Block II Spec

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, L. I., NEW YORK

ICD NO. LIS 370-10007

INTERFACE CONTROL DOCUMENT

TDRR 21638 AUG 17 1965

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APPROVALS

AUTHORIZED SIGNATURES	REPRESENTING	DATE
E. Stone HJD	GAEC	7/30/65
	GAEC	
WB	MIT/IL	

PREPARED BY: A. Bucello

CHECKED:

TITLE:

LEM-PGNS 800 CPS POWER ELECTRICAL INTERFACE

CCA NO.

REV	MODEL NUMBER	REV	MODEL NUMBER	REV	MODEL NUMBER

EFFECTIVITY

CODE IDENT NO.	SHEET	ICD NO.	REV
26512	SHEET 1 OF 7	ICD NO. LIS 370-10007	

INTERFACE CONTROL DOCUMENT

ENG 37 1-64

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
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REVISIONS

REV LTR	IRN NO.	SHEET	DESCRIPTION — INCLUDE CCA NUMBER	REV. BY	APPROVALS		DATE
					GAEC		

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BETHPAGE, L. I., NEW YORK

KEY: Responsibility is defined herein as follows:

(1) Grumman Aircraft Engineering Corporation
Bethpage. L.I. N.Y.

(2) Massachusetts Institute of Technology
Department of Aeronautics & Astronautics
Instrumentation Laboratory
Cambridge, Massachuestts

(3) National Aeronautics and Space Administration
Manned Spacecraft Center
Houston. Texas

(4) Design data to be supplied by

INTERFACE CONTROL DOCUMENT	SHEET 3 OF 7	ICD NO. LIS 370-10007	REV

ENG 37.2 1-64

INTRODUCTION

1.0 This ICD defines the 800 cps power interface that exists between PGNS and LEM (Rendezvous Radar resolver, Gimble Angle Sequence Transformation Assembly, Attitude error demodulators, hand controllers and throttle controllers).

1.1 The 800 cps power signal supplied by PGNS will have the following characteristics under the load conditions specified in (3) and (4) below.

(1) Normal conditions (800 cps frequency synchronized by LGC clock).

(a) Voltage: 28 ± 2% VRMS
(b) Frequency: 800 ± 0.5% cps
(c) Harmonic Content: 5% max

(2) Degraded conditions (800 cps frequency not synchronized by the LGC clock).

(a) Voltage: 28 ± 5% VRMS
(b) Frequency: 750 ± 40 cps
(c) Harmonic Content: 5% max

(3) Maximum load: 7 watts at 28 VRMS 800 cps

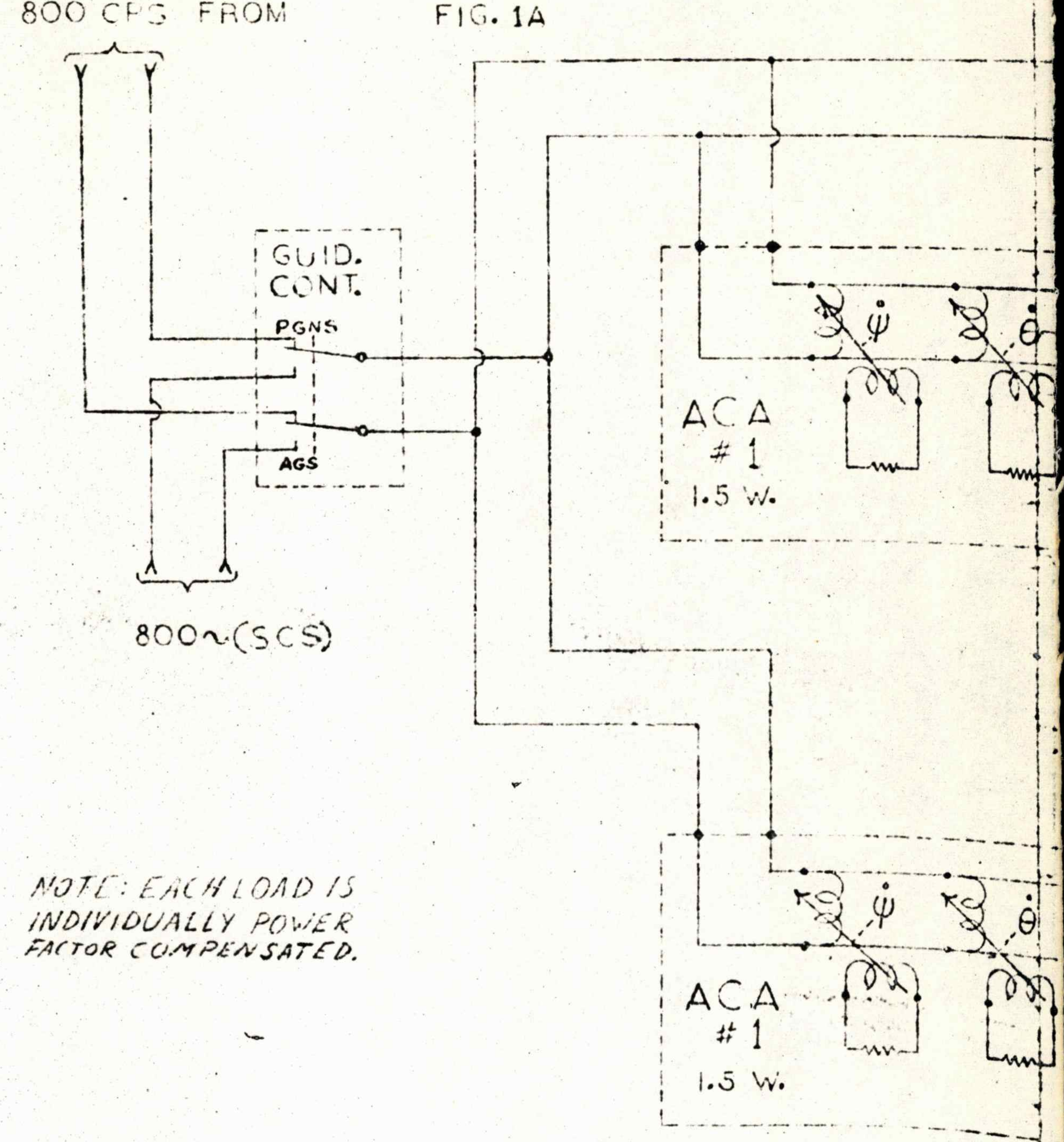
(4) Load conditions

(a) Maximum reactive load shall be 3.5 VAR
(b) The instantaneous value of load current shall not deviate by more than ± 15% of the peak value of the fundamental, from the instantaneous value of the fundamental current, when the load is excited by the voltage defined in 1.1(1) under steady state conditions.

(5) The voltage at PGNS turn-on shall not exceed 45 volts rms, and shall be within tolerance in less than 5 seconds.

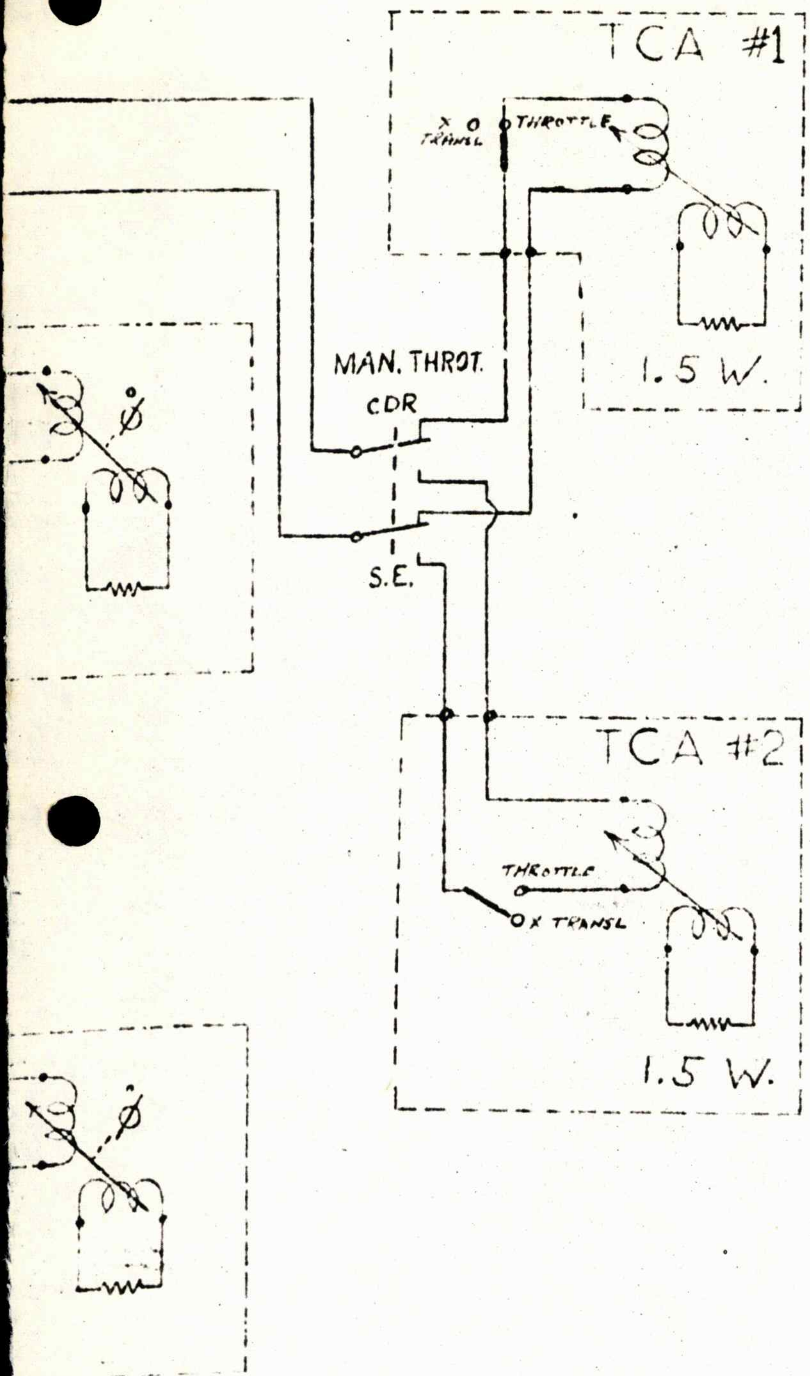
(6) The load shall be DC ground isolated.

FIG. 1B: PGNS 800 CPS DISTRIB



NOTE: EACH LOAD IS INDIVIDUALLY POWER FACTOR COMPENSATED.

UTION

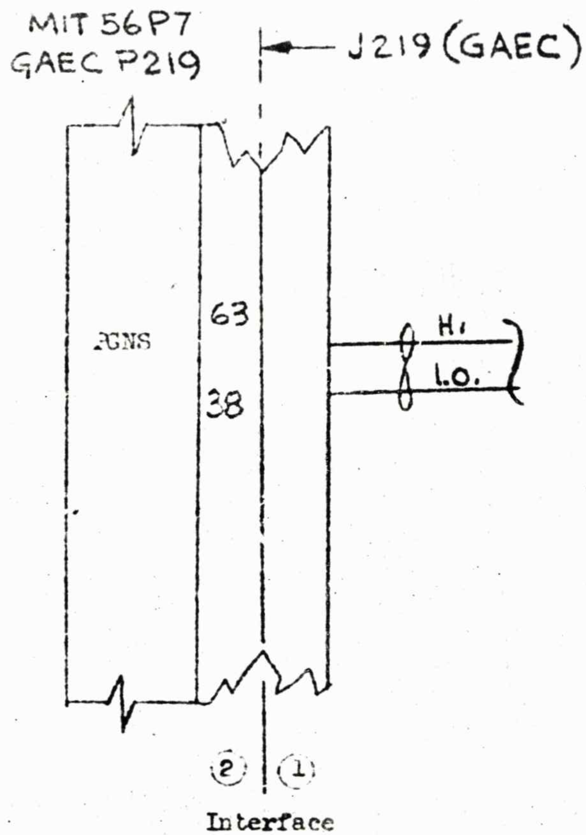


FOR REFERENCE ONLY

CDR - COMMANDER
GUID. CONT. - GUIDANCE CONTROL
MAN. THROT. - MANUAL THROTTLE
S.E. - SYSTEM ENGINEER

XCITATION SIGNAL ELECTRICAL INTERFACE	SHEET 6 OF 7	ICD NO. LIS 370-10007	REV

INTERFACE CONTROL DOCUMENT



CONNECTOR IDENTIFICATION		J219 - GAEC (P219) MIT 56P7
PIN #		Signal Identification
63		800 cps Reference
38		800 cps Reference - LOW

NOTE: Connector types are defined in LIS 390-10001.

FIGURE #2 800 CPS EXCITATION ELECTRICAL INTERFACE CONNECTIONS

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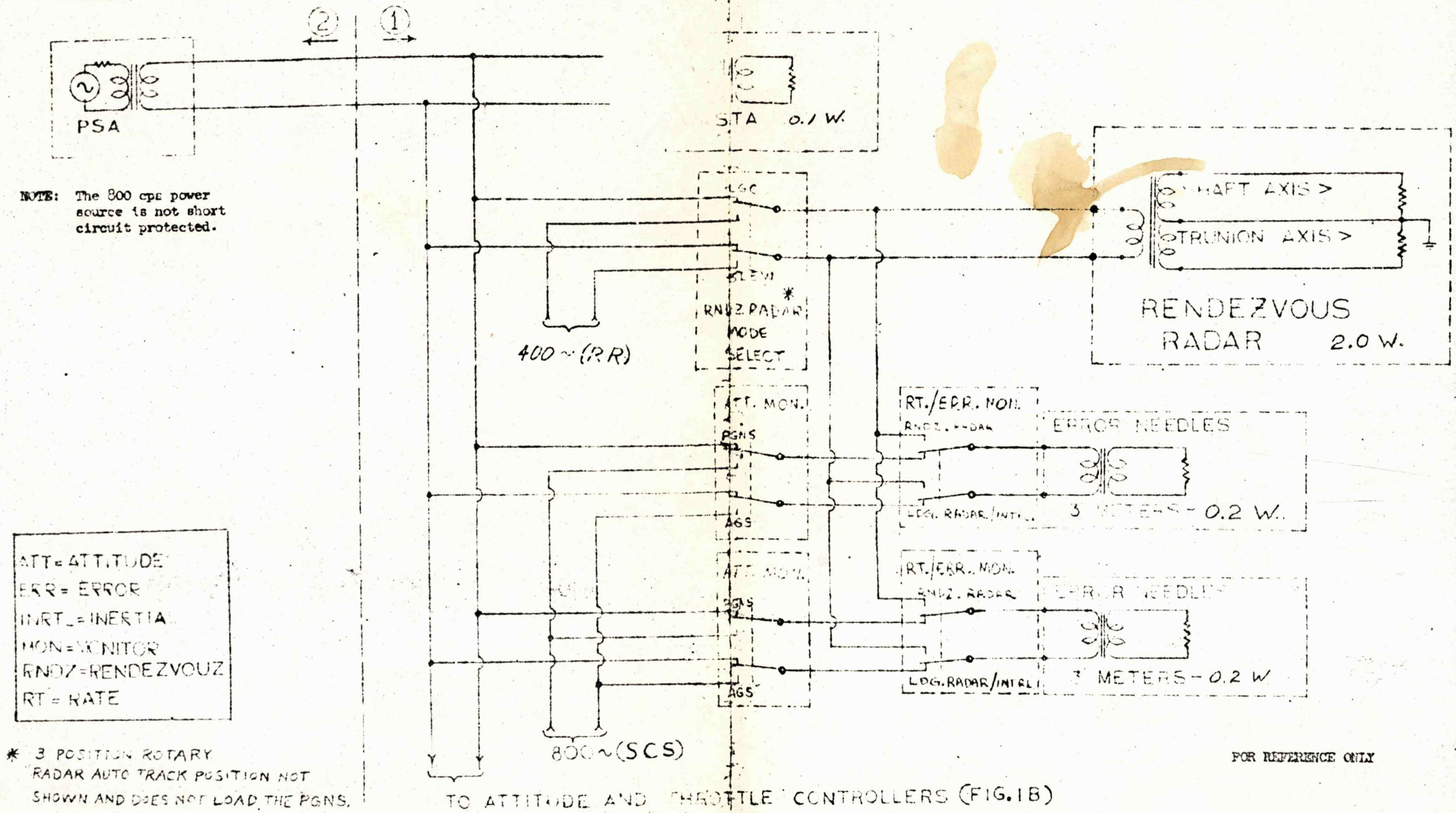
FIG. 1A: PGNS 800 CPS DISTRIBUTION



FOR REFERENCE ONLY

INTERFACE CONTROL DOCUMENT	FIGURE 1-A LEM PGNS 800 CPS EXCITATION SIGNAL ELECTRICAL INTERFACE	SHEET 3 OF 7	ICD NO. LIS 370-10007	REV

E6

MH01-01327-216

REVISIONS

TDRR 21387 AUG 6 1965

APPROVALS

AUTHORIZED SIGNATURES	REPRESENTING	DATE
W L Wheeler	NAA/S&ID	7/15/65
D. G. Hoag / W. A. Stameris	MIT	[illegible]

INTERFACE CONTROL DOCUMENT

DR BY		
CHK BY		

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NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION
12214 LAKEWOOD BLVD., DOWNEY, CALIFORNIA

Guidance & Navigation Electrical Input Power

Block II - MIT NAA

CODE IDENT NO.	SIZE	
03953	A	MH01-01327-216

REVISIONS

MODEL	PART NO.	DESCRIPTION	APPLICABLE SPEC

EFFECTIVITY AND SPECIFICATIONS

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CODE IDENT NO.	SIZE	
03953	A	MH01-01327-216

SHEET 2

Form M 110-N-57 Rev 4-63

REVISIONS					
SYM	DESCRIPTION	REQD	REP	DATE	APPROVED

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CODE IDENT NO.	SIZE	
03953	A	MH01-01327-216
		SHEET 3

ALL PARTIES AFFECTED

FORM M110-N-96 NEW 4-63

REVISIONS

NOTES: Unless Otherwise Specified

1 1. North American Aviation, Inc.
Space and Information Systems Division
Downey, California

2 2. Massachusetts Institute of Technology
Instrumentation Laboratory
Cambridge, Massachusetts

3 3. Refer to ICD MH01-01306-116 for additional connector details and location.

4. All reference documents shall be of latest issue.

4 5. The present MIT design provides a power ground which is in conflict with the CSM single point ground philosophy. NASA will provide NAA a waiver permitting this deviation to the standard CSM practice.

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CODE IDENT NO.	SIZE	
03953	A	MH01-01327-216
		SHEET 4

REVISIONS

DC Power Characteristics:

Basic DC Steady State Voltage limits shall be 25.8 and 30.8 volts from input to negative return at G&N/S&ID electrical power interface.

Variations to Basic-DC Steady State Voltage:

	Max. Instantaneous Values	Min. Instantaneous Values	Utilization
a.	31.8 VDC	25.8	At all times (due to bus ripple) with the exception of those listed in b, c, and d.
b.	31.8 VDC	24.0	Starting gimbal motors (approximately five minutes prior to Delta V's) shall return to normal limits in less than one second for each motor "start" pulse.
c.	32.8 VDC	25.8 VDC	Switching on of S/C battery prior to Delta V's or entry.
d.	+80 VDC	-24 VDC	Values are open circuit voltages. These are random voltage pulses of 10 microseconds maximum duration. Equipment shall be tested for compatibility as specified in Figure #1. Source impedance of the pulses shall not be less than that of the test circuit specified in Figure 1.

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CODE IDENT NO.	SIZE	
03953	A	MH01-01327-216

REVISIONS

Power Interruption: There shall be no interruption of DC power to loads, from prelaunch through earth landing flight phases for normal or emergency operations modes.

Power Loads:

	Maximum	Nominal	Minimum
AGC Operate	130	110	90
Standby	12	10	8
Optics	150	130	90
IMU Operate	380	300	220
Standby	80	60	40
Displays and Controls	70	40	20
TOTAL	730	580	420

Power Source: The Guidance and Navigation System shall operate from the spacecraft DC and AC supply or its simulated equivalent.

4 **Negative Connection:** Negative bus power return for the AGC will be connected to the AGC chassis through a choke. Negative bus power returns for other G&N subsystems shall be DC isolated from MIT chassis and shall be grounded, by NAA, at the negative bus only.

Neutral Connection: Neutral bus power return terminals shall be isolated from MIT chassis and from negative DC terminals and shall be grounded, by NAA, at the neutral bus only.

Circuit Breaker Ratings:

CB #73, 10 Amp	COMPUTER (Operate and Standby)
CB #74, 10 Amp	
CB #75, 10 Amp	Optics
CB #76, 10 Amp	
CB #69, 25 Amp	IMU (Operate)
CB #70, 25 Amp	
CB #71, 7.5 Amp	IMU HTR
CB #72, 7.5 Amp	
CB #67, 2.0 Amp	AC POWER
CB #68, 2.0 Amp	

Isolation: Isolation between the spacecraft 28 VDC bus "A" and 28 VDC bus "B" shall be provided by diodes within the G&N System. These diodes shall have a "peak" inverse voltage capability of greater than 60 volts.

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ALL PARTIES AFFECTED | SHEET 5

FORM M1:0-N-30 NEW 4-63

REVISIONS

Peak Power: The peak power drawn by the G&N System shall not exceed 700 watts DC and 57 watts AC (exclusive of short durations transients of 5 sec. maximum).

AC Power Characteristics:

Power Phases: Single phase

Power Frequency: 400 cps

Tolerance:

Normal operating tolerance is negligible (sychronized to master timing system).

Emergency: 400 ± 7 cps (loss of master timing signal)

Basic AC Steady State Voltage limits shall be 111.0 and 119.0 volts rms.

Variations to Basic AC Steady State Voltage:

1. Normal operational instantaneous voltage limits greater than basic steady state voltage, may be 50 and 150 volts rms returing to 105 - 125 volts rms within 15 ms and to basic steady state limits within 50 ms.

2. Abnormal instantaneous high limit voltage for greater duration than normal operational high limit voltage, may be 150 volts rms for 100 ms.

3. Modulation: 0.5 percent

4. Inverter Failure: There is a maximum of 1 minute switchover time for AC power in the event the primary inverter fails and switchover to secondary inverter is required.

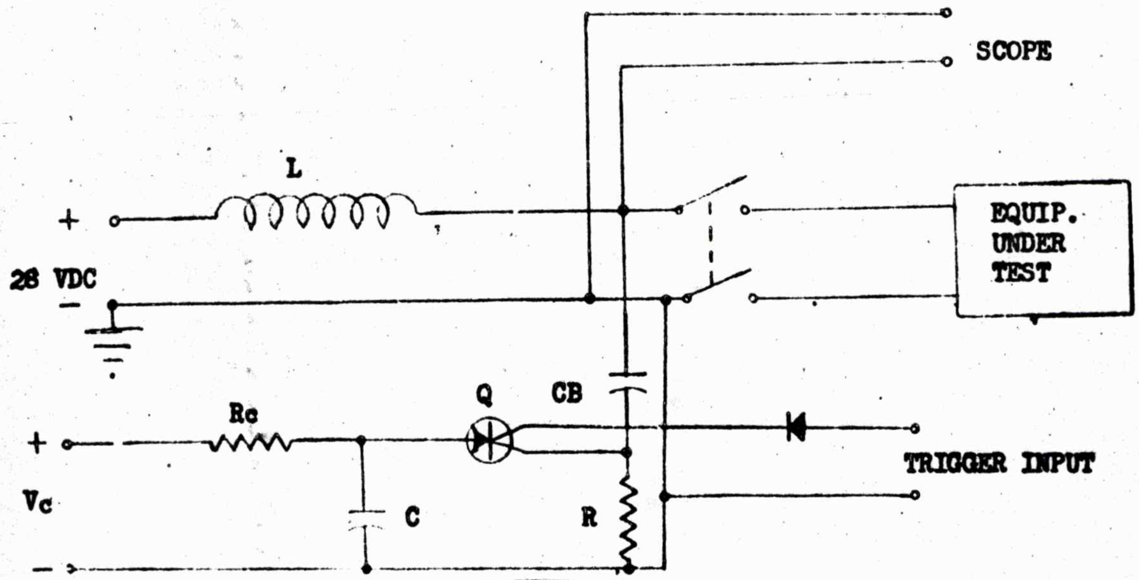
Wave Shape:

Sinusoidal
Total Distortion: 5% Maximum of Fundamental
Highest Harmonic: 4% Maximum of Fundamental
Crest Factors: 1.414 ± 10%

CHASE ORDER BETWEEN ALL PARTIES AFFECTED | SHEET 6

REVISIONS

TRANSIENT SUSCEPTIBILITY TEST



Trigger Specifications:

Duration:	less than 20 usec.
Rate:	10 pps
Ampl.:	50 to 85 milliamps into zero resistance load
Rise Time:	0.5 usec. or less

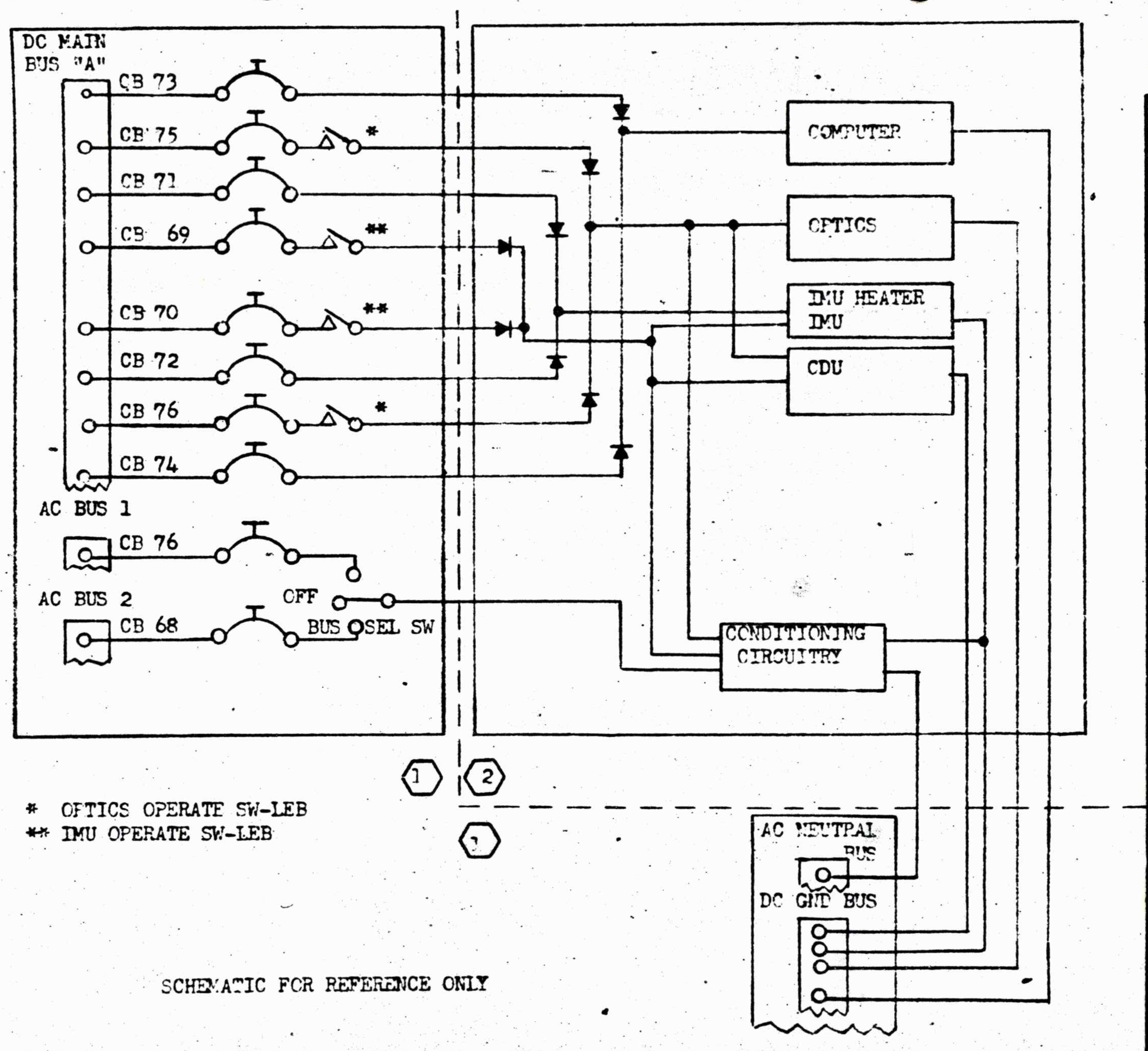
R	= 5 ohms nominal, carbon, 1/2 watt	Q	= SCR min rating 10 a, 200 v
C	= Nominal 1 ufd, paper, 600 wvdc	L	= 250 µh
Rc	= Nominal 10K, carbon, 1 watt	Vc	= DC Source 100 to 150 V
CB	= 10 ufd. paper, 200 wvdc		

No change in indication beyond system tolerance, or temporary or permanent damage shall result in any equipment when a 50 volt pulse of 10 microsecond duration and a 10 pps repetition is induced above and below the 28 volt (nominal) DC supply voltage level for a period of 5 minutes minimum on either Bus A or Bus B lines.

The test circuit, as shown in the accompanying figure, shall be used. The existence of the 50 volt spike shall be measured with the test circuit in an open circuited configuration. The equipment to be tested is then connected to the test set-up, the repetitive pulses applied to the equipment input, and resultant effect on equipment measured.

"Equipment Under Test" shall be interpreted to mean the subsystem or subsystems which make up the equipment of one circuit breaker as shown on sheet 9. This test shall not be performed at any lower equipment level.

FIGURE 1



* OPTICS OPERATE SW-LEB
** IMU OPERATE SW-LEB

SCHEMATIC FOR REFERENCE ONLY

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INTERFACE CONTROL DOCUMENT

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CODE IDENT NO.	SIZE
03953	A

MH01-01327-216

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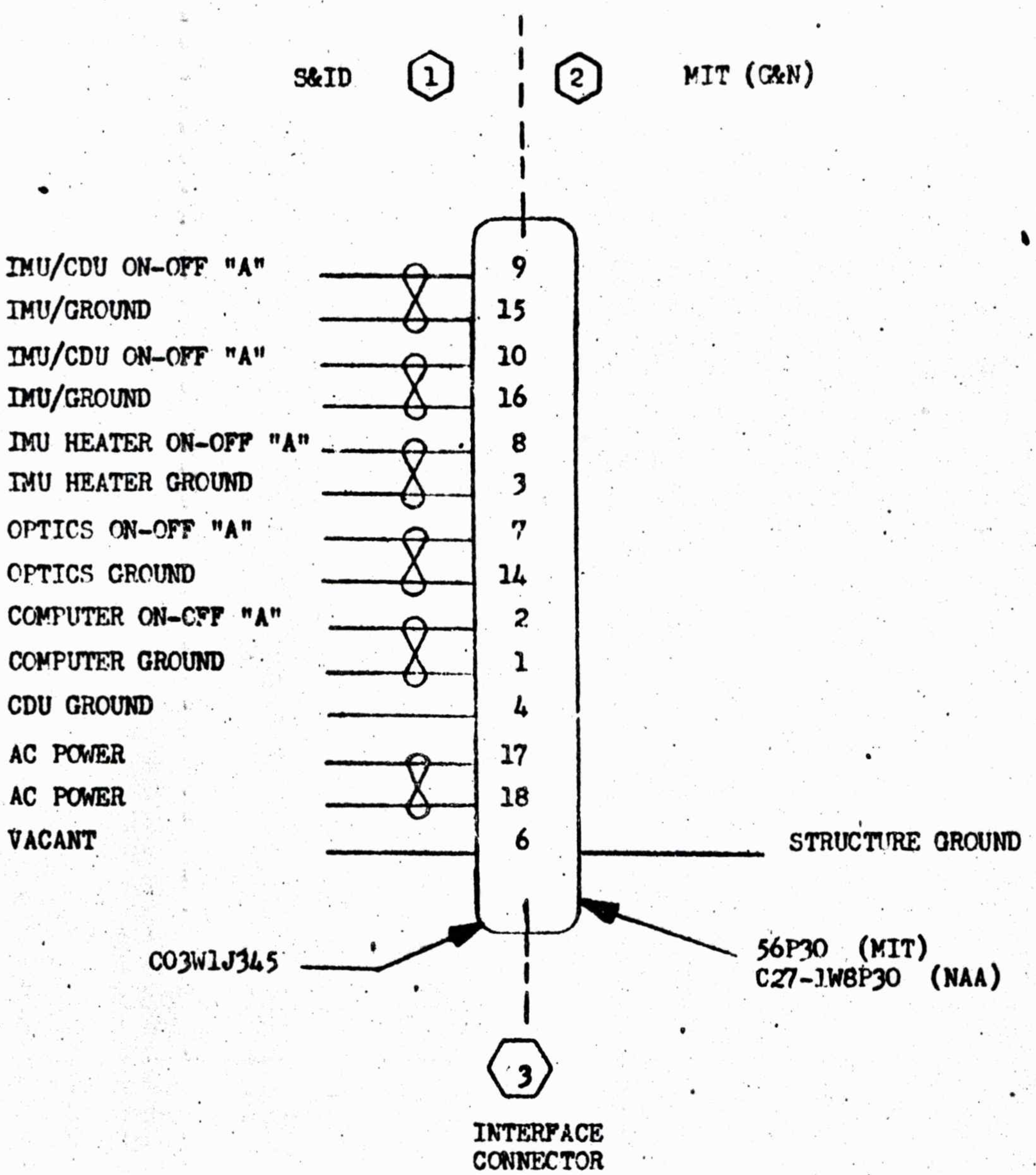

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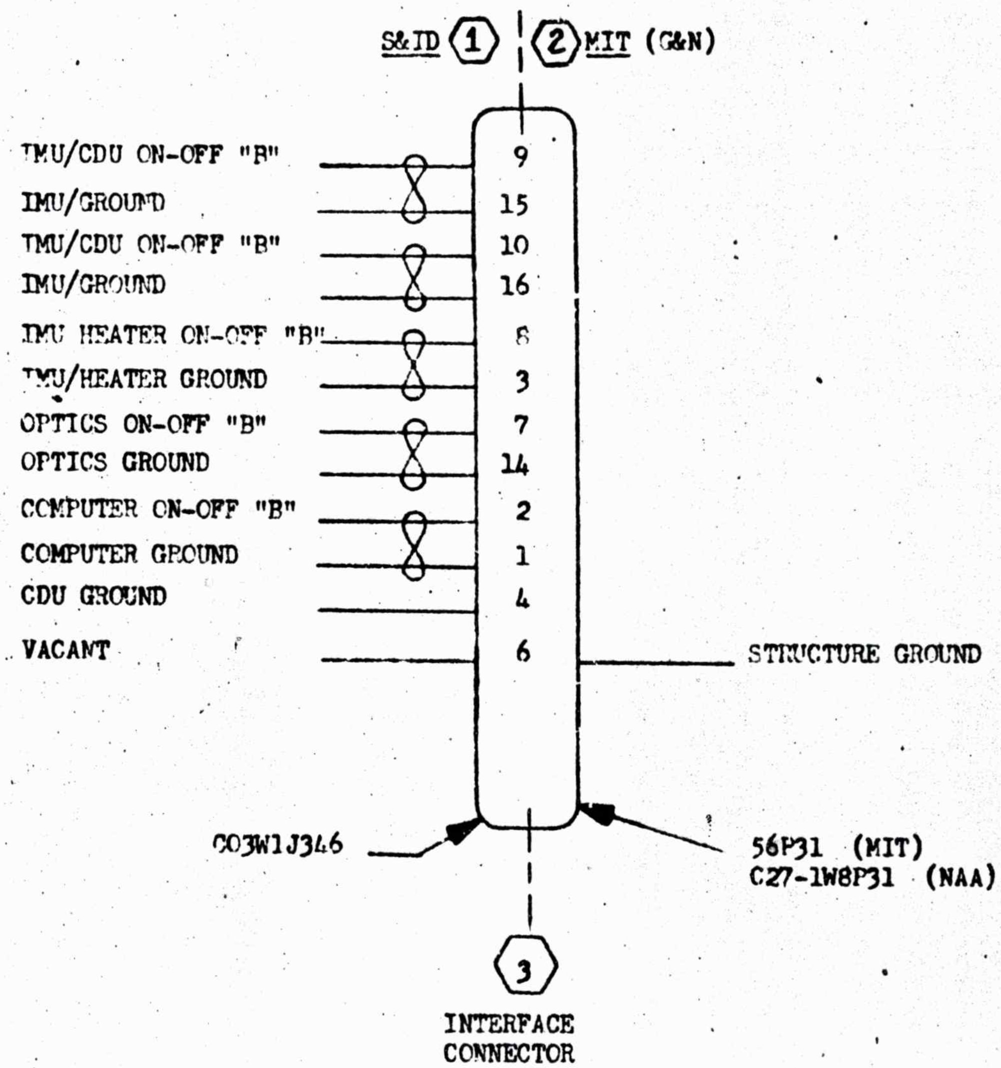
	CODE IDENT NO. 03953	SIZE A	MH01-01327-216 10
			SHEET 10

REVISIONS



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SHEET 11

EC

REV

ICD NO. LIS-390-10002

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, L. I., NEW YORK

INTERFACE CONTROL DOCUMENT

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APPROVALS

AUTHORIZED SIGNATURES	REPRESENTING	DATE
[illegible] HJD	GAEC	7/30/65
D. G. Hoag ws	MIT	30 Jul 65

PREPARED BY: M. Malison/M. Malison 7-30-65

CHECKED: V. Maiorana/E E Miller for VPM 7-30-65

TITLE:

PGNS PRIME POWER REQUIREMENTS AND CHARACTERISTICS

CCA NO.

REV	MODEL NUMBER	REV	MODEL NUMBER	REV	MODEL NUMBER

EFFECTIVITY

CODE IDENT NO.	SHEET	ICD NO.	REV
26512	1 OF 8	LIS-390-10002	

INTERFACE CONTROL DOCUMENT

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REVISIONS							
REV LTR	IRN NO.	SHEET	DESCRIPTION — INCLUDE CCA NUMBER	REV. BY	APPROVALS		DATE
					GAEC		

INTERFACE CONTROL DOCUMENT	SHEET 2 OF 8	ICD NO. LIS-390-10002	REV

ENG 37.1 1-64

KEY: Responsibility is identified herein as follows:

1. Grumman Aircraft Engineering Corporation
   Bethpage, L.I., New York

2. Massachusetts Institute of Technology
   Cambridge, Massachusetts

3. National Aeronautics and Space Administration
   Manned Spacecraft Center
   Houston, Texas

4. Design data to be supplied by:

1.0 D.C. System Characteristics

1.1 D.C. Power Characteristics

1.1.1 D.C. Steady-State Voltage

The following d-c steady-state voltages, including ripple voltages, between 20 cycles and 15 Kcps, shall be provided by GAEC at the GAEC-MIT J/P 222 and J/P 231 electrical power interface connectors:

Instantaneous Steady-State Voltage		Mission Phases
Max	Min	
32.5v	22.0v	All mission phases in which only IMU/Standby Mode exists.
32.5v	23.5v	All mission phases in which PGNS is in operating modes.

1.1.2 Power Interruption

During those mission phases in which only the IMU/Standby Mode exists possible power interruptions (zero voltage) may occur for periods up to three minutes.

