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147830

ACCEPTANCE TEST PROCEDURE
FOR
SHUTTLE ACTUATORS SIMULATOR
(ELEVON SUBSYSTEM)

Job Order 35-479

(NASA-CR-147830) ACCEPTANCE TEST PROCEDURE FOR SHUTTLE ACTUATORS SIMULATOR (ELEVON SUBSYSTEM) (Lockheed Electronics Co.) 224 p HC $7.75 CSCL 14B

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Aerospace Systems Division
Houston, Texas

Contract NAS 9-12200

For

CONTROL SYSTEMS DEVELOPMENT DIVISION

National Aeronautics and Space Administration
LYNDON B. JOHNSON SPACE CENTER
Houston, Texas

April 1976

LEC-8124

JSC-11095

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FOR
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Job Order 35-479

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TECHNICAL REPORT INDEX/ABSTRACT
(See instructions on reverse side.)

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13. ABSTRACT

14. SUBJECT TERMS

Elevon	Shuttle Actuator Simulator	
SAIL		
Shuttle		

JSC Form 833 (Rev Sep 74) NASA-JSC

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Appendix

TABLES

FIGURES

ABBREVIATIONS, ACRONYMS, AND SYMBOLS LIST

amps	amperes
ASA	Aerosurface Amplifier
ASD	Aerospace Systems Division
ATP	acceptance test procedure
CCW	counter clockwise
CH	channel
CMOS	complementary metal oxide semiconductor
CMRR	common mode rejection ratio
COM	common
CW	clockwise
dB	decibel
dc	direct current
deg	degree
deg/sec	degree per second
DN	down
DVM	digital voltmeter
F	Fahrenheit
FET	field-effective transistor
Hg	mercury
Hz	hertz
IC	initial condition
in	inches
in-lb	inch-pound
in/sec	inches per second

in/sec^2	inches per second per second
ISO	isolation
kΩ	kilohm
lb	pound
LEC	Lockheed Electronics Company, Inc.
mA	milliampere
max or MAX	maximum
min or MIN	minimum
mm/sec	millimeters per second
mV	millivolt
NA	not applicable
PN	part number
p-p	peak-to-peak
p-p/in	peak-to-peak per inch
PS	power supply
psi or PSI	pounds per square inch
psia or PSIA	pounds per square inch, absolute
psid or PSID	pounds per square inch, differential
psig or PSIG	pounds per square inch, gauge
QA	quality assurance
rad	radians
ref or REF	reference
rms or RMS	root mean square
R&QA	Reliability and Quality Assurance
R/SD	Rockwell/Space Division
SAIL	Shuttle Avionics Integration Laboratory

SAS	Shuttle Actuator Simulator
sec	second
SIS	Simulator Interface Subsystem
STE	special test equipment
TBS	to be supplied
TOC	Test Operations Center
TTL	transistor-transistor logic
UUT	unit under test
V	volt
VDS	vehicle dynamic simulation
VOM	volt-ohm meter
$<$	less than
$>$	greater than
$=$	equals
$\pm$	plus or minus
ΔP	differential pressure

1. SCOPE

This document describes the acceptance test procedure for the Lockheed Electronics Elevon Servoactuator Simulator to be used in the Shuttle Avionics Integration Laboratory (SAIL). The intent of this acceptance test procedure is to comply with the technical requirements detailed in JSC-10620 (NASA/JSC) *Shuttle Actuators Simulator Requirements*. Acceptance tests will be performed on each Elevon Servoactuator Simulator.

NOTE: A black bar in the margin of a page indicates the information that has been changed or added since April 1976. The date of revision appears in the lower right or left corner.

2. GENERAL REQUIREMENTS

2.1 APPLICABLE DOCUMENTS

The following documents in effect on the date of this publication will form a part of this procedure to the extent specified herein. In the event of a conflict between the documents referenced herein and the contents of this acceptance test procedure (ATP), the contents of this ATP will take precedence.

SPECIFICATION

MC621-0014 C4 August 12, 1975	Servoactuator, Elevon, Electro-Command, Hydraulic
ICD-3-1603-03	Interface Control Document, Section 13
SD74-SH-0324A September 1975	Descriptions and Mathematical Models of Aerosurface Actuators
JSC-10620 January 1976	Shuttle Actuators Simulator Requirements
SD75-SH-0248 October 1975	SAIL Aerosurface Actuator Simulator Requirements
392-200-75-340 July 7, 1975	ASA-Elevon Actuator Interface Requirements and Description

In the event of a conflict between the specification documents, the contents of JSC-10620 will take precedence.

STANDARDS

Federal

MIL-STD-12C (2) February 1, 1971	Abbreviations for Use on Drawings, Specification, Standards, and in Technical Documents
JSC-8070	JSC Metrology Requirements Manual
JSCM-5312	Reliability and Quality Assurance Manual

REPORTS/PROCEDURES

Hydraulic Research and Manufacturing Company

HR 73700171 Revision C March 1975	Acceptance Test Procedure for Elevon Servoactuator

DRAWINGS, Lockheed Electronics Company, Inc., ASD

SAS1001	Isolation Valve
SAS1002	Fault Insertion Logic
SAS1003	Transducer Simulator
SAS1004	Servo Valve Interface
SAS1005	Hysteresis
SAS1006	SIS Interface
SAS1007	Power Spool Driver
SAS1008	Power Spool
SAS1009	Hydraulic Supply Simulator
SAS1010	TOC Interface
SAS1011	Dropped Pressure
SAS1012	Load Flow
SAS1013	Ram Actuator Dynamics
SAS1014	Nonlinear Element
SAS1015	Resistor Card

Plus applicable mechanical, wiring, and system drawings

2.2 SPECIAL TEST EQUIPMENT

Acceptance testing will be performed using Special Test Equipment (STE) which is a particular type that has been designed and constructed for testing the Elevon Servoactuator Simulator.

2.2.1 TEST EQUIPMENT SYSTEM

The test equipment system consists of an electronic console, load fixture, and appropriate instrumentation. This is further enumerated in subsequent paragraphs.

2.2.1.1 Electronic Test Console

2.2.1.2 Electronic Instruments

Electronic instruments to be used for measuring all electrical parameters will be as described in subsequent paragraphs.

2.2.2 MEASURES AND CALIBRATION

All instrumentation used to perform the tests herein will be maintained in a current state of calibration by JSC's metrology laboratory.

2.2.3 INSTRUMENTATION ACCURACY

Instrumentation accuracy will be one-tenth of the tolerance specified for the parameter.

2.3 TEST TOLERANCES AND CONDITIONS

The test tolerances and conditions for acceptance testing are in accordance with MC621-0014, and unless specified herein, will be:

Relative humidity	50 percent ± 30 percent
Ambient temperature	+73° ± 18°F
Ambient pressure	28.5 $\pm^{2}_{4}$ inches of Hg
AC supply voltage	±2 percent of nominal

2.4 TEST FAILURE AND REPORTING

2.4.1 GENERAL REQUIREMENTS

Any test that results in the following will be reported in accordance with section 2.4.2:

(a) Tests that result in catastrophic failure

(b) Test results that deviate from requirements JSC-10620 parameters

(c) Any test deemed by the cognizant test personnel as indicating a failure. See exception, paragraphs 2.4.1.1 and 2.4.1.2.

2.4.1.1 Exception

For a test anomaly that results from improper test technique or test apparatus malfunction, it will be permissible to reconduct, under improved conditions and without failure connotation, that specific test sequence in which the anomaly occurred.

2.4.1.2 Parts Failure and Replacement for Deliverable Items

Disassembly of the unit for parts maintenance or replacement is permissible during testing under the following conditions:

(a) In the event of a failure resulting from defective material, workmanship, or assembly, it will be permissible to replace the defective part of the assembly. In case of such replacement, all prior acceptance tests will be reconducted on the replaced unit or parts unless waived by customer.

(b) Subsequent successful acceptance testing of the unit and appropriate corrective action will allow delivery of the unit.

2.4.2 FAILURE REPORTING

Failure reporting will comply with LEC's Manual of Quality Assurance Procedure 6-10. Discrepancies will be reported using JSC Form 2176 and 2176A. Minor discrepant conditions (e.g. workmanship defects), which can be readily corrected without engineering investigation, will be reported using an Inspection Squawk Tag JSC Form 860.

2.4.3 TEST PROCEDURE DEVIATION

2.4.3.1 Scope

Changes in the test plan which become necessary during testing will be approved through use of the Test Procedure Deviation Form. (See figure 2-1.) This form is intended to cover minor

TEST PROCEDURE DEVIATION FORM

LEC report number ______________________________

Paragraph affected ______________________________

Change description ______________________________

____

____

____

____

____

____

Reason for change ______________________________

____

____

____

____

____

____

Initiated by:

____
Test operator
Date ______________________

Elevon engineering:

____
System engineering
Date ______________________

____

____
Manufacturing engineering
Date ______________________

____
Project engineering
Date ______________________

Figure 2-1. — Sample test procedure deviation form.

improvement changes in testing or to correct test anomalies that result from improper test technique or apparatus malfunction.

2.4.3.2 Deviation Procedure

The form will be completed and signed by the authorized personnel per section 2.4.3.3. The forms will be identified in sequential numerical order and filed with the log book. Upon conclusion of testing, the completed forms will be included in the acceptance test package documentation. Three copies of deviations generated during the ATP run will be submitted to EJ7 and two to EG5.

2.4.3.3 Authorized Signatures

A list of approved signatures for signing deviation forms will be compiled and available before testing. The list will indicate cognizant personnel.

2.5 LOG BOOK, ACCEPTANCE TESTS

2.5.1 SCOPE

A log book for acceptance tests will be used as a permanent record book for the Shuttle Actuators Simulator (SAS).

2.5.1.1 General

A complete list of the STE equipment, manuals, calibration records, and maintenance records will be included.

2.5.2 EQUIPMENT

A list of the equipment contained and a copy of the drawing will be available. The list or drawing will include the following descriptive information:

a. Nomenclature (item name)

b. Schematic

c. Assembly

d. Parts list

Equipment will be connected per figure 2-2.

2.5.3 MANUALS

A list of STE manuals will be entered.

2.5.4 MAINTENANCE RECORD

This will contain a record of test equipment failures and corrective action taken. Routine maintenance will be entered. The record also will include:

a. Date

b. Equipment affected

c. Type of work performed

d. Remarks

e. Signature of person making entry

2.5.5 CALIBRATION RECORD

An entry will be made in this section each time a calibration is performed. The entry will include:

a. Date

b. Equipment affected

c. Due date of next calibration

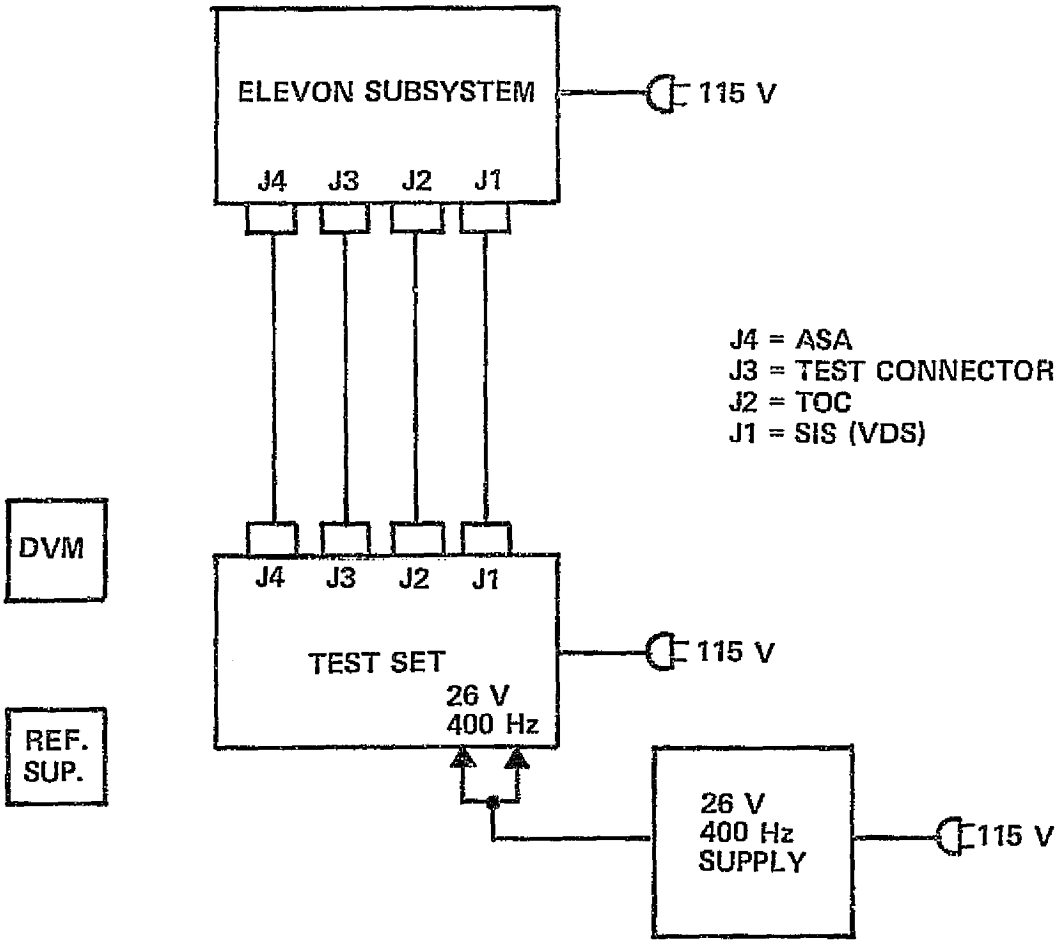
d. Remarks

e. Signature of person making entry

2.6 TEST DATA SHEETS

For a test record, test data sheets will be completed after each test is performed. Data sheets will be provided with each

ELEVON SUBSYSTEM



ACCEPTANCE TEST INTERCONNECT

Figure 2-2. — Equipment connection.

ATP or use generated plots as data sheets. The following information as a minimum will be included in each data sheet:

a. Test identification, Title _____ ATP paragraph number _____

b. System type _______________ Serial number _________________

c. Test engineer

d. Test parameters required (acceptance criterion)

e. Test parameters obtained (actual measurements)

f. Test engineer's comments

2.7 TEST FACILITIES

2.7.1 LOCATION

All acceptance testing will be performed at Lockheed Electronics test facilities.

2.8 TEST SEQUENCE

All tests are to be performed in the preferred sequential order given in this document. See table 2-I for test sequence.

2.9 PREACCEPTANCE EVALUATION

2.9.1 CLEANLINESS

Internal cleanliness control of the SAS will be verified. Cleanliness control is to be verified by review of accompanying processing records for each subassembly.

2.9.2 IDENTIFICATION AND MARKING

Permanent markings will identify all interface connections. Identification will be in accordance with supplied mechanical drawings.

TABLE 2-I. — ACCEPTANCE REQUIREMENTS-SEQUENCE

Inspections and tests	Paragraph
Insulation Resistance	3.7.1
Interface Wiring	3.5
Grounding	3.6
Chassis Power	3.12
Low Pressure	3.4
Subsystem Initialization	3.7.12
Fault Insertion	3.7.11
*Product Examination	3.2
*Stroke Adjustment	3.3
*Performance Record	3.7
*Servo Valve Simulator	3.7.2
*Position Transducer Simulator	3.7.3
*Differential Pressure Transducer Simulator	3.7.4
*Isolation Valve	3.7.5
*Panel Rate - Piston Force	3.7.6
*Accuracy and Velocity Gain	3.7.7
*Friction	3.7.7.3
*Channel Imbalance	3.7.7.4
*Stall Pressure	3.7.7.5
*Frequency Response and Peaking Limit	3.7.8
*Closed Loop Frequency Response	3.7.9
*Closed Loop Transient Response	3.7.10
*Piston Force	3.8
*Power Valve Pressure Gain	3.10
Piston Travel	3.9
Post-test Examination	3.11

*Sequence may be varied for these tests.

2.9.3 ASSEMBLY AND INSPECTION RECORDS

Insure that all applicable records fully document and verify that the specific assembly is ready for acceptance testing before testing begins.

2.10 TEST NOTIFICATION

Before conducting an acceptance test, the SAS engineering organization will notify EG5, EJ7, and Rockwell Space Division that a specific test(s) will be conducted on a specific date. If feasible, 24-hour advance notice will be given. The representative(s) may monitor the tests on a surveillance basis, but test attendance is not mandatory or a requisite for conducting the tests.

2.11 PRETEST CONDITIONS

The following conditions describe the status which prevails for various tests.

2.11.1 CONDITION A

Indicates emergency shutdown because of hazard to personnel or equipment. Actuate main power switch OFF. This turns OFF all equipment and power.

2.11.2 CONDITION C

Normal operation mode

2.11.3 CONDITION E

Low pressure mode

2.11.4 CONDITION S.

Normal shutdown mode.

2.12 TEST MEASUREMENTS

Tables 2-II and 2-III list the signals and their associated scale factors appearing at the test connector. Each of the signals is brought out, on a pin-for-pin basis, to the test fixture front panel. The SIS, TOC, and ASA connectors are also brought to the front panel points on the test fixture. Table 2-IV gives the SIS interface. The TOC interface is shown in table 2-V, and table 2-VI lists the ASA interface.

TABLE 2-II. — TEST CONNECTOR ASSIGNMENTS (INBOARD)

Pin	Signal	Scale factor	Units volts	Pin	Signal	Scale factor	Units volts
1	I1	0.86	mA	31	-10	1.0	V
2	I2	0.86	mA	32	X_{RO} (TOC)	.7320	in
3	I3	0.86	mA	33	R_{ST}	1.0	V
4	I4	0.86	mA	34	TMC CH1 TST	0.860	mA
5	IS01	1.0	V	35	DELETOC	3.65	deg
6	IS02	1.0	V	36	DELEDTOC	10.00	deg/sec
7	IS03	1.0	V	37	Q_L	40.00	in^3/sec
8	IS04	1.0	V	38	IHST1	.86	mA
9	P1	300.	psi	39	IHST2	.86	mA
10	P2	300.	psi	40	IHST3	.86	mA
11	P3	300.	psi	41	IHST4	.86	mA
12	P4	300.	psi	42	HP1	300.	psi
13	ZD	.0065	in	43	HP2	300.	psi
14	ZL	.0001	in	44	HP3	300.	psi
15	IC (Local)*	1.0	V	45	HP4	300.	psi
16	X_{PS}	.0065	in	46	$-P_{SS}$	300.	psi
17	P_V	300.	psi	47	TAERO	1×10^6	in-1b
18	P_S	300.	psi	48	X_{RO}		
19	P_{SS}	300.	psi	49			
20	P_{SP}	300.	psi	50	HPL1	300.	psi
21	P_L	300.	psi	51	HPL2	300.	psi
22	δe (DELE)	3.65	deg	52	HPL3	300.	psi
23	$\dot{\delta} e$ (DELED)	10.0	deg/sec	53	HPL4	300.	psi
24	$\ddot{\delta} e$ (DELEDD)	107.578	deg/sec^2	54			
25	X_{FB}	.7320	in	55			
26	X_{STR}	.7320	in	56			
27	M_R	.1510	in	57			
28	+15	1.0	V	58			
29	-15	1.0	V	59			
30	+10	1.0	V	60			
				61	Ground	—	—

*Input

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TABLE 2-III. — TEST CONNECTOR ASSIGNMENTS (OUTBOARD)

Pin	Signal	Scale factor	Units volts	Pin	Signal	Scale factor	Units volts
1	I1	0.86	mA	31	-10	1.0	V
2	I2	0.86	mA	32	X_{RO}	.4266	in
3	I3	0.86	mA	33	R_{ST}	1.0	V
4	I4	0.86	mA	34	TMC CHI TST	0.860	mA
5	IS01	1.0	V	35	DELETOC	3.65	deg
6	IS02	1.0	V	36	DELEDTOC	10.00	deg/sec
7	IS03	1.0	V	37	Q_L	18.00	in^3/sec
8	IS04	1.0	V	38	IHST1	.86	mA
9	P1	300.	psi	39	IHST2	.86	mA
10	P2	300.	psi	40	IHST3	.86	mA
11	P3	300.	psi	41	IHST4	.86	mA
12	P4	300.	psi	42	HP1	300.	psi
13	ZD	.0065	in	43	HP2	300.	psi
14	ZL	.0001	in	44	HP3	300.	psi
15	IC (Local)*	1.0	V	45	HP4	300.	psi
16	X_{PS}	.0065	in	46	$-P_{SS}$	300.	psi
17	P_V	300.	psi	47	TAERO	5×10^4	in-lb
18	P_S	300.	psi	48			
19	P_{SS}	300.	psi	49			
20	P_{SP}	300.	psi	50	HPL1	300.	psi
21	P_L	300.	psi	51	HPL2	300.	psi
22	δe (DELE)	3.65	deg	52	HPL3	300.	psi
23	$\dot{\delta} e$ (DELED)	10.0	deg/sec	53	HPL4	300.	psi
24	$\ddot{\delta} e$ (DELEDD)	107.578	deg/sec^2	54			
25	X_{FB}	.4266	in	55			
26	X_{STR}	.4266	in	56			
27	M_R	.860	in	57			
28	+15	1.0	V	58			
29	-15	1.0	V	59			
30	+10	1.0	V	60			
				61	Ground	—	—

*Input

TABLE 2-IV. — SIS INTERFACE (J1)

Pin number	Description	Scale factor	
		Inboard	Outboard
1			
2			
3	Position (-) δe	3.65 deg/V	
4	Position (+) δe	3.65 deg/V	
5	Shield		
6			
7			
8	Acceleration (-) $\ddot{\delta} e$	605 deg/sec^2/V	1077 deg/sec^2/V
9	Acceleration (+) $\ddot{\delta} e$	605 deg/sec^2/V	1077 deg/sec^2/V
10	Shield		
11			
12			
13	Hinge moment (-) M_{HE}	1×10^5 in-lb/V	5×10^4 in-lb/V
14	Hinge moment (+) M_{HE}	1×10^5 in-lb/V	5×10^4 in-lb/V
15	Shield		
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			

TABLE 2-V. — TOC INTERFACE (J2)

Pin number	Description	Scale factor
1		
2		
3	Operate	(in) Discrete TTL
4	Operate return	(in) Discrete TTL
5	Start	(in) Discrete TTL
6	Start return	(in) Discrete TTL
7	Shield	
8		
9	Initial condition	(in) 4 V/V (2.5 V = 0)
10	Initial condition return	(in) 4 V/V (2.5 V = 0)
11	Shield	
12		
13	Rate $\dot{\delta}e$	(out) 40 deg/sec/V
14	Rate return $\dot{\delta}e$	(out) 40 deg/sec/V
15	Shield	
16	Position δe	(out) 14.4 deg/V
17	Position return δe	(out) 14.4 deg/V
18	Shield	
19	TMC CH1	(out) 3.44 mA/V
20	TMC CH1	(out) 3.44 mA/V
21	Shield	
22	Fault 1	(in) Discrete TTL
23	Fault 1 return	(in) Discrete TTL
24	Fault 2	(in) Discrete TTL
25	Fault 2 return	(in) Discrete TTL
26		

TABLE 2-VI. — ASA SIMULATOR* — TEST SET

Name	Scale factor	Function
Input	15 mA/V (open loop) 1.427/0.832 in/V	Command input to ASA channel
ΔP_P (output)	487 psi/V	Demodulated load pressure feedback
ΔP_S (output)	487 psi/V	Demodulated secondary pressure feedback
POS_{FB} (output)	1.189 in/V 0.693 in/V	Demodulated position feedback
Isolation switch	N/A	DN = not isolated UP = isolated
ΔP_P switch	N/A	DN = feedback open UP = normal
ΔP_S switch	N/A	DN = feedback open UP = normal
POS_{FB} switch	N/A	DN = feedback open UP = normal
Reset switch	N/A	Push to reset ΔP_S lag circuit

*One of four identical channels on test set

3. ACCEPTANCE TESTS

3.1 SCOPE

Acceptance tests will be performed on all units before delivery to the customer. Specification requirements as described in JSC-10620 will be met to verify acceptable performance.

See table 2-I for a listing of tests and inspections to be performed on the end item delivery unit.

See figure 3-1 for a flow chart diagram which illustrates the test flow from component level to subassembly module level, and through final assembly to the ATP – the test procedure for end item delivery units.

Acceptance tests will be conducted as described in the following manner. The first two tests, Product Examination and Chassis Power, will be performed in that order. All other tests may be conducted in any sequence except that the last two tests will be Piston Travel and Post-test Examination, run in that order.

3.2 PRODUCT EXAMINATION

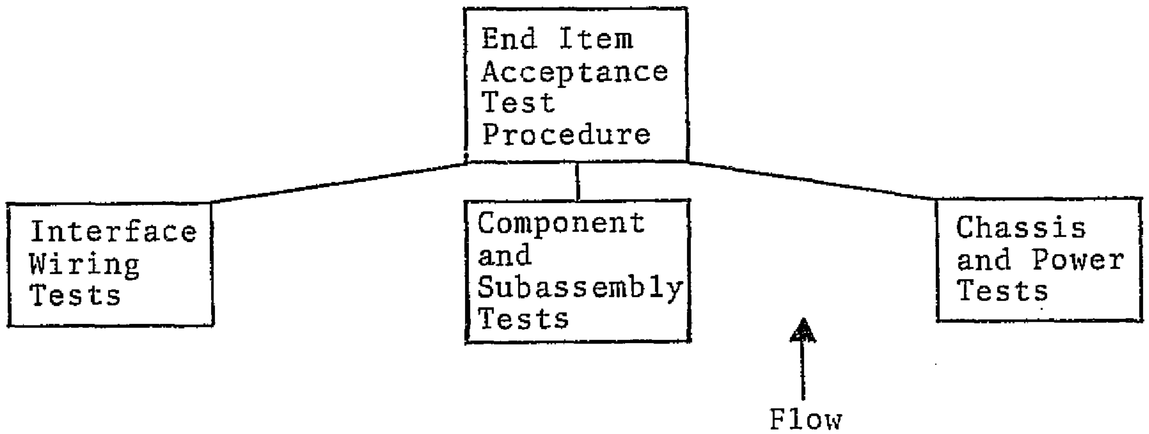
3.2.1 PURPOSE

The purpose of this acceptance test procedure is to verify conformance with paragraph 7.1 of JSC-10620 specification. This includes examination of the unit and review of assembly and inspection records.

3.2.2 TEST METHOD

This procedure will be implemented by performing the following steps:

a. Visually inspect the unit for correct marking and identification.



NOTE: An end item is comprised of 26 subassembly modules. See final assembly parts list to match subassembly modules to end item final assembly.

Figure 3-1. — Flow chart - testing.

b. Review of assembly and inspection records to verify compliance with drawings and specification requirements. This will include workmanship, finish, and cleanliness.

c. Should there be any deficiency, it will be corrected before proceeding to the next test unless waived by Quality Assurance.

d. Insure that LEC-supplied performance data is available for inclusion in the acceptance test data package for the subsystem subassemblies.

3.3 STROKE ADJUSTMENT

3.3.1 PURPOSE

Intent of this test is to demonstrate that the actuator has the correct stroke length. This test, along with others, will verify conformance with MC621-0014 specification, paragraph 4.2.2.9.

3.3.2 OTHER TESTS

Subassembly tests have been performed on the ram dynamics (SAS1013) and nonlinear (SAS1014) modules. This test data will be included in the final acceptance data package.

3.3.3 TEST METHOD

1. Status is Condition C and electric power is ON.
2. System will be open loop, local, operate.
3. Apply 3000 ± 100 psig supply pressure to the servoactuator.
4. Uniformly command the piston to full retract position. Apply normal load.[1] Load is input via SIS connector on test panel.

---

[1] Inboard = 31,450 $\pm_{0}^{2000}$ lbs; outboard = 26,130 $\pm_{0}^{2000}$ lbs.

Revised
May 1976

6. Measure nominal length in full retract position. This dimension will be -7.32 ± .073 inches for inboard and -4.266 ± .043 inches for outboard actuator.

7. Command piston to the mid-stroke position which is equal to electrical null.

8. Measure length in mid-stroke position. This dimension will be 0.0 ± .073 inches for inboard and 0.0 ± .046 inches for outboard actuator.

9. Command piston to full extended position. Apply normal load.[1]

10. Measure nominal length in full extended position. This dimension will be 7.320 ± .073 inches for inboard and 4.266 ± .043 inches for outboard actuator.

11. Valve status is Condition F and electric power is OFF.

3.4 LOW PRESSURE TEST

3.4.1 PURPOSE

The purpose of this acceptance test is to verify that the unit can operate with low pressure. Thus, the elevon servoactuator will demonstrate its operation capability within lower normal operating pressures.

3.4.1.1 Test Method

1. Turn electric power ON and initiate valve status Condition C. Mode is local, operate.

2. Mount 1-8 on extender. Operate switches on boards 1-8 (SAS1009), switch S1-1 to open and S1-2 to not open. Monitor P_{SS} and adjust pot on board to yield 2250 $\pm^{50}_{25}$ psi.

---

[1] Inboard = -31,450 $\pm^{2000}_{0}$ lbs; outboard = -26,130 $\pm^{2000}_{0}$ lbs.

3. Command ram to full extend.

4. Hold this for 1 minute $\pm^{20}_{0}$ seconds.

5. Measure nominal length in full extended position. This dimension will be 7.320 ± 0.03 inches for inboard and 4.266 ± 0.03 inches for outboard actuator.

6. Command ram to full retract.

7. Hold this for 1 minute $\pm^{20}_{0}$ seconds.

8. Measure nominal length in full retract position. This dimension will be -7.32 ± 0.03 inches for inboard and -4.266 ± 0.03 inches for outboard actuator.

9. Reduce pressure to 0 psig by operating S1-2 to open and S1-3 to not open. Place short on external pressure jacks at rear of chassis.

10. Repeat steps 2 through 9 two successive times.

11. There will be no malfunction of the control system.

12. Initiate status F.

3.5 INTERFACE WIRING

3.5.1 PURPOSE

This test procedure verifies that all interface wiring entering or leaving the SAS is properly connected so that no signal polarity reversal can occur. The proper polarity for each signal is based on Interface Control Document ICD-3-1603-03, section 13, Elevon Actuator for the ASA and TOC interfaces. The SIS interface polarities are based on the following conventions:

SIS Interface Cable

Signal (positive lead) - higher pin number of pair
Signal return (negative lead) - lower pin number of pair

SAS Cable(s)

Signal (positive lead) - higher alpha character of pair

Signal return (negative lead) - lower alpha character of pair

3.5.2 TEST METHOD

Each signal entering or leaving the SAS is carried by a shielded and/or twisted wire pair. One member of each pair is designated as the "signal" or positive side. (All signals have names or mnemonics indicating their circuit function.) The second member of each pair is designated as the "signal return" or negative side.

The polarity test will be performed by applying a positive voltage to the signal side and a ground reference to the signal return. The voltage and ground reference will be applied at the interface connectors and measured at the source (or destination) card connector pins as shown in figure 3-3.

NOTE: Remove all PC boards before test. Since this is a polarity test, the meter may be calibrated to the applied nominal +10 V. During testing, correct polarity will be checked. However, any difference between measurements greater than 1 percent may indicate a defective connection or wire. If this occurs, it should be noted and corrected before final acceptance.

The measurements will be made according to table 3-I for each interface connector.

NOTE: Control panel switches must be in the following positions before testing.

