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Prepared under

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Final Report
for
A PROGRAM TO EVALUATE A CONTROL SYSTEM BASED ON FEEDBACK OF AERODYNAMIC PRESSURE DIFFERENTIALS

KU-FRL-490-2

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December 1981

ABSTRACT

This report documents work performed to evaluate the use of aerodynamic pressure differentials to position a control surface. The system is a differential pressure command loop, analogous to a position command loop, where the surface is commanded to move until a desired differential pressure across the surface is achieved. This type of control may simplify control laws. It is also a more direct and accurate method of control, as it is the differential pressure which causes the control forces and moments.

A frequency response test was performed in the Kansas University low speed windtunnel to measure the performance of the system. Both pressure and position feedback were tested. It was found that the pressure feedback performed as well as position feedback--implying that the actuator, with a break frequency on the order of 10 Rad/sec, was the limiting component. Theoretical considerations indicate that aerodynamic lags will not appear below frequencies of 50 Rad/sec, or higher. Thus pressure feedback should work well, even with higher frequencies than tested in this report.

Since this application is feasible, it is left to evaluate other possibilities. These would include:

1) Angle of attack/sideslip control
2) Gust-load alleviation
3) Stall prevention.

It is recommended that any or all of these possible applications be the subject of further research.

ACKNOWLEDGEMENTS

We would like to thank Ken Szalai and James Black, of the NASA Dryden Flight Research Center for their financial and technical support of this program. Special thanks go to Ron Hrabak, for his technical and management expertise during the first two phases of the project. Thanks are also extended to Nancy Hanson, for her typing of the report; and to Sheryl R. Scott and Carlos Blacklock, for their endless hours spent reducing the strip-chart data.

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LIST OF SYMBOLS

Symbol	Definition	Units
A	Amplitude	
k	Strouhal number	
M	Magnitude ratio	dB
P_s	Static pressure	lbs/ft^2
P_T	Stagnation pressure	lbs/ft^2
$\bar{q}$	Dynamic pressure	lbs/ft^2
α	Angle of attack	deg, rad
ΔC_p	Differential pressure coefficient ($= C_{p_{LOWER}} - C_{p_{UPPER}}$)	-
ΔP	Differential pressure ($= \bar{q}\Delta C_p$)	lbs/ft^2
δ_E	Elevator deflection angle	deg, rad
δ_F	Flap deflection angle	deg, rad
ε	Error signal	Volts
θ	Pitch attitude angle	deg, rad
ϕ	Phase angle	deg, rad
ω	Frequency	Hz, rad/sec

LIST OF SUBSCRIPTS

Subscript	Definition
c	Commanded
i	Input
o	Output

LIST OF FIGURES

LIST OF FIGURES (continued)

1. INTRODUCTION

This study was performed under NAG 4-5 (CRINC/FRL 4900), sponsored by the NASA Dryden Flight Research Center. This program was accomplished during the period 25 August 1980 to 15 January 1982.

1.1 PURPOSE

The purpose of this study is to provide initial information leading to the determination of using differential pressure to control position of a flight control surface. It is also desired to suggest possible applications of differential pressure feedback and to recommend avenues of research to evaluate these applications.

1.2 BACKGROUND

In nearly all airplanes equipped with automatic flight controls (AFC), the control surfaces are positioned via feedback of control surface deflection, actuator current drain, or hydraulic valve pressure. Since in most instances control power is linearly related to these quantities, these types of feedback work well.

However, in many instances, it is found necessary to schedule the feedback gain as a function of flight attitude, dynamic pressure, Mach number, or a combination thereof.

Since the purpose of a control deflection is to create a pressure differential across a surface (and, therefore, forces and moments), it is logical to consider a system whereby the control surface is positioned via direct feedback of the pressure differential across that surface. This differential would then have to be sensed by a suitable pressure sensor.

This method of control surface signalling may simplify control laws. Since pressure differential is a result of airplane velocity and angle of attack, pressure feedback may allow for direct control of these important variables as well.

1.3 METHODOLOGY

This study was performed in the following three phases:

I) Pressure profile study

II) Determination of sensor characteristics

III) Frequency response testing.

The pressure profile study is used to determine the pressure characteristics of the test surface. This in turn determines the best sensor position and the required sensor range. The determination of sensor characteristics ensures that the sensor will perform adequately. The frequency response testing is the critical phase, for it determines the feasibility of the system.

The first two phases are described in detail in Reference 1. However, a summary of the procedures and results are contained herein.

2. SYSTEM DESCRIPTION

2.1 OVERALL SYSTEM THEORY

The control system discussed in this report can best be described as a differential pressure (ΔP) command system. Analogous to a position command, which commands a flap defelction in degrees, ΔP command drives the flap to a position such that the desired differential pressure is achieved at a certain point on the surface. The deflection depends on dynamic pressure, angle of attack, Mach number, sensor position, and configuration.

One application of the ΔP command system is in the pitch attitude hold block diagram shown in Figure 2.1. The ΔP command loop, enclosed in the dotted lines, merely replaces the conventional position command loop presently used in most systems. It is this inner loop that is evaluated in this report. The hardware used to implement the ΔP command loop is shown schematically in Figure 2.2 and discussed in Section 2.2.

2.2 COMPONENT BREAKDOWN

Detail drawings of the components used in the testing are available through the Kansas University Flight Research Laboratory (KU-FRL) and are listed in Table 2.1.

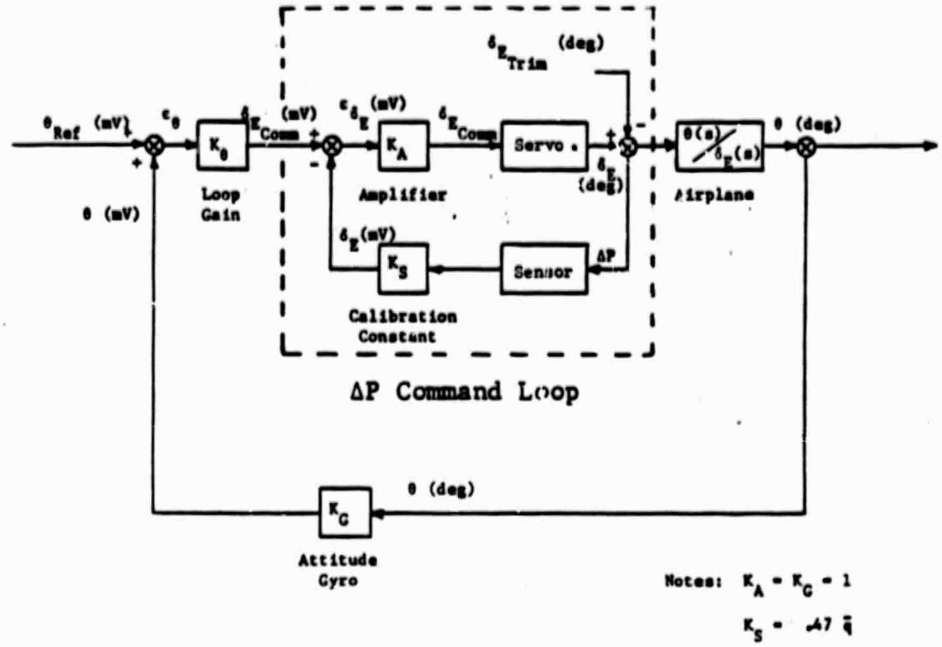

Figure 2.1 Pitch Attitude Hold Block Diagram with ΔP Command.

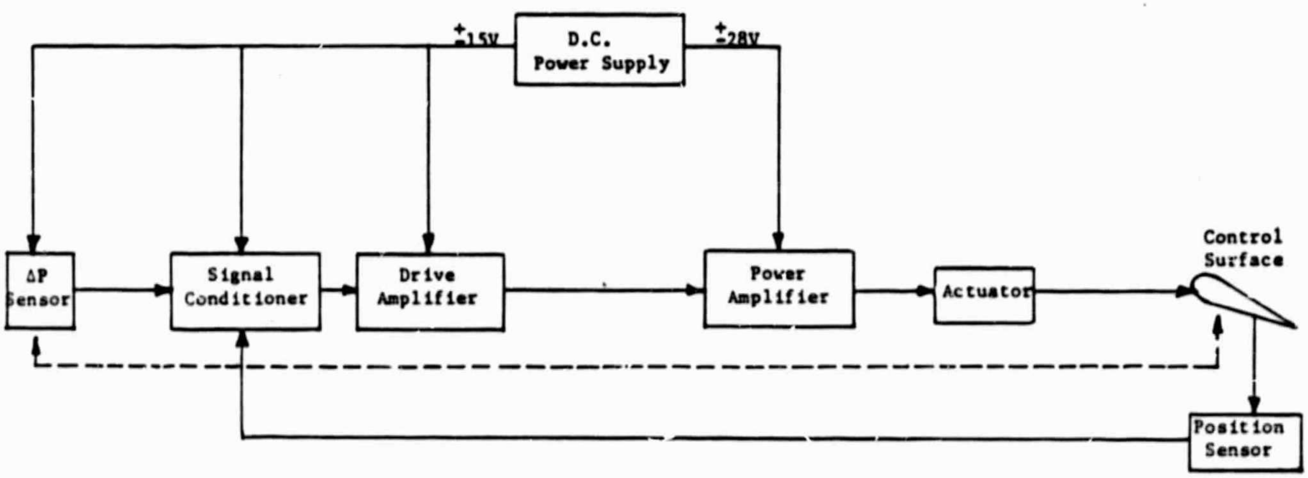

Figure 2.2 System Flow Diagram

Table 2.1 Guide to Delta P Drawings

Drawing No.(s)	Components
DP-0101	Assembly View
DP-0102	Potentiometer Clevis, Actuator Clevis, Windtunnel Mount, Mounting Rib
DP-0103	Aft and Fore Actuator Mounts
DP-0104	Endplate and Mount
DP-0105	Thermistor Pressure Sensor
DP-0201	Terminal Strip Identification
DP-0202	Connector Identification
DP-0203	Power Amplifier Details
DP-0204	Signal Conditioner and Sensor Circuit Schematics and Wiring Diagrams
DP-0205	Rectifier Circuit Schematic and Wiring Diagrams
DP-0301	Drive Component Set-Up

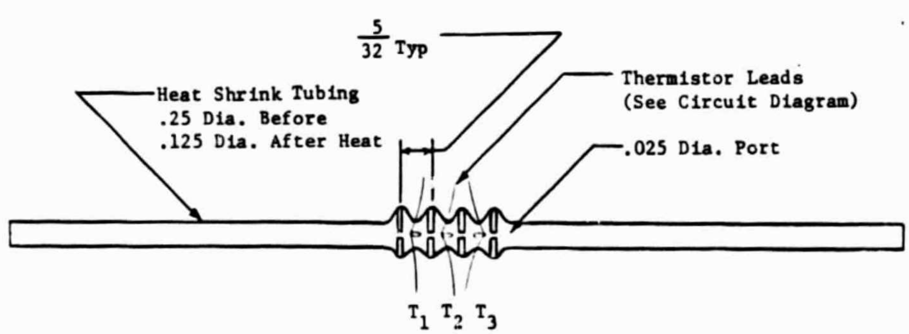

Figure 2.3 Differential Pressure Sensor

2.2.1 SENSORS

The first sensor evaluated in this study was designed by Jim Black, NASA DFRC Engineer. Illustrated in Figure 2.3, the sensor uses three thermistors inside of a length of heat shrink tubing. The middle thermistor is heated to a constant temperature. As air flows past the front thermistor (flow due to differential pressure), it is cooled. After the flow passes the middle thermistor, it is heated and increases the temperature of the rear thermistor. This temperature difference causes a voltage difference in the sensor circuit, shown in Figure 2.4. The temperature difference, and therefore the voltage difference, are proportional to the pressure differential.

The sensor was originally designed for a wing-leveller autopilot, and thus only needed to sense small differential pressures. It was discovered that the range required for this system was too large for the thermistor sensor, so another pressure transducer had to be chosen. There are two major types available: 1) Diaphragm and 2) Piezoresistive. The Microswitch 142PC01D (of the second type), shown in Figure 2.5, was chosen because of low cost and availability.

For more information concerning the thermistor and piezoresistive sensors, see Sections 3.2 and 4.2, respectively.

2.2.2 SIGNAL CONDITIONER

The signal conditioner (designed by D. G. Daugherty, KU electrical engineering professor) performs the following tasks:

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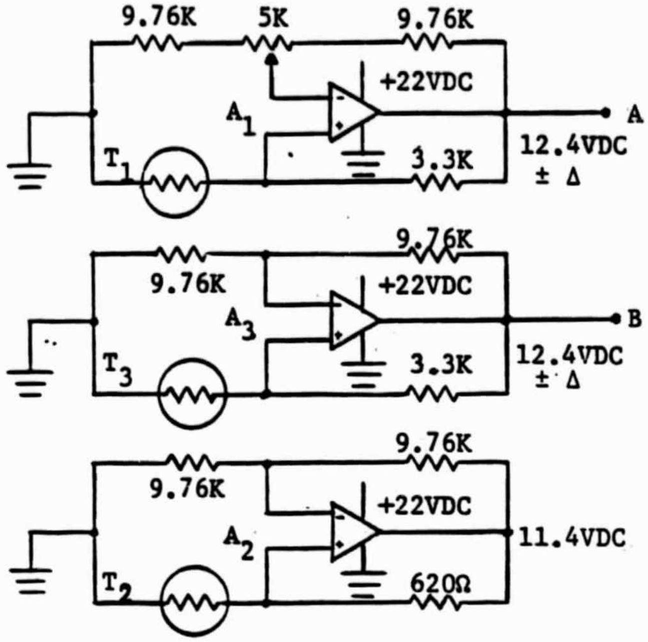

Figure 2.4 Sensor Circuit Schematic

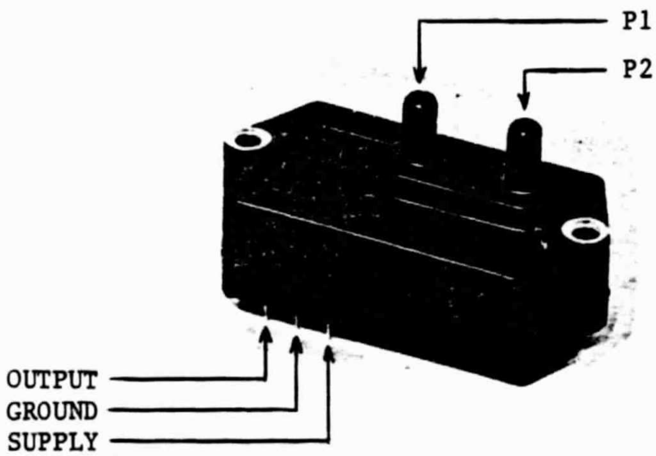

Figure 2.5 Microswitch 142PC01D Piezoresistive Differential Pressure Sensor

1) Reads the differential pressure signal from the pressure sensor

2) Allows for pressure or position feedback

3) Allows for pressure and position command inputs

4) Allows for lead-lag compensation, if necessary.

The circuit diagram is shown in Figure 2.6.

In the pressure feedback mode, the signal conditioner also monitors flap position to prevent a hardover condition. Sinusoidal pressure and position command inputs were used in Phase III to evaluate the frequency response characteristics.

2.2.3 DRIVE AMPLIFIER (REFERENCE 1)

The drive amplifier used in this study is from the NASA M99 Separate Surface Stability Augmentation (SSSA) Project*. The schematic of the drive amplifier may be found in Figure 2.7.

The drive amplifier uses standard op-amp methods for developing opposite phase drive signals required by the power amplifier. Discrete transistors connected as complementary emitter-followers provide the necessary drive current for the power amplifier inputs. Small (56 Ω) resistors are included in the collector circuits of these emitter-followers as protection against mishaps during circuit testing. In normal circuit operation their function is inconsequential (Reference 2).

The drive amplifier receives the V_{IN} signal from the signal conditioner, while also monitoring the position of the surface

*For more information, see: Johnson, L. R.; A Summary of SSSA Attitude Command Electronic System Design and Development, KU-FRL-359; Kansas University Center for Research, Inc.; Flight Research Laboratory; Lawrence, Kansas 66045; April 1976.

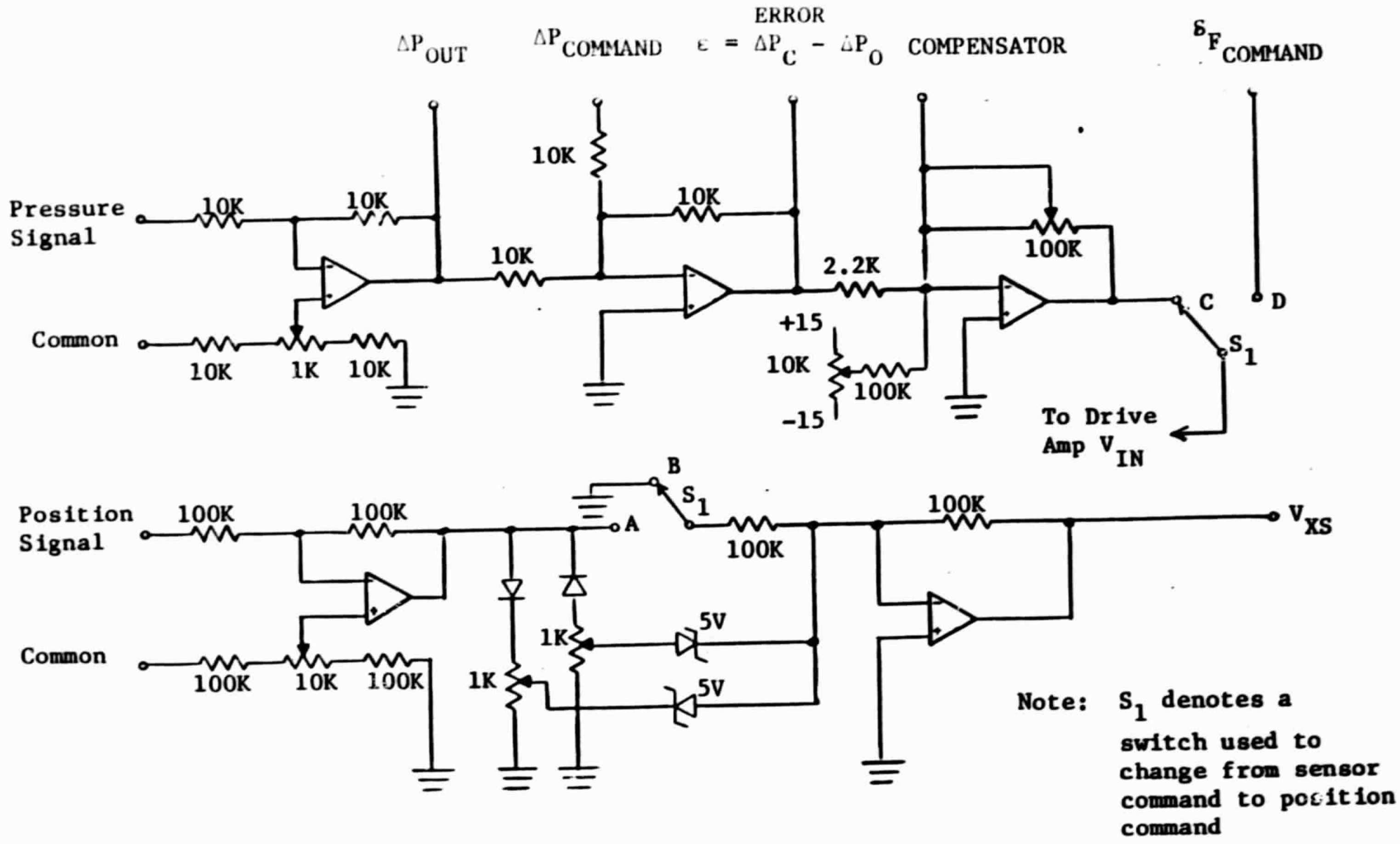

Figure 2.6 Signal Conditioner Schematic

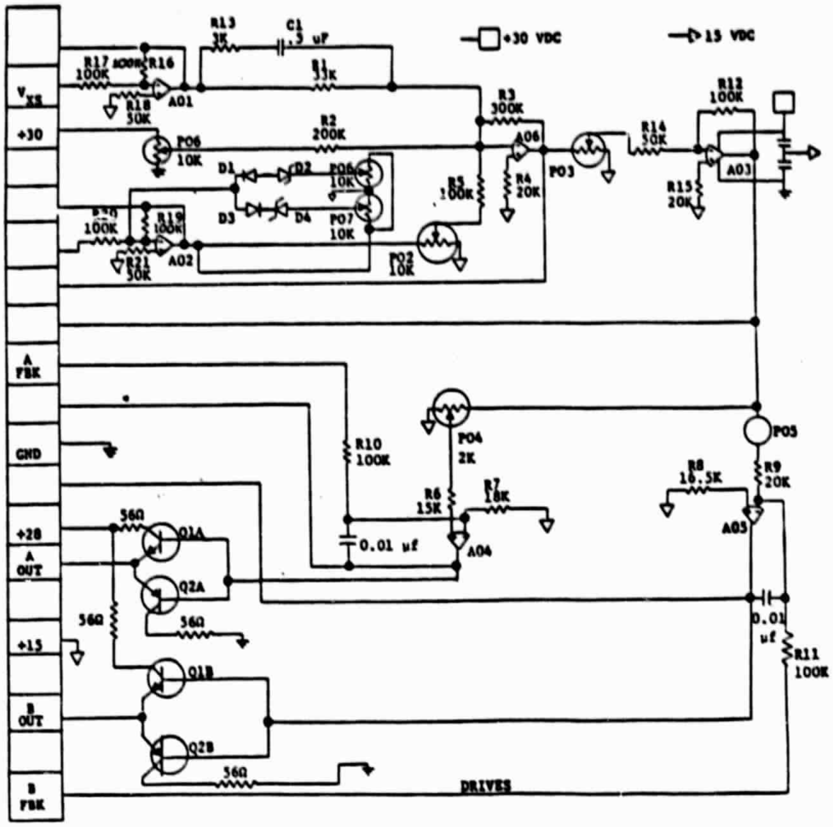

Figure 2.7 Drive Amplifier Schematic (Reference 2)

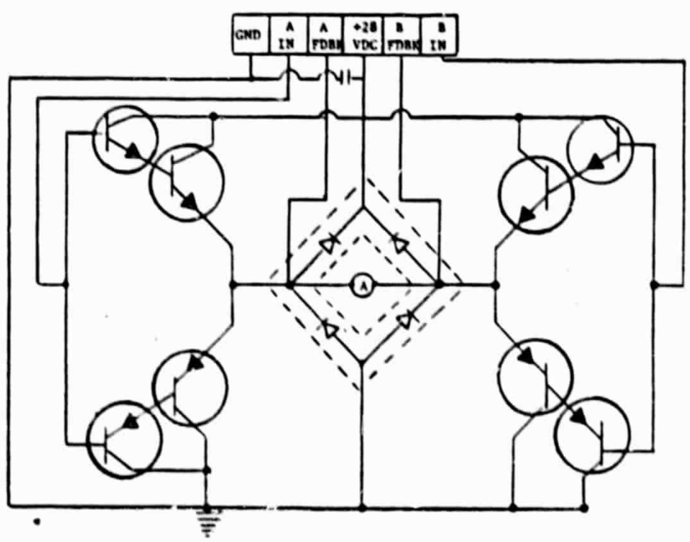

Figure 2.8 Power Amplifier Schematic

through the V_{XS} terminal. The output then goes to the power amplifier.

2.2.4 POWER AMPLIFIER (REFERENCE 1)

The power amplifier used in this study is also from the SSSA project. The schematic of the power amplifier is given in Figure 2.8.

The power amplifier is a Class-B push-pull bridge configuration. This configuration was used in order to attain actuator voltages approaching ±28 volts (56 volts, peak-to-peak). Diodes are included for protecting the power transistors against inductive spikes from the actuator (Reference 2).

The power amplifier receives four (4) signals from the drive amplifier:

1) A FDBK
2) A IN
3) B FDBK
4) B IN

The A and BFDBK signals are transmitted directly to the actuator. It is these signals which drive the actuator. The A and B IN signals originate at the drive amplifier. The A and B IN signals are connected to the drive amplifiers A and B OUT terminals respectively.

2.2.5 ACTUATOR

The actuator used in this study is the McDonnell Douglas "Solactor," also used in the SSSA project. It is of the electromechanical jackscrew type and is shown in Figure 2.9. The output properties are shown in Figure 2.10.

2.2.6 POSITION POTENTIOMETER

The position potentiometer (LVDT) is a Computer Instruments Corporation Type III, with 2000 Ω ±10% resistance and 3" range (linearity 1%).

2.2.7 TEST SURFACE AND MOUNTING HARDWARE

The test surface used in this study is a section of the elevator-trim tab assembly of a Beech Model 60 (Duke). The surface was donated by the Kansas University Department of Aerospace Engineering. Figures 2.11 and 2.12 are component and assembly photographs. The surface modifications include:

1) Actuator and LVDT mounting rib
2) Endplate
3) Static pressure taps
4) Wind tunnel mount.

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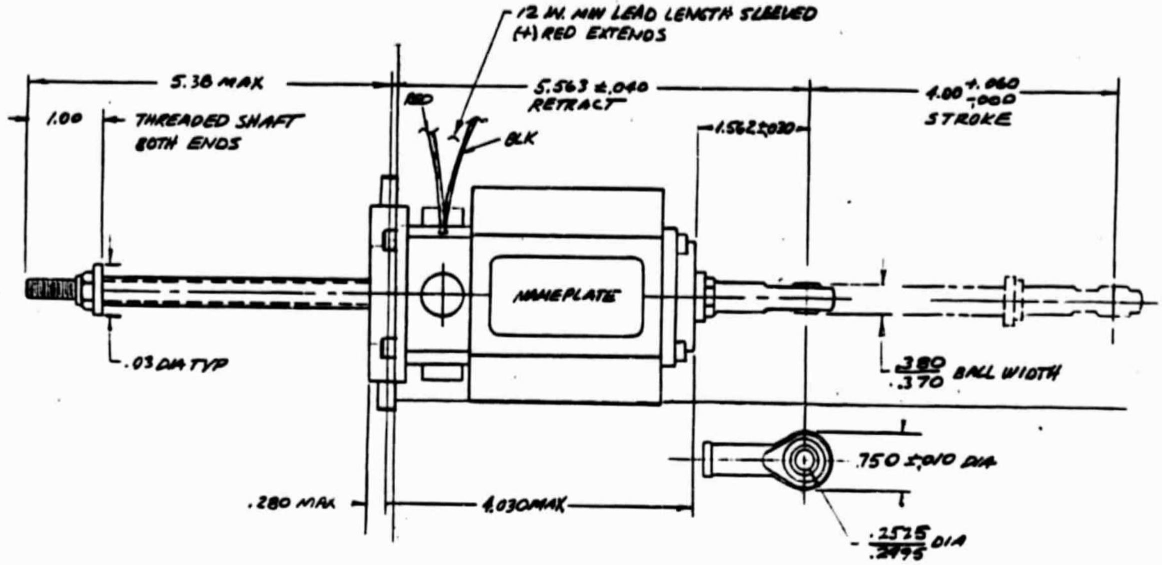

Figure 2.9 Solactor Actuator.

(Ref: SSSA drawing no. 6023A)

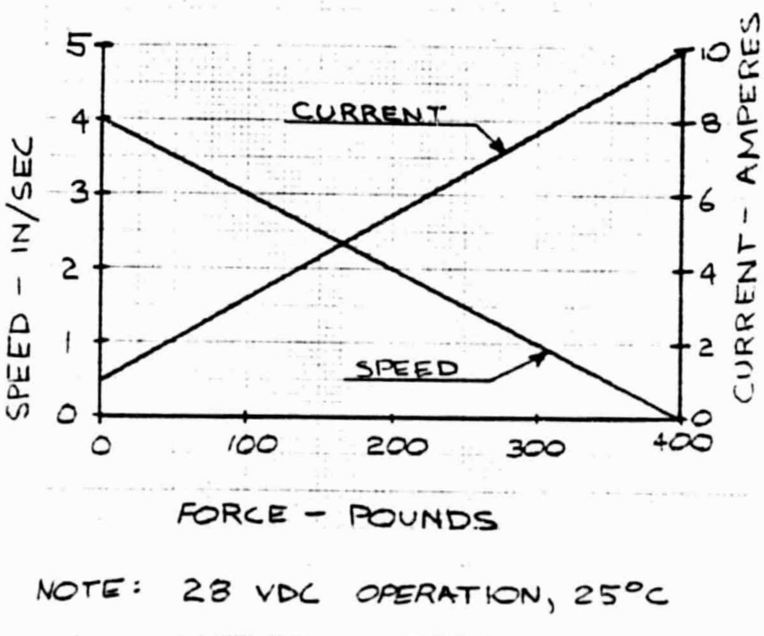

Figure 2.10 Solactor Actuator Properties

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Figure 2.11 Test Surface and Mounting Hardware

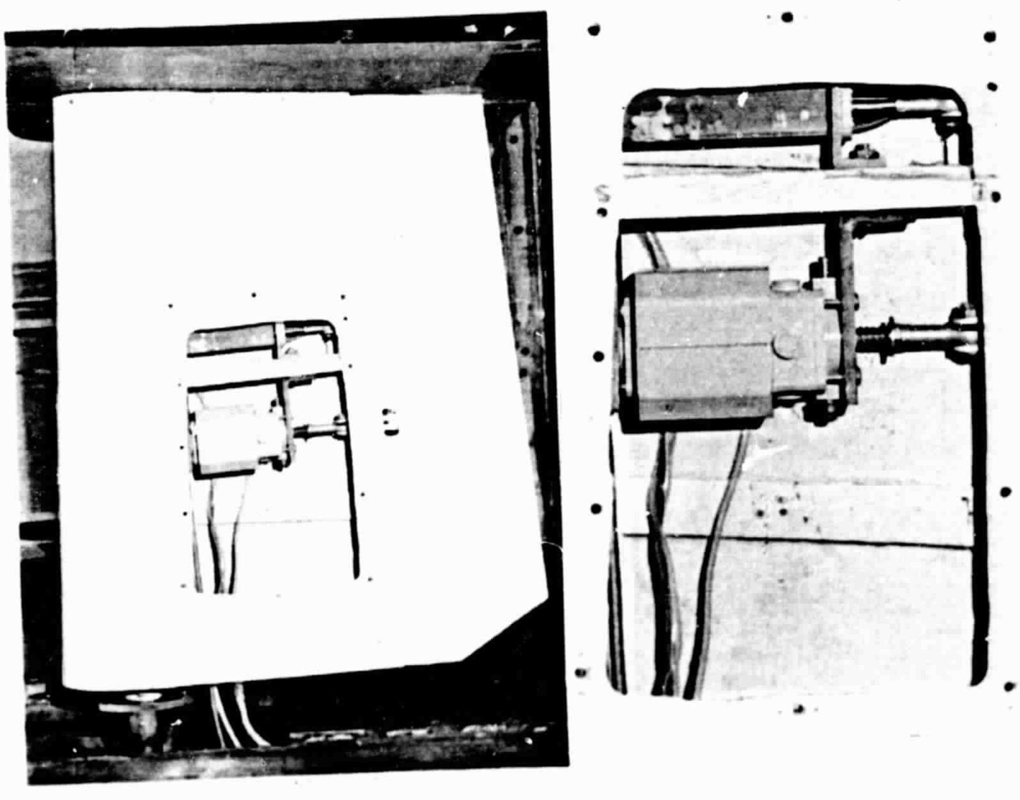

Figure 2.12 Test Surface Assembly

3. SUMMARY OF RESULTS FROM INTERIM REPORT

This chapter is a condensed presentation of the procedures and results contained in Reference 1. All data have been excluded, but the outcomes important to the frequency response testing are discussed herein.

3.1 PHASE I: PRESSURE PROFILE STUDY

3.1.1 PURPOSE

As mentioned earlier, the test surface is an elevator-trim tab assembly from a Beech M60. Thus the airfoil is not a standard NACA cross-section (see Figure 3.1). It was desired to obtain baseline data on the pressure distribution around the airfoil for all combinations of angle of attack and flap deflection. These data then can be used to determine best sensor location and the required range.

3.1.2 FACILITIES, HARDWARE, AND PROCEDURES

All testing was performed in the University of Kansas Aerospace Engineering Department's 3' x 4' low speed windtunnel. Facilities include a slant manometer board, shown in Figure 3.2.

Static pressure taps were installed at 13 chordwise locations (on both sides of the surface) and connected to the manometer board. The surface and endplate were then installed in the windtunnel. The actuator and LVDT were installed in the test surface but were

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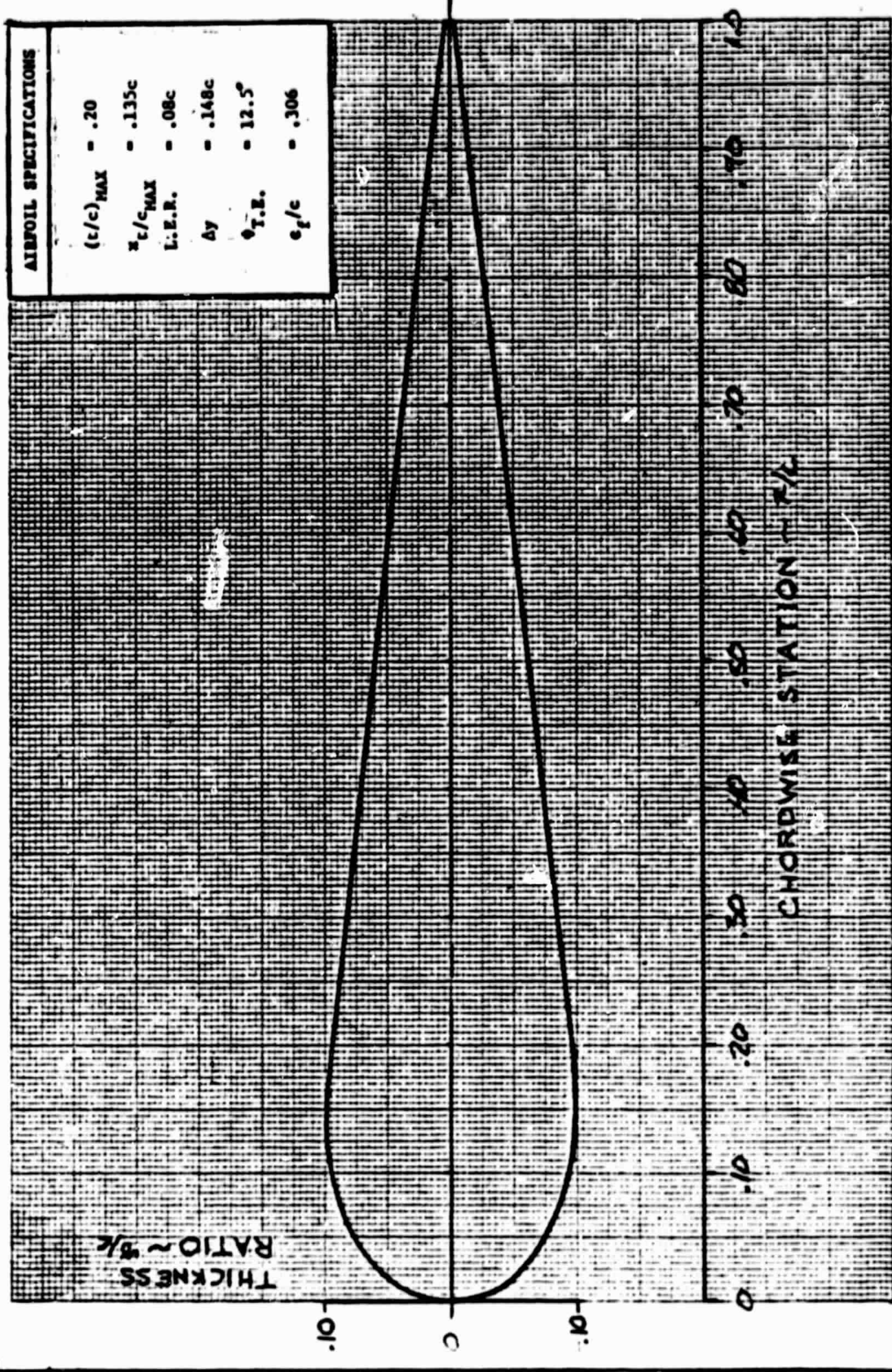

CALC	*(signature)*	6/1/81	REVISED	DATE	Figure 3.1 ΔP Test Airfoil Cross Section
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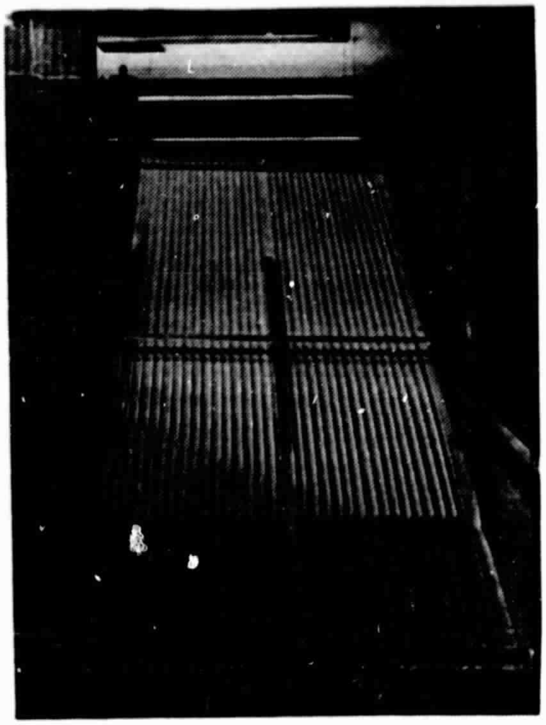

Figure 3.2 Manometer Board.

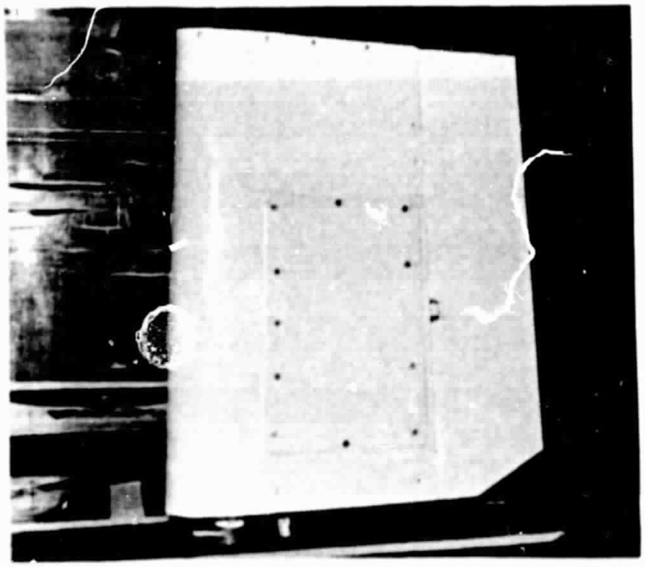

Figure 3.3 Test Surface in Windtunnel.

not powered up. The pressure transducers were not installed. The surface is shown before a typical run in Figure 3.3.

A total of nine runs were performed in the pressure survey. Each run consisted of an angle of attack sweep, from -8° to +8° by increments of 2°, with a constant flap deflection. Flap deflections from -20° to +20° by increments of 5° were tested. At each angle of attack and flap deflection combination, the static pressure at all 26 locations on the airfoil, reference static pressure, and tunnel dynamic pressure were recorded. After applicable corrections were made, the data were put into standard pressure coefficient form:

$$C_p = \frac{P_s - P_\infty}{\bar{q}}$$

Since differential pressure is the quantity to be investigated, the difference between upper and lower surfaces is calculated:

$$\Delta C_p = C_{p_{LOWER}} - C_{p_{UPPER}}$$

3.1.3 RESULTS AND DISCUSSION

To facilitate interpretation, the data are plotted in the form of Figure 3.4, for each of the 13 tap positions. In the figure, the vertical spread of the constant alpha lines indicates the sensitivity of differential pressure to changes in angle of attack. The slope of the constant alpha lines indicates flap deflection sensitivity. The plots for each tap are contained in Appendix A of Reference 1.

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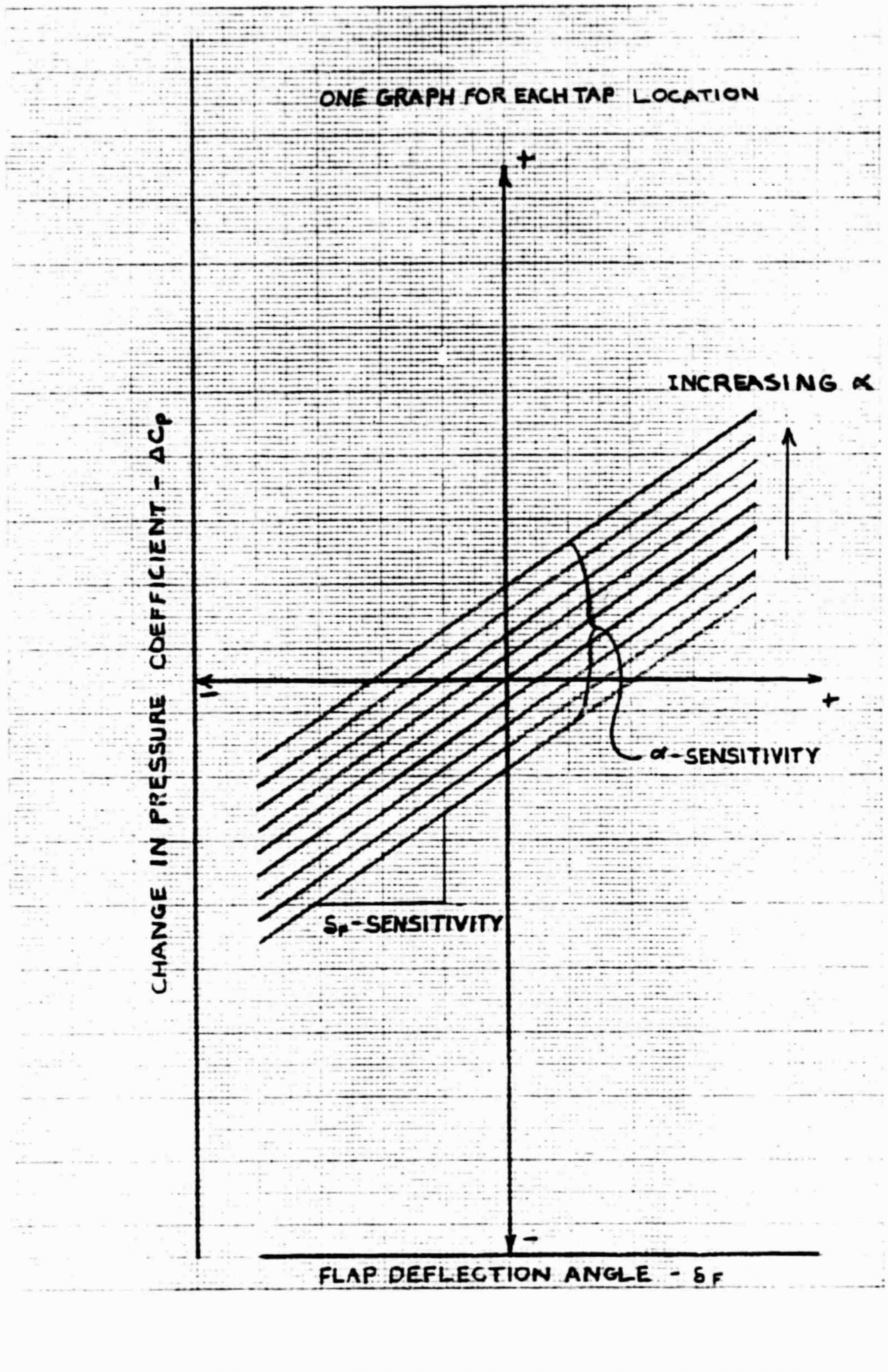

CALC	C. BLACKLOCK	12-11-81	REVISED	DATE	Figure 3.4 Presentation of Pressure Profile Data.
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The results of the pressure survey show the following:

1) Tap located at hingeline:

   a) Sensitivity to flap deflection

   b) Insensitivity to angle of attack

   c) Good linearity

2) Tap located at maximum thickness:

   a) Small sensitivity to flap deflection

   b) Sensitivity to angle of attack

   c) Good linearity.

The pressure coefficient limits were found to be:

$$-1.2 < \Delta C_p < 1.2$$

If the test is performed at a dynamic pressure of $\bar{q} = 25$ psf, the pressure range required of the sensor is:

$$-30 < \Delta P < 30 \text{ psf.}$$

3.2 SENSOR CALIBRATION

3.2.1 PURPOSE

The sensor calibration process is performed to determine the voltage output to pressure input relationship for the thermistor sensor. The sensor must satisfy the pressure range requirement dictated in Section 3.1.3.

3.2.2 FACILITIES, HARDWARE, AND PROCEDURES

The calibration tests were performed in the KU windtunnel. To record the data, the Hewlett Packard (HP) 2012 Data Acquisition

(DAS), HP9825A desktop calculator, and HP9872 X-Y plotter were used. These are photographed in Figures 3.5 and 3.6, and a system schematic is shown in Figure 3.7.

Hardware used in this test include:

1) Thermistor pressure sensor

2) Sensor calibration mount

3) Signal conditioner.

Figure 3.8 shows the sensor calibration mount installed in the windtunnel. The mount provides a pitot-static pressure differential across the sensor. This allows calibration against the windtunnel manometer.

The procedure consists of the following steps:

1) Zero sensor output.

2) Set tunnel speed to desired dynamic pressure.

3) Read sensor output.

4) Repeat 2) and 3) throughout desired range.

Step 3) is accomplished by the DAS, which averages the values of 10 output samples for each dynamic pressure.

3.2.3 RESULTS AND DISCUSSION

The output of the calibration is shown in Figure 3.9. It is seen that the linear range of the sensor is ±2 psf, and that the maximum output was at ±13 psf. This does not satisfy the requirements set forth in Subsection 3.1.3, which state the required range to be ±30 psf.

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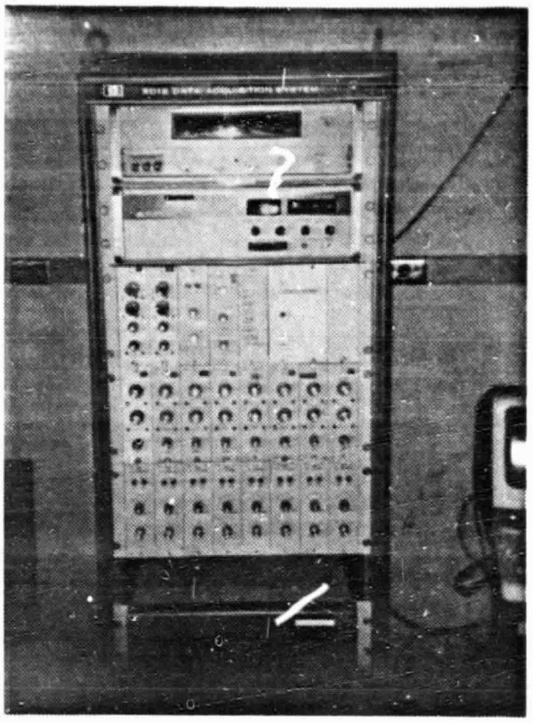

Figure 3.5 HP 2012 Data Acquisition System

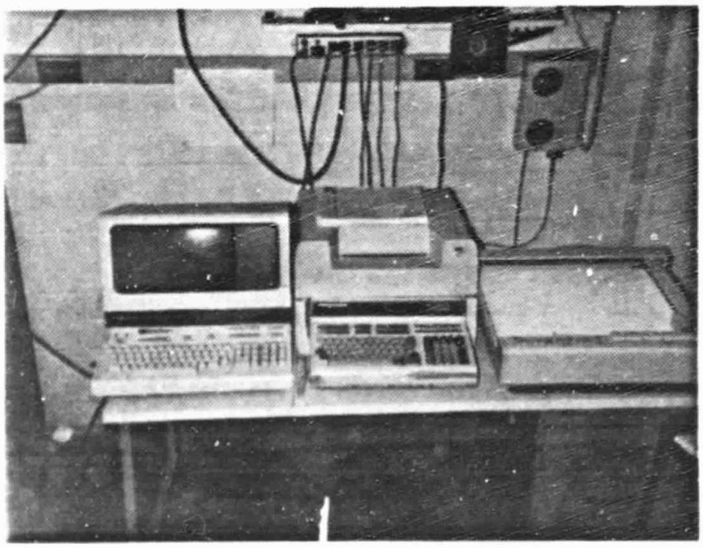

Figure 3.6 HP 9825A Desktop Calculator and 9872 Plotter

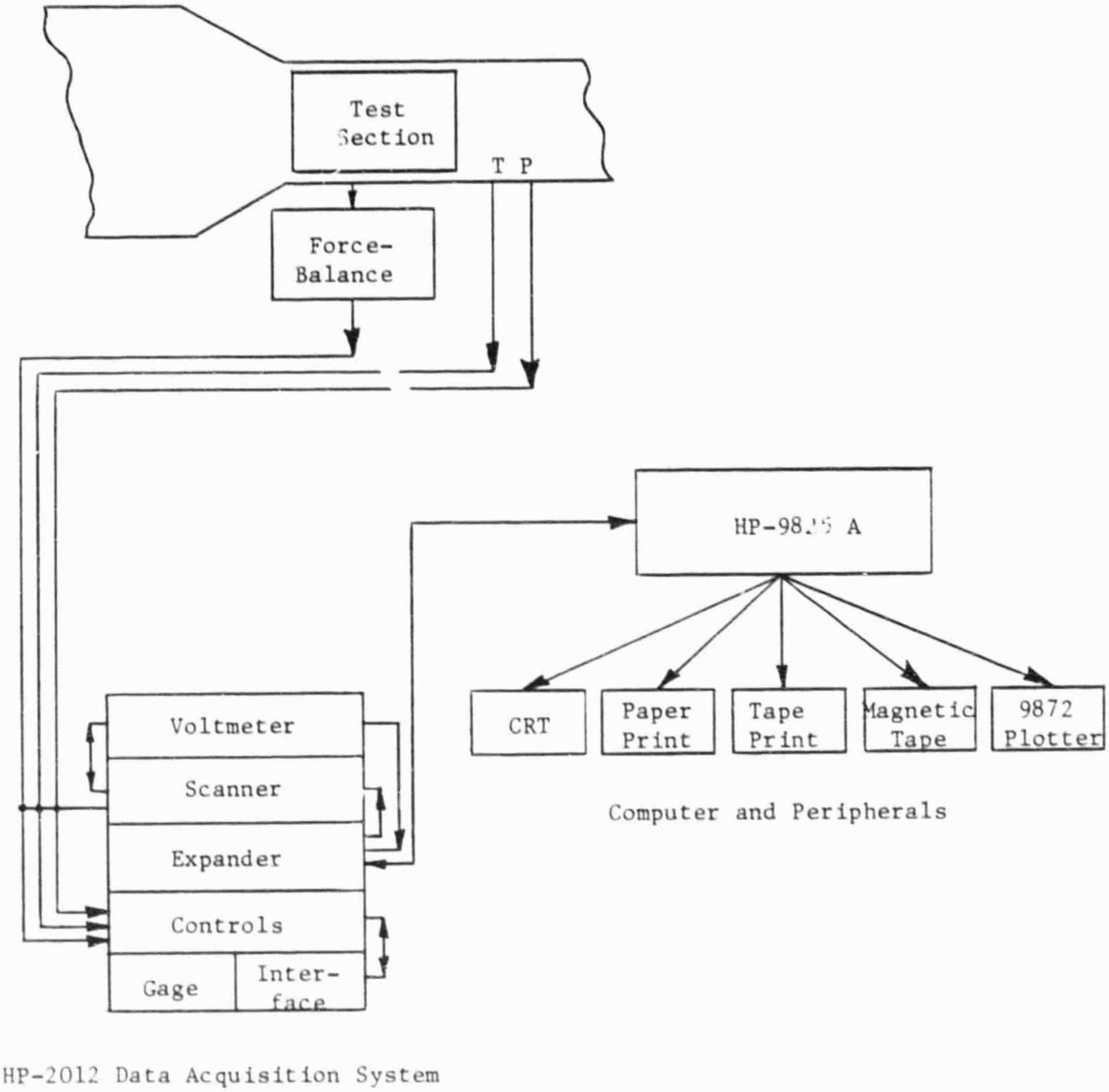

Figure 3.7 Data Acquisition System Schematic

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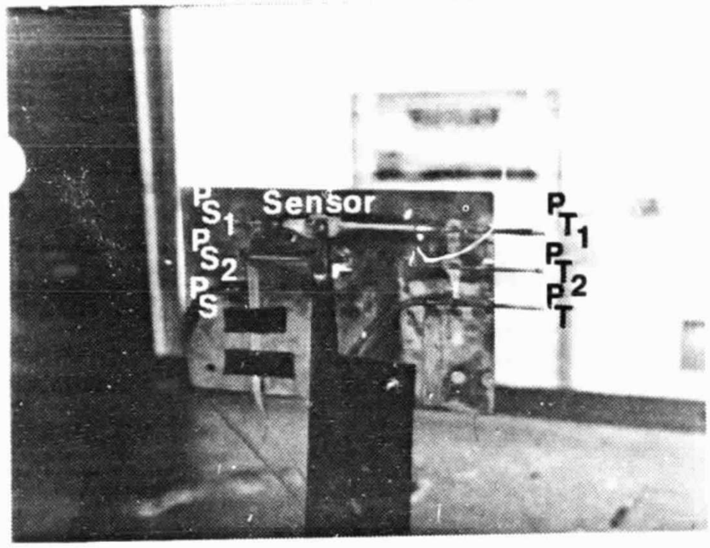


Figure 3.8 Pressure Sensor Calibration Mount.

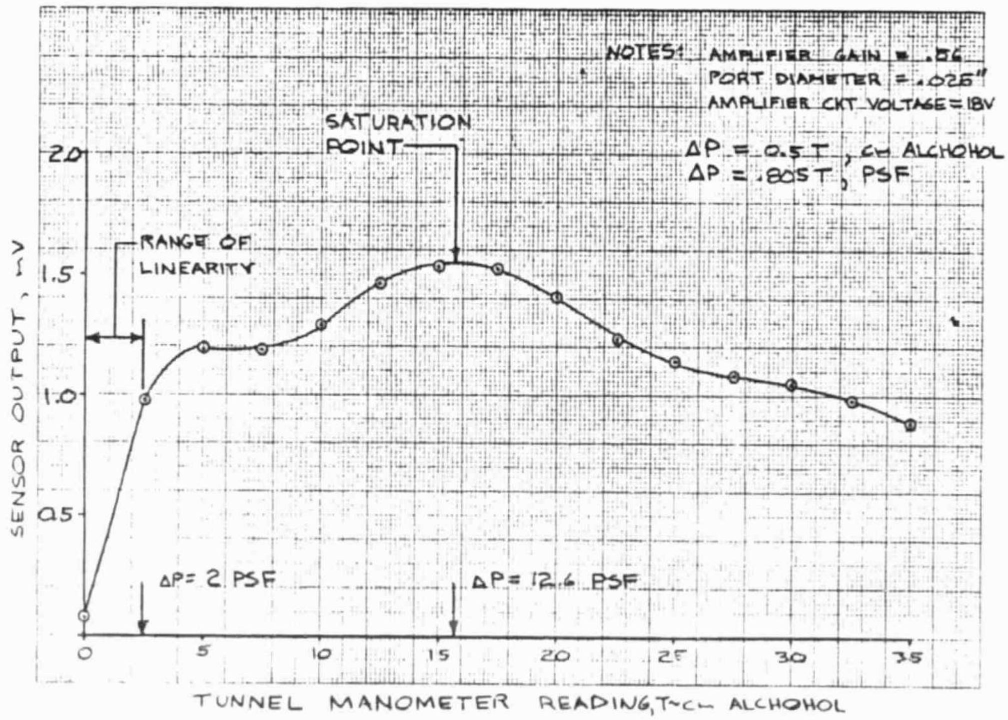


Figure 3.9 Thermistor Sensor Calibration Curve.

