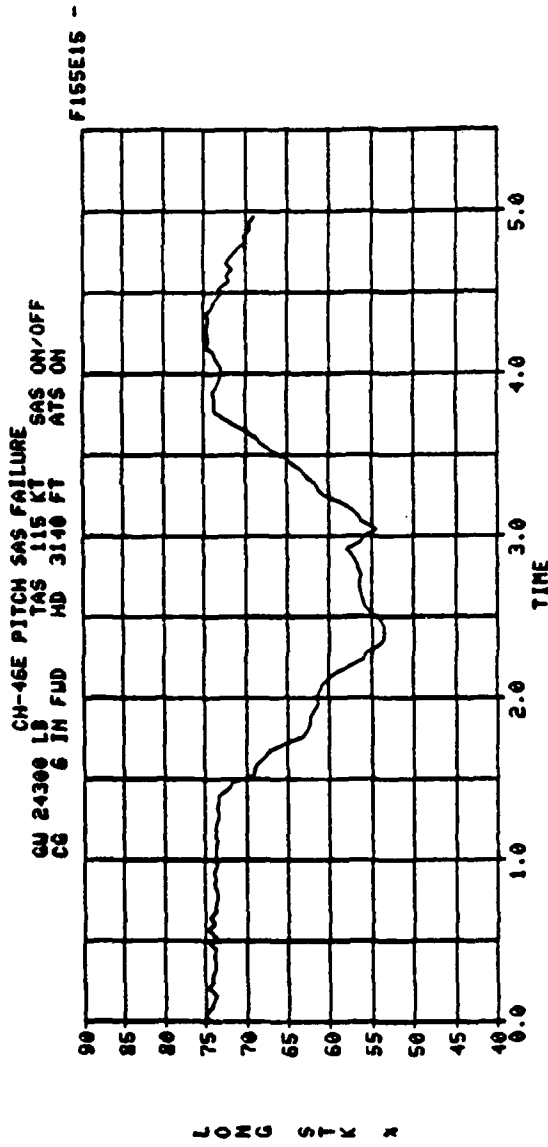


FIGURE 20A

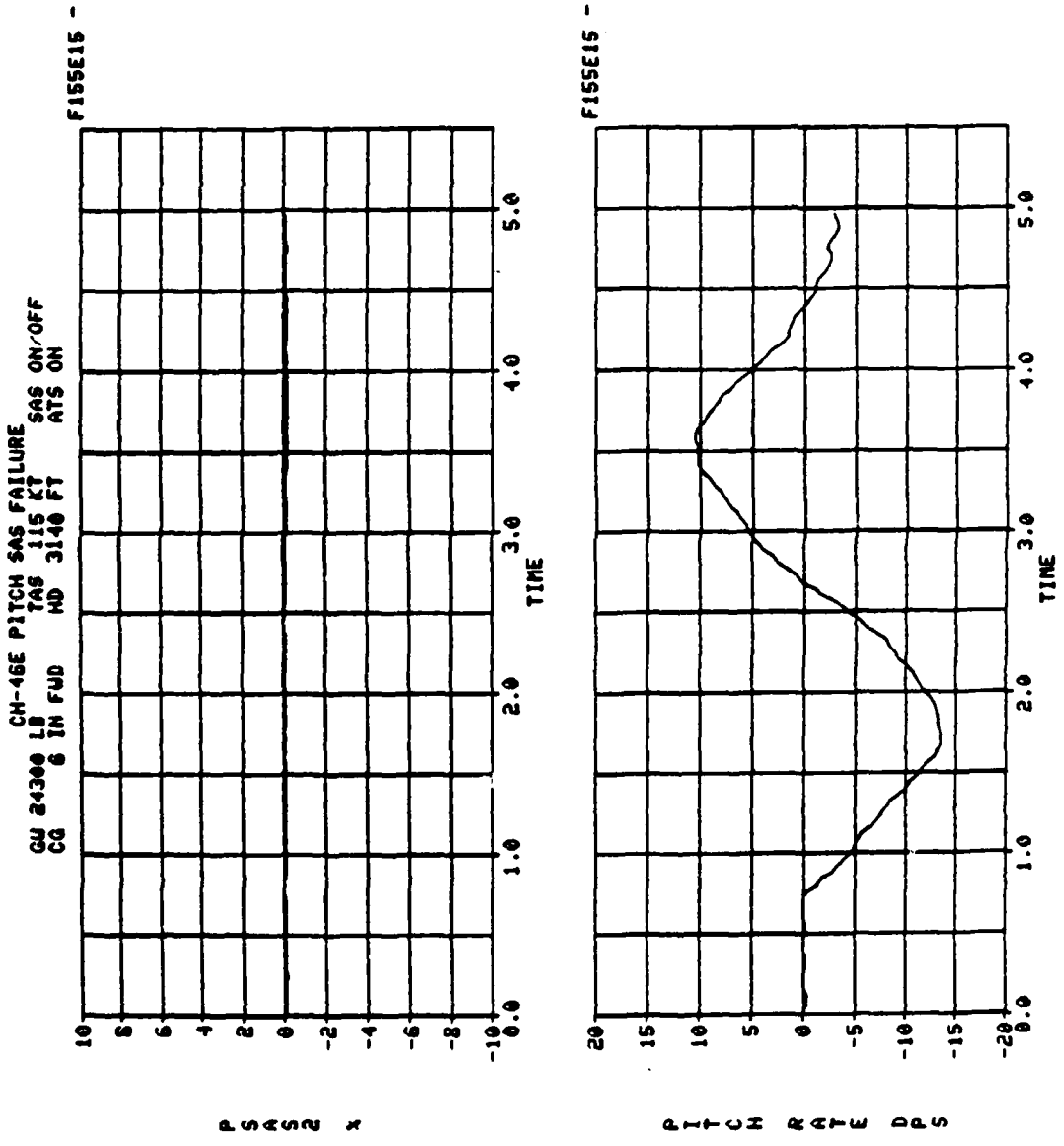


FIGURE 20B

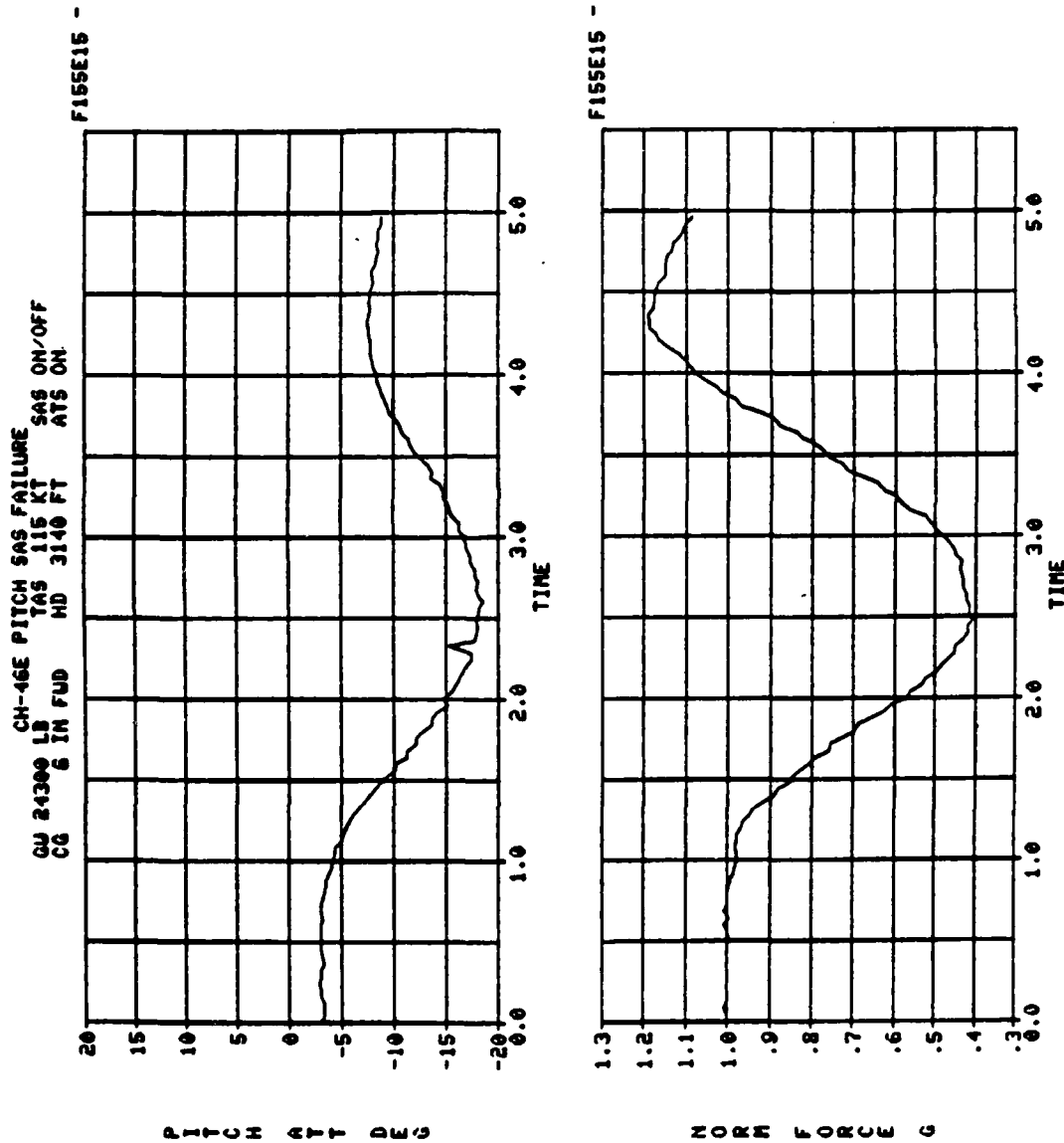


FIGURE 20C

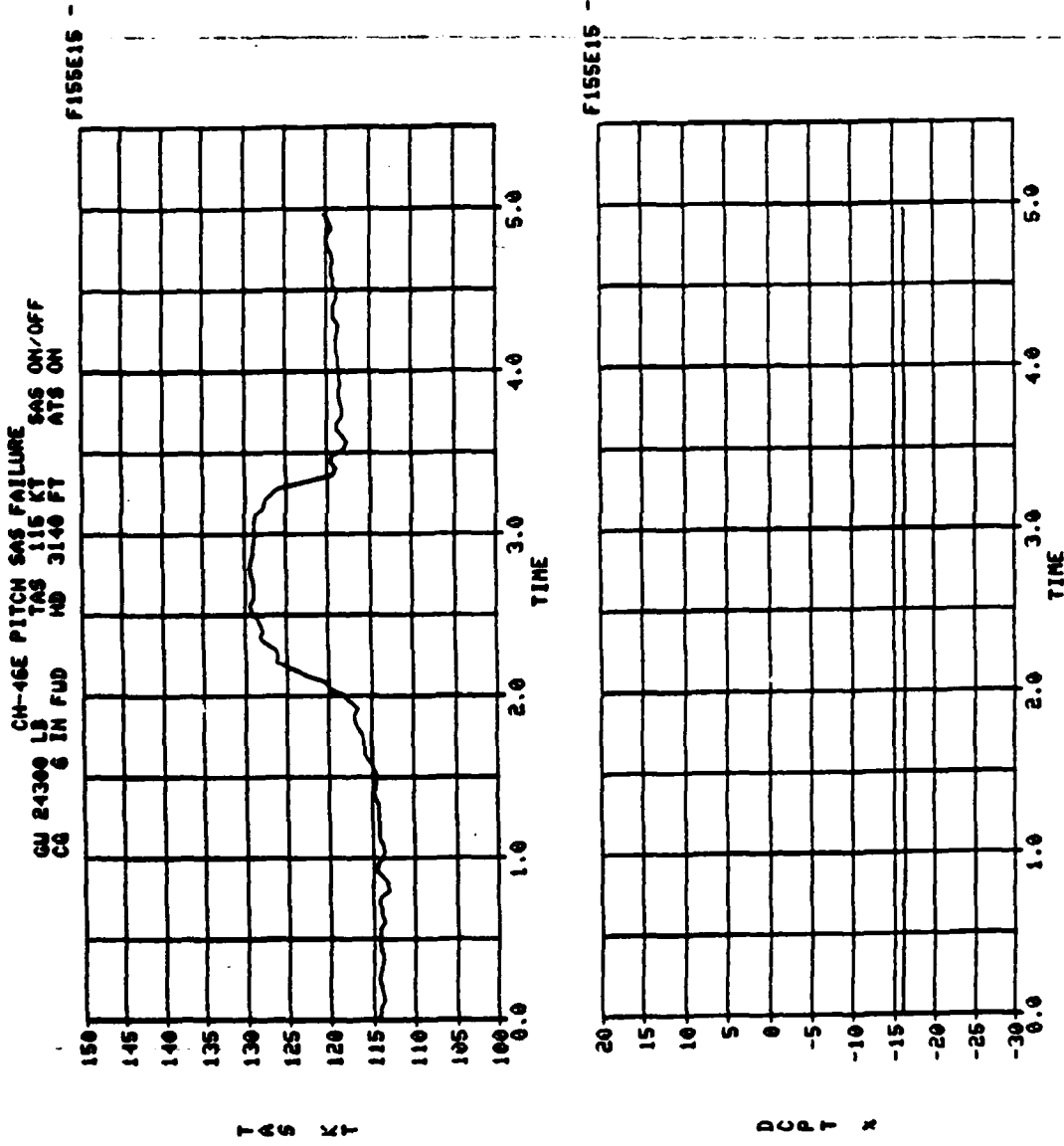


FIGURE 20D

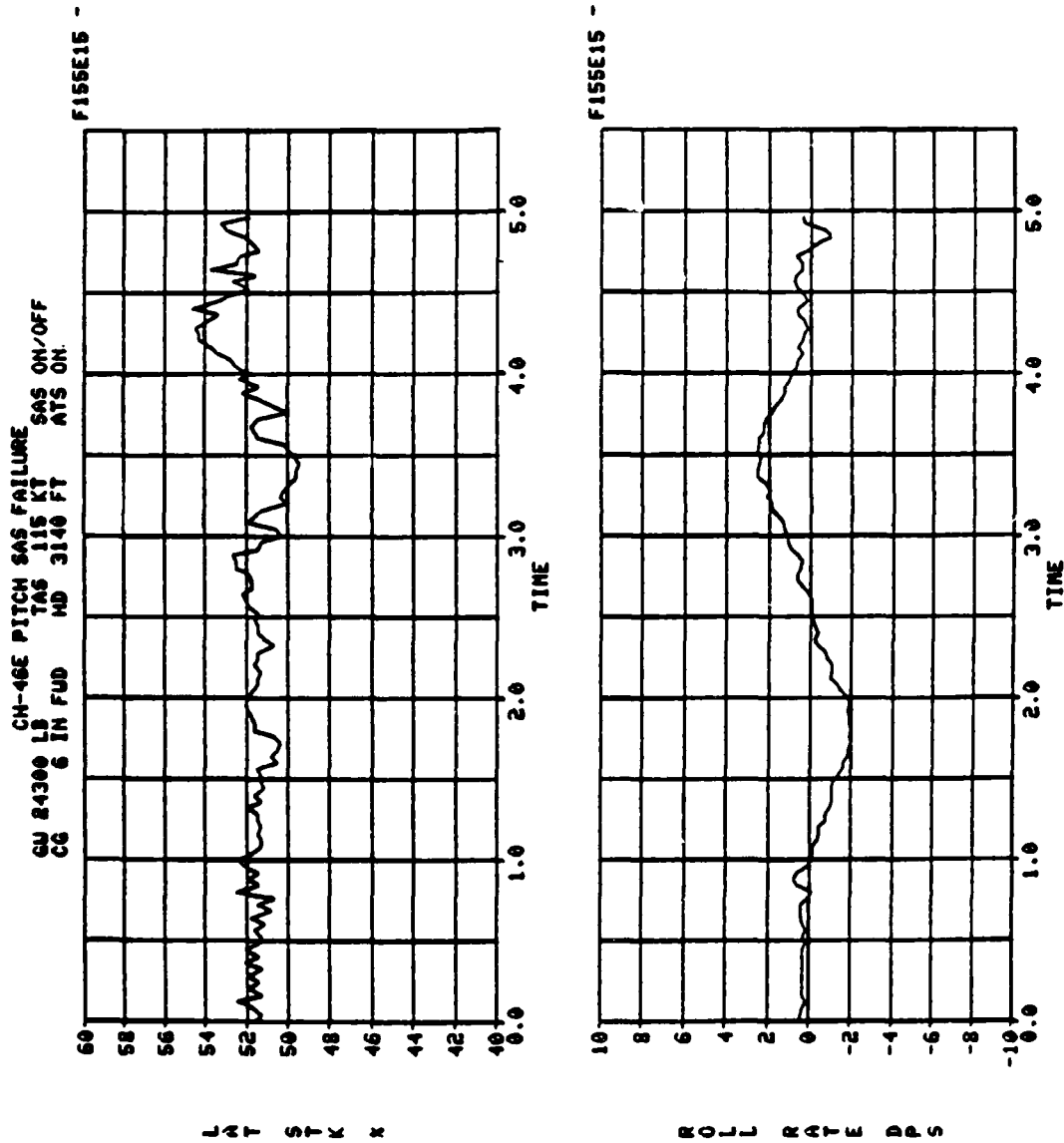


FIGURE 20E

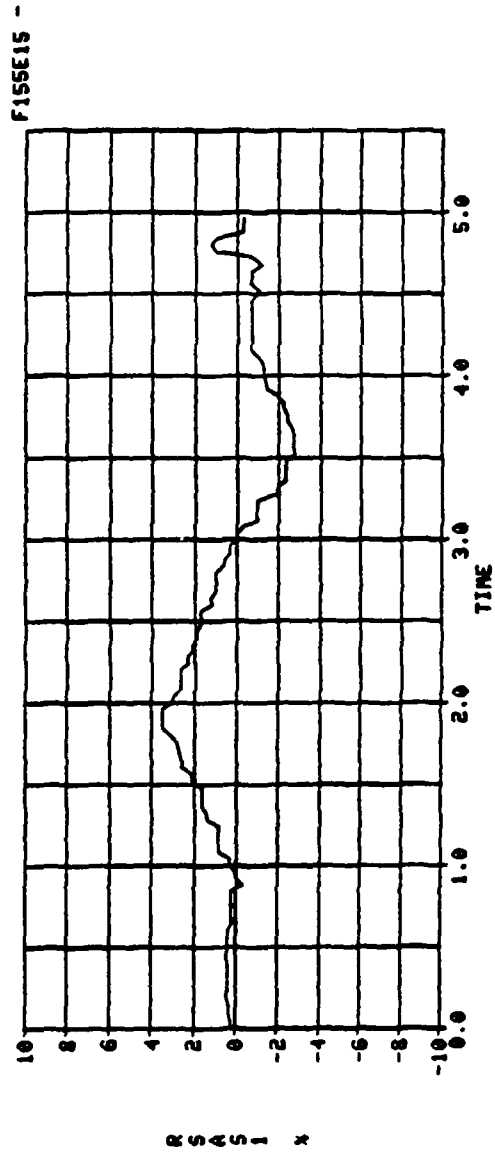
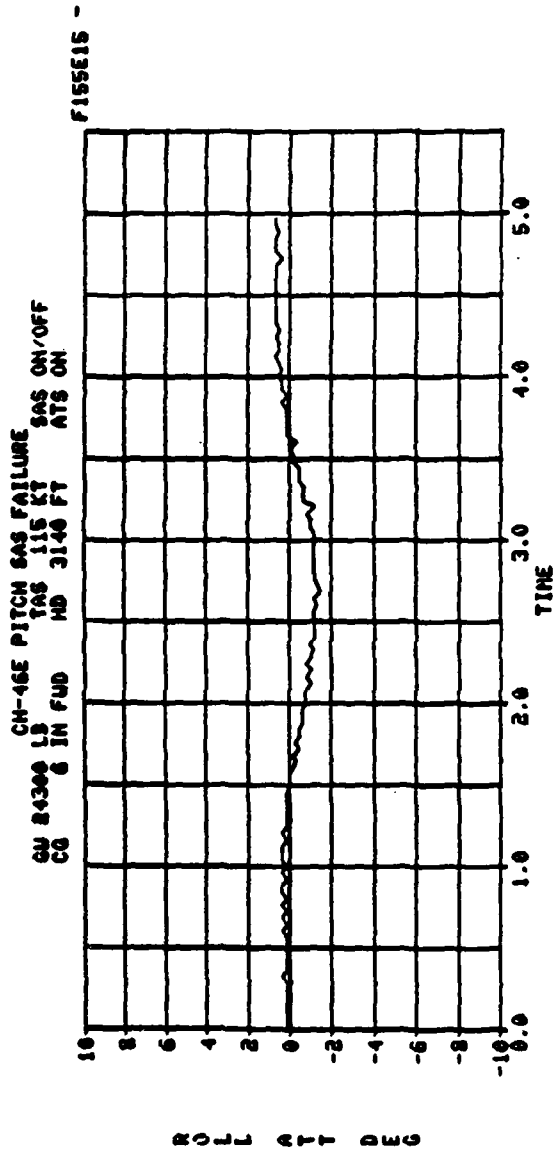


FIGURE 20F

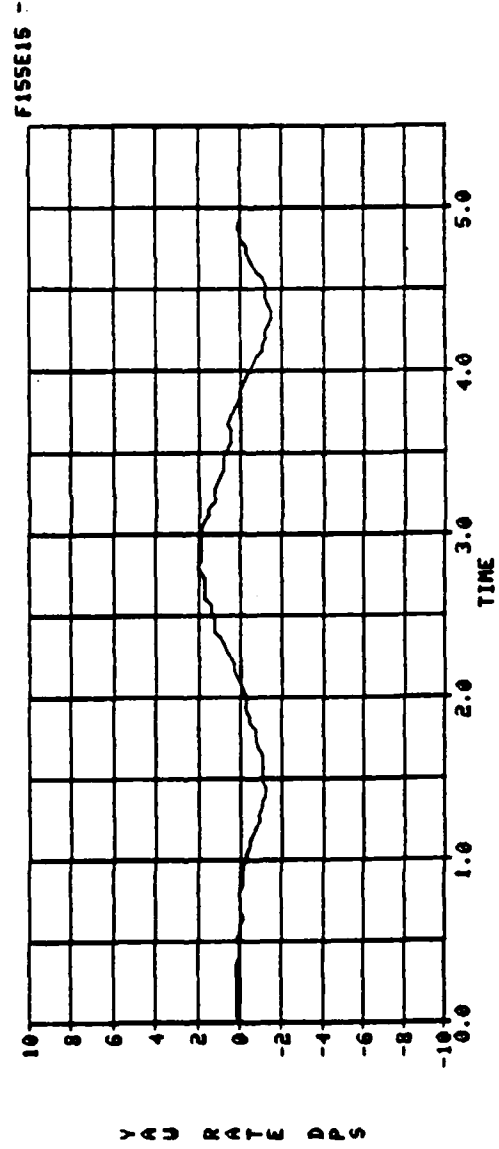
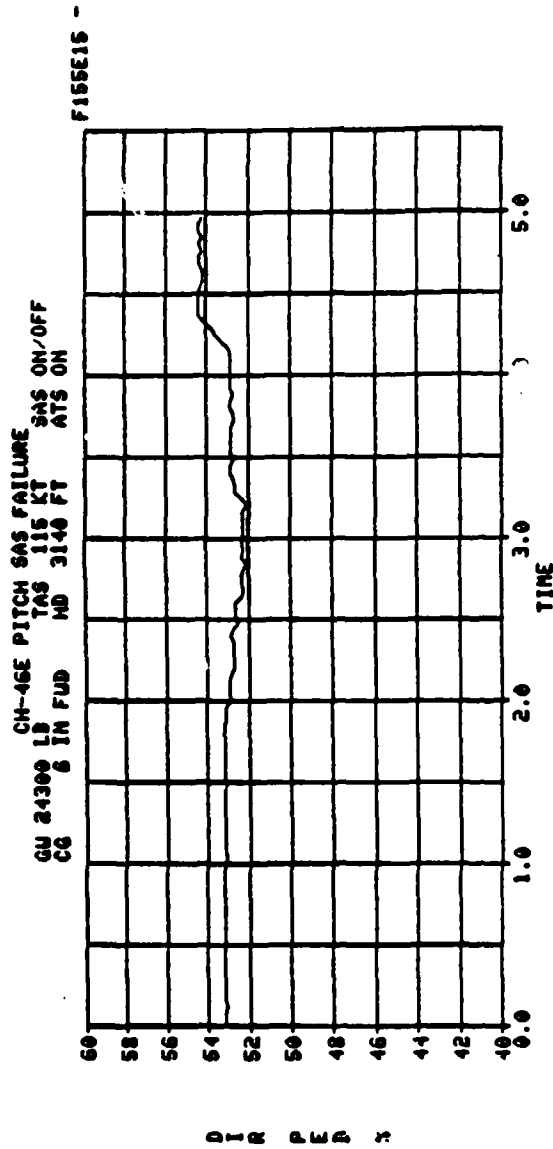


FIGURE 20G

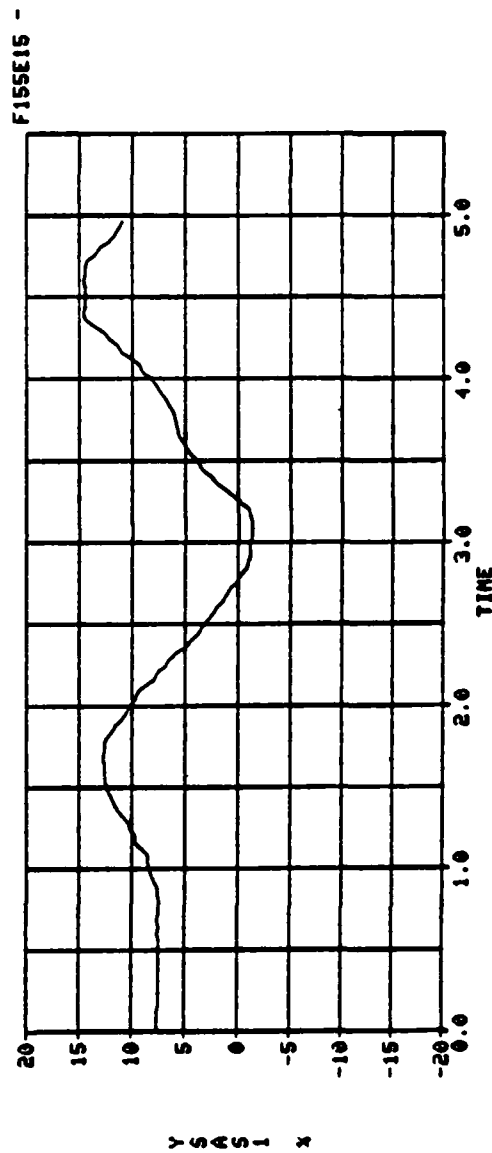
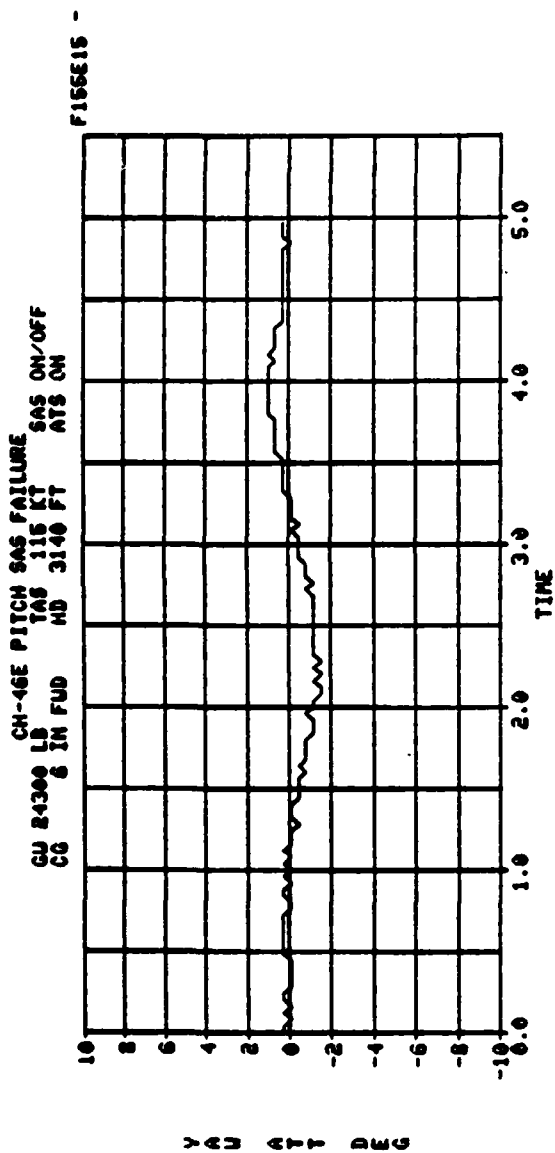


