DYNAMIC DOCKING TEST SYSTEM (DDTS) ACTIVE TABLE FREQUENCY RESPONSE TEST RESULTS

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DYNAMIC DOCKING TEST SYSTEM (DOTS) ACTIVE TABLE FREQUENCY RESPONSE TEST RESULTS

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<th>DESCRIPTION</th>
<th>DATE</th>
<th>APPROVED</th>
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ABSTRACT

This document presents the results of the frequency response test performed on the Dynamic Docking Test System (DDTS) active table. Sinusoidal displacement commands were applied to the table and the dynamic response determined from measured actuator responses and accelerometers mounted to the table and one actuator.

KEY WORDS

Docking Simulator
Dynamic Docking Test System (DDTS)
Frequency Response Test
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1.0 INTRODUCTION

The DDTS is a six-degree-of-freedom motion simulator developed to perform docking simulations using the USA and USSR docking hardware for the Apollo Soyuz Test Project. The simulator consists of a rigid structure supporting one set of docking hardware and active table to which the other set of docking hardware is attached as shown in Figure 1. The active table is a rigid structure supported by six hydraulic actuators. The motion of each actuator is controlled by an electronic control system which receives commands from equations of motion which provide the desired relative motions of the two spacecraft during docking.

Frequency response tests were conducted to determine the dynamic response of the active table to sinusoidal table motion commands. This document presents the results of these tests and compares them with analytical predictions provided by NASA Advanced Docking System (NADS), a computer program developed to model the dynamics of the active table in response to table motion commands. The mathematical model is derived in Reference 1, and the computer program is described in Reference 2.

2.0 INSTRUMENTATION

2.1 TABLE MOTION

Table displacements are determined by recording time-histories of the six actuator displacements measured by the linear potentiometers used in the displacement feedback of each actuator control system. These measured actuator lengths are then transformed to table displacements.

Simplified transformations from actuator lengths to table displacements are derived assuming small displacements about a nominal table position. Frequency response tests were run with no angular misalignments of the table; therefore, the Euler angles are zero. The inertial components of the actuator lengths at the reference position are then:
Figure 1. DDTS Simulator Facility
2.1 (Continued)

\[
\begin{bmatrix}
 r_{sx_i} \\
 r_{sy_i} \\
 r_{sz_i}
\end{bmatrix} = \begin{bmatrix}
 x_{I_0} \\
 y_{I_0} \\
 z_{I_0}
\end{bmatrix} + \begin{bmatrix}
 r_{xa_i} \\
 r_{ya_i} \\
 r_{za_i}
\end{bmatrix} - \begin{bmatrix}
 x_{f_i} \\
 y_{f_i} \\
 z_{f_i}
\end{bmatrix}
\]  

(1)

where \(x_{I_0}, y_{I_0},\) and \(z_{I_0}\) are the initial inertial positions of the table c.g.; \(r_{xa_i}, r_{ya_i}, r_{za_i}\) are the \(x, y, z\) coordinates of the \(i^{th}\) table swivel joint with respect to the table c.g.; and \(x_{f_i}, y_{f_i}, z_{f_i}\) are the inertial coordinates of the floor swivel joints for the \(i^{th}\) actuator (see Figure 2).

Initial actuator lengths are then:

\[
l_{0_i} = \sqrt{r_{sx_i}^2 + r_{sy_i}^2 + r_{sz_i}^2}
\]  

(2)

For geometry transformation purposes, it can be assumed that \(r_{sx_i}, r_{sy_i},\) and \(l_{0_i}\) are constant. Incremental motions of the actuators can then be transformed to table motions. The transformation between table coordinates and inertial coordinates is unity.

In general:

\[
\dot{p}_i = \left[ \begin{array}{c}
 r_{sx_i} \dot{r}_{sx_i} + r_{sy_i} \dot{r}_{sy_i} + r_{sz_i} \dot{r}_{sz_i} \\
 r_{sx_i} \dot{r}_{sx_i} + r_{sy_i} \dot{r}_{sy_i} + r_{sz_i} \dot{r}_{sz_i} \\
 r_{sx_i} \dot{r}_{sx_i} + r_{sy_i} \dot{r}_{sy_i} + r_{sz_i} \dot{r}_{sz_i}
\end{array} \right] / l_{0_i}
\]  

(3)
Figure 2. Active Table Coordinate Systems
2.1 (Continued)

but, if we let

\[
\begin{align*}
\{ \dot{r}_{s_x i} \} &= \{ \dot{x}_T \} \\
\{ \dot{r}_{s_y i} \} &= \{ \dot{y}_T \} \\
\{ \dot{r}_{s_z i} \} &= \{ \dot{z}_T \}
\end{align*}
\]

\[
\begin{bmatrix}
0 & -\omega_z & \omega_y \\
\omega_z & 0 & -\omega_x \\
-\omega_y & \omega_x & 0
\end{bmatrix}
\]

\[
\begin{align*}
r_{xa_i} \\
r_{ya_i} \\
r_{za_i}
\end{align*}
\]

(4)

where \( \dot{x}_T, \dot{y}_T, \dot{z}_T \) are table translational velocities at any centerline reference point, and \( \omega_x, \omega_y, \omega_z \) are table angular velocities.

A system of six equations (one for each actuator) and six unknowns \( \{ \dot{x}_T, \dot{y}_T, \dot{z}_T, \omega_x, \omega_y, \omega_z \} \) can be written and solved.

\[
\begin{bmatrix}
\dot{x}_T \\
\dot{y}_T \\
\dot{z}_T \\
\omega_x \\
\omega_y \\
\omega_z
\end{bmatrix} = \begin{bmatrix}
i_1 \\
i_2 \\
i_3 \\
i_4 \\
i_5 \\
i_6
\end{bmatrix}
\]

\[
[A]
\]

(5)

hence:

\[
\begin{bmatrix}
\dot{x}_T \\
\dot{y}_T \\
\dot{z}_T \\
\omega_x \\
\omega_y \\
\omega_z
\end{bmatrix} = \begin{bmatrix}
i_1 \\
i_2 \\
i_3 \\
i_4 \\
i_5 \\
i_6
\end{bmatrix}
\]

\[
[A]^{-1}
\]

(6)
2.1 (Continued)

The elements of the $i^{th}$ row of the $[A]$ matrix are:

\[ A_{i1} = \frac{r_{sx_i}}{l_{0_i}} \]

\[ A_{i2} = \frac{r_{sy_i}}{l_{0_i}} \]

\[ A_{i3} = \frac{r_{sz_i}}{l_{0_i}} \]

\[ A_{i4} = \left( -r_{sy_i} r_{za_i} + r_{sz_i} r_{ya_i} \right) / l_{0_i} \]

\[ A_{i5} = \left( r_{sx_i} r_{za_i} - r_{sz_i} r_{xa_i} \right) / l_{0_i} \]

\[ A_{i6} = \left( -r_{sx_i} r_{ya_i} + r_{sy_i} r_{xa_i} \right) / l_{0_i} \]

Likewise, the same transformation can be used to solve for incremental table displacements relative to its initial position.

\[
\begin{pmatrix}
\Delta x_T \\
\Delta y_T \\
\Delta z_T \\
\Delta \theta_x \\
\Delta \theta_y \\
\Delta \theta_z
\end{pmatrix} = \left[ A \right]^{-1} \begin{pmatrix}
1_1 - l_{01} \\
1_2 - l_{02} \\
1_3 - l_{03} \\
1_4 - l_{04} \\
1_5 - l_{05} \\
1_6 - l_{06}
\end{pmatrix}
\]
2.1 (Continued)

where:

\[ \begin{align*}
\Delta \theta_x &= \phi \\
\Delta \theta_y &= 0 \\
\Delta \theta_z &= \psi
\end{align*} \]

Euler angles (9)

2.2 ACCELERATIONS

Accelerometers were mounted to the active table and to one of the six hydraulic actuators. Figure 3 shows the location of the ten accelerometers available. One triaxial accelerometer is mounted to the active table truss structure and measures accelerations in the x, y, and z directions. A second triaxial accelerometer mounted to the table corner measures x, radial, and tangential accelerations. Actuator 6 accelerations are measured at the top of the cylinder in two orthogonal lateral directions and the axial direction. Actuator extension accelerations are measured by a Kistler servo accelerometer mounted to the upper end of the actuator piston.

The table on Page 9 shows the accelerometers recorded and those used as abort limit cues.

2.3 HYDRAULIC PRESSURES

Hydraulic pressure measurements were recorded on oscillograph recorders for each actuator. Due to recorder channel limitations, supply pressure measurements for all six actuators were measured while differential pressure measurements for actuators 1 through 5 were recorded. Differential pressures were obtained from the pressure feedback signals in the control system for each actuator.
Figure 3. Active Table Accelerometer Locations
### DDTS Table

**Frequency Response Test Accelerometers**

<table>
<thead>
<tr>
<th>Accel. No.</th>
<th>Record on Tape</th>
<th>Used As Abort Limit</th>
<th>Limit Accl.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1L</td>
<td>X</td>
<td>X</td>
<td>±3.0 g</td>
</tr>
<tr>
<td>2R</td>
<td>X</td>
<td>X</td>
<td>±3.0 g</td>
</tr>
<tr>
<td>3T</td>
<td>X</td>
<td>X</td>
<td>±3.0 g</td>
</tr>
<tr>
<td>4R</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5T</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7Y</td>
<td>X</td>
<td>X</td>
<td>±3.0 g</td>
</tr>
<tr>
<td>8Z</td>
<td>X</td>
<td>X</td>
<td>±3.0 g</td>
</tr>
<tr>
<td>9X</td>
<td>X</td>
<td>X</td>
<td>±3.0 g</td>
</tr>
<tr>
<td>SL</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.0 TEST INPUTS

The frequency response test was conducted with the table positioned on the simulator centerline with the actuators at mid-stroke \( x_{0} = 88.159; y_{0} = z_{0} = 0 \). Sinusoidal table commands of 0.05 inch amplitude were used in each of the \( x, y, \) and \( z \) directions.

Commanded actuator lengths are determined from

\[
\begin{pmatrix}
\Delta l_1 \\
\Delta l_2 \\
\Delta l_3 \\
\Delta l_4 \\
\Delta l_5 \\
\Delta l_6
\end{pmatrix}
= \begin{bmatrix}
A & \Delta x_I \\
\Delta y_I \\
\Delta z_I \\
\Delta \theta_x \\
\Delta \theta_y \\
\Delta \theta_z
\end{bmatrix}
\tag{10}
\]

where the terms of the \([A]\) matrix are defined in equation (7).

During docking simulations, each actuator receives a position command and a velocity command as indicated in the actuator control system block diagram shown in Figure 4. However, for the frequency response test, the rate command gain, \( K_{rc} \), was set to zero because the automatic signal generator used in the test was not capable of generating a constant amplitude sine sweep position command and a corresponding rate command simultaneously.

To minimize the magnitudes of table and actuator responses and to reduce the wear and tear on the linear potentiometers, a .05 inch magnitude sinusoidal table position command signal was used. An automatic frequency sweeping signal generator was used to sweep from 1.0 Hz to 40 Hz in 1.0 Hz increments. Fifteen cycles of command signal were used at each frequency.
Figure 4. Single-Axis Servo Block Diagram
4.0 FREQUENCY RESPONSE PREDICTIONS

Frequency response characteristics of the table for position commands in the x, y, and z directions were obtained using NADS computer program (References 1 and 2). These predictions are shown in Figure 5. The table frequency response exhibits two resonances—one at the hydraulic resonant frequency (~30 Hz) and another which corresponds to the bending frequency of the actuators (~11 Hz). In the lateral directions, the hydraulic resonance occurs at approximately 22 Hz due to increased effective mass in the lateral direction.

Table and actuator acceleration predictions for each test were also obtained (Figures 6 and 7). Based on these acceleration predictions, a table and actuator acceleration limit of ±3.0 g was established to preclude possible damage to the table or actuators. Accelerometers on the table and actuator 6 (see Section 2.1) were monitored during the test, and an automatic abort capability was utilized.

5.0 TEST RESULTS

Frequency response tests were attempted in the x, y, and z directions. The first test (z-axis) was aborted automatically at 9 Hz due to measured accelerations exceeding the abort limit of 2.5 g. The abort limit was raised to 3.0 g, and the test was rerun. Again the test was automatically aborted at 9 Hz due to excessive accelerations.