Isolation valve channel 1	Down
Isolation valve channel 2	Down
Isolation valve channel 3	Down
Isolation valve channel 4	Down

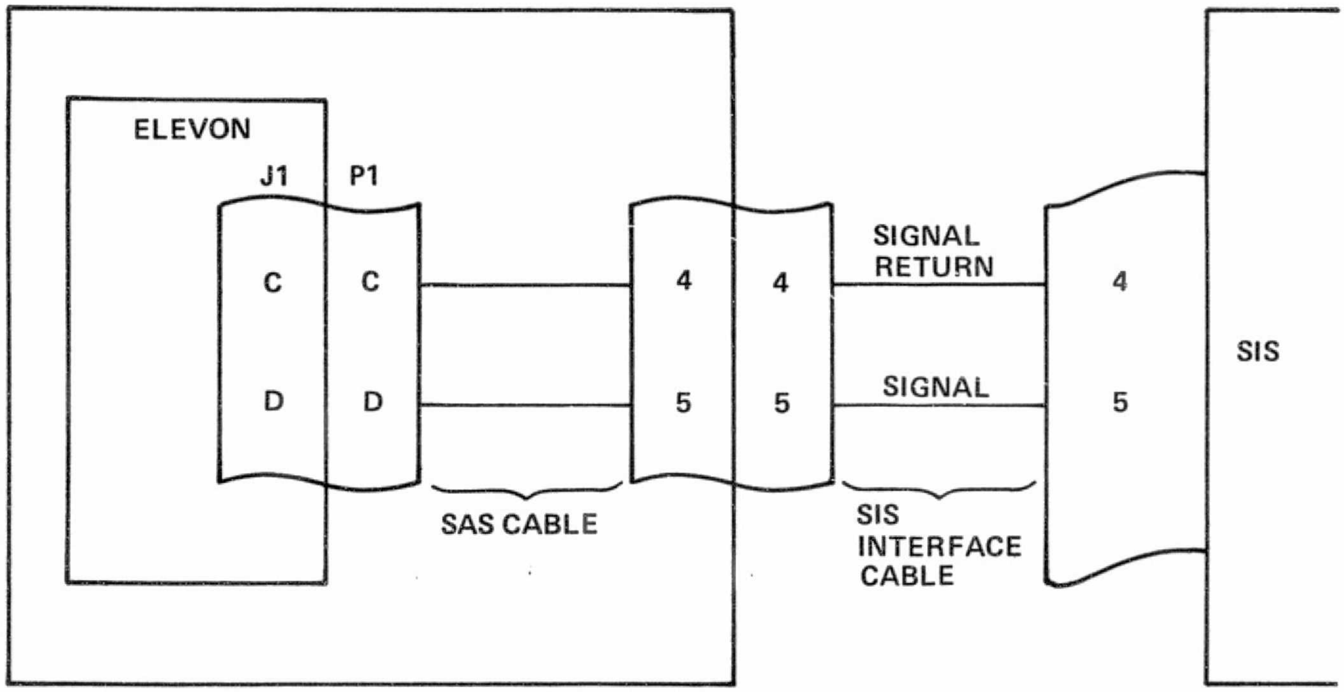


Figure 3-2. – SIS cable group drawing.

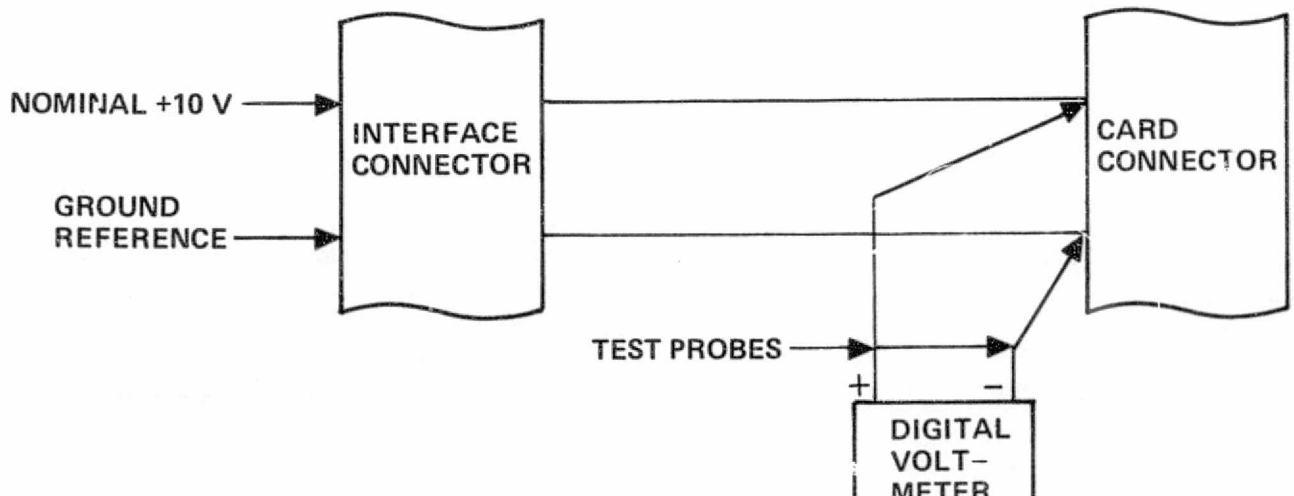


Figure 3-3. – Test setup.

TABLE 3-I. – INTERFACE CONNECTORS

Measurement number	J4 pin: Apply +10 V	J4 pin: Apply ground	SAS/ASA Measure +10 V to signal reference on card connector pin: Measure ~ +10 V	To signal reference	Signal name	✓	Comments
01	J4 - 1	J4 - 2	1-22-B	1-22-1	ΔP SEC CH1		
02	J4 - 4	J4 - 5	1-26-B	1-26-1	PØSITION CH1		
03	J4 - 6	J4 - 7	1-24-B	1-24-1	ΔP PRI CH1		
04	J4 - 8	J4 - 9	1-18-9	1-18-A	SERVØ CH1		
05	J4 - 10	J4 - 11	1-2-1	1-2-5	ISØ CH1		
06	J4 - 12	J4 - 13	1-22-6	1-22-5	26VAC1		
07	J4 - 14	J4 - 15	1-26-6	1-26-5	26VACP1		
08	J4 - 17	J4 - 18	1-22-20	1-22-V	ΔP SEC CH2		
09	J4 - 20	J4 - 21	1-26-20	1-26-V	POSITION CH2		
10	J4 - 22	J4 - 23	1-24-20	1-24-V	ΔP PRI CH2		
11	J4 - 24	J4 - 25	1-18-7	1-18-8	SERVØ CH2		
12	J4 - 26	J4 - 27	1-2-20	1-2-16	ISØ CH2		
13	J4 - 28	J4 - 29	1-22-17	1-22-16	26VAC2		
14	J4 - 30	J4 - 31	1-26-17	1-26-16	26VACP2		
15	J4 - 34	J4 - 35	2-22-B	2-22-1	ΔP SEC CH3		
16	J4 - 37	J4 - 38	2-26-B	2-26-1	POSITION CH3		
17	J4 - 39	J4 - 40	2-24-B	2-24-1	ΔP PRI CH3		
18	J4 - 41	J4 - 42	1-18-15	1-18-X	SERVO CH3		
19	J4 - 43	J4 - 44	2-2-1	2-2-5	ISO CH3		
20	J4 - 45	J4 - 46	2-22-6	2-22-5	26VAC3		
21	J4 - 47	J4 - 48	2-26-6	2-26-5	26VACP3		
22	J4 - 50	J4 - 51	2-22-20	2-22-V	ΔP SEC CH4		
23	J4 - 53	J4 - 54	2-26-20	2-26-V	POSITION CH4		
24	J4 - 55	J4 - 56	2-24-20	2-24-V	ΔP PRI CH4		
25	J4 - 57	J4 - 58	1-18-17	1-18-16	SERVO CH4		
26	J4 - 59	J4 - 60	2-2-20	2-2-16	ISØ CH4		
27	J4 - 61	J4 - 62	2-22-17	2-22-16	26VAC4		
28	J4 - 63	J4 - 64	2-26-17	2-26-16	26VACP4		
			SAS/TØC				J2
29	J2 - C	J2 - D	2-6-16	2-6-15	OPERATE		
30	J2 - E	J2 - F	2-6-17	2-6-18	START		
31	J2 - J	J2 - K	2-6-V	2-6-U	INITIAL CONDITIONS		
32	J2 - N	J2 - P	2-6-8	2-6-7	DEDOT (δe)		
33	J2 - S	J2 - T	2-6-5	2-6-4	DE (δe)		
34	J2 - V	J2 - W	2-6-2	2-6-1	TMC CH1		
35	J2 - Y	J2 - Z	2-4-T	2-4-15	FAULT 1		
36	J2 - a	J2 - b	2-4-9	2-4-8	FAULT 2		
			SAS/SIS				J1
37	J1 - D	J1 - C	1-6-17	1-6-16	POSITION (δe)		
38	J1 - J	J1 - H	1-6-3	1-6-2	ACCELERATION (δe)		
39	J1 - P	J1 - N	1-6-14	1-6-15	TAERO		

3.6 GROUNDING

3.6.1 PURPOSE

Intent of this test is to demonstrate the following: (1) to verify that there is no single conductor for more than one type of return, (2) verify that a dc isolation resistance of 2 megohms minimum exists between separate returns and from returns and chassis ground within the equipment, and (3) verify that the resistance between unpainted chassis and connector shell will not exceed 100 milliohms. Tests will verify conformance with JSC-10620 specification, paragraph 3.1.3.

3.6.2 TEST METHOD

1. Valve status is Condition F and all electric power is OFF.
2. Use insulation resistance in measurements of test (3.7.1) to satisfy items 1 and 2 of 3.6.1.
3. Measure resistance between external chassis and connector shell. Resistance will not exceed 100 milliohms.

3.7 PERFORMANCE RECORD TESTS

Performance record tests will be conducted to verify the capability of the unit to fulfill performance requirements. Performance record tests will be comprised of the following:

3.7.1 Insulation Resistance
3.7.2 Servo Valve Simulator
3.7.3 Position Transducer Simulator
3.7.4 Differential Pressure Transducer Simulator
3.7.5 Isolation Valve
3.7.6 Panel Rate - Piston Force
3.7.7 Accuracy and Velocity Gain
3.7.8 Frequency Response and Peaking Limit
3.7.9 Closed Loop Frequency Response
3.7.10 Closed Loop Transient Response
3.7.11 Fault Insertion
3.7.12 Subsystem Initialization

3.7.1 INSULATION RESISTANCE

3.7.1.1 Purpose

Intent of this acceptance test is to demonstrate the isolation resistance between all isolated signal lines used in the elevon subsystems of the SAS. Isolation resistance will be 10 megohms or greater. Tests will verify conformance with JSC-10620 specification, paragraph 3.1.

3.7.1.2 Test Method

1. Valve status will be Conditon F, and electrical power is OFF and disconnected from the servoactuator.
2. Prepare to measure 10 megohms minimum.
3. Insulation resistance test source current will not exceed 5 milliamperes with its terminals or leads shorted.
4. Remove the following cards before beginning the test.
   a. 1-18, 1-6, 2-6, and 2-4.

5. Connect to required terminals until the resistance value stabilizes.

6. Check continuity between the points as shown in table 3-II. If the resistance is greater than 10 MΩ, continue test. If the resistance is < 10 MΩ, record on data sheet (comments) and discontinue acceptance test after all table 3-II measurements are taken. If all resistance values are greater than 10 megohms, indicate so in comments and continue tests.

NOTE: Shell in table 3-II refers to connector shell.

3.7.2 SERVO VALVE SIMULATOR

3.7.2.1 Exception

Because the servo valves are completely performance tested at the component level, they will not be acceptance tested subsequently at the servoactuator assembly level. This test data will be included in the final acceptance data package.

3.7.3 POSITION TRANSDUCER SIMULATOR

3.7.3.1 Exception

Since the position transducers are completely performance tested at the component level, they will not be acceptance tested subsequently at the servoactuator assembly level. This test data will be included in the final acceptance data package.

3.7.4 DIFFERENTIAL PRESSURE TRANSDUCER SIMULATORS

3.7.4.1 Exception

Because the differential pressure transducers are completely performance tested at the component level, they will not be acceptance tested subsequently at the servoactuator assembly level. This test data will be included in the final acceptance data package.

TABLE 3-II. — INSULATION RESISTANCE

Check continuity			
From	To	From	To
J1-C	J1-P	J1-C	J1-N
J1-C	J1-H	J1-C	J1-J
J1-D	J1-H	J1-D	J1-J
J2-V	J2-S	J2-V	J2-N
J2-N	J2-S	J2-E	J2-C
J2-E	J2-P	J2-C	Shell
J2-K	J2-J	J2-E	J2-K
J2-C	J2-J	J2-C	J2-K
J2-K	Shell	J2-J	Shell
J2-Y	J2-a	J2-Y	Shell
J2-a	Shell	J4-12	J4-28
J4-12	J4-1	J4-12	J4-17
J4-12	Shell	J4-28	J4-1
J4-28	J4-17	J4-28	Shell
J4-1	J4-17	J4-1	Shell
J4-8	J4-24	J4-17	Shell
J4-8	J4-41	J4-8	J4-57
J4-8	Shell	J4-24	J4-41
J4-24	J4-57	J4-24	Shell
J4-41	J4-57	J4-41	Shell
J4-57	Shell	J4-45	J4-61
J4-45	J4-34	J4-45	J4-50
J4-45	Shell	J4-61	J4-34
J4-61	J4-50	J4-61	Shell
J4-34	J4-50	J4-34	Shell
J4-50	Shell	J4-6	J4-22
J4-6	Shell	J4-22	Shell
J4-39	J4-55	J4-39	Shell
J4-55	Shell	J4-4	J4-20

TABLE 3-II. — INSULATION RESISTANCE - Concluded

Check continuity			
From	To	From	To
J4-4	J4-30	J4-4	J4-14
J4-4	Shell	J4-20	J4-30
J4-20	J4-14	J4-20	Shell
J4-30	J4-14	J4-30	Shell
J4-14	Shell	J4-37	J4-53
J4-37	J4-17	J4-37	J4-6
J4-37	Shell	J4-53	J4-17
J4-53	Shell	J4-53	J4-6
J4-17	J4-6	J4-17	Shell
J4-6	Shell	J4-10	J4-26
J4-43	J4-59	J4-43	Shell
J4-10	Shell	J4-26	Shell
J4-59	Shell		

3.7.5 ISOLATION VALVE

3.7.5.1 Purpose

The purpose of this test is to verify operation of the secondary valve isolation circuits per paragraph 3.8.4 of 392-200-75-340 (ASA Interface Requirements).

3.7.5.2 Test Method

1. Valve status is Condition C and electric power is ON, closed loop.
2. Hydraulic supply pressure should be 3000 ± 100 psi.
3. Activate the isolation valve for all four channels.
4. Command the actuator to move ±0.166 inches for outboard and ±0.285 inches for inboard at a sinusoidal rate of 1 Hz.
5. Observe no motion of X_{STR}.
6. Activate the isolation valves for Channels 2, 3, and 4. Channel 1 operational.
7. Repeat step 4.
8. Observe X_{STR} move sinusoidally at a rate of 1 Hz with an amplitude of inches outboard and inches inboard.
9. Activate the isolation valves for Channels 1, 3, and 4. Channel 2 operational.
10. Repeat step 4.
11. Repeat step 8.
12. Activate the isolation valves for Channels 1, 2, and 4. Channel 3 operational.
13. Repeat step 4.
14. Repeat step 8.

15. Activate the isolation valves for Channels 1, 2, and 3. Channel 4 operational.

16. Repeat step 4.

17. Repeat step 8.

3.7.6 PANEL RATE - PISTON FORCE

3.7.6.1 Purpose

Intent of this test is to measure piston velocity and piston force. The test will verify conformance with MC621-0014 specification, paragraphs 4.2.2.6.11 and 4.2.2.7.

3.7.6.2 Test Method

1. Valve status is Condition C and electric power is ON.
2. External loading, pressure, and velocity conditions for the elevons will be as shown in the following table.

TABLE 3-III. — TEST CONDITIONS

Function	Inboard	Outboard
Dynamic Condition A		
Minimum load (lbs)[1]	47,700	39,450
Minimum velocity (deg/sec)	15.40	15.40
Maximum differential Pressure (psid)[2]	2,650	2,650
Dynamic Condition B		
Minimum load (lbs)[1]	31,600	26,130
Minimum velocity (deg/sec)	20.55	20.55
Maximum differential Pressure (psid)[2]	2,500	2,500

[1]Load tolerance +4000., - 0.0.

[2]Pressure tolerance +0.0, - 100.

3. Connect Brush recorder as shown in table 3-IV.

4. Uniformly command the four-channel servo, closed loop.

5. Apply an 8 V (p-p) triangular wave of 0.1 to 0.6 Hz.

6. Adjust frequency for 7.6 mA (8.84 V) of current at pin 1.

7. Record data on Brush recorder.

8. Reduce pressure loading and command current to 0.

9. Valve status is Condition F and electrical power is OFF.

TABLE 3-IV. — BRUSH RECORDER CONNECTIONS

Channel	J3-pin	Signal
1	1	I1
2	2	I2
3	3	I3
4	4	I4
5	23	DELED
6	21	PL
7	47	TAERO
8	25	X_{FB}

3.7.7 ACCURACY AND VELOCITY GAIN

3.7.7.1 Purpose

Tests will verify conformance with MC621-0014 specification paragraph 4.2.2.6.12.

Intent of this series of tests is as follows:

(a) Determination of unit hysteresis - This is defined as the maximum difference between the current required to start the unit piston in one direction and that required to start the unit piston in the other direction. (Refer to figure 3-4.)

(b) Velocity gain - The slope of the straight line representation of unit piston rate versus command current.

3.7.7.2 Test Method

A. Hysteresis

1. Valve status is Condition C and electric power is ON.
2. Apply no external load; system is local, IC.
3. Supply pressure will be 3000 ± 100 psig.
4. Bring actuator piston to stationary position at mid-stroke. Insure that all solenoids* are deenergized. Apply ±1 mA ± 5 percent at a sinusoidal rate of 0.03 to 0.1 Hz to four-channel servo.
5. Record load flow versus command current on x-y plotter. Hysteresis for command current input will not exceed 0.45 mA, and the threshold will not exceed 0.30 mA.
6. Inactivate one channel of servo by energizing one solenoid.
7. Apply command current per step 4 to three channels.
8. Record load flow versus command current on x-y plotter. Hysteresis for command current input will not exceed 0.50 mA, and threshold will not exceed 0.30 mA.

*ISO switch on test panel.

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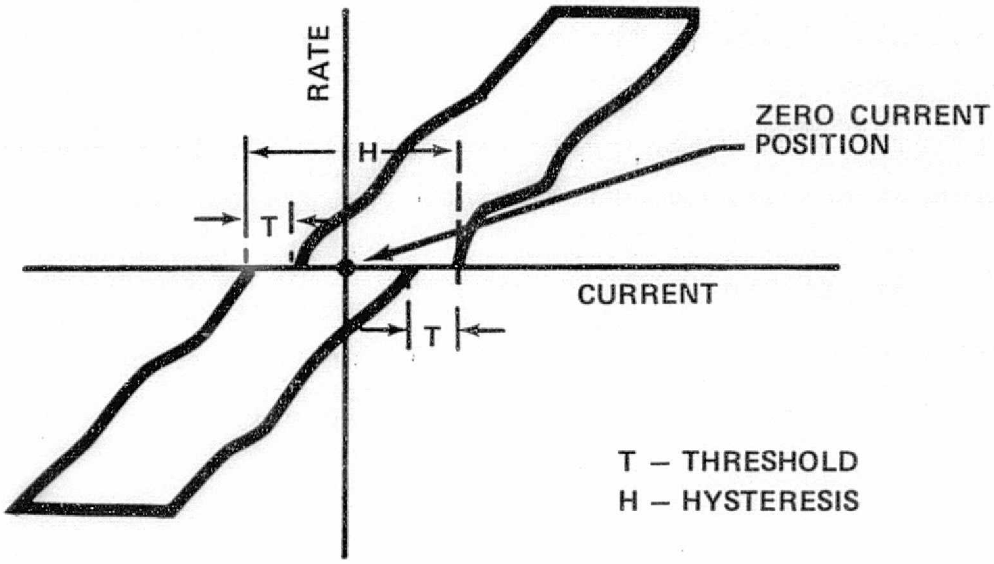


Figure 3-4. – Definitions of actuator threshold and hysteresis (for reference only).

9. Deenergize all solenoids.*
   Apply 8.6 mA command to one channel.
   Command remaining three channels of servo with ±1 mA at 0.03 to 0.1 Hz.

10. Record load flow versus command current.
    Hysteresis for command current input will not exceed 0.90 mA, and threshold will not exceed 0.30 mA.

11. Bring actuator piston to mid-stroke position.
    Deenergize all solenoids.*
    Apply a 0 mA (open circuit) to one channel. Command three channels with ±1 mA at a sinusoidal rate of 0.03 to 0.1 Hz.

12. Record load flow versus command current on x-y plotter.
    Hysteresis for command current input will not exceed 0.55 mA, and threshold will not exceed 0.35 mA.

13. Bring actuator to mid-stroke position.
    Inactivate two channels of servo (2 and 4) by energizing two solenoids.*
    Apply command current ±1 mA at a sinusoidal rate of 0.03 to 0.1 Hz.

14. Record load flow versus command current on x-y plotter.
    Hysteresis for command current input will not exceed 0.89 mA, and threshold will not exceed 0.63 mA.

15. Valve status is Condition F.

B. <u>Velocity Gain</u>

1. Hydraulic pressure will be 2800/3000 psi.

2. Valve status is Condition C, electric power is ON, and mode control is operate, local.

*ISO switch on test panel.

3. The ASA simulator will be used to operate the unit in the closed loop configuration (position feedback only).

4. Record on the strip chart, as a function of time, the input, load pressure, elevon rate, actuator position, and currents.

5. Apply a sufficient triangular wave command to:

   (a) Drive the actuator piston one-half to full stroke.

   (b) Obtain the panel rate as shown in table 3-V.

TABLE 3-V. – VELOCITY GAIN RATES

Current	Rates (deg/sec ± 10 percent)
TBS	2.90
TBS	4.10
TBS	5.30
TBS	6.50
TBS	7.70

6. Zero load, all active channels velocity gain test. With no load on the actuator, apply a command to all channels per steps 3 and 5, recording data as per step 4.

7. Zero load, one nulled, failed channel velocity gain test. Bring the actuator to a stop. With all solenoids deenergized, apply a 0 mA (open circuit) signal to one channel. With no load on the actuator, apply a command to the remaining three channels per steps 3 and 5, recording data as per step 4.

8. Opposing load conditions will be as follows:*

Inboard actuator: 45,700 ± 2000 lbs (690,000 in-lbs)
Outboard actuator: 37,450 ± 2000 lbs (329,500 in-lbs)

9. Loaded actuator with all channels active velocity gain test. With the load as per step 8 on the actuator, apply a command to all channels per steps 3 and 5, recording data per step 4.

10. Loaded actuator, one nulled failed channel velocity gain test. Bring the actuator to a stop. With all solenoids deenergized, apply a 0 mA (open circuit) signal to one channel. With the load per step 8, apply a command to the remaining three channels per steps 3 and 5, recording data as per step 4.

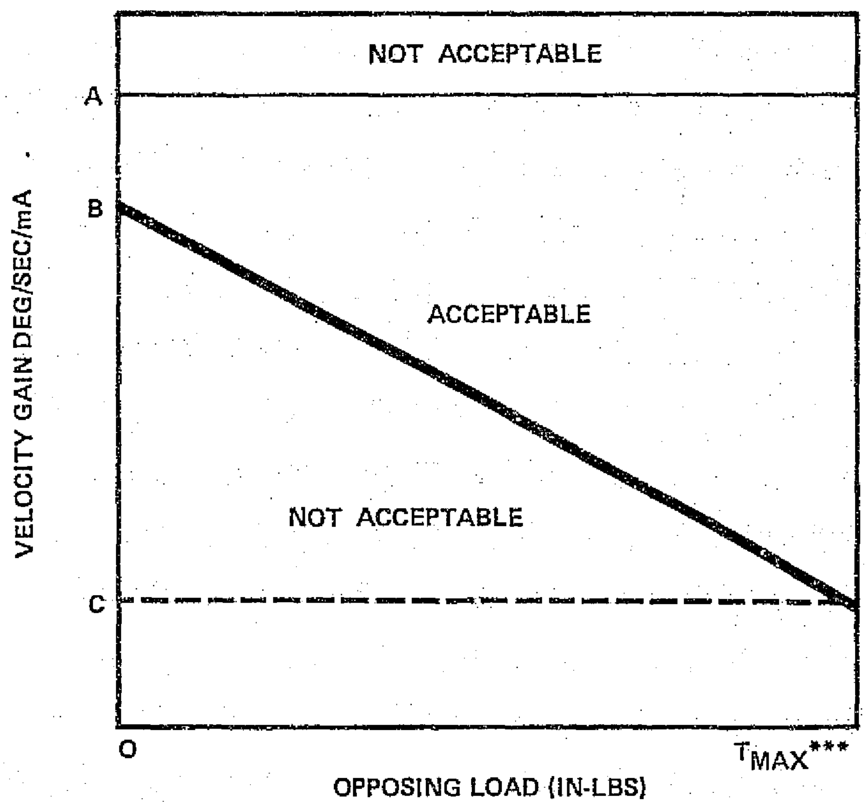
11. From the test data, the constant rate with the corresponding constant current will be used to obtain the velocity gain:

    (a) Average the current for the two, three, or four channels (as the case may be) for extending rate.

    (b) Average the current for the two, three, or four channels (as the case may be) for retracting rate.

    (c) Obtain the velocity gain analytically or graphically for the extend case and for the retract case by using a least-square-error curve fit. The slope of the velocity curve versus rate is the velocity gain. The velocity gain will fit in the acceptable region of figure 3-5.

*Once load force is selected, it will not vary more than 500 lbs for the 10 values of test current (extend and retract) for each test.



Velocity gain, deg/sec/mA at 2650 psi (maximum) ΔP_L port-to-port				
Break points	Inboard (0 to 7.8 deg/sec)		Outboard (0 to 7.8 deg/sec)	
	Normal status*	Unbypassed failure**	Normal status*	Unbypassed failure**
A	10.42	10.50	8.29	8.50
B	6.49	5.54	6.05	4.75
C	2.57	2.10	2.44	1.90

*No channels failed, or failed channels bypassed
**One failed channel not bypassed
***T_{MAX}: Inboard = 720,270 in-lbs
Outboard = 347,160 in-lbs

Figure 3-5. — Normalized velocity gain requirements.

12. The velocity gain linearity is determined from the plots of current versus velocity. A band of ±10 percent (of maximum value) will be drawn parallel to the best straight line on these plots. All five test points for each condition must be within this band.

3.7.7.3 Friction

3.7.7.3.1 Exception

It is more appropriate to conduct the test during the ram dynamics subassembly tests rather than end item ATP testing. Test data will be included in the final acceptance data package.

3.7.7.4 Channel Imbalance

3.7.7.4.1 Exception

It is more appropriate to conduct this test during the power spool driver subassembly testing rather than end item ATP testing. Test data will be included in the final acceptance data package.

3.7.7.5 Stall Pressure

3.7.7.5.1 Exception

It is more appropriate to conduct this test during the load flow subassembly testing rather than end item ATP testing. Test data will be included in the final acceptance data package.

3.7.8 FREQUENCY RESPONSE AND PEAKING LIMIT

3.7.8.1 Purpose

Object of the test is to demonstrate that the units frequency response complies with figures 3-6 and 3-7 which are plots of gain versus frequency and phase angle versus frequency,

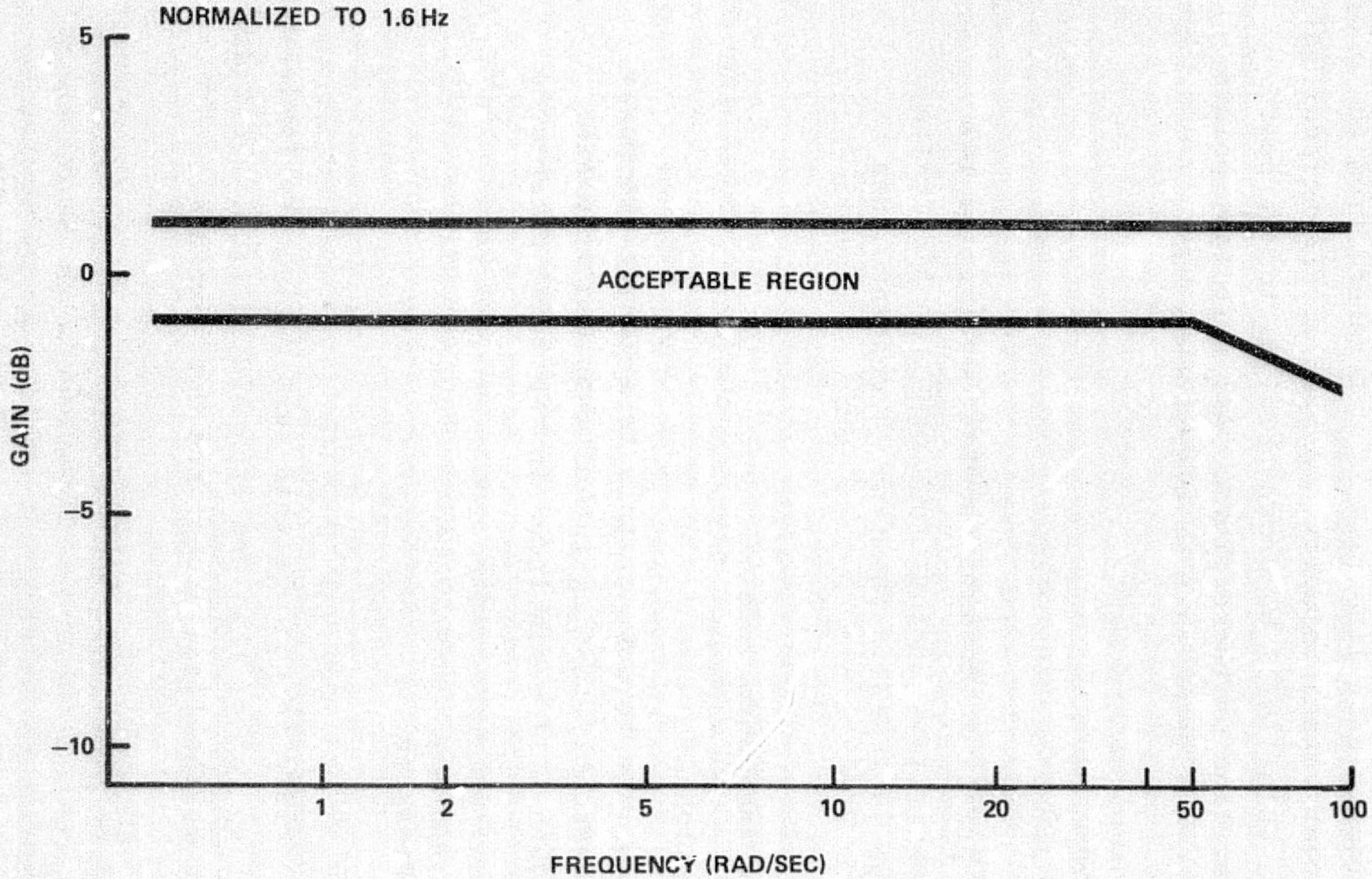


Figure 3-6. – Elevon (inboard or outboard) load flow to servo valve command gain response unloaded.