FIGURE 20H

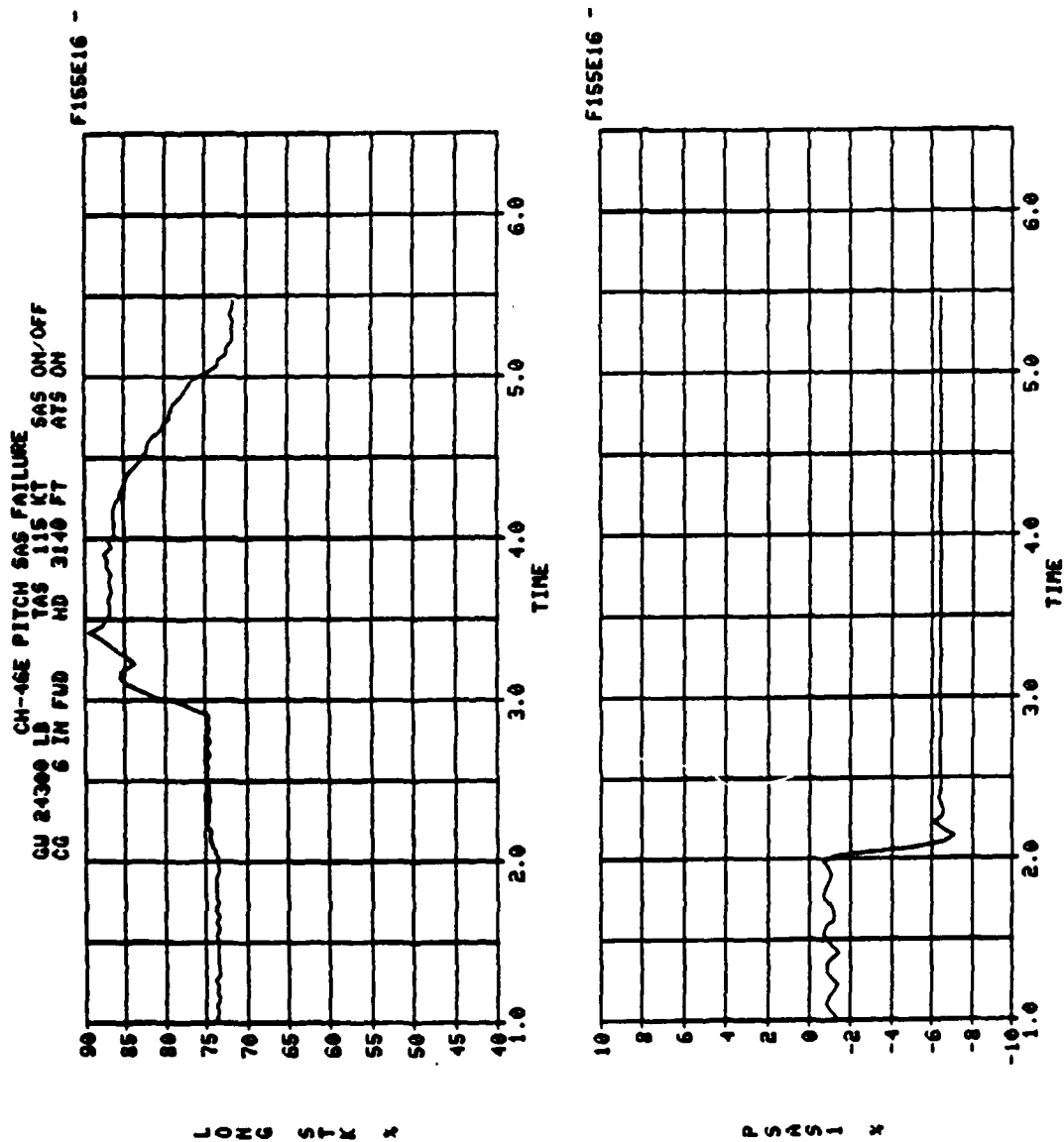


FIGURE 21A

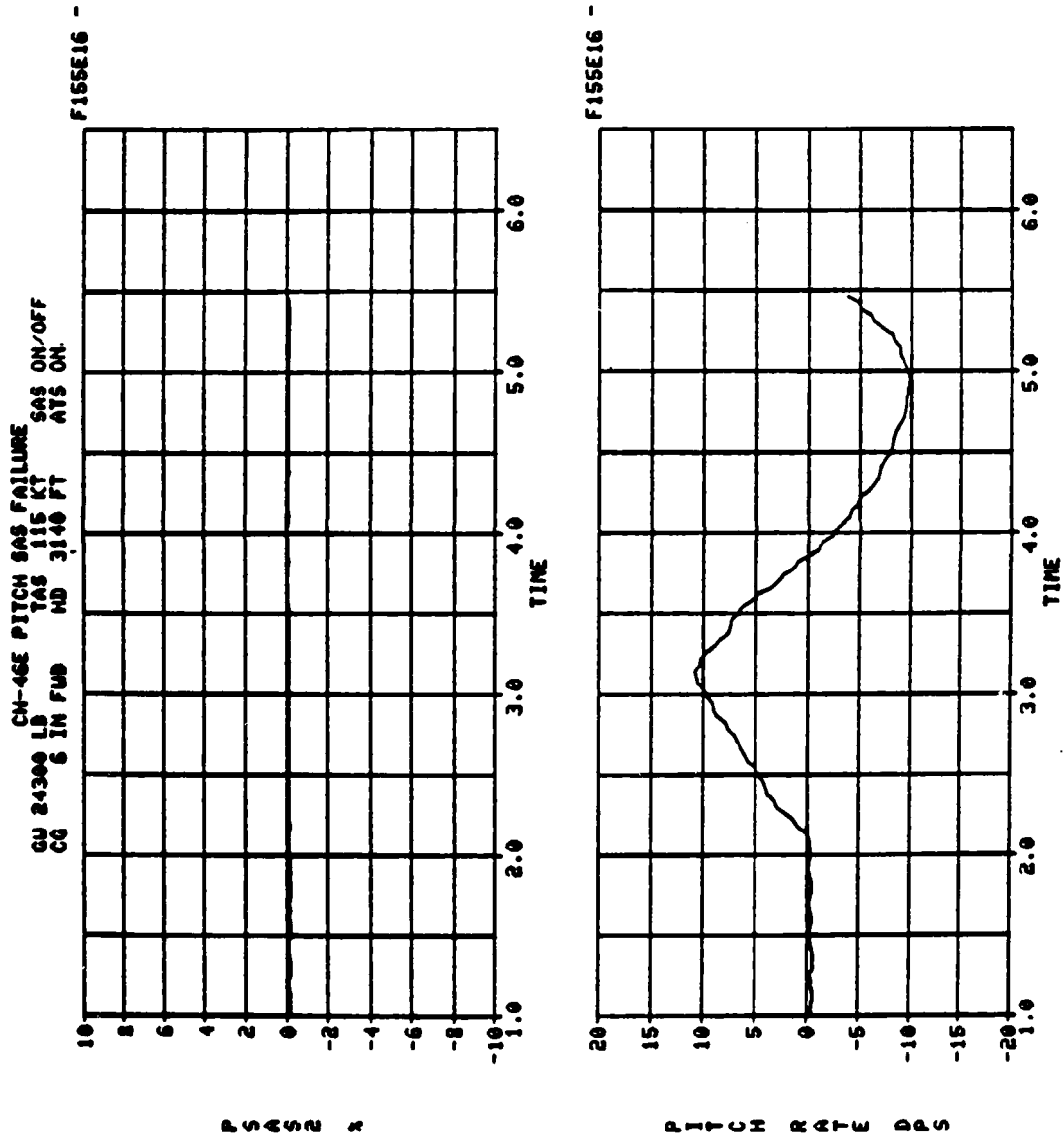


FIGURE 21B

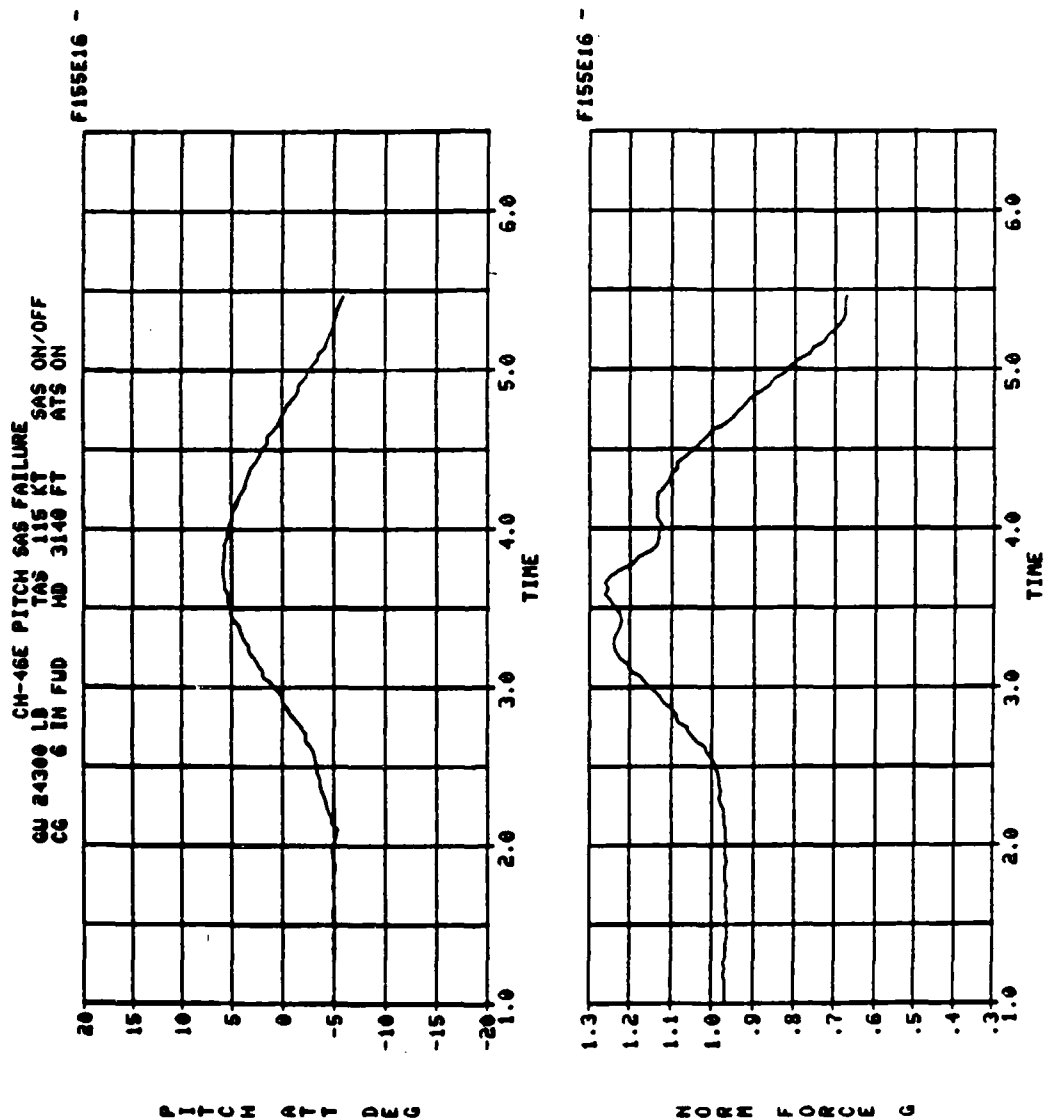


FIGURE 21C

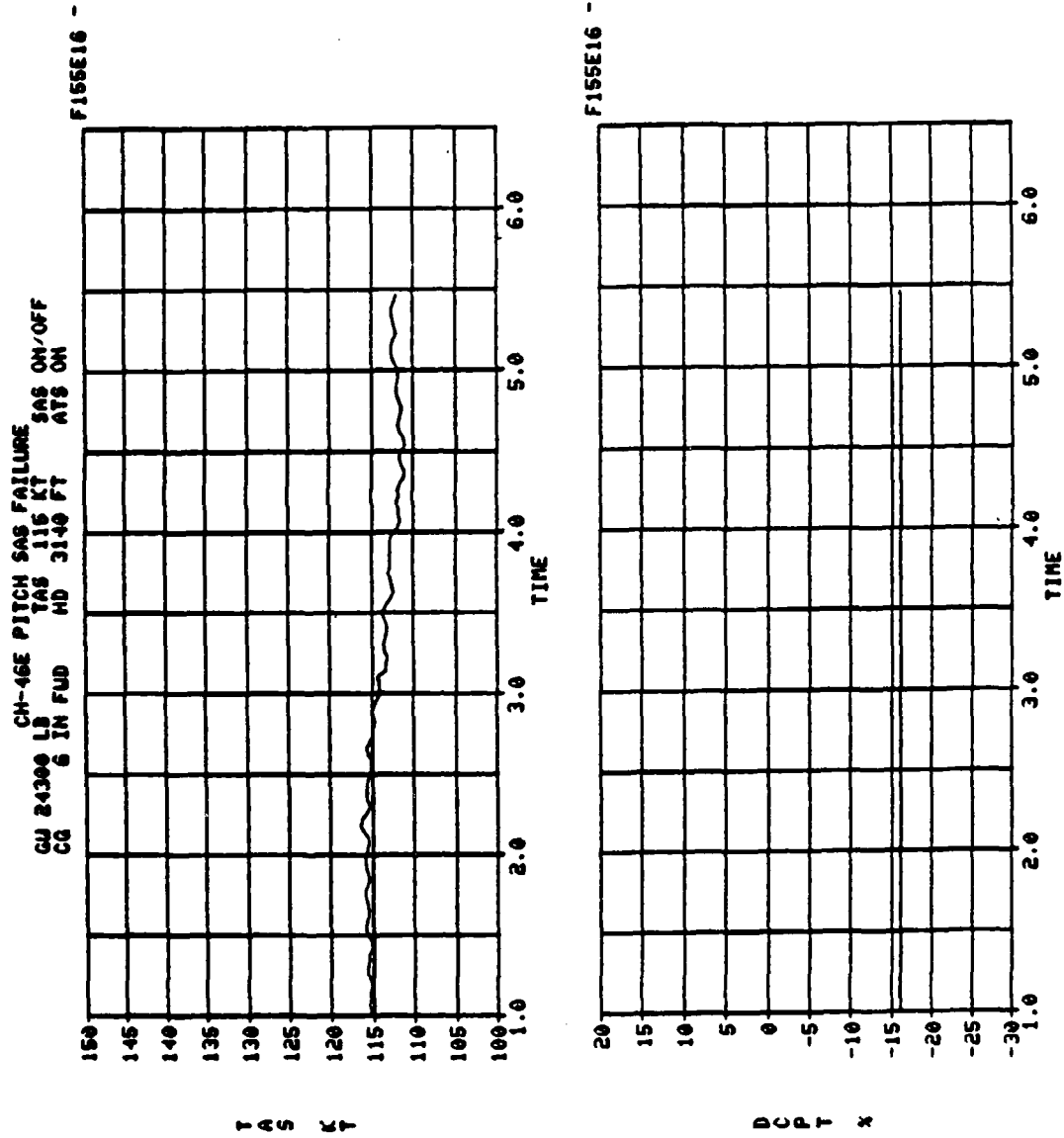


FIGURE 21D

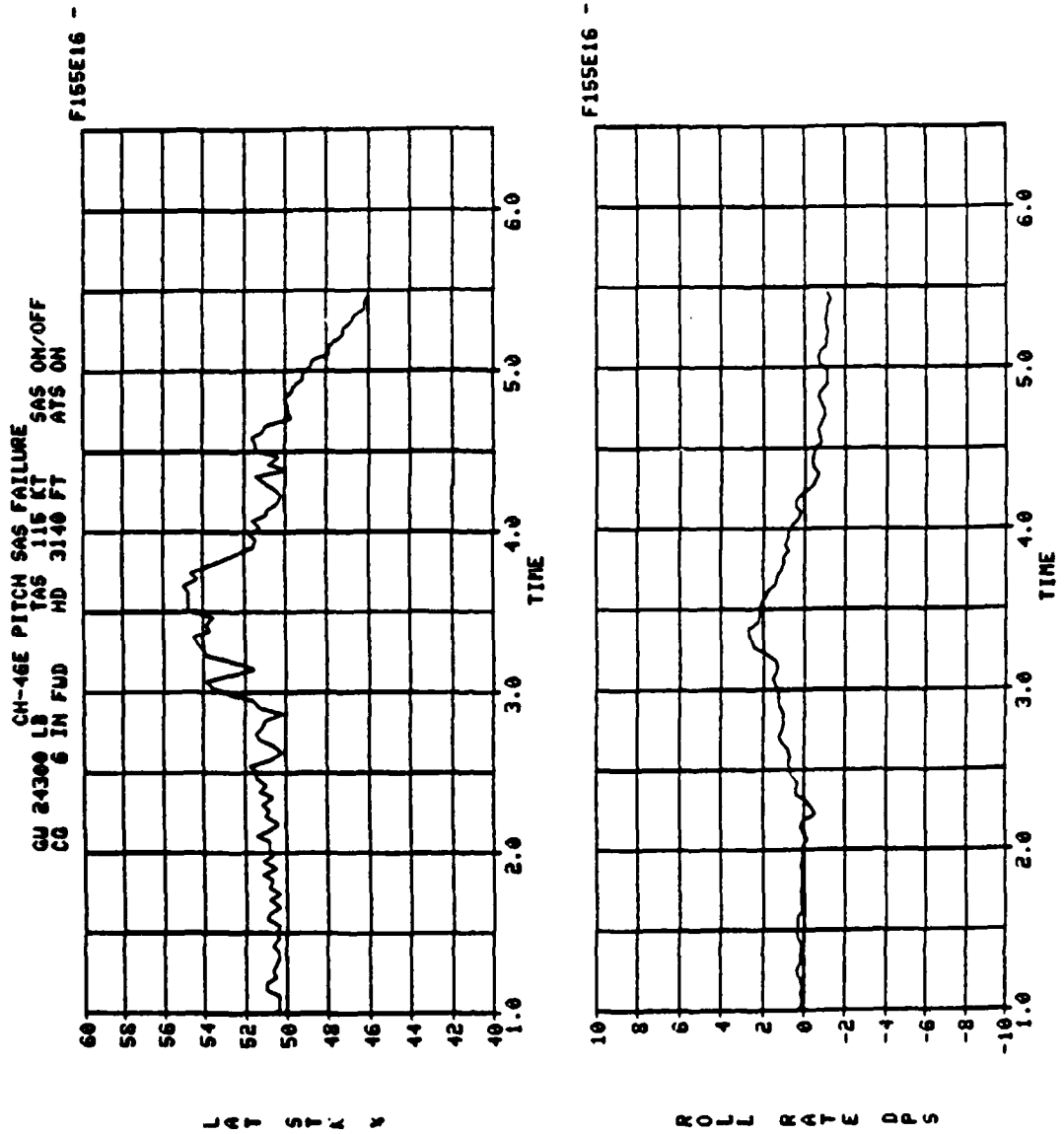


FIGURE 21E

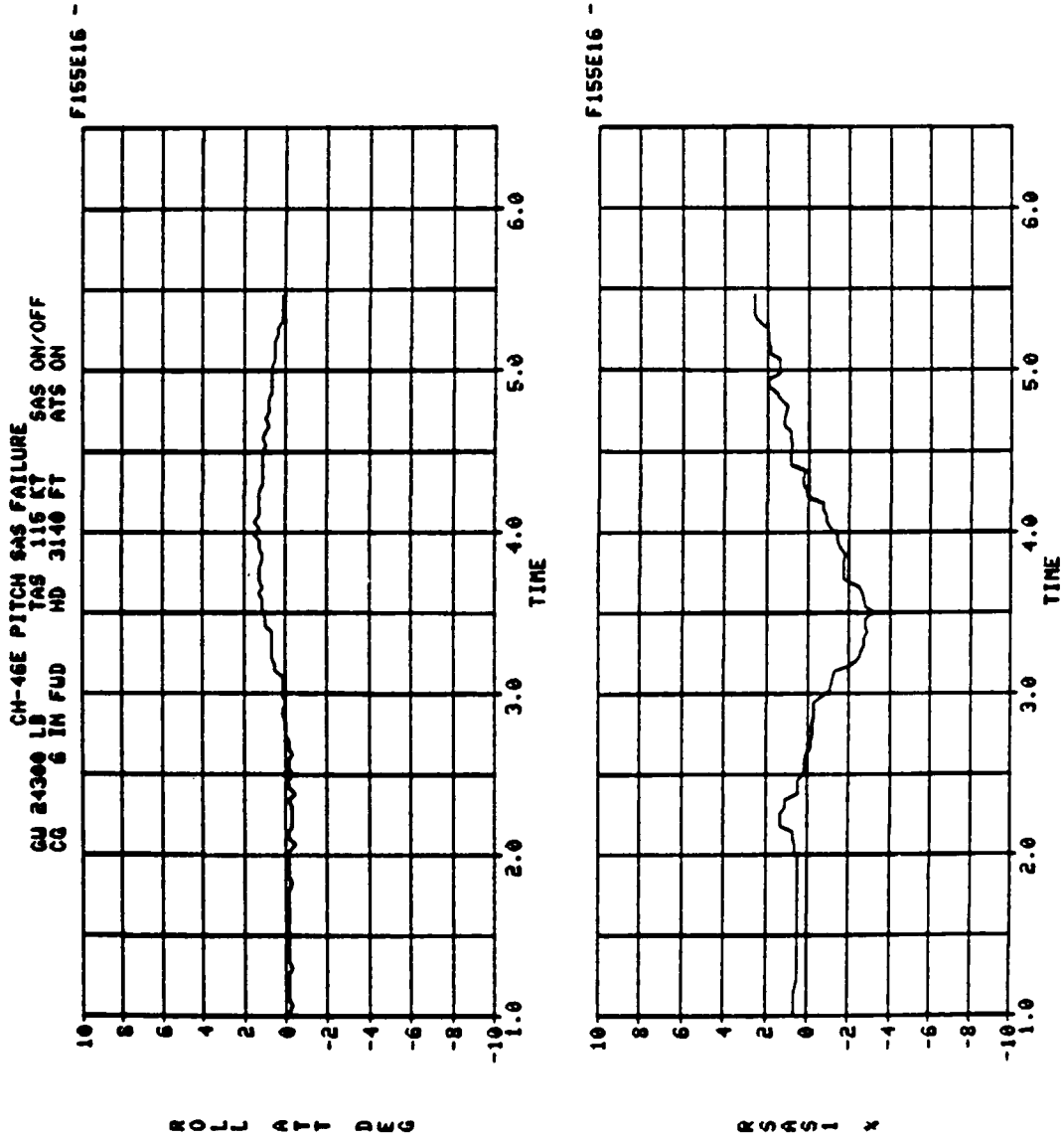


FIGURE 21F

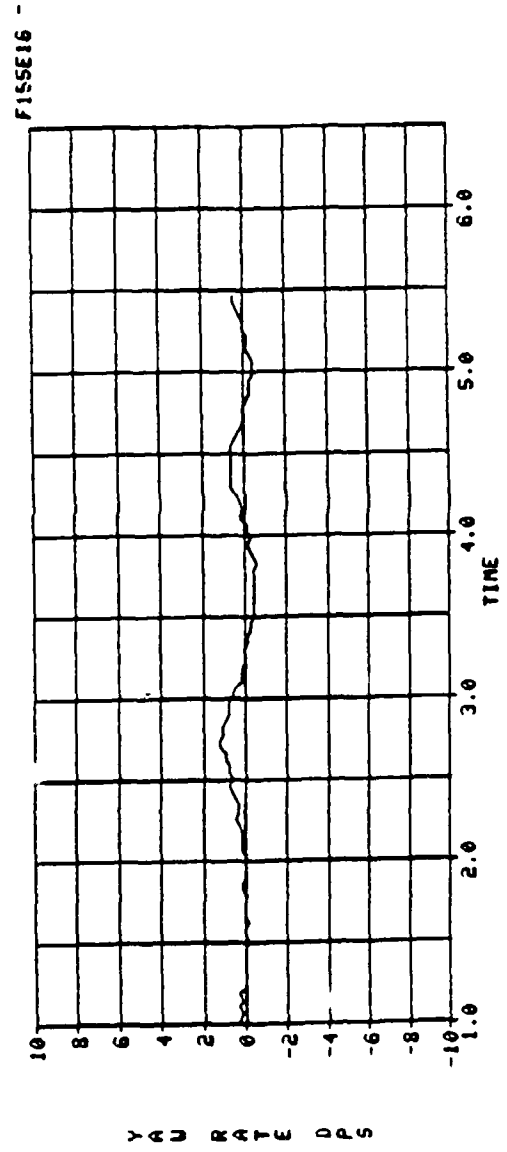
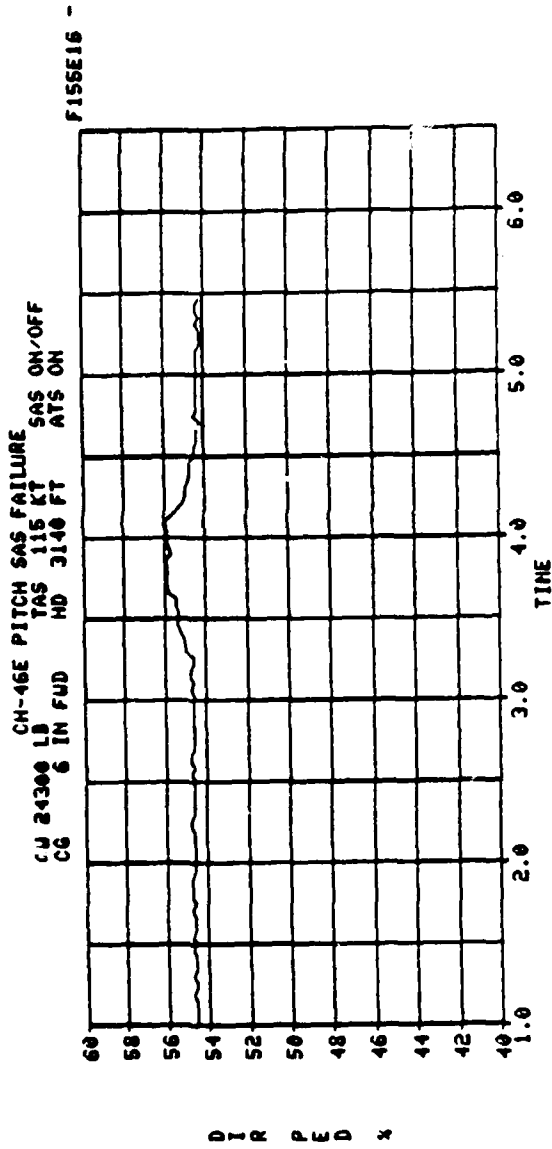