It was apparent that the table possessed a resonant peak in the 10-15 Hz range which is higher in magnitude than predicted. Therefore, to prevent possible damage to the table, actuators, or potentiometers, the tests in the y and x directions were conducted using the same 3.0 g abort limit. The y-axis test was automatically aborted at 9 Hz, and the x-axis test was aborted at 11 Hz.
Figure 5. Table Displacement Prediction
Figure 6. Table Acceleration Prediction
Figure 7. Actuator Acceleration Prediction
5.0 (Continued)

A comparison of frequency response test table motions with predicted table displacements is shown in Figure 8. A complete set of table motion frequency response test data is presented in the appendices. Measured table accelerations are compared with predicted table accelerations in Figure 9. Figure 10 compares measured actuator lateral accelerations at the upper end of actuator 6 cylinder with predicted actuator accelerations.

The cause of the higher dynamic responses has not been identified. Reducing the damping associated with actuator bending dynamics resulted in slightly higher analytical table dynamics, but could not account for the observed difference.

The analytical frequency response predictions show negligible coupling between table responses in the commanded direction and responses in the other directions. Test results show that the off-axis coupling was less than 30 percent of the commanded table motion at frequencies below 10 Hz. Test results shown in the appendices indicate that the coupling becomes more significant as the command frequency approaches the resonant frequency of the table.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The DDTS active table exhibits significantly higher dynamic characteristics than was predicted. It is recommended that further study be conducted to understand this discrepancy. This information is desirable so that the feasibility of utilizing the DDTS to perform other dynamic motion simulations and dynamic tests can be assessed.
Figure 8. Table Displacement Frequency Response
Figure 9. Table Accelerations, Frequency Response Test
Figure 10. Actuator Accelerations, Frequency Response Test
D2-118546-1

DOTS FREQUENCY RESPONSE TEST
SUMMARY OF INPUT INERTIAL CONDITIONS AND TRANSFORM MATRIX

FREQUENCY RESPONSE TEST

TABLE COORDINATES

<table>
<thead>
<tr>
<th>ACTUATOR</th>
<th>SERVO TABLE SWIVEL JOINTS</th>
<th>FLOOR SWIVEL JOINTS</th>
<th>COMPONENTS OF ACTUATOR LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>Y</td>
<td>Z</td>
</tr>
<tr>
<td>1</td>
<td>.0000</td>
<td>25.1020</td>
<td>49.5000</td>
</tr>
<tr>
<td>2</td>
<td>.0000</td>
<td>-55.4190</td>
<td>3.0000</td>
</tr>
<tr>
<td>3</td>
<td>.0000</td>
<td>-55.4190</td>
<td>3.0000</td>
</tr>
<tr>
<td>4</td>
<td>.0000</td>
<td>25.1020</td>
<td>-49.5000</td>
</tr>
<tr>
<td>5</td>
<td>.0000</td>
<td>30.2960</td>
<td>46.6050</td>
</tr>
<tr>
<td>6</td>
<td>.0000</td>
<td>30.2960</td>
<td>46.6050</td>
</tr>
</tbody>
</table>

TRANSFORM MATRIX

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
<th>z</th>
<th>x</th>
<th>y</th>
<th>z</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.22779×10^-1</td>
<td>-2.2942×10^-1</td>
<td>-2.2942×10^-1</td>
<td>-2.2942×10^-1</td>
<td>-2.2942×10^-1</td>
<td>-2.2942×10^-1</td>
</tr>
<tr>
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<td>-1.22779×10^-1</td>
<td>-1.22779×10^-1</td>
<td>-1.22779×10^-1</td>
<td>-1.22779×10^-1</td>
<td>-1.22779×10^-1</td>
</tr>
<tr>
<td>1.22779×10^-1</td>
<td>2.2905×10^-1</td>
<td>2.2905×10^-1</td>
<td>2.2905×10^-1</td>
<td>2.2905×10^-1</td>
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<td>-2.2942×10^-1</td>
<td>-2.2942×10^-1</td>
<td>-2.2942×10^-1</td>
<td>-2.2942×10^-1</td>
<td>-2.2942×10^-1</td>
</tr>
</tbody>
</table>

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR.
FREQUENCY RESPONSE TEST

FREQUENCY = 1.00 Hz

INERTIAL TABLE COORDINATES: X = 88.16 IN Y = .00 IN Z = .00 IN

TIME = 11 HRS 0 MIN = GRID TIME

TABLE COMMAND IN INCHES: 0.06 0.04 0.02 0 0.02 0.04 0.06

SECONDS: 57 59 61 63 65
FREQUENCY RESPONSE TEST

FREQUENCY = 1.00 Hz

INERTIAL TABLE COORDINATES: X = .89.16 in Y = .00 in Z = .00 in

TEST DATE 3/08/74

TIME = 11 HRS 0 MIN + GRID TIME
FREQUENCY RESPONSE TEST 1

FREQUENCY = 1.00 Hz
INERTIAL TABLE COORDINATES: X = 86.16 IN Y = .03 IN Z = .00 IN

TIME = 11 MINS 6 MIN - GRID TIME

---

Inertial table coordinates and frequency response test data are shown in the diagram. The table coordinates are X = 86.16 IN, Y = .03 IN, Z = .00 IN. The test was conducted at a frequency of 1.00 Hz. The time duration was 11 minutes and 6 seconds.
FREQUENCY RESPONSE TEST 1
FREQUENCY = 1.00 HZ
INERTIAL TABLE COORDINATES: X = 88.15 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 0 MIN + GRID TIME

[Graph showing frequency response with plots for X, Y, and Z coordinates over time]
FREQUENCY RESPONSE TEST I
FREQUENCY = 1.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 in, Y = 0.00 in, Z = 0.00 in
TIME = 11 HRS 0 MIN + GRID TIME

[Graph showing frequency response plots]
FREQUENCY RESPONSE TEST 1
FREQUENCY = 2.09 Hz
INERTIAL TABLE COORDINATES: X = .00 IN Y = .00 IN Z = .00 IN
TIME = 11 WAS 1 MIN - GRID TIME

TABLE COMMAND: INCHES
-0.06 -0.04 -0.02 -0.00 0.00 0.02 0.04 0.06
10 11 12 13 14 15 SECONDS
FREQUENCY RESPONSE TEST I
INERTIAL TABLE COORDINATES: X
Y
Z
TIME - 11 HRS 1 MIN
GRID TIME
169.43
166.42
169.41
166.39
167.93
167.92
167.91
167.97
168.1
169.17
169.13
169.12
169.11
SECONDS
PAGE 17.
FREQUENCY RESPONSE TEST 1
FREQUENCY = 2.00 HZ INERTIAL TABLE COORDINATES: X = 68.16 IN Y = .00 IN Z' = .00 IN
TIME = 11 HRS 1 MIN GRID TIME
FREQUENCY RESPONSE TEST I

FREQUENCY = 2.00 Hz

INERTIAL TABLE COORDINATES: X = 88.16 IN  Y = .00 IN  Z = .90 IN

TIME = 11 HRS 1 MIN  GRID TIME
FREQUENCY RESPONSE TEST 1
FREQUENCY = 2.00 Hz
INERTIAL TABLE COORDINATES: X = 89.15 in Y = .00 in Z = .00 in
TIME = 11 hrs 1 min = GRID TIME

---

GRAPHIC DATA:

FREQUENCY = 2.00 Hz
INERTIAL TABLE COORDINATES: X = 89.15 in Y = .00 in Z = .00 in
TIME = 11 hrs 1 min = GRID TIME

---

A-12
FREQUENCY RESPONSE TEST I

FREQUENCY = 3.00 HZ
INERTIAL TABLE COORDINATES: X = .00 IN Y = .00 IN Z = .00 IN

TIME = 1 MIN Grid Time

FREQUENCY RESPONSE TEST DATE 3/08/74

V X

| -0.06 | 16.75 |
| -0.04 | 17.25 |
| 0.00  | 17.75 |
| 0.02  | 18.25 |
| 0.04  | 18.75 |
| 0.06  | 19.25 |
| -0.02 | 19.75 |
| -0.04 | 20.25 |

TABLE COMMAND IN INCHES

SECONDS
FREQUENCY RESPONSE TEST

FREQUENCY = 3.00 HZ
INERTIAL TABLE COORDINATES: X = 88.16 IN  Y = .00 IN  Z = .00 IN
TIME = 11 HRS 1 MIN  GRID TIME

--- Graphical Data ---

--- Additional Text ---

--- Diagram Details ---

--- Annotations ---
FREQUENCY RESPONSE TEST 1

FREQUENCY = 1.00 HZ
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 1 MIN + GRID TIME

TEST DATE 3/08/74

- Grid Time
- Seconds
- Inches
FREQUENCY RESPONSE TEST 1

FREQUENCY = 3.00 HZ
INERTIAL TABLE COORDINATES: X = 8.16 IN, Y = .00 IN, Z = .00 IN
TIME = 11 HRS 1 MIN * GRID TIME

[Graph showing frequency response data with axes labeled X, Y, Z, and time in seconds]
FREQUENCY RESPONSE TEST I

FREQUENCY = 3.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = .00 IN Z = .60 IN

TIME = 11 HRS 1 Min = GRID TIME

TEST DATE 3/03/74
FREQUENCY RESPONSE TEST I

FREQUENCY = 4.00 Hz
INERTIAL TABLE COORDINATES: X = 68.16 IN Y = .00 IN Z = .00 IN

TIME = 11 HAS 1 MIN. * GRID TIME
FREQUENCY RESPONSE TEST 1

FREQUENCY = 4.00 Hz
INERTIAL TABLE COORDINATES: X = 0.00 IN
Y = 0.00 IN
Z' = 0.00 IN
TIME = 11 HRS 1 MIN + GRID TIME

TEST DATE 3/8/74
FREQUENCY RESPONSE TEST 1

FREQUENCY = 4.00 HZ
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = 0.00 IN Z = 0.00 IN
TIME = 11 HR 1 MIN GRID TIME

[Graph showing frequency response data with various coordinates and time intervals]
FREQUENCY RESPONSE TEST I

INERTIAL TABLE COORDINATES:

\[ x = 89.16 \text{ in} \quad y = 0.00 \text{ in} \quad z = 0.00 \text{ in} \]

TEST DATE 3/08/74

TIME = 11 HRS 1 MIN 59.99988 GRID TIME

- SECONDS PAGE 31.
FREQUENCY RESPONSE TEST I

FREQUENCY = 4.00 Hz
INERTIAL TABLE COORDINATES: X = 80.16 IN  Y = .00 IN  Z = .00 IN
TIME = 11 HRS 1 MIN  GRID TIME

D2-118546-1

A-22
FREQUENCY RESPONSE TEST I
FREQUENCY = 5.00 Hz
INERTIAL TABLE COORDINATES: X = 86.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 1 MIN + GRID TIME

-0.04
-0.02
-0.00
+0.00
+0.02
+0.04

-0.05 24.75 25 25.25 25.5 25.75 26 26.25 26.5 26.75 27

SECONDS
TABLE COMMAND IN INCHES

PAGE 85.
FREQUENCY RESPONSE TEST I
FREQUENCY = 5.00 HZ
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 1 MIN = GRID TIME

\begin{figure}
\centering
\includegraphics[width=\textwidth]{frequency_response_test}
\end{figure}
FREQUENCY RESPONSE TEST

FREQUENCY = 5.00 HZ
INERTIAL TABLE COORDINATES: X = 89.16 IN Y = .00 IN Z" = .00 IN
TIME = 11 HRS 1 MIN + GRID TIME

TEST DATE 3/08/74

A-25
FREQUENCY RESPONSE TEST I

FREQUENCY = 5.00 HZ

INERTIAL TABLE COORDINATES: X = 88.16 IN Y = .00 IN Z = .00 IN

TEST DATE 3/08/74

TIME = 11 HRS 1 MIN GRID TIME

GRAPHIC DATA
FREQUENCY RESPONSE TEST

FREQUENCY = 5.00 Hz
INERTIAL TABLE COORDINATES: X = 6.16 IN Y = .66 IN Z = .66 IN
TIME = 11 HRS 1 MIN + GRID TIME

Graphs showing data over time.
FREQUENCY RESPONSE TEST 1
FREQUENCY = 6.00 Hz
INERTIAL TABLE COORDINATES: X = 80.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 1 MIN * GRID TIME