Although no dynamic response data were taken at this time, a significant lag in the response of the sensor to pressure changes was observed. This type of behavior is not acceptable in a feedback system.

Various modifications were tried to achieve the desired characteristics. Decreased port diameter increased the saturation point but further degraded dynamic response. Amplifier gain had no effect on the saturation point. Increased amplifier voltage and different middle thermistors were used to increase the power dissipated by the middle thermistor. The results were encouraging, but the desired results were still not obtained.

3.3 CONCLUSIONS AND RECOMMENDATIONS FROM PHASES I AND II

Since the objective of this study is to control flap position, the tap locations near the hingeline are the logical choices. To determine the effect of the hinge itself, positions just forward and aft of the hinge are tested in Phase III.

The sensor does not have the characteristics required by the system. As mentioned before, the Microswitch 142PC01D piezoresistive sensor is used in Phase III. See Section 4.2 for a discussion of the sensor characteristics and the circuit modifications required.

4. PHASE III: FREQUENCY RESPONSE TESTING

4.1 PURPOSE

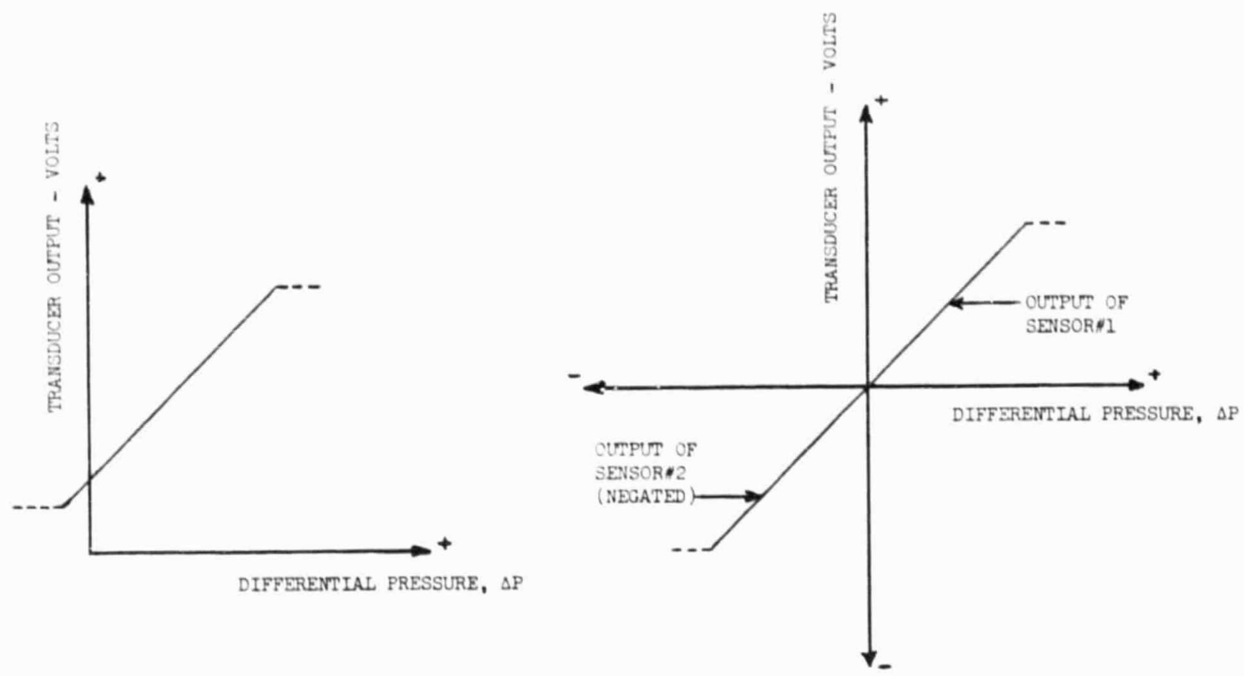
The frequency response test is designed to determine the dynamic characteristics of the pressure feedback system. This requires testing of the actuator alone (with position feedback) and the actuator with pressure feedback. If the signal conditioner and amplifier are assumed to be pure gains, then the transfer function of the pressure sensor (and associated aerodynamic lags) can be determined.

4.2 SYSTEM MODIFICATIONS

As mentioned previously, the sensor originally designed in the system was not acceptable. The piezoresistive sensor, to be included in the system, necessitates certain changes. First, the sensor circuit shown in Figure 2.4 is no longer needed.

Second, the piezoresistive sensor can only measure positive pressures--the signal "nulls out" at negative pressures, as shown in Figure 4.1(a). Thus two sensors are needed to sense positive and negative pressures. The outputs of both sensors are fed into a "rectifier" circuit, which performs three functions:

1) Zero the null offset of each sensor
2) Invert the signal coming from the negative pressure sensor
3) Block the signal coming from the sensor which has nulled out.



a) Without Rectifier Circuit.

b) With Rectifier Circuit.

Figure 4.1 Microswitch Pressure Sensor Characteristics

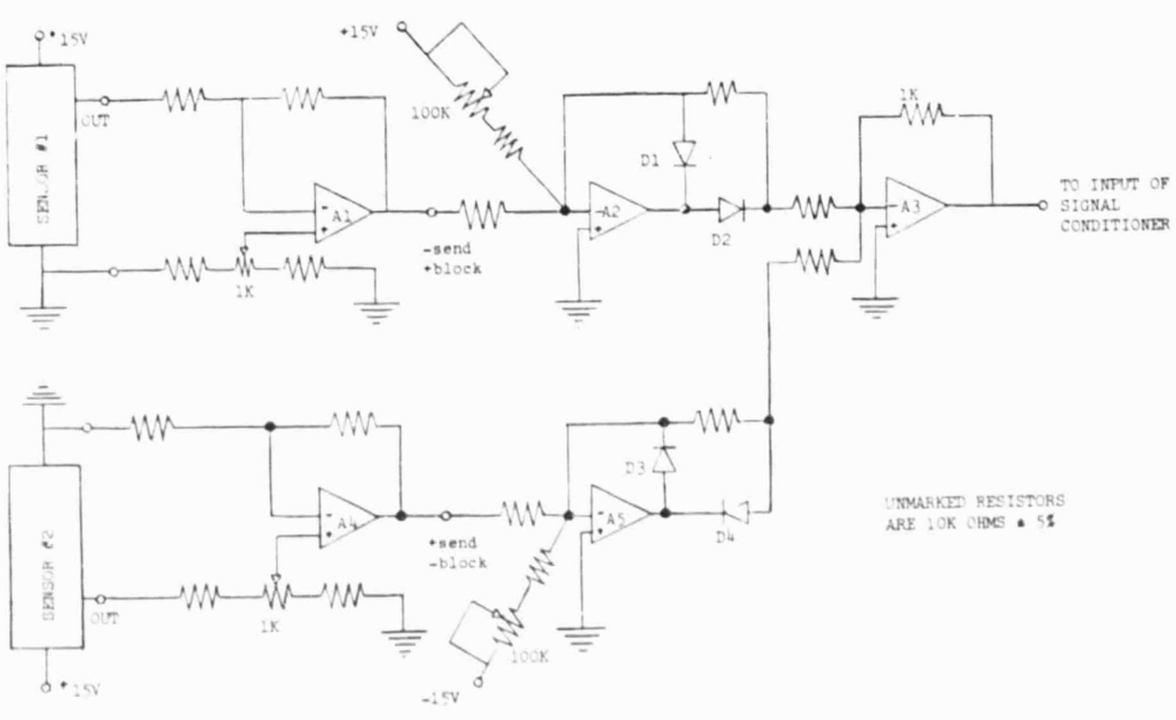


Figure 4.2 Rectifier Circuit Schematic.

The resulting output from the rectifier is shown in Figure 4.1(b). A schematic of the rectifier circuit is shown in Figure 4.2. The circuit performs the function of the first op-amp in the signal conditioner pressure feedback loop (see Figure 2.5), and has an overall gain of 10 volts/volt. The modified system flow diagram is shown in Figure 4.3.

New pressure taps were installed to accommodate two sensors. Four sets were installed, one at each of the following locations:

Tap Set#	x/c
1	.641
2	.668
3	.720
4	.747

The hingeline is at x/c = .694.

4.3 TEST SET-UP AND PROCEDURES

Once troubleshooting of the circuits had been completed, the surface was installed in the windtunnel. A Hewlett Packard Model 202A function generator was used to input sinusoidal position and pressure commands to the signal conditioner; and a Gulton/Techni-rite TR 888 strip chart recorder was used to record the commanded input, flap position, and pressure output (see Figure 4.4).

Before frequency response testing began, it was desired to see how the system would respond to a step input. Typical examples are shown in Figure 4.5. Since no problems were uncovered, the frequency response testing began.

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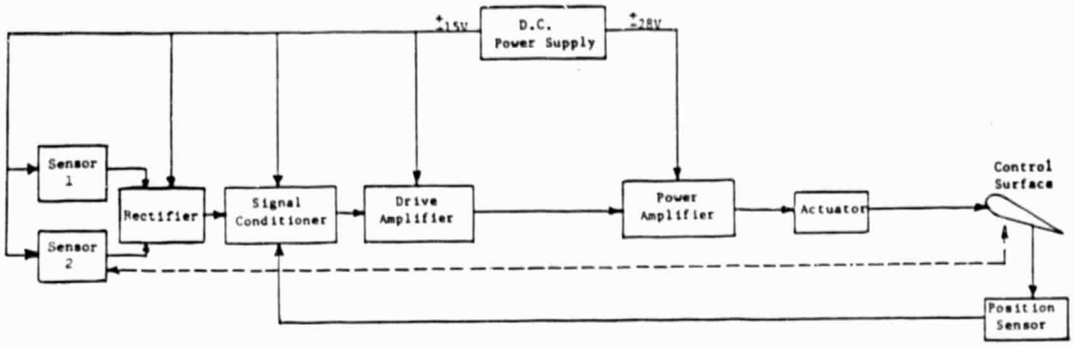

Figure 4.3 Modified System Flow Diagram.

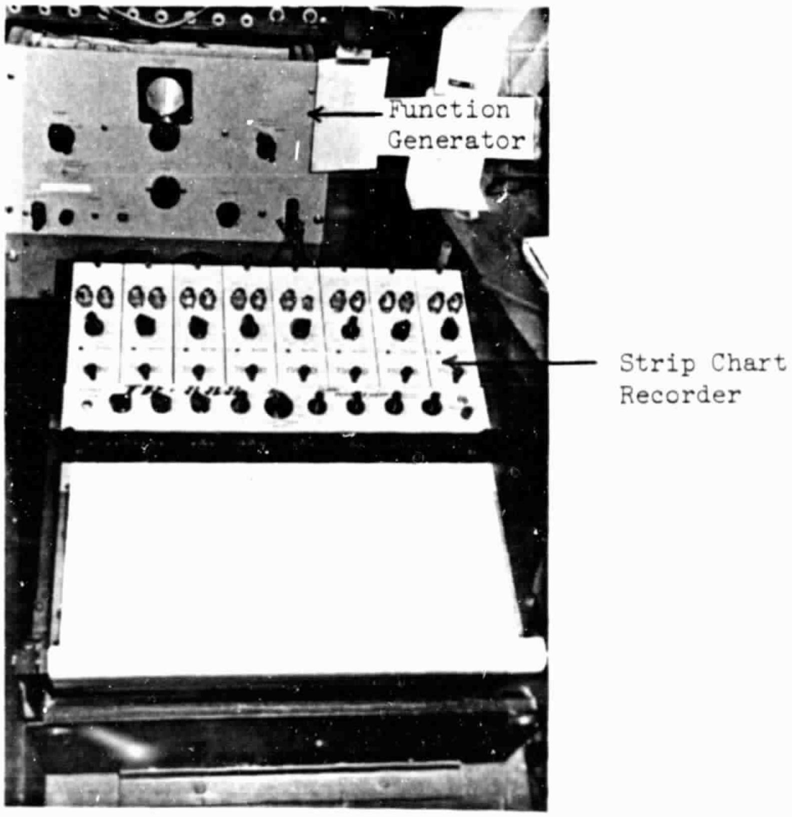

Figure 4.4 Hewlett Packard 202A Function Generator and Gulton/Techni-Rite TR888 Strip Chart Recorder.

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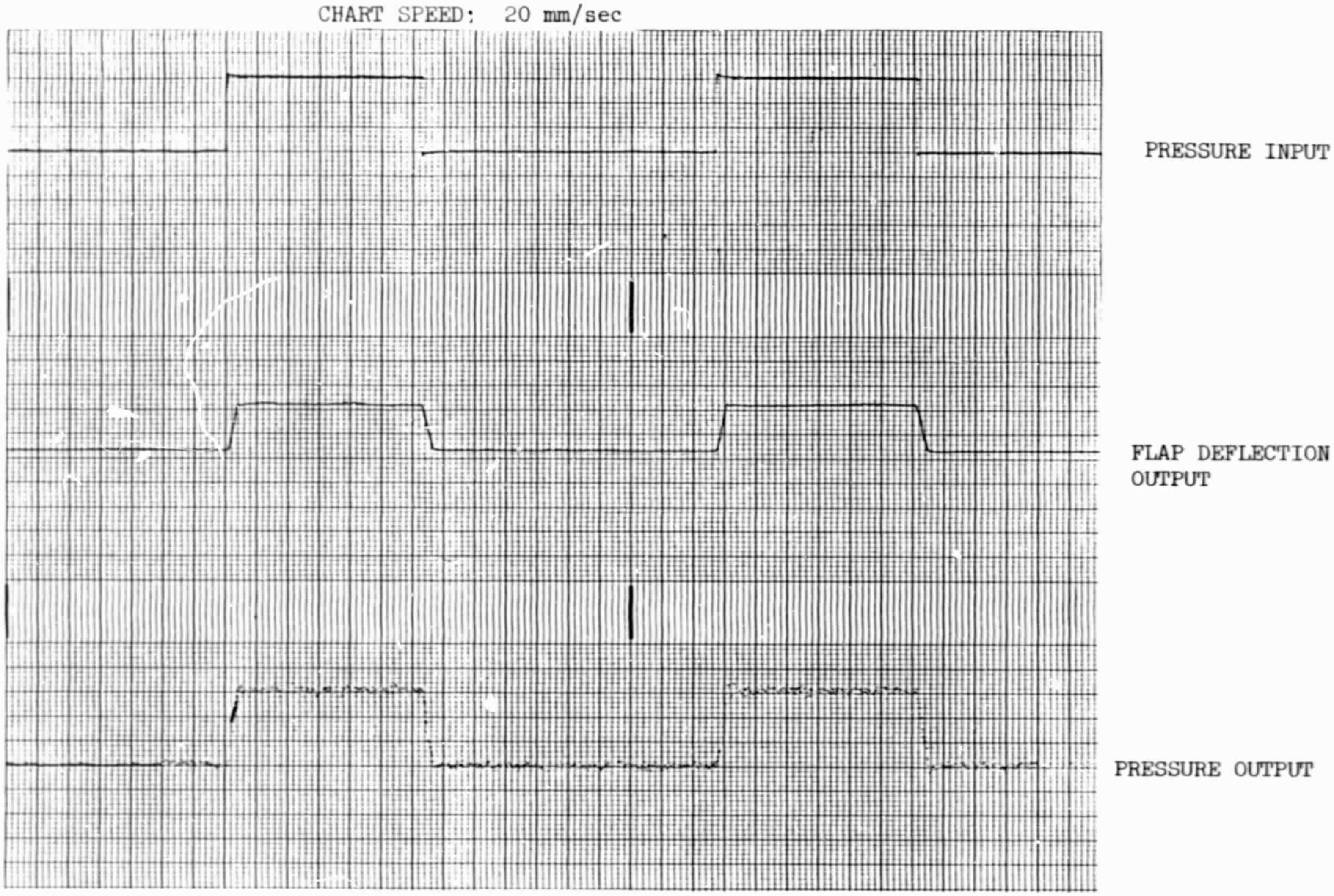

Figure 4.5 Step Input Response.

The procedures for the position and pressure command testing were essentially similar:

1) Set tunnel dynamic pressure
2) With generator set at low frequency (≈0.5 Hz), set generator amplitude so that desired flap deflection amplitude was achieved.
3) Increase frequency, taking data points at regular intervals.

In the position command mode, the generator amplitude setting was essentially constant with dynamic pressure for a given flap position amplitude. In the pressure command mode, however, input voltage must increase with dynamic pressure to keep the flap position amplitude constant.

The testing was all done at zero angle of attack. However, for attached flow, it is reasonable to assume that the frequency response will be unaffected.

Forces and moments were measured at the same combination of angle of attack and flap deflection as the pressure profile study (Section 3.1.2).

A complete run log is included in Appendix A.

4.4 DATA REDUCTION

The output of the strip chart recorder consists of three periodic traces. Figure 4.6 shows a typical case. To facilitate analysis, the magnitude ratios are converted to dB:

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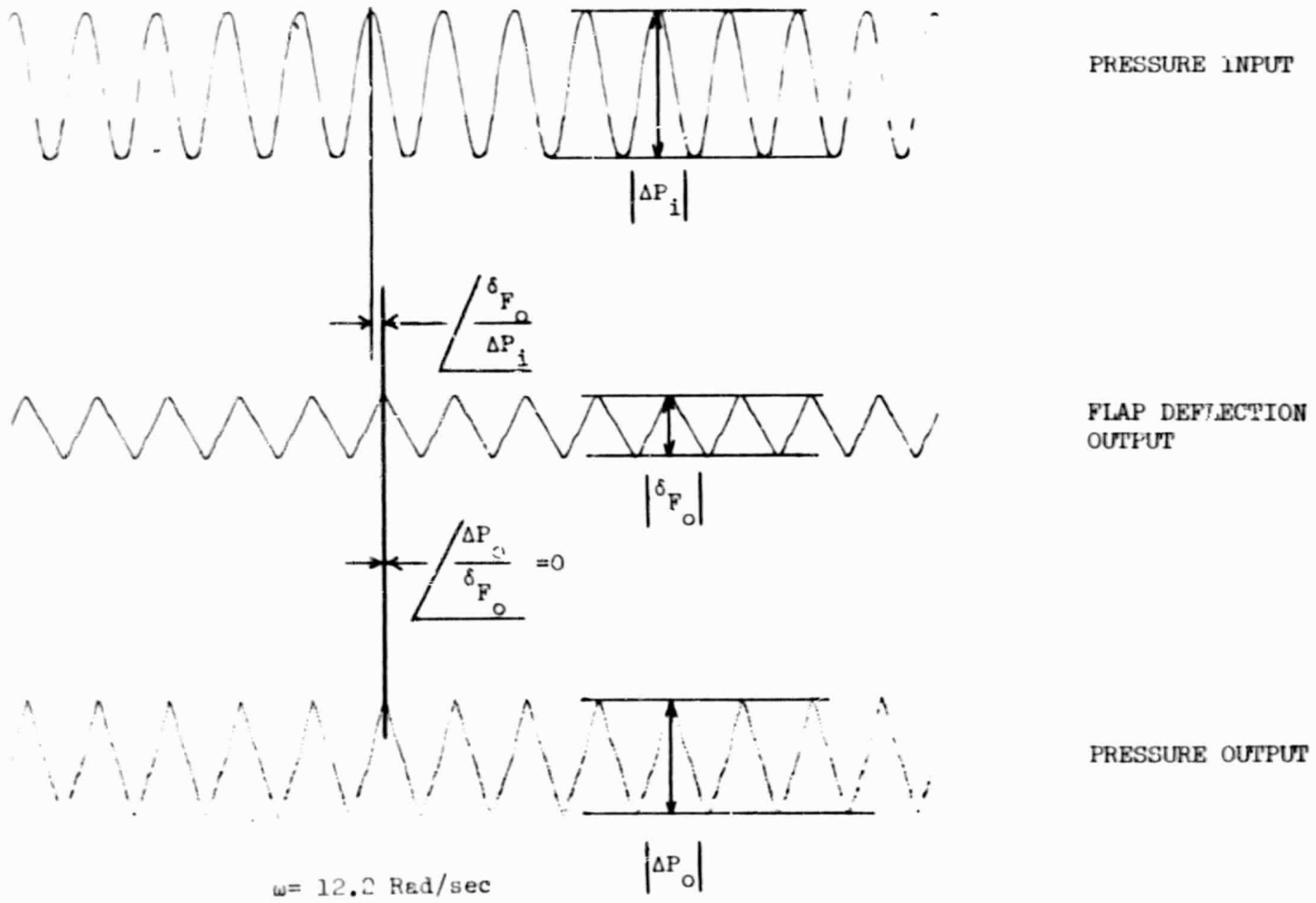

Figure 4.6 Typical Strip Chart Output.

$$M(\omega) = 20 \log \frac{A_o(\omega)}{A_i(\omega)} \quad , \text{dB}$$

where: $A_o(\omega)$ = output amplitude

$A_i(\omega)$ = input amplitude.

The phase angle, $\phi(\omega)$, is also measured.

All the data are plotted in standard Bode form in Appendix B, where the amplitude ratios are normalized to zero dB. This is reasonable for this system, since the actual value of the gain is not important. This is not reasonable if the system were to be inside the loop of an automatic flight control system. The gain would then contribute to overall system stability.

The lift and pitching moment characteristics are also included in Appendix B.

4.5 RESULTS AND DISCUSSION

Examination of the Bode plots in Appendix B, and the variation of break frequency with amplitude and dynamic pressure shown in Figure 4.7, reveal some interesting results. First the frequency response of the pressure feedback system is still first order. In some cases, the break frequency with pressure feedback is actually higher than that with position feedback. Second, reduction in break frequency with increasing amplitude is similar for both pressure and position feedback. These facts, coupled with the fact that there was no observable lag between pressure output and position output, lead to the conclusion that the pressure

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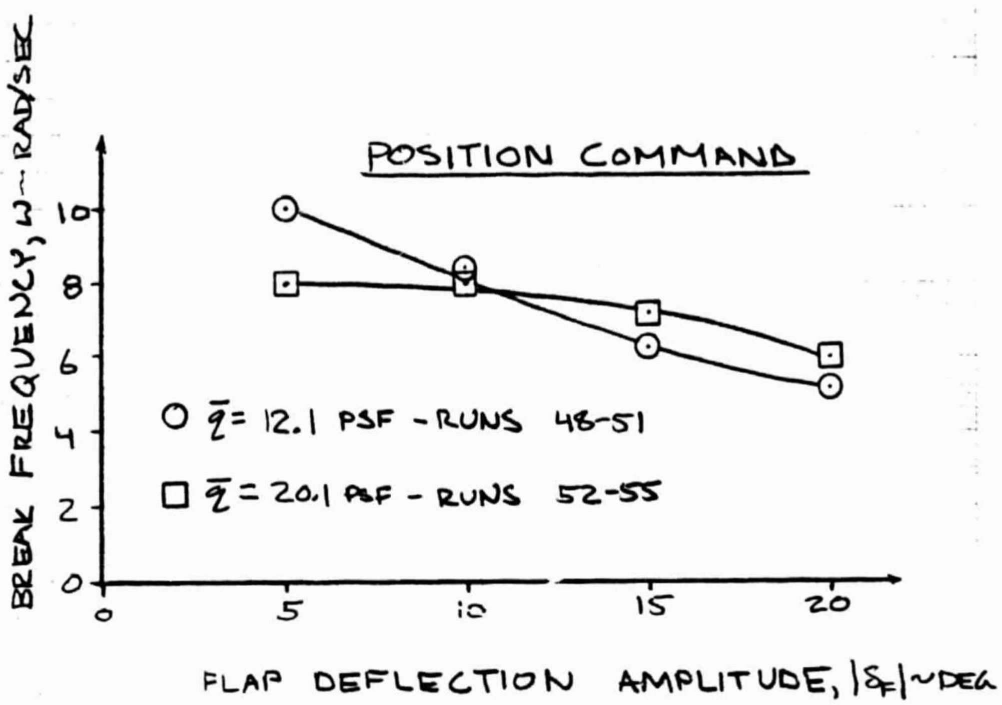

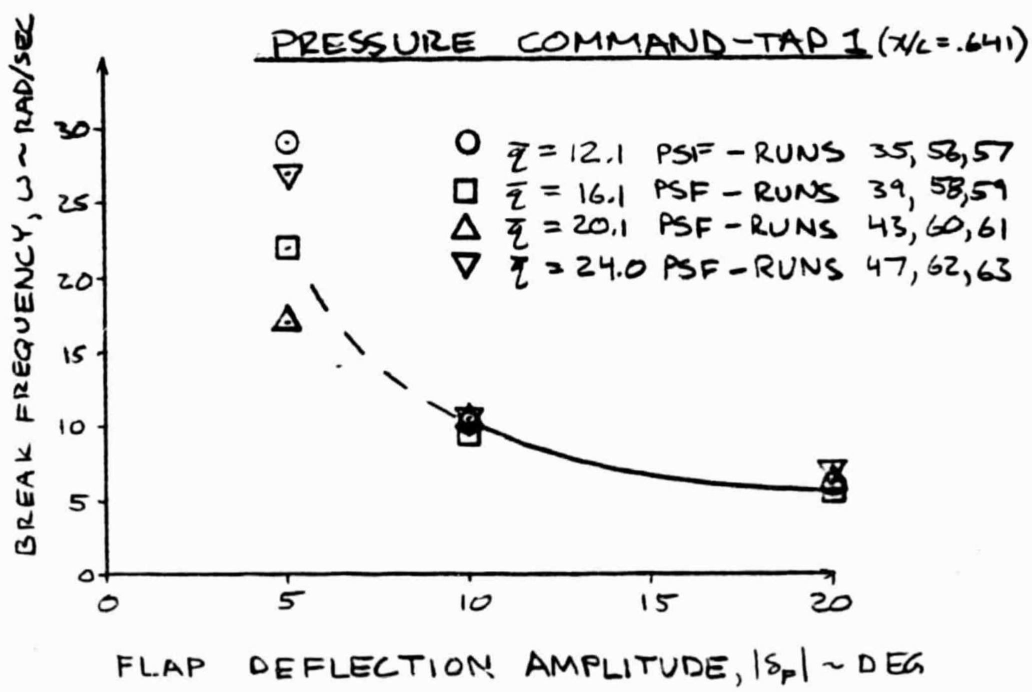

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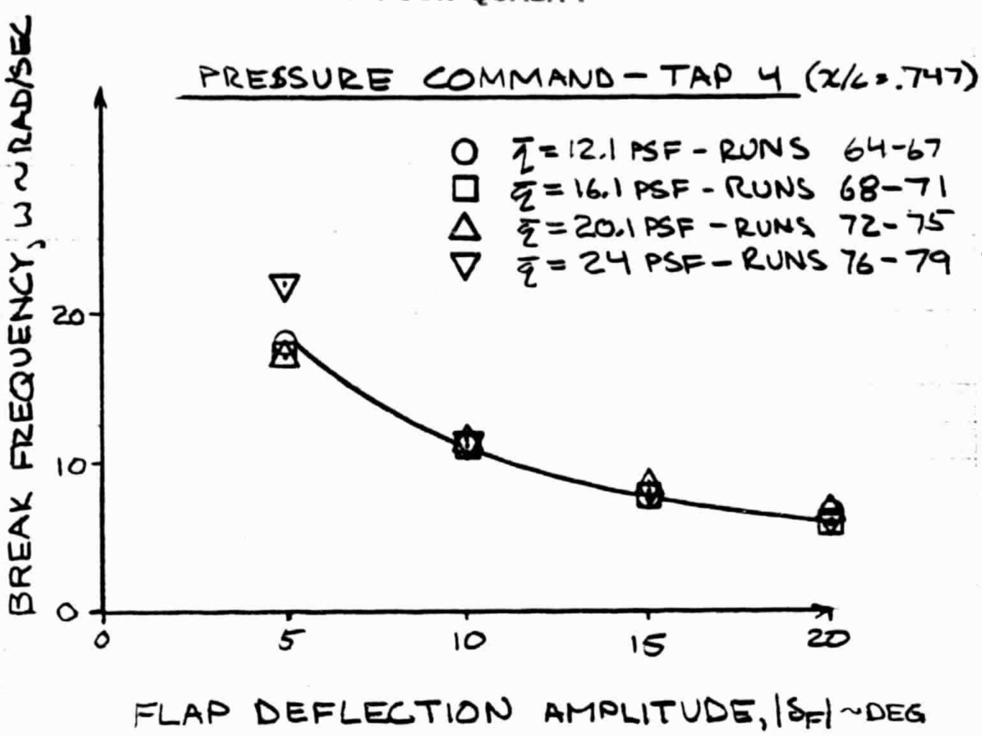

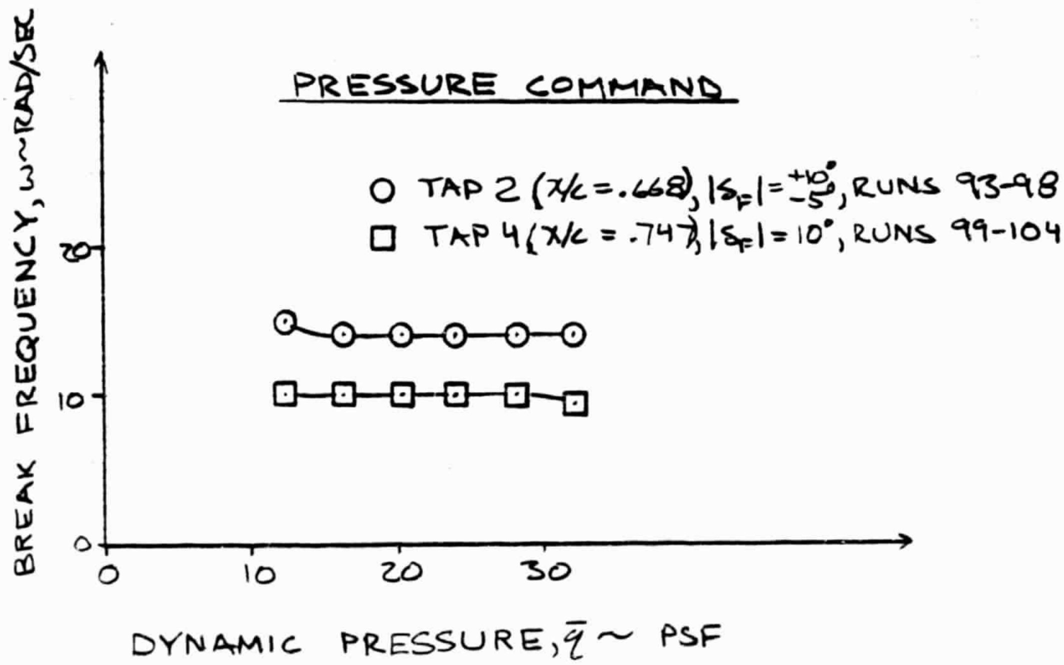

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feedback path can be approximated by a pure gain. Third, it is observed that the break frequency is constant, or increases, with dynamic pressure. Fourth, break frequency is independent of tap location for the range tested. Undoubtedly, lags would appear if the tap were placed too far forward.

Thus, for the range of frequencies tested, the response of the closed loop system is limited by the actuator, and not the pressure feedback. Inherent in the system is a gain proportional to dynamic pressure.

Reference 3 contains a study of the unsteady aerodynamic problem involved. It states that the aerodynamic phase lag is a function of the reduced frequency, or Strouhal number:

$$k = \frac{\omega \bar{c}}{2U_1}$$

For $k < .5$, the lift developed on a surface due to a flap deflection is essentially instantaneous (i.e., zero phase lag), according to Table II of Reference 3.

Thus, the aerodynamic "break frequency" is directly proportional to the freestream velocity, as shown in Figure 4.8. It is seen that these frequencies are well above those of which the actuator is capable.

These results are only valid for incompressible flow. The effect of Mach number is not considered here.

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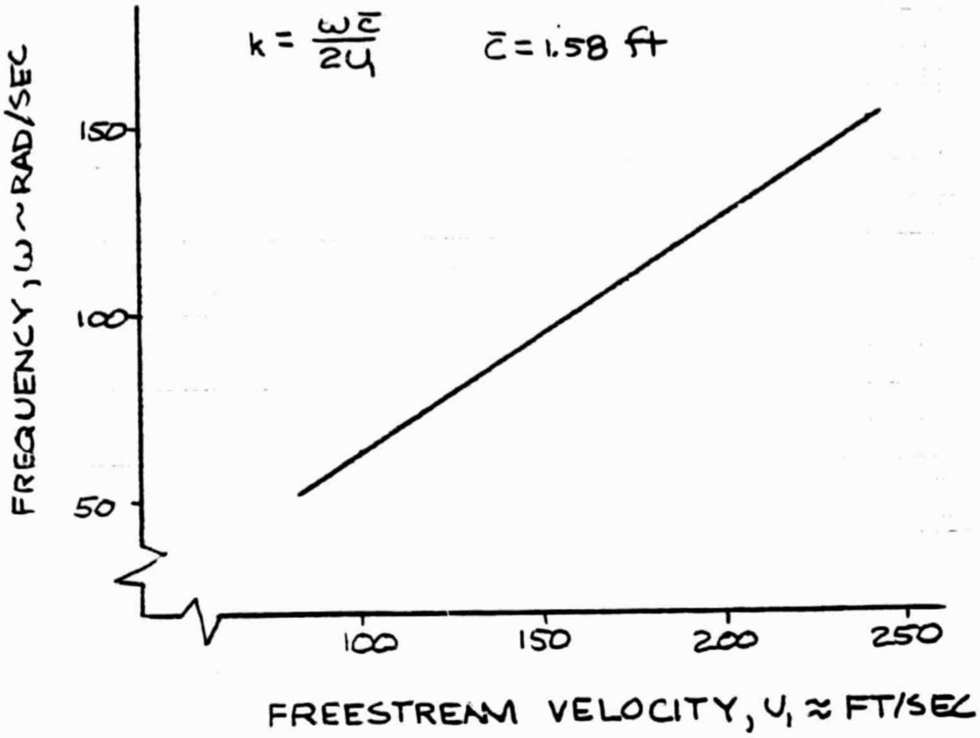

Figure 4.8 Frequency for Strouhal Number = 0.5.

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5. POSSIBLE APPLICATIONS AND PROBLEMS

It is evident that the system is feasible for moderate frequency applications. It is not known at this time how the system will perform in the high subsonic speed regime. It is doubtful that pressure feedback could be used in the transonic range, as the existence of a shock and the inherent pressure changes can have undesirable effects.

It is not known at this time what effect slush and ice contamination would have on a pressure feedback system installed in an airplane. Obviously, icing could plug up the static pressure ports--disabling the system. Rain could get into the ports--plugging them up or damaging the sensor. Icing could be prevented by heating the ports, but the possibility of clogging with water or foreign matter still presents a problem.

One solution would be to seal the sensor in a chamber with one side exposed to the surface. Figure 5.1 shows this installation. The common panel would be flexible, so that the pressure inside the chamber would adjust to that on the surface.

Once these problems (and perhaps others unknown at this time) are solved, it is left to evaluate the applications of the system. The function tested in this study, that of flap position control, is one such application. Others include:

1) Angle of attack/sideslip control
2) Gust-load alleviation
3) Stall prevention.

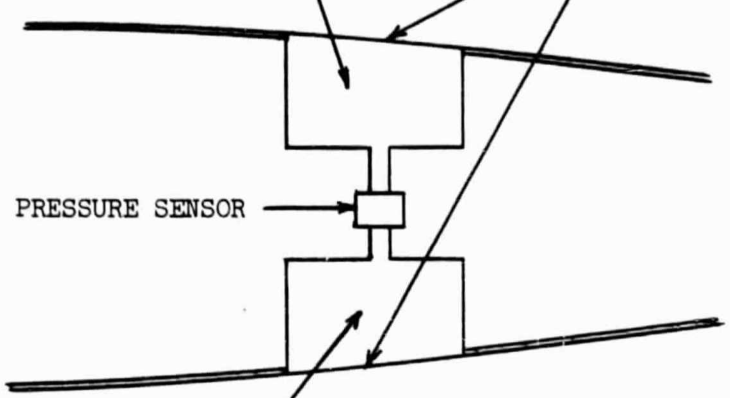

Figure 5.1 Sealed Pressure Sensor Installation.

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Angle of attack and sideslip can be controlled by placing a sensor at the maximum thickness of the airfoil. The system would then try to keep the total pressure, which is proportional to angle of attack (or sideslip, on a vertical tail), constant. The sensor(s) could be placed on either the main wing or the horizontal tail and would be connected to an actuator controlling elevator deflection.

Gust alleviation (ride smoothing) can be achieved by placing sensors on the main wing near the ailerons. Then, when the airplane is hit by a gust, the sensors would detect the increase in pressure and command the ailerons to deflect up--killing the unnecessary lift. The opposite would be true for a down gust. This concept can be extended to alleviate side and pitching moment gusts by putting sensors in the vertical and horizontal tails.

Stall prevention is possible with sensors on the horizontal tail. A given download on the horizontal tail is necessary to provide the control power needed to pitch up into a stall. Pressure sensors on the horizontal tail would sense this download and prevent the stall. It may be necessary to adjust the pressure for different flight speeds (accelerated stall limiting) or center of gravity locations.

All of the above functions could be performed with the same set of sensors. The system could be added to an existing autopilot as well. Other possibilities exist; they are only limited by the imagination of the designer.

6. CONCLUSIONS AND RECOMMENDATIONS

From the results discussed in Chapter 4, it is evident that it is feasible to position a control surface by feeding back the differential pressure across that surface. It also appears that angle of attack can be sensed and controlled using the same concept, but this application has not been tested.

For control surface positioning, the best sensor location is at the hingeline. Turbulence caused by the hinge does not appear to degrade performance drastically. The previous statement, of course, depends upon the specific installation. Angle of attack control is achieved by placing the sensor at the maximum thickness, where pressure is fairly independent of flap position. Both variables could be controlled with sensors at both locations.

Further research is recommended. A short windtunnel program should be conducted to evaluate the angle of attack control concept. This could conceivably be performed at a transonic facility to measure compressibility effects. An analog or digital simulation would be the next logical step, followed eventually by a flight test program. The gust-load alleviation system holds the most promise and is recommended for simulation and flight test. An Airplane equipped with an autopilot could easily be modified to accept the pressure feedback principle.

7. REFERENCES

1. Hrabak, R., et al.; Interim Report for a Program to Evaluate a Control System Based on Feedback of Aerodynamic Pressure Differential, KU-FRL-490-1; Kansas University Center for Research, Inc., Flight Research Laboratory; Lawrence, Kansas 66045; August 1981.

2. Daugherty, D. G.; A Critical Review of an Automatic Attitude Command Control System Electronics Design, KU-FRL-325; Kansas University Center for Research, Inc., Flight Research Laboratory; Lawrence, Kansas 66045; November 1974.

3. Lan, C. E.; The Induced Drag of Oscillating Airfoils in Linear Subsonic Compressible Flow, KU-FRL-400; Kansas University Center for Research, Inc., Flight Research Laboratory; Lawrence, Kansas 66045; June 1975.

APPENDIX A. DELTA P PHASE III WINDTUNNEL TEST RUN LOG

INTRODUCTION

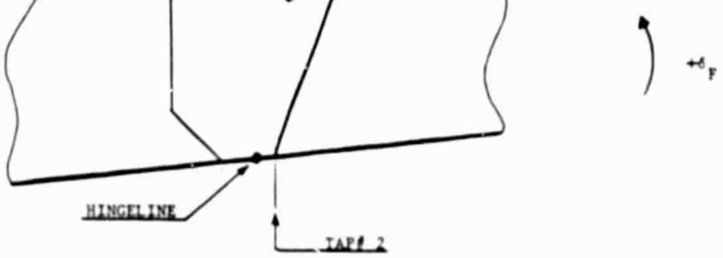
The following is a listing of the conditions present during each run.

Runs 1-12 were position command step inputs, where a voltage was input such that a certain flap deflection resulted. Runs 13-27 were pressure command step inputs.

Run 28 begins the frequency response testing. Runs 28-47 used a Heathkit function generator that had insufficient power output. One hundred percent (100%) amplitude corresponded to approximately 5 deg of flap deflection. Run 28 was so poor as to be unreadable. After Run 47, the HP202A function generator, which had enough power to command deflections in excess of 20 deg, was used.

Runs 48-55 were position feedback runs. After Run 55, the pressure command amplitude was adjusted to give a certain amplitude in degrees. This allows direct correlation with the position command runs.

Tap #2 (Runs 89-98) had a unique installation which affected flap deflection:



When the flap deflection reached $\delta_F \approx -5$ deg, the rounded edge protruded into the freestream--perhaps causing a low pressure bubble due to separation. This "fooled" the system into thinking it had reached the desired deflection. The frequency response characteristics were not degraded appreciably.

DELTA P PHASE III WINDTUNNEL TEST RUN LOG

RUN #	FIGURE #	$\bar{q}$(psf)	ΔP_{in}	$\delta_{F_{in}}$	TAP #	REMARKS
1	*	8.0	---	5 DEG.	---	STEP INPUTS
2	↓	8.0	---	10	---	(Position Command)
3		8.0	---	15	---	*Step inputs not plotted
4		8.0	---	20	---	
5		16.1	---	5	---	
6		16.1	---	10	---	
7		16.1	---	15	---	
8		16.1	---	20	---	
9		24.0	---	5	---	
10		24.0	---	10	---	
11		24.0	---	15	---	
12		24.0	---	20	---	
13		8.0	1 Volt	---	1	(Pressure Command)
14		8.0	2	---	1	
15		8.0	3	---	1	
16		12.1	1	---	1	
17		12.1	2	---	1	
18		12.1	3	---	1	
19		16.1	1	---	1	
20		16.1	2	---	1	
21		16.1	3	---	1	
22		20.1	1	---	1	
23		20.1	2	---	1	
24		20.1	3	---	1	
25		24.0	1	---	1	
26		24.0	2	---	1	
27		24.0	3	---	1	END OF STEP INPUTS

DELTA P PHASE III WINDTUNNEL TEST RUN LOG (CONTINUED)

RUN #	FIGURE #	$\bar{q}$(psf)	ΔP_{in}	$\delta_{F_{in}}$	TAP #	REMARKS
28	*	8.0	40%**	---	1	BEGIN FREQUENCY RESPONSE
29	B1	8.0	60%	---	1	*Not plotted--bad data
30	B2	8.0	80%	---	1	**% of full amplitude
31	B3	8.0	100%	---	1	on signal generator
32	B4	12.1	40%	---	1	
33	B5	12.1	60%	---	1	
34	B6	12.1	80%	---	1	
35	B7	12.1	100%	---	1	
36	B8	16.1	40%	---	1	
37	B9	16.1	60%	---	1	
38	B10	16.1	80%	---	1	
39	B11	16.1	100%	---	1	
40	B12	20.1	40%	---	1	
41	B13	20.1	60%	---	1	
42	B14	20.1	80%	---	1	
43	B15	20.1	100%	---	1	
44	B16	24.0	40%	---	1	
45	B17	24.0	60%	---	1	
46	B18	24.0	80%	---	1	
47	B19	24.0	100%	---	1	
48	B20	12.1	---	5 DEG.	---	
49	B21	12.1	---	10	---	Begin using HP202A
50	B22	12.1	---	15	---	signal generator
51	B23	12.1	---	20	---	Runs 48-55 are
52	B24	20.1	---	5	---	Position command
53	B25	20.1	---	10	---	
54	B25	20.1	---	15	---	
55	B27	20.1	---	20	---	
56	B28	12.1	32%	10	1	Hardware checked out--
57	B29	12.1	39%	20	1	Everything OK
58	B30	16.1	38%	10	1	

DELTA P PHASE III WINDTUNNEL TEST RUN LOG (CONTINUED)

RUN #	FIGURE #	$\bar{q}$(psf)	ΔP_{in}	$\delta_{F_{in}}$	TAP #	REMARKS
59	B31	16.1	44%	20	1	
60	B32	20.1	40%	10	1	
61	B33	20.1	48%	20	1	
62	B34	24.0	43%	10	1	
63	B35	24.0	49%	20	1	
64	B36	12.1	28%	5	4	Re-zeroed function generator
65	B37	12.1	36%	10	4	
66	B38	12.1	40%	15	4	
67	B39	12.1	43%	20	4	
68	B40	16.1	32%	5	4	
69	B41	16.1	40%	10	4	
70	B42	16.1	46%	15	4	
71	B43	16.1	50%	20	4	
72	B44	20.1	37%	5	4	
73	B45	20.1	44%	10	4	
74	B46	20.1	49%	15	4	
75	B47	20.1	54%	20	4	
76	B48	24.0	36%	5	4	Run 76-- Amplitude might have been slightly less than 5 deg.
77	B49	24.0	47%	10	4	
78	B50	24.0	52%	15	4	
79	B51	24.0	55%	20	4	

RUNS 80-88 WERE FORCE AND MOMENT RUNS AND

ARE LISTED ON NEXT PAGE.

DELTA P PHASE III WINDTUNNEL TEST RUN LOG (CONTINUED)

RUN #	$\bar{q}$ (cm. of alcohol)	α	δ_F	REMARKS
80	20.1	① *	-20 DEG	FORCE & MOMENT RUNS
81	20.1	①	-15	* ① → α = -8, -6, -4, -2, 2, 4, 6, 8 DEG
82	20.1	①	-10	
83	20.1	①	-5	
84	20.1	①	0	
85	20.1	①	+5	
86	20.1	①	+10	
87	20.1	①	+15	
88	20.1	①	+20	END OF FORCE & MOMENT RUNS

FREQUENCY RESPONSE RUN LOG CONTINUES ON NEXT PAGE

DELTA P PHASE III WINDTUNNEL TEST RUN LOG (CONTINUED)

RUN #	FIGURE #	$\bar{q}$(psf)	ΔP_{in}	$\delta_{F_{in}}$	TAP #	REMARKS
89	B52	12.1	27%	+10-5*	2	CONTINUE FREQ. RESPONSE
90	B53	12.1	37%	+20-8	2	*Asymmetrical flap deflection due to nature of Tap #2
91	B54	20.1	33%	+10-5	2	
92	B55	20.1	47%	+20-8	2	
93	B56	12.1	25%	+10-5	2	
94	B57	16.1	31%	+10-5	2	
95	B58	20.1	34%	+10-5	2	
96	B59	24.0	38%	+10-5	2	
97	B60	28.2	39%	+10-5	2	
98	B61	32.2	40%	+10-5	2	
99	B62	12.1	37%	+10-10	4	
100	B63	16.1	41%	+10-10	4	
101	B64	20.1	45%	+10-10	4	Re-zeroed and calibrated strip chart recorder
102	B65	24.0	49%	+10-10	4	
103	B66	28.2	52%	+10-10	4	
104	B67	32.2	54%	+10-10	4	

END OF TEST

APPENDIX B. BREAK FREQUENCY DATA

Contained herein are the reduced data obtained from the Phase III frequency response testing.

The quality of the data obtained for Runs 28-47 is rather poor because of the small flap deflections. For this reason, only the 100% (5 deg) amplitudes are plotted, with the subsequent runs, in Figure 4.7. They are all plotted in this Appendix, however. In general, the phase angle data are not good and are not analyzed.

Break frequencies are tabulated on the following page.