FIGURE 21G

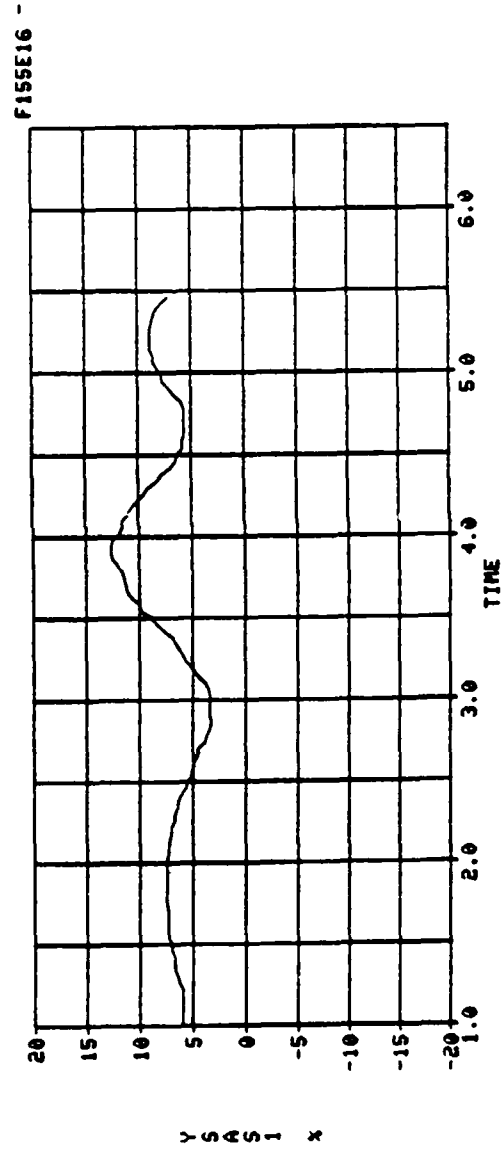
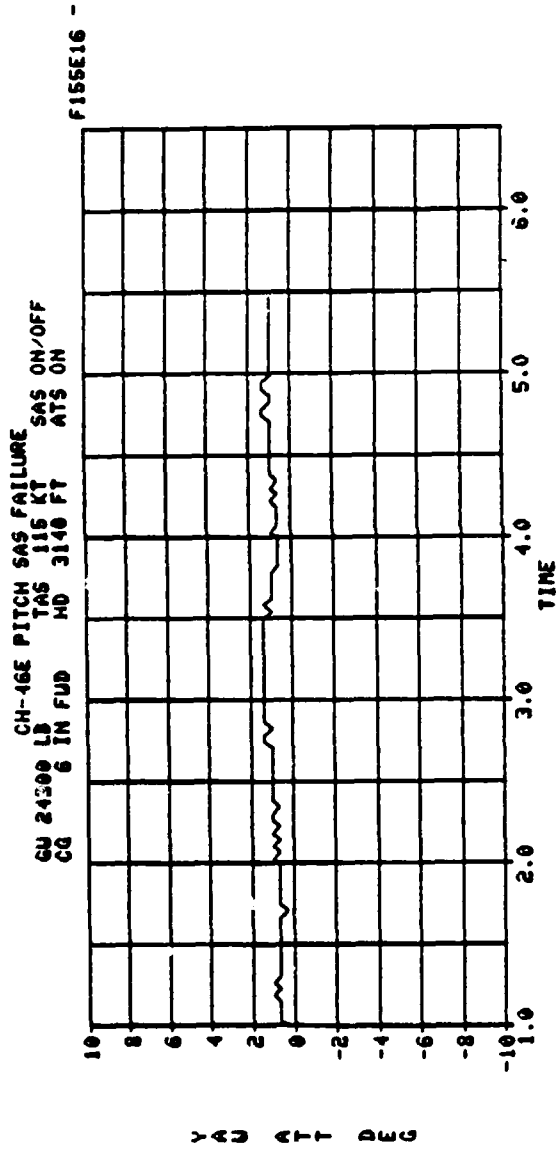


FIGURE 21H

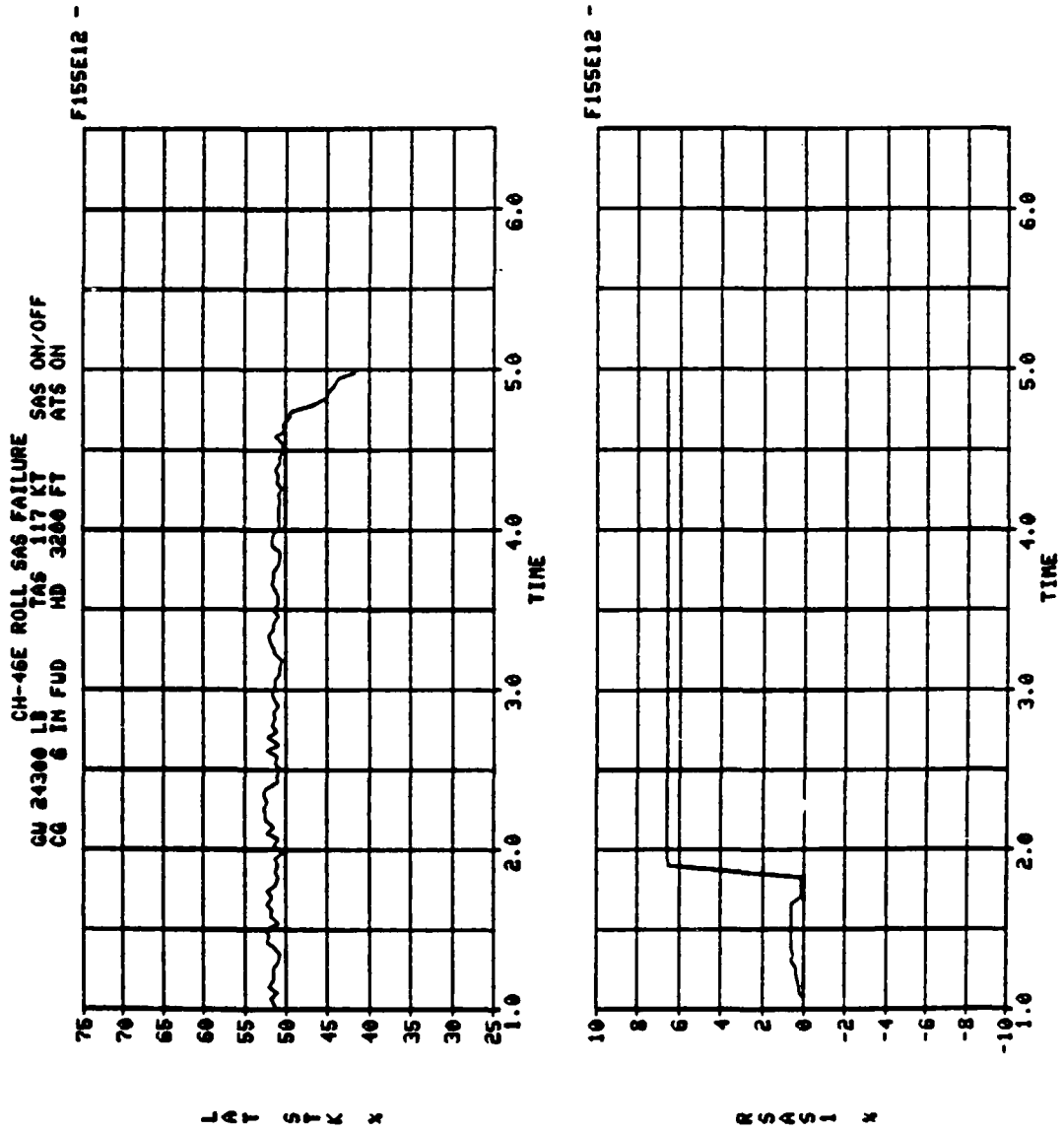


FIGURE 22A

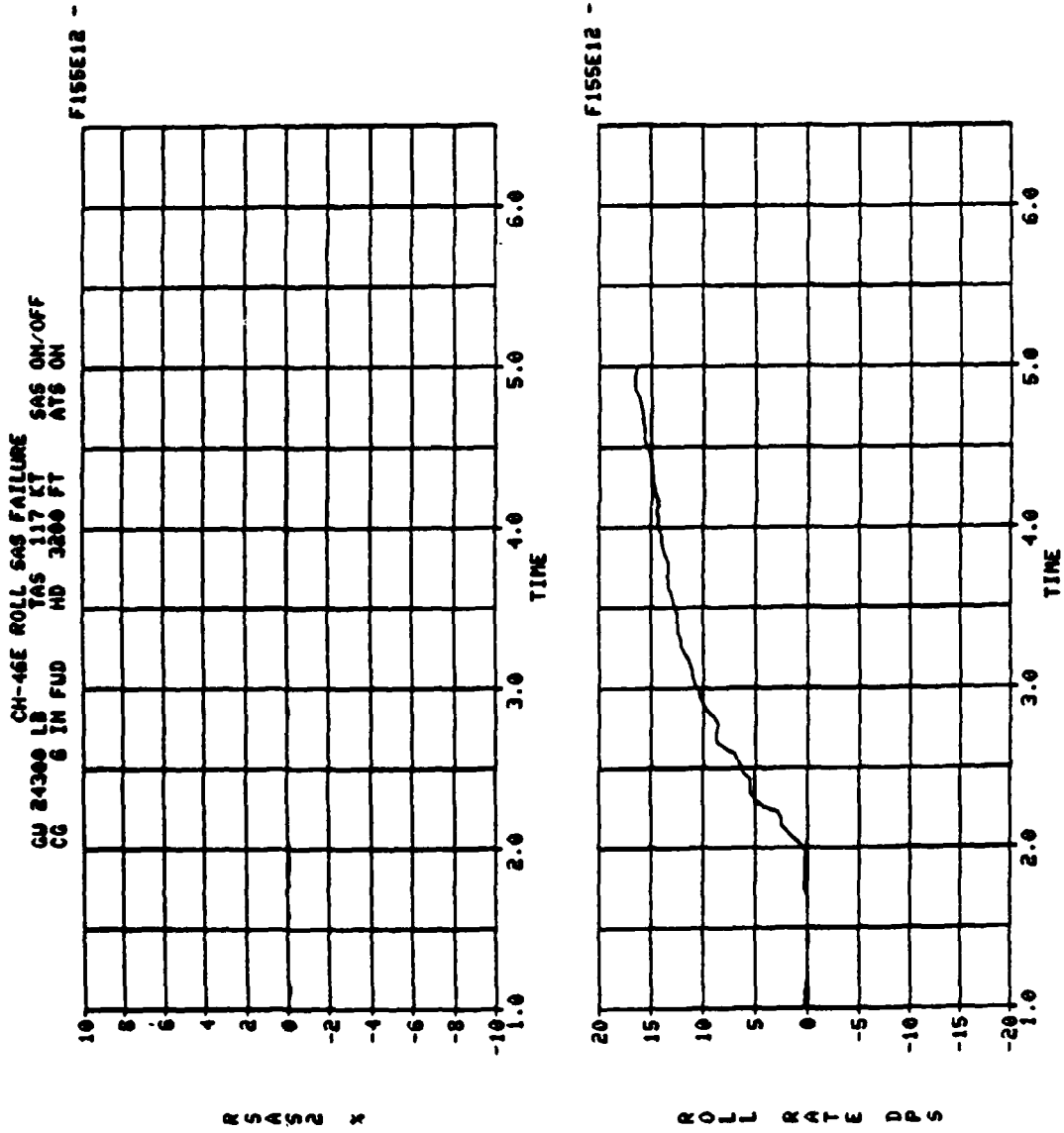


FIGURE 22B

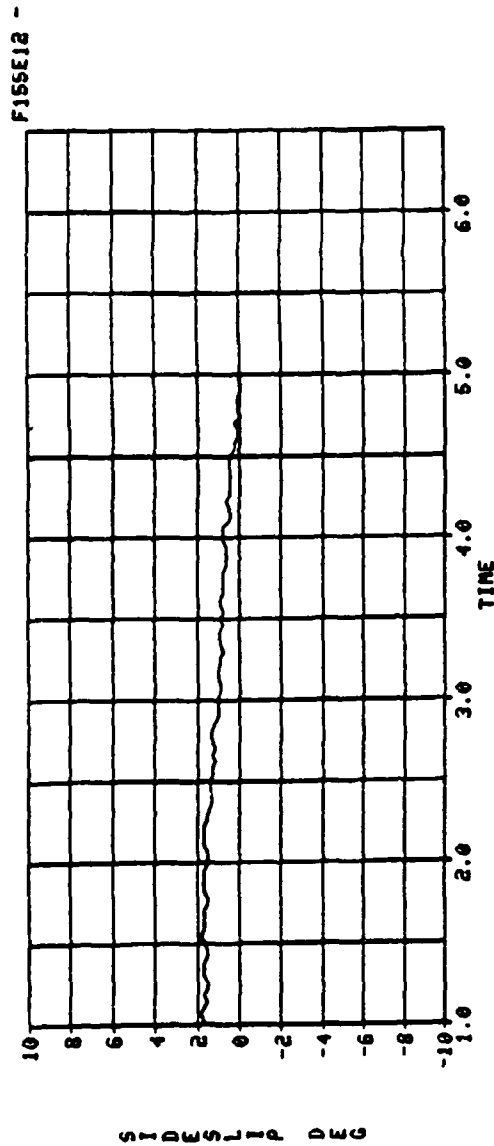
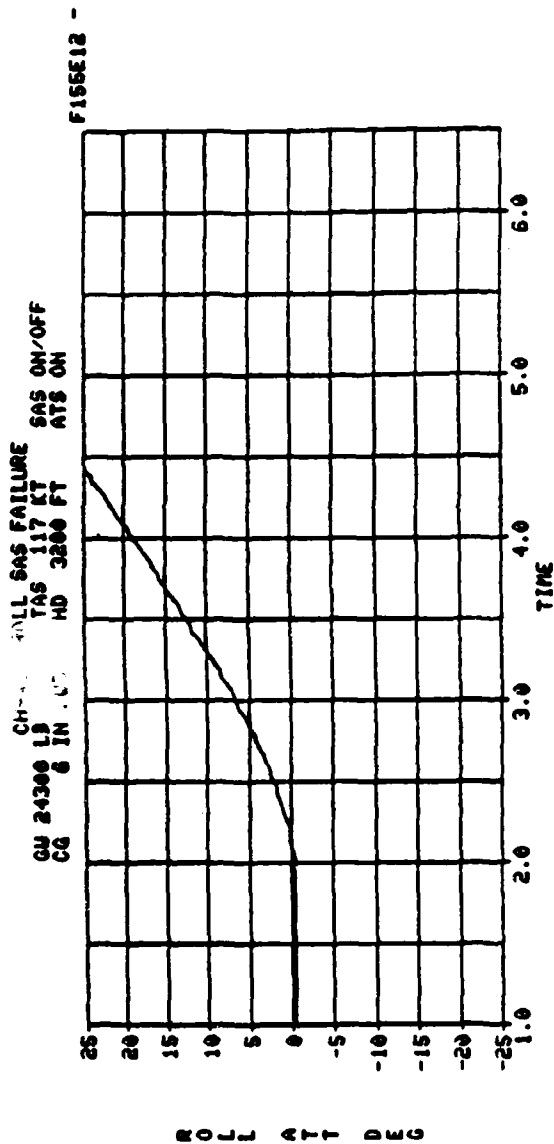