![Graph showing frequency response test data with X = 80.16 IN, Y = .00 IN, Z = .00 IN, and time in hours and minutes. The graph plots table command in inches against time in seconds.](image)
FREQUENCY RESPONSE TEST 1

FREQUENCY = 6.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 1 MIN 0 GRID TIME
FREQUENCY RESPONSE TEST I
FREQUENCY = 6.00 HZ
TEST DATE 3/08/74
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = .68 IN Z = .30 IN
TIME = 11 HRS 1 MIN 46 SECONDS
PAGE 60
FREQUENCY RESPONSE TEST

TEST DATE: 3/00/74

FREQUENCY = 6.00 Hz

INERTIAL TABLE COORDINATES: X = 88.16 IN Y = .80 IN Z = .00 IN

TIME = 11 HRS 1 MIN - GRID TIME

[Graph showing delta X, Y, Z in inches over time]
FREQUENCY RESPONSE TEST

FREQUENCY = 6.00 Hz
INERTIAL TABLE COORDINATES: X = 0.00 IN Y = 0.00 IN Z = 0.00 IN
TIME = 11 HRS 1 MIN + GRID TIME

TEST DATE 3/28/74

<table>
<thead>
<tr>
<th>TIME SECONDS</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.7</td>
<td>27.9</td>
<td>28.1</td>
<td>28.3</td>
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<tr>
<td>28.5</td>
<td>28.7</td>
<td>28.9</td>
<td>29.1</td>
</tr>
<tr>
<td>29.3</td>
<td>29.5</td>
<td>29.7</td>
<td>29.9</td>
</tr>
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A-32
FREQUENCY RESPONSE TEST 1
FREQUENCY = 7.00 Hz
INERTIAL TABLE COORDINATES: X = 68.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 1 MIN .0100 GRID TIME

---

PAGE 95.
FREQUENCY RESPONSE TEST 1
FREQUENCY = 7.00 HZ
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = 0.00 IN Z = 0.00 IN
TIME = 11 HRS 1 MIN + GRID TIME

[Graph showing frequency response over time]
FREQUENCY RESPONSE TEST 1
FREQUENCY = 7.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN  Y = .00 IN  Z = .00 IN
TIME = 11 HRS 1 MIN 0 SEC TIME

[Diagram of frequency response test results]

A-35
FREQUENCY RESPONSE TEST 1

FREQUENCY = 7.00 Hz
INERTIAL TABLE COORDINATES: X = 80.16 in  Y = .00 in  Z = .00 in
TIME = 11 HRS 1 MIN + GRID TIME

TEST DATE 3/08/74

---

A-36
FREQUENCY RESPONSE TEST I
FREQUENCY = 7.00 Hz
INERTIAL TABLE COORDINATE: X = 88.16 IN, Y = .00 IN, Z* = .00 IN
TIME = 11 HRS 1 MIN GRID TIME

0.0001

0.0001

0.0001

0.0001

-0.1 30.4 30.7 31 31.3 31.6

-0.1 30.4 30.7 31 31.3 31.6

-0.1 30.4 30.7 31 31.3 31.6

-0.1 30.4 30.7 31 31.3 31.6

-0.1 30.4 30.7 31 31.3 31.6
FREQUENCY RESPONSE TEST

FREQUENCY = 8.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN  Y = .00 IN  Z = .00 IN
TIME = 11 Hwy 1 Min  Grid Time

<table>
<thead>
<tr>
<th>TABLE COMMAND IN INCHES</th>
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<tbody>
<tr>
<td>-0.06</td>
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<tr>
<td>0.00</td>
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<tr>
<td>0.00</td>
</tr>
<tr>
<td>0.04</td>
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<tr>
<td>0.06</td>
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</table>

SECONDS: 32.2 32.4 32.6 32.8 33.0 33.2 33.4
FREQUENCY RESPONSE TEST 1

FREQUENCY = 60.00 HZ

INITIAL TABLE COORDINATES: X = 88.16 IN, Y = .00 IN, Z = .00 IN

TIME = 11 HRS 1 MIN + GRID TIME

TEST DATE 3/08/74

<table>
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<tr>
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<tbody>
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<table>
<thead>
<tr>
<th>TIME</th>
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<td>11 HRS 1 MIN</td>
<td>168.46</td>
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<table>
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</table>

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<td>32.2</td>
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</tbody>
</table>

A-39
FREQUENCY RESPONSE TEST 1
FREQUENCY = 8.00 Hz
INERTIAL TABLE COORDINATES: X = 89.16 IN  Y = .00 IN Z = .00 IN
TEST DATE 3/08/74
TIME = 11 HRS 1 MIN + GRID TIME

[Graph of linear inches vs. seconds]
FREQUENCY RESPONSE TEST I

TEST DATE 3/08/74

FREQUENCY = 9.00 KC

INERTIAL TABLE COORDINATES: X = 88.16 IN  Y = .00 IN  Z = .00 IN

TIME = 31 FPS 1 MIN 0 GRID TIME

INCHES

DIAGRAM 1

DIAGRAM 2

DIAGRAM 3

SECONDS

PAGE 118
FREQUENCY RESPONSE TEST I

FREQUENCY = 8.00 Hz
INERTIAL TABLE COORDINATES: X = 80.16 IN Y = .00 IN Z = .60 IN
TIME = 11 HRS 1 MIN 2 SEC GRID TIME

[Graph showing data over time]
FREQUENCY RESPONSE TEST

REFERENCE SENSOR: TACOM

TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 Hz
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 8.00 Hz WAS 0.100 Hz TO 0.800 Hz

DATE PROCESSED: 09APR74

TOTAL PERIOD PROCESSED = 40.77 sec
FREQUENCY INCREMENTS = 1.00 Hz

Amplitude vs Frequency (in Hz)

Amplitude

0.0509
0.0507
0.0505
0.0503
0.0501
0.0499

Frequency (in Hz)

1 2 3 4 5 6 7 8

PAGE 0.
FREQUENCY RESPONSE TEST

SENSOR: DELT X, NORMALIZED BY REFERENCE SENSOR: TABCOR
TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 Hz
BANDWIDTH RANGE FOR FREQUENCY INTERVAL = 0.00 Hz to 8.00 Hz

DATE PROCESSED = GRAPHIC
TOTAL PERIOD PROCESSED = 40.77 SEC
FREQUENCY ENCRREMENTS = 1.00 Hz

DECIBELS

PHASE ANGLE IN DEGREES

FREQUENCY IN HZ
FREQUENCY RESPONSE TEST

SENSOR: DELT normalized by reference sensor - Tarcom
TOTAL CYCLES PROCESSED: 8
FIRST FREQUENCY: 1.00 HZ
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 8.00 HZ WAS: 0.100 TO 0.800

DATE PROCESSED: 09APR74
TOTAL PERIOD PROCESSED: 46.77 SEC
FREQUENCY INCREMENTS: 1.00 HZ

DECIBELS

PHASE ANGLE IN DEGREES

FREQUENCY IN HZ

PAGE 2.
FREQUENCY RESPONSE TEST I

SENSOR - DELT Z NORMALIZED BY REFERENCE SENSOR - TABCON

TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 Hz
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 8.00 Hz was .10 Hz to .80 Hz

DATE PROCESSED = 09APR74
TOTAL PERIOD PROCESSED = 40.77 SEC
FREQUENCY INCREMENTS = 1.00 Hz

PAGE 3.
FREQUENCY RESPONSE TEST
SENSOR - ΘETA NORMALIZED BY REFERENCE SENSOR - ΘABCOM
TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 Hz
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 8.00 Hz WAS .100 Hz TO .800 Hz

DATE PROCESSED - 30APR74
TOTAL PERIOD PROCESSED = 40.77 SEC
FREQUENCY INCREMENTS = 1.00 Hz
FREQUENCY RESPONSE TEST I
SENSOR - YTHETA NORMALIZED BY REFERENCE SENSOR - TABCOM
TOTAL CYCLES PROCESSED = 6
FIRST FREQUENCY = 1.00 HZ
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 8.00 HZ WAS .100 HZ TO .800 HZ

DATE PROCESSED - 09APR74
TOTAL CYCLES PROCESSED = 0
TOTAL PERIOD PROCESSED = 40.77 SEC
FREQUENCY INCREMENTS = 1.00 HZ

-300  -200  -100  0  100  200  300

DEGREES

-100  -90  -80  -70  -60  -50  -40  -30  -20  -10  0  10  20  30  40  50  60  70  80

PHASE

1  2  3  4  5  6  7  8
FREQUENCY IN HZ

1  2  3  4  5  6  7  8
FREQUENCY IN HZ
FREQUENCY RESPONSE TEST 1
SENSOR ZTTHETA NORMALIZED BY REFERENCE SENSOR TABCOM
TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 HZ
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 8.00 HZ WAS .100 Hz TO .800 Hz

DATE PROCESSED: 09APR74
TOTAL PERIOD PROCESSED = 40.77 SEC
FREQUENCY INCREMENTS = 1.00 HZ

PAGE 6
APPENDIX B

TEST NO. 2 Z-AXIS
### DOTS FREQUENCY RESPONSE TEST

**SUMMARY OF INPUT INERTIAL CONDITIONS AND TRANSFORM MATRIX**

**FREQUENCY RESPONSE TEST**

**TEST DATE 3/08/74**

<table>
<thead>
<tr>
<th>TABLE COORDINATES</th>
<th>88.159</th>
<th>.000</th>
<th>.000</th>
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</thead>
<tbody>
<tr>
<td><strong>ACTUATOR</strong></td>
<td><strong>X</strong></td>
<td><strong>Y</strong></td>
<td><strong>Z</strong></td>
</tr>
<tr>
<td>1</td>
<td>.0000</td>
<td>25.1020</td>
<td>49.4000</td>
</tr>
<tr>
<td>2</td>
<td>.0000</td>
<td>-55.4190</td>
<td>3.4000</td>
</tr>
<tr>
<td>3</td>
<td>.0000</td>
<td>-55.4190</td>
<td>-3.0000</td>
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<tr>
<td>4</td>
<td>.0000</td>
<td>25.1020</td>
<td>-49.4000</td>
</tr>
<tr>
<td>5</td>
<td>.0000</td>
<td>30.2980</td>
<td>46.5000</td>
</tr>
<tr>
<td>6</td>
<td>.0000</td>
<td>30.2980</td>
<td>46.5000</td>
</tr>
<tr>
<td><strong>FLOOR SWIVEL JOINTS</strong></td>
<td><strong>X</strong></td>
<td><strong>Y</strong></td>
<td><strong>Z</strong></td>
</tr>
<tr>
<td>1</td>
<td>210.4070</td>
<td>-64.3110</td>
<td>123.1780</td>
</tr>
<tr>
<td>2</td>
<td>210.4290</td>
<td>-74.5730</td>
<td>116.8190</td>
</tr>
<tr>
<td>3</td>
<td>210.4170</td>
<td>-62.4120</td>
<td>123.6010</td>
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<tr>
<td>4</td>
<td>210.4100</td>
<td>138.4530</td>
<td>-5.9750</td>
</tr>
<tr>
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<td>210.4170</td>
<td>138.4530</td>
<td>-5.9750</td>
</tr>
<tr>
<td>6</td>
<td>210.4100</td>
<td>138.4530</td>
<td>-5.9750</td>
</tr>
<tr>
<td><strong>SERVO TABLE SWIVEL JOINTS</strong></td>
<td><strong>X</strong></td>
<td><strong>Y</strong></td>
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<tr>
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<td>210.4070</td>
<td>-64.3110</td>
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<td>210.4290</td>
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<tr>
<td>6</td>
<td>210.4100</td>
<td>138.4530</td>
<td></td>
</tr>
</tbody>
</table>

| **COMPONENTS OF ACTUATOR LENGTH** | **ACTUATOR** |
| 1 | -122.2400 | 89.4130 | -73.6780 |
| 2 | -122.2730 | 80.9619 | -113.1042 |
| 3 | -122.2630 | 19.1548 | 113.8193 |
| 4 | -122.2590 | 87.8140 | 74.1430 |
| 5 | -122.2510 | -126.1650 | -40.5250 |
| 6 | -122.2120 | -120.9910 | 30.4550 |