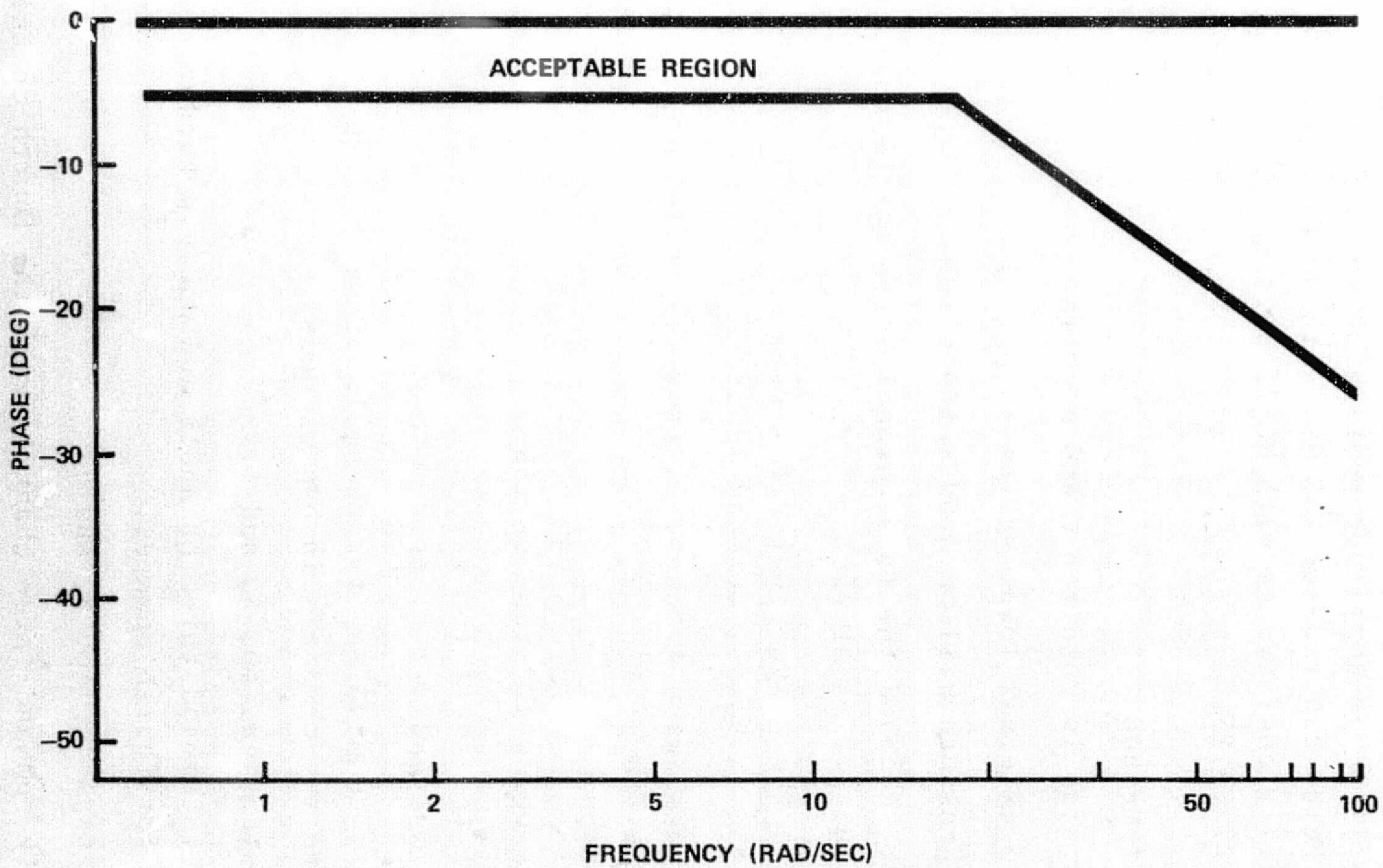


Figure 3-7. — Elevon (inboard or outboard) load flow to command phase response unloaded.

respectively, under no load. Also, it will be demonstrated that there will be no amplitude peaking above 1 dB for frequencies below 220 rad/sec (35 Hz) with no load on unit. Test will verify conformance with MC621-0014 specification, paragraph 4.2.2.6.13.

3.7.8.2 Test Method

1. Valve status is Conditon C and electric power is ON.
2. Apply no external load; system is open loop, local, IC.
3. Supply pressure will be 3000 ± 100 psig.
4. Uniformly command the four-channel servo for channels to be within ±.02 mA of each other.
   a. Cycle the servoactuator ram from null position with a ±2 mA sinusoidal command input.
   b. Perform sweep frequencies from 0.5 to 100 Hz. Normalize at 1.6 Hz.
5. There will be no amplitude peaking above 1 dB for frequencies below 220 rad/sec (35 Hz).
6. Plots of test data for gain and phase angle will match the figures 3-6 and 3-7 plots.
7. Uniformly command any two channels of servo with the remaining two channels in bypass mode.
8. Repeat steps 4a, 4b, 5, and 6.
9. Uniformly command three channels and apply a hardover command for fourth channel.
10. Repeat steps 4a, 4b, 5, and 6.
11. Uniformly command three channels with the fourth channel commanded with zero current.
12. Repeat steps 4a, 4b, 5, and 6.

13. Record all data.

14. Initiate valve status Condition F.

NOTE: Actuator piston must be repositioned and current readjusted for each simulated failure condition. Actuator piston movement will be from mid-stroke position.

3.7.9 CLOSED LOOP FREQUENCY RESPONSE

3.7.9.1 Purpose

The object of the test is to demonstrate that the units frequency response complies with the data presented at the design review. The test will verify conformance with SD74-SH-324A.

3.7.9.2 Test Method

1. Valve status is Condition C and electric power is ON.
2. Apply no external load, closed-loop condition, position, and ΔP_p.
3. Supply pressure will be 3000 ± 100 psig.
4. Uniformly command the four-channel servo
   a. Cycle the servoactuator ram from null with a ±1° commanded sinusoidal input.
   b. Sweep frequency from 0.5 to 20 Hz.
5. Plots of test data for gain* and phase will be given to LEC engineering for final evaluation, and LEC engineering will make disposition as to acceptability of data. NASA/EG5 will make final acceptance of the data.

*Gain is gain from input to X_{FB} (pin 25).

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3.7.10 CLOSED LOOP TRANSIENT RESPONSE

3.7.10.1 Purpose

The object of the test is to demonstrate that the transient response of the unit complies with the data presented at the design review. The test will verify conformance with SD74-SH-324A.

3.7.10.2 Test Method

1. Valve status is Conditon C and electric power is ON.
2. Apply no external load, closed-loop condition.
3. Supply pressure will be 3000 ± 100 psig.
4. Uniformly command the four-channel servo with a ±1°, ±5°, and ±10° step input.
5. Record on a strip-chart recorder:
   I1 (pin 1), X_{PS} (pin 16), Q_L (pin 37), P_L (pin 21), $\ddot{\delta}e$ (pin 24), $\dot{\delta}e$ (pin 23), δe (pin 22), and input.
6. Uniformly command the four-channel servo with a triangle wave having a slope of 20 deg/sec and amplitudes of ±1°, ±5°, and ±10°.
7. Record the signals on a strip-chart recorder per step 5.
8. Plots of step and ramp response will be given to LEC engineering, and LEC engineering will make disposition as to acceptability of data. NASA/EG5 will make final acceptance of the data.

3.7.11 FAULT INSERTION

3.7.11.1 Purpose

The purpose of this acceptance test is to verify conformance with section 5 of JSC-10620. The test will demonstrate proper operation of the manual switching circuitry and the control interface.

3.7.11.2 Test Method

1. Faults are inserted through the TOC connector area of the test set:

   Fault 1: +4.5 ± 0.5 volts to pin 22 and ground to pin 23.

   Fault 2: +4.5 ± 0.5 volts to pin 24 and ground to pin 25.

   To remove the fault command, simply remove the +4.5 input.

2. Apply +4.5 ± 0.5 volts to TOC pin 5 and ground to pin 6.

3. Apply +3.0 ± 0.10 volts to TOC pin 9 and ground to pin 10.

4. Apply +3.0 ± 0.10 volts to SIS pin 14 and ground to pin 13.

5. Check fault insertion for ΔP primary for each of the four channels.

6. Check fault insertion for ΔP position for each of the four channels.

7. To check the secondary ΔP circuits, a fault must be inserted into one channel to observe operation of the unfaulted channels. A -HARDOVER will be inserted in channel 4. The other channels should share the faulted channel's load.

8. Check the fault insertion for ΔP secondary for each of the four channels.

3.7.12 SUBSYSTEM INITIALIZATION

3.7.12.1 Purpose

The purpose of this acceptance test is to verify conformance with section 10 of JSC-10620. The test will demonstrate the performance of initialization circuitry for the elevons.

3.7.12.2 Test Method

1. Place integrator in IC mode and measure and record voltages indicated on data sheets.

2. Place integrator in OPERATE mode and measure and record voltages indicated on data sheets.

3.8 PISTON FORCE

3.8.1 EXCEPTION

Since piston force is an integral part of piston velocity, the two tests are combined as a panel rate - piston force test.

3.9 PISTON TRAVEL

3.9.1 PURPOSE

Intent of this test is to demonstrate that the servoactuator piston travel requirements comply with the requirements of R/SD Specification MC621-0014, paragraph 4.2.2.8.

3.9.2 TEST METHOD

1. Valve status is Condition C with electric power ON.
2. Uniformly command the four-channel servo. Apply ±0.573 V at ASA input (- retract, + extend). Apply 8.66 V to SIS connector pin 14 and ground to pin 13.
3. Supply pressure will be 3000 ± 100 psig.
4. Fully extend and retract the piston until the respective stops are impacted.
5. Measure and record the total travel of the piston. Inboard piston travel will be 14.640 ± 0.03 inches. Outboard piston travel will be 8.532 ± 0.03 inches.
6. Return to Condition F. Turn OFF electric power.

3.10 POWER VALVE PRESSURE GAIN

3.10.1 PURPOSE

Intent of this test is to demonstrate that the power valve spool provides a pressure gain of 1,000,000 psid/in minimum over the range of ±1200 psid at zero output flow.

3.10.2 EXCEPTION

It is more appropriate to perform this test at the component level and use a test fixture with a power valve spool and sleeve. Therefore, this test will not be conducted on a servoactuator assembly. Each power valve assembly will be tested, and this data will be included in the final acceptance data package.

3.11 POST-TEST EXAMINATION

3.11.1 PURPOSE

Intent of this examination after testing is to determine that the unit is acceptable for delivery.

3.11.2 TEST METHOD

After all acceptance tests have been completed satisfactorily, visually examine the unit externally for damage. *Do not disassemble the simulator.* Insure that the unit is in full compliance with this test procedure and specification requirements unless specific requirements have been waived by the customer. Attach a QA-provided tag to the unit with safety wire or equivalent to indicate unit designation and stating it successfully passed acceptance test.

3.12 CHASSIS POWER

3.12.1 PURPOSE

The purpose of this acceptance test is to verify operation of the dc power supplies and regulation.

3.12.2 TEST METHOD

This procedure will be implemented by performing the following steps:

1. Status is Condition C and electric power is ON.
2. Measure the voltage at pin 28. This voltage will be +15.0 ± 0.2 volts. There will be less than 2.0 mV (rms) of ripple.
3. Measure the voltage at pin 29. This voltage will be -15.0 ± 0.2 volts. There will be less than 2.0 mV (rms) of ripple.
4. Measure the voltage at pin 30. This voltage will be +10.0 ± 0.010 volts. There will be less than 1.0 mV (rms) of ripple.
5. Measure the voltage at pin 31. This voltage will be -10.0 ± 0.010 volts. There will be less than 1.0 mV (rms) of ripple.
6. Status is Condition F and electric power is OFF.

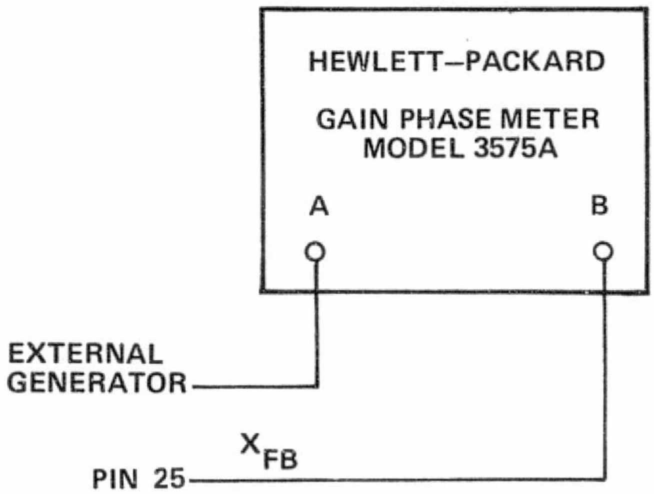


Figure 3-8. – Frequency response test setup.

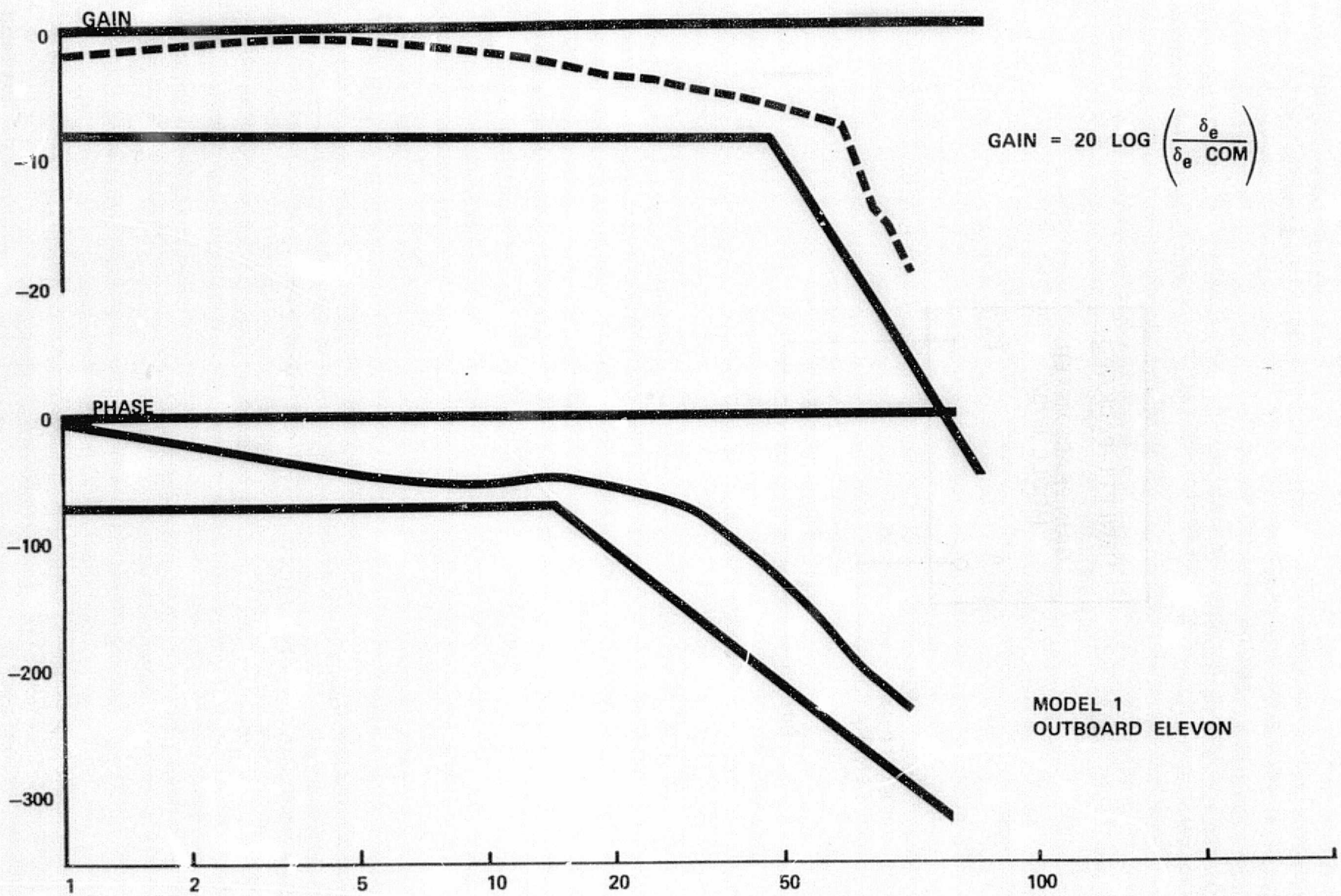


Figure 3-9. — Closed loop frequency response.

4. ACCEPTANCE TEST CERTIFICATION

4.1 CERTIFICATION

Execution of this ATP completion form certifies that this unit has been acceptance tested successfully and meets the performance parameters.

Name Elevon Servoactuator Simulator

Part number ____________________ Type ________________

Serial number ____________________ Date ________________

List by numbers and date any approved deviations or waivers

____

Comments ____

____

Acceptance Tests Completion Certification

Elevon Project Engineer(s) ________________________ Date ______

Quality Assurance ________________________________ Date ______

Witnessed by EG5 (optional) ________________________ Date ______

Witnessed by EJ7 (optional) ________________________ Date ______

Witnessed by R/SD (optional) _______________________ Date ______

APPENDIX A

SUBASSEMBLY PERFORMANCE TESTS

SUBASSEMBLY TEST PROCEDURE
ISOLATION VALVE INTERFACE
SAS1001

I. TEST SETUP

1. Connect the following as shown in figure 1.

   A. Connect +15 Vdc power supply to pins 13 or P, ground to pins 12 or N.

   B. Connect scope probe A to input pin 1.

   C. Connect scope probe B to output pin 18 with probe ground connected to pin 12 or N.

   D. Connect digital voltmeter (DVM) or volt-ohm meter (VOM) to pin 18 with ground on pin 12 or N.

   E. Set scope in chopped position and time base for slow cycle operation. Connect VOM or DVM on dc volts to handle up to 15 Vdc.

2. Check regulator U1 pin 2 for approximately 12 Vdc out.

3. Connect +28 Vdc supply to pins 1 for HI (+) and 5 for LO (-).

4. Cycle the input signal by pulling and reconnecting + input to pin 1 from +28 V supply.

5. Observe the output on the scope and DVM (VOM) to see that the output cycles. A plus in should give a plus out (12 V). On the DVM the output should go to 0.0 when the input is LO. There should be no offset voltage.

6. Remove connections to pin 1 and reconnect them to pin 20.

7. Remove connections to pin 5 and reconnect to pin 16.

8. Remove connections to pin 18 and reconnect to pin 17.

9. Repeat steps 4 and 5. When steps are complete and all conditions met, board has met requirements.

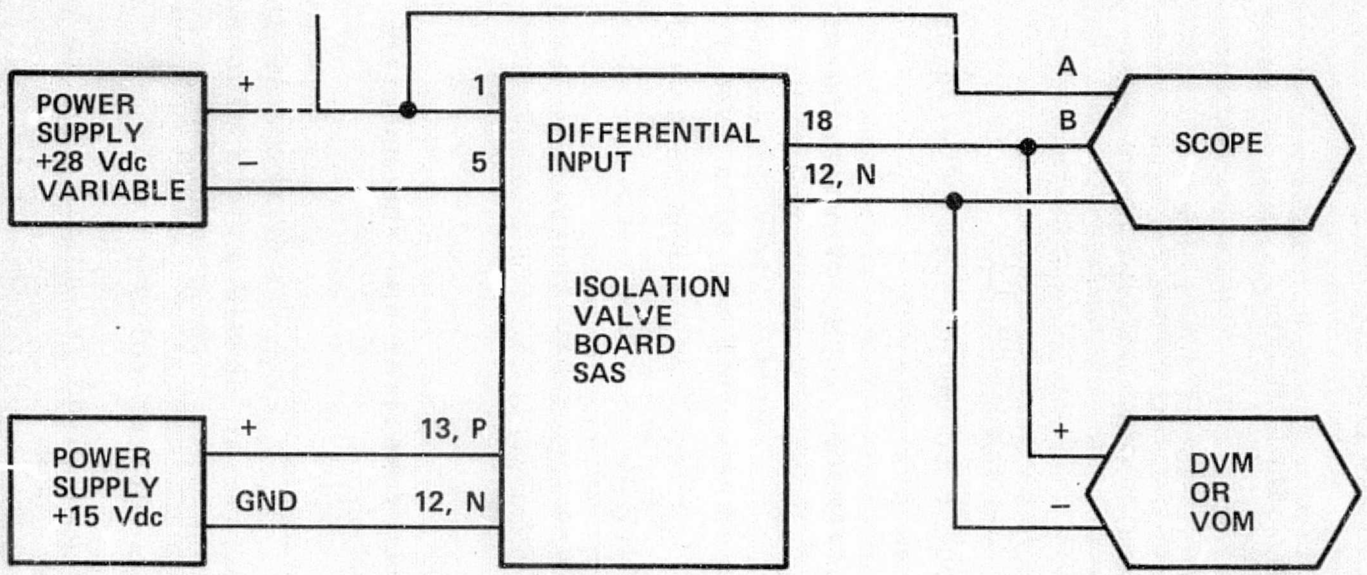


Figure 1. — Test setup.

DATA SHEET
SAS1001

Serial number ________________ Revision ___________ Date ___________

Checked by ____________________________

1. Supply checks

+14.95 V ____ 15.05 V

-15.05 V ____ -14.95 V

+15 V current ___________________________________ mA

-15 V current ___________________________________ mA

±15 V common current ____________________________ mA

9.990 V ____ 0.010 V

-10.010 V _______________________________________ -9.990 V

+10 V current ___________________________________ mA

-10 V current ___________________________________ mA

2. Regulator check

Measure and record voltage at pin 2 of U1.

+11.4<__________________________<12.6

3. Circuit A check

A. Apply 28 volts to pin 1.

B. Apply ground to pin 5.

C. Measure and record voltage at TP4.

11.4<__________________________<12.6

D. Apply ground to pin 1.

E. Measure and record voltage at TP4.

-0.5<__________________________<0.5

DATA SHEET - Concluded
SAS1001

4. Circuit B check

   A. Apply 28 volts to pin 20.

   B. Apply ground to pin 16.

   C. Measure and record voltage at TP3.

      11.4<______________________________<12.6

   D. Apply ground to pin 20.

   E. Measure and record voltage at TP3.

      -0.5<______________________________<0.5

SUBASSEMBLY TEST PROCEDURE
FAULT INSERTION LOGIC CARD
SAS1002

1. PURPOSE

The purpose of this procedure is to test the logic circuitry used for fault insertion in the Shuttle Actuators Simulator.

2. TEST EQUIPMENT

The following equipment is required for testing:

1. Four and one-half-digit digital multimeter
2. +15 Vdc power supply
3. Hydraulic test fixture/fault insertion

3. TEST SETUP

1. Insure that +15 V power supply is turned OFF. Connect test fixture as shown in figure 1. Set S5 through S15 to fault insertion. Set S16, S17, S20, and S21 to 0.
2. Insert the fault insertion logic card SAS1002 into the test fixture with the component side facing S21.
3. Set S18 to the +15 position and turn +15 V power supply ON. Adjust for +15.0 ± 0.2 Vdc on the digital voltmeter. Set S18 to OFF.

   NOTE: Should power supply voltage fail to come up, check power supply current limit.
4. Observe current level. Current level shall not exceed 200 mA. (record)

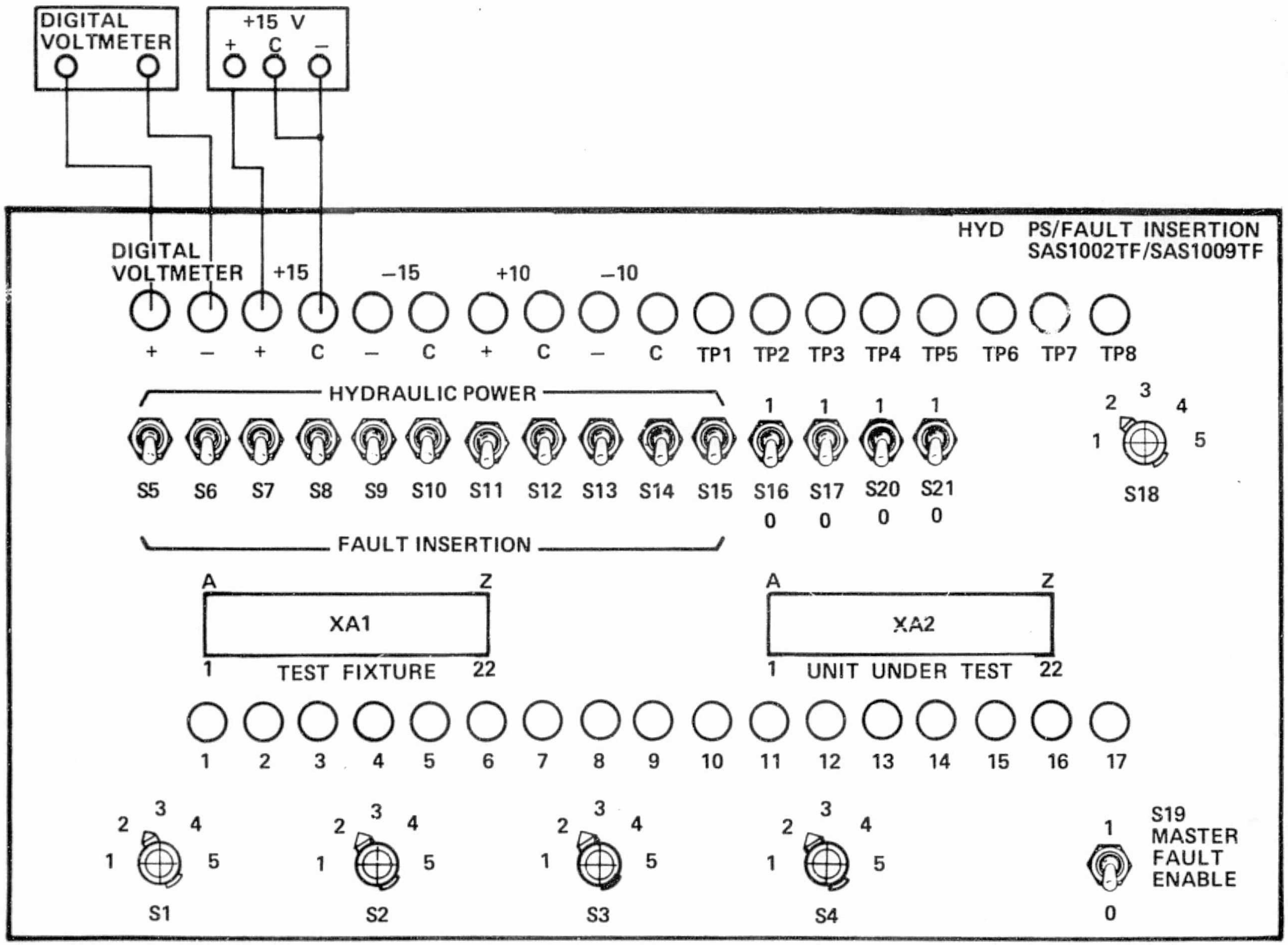


Figure 1. — Test interconnection.

4. TEST PROCEDURES

1. Connect DVM to TP2 and observe +12.0 ± 0.5 Vdc. (record)
2. Set S1, S2, S3, and S4 to position 2 and S19 to "1." Observe that lamps 1 through 16 are OFF. (check)
3. Set S19 to "1" and S1, S2, S3, and S4 to position 3. Observe that lamps 1, 4, 7, and 10 are ON. (record)
4. Set S19 to "0" and S1, S2, S3, and S4 to position 3. Observe that lamps 1, 4, 7, and 10 are OFF. (record)
5. Set S19 to "1." Set S1, S2, S3, and S4 to the positions indicated in table 1 and observe that the lamps are as indicated in table 1. (record)
6. Set S1, S2, S3, and S4 to position 1 and set S19 to position 1 and observe that all lamps are OFF. (check)
7. Set S16 to "1." Observe that lamps 13 and 15 are ON and lamps 14 and 16 are OFF. (record). All other lamps are OFF. (check)
8. Set S16 to "0" and S17 to "1." Observe that lamps 14 and 16 are ON and lamps 13 and 15 are OFF. (record). All other lamps are OFF. (check)
9. Certify that all the requirements of this test procedure have been met and that the card can be installed as necessary. (initial)

TABLE 1. — LAMP LOGIC STATES

Switch position				Logic state lamps (1 = ON)															
S1	S2	S3	S4	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	3	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1	4	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1	5	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	3	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
1	1	4	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1	1	5	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
1	1	1	4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
1	1	1	5	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Represents UUT pin number				4	7	3	21	R	20	Y	A	X	H	L	F	10	14	T	9

NOTE: Lamps 15 and 16 are arranged to test for an undesirable grounding of pins T and 9.

DATA SHEET
SAS1002

Serial number ______________ Revision __________ Date __________

Checked by ____

Only paragraphs which require data entries will be shown.

3. TEST SETUP

4. Current level of 15 V power supply _____ (<200 mA)

4. TEST PROCEDURES

1. Digital voltmeter displays __________ (+11.5 Vdc to +12.5 Vdc)

2. All lamps are extinguished _____'. (check)

3. S19 = "1." Logic state lamps

   1 ______________ (ON = PASS)

   4 ______________ (ON = PASS)

   7 ______________ (ON = PASS)

   10 ______________ (ON = PASS)

4. S19 = "0." Logic state lamps

   1 ______________ (OFF = PASS)

   4 ______________ (OFF = PASS)

   7 ______________ (OFF = PASS)

   10 ______________ (OFF = PASS)

5. Record logic level of lamp observed (1 = illuminated, 0 = extinguished). To pass, entries must agree with the procedure in table 1.

DATA SHEET - Continued

SAS1002

Serial number __________

Date __________

Switch position				Logic state lamps															
S1	S2	S3	S4	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2	1	1	1																
3	1	1	1																
4	1	1	1																
5	1	1	1																
1	2	1	1																
1	3	1	1																
1	4	1	1																
1	5	1	1																
1	1	2	1																
1	1	3	1																
1	1	4	1																
1	1	5	1																
1	1	1	2																
1	1	1	3																
1	1	1	4																
1	1	1	5																

6. All lamps are OFF _____. (check)

7. Logic state of lamps

Lamp number		
13	__________	(ON = PASS)
16	__________	(OFF = PASS)
14	__________	(OFF = PASS)
15	__________	(ON = PASS)

All other lamps OFF _____. (check)

DATA SHEET - Concluded
SAS1002

Serial number ___________

Date ____________________

8. Logic state of lamps

Lamp number		
13	___________	(OFF = PASS)
16	___________	(ON = PASS)
14	___________	(ON = PASS)
15	___________	(OFF = PASS)

All other lamps are OFF _____. (check)

9. All requirements of this test procedure have been met.
_____ (initial)

SUBASSEMBLY TEST PROCEDURE
TRANSDUCER SIMULATOR CARD
SAS1003

1. PURPOSE

The purpose of this test procedure is to adjust offset, gain, and phase of the two transducer circuits on this card. Functional testing consists of static gain check, frequency response tests, and input switching tests.

2. TEST EQUIPMENT

1. Four and one-half-digit digital multimeter
2. Gain phase meter
   HP-3575A
3. X-Y impedance bridge — GR
4. AC rms voltmeter — GR
5. VOM
6. ±15 Vdc power supply
7. +10 Vdc power supply
8. Function generator
   Wavetek 154 or equivalent
9. Variable power supply 0 to ±10 Vdc
10. Test fixture
    Transducer simulator
11. 400 Hz, 26 Vac power supply

3. SETUP

1. Excitation signal of 26 V ± 1 Vac 400 Hz ± 7 Hz applied with high to pins 6 and 17 and low to pins 5 and 16. The low side of the excitation power will be referenced to the ±15 Vdc power supply common.
2. Analog input signal – Variable dc voltage 0 to ±10 V applied to pins 8 and 9, low side referenced to ±15 V common.
3. Fail signal – +10 applied to pins 7 and 10, low side referenced to ±15 V common.
4. Output load – 105 kΩ loads connected between pins B and 1 and between pins 20 and V. Pins 1 and V are referenced to ±15 V common.
5. Logic level signals – Connect pins 15 and 14 to ±15 V common. These are the field-effect transistor (FET) switch logic signals. They should never exceed +10 V or -1 V and should never be left open.