FIGURE 22C

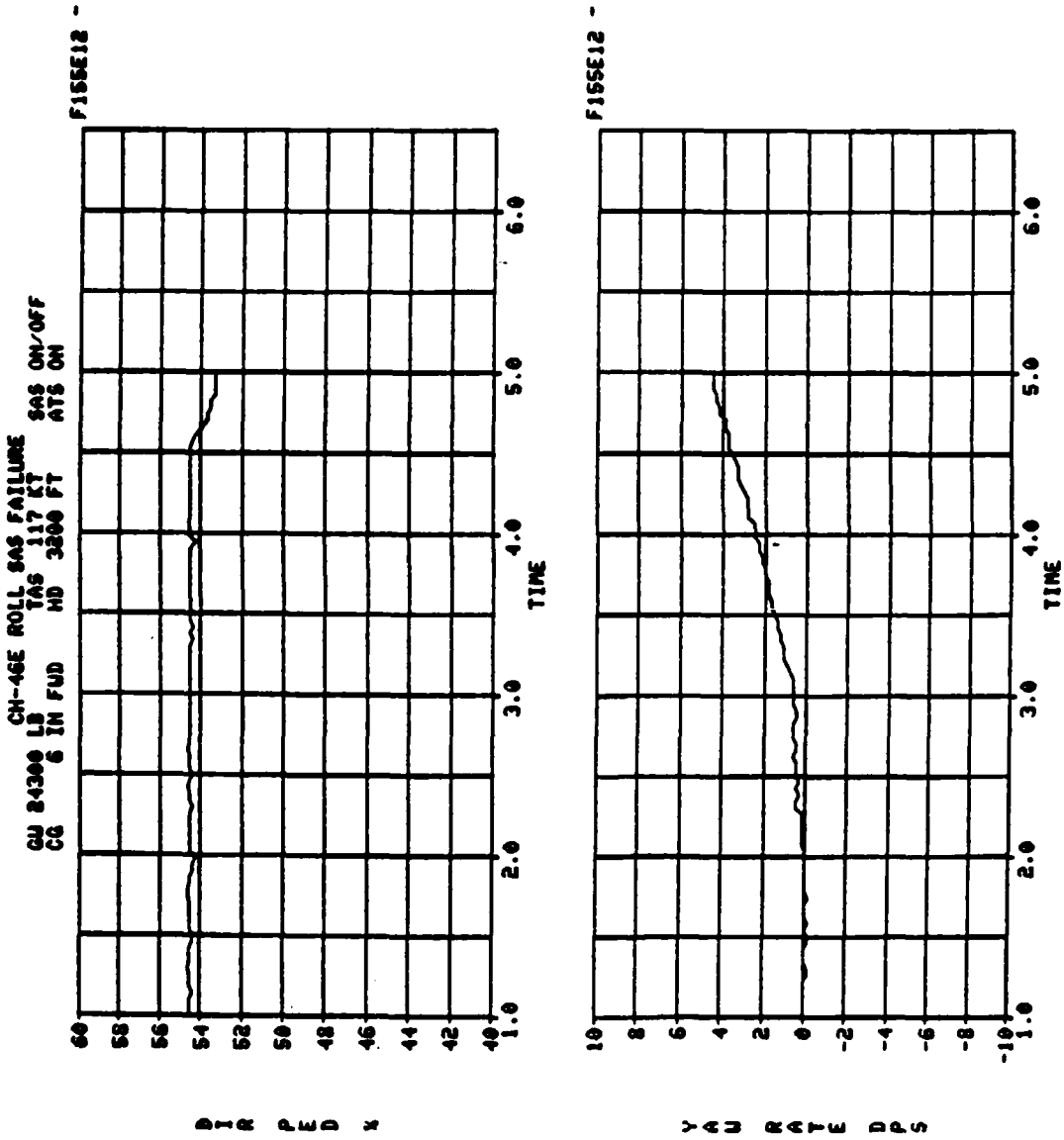


FIGURE 22D

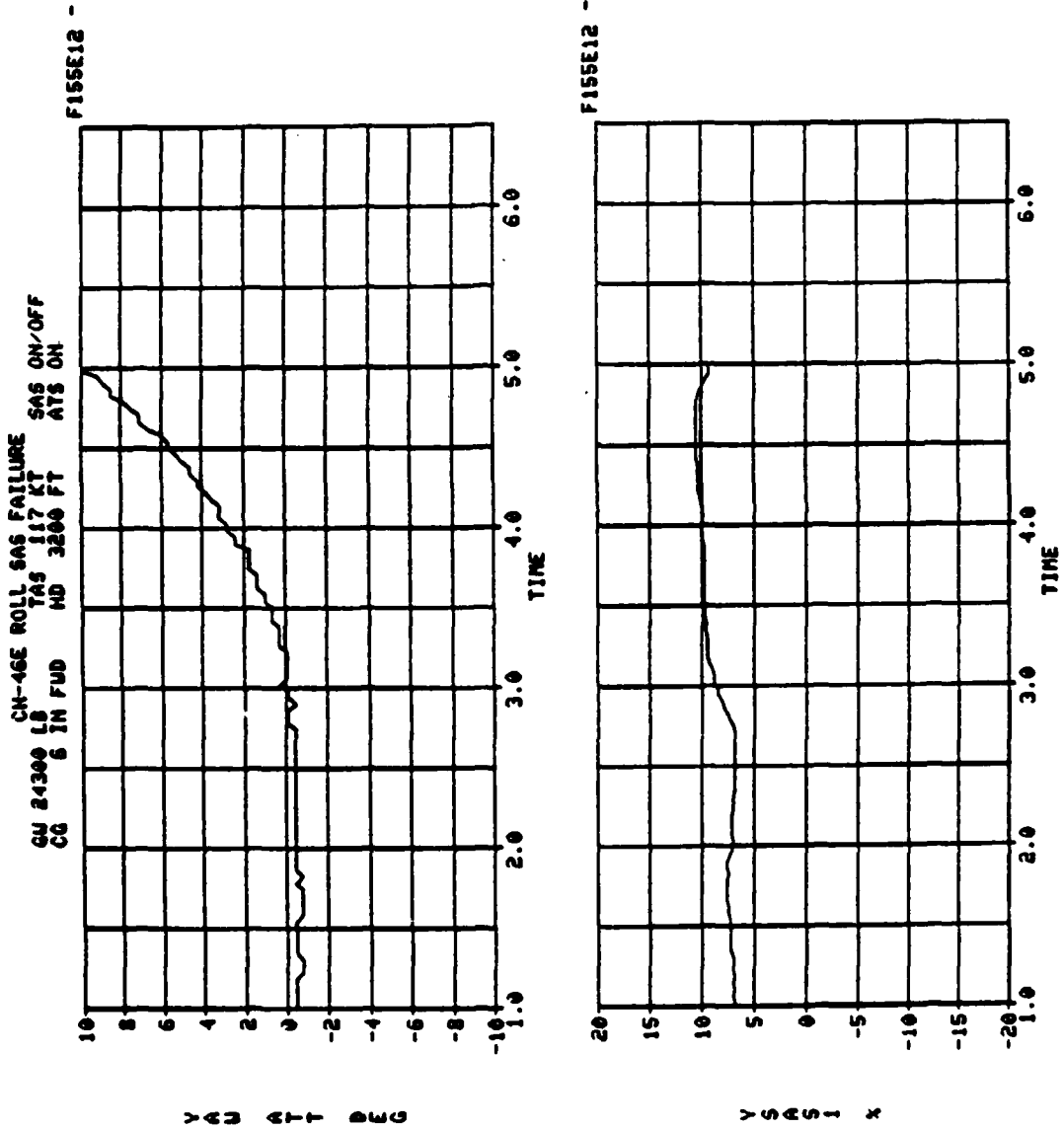


FIGURE 22E

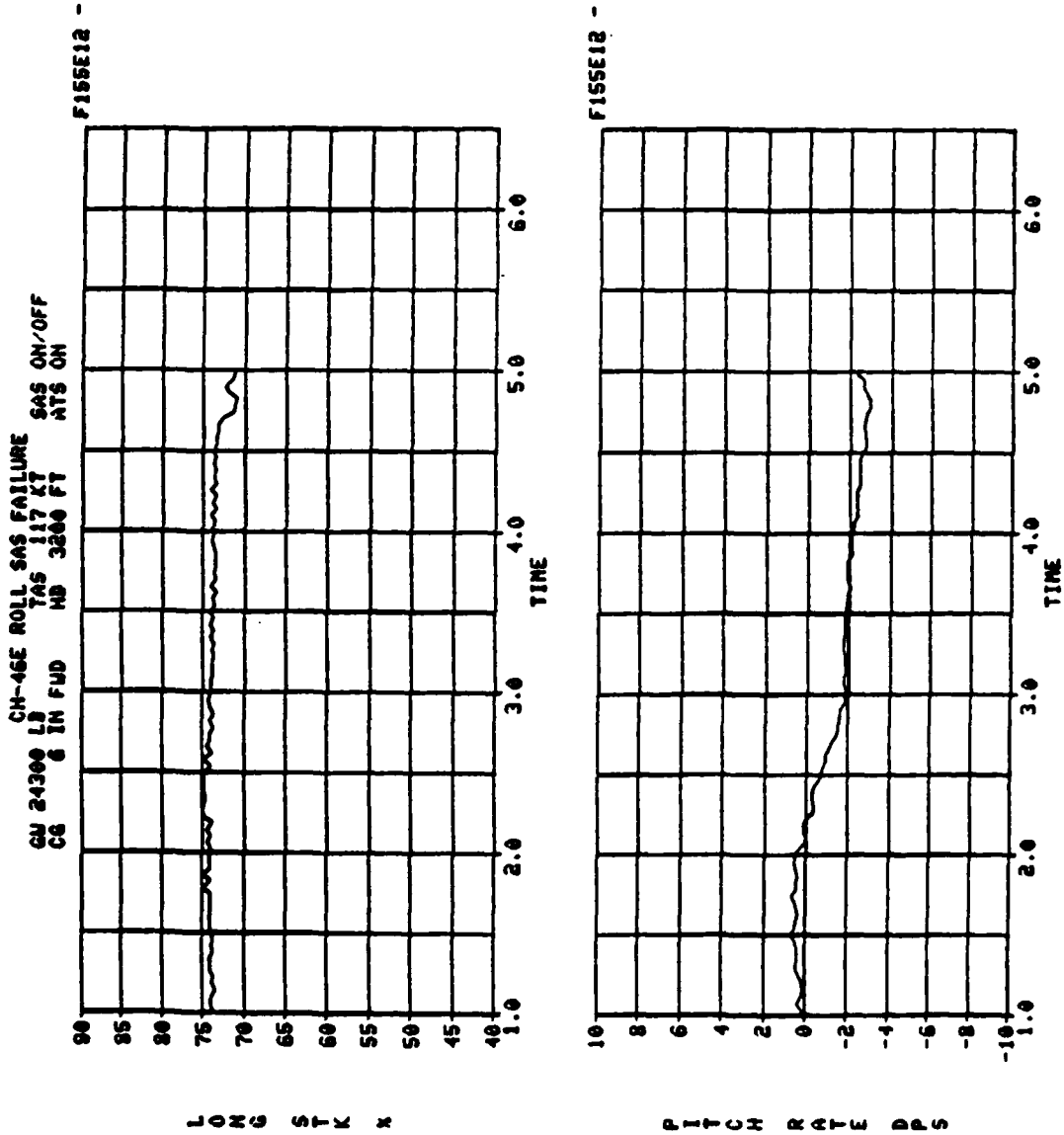


FIGURE 22F

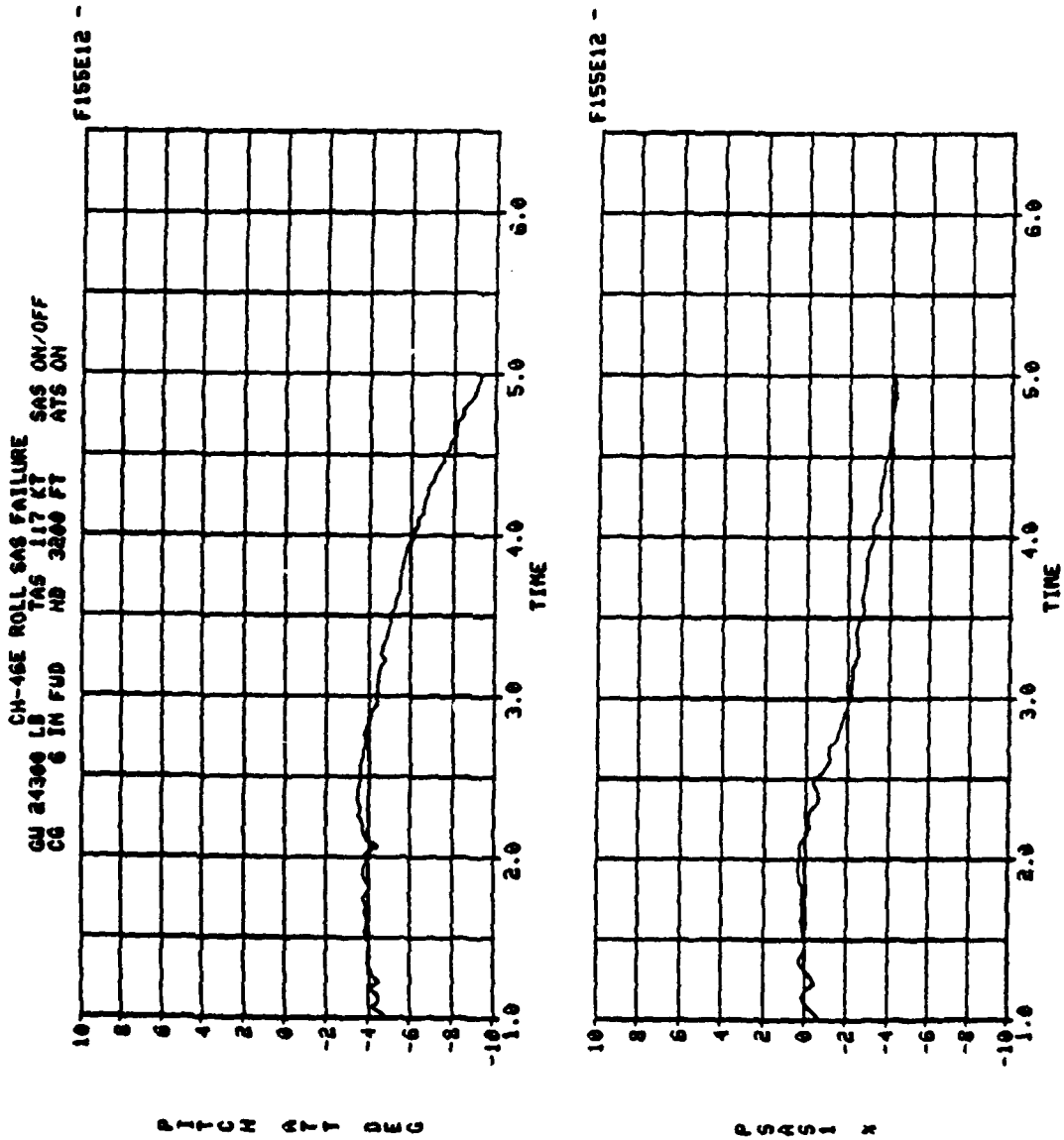


FIGURE 22G

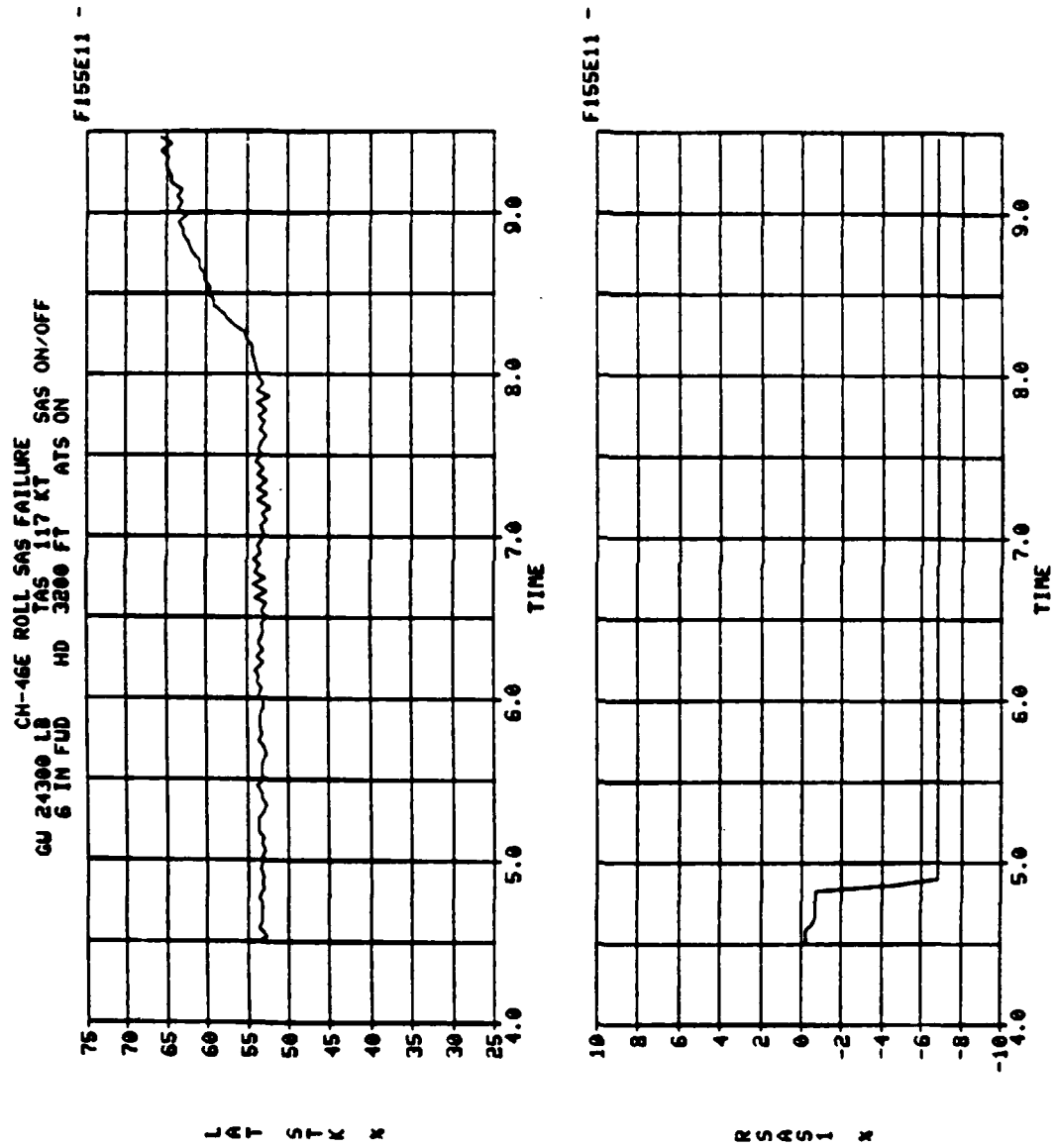


FIGURE 23A

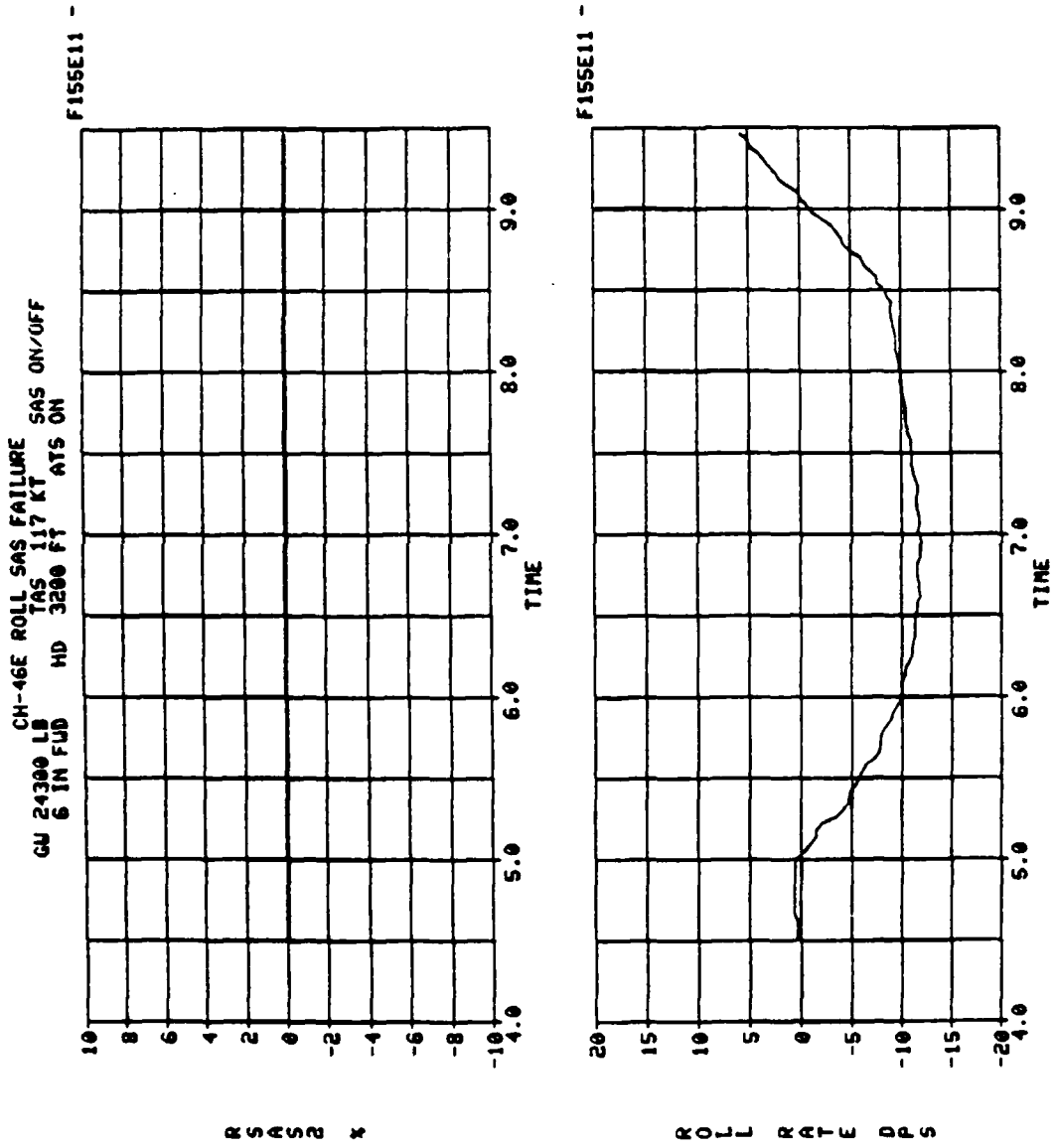


FIGURE 23B

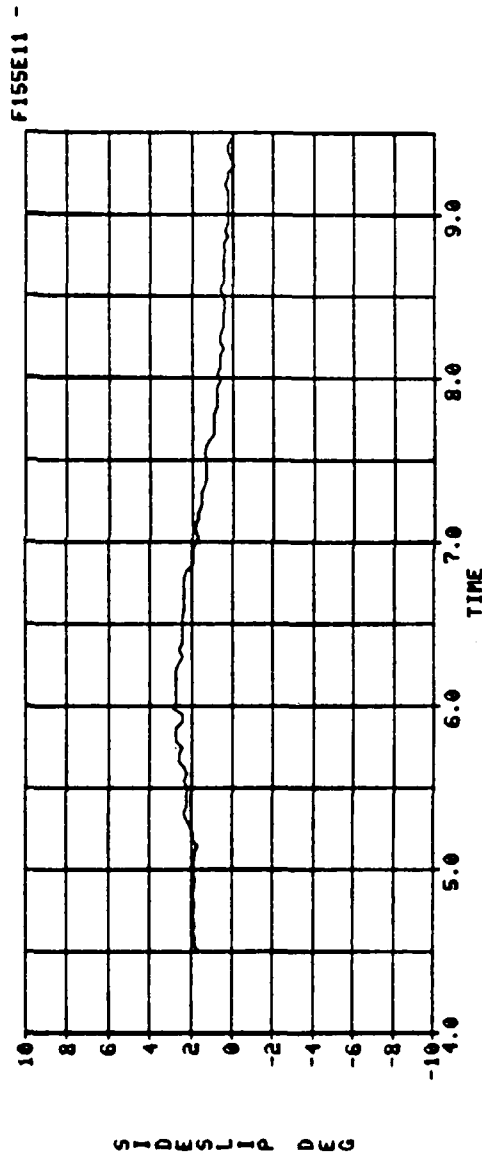
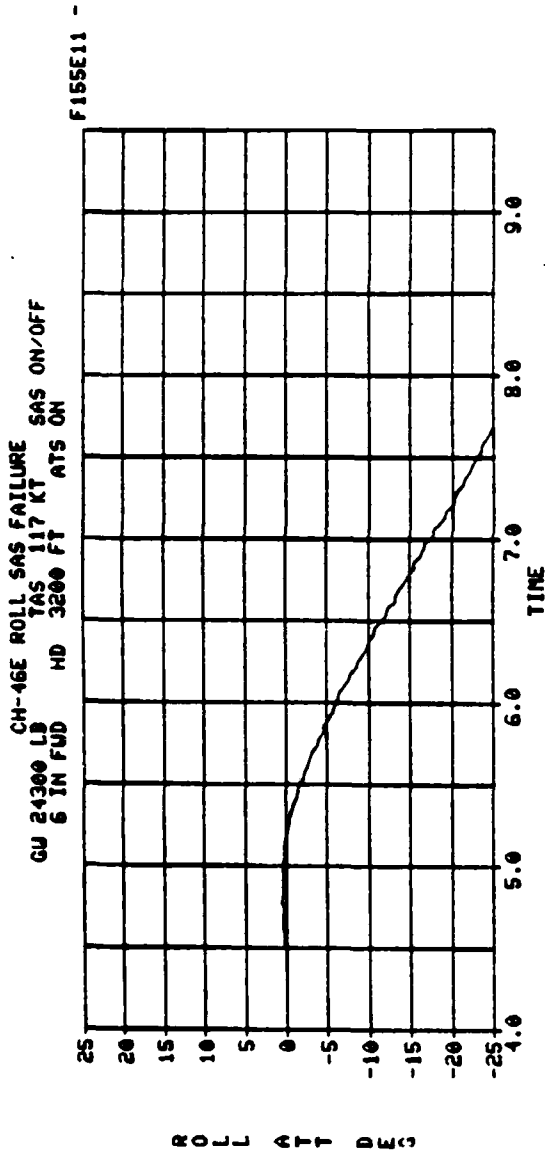