**TRANSFORM MATRIX**

\[
\begin{pmatrix}
-0.227798 & -0.209422 & -0.228575 & -0.229422 \\
-0.228575 & -0.229422 & -0.228575 & -0.229422 \\
-0.447118 & -0.303266 & -0.442709 & -0.448595 \\
-0.442709 & -0.448595 & -0.447118 & -0.303266 \\
-0.227798 & -0.209422 & -0.228575 & -0.229422 \\
-0.447118 & -0.303266 & -0.442709 & -0.448595 \\
-0.543719 & -0.835894 & -0.544980 & -0.835894 \\
-0.835894 & -0.544980 & -0.543719 & -0.835894 \\
\end{pmatrix}
\]

**REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR**

B-2
FREQUENCY RESPONSE TEST 2
FREQUENCY = 1.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = 0.00 IN Z = 0.00 IN
TIME = 11 HRS 10 MIN GRID TIME

[Graph showing a sine wave with labeled time and coordinates]
**Frequency Response Test 2**

Frequency: 1,000 Hz

Inertial Table Coordinates:
- X = 88.16 in
- Y = 0.00 in
- Z = 0.00 in

Time = 10 min

**Graphs:**
- Frequency vs. Time for different channels
- Graphs show oscillations at 1,000 Hz

Test Date: 3/29/74
FREQUENCY RESPONSE TEST 2

FREQUENCY = 1.00 HZ
INERTIAL TABLE COORDINATES: X = 89.16 IN Y = 0.00 IN Z" = 0.00 IN

TEST DATE 3-08-74
TIME = 11 HRS 18 MIN + GRID TIME
FREQUENCY RESPONSE TEST 2

FREQUENCY = 1.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = .00 IN Z" = .32 IN
TIME = 11 HRS 10 MIN, GRID TIME

THRITA X RADIANS

0.0001

0 9 10 11 12 13 14 15 16 17 18

THRITA Y RADIANS

0

0 9 10 11 12 13 14 15 16 17 18

THRITA Z RADIANS

0

0 9 10 11 12 13 14 15 16 17 18

SECONDS

PAGE 5
FREQUENCY RESPONSE TEST 2

FREQUENCY = 2.00 HZ

INERTIAL TABLE COORDINATES: X = 0.16 IN Y = 0.00 IN Z' = 0.20 IN

TIME = 11 HRS 10 MIN - GRID TIME

---

PAGE 16.
FREQUENCY RESPONSE TEST 2

FREQUENCY = 2.00 HZ

INERTIAL TABLE COORDINATES: X = 80.18 IN Y = .00 IN Z = .00 IN

TIME = 11 HRS 10 MIN . GRID TIME

TEST DATE 3/09/74
FREQUENCY RESPONSE TEST 2
FREQUENCY = 2.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN  Y = .00 IN  Z = .00 IN
TIME = 11 HRS 10 MIN  GRID TIME

[Graph showing data for delta X, delta Y, and delta Z over time]
FREQUENCY RESPONSE TEST 2
FREQUENCY = 2.00 Hz
INERTIAL TABLE COORDINATES: X = 89.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 10 MIN + GRID TIME

0.0001

THETA X RADIAN

0.0001

THETA Y RADIAN

0.0001

THETA Z RADIAN

20.5 21.5 22.5 23.5 24.5 25.5
SECONDS

PAGE 20.
FREQUENCY RESPONSE TEST 2
FREQUENCY = 3.00 Hz
INERTIAL TABLE COORDINATES: X = 80.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 18 MIN + GRID TIME

<table>
<thead>
<tr>
<th>TABLE COMMAND IN INCHES</th>
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<tbody>
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<td>-0.02</td>
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<td>30.25</td>
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<tr>
<td>31</td>
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</tbody>
</table>

PAGE 31.
FREQUENCY RESPONSE TEST 2

FREQUENCY = 3.00 HZ

INERTIAL TABLE COORDINATES: X = 0.16 IN  Y = 0.00 IN  Z = 0.00 IN

TIME = 11 HRS 18 MIN + GRID TIME
FREQUENCY RESPONSE TEST 2

FREQUENCY = 3.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN  Y = .00 IN  Z' = .00 IN
TIME = 11 HRS 18 MIN  + GRID TIME
FREQUENCY RESPONSE TEST 2

FREQUENCY = 3.00 Hz
INERTIAL TABLE COORDINATES: X = 80.16 in Y = .00 in Z = .00 in
TIME = 11 HRS 18 MIN + GRID TIME

TIME = 0.0001
0.0001

THEETA X RADIAN

THEETA Y RADIAN

THEETA Z RADIAN

SECONDS

PAGE 35
FREQUENCY RESPONSE TEST 2
FREQUENCY = 4.00 Hz
INERTIAL TABLE COORDINATES: X = 08.16 IN  Y = .00 IN  Z" = .00 IN
TIME = 11 HRS 10 MIN - GRID TIME

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<th>TABLE COMMAND IN INCHES</th>
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<tr>
<td>33.5</td>
<td>0.02</td>
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PAGE 48
FREQUENCY RESPONSE TEST 2
FREQUENCY = 4.00 Hz
INERTIAL TABLE COORDINATES: X = 89.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 18 MIN - GRID TIME

The diagram shows a series of lines and markers, possibly representing data points or measurements over time. The values and coordinates mentioned suggest a measurement or test setup, possibly related to frequency or inertial table coordinates.
FREQUENCY RESPONSE TEST 2
FREQUENCY = 4.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = 00 IN Z = 00 IN
TIME = 11 HRS 18 MIN
GRID TIME

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</table>
FREQUENCY RESPONSE TEST
FREQUENCY = 4.03 KHz
INERTIAL TABLE COORDINATES: X = 80.16 IN  Y = .00 IN  Z' = .00 IN
TEST DATE 3/08/74
TIME = 11 HRS 18 MIN + GRID TIME
FREQUENCY RESPONSE TEST 2
FREQUENCY = 4.00 Hz
INERTIAL TABLE COORDINATES: X = 88.15 IN Y = .80 IN Z' = .60 IN
TIME = 11 HRS 18 MIN + GRID TIME

-0.0002
0.0001
0.0000
0.0001

0
0

0
0

0
0

0
0

THETA X RADIAN
THETA Y RADIAN
THETA Z RADIAN

-32 32.5 33 33.5 34 34.5
-32 32.5 33 33.5 34 34.5
-32 32.5 33 33.5 34 34.5

SECONDS
PAGE 52.
FREQUENCY RESPONSE TEST 2
FREQUENCY = 5.00 Hz
TEST DATE 3/08/74
FREQUENCY RESPONSE
TIME = 11 HRS 16 MIN - GRID TIME
FREQUENCY RESPONSE TEST 2

FREQUENCY = 5.06 Hz
INERTIAL TABLE COORDINATES: X = -88.16 IN Y = .00 IN Z = .00 IN

TEST DATE 3/08 74

TIME = 11 HRS 18 MIN - GRID TIME

169.44
169.43
169.42
169.41
169.40
169.39
169.38
169.37
169.36

35.6
35.9
36.2
36.5
36.8
37.1
37.4
37.7

167.93
167.92
167.91
167.90
167.89
167.88
167.87
167.86

167.65
167.64
167.63
167.62
167.61
167.60
167.59
167.58

166.75
166.74
166.73
166.72
166.71
166.70
166.69
166.68

166.10
166.09
166.08
166.07
166.06
166.05
166.04
166.03

165.11
165.10
165.09
165.08
165.07
165.06
165.05
165.04

SECONDS

PAGE 64
FREQUENCY RESPONSE TEST 2

FREQUENCY: 5.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 in Y = .00 in Z = .00 in
TIME = 11 HRS 18 MIN - GRID TIME

---

TEST DATE 3/08/74

---

PAGE 65
FREQUENCY RESPONSE TEST 2

FREQUENCY = 5.00 Hz

INERTIAL TABLE COORDINATES: X = 80.16 in Y = 0.06 in Z = 0.00 in

TEST DATE 3/08/74

TIME = 2 HRS 10 MIN GRID TIME

--- Graphical Data ---
FREQUENCY RESPONSE TEST 2
FREQUENCY = 5.20 Hz
INERTIAL TABLE COORDINATES: X = 69.18 IN  Y = .00 IN  Z = .00 IN
TIME = 11 NAS 10 MIN + GRID TIME

\[ \theta_x \] radians

\[ \theta_y \] radians

\[ \theta_z \] radians

\[ \text{SECONDS} \]
FREQUENCY RESPONSE TEST 2

FREQUENCY = 6.00 Hz

INERTIAL TABLE COORDINATES: 
X = .80.16 in 
Y = .60 in 
Z = .00 in

TIME = II HRS 18 MIN + GRID TIME

TABLE COMMAND IN INCHES

-0.04
-0.02
-0.02
-0.04

-0.02
-0.04
-0.02
-0.04

39.4
39.6
39.8
40
40.2

SECONDS
FREQUENCY RESPONSE TEST 2

FREQUENCY = 6.00 Hz
INERTIAL TABLE COORDINATES: X = 60.16 IN  Y = .30 IN  Z = .30 IN
TIME = 11 HRS 18 MIN = GRID TIME
FREQUENCY RESPONSE TEST 2

FREQUENCY = 6.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 in. Y = .00 in. Z = .00 in.
TIME = 11 HRS 10 MIN = GRID TIME.
FREQUENCY RESPONSE TEST 2
FREQUENCY = 6.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = 0.00 IN Z = 0.00 IN
TIME = 11 HRS 18 MIN + GRID TIME

Graphs showing displacement over time for different coordinates.
FREQUENCY RESPONSE TEST 2

FREQUENCY = 6.00 Hz
INERTIAL TABLE COORDINATES: X = 88.15 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 18 MIN + GRID TIME

0.0001
G.001
0.0001

0.0001
0.0001

0.0001
0.0001

0.0001
0.0001

0.0001
0.0001

0.0001
0.0001
FREQUENCY RESPONSE TEST 2

FREQUENCY = 7.00 Hz
INERTIAL TABLE COORDINATES: X = 00.16 in
TEST DATE 3/09/74
Y = .00 in
Z' = .00 in
TIME = 11 HRS 18 MIN + GRID TIME

-0.06 0.04 0.02 0.00 0.02 0.04 0.06 TABLE COMMAND IN INCHES
-0.04 -0.02 -0.00 -0.02 -0.04

41.1 41.4 41.7 SECONDS 42.0 42.3

PAGE 95.
FREQUENCY RESPONSE TEST 2

FREQUENCY = 7.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = .00 IN Z = .00 IN
TIME = IT HAS 18 MIN + GRID TIME

[Graph showing frequency response data with time and values]
FREQUENCY RESPONSE TEST 2

FREQUENCY = 7.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN, Y = .00 IN, Z = .00 IN
TIME = 11 HRS 18 MIN = GRID TIME

---

DATE: 3/08,74

---

TIME = 11 HRS 18 MIN = GRID TIME

---

S167.64 87.61 17.61 40.8 11.4 1.7 42 2.3
S167.65 87.61 17.61 40.8 11.4 1.7 42 2.3
S167.66 87.61 17.61 40.8 11.4 1.7 42 2.3
S167.67 87.61 17.61 40.8 11.4 1.7 42 2.3

---

SECONDS

PAGE 97.
FREQUENCY RESPONSE TEST 2
FREQUENCY = 7.00 Hz
INERTIAL TABLE COORDINATES: X = 80.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 18 MIN = GRID TIME
FREQUENCY RESPONSE TEST 2
FREQUENCY = 7.00 Hz
INERTIAL TABLE COORDINATES: X = .8816 in Y = .00 in Z = .00 in
TIME = 11 HRS 10 MIN = GRID TIME

---

[Graph showing frequency response with axes labeled θ_x, θ_y, and θ_z in radians and time in seconds, illustrating the test results.]
FREQUENCY RESPONSE TEST

FREQUENCY = 8.00 Hz
INERTIAL TABLE COORDINATES: X = 80.16 IN, V = .00 IN, Z = .00 IN
TIME = 11 HRS 18 MIN + GRID TIME

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<thead>
<tr>
<th>TABLE COMMAND</th>
<th>SECONDS</th>
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<tbody>
<tr>
<td>-0.00</td>
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<td>0.04</td>
<td>43.1</td>
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<tr>
<td>-0.04</td>
<td>43.9</td>
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<tr>
<td>0.00</td>
<td>44.1</td>
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</tbody>
</table>
FREQUENCY RESPONSE TEST 2

TEST DATE 3/08/74

FREQUENCY = 0.00 HZ
INERTIAL TABLE COORDINATES: X = .00 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 18 MIN + GRID TIME