1.1.3 Transient Voltages

No change in equipment operation beyond system tolerances, or temporary or permanent damage shall result in any equipment when transient voltages, as specified in Figure 1 are injected into the d-c voltage supply leads.

1.2 D.C. Negative Power Returns

The LGC D.C. negative power return will be connected internally to the LGC chassis; all other d-c negative power returns shall be d-c isolated from PGNS chassis and a-c power return, and will be grounded at one point only, i.e., the LEM D.C. Negative Bus.

D.C. negative power returns shall be provided for PGNS as shown in Figure 2.

1.3 Influence on D-C Electrical System

1.3.1 Reflected Ripple

The utilization equipment shall not cause current modulation of the steady-state d-c current in excess of 2 amps peak to peak from 20 cps to 4 Kcps and decreasing at 20db. per decade above 4Kcps when measured with a 0.25 ohm resistor in the power distribution line.

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1.3.2 Inrush Current

Inrush current shall be less than 60 amperes after 80 microseconds, with a 0.1 ohm line impedance.

2.0 A-C SYSTEM CHARACTERISTICS

2.1 A-C POWER CHARACTERISTICS

2.1.1 A-C STEADY-STATE VOLTAGE

The steady-state input voltage provided by GAEC at the GAEC-MIT electrical power interface connector shall be 115 ± 2.5 volts, rms.

2.1.2 TRANSIENT VOLTAGES

Transient voltages shall not exceed 225 volts, peak, from transient start to 2.5 millisecond. After 2.5 milliseconds the voltage shall be within the limits of 144 volts, peak, to 188 volts, peak with recovery to steady-state conditions within 50 milliseconds.

2.1.3 VOLTAGE SPIKES

Voltage spikes, superimposed on the sinusoidal wave shape, shall not exceed 10 volts, peak, with 90% recovery within 0.25 milliseconds.

2.1.4 PHASES - Single phase.

2.1.5 FREQUENCY - 400 ± 10 cps

2.1.6 WAVE SHAPE -

Sinusoidal -
Crest Factor - 1.41 ± 0.1
Total Distortion - 5% max.
Individual Harmonic Distortion - 4% max.

2.2 A-C POWER RETURN

The a-c power return shall be isolated from MIT chassis and d-c return.

5

3.0 POWER DISTRIBUTION SYSTEM

Figure 2 depicts the power distribution system.

3.1 CIRCUIT BREAKER RATINGS (For reference only)

CB	4CB124	15 amp	IMU oper/CDU's
CB	4CB161	3 amp	IMU Standby
CB	4CB122	5 amp	LGC
CB	4CB212	3 amp a-c	AOT
CB	4CB213	3 amp	AOT Heater

4.0 POWER REQUIREMENTS

The power required shall not exceed (at 28V.D.C.) the following:

Equipment/Mode	Max Power	Av. Power	Min Power
IMU/Standby	80	60	40
IMU/Operate	380	300	220
LGC/Standby	12	10	8
LGC/Operate	130	110	90
AOT	5	5	5
AOT (a-c power at 115v.a.c.)	9.2	Neg.	Neg.

6

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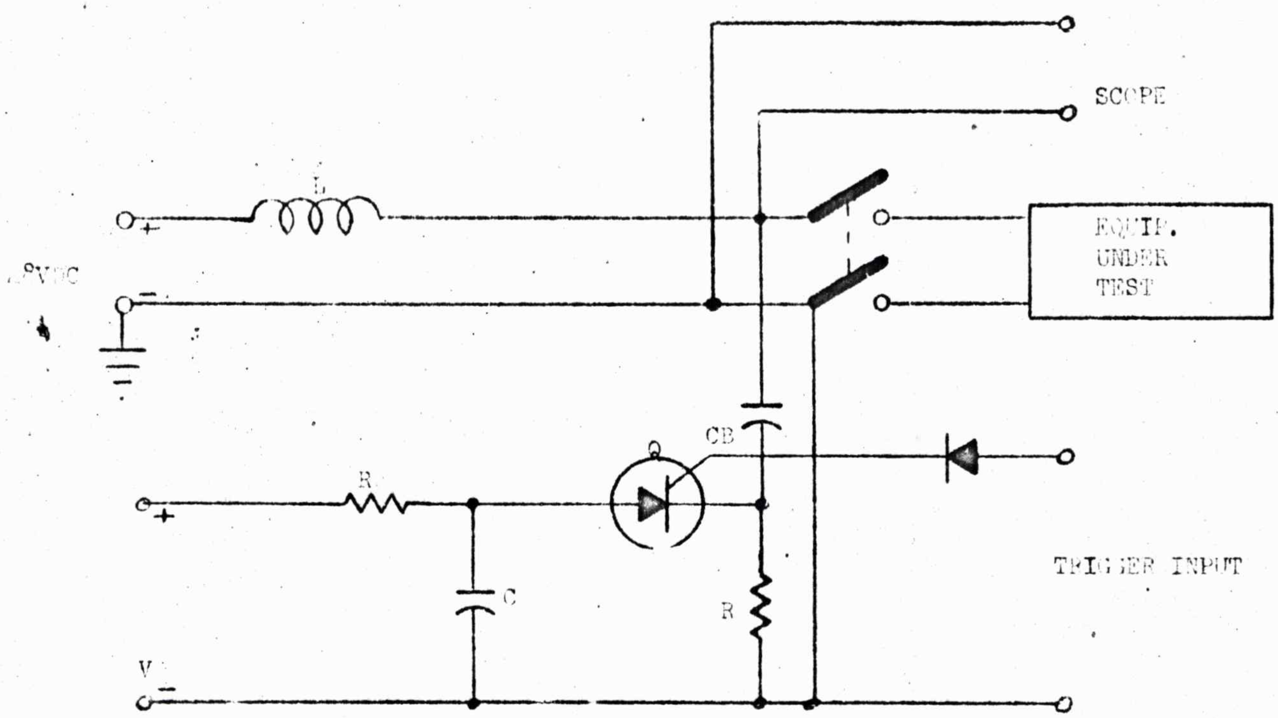
Figure 1 - TRANSIENT SUSCEPTIBILITY TEST



Trigger Specifications:
- Duration: less than 20 μsec.
- Rate: 10pps
- Ampl.: 50 to 85 milliamps into zero resistance load.
- Rise Time: 0.5 μsec. or less

R	= 5 ohms nominal, carbon, ½ watt	Q	= SCR min. rating 10 a. 200 v
C	= Nominal 1 μfd, paper 600 wvdc	L	= 250 microhenries
R	= Nominal 10K, carbon, 1 watt	Vc	= DC Source 100 to 150 V
CB	= 10 μfd. paper. 200 wvdc		

No change in indication beyond system tolerance, or temporary or permanent damage shall result in any equipment when a 50 volt pulse of 10 microsecond duration and a 10 pps repetition is induced above and below the 28 volt (nominal) DC supply voltage level for a period of 5 minutes minimum.

The test circuit, as shown in the accompanying figure, shall be used. The existence of the 50 volt spike shall be measured with the test circuit in an open circuited configuration. The equipment to be tested is then connected to the test set-up, the repetitive pulses applied to the equipment input, and resultant effect on equipment measured. "Equipment under test" shall be interpreted to mean the subsystem or subsystems which make up the equipment of one circuit breaker as shown on sheet 8. This test shall not be performed at any lower equipment level.

7

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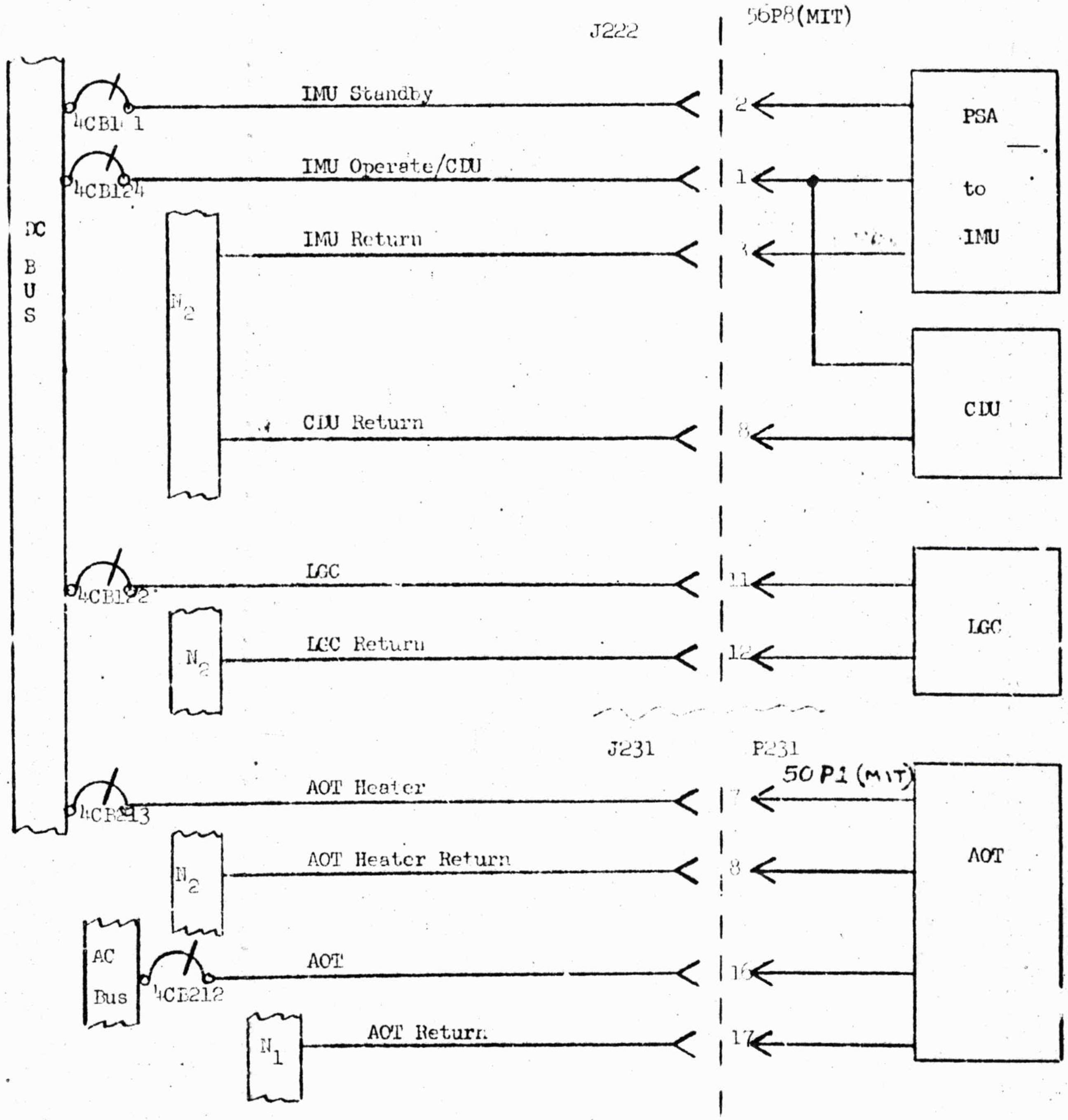

N_1 = A-C Ground Bus

N_2 = D-C Ground Bus

NOTE: Connector types are defined in LIS-390-10001.

FIGURE 2 - POWER DISTRIBUTION SYSTEM

BLOCK II AC POWER SUPPLY SPECS

392-20-0709

AMPLIFIERS		DESIG MARGIN REQUIREMENTS								FUNCTIONAL REQUIREMENTS					OPERATING RANGE		
MODULE	RATED LOAD	BIAS MA.	F.L. SUPPLY A	ϕ_M f_{co}	G_M	G_{OL}	Θ_{OL}	ASYM. (I_{HW})	$DIST_{OL}$ @ 34 VOLT	GAIN V/V	OUTPUT V	MONITOR V	Θ_{CL}	$DIST_{CL}$	B+	ASSY TEMP.	FREQ
800 CPS 1% (2007110)	56Ω ±5%	* ~~12-40~~ 7-120	.95±.2	>45° 45-11KC	>10 DB	20± 3DB	180°± 30°	<25%	<10%	21.6± 2.2	28.0 ±.2	14±1.0	180°± 3°	<1%	25-30	15-65°C	800± 8
800CPS 5% (2007111)	30Ω ±5%	13-20	1.7±.4	>45° 5-16KC	>10 DB	20± 3DB	180± 30°	<20%	<10%	1.00± .04		14±1.4	270± 3°	<5%	25-30	15-65°C	800± 8
3200CPS 1%	150Ω ±5%	* ~~13-26~~ 13-40	.375± .075	>45° 12-30KC	>10 DB	20± 3DB	180°± 30°	<25%	<10%	30.2±		14±1.0	180± 3°	<1%	25-30	15-65°C	3200± 32

* Bias at 40±5°C

ϕ_M = PHASE MARGIN (DEGREES)

f_{co} = 0 DB CROSS OVER FREQ

G_M = GAIN MARGIN (DB)

Θ_{OL} = OPEN LOOP PHASE SHIFT

ASYM = 0 TO PEAK ASYM. OF HALF WAVE CURRENTS (EXPRESSED AS % OF SMALLER O-P VALUE)

AAC, FILTER & MULTIVIB.	DESIGN MARGIN REQUIREMENTS				FUNCTIONAL REQUIREMENTS					OPERATING RANGE			
MODULE	DYNAMIC RANGE	ASYMM (MV)	NO SYNCH FULL SYNC	DC MA	CONTROL VOLTS	NON-SYNC FREQ.	DISTORT.	Θ_{OP}	MONITOR VOLTAGE	B+	ASS'Y TEMP	SYNCH FREQ	SYNCH AMPLIT.
800 CPS (2007112)	<.5% ΔV_o FOR A_V 14.4-43.2	<10% NON S. <2% SYNC	<.5 V_{O-P} >2 V_{O-P}	30±10	28.00±.28 28.0±1.4 NON-SYNC	760±40 CPS	<.75% SYNC <2% NON.S.	180±7°	.657± .12	25-30	15-40°C	800±1	7±3 V_{O-P}
3200 CPS (2007109)	<.5% ΔV_o FOR A_V 15.1-60.4	<10% NON S. <2% SYNC	<.5 V_{O-P} >2 V_{O-P}	30±10	28.6±.29* 28.6±1.4 NON-SYNC	3060 ±100	<.75% SYNC <2% NON-S.	180±7°	.495±.09	25-30	15-40°C	3200±4	7±3 V_{O-P}

* DURING TURN-ON, ≦ 31.5V

ASYM (MV) = ASYMMETRY OF MULTIVIB 1/2 CYCLE TIMES (IN % OF FULL CYCLE TIME)

9-28-65
E Conger

Specification Definitions

asymmetry = Percent difference between 0 to peak B+ current values for both half cycles of a full wave. (Expressed in terms of lowest value)

*Phase Margin = 360° − phase shift, measured at 0 db gain.

*Gain Margin = − DB gain measured at 0° phase margin.

* Input conditions provided in the individual specs.

APOLLO II IRIG Specification

MC 25-868

Release Date Mar. 8, 1965

Release Revision --

Class A Release

TDRR 17180

Return to Tom Wolff

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NOT To Be Used For PRODUCTION

20 20
22 25
23 42
25 44

IRIG Preamplifier Specifications

and Test Procedure

Date	Revision Letter	TDRR No.	Pages Revised	Approval MIT	Approval NASA
3/8/65	---	17180	Initial Release	W L Hayden	W J Rhine
5/11/65	A	19836	1, 2, 3	WR	[illegible]

TP#11938

This MC specification consists of page i ~~to~~ ___ and 1 to 3 inclusive.

1. ELECTRICAL SPECIFICATION

1.1 PRIMARY. The assembly shall perform as specified in this section (1.1) within the limits of the following constraints:

a. Supply Voltage: 25 to 30 vdc
b. Assembly Temperature: 60°F to 140°F
c. Load Resistance: 10 K
d. Signal ground connected to 0 vdc

1.1.1 Voltage Gain Range. With a 3200 cps sine wave input of 10 mv. rms, the voltage gain shall be adjustable from 88 to 165. This adjustment shall be made by selecting the appropriate value of R12 which will be connected to P10 and P11 during IRIG calibration.

1.1.2 Voltage Gain Stability. After the voltage gain has been adjusted as described in 1.1.1 it shall not vary more than 4 percent for the constraint variations within the limits specified in 1.1.

1.1.3 Phase Shift. With a 3200 cps sine wave input of 10 mv. rms, the phase shift of the output with respect to the input shall be $180° \pm 10°$ for all voltage gains within the range specified in 1.1.1.

1.1.4 Dynamic Range. For all voltage gains within the range specified in 1.1.1, the voltage gain for an output of 10 V rms shall be within 5% of the voltage gain determined by the conditions of 1.1.1.

1.1.5 Harmonic Distortion. The harmonic distortion of the output voltage shall be less than 1 percent under the conditions specified in 1.1.1 and less than 5 percent under the conditions specified in 1.1.4.

1.1.6 Zero Signal Noise. With the input terminals shorted to 0 vdc the output voltage shall be less than 20 mv. rms.

1.1.7 Demodulator Load Correction Resistance, R11. The resistance measured between pin 5 and pin 1 shall be $10K \pm 5\%$ ohms.

1.1.8 Resolver Power Factor Correction Capacitance, C3. The capacitance measured between pin 9 and pin 1 shall be $0.01 \pm 10\%\ \mu f$.

1.2 DESIGN MARGIN. Compliance of this assembly with design margin specifications is required prior to acceptance only. The assembly shall perform as specified in this section (1.2) within the limits of the following constraints:

a. Supply Voltage: 27.5 vdc
b. Assembly Temperature: 80°F

Rev. A 5/11/65

c. R12: 150K ohms
d. Load Resistance: 10 K ohms
e. Signal ground connected to 0 vdc

1.2.1 Loop Gain. With a 3200 cps sine wave input and the output voltage fixed at 1.0 V rms, the loop gain shall be 20 ± 1 db.

1.2.2 Phase Margin. The phase margin shall be greater than 45° under the following conditions:

a. Loop gain shall be as specified in 1.2.1.

b. The input voltage shall be maintained at a level equal to that which is required to produce a voltage at the output terminals of 1.0 V rms at 3200 cps.

1.2.3 Gain Margin. The gain margin shall be greater than 6 db under the following conditions:

a. Loop gain shall be as specified in 1.2.1.

b. The input voltage shall be maintained at a level equal to that which is required to produce a voltage at the output terminals of 1.0 V rms at 3200 cps.

2. ELECTRICAL TEST AND NOMINAL SELECTION PROCEDURES

Rev. A 5/11/65

2.1 PRIMARY. The tests in this section (2.1) shall be performed within the limits of the following constraints:

a. Supply Voltage: 25 ± 0.3 vdc and 30 ± 0.3 vdc
b. Assembly Temperature: 80° ± 10°F
c. Load Resistor: 10 K ohms ± 5%
d. Signal ground connected to 0 vdc

2.1.1 Voltage Gain Range. With a 3200 ± 32 cps sine wave of 10 ± 0.1 mv. rms connected to the input terminals, measure the voltage gain with

a. R12 equal to 150 K ohms ± 2%
b. R12 equal to 17 K ohms ± 2%

2.1.2 Voltage Gain Stability. Using data acquired in 2.1.1 calculate voltage gain stability for:

a. R12 equal to 150 K ohms ± 2%
b. R12 equal to 17 K ohms ± 2%

2.1.3 Phase Shift. Apply a 3200 ± 32 cps sine wave of 10 ± 0.1 mv. rms to the input terminals. Measure the phase shift of the output with respect to the input:

a. With R12 equal to 150 K ohms ± 2%

b. With R12 equal to 17 K ohms ± 2%

2.1.4 Dynamic Range. Apply a 3200 ± 32 cps sine wave to the input terminals. Adjust its amplitude to produce 10 ± 0.1V rms at the output terminals:

a. With R12 equal to 150 K ± 2%

b. With R12 equal to 17 K ± 2%

2.1.5 Harmonic Distortion. Measure the harmonic distortion of the output voltage for the conditions of 2.1.1 and 2.1.4.

2.1.6 Zero Signal Noise. Short the input terminals to 0 vdc and measure the output voltage.

2.1.7 Demodulator Load Correction Resistance, R11. Measure the resistance between pin 5 and pin 1.

2.1.8 Resolver Power Factor Correction Capacitance, C3. Measure the capacitance between pin 9 and pin 1.

2.2 DESIGN MARGIN. The tests and nominal selection procedures in this section (2.2) shall be performed within the limits of the following constraints:

a.	Supply Voltage:	27.5 ± 0.3 vdc
b.	Assembly Temperature:	80° ± 10°F
c.	Load Resistance:	10 K ohms ± 5%
d.	Signal ground connected to 0 vdc	

Rev. A 5/11/65

2.2.1 Loop Gain. Adjust the loop gain to 20 ± 1 db by selecting the appropriate value of R2 under the following conditions:

a. Input Voltage Frequency: 3200 ± 32 cps

b. Voltage at the output terminals maintained at 1.0 ± 0.05 V rms.

2.2.2 Phase Margin. Measure the phase margin under the following conditions:

a. Loop gain shall be as specified in 1.2.1.

b. The applied voltage shall be maintained at a level equal to that which is required to produce a voltage at the output terminals of 1.0 ± 0.05 V rms at 3200 ± 32 cps.

2.2.3 Gain Margin. Measure the gain margin under the following conditions:

a. Loop gain shall be as specified in 1.2.1.

b. The applied voltage shall be maintained at a level equal to that which is required to produce a voltage at the output terminals of 1.0 ± 0.05 V rms at 3200 ± 32 cps.

Apollo G&N Specification
PS 2007019 Rev B
Original Issue Date: 13/6/65
Release Authority: TDRR 20749
Class Release: A

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

DUCOSYN TRANSFORMER ASSEMBLY
DRAWING NO. 2007019

Date	Revision Letter	TDRR No.	Pages Revised	Approvals MIT	Approvals NASA
M 10/19/65	A	23290	3	WK	---
M 9/22/66	B	31222	3	MGM/EA	---

This specification consists of Pages 1 to 7 inclusive.

APPROVALS	W J Rhine NASA/MSC 7-13-65	Manuel Kramer 2 July 65 W J Aupffer 13 July 65 MIT/IL	ACSP

1. SCOPE

1.1 This specification establishes the detail requirements for complete identification and acceptance of the Ducosyn Transformer Assembly PART NO. 2007019.

1.2 PRODUCT CONFIGURATION BASELINE ACCEPTANCE

1.2.1 The product configuration baseline shall be established by F.A.C.I. of the end item Serial No.   . This unit and all subsequent units regardless of intended use shall be accepted to the configuration defined by Serial No. unless formally approved otherwise as required by ANA Bulletin No. 445.

2. APPLICABLE DOCUMENTS

2.1 The following documents form a part of this specification to the extent specified herein.

2.1.2 Effective issue. Unless otherwise specified herein, Military and Government Standards and specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATION

ND 1002214

STANDARDS

MIL-STD 202

DRAWINGS

APOLLO G&N 2007019

Copies of Specifications, Standards, Drawings, Bulletins and Publications required by suppliers in connection with specific procurement functions should be obtained from the Procuring Activity or as directed by the contracting office.

2.2 CONFLICTING REQUIREMENTS. In the event of conflict between the requirements of the contract, this document and the documents listed in this section, the following order of precedence shall apply and the contractor shall notify MIT Apollo Management of the conflict as soon as it is determined.

a. The contract
b. This specification
c. Documents listed in this section

3. ELECTRICAL SPECIFICATION.

3.1 PRIMARY. The assembly shall perform as specified in this section (3.1) within the limits of the following constraints unless otherwise noted:

a.	Assembly temperature:	15° to 65°C
b.	Input voltage:	28.0 ± 0.2 V rms
c.	Frequency:	3200 ± 32 cps
d.	Loads:	
	I. IRIG	6.6Ω, 5% PIN 5-6
	II. PIP	3.8Ω, 5% " 3-4

3.1.1 Driving Point Impedance. The impedance from pin 1 to pin 2 shall have a magnitude of 370±55Ω at a phase angle of -79° ±7°, with the loads removed.

3.1.2 Output Voltage. The voltage between pins 5 and 6 shall be 4.00 ± 0.12 V rms. The voltage between pins 3 and 4 shall be 2.00 ± 0.06.

3.1.3 Phase. The voltage between pins 3 and 4 and between pins 5 and 6 shall be in phase with respect to the voltage between pins 1 and 2.

3.1.4 Continuity. The resistance between pin 4 and pin 7 shall be 0.5Ω max. with input voltage and loads removed.

3.3 PRODUCT CONFIGURATION.

3.3.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007019 and all drawings and engineering data referenced thereon.

3.3.2 Maximum Weight. 68 grams

3.3.3 Insulation Resistance. The resistance between the electrical interconnection of all assembly pins and the assembly mounting screws shall be at least 100 megohms. The insulation resistance between pins 1 and 3, between pins 1 and 5, and between pins 3 and 5 shall be at least 100 megohms.

4. QUALITY ASSURANCE PROVISIONS.

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 The failure of the end product to pass any examination or test of this section will automatically classify the unit as nonconforming. When nonconforming units are corrected by the contractor, the unit shall be reinspected. When corrective action has been taken, the reinspection of a nonconforming unit may be limited to the test or examination whech defined the nonconformance, or when so directed by the cognizant inspecter, a complete re-examination and retest of the unit may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.1.2 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

a.	Temperature:	25 ± 10°C
b.	Relative Humidity:	90% max.
c.	Barometric Pressure:	23 to 32 inches of Hg

4.3 TEST PROCEDURES.

4.3.1 Primary. The tests required by this section (4.3.1) shall be performed within the limits of the following constraints unless otherwise noted:

a.	Assembly temperature:	15° to 40°C
b.	Input voltage:	28.0 ± 0.2 V rms
c.	Frequency:	3200 ± 32 cps
d.	Test setup as indicated in Figure 1	

4.3.1.1 Electrical Performance Tests. Measure the following:

a. Driving point impedance (Ref. para. 3.1.1)
b. Output voltages (Ref. para. 3.1.2)
c. Phase (Ref. para. 3.1.3)
d. Continuity (with input voltage and loads removed) (Ref. para. 3.1.4)

4.4 DRAWING COMPLIANCE. The assembly shall be visually examined for compliance to the requirements of APOLLO G&N Drawing 2007019. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulation defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.5 INSULATION RESISTANCE. With the assembly mounted by its mounting screws to a metal plate and with all pins connected together, the resistance from the electrical interconnection to the metal plate shall be measured using Method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output of 225 ± 75 V dc, limited to a short circuit of 6.0 ua. The resistance indicated shall be at least 100 megohms. The resistance between the pins 1 and 3, between pins 1 and 5, and between pins 3 and 5 shall also be at least 100 megohms.

4.6 WORKMANSHIP VIBRATION TESTS. The workmanship vibration test shall be performed within the limits of the following constraints:

a.	Assembly temperature:	15° to 40°C
b.	Input voltage:	28.0 ± 0.2 V rms
c.	Frequency:	3200 ± 32 cps
d.	Loads:	
	I. IRIG	6.6Ω, 5%
	II. PIP	3.8Ω, 5%

4.6.1 Subject the module to vibration along an axis perpendicular to the plane of the base. The vibration shall be simple harmonic motion swept from 10 to 2000 cps at a rate of one (1) octave per 15 seconds. The magnitude of the vibration shall be 6.0 grms, limited to 0.4 inch PP constant displacement from 10 cps to the crossover frequency.

4.6.2 During vibration the IRIG exictation voltage shall not lie outside the range 4.00 ± 0.4 V rms for a period greater than 1 m. sec. The PIP excitation voltage shall not lie outside the range 2.00 ± 0.2 V rms for a period greater than 1 m. sec.

5. PREPARATION FOR DELIVERY.

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND 1002214.

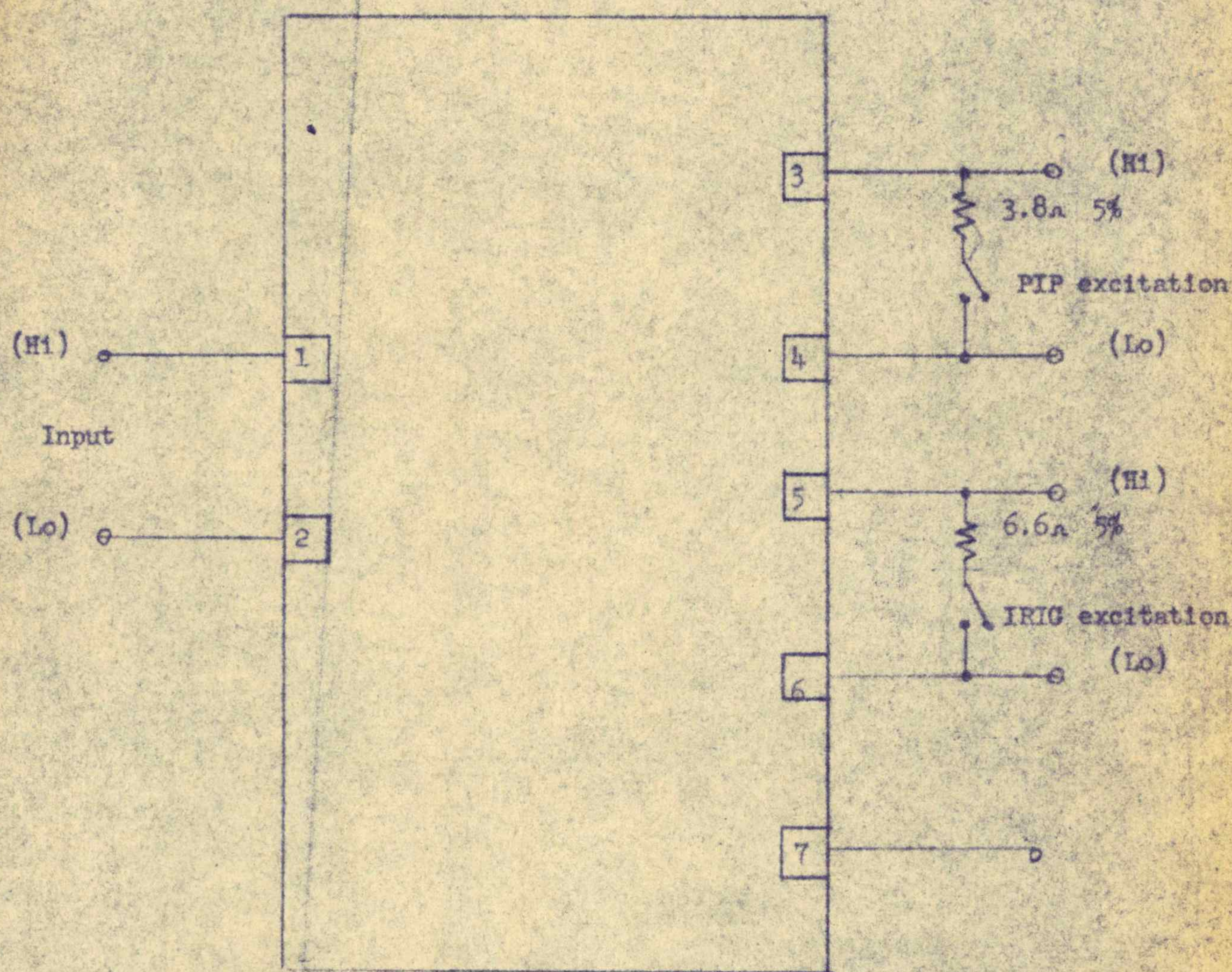

3
(Hi)
3.8Ω 5%
PIP excitation
(Hi)
1
4
(Lo)
Input
5
(Hi)
6.6Ω 5%
(Lo)
2
IRIG excitation
6
(Lo)
7

Figure 1

APOLLO G&N Specification
PS2007060 REV B
Original Issue Date: 24 Aug 1965
Release Authority: TDRR 21803
Class A Release
Code Ident. No. 80230

PS 2007060

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

PIP PREAMP ASSEMBLY

DRAWING NUMBER 2007060

REFERENCE COPY ONLY
Subject to Change without Notice
No Parts to be Fabricated to this Print

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				MIT	NASA
M 11/2/65	A	23606	4 RDG/AU	WK	--
M 1/11/66	B	25173	3, 10 RDG/AL	WK	--

This specification consists of page 1 to 11 inclusive.

APPROVALS	NASA/MSC		MIT/IL	ACSP	
	A.C.M.	A. Satoner 8/20/65	W. Hoefer 24 Aug 65	L. FERRISS	E.T. Powers

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of the PIP Preamp Assembly, Part Number 2007060-011.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&N

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment

STANDARDS

Military

MIL-STD-202C	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&N

2007060	PIP Preamp Assembly

(Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer).

2.2 CONFLICTING REQUIREMENTS. In the event of a conflict between requirements, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this section.

3. REQUIREMENTS. DESCRIPTION.

The assembly contains the differential preamplifier circuitry to amplify the accelerometer signal generator output signal.

3.1 PERFORMANCE

3.1.1 Inputs. The assembly shall perform as specified herein with the following electrical inputs.

a. DC Supply Voltages. The DC supply voltage shall be as follows:

1. +27.5 Vdc nominal
2. +31.6 Vdc enhanced
3. +23.4 Vdc degraded

b. Input Signals. Input signals shall be as specified in Table I.

TABLE I

INPUT SIGNALS

SIGNAL	AMPLITUDE	FREQUENCY	DISTORTION
Balanced Input	Variable 0 to 1V pp	Variable 100 cps to 100 kc	$\leq$ 5%
Single-ended Input	2Vpp +2%	1kc, 3.2kc, and 10kc ±2%	$\leq$ 5%

3.1.2 Characteristics

3.1.2.1 Supply Current Drain. The dc current drain from the +28 vdc supply shall be as follows:

a. 0.52 ma minimum
b. 0.57 ma nominal
c. 0.62 ma maximum

3.1.2.2 Frequency Response. The preamplifier frequency response, prior to electrical connection of C2 shall be as specified in Table II. **This test shall be run prior to encapsulation only.**

TABLE II

FREQUENCY RESPONSE

INPUT CONDITIONS BALANCED INPUT		OUTPUT REQUIREMENTS DIFFERENTIAL OUTPUT
Frequency cps ±2%	Amplitude mv pp ±2%	GAIN V/V
100	100	19.5 + 5%, -40%
320	↑	19.5 ±5%
1kc		↑
3.2kc		↓
10kc		19.5 ±5%
32kc	↓	19.5 +5%, -10%
100kc	100	19.5 +5%, -40%

3.1.2.3 Gain and Phase. The transfer characteristics shall be as specified in Table III.

TABLE III

GAIN AND PHASE

INPUT SIGNAL		DC SUPPLY	OUTPUT	
Frequency (±8 cps)	Amplitude (mv pp)	(Vdc)	Gain (±5%)	Phase (±3°)
3.2 kc	100	+23.4	14	-46°
3.2 kc	100	+27.5	14	-46°
3.2 kc	100	+31.6	14	-46°

3.1.2.4 Noise. Preamplifier output noise shall be 2 mv pp maximum for a bandwidth of 0.06 cps to 10 KC.

3.1.2.5 Overload-Distortion. The preamplifier distortion shall be 5 percent maximum for an output level of 5 Vpp.

3.1.2.6 Common-Mode Rejection Ratio. The common-mode rejection ratio for the preamplifier shall be as specified in Table IV.

TABLE IV

COMMON MODE REJECTION RATIO

SINGLE ENDED INPUT		COMMON MODE REJECTION RATIO (CMRR)
Frequency (kc) ±2%	Amplitude (Vpp)±2%	
1	2	≥3300
3.2	2	≥5000
10	2	≥3300

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007060 and all drawings and engineering data referenced thereon.

3.2.2 Standards of Manufacturing, Manufacturing Process and Production

3.2.2.1 Insulation Resistance. The resistance between the electrical interconnection of all assembly pins and the assembly mounting screws shall be at least 100 megohms.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 Test Conditions

4.1.1.1 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

a. Temperature: 25° ±10°C
b. Relative Humidity: 90% max
c. Barometric Pressure: 28 to 32 inches of Hg

4.1.1.2 Supply Voltages. The assembly shall be tested with the dc supply voltage specified in 3.1.1.a.

4.1.1.3 Test Signals. The required input signals are specified in Table I.

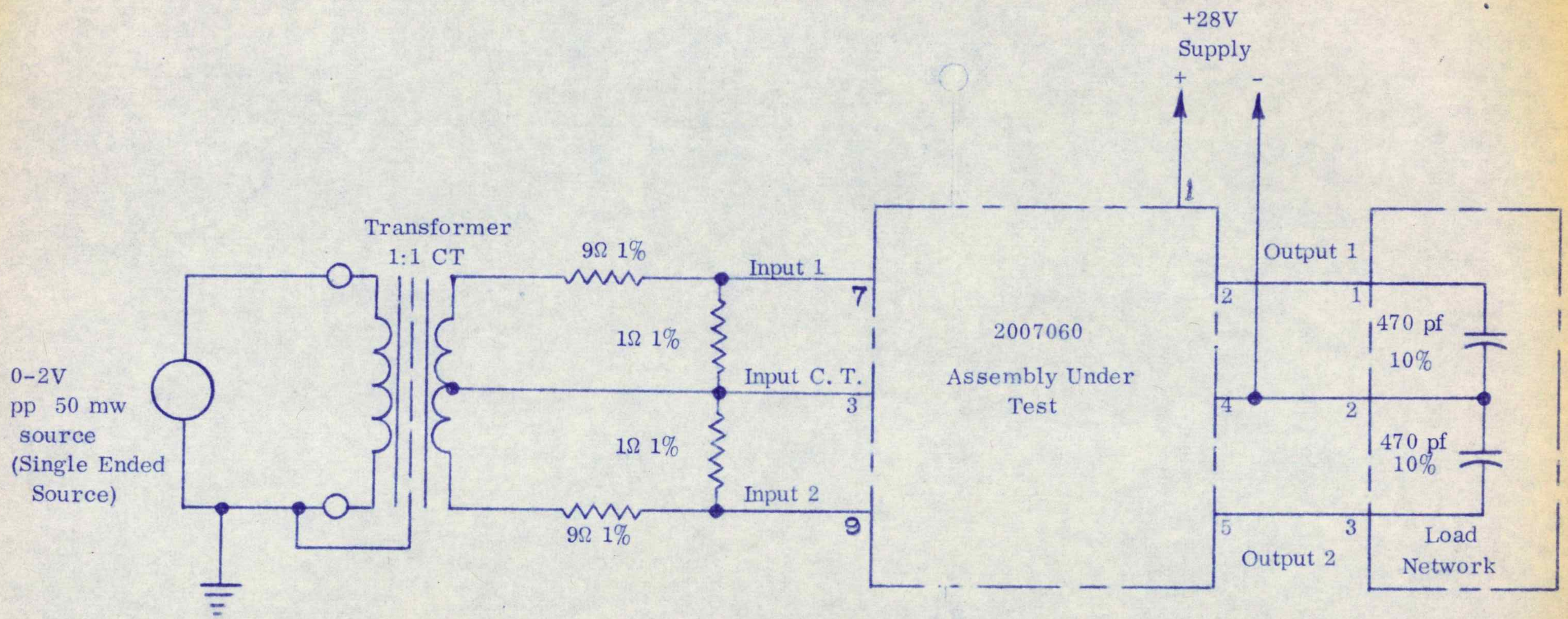
4.1.1.4 Test Setup. The required test setup is shown in Figure 1.