FIGURE 23C

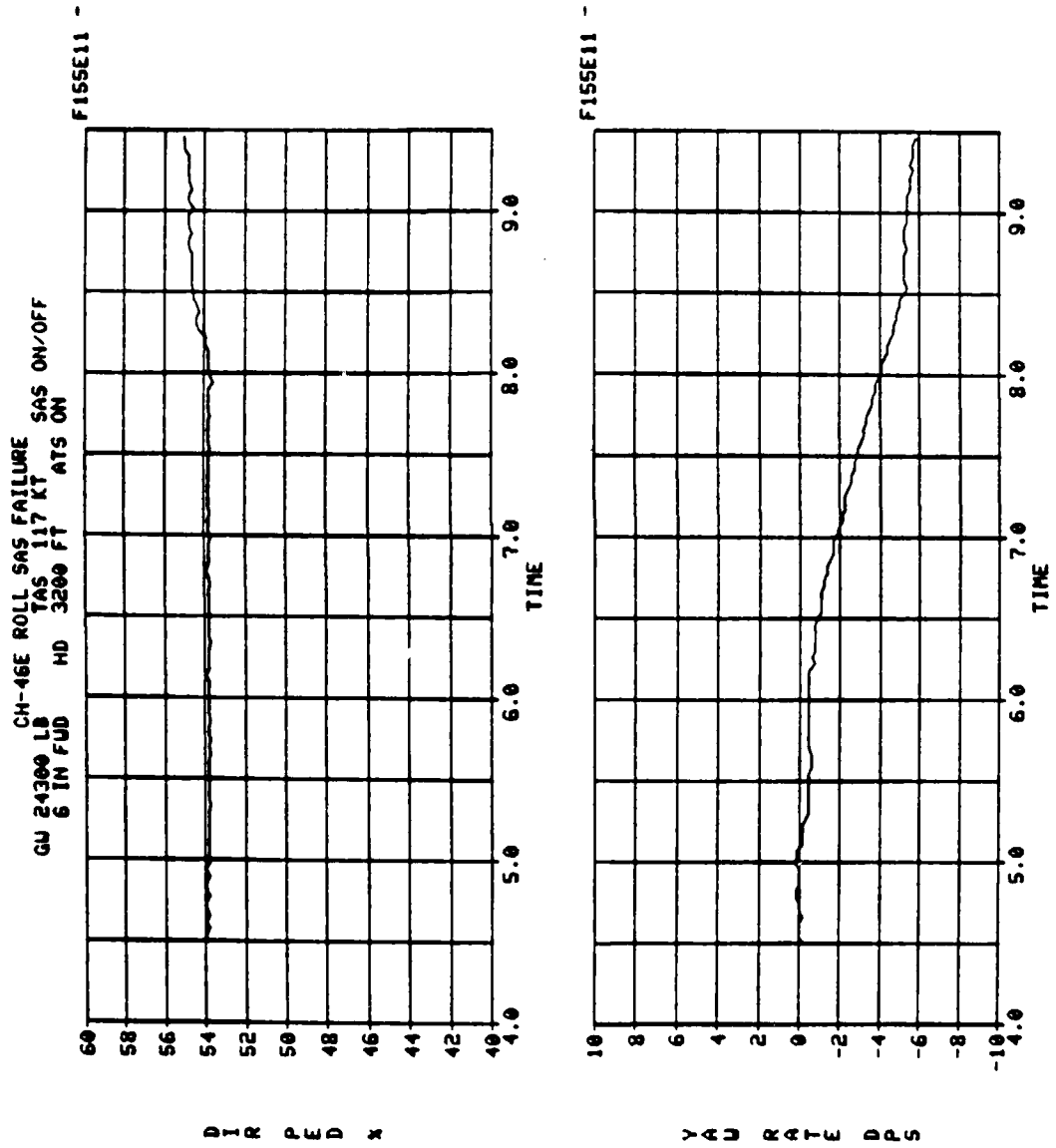


FIGURE 230

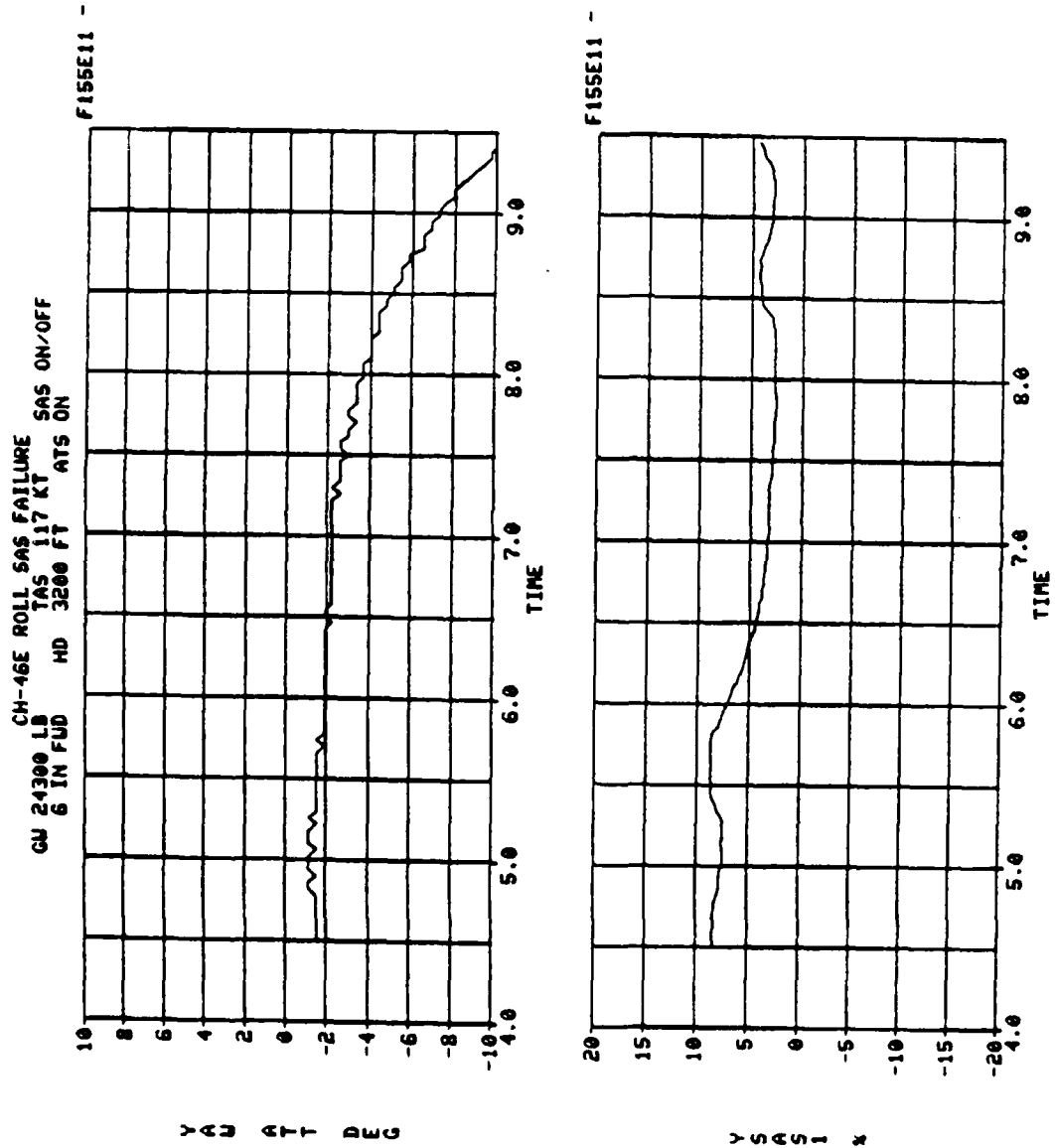


FIGURE 23E

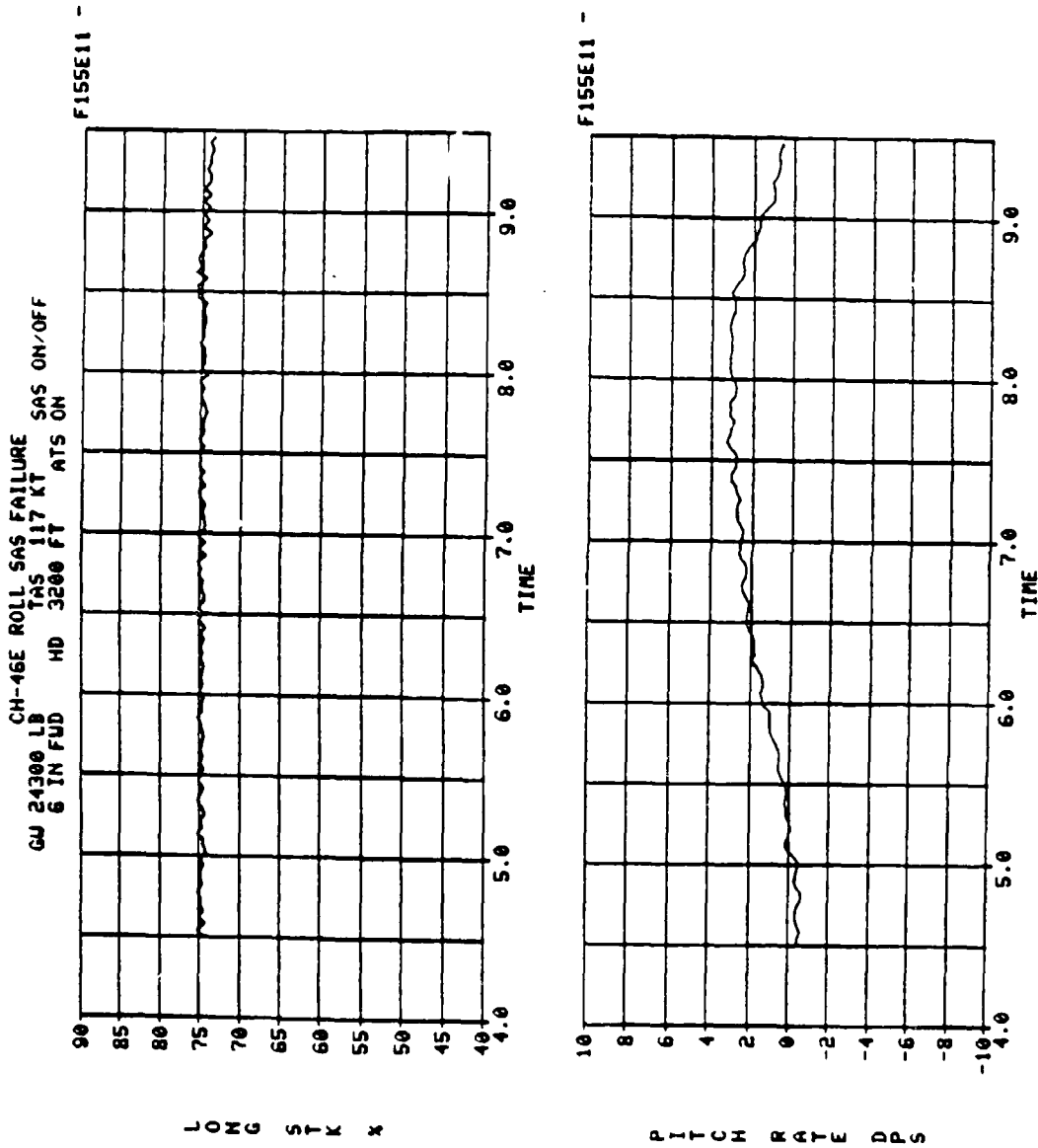


FIGURE 23F

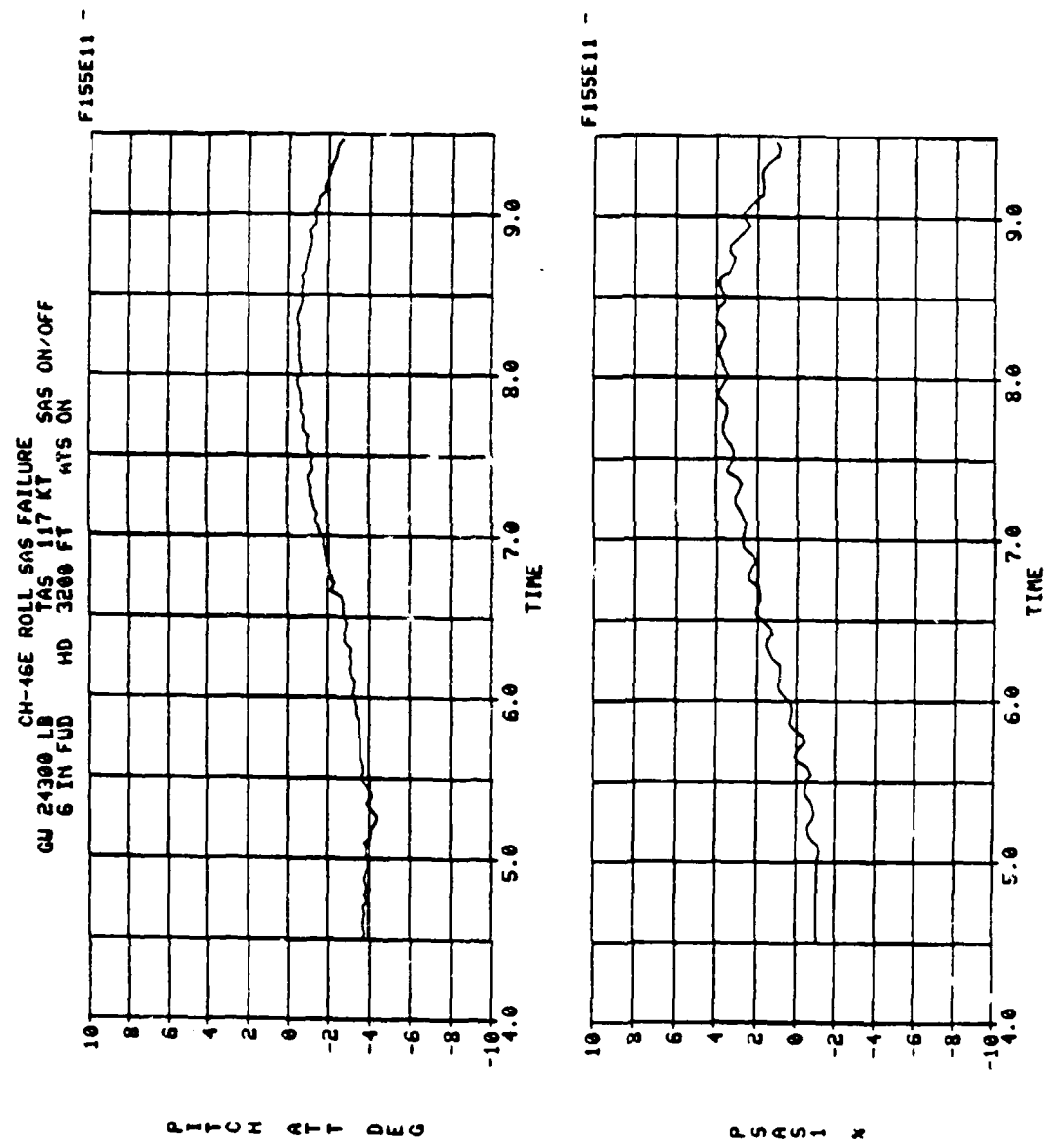


FIGURE 23G

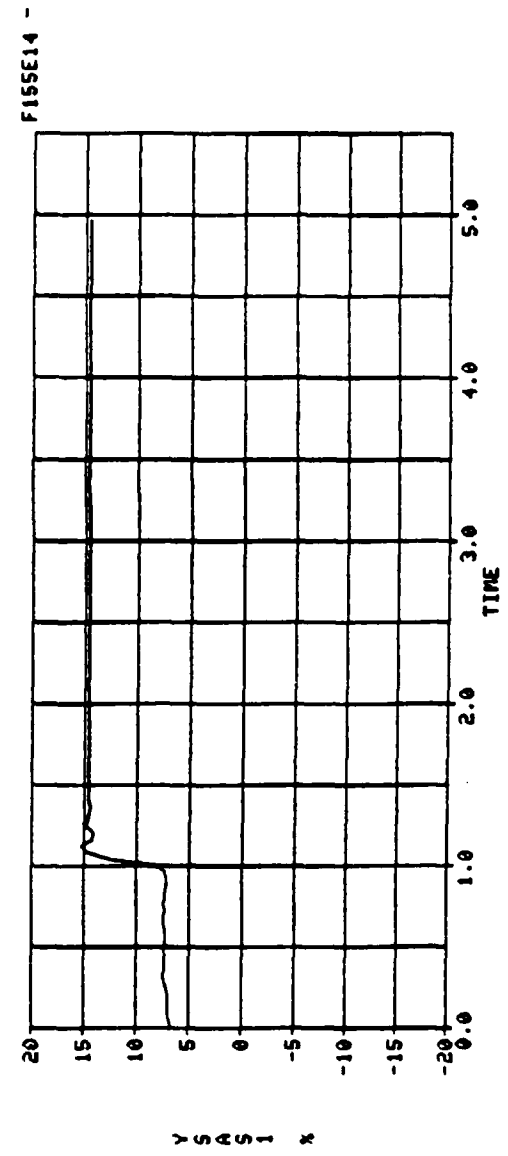
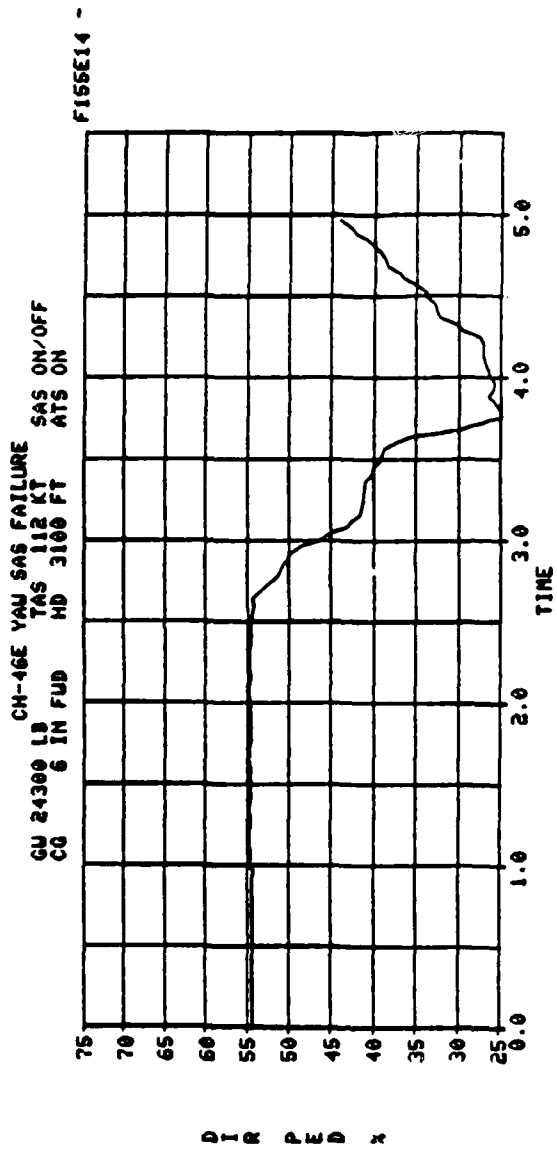


FIGURE 24A

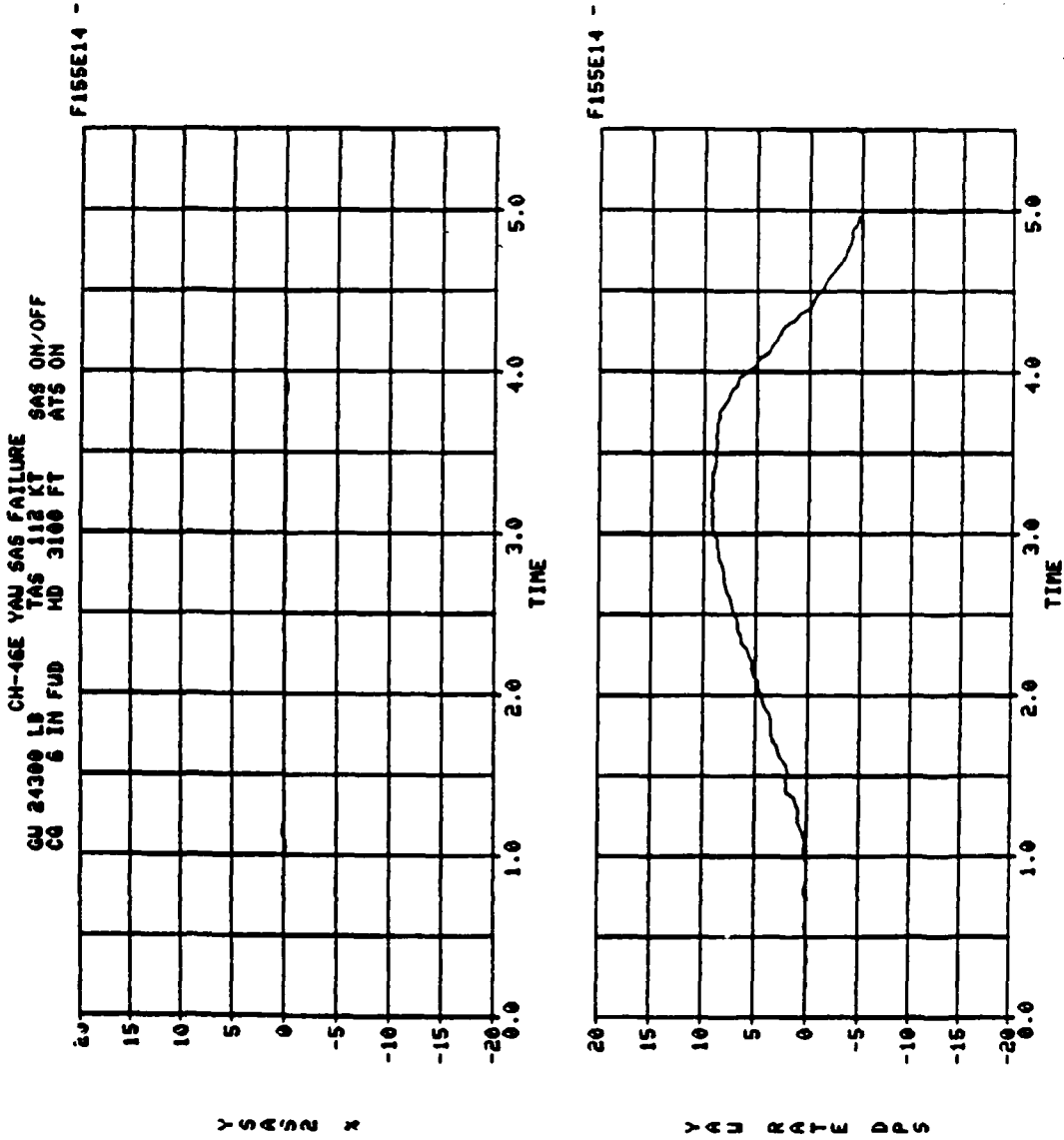


FIGURE 24B

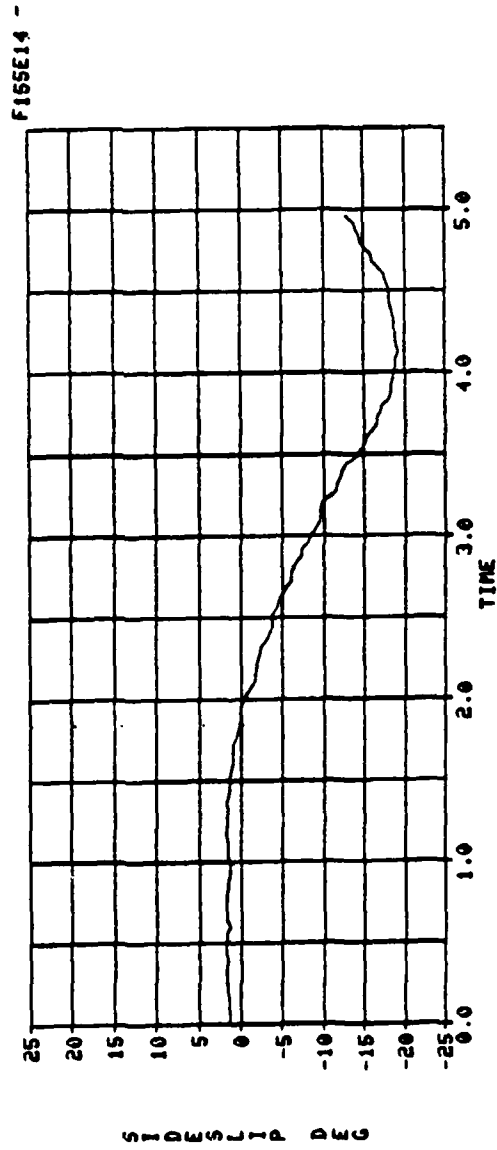
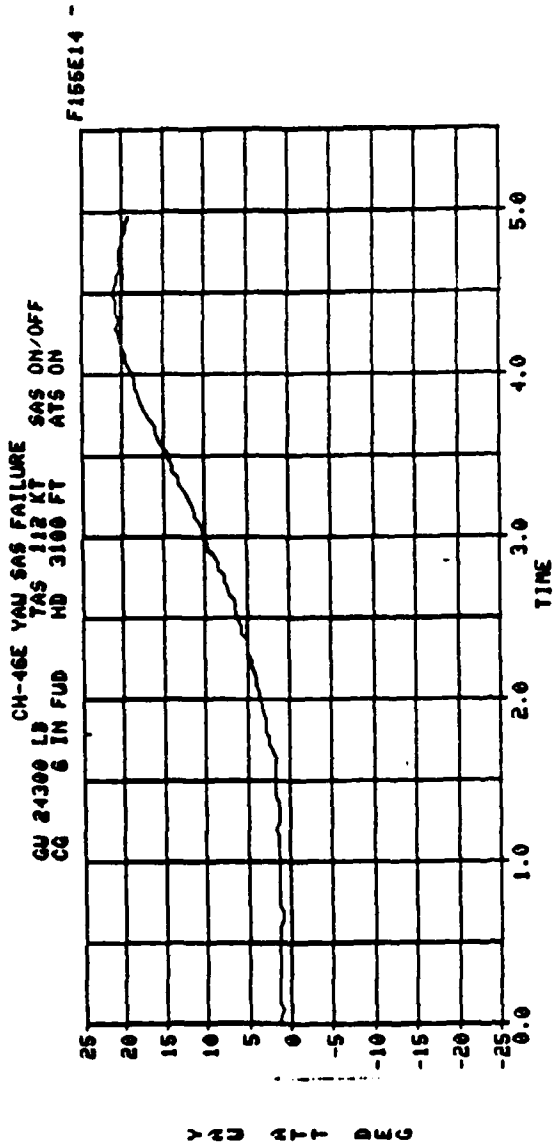


FIGURE 24C

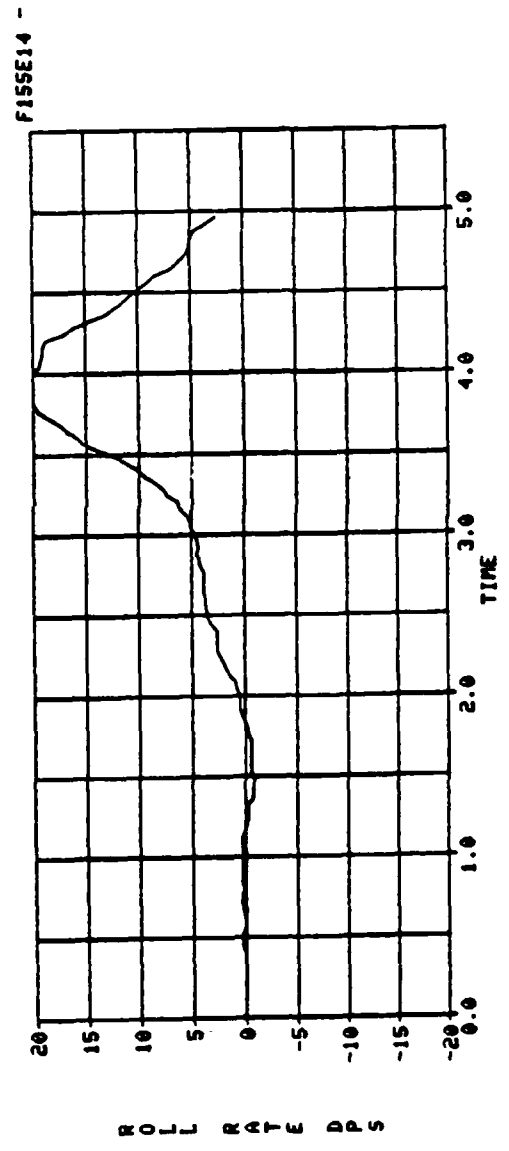
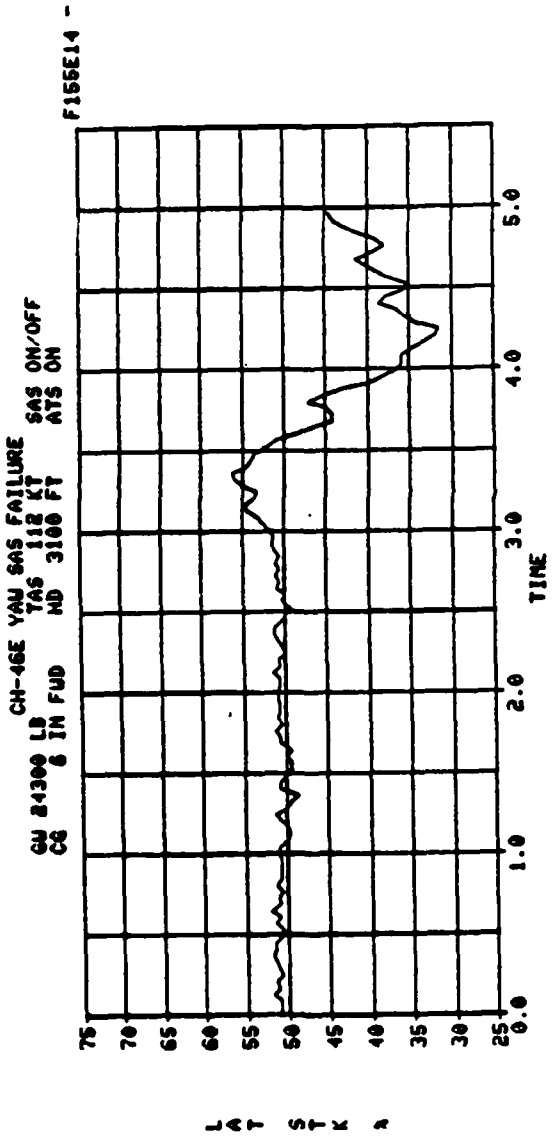


FIGURE 24D

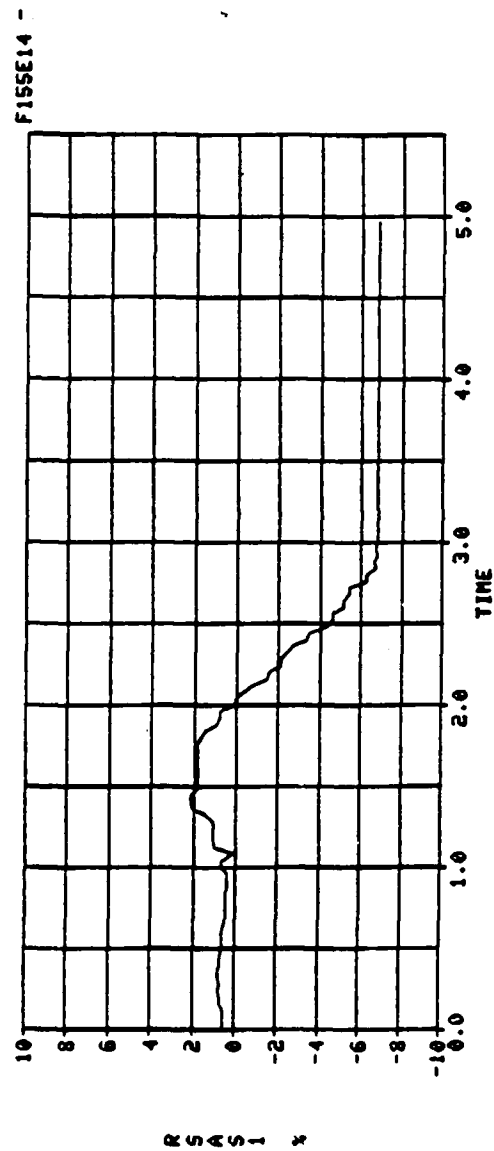
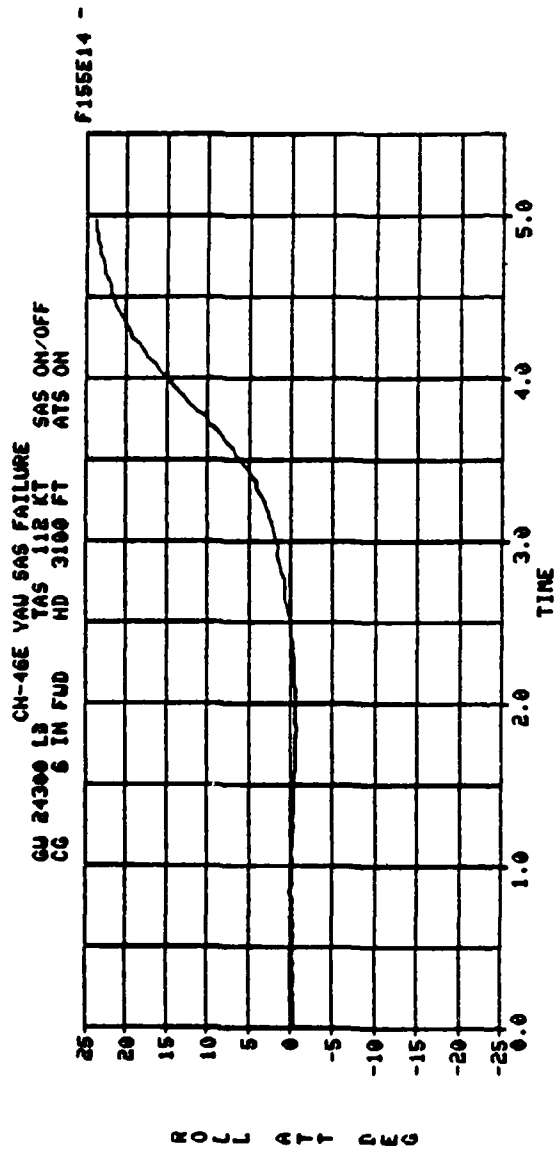