TIME - 11 HRS 18 MIN + GRID TIME

PAGES 116.
FREQUENCY RESPONSE TEST 2
FREQUENCY = 6.25 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = .60 IN Z = .60 IN
TEST DATE 3/08/74
TIME = 11 HRS 18 MIN 14 SECONDS

PAGE 147.
FREQUENCY RESPONSE TEST 2
FREQUENCY = 9.02 Hz
INERTIAL TABLE COORDINATES: X = 89.15 IN  Y = .00 IN  Z" = .00 IN
TIME = IT HRS 18 MIN = GRID TIME

DELTA X IN INCHES

DELTA Y IN INCHES

DELTA Z IN INCHES

42.9 43.1 43.3 43.5 43.7 43.9 44.1 SECONDS

PAGE 118

B-41
Frequency Response Test 2
Reference Sensor - TABCON
Total Cycles Processed = 0
First Frequency = 1.00 Hz
Bandwidth range for frequency interval to 8.00 Hz was .100 Hz to .800 Hz

DATE PROCESSED - GRAPH
Total Period Processed = 40.76 SEC
Frequency Increments = 1.00 Hz

Amplitude vs Frequency in Hz

PAGE 2.
FREQUENCY RESPONSE TEST 2

SENSOR - DELT X  NORMALIZED BY REFERENCE SENSOR - TACCON

TOTAL CYCLES PROCESSED = 5

FIRST FREQUENCY = 1.00 Hz

BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 6.00 Hz MAS .100 Hz TO .800 Hz

DATE PROCESSED = 09APR74

TOTAL PERIOD PROCESSED = 40.76 SEC

FREQUENCY INCREASES = 1.00 Hz
FREQUENCY RESPONSE TEST

SENSOR - D.C. V. - NORMALIZED BY REFERENCE SENSOR - TACOM
TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 Hz
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO = 8.00 Hz
TOTAL PERIOD PROCESSED = 40.76 SEC
FREQUENCY INCREMENTS = 1.00 Hz

DATE PROCESSED - 09 APR 74

DECEIBELS

PHASE ANGLE IN DEGREES

FREQUENCY IN HZ
FREQUENCY RESPONSE TEST

- Delta Z normalized by reference sensor - TABCON

Total cycles processed: 0
First frequency: 1.00 Hz

Bandwidth range for frequency interval to 8.00 Hz was .100 Hz to .800 Hz

Date processed: 09APR70

Total period processed: 40.76 sec
Frequency increments: 1.00 Hz
FREQUENCY RESPONSE TEST 2
SENSOR - XTHETA, NORMALIZED BY REFERENCE SENSOR - TABCON
TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 Hz

FREQUENCY IN HZ

DECIBELS

PHASE ANGLE IN DEGREES

TOTAL PERIOD PROCESSED = 40.76 SEC
FREQUENCY INCREMENTS = 1.00 Hz.

BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 8.00 Hz was .100 Hz to .800 Hz.

PAGE 4.
FREQUENCY RESPONSE TEST 2
SENSOR - YTHETA NORMALIZED BY REFERENCE SENSOR - TABCOM
TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 HZ
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 8.00 HZ WAS 0.00 HZ TO 8.00 HZ

DATE PROCESSED - 09 APR 74
TOTAL PERIOD PROCESSED = 40.76 SEC
FREQUENCY INCREMENTS = 1.00 HZ

-300  -200  -100   0   100  200  300
-360  -270  -180   0   90  180  270  360

FREQUENCY IN HZ
DEGREES

PHASE ANGLE IN DEGREES

FREQUENCY IN HZ

DEGREES
FREQUENCY RESPONSE TEST 2
SENSOR - ZTHETA  NORMALIZED BY REFERENCE SENSOR - TABCOM

TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 Hz

BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO IS 100 Hz TO 800 Hz

DATE PROCESSED - 09 APR 74
TOTAL PERIOD PROCESSED = 40.76 SEC
FREQUENCY INCREMENTS = 1.00 Hz

Page 6.
APPENDIX C

TEST NO. 3 Y-AXIS
DOTS FREQUENCY RESPONSE TEST
SUMMARY OF INPUT INERTIAL CONDITIONS AND TRANSFORM MATRIX
FREQUENCY RESPONSE TEST 3.
TEST DATE 3/08/74

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<th>Z</th>
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<th>TABLE COORDINATES</th>
<th>FLOOR SWIVEL JOINTS</th>
<th>COMPONENTS OF ACTUATOR LENGTH</th>
<th>TRANSFORM MATRIX</th>
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<td>115.1740</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>210.4070</td>
<td>-74.5730</td>
<td>-116.8190</td>
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</tr>
<tr>
<td>2</td>
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<td>-74.5730</td>
<td>-116.8190</td>
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<td></td>
<td>116.1240</td>
<td>113.6140</td>
<td>167.6879</td>
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<td>-76.3960</td>
<td>115.1740</td>
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<td></td>
<td>210.4170</td>
<td>-74.5730</td>
<td>-116.8190</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>X: .000, Y: 30.298, Z: -46.500</td>
<td>210.3690</td>
<td>138.3890</td>
<td>8.0050</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>210.3690</td>
<td>138.3890</td>
<td>8.0050</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>210.3690</td>
<td>138.3890</td>
<td>8.0050</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>X: .000, Y: 30.298, Z: 46.500</td>
<td>210.3690</td>
<td>138.3890</td>
<td>8.0050</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>210.3690</td>
<td>138.3890</td>
<td>8.0050</td>
<td></td>
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<td></td>
<td>210.3690</td>
<td>138.3890</td>
<td>8.0050</td>
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</tr>
<tr>
<td>6</td>
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<td>138.3890</td>
<td>8.0050</td>
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<td></td>
<td>210.3690</td>
<td>138.3890</td>
<td>8.0050</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>210.3690</td>
<td>138.3890</td>
<td>8.0050</td>
<td></td>
</tr>
</tbody>
</table>

TRANSFORM MATRIX

Reproducibility of the original page is poor.
FREQUENCY RESPONSE TEST 3

FREQUENCY = 1.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 in  Y = .00 in  Z* = .00 in
TIME = 11 HRS 29 MIN.  GRID TIME

TABLE COMMAND IN INCHES

SECONDS

PAGE 1.
FREQUENCY RESPONSE TEST 3

FREQUENCY = 1.0 Hz
INERTIAL TABLE COORDINATES: X = 60.16 in  Y = 0.00 in  Z = 0.00 in
TIME = 11 hrs 29 min + GRID TIME

[Graph showing frequency response data with coordinates and grid times.]
FREQUENCY RESPONSE TEST 3

FREQUENCY = 1.05 Hz

INERTIAL TABLE COORDINATES: X = 88.16 in  Y = .20 in  Z' = .30 in

TIME = 11 HRS 29 MIN 44 SEC

TEST DATE 3/08/74
FREQUENCY RESPONSE TEST 1
FREQUENCY = 1.00 Hz
INERTIAL TABLE COORDINATES: X = 08.16 IN Y = .00 IN Z" = .00 IN
TIME = 11 HRS 29 MIN - GRID TIME

[Graph showing frequency response data with coordinates X, Y, and Z over time]
FREQUENCY RESPONSE TEST 3

FREQUENCY = 1.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 in Y = .00 in Z =.00 in
TIME = 11 hrs 29 min = GRID TIME

THETA X RADIANS

THETA Y RADIANS

THETA Z RADIANS

SECONDS
FREQUENCY RESPONSE TEST 3

TEST DATE 3/08/74

FREQUENCY = 2.00 HZ

INERTIAL TABLE COORDINATES: X = 80.16 IN. Y = .00 IN. Z = .00 IN.

TIME = 11 HRS 29 MIN. GRID TIME.
FREQUENCY RESPONSE TEST 3

INERTIAL TABLE COORDINATES:
X = 89.16 IN
Y = 0.00 IN
Z = 0.00 IN

TIME = 11 HRS 29 MIN
GRID TIME = 168.43 SECONDS

FREQUENCY = 2.00 HZ

D2-118546-1
FREQUENCY RESPONSE TEST 3
FREQUENCY = 2.00 HZ
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 20 MIN + GRID TIME

..Graphical data showing frequency response over time...

(test data and coordinates as noted in the image)
FREQUENCY RESPONSE TEST 3
FREQUENCY = 2.00 Hz
INERTIAL TABLE COORDINATES:  X = 68.16 IN  Y = .00 IN  Z = .00 IN
TIME = 11 HRS 29 MIN + GRID TIME

DELTA X INCHES

DELTA Y INCHES

DELTA Z INCHES

SECONDS
FREQUENCY RESPONSE TEST 3
FREQUENCY = 2.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 29 MIN + GRID TIME

--- Graphs ---

- Theta X (Radians)
- Theta Y (Radians)
- Theta Z (Radians)

--- Axes ---

- Frequency on the X-axis
- Time (seconds) on the Y-axis
FREQUENCY RESPONSE TEST 3
FREQUENCY = 3.25 Hz
INERTIAL TABLE COORDINATES: X = 0.16 IN, Y = 0.00 IN, Z = 0.00 IN
TIME = 11 HRS 29 MIN + GRID TIME

![Graph of frequency response test 3 with data points and frequency axis labeled.]
**FREQUENCY RESPONSE TEST 3**

**FREQUENCY** = 3.00 HZ

**INERTIAL TABLE COORDINATES:**
- X = 88.16 IN
- Y = 0.00 IN
- Z = 0.00 IN

**TIME** = 11 HRS 29 MIN + GRID TIME

---

<table>
<thead>
<tr>
<th>SECONDS</th>
<th>30.25</th>
<th>31.25</th>
<th>32.25</th>
<th>33.50</th>
<th>34.25</th>
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<tbody>
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</tr>
<tr>
<td>168.30</td>
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<td></td>
</tr>
</tbody>
</table>

---

C-14
FREQUENCY RESPONSE TEST 3

FREQUENCY = 3.00 Hz
INERTIAL TABLE COORDINATES: X = .00 IN Y = .00 IN Z = .00 IN

TIME = 11 HRS 29 MIN GRID TIME

[Diagram of frequency response data with various measurements and values]
FREQUENCY RESPONSE TEST 3
FREQUENCY = 5.00 Hz
INERTIAL TABLE COORDINATES: X = .8816 in, Y = .00 in, Z = .00 in
TIME = 11 hrs 29 min + GRID TIME
FREQUENCY RESPONSE TEST 3

FREQUENCY = 3.00 Hz
INERTIAL TABLE COORDINATES: X = 89.16 in  Y = 0.00 in  Z = 0.05 in
TIME = 11 HRS 29 MIN + GRID TIME

X RADIANS

Y RADIANS

Z RADIANS

SECONDS
FREQUENCY RESPONSE TEST

FREQUENCY = 4.00 Hz
INERTIAL TABLE COORDINATES: X = 80.16 in  Y = 0.00 in  Z = 0.00 in
TIME = 11 NAS PW MIN = GRID TIME

<table>
<thead>
<tr>
<th>TABLE COMMAND IN INCHES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.04</td>
</tr>
<tr>
<td>0.02</td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>-0.02</td>
</tr>
<tr>
<td>-0.04</td>
</tr>
<tr>
<td>-0.06</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SECONDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>35.25</td>
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<tr>
<td>35.75</td>
</tr>
<tr>
<td>36.25</td>
</tr>
<tr>
<td>36.75</td>
</tr>
<tr>
<td>37.25</td>
</tr>
<tr>
<td>37.75</td>
</tr>
</tbody>
</table>
FREQUENCY RESPONSE TEST 3

FREQUENCY = 4.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 in Y = .00 in Z = .00 in
TIME = 11 hrs 29 min = GRID TIME

...Graph...
FREQUENCY RESPONSE TEST 3

FREQUENCY = 4.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 29 MIN + GRID TIME
FREQUENCY RESPONSE TEST 3

TEST DATE 3/08/74

FREQUENCY = 5.00 Hz

INERTIAL TABLE COORDINATES: X = 88.16 IN, Y = .00 IN, Z = .00 IN

TIME = 11 HRS 23 MIN + GRID TIME

<table>
<thead>
<tr>
<th>TABLE COMMAND IN INCHES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.04</td>
</tr>
<tr>
<td>0.02</td>
</tr>
<tr>
<td>-0.02</td>
</tr>
<tr>
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<tr>
<td>0.02</td>
</tr>
<tr>
<td>-0.02</td>
</tr>
<tr>
<td>-0.04</td>
</tr>
</tbody>
</table>