TABLE B1 BREAK FREQUENCIES

Break Frequencies in Rad/sec

POSITION COMMAND

$\bar{q}$(psf)	δ_F = 5°	10°	15°	20°
12.1	10	8.4	6.3	5.2
20.1	8.0	8.0	7.2	6.0

PRESSURE COMMAND

TAP 1

$\bar{q}$(psf)	δ_F = 5°	10°	-	20°
8	15	-	-	-
12.1	29	10	-	6
16.1	22	9.5	-	5.8
20.1	17	10.5	-	6
24.0	27	10.1	-	6.7

TAP 2

$\bar{q}$(psf)	δ_F = +10 → -5°	+20 → -8°
12.1	14/15	13
16.1	15/14	10
20.1	14	-
24.0	14	-
28.2	14	-
32.2	14	-

TABLE B1 BREAK FREQUENCIES (CONTINUED)

Break Frequencies in Rad/Sec

TAP 4

$\bar{q}$(psf)	δ_F = 5°	10°	15°	20°
12.1	18	11/10	7.5	6.6
16.1	17	11/10	7.5	6
20.1	17	11.5/10	8.5	6.4
24.0	22	9.5/10	8	6
28.2	-	10	-	-
32.2	-	9.4	-	-

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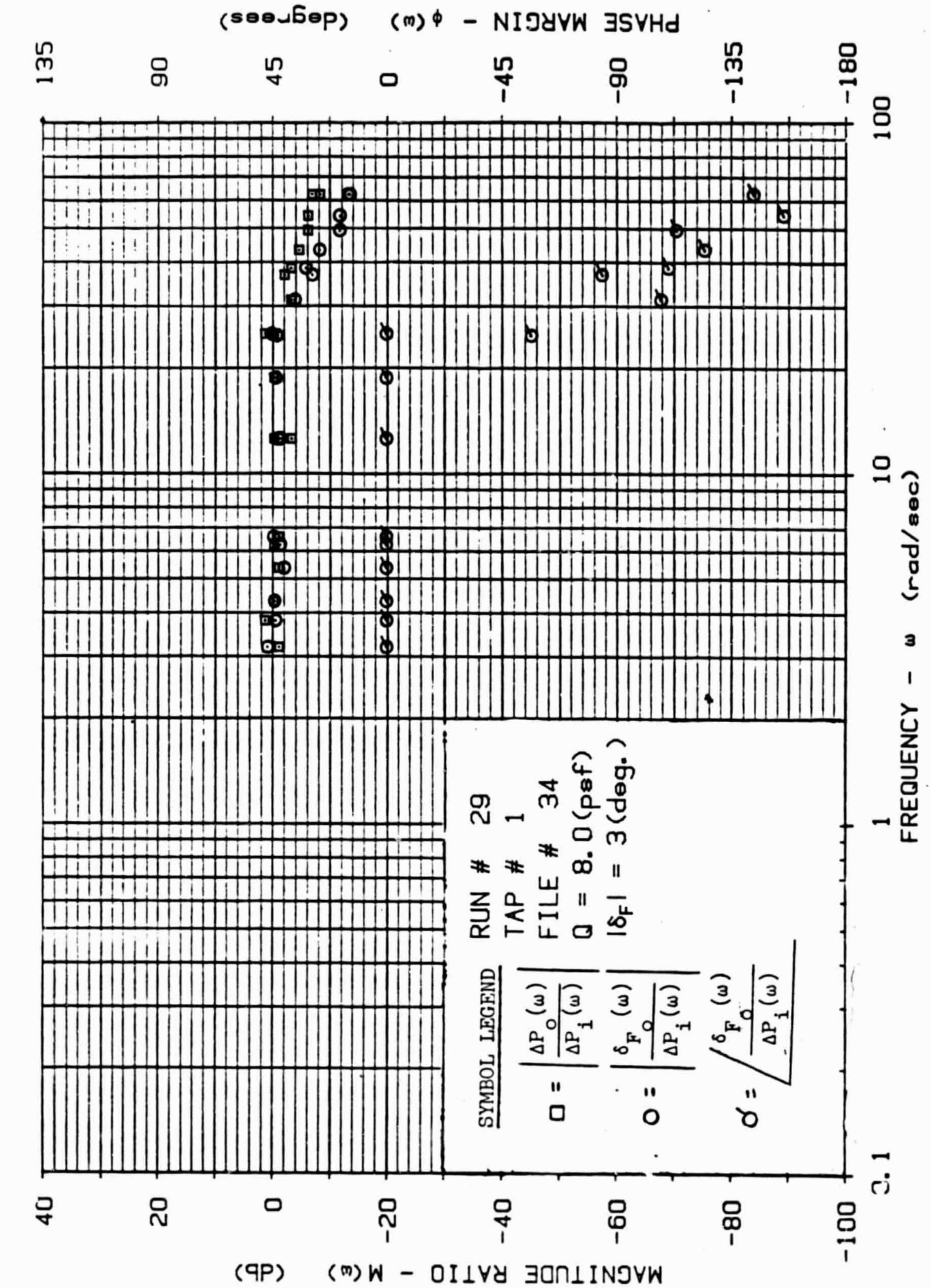

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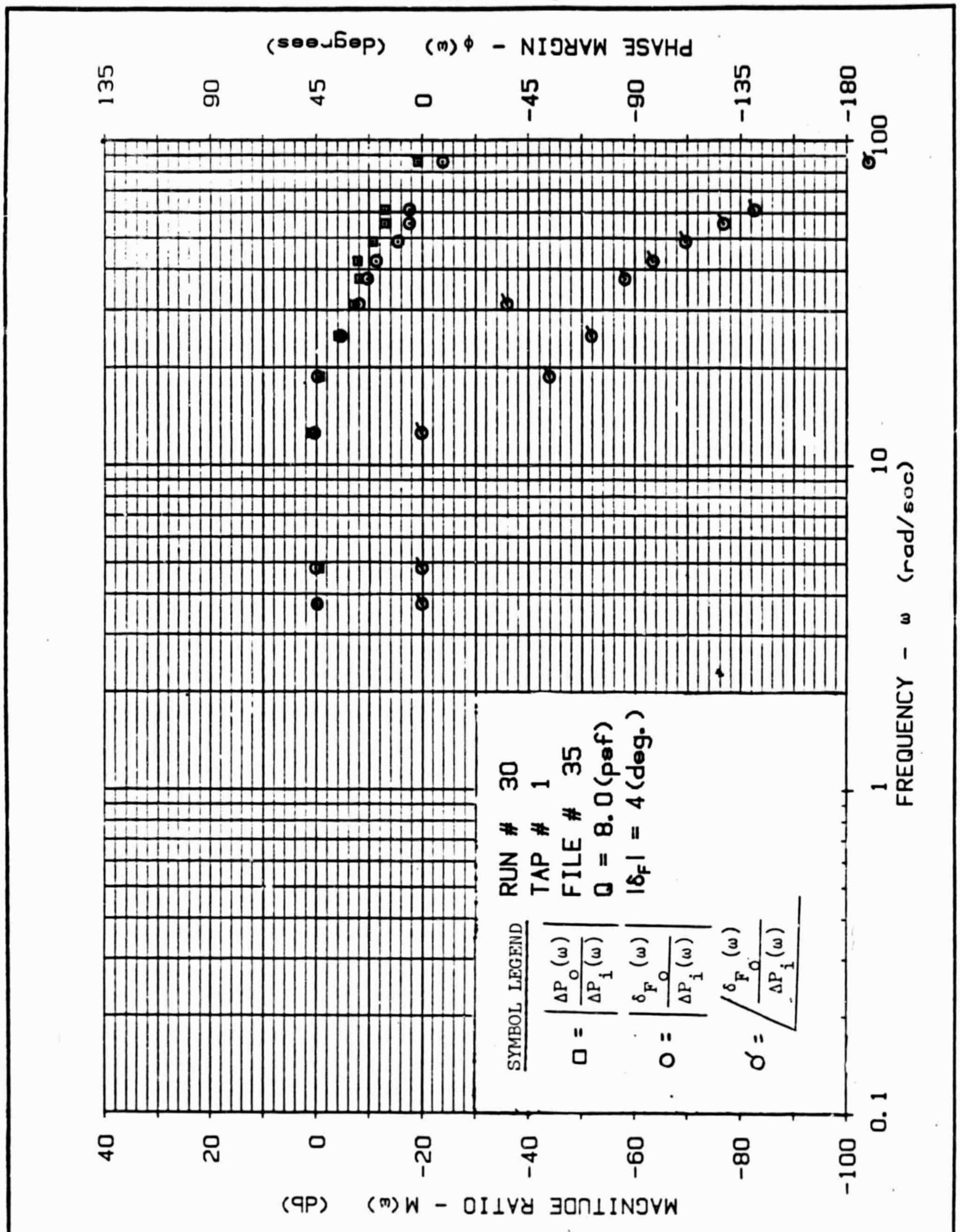

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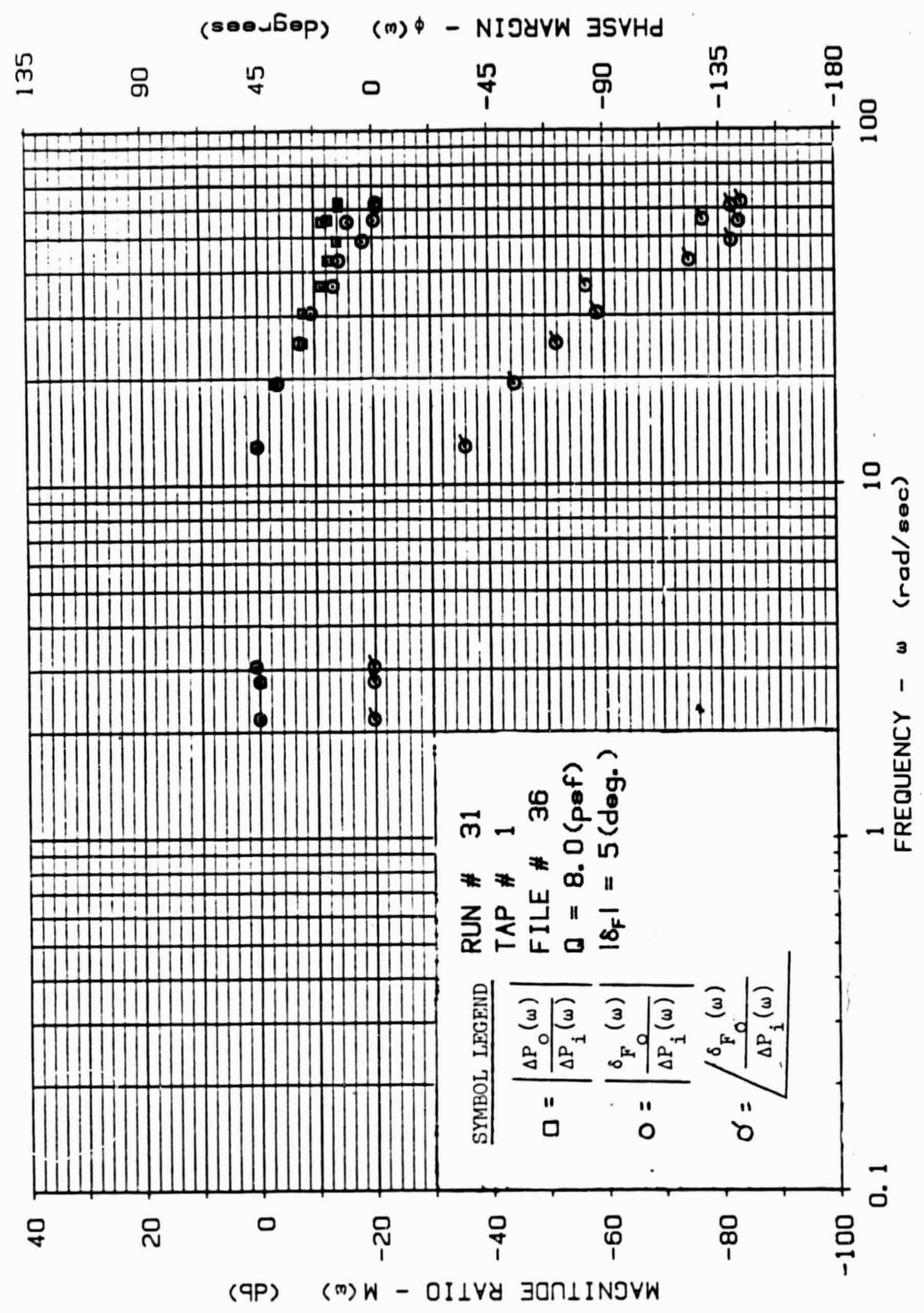

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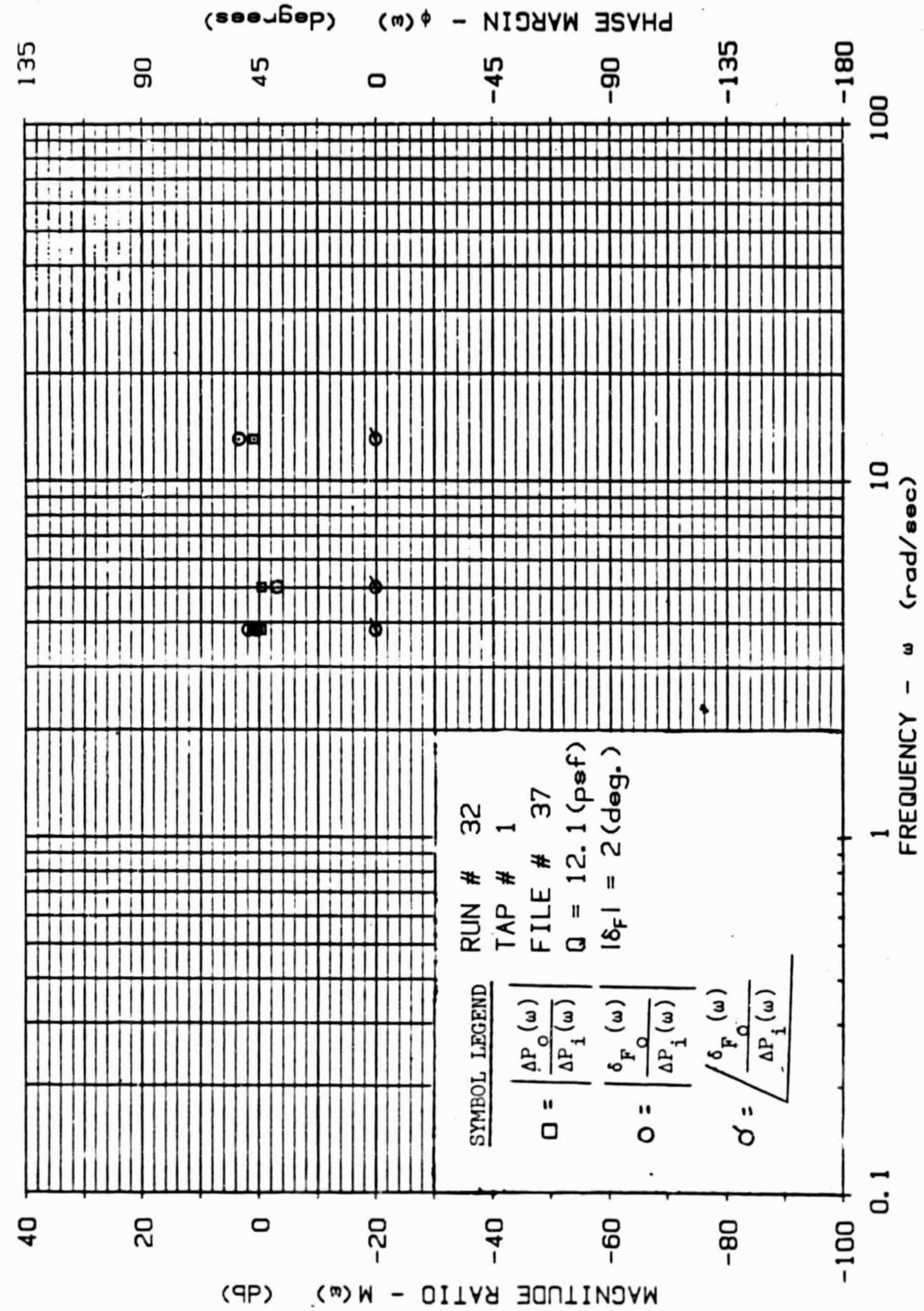

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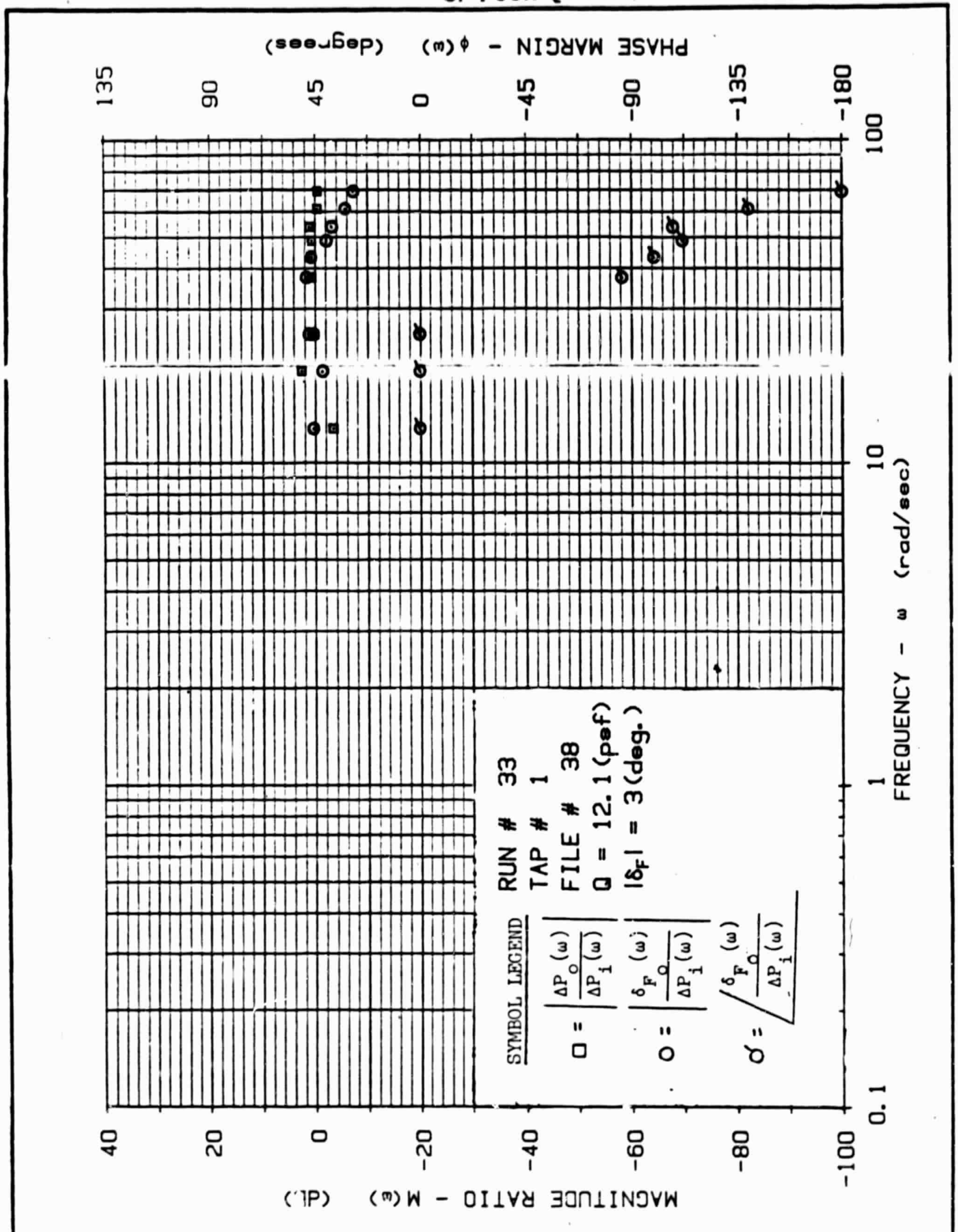

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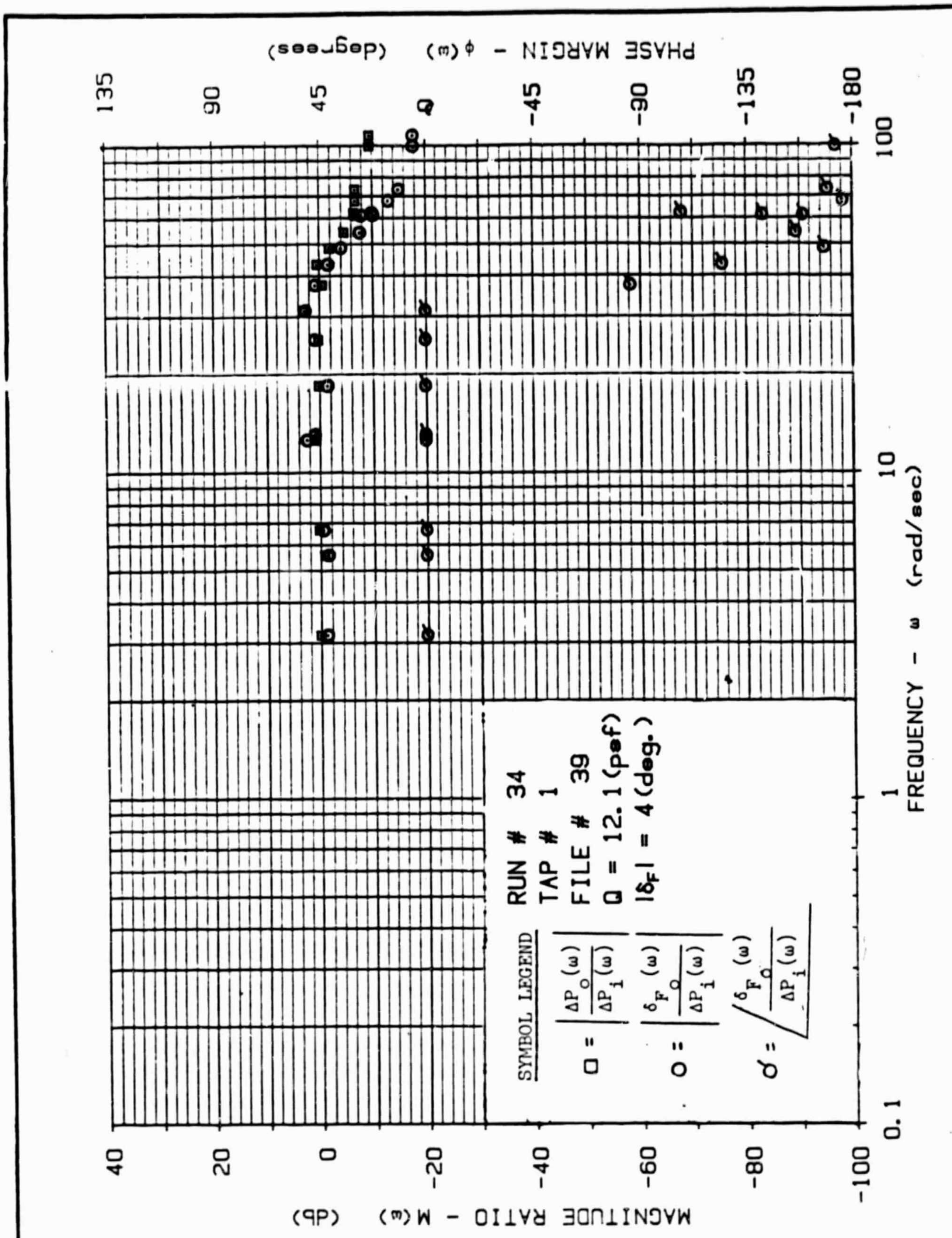

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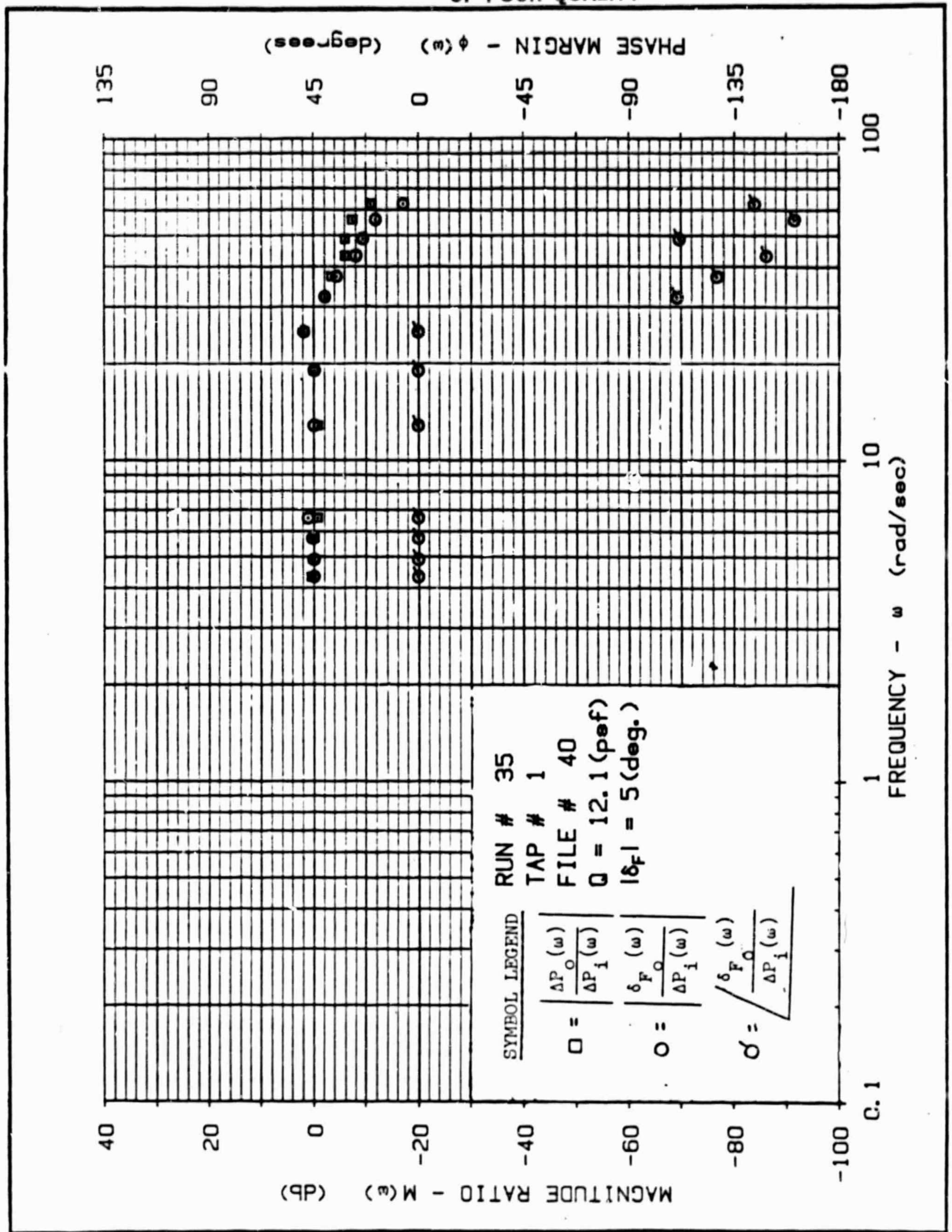

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FIGURE B7. PRESSURE COMMAND BODE - q= 12.1(psf), $|\delta_F|$ = 5 (deg.), TAP# 1

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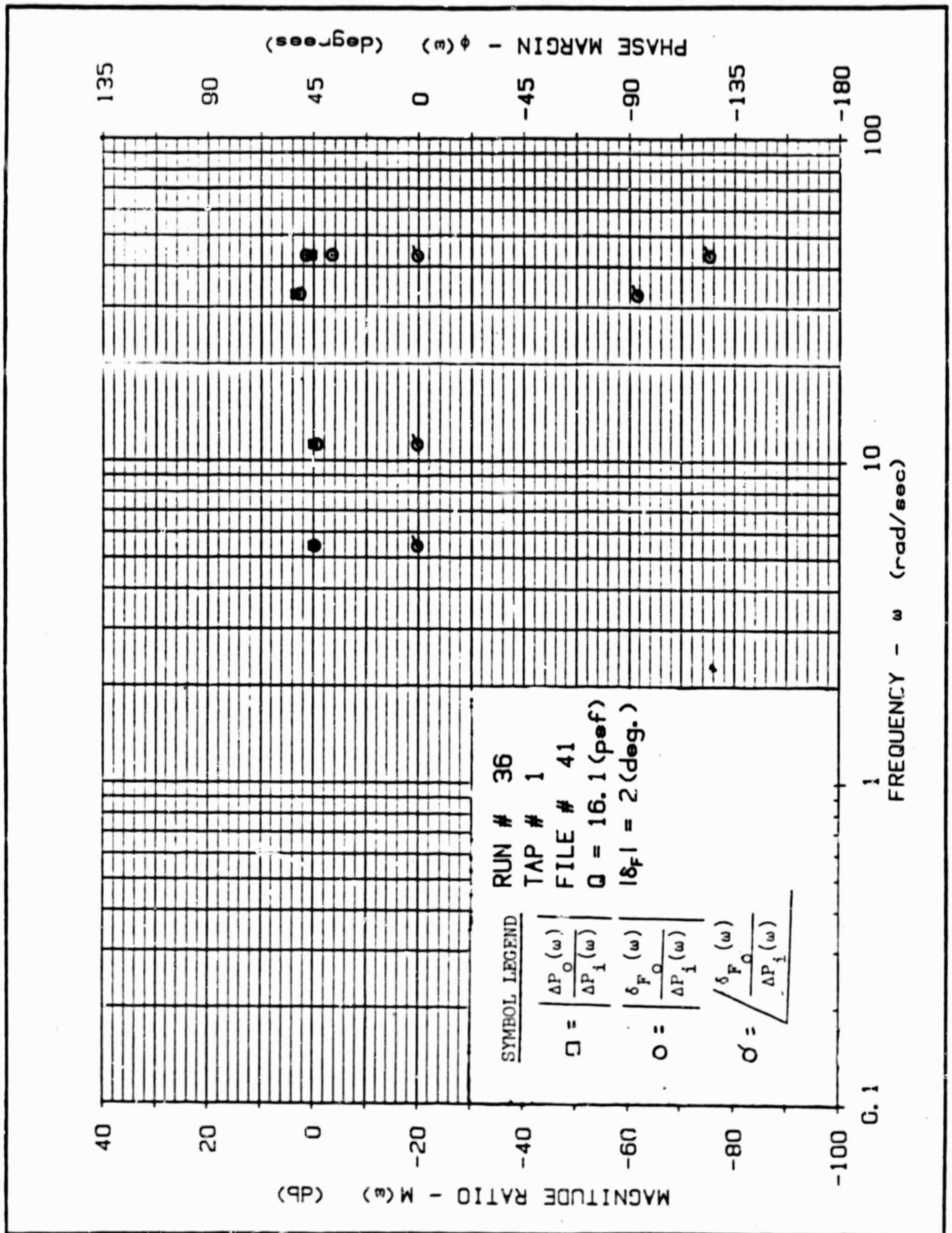

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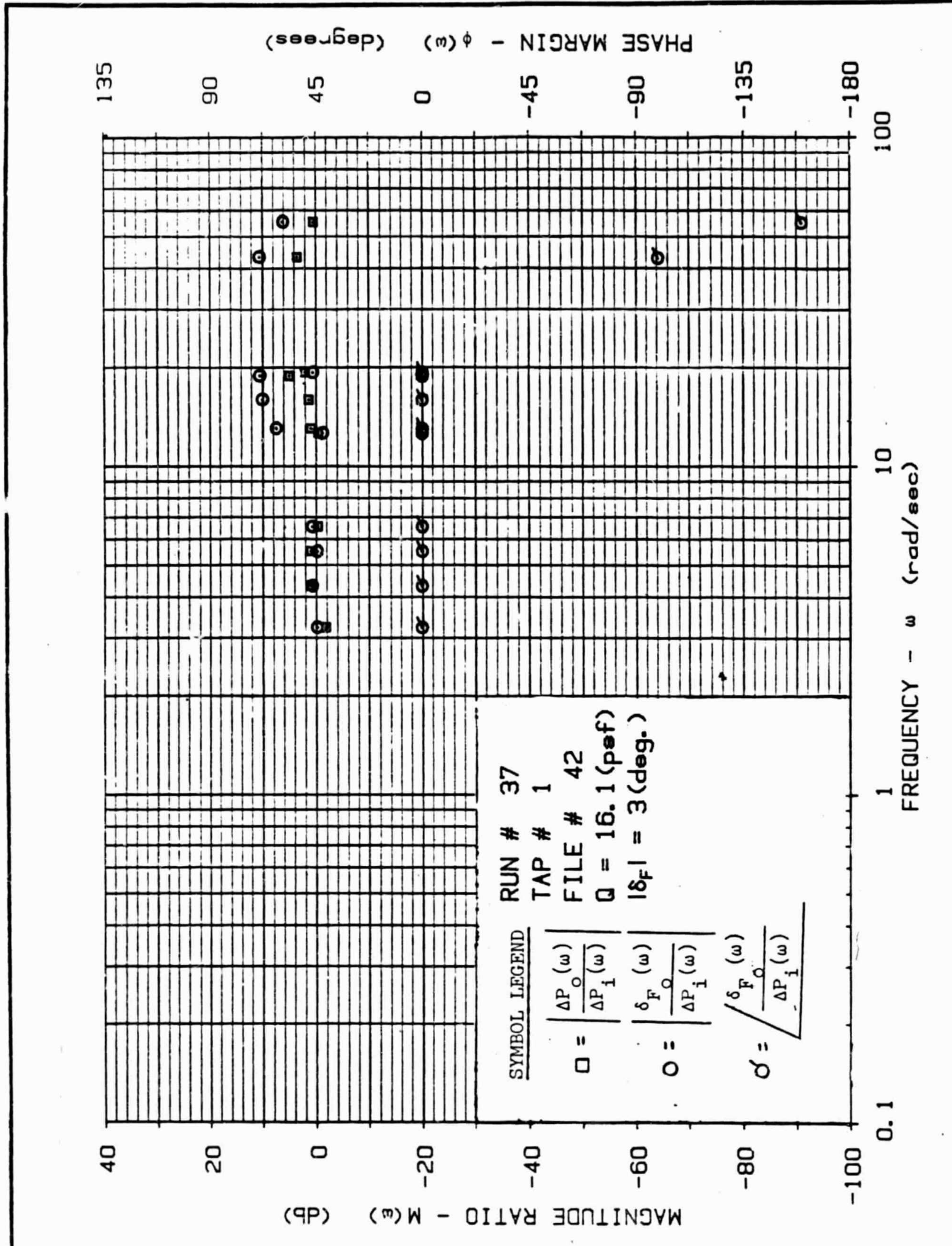

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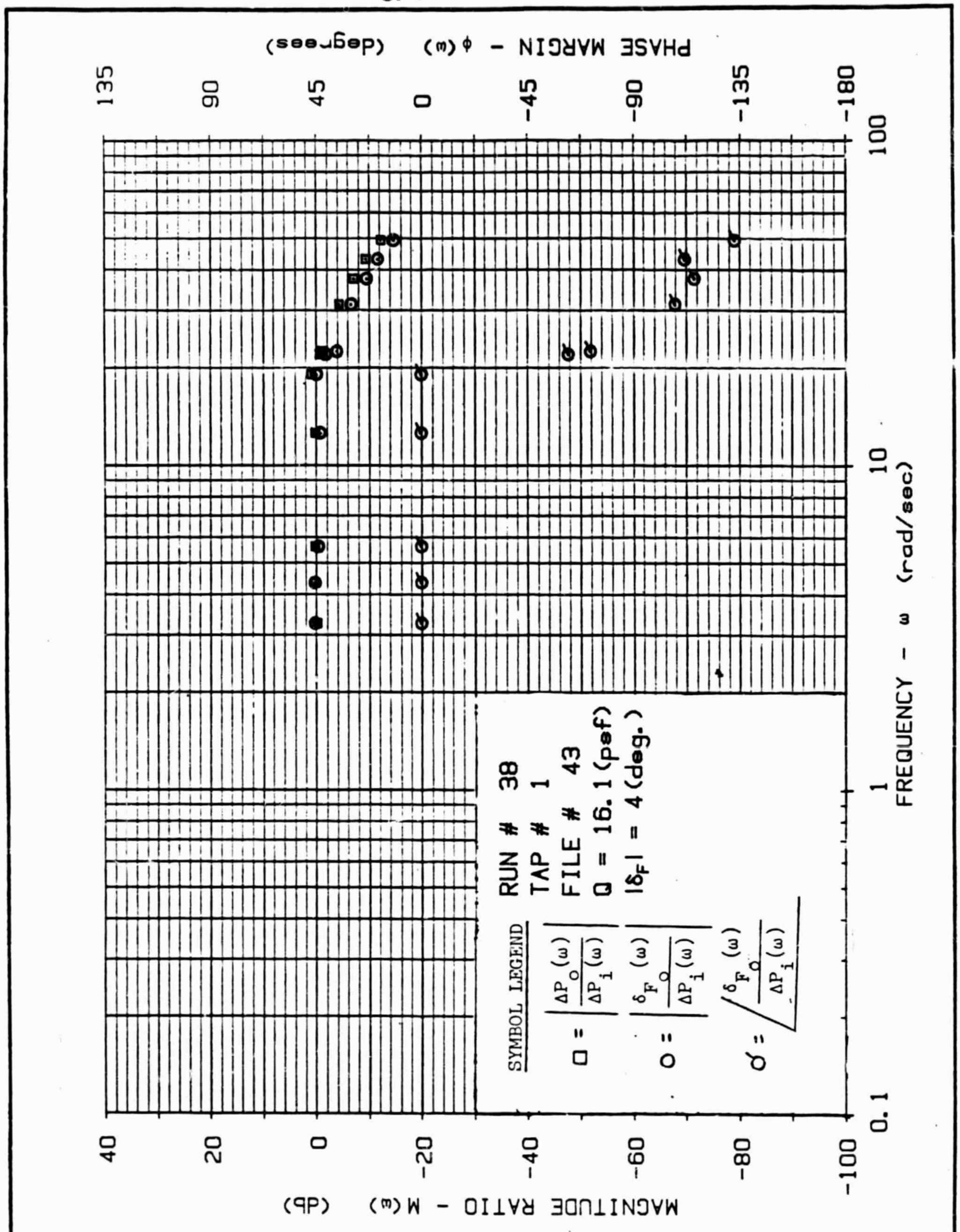

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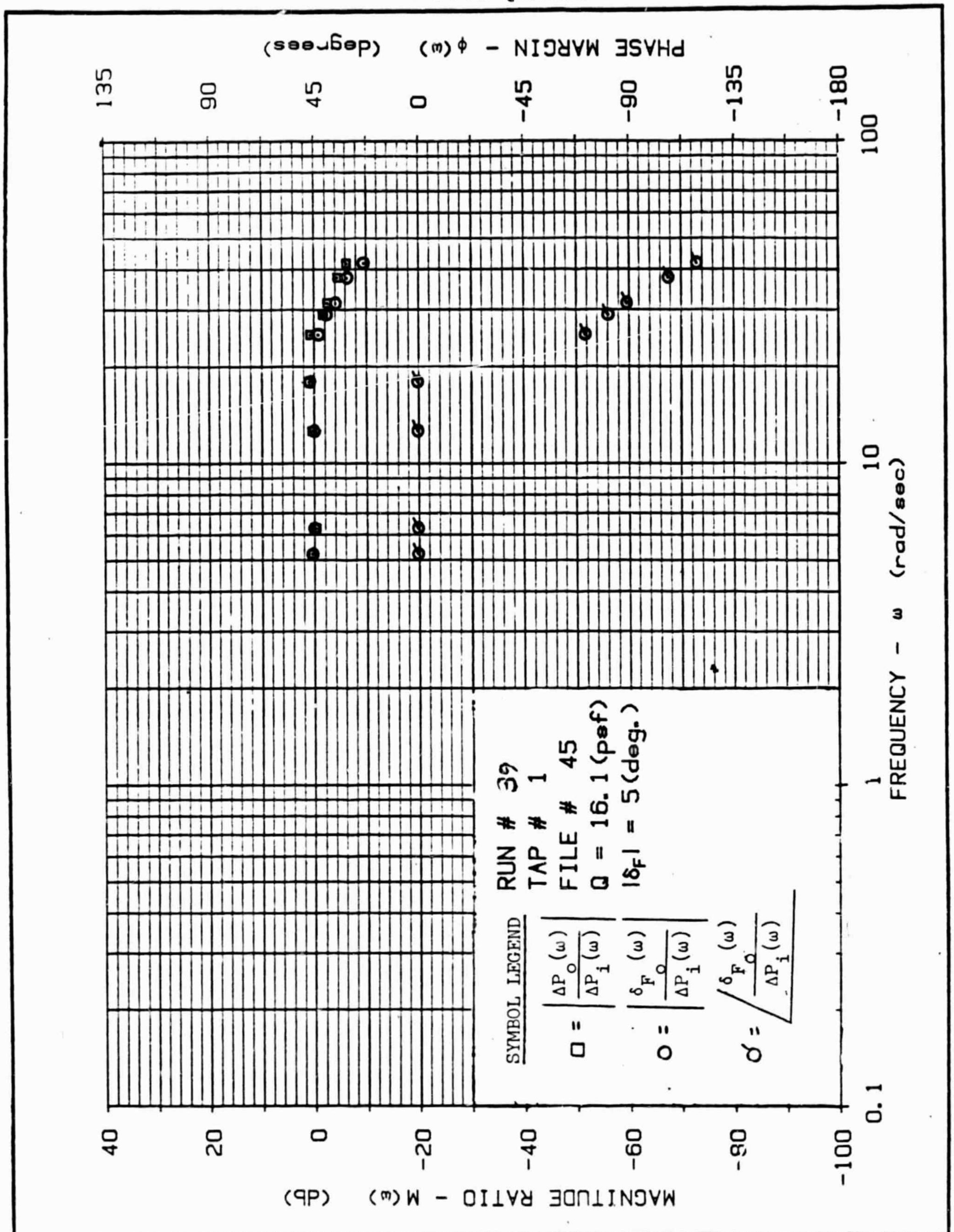

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FIGURE B11. PRESSURE COMMAND BODE - $q = 16.1$ (psf), $|\delta_F| = 5$ (deg.), TAP# 1

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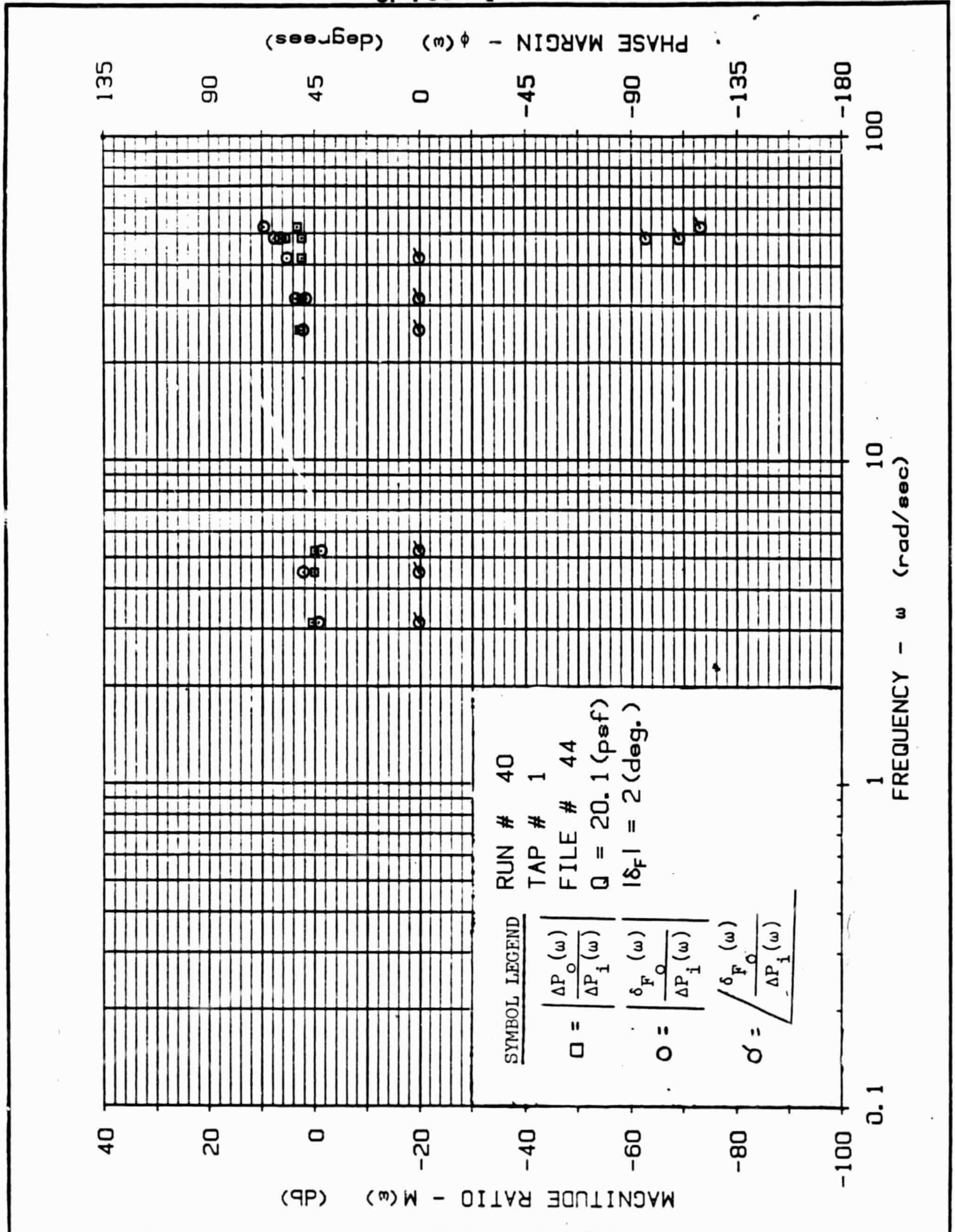

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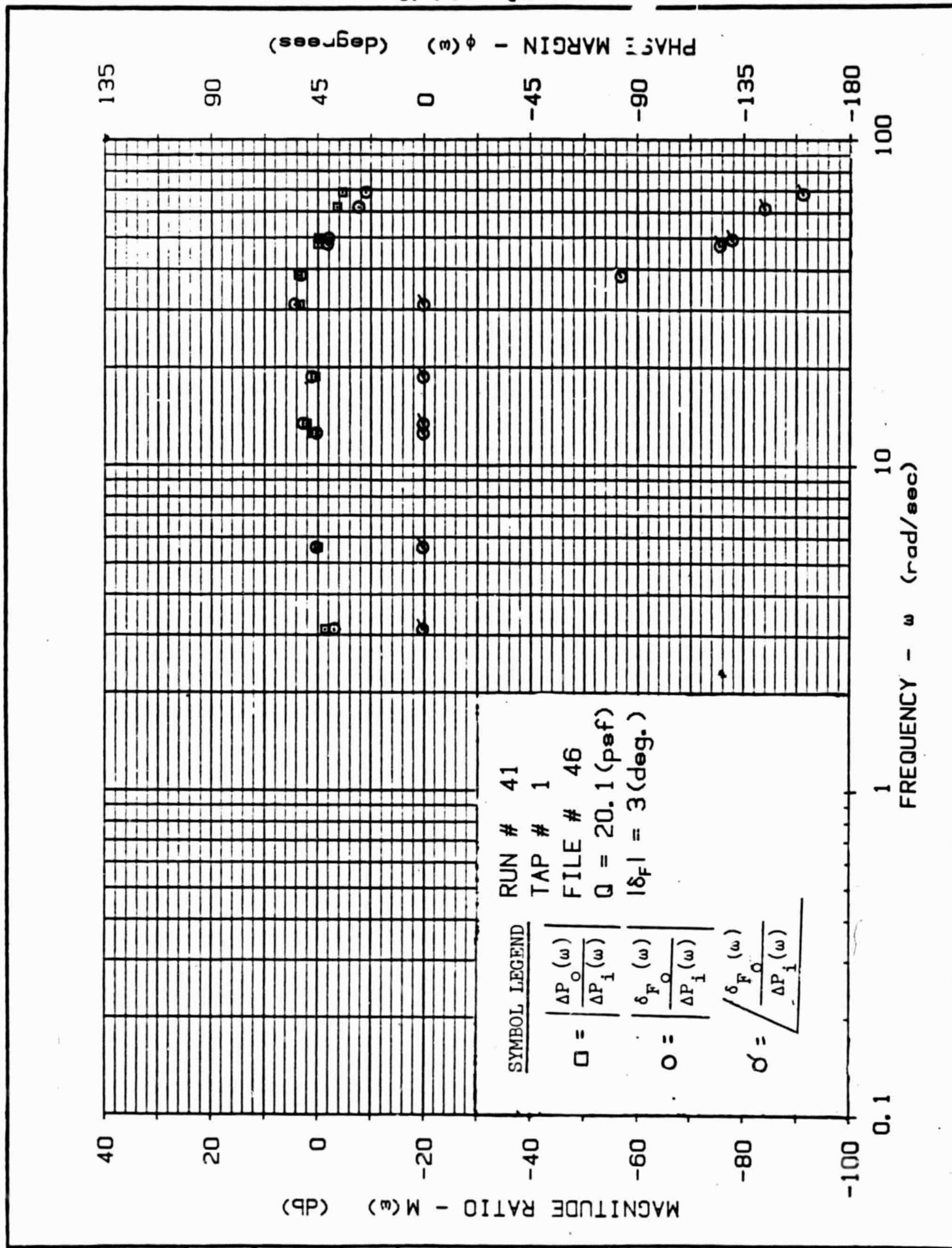

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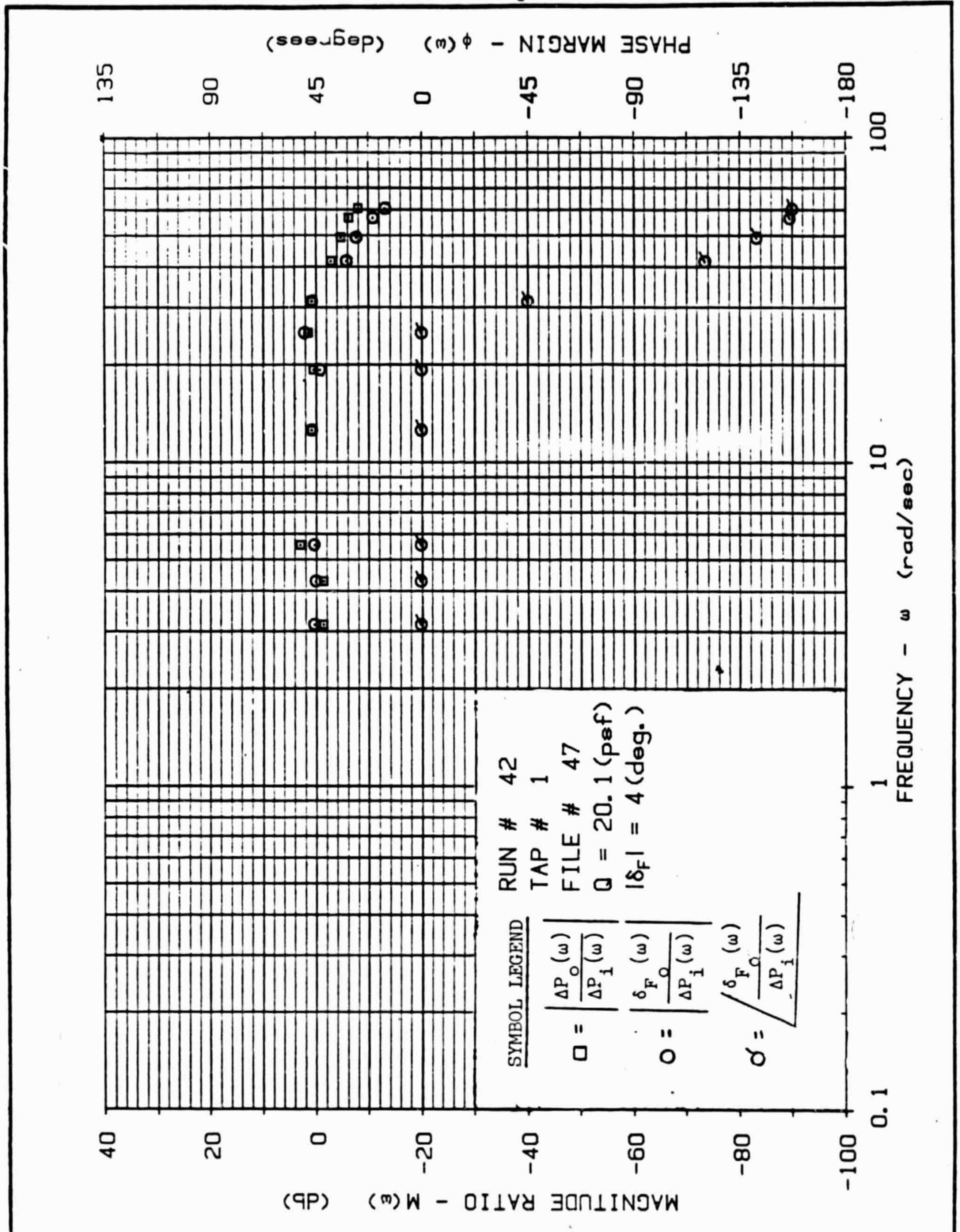

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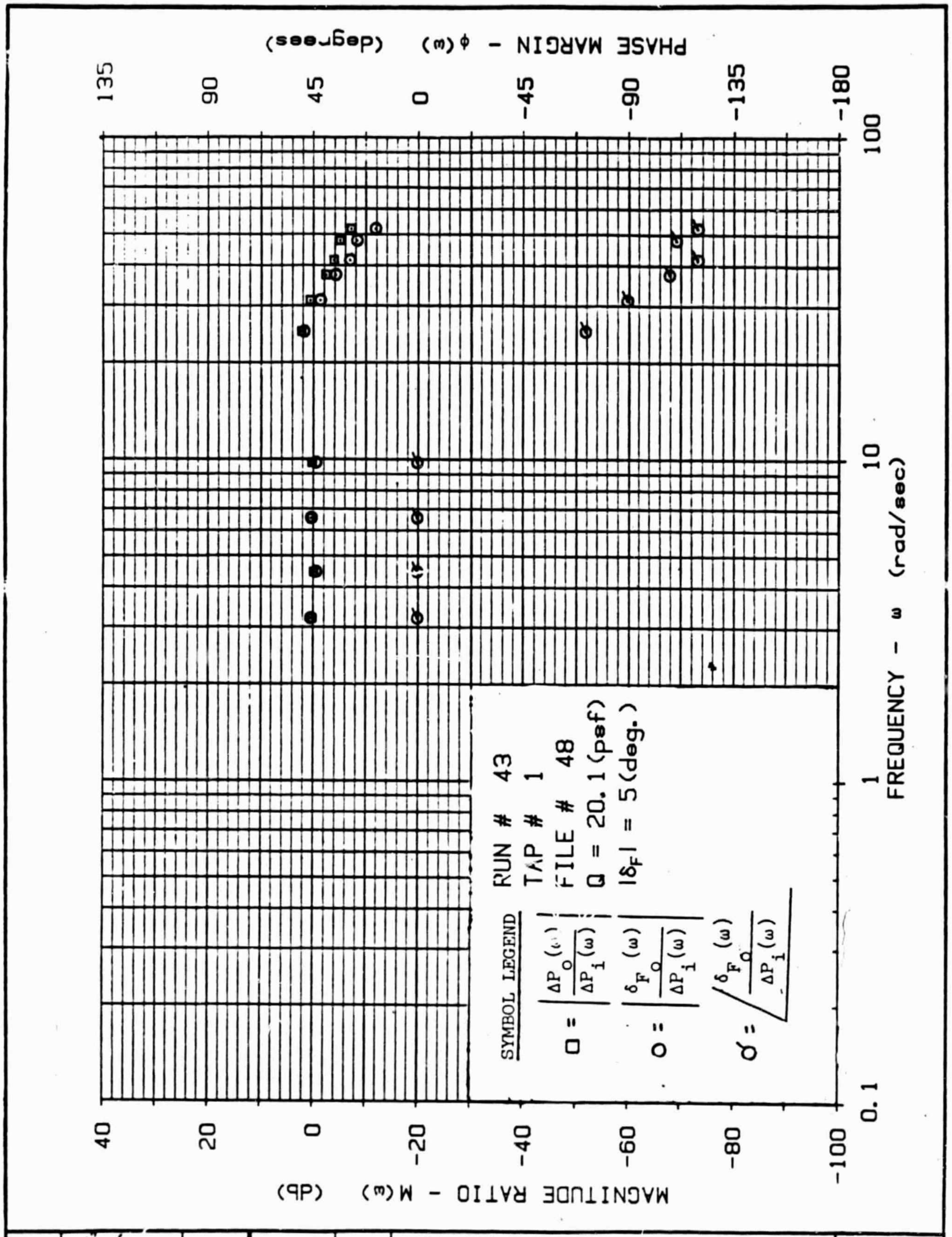

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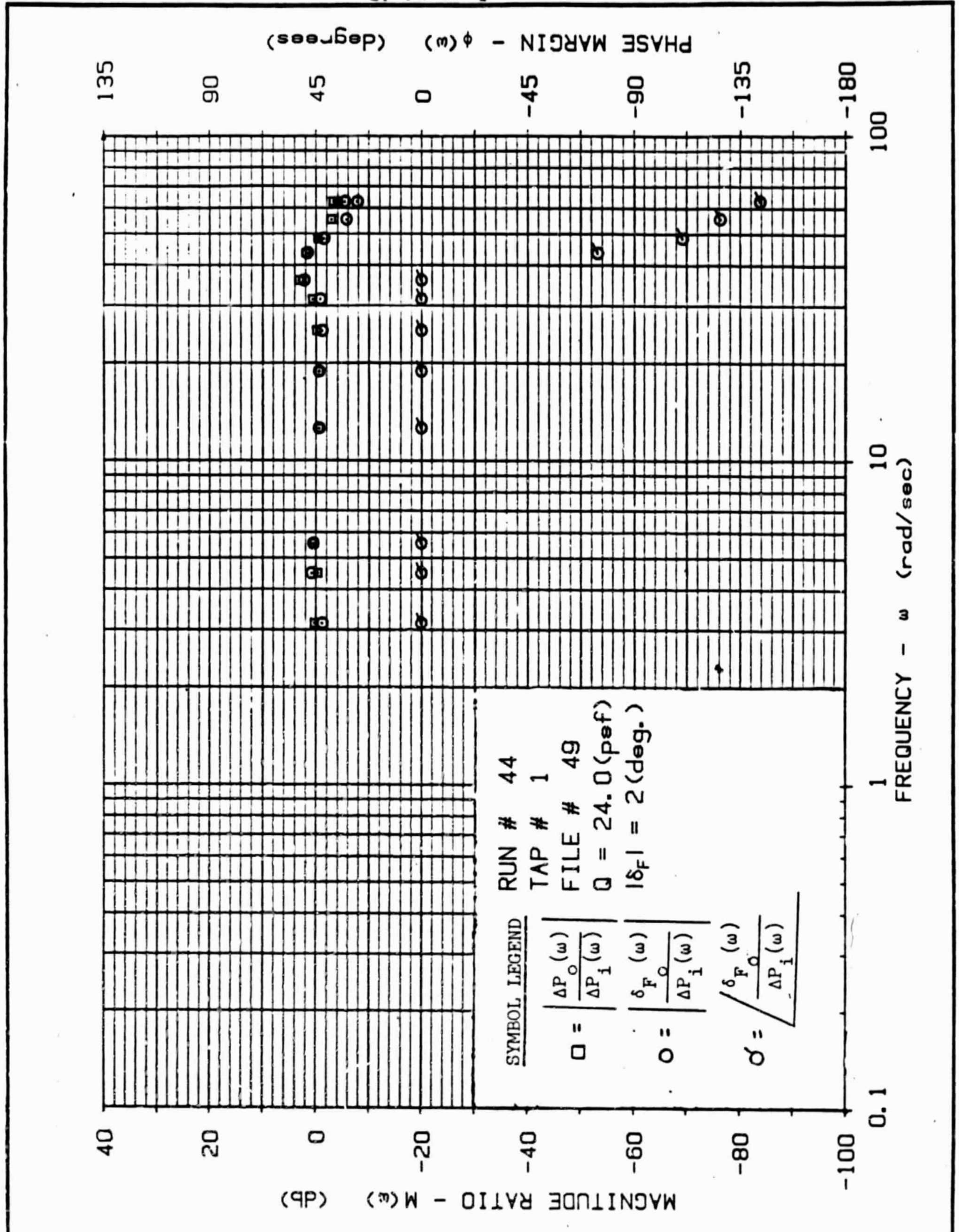