FIGURE 24E

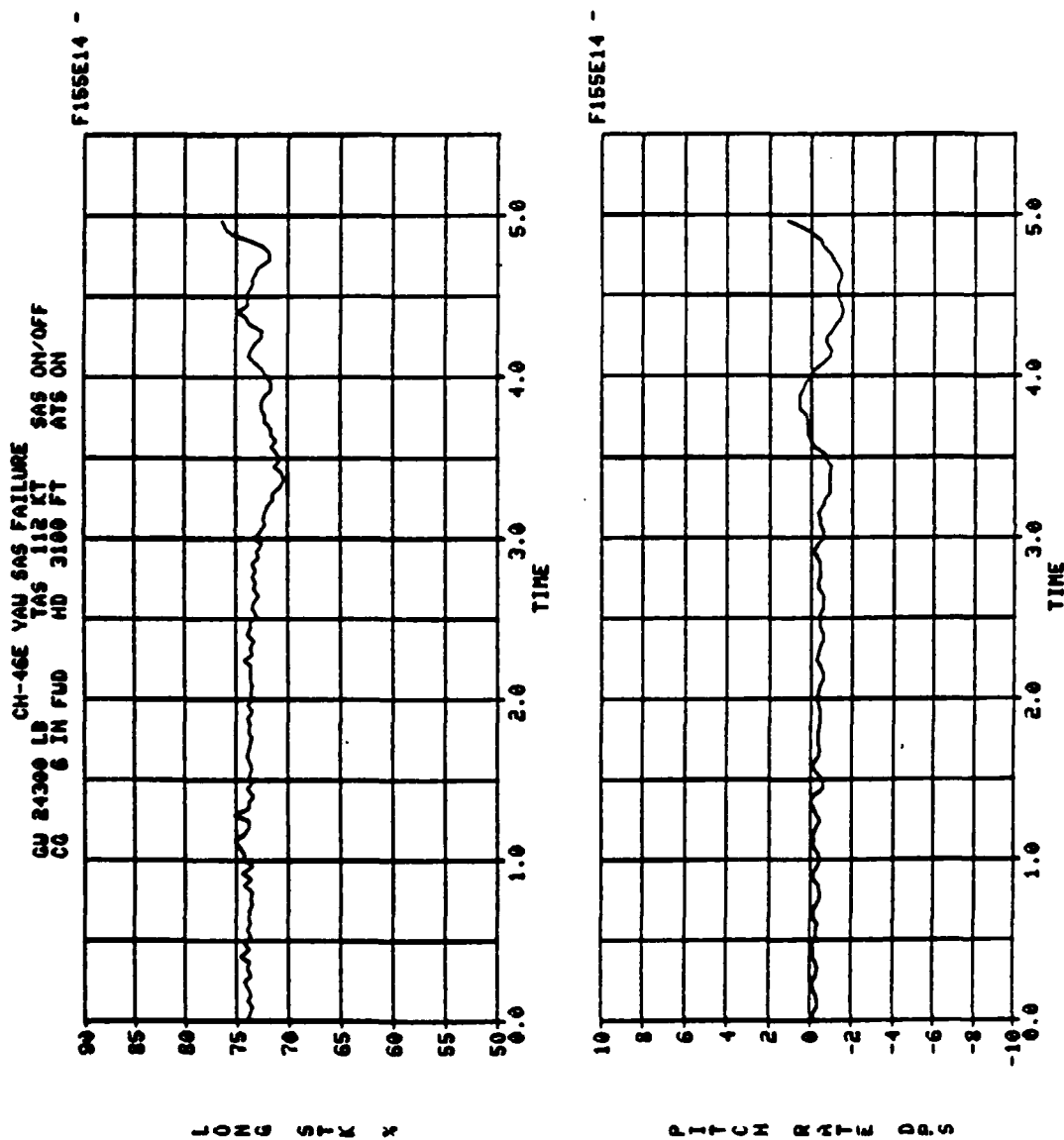


FIGURE 24F

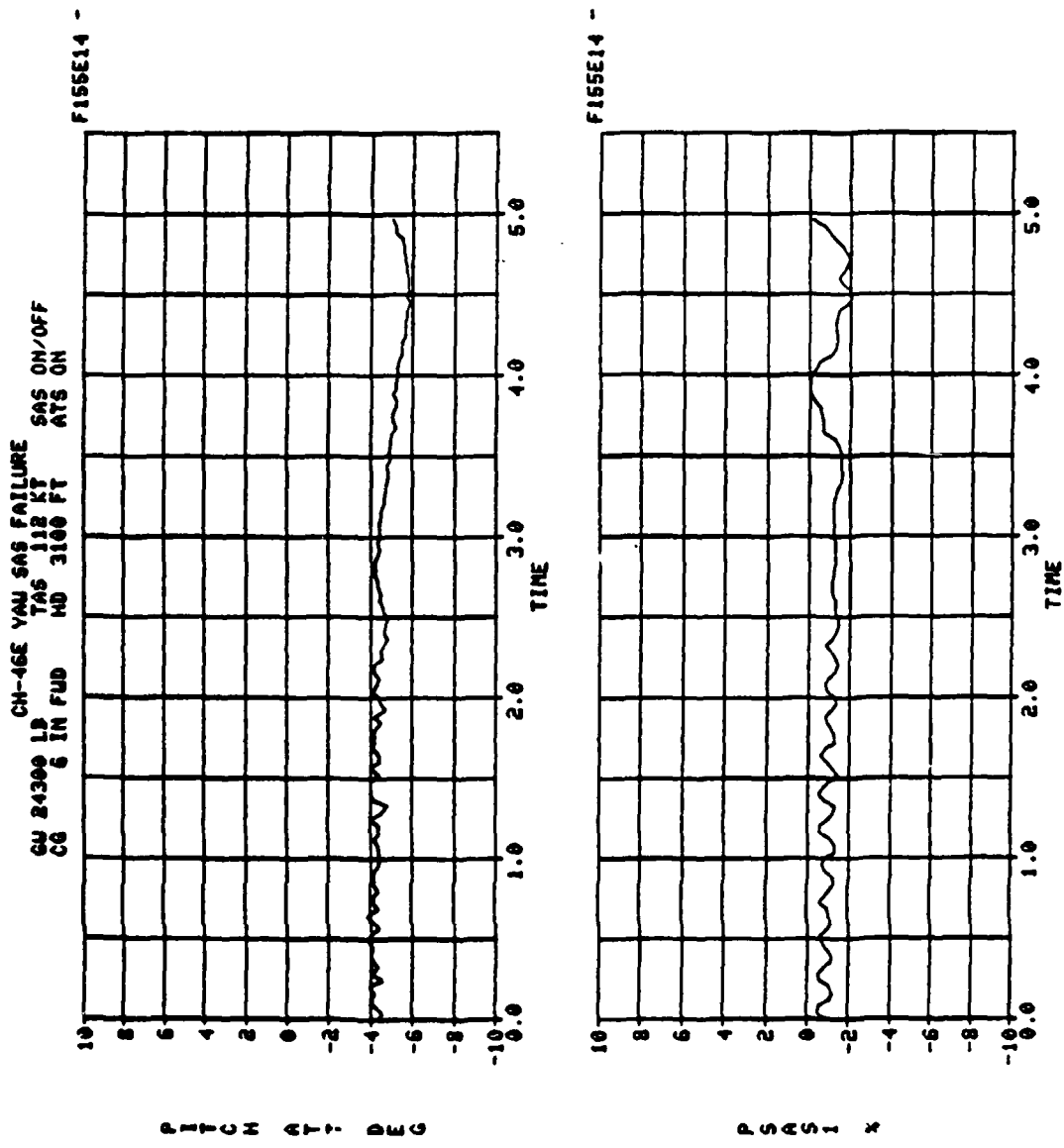


FIGURE 24G

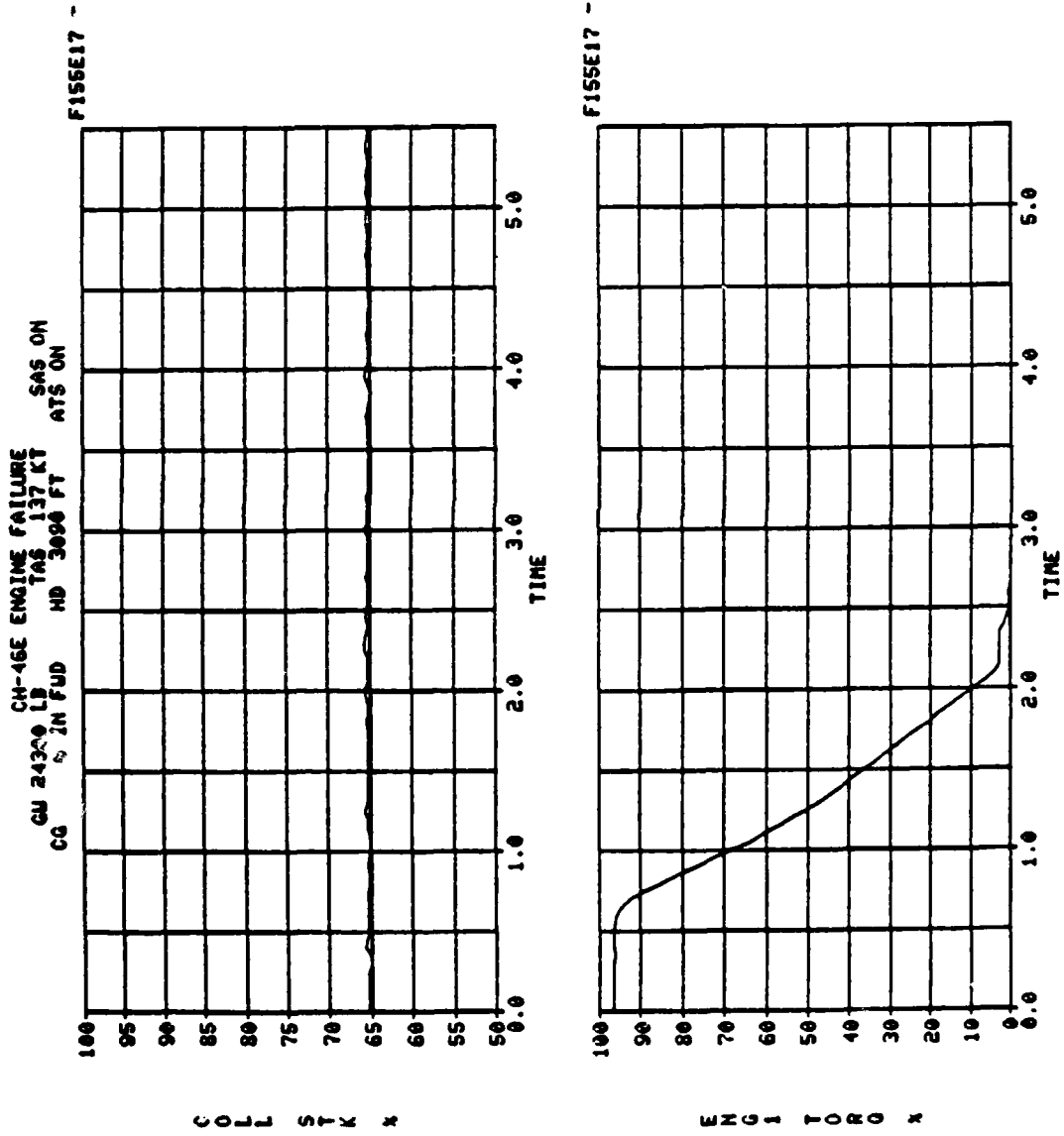


FIGURE 25A

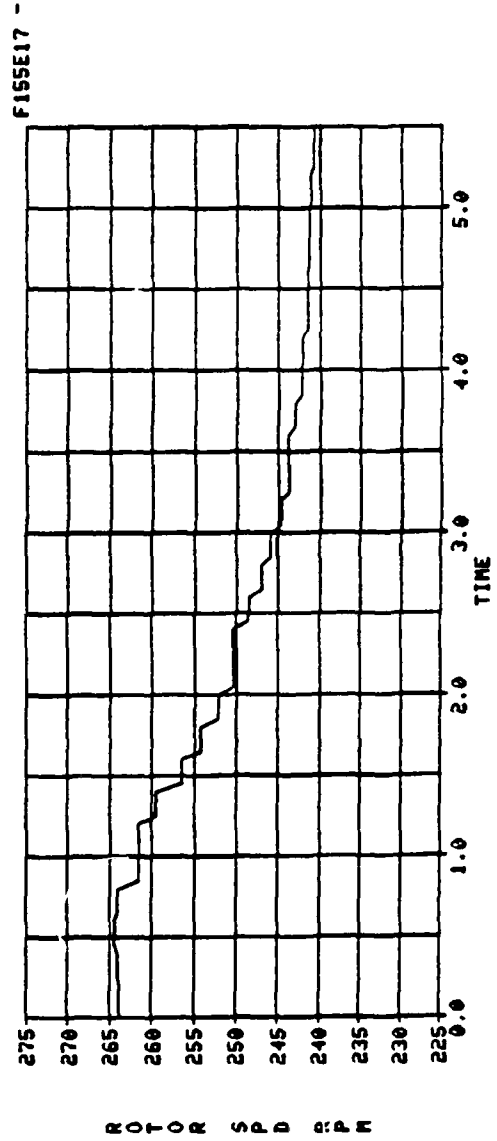
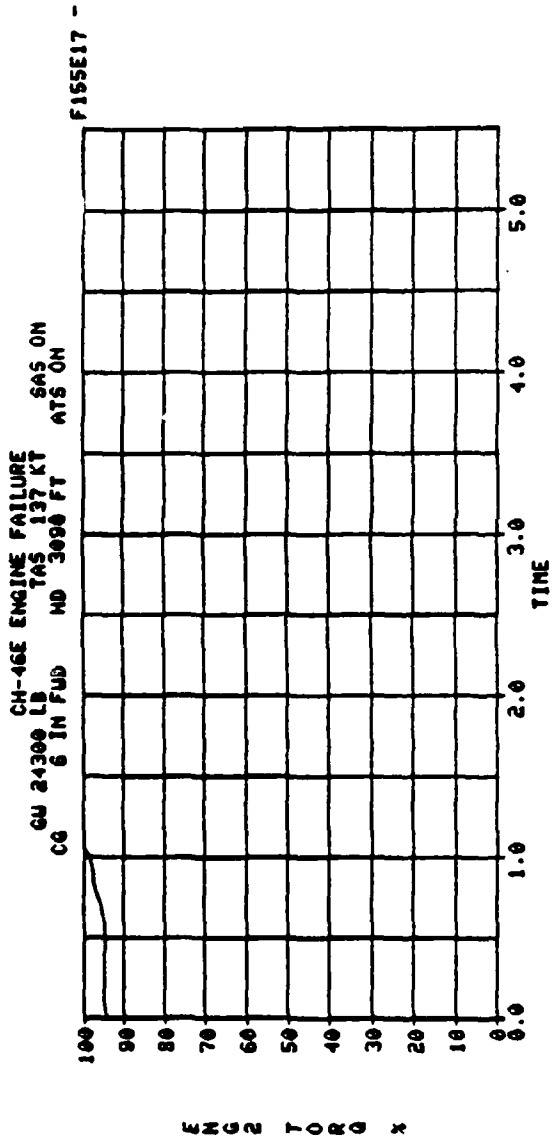


FIGURE 25B

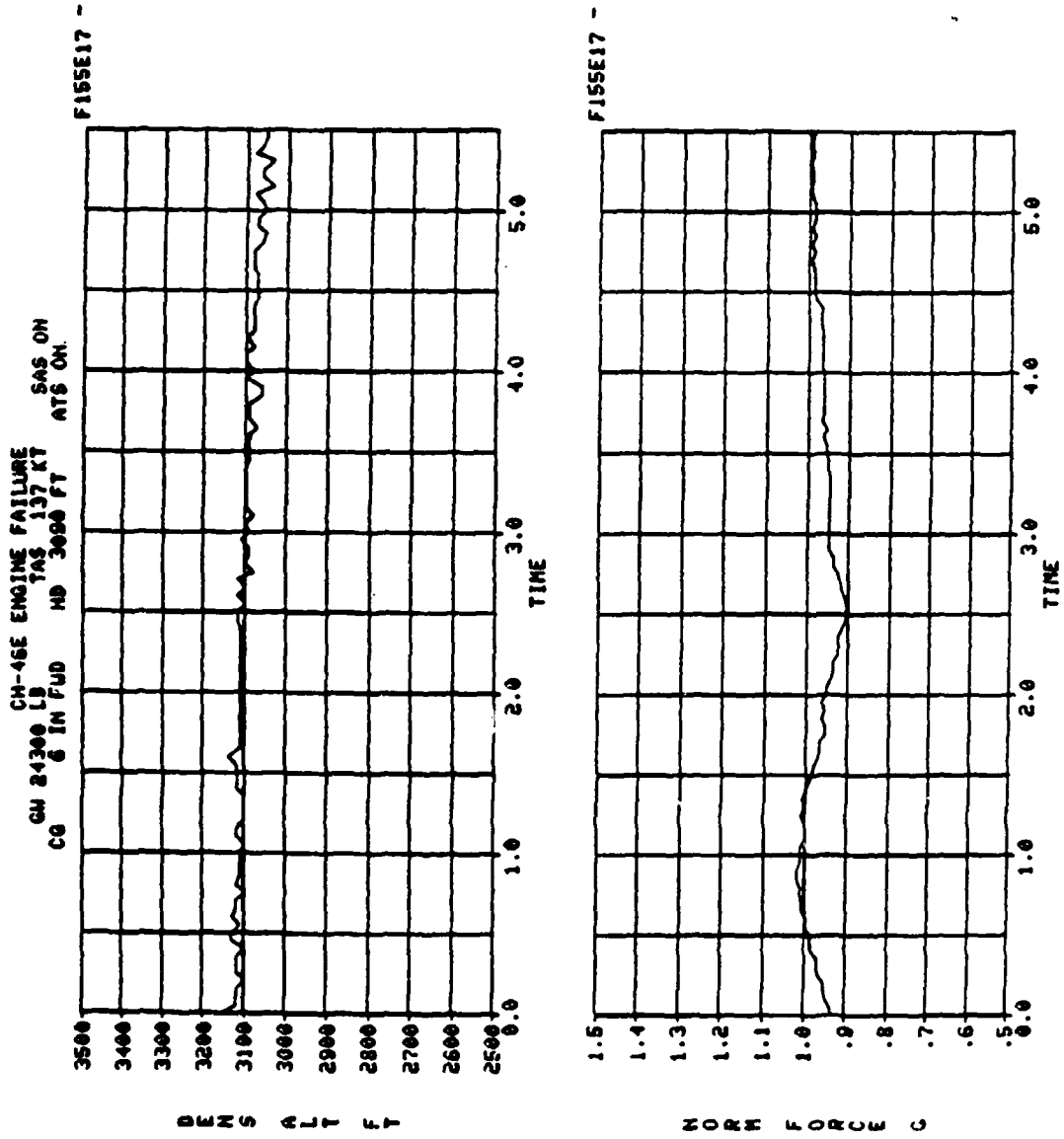


FIGURE 25C

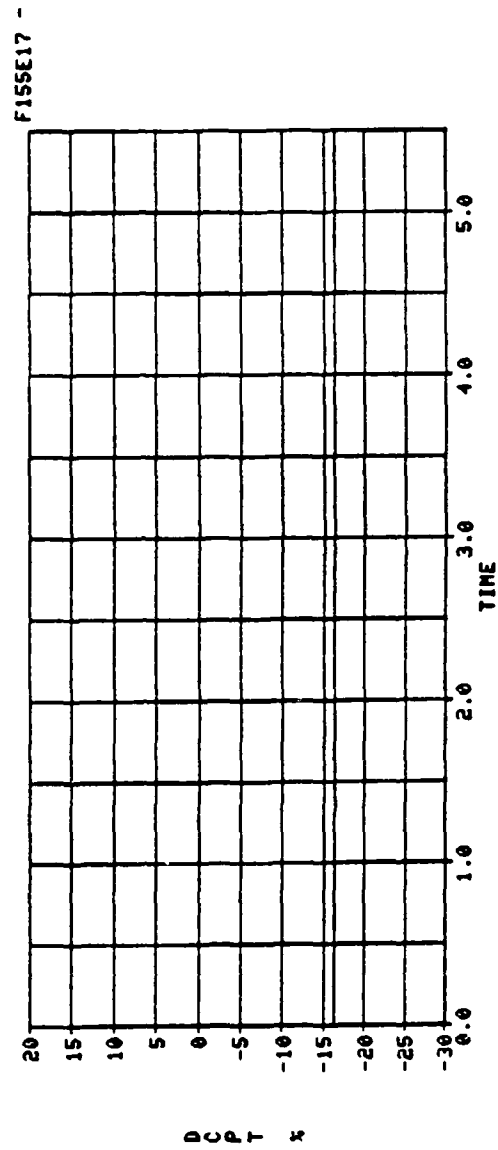
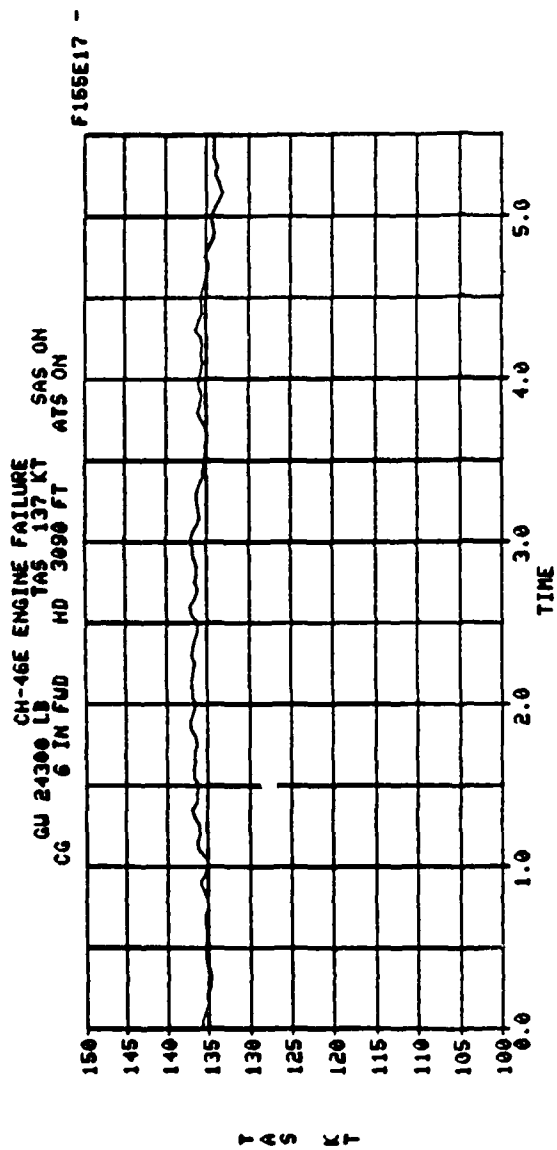