SECONDS 38 39.1 39.4 39.7 40 40.3 40.6 40.9 42.6 42.9
FREQUENCY RESPONSE TEST 3

FREQUENCY - 5.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN  Y = .60 IN  Z" = .60 IN

TIME = 11 HRS 29 MIN - GRID TIME
FREQUENCY RESPONSE TEST 1
FREQUENCY = 5.02 HZ
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = .00 IN Z' = .00 IN
TEST DATE 3/68/74
TIME = 11 HRS 29 MIN + GRID TIME

Graph showing frequency response with coordinates and graph.
FREQUENCY RESPONSE TEST 3

FREQUENCY = 5.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN  Y = 0.02 IN  Z = 0.00 IN
TIME = 11 HRS 29 MIN + GRID TIME

- Theta X RADIANS
- Theta Y RADIANS
- Theta Z RADIANS

0.0201

SECONDS

PAGE 67

C-27
FREQUENCY RESPONSE TEST 3

FREQUENCY = 6.00 Hz
INERTIAL TABLE COORDINATES: X = 89.16 in, Y = 0.00 in, Z = 0.00 in

TIME = 11 hrs 29 min - GRID TIME

---

[Graph showing waveforms with labeled axes: TABLE COMMAND IN INCHES and SECONDS]
FREQUENCY RESPONSE TEST 3

FREQUENCY: 6.00 Hz

INERTIAL TABLE COORDINATES: X = 08.18 in, Y = .00 in, Z = .00 in

TIME = 11 hours 29 min + GRID TIME
FREQUENCY RESPONSE TEST 3
FREQUENCY = 6.00 Hz
INERTIAL TABLE COORDINATES: X = 89.16 IN Y = .00 IN Z = .30 IN
TIME = 11 HRS 29 MIN + GRID TIME

[Graph depicting frequency response data with X, Y, and Z coordinates plotted against time in seconds.]

PAGE 20
FREQUENCY RESPONSE TEST 3
FREQUENCY = 6.00 Hz  
INERTIAL TABLE COORDINATES: X = 60.16 IN  Y = .00 IN  Z = .00 IN
TIME = 31 WRS 90 MIN  = GRID TIME

![Graph showing frequency response data with coordinates X, Y, Z over time.](image-url)
FREQUENCY RESPONSE TEST 3

FREQUENCY = 6.00 Hz

INERTIAL TABLE COORDINATES: X = 88.16 IN Y = .00 IN Z = .00 IN

TIME - 11 HAS 29 MIN - GRID TIME

TEST DATE 3/08/74
FREQUENCY RESPONSE TEST 3

FREQUENCY = 7.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 in  Y = .00 in  Z = .00 in
TIME = 11 HRS 29 MIN + GRID TIME

Y = 0.00 IN
Z = 0.00 IN

0.00
0.04
0.08
0.12
-0.02
-0.06
-0.10

0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
SECONDS
FREQUENCY RESPONSE TEST 3

FREQUENCY = 7.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 in Y = .00 in Z = .00 in
TIME = 11 HRS 29 MIN - GRID TIME
FREQUENCY RESPONSE TEST 3

INERTIAL TABLE COORDINATES: X = 39.16 IN Y = .00 IN Z = .00 IN

TEST DATE 3/08/74

FREQUENCY = 7.00 Hz

TIME = 11 HRS 29 MIN 00 SEC TIME
FREQUENCY RESPONSE TEST 3

FREQUENCY = 7.00 Hz
INERTIAL TABLE COORDINATES: X = 0.16 IN  Y = 0.00 IN  Z = 0.00 IN
TIME = 11 HRS 29 MIN + GRID TIME

---

C-36
FREQUENCY RESPONSE TEST 3

FREQUENCY = 7.60 HZ
INERTIAL TABLE COORDINATES: X = 0.16 IN Y = 0.60 IN Z = 0.60 IN

TIME = 11 has 29 MIN + GRID TIME

Graph showing the response of the system with various time and frequency variables.
FREQUENCY RESPONSE TEST 3

FREQUENCY = 6.00 Hz
INERTIAL TABLE COORDINATES: X = .66.16 IN  Y = .30 IN Z = .00 IN
TIME = 11 HRS 28 MIN = GRID TIME

TIME (SECONDS)
FREQUENCY RESPONSE TEST 1

FREQUENCY = 8.60 Hz
INERTIAL TABLE COORDINATES: X = 89.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 29 MIN - GRID TIME

![Graph showing frequency response test results with coordinates X, Y, and Z.]
FREQUENCY RESPONSE TEST 3

INERTIAL TABLE COORDINATES: X = 88.15 IN  Y = .00 IN  Z = .00 IN

FREQUENCY = 8.03 Hz

TEST DATE 3/0B/74

TIME = 11 HRS 29 MIN  GRID TIME

PAGE 118.
FREQUENCY RESPONSE TEST 3
FREQUENCY = 9.000 HZ
INERTIAL TABLE COORDINATES: X = 88.16 IN  Y = .60 IN  Z = .60 IN
TIME = 90 MIN  90 SEC  GRID TIME
FREQUENCY RESPONSE TEST 3

FREQUENCY = 9.02 Hz

INERTIAL TABLE COORDINATES: X = 00.16 IN Y = 00 IN Z = 00 IN

TIME = 11 HRS 29 MIN + GRID TIME

TABLE COMMAND IN INDEXES

-0.06
-0.04
-0.02
-0.02
-0.04
-0.06

47.9 48.1 48.3 48.5 48.7 48.9 49.1 SECONDS
FREQUENCY RESPONSE TEST 3

FREQUENCY = 9.68 HZ
INERTIAL TABLE COORDINATES: X = 89.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 29 MIN + GRID TIME
FREQUENCY RESPONSE TEST 3

FREQUENCY = 9.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 in Y = .00 in Z = .00 in
TIME = 11 hrs 29 min = GRID TIME
FREQUENCY RESPONSE TEST 3

FREQUENCY = 9.00 Hz
INERTIAL TABLE COORDINATES: X = .00 IN Y = .00 IN Z = .00 IN

TIME = 11 HRS 29 MIN = GRID TIME

[Graph showing variations in X, Y, and Z coordinates over time]
FREQUENCY RESPONSE TEST 3

FREQUENCY = 9.20 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN  Y = .00 IN  Z = .00 IN

TIME = 11 HRS 29 MIN = GRID TIME

0.0001
0.0002
0.0003

THETA X RADIAN

0.0001
0.0002

THETA Y RADIAN

0.0001

THETA Z RADIAN

0.0001

07.9 48.1 48.3 48.5 48.7 48.9 49.1
07.9 48.1 48.3 48.5 48.7 48.9 49.1
07.9 48.1 48.3 48.5 48.7 48.9 49.1

C-47
FREQUENCY RESPONSE TEST 3
REFERENCE SENSOR: TAREX
TOTAL CYCLES PROCESSED: 0
FIRST FREQUENCY: 1.00 Hz
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 9.00 Hz WAS 0.100 Hz TO 0.900 Hz

DATE PROCESSED: 09 APR 74
TOTAL PERIOD PROCESSED: 42.45 sec
FREQUENCY INCREMENTS: 1.00 Hz

AMPLITUDE
0.0511
0.0509
0.0507
0.0505
0.0503
0.0501
1 2 3 4 5 6 7 8 9
FREQUENCY IN Hz

PAGE 0
FREQUENCY RESPONSE TEST 3
SENSOR - GDT X - NORMALIZED BY REFERENCE SENSOR - TACGON

TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 Hz
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 9.00 Hz WAS .100 Hz TO .920 Hz

DATE PROCESSED - 09APR74

TOTAL PERIOD PROCESSED = 42.43 Sec
FREQUENCY INCREMENTS = 1.00 Hz
FREQUENCY RESPONSE TEST 3
SENSORS - DELTA, NORMALIZED BY REFERENCE SENSOR - TABCOM
TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 Hz
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO = 9.00 Hz
MAX. 1.00 Hz TO 9.00 Hz

DATE PROCESSED - 09APR74
TOTAL PERIOD PROCESSED = 42.43 SEC
FREQUENCY INCREMENTS = 1.00 Hz

DEGREES

-300 -200 -100 0 100 200

DEGREES

1 2 3 4 5 6 7 8 9

FOURIER TRANSFORM OF FREQUENCY RESPONSE TEST 3

FREQUENCY IN HZ
FREQUENCY RESPONSE TEST 3
SENSOR - DLT 2
NORMALIZED BY REFERENCE SENSOR - TABCOM
TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 HZ
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 9.00 HZ WAS .100 HZ TO .900 HZ

DATE PROCESSED - APR 74
TOTAL PERIOD PROCESSED = 42.43 SEC
FREQUENCY INCREMENTS = 1.00 HZ
FREQUENCY RESPONSE TEST 3
SENSOR - XT-472Z  NORMALIZED BY REFERENCE SENSOR - TABCON
TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 HZ
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 9.00 HZ WAS .100 HZ TO .900 HZ

DATE PROCESSED - 09APR74
TOTAL PERIOD PROCESSED = 42.93 SEC
FREQUENCY INCREMENTS = 1.00 HZ
FREQUENCY RESPONSE TEST 3
SENSOR - YTHETA. NORMALIZED BY REFERENCE SENSOR - TABCOM
TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 Hz
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 9.00 Hz WAS .100 Hz TO .900 Hz
FREQUENCY RESPONSE TEST
SENSOR - ZTHETA  NORMALIZED BY REFERENCE SENSOR - TABCOM
TOTAL CYCLES PROCESSED - 0
FIRST FREQUENCY  - 1.00 Hz
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 9.00 Hz WAS .100 Hz TO .900 Hz

DATE PROCESSED - 09APR74
TOTAL PERIOD PROCESSED - 42.93 SEC
FREQUENCY INCREMENTS - 1.00 Hz

DECIBELS

PHASE ANGLE IN DEGREES

FREQUENCY IN HZ
APPENDIX D

TEST NO. 4 X-AXIS
# DOTS Frequency Response Test

**Summary of Input Inertial Conditions and Transform Matrix**

### Frequency Response Test

**Test Date:** 3/08/74

<table>
<thead>
<tr>
<th>Actuator</th>
<th>Servo Table Swivel Joints</th>
<th>Floor Swivel Joints</th>
<th>Components of Actuator</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X: 0.000 Y: 95.599 Z: 9.599</td>
<td>X: 215.910 Y: -68.311 Z: 123.170</td>
<td>X: -120.774 Y: 89.413 Z: -78.672</td>
<td>166.427</td>
</tr>
</tbody>
</table>

### Transform Matrix

\[
\begin{bmatrix}
-0.227398 & -0.229422 & 0.228266 & 0.228741 & 0.228741 & 0.225100 \\
-0.447120 & -0.448626 & 0.449077 & 0.449777 & 0.449777 & 0.225100 \\
-0.498202 & -0.498202 & 0.498202 & 0.498202 & 0.498202 & 0.225100 \\
-0.550173 & -0.550173 & 0.550173 & 0.550173 & 0.550173 & 0.225100 \\
-0.648215 & -0.648215 & 0.648215 & 0.648215 & 0.648215 & 0.225100 \\
-0.797190 & -0.797190 & 0.797190 & 0.797190 & 0.797190 & 0.225100 \\
\end{bmatrix}
\]

*Reproducibility of the original page is poor*
FREQUENCY RESPONSE TEST 4

FREQUENCY = 1.00 Hz

INERTIAL TABLE COORDINATES: X = 68.16 IN  Y = .00 IN  Z = .00 IN
TIME = 11 HRS 99 MIN  GRID TIME

TEST DATE 3/5/74

FREQUENCY RESPONSE

TABLE COMMAND IN INCHES

50 52 54 56 58 60

SECONDS

-0.06 -0.04 -0.02 0.00 0.02 0.04 0.06
FREQUENCY RESPONSE TEST 4
FREQUENCY = 1.00 Hz
INERTIAL TABLE COORDINATES: X = 80.46 IN, Y = .05 IN, Z = .05 IN
TIME = IT HAS 30 MIN + GRID TIME

[Graph showing frequency response data with various measurements and coordinates]
FREQUENCY RESPONSE TEST 4
FREQUENCY = 1.00 HF
INERTIAL TABLE COORDINATES: X = 60.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 38 MIN = GRID TIME