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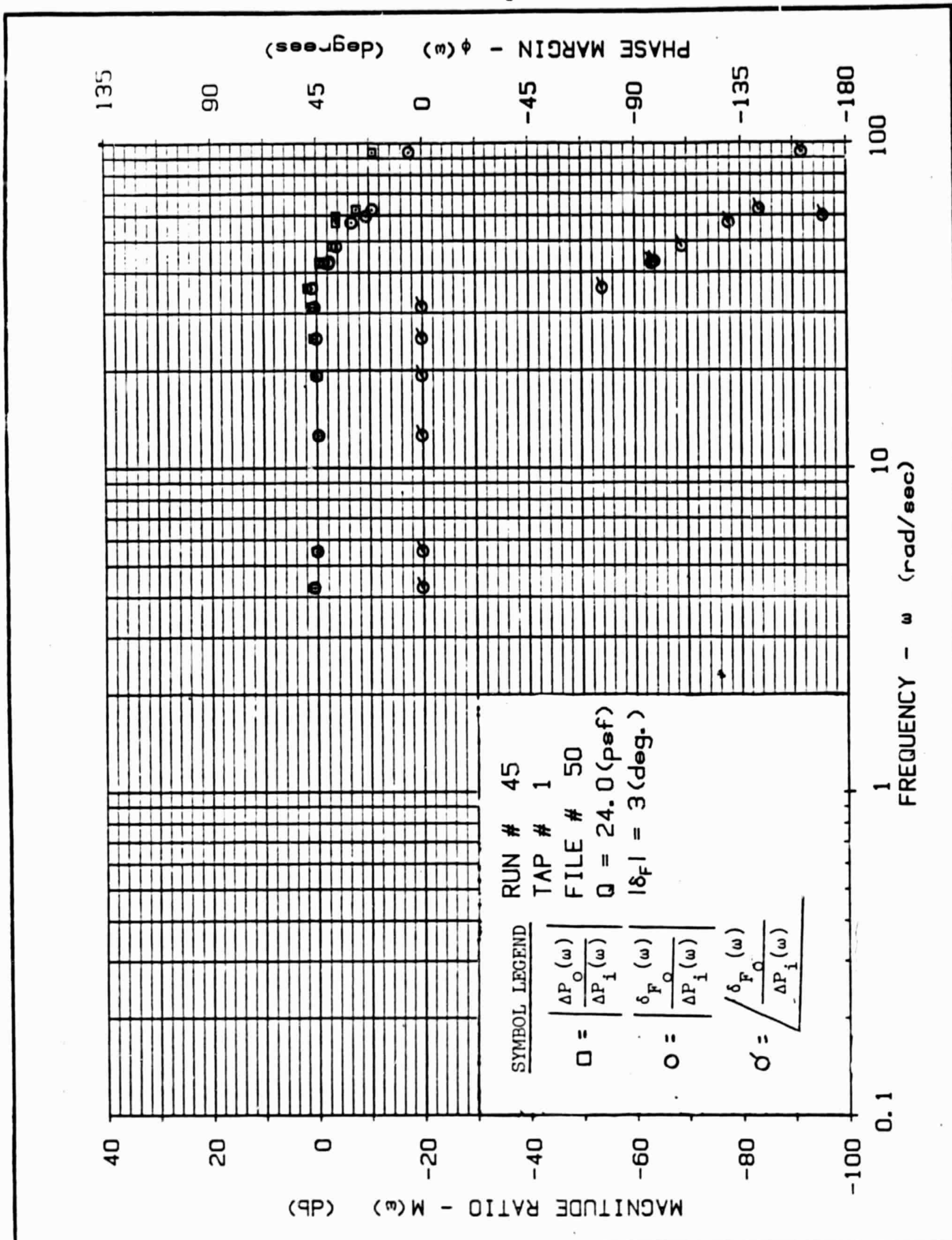

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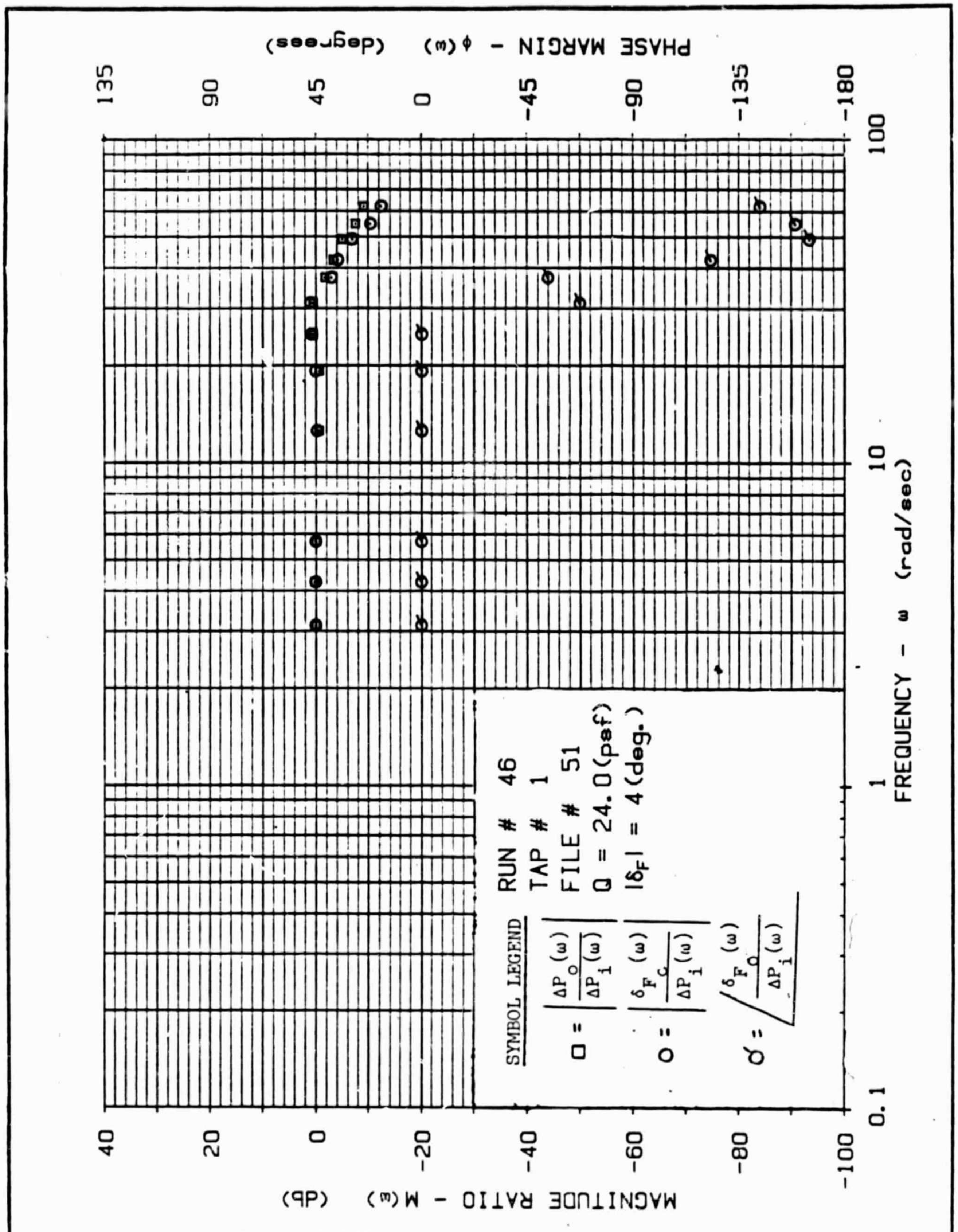

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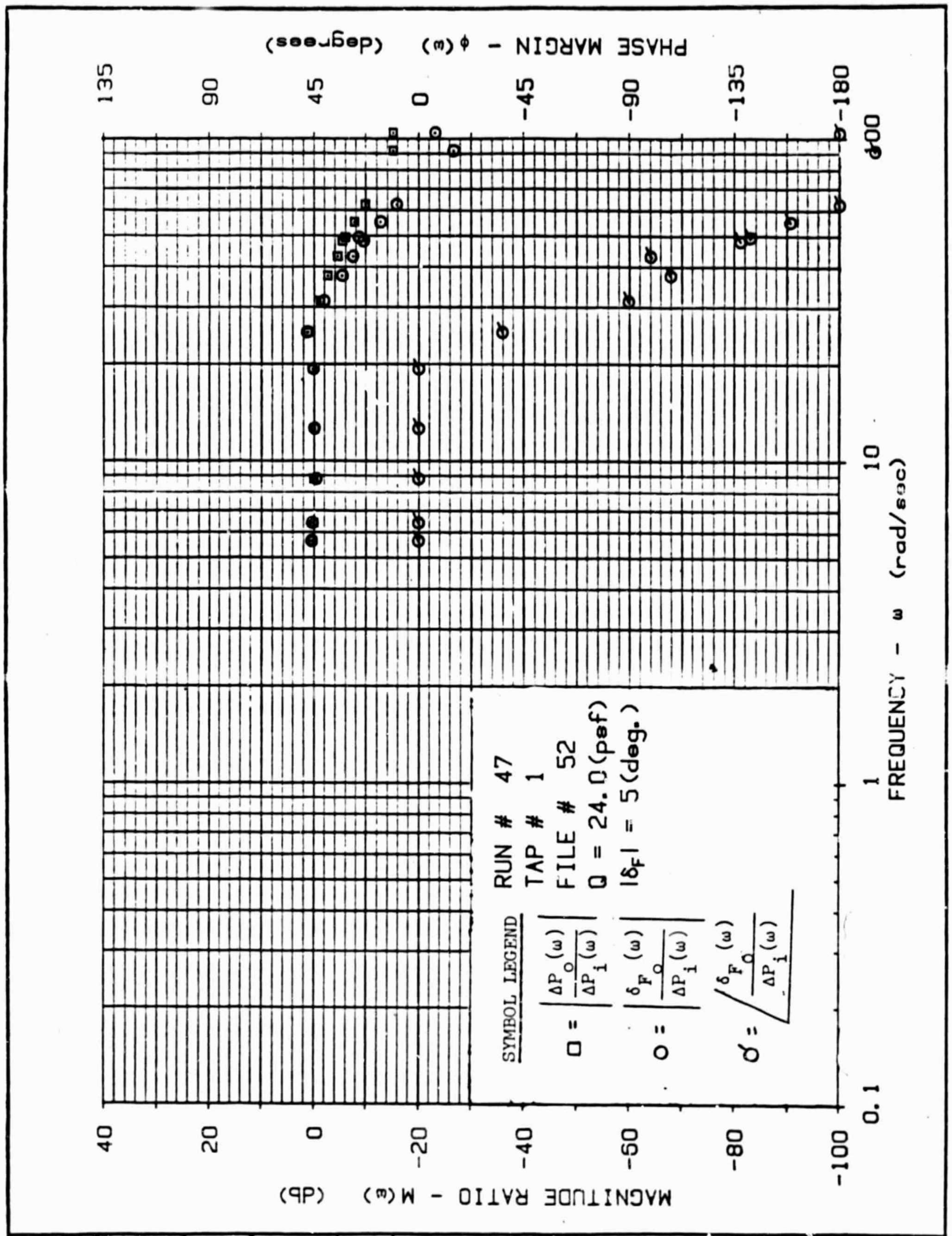

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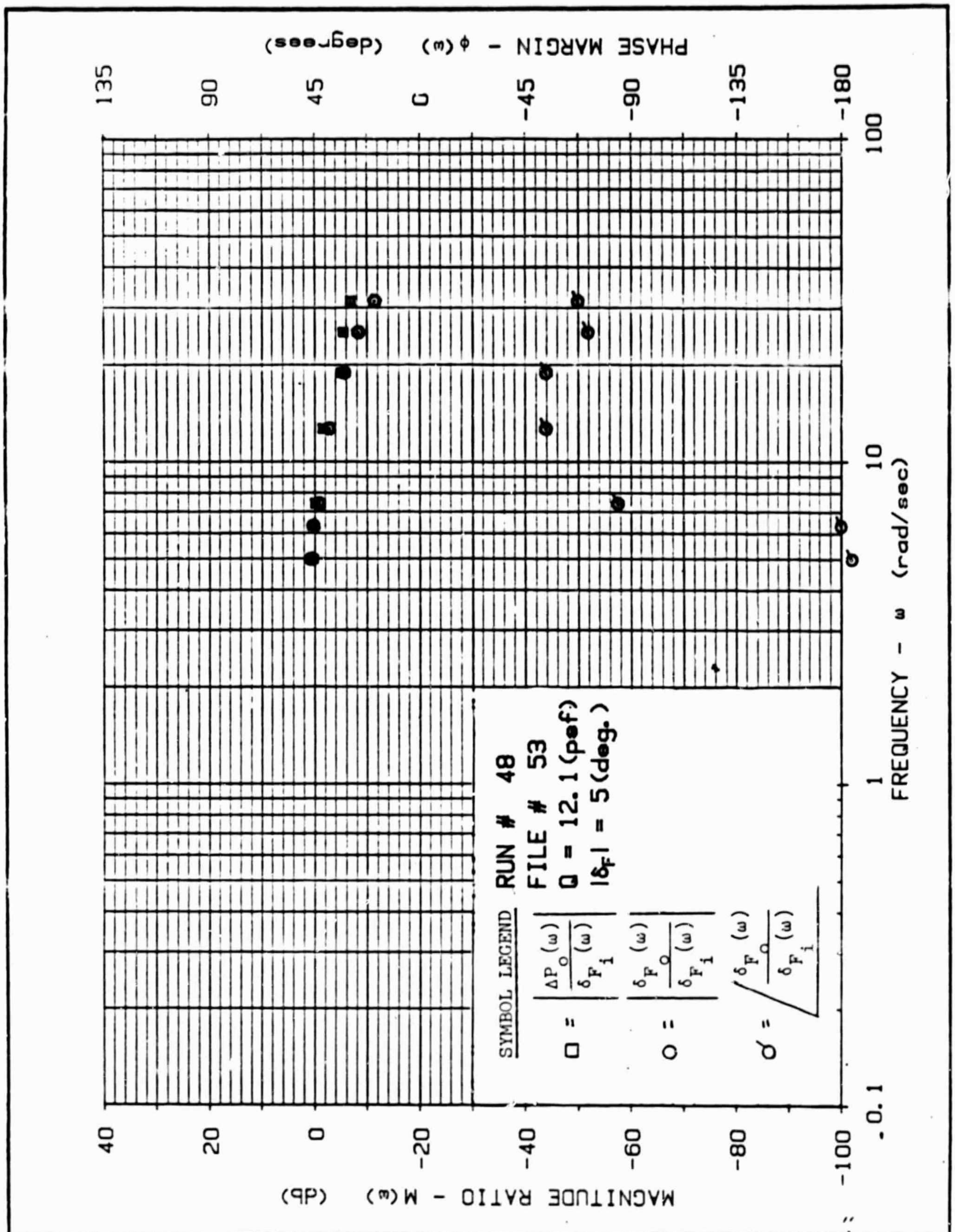

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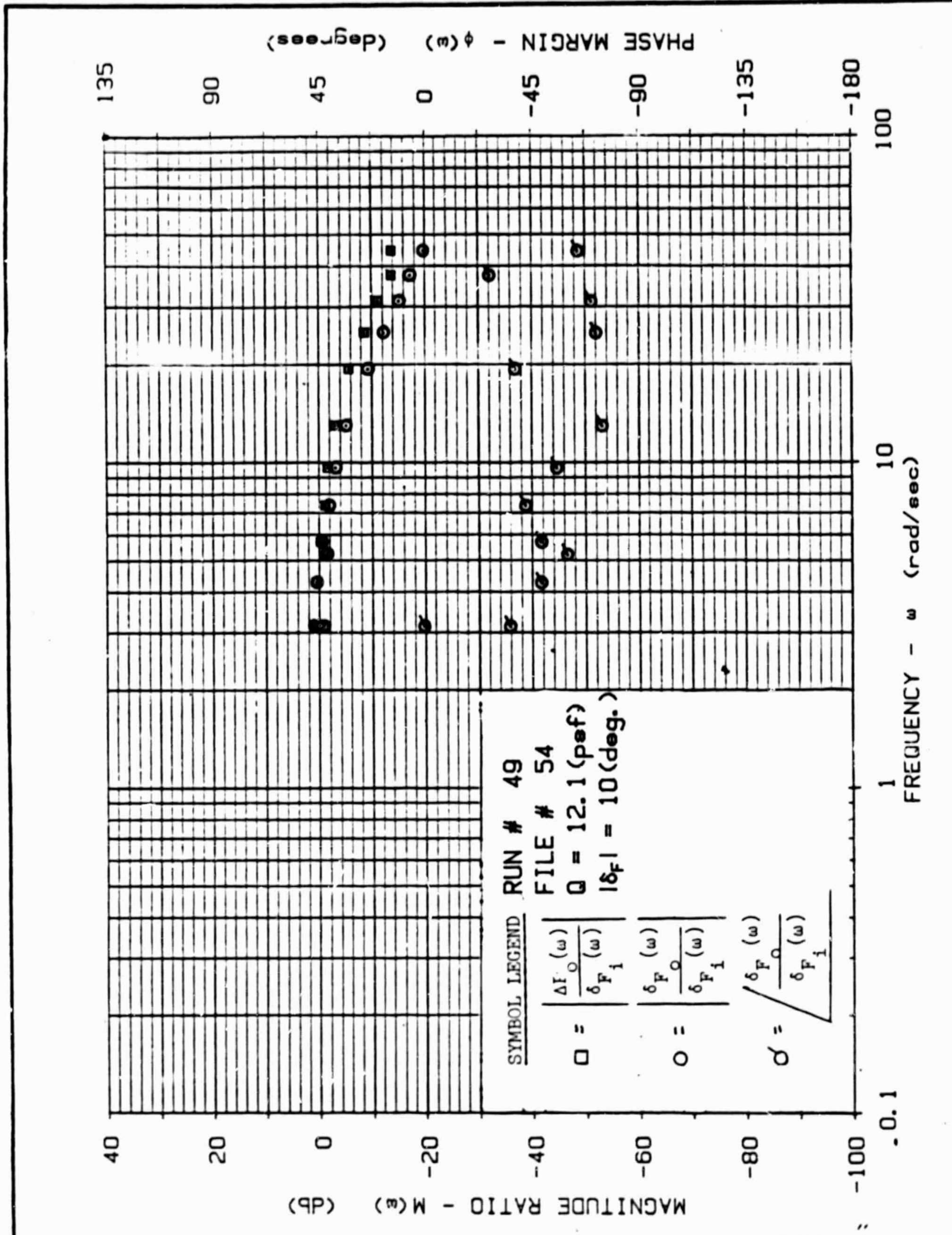

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FIGURE B21. PRESSURE COMMAND BODE - q= 12.1 (psf), $|\delta_F|$ = 10 (deg.)

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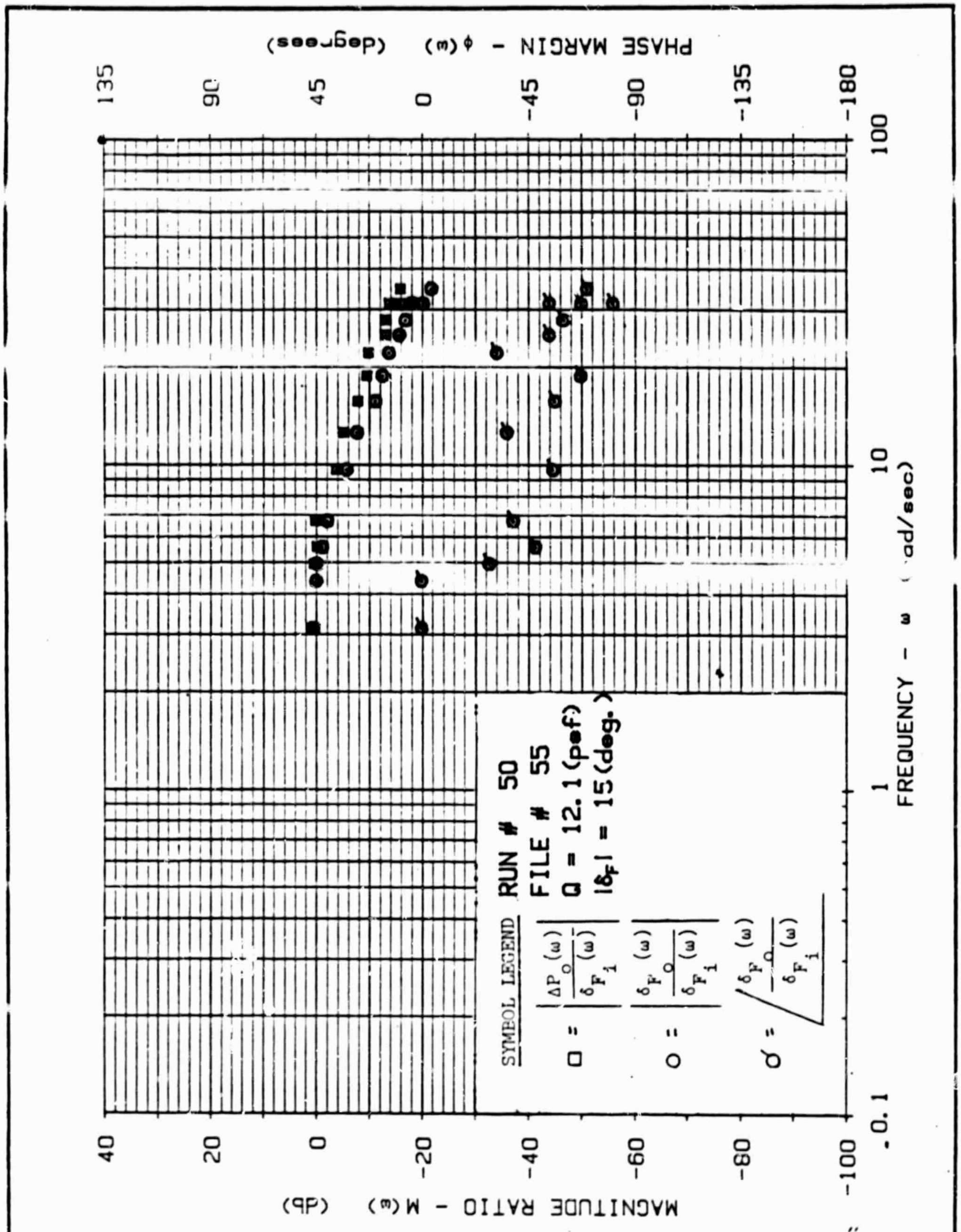

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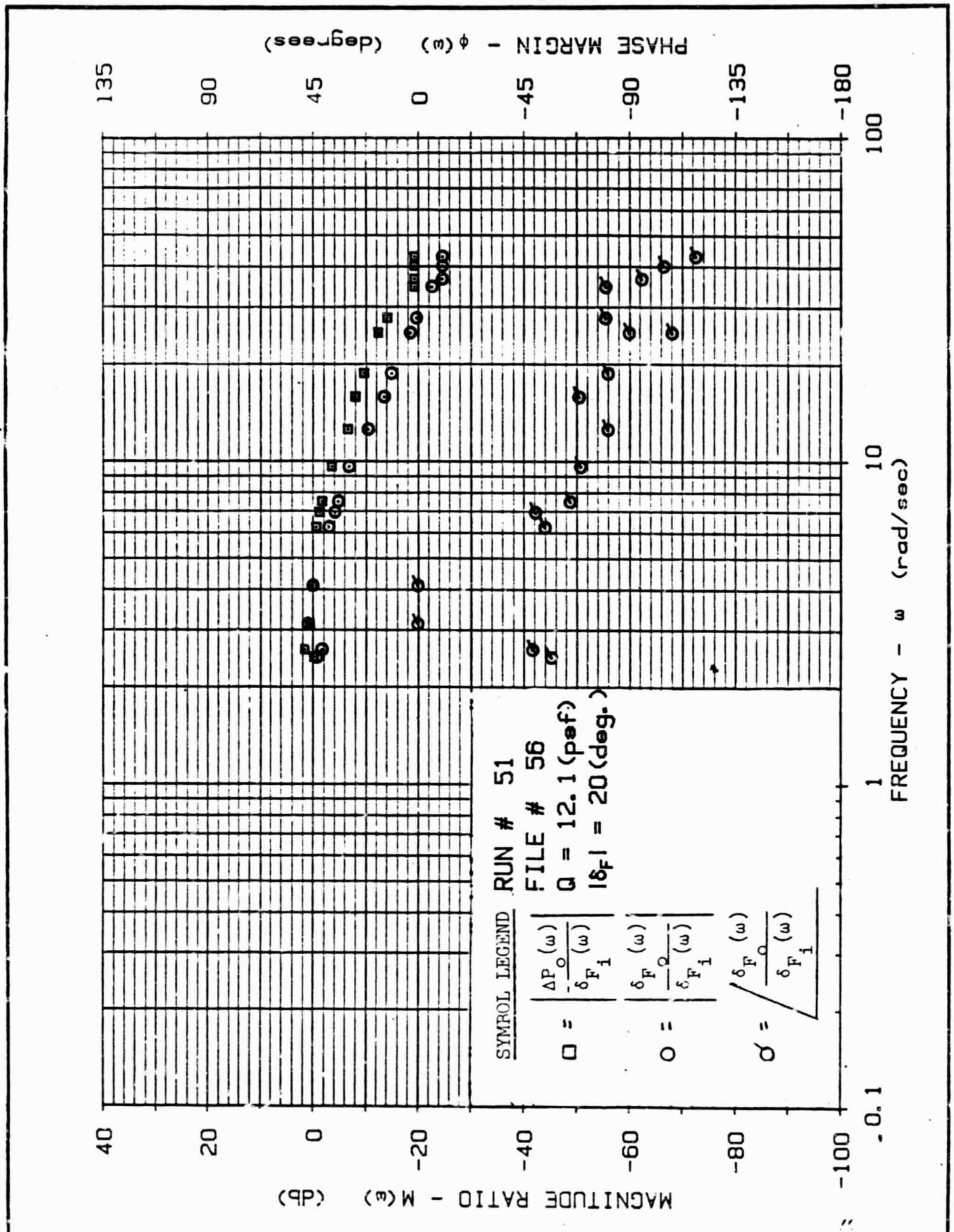

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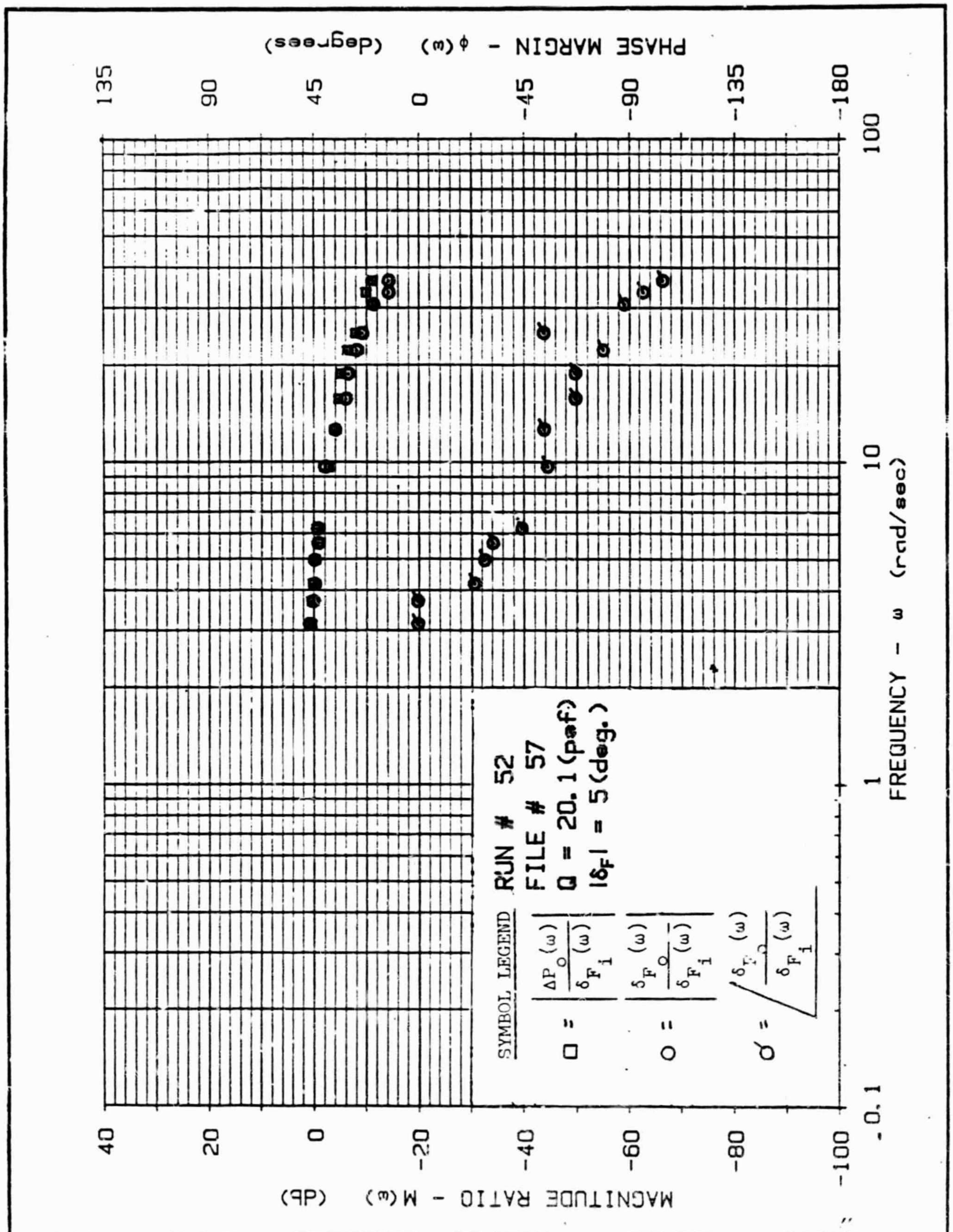

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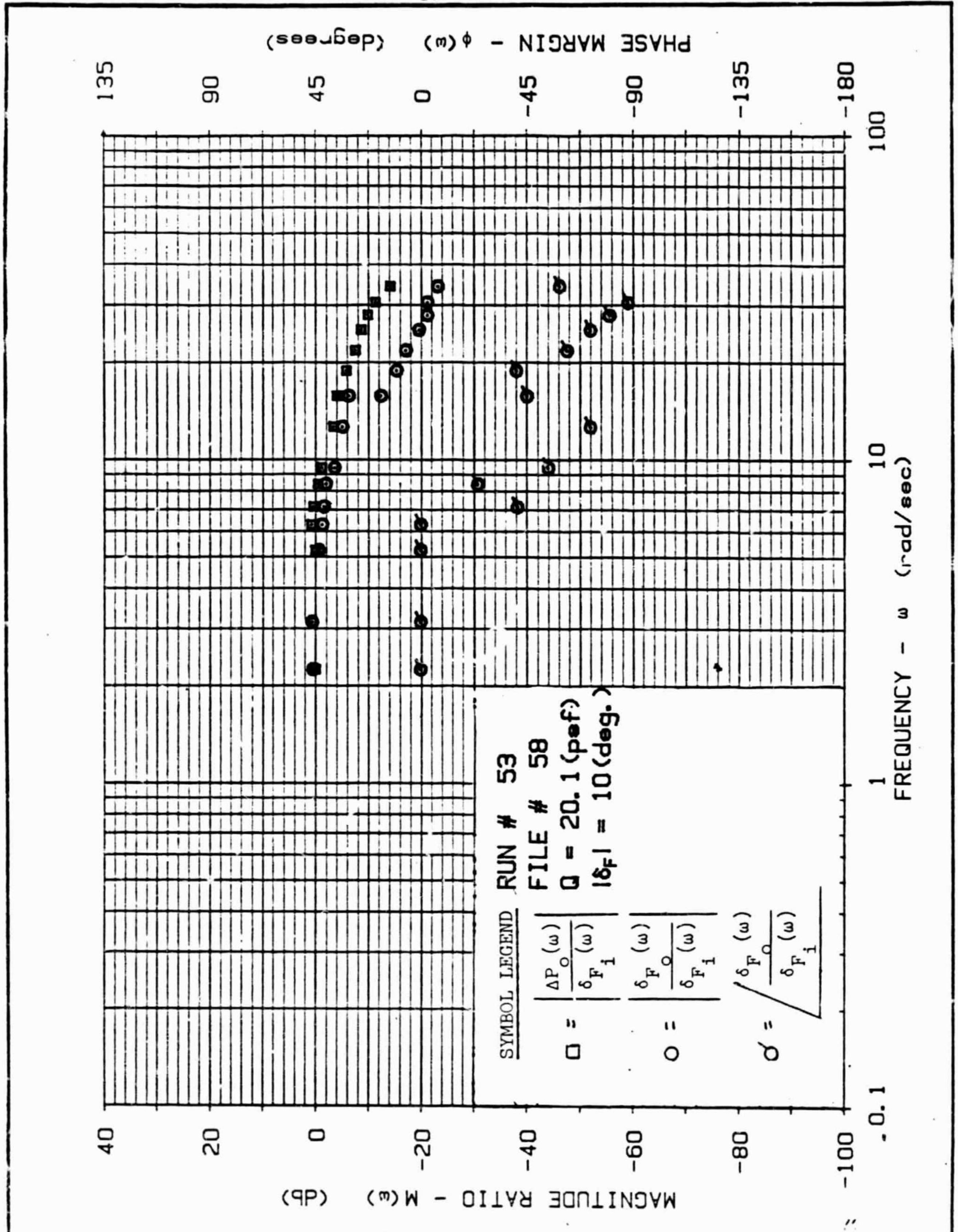

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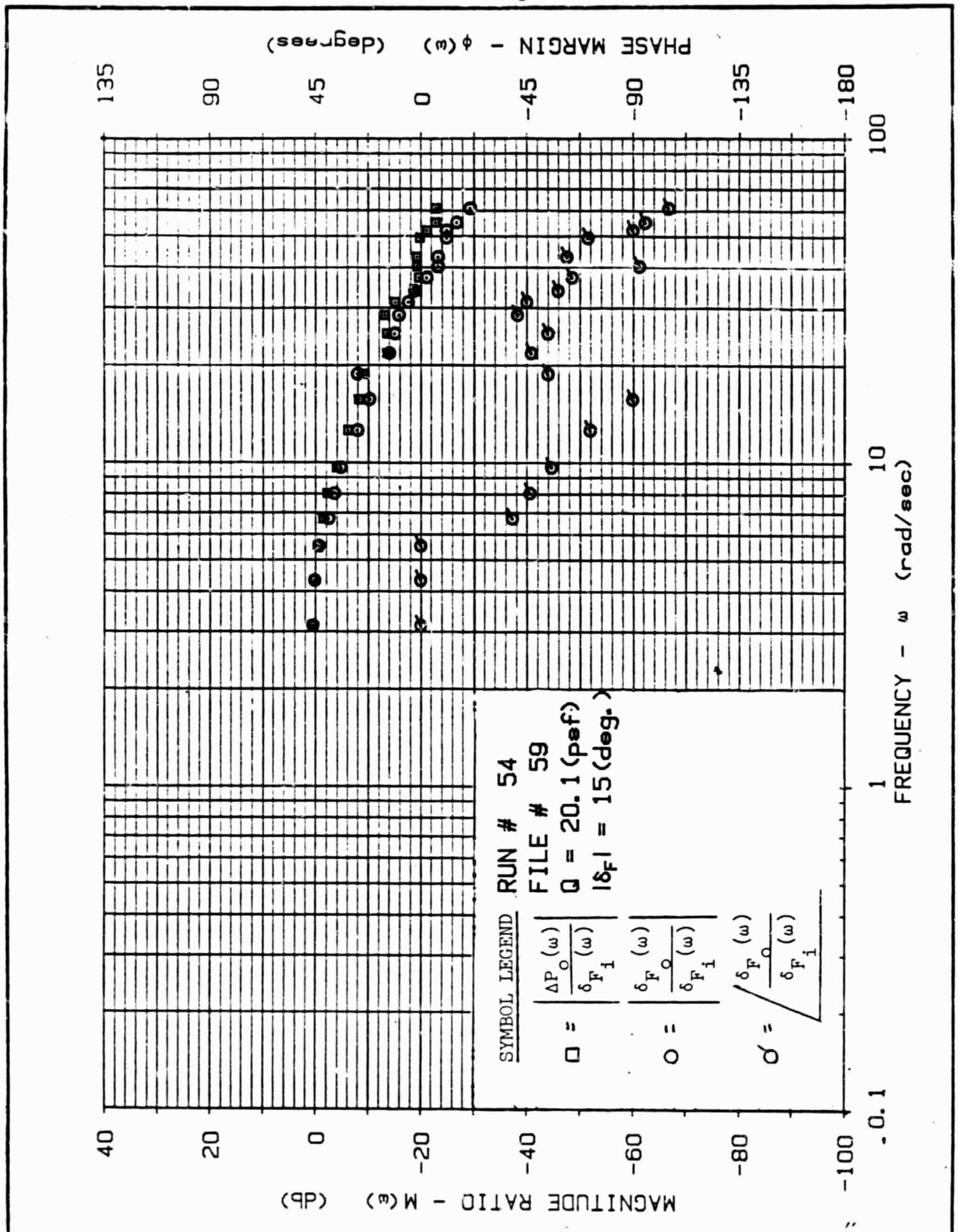

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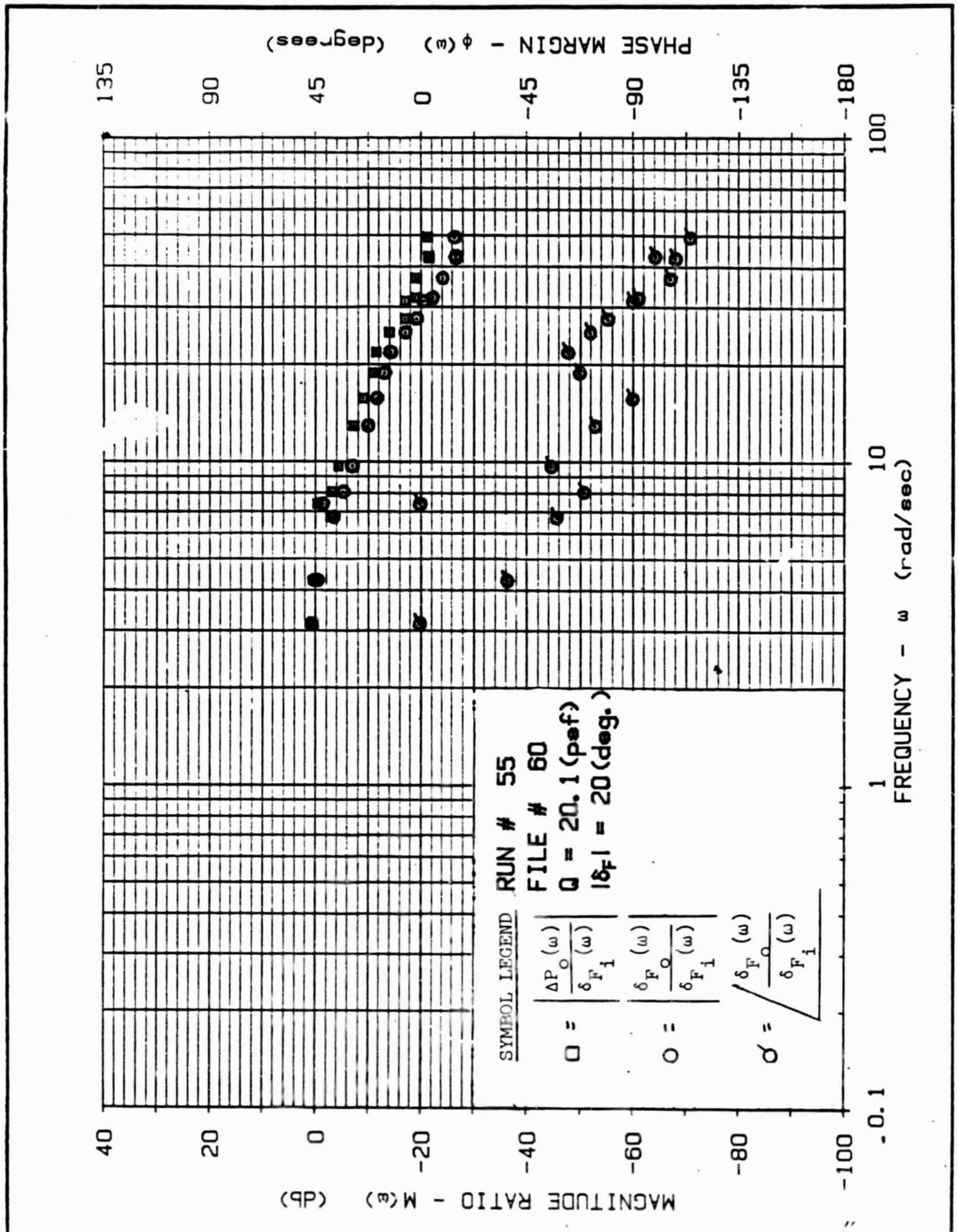

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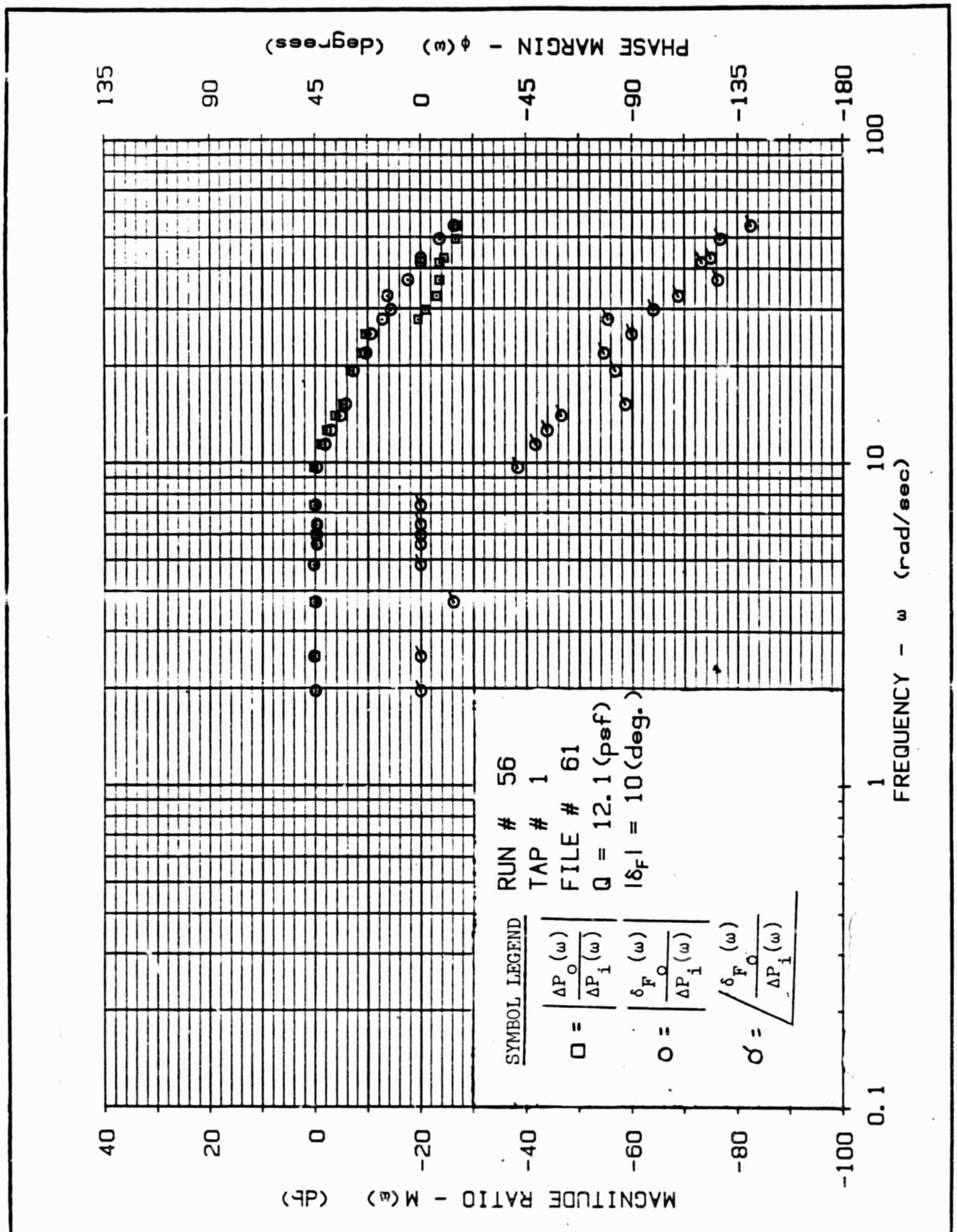

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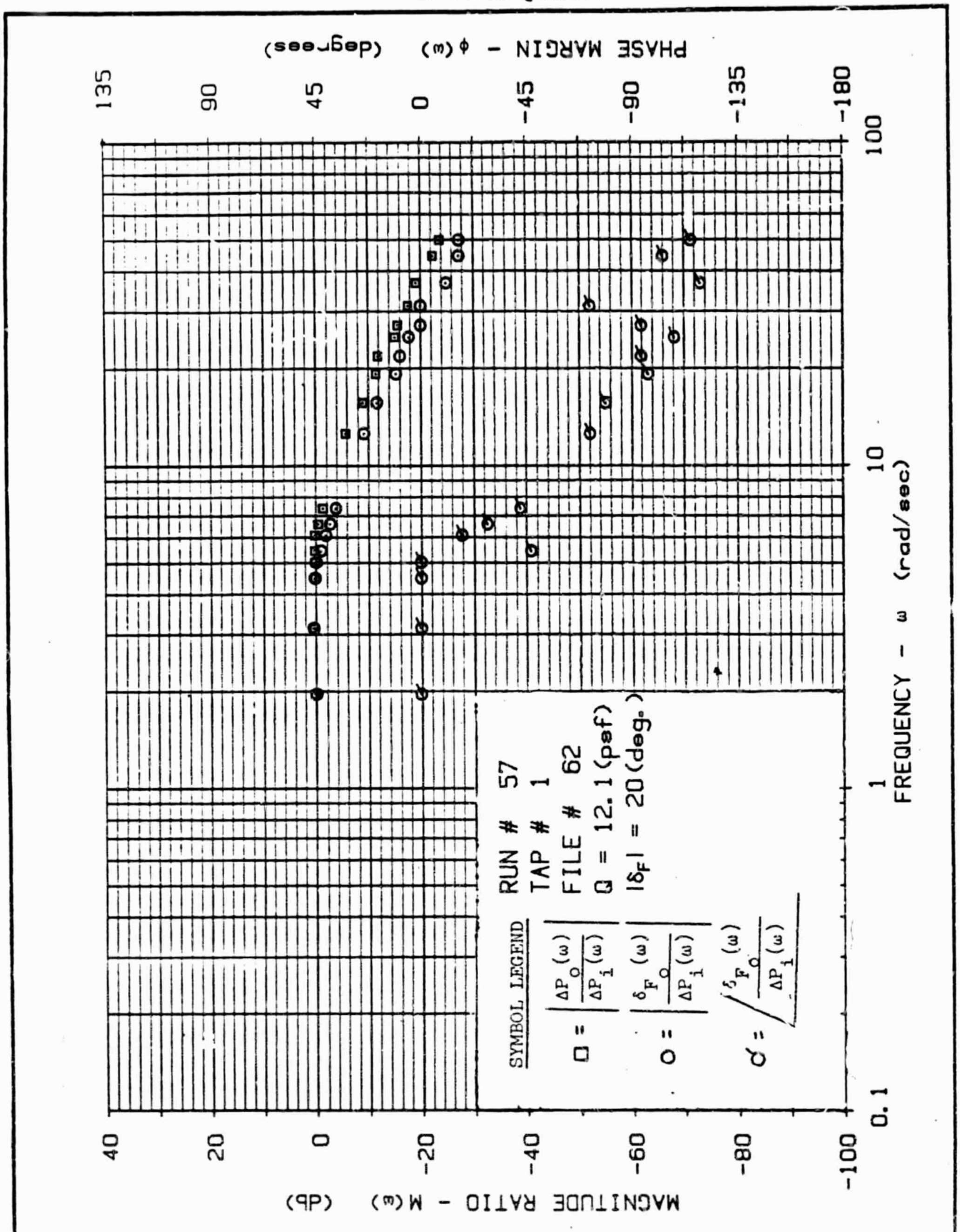

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FIGURE B29. PRESSURE COMMAND BODE - q= 12.1 (psf), $|\delta_F|$ = 20 (deg.), TAP# 1

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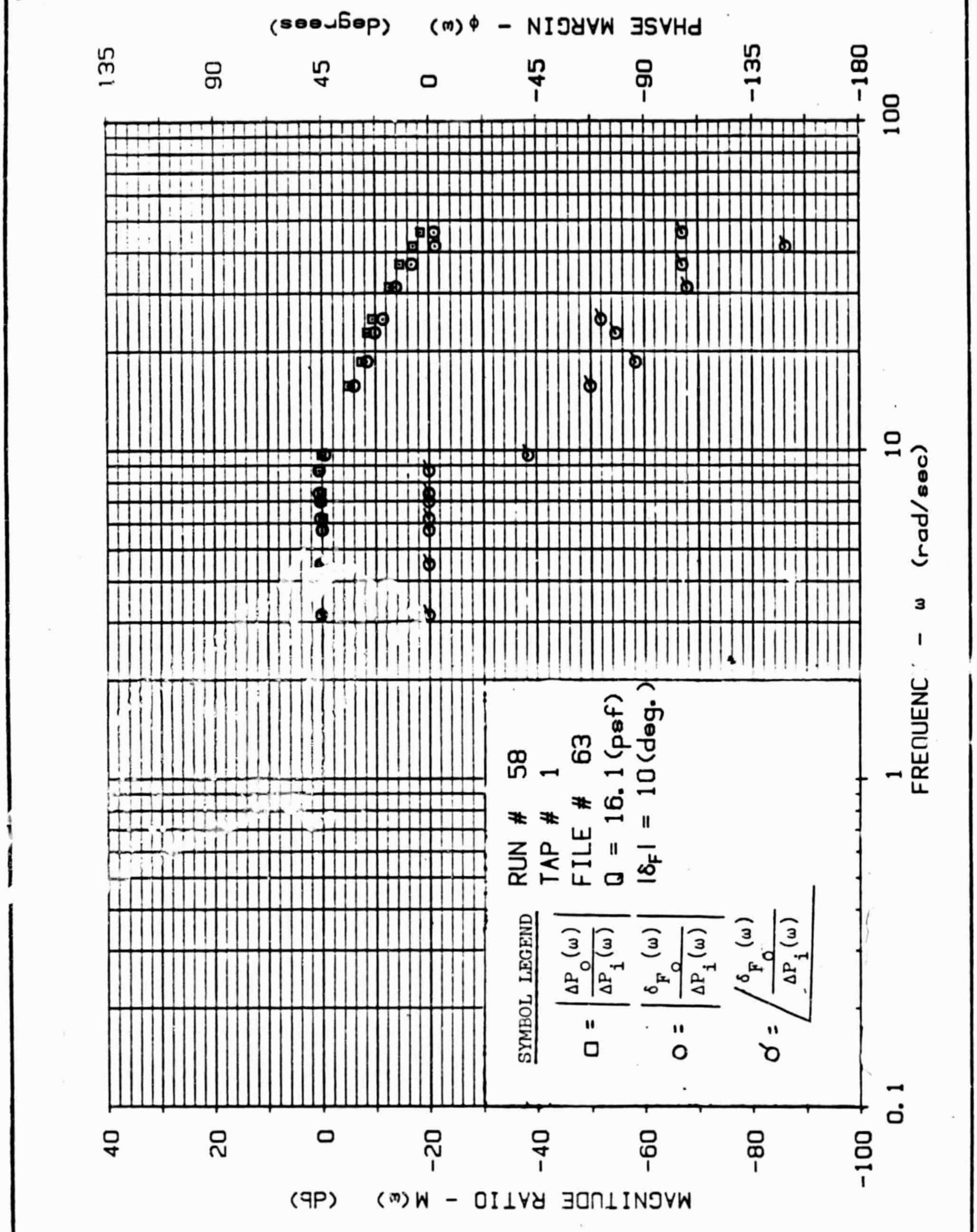

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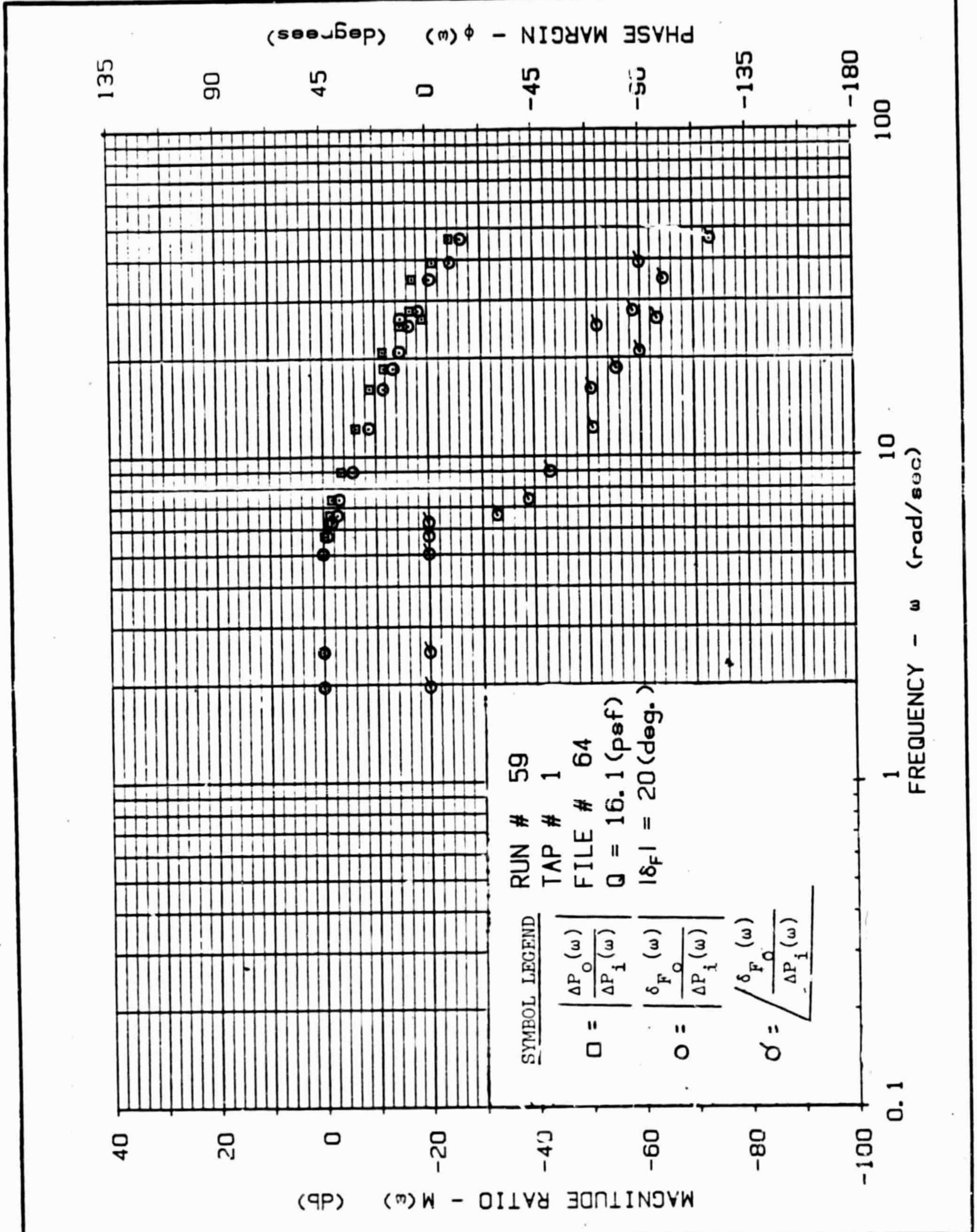