FIGURE 25D

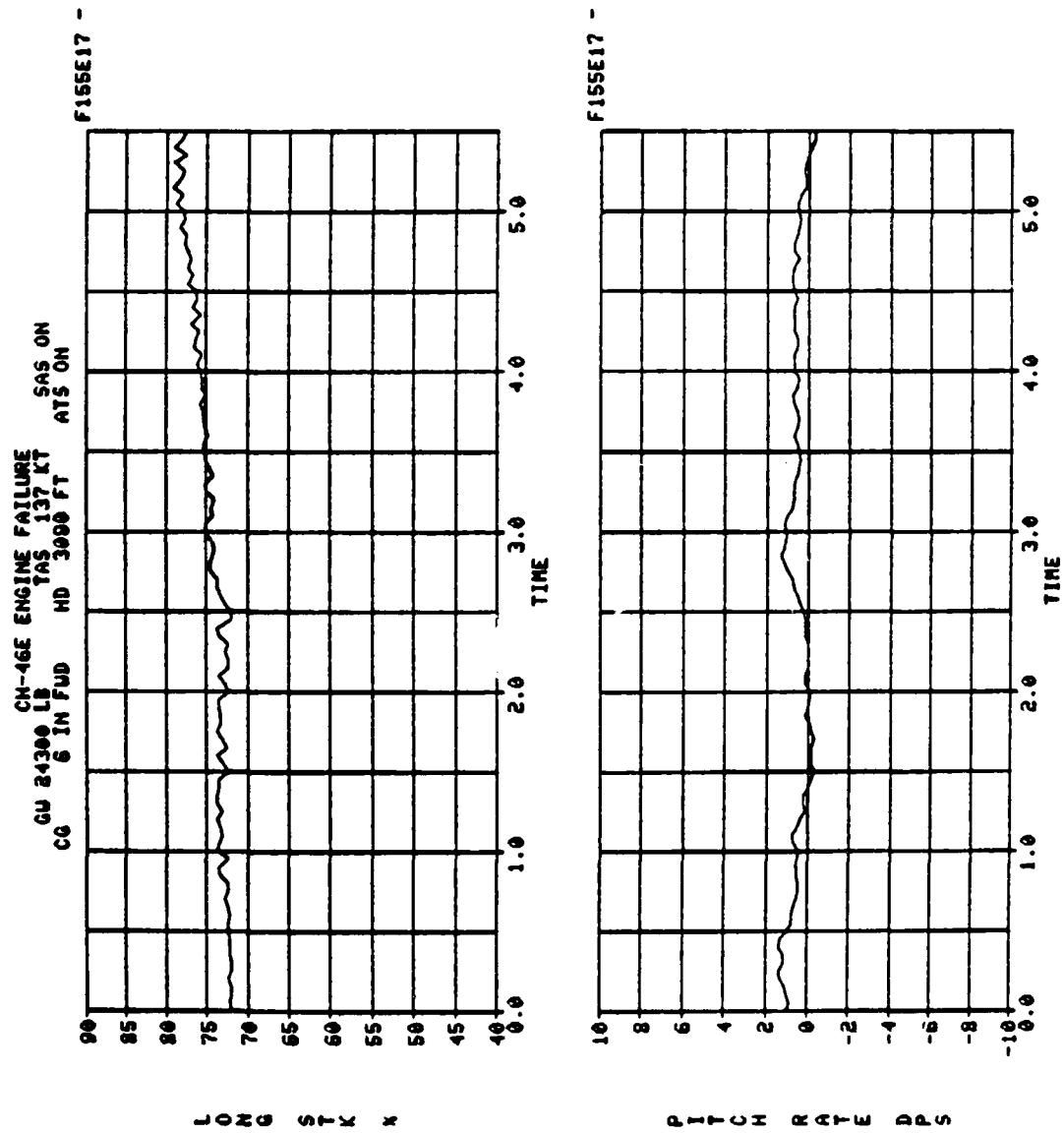


FIGURE 25E

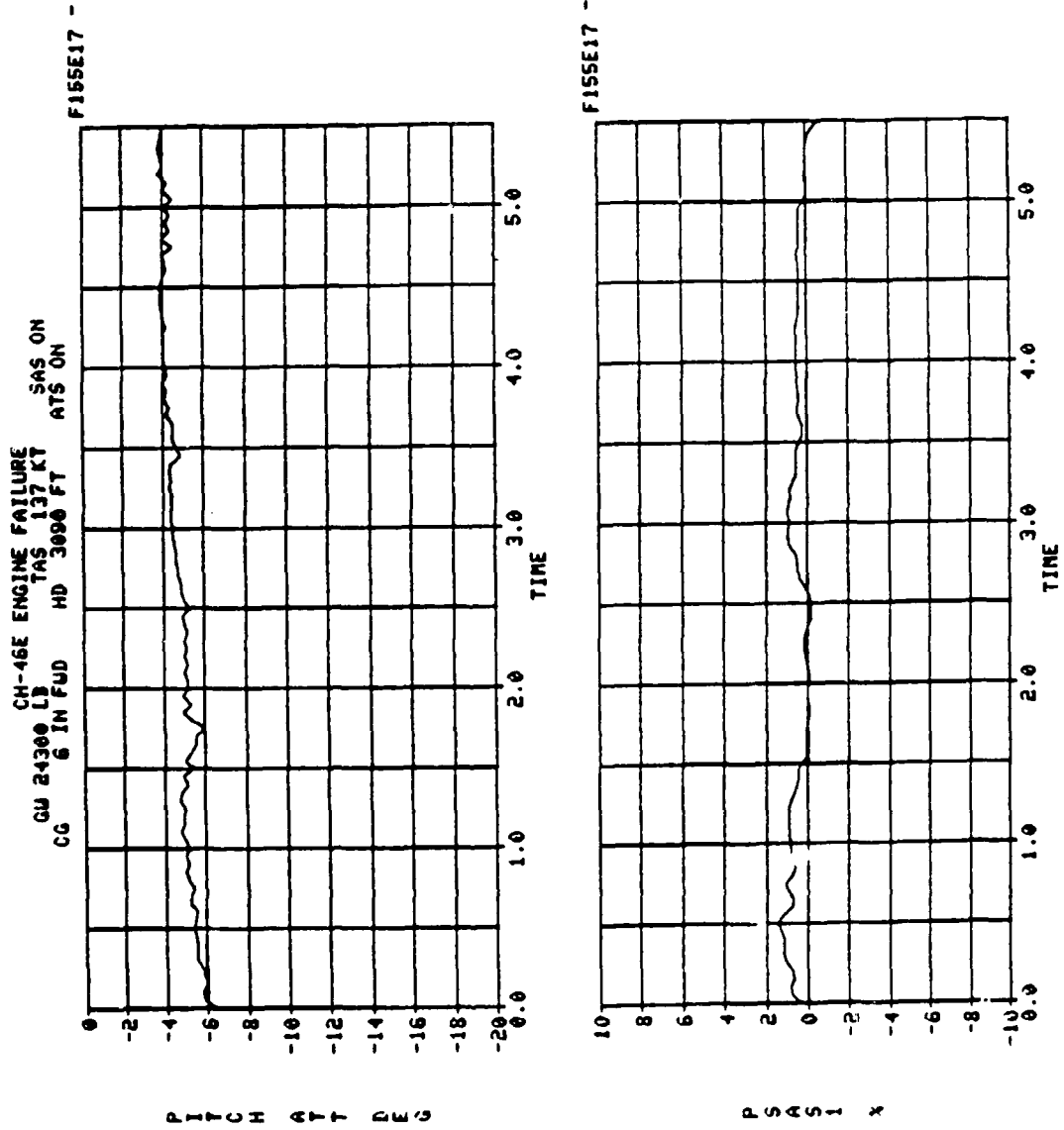


FIGURE 25F

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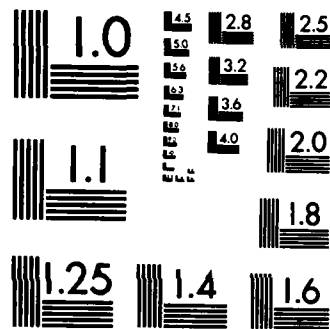
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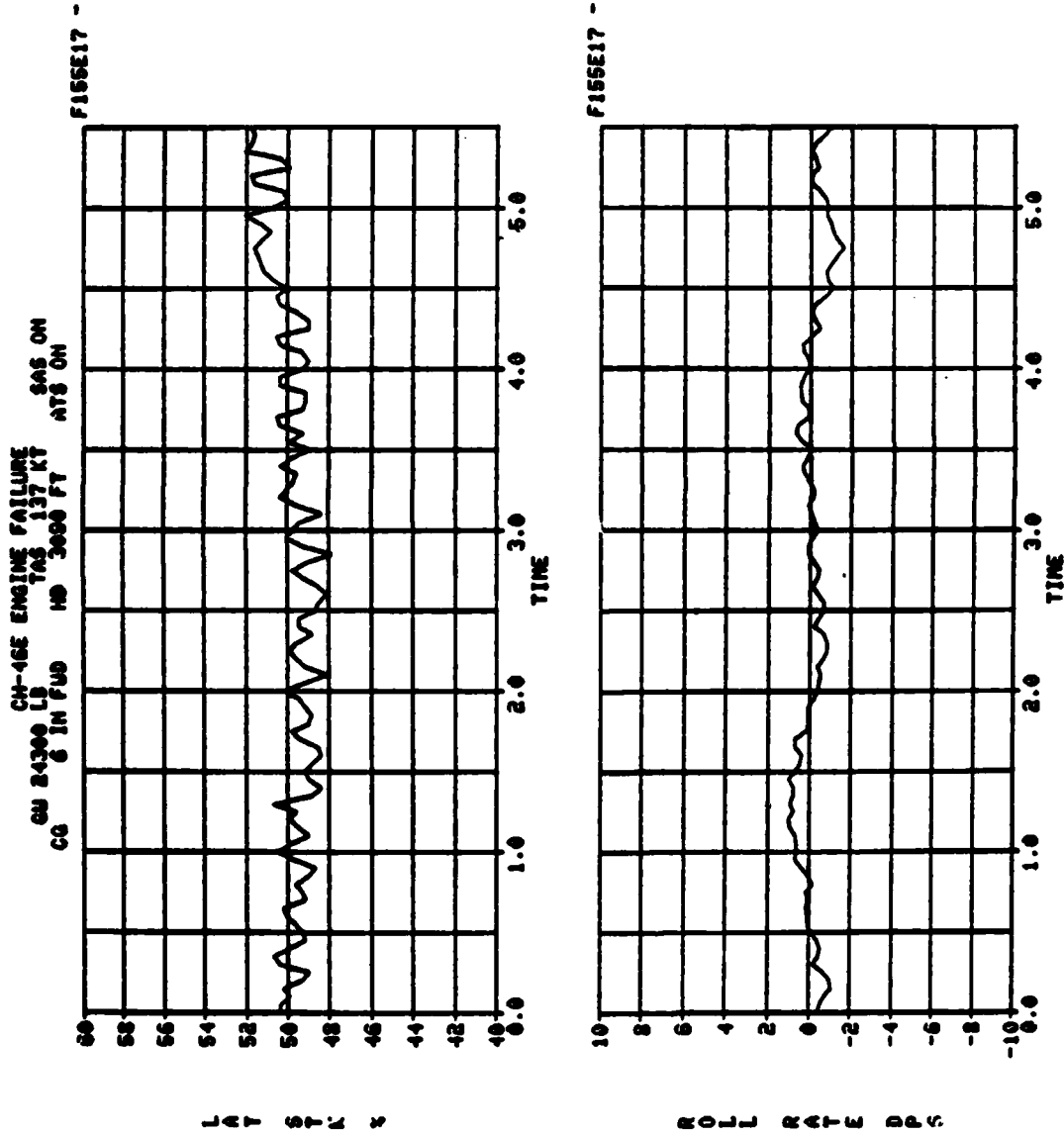