4. POWER-ON CHECKS

Measure and record on the data sheet all power supply voltages and currents, set up per figure 1.

5. IMPEDANCE MEASUREMENTS

With power on and excitation removed, measure input impedance at pins 6 and 5 for circuit A and at pins 17 and 16 for circuit B. Record data on data sheet. Nominal value is 430 + j300.

Measure output impedance at pins B and 1 with power on, excitation power removed, and the 105 kΩ load resistor removed. Repeat for circuit B and pins 20 and V. Record data on data sheet. Nominal value is 240 + j170.

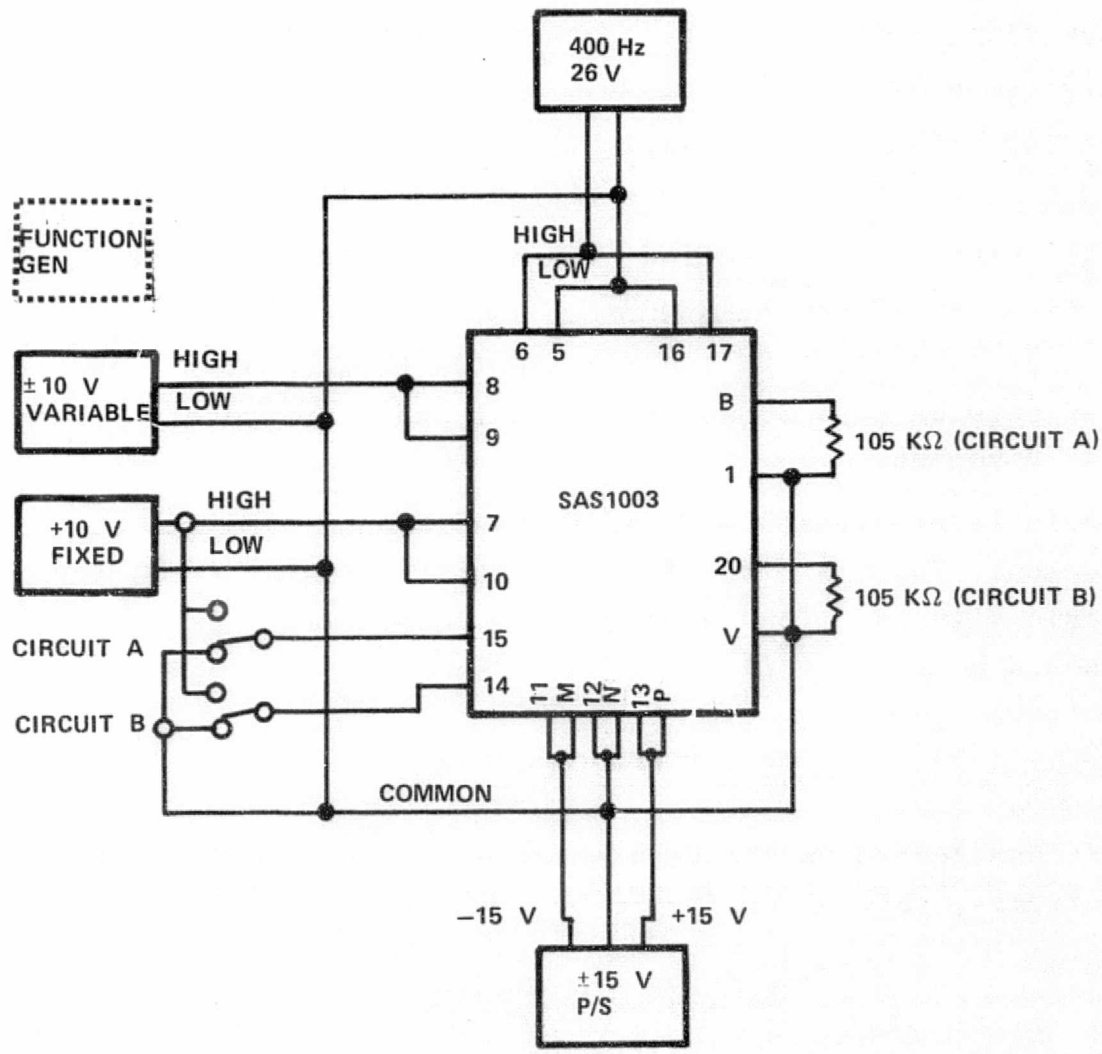


Figure 1. – Performance test setup.

6. ADJUSTMENT

1. <u>Multiplier offset adjustment</u> - Perform with *all* analog signals and excitation power input at 0 volts.

   Adjust R8 to achieve a 0-volt signal at TP7. Adjust R25 to achieve a 0-volt signal at TP1.

2. <u>Gain and phase adjustment</u>

   A. With an input of 26 Vac ± 0.1 Vac 400 Hz ± 7 Hz applied at the input (pins 6 and 5) and 0 Vdc at pin 9, check TP11, TP7, and TP10. Measure rms voltage and record data (ac feed-through check).

   B. Change analog input voltage to +10 Vdc and adjust R9 until the output across the 105 kΩ load resistor at pins B and 1 is 5.13 V rms.

   C. Adjust R26 until output voltage across 105 kΩ load resistor at pins 20 and V is 5.13 V rms.

   D. Using gain-phase meter, adjust R11 until phase difference between input (signal at pins 6 and 5) and output (signal at pins B and 1) is nearly zero.

   E. Repeat step D adjusting R28. Input is on pins 7 and 16 and output is on pins 20 and V.

   F. Recheck gain and adjust if necessary.

   G. Recheck phase and adjust if necessary.

7. PERFORMANCE CHECKS

1. <u>Static checks</u>

   Check static transfer ratio between analog input and output across the 105 kΩ load resistor for circuit A by applying a dc voltage to the normal input and measuring the output. Repeat for circuit B.

Input voltage and acceptable output voltage are shown on the data sheet. Record all data.

2. Dynamic checks

Check frequency response of the analog input voltage amplifier. Frequency response should be as shown in figure 2.

Check is made from the analog input pin 8 to the output of U1 pin 10 for circuit A and between the analog input pin 9 and the output of U5 pin 10 for circuit B.

3. Switch performance checks

With the input to the complementary metal oxide semiconductor (CMOS) switch grounded (pin 15) -10 Vdc into the analog input on pin 8, measure the output at TP5. The other side of the switch should have +10 V on it (pin 7). Operate the switch by changing the input signal on pin 15 from ground to +10 V. Measure the output of TP5. Record all data on the data sheet. Repeat for circuit B.

4. Impedance measurements

All impedance measurements are made with the card removed from the test fixture. Measure input impedance at pins 6-5 and 17-16. Short TP10 to TP4 and TP6 to TP4. Measure output impedance at pins B-1 and pins 20-V. Use test setup shown in figure 3.

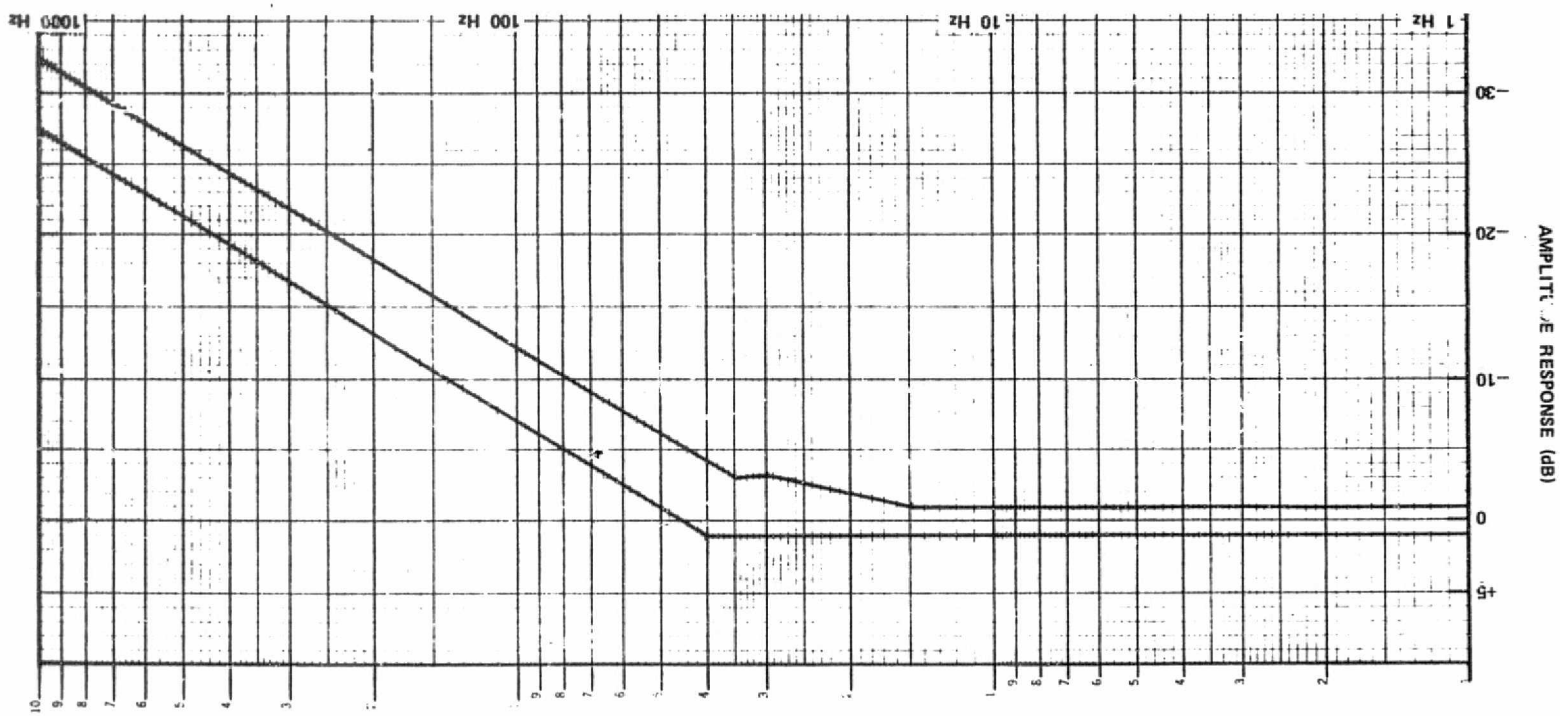


Figure 2. – Frequency response transducer simulator.

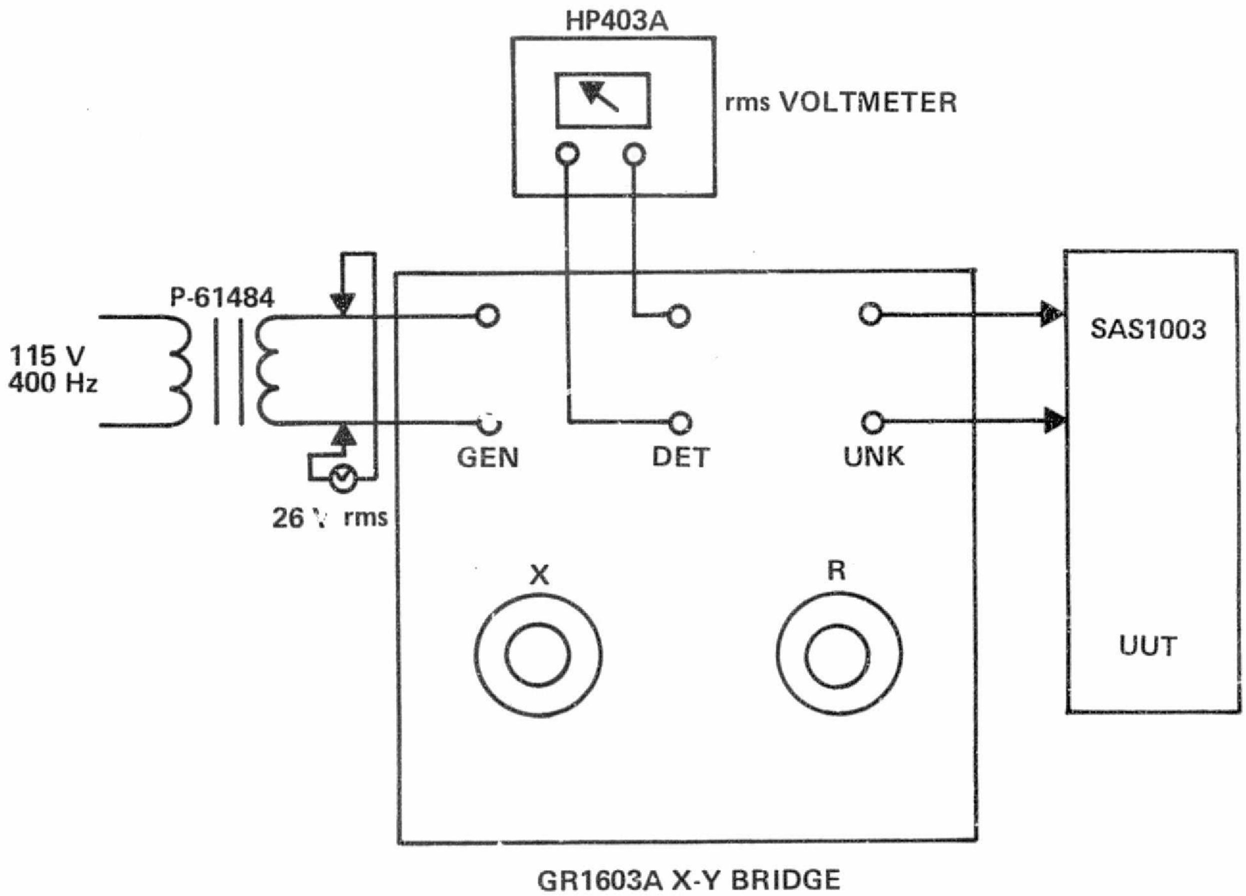


Figure 3. – Test setup for impedance measurements.

DATA SHEET
SAS1003

Serial number ______________ Revision __________ Date __________

Checked by __________________________

1. Supply checks

+14.95 V ________________________________ 15.05 V

-15.05 V ________________________________ -14.95 V

+15 V current ___________________________ mA

-15 V current ___________________________ mA

±15 V common current ____________________ mA

DATA SHEET - Continued

SAS1003

IMPEDANCE CHECKS

Circuit A

Input impedance

423 ____________________ 523 + J292 ____________________ 369

Output impedance

235 ____________________ 293 + J163 ____________________ 211

Circuit B

Input impedance

423 ____________________ 523 + J292 ____________________ 369

Output impedance

235 ____________________ 293 + J163 ____________________ 211

2. AC feed-through checks

Circuit A		Circuit B	
TP7 __________	V rms	TP1 __________	V rms
TP10 __________	V rms	TP6 __________	V rms
TP11 __________	V rms	TP2 __________	V rms

DATA SHEET - Continued

SAS1003

PERFORMANCE CHECKS CIRCUIT A

Input Vdc (pin 8) output V rms phase

10.000	5.181		5.079	6°<		<6
8.000	4.155		4.053	6°<		<6
6.000	3.129		3.027	6 <		<6
4.000	2.103		2.001	6 <		<6
2.000	1.077		0.975	6 <		<6
1.000	0.564		0.462	6 <		<6
0.000	0.051		0.051		N/A	
-1.000	0.462		0.564	-183°<		<-177°
-2.000	0.975		1.077	-183°<		<-177°
-4.000	2.001		2.103	-183°<		<-177°
-6.000	3.027		3.129	-183°<		<-177°
-8.000	4.053		4.155	-183°<		<-177°
-10.00	5.079		5.181	-183°<		<-177°

Excitation (pins 6 and 5) 25.900≤ ______________ ≤26.100
V rms

DATA SHEET - Continued

SAS1003

PERFORMANCE CHECKS CIRCUIT B

Performance checks for circuit B

10.000	5.181	________	5.079	6°<	________	<6
8.000	4.155	________	4.053	6°<	________	<6
6.000	3.129	________	3.027	6 <	________	<6
4.000	2.103	________	2.001	6 <	________	<6
2.000	1.077	________	0.975	6 <	________	<6
1.000	0.564	________	0.462	6 <	________	<6
0.000	0.051	________	0.051		N/A	
-1.000	0.462	________	0.564	-183°<	________	<-177°
-2.000	0.975	________	1.077	-183°<	________	<-177°
-4.000	2.001	________	2.103	-183°<	________	<-177°
-6.000	3.027	________	3.129	-183°<	________	<-177°
-8.000	4.053	________	4.155	-183°<	________	<-177°
-10.00	5.079	________	5.181	-183°<	________	<-177°

Excitation (pins 17 and 16) 25.900≤ ________ ≤26.100
V rms

DATA SHEET - Continued

SAS1003

Dynamic check circuit A

	Input pin 8		Output (pin 10 of U1)	
1 V rms	Frequency	Nominal output	Gain (dB)	Phase°
1	1	0/-1°	-.5<________<+.5	-3° ________<+3°
1	2	0/-3°	-.5<________<+.5	-6°<________<+0
1	4	0/-6°	-.5<________<+.5	-9°<________<-3°
1	8	-16/-11°	-.7<________<+.3	-15°<________<-8°
1	10	-.25/-14°	-.8<________<+.2	-20°<________<-10°
1	20	-0.9/-26°	-1.5<________<+0.0	-30°<________<-20°
1	30	-1.9/-36°	-2.5<________<-.5	-45°<________ ≤30°
1	40	-2.9/-44.4°	-3.5<________<-1.0	________ ≤40°
1	50	-4.0/-51°	________<-2.0	________ ≤45°
1	60	-5.0/-56°	________<-3.0	________ <45°
1	80	-6.9/-63°	________<-4.0	________ <45°
1	100	-8.5/-68°	________<-6.0	________ <45°

NOTE: Set gain/phase meter on -A for reference.

DATA SHEET - Continued
SAS1003

Dynamic check circuit B

	Input pin 9		Measured output (pin 10 of U5)	
Voltage	Frequency	Nominal output	Gain	Phase°
1	1	0/-1°	-.5< ______ <+.5	-3°< ______ <3°
1	2	0/-3°	-.5< ______ <+.5	-6°< ______ <0°
1	4	0/-6°	-.5< ______ <+.5	-9°< ______ <-3°
1	8	-.16/-11°	-.7< ______ <+.3	-15°< ______ <-8°
1	10	-.25/-14°	-.8< ______ <+.2	-20°< ______ <-10°
1	20	-0.9/-26°	-1.5< ______ <0.0	-35°< ______ <-20°
1	30	-1.9/-36°	-2.5< ______ <-.5	-45°< ______ <-30°
1	40	-2.9/ 44°	-3.5< ______ <-1.0	______ <-40°
1	50	-4.0/-51°	______ <-2.0	______ <-45°
1	60	-5.0/-56°	______ <-3.0	______ <-45°
1	80	-6.9/-63°	______ <-4.0	______ <-45°
1	100	-8.5/-68°	______ <-6.0	______ <-45°

NOTE: Set gain/phase meter on -A for reference.

DATA SHEET - Concluded
SAS1003
SWITCH PERFORMANCE

Circuit A

Pin 15	Pin 8	Pin 7	TP5
Gnd	-10.000	+10.000	-10.20<__________<-9.80
+10	-10.000	+10.000	+9.80<__________<+10.20

Circuit B

Pin 14	Pin 9	Pin 10	TP8
Gnd	-10.000	+10.000	-10.20<__________<-9.80
+10	-10.000	+10.000	+9.80<__________<10.20

SUBASSEMBLY TEST PROCEDURE
SERVO VALVE CARD
SAS1004

1. PURPOSE

The purpose of this test procedure is to adjust the gain of the four servo valve current-to-voltage circuits on this card. The performance test consists of static gain check, common mode rejection ratio (CMRR) checks, and output offset voltage checks.

2. TEST EQUIPMENT REQUIRED

1. Four and one-half-digit digital voltmeter
2. VOM
3. ±15 Vdc power supply
4. Precision current source - John Fluke
5. Test fixture - servo valve

3. SETUP

The test setup is as shown in figure 1. Each circuit is checked one at a time; therefore, it is not necessary to hook up the input signal to all circuits at the same time.

4. POWER-ON CHECKS

Measure all power supply voltages and currents and record on the data sheet.

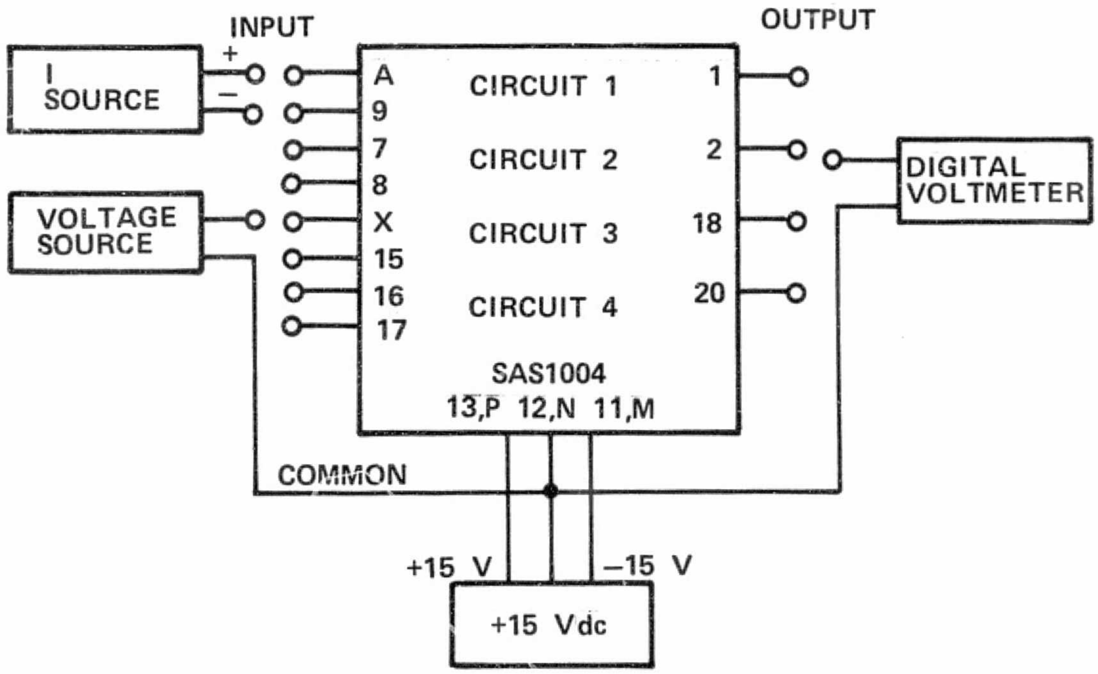


Figure 1. – Test setup.

5. ADJUSTMENTS

1. CMRR adjustment

   Short the two input pins together and apply a +10 V signal. Record this value (A). Change the input to -10 V and record this value (B). Adjust R5 by using a resistance decade box until output voltage at TP13 is $V_0 = (A+B)/2$. Repeat this several times until the output changes only several mV when the input is switched from +10 to -10 V. Repeat this procedure for the other circuits.

2. Gain adjustments

   With a floating current source as the input at pins A and 9, adjust the circuit gain to yield an output voltage at pin 1 or TP13 of 10 V for an input current of 8.6 mA. This gain is adjusted by changing the value of R25. Repeat this procedure for the other three circuits.

6. PERFORMANCE CHECKS

1. CMRR check

   With the two input shorted together, apply an input of +10 V (A). Record the value of the output on the data sheet. Change the input to -10 V and again record the output voltage (B). Calculate the CMRR.

   $$\text{CMRR} = 20 \log_{10}\left(\frac{|A-B|}{20}\right)$$

   Repeat this check for the other three circuits. Record all data.

2. Offset output voltage checks

   With the input signal set at 0 mA, record the output voltage on the data sheet. Repeat this for the other three circuits.

3. Gain checks

Perform the gain checks with the input current values as shown on the data sheets. Repeat for the other three circuits.

DATA SHEET
SAS1004

Serial number ____________ Revision ____________ Date ____________

Checked by ____

1. Supply checks

+14.95 V ______________________________ +15.05

-15.05 V ______________________________ -14.95

+15 V current __________________________ mA

-15 V current __________________________ mA

±15 V common current ____________________ mA

DATA SHEET - Continued

SAS1004

COMMON MODE REJECTION RATIO

Circuit 1

Input	Output	|A-B|	CMRR
+10 V	A=______	N/A	N/A
-10 V	B=______	| |	______

$$CMRR = 20 \log_{10}\left(\frac{|A-B|}{20}\right)$$

Circuit 2

	Output	|A-B|	CMRR
+10 V	A=______	N/A	N/A
-10 V	B=______	| |	______

Circuit 3

Input	Output	|A-B|	CMRR
+10 V	A=______	N/A	N/A
-10 V	B=______	| |	______

Circuit 4

Input	Output	|A-B|	CMRR
+10 V	A=______	N/A	N/A
-10 V	B=______	| |	______

C-2

DATA SHEET - Continued

SAS1004

OFFSET OUTPUT VOLTAGE CHECKS

Circuit 1

Input	Output
0 mA	________ V

Circuit 2

Input	Output
0 mA	________ V

Circuit 3

Input	Output
0 mA	________ V

Circuit 4

Input	Output
0 mA	________ V

DATA SHEET - Continued

SAS1004

GAIN CHECKS FOR CIRCUIT 1

I_{IN} (mA)	V_{OUT} ± 0.1 V		
8.6	-10.000	______	V
8.0	-9.302	______	V
6.0	-6.977	______	V
4.0	-4.651	______	V
2.0	-2.326	______	V
0.0	0.000	______	V
-2.0	+2.326	______	V
-4.0	+4.651	______	V
-6.0	+6.977	______	V
-8.0	+9.302	______	V
-8.6	+10.000	______	V

GAIN CHECKS FOR CIRCUIT 2

I_{IN} (mA)	V_{OUT} ± 0.1 V		
8.6	-10.000	______	V
8.0	-9.302	______	V
6.0	-6.977	______	V
4.0	-4.651	______	V
2.0	-2.326	______	V
0.0	0.000	______	V
-2.0	+2.326	______	V
-4.0	+4.651	______	V
-6.0	+6.977	______	V
-8.0	+9.302	______	V
-8.6	+10.000	______	V

DATA SHEET - Continued

SAS1004

GAIN CHECKS FOR CIRCUIT 3

I_{IN} (mA)	V_{OUT} ± 0.1 V		
8.6	-10.000	______	V
8.0	-9.302	______	V
6.0	-6.977	______	V
4.0	-4.651	______	V
2.0	-2.326	______	V
0.0	0.000	______	V
-2.0	+2.326	______	V
-4.0	+4.651	______	V
-6.0	+6.977	______	V
-8.0	+9.302	______	V
-8.6	+10.000	______	V

GAIN CHECKS FOR CIRCUIT 4

I_{IN} (mA)	V_{OUT} ± 0.1 V		
8.6	-10.000	______	V
8.0	-9.302	______	V
6.0	-6.977	______	V
4.0	-4.651	______	V
2.0	-2.326	______	V
0.0	0.000	______	V
-2.0	+2.326	______	V
-4.0	+4.651	______	V
-6.0	+6.977	______	V
-8.0	+9.302	______	V
-8.6	+10.000	______	V

SUBASSEMBLY TEST PROCEDURES
HYSTERESIS CIRCUIT
SAS1005

1. EQUIPMENT REQUIRED

1. Oscilloscope — X-Y type
2. ±15 V power supply
3. ±10 V power supply
4. Universal test fixture
5. Function generator
6. Digital voltmeter (DVM)

2. TEST SETUP

The test setup is shown in figure 1.

3. ADJUSTMENT AND CHECKOUT PROCEDURE

1. Obtain the correct schematic for the hysteresis card being checked out. The dash number of the schematic must match the dash number on the card.
2. Adjustment and checkout procedure for only one of the four circuits on this card will be given since the others differ only in their input and output pin numbers.
3. Adjustment procedure - Circuit A
   A. Input is on pin D, output is on pin 6, and the inverted output is on pin E.

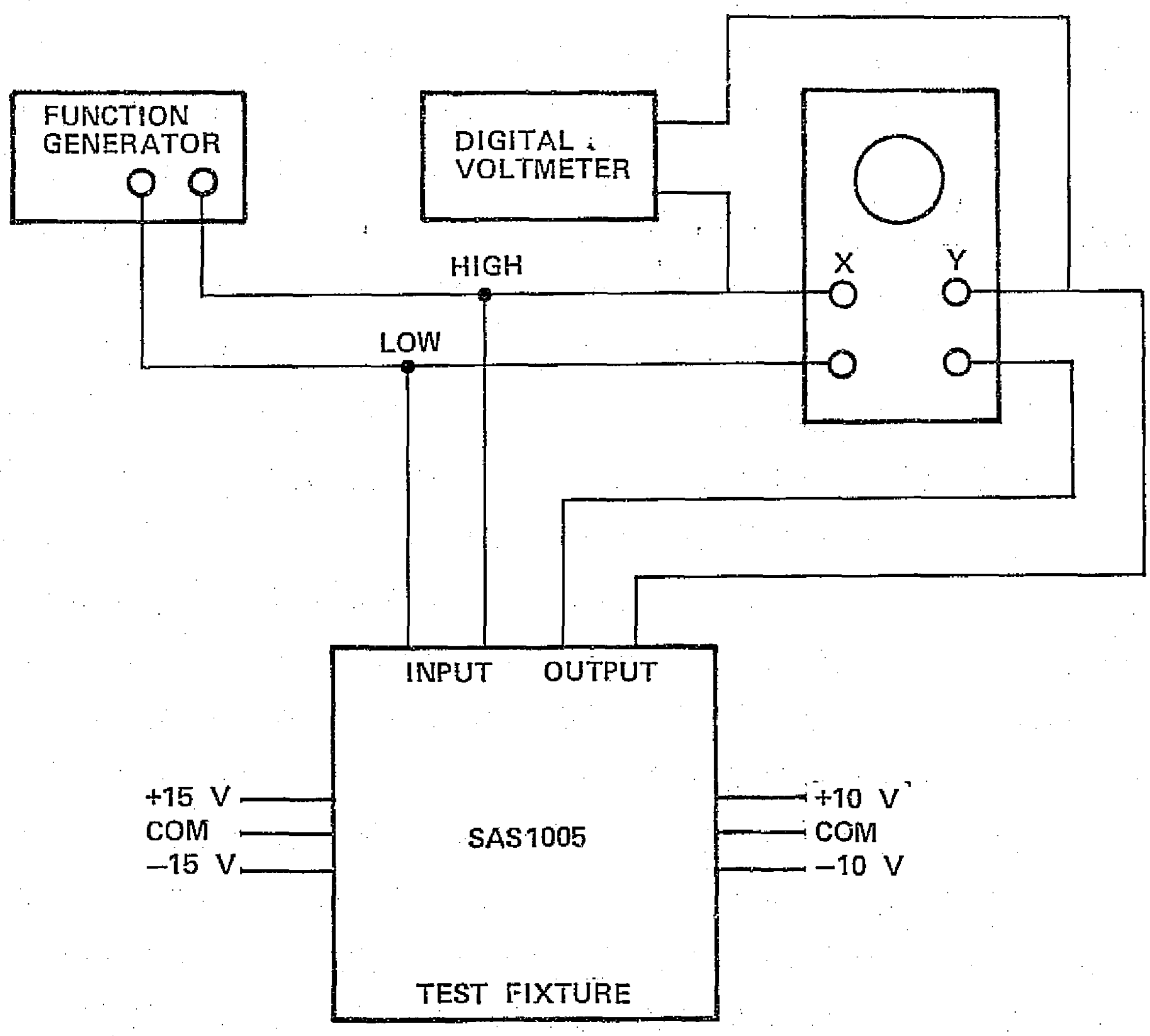


Figure 1. – Test setup.