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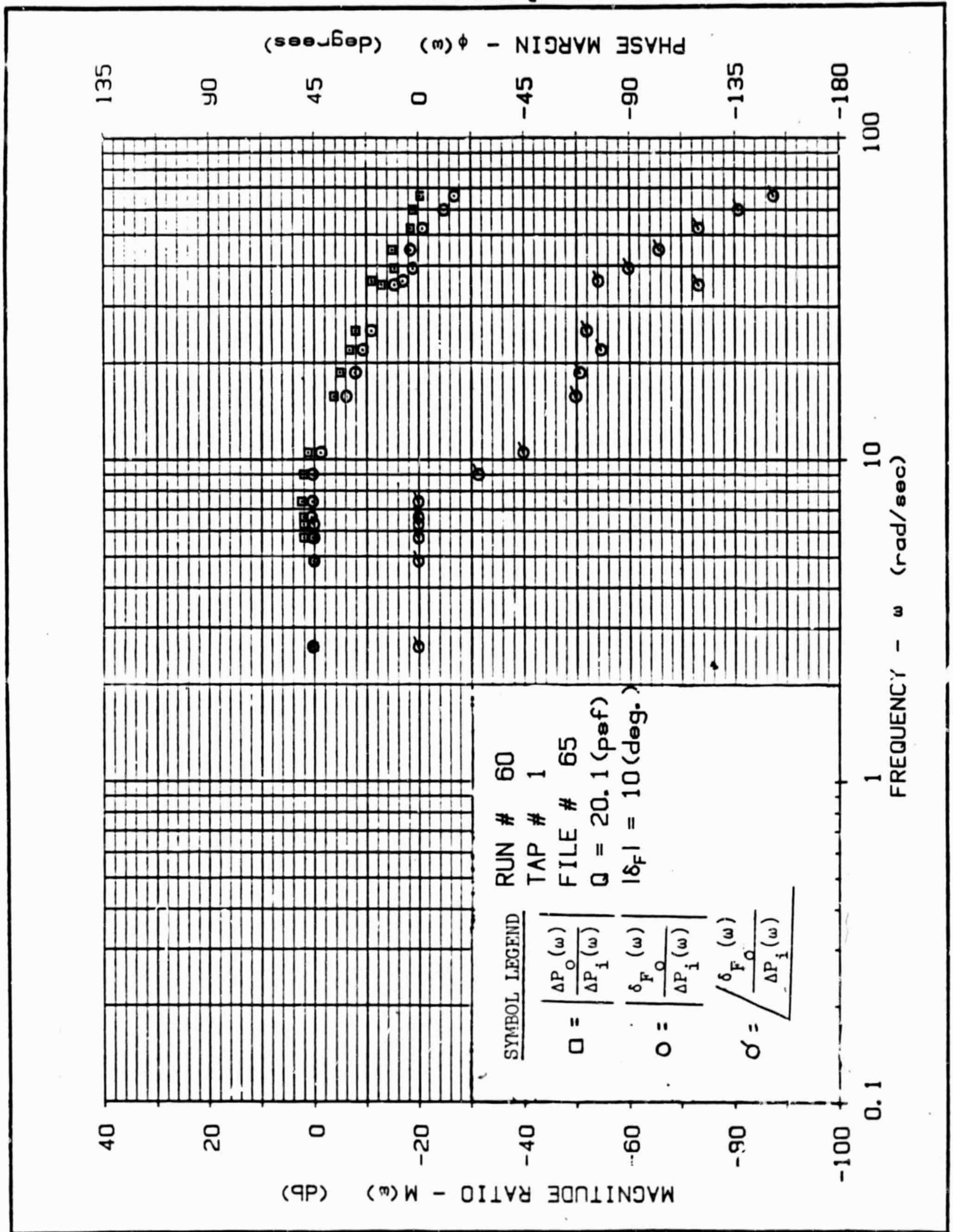

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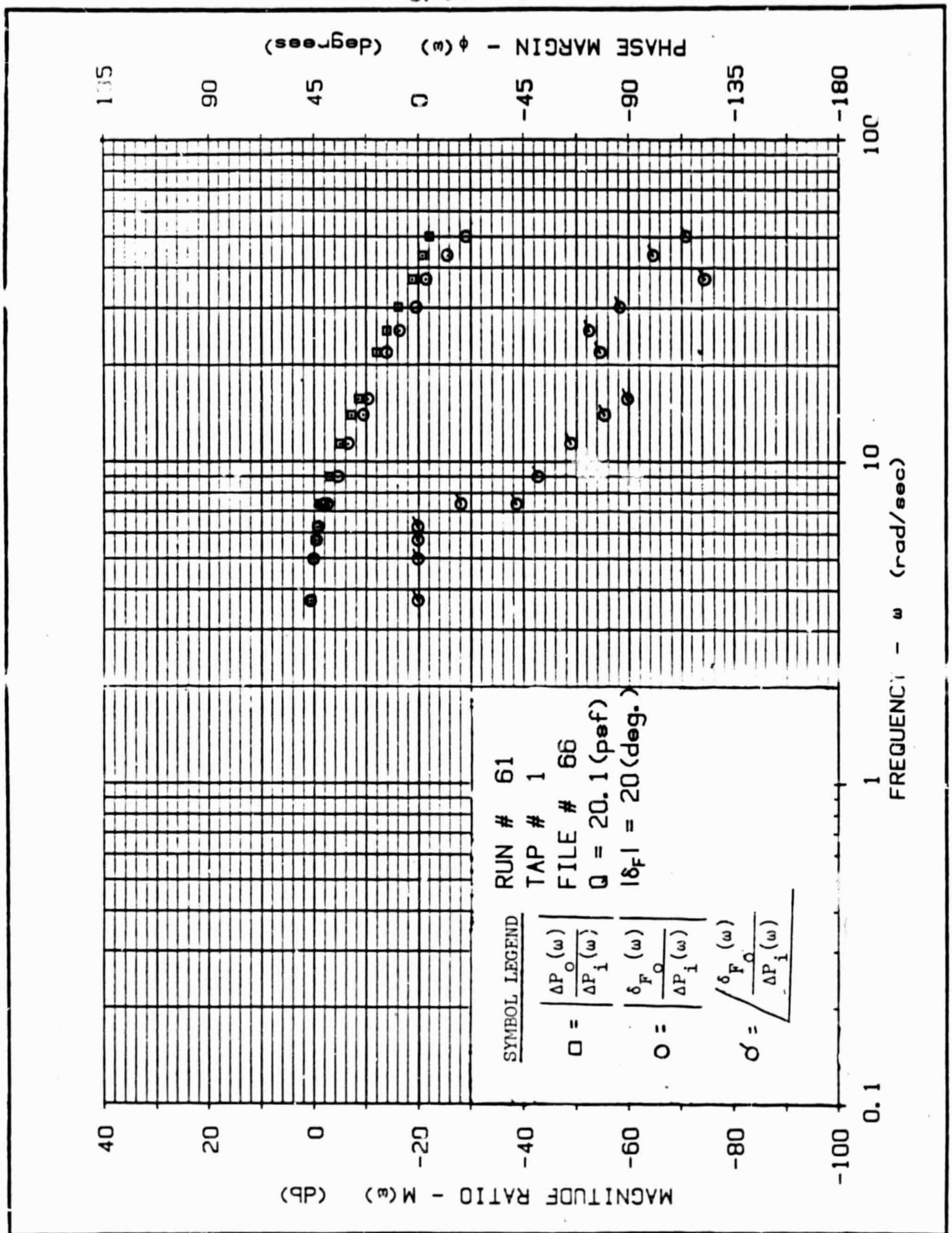

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FIGURE B 33. PRESSURE COMMAND BODE - q= 20.1 (psf), $|\delta_F|$ = 20 (deg.), TAP# 1

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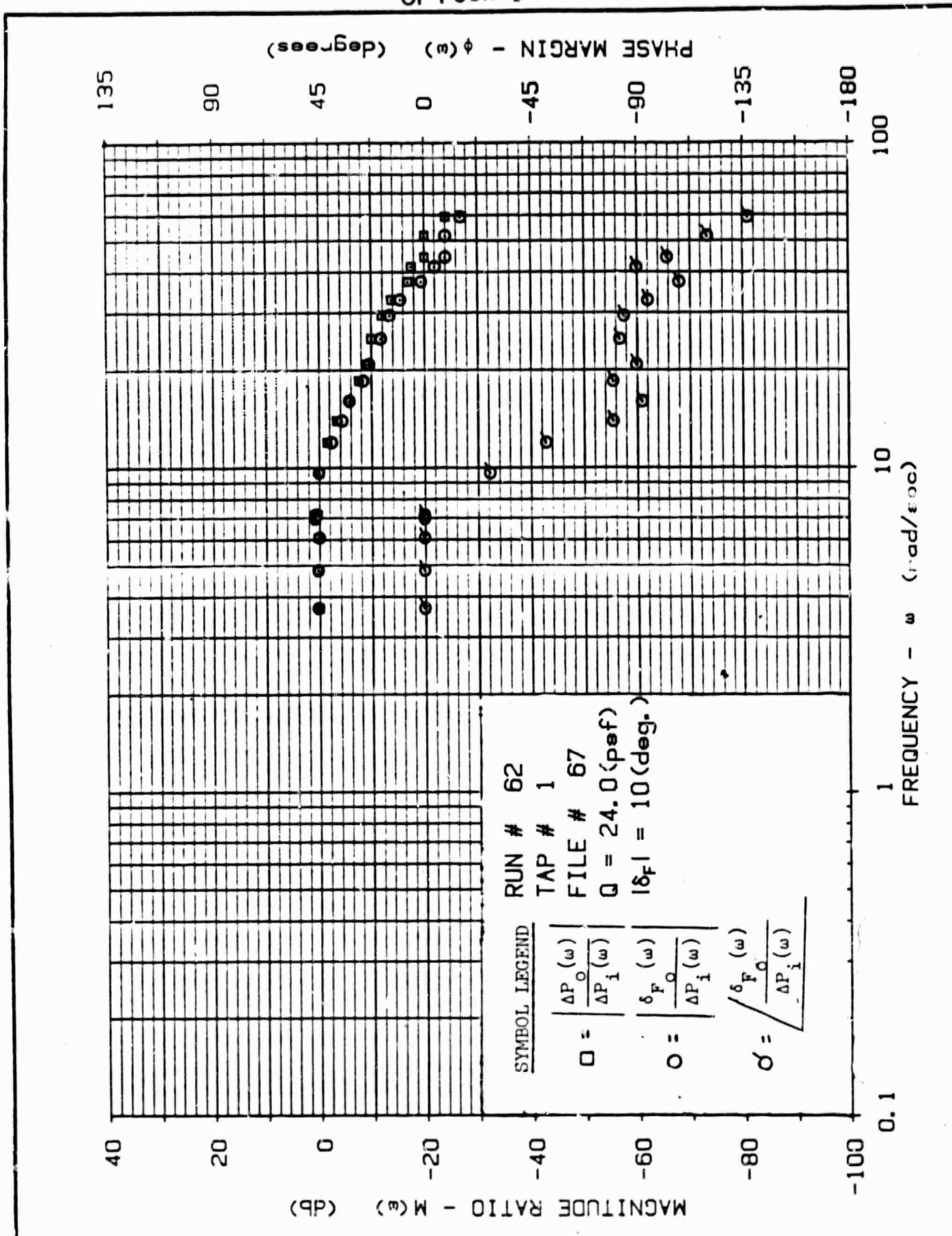

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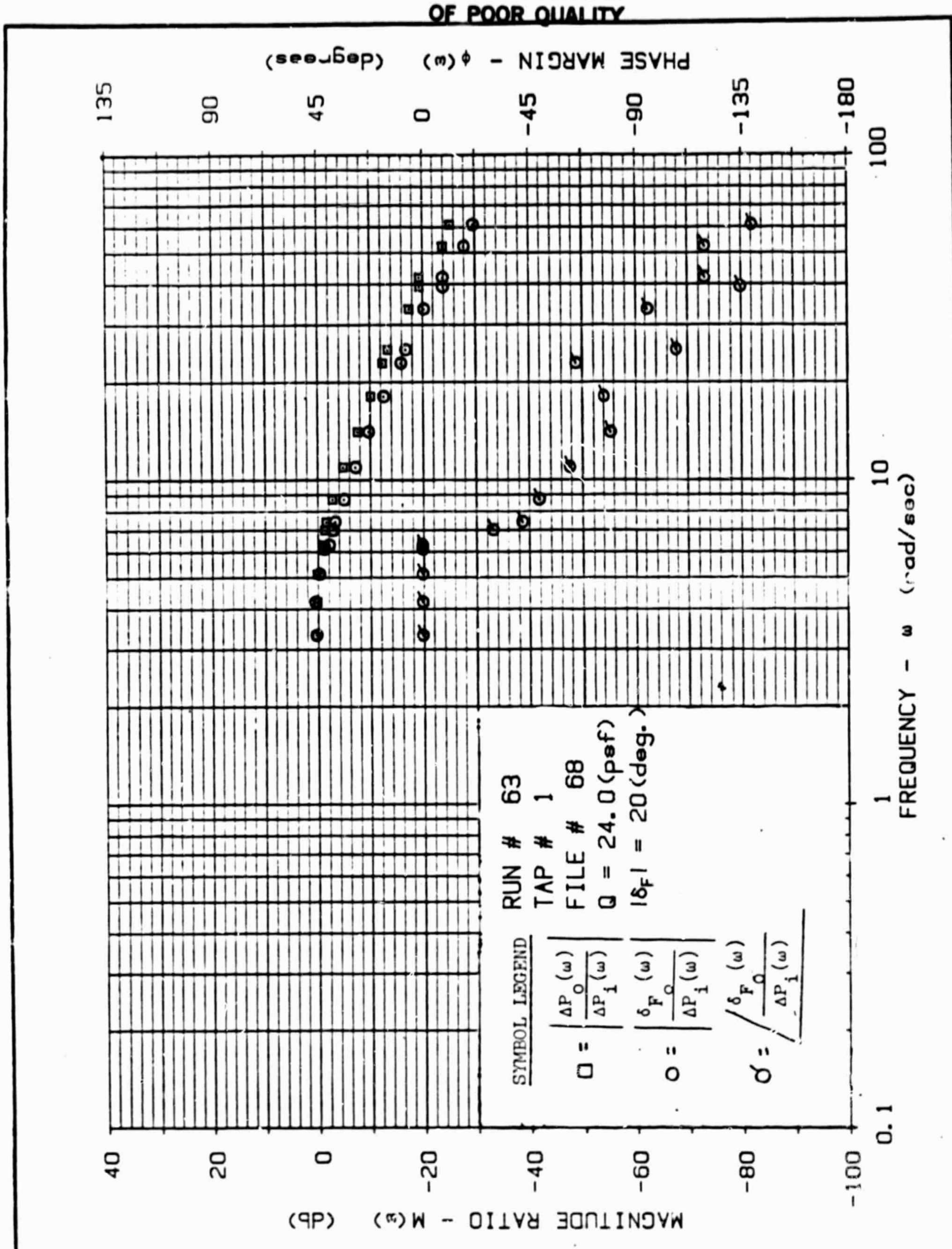

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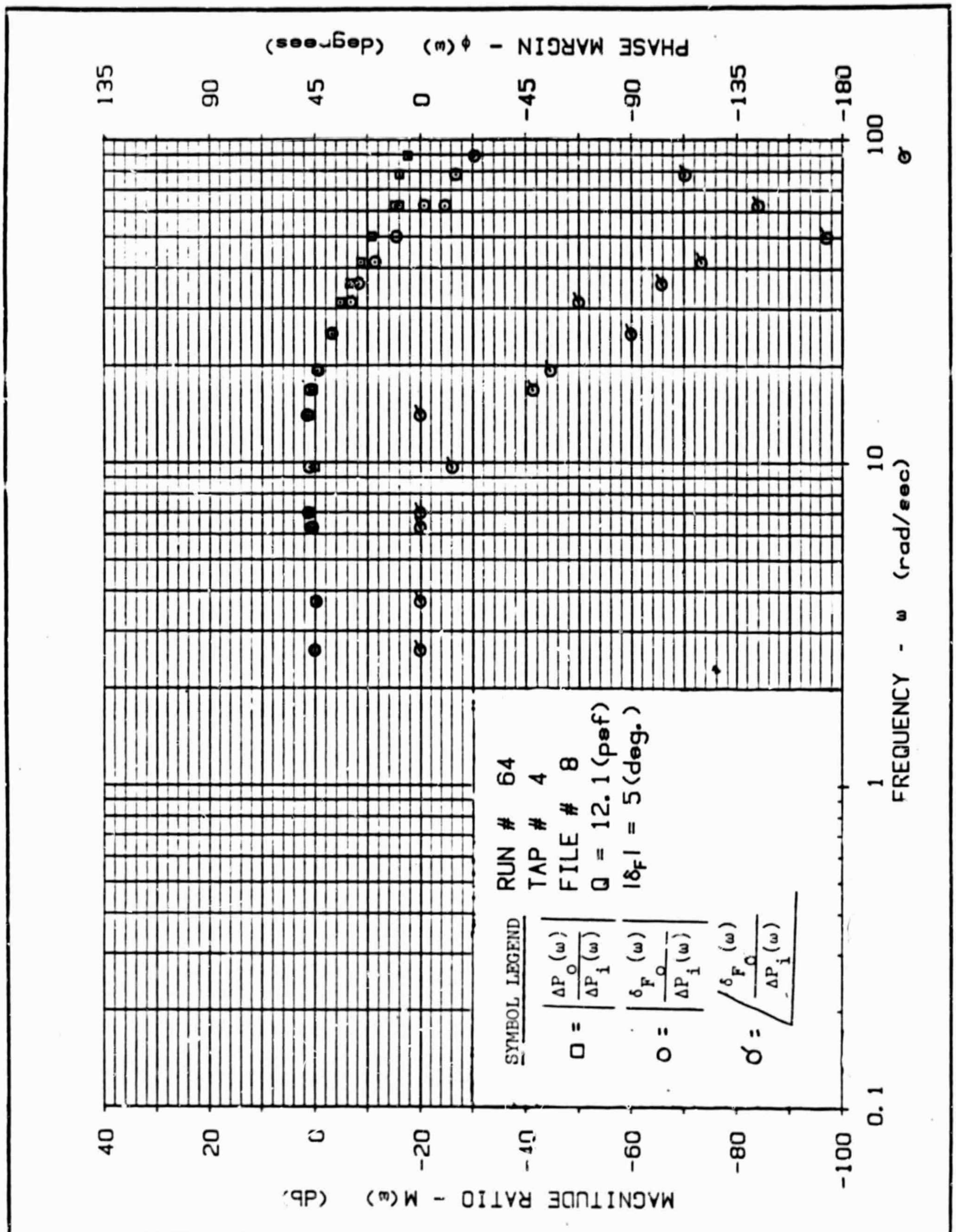

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FIGURE B 36. PRESSURE COMMAND BODE - q= 12.1(psf), $|\delta_F|$ = 5 (deg.), TAP# 4

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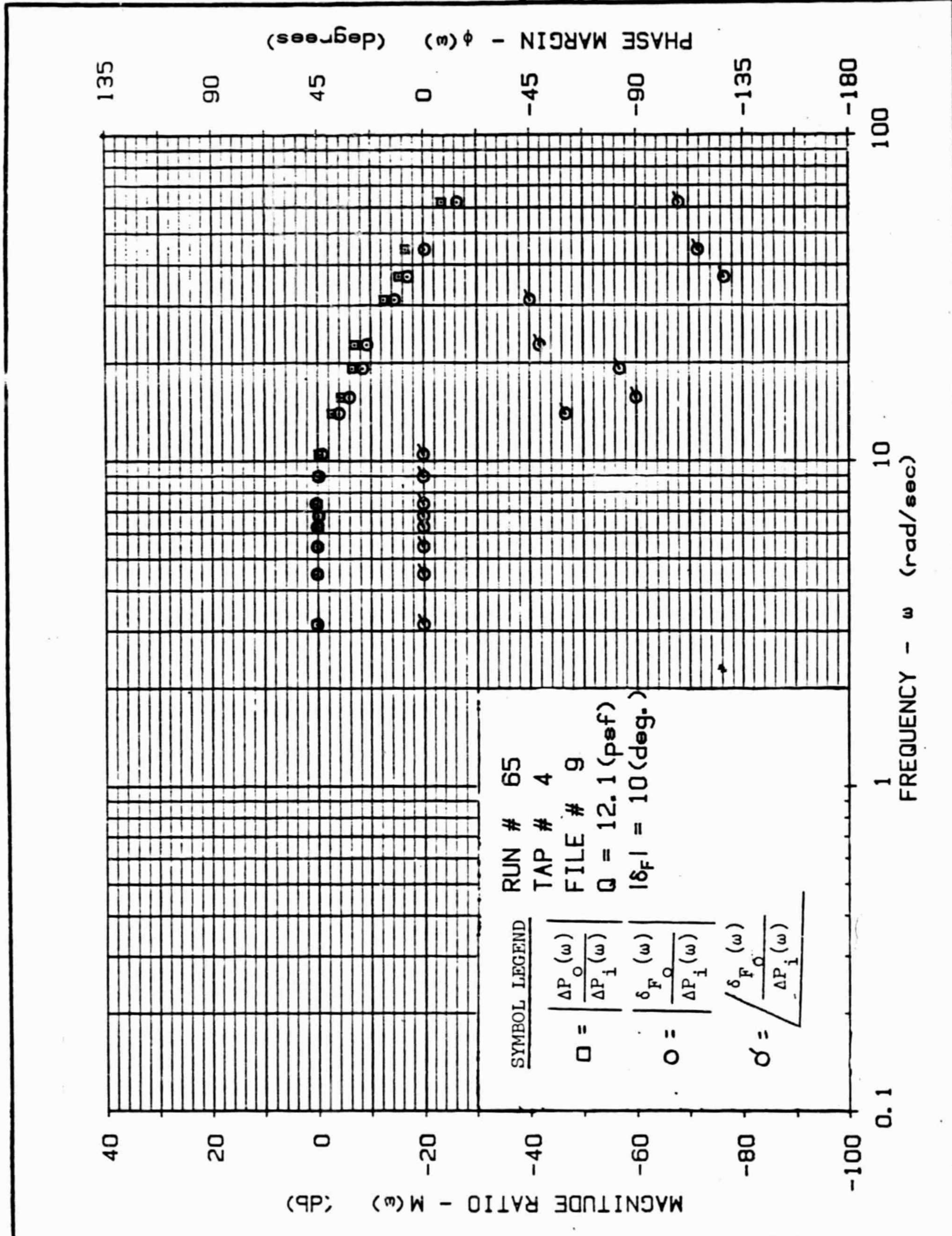

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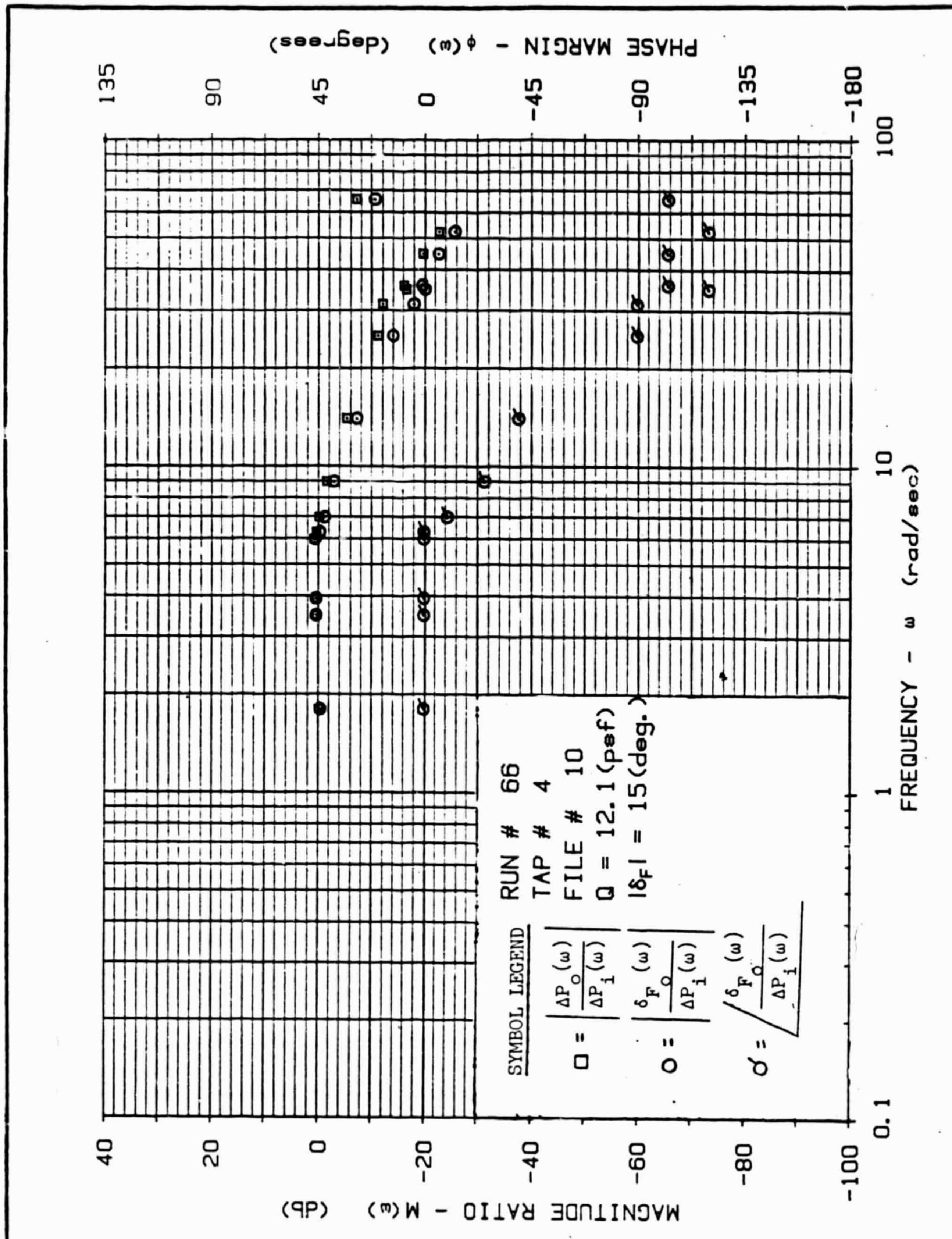

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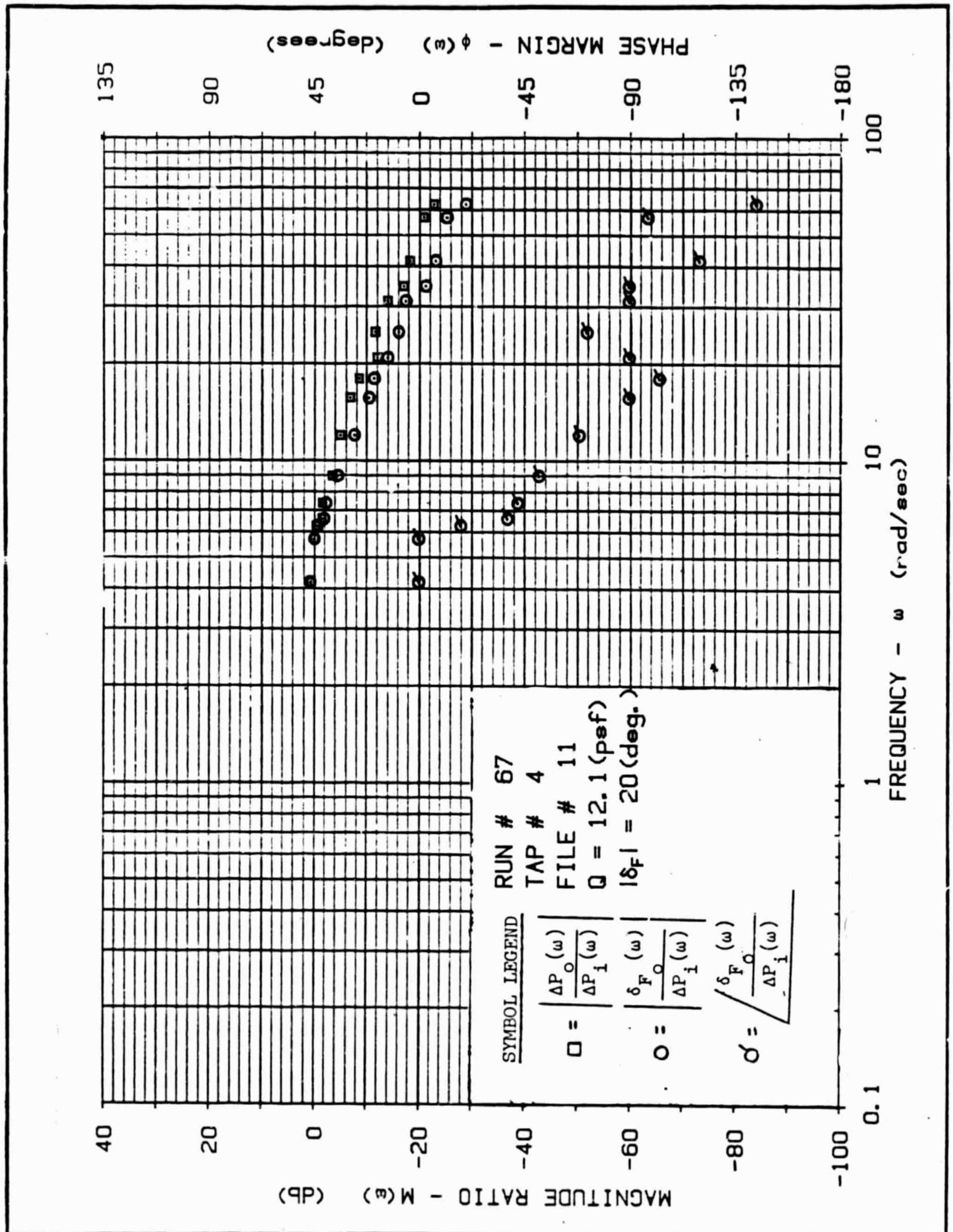

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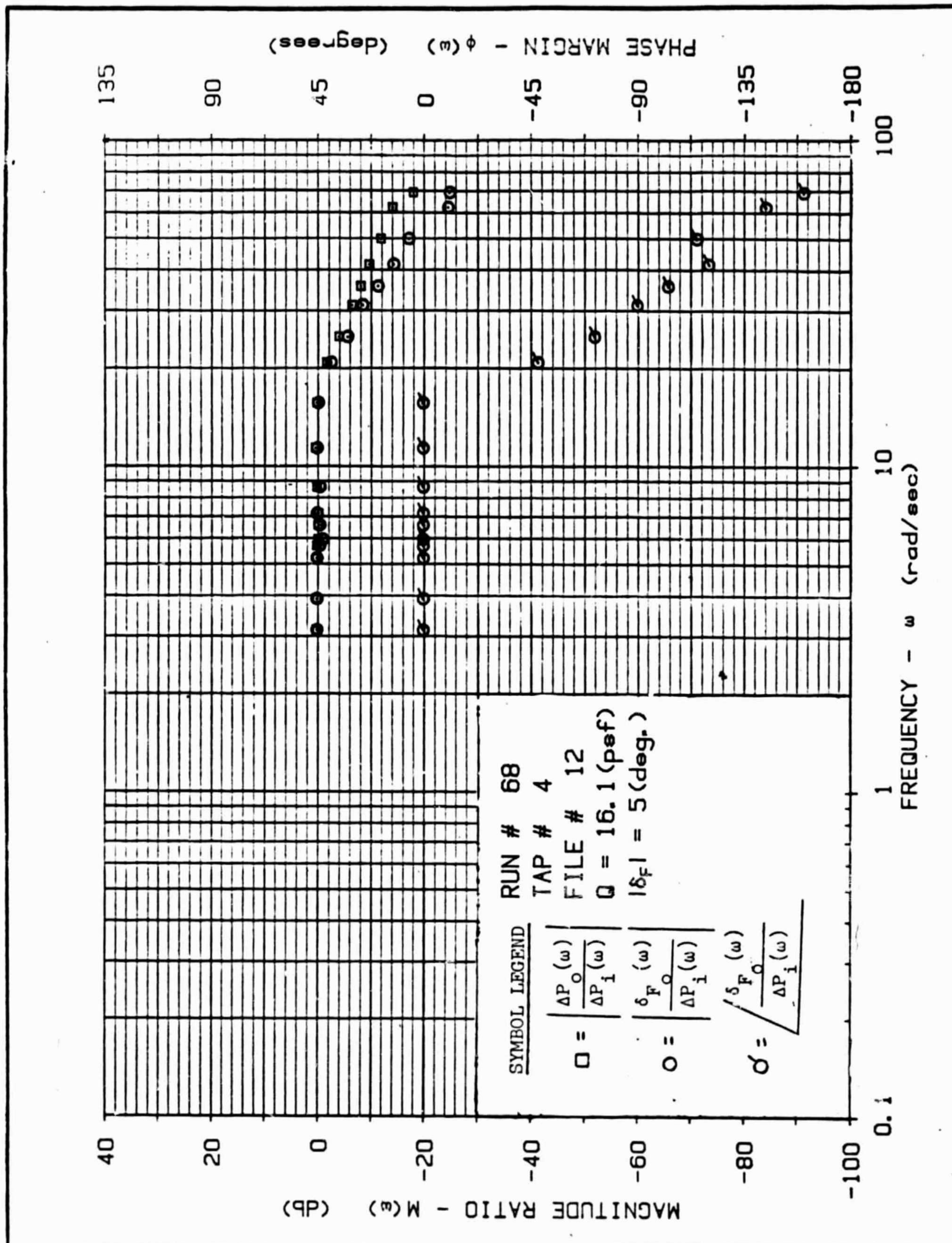

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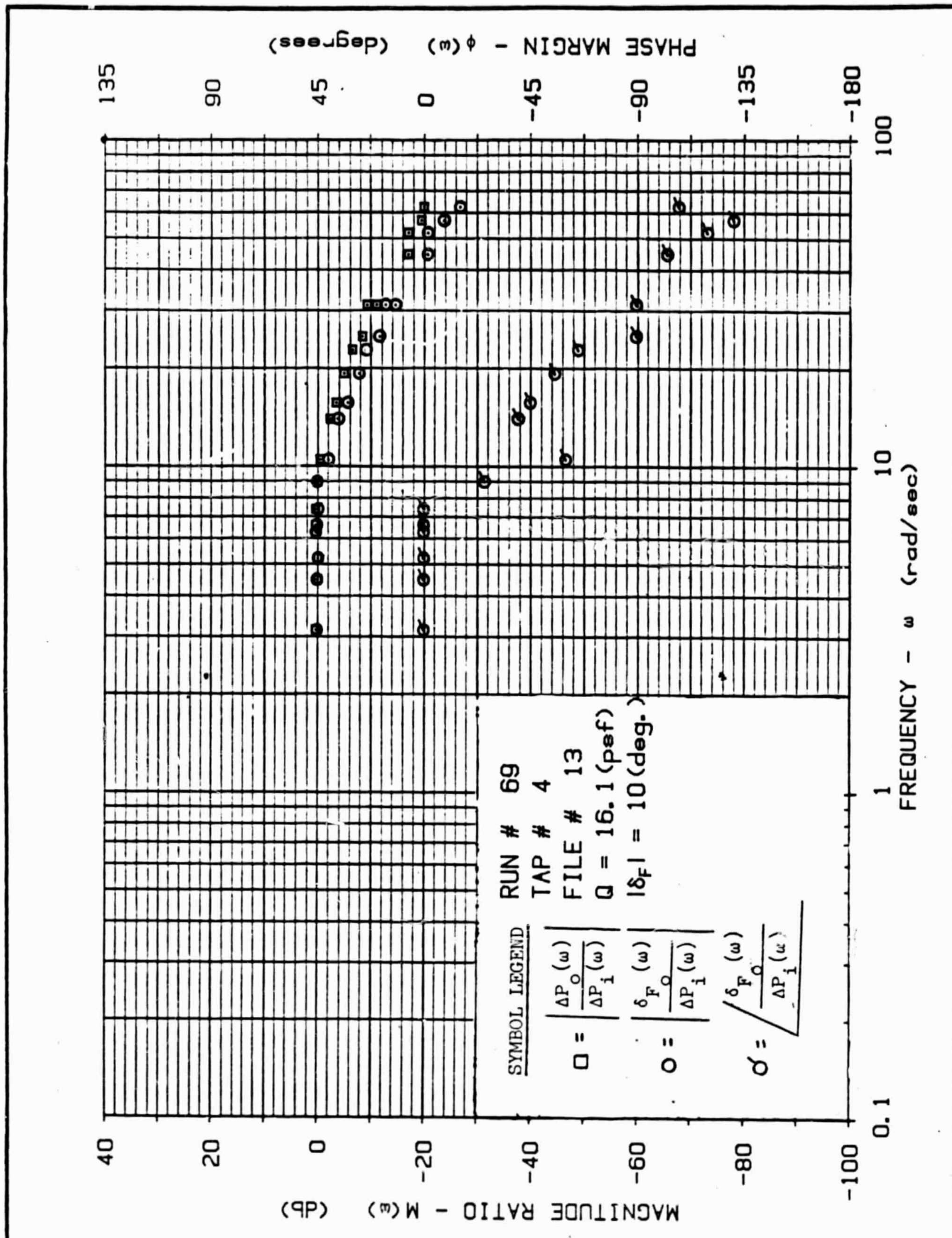

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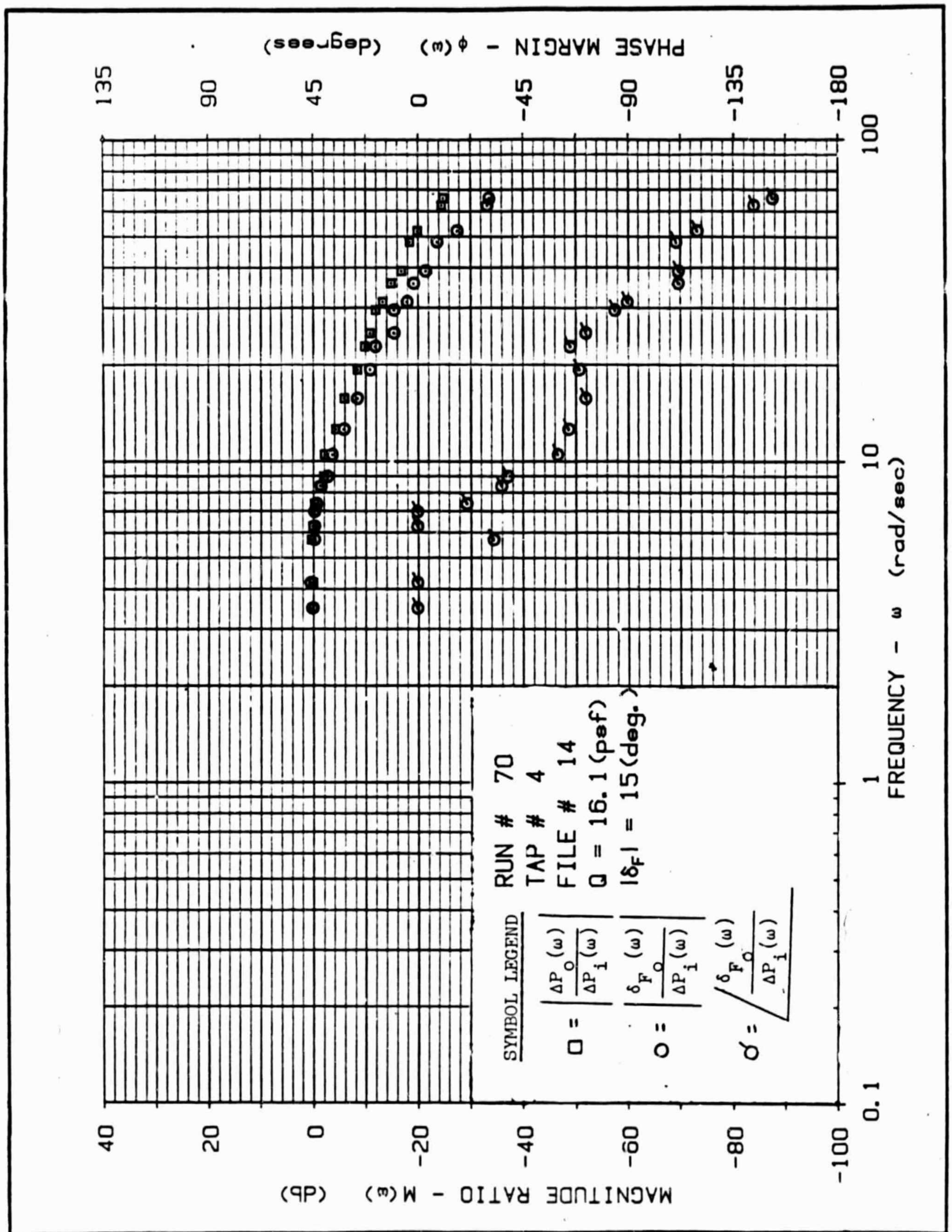

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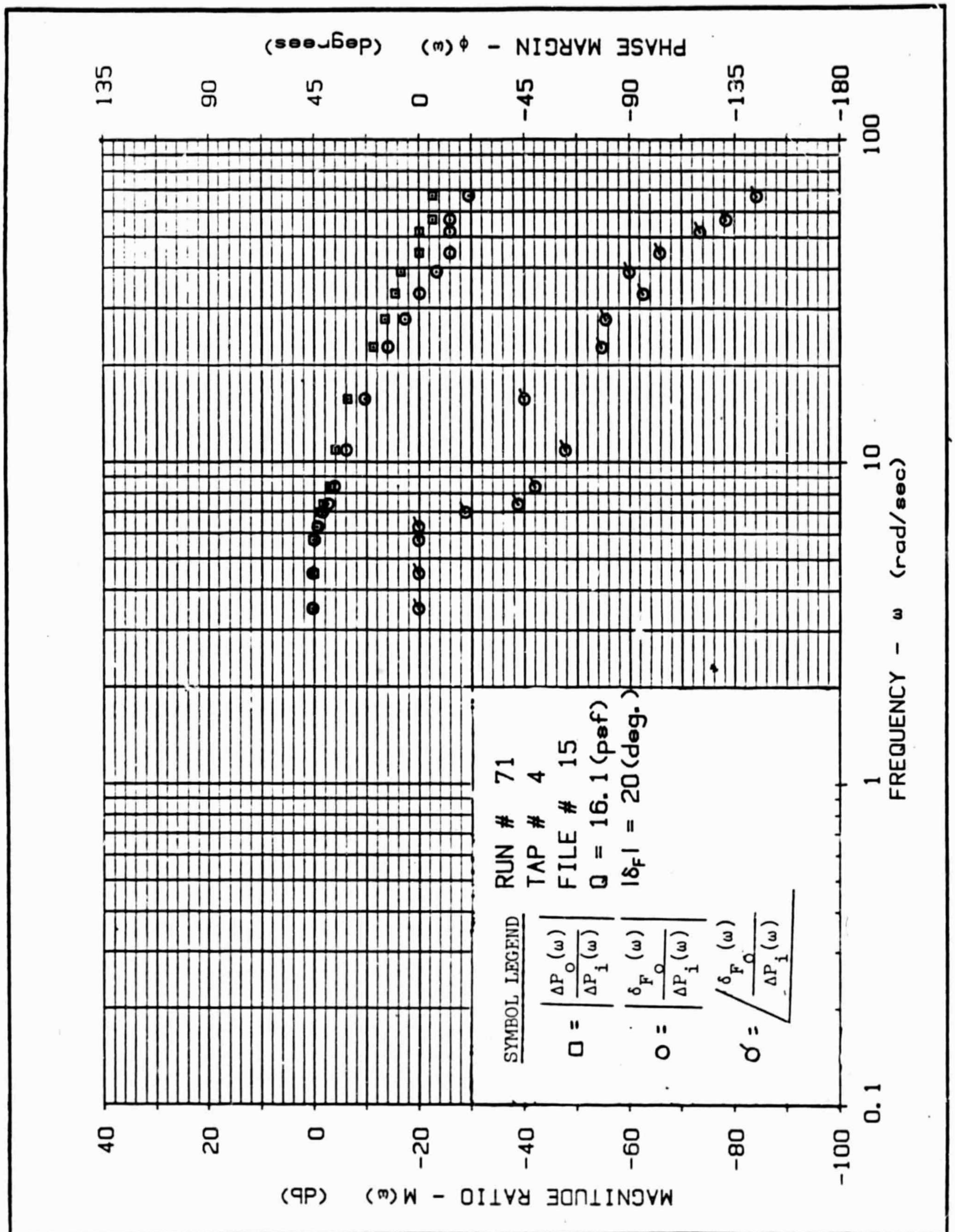

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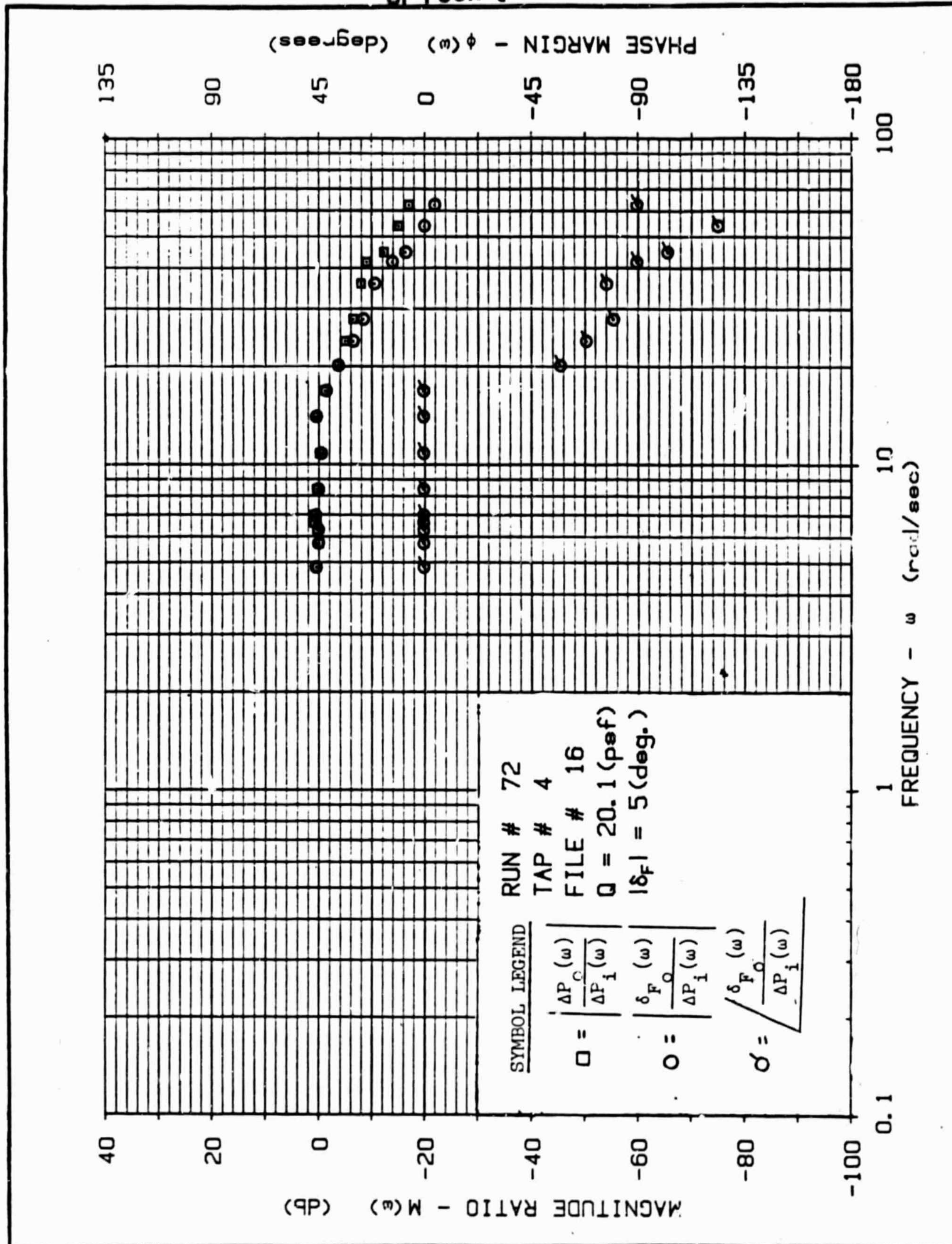

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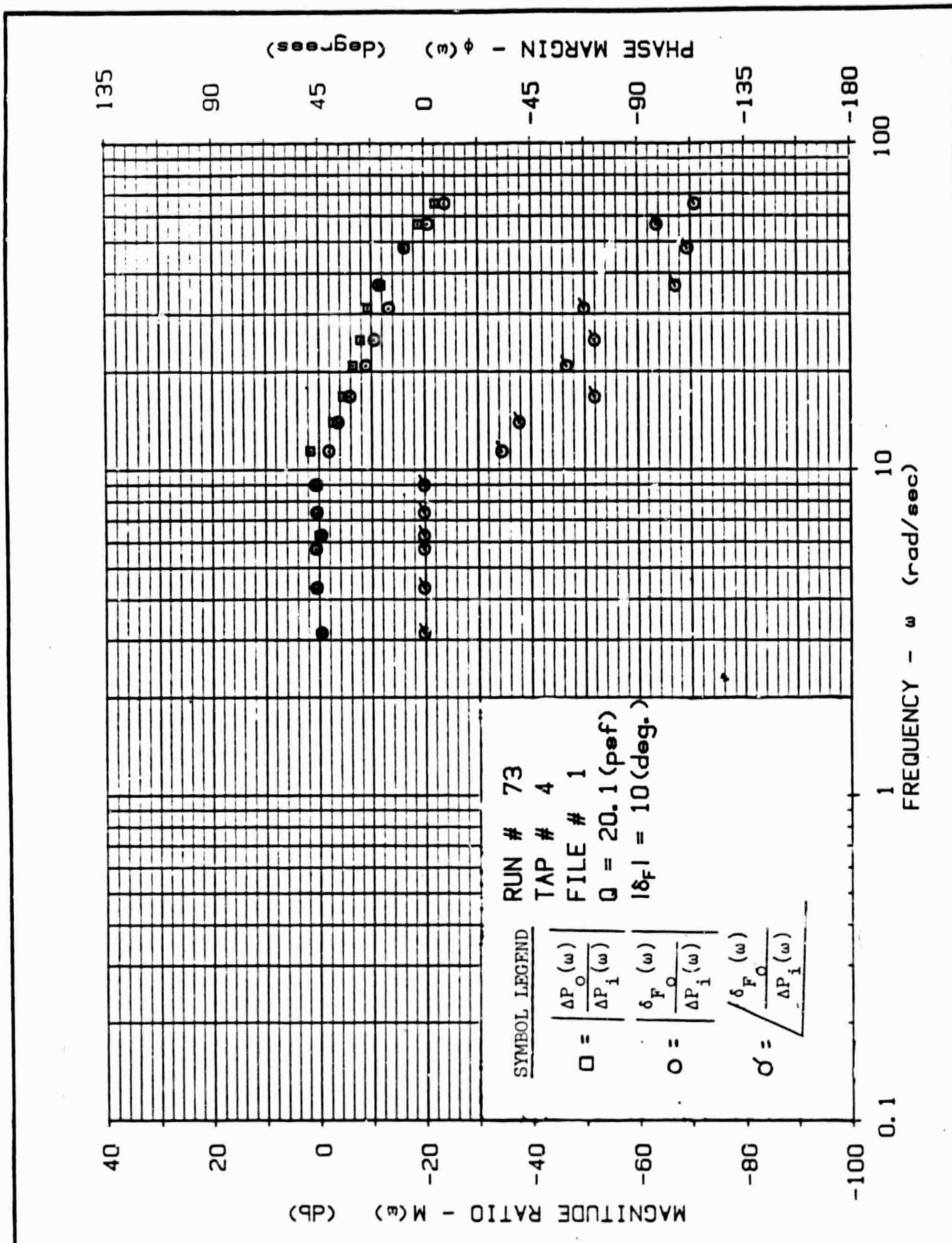

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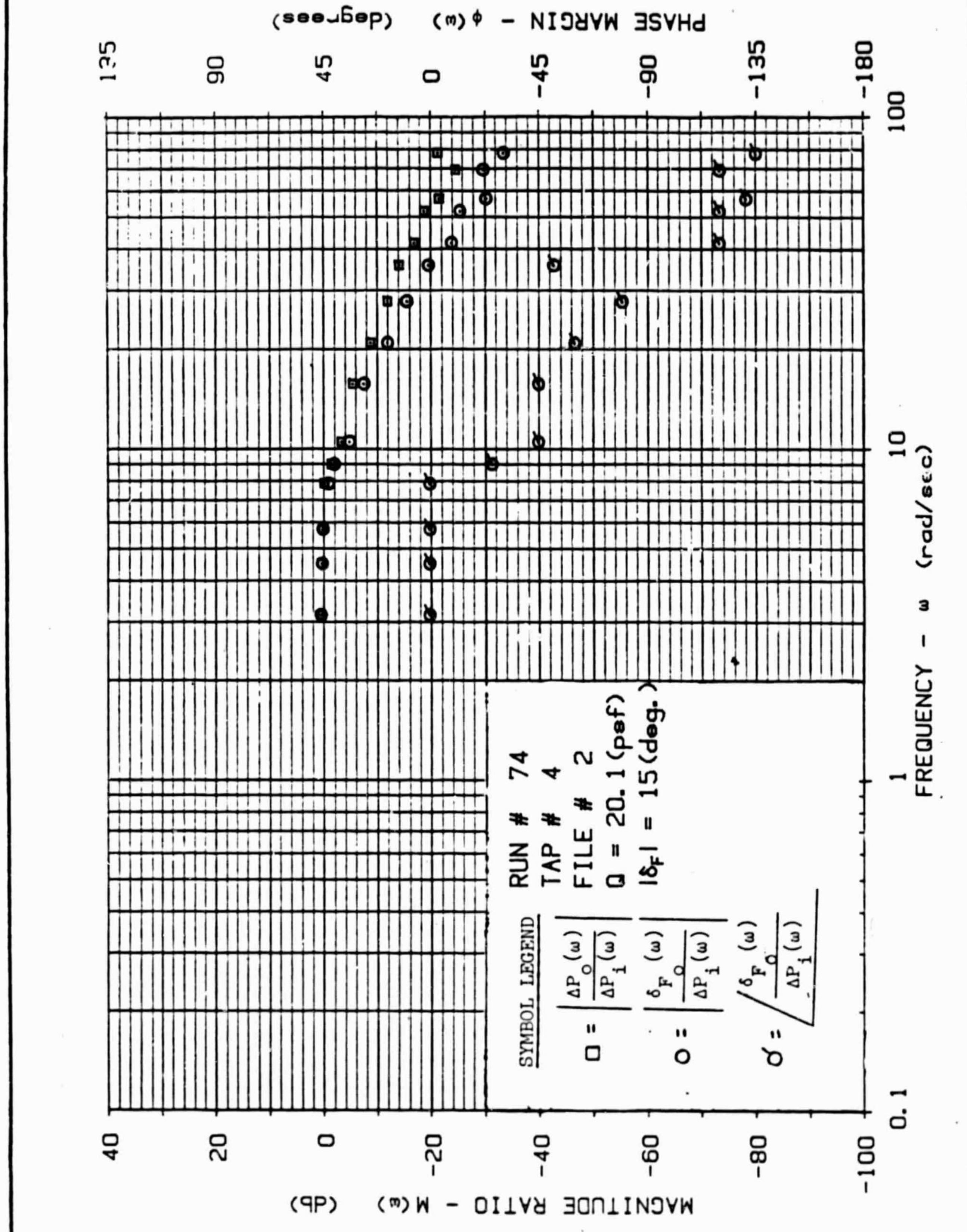

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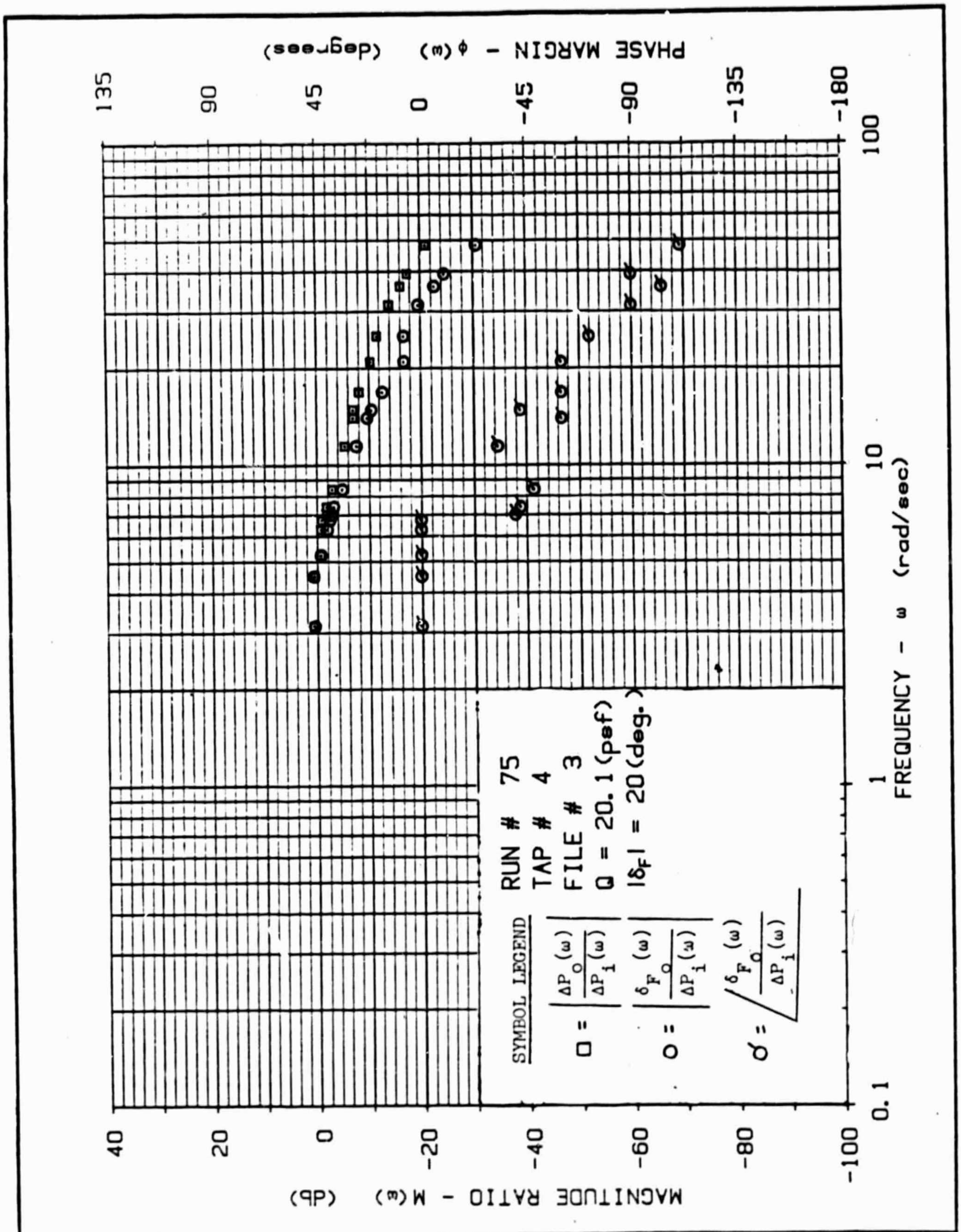

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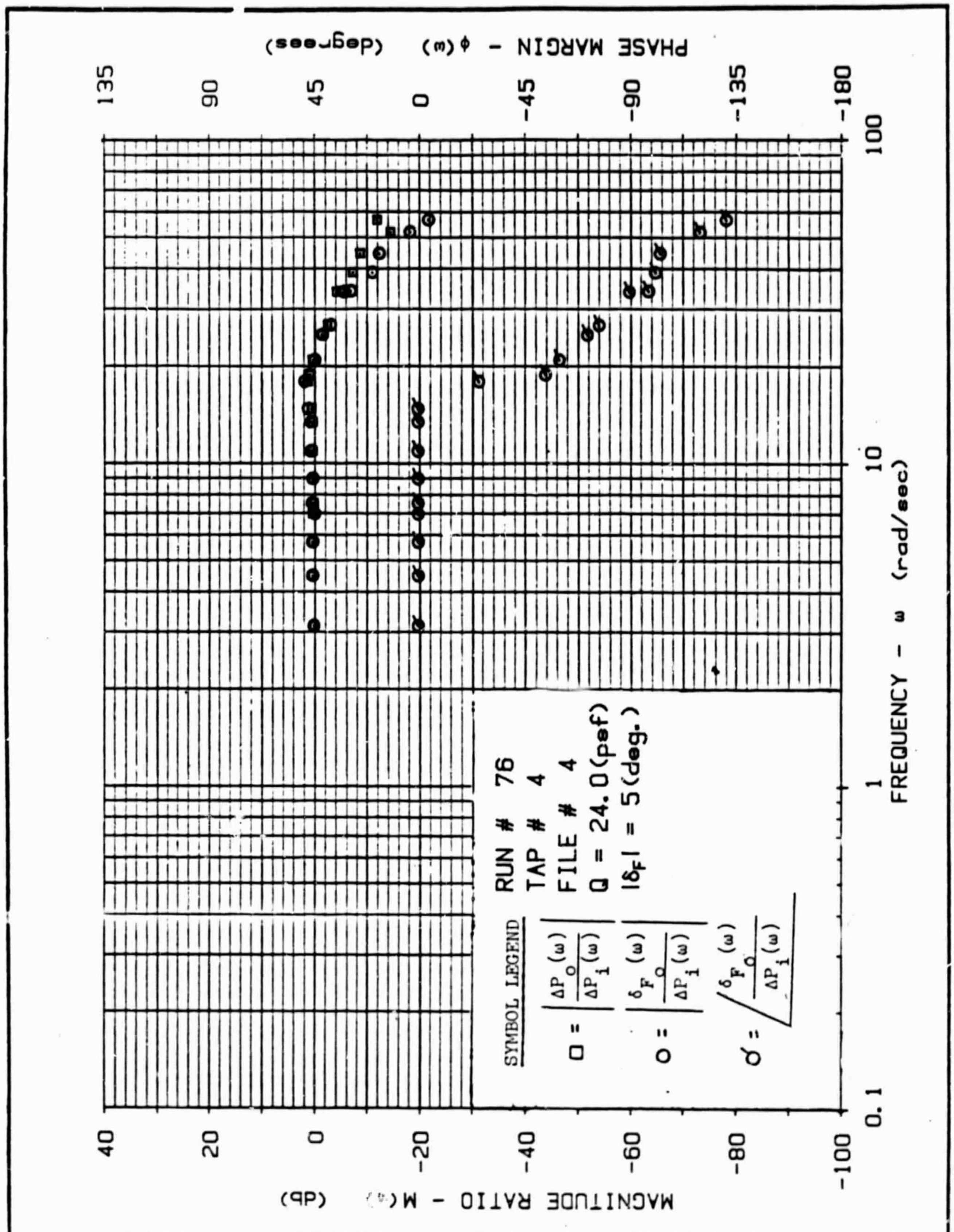

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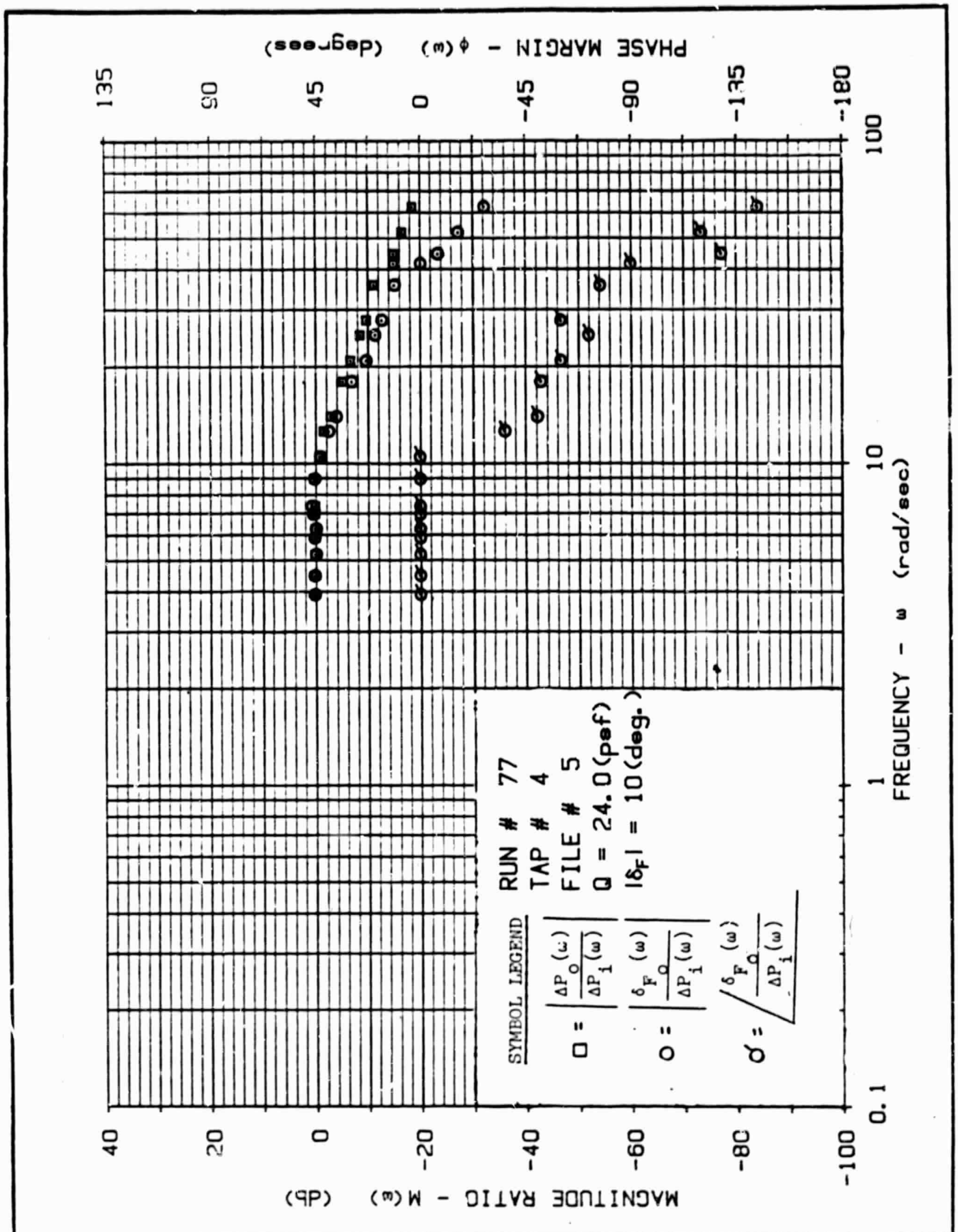

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FIGURE B 49. PRESSURE COMMAND BODE - q= 24.0(psf), $|\delta_F|$ = 10 (deg.), TAP# 4

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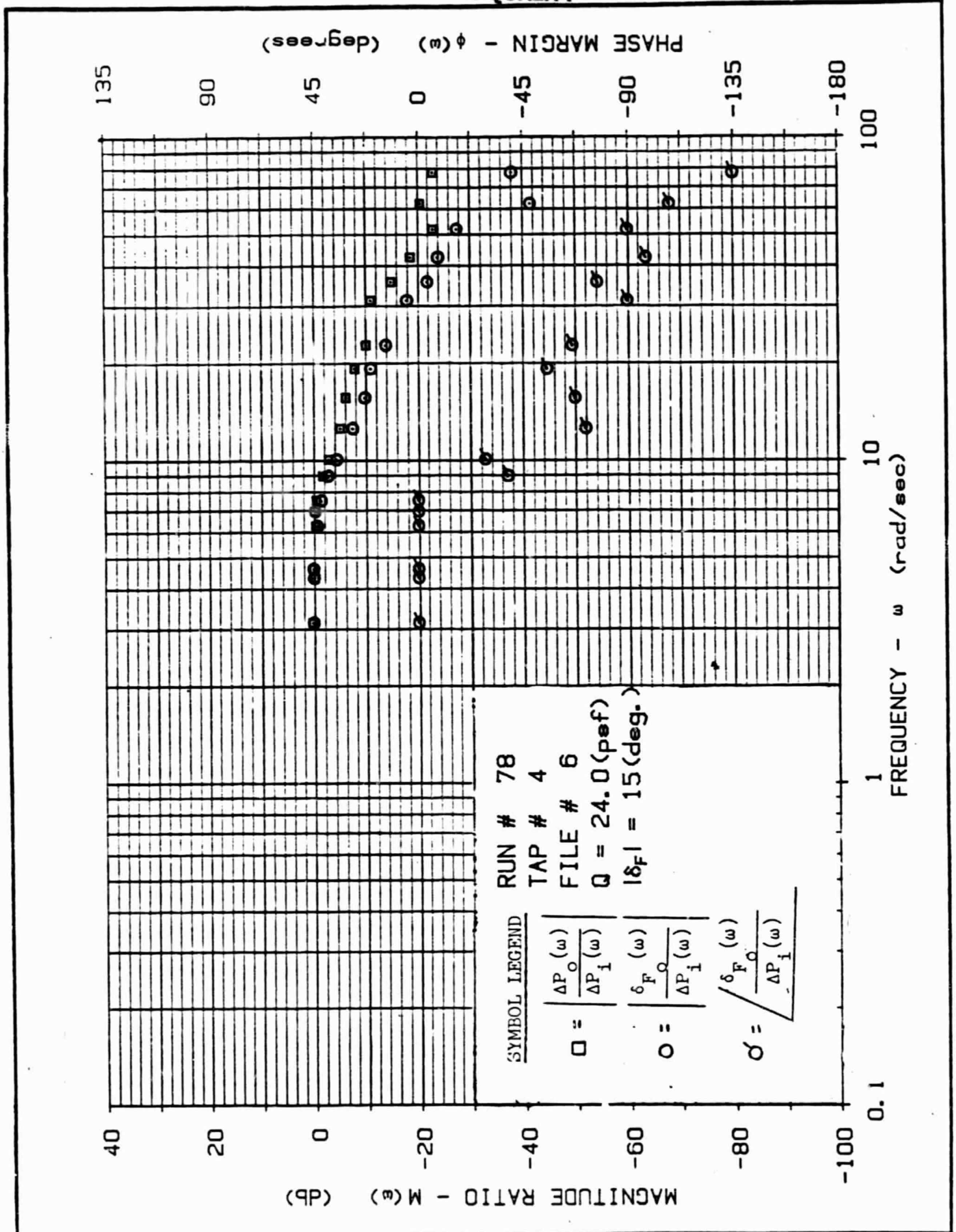

CALC	R. Lina	15-12-4	REVISED	DATE	FIGURE B 50. PRESSURE COMMAND BODE - q= 24.0(psf), $|\delta_F|$ = 15 (deg.), TAP# 4	
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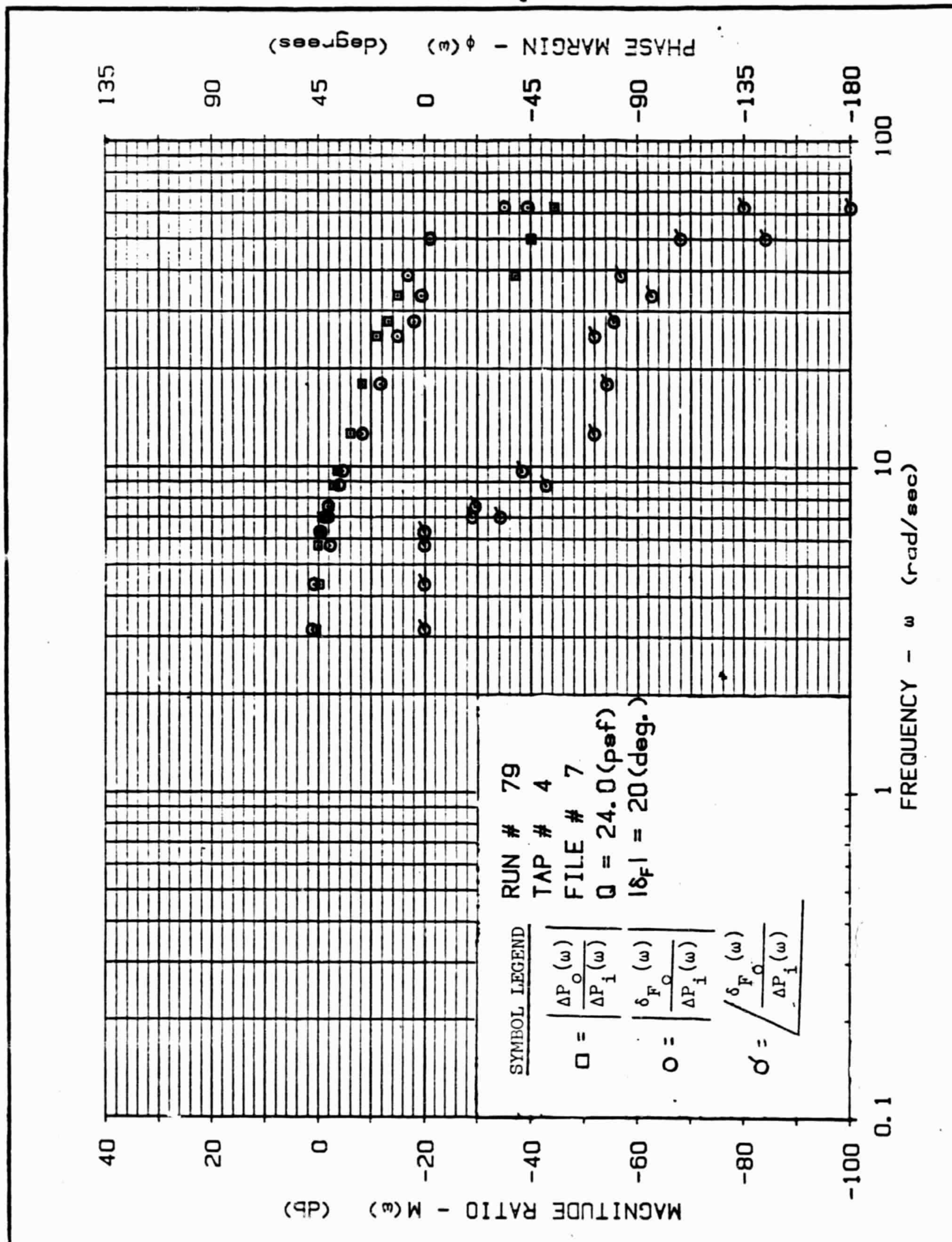

CALC		15-12-?	REVISED	DATE	FIGURE 51. PRESSURE COMMAND BODE - q= 24.0(psf), $|\delta_F i|$ = 20 (deg.), TAP# 4
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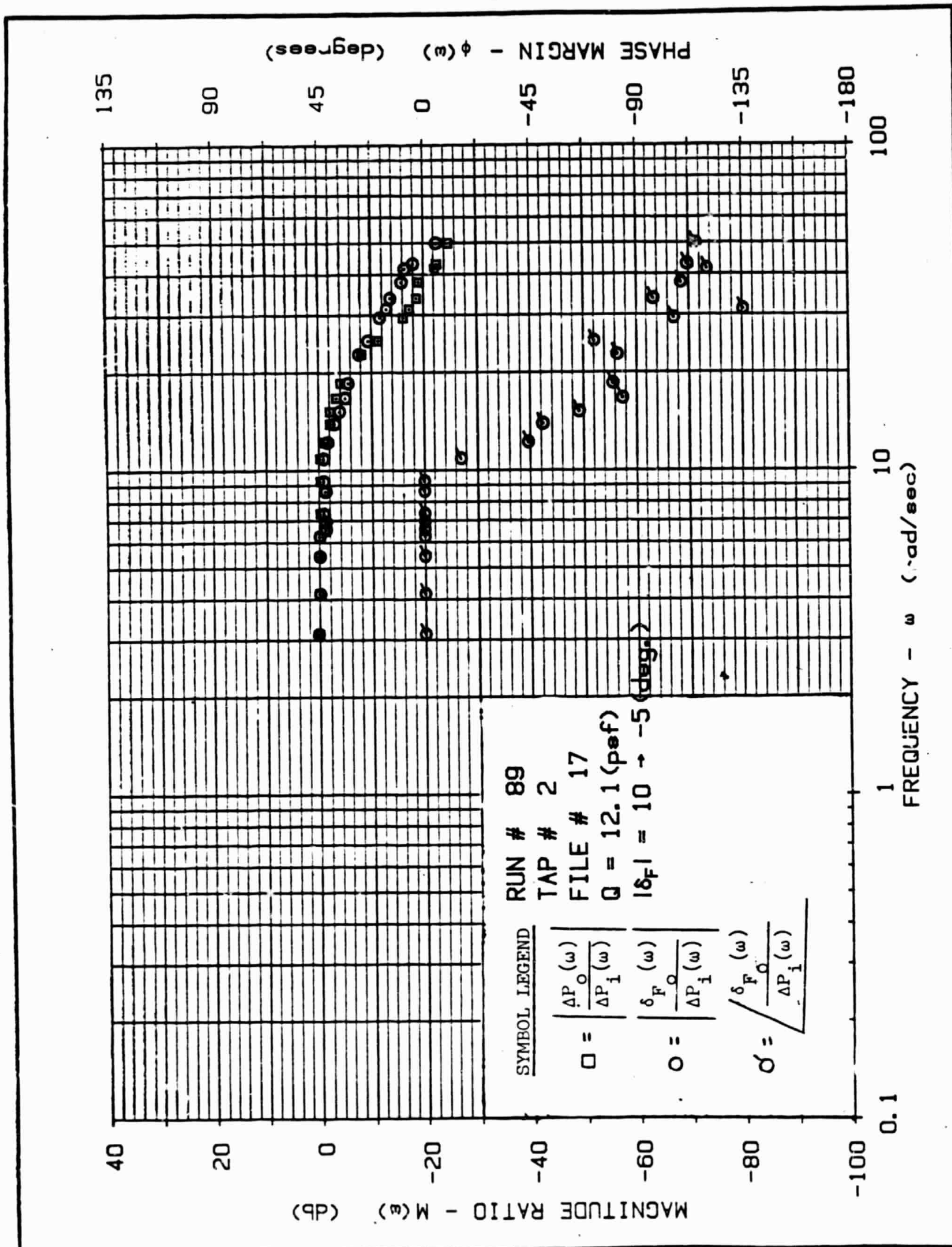

CALC		15-12-?	REVISED	DATE	FIGURE B 52. PRESSURE COMMAND BODE - q= 12.1 (psf), $\lvert\delta_F\rvert$ = 10 → -5 (deg.), TAP# 2
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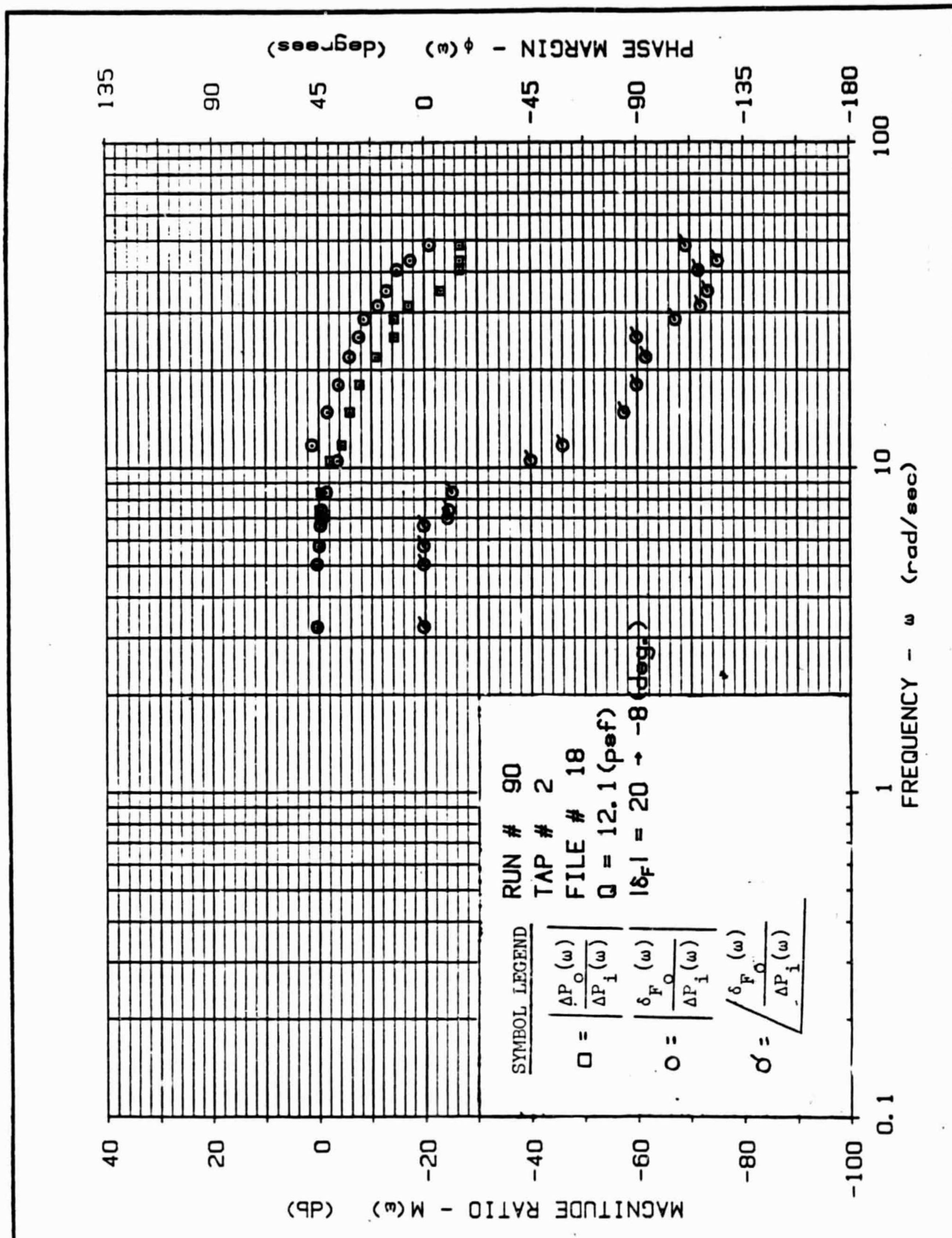

CALC			REVISED	DATE	FIGURE B 53. PRESSURE COMMAND BODE - q= 12.1(psf), $|\delta_F|$ = 20 → -8 (deg.), TAP# 2	
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APPD					UNIVERSITY OF KANSAS	PAGE B56

K&E 10 7156 5-60 MC1066e

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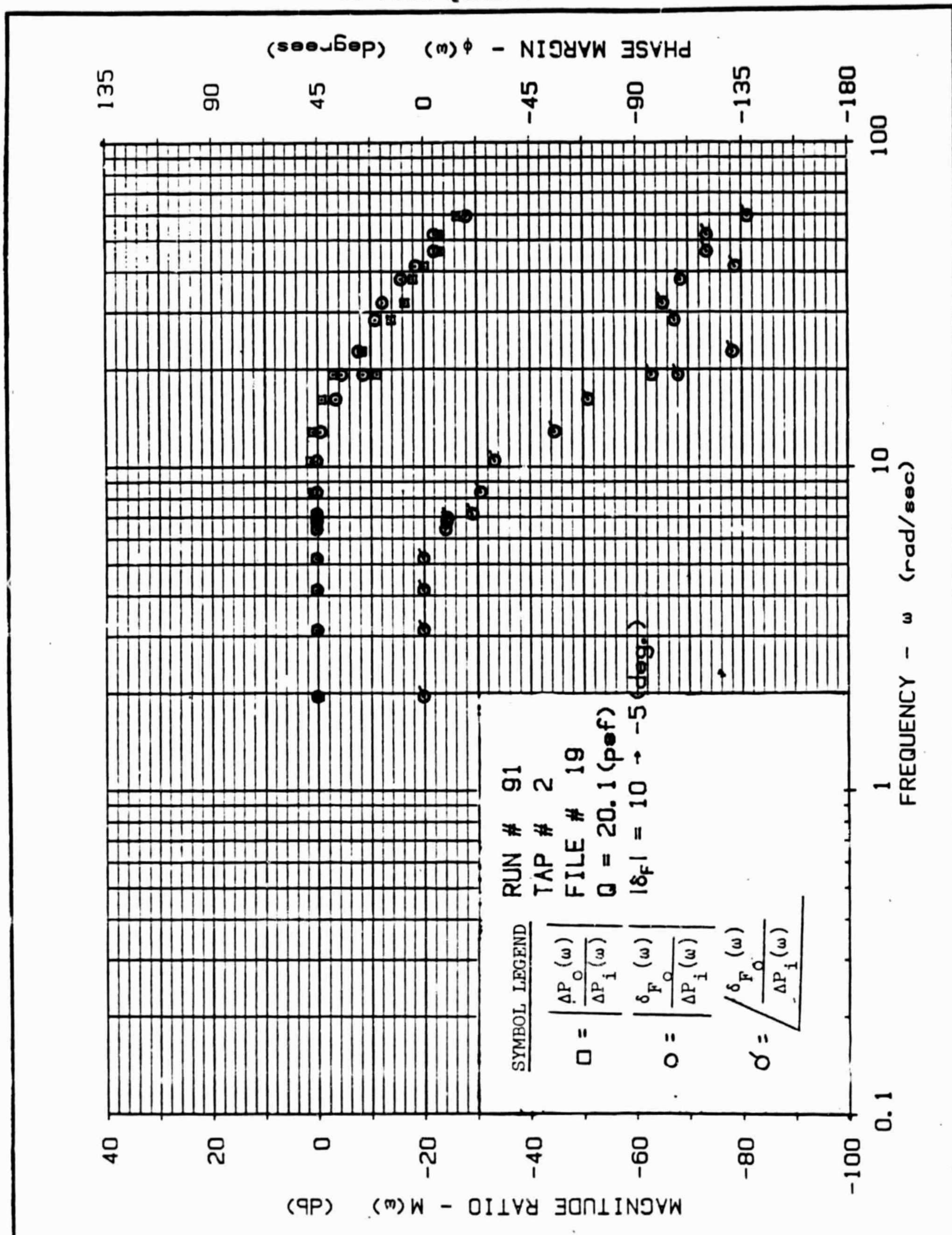

CALC			REVISED	DATE	FIGURE B55. PRESSURE COMMAND BODE - q= 20.1 (psf), $|\delta_F|$ = 10 → -5 (deg.), TAP# 2
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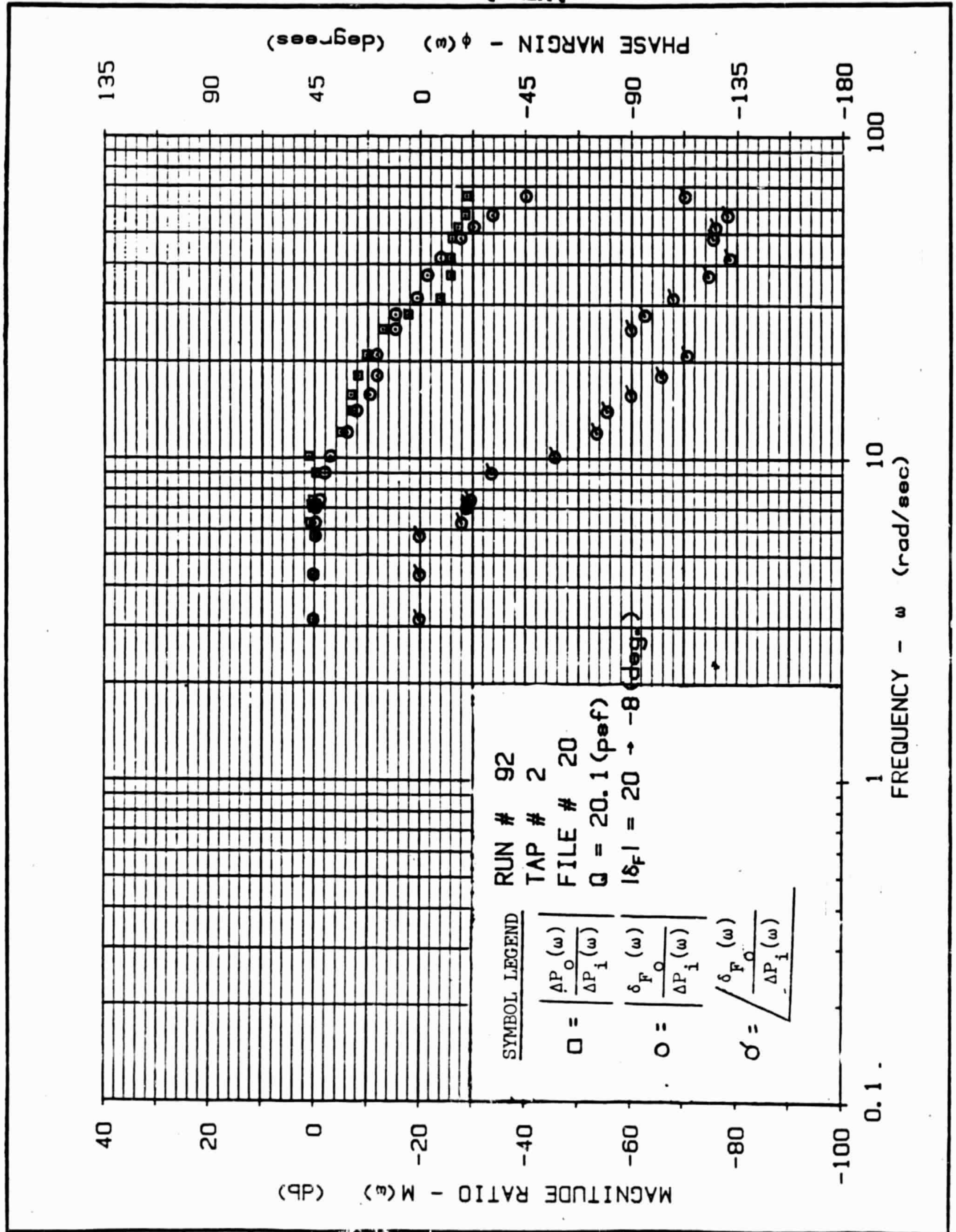

CALC		15-12-?	REVISED	DATE	FIGURE B 55. PRESSURE COMMAND BODE - q= 20.1 (psf), $|\delta_F|$ = 20 → -8 (deg.), TAP# 2
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APPD					UNIVERSITY OF KANSAS

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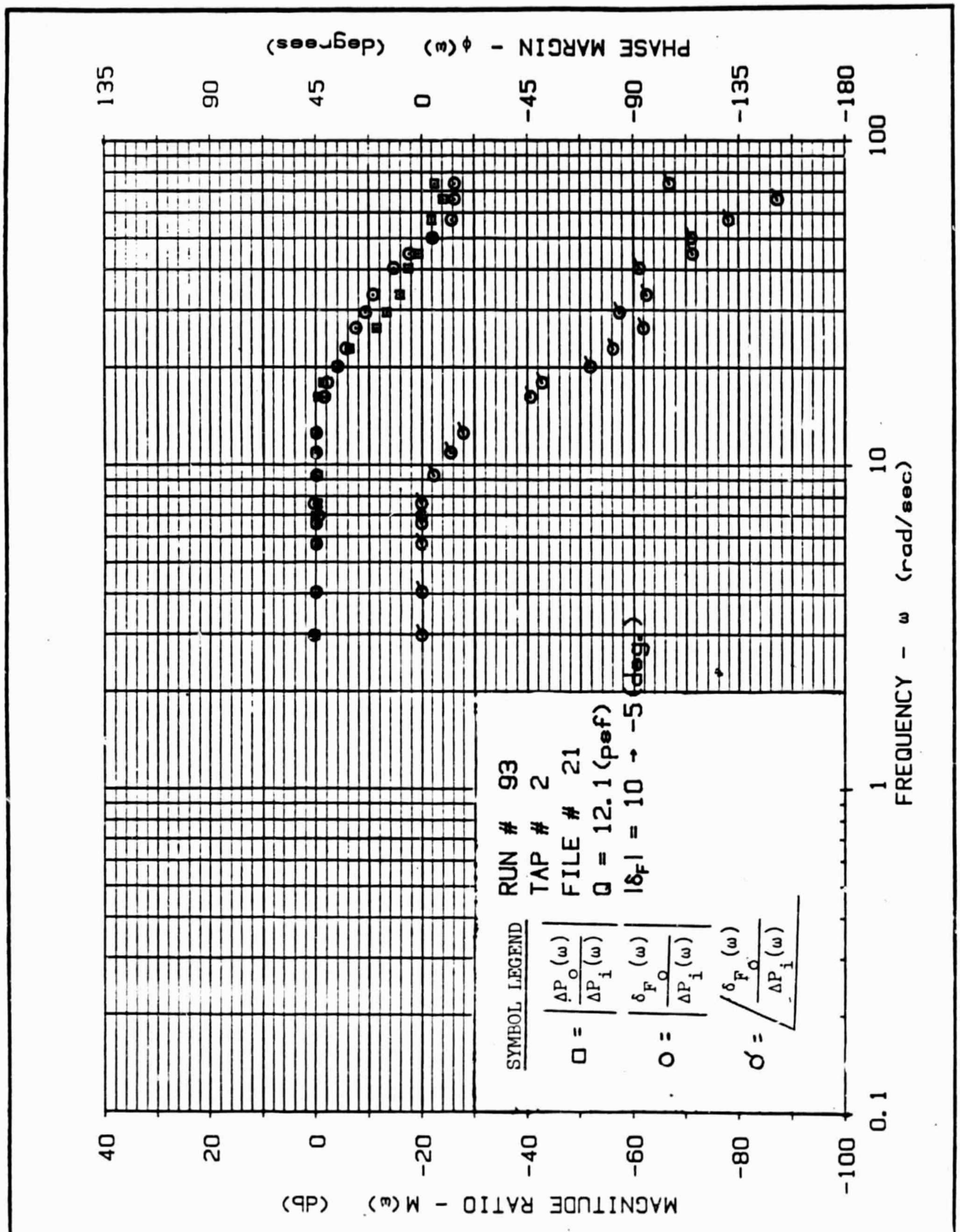

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FIGURE B 56. PRESSURE COMMAND BODE - q= 12.1 (psf), $|\delta_F|$ = 10 → -5 (deg.), TAP# 2

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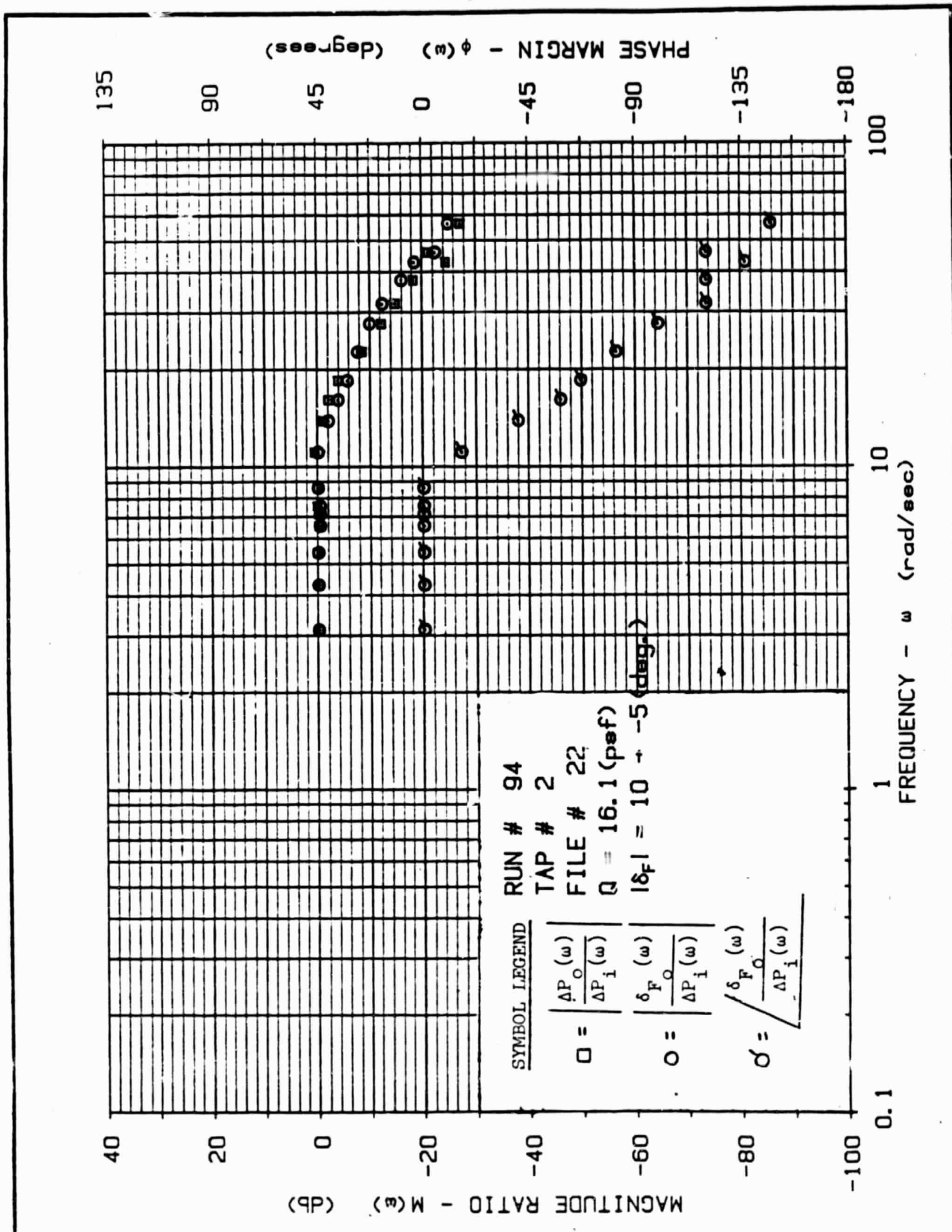

CALC		15-12-?	REVISED	DATE	FIGURE B 57. PRESSURE COMMAND BODE - q= 16.1 (psf), $|\delta_F|$ = 10 → -5 (deg.), TAF# 2	
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APPD					UNIVERSITY OF KANSAS	PAGE B60

K&E 10 /156 5-60 MC1068e

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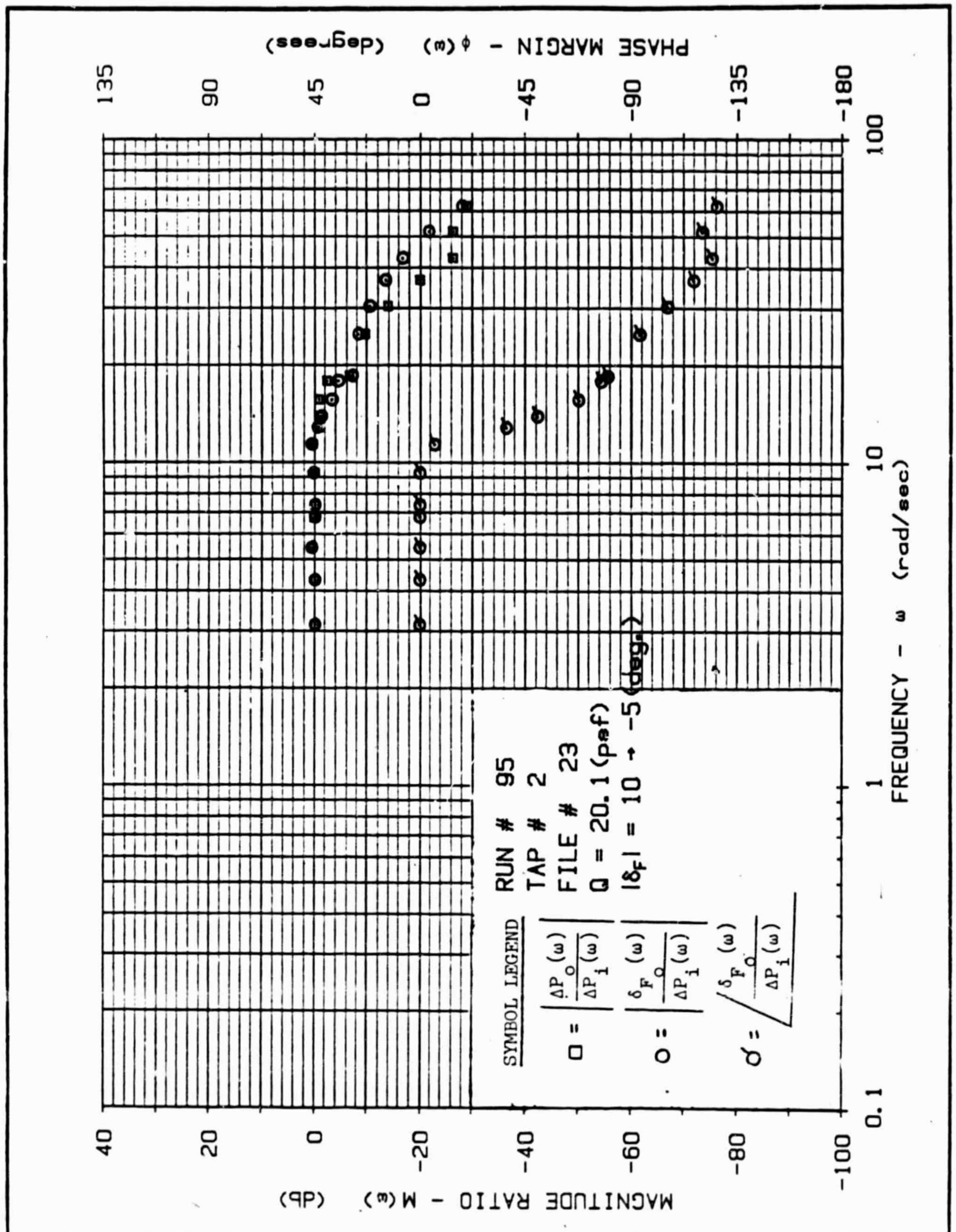

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FIGURE B 58. PRESSURE COMMAND BODE - q= 20.1 (psf), $|\delta_F|$ = 10 → -5 (deg.), TAP# 2

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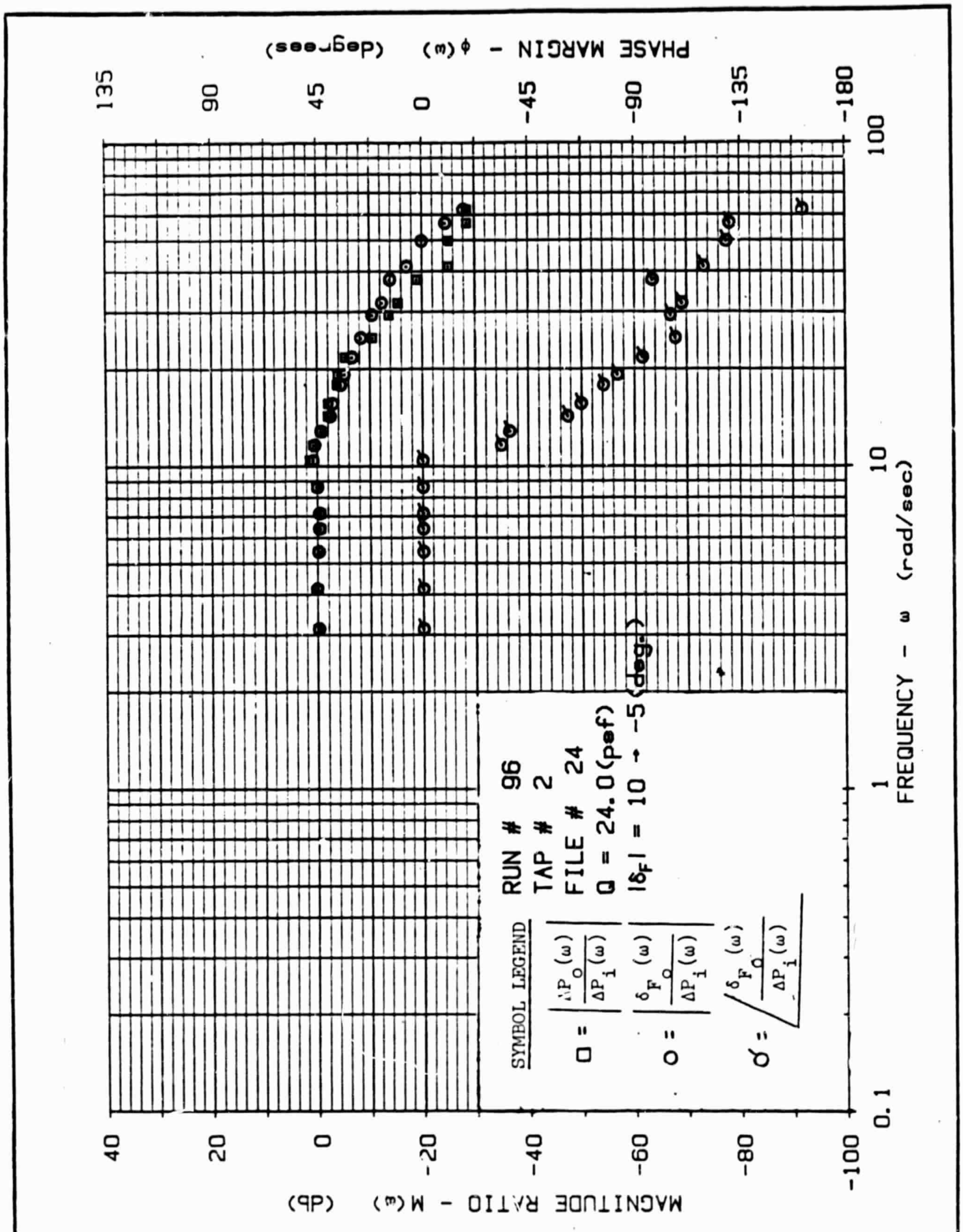

CALC		15-12-..	REVISED	DATE	FIGURE B 59. PRESSURE COMMAND BODE - q= 24.0(psf), $|\delta_F|$ = 10 → -5 (deg.), TAP# 2	
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APPD					UNIVERSITY OF KANSAS	PAGE B62

K&E 10 7196 9-60 MC1060e

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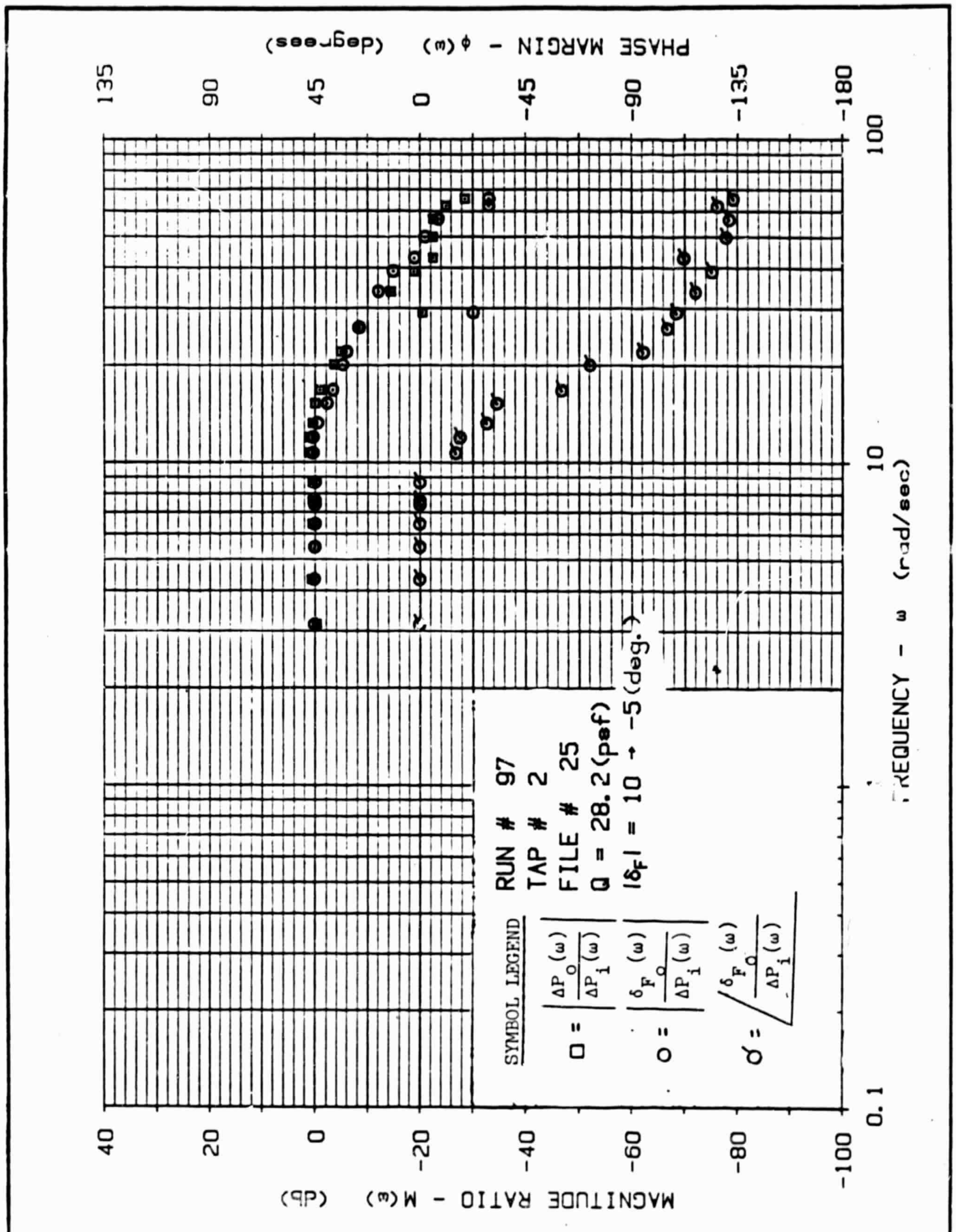

CALC		15-12-?	REVISED	DATE	FIGURE B 60. PRESSURE COMMAND BODE - q= 28.2(psf), $|\delta_F|$ = 10 → -5 (deg.), TAP# 2
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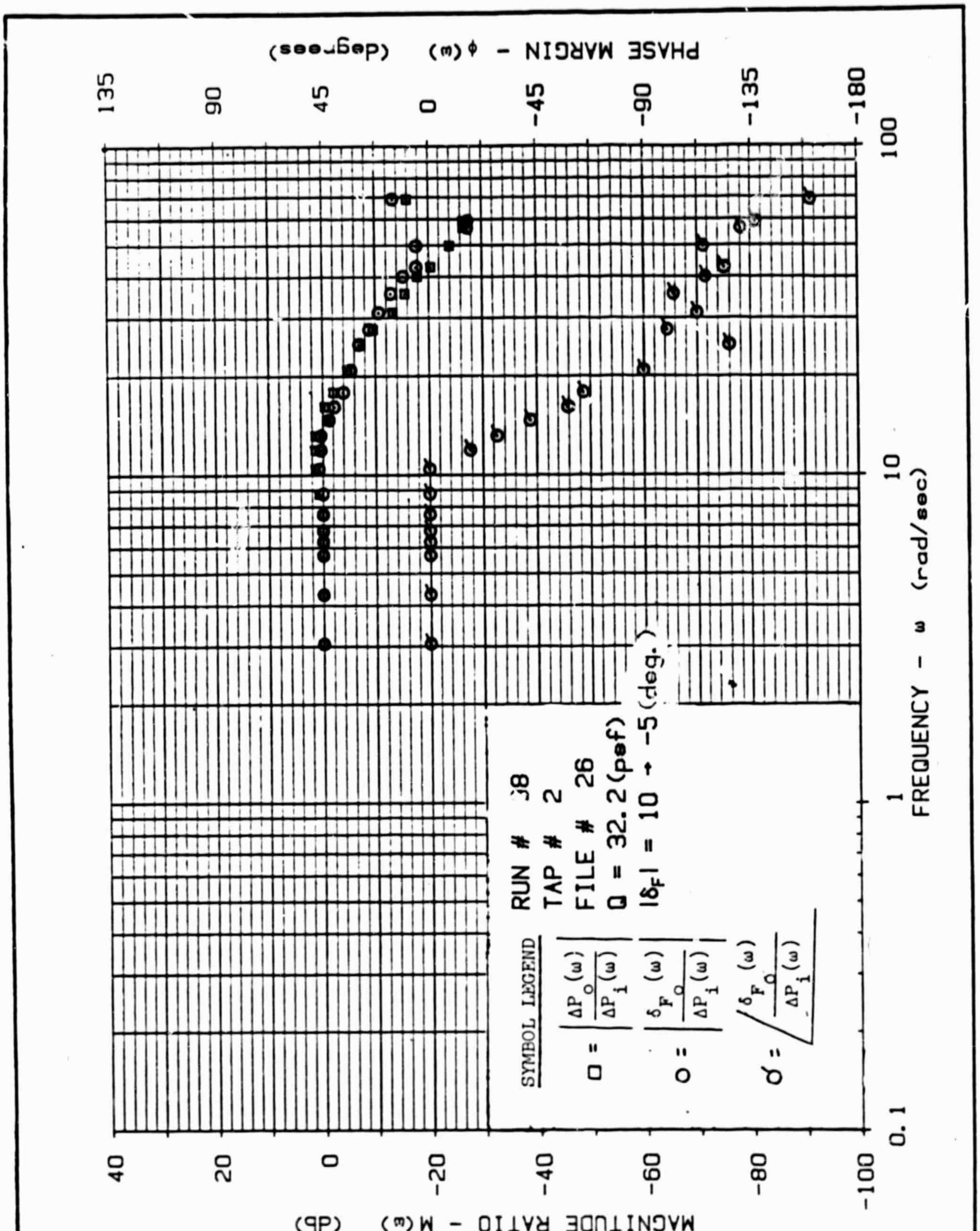

CALC		15-12-?	REVISED	DATE	FIGURE B 61. PRESSURE COMMAND BODE - q= 32.2(psf), $|\delta_F|$ = 10 → -5 (deg.), TAP# 2
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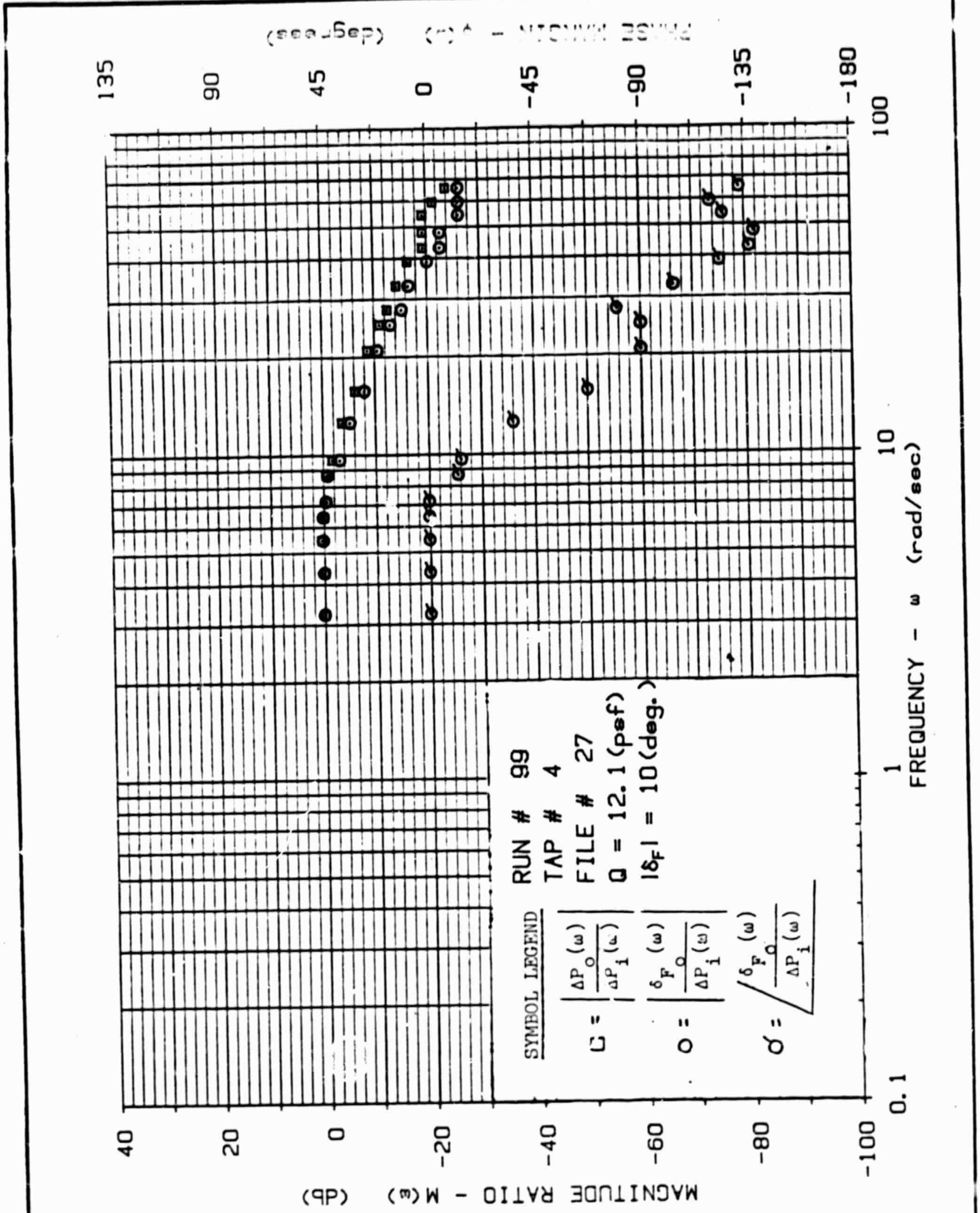

CALC	R. Lin	15-12-79	REVISED	DATE	FIGURE B 62. PRESSURE COMMAND BODE - q= 12.1 (psf), $|\delta_F|$ = 10 (deg.), TAP# 4
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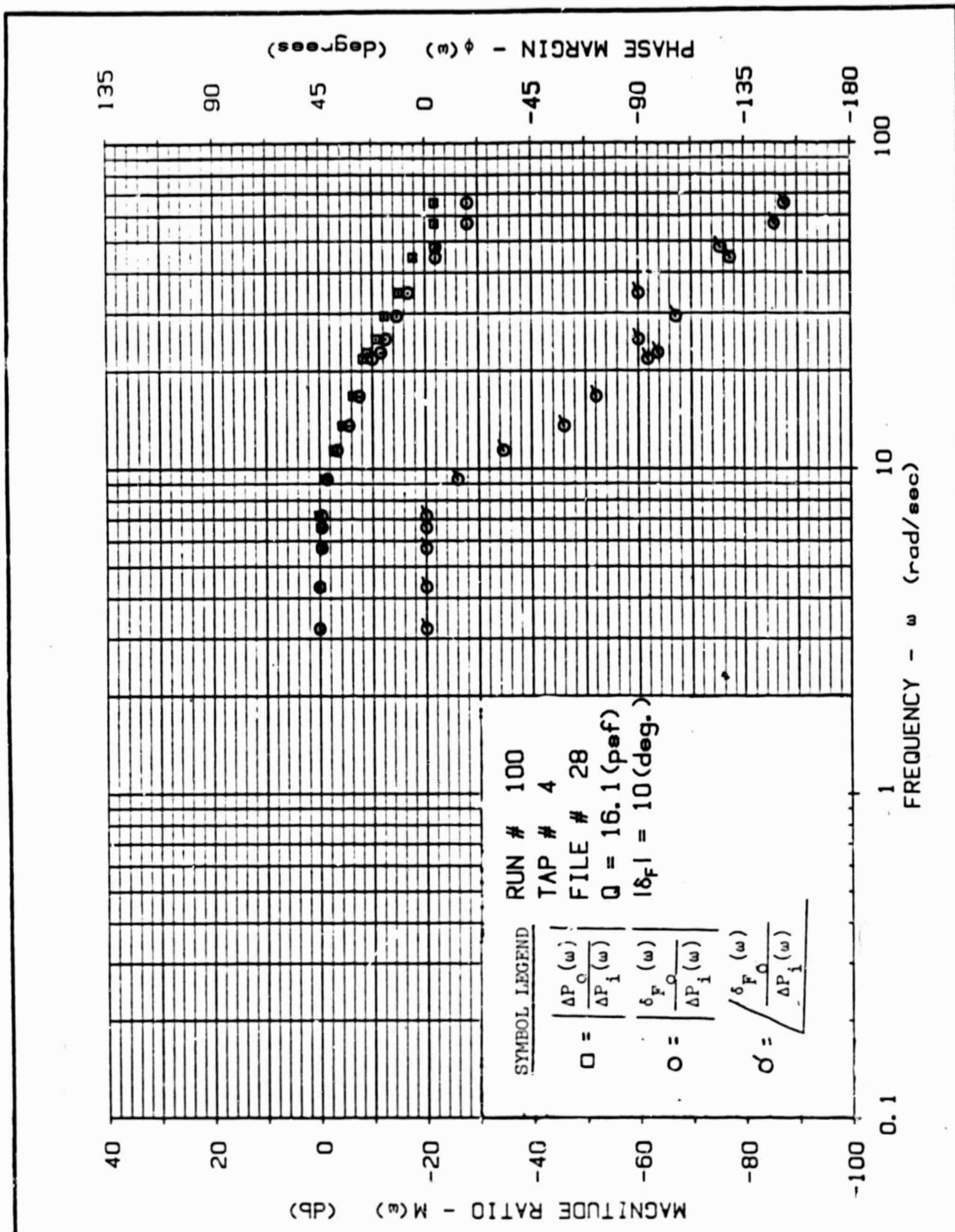

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FIGURE B 63. PRESSURE COMMAND BODE - q= 16.1 (psf), $|\delta_F|$ = 10 (deg.), TAP# 4

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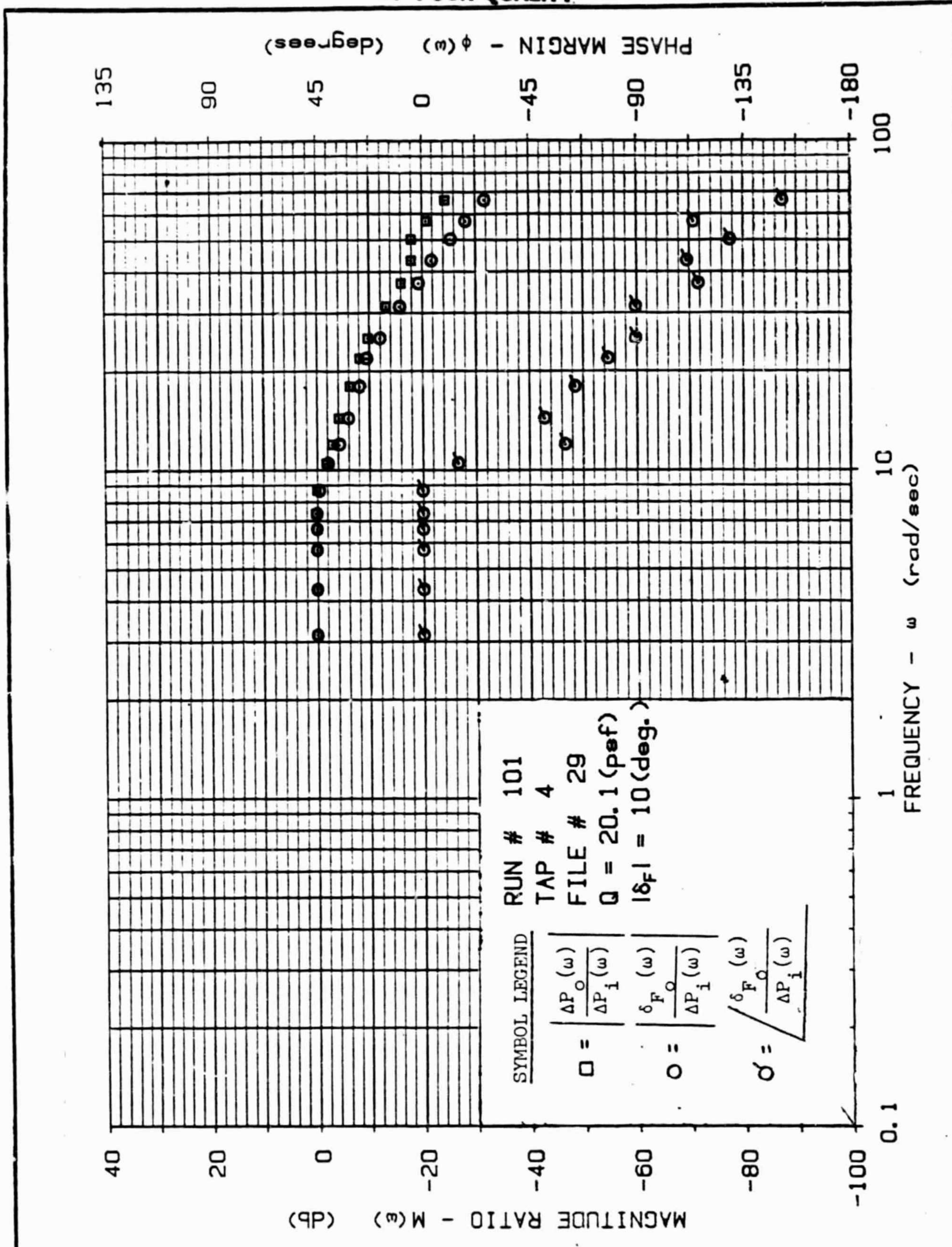

CALC		15-12-?	REVISED	DATE	FIGURE B 64. PRESSURE COMMAND BODE - q= 20.1 (psf), $|\delta_F|$ = 10 (deg.), TAP# 4
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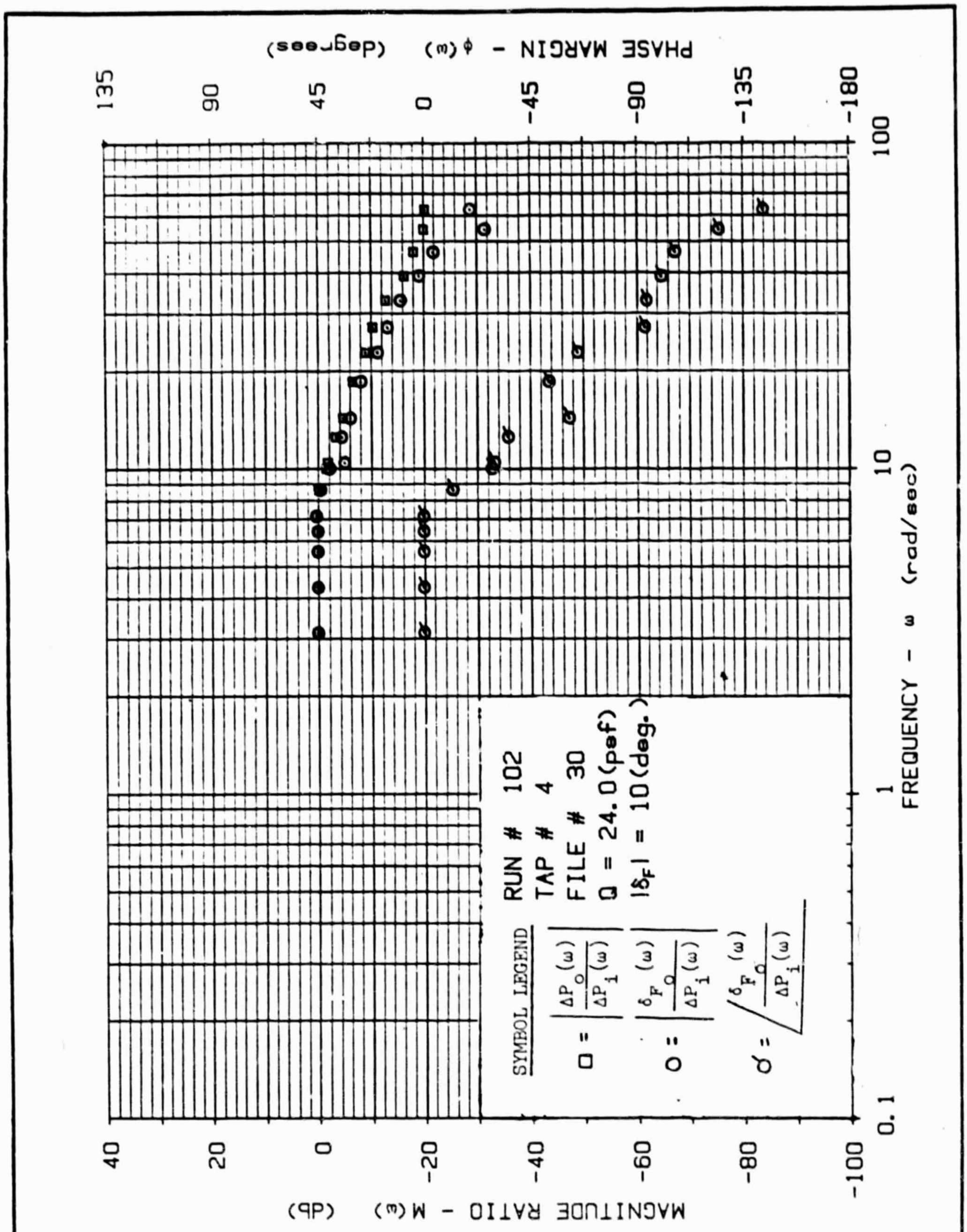

CALC		15-12-4	REVISED	DATE	FIGURE B 65. PRESSURE COMMAND BODE - q= 24.0(psf), $|\delta_F|$ = 10 (deg.), TAP# 4
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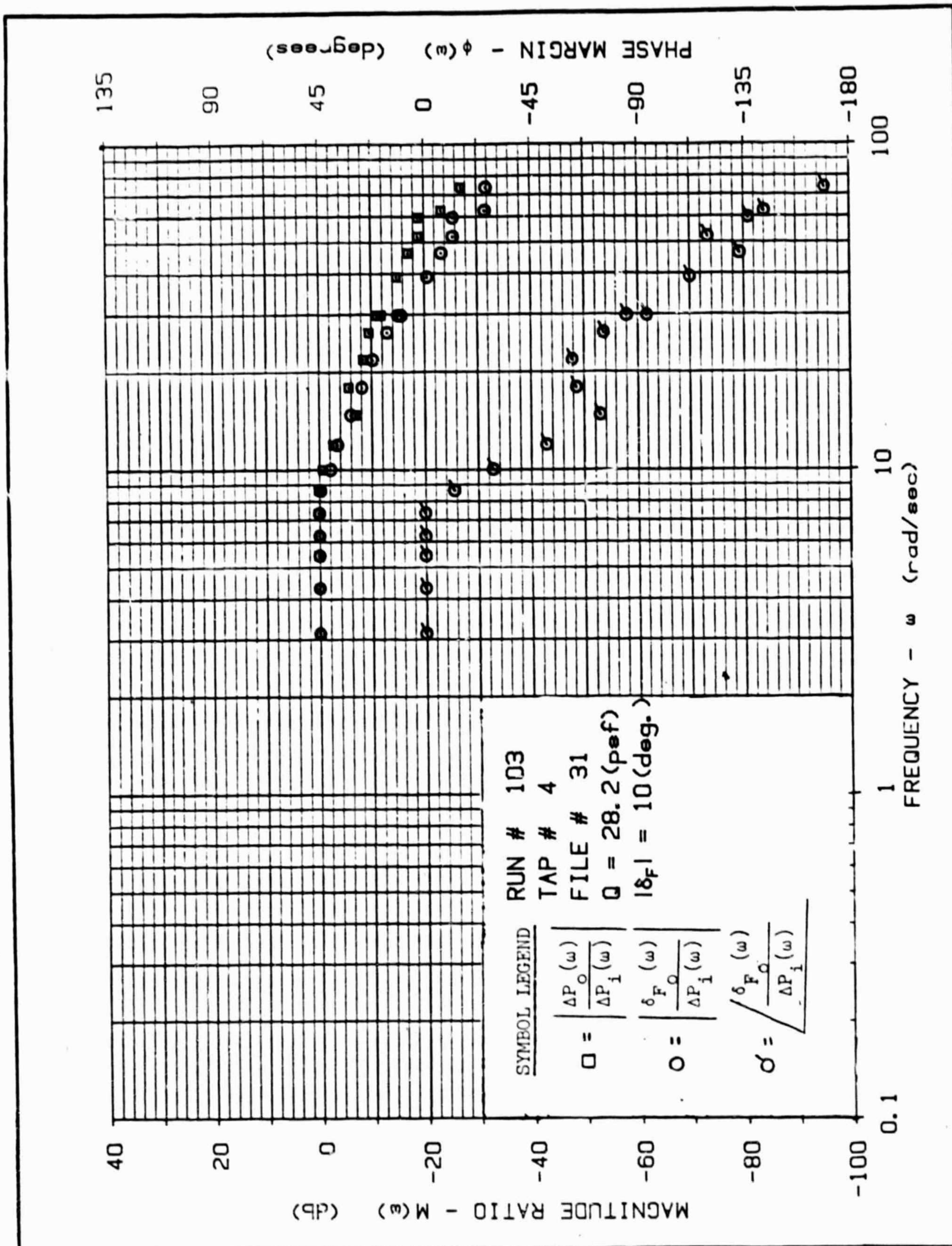

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FIGURE B 66. PRESSURE COMMAND BODE - q= 28.2 (psf), $|\delta_F|$ = 10 (deg.), TAP# 4

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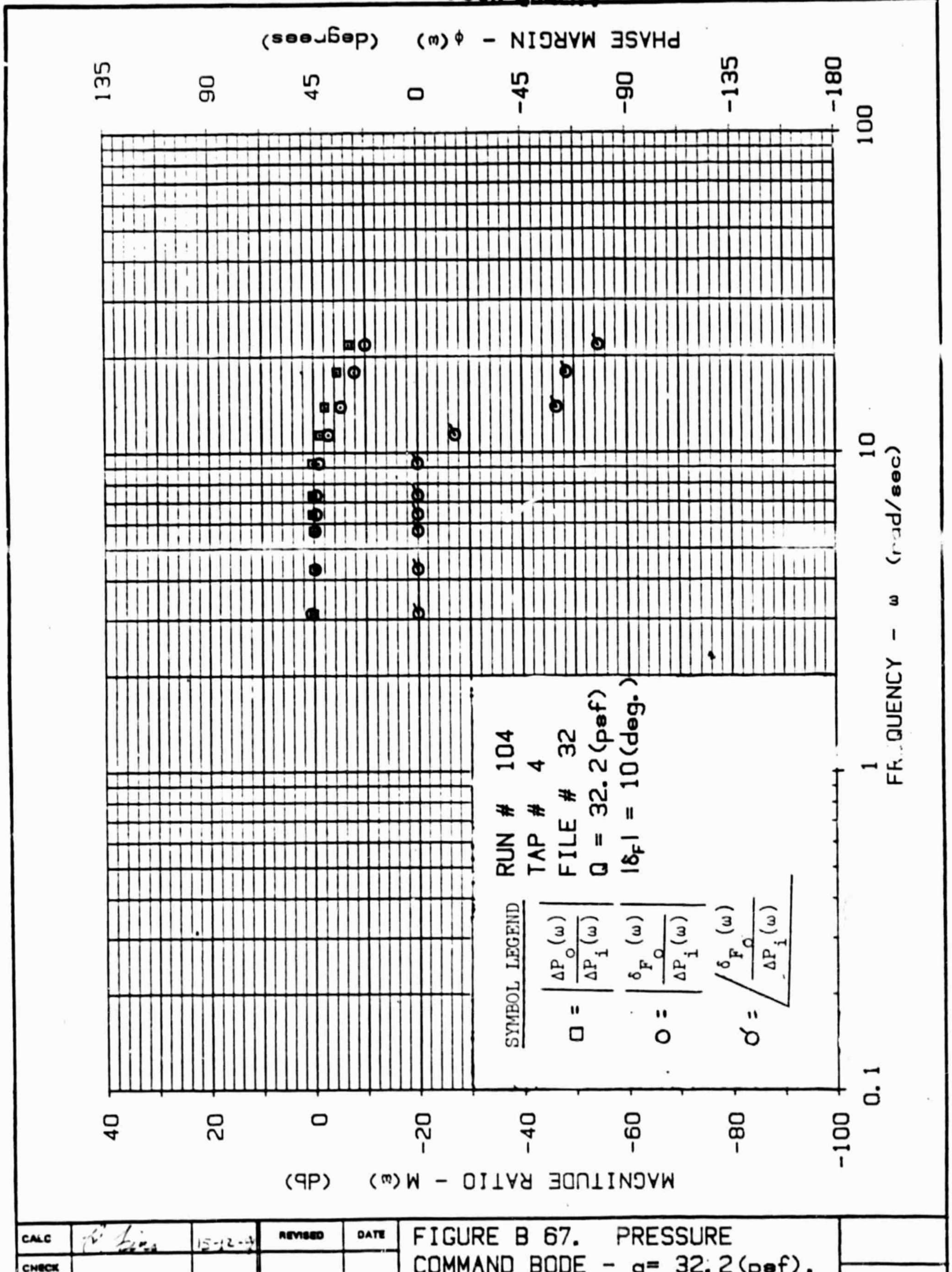

CALC		15-12-4	REVISED	DATE	FIGURE B 67. PRESSURE COMMAND BODE - q= 32.2 (psf), $|\delta_F|$ = 10 (deg.), TAP# 4
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TAP # 1 RUN # 29 FILE # 34

DYNAMIC PRESSURE 8.0 (psf)

MAGNITUDE OF delta FLAP = 3 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.20	1.08	0.94	0.00
2	3.81	0.92	1.25	0.00
3	4.33	0.94	1.04	0.00
4	5.39	0.77	0.94	0.00
5	6.28	0.83	1.04	0.00
6	6.61	0.96	0.94	0.00
7	12.60	0.88	1.04	0.00
8	12.60	0.83	0.73	0.00
9	18.80	0.92	1.04	0.00
10	25.10	1.00	1.25	0.00
11	24.80	0.90	1.04	56.80
12	31.40	0.63	0.73	108.00
13	37.00	0.44	0.83	84.70
14	38.70	0.50	0.73	111.00
15	43.60	0.38	0.63	125.00
16	49.60	0.25	0.52	114.00
17	54.60	0.25	0.52	156.00
18	62.80	0.20	0.41	144.00
19	62.80	0.21	0.48	144.00

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TAP # 1 RUN # 30 FILE # 35

DYNAMIC PRESSURE 8.0 (psf)

MAGNITUDE OF delta FLAP = 4 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.74	0.88	1.03	0.00
2	4.83	0.91	0.97	0.00
3	12.60	0.94	1.19	0.00
4	18.80	0.88	0.97	54.00
5	25.10	0.53	0.65	72.00
6	31.40	0.35	0.47	36.00
7	37.70	0.29	0.41	86.40
8	42.80	0.24	0.42	98.20
9	49.10	0.15	0.30	112.00
10	55.90	0.12	0.24	128.00
11	61.60	0.12	0.24	141.00
12	86.70	0.06	0.11	189.50

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TAP # 1 RUN # 31 FILE # 36

DYNAMIC PRESSURE 8.0 (psf)

MAGNITUDE OF delta FLAP = 5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.06	0.92	1.13	0.00
2	2.17	0.85	1.04	0.00
3	2.77	0.85	1.00	0.00
4	12.80	0.88	1.08	36.00
5	19.30	0.58	0.75	55.40
6	25.10	0.38	0.42	72.00
7	30.60	0.29	0.42	87.80
8	36.50	0.19	0.29	83.70
9	43.10	0.17	0.25	123.50
10	48.90	0.10	0.21	140.00
11	56.10	0.08	0.25	129.00
12	55.40	0.14	0.28	143.00
13	62.80	0.08	0.20	144.00
14	61.30	0.08	0.20	140.00

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TAP # 1 RUN # 32 FILE # 37

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 2 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.77	0.86	1.43	0.00
2	3.77	1.00	1.67	0.00
3	4.96	0.57	1.43	0.00
4	12.90	1.20	1.67	0.00

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TAP # 1 RUN # 33 FILE # 38

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 3 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	12.80	0.71	1.05	0.00
2	19.30	0.58	2.11	0.00
3	25.10	0.79	1.58	0.00
4	25.10	0.71	1.58	0.00
5	37.70	0.83	1.67	86.40
6	43.60	0.75	1.67	100.00
7	49.00	0.53	1.67	112.00
8	54.10	0.47	1.76	108.00
9	61.50	0.35	1.47	140.00
10	59.80	0.29	1.47	180.00

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TAP # 1 RUN # 34 FILE # 39

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 4 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	12.60	0.75	0.25	0.00
2	3.18	0.49	0.22	0.00
3	5.59	0.48	0.20	0.00
4	6.68	0.53	0.23	0.00
5	13.10	0.63	0.25	0.00
6	18.50	0.48	0.23	0.00
7	25.60	0.63	0.23	0.00
8	31.40	0.77	0.31	0.00
9	37.70	0.62	0.21	86.40
10	43.60	0.46	0.23	125.00
11	48.90	0.35	0.18	168.00
12	54.60	0.23	0.13	156.00
13	62.80	0.18	0.10	108.00
14	61.80	0.18	0.10	142.00
15	61.60	0.23	0.10	159.00
16	68.30	0.13	0.10	176.00
17	73.90	0.10	0.10	169.40
18	100.50	0.07	0.07	172.80
19	108.30	0.07	0.07	217.20
20	130.00	0.05	0.10	223.00

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TAP # 1 RUN # 35 FILE # 40

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	4.33	0.52	1.10	0.00
2	4.90	0.52	1.03	0.00
3	5.71	0.54	1.03	0.00
4	6.61	0.59	0.97	0.00
5	12.80	0.52	0.97	0.00
6	19.00	0.52	1.03	0.00
7	25.10	0.66	1.29	0.00
8	32.20	0.41	0.83	111.00
9	37.30	0.31	0.71	128.00
10	43.30	0.21	0.52	149.00
11	48.90	0.18	0.52	112.00
12	56.10	0.13	0.44	161.00
13	62.80	0.07	0.30	144.00

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TAP # 1 RUN # 36 FILE # 41

DYNAMIC PRESSURE 16.1 (psf)

MAGNITUDE OF delta FLAP = 2 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	5.42	0.44	1.09	0.00
2	11.20	0.42	1.09	0.00
3	43.30	0.53	1.14	0.00
4	32.80	0.61	1.62	93.90
5	43.50	0.30	1.10	124.60

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TAP # 1   RUN # 37   FILE # 42

DYNAMIC PRESSURE 16.1 (psf)

MAGNITUDE OF delta FLAP = 3 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.22	0.47	1.32	0.00
2	4.31	0.53	1.84	0.00
3	5.50	0.47	1.84	0.00
4	6.54	0.53	1.58	0.00
5	12.60	0.42	1.58	0.00
6	19.30	0.53	2.11	0.00
7	13.00	1.16	1.84	0.00
8	15.90	1.56	1.94	0.00
9	18.80	1.65	2.94	0.00
10	43.30	1.67	2.50	99.30
11	55.50	1.00	1.76	159.00

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TAP # 1 RUN # 38 FILE # 43

DYNAMIC PRESSURE 16.1 (psf)

MAGNITUDE OF delta FLAP = 4 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.26	0.60	0.88	0.00
2	4.35	0.60	0.92	0.00
3	5.63	0.56	0.92	0.00
4	12.60	0.54	0.92	0.00
5	19.10	0.58	1.00	0.00
6	22.50	0.38	0.79	72.00
7	22.00	0.48	0.83	62.60
8	31.40	0.27	0.54	108.00
9	37.70	0.20	0.39	116.00
10	43.30	0.15	0.30	112.00
11	49.60	0.11	0.22	133.00

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TAP # 1 RUN # 39 FILE # 45

DYNAMIC PRESSURE 16.1 (psf)

MAGNITUDE OF delta FLAP = 5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	5.23	0.92	5.83	0.00
2	6.28	0.88	5.42	0.00
3	12.60	0.88	5.83	0.00
4	17.90	0.96	6.25	0.00
5	25.10	0.79	6.04	72.00
6	31.40	0.54	4.17	90.00
7	28.90	0.67	4.58	82.00
8	37.70	0.42	3.33	108.00
9	41.80	0.29	2.71	120.00

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TAP # 1 RUN # 40 FILE # 44

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 2 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.17	0.44	0.00
2	4.49	0.24	0.42	0.00
3	5.23	0.16	0.42	0.00
4	25.10	0.24	0.58	0.00
5	31.40	0.22	0.56	0.00
6	31.40	0.28	0.56	0.00
7	41.90	0.33	0.56	0.00
8	48.30	0.39	0.56	111.00
9	48.30	0.44	0.78	96.90
10	52.30	0.56	0.61	120.00

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TAP # 1 RUN # 41 FILE # 46

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 3 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.22	1.09	0.00
2	5.61	0.33	1.27	0.00
3	13.50	0.44	1.64	0.00
4	18.80	0.36	1.36	0.00
5	12.60	0.33	1.45	0.00
6	31.40	0.53	1.90	0.00
7	38.70	0.46	2.00	83.10
8	48.30	0.26	1.30	125.00
9	50.30	0.25	1.27	130.00
10	62.80	0.13	0.86	144.00
11	69.80	0.11	0.76	160.00

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TAP # 1 RUN # 42 FILE # 47

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 4 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.40	1.18	0.00
2	4.28	0.39	1.18	0.00
3	5.54	0.40	1.94	0.00
4	12.56	0.42	1.53	0.00
5	19.30	0.35	1.47	0.00
6	25.10	0.49	1.65	0.00
7	31.40	0.42	1.53	45.00
8	41.90	0.20	1.00	120.00
9	49.60	0.16	0.81	142.00
10	57.10	0.11	0.69	156.00
11	61.00	0.09	0.56	157.00

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TAP # 1 RUN # 43 FILE # 48

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.22	0.36	1.12	0.00
2	4.49	0.32	1.08	0.00
3	6.61	0.35	1.13	0.00
4	9.81	0.32	1.12	0.00
5	25.10	0.42	1.42	72.00
6	31.40	0.29	1.17	90.00
7	37.70	0.21	0.83	108.00
8	41.90	0.15	0.70	120.00
9	48.30	0.13	0.61	111.00
10	52.50	0.09	0.48	120.00

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TAP # 1 RUN # 44 FILE # 49

DYNAMIC PRESSURE 24.0 (psf)

MAGNITUDE OF delta FLAP = 2 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.48	3.10	0.00
2	4.49	0.61	2.86	0.00
3	5.54	0.59	3.10	0.00
4	12.56	0.52	2.76	0.00
5	18.80	0.52	2.76	0.00
6	25.10	0.48	2.93	0.00
7	31.40	0.50	3.21	0.00
8	35.90	0.71	4.29	0.00
9	43.60	0.67	3.70	75.00
10	48.30	0.46	2.86	111.00
11	55.40	0.29	2.14	127.00
12	62.80	0.30	1.85	144.00
13	62.80	0.22	2.05	144.00

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TAP # 1 RUN # 45 FILE # 50

DYNAMIC PRESSURE 24.0 (psf)

MAGNITUDE OF delta FLAP = 3 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	4.28	0.47	2.08	0.00
2	5.54	0.43	2.00	0.00
3	12.60	0.42	1.91	0.00
4	19.30	0.43	1.91	0.00
5	25.10	0.43	2.09	0.00
6	31.40	0.45	2.17	0.00
7	35.90	0.47	2.36	77.10
8	42.80	0.33	1.83	98.20
9	43.30	0.33	1.82	99.30
10	48.30	0.28	1.39	111.00
11	59.80	0.15	1.27	171.00
12	57.10	0.20	1.27	131.00
13	62.80	0.13	0.82	144.00
14	94.20	0.06	0.57	162.00

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TAP # 1 RUN # 46 FILE # 51

DYNAMIC PRESSURE 24.0 (psf)

MAGNITUDE OF delta FLAP = 4 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.40	1.71	0.00
2	4.28	0.40	1.76	0.00
3	5.72	0.40	1.71	0.00
4	12.60	0.39	1.60	0.00
5	19.30	0.40	1.60	0.00
6	25.10	0.44	1.82	0.00
7	31.40	0.45	1.82	67.50
8	37.70	0.28	1.41	54.00
9	42.80	0.25	1.18	123.00
10	49.60	0.18	0.97	165.90
11	55.40	0.12	0.73	159.00
12	62.80	0.10	0.61	144.00

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TAP # 1 RUN # 47 FILE # 52

DYNAMIC PRESSURE 24.0 (psf)

MAGNITUDE OF delta FLAP = 5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	6.42	0.38	1.48	0.00
2	8.79	0.35	1.48	0.00
3	5.64	0.39	1.52	0.00
4	12.60	0.37	1.44	0.00
5	19.30	0.38	1.52	0.00
6	25.10	0.43	1.68	36.00
7	31.40	0.30	1.28	90.00
8	37.70	0.20	1.08	108.00
9	43.30	0.16	0.88	99.30
10	48.30	0.13	0.79	138.00
11	49.60	0.14	0.74	142.00
12	55.40	0.09	0.61	159.00
13	62.80	0.06	0.48	180.00
14	92.40	0.02	0.26	195.00
15	105.00	0.03	0.26	180.00

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RUN # 48 FILE # 53

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	4.96	0.37	0.72	184.70
2	6.28	0.36	0.71	180.00
3	7.39	0.32	0.68	84.70
4	12.60	0.25	0.58	54.00
5	18.80	0.18	0.38	54.00
6	25.10	0.13	0.37	72.00
7	31.40	0.09	0.32	67.50

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RUN # 49 FILE # 54

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 10 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.41	0.60	0.00
2	4.28	0.38	0.59	49.10
3	5.71	0.35	0.54	49.10
4	3.14	0.33	0.50	36.00
5	5.23	0.31	0.50	60.00
6	7.38	0.29	0.49	42.30
7	9.66	0.26	0.46	55.40
8	13.00	0.21	0.40	74.50
9	19.40	0.13	0.29	37.90
10	25.10	0.09	0.21	72.00
11	31.40	0.07	0.16	70.00
12	37.70	0.05	0.12	27.00
13	44.90	0.04	0.12	64.30

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RUN # 50 FILE # 55

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 15 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.42	0.66	0.00
2	4.39	0.38	0.65	0.00
3	4.96	0.38	0.67	28.40
4	5.59	0.34	0.63	48.00
5	6.73	0.30	0.66	38.60
6	9.67	0.20	0.42	55.40
7	12.57	0.16	0.35	36.00
8	15.70	0.11	0.26	56.30
9	18.80	0.09	0.22	67.50
10	22.10	0.08	0.21	31.80
11	25.10	0.06	0.14	54.00
12	27.90	0.06	0.14	60.00
13	31.40	0.05	0.13	67.50
14	31.40	0.04	0.12	54.00
15	31.40	0.05	0.10	81.00
16	34.90	0.03	0.10	70.00

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RUN # 51 FILE # 56

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 20 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.37	0.48	0.00
2	4.13	0.33	0.45	0.60
3	2.48	0.30	0.44	56.80
4	2.62	0.27	0.54	49.00
5	6.28	0.23	0.42	54.00
6	6.98	0.20	0.39	50.00
7	7.54	0.19	0.37	64.80
8	9.67	0.15	0.30	69.20
9	12.60	0.10	0.21	81.00
10	15.90	0.07	0.18	68.60
11	18.80	0.06	0.15	81.00
12	25.10	0.04	0.11	108.00
13	25.10	0.04	0.11	90.00
14	27.90	0.04	0.09	80.00
15	34.90	0.03	0.05	80.00
16	36.90	0.02	0.05	95.30
17	40.50	0.02	0.05	104.50
18	43.30	0.02	0.05	118.00

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RUN # 52 FILE # 57

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.42	1.58	0.00
2	3.70	0.39	1.58	0.00
3	4.19	0.38	1.53	24.00
4	4.96	0.38	1.47	28.40
5	5.61	0.35	1.35	32.10
6	6.21	0.35	1.41	44.40
7	9.67	0.30	1.09	55.40
8	12.60	0.24	0.97	54.00
9	15.70	0.19	0.88	67.50
10	18.80	0.18	0.85	67.50
11	22.20	0.15	0.73	79.40
12	25.10	0.14	0.61	54.00
13	30.80	0.11	0.42	88.20
14	33.60	0.08	0.48	96.40
15	36.50	0.08	0.42	104.60

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RUN # 53 FILE # 58

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 10 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.33	1.16	0.00
2	2.24	0.32	1.08	0.00
3	5.23	0.28	1.08	0.00
4	6.28	0.26	1.18	0.00
5	7.14	0.25	1.13	40.90
6	9.42	0.20	0.95	54.00
7	8.38	0.24	1.03	24.00
8	12.60	0.17	0.74	72.00
9	15.70	0.15	0.68	45.00
10	15.70	0.07	0.63	45.00
11	18.80	0.05	0.55	40.50
12	21.70	0.04	0.46	62.10
13	25.10	0.03	0.41	72.00
14	27.90	0.03	0.35	80.00
15	30.60	0.03	0.30	87.80
16	34.30	0.02	0.22	58.90

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RUN # 54 FILE # 59

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 15 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.42	1.30	0.00
2	4.33	0.40	1.26	0.00
3	5.54	0.37	1.17	0.00
4	6.73	0.30	1.04	38.60
5	9.67	0.23	0.78	55.40
6	8.06	0.26	0.96	46.10
7	12.60	0.16	0.61	72.00
8	15.70	0.12	0.48	90.00
9	18.80	0.16	0.43	54.00
10	21.80	0.08	0.26	46.90
11	25.10	0.07	0.26	54.00
12	28.60	0.06	0.27	40.90
13	31.40	0.05	0.22	45.00
14	34.00	0.05	0.14	58.40
15	37.40	0.03	0.13	64.30
16	40.50	0.03	0.14	92.90
17	43.30	0.03	0.14	62.10
18	49.60	0.02	0.13	71.10
19	52.30	0.02	0.11	90.00
20	55.40	0.02	0.09	95.30
21	61.30	0.01	0.09	105.00

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RUN # 55 FILE # 60

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 20 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.39	1.03	0.00
2	4.28	0.34	0.97	36.80
3	4.28	0.36	1.03	36.80
4	7.39	0.31	0.94	0.00
5	6.73	0.24	0.71	57.80
6	8.05	0.19	0.69	69.20
7	9.67	0.16	0.60	55.40
8	12.90	0.11	0.43	74.10
9	15.70	0.09	0.35	90.00
10	18.80	0.08	0.29	67.50
11	21.80	0.07	0.26	62.60
12	25.10	0.05	0.20	72.00
13	27.70	0.04	0.14	79.40
14	31.40	0.03	0.14	90.00
15	32.20	0.03	0.11	92.30
16	37.00	0.02	0.11	106.00
17	43.30	0.02	0.09	99.30
18	42.80	0.02	0.09	108.00
19	49.60	0.02	0.09	114.00

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TAP # 1 RUN # 56 FILE # 61

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 10 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	1.96	0.53	2.67	0.00
2	2.51	0.55	2.67	0.00
3	3.70	0.53	2.76	14.00
4	4.83	0.55	2.77	0.00
5	5.59	0.52	2.59	0.00
6	5.98	0.52	2.67	0.00
7	6.44	0.52	2.59	0.00
8	7.39	0.53	2.76	0.00
9	9.67	0.52	2.76	41.50
10	12.60	0.38	2.07	54.00
11	11.40	0.43	2.33	49.10
12	14.00	0.31	1.72	60.00
13	15.20	0.28	1.47	87.30
14	19.30	0.23	1.25	83.10
15	21.90	0.18	0.98	78.20
16	25.10	0.16	0.89	90.00
17	27.90	0.13	0.29	80.00
18	29.90	0.10	0.24	99.40
19	33.00	0.11	0.19	110.00
20	37.00	0.07	0.18	127.00
21	41.90	0.05	0.18	120.00
22	43.30	0.05	0.16	124.00
23	49.60	0.04	0.13	128.00
24	54.60	0.03	0.12	141.00

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TAP # 1 RUN # 57 FILE # 62

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 20 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	1.96	0.67	0.90	0.00
2	3.14	0.71	0.92	0.00
3	4.49	0.69	0.90	0.00
4	5.03	0.67	0.90	0.00
5	5.46	0.61	0.90	47.00
6	6.10	0.55	0.90	17.50
7	6.61	0.50	0.84	28.40
8	7.39	0.44	0.76	42.30
9	12.60	0.24	0.46	72.00
10	15.70	0.18	0.32	78.80
11	19.30	0.12	0.24	96.90
12	21.90	0.11	0.23	93.90
13	25.10	0.09	0.16	108.00
14	27.30	0.07	0.15	93.90
15	31.40	0.07	0.12	72.00
16	37.00	0.04	0.10	119.00
17	44.90	0.03	0.07	103.00
18	50.30	0.03	0.06	115.00

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TAP # 1 RUN # 58 FILE # 63

DYNAMIC PRESSURE 16.1 (psf)

MAGNITUDE OF delta FLAP = 10 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.41	1.02	0.00
2	4.49	0.41	1.02	0.00
3	5.71	0.40	1.00	0.00
4	6.19	0.42	0.98	0.00
5	6.98	0.42	1.00	0.00
6	7.39	0.43	1.00	0.00
7	8.67	0.43	1.05	0.00
8	9.67	0.38	1.00	41.50
9	15.70	0.20	0.57	67.50
10	18.60	0.15	0.43	86.40
11	22.80	0.13	0.38	78.30
12	25.10	0.11	0.34	72.00
13	31.40	0.08	0.24	108.00
14	36.90	0.06	0.19	106.00
15	41.90	0.04	0.14	149.00
16	46.20	0.04	0.12	106.00

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TAP # 1 RUN # 59 FILE # 64

DYNAMIC PRESSURE 16.1 (psf)

MAGNITUDE OF delta FLAP = 20 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	2.51	0.53	1.08	0.00
2	1.96	0.53	1.08	0.00
3	5.03	0.53	1.08	0.00
4	5.71	0.48	1.04	0.00
5	6.28	0.43	0.96	0.00
6	6.61	0.38	0.92	29.20
7	7.39	0.37	0.88	42.30
8	8.98	0.27	0.72	51.40
9	12.20	0.19	0.52	69.90
10	16.10	0.14	0.38	69.20
11	18.60	0.11	0.28	80.00
12	20.90	0.10	0.29	90.00
13	25.10	9.08	0.20	72.00
14	27.90	0.06	0.16	87.10
15	26.40	0.10	0.12	97.30
16	34.90	0.05	0.15	100.00
17	39.30	0.03	0.10	90.00
18	46.50	0.03	0.07	120.00

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TAP # 1 RUN # 60 FILE # 65

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 10 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	2.61	0.36	0.88	0.00
2	4.83	0.35	0.88	0.00
3	5.71	0.35	0.90	0.00
4	5.71	0.36	1.10	0.00
5	6.28	0.35	1.10	0.00
6	6.61	0.37	1.10	0.00
7	7.39	0.36	1.15	0.00
8	8.98	0.36	1.10	25.70
9	10.50	0.30	1.00	45.00
10	15.70	0.17	0.57	67.50
11	18.60	0.14	0.50	69.20
12	21.90	0.12	0.40	78.30
13	25.10	0.10	0.35	72.00
14	35.90	0.05	0.25	77.10
15	34.90	0.06	0.20	120.00
16	39.30	0.04	0.15	90.00
17	44.90	0.04	0.16	103.00
18	52.30	0.03	0.11	120.00
19	59.80	0.02	0.10	137.00
20	66.10	0.02	0.08	152.00

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TAP # 1 RUN # 61 FILE # 66

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 20 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	4.99	0.39	1.03	0.00
2	3.70	0.41	1.10	0.00
3	5.71	0.36	1.00	0.00
4	6.28	0.35	0.97	0.00
5	7.39	0.31	0.90	18.50
6	7.39	0.28	0.87	42.30
7	9.00	0.23	0.72	51.40
8	11.40	0.18	0.58	65.40
9	14.00	0.13	0.45	80.00
10	15.70	0.12	0.39	90.00
11	21.90	0.08	0.26	78.20
12	25.60	0.06	0.21	73.50
13	30.30	0.04	0.16	86.70
14	37.00	0.03	0.12	123.00
15	43.90	0.02	0.09	101.00
16	50.30	0.01	0.08	115.00

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TAP # 1 RUN # 62 FILE # 67

DYNAMIC PRESSURE 24.0 (psf)

MAGNITUDE OF delta FLAP = 10 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	6.10	0.27	1.08	0.00
2	3.69	0.28	1.04	0.00
3	4.83	0.28	1.08	0.00
4	6.98	0.30	1.13	0.00
5	7.18	0.30	1.08	0.00
6	9.67	0.28	1.04	27.70
7	12.00	0.21	0.88	51.40
8	14.00	0.17	0.71	80.00
9	16.10	0.14	0.54	92.30
10	18.60	0.10	0.44	80.00
11	20.90	0.09	0.38	90.00
12	25.10	0.07	0.33	82.80
13	29.60	0.06	0.27	84.70
14	33.10	0.05	0.22	94.70
15	37.70	0.03	0.15	108.00
16	41.90	0.02	0.14	90.00
17	44.90	0.02	0.10	103.00
18	52.30	0.02	0.10	120.00
19	59.80	0.01	0.07	137.00

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TAP # 1 RUN # 63 FILE # 68

DYNAMIC PRESSURE 24.0 (psf)

MAGNITUDE OF delta FLAP = 20 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.31	0.34	1.03	0.00
2	4.19	0.35	1.00	0.00
3	5.11	0.32	1.00	0.00
4	6.10	0.29	0.90	0.00
5	6.28	0.26	0.87	0.00
6	6.98	0.24	0.85	30.00
7	7.39	0.23	0.82	42.30
8	8.67	0.18	0.72	49.60
9	10.90	0.14	0.56	62.60
10	14.00	0.11	0.41	80.00
11	18.00	0.08	0.31	77.10
12	22.80	0.05	0.24	65.40
13	25.10	0.05	0.21	108.00
14	33.50	0.03	0.13	96.00
15	41.90	0.02	0.11	120.00
16	39.20	0.02	0.11	135.00
17	52.30	0.01	0.06	120.00
18	61.00	0.01	0.05	140.00

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TAP # 4 RUN # 64 FILE # 8

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	2.61	0.36	1.05	0.00
2	3.70	0.35	1.05	0.00
3	6.28	0.38	1.11	0.00
4	6.28	0.39	1.11	0.00
5	6.98	0.42	1.17	0.00
6	9.67	0.41	1.05	13.80
7	14.00	0.43	1.22	0.00
8	16.80	0.40	1.11	48.00
9	19.30	0.34	1.00	55.40
10	25.10	0.25	0.74	90.00
11	31.40	0.17	0.61	67.50
12	35.90	0.14	0.50	103.00
13	41.90	0.10	0.39	120.00
14	50.30	0.06	0.31	173.00
15	62.80	0.02	0.18	144.00
16	62.80	0.03	0.17	144.00
17	78.50	0.02	0.17	113.00
18	89.70	0.01	0.14	206.00

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TAP # 4 RUN # 65 FILE # 9

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 10 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.45	1.08	0.00
2	4.49	0.45	1.05	0.00
3	5.46	0.44	1.06	0.00
4	6.28	0.45	1.03	0.00
5	6.79	0.43	1.03	0.00
6	7.39	0.46	1.06	0.00
7	8.98	0.43	1.05	0.00
8	10.50	0.40	1.03	0.00
9	14.00	0.28	0.78	60.00
10	15.70	0.22	0.64	90.00
11	19.30	0.17	0.50	83.00
12	22.80	0.15	0.47	49.10
13	31.40	0.08	0.25	45.00
14	37.00	0.06	0.18	127.00
15	44.90	0.04	0.16	116.00
16	62.80	0.02	0.07	108.00

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TAP # 4 RUN # 66 FILE # 10

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 15 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	1.80	0.51	1.05	0.00
2	3.49	0.56	1.11	0.00
3	3.93	0.56	1.11	0.00
4	5.98	0.56	1.18	0.00
5	6.28	0.51	1.11	0.00
6	6.98	0.46	1.05	10.00
7	8.98	0.38	0.89	25.70
8	14.00	0.23	0.58	40.00
9	65.90	0.16	0.47	103.00
10	25.10	0.11	0.29	90.00
11	31.40	0.07	0.27	90.00
12	35.90	0.06	0.17	103.00
13	34.90	0.05	0.16	120.00
14	44.90	0.04	0.11	103.00
15	52.40	0.03	0.08	120.00

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TAP # 4 RUN # 67 FILE # 11

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 20 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	4.19	0.55	1.08	0.00
2	5.71	0.50	1.00	0.00
3	6.28	0.47	0.96	18.00
4	6.61	0.40	0.84	37.90
5	7.39	0.38	0.83	42.30
6	8.98	0.30	0.67	51.40
7	12.00	0.21	0.57	68.60
8	15.70	0.15	0.46	90.00
9	18.00	0.13	0.38	103.00
10	20.90	0.10	0.25	90.00
11	25.10	0.08	0.26	72.00
12	31.40	0.07	0.20	90.00
13	34.90	0.04	0.14	90.00
14	41.90	0.03	0.12	120.00
15	57.10	0.03	0.09	98.10
16	62.80	0.02	0.07	144.00

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TAP # 4 RUN # 68 FILE # 12

DYNAMIC PRESSURE 16.1 (psf)

MAGNITUDE OF delta FLAP = 5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.29	1.06	0.00
2	3.92	0.29	1.06	0.00
3	5.23	0.29	1.06	0.00
4	5.71	0.27	1.06	0.00
5	5.98	0.26	1.03	0.00
6	6.61	0.27	1.03	0.00
7	7.18	0.29	1.03	0.00
8	8.67	0.27	1.06	0.00
9	11.40	0.29	1.10	0.00
10	15.70	0.28	1.07	0.00
11	20.90	0.22	0.87	48.00
12	25.10	0.15	0.67	72.00
13	31.40	0.11	0.50	90.00
14	35.90	0.08	0.41	103.00
15	41.90	0.06	0.34	120.00
16	50.30	0.04	0.27	115.00
17	62.80	0.02	0.21	144.00
18	69.80	0.02	0.13	160.00

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TAP # 4 RUN # 69 FILE # 13

DYNAMIC PRESSURE 16.1 (psf)

MAGNITUDE OF delta FLAP = 10 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.35	1.10	0.00
2	4.49	0.35	1.05	0.00
3	5.23	0.34	1.05	0.00
4	6.28	0.36	1.11	0.00
5	6.61	0.35	1.10	0.00
6	7.39	0.34	1.10	0.00
7	8.97	0.35	1.05	25.70
8	10.50	0.27	1.00	60.00
9	14.00	0.22	0.80	40.00
10	15.70	0.18	0.70	45.00
11	19.30	0.14	0.60	55.40
12	22.80	0.12	0.50	65.40
13	25.10	0.09	0.40	90.00
14	31.40	0.08	0.36	90.00
15	31.40	0.06	0.29	90.00
16	44.90	0.03	0.15	103.00
17	52.30	0.03	0.15	120.00
18	57.10	0.02	0.11	131.00
19	62.80	0.02	0.11	108.00

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TAP # 4 RUN # 70 FILE # 14

DYNAMIC PRESSURE 16.1 (psf)

MAGNITUDE OF delta FLAP = 15 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.49	0.37	1.07	0.00
2	4.19	0.38	1.08	0.00
3	5.71	0.36	1.11	32.70
4	6.28	0.36	1.07	0.00
5	6.98	0.36	1.04	0.00
6	7.39	0.34	1.04	21.10
7	8.98	0.27	0.85	38.60
8	8.38	0.31	0.92	36.00
9	10.50	0.24	0.84	60.00
10	12.60	0.18	0.65	64.80
11	15.70	0.14	0.54	72.00
12	19.30	0.10	0.41	69.20
13	22.80	0.09	0.35	65.50
14	25.10	0.06	0.31	72.00
15	29.60	0.06	0.27	84.70
16	31.40	0.05	0.23	90.00
17	35.90	0.04	0.19	112.00
18	39.20	0.03	0.15	112.00
19	48.30	0.02	0.13	111.00
20	52.30	0.02	0.11	120.00
21	62.80	0.01	0.06	144.00
22	66.10	0.01	0.06	152.00

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TAP # 4 RUN # 71 FILE # 15

DYNAMIC PRESSURE 16.1 (psf)

MAGNITUDE OF delta FLAP = 20 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.49	0.38	1.03	0.00
2	4.49	0.38	1.00	0.00
3	5.71	0.36	1.03	0.00
4	6.28	0.34	0.94	0.00
5	6.98	0.31	0.91	20.00
6	7.39	0.27	0.82	42.30
7	8.38	0.24	0.71	49.70
8	10.90	0.18	0.64	62.60
9	15.70	0.12	0.48	45.00
10	22.80	0.07	0.27	78.30
11	27.90	0.05	0.21	80.00
12	33.50	0.04	0.17	96.00
13	39.20	0.03	0.15	90.00
14	44.90	0.02	0.10	103.00
15	52.30	0.02	0.10	120.00
16	57.10	0.02	0.08	131.00
17	67.80	0.01	0.08	144.00

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TAP # 4 RUN # 72 FILE # 16

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	4.83	0.26	1.19	0.00
2	5.72	0.25	1.13	0.00
3	6.28	0.25	1.19	0.00
4	6.61	0.27	1.27	0.00
5	6.98	0.27	1.27	0.00
6	8.38	0.25	1.19	0.00
7	10.80	0.24	1.12	0.00
8	14.00	0.26	1.19	0.00
9	16.80	0.21	1.00	0.00
10	20.10	0.16	0.75	57.60
11	23.90	0.12	0.65	68.60
12	27.90	0.09	0.54	80.00
13	35.90	0.07	0.45	77.10
14	41.90	0.05	0.40	90.00
15	44.90	0.04	0.28	103.00
16	54.10	0.03	0.20	124.00
17	62.80	0.02	0.16	90.00

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TAP # 4 RUN # 73 FILE # 1

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 10 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.25	1.04	0.00
2	4.33	0.28	1.12	0.00
3	5.71	0.28	1.17	0.00
4	6.28	0.25	1.08	0.00
5	7.39	0.28	1.12	0.00
6	8.98	0.29	1.12	0.00
7	11.40	0.22	1.31	32.70
8	14.00	0.18	0.80	40.00
9	16.80	0.14	0.64	72.00
10	20.90	0.10	0.52	60.00
11	25.10	0.08	0.44	72.00
12	31.41	0.06	0.38	67.50
13	37.00	0.07	0.28	106.00
14	48.30	0.04	0.17	111.00
15	57.10	0.03	0.13	98.10
16	66.10	0.02	0.09	114.00

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TAP # 4 RUN # 74 FILE # 2

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 15 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.29	1.09	0.00
2	4.49	0.29	1.09	0.00
3	5.71	0.28	1.06	0.00
4	7.85	0.25	1.03	0.00
5	8.98	0.22	0.88	25.70
6	10.50	0.16	0.71	45.00
7	15.70	0.12	0.56	45.00
8	20.90	0.07	0.38	60.00
9	27.90	0.05	0.26	80.00
10	35.90	0.03	0.21	51.40
11	41.90	0.02	0.15	120.00
12	52.40	0.02	0.12	120.00
13	57.10	0.01	0.09	131.00
14	69.80	0.01	0.06	120.00
15	78.50	0.01	0.09	135.00

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TAP # 4 RUN # 75 FILE # 3

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 20 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.32	1.09	0.00
2	4.49	0.33	1.07	0.00
3	5.23	0.28	0.93	0.00
4	6.73	0.23	0.91	0.00
5	6.28	0.24	0.93	0.00
6	6.98	0.22	0.82	40.00
7	7.39	0.21	0.82	42.30
8	8.38	0.17	0.73	48.00
9	13.97	0.10	0.45	60.00
10	11.40	0.13	0.55	32.70
11	14.80	0.09	0.45	42.30
12	16.80	0.07	0.40	60.00
13	20.90	0.04	0.31	60.00
14	25.10	0.04	0.27	72.00
15	31.40	0.03	0.20	90.00
16	35.90	0.02	0.16	103.00
17	39.30	0.02	0.14	90.00
18	48.30	0.01	0.09	111.00

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TAP # 4 RUN # 76 FILE # 4

DYNAMIC PRESSURE 24.0 (psf)

MAGNITUDE OF delta FLAP = 5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.16	1.04	0.00
2	4.49	0.16	1.06	0.00
3	5.71	0.16	1.06	0.00
4	6.98	0.16	1.06	0.00
5	7.54	0.16	1.04	0.00
6	8.98	0.16	1.06	0.00
7	10.93	0.17	1.06	0.00
8	13.46	0.17	1.06	0.00
9	14.78	0.18	1.09	0.00
10	17.95	0.19	1.19	25.70
11	18.85	0.18	1.13	54.00
12	20.94	0.16	1.06	60.00
13	25.10	0.13	0.88	72.00
14	26.90	0.11	0.77	77.10
15	34.10	0.08	0.63	90.00
16	34.30	0.07	0.58	98.20
17	39.20	0.04	0.44	101.00
18	44.90	0.04	0.38	103.00
19	52.30	0.02	0.19	120.00
20	57.10	0.01	0.26	131.00

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TAP # 4 RUN # 77 FILE # 5

DYNAMIC PRESSURE 24.0 (psf)

MAGNITUDE OF delta FLAP = 10 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.92	0.21	1.06	0.00
2	4.49	0.21	1.06	0.00
3	5.23	0.20	1.06	0.00
4	5.89	0.21	1.06	0.00
5	6.28	0.20	1.06	0.00
6	6.98	0.21	1.06	0.00
7	7.39	0.22	1.06	0.00
8	8.98	0.21	1.09	0.00
9	10.50	0.18	0.97	0.00
10	12.60	0.15	0.88	36.00
11	14.00	0.13	0.76	50.00
12	18.00	0.09	0.58	51.40
13	20.90	0.07	0.48	60.00
14	25.10	0.05	0.39	72.00
15	27.90	0.05	0.34	60.00
16	35.90	0.04	0.29	77.10
17	41.90	0.02	0.19	90.00
18	44.90	0.01	0.19	128.60
19	52.34	0.01	0.16	120.00
20	62.80	0.01	0.13	144.00

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TAP # 4 RUN # 78 FILE # 6

DYNAMIC PRESSURE 24.0 (psf)

MAGNITUDE OF delta FLAP = 15 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.24	1.10	0.00
2	4.33	0.24	1.05	0.00
3	4.62	0.24	1.07	0.00
4	6.28	0.22	1.02	0.00
5	6.98	0.23	1.05	0.00
6	7.54	0.20	1.00	0.00
7	8.98	0.17	0.86	38.60
8	10.10	0.14	0.76	28.80
9	12.60	0.10	0.59	72.00
10	15.70	0.08	0.52	67.50
11	19.30	0.07	0.43	55.40
12	22.80	0.05	0.33	66.40
13	31.40	0.03	0.30	90.00
14	35.90	0.02	0.19	77.10
15	42.80	0.02	0.13	98.10
16	52.30	0.01	0.08	90.00
17	62.80	0.00	0.10	108.00
18	78.50	0.00	0.08	135.00

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TAP # 4 RUN # 79 FILE # 7

DYNAMIC PRESSURE 24.0 (psf)

MAGNITUDE OF delta FLAP = 20 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	2.64	10.80	0.00
2	4.33	2.54	10.00	0.00
3	5.71	1.76	10.40	0.00
4	6.28	2.23	9.62	0.00
5	6.28	2.16	10.00	0.00
6	6.98	2.00	9.60	20.00
7	6.98	1.85	8.85	32.00
8	7.54	1.84	8.40	21.60
9	8.75	1.46	7.31	51.40
10	9.67	1.36	6.80	41.50
11	12.60	0.88	5.20	72.00
12	17.90	0.60	4.00	77.10
13	25.10	0.42	2.92	72.00
14	27.90	0.29	2.29	80.00
15	33.50	0.25	1.88	96.00
16	38.70	0.33	0.15	83.00
17	50.20	0.21	0.10	108.00
18	50.20	0.21	0.10	144.00
19	62.80	0.04	0.06	135.00
20	62.80	0.03	0.06	180.00

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TAP # 2 RUN # 89 FILE # 17

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 10 → -5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.69	1.29	0.00
2	4.18	0.66	1.29	0.00
3	5.46	0.66	1.29	0.00
4	6.28	0.66	1.29	0.00
5	6.61	0.58	1.13	0.00
6	6.98	0.58	1.13	0.00
7	7.39	0.60	1.25	0.00
8	8.66	0.58	1.13	0.00
9	9.30	0.60	1.25	0.00
10	10.92	0.60	1.25	15.65
11	12.26	0.55	1.13	43.90
12	13.96	0.48	1.00	50.00
13	15.23	0.43	1.00	65.45
14	16.75	0.38	0.88	84.00
15	18.6[illegible]	0.35	0.80	80.00
16	22.84	0.28	0.50	81.31
17	25.13	0.23	0.35	72.00
18	29.56	0.18	0.20	105.80
19	31.41	0.15	0.18	135.00
20	33.96	0.14	0.15	97.29
21	38.08	0.11	0.14	109.09
22	41.88	0.10	0.10	120.00
23	43.33	0.08	0.10	111.70
24	50.26	0.05	0.08	115.20

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TAP # 2 RUN # 90 FILE # 18

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 20 → -8 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.22	0.56	1.08	0.00
2	5.02	0.56	1.08	0.00
3	5.72	0.54	1.05	0.00
4	6.61	0.53	1.03	0.00
5	6.98	0.50	1.03	10.00
6	7.39	0.51	1.03	10.60
7	8.37	0.46	1.00	12.00
8	10.47	0.36	0.82	45.00
9	11.69	0.63	0.63	58.60
10	14.78	0.45	0.53	84.70
11	17.95	0.35	0.43	90.00
12	21.85	0.28	0.30	93.90
13	25.13	0.23	0.20	90.00
14	28.56	0.20	0.20	106.30
15	31.41	0.15	0.15	117.00
16	34.90	0.12	0.07	120.00
17	40.50	0.10	0.05	116.10
18	43.33	0.07	0.05	124.10
19	48.33	0.05	0.05	110.70

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TAP # 2 RUN # 91 FILE # 19

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 10 → −5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	1.96	0.34	1.07	0.00
2	3.14	0.34	1.14	0.00
3	4.18	0.34	1.14	0.00
4	5.23	0.34	1.14	0.00
5	6.44	0.34	1.14	9.23
6	6.79	0.34	1.14	9.73
7	6.98	0.34	1.14	10.00
8	7.18	0.34	1.14	20.50
9	8.37	0.34	1.21	24.00
10	10.47	0.34	1.29	30.00
11	12.88	0.31	1.21	55.30
12	16.21	0.23	1.00	69.60
13	19.33	0.20	0.79	96.90
14	22.80	0.14	0.42	130.90
15	19.33	0.13	0.31	108.00
16	28.55	0.10	0.22	106.36
17	32.22	0.08	0.17	101.50
18	38.08	0.06	0.14	109.10
19	41.88	0.04	0.11	132.00
20	46.54	0.03	0.08	120.00
21	52.36	0.03	0.08	120.00
22	59.84	0.01	0.05	137.10

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TAP # 2 RUN # 92 FILE # 20

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 20 → -8 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.32	1.05	0.00
2	4.33	0.32	1.03	0.00
3	5.71	0.30	1.03	0.00
4	6.28	0.30	1.14	18.00
5	6.98	0.30	1.07	20.00
6	7.14	0.30	1.10	20.50
7	7.39	0.28	1.07	21.80
8	8.97	0.25	1.00	30.70
9	10.10	0.22	1.17	57.60
10	12.00	0.15	0.59	75.40
11	14.00	0.12	0.45	80.00
12	15.70	0.09	0.47	90.00
13	18.00	0.08	0.40	103.00
14	20.90	0.08	0.33	114.00
15	25.10	0.05	0.23	90.00
16	27.90	0.05	0.13	96.00
17	31.41	0.03	0.07	108.00
18	37.00	0.03	0.05	123.00
19	41.90	0.02	0.05	132.00
20	48.30	0.01	0.05	125.00
21	52.30	0.01	0.05	126.00
22	57.10	0.01	0.04	131.00
23	65.40	0.00	0.04	113.00

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TAP # 2 RUN # 93 FILE # 21

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 10 → -5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	2.99	0.67	1.27	0.00
2	4.05	0.63	1.27	0.00
3	5.71	0.63	1.27	0.00
4	6.61	0.63	1.27	0.00
5	6.98	0.60	1.27	0.00
6	7.61	0.67	1.20	0.00
7	9.30	0.63	1.20	5.33
8	10.92	0.63	1.27	12.52
9	12.56	0.63	1.27	18.00
10	16.21	0.53	1.20	46.45
11	17.95	0.50	1.07	51.42
12	20.10	0.40	0.80	72.00
13	22.84	0.33	0.60	81.81
14	26.45	0.27	0.33	94.73
15	29.56	0.22	0.27	84.70
16	33.51	0.18	0.20	96.00
17	40.53	0.12	0.17	92.90
18	44.88	0.08	0.13	115.71
19	50.26	0.05	0.10	115.20
20	57.12	0.03	0.10	130.91
21	66.13	0.03	0.08	151.57
22	73.92	0.03	0.09	105.88

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TAP # 2 RUN # 94 FILE # 22

DYNAMIC PRESSURE 16.1 (psf)

MAGNITUDE OF delta FLAP = 10 → -5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.43	1.11	0.00
2	4.33	0.43	1.11	0.00
3	5.46	0.43	1.14	0.00
4	6.61	0.41	1.10	0.00
5	7.18	0.41	1.10	0.00
6	7.61	0.41	1.14	0.00
7	8.66	0.43	1.14	0.00
8	11.17	0.43	1.21	16.00
9	13.96	0.34	1.00	40.00
10	16.21	0.28	0.90	58.06
11	18.61	0.22	0.72	66.66
12	22.84	0.18	0.43	81.81
13	27.92	0.14	0.28	99.57
14	32.22	0.10	0.21	120.00
15	38.08	0.07	0.14	120.00
16	43.33	0.05	0.07	136.55
17	46.54	0.03	0.10	120.00
18	57.12	0.03	0.05	147.27

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TAP # 2 RUN # 95 FILE # 23

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 10 → -5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.33	1.11	0.00
2	4.33	0.33	1.11	0.00
3	5.46	0.35	1.18	0.00
4	6.79	0.33	1.14	0.00
5	7.39	0.33	1.11	0.00
6	9.30	0.34	1.11	0.00
7	11.42	0.36	1.17	6.54
8	12.88	0.31	1.03	36.92
9	13.96	0.29	1.00	50.00
10	15.70	0.23	1.03	67.50
11	17.95	0.20	0.86	77.14
12	18.61	0.15	0.53	80.00
13	25.13	0.13	0.37	93.60
14	30.65	0.10	0.23	105.36
15	36.96	0.07	0.11	116.47
16	43.33	0.05	0.06	124.13
17	52.36	0.03	0.06	120.00
18	62.83	0.01	0.04	126.00

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TAP # 2 RUN # 96 FILE # 24

DYNAMIC PRESSURE 24.0 (psf)

MAGNITUDE OF delta FLAP = 10 → -5'(degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.27	1.18	0.00
2	4.18	0.28	1.18	0.00
3	5.46	0.27	1.18	0.00
4	6.44	0.27	1.11	0.00
5	7.18	0.27	1.11	0.00
6	8.66	0.28	1.22	0.00
7	10.47	0.31	1.41	0.00
8	11.69	0.29	1.29	33.48
9	12.88	0.26	1.11	36.92
10	14.36	0.21	0.94	61.71
11	15.70	0.20	0.94	67.50
12	17.95	0.17	0.78	77.14
13	19.33	0.15	0.76	83.07
14	21.85	0.13	0.65	93.91
15	25.13	0.11	0.35	108.00
16	29.36	0.08	0.24	105.88
17	32.22	0.07	0.20	110.77
18	38.08	0.06	0.13	98.18
19	41.88	0.04	0.07	120.00
20	50.26	0.03	0.07	129.60
21	57.12	0.02	0.04	130.91
22	62.83	0.01	0.04	162.00

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TAP # 2 RUN # 97 FILE # 25

DYNAMIC PRESSURE 28.2 (psf)

MAGNITUDE OF delta FLAP = 10 + -5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.24	1.11	0.00
2	4.33	0.25	1.24	0.00
3	5.46	0.24	1.17	0.00
4	6.44	0.24	1.22	0.00
5	7.39	0.24	1.17	0.00
6	7.61	0.24	1.22	0.00
7	8.66	0.24	1.22	0.00
8	10.69	0.26	1.33	15.32
9	11.96	0.26	1.33	17.14
10	13.22	0.23	1.22	28.42
11	15.23	0.19	1.17	32.72
12	16.75	0.17	1.06	60.00
13	20.10	0.13	0.78	72.00
14	22.04	0.12	0.67	94.73
15	26.18	0.09	0.44	105.00
16	29.22	0.01	0.11	108.83
17	33.96	0.06	0.22	116.75
18	39.27	0.04	0.13	123.75
19	43.33	0.03	0.09	111.72
20	50.26	0.02	0.09	129.60
21	57.12	0.02	0.09	130.91
22	62.83	0.01	0.07	126.00
23	66.13	0.01	0.04	132.63

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TAP # 2 RUN # 98 FILE # 26

DYNAMIC PRESSURE 32.2 (psf)

MAGNITUDE OF delta FLAP = 10 → -5 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	6.28	0.21	1.14	0.00
2	3.06	0.21	1.14	0.00
3	4.33	0.21	1.14	0.00
4	5.71	0.21	1.14	0.00
5	6.79	0.21	1.14	0.00
6	7.61	0.21	1.14	0.00
7	8.79	0.21	1.24	0.00
8	10.47	0.23	1.33	0.00
9	11.96	0.22	1.33	17.14
10	13.22	0.22	1.33	28.42
11	14.78	0.18	1.05	42.35
12	16.21	0.16	1.10	58.06
13	17.95	0.13	0.90	64.28
14	20.94	0.11	0.67	90.00
15	25.13	0.10	0.52	126.00
16	27.92	0.08	0.38	100.00
17	31.41	0.06	0.25	112.50
18	35.90	0.05	0.19	102.85
19	40.53	0.04	0.15	116.13
20	43.33	0.03	0.11	124.13
21	50.26	0.03	0.07	115.20
22	57.12	0.01	0.05	130.91
23	59.84	0.01	0.05	137.14
24	69.81	0.05	0.18	160.00

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TAP # 4 RUN # 99 FILE # 27

DYNAMIC PRESSURE 12.1 (psf)

MAGNITUDE OF delta FLAP = 10 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.22	0.50	1.13	0.00
2	4.33	0.50	1.13	0.00
3	5.46	0.51	1.20	0.00
4	6.44	0.51	1.13	0.00
5	7.18	0.48	1.06	0.00
6	8.66	0.45	1.07	12.41
7	9.66	0.35	0.93	13.84
8	12.56	0.28	0.75	36.00
9	15.70	0.20	0.56	67.50
10	20.94	0.15	0.43	90.00
11	25.13	0.11	0.33	90.00
12	27.92	0.09	0.28	80.00
13	33.07	0.08	0.23	104.21
14	39.27	0.05	0.18	123.75
15	43.33	0.04	0.13	136.55
16	48.33	0.04	0.13	138.46
17	54.63	0.03	0.13	125.21
18	59.84	0.03	0.10	120.00
19	66.13	0.03	0.08	132.63

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TAP # 4 RUN # 100 FILE # 28

DYNAMIC PRESSURE 16.1 (psf)

MAGNITUDE OF delta FLAP = 10 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.22	0.35	1.14	0.00
2	4.33	0.35	1.09	0.00
3	5.71	0.33	1.09	0.00
4	6.61	0.33	1.09	0.00
5	7.18	0.33	1.14	0.00
6	9.31	0.29	1.00	13.34
7	11.42	0.24	0.82	32.72
8	13.58	0.18	0.68	58.37
9	16.75	0.15	0.55	72.00
10	22.84	0.09	0.40	98.18
11	21.85	0.11	0.44	93.91
12	25.13	0.08	0.33	90.00
13	29.56	0.06	0.27	105.88
14	34.90	0.05	0.20	90.00
15	44.88	0.03	0.15	128.57
16	48.33	0.03	0.09	124.61
17	57.12	0.01	0.09	147.27
18	66.13	0.01	0.09	151.57

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TAP # 4 RUN # 101 FILE # 29

DYNAMIC PRESSURE 20.1 (psf)

MAGNITUDE OF delta FLAP = 10 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.27	1.15	0.00
2	4.33	0.27	1.15	0.00
3	5.71	0.27	1.15	0.00
4	6.61	0.27	1.15	0.00
5	7.37	0.27	1.19	0.00
6	8.66	0.25	1.15	0.00
7	10.47	0.21	0.93	15.00
8	11.96	0.16	0.81	60.00
9	14.36	0.13	0.70	51.42
10	17.95	0.10	0.56	64.28
11	21.85	0.09	0.44	78.26
12	25.13	0.07	0.37	90.00
13	31.41	0.04	0.25	90.00
14	36.96	0.03	0.18	116.47
15	43.33	0.02	0.14	111.72
16	50.26	0.01	0.14	129.60
17	57.12	0.01	0.10	114.54
18	66.13	0.01	0.07	151.57

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TAP # 4 RUN # 102 FILE # 30

DYNAMIC PRESSURE 24.0 (psf)

MAGNITUDE OF delta FLAP = 10 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.21	1.11	0.00
2	4.33	0.21	1.11	0.00
3	5.58	0.21	1.11	0.00
4	6.44	0.21	1.11	0.00
5	7.18	0.21	1.14	0.00
6	8.66	0.19	1.08	12.41
7	10.47	0.11	0.89	30.00
8	10.05	0.16	0.91	28.80
9	12.56	0.12	0.75	36.00
10	14.36	0.10	0.64	61.71
11	18.61	0.08	0.51	53.33
12	22.84	0.06	0.39	65.45
13	27.31	0.04	0.33	93.91
14	33.07	0.03	0.25	94.73
15	39.27	0.02	0.17	101.25
16	46.54	0.02	0.14	106.67
17	54.63	0.01	0.11	125.21
18	62.83	0.01	0.11	144.00

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TAP # 4 RUN # 103 FILE # 31

DYNAMIC PRESSURE 28.2 (psf)

MAGNITUDE OF delta FLAP = 10 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.18	1.05	0.00
2	4.33	0.18	1.05	0.00
3	5.46	0.18	1.08	0.00
4	6.28	0.18	1.05	0.00
5	7.38	0.18	1.08	0.00
6	8.66	0.18	1.08	12.41
7	10.05	0.14	0.98	28.80
8	11.96	0.12	0.78	51.42
9	14.78	0.09	0.48	74.11
10	17.95	0.07	0.55	64.28
11	21.85	0.06	0.40	62.60
12	26.45	0.04	0.35	75.79
13	29.92	0.03	0.29	85.71
14	29.92	0.03	0.27	94.28
15	39.27	0.02	0.19	112.50
16	46.54	0.01	0.15	133.34
17	52.36	0.01	0.12	120.00
18	59.84	0.01	0.12	137.14
19	62.83	0.00	0.07	144.00
20	73.92	0.00	0.05	169.41

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TAP # 4 RUN # 104 FILE # 32

DYNAMIC PRESSURE 32.2 (psf)

MAGNITUDE OF delta FLAP = 10 (degrees)

#	FREQ (rad/sec)	POSITION MAGNITUDE RATIO	PRESSURE MAGNITUDE RATIO	PHASE ANGLE (degrees)
1	3.14	0.16	0.98	0.00
2	4.33	0.15	0.98	0.00
3	5.71	0.15	0.98	0.00
4	6.44	0.15	1.00	0.00
5	7.39	0.15	1.00	0.00
6	9.30	0.14	1.00	0.00
7	11.42	0.11	0.84	16.36
8	13.96	0.08	0.76	60.00
9	17.95	0.06	0.58	64.28
10	21.85	0.05	0.44	78.26

C-3

GRAPHICAL DATA OUTPUT PROGRAM LISTING

```
0: dim L$[80],P$[10],R$[61],Q$[120]
1: dim T$[20],D$[5],F$[45]
2: dim B[25,4],R,N,T,Q
3: ent "FILE NUMBER?",F;if flg13;gto +0
4: if F<1;gto -1
5: trk 1;fdf F
6: ldf F,B[*],R,N,T,Q
7: pclr;scl -1,2,-100,40;csiz 3/1.4,1.5,14/19,0
8: 0→r2→r3;for S=1 to 3;B[S,3]+r3→r3;B[S,2]+r2→r2;next S;3/r2→r2;3/r3→r3
9: for S=1 to N
10: plt log(B[S,1]),20log(r2B[S,2]),-2
11: cll 'symbol'(1,(2--1)/18,(40--100)/14)
12: pen
13: next S
14: for S=1 to N
15: plt log(B[S,1]),20log(r3B[S,3]),-2
16: cll 'symbol'(2,(2--1)/18,(40--100)/14)
17: pen;next S
18: scl -1,2,-180,135
19: for S=1 to N;plt log(B[S,1]),-B[S,4],-2
20: iplt .03,2,-2;iplt -.03,-2,-1
21: cll 'symbol'(1,(2--1)/18·.45--270)/14)
22: pen;next S
23: plt -.32,-40,-1;fxd 0;str(R)→T$;"RUN # "&T$→L$;gsb "L"
24: lbl L$;cplt -len(L$),-1
25: "TAP # "&str(T)→L$;gsb "L"
26: lbl L$;cplt -len(L$),-1
27: "FILE # "&str(F)→L$;gsb "L"
28: lbl L$;cplt -len(L$),-1
29: fxd 1;"Q ="&str(Q)&"(psf)"→L$;gsb "L"
30: lbl L$;cplt -len(L$),-1
31: ent "DELTA COMMAND?",D$;0→r1;gsb "DELTA"
32: " = "&D$&"(deg.)"→L$;gsb "L"
33: lbl L$;cplt -len(L$),-1
34: fxd 0;ent "FIGURE NUMBER?",F$;if val(F$)>32;str(val(F$)-1)→F$
35: "B"&F$→F$;gsb "LABLE"
36: end
37: "symbol":
38: "0002445090901203006018144180720009030120540720006060120001202"→R$
39: val(R$[5p1-4,5p1-3])→p4;val(R$[5p1-2,5p1])→p5
40: p4→p6;iplt .1p2cos(p6),.1p3sin(p6),1
41: p6+p5→p6;iplt .1p2(cos(p6)-cos(p6-p5)),.1p3(sin(p6)-sin(p6-p5)),2
42: if p6-360≠p4 and p6-720≠p4;gto -1
43: iplt -.1p2cos(p6),-.1p3sin(p6),1;ret
44: "LABLE":fxd 1;180+90→r1;plt -1.48,3,1;csiz 3/1.4,1.5,14/19,90+180
45: "FIGURE "&F$&".  PRESSURE"→L$;gsb "L"
46: lbl L$;cplt -len(L$),-.9
47: "COMMAND BODE - q="&str(Q)&"(psf),"→L$;gsb "L"
48: lbl L$;cplt -len(L$),-.9
49: gsb "DELTA"
50: fxd 0;" = "&D$&" (deg.), TAP# "&str(T)→L$;gsb "L"
51: lbl L$;cplt -len(L$),-.9
52: ret
53: "DELTA":csiz 1.5/1.4,1.1,14/19,r1
54: "uc5,12,99,-3,4,-1,-2,0,-2,4,-7,0,-2,-1,-2,-1,-1,-1,0,-1,1,-1,2,0,3,"→Q$
55: Q$&"1,2,2,1,-99"→Q$
56: wrt 705,"uc2,0,99,0,16,-99"
57: wrt 705,Q$
58: csiz 2/1.4,1.5,14/19,r1;cplt .2,-.3;lbl "F";cplt 0,.3
59: csiz 1.5/1.4,1.2,14/19,r1
60: wrt 705,"uc3,0,99,0,16,-99"
61: csiz 3/1.4,1.5,14/19,r1
62: ret
63: "L":
64: if pos(L$,"0")≠0;"O"→L$[pos(L$,"0"),pos(L$,"0")];if pos(L$,"0")≠0;gto +0
65: ret
*29322
```

TABULAR DATA OUTPUT PROGRAM LISTING

```
0: "DELTA P DOP  PHASE III  FREQ RESPONSE DATA":
1: dim L$[80],P$[80],R$[80],Q$[80]
2: dim T$[20],D$[5],F$[45]
3: dim B[25,4],R,N,T,Q
4: ent "FILE NUMBER?",F;if flg13;gto +0
5: if F<1;gto -1
6: trk 1;fdf F
7: ldf F,B[*],R,N,T,Q
8: fmt 1,9x,"*",f3.0,"  *",f9.2,3f12.2,"  *"
9: fmt 2,9x,"*",5x,"*",47x,"*"
10: fmt 3,9x,"RUN # ",f3.0,7x,"FILE # ",f3.0
11: fmt 4,9x,"DYNAMIC PRESSURE ",f4.1," (psf)"
12: fmt 5,9x,"MAGNITUDE OF delta FLAP =",f3.0," (degrees)"
13: for S=1 to 55;"*"→Q$[S];next S;cll 'Q'
14: Q$→R$
15: wrt 6,"            -";for S=1 to 7;wrt 6;next S
16: "UNIVERSITY OF KANSAS"→Q$;cll 'Q'
17: wrt 6,Q$
18: "CENTER FOR RESEARCH"→Q$;cll 'Q'
19: wrt 6,Q$
20: "DELTA P PROJECT"→Q$;cll 'Q'
21: wrt 6,Q$;wrt 6;wrt 6;wrt 6
22: ent "MAG INPUT?",D
23: wrt 6.3,R,F;wrt 6;wrt 6.4,Q;wrt 6;wrt 6.5,D
24: wrt 6;wrt 6;wrt 6,R$;wrt 6.2
25: "        *  #  *     FREQ      POSITION    PRESSURE     PHASE  *"→P$
26: wrt 6,P$
27: "        *     *               MAGNITUDE   MAGNITUDE     ANGLE  *"→P$
28: wrt 6,P$
29: "        *     *  (rad/sec)      RATIO       RATIO    (degrees)*"→P$
30: wrt 6,P$;wrt 6.2
31: 0→A;wrt 6,R$;wrt 6.2;for S=1 to N;1+A→A
32: wrt 6.1,S,B[S,1],B[S,2],B[S,3],B[S,4];K+1→K
33: if A=5;0→A;wrt 6.2;K+1→K
34: next S
35: if A#0;wrt 6.2;K+1→K
36: wrt 6,R$
37: for S=1 to 37-K;wrt 6;next S
38: wrt 6,"             -"
39: end
40: "L":
41: if pos(L$,"0")#0;"O"→L$[pos(L$,"0"),pos(L$,"0")];if pos(L$,"0")#0;gto +0
42: ret
43: "Q":len(Q$)→p1
44: for S=1 to 36-int(p1/2);" "&Q$→Q$;next S
45: ret
*12
```

APPENDIX C. FORCE AND MOMENT DATA

Force and moment data were obtained during runs 80-88. These measurements were deemed necessary in case any correlation of pressure data with the overall surface characteristics was desired. As it turned out, this was not necessary for this application. However, it may be of future use and is therefore included.

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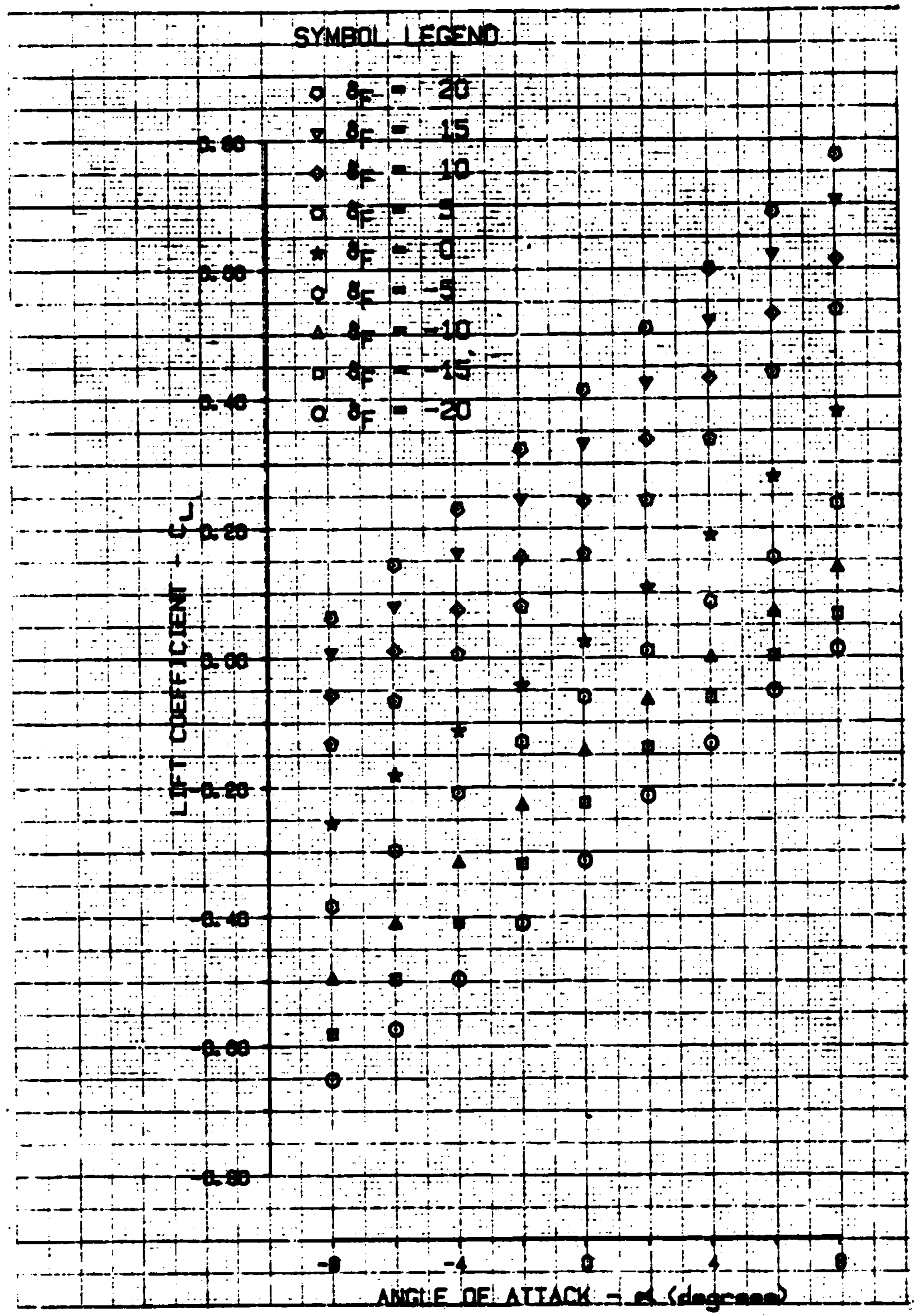

CALC		20-12-81	REVISED	DATE	Figure C1. Lift Characteristics.	
CHECK		22-12-81				
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APPD					UNIVERSITY OF KANSAS	PAGE C2

K&E 10 7196 5-00 MC1000

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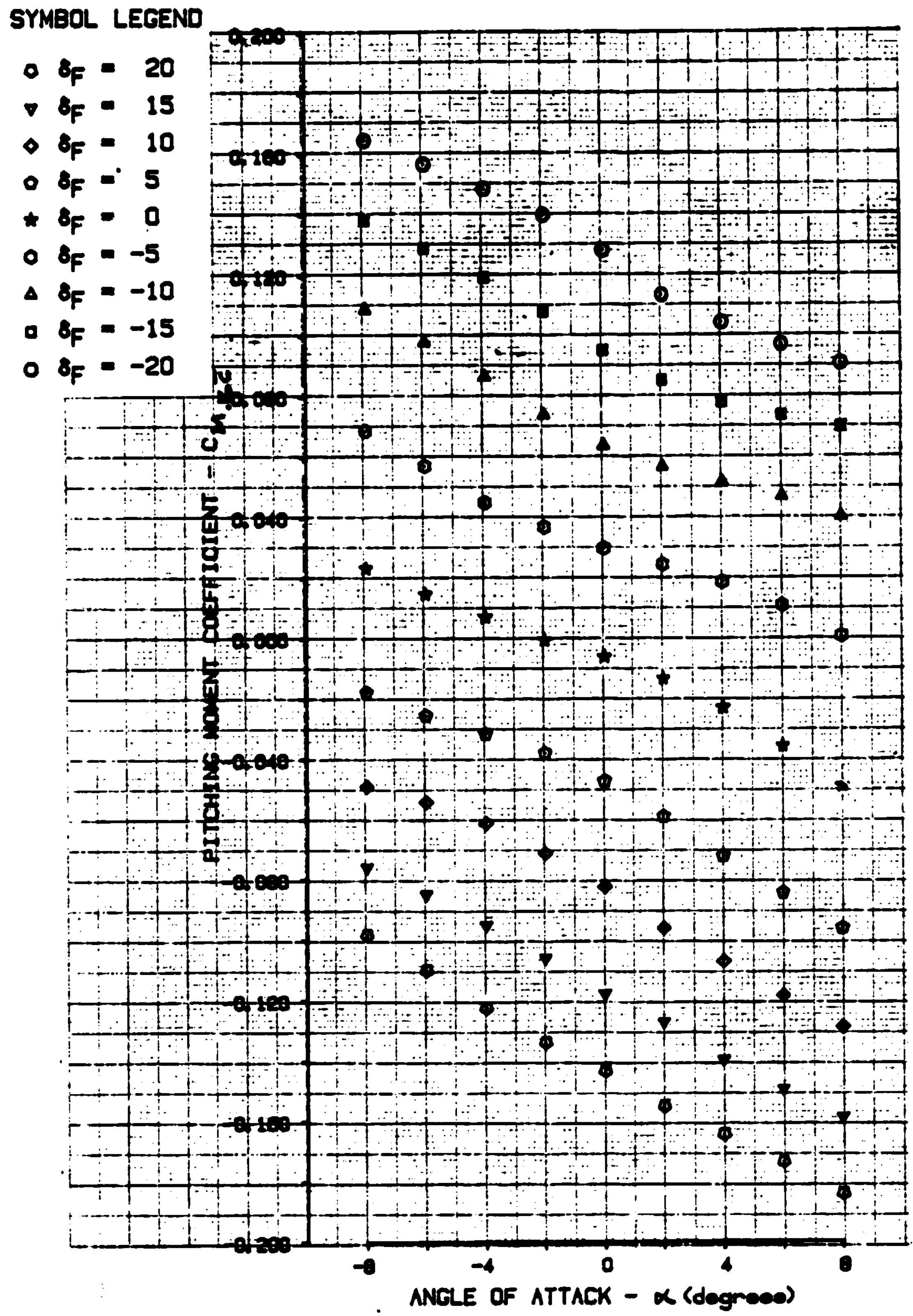

CALC		20-12-81	REVISED	DATE
CHECK		22-12-81		
APPD				
APPD				

Figure C2. Pitching Moment Characteristics.

UNIVERSITY OF KANSAS

K&E 10 7195 9-60 MC1003

FILE NUMBER 1
DELTA P FORCE AND MOMENT TEST PHASE III CRINC 4900
RUN 80 alpha SWEEP -8 to 8 by 2 delta = -20 8 NOV. 1981

CL	CD	CM	CP1	C1	CP2	Q	T	ALPHA	BETA	RN
-0.653	0.118	0.165	0.000	0.150	0.000	24	298	-8.0	0.0	1311468
-0.575	0.101	0.157	0.000	0.151	0.000	24	298	-6.0	0.0	1310157
-0.497	0.087	0.148	0.000	0.151	0.000	24	298	-4.0	0.0	1308371
-0.411	0.076	0.140	0.000	0.151	0.000	25	299	-2.0	0.0	1309518
-0.314	0.066	0.128	0.000	0.151	0.000	24	299	0.0	0.0	1307987
-0.215	0.058	0.113	0.000	0.151	0.000	24	299	2.0	0.0	1305780
-0.134	0.054	0.104	0.000	0.153	0.000	24	299	4.0	0.0	1295064
-0.053	0.052	0.097	0.000	0.152	0.000	24	299	6.0	0.0	1292738
0.012	0.052	0.090	0.000	0.152	0.000	24	299	8.0	0.0	1289387

WING AREA = 0.3176 (sq. meters)
MEAN AERODYNAMIC CHORD = 0.5207 (meters)
WING SPAN = 0.6096 (meters)
BAROMETRIC PRESSURE = 29.2700 (inches Hg)
TEMPERATURE = 76.0000 (degrees F)

FILE NUMBER 2
DELTA P FORCE AND MOMENT TEST PHASE III CRINC 4900
RUN 81 alpha SWEEP delta flap = -15 degrees 8 NOV 1981

CL	CD	CM	CP1	C1	CP2	Q	T	ALPHA	BETA	RN
-0.582	0.096	0.138	0.000	0.000	0.000	25	299	-8.0	0.0	1311593
-0.497	0.082	0.129	0.000	0.000	0.000	25	299	-6.0	0.0	1309890
-0.409	0.069	0.119	0.000	0.000	0.000	25	299	-4.0	0.0	1309662
-0.320	0.060	0.108	0.000	0.000	0.000	25	299	-2.0	0.0	1306650
-0.225	0.051	0.095	0.000	0.000	0.000	25	299	0.0	0.0	1305924
-0.139	0.046	0.085	0.000	0.000	0.000	24	300	2.0	0.0	1297789
-0.063	0.043	0.078	0.000	0.000	0.000	24	300	4.0	0.0	1293757
0.001	0.042	0.073	0.000	0.000	0.000	24	300	6.0	0.0	1289167
0.066	0.044	0.069	0.000	0.000	0.000	24	300	8.0	0.0	1284986

WING AREA = 0.3176 (sq. meters)
MEAN AERODYNAMIC CHORD = 0.5207 (meters)
WING SPAN = 0.6096 (meters)
BAROMETRIC PRESSURE = 29.2400 (inches Hg)
TEMPERATURE = 76.0000 (degrees F)

FILE NUMBER 3
DELTA P FORCE AND MOMENT TEST PHASE III CRINC 4900
RUN 82 alpha SWEEP -8 to 8 by 2 delta = -10 8 NOV. 1981

CL	CD	CM	CP1	C1	CP2	Q	T	ALPHA	BETA	RN
-0.498	0.079	0.109	0.000	0.000	0.000	24	301	-8.0	0.0	1294788
-0.412	0.066	0.098	0.000	0.000	0.000	25	301	-6.0	0.0	1298431
-0.318	0.055	0.086	0.000	0.000	0.000	25	301	-4.0	0.0	1296549
-0.230	0.046	0.074	0.000	0.000	0.000	24	301	-2.0	0.0	1294069
-0.145	0.040	0.063	0.000	0.000	0.000	24	301	0.0	0.0	1292834
-0.067	0.037	0.056	0.000	0.000	0.000	24	301	2.0	0.0	1286346
-0.002	0.036	0.051	0.000	0.000	0.000	24	301	4.0	0.0	1284887
0.069	0.038	0.047	0.000	0.000	0.000	24	301	6.0	0.0	1277303
0.137	0.042	0.040	0.000	0.000	0.000	24	301	8.0	0.0	1270497

WING AREA = 0.3176 (sq. meters)
MEAN AERODYNAMIC CHORD = 0.5207 (meters)
WING SPAN = 0.6096 (meters)
BAROMETRIC PRESSURE = 29.2400 (inches Hg)
TEMPERATURE = 76.0000 (degrees F)

FILE NUMBER 4
DELTA P FORCE AND MOMENT TEST PHASE III CRINC 4900
RUN 83 alpha SWEEP -8 to 8 by 2 delta = -5 8 NOV. 1981

CL	CD	CM	CP1	C1	CP2	Q	T	ALPHA	BETA	RN
-0.384	0.061	0.069	0.000	0.000	0.000	25	302	-8.0	0.0	1294143
-0.298	0.051	0.057	0.000	0.000	0.000	24	302	-6.0	0.0	1290248
-0.209	0.042	0.045	0.000	0.000	0.000	25	302	-4.0	0.0	1292830
-0.130	0.037	0.037	0.000	0.000	0.000	24	302	-2.0	0.0	1283288
-0.061	0.034	0.030	0.000	0.000	0.000	24	302	0.0	0.0	1276163
0.010	0.033	0.024	0.000	0.000	0.000	24	302	2.0	0.0	1281519
0.085	0.036	0.018	0.000	0.000	0.000	24	302	4.0	0.0	1270331
0.154	0.039	0.010	0.000	0.000	0.000	24	302	6.0	0.0	1268200
0.237	0.047	0.000	0.000	0.000	0.000	24	302	8.0	0.0	1265923

WING AREA = 0.3176 (sq. meters)
MEAN AERODYNAMIC CHORD = 0.5207 (meters)
WING SPAN = 0.6096 (meters)
BAROMETRIC PRESSURE = 29.2400 (inches Hg)
TEMPERATURE = 76.0000 (degrees F)

FILE NUMBER 5

DELTA P FORCE AND MOMENT TEST PHASE III CRINC 4900

RUN 84 alpha SWEEP -8 to 8 by 2 delta = 0 degrees 8 NOV. 1981

CL	CD	CM	CP1	C1	CP2	Q	T	ALPHA	BETA	RN
-0.256	0.048	0.023	0.000	0.000	0.000	25	303	-8.0	0.0	1286014
-0.182	0.042	0.014	0.000	0.000	0.000	24	303	-6.0	0.0	1281864
-0.113	0.036	0.007	0.000	0.000	0.000	24	303	-4.0	0.0	1281448
-0.043	0.033	-0.001	0.000	0.000	0.000	24	303	-2.0	0.0	1274943
0.025	0.033	-0.007	0.000	0.000	0.000	24	303	0.0	0.0	1271147
0.107	0.035	-0.014	0.000	0.000	0.000	24	303	2.0	0.0	1262942
0.188	0.041	-0.024	0.000	0.000	0.000	24	303	4.0	0.0	1264178
0.279	0.049	-0.036	0.000	0.000	0.000	24	303	6.0	0.0	1257248
0.378	0.061	-0.049	0.000	0.000	0.000	23	303	8.0	0.0	1251501

WING AREA = 0.3176 (sq. meters)
MEAN AERODYNAMIC CHORD = 0.5207 (meters)
WING SPAN = 0.6096 (meters)
BAROMETRIC PRESSURE = 29.2400 (inches Hg)
TEMPERATURE = 76.0000 (degrees F)

FILE NUMBER 6

DELTA P FORCE AND MOMENT TEST PHASE III CRINC 4900

RUN 85 alpha SWEEP -8 to 8 by 2 delta = 5 degrees 8 NOV. 1981

CL	CD	CM	CP1	C1	CP2	Q	T	ALPHA	BETA	RN
-0.133	0.040	-0.018	0.000	0.000	0.000	24	303	-8.0	0.0	1273766
-0.067	0.036	-0.026	0.000	0.000	0.000	24	304	-6.0	0.0	1268880
0.006	0.034	-0.032	0.000	0.000	0.000	24	304	-4.0	0.0	1267178
0.079	0.035	-0.038	0.000	0.000	0.000	24	304	-2.0	0.0	1265798
0.161	0.039	-0.048	0.000	0.000	0.000	24	304	0.0	0.0	1257846
0.243	0.046	-0.059	0.000	0.000	0.000	24	304	2.0	0.0	1254687
0.337	0.057	-0.073	0.000	0.000	0.000	23	304	4.0	0.0	1249708
0.439	0.069	-0.085	0.000	0.000	0.000	23	304	6.0	0.0	1245813
0.536	0.086	-0.097	0.000	0.000	0.000	23	304	8.0	0.0	1238090

WING AREA = 0.3176 (sq. meters)
MEAN AERODYNAMIC CHORD = 0.5207 (meters)
WING SPAN = 0.6096 (meters)
BAROMETRIC PRESSURE = 29.2400 (inches Hg)
TEMPERATURE = 76.0000 (degrees F)

FILE NUMBER 7
DELTA P FORCE AND MOMENT TEST   PHASE III   CRINC 4900
RUN 86 alpha SWEEP -8 to 8 by 2 delta = 10 deg.   8 NOV. 1981

CL	CD	CM	CP1	C1	CP2	Q	T	ALPHA	BETA	RN
-0.059	0.040	-0.049	0.000	0.000	0.000	24	304	-8.0	0.0	1262259
0.011	0.038	-0.054	0.000	0.000	0.000	24	304	-6.0	0.0	1260115
0.074	0.037	-0.062	0.000	0.000	0.000	24	304	-4.0	0.0	1261019
0.156	0.040	-0.072	0.000	0.000	0.000	24	304	-2.0	0.0	1256612
0.242	0.047	-0.083	0.000	0.000	0.000	24	304	0.0	0.0	1253320
0.337	0.057	-0.096	0.000	0.000	0.000	23	304	2.0	0.0	1243385
0.431	0.069	-0.107	0.000	0.000	0.000	23	304	4.0	0.0	1241784
0.530	0.084	-0.119	0.000	0.000	0.000	23	304	6.0	0.0	1237034
0.614	0.102	-0.129	0.000	0.000	0.000	23	304	8.0	0.0	1232994

WING AREA = 0.3176 (sq. meters)
MEAN AERODYNAMIC CHORD = 0.5207 (meters)
WING SPAN = 0.6096 (meters)
BAROMETRIC PRESSURE = 29.2400 (inches Hg)
TEMPERATURE = 76.0000 (degrees F)

FILE NUMBER 8
DELTA P FORCE AND MOMENT TEST   PHASE III   CRINC 4900
RUN 87 alpha SWEEP -8 to 8 by 2 delta = 15 deg.   8 NOV. 1981

CL	CD	CM	CP1	C1	CP2	Q	T	ALPHA	BETA	RN
0.008	0.044	-0.076	0.000	0.000	0.000	24	305	-8.0	0.0	1255997
0.080	0.043	-0.085	0.000	0.000	0.000	24	305	-6.0	0.0	1254148
0.162	0.046	-0.095	0.000	0.000	0.000	24	305	-4.0	0.0	1251053
0.246	0.052	-0.106	0.000	0.000	0.000	24	305	-2.0	0.0	1248605
0.332	0.060	-0.118	0.000	0.000	0.000	23	305	0.0	0.0	1244493
0.425	0.071	-0.127	0.000	0.000	0.000	23	305	2.0	0.0	1242146
0.521	0.086	-0.140	0.000	0.000	0.000	23	305	4.0	0.0	1231416
0.622	0.103	-0.150	0.000	0.000	0.000	23	305	6.0	0.0	1227386
0.706	0.123	-0.159	0.000	0.000	0.000	22	305	8.0	0.0	1218138

WING AREA = 0.3176 (sq. meters)
MEAN AERODYNAMIC CHORD = 0.5207 (meters)
WING SPAN = 0.6096 (meters)
BAROMETRIC PRESSURE = 29.2400 (inches Hg)
TEMPERATURE = 76.0000 (degrees F)

FILE NUMBER 9
DELTA P FORCE AND MOMENT TEST PHASE III CRINC 4900
RUN 88 alpha SWEEP -8 to 8 by 2 delta = 20 deg. 8 NOV. 1981

CL	CD	CM	CP1	C1	CP2	Q	T	ALPHA	BETA	RN
0.063	0.052	-0.098	0.000	0.000	0.000	24	305	-8.0	0.0	1249341
0.144	0.054	-0.110	0.000	0.000	0.000	24	305	-6.0	0.0	1248533
0.231	0.058	-0.123	0.000	0.000	0.000	23	305	-4.0	0.0	1243761
0.322	0.066	-0.134	0.000	0.000	0.000	23	305	-2.0	0.0	1241346
0.414	0.077	-0.143	0.000	0.000	0.000	23	305	0.0	0.0	1236494
0.510	0.090	-0.155	0.000	0.000	0.000	23	305	2.0	0.0	1229235
0.600	0.107	-0.165	0.000	0.000	0.000	23	305	4.0	0.0	1223110
0.688	0.125	-0.174	0.000	0.000	0.000	22	305	6.0	0.0	1215968
0.775	0.146	-0.184	0.000	0.000	0.000	22	305	8.0	0.0	1210486

WING AREA = 0.3176 (sq. meters)
MEAN AERODYNAMIC CHORD = 0.5207 (meters)
WING SPAN = 0.6096 (meters)
BAROMETRIC PRESSURE = 29.2400 (inches Hg)
TEMPERATURE = 76.0000 (degrees F)