4.1.2 Nonconforming Units. Failure of the unit to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or when directed by the cognizant inspector, a complete retest and reexamination may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.2 TESTS

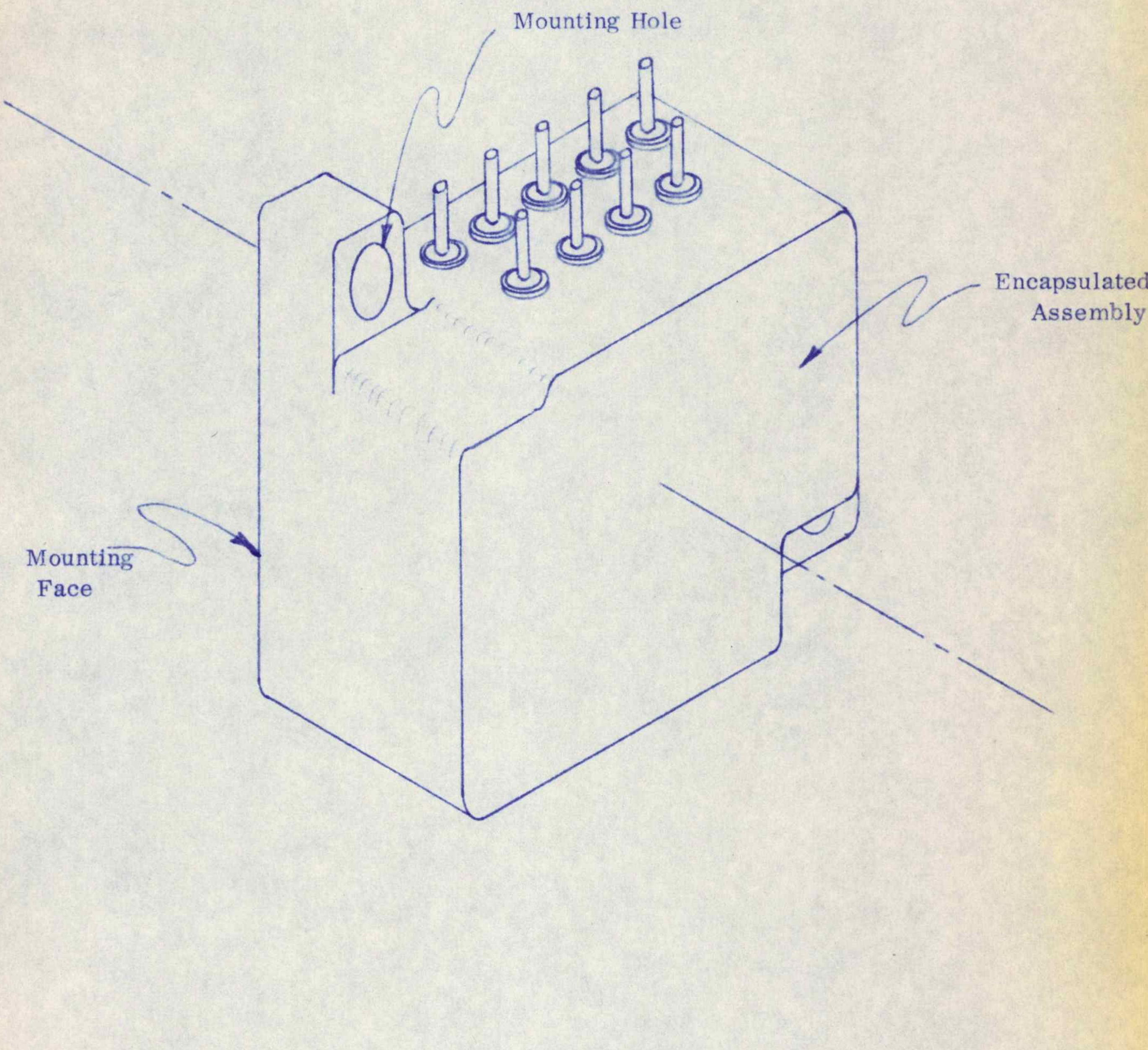
4.2.1 Drawing Compliance. The assembly shall be visually examined for compliance to the requirements of APOLLO G&N Drawing 2007060. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of marking.

4.2.2 Workmanship-Vibration. The assembly shall be vibrated along the axis shown in Figure 2. The vibration shall be simple harmonic motion swept from 10 to 2000 cps at a rate of 1 octave/ 15 sec. The magnitude of vibration shall be 6.0g rms limited to a 0.4 inch pp constant displacement from 10 cps to the crossover frequency. The assembly shall be energized in accordance with Figure 1. The balanced input signal shall be 100 mv pp. The preamplifier output shall be monitored (see Figure 3) such that significant changes in the amplitude and phase relationship of the output will be detected. The relationship of the output shall remain unchanged before, during and after vibration. A change in relationship shall constitute a failure. After vibration, the assembly shall be visually examined as specified in 4.2.1.



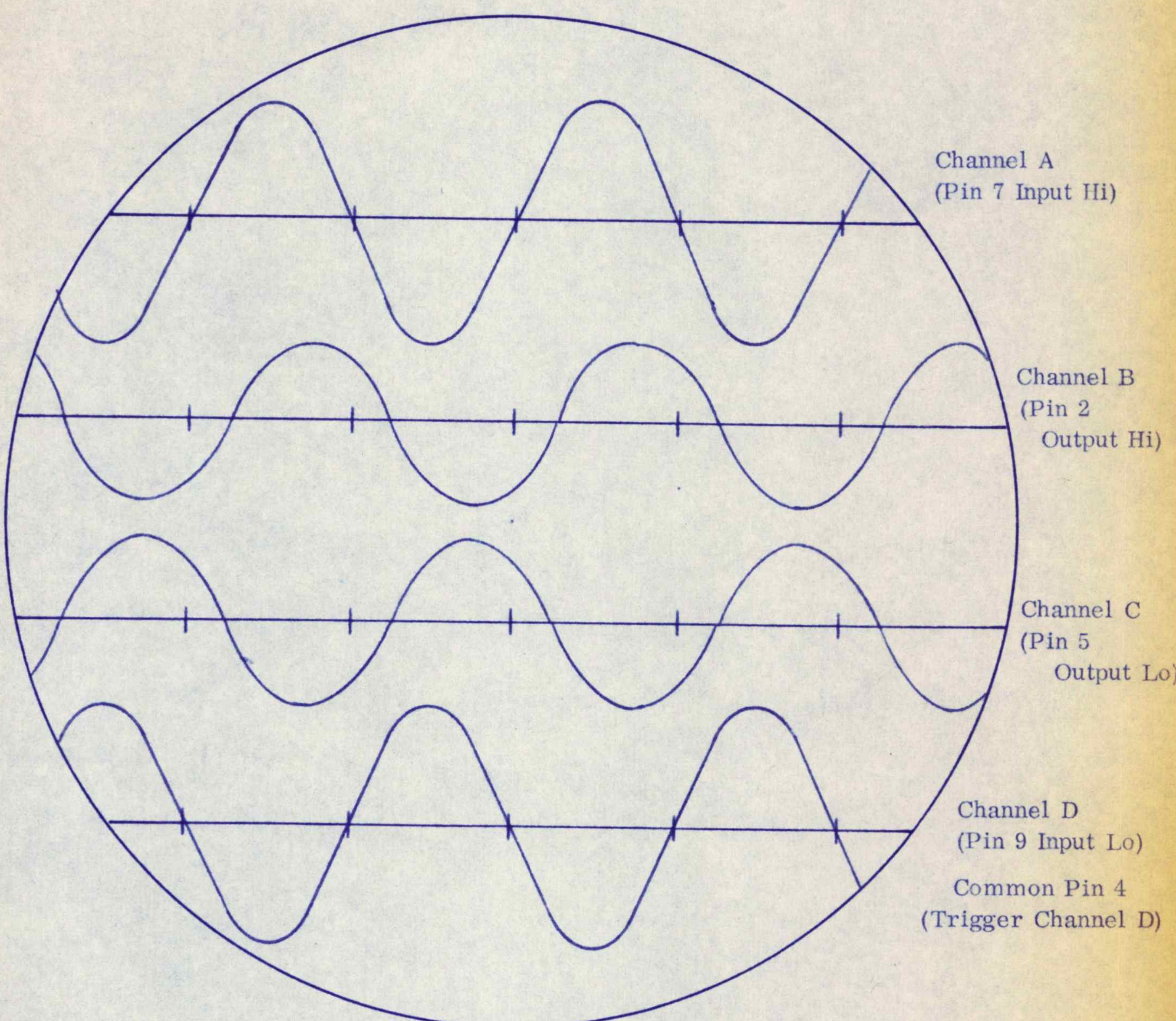
REQUIRED TEST SETUP

FIGURE 1



VIBRATION AXIS OF ASSEMBLY

FIGURE 2



4 TRACE DISPLAY

FIGURE 3

4.2.3 Insulation Resistance. With the assembly mounted by its mounting screws to a metal plate and all pins electrically connected together, the resistance shall be measured from the electrical interconnection to the metal plate in accordance with method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output of 225±75 vdc, limited to a short circuit of 6.0 μa. The resistance indicated shall be at least 100 megohms.

4.2.4 Supply Current Drain. With the test setup shown in Figure 1 and the following conditions established, the current at pin 1 shall be 0.52 ma minimum to 0.62 ma maximum.

a. Nominal dc supply voltage applied to pin 1 (+) and pin 4 (-).

b. The amplitude of the balanced input signal applied to pin 6 (Input 1), pin 8 (Input 2) and pin 3 (center tap ground) reduced to zero.

4.2.5 Frequency Response. With the following conditions established, the differential amplifier frequency response shall be as specified in Table II.

a. Capacitor C2 electrically disconnected.

b. Nominal dc supply voltage applied to pin 1 (+) and pin 4 (-).

c. Balanced input signal of 100 mv pp applied to pin 7 (Input 1), pin 9 (Input 2) and pin 3 (center tap ground).

d. The output signal measured differentially from pin 2 (output 1) to pin 5 (output 2) with pin 4 common.

e. **This test shall be run prior to encapsulation only.**

4.2.6 Gain and Phase. With the following conditions established, the preamplifier gain and phase at pin 2 (output 1), pin 5 (output 2) and pin 4 (common) shall be as specified in Table III.

a. A 100 mv balanced input signal applied to pin 7 (Input 1), pin 9 (Input 2) and pin 3 (center tap ground).

b. The dc supply voltage adjusted in accordance with Table III.

c. Phase measurements made with respect to the signal applied differentially in accordance with a.

4.2.7 Noise. With the following conditions established, the preamplifier output noise shall be 2 mv pp maximum for a bandwidth of 0.06 cps to 10Kc.

a. Nominal dc supply voltage applied to pin 1 (+) and pin 4 (-).

b. Pins 7 and 9disconnected from the balanced input and connected to pin 3.

4.2.8 Overload-Distortion. With the following conditions established, the preamplifier distortion shall be 5 percent maximum from pin 2 to pin 5 with pin 4 common.

a. Nominal dc supply voltage applied to pin 1 (+) and pin 4 (-).

b. The balanced input signal adjusted to produce a 5 Vpp output at pin 2 to pin 5 with pin 4 common.

4.2.9 Common-Mode Rejection Ratio. With the following conditions established the common-mode rejection ratio (CMRR) shall be as specified in Table IV.

a. Nominal dc supply voltage applied to pin 1 (+) and pin 4 (-).

b. The balanced input signal disconnected and a single ended signal of 2Vpp varied in frequency in accordance with Table IV applied to pins 7 and 9 (Hi) and pin 3 (Lo).

c. The output signal measured differentially from pin 2 (Output 1) to pin 5 (Output 2) with pin 4 common.

d. The common mode gain (A_{CM}) calculated at each frequency by dividing the output signal amplitude (c) by the input signal amplitude (b).

e. The CMRR obtained by dividing the nominal amplifier gain (A_D) which equals 14.2 by the common mode gain (A_{CM}).

$$CMRR = \frac{A_D}{A_{CM}}$$

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

ETP:efo

APOLLO G&N Specification
PS 2007064 Rev: G
Original Issue Date: 8 JUN 65
Release Authority: TDRR 19912
Class A Release

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

TEMPERATURE CONTROL MODULE ASSY

DRAWING NO. 2007064

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				MIT	NASA
7 Jul 65	A	20664	6, 7 and 8	WK	
8/17/65	B	21657	5	WK	ACM
M 11/9/65	C	23923	7 RDG/AC	WK	TM
M 11/30/65	D	24426	4, 5, 6, 7 RDG/AC	WK	TM
M 2/8/66	E	25946	4, 6, 7 RDG/AC	WK	--
M 2/23/66	F	26563	5,7 JH/AC	WK	---
M 5/18/66	G	29032	7 RDG/AC	MGM	--

This specification consists of Pages 1 to 8 inclusive.

APPROVALS	NASA/MSC	MIT/IL		ACSP
	[illegible]	[illegible] 3/25/65	W Kupfer 8 Jun 65	[illegible] 3-24-65

MIT

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of the Temperature Control Module, Part No. 2007064-011.

1.2 PRODUCT CONFIGURATION BASELINE ACCEPTANCES. The product configuration baseline shall be established by the FACI of CEI Serial No. . This unit and all subsequent units, regardless of intended use, shall be accepted to the configuration defined by Serial No. unless formally approved otherwise as required by ANA Bulletin No. 445.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&N

ND 1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment

STANDARDS

Military

MIL-STD-202	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&N

2007064	Temperature Control Module Assy

(Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In the event of a conflict between requirements of the contract, this specification and the documents listed in this section, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this section

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Test Environment. The module shall function as specified herein when the temperature of the heatsink is in the range of 15° to 65°C.

3.1.2 Electrical Input. The module shall function as specified herein when supplied with an electrical input from 22.0 to 33.5 vdc.

3.1.3 "On" Mode of Operation. With a voltage from 22.0 to 33.5 vdc applied to the excitation terminals and a load resistor of 8.9±1.1 ohms connected to the load terminal, the output transistor saturation voltage (V_{CE}) shall be less than 1.8 vdc.

3.1.4 "Off" Mode of Operation. With the conditions established as specified in 3.1.3 and the input shorted to 0 vdc, the load voltage drop shall not exceed 0.2 vdc.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the module shall be in accordance with the APOLLO G&N Drawing 2007064 and all the drawings and engineering data referenced thereon.

3.2.1.1 Weight. The maximum weight of the module shall not exceed 3 ounces.

3.2.2 Insulation Resistance. The insulation resistance between each module pin and the module mounting screws shall be equal to or greater than 100 megohms.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 Nonconforming Units. Failure of the unit to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or, when directed by the cognizant inspector, a complete retest and reexamination may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.1.2 Test Conditions

4.1.2.1 Environmental. Unless otherwise specified, the module shall be tested under the following ambient conditions:

a. Temperature: 25°±10°C

b. Relative Humidity: 90% max

c. Barometric Pressure: 28 to 32 inches of Hg

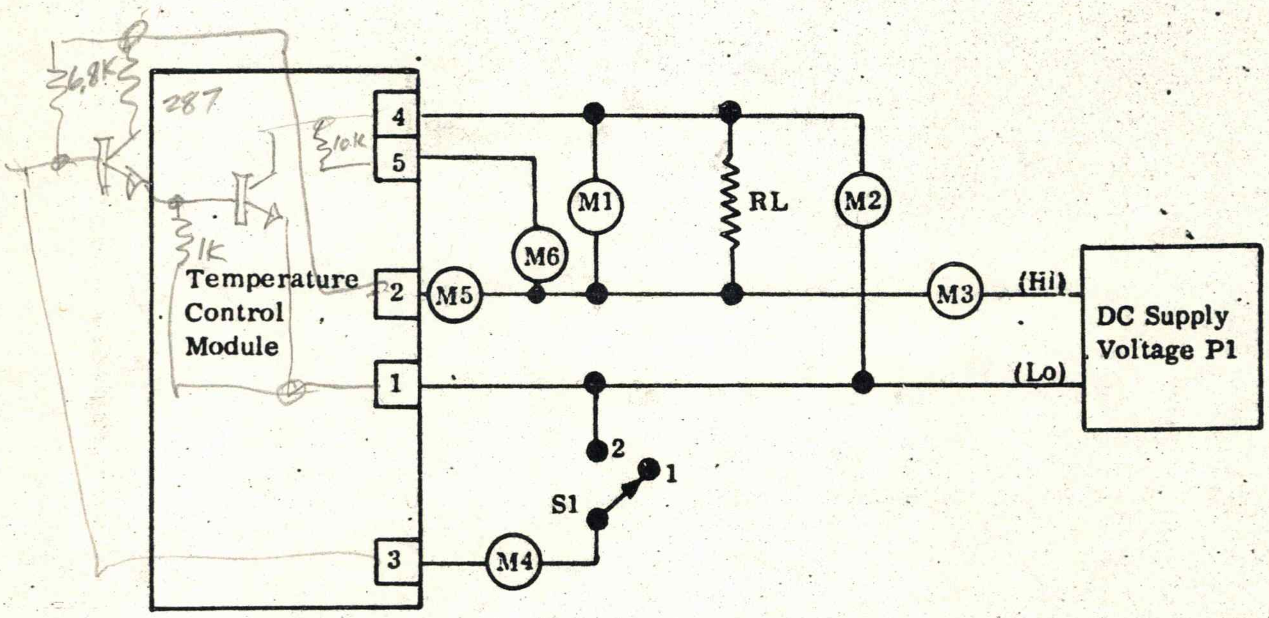
4.1.2.2 Test Power. An electrical input from 22.0 to 33.5 vdc is necessary to perform the tests specified herein:

4.1.2.3 Test Setup. Prior to performing the tests specified in 4.2.3 through 4.2.7, the module shall be set up for test as shown in Figure 1.

4.2 TESTS

4.2.1 Drawing Compliance. The module shall be visually examined for compliance to the requirements of the APOLLO G&N Drawing 2007064. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.2.1.1 Weight. The weight of the module shall not exceed 3 ounces.



P1 - Variable DC Power Supply, 22.0 to 33.5 vdc, 0 to 5 amp capacity
RL - Load Resistor, 9.0 ohms ± 1 percent, 200 W
S1 - Switch, SPST
M1 - Digital Voltmeter, Weston Model 1420 or equivalent
M2 - Digital Voltmeter, Weston Model 1420 or equivalent
M3 - DC Ammeter, 0 to 5 amp, Weston Model 622 or equivalent
M4 - Clipon Ammeter, Hewlett-Packard Model 428 or equivalent
M5 - Clipon Ammeter, Hewlett-Packard Model 428 or equivalent
M6 - Clipon Ammeter, Hewlett-Packard Model 428 or equivalent

TEST SETUP
FIGURE 1

4.2.2 Insulation Resistance. With the module mounted by its mounting screws on a metal plate, the insulation resistance shall be tested in accordance with Method 302 of Standard MIL-STD-202. The insulation resistance as measured between the pins and the mounting bracket shall be 100 megohms or greater. The megohmmeter used shall have an output voltage of 225±75 vdc limited to a short circuit current of 6.0 μa.

4.2.3 Workmanship-Vibration. With the module mounted on a heatsink and connected as shown in Figure 1 and a supply voltage of between 22.0 and 33.5 vdc applied, the module sha vibrated along the radial axis as shown in Figure 2. The vibration shall be simple harmonic from 10 to 2000 cps swept at a rate of one octave per minute with an input of 6.0g rms limited to 0.4 inch pp constant displacement from 10 cps to crossover frequency. During vibration the module shall be monitored in accordance with the requirements of 4.2.4, 4.2.5 and 4.2.6. Any out-of-tolerance condition which exists for a period greater than 1 msec shall be cause for rejection of the module. Perform this test in both modes of operation: "on" mode and "off" mode. After vibration the module shall be visually examined as specified in 4.2.1.

4.2.4 "On" Mode of Operation. With the voltage at pin 2 adjusted to 33.5 ±0.3 vdc switch S1 set to position "1" (open), the following shall occur:

a. The current flowing to pin 2 as indicated on meter M5 shall be 117±7 ma.

b. The voltage between pins 4 and 1 as indicated on meter M2 shall be a maximum of 1.6 vdc.

c. The current flowing to pin 5 as indicated on meter M6 shall be 3.3±0.2 ma.

4.2.5 "Off" Mode of Operation. With the voltage at pin 2 adjusted to 33.5 ±0.3 vdc switch S1 set to position "2" (closed), the following shall occur:

a. The current flowing to pin 3 as indicated on meter M4 shall be 5.0±0.5 ma.

b. The voltage between pins 2 and 4 as indicated on meter M1 shall be a maximum of 0.2 vdc.

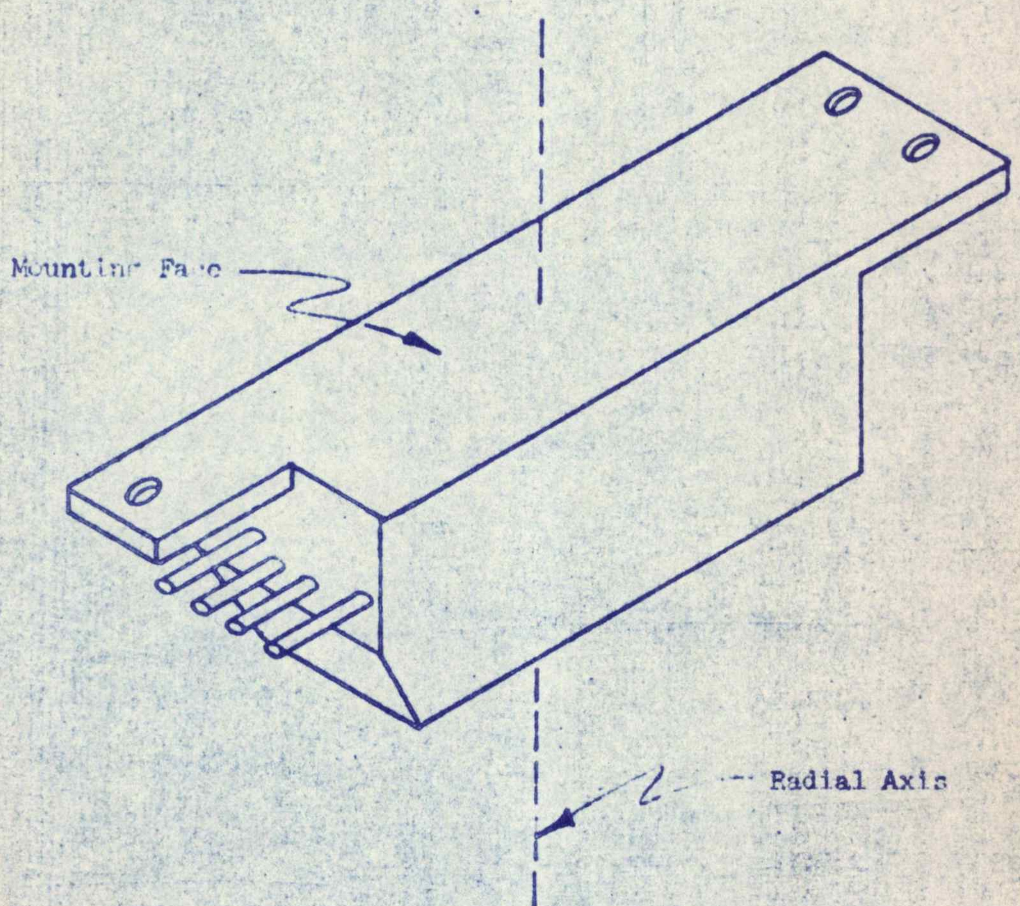
4.2.6 Current Drain. With the conditions established as specified in 4.2.4, the current drain from the power supply shall be between 3.5 and 3.9 amp as indicated on meter M3.

4.2.7 High Temperature. Repeat 4.2.4 through 4.2.6 with the module at an ambient temperature of 65° ±3°C. In 4.2.4.b meter M2 indication shall be a maximum of 1.8 vdc.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.



VIBRATION AXIS OF MODULE

FIGURE 2

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

DC DIFFERENTIAL AMPLIFIER AND PVR ASSEMBLY

DRAWING NO. 2007101

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals AC	Approvals NASA
M 9/28/65	A	22787	3, 10 [illegible]	WK	TM
M 7-5-66	B	30019	7 [illegible]	MGM	--
M 1/12/67	C	32626	4 [illegible]	MGM EA	--

This specification consists of page 1 to 12 inclusive.

APPROVALS	A. C. [illegible] NASA/MSC	[illegible] 8/15/65 [illegible] 27 July 65 MIT/IL	L. Ferriss [illegible] AC

3.2.2 Maximum Weight. Not applicable.

3.2.3 Standards of Manufacturing, Manufacturing Process and Production.

3.2.3.1 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms. The resistance between pin 1 and the heat sink shall be less than or equal to 0.5 ohm.

3.2.3.2 Temperature Compensation. Components R23, R24, R25, CR6, CR7, CR8, and CR9 shall be selected such that over a 10°C operating temperature range centered about 35°C, the temperature coefficient of the output shall be $0 \pm 18\ \mu v/^{\circ}C$. Ordinarily selection of R25 is sufficient to obtain the desired degree of temperature compensation.

3.2.3.3 Output Voltage Normalization. Components R26 and R27 shall be selected such that adjustment of R1 within a range of 5 turns from its mechanical midpoint shall produce an output voltage of 6.000000 ± 0.000010 vdc.

APOLLO G&C Specification
PS2007102 REV E
Original Issue Date: 13 Oct 1965
Release Authority: TDRR 23135
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

ASSEMBLY, GYRO CALIBRATION

DRAWING NO. 2007102

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
M 2/8/66	A	26016	6, ~~15~~, ~~18~~ RDG/AC	W. K.	-----
M 5/17/66	B	28923	16 DH/AC	MGM	- -
M 7-5-66	C	30018	8, ~~14~~ RDG/AC	MGM	—
M 12/28/66	D	32425	14, 15, 17, ~~18~~ RDG/AC	JP MGM	--
M 1/12/67	E	32626	7, 18 RDG/AC	MGM EA	--

This specification consists of page 1 to 18 inclusive.

APPROVALS	NASA/MSC	MIT/IL	ACSP
		10/8/65 13 Oct 65	J. Harding J. W. Baut 25

NOT REQUIRED PER LETTER
NASA PP7-65-612

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of the Gyro Calibration Assembly, Part Number 2007102-011.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

Military

MIL-T-21038B	Transformers, Pulse, Lower Power, General Specification for

APOLLO G&C

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment

STANDARDS

Military

MIL-STD-202C	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&C

1000752	Transformer, Pulse
1010830	Diode Voltage Regulator (For Reference Only)
2007102	Gyro Calibration Assembly

(Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In event of a conflict between requirements, the following order of precedence shall apply. The contractor shall also notify MIL/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this section

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Inputs. The assembly shall perform as specified herein with the following inputs:

a. DC supply voltages as specified in Table I.

TABLE I

DC SUPPLY VOLTAGES

SUPPLY VOLTAGES	CONDITIONS (±1%)			APPLIED AT PINS	
	Nominal	Enhanced	Degraded	Hi	Lo
+28 vdc	27.5	32	23	33	19
+120 vdc	120	126	114	15	37

b. Test signals as specified in Table II and III, having pulse characteristics as defined in Specification MIL-T-21038.

TABLE II

GYRO TORQUE ENABLE AND GYRO SELECT PULSES

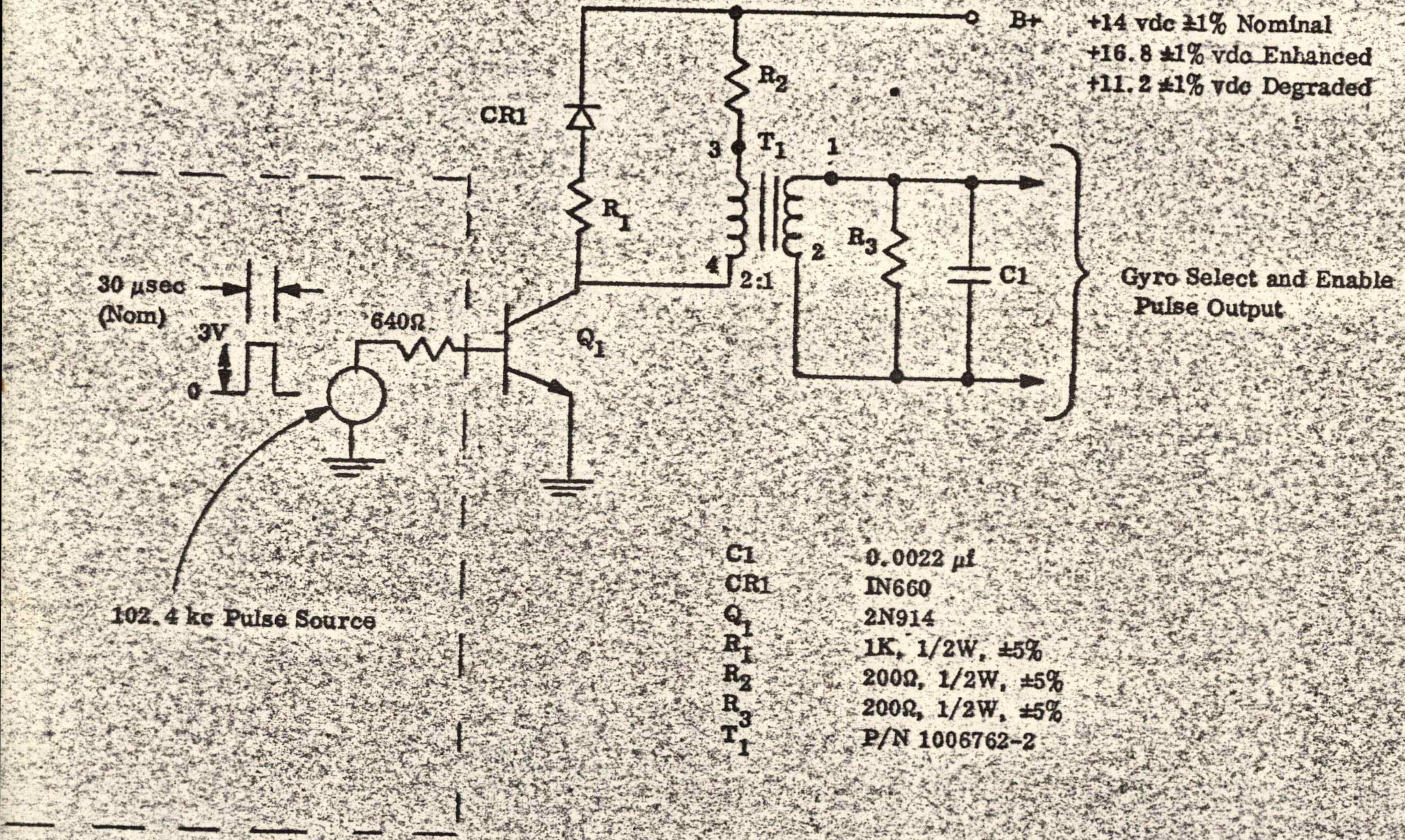
PULSE *1 CHARACTERISTICS	CONDITIONS		
	Nominal	Enhanced	Degraded
PRF	102.4 kc ±2%	102.4 kc ±2%	102.4 kc ±2%
Amplitude	+6.90±0.25V peak	*2	*3
Risetime	0.22±0.05 μsec	*2	*3
Falltime	0.45±0.20 μsec	*2	*3
Pulse Width	3.0±0.3 μsec	3.0±0.3 μsec	3.0±0.3 μsec

*1 Nominal pulse characteristics to be established using circuit as shown in Figure 1 without connection to the assembly.
*2 To obtain enhanced pulse inputs, raise the pulse circuit (Figure 1) B+ voltage from +14.0 vdc ±1% (nominal) to +16.8 vdc ±1%.
*3 To obtain degraded pulse inputs, lower the pulse circuit (Figure 1) B+ voltage from +14.0 vdc ±1% (nominal) to +11.2 vdc ±1%.

TABLE III

GYRO SET AND RESET PULSES

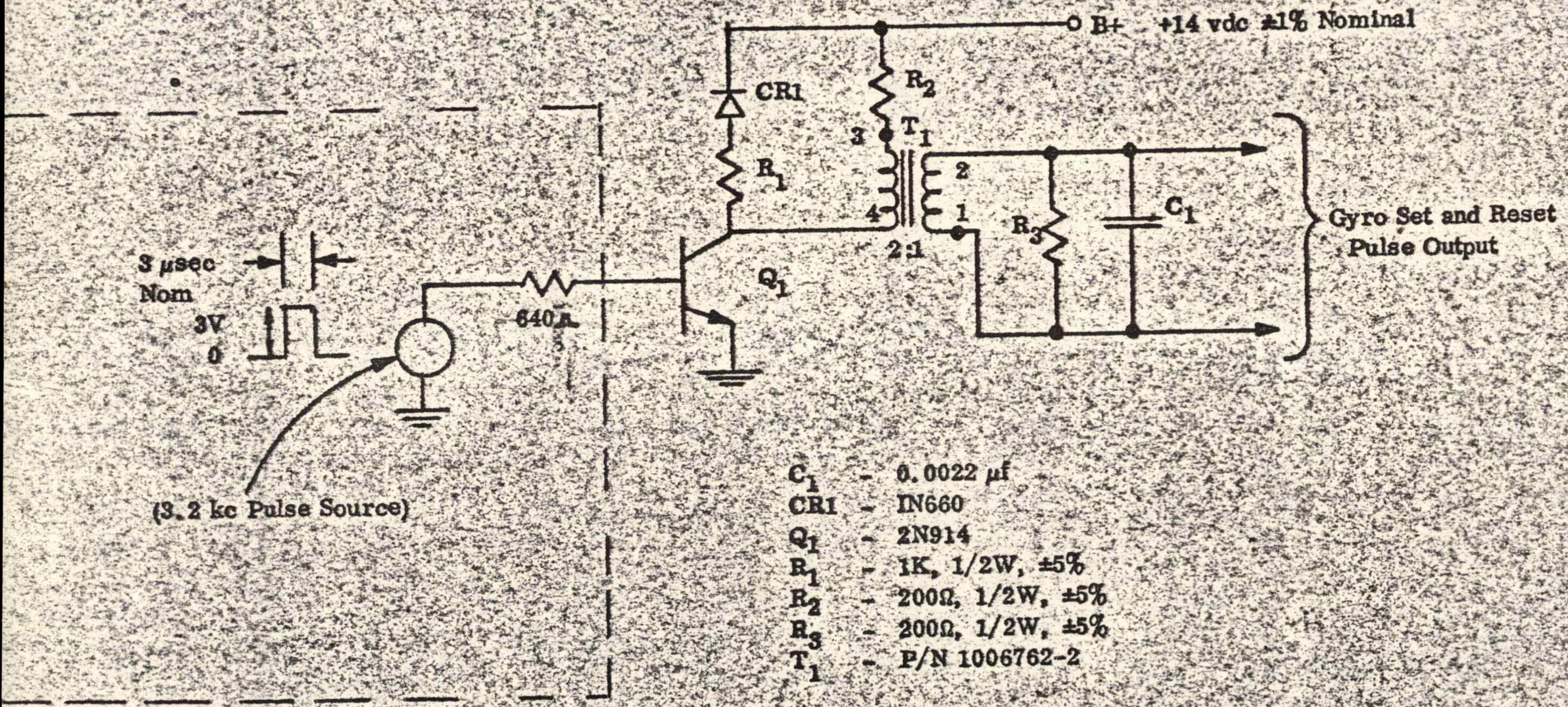
PULSE CHARACTERISTICS	CONDITIONS NOMINAL
PRF	3.2 kc ±2%
Amplitude	-5.50±0.25V peak
Risetime	0.20±0.05 μsec
Falltime	0.60±0.20 μsec
Pulse Width	3.0±0.3 μsec



C1	0.0022 μf
CR1	IN660
Q_1	2N914
R_1	1K, 1/2W, ±5%
R_2	200Ω, 1/2W, ±5%
R_3	200Ω, 1/2W, ±5%
T_1	P/N 1006762-2

PULSER CIRCUIT GYRO SELECT AND ENABLE PULSES

FIGURE 1



C_1	-	0.0022 μf
CR1	-	IN660
Q_1	-	2N914
R_1	-	1K, 1/2W, ±5%
R_2	-	200Ω, 1/2W, ±5%
R_3	-	200Ω, 1/2W, ±5%
T_1	-	P/N 1006762-2

PULSER CIRCUIT GYRO SET AND RESET PULSE

FIGURE 2

3.1.2 Characteristics

3.1.2.1 Transformer Outputs. The output of the Set and Reset pulse lines shall be as specified in Table IV.

TABLE IV

SET AND RESET PULSE CHARACTERISTICS

PULSE CHARACTERISTICS	CONDITIONS NOMINAL
Amplitude	-11±1V peak
Risetime	150±50 nsec
Falltime	500±150 nsec
Pulse Width	3.0±0.3 μsec

3.1.2.2 Gyro Enable Circuit

3.1.2.2.1 Relay Turn On Delay. Under degraded input conditions, relay K1 shall energize within 5 msec after application of the first gyro torque enable pulse.

3.1.2.2.2 Turn Off Delay. Under enhanced input conditions, relay K1 shall deenergize within 15 msec after removal of the gyro torque enable pulses.

3.1.2.3 Gyro Torquing

3.1.2.3.1 Dummy Output. The scale factor voltage (output voltage) in the absence of all gyro select pulses and with the dummy signal applied shall be 6.0±0.1 vdc after adjustment of potentiometer R_1 (Figure 6).

3.1.2.3.2 Saturation Voltage. The saturation voltage drop across each transistor switching circuit with its related gyro select pulse applied shall be 1.0 vdc maximum.

3.1.2.3.3 Scale Factor or Output Voltage. The scale factor voltage (output voltage) with any one gyro select signal applied shall be 6.0±0.3 vdc.

3.1.2.4 Gyro Torquing Leakage Current. The leakage current in any one channel in the absence of its corresponding gyro select signal and in the presence of its opposite gyro select signal shall be 750 namp maximum.

3.2 PRODUCT CONFIGURATION

3.2.1 Description. The assembly contains the enable, select and compensation network circuitry necessary for time-shared pulse torgue operation of the associated 3 gyros.

3.2.2 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&C Drawing 2007102 and all drawings and engineering data referenced thereon.

3.2.3 Maximum Weight. Not applicable.

3.2.4 Standards of Manufacturing, Manufacturing Process and Production.

3.2.4.1 Insulation Resistance. The insulation resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms. The resistance between pin 1 and the heatsink shall be less than or equal to 0.5 ohm.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 Test Conditions

4.1.1.1 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

a. Temperature: 25° ±10°C
b. Relative Humidity: 90% max
c. Barometric Pressure: 28 to 32 inches of Hg

4.1.1.2 Test Inputs

a. The assembly shall be tested with the supply voltages and conditions specified in Table I.

b. The assembly shall be tested with the test inputs specified in Tables II and III.