B. Using a decade resistor box, select resistor R4 to be 100 kΩ.

C. With a ±1 V at 0.1 Hz triangle waveform signal into the input, adjust the offset pot R10 unit. The output waveform has a flat top and bottom. Repeat the procedure using a frequency of 0.02 Hz. The top and bottom may have a slight curve but it should look relatively flat. (See figure 2.)

D. After consulting the schematic to determine the correct amount of hysteresis, put an input triangle waveform of ±5 V at 0.1 Hz into the input and adjust the decade resistor box to obtain the correct hysteresis value. The hysteresis value is read from the DVM connected at pins 5 and F. (See figure 2.)

E. Repeat for the other three circuits

4. Checkout procedure

A. Make the required power supply voltage and current checks recording all data on the data sheets.

B. Using the X-Y oscilloscope or DVM and applying the input signals as shown on the data sheets, measure the plus and minus half hysteresis in volts and record the data in the column "Hysteresis." Observe the hysteresis and record in the column marked "Correct waveform." The hysteresis is the voltage between the two points where the signal crosses the X axis.

C. Repeat for the other three circuits.

D. Exercise care concerning board cleanliness. Board is sensitive to flux and resin.

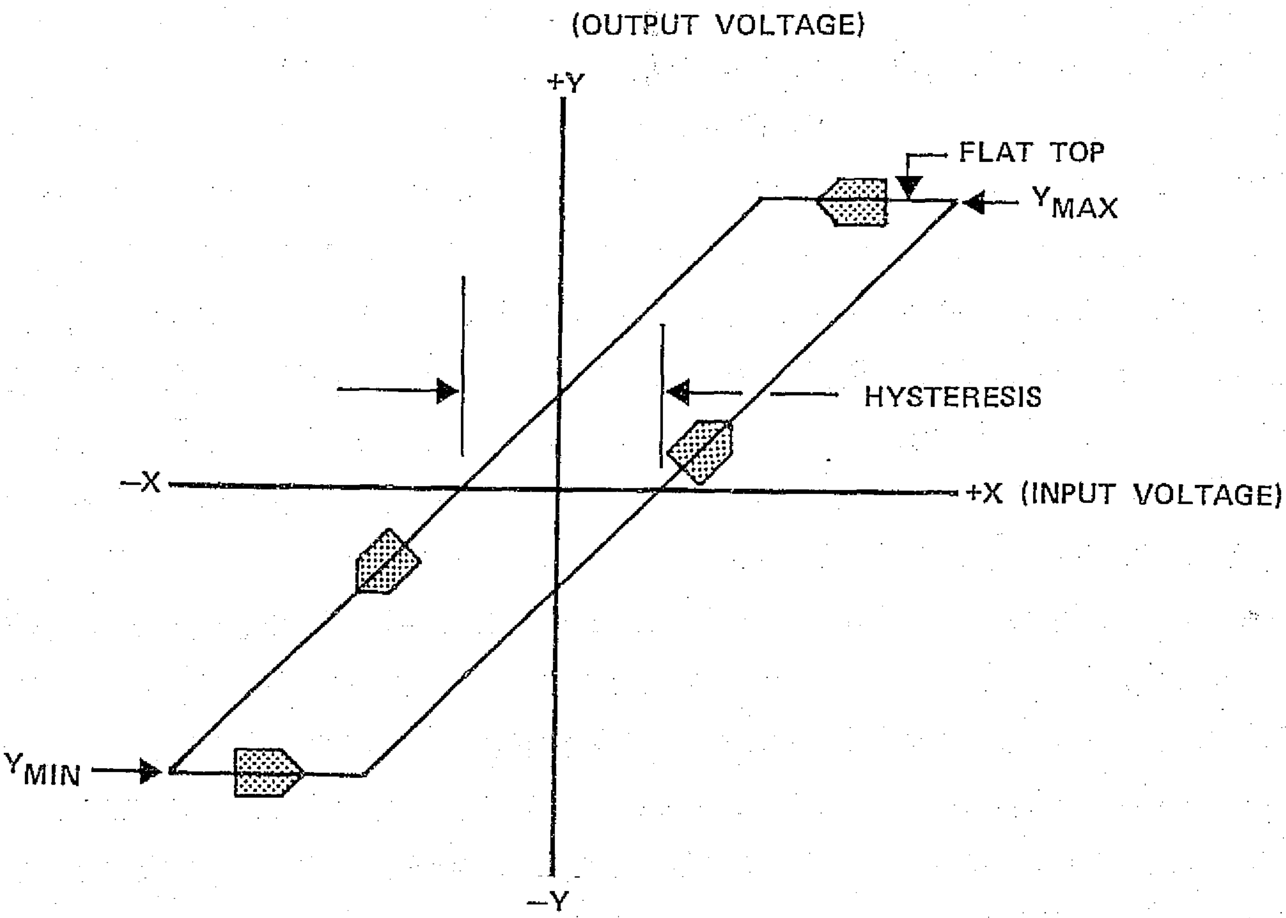


Figure 2. — Hysteresis curve.

DATA SHEET
SAS1005

Serial number ____________ Revision ____________ Date ____________

Checked by ____

Power supply checks:

Voltage checks

+15 V :	14.950 V <	____________	< 15.050 V
-15 V :	-15.050 V <	____________	<-14.950 V
+10 V :	9.990 V <	____________	< 10.010 V
-10 V :	-10.010 V <	____________	< -9.990 V

Current checks

+15 V :	____________	mA
-15 V :	____________	mA
±15 V COM :	____________	mA
+10 V :	____________	mA
-10 V :	____________	mA
±10 V COM :	____________	mA

DATA SHEET - Continued
SAS1005
PERFORMANCE CHECKS

Serial number __________

CIRCUIT A

Hysteresis check

V_{IN} (triangle wave)	Hysteresis	Correct waveform
1. 10 Hz at ±10 V	+ ________ V	________
	- ________ V	
2. 1 Hz at ±10 V	+ ________ V	________
	- ________ V	
3. 0.1 Hz at ±10 V	+ ________ V	________
	- ________ V	
4. 1 Hz at ±1 V	+ ________ V	________
	- ________ V	

CIRCUIT B

1. 10 Hz at ±10 V	+ ________ V	________
	- ________ V	
2. 1 Hz at ±10 V	+ ________ V	________
	- ________ V	
3. 0.1 Hz at ±10 V	+ ________ V	________
	- ________ V	
4. 1 Hz at ±1 V	+ ________ V	________
	- ________ V	

DATA SHEET - Concluded
SAS1005

CIRCUIT C

V_{IN} (triangle wave)	Hysteresis	Correct waveform
1. 10 Hz at ±10 V	+ ________ V	________
	- ________ V	
2. 1 Hz at ±10 V	+ ________ V	________
	- ________ V	
3. 0.1 Hz at ±10 V	+ ________ V	________
	- ________ V	
4. 1 Hz at ±1 V	+ ________ V	________
	- ________ V	

CIRCUIT D

1. 10 Hz at ±10 V	+ ________ V	________
	- ________ V	
2. 1 Hz at ±10 V	+ ________ V	________
	- ________ V	
3. 0.1 Hz at ±10 V	+ ________ V	________
	- ________ V	
4. 1 Hz at ±1 V	+ ________ V	________
	- ________ V	

SUBASSEMBLY TEST PROCEDURES

SAS/SIS INTERFACE

SAS1006A

1. Measure and record the ±15 voltage and current.

2. Jumper pins 14 and 15 to ground.
   Monitor pin A with a digital voltmeter (DVM) with an accuracy of ±0.1 mV or better.
   Adjust offset pot R8 until the minimum voltage reading on pin A or TP7 is obtained. Record the offset voltage reading. Put LOC-TITE or GLYPTOL on the pot adjustment screw.

3. Using an accurate voltage source (±0.1 mV or better), vary the input voltage to pins 14 and 15 as shown on the data sheet and record the output voltages.

4. Jumper pins X and K to ground.
   Monitor pin 16 or TP3 with DVM, adjust R17 for minimum offset voltage, and record on the data sheet.
   Monitor pin 17 or TP2 with DVM, adjust R15 for minimum offset voltage, and record on the data sheet.
   Monitor pin 2 or TP10 with DVM, adjust R27 for minimum offset, and record on the data sheet.
   Monitor pin 3 or TP9 with the DVM, adjust R25 for minimum offset, and record on the data sheet.

5. Using an accurate voltage source, vary the input to pins X and K as shown on the data sheet.
   Record the output voltages.

DATA SHEET
SAS1006A

Serial number ____________ Revision ____________ Date ____________

Checked by ____

1. +15 V ________________ +15 current ________________

   -15 V ________________ -15 current ________________

2. Offset voltage ____________________________
   (pin A)

3. V_{IN} (pins 14 and 15) V_{OUT} (pin A)

V_{IN} (pins 14 and 15)	V_{OUT} (pin A)
+10.000	____________
+ 8.000	____________
+ 6.000	____________
+ 4.000	____________
+ 2.000	____________
+ 1.000	____________
0.000	____________
- 1.000	____________
- 2.000	____________
- 4.000	____________
- 6.000	____________
- 8.000	____________
-10.000	____________

DATA SHEET - Concluded

SAS1006A

4. Offset voltage pin 16 or TP3 ______________________

Offset voltage pin 17 or TP2 ______________________

Offset voltage pin 2 or TP10 ______________________

Offset voltage pin 3 or TP9 ______________________

5.

V_{IN} (pins X and K)	Differential V_{OUT} (pins 17+ and 16-)	Differential V_{OUT} (pins 3+ and 2-)
+10.000		
+ 8.000		
+ 6.000		
+ 4.000		
+ 2.000		
+ 1.000		
0.000		
- 1.000		
- 2.000		
- 4.000		
- 6.000		
- 8.000		
-10.000		

SUBASSEMBLY TEST PROCEDURE
POWER SPOOL DRIVER
SAS1007

1. PURPOSE

The purpose of this test is to verify conformance with paragraphs 3.2.1.12.2, 3.2.1.12.2.1, and 3.2.1.12.2.2 of MC621-0014 and to demonstrate conformance with small signal, gain-phase characteristics of the implementation model.

2. TEST EQUIPMENT

1. Variable dc power supply 0 to 10 volts
   Power Designs Model 205 or equivalent
2. Four and one-half-digit digital multimeter
   Nonlinear Systems Series X-2 or equivalent
3. Waveform generator
   Wavetek 154 or equivalent
4. Gain-phase meter
   HP-3575A or equivalent
5. Oscilloscope
   Tektronix 503 or equivalent
6. Control valve module test fixture

3. TEST METHOD

1. Insert board in J1 of test fixture and apply power. Measure and record supply voltages.

2. Perform offset adjustment

3. Perform isolation (ISO) valve and fault insertion checkout.

4. Perform locked power spool checkout.

5. Perform frequency response checkout.

DATA SHEET
SAS1007

Serial number ____________________ Date ____________________

Operator ______________________________

Summary of results:

1. Power on Good ____________________
2. Offset adjustment Good ____________________
3. ISO and fault check Good ____________________
4. Locked spool check Good ____________________
5. Frequency response Good ____________________

Data reviewed by
system engineer ____________________

DATA SHEET - Continued

SAS1007

1. Power-on checkout

   Insert board in J1 of test fixture and apply power.

   -10.01< ______________________________ < -9.99

   9.99< ______________________________ < 10.01

   -15.10< ______________________________ <-14.90

   14.90< ______________________________ < 15.10

2. Offset adjustment

   A. Gound pins 2 and 16.

   B. Apply +10.0 V to pins 20 and 18.
      Apply -10.0 V to pin 17.

   C. Switch ISO and fault down.

   D. Monitor TP1 and null using R67.

   -0.010< ______________________________ <0.010

3. Isolation valve and fault insertion checkout

   A. Patch pin 7 to +10 V.

   B. Switch ISO to true.

   C. Patch variable dc supply to pin 16. Measure and record.

DATA SHEET - Continued

SAS1007

dc supply	Actual supply	TP3	TP1 (0.0 ± 0.5 V)
-10.00			
-8.00			
-6.00			
-4.00			
-2.00			
0.00			
2.00			
4.00			
6.00			
8.00			
10.00			

NOTE: TP3 should be within ±20 mV of the dc supply actual.

D. Switch fault to true. Measure pin 8.

-0.5< ______________________________ <0.50 V

E. Switch ISO down. Measure pin 8.

+9.90< ______________________________ <10.10

F. Switch fault down. Measure pin 8.

-10.10< ______________________________ <-9.90

4. Locked power spool test

A. Patch pin 16 to ground.

B. Patch pin 2 to variable dc supply.

DATA SHEET - Continued
SAS1007

C. Measure and record at test points 1, 2, and 6.

Pin 2 ±0.01 V	TP1	TP2	TP6
-10.00			
-8.00			
-7.00			
-6.00			
-4.00			
-2.00			
-1.00			
0.00			
1.00			
2.00			
4.00			
6.00			
7.00			
8.00			
10.00			

Compare data to standard

TP1 data is good. yes _____ no _____

TP2 data is good. yes _____ no _____

TP6 data is good. yes _____ no _____

DATA SHEET - Continued

SAS1007

5. Frequency response checkout

   A. Patch - XPS to SFS.

   B. Patch - P1 to F1.

   C. Patch J2-Pin 14 to +10 V.

   D. Patch waveform generator to pin 2.

   E. Patch channel A of the gain-phase meter to pin 2.

   F. Patch channel B of the gain-phase meter to pin 16.

   G. Set up gain-phase meter.

Switch	Setting
Channel A	2 mV to 20 V
Channel B	2 mV to 20 V
Frequency	1 to 1 k
Phase	A
Amplitude function	A

   H. Set up waveform generator.

Frequency	1.00 x 1
dc offset	0.0
Amplitude	4.00 x 1
Sine wave	

   I. Measure gain-phase at 1.00 Hz

Amplitude A	8.2<__________<9.2
Amplitude B	7.5<__________<8.5
Phase	178<__________<180

DATA SHEET - Concluded
SAS1007

J. Frequency response data

Frequency (Hz)	B/A	Phase
1.00		
2.		
5.		
10.		
20.		
40.		
50.		
60.		
70.		
80.		
90.		
100.		
120.		
150.		
200.		
250.		
300.		
350.		
400.		
500.		
600.		
700.		
800.		
900.		
1000.		

Compare data to standard

B/A (gain) data is good. yes _____ no _____

Phase data is good. yes _____ no _____

SUBASSEMBLY TEST PROCEDURE

POWER SPOOL

SAS1008

1. PURPOSE

The purpose of this test is to verify conformance with small signal, gain-phase characteristics of the implementation model and with the correct valve dimensions.

2. TEST EQUIPMENT

1. Variable dc power supply 0 to 10 volts
   Power Designs Model 205 or equivalent
2. Four and one-half-digit digital multimeter
   Nonlinear Systems Series X-2 or equivalent
3. Waveform generator
   Wavetek 154 or equivalent
4. Gain-phase meter
   HP-3575A or equivalent
5. Oscilloscope
   Tektronix 503 or equivalent
6. Control valve module test fixture

3. TEST METHOD

1. Insert board in J2 of test fixture and apply power. Measure and record supply voltages.
2. Perform adjustments procedure on U3 and U4.
3. Dead zone checkout.
4. Perform frequency response checkout.

4. INITIAL SETUP

1. Connect F1 to ground.
2. Connect PV to ground.
3. Insert standard power spool driver (SAS1007) in J1.

DATA SHEET
SAS1008

Serial number ____________________ Date ____________________

Operator ____________________

Summary of results:

1. Power-on check — Good ____________________
2. Adjustments procedure — Good ____________________
3. Dead zone check — Good ____________________
4. Frequency response — Good ____________________

Data reviewed by
system engineer ____________________

DATA SHEET - Continued

SAS1008

1. Power-on checkout

Insert board in J2 of the test fixture and apply power ON.

-10.01<____________________< -9.99

9.99<____________________< 10.01

-15.10<____________________<-14.90

14.90<____________________< 15.10

2. Adjustment procedure on U3 and U4

A. Adjustment of U4

1. Short across R33 by jumpering across the resistor with clip leads.

2. Jumper switch across C12.

3. Adjust R35 until U4 drifts to negative limit.

-10.10<________________<-9.90 volts

4. Adjust R35 until U4 drifts to positive limit.

+9.90<________________<+10.10 volts

5. Adjust R35 until there is no drift after resetting the integrator using the jumper switch.

-0.005<________________<0.005 volts/second

B. Adjustment of U3

1. Connect F1 to ground.

2. Connect PV to ground.

3. Remove jumper switch from C12 and jumper across C5.

4. Adjust R24 until there is no drift after resetting integrator using the jumper switch.

-0.005<________________<0.005 volts/seconds

DATA SHEET - Continued
SAS1008

3. Dead zone checkout

   A. Apply 10.0 volts to PV.

   B. Remove jumper from R33 and switch from C5.

   C. Apply a 1.0 V ± 0.1 V peak-to-peak triangular wave to F1.

   D. With scope in X-Y mode, connect TP6 to the X-input and connect TP1 to the Y-input.

   E. Observe and record dead zone

   -0.160< ______________________________ <-0.148 volts

   0.148< ______________________________ <0.160 volts

4. Frequency response checkout

   A. Connect P1 to F1

   B. Connect XPS to SFS

   C. Patch waveform generator to IHST and to channel A of the gain-phase meter.

   D. Patch channel B of the gain-phase meter to XPS.

   E. Set up the gain-phase meter.

Switch	Setting
Channel A	2 mV to 20 V
Channel B	2 mV to 20 V
Frequency	1 to 1 k
Phase	A
Amplitude function	A

DATA SHEET - Continued
SAS1008

F. Set up the waveform generator

Switch	Setting
Frequency	1.00 x 1
dc offset	0.0
Amplitude	4.00 x 1
Function	∿

G. Measure gain-phase at 1.00 Hz

Amplitude A	8.2<	______________	<9.2
Amplitude B	7.5<	______________	<8.5
Phase	178<	______________	<180

H. Set amplitude function to B/A. Measure and record gain and phase data.

DATA SHEET - Concluded

SAS1008

Frequency (Hz)	B/A	Phase
1.00		
2.		
5.		
10.		
20.		
40.		
50.		
60.		
70.		
80.		
90.		
100.		
120.		
150.		
200.		
250.		
300.		
350.		
400.		
500.		
600.		
700.		
800.		
900.		
1000.		

Compare data to standard

B/A (gain) data is good. yes __________ no __________

Phase data is good. yes __________ no __________

SUBASSEMBLY TEST PROCEDURE
HYDRAULIC PRESSURE SOURCE
SAS1009-1

1. PURPOSE

The purpose of this procedure is to test the circuitry required to simulate the hydraulic power supply and to simulate motor failures in the rudder, speedbrake, and body flap simulated subsystems.

2. TEST EQUIPMENT REQUIRED

1. Four and one-half-digit digital voltmeter
2. +15 Vdc power supply
3. -15 Vdc power supply
4. +10 Vdc power supply
5. Multimeter

3. SETUP

1. Insure that all power supplies to be used are turned OFF and voltage adjustment knobs are set to minimum voltage. Connect +15, +10, and -15 Vdc supplies as shown in figure 1. Set switches S5 through S17 to hydraulic pressure. Set S16 and S17 to 0, S20 and S21 to 1.
2. Insert the hydraulic pressure source card SAS1009 into the test fixture with the component side facing switches S16, S17, S20, and S21.
3. Set S18 to the +15 position and turn +15 V power supply ON. Adjust for +15.0 ± 0.2 Vdc on the digital voltmeter.

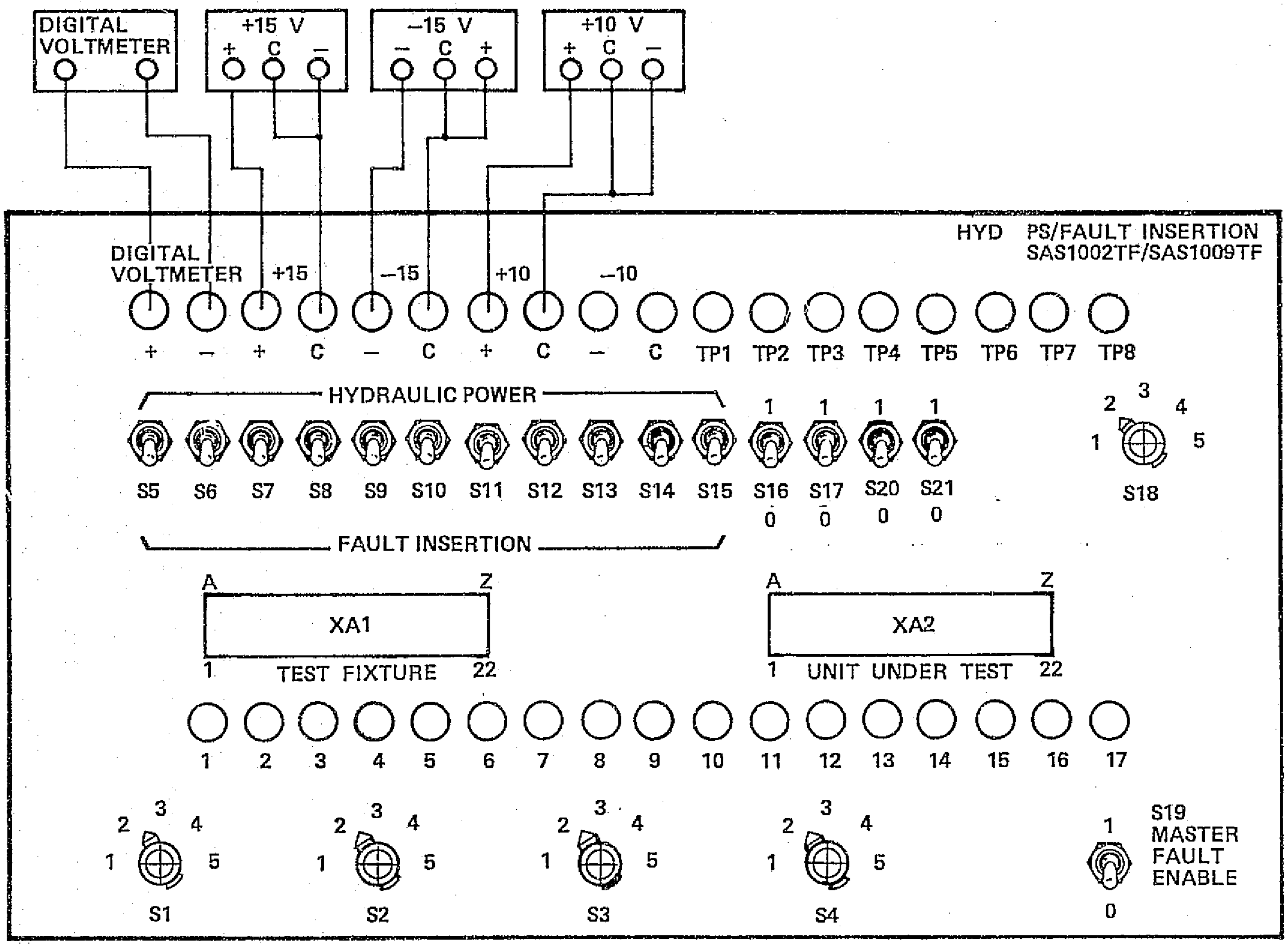


Figure 1. — Test interconnection.

4. Set S18 to the -15 position and turn -15 V power supply ON. Adjust for -15.0 ± 0.2 Vdc on the digital voltmeter.

5. Set S18 to the +10 position and turn +10 V power supply ON. Adjust for +10.00 ± 0.01 Vdc on the digital voltmeter.

6. Set S18 to OFF.

NOTE: Should any of the power supply voltages fail to come up check power supply current limit.

4. TEST PROCEDURES

1. Close S1-1 and open S1-2 and S1-3. Set all S2 switches open and all S3 switches open.

NOTE: The 1 position of a switch module is the switch which connects pin 1 to 6, the -2 position connects pin 2 to 5, and the -3 position connects pin 3 to 4.

2. Using the digital voltmeter, connect the "volts" lead to test fixture TP5 and observe +10.0 ± 0.3 Vdc. (record)

3. Connect the voltage lead of the digital voltmeter to test fixture TP6 and observe +15.0 ± 0.3 Vdc. (record)

4. Connect the voltage lead of the digital voltmeter to TP3 and then TP4 and observe +10.0 ± 0.1 Vdc. (record)

NOTE: If this reading is out of tolerance, recheck +10 V power supply input as per step 5 above. Readjust if necessary and repeat the preceding step. Fail after repeating once.

5. Connect the voltage lead of the digital voltmeter to TP1 and then TP2 and observe -10.0 ± 0.1 Vdc. (record)

6. Set S1-1 open and close S1-2. Connect digital voltmeter "volts" lead to TP3. Rotate R15 fully clockwise (CW) and observe that TP3 measures +9.9 ± 0.1 Vdc. (record)

7. Slowly adjust R15 fully counter clockwise (CCW) and observe that during adjustment periods the digital voltmeter changes smoothly (no discontinuities). (check)

8. Observe that digital voltmeter displays $6.7\ {}^{+0.3}_{-0.4}$ Vdc. (record)

9. Set S1-1 and S1-2 open and close S1-3. Observe that the digital voltmeter now displays +10.4 ± 0.3 Vdc. (record)

10. Connect the "volts" lead of the digital voltmeter as per table 1. Set the switches as shown and observe the voltage indicated.

11. Certify that all the requirements of this test procedure have been met (check by initialing).

TABLE 1. – TEST TABLE

S2-1	S2-2	S2-3	S3-1	S3-2	S3-3	Check test point	Voltage	Remarks
Close	Open	Open	Open	Open	Open	TP8	10.0 ± 0.5 V	(Record)
Open	Close	Open	Open	Open	Open	TP7	10.0 ± 0.5 V	(Record)
Open	Open	Close	Open	Open	Open	TP9	10.0 ± 0.5 V	(Record)
Open	Open	Open	Close	Open	Open	TP8	10.0 ± 0.5 V	(Record)
Open	Open	Open	Open	Close	Open	TP7	10.0 ± 0.5 V	(Record)
Open	Open	Open	Open	Open	Close	TP9	10.0 ± 0.5 V	(Record)

DATA SHEET
SAS1009-1

Serial number ____________ Revision ____________ Date ____________

Checked by ____

NOTE: Only those paragraphs which require data entries will be shown.

DATA SHEET - Concluded
SAS1009-1

Serial number ____________

Date ______________________

4. TEST PROCEDURES

2.	TP5 voltage	____________	(+9.7 to 10.3 Vdc)
3.	TP6 voltage	____________	(+14.7 to +15.3 Vdc)
4.	TP3 voltage	____________	(+9.9 to +10.1 Vdc)
	TP4 voltage	____________	(+9.9 to +10.1 Vdc)
5.	TP1 voltage	____________	(-9.9 to -10.1 Vdc)
	TP2 voltage	____________	(-9.9 to -10.1 Vdc)
6.	TP3 voltage	____________	(+9.8 to +10.0 Vdc)
7.	Digital voltmeter changes smoothly	____________	(check)
8.	Digital voltmeter displays	______	(6.4 to 7.1 Vdc)
9.	Digital voltmeter displays	______	(+10.1 to +10.7 Vdc)
10.	TP8 (S2-1 closed)	____________	(9.5 to 10.5 Vdc)
	TP7 (S2-2 closed)	____________	(9.5 to 10.5 Vdc)
	TP9 (S2-3 closed)	____________	(9.5 to 10.5 Vdc)
	TP8 (S3-1 closed)	____________	(9.5 to 10.5 Vdc)
	TP7 (S3-2 closed)	____________	(9.5 to 10.5 Vdc)
	TP9 (S3-3 closed)	____________	(9.5 to 10.5 Vdc)

11. All requirements of this test procedure have been met.

____
(initial)

SUBASSEMBLY TEST PROCEDURE
SAS TO/FROM TOC INTERFACE
SAS1010A

1. PURPOSE

The purpose of this test is to verify the circuit operation of the various circuits on the board. There is only one adjustment to be made. The offset of the initial condition to the X_{R0} circuit must be made with 2.500 volts input. The output should be 0.000 volts. If not, adjust pot R43. All other tests are "GO/NO GO" type tests.

2. TEST EQUIPMENT REQUIRED

The following test equipment is required. Equivalent items may be substituted and variations to test setup and procedures may be used to verify that the circuits meet the requirements.

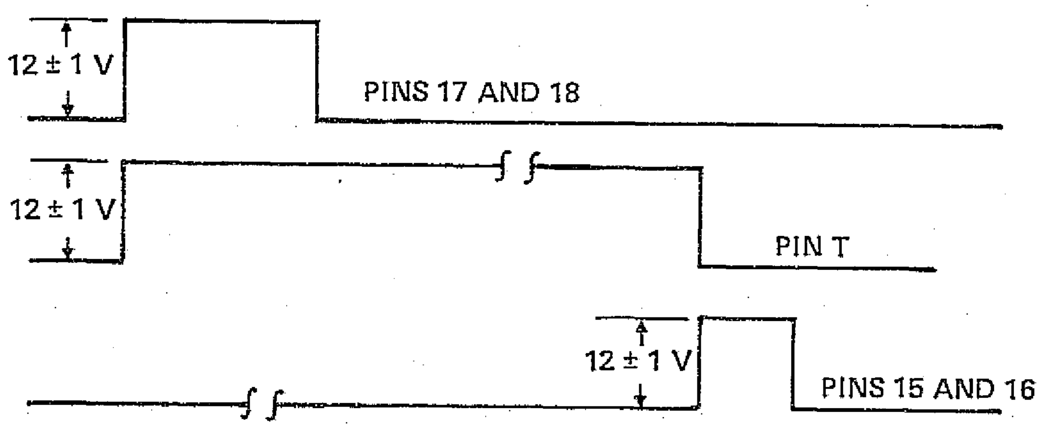
1. Two digital voltmeters of 10,000 ± .001 V range
2. Two function generators, one with external input
3. ±15 Vdc power supply
4. +10 Vdc power supply
5. Voltage/current calibrator
6. Test fixture

3. TEST METHODS

1. Measure voltages and currents and record in the appropriate place on the data sheet.
2. Tie pins J, H, and F together. Apply the voltages called for on the data sheet and record the outputs.

3. Connect voltage source across U and V, with U low and tied to ±15 volt common. Apply 2.500 volts and adjust offset pot R43 until the output at pin L reads 0.000. Then apply the voltages as called out on the data sheet and record the output data. Also verify that pin K has the same output as pin L.

4. Refer to figure 1 for test configuration. The input to pins 17 and 18 is a transistor-transistor logic (TTL) level and is used to set the "Q" output of U2 to a high level. The input to pins 16 and 15 is delayed and is used to "Reset" the "Q" output to a low level (pin T). A scope is used to monitor the output. The pulse shape should be as follows:



The pulse repetition rate may be any convenient value. In actual use the time that "T" remains high may be several minutes, but for testing, a faster rate may be used for ease in observing the waveform on the scope.