---

D-5
FREQUENCY RESPONSE TEST

FREQUENCY = 1.00 HZ
INERTIAL TABLE COORDINATES: X = 60.16 IN Y = .00 IN Z = .50 IN

TEST DATE 3/08/74

TIME = 11 HRS 39 MIN + OHD TIME

0.07
0.05
0.03
0.01
0.01
-0.03
-0.05
50 52 54 56 58 60

0.009
-0.01
-0.012
-0.014
-0.016
-0.018
50 52 54 56 58 60

0.002
-0.004
-0.006
-0.008
-0.01
-0.012
-0.014
-0.016
50 52 54 56 58 60

SECONDS

PAGE 4.
FREQUENCY RESPONSE TEST 4

FREQUENCY = 1.00 Hz

INERTIAL TABLE COORDINATES: X = 68.46 IN  Y = .00 IN  Z = .00 IN

TIME = 11 HRS 29 MIN  GAID TIME
FREQUENCY RESPONSE TEST 4

FREQUENCY  =  2.00 HZ
INERTIAL TABLE COORDINATES: X = 0.00 IN  Y = 0.00 IN  Z = 0.05 IN
TIME = 11 HRS 42 MIN  GRID TIME

<table>
<thead>
<tr>
<th>TABLE COMMAND</th>
<th>SECONDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.06</td>
<td>1</td>
</tr>
<tr>
<td>0.04</td>
<td>2</td>
</tr>
<tr>
<td>0.02</td>
<td>3</td>
</tr>
<tr>
<td>0.00</td>
<td>4</td>
</tr>
<tr>
<td>-0.02</td>
<td>5</td>
</tr>
<tr>
<td>-0.04</td>
<td>6</td>
</tr>
<tr>
<td>-0.06</td>
<td>7</td>
</tr>
<tr>
<td>-0.04</td>
<td>8</td>
</tr>
</tbody>
</table>
FREQUENCY RESPONSE TEST 4

FREQUENCY = 2.00 Hz
INERTIAL TABLE COORDINATES: X = 0.16 IN  Y = 0.00 IN  Z = 0.00 IN
TIME = 11 HRS 40 MIN  = GAIT TIME

TEST DATE 3/08/74

--- Chart as a graphic representation of data with labeled axes and values, showing frequency response analysis.---
FREQUENCY RESPONSE TEST 4
FREQUENCY = 2.00 HZ
INERTIAL TABLE COORDINATES: X = 88.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 40 MIN GRID TIME

PAGE 10
FREQUENCY RESPONSE TEST 4
FREQUENCY = 0.60 Hz
INERTIAL TABLE COORDINATE: X = 88.16 IN, Y = 0.60 IN, Z = 0.50 IN
TIME = 11 HRS 40 MIN, GRID TIME

<table>
<thead>
<tr>
<th>DELTA X INCHES</th>
<th>DELTA Y INCHES</th>
<th>DELTA Z INCHES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.07</td>
<td>0.05</td>
<td>0.03</td>
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<td>0.03</td>
<td>0.01</td>
<td>0.01</td>
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<td>0.00</td>
<td>0.00</td>
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<tr>
<td>-0.01</td>
<td>-0.03</td>
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<tr>
<td>-0.05</td>
<td>-0.05</td>
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</tr>
<tr>
<td>-0.028</td>
<td>-0.012</td>
<td>-0.016</td>
</tr>
<tr>
<td>-0.016</td>
<td>-0.014</td>
<td>-0.018</td>
</tr>
<tr>
<td>-0.02</td>
<td>-0.01</td>
<td>0.00</td>
</tr>
<tr>
<td>-0.002</td>
<td>-0.004</td>
<td>-0.006</td>
</tr>
<tr>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

SECONDS | PAGE 19.
3        | 4        | 5        | 6        | 7        | 8        |
FREQUENCY RESPONSE TEST
FREQUENCY = 2.00 Hz
INERTIAL TABLE COORDINATES: X = 0.16 IN Y = 0.00 IN Z = 0.00 IN
TIME = 11 HRS 46 MIN + GRID TIME

0.0001
0.0001

THETA X RADIAN

THETA Y RADIAN

THETA Z RADIAN

SECONDS
FREQUENCY RESPONSE TEST

FREQUENCY = 3.00 HZ
TEST DATE 3/9/74
INERTIAL TABLE COORDINATES: X = 0.16 IN, Y = 0.00 IN, Z = .00 IN
TIME = 11 HRS 46 MIN + GRID TIME

TABLE COMMAND IN INCHES

-0.06
-0.04
-0.02
0
0.02
0.04
0.06

9.75 10.25 10.75 11.25 11.75 12.25 12.75 13.25 SECONDS
FREQUENCY RESPONSE TEST 4
FREQUENCY = 3.00 Hz
INERTIAL TABLE COORDINATES: X = 68.16 IN Y = .20 IN Z = .00 IN
TIME = 11 HRS 49 MIN * GRID TIME

D-14
FREQUENCY RESPONSE TEST 4

FREQUENCY = 3.00 Hz
INERTIAL TABLE COORDINATES: X = 98.16 IN  Y = .05 IN  Z = .05 IN
TIME = 11 HRS 40 MIN = GRID TIME

TEST DATE 3/08/74
FREQUENCY RESPONSE TEST

TEST DATE 3/08/76

FREQUENCY = 3.00 HZ

INERTIAL TABLE COORDINATES: X = 60.16 IN Y = .03 IN Z = .00 IN

TIME = 11 HRS 46 MIN GRID TIME
FREQUENCY RESPONSE TEST 4

FREQUENCY = 3.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 in  Y = .00 in  Z = .00 in
TIME = 11 HRS 46 MIN + GRID TIME

THEA X RADIANS

THEA Y RADIANS

THEA Z RADIANS

SECONDS
FREQUENCY RESPONSE TEST 4

FREQUENCY = 4.00 Hz

INERTIAL TABLE COORDINATES: X = 88.16 IN  Y = .00 IN  Z = .60 IN

TEST DATE 3/28/74

TIME = 11 HRS 40 MIN - GRID TIME

GRAPH OF TABLE COMMAND IN INCHES VS SECONDS

-0.08  -0.06  -0.04  -0.02  0  0.02  0.04  0.06

14.5  15  15.5  16  16.5  17
FREQUENCY RESPONSE TEST

FREQUENCY = 4.00 Hz
INERTIAL TABLE COORDINATES: X = 0.16 IN  Y = 0.00 IN  Z = -0.00 IN
TIME = 11 HRS 40 MIN  GRID TIME

TEST DATE 3/08/74
FREQUENCY RESPONSE TEST 4

FREQUENCY = 4.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 in Y = .00 in Z = .00 in
TIME = 11 HRS 49 MIN = GRID TIME

DELTA X IN INCHES

-0.05
0.00
0.05
0.10
-0.15
-0.20
-0.25

14.5 15 15.5 16 16.5 17

DELTA Y IN INCHES

-0.05
-0.10
-0.15
-0.20
-0.25

14.5 15 15.5 16 16.5 17

DELTA Z IN INCHES

-0.05
-0.10
-0.15
-0.20
-0.25

14.5 15 15.5 16 16.5 17

SECONDS
FREQUENCY RESPONSE TEST 4

FREQUENCY = 4.00 Hz
INERTIAL TABLE COORDINATES: x = 0.16 in  y = 0.60 in  z = 0.00 in
TIME = 11 HRS 49 MIN 48.00 IN

TEST DATE 3/28/74

FREQUENCY = 4.00 Hz
INERTIAL TABLE COORDINATES: x = 0.16 in  y = 0.60 in  z = 0.00 in
TIME = 11 HRS 49 MIN 48.00 IN

TEST DATE 3/28/74

FREQUENCY = 4.00 Hz
INERTIAL TABLE COORDINATES: x = 0.16 in  y = 0.60 in  z = 0.00 in
TIME = 11 HRS 49 MIN 48.00 IN

PAGE 50.
FREQUENCY RESPONSE TEST

FREQUENCY = 5.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 in, Y = -0.00 in, Z = 0.00 in
TIME = 11 HRS 40 MIN - GRID TIME

![Graph of frequency response test](image-url)
FREQUENCY RESPONSE TEST 4
FREQUENCY = 5.00 Hz
INERTIAL TABLE COORDINATES: X = 66.16 in Y = .00 in Z = .00 in
TIME = 11 HRS 40 MIN, GRID TIME
FREQUENCY RESPONSE TEST 4
FREQUENCY = 0.02 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN  Y = .00 IN  Z = .00 IN
TIME = 11 HRS 40 MIN  GRID TIME

DELTA X IN INCHES

DELTA Y IN INCHES

DELTA Z IN INCHES

SECONDS
FREQUENCY RESPONSE TEST

FREQUENCY = .02 Hz
INERTIAL TABLE COORDINATES: X = 60.16 in
Y = 6.60 in
Z = 6.60 in
TIME = 11 IN 40 MIN.

PAGE 87.
FREQUENCY RESPONSE TEST

FREQUENCY = 6.00 Hz
INERTIAL TABLE COORDINATES: X = 08.16 IN  Y = 0.00 IN  Z = 0.00 IN
TIME = 11 HOURS 40 MIN.  GRID TIME

Table command in inches

0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06

11.6 21.2 20.8 21.4 22.0 22.6 23.2 23.8 24.4 25.0 25.6 26.2

SECONDS
FREQUENCY RESPONSE TEST 4

FREQUENCY = 6.00 Hz
INERTIAL TABLE COORDINATES: X = 0.10 IN  Y = 0.60 IN  Z = 0.60 IN
TIME = 11 HRS 45 MIN + GRID TIME
FREQUENCY RESPONSE TEST

FREQUENCY = 6.10 HZ
INERTIAL TABLE COORDINATES: X = 89.15 IN Y = 0.00 IN Z = 0.00 IN

TIME = 11 HRS 40 MIN GRID TIME

Delta X IN INCHES

Delta Y IN INCHES

Delta Z IN INCHES

20.8 21.2 21.6 22.0 22.4 22.8

Delta X IN INCHES

Delta Y IN INCHES

Delta Z IN INCHES

20.8 21.2 21.6 22.0 22.4 22.8
FREQUENCY RESPONSE TEST

FREQUENCY = 6.00 HZ
INERTIAL TABLE COORDINATES: X = 80.16 IN Y = .63 IN Z = .63 IN
TIME = 11 MIN 40 SEC GRID TIME

\[ \begin{array}{c}
\text{THEIA X RADIANES} \\
\text{THEIA Y RADIANES} \\
\text{THEIA Z RADIANES}
\end{array} \]
FREQUENCY RESPONSE TEST

FREQUENCY = 7.00 Hz

INERTIAL TABLE COORDINATES: X = 00.00 IN  Y = .00 IN  Z = .00 IN

TIME = 11 HRS 46 MIN 46 GRD TIME

GRAPHIC REPRESENTATION OF THE FREQUENCY RESPONSE TEST DATA.
FREQUENCY RESPONSE TEST 4

FREQUENCY = 7.00 Hz
INERTIAL TABLE COORDINATES: X = 0.15 in Y = 0.00 in Z = 0.30 in

TIME = 11 HRS 40 MIN - GRID TIME
FREQUENCY RESPONSE TEST

FREQUENCY = 7.63 Hz
INERTIAL TABLE COORDINATES: X = 00.16 IN  Y = .00 IN  Z = .00 IN
TIME = 11 HRS 40 MIN = GRID TIME

[Graph of frequency response test data with grid and axes]
FREQUENCY RESPONSE TEST 4

FREQUENCY = 7.00 Hz

INERTIAL TABLE COORDINATES: X = 00.16 IN  Y = .00 IN  Z = .00 IN

TIME = 11 hrs 40 min + GRID TIME
FREQUENCY RESPONSE TEST 4

FREQUENCY = 7.00 Hz

INERTIAL TABLE COORDINATES: X = 88.16 IN  Y = .06 IN  Z = .00 IN

TIME = 11 Hrs 40 Min + GRID TIME
FREQUENCY RESPONSE TEST

FREQUENCY = 8.00 Hz

TEST DATE 3/CR/74

INERTIAL TABLE COORDINATES: X = BB.16 IN, Y = .00 IN, Z = .00 IN

TIME = 11 HRS 40 MIN, GRIP TIME

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR
FREQUENCY RESPONSE TEST 4

FREQUENCY = 8.03 MZ
INERTIAL TABLE COORDINATES: X = 89.16 IN  Y = .02 IN  Z = .02 IN
TIME = 11 HRS 40 MIN + GRID TIME

TEST DATE 3/06/74

D-40
FREQUENCY RESPONSE TEST 4
FREQUENCY = 8.00 Hz
INERTIAL BASE COORDINATES: X = 80.10 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 49 MIN GRID TIME