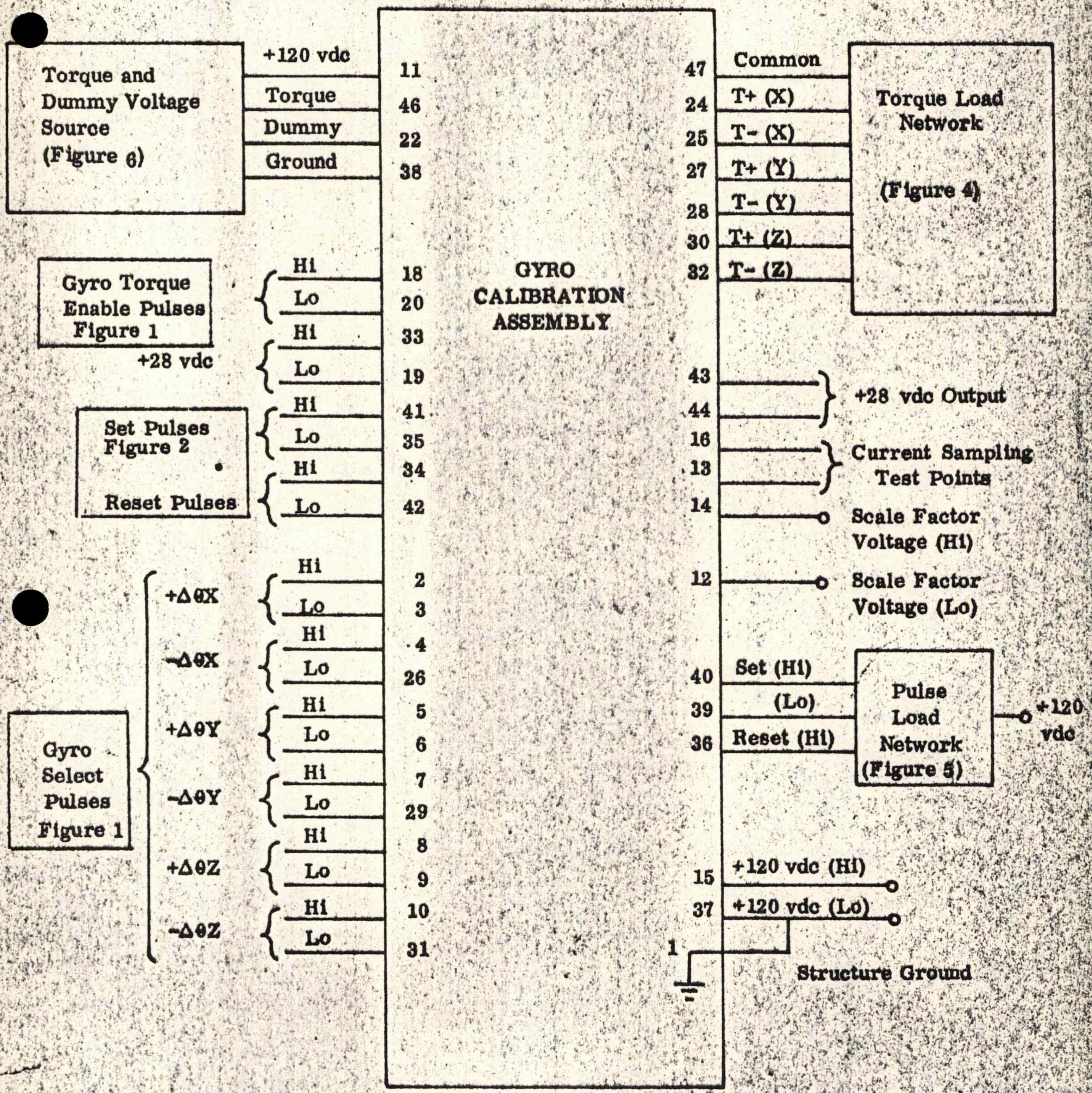
4.1.1.3 Test Set-Up. The recommended test set-up is shown in Figures 1 thru 6.

4.1.2 Nonconforming Units. Failure of the unit to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or, when directed by the cognizant inspector, a complete retest and reexamination may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.2 TESTS

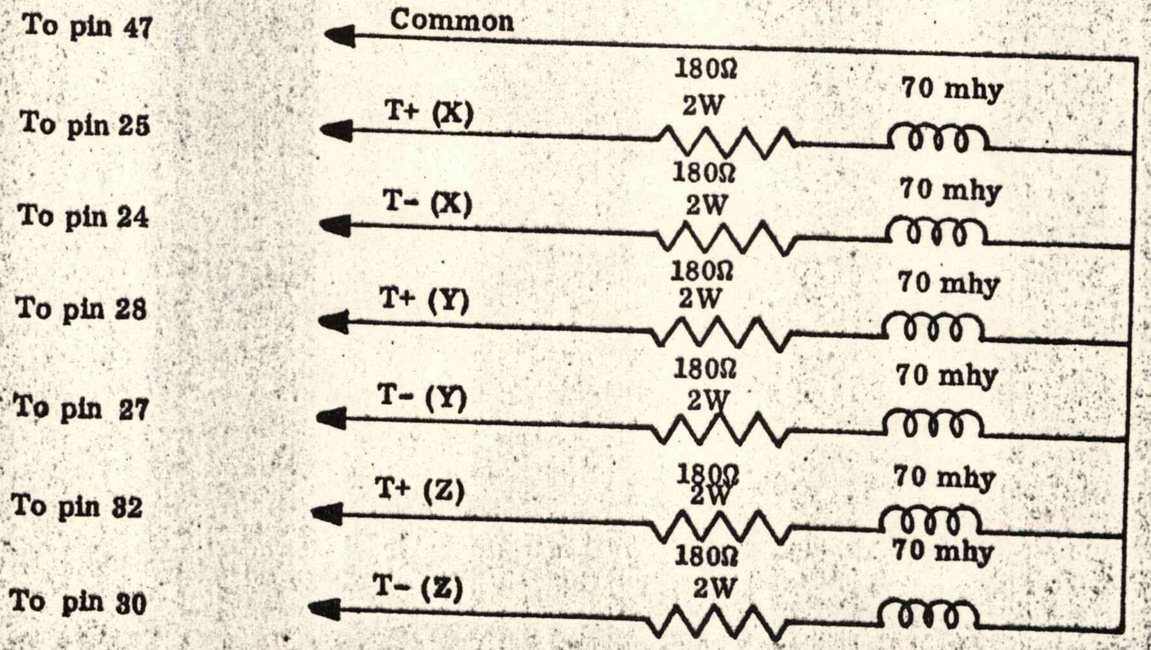
4.2.1 Drawing Compliance. The assembly shall be visually examined for compliance to the requirements of APOLLO G&C Drawing 2007102. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of marking.

4.2.2 Workmanship-Vibration. With the conditions specified below, the assembly shall be energized as indicated in Figure 3 and subjected to vibration along the axis shown in Figure 7. The vibration shall be simple harmonic motion swept from 10 to 2000 cps at a rate of 1 octave/15 seconds. The magnitude of vibration shall be 6.0g rms limited to a 0.4 inch pp constant displacement from 10 cps to the crossover frequency. Before, during and after vibration, the output signals shall remain unchanged except for those intervals when external switching of input signals may occur. Any out-of-tolerance condition in excess of 1 msec shall constitute a failure. After vibration, the assembly shall be visually examined as specified in 4.2.1.



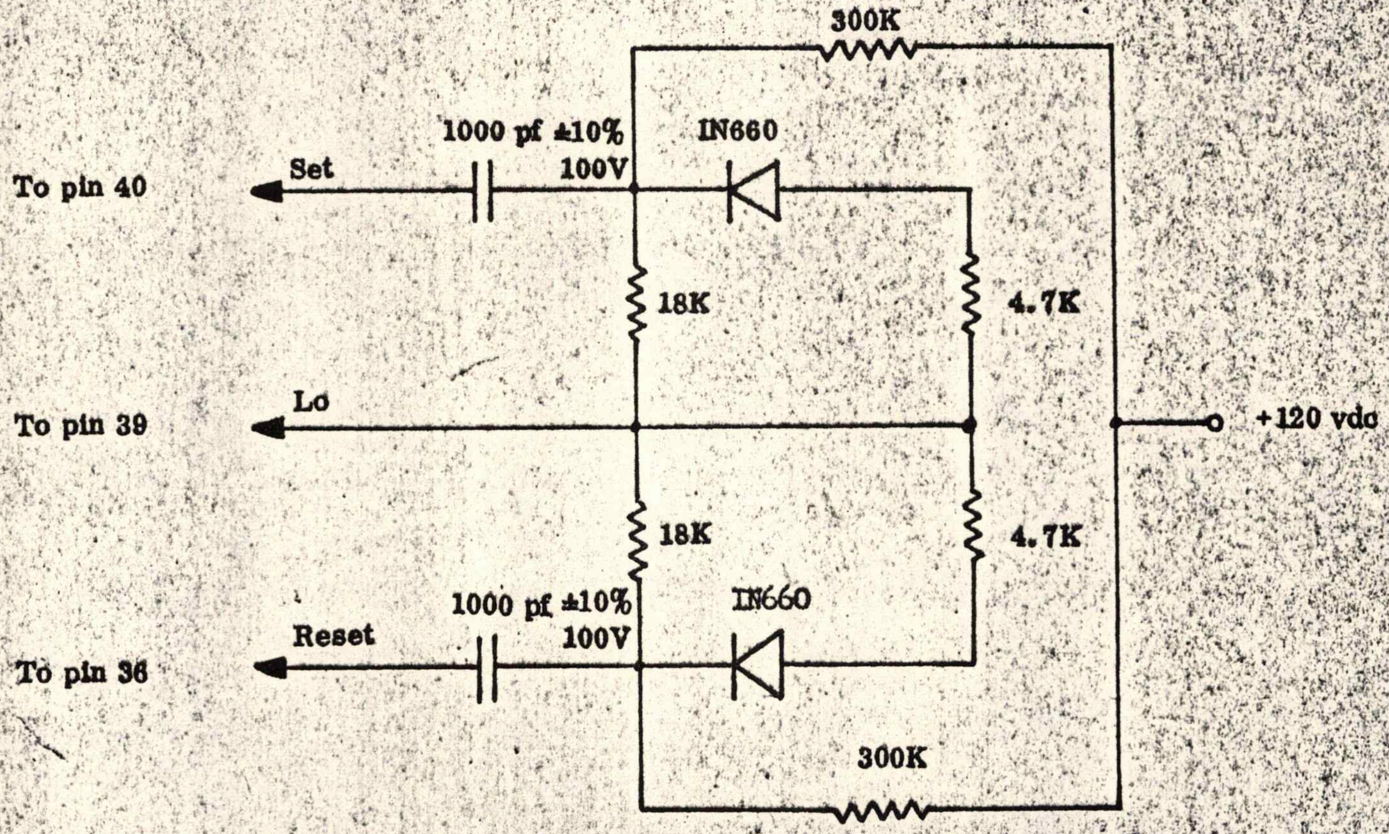
MODULE TEST SETUP

FIGURE 3



TORQUE LOAD NETWORK

FIGURE 4

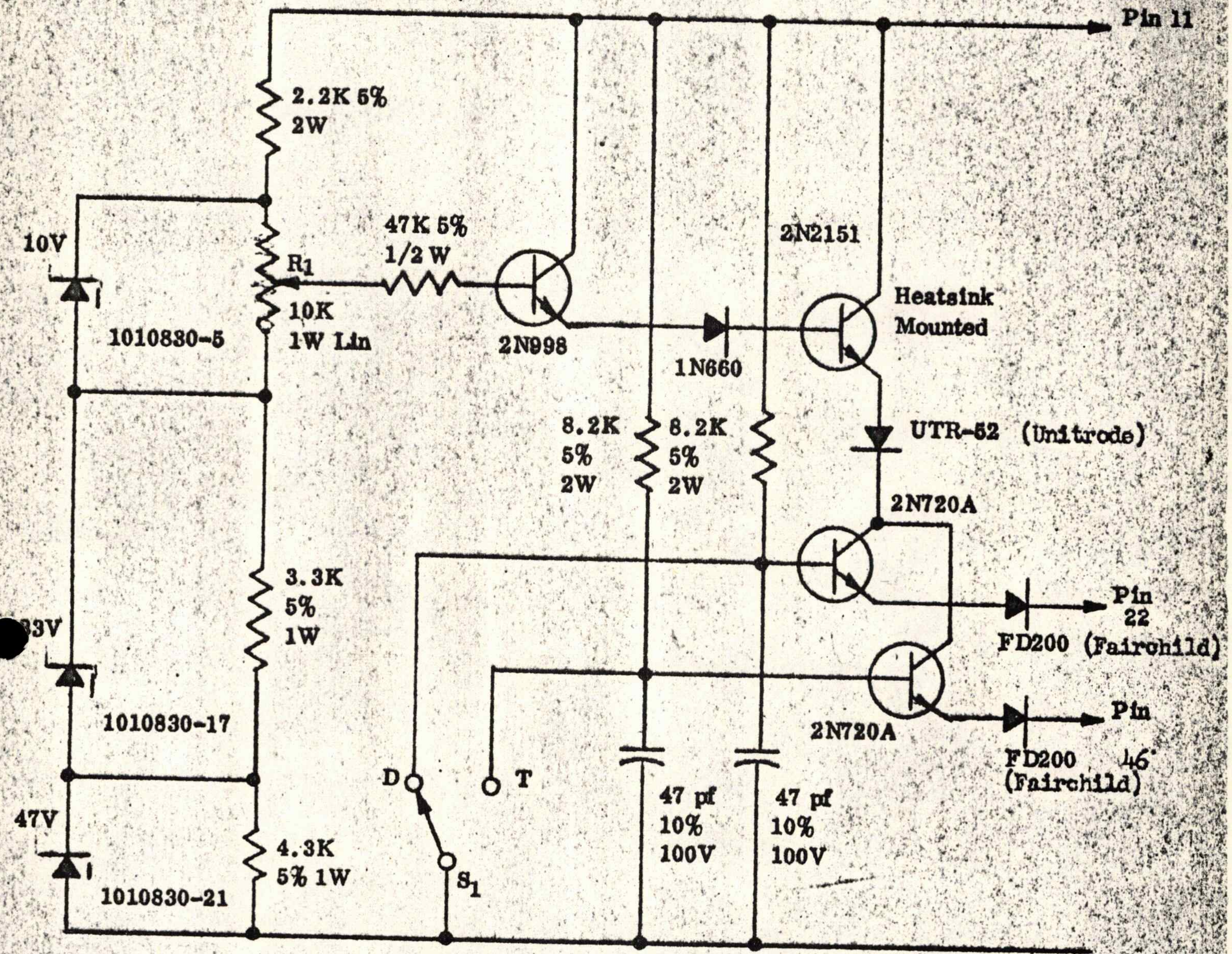


Note:

Resistors 1/2W ±5%

PULSE LOAD NETWORK

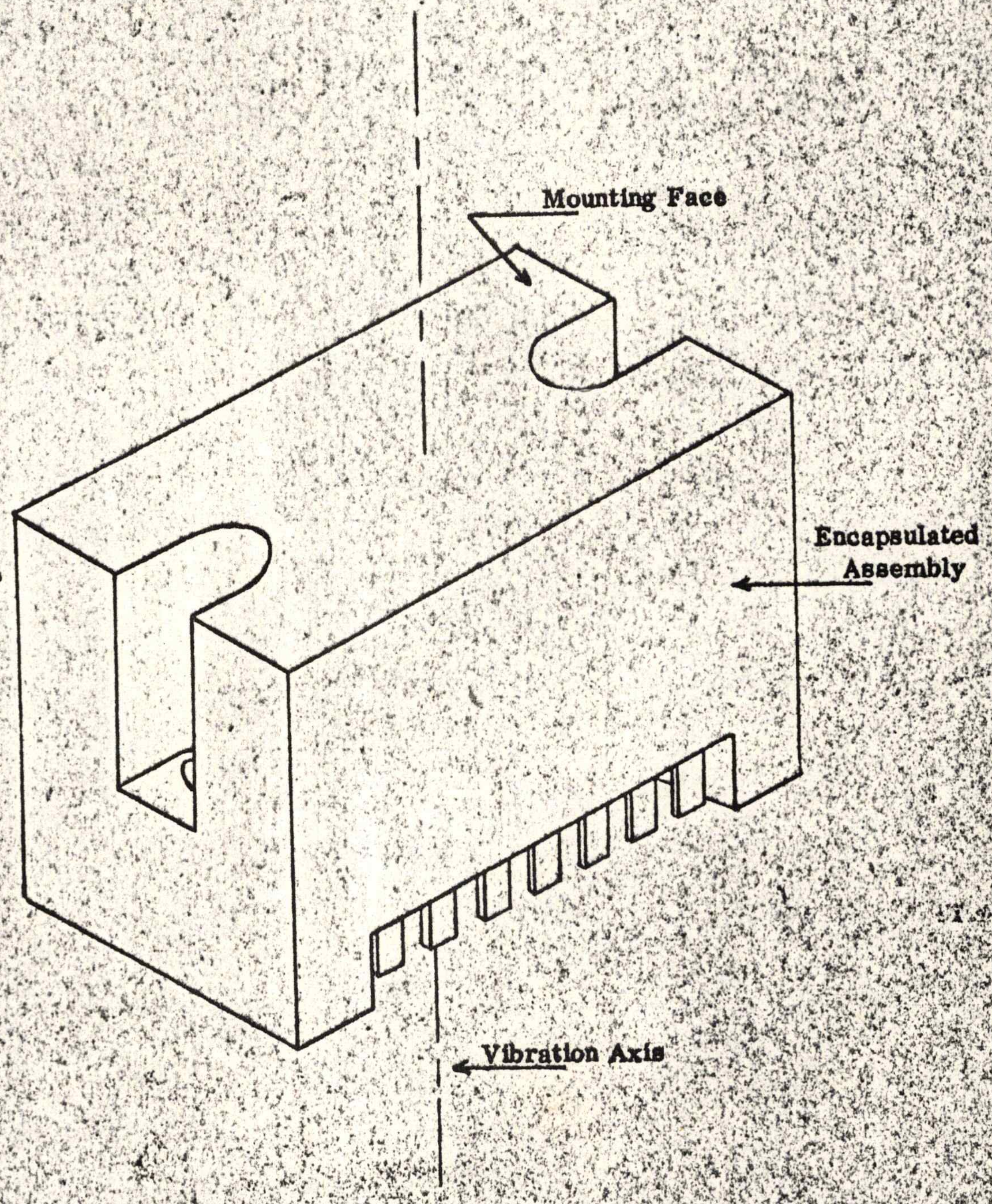
FIGURE 5



NOTE: To apply torque current, place S_1 in T position; to apply dummy current, place in D position.

TORQUE CURRENT SOURCE

FIGURE 6



VIBRATION AXIS OF ASSEMBLY

FIGURE 7

a. With the inputs to the assembly degraded in accordance with Tables I and II, the Gyro Torque Enable Pulses applied at Pins 18 (Hi) and 20 (Lo), the output voltage at pins 16 (Hi) and 12 (Lo) shall be monitored as the Gyro Select Pulses are successively applied to each channel indicated in Table V. The application of the various inputs and subsequent output voltage monitoring shall be accomplished in the following sequence:

(1) Dummy Voltage applied to pins 22 (Hi) and 37 (Lo)

(2) Gyro Select Pulse applied to first channel (Table V)

(3) Dummy Voltage removed and Torquing Voltage applied to pins 46 (Hi) and 38 (Lo)

(4) Monitor the output

(5) Remove the Torquing Voltage

The above cycle shall be repeated for all channels indicated in Table V. The output voltage shall be 7.0±0.3 VDC.

TABLE V

GYRO SELECT PULSES APPLIED

MONITOR CHANNEL	APPLY PULSES (pins) Hi	Lo
$+\Delta\theta_X$ or T+(X)	2	3
$-\Delta\theta_X$ or T-(X)	4	26
$+\Delta\theta_Y$ or T+(Y)	5	6
$-\Delta\theta_Y$ or T-(Y)	7	29
$+\Delta\theta_Z$ or T+(Z)	8	9
$-\Delta\theta_Z$ or T-(Z)	10	31

b. With the Set and Reset Pulses specified in Table III applied to pins 41 (Hi) and 35 (Lo) and pins 34 (Hi) and 42 (Lo) respectively, the outputs at pins 40 (Hi) and 39 (Lo) for Set and pins 36 (Hi) and 39 (Lo) for Reset shall be continuously monitored. The outputs shall be as specified in Table IV.

4.2.3 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be as specified in 3.2.4.1 when measured in accordance with Method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output voltage of 225±75 vdc, limited to a short circuit current of 6 microamps. The resistance between pin 1 and the heatsink shall be as specified in 3.2.4.1 when measured in accordance with Method 303 of Standard MIL-STD-202. To assure a good electrical connection the anodizing may be penetrated.

a. With the inputs to the assembly degraded in accordance with Tables I and II, torquing voltage applied at pins 46 (Hi) and 38 (Lo) and Gyro Torque Enable Pulses applied at pins 18 (Hi) and 20 (Lo), the output voltage at pins 16 (Hi) and 12 (Lo) shall be monitored as the Gyro Select Pulses are successively applied to each channel indicated in Table V. The output voltage shall be 7.0±0.3 vdc.

TABLE V

GYRO SELECT PULSES APPLIED

MONITOR CHANNEL	APPLY PULSES (pins)	
	Hi	Lo
$+\Delta\theta_x$ or T+(X)	2	3
$-\Delta\theta_x$ or T-(X)	4	26
$+\Delta\theta_y$ or T+(Y)	5	6
$-\Delta\theta_y$ or T-(Y)	7	29
$+\Delta\theta_z$ or T+(Z)	8	9
$-\Delta\theta_z$ or T-(Z)	10	31

b. With the Set and Reset Pulses specified in Table III applied to pins 41 (Hi) and 35 (Lo) and pins 34 (Hi) and 42 (Lo) respectively, the outputs at pins 40 (Hi) and 39 (Lo) for Set and pins 36 (Hi) and 39 (Lo) for Reset shall be continuously monitored. The outputs shall be as specified in Table IV.

4.2.3 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be as specified in 3.2.3.2 when measured in accordance with Method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output voltage of 225±75 vdc, limited to a short circuit current of 6 microamps. The resistance between pin 1 and the heatsink shall be as specified in 3.2.3.2 when measured in accordance with Method 303 of Standard MIL-STD-202. To assure a good electrical connection the anodizing may be penetrated.

4.2.4 Set and Reset Pulse Transformer

4.2.4.1 Set Pulse. With the input pulse adjusted to the conditions specified in Table III and applied at pins 41 (Hi) and 35 (Lo), the Set Pulse output at pins 40 (Hi) and 39 (Lo) shall be as specified in Table IV.

4.2.4.2 Reset Pulse. With the input pulse adjusted to the conditions specified in Table III and applied at pins 34 (Hi) and 42 (Lo), the Reset Pulse output at pins 36 (Hi) and 39 (Lo) shall be as specified in Table IV.

4.2.4 Set and Reset Pulse Transformer

4.2.4.1 Set Pulse. With the input pulse adjusted to the conditions specified in Table III and applied at pins 41 (Hi) and 35 (Lo), the Set Pulse output at pins 40 (Hi) and 39 (Lo) shall be as specified in Table IV.

4.2.4.2 Reset Pulse. With the input pulse adjusted to the conditions specified in Table III and applied at pins 34 (Hi) and 42 (Lo), the Reset Pulse output at pins 36 (Hi) and 39 (Lo) shall be as specified in Table IV.

4.2.5 Gyro Enable Circuit, Relay Switching Delay. With the following input conditions established, the relay switching delay as evidenced by the delay of rise of the +120 vdc output at pin 11 and the delay of rise of the +28 vdc output at pins 43 and 44 shall be 10 msec maximum (reference Figure 8). The delay measurement shall be made from the time the first enable pulse is applied to the time the +120 vdc output or the +28 vdc output reaches steady state output, whichever time is greater.

a. Gyro Torque Enable Pulses applied at pins 18 (Hi) and 20 (Lo).

b. Input supply voltages and Gyro Torque Enable Pulses adjusted sequentially from nominal to enhanced to degraded conditions in accordance with Tables I and II respectively.

4.2.6 Gyro Enable Circuit, Dropout Relay. With the following input conditions established, the relay K1 shall deenergize within 15 msec after removal of the gyro torque enable pulses. This delay measurement shall be made from the time the gyro torque enable pulses are removed to the time the +120 vdc output measured at pin 11 or the +28 vdc output measured at pin 43 reached zero volts, whichever is greater.

a. Input supply voltage adjusted to the enhanced conditions as specified in Table I.
b. A module heatsink temperature of +140° ±5°F.

4.2.7 Dummy Output. With the following input conditions established, the output voltage across pins 14 (Hi) and 12 (Lo) shall be 6.0±0.1 vdc.

a. Dummy voltage applied to pins 22 (Hi) and 38 (Lo).

b. Gyro Torque Enable pulses applied to pins 18 (Hi) and 20 (Lo).

c. Input supply voltages and Gyro Torque Enable pulses adjusted to nominal conditions in accordance with Tables I and II respectively.

d. Adjust potentiometer R1 (Figure 6) to give the desired output voltage.

4.2.5 Gyro Enable Circuit, Relay Switching Delay. With the following input conditions established, the relay switching delay as evidenced by the delay of rise of the +120 vdc output at pin 11 and the delay of rise of the +28 vdc output at pins 43 and 44 shall be 5 msec maximum (reference Figure 8). The delay measurement shall be made from the time the first enable pulse is applied to the time the +120 vdc output or the +28 vdc output reaches steady state output, whichever time is greater.

a. Gyro Torque Enable Pulses applied at pins 18 (Hi) and 20 (Lo).

b. Input supply voltages and Gyro Torque Enable Pulses adjusted sequentially from nominal to enhanced to degraded conditions in accordance with Tables I and II respectively.

4.2.6 Gyro Enable Circuit, Dropout Relay. With the following input conditions established, the relay K1 shall deenergize within 15 msec after removal of the gyro torque enable pulses. This delay measurement shall be made from the time the gyro torque enable pulses are removed to the time the +120 vdc output measured at pin 11 or the +28 vdc output measured at pin 43 reached zero volts, whichever is greater.

a. Input supply voltage adjusted to the enhanced conditions as specified in Table I.
b. A module heatsink temperature of +140° ±5°F.

4.2.7 Dummy Output. With the following input conditions established, the output voltage across pins 14 (Hi) and 12 (Lo) shall be 6.0±0.1 vdc.

a. Dummy voltage applied to pins 22 (Hi) and 38 (Lo).

b. Gyro Torque Enable pulses applied to pins 18 (Hi) and 20 (Lo).

c. Input supply voltages and Gyro Torque Enable pulses adjusted to nominal conditions in accordance with Tables I and II respectively.

d. Adjust potentiometer R1 (Figure 6) to give the desired output voltage.

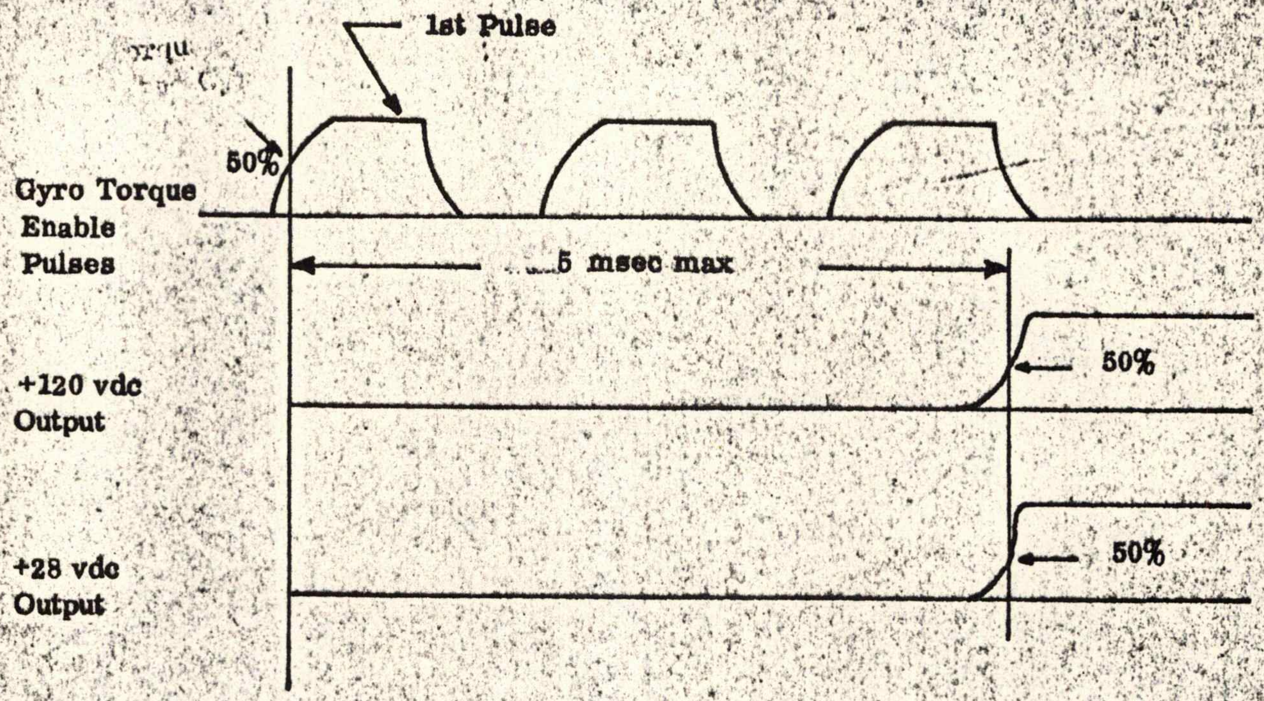
4.2.8 Gyro Torquing. With the following input conditions established, the saturation voltage across the switching circuit of each Gyro Select Channel, at the pins indicated in Table VI, shall be 1.0 vdc maximum. The output voltage across pins 14 (Hi) and 12 (Lo) for each condition shall be 6.0±0.3 vdc.

a. Torquing voltage applied at pins 46 (Hi) and 38 (Lo).

b. Gyro Torque Enable pulses applied at pins 18 (Hi) and 20 (Lo).

c. Gyro Select pulses applied to the pins indicated in Table VI.

d. Input supply voltages, Gyro Torque Enable and Gyro Select pulses adjusted sequentially from normal to enhanced to degraded conditions in accordance with Tables I and II respectively.



Note: The +120 vdc and +28 vdc outputs may not rise simultaneously, but both should do so within 5 msec after application of the gyro torque enabling pulses.

TIMING DIAGRAM

FIGURE 8

4.2.8 Gyro Torquing. With the following input conditions established, the saturation voltage across the switching circuit of each Gyro Select Channel, at the pins indicated in Table VI, shall be 1.0 vdc maximum. The output voltage across pins 14 (Hi) and 12 (Lo) for each condition shall be 6.0±0.3 vdc.

a. Gyro Torque Enable Pulses applied at pins 18 (Hi) and 20 (Lo).

b. The application of the Dummy Voltage, Torquing Voltage, and Gyro Select Pulses and subsequent monitoring shall be accomplished in the following sequence:

(1) Dummy Voltage applied to pins 22 (Hi) and 37 (Lo)
(2) Gyro Select Pulse applied to the first channel (Table VI)
(3) Dummy Voltage removed and Torquing Voltage applied to pins 46 (Hi) and 38 (Lo)
(4) Monitor the saturation voltage corresponding to the first channel (Table VI)
(5) Monitor the Output Voltage
(6) Remove the Torquing Voltage

The above cycle shall be repeated for all channels indicated in Table VI.

c. Input supply voltage, Gyro Torque Enable and Gyro Select Pulses adjusted sequentially from nominal to enhanced to degraded conditions in accordance with Tables I and II, respectively.

TABLE VI

SWITCHING CIRCUIT

CHANNEL	APPLY GYRO SELECT PULSE (pins)		CIRCUIT MONITORED	
	Hi	Lo	Hi	Lo
$+\Delta\theta X$	2	3	25	16
$-\Delta\theta X$	4	26	24	16
$+\Delta\theta Y$	5	6	28	16
$-\Delta\theta Y$	7	29	27	16
$+\Delta\theta Z$	8	9	32	16
$-\Delta\theta Z$	10	31	30	16

4.2.9 Gyro Torque Leakage. With the following input conditions established, the leakage current in any one Gyro Select Channel, monitored at the pin indicated in Table VII, shall be 1000 namps maximum.

a. Gyro Torque Enable Pulses applied to pins 18 (Hi) and 20 (Lo).

b. Input supply voltages, Gyro Torque Enable and Gyro Select Pulses adjusted to the enhanced conditions in accordance with Tables I and II, respectively.

c. Module heatsink temperature of +140±5 degrees F.

d. The application of the Dummy Voltage, Torquing Voltage, and Gyro Select Pulses and subsequent monitoring shall be accomplished in the following sequence:

(1) Dummy voltage applied to pins 22 (Hi) and 37 (Lo)

(2) Gyro Select Pulses applied to the first channel (Table VII).

(3) Dummy Voltage removed and Torquing Voltage applied to pins 46 (Hi) and 38 (Lo)

(4) Monitor the leakage current corresponding to the first channel (Table VII)

(5) Remove the Torquing Voltage

The above cycle shall be repeated for all channels indicated in Table VII.

TABLE VII

LEAKAGE CURRENT

CHANNEL MONITORED	GYRO SELECT PULSES APPLIED (pins)		MONITORED PIN	OUTPUT CHANNEL
	Hi	Lo		
$+\Delta\theta X$	4	26	25	T-(X)
$-\Delta\theta X$	2	3	24	T+(X)
$+\Delta\theta Y$	7	29	28	T-(Y)
$-\Delta\theta Y$	5	6	27	T+(Y)
$+\Delta\theta Z$	10	31	32	T-(Z)
$-\Delta\theta Z$	8	9	30	T+(Z)

4.2.10 Weight. Not applicable.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

4.2.10 Gyro Torque Leakage. With the following input conditions established, the leakage current in any one Gyro Select Channel, monitored at the pin indicated in Table VII, shall be 750 namps maximum.

a. Torquing voltage applied at pins 46 (Hi) and 38 (Lo).

b. Gyro Select pulses applied to the pins indicated in Table VII.

c. Gyro Torque Enable pulses applied to pins 16 (Hi) and 20 (Lo).

d. Input supply voltages, Gyro Torque Enable and Gyro Select pulses adjusted to the enhanced conditions in accordance with Tables I and II respectively.

e. Module heatsink temperature of +140° ±5°F.

TABLE VII

LEAKAGE CURRENT

CHANNEL MONITORED	GYRO SELECT PULSES APPLIED (pins)		MONITORED PIN	OUTPUT CHANNEL
	Hi	Lo		
$+\Delta\theta X$	4	26	25	T-(X)
$-\Delta\theta X$	2	3	24	T+(X)
$+\Delta\theta Y$	7	29	28	T-(Y)
$-\Delta\theta Y$	5	6	27	T+(Y)
$+\Delta\theta Z$	10	31	32	T-(Z)

4.2.11 Weight. The assembly shall be weighed to determine that the weight of the assembly does not exceed 0.470 pound.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

JHH:lv

APOLLO G&C Specification
PS2007103 REV G
Original Issue Date: 24 Aug 1965
Release Authority: TDRR 21304
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

BINARY CURRENT SWITCH

DRAWING NO. 2007103

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
M 9/28/65	A	22788	7, 19, 20 RDG/AL	WK	-------
M 11/23/65	B	24304	17 RDG/AL	WK	-------
M 12/21/65	C	24788	5 RDG/AL	WK	TM
M 2/8/66	D	26017	7 RDG/AL	WK	- - -
M 4/20/66	E	28186	5, 6, 7, 17, 20 RDG/AL	WK	TM
M 8/18/66	F	30693	5 RDG/AL	MGM EA	----
M 1/12/67	G	32626	8 RDG/AL	MGM EA	----

This specification consists of page 1 to 20 inclusive.

APPROVALS	NASA/MSC	8/24/65	MIT/IL 24 Aug 65	L.S. FERRISS	AC

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&C Drawing 2007103 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 Continuity. The resistance between pin 1 and the heat sink shall be less than or equal to 0.5 ohm.

3.2.3.2 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms.

3.2.3.3 Bias Normalization. Resistor R5 shall be capable of adjustment so that the average values of the current output, when switched at the sampling rate, shall differ by no more than 12 ppm.

APOLLO G&N Specification
PS2007104 REV E
Original Issue Date: 8-3-65
Release Authority: TDRR 21310
Class A Release
CODE IDENT. NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

AC DIFFERENTIAL AMPLIFIER AND INTERROGATOR

DRAWING NO. 2007104

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised		Approvals AC	Approvals NASA
M 11/2/65	A	23607	6, 8, 16	RDG/AC	WK	ACM
M 5/17/66	B	28924	6, 8, 15, 17	JH/AC	MGM	---
M 6/21/66	C	29726	8	RDG/AC	MGM	---
M 9/15/66	D	31073	6, 16	RDG/AC	MGM EA	---
M 1/12/67	E	32625	9	RDG/AC	MGM EA	---

This specification consists of page 1 to 18 inclusive.

APPROVALS	A. [signature] NASA/MSC	J. Sitomer 8/2/65	W. [signature] 3 Aug 65 MIT/IL	[signature] L. Ferriss AC ELECTRONICS

3.1.2.9 Threshold. Alternate TM+set and TM-set output pulses meeting the requirements as specified in Table X shall occur in response to a Mode 1-1 balanced input having an amplitude of 660 μv pp ± 2 percent.

TABLE X

THRESHOLD OUTPUT PULSE REQUIREMENTS

CHARACTERISTIC	VALUE
Amplitude	-18.0±2.0V
Residual Amplitude	∠±3V
PRF	1.6 kc ±2%

3.1.2.10 Phasing. With mode O input, 1 mv pp input, the output pulses shall be as shown in Table XI. With mode I input, 1 mv pp input, the output pulses shall be as shown in Table XI.

TABLE XI

OUTPUT PULSE PHASING REQUIREMENT

INPUT CONDITION	TM-SET PULSE AMPLITUDE	TM+SET PULSE AMPLITUDE
Mode O	-18.0 ±2V	∠±3V
Mode I	∠±3V	-18.0 ±2V

3.2. PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007104 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Standards of Manufacturing. Manufacturing Process and Production.

3.2.3.1 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms. The resistance between pin 1 and the heat sink shall be less than or equal to 0.5 ohm.

APOLLO G&N Specification
PS2007105 REV B
Original Issue Date: 24 Aug 1965
Release Authority: TDRR 21763
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

C/M PIPA CALIBRATION MODULE

DRAWING NO. 2007105

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals AC	Approvals NASA
M 8/4/66	A	30365	4 RDG/AC	EA	--
M 1/12/67	B	32625	4 RDG/AC	MGM EA	--

This specification consists of page 1 to 10 inclusive.

APPROVALS	NASA/MSC	J Sutomek for WS Stameris 8/24/65 MIT/IL	W. [illegible] CB 2 Aug 65	[illegible] AC	C.T. Powers J W Doty

3. REQUIREMENTS. Description. The assembly contains the torque generator compensation, bias and scale factor networks necessary to normalize the associated accelerometer for pulse torque operation.

3.1 PERFORMANCE

3.1.1 Supply Voltage. The assembly shall perform as specified herein with an ac supply voltage having the following characteristics. In addition, the supply shall be double-ended and capable of simultaneously supplying 0^{o} phase, 180^{o} phase and ground reference.

a. Magnitude: 17±1V rms
b. Frequency: 4.8 Kc±2%
c. Output Impedance: 60Ω max
d. Total Harmonic Distortion: 2.0% max

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007105 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 DC Resistance. The dc resistance between the assembly pins shall be as specified in Table I.

TABLE I

DC RESISTANCE

PINS		REQUIRED DC RESISTANCE (Ohms)	
FROM(+)	TO(-)	MINIMUM	MAXIMUM
2	1	600	675
2	3	195,000	205,000
3	4	600	675
5	8	9	11
5	10	61	75
7	5	0	0.5
8	9	0	0.5
9	10	52	64
10	11	0	0.5
12	13	0	0.5
6	heatsink*	0	0.5

*To assure good electrical contact, the anodizing may be penetrated.