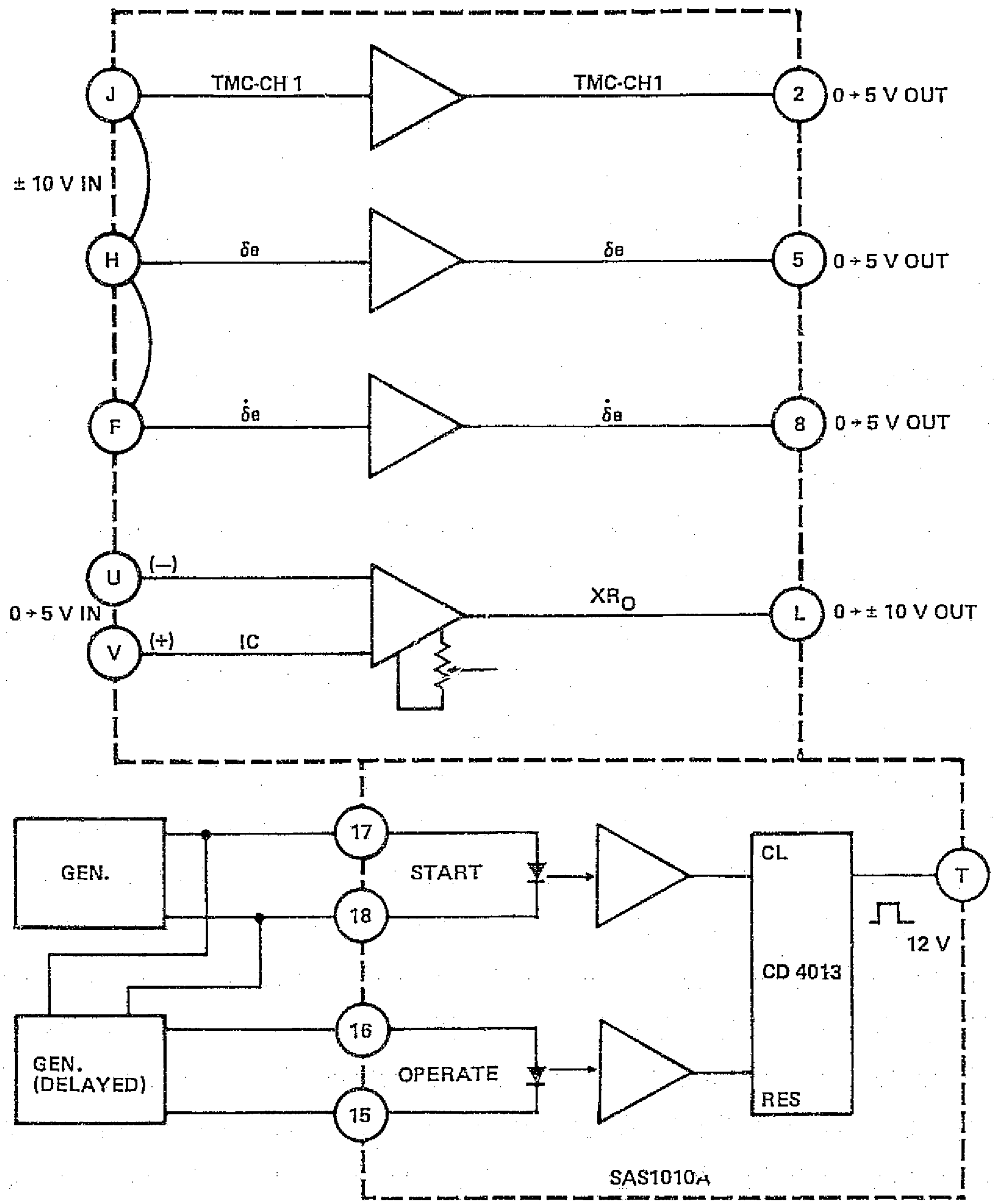


Figure 1. — Test setup schematic.

DATA SHEET

SAS1010A

Serial number ____________ Revision ____________ Date ____________

Checked by ____

1. Power supply Voltage Current

Power supply	Voltage	Current	
+15 Vdc	________	________	(30 mA)
-15 Vdc	________	________	(20 mA)
+10 Vdc	________	________	(5 mA)

2. SAS to TOC section (inputs J, H, and F tied together)

Input voltage (±1 mV)	Actual output voltage			Required output voltage
	Pins 2 and 3	Pins 5 and 6	Pins 8 and 9	
+10.000	______	______	______	5.000 ± .050
+8.000	______	______	______	4.500
+6.000	______	______	______	4.000
+4.000	______	______	______	3.500
+2.000	______	______	______	3.000
+1.000	______	______	______	2.750
0.000	______	______	______	2.500
-1.000	______	______	______	2.250
-2.000	______	______	______	2.000
-4.000	______	______	______	1.500
-6.000	______	______	______	1.000
-8.000	______	______	______	0.500
-10.000	______	______	______	0.000

DATA SHEET — Concluded

SAS1010A

Input to pins U and V		Output voltage (typical)	Output voltage actual
2.500	Adjust R43 to	0.000	______
0.000		-10.000	______
0.500		-8.000	______
1.000		-6.000	______
1.500		-4.000	______
2.000		-2.000	______
2.500		0.000	______
3.000		+2.000	______
3.500		+4.000	______
4.000		+6.000	______
4.500		+8.000	______
5.000		+10.000	

SUBASSEMBLY TEST PROCEDURE
DROPPED PRESSURE CARD
SAS1011

1. PURPOSE

The purpose of this test procedure is to adjust the offset of the multipliers and to verify static gain and linearity performance. The circuits must be in conformance with SD74-SH-0324A, figure 3.

2. TEST EQUIPMENT REQUIRED

1. Variable dc power supply, 0 to 10 V. Power Designs Model 205 or equivalent.
2. Four and one-half-digit digital multimeter. Non-linear Systems Series X-2 or equivalent.
3. Waveform generator — Wavetek 154 or equivalent.
4. Oscilloscope — Tektronix 503 or equivalent.

3. TEST METHOD

1. Power-on checks
2. Q_L^2 offset adjustment
3. P_s' checks
4. P_s checks
5. P_v checks

DATA SHEET

SAS1011

Serial number ______________ Date ______________

Operator ______________________________

Summary of results:

1. Power-on checks Good ______________
2. Offset adjustment Good ______________
3. P_s' checks Good ______________
4. P_s checks Good ______________
5. P_v checks Good ______________

Data reviewed by
system engineer ______________________________

DATA SHEET – Continued
SAS1011

1. Power-on checks

The test setup is shown in figure 1.

Measure and record below all power supply voltages and currents.

+14.90< ____________________ <+15.10

-15.10< ____________________ <-14.90

+ 9.99< ____________________ <+10.01

-10.01< ____________________ < -9.99

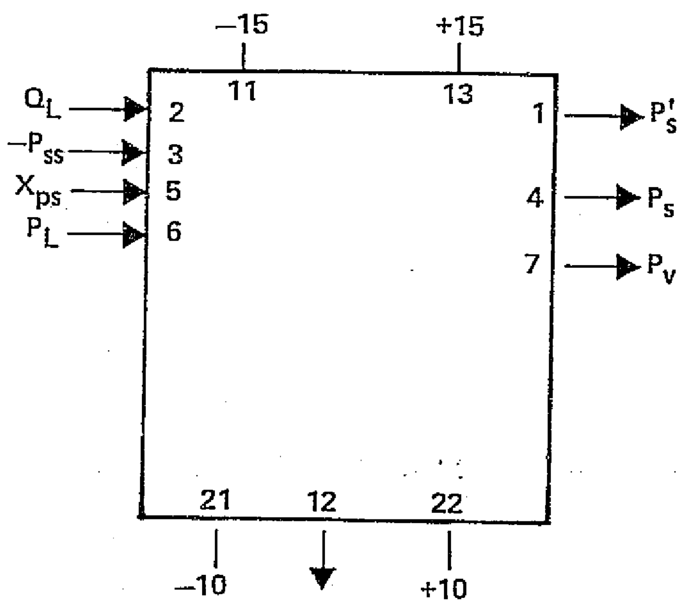


Figure 1. – Test setup.

2. Offset adjustment

A. Ground pin 2. Measure and record voltage at TP2.

-0.005< ____________________ <0.005

B. Observe TP3. Adjust R6 until the voltage at TP3 is less than 2.5 mV.

-0.0025< ____________________ <0.0025

DATA SHEET — Continued

SAS1011

3. P_s' checks

   A. Connect $-P_{ss}$ (pin 3) to -10.00 V.

   B. Connect Q_L (pin 2) to variable dc supply (observe input at TP1).

   C. Measure and record voltages at TP4.

Q_L (pin 2)	P_s' (TP4)	
-10.000	5.029<	< 5.129
- 8.000	6.781<	< 6.881
- 6.000	8.148<	< 8.248
- 4.000	9.129<	< 9.229
- 2.000	9.725<	< 9.825
0.000	9.936<	<10.036
+ 2.000	9.725<	< 9.825
+ 4.000	9.129<	< 9.229
+ 6.000	8.148<	< 8.248
+ 8.000	6.781<	< 6.881
+10.000	5.029<	< 5.129

4. P_s checks

   A. Connect $-P_{ss}$ (pin 3) to -10.00 V.

   B. Connect Q_L (pin 2) to variable dc supply (observe input at TP1).

   C. Measure and record voltages at TP5.

DATA SHEET — Continued

SAS1011

Q_L (TP1)	P_S (TP5)	
-10.000	4.191<	< 4.291
- 8.000	6.243<	< 6.343
- 6.000	7.844<	< 7.944
- 4.000	8.993<	< 9.093
- 2.000	9.690<	< 9.790
0.000	9.936<	<10.036
2.000	9.690<	< 9.790
4.000	8.993<	< 9.093
6.000	7.844<	< 7.944
8.000	6.243<	< 6.343
10.000	4.191<	< 4.291

5. P_v checks

   A. Comparator and switch checks.

      1. Apply +10.000 V to P_L (pin 6).

      2. Apply a triangular wave of approximately 2.0 V peak-to-peak at 1.0 Hz to pin 5.

      3. With oscilloscope configured in X-Y mode, connect X input to the waveform generator and the Y input to TP6.

      4. Measure and record comparator switching points

         -0.175< ______________________ <0.0

         -0.0< ______________________ <0.025

      5. Apply -10.0 to pin 5. Measure and record voltage at TP6.

         -10.050< ______________________ <-9.950

DATA SHEET — Concluded

SAS1011

6. Apply +10.0 to pin 5. Measure and record voltage at TP6.

   +9.950< ______________________ <10.050

B. P_V static checks

1. Apply -10.000 V to P_L (pin 6).
2. Apply +10.000 V to X_{ps} (pin 5).
3. Apply -10.000 V to $-P_{ss}$ (pin 3).
4. Apply +10.000 V to Q_L (pin 2).
5. Measure and record voltage at

TP2,	10.005<	______________	< 9.995
TP3,	10.050<	______________	< 9.950
TP5,	0.318<	______________	< 0.518
TP6,	-10.005<	______________	<-9.995
TP7,	-9.678<	______________	<-9.486

SUBASSEMBLY TEST PROCEDURE
DROPPED PRESSURE CARD
SAS1011-1

1. PURPOSE

The purpose of this test procedure is to adjust the offset of the multipliers and to verify static gain and linearity performance. The circuits must be in conformance with SD74-SH-0324A, figure 3.

2. TEST EQUIPMENT REQUIRED

1. Variable dc power supply, 0 to 10 V. Power Designs Model 205 or equivalent.
2. Four and one-half-digit digital multimeter. Non-linear Systems Series X-2 or equivalent.
3. Waveform generator — Wavetek 154 or equivalent.
4. Oscilloscope — Tektronix 503 or equivalent.

3. TEST METHOD

1. Power-on checks
2. Q_L^2 offset adjust
3. P_s' checks
4. P_s checks
5. ρ_v checks

DATA SHEET
SAS1011-1

Serial number ____________ Date ______________

Operator ______________________________

Summary of results:

1. Power-on checks Good ____________
2. Offset adjustment Good ____________
3. P_s' checks Good ____________
4. P_s checks Good ____________
5. P_v checks Good ____________

Data reviewed by
system engineer ______________________________

DATA SHEET — Continued

SAS1011-1

1. Power-on checks

The test setup is shown in figure 1.

Measure and record below all power supply voltages and currents.

+14.90< ______________________________ <+15.10

-15.10< ______________________________ <-14.90

+ 9.99< ______________________________ <+10.01

-10.01< ______________________________ < -9.99

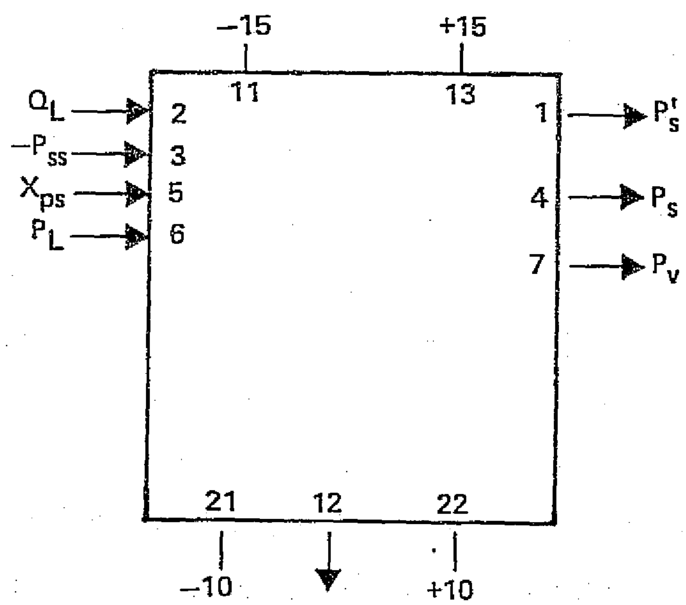


Figure 1. — Test setup.

2. Offset adjustment

A. Ground pin 2. Measure and record voltage at TP2.

-0.005< ______________________________ <0.005

B. Observe TP3. Adjust R6 until the voltage at TP3 is less than 2.5 mV.

-0.0025< ______________________________ <0.0025

DATA SHEET — Continued

SAS1011-1

3. P_s' checks

A. Connect $-P_{ss}$ (pin 3) to -10.00 V.

B. Connect Q_L (pin 2) to variable dc supply (observe input at TP1).

C. Measure and record voltages at TP4.

Q_L (pin 2)	P_s' (TP4)	
-10.000	4.489<	< 4.579
- 8.000	6.408<	< 6.538
- 6.000	7.906<	< 8.066
- 4.000	8.983<	< 9.165
- 2.000	9.640<	< 9.834
0.000	9.874<	<10.074
+ 2.000	9.640<	< 9.834
+ 4.000	8.983<	< 9.165
+ 6.000	7.906<	< 8.066
+ 8.000	6.408<	< 6.538
+10.000	4.489<	< 4.579

4. P_s checks

A Connect $-P_{ss}$ (pin 3) to -10.00 V.

B. Connect Q_L (pin 2) to variable dc supply (observe input at TP1).

C. Measure and record voltages at TP5.

DATA SHEET — Continued

SAS1011-1

Q_L (TP1)	P_S (TP5)	
-10.000	0.318<	< 0.518
- 8.000	3.800<	< 3.873
- 6.000	6.435<	< 6.565
- 4.000	8.237<	< 8.495
- 2.000	9.473<	< 9.665
0.000	9.874<	<10.074
2.000	9.473<	< 9.665
4.000	8.237<	< 8.495
6.000	6.435<	< 6.565
8.000	3.800<	< 3.873
10.000	0.318<	< 6.518

5. P_V checks

A. Comparator and switch checks.

1. Apply +10.000 V to P_L (pin 6).
2. Apply a triangular wave of approximately 2.0 V peak-to-peak at 1.0 Hz to pin 5.
3. With oscilloscope configured in X-Y mode, connect X input to the waveform generator and the Y input to TP6.
4. Measure and record comparator switching points

   -0.175< ______________________ <0.0

   -0.0< ______________________ <0.025

5. Apply -10.0 to pin 5. Measure and record voltage at TP6.

   -10.050< ______________________ <-9.950

DATA SHEET — Concluded
SAS1011-1

6. Apply +10.0 to pin 5. Measure and record voltage at TP6.

   +9.950< ________________ <10.050

B. P_V static checks

1. Apply -10.0 V to P_L (pin 6).
2. Apply +10.000 V to X_{ps} (pin 5).
3. Apply -10.000 V to $-P_{ss}$ (pin 3).
4. Apply +10.000 V to Q_L (pin 2).
5. Measure and record voltage at

TP2,	10.005<	________________	< 9.995
TP3,	10.050<	________________	< 9.950
TP5,	0.318<	________________	< 0.518
TP6,	-10.005<	________________	<-9.995
TP7,	-9.678<	________________	<-9.486

SUBASSEMBLY TEST PROCEDURE

LOAD FLOW

SAS1012

1. PURPOSE

The purpose of this test is to verify conformance with the flow-pressure characteristics of SD74-SH-0324A and the implementation model.

2. TEST EQUIPMENT

1. Variable dc power supply 0 to 10 volts. Power Designs Model 205 or equivalent.
2. Four and one-half-digit digital multimeter. Non-linear Systems Series X-2 or equivalent.
3. Waveform generator — Wavetek 154 or equivalent.
4. Oscilloscope — Tektronix 503 or equivalent.
5. Utility board fixture.

3. TEST METHOD

1. Perform power-on checks.
2. Perform offset adjustments.
3. Perform circuit A checkout.
4. Perform circuit B checkout.

DATA SHEET

SAS1012

Serial number ______________ Date ________________

Operator ____

Summary of results:

1. Power-on checks Good ______________
2. Offset adjustment Good ______________
3. Circuit A check Good ______________
4. Circuit B check Good ______________

Data reviewed by
system engineer ________________________________

DATA SHEET — Continued
SAS1012

1. Power-on checks

   A. Insert board in fixture and apply power as shown in figure 1.

   B. Measure and record power supply voltages.

      -10.005< ______________________ < -9.995

      9.995< ______________________ < 10.005

      -15.100< ______________________ <-14.900

      14.900< ______________________ < 15.100

2. Offset adjustment procedure

   A. Apply ground to edge connector pin A.

   B. Apply +10.00 volts to edge connector pin 8.

   C. Monitor TP4 and null using R14.
      Record null voltage.

      -0.005< ______________________ < 0.005 volts

3. Circuit A checkout

   A. Patch variable dc voltage supply to edge connector pin 8.

   B. Measure and record voltages at TP5 (ABSOLUTE VALUE).

Input	TP5 (nominal ±100mV)
-10.000	______________
-8.000	______________
-6.000	______________
-4.000	______________
-2.000	______________
0.000	______________
2.000	______________
4.000	______________

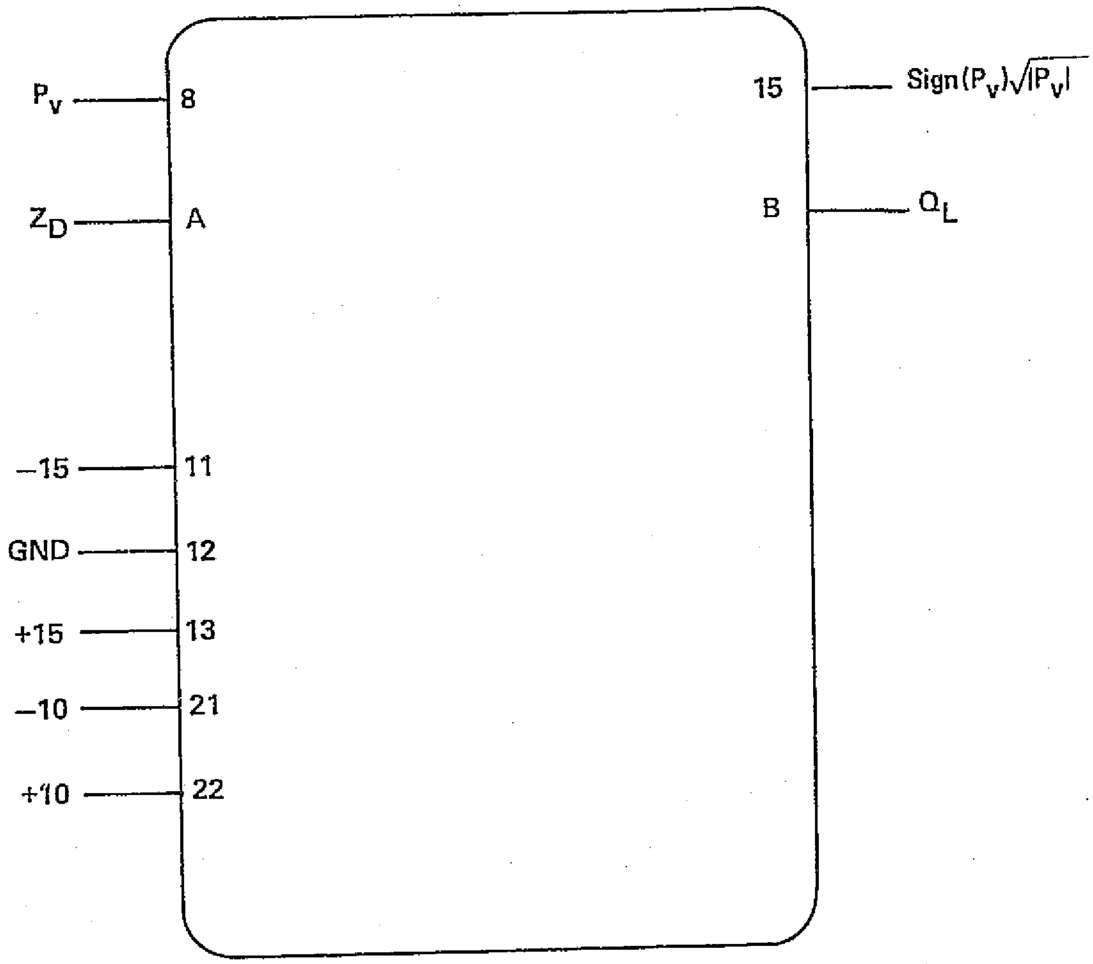


Figure 1. – Load flow board test configuration.

DATA SHEET — Continued

SAS1012

Input	TP5	(nominal ±100 mV)
6.000	______________	
8.000	______________	
10.000	______________	

C. Measure and record voltages at TP1.

Input	TP1		(nominal ±1% of reading)
-10.000	-10.100<	______________	<-9.900
-8.000	-9.034<	______________	<-8.855
-6.000	-7.823<	______________	<-7.668
-4.000	-6.388<	______________	<-6.261
-2.000	-4.517<	______________	<-4.427
0.000	-0.100<	______________	< 0.100
2.000	4.427<	______________	< 4.517
4.000	6.261<	______________	< 6.388
6.000	7.668<	______________	< 7.823
8.000	8.855<	______________	< 9.034
10.000	9.900<	______________	<10.100

4. Circuit B checkout

A. Patch +10.000 volts to edge connector pin 8.

B. Patch variable dc source to edge connector pin A.

C. Measure and record voltage at TP4. (Tolerance is ±1 percent of reading).

DATA SHEET - Concluded
SAS1012

Pin A (input)	Upper limit	TP4	Lower limit
10.000	-10.143		-10.348
8.000	- 8.114		- 8.278
6.000	- 6.085		- 6.209
4.000	- 4.057		- 4.139
2.000	- 2.028		- 2.070
1.000	- 1.014		- 1.035
0.000	0.010		- 0.010
- 1.000	1.035		1.014
- 2.000	2.070		2.028
- 4.000	4.139		4.057
- 6.000	6.209		6.085
- 8.000	8.278		8.114
-10.000	10.348		10.143

D. Apply -9.760 volts to connector pin A.

E. Apply a 10.0 volt peak 10 Hz triangular wave to connector pin 8.

F. With scope in X-Y mode connect X input to waveform generator and Y input to TP4.

G. Compare waveform to figure 2.
Waveform is/is not similar. (Circle one)

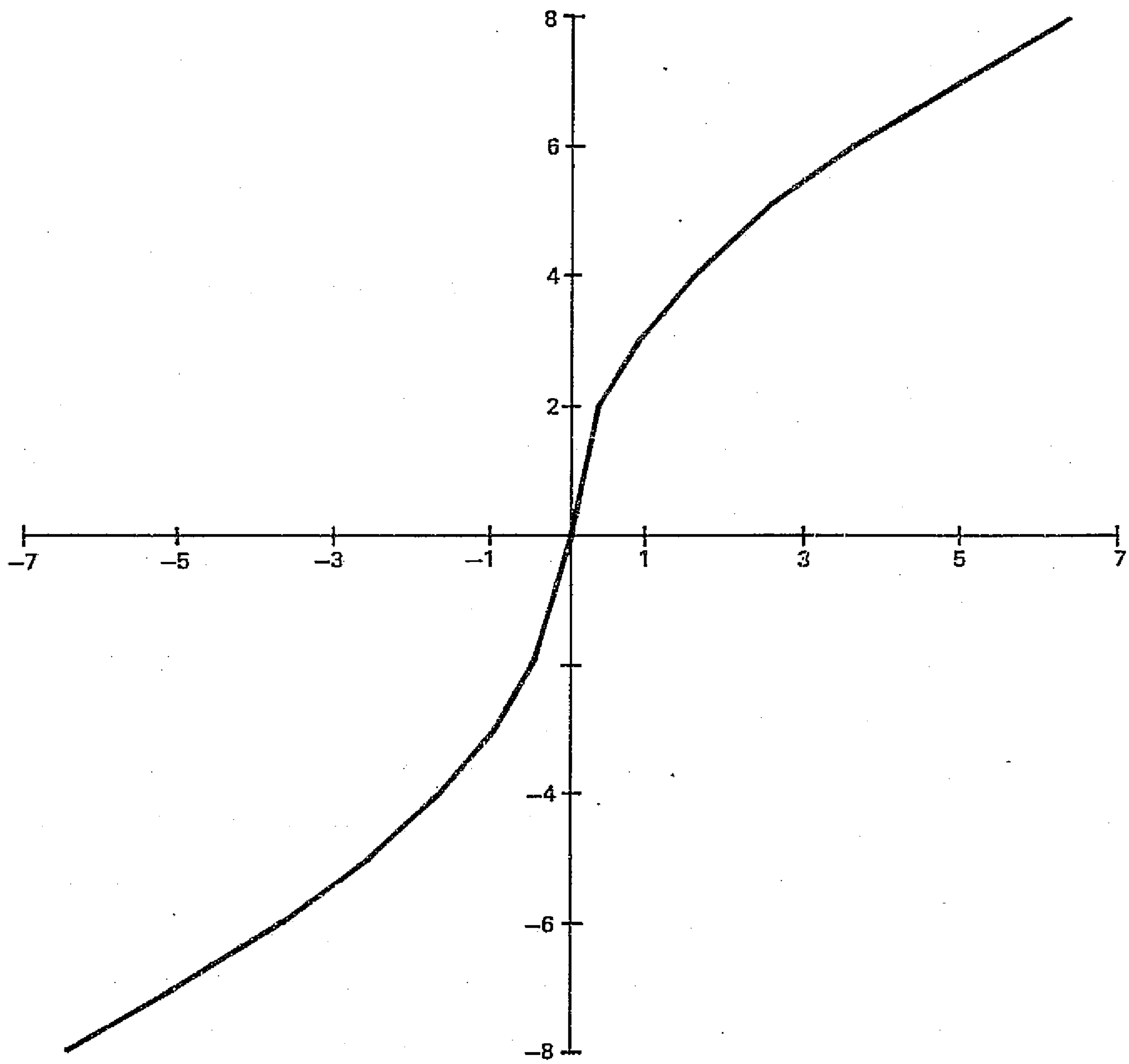


Figure 2. — Waveform at TP4 for step 5.G, SAS1012.

SUBASSEMBLY TEST PROCEDURE
LOAD FLOW
SAS1012-2

1. PURPOSE

The purpose of this test is to verify conformance with the flow-pressure characteristics of SD74-SH-0324A and the implementation model.

2. TEST EQUIPMENT

1. Variable dc power supply 0 to 10 volts. Power Designs Model 205 or equivalent.
2. Four and one-half-digit digital multimeter. Non-linear Systems Series X-2 or equivalent.
3. Waveform generator – Wavetek 154 or equivalent.
4. Oscilloscope – Tektronix 503 or equivalent.
5. Utility board fixture.

3. TEST METHOD

1. Perform power-on checks.
2. Perform offset adjustments.
3. Perform circuit A checkout.
4. Perform circuit B checkout.

DATA SHEET
SAS1012-2

Serial number ____________________ Date ______________________

Operator ____

Summary of results:

1. Power-on checks Good ____________________
2. Offset adjustment Good ____________________
3. Circuit A check Good ____________________
4. Circuit B check Good ____________________

Data reviewed by
system engineer ______________________________________

DATA SHEET — Continued

SAS1012-2

1. Power-on checks

   A. Insert board in fixture and apply power as shown in figure 1.

   B. Measure and record power supply voltages.

      -10.005< ______________________ < -9.996

      9.995< ______________________ < 10.005

      -15.100< ______________________ <-14.900

      14.900< ______________________ < 15.100

2. Offset adjustment procedure

   A. Apply ground to edge connector pin A.

   B. Apply +10.00 volts to edge connector pin 8.

   C. Monitor TP4 and null using R14.
      Record null voltage.

      -0.005< ______________________ <0.005 volts

3. Circuit A checkout

   A. Patch variable dc voltage supply to edge connector pin 8.

   B. Measure and record voltages at TP5 (ABSOLUTE VALUE).

Input	TP5 (nominal ±100 mV)
-10.000	______________________
-8.000	______________________
-6.000	______________________
-4.000	______________________
-2.000	______________________
0.000	______________________
2.000	______________________
4.000	______________________

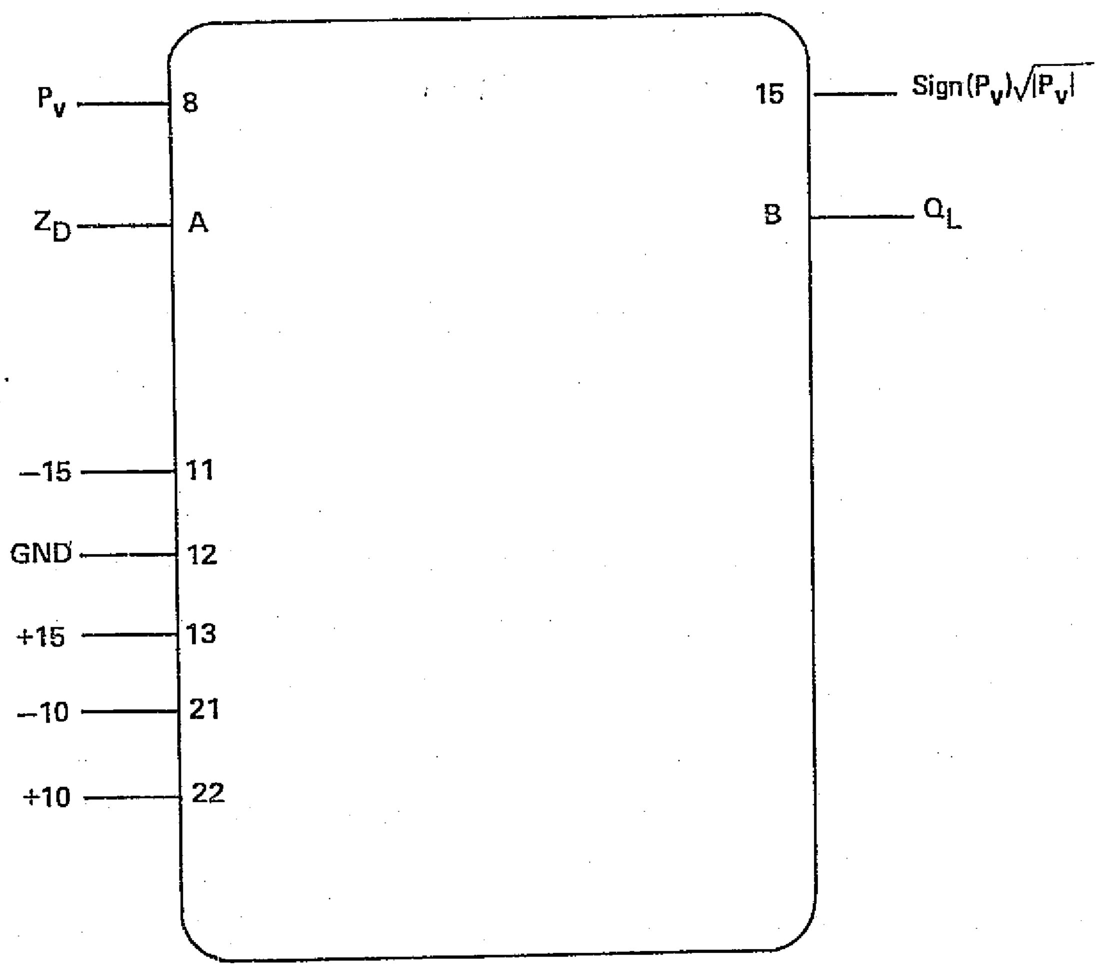


Figure 1. – Load flow board test configuration.