FIGURE 25G

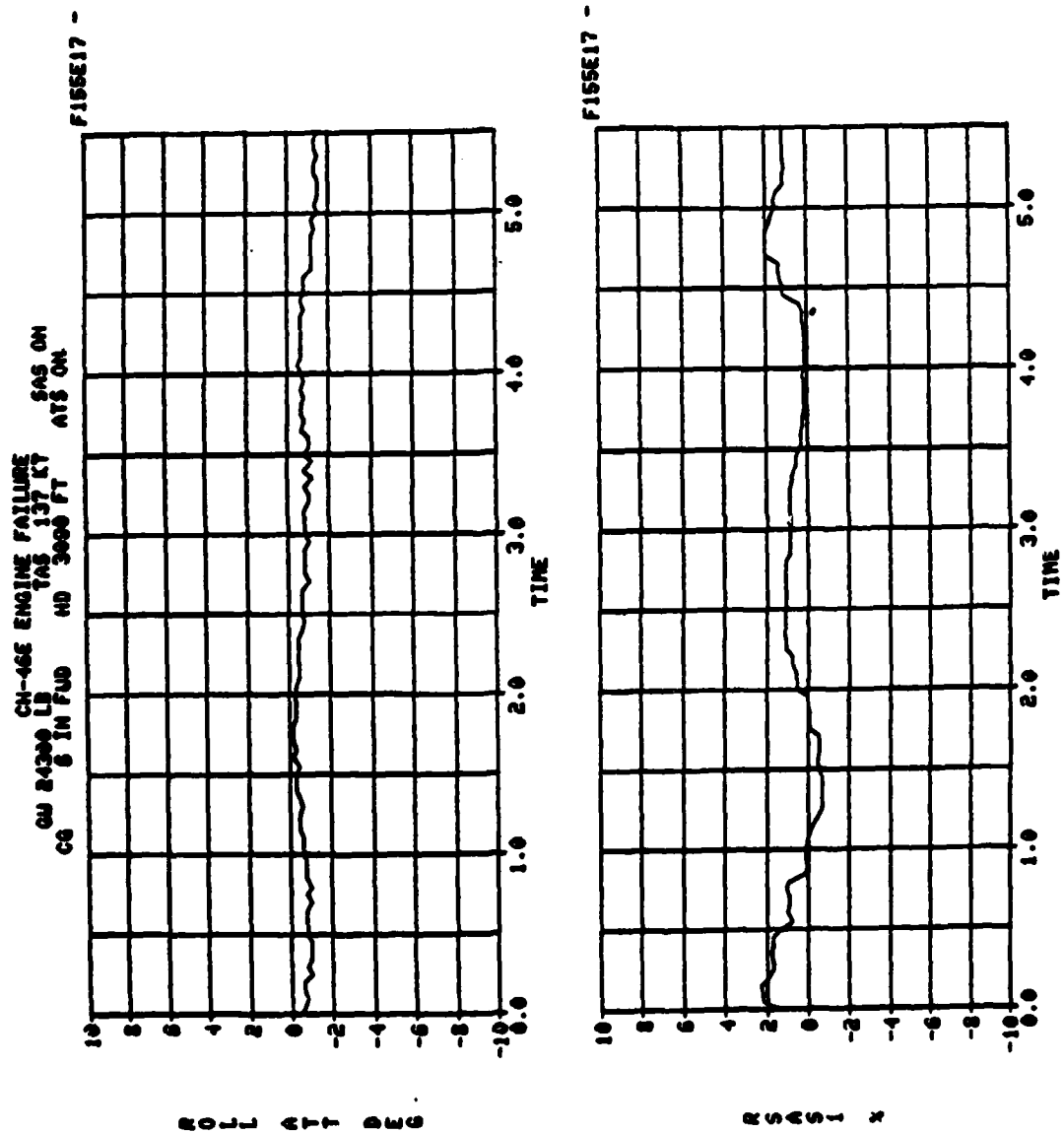


FIGURE 25H

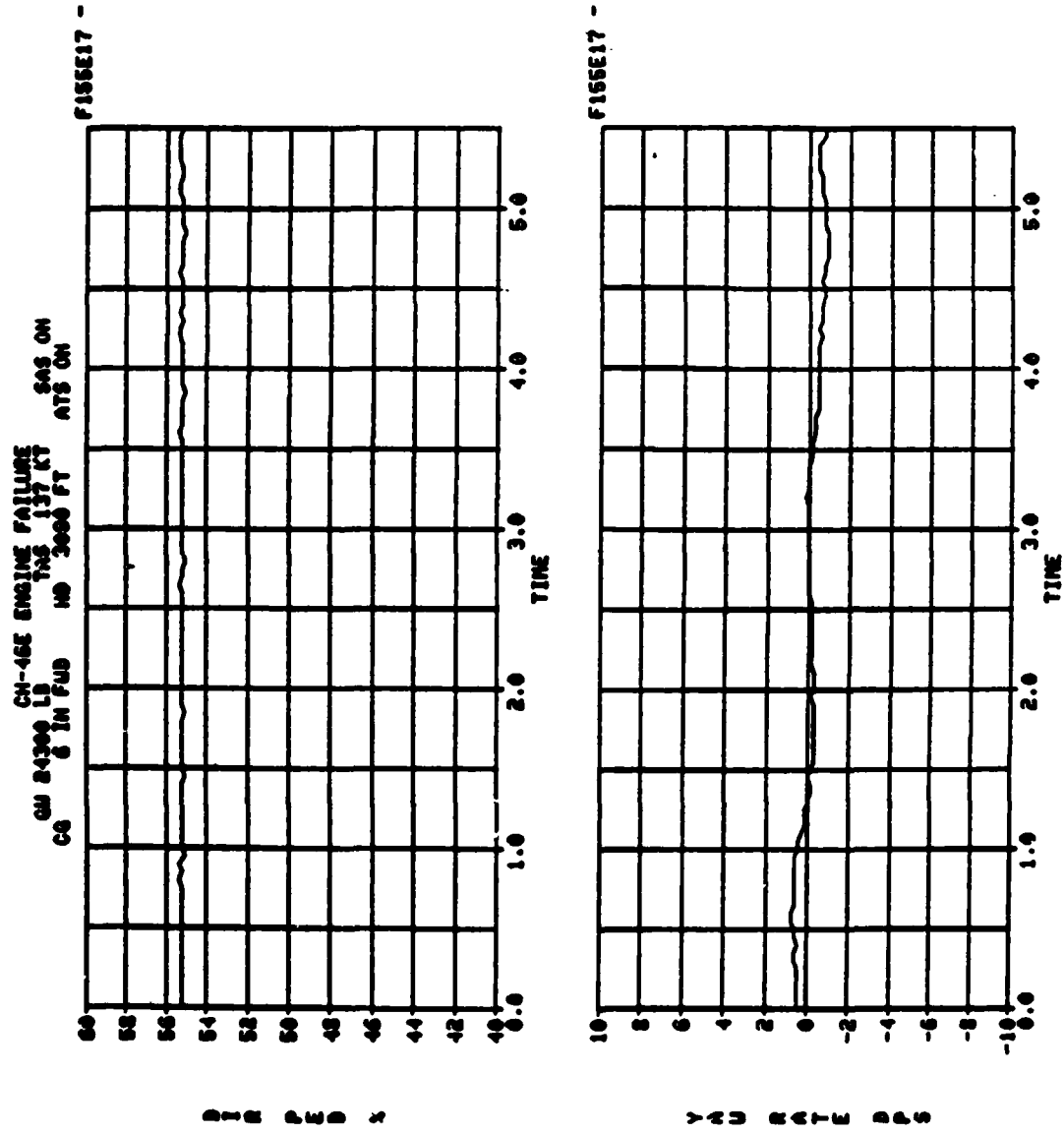


FIGURE 25I

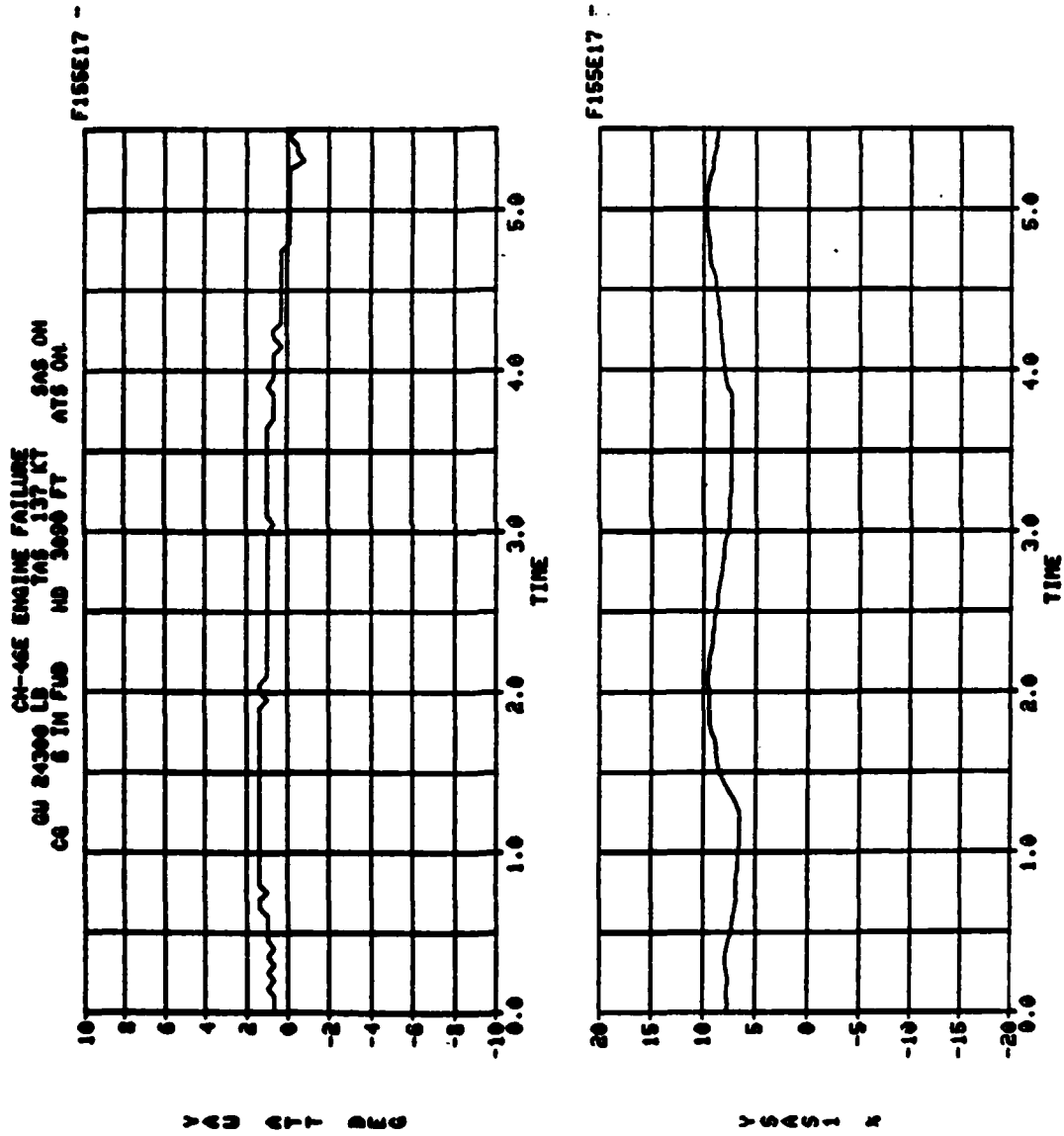


FIGURE 25J

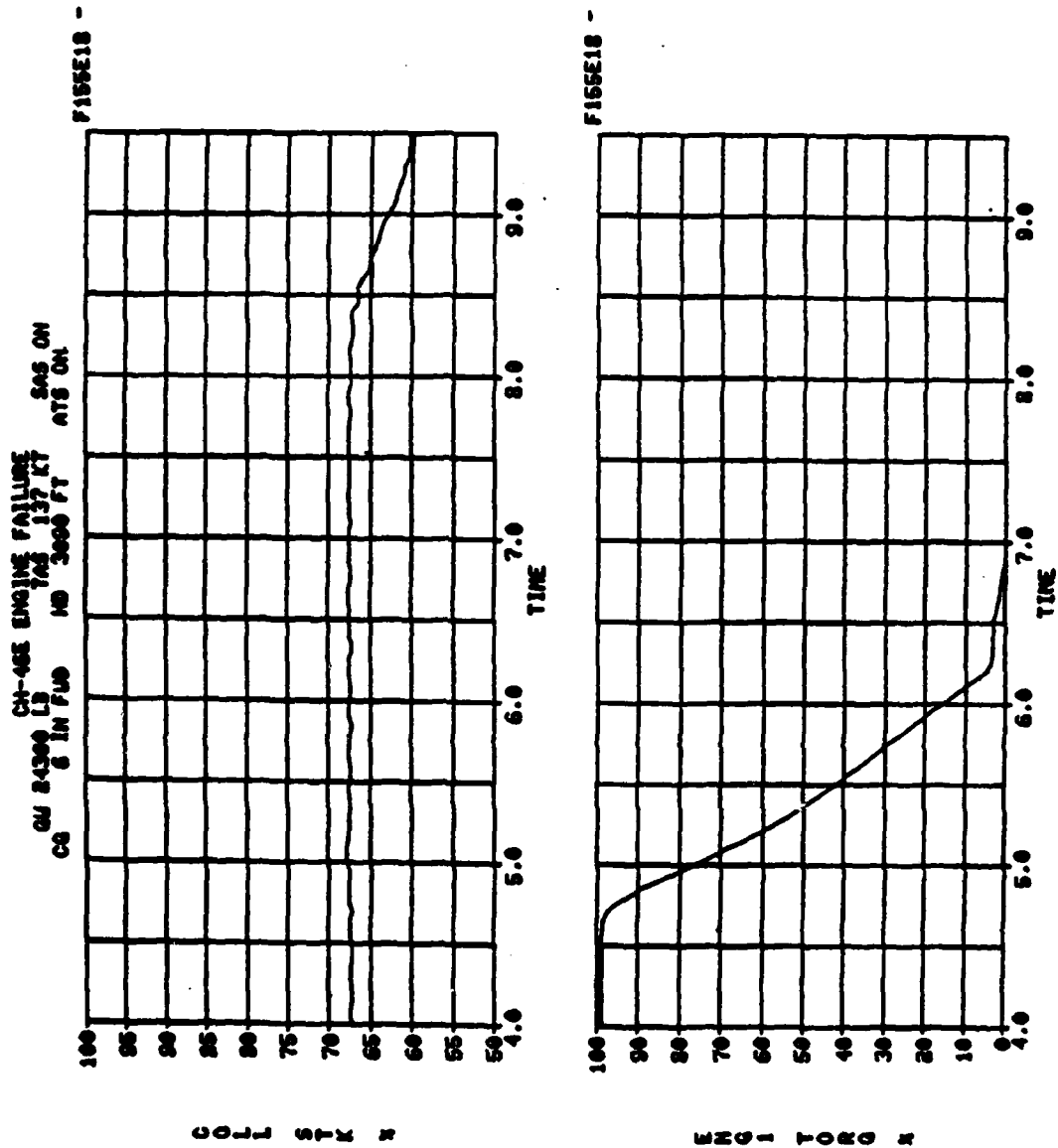


FIGURE 26A

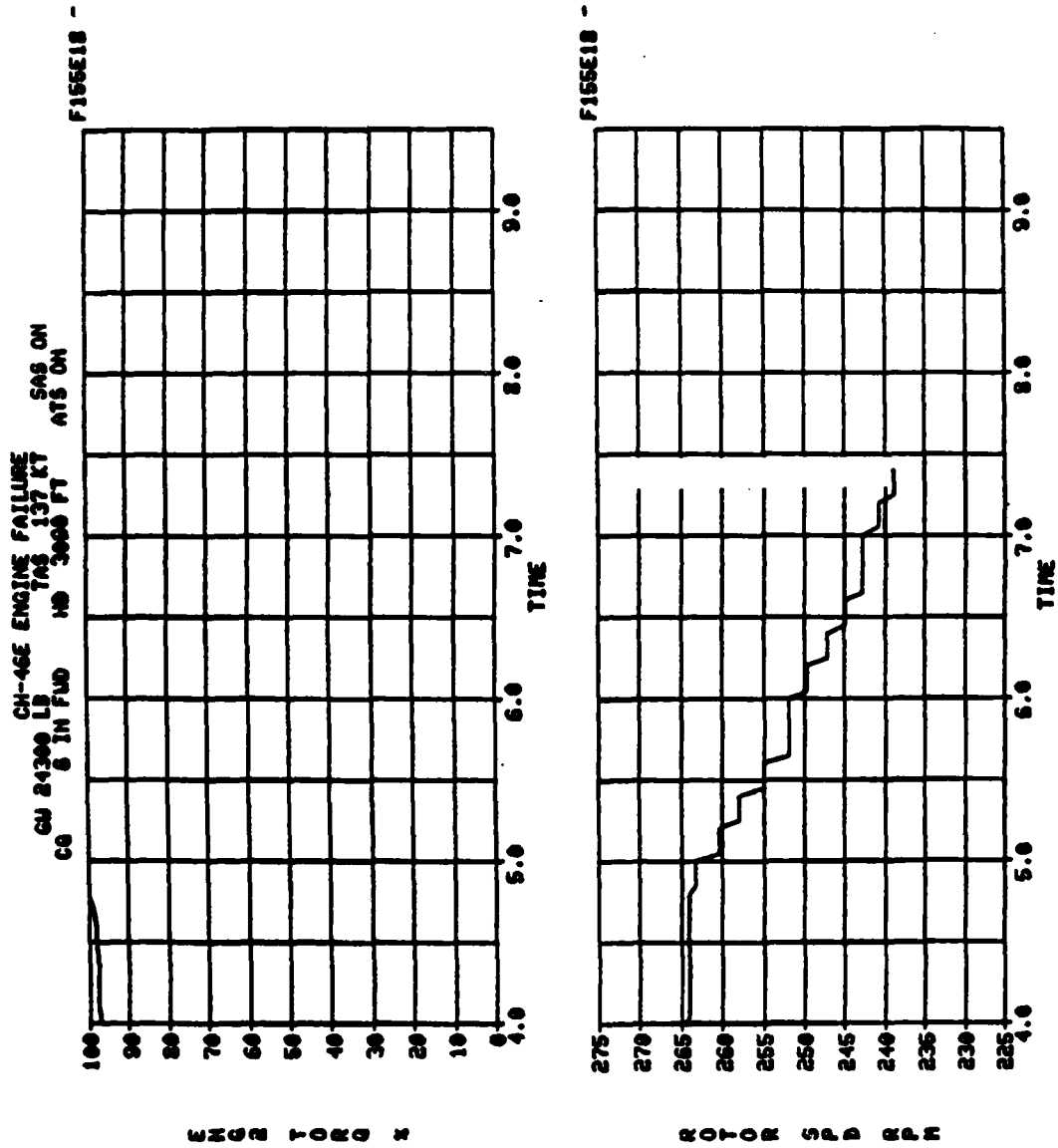


FIGURE 26B

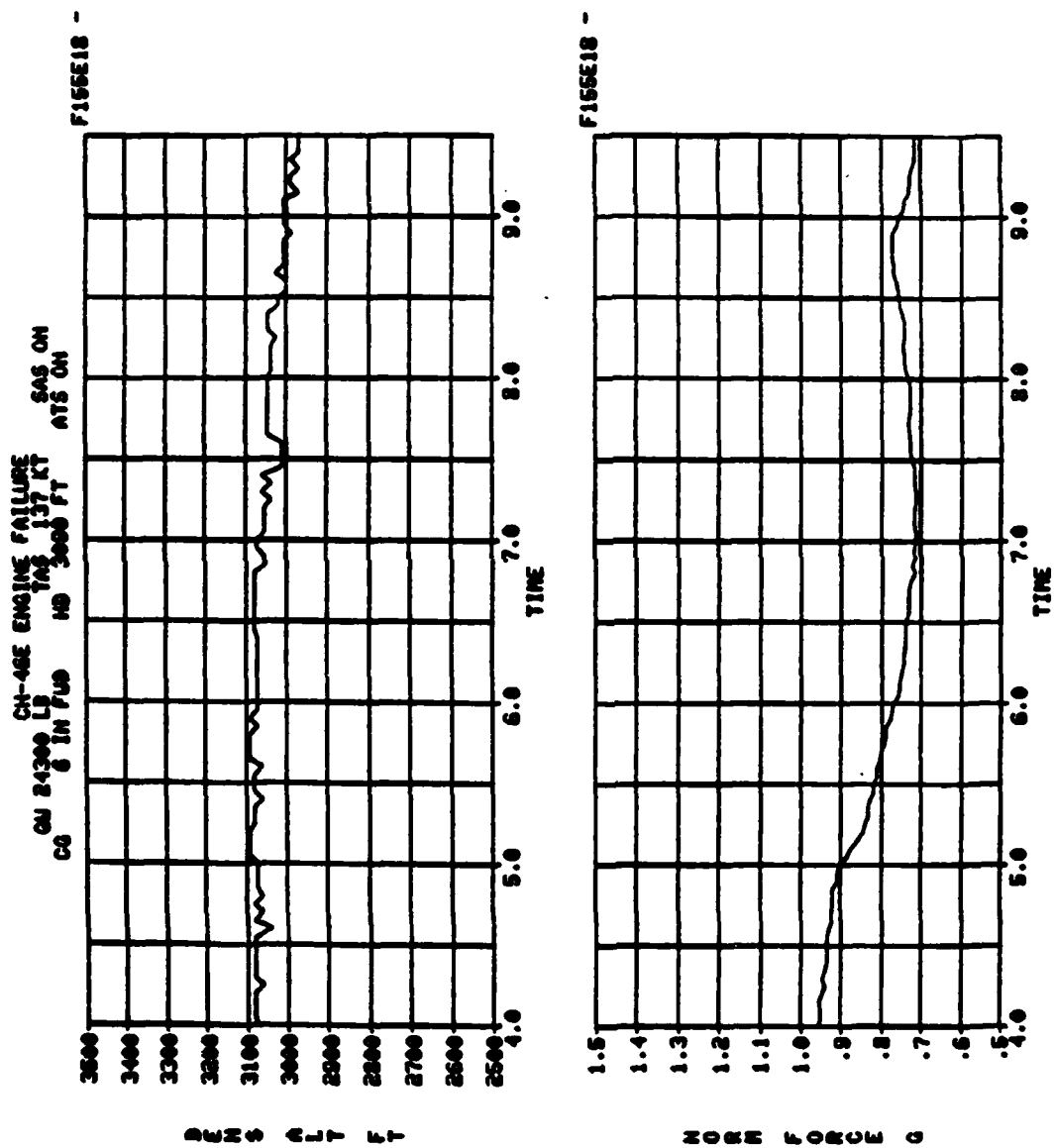


FIGURE 26C

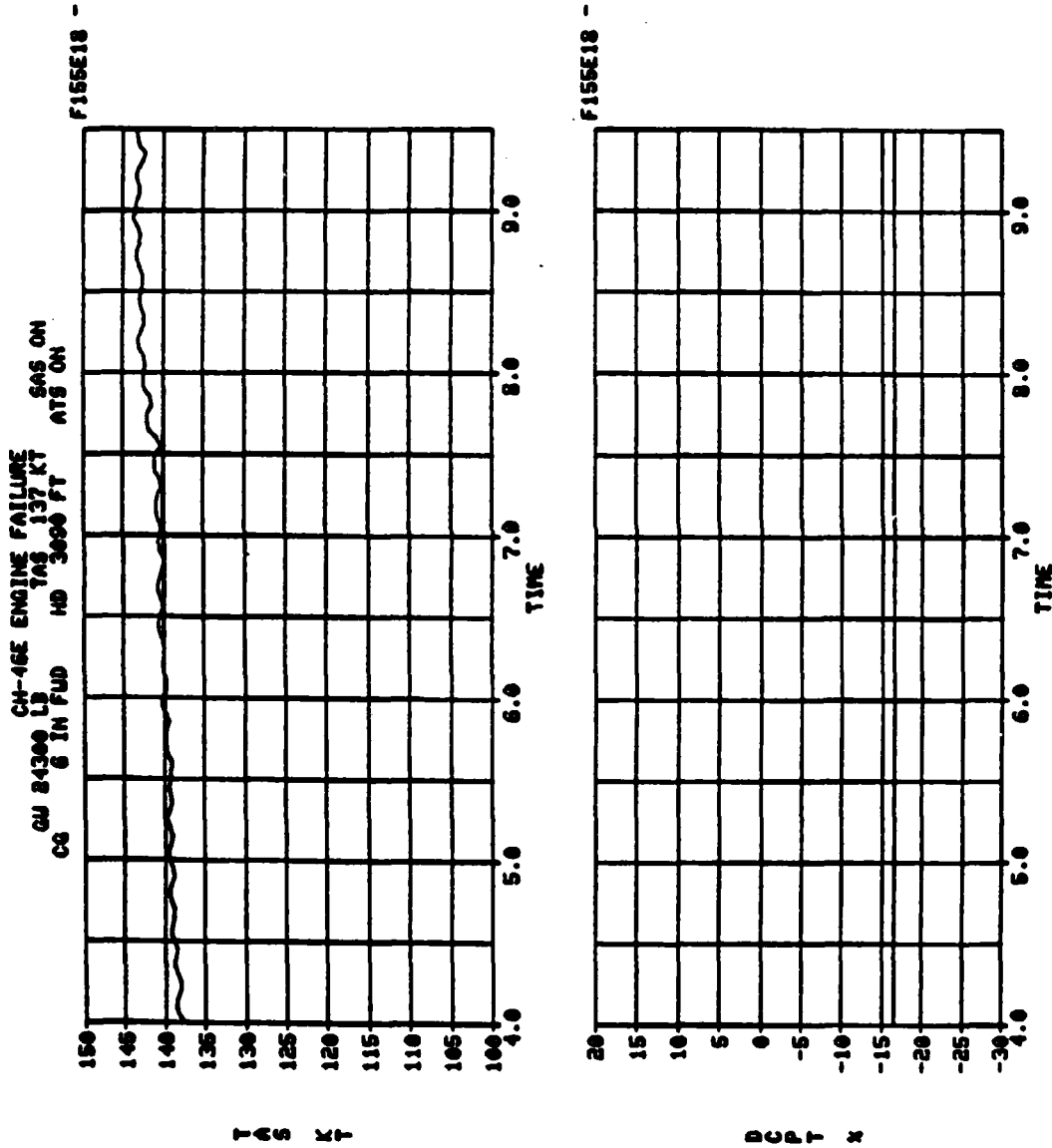


FIGURE 26D

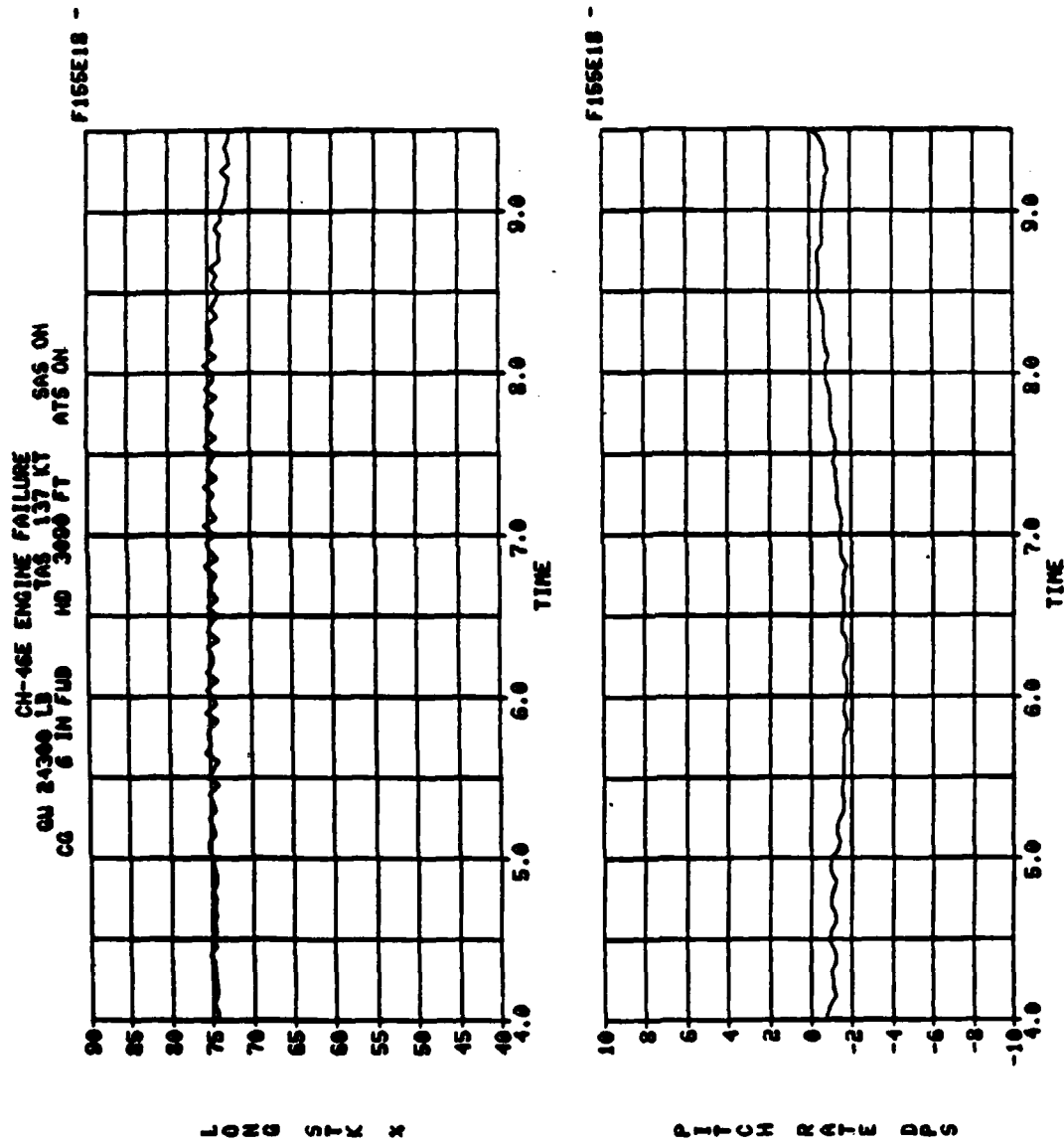


FIGURE 26E

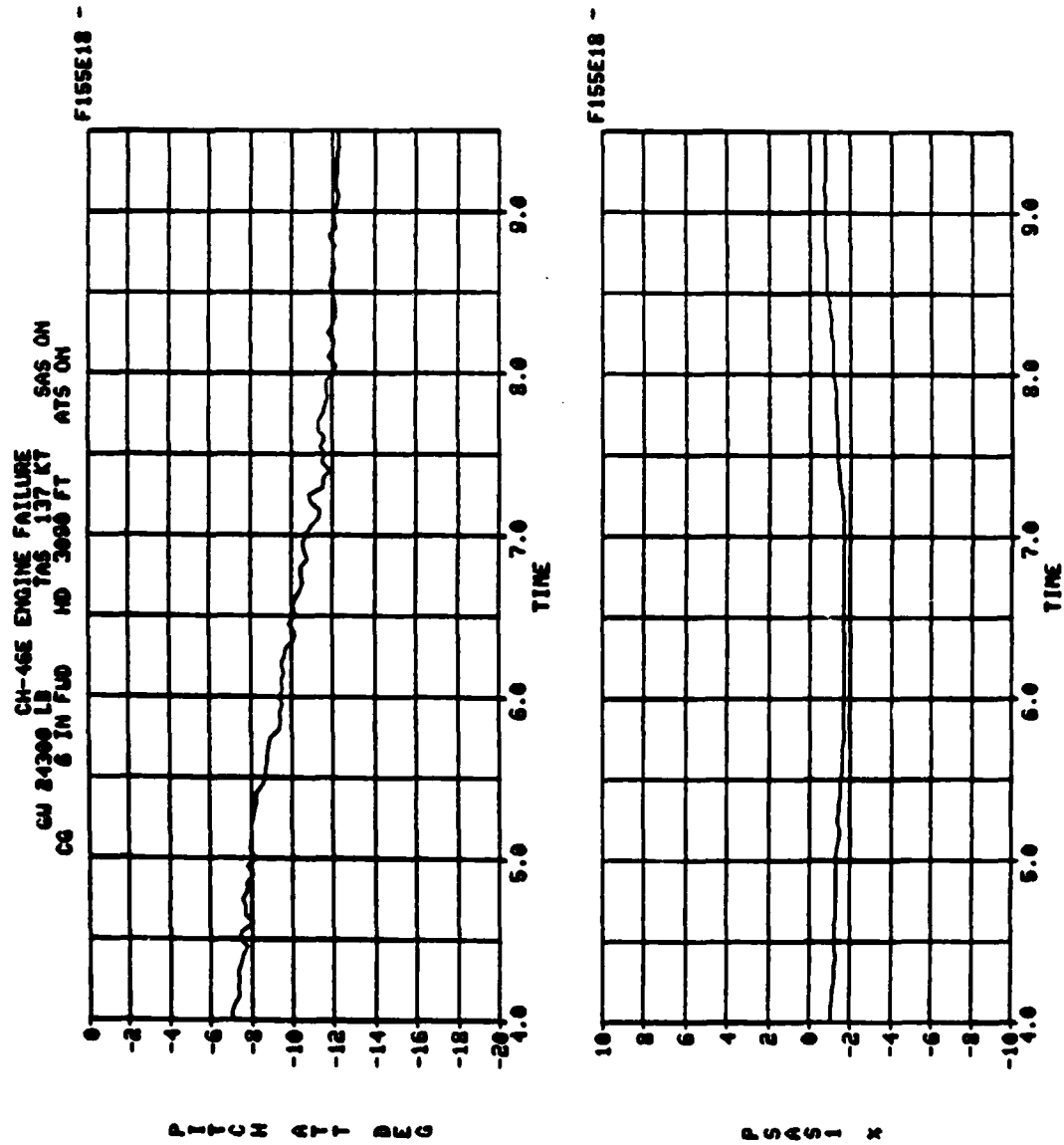


FIGURE 26F

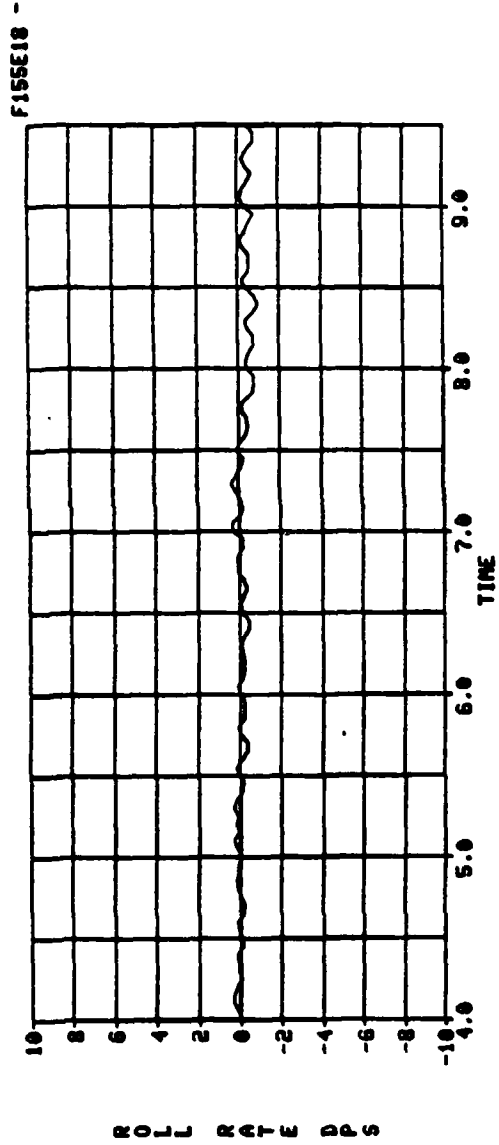
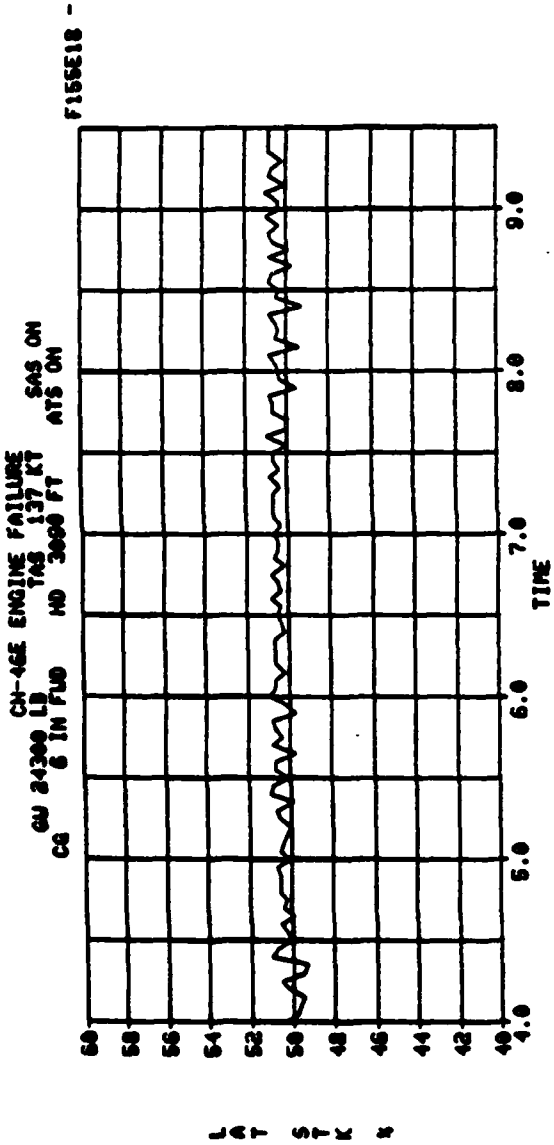


FIGURE 26G

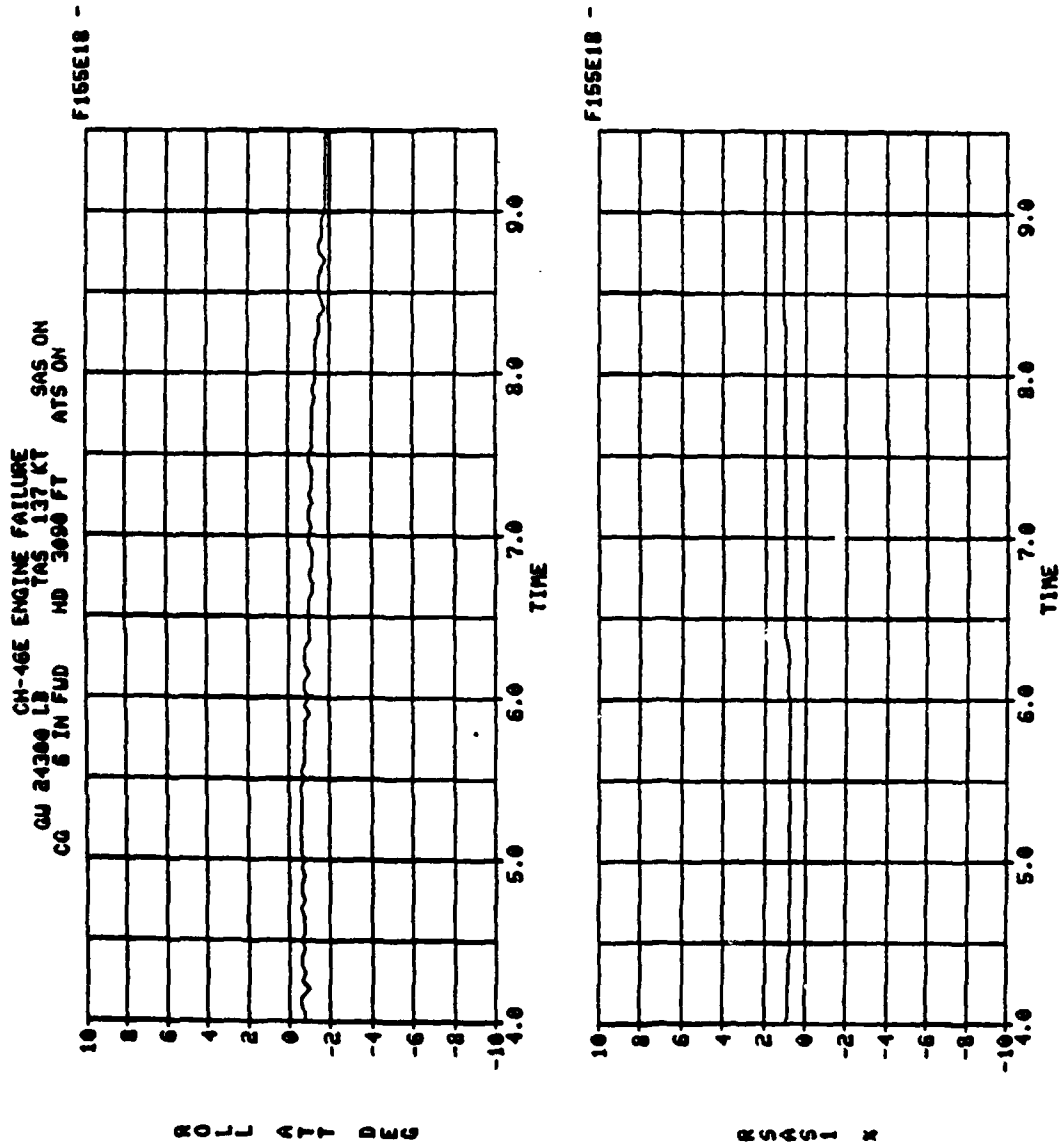


FIGURE 26H

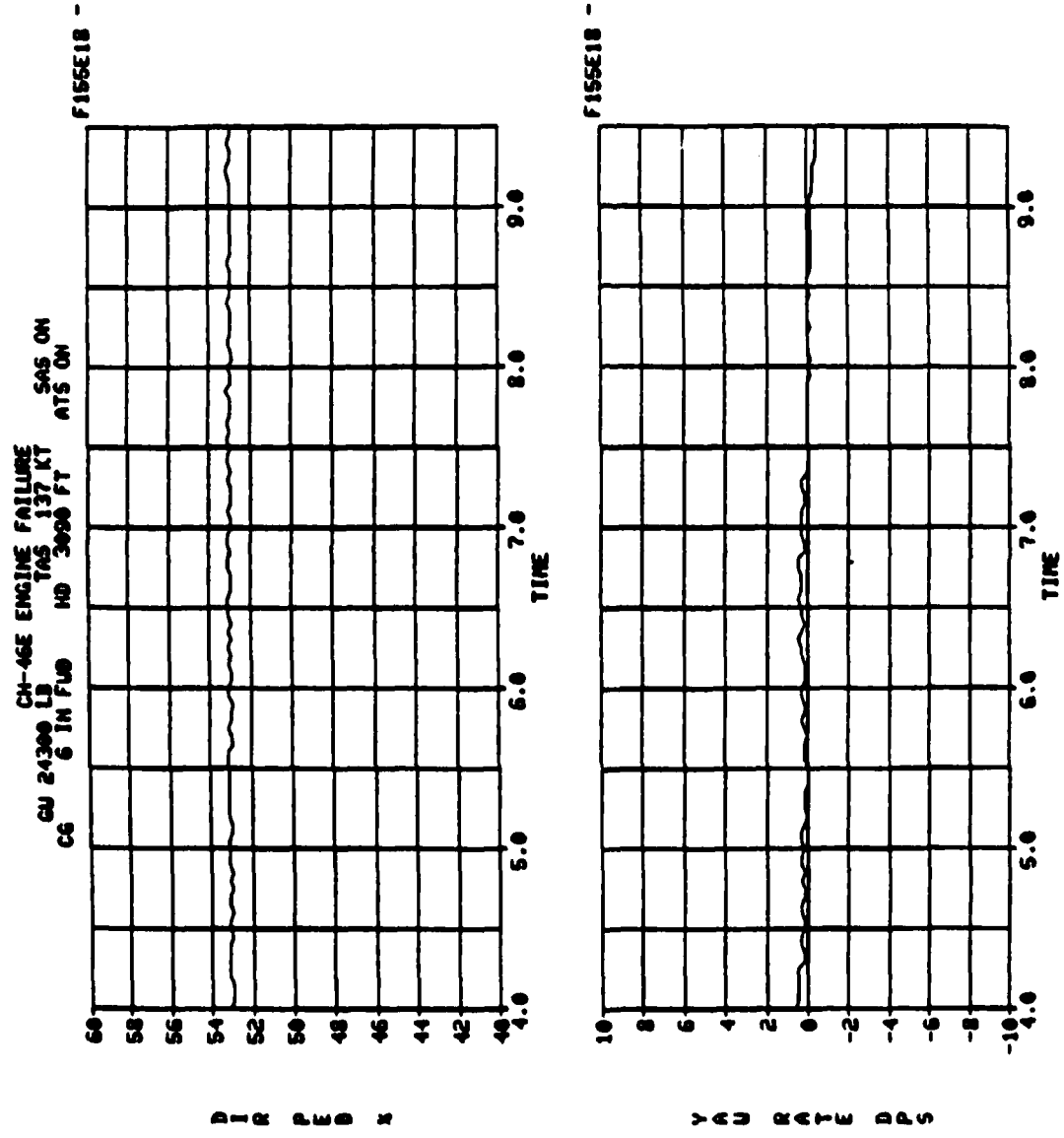


FIGURE 261

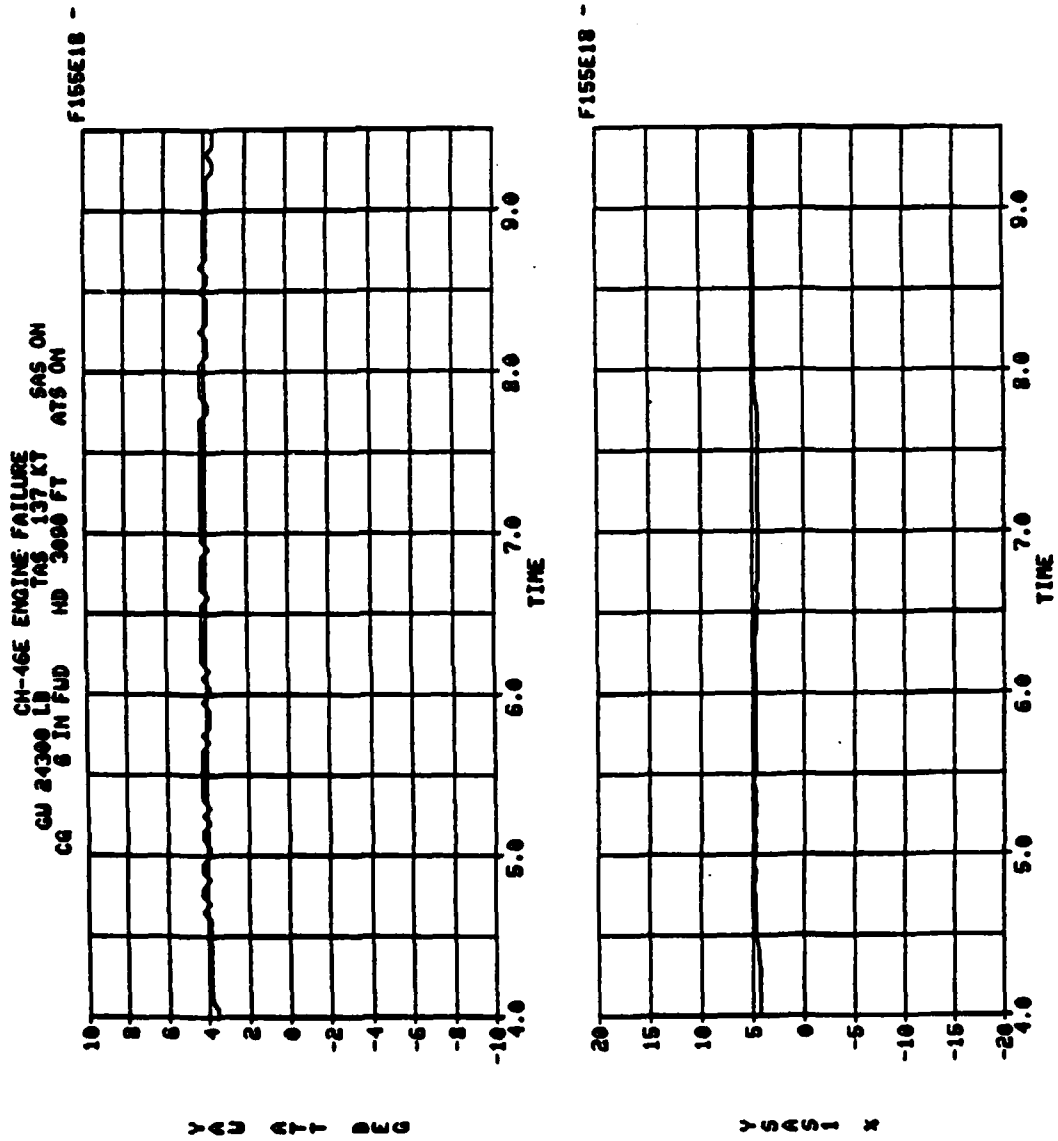


FIGURE 26J

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