APOLLO G&C Specification
PS2007106 REV F
Original Issue Date: 28 SEPT 1965
Release Authority: TDRR 22786
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

PULSE TORQUE POWER SUPPLY

DRAWING NUMBER 2007106

Record of Revisions

	Date	Revision Letter	TDRR No.	Pages Revised		Approvals AC	Approvals NASA
M	2/23/66	A	26582	4, 12	RDG/AL	WK	--
M	4/5/66	B	27761	12	RDG/AL	WK	--
M	5/3/66	C	28497	7, 19	RDG/AL	WK	--
M	6/21/66	D	29725	5, 6, 14, and 18	RDG/AL	MGM	--
M	9/15/66	E	31074	5, 14, 18	SJ/AL	MGM EA	--
M	1/12/67	F	32626	7, 19	RDG/AL	MGM EA	--

This specification consists of page 1 to 20 inclusive.

APPROVALS	NASA/MSC	J Sitomer 8/22/65	Whaley 28 Sept 65 MIT/IL		AC	E T Powers

NOT REQUIRED PER LETTER
NASA PP7-65-612

3.2.2.2 Circuit Isolation. The following pins shall be isolated from one another and pin 4 connected to pin 17 by at least 100 megohms.

a. Pin 35 (+28 vdc Return, X PIPA PVR)
b. Pin 32 (+28 vdc Return, Y PIPA PVR)
c. Pin 31 (+28 vdc Return, Z PIPA PVR)

3.2.2.3 Continuity and DC Resistance. Continuity and dc resistance shall be as follows:

a. The resistance between pins electrically connected in parallel within the assembly shall be ≤ 0.5 ohm.

b. The resistance between pin 1 and the heat sink shall be ≤ 0.5 ohm.

3.2.2.4 Weight. Not applicable.

e. The nominal condition measurements obtained in b shall be subtracted from the enhanced condition measurements obtained in c and the differences compared to the requirement in Table V.

f. The nominal condition measurements obtained in b shall be subtracted from the degraded condition measurements obtained in d and the differences compared to the requirements in Table V.

g. The assembly heat sink temperature maintained at 100° ±5°F.

4.2.11 Turn On Delay. The +120 vdc output shall be measured at 400±50 milliseconds and the +28 vdc outputs measured at 5.0±0.5 and 10.0±0.5 seconds after application of the nominal dc supply voltages. The voltages measured shall be in accordance with Table VI. Input voltage application shall be such that the risetime shall be <50 milliseconds, (Figure 8), from 10 to 90 percent of input voltage magnitude.

4.2.12 Weight. Not applicable.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

EP:jls

APOLLO [illegible] SPECIFICATION
[illegible] REV. —
Original Issue Date [illegible]
Release Authority [illegible]
Released [illegible]
[illegible] SHEET NO. [illegible]

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

PULSE TORQUE [illegible] SUPPLY

DRAWING NUMBER 2007166

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Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals MIT	Approvals NASA

This specification consists of pages [illegible] to [illegible] inclusive.

APPROVALS	NASA MSC					

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of all units of Pulse Torque Power Supply, Part Number 2007106-011.

2. APPLICABLE DOCUMENT

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&C

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment

Military

MIL-T-21038	Transformers, Pulse, Low Power, General Specification for

STANDARDS

Military

MIL-STD-202C	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&C

2007106	Pulse Torque Power Supply

(Copies of specification, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In the event of a conflict between requirements, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this section.

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Inputs. The assembly shall perform as specified herein with the following electrical inputs:

a. DC Supply Voltages. The dc supply voltages shall be as specified in Table I.

TABLE I

DC SUPPLY VOLTAGES

SUPPLY VOLTAGE	CONDITIONS (Vdc ±0.25 vdc)		
	Nominal	Enhanced	Degraded
+28 VDC Supply	+27.5	+31.8	+24.75
-28 VDC Supply	-27.5	-31.8	-24.75

b. Input Signal. The input signal shall be as specified in Table II. The signal pulse characteristics shall be as described in Specification MIL-T-21038B.

TABLE II

INPUT SIGNAL CHARACTERISTICS

CHARACTERISTIC	CONDITION			
	Nominal	Enhanced	Degraded	Threshold
Amplitude	5.5±0.25V	7.00±0.25V	4.00±0.25V	2.5±0.1V
Rise Time	200±50 ns	100±50 ns	500±50 ns	-
Decay Time	600±200 ns	600±200 ns	800±200 ns	-
Pulse Width	3.0±0.3 μs	3.0±0.3 μs	3.0±0.3 μs	3.0±0.3 μs
Overshoot	≤1V	-	-	-
Backswing	≤2V	-	-	-
Droop	≤2V	-	-	-
PRF	12.8 kc ±2%	12.8kc ±2%	12.8 kc ±2%	12.8 kc ±2%

3.1.2 Characteristics

3.1.2.1 Description. The assembly contains the dc to dc power converter and regulated power supplies for the accelerometer and gyro pulse torque electronics.

3.1.2.2 DC Supply Current Drain. The steady state dc current drains shall be as specified in Table III.

TABLE III

CURRENT DRAIN

DC SUPPLY VOLTAGE	DC CURRENT DRAIN		
	Minimum	Maximum	Typical
+28 vdc	3.04 amp	3.36 amp	3.2 amp
-28 vdc	22 ma	28 ma	25 ma

3.1.2.3 Converter Switching. The conduction times of the converter primary switching transistors under unsynchronized converter operating conditions shall be equal to within 2 μsec. The simultaneous nonconduction times shall be greater than 0.75 μsec at an assembly heat sink temperature of 140° ±5°F.

3.1.2.4 Free-Running Frequency. The unsynchronized converter operating frequency shall be between 5 kc and 5.7 kc.

3.1.2.5 Input Current Spiking. The ac component of the input current shall be ≤1.5 amp pp under nominal and threshold input conditions at an assembly heat skin temperature of 140° ±5°F.

3.1.2.6 Output Voltages. The output voltages for nominal input conditions at an assembly heat sink temperature of 100° ±5°F shall be as specified in Table IV.

TABLE IV

OUTPUT VOLTAGES

OUTPUT	DC VALUE		AC COMPONENT
	Inhibited	Normal	Normal
+120 vdc to PIPA and Gyro Loops	≤1 vdc	+120 vdc ±3%	≤0.3V pp
+20 vdc to PIPA and Gyro Loops	+20 vdc ±6%	+20 vdc ±6%	≤0.4V pp
-20 vdc to PIPA and Gyro Loops	-20 vdc ±10%	-20 vdc ±10%	≤0.4V pp
+28 vdc X PIPA PVR	≤0.5 vdc	+28 vdc ±5%	≤0.5V pp
+28 vdc Y PIPA PVR	≤0.5 vdc	+28 vdc ±5%	≤0.5V pp
+28 vdc Z PIPA PVR	≤0.5 vdc	+28 vdc ±5%	≤0.5V pp

3.1.2.7 Output Voltage Regulation. The output voltage change for corresponding input voltage changes at an assembly heat sink temperature of 100° ±5° shall be as specified in Table V.

TABLE V

REGULATION

OUTPUT VOLTAGE	CHANGE IN OUTPUT VOLTAGE FOR CHANGE IN INPUT	
	Input Nominal to Enhanced	Input Nominal to Degraded
+120 vdc	$\leq$2.4V	>116V*
+20 vdc	$\leq$0.45V	$\leq$0.3V
-20 vdc	$\leq$1V	$\leq$1V
+28 X PIPA	$\leq$0.15V	$\leq$0.15V
+28 Y PIPA	$\leq$0.15V	$\leq$0.15V
+28 Z PIPA	$\leq$0.15V	$\leq$0.15V

*Absolute voltage measurement.

3.1.2.8 **Turn On Delay.** The +120V and each +28V output shall have the delay characteristics specified in Table VI.

TABLE VI

TURN ON DELAY CHARACTERISTICS

OUTPUT VOLTAGE	VOLTAGE (vdc) AT		
	t_o* +0.4 sec	t_o* +5.0 sec	t_o* +10 sec
+120 vdc	$\geq$100	-	-
+20 vdc	-	-	-
-20 vdc	-	-	-
+28 vdc X PIPA PVR	-	$\leq$2	$\geq$25
+28 vdc Y PIPA PVR	-	$\leq$2	$\geq$25
+28 vdc Z PIPA PVR	-	$\leq$2	$\geq$25

*t_o is the time at which the supply input voltage is applied.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&C Drawing 2007106 and all drawings and engineering data referenced thereon.

3.2.2 Standards of Manufacturing, Manufacturing Process and Production

3.2.2.1 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms.

3.2.2.2 Circuit Isolation. The following pins shall be isolated from one another and pin 4 connected to pin 17 by at least 100 megohms.

a. Pin 35 (+28 vdc Return, X PIPA PVR)
b. Pin 32 (+28 vdc Return, Y PIPA PVR)
c. Pin 31 (+28 vdc Return, Z PIPA PVR)

3.2.2.3 Continuity and DC Resistance. Continuity and dc resistance shall be as follows:

a. The resistance between pins electrically connected in parallel within the assembly shall be ≤0.5 ohm.

b. The resistance between pin 1 and the heat sink shall be ≤0.5 ohm.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 Test Conditions

4.1.1.1 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

a. Temperature: 25° ±10°C
b. Relative Humidity: 90% max
c. Barometric Pressure: 28 to 32 inches of Hg

4.1.1.1.1 Case Temperature. Unless otherwise specified, the assembly shall be mounted to a heat sinking device such that the assembly case temperature is maintained between 0° and 60°C during tests.

4.1.1.2 Supply Voltages. The assembly shall be tested with the dc supply voltages specified in Table I.

4.1.1.3 Test Signals. The required input signals are specified in Table II.

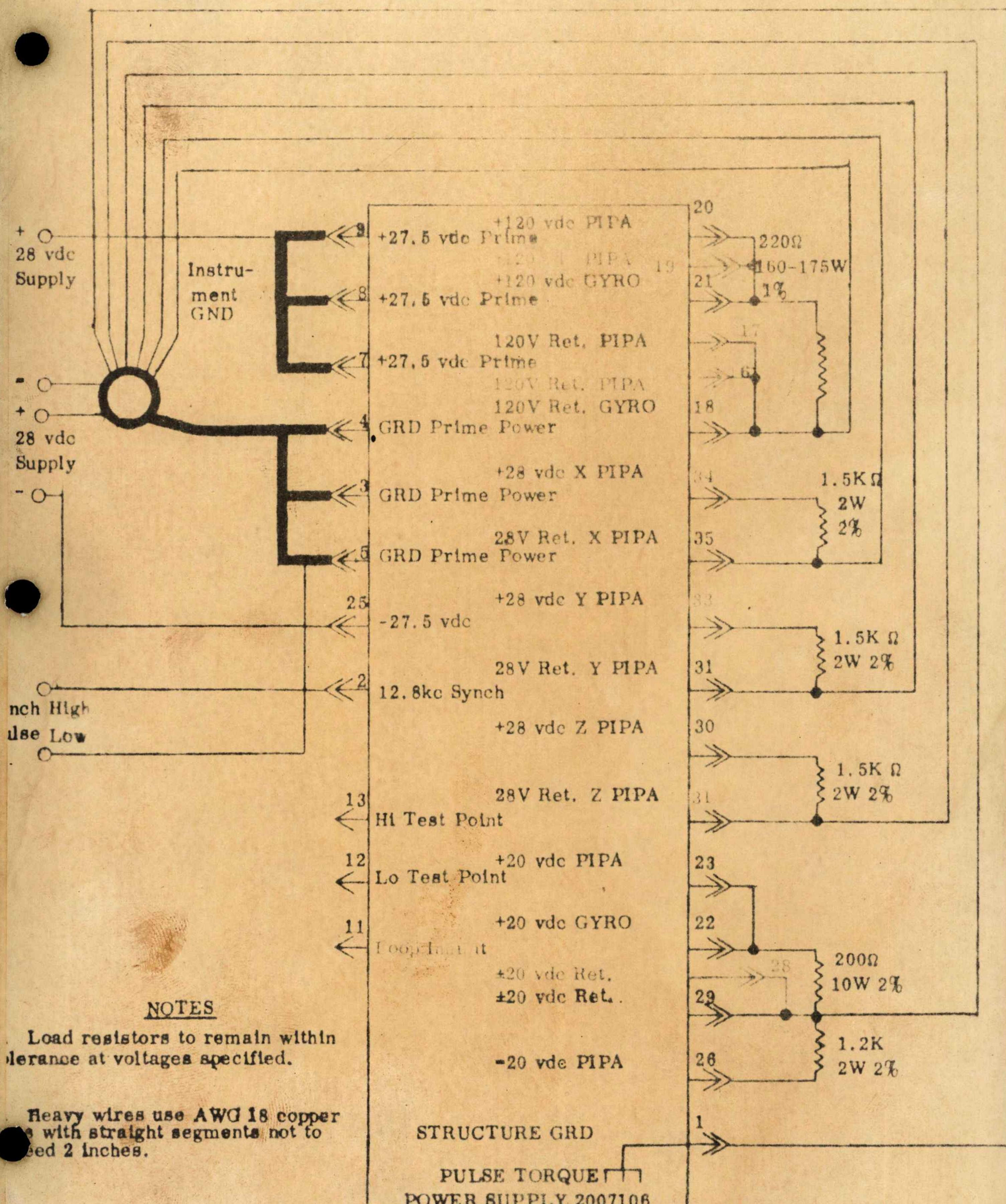
4.1.1.4 Test Setup. The required test setup is shown in Figure 1.

4.1.2 Nonconforming Units. Failure of the unit to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or when directed by the cognizant inspector, a complete retest and reexamination may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.2 TESTS

4.2.1 Drawing Compliance. The assembly shall be visually examined for compliance to the requirements of APOLLO G&C Drawing 2007106. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of marking.

4.2.2 Workmanship-Vibration. The assembly shall be vibrated along the axis shown in Figure 2. The vibration shall be simple harmonic motion swept from 10 to 2000 cps at a rate of 1 octave/15 sec. The magnitude of vibration shall be 6.0g rms limited to a 0.4 inch pp constant displacement from 10 cps to the crossover frequency. The assembly shall be energized during vibration in accordance with Figure 1. With nominal dc supply voltage inputs applied to the vibration monitoring network shown in Figure 3, the +28 vdc outputs designated

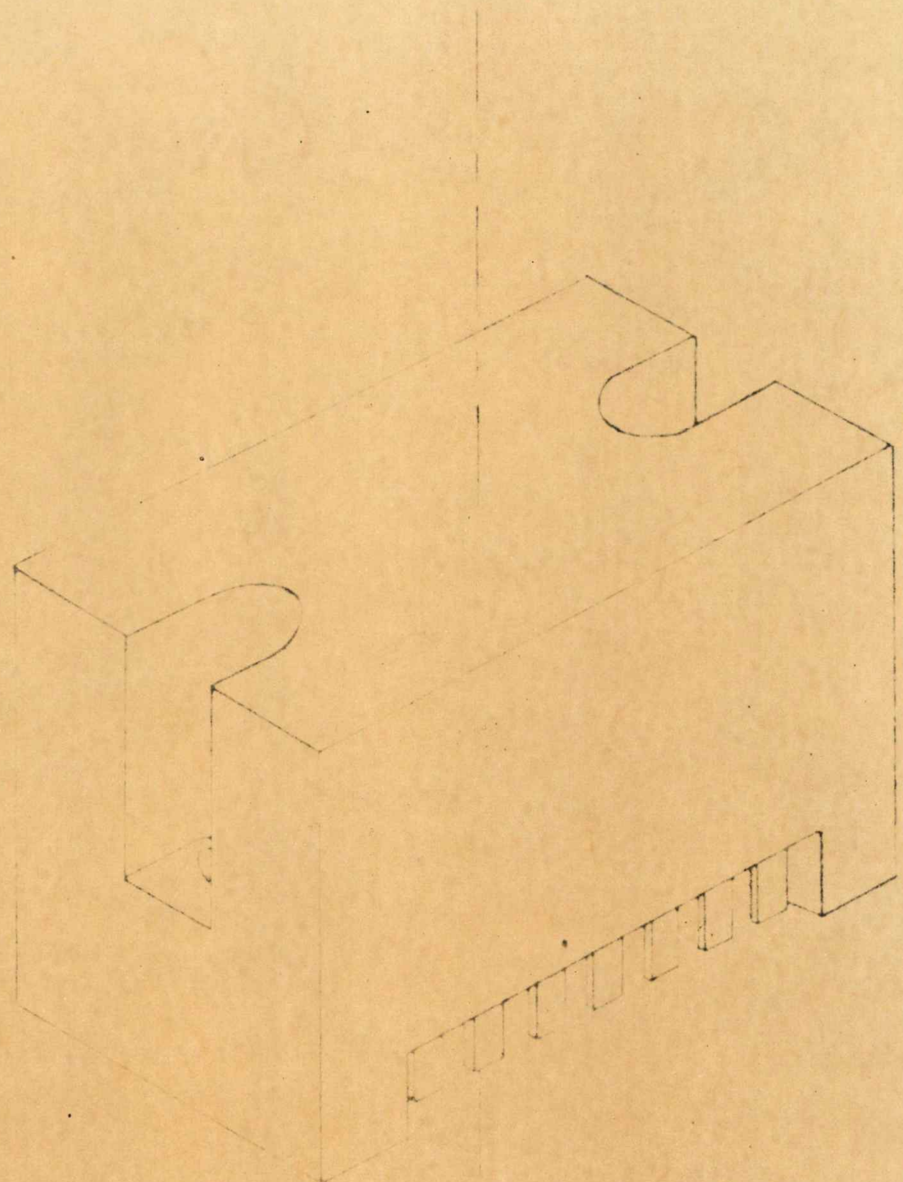


NOTES

Load resistors to remain within tolerance at voltages specified.

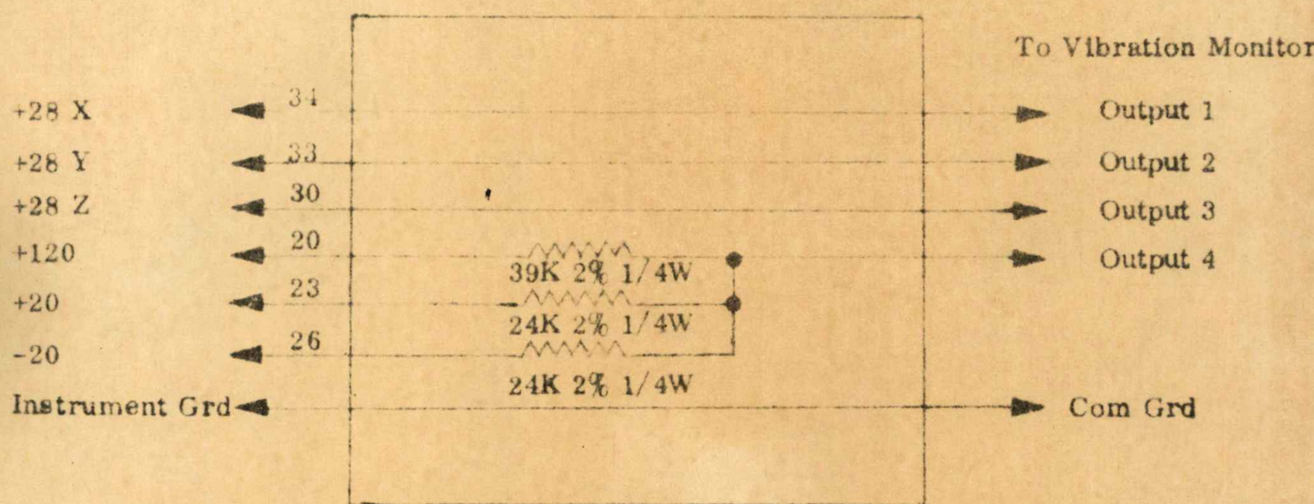
Heavy wires use AWG 18 copper with straight segments not to exceed 2 inches.

RECOMMENDED TEST SETUP
FIGURE 1



VIBRATION AXIS OF ASSEMBLY

FIGURE 2



VIBRATION MONITORING

FIGURE 3

outputs 1 through 4 shall remain at +28 vdc ±10 percent before, during and after vibration. The assembly shall be monitored with equipment capable of measuring out-of-tolerance conditions which exist for a period greater than 1 millisecond. Any out-of-tolerance condition shall constitute a failure. After vibration, the assembly shall be visually examined as specified in 4.2.1.

4.2.3 Insulation Resistance and Circuit Isolation. The resistance between pin 1 and the remaining assembly pins shall be as specified in 3.2.2.1 when measured in accordance with method 302 of Standard MIL-STD-202. The resistance between the pins shown in Table VII shall be as specified therein when measured in accordance with method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output of 225±75 vdc, limited to a short circuit of 6.0 μa.

TABLE VII

CIRCUIT ISOLATION*

FROM		TO		RESISTANCE
Circuit Point	Pin	Circuit Point	Pin	
Grd. Prime Power	3	28V Ret. X PIPA	35	$\geq$100
Grd. Prime Power	3	28V Ret. Y PIPA	31	
Grd. Prime Power	3	28V Ret. Z PIPA	27	
28V Ret. X PIPA	35	28V Ret. Y PIPA	32	
28V Ret. X PIPA	35	28V Ret. Z PIPA	27	
28V Ret. Y PIPA	31	28V Ret. Z PIPA	27	$\geq$100

*Connect pins 1, 3 and 7 together during this test.

4.2.4 Continuity and DC Resistance. The resistance between the pins electrically connected in parallel within the assembly and pin 1 to the heat sink shall be as specified in Table VIII when measured in accordance with method 303 of Standard MIL-STD-202.

TABLE VIII

CONTINUITY

FROM		TO		RESISTANCE
Circuit Point	Pin	Circuit Point	Pin	(ohms)
+27.5 vdc System Prime Power	7	+27.5 vdc System Prime Power	8	≤ 0.5
+27.5 vdc System Prime Power	7	+27.5 vdc System Prime Power	9	
+27.5 vdc System Prime Power	8	+27.5 vdc System Prime Power	9	
Grd - Prime Power	3	Grd - Prime Power	4	
Grd - Prime Power	3	Grd - Prime Power	5	
Grd - Prime Power	4	Grd - Prime Power	5	
+120 vdc to PIPA Loops	19	+120 vdc to PIPA Loops	20	
+120 vdc to PIPA Loops	19	+120 vdc to Gyro Loops	21	
+120 vdc to PIPA Loops	20	+120 vdc to Gyro Loops	21	
+120 vdc Ret PIP	16	+120 vdc Ret PIPA	17	
+120 vdc Ret PIPA	16	+120 vdc Ret Gyro	18	
+120 vdc Ret PIPA	17	+120 vdc Ret Gyro	18	
+20 vdc PIPA	23	+20 vdc to Gyro Loops	22	
+20 vdc Return	28	+20 vdc Return	29	
Structure Ground	1	Heatsink*	-	≤ 0.5

* To assure good electrical contact the anodizing may be penetrated

4.2.5 DC Supply Current Drain. With the following conditions established, the +28 vdc supply current entering pins 7, 8 and 9 and the -28 vdc current leaving pin 25 shall be as specified in Table III.

a. The assembly connected as shown in Figure 1.

b. Nominal dc supply voltages in accordance with Table I and nominal input signal in accordance with Table II applied.

c. Measurements made at least 10 seconds after application of dc supply voltages and input signal

4.2.6 Converter Switching

a. Negative Half-Cycle. With the following conditions established, the negative half-cycles of the converter primary voltage waveforms shall be of equal time duration to within less than a 2 ± 0.2 µsec difference.

(1) The assembly connected as shown in Figure 1.

(2) Nominal dc supply voltages and threshold input signal applied.

(3) The negative half-cycles appearing between pin 12 (LO TEST POINT) and pins 3, 4 and 5 (Grd) shall be compared with the negative half-cycle appearing between pin 13 (HI TEST POINT) and pins 3, 4 and 5 (Grd) for pulse difference in duration (see Figure 4).

(4) Measurements shall be made at least 1 minute after application of inputs.

(5) Oscilloscope triggering (ac external trigger) provided by the circuit shown in Figure 5.

b. Simultaneous Nonconduction Time. With the following conditions established, the simultaneous nonconduction time, defined as the time between the 90 percent points of the converter primary voltage waveforms during the switching interval, shall be greater than 0.75 μsec.

(1) The assembly connected as shown in Figure 1.

(2) Nominal dc supply voltages and input signals applied.

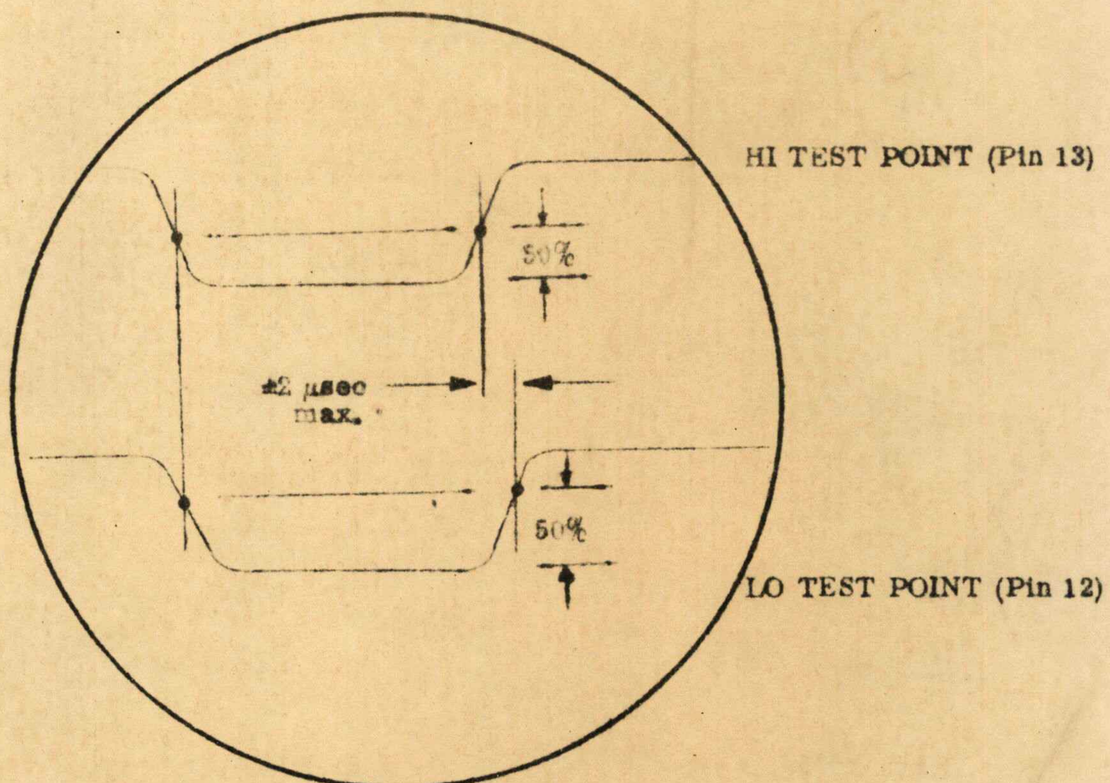
(3) The positive going waveform appearing at pin 12 (LO TEST POINT) with respect to pins 3, 4 and 5 (Grd), displayed simultaneously with the negative going waveform appearing at pin 13 (HI TEST POINT) to permit a precise time measurement (see Figure 6).

(4) The negative going waveform appearing at pin 12 (LO TEST POINT) with respect to pins 3, 4 and 5 (Grd), displayed simultaneously with the positive-going waveform appearing at pin 13 (HI TEST POINT) to permit a precise time measurement (see Figure 7).

(5) The assembly heatsink temperature established at 140° ±5°F.

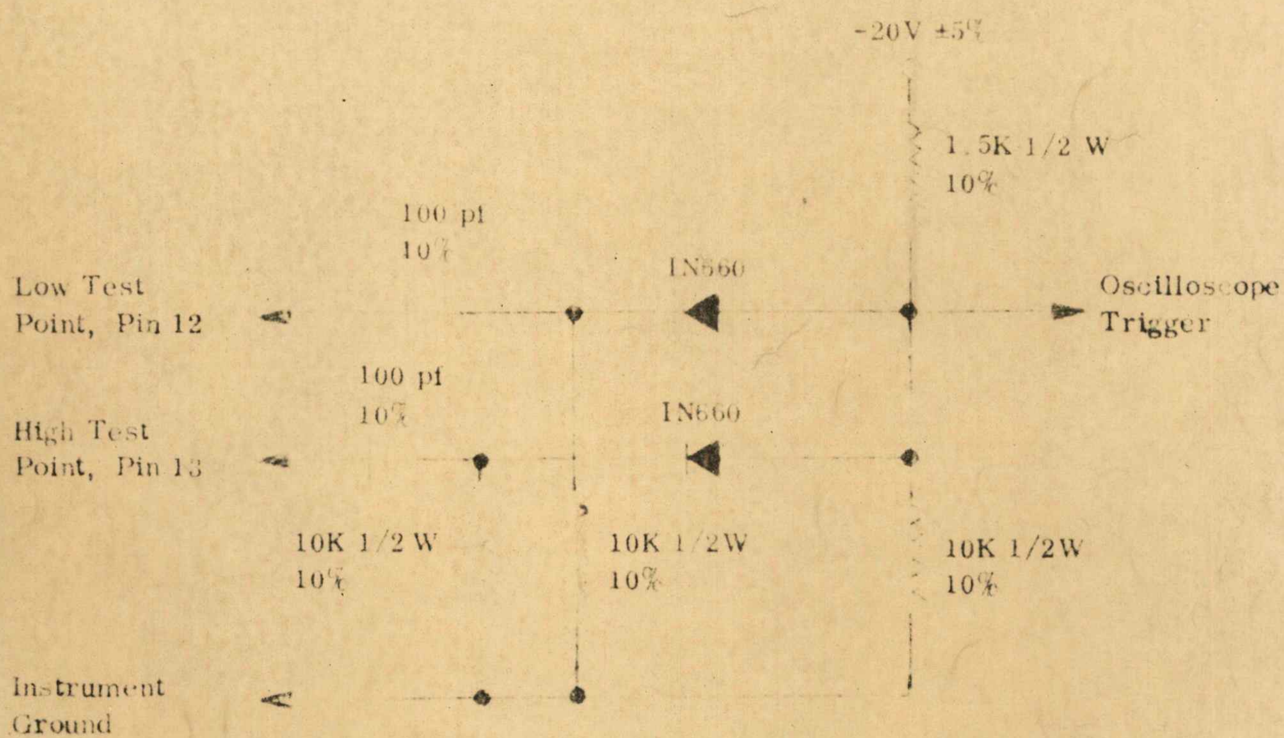
(6) Measurements shall be made at least 1 minute after application of inputs.

4.2.7 Free Running Frequency. With the following conditions established, the full period of the voltage waveform at pin 13 (HI TEST POINT) with respect to pins 3, 4 and 5 shall be between 175 and 200 μsec.



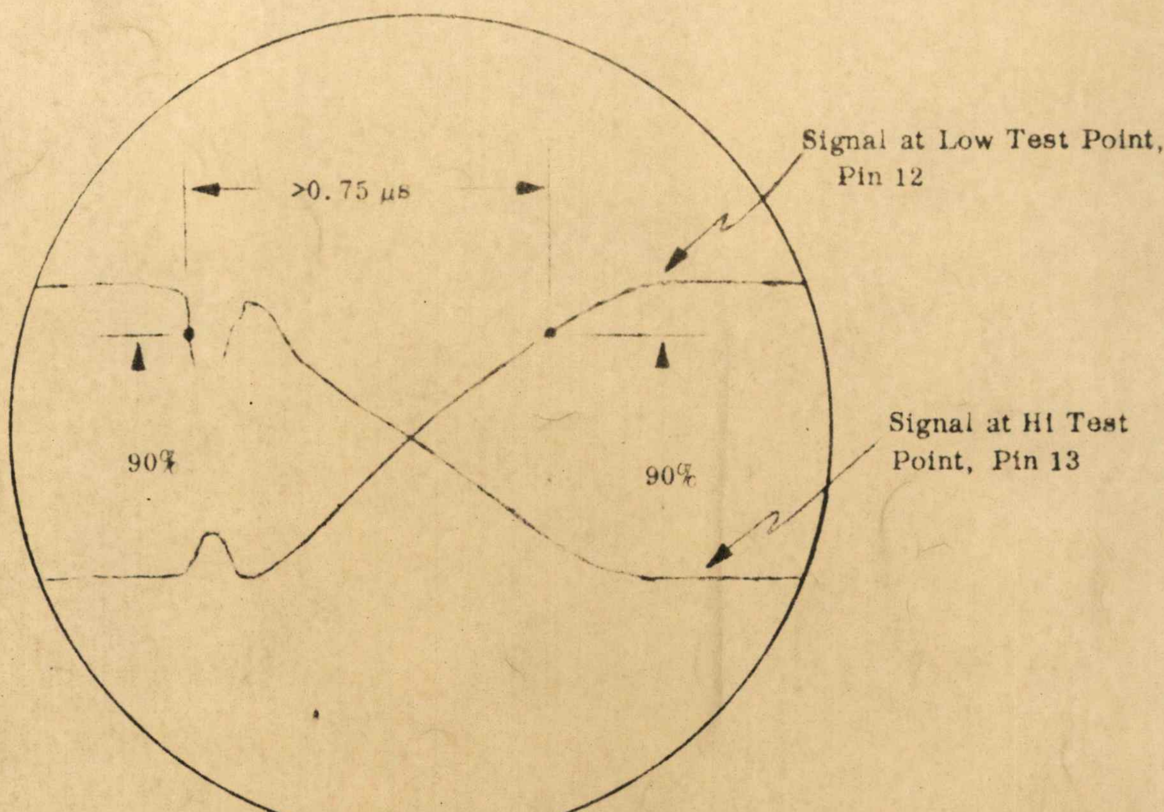
SWITCHING SYMMETRY

FIGURE 4

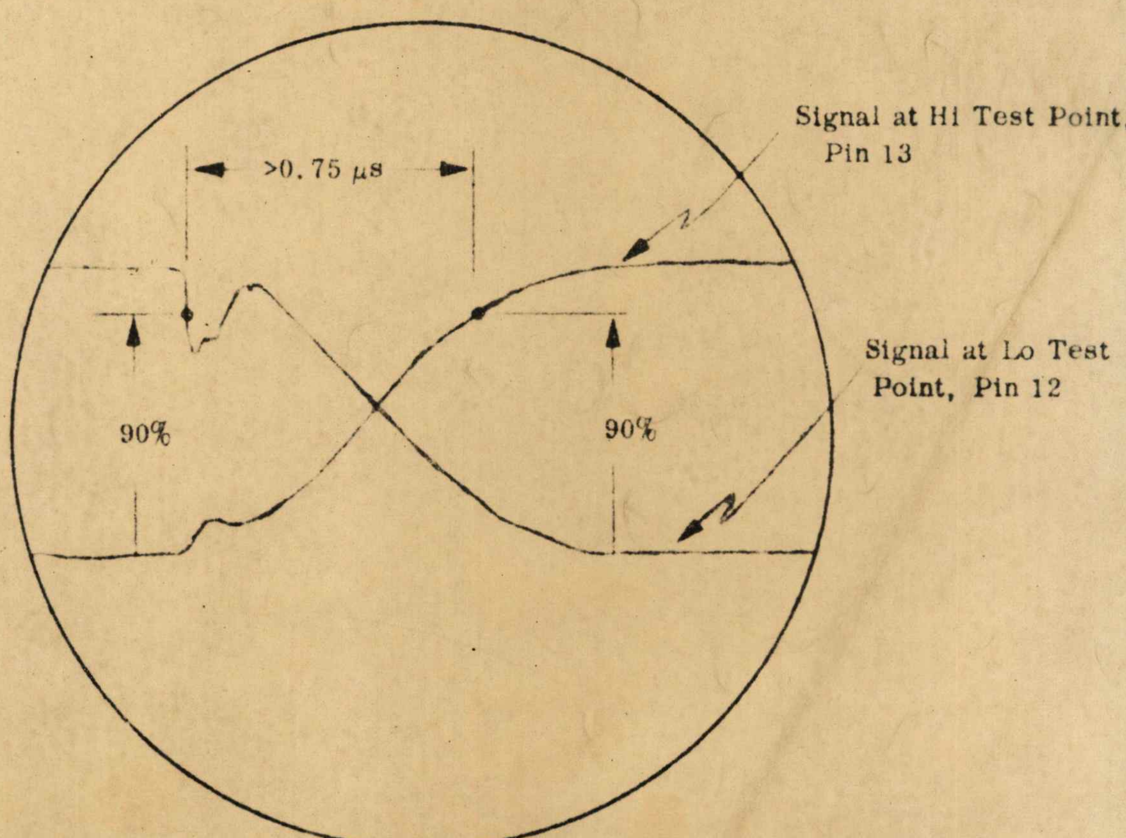


OSCILLOSCOPE TRIGGERING CIRCUIT FOR TIME BASE B

FIGURE 5



NEGATIVE NONCONDUCTION TIME
FIGURE 6



POSITIVE NONCONDUCTION TIME
FIGURE 7

a. The assembly connected as shown in Figure 1.
b. Nominal dc supply voltages applied.
c. Input signal at the threshold condition specified in Table II.

4.2.8 Input Spiking. With the following conditions established the pp input current shall be ≤1.5 amp:

a. The assembly connected as shown in Figure 1.
b. Nominal dc supply voltages and nominal input signal followed by threshold input signal applied.
c. Measurements made at least 10 seconds after application of inputs.
d. Assembly heat sink temperature established at 140° ±5°F.

4.2.9 Output Voltages. With the following conditions established the output voltages measured at the module mating connector with respect to instrument ground shall be as specified in Table IV:

a. The assembly connected as shown in Figure 1
b. Nominal dc supply voltages and signal input applied.
c. Inhibited output voltages measured with pin 11 (Loop Inhibit) connected to pins 3, 4 and 5 (Figure 1)
d. Normal output voltages measured with pin 11 disconnected from pins 3, 4 and 5.
e. The assembly heat sink temperature maintained at 100° ±5°F.
f. Measurements made at least 1 minute after application of the input in b.

4.2.10 Output Voltage Regulation. With the following conditions established, output voltage changes resulting from input voltage changes of the dc supply voltages shall be as specified in Table V.

a. The assembly shall be connected as shown in Figure 1.

b. Nominal Conditions. With nominal dc supply voltages and signal input applied, the +120, +20, -20, and +28 vdc outputs shall be measured at least 1 minute after application of the nominal inputs.

c. Enhanced Conditions. With enhanced dc supply voltages and input signal in accordance with Tables I and II applied, the +120, +20, -20, and +28 vdc outputs shall be measured at least 1 minute after application of the enhanced inputs.

d. Degraded Conditions. With degraded dc supply voltages and input signal in accordance with Tables I and II applied, the +120, +20, -20, and +28 vdc outputs shall be measured at least 1 minute after application of the degraded inputs.

[illegible]

[illegible] The [illegible] [illegible] [illegible] in [illegible].

[illegible] The assembly leak [illegible] [illegible].

4.[illegible] Time Of Delay. [illegible] The voltages measured shall be [illegible]. Input voltage application shall be such that the [illegible] from 10 to 90 per cent of input voltage magnitude.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification [illegible].

6. NOTES. None.

EP:jls

APOLLO G&N Specification
PS2007166 REV – D
Original Issue Date: 5 July 1966
Release Authority: TDRR 30075
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

PULSE TORQUE POWER SUPPLY

DRAWING NUMBER 2007166

REFERENCE COPY ONLY
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Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals AC	Approvals NASA
1/12/67	A	32626	6, 20 RDG/AC	MGM EA	--
1/26/67	B	32803	5, 20 RDG/AC	MGM EA	--
2/3/67	C	32914	8 RDG/AC	MGM EA	--
2/3/67	D	32915	5, 18, 19, 20 RDG/AC	MGM EA	ACM

This specification consists of page 1 to 21 inclusive.

APPROVALS	A. C. METZGER NASA/MSC	McLeis 7-1-66 / A Setomen 7-1-66 / MG Marley 7-5-66 MIT/IL	T. W Bautz / J Duvenberger AC

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of the Pulse Torque Power Supply, Part Number 2007166-011, hereafter referred to as the assembly.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&N

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment

Military

MIL-T-21038 B	Transformers, Pulse, Low Power, General Specification for

STANDARDS

Military

MIL-STD-202	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&N

2007166	Pulse Torque Power Supply

(Copies of specification, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In the event of a conflict between requirements, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this section.

3. REQUIREMENTS

3.1 DESCRIPTION. The assembly consists of the dc-to-dc power converter and regulated power supplies for the accelerometer and gyro pulse torque electronics.

3.2 PERFORMANCE

3.2.1 DC Supply Current Drain. The steady-state dc current drains shall be as specified in Table I.

TABLE I

CURRENT DRAIN

DC SUPPLY VOLTAGE	DC CURRENT DRAIN		
	Minimum	Maximum	Typical
+27.5 vdc	2.9 amp	3.26 amp	3.1 amp
-27.5 vdc	22 ma	28 ma	25 ma

3.2.2 Converter Switching. The conduction times of the converter primary switching transistors under unsynchronized converter operating conditions shall be equal to within 2 μsec. The simultaneous nonconduction times shall be greater than 0.75 μsec at an assembly heat sink temperature of 120°F ±5°F.

3.2.3 Free-Running Frequency. The unsynchronized converter operating frequency shall be between 5 kc and 5.7 kc.

3.2.4 Input Current Spiking. The ac component of the input current shall be $\leq$1.5 amp pp under nominal and threshold input conditions at an assembly heat sink temperature of 120°F ±5°F.

3.2.5 Output Voltages. The output voltages for nominal input conditions at an assembly heat sink temperature of 100° ±5°F shall be as specified in Table II.

TABLE II

OUTPUT VOLTAGES

OUTPUT	DC VALUE		AC COMPONENT
	Inhibited	Normal	Normal
+120 vdc to PIPA and Gyro Loops	≤1 vdc	+120 vdc ±3%	≤0.3V pp
+20 vdc to PIPA and Gyro Loops	+20 vdc ±6%	+20 vdc ±6%	≤0.4V pp
-20 vdc to PIPA and Gyro Loops	-20 vdc ±10%	-20 vdc ±10%	≤0.4V pp
+28 vdc X PIPA PVR	≤0.5 vdc	+28 vdc ±5%	≤0.5V pp
+28 vdc Y PIPA PVR	≤0.5 vdc	+28 vdc ±5%	≤0.5V pp
+28 vdc Z PIPA PVR	≤0.5 vdc	+28 vdc ±5%	≤0.5V pp

3.2.6 Output Voltage Regulation. The output voltage change for corresponding input voltage changes at an assembly heat sink temperature of 100° ±5°F shall be as specified in Table III.

TABLE III

REGULATION

OUTPUT VOLTAGE	CHANGE IN OUTPUT VOLTAGE FOR CHANGE IN INPUT		
	Input Nominal to Enhanced (A&B)	Input Nominal to Degraded (A&B)	Input Enhanced to Degraded (A&B)
+120 vdc	≤2.8V	>116V*	≤1.3V
+20 vdc	≤0.60V	≤0.3V	
-20 vdc	≤1V	≤1.5V	
+28 X PIPA	≤0.15V	≤0.15V	
+28 Y PIPA	≤0.15V	≤0.15V	
+28 Z PIPA	≤0.15V	≤0.15V	

*Absolute voltage measurement

3.2.7 Turn On Delay. The +120V and each +28V output shall have the delay characteristics specified in Table IV.

TABLE IV

TURN ON DELAY CHARACTERISTICS

OUTPUT VOLTAGE	VOLTAGE (vdc) AT			
	t_o* +0.2 sec	t_o * +0.4 sec	t_o * +5.0 sec	t_o *+10 sec
+120 vdc	<5	$\geq$100	-	-
+20 vdc	-	-	-	-
-20 vdc	-	-	-	-
+28 vdc X PIPA PVR	-	-	$\leq$2	$\geq$25
+28 vdc Y PIPA PVR	-	-	$\leq$2	$\geq$25
+28 vdc Z PIPA PVR	-	-	$\leq$2	$\geq$25

*t_o is the time at which the supply input voltage is applied.

3.3 PRODUCT CONFIGURATION

3.3.1 Drawings. The configuration of the assembly shall be in accordance with Drawing 2007166 and all drawings and engineering data referenced thereon.

3.3.2 Maximum Weight. Not applicable. ——————————————

3.3.3 Standards of Manufacturing, Manufacturing Process and

3.3.3.1 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms.

3.3.3.2 Circuit Isolation. The following pins shall be isolated from one another and from pins 4 and 17 by at least 100 megohms.

a. Pin 35 (+28 vdc Return, X PIPA PVR)
b. Pin 32 (+28 vdc Return, Y PIPA PVR)
c. Pin 31 (+28 vdc Return, Z PIPA PVR)

3.3.3.3 Continuity and DC Resistance. The resistance between pins electrically connected in parallel within the assembly shall be $\leq$0.5 ohm. The resistance between pin 1 and the heat sink shall be $\leq$0.5 ohm.

4. QUALITY ASSURANCE PROVISIONS

4.1 PRODUCT PERFORMANCE AND CONFIGURATION REQUIREMENTS/QUALITY VERIFICATION CROSS REFERENCE INDEX

Test/Examination	Requirement	Method
DC Supply Current Drain	3.2.1	4.3.5
Converter Switching	3.2.2	4.3.6
Free-Running Frequency	3.2.3	4.3.7
Input Current Spiking	3.2.4	4.3.8
Output Voltages	3.2.5	4.3.9
Output Voltage Regulation	3.2.6	4.3.10&4.3.11
Turn On Delay	3.2.7	4.3.12
Drawings	3.3.1	4.3.1
Weight	3.3.2	4.3.13
Insulation Resistance and Circuit Isolation	3.3.3.1, 3.3.3.2	4.3.3
Continuity and DC Resistance	3.3.3.3	4.3.4

4.2 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.2.1 Test Conditions

4.2.1.1 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

a. Temperature: 25° ±10°C
b. Relative Humidity: 90% max
c. Barometric Pressure: 28 to 32 inches of Hg

4.2.1.1.1 Case Temperature. Unless otherwise specified, the assembly shall be mounted to a heat sinking device such that the assembly case temperature is maintained between 0° and 50°C during tests.

4.2.1.2 Supply Voltages. The assembly shall be tested with the dc supply voltages specified in Table V.

TABLE V

DC SUPPLY VOLTAGES

SUPPLY VOLTAGE	CONDITIONS (V dc ±0.25 vdc)				
	Nominal	Enhanced		Degraded	
		A	B	A	B
+28 VDC Supply	+27.5	+31.4	33.1	+25.4	+24.10
-28 VDC Supply	-27.5	-31.4	-33.1	-25.4	-24.10

4.2.1.3 Test Signals. The required input signals are specified in Table VI.

TABLE VI

INPUT SIGNAL CHARACTERISTICS

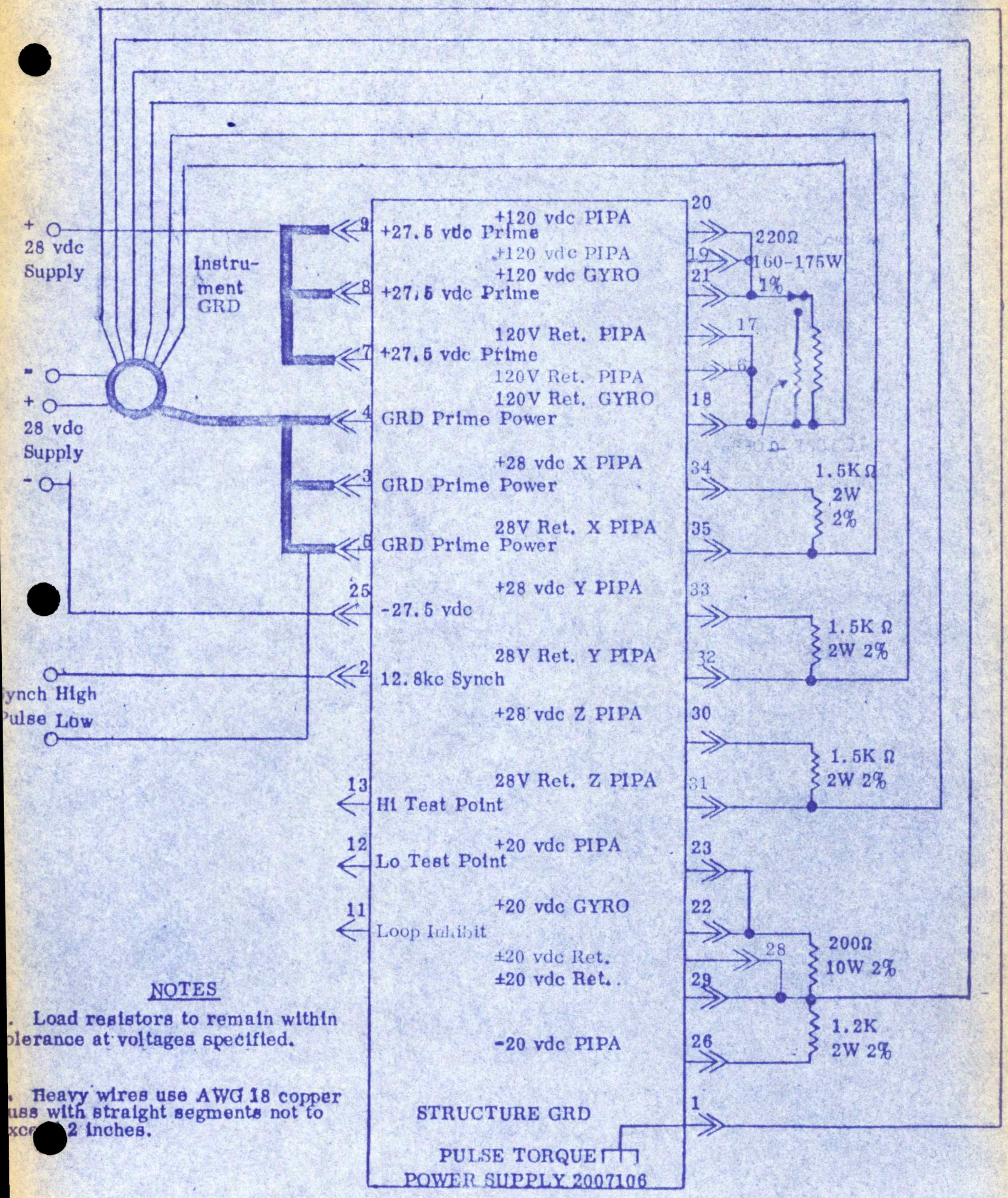
CHARACTERISTIC*	CONDITIONS			
	Nominal	Enhanced	Degraded	Threshold
Amplitude	5.5±0.25V	7.00±0.25V	4.00±0.25V	2.0±0.1V
Rise Time	200±50 ns	100±50 ns	500±50 ns	-
Decay Time	600±200 ns	600±200 ns	800±200 ns	-
Pulse Width	3.0±0.3 μs	3.0±0.3 μs	3.0±0.3 μs	3.0±0.3 μs
Overshoot	≤1V	-	-	-
Backswing	≤2V	-	-	-
Droop	≤2V	-	-	-
PRF	12.8 kc ±2%	12.8kc ±2%	12.8 kc ±2%	12.8 kc ±2%
*Characteristics shall be as described in Specification MIL-T-21038B.				

4.2.1.4 Test Setup. The required test setup is shown in Figure 1.

4.2.2 Nonconforming Units. Failure of the unit to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or when directed by the cognizant inspector, a complete retest and re-examination may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.3 TESTS

4.3.1 Drawing Compliance. The assembly shall be visually examined for compliance to the requirements of APOLLO G&N Drawing 2007166. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of marking.



NOTES

1. Load resistors to remain within tolerance at voltages specified.

2. Heavy wires use AWG 18 copper buss with straight segments not to exceed 2 inches.

FIGURE 1

4.3.2. Workmanship - Vibration. The assembly shall be vibrated along the axis shown in Figure 2. The vibration shall be simple harmonic motion swept from 10 to 2000 cps at a rate of 1 octave/15 sec. The magnitude of vibration shall be 6.0g rms limited to a 0.4 inch pp constant displacement from 10 cps to the crossover frequency. The assembly shall be energized during vibration in accordance with Figure 1, Condition A,& The load between pin 26 and pins 28 or 29 shall be removed. With nominal dc supply voltage inputs applied, and with the vibration monitoring network shown in Figure 3, the outputs designated outputs 1 through 4 shall remain within ±10 percent of the measured pre-vibration value both during and after vibration. The assembly shall be monitored with equipment capable of measuring out-of-tolerance conditions which exist for a period greater than 1 millisecond. Any out-of-tolerance condition shall constitute a failure. After vibration, the assembly shall be visually examined as specified in 4.3.1.

4.3.3 Insulation Resistance and Circuit Isolation. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms when measured in accordance with method 302 of Standard MIL-STD-202. The resistance between the pins shown in Table VII shall be as specified therein, when measured in accordance with method 303 of Standard MIL-STD-202. The megohmmeter used shall have an output of 225±75 vdc, limited to a short circuit current of 6.0 ma.

TABLE

CIRCUIT ISOLATION

FROM		TO		RESISTANCE
Circuit Point	Pin*	Circuit Point	Pin	MEGOHMS
Grd. Prime Power	3	28V Ret. X PIPA	35	≥100
Grd. Prime Power	3	28V Ret. Y PIPA	32	
Grd. Prime Power	3	28V Ret. Z PIPA	31	
28V Ret. X PIPA	35	28V Ret. Y PIPA	32	
28V Ret. X PIPA	35	28V Ret. Z PIPA	31	
28V Ret. Y PIPA	32	28V Ret. Z PIPA	31	≥100

*Connect pins 1, 3 and 17 together during this test.

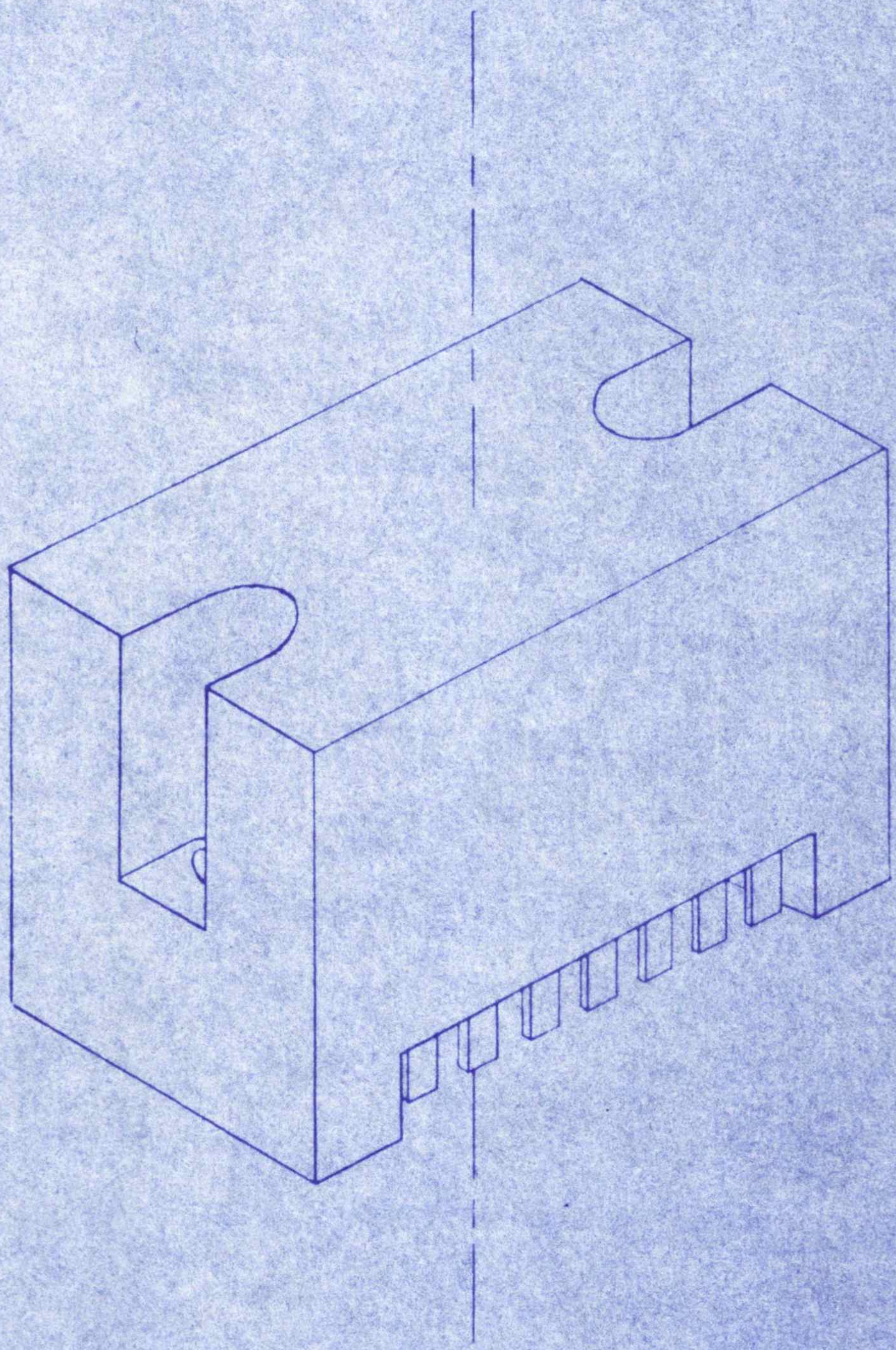
4.3.4 Continuity and DC Resistance. The resistance between the pins electrically connected in parallel within the assembly and pin 1 to the heat sink shall be as specified in Table VIII when measured in accordance with method 303 of Standard MIL-STD-202.

4.3.5. DC Supply Current Drain. With the following conditions established, the +28 vdc supply current entering pins 7, 8 and 9 and the -28 vdc current leaving pin 25 shall be as specified in Table 1.

a. The assembly connected as shown in Figure 1, Load A Condition.

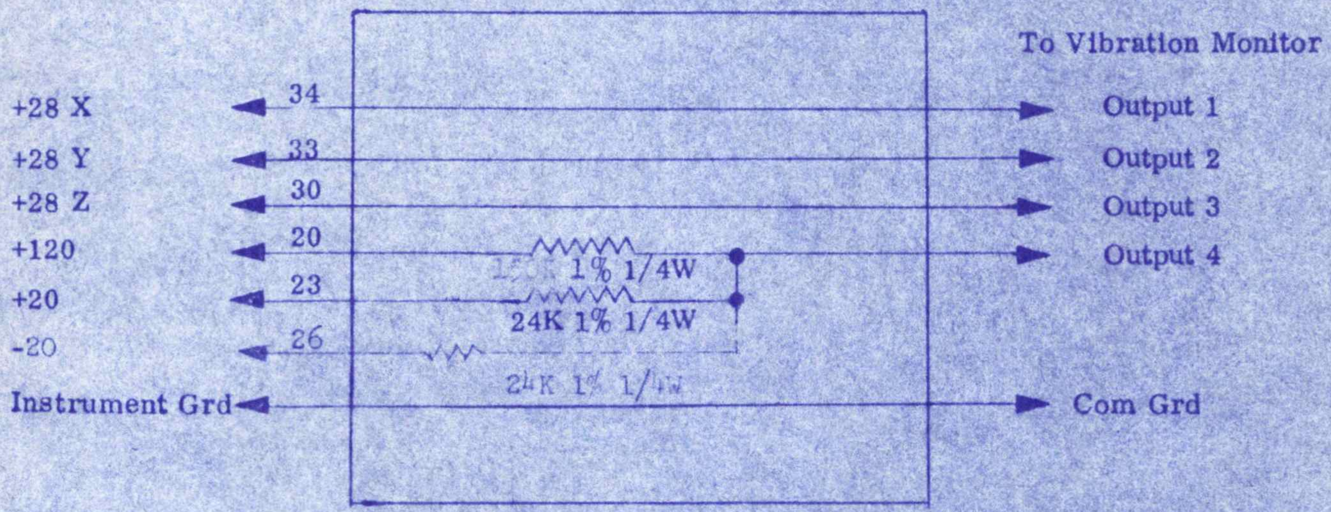
b. Nominal dc supply voltages in accordance with Table V and nominal input signal in accordance with Table VI applied.

c. Measurements made at least 10 seconds after application of dc supply voltages and input signal.



VIBRATION AXIS OF ASSEMBLY

FIGURE 2



VIBRATION MONITORING

FIGURE 3

TABLE VIII

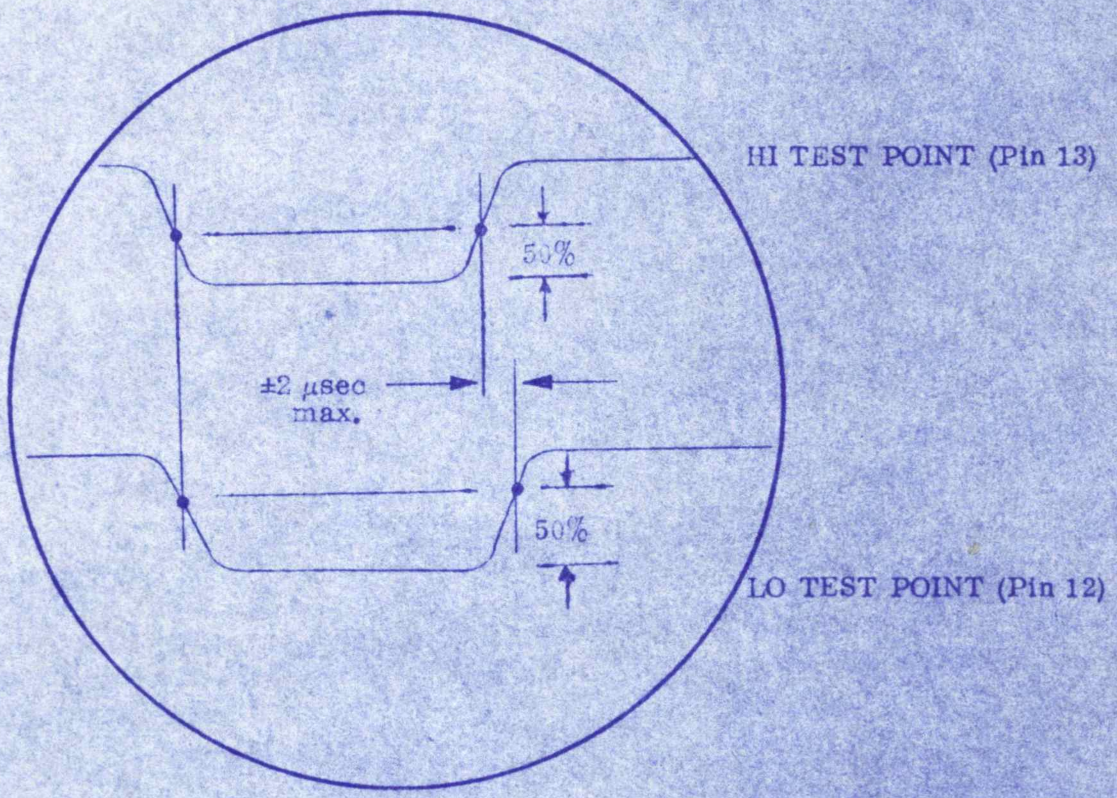
CONTINUITY

FROM		TO		RESISTANCE (ohms)
Circuit Point	Pin	Circuit Point	Pin	
+27.5 vdc System Prime Power	7	+27.5 vdc System Prime Power	8	≤ 0.5
+27.5 vdc System Prime Power	7	+27.5 vdc System Prime Power	9	
+27.5 vdc System Prime Power	8	+27.5 vdc System Prime Power	9	
Grd - Prime Power	3	Grd - Prime Power	4	
Grd - Prime Power	3	Grd - Prime Power	5	
Grd - Prime Power	4	Grd - Prime Power	5	
+120 vdc to PIPA Loops	19	+120 vdc to PIPA Loops	20	
+120 vdc to PIPA Loops	19	+120 vdc to Gyro Loops	21	
+120 vdc to PIPA Loops	20	+120 vdc to Gyro Loops	21	
+120 vdc Ret PIPA	16	+120 vdc Ret PIPA	17	
+120 vdc Ret PIPA	16	+120 vdc Ret Gyro	18	
+120 vdc Ret PIPA	17	+120 vdc Ret Gyro	18	
+20 vdc PIPA	23	+20 vdc to Gyro Loops	22	
±20 vdc Return	28	±20 vdc Return	29	
Structure Ground	1	Heatsink*	-	≤ 0.5

* To assure good electrical contact the anodizing may be penetrated.

4.3.6 Converter Switching

a. Negative Half-Cycle. With the following conditions established, the negative half-cycles of the converter primary voltage waveforms shall have a time duration difference of 2.0 µsec maximum (see Figure 4).



SWITCHING SYMMETRY

FIGURE 4

(1) The assembly connected as shown in Figure 1, Load A Condition.

(2) Nominal dc supply voltages and threshold input signal applied.

(3) The negative half-cycles appearing between pin 12 (LO TEST POINT) and pins 3, 4 and 5 (Grd) shall be compared with the negative half-cycle appearing between pin 13 (HI TEST POINT) and pins 3, 4 and 5 (Grd) for pulse difference in duration (see Figure 4).

(4) Measurements shall be made at least 1 minute after application of inputs.

(5) Oscilloscope triggering (ac external trigger) provided by the circuit shown in Figure 5.

b. Simultaneous Nonconduction Time. With the following conditions established, the simultaneous nonconduction time, defined as the time between the 90 percent points of the converter primary voltage waveforms during the switching interval, shall be greater than 0.75 μsec.

(1) The assembly connected as shown in Figure 1, Load A Condition.

(2) Condition A enhanced dc supply voltages and input signals applied.

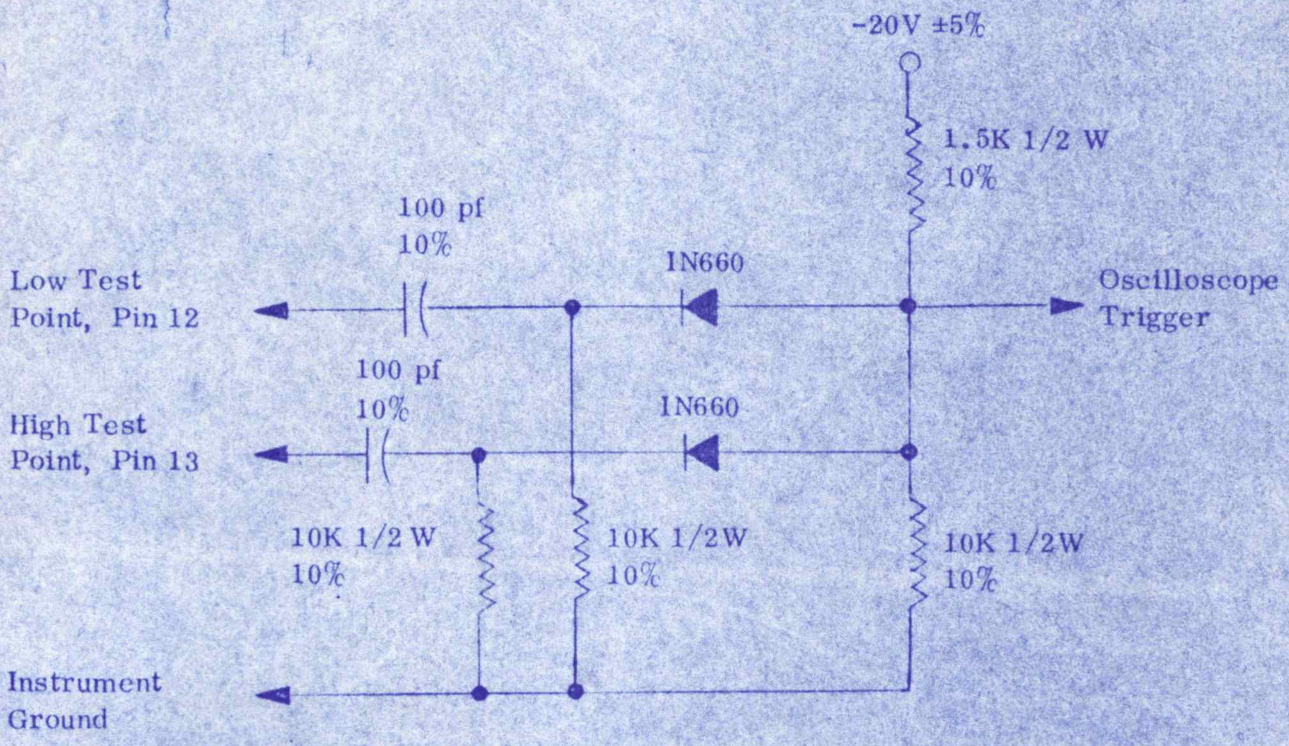
(3) The positive going waveform appearing at pin 12 (LO TEST POINT) with respect to pins 3, 4 and 5 (Grd), displayed simultaneously with the negative going waveform appearing at pin 13 (HI TEST POINT) to permit a precise time measurement (see Figure 6).

(4) The negative going waveform appearing at pin 12 (LO TEST POINT) with respect to pins 3, 4 and 5 (Grd), displayed simultaneously with the positive-going waveform appearing at pin 13 (HI TEST POINT) to permit a precise time measurement (see Figure 7).

(5) The assembly heatsink temperature established at 120°F ±5°F.

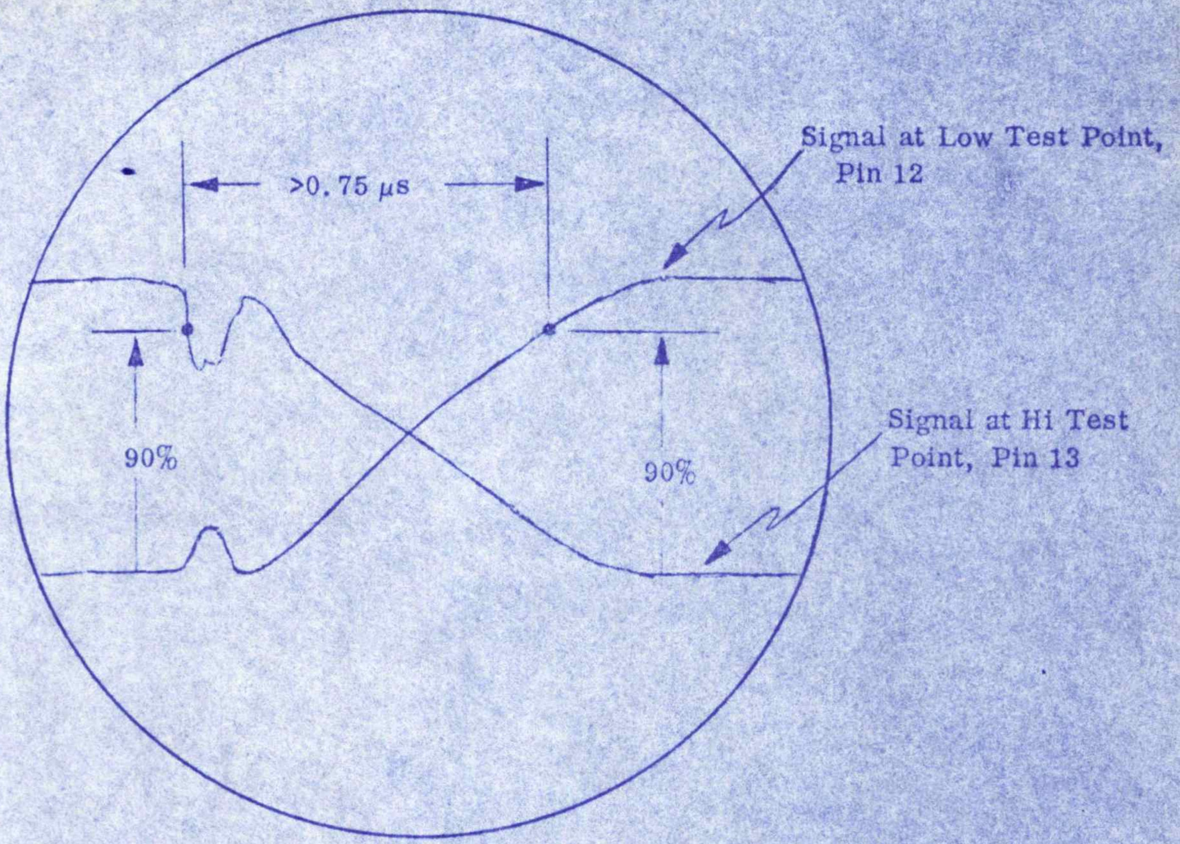
(6) Measurements shall be made at least 1 minute after application of inputs.

4.3.7 Free-Running Frequency. With the following conditions established, the full period of the voltage waveform at pin 13 (HI TEST POINT) with respect to pins 3, 4 and 5 shall be between 175 and 200 μsec.

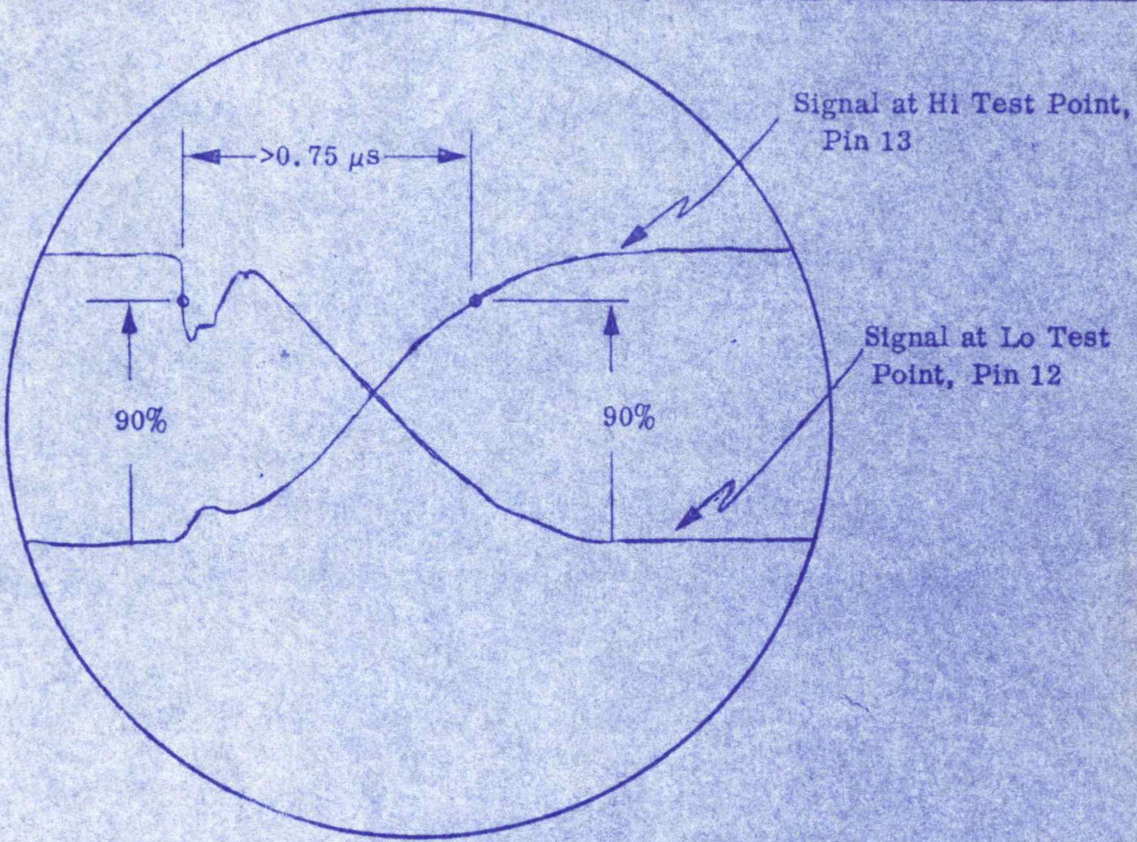


OSCILLOSCOPE TRIGGERING CIRCUIT FOR TIME BASE B

FIGURE 5



NEGATIVE NONCONDUCTION TIME
FIGURE 6



POSITIVE NONCONDUCTION TIME
FIGURE 7

a. The assembly connected as shown in Figure 1.
b. Nominal dc supply voltages applied.
c. Input signal at the threshold condition specified in Table VI.

4.3.8 Input Current Spiking. With the following conditions established, the pp input current shall be ≤1.5 amp.

a. The assembly connected as shown in Figure 1, Load A Condition.

b. Nominal dc supply voltages and nominal input signal followed by threshold input signal applied.

c. Measurements made at least 10 seconds after application of inputs, using a current probe, Tektronix P6016 or equivalent.

d. Assembly heat sink temperature established at 120°F ±5°F.

4.3.9 Output Voltages. With the following conditions established, the output voltages measured at the module mating connector with respect to instrument ground shall be as specified in Table II.

a. The assembly connected as shown in Figure 1.

b. Nominal dc supply voltages and signal input applied.

c. Inhibited output voltages measured with pin 11 (Loop Inhibit) connected to pins 3, 4, and 5 (Figure 1).

d. Normal output voltages measured with pin 11 disconnected from pins 3, 4, and 5.

e. The assembly heat sink temperature maintained at 100° ±5°F.

f. Measurements made at least 1 minute after application of the input in b.

4.3.10 Output Voltage Regulation, Condition A. With the following conditions established, output voltage changes resulting from input voltage changes of the dc supply voltages shall be as specified in Table III.

a. The assembly shall be connected as shown in Figure 1, Load A Condition.

b. Nominal Conditions. With nominal dc supply voltages and signal input applied, the +120, +20, -20, and +28 vdc outputs shall be measured at least 1 minute after application of the nominal inputs.

c. Enhanced Conditions. With Condition A enhanced dc supply voltages and input signal in accordance with Tables V and VI applied, the +120, +20, -20, and +28 vdc outputs shall be measured at least 1 minute after application of the enhanced inputs.

d. Degraded Conditions. With Condition A degraded dc supply voltages and input signal in accordance with Tables V and VI applied, the +120, +20, -20, and +28 vdc outputs shall be measured at least 1 minute after application of the degraded inputs.

e. The nominal condition measurements obtained in b shall be subtracted from the enhanced condition measurements obtained in c and the differences compared to the requirements in Table III.

f. The degraded condition measurements obtained in d shall be subtracted from the nominal condition measurements obtained in b and the differences compared to the requirements in Table III.

g. For +120 vdc only, the degraded condition measurement obtained in "d" shall be subtracted from the enhanced condition measurement obtained in "c" and the difference compared to the requirement in Table III.

h. The assembly heat sink temperature maintained at 100° ±5°F.

4.3.11 Output Voltage Regulation (Condition B). With the following conditions established, output voltage changes resulting from input voltage changes of the dc supply voltages shall be as specified in Table III.

a. The assembly shall be connected as shown in Figure 1, Load B Condition.

b. Nominal Conditions. With nominal dc supply voltages and signal input applied, the +120, +20, -20, and +28 vdc outputs shall be measured at least 1 minute after application of the nominal inputs.

c. Enhanced Conditions. With Condition B enhanced dc supply voltages and input signal in accordance with Tables V and VI applied, the +120, +20, -20, and +28 vdc outputs shall be measured at least 1 minute after application of the enhanced inputs.

d. Degraded Conditions. With Condition B degraded dc supply voltages and input signal in accordance with Tables V and VI applied, the +120, +20, -20, and +28 vdc outputs shall be measured at least 1 minute after application of the degraded inputs.

e. The nominal condition measurements obtained in b shall be subtracted from the enhanced condition measurements obtained in c and the differences compared to the requirements in Table III.

f. The degraded condition measurements obtained in d shall be subtracted from the nominal condition measurements obtained in b and the difference compared to the requirements in Table III.

g. For +120 vdc only, the degraded condition measurement obtained in "d" shall be subtracted from the enhanced condition measurement obtained in "c" and the difference compared to the requirement in Table III.

h. The assembly heat sink temperature maintained at 100° ±5°F.

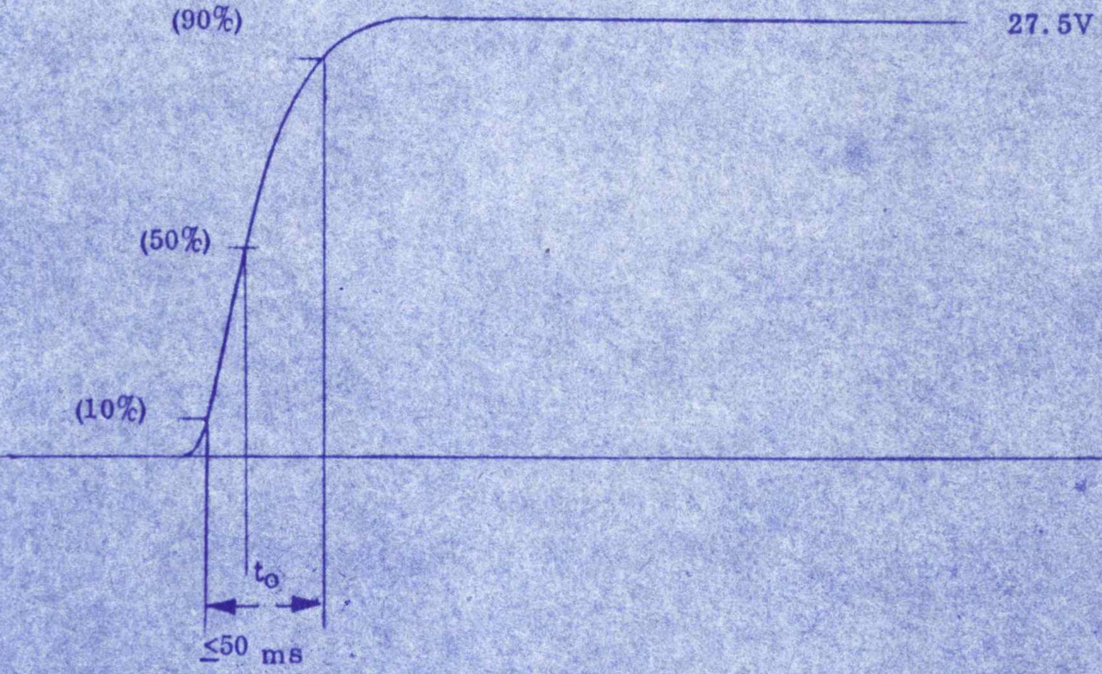
4.3.12 Turn on Delay. The +120 vdc output shall be measured at 200 ± 10 and 400 ± 50 milliseconds and the 28 vdc outputs shall be measured at 5.0 ± 0.5 and 10.0 ± 0.5 seconds after application of the nominal supply voltage. The voltages measured shall be in accordance with Table IV. Input voltage application shall be such that the risetime shall be <50 milliseconds (Figure 8) from 10 to 90 percent of input voltage magnitude.

4.3.13 Weight. Not applicable.

5. PREPARATION FOR DELIVERY.

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.



TURN ON DELAY

FIGURE 8

J

Apollo G&N Specification
PS 2007107 Rev - C
Original Issue Date: 10 Aug 65
Release Authority: TDRR 21429
Class Release: A

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

POWER SUPPLY -28 VOLT DC ASSEMBLY

DRAWING NO. 2007107

NO ECO

Date	TDRR No.	Rev. Let.	Pages Revised	Approvals AC	Approvals NASA
1/12/67	32626	A	5	MGM EA	--
2/8/68	35574	B	4	MGM EA	--
12/19/68	37131	C	2, 10	MGM EA	--

This specification consists of Pages 1 to 11 inclusive.

APPROVALS	NASA/MSC	Manuel Kramer 26 July 65 MIT/IL	AC

1. SCOPE

1.1 This specification establishes the detail requirements for complete identification and acceptance of the Power Supply -28 Volt DC Assembly.

1.2 CLASSIFICATION. The requirements for the equipment covered by this specification shall be classified as follows. Unless identified by the respective type, all requirements of this specification are applicable for all types.

a. Type I. The requirements for part number 2007107-011 shall be designated as Type I in this specification.

b. Type II. The requirements for part number 2007107-021 shall be designated as Type II in this specification.

1.3 PRODUCT CONFIGURATION BASELINE ACCEPTANCE

1.3.1 The product configuration baseline shall be established by F.A.C.I. of the end item Serial No. . This unit and all subsequent units regardless of intended use shall be accepted to the configuration defined by Serial No. unless formally approved otherwise as required by ANA Bulletin No. 445.

2. APPLICABLE DOCUMENTS

2.1 The following documents form a part of this specification to the extent specified herein.

2.1.2 Effective Issues. Unless otherwise specified herein, Military and Government Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATION

APOLLO G&N

ND1002214

STANDARDS

MIL-STD-202

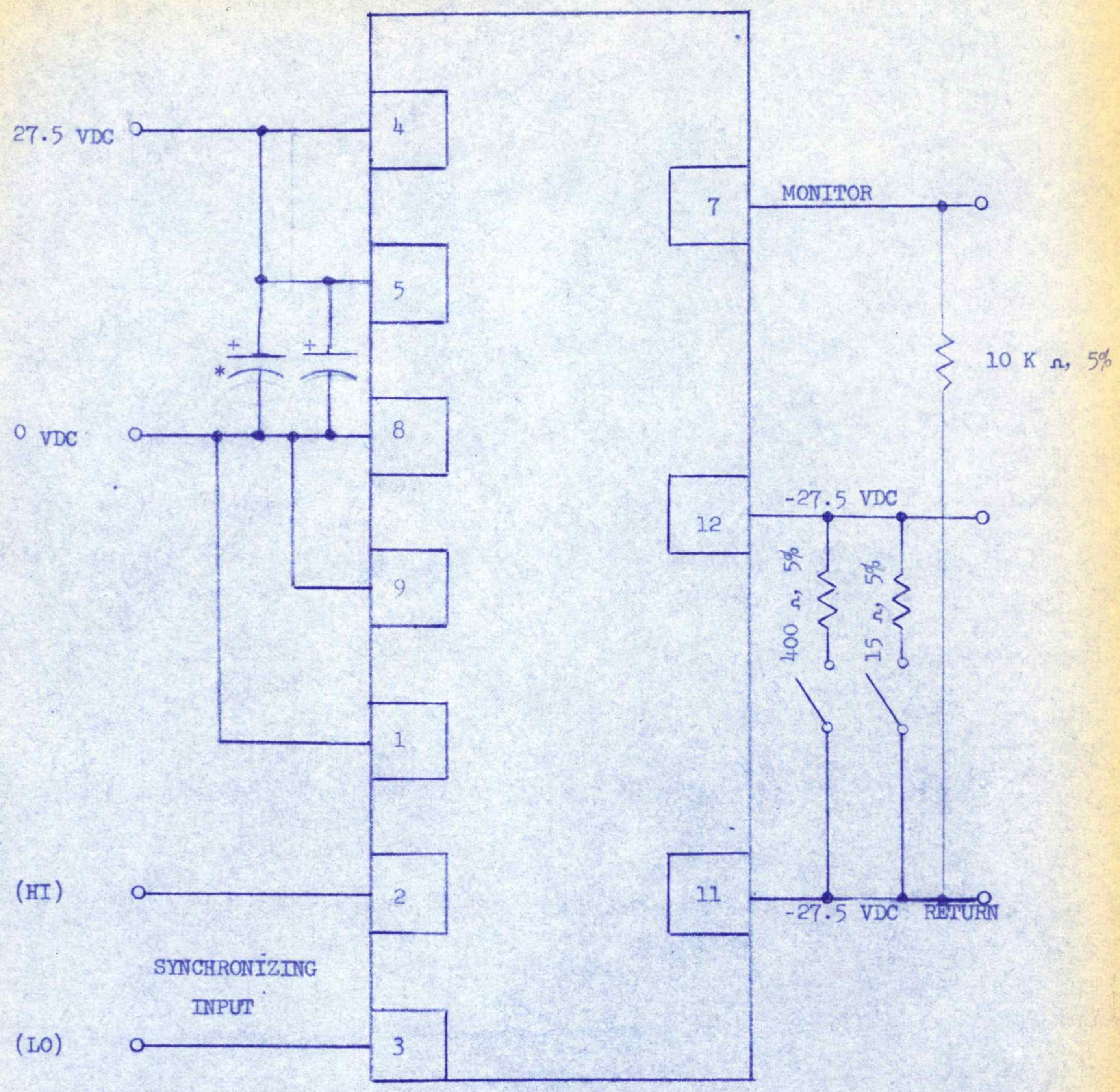
DRAWINGS

APOLLO G&N 2007107

Copies of Specifications, Standards, Drawings, Bulletins and Publications required by suppliers in connection with specific procurement functions should be obtained from the Procuring Activity or as directed by the contracting office.

2.2 CONFLICTING REQUIREMENTS. In the event of conflict between the requirements of the contract, this document and the documents listed in the section, the following order of precedence shall apply and the contractor shall notify MIT Apollo Management of the conflict as soon as it is determined.

a. The contract.
b. This specification
c. Documents listed in this section



*Type II Only 22 MFD P/N 1006755-182 (two req'd.) or equivalent.

FIGURE 1

Apollo G&N Specification
PS 2007107 Rev - B
Original Issue Date: 10 Aug 65
Release Authority: TDRR 21429
Class Release: A

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

POWER SUPPLY -28 VOLT DC ASSEMBLY

DRAWING NO. 2007107

Date	TDRR No.	Rev. Let.	Pages Revised	Approvals AC	Approvals NASA
1/12/67	32626	A	5	MGM EA	--
2/8/68	35574	B	4	MGM EA	--

This specification consists of Pages 1 to 11 inclusive.

APPROVALS	NASA/MSC	Manuel Kramer 26 July 65 MIT/IL	AC

4. Synchronizing input: 25.6 ± 0.3 kc, 7 ± 3 V peak, 3.0 ± 0.5 μ sec pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec max.

3.1.2.1 Output Voltage. The output voltage shall be between the limits specified in Table 1.

TABLE I

Supply Voltage	Load	Output Voltage V dc	
		Limit 1	Limit 2
25 V	1 15Ω	-23.0	-25.0
25 V	2 400Ω	-24.2	-26.2
30 V	1 15Ω	-28.0	-30.0
30 V	2 400Ω	-29.3	-31.3

With synchronizing input removed the output voltage shall be per Table II.

TABLE II

Supply Voltage	Load	Output Voltage V dc	
		Limit 1	Limit 2
30	1	-28.0	-30.8

3.1.2.2 Output Ripple Voltage. Using load 1, the output ripple voltage shall be less than 1.5 volts peak to peak.

3.1.2.3 Monitor Voltage. With a supply voltage of 30 V dc, using load 1, and with a 10 k Ω, 5% resistor between the monitor output and the +27.5 V dc return the voltage at the output monitor shall be -14.5 ± 1.0 V dc.

3.1.2.4 Continuity. With all inputs and load removed, the resistance between pins 4 and 5 and between pins 8 and 9 shall be less than 0.5 Ω.

3.2 PRODUCT CONFIGURATION.

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007107 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms. The resistance between pin 1 and the heat sink shall be less than or equal to 0.5 ohms.

Return to
T. Wolff
32-31

Apollo G&N Specification
PS 2007107 Rev -
Original Issue Date: 10 Aug 65
Release Authority: TDRR 21429
Class Release: A

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

POWER SUPPLY -28 VOLT DC ASSEMBLY

DRAWING NO. 2007107

REFERENCE COPY ONLY
Subject to Change without Notice
No Parts to be Fabricated to this Print

Date	Revision Letter	TDRR No.	Pages Revised	Approvals MIT	Approvals NASA

This specification consists of Pages 1 to 11 inclusive.

APPROVALS	NASA/MSC	Manuel Bramco 26 Jul 65 MIT/IL	ACED

1. SCOPE.

1.1 This specification establishes the detail requirements for complete identification and acceptance of the Power Supply -28 Volt DC Assembly PART NO. 2007107-011.

1.2 PRODUCT CONFIGURATION BASELINE ACCEPTANCE

1.2.1 The product configuration baseline shall be established by F.A.C.I. of the end item Serial No. . This unit and all subsequent units regardless of intended use shall be accepted to the configuration defined by Serial No. unless formally approved otherwise as required by ANA Bulletin No. 445.

2. APPLICABLE DOCUMENTS

2.1 The following documents fom a part of this specification to the extent specified herein.

2.1.2 Effective Issues. Unless otherwise specified herein, Military and Government Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATION

APOLLO G&N ND 1002214

STANDARDS

MIL-STD 202

DRAWINGS

APOLLO G&N 2007107

Copies of Specifications, Standards, Drawings, Bulletins and Publications required by suppliers in connection with specific procurement functions should be obtained from the Procuring Activity or as directed by the contracting office.

2.2 CONFLICTING REQUIREMENTS. In the event of conflict between the requirements of the contract, this document, and the documents listed in the section, the following order of precedence shall apply and the contractor shall notify MIT Apollo Management of the conflict as soon as it is determined.

a. The contract.
b. This specification.
c. Documents listed in this section.

3. REQUIREMENTS

3.1 PERFORMANCE.

3.1.1 Pre-Encapsulation Requirements. The assembly is required to conform to the following design margin specification before encapsulation only. The assembly shall perform as specified in this section (3.1.1) within the limits of the following constraints unless otherwise noted:

a. Supply voltage:	27.5 ± 0.1 V dc
b. Assembly temperature:	15° to 65°C
c. Load:	15Ω, 5%
d. Synchronizing input:	25.6 ± 0.3 kc, 7 ± 3 V peak, 3.0 ± 0.5 μ sec pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec max.

3.1.1.1 Synchronization Level. The assembly shall not be synchronized when the peak amplitude of the synchronizing input is less than 1.0 V. The assembly shall be synchronized when the peak amplitude of the synchronizing input is greater than 3.0 V.

3.1.1.2 Unsynchronized Frequency. With the synchronizing input removed the frequency of the oscillator shall be 11.8 ± 0.5 kc.

3.1.1.3 Synchronizing Input Impedance. With the supply voltage removed, at a frequency of 100 ± 1 kc the magnitude of the input impedance at the synchronizing input terminals shall be 350 ± 50Ω.

3.1.1.4 DC Supply Current. With the load removed the average DC supply current shall be 17 ± 4 ma. With a 30 V dc supply voltage and with the load connected the maximum instantaneous current shall be less than or equal to 3 A.

3.1.1.5 Input Capacitor Test. With 30 V dc applied between terminals 4 and 5 and 0 V dc through a 1Ω resistor, the ripple on the DC supply current shall be less than 0.75 A peak to peak.

3.1.2 Functional Requirements. The assembly shall perform as specified in this section (3.1.2) within the limits of the following constraints unless otherwise noted, after encapsulation:

a. Supply voltage:	25 to 30 V dc
b. Assembly temperature	15° to 65°C
c. Loads:	
1	15 Ω, 5%
2	400 Ω, 5%

d. Synchronizing input: 25.6 ± 0.3 kc, 7 ± 3 V peak, 3.0 ± 0.5 μ sec pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec max.

3.1.2.1 Output Voltage. The output voltage shall be between the limits specified in Table 1.

TABLE I

Supply Voltage	Load	Output Voltage V dc	
		Limit 1	Limit 2
25 V	1	-23.0	-25.0
25 V	2	-24.2	-26.2
30 V	1	-28.0	-30.0
30 V	2	-29.3	-31.3

With synchronizing input removed the output voltage shall be per Table II.

TABLE II

Supply Voltage	Load	Output Voltage V dc	
		Limit 1	Limit 2
30	1	-28.0	-30.0

3.1.2.2 Output Ripple Voltage. Using load 1, the output ripple voltage shall be less than 1.5 volts peak to peak.

3.1.2.3 Monitor Voltage. With a supply voltage of 30 V dc, using load 1, and with a 10 k Ω, 5% resistor between the monitor output and the -27.5 V dc return the voltage at the output monitor shall be -14.5 ± 1.0 V dc.

3.1.2.4 Continuity. With all inputs and load removed, the resistance between pins 4 and 5 and between pins 8 and 9 shall be less than 0.5 Ω.

3.2 PRODUCT CONFIGURATION.

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007107 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. 1.25 lbs.

3.2.3 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms. The resistance between pin 1 and the heat sink shall be less than or equal to 0.5 ohms.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 The failure of the end product to pass any examination or test of this section will automatically classify the unit as nonconforming. When nonconforming units are corrected by the contractor, the unit shall be reinspected. When corrective action has been taken, the reinspection of the nonconforming unit may be limited to the test or examination which defined the nonconformance, or when so directed by the cognizant inspector, a complete re-examination and retest of the unit may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.1.2 Environmental. Unless otherwise specified the assemblies shall be tested under the following ambient conditions:

a. Temperature:	25 ± 10°C
b. Relative Humidity:	90% max
c. Barometric Pressure:	23 to 32 inches of Hg

4.2 PROCEDURE FOR SELECTION OF COMPONENTS

4.2.1 Symmetry Capacitor Selection. The selection of the symmetry capacitors, C5 and C6, shall be performed within the limits of the following constraints:

a. Supply voltage:	27.5 ± 0.1 V dc
b. Assembly temperature:	15° to 65°C
c. Load:	15 Ω, 5%
d. C5 and C6 initially equal to 24 pf.	

4.2.1.1 Selection Procedure. Lower one capacitor such that the difference between the conducting periods of the two collectors shall be less than 1 μ sec. If necessary raise the opposite capacitor and readjust the one initially lowered.

4.3 TEST PROCEDURES.

4.3.1 Pre-Encapsulation Tests. The tests required by this section (4.3.1) shall be performed before encapsulation only and shall be performed within the limits of the following constraints unless otherwise noted:

a. Supply voltage:	27.5 ± 0.1 V dc
b. Assembly temperature:	15° to 65°C
c. Load:	15 Ω, 5%

d. Synchronizing input: 25.6 ± 0.3 kc, 7 ± 3 V peak, 3.0 ± 0.5 μ sec pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec max.

4.3.1.1 Synchronization Level. Measure the maximum synchronizing input amplitude at which assembly is not synchronized and the minimum synchronizing input amplitude at which the assembly is synchronized (Ref. Para. 3.1.1.1).

4.3.1.2 Unsynchronized Frequency. Measure the unsynchronized frequency (Ref. Para. 3.1.1.2).

4.3.1.3 Synchronizing Input Impedance. Measure the synchronizing input impedance (Ref. Para. 3.1.1.3).

4.3.1.4 DC Supply Current. Measure the DC supply currents (Ref. Para. 3.1.1.4).

4.3.1.5 Input Capacitor Test. Measure the ripple on the DC supply current (Ref. Para. 3.1.1.5).

4.3.2 Functional Tests. The tests required by this section (4.3.2) shall be performed within the limits of the following constraints unless otherwise noted after encapsulation:

a. Supply voltage - tests shall be conducted twice, at 25.1 ± 0.1 V dc and at 29.9 ± 0.1 V dc.

b. Assembly temperature 15° to 65°C

c. Loads:

1 15 Ω, 5%
2 400 Ω, 5%

d. Synchronizing input: 25.6 ± 0.3 kc, 7 ± 3 V peak, 3.0 ± 0.5 μ sec pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec max.

e. Test setup as indicated in Figure 1

4.3.2.1 Electrical Performance Tests. Measure the following:

a. Output voltage (Ref. Para. 3.1.2.1)
b. Output ripple voltage (Ref. Para. 3.1.2.2)
c. Monitor oltage (Ref. Para. 3.1.2.3)
d. Continuity (with inputs and load removed) (Ref. Para. 3.1.2.4)

4.4 DRAWING COMPLIANCE. The assembly shall be visually examined for compliance to the requirements of APOLLO G&N Drawing 2007107. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulation defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.5 WORKMANSHIP VIBRATION TEST. The workmanship vibration test shall be performed within the limits of the following constraints:

a. Supply voltage: 27.5 ± 0.1 V dc

b. Assembly temperature: 15° to 65°C

c. Load: 15 Ω, 5%

d. Synchronizing input: 25.6 ± 0.3 kc, 7 ± 3 V peak, 3.0 ± 0.5 μ sec pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec max.

4.5.1 Subject the module to vibration along the axis shown in Figure 2. The vibration shall be simple harmonic motion swept from 10 to 2000 cps at a rate of one (1) octave per 15 seconds. The magnitude of the vibration shall be 6.0 grms limited to 0.4 inch PP constant displacement from 10 cps to the crossover frequency.

4.5.2 During vibration the output voltage shall not lie outside the range -25.5 ± 2.5 for a period greater than 1 msec.

4.6 INSULATION RESISTANCE. The insulation resistance between pin 1 and the remaining assembly pins shall be as specified in Para. 3.2.3 when measured in accordance with method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output voltage of 225 ± 75 V dc limited to a short circuit current of 6.0 ua. The resistance between pin 1 and the heat sink shall be as specified in Para. 3.2.3 when measured in accordance with method 303 of Standard MIL-STD-202. To assure a good electrical connection the anodizing may be penetrated.

5. PREPARATION FOR DELIVERY.

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND 1002214.

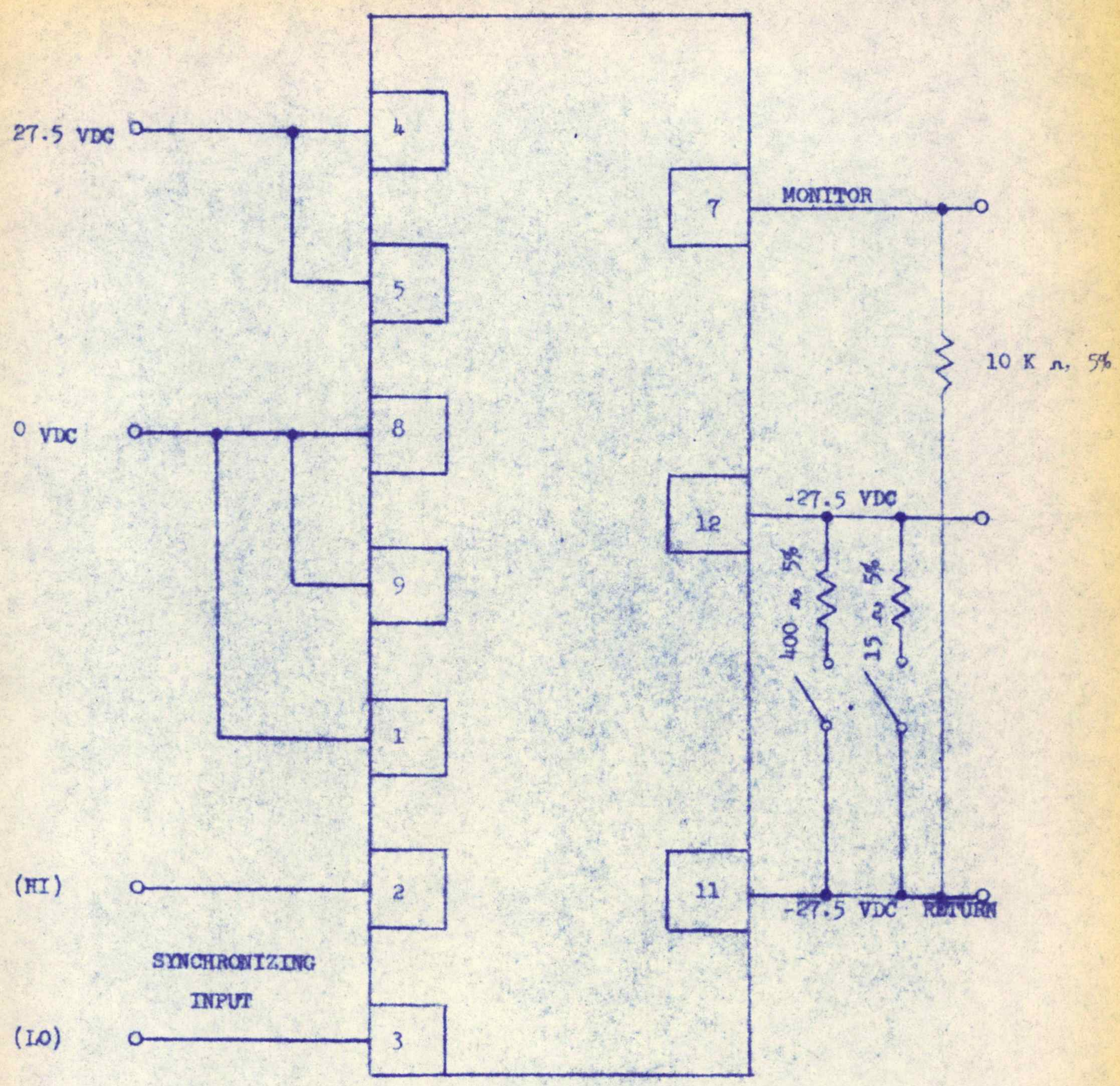
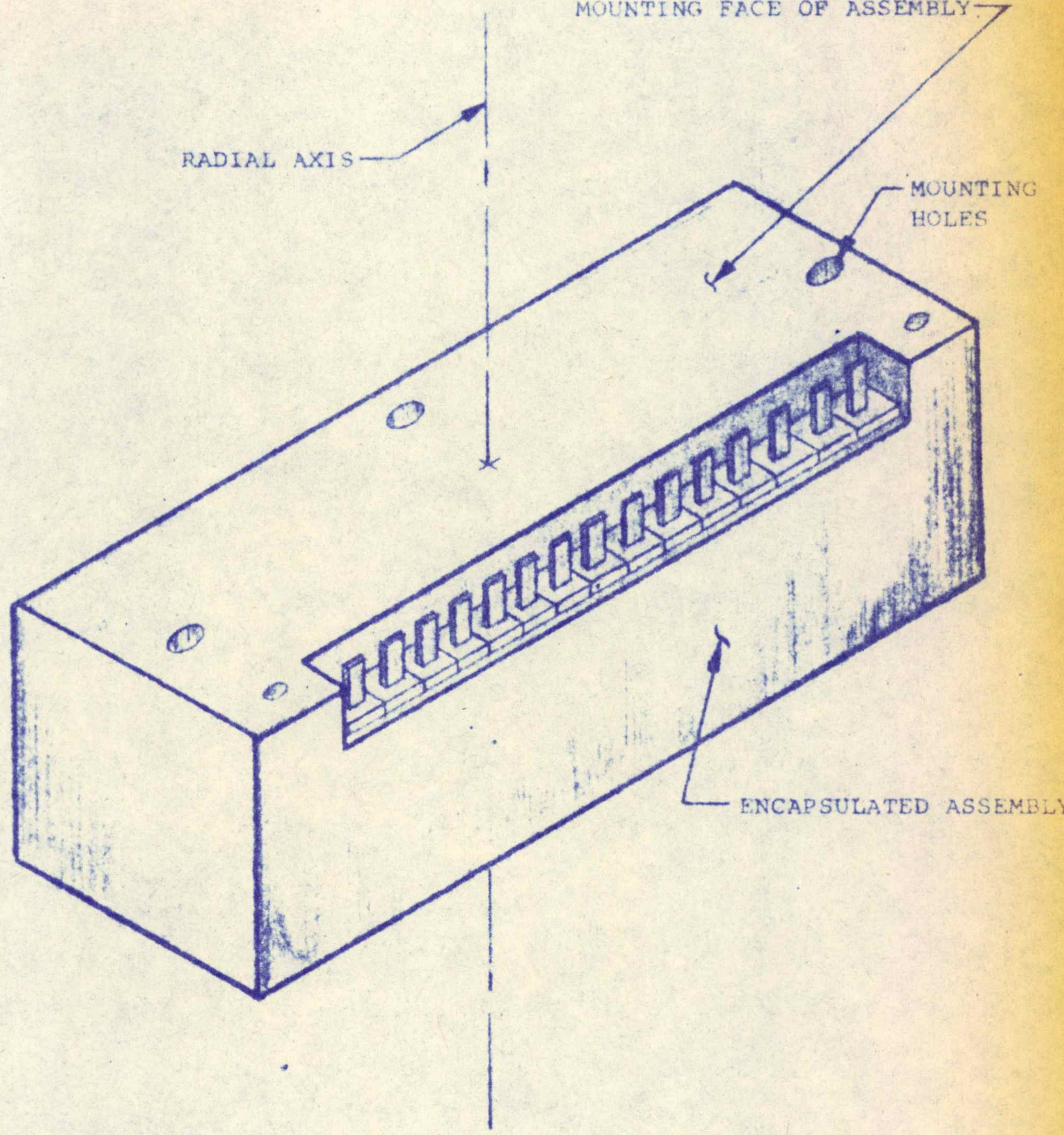

27.5 VDC
4
5
0 VDC
8
9
1
(HI)
2
SYNCHRONIZING
INPUT
(LO)
3
7
MONITOR
10 K Ω, 5%
12
-27.5 VDC
400 Ω 5%
15 Ω 5%
11
-27.5 VDC RETURN

FIGURE 1



RADIAL AXIS OF COMPONENTS

FIGURE 2

73

3000 CPS Spec

Apollo G&N Specification
PS 2007108 Rev C
Original Issue Date: 8/3/65
Release Authority: TDRR 21353
Class Release: A

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

AMPLIFIER 3200 CPS 1% ASSEMBLY

DRAWING NO. 2007108

Date	Revision Letter	TDRR No.	Pages Revised	Approvals AC	Approvals NASA
9/28/65	A	22847	3	WK	------
8/11/66	B	30633	6	EA	------
1/12/67	C	32626	4	MGM EA	--------

This Specification consists of Pages 1 to 10 inclusive

APPROVALS	NASA/MSC	MIT	AC
	8/4/65	Manuel Kramer 20 July 65	

3.1.2.1 Gain. The voltage gain of the assembly shall be 30.2 ± 3.2 V/V.

3.1.2.2 Monitor. With a 10 kΩ, 5% resistor connected berween the monitor and 0 V dc, the voltage at the monitor shall be 14.0 ± 1.0 V rms.

3.1.2.3 Phase. The phase of the output voltage with respect to the input voltage shall be 180° ± 3°.

3.1.2.4 Harmonic Distortion. The harmonic distortion of the output voltage shall be less than 1%.

3.1.2.5 Continuity. The resistance between pins 5 and 6 and between pins 7 and 8 shall be less than 0.5 Ω with inputs and load removed.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with Apollo G&N Drawing 2007108 and all drawings and engineering data reference thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms. The resistance between pin 1 and the heat sink shall be less than or equal to 0.5 ohms.

Apollo G&N Specification
PS 2007108 Rev B
Original Issue Date: 8/3/65
Release Authority: TDRR 21353
Class Release: A

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

AMPLIFIER 3200 CPS 1% ASSEMBLY

DRAWING NO. 2007108

Date	Revision Letter	TDRR No.	Pages Revised	Approvals MIT	Approvals NASA
9/28/65	A	22847	3	WR	------
8/11/66	B	30633	6	EA	------

This Specification consists of Pages 1 to 10 inclusive

APPROVALS	NASA/MSC	Manuel Kramer 20 July 65 MIT	ACED

1. SCOPE

1.1 This specification establishes the detail requirements for complete identification and acceptance of the 3200 cps 1% Amplifier Assembly Part No. 2007108-011.

1.2 PRODUCT CONFIGURATION BASELINE ACCEPTANCE

1.2.1 The product configuration baseline shall be established by F.A.C.I. of the end item Serial No. . This unit and all subsequent units regardless of intended use shall be accepted to the configuration defined by Serial No. unless formally approved otherwise as required by ANA Bulletin No. 445.

2. APPLICABLE DOCUMENTS

2.1 The following documents form a part of this specification to the extent specified herein.

2.1.2 Effective Issues. Unless otherwise specified herein, Military and Government Standards and specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

Apollo G&N ND 1002214

STANDARDS

MIL STD 202

DRAWINGS

APOLLO G&N 2007108

Copies of Specification, Standards, Drawings, Bulletins and Publications required by suppliers in connection with specific procurement functions should be obtained from the Procuring Activity or as directed by the contracting office.

2.2 CONFLICTING REQUIREMENTS In the event of conflict between the requirements of the contract, this document and the documents listed in this section, the following order of precedence shall apply and the contractor shall notify MIT Apollo Management of the conflict as soon as it is determined.

a. The contract.
b. This specification.
c. Documents listed in this section.

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Pre-Encapsulation Requirements. The assembly is required to conform to the following design margin specification before encapsulation only. The assembly shall perform as specified in this section (3.1.1) within the limits of the following constraints unless otherwise noted.

a. Supply voltage:	27.5 ± 0.1 V dc
b. Assembly temperature:	40° ∓ 15°C
c. Load:	150Ω ± 5%
d. Signal ground connected to 0 Vdc	
e. Open loop.	

3.1.1.1 Bias Current. With the input shorted to 0 Vdc, the bias current shall be greater than 10 ma and less than 60 ma, at 40°C±5°C.

3.1.1.2 DC Supply Current. With an output of 28.0 ± 0.2 V rms at 3200 ± 32 cps, the DC supply current shall be 375 ± 75 mA.

3.1.1.3 Phase Margin and Crossover Frequency. With the input voltage such that the output is 14.0 ± 0.1 V rms at 3200 ± 32 cps, the phase margin shall be greater than 45° at a crossover frequency between 12 kc and 30 kc.

3.1.1.4 Gain Margin. With the input voltage such that the output is 14.0 ± 0.1 V rms, at 3200 ± 32 cps, the gain margin shall be greater than 10 dB.

3.1.1.5 Loop Gain. With an output of 28.0 ± 0.2 V rms at 3200 ± 32 cps, the loop gain shall be 20 ± 3 dB.

3.1.1.6 Phase Shift. With an output of 28.0 ± 0.2 V rms at 3200 ± 32 cps, the phase of the output voltage with respect to the input voltage shall be 180° ± 30°.

3.1.1.7 Asymmetry. With an output of 28.0 ± 0.2 V rms at 3200 ± 32 cps, the asymmetry between channels shall be less than 25%.

3.1.1.8 Maximum Undistorted Output. An output of 34 V rms at 3200 ± 32 cps, shall have less than 10% distortion.

3.1.2 Functional Requirements. The assembly shall perform as specified in this section (3.1.2) within the limits of the following constraints unless otherwise noted, after encapsulation:

a. Supply voltage:	25 to 30 V dc
b. Assembly temperature:	15° to 65°C
c. Frequency:	3200 ± 32 cps
d. Output voltage:	28.0 ∓ 0.2 V rms
e. Load:	150Ω ± 5%
f. Signal ground connected to 0 Vdc:	

3.1.2.1 Gain. The voltage gain of the assembly shall be 30.2 ± 3.2 V/V.

3.1.2.2 Monitor. With a 10 kΩ, 5% resistor connected berween the monitor and 0 V dc, the voltage at the monitor shall be 14.0 ± 1.0 V rms.

3.1.2.3 Phase. The phase of the output voltage with respect to the input voltage shall be 180° ± 3°.

3.1.2.4 Harmonic Distortion. The harmonic distortion of the output voltage shall be less than 1%.

3.1.2.5 Continuity. The resistance between pins 5 and 6 and between pins 7 and 8 shall be less than 0.5 Ω with inputs and load removed.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with Apollo G&N Drawing 2007108 and all drawings and engineering data reference thereon.

3.2.2 . Maximum Weight. 0.70 lbs.

3.2.3 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms. The resistance between pin 1 and the heat sink shall be less than or equal to 0.5 ohms.

4. QUALITY ASSURANCE PROVISION

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 The failure of an end product to pass any examination or test of this section will automatically classify the unit as nonconforming. When nonconforming units are corrected by the Contractor, the unit shall be reinspected. When corrective action has been taken, the reinspection of a nonconforming unit may be limited to the test or examination which defined the nonconformance, or when so directed by the cognizant inspector, a complete re-examination and retest of the unit may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the Contractor to the cognizant NASA representative.

4.1.2 Environmental. Unless otherwise specified, the assemblies shall be tested under the following constraints:

a. Temperature:	$25 \pm 10^\circ C$
b. Relative Humidity:	90% Max.
c. Barometric Pressure:	23 to 32 inches of Hg

4.2 PROCEDURE FOR SELECTION OF COMPONENTS

4.2.1 Bias Resistor Selection. The selection of the bias resistor shall be performed within the limits of the following constraints:

a. Supply voltage:	27.5 ± 0.1 Vdc
b. Assembly temperature:	$40^\circ \pm 5^\circ C$
c. Input shorted to 0 Vdc	

4.2.1.1 Selection Procedure. Select the lowest value for R8 such that the bias current is less than 15 mA. Then select the highest value for R9 such that the bias current is greater than 15 mA.

4.2.2 Loop Gain Resistor Selection. The selection of the loop gain resistor shall be performed within the limits of the following constraints:

a. Supply voltage:	27.5 ± 0.1 V dc
b. Assembly temperature:	$40^\circ \pm 5^\circ C$
c. Frequency:	3200 ± 32 cps
d. Output voltage:	28.0 ± 0.2 V rms
e. Load:	$150\ \Omega \pm 5\%$
f. Signal ground connected to 0 Vdc	
g. Open Loop	

4.2.2.1 Selection Procedure. Select R2 such that the loop gain is 20 ± 1 dB.

4.3 TEST PROCEDURES

4.3.1 Pre-Encapsulation Tests. The tests required by this section (4.3.1) shall be performed before encapsulation only and shall be performed within the limits of the following constraints:

a. Supply voltage:	27.5 ± 0.1 Vdc
b. Assembly temperature:	40° ∓ 15°C
c. Load:	150Ω, ± 5%
d. Signal ground connected to 0 Vdc	
e. Open loop	

4.3.1.1 Bias Current. With the input shorted to 0 Vdc, measure the bias current. (Ref. Para. 3.1.1.1).

4.3.1.2 DC Supply Current. With an output of 28.0 ± 0.2 V rms at 3200 ± 32 cps, measure the DC supply current. (Ref. Para. 3.1.1.2).

4.3.1.3 Phase Margin and Crossover Frequency. With the input voltage such that the output is 14.0 ± 0.1 V rms at 3200 ± 32 cps, measure the phase margin and the crossover frequency. (Ref. Para. 3.1.1.3).

4.3.1.4 Gain Margin. With the input voltage such that the output is 14.0 ± 0.1 Vrms at 3200 ± 32 cps, measure the gain margin (Ref. Para. 3.1.1.4).

4.3.1.5 Loop Gain. With an output of 28.0 ± 0.2 V rms at 3200 ± 32 cps, measure the loop gain. (Ref. Para. 3.1.1.5)

4.3.1.6 Phase Shift. With an output of 28.0 ± 0.2 V rms at 3200 ± 32 cps, measure the phase shift. (Ref. Para. 3.1.1.6).

4.3.1.7 Asymmetry. With an output of 28.0 ± 0.2 V rms at 3200 ± 32 cps, measure the asymmetry. (Ref. Para. 3.1.1.7).

4.3.1.8 Maximum Undistorted Output. With an output of 34.1 ± 0.1 V rms at 3200 ± 32 cps, measure the distortion. (Ref. Para. 3.1.1.8).

4.3.2 Functional Tests. The tests required by this section (4.3.2) shall be performed within the limits of the following constraints unless otherwise noted, after encapsulation:

a. Supply voltage - tests shall be conducted twice, at 25.1 ± 0.1 Vdc and at 29.0 ± 0.1 Vdc.

b. Assembly temperature:	40° ± 25°C
c. Frequency:	3200 ± 32 cps
d. Output voltage:	28.0 ∓ 0.2 V rms
e. Test setup as indicated in Fig. 1	

4.3.2.1 Electrical Performance Tests. Measure the following:

a. Gain (Ref. Para. 3.1.2.1)
b. Monitor (Ref. Para 3.1.2.2)
c. Phase (Ref. Para. 3.1.2.3)
d. Harmonic distortion (Ref. Para. 3.1.2.4)
e. Continuity(with inputs and load removed) (Ref. Para. 3.1.2.5)

4.4 DRAWING COMPLIANCE. The assembly shall be visually examined for compliance to the requirements of APOLLO G&N Drawing 2007108. Particular attentional shall be given to inspection for nicks, scratches, burrs, dents, encapsulation defects, contaminants, pin misalignment, and legibility and appearance of marking.

4.5 WORKMANSHIP VIBRATION TESTS. The workmanship vibration test shall be performed within the limits of the following constraints:

a. Supply voltage	27.5 ± 0.1 Vdc
b. Assembly temperature	15^{o} to 65^{o}C
c. Frequency	3200 ± 32 cps
d. Output voltage	28.0 ∓ 0.2 V rms
e. Load	$150\Omega, \mp 5\%$
f. Signal ground connected to 0 Vdc	

4.5.1 Subject the module to vibration along the axis shown in Figure 2. The vibration shall be simple harmonic motion swept from 10 to 2000 cps at a rate of one (1) octave per 15 seconds. The magnitude of the vibration shall be 6.0 grms limited to 0.4 inch PP constant displacement from 10 cps to the crossover frequency.

4.5.2 During vibration the output voltage shall not lie outside the range 28.0 ± 2.8 V rms for a period greater than 1 m sec.

4.6 INSULATION RESISTANCE. The insulation resistance between pin 1 and the remaining assembly pins shall be as specified in Para. 3.2.3 when measured in accordance with method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output voltage of 225 ± 75 VDC limited to a short circuit current of 6.0 μa. The resistance between pin 1 and the heat sink shall be as specified in Para. 3.2.3 when measured in accordance with method 303 of Standard MIL-STD-202. To assure a good electrical connection the anodizing may be penetrated.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND 1002214.

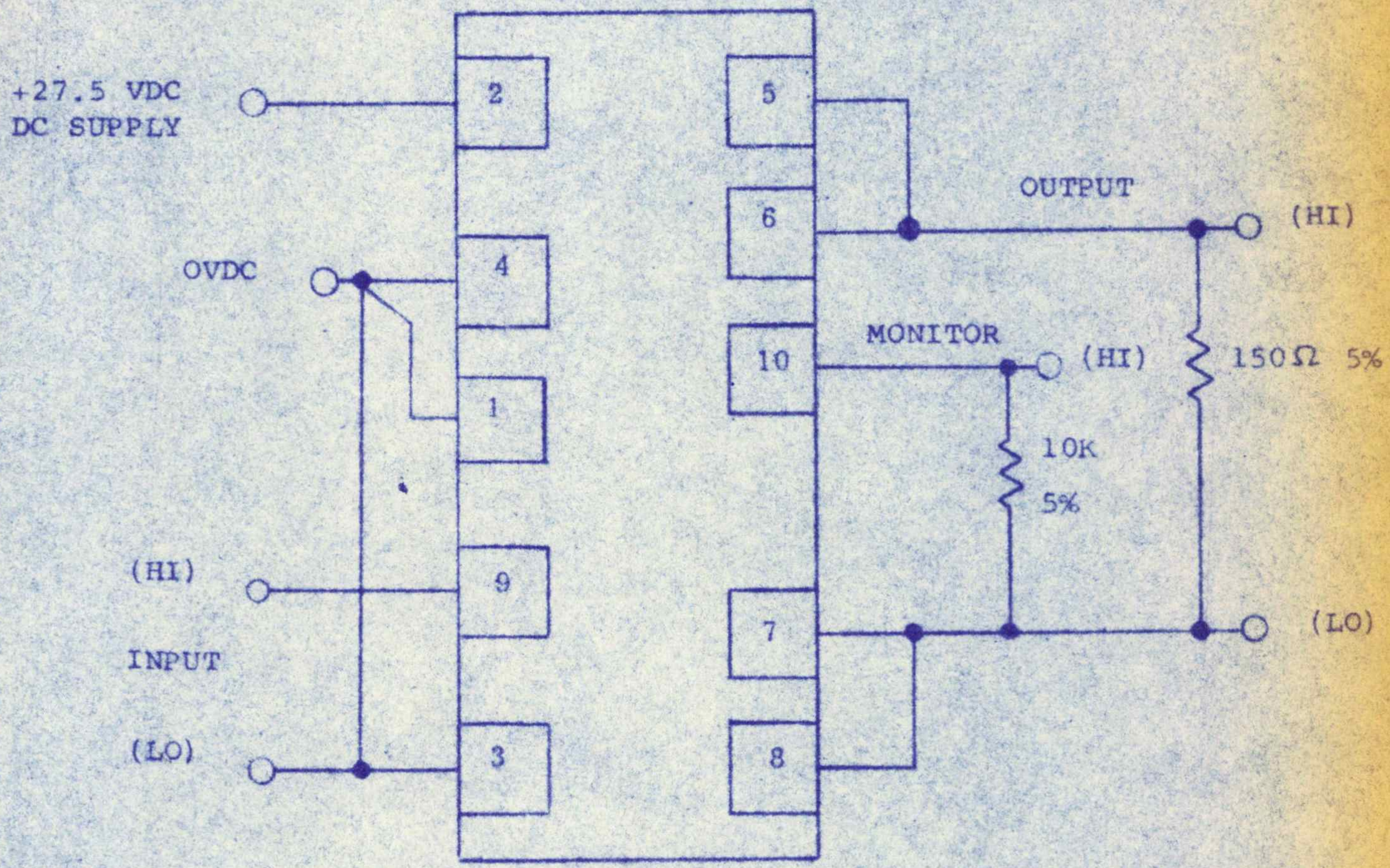
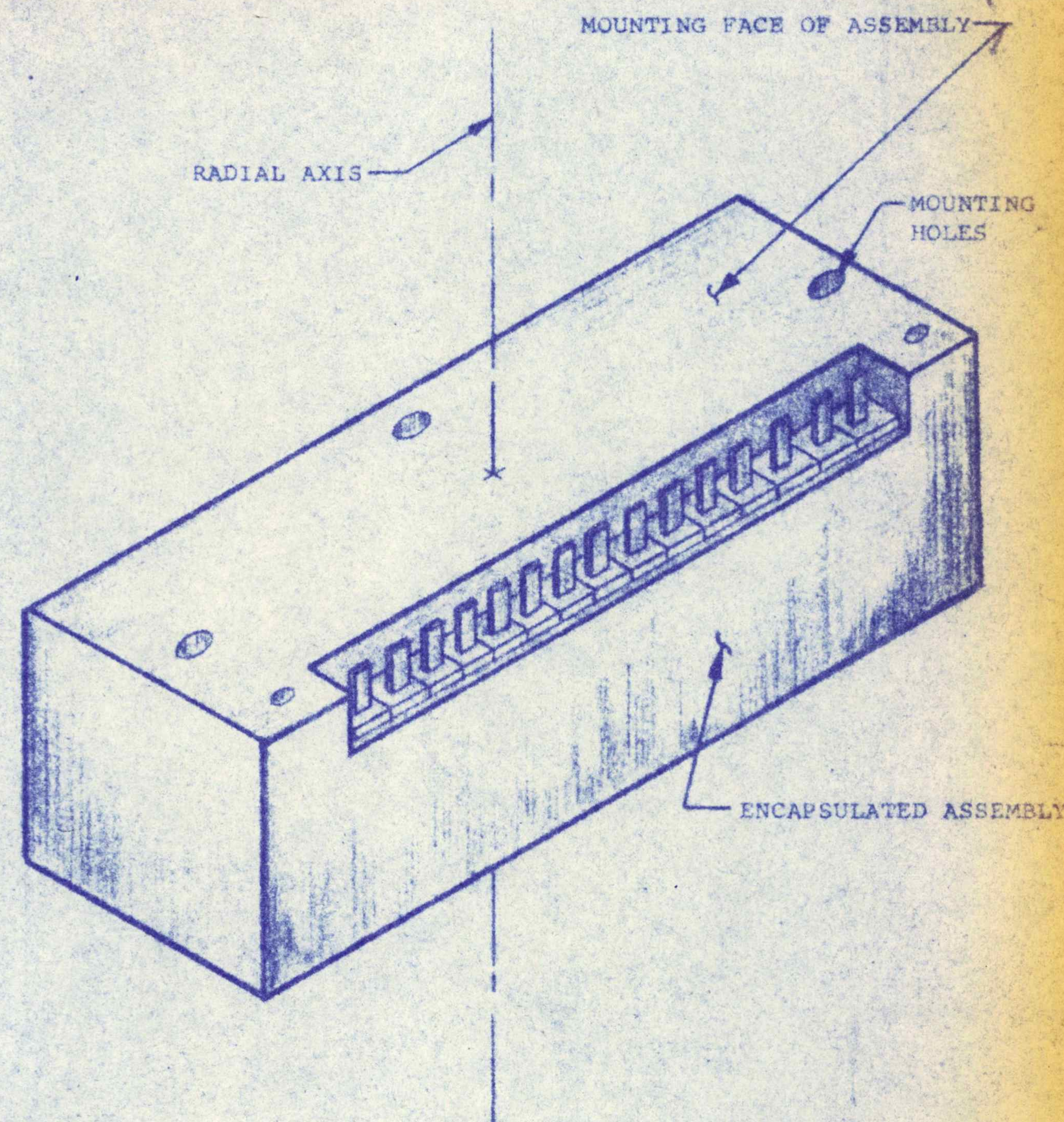

+27.5 VDC
DC SUPPLY
OVDC
(HI)
INPUT
(LO)
2
4
1
9
3
5
6
10
7
8
OUTPUT
(HI)
MONITOR
(HI)
150Ω 5%
10K
5%
(LO)

FIGURE 1



RADIAL AXIS OF COMPONENTS

FIGURE 2

Apollo G&N Specification
PS 2007109 Rev F
Original Issue Date: 8/3/65
Release Authority: TDRR 21353
Class Release: A

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

AAC FILTER AND MULTIVIBRATOR 3200 CPS ASSEMBLY

DRAWING NO. 2007109

Date	Revision Letter	TDRR No.	Pages Revised	Approvals AC	Approvals NASA
8/10/65	A	21428	4, 5, 8 and 10	WK	TM
9/8/65	B	22339	4, 7	MGM	TM
10/10/65	C	23289	6	WK	--
11/16/65	D	24038	10	WK	--
1/11/66	E	25124	10	WK	--
1/12/67	F	32626	4	MGM EA	--

This specification consists of Pages 1 to 11 inclusive.

APPROVALS	NASA/MSC	Manuel Kramer 8/2/65 MIT/IL	AC

c. Operation: The assembly shall perform as specified herein when the output of the assembly drives NASA Part No. 2007108 or equivalent, hereinafter called the amplifier, and the output of the amplifier drives the remote sensing input of the assembly.

d. Synchronizing Input: 0 and π phase 3200±4 pps, 7±3V peak, 3.0±0.5 μsec pulse width at half amplitude, risetime (10 to 90 percent) 0.5 μsec max.

3.1.2.1 Controlled Voltage Setting. The voltage at the remote sensing input of the assembly shall be 28.60±0.29V rms with a synchronizing input and 28.6±1.4V rms without a synchronizing input.

3.1.2.2 Non-synchronized Frequency. With synchronizing input removed the frequency of the output voltage shall be 3060±100 cps.

3.1.2.3 Harmonic Distortion. The harmonic distortion of the filter output voltage shall be less than 0.75 percent with a synchronizing input and less than 2 percent without a synchronizing input.

3.1.2.4 Phase Shift. The phase shift between the zero phase synchronizing input and the filter output voltage shall be 180° ±7°.

3.1.2.5 Monitor Voltage. With a 51K Ω ±5 percent resistance connected between the Test Point and 3200 cps Lo, the voltage between these points shall be 0.495±0.09V rms.

3.1.2.6 Continuity. The resistance between the two 3200 cps Lo pins shall be less than 0.5Ω with all inputs removed.

3.1.2.7 Turn-On Characteristic. During turn-on, the controlled voltage shall attain steady state without exceeding 31.5V rms.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007109 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms. The resistance between pin 1 and the heat sink shall be less than or equal to 0.5 ohms.

Apollo G&N Specification
PS 2007109 Rev E
Original Issue Date: 1/3/65
Release Authority: TDRR 21353
Class Release: A

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

AAC FILTER AND MULTIVIBRATOR 3200 CPS ASSEMBLY

DRAWING NO. 2007109

Date	Revision Letter	TDRR No.	Pages Revised	Approvals MIT	Approvals NASA
8/10/65	A	21428	4, 5, 8 and 10	WK	TM
9/8/65	B	22339	4, 7	MGM	TM
10/10/65	C	23289	6	WK	--
11/16/65	D	24038	10	WK	--
1/11/66	E	25124	10	WK	--

This specification consists of Pages 1 to 11 inclusive.

APPROVALS	NASA/MSC	MIT/IL	ACED
	[illegible]	Manuel Kramer 8/2/65	

1. SCOPE

1.1 This specification establishes the detail requirements for complete identification and acceptance of the AAC, Filter and Multivibrator 3200 cps Assembly PART NO. 2007109-011.

1.2 PRODUCT CONFIGURATION BASELINE ACCEPTANCE.

1.2.1 The product configuration baseline shall be established by F.A.C.I. of the end item Serial No. . This unit and all subsequent units regardless of intended use shall be accepted to the configuration defined by Serial No. unless formally approved otherwise as required by ANA Bulletin No. 445.

2. APPLICABLE DOCUMENTS

2.1 The following documents form a part of this specification to the extent specified herein.

2.1.2 Effective Issues. Unless otherwise specified herein, Military and Government Standards and specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&N ND 1002214

STANDARDS

MIL-STD 202

DRAWINGS

APOLLO G&N 2007109

Copies of Specifications, Standards, Drawings, Bulletins and Publications required by suppliers in connection with specific procurement functions should be obtained from the Procuring Activity or as directed by the contracting office.

2.2 CONFLICTING REQUIREMENTS. In the event of conflict between the requirements of the contract, this document and the documents listed in this section, the following order of precedence shall apply and the contractor shall notify MIT Apollo Management of the conflict as soon as it is determined.

a. The contract.
b. This specification.
c. Documents listed in this section.

3. REQUIREMENTS

3.1 PERFORMANCE.

3.1.1 Pre-Encapsulation Requirements. The assembly is required to conform to the following requirements before encapsulation only. The assembly shall perform as specified in this section (3.2.1) within the limits of the following constraints unless otherwise noted:

a. Supply voltage:	27.5 ± 0.1 V dc
b. Assembly temperature:	15° to 40°C
c. Operation:	The output of the assembly drives NASA Part No. 2007108 or equivalent, hereinafter called the amplifier, and the output of the amplifier drives the remote sensing input of the assembly.
d. Synchronizing input:	0 and π phase 3200 ± 4 pps, 7 ± 3 V peak, 3.0 ± 0.5 μ sec pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec max.

3.1.1.1 Linear Dynamic Range. The controlled voltage shall change less than 0.5% for a change in amplifier gain from 30.2 ± 3.2 V/V to 15.1 ± 1.6 V/V and from 30.2 ± 3.2 V/V to 60.4 ± 6.4 V/V.

3.1.1.2 Asymmetry. With the synchronizing input removed, the asymmetry at the multivibrator collector which drives the chopper shall be less than 10%. With the synchronizing input present asymmetry shall be less than 2%.

3.1.1.3 Synchronization Level. Synchronizing inputs having an amplitude greater than 2 V peak shall synchronize both sides of the multivibrator. Synchronizing inputs having an amplitude less than 0.5 V peak shall not synchronize either side of the multivibrator.

3.1.1.4 Nominal DC Supply Current. The DC supply current shall be 30 ± 10 ma.

3.1.2 Functional Requirements. The assembly shall perform as specified in this section (3.1.2) within the limits of the following constraints unless otherwise noted, after encapsulation:

a. Supply voltage:	25 to 30 V dc
b. Assembly temperature:	15° to 40°C

c. Operation: The assembly shall perform as specified herein when the output of the assembly drives NASA Part No. 2007108 or equivalent, hereinafter called the amplifier, and the output of the amplifier drives the remote sensing input of the assembly.

d. Synchronizing Input: 0 and π phase 3200±4 pps, 7±3V peak, 3.0±0.5 μsec pulse width at half amplitude, risetime (10 to 90 percent) 0.5 μsec max.

3.1.2.1 Controlled Voltage Setting. The voltage at the remote sensing input of the assembly shall be 28.60±0.29V rms with a synchronizing input and 28.6±1.4V rms without a synchronizing input.

3.1.2.2 Non-synchronized Frequency. With synchronizing input removed the frequency of the output voltage shall be 3060±100 cps.

3.1.2.3 Harmonic Distortion. The harmonic distortion of the filter output voltage shall be less than 0.75 percent with a synchronizing input and less than 2 percent without a synchronizing input.

3.1.2.4 Phase Shift. The phase shift between the zero phase synchronizing input and the filter output voltage shall be 180° ±7°.

3.1.2.5 Monitor Voltage. With a 51K Ω ±5 percent resistance connected between the Test Point and 3200 cps Lo, the voltage between these points shall be 0.495±0.09V rms.

3.1.2.6 Continuity. The resistance between the two 3200 cps Lo pins shall be less than 0.5Ω with all inputs removed.

3.1.2.7 Turn-On Characteristic. During turn-on, the controlled voltage shall attain steady state without exceeding 31.5V rms.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007109 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. 0.8 lbs.

3.2.3 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms. The resistance between pin 1 and the heat sink shall be less than or equal to 0.5 ohms.

Revised

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 The failure of an end product to pass any examination or test of this section will automatically classify the unit as nonconforming. When nonconforming units are corrected by the contractor, the unit shall be reinspected. When corrective action has been taken, the reinspection of a nonconforming unit may be limited to the test or examination which defined the nonconformance, or when so directed by the cognizant inspector, a complete re-examination and retest of the unit may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.1.2 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

a.	Temperature:	25 ± 10°C
b.	Relative humidity:	90% max.
c.	Barometric pressure:	23 to 32 inches of Hg

4.2 PROCEDURES FOR SELECTION OF COMPONENTS.

4.2.1 Selection of Controlled Voltage Setting Resistors. Selection of the controlled voltage setting resistors shall be performed within the limits of the following constraints:

a.	Supply voltage:	27.5 ± 0.1 V dc
b.	Assembly temperature:	25 ± 5°C
c.	Synchronizing input:	0 and π phase 3200 ± 4 pps, 7 ± 3 V peak, 3.0 ± 0.5 μsec pulse width at half amplitude, risetime (10 to 90%) 0.5μ sec max.

d. Test setup as indicated in Figure 1. The amplifier shall be NASA Part No. 2007108 or equivalent.

4.2.1.1 Selection Procedure. With R3 not connected, select the lowest value for R2 such that the controlled voltage is less than 28.20 V rms. With R2 connected, select a value for R3 such that the controlled voltage is 28.60 ± 0.06 V rms.

4.2.2 Selection of Non-synchronized Frequency Setting Capacitors. Selection of the capacitors that determine non-synchronized frequency shall be performed within the limits of the following constraints:

a.	Supply voltage:	27.5 ± 0.1 V dc
b.	Assembly temperature:	25 ± 5°C
c.	Synchronizing input:	none

d. Test setup as indicated in Figure 1. The amplifier shall be NASA Part No. 2007108 or equivalent.

4.2.2.1 Selection Procedure. Select identical value capacitors C8 and C11 for a filter output frequency of 3040 ± 60 cps.

4.2.3 Selection of Phase Setting Capacitors. Selection of the output filter capacitors shall be performed within the limits of the following constraints:

a. Supply voltage:	27.5 ± 0.1 V dc
b. Assembly temperature:	15° to 40°C
c. Synchronizing input:	0 and π phase 3200 ± 1 pps, 7 ± 3 V peak, 3.0 ± 0.5 μ sec pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec max.

d. Test setup as indicated in Figure 1. The amplifier shall be NASA Part No. 2007108 or equivalent.

4.2.3.1 Selection Procedure. With C7 not connected, select the highest value for C6 such that the filter output voltage lags the 0 phase synchronizing input by less than 180°. With C6 connected, select a value for C7 such that the filter output voltage lags the 0 phase synchronizing input by 180° ± 2°.

4.3 TEST PROCEUDRES.

4.3.1 Pre-Encapsulation Tests. The tests required by this section (4.3.1) shall be performed before encapsulation only and shall be performed within the limits of the following constraints unless otherwise noted:

a. Supply voltage:	27.5 ± 0.1 V dc
b. Assembly temperature:	15° to 40°C
c. Synchronizing input:	0 and π phase 3200 ± 4 pps 7 ± 3 V peak, 3.0 ± 0.5 μ sec pulse width at half amplitude, risetime (10 to90%) 0.5 μ sec max.

d. Test setup as indicated in Figure 1. The amplifier shall be NASA Part No. 2007108 or equivalent.

4.3.1.1 Linear Dynamic Range. With the synchronizing input present, measure the controlled voltage under the following conditions (Ref. Para. 3.1.1.1):

a. Amplifier gain:	30.2 ± 3.2 V/V
b. Amplifier gain:	15.1 ± 1.6 V/V
c. Amplifier gain:	60.4 ± 6.4 V/V

4.3.1.2 Asymmetry. Measure asymmetry at the multivibrator collector which drives the chopper, under the following conditions (Ref. Para. 3.1.1.2):

a. Synchronizing input present
b. Synchronizing input removed

4.3.1.3 Synchronization Level. The synchronizing input used for these tests shall differ from the input specified in 4.3.1.c only with respect to peak amplitude. Observe whether each side of the multivibrator is synchronized under the following conditions (ref. Para. 3.1.1.3):

a.	Synchronizing input amplitude:	0.4 ± 0.1 V peak
b.	Synchronizing input amplitude:	2.1 ± 0.1 V peak.

4.3.1.4 Nominal DC Supply Current. With the synchronizing input present, measure the DC supply current (Ref. Para. 3.1.1.4).

4.3.2 Functional Tests. The tests required by this section (4.3.2) shall be performed within the limits of the following constraints unless otherwise noted, after encapsulation:

a.	Supply voltage:	Tests shall be conducted twice (at 25.1 ± 0.1 V dc and at 29.9 ± 0.1 V dc).
b.	Assembly temperature:	15° to 40°C
c.	Synchronizing input:	0 and π phase 3200 ± 4 pps, 7 ± 3 V peak, 3.0 ± 0.5 μ sec pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec max.

d. Test setup as indicated in Figure 1. The amplifier shall be NASA Part No. 2007108 or equivalent.

4.3.2.1 With the synchronizing input present, measure the following:

a. Controlled voltage (Ref. Para. 3.1.2.1)
b. Harmonic distortion (Ref. Para. 3.1.2.3)
c. Phase shift (Ref. Para. 3.1.2.4)
d. Monitor voltage (Ref. Para. 3.1.2.5). This measurement need be made only once.

4.3.2.2. With the synchronizing input removed, measure the following:

a. Controlled voltage (Ref. Para. 3.1.2.1)
b. Frequency (Ref. Para. 3.1.2.2)
c. Harmonic distortion (Ref. Para. 3.1.2.3)

4.3.2.3 Continuity. With external connections removed from all other pins, measure the resistance between the two 3200 cps Lo pins (Ref. Para. 3.1.2.6).

4.3.2.4 Turn-On Characteristic. Monitor controlled voltage from turn-on of supply voltage until controlled voltage attains steady state (Ref. Para. 3.1.2.7).

4.4 DRAWING COMPLIANCE. The assembly shall be visually examined for compliance to the requirements of Apollo G&N Drawing 2007109. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulation defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.5 WORKMANSHIP VIBRATION TEST. The workmanship vibration test shall be performed within the limits of the following constraints:

a. Supply voltage:	27.5 ± 0.1 V ~~dc~~
b. Assembly temperature:	15° to 40°C
c. Operation:	The assembly shall perform as specified herein when the output of the assembly drives NASA Part No. 2007108 or equivalent, called the amplifier, and the output of the amplifier drives the remote sensing input of the assembly.
d. Synchronizing input:	0 and π phase 3200 ± 32 pps, 7 ± 3 V peak, 3.0 ± 0.5 μ sec pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec max.

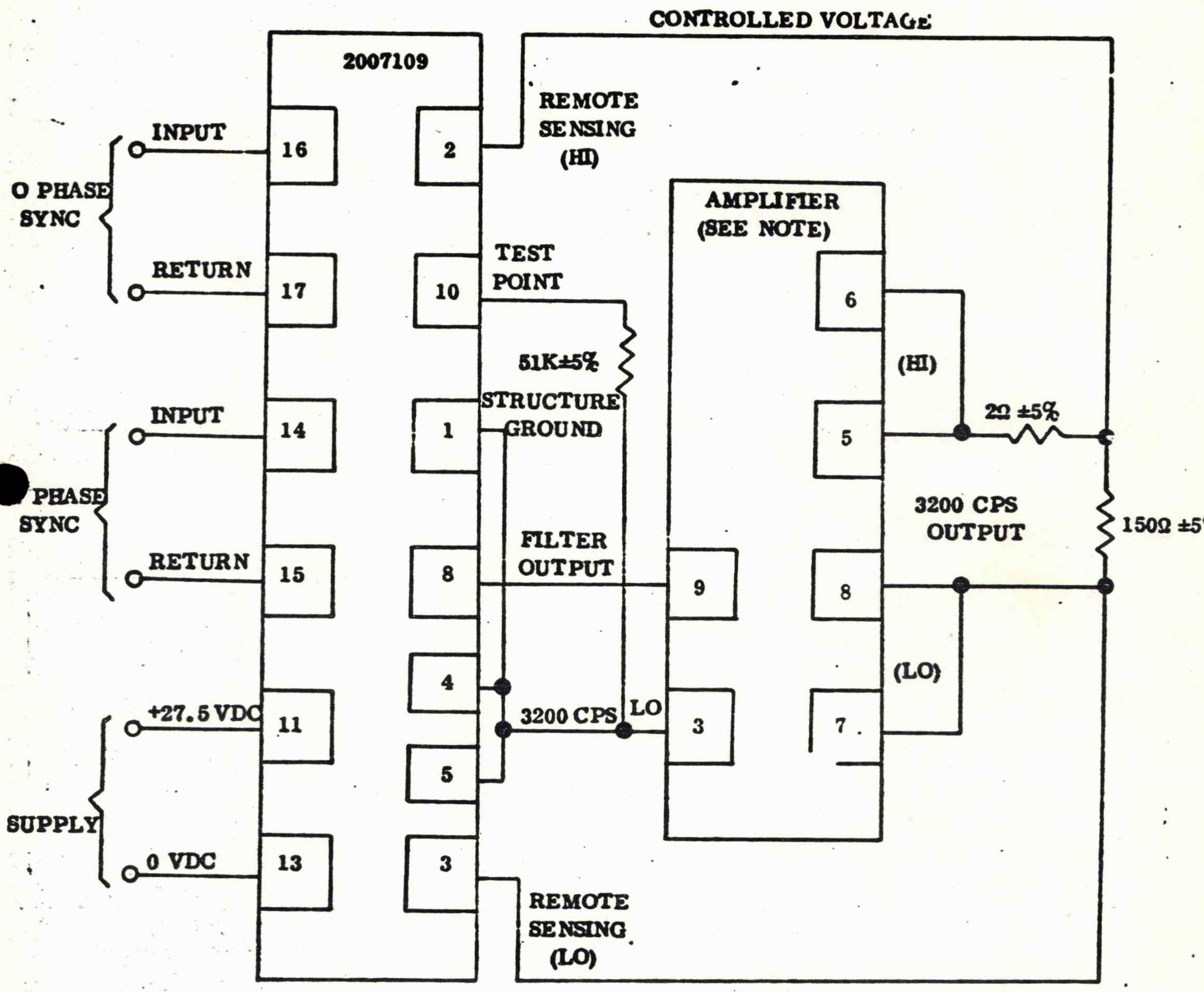
4.5.1 Subject the module to vibration along the axis shown in Figure 2. The vibration shall be simple harmonic motion swept from 10 to 2000 cps at a rate of one (1) octave per 15 seconds. The magnitude of the vibration shall be 6.0 grms limited to 0.4 inch PP constant displacement from 10 cps to the crossover frequency.

4.5.2 During vibration the remote sensing input voltage shall not be outside the range of 28.6 ± 2.9 V rms for a period greater than 1 msec.

4.6 INSULATION RESISTANCE. The insulation resistance between pin 1 and the remaining assembly pins shall be as specified in Para. 3.2.3 when measured in accordance with method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output voltage of 225 ± 75 V dc limited to a short circuit current of 6.0 μa. The resistance between pin 1 and the heat sink shall be as specified in Para. 3.2.3 when measured in accordance with method 303 of Standard MIL-STD-202. To assure a good electrical connection the anodizing may be penetrated.

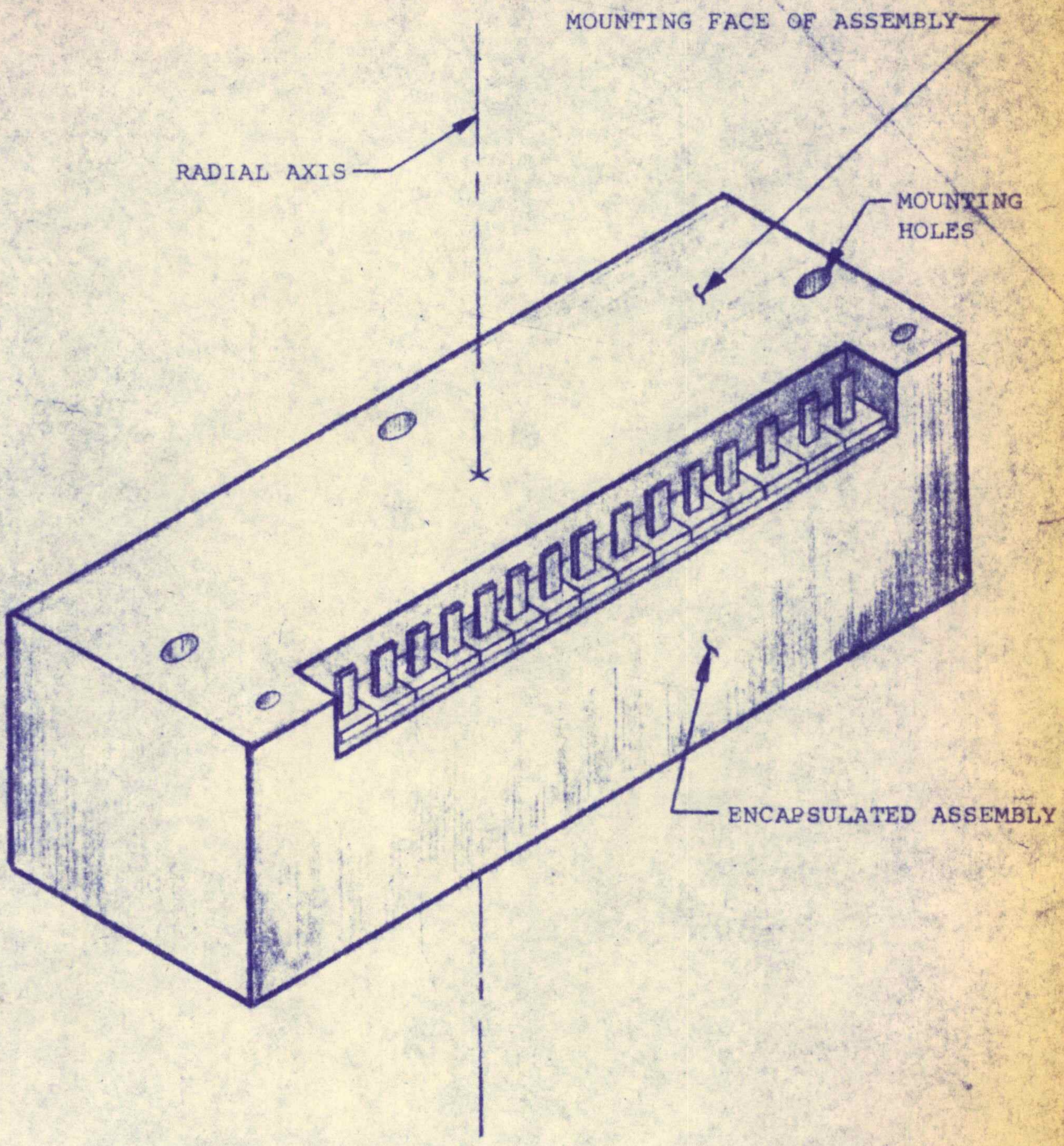
5. PREPARATION FOR DELIVERY.

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND 1002214



NOTE: AMPLIFIER PIN NUMBERS REFER TO NASA PART NO. 2007108.

FIGURE 1



RADIAL AXIS OF COMPONENTS

FIGURE 2

800CPS Specs

Apollo G&N Specification
PS 2007110 Rev B
Original Issue Date: 8/3/65
Release Authority: TDRR 21353
Class Release: A

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

AMPLIFIER 800 CPS 1% ASSEMBLY

DRAWING NO. 2007110

Date	Revision Letter	TDRR No.	Pages Revised	Approvals AC	Approvals NASA
M 9/28/65	A	22846	3	WK	------
M 1/12/67	B	32626	4	MGM EA	------

This specification consists of Pages 1 to 10 inclusive.

APPROVALS	NASA/MSC	W. Kupfer 3 Aug 65 / Manuel Kramer 13 July 65 MIT/IL		AC

3.1.2.1 Gain. The voltage gain of the assembly shall be 21.6 $\pm$ 2.2 V/V.

3.1.2.2 Output to AAC. With a 7.5 kΩ, 5% resistor connected between the output to AAC and 0 V dc, the voltage at the output to AAC shall be 28.0 $\pm$ 0.2 V rms.

3.1.2.3 Monitor. With a 10 kΩ, 5% resistor connected between the monitor and 0 V dc, the voltage at the monitor shall be 14.0 $\pm$ 1.0 V rms.

3.1.2.4 Phase. The phase of the output voltage with respect to the input voltage shall be 180° $\pm$ 3°.

3.1.2.5 Harmonic Distortion. The harmonic distortion of the output voltage shall be less than 1%.

3.2 PRODUCT CONFIGURATION.

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007110 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms. The resistance between pin 1 and the heat sink shall be less than or equal to 0.5 ohms.

Apollo G&N Specification
PS 2007110 Rev A
Original Issue Date: 8/3/65
Release Authority: TDRR 21853
Class Release: A

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

AMPLIFIER 800 CPS 1% ASSEMBLY

DRAWING NO. 2007110

Date	Revision Letter	TDRR No.	Pages Revised	Approvals MIT	Approvals NASA
9/28/65	A	22846	3	WK	———

This specification consists of Pages 1 to 10 inclusive.

APPROVALS	W Mutzel 8/3/65 NASA/MSC	W. Kupfer 3 Aug 65 Manuel Kramer 13 July 65 MIT/IL	ACED

1. SCOPE

1.1 This specification establishes the detail requirements for complete identification and acceptance of the 800 cps 1% Amplifier Assembly PART NO. 2007110-011.

1.2 PRODUCT CONFIGURATION BASELINE ACCEPTANCE

1.2.1 The product configuration baseline shall be established by F.A.C.I. of the end item Serial No.   . This unit and all subsequent units regardless of intended use shall be accepted to the configuration defined by Serial No. unless formally approved otherwise as required by ANA Bulletin No. 445.

2. APPLICABLE DOCUMENTS

2.1 The following documents form a part of this specification to the extent specified herein.

2.1.2 Effective Issues. Unless otherwise specified herein, Military and Government Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&N ND 1002214

STANDARDS

MIL-STD 202

DRAWINGS

APOLLO G&N 2007110

Copies of Specifications, Standards, Drawings, Bulletins and Publications required by suppliers in connection with specific procurement functions should be obtained from the Procuring Activity or as directed by the contracting office.

2.2 CONFLICTING REQUIREMENTS. In the event of conflict between the requirements of the contract, this document and the documents listed in this section, the following order of precedence shall apply and the contractor shall notify MIT Apollo Management of the conflict as soon as it is determined.

a. The contract.
b. This specification
c. Documents listed in this section.

3. REQUIREMENTS

3.1 PERFORMANCE.

3.1.1 Pre-Encapsulation Requirements. The assembly is required to conform to the following design margin specification before encapsulation only. The assembly shall perform as specified in this section (3.1.1) within the limits of the following constraints: unless otherwise noted.

a.	Supply voltage	27.5 ± 0.1 V dc
b.	Assembly temperature:	40° ± 15°C
c.	Load:	56 Ω, 5%
d.	Signal ground connected to 0 V dc	
e.	Open Loop	

3.1.1.1 Bias Current. With the input shorted to 0 V dc, the bias current shall be greater than 7 ma and less than 120 ma., at 40°C±5°C.

3.1.1.2 DC Supply Current. With an output of 28.0 ± 0.2 V rms at 800 ± 8 cps, the DC supply current shall be 0.95 ± 0.2 A.

3.1.1.3 Phase Margin and Crossover Frequency. With the input voltage such that the output is 14.0 ± 0.1 V rms at 800 ± 8 cps, the phase margin shall be greater than 45° at a crossover frequency between 4.5 kc and 11 kc.

3.1.1.4 Gain Margin. With the input voltage such that the output is 14.0 ± 0.1 V rms at 800 ± 8 cps, the gain margin shall be greater than 10 dB.

3.1.1.5 Loop Gain. With an output of 28.0 ± 0.2 V rms at 800 ± 8 cps, the loop gain shall be 20 ± 3 dB.

3.1.1.6 Phase Shift. With an output of 28.0 ± 0.2 V rms at 800 ± 8 cps, the phase of the output voltage with respect to the input voltage shall be 180° ± 30°.

3.1.1.7 Asymmetry. With an output of 28.0 ± 0.2 V rms at 800 ± 8 cps, the asymmetry between channels shall be less than 25%.

3.1.1.8 Maximum Undistorted