DATA SHEET – Continued

SAS1012-2

Input	TP5 (nominal ±100 mV)
6.000	
8.000	
10.000	

C. Measure and record voltages at TP1.

Input	TP1 (nominal ±1% of reading)		
-10.000	-10.100<		<-9.900
-8.000	-9.034<		<-8.855
-6.000	-7.823<		<-7.668
-4.000	-6.388<		<-6.261
-2.000	-4.517<		<-4.427
0.000	-0.100<		< 0.100
2.000	4.427<		< 4.517
4.000	6.261<		< 6.388
6.000	7.668<		< 7.823
8.000	8.855<		< 9.034
10.000	9.900<		<10.100

4. Circuit B checkout

   A. Patch +10.000 volts to edge connector pin 8.

   B. Patch variable dc source to edge connector pin A.

   C. Measure and record voltage at TP4. (Tolerance is ±1 percent of reading).

DATA SHEET — Concluded

SAS1012-2

Pin A (input)	Upper limit	TP4	Lower limit
10.000	-10.143		-11.210
8.000	- 8.114		- 8.968
6.000	- 6.085		- 6.726
4.000	- 4.057		- 4.484
2.000	- 2.028		- 2.242
1.000	- 1.014		- 1.121
0.000	0.010		- 0.010
- 1.000	1.121		1.014
- 2.000	2.242		2.028
- 4.000	4.484		4.057
- 6.000	6.726		6.085
- 8.000	8.968		8.114
-10.000	11.210		10.143

D. Apply -9.760 volts to connector pin A.

E. Apply a 10.0 volt peak 10 Hz triangular wave to connector pin 8.

F. With scope in X-Y mode connect X input to waveform generator and Y input to TP4.

G. Compare waveform to figure 2.
Waveform is/is not similar. (Circle one)

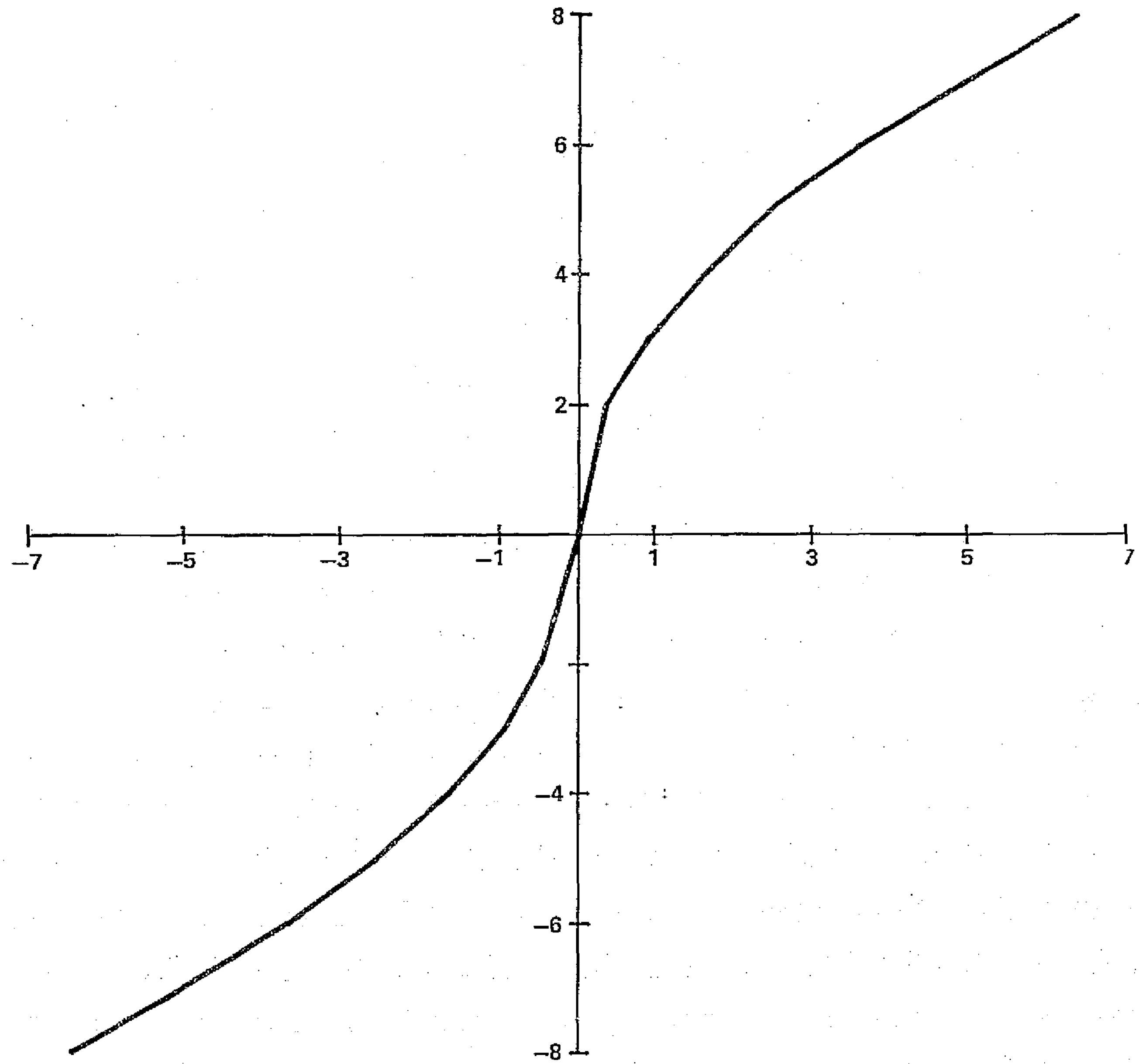


Figure 2. - Waveform at TP4 for step 5.G, SAS1012.

SUBASSEMBLY TEST PROCEDURE

NONLINEAR ELEMENT

SAS1014-1

1. PURPOSE

The purpose of this test is to verify conformance with structural dimensions of NASA/JSC-10621 and R/SD SD74-SH-0324A.

2. TEST EQUIPMENT

1. Variable dc supply 0 to 10 volts
   Power Designs Model 205 or equivalent
2. Four and one-half-digit digital multimeter - DANA 5900
   Nonlinear Systems Series X-2 or equivalent
3. Oscilloscope
   Tektronix 503 or equivalent
4. Universal card test fixture

3. TEST METHOD

1. Make power-on checks.
2. Make offset adjustments.
3. Circuit A checkout
4. Circuit B checkout

DATA SHEET

SAS1014-1

Serial number ____________________ Date ________________________

Operator ____

Summary of results:

1. Power-on checks Good ____________________

2. Offset adjustment Good ____________________

3. Circuit A check Good ____________________

4. Circuit B check Good ____________________

Data reviewed by
system engineer ______________________________

DATA SHEET – Continued
SAS1014-1

1. Power-on checkout

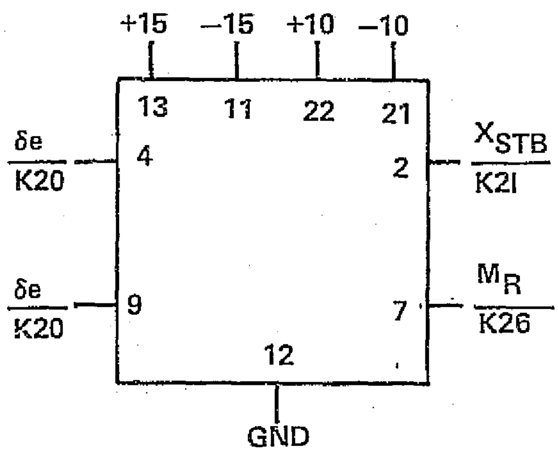
Insert board in J1 of test fixture and apply power.

-10.01< ______________________ < -9.99 (pin Y)

9.99< ______________________ < 10.01 (pin Z)

-15.10< ______________________ <-14.90

14.90< ______________________ < 15.10



2. Offset adjustment

A. Ground pin 9.

B. Monitor TP8.

-0.001< ______________________ <+0.001

C. Monitor TP6 and null R25.

-0.003< ______________________ <+0.003

DATA SHEET — Continued

SAS1014-1

3. Circuit A checkout

A. Patch variable dc supply to pin 4. Measure and record TP1.

dc supply			
-10.000	-10.183<	________	<-10.043
-8.220	-7.907<	________	<-7.767
-5.480	-4.405<	________	<-4.265
-2.740	-0.902<	________	<-0.762
0.000	2.600<	________	< 2.740
2.740	6.103<	________	< 6.243
4.110	7.854<	________	< 7.994
5.480	9.605<	________	< 9.745
5.890	10.129<	________	<10.269

4. Circuit B checkout

A. Patch variable dc supply to pin 9. Measure and record TP5.

dc supply	V_F	V_L
-10.000		
5.890		

B. Compute

$$V_{NULL} = V_F + \frac{17.507 - V_F - V_L}{2}$$

DATA SHEET — Concluded

SAS1014-1

C. Monitor TP5 and adjust R24.

dc supply			
-10.000	$(V_{NULL} - 0.002)<$	______	$<(V_{NULL} + 0.002)$

D. Measure and record TP5.

dc supply			
-10.000	8.756<	______	< 8.896
-8.493	9.205<	______	< 9.345
-5.205	9.803<	______	< 9.943
-2.740	9.930<	______	<10.070
0.000	9.783<	______	< 9.923
2.466	9.422<	______	< 9.562
4.110	9.074<	______	< 9.214
4.932	8.871<	______	< 9.011
5.890	8.611<	______	< 8.751

SUBASSEMBLY TEST PROCEDURE
NONLINEAR ELEMENT
SAS1014-2

1. PURPOSE

The purpose of this test is to verify conformance with structural dimensions of NASA/JSC-10621 and R/SD SD74-SH-0324A.

2. TEST EQUIPMENT

1. Variable dc supply 0 to 10 volts
   Power Designs Model 205 or equivalent
2. Four and one-half-digit digital multimeter
   Nonlinear Systems Series X-2 or equivalent
3. Oscilloscope
   Tektronix 503 or equivalent
4. Universal card test fixture

3. TEST METHOD

1. Make power-on checks.
2. Make offset adjustments.
3. Circuit A checkout
4. Circuit B checkout

DATA SHEET
SAS1014-2

Serial number ____________ Date ________________

Operator ______________________________________

Summary of results:

1. Power-on checks Good ________________
2. Offset adjustment Good ________________
3. Circuit A check Good ________________
4. Circuit B check Good ________________

Data reviewed by
system engineer ______________________________

DATA SHEET — Continued

SAS1014-2

1. Power-on checkout

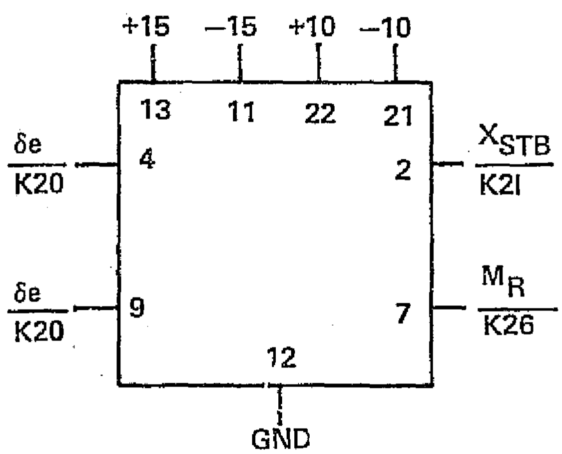
Insert board in J1 of test fixture and apply power.

-10.01< ________________ < -9.99

9.99< ________________ < 10.01

-15.10< ________________ <-14.90

14.90< ________________ < 15.10



2. Offset adjustment

A. Ground pin 9.

B. Monitor TP8.

-0.001< ________________ <+0.001

C. Monitor TP6 and null R25.

-0.003< ________________ <+0.003

DATA SHEET — Continued

SAS1014-2

3. Circuit A checkout

   A. Patch variable dc supply to pin 4. Measure and record TP1.

dc supply			
-10.000	-10.215<	__________	<-10.075
-8.220	-7.939<	__________	< -7.799
-5.480	-4.436<	__________	< -4.296
-2.740	-0.932<	__________	< -0.792
0.000	2.571<	__________	< 2.711
2.740	6.074<	__________	< 6.214
4.110	7.826<	__________	< 7.966
5.480	9.578<	__________	< 9.718
5.890	10.102<	__________	< 10.242

4. Circuit B checkout

   A. Patch variable dc supply to pin 9. Measure and record TP5.

dc supply	V_F	V_L
-10.000		
5.890		

   B. Compute

$$V_{NULL} = V_F + \frac{17.485 - V_F - V_L}{2}$$

DATA SHEET — Concluded

SAS1014-2

C. Monitor TP5 and adjust R25.

<u>dc supply</u>

-10.000 $(V_{NULL} - 0.002) <$ ____________ $< (V_{NULL} + 0.002)$

D. Measure and record TP5.

dc supply			
-10.000	8.645<	____________	< 8.785
-8.493	9.128<	____________	< 9.268
-5.205	9.776<	____________	< 9.916
-2.740	9.929<	____________	< 10.069
0.000	9.807<	____________	< 9.947
2.466	9.470<	____________	< 9.610
4.110	9.141<	____________	< 9.281
4.932	8.947<	____________	< 9.087
5.890	8.700<	____________	< 8.840

APPENDIX B

ATP DATA SHEETS

ATP DATA SHEET - TEST 3.2

PRODUCT EXAMINATION

Make appropriate notations and comments as applicable for the following items.

Test operator ______________ Date ______________

Serial number ______________ Type ______________

1. Unit has correct marking and identification.

   ______________ (requirement: yes)

2. Assembly and inspection records indicate acceptance.

   ______________ (requirement: yes)

3. LEC performance data is available for subassemblies.

   ______________ (requirement: yes)

Comments ____

____

____

____

____

Witnessed by NASA R&QA ______________________________

Witnessed by EG5 (optional) ______________________________

Witnessed by EJ7 (optional) ______________________________

Witnessed by R/SD (optional) ______________________________

ATP DATA SHEET - TEST 3.3
STROKE ADJUSTMENT

Make appropriate notations and comments as applicable for the following items.

Test operator ________________ Date __________________________

Serial number ________________ Type __________________________

1. Measure and record supply pressure.

   Required measurements:

   P_{SS} (pin 19) 10.00 ± 1 percent volts.

   Actual measurement:

   P_{SS} ______________________________ volts. (3000 ± 1 percent psi)

2. Determine length in retracted position. (open loop)
   System is open loop, local, operate.
   ASA input is +0.573 ± 0.01 volts.
   Load input (SIS pins 14 and 13) is 4.255 ± 0.115 volts.

   Required measurements:

   I1 (pin 1) -9.30 ± 5 percent volts. (command current)

   X_{STR} (pin 26) -10.00 ± 1 percent volts. (actuator position)

   Actual measurements:

   I1 ______________________________ volts. (-8.0 ± 5 percent mA)

   X_{STR} ______________________________ volts. $\left\{ \begin{matrix} -7.320 \\ -4.266 \end{matrix} \pm 1 \begin{matrix} \text{percent} \\ \text{inches} \end{matrix} \right\}$

   TAERO (pin 47) ________________ volts. $\left\{ \begin{matrix} +31{,}450 \\ +26{,}130 \end{matrix} \text{ pounds} \right\}$

3. Determine length in mid-stroke position. (closed loop)

   Required measurements:

   I1 (pin 1)

   X_{STR} (pin 26) 0.00 ± 0.100 volts.

Revised
May 1976

ATP DATA SHEET - TEST 3.3 - Concluded
STROKE ADJUSTMENT

Actual measurements:

I1 ______________________ volts. (0.0 mA)

X_{STR} ______________________ volts. (0.0 inches)

TAERO ______________________ volts. (0 pounds)

4. Determine length in extended position. (open loop)

Required measurements:

I1 (pin 1) 9.30 ± 5 percent volts.

X_{STR} (pin 26) 10.00 ± 1 percent volts.

TAERO (pins 14 and 13) -4.255 ± .115 volts.

Actual measurements:

I1 ______________________ volts. (8.0 ± 5 percent mA)

X_{STR} ______________________ volts. {7.320 / 4.266 ± 1 percent inches}

TAERO (pin 47) ____________ volts. {-31,450 / -26,130 pounds}

Comments ____

____

____

____

____

Witnessed by NASA R&QA ______________________

Witnessed by EG5 (optional) ______________________

Witnessed by EJ7 (optional) ______________________

Witnessed by R/SD (optional) ______________________

ATP DATA SHEET - TEST 3.4

LOW PRESSURE

Make appropriate notations and comments as applicable for the following items.

Test operator ________________ Date ________________________

Serial number ________________ Type ________________________

1. Adjust pot on 1-8 (SAS1009) to yield 7.500 (+0.167, -0.083) volts at pin 19.

   Actual voltage supplied: ______ volts. (2225/2300 psi)

2. Command the ram to full extend at test set. Required hold duration: 1 minute ± 20 seconds.

   Actual hold duration: _________ minutes.

   Measure and record X_{FB} (pin 25).

   Required: 10.00 ± 5 percent.

   Actual: _________ volts. |4.05/4.48 inches|
|6.95/7.69 inches|

3. Command the ram to full retract. Required hold duration: 1 minute ± 20 seconds.

   Actual hold duration: _________ minutes.

   Measure and record position, X_{FB} (pin 25). Required: -10.00 ± 5 percent volts.

   Actual measurement: X_{FB} = _____ volts. |-4.48/-4.05 inches|
|-7.69/-6.95 inches|

4. Reduce pressurization signal to 0.00 volts. Required hold duration: 1 minute ± 20 seconds.

   Actual hold duration: _________ minutes.

ATP DATA SHEET - TEST 3.4 - Continued
LOW PRESSURE

5. Operate S1-3 to open and S1-2 to not open. Monitor pin 19.

   Actual voltage supplied: ______ volts (pin 19).
   (2225/2300 psi)

6. Command the ram to full extend. Required hold duration: 1 minute ± 20 seconds.

   Actual hold duration: _________ minutes.

   Measure and record X_{FB} (pin 25).

   Required: 10.00 ± 5 percent.

   Actual: _________ volts. |4.05/4.48 inches| |6.95/7.69 inches|

7. Command the ram to full retract. Required hold duration: 1 minute ± 20 seconds.

   Actual hold duration: _________ minutes.

   Measure and record position, X_{FB} (pin 25). Required: -10.00 ± 5 percent volts.

   Actual measurement: X_{FB} = _______ volts. |-4.48/4.05 inches| |-7.69/6.95 inches|

8. Reduce pressurization signal to 0.00 volts. Required hold duration: 1 minute ± 20 seconds.

   Actual hold duration: ___________ minutes.

9. Operate S1-3 to open and S1-2 to not open. Monitor pin 19.

   Actual voltage supplied: ______ volts. (2225/2300 psi)

ATP DATA SHEET - TEST 3.4 - Continued
LOW PRESSURE

10. Command the ram to full extend. Required hold duration: 1 minute ± 20 seconds.

    Actual hold duration: ________ minutes.

    Measure and record X_{FB} (pin 25).

    Required: 10.00 ± 5 percent.

    Actual: ________ volts. |4.05/4.48 inches| |6.95/7.69 inches|

11. Command the ram to full retract. Required hold duration: 1 minute ± 20 seconds.

    Actual hold duration: ________ minutes.

    Measure and record position, X_{FB} (pin 25). Required: -10.00 ± 5 percent volts.

    Actual measurement: X_{FB} = ______ volts. |-4.48/-4.05 inches| |-7.69/-6.95 inches|

12. Reduce pressurization signal to 0.00 volts. Required hold duration: 1 minute ± 20 seconds.

    Actual hold duration: ________ minutes.

13. Provide a pressurization signal of 10.00 ± 5 percent volts by operating S1-2 to open and S1-1 to not open. Monitor pin 19. Command the ram to mid-stroke position.

14. Note the existence or absence of any control malfunction. The requirement is no malfunction on any step.

    There (was, was no) control malfunction.
    circle one

    List location, if any ______________________________

ATP DATA SHEET - TEST 3.4 - Concluded
LOW PRESSURE

Comments ______________________________

____

____

____

Witnessed by NASA R&QA ______________________________

Witnessed by EG5 (optional) ______________________________

Witnessed by EJ7 (optional) ______________________________

Witnessed by R/SD (optional) ______________________________

ATP DATA SHEET - TEST 3.6
GROUNDING

Make appropriate notations and comments for the following items.

Test operator ________________ Date ____________________________

Serial number ________________ Type ____________________________

1. Satisfactory completion of the insulation resistance test (3.7.1) will verify that there is no single conductor for more than one type of return. Insulation resistance test (was, was not) satisfactory.
   circle one

2. Satisfactory completion of the insulation resistance test (3.7.1) will verify that an isolation resistance of 2 megohms minimum exists between returns and between returns and chassis ground within the equipment. Insulation resistance test (was, was not) satisfactory.
   circle one

   Comments ____

   ____

   ____

3. Resistance will not exceed 100 milliohms between bonding surface and connector shell.

   Record actual resistance:

   Connector 1 _____, 2 _____, 3 _____, 4 _____

   AC power connector to chassis __________.

   Comments ____

   ____

   ____

ATP DATA SHEET - TEST 3.6 - Concluded
GROUNDING

Witnessed by NASA R&QA ______________________________

Witnessed by EG5 (optional) ______________________________

Witnessed by EJ7 (optional) ______________________________

Witnessed by R/SD (optional) ______________________________

ATP DATA SHEET - TEST 3.7.1

SIGNAL INSULATION TEST

Test operator ________________ Date ________________________

Serial number ________________ Type ________________________

Comments (indicate resistances less than 10 megohms)

____

____

____

____

____

All resistances greater than 10 megohms

____
(requirement: yes)

Comments ____

____

____

Witnessed by NASA R&QA ____

Witnessed by EG5 (optional) ___________________________________

Witnessed by EJ7 (optional) ___________________________________

Witnessed by R/SD (optional) __________________________________

ATP DATA SHEET - TEST 3.7.5
ISOLATION VALVE

Make appropriate notations and comments as applicable for the following items.

Test operator ________________ Date ________________________

Serial number ________________ Type ________________________

1. Measure P_{SS} required +10.0 ± 0.3 volts. (3000 psi)

   Actual P_{SS}, pin 19 ____________ volts.

2. Activate the ISO command for Channels 1, 2, 3, and 4.

   Isolate switches for Channels 1, 2, 3, and 4.

3. Command the actuator with a ±.200 V ± .050 V at 1 Hz sinusoidal voltage.

   Actual command _______________ volts.

4. Measure voltage at X_{STR} (no motion).*

   Required: X_{STR} (pin 26)

   Actual: X_{STR} = ________________ volts.

5. Remove ISO command to Channel 1 and repeat step 3.

   Actual ___________________________ volts.

6. Measure voltage at X_{STR} (pin 26).

   Required: X_{STR} = ±.300 ± .200 volts at 1.0 Hz.

   Actual: X_{STR} = ____________ volts.

7. Remove ISO command to Channel 2 and activate ISO for Channel 1. Repeat step 3.

   Actual _______________________ volts.

*NOTE: X_{STR} is nonsinusoidal and may drift to either limit.

Revised
May 1976

ATP DATA SHEET - TEST 3.7.5 - Concluded
ISOLATION VALVE

8. Measure voltage at X_{STR} (pin 26).

   Required: X_{STR} = ±.300 ± .200 volts at 1.0 Hz.

   Actual: X_{STR} = ________________ volts.

9. Remove ISO from Channel 3 and activate ISO to Channel 2. Repeat step 3.

   Actual __________________________ volts.

10. Measure voltage at X_{STR} (pin 26).

   Required: X_{STR} = ±.300 ± .200 volts at 1.0 Hz.

   Actual: X_{STR} = ________________ volts.

11. Remove ISO from Channel 4 and activate ISO to Channel 3. Repeat step 3.

   Actual __________________________ volts.

12. Measure voltage at X_{STR} (pin 26).

   Required: X_{STR} = ±.300 ± .200 volts at 1.0 Hz.

   Actual: X_{STR} = ________________ volts.

Comments ____

____

____

____

Witnessed by NASA R&QA ______________________________________

Witnessed by EG5 (optional) _________________________________

Witnessed by EJ7 (optional) _________________________________

Witnessed by R/SD (optional) ________________________________

Revised
May 1976

ATP DATA SHEET - TEST 3.7.6

PANEL RATE - PISTON FORCE

Make appropriate notations and comments for the following items.

Test operator ____________________ Date ______________________

Serial number ____________________ Type ______________________

1. Operate system closed loop. Set load and pressure according to the following table. (Reference procedure 3.4.1.1.2 and data sheet test 3.4.1.)

INPUT OPPOSING LOAD REQUIREMENTS (VOLTS)
AT SIS PINS 14 AND 13

	Inboard		Outboard	
	Minimum	Maximum	Minimum	Maximum
A	6.766	6.770	6.603	6.703
B	4.432	4.435	4.272	4.372

2. Supply a triangular wave of 8 V (p-p) and adjust frequency to attain proper velocity. Start at 0.03 Hz.

3. Measure piston velocity for inboard actuator for dynamic Condition A, opposing loads.

   Required: Minimum velocity 1.500 volts (15.0 deg/sec) ± 0.1 volts
   Differential pressure 8.833 ± 0.003 volts (2650 psi)

   Actual: (23) Velocity ______________________ volts
   (19) Differential pressure __________ volts
   (47) Opposing load __________________ volts
   (1) Minimum current ________________ volts

Revised
May 1976

ATP DATA SHEET - TEST 3.7.6 - Concluded
PANEL RATE · PISTON FORCE

4. Measure piston velocity for inboard actuator for dynamic Condition B, opposing loads.

Required: Minimum velocity 2.055 volts (20.55 deg/sec)
Differential pressure 8.167 ± 0.003 volts (2450 psi)

Actual: (23) Velocity ______________ volts
(19) Differential pressure ______________ volts
(47) Opposing load ______________ volts
(1) Minimum current ______________ volts

5. Measure piston velocity for outboard actuator for dynamic Condition A, opposing loads.

Required: Minimum velocity 1.500 volts (15.0 deg/sec)
Differential pressure 8.833 ± 0.003 volts (2650 psi)

Actual: (23) Velocity ______________ volts
(19) Differential pressure ______________ volts
(47) Opposing load ______________ volts
(1) Minimum current ______________ volts

6. Measure piston velocity for outboard actuator for dynamic Condition B, opposing loads.

Required: Minimum velocity 2.055 volts (20.5 deg/sec)
Differential pressure 8.167 ± 0.003 volts (2450 psi)

Actual: (23) Velocity ______________ volts
(19) Differential pressure ______________ volts
(47) Opposing load ______________ volts
(1) Minimum current ______________ volts

Comments ____

____

Witnessed by NASA R&QA ______________________________
Witnessed by EG5 (optional) ______________________________
Witnessed by EJ7 (optional) ______________________________
Witnessed by R/SD (optional) ______________________________

ATP DATA SHEET - TEST 3.7.7
ACCURACY AND VELOCITY GAIN

A. Hysteresis

Make appropriate notations and comments for the following items.

Test operator ____________ Date ________________________

Serial number ____________ Type ________________________

For all tests, hydraulic pressure will be 10.00 ± 0.01 volts, pin 19. (3000 ± 100 psig)

Record hydraulic pressure: supply _____ volts.

1. Uniformly command four-channel servo with 0.067 volts (peak) ± 5 percent at a sinusoidal rate of .03 to .1 Hz. (±1 mA)

   Record current (pin 1) _____ volts. Record _____ Hz.
   Record hysteresis and threshold as measured on x-y plot per figure 3-4. (x input pin 1, y input pin 37)
   Required hysteresis 0.523 volts maximum. (.45 mA)
   Actual hysteresis _____ volts.
   Required threshold 0.349 volts maximum. (0.30 mA)
   Actual threshold _____ volts.

2. Uniformly command three channels of servo; isolate Channel 2. Command input will be 0.067 volts (peak) ± 5 percent at rate of .03 to .1 Hz to three channels. (±1 mA)

   Record current (pin 1) _____ (peak to peak) volts.
   Record _____ Hz.
   Record hysteresis and threshold as measured on x-y plot per figure 3-4.
   Required hysteresis 0.581 volts maximum. (0.5 mA)
   Actual hysteresis _____ volts.
   Required threshold 0.349 volts maximum. (0.30 mA)
   Actual threshold _____ volts.

Revised
May 1976

ATP DATA SHEET - TEST 3.7.7 - Continued
ACCURACY AND VELOCITY GAIN

3. Command 8.6 mA to Channel 2. (0.573 volts)
   Command input 0.067 volts ± 5 percent at a sinusoidal rate of .03 to .1 Hz to Channels 1, 3, and 4. (±1 mA)
   Record _____ volts to Channel 1.
   Record _____ Hz.
   Record hysteresis and threshold as measured on x-y plot per figure 3-4.
   Required hysteresis 1.035 volts maximum. (0.89 mA)
   Actual hysteresis _____ volts.
   Required threshold .732 volts maximum. (.63 mA)
   Actual threshold _____ volts.

4. Command 0.0 mA to Channel 2. (0 volts)
   Command input .067 volts ± 5 percent at a sinusoidal rate of .03 to .1 Hz to Channels 1, 3, and 4. (±1 mA)
   Record _____ volts to Channel 1.
   Record _____ Hz.
   Record hysteresis and threshold as measured on x-y plot per figure 3-4. (x input pin 1, y input pin 37)
   Required hysteresis 1.035 volts maximum. (0.60 mA)
   Actual hysteresis _____ volts.
   Required threshold .732 volts maximum. (0.63 mA)
   Actual threshold _____ volts.

Comments ____

____

____

ATP DATA SHEET 3.7.7 - Continued

ACCURACY AND VELOCITY GAIN

B. Velocity gain

1. Closed loop condition, position feedback only. Uniformly command the four-channel servo. For inboard and outboard apply a zero load for both polarities. Record command current which corresponds to specific rates.

Current pin 1, volts	Required rates (volts ± 10 percent)		Actual rates pin 23, volts
	volts	deg/sec	
______	0.290	(2.90)	______
______	0.410	(4.10)	______
______	0.530	(5.30)	______
______	0.650	(6.50)	______
______	0.770	(7.70)	______
______	-0.290	(-2.90)	______
______	-0.410	(-4.10)	______
______	-0.530	(-5.30)	______
______	-0.650	(-6.50)	______
______	-0.770	(-7.70)	______

2. Make a plot of command current versus actual rates.

3. After applying 0 mA to one channel, uniformly command three channels of servo with TBS ± current in both polarities. Record command current which corresponds to specific rates.