![Graphical Data]
FREQUENCY RESPONSE TEST 4

FREQUENCY = 8.00 Hz
INERTIAL TABLE COORDINATES: X = 60.16 in  Y = .00 in  Z = .00 in

TEST DATE 3/08/74
TIME = 11 HRS 45 MIN
GRID TIME

[Graph showing frequency response test data with X, Y, and Z coordinates plotted against seconds.]
FREQUENCY RESPONSE TEST

FREQUENCY = 9.00 Hz
INERTIAL TABLE COORDINATES: X = 88.16 IN, Y = .00 IN, Z = .00 IN
TIME = 11 HRS 40 MIN + GRID TIME

TEST DATE 3/20/74
FREQUENCY RESPONSE TEST 4

FREQUENCY = 9.00 Hz

INERTIAL TABLE COORDINATES:

X = 80.16 IN
Y = 0.0 IN
Z = 0.0 IN

TIME = 11 HRS 40 MIN * GRID TIME

Grd time: 168.44

168.46
168.45
168.44
168.43
168.42
168.41
168.40
168.39
168.38
168.37
27.1
27.3
27.5
27.7
27.9
28.1
28.3

167.99
167.98
167.97
167.96
167.95
167.94
167.93
167.92
27.1
27.3
27.5
27.7
27.9
28.1
28.3

167.86
167.85
167.84
167.83
167.82
167.81
167.80
167.79
27.1
27.3
27.5
27.7
27.9
28.1
28.3

167.00
166.99
166.98
166.97
166.96
166.95
166.94
166.93
27.1
27.3
27.5
27.7
27.9
28.1
28.3

166.00
165.99
165.98
165.97
165.96
165.95
165.94
165.93
27.1
27.3
27.5
27.7
27.9
28.1
28.3

160.00
159.99
159.98
159.97
159.96
159.95
159.94
159.93
27.1
27.3
27.5
27.7
27.9
28.1
28.3

150.00
149.99
149.98
149.97
149.96
149.95
149.94
149.93
27.1
27.3
27.5
27.7
27.9
28.1
28.3

PAGE 13 of
FREQUENCY RESPONSE TEST 4

FREQUENCY = 9.00 HZ

INERTIAL TABLE COORDINATES: X = 98.16 IN Y = .00 IN Z = .00 IN

TIME = 11 HRS 40 MIN + GRID TIME

167.67 167.66 167.65 167.64 167.63 167.62 167.61 167.60 167.59
168.1 168.2 168.3 168.4 168.5 168.6 168.7 168.8 168.9 169.0
169.1 169.2 169.3 169.4 169.5 169.6 169.7 169.8 169.9 170.0
170.1 170.2 170.3 170.4 170.5 170.6 170.7 170.8 170.9 171.0

27.1 27.3 27.5 27.7 27.9 28.1 28.3

SECONDS

PAGE 15.
FREQUENCY RESPONSE TEST 4
FREQUENCY = 9.60 Hz
INERTIAL TABLE COORDINATES: X = 66.16 IN Y = .00 IN Z = .00 IN
TIME = 11 HRS 40 MIN + GRID TIME

Graph showing frequency response with X, Y, Z coordinates.
FREQUENCY RESPONSE TEST

TEST DATE: 1/29/74

FREQUENCY = 10.00 Hz

INERTIAL TABLE COORDINATES: X = 66.16 in, Y = 0.00 in, Z = 0.00 in

TIME = 11 HRS 40 MIN = GRID TIME

INCHES

SECOND

D-48
FREQUENCY RESPONSE TEST 4

FREQUENCY = 10.00 Hz
INERTIAL TABLE COORDINATES: x = 89.16 IN
y = 6.00 IN
z = 62.00 IN

TIME = 11 HRS 40 MIN • GRID TIME

---

D-49
FREQUENCY RESPONSE TEST

Frequency: 10.00 Hz
Inertial Table Coordinates: X = 60.16 in, Y = .00 in, Z = .00 in
Time: 11 hrs 49 min + Grid Time

29.7
29.5
29.3
29.1
28.9
28.7
28.5
28.3
28.1
27.9
27.7
27.5
27.3
27.1
26.9
26.7
26.5
26.3
26.1
25.9
25.7
25.5
25.3
25.1
24.9
24.7
24.5
24.3
24.1
23.9
23.7
23.5
23.3
23.1
22.9
22.7
22.5
22.3
22.1
21.9
21.7
21.5
21.3
21.1
20.9
20.7
20.5
20.3
20.1
19.9
19.7
19.5
19.3
19.1
18.9
18.7
18.5
18.3
18.1
17.9
17.7
17.5
17.3
17.1
16.9
16.7
16.5
16.3
16.1
15.9
15.7
15.5
15.3
15.1
14.9
14.7
14.5
14.3
14.1
13.9
13.7
13.5
13.3
13.1
12.9
12.7
12.5
12.3
12.1
11.9
11.7
11.5
11.3
11.1
10.9
10.7
10.5
10.3
10.1
9.9
9.7
9.5
9.3
9.1
8.9
8.7
8.5
8.3
8.1
7.9
7.7
7.5
7.3
7.1
6.9
6.7
6.5
6.3
6.1
5.9
5.7
5.5
5.3
5.1
4.9
4.7
4.5
4.3
4.1
3.9
3.7
3.5
3.3
3.1
2.9
2.7
2.5
2.3
2.1
1.9
1.7
1.5
1.3
1.1
0.9
0.7
0.5
0.3
0.1
0
-0.1
-0.3
-0.5
-0.7
-0.9
-1.1
-1.3
-1.5
-1.7
-1.9
-2.1
-2.3
-2.5
-2.7
-2.9
-3.1
-3.3
-3.5
-3.7
-3.9
-4.1
-4.3
-4.5
-4.7
-4.9
-5.1
-5.3
-5.5
-5.7
-5.9
-6.1
-6.3
-6.5
-6.7
-6.9
-7.1
-7.3
-7.5
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-7.9
-8.1
-8.3
-8.5
-8.7
-8.9
-9.1
-9.3
-9.5
-9.7
-9.9
-10.1
-10.3
-10.5
-10.7
-10.9
-11.1
-11.3
-11.5
-11.7
-11.9
-12.1
-12.3
-12.5
-12.7
-12.9
-13.1
-13.3
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-14.1
-14.3
-14.5
-14.7
-14.9
-15.1
-15.3
-15.5
-15.7
-15.9
-16.1
-16.3
-16.5
-16.7
-16.9
-17.1
-17.3
-17.5
-17.7
-17.9
-18.1
-18.3
-18.5
-18.7
-18.9
-19.1
-19.3
-19.5
-19.7
-19.9
-20.1
-20.3
-20.5
-20.7
-20.9
-21.1
-21.3
-21.5
-21.7
-21.9
-22.1
-22.3
-22.5
-22.7
-22.9
-23.1
-23.3
-23.5
-23.7
-23.9
-24.1
-24.3
-24.5
-24.7
-24.9
-25.1
-25.3
-25.5
-25.7
-25.9
-26.1
-26.3
-26.5
-26.7
-26.9
-27.1
-27.3
-27.5
-27.7
-27.9
-28.1
-28.3
-28.5
-28.7
-28.9
-29.1
-29.3
-29.5
-29.7
Page 152
FREQUENCY RESPONSE TEST

Frequency = 11.00 Hz
Inertial Table Coordinates: X = 69.16 IN Y = .09 IN Z = .06 IN
Time = 11 HRS 40 MIN + GRID TIME

Graph showing motion in inches over time.
FREQUENCY RESPONSE TEST 4

FREQUENCY = 11.00 Hz
INERTIAL TABLE COORDINATES: X = .60 IN  Y = .00 IN  Z = .30 IN

TIME = 1 HR 40 MIN 01 RD

TEST DATE 3/09/74

D-55
FREQUENCY RESPONSE TEST 4

FREQUENCY = 11.00 Hz
INERTIAL TABLE COORDINATES: X = 60.16 IN  Y = 0.00 IN  Z = 0.00 IN

TIME = 11 HRS 40 MIN  GRID TIME

D-56
FREQUENCY RESPONSE TEST 4
FREQUENCY = 11.52 Hz
INERTIAL TABLE COORDINATES: X = 0.15 in Y = .00 in Z = .00 in
TIME = 11 hrs 46 min + GRID TIME

--- Graphs showing theta x and theta y over time in radians. ---
FREQUENCY RESPONSE TEST
REFERENCE SENSOR - TABCOM
TOTAL CYCLES PROCESSED - 0
FIRST FREQUENCY - 1.0 Hz
BANDWIDTH RANGE FOR FREQUENCY INTERVAL 0.05 Hz TO 1.10 Hz WAS 0.10 Hz TO 1.10 Hz

DATE PROCESSED - 09APR74
TOTAL PERIOD PROCESSED - 45.30 SEC
FREQUENCY INCREMENTS - 1.00 Hz

AMPLITUDE

0.0503
0.0505
0.0507
0.0509
0.0511
0.0513

FREQUENCY IN Hz

1 2 3 4 5 6 7 8 9 10 11
FREQUENCY RESPONSE TEST
SENSOR - DELT X  NORMALIZED BY REFERENCE SENSOR - TARCON
TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 Hz
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 11.00 Hz WAS .100 Hz TO 1.100 Hz

DATE PROCESSED - 09 APR 74
TOTAL PERIOD PROCESSED = 45.30 SEC
FREQUENCY INCREMENTS = 1.00 Hz
FREQUENCY RESPONSE TEST

SENSOR - DLY NORMIALIZED BY REFERENCE SENSOR - TANSOHM
TOTAL CYCLES Processed = 0
FIRST FREQUENCY = 4.00 Hz
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 11.00 Hz WAS 0.00 Hz TO 1.00 Hz

DATE Processed - 09437
FREQUENCY RESPONSE TEST 4
SENSOR - DELT 2, NORMALIZED BY REFERENCE SENSOR - TABCOM
TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 Hz
BANDWIDTH RANGE FOR FREQUENCY INTERVAL 0 TO 11.00 Hz WAS .100 Hz TO 1.100 Hz

DATE PROCESSED = 09APR74
TOTAL PERIOD PROCESSED = 45.30 SEC
FREQUENCY INTERVALS = 1.00 Hz

DEGREES DEGREES DEGREES

FREQUENCY IN Hz
FREQUENCY RESPONSE TEST

SENSOR - XTHETA NORMALIZED BY REFERENCE SENSOR - XTHCM
TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 Hz
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 11.00 Hz was .100 Hz to 1.100 Hz

DATE PROCESSED - 29APR76

TOTAL PERIOD PROCESSED = 45.30 SEC
FREQUENCY INCREMENTS = 1.00 Hz

DEGIBELS vs FREQUENCY IN Hz

PHASE ANGLE IN DEGREES vs FREQUENCY IN Hz
FREQUENCY RESPONSE TEST

SENSOR = THETA
NORMALIZED BY REFERENCE SENSOR = TABCON
TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 Hz
RANGE WIDTH FOR FREQUENCY INTERVAL TO 11.00 Hz WAS 0.100 Hz TO 1.100 Hz

TOTAL CYCLES PROCESSED = 0
TOTAL PERIOD PROCESSED = 45.30 sec
FREQUENCY INCREMENTS = 1.00 Hz

DECIBELS

PHASE ANGLE IN DEGREES

FREQUENCY IN Hz

PAGE 5.
FREQUENCY RESPONSE TEST
SENSOR = ZTHETA NORMALIZED BY REFERENCE SENSOR = TABCOM
TOTAL CYCLES PROCESSED = 0
FIRST FREQUENCY = 1.00 Hz
BANDWIDTH RANGE FOR FREQUENCY INTERVAL TO 11.00 Hz HAS .100 Hz TO 1.100 Hz

DATE PROCESSED - 09APR74
TOTAL PERIOD PROCESSED = 45.30 SEC
FREQUENCY INCREMENTS = 1.63 Hz