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therefore,

$$\theta(t) = \frac{H}{J} \int_0^t \psi(t) dt$$

A similar derivation holds for the other axis; i.e., a transfer function relating θ and ψ can be interchanged so that

$$\frac{\Psi(s)}{\theta(s)}$$

The "ideal" model (Section III.A), behaves like a perfect gyroscope. The "dynamic" gyroscope is far more complicated with realistic inertia and damping terms being considered. A 2-DOF dynamic gyro is represented by two second order differential equations as given in Section III.B.

III. MATHEMATICAL GYRO MODELS

The mathematical formulation of the two gyroscope models is given in the following paragraphs.

A. Ideal 2-DOF Gimballled Gyroscope

Figure 1 describes the orientation of the seeker gyro coordinate system (x_s, y_s, z_s) by using the seeker Euler angles θ and then ψ with respect to the body coordinate system (X_B, Y_B, Z_B). The gyro coordinate system is chosen so that the origin is at the center of mass of the gyro and the x_s -axis is the axis of symmetry of the gyro. Also let ω' be the absolute angular velocity or rate of the seeker gyro. Then the general expression for components of angular momentum H of the gyro is

$$H_x = I_{xx} \omega'_x$$

$$H_y = I_{yy} \omega'_y$$

$$H_z = I_{zz} \omega'_z \quad (1)$$

Let ω be the absolute angular velocity of the x_s, y_s, z_s system and s be the angular velocity or spin rate of the gyro as measured relative to the x_s, y_s, z_s system. Then the angular velocity terms ($\omega'_x, \omega'_y, \omega'_z$) are

CONTENTS

	Page
I. INTRODUCTION	3
II. PROBLEM DEFINITION	3
III. MATHEMATICAL GYRO MODELS	4
A. Ideal 2-DOF Gimballed Gyroscope	4
B. Dynamic (Realistic) 2-DOF Gimballed Gyroscope Model	7
IV. SYSTEM SIMULATION	16
A. 6-DOF Digital Simulation with Ideal 2-DOF Gimballed Gyro Model	16
B. Dynamic (Realistic) 2-DOF Gimballed Gyro	19
C. Comparative Analyses	24
V. CONCLUSION	26
REFERENCES	143
Appendix A. 6-DOF DIGITAL TRAJECTORY SIMULATION WITH AN IDEAL GYROSCOPE MODEL	145
Appendix B. CSSL PROGRAM -- DYNAMIC GYRO MODEL	207
Appendix C. 6-DOF DIGITAL MISSILE TRAJECTORY SIMULATION WITH DYNAMIC GYROSCOPE MODEL	212

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I. INTRODUCTION

A gimbaled two-degree-of-freedom (DOF) attitude gyro whose spin axis is torqued to a point along the line-of-sight (LOS) is a primary guidance device used in today's missile technology. LOS rate for proportional navigation guidance (PNG) is derived from this type of gyro. The guidance law for this scheme is PNG. The missile used here is tail controlled with proportional vane deflection and roll rate controlled. When the missile is near enough to the target to be seen by the guidance device (seeker) which is mounted on the gyroscope, an LOS error (the difference as measured in both yaw and pitch plane of where the seeker is presently pointing and where it should be pointing) is computed. This LOS error torques the gyroscope and eventually drives the missile body vanes which turn the body into line with the pointing seeker. Missile targeting accuracy is described for two types of 2-DOF gimbaled gyros (idealized and dynamic) models when implemented in a 6-DOF digital missile simulation with no changes in airframe, aero, autopilot, and guidance law.

II. PROBLEM DEFINITION

For many studies using digital simulation, it is desirable to model a gyro which has no second order (inertia) and damping terms in the mathematical formulation. This model is one represented by a perfect integrator, $1/s$, in the Laplace notation. The following paragraphs display the rationale in developing such a model.

The differential equation relating output axis motion to input torque or rate is

$$J\ddot{\theta} + B\dot{\theta} + K\theta = H\dot{\psi} \quad .$$

Laplace transformation with zero initial conditions is applied

$$\frac{\Theta(s)}{\Psi(s)} = \frac{Hs}{Js^2 + Bs + K}$$

and it is assumed that $J \gg B$ and $J \gg K$

$$\frac{\Theta(s)}{\Psi(s)} = \frac{Hs}{Js^2} = \left(\frac{H}{J}\right) \frac{1}{s} \quad ;$$

therefore,

$$\theta(t) = \frac{K}{J} \int_0^t \psi(t) dt \quad .$$

A similar derivation holds for the other axis; i.e., a transfer function relating θ and ψ can be interchanged so that

$$\frac{\Psi(s)}{\theta(s)} \quad .$$

The "ideal" model (Section III.A), behaves like a perfect gyroscope. The "dynamic" gyroscope is far more complicated with realistic inertia and damping terms being considered. A 2-DOF dynamic gyro is represented by two second order differential equations as given in Section III.B.

III. MATHEMATICAL GYRO MODELS

The mathematical formulation of the two gyroscope models is given in the following paragraphs.

A. Ideal 2-DOF Gimballed Gyroscope

Figure 1 describes the orientation of the seeker gyro coordinate system (x_s, y_s, z_s) by using the seeker Euler angles θ and then ψ with respect to the body coordinate system (X_B, Y_B, Z_B). The gyro coordinate system is chosen so that the origin is at the center of mass of the gyro and the x_s -axis is the axis of symmetry of the gyro. Also let ω' be the absolute angular velocity or rate of the seeker gyro. Then the general expression for components of angular momentum H of the gyro is

$$H_x = I_{xx} \omega'_x$$

$$H_y = I_{yy} \omega'_y$$

$$H_z = I_{zz} \omega'_z \quad . \quad (1)$$

Let ω be the absolute angular velocity of the x_s, y_s, z_s system and s be the angular velocity or spin rate of the gyro as measured relative to the x_s, y_s, z_s system. Then the angular velocity terms ($\omega'_x, \omega'_y, \omega'_z$) are

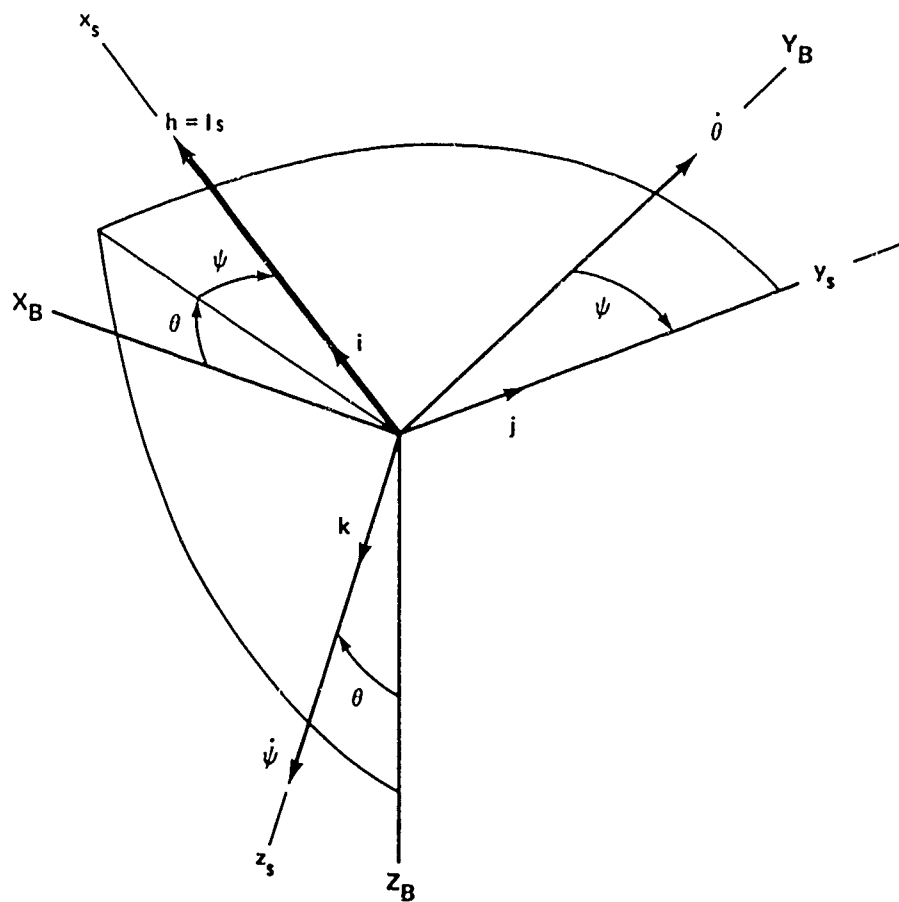


Figure 1. Seeker gyro coordinate system.

$$\omega'_x = \omega_x + s$$

$$\omega'_y = \omega_y$$

$$\omega'_z = \omega_z \quad (2)$$

and Equation (1) becomes

$$H_x = I_{xx} (\omega_x + s)$$

$$H_y = I_{yy} \omega_y$$

$$H_z = I_{zz} \omega_z \quad . \quad (3)$$

The general vector equation of motion is $\underline{M} = \dot{\underline{H}}$. Recalling that the rate of change of $\underline{H}$ is

$$\dot{\underline{H}} = (\dot{\underline{H}})_r + \underline{\omega} \times \underline{H} \quad (4)$$

where $(\dot{\underline{H}})_r$ is the rate of change of the absolute angular momentum as measured in the seeker gyro basis, i.e.,

$$(\dot{\underline{H}})_r = I_{xx} (\dot{\omega}_x + s) \underline{i} + (I_{yy} \dot{\omega}_y) \underline{j} + (I_{zz} \dot{\omega}_z) \underline{k} \quad . \quad (5)$$

From Figure 1,

$$\underline{\omega} = \dot{\theta} \sin \psi \underline{i} + \dot{\theta} \cos \psi \underline{j} + \dot{\psi} \underline{k} \quad . \quad (6)$$

Because of the gyro symmetry and actual specification values, a special case is treated here, i.e.,

$$I = I_{xx} = I_{yy} = I_{zz} \quad . \quad (7)$$

In Figure 1, s is a constant spin rate and $s \gg \omega_y$ and ω_z ; therefore,

$$\underline{H} \doteq I s \underline{i} = \underline{h} \quad . \quad (8)$$

For an ideal gyro, the rotor gimballed terms ($\dot{\omega}_y$ and $\dot{\omega}_z$) are small when compared to the $\omega_y s$ and $\omega_z s$ terms; also, no $\dot{\omega}_x$ term is possible due to the physical system constraints. Therefore, $(\dot{\underline{H}})_r$ can be neglected in comparison with $\underline{\omega} \times \underline{H}$.

Evaluating $\underline{\omega} \times \underline{H}$ using the determinant form of the cross product gives

$$\underline{\omega} \times \underline{h} = \begin{vmatrix} \underline{i} & \underline{j} & \underline{k} \\ \dot{\theta} \sin \psi & \dot{\theta} \cos \psi & \dot{\psi} \\ I_s & 0 & 0 \end{vmatrix} \quad (9)$$

Then

$$M_x = 0$$

$$M_y = I_s \dot{\psi}$$

$$M_z = -I_s \dot{\theta} \cos \psi, \quad (10)$$

where I_s is angular momentum and is considered a constant gain value in the model.

B. Dynamic (Realistic) 2-DOF Gimballed Gyroscope Model

Figure 2 shows the system in a configuration (with respect to body fixed reference X_I, Y_I, Z_I) and orientation of the gyro system by using the seeker Euler angles ψ and then θ . The system has 2-DOF (the speed n of the rotor with respect to gimbal G prescribed as constant). Angle θ defines the angular position of the inner gimbal G with respect to the outer gimbal O. The angle ψ defines the angular position of the outer gimbal with respect to the vehicle I. Using the general vector equation of motion $\{\underline{M}\} = \{\underline{\dot{H}}\}$ and rewriting in matrix expressions gives

$$\{M_O\} = \{\dot{H}_{TS}\}_I \quad (11)$$

$$\{H_{TS}\} = \{H_O\} + \{H_G\} + \{H_R\} \quad (12)$$

but

$$\{H_O\} = [I_O] \{\omega_{O-I}\} \quad (13)$$

$$\{H_G\} = [I_G] \{\omega_{G-I}\} \quad (14)$$

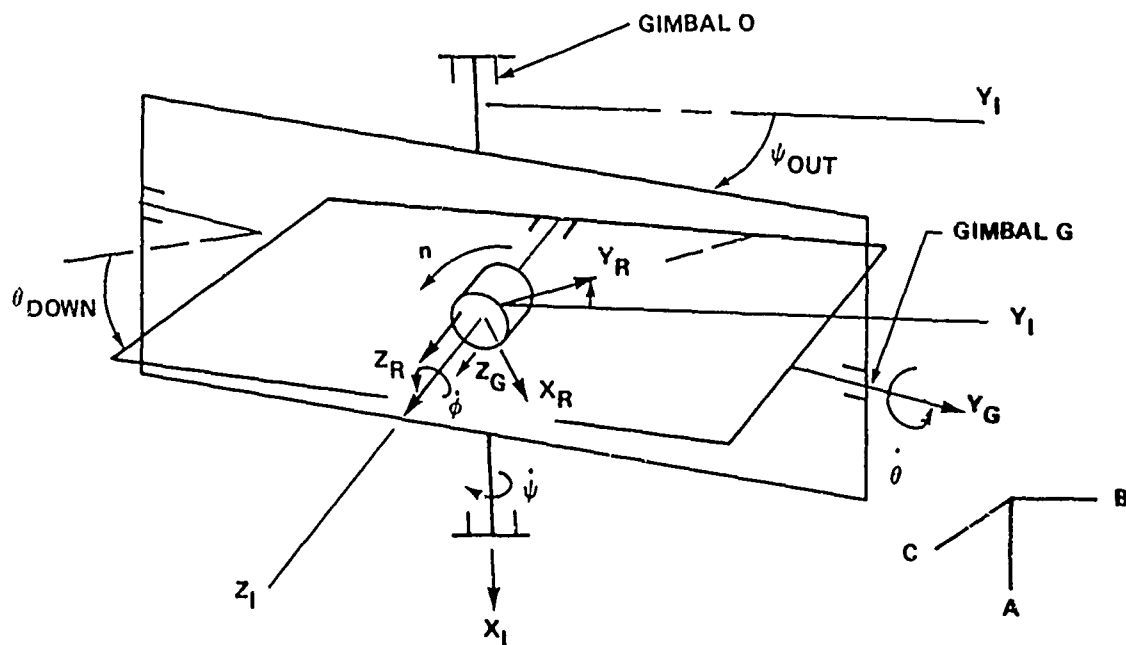


Figure 2. Dynamic seeker gyro coordinate system.

and

$$\{H_R\} = [I_R] \{\omega_{R-I}\} = [I_R] \{\omega_{R-G}\} + \{\omega_{G-I}\} \quad (15)$$

but $\{\omega_{R-G}\} \doteq \{\dot{\phi}\}$. Therefore,

$$H_R = [I_R] \{\dot{\phi}\} + [I_R] \{\omega_{G-I}\} \quad (16)$$

but $[I_R] \{\dot{\phi}\} \doteq \{h\}$. Then

$$\{H_R\} = \{h\} + [I_R] \{\omega_{G-I}\} \quad (17)$$

where

$\{M_O\}$ = moment or torque (column matrix) about outer gimbal

$\{H_{TS}\}_I$ = angular momentum of total system (column matrix) in vehicle frame

$\{H_O\}$ = angular momentum (column matrix) of outer gimbal

$\{H_G\}$ = angular momentum (column matrix) of inner gimbal

$\{h\}$ = angular momentum (column matrix) of rotor

$\{H_R\}$ = total angular momentum (column matrix) of rotor

$[I_O]$ = inertia tensor of outer gimbal

$[I_G]$ = inertia tensor of inner gimbal

$[I_R]$ = inertia tensor of rotor

$\{\omega_{O-I}\}$ = angular velocity (column matrix) of outer wrt vehicle

$\{\omega_{G-I}\}$ = angular velocity (column matrix) of inner wrt vehicle

$\{\omega_{R-I}\}$ = angular velocity (column matrix) of rotor wrt vehicle .

$$\{\dot{\phi}\} = \begin{Bmatrix} 0 \\ \dot{\phi} \\ \dot{\phi} \end{Bmatrix}$$

Rearranging Equation (12) and taking derivatives of Equations (11) and (12) gives

$$\begin{aligned} \{M_O\} &= \{\dot{H}_{TS}\}_G + [\omega_{G-I}] \{H_{TS}\} = \frac{d}{dt} \left[\{h\} + [I_R] \{\omega_{G-I}\} \right. \\ &\quad \left. + [I_G] \{\omega_{G-I}\} + [I_O] \{\omega_{O-I}\} \right]_G + [\omega_{G-I}] \\ &\quad \left[\{h\} + [I_R] \{\omega_{G-I}\} + [I_G] \{\omega_{G-I}\} + [I_O] \{\omega_{O-I}\} \right] \end{aligned} \quad (18)$$

where

$$[\omega_{G-I}] = \begin{bmatrix} 0 & -\omega_z & \omega_y \\ \omega_z & 0 & -\omega_x \\ -\omega_y & \omega_x & 0 \end{bmatrix} .$$

Therefore,

$$\begin{aligned}
 \{\dot{H}_{TS}\}_I &= \{\dot{h}\}_G + [I_R]_G \{\omega_{G-I}\} + [\dot{I}_R]_G \{\dot{\omega}_{G-I}\}_G + [\dot{I}_G]_G \{\omega_{G-I}\} \\
 &+ [I_G] \{\dot{\omega}_{G-I}\}_G + [\dot{I}_O]_O \{\omega_{O-I}\} + [I_O] \{\dot{\omega}_{O-I}\}_O \\
 &+ [\omega_{G-I}] \{h\} + [\omega_{G-I}] ([I_R] + [I_G]) \{\omega_{G-I}\} \\
 &+ [\omega_{G-I}] [I_O] \{\omega_{O-I}\} \quad . \quad . \quad (19)
 \end{aligned}$$

Collecting terms gives

$$\begin{aligned}
 \{M_O\} &= \{\dot{H}_{TS}\}_I = \{\dot{h}\}_G + ([I_R] + [I_G]) \{\dot{\omega}_{G-I}\}_G + [I_O] \{\dot{\omega}_{O-I}\}_O \\
 &+ [\omega_{G-I}] \{h\} + [\omega_{G-I}] ([I_R] + [I_G]) \{\omega_{G-I}\} \quad . \quad (20)
 \end{aligned}$$

Consider that for a constant speed motor

$$\{\dot{h}\}_G = 0, \quad (21)$$

and neglecting the second order terms,

$$[\omega_{G-I}] ([I_R] + [I_G]) \{\omega_{G-I}\}$$

then,

$$\{M_O\} = ([I_R] + [I_G]) \{\dot{\omega}_{G-I}\}_G + [I_O] \{\dot{\omega}_{G-I}\}_O + [\omega_{G-I}] \{h\} \quad . \quad (22)$$

Thus, Equation (22) is the simplified moment equation, but the moment equation for a complete gyro is Equation (20).

Coordinating the equation to get scalar components in the inner gimbal frame G, then

$$\{h\} = [I_R] \{\omega_{R-G}\} \quad . \quad (23)$$

Therefore,

$$\{\dot{h}\}_G = \frac{d}{dt} \left([I_R] \{\omega_{R-G}\} \right)_G = [\dot{I}_R]_G \{\omega_{R-I}\} + [I_R] \{\omega_{R-G}\}_G \quad (24)$$

Then

$$\{\dot{h}\}_G = [I_R] \{\dot{\phi}\} \quad (25)$$

$\{\dot{h}\}_G$ would be zero if spin rotor rotated at a constant speed as with a hysteresis motor. In some application, "h-modulation" may be desirable, so retain the term $\{\dot{h}\}_G$, i.e., $\{\dot{h}\}_G \neq 0$

Using the matrix properties of the inertia tensor to find an orientation of a given rigid body so that all products of inertia are zero simultaneously, i.e., the inertia matrix is diagonal. Substituting A, B, C for I_{xx} , I_{yy} , I_{zz} , respectively, then Equation (25) becomes

$$\{\dot{h}\}_G = [I]_R \{\dot{\phi}\}_G = \begin{bmatrix} A_R & 0 & 0 \\ 0 & B_R & 0 \\ 0 & 0 & C_R \end{bmatrix} \begin{bmatrix} \dot{\phi} \\ \dot{\phi} \\ \dot{\phi} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ C_R \ddot{\phi} \end{bmatrix} \quad (26)$$

$$\left([I_R]_G + [I_G]_G \right) = \begin{bmatrix} A_R + A_G & 0 & 0 \\ 0 & B_R + B_G & 0 \\ 0 & 0 & C_R + C_G \end{bmatrix} \quad (27)$$

Knowing

$$\{\omega_{G-I}\}_G = \{\omega_{G-O}\}_G + T_{OG} \{\omega_{O-I}\}_O \quad ; \quad (28)$$

then

$$\{\omega_{G-O}\}_G = \begin{bmatrix} 0 \\ \dot{\theta} \\ 0 \end{bmatrix} ; \quad \{\omega_{O-I}\}_O = \begin{bmatrix} \dot{\psi} \\ 0 \\ 0 \end{bmatrix} \quad (29)$$

and

$$T_{OG} = \begin{bmatrix} c\theta & 0 & -s\theta \\ 0 & 1 & 0 \\ s\theta & 0 & c\theta \end{bmatrix} \quad (30)$$

where $c\theta = \cos \theta$, $s\theta = \sin \theta$. Therefore,

$$\{\omega_{G-I}\}_G = \begin{bmatrix} 0 \\ \dot{\theta} \\ 0 \end{bmatrix} + \begin{bmatrix} c\theta & 0 & -s\theta \\ 0 & 1 & 0 \\ s\theta & 0 & c\theta \end{bmatrix} \begin{bmatrix} \dot{\psi} \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} \dot{\psi} c\theta \\ \dot{\theta} \\ \dot{\psi} s\theta \end{bmatrix} \quad (31)$$

Thus

$$\{\dot{\omega}_{G-I}\}_G = \begin{bmatrix} \ddot{\psi} c\theta - \dot{\psi} s\theta \dot{\theta} \\ \ddot{\theta} \\ \ddot{\psi} s\theta + \dot{\psi} c\theta \dot{\theta} \end{bmatrix} \quad (32)$$

and

$$[I_O] \{\dot{\omega}_{O-I}\}_O = \{\dot{H}_O\} = [I_O]_I \{\dot{\omega}_{O-I}\}_O = \begin{bmatrix} A_O \ddot{\psi} \\ 0 \\ 0 \end{bmatrix} \quad (33)$$

Therefore, the derivative of H_O in I frame coordinatized in the G frame is

$$\begin{aligned} \{\dot{H}_O\}_G &= T_{OG} T_{IO} \{\dot{H}_O\}_I \\ &= \begin{bmatrix} c\theta & 0 & -s\theta \\ 0 & 1 & 0 \\ s\theta & 0 & c\theta \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & -s\psi & c\psi \\ 0 & c\psi & s\psi \end{bmatrix} \begin{bmatrix} A_O \ddot{\psi} \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} A_O \ddot{\psi} c\theta \\ 0 \\ A_O \ddot{\psi} s\theta \end{bmatrix} \end{aligned} \quad (34)$$

and

$$[\omega_{G-I}]_G \{h\}_G = \begin{bmatrix} \dot{\theta} h \\ -h \dot{\psi} c\theta \\ 0 \end{bmatrix} \quad (35)$$

where

$$[\omega_{G-I}]_G = \begin{bmatrix} 0 & -\dot{\psi}s\theta & \dot{\theta} \\ \dot{\psi}s\theta & 0 & -\dot{\psi}c\theta \\ -\dot{\theta} & \dot{\psi}c\theta & 0 \end{bmatrix}$$

and

$$[\omega_{G-I}] [I_R] + [I_G] \{\omega_{G-I}\} = \begin{bmatrix} (C' - B') \dot{\theta}\dot{\psi}s\theta \\ (A' - C') \dot{\psi}^2 c\theta s\theta \\ (B' - A') \dot{\theta}\dot{\psi}c\theta \end{bmatrix} \quad (36)$$

where

$$A' = A_R + A_G$$

$$B' = B_R + B_G$$

$$C' = C_R + C_G$$

$$\{M_O\}_G = \begin{bmatrix} M_{OXG} \\ M_{OYG} \\ M_{OZG} \end{bmatrix} \quad (37)$$

Collect all terms in Equations (26) through (37) to get matrix formulation:

$$\begin{bmatrix} M_{OXG} \\ M_{OYG} \\ M_{OZG} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ C_R \ddot{\phi} \end{bmatrix} + \begin{bmatrix} A' & 0 & 0 \\ 0 & B' & 0 \\ 0 & 0 & C' \end{bmatrix} \begin{bmatrix} \ddot{\psi}c\theta - \dot{\psi}s\theta\dot{\theta} \\ \ddot{\theta} \\ \ddot{\psi}s\theta + \dot{\theta}c\theta\dot{\theta} \end{bmatrix} + \begin{bmatrix} A_O \ddot{\psi}c\theta \\ 0 \\ A_O \ddot{\psi}s\theta \end{bmatrix} \\ + \begin{bmatrix} \dot{\theta}h \\ -h\dot{\psi}c\theta \\ 0 \end{bmatrix} + \begin{bmatrix} (C' - B') \dot{\theta}\dot{\psi}s\theta \\ (A' - C') \dot{\psi}^2 c\theta s\theta \\ (B' - A') \dot{\theta}\dot{\psi}c\theta \end{bmatrix} \quad (38)$$

Add all matrices as indicated and break out individual components as follows to get complete nonlinear equations with no restraints on motor:

$$\begin{aligned}
 M_{OXG} &= (A_R + A_G + A_O) \ddot{\psi} c\theta \\
 &\quad + (-A_R - A_G - B_R - B_G + C_R + C_G) \dot{\theta} \dot{\psi} s\theta + h \dot{\theta} \\
 M_{OYG} &= (B_R + B_G) \ddot{\theta} + (A_R + A_G - C_R - C_G) \dot{\psi}^2 c\theta s\theta - h \dot{\psi} c\theta \\
 M_{OZG} &= C_R \ddot{\phi} + (C_R + C_G + B_R + B_G - A_R - A_G) \dot{\theta} \dot{\psi} c\theta \\
 &\quad + (C_R + C_G + A_O) \ddot{\psi} s\theta
 \end{aligned} \tag{39}$$

where

$$\begin{aligned}
 M_{OXG} &= M_\psi c\psi - r \dot{\psi} \\
 M_{OYG} &= M_\theta c\theta - h \dot{\theta} \\
 M_{OZG} &= 0
 \end{aligned} \tag{40}$$

and

$r \dot{\psi} \triangleq$ gimbal bearing friction between the outer gimbal and base
 $h \dot{\theta} \triangleq$ bearing friction between outer and inner gimbal .

For a general linear solution of Equation (39), linearize about an equilibrium position by letting:

$$\begin{aligned}
 \theta &= \theta + \delta\theta \\
 \dot{\theta} &= \dot{\theta} + \delta\dot{\theta} \\
 \psi &= \psi + \delta\psi \\
 \dot{\psi} &= \dot{\psi} + \delta\dot{\psi} , \quad \text{etc.}
 \end{aligned}$$

Substitute into the nonlinear Equation (39); i.e., about $\theta = 0$ for small θ about equilibrium, e.g.,

$$c\theta = c(\theta + \delta\theta) = c_0c\delta\theta - s_0s\delta\theta = 1$$

$$s\theta = s(\theta + \delta\theta) = s_0c\delta\theta + c_0s\delta\theta = \delta\theta \quad . \quad (41)$$

Using the first of Equation (39) and substituting the preceding gives

$$M_{OXG} \text{ (linearized)} = A\ddot{\psi} + A'\dot{\theta}\dot{\psi}\delta\theta + h\dot{\theta} \quad (42)$$

where

$$A = A_R + A_G + A_O$$

$$B = -A_R - A_G - B_R - B_G + C_R + C_G$$

$$M_{OXG} + \delta M_{OXG} = A\ddot{\psi} + A\delta\ddot{\psi} + B(\dot{\theta} + \delta\dot{\theta})(\dot{\psi} + \delta\dot{\psi})\delta\psi + h\dot{\theta} + h\delta\dot{\theta} \quad . \quad (43)$$

Subtracting Equation (42) from Equation (43) gives

$$\delta M_{OXG} = A\delta\ddot{\psi} + B\dot{\theta}\delta\dot{\psi}\delta\theta + B\delta\dot{\theta}\dot{\psi}\delta\theta + B\delta\dot{\theta}\delta\dot{\psi}\delta\theta + h\delta\dot{\theta} \quad . \quad (44)$$

All small second terms can be removed in Equation (45), therefore,

$$\delta M_{OXG} = A\delta\ddot{\psi} + h\delta\dot{\theta} \quad . \quad (45)$$

A similar method can be applied to the M_{OYG} equation in Equation (39) to give

$$\delta M_{OYG} = B\delta\ddot{\theta} - h\dot{\theta}\dot{\psi} \quad , \quad (46)$$

dropping the $\delta\dot{\theta}$ terms for small angle approximation to get

$$M_{OXG} = A\ddot{\psi} + h\dot{\theta}$$

$$M_{OYG} = B\ddot{\theta} - h\dot{\psi} \quad (47)$$

Substituting values from Equation (40) for M_{OXG} and M_{OYG} with small angle approximation into Equation (47) to get

$$A\ddot{\psi} + r\dot{\psi} + h\dot{\theta} = M_{\psi}$$

$$B\ddot{\theta} + b\dot{\theta} - h\dot{\psi} = M_{\theta} \quad (48)$$

IV. SYSTEM SIMULATION

The guidance and control system block diagram pitch/yaw channels for the 6-DOF digital simulation is presented in Figure 3. Figure 3 shows how the signal generated by the seeker is used to drive the vanes. The seeker signal is routed to the gyroscope and damping network before going to the guidance filter. It also goes directly to the guidance filter. The output from the guidance filter is then sent to the actuator which in turn drives the vanes. The only change between evaluation of the two types of gyro models would be in the torque gain terms and the block marked "Gyro Model" as shown in Figure 3. The 6-DOF computer program listings are given in Appendices A and C. A Continuous System Simulation Language (CSSL) program is given in Appendix B. The CSSL program was utilized to analyze only the motion of the dynamic gyro prior to implementation in the 6-DOF simulation.

In this section, the CSSL program results are given for the dynamic gyro model. The 6-DOF digital missile trajectory results are given for both the idealized and the dynamic gyro models. In addition, comparison analyses of the two trajectory simulation results are made.

A. 6-DOF Digital Simulation with Ideal 2-DOF Gimballed Gyro Model

A detailed block diagram of the ideal gyro model is shown in Figure 4; of the dynamic gyro model in Figure 5. The gyro system equations of motion are presented for pitch/yaw channels as follows:

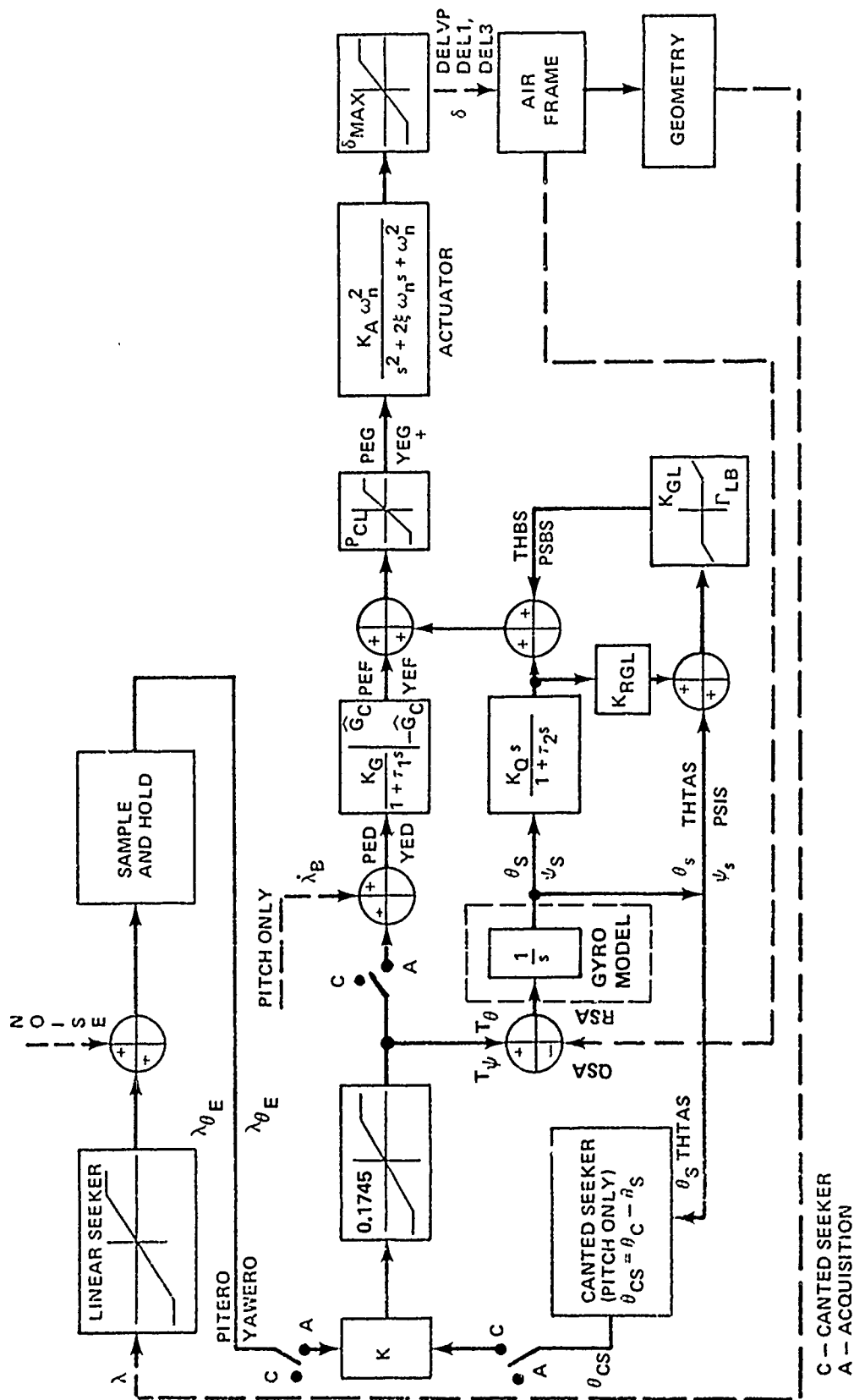


Figure 3. Guidance and control system block diagram pitch/yaw channels.

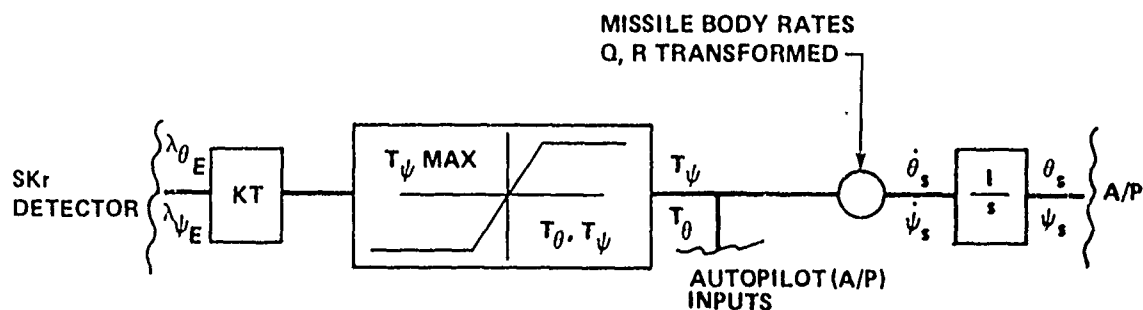


Figure 4. Ideal gyro model.

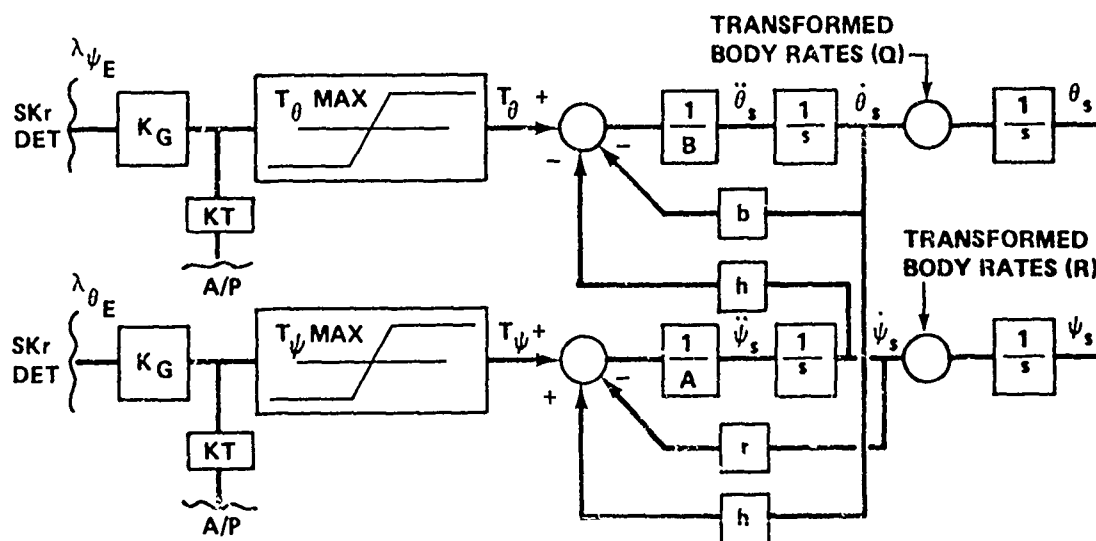


Figure 5. Gyro model in the 6-DOF simulation.

$$T_{\psi} = \dot{\theta}_s \cos \psi_s + QSA$$

$$T_{\theta} = \dot{\psi}_s + RSA$$

(49)

where QSA and RSA are transformed of missile body rates, Q, R; respectively, and $\dot{\theta}_s \cos \psi_s$ and $\dot{\psi}_s$ are M_z and M_y , respectively, as taken from Equation (9). Table 1 gives the units, symbols, and names of the missile parameters used for all plots with respect to the time presented in this report. The 6-DOF digital trajectory simulation program and tabulated results are presented in Appendix A. Plots of

the missile parameters are given in Figures 6 through 55. Figures 6 through 14 represent the results of the missile (translational and angular velocities) and body Euler angles. Figures 15 through 20 show the missile position and missile to target displacements. Figures 21 through 35 represent the autopilot and actuator parameters during flight. Figures 36 through 39 show the seeker input-output values in flight. Gyro parameters are given in Figures 40 through 55. Results indicated that when an ideal gyro is utilized, the missile to target RSS accuracy is 0.215 ft at impact for a 4-km (13,120-ft) target in 14.922 sec. X, Y, Z missile error components at impact are 0, -0.0183, and -0.2, respectively. The signs on the error components mean the missile hit to the left and above the target.

B. Dynamic (Realistic) 2-DOF Gimballed Gyro

In order to obtain a more realistic assessment of a 2-DOF gimballed gyro performance, efforts were made to model the dynamics of the gyro more accurately. The equations of this model are given in Section III.B.

When considering Equation (48) for the 6-DOF digital simulation, the signs on the precession rates ($\dot{h}_\theta$, $\dot{h}_\psi$) will change because of different coordinate systems, i.e., a positive T_ψ will give a negative $\dot{h}_\theta$ precession rate and positive T_θ will give a positive $\dot{h}_\psi$ precession rate.

Thus,

$$A\ddot{\psi} + r\dot{\psi} - h\dot{\theta} = T_\psi$$

$$B\ddot{\theta} + b\dot{\theta} + h\dot{\psi} = T_\theta$$

where

A and B = moments of inertia

r, b = gimbal bearing friction

h = angular momentum

T_ψ , T_θ = moments or torques

The preceding typical parameter values of this gyro, which has to exhibit a 10-deg/sec tracking rate and 160-Hz nutation frequency, is given in Table 2.

TABLE 1. PROGRAM VARIABLES AND DEFINITIONS

Time		Time of missile trajectory (sec)
U		Missile velocity in body coordinate system (BCS) (X-comp) (ft/sec)
V		Missile velocity in BCS (Y-comp) (ft/sec)
W		Missile velocity in BCS (Z-comp) (ft/sec)
P		Angular velocity of missile (about X-axis, roll rate) (rad/sec)
Q		Angular velocity of missile (about Y-axis, pitch rate) (rad/sec)
R		Angular velocity of missile (about Z-axis, yaw rate) (rad/sec)
PHI	ϕ	Euler angle transforming earth coordinate system (ECS) to BCS (rad)
THTA	θ	Euler angle transforming ECS to BCS (rad)
PSI	ψ	Euler angle transforming ECS to BCS (rad)
X		Position of missile in ECS (X-component) (ft)
Y		Position of missile in ECS (Y-component) (ft)
Z		Position of missile in ECS (Z-component) (ft)
DELXS		Missile to target displacement in seeker coordinate system (SCS) (X-direction) (ft)
DELYS		Missile to target displacement in SCS (Y-direction) (ft)
DELZS		Missile to target displacement in SCS (Z-direction) (ft)
THRBS		Output of the differentiator (rate damping) of pitch autopilot (A/P) (rad)
PSRBS		Output of the differentiator (rate damping) of yaw A/P (rad)
THBS		Output of the dead band zone limiter pitch A/P (rad)
PSBS		Output of the dead band zone limiter pitch A/P (rad)
PED		Input to guidance filter (pitch plane) (rad/sec)
YED		Input to guidance filter (yaw plane) (rad/sec)
PEF		Output of guidance filter (pitch plane) (rad/sec)
YEF		Output of guidance filter (yaw plane) (rad/sec)

TABLE 1. (CONCLUDED)

PEG		Output of pitch A/P (rad)
YEG		Output of yaw A/P (rad)
PHIG		Input to shaping filter of roll A/P
REG		Output of roll A/P (rad)
DELVP		Equivalent vane deflection (pitch plane) (rad)
DEL1		Deflection of Vane 1 (rad)
DEL3		Deflection of Vane 3 (rad)
PITERR		Seeker input - LOS error in pitch plane (rad)
PITERO		Seeker output - LOS error in pitch plane (rad)
YAWERR		Seeker input - LOS error in yaw plane (rad)
YAWERO		Seeker output - LOS error (rad)
DTHTAS	$\dot{\theta}_s$	Time derivative of THTAS (rad/sec)
THTAS	θ_s	THETA angle of gyro seeker (rad) - pitch angle between the body and seeker axis
DPSIS	$\dot{\psi}_s$	Time derivative of PSIS (rad/sec)
PSIS	ψ_s	PSI angle of gyro seeker (rad) - yaw angle between the body and seeker axis
OMEGZ		Gyro torque input from seeker (rad/sec)
OMEGY		Gyro torque input from seeker (rad/sec)
QSA		Transformation of P, Q, R into the SCS for gyro (pitch plane)
RSA		Transformation of P, Q, R into the SCS for gyro (yaw plane)
DTHASD	$\ddot{\theta}_s$	Time derivative of THASD [(rad/sec)/sec]
THASD	$\dot{\theta}_s$	State variable - time derivative of THATS (rad/sec)
DPSISD	$\ddot{\psi}_s$	Time derivative of PSISD [(rad/sec)/sec]
PSISD	$\dot{\psi}_s$	State variable time derivation of PSIS (rad/sec)

1. CSSL Program

The gyro model with parameters (Table 2) was incorporated into the CSSL simulation. The results, presented in Figure 56 with use of the typical CSSL program listing given in Appendix B, indicated the gyro behaved as expected with step inputs, that is, it exhibited the 10-deg/sec tracking rate and the 160-Hz nutation frequency. At this point, the gyro model was incorporated into the 6-DOF digital missile trajectory simulation. Section IV.B.2 gives the results of implementing the dynamic gyro model in the 6-DOF simulation.

2. 6-DOF Digital Simulation with Dynamic 2-DOF Gimballed Gyro Model

The idealized gyro model was replaced by the dynamic gyro model and successfully implemented in the 6-DOF simulation. A detailed block diagram of the dynamic gyro model is described in Figure 5 and the second order differential equations of motions for the gyro are shown for the pitch/yaw channels.

$$A\ddot{\psi}_s + r\dot{\psi}_s - h\dot{\theta}_s = T_\psi$$

$$B\ddot{\theta}_s + b\dot{\theta}_s + h\dot{\psi}_s = T_\theta$$

The 6-DOF digital trajectory simulation program and tabulated results are shown in Appendix B. Again plots of the missile parameters are presented in Figures 57 through 120. Figures 57 through 65 give the results of the missile translational and angular velocities and body Euler angles in flight. Plots of the missile position and target displacements are shown in Figures 66 through 73. Figures 74 through 88 give autopilots and actuator parameters plots. Plots of seeker input-output values are shown in Figures 89 through 92. Gyro parameters are given in Figures 93 through 120. The missile to target RSS accuracy is 1.68 ft at impact for the 4-km target in 14.936 sec. X, Y, Z missile error components at impact are 2.00, -0.154, and 0.1, respectively. The signs on the error components mean the missile hit in front, to the left, and above the target.

TABLE 2. DYNAMIC SEEKER -- GYRO SPECIFICATIONS

Description	Notation	Eng. Units	Simulation Units	
			CSSL	6-DOF
Pitch Inertia	B	0.462 lb in. ²	0.0032083 lb-ft ²	0.00009972 slug ft ²
Yaw Inertia	A	0.390 lb in. ²	0.0027083 lb-ft ²	0.00008414 slug ft ²
Spin Momentum	h, H	17.7 in. oz-sec	0.0921875 ft lb-sec	0.0921875 ft lb-sec
Gimbal Axis Friction 1 per axis	r, b	0.033 oz-in.	0.00017192 lb-ft	0.00017192 lb-ft
Moments or Torques	T _ψ , T _θ	3.0 in.-oz 3.18 in.-oz*	0.015625 ft-lb	0.016562 ft-lb

*An updated gyro specification.

C. Comparative Analyses

When considering the dynamic gyro model without the damping terms ($r\dot{\psi}$, $b\dot{\theta}$), the gyro equations of motion become

$$\begin{aligned} B\ddot{\theta} + h\dot{\psi} &= T_{\theta} \\ -h\dot{\theta} + A\ddot{\psi} &= T_{\psi} \end{aligned} \quad (50)$$

The Laplace transform is used for the equation of motion:

$$\begin{bmatrix} s^2 + \frac{h}{B}s \\ -\frac{h}{A}s + s^2 \end{bmatrix} \begin{bmatrix} \theta \\ \psi \end{bmatrix} = \begin{bmatrix} \frac{T_{\theta}(s)}{B} + s\theta(0^+) + \dot{\theta}(0^+) + \frac{h\psi}{B}(0^+) \\ \frac{T_{\psi}(s)}{A} - \frac{h}{A}\theta(0^+) + s\psi(0^+) + \dot{\psi}(0^+) \end{bmatrix} \quad (51)$$

Therefore, the characteristic equation is given from the left-hand side of the preceding equation by

$$s^2 \left(s^2 + \frac{h^2}{AB} \right) = 0 \quad (52)$$

the roots of which are $s = 0, 0$ and $s = \pm jh\sqrt{AB}$. The zero roots give "constant" motion. The imaginary roots give an oscillation at frequency $\omega = h/\sqrt{AB}$. To obtain a magnitude of ω , the gimbals are massless and B, A are diametral moments of inertia of the rotor. They are equal to one-half its polar moment of inertia, $B = A = I_r/2$. Since $h = I_r n$ where n = rotor speed, then

$$\omega = \frac{I_r n}{\sqrt{\frac{I_r^2}{4}}} = 2n \quad (53)$$

Therefore, the oscillation frequency is twice the spin speed. However, because real gimbals are not massless, the real gyro has an oscillation frequency somewhat less than $2n$ as is true in the dynamic gyro model. From the preceding characteristic equation, the oscillatory motion is undamped. Therefore, the rate-dependent terms ($h\dot{\theta}$, $h\dot{\psi}$) act only as the gyroscopic coupling terms and do not produce energy dissipation for damping. Therefore, all damping occurs from the $r\dot{\psi}$ and $b\dot{\theta}$ terms.

Figures 93 through 100 and Figures 105 through 112 demonstrate the oscillatory frequency with damping and precession of the dynamic gyro. Figures 96 and 108 exhibit the 160-Hz nutation frequency of the gyro and 10-deg/sec tracking rate. The ideal gyro model reflects only the 1/s characteristics as seen in Figures 40 through 49.

The velocity and rotational components (V, W, Q, and R) of a missile in flight with the dynamic gyro model (given in Figures 58, 59, 61, and 62) show a definite increase and oscillatory effect with damping in the velocity components as compared to the ideal gyro. The body Euler angles θ and ψ reflect this motion. The autopilot parameters also show the influence of the dynamic gyro response. Actuator output to the vanes (DELVP, DEL1, and DEL3) also reflect the differences between the ideal and dynamic gyro models.

Impact accuracy of the missile to target when utilizing an ideal gyro model or a dynamic gyro model in a 6-DOF digital simulation is shown in Table 3.

TABLE 3. IMPACT ACCURACY

	Time	X	Y Error	Z	RSS Miss Distance
Ideal Gyro	14.922	13120	-0.01832	-4000.2	0.2146
Dynamic Gyro	14.936	13118	-0.15455	-4000.1	1.6799

NOTES: X indicates range of target at 13,120 (4 km).
Y indicates crossrange error (minus left of target).
Z indicates vertical error (launched at -4000 ft above sea level).

As can be seen in Table 3, the dynamic model will produce a better assessment of the missile accuracy at impact because a more realistic gyro model is used in the simulation.

The primary 6-DOF programming difference between the ideal and dynamic gyro models as seen in Appendices A and C, respectively, is in the subroutine EDSKRGYRO. This subroutine reflects the change in gyro models.

V. CONCLUSION

This report has demonstrated that a dynamic gyro model, when utilized in a 6-DOF digital missile trajectory simulation, will give a more realistic assessment of a seeker gyro than an ideal gyro model. Most 6-DOF digital simulations in the past have used primarily the 2-DOF ideal gyro model. No efforts were made to change the autopilot or seeker characteristic in this study to accommodate the dynamic model. Reasonable results were obtained without change. However, considerations should be given to the use of the 2-DOF dynamic model based on results of this report. More accurate autopilot design and seeker interface design would probably result in the use of the dynamic gyro model for digital simulations.

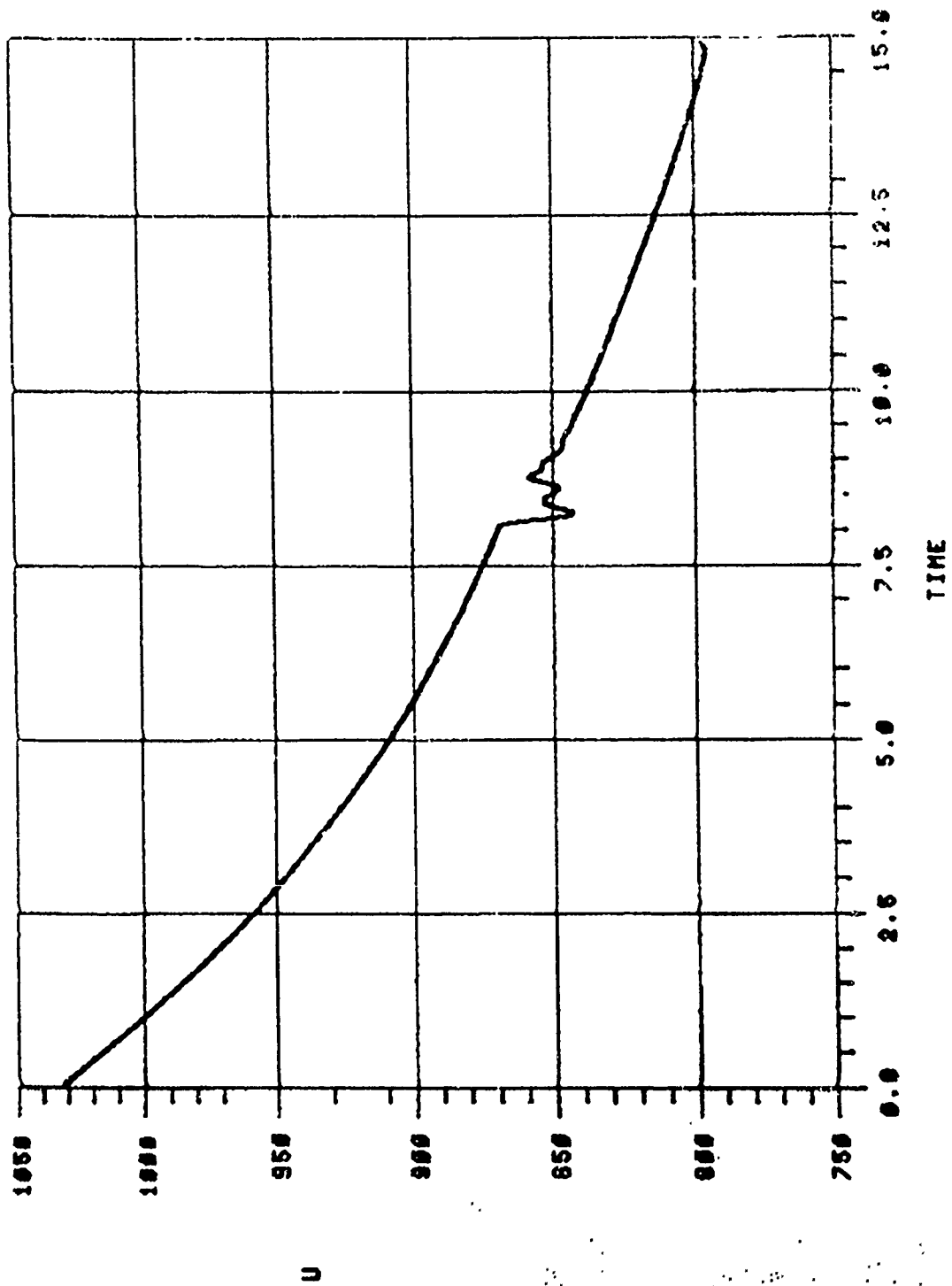


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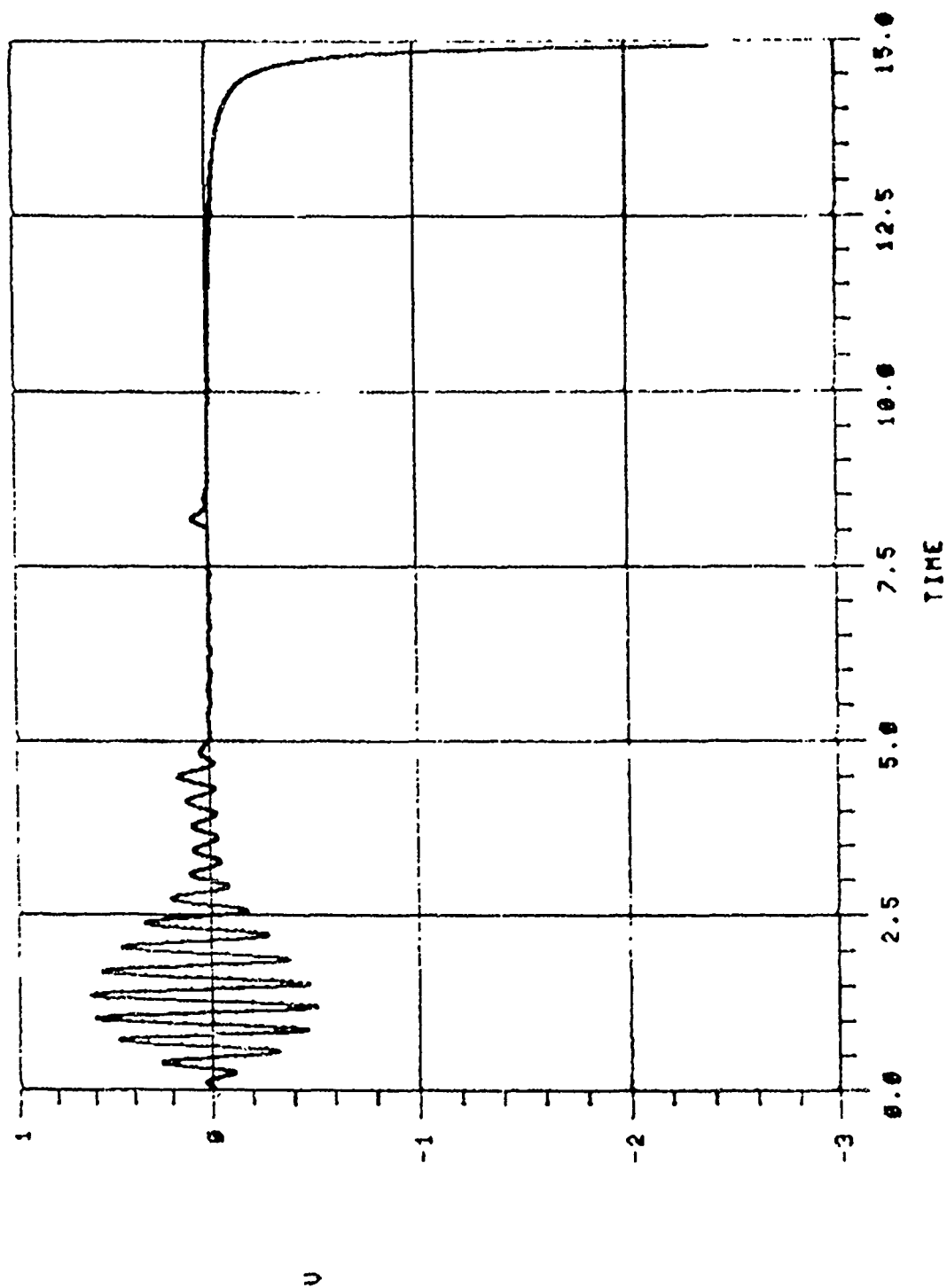


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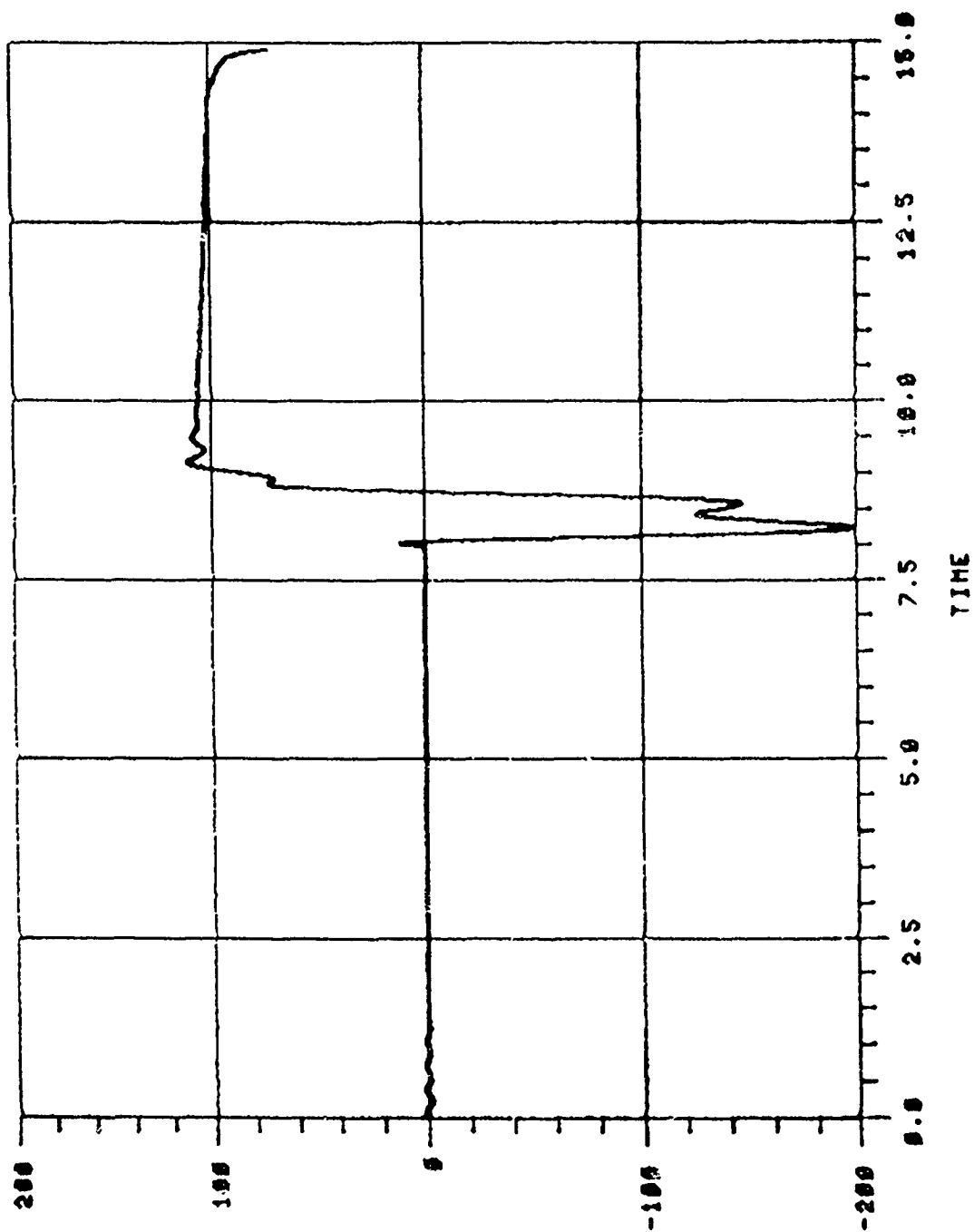


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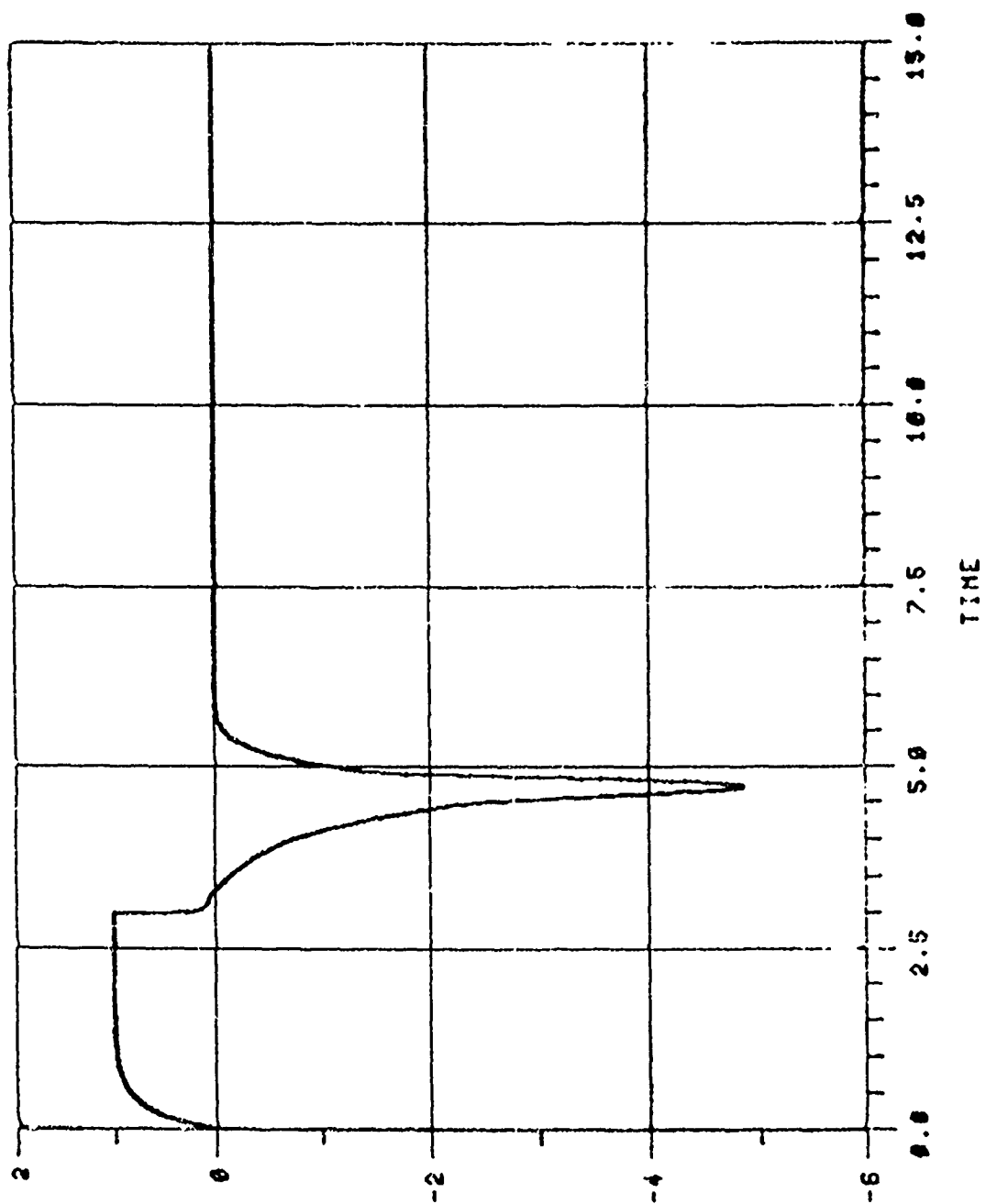


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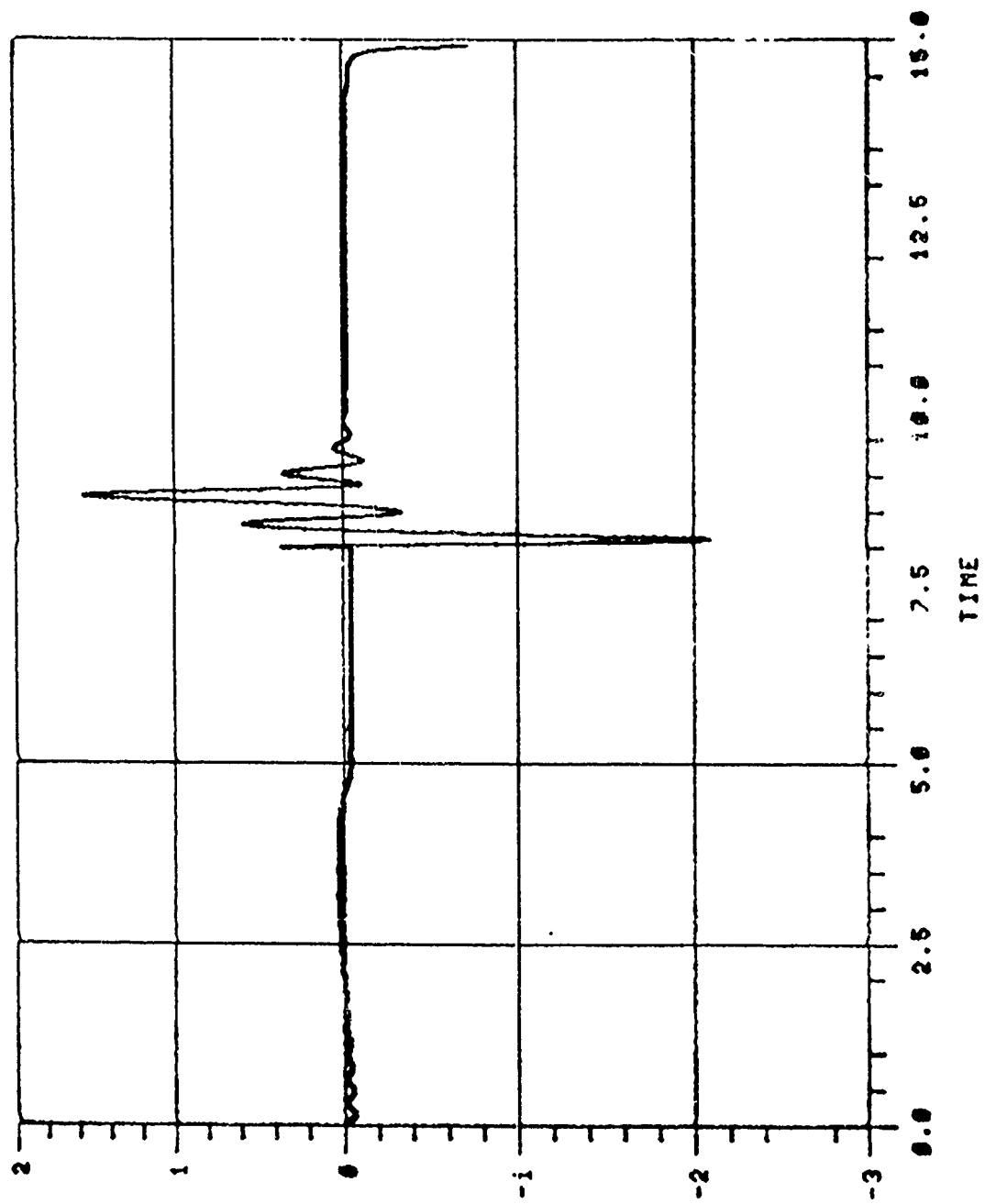


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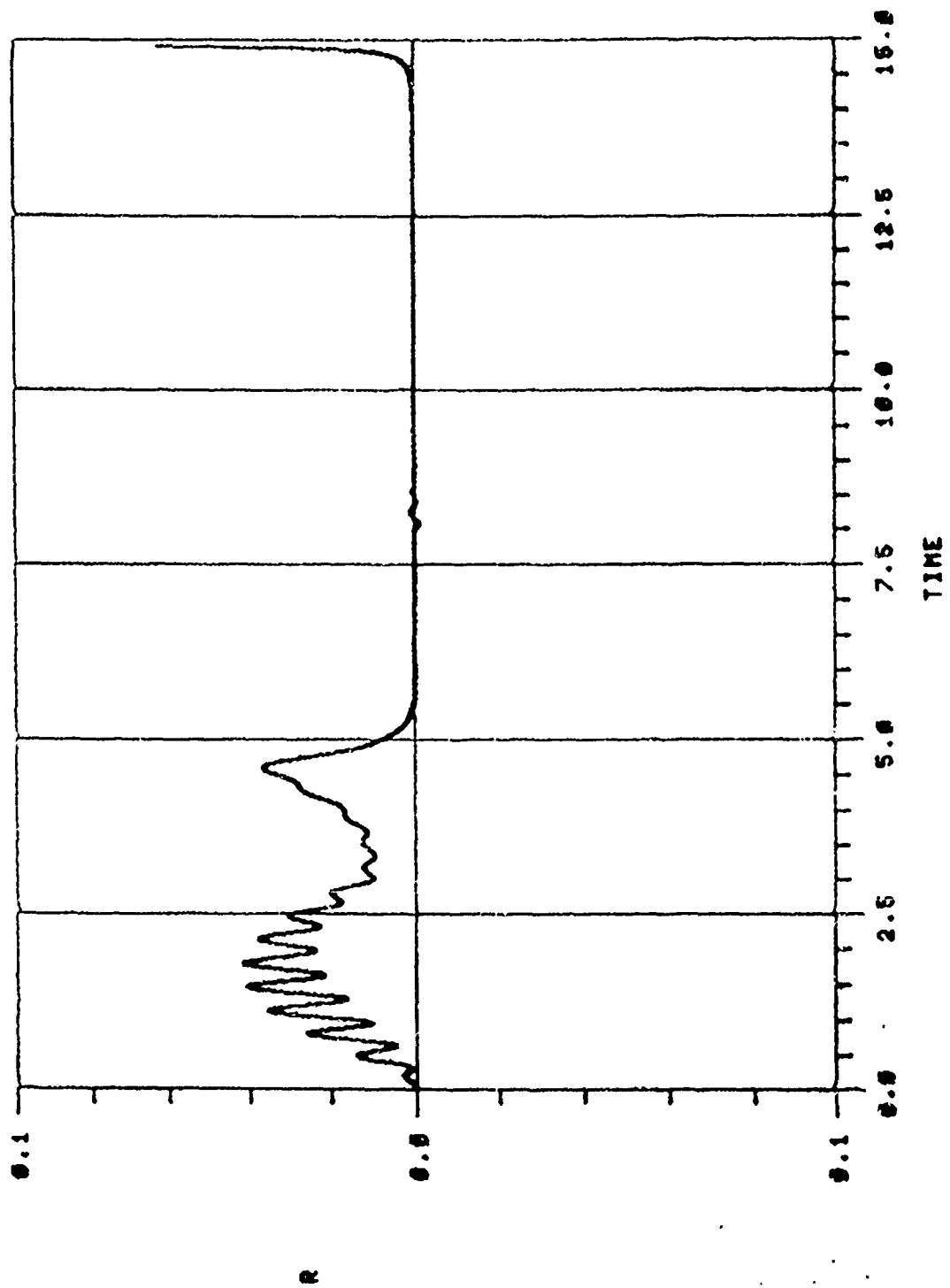


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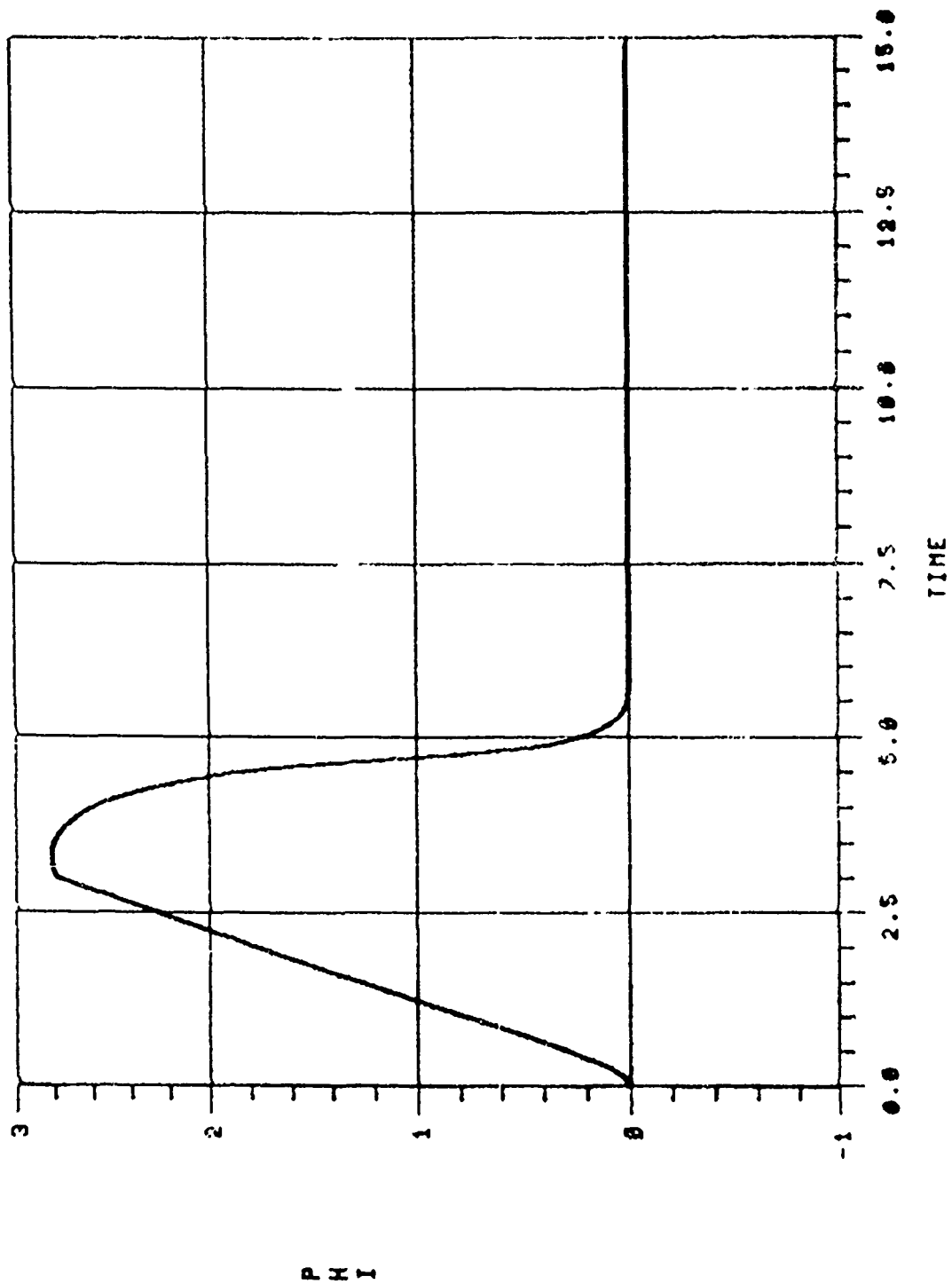


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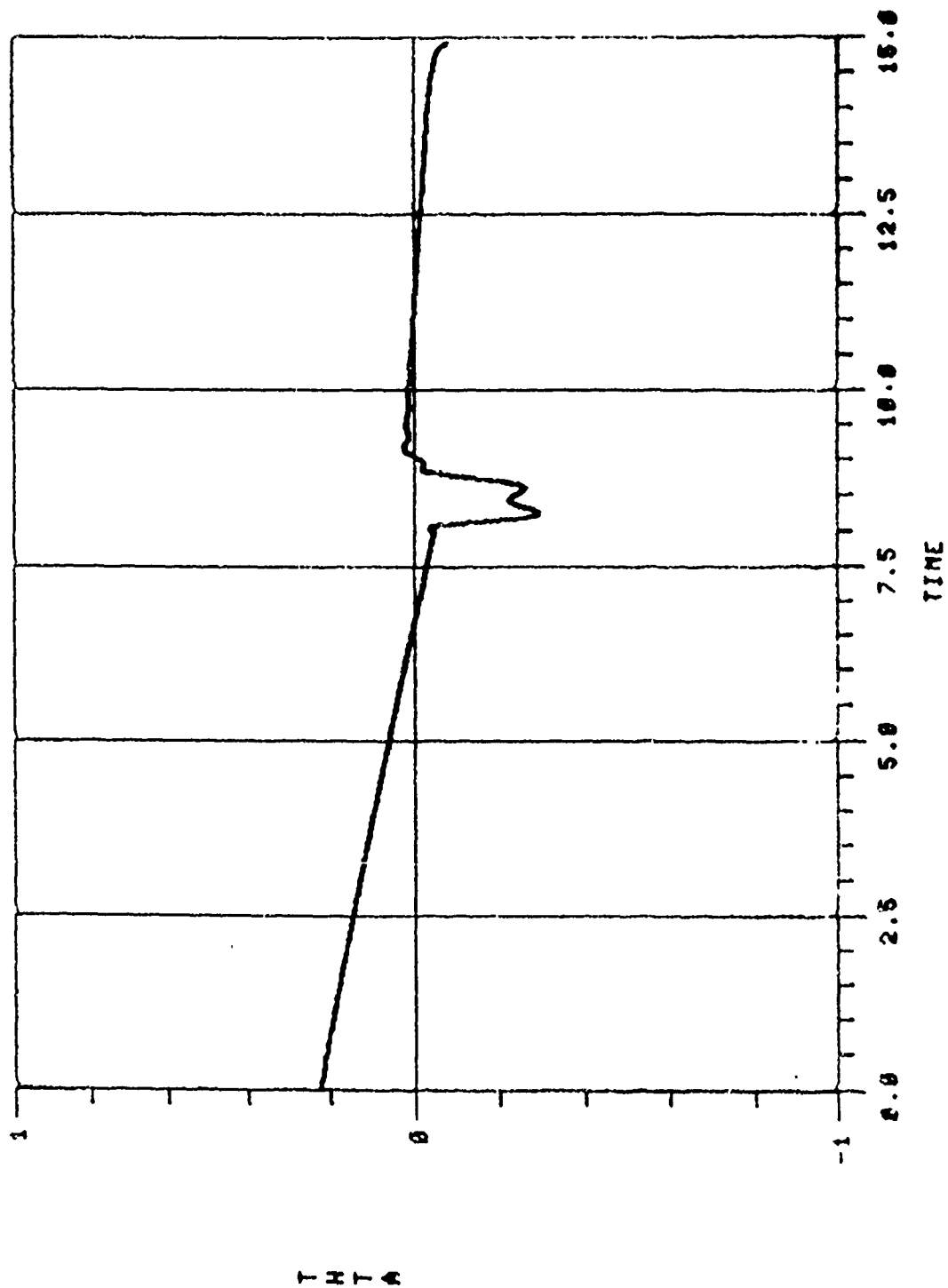


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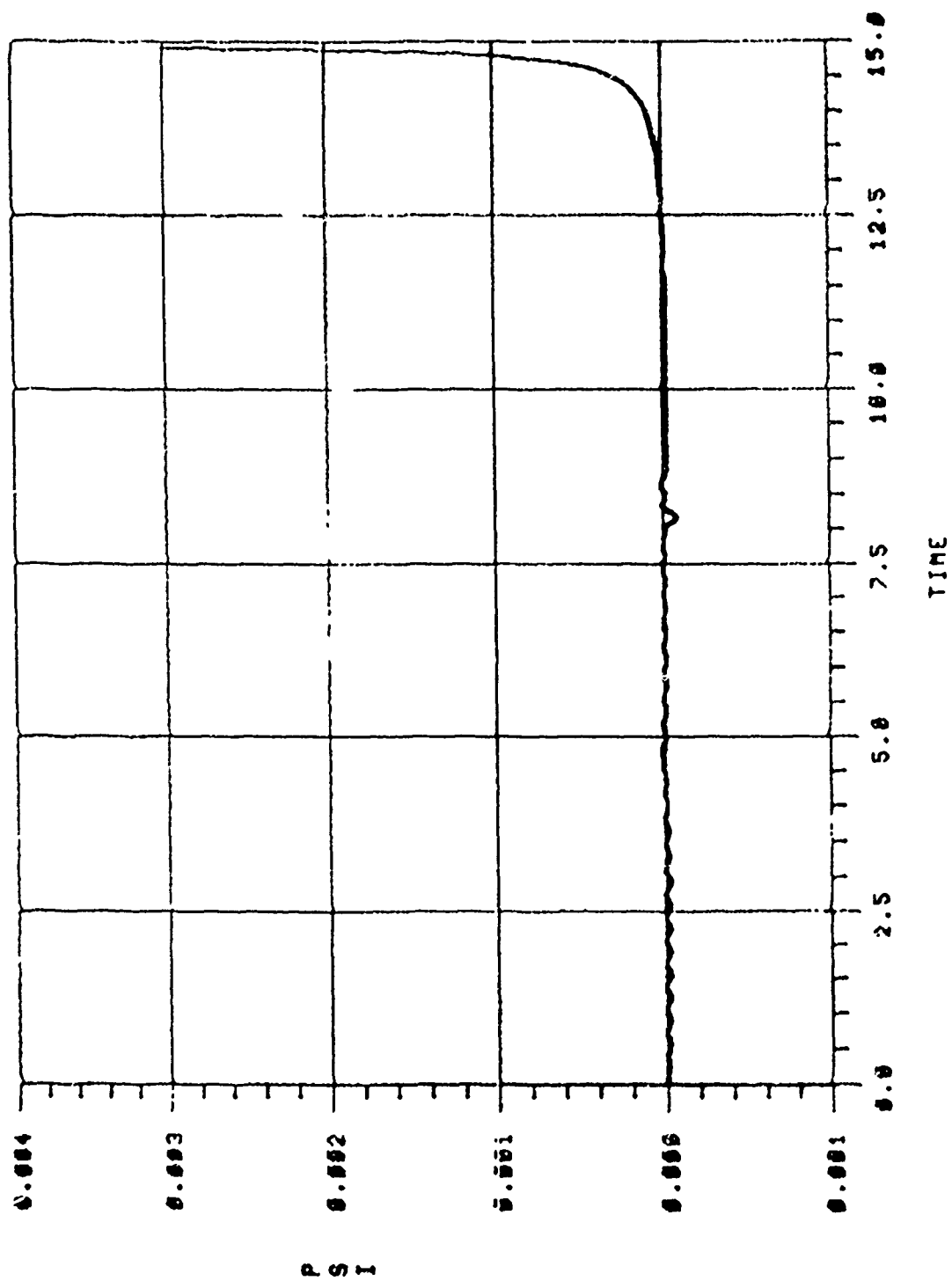


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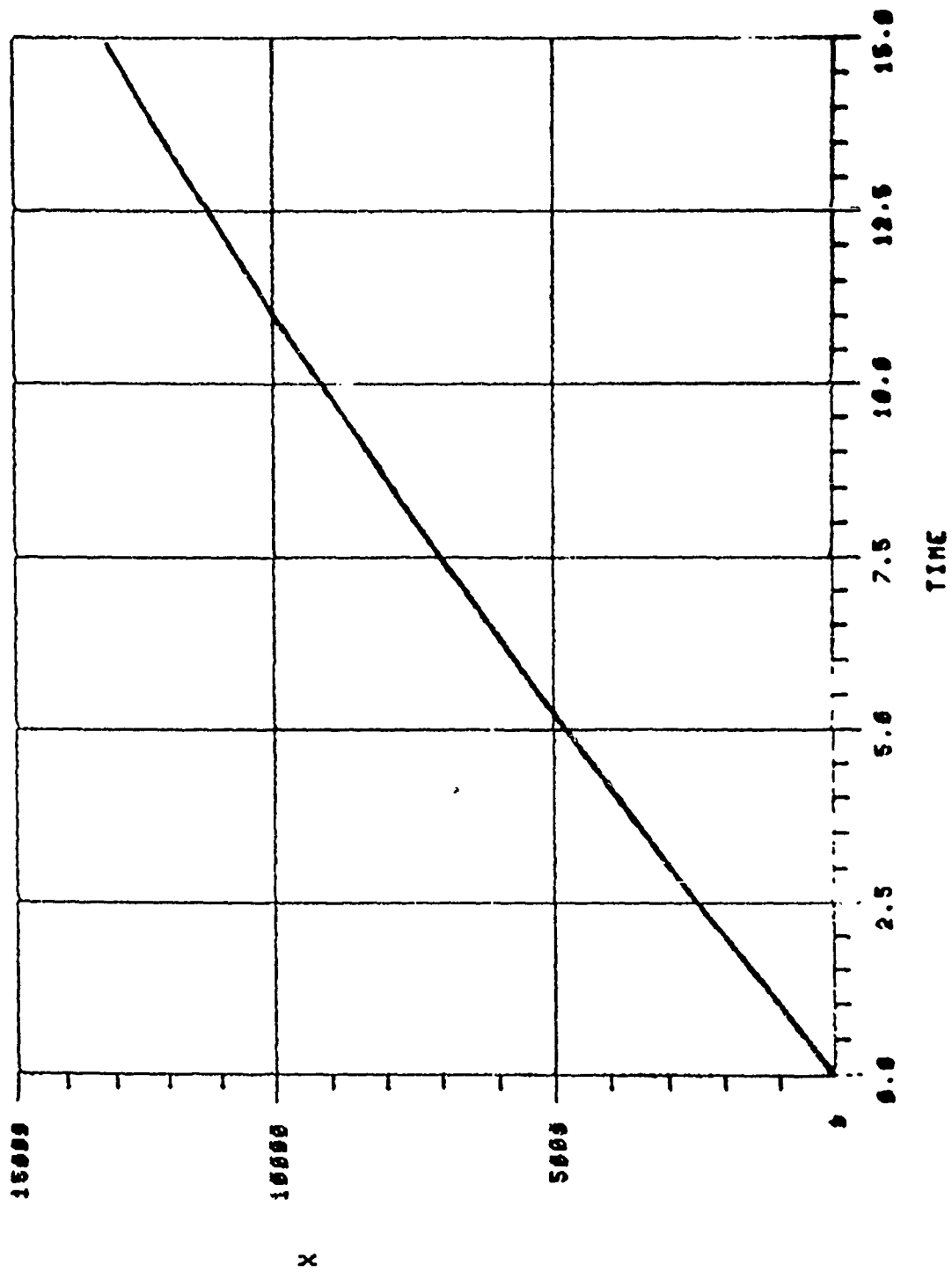


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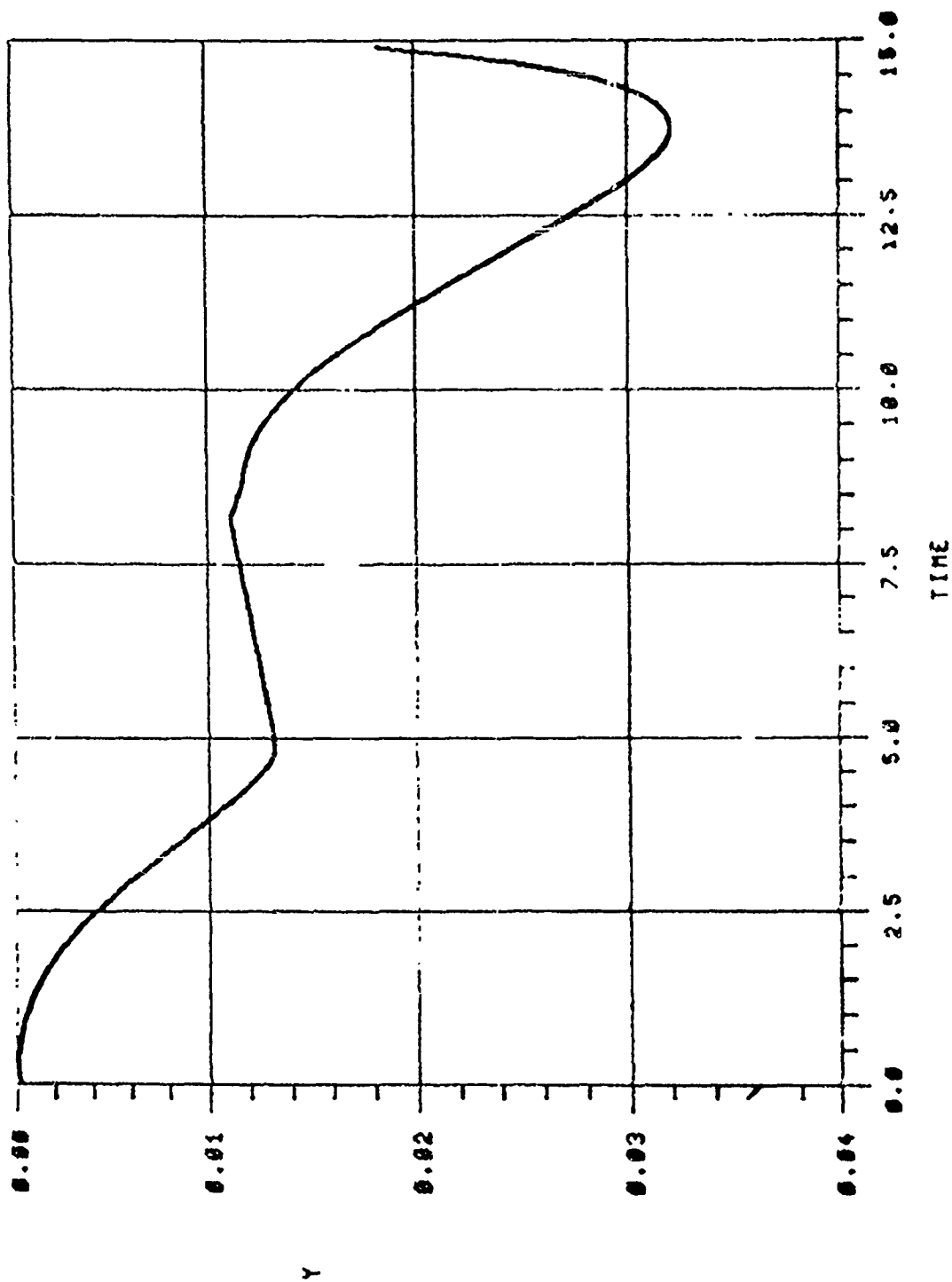


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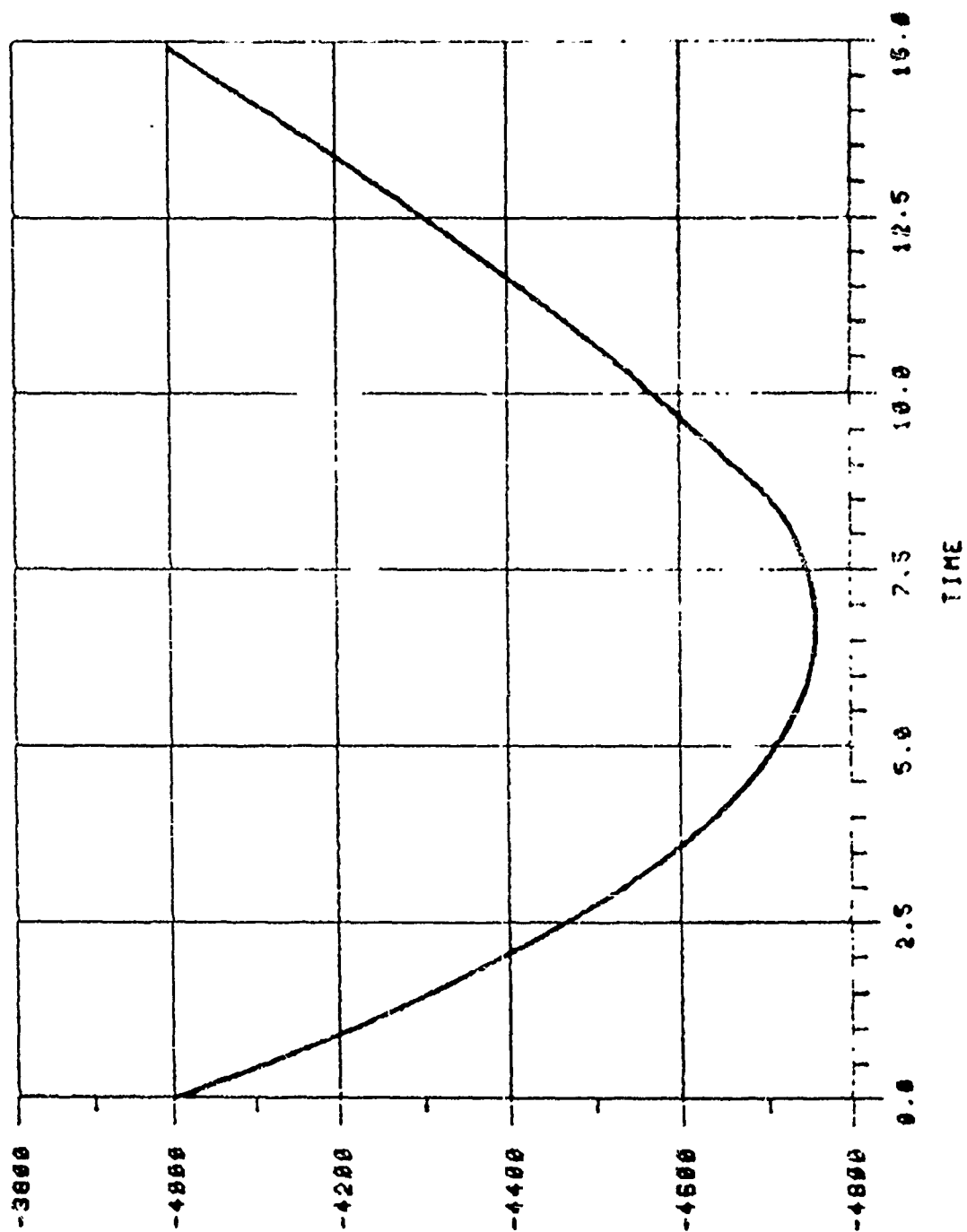


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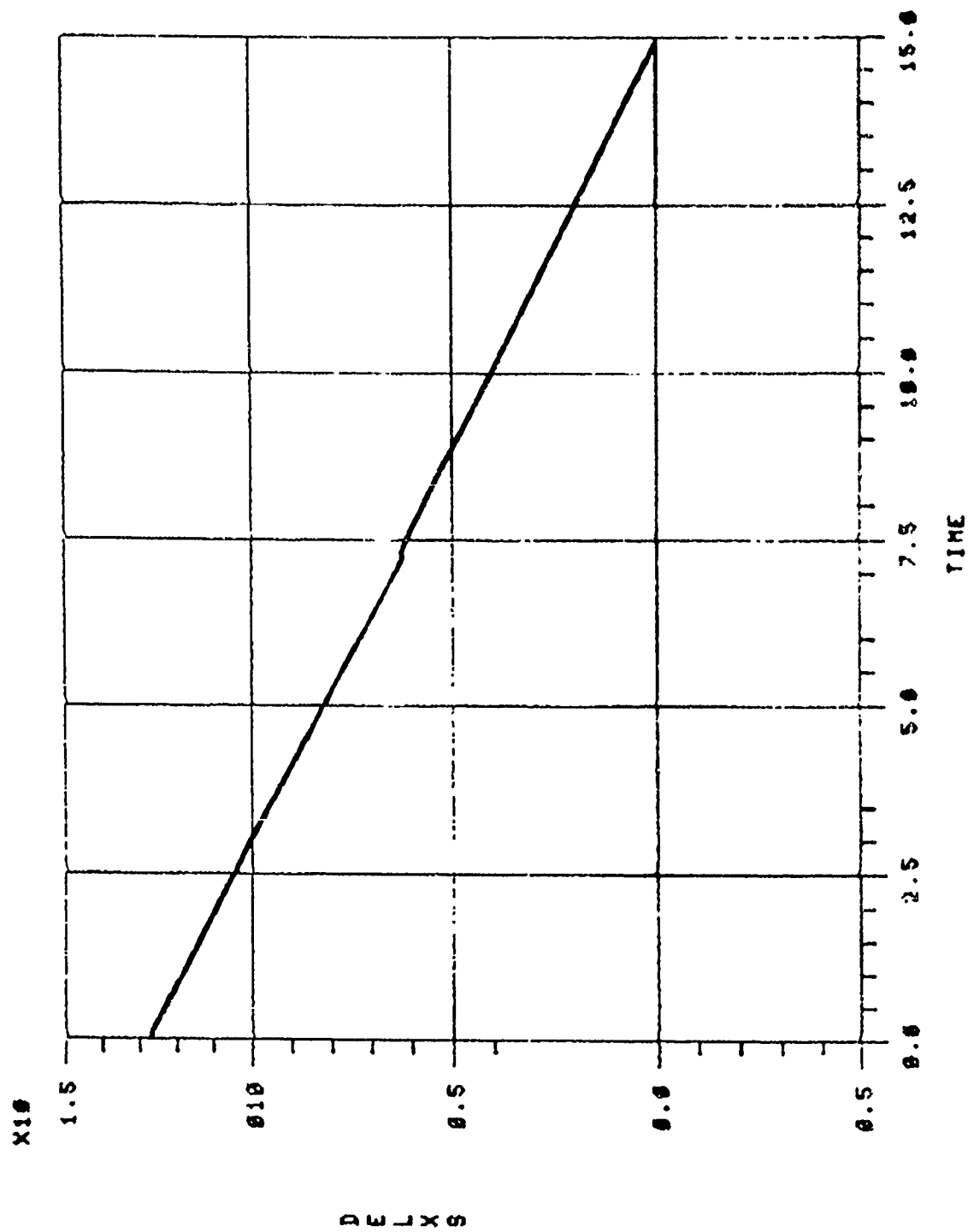


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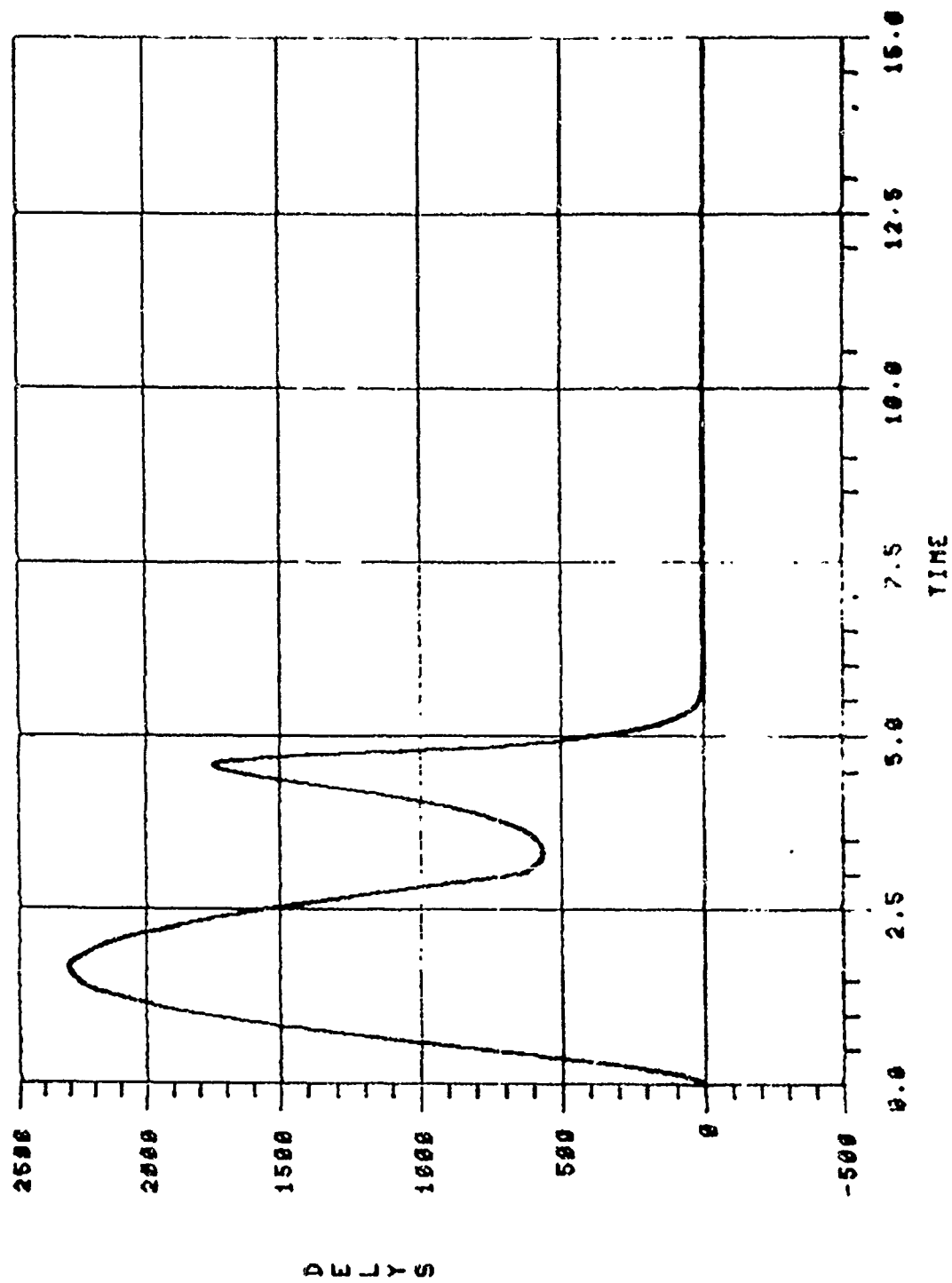


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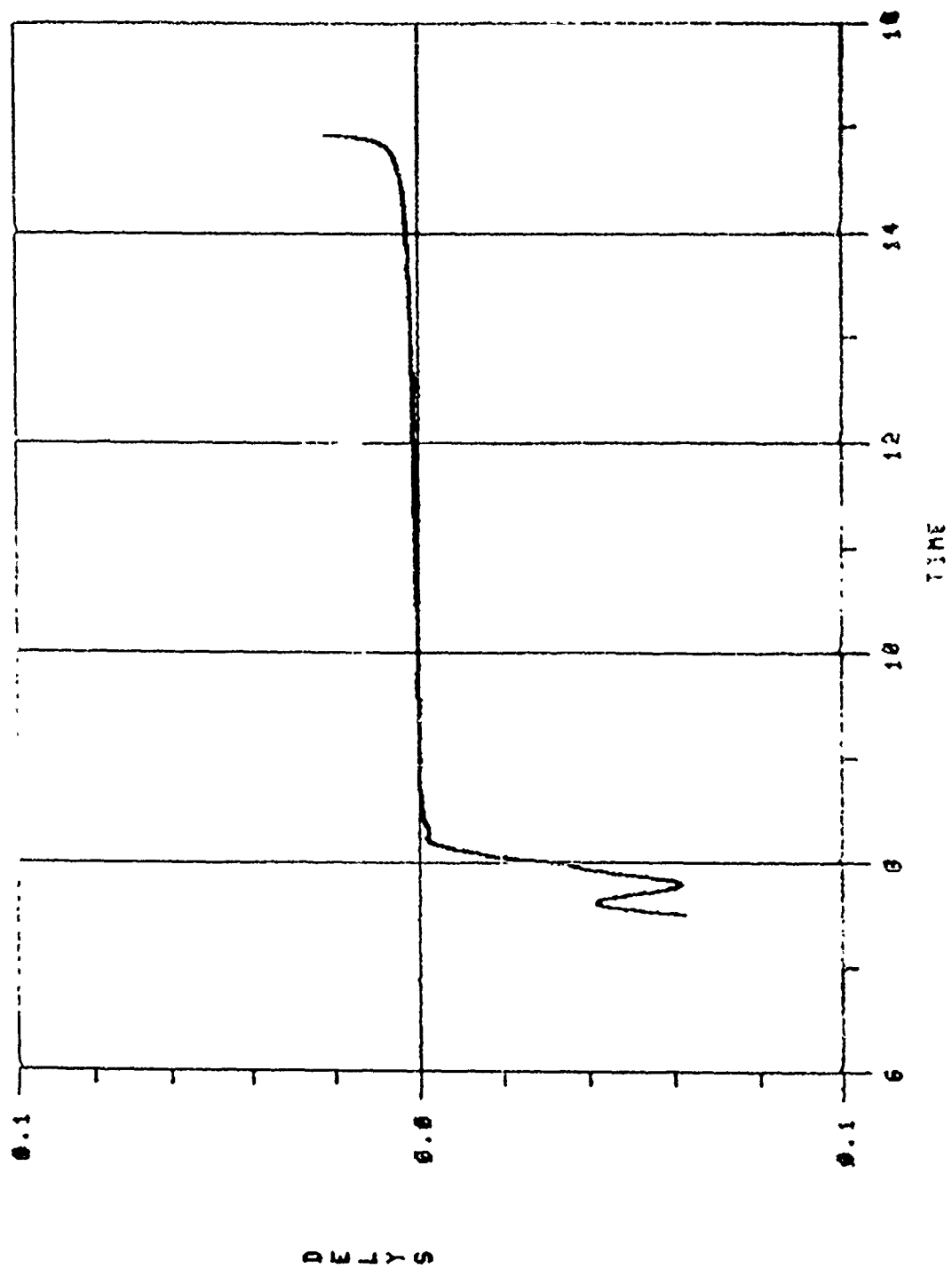


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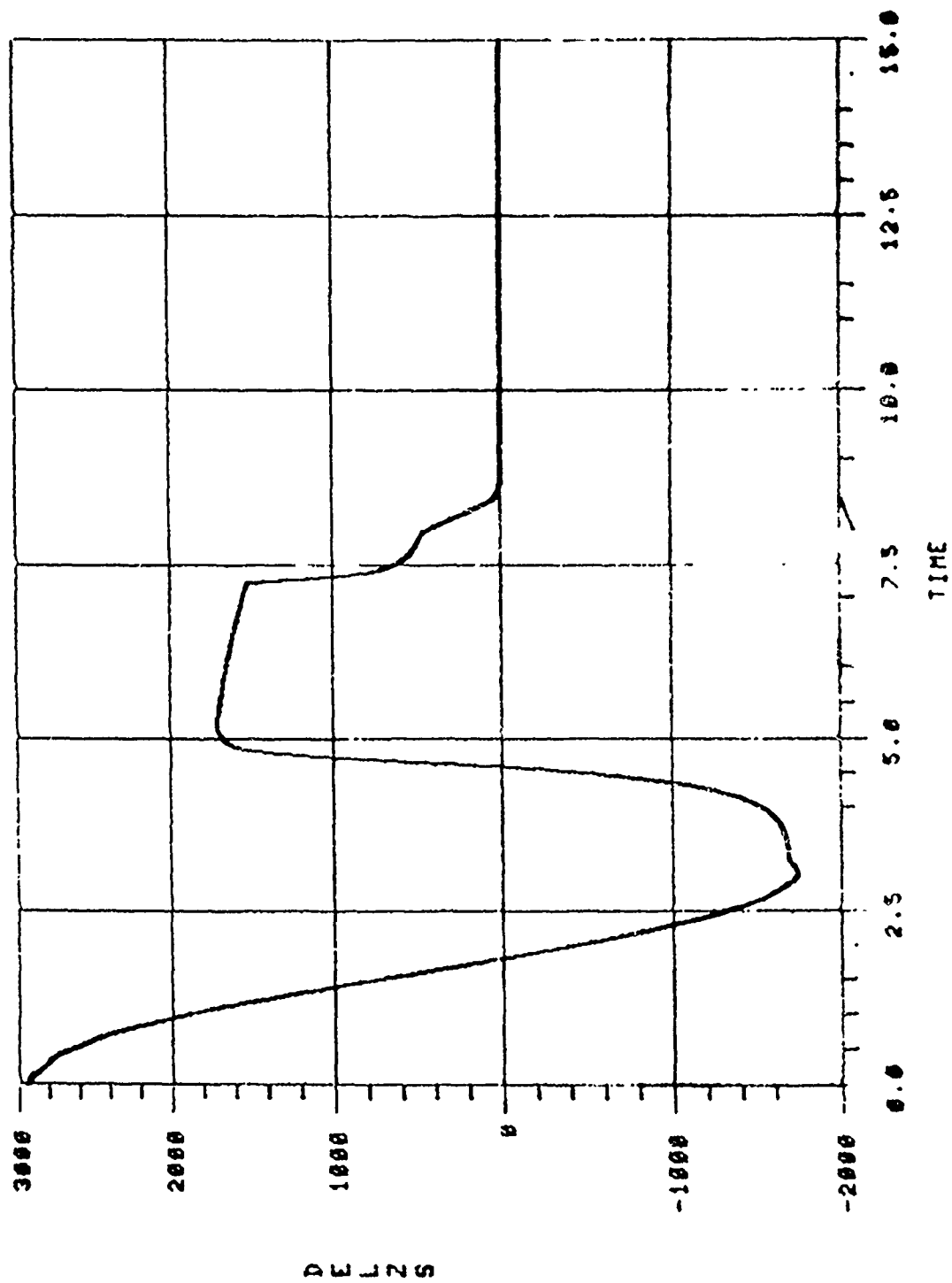


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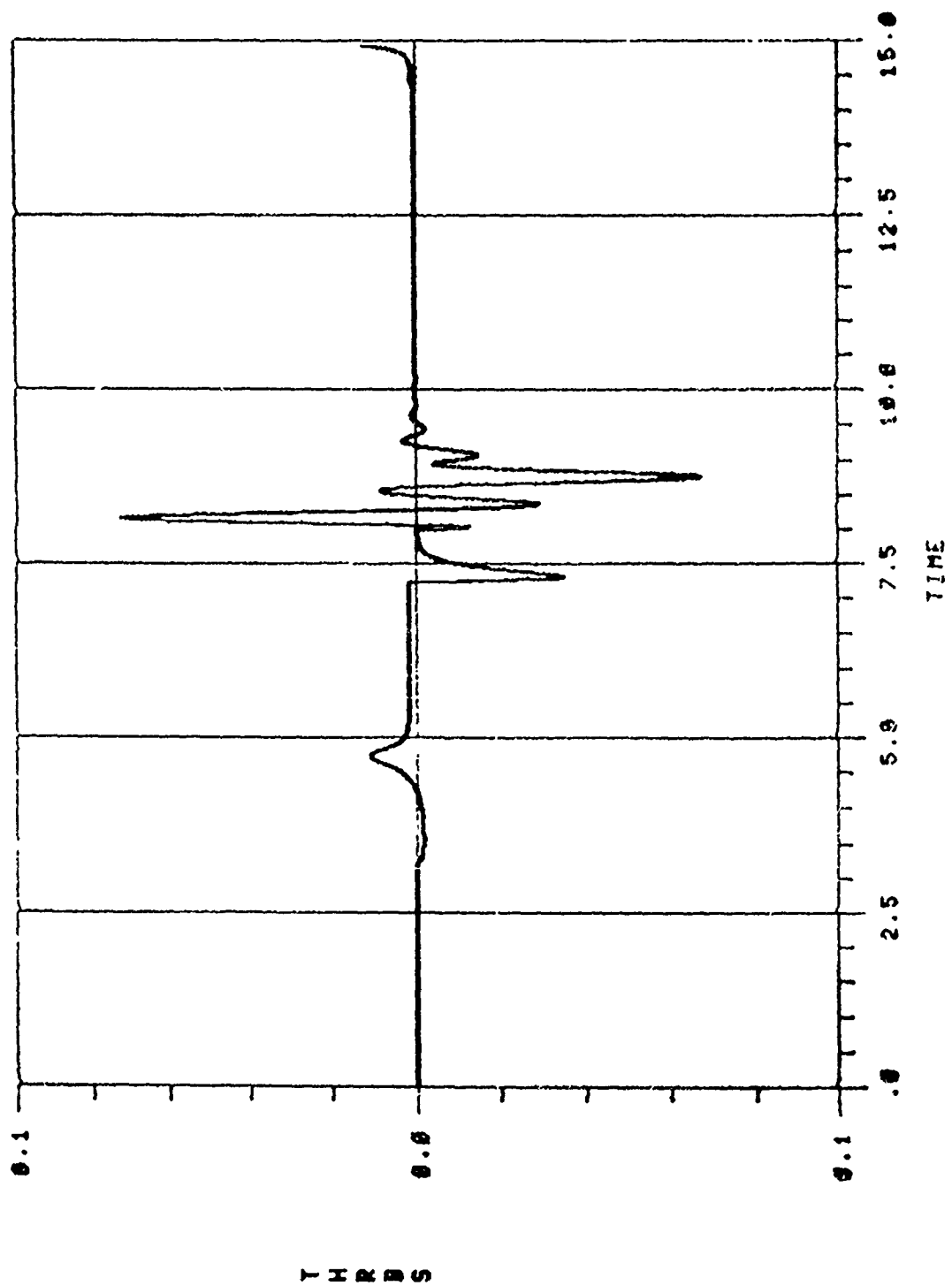
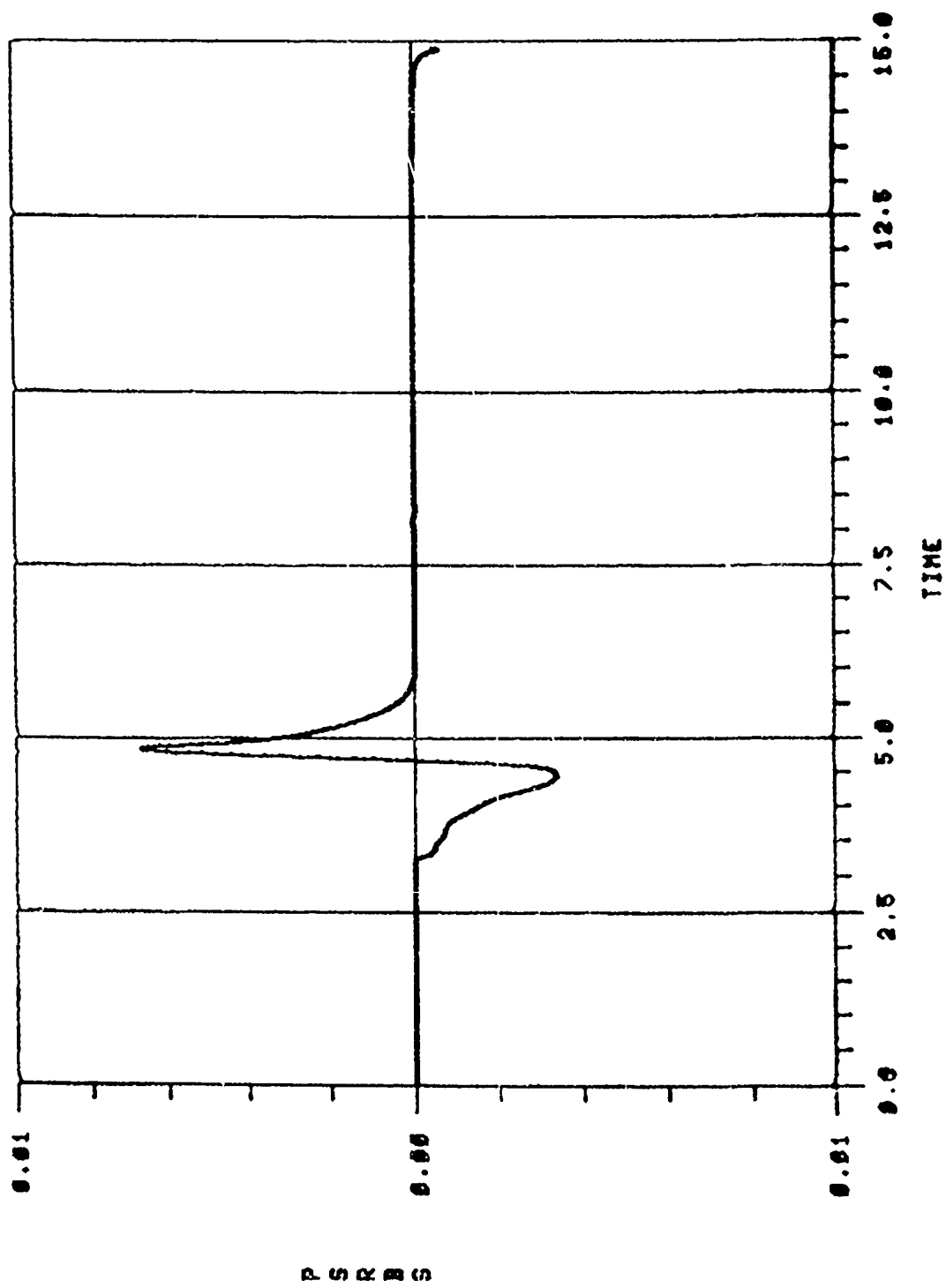


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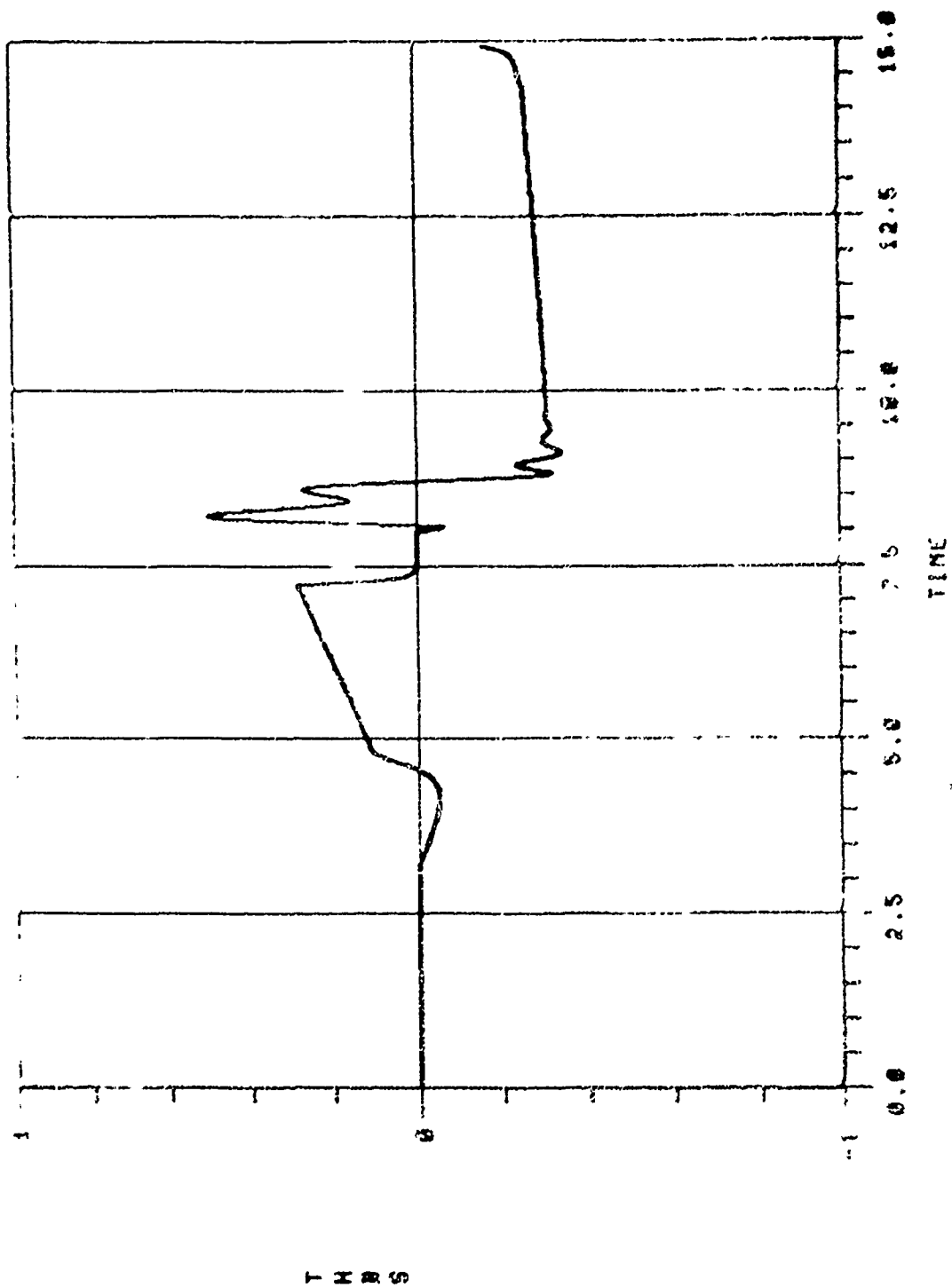


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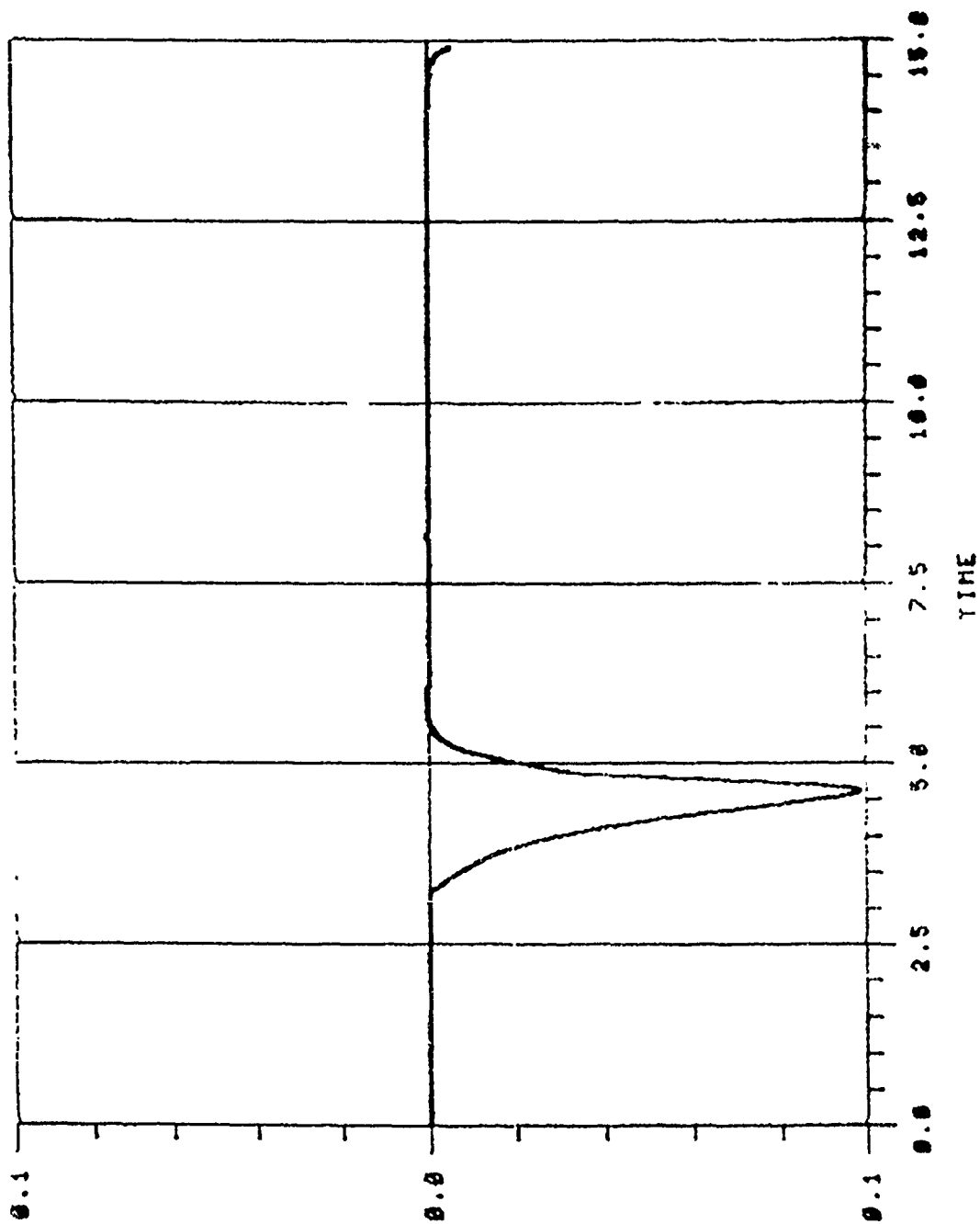


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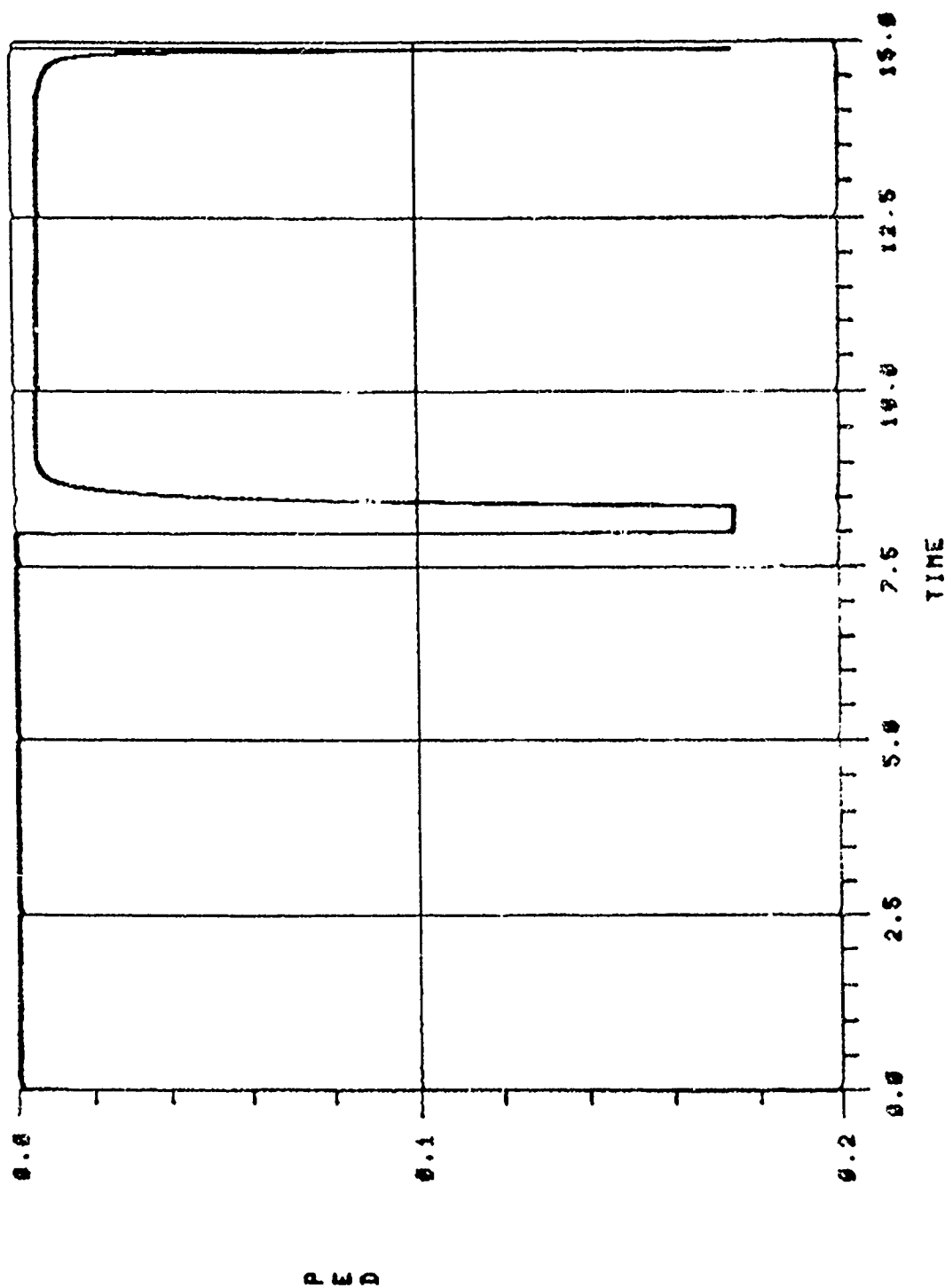


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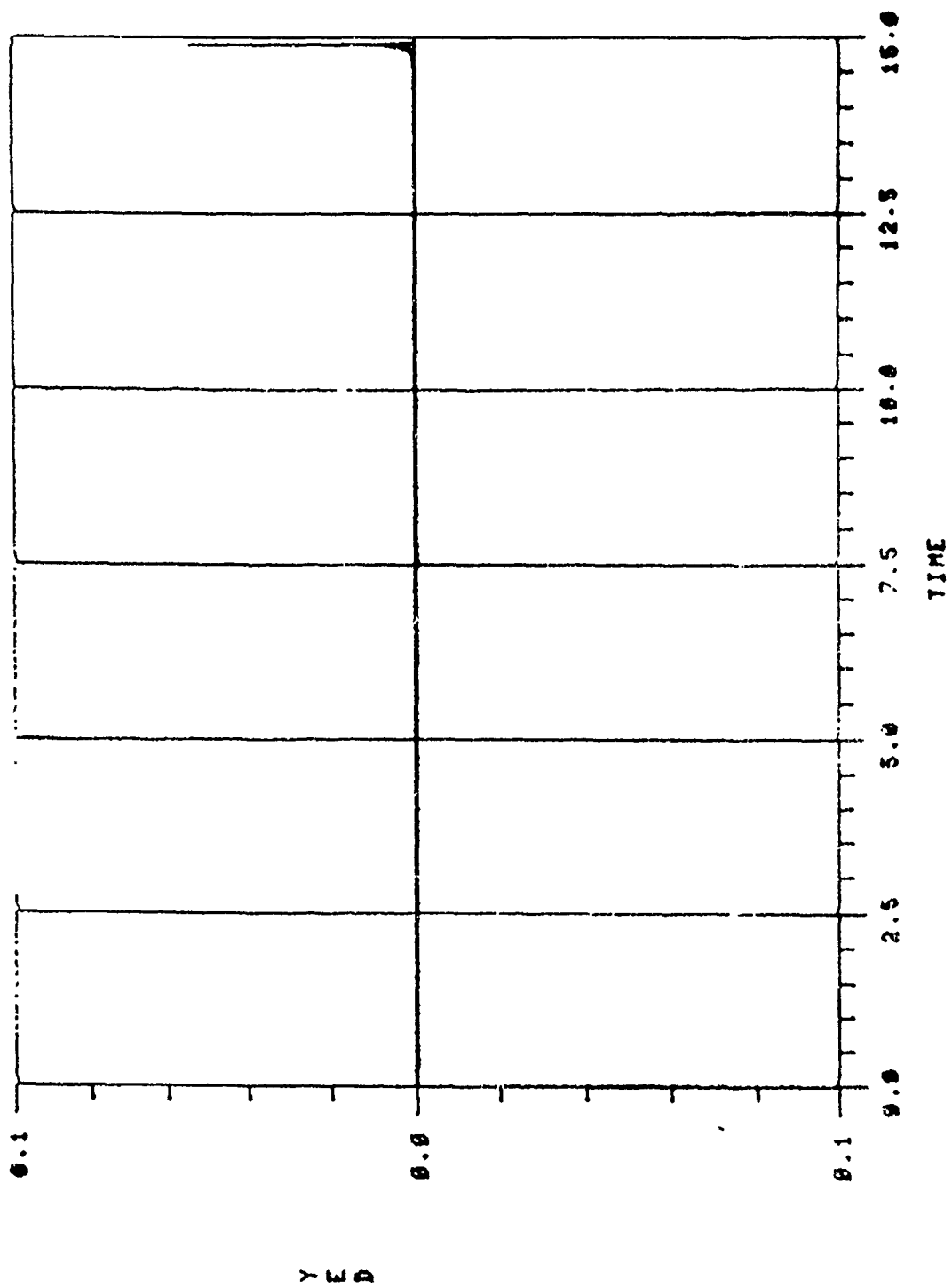


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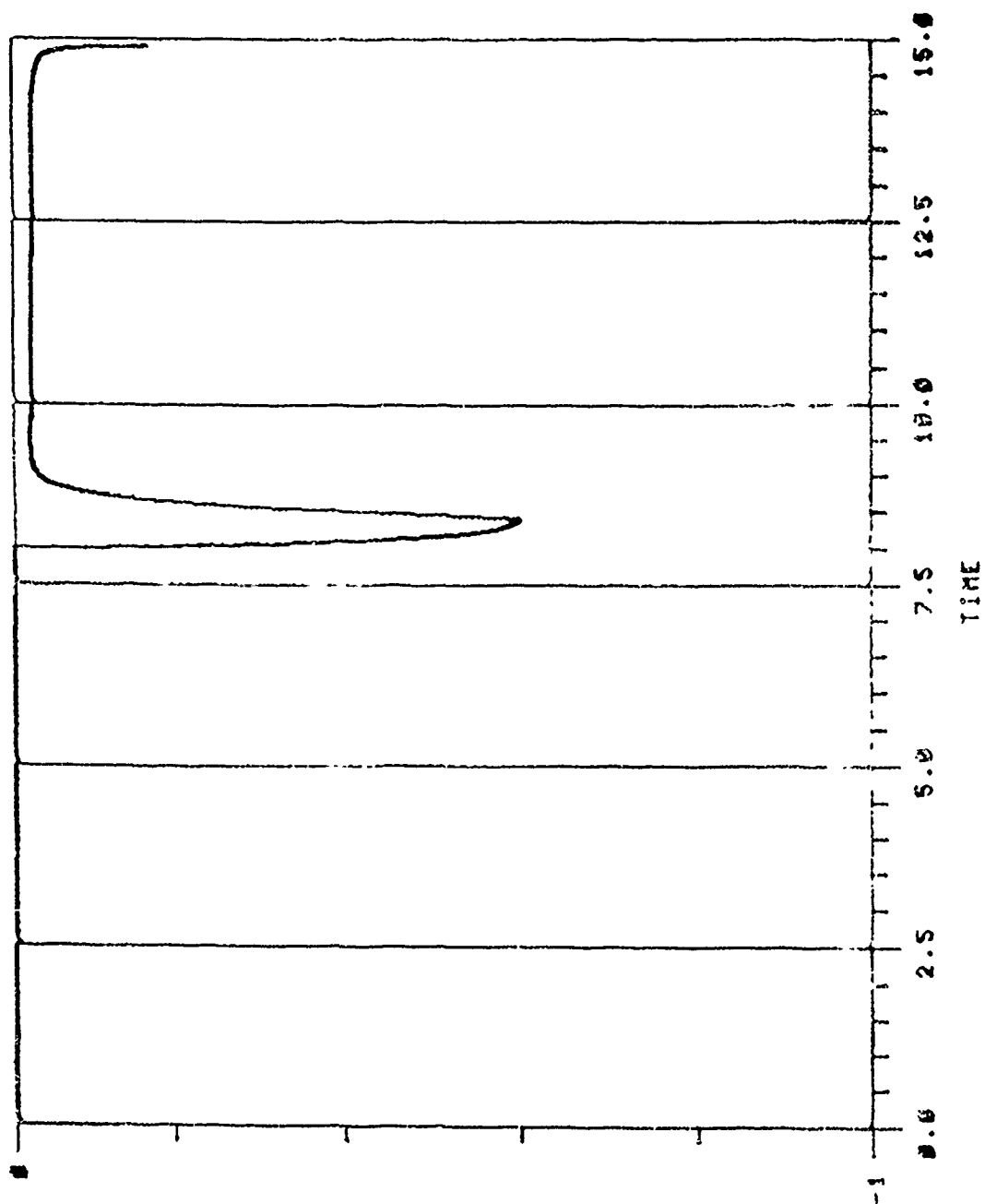


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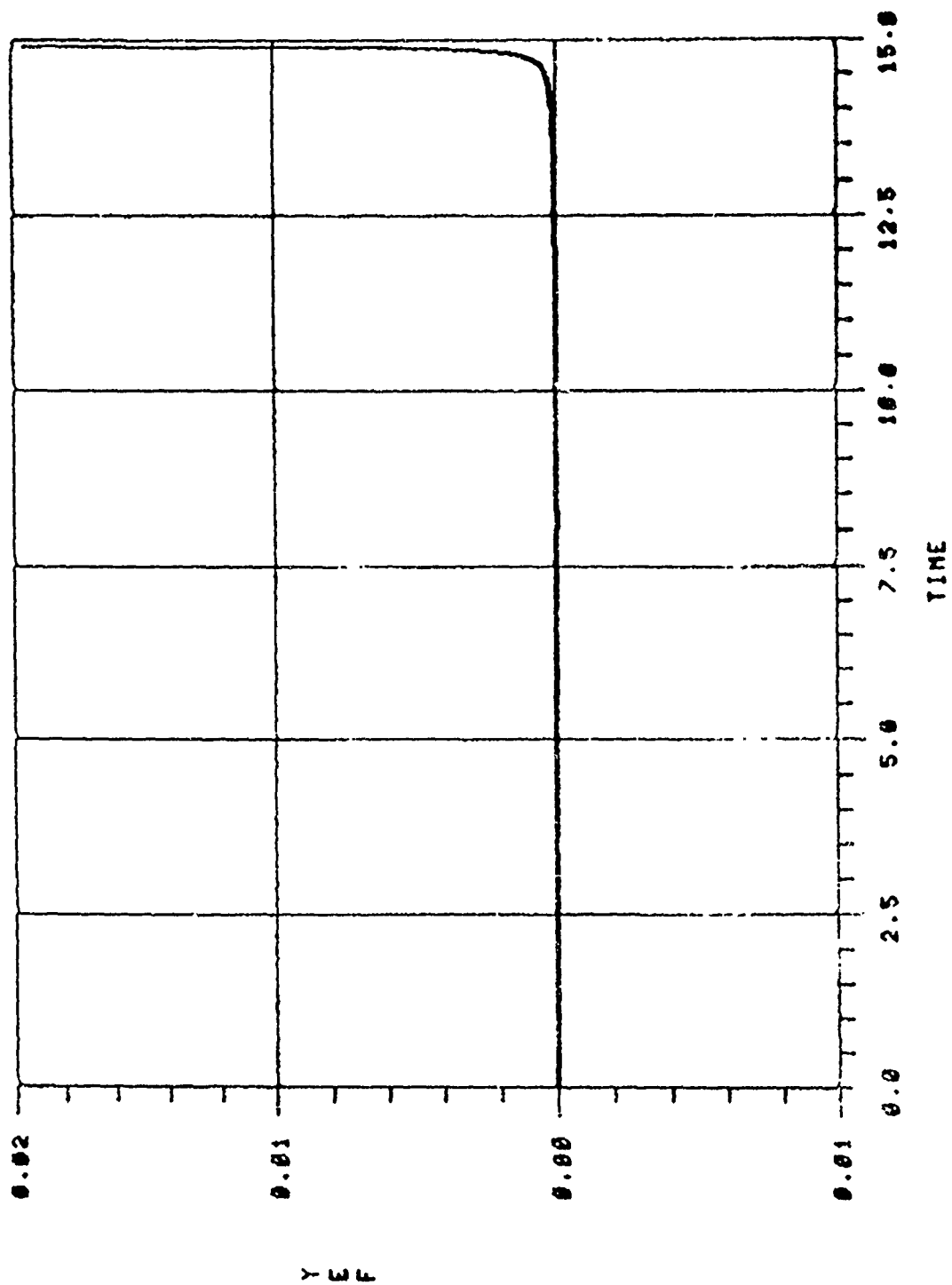


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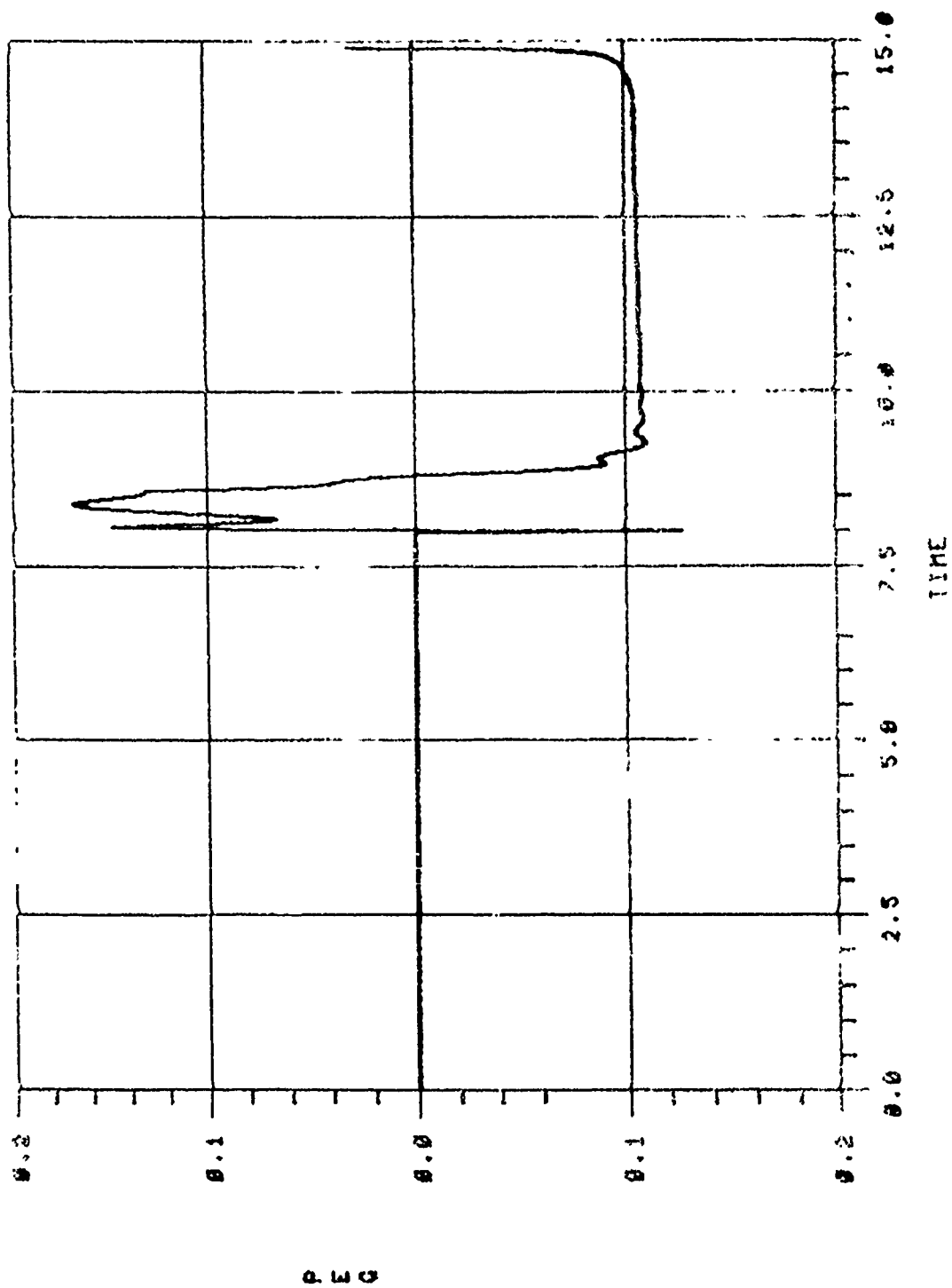


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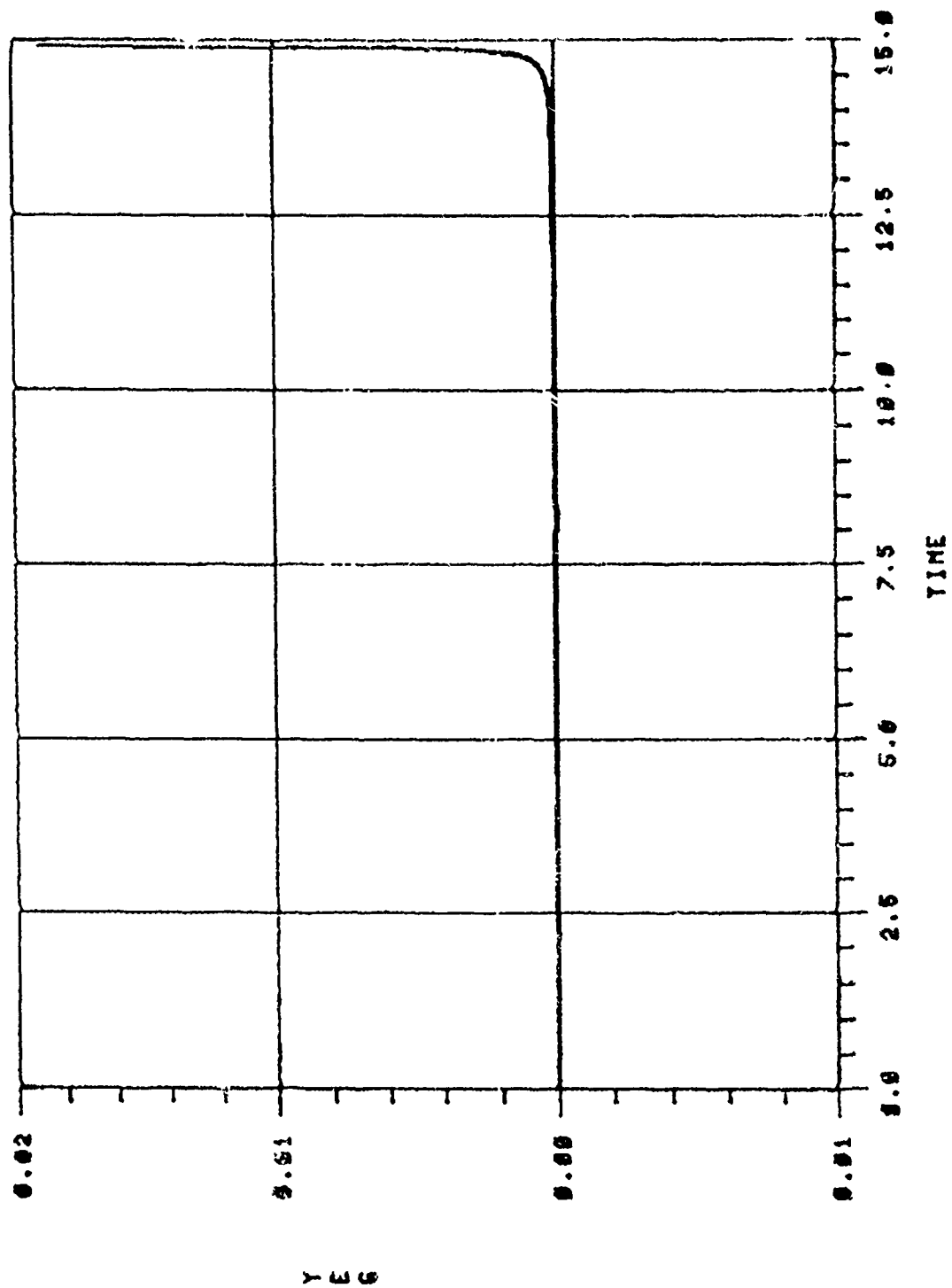


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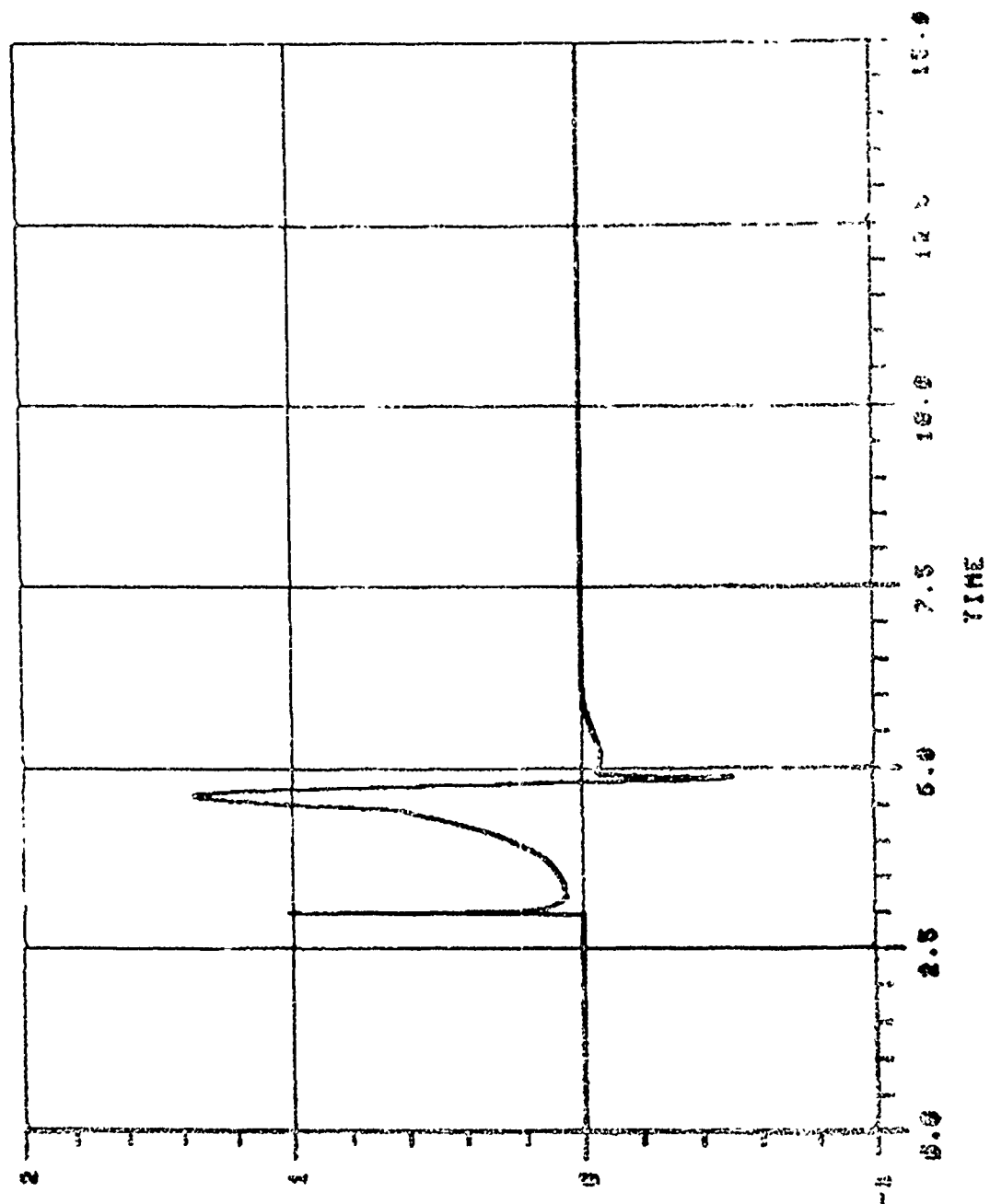


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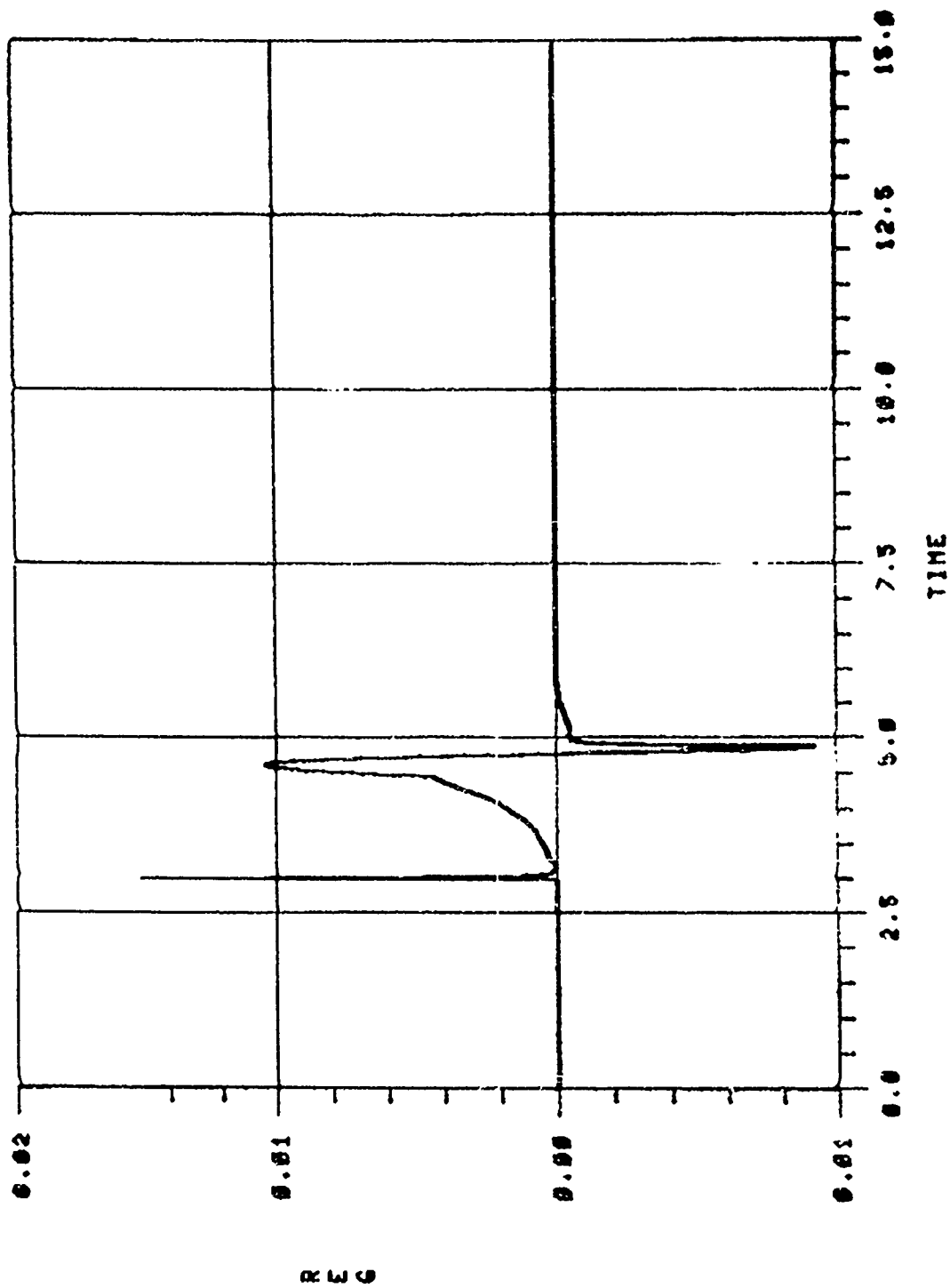


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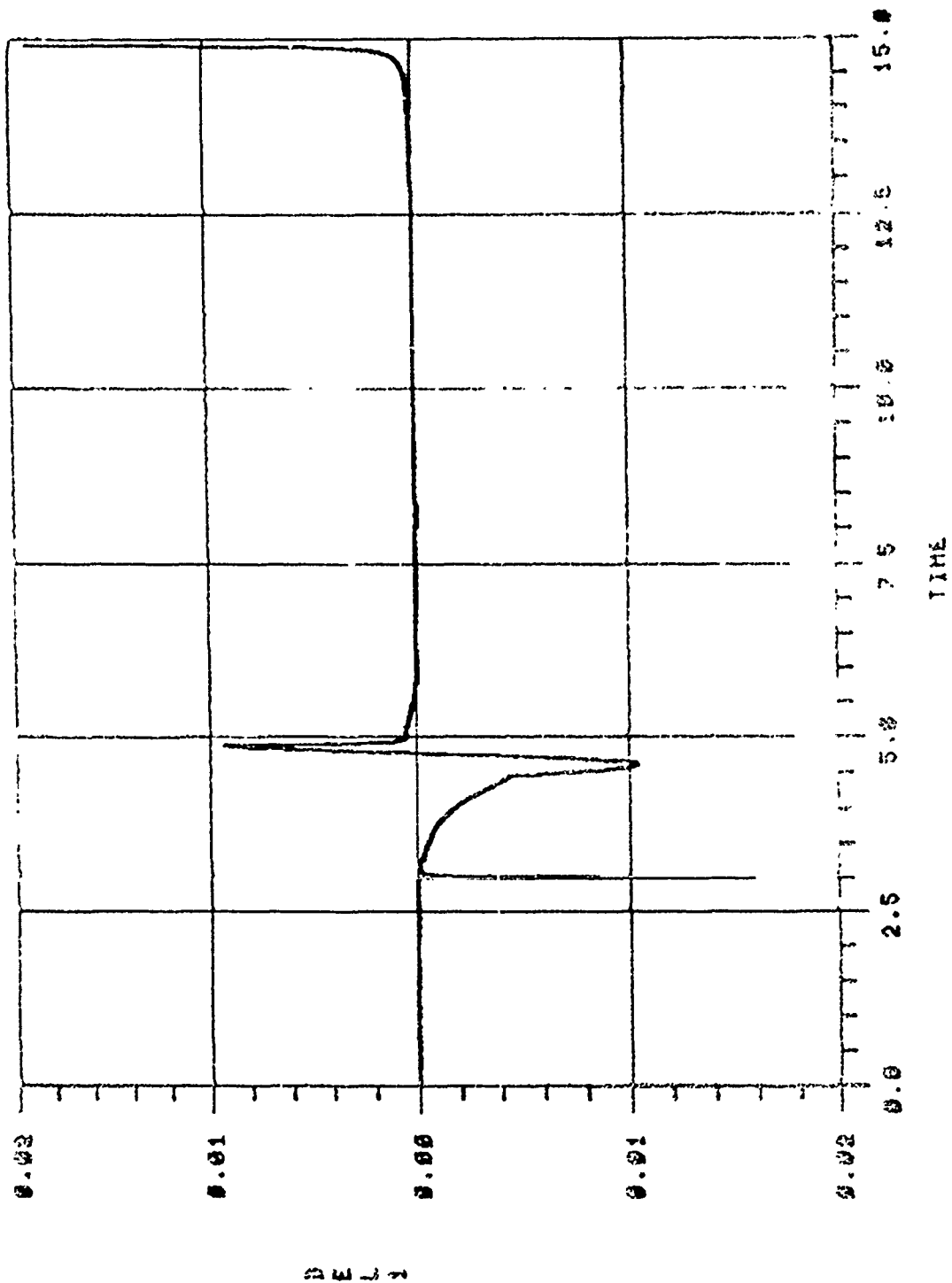


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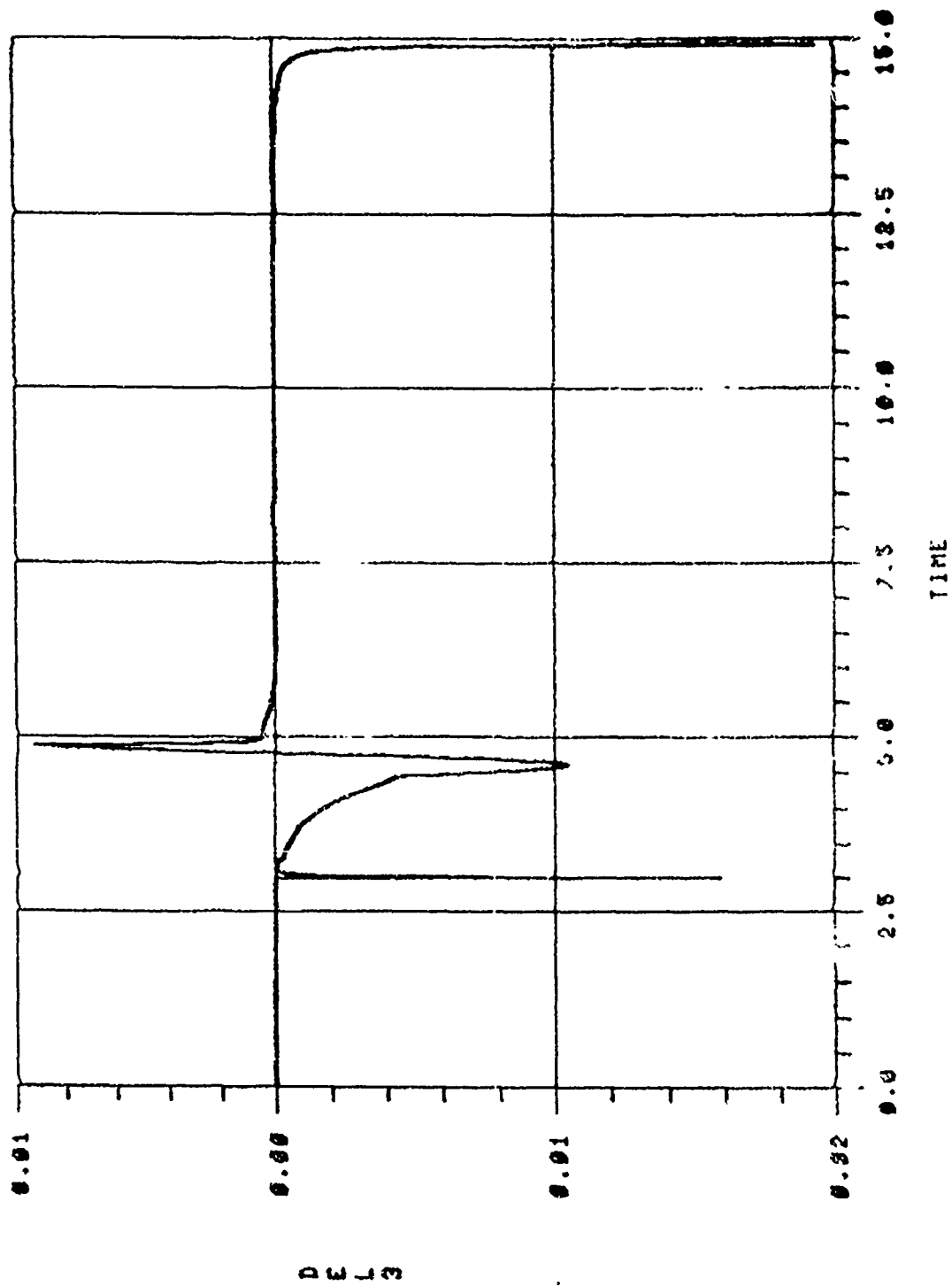


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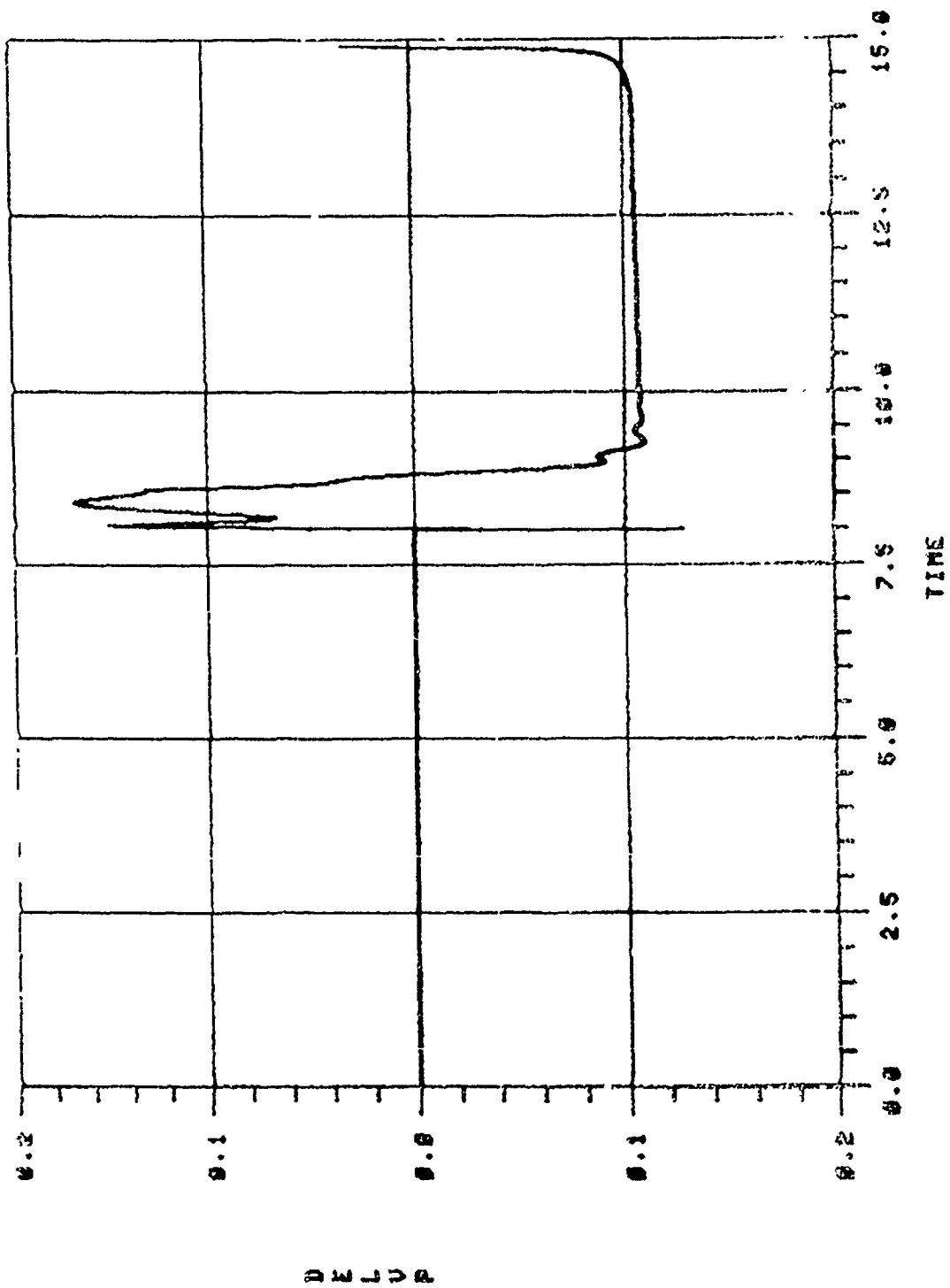


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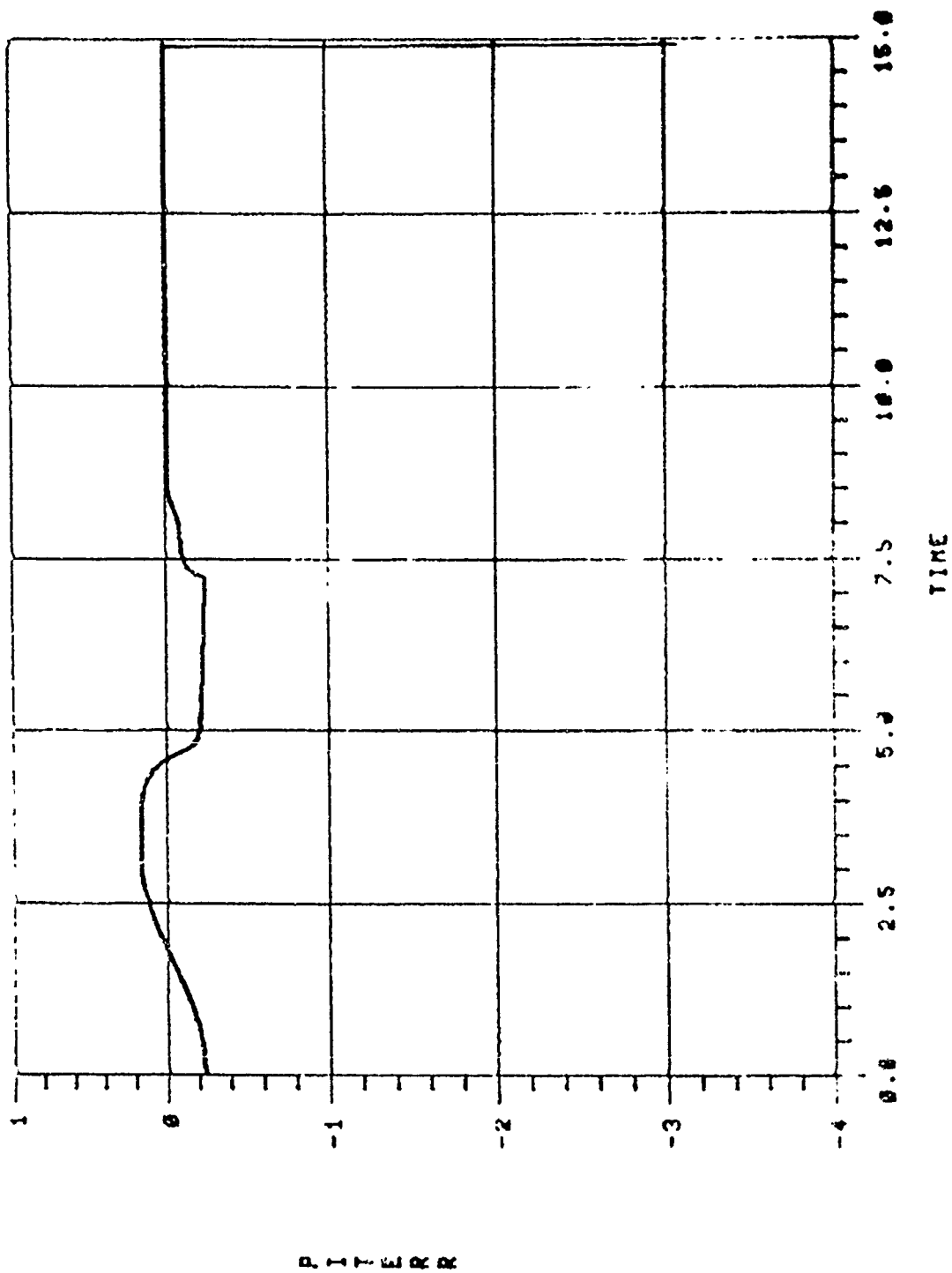


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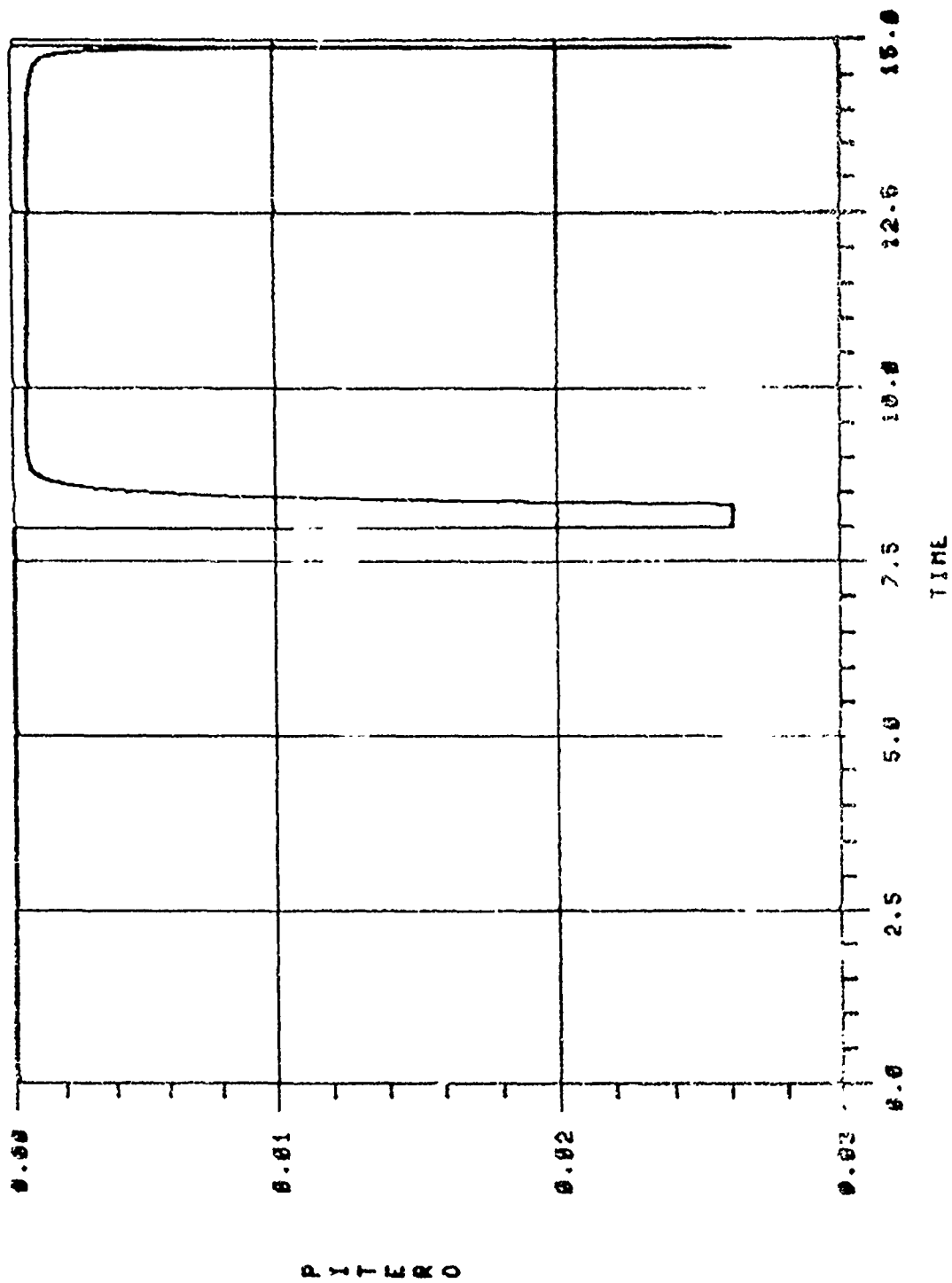


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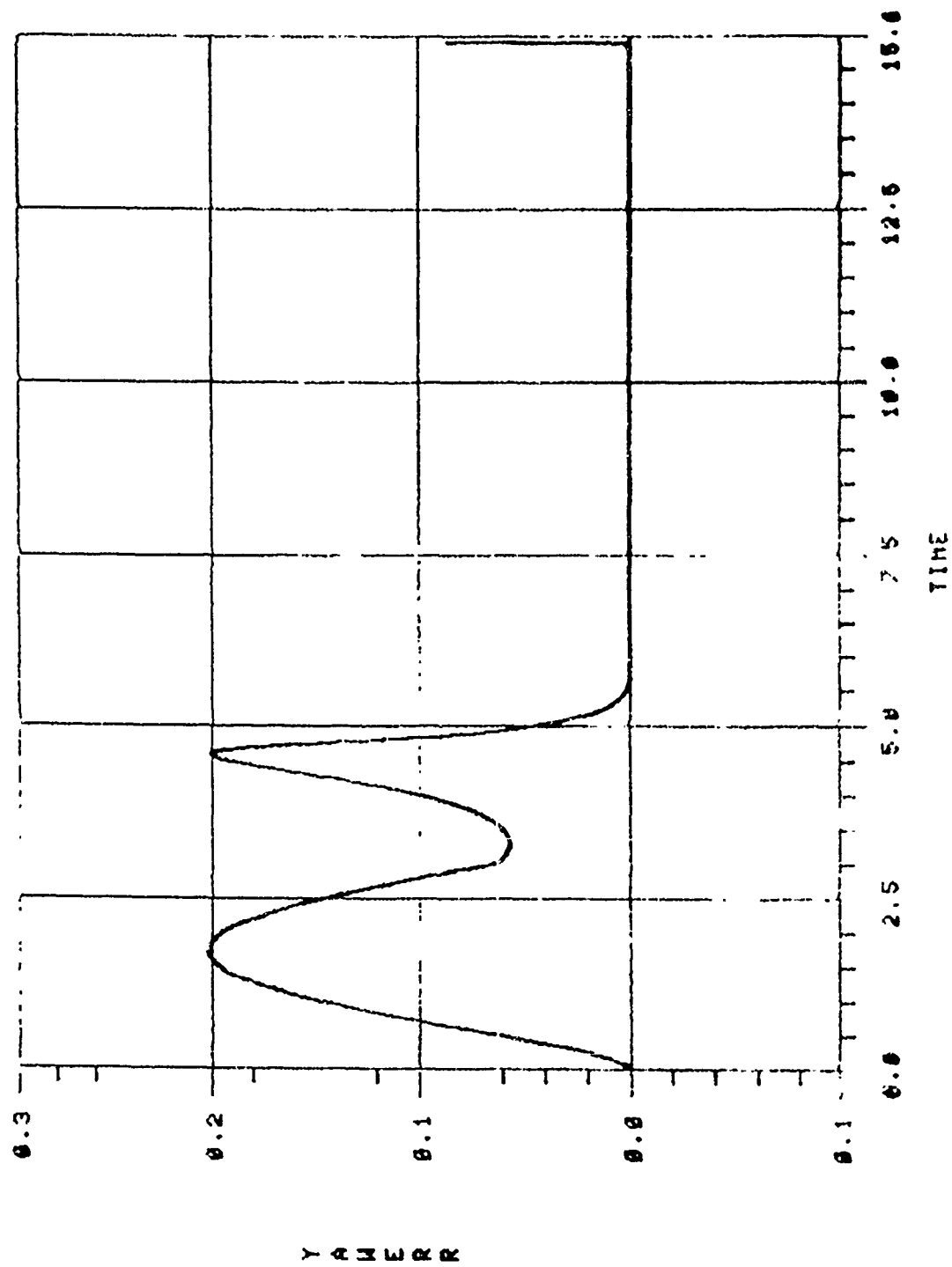


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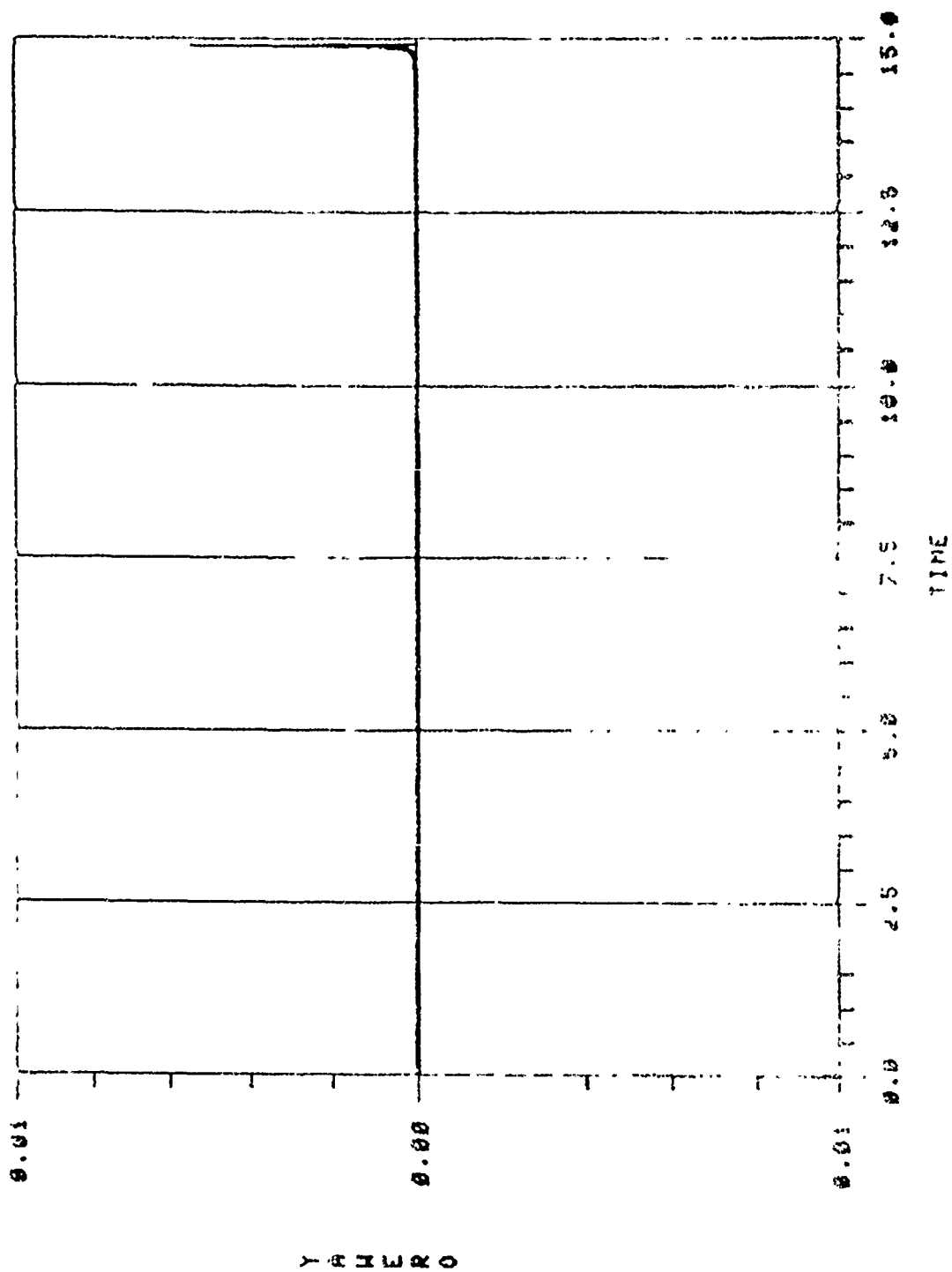


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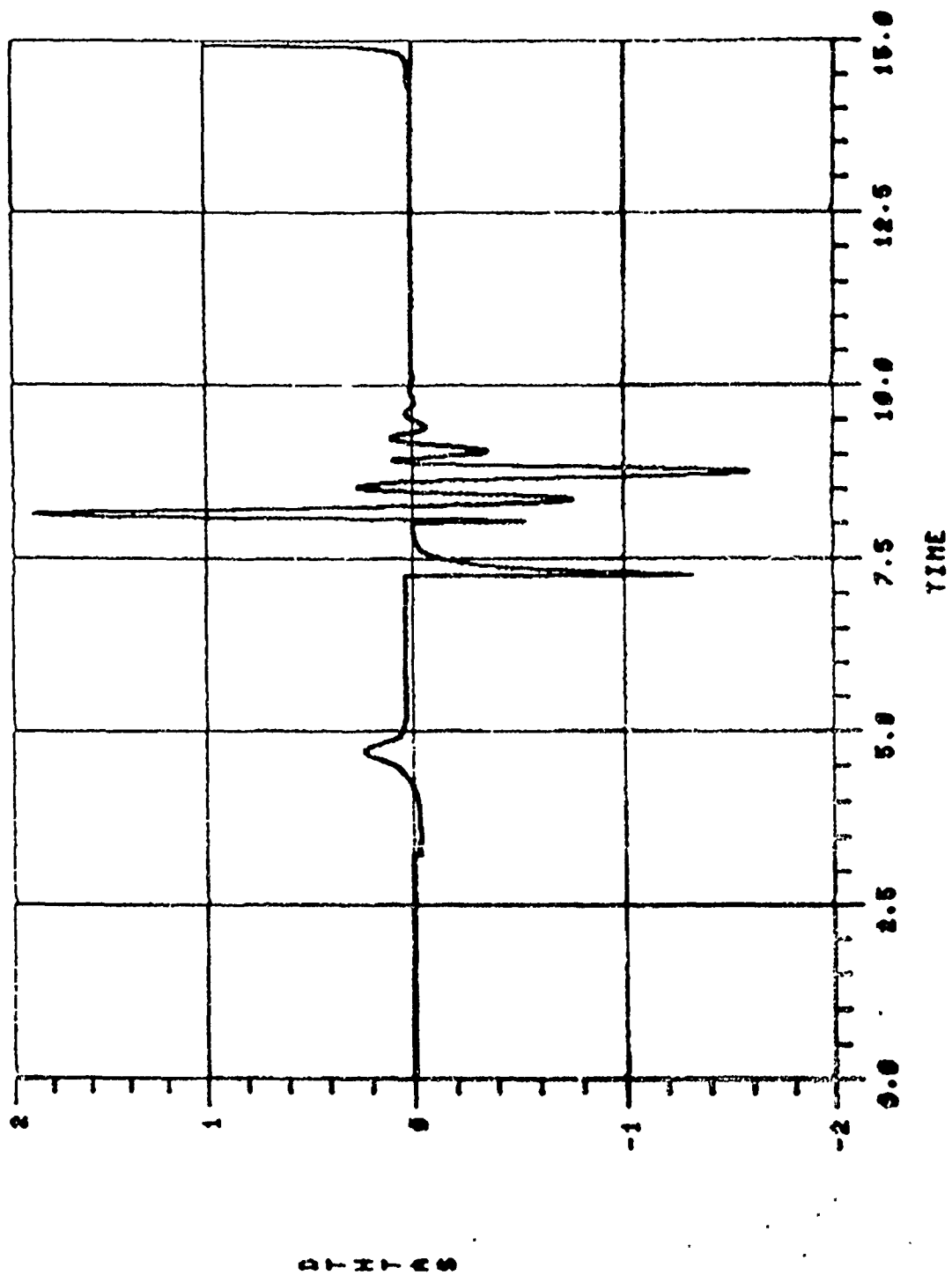


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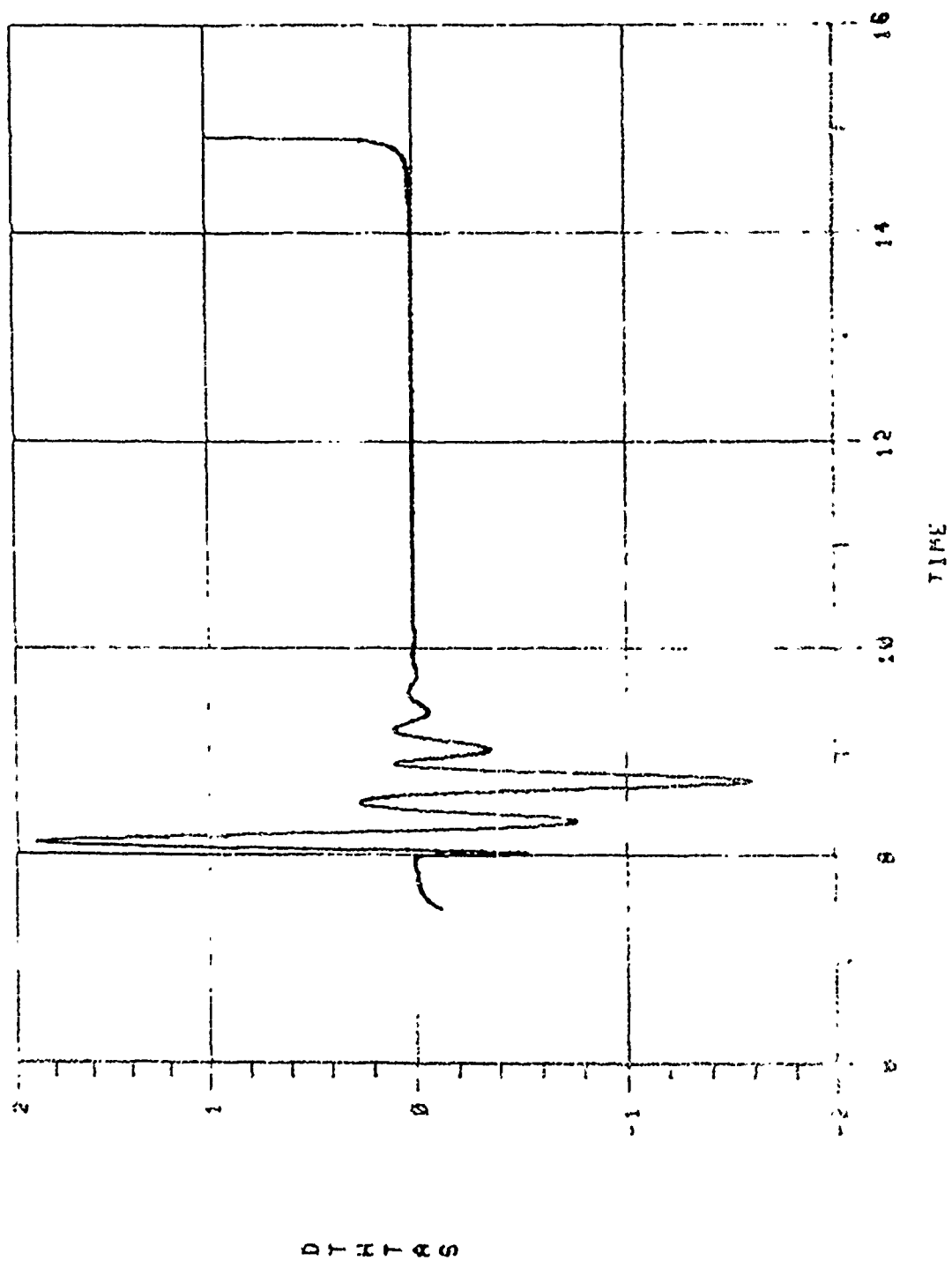


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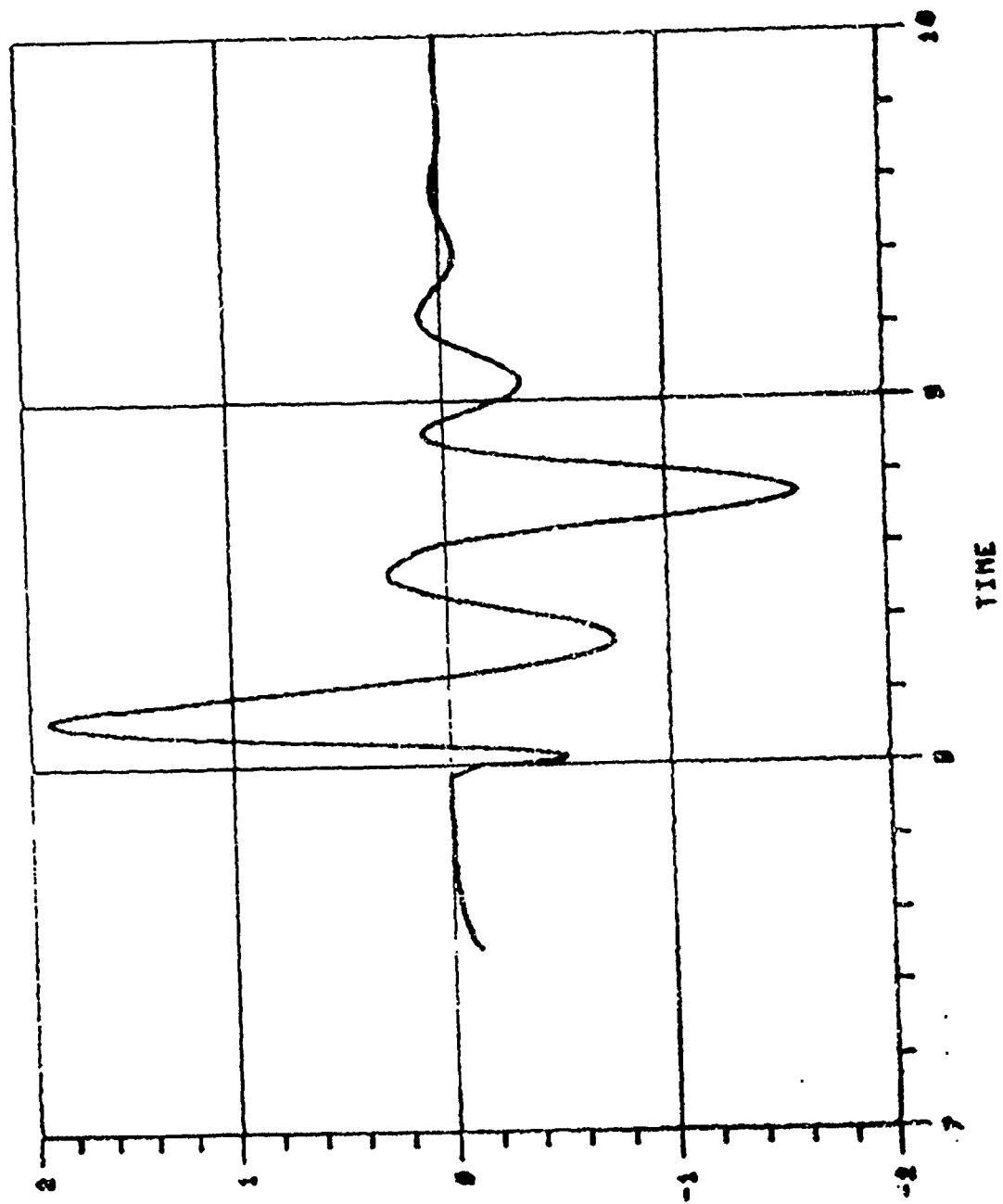


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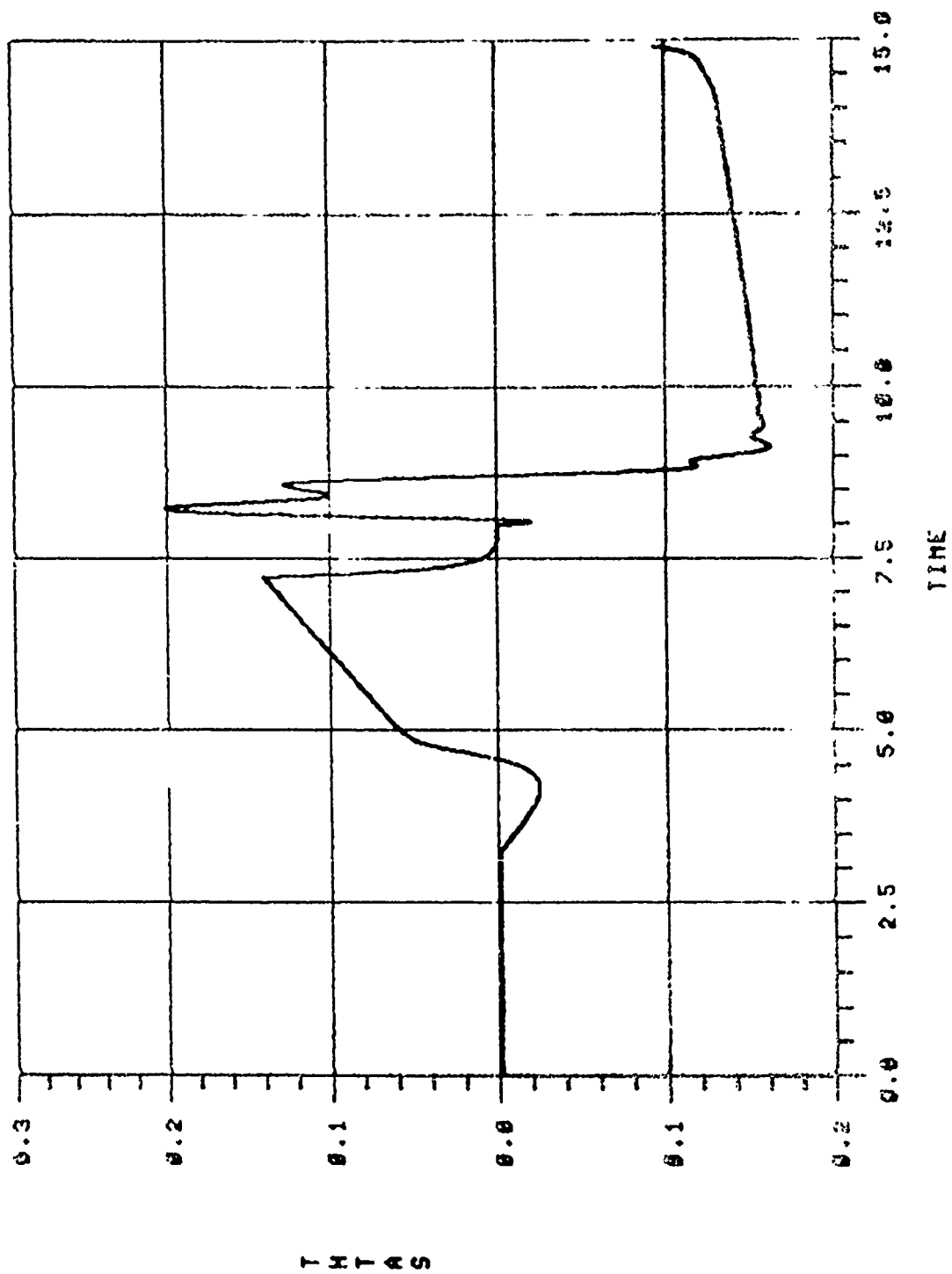


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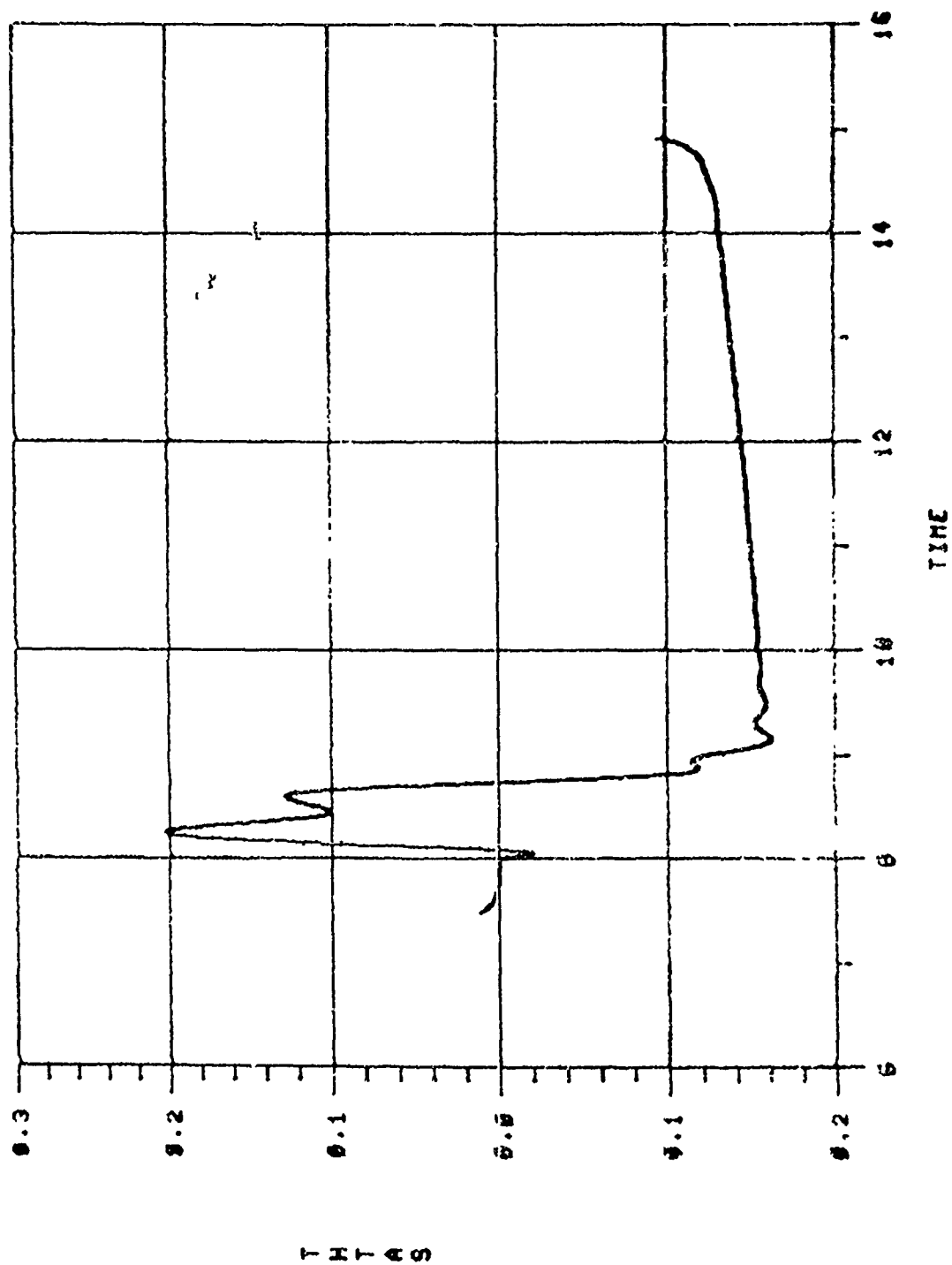


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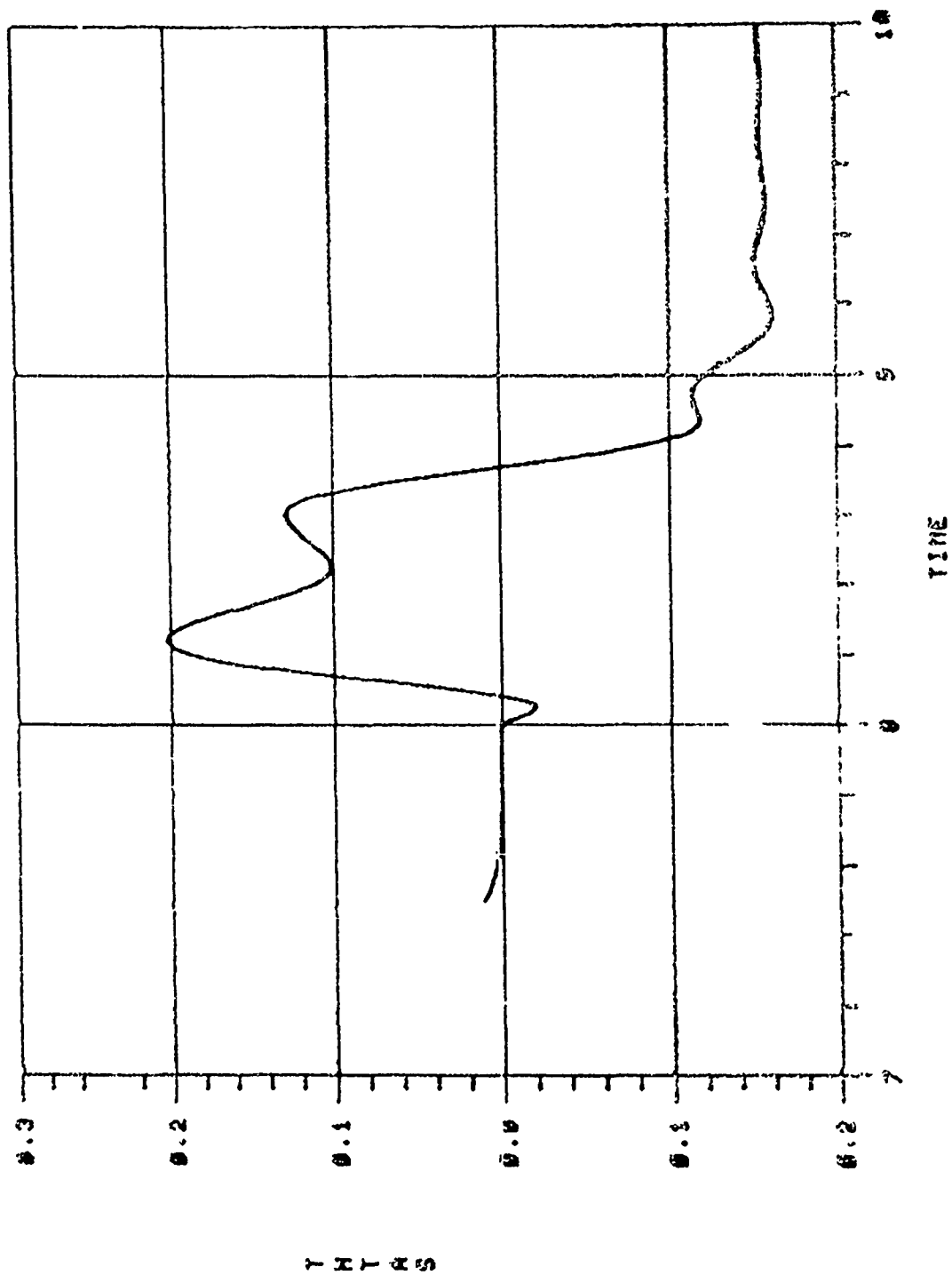


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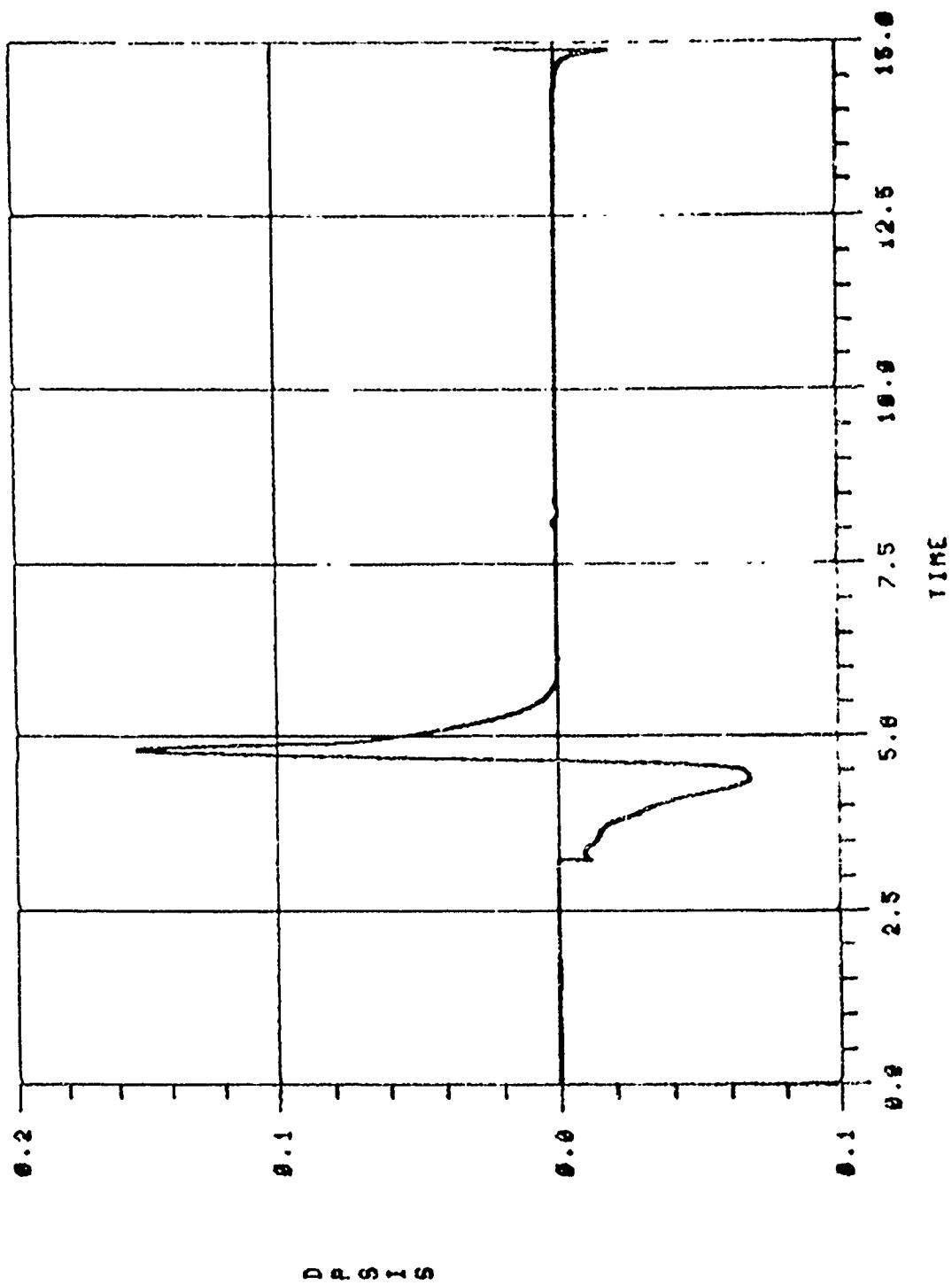


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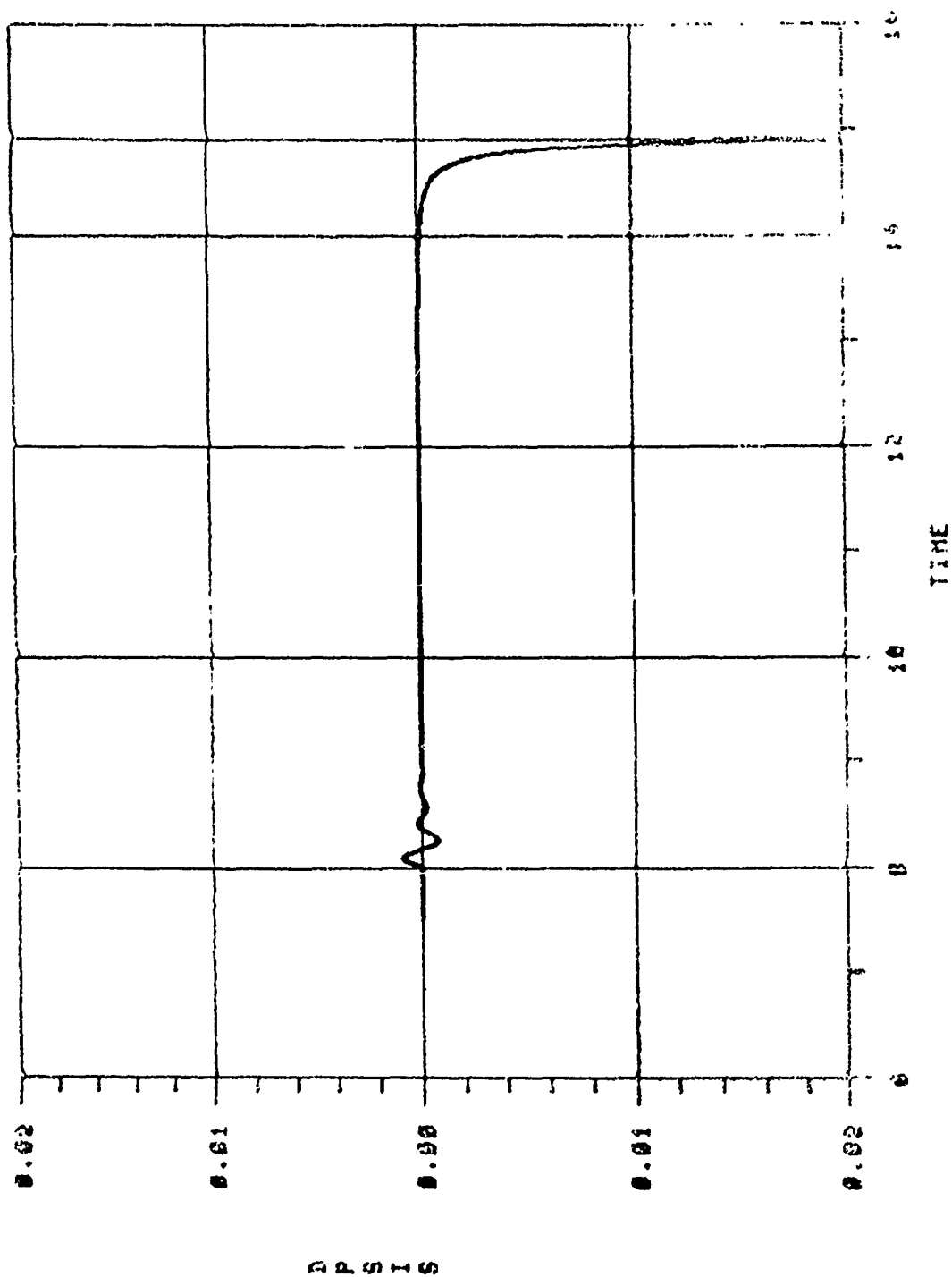


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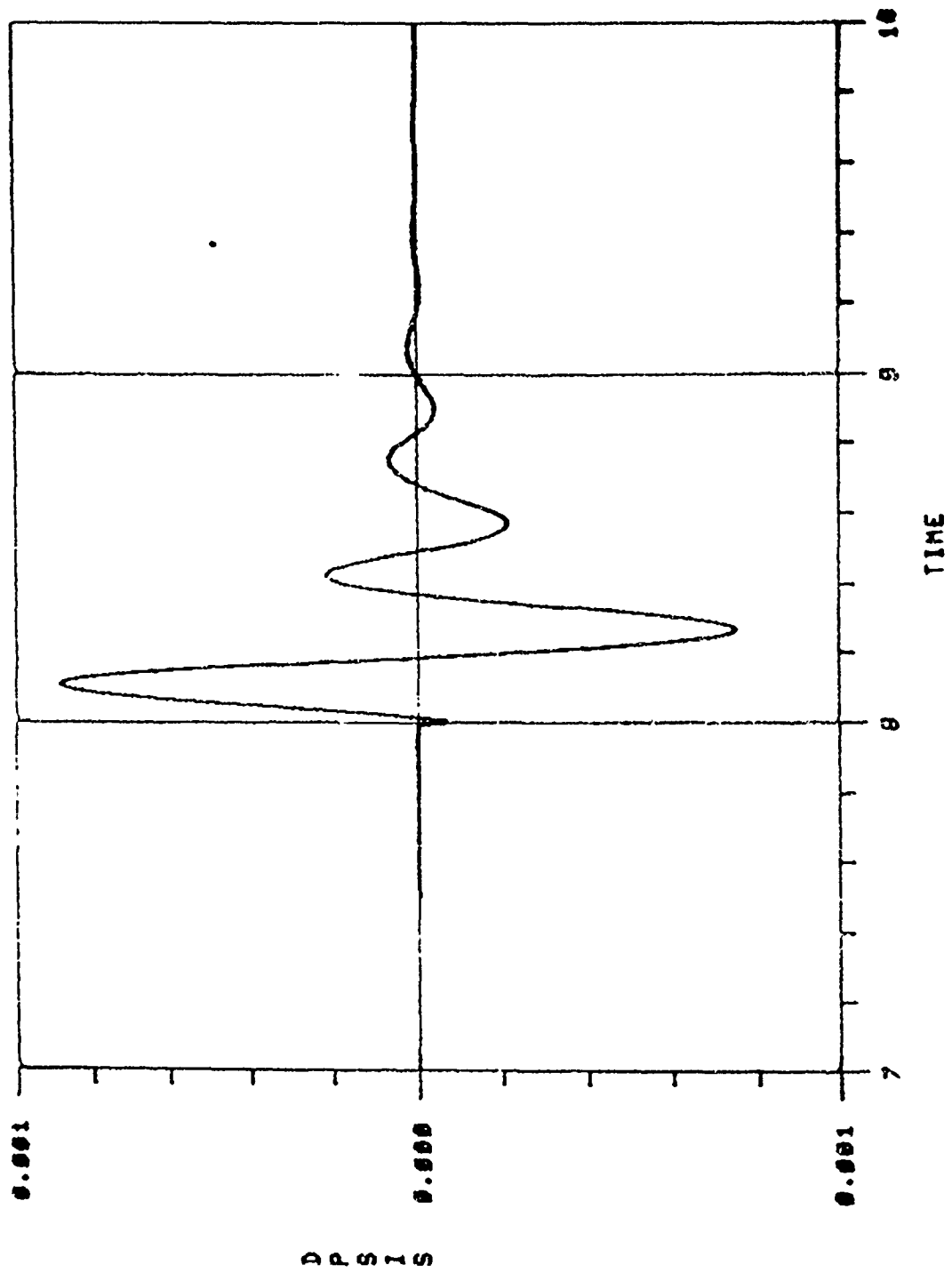


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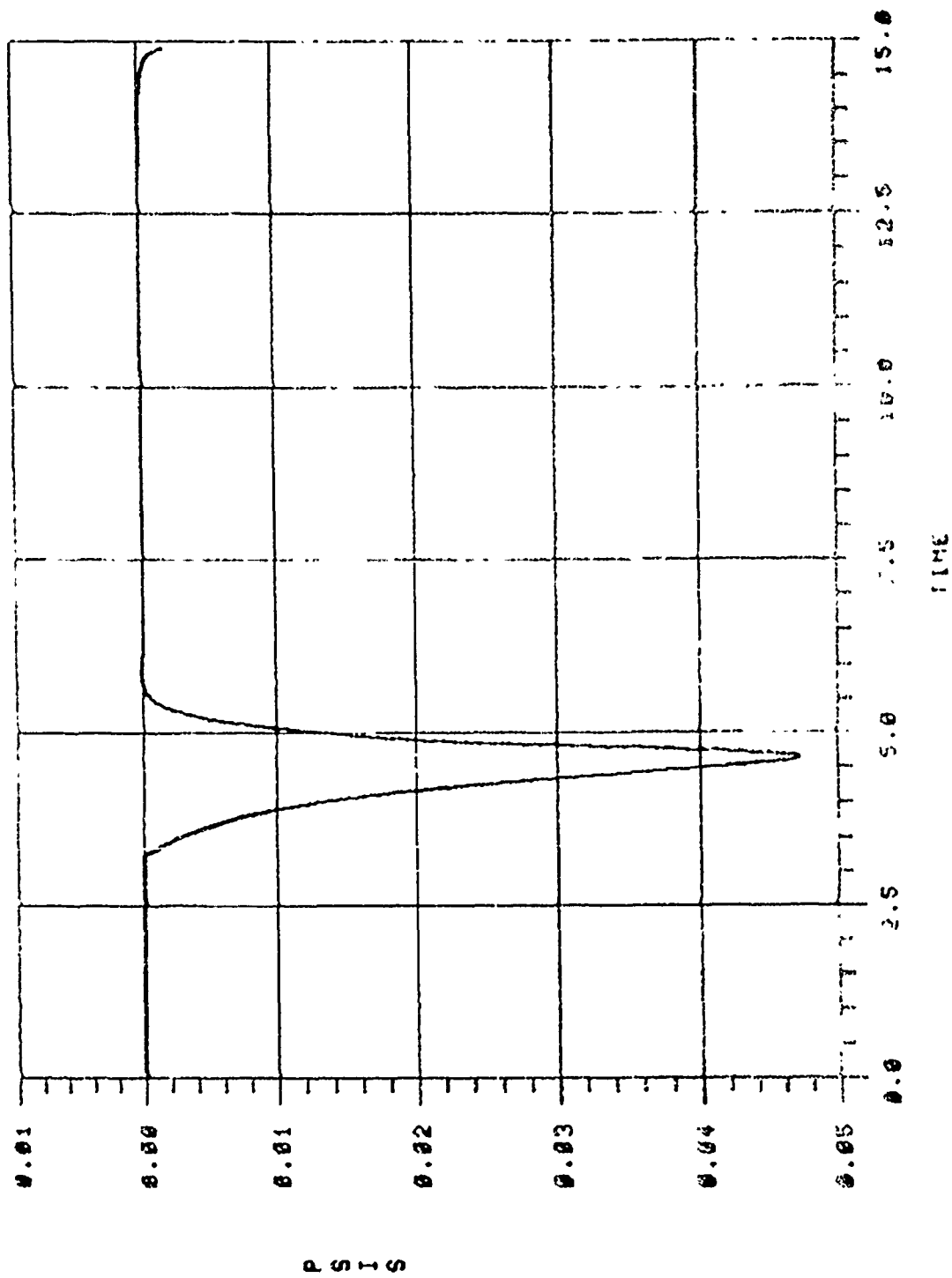


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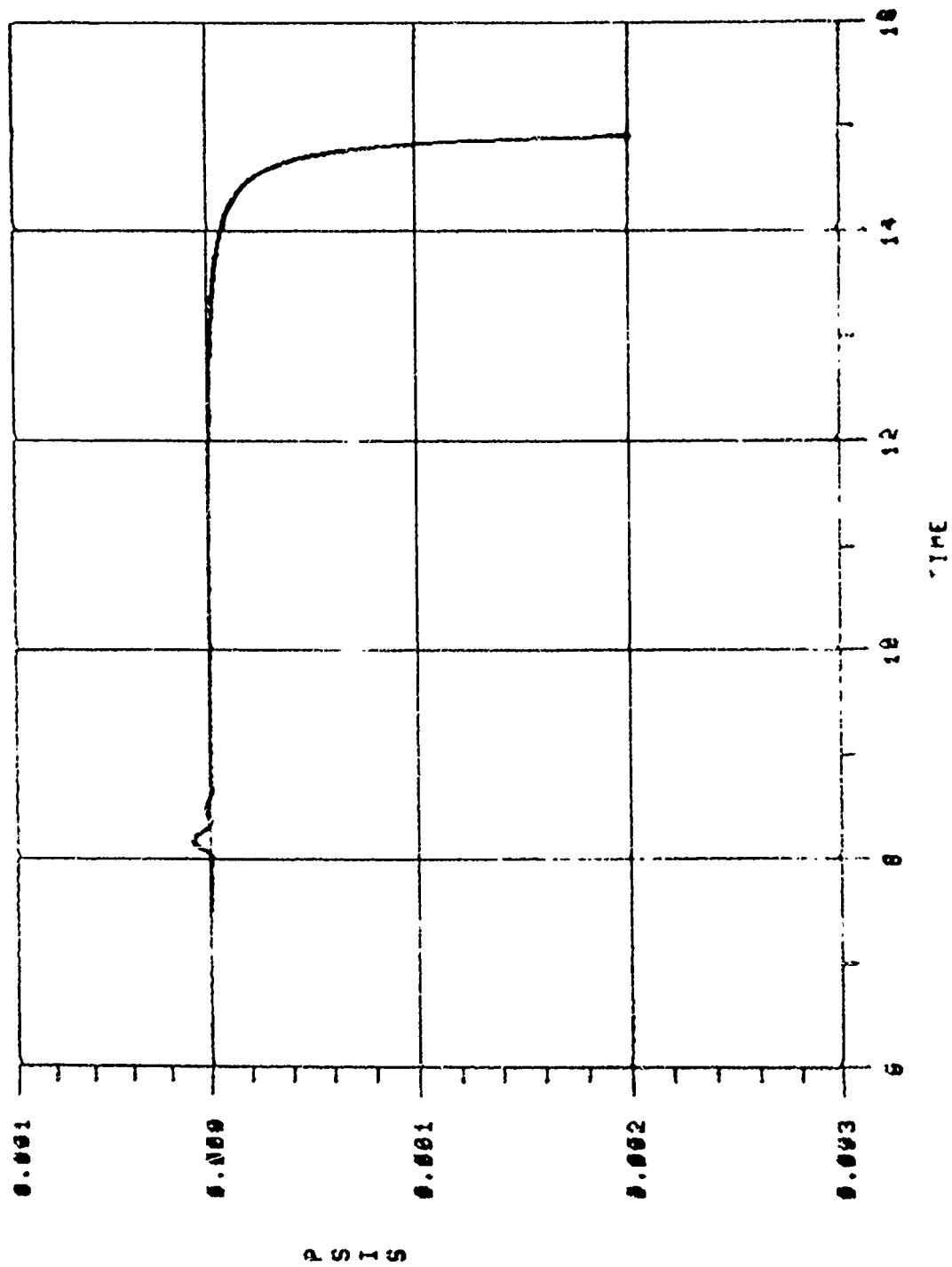


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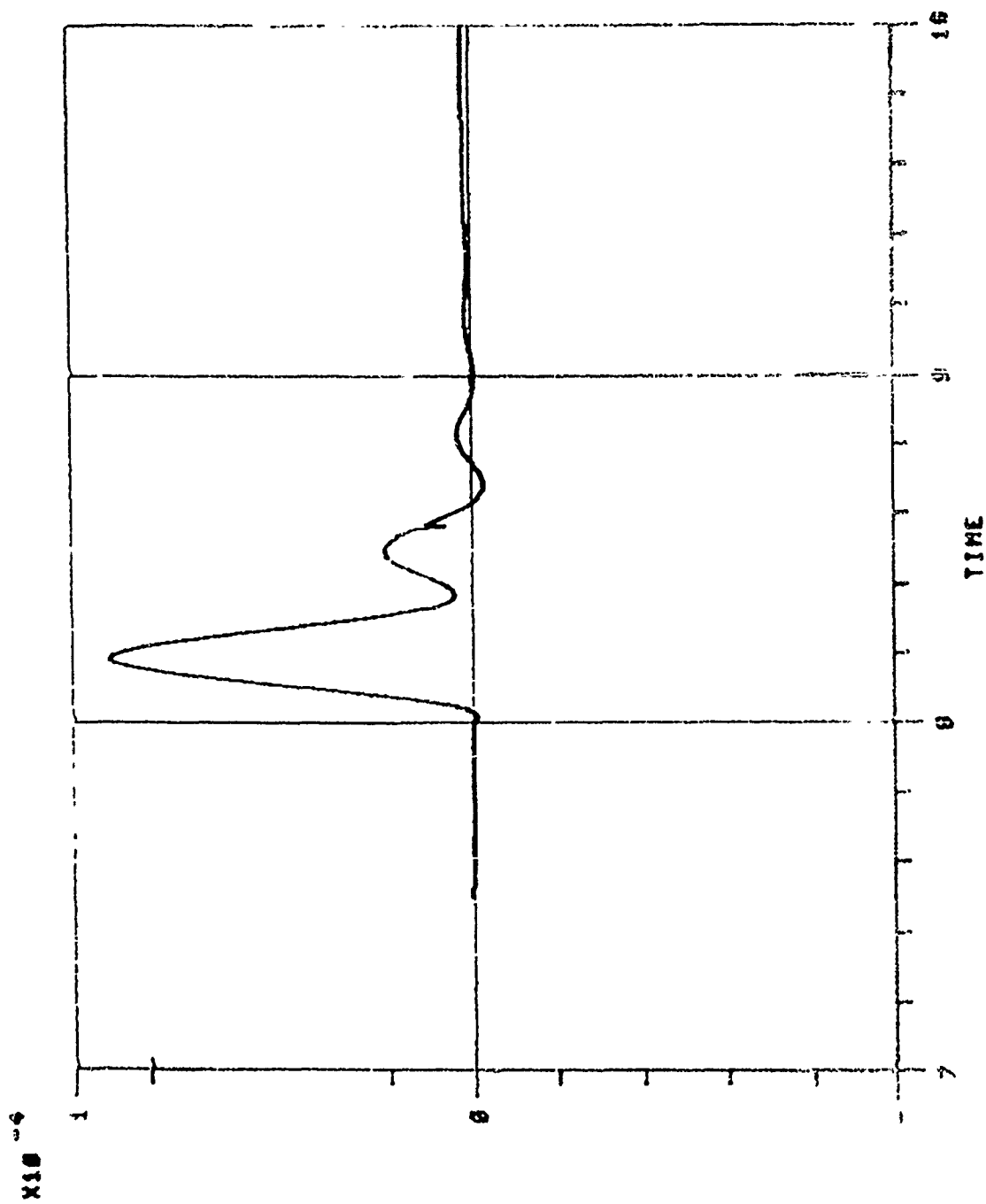


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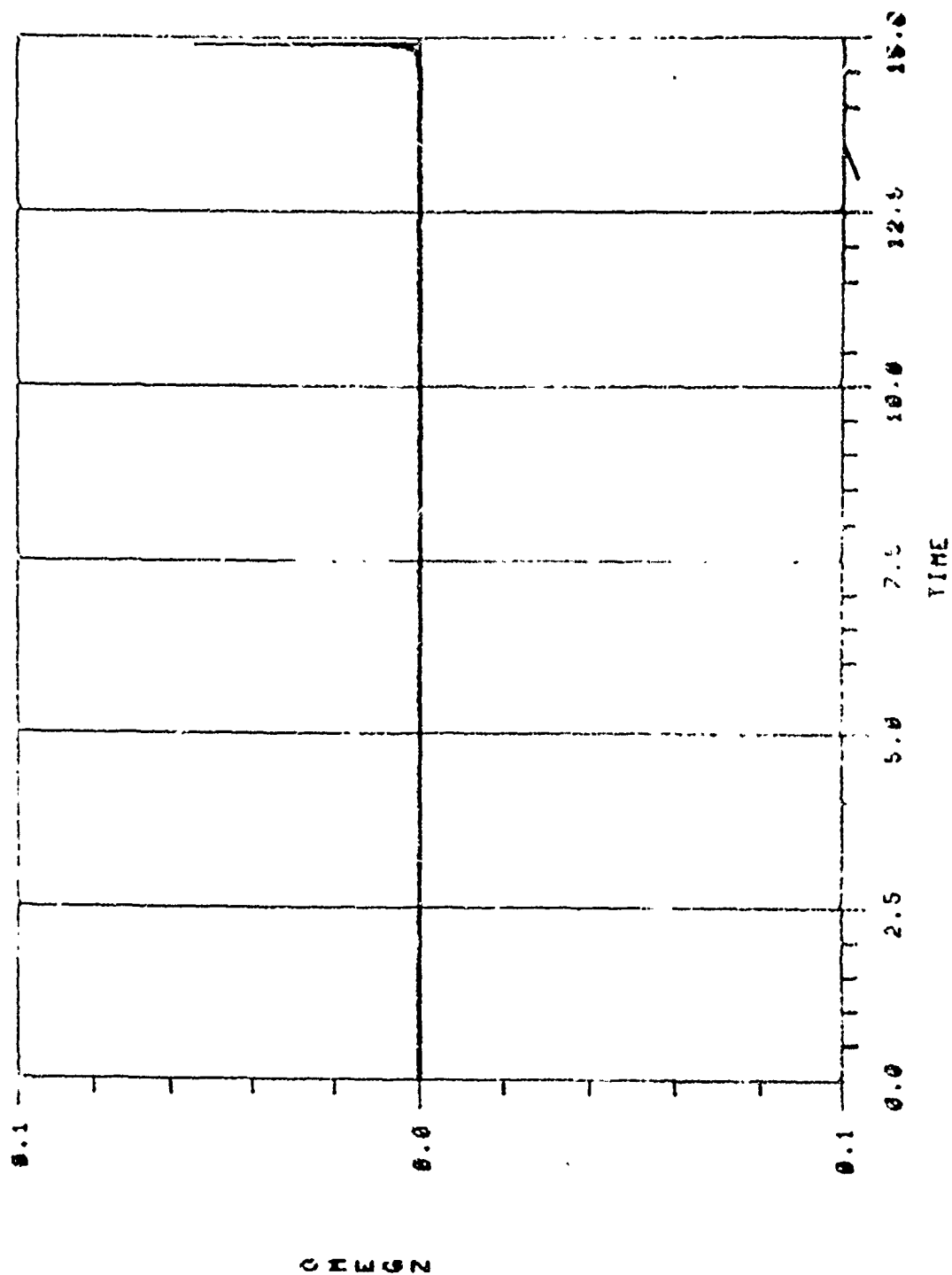


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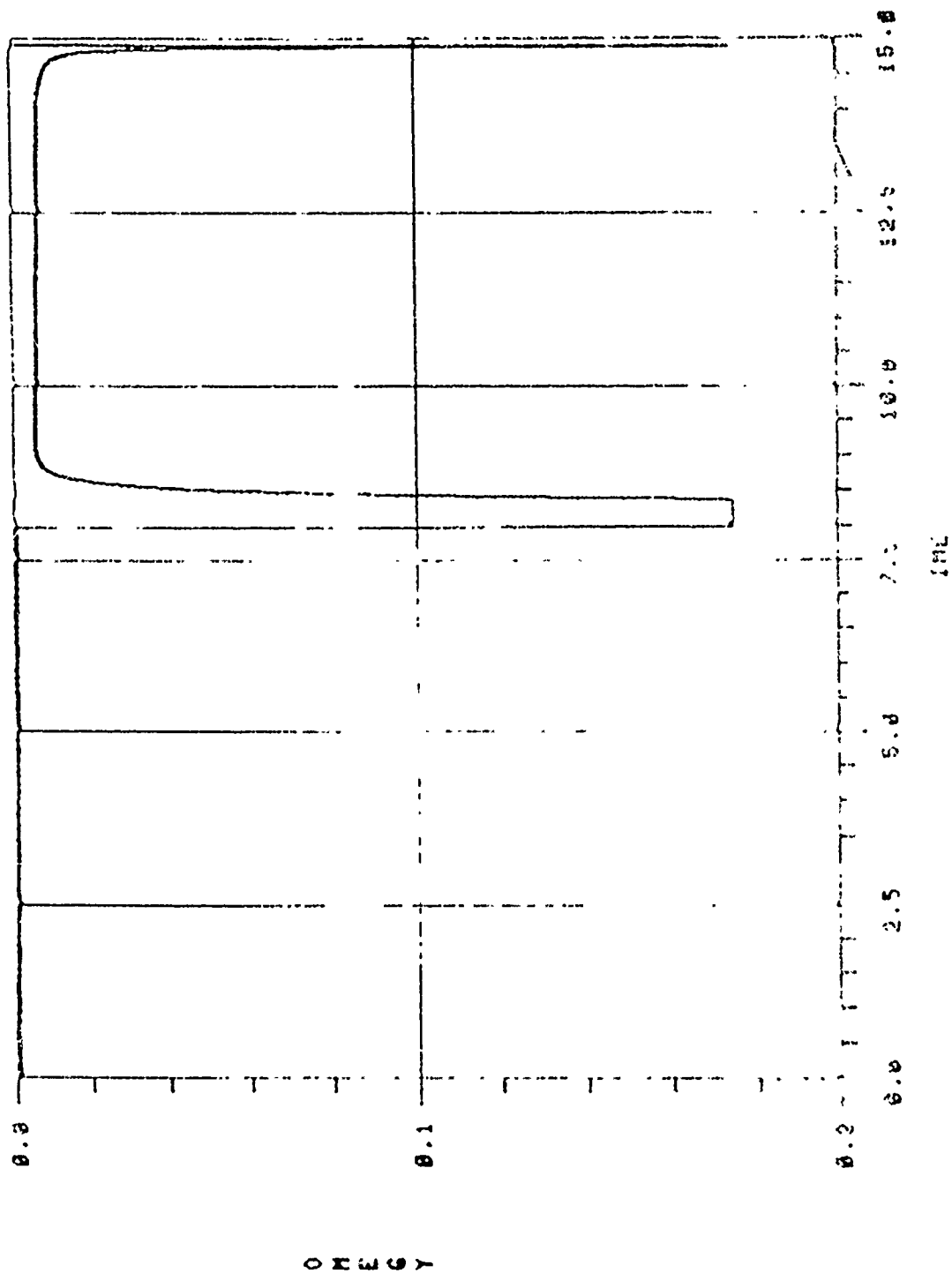


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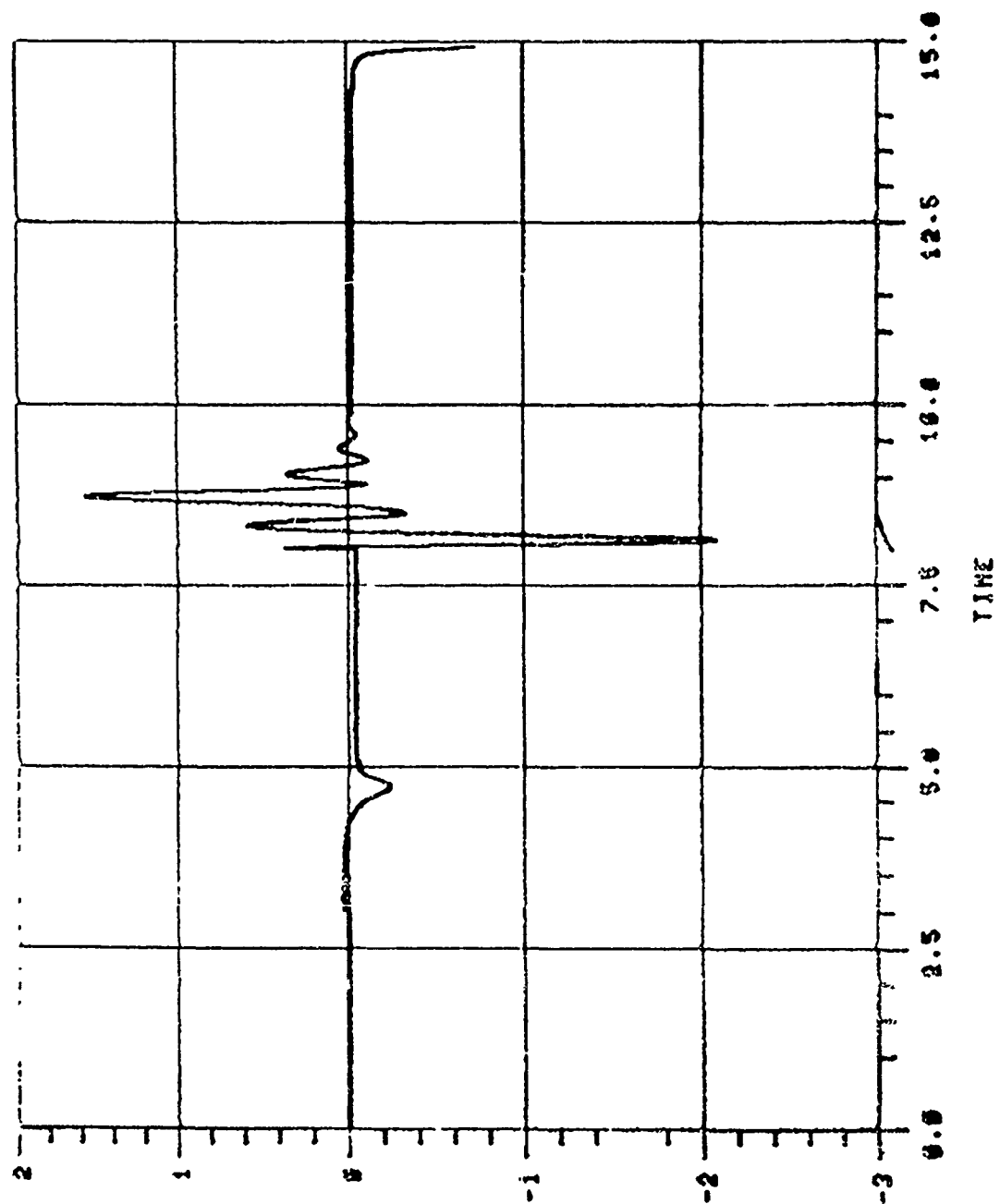


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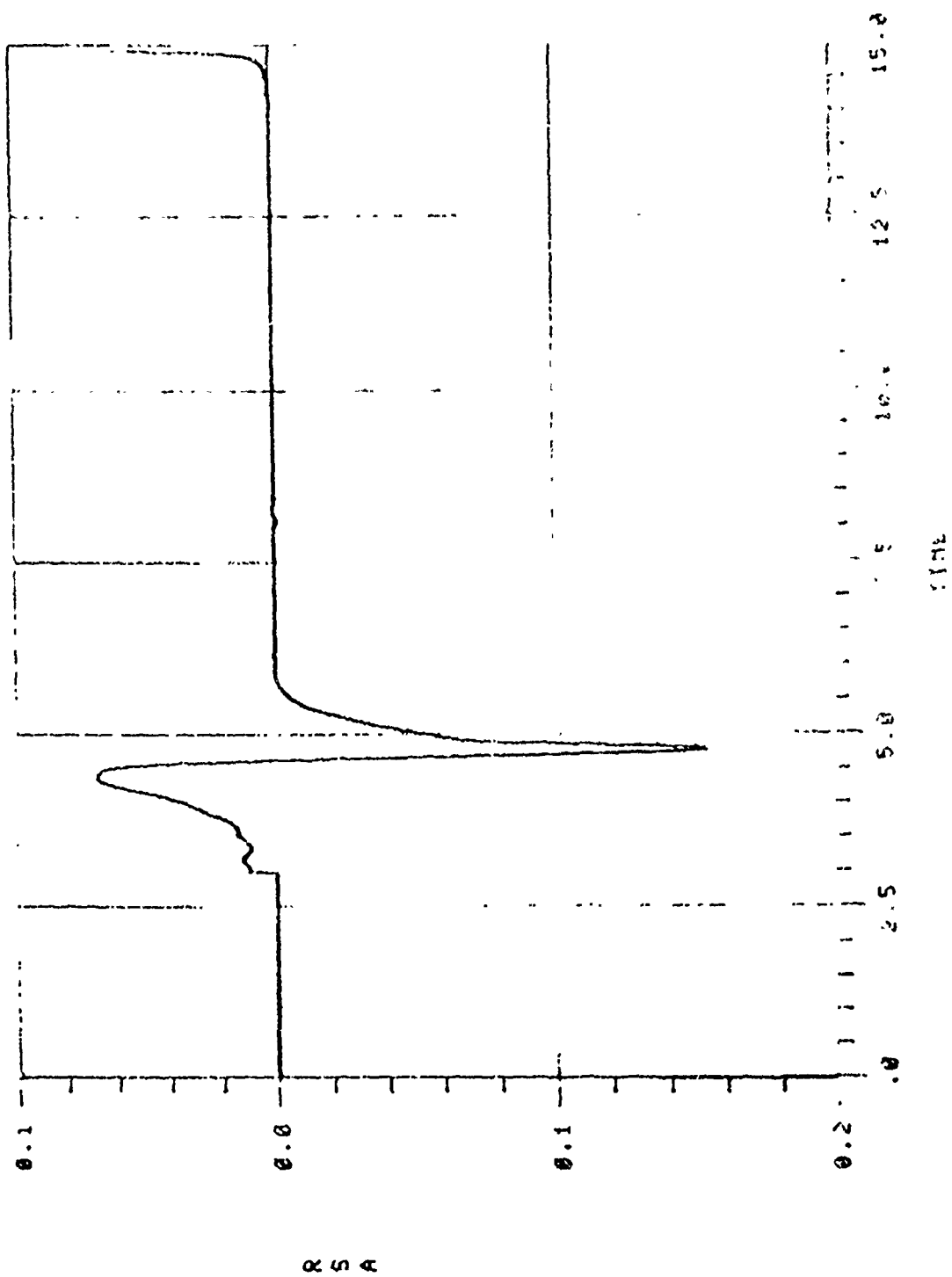


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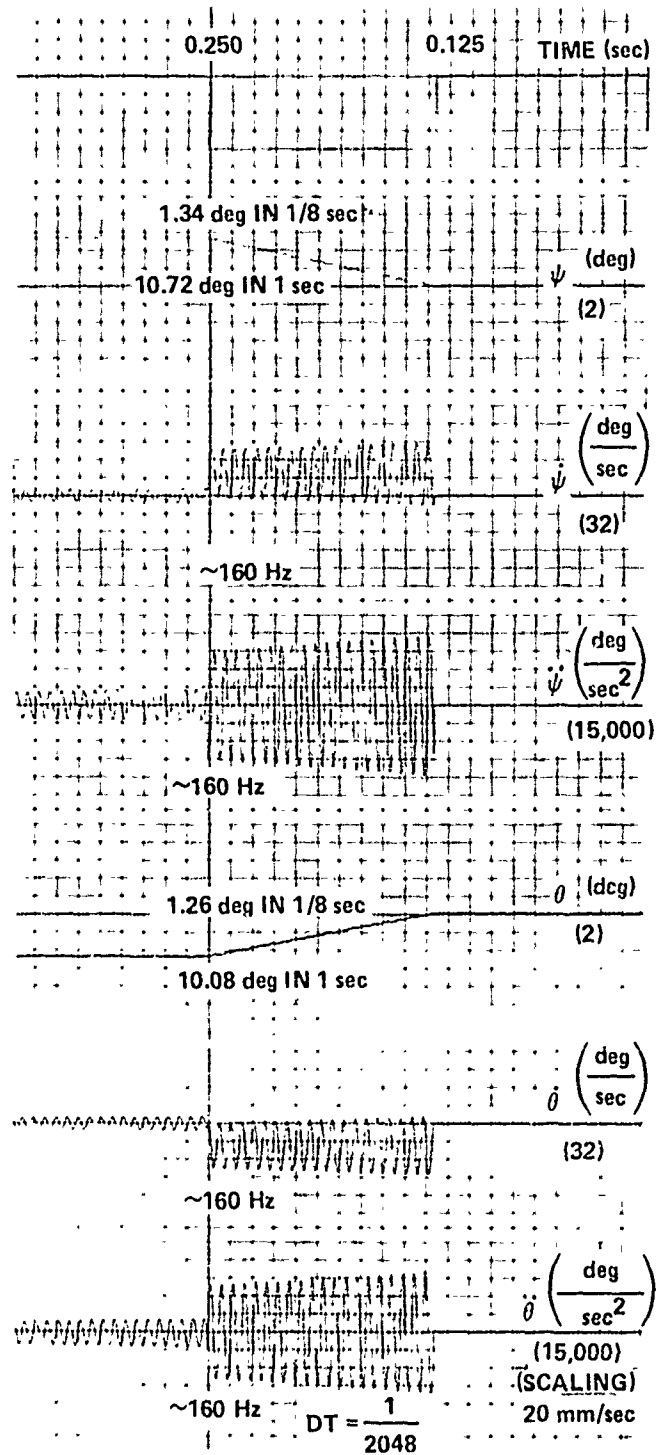


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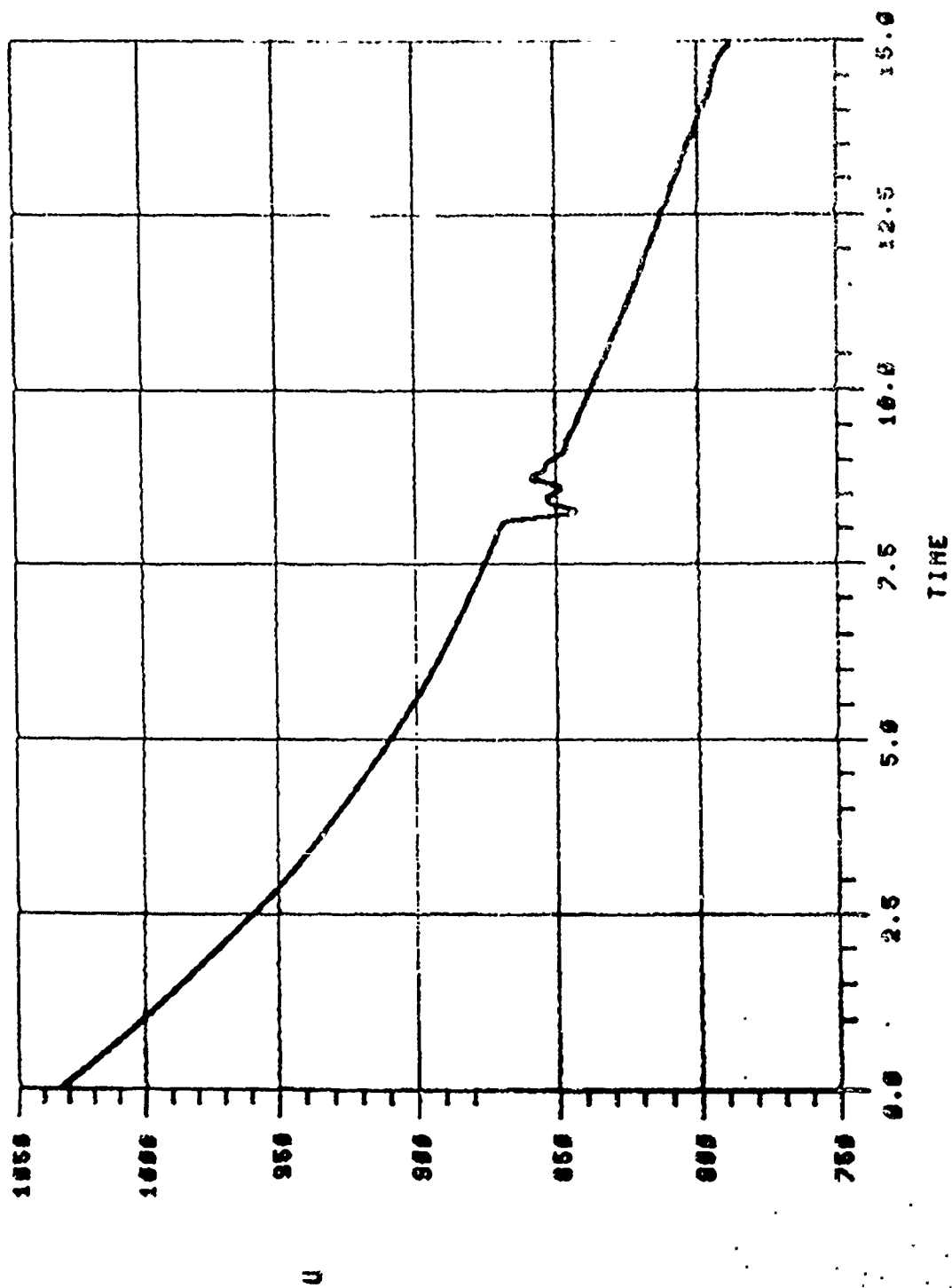


Figure 57.

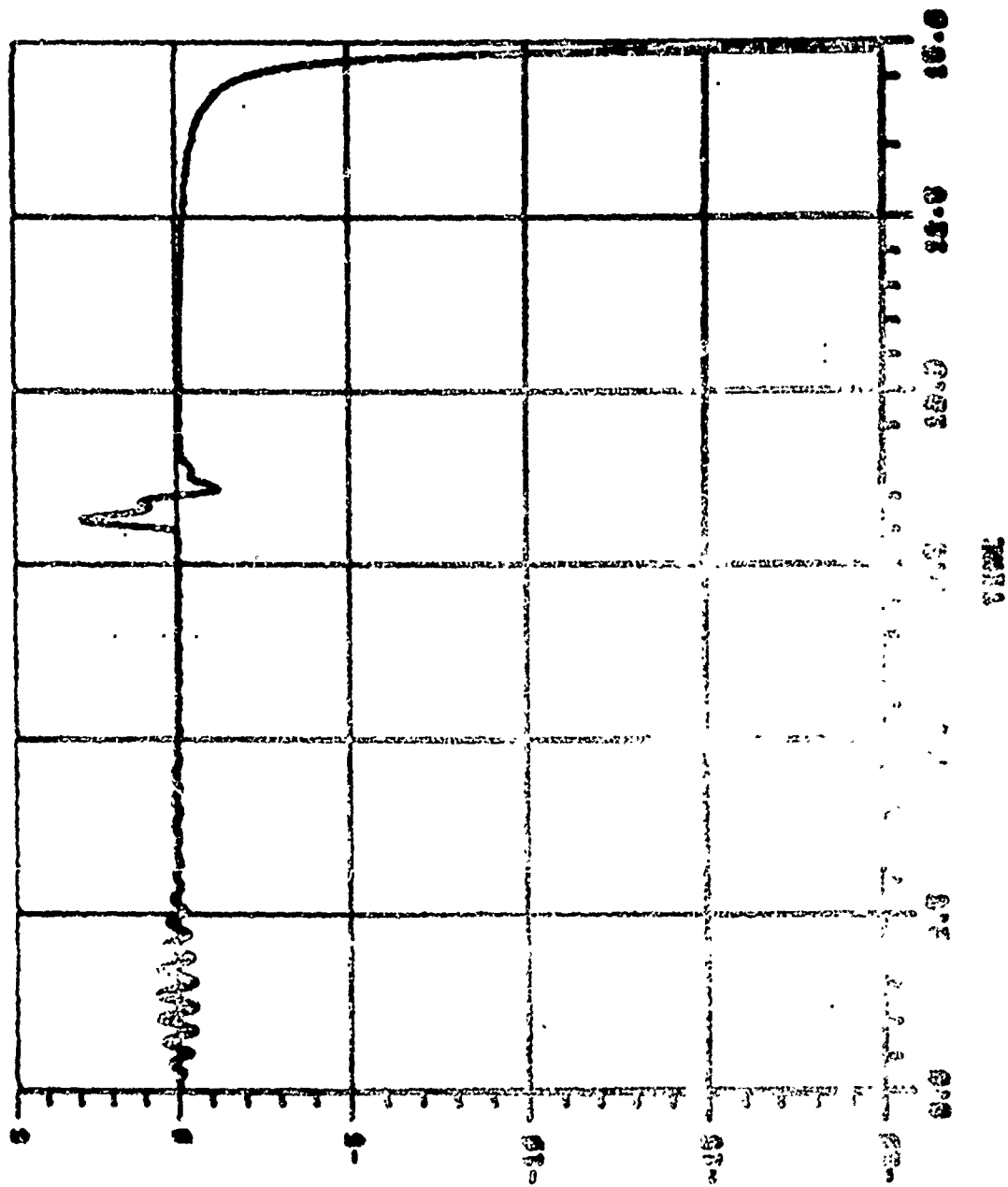
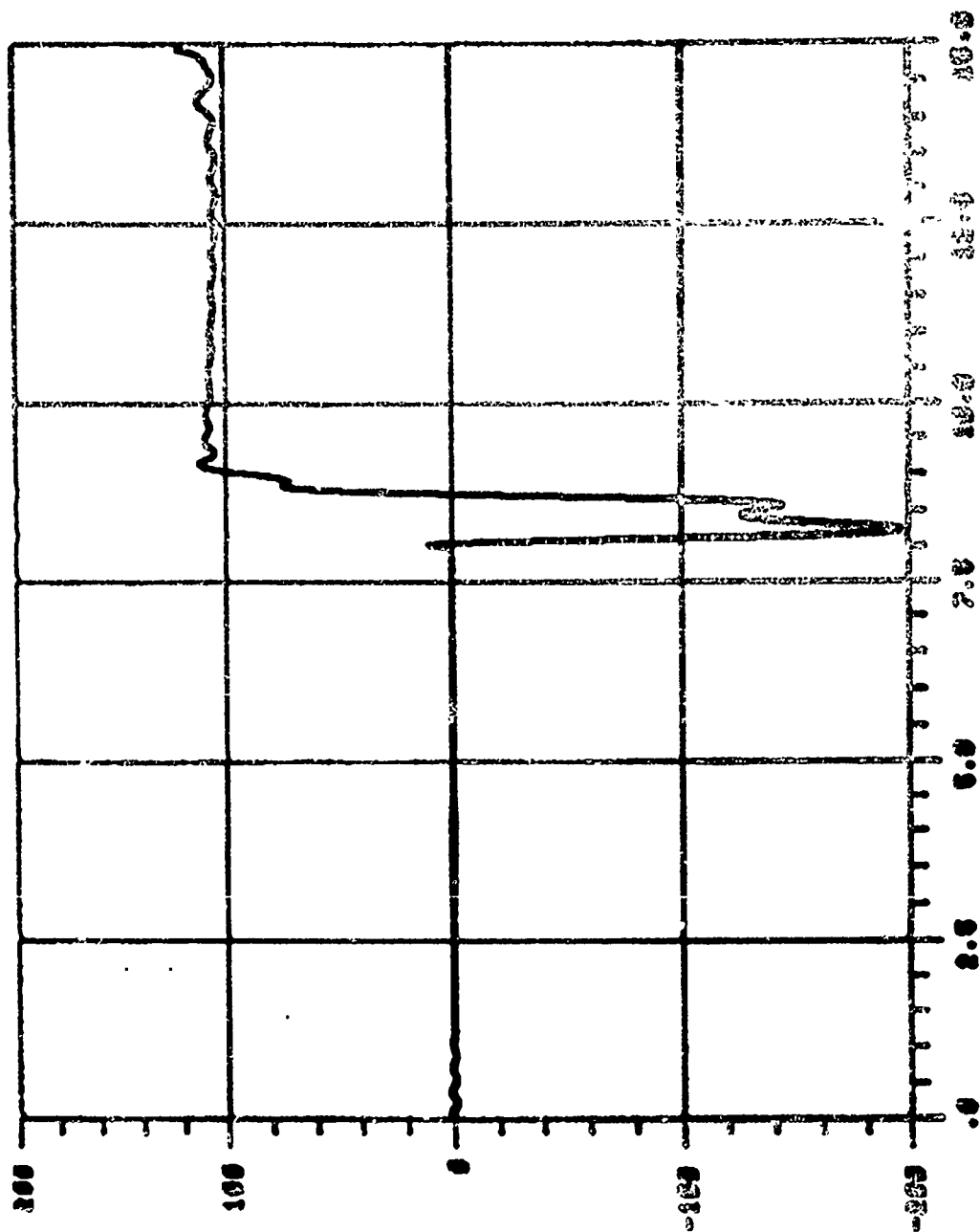


Figure 58.



Time

Figure 59.

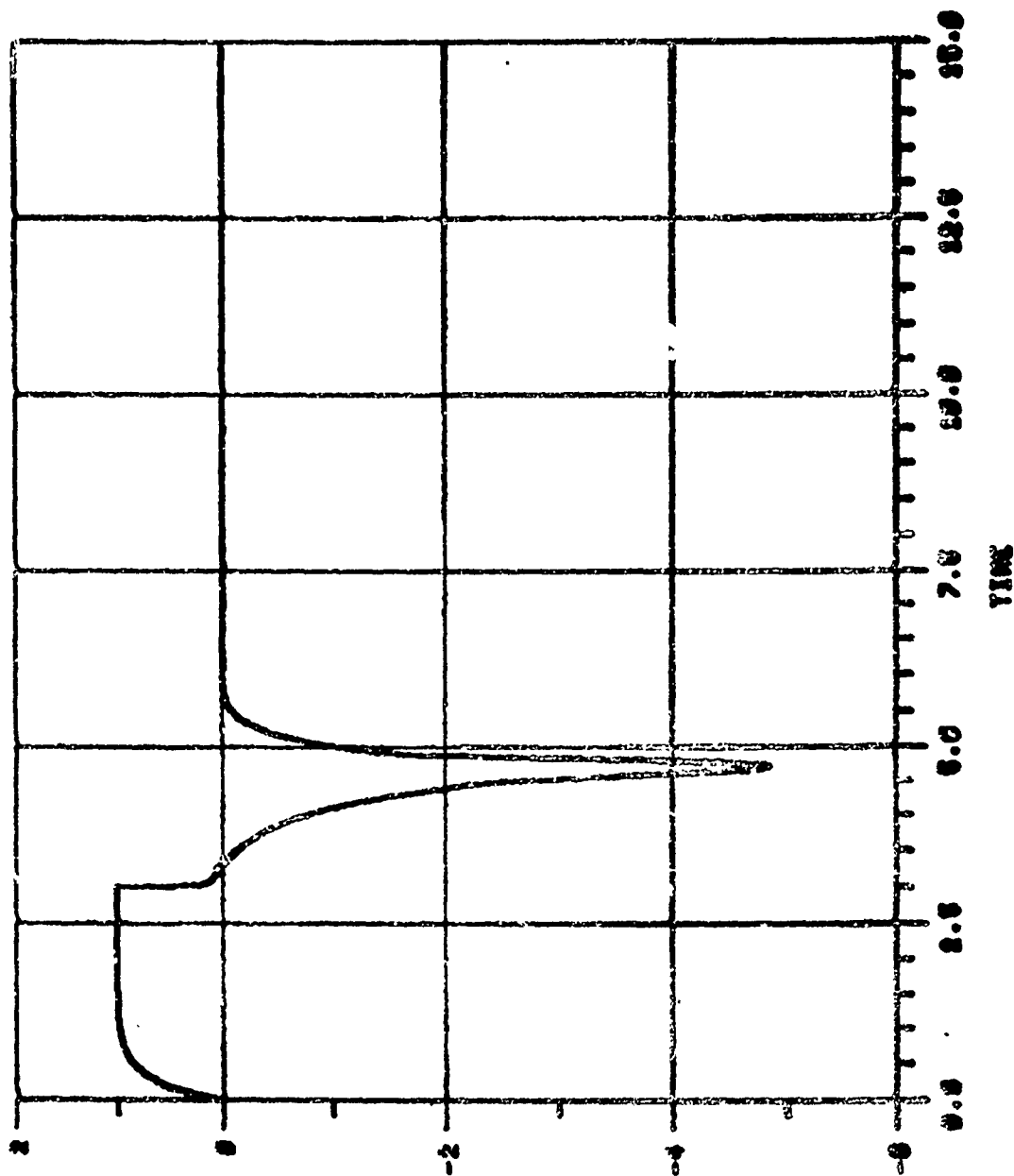


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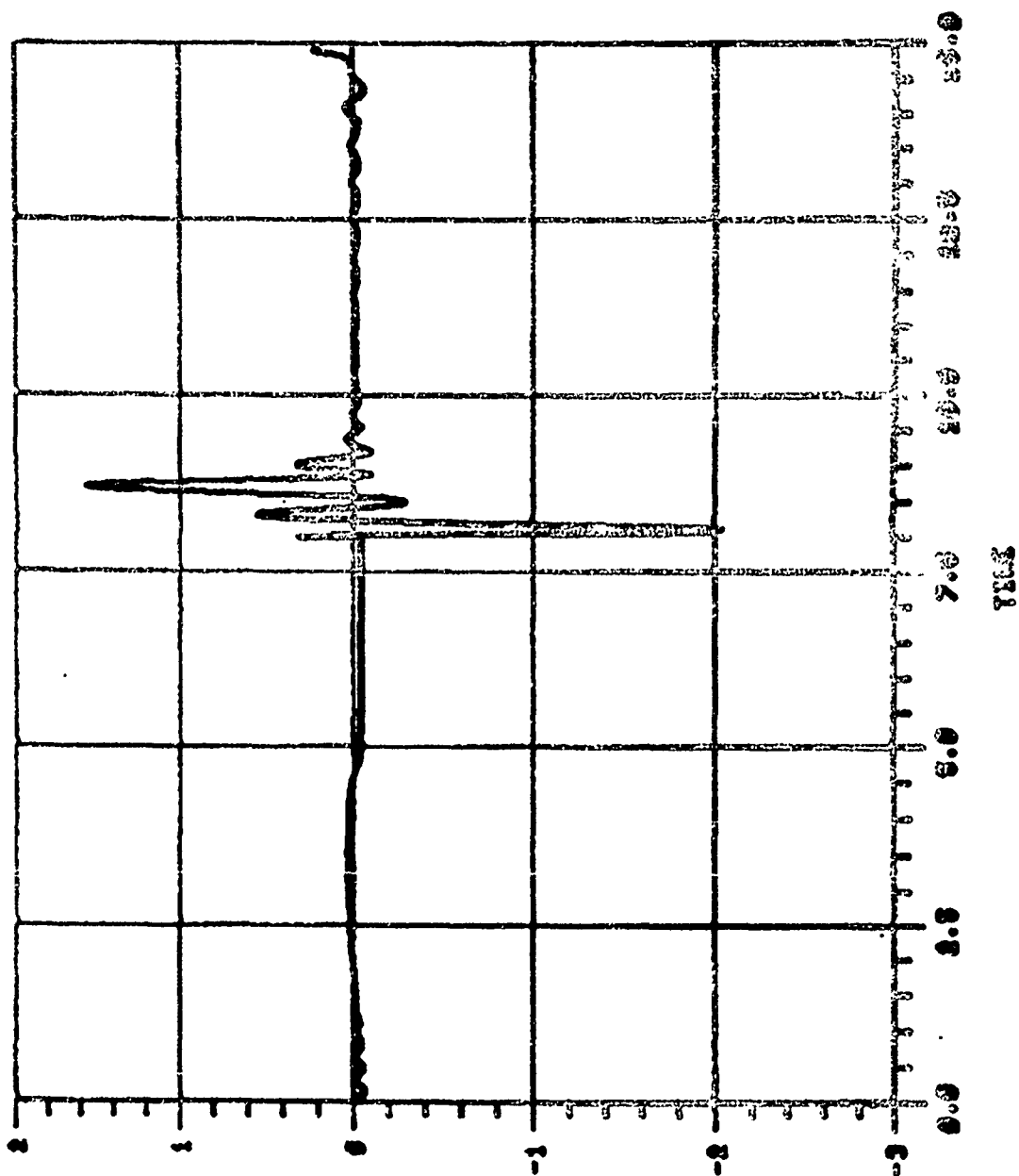


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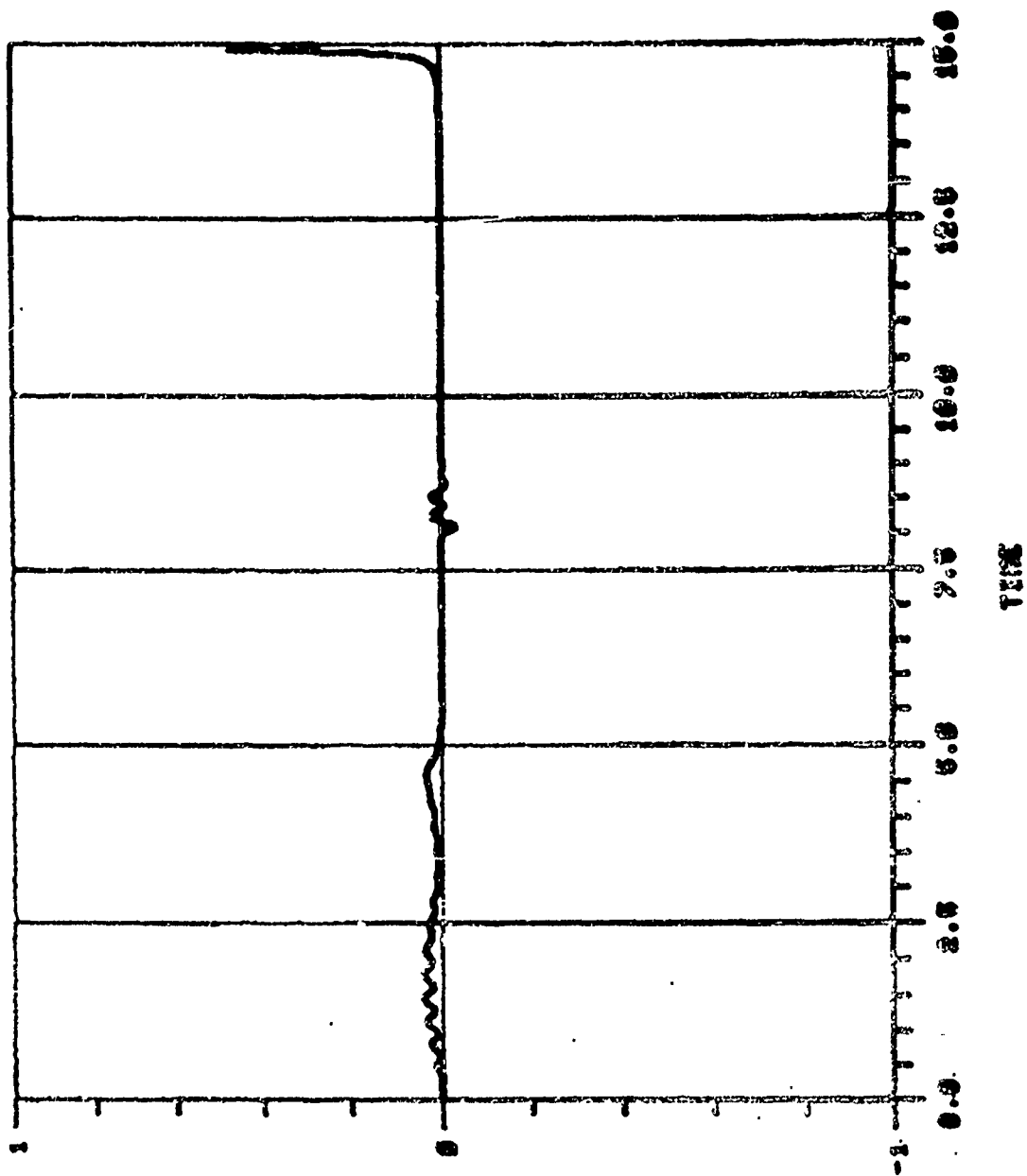


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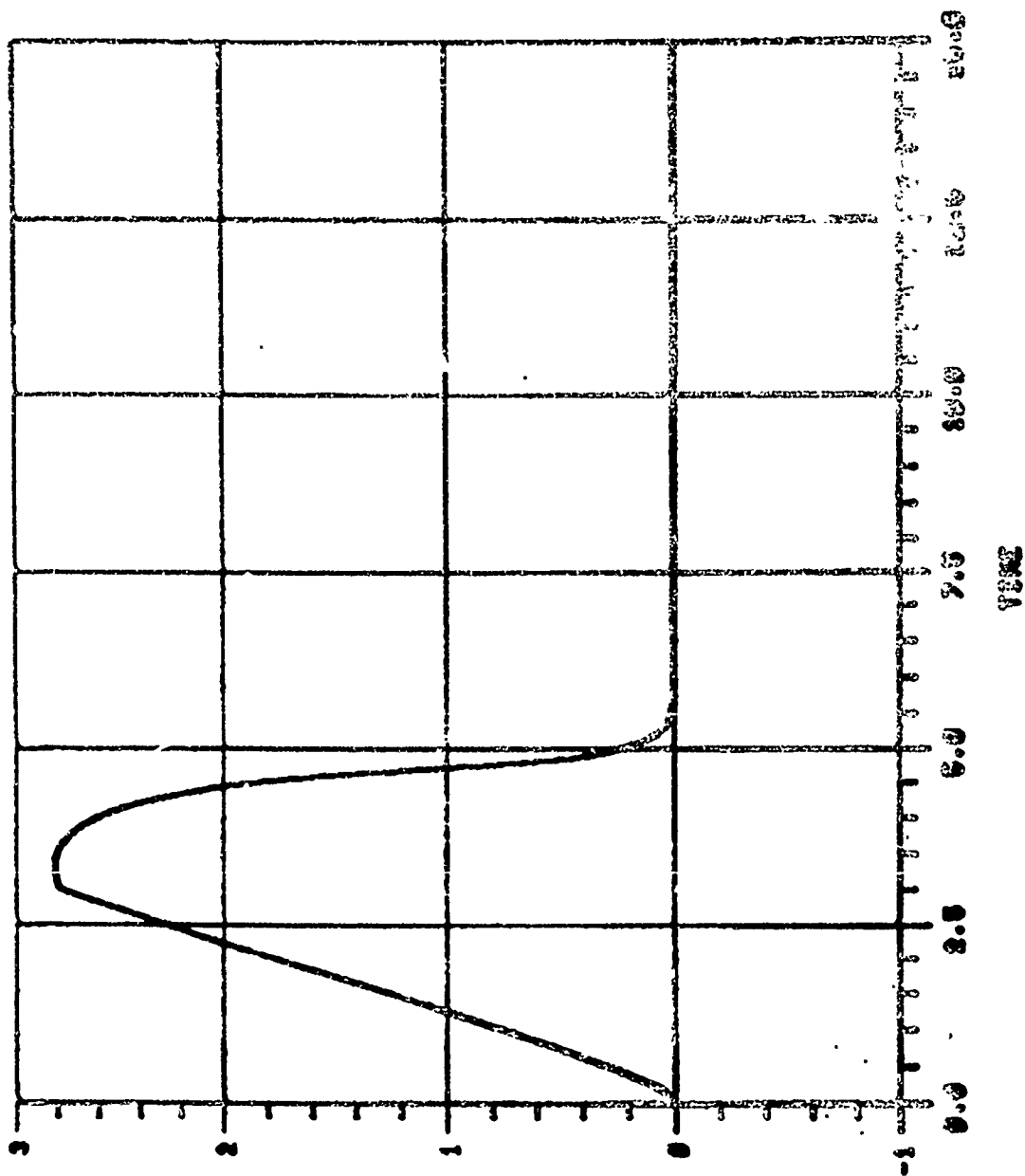


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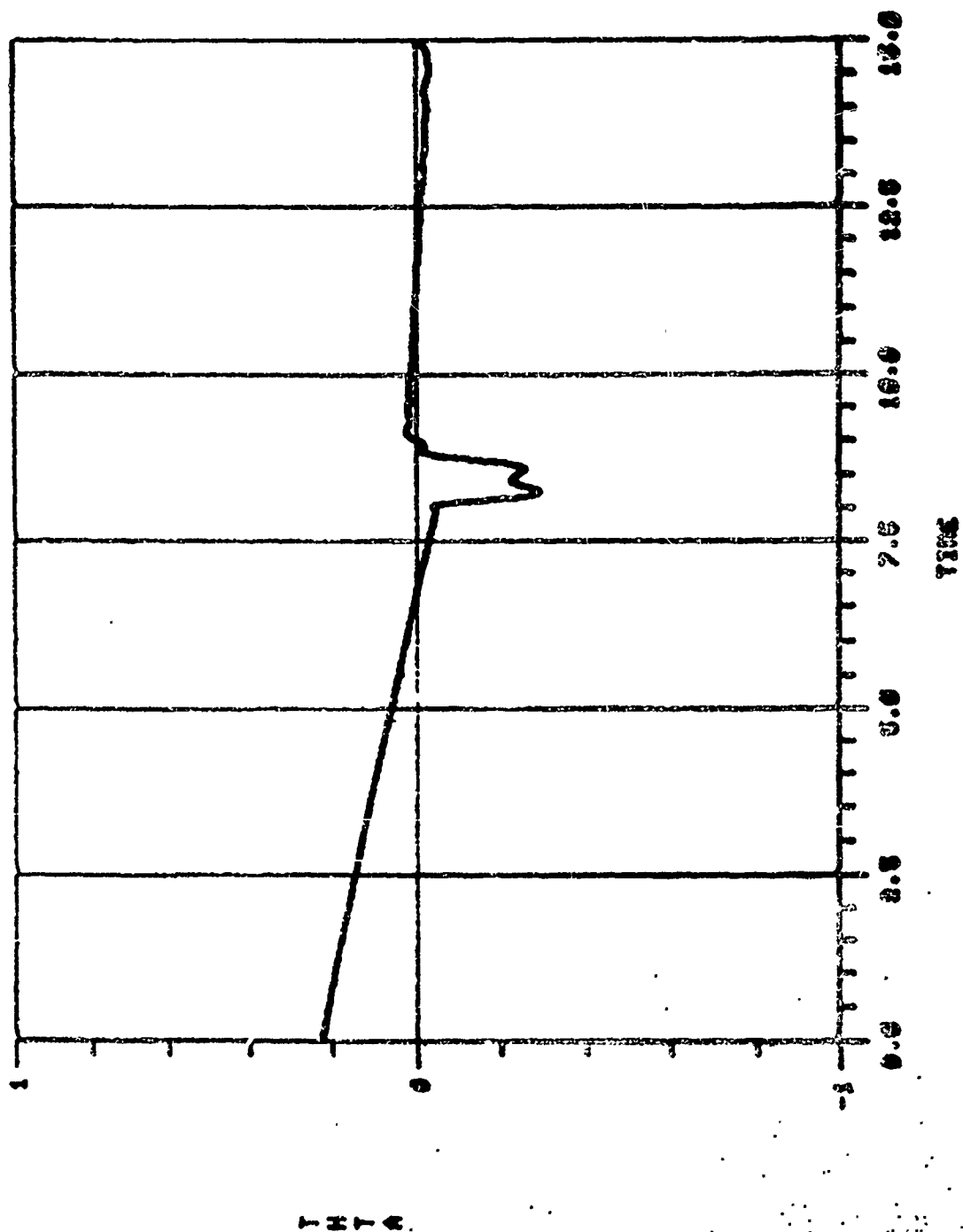
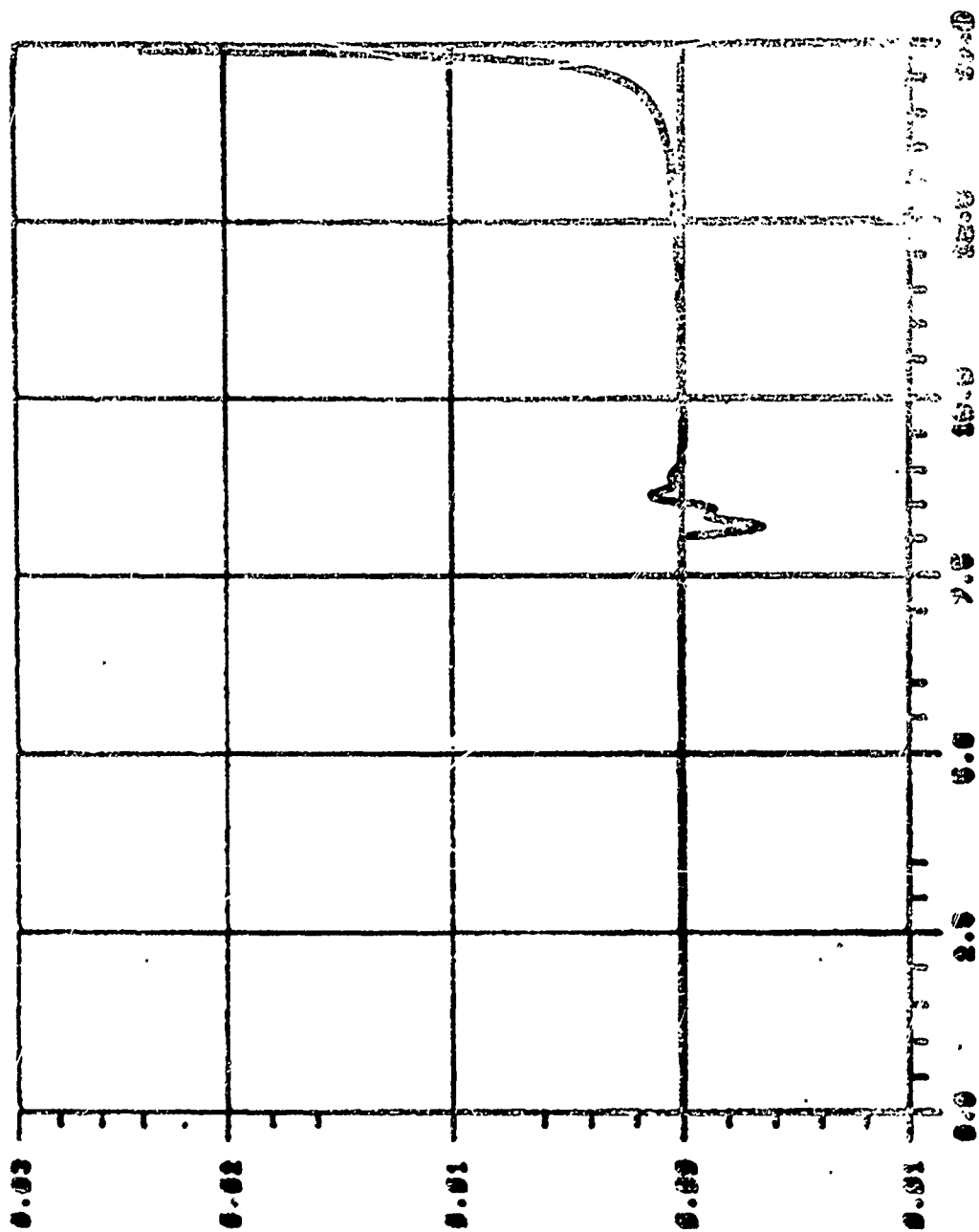


Figure 64.



7324

Figure 65.

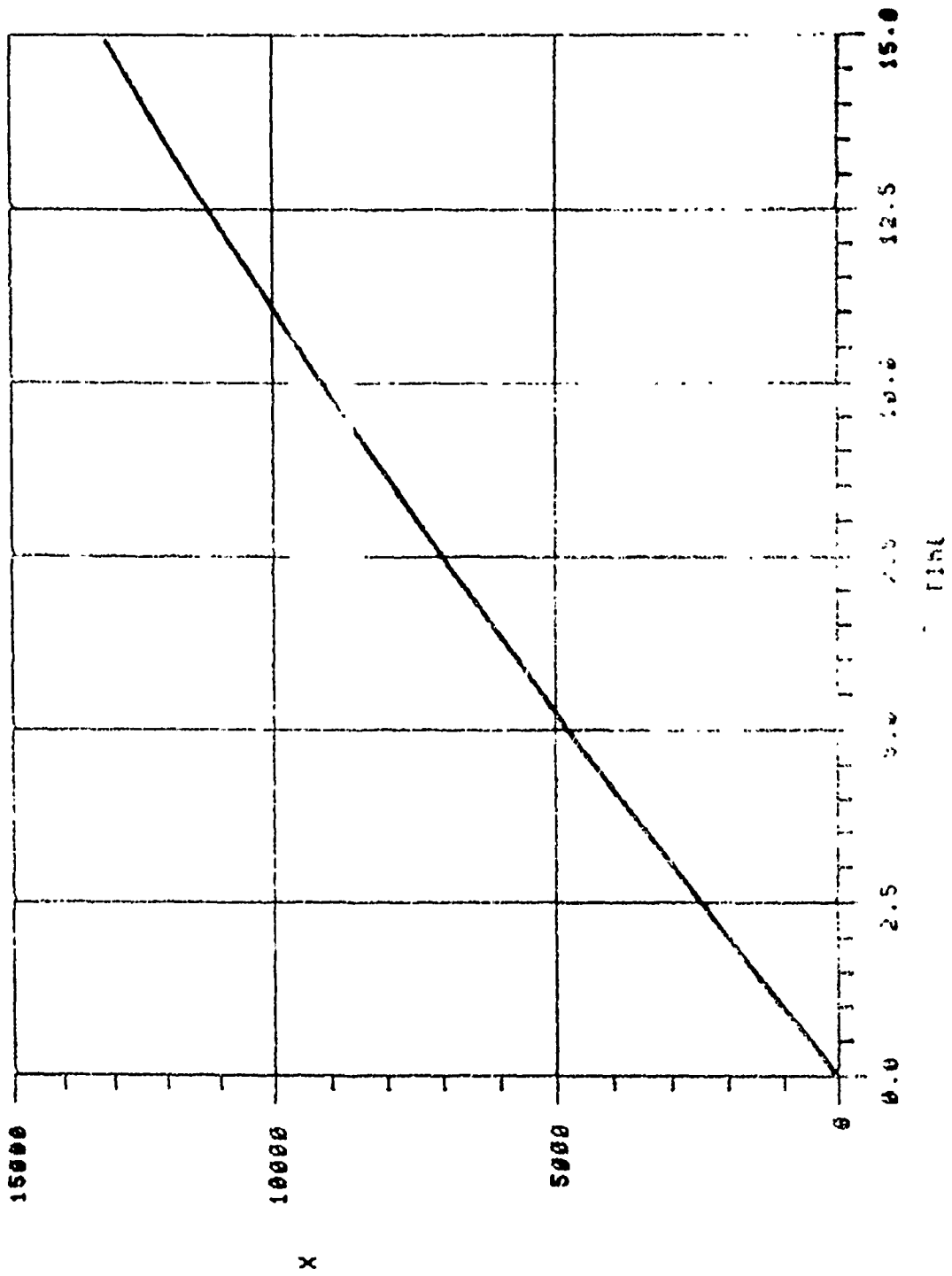


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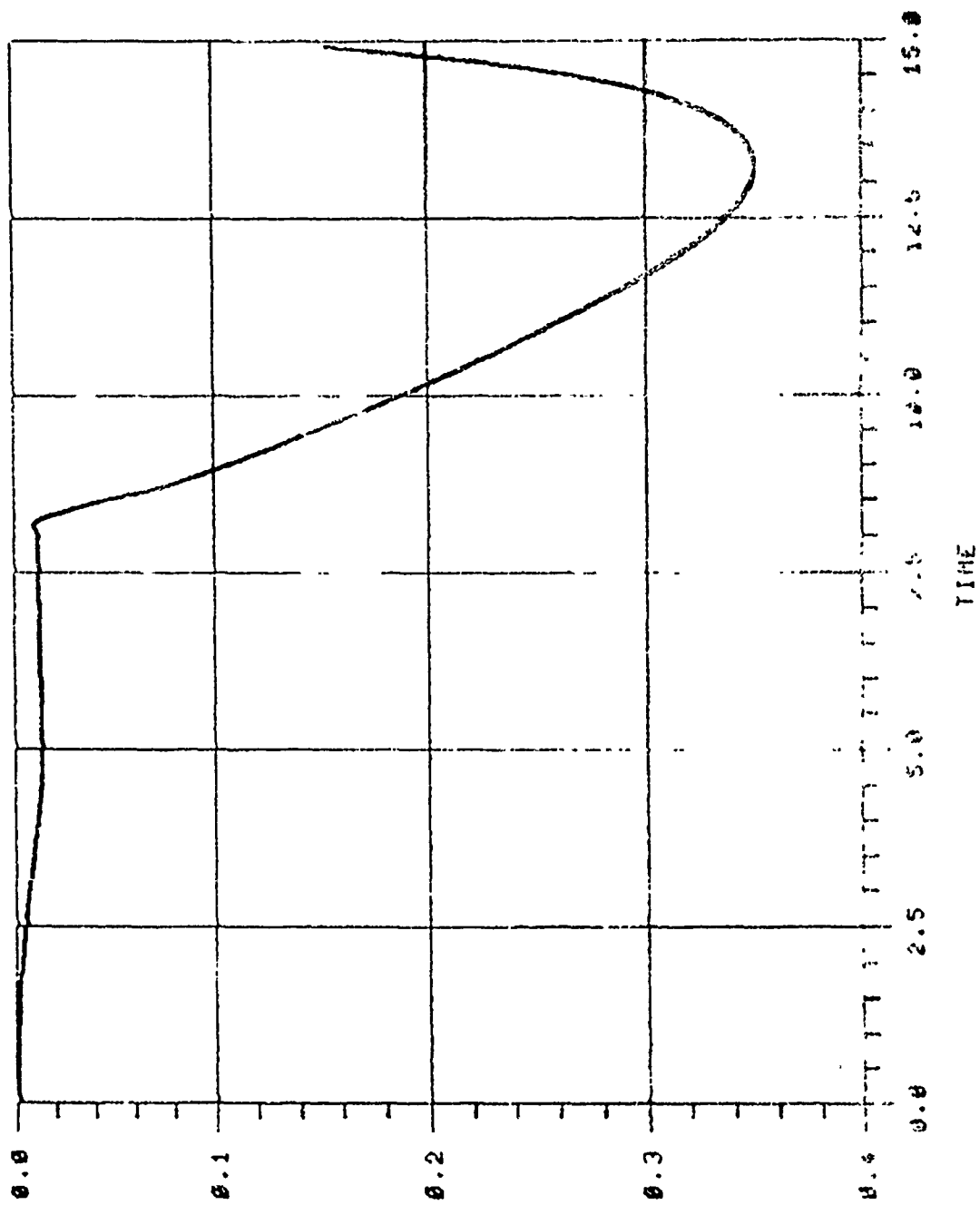


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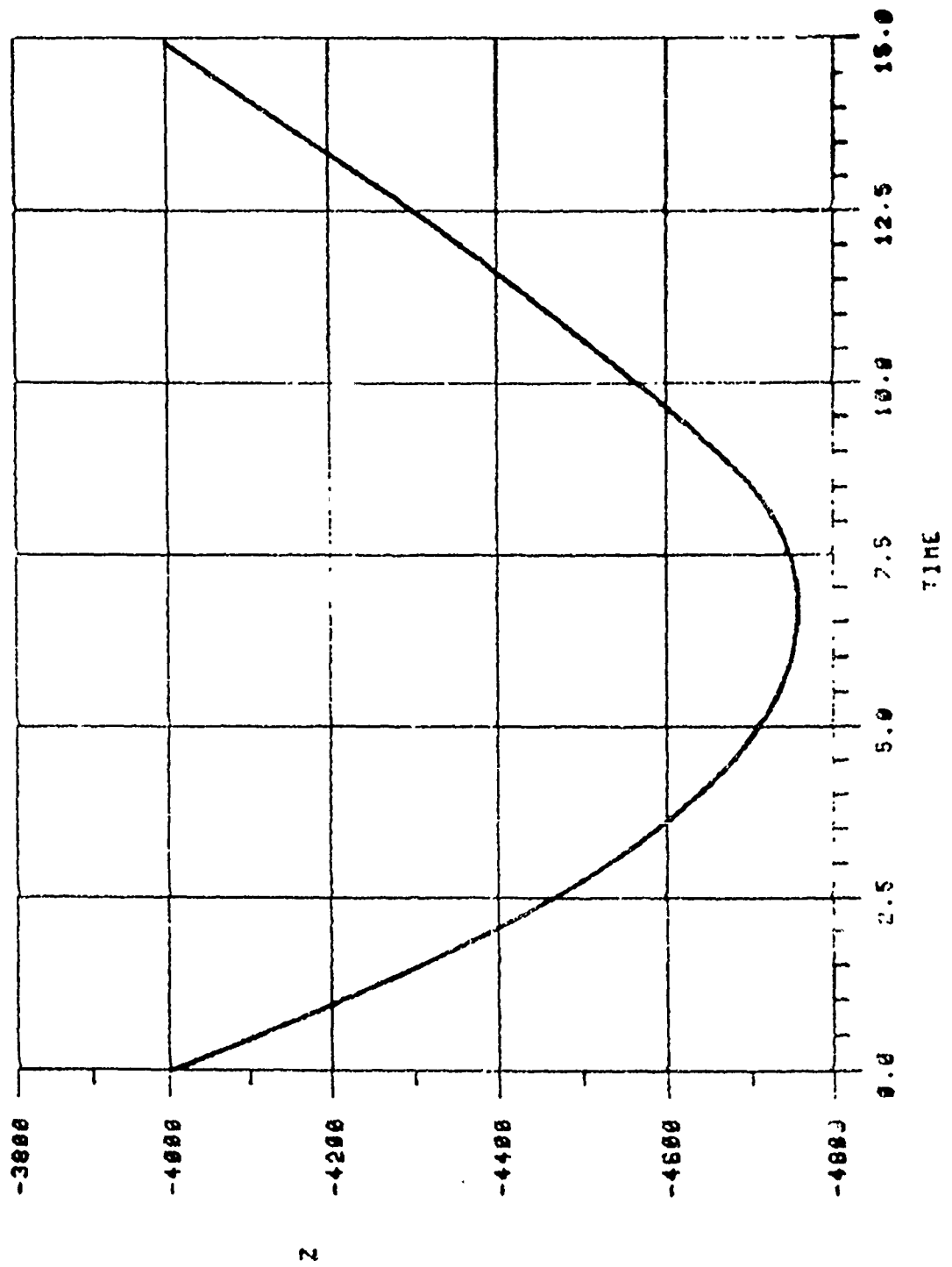


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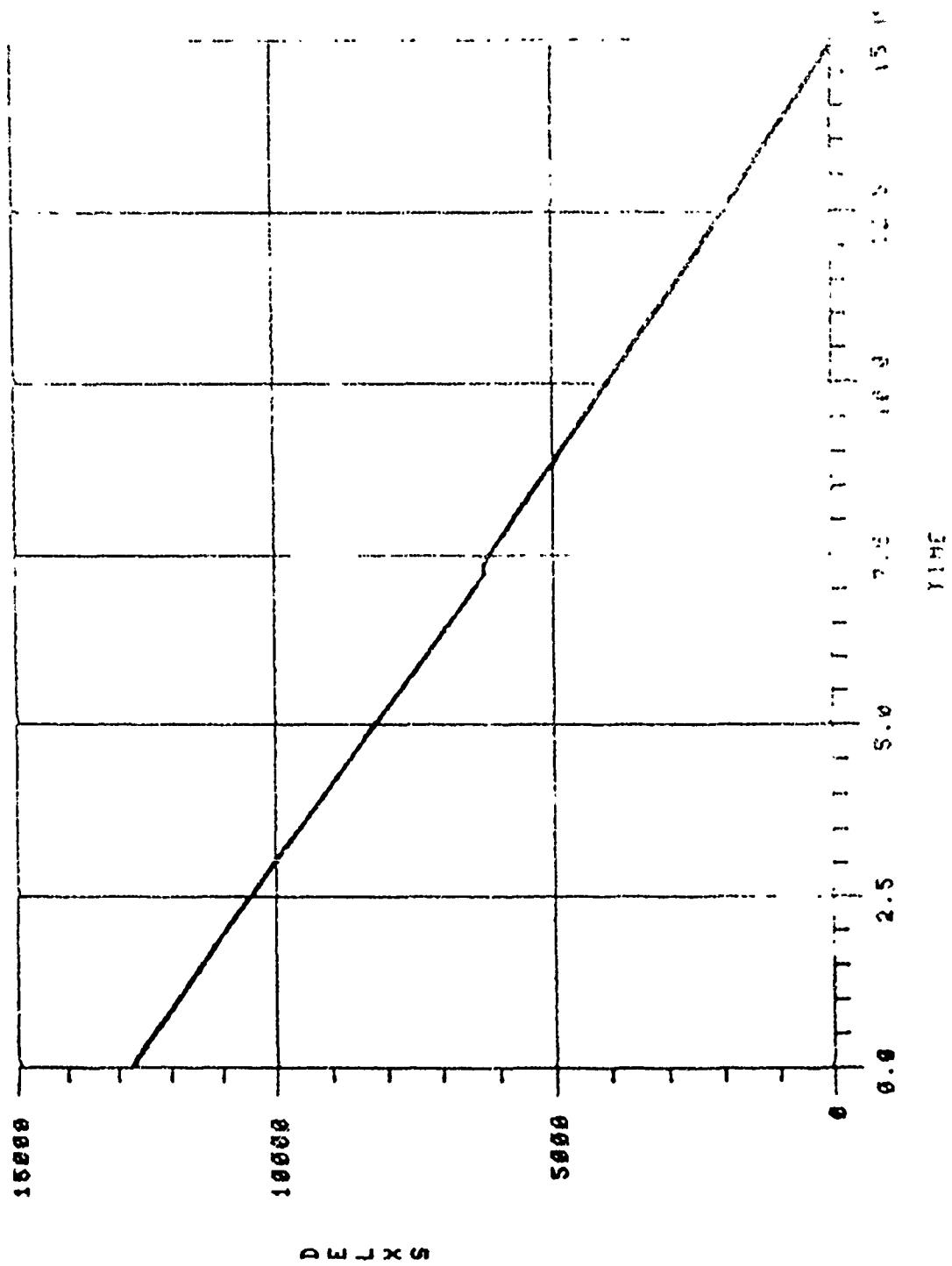


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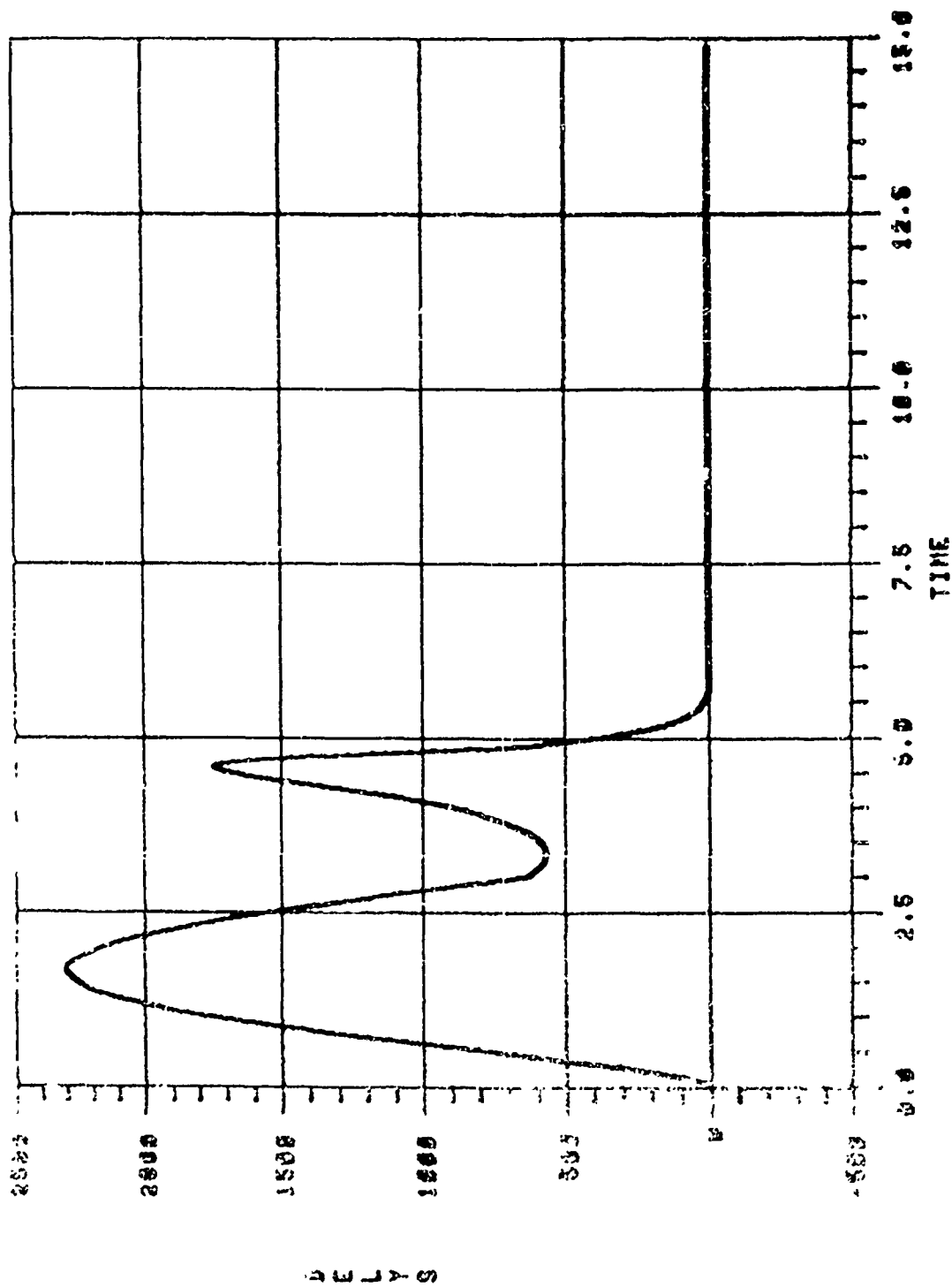


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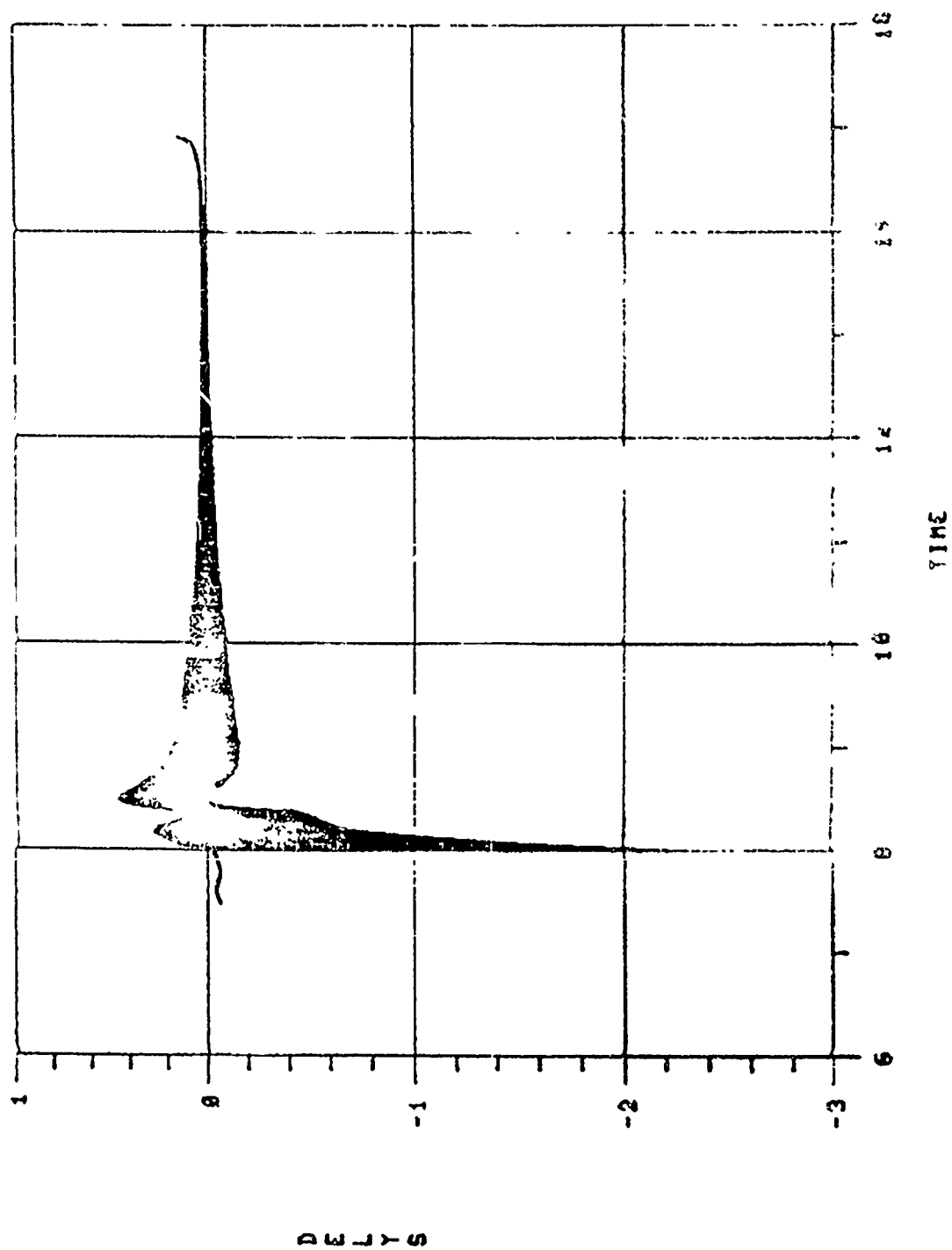


Figure 71.

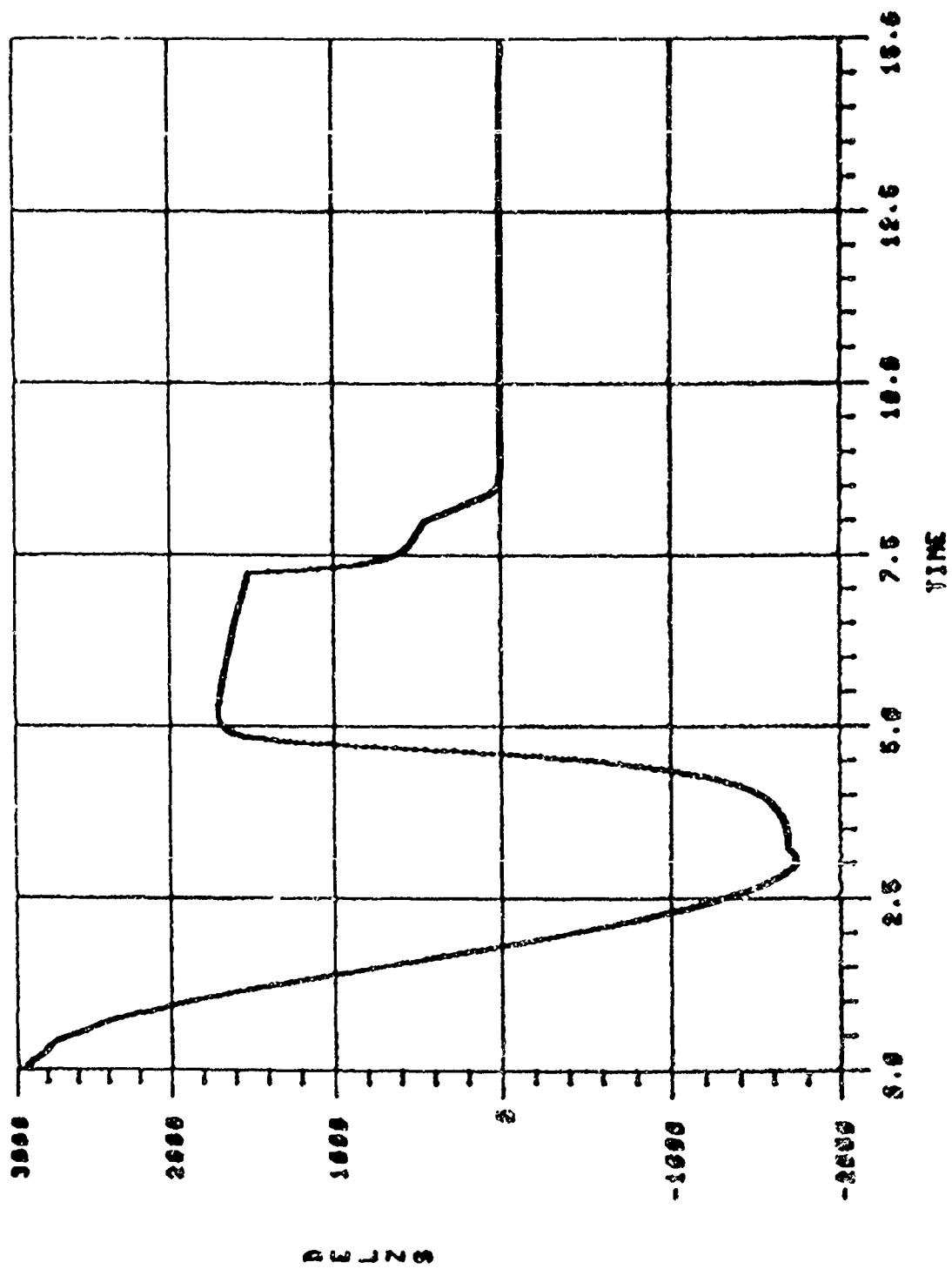


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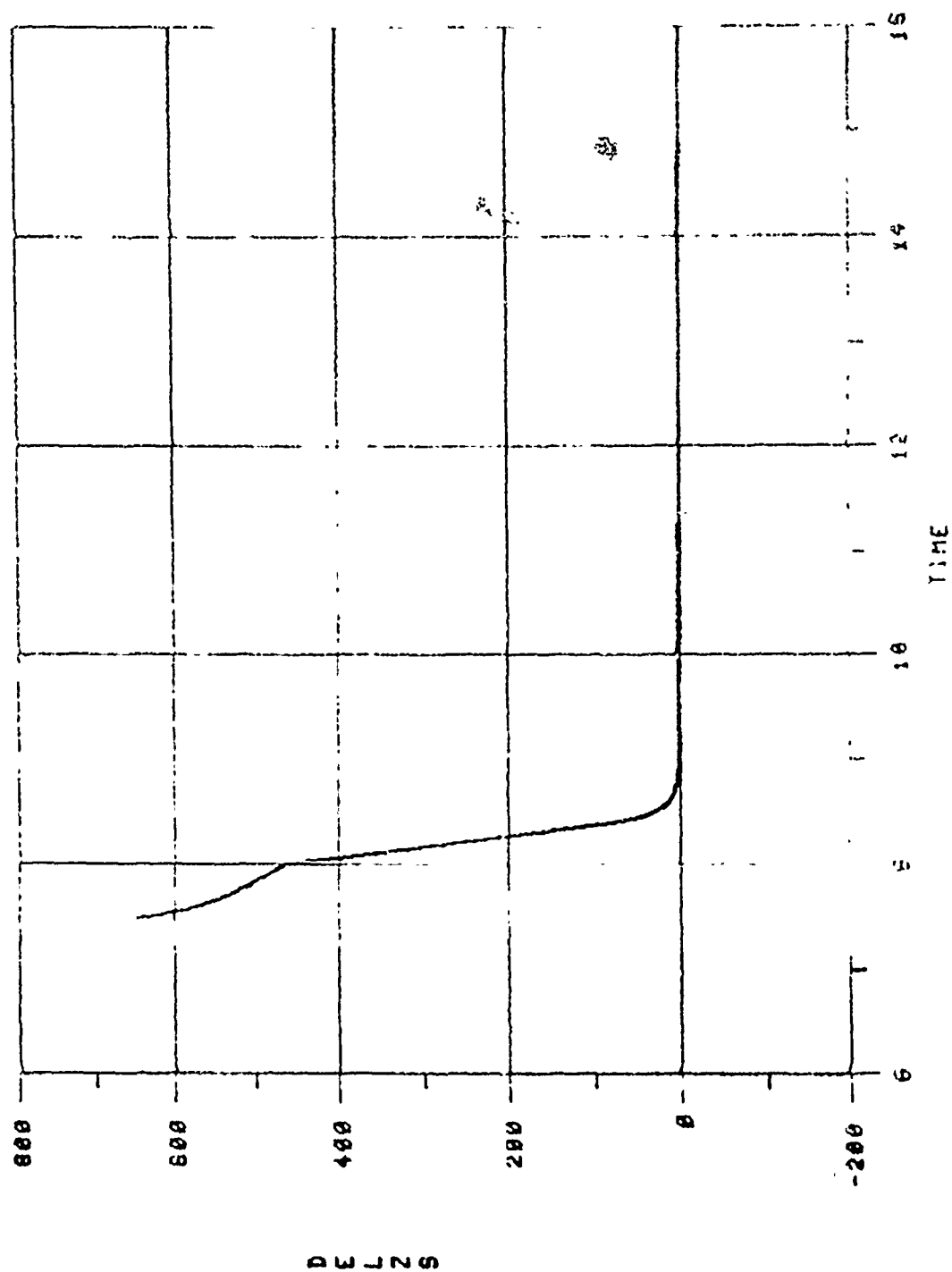


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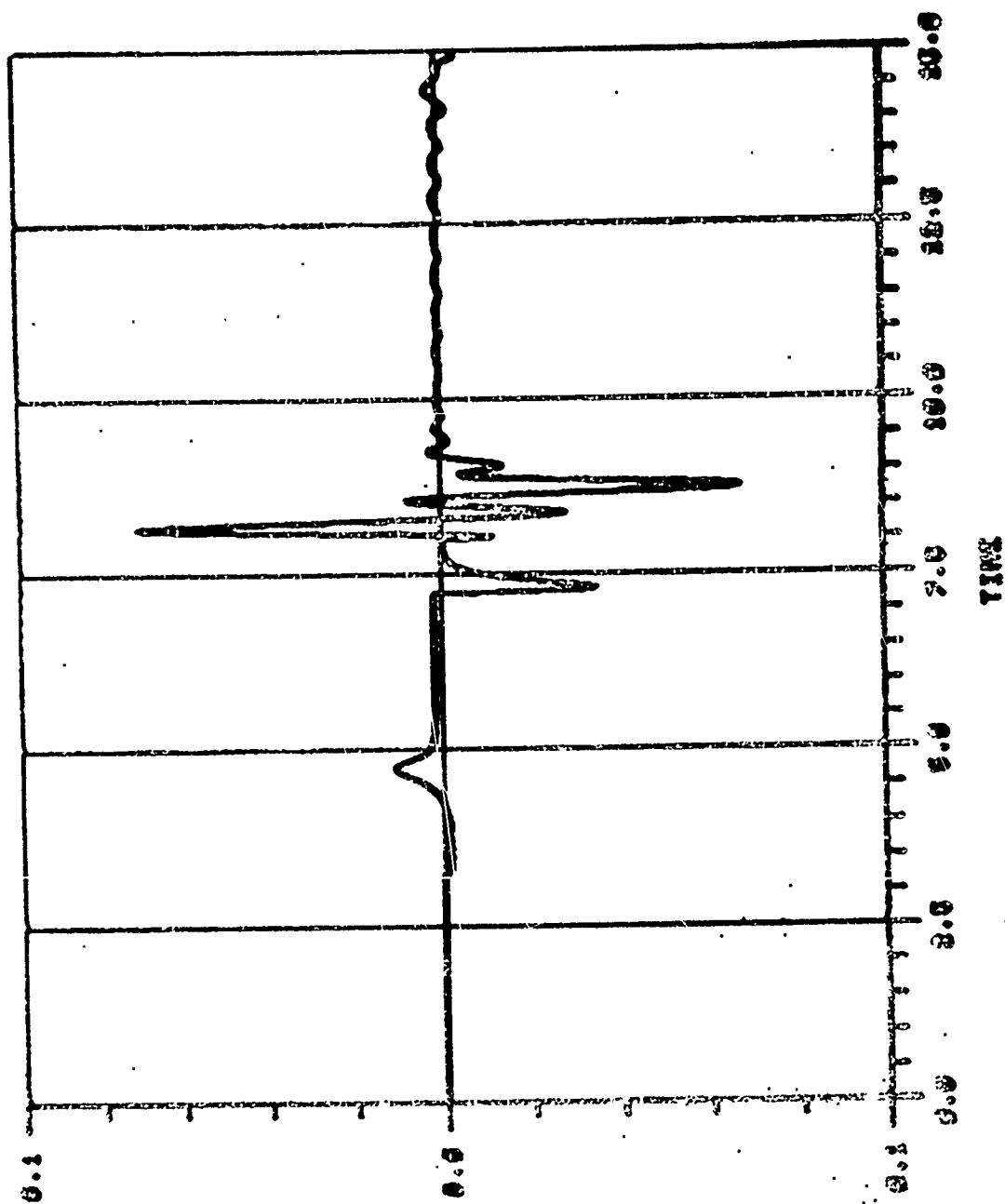


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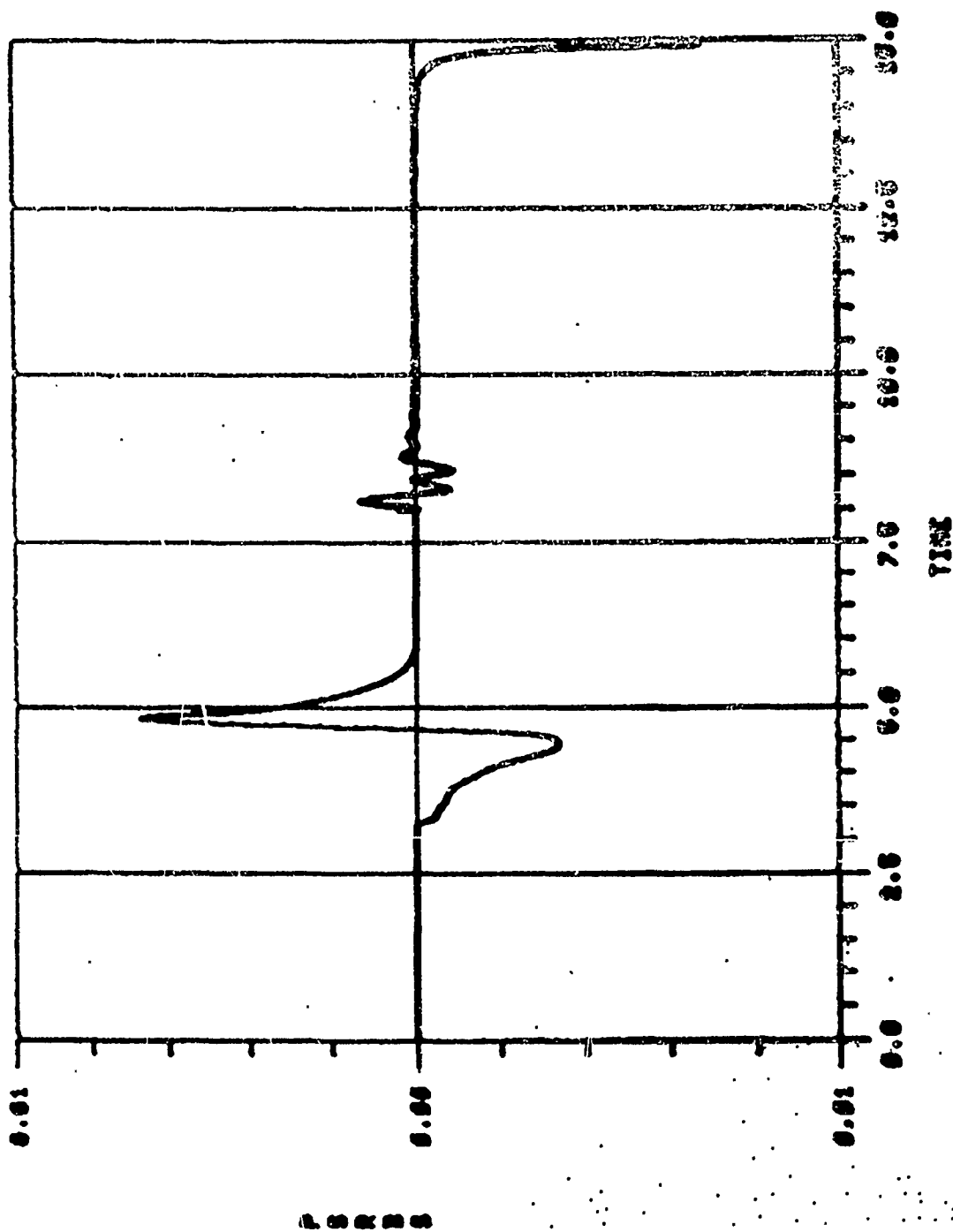


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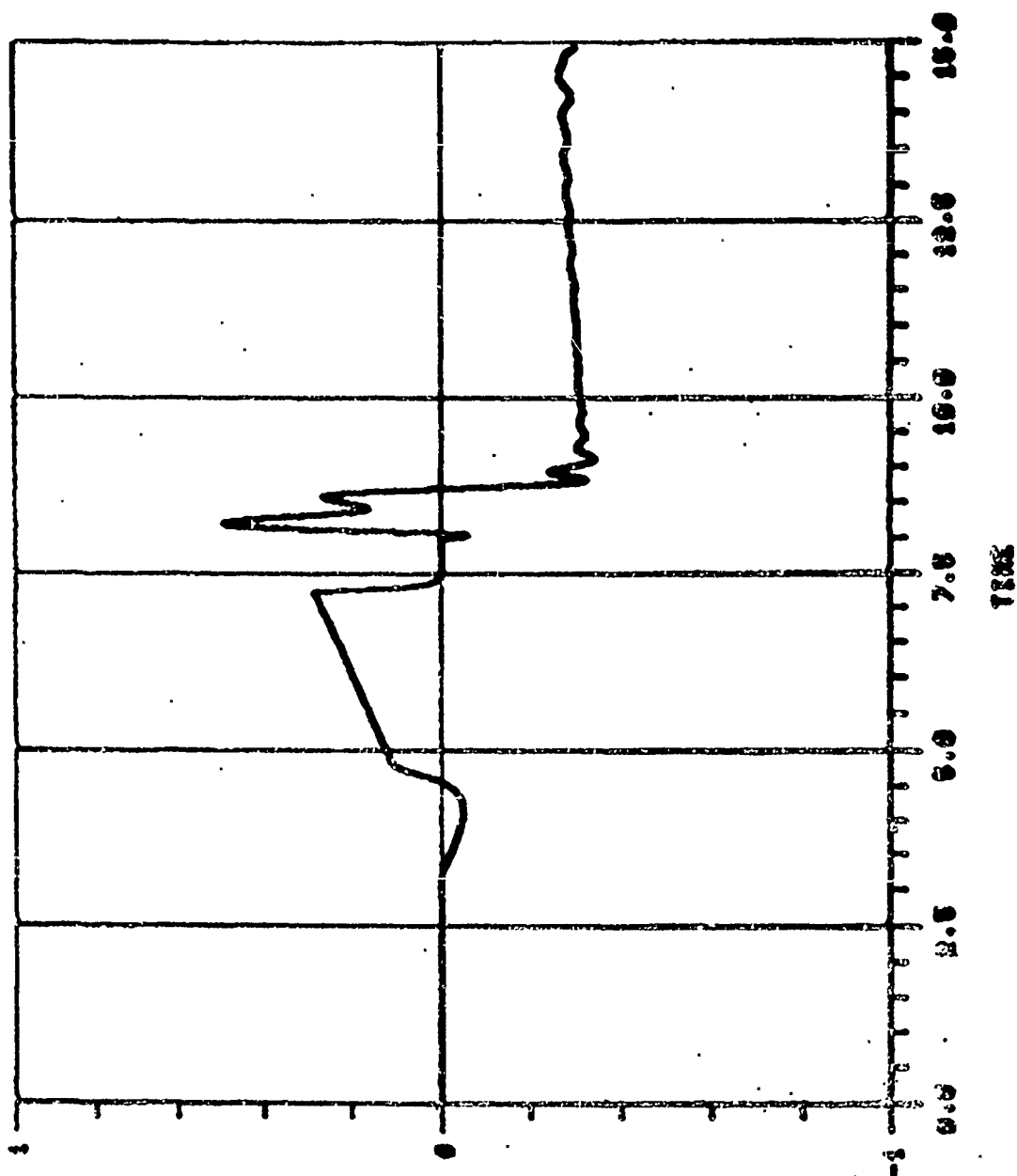


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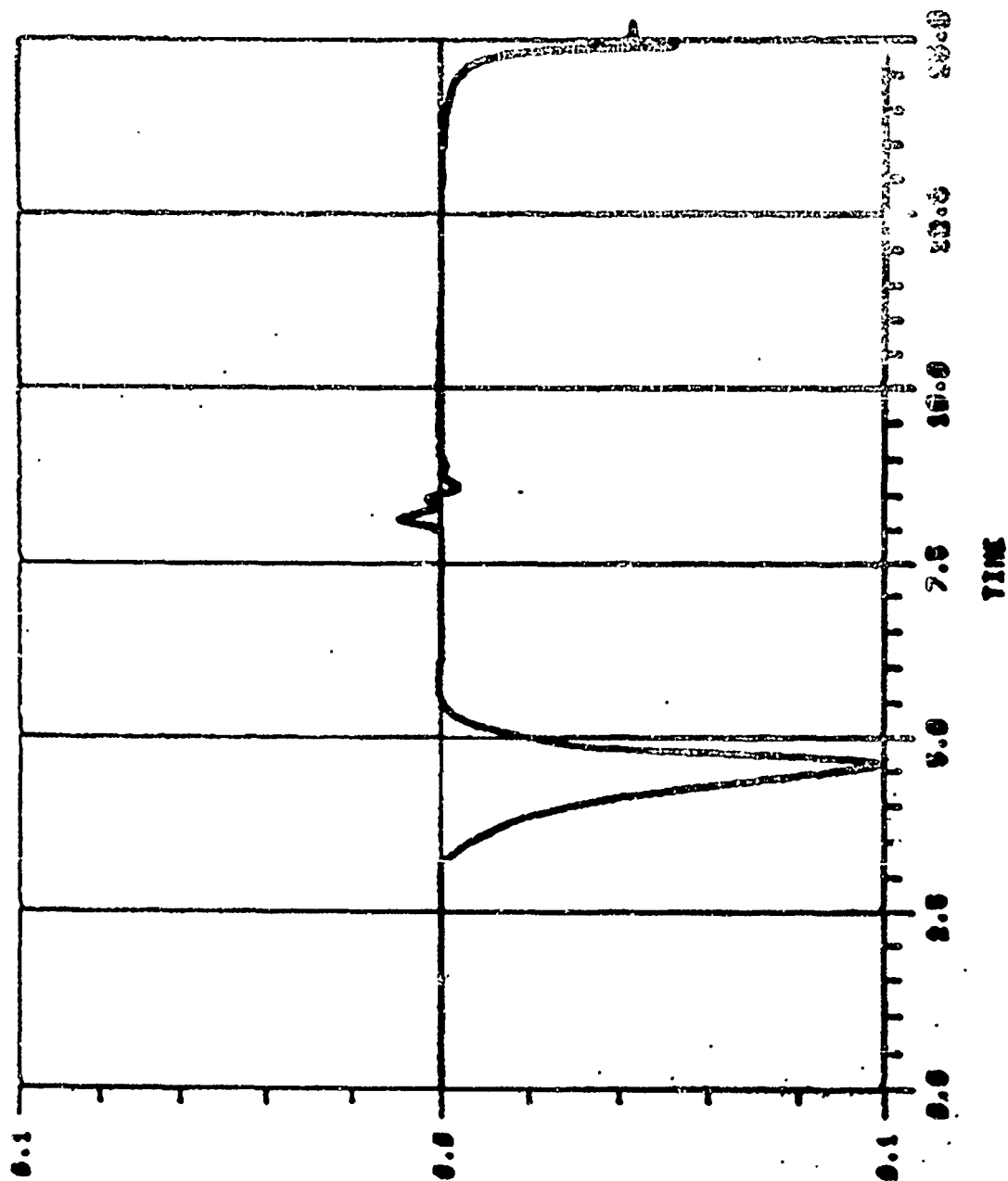


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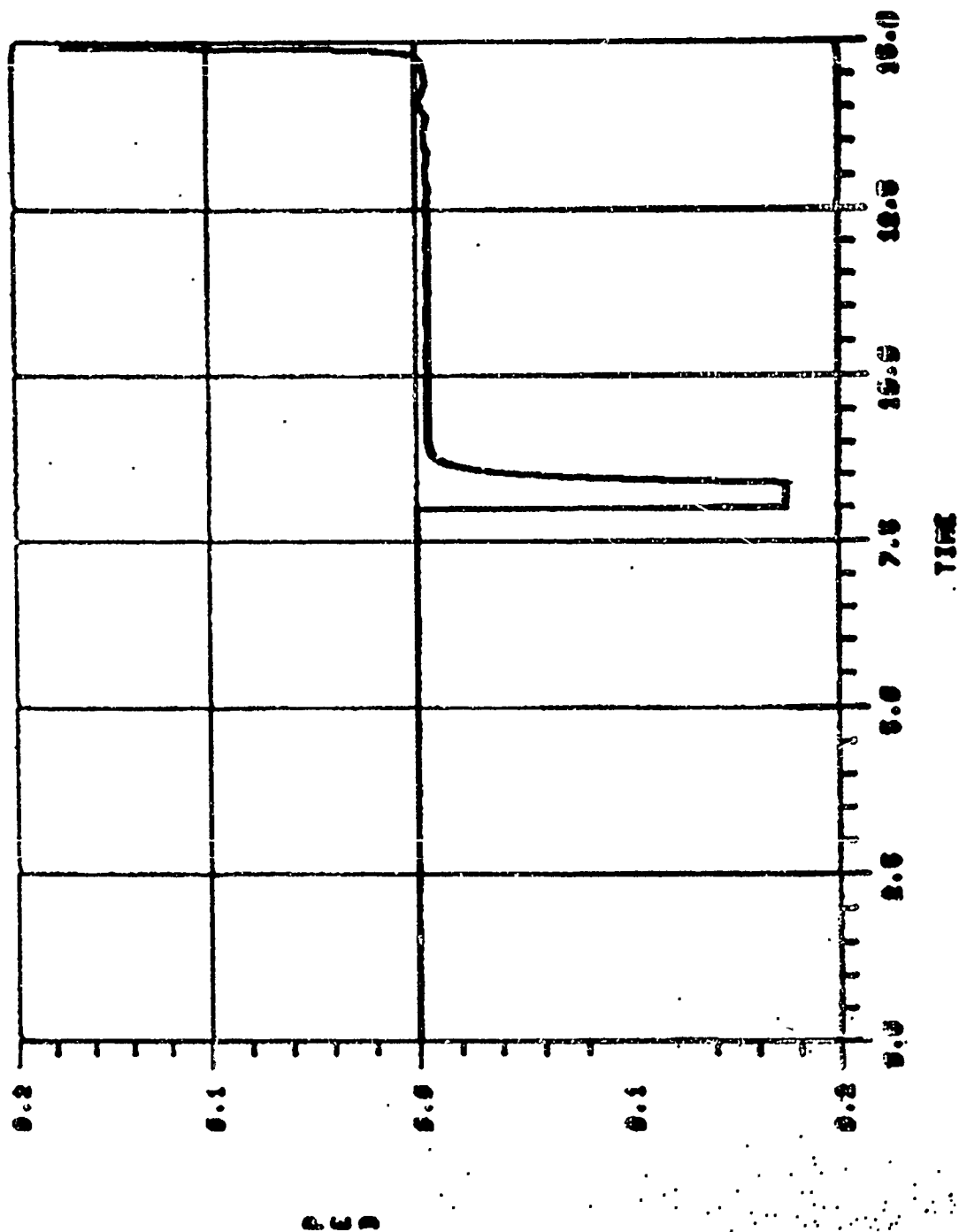


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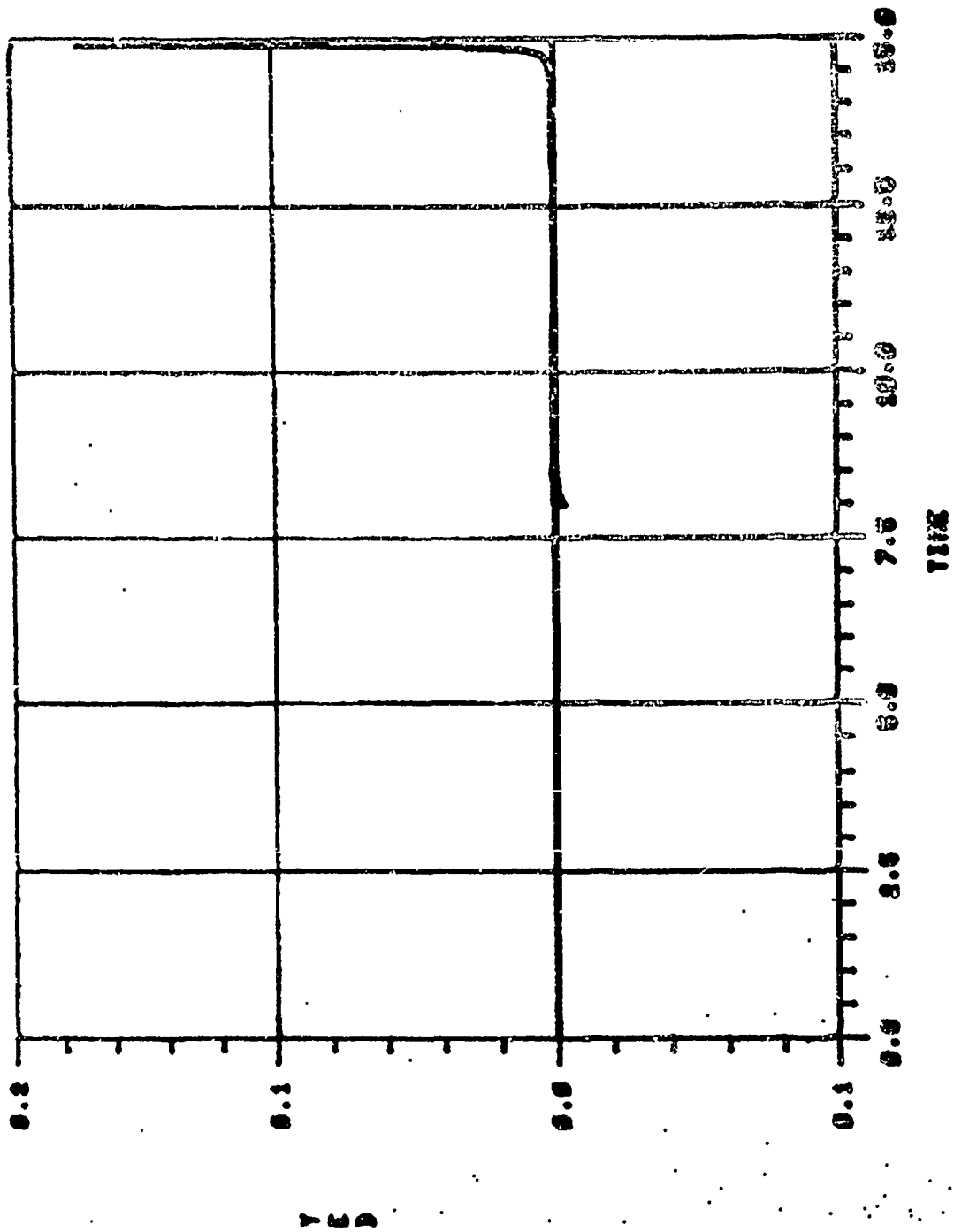


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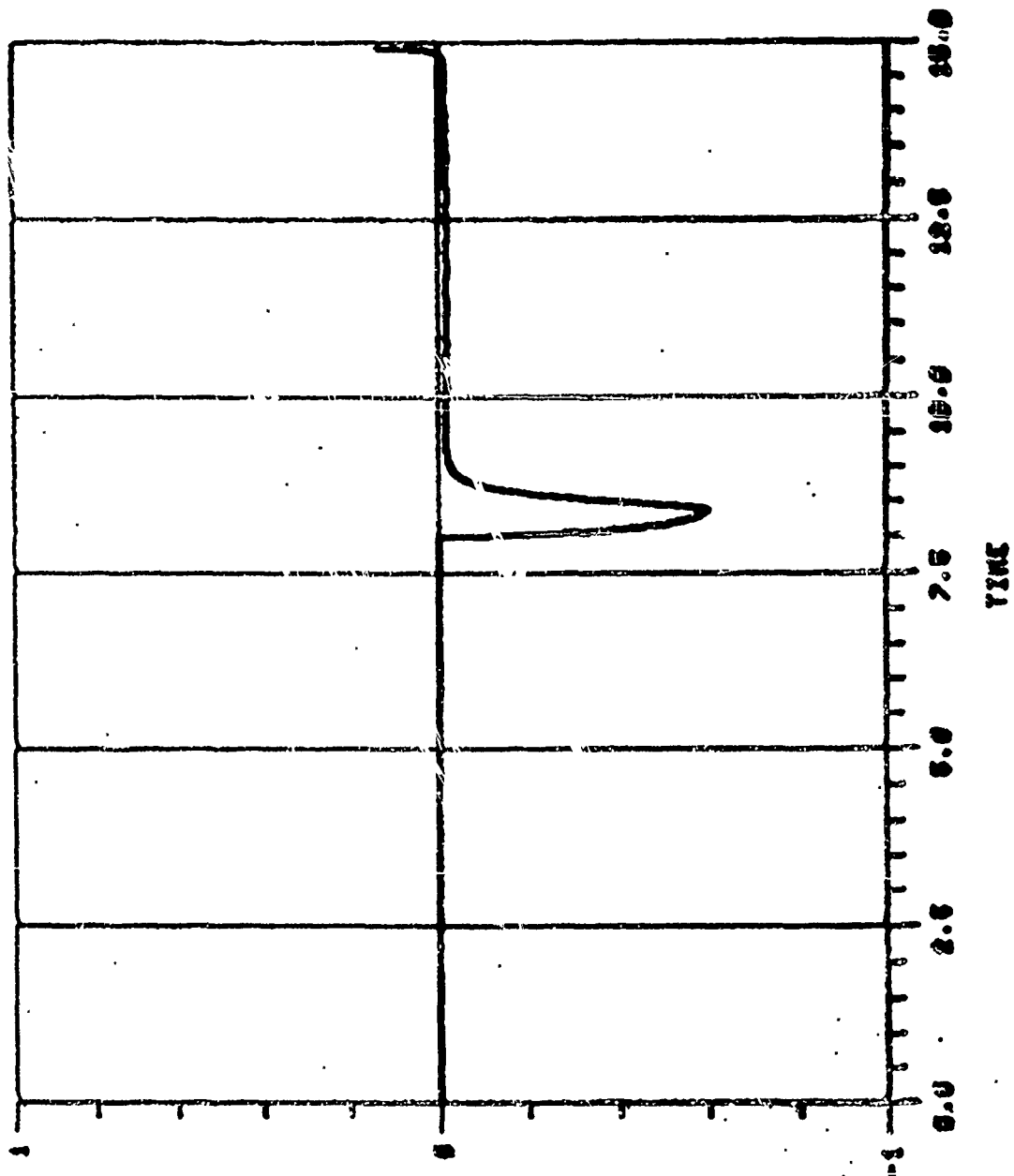


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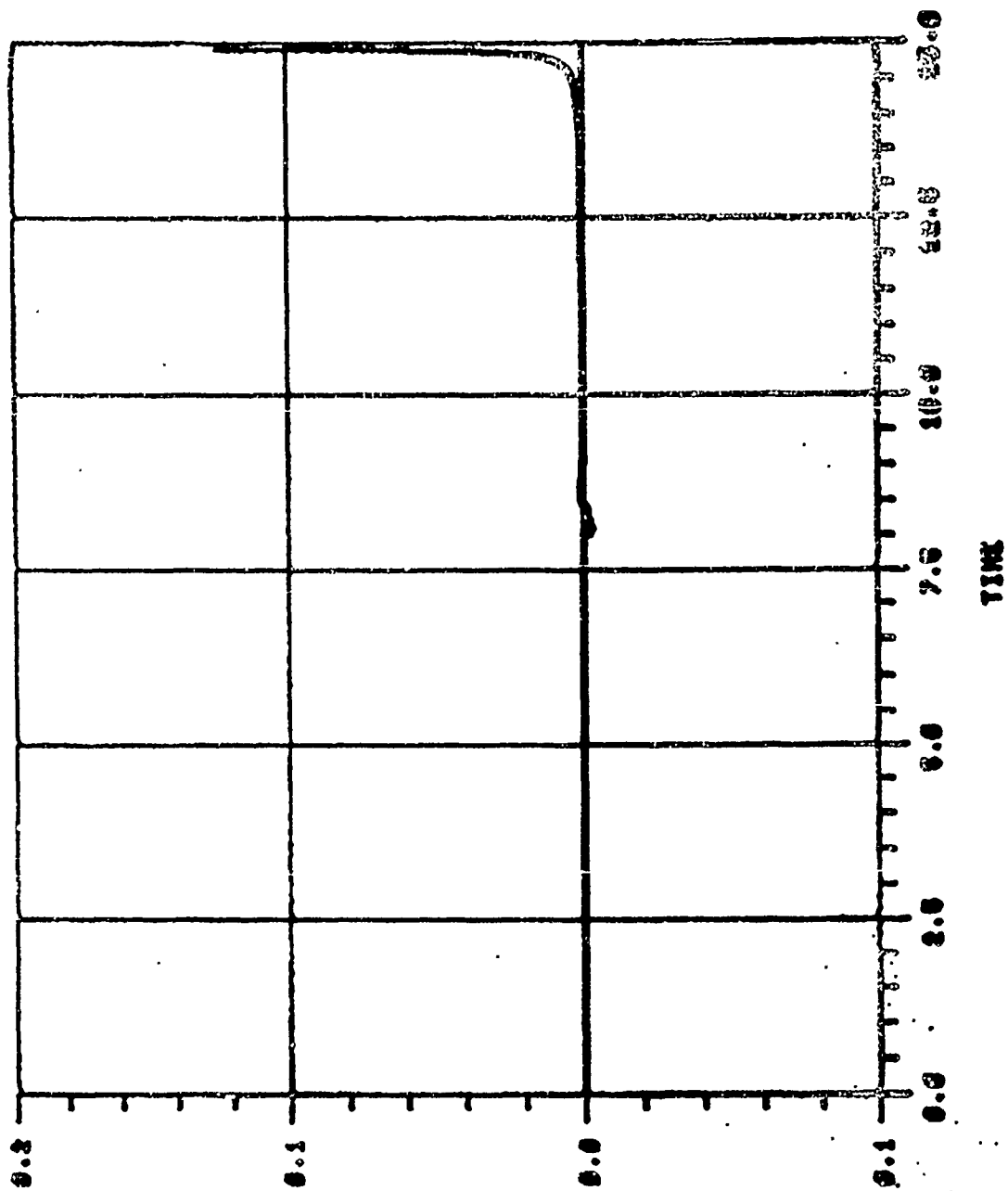


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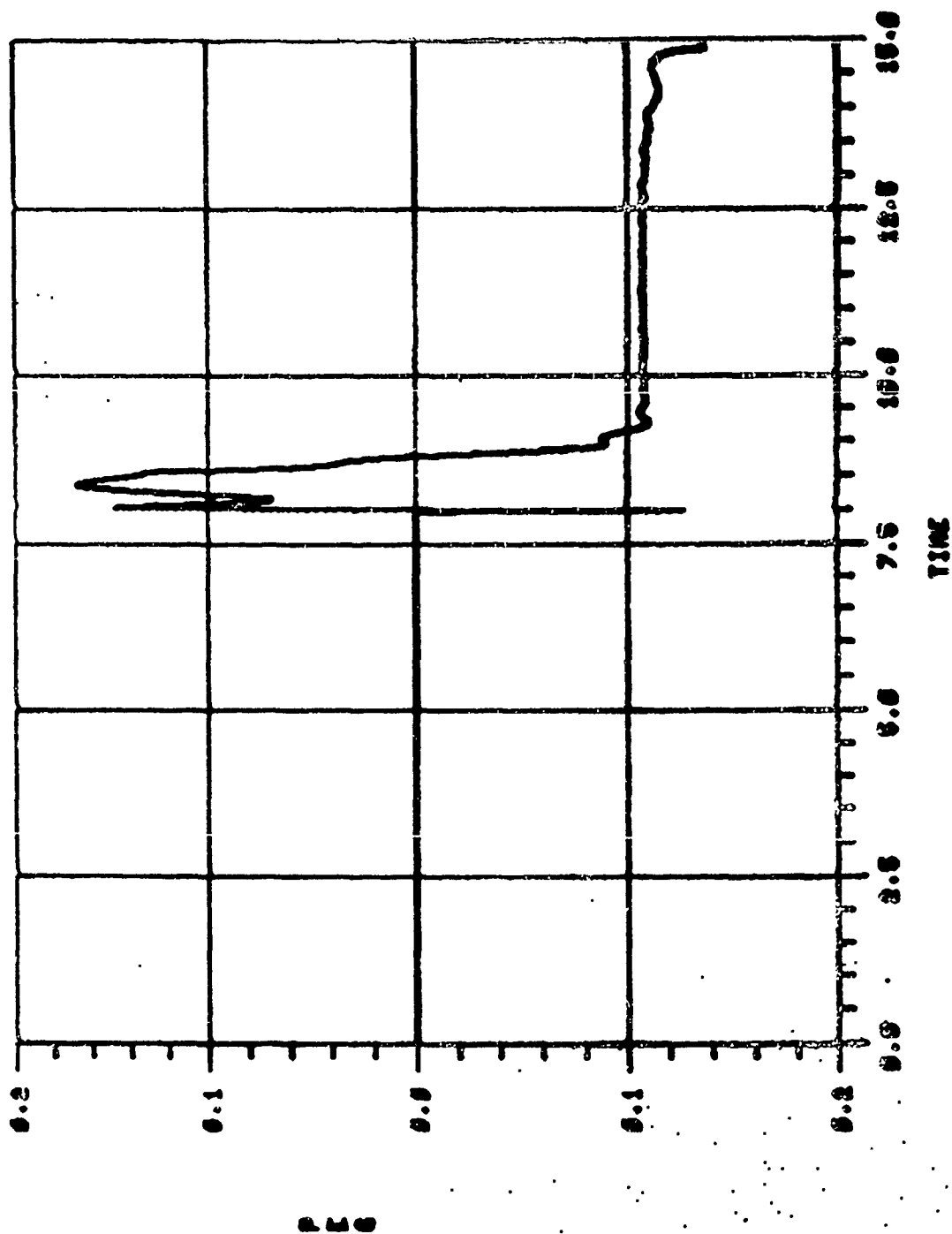


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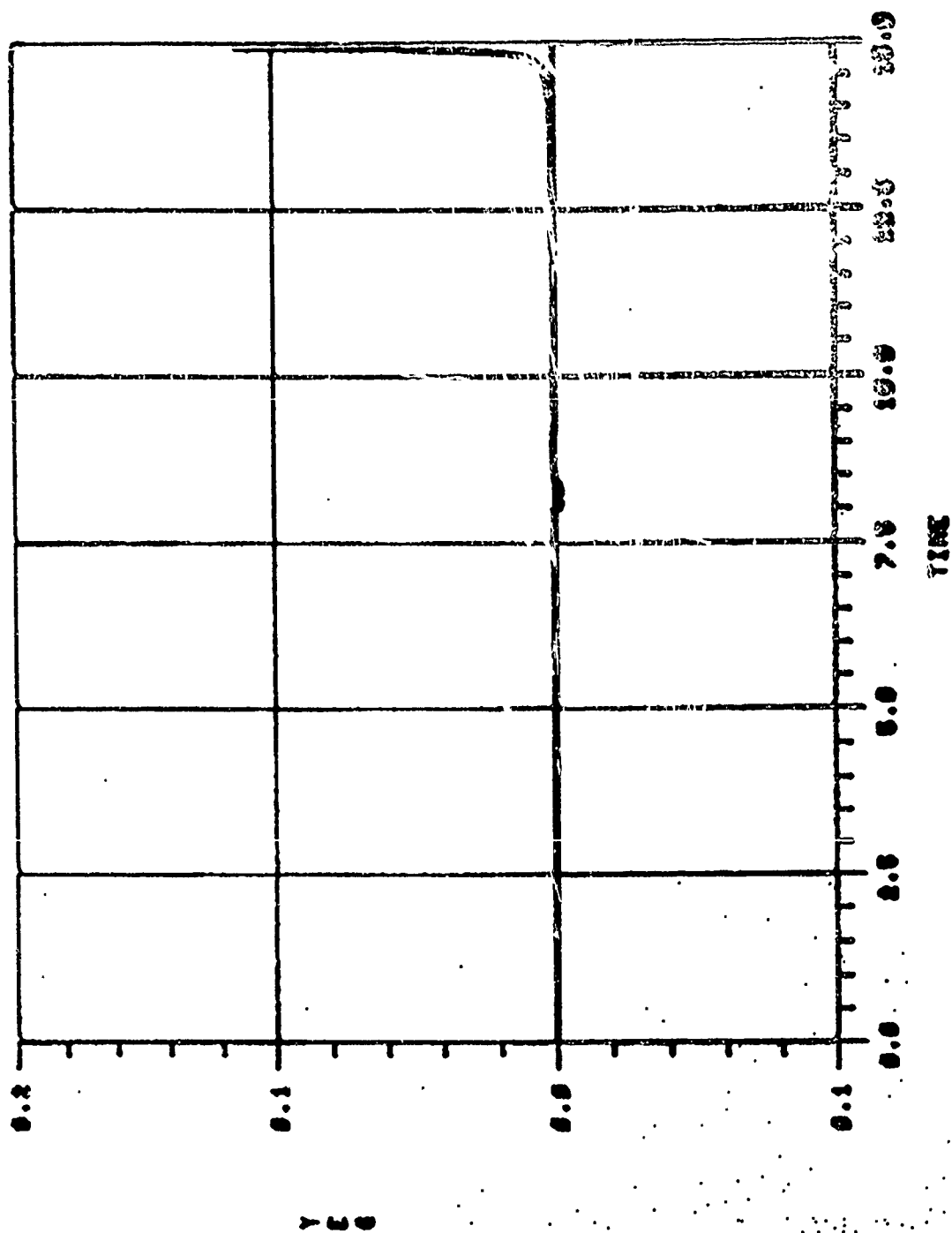


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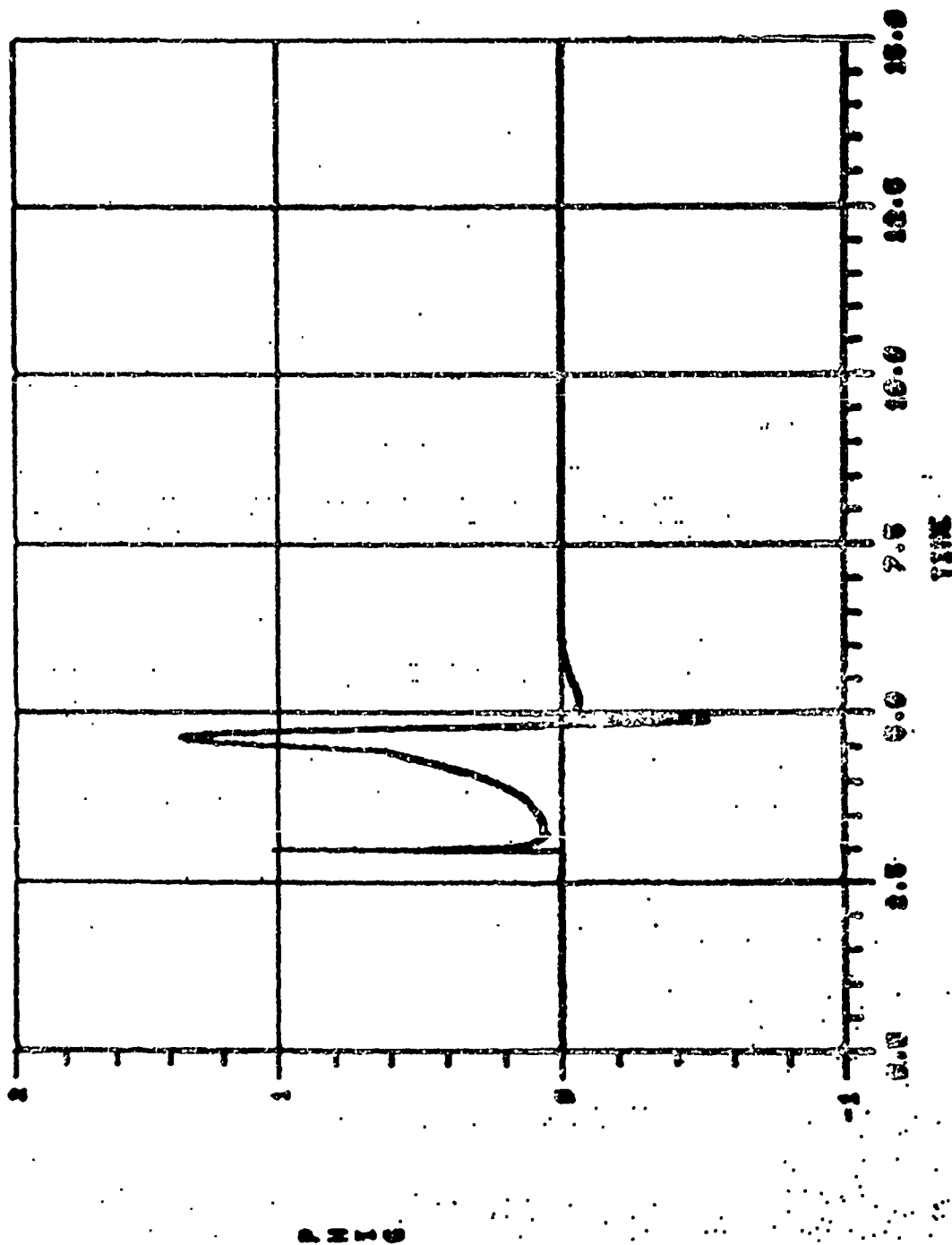


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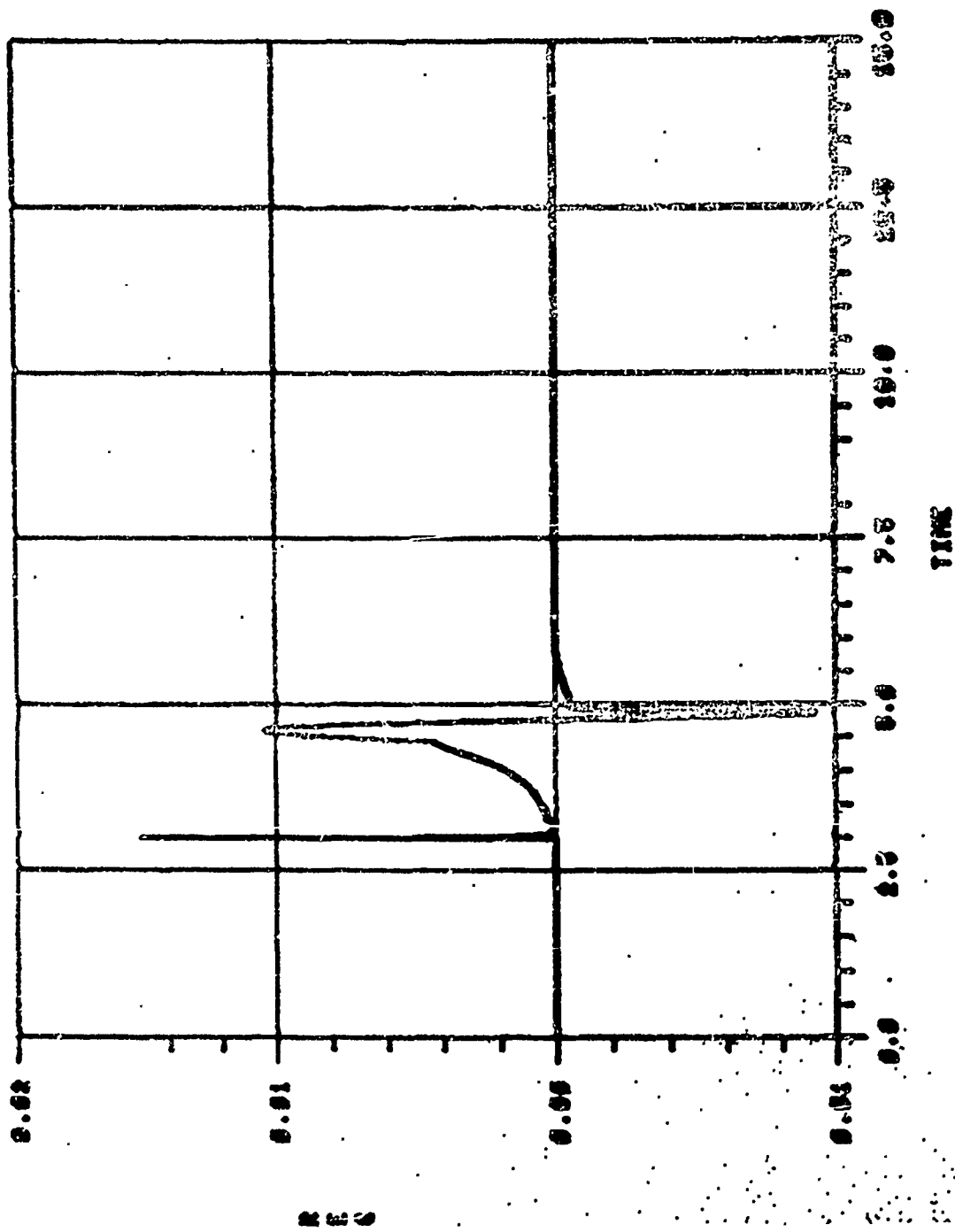


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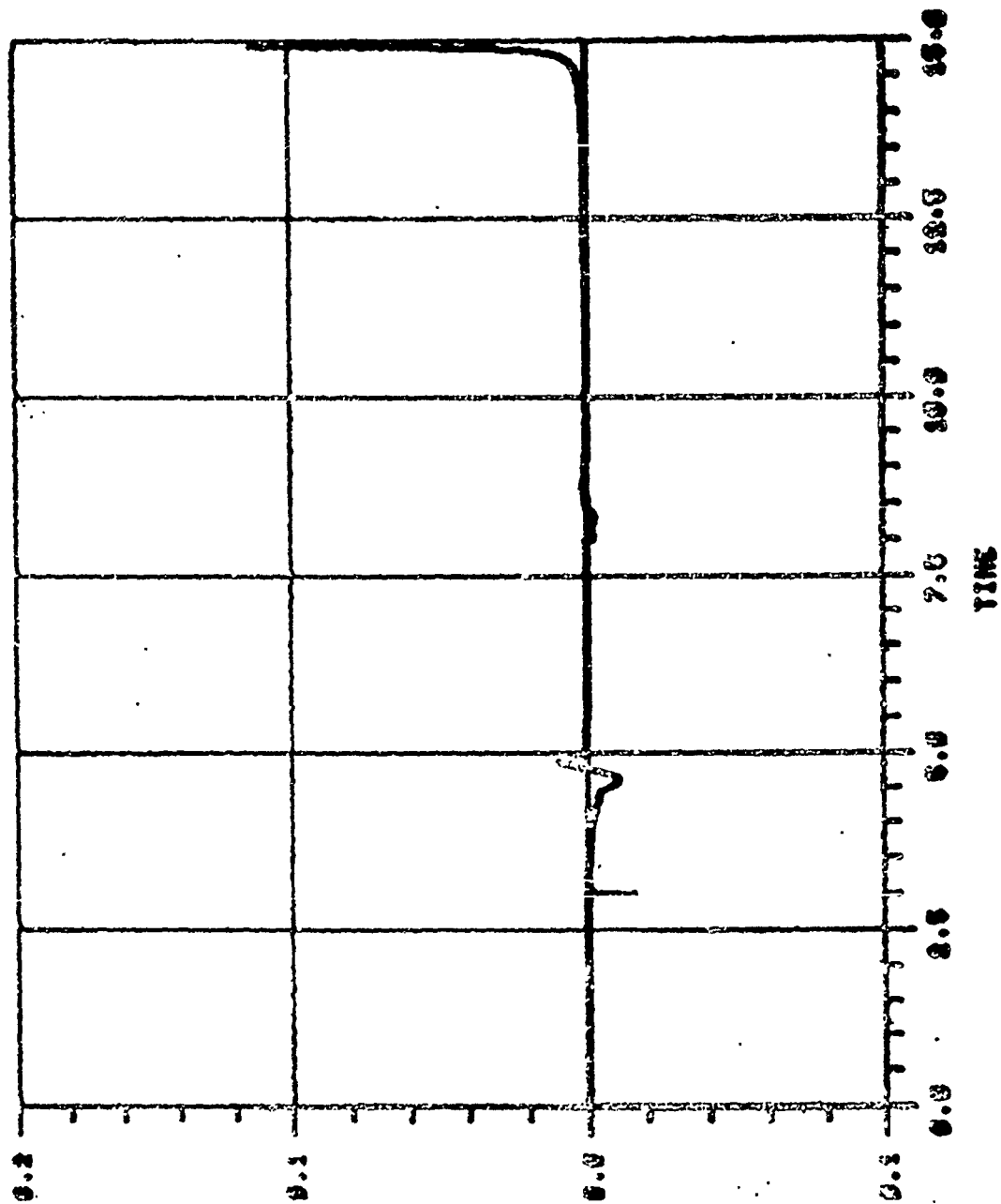


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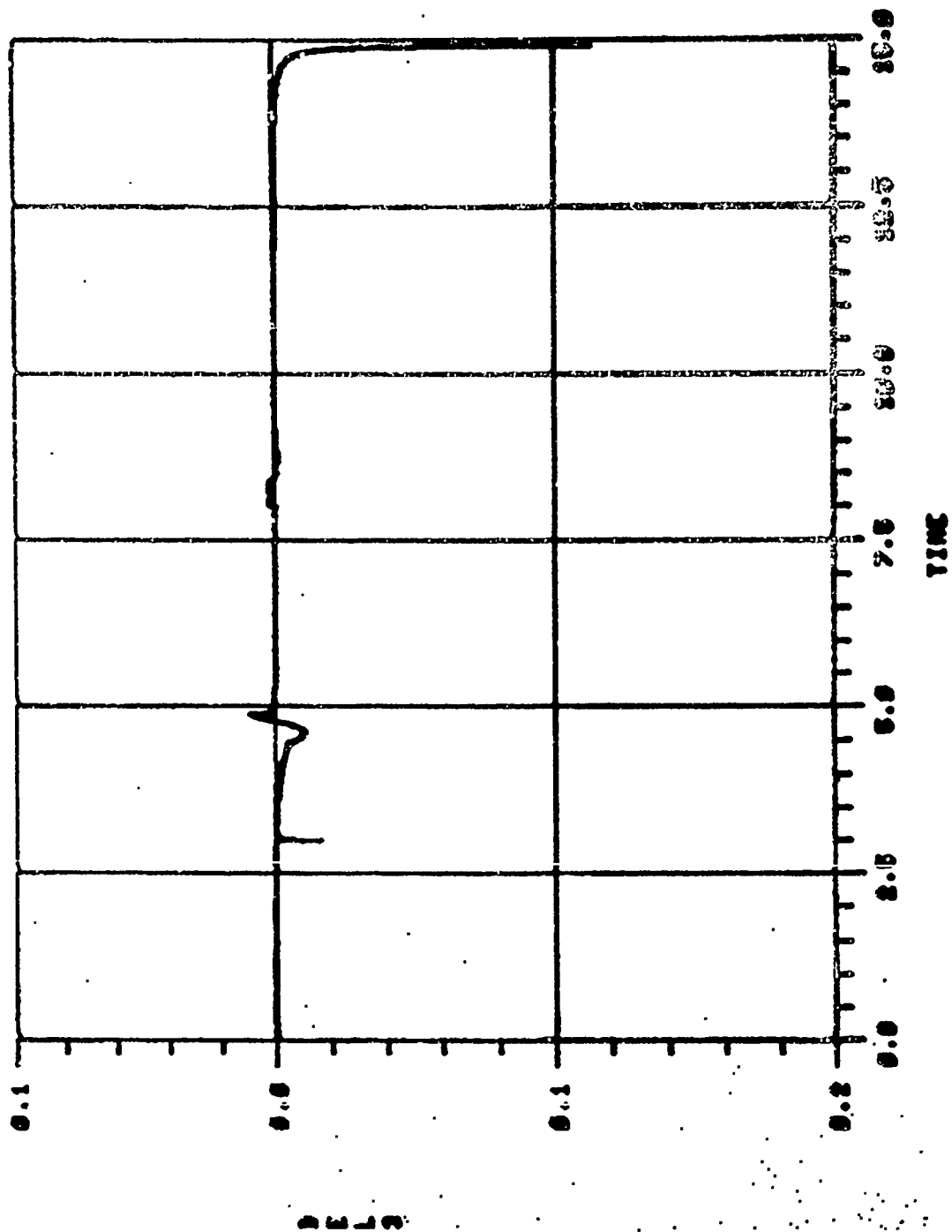


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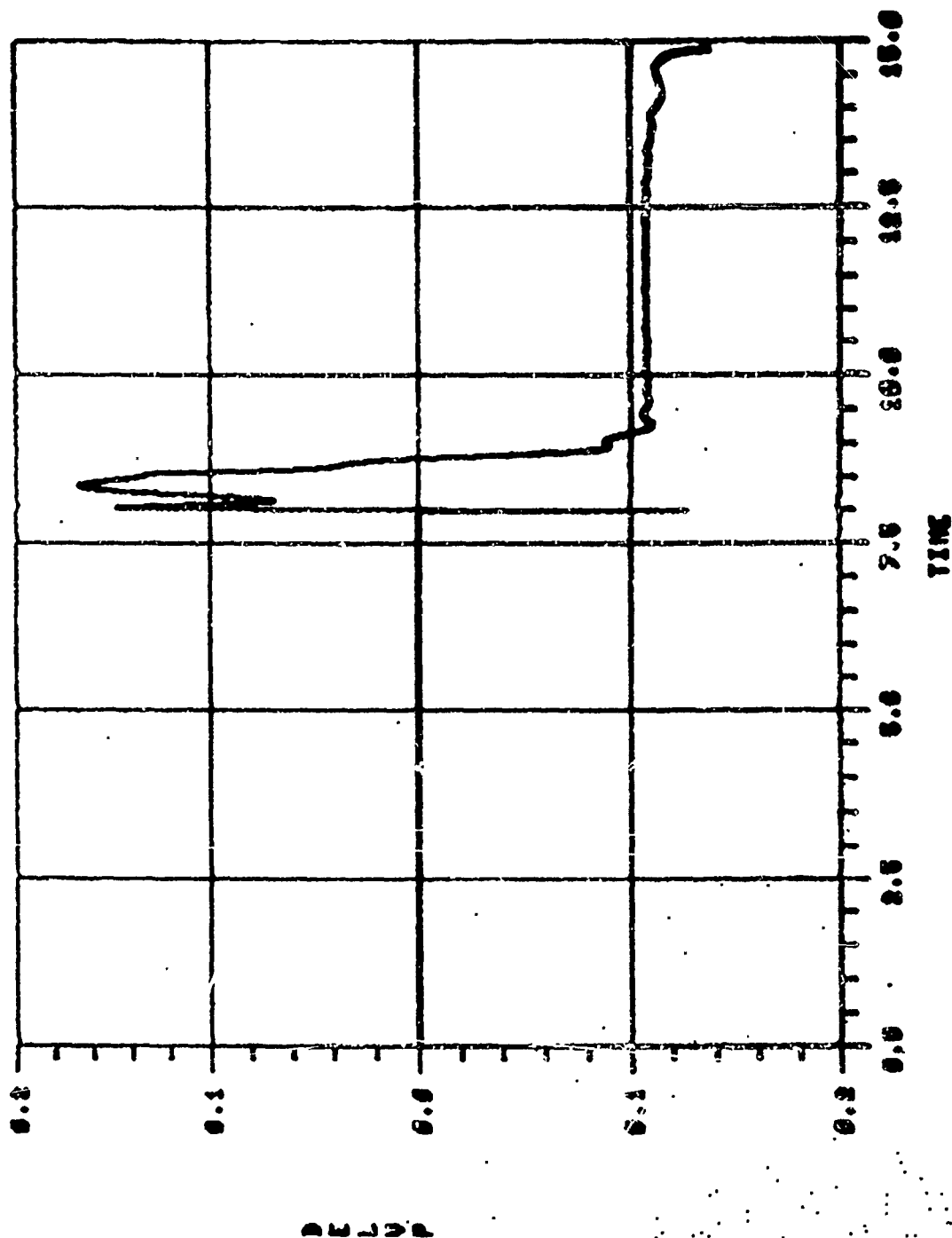


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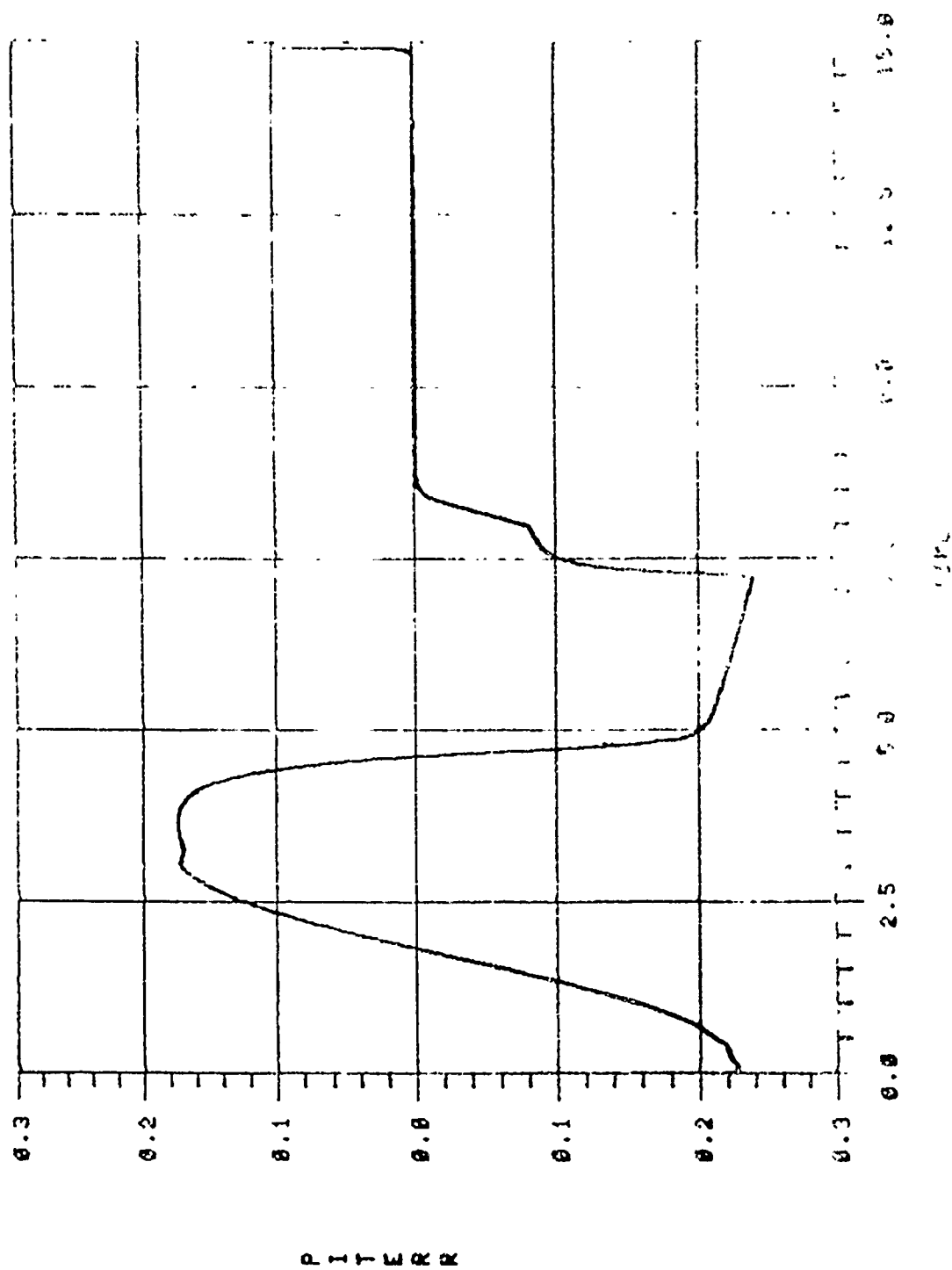


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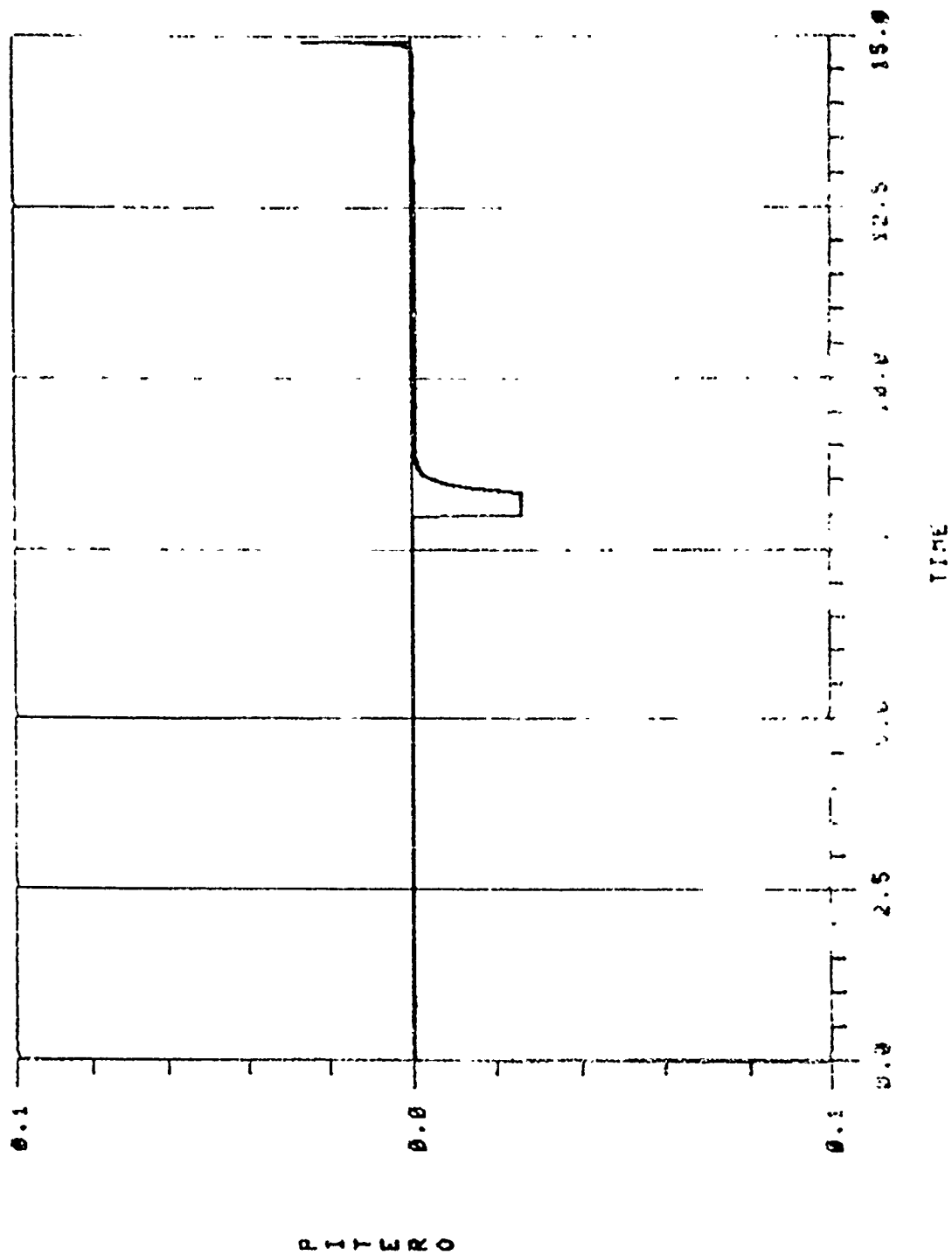


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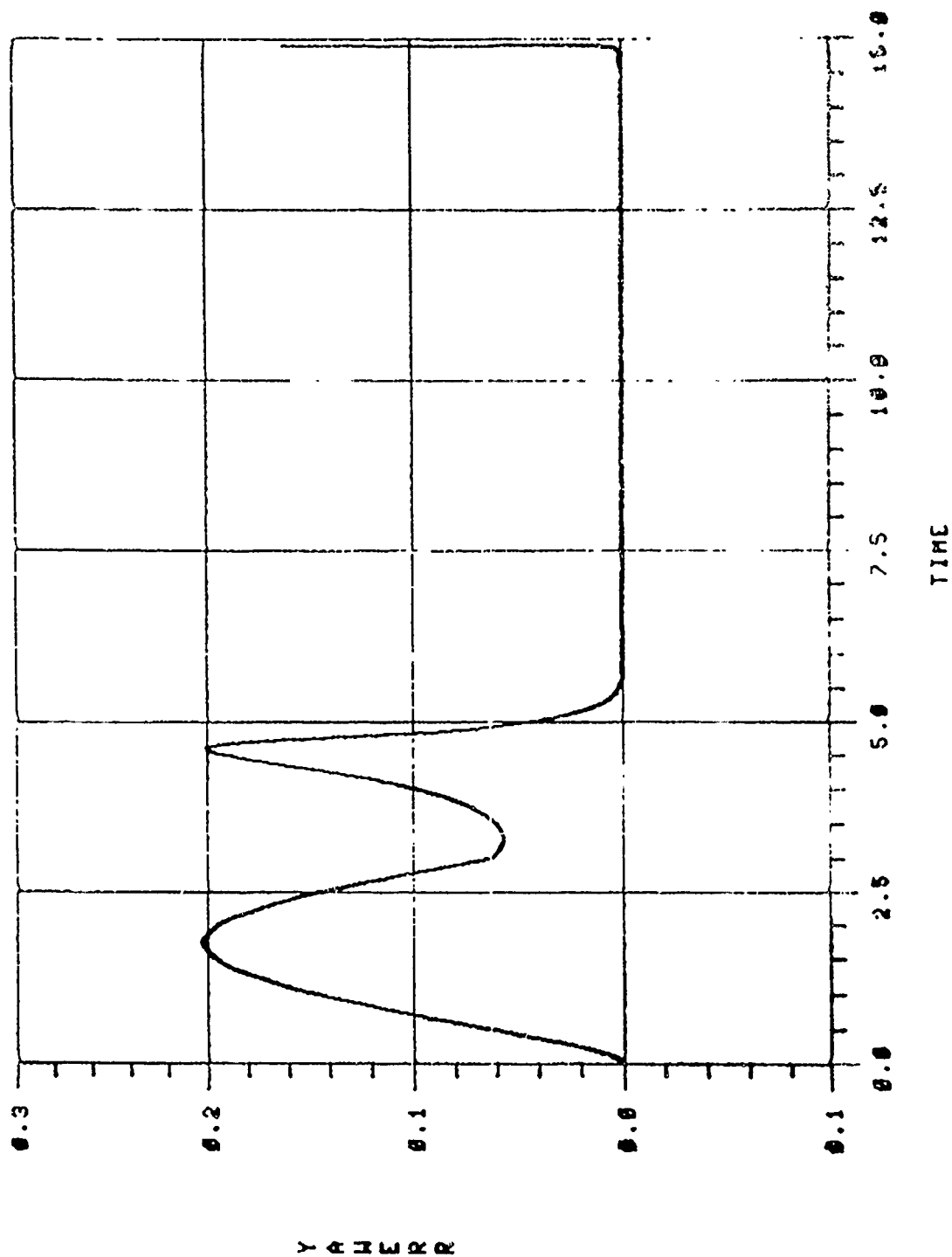


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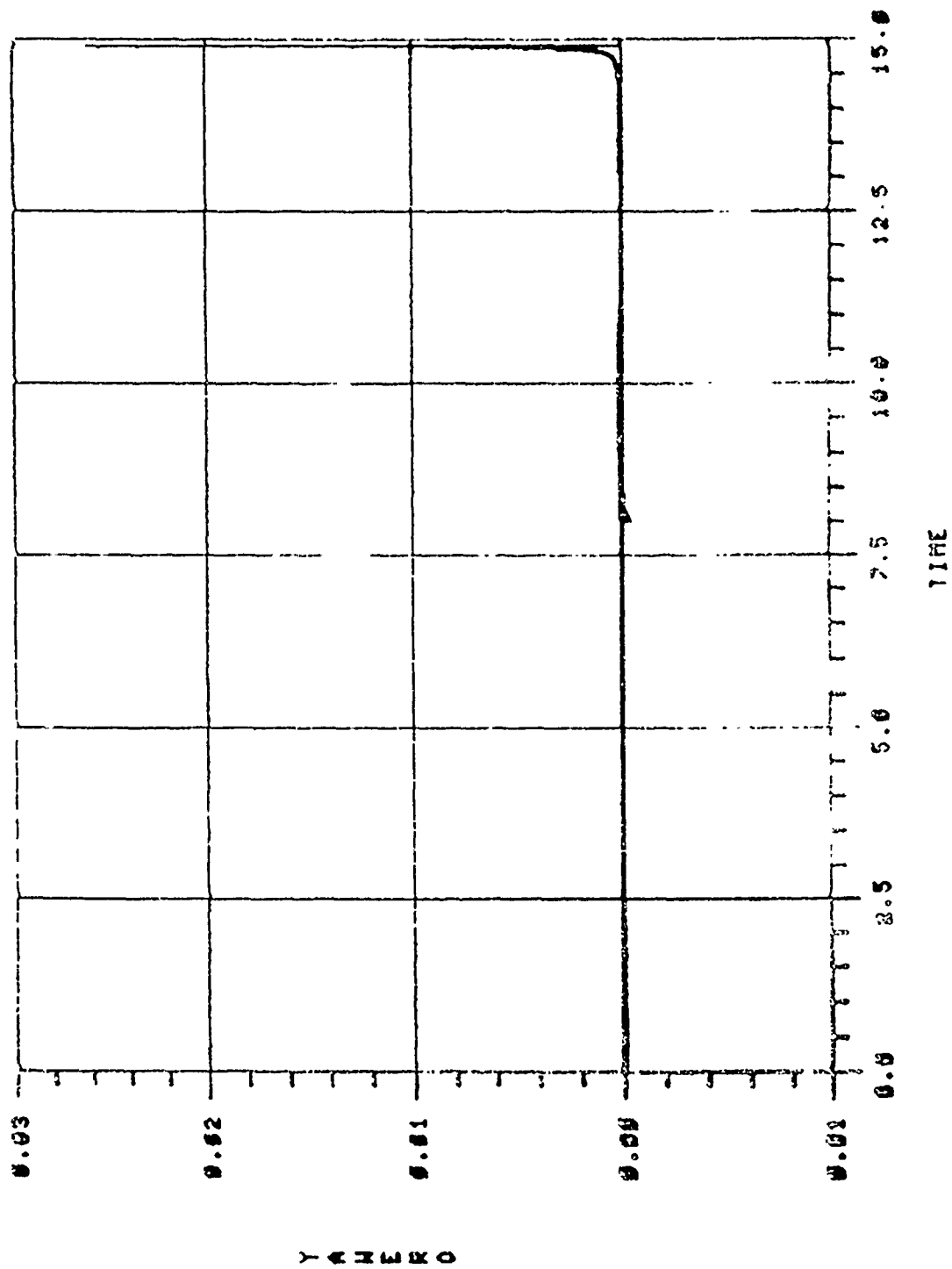


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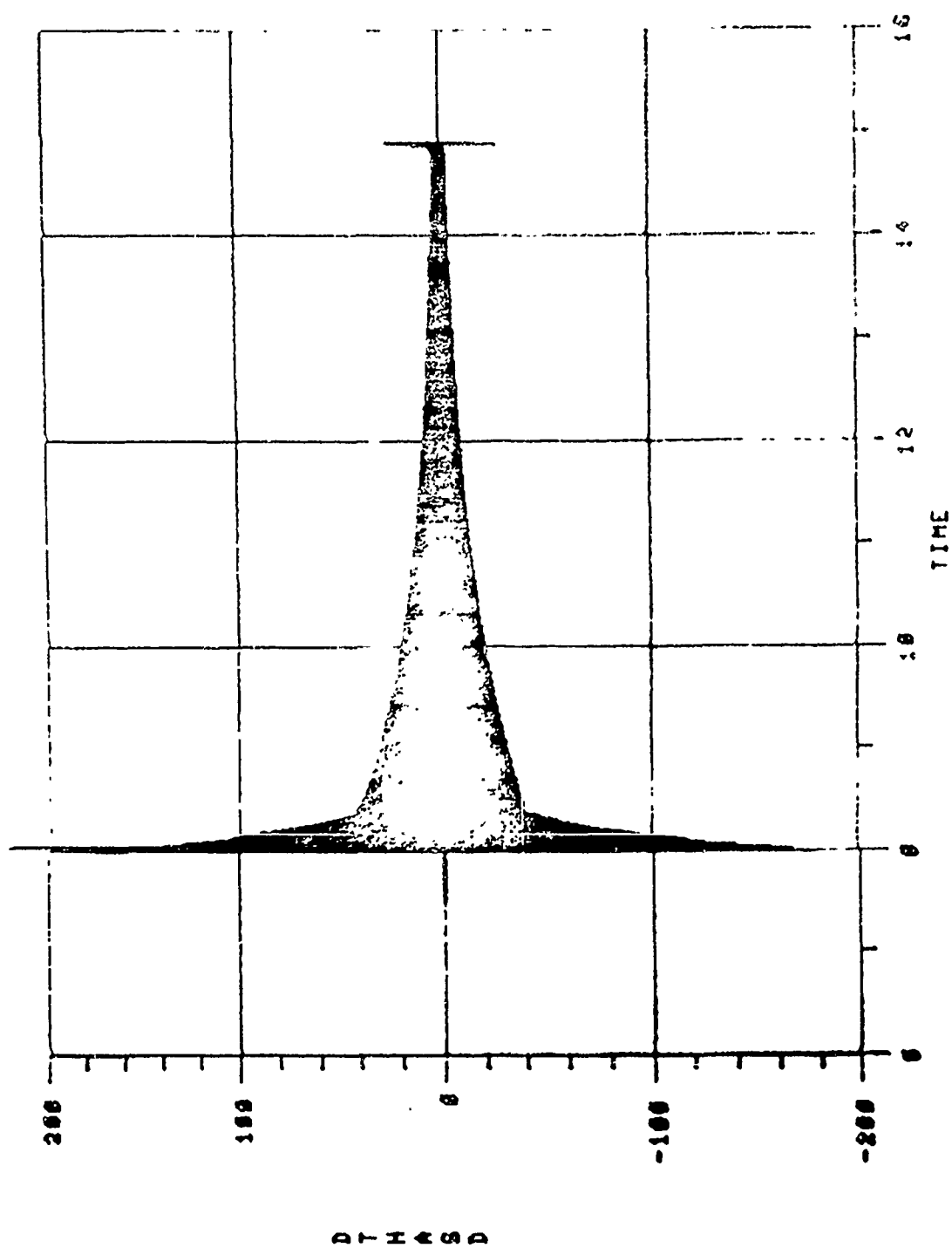


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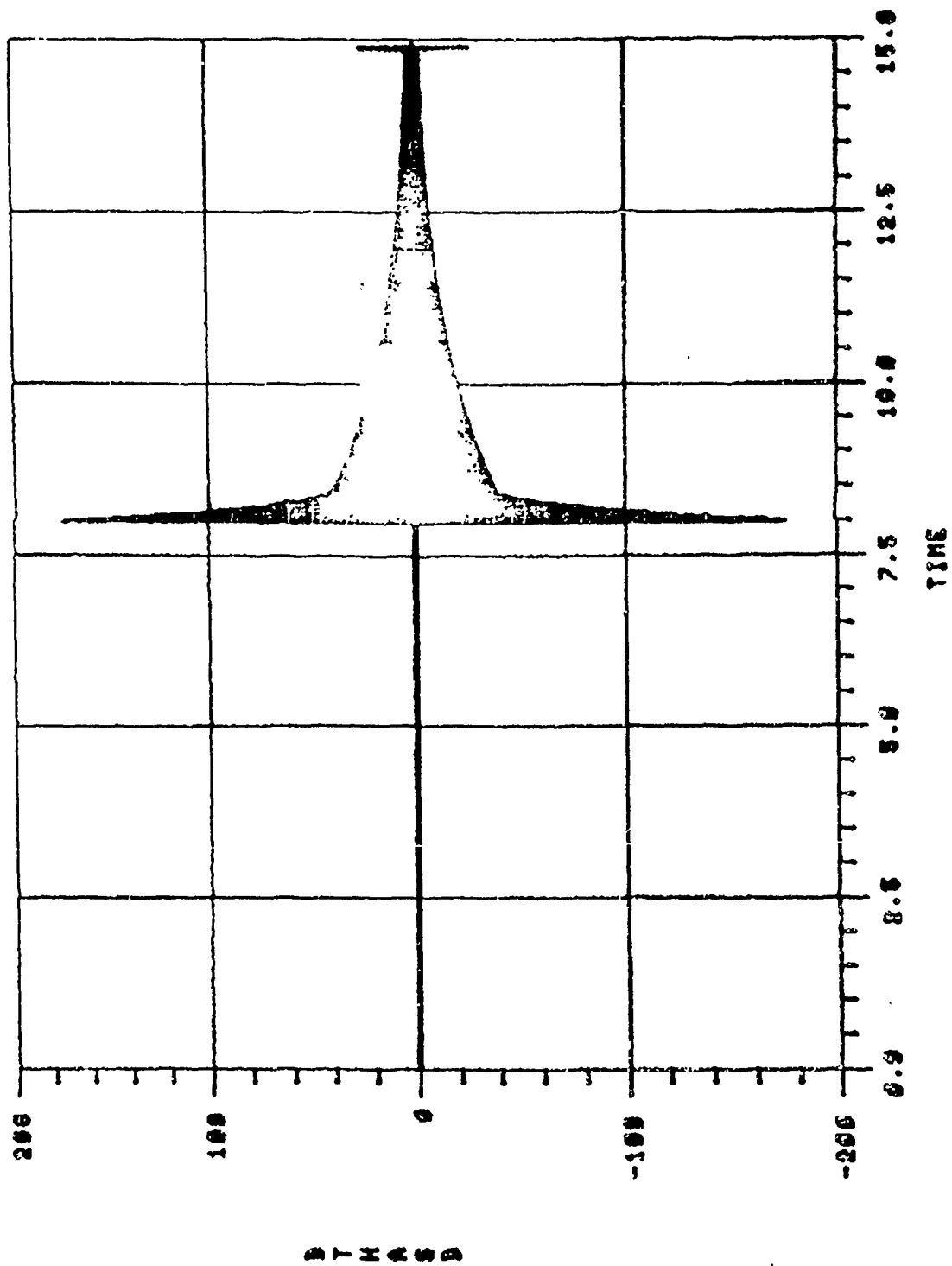


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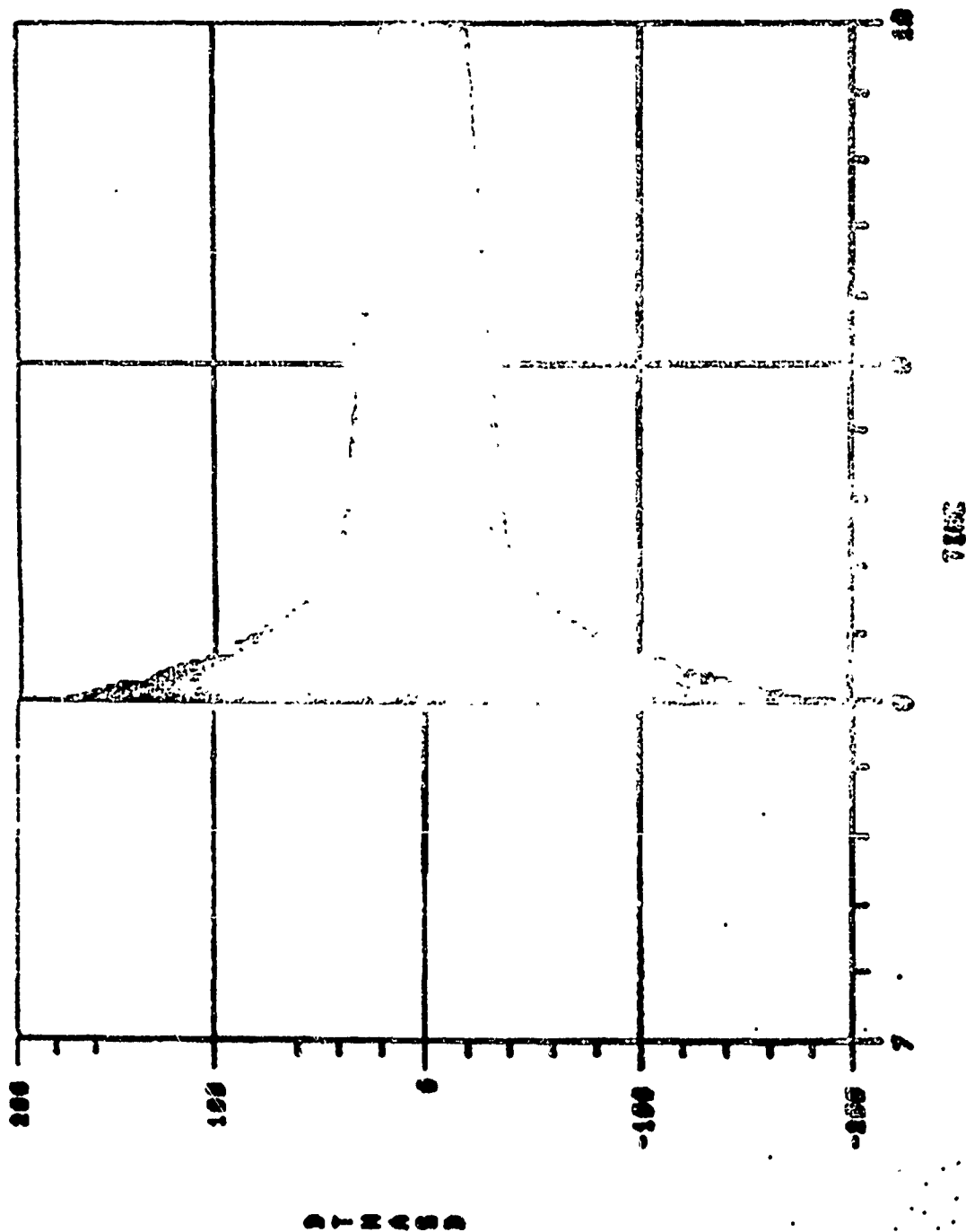


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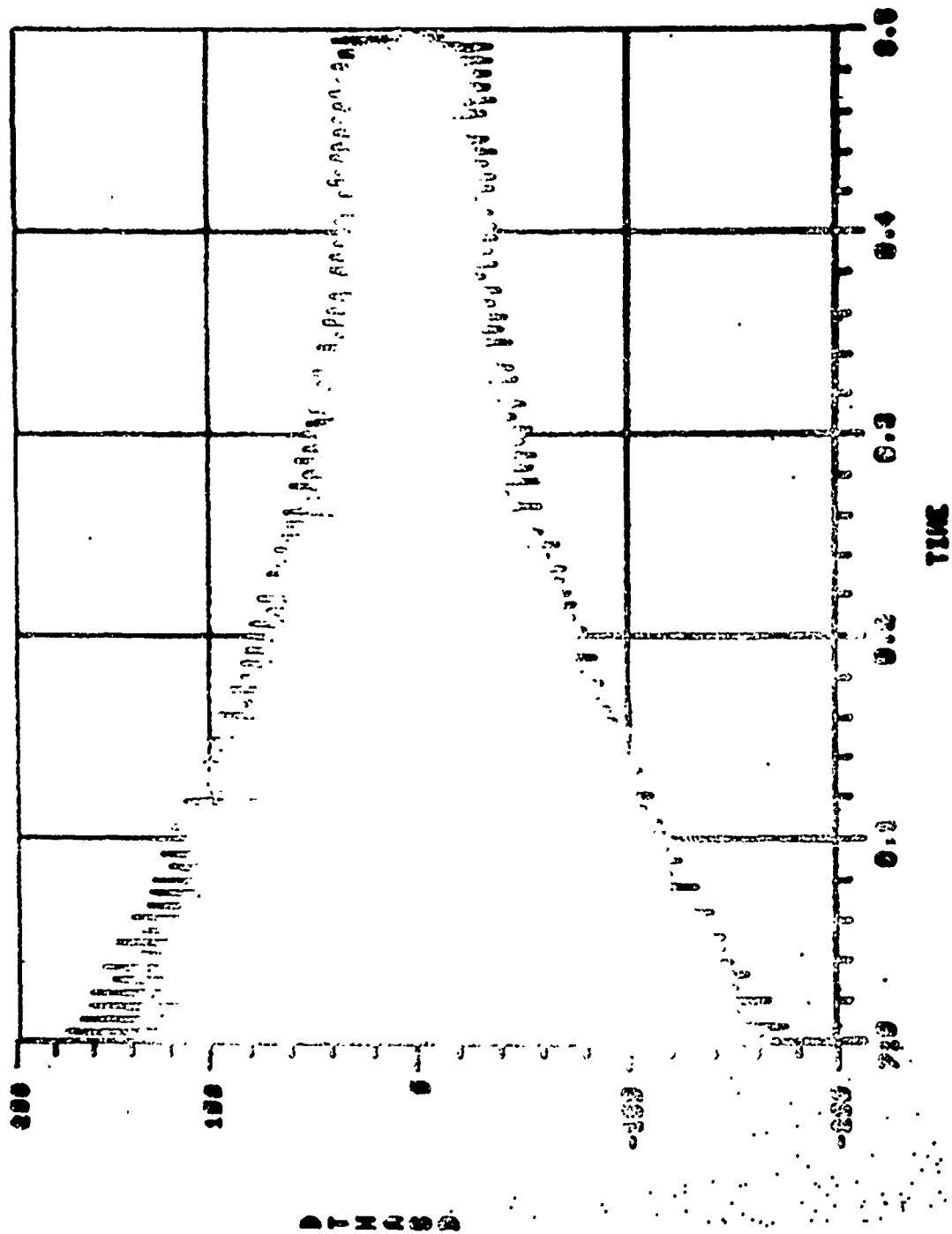


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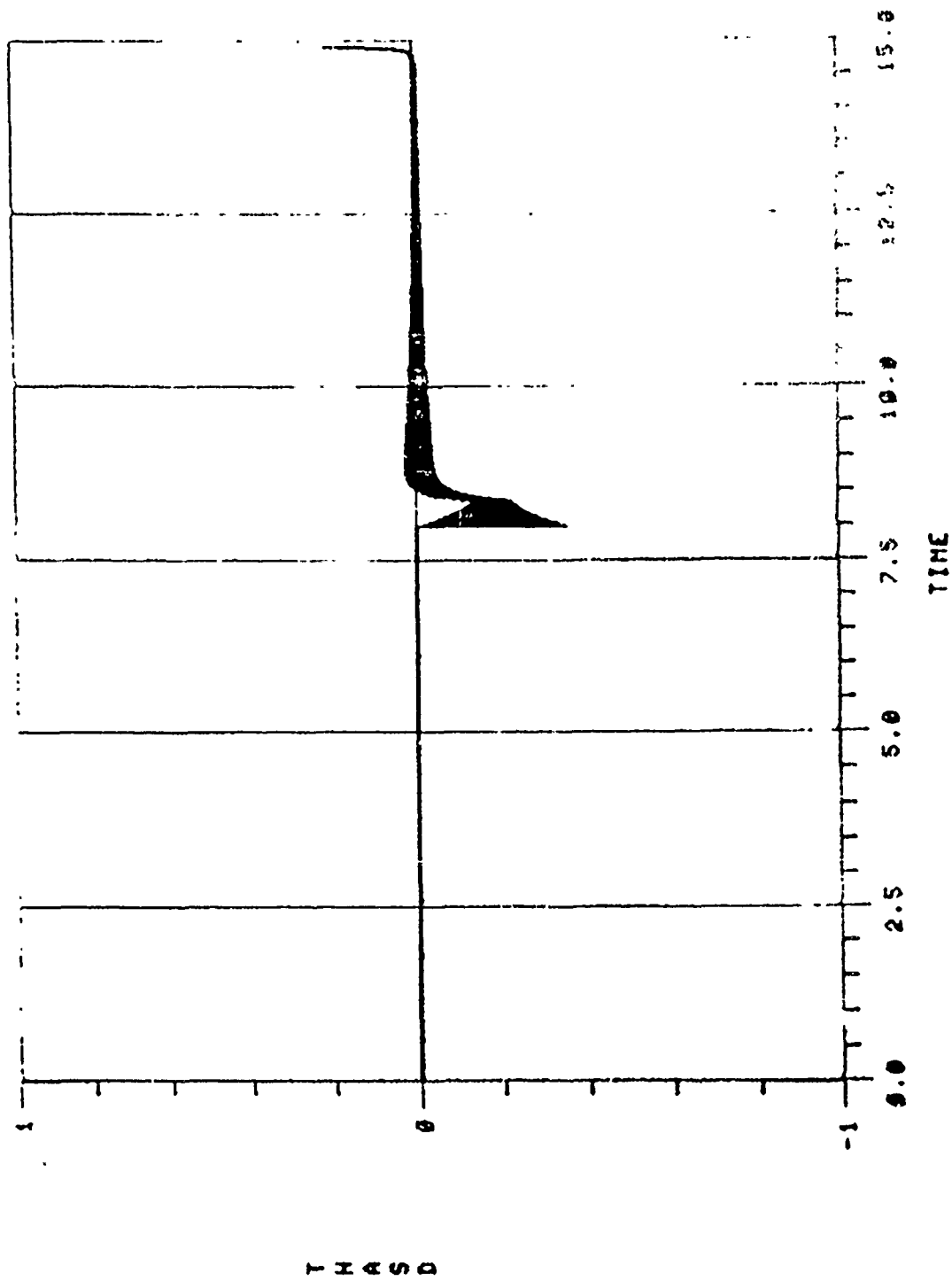


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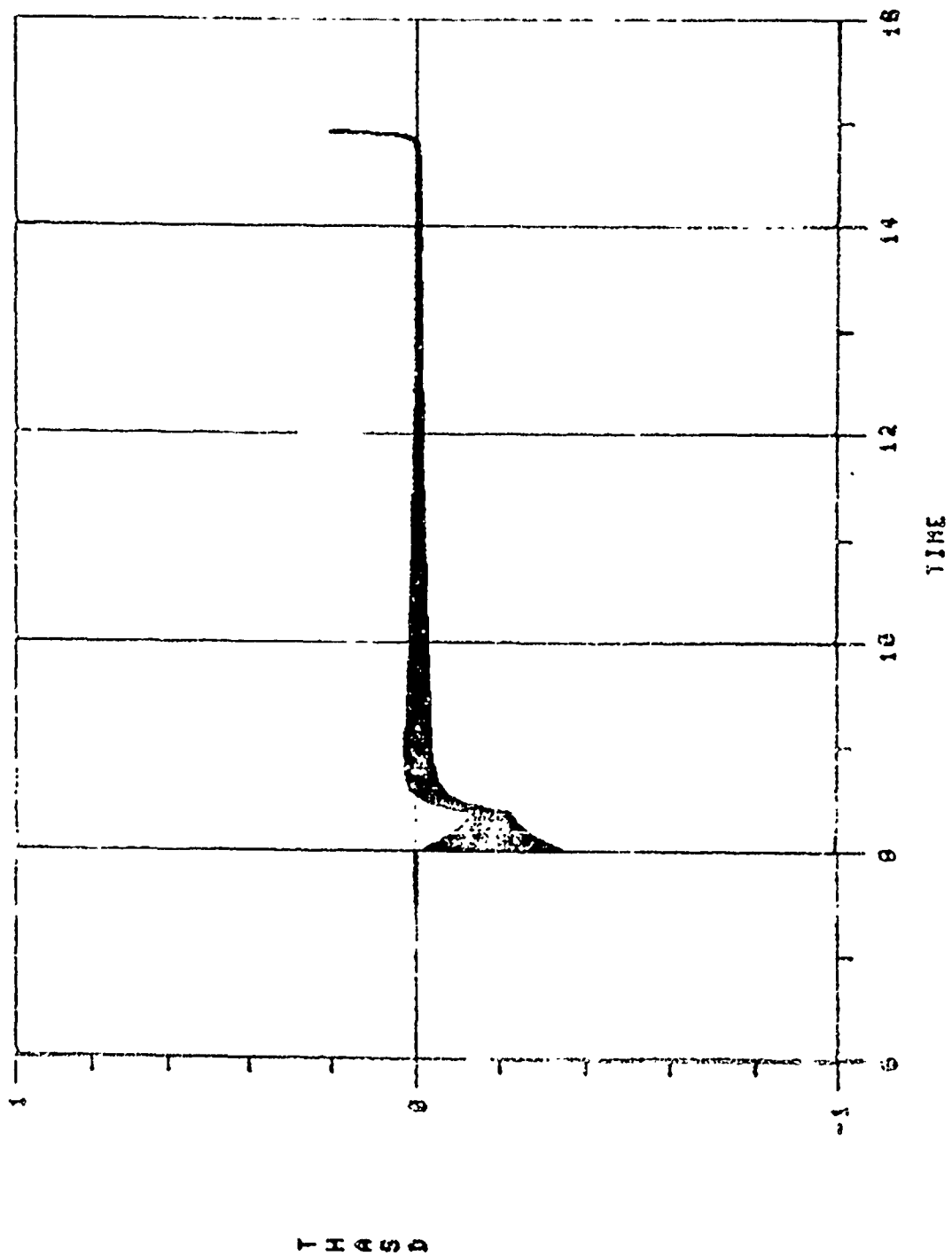


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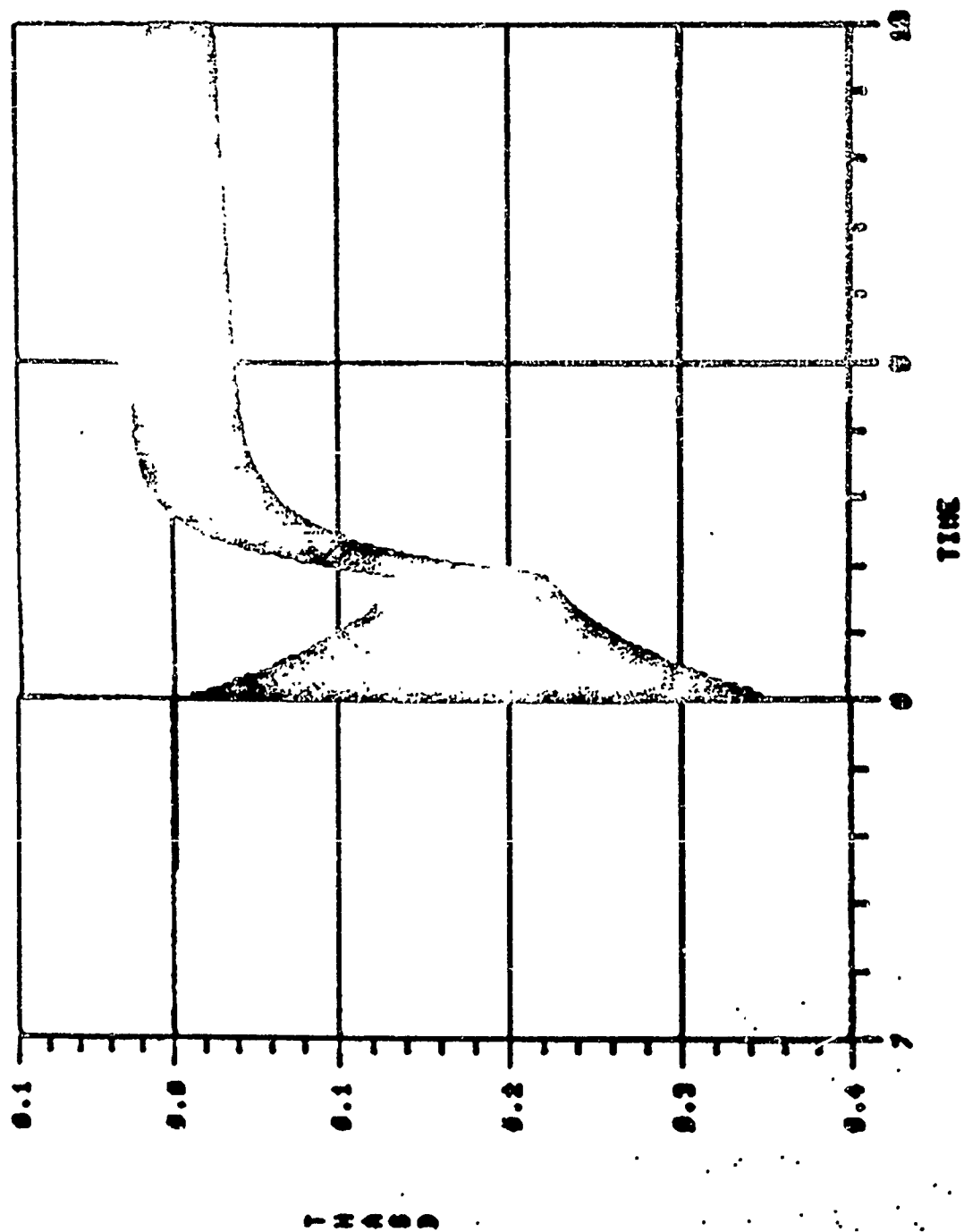


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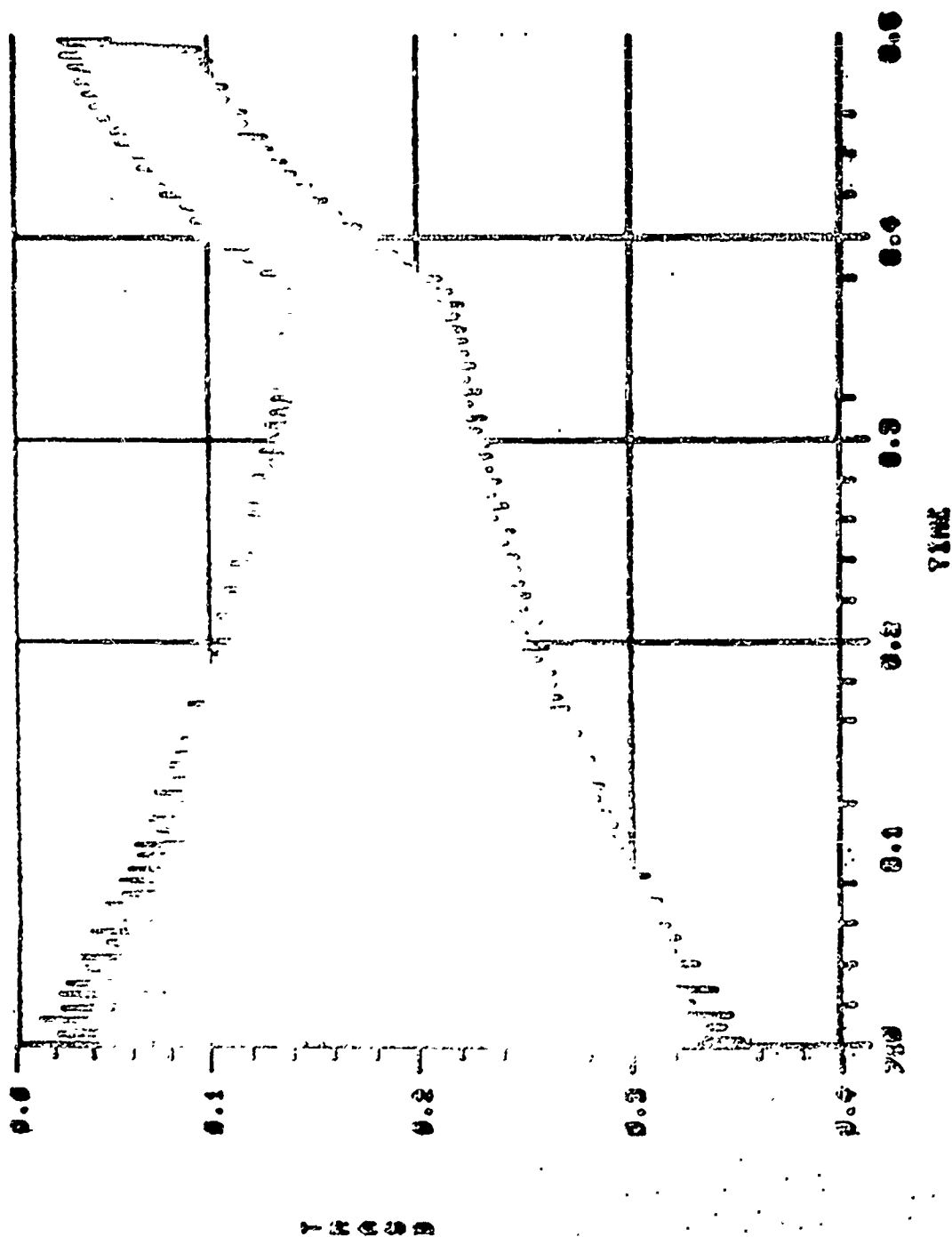


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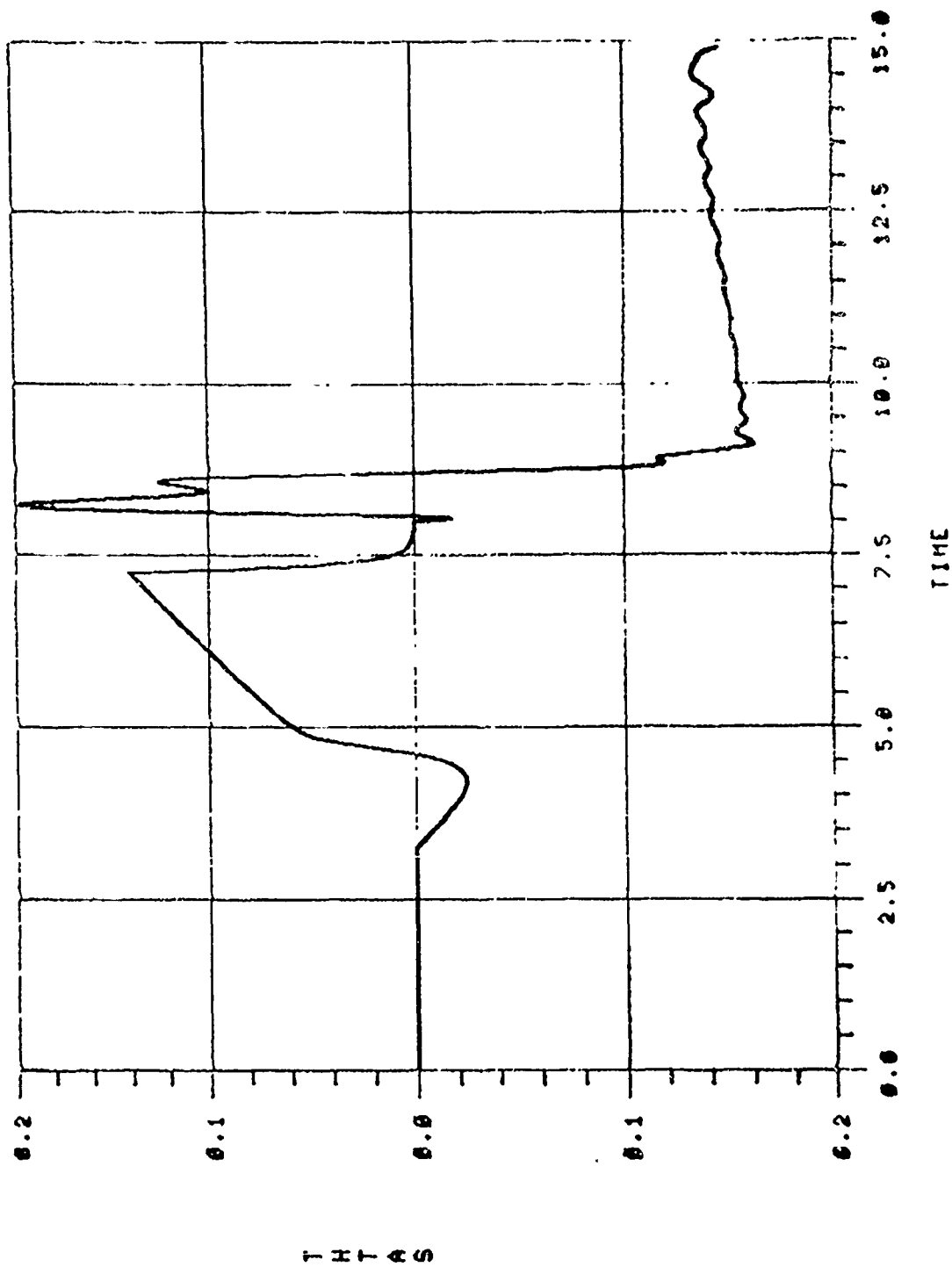


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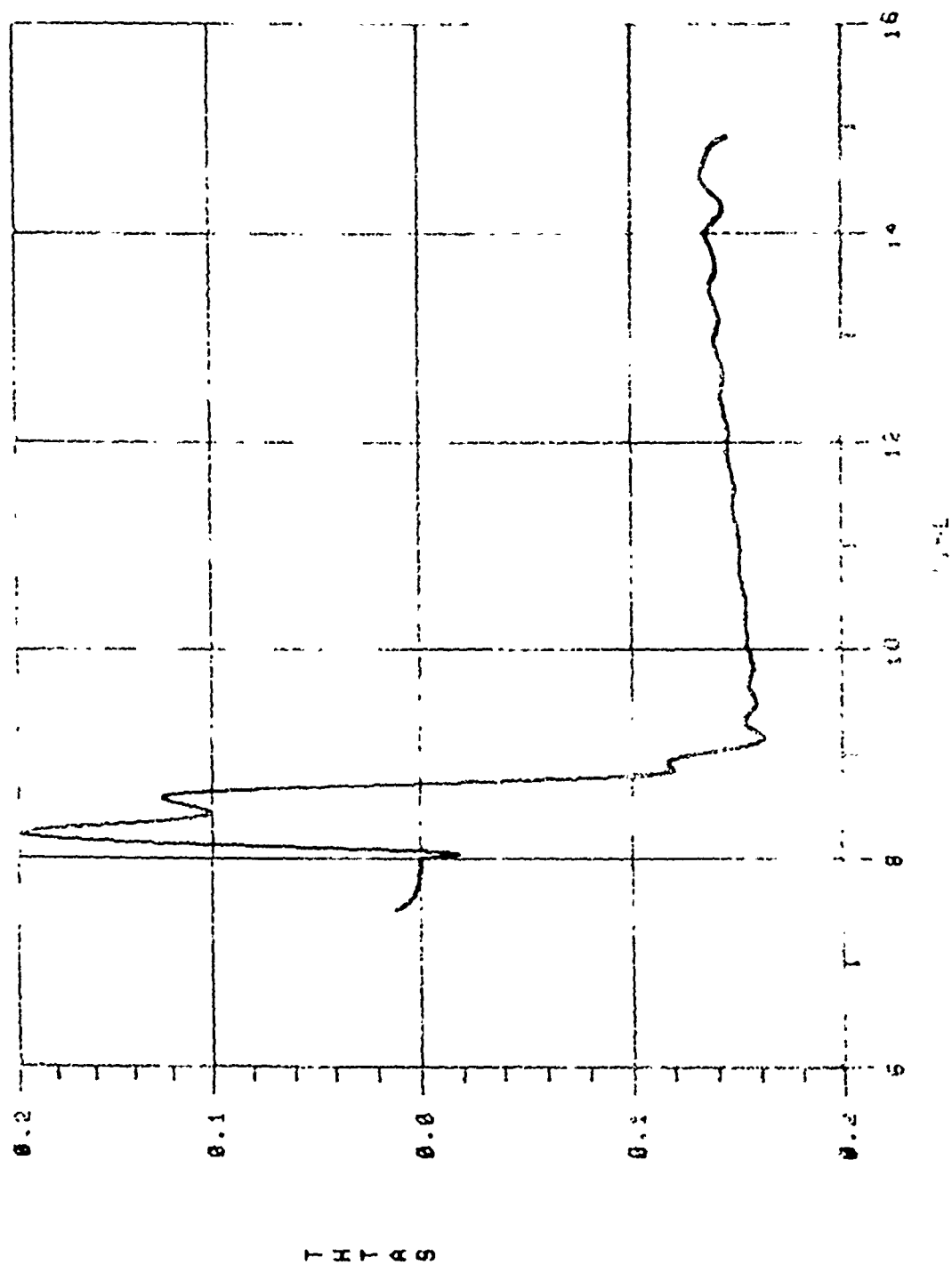


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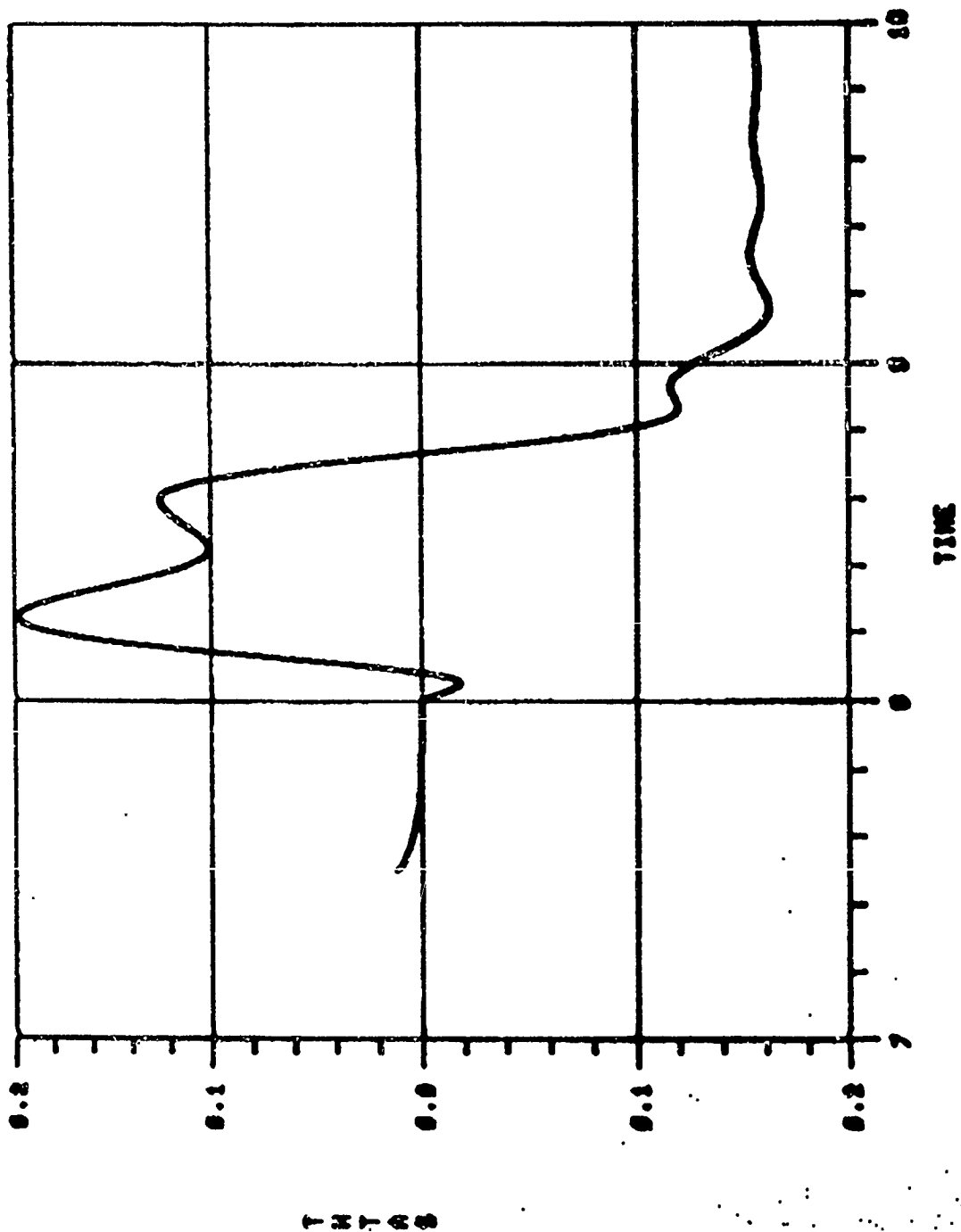


Figure 103.

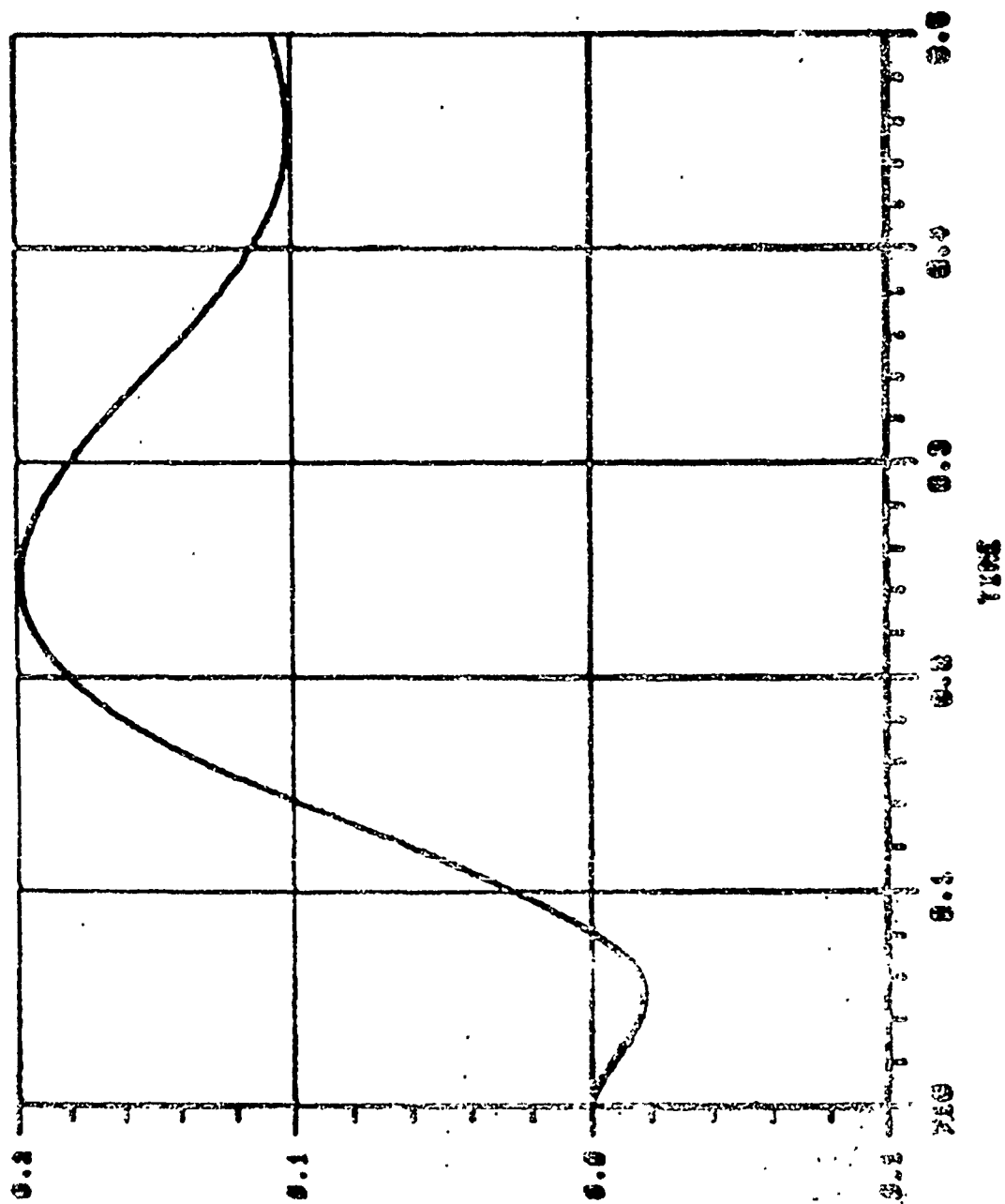


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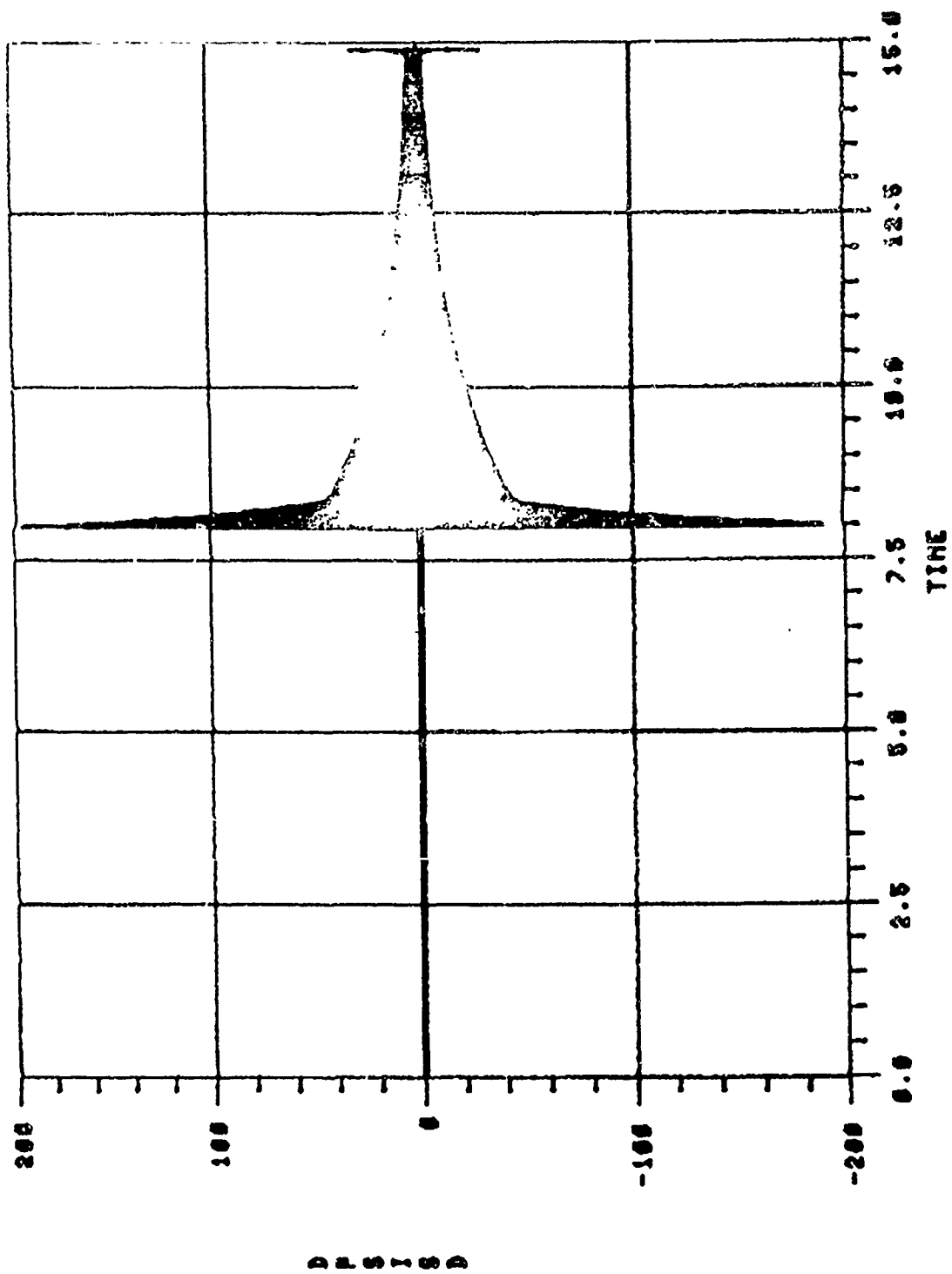


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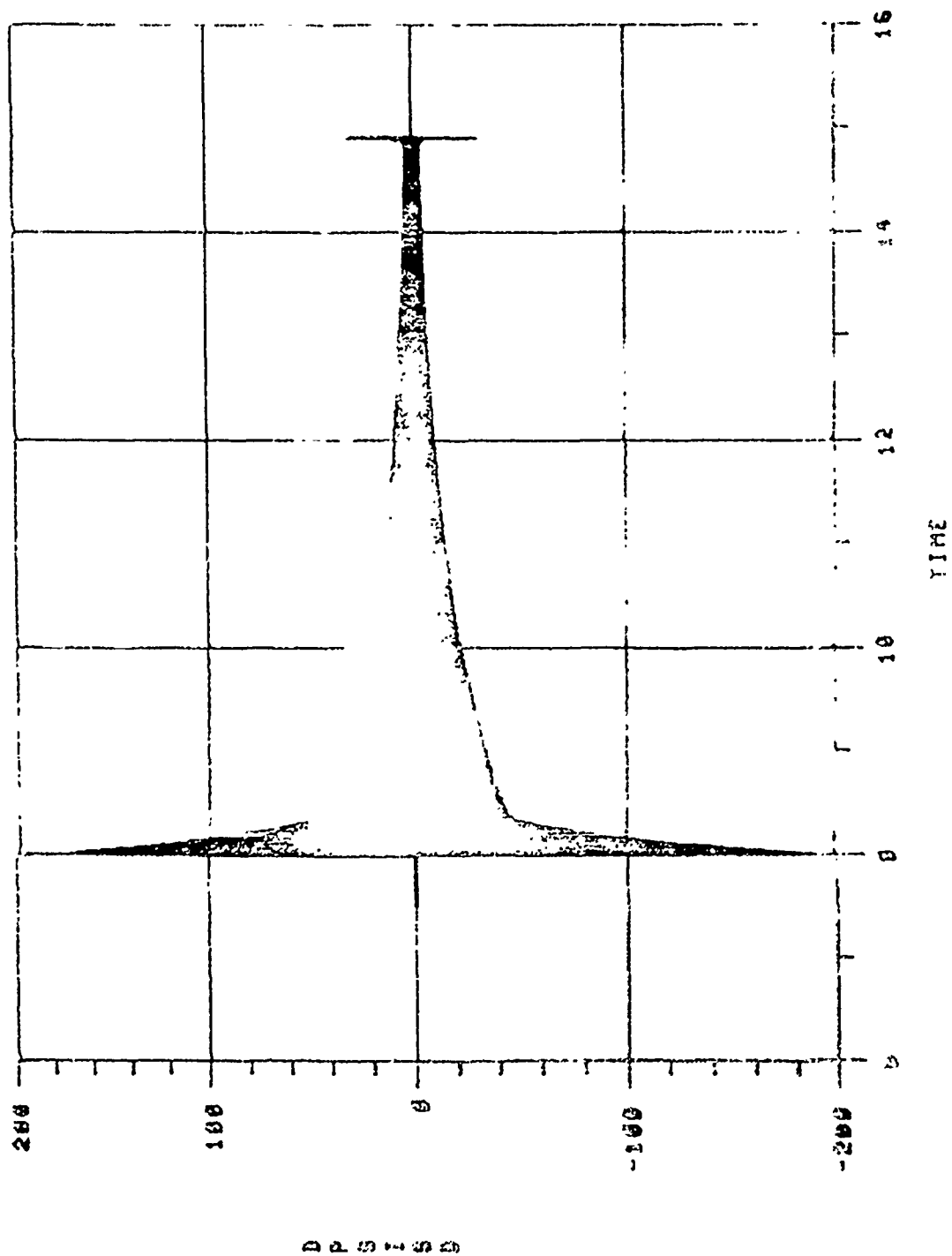


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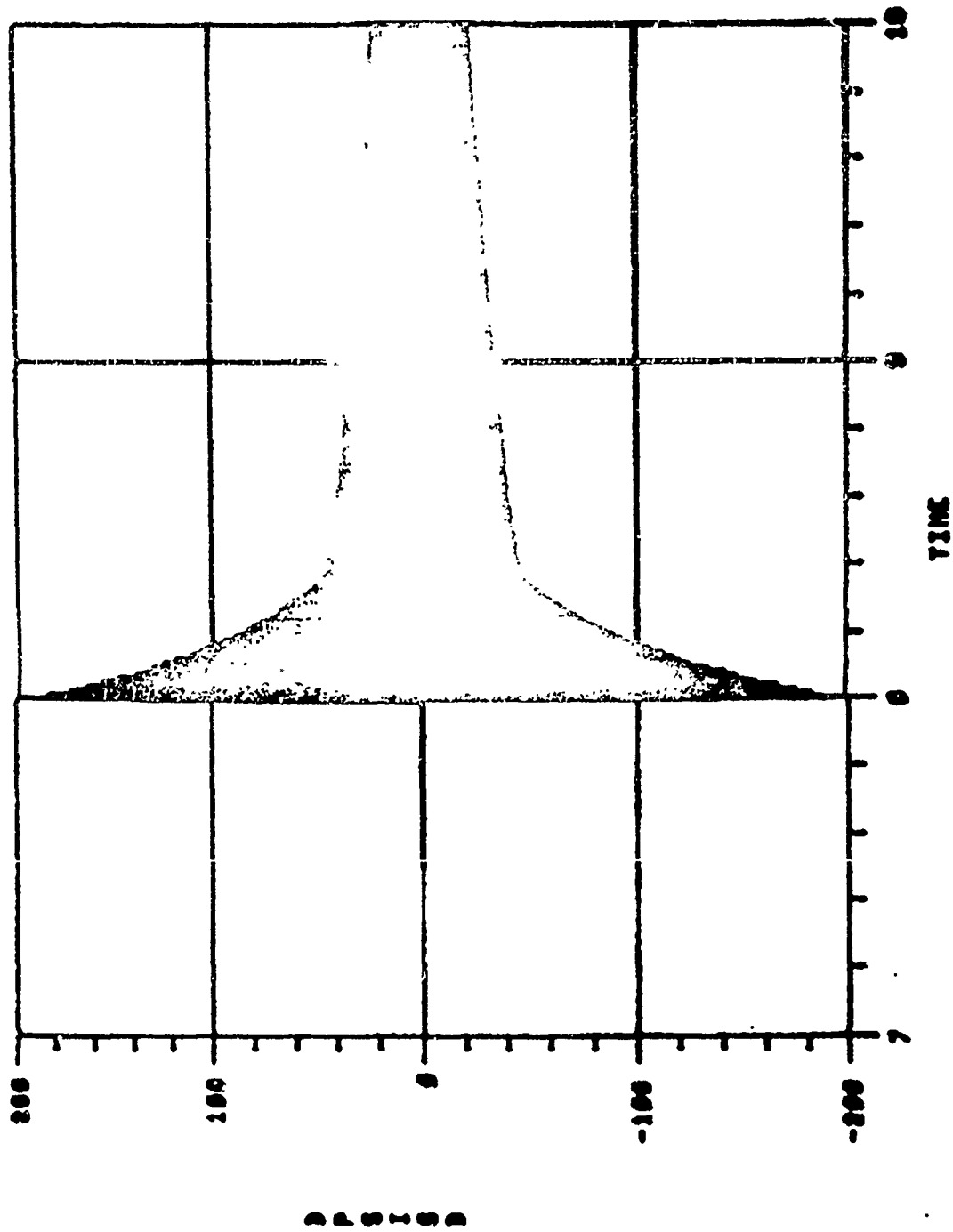


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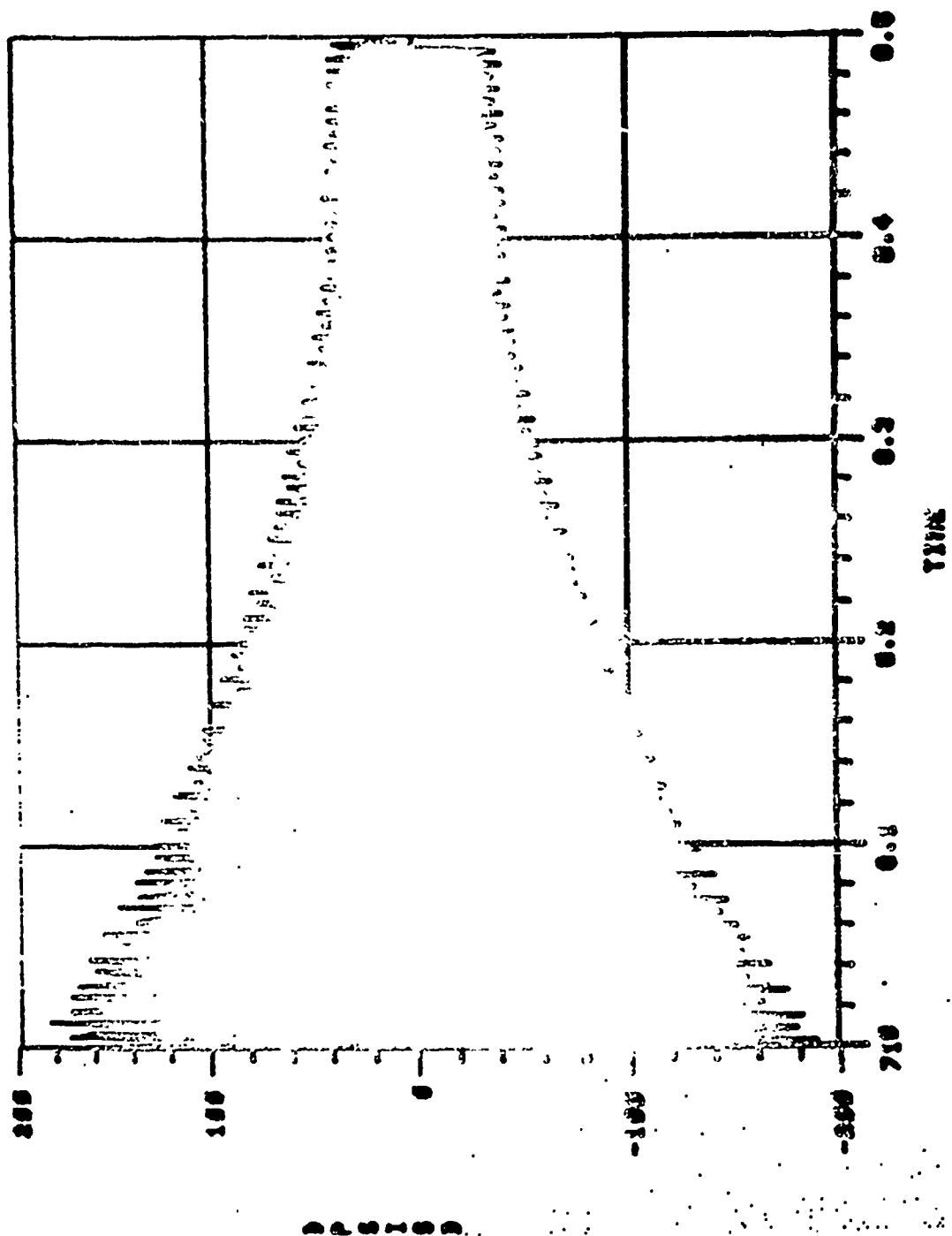


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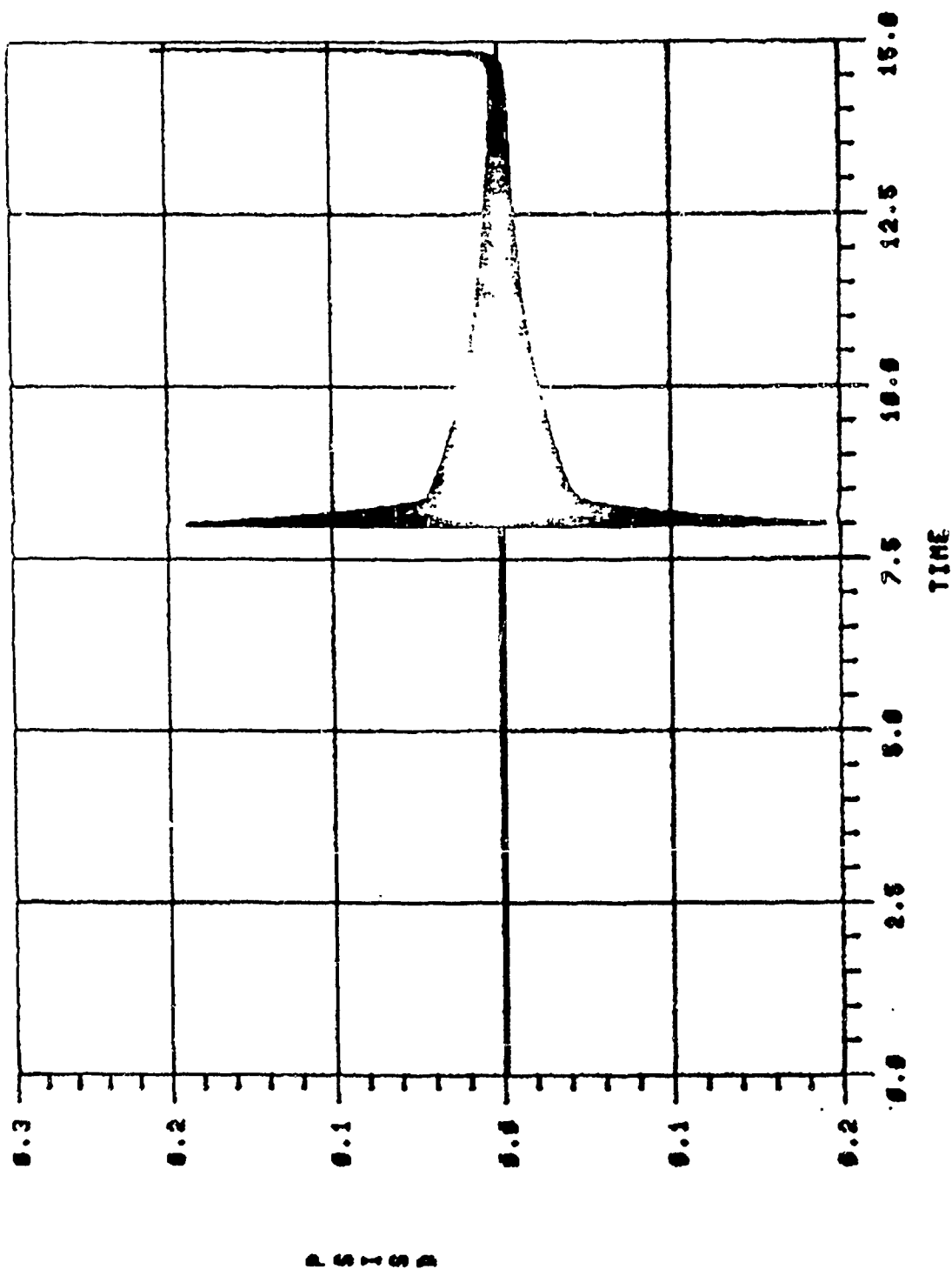


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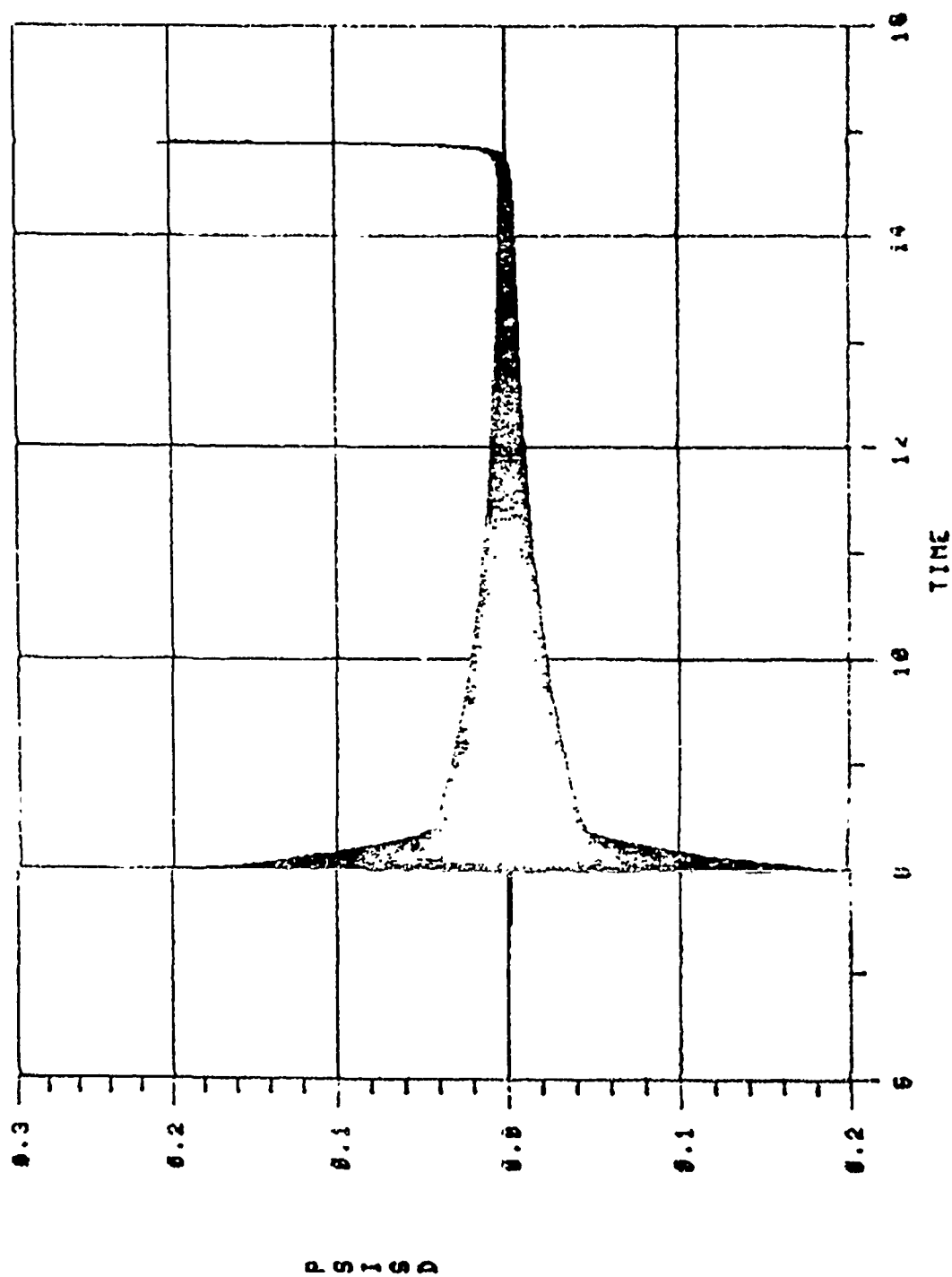


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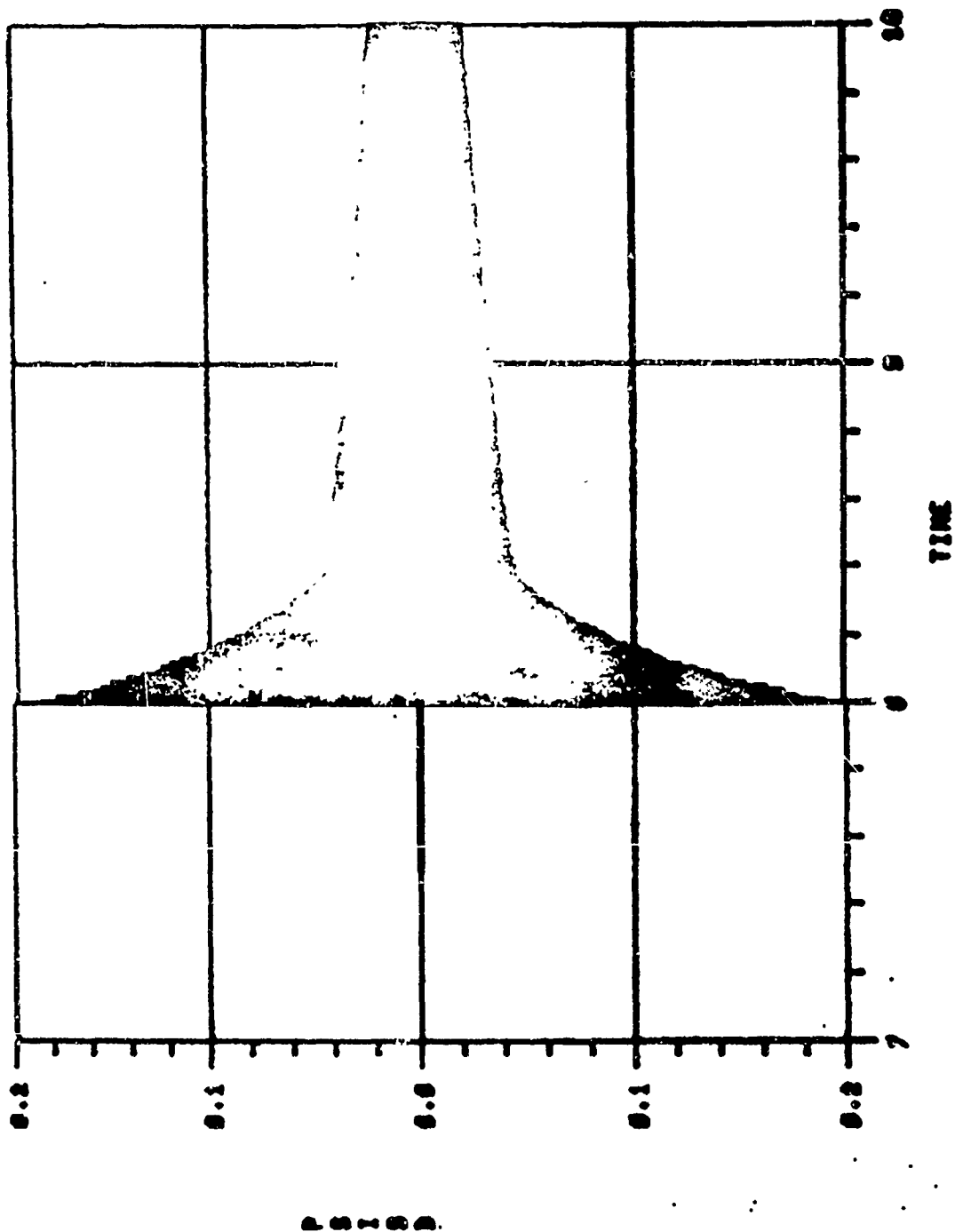


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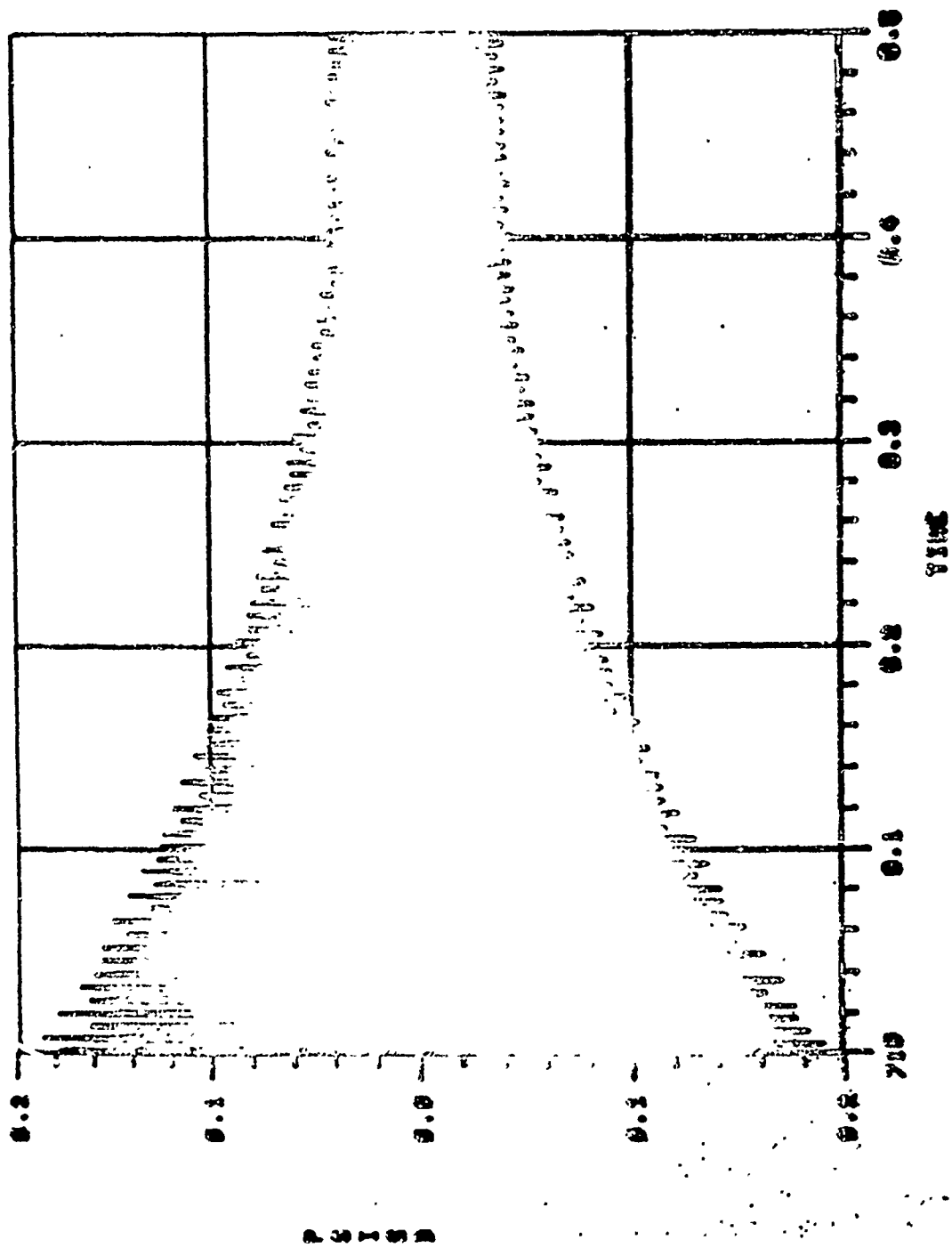


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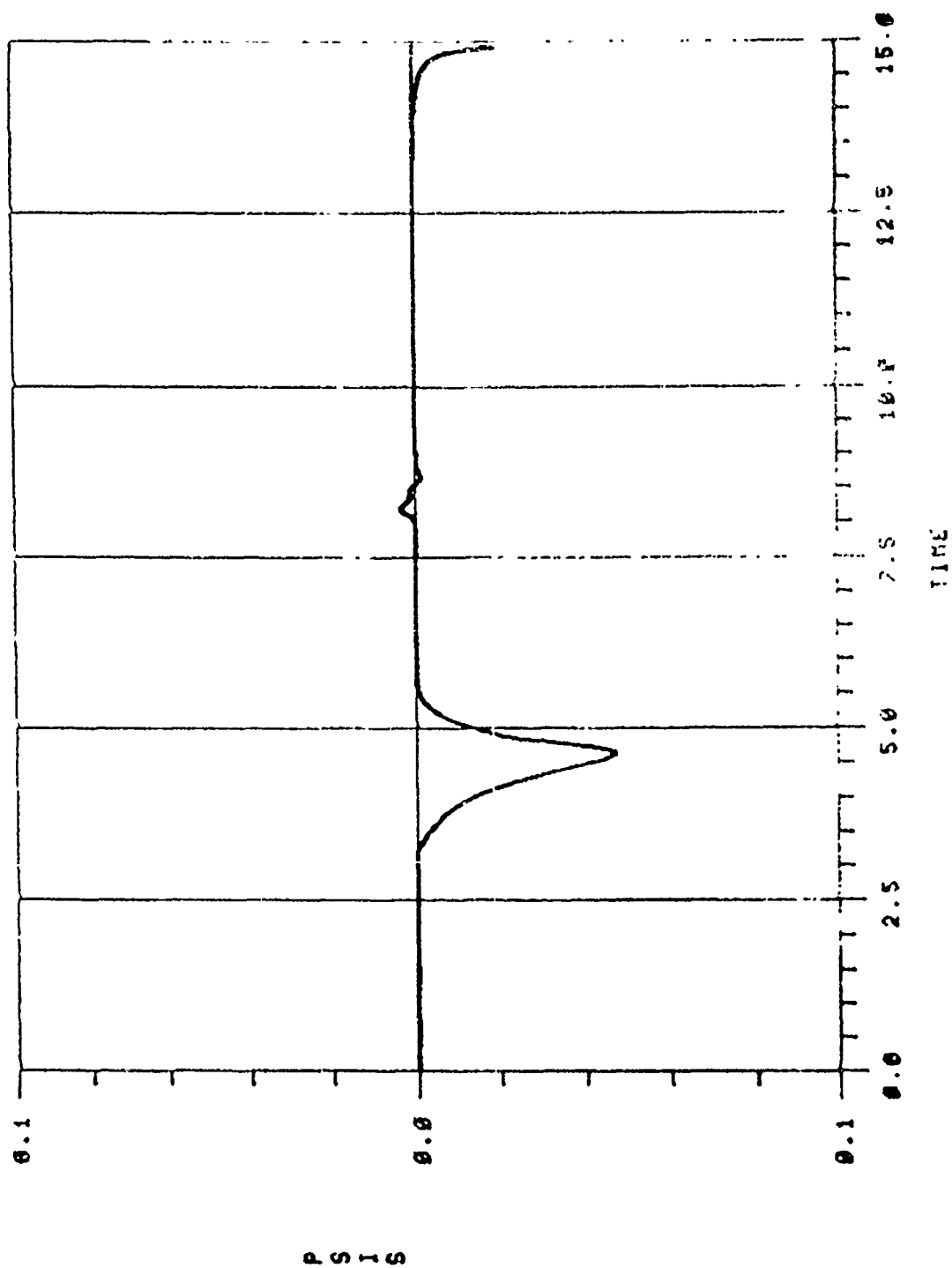
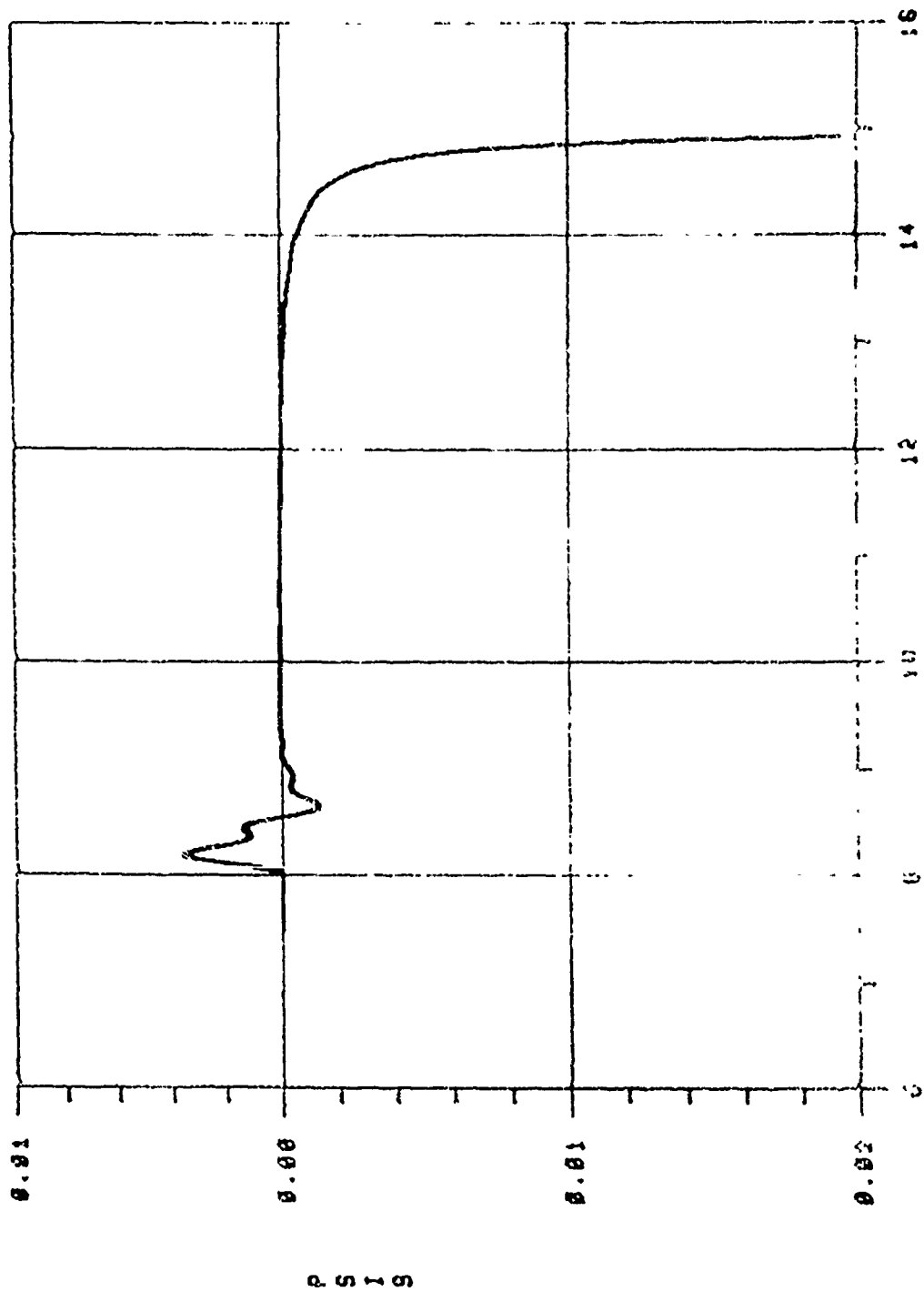


Figure 113.



Time

Figure 114.

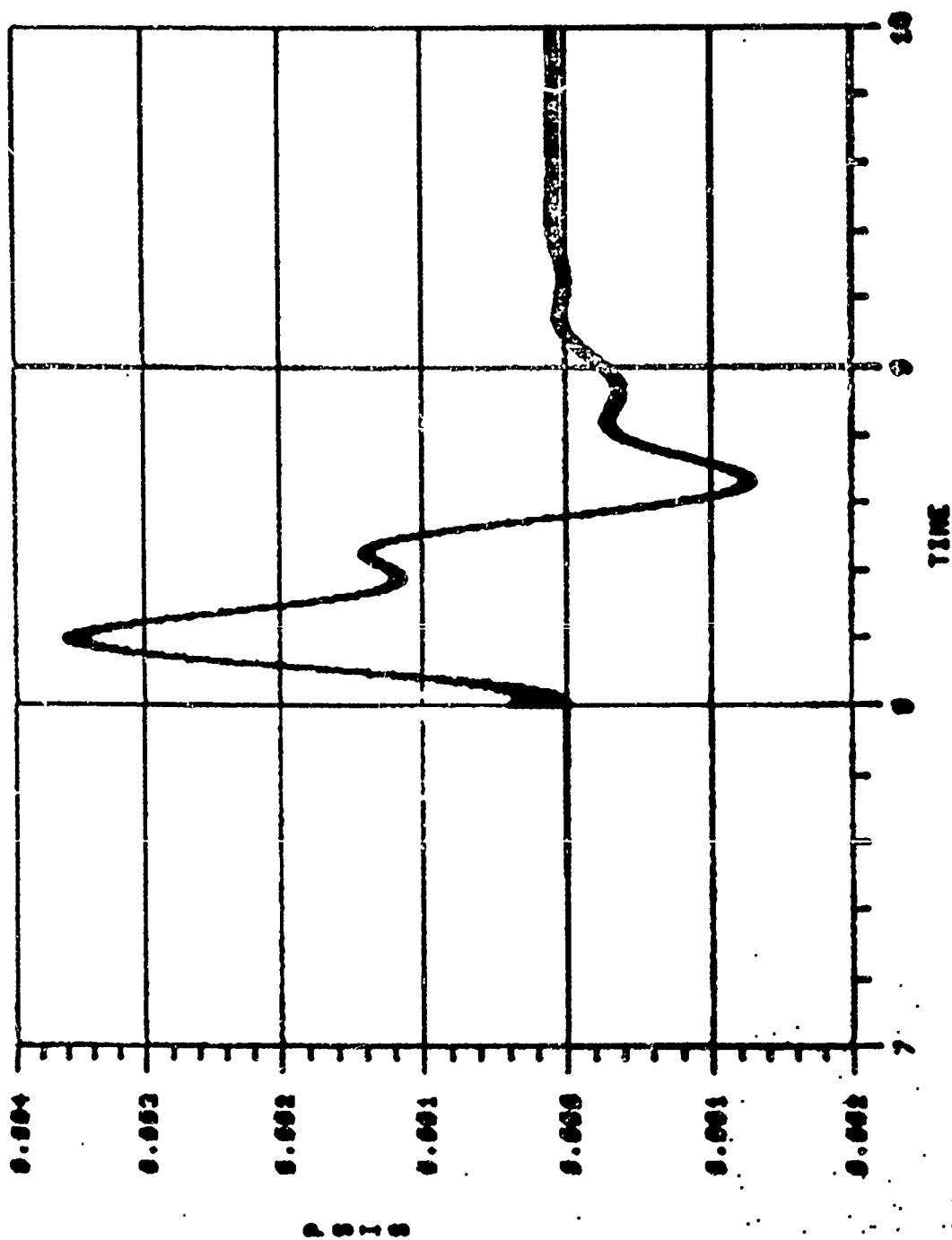


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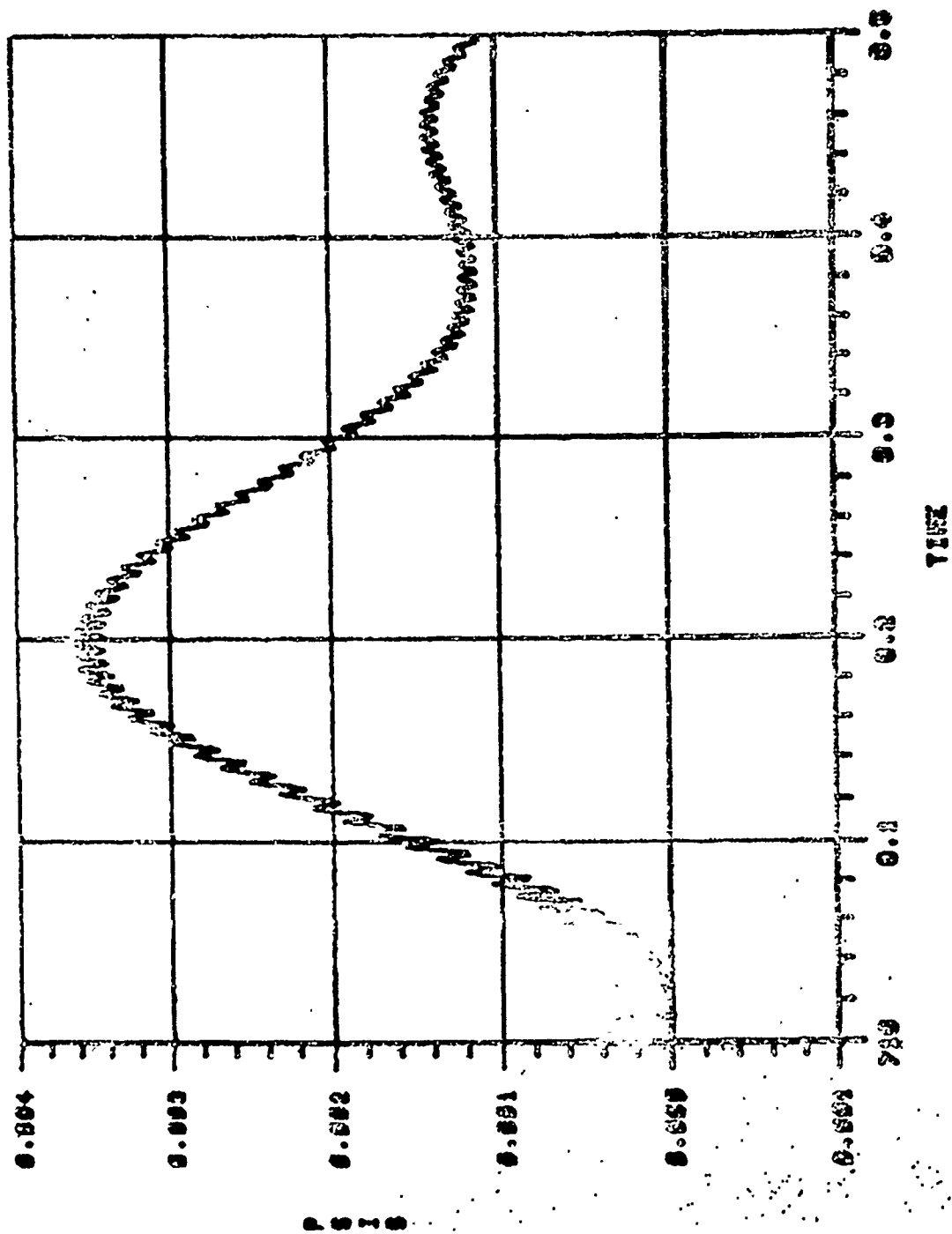


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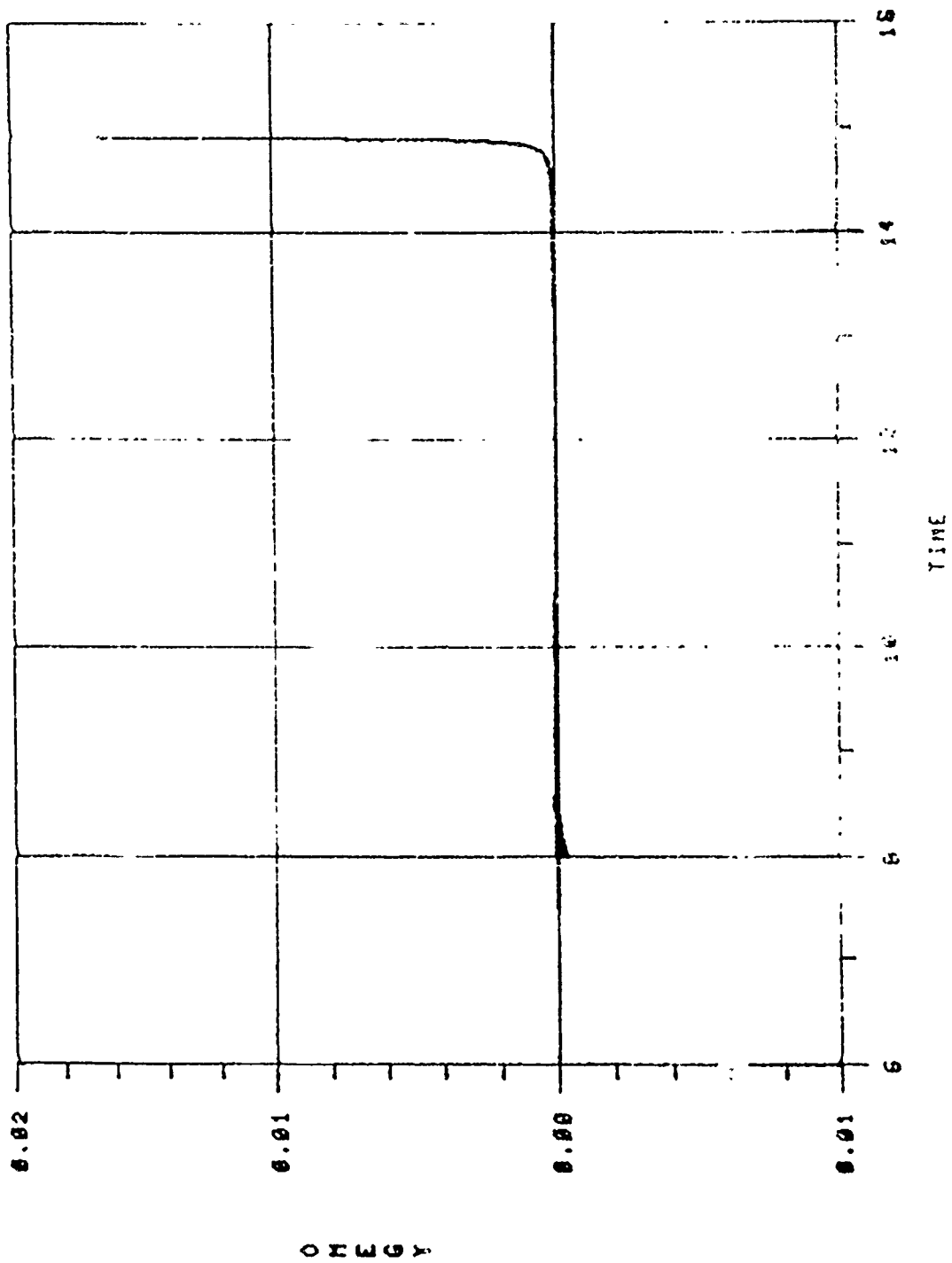


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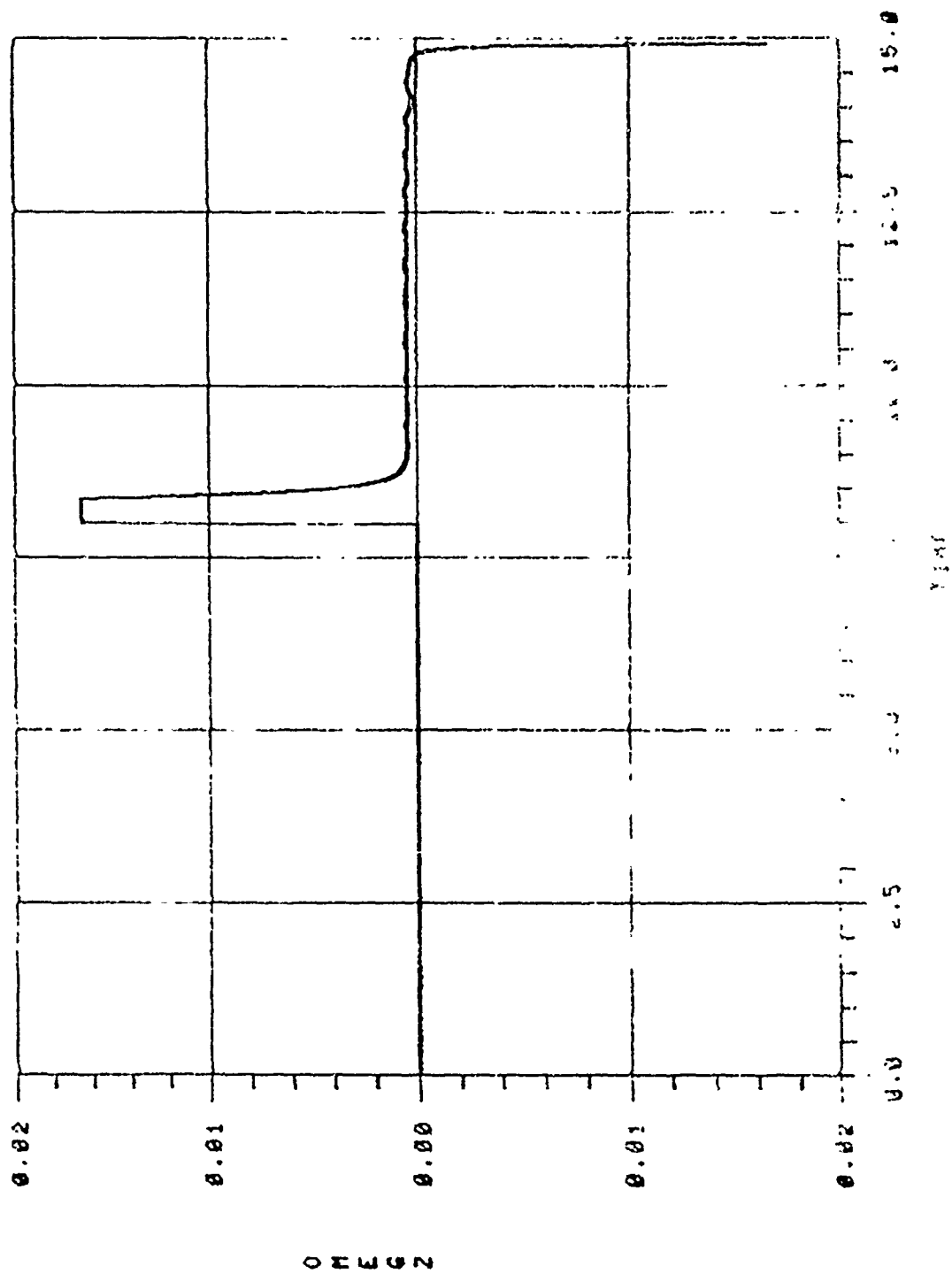


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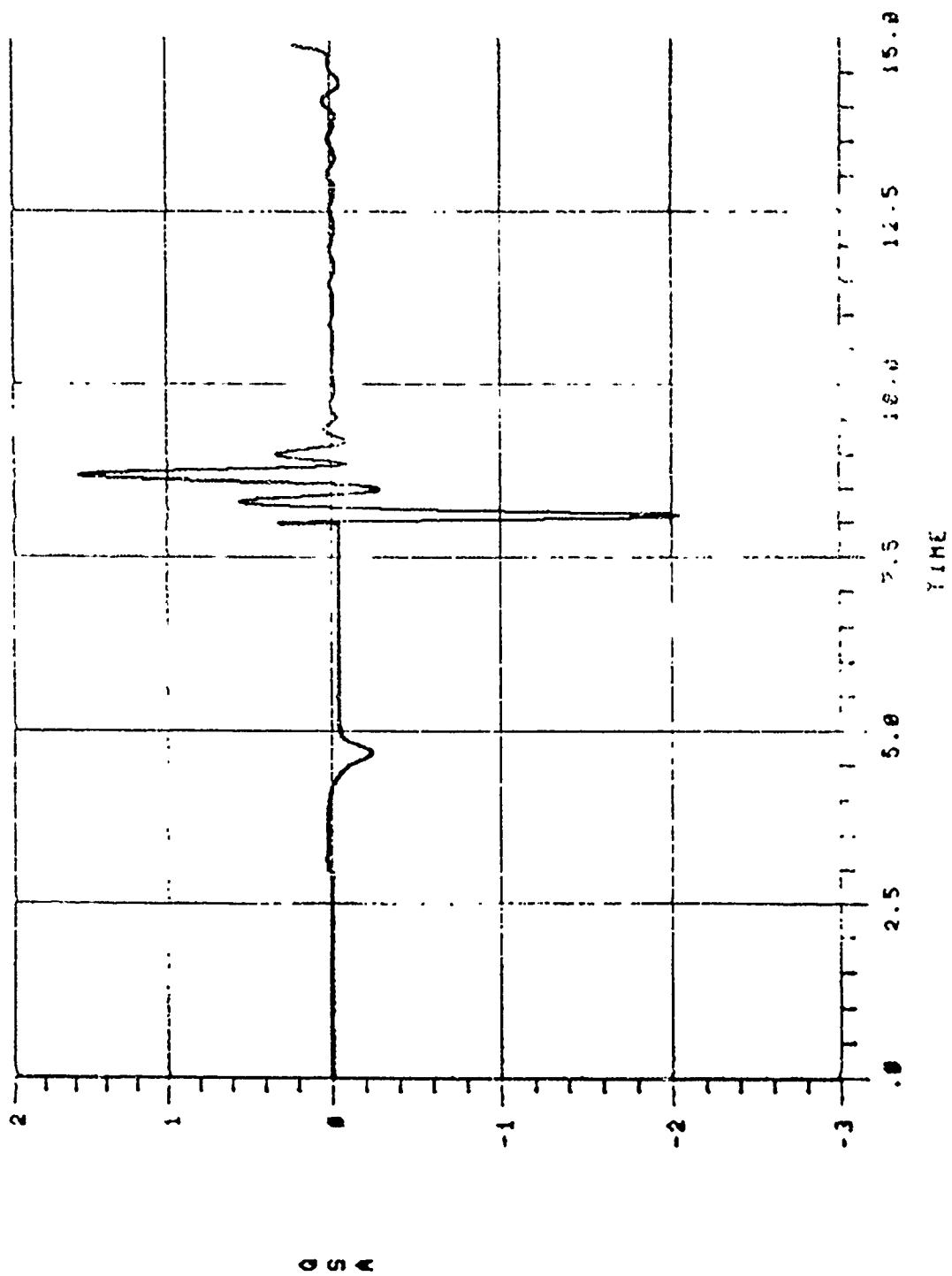


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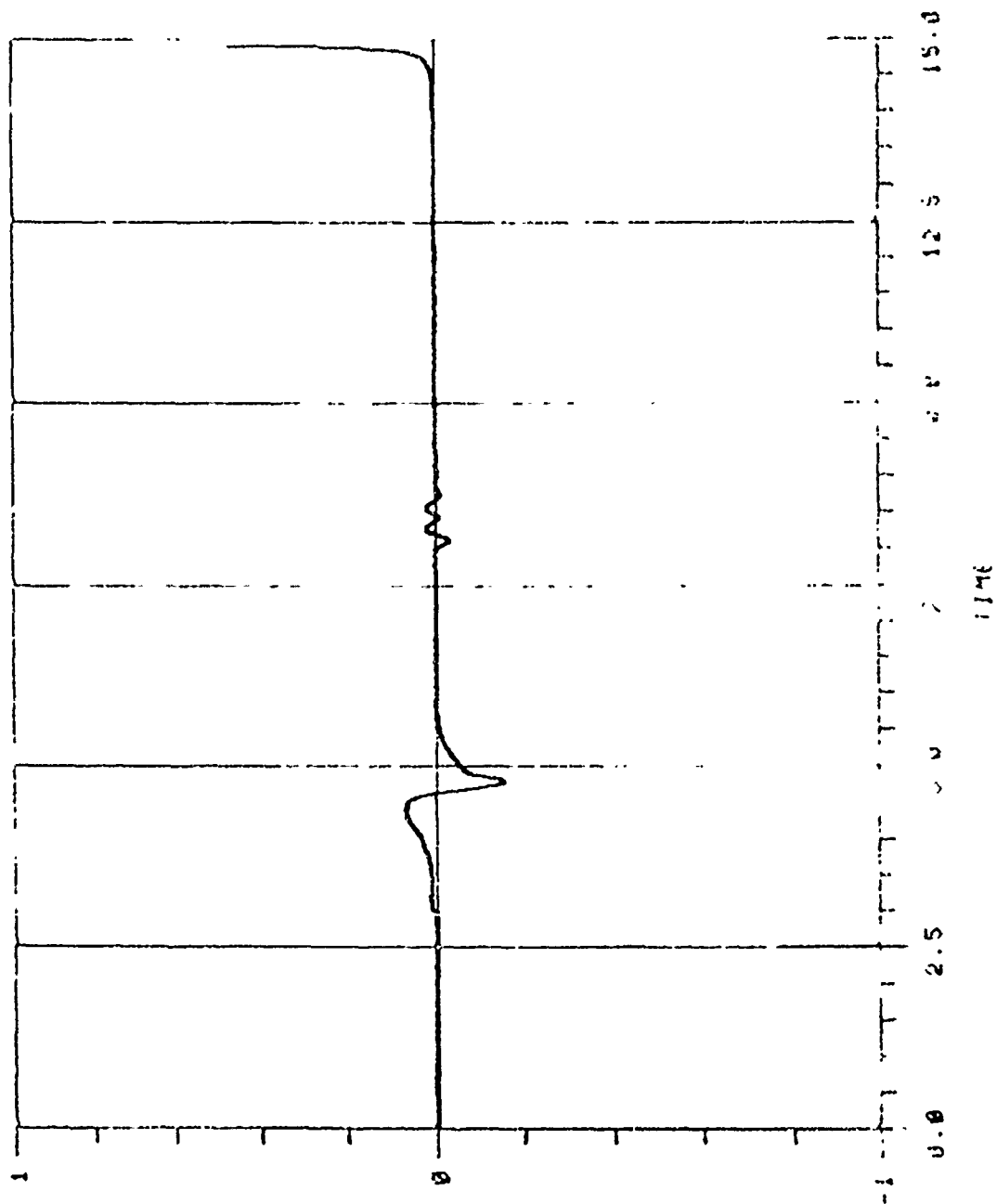


Figure 120.

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2. Pastrick, H. L. and Hollman, H. C., Analysis and Digital Simulation Models for CLGP: Martin Marietta Aerospace Design, US Army Missile Command, Redstone Arsenal, Alabama, 35809, December 1974, Report No. RG-75-29.
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Appendix A.

6-DOF DIGITAL MISSILE TRAJECTORY SIMULATION
WITH AN IDEAL GYROSCOPE MODEL

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JAR 409F,DIGITAL MISSILE TRAJECTORY SIMULATION WITH AN IDEAL GYROSCOPE MODEL
ATLBY (FILE,X6),(FORMAT,C),(FSIZE,1950),SAVE
UPDATE

1	C ***	AERODYNAMICS AS AT 12/20/72 AND MEASURED SEEKER PERFOR-
2	C ***	MANOE DATA AT 12/72.
3		EXTERNAL DERIVATIVES
4	1	CALL INITIAL (IS, DERIVATIVES)
5	2	CALL RUNGK
6		CALL FINISH
7		GO TO 2
8		END

```

1      S L R E S I T I A L I N I T I A L (FWDRL, DERIVS)
2      DOUBLE PRECISION DT, FSTSM, SPER, TME, TIME0, TIME1, TIME2, TIME3,
3      TIME4, TST, DTA, TIME
4      REAL KPC, KP, KQ, KY, KT10, KT20
5      REAL KT30
6      REAL KB, KGL, KP
7      REAL KG, KGL, KG, LAMP, LAMPY, LAMB1
8      REAL LP, KC, KS, KA, K5, KR
9      REAL MACH, MASS, IX, IYZ, IT, IA
10     REAL XAT(33), XBT(33)
11     COMMON/INTG/KUTTA, NX, DTRK, U, V, W, P, Q, R, PH1, TWTA, PSI, X, Y, Z, RTHTA,
12     1RPS1, THTAS, THASD, PSIS, PSISC, OMEGA, TXFD, PXFD, PEF, YEF, DEL1, DELVP,
13     2DEL3, COEL1, COELVP, COEL3, RLAMP, RLAMP, RPH13, RPH10, DU, DV, DW, CP, DP, DR,
14     3CPH1, CTHTA, RPS1, CX, CY, CZ, RTHTA, DRPS1, CTHTAS, CTASD, OPSIS, OPSISO,
15     4OMEGA, CTXED, DPXFD, DPEF, CYEF, COELP1, COELP2, COELP3, COELP4, COELP5,
16     5COELP6, COELP7, COELP8, COELP9, COELP10, COELP11, COELP12, COELP13, COELP14, COELP15,
17     16COMMON/ETB/EB11, EB12, EB13, EB21, EB22, EB23, EB31, EB32, EB33
18     17COMMON/STB/BS11, BS12, BS13, BS21, BS22, BS23, BS31, BS32, BS33
19     18COMMON/TOG/CPH1, SPS1, SPH1, CPH1
20     19COMMON/IN/ GAMP, GAMV, DELXTR, DELYTB, DELZTR
21     20COMMON/RTV/DELXV, DELYV, DELZV
22     21COMMON/DEL/DELX, DELY, DELZ
23     22COMMON/STUFF/ DELXS, DELYS, DELZS
24     23COMMON/NPSKR/PTERR, YAWERR
25     24COMMON/MACL/MACH, VSVC, UR, VR, WR, VRS, VRW, VJ
26     25COMMON/F/WXL, WYS, WZS
27     26COMMON/COEF/CAZ, CV, CN, CLP, CMCG, CYCG, CLD, CMG, CNR, ALPHA, BETA, GAMAD,
28     27ICLXAC
29     28COMMON/TOG/AXB, AYB, AZB, CLB, CNB, ALB, AMB, ANB, CMB
30     29COMMON/CO/DELXV, DELYV, DELZV, DELR, DELR9L
31     30COMMON/JUNK/TIME, TIME3, RH0, S, D, SCUM, CAP, IRAP, RAPTH1, RAPTH2, IACT,
32     31SLUFF1, RT1, RAPTH3, SLOPE2, ST2, CTT, CPT, SPT, XLTA, STT, GAPS, GAPSD,
33     32CAPSCM, TH
34     33COMMON/FF/FFCLB, FFCMB, FFCNB, FFAXB, FFAYB, FFAZB, FFALB, FFAMB, FFANB
35     34COMMON/GB/GBB, GVB, GZB
36     35COMMON/JUNK1/TNOLD, TRCLLO, MASS, IX, IYZ, XINTIA, NAVY
37     36COMMON/PO/GERALT, TB, TORAD, RH0BL, ARS1, WTH0L, RSTAR,
38     371RMBE, ARU2, GY, TMSL
39     38COMMON/TT/FSTSM, TIME4, DT, DTA, TST, TME, SPER, TSAM, DO, JMAX, IPRINT, T2
40     39COMMON/JUNK2/GRACE, TPUP, TACC, RDET, YAWERS, PTERR, PHFOV, BA, RNGLIN,
41     401PITYASC, R20, NULSKR, BRS, REFLECT, NULL, KAGE
42     41COMMON/BOH/BSL, KT, KT10, KT20, LAMP, LAMPY, RTH, RTHIN, RSSE, ED1, FLO4,
43     421RSA, FO4, QSA
44     43COMMON/PERV/PEOV, ME03Z
45     44COMMON/PUTAP/VEG, REG, PEG
46     45COMMON/XRR0X/PH10, FLG1, FLG2, FLG3, REF, RPL, YED, PED, THRS0, PSR06,
47     461THRS, PSBS, GRLV, PFFL, KPD, KG, KP, KB, LAMB1, POLES
48     47COMMON/SS/S1, S2, S3, S4, S5, S6
49     10COMMON/GP/R9, RR, W, A, B, KT30
50     20COMMON/STUFF1/DELXS, DELYS, DELZS
51     30C
52     40C
53     50C
54     60C
55     70C
56     80C
57     90C
58     100C
59     110C
60     120C
61     130C
62     140C

```



```

170      C      INPUT VALUES
171      C
172      GATE(001) * RST; GATE(002) * RST; GATE(003) * RST; GATE(004) * RST-----
173      GATE(005) * RST; GATE(006) * RST; GATE(007) * RST-----
174      TIME      * DOUBLE(001)
175      AX        * FIXED(001); AXM      * FIXED(002)
176      IPRINT    * FIXED(003); APPS     * FIXED(004)
177      ADY       * FIXED(005); ADYA     * FIXED(006)
178      KAGE      * FIXED(007); KULSKR   * FIXED(008)
179      XAVY      * FIXED(009); TOUIM     * FIXED(010)
180      IFLM      * FIXED(011); IRALL    * FIXED(012)
181      ISKR      * FIXED(013); IRAP     * FIXED(014)
182      IACT      * FIXED(015); IRALLDC  * FIXED(016)
183      IACG      * FIXED(017); KULL     * FIXED(018)
184      KAGE      * FIXED(019); TOUM     * FIXED(020)
185      ICLM      * FIXED(021); TOUM     * FIXED(022)
186      ICLM      * FIXED(023); TOUM     * FIXED(024)
187      ICLM      * FIXED(025); TOUM     * FIXED(026)
188      ICLM      * FIXED(027); TOUM     * FIXED(028)
189      ICLM      * FIXED(029); TOUM     * FIXED(030)
190      FLGS      * LOGICAL(001); IMPACT * LOGICAL(002)
191      ENFRW     * LOGICAL(003)
192      WTMAL     * REAL(001); T9        * REAL(002)
193      GO        * REAL(003); TORAD     * REAL(004)
194      QO        * REAL(005); RWBSL     * REAL(006)
195      QSTAR     * REAL(007); CG        * REAL(008)
196      PASS      * REAL(009); IX       * REAL(010)
197      ITT       * REAL(011); D        * REAL(012)
198      REFLECT   * REAL(013); PI       * REAL(014)
199      WACR      * REAL(015); R2       * REAL(016)
200      FSTSYM     * DBLE(REAL(017)); BRS * REAL(018)
201      DELROL     * REAL(019); LAMPRI   * REAL(020)
202      KB        * REAL(021); KQ       * REAL(022)
203      KU        * REAL(023); KROL     * REAL(024)
204      PC        * REAL(025); RVBIAS    * REAL(026)
205      RF        * REAL(027); S3       * REAL(028)
206      AF        * REAL(029); BRS      * REAL(030)
207      PLIMAX    * REAL(031); RTOL     * REAL(032)
208      RA        * REAL(033); CS       * REAL(034)
209      KP        * REAL(035); GC       * REAL(036)
210      KGL       * REAL(037); FFCLB    * REAL(038)
211      FFCMB     * REAL(039); FFCNB    * REAL(040)
212      FFAXB     * REAL(041); FFAYB    * REAL(042)
213      FFALB     * REAL(043); FFALB    * REAL(044)
214      FFAPB     * REAL(045); FFAB     * REAL(046)
215      BMMCB     * REAL(047); PCL      * REAL(048)
216      YCL       * REAL(049); TWTAC    * REAL(050)
217      GF        * REAL(051); CLO      * REAL(052)
218      IA        * REAL(053); IT       * REAL(054)
219      KC        * REAL(055); RVGLI    * REAL(056)
220      PLFV      * REAL(057); VWFV     * REAL(058)
221      CLIMX     * REAL(059); DFLMY    * REAL(060)
222      VRTF      * REAL(061); K4       * REAL(062)
223      K5        * REAL(063); FRGN     * REAL(064)
224      K5        * REAL(065); BMEGA    * REAL(066)
225      PCA       * REAL(067); U        * REAL(068)
226      V         * REAL(069); W        * REAL(070)
227      P         * REAL(071); Q        * REAL(072)
228      S         * REAL(073); PSI      * REAL(074)
229      TMTA      * REAL(075); PHI      * REAL(076)
230      Y         * REAL(077); Y        * REAL(078)
231      Z         * REAL(079); PSI3     * REAL(080)

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237	THYAS	* REAL(191))	DP	* REAL(1082)
237	PG	* REAL(193))	DP	* REAL(1084)
238	CL	* REAL(195))	DP	* REAL(1086)
238	DX	* REAL(197))	DFLYB	* REAL(1088)
238	DELYB	* REAL(199))	DFLZB	* REAL(1090)
237	DELYS	* REAL(191))	DFLYS	* REAL(1092)
238	DELZS	* REAL(193))	PITERR	* REAL(1094)
239	YAAERR	* REAL(195))	PITERR	* REAL(1096)
240	YAAERR	* REAL(197))	MEGY	* REAL(1098)
241	PEF07	* REAL(199))	PCR3	* REAL(1100)
242	BT1	* REAL(101))	BT2	* REAL(1102)
243	THYOL	* REAL(103))	KC	* REAL(1104)
244	SFC	* REAL(105))	SF1	* REAL(1106)
245	SF2	* REAL(107))	SF3	* REAL(1108)
246	SF4	* REAL(109))	SF5	* REAL(1110)
247	SF6	* REAL(111))	SF7	* REAL(1112)
248	SF8	* REAL(113))	SF9	* REAL(1114)
249	SF10	* REAL(115))	SF11	* REAL(1116)
250	SF12	* REAL(117))	SF13	* REAL(1118)
251	SF14	* REAL(119))	SF15	* REAL(1120)
252	TIC	* REAL(121))	TICI	* REAL(1122)
253	YHR0	* REAL(123))	YHR3	* REAL(1124)
254	CSA	* REAL(125))	RSA	* REAL(1126)
255	PEG	* REAL(127))	YFG	* REAL(1128)
256	REG	* REAL(129))	RFY	* REAL(1130)
257	REN	* REAL(131))	RED	* REAL(1132)
258	Y2	* REAL(133))	DFLYV	* REAL(1134)
259	DELYV	* REAL(135))	DFLZV	* REAL(1136)
260	DEL1	* REAL(137))	DFL2	* REAL(1138)
261	DEL3	* REAL(139))	DFL4	* REAL(1140)
262	DELYP	* REAL(141))	DFLYIC	* REAL(1142)
263	TH	* REAL(143))	THB9	* REAL(1144)
264	PSRS	* REAL(145))	THRBS	* REAL(1146)
265	THRS	* REAL(147))	THX0	* REAL(1148)
266	REF	* REAL(149))	PEF	* REAL(1150)
267	YEF	* REAL(151))	YXED	* REAL(1152)
268	EXFD	* REAL(153))	F1	* REAL(1154)
269	FE	* REAL(155))	F3	* REAL(1156)
270	PSISC	* REAL(157))	THASD	* REAL(1158)
271	CRTHTA	* REAL(159))	DHP31	* REAL(1160)
272	CCEL1	* REAL(161))	DDEL3	* REAL(1162)
273	CCFLP1	* REAL(163))	CCFLP3	* REAL(1164)
274	CCFLVP	* REAL(165))	DDELPP	* REAL(1166)
275	CCCEL1	* REAL(167))	DDDEL3	* REAL(1168)
276	CCFLP	* REAL(169))	CRLAMP	* REAL(1170)
277	CRAMP	* REAL(171))	DHPW13	* REAL(1172)
278	RLAMP	* REAL(173))	RLAMP	* REAL(1174)
279	RPL10	* REAL(175))	RPS1	* REAL(1176)
280	RTLYA	* REAL(177))	XY	* REAL(1178)
281	YT	* REAL(179))	ZY	* REAL(1180)
282	CHCIC	* REAL(181))	CHTYAS	* REAL(1182)
283	THYAS	* REAL(183))	THY	* REAL(1184)
284	PEC	* REAL(185))	YFD	* REAL(1186)
285	CHFF	* REAL(187))	CHFF	* REAL(1188)
286	PEFL	* REAL(189))	PHIG	* REAL(1190)
287	DPW10	* REAL(191))	THYAC	* REAL(1192)
288	VP	* REAL(193))	DPW10	* REAL(1194)
289	DDP10	* REAL(195))	THBLO	* REAL(1196)
290	RCFT	* REAL(197))	TIMEC	* REAL(1198)
291	TIME1	* REAL(199))	TIME2	* REAL(1200)
292	TIME3	* REAL(201))	TIME4	* REAL(1202)
293	ZFIN	* REAL(203))	RTMIN	* REAL(1204)

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294      CLW      = REAL(205) DUM      = REAL(206)
295      CTLASC    = REAL(208) DPSIS    = REAL(209)
296      C
297      C-----
298      C-----
299      C-----
300      ARG1=1.+(CD*WTM1)/(RSTAR*TRPAD)
301      XINT1A = (IYZ-IX)/IYZ
302      S=.25*PI*CD*W
303      WANG=PI*W2
304      C-----
305      CS=AA*G*CMS(VANG)
306      CPER=1.00/DPLE(FLAAT(VPPS))
307      TPF=CPER
308      CT=1.00/DPLE(FLAAT(NDT))
309      CTEK=ENGL(CT)
310      C-----
311      CTXWTD00/CDEF(FRATINDTA)
312      DELRRL=REAL(C19)/R2D
313      DELRRL=DELRRL/R2D
314      LAMP1=LAMP1/R2D
315      PHIMAX=PHIMAX/R2D
316      GAMLR=GAMLR/R2D
317      VCL=VCL/R2D
318      PHFVV=PHFVV/R2D
319      VRATE=VRATE/R2D
320      RVRIAS=RVRIAS/R2D
321      GC=GC/R2D
322      PCL=PCL/R2D
323      TMYCTMTAC/R2D
324      C1=(IT-IA)/IT
325      R1=IA/IT
326      RANGLIA=RANGLIA/R2D
327      VMEFV=VMEFV/R2D
328      KA=KA/R2D
329      TMTA=MTA/R2D
330      CPSIS=CPS(PSIS)
331      C**** JMAX=PRINT CONTROL. PRINTING OCCURS EVERY JMAX INTERVALS.
332      JMAX=1.00/CT+.000001
333      INPRT(105)
334      ZHALC=Z
335      C-----
336      TMTA=MTA
337      TC1=TC+.4)TC2=TC1+.4
338      TC3=TC2+.2
339      TC4=TC3+.2
340      TC5=TC4+.2
341      TC6=TC5+.2
342      T1=TC+2.
343      IF(T2-LT+.01)T2=T1+.4.
344      CIT=CPS(THETAT)
345      SIT=SIN(THETAT)
346      CPT=CPS(PSIT)
347      SPT=SIN(PSIT)
348      IF(IRALLDC*FC.2)IAC=2
349      C**** RANGE TARGET FROM MISSILE=RTM IN FEET.
350      RTM=SQRT((XT-X)**2+(YT-Y)**2+(ZT-Z)**2)
351      C****
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• **Wash**

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417 1236 CONTINUE
418 IF(GATE(C06))G0 T0 1237
419 IF(TIME.LT+TIME2)G0 T0 1237
420 GATE(C06)SET
421 IPRINT#2
422 1237 CONTINUE
423 IF(GATE(C06))G0 T0 1238
424 IF(TIME.LT+TIME4)G0 T0 1238
425 GATE(C06)SET
426 IPRINT#2
427 1238 IF(GATE(C07))G0 T0 1239
428 IF(TIME.LT+T1)G0 T0 1239
429 GATE(C07)SET
430 IPRINT#2
431 1239 CONTINUE
432 C
433 C LOS ERROR IN SCS
434 CALL LOSERR
435 C
436 C** SUBROUTINE SPEK DETECTS TARGET WITHIN THE DEFLECTION RANGE OF SEEKER,
437 TARGET WITHIN THE FIELD OF VIEW, SCA=H, SEEKER WITHIN LINEAR RANGE
438 CALL SLEK
439 100 CONTINUE
440 C
441 C** MISSILE VELOCITY WRT AIR MASS
442 WNDV=+.00007367*Z+5.236
443 WNDVWDB=(1.+0.6*SIN(WNDV))
444 WXS = WNDV*WDB
445 WYS = WNDV*CSWDB
446 CALL MCALE
447 C
448 C** ANGLE OF ATTACK COMPONENTS
449 C** TERMS FOR EQUATIONS OF MOTION
450 C** ZERO AND CONTROL FORCES AND MOMENTS
451 C** SUBROUTINE FORMBN CALCULATES FORCES AND MOMENTS FOR THE DIFEC EQUATIONS
452 CALL FORMBN
453 C
454 C** SUBROUTINE DIFEC CONSTRUCTS THE EQUATIONS OF MOTION
455 CALL DIFEC
456 IPRINT#2,C10# T0 5150
457 IF(TIME.LT+T1)G0 T0 406
458 IF(.NOT.FLG0)G0 T0 6666
459 PRINT 90001,IPRINT#2,FLG0#.NOT.FLG0
460 6666 CONTINUE
461 NX#33
462 C
463 C** SUBROUTINE EDSKRGYR CONSTRUCTS THE SEEKER GYRO MODEL FOR ED
464 CALL EDSKRGYR
465 5203 CONTINUE
466 C
467 C** FC AUTOPILOT
468 CALL EDAF
469 G0 T0 226
470 C
471 C ENGINEERING DESIGN AUTOPILOT
472 C
473 5450 IF(TIME.LT+T E3)G0 T0 401
474 IF(.NOT.FLG5)G0 T0 6671
475 PRINT 90010,IPRINT#2,FLG5#.FALSE.
476 6671 CONTINUE
477 NX = 32
478 3PFG7=WXS=YAWFR0

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541      PEG=THRRS+THRS+PFF
542      YEG=PSRRS+PSRS+VFF
543      REG = -PEG
544      IF (ABS(PEG).GT.PCL) PEG=SIGN(PCL,PEG)
545      IF (ABS(YEG).GT.YCL) YEG=SIGN(YCL,YEG)
546      C***ROLL DECOUPLER
547      101 CONTINUE
548      IF (TIME-LE.TIME3)G9 TO 406
549      GO TO (1401,1402),IRALLDC
550      1401 CONTINUE
551      C***PREVIOUS ROLL DECOUPLER
552      IF (IACC.EG.2 .AND. TIME.GT.TIME4 .AND. NULSKR.EG.2) GO TO 300
553      RLAMY=PSIS
554      RLAMP=THIAS-RTHTA
555      GO TO 302
556      300 CONTINUE
557      CRLAMY=LAMYR
558      CRLAMP=LAMPB
559      302 CONTINUE
560      RICY=PSIS
561      RICP=THIAS-RTHTA
562      REC=RICP-RLAMP
563      REN=RICY-RLAMP+RES1
564      305 CONTINUE
565      IF (RED.LT..4363) RED=.4363
566      IF (RED.GT.1.7453) RED=1.7453
567      RET=REN/RED
568      PHIO=RET
569      GO TO 1404
570      1402 CONTINUE
571      C***LATEST ROLL DECOUPLER
572      CRLAMY=RRS(PSIS-RLAMY)
573      IF (IACC.EG.2) DRLAMY=0.
574      RES1=RRS(S2-RLAMY+S3+PSIS)
575      REC=SA+THIAS-SS-RTHTA
576      IF (ABS(RET).LT.RTOL) GO TO 304
577      C***CHECK FOR SATURATION
578      IF (ABS(PHIMAX-ABS(RET)).LT.RTOL .AND. RED.LT.RFA/RET) GO TO 300
579      C***
580      304 RET=SIGN(S3,RET)
581      IF (RED.GT.0.) RET=REN/RED
582      306 CONTINUE
583      IF (ABS(RET).GT.PHIMAX) RET=SIGN(PHIMAX,RET)
584      PHIO=RET
585      1404 CONTINUE
586      CPHIOG=BG+PHIO-RO+11*BG/AF)*PHIO
587      REF=(PG/AF)*PHIO+RPHIO
588      REF=XP*REF
589      IF (ABS(REF).GT..17453) REF=SIGN(.17453,REF)
590      303 CONTINUE
591      REG=REF+RVBIAS
592      C
593      C** CONTROL SYSTEM, CANARDS FOR EACH PLANE ON COMMON SHAFT
594      207 CONTINUE
595      IF (IACC.EG.2 .AND. NULSKR.EG.2) GO TO 226
596      221 CONTINUE
597      YEG=0.
598      PEG=0.
599      226 CONTINUE
600      CALL CONTRL
601      C** 4TH ORDER RUNGE KUTTA INTEGRATION
602      406 CONTINUE

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158

664	14HRT1,4H	,RT1	,4HRT2,4H	,RT2
665	14HCPT,4H	,CPT	,4HSTT,4H	,STT
666	14HCS,4H	,CS	,4HFFCM,4HB	,FFCMR,
667	14HCTT,4H	,CTT	,4HRAPT,4HM3	,RAPTM3
668	14HD,4H	,D	,4HKG,4H	,KG,
669	14HDELM,4HY	,DELMY	,4HEDO,4H	,EDO
670	14HED1,4H	,ED1	,4HED2,4H	,ED2
671	14HED3,4H	,ED3	,4HED4,4H	,ED4
672	14HED5,4H	,ED5	,4HKT10,4H	,KT10
673	14HFFAL,4HB	,FFALB	,4HYCL,4H	,YCL,
674	14HFFAN,4HB	,FFANB	,4HGF,4H	,GF,
675	14HFFCL,4HB	,FFCLB	,4HFFAZ,4HB	,FFAZR,
676	14HFFCN,4HB	,FFCNB	,4HFFAM,4HB	,FFAMR,
677	14HGAPL,4HB	,GAPLB	,4HPPFB,4HV	,PPFRV,
678	14HGC,4H	,GC	,4HFFAX,4HB	,FFAXB,
679	14HIACT,4H	,IACT	,4HIRSL,4HLOC	,IROLLOC
680	14HIDL,4H	,IDUM		
681	14HIFUF,4HB	,IFUF8	,4HNULL,4H	,NULL
682	14HIRSL,4HL	,IRALL	,4HKT20,4H	,KT20
683	14HISK,4H	,ISKR	,4HSS,4H	,SS
684	14HIT,4H	,IT	,4HFBGN,4H	,FBGN,
685	14HIX,4H	,IX	,4HBD,4H	,BD,
686	14HIYZ,4H	,IYZ	,4HR2,4H	,R2
687	14HKA,4H	,KA	,4HPCA,4H	,PCA,
688	14HKB,4H	,KB	,4HRVBI,4HAS	,RVBIAS,
689	14HKC,4H	,KC	,4HTHT8,4HL	,THT8L
690	14HKG,4H	,KGL	,4HFFAY,4HB	,FFAYR,
691	14HKPC,4H	,KPC	,4HT105,4H	,T105
692	14HKRGL,4H	,KRGL	,4HAF,4H	,AF,
693	14HKS,4H	,KS	,4HKM,4H	,KM
694	14HLAMB,4HI	,LAMB1	,4HJMAX,4H	,JMAX
695	14HMASS,4H	,MASS	,4HCG,4H	,CG,
696	14HARLN,4H	,ARUN		
697	14HPCL,4H	,PCL	,4HTA,4H	,TA,
698	14HPHIM,4HAX	,PHIMAX	,4HSS,4H	,SS
699	14HPRIN,4HTM	,PRINTM	,4HJMAX,4H	,JMAX
700	14HRAPT,4HM2	,RAPTM2	,4HRAPT,4HM1	,RAPTM1
701	14HREDT,4H	,REDT	,4HDTA,4H	,DTA
702	14HRFLE,4HCT	,REFLECT	,4HPI,4H	,PI,
703	14HRLAM,4HP	,RLAMP	,4HRPS1,4H	,RPS1
704	14HRLAM,4HY	,RLAMY	,4HVRAT,4HF	,VRATE,
705	14HRNGL,4HIN	,RNLIN	,4HKM,4H	,KM
706	14HRTMI,4HN	,RTMIN	,4HS6,4H	,S6
707	14HS7,4H	,S7	,4HS9,4H	,S9
708	14HS10,4H	,S10	,4HS11,4H	,S11
709	14HS12,4H	,S12	,4HS3,4H	,S3
710	14HS4,4H	,S4	,4HS1,4H	,S1
711	14HS2,4H	,S2	,4HDELM,4HX	,DELMX
712	14HS,4H	,S	,4HSF1,4H	,SF1
713	14HSF0,4H	,SF0	,4HSF3,4H	,SF3
714	14HSF2,4H	,SF2	,4HSF5,4H	,SF5
715	14HSF4,4H	,SF4	,4HSF7,4H	,SF7
716	14HSF6,4H	,SF6	,4HSF9,4H	,SF9
717	14HSF8,4H	,SF8	,4HSF11,4H	,SF11
718	14HSF10,4H	,SF10	,4HSF13,4H	,SF13
719	14HSF12,4H	,SF12	,4HSF15,4H	,SF15
720	14HSF14,4H	,SF14		
721	14HSLAP,4HE2	,SLOPE2	,4HSLAP,4HF1	,SLOPF1
722	14HTC1,4H	,TC1	,4HTO,4H	,TO
723	14HTC3,4H	,TC3	,4HTOP,4H	,TO2
724	14HTO5,4H	,TO5	,4HTO4,4H	,TO4
725	14HTO7,4H	,TC7	,4HTO6,4H	,TO6

726	14HT2 ,4H	,T2	,4HT1 ,4H	,T1	,
727	14HTB ,4H	,TB	,4HSPT ,4H	,SPT	,
728	14HTHPL,4HC	,THPLD,			
729	14HTHTA,4HC	,THTIC	,4HKD ,4H	,KD,	
730	14HTHET,4HAT	,THETAT	,4HJRAP,4H	,JRAP	,
731	14HTHOL,4HD	,THPLC			
732	14HTIC ,4H	,TIC	,4HTICI,4H	,TICI,	
733	14HTIME,4H3	,TIME3	,4HTIME,4H3	,TIME3	,
734	14HTIME,4H1	,TIME1	,4HTIME,4H1	,TIME1	,
735	14HTIFI,4H	,TIPI	,4HTT ,4H	,DT	,
736	14HYHFB,4HV	,YHFBV	,4HKS ,4H	,KS,	
737	14HZMIN,4H	,ZMIN	,4HTIME,4H4	,TIME4	,
738	14HWCN,4H	,WCN	,4HZMIN,4H	,ZMIN	,
739	GATE(001)=SET				
740	1661	CONTINUE			
741	PRINT 900C7				
742	PRINT 900C0,4,4HPRRJ,4HCCI,4HLE1 ,4H				
743	14HTIME,4H	,TIME	,4HRSR ,4H	,RSA	,
744	14HDELV,4HP	,DELVP	,4HU ,4H	,U	,
745	14HV ,4H	,V	,4HW ,4H	,W	,
746	14HTHTA,4H	,THTA	,4HPHD ,4H	,PHD	,
748	14HDELZ,4H	,DELZ	,4HTSTA,4HCC	,TSTACT	,
749	14HCZ ,4H	,DZ	,4HDY ,4H	,DY	,
750	14HCPHI,4H	,CPHI	,4HDTHT,4HA	,DTHTA	,
751	14HCX ,4H	,DX	,4HPSI,4H	,PSI	,
752	14HCR ,4H	,DR	,4HQ ,4H	,Q	,
753	14HCP ,4H	,DP	,4HDW ,4H	,DW	,
754	14HCU ,4H	,CU	,4HCV ,4H	,CV	,
755	14HVRW ,4H	,VRW	,4HMACH,4H	,MACH	,
756	14HCAP ,4H	,GAP	,4HPSI ,4H	,PSI	,
757	14HP ,4H	,P	,4HQ ,4H	,Q	,
758	14HR ,4H	,R	,4HDELV,4HV	,DELVV	,
760	14HAZB ,4H	,AZB	,4HDELX,4HV	,DELXV	,
761	14HDELY,4HV	,DELVV	,4HDELZ,4HV	,DELZV	,
762	14HX ,4H	,X	,4HY ,4H	,Y	,
763	14HZ ,4H	,Z	,4HAM ,4H	,AM	,
764	14HXT ,4H	,XT	,4HYT ,4H	,YT	,
766	14HDTHT,4HA	,DTHTA			
766	14HCPHI,4H	,CPHI	,4HSPHI,4H	,SPHI	,
767	14HCPSI,4H	,CPSI	,4HSPSI,4H	,SPSI	,
768	14HCPSI,4HS	,CPSIS	,4HGZB ,4H	,GZB	,
768	14HGYB ,4H	,GYB	,4HGXB ,4H	,GBX	,
771	PRINT 90000,4,4HAUTO,4HPILO,4HTI ,4H				
772	14HCOPI,4HIO	,COPIIO			
773	14HDELX,4HS	,DELXS	,4HPEG ,4H	,PEG	,
774	14HDELM,4HIS	,DELMIS	,4HTXED,4H	,TXED	,
775	14HDELZ,4HS	,DELZS	,4HMEG,4HA	,MEGA	,
776	14HDEYF,4H	,DEYF	,4HPEF,4H	,PEF	,
777	14HDTHT,4HAS	,DTHTAS	,4HRTM ,4H	,RTM	,
778	14HKT ,4H	,KT	,4HPEFL,4H	,PEFL	,
779	14HNULL,4H	,NULL	,4HDELP,4H	,DELP	,
780	14HMEG,4HZ	,MEGZ	,4HSPSG,4H	,PSRG	,
781	14HPED ,4H	,PED	,4HPEF ,4H	,PEF	,
782	14HPITE,4HRO	,PITERO	,4HPHIG,4H	,PHIG	,
783	14HPSIS,4H	,PSIS			
784	14HPXED,4H	,PXED	,4HTHRS,4H	,THRS	,
785	14HPSBS,4H	,PSBS	,4HDEL1,4H	,DEL1	,
786	14HRLAM,4HY	,RLAMY	,4HRLAM,4HP	,RLAMP	,
787	14HTHTA,4HS	,THTAS	,4HTHQB,4HS	,THRBS	,
788	14HYEF ,4H	,YEF	,4HPEF ,4H	,PEF	,
789	14HYED ,4H	,YED	,4HPED ,4H	,PED	,
790	14HYEF ,4H	,YEF	,4HYBRG,4H	,YBRG	,

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791      14HVEG ,4H ,YEG ,4HDELY,4HS ,DELYS ,
792      14HYAVE,4HRR ,YAVERR ,4HYAVE,4HRR ,YAVEERR ,
793      14HLAMY,4HR ,LAMVR ,4HLAMP,4HR ,LAMPVR ,
794      14HDSA ,4H ,GSA ,4HDCAPS,4H ,CAPS ,
795      14HDPSI,4HS ,DPSIS ,4HIACC,4H ,IACC ,
796      14HPSRB,4HS ,PSRRS ,4HREN ,4H ,REN ,
797      PRINT 90000,2,4HLOGI,4HCT ,
798      14HGATE,4H ,1,GATE(001),4HGATE,4H ,2,GATE(002),
799      24HGATE,4H ,3,GATE(003),4HGATE,4H ,4,GATE(004),
800      24HGATE,4H ,5,GATE(005),4HGATE,4H ,6,GATE(006),
801      34HGATE,4H ,7,GATE(007)
802      PRINT 90000,4,4HWAERR,4HWDYNA,4HMICS,4HI ,
803      14HCLD ,4H ,CLD ,4HALB ,4H ,ALB ,
804      14HCNR ,4H ,CNR ,4HCMC ,4H ,CMC ,
805      14HCY ,4H ,CY ,4HCAZ ,4H ,CAZ ,
806      14HCLP ,4H ,CLP ,4HCN ,4H ,CN ,
807      14HCYCG,4H ,CYCG ,4HCMCG,4H ,CMCG ,
808      14HANE ,4H ,ANE ,4HCLB ,4H ,CLB ,
809      14HCB ,4H ,CB ,4HCNB ,4H ,CNB ,
1*      14HTHAS,4HD ,THASD ,4HDTHA,4HSD ,DTHASD ,
2*      14HPSIS,4HD ,PSISD ,4HDCPSI,4HSD ,DPSISD ,
810      14HALPH,4HA ,ALPHA ,4HRETA,4H ,BETA ,
811      PRINT 90000,1,4HRAPI ,
812      14HSTT ,4H ,STT ,4HCTT ,4H ,CTT ,
813      14HSPT ,4H ,SPT ,4HCPT ,4H ,CPT ,
1*      14HTH ,4H ,TH ,4HXLTA,4H ,XLTA ,
815      PRINT 90000,3,4HDEBU,4HGR PR,4HINTI ,
816      14HDELX,4HB ,DELXB ,4HDELY,4HB ,DELYB ,
1*      14HDELZ,4HB ,DELZB ,4HDELY,4HB ,DELYB ,
818      14HDELY,4HB ,DELYS ,4HDELZ,4HB ,DELZS ,
819      14HKUTT,4HA ,KUTTA ,
820      14HPITE,4HRR ,PITERR ,4HYAVE,4HRR ,YAVERR ,
821      14HPITE,4HRR ,PITERR ,4HYAVE,4HRR ,YAVERR ,
822      14HDLA,4HMY ,DLAMY ,4HPS ,4H ,PS ,
823      14HDRPS,4HI ,DRPSI ,4HDRTH,4HTA ,DRTHTA ,
824      14HCRPH,4HIG ,CRPHIG ,4HCRPH,4HIG ,CRPHIG ,
825      14HDELV,4HR ,DELVR ,4HDPH,4HC ,DPHIC ,
826      14HG ,4H ,G ,4HVSND,4H ,VSND ,
827      14HISKR,4H ,ISKR ,4HIACT,4H ,IACT ,
828      14HTOCT,4HDE ,TOCTDE ,4HTRAP,4H ,TRAP ,
829      14HKAGE,4H ,KAGE ,4HNAVY,4H ,NAVY ,
830      14HFI ,4H ,FI ,4HDLA,4HMP ,DLAMP ,
831      14HNUH ,4H ,NUH ,4HIPIR,4HNT ,IPIRNT ,
832      14HNPPS,4H ,NPPS ,4HNDT ,4H ,NDT ,
833      14HNDTA,4H ,NDTA ,4HNULS,4HXR ,NULSKR ,
834      14HPEFL,4H ,PEFL ,4HDPHIG,4H ,DPHIG ,
835      14HRHO ,4H ,RHO ,
836      14HS2 ,4H ,S2 ,4HDEL,4HHL ,DEL9AL ,
837      14HRED ,4H ,RED ,4HRET ,4H ,RET ,
838      14HREG ,4H ,REG ,4HRRPSI,4H ,RRPSI ,
1*      14HRTHT,4HA ,RTHTA ,
840      14HMEQ,4HY ,MEQY ,4HMEQ,4H2 ,MEQ17 ,
841      14HAX ,4H ,AX ,
842      72 IF(IMPACT)PRINT 90000,2,4HIMPA,4HCTI ,
843      14HPCAT,4H ,PCAT ,4HPCAX,4H ,PCAX ,
844      14HPCAY,4H ,PCAY ,4HPCAZ,4H ,PCAZ ,
845      14HPCA ,4H ,PCA ,
846      IF(IMPACT .OR. ERROR) PRINT 90000,3,4HIMPACT,4HCTI ,
847      50 C O N T I N U E
848      C
849      C DISPLACEMENT ERRORS FROM AIR POINT
850      C

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END RUN

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851      C      DISPLACEMENT ERRORS FROM SPOT
852      DELX=XT-X
853      DELY=YT-Y
854      DELZ=ZT-Z
855      IF (TIME-LT,TIME)GO TO 51
856      C
857      IF (ABS(DEL1 ).GT. DELMY)DEL1 =SIGN(DELMY,DEL1)
858      IF (ABS(DELVP).GT. DELMX)DELVP=SIGN(DELMX,DELVP)
859      IF (ABS(DEL3 ).GT. DELMY)DEL3 =SIGN(DELMY,DEL3)
860      IF (ABS(DDELVP).GT. VRATE)DDELVP=SIGN(VRATE,DDELVP)
861      IF (ABS(DDEL1 ).GT. VRATE)DDEL1 =SIGN(VRATE,DDEL1)
862      IF (ABS(DDEL3 ).GT. VRATE)DDEL3 =SIGN(VRATE,DDEL3)
863      IF (IACT.GT.0)GO TO 51
864      DEL1 = YEG*REG
865      DELVP = PEG
866      DEL3 = -YEG*REG
867      IF (IACT.EQ.2)DEL1=REG+YFG
868      IF (IACT.EQ.2)DEL3=REG+YFG
869      51 CONTINUE
870      R E T U R N
871      C
872      E N T R Y F I N I S H
873      C
874      C
875      IF (IACC.EQ.1)GO TO 40
876      XT = XT+DTRK*VXT
877      YT = YT+DTRK*VYT
878      40 CONTINUE
879      VMS=L*U+V*V+W*W
880      VM=SGRT(VMS)
881      TOTACC=(SGRT(AYB*AYB+AZB*AZB))/MASS
882      C***TRAJECTORY TERMINATION
883      IF (TIME.GT.5. .AND. Z.GT.ZMIN)GO TO 45
884      IF (Z-LT,ZMIN)GO TO 157
885      45 CONTINUE
886      DELXT = XT-X
887      DELYT = YT-Y
888      DELZT = ZT-Z
889      DELXTB=EB11*DELXT+EB12*DELYT+EB13*DELZT
890      DELYTB=EB21*DELXT+EB22*DELYT+EB23*DELZT
891      DELZTB=EB31*DELXT+EB32*DELYT+EB33*DELZT
892      C** LRS IN ECS
893      VERLAM=ATAN2(-DELZ,SGRT(DELX*DELX+DELY*DELY))
894      WORLAM=ATAN2(DELY,DELX)
895      C** TOTAL MISSILE NON-FIELD ACCELERATION
896      C
897      GAMU=ATAN2(W,U)
898      RTUWS=SGRT(U*U+W*W)
899      GAMV=ATAN2(V,RTUWS)
900      C** RCS TO VCS TRANSFORMATION
901      CALL TRSFV
902      DELMT=SGRT(DELYV**2+DELZV**2)
903      GO TO 73
904      157 CONTINUE
905      C*** RANGE TARGET FROM MISSILE=RTM IN FEET.
906      RTM=SGRT((XT-X)**2+(YT-Y)**2+(ZT-Z)**2)
907      C*** POINT OF CLOSEST APPROACH COMPUTATION=PCA IN FEET.
908      IF (RTM.GT.PCA)GO TO 55
909      PCAT=ENGL(TIME);PCAX=X;PCAY=Y;PCAZ=Z;PCA=RTM
910      55 CONTINUE
911      GO TO 9
912      73 IMPACT=.TRUE.

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913		IFPRINT=2
914		PRINT 90000,2,4HIMPA,4HCT1,4HTIME,4H,TIME
915		GO TO 9
916	9999	GATE(002)=8FT
917		ERROR=.TRUE.
918		GO TO 70
919	9998	PRINT 90000,5,4HEND=,4HBF=F,4HILE,4HON U,4HNTI,
920		14HLS'I,4HT,UNIT
921		DB 3.21 I=1,16
922	3121	WDAC(1)=0
923		DB 3122 I=1,1500
924	X	CALL WDACS(0,16,WDAC)
925	3122	CONTINUE
1*		CALL WERF(IE)
2*		CALL WERF#88
3*		CALL WERF#88
926	X	CALL MODE('R')
927	X	CALL MODE('P')
928	X	CALL WERF
929	X	CALL PLPT(1,TIME,2,1, TXED 1)
930	X	CALL FGRLS(18V,1)
931		STOP
932		END

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1      SUBROUTINE SEEKER(SRAGE,RFLEC,ERR,FR9)
2      DIMENSION TRAGE(18),TRFLEC(7),TMS(18,2),TMS(18,2),TMS(18,2)
3      DIMENSION TRAC(6)
4      DATA TRAGE/100.,200.,300.,400.,500.,600.,700.,800.,900.,1000.,1100.,1200.,1300.,1400.,1500.,1600.,1700.,1800./
5      DATA TRFLEC /1.25,5./
6      DATA TLOS /-1.5,-1.333,-1.167,-1.0,-.833,-.667,-.5,-.333,-.167,-.0,-.167,-.333,-.5,-.667,-.833,-1.0,-1.167,-1.333,-1.5/
7      DATA TRAC /4.3E-14,4.6E-13,4.5E-12,4.1E-11,4.1E-10,2.6E-9/
8      DATA TMS/9.3E-11,2.6E-11,9.6E-12,5.6E-12,7.6E-12,2.3E-12,1.1E-12,1.9E-13,2.1E-13,9.3E-14,5.0E-14,3.0E-14,2.2E-14,1.4E-14,7.7E-15,
9      25.0E-15,3.6E-15,2.6E-15,
10     33.7E-9,9.0E-10,3.7E-11,2.1E-11,1.4E-11,9.2E-12,5.0E-12,3.3E-12,
11     48.4E-13,3.7E-13,2.0E-13,1.4E-13,8.4E-14,4.6E-14,3.0E-14,2.0E-14,
12     51.8E-14,1.0E-14/
13     DATA TERO/2.2,-1.95,-1.86,-1.8,-1.72,-1.5,-1.29,-1.65,-1.44,
14     1.75,1.05,1.2,1.3,1.4,1.5,1.5,1.6,
15     2.4,-.4,-.395,-.385,-.36,-.335,-.28,-.21,-.185,-.16,2.15,3.1,3.45,
16     33.7,3.75,3.9,3.95,4.,4.,
17     44.7,44.7,44.65,-.5,-.45,-.42,-.32,-.26,-.15,-.7,2.3,3.2,3.5,3.7,
18     53.75,3.8,3.9,3.9,3.9,
19     64.5,3.9,3.25,3.1,2.9,2.8,2.5,2.05,-1.15,0.1,1.3,1.7,1.95,
20     72.1,2.4,2.5,2.6,2.6,2.6,
21     83.55,-.355,-.36,-.34,-.32,-.30,-.285,-.25,-.18,-.9,-.4,-.05,-.25,
22     9.5,-.7,-.9,1.1,1.05,1.1,
23     A=2.4,-.24,-.235,-.23,-.22,-.2,-.185,-.1,-.1,-.095,-.8,-.5,-.35,
24     B=-.2,-.1,-.05,-.025,-.05,-.05/
25     DIMENSION AMS(4),AEND(4)
26     DATA IS,IR, JM/300/
27     I =18
28     CALL FIND(I,TRAGE,18,SRAGE)
29     IF(1.EQ.IS) GO TO 10
30     IS=1
31     CALL NTERP (AMS,TMS,I,TRAGE,18,TRFLEC)
32     10 H8=FUNCTION(AMS,SRAGE,RFLEC)
33     RRR=ERR*57.296
34     IF(18) JM=J
35     CALL FIND(I,TLOS,19,RRR)
36     CALL FIND(J,TRAC,6,MS)
37     IF(I.NE.18) GO TO 20
38     IF(J.EQ.JM) GO TO 30
39     IS=1
40     JM=J
41     CALL NTERP (AEND,TERO,1,TLOS,19,J,TRAD)
42     20 END=FUNCTION(AEND,RRR,MS)
43     30 END=FUNCTION(AEND,RRR,MS)
44     ERR = END/4./57.296
45     RETURN
46     END

```

```

1      SUBROUTINE AFRO (T1,T2,FMACH,ALPHA,BETA,DELTA,DELTA1,DELTA2,DELTA3,
2      1  CN,CMCG,CY,CLACG,CA,CLP,CLO,CMO,CMAD,CLAR,CLAAD)
3      IMPLICIT REAL*8 (A-H,O-Z)
4      C
5      C
6      C
7      C
8      C
9      C
10     C
11     C
12     C
13     C
14     C
15     C
16     C
17     C
18     C
19     C
20     C
21     C
22     C
23     C
24     C
25     C
26     C
27     C
28     C
29     C
30     C
31     C
32     C
33     C
34     C
35     C
36     C
37     C
38     C
39     C
40     C
41     C
42     C
43     C
44     C
45     C
46     C
47     C
48     C
49     C
50     C
51     C
52     C
53     C
54     C
55     C
56     C
57     C
58     C
59     C
60     C
61     C
62     C

```

T1 * TIME - SEC.
 T2 * TIME TO START CONTROL PHASE - SEC.
 FMACH * FREE STREAM MACH NUMBER
 ALPHA * ANGLE OF ATTACK (PITCH PLANE) - DEG.
 BETA * ANGLE OF ATTACK (YAW PLANE) - DEG.
 DELTA * CONTROL DEFLECTION ANGLE (PITCH PLANE) - DEG.
 DELTA1 * CONTROL DEFLECTION ANGLE (YAW PLANE) - DEG.
 DELTA2 * CONTROL DEFLECTION (ROLL) - DEG.

CN * NORMAL FORCE COEFF.
 CMCG * PITCHING MOMENT COEFF.
 CY * YAW FORCE COEFF.
 CLACG * YAW MOMENT COEFF.
 CA * AXIAL FORCE COEFF.
 CLP * ROLL DAMPING COEFF. - (1/RAD)
 CLO * ROLL MOMENT COEFF. - (1/DEG)
 CMO * PITCH DAMPING COEFF. DUE TO DELTA DOT
 CMAD * PITCH DAMPING COEFF. DUE TO ALPHA DOT
 CLAR * YAW DAMPING COEFF. DUE TO PSI DOT
 CLAAD * YAW DAMPING COEFF. DUE TO ALPHA DOT

TCN1 * TABLE OF CN FOR CONTROL PHASE
 TCMCG1 * TABLE OF CMCG FOR CONTROL PHASE
 TCA1 * TABLE OF CA FOR CONTROL PHASE
 TCN2 * TABLE OF CN FOR BALLISTIC PHASE
 TCMCG2 * TABLE OF CMCG FOR BALLISTIC PHASE
 TCX2 * TABLE OF CX FOR BALLISTIC PHASE
 TDEL1 * TABLE OF DELTA FOR CN,CMCG
 TMACH1 * TABLE OF FMACH FOR CONTROL PHASE
 TMACH2 * TABLE OF FMACH FOR BALLISTIC PHASE
 TMACH3 * TABLE OF FMACH FOR CLP,CLO
 TMACH4 * TABLE OF FMACH FOR CMO
 TMACH5 * TABLE OF FMACH FOR CA (BALLISTIC PHASE)

DOUBLE PRECISION T1,T2
 DIMENSION TALP(6),TDEL1(17), TCN1(6,7,3),TCN2(6,5)
 DIMENSION TCMCG1(6,7,3),TCMCG2(6,5),TCA1(6,7,3),TCA2(15)
 DIMENSION TCLP(8),TCLD(8),TCMO(10,5),TALP(10)
 DIMENSION TMACH1(3),TMACH2(3),TMACH3(8),TMACH4(5),TMACH5(10)
 DIMENSION ACN(8), ACMCG(8), ACY(8),ACLACG(8),ACAP(8),
 1 ACAB(8), ACAO(8),ACLP(2), ACLD(2), ACMO(8), ACLNR(8)
 DIMENSION ISAVE(13)
 DATA ISAVE /19*0/
 DATA TCN1 /

52	X	-1.25	.009	.001	.009	.0096	.0018	.0020
53	X	-1.2	.006	.004	.0035	.004	.0039	.0015
54	X	-1.0	.006	.007	.0041	.0072	.0045	.0010
55	X	-.44	.0035	.0032	.0019	.0074	.006	.005
56	X	.0	.003	.008	.0029	.0094	.008	.007
57	X	.4	.003	.0084	.003	.0095	.0095	.005
58	X	.95	.004	.0084	.0043	.0092	.0063	.0010
59	X	-1.35	.009	.002	.005	.001	.0034	.0020
60	X	-1.25	.0065	.004	.0048	.0054	.0067	.0015
61	Y	-1.1	.009	.0095	.009	.0089	.0089	.0010
62	X	-.56	.004	.0045	.0029	.001	.0002	.005

63	X	.0	.105	.185	.204	.331	.428		
64	X	.48	.138	.195	.204	.34	.439		
65	X	1	.156	.21	.208	.356	.45		1
66	X	2	.117	.202	.127	.25	.413		-20
67	X	-1.7	.064	.099	.107	.304	.466		-15
68	X	.12	.0	.1	.204	.362	.505		-10
69	X	.06	.048	.154	.205	.405	.523		-5
70	X	.0	.105	.22	.307	.425	.532		0
71	X	.43	.146	.26	.344	.428	.538		5
72	X	18	.21	.285	.315	.438	.541		10
73	DATA TCN2 /								
74	X	.0	.093	.18	.2029	.294	.38		0
75	X	.0	.105	.185	.204	.331	.428		0
76	X	.0	.105	.22	.307	.425	.532		0
77	X	.0	.085	.18	.205	.42	.56		0
78	X	.0	.089	.18	.205	.35	.45		0
79	DATA TCN01 /								
80	X	3.6	.0	.335	.205	.18	.13		-20
81	X	3.4	.12	.19	.101	.08	.04		-15
82	X	2.84	.157	.053	.025	.05	.02		-10
83	X	1.25	.037	.075	.132	.070	.03		-5
84	X	.0	.125	.21	.182	.102	.098		0
85	X	-1.1	.235	.22	.17	.105	.135		5
86	X	-2.7	.29	.225	.205	.104	.165		10
87	X	3.25	.0	.36	.216	.17	.15		-20
88	X	3.6	.08	.195	.088	.03	.041		-15
89	X	3.1	.165	.035	.04	.07	.025		-10
90	X	1.85	.12	.105	.105	.105	.083		-5
91	X	.0	.17	.228	.22	.108	.152		0
92	X	.12	.257	.256	.26	.235	.18		5
93	X	-3.94	.31	.3	.298	.27	.216		10
94	X	5.9	.496	.317	.198	.13	.10		-20
95	X	4.98	.332	.182	.051	.04	.079		-15
96	X	3.05	.18	.127	.112	.208	.201		-10
97	X	1.7	.007	.142	.30	.305	.272		-5
98	X	.0	.165	.332	.044	.041	.304		0
99	X	-1.23	.33	.057	.475	.443	.32		5
100	X	-2.95	.47	.527	.49	.445	.338		10
101	DATA TCN02 /								
102	X	.0	.125	.201	.202	.208	.200		0
103	X	.0	.17	.228	.22	.108	.152		0
104	X	.0	.165	.332	.044	.041	.304		0
105	X	.0	.09	.18	.238	.217	.085		0
106	X	.0	.028	.045	.057	.057	.057		0
107	DATA TCA1 /								
108	X	.71	.089	.05	.0383	.178	.003		-20
109	X	.585	.006	.0387	.024	.173	.002		-15
110	X	.435	.035	.0275	.0169	.102	.003		-10
111	X	.328	.0311	.026	.024	.245	.022		-5
112	X	.295	.0294	.0313	.0341	.323	.019		0
113	X	.32	.0266	.0412	.0476	.425	.0404		5
114	X	.42	.067	.0402	.087	.425	.05		10
115	X	.75	.0767	.052	.019	.24	.041		-20
116	X	.64	.0384	.035	.0298	.153	.068		-15
117	X	.61	.0419	.0348	.025	.194	.153		-10
118	X	.375	.0352	.0309	.0301	.29	.026		-5
119	X	.338	.0336	.0381	.0390	.403	.0387		0
120	X	.373	.0399	.0482	.051	.447	.0519		5
121	X	.475	.053	.0581	.0615	.45	.066		10
122	X	1.23	.111	.088	.0845	.47	.216		-20
123	X	1.06	.0855	.0709	.054	.363	.175		-15
124	X	.79	.0673	.061	.0515	.354	.226		-10

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125      X      .643      .605      .56      .54      .56      .382      /      = 1.
126      X      .582      .61      .495      .54      .54      .50      /      = 1.
127      X      .63      .685      .753      .775      .769      .74      /      5 1.
128      X      .73      .83      .90      .918      .92      .89      /      12 1.
129      DATA TCA2      /      .31,.314,.32,.322,.327,.328,.335,.338,
130      X      .615,.639,.645,.639,.628,.60,.565/
131      DATA TALP      /0.,5.,10.,15.,20.,25./
132      DATA TALP4      /0.,4.,6.,8.,10.,12.,14.,16.,18.,20./
133      DATA TDEL1      /-20.,-15.,-10.,-4.,0.,5.,10./
134      DATA TMACH1      /-.4.,.871:0/
135      DATA TMACH2      /-.4.,.8,1.0,1.3,1.4/
136      DATA TMACH4      /-.4.,.8,1.0,1.3,1.4/
137      DATA TMACH3      /-.4.,.6,.8,1.0,1.2,1.4,1.6,1.4/
138      DATA TMACH5      /-.4.,.5,.6,.7,.8,.85,.9,.95,1.0,1.1,1.2,
139      X      1.3,1.4,1.6,1.4/
140      DATA TCCLP      /-16.5,17.7,17.7,C72,28.1,26.1,21.7,17.7,14.7/
141      DATA TCCLD      /-.085,.087,.090,.097,.096,.073,.061,.049/
142      DATA TCMG /
143      X      .145,.165,.162,.125,.100,.101,.102,.104,.105,.107,
144      X      .150,.185,.190,.165,.135,.108,.75,.75,.75,.75,
145      X      .160,.205,.218,.220,.234,.240,.244,.227,.180,.107,
146      X      .178,.194,.195,.195,.194,.192,.191,.174,.146,.110,
147      X      .130,.156,.162,.155,.150,.143,.134,.120,.105,.87/
148      ABALP = ABS(ALPHA)*57.296
149      ABBET = ABS(BETA)*57.296
150      IF(T1.LT.T2) GO TO 2
151      DELP = DELP1*57.296
152      DELY = DELY1*57.296
153      IF(ALPHA.LT.0.) DELP=-DELP
154      IF(BETA.LT.0.) DELY=-DELY
155      I = ISAVE(1)
156      J = ISAVE(2)
157      K = ISAVE(3)
158      CALL FIND(I,TALP,6,ABALP)
159      CALL FIND(J,TDEL1,7,DELP)
160      CALL FIND(K,TMACH1,3,PHACH)
161      IF(I.NE.ISAVE(1))      GO TO 50
162      IF(J.NE.ISAVE(2))      GO TO 60
163      IF(K.NE.ISAVE(3))      GO TO 70
164      GO TO 80
165      50      ISAVE(1) = I
166      60      ISAVE(2) = J
167      70      CONTINUE
168      CALL NTERP (ACH,TCM1,I,TALP,6,J,TDEL1,7,K,TMACH1)
169      CALL NTERP (ACMCG,TCMCG1)
170      CALL NTERP (ACAP,TCA1)
171      80      I = ISAVE(4)
172      J = ISAVE(5)
173      CALL FIND(I,TALP,6,ABET)
174      CALL FIND(J,TDEL1,7,DELY)
175      IF(I.NE.ISAVE(4))      GO TO 150
176      IF(J.NE.ISAVE(5))      GO TO 160
177      IF(K.NE.ISAVE(3))      GO TO 170
178      GO TO 180
179      150      ISAVE(4) = I
180      160      ISAVE(5) = J
181      170      CONTINUE
182      CALL NTERP (ACV,TCM1,I,TALP,6,J,TDEL1,7,K,TMACH1)
183      CALL NTERP (ACLNCG,TCMCG1)
184      CALL NTERP (ACAB,TCA1)
185      180      IF(K.EQ.ISAVE(3))      GO TO 190
186      C

```

```

187      C SET I & J FOR ALPHA = DELTA = 0.0 IN TALP & TDELT1
188      C
189      I = 1
190      J = 5
191      CALL NTERP (ACAP, TCA2, 1, TALP, 6, J, TDELT1, 7, K, FMACH1)
192      ACAB(2) = ACAB(5)
193      ISAVE(3) = K
194      190 CONTINUE
195      CN = FUNCTION(ACN, ABALP, DELP, FMACH)
196      CMCG = FUNCTION(ACMCG)
197      CAP = FUNCTION(ACAP)
198      CY = FUNCTION(ACY, ABBET, DELY, FMACH)
199      CLNCG = FUNCTION(ACLNCG)
200      CAB = FUNCTION(ACAB)
201      CAG = FUNCTION(ACA9, FMACH)
202      CA = CAP * CAB - CAG
203      GO TO 3
204      C
205      2 I = ISAVE(6)
206      J = ISAVE(7)
207      K = ISAVE(8)
208      CALL FIND(I, TALP, 6, ABALP)
209      CALL FIND(J, TMACH2, 5, FMACH)
210      CALL FIND(K, TALP, 6, ABBET)
211      IF(J .NE. ISAVE(7)) GO TO 250
212      IF(I .EQ. ISAVE(6)) GO TO 260
213      250 ISAVE(6) = I
214      CALL NTERP (ACN, TCN2, 1, TALP, 6, J, TMACH2)
215      CALL NTERP (ACMCG, TCMCG2)
216      260 IF(J .NE. ISAVE(7)) GO TO 270
217      IF(K .EQ. ISAVE(8)) GO TO 280
218      270 ISAVE(7) = J
219      ISAVE(8) = K
220      CALL NTERP (ACY, TCN2, K, TALP, 6, J, TMACH2)
221      CALL NTERP (ACLNCG, TCMCG2)
222      280 I = ISAVE(9)
223      CALL FIND(I, TMACH5, 15, FMACH)
224      IF(I .EQ. ISAVE(9)) GO TO 290
225      ISAVE(9) = I
226      CALL NTERP (ACAP, TCA2, 1, TMACH5)
227      290 CONTINUE
228      CN = FUNCTION(ACN, ABALP, FMACH)
229      CMCG = FUNCTION(ACMCG)
230      CY = FUNCTION(ACY, ABBET, FMACH)
231      CLNCG = FUNCTION(ACLNCG)
232      CA = FUNCTION(ACAP, FMACH)
233      C
234      3 I = ISAVE(10)
235      CALL FIND(I, TMACH3, 8, FMACH)
236      IF(I .EQ. ISAVE(10)) GO TO 350
237      ISAVE(10) = I
238      CALL NTERP (ACLP, TCLP, 1, TMACH3)
239      CALL NTERP (ACLD, TCLD)
240      350 I = ISAVE(11)
241      J = ISAVE(12)
242      K = ISAVE(13)
243      CALL FIND(I, TMACH4, 5, FMACH)
244      CALL FIND(J, TALP, 10, ABALP)
245      CALL FIND(K, TALP, 10, ABBET)
246      IF(I .NE. ISAVE(11)) GO TO 360
247      IF(J .EQ. ISAVE(12)) GO TO 370
248      360 ISAVE(12) = J

```

249		CALL NTERP (ACMG,TCMQ,J,TALP4,10,I,TMACH4)	
250	370	IF(I .NE. ISAVE(11))	GO TO 380
251		IF(K .EQ. ISAVE(13))	GO TO 390
252	380	ISAVE(11) = I	
253		ISAVE(13) = K	
254		CALL NTERP (ACLR,TCMQ,K,TALP4,10,I,TMACH4)	
255	390	CONTINUE	
256		CLP = FUNCTION(ACLP,FMACH)	
257		CLD = FUNCTION(ACLD)	
258		CMG = FUNCTION(ACMG,ABALP,FMACH)	
259		CLNR = FUNCTION(ACLR,ABBET,FMACH)	
260		IF(ALPHA .LT. 0.0) CN = -CN	CMCG = -CMCG
261		IF(BETA .LT. 0.0) CY = -CY	CLNCG = -CLNCG
262		CMAD=C.	
263		CLNAD=0.	
264		RETURN	
265		END	

```

1 SUBROUTINE TRSFER
2 C *** THIS SUBROUTINE PERFORMS THE EARTH TO BODY COORDINATE SYS. TRANSFORMATION
3 C
4 DIMENSION DUM(7),DUMY(57)
5 COMMON/INTEG/I,J,DUM,PHI,THTA,PSI,DUMY
6 COMMON/ETB/EB11,EB12,EB13,EB21,EB22,EB23,EB31,EB32,EB33
7 COMMON/TDC/CPSI,SPSI,SPHI,CPHI
8 CPSI=COS(PSI)
9 SPSI=SIN(PSI)
10 CHTA=COS(THTA)
11 SHTA=SIN(THTA)
12 CPHI=COS(PHI)
13 SPHI=SIN(PHI)
14 EB11=CPHI*CTHTA
15 EB12=SPHI
16 EB13=CPHI*STHTA
17 EB21=SPHI*STHTA*CPHI*SPSI*CTHTA
18 EB22=CPHI*CPHI
19 EB23=SPHI*CTHTA*CPHI*SPSI*STHTA
20 EB31=CPHI*STHTA*SPHI*SPSI*CTHTA
21 EB32=SPHI*CPHI
22 EB33=CPHI*CTHTA*SPHI*SPSI*STHTA
23 RETURN
24 END

```

1	SUBROUTINE TRSFBS
2	C *** THIS SUBROUTINE PERFORMS THE BODY TO SEEKER COORDINATE SYS. TRANSFORMATION
3	C
4	DIMENSION DUM(15),DUMR(9)
5	COMMON/INTEG/I,J,DUM,THTA9,GC,PS19,DUMR
6	COMMON/BTS/BS11,BS12,BS13,BS21,BS22,BS23,BS31,BS32,BS33
7	BS12= SIN(PS19)
8	BS22= COS(PS19)
9	BS31= SIN(THTA9)
10	BS33= COS(THTA9)
11	BS11= BS22*BS33
12	BS13= BS22*BS31
13	BS21= BS12*BS33
14	BS23= BS12*BS31
15	BS32= 0.
16	RETURN
17	END

1	SUBROUTINE TRSF8V
2	C *** THIS SUBROUTINE PERFORMS THE BCS TO VCS TRANSFORMATION
3	C
4	COMMON/ IN/ GAMP, GAMY, DFLXTR, DELVTR, DELZTR
5	COMMON/ RTV/ DELXV, DELYV, DELZV
6	BV12=SIN(GAMY)
7	BV22=COS(GAMY)
8	BV31=SIN(GAMP)
9	BV33=COS(GAMP)
10	BV11=BV22*BV33
11	BV13=-BV22*BV31
12	BV21=-BV12*BV33
13	BV23=BV12*BV31
14	BV32=C
15	DELXV=BV11*DELXTR+BV12*DELYTR+BV13*DFLZTR
16	DELYV=BV21*DELXTR+BV22*DELYTR+BV23*DFLZTR
17	DELZV=BV31*DELXTR+BV32*DELYTR+BV33*DFLZTR
18	RETURN
19	END

```

1      SUBROUTINE LOSERR
2      C*** THIS SUBROUTINE TRANSFORMS MISSILE TO TARGET DISPLACEMENTS
3      C*** FROM ECS TO BCS, FROM BCS TO SCS AND COMPUTES LOS ERROR IN SCS
4      C
5      COMMON/BT8/BS11,BS12,BS13,BS21,BS22,BS23,BS31,BS32,BS33
6      COMMON/ET8/EB11,EB12,EB13,EB21,EB22,EB23,EB31,EB32,EB33
7      COMMON/INPSKR/PITERR,YAWERR
8      COMMON/DEL/DELX,DELY,DELZ
9      COMMON/STUFF/ DELX6,DELY6,DELZ6
10     COMMON/STUFF1/DELX8,DELY8,DELZ8
11     DELX8=EB11*DELX+EB12*DELY+EB13*DELZ
12     DELY8=EB21*DELX+EB22*DELY+EB23*DELZ
13     DELZ8=EB31*DELX+EB32*DELY+EB33*DELZ
14     DELX6=BS11*DELX8+BS12*DELY8+BS13*DELZ8
15     DELY6=BS21*DELX8+BS22*DELY8+BS23*DELZ8
16     DELZ6=BS31*DELX8+BS32*DELY8+BS33*DELZ8
17     PITERR=ATAN2(-DELZ6,DELX6)
18     YAWERR=ATAN2(DELY6,SGRT(DELY6*DELY6+DELZ6*DELZ6))
19     RETURN
20     END

```

1	SUBROUTINE MCALC
2	C*** THIS SUBROUTINE CALCULATES THE MACH NUMBER
3	C
4	DIMENSION RUM(63)
5	REAL MACH
6	COMMON/ETC/EB11,EB12,EB13,EB21,EB22,EB23,EB31,EB32,EB33
7	COMMON/MACL/MACH,VSND,UR,VR,WR,VRS,VRW,VW
8	COMMON/INTEG/I,J,CS,U,V,W,RUM
9	COMMON/F/WXS,WYS,WZS
10	UW=EB11*WXS+EB12*WYS
11	VW=EB21*WXS+EB22*WYS
12	WW=EB31*WXS+EB32*WYS
13	UR=U-UW
14	VR=V-VW
15	WR=W-WW
16	VRS=UR*UR+VR*VR+WR*WR
17	VRW=SGRT(VRS)
18	MACH=VRW/VSND
19	RETURN
20	END

```

1      SUBROUTINE FERRMAN
2      C** SUBROUTINE FERRMAN CALCULATES FORCES AND MOMENTS FOR THE DIFFERENTIALS
3      C
4      DOUBLE PRECISION TIME, TIME3
5      REAL MACH
6      DIMENSION HMM(4), HMM1(17), HMM1(40)
7      COMMON/TOGEG/AXB,AYB,AZB,CLP,CNB,ALP,AMP,ALP,CMB
8      COMMON/CDEF/CAZ,CV,CN,CLP,CMBG,CVCG,CLO,CNC,CNR,ALPHA,BETA,CNAD,
9      CCLAD
10     COMMON/MACH/MACH,AX,UR,VX,VY,VZ,VRS,VRS,VX
11     COMMON/CD/DEL VY,DEL VZ,DEL R,DEL ROL
12     COMMON/JUNK/TIME,TIME3,RMS,S,D,SCUR,CAP,IOAP,RAPTM1,RAPTM2,IACT,
13     C SLOPE1,BT1,RAPTM3,SLOPE2,BT2,CTT,CPT,SPT,XLTA,STT,CAPS,CAPSO,
14     C CAPSD,TH
15     COMMON/INTEG/I,J,WMW,P,G,R,HMM1,DEL1,DEL VZ,DEL3,HMM1
16     COMMON/FF/FFCLB,FFCNC,FFCNCB,FFAXB,FFAYB,FFAZB,FFALB,FFAMB,FFANB
17     ALPHA=ATAN2(UR,VR)
18     SCL=SQRT(UR*UR+VR*VR)
19     BETA=ATAN2(VR,SCLW)
20     CAP=5*RM3*VRS
21     CAPS=CAP*S
22     CAPSD=CAPSD
23     IF(VRS.EQ.0.)GO TO 121
24     CAPSD=CAPSD/D/(2.*VRS)
25     GO TO 122
26     121 CAPSD=C
27     122 CONTINUE
28     DEL VY=(DEL1+DEL3)/2.
29     DEL VZ=(DEL1+DEL3)/2.
30     IF(IACT.EQ.2)DEL VY=(DEL3+DEL1)*.5
31     IF(TIME.GE.TIME3)DEL ROL=DEL VZ
32     DEL R=CELMOL*.572957795
33     CALL AERO(TIME,TIME3,MACH,ALPHA,BETA,DEL VZ,DEL VY,DEL R,CN,CMBG,CY,
34     C CYCG,CXZ,CCLP,CCLC,CMB,CNR,CNAD)
35     CLB=CAPSD*CLC*DEL R*FFCLB
36     CMB=CAPSD*CMC*FFCMB
37     CNB=CAPSD*CN*FFCNB
38     AXB=CAP*CAZ*FFAXB
39     AYB=CAP*CV*FFAYB
40     AZB=CAP*CN*FFAZB
41     ALB=CAPSD*CLP*P*FFALB
42     APB=CAPSD*CMC*FFAPB
43     ANB=CAPSD*CYCG*FFANB
44     IF(IOAP.EQ.0)RAPTM1=TIME,RAPTM2=TIME,RAPTM3=TIME
45     IF(TIME.LE.RAPTM2)TH=SLAPF1*TIME+BT1
46     IF(TIME.GT.RAPTM2)AND(TIME.LE.RAPTM3)TH=SLAPF2*TIME+BT2
47     IF(TIME.GT.RAPTM3)TH=0.
48     IF(TIME.GT.RAPTM3)IOAP=0
49     123 AXB=AXB+TH*CPT*CPT
50     AYB=AYB+TH*CPT*SPT
51     AZB=AZB+TH*STT
52     ALB=ALB+TH*STT*XLTA
53     ANB=ANB+TH*CTT*SPT*XLTA
54     RETURN
55     END

```

```

1      SUPPLUTINE DIFEG
2      C***SUBROUTINE DIFEG CONSTRUCTS THE EQUATIONS OF MOTION
3      DOUBLE PRECISION TIME
4      DIMENSION DMG(27),CMW(21)
5      REAL MASS,IX,IYZ
6      COMMON/ETB/EB11,EB12,EB13,EB21,EB22,EB23,EB31,EB32,EB33
7      COMMON/TODEQ/AXB,AYB,AZB,CLB,CNB,ALB,AMB,ANB,CM2
8      COMMON/INTEG/I,J,GC,U,V,W,P,Q,R,DSG,DU,DV,DW,DP,DC,DR,
9      IDPHI,DTHTA,DPSI,DX,DY,DZ,C9%
10     COMMON/JUNK/TIME
11     COMMON/JUNK1/THOLD,IROLL,G,MASS,IX,IYZ,XINTIA,NAVY
12     COMMON/TGC/CPHI,SPHI,SPHI,CPHI
13     COMMON/GG/GXB,GYB,GZB
14     C** GRAVITY RESOLUTION TO BCS
15     GXB=EB13*G
16     GYB=EB23*G
17     GZB=EB33*G
18     C** EQUATIONS OF MOTION
19     CL=AXB/MASS+R*V-C*W+GXB
20     IF(TIME.LT.THOLD.AND.NAVY.EC.1)CL=0.
21     CV=AYB/MASS+P*W-R*L+GYB
22     DW=AZB/MASS+Q*U-P*V+GZB
23     CP=(ALB+CLB)/IX
24     DG=(AMB+CNB)/IYZ+P*R-XINTIA
25     DR=(ANB+CNB)/IYZ-P*Q-XINTIA
26     DTHTA=(G*CPHI-R*SPHI)/CPSI
27     CPHI=P-DTHTA*SPSI
28     DPSI=R*CPHI-C*SPHI
29     IF(IROLL.NE.C)CP=0.
30     IF(IROLL.NE.C)P=0.
31     C** MISSILE VELOCITY IN ECS
32     CX=EB11*U+EB21*V+EB31*W
33     CY=EB12*U+EB22*V+EB32*W
34     CZ=EB13*U+EB23*V+EB33*W
35     RETURN
36     END

```

```

1      SUBROUTINE METO
2      C** SUBROUTINE METO CALCULATES THE VELOCITY OF SOUND
3      C
4      DOUBLE PRECISION TIME, TIME3
5      DIMENSION DUM(22), CUMY(6)
6      REAL MACH
7      COMMON/MO/GEALTY, T0, TGRAD, RHOSL, ARG1, WTMOL, RSTAR,
8      1RHOB, ARG2, GR, TMOL
9      COMMON/JUNK/TIME, TIME3, RHP, DUM
10     COMMON/MACH/MACH, VSND, DUMY
11     IF (GEALTY.GT.36089.2389) GO TO 12
12     TMOL=T0+TGRAD*GEALTY
13     RHO=RHOSL*(T0/TMOL)**ARG1
14     RHOB=RHO
15     VSND=SGRT(1.4*RSTAR*TMOL/WTMOL)
16     GO TO 13
17     12 CONTINUE
18     ARG2=GR*WTMOL*(GEALTY-36089.2389)/(RSTAR*TMOL)
19     RHO=RHOB*EXP(ARG2)
20     13 RETURN
21     END

```

```

1      SUBROUTINE SEEK
2      C** THIS SUBROUTINE DETECTS TARGET WITHIN THE DETECTION RANGE OF SEEKER,
3      C TARGET WITHIN THE FIELD OF VIEW, S=A-W, SEEKER WITHIN LINEAR RANGE
4      C
5      DOUBLE PRECISION TIME, FSTSAM, TIME*, DT, DTA, TST, TME, SPER
6      DIMENSION CAT(14), RAT(49)
7      COMMON/STUFF/DELXS, DELYS, DELZS
8      COMMON/JUNK2/SRNGE, IFUPR, IACC, RDET, YAWERR, PITERR, PHFOV, BA, RNGLIN,
9      PITV, JG, R2D, NULSKR, BRS, RFLCT, NULL, KAGE
10     COMMON/INPSKR/PITERR, YAWERR
11     COMMON/JUNK/TIME
12     COMMON/INTEG/I, J, DTRK, CAT, THTAS, THASP, PSIS, RAT
13     COMMON/TT/FSTSAM, TIME*, DT, DTA, TST, TME, S, TSAM, DO, JMAX, IPRINT, T2
14     SRNGE=SCRT(DELXS*DELXS+DELYS*DELYS+DELZS*DELZS)
15     DATA IACQ1/0/
16     IF(IACQ1.EQ.0)GO TO 560
17     IF(TIME.LT.T2)GO TO 105
20     IF(IACQ1.NE.0)GO TO 11
21     IF(IACQ1.NE.1)GO TO 10
22     FSTSAM=TIME
23     IF(IACQ1.EQ.2)IACQ1=1
24     10 CONTINUE
25     GO TO(565,107),IACQ
26     560 CONTINUE
27     IF(IACQ.EQ.2)GO TO 107
28     FSTSAM=TIME
29     IF(TIME.GE.TIME*)GO TO 565
30     IF(TIME.LT.TIME*)GO TO 105
31     C**** ACQUISITION(IACQ=2) WHEN TARGET IS WITHIN FWHV AND RDET
32     565 CONTINUE
33     C
34     C** LINEAR SEEKER, NO OUTPUT WHEN OUT OF FOV
35     IF(SRNGE.GT.RDET)GO TO 101
36     IF(SCRT(YAWERR**2+YAWERR**2+PITERR**2+PITERR**2).GT.PHFOV)GO TO 101
37     IF(SCRT(PITERR**2+YAWERR**2).GT.0.0872664)GO TO 101
38     IF(SCRT(PSIS**2+PSIS**2+THTAS**2+THTAS**2).LT.BA)GO TO 101
39     567 CONTINUE
40     C**** PRINT EVERY JMAX INTERVALS
41     JMAX=1.00/DTA+.000001
42     DT=DTA
43     DTRK=RNGL(DT)
44     IACQ=2
45     IPRINT=2
46     PRINT 90005
47     90005 FORMAT(/,2X,'ACQUISITION')
48     GO TO 103
49     107 CONTINUE
50     C**** NULL SEEKER
51     PITERR=ATAN2(-DELYS,DELXS)
52     YAWERR=ATAN2(DELYS,SCRT(DELXS*DELXS+DELYS*DELYS+.25))
53     C
54     C** LOSS OF ACQUISITION
55     C
56     IF(SCRT(PITERR**2+PITERR**2+YAWERR**2+YAWERR**2).GT.PHFOV)GO TO 101
57     PITV=SCRT(PITERR**2+PITERR**2+YAWERR**2+YAWERR**2)
58     IF(PITV**2.LT.0.5/R2D)NULSKR=2
59     103 CONTINUE
60     C** SAMPLE AND HOLD IF FSTSAM=TIME IS INCLUDED AFTER STATEMENT 107
61     TST=TIME-FSTSAM
62     TSAM=TST+TME
63     IF(TSAM.GE.SPER)104,104,104
64     104 TME=SPER

```

```

58      IF (SRNGE.LT.BRS) GO TO 108
59      IF (SGRT(YAWERR*YAWERR+PITERR*PITERR).GT.PHFBV) GO TO 108
60      IF (SGRT(P SIS*P SIS+TWTAS*TWTAS).LT.BA) GO TO 108
61      CALL SEEKER(SRNGE,RFLECT,PITERR,PITERB)
62      CALL SEEKER(SRNGE,RFLECT,YAWERR,YAWERB)
63      PITERR=PITERR
64      YAWERB=YAWERR
65      GO TO 109
66      101 !ACC=NULL*KAGE=1
67      108 YAWERB=0.
68      PITERB=0.
69      109 CONTINUE
70      C
71      C** SEEKER WITH LINEAR RANGE
72      IF (ABS(YAWERB).GE.RNGLIN) YAWERB=SIGN(RNGLIN,YAWERB)
73      IF (ABS(PITERB).GE.RNGLIN) PITERB=SIGN(RNGLIN,PITERB)
74      105 RETURN
75      END

```

```

1 SUBROUTINE EDSKRGYRS
2 C THIS SUBROUTINE CONSTRUCTS THE SEEKER GYRO MODEL FOR ED
3 C
4 DOUBLE PRECISION TIME
5 REAL KT,KT10,KT20,LAMPR,LAMVR
6 REAL KG,KT30
7 LOGICAL FLGA,TRLE,
8 COMMON/INTG/KUTTA,NX,DTRK,U,V,W,P,Q,R,PHI,THTA,PSI,X,Y,Z,RTHTA,
9 I,PSI,THTA,THASD,PSIS,PSISD,OMEGA,TXFC,PXFD,PFF,YEF,DEL1,DELVP,
10 ZDEL3,CDEL1,DDELVP,CDEL3,RLAMY,RLAMP,RPHTG,DPHTO,OU,OV,OW,CP,CC,CR,
11 3CPH1,CTHTA,DPSI,CX,DY,DZ,DRHTA,DRPSI,DTHTA,DTASD,DPSIS,DPSISD,
12 4COMEGA,DTXED,DPXFD,DPEF,DYEF,DDEL1,DDELPP,DDFLP3,CDEL1,DDUEL1,
13 5CDEL3,DRLAMY,DRLAMP,DRPHIG,CDPHIO
14 COMMON/JUNK/TIME
15 COMMON/TT/FSTSAH,TIME4,DT,DYA,TST,TMF,SPER,TSAM,CO,JMAX,IFRINT,T2
16 COMMON/PEV, ,GV,OMEGZ
17 COMMON/BOH/RSL,K,KT10,KT20,LAMPR,LAMVR,RTM,RTMIN,RSGE,ED1,PLGA,
18 1RSA,ED4,GSA
19 COMMON/BTS/BS11,BS12,BS13,BS21,BS22,BS23,BS31,BS32,BS33
20 COMMON/JUNK2/SRAGE,IFUFF,IACQ,RDET,YAHERA,PITERA,PHFQV,BA,RNGLIN,
21 1PITYAHSQ,R2D,NULSKR,BRS,REFLECT,NLLL,KAGE
22 COMMON/OP/RB,RR,H,A,B,KT30
23 DPHIO=DPH1
24 RSL=125./R2D,IF(ABS(CPHIO).GT.RSL)DPHIO=SIGN(RSL,CPHIO)
25 IF(TIME.LT.T2)GO TO 5005
26 C
27 C*****CHECK FOR NULL SEEKER
28 IF(TIME.GT.10.AND.RTH.LT.RYMIN)GO TO 5000
29 IF(NULL.EC.2)GO TO 5000
30 NULL=1
31 RSGE=SQRT(THAS*THAS+PSIS*PSIS),IF(RSGE.LE.0.5/R2D.AND.IACQ.EC.2)
32 1NULL=2
33 C*****IF(SQRT(PITER**2+YAHER**2).GT.PHFQV)IACQ=NULL=1
34 5000 IF(IACQ.EC.1)NULL=1
35 C
36 IF(NULL.EC.1)LAMPR=LAMVR=0.
37 C
38 IF(NULL.EC.1)KT=KT20
39 IF(NULL.EC.2)KT=KT10
40 IF(ABS(RLAMY).GT.1.87265*10**10)RLAMY=SIGN(1.87265*10**10,RLAMY)
41 OMEGY=KT*PITER
42 OMEQZ=KT*YAHER
43 IF(ABS(OMEGY).GT.1745329)OMEGY=SIGN(1745329,OMEGY)
44 IF(ABS(OMEQZ).GT.1745329)OMEQZ=SIGN(1745329,OMEQZ)
45 LAMPR=OMEGY
46 LAMVR=OMEQZ
47 C SEEKER GYRO FOR ED
48 C
49 5005 CONTINUE
50 IF(TIME.LT.ED1)GO TO 6670
51 IF(.NOT.FLGA)GO TO 6670
52 KAGE=2*FLGA*DT*PLG*IFRINT*90000
53 9000A FORMAT(/,2X,'UNCAGE GYRO FOR ROLL TO VERTICAL')
54 6470 CONTINUE
55 IF(TIME.GT.ED4.AND.IACQ.NE.2.AND.IUFF.EF.2)KAGE=1
56 IF(IACQ.EC.2)KAGE=2
57 GSA=BS21*F+BS22*C+BS23*R
58 RSA=BS31*F+BS32*C+BS33*R
59 GO TO(5200,5201),KAGE
60 C
61 C
62 C CAGE

```

61	5200	DTLTAS=-10.*THTAS/CPSIS=-10.*PSIS
62		GO TO 5203
63	5201	GO TO (5202,5204),IACG
64	C	
65	C	LNCAGE
66	C	
67	C	FREE GYRH
68	C	
69	5202	DTLTAS=-GSA/COS(PSIS)
70		CPSIS=-RSA
71		GO TO 5203
72	C	
73	C	TRACK
74	C	
75	5204	DTLTAS=(OMEGY-GSA)/COS(PSIS)
76		CPSIS=OMEGZ-RSA
77	5203	RETURN
78		END

```

1      SUBROUTINE EDAP
2      C** THIS SUBROUTINE CONSTRUCTS THE ALTRPIL0T MODEL FOR ED VERSION
3      DOUBLE PRECISION TIME
4      LOGICAL FLG1,TRUE,/,FLG2,TRUE,/,FLG3,TRUE,/,
5      COMMON/JUNK/TIME
6      COMMON/SS/S1,S2,S3,S4,S5,S6
7      REAL POLES(01)/+20,/,
8      REAL KPD,KQ,KM,LAMB1,LAMP1,LAMYR,KQ
9      COMMON/OUTAP/YEG,REG,PEG
10     COMMON/BOW/ISL,XT,KT10,KT20,LAMP1,LAMYR,RT1,RT1IN,RSCE,ED1,FLG4,
11     IISA,EDA,ISA
12     COMMON/JUNK2/SRNGE,IFUFR,IACQ,ROFT,YAWERR,PITFR,PHF0V,BA,RNGL1,
13     IPITYASG,R2D,NULSKR,BRS,REFLECT,NUL,KAGE
14     COMMON/ARROW/PHIG,FLG1,FLG2,FLG3,REF,RFL,YED,PEC,THRBS,PSRBS,
15     1THBS,PSBS,GBLV,PEFL,KPD,KQ,KM,KQ,LAMB1,PALES
16     COMMON/INTG/KUTTA,NX,DTRK,U,V,W,P,C,R,PHI,THTA,PS1,X,Y,Z,RTHTA,
17     1RPS1,THTAS,TWASD,PSIS,PSISD,OMEGA,TXFD,PXFD,PEF,YEF,DEL1,DELVP,
18     2DEL3,ODEL1,ODELVP,ODEL3,RLAMY,RLAMP,RPHIG,DPMIO,OU,OV,OW,OP,OG,OR,
19     3DPM1,DTHTA,DPS1,DX,DY,DZ,DRHTA,DRPS1,DTHTAS,CTWASD,OPIS,OPISD,
20     4COMEGA,DTXED,OPXED,OPEF,DYEF,ODELP1,ODELPP,ODELP3,ODEL1,ODELP,
21     5ODEL3,ORLAMY,ORLAMP,DRPHIG,DPMIO
22     COMMON/IT/PSTSA,TIME4,OT,DTA,TSY,TIME,SPER,TSAM,CO,JMAX,IPRINT,T2
23     C ROLL AUTOPILOT
24     C
25     IF (TIME.GE.ED4)GO TO 5025
26     PHIG=DPMIO*S1+.75*.PSIS=32
27     GO TO 5030
28     5015 IF (IFUFR.EQ.2)GO TO 5025
29     IF (IACQ.EQ.2)GO TO 5025
30     PHIG=DPMIO*S1+.75*.PSIS=32
31     GO TO 5030
32     5025 IF (.NOT.FLG1)GO TO 6667
33     PRINT 90002,IPRINT=2,FLG1=.NOT.FLG1
34     90002 FORMAT(//2X,'ROLL HOLD')
35     6667 CONTINUE
36     ORLAMY=10.*DPMIO
37     PHIG=DPMIO*S1+RLAMY*83
38
39     C LEAD LAG ROLL AUTOPILOT REG/PHIG=KPD*(S+.5)/S+.12.5)
40     5030 CONTINUE
41     CALL FLTR(PHIG,RPHIG,DRPHIG,REG,12.5,5.,KPD)
42     RFL=7./REG,IF (ABS(REG).GT.RFL)REG=8./GN(RFL,REG)
43
44     C
45     C** PITCH YAW AUTOPILOT
46     C** RATE DAMPING OF GIMBAL ANGLES THRBS/THTAS=KG*S/(.0067*S+1)
47     CALL EDRTDAMP(THTAS,TXED,DTXED,THRBS,POLES(01),KQ,KM,THBS,
48     CALL EDRTDAMP(PSIS,PXED,DPXED,PSRBS,POLES(01),KQ,KM,PSBS)
49     C INPUT TO GUIDANCE FILTER=PED,YED
50     5065 CONTINUE
51     PED=LAMP1
52     YED=LAMYR
53     C GUIDANCE FILTER=PEF/PED=KQ/(1+.S+1)
54     5075 CONTINUE
55     CALL FTLG(PED,PEF,DPEF,KQ,10.)
56     CALL FTLG(YED,YEF,DYEF,KQ,10.)
57     PEFL=PEF+LAMB1
58     GBLV=8./R2D
59     IF (ABS(PEFL).GT.GBLV)PEFL=SIGN(GBLV,PEFL)
60     IF (ABS(YEF).GT.GBLV)YEF=SIGN(GBLV,YEF)
61     IF (TIME.LT.T2+6R,IACQ.EG.1)GO TO 5100
62     IF (.NOT.FLG2)GO TO 4668
63     PRINT 90003,IPRINT=2,FLG2=.NOT.FLG2

```

63	90003	FORMAT(/,2X,'LATERAL ENABLE')
64	6668	CONTINUE
65		GO TO (5080,5085),NULL
66	5080	PEG=(PEFL*THRBS*S6+YHRBS*S4)*S5
67		YEG=YEF+PSBS*S6-PSRBS*S4
68		GO TO 5100
69	5085	IF(.NOT.FLG3)GO TO 6669
70		PRINT 90004,IPRINT=2,FLG3=.NOT.FLG3
71	90004	FORMAT(/,2X,'GUIDANCE ENABLE')
72	6669	CONTINUE
73		PEG=(PEFL*THRBS*S4)*S5
74		YEG=YEF+PSRBS*S4
75	5100	IF(ABS(PEG).GT..20943948)PEG=SIGN(.20943948,PEG)
76		IF(ABS(YEG).GT..20943948)YEG=SIGN(.20943948,YEG)
77		RETURN
78		END

```

1      SUBROUTINE FLTR(X,Y,Z,A,B,C,D)
2      Z=X*B*Y
3      A=(C*Y+Z)*D
4      RETURN
5      END

```

```

1      SUBROUTINE EDRTDAMP(X,Y,Z,A,B,C,D,E)
2      Z=B*(C*X*Y)
3      A=B*(C*X*Y)
4      E=D*(X+A)
5      RETURN
6      END

```

```

1      SUBROUTINE FTLG(X,Y,Z,A,B)
2      Z=B*(A*X*Y)
3      RETURN
4      END

```

```

1      SUBROUTINE CONTROL
2      C** THIS SUBROUTINE CONTAINS THE CONTROL SYSTEM, PARADIGMS FOR EACH PLANE ON
3      C COMMON SHAFT, SECOND ORDER ACTUATOR MODEL
4      DIMENSION ACT(24),ACT8(27),ACTR(4)
5      COMMON/JUNK2/SRAGE,IFUPP,IACC,RDEF,YAWERR,PITFRS,PHF0V,BA,RNGLIN,
6      1PITYAKSC,R2D,AULSKR,BRS,RFLECT,ALLL,KAGE
7      COMMON/RUTAP/YEG,REG,PEO
8      COMMON/INTEG/I,J,ACT,DEL1,DELVP,DEL3,ODEL1,ODELVP,ODEL3,ACTR,
9      1ODELP1,ODELPP,ODELP3,ODEL1,ODELP,ODEL3,ACTR
10     COMMON/JUNK/TIME,TIME3,RMS,D,SCOW,CAP,TRAP,RAPTH1,RAPTH2,IACT,
11     1SLAPE1,BT1,RAPTH3,SLAPE2,BT2,CTT,CPT,SPT,XLYA,BTY,CAPS,CAPSU,
12     2CAPSCM,TH
13     OODEL1=60.*(60.*(YEG-REG-DEL1)-ODEL1)
14     OODELP=50.*(50.*(PEO-DELVP)-ODELVP)
15     OODEL3=60.*(60.*(YEG-RFG-DEL3)-ODEL3)
16     IF(IACT.EQ.2)OODEL1=60.*(60.*(REG-YEG-DEL1)-ODEL1)
17     IF(IACT.EQ.2)OODEL3=60.*(60.*(REG-YEG-DEL3)-ODEL3)
18     ODEL1=ODEL1
19     ODELVP=ODELVP
20     ODEL3=ODEL3
21     RETURN
22     END

```

```
ALLRPT (FILE,X1),(FORMAT,U),(RSIZE,202),(FSIZE,240)
ALLRPT (FILE,X2),(FORMAT,U),(RSIZE,202),(FSIZE,100)
ASSIGN (MISI,RT,X6)
```

```
FORMAT SI,GR,NS,HC
```

```
ALPAC (TEMP,ECC),(LIP,USER,SYSTEM)
```

```
:RROT (FILE,RT,GA,EED)
```

```
:(FILE,D1,$SYSLIP,EED)
```

```
  L SRFF  LL      7DPT
```

```
  L SRFF  LL      7DPT
```

```
LOADING WAS COMPLETED
```

```
WARNING: UNSATISFIED REF'S
```

```
REWIND STARC
```

```
RAV
```

BRAIN PRECUTION									
BP	6.2500	R70L	100000	240.00	RA	100000	SR5	2.0000	
KP	10.000	R5	0.0000	50000	371	211.22	BT2	525.00	
CPY	1.0000	STT	0.0000	100000	PTCHB	1.0000	CTT	1.0000	
RAPTH3	13.000	O	0.0000	3.5000	DELY	34907	ED0	3.0000	
E21	3.2500	EDR	0.0000	3.5000	EDY	7.2500	ED5	3.0000	
K71C	10.000	FFALB	1.0000	0.0000	FFANB	1.0000	GF	5.0000	
FFCLB	1.0000	FFZB	1.0000	1.0000	FFZB	1.0000	GRCLB	1.3983	
PLF8V	0.21017	GC	0.26180	1.0000	IACT	0	IRCLLDC	1	
ICLPM		O			IRCLL	0	IX	20.000	
ISKR		C			IRCLL	0	IX	20.000	
SC	149.23	IVZ	1.0000	162268-04	IRCLL	0	PCA	2000.0	
KR	10000	RVR1AS	0.0000	0.0000	IRCLL	0	KGL	1.0000	
FFAIB	1.0000	KPD	1.0000	1.0000	IRCLL	0	KGL	1.0000	
KS	6.0000	KM	2.0000	1.2651	JMAX	126	MASS	4.4887	
CG	5.3120	KRLA	108198483	0.76180	IA	239282-04	PHMAX	1.7459	
BA	1.0000	PRINTP	1.0000	1.0000	12A	6.5000	RAPTH1	0.0000	
RSET	7000.0	DTA	39043E-02	5.0000	81	3.1414	RLAMP	0.0000	
PRIT	0.0000	RLAMP	0.0000	0.0000	RNGLIN	261802-01	VRATE	5.2360	
RTAIA	10000	KM	2.0000	1.0000	86	1.0000	S10	1.0000	
S9	1.0000	S12	1.0000	1.0000	84	1.0000	S3	1.0000	
S2	1.0000	S1	1.0000	1.0000	DELIX	26180	SFO	1.0000	
SP1	100.00	SP2	100.00	20292	87A	20.000	SFB	15.000	
SFA	15.000	SP7	15.000	1.0000	SP9	50.000	SF10	20.000	
SF11	20.000	SF12	50.000	1.0000	SP13	15.000	SF15	12.000	
SLMP2	11.538	SLMP1	361735	1.0000	TO	1.0000	TO3	2.0000	
T02	1.8000	T05	2.4000	2.2000	T07	2.8000	T06	2.6000	
T2	8.0000	T1	3.0000	4.0000	SPT	0.0000	TMB-D	0.0000	
TMTAC	13080	KD	20000	0.0000	IRAP	0	TMB-D	0.0000	
TIC	12500	TIC1	12500	0.0000	TME2	65000	TME	0.0000	
TIMFC	13000	TIP1	0.0000	0.781257-09	YHFBV	21817	K5	0.0000	
ZPIN	0.0000	TME*	6.8000	100000	ZIN	0.0000			

189

PROJECTILE									
TYPE	3	0000C	REX	110341E-01	DELTA	100000	U	347103	110342E-02
W	0	19455E-01	THIA	0	13087	2,7758	DELZ	530,70	TOTACC
DZ	0	123,37	DY	0	1875CE-02	DPHT	DPHTA	0	938,99
DRS1	0	20232E-03	DR	0	3379CE-01	DQ	DP	0	3,6535
DU	0	21,611	DV	0	1,5877	VRW	MACM	0	931,71
PR1	0	11365E-04	P	0	1,0164	Q	R	0	0,0000
Y	0	18731E-01	DELXV	0	0,0000	DELXV	DELTA	0	29,127
Y	0	62355E-02	Z	0	4530,7	AB	X7	0	0,0000
DMTA	0	29447E-01	CPHT	0	93384	SPH1	SPH1	0	11365E-04
CSIS	0	1,0000	GZB	0	29,776	GVB	GVB	0	0,1967
AL78PIL871									
DMPTO	0	0,0000	DELXS	0	10031	PEQ	DELMS	0	0,0000
DELZS	0	1735,3	MEGA	0	10180E-19	DVEF	DVEF	0	0,0000
RTM	0	10221	XY	0	20,000	PEFL	NULL	0	0,0000
MEGZ	0	0,0000	PRQD	0	0,0000	PEO	PEF	0	0,0000
PRIG	0	1,0164	PRIS	0	0,0000	PEO	THRS	0	0,0000
DEL1	0	0,0000	RLAMV	0	0,0000	RLAMP	THAS	0	0,0000
YED	0	0,0000	PEY	0	0,0000	YED	YED	0	0,0000
YARD	0	0,0000	VEG	0	0,0000	DELYS	YAKERR	0	0,0000
LAMR	0	0,0000	LAMR	0	0,0000	OSA	QARS	0	0,0000
IACC	0	0,0000	1	0	0,0000	REN	DPSIS	0	0,0000
LABIC1									
DATE	1	DATE	2	DATE	3	DATE	4	DATE	5
GATE	6	GATE	7	GATE	8	GATE	9	GATE	0
AFRDNAMICS1									
CLC	0	92164E-01	ALB	0	61931	CNR	CYC	0	1451CE-04
CAZ	0	4134	CLP	0	23,973	CN	CYCG	0	39623E-03
AXR	0	22192E-02	CLB	0	0,0000	CH	CNE	0	0,0000
OMASD	0	0,0000	PSISD	0	0,0000	DPISD	ALPHA	0	12094E-05
RAP1	0	0,0000	CTT	0	1,0000	RPT	CPT	0	0,0000
SLTA	0	1,6667							
DEPLG PRINT1									
DEPLX	0	10031	DELYE	0	664,83	DELZA	DELXS	0	664,53
DEPLS	0	1735,3	KLTTA	0	17096	PIERR	YAKERR	0	0,0000
YAKERR	0	0,0000	DELAMV	0	0,0000	P3	DPST	0	0,0000
DEPLIG	0	9994	DEPLIG	0	13287E-02	DELYR	DPHIO	0	32,160
DEPL	0	10031	ISKR	0	0	1ACT	10CTOE	0	0
KAGF	0	1	NAVY	0	0	F1	DELAMP	0	0
IPRIAT	0	1	NPPS	0	20	NPT	ACTA	0	2
PEFI	0	12451	PHIG	0	1,0164	RHA	SP	0	0,0000
REF	0	0,0000	REF	0	0,0000	REG	DELRL	0	0,0000
MEGV	0	0,0000	MEGV	0	0,0000	NX	RTTA	0	0,0000

UNCASE GVRP FOR R9LL TR VERTICAL

PROJECTILE									
TYPE	6.6316	RSX	193281E-04	DELVS	0.00000	U	885.95	V	12702E-02
W	.59483E-01	TMTA	.4644E-02	PND	.19077E-03	DELZ	.757.25	TOTACC	.129674E-C1
DZ	.4.0568	DY	.5812E-03	DPHI	.10578E-03	DTMTA	.35802E-01	UX	.889.99
DP81	.5782E-04	DR	.1280E-03	DQ	.3607E-09	DP	.61901E-02	DM	.4.1067
DU	.12.824	DV	.5055E-01	VRN	.845.95	WACH	.180685	CAP	.809.79
PS1	.20802E-05	D	.00571E-03	Q	.35802E-01	R	.50992E-04	DELVS	.00000
Y28	.113318	DELVS	.00000	DELVS	.00000	X	.00000	Y	.639.5
Y	.12136E-01	Z	.4757.3	AMB	.110950	XT	.13120.	YT	.00000
DTMTA	.35802E-01	CM1	.1.0000	8PH	.119077E-03	CP81	.1.0000	SPS1	.120802E-05
CP819	.1.0000	Q18	.32.159	Q18	.61346E-09	Q18	.1.14943		
AUTOPILOT									
DEP10	.00000	DELVS	.678273	PEO	.00000	DELVS	.00000	TACD	.67947E-02
DELVS	.1594.9	OMEGA	.28164E-16	DVEF	.00000	DEFF	.00000	DTMTAS	.35802E-C1
RTM	.6947.8	KT	.20.000	PEPL	.12651	NULL	.00000	DELVS	.1374E-03
DEP2	.00000	PRD	.00000	PEO	.00000	PEF	.00000	PIVER8	.00000
PH10	.13853E-04	PS1S	.55952E-05	PRD	.15778E-04	THDS	.123901	PS89	.73330E-06
DEL1	.24023E-05	RLAM	.00000	RLAMP	.00000	THAS	.11770	THRS8	.18045E-04
VEP	.00000	PEP	.00000	YEC	.00000	PEO	.00000	VEP	.00000
YBRD	.00000	VEG	.00000	DELVS	.119081	YAMERH	.27389E-04	YAMER8	.00000
LAMVR	.00000	LAMVR	.00000	OSA	.35802E-01	CAPS	.164.32	DPS1S	.598221E-C4
IACS	.1.0000	PS888	.59618E-05	REN	.00000				
LEGICI									
DATE	1	DATE	2	DATE	3	DATE	4	DATE	5
GATE	6	GATE	7	GATE	8	GATE	9	GATE	10
AFRODYNAMICS									
CLD	.9024CE-C1	ALB	.20680E-03	CNR	.150.34	CMC	.150.38	CY	.17193E-C4
CAZ	.34036	CLP	.21.274	CH	.81031E-03	CYCG	.27869E-04	CMCG	.13110E-C2
YAM	.23377E-02	CLB	.10374E-02	CPS	.112899	CNE	.15385E-03	THASD	.00000
DTM80	.00000	PS1SD	.00000	DP1SD	.00000	ALPHA	.67366E-04	BETA	.14337E-05
RAJ1	.00000	CTT	.1.0000	SPT	.00000	CPT	.1.0000	TM	.00000
XYTA	.1.6657								
DEBLQ PRINT									
DELVS	.6922.9	DELVS	.15286	DELVS	.789.43	DELVS	.6752.3	DELVS	.19081
DELVS	.1594.9	KUTTA	.00000	PIERR	.23124	YAMER8	.27385E-04	PIERR8	.00000
YAMER8	.00000	DELVS	.00000	PS	.00000	CP81	.00000	DTMTA	.00000
DRPH10	.26813E-03	RM10	.2258E-04	DELVS	.124023E-04	CP10	.4578E-03	G	.32.159
VSCT	.10910	19KR	.0	1ACT	.0	1GIDE	.0	TRAP	.0
KAGE	.2	NAVY	.0	F1	.00000	DLAMP	.00000	NLM	.0
IPRIAT	.1	NAPS	.20	NDT	.00000	NOTA	.0	NLSKR	.0
PFEL	.12651	PM10	.13853E-04	RM9	.20633E-02	82	.1.0000	DELVS	.24023E-C5
REF	.00000	SET	.00000	REG	.00000	apsi	.00000	RTMTA	.00000
AMFGY	.00000	AMEGZ	.00000	NX	.00000				

PROJECT/FILE	TYPE	DATE	TIME	USER	STATUS	DESCRIPTION	REMARKS
PROJECT/FILE	TYPE	DATE	TIME	USER	STATUS	DESCRIPTION	REMARKS
12.000	RSA	10.28E-04	DELVP				
103.82	YMTA	.88930E-02	PHD				
111.75	DY	.59735E-02	DPHI				
11.837E-04	DR	.75425E-05	DQ				
5.3203	DV	.94951E-02	VRK				
1.69735E-05	P	.69735E-07	C				
103.82	DELXV	.00000	DELXV				
2.24308E-01	Z	.36112	AMB				
1.1560E-01	CPMT	1.0000	CPMT				
1.0000	GZB	32.159	GVB				
12.000	RSA	10.28E-04	DELVP				
103.82	YMTA	.88930E-02	PHD				
111.75	DY	.59735E-02	DPHI				
11.837E-04	DR	.75425E-05	DQ				
5.3203	DV	.94951E-02	VRK				
1.69735E-05	P	.69735E-07	C				
103.82	DELXV	.00000	DELXV				
2.24308E-01	Z	.36112	AMB				
1.1560E-01	CPMT	1.0000	CPMT				
1.0000	GZB	32.159	GVB				

[illegible]

	DATE	TIME	DATE	TIME	DATE	TIME
LADIC:						
DATE	1	1	DATE	2	7	8
GATE	6	7	GATE	3	7	8

[illegible]

	CYT	SPT	CPT	TW
GADI	.0000C	.	.00000	.
SYT	1.6A67	.	1.0000	.00000
XLTB				

[illegible]


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PROJECTILE:
TIME 14.000 100.91 127.67 164.88 191.07 217.31 243.55 269.79 296.03 322.27 348.51 374.75 401.00 427.24 453.48 479.72 505.96 532.20 558.44 584.68 610.92 637.16 663.40 689.64 715.88 742.12 768.36 794.60 820.84 847.08 873.32 899.56 925.80 952.04 978.28 1004.52 1030.76 1057.00 1083.24 1109.48 1135.72 1161.96 1188.20 1214.44 1240.68 1266.92 1293.16 1319.40 1345.64 1371.88 1398.12 1424.36 1450.60 1476.84 1503.08 1529.32 1555.56 1581.80 1608.04 1634.28 1660.52 1686.76 1713.00 1739.24 1765.48 1791.72 1817.96 1844.20 1870.44 1896.68 1922.92 1949.16 1975.40 2001.64 2027.88 2054.12 2080.36 2106.60 2132.84 2159.08 2185.32 2211.56 2237.80 2264.04 2290.28 2316.52 2342.76 2369.00 2395.24 2421.48 2447.72 2473.96 2500.20 2526.44 2552.68 2578.92 2605.16 2631.40 2657.64 2683.88 2710.12 2736.36 2762.60 2788.84 2815.08 2841.32 2867.56 2893.80 2920.04 2946.28 2972.52 2998.76 3025.00 3051.24 3077.48 3103.72 3129.96 3156.20 3182.44 3208.68 3234.92 3261.16 3287.40 3313.64 3339.88 3366.12 3392.36 3418.60 3444.84 3471.08 3497.32 3523.56 3549.80 3576.04 3602.28 3628.52 3654.76 3681.00 3707.24 3733.48 3759.72 3785.96 3812.20 3838.44 3864.68 3890.92 3917.16 3943.40 3969.64 3995.88 4022.12 4048.36 4074.60 4100.84 4127.08 4153.32 4179.56 4205.80 4232.04 4258.28 4284.52 4310.76 4337.00 4363.24 4389.48 4415.72 4441.96 4468.20 4494.44 4520.68 4546.92 4573.16 4599.40 4625.64 4651.88 4678.12 4704.36 4730.60 4756.84 4783.08 4809.32 4835.56 4861.80 4888.04 4914.28 4940.52 4966.76 4993.00 5019.24 5045.48 5071.72 5097.96 5124.20 5150.44 5176.68 5202.92 5229.16 5255.40 5281.64 5307.88 5334.12 5360.36 5386.60 5412.84 5439.08 5465.32 5491.56 5517.80 5544.04 5570.28 5596.52 5622.76 5649.00 5675.24 5701.48 5727.72 5753.96 5780.20 5806.44 5832.68 5858.92 5885.16 5911.40 5937.64 5963.88 5990.12 6016.36 6042.60 6068.84 6095.08 6121.32 6147.56 6173.80 6200.04 6226.28 6252.52 6278.76 6305.00 6331.24 6357.48 6383.72 6409.96 6436.20 6462.44 6488.68 6514.92 6541.16 6567.40 6593.64 6619.88 6646.12 6672.36 6698.60 6724.84 6751.08 6777.32 6803.56 6829.80 6856.04 6882.28 6908.52 6934.76 6961.00 6987.24 7013.48 7039.72 7065.96 7092.20 7118.44 7144.68 7170.92 7197.16 7223.40 7249.64 7275.88 7302.12 7328.36 7354.60 7380.84 7407.08 7433.32 7459.56 7485.80 7512.04 7538.28 7564.52 7590.76 7617.00 7643.24 7669.48 7695.72 7721.96 7748.20 7774.44 7800.68 7826.92 7853.16 7879.40 7905.64 7931.88 7958.12 7984.36 8010.60 8036.84 8063.08 8089.32 8115.56 8141.80 8168.04 8194.28 8220.52 8246.76 8273.00 8299.24 8325.48 8351.72 8377.96 8404.20 8430.44 8456.68 8482.92 8509.16 8535.40 8561.64 8587.88 8614.12 8640.36 8666.60 8692.84 8719.08 8745.32 8771.56 8797.80 8824.04 8850.28 8876.52 8902.76 8929.00 8955.24 8981.48 9007.72 9033.96 9060.20 9086.44 9112.68 9138.92 9165.16 9191.40 9217.64 9243.88 9270.12 9296.36 9322.60 9348.84 9375.08 9401.32 9427.56 9453.80 9480.04 9506.28 9532.52 9558.76 9585.00 9611.24 9637.48 9663.72 9689.96 9716.20 9742.44 9768.68 9794.92 9821.16 9847.40 9873.64 9900.00 9926.24 9952.48 9978.72 10005.00 10031.24 10057.48 10083.72 10110.00 10136.24 10162.48 10188.72 10215.00 10241.24 10267.48 10293.72 10320.00 10346.24 10372.48 10398.72 10425.00 10451.24 10477.48 10503.72 10530.00 10556.24 10582.48 10608.72 10635.00 10661.24 10687.48 10713.72 10740.00 10766.24 10792.48 10818.72 10845.00 10871.24 10897.48 10923.72 10950.00 10976.24 11002.48 11028.72 11055.00 11081.24 11107.48 11133.72 11160.00 11186.24 11212.48 11238.72 11265.00 11291.24 11317.48 11343.72 11370.00 11396.24 11422.48 11448.72 11475.00 11501.24 11527.48 11553.72 11580.00 11606.24 11632.48 11658.72 11685.00 11711.24 11737.48 11763.72 11790.00 11816.24 11842.48 11868.72 11895.00 11921.24 11947.48 11973.72 12000.00 12026.24 12052.48 12078.72 12105.00 12131.24 12157.48 12183.72 12210.00 12236.24 12262.48 12288.72 12315.00 12341.24 12367.48 12393.72 12420.00 12446.24 12472.48 12498.72 12525.00 12551.24 12577.48 12603.72 12630.00 12656.24 12682.48 12708.72 12735.00 12761.24 12787.48 12813.72 12840.00 12866.24 12892.48 12918.72 12945.00 12971.24 12997.48 13023.72 13050.00 13076.24 13102.48 13128.72 13155.00 13181.24 13207.48 13233.72 13260.00 13286.24 13312.48 13338.72 13365.00 13391.24 13417.48 13443.72 13470.00 13496.24 13522.48 13548.72 13575.00 13601.24 13627.48 13653.72 13680.00 13706.24 13732.48 13758.72 13785.00 13811.24 13837.48 13863.72 13890.00 13916.24 13942.48 13968.72 13995.00 14021.24 14047.48 14073.72 14100.00 14126.24 14152.48 14178.72 14205.00 14231.24 14257.48 14283.72 14310.00 14336.24 14362.48 14388.72 14415.00 14441.24 14467.48 14493.72 14520.00 14546.24 14572.48 14598.72 14625.00 14651.24 14677.48 14703.72 14730.00 14756.24 14782.48 14808.72 14835.00 14861.24 14887.48 14913.72 14940.00 14966.24 14992.48 15018.72 15045.00 15071.24 15097.48 15123.72 15150.00 15176.24 15202.48 15228.72 15255.00 15281.24 15307.48 15333.72 15360.00 15386.24 15412.48 15438.72 15465.00 15491.24 15517.48 15543.72 15570.00 15596.24 15622.48 15648.72 15675.00 15701.24 15727.48 15753.72 15780.00 15806.24 15832.48 15858.72 15885.00 15911.24 15937.48 15963.72 15990.00 16016.24 16042.48 16068.72 16095.00 16121.24 16147.48 16173.72 16200.00 16226.24 16252.48 16278.72 16305.00 16331.24 16357.48 16383.72 16410.00 16436.24 16462.48 16488.72 16515.00 16541.24 16567.48 16593.72 16620.00 16646.24 16672.48 16698.72 16725.00 16751.24 16777.48 16803.72 16830.00 16856.24 16882.48 16908.72 16935.00 16961.24 16987.48 17013.72 17040.00 17066.24 17092.48 17118.72 17145.00 17171.24 17197.48 17223.72 17250.00 17276.24 17302.48 17328.72 17355.00 17381.24 17407.48 17433.72 17460.00 17486.24 17512.48 17538.72 17565.00 17591.24 17617.48 17643.72 17670.00 17696.24 17722.48 17748.72 17775.00 17801.24 17827.48 17853.72 17880.00 17906.24 17932.48 17958.72 17985.00 18011.24 18037.48 18063.72 18090.00 18116.24 18142.48 18168.72 18195.00 18221.24 18247.48 18273.72 18300.00 18326.24 18352.48 18378.72 18405.00 18431.24 18457.48 18483.72 18510.00 18536.24 18562.48 18588.72 18615.00 18641.24 18667.48 18693.72 18720.00 18746.24 18772.48 18798.72 18825.00 18851.24 18877.48 18903.72 18930.00 18956.24 18982.48 19008.72 19035.00 19061.24 19087.48 19113.72 19140.00 19166.24 19192.48 19218.72 19245.00 19271.24 19297.48 19323.72 19350.00 19376.24 19402.48 19428.72 19455.00 19481.24 19507.48 19533.72 19560.00 19586.24 19612.48 19638.72 19665.00 19691.24 19717.48 19743.72 19770.00 19796.24 19822.48 19848.72 19875.00 19901.24 19927.48 19953.72 19980.00 20006.24 20032.48 20058.72 20085.00 20111.24 20137.48 20163.72 20190.00 20216.24 20242.48 20268.72 20295.00 20321.24 20347.48 20373.72 20400.00 20426.24 20452.48 20478.72 20505.00 20531.24 20557.48 20583.72 20610.00 20636.24 20662.48 20688.72 20715.00 20741.24 20767.48 20793.72 20820.00 20846.24 20872.48 20898.72 20925.00 20951.24 20977.48 21003.72 21030.00 21056.24 21082.48 21108.72 21135.00 21161.24 21187.48 21213.72 21240.00 21266.24 21292.48 21318.72 21345.00 21371.24 21397.48 21423.72 21450.00 21476.24 21502.48 21528.72 21555.00 21581.24 21607.48 21633.72 21660.00 21686.24 21712.48 21738.72 21765.00 21791.24 21817.48 21843.72 21870.00 21896.24 21922.48 21948.72 21975.00 22001.24 22027.48 22053.72 22080.00 22106.24 22132.48 22158.72 22185.00 22211.24 22237.48 22263.72 22290.00 22316.24 22342.48 22368.72 22395.00 22421.24 22447.48 22473.72 22500.00 22526.24 22552.48 22578.72 22605.00 22631.24 22657.48 22683.72 22710.00 22736.24 22762.48 22788.72 22815.00 22841.24 22867.48 22893.72 22920.00 22946.24 22972.48 23000.00 23026.24 23052.48 23078.72 23105.00 23131.24 23157.48 23183.72 23210.00 23236.24 23262.48 23288.72 23315.00 23341.24 23367.48 23393.72 23420.00 23446.24 23472.48 23498.72 23525.00 23551.24 23577.48 23603.72 23630.00 23656.24 23682.48 23708.72 23735.00 23761.24 23787.48 23813.72 23840.00 23866.24 23892.48 23918.72 23945.00 23971.24 24000.00 24026.24 24052.48 24078.72 24105.00 24131.24 24157.48 24183.72 24210.00 24236.24 24262.48 24288.72 24315.00 24341.24 24367.48 24393.72 24420.00 24446.24 24472.48 24498.72 24525.00 24551.24 24577.48 24603.72 24630.00 24656.24 24682.48 24708.72 24735.00 24761.24 24787.48 24813.72 24840.00 24866.24 24892.48 24918.72 24945.00 24971.24 25000.00 25026.24 25052.48 25078.72 25105.00 25131.24 25157.48 25183.72 25210.00 25236.24 25262.48 25288.72 25315.00 25341.24 25367.48 25393.72 25420.00 25446.24 25472.48 25498.72 25525.00 25551.24 25577.48 25603.72 25630.00 25656.24 25682.48 25708.72 25735.00 25761.24 25787.48 25813.72 25840.00 25866.24 25892.48 25918.72 25945.00 25971.24 26000.00 26026.24 26052.48 26078.72 26105.00 26131.24 26157.48 26183.72 26210.00 26236.24 26262.48 26288.72 26315.00 26341.24 26367.48 26393.72 26420.00 26446.24 26472.48 26498.72 26525.00 26551.24 26577.48 26603.72 26630.00 26656.24 26682.48 26708.72 26735.00 26761.24 26787.48 26813.72 26840.00 26866.24 26892.48 26918.72 26945.00 26971.24 27000.00 27026.24 27052.48 27078.72 27105.00 27131.24 27157.48 27183.72 27210.00 27236.24 27262.48 27288.72 27315.00 27341.24 27367.48 27393.72 27420.00 27446.24 27472.48 27498.72 27525.00 27551.24 27577.48 27603.72 27630.00 27656.24 27682.48 27708.72 27735.00 27761.24 27787.48 27813.72 27840.00 27866.24 27892.48 27918.72 27945.00 27971.24 28000.00 28026.24 28052.48 28078.72 28105.00 28131.24 28157.48 28183.72 28210.00 28236.24 28262.48 28288.72 28315.00 28341.24 28367.48 28393.72 28420.00 28446.24 28472.48 28498.72 28525.00 28551.24 28577.48 28603.72 28630.00 28656.24 28682.48 28708.72 28735.00 28761.24 28787.48 28813.72 28840.00 28866.24 28892.48 28918.72 28945.00 28971.24 29000.00 29026.24 29052.48 29078.72 29105.00 29131.24 29157.48 29183.72 29210.00 29236.24 29262.48 29288.72 29315.00 29341.24 29367.48 29393.72 29420.00 29446.24 29472.48 29498.72 29525.00 29551.24 29577.48 29603.72 29630.00 29656.24 29682.48 29708.72 29735.00 29761.24 29787.48 29813.72 29840.00 29866.24 29892.48 29918.72 29945.00 29971.24 30000.00 30026.24 30052.48 30078.72 30105.00 30131.24 30157.48 30183.72 30210.00 30236.24 30262.48 30288.72 30315.00 30341.24 30367.48 30393.72 30420.00 30446.24 30472.48 30498.72 30525.00 30551.24 30577.48 30603.72 30630.00 30656.24 30682.48 30708.72 30735.00 30761.24 30787.48 30813.72 30840.00 30866.24 30892.48 30918.72 30945.00 30971.24 31000.00 31026.24 31052.48 31078.72 31105.00 31131.24 31157.48 31183.72 31210.00 31236.24 31262.48 31288.72 31315.00 31341.24 31367.48 31393.72 31420.00 31446.24 31472.48 31498.72 31525.00 31551.24 31577.48 31603.72 31630.00 31656.24 31682.48 31708.72 31735.00 31761.24 31787.48 31813.72 31840.00 31866.24 31892.48 31918.72 31945.00 31971.24 32000.00 32026.24 32052.48 32078.72 32105.00 32131.24 32157.48 32183.72 32210.00 32236.24 32262.48 32288.72 32315.00 32341.24 32367.48 32393.72 32420.00 32446.24 32472.48 32498.72 32525.00 32551.24 32577.48 32603.72 32630.00 32656.24 32682.48 32708.72 32735.00 32761.24 32787.48 32813.72 32840.00 32866.24 32892.48 32918.72 32945.00 32971.24 33000.00 33026.24 33052.48 33078.72 33105.00 33131.24 33157.48 33183.72 33210.00 33236.24 33262.48 33288.72 33315.00 33341.24 33367.48 33393.72 33420.00 33446.24 33472.48 33498.72 33525.00 33551.24 33577.48 33603.72 33630.00 33656.24 33682.48 33708.72 33735.00 33761.24 33787.48 33813.72 33840.00 33866.24 33892.48 33918.72 33945.00 33971.24 34000.00 34026.24 34052.48 34078.72 34105.00 34131.24 34157.48 34183.72 34210.00 34236.24 34262.48 34288.72 34315.00 34341.24 34367.48 34393.72 34420.00 34446.24 34472.48 34498.72 34525.00 34551.24 34577.48 34603.72 34630.00 34656.24 34682.48 34708.72 34735.00 34761.24 34787.48 34813.72 34840.00 34866.24 34892.48 34918.72 34945.00 34971.24 35000.00 35026.24 35052.48 35078.72 35105.00 35131.24 35157.48 35183.72 35210.00 35236.24 35262.48 35288.72 35315.00 35341.24 35367.48 35393.72 35420.00 35446.24 35472.48 35498.72 35525.00 35551.24 35577.48 35603.72 35630.00 35656.24 35682.48 35708.72 35735.00 35761.24 35787.48 35813.72 35840.00 35866.24 35892.48 35918.72 35945.00 35971.24 36000.00 36026.24 36052.48 36078.72 36105.00 36131.24 36157.48 36183.72 36210.00 36236.24 36262.48 36288.72 36315.00 36341.24 36367.48 36393.72 36420.00 36446.24 36472.48 36498.72 36525.00 36551.24 36577.48 36603.72 36630.00 36656.24 36682.48 36708.72 36735.00 36761.24 36787.48 36813.72 36840.00 36866.24 36892.48 36918.72 36945.00 36971.24 37000.00 37026.24 37052.48 37078.72 37105.00 37131.24 37157.48 37183.72 37210.00 37236.24 37262.48 37288.72 37315.00
```

[illegible][illegible]

DATE	TIME	DATE	TIME
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
10	10	10	10
11	11	11	11
12	12	12	12

[illegible]

XIYA	\$ 1,6667
SIT	* 1,0000
STP	CFT * 1,0000
YJBI	SPT \$ 1,0000 CFT * 1,0000 YH * 1,0000

[illegible][illegible]

501 11-7 371 403 604 604

951E11C0-5411 7V4-0

Appendix B.
CSSL PROGRAM – DYNAMIC GYRO MODEL

```

04 CSSL, -JYR0
EWING STARC
VERSION HREM
2-DOF GYRO MODEL
DYNAMIC (REALISTIC)
UNITS
A - 1b ft 2
B - 1b ft 2
RR, R8 - 1b ft
H - ft 1b - sec
RMY, RMP - ft 1b
TIME - sec
ψ, θ - rad
ψ, θ - rad /sec
ψ, θ - rads /sec 2

PROGRAM GYRO
INITIAL
H=.0921875
A=.0027083
R=.0032083
RR=.0017192
R8=.0017192
THTAS=PSISO.
TFINE=0.
END
DYNAMIC
IF(T-TFIN)11,11,12
11 CONTINUE
DERIVATIVE GYRO
RMY=STEP(0,T)
RMY=.015625*MYL
RMP=STEP(0,T)
RMP=.015625*MYL
DESISD=THTAS*(H/A)-(R/A)*PSISD*(RMY/A)
PSISD=INTEG(DESISD,Q)
PSISD=INTEG(PSISD,C)
CMTASD=PSISD*(H/B)-(R/B)*THTASD*(RMP/B)
THTASD=INTEG(CMTASD,Q)
THTAS=INTEG(THTASD,C)
PUT Y,T
PUT DESISD,CMTASD,PSISD,THTASD,R8[9],THTAS,T
CINTERVAL CINT=1.
NSTEPS=86400
END DERIVATIVE
END DYNAMIC
TERMINAL
LP=CONTINUE
END TERMINAL
END PROGRAM

```

```

CONNECT (PZ6E,RT9L)
END
SUBROUTINE RTSL
  COMMON/ZC004/Z0004(58)
  COMMON/ZCCC4/RMYU, RMY, RMPU, RMP, H, A, RR, PSIS, B, RB, THTAS
  EQUIVALENCE (ZC004(4), DPSISD), (Z0004(3), Z0000), (Z0004(18), PSISD), (
  1Z0004(17), Z0001), (Z0004(32), DTHTASD), (Z0004(31), Z0002), (Z0004(46),
  2THTASD), (Z0004(45), Z0003)
  EXTERNAL GYR8
99997 Z9995=C
  NST=256
  CINT=1.0
  T=C.0
  IALGBR=5
  JALGBR=5
  HMINT=0.000001
  NIST=1
  ITER=2
  Z0004(14)=0.
  Z0004(28)=0.
  Z0004(42)=0.
  Z0004(56)=0.
  H=C921875
  A=C027083
  B=C032083
  RR=C0017192
  RB=C0017192
  THTAS=PSIS=C.
  TFIN=10.
  CALL Z9998(4, Z0004, GYR8, NST, CINT, T, 0)
99999 CONTINUE
  IF (T-TFIN) 90000, 90000, 90001
90000 CONTINUE
  PRINT 90003, T
90003 FORMAT(618X, E12.5)
90002 CONTINUE
  PRINT 90005, DPSISD, DTHTASD, PSISD, THTASD, PSIS, THTAS
90005 FORMAT(618X, E12.5)
90004 CONTINUE
  CALL Z9999(4, Z0004, GYR8, NST, CINT, T, IALGBR, JALGBR, HMINT, NIST, ITER, I
  1ERR)
  Z9995=1.
  GO TO 99999
99998 CONTINUE
90001 CONTINUE
  STOP
  END
SUBROUTINE GYR8(T)
  COMMON/ZC004/Z0004(58)
  EQUIVALENCE (ZC004(4), DPSISD), (Z0004(3), Z0000), (Z0004(18), PSISD), (
  1Z0004(17), Z0001), (Z0004(32), DTHTASD), (Z0004(31), Z0002), (Z0004(46),
  2THTASD), (Z0004(45), Z0003)
  COMMON/Z0004/RMYU, RMY, RMPU, RMP, H, A, RR, PSIS, B, RB, THTAS
  RMYU=STEP(C., T)
  RMY=C15625*RMYU
  RMPU=STEP(0., T)
  RMP=C015625*RMPU
  PSISD=ZCCC0
  PSIS=ZC001
  THTASD=ZCCC3
  THTAS=ZC003

```

```

DPSISD=(THTASD*(H/A)-(RZ/A)*PSISD+(RMY/A)
C1THTASD=PSISC*(H/B)-(RB/B)*THTASD+(RMP/B)
RETURN
END
*TFP* 0
EBF 9TA8C
TAL JOB TIME=00:02:10

```

```

***FIRST PASS DONE***
INVOKING PROGRAM MACRO
INVOKING INITIAL MACRO
INVOKING DYNAMIC MACRO
INVOKING BLT MACRO
INVOKING BLT MACRO
INVOKING TERMINAL MACRO
***SECOND PASS DONE***
***THIRD PASS DONE 0 ERRORS***
***FOURTH PASS DONE 0 ERRORS***
***FIFTH PASS DONE***
***SIXTH PASS DONE***

```

OR STAGE,TRC

EMJND STASO

RFC STABOJ3

SSIGN (MISI,STASO)

STRAN SI,GS,N6,RC

LOAD NO,(TEMP,ROC),(I18,USER,SYSTEM)

ADING WAS COMPLETED

AV

TIME	COOGE 00	COOGE 00	COOGE 00	COOGE 00	COOGE 00	COOGE 00
5769E 01	4970E 01	0000E 00	0000E 00	0000E 00	0000E 00	0000E 00
1000E 01	3840E 01	35861E-01	94347E-02	1694E 00	17084E 00	17084E 00
2000E 01	2839E 01	70711E-01	13856E-01	3387E 00	3416E 00	3416E 00
3000E 01	1888E 01	10389E 00	13716E-01	5072E 00	5124E 00	5124E 00
4000E 01	9960E 00	13484E 00	98200E-02	6743E 00	6830E 00	6830E 00
5000E 01	18270E 00	16314E 00	11818E-02	8487E 00	8536E 00	8536E 00
6000E 01	15447E 00	18843E 00	8840E-02	1014E 01	1024E 01	1024E 01
7000E 01	11796E 01	21030E 00	21846E-01	1182E 01	1194E 01	1194E 01
8000E 01	17181E 01	72922E 00	36781E-01	13510E 01	13640E 01	13640E 01
9000E 01	12189E 01	24459E 00	42948E-01	15131E 01	1533E 01	1533E 01
1000E 02	128032E 01	25648E 00	69866E-01	16872E 01	17039E 01	17039E 01
13404E 01						

TOP 0

IN

TAL JAR TIME=00100137

BEGIN 10E

Appendix C.

6-DOF DIGITAL MISSILE TRAJECTORY SIMULATION
WITH DYNAMIC GYROSCOPE MODEL

```

      CAR 409F,DIGITAL MISSILE TRAJECTORY SIMULATION WITH A DYNAMIC GYROSCOPE MODEL
      ALLPRT (FILE,X6),(FORMAT,C),(PFSIZE,1950),SAVE
      *PRATE

```

```

1  C ***      AERODYNAMICS AS AT 12/20/72 AND MEASURED SEEKER PERFOR-
2  C *** PANCE DATA AT 12/72.
3  EXTERNAL DERIVATIVES
4  1 CALL INITIAL (IS,DERIVATIVES)
5  2 CALL RUNGK
6  CALL FINISH
7  GO TO 2
8  END

```

```

1      SUBROUTINE INITIAL (ENDRUN,CEIVS)
2      DOUBLE PRECISION DT,FSTSAM,SPER,TME,TMFC,TMFI,TIME2,TIME3,
3      TIME4,TST,DTA,TIME
4      REAL KPC,KX,KC,KY,KT10,KT20
5      REAL KT30
6      REAL KB,KQL,KP
7      REAL KC,KQL,KO,LAMPR,LAMYR,LAMB1
8      REAL LP,KD,K6,K4,K5,KR
9      REAL PACH,MASS,IX,IYZ,IT,IA
10     REAL XBT(33),XBT(33)
11     COMMON/INTEG/KUTTA,NX,OTRK,U,V,W,P,Q,R,PHI,THTA,PEI,X,Y,Z,RTHTA,
12     1RPS1,THTAS,TWASD,PSIS,PSISC,OMEGA,TXFD,PXPD,PFF,YEF,DEL1,DELVD,
13     2DEL3,COEL1,DOELVP,ODEL3,RLAMY,RLAMP,RPM10,OPW10,CU,DV,DH,CP,CC,CR,
14     3CPH1,CTHTA,OPSI,CX,DY,DZ,RTHTA,CRPS1,CTHTAS,CTWASD,CPSIS,OPSID,
15     4COMEGA,CTXED,OPXED,DPEF,CYEF,COELP1,CDELPP,CDEL3,ODEL1,CDELVP,
16     5CDEL3,ORLAMY,ORLAMP,ORPM10,ORPH10
17     COMMON/ETB/EB11,EB12,EB13,EP21,EB22,FB23,FA31,EB32,EB33
18     COMMON/BTS/BS11,BS12,BS13,BS21,BS22,BS23,BS31,BS32,BS33
19     COMMON/TDC/CP61,SP61,SPW1,CPW1
20     COMMON/IN/ GAMP,GAMY,DELXTB,DELYTB,DELZTB
21     COMMON/ETV/DELXV,DELYV,DELZV
22     COMMON/DEL/DELX,DELY,DELZ
23     COMMON/STLFF/ DELXS,DELYS,DELZS
24     COMMON/INPSKR/PIERR,YALERR
25     COMMON/MACL/MACH,VEND,UR,VR,WR,VRS,VRW,VV
26     COMMON/F/XXS,WYS,WZS
27     COMMON/COEF/CAZ,CY,CH,CLP,CMC,CYC,CCL,CMC,CNR,ALPHA,BETA,CPAD,
28     1CLXAC
29     COMMON/TOEG/AXB,AYB,AZB,CLB,CNB,ALB,AMB,ANB,CMB
30     COMMON/DO/DELYV,DELYR,DELR,DELR0L
31     COMMON/JUNK/TINE,TIME3,RMR,S,D,SCUW,CAP,IRAP,RAPTH1,RAPTH2,IAC,
32     1SLOPE1,BT1,RAPTH3,SLOPE2,BT2,CTT,CMT,SPT,XLTA,STT,QAPB,QAPBD,
33     2CAPSCH,TH
34     COMMON/FP/FPCL0,FPCH0,FPCH0,FPXAB,FPYAB,FPXAB,FPXAB,FPXAB,FPXAB,FPXAB,
35     1COMMON/GG/GXB,GYB,GZB
36     COMMON/JUNK1/THOLD,IROLL,G,MASS,IX,IYZ,XINT1A,NAVY
37     COMMON/MO/QEBALT,TB,TORAD,RMOBL,ARG1,NTMOL,RSTAR,
38     1RMBE,ARG2,QE,THOL
39     COMMON/TT/FSTSAM,TIME4,DT,DTA,TST,TME,SPER,TSAM,CC,JMAX,IPRINT,T2
40     COMMON/JUNK2/SRKE,IFUP,IAC,RCET,YANER,PITFR,PMPGV,GA,RNGLIN,
41     1PIYASC,R2D,NULSKR,BRS,RPLECT,NUL,KAGE
42     COMMON/BOH/RBL,KT,KT10,KT20,LAMPR,LAMYR,RTM,RTMIN,RSGE,ED1,FLG4,
43     1RBA,ED4,QBA
44     COMMON/PERY/OMEGY,OMEGZ
45     COMMON/OUTAP/YEG,REG,PEG
46     COMMON/ARROW/PH10,PL01,PL02,PL03,REF,MFL,YEC,PEC,THRBG,PSRSG,
47     1THBS,PSBS,ORLV,PFPL,KPD,KC,KM,KG,LAMB1,P9LFS
48     COMMON/SS/S1,S2,S3,S4,S5,S6
49     COMMON/CP/RB,RR,W,A,B,KT30
50     COMMON/STUFF1/DELXB,DELYB,DELZB
51
52     C
53     C
54     C
55     C
56     C
57     C
58     C
59     C
60     C
61     C
62     C
63     C
64     C
65     C
66     C
67     C
68     C
69     C
70     C
71     C
72     C
73     C
74     C
75     C
76     C
77     C
78     C
79     C
80     C
81     C
82     C
83     C
84     C
85     C
86     C
87     C
88     C
89     C
90     C
91     C
92     C
93     C
94     C
95     C
96     C
97     C
98     C
99     C
100    C

```

180	C		
48	C		
49	C	DEFAULT VALUES	
50	C		
51		REAL REAL(206)/	
52		1+2.89660000E+01,+5.186*8000E+C2,+3.21747400E+C1,	CC1=-CC3
53		2+3.56616000E-03,+2.08553150E+C7,+2.37690000E-03,	CC4=-C06
54		3+4.971962570E+04,+5.31200000E+C0,+4.48363000E+00,	CC7=-C09
55		4+2.01000000E-C1,+5.72300000E+CC,+5.08300000E-C1,	010=-012
56		5+5.00000000E+00,+3.141592653E+CC,+0.00000000E+00,	013=-015
57		6+0.00000000E+00,+0.00000000E+00,+0.00000000E+00,	016=-018
58		7+4.00000000E+00,+8.00000000E+01,+0.00000000E+00,	019=-021
59		8+1.50000000E+C1,+8.00000000E-C2,+6.00000000E-01,	022=-024
60		9+1.49250000E+02,+4.00000000E+CC,+6.25000000E+00,	025=-027
61		A+2.50000000E+02,+2.50000000E+C1,+2.00000000E+00,	028=-030
62		B+1.00000000E+02,+1.00000000E+00,+0.00000000E+00,	031=-033
63		C+0.00000000E+00,+5.00000000E-01,+1.50000000E+01,	034=-036
64		D+1.00000000E+00,+1.00000000E+CC,+1.00000000E+00,	037=-039
65		E+1.00000000E+00,+1.00000000E+00,+1.00000000E+00,	040=-042
66		F+1.00000000E+00,+1.00000000E+CC,+1.00000000E+00,	043=-045
67		G+1.00000000E+00,+8.00000000E+00,+1.50000000E+C1,	046=-048
68		H+1.00000000E+01,+7.50000000E+CC,+5.00000000E+00,	049=-051
69		I+5.00000000E-02,+2.35280000E-08,+1.62267000E-05,	052=-054
70		J+2.00000000E-01,+1.50000000E+00,+1.25000000E+01,	055=-057
71		K+1.25000000E+01,+1.50000000E+C1,+2.00000000E+01,	058=-060
72		L+3.00000000E+02,+1.00000000E+01,+0.00000000E+00,	061=-063
73		M+1.00000000E-01,+6.00000000E+00,+3.14000000E+02,	064=-066
74		N+2.00000000E+03,+1.25000000E+03,+0.00000000E+00,	067=-069
75		O+0.00000000E+00,+0.00000000E+00,+0.00000000E+00,	070=-072
76		P+0.00000000E+00,+0.00000000E+00,+2.83000000E+01,	073=-075
77		Q+0.00000000E+CC,+0.00000000E+CC,+0.00000000E+00,	076=-078
78		R+4.00000000E+03,+0.00000000E+CC,+0.00000000E+00,	079=-081
79		S+0.00000000E+00,+0.00000000E+00,+0.00000000E+00,	082=-084
80		T+0.00000000E+00,+0.00000000E+CC,+0.00000000E+00,	085=-087
81		U+0.00000000E+00,+0.00000000E+00,+0.00000000E+00,	088=-090
82		V+0.00000000E+00,+0.00000000E+00,+0.00000000E+00,	091=-093
83		W+0.00000000E+00,+0.00000000E+00,+0.00000000E+00,	094=-096
84		X+0.00000000E+00,+0.00000000E+CC,+0.00000000E+00,	097=-099
85		Y+0.00000000E+00,+2.112244897E+02,+5.25000000E+02,	100=-102
86		Z+6.72460000E-03,+1.00000000E+00,+0.00000000E+00,	103=-105
87		1+C.00000000E+CC,+0.00000000E+CC,+0.00000000E+00,	106=-108
88		2+C.00000000E+00,+0.00000000E+CC,+0.00000000E+00,	109=-111
89		3+C.00000000E+CC,+0.00000000E+CC,+0.00000000E+00,	112=-114
90		4+C.00000000E+00,+0.00000000E+CC,+0.00000000E+00,	115=-117
91		5+C.00000000E+CC,+0.00000000E+00,+0.00000000E+00,	118=-120
92		6+C.00000000E+CC,+1.25000000E+C1,+0.00000000E+00,	121=-123
93		7+C.00000000E+00,+0.00000000E+CC,+0.00000000E+00,	123=-125
94		8+C.00000000E+00,+0.00000000E+00,+0.00000000E+00,	126=-128
95		9+C.00000000E+00,+0.00000000E+CC,+0.00000000E+00,	129=-131
96		A+C.00000000E+00,+0.00000000E+00,+0.00000000E+00,	132=-134
97		B+C.00000000E+00,+0.00000000E+CC,+0.00000000E+00,	135=-137
98		C+C.00000000E+CC,+0.00000000E+CC,+0.00000000E+00,	138=-140
99		D+C.00000000E+CC,+0.00000000E+00,+0.00000000E+00,	141=-143
100		E+C.00000000E+00,+0.00000000E+CC,+0.00000000E+00,	144=-146
101		F+C.00000000E+CC,+0.00000000E+CC,+0.00000000E+00,	147=-149
102		G+C.00000000E+00,+0.00000000E+00,+0.00000000E+00,	150=-152
103		H+C.00000000E+CC,+0.00000000E+00,+0.00000000E+00,	153=-155
104		I+0.00000000E+00,+0.00000000E+00,+0.00000000E+00,	156=-158
105		J+C.00000000E+00,+0.00000000E+CC,+0.00000000E+00,	159=-161
106		K+C.00000000E+00,+0.00000000E+CC,+0.00000000E+00,	162=-164
107		L+C.00000000E+00,+0.00000000E+CC,+0.00000000E+00,	165=-167
108		M+C.00000000E+00,+0.00000000E+CC,+0.00000000E+00,	168=-170

```

109      5+C,000000000E+00,+0.000000000F+C0,+0.000000000E+0C,      171--173
110      5+C,000000000E+00,+0.000000000E+0C,+0.000000000E+00,      174--176
111      5+2.608000000E+04,+0.000000000E+00,+0.000000000E+C3,      178--180
112      5+C,000000000E+0C,+0.000000000E+0C,+0.000000000E+0C,      180--182
113      5+C,000000000E+00,+0.000000000E+0C,+0.000000000E+0C,      183--185
114      5+C,000000000E+00,+0.000000000E+0C,+0.000000000E+00,      186--188
115      5+C,000000000E+0C,+0.000000000E+0C,+0.000000000E+0C,      189--191
116      5+C,000000000E+00,+0.000000000E+00,+0.000000000E+0C,      192--194
117      5+C,000000000E+0C,+0.000000000E+03,+0.000000000E+0C,      196--198
118      5+1.300000000E+00,+0.000000000E+00,+0.020000000E+01,      199--201
119      5+1.440000000E+01,+0.000000000E+03,+0.000000000E+03,      202--204
120      5+C,000000000E+0C,+0.000000000E+00/      205--206
121      DOUBLE PRECISION DOUBLE(001)/
122      1+C,000000000E+00/
123      INTEGER FIXED(030)/
124      1+CCCCCCCC01,+0000000000,+0000000027,+0000000020,+0000000128,      001--005
125      1+CCCCCCCC0256,+0000000001,+0000000002,+0000000000,+0000000000,      006--010
126      3+CCCCCCCC0000,+0000000000,+0000000000,+0000000000,+0000000000,      011--015
127      3+CCCCCCCC0001,+0000000001,+0000000001,+0000000001,+0000000001,      016--020
128      3+CCCCCCCC0006,+0000000006,+0000000006,+0000000000,+0000000000,      021--025
129      3+CCCCCCCC0000,+0000000000,+0000000000,+0000000000,+0000000000/      026--030
130      LOGICAL DATE(07),SET,TRUE,/,SET,/,FALSE,/,
131      LOGICAL LOGICAL(008)/
132      1,TRUE,/,FALSE,/,FALSE,/,FALSE,/,FALSE,/,FALSE,/,FALSE,/,
133      NAMELIST TIME,X,Y,Z,U,V,W,P,Q,R,TMTA,PSI,PHI,RTMTA,RPSI,RLMY,
134      XRLAMP,RMTB,RODET,LAMBDA,BP,KQ,TIME0,TIME1,TIME2,TIME3,TIME4,TIME5,
135      CXT,YT,ZT,VXT,VYT,VZT,
136      CPMFOV,TMPOV,TMTAC,DT,DTAC,CPASS,IX,IY,IZ,TS,TME,BRSJ,DELR0L,KB,KQ,
137      DKG,KRGL,BD,BF,BQ,AF,BA,CS,KP,GC,KQL,GAMLB,PCL,YCL,C1,IT,IA,BF,
138      ECLD,KRGLIN,DELMX,DELPY,VNATE,KX,KY,PBQW,KQ,RVBIAS,BRS,PHIPAX,IROLL
139      F,RTCL,S1,S2,S3,S4,S5,ISHR,IROLLDC,IACT,IACC,IPRINT,JMAX,IRAP,
140      GTMETAT,PSIT,SLOPE1,SLOPE2,BT1,BT2,XLTA,RAPTH1,RAPTH2,RAPTH3
141      H,TE,TO,T01,T02,T03,T04,T05,T06,TC7,T1,T2,NULL,IFUFO,IQUIDE,TIP1,
142      JTIPO,KPC,KK,KC,TMTBL,DTAK,S6,S7,S8,S9,S10,S11,S12,KT,KT10,KT20
143      K,BFC,SF1,SF2,SF3,SF4,SF5,SF6,SF7,SF8,SF9,SF10,SF11,SF12,SF13,SF14,
144      LSP19,RTMIN,KAGE,FFCLB,FFCMB,FFCNB,FFAXB,FFAYB,FFAZB,FFALB,FFAMB,
145      HFFANB,FULL,TMOLD,NAVY,KT30,KQ
146      REAL PDAC(10)/1000,/,POLES(01)/
147      1+2.000000000E+01/
148      LOGICAL FL00,/,TRUE,/,FL01,/,TRUE,/,FL02,/,TRUE,/,FL03,/,TRUE,/,FULL,/,
149      IFALSE,/,FL04,/,TRUE,/,IMPACT,ERROR,FL05
150      DATA KG,KQ,KP,KP,KPD,KR/3.5,0.05,2.10,0.015,75,/,
151      DATA TB,TC/,6,10,/,KT,KT10,KT20/20,10,20,/,
152      DATA S1,S2,S3,S4,S5,S6,S7,S8,S9,S10,S11,S12/1,1,3,1,7,1,/,
153      DATA SLOPE1,SLOPE2/36.7346938,-11.53846154/,XLTA/1.666667/
154      DATA RAPTH1,RAPTH2,RAPTH3/16,8,5,13,/,
155      DATA R2P/S:72257755E+01/,Q2P/.01745129/
156      DATA RB,RH,M,A,B/2,0.00017192,0.021875,0.00008418,0.0009972/
157      CALL ABORTSET(99995,1)
158      CALL EOFSET(99995,LUN17)
159      1 CONTINUE
160      X CALL WYELIS
161      X CALL MODE('R')
162      X CALL MODE('C')
163      DO 1734 I=0,15000
164      CALL WDACS(0,16,PDAC)
165      1234 CONTINUE
166      C
167      C PASS ADDRESSES AND INITIALIZE LIBRARY RUNGE-KUTTA INTEGRATOR
168      C
169      CALL RUNGK(DD,LL,DT,TIME,X0,X8,NX,DERIVS)

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170      C      INPUT VALUES
171      C
172      GATE(001) * RST; GATE(002) * RST; GATE(003) * RST; GATE(004) * RST-----
173      GATE(005) * RST; GATE(006) * RST; GATE(007) * RST-----
174      TIME      * DPULF(001)-----
175      AX      * FIXED(001); XUM      * FIXED(002)-----
176      IPRIAT   * FIXED(003); APPS      * FIXED(004)-----
177      ACT      * FIXED(005); NDTA      * FIXED(006)-----
178      KAGE      * FIXED(007); NULSKR   * FIXED(008)-----
179      KAVY      * FIXED(009); ISUIE     * FIXED(010)-----
180      IFLFO     * FIXED(011); IRALL     * FIXED(012)-----
181      ISKR      * FIXED(013); TRAP      * FIXED(014)-----
182      IACT      * FIXED(015); IRALLDC  * FIXED(016)-----
183      IACG      * FIXED(017); NULL      * FIXED(018)-----
184      KAGE      * FIXED(019); IDUM      * FIXED(020)-----
185      ICLP      * FIXED(021); IDUM      * FIXED(022)-----
186      ICLP      * FIXED(023); IDUM      * FIXED(024)-----
187      ICLP      * FIXED(025); IDUM      * FIXED(026)-----
188      ICLP      * FIXED(027); IDUM      * FIXED(028)-----
189      ICLP      * FIXED(029); IDUM      * FIXED(030)-----
190      FLGS      * LOGICAL(001); IMPACT * LOGICAL(002)-----
191      ERORR     * LOGICAL(003)-----
192      WTMOL      * REAL(001); TR      * REAL(002)-----
193      GO      * REAL(003); TORAC      * REAL(004)-----
194      RO      * REAL(005); RWOSL      * REAL(006)-----
195      RGTAR     * REAL(007); CO      * REAL(008)-----
196      PASS      * REAL(009); IX      * REAL(010)-----
197      IYZ      * REAL(011); O      * REAL(012)-----
198      RFLECT    * REAL(013); PI      * REAL(014)-----
199      WACO      * REAL(015); RE      * REAL(016)-----
200      FSTYSAH   * DBLE(REAL(017)); RRS * REAL(018)-----
201      CELROL     * REAL(019); LAMBI    * REAL(020)-----
202      KB      * REAL(021); KG      * REAL(022)-----
203      KB      * REAL(023); KROL      * REAL(024)-----
204      BC      * REAL(025); RVBIAS    * REAL(026)-----
205      BF      * REAL(027); BG      * REAL(028)-----
206      AF      * REAL(029); BR5      * REAL(030)-----
207      PHIMAX    * REAL(031); BTOL    * REAL(032)-----
208      BA      * REAL(033); CS      * REAL(034)-----
209      KP      * REAL(035); GC      * REAL(036)-----
210      KGL      * REAL(037); FFCLEB   * REAL(038)-----
211      FFCFB     * REAL(039); FFCNB   * REAL(040)-----
212      FFAXB     * REAL(041); FFAYB   * REAL(042)-----
213      FFAZE     * REAL(043); FFALB   * REAL(044)-----
214      FFAMB     * REAL(045); FFANB   * REAL(046)-----
215      GANLB     * REAL(047); PGL     * REAL(048)-----
216      YCL      * REAL(049); TMTAC    * REAL(050)-----
217      GF      * REAL(051); CLD      * REAL(052)-----
218      JA      * REAL(053); IT      * REAL(054)-----
219      KD      * REAL(055); RNLIN     * REAL(056)-----
220      PHFVV     * REAL(057); YMFVV   * REAL(058)-----
221      DELPX     * REAL(059); DELMY   * REAL(060)-----
222      VRATE     * REAL(061); K4      * REAL(062)-----
223      KB      * REAL(063); FBGN      * REAL(064)-----
224      KB      * REAL(065); BMEGA     * REAL(066)-----
225      PCA      * REAL(067); U      * REAL(068)-----
226      V      * REAL(069); W      * REAL(070)-----
227      P      * REAL(071); Q      * REAL(072)-----
228      R      * REAL(073); PRI      * REAL(074)-----
229      TMTA     * REAL(075); PHI      * REAL(076)-----
230      X      * REAL(077); Y      * REAL(078)-----
231      Z      * REAL(079); P91g     * REAL(080)-----

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232	THYAS	REAL(081)	DP	REAL(082)
233	CC	REAL(083)	DR	REAL(084)
234	CL	REAL(085)	DV	REAL(086)
235	CK	REAL(087)	DPLXB	REAL(088)
236	CELYB	REAL(089)	DELZB	REAL(090)
237	CELYS	REAL(091)	DFLYS	REAL(092)
238	CELYS	REAL(093)	PITFRQ	REAL(094)
239	YAWERR	REAL(095)	PITERR	REAL(096)
240	YAWERO	REAL(097)	BMEDY	REAL(098)
241	BMEDZ	REAL(099)	PSR3	REAL(100)
242	BT1	REAL(101)	BT2	REAL(102)
243	THYOL	REAL(103)	KC	REAL(104)
244	SFO	REAL(105)	SF1	REAL(106)
245	SF2	REAL(107)	SF3	REAL(108)
246	SF4	REAL(109)	SF5	REAL(110)
247	SF6	REAL(111)	SF7	REAL(112)
248	SF8	REAL(113)	SF9	REAL(114)
249	SF10	REAL(115)	SF11	REAL(116)
250	SF12	REAL(117)	SF13	REAL(118)
251	SF14	REAL(119)	SF15	REAL(120)
252	TIC	REAL(121)	TICI	REAL(122)
253	PSR0	REAL(123)	YER0	REAL(124)
254	QSA	REAL(125)	RSA	REAL(126)
255	PE0	REAL(127)	YF0	REAL(128)
256	REG	REAL(129)	RET	REAL(130)
257	REN	REAL(131)	RED	REAL(132)
258	T2	REAL(133)	DELXV	REAL(134)
259	CELYV	REAL(135)	DPLZV	REAL(136)
260	CEL1	REAL(137)	DEL2	REAL(138)
261	CEL3	REAL(139)	DPL4	REAL(140)
262	CELYP	REAL(141)	DEL418	REAL(142)
263	TH	REAL(143)	THB5	REAL(144)
264	PSB5	REAL(145)	THRB5	REAL(146)
265	PSRB5	REAL(147)	THYAO	REAL(148)
266	REF	REAL(149)	PEF	REAL(150)
267	YEF	REAL(151)	TXED	REAL(152)
268	PXED	REAL(153)	F1	REAL(154)
269	P2	REAL(155)	F3	REAL(156)
270	PSISC	REAL(157)	THAGD	REAL(158)
271	DRMTA	REAL(159)	DRP81	REAL(160)
272	DCEL1	REAL(161)	DOEL3	REAL(162)
273	CCELP1	REAL(163)	DOELP3	REAL(164)
274	CCFLVP	REAL(165)	DOELPP	REAL(166)
275	DCCEL1	REAL(167)	DCCEL3	REAL(168)
276	DCCEL2	REAL(169)	DRLAMP	REAL(170)
277	DRAMP	REAL(171)	DRPHIO	REAL(172)
278	RLAMP	REAL(173)	RLAMP	REAL(174)
279	RPHIO	REAL(175)	RPS1	REAL(176)
280	RTMTA	REAL(177)	XT	REAL(178)
281	YT	REAL(179)	ZT	REAL(180)
282	CP81S	REAL(181)	DTMTAS	REAL(182)
283	THETAT	REAL(183)	PS1T	REAL(184)
284	PE0	REAL(185)	YF0	REAL(186)
285	CPFP	REAL(187)	DYEP	REAL(188)
286	PEFL	REAL(189)	PHIO	REAL(190)
287	CPHIO	REAL(191)	TPTACC	REAL(192)
288	VP	REAL(193)	DPHIO	REAL(194)
289	COPIIC	REAL(195)	TWOLD	REAL(196)
290	RCET	REAL(197)	TIME0	REAL(198)
291	TIME1	REAL(199)	TIME2	REAL(200)
292	TIME3	REAL(201)	TIME4	REAL(202)
293	ZFIN	REAL(203)	RTFIN	REAL(204)

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294      OLM      * REAL(205); OLM      * REAL(206)
1.      CTHASC   * REAL(205); OPSISD   * REAL(206)
295      C
296      C-----CALCULATED VALUES-----
297      C
298      ARG1=1.+(GB*WTR/L)/(RSTAR*TRAD)
299      XIATIA = (IYZ-IX)/IYZ
300      SE=.75*PI*O*O
301      WANG=PI*R2
302      SNAKOWSTK(WANG)
303      CS=ANG*CS(WANG)
304      SPER=1.00/DBLE(FLOAT(NPPS))
305      TPE=SPER
306      CT=1.00/DBLE(FLOAT(NCT))
307      CTRK=SNGL(CT)
308      CTXVI=CT/COLE(FLOAT(NCTA))
309      DELROL=REAL(C19)/R2D
310      DELROL=DELROL/R2D
311      LAMB1=LAMB1/R2D
312      PHIMAX=PHIMAX/R2D
313      GAMLB=GAMLB/R2D
314      YCL=YCL/R2D
315      PHF0V=PHF0V/R2D
316      VRATE=VRATE/R2D
317      RVBIAS=RVBIAS/R2D
318      GC=GC/R2D
319      PCL=PCL/R2D
320      TMTACTMTAC/R2D
321      CI=(IT-IA)/IT
322      RI=IA/IT
323      RANGLIN=RANGLIN/R2D
324      YMF0V=YMF0V/R2D
325      KA=KA/R2D
326      TMTACTMTA/R2D
327      CPSIS=CS(PSIS)
328      C**** JMAX=PRINT CONTROL. PRINTING OCCURS EVERY JMAX INTERVALS.
329      JMAX=1.00/DT+.000001
330      INPUT(105)
331      ZHOLC=Z
332      TMTACTMTA
333      TC1=TC+.2; T02=TC1+.2
334      TC3=TC2+.2
335      TC4=TC3+.2
336      TC5=TC4+.2
337      TC6=TC5+.2
338      TC7=TC6+.2
339      T1=TC+.2
340      IF(T2-LY+.01)T2=T1+.2
341      CTT=CS(TMETAT)
342      STT=SN(TMETAT)
343      CPT=CS(PSIT)
344      SPT=SN(PSIT)
345      IF(IRLLDC*EC.2)IAC=2
346      C**** RANGE TARGET FROM MISSILE RTM IN FEET.
347      RTM=SGRT((XT-X)**2+(YT-Y)**2+(ZT-Z)**2)
348      C****
349      C WHITE SANDS ALTITUDE=4000. FT.
350      C**** IMPORTANT DEFINE TIMEO FOR EACH TRAJECTORY.
351      C****
352      C**** START ROLL GYRO(LINE 358) AT TIME1
353      C**** START PITCH AND YAW GYRO(LINE 367)/ROLL CONTROL(LINE 399) AT TIME3
354      C**** ENABLE TRACK AT TIME4 IF TARGET IS WITHIN F0V AND ROET

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220

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417      1236 CONTINUE
418      IF (DATE(OC5)) GO TO 1237
419      IF (TIME.LT.TIME2) GO TO 1237
420      DATE(OC5)=SET
421      IPRINT=2
422      1237 CONTINUE
423      IF (DATE(OC6)) GO TO 1238
424      IF (TIME.LT.TIME4) GO TO 1238
425      DATE(OC6)=SET
426      IPRINT=2
427      1238 CONTINUE
428      IF (DATE(OC7)) GO TO 1239
429      IF (TIME.LT.TIME1) GO TO 1239
430      DATE(OC7)=SET
431      IPRINT=2
432      1239 CONTINUE
433      C
434      C LOS ERROR IN SC5
435      CALL LOSERR
436      C
437      C** SUBROUTINE SEEK DETECTS TARGET WITHIN THE DETECTION RANGE OF SEEKER,
438      C TARGET WITHIN THE FIELD OF VIEW, S=A-W, SEEKER WITHIN LINEAR RANGE
439      CALL SEEK
440      105 CONTINUE
441      C
442      C** MISSILE VELOCITY WRT AIR MASS
443      WACV=0.0007367*Z*5.236
444      WACW=0.0007367*Z*5.236
445      WACV=0.0007367*Z*5.236
446      WACW=0.0007367*Z*5.236
447      C
448      C** ANGLE OF ATTACK COMPONENTS
449      C** TERMS FOR EQUATIONS OF MOTION
450      C** AERO AND CONTROL FORCES AND MOMENTS
451      C** SUBROUTINE FORMAN CALCULATES FORCES AND MOMENTS FOR THE DIFEG EQUATIONS
452      CALL FORMAN
453      C
454      C** SUBROUTINE DIFEG CONSTRUCTS THE EQUATIONS OF MOTION
455      CALL DIFEG
456      IF (TIME.LT.TIME3) GO TO 5150
457      IF (TIME.LT.TIME1) GO TO 406
458      IF (KOT.FLG0) GO TO 6666
459      PRINT 90001, IPRINT=2, FLG0=NOT.FLG0
460      6666 CONTINUE
461      1*
462      C
463      C** SUBROUTINE EDSKRGYR CONSTRUCTS THE SEEKER GYRO MODEL FOR EO
464      CALL EDSKRGYR
465      5203 CONTINUE
466      C
467      C** EO ALTOPILST
468      CALL EOP
469      GO TO 226
470      C
471      C ENGINEERING DESIGN ALTOPILST
472      C
473      5150 IF (TIME.LT.TIME3) GO TO 401
474      IF (KOT.FLG5) GO TO 6671
475      PRINT 90010, IPRINT=2, FLG5=FALSE.
476      6671 CONTINUE
477      1*
478      9762=K8*YAWZRO

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FLG5
FLG5
FLG5

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479 C***CANTSEEKER
480 C***CANTSEEKER-UNTIL ACQUISITION(IACC#2)
481 OMEGY*KS*(THTAC-THTAS)
482 IF(IACC-EG#2) OMEGY*KS*PI*ERN
483 IF(ABS(OMEGY).GT..10*72) OMEGY=SIGN(.10*72,OMEGY)
484 IF(ABS(OMEGZ).GT..10*72) OMEGZ=SIGN(.10*72,OMEGZ)
485 C ICEAL GYRO
486 OSA#BS21#P#BS22#C#BS23#R
487 RSA#BS31#P#BS32#C#BS33#R
488 F1#OMEGY#OSA/COS(PSTIS)
489 F3#OMEGZ#RSA
490 CPSIS#COS(PSTIS)
491 IF(ISKR-EG#1)F1#(OMEGY#RSA)/CPSIS
492 IF(ISKR-EG#1)F3#OMEGZ#OSA
493 F#C.
494 F#C.
495 LAMPR # OMEGY
496 LAMZR # OMEGZ
497 IF(IACC-NE#2)LAMPR#LAMZR#C.
498 C BYRD EQUATIONS FOLLOW
499 CTHTAS#F1
500 CTWASC#F2
501 CPSIS#F3
502 CPSTIS#F#
503 COMEGA#F5
504 C
505 C*** ROLL RATE GYRO
506 C01 CONTINUE
507 IF (TIME-LT,TIME1)GO TO 404
508 C*** ROLL BYRD EOS
509 TFP3 # SIN(RTHTA)
510 TFP4 # COS(RTHTA)
511 CRTHTA # (P#TMP#R#TMP3)*TAN(HPS1)-Q
512 CRPS1 # (P#TMP3#R#TMP4)
513 C***RATE DAMPING OF GIMBAL ANGLES
514 C IF (TIME-LT,TIME1)GO TO 301
515 IF (TIME-LT,TIME3)GO TO 301
516 CTXED#ED*(TXED-KQ#THTAS)
517 THRS#BD*(KQ#THTAS-TXED)
518 CPXED#ED*(PXED-KQ#PSTIS)
519 PSRS#BD*(KQ#PSTIS-PXED)
520 THRS#KROL#THRS#THTAS
521 PSRS#KROL#PSRS#PSTIS
522 C***DEAC BAND ZONE FOR PSRS,THRS
523 IF(ABS(THRS).LE.GAPLB) GO TO 160
524 THRS # KOL*(THRS#SIGN(GAPLB,THRS))
525 GO TO 161
526 160 THRS#0.
527 161 IF(ABS(PSRS).LE.GAPLB) GO TO 162
528 PSRS # KOL*(PSRS#SIGN(GAPLB,PSRS))
529 GO TO 163
530 162 PSRS#0.
531 163 CONTINUE
532 C *** GUIDANCE FILTER WILL
533 C ***KQ AND LAMB1 ARE TIME CONTROLLED CONSTANTS
534 164 CONTINUE
535 PED#LAMPR#LAMB1#KB#THTAS
536 YED#LAMZR
537 CPEF#-BF*(PEF-KQ#PED)
538 CYEF#-BF*(YEF-KQ#YED)
539 IF(ABS(PEF).GT.GC)PEF=SIGN(GC,PEF)
540 IF(ABS(YEF).GT.GC)YEF=SIGN(GC,YEF)

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541      PEG=THRS+THBS+PEF
542      YEG=PSRBS+PSBS+YFF
543      PEG = -PEG
544      IF (ABS(PEG).GT.PCL) PEG=SIGN(PCL,PEG)
545      IF (ABS(YEG).GT.YCL) YEG=SIGN(YCL,YEG)
546      C****LL DECOUPLER
547      301 CONTINUE
548      IF (TIME+LE,TIME) GO TO 406
549      GO TO (1401,1402),IROLLDC
550      1401 CONTINUE
551      C****PREVIOUS ROLL DECOUPLER
552      IF (IACQ.EG+2 .AND. TIME.GT.TIME+ .AND. NULSKR.EG+2) GO TO 300
553      RLAMP=PSIS
554      RLAMP+THTAS=RTHTA
555      GO TO 302
556      300 CONTINUE
557      ORLAMP=LANR
558      ORLAMP+LANR
559      302 CONTINUE
560      RICV=PSIS
561      RICP+THTAS=RTHTA
562      REC=RICP+RLAMP
563      REN=RICV+RLAMP+RPSI
564      305 CONTINUE
565      IF (RED.LT+.4363) RED=.4363
566      IF (RED.GT+.17453) RED=.17453
567      RET=REN/RED
568      PHIG=2+RET
569      GO TO 1404
570      1402 CONTINUE
571      C****LATEST ROLL DECOUPLER
572      ORLAMP=BR5*(PSIS-RLAMP)
573      IF (IACQ.EG+2) ORLAMP=0.
574      REN=PSI+RPSI+ORLAMP+SS*PSIS
575      RED=SS+THTAS=SS+RTHTA
576      IF (ABS(RET).LT.RTOL) GO TO 304
577      C****CHECK FOR SATURATION
578      IF (ABS(PHIMAX-ABS(RET)).LT.RTOL .AND. RED.LT.RFN/RET) GO TO 306
579      C****
580      304 RET=SIGN(999,RET)
581      IF (RED.GT.0.) RET=REN/RED
582      306 CONTINUE
583      IF (ABS(RET).GT.PHIMAX) RET=SIGN(PHIMAX,RET)
584      PHIG=RET
585      1404 CONTINUE
586      DRPHIG=OG+RPHIG+SS*(1.-BG/AF)*PHIG
587      REF=(BG/AF)*PHIG+RPHIG
588      REF=KP*REF
589      IF (ABS(REF).GT+.17453) REF=SIGN(.17453,REF)
590      303 CONTINUE
591      REG=REF+RVBIAS
592      C
593      C** CONTROL SYSTEM, CANARDS FOR EACH PLANE ON COMMON SHAFT
594      307 CONTINUE
595      IF (IACQ.EG+2 .AND. NULSKR.EG+2) GO TO 226
596      221 CONTINUE
597      YEG=0.
598      PEG=0.
599      226 CONTINUE
600      CALL CONTRL
601      C** 4TH ORDER RUNGE KUTTA INTEGRATION
602      406 CONTINUE

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224

664	14HBT1,4H	,BT1	,4HBT2,4H	,BT2
665	14HCPT,4H	,CPT	,4HCSTT,4H	,STT
666	14HCS,4H	,CS	,4HFFCM,4H	,FFCMP,
667	14HCTY,4H	,CTY	,4HCPAT,4H	,RAPT3
668	14HC,4H	,D	,4HKG,4H	,KG,
669	14HDELM,4H	,DELMY	,4HED0,4H	,ED0
670	14HED1,4H	,ED1	,4HED2,4H	,ED2
671	14HED3,4H	,ED3	,4HED4,4H	,ED4
672	14HED5,4H	,ED5	,4HKT10,4H	,KT10
673	14HFFAL,4H	,FFALB	,4HYCL,4H	,YCL,
674	14HFFAN,4H	,FFANB	,4HGF,4H	,GF,
675	14HFFCL,4H	,FFCLB	,4HFFAZ,4H	,FFAZR,
676	14HFFCN,4H	,FFCNB	,4HFFAM,4H	,FFAMR,
677	14HGFAL,4H	,GFALB	,4HGFH,4H	,GFHVR,
678	14HGC,4H	,GC	,4HFFAX,4H	,FFAXR,
679	14HJACT,4H	,JACT	,4HJIRL,4H	,JIRLOC
680	14HJCLM,4H	,JCLM		
681	14HJFUF,4H	,JFUFB	,4HNULL,4H	,NULL
682	14HJIRL,4H	,JIRLL	,4HKT20,4H	,KT20
683	14HJSKR,4H	,JSKR	,4HSS,4H	,SS
684	14HIT,4H	,IT	,4HFBGN,4H	,FBGN,
685	14HIX,4H	,IX	,4HBD,4H	,BD,
686	14HIYZ,4H	,IYZ	,4HR2,4H	,R2
687	14HK4,4H	,K4	,4HPCA,4H	,PCA,
688	14HKB,4H	,KB	,4HVR1,4H	,RVBIAS,
689	14HKC,4H	,KC	,4HTHTB,4H	,THTBL
690	14HKGL,4H	,KGL	,4HFFAY,4H	,FFAYB,
691	14HKPC,4H	,KPC	,4HTIPS,4H	,TIPS
692	14HKRGL,4H	,KRGL	,4HAF,4H	,AF,
693	14HKS,4H	,KS	,4HXM,4H	,XM
694	14HLAMB,4H	,LAMB1	,4HJMAX,4H	,JMAX
695	14HMASS,4H	,MASS	,4HCG,4H	,CG,
696	14HNRLN,4H	,NRUN		
697	14HPCL,4H	,PCL	,4HTA,4H	,TA,
698	14HPHIM,4H	,PHIMAX	,4HSB,4H	,SB
699	14HPRIN,4H	,PRINTM	,4HJMAX,4H	,JMAX
700	14HRAPT,4H	,RAPTM2	,4HRAPT,4H	,RAPTM1
701	14HRCET,4H	,RCET	,4HDTA,4H	,DTA
702	14HRFLE,4H	,RFLECT	,4HPI,4H	,PI,
703	14HRLAM,4H	,RLAMF	,4HPSIT,4H	,PSIT
704	14HRLAM,4H	,RLAMY	,4HRSI,4H	,RSI
705	14HRNGL,4H	,RNGLIN	,4HVRAT,4H	,VRATF,
706	14HRTMI,4H	,RTMIA	,4HXM,4H	,XM
707	14HS7,4H	,S7	,4HS6,4H	,S6
708	14HS10,4H	,S10	,4HS9,4H	,S9
709	14HS12,4H	,S12	,4HS11,4H	,S11
710	14HS4,4H	,S4	,4HS3,4H	,S3
711	14HS2,4H	,S2	,4HS1,4H	,S1
712	14HS,4H	,S	,4HDELM,4H	,DELMX
713	14HSF0,4H	,SF0	,4HSF1,4H	,SF1
714	14HSF2,4H	,SF2	,4HSF3,4H	,SF3
715	14HSF4,4H	,SF4	,4HSF5,4H	,SF5
716	14HSF6,4H	,SF6	,4HSF7,4H	,SF7
717	14HSF8,4H	,SF8	,4HSF9,4H	,SF9
718	14HSF10,4H	,SF10	,4HSF11,4H	,SF11
719	14HSF12,4H	,SF12	,4HSF13,4H	,SF13
720	14HSF14,4H	,SF14	,4HSF15,4H	,SF15
721	14HSLOP,4H	,SLOPE2	,4HSLOP,4H	,SLOPE1
722	14HT01,4H	,T01	,4HT0,4H	,T0
723	14HT03,4H	,T03	,4HT02,4H	,T02
724	14HT05,4H	,T05	,4HT04,4H	,T04
725	14HT07,4H	,T07	,4HT06,4H	,T06

226

791	14HYEG,4H	,YEG	,4HDELY,4HS	,DELYS	,
792	14HYAWE,4HRR	,YAWERR	,4HYAWE,4HRR	,YAWERR	,
793	14HLAMY,4HR	,LAMYR	,4HLAMP,4HR	,LAMP	,
794	14HCSA,4H	,CSA	,4HCAPS,4H	,CAPS	,
795	14HCPSI,4HS	,DPSIS	,4HJACG,4H	,JACG	,
796	14HPSRB,4HS	,PSRRS	,4HREN,4H	,REN	,
797	PRINT 90000,2,4HLAGI,4HCI				
798	14HGATE,4H	1,GATE(001),4HGATE,4H	2,GATE(002),		
799	24HGATE,4H	3,GATE(003),4HGATE,4H	4,GATE(004),		
800	24HGATE,4H	5,GATE(005),4HGATE,4H	6,GATE(006),		
801	34HGATE,4H	7,GATE(007)			
802	PRINT 90000,4,4HAERB,4HDYNA,4HHICS,4HI				
803	14HCLD,4H	,CLD	,4HALB,4H	,ALB	,
804	14HCNR,4H	,CNR	,4HCMG,4H	,CMG	,
805	14HCY,4H	,CY	,4HCAZ,4H	,CAZ	,
806	14HCLP,4H	,CLP	,4HCN,4H	,CN	,
807	14HCYCG,4H	,CYCG	,4HCMCG,4H	,CMCG	,
808	14HANB,4H	,ANB	,4HCLB,4H	,CLB	,
809	14HCPB,4H	,CPB	,4HCNB,4H	,CNB	,
1*	14MTHAS,4HD	,THASD	,4MOTHA,4HSD	,OTHASD	,
2*	14MPSIS,4HD	,PSISD	,4MOPSI,4HSD	,OPSID	,
810	14HALPH,4HA	,ALPHA	,4HBETA,4H	,BETA	,
811	PRINT 90000,1,4HRAPI				
812	14HSTT,4H	,STT	,4HCTT,4H	,CTT	,
813	14HSPT,4H	,SPT	,4HCPT,4H	,CPT	,
1*	14HXTA,4H	,XTA			
815	PRINT 90000,3,4HDEBU,4HGR,4HINTI				
816	14HDELX,4HB	,DELXB	,4HDELY,4HB	,DELYB	,
1*	14HDELZ,4HB	,DELZB	,4HDELX,4HB	,DELXB	,
818	14HDELY,4HB	,DELYB	,4HDELZ,4HB	,DELZB	,
819	14HKUTT,4HA	,KUTTA			
820	14HPITE,4HRR	,PITERR	,4HYAWE,4HRR	,YAWERR	,
821	14HPITE,4HRR	,PITERB	,4HYAWE,4HRR	,YAWERR	,
822	34HDLA,4HMY	,DLAMY	,4HFS,4H	,FS	,
823	34HDRPS,4HI	,DRPSI	,4HDRTH,4HTA	,DRTHTA	,
824	34HCRPH,4HIQ	,CRPHIQ	,4HCRPHI,4HKG	,CRPHIG	,
825	14HDELV,4HR	,DELVR	,4HDPHI,4HO	,DPHI	,
826	14HVG,4H	,VG	,4HVSND,4H	,VSND	,
827	14HISKR,4H	,ISKR	,4HIACT,4H	,IACT	,
828	14HIOUT,4HDE	,IOUTDE	,4HTRAP,4H	,TRAP	,
829	14HKAGE,4H	,KAGE	,4HNAVY,4H	,NAVY	,
830	34HF1,4H	,F1	,4HDLA,4HMY	,DLAMP	,
831	14HNUM,4H	,NUM	,4HPRINT,4HNT	,PRINT	,
832	14HNPPS,4H	,NPPS	,4HNOT,4H	,NOT	,
833	14HNOTA,4H	,NOTA	,4HNULS,4HKR	,NULSKR	,
834	34HPEFL,4H	,PEFL	,4HPHIG,4H	,PHIG	,
835	14HRMB,4H	,RMB			
836	14HS2,4H	,S2	,4HDELR,4HBL	,DELRBL	,
837	14HRED,4H	,RED	,4HRET,4H	,RET	,
838	14HREG,4H	,REG	,4HRPST,4H	,RPST	,
1*	14HRTHT,4HA	,RTHTA			
840	14HMEBY,4HY	,MEBY	,4HMEBY,4HZ	,MEBY	,
841	14HXX,4H	,XX			
842	72 IF(IMPACT)PRINT 90000,2,4HIMPA,4HCTI				
843	14HPCAT,4H	,PCAT	,4HPCAX,4H	,PCAX	,
844	14HPCAY,4H	,PCAY	,4HPCAZ,4H	,PCAZ	,
845	14HPCA,4H	,PCA			
846	IF(IMPACT)PRINT 90000,3,4HERRR,4HERRR				
847	50 CONTINUE				
848	C				
849	C DISPLACEMENT ERRORS FROM AIM POINT				
850	C				

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851      C      DISPLACEMENT ERRORS FROM SPRT
852      DELX=XT-X
853      DELY=YT-Y
854      DELZ=ZT-Z
855      IF (TIME-LT,TIME3)GO TO 51
856      C
857      IF (ABS(DEL1 ).GT.DELMY)DEL1 =SIGN(DFLMY,DEL1)
858      IF (ABS(DELVP).GT.DELMX)DELVP=SIGN(DFLPX,DELVP)
859      IF (ABS(DEL3 ).GT.DELMY)DEL3 =SIGN(DFLMY,DEL3)
860      IF (ABS(DDELVP).GT.VRATE)DDELVP=SIGN(VRATE,DDELVP)
861      IF (ABS(DDEL1 ).GT.VRATE)DDEL1 =SIGN(VRATE,DDEL1 )
862      IF (ABS(DDEL3 ).GT.VRATE)DDEL3 =SIGN(VRATE,DDEL3 )
863      IF (IACT.GT.0)GO TO 51
864      DEL1 =YEQ=REG
865      DELVP = PEG
866      DEL3 =YEQ=REG
867      IF (IACT.EG.2)DEL1=REG=YEQ
868      IF (IACT.EG.2)DEL3=REG=YEQ
869      51 CONTINUE
870      R E T U R N
871      C
872      E N T R Y   F I N I S H
873      C
874      C
875      IF (IACC.EG.1)GO TO 40
876      XT = XT+DTRK*VXT
877      YT = YT+DTRK*VYT
878      40 CONTINUE
879      VMS=U+V+V+W+W
880      VM=SGRT(VMS)
881      TOTACC=(SGRT(AYB*AYB+AZB*AZB))/VMS
882      C**** TRAJECTORY TERMINATION
883      IF (TIME.GT.5. AND. Z.GT.ZMIN)GO TO 45
884      IF (Z.LT.ZMIN)GO TO 157
885      45 CONTINUE
886      DELXT = XT-X
887      DELYT = YT-Y
888      DELZT = ZT-Z
889      DELXTB=EB11*DELXT+EB12*DELYT+EB13*DELZT
890      DELYTB=EB21*DELXT+EB22*DELYT+EB23*DELZT
891      DELZTB=EB31*DELXT+EB32*DELYT+EB33*DELZT
892      C** LOS IN ECS
893      VERLAP=ATAN2(-DELZ,SGRT(DELX*DELX+DELY*DELY))
894      HORLAP=ATAN2(DELY,DELX)
895      C** TOTAL MISSILE NON-FIELD ACCELERATION
896      C
897      GAMP=ATAN2(W,U)
898      RTUWS=SGRT(U*U+W*W)
899      GAMV=ATAN2(V,RTUWS)
900      C** SC TO VCS TRANSFORMATION
901      CALL TRSFV
902      DELMIS=SGRT(DELYV**2+DELZV**2)
903      GO TO 73
904      157 CONTINUE
905      C*** RANGE TARGET FROM MISSILE=RTM IN FEET.
906      RTM=SGRT((XT-X)**2+(YT-Y)**2+(ZT-Z)**2)
907      C*** POINT OF CLOSEST APPROACH COMPUTATION=PCA IN FEET.
908      IF (RTM.GT.PCA)GO TO 55
909      PCAT=SNGL(TIME);PCAX=X;PCAY=Y;PCAZ=Z;PCA=RTM
910      55 CONTINUE
911      GO TO 9
912      73 IMPACT=.TRUE.

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913		IPRINT=2
914		PRINT 90000,2,4HIMPA,4HETT,4HTIME,4H,TIME
915		GO TO 9
916	9999	GAYE13021,SET
917		ERROR=.TRUE.
918		GO TO 70
919	9998	PRINT 90000,5,4HEND=,4HOF=F,4HILE,4HON U,4HNTI,
920		14MLUNI,4HT,LUNIT
921		DO 3121 1=1,16
922	3121	MDAC(I)=0.
923		DO 3122 1=1,1500
924	X	CALL MDACS(0,16,MDAC)
925	3122	CONTINUE
1*		CALL BEOF(IE)
2*		CALL WEOF#88
3*		CALL WEOF#88
926	X	CALL MODE('R')
927	X	CALL MODE('P')
928	X	CALL WEOF
929	X	CALL PLOT(1,TIME,2,1, TXED 1)
930	X	CALL FGORLS(10V 1)
931		STOP
932		END

```

1      SUBROUTINE SEEKER(SRNGE,REFLEC,ERR,ERR0)
2      DIMENSION TRNGE(18),TRFLEC(2),TMS(18,2),TLRS(19),TER0(19,6)
3      DIMENSION TRAD(6)
4      DATA TRNGE/100.,200.,300.,400.,500.,600.,700.,800.,900.,1000.,1200.,1400.,1600.,1800.,2000.,3000./
5      DATA TRFLEC /1.25,5./
6      DATA TLRS /-1.5,-1.333,-1.167,-1.,-.833,-.667,-.5,-.333,-.167,0.,
7      1.167,.333,.5,.667,.833,1.,1.167,1.333,1.5/
8      DATA TRAD /4.3E-14,4.6E-13,4.5E-12,4.1E-11,4.1E-10,2.6E-9/
9      DATA TMS/9.3E-11,2.6E-11,9.4E-12,5.6E-12,3.6E-12,2.9E-12,1.9E-12,
10     19.0E-13,2.1E-13,9.3E-14,5.0E-14,3.0E-14,2.2E-14,1.4E-14,7.5E-15,
11     25.0E-15,3.0E-15,2.6E-15,
12     33.7E-9,9.0E-10,3.7E-11,2.1E-11,1.4E-11,9.2E-12,5.0E-12,3.3E-12,
13     48.4E-13,3.7E-13,2.0E-13,1.4E-13,8.4E-14,4.6E-14,3.0E-14,2.0E-14,
14     51.8E-14,1.0E-14/
15     DATA TER0/2.,2.,-1.95,-1.86,-1.8,-1.72,-1.5,-1.29,-.85,0.,.33,
16     1.75,1.05,1.2,1.3,1.4,1.5,1.5,1.6,
17     2.4,-.4,-.3,95,-3.85,-3.6,-3.35,-7.8,-2.1,-.85,.4,2.15,3.1,3.45,
18     33.7,3.75,3.9,3.95,4.,
19     4.4,7.,4.7,4.65,4.5,4.5,-4.2,-3.2,-2.6,-1.15,.7,2.3,3.2,3.5,3.7,
20     53.75,3.8,3.9,3.9,3.9,
21     6.3,5.3,3.4,3.25,3.1,2.9,2.8,2.5,2.05,-1.9,0.,1.3,1.7,1.85,
22     72.1,2.4,2.5,2.6,2.6,2.6,
23     8.3,55.3,55.3,5.3,3.4,3.2,3.0,2.85,2.5,-1.8,-.9,-.4,.05,.25,
24     9.5,.7,.9,1.,1.05,1.1,
25     1.2,4.,2.4,2.35,2.3,2.2,2.,-1.85,-1.,-1.1,-.95,-.8,-.5,-.35,
26     8.-2,-.1,-.05,.025,.05,.05/
27     DIMENSION AMS(4), AEND(4)
28     DATA IS,IR, JM/30/
29     T=IS
30     CALL FIND(I,TRNGE,18,SRNGE)
31     IF(I.EQ.IS) GO TO 10
32     IS=I
33     CALL NTERP (AMS,TMS,I,TRNGE,18,1,TRFLEC)
34     10 HS=FLACTION(AMS,SRNGE,REFLEC)
35     RRR=ERR+57.296
36     IF(I5) J=JM
37     CALL FIND(I,TLRS,19,RRR)
38     CALL FIND(J,TRAD,6,HS)
39     IF(I.EQ.IS) GO TO 20
40     IF(J.EQ.JM) GO TO 30
41     20 IS=I; JM=J
42     CALL NTERP (AEND,TER0,I,TLRS,19,J,TRAD)
43     30 ENDFUNCTION(AEND,RRR,HS)
44     ERR=END/4./57.296
45     RETURN
46     END

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1      SUBROUTINE AERO (T1,T2,FMACH,ALPHA,BETA,DELPIT,DELYAW,DELROL,
2      CN,CMCO,CY,CLNCO,CA,CLP,CLD,CMQ,CMAD,CLNR,CLNAD)
3      MP
4
5      C
6      C      INPUTS
7      C      T1      * TIME * SEC.
8      C      T2      * TIME TO START CONTROL PHASE - SEC.
9      C      FMACH   * FREE STREAM MACH NUMBER
10     C      ALPHA   * ANGLE OF ATTACK (PITCH PLANE) * DEG.
11     C      BETA    * ANGLE OF ATTACK (YAW PLANE) * DEG.
12     C      DELPIT  * CONTROL DEFLECTION ANGLE (PITCH PLANE) * DEG.
13     C      DELYAW  * CONTROL DEFLECTION ANGLE (YAW PLANE) * DEG.
14     C      DELROL  * CONTROL DEFLECTION (ROLL) * DEG.
15     C
16     C      OUTPUT
17     C      CN      * NORMAL FORCE COEFF.
18     C      CMCO    * PITCHING MOMENT COEFF.
19     C      CY      * YAW FORCE COEFF.
20     C      CLNCO   * YAW MOMENT COEFF.
21     C      CA      * AXIAL FORCE COEFF.
22     C      CLP     * ROLL DAMPING COEFF. * (1/RAD)
23     C      CLD     * ROLL MOMENT COEFF. * (1/DEG)
24     C      CMQ     * PITCH DAMPING COEFF. DUE TO THETA DOT
25     C      CMAD    * PITCH DAMPING COEFF. DUE TO ALPHA DOT
26     C      CLNR    * YAW DAMPING COEFF. DUE TO PSI DOT
27     C      CLNAD   * YAW DAMPING COEFF. DUE TO ALPHA DOT
28     C
29     C      TABLES
30     C      TCN1     * TABLE OF CN FOR CONTROL PHASE
31     C      TCNCO1   * TABLE OF CMCO FOR CONTROL PHASE
32     C      TCA1     * TABLE OF CA FOR CONTROL PHASE
33     C      TCN2     * TABLE OF CN FOR BALLISTIC PHASE
34     C      TCNCO2   * TABLE OF CMCO FOR BALLISTIC PHASE
35     C      TCA2     * TABLE OF CA FOR BALLISTIC PHASE
36     C      TDELT1   * TABLE OF DELTA FOR CN,CMCO
37     C      TPACH1    * TABLE OF FMACH FOR CONTROL PHASE
38     C      TPACH2    * TABLE OF FMACH FOR BALLISTIC PHASE
39     C      TPACH3    * TABLE OF FMACH FOR CLP,CLD
40     C      TPACH4    * TABLE OF FMACH FOR CMQ
41     C      TPACH5    * TABLE OF FMACH FOR CA (BALLISTIC PHASE)
42     C
43     C      DOUBLE-PRECISION T1,T2
44     C      DIMENSION TALP(6),TDELT1(7), TCN1(6,7,3),TCN2(6,6)
45     C      DIMENSION TCNCO1(6,7,3),TCNCO2(6,5),TCA1(4,7,3),TCA2(16)
46     C      DIMENSION TCLP(8),TCLD(8),TCMQ(10,5),TALP(10)
47     C      DIMENSION TPACH1(3),TPACH2(3),TPACH3(8),TPACH4(3),TPACH5(15)
48     C      DIMENSION ACN(8), ACMCO(8), ACY(8),ACLNCO(8),ACAP(8),
49     C      ACAB(8), ACAQ(8),ACLP(2), ACLO(2), ACMQ(4), ACLNR(8)
50     C      DIMENSION ISAVE(13)
51     C      DATA TCN1 /
52     C      DATA TCNCO1 /
53     C      DATA TCNCO2 /
54     C      DATA TCA1 /
55     C      DATA TCA2 /
56     C      DATA TDELT1 /
57     C      DATA TPACH1 /
58     C      DATA TPACH2 /
59     C      DATA TPACH3 /
60     C      DATA TPACH4 /
61     C      DATA TPACH5 /
62     C

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DATA	TCN1	TCNCO1	TCNCO2	TCA1	TCA2	TDELT1	TPACH1	TPACH2	TPACH3	TPACH4	TPACH5
1	1.25	1.05	1.01	1.91	1.98	3.12	1.20	1.00	1.00	1.00	1.00
2	1.2	1.06	1.04	1.35	2.4	3.39	1.15	1.00	1.00	1.00	1.00
3	1.1	1.06	1.07	1.81	2.72	3.45	1.10	1.00	1.00	1.00	1.00
4	1.04	1.35	1.32	2.19	2.78	3.60	1.05	1.00	1.00	1.00	1.00
5	1.0	1.53	1.48	2.29	2.95	3.8	1.00	1.00	1.00	1.00	1.00
6	1.4	1.3	1.84	2.3	3.05	3.95	1.00	1.00	1.00	1.00	1.00
7	1.95	1.15	1.65	2.43	3.2	4.05	1.00	1.00	1.00	1.00	1.00
8	1.35	1.09	1.2	1.05	2.1	3.35	1.20	1.00	1.00	1.00	1.00
9	1.25	1.05	1.04	1.48	2.56	3.67	1.15	1.00	1.00	1.00	1.00
10	1.1	1.09	1.05	1.9	2.59	3.89	1.10	1.00	1.00	1.00	1.00
11	1.06	1.04	1.05	2.29	3.1	4.08	1.05	1.00	1.00	1.00	1.00

63	X	.C	1.05	1.85	2.54	3.31	4.28	0.0
64	X	.45	1.35	1.95	2.64	3.45	4.39	5.0
65	X	1.0	1.56	2.1	2.8	3.56	4.5	10.0
66	X	-2.0	1.17	1.02	1.73	2.5	3.13	-20.0
67	X	-1.7	1.44	1.59	1.7	3.06	4.65	-15.0
68	X	-1.2	1.0	1.1	2.74	3.62	5.05	-10.0
69	X	-.6	1.48	1.56	2.75	4.05	5.23	-5.0
70	X	.0	1.05	2.2	3.3	4.25	5.32	0.0
71	X	.43	1.06	2.6	3.44	4.28	5.34	5.0
72	X	1.0	1.1	2.85	3.5	4.34	5.41	10.0
73	DATA TCNE /							
74	X	.0	1.93	1.8	2.29	2.94	3.8	0.0
75	X	.0	1.05	1.85	2.54	3.31	4.28	0.0
76	X	.C	1.05	2.2	3.3	4.25	5.32	0.0
77	X	.0	1.85	1.8	2.85	4.2	5.6	0.0
78	X	.0	1.59	1.4	2.5	3.5	4.9	0.0
79	DATA TCPC81 /							
80	X	3.6	1.0	3.35	2.35	1.8	1.3	-20.0
81	X	3.4	1.12	1.9	1.1	1.48	1.4	-15.0
82	X	2.84	1.57	1.53	1.25	1.5	1.2	-10.0
83	X	1.25	1.37	1.75	1.32	1.70	1.3	-5.0
84	X	.0	1.25	2.1	1.62	1.12	1.98	0.0
85	X	-1.1	2.35	2.2	1.7	1.5	1.35	5.0
86	X	-2.7	2.9	2.25	2.05	1.94	1.65	10.0
87	X	3.85	1.0	3.6	2.16	1.7	1.5	-20.0
88	X	3.6	1.2	1.95	1.8	1.3	1.1	-15.0
89	X	3.1	1.65	1.35	1.0	1.7	1.25	-10.0
90	X	1.65	1.3	1.108	1.15	1.135	1.63	-5.0
91	X	.0	1.7	2.28	2.2	1.95	1.52	0.0
92	X	1.2	2.57	2.56	2.5	2.35	1.8	5.0
93	X	3.94	1.1	3.1	2.98	2.7	2.16	10.0
94	X	5.9	1.94	3.17	1.98	1.3	1.1	-20.0
95	X	4.98	3.32	1.52	1.53	1.4	1.79	-15.0
96	X	3.55	1.14	1.27	1.12	1.12	1.21	-10.0
97	X	1.7	1.02	1.42	1.30	1.35	1.72	-5.0
98	X	.0	1.65	3.32	4.4	4.1	3.04	0.0
99	X	-1.23	3.3	4.57	4.75	4.3	3.2	5.0
100	X	-2.95	4.7	5.27	4.9	4.45	3.38	10.0
101	DATA TCPC82 /							
102	X	.0	1.25	2.1	1.62	1.12	1.98	0.0
103	X	.0	1.7	2.28	2.2	1.98	1.52	0.0
104	X	.0	1.65	3.32	4.4	4.1	3.04	0.0
105	X	.0	1.9	1.8	2.38	2.17	1.63	0.0
106	X	.0	1.28	1.45	1.57	1.57	1.57	0.0
107	DATA TCA1 /							
108	X	.71	1.09	1.55	1.363	1.176	1.03	-20.0
109	X	.585	1.506	1.382	1.24	1.173	1.02	-15.0
110	X	.495	1.35	1.275	1.149	1.102	1.09	-10.0
111	X	.328	1.311	1.26	1.24	1.245	1.22	-5.0
112	X	.295	1.294	1.313	1.341	1.323	1.19	0.0
113	X	.32	1.366	1.412	1.496	1.425	1.404	5.0
114	X	.42	1.47	1.502	1.59	1.529	1.5	10.0
115	X	.78	1.767	1.652	1.419	1.24	1.061	-20.0
116	X	.64	1.384	1.435	1.298	1.153	1.068	-15.0
117	X	.51	1.419	1.345	1.24	1.196	1.153	-10.0
118	X	.375	1.352	1.304	1.301	1.29	1.24	-5.0
119	X	.338	1.338	1.381	1.340	1.403	1.383	0.0
120	X	.373	1.425	1.482	1.51	1.545	1.515	5.0
121	X	.478	1.53	1.581	1.635	1.65	1.66	10.0
122	X	1.23	1.11	1.88	1.85	1.87	1.214	-20.0
123	X	1.06	1.855	1.705	1.56	1.363	1.175	-15.0
124	X	.79	1.673	1.61	1.518	1.356	1.226	-10.0

```

125      X      .643      .605      .758      .54      .456      .382      .5 1.0
126      X      .582      .61      .795      .58      .44      .50      .0 1.0
127      X      .63      .685      .753      .775      .765      .74      .5 1.0
128      X      .73      .83      .90      .918      .92      .89      .10 1.0
129      DATA TCA2      / .31,.31,.32,.32,.367,.428,.505,.58,
130      X .615,.639,.645,.639,.628,.60,.565/
131      DATA TALP      /0.5,.10,.15,.20,.25./
132      DATA TALP2      /0.4,.6,.8,.10,.12,.14,.16,.18,.20./
133      DATA TDEL1      /-20,-15,-10,-5,0,5,10./
134      DATA TMACH1      /-.4,.8,1.0/
135      DATA TMACH2      /-.4,.8,1.0,1.3,1.8/
136      DATA TMACH3      /-.4,.8,1.0,1.3,1.8/
137      DATA TMACH4      /-.4,.6,.8,1.0,1.2,1.4,1.6,1.8/
138      DATA TMACH5      /-.4,.5,.6,.7,.8,.85,.9,.95,1.0,1.1,1.2/
139      X 1.3,1.4,1.6,1.8/
140      DATA TCLP      /-.85,-17.7,-21.0,-29.1,-26.7,-21.7,-14.7/
141      DATA TCLD      /-.085,-.087,-.090,-.097,-.086,-.073,-.061,-.049/
142      DATA TCPQ      /
143      X -.145,-.165,-.162,-.125,-.100,-.101,-.102,-.104,-.105,-.107,
144      X -.150,-.185,-.190,-.165,-.135,-.108,-.75,-.75,-.75,-.75,
145      X -.160,-.205,-.218,-.220,-.234,-.240,-.244,-.227,-.180,-.107,
146      X -.178,-.194,-.195,-.195,-.194,-.192,-.184,-.174,-.148,-.110,
147      X -.130,-.155,-.162,-.155,-.150,-.143,-.134,-.120,-.105,-.67/
148      ABALP = ABS(ALPHA)*57.296
149      ABSET = ABS(BETA)*57.296
150      IF (T1<T2) GO TO 2
151      CELP = DELPIT*57.296
152      DELY = DELYAX*57.296
153      IF (ALPHA<0.) CELP=-DELP
154      IF (BETA<0.) DELY=-DELY
155      I = ISAVE(1)
156      J = ISAVE(2)
157      K = ISAVE(3)
158      CALL FIND(I,TALP,6,ABALP)
159      CALL FIND(J,TDEL1,7,DELP)
160      CALL FIND(K,TMACH1,8,FMACH)
161      IF (I.NE. ISAVE(1)) GO TO 50
162      IF (J.NE. ISAVE(2)) GO TO 60
163      IF (K.NE. ISAVE(3)) GO TO 70
164      GO TO 80
165      50 ISAVE(1) = I
166      60 ISAVE(2) = J
167      70 CONTINUE
168      CALL NTERP (ACN,TCN1,1,TALP,6,J,TDEL1,7,K,FMACH1)
169      CALL NTERP (ACMCG,TCMCG1)
170      CALL NTERP (ACAP,TCA1)
171      80 I = ISAVE(4)
172      J = ISAVE(5)
173      CALL FIND(I,TALP,6,ABSET)
174      CALL FIND(J,TDEL1,7,DELY)
175      IF (I.NE. ISAVE(4)) GO TO 150
176      IF (J.NE. ISAVE(5)) GO TO 160
177      IF (K.NE. ISAVE(3)) GO TO 170
178      GO TO 180
179      150 ISAVE(4) = I
180      160 ISAVE(5) = J
181      170 CONTINUE
182      CALL NTERP (ACV,TCN1,1,TALP,6,J,TDEL1,7,K,FMACH1)
183      CALL NTERP (ACLNCG,TCMCG1)
184      CALL NTERP (ACAB,TCA1)
185      180 IF (K.NE. ISAVE(3)) GO TO 190
186      C

```

```

187      C SFT I & J FOR ALPHA = DELTA = 0.0 IN TALP & TDEL T1
188      C
189      I = 1
190      J = 5
191      CALL NTERP (ACAB,TCA1,I,TALP,6,J,TDFLT1,7,K,FMACH1)
192      ACAB(2) = ACAB(5)
193      ISAVE(3) = K
194      190 CONTINUE
195      CA = FUNCTION(ACN,ABALP,DELP,FMACH)
196      CMCG = FUNCTION(ACMCG)
197      CAP = FUNCTION(ACAP)
198      CY = FUNCTION(ACY,ABSET,DELY,FMACH)
199      CLNCG = FUNCTION(ACLNCG)
200      CAB = FUNCTION(ACAB)
201      CA8 = FUNCTION(ACAB,FMACH)
202      CA = CAP * CAB * CA8
203      GO TO 3
204      C
205      ? I = ISAVE(6)
206      J = ISAVE(7)
207      K = ISAVE(8)
208      CALL FIND(I,TALP,6,ABALP)
209      CALL FIND(J,FMACH2,5,FMACH)
210      CALL FIND(K,TALP,6,ABSET)
211      IF(J.NE.ISAVE(7)) GO TO 250
212      IF(I.EQ.ISAVE(6)) GO TO 260
213      250 ISAVE(6) = I
214      CALL NTERP (ACN,TCN2,I,TALP,6,J,FMACH2)
215      CALL NTERP (ACMCG,TCMCG2)
216      IF(J.NE.ISAVE(7)) GO TO 270
217      IF(K.EQ.ISAVE(8)) GO TO 280
218      270 ISAVE(7) = J
219      ISAVE(8) = K
220      CALL NTERP (ACY,TCN2,K,TALP,6,J,FMACH2)
221      CALL NTERP (ACLNCG,TCMCG2)
222      I = ISAVE(9)
223      CALL FIND(I,FMACH5,15,FMACH)
224      IF(I.EQ.ISAVE(9)) GO TO 290
225      ISAVE(9) = I
226      CALL NTERP (ACAP,TCA2,I,FMACH5)
227      290 CONTINUE
228      CA = FUNCTION(ACN,ABALP,FMACH)
229      CMCG = FUNCTION(ACMCG)
230      CY = FUNCTION(ACY,ABSET,FMACH)
231      CLNCG = FUNCTION(ACLNCG)
232      CA = FUNCTION(ACAP,FMACH)
233      C
234      3 I = ISAVE(10)
235      CALL FIND(I,FMACH3,8,FMACH)
236      IF(I.EQ.ISAVE(10)) GO TO 350
237      ISAVE(10) = I
238      CALL NTERP (ACLP,TCLP,I,FMACH3)
239      CALL NTERP (ACLD,TCLD)
240      350 I = ISAVE(11)
241      J = ISAVE(12)
242      K = ISAVE(13)
243      CALL FIND(I,FMACH4,5,FMACH)
244      CALL FIND(J,TALP4,10,ABALP)
245      CALL FIND(K,TALP4,10,ABSET)
246      IF(I.NE.ISAVE(11)) GO TO 360
247      IF(J.EQ.ISAVE(12)) GO TO 370
248      360 ISAVE(12) = J

```

249		CALL NTERP (ACMG,TCMQ,J,TALP4,10,I,TMACH4)	
250	370	IF(I .NE. ISAVE(11))	GO TO 380
251		IF(K .EQ. ISAVE(13))	GO TO 390
252	380	ISAVE(11) = I	
253		ISAVE(13) = K	
254		CALL NTERP (ACLNR,TCMQ,K,TALP4,10,I,TMACH4)	
255	390	CONTINUE	
256		CLP = FUNCTION(ACLP,FMACH)	
257		CLO = FUNCTION(ACLO)	
258		CMG = FUNCTION(ACMG,ABALP,FMACH)	
259		CLNR = FUNCTION(ACLNR,ABBET,FMACH)	
260		IF(ALPHA .LT. 0.0) CN = -CN	CMCG = -CMCG
261		IF(BETA .LT. 0.0) CY = -CY	CLNCG = -CLNCG
262		CMAD = 0.	
263		CLNAD = 0.	
264		RETURN	
265		END	

```

1 SUBROUTINE TRSFEB
2 C *** THIS SUBROUTINE PERFORMS THE EARTH TO BODY COORDINATE SYS. TRANSFORMATION
3 C
4 DIMENSION DUM(7),DUMY(57)
5 COMMON/INTEG/I,J,DUM,PHI,THTA,PSI,DUMY
6 COMMON/ETB/EB11,EB12,EB13,EB21,EB22,EB23,EB31,EB32,EB33
7 COMMON/TDC/CPSI,SPSI,SPHI,CPHI
8 CPSI=COS(PSI)
9 SPSI=SIN(PSI)
10 CHTA=COS(THTA)
11 SHTA=SIN(THTA)
12 CPHI=COS(PHI)
13 SPHI=SIN(PHI)
14 EB11=CPSI*CHTA
15 EB12=SPSI
16 EB13=CPSI*STHTA
17 EB21=SPHI*STHTA+CPHI*SPSI*CHTA
18 EB22=CPHI*CPSI
19 EB23=SPHI*CHTA+CPHI*SPSI*STHTA
20 EB31=CPHI*STHTA+SPHI*SPSI*CHTA
21 EB32=-SPHI*CPSI
22 EB33=CPHI*CHTA+SPHI*SPSI*STHTA
23 RETURN
24 END

```

```

1  SUBROUTINE TRSFBS
2  C*** THIS SUBROUTINE PERFORMS THE BODY TO SEEKER COORDINATE SYS. TRANSFORMATION
3  C
4  DIMENSION DUM(15),DUMR(49)
5  COMMON/INTEG/I,J,DUM,THIAS,QQ,PS19,DUMR
6  COMMON/BTS/PS11,BS12,BS13,BS21,BS22,BS23,BS31,BS32,BS33
7  BS12= SIN(PS18)
8  BS22= COS(PS18)
9  BS31= SIN(THIAS)
10 BS33= COS(THIAS)
11 BS11= BS22*BS33
12 BS13= BS22*BS31
13 BS21= BS12*BS33
14 BS23= BS12*BS31
15 BS32= 0.
16 RETURN
17 END

```

1	CLPRACTINE TRSFV
2	C *** THIS SUBROUTINE PERFORMS THE BCS TO VCS TRANSFORMATION
3	C
4	COMMON/ IN/ GAMP, GAMP, GAMP, DFLXTB, DELYTB, DELZTB
5	COMMON/ RTV/ DELXV, DELYV, DELZV
6	BV12= SIN(GAMP)
7	BV22= COS(GAMP)
8	BV31= SIN(GAMP)
9	BV33= COS(GAMP)
10	BV11= BV22*BV33
11	BV13= -BV22*BV31
12	BV21= -BV12*BV33
13	BV23= BV12*BV31
14	BV32= 0.
15	DELXV= BV11*DELXTB+BV12*DELYTB+BV13*DELZTB
16	DELYV= BV21*DELXTB+BV22*DELYTB+BV23*DELZTB
17	DELZV= BV31*DELXTB+BV32*DELYTB+BV33*DELZTB
18	RETURN
19	END

```

1  SURALTIME LASER
2  THIS SUBROUTINE TRANSFORMS MISSLE TO TARGET DISPLACEMENTS
3  FROM FCS TO RCS, FROM RCS TO SCS AND COMPUTES LAS ERROR IN SCS
4
5  COMMON/RTS/RS11,RS12,RS13,BS21,BS22,BS23,RS31,BS32,BS33
6  COMMON/ETR/ER11,ER12,ER13,ER21,ER22,ER23,ER31,ER32,ER33
7  COMMON/INPSKR/PIERR,YA,ERR
8  COMMON/DEL/DELX,DELY,DELZ
9  COMMON/STUFF/ CFLXS,DELYS,DFLZS
10 COMMON/STUFF1/DELXR,DELYR,DFLZR
11 DELXR=ER11*DELX+ER12*DELY+ER13*DFLZ
12 DELYR=ER21*DELX+ER22*DELY+ER23*DFLZ
13 DELZR=ER31*DELX+ER32*DELY+ER33*DFLZ
14 DELXS=RS11*DELXR+RS12*DELYR+RS13*DFLZR
15 DELYS=RS21*DELXR+RS22*DELYR+RS23*DFLZR
16 DELZS=RS31*DELXR+RS32*DELYR+RS33*DFLZR
17 PIERR=ATAN2(-DELZS,DELYS)
18 YAWERR=ATAN2(DELYS,DELYS*DELXS+DELZS*DELZS))
19 RETURN
20 END

```

```

1  SUBROUTINE WCALC
2  C*** THIS SUBROUTINE CALCULATES THE MACH NUMBER
3  C
4  DIMENSION RHM(63)
5  REAL MACH
6  COMMON/ETB/FR11,ER12,EB13,ER21,EB22,FR23,ER31,ER32,EB33
7  COMMON/MACH/MACH,VSND,UR,VR,WR,VRS,VRW,VW
8  COMMON/INTEG/I,J,GG,U,V,W,RHM
9  COMMON/F/WXS,WYS,WZS
10 LW=ER11*WXS+ER12*WYS
11 VU=ER21*WXS+ER22*WYS
12 WU=ER31*WXS+ER32*WYS
13 UR=U*LW
14 VR=V*VW
15 WR=W*WV
16 VRS=UR*VR+VR*VR*WR
17 VRW=SGRT(VRS)
18 MACH=VRW/VSND
19 RETURN
20 END

```



```

1 SUBROUTINE DIFEC
2 C**SUBROUTINE DIFEC CONSTRUCTS THE EQUATIONS OF MOTION
3 COUPLE PRECISION TIME
4 DIMENSION DNG(27),COW(21)
5 REAL MASS,IX,IYZ
6 COMMON/ETA/EF11,FR12,FR13,FR21,FR22,FR23,FR31,FR32,FR33
7 COMMON/TODEC/AXB,AYB,AZB,CLB,CNB,ALB,AMB,ANB,CM3
8 COMMON/INTEG/I,J,GC,U,V,W,P,Q,R,DAG,U,DV,DZ,DP,DC,DR,
9 DPHI,DTHTA,DPSI,DX,DY,DZ,COW
10 COMMON/JUNK/TIME
11 COMMON/JUNK1/THOLD,IROLL,G,MASS,IX,IYZ,XINTIA,NAVY
12 COMMON/TDC/CPSI,SPSI,SPHI,CPHI
13 COMMON/GG/GXB,GYB,GZR
14 C** GRAVITY RESOLUTION TO BCS
15 GXB=EB13*G
16 GYB=EB23*G
17 GZR=EB33*G
18 C** EQUATIONS OF MOTION
19 CU=AXB/MASS+R*V*G*W+GXB
20 IF(TIME*LT*THOLD.AND.NAVY.EQ.1)CU=0.
21 CV=AYB/MASS+P*W+R*U+GYB
22 CW=AZB/MASS+G*U+P*V+GZB
23 CP=(ALB+CLB)/IX
24 CG=(ANB+CNB)/IYZ+P*R*XINTIA
25 DR=(ANB+CNB)/IYZ+P*Q*XINTIA
26 DTHTA=(G*CPHI-R*SPHI)/CPSI
27 CPHI=P*DTHTA*SPSI
28 CPSI=R*CPHI+G*SPHI
29 IF(IROLL.NE.C)DP=0.
30 IF(IROLL.NE.O)P=0.
31 C** MISSILE VELOCITY IN ECS
32 CX=EB11*U+EB21*V+EB31*W
33 DY=EB12*U+EB22*V+EB32*W
34 CZ=EB13*U+EB23*V+EB33*W
35 RETURN
36 END

```

```

1 SUBROUTINE MOTO
2 C** SUBROUTINE MOTO CALCULATES THE VELOCITY OF SOUND
3 C
4 DOUBLE PRECISION TIME,TIME3
5 DIMENSION DUM(22),DUMY(6)
6 REAL MACH
7 COMMON/MO/GERALT,TA,TGRAD,RHSL,ARG1,ATML,RSTAR,
8 IRMR,ARG2,GR,TML
9 COMMON/JUNK/TIME,TIME3,RH,NUM
10 COMMON/MACH/MACH,VEND,DUMY
11 IF(GERALT.GT.36089.2389) GO TO 12
12 TML=TA+TGRAD*GERALT
13 RH=RHSL*(TA/TML)**ARG1
14 RH=RH
15 VSND=SQRT(1.4*RSTAR*TML/INTML)
16 GO TO 13
17 CONTINUE
18 ARG2=-GR*TML*(GERALT+36089.2389)/(RSTAR*TML)
19 RH=RH*EXP(ARG2)
20 RETURN
21 END

```

```

1      SUBROUTINE SEEK
2      C** THIS SUBROUTINE DETECTS TARGET WITHIN THE DETECTION RANGE OF SEEKER,
3      C TARGET WITHIN THE FIELD OF VIEW, S-A-M, SEEKER WITHIN LINEAR RANGE
4      C
5      DOUBLE PRECISION TIME, FTSAM, TIMEA, DT, DTA, TST, TME, SPER
6      DIMENSION CAT(14), RAT(49)
7      COMMON/STUFF/DELXS, DELYS, DELZS
8      COMMON/JUNK/BRNGE, IFUF0, IACQ, RDET, YAWERR, PITERR, PHFOV, BA, RNGLIN,
9      IPITYAHSC, R2D, NULSKR, BRG, RFLCT, NULL, KAGE
10     COMMON/INPSKR/PITERR, YAWERR
11     COMMON/JUNK/TIME
12     COMMON/INTJ/I, J, DTRK, CAT, THYAS, THASD, PSIS, RAT
13     COMMON/TT/FTSAM, TIMEA, DTA, TST, TME, SPER, YAS, DO, JMAX, IPRINT, T2
14     BRNGE=SQRT(DELXS*DELXS+DELYS*DELYS+DELZS*DELZS)
15     DATA IACQ1/0/
16     IF (IPFOV.EQ.0) GO TO 560
17     IF (TIME.LT.T2) GO TO 105
18     IF (IACQ1.EQ.0) GO TO 11
19     IF (IACQ1.EQ.1) GO TO 10
20     FTSAM=TIME
21     IF (IACQ.EQ.2) IACQ1=1
22     IF (IACQ.EQ.1) CONTINUE
23     GO TO (565, 107), IACQ
24     560 CONTINUE
25     IF (ACQ.EQ.2) GO TO 107
26     FTSAM=TIME
27     IF (TIME.GE.TIMEA) GO TO 565
28     IF (TIME.LT.TIMEA) GO TO 105
29     C*** ACQUISITION (IACQ=2) WHEN TARGET IS WITHIN PHFOV AND RDET
30     565 CONTINUE
31     C
32     C** LINEAR SEEKER, NO OUTPUT WHEN OUT OF FOV
33     IF (BRNGE.GT.RDET) GO TO 101
34     IF (SQRT(YAWERR*YAWERR+PITERR*PITERR).GT.PHFOV) GO TO 101
35     IF (SQRT(PITERR**2+YAWERR**2).GT.0.0872664) GO TO 101
36     IF (SQRT(PSIS*PSIS+THYAS*THYAS).LT.BA) GO TO 101
37     567 CONTINUE
38     C*** PRINT EVERY JMAX INTERVALS
39     JMAX=1024
40     DT=DTA
41     DTRK=SNGL(DT)
42     IACQ=2
43     IPRINT=2
44     PRINT=90005
45     FORMAT(//2X, 'ACQUISITION')
46     GO TO 103
47     107 CONTINUE
48     C*** NULL SEEKER
49     PITERR=ATAN2(-DELZS, DELXS)
50     YAWERR=ATAN2(DELYS, SQRT(DELXS*DELXS+DELZS*DELZS))
51     C
52     C** LOSS OF ACQUISITION
53     IF (SQRT(PITERR*PITERR+YAWERR*YAWERR).GT.PHFOV) GO TO 101
54     PITAHSC=SQRT(PITERR*PITERR+YAWERR*YAWERR)
55     IF (PITAHSC.LE.0.5/R2D) NULSKR=2
56     103 CONTINUE
57     C** SAMPLE AND HOLD IF FTSAM+TIME IS INCLUDED AFTER STATEMENT 102
58     TST=TIME-FTSAM
59     TSAM=TST+TME
60     IF (TSAM-SPER) 104, 104, 104
61     104 TME=TME-SPER

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```

59 IF (SRNGE.LT.PRS)G9 T9 108
60 IF (SQRT(YAWERR*YAWERR+PITERR*PITERR).GT.PLEFV)G9 T9 108
61 IF (SQRT(PSIS*PSIS+THIAS*THIAS).LT.BA)G9 T9 108
62 CALL SEEKER(SRNGE,REFLECT,YAWERR,YAWERR)
63 PITERR=PITERR
64 YAWERR=YAWERR
65 G9 T9 109
66 101 IACC=NULL*KAGE=1
67 108 YAWERR=0
68 PITERR=0
69 109 CONTINUE
70 C
71 C** SEEKER WITH LINEAR RANGE
72 IF (ABS(YAWERR).GE.RNGLIN)YAWERR=SIGN(RNGLIN,YAWERR)
73 IF (ABS(PITERR).GE.RNGLI)PITERR=SIGN(RNGLIN,PITERR)
74 105 RETURN
75 END

```

```

1      BLRRROUTINE EDSKRGYR0
2      C      THIS SUBROUTINE CONSTRUCTS THE SEEKER GYRO PDEL FOR ED
3      C
4      DOUBLE PRECISION TIME
5      REAL KT,KT10,KT20,LAMPR,LAMPR
6      REAL KG,KT30
7      LOGICAL FLG4,.TRUE./
8      COMMON/INTEG/KUTTA,NX,DTRK,U,V,W,P,Q,R,PHI,THTA,PSI,X,Y,Z,RTHTA,
9      1RPSI,THYAS,THASD,PSIS,PSISD,OMEGA,TXED,DXED,PEF,YEF,DEL1,DELVP,
10     2DEL3,DEL1,DELVP,DEL3,RLAMY,RLAMP,RLPHIG,DPHTO,OC,OV,OW,OP,OG,OR,
11     3DPHI,DTHTA,DPSI,CX,DY,DZ,DRHTA,DRPSI,DTHTAG,CTHASD,OPSI,OPSI,
12     4OMEGA,DTXED,OPXED,OPED,DYEF,DEL1,DELVP,DEL3,DEL1,DELVP,
13     5DEL3,DRAMY,DRAMP,DRPHIG,DDPHIO
14     COMMON/JUNK/TIME
15     COMMON/TT/FSTSA,TIME,DT,DTA,TST,TTF,SPER,TSAM,CO,JMAX,IPRINT,T2
16     COMMON/PERV/OMEGY,OMEGZ
17     COMMON/BOH/RGL,KT,KT10,KT20,LAMPR,LAMPR,RTM,RTMIN,RSQE,ED1,FLG4,
18     1RGA,EC,GSA
19     COMMON/BTS/BS11,BS12,BS13,BS21,BS22,BS23,BS31,BS32,BS33
20     COMMON/JUNK2/SRNGE,IFUPR,IACQ,RDET,YAERR,PITER,PMFOY,BA,RMGLIN,
21     1PIYASQ,R2D,NULSKR,BRS,REFLECT,NULL,KAGE
22     COMMON/GP/RG,RR,HZA,B,KT30
23     DPHIO=DPHI
24     RSLV125/R2D/IF(ABS(DPHIO).GT.RSLIDPHIO*SIGN(RSL,DPHI))
25     IF(TIME.LT.T2)GO TO 5005
26     C
27     C=====CHECK FOR NULL SEEKER
28     IF(TIME.GT.10.AND.RTM.LT.RTMIN)GO TO 5000
29     IF(NULL.EC.2)GO TO 5000
30     NULL=1
31     RSQE=SQRT(THYAS*THYAS*PSIS*PSIS)/IF(RSGE.LE.0.5/R2D.AND.IACQ.EC.2)
32     INULL=2
33     C=====IF(SQRT(PITER**2+YAERR**2).GT.PMFOY)IACQ=NULL=1
34     5000 IF(IACQ.EC.1)INULL=1
35     C
36     IF(NULL.EC.1)LAMPR=LAMPR*0.
37     C
38     IF(NULL.EC.1)KT=KT20
39     IF(NULL.EC.2)KT=KT10
40     IF(ABS(RLAMY).GT.87266*RLAMY*SIGN(87266,RLAMY))
41     10     KG=KT*KT30
42     20     OMEGY=KG*YAERR
43     30     OMEGZ=KG*PITER
44     40     IF(ABS(OMEGZ).GT.0.0165625) OMEGZ=SIGN(0.0165625,OMEGZ)
45     50     IF(ABS(OMEGY).GT.0.0165625) OMEGY=SIGN(0.0165625,OMEGY)
46     60     LAMPR=OMEGZ/KT30
47     70     LAMPR=OMEGY/KT30
48     80     IF(ABS(LAMPR).GT.1745329)LAMPR=SIGN(1745329,LAMPR)
49     90     IF(ABS(LAMPR).GT.1745329)LAMPR=SIGN(1745329,LAMPR)
50     C
51     C      SEEKER GYRO FOR ED
52     C
53     5005 CONTINUE
54     IF(TIME.LT.ED1)GO TO 6670
55     IF(.NOT.FLG4)GO TO 6670
56     KAGE=2/FLG4*.NOT.FLG4/PRINT 90004
57     90005 FORMAT(1X,1UNCLAGE GYRO FOR ROLL TO VERTICAL)
58     6670 CONTINUE
59     IF(TIME.GT.ED.AND.IACQ.NE.2.AND.IFUPR.NE.2)KAGE=1
60     IF(IACQ.EC.2)KAGE=2
61     05A=BS11*P+BS22*C+BS23*R
62     05A=BS31*P+BS32*C+BS33*R
63     GO TO(5200,5201),KAGE

```

58	C	
59	C	CAGE
60	C	
61	5200	DTHTAS=10*THTAS/DPSIS=10*PSIS
62		GO TO 5203
63	5201	GO TO (5202,5204),IACC
64	C	
65	C	LNAGE
66	C	
67	C	FREE GYRO
68	C	
1*	5202	DTHTAS=THASD-GSA/CBS(PSIS)
2*		DPSIS=PSISD-RSA
3*		DTHASD=(H*PSISD-RB*THASD)/B
4*		DPSISD=(RR*PSISD+H*DTHASD)/A
71		GO TO 5203
72	C	
73	C	TRACK
74	C	
1*	5204	DTHTAS=THASD-GSA/CBS(PSIS)
2*		DPSIS=PSISD-RSA
3*		DTHASD=(H*PSISD-RB*THASD+BMEGY)/B
4*		DPSISD=(BMEGZ-RR*PSISD+H*THASD)/A
77	5203	RETURN
78		END

63	90002	FORMAT(/,2X,'LATERAL ENABLER')
64	4668	CONTINUE
65	63	TA (5080,5085),NULL
66	4080	PEG=(PEFL+THRS*57+THRS*54)*55
67	4669	YEG=VEF+PSRS*56+PSRS*54
68	30	TA 5100
69	4085	IF (.NOT.FLG3)GA TO 4669
70	PRINT	90004;PRINT*2JFLG3=.NOT.F133
71	90004	FORMAT(/,2X,'GUIDANCE ENABLER')
72	4669	CONTINUE
73	PEG=(PEFL+THRS*54)*55	
74	YEG=VEF+PSRS*54	
75	4100	IF (ARS(PEG).GT..20943948)PEG=SIG\(.20943948,PEG)
76	IF (ARS(YEG).GT..20943948)YEG=SIG\(.20943948,YEG)	
77	RETURN	
78	END	

```

1          SUBROUTINE FLTR(X,Y,Z,A,B,C,D)
2          Z=X-P*Y
3          A=(C*Y+Z)*D
4          RETURN
5          END

```

```

1          SUBROUTINE EDRTDAMP(X,Y,Z,A,B,C,D,E)
2          Z=P*(C*X-Y)
3          A=P*(C*X-Y)
4          E=D*(X+A)
5          RETURN
6          END

```

```

1          SUBROUTINE FTLG(X,Y,Z,A,B)
2          Z=P*(A*X-Y)
3          RETURN
4          END

```

```

1 SUBROUTINE CONTROL
2 C** THIS SUBROUTINE CONTAINS THE CONTROL SYSTEM CARDS FOR EACH PLANE ON
3 C COMMON SHAFT, SECOND ORDER ACTUATOR MODEL
4 DIMENSION ACT(24),ACTB(27),ACTR(4)
5 COMMON/JUNK2/9RNGE,IFUF0,IAC0,RDET,YAWER0,PITER0,PHF0V,BA,RNGLIN,
6 IPITYAWSG,R2D,NULSKR,BRS,RFLECT,NUKAGE
7 COMMON/OUTAP/YEG,REG,PEG
8 COMMON/INTEG7/J,ACT,DEL1,DELVP,DEL3,DDEL1,DDELVP,DDEL3,ACT0,
9 DDEL1,DDELVP,DDEL3,DDEL1,DDELVP,DDEL3,ACTR
10 COMMON/JUNK7/TIME,TIME3,RMS,S,D,SGUW,CAP,IRAP,RAPTM1,RAPTM2,FACT,
11 SLOPE1,BT1,RAPTM3,SLOPE2,BT2,CTT,CPT,SPT,XLTA,STT,GAPS,GAPSD,
12 2GAPSD,TH
13 DDEL1=60.*(60.*(YEG-REG=DEL1)=DDEL1)
14 DDELVP=50.*(50.*(PEG=DELVP)=DDELVP)
15 DDEL3=60.*(60.*(YEG-REG=DEL3)=DDEL3)
16 IF (ACT.EG.2) DDEL1=60.*(60.*(REG=YEG=DEL1)=DDEL1)
17 IF (ACT.EG.2) DDEL3=60.*(60.*(REG=YEG=DEL3)=DDEL3)
18 DDELVP=DDEL1
19 DDELVP=DDELVP
20 DDEL3=DDEL3
21 RETURN
22 END

```

ATTNBT (FILE,X1),(FORMAT,U),(RSIZE,202),(FSIZE,240)
ATTNBT (FILE,X2),(FORMAT,L),(RSIZE,202),(FSIZE,100)
ASSIGN (MISI,BT,X6)
FRTTAN SY,GP,KS,BC
BLAD (TEMP,500),(LIP,USER,SYSTEM)
:ROOT (FILE,BT,GB,E0D)
:(FILE,D1,SSYSLIB,E0D)
U SREF UL 7DPT
U SREF UL 7DPDT
LOADING WAS COMPLETED

WARNING: UNSATISFIED REFS
REWIND 9TARC
RAV

BEGIN EXECUTION!

HP	82500	RTBL	1	10000E+19	88	1	80700	KA	1	00000	885	1	20000
KP	10.000	BRS	1	00000	KG	1	50000E-01	BT1	1	211.22	BT2	1	20000
CPY	1.00000	STY	1	00000	CB	1	00000	PFCHS	1	1.0000	CTT	1	10000
RAPTIME	13.000	D	1	50830	KG	1	3.5000	DELMY	1	7.4907	ED0	1	3.0000
FD1	32500	ED2	1	8.0000	ED3	1	3.5000	FD5	1	7.2500	ED5	1	3.0000
XT10	10.000	FFALB	1	1.0000	YCL	1	.26180	FFANS	1	1.0000	GF	1	5.0000
FFCLB	10000	FFAZB	1	1.0000	FFCHS	1	1.0000	FFANS	1	1.0000	GMLO	1	1.9983
BLFHV	21817	QC	1	.26180	FFAXB	1	1.0000	IACT	1	0	IROLLOC	1	1
TCLM	0	0	1	1.0000	NULL	1	1.0000	IROLL	1	0	KT20	1	20.000
ISKR	0	0	1	1.0000	1	1	1.0000	IROLL	1	0	KT20	1	20.000
PC	149.25	1YZ	1	57230	R2	1	.16224E-04	FBON	1	.10000	IX	1	.20100
KB	100000	RVBIAS	1	00000	KC	1	00000	KA	1	.17453	PCA	1	.20000
FRAYS	10000	KPC	1	13000E+01	11P5	1	00000	KTOL	1	.87264E-02	KQL	1	1.0000
KS	60000	KM	1	2.0000	LAMB1	1	.1265	KROL	1	00000	AP	1	25.000
PG	83120	KRUN	1	1.0000	0	1	.26180	JMAX	1	128	MASS	1	4.4587
SA	1.0000	PRINTM	1	00000	JMAX	1	128	IA	1	.23528E-04	PHIMAX	1	1.7453
RDET	7000.0	DTA	1	.97655E+03	REFLECT	1	8.0000	PI	1	6.5000	RAPYMI	1	00000
RSIT	00000	RLAMP	1	00000	RPSI	1	00000	RNGLIN	1	9.1416	RLAMP	1	00000
RTTA	1000.0	KP	1	2.0000	87	1	1.0000	88	1	.24180E-01	VRATE	1	5.2360
R9	1.0000	S12	1	1.0000	811	1	1.0000	S4	1	1.0000	53	1	1.0000
S2	1.0000	S1	1	1.0000	8	1	.20292	DELMX	1	.26180	SFO	1	1.0000
RF1	100.00	SF2	1	100.00	SF3	1	20.000	SF4	1	20.000	SF5	1	15.000
SF6	15.000	SF7	1	15.000	SF8	1	1.0000	SF9	1	50.000	SF10	1	20.000
SF11	20.000	SF12	1	50.000	SF13	1	125.00	SF14	1	15.000	SF15	1	12.000
SLBPE2	11.838	SLBPE1	1	38725	T01	1	1.0000	T0	1	1.0000	T09	1	2.0000
T02	1.0000	T05	1	2.4000	T04	1	2.2000	T07	1	2.8000	T08	1	2.6000
T2	8.0000	T1	1	3.0000	T6	1	.60000	SPT	1	.00000	THOLD	1	.00000
TH7AC	.13080	KC	1	.20000	THETAT	1	.00000	IRAP	1	.00000	THOLD	1	.00000
TIC	.12500	TIC1	1	.12500	TIMES3	1	3.0000	TIMES2	1	.65000	TIMEL	1	.60000
TIMEO	.30000	TIP1	1	.00000	DT	1	.78124E-02	YHFBV	1	.21817	KB	1	.00000
TIME2	.00000	TIME3	1	.00000	W2	1	.00000	TIME4	1	.00000	TIME5	1	.00000

[illegible][illegible]

Gate	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
GATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

FLC	9487CE=01	ALB	W	100000	CMR	W	156.96	CMQ	W	100000
CAZ	5A374	CLP	W	26566	CN	W	100000 <td>CYQ</td> <td>W</td> <td>100000 </td>	CYQ	W	100000
ANB	100000	CLS	W	17791	CBS	W	100000 <td>CBS</td> <td>W</td> <td>100000 </td>	CBS	W	100000
CTH4SC	100000	PS18D	W	100000	DP518D	W	100000 <td>ALPHA</td> <td>W</td> <td>100000 </td>	ALPHA	W	100000
								BETA	W	100000

	CITY	A	-SPY	,00000-	-CPT	A	1,0000	TM	*00000!
SST	0	.00000							
XLT	0	1,667							

[illegible]

[illegible][illegible]

LOGIC:

GATE 1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
GATE 6	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
GATE 11	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
GATE 16	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
GATE 21	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
GATE 26	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75																									

[illegible]

NAME	W	CPT	SPT	D	CPT	D	TH
STT	1.00000				1.00000		
XLTA	1.6667						

[illegible]

PROJECTILE													
TYPE	1	2	3	4	5	6	7	8	9	10	11	12	13
W	.32080	TYA	.13646	PHD	.00000	DELZ	.213.48	TOTACC	.23957				
D7	.194.789	DY	.11470E+02	DPMT	.98830	DTHTA	.17827E+01	DX	.24847				
SP91	.18288E+03	DR	.110995	DQ	.94910E+01	DP	.96090E+01	CM	.981.95				
DL	.30.919	DV	.9.372	VRM	100.0	FACH	.90952	GAP	.1650.0				
PS1	.82042E+06	P	.96850	Q	.12943E+01	R	.12240E+01	DELVY	.00000				
ZH	.352132	DELXV	.00000	DELVV	.00000	DELZY	.00000	X	.93.13				
Y	.50416E+03	Z	.4213.5	AMB	.66551	XY	.13120.	YT	.00000				
DTHTA	.17827E+01	CPMT	.72330	SPMT	.68021	CP81	.1.0000	SP81	.82042E+06				
CP818	.1.0000	G28	.23.121	GVB	.21.454	GVB	.6.2778						
ALTSPL1871													
DCPHIO	.00000	DELX8	.178577	PEO	.00000	DELX18	.00000	TXEO	.00000				
DELZ8	.1688.5	DMEDA	.314.00	DVEP	.00000	DVEP	.00000	DTHTA8	.00000				
RTV	.12128.	KT	.201.00	PEPL	.00000	NULL	.00000	1	.69813E+01				
8WEU2	.00000	PSRQ	.00000	PEO	.00000	PEP	.00000	PIY280	.00000				
PHIG	.00000	PS18	.00000	PXEO	.00000	TH88	.00000	PS85	.00000				
DEL1	.00000	RLAPY	.00000	RLAMP	.00000	TH88	.00000	TH88	.00000				
YEP	.00000	PEP	.00000	YEO	.00000	YEO	.00000	YEP	.00000				
YHRQ	.00000	YEO	.00000	DELX8	.1785.	YANERR	.14501	YANERR	.00000				
LAMP8	.00000	LAMP8	.00000	QSA	.00000	QAP8	.213.07	DP818	.00000				
IACC	.00000	1	.00000	REN	.00000								
LEGIC1													
GATE	1	2	3	4	5	6	7	8	9	10	11	12	13
GATE	6	7	8	9	10	11	12	13	14	15	16	17	18
AERODYNAMICS1													
CLC	.93833E+01	ALB	.69015	CNR	.155.65	CM8	.155.66	CY	.35421E+02				
CL7	.51928	CLP	.25.381	CN	.3574E+02	CYCD	.56425E+02	CMCQ	.6150E+02				
AV8	.76110	CLS	.70945	CM8	.3574E+01	CM8	.3242E+01	THA88	.00000				
DTMA80	.00000	PS18C	.00000	DP818D	.00000	ALPHA	.32040E+03	BETA	.23439E+03				
RAPI													
RTT	.00000	CTT	.1.0000	8PT	.00000	CPY	.1.0000	TH	.00000				
XLTA	.1.6667												
DEBUG PRINT1													
CLX8	.11851.	DELX8	.1752.5	DELZ8	.1888.5	DELX8	.11851.	DELX5	.1752.5				
CLZ8	.1883.5	KLITA	.00000	1	.15808	YANERR	.14501	PIYERO	.00000				
YANERR	.00000	ORLAMY	.00000	F3	.00000	DP81	.00000	CRITYA	.00000				
DP818	.00000	APL13	.00000	DELVR	.00000	DPH10	.00000	G	.32.161				
Y8K	.1106.2	ISAR	.00000	0	.00000	0	.00000	0	.00000				
KAGE	.00000	1	.00000	F1	.00000	DELAMP	.00000	NUM	.00000				
PRINT	.00000	APDS	.00000	20	.00000	MDTA	.00000	256	.00000				
PFLL	.00000	PH10	.00000	R40	.20974E+03	S2	.00000	AULSKR	.00000				
REF	.00000	REF	.00000	REG	.00000	SP81	.00000	DELROL	.12185E+02				
AMECY	.00000	8PEOZ	.00000	NX	.00000	1	.00000	RYMTA	.00000				

PROJECTILE									
TYPE	W	570000	NSX	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA
W	39976E-01	167A.4	61339E-01	P4D	23288	709.55	709.55	709.55	709.55
DZ	28.242	8392.0	33309E-03	DPH1	110977	136423E-01	136423E-01	136423E-01	136423E-01
CP91	50776E-04	0	3848E-01	QD	11251E-02	DP	DP	DP	DP
CU	16.338	0	284739	VRW	909128	MACM	MACM	MACM	MACM
PR1	1257E-05	0	1.0372	Q	1.0372	Q	Q	Q	Q
YB8	59183E-01	0	100000	DELTA	100000	DELTA	DELTA	DELTA	DELTA
Y	13141E-01	0	4709.6	AMB	75138E-01	X7	X7	X7	X7
DTMTA	36423E-01	0	57301	CPH1	723075	CPH1	CPH1	CPH1	CPH1
CP918	1.0000	0	31.238	QXB	7.4065	QXB	QXB	QXB	QXB
AUTOPILOT									
CPH10	00000	0	8212.8	P20	00000	DELTA	DELTA	DELTA	DELTA
CELZ8	167A.4	0	00000	QVEP	00000	QVEP	QVEP	QVEP	QVEP
RTM	8392.0	0	204000	PEFL	12651	NULL	NULL	NULL	NULL
SMEG2	00000	0	00000	PEP	00000	PEP	PEP	PEP	PEP
PH10	51485E-01	0	13942E-01	PXED	8898E-03	TH88	TH88	TH88	TH88
CELL1	50223E-03	0	00000	RLAMP	00000	TH88	TH88	TH88	TH88
VEP	00000	0	00000	PEP	00000	PEP	PEP	PEP	PEP
VRQD	00000	0	00000	DELTA	397.43	YAHERR	YAHERR	YAHERR	YAHERR
LAMPY	00000	0	00000	SSA	50725E-01	QAPB	QAPB	QAPB	QAPB
1ACQ	0	0	34584E-02	REN	00000	0	0	0	0
LOGIC									
GATE	1	1	GATE	2	2	GATE	3	3	GATE
GATE	6	6	GATE	7	7	GATE	8	8	GATE
AERODYNAMICS									
CLD	30978E-01	0	139760	CNR	181.41	CMQ	CMQ	CMQ	CMQ
CAZ	37210	0	22.118	CN	5289E-03	CYCQ	CYCQ	CYCQ	CYCQ
AKB	25700E-01	0	23053	CMB	13214	CMQ	CMQ	CMQ	CMQ
DTM4SD	00000	0	00000	DP81SD	00000	ALPHA	ALPHA	ALPHA	ALPHA
RAP1	00000	0	100000	887	00000	CPY	CPY	CPY	CPY
STT	00000	0	1.6667	0	00000	TH	TH	TH	TH
XLTA	0	0	0	0	00000	0	0	0	0
DEBLG PRINT									
DELX8	8902.0	0	282.89	DELZ8	1192.7	DELX8	DELX8	DELX8	DELX8
CLZS	1678.4	0	00000	1	20198	YAHERR	YAHERR	YAHERR	YAHERR
YAHERR	00000	0	00000	F3	00000	DR91	DR91	DR91	DR91
CRP10	21192E-01	0	24233E-02	DELVR	50223E-03	DPH10	DPH10	DPH10	DPH10
YK8	1698.2	0	0	1467	0	1467	1467	1467	1467
KAGE	0	0	0	0	0	0	0	0	0
1PPRINT	0	0	0	0	0	0	0	0	0
PPFL	12651	0	5148E-01	R40	20661E-02	S2	S2	S2	S2
WFO	00000	0	00000	R20	9999E-03	RP81	RP81	RP81	RP81
AMPFG	00000	0	00000	NK	33	33	33	33	33

PROJECTILE!									
TYPE	1	2	3	4	5	6	7	8	9
W	56016	RSX	9881E-04	DELVR	0	00000	DELZ	85193	TOTACC
DZ	59683E-01	DTA	4566E-08	PHO	0	19077E-03	DELZ	75728	DX
CS51	85812E-03	DTA	8812E-03	DPFT	0	10578E-03	DTA	35802E-01	DX
CU	87822E-04	DR	2288E-03	DQ	0	3068E-02	DP	61901E-02	DX
P	12826	CV	5058E-01	YRA	0	85555	MACM	80683	QAP
P81	20502E-05	P	40571E-03	Q	0	35802E-01	R	80992E-04	DELVR
XZB	113318	DELVR	00000	DELVR	0	00000	DELVR	10000	X
Y	12136E-01	Z	47571	AMB	0	10980	XT	13120	Y
DTA	35802E-01	SPH	10000	SPH	0	19077E-03	CP81	10000	SPH
CS18	10000	Q18	32159	Q18	0	6134E-02	Q18	11493	Q18

AUTAPILGT!									
TYPE	1	2	3	4	5	6	7	8	9
DELVS	00000	DELVS	6783E-1	PEO	0	00000	DELVS	00000	DELVS
DELVS	1566.9	DELVS	00000	PEO	0	00000	DELVS	00000	DELVS
RTM	687.8	RTM	20.000	PEO	0	12631	PEO	00000	DELVS
MEGZ	00000	MEGZ	00000	PEO	0	00000	PEO	00000	DELVS
PHIG	13853E-04	PHIG	55952E-05	PEO	0	5778E-08	PEO	2301	DELVS
DELVS	22023E-05	DELVS	00000	PEO	0	00000	PEO	1170	DELVS
YRQ	00000	YRQ	00000	PEO	0	00000	PEO	00000	DELVS
LAMP	00000	LAMP	00000	PEO	0	19081	PEO	2738E-04	DELVS
LACC	00000	LACC	5961E-05	PEO	0	35802E-01	PEO	16432	DELVS

LOGIC!									
TYPE	1	2	3	4	5	6	7	8	9
CLC	9240E-01	CLC	2080E-03	CNR	0	150.34	CNR	150.34	CLC
CAZ	34636	CAZ	21.274	CN	0	81051E-03	CYCG	2786E-04	CLC
ANB	23277E-02	ANB	1037E-02	CNR	0	12894	CNR	1836E-03	CLC
CTWASD	00000	CTWASD	00000	DP81SD	0	00000	ALPHA	6736E-04	BEYA

RAPI									
TYPE	1	2	3	4	5	6	7	8	9
STT	00000	STT	10000	SPY	0	00000	CPY	10000	TM
XLTA	16667	XLTA	10000	SPY	0	00000	CPY	10000	TM

DESLG PRINT!									
TYPE	1	2	3	4	5	6	7	8	9
DELVS	6922.9	DELVS	19288	DELVS	0	789.43	DELVS	6782.3	DELVS
DELVS	1566.9	DELVS	00000	DELVS	0	23124	DELVS	2738E-04	DELVS
VALERR	00000	VALERR	00000	DELVS	0	00000	DELVS	00000	DELVS
DPH10	26813E-03	DPH10	22583E-04	DELVS	0	24023E-05	DELVS	4057E-03	DELVS
VALERR	1094.0	VALERR	00000	DELVS	0	00000	DELVS	00000	DELVS
KAGF	00000	KAGF	00000	DELVS	0	00000	DELVS	00000	DELVS
TPRTY	00000	TPRTY	00000	DELVS	0	00000	DELVS	00000	DELVS
PFEL	12451	PFEL	13853E-04	DELVS	0	20633E-02	DELVS	10000	DELVS
REC	00000	REC	00000	DELVS	0	00000	DELVS	00000	DELVS
AMEGY	00000	AMEGY	00000	DELVS	0	00000	DELVS	00000	DELVS

PROJECTILE									
TYPE	90000	851793	851793	851793	851793	851793	851793	851793	851793
W	80.935	851793	851793	851793	851793	851793	851793	851793	851793
PZ	88.886	851793	851793	851793	851793	851793	851793	851793	851793
CP81	27536E-02	851793	851793	851793	851793	851793	851793	851793	851793
PL	33.631	851793	851793	851793	851793	851793	851793	851793	851793
PC1	29276E-03	851793	851793	851793	851793	851793	851793	851793	851793
AZH	72.318	851793	851793	851793	851793	851793	851793	851793	851793
V	10529	851793	851793	851793	851793	851793	851793	851793	851793
CTMTA	27192	851793	851793	851793	851793	851793	851793	851793	851793
CP818	1.0000	851793	851793	851793	851793	851793	851793	851793	851793
ALTOPILOT									
DCPMT0	90000	851793	851793	851793	851793	851793	851793	851793	851793
DELZ8	2.7168	851793	851793	851793	851793	851793	851793	851793	851793
RTM	487.7	851793	851793	851793	851793	851793	851793	851793	851793
AMEG2	51231E-03	851793	851793	851793	851793	851793	851793	851793	851793
PHID	75186E-03	851793	851793	851793	851793	851793	851793	851793	851793
DEL1	34922E-03	851793	851793	851793	851793	851793	851793	851793	851793
VEF	24790E-03	851793	851793	851793	851793	851793	851793	851793	851793
YRRD	00000	851793	851793	851793	851793	851793	851793	851793	851793
LAMPY	25553E-03	851793	851793	851793	851793	851793	851793	851793	851793
TACG	2	851793	851793	851793	851793	851793	851793	851793	851793
IADIC1									
DATE	1	DATE	2	DATE	3	DATE	4	DATE	5
GATE	6	GATE	7	GATE	8	GATE	9	GATE	10
AERADYAPICSI									
CLC	89887E-01	851793	851793	851793	851793	851793	851793	851793	851793
CAZ	34810	851793	851793	851793	851793	851793	851793	851793	851793
AKB	73A77E-01	851793	851793	851793	851793	851793	851793	851793	851793
DTHASD	14.4C5	851793	851793	851793	851793	851793	851793	851793	851793
RAP1	00000	851793	851793	851793	851793	851793	851793	851793	851793
STY	1.6667	851793	851793	851793	851793	851793	851793	851793	851793
XLTA	1.6667	851793	851793	851793	851793	851793	851793	851793	851793
CRUD PRINT1									
DELZ8	484.7	851793	851793	851793	851793	851793	851793	851793	851793
DELZ8	2.7168	851793	851793	851793	851793	851793	851793	851793	851793
YARRA	25553E-04	851793	851793	851793	851793	851793	851793	851793	851793
CPHID	51232E-04	851793	851793	851793	851793	851793	851793	851793	851793
YARRA	109814	851793	851793	851793	851793	851793	851793	851793	851793
YARRA	2	851793	851793	851793	851793	851793	851793	851793	851793
YARRA	1	851793	851793	851793	851793	851793	851793	851793	851793
YARRA	9A092E-01	851793	851793	851793	851793	851793	851793	851793	851793
YARRA	00000	851793	851793	851793	851793	851793	851793	851793	851793
YARRA	23643E-04	851793	851793	851793	851793	851793	851793	851793	851793

269

[illegible][illegible]

DATE	TIME	LOCATION	REMARKS
GATE 6	7 00		
GATE 2	7 00		
GATE 3	7 00		
GATE 4	7 00		
GATE 5	7 00		

[illegible]

STY	LTZ	SPY	1.0000	TH
XL7A	1.6667	1.0000	1.0000	1.0000

[illegible]

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