ATP DATA SHEET 3.7.7 - Continued

ACCURACY AND VELOCITY GAIN

Current pin 1, volts	Required rates (volts ± 10 percent)		Actual rates pin 23, volts
	volts	deg/sec	
______	0.290	(2.90)	______
______	0.410	(4.10)	______
______	0.530	(5.30)	______
______	0.650	(6.50)	______
______	0.770	(7.70)	______
______	-0.290	(-2.90)	______
______	-0.410	(-4.10)	______
______	-0.530	(-5.30)	______
______	-0.650	(-6.50)	______
______	-0.770	(-7.70)	______

Make a plot of command current versus actual rates.

4. Opposing load forces will be as follows:

   Inboard actuator 6.599/7.203 volts
   (690,000 ± 30,200 in-lbs)
   Outboard actuator 6.239/6.943 volts
   (329,500 ± 17,600 in-lbs)

Record opposing loads used (pin 47): Inboard ______ volts
Outboard ______ volts

Uniformly command four-channel servo with sufficient mA to meet the following rates. Record current.

ATP DATA SHEET 3.7.7 - Continued
ACCURACY AND VELOCITY GAIN

Current pin 1, volts	Required rates (volts ± 10 percent)		Actual rates pin 23, volts
	volts	deg/sec	
________	0.290	(2.90)	________
________	0.410	(4.10)	________
________	0.530	(5.30)	________
________	0.650	(6.50)	________
________	0.770	(7.70)	________
________	-0.290	(-2.90)	________
________	-0.410	(-4.10)	________
________	-0.530	(-5.30)	________
________	-0.650	(-6.50)	________
________	-0.770	(-7.70)	________

5. Make a plot of command current versus actual rates. Velocity gain values will fit within the operating parameter envelope of figure 3-5.
   Velocity gain values are (acceptable, unacceptable).
   circle one

6. Use opposing load forces as follows:

   Inboard actuator 6,599/7.203 volts
   (690,000 ± 30,200 in-lbs)
   Outboard actuator 6.239/6.943 volts
   (329,500 ± 17,600 in-lbs)

   Record opposing loads used: Inboard __________ volts
   Outboard __________ volts

   Apply a 0 mA (open circuit) to one channel.
   Uniformly command three channels of servo with TBS ± current in both polarities. Record command current which corresponds to specific rates.

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ATP DATA SHEET 3.7.7 - Continued

ACCURACY AND VELOCITY GAIN

Current pin 1, volts	Required rates (volts ± 10 percent)		Actual rates pin 23, volts
	volts	deg/sec	
______	0.290	(2.90)	______
______	0.410	(4.10)	______
______	0.530	(5.30)	______
______	0.650	(6.50)	______
______	0.770	(7.70)	______
______	-0.290	(-2.90)	______
______	-0.410	(-4.10)	______
______	-0.530	(-5.30)	______
______	-0.650	(-6.50)	______
______	-0.770	(-7.70)	______

7. Make a plot of command current versus actual rates. Verify that velocity gain values fit within the operating parameter envelope of figure 3-5. Velocity gain values are (acceptable, unacceptable).
circle one

8. Plot a graph using the derived test values of velocity gain versus command current under load conditions, and make a least-squares-error fit by drawing a best straight line (as a median) through the test data points.

   The graph will be suitably identified with appropriate test identification.

   Use an overlay straight line plot of velocity versus current with a +10 percent tolerance on data points, to lay over the least-squares-error fit line plotted previously.

ATP DATA SHEET 3.7.7 - Concluded

ACCURACY AND VELOCITY GAIN

For actuator rates up to 7.8 deg/sec velocity gain values will not exceed the +10 percent tolerance band shown on overlay. Note any data points by value which fall outside the +10 percent tolerance band.

____

____

Graphical data results (are, are not) acceptable.
circle one

Copies of graphical data will be given to LEC engineering for final evaluation, and LEC engineering will make final disposition as to acceptability of data. Copies will be made available to NASA/EG5 upon request.

Comments ______________________________________

____

Witnessed by NASA R&QA ______________________

Witnessed by EG5 (optional) __________________

Witnessed by EJ7 (optional) __________________

Witnessed by R/SD (optional) _________________

ATP DATA SHEET 3.7.8

FREQUENCY RESPONSE AND PEAKING LIMIT

Make appropriate notations and comments for the following items.

Test operator ____________________ Date ________________________

Serial number ____________________ Type ________________________

1. Open loop condition. No external loads, local, IC.
   Uniformly command four-channel servo with ±0.133 volts. (±2 mA)
   Channel output will be within ±0.020 volts of each other.
   (±0.2 mA)
   Record channel output: Channel 1, pin 1 __________ volts;
   Channel 2, pin 2 __________ volts; Channel 3, pin 3 __________
   volts; and Channel 4, pin 4 __________ volts.
   Setup for frequency sweep per figure 3-8 except Channel "A"
   from pin 1, Channel "B" from pin 16.
   Perform frequency sweep from .1 to 20 Hz.
   Normalize at 1.6 Hz.
   Requirement: No amplitude peaking above 1 dB for frequencies below 35 Hz.
   Record: There (was, was no) amplitude peaking above 1 dB.
   circle one
   Requirement: Generated plots of test data for gain
   and phase angle will match figures 3-6 and 3-7 plots.
   Record: x-y plots (match, do not match) figures 3-6 and 3-7.
   circle one

2. Same as step 1 of data sheet except uniformly command two
   channels of servo with ±0.133 volts and place two channels
   in bypass mode. (±2 mA)
   Record channel output: Channel 1 ________ volts and
   Channel 2 _______ volts.
   Record: There (was, was no) amplitude peaking above 1 dB
   circle one
   for frequencies below 35 Hz.
   Record: plots (match, do not match) figures 3-6 and 3-7.
   circle one

Revised
May 1976

ATP DATA SHEET 3.7.8 - Concluded

FREQUENCY RESPONSE AND PEAKING LIMIT

3. Same as step 1 of data sheet except uniformly command three channels and command fourth channel with zero current.

   Record channel output: Channel 1 ________ volts,
   Channel 2 ________ volts, Channel 3 ________ volts, and
   Channel 4 ________ volts.

   Record: There (was, was no) amplitude peaking above 1 dB
   circle one
   for frequency 35 Hz.

   Record: plots (match, do not match) figures 3-6 and 3-7.
   circle one

Comments ____

____

Witnessed by NASA R&QA ________________________

Witnessed by EG5 (optional) ____________________

Witnessed by EJ7 (optional) ____________________

Witnessed by R/SD (optional) ___________________

ATP DATA SHEET - TEST 3.7.9

CLOSED LOOP FREQUENCY RESPONSE

Make appropriate notations and comments for the following items.

Test operator ____________________ Date __________________________

Serial number ____________________ Type __________________________

1. Closed loop condition. No external load. Uniformly command the four-channel servo with ±0.065 volts. Record channel output: Channel 1, pin 1 ________ volts; Channel 2, pin 2 ________ volts; Channel 3, pin 3 ________ volts; and Channel 4, pin 4 ________ volts.
2. Setup for frequency sweep per figure 3-8.
   Perform frequency sweep from 0.5 to 20 Hz. Normalize at 1.0 Hz.
   Requirement: Generated plots of test data for gain and phase angle will match figure 3-9.

Comments ____

____

____

Witnessed by NASA R&QA ______________________________________

Witnessed by EG5 (optional) _________________________________

Witnessed by EJ7 (optional) _________________________________

Witnessed by R/SD (optional) ________________________________

Acceptance of reduced data:

LEC engineering ____

NASA/EG5 ____

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May 1976

ATP DATA SHEET - TEST 3.7.10

CLOSED LOOP TRANSIENT RESPONSE

Make appropriate notations and comments for the following items.

Test operator ________________ Date ________________________

Serial number ________________ Type ________________________

1. Closed loop condition. No external load. Pressure supply will be +10.0 ± 0.333 volts. Actual pressure, P_{SS} (pin 19) _______ volts.
2. Uniformly apply a square wave input of ±0.137 ± 0.010 volts to all four channels having a 5-second period.
3. Record on a strip-chart recorder at a chart speed of at least 100 mm/sec:
   I1 (pin 1), X_{PS} (pin 16), Q_L (pin 37), P_L (pin 21), $\ddot{\delta}e$ (pin 24), $\dot{\delta}e$ (pin 23), δe (pin 22), and input.
4. Uniformly apply a square wave input of ±0.685 ± 0.010 volts and a 5-second period to all four channels.
5. Repeat step 3.
6. Uniformly apply a square wave input of ±1.370 ± 0.010 volts and a 5-second period to all four channels.
7. Repeat step 3.
8. Uniformly apply a triangle wave input of ±0.137 ± 0.010 volts at a frequency of 10 Hz to all four channels.
9. Uniformly apply a triangle wave input of ±0.685 ± 0.010 volts at a frequency of 1.0 Hz to all four channels.
10. Repeat step 3.
11. Uniformly apply a triangle wave input of ±1.370 ± 0.010 volts at a frequency of 0.5 Hz to all four channels.

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ATP DATA SHEET - TEST 3.7.10 - Concluded
CLOSED LOOP TRANSIENT RESPONSE

12. Recorder plots of test data for step and ramp response will be given to LEC engineering, and LEC engineering will make disposition as to acceptability of data. NASA/EG5 will make final acceptance of the data.

Comments ____

____

____

Witnessed by NASA R&QA ______________________________

Witnessed by EG5 (optional) __________________________

Witnessed by EJ7 (optional) __________________________

Witnessed by R/SD (optional) _________________________

Acceptance of reduced data:

LEC engineering ______________________________________

NASA/EG5 ____

ATP DATA SHEET - TEST 3.7.11
FAULT INSERTION

Make appropriate notations and comments as applicable for the following items.

Test operator ______________________ Date ______________

Serial number ______________________ Type ______________

A. Valve status is Condition C; electric power is ON; mode is remote.

B. Perform fault insertion checks under the following conditions:

   1. ASA inputs for each of the four channels are shorted.

   2. The system is initialized by:

      a. Applying 4.5 ± 0.5 volts dc to TOC pin 5 and ground to pin 6.

      b. Applying +3.0 ± 0.1 volts dc to TOC pin 9 and ground to pin 10.

      c. Applying +3.0 ± 0.1 volts dc to SIS pin 14 and ground to pin 13.

   3. Faults are inserted (enabled) by TOC:

      a. Fault 1: apply +4.5 ± 0.5 volts to pin 22 and ground to pin 23.

      b. Fault 2: apply +4.5 ± 0.5 volts to pin 24 and ground to pin 25.

C. Make and record the fault insertion checks.

   1. Primary ΔP fault insertion

      a. Set the switches to: type = +H, order = 1, master enable = ON, ΔP primary = ON. Remove both faults

FAULT INSERTION

and measure ΔP_p = "A." ΔP_p = __________ volts.

b. Enable Fault 1: measure ΔP_p = "B."
ΔP_p = __________ volts.

c. Enable Faults 1 and 2. Measure and record ΔP_p for the switch settings shown.

CHANNEL 1

Switch settings					
Type	Order	Master enable	ΔP primary	Check test set ΔP_p	Require-ments*
+H	1	ON	OFF		A
+H	1	ON	ON		B
+H	1	OFF	ON		A
+H	2	ON	OFF		A
+H	2	ON	ON		B
+H	2	OFF	ON		A
+H	None	ON	ON		A
Z	1	ON	OFF		A
Z	1	ON	ON		C
Z	1	OFF	ON		A
Z	2	ON	OFF		A
Z	2	ON	ON		C
Z	2	OFF	ON		A
Z	None	ON	ON		A
-H	1	ON	OFF		A
-H	1	ON	ON		D
-H	1	OFF	ON		A
-H	2	ON	OFF		A
-H	2	ON	ON		D
-H	2	OFF	ON		A
-H	None	ON	ON		A

ATP DATA SHEET - TEST 3.7.11 - Continued

FAULT INSERTION

CHANNEL 1 - Concluded

Conditions: A: NO FAULT → -2.0 ± 0.5 volts
B: + HARDOVER → +6.16 ± 0.2 volts
C: ZERO → 0.0 ± 0.2 volts
D: - HARDOVER → -6.16 ± 0.2 volts

*Required voltage reading

d. Set the switches to: type = +H, order = 2, master enable = ON, ΔP_p = ON. Remove both faults and measure ΔP_p = "A." ΔP_p = __________ volts.

e. Enable Fault 2; measure ΔP_p = "B."
ΔP_p = __________ volts.

f. Enable Faults 1 and 2. Measure and record ΔP_p for the switch settings shown.

CHANNEL 2

Switch settings					
Type	Order	Master enable	ΔP primary	Check test set ΔP_p	Requirements*
+H	1	ON	OFF		A
+H	1	ON	ON		B
+H	1	OFF	ON		A
+H	2	ON	OFF		A
+H	2	ON	ON		B
+H	2	OFF	ON		A
+H	None	ON	ON		A
Z	1	ON	OFF		A
Z	1	ON	ON		C
Z	1	OFF	ON		A
Z	2	ON	OFF		A
Z	2	ON	ON		C
Z	2	OFF	ON		A

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ATP DATA SHEET - TEST 3.7.11 - Continued

FAULT INSERTION

CHANNEL 2 - Concluded

Z	None	ON	ON		A
-H	1	ON	OFF		A
-H	1	ON	ON		D
-H	1	OFF	ON		A
-H	2	ON	OFF		A
-H	2	ON	ON		D
-H	2	OFF	ON		A
-H	None	ON	ON		A

Conditions: A: NO FAULT → -2.0 ± 0.5 volts

B: + HARDOVER → +6.16 ± 0.2 volts

C: ZERO → 0.0 ± 0.2 volts

D: - HARDOVER → -6.16 ± 0.2 volts

*Required voltage reading

g. Set the switches to: type = +H, order = 1, master enable = ON, ΔP_p = ON. Remove both faults and measure ΔP_p = "A." ΔP_p = __________ volts.

h. Enable Fault 2; measure ΔP_p = "A." ΔP_p = __________ volts.

i. Enable both faults. Measure and record ΔP_p for the switch settings shown.

CHANNEL 3

Switch settings					
Type	Order	Master enable	ΔP primary	Check test set ΔP_p	Requirements*
+H	1	ON	OFF		A
+H	1	ON	ON		B
+H	1	OFF	ON		A
+H	2	ON	OFF		A

FAULT INSERTION

CHANNEL 3 - Concluded

+H	2	ON	ON		B
+H	2	OFF	ON		A
+H	None	ON	ON		A
Z	1	ON	OFF		A
Z	1	ON	ON		C
Z	1	OFF	ON		A
Z	2	ON	OFF		A
Z	2	ON	ON		C
Z	2	OFF	ON		A
Z	None	ON	ON		A
-H	1	ON	OFF		A
-H	1	ON	ON		D
-H	1	OFF	ON		A
-H	2	ON	OFF		A
-H	2	ON	ON		D
-H	2	OFF	ON		A
-H	None	ON	ON		A

Conditions: A: NO FAULT → -2.0 ± 0.5 volts
B: + HARDOVER → 6.16 ± 0.2 volts
C: ZERO → 0.0 ± 0.2 volts
D: - HARDOVER → -6.16 ± 0.2 volts

*Required voltage reading

j. Set the switch settings to: type = +H, order = 2, master enable = ON, ΔP_p = ON. Remove both faults and measure ΔP_p = "A." ΔP_p = ____________ volts.

k. Enable Fault 1; measure ΔP_p = "A."
ΔP_p = ____________ volts.

l. Enable Faults 1 and 2. Measure and record ΔP_p for the switch settings shown.

Revised
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ATP DATA SHEET - TEST 3.7.11 - Continued

FAULT INSERTION

CHANNEL 4

Switch settings					
Type	Order	Master enable	ΔP primary	Check test set ΔP_p	Requirements*
+H	1	ON	OFF		A
+H	1	ON	ON		B
+H	1	OFF	ON		A
+H	2	ON	OFF		A
+H	2	ON	ON		B
+H	2	OFF	ON		A
+H	None	ON	ON		A
Z	1	ON	OFF		A
Z	1	ON	ON		C
Z	1	OFF	ON		A
Z	2	ON	OFF		A
Z	2	ON	ON		C
Z	2	OFF	ON		A
Z	None	ON	ON		A
-H	1	ON	OFF		A
-H	1	ON	ON		D
-H	1	OFF	ON		A
-H	2	ON	OFF		A
-H	2	ON	ON		D
-H	2	OFF	ON		A
-H	None	ON	ON		A

Conditions: A: NO FAULT → -2.0 ± 0.5 volts

B: + HARDOVER → 6.16 ± 0.2 volts

C: ZERO → 0.0 ± 0.2 volts

D: - HARDOVER → -6.16 ± 0.2 volts

*Required voltage reading

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ATP DATA SHEET - TEST 3.7.11 - Continued

FAULT INSERTION

2. Position transducer fault insertion

a. Enable Faults 1 and 2.

b. Measure and record position for the switch settings shown below.

CHANNEL 1

Switch settings					
Type	Order	Master enable	Position	Check test set position	Requirements*
+H	1	ON	OFF		A
+H	1	ON	ON		B
+H	1	OFF	ON		A
+H	2	ON	OFF		A
+H	2	ON	ON		B
+H	2	OFF	ON		A
+H	None	ON	ON		A
Z	1	ON	OFF		A
Z	1	ON	ON		C
Z	1	OFF	ON		A
Z	2	ON	OFF		A
Z	2	ON	ON		C
Z	2	OFF	ON		A
Z	None	ON	ON		A
-H	1	ON	OFF		A
-H	1	ON	ON		D
-H	1	OFF	ON		A
-H	2	ON	OFF		A
-H	2	ON	ON		D
-H	2	OFF	ON		A
-H	None	ON	ON		A

ATP DATA SHEET - TEST 3.7.11 - Continued

FAULT INSERTION

CHANNEL 1 - Concluded

Conditions: A: NO FAULT → -1.25 ± 0.25 volts
B: + HARDOVER → -6.16 ± 0.2 volts
C: ZERO → 0.0 ± 0.2 volts
D: - HARDOVER → +6.16 ± 0.2 volts

*Required voltage reading

c. Measure and record position for the switch settings shown below.

CHANNEL 2

Switch settings					
Type	Order	Master enable	Position	Check test set position	Require ments*
+H	1	ON	OFF		A
+H	1	ON	ON		B
+H	1	OFF	ON		A
+H	2	ON	OFF		A
+H	2	ON	ON		B
+H	2	OFF	ON		A
+H	None	ON	ON		A
Z	1	ON	OFF		A
Z	1	ON	ON		C
Z	1	OFF	ON		A
Z	2	ON	OFF		A
Z	2	ON	ON		C
Z	2	OFF	ON		A
Z	None	ON	ON		A
-H	1	ON	OFF		A
-H	1	ON	ON		D
-H	1	OFF	ON		A
-H	2	ON	OFF		A

ATP DATA SHEET - TEST 3.7.11 - Continued

FAULT INSERTION

CHANNEL 2 - Concluded

-H	2	ON	ON		D
-H	2	OFF	ON		A
-H	None	ON	ON		A

Conditions: A: NO FAULT $\rightarrow$ -1.25 ± 0.25 volts

B: + HARDOVER $\rightarrow$ -6.16 ± 0.2 volts

C: ZERO $\rightarrow$ 0.0 ± 0.2 volts

D: - HARDOVER $\rightarrow$ +6.16 ± 0.2 volts

*Required voltage reading

d. Measure and record position for the switch settings shown below.

CHANNEL 3

Switch settings					
Type	Order	Master enable	Position	Check test set position	Require-ments*
+H	1	ON	OFF		A
+H	1	ON	ON		B
+H	1	OFF	ON		A
+H	2	ON	OFF		A
+H	2	ON	ON		B
+H	2	OFF	ON		A
+H	None	ON	ON		A
Z	1	ON	OFF		A
Z	1	ON	ON		C
Z	1	OFF	ON		A
Z	2	ON	OFF		A
Z	2	ON	ON		C
Z	2	OFF	ON		A
Z	None	ON	ON		A
-H	1	ON	OFF		A

ATP DATA SHEET - TEST 3.7.11 - Continued

FAULT INSERTION

CHANNEL 3 - Concluded

-H	1	ON	ON		D
-H	1	OFF	ON		A
-H	2	ON	OFF		A
-H	2	ON	ON		D
-H	2	OFF	ON		A
-H	None	ON	ON		A

Conditions: A: NO FAULT → -1.25 ± 0.25 volts

B: + HARDOVER → -6.16 ± 0.2 volts

C: ZERO → 0.0 ± 0.2 volts

D: - HARDOVER → +6.16 ± 0.2 volts

*Required voltage reading

e. Measure and record position for the switch settings shown below.

CHANNEL 4

Switch settings					
Type	Order	Master enable	Position	Check test set position	Requirements*
+H	1	ON	OFF		A
+H	1	ON	ON		B
+H	1	OFF	ON		A
+H	2	ON	OFF		A
+H	2	ON	ON		B
+H	2	OFF	ON		A
+H	None	ON	ON		A
Z	1	ON	OFF		A
Z	1	ON	ON		C
Z	1	OFF	ON		A
Z	2	ON	OFF		A
Z	2	ON	ON		C

ATP DATA SHEET - TEST 3.7.11 - Continued
FAULT INSERTION

CHANNEL 4 - Concluded

Z	2	OFF	ON		A
Z	None	ON	ON		A
-H	1	ON	OFF		A
-H	1	ON	ON		D
-H	1	OFF	ON		A
-H	2	ON	OFF		A
-H	2	ON	ON		D
-H	2	OFF	ON		A
-H	None	ON	ON		A

Conditions: A: NO FAULT → -1.25 ± 0.25 volts
B: + HARDOVER → -6.16 ± 0.2 volts
C: ZERO → 0.0 ± 0.2 volts
D: - HARDOVER → $+6.16 \pm 0.2$ volts

*Required voltage reading

3. Secondary ΔP fault insertion

   a. Enable Faults 1 and 2.

   b. Set the switches on Channel 4 to: type = -H, order = 1, master enable = ON, ΔP secondary = ON.

   c. Measure and record ΔP_S for Channel 4. Requirements = $+6.13 \pm 0.2$ volts.
   ΔP_S = __________ volts.

   d. Set the fault order switch for Channels 1, 2, and 3 to "NO FAULT." Measure and record ΔP_S for the switch settings shown.

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ATP DATA SHEET - TEST 3.7.11 - Continued

FAULT INSERTION

CHANNEL 1

Switch settings				Channel A	
Type	Order	Master enable	ΔP secondary	Check test set ΔP_S	Requirements*
+H	1	ON	OFF		A
+H	1	ON	ON		B
+H	1	OFF	ON		C
+H	2	ON	OFF		A
+H	2	ON	ON		B
+H	2	OFF	ON		C
+H	None	ON	ON		A
Z	1	ON	OFF		A
Z	1	ON	ON		C
Z	1	OFF	ON		C
Z	2	ON	OFF		A
Z	2	ON	ON		C
Z	2	OFF	ON		C
Z	None	ON	ON		A
-H	1	ON	OFF		A
-H	1	ON	ON		D
-H	1	OFF	ON		C
-H	2	ON	OFF		A
-H	2	ON	ON		D
-H	2	OFF	ON		C
-H	None	ON	ON		A

Conditions: A: NO FAULT → -2.00 ± 0.3 volts
B: + HARDOVER → -6.13 ± 0.2 volts
C: ZERO → 0.0 ± 0.2 volts
D: - HARDOVER → +6.13 ± 0.2 volts

*Required voltage reading

ATP DATA SHEET - TEST 3.7.11 - Continued
FAULT INSERTION

e. Set the order switch on Channel A to "NO FAULT."

f. Measure and record ΔP_S for the switch settings shown.

CHANNEL 2

Switch settings				Channel B	
Type	Order	Master enable	ΔP secondary	Check test set ΔP_S	Require-ments*
+H	1	ON	OFF		A
+H	1	ON	ON		B
+H	1	OFF	ON		C
+H	2	ON	OFF		A
+H	2	ON	ON		B
+H	2	OFF	ON		C
+H	None	ON	ON		A
Z	1	ON	OFF		A
Z	1	ON	ON		C
Z	1	OFF	ON		C
Z	2	ON	OFF		A
Z	2	ON	ON		C
Z	2	OFF	ON		C
Z	None	ON	ON		A
-H	1	ON	OFF		A
-H	1	ON	ON		D
-H	1	OFF	ON		C
-H	2	ON	OFF		A
-H	2	ON	ON		D
-H	2	OFF	ON		C
-H	None	ON	ON		A

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ATP DATA SHEET - TEST 3.7.11 - Continued

FAULT INSERTION

CHANNEL 2 - Concluded

Conditions: A: NO FAULT → -2.00 ± 0.3 volts

B: + HARDOVER → -6.13 ± 0.2 volts

C: ZERO → 0.0 ± 0.2 volts

D: - HARDOVER → +6.13 ± 0.2 volts

*Required voltage reading

g. Set the order switch on Channels 1 and 2 to "NO FAULT."

h. Measure and record ΔP_S for the switch settings shown.

CHANNEL 3

Switch settings				Channel C	
Type	Order	Master enable	ΔP secondary	Check test set ΔP_S	Require- ments*
+H	1	ON	OFF		A
+H	1	ON	ON		B
+H	1	OFF	ON		C
+H	2	ON	OFF		A
+H	2	ON	ON		B
+H	2	OFF	ON		C
+H	None	ON	ON		A
Z	1	ON	OFF		A
Z	1	ON	ON		C
Z	1	OFF	ON		C
Z	2	ON	OFF		A
Z	2	ON	ON		C
Z	2	OFF	ON		C

ATP DATA SHEET - TEST 3.7.11 - Continued

FAULT INSERTION

CHANNEL 3 - Concluded

Z	None	ON	ON		A
-H	1	ON	OFF		A
-H	1	ON	ON		D
-H	1	OFF	ON		C
-H	2	ON	OFF		A
-H	2	ON	ON		D
-H	2	OFF	ON		C
-H	None	ON	ON		A

Conditions: A: NO FAULT → -2.00 ± 0.3 volts

B: + HARDOVER → -6.13 ± 0.2 volts

C: ZERO → 0.0 ± 0.2 volts

D: - HARDOVER → +6.13 ± 0.2 volts

*Required voltage reading

i. Set the switches on Channel 1 to: type = -H, order = 1, master enable = ON, ΔP secondary = ON.

j. Measure and record ΔP_S for the switch settings shown below.

CHANNEL 4

Switch settings				Channel D	
Type	Order	Master enable	ΔP secondary	Check test set ΔP_S	Require-ments*
+H	1	ON	OFF		A
+H	1	ON	ON		B
+H	1	OFF	ON		C
+H	2	ON	OFF		A
+H	2	ON	ON		B

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FAULT INSERTION

CHANNEL 4 - Concluded

+H	2	OFF	ON		C
+H	None	ON	ON		A
Z	1	ON	OFF		A
Z	1	ON	ON		C
Z	1	OFF	ON		C
Z	2	ON	OFF		A
Z	2	ON	ON		C
Z	2	OFF	ON		C
Z	None	ON	ON		A
-H	1	ON	OFF		A
-H	1	ON	ON		D
-H	1	OFF	ON		C
-H	2	ON	OFF		A
-H	2	ON	ON		D
-H	2	OFF	ON		C
-H	None	ON	ON		A

Conditions: A: NO FAULT → -2.00 ± 0.3 volts

B: + HARDOVER → -6.13 ± 0.2 volts

C: ZERO → 0.0 ± 0.2 volts

D: - HARDOVER → +6.13 ± 0.2 volts

*Required voltage reading

Comments ______________________________

____

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ATP DATA SHEET - TEST 3.7.11 - Concluded

FAULT INSERTION

Witnessed by NASA R&QA ______________________________

Witnessed by EG5 (optional) ______________________________

Witnessed by EJ7 (optional) ______________________________

Witnessed by R/SD (optional) ______________________________

ATP DATA SHEET - TEST 3.7.12
SUBSYSTEM INITIALIZATION

Make appropriate notations and comments as applicable for the following items.

Test operator ______________________ Date ____________

Serial number ______________________ Type ____________

1. For initial condition mode, apply 5 volt to pin 5 and pin 6 at TOC interface. Measure output voltage at POS location on front panel of test set. Voltage at POS location should correspond to voltages in parenthesis. Input IC voltage on pin 9 and pin 10 of TOC interface. Tolerance is ±0.10 volts.

Input IC voltage	Voltage at pin 26
0 V	________ (-10.000)
0.500 V	________ (-8.000)
1.000 V	________ (-6.000)
1.500 V	________ (-4.000)
2.000 V	________ (-2.000)
2.500 V	________ (0.000)
3.000 V	________ (2.000)
3.500 V	________ (4.000)
4.000 V	________ (6.000)
4.500 V	________ (8.000)
5.000 V	________ (10.000)

2. Operate mode, system is closed loop.

   Remove IC voltage from pin 5 of TOC and input voltage at pin 3 and ground at pin 4. Measure output at pin 26 location on front panel of test set. Output at pin 26 should read 0.0 ± 0.06.

   POS = ________________ volts.

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ATP DATA SHEET - TEST 3.7.12 - Concluded
SUBSYSTEM INITIALIZATION

Comments ______________________________

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Witnessed by NASA R&QA ______________________________

Witnessed by EG5 (optional) ______________________________

Witnessed by EJ7 (optional) ______________________________

Witnessed by R/SD (optional) ______________________________

ATP DATA SHEET 3.9

PISTON TRAVEL

Make appropriate notations and comments for the following items.

Test operator ________________ Date ____________________

Serial number ________________ Type ____________________

1. Extend and retract piston, system is open loop. Apply ±0.573 volts to each input. Measure piston travel at each limit on pin 26.

   Requirement: Inboard piston travel 20.00 ± 0.20 volts. (14.64 inches)

   Requirement: Outboard piston travel 20.00 ± 0.20 volts. (8.532 inches)

   Actual travel __________ volts (pin 26).

Comments ____

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Witnessed by NASA R&QA ____________________________

Witnessed by EG5 (optional) ________________________

Witnessed by EJ7 (optional) ________________________

Witnessed by R/SD (optional) _______________________

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ATP DATA SHEET 3.11

POST TEST EXAMINATION

Make appropriate notations and comments for the following items.

Test operator ________________ Date ________________________

Serial number ________________ Type ________________________

After visual external examination of the servoactuator, circle the appropriate word(s).

The unit (does, does not) indicate damage.

Comments ____

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Witnessed by NASA R&QA ____

Witnessed by EG5 (optional) ___________________________________

Witnessed by EJ7 (optional) ___________________________________

Witnessed by R/SD (optional) __________________________________

ATP DATA SHEET - TEST 3.12
CHASSIS POWER

Make appropriate notations and comments as applicable for the following items.

Test operator ______________ Date ______________________

Serial number ______________ Type ______________________

1. Measure and record voltages.

Required measurements:	+15 (pin 28)	+15.0 ± 0.200	volts
	-15 (pin 29)	-15.0 ± 0.200	volts
	+10 (pin 30)	+10.0 ± 0.010	volts
	-10 (pin 31)	-10.0 ± 0.010	volts

Actual measurements:	+15,	__________________	volts
	-15,	__________________	volts
	+10,	__________________	volts
	-10,	__________________	volts

2. Measure and record noise and ripple.

Required measurements:	+15 (pin 28)	noise < 2.0 mV (rms)
	-15 (pin 29)	noise < 2.0 mV (rms)
	+10 (pin 30)	noise < 1.0 mV (rms)
	-10 (pin 31)	noise < 1.0 mV (rms)

Actual measurements:	+15,	________________	mV (rms)
	-15,	________________	mV (rms)
	+10,	________________	mV (rms)
	-10,	________________	mV (rms)

Comments ____

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Witnessed by NASA R&QA ______________________________

Witnessed by EG5 (optional) ______________________________

Witnessed by EJ7 (optional) ______________________________

Witnessed by R/SD (optional) ______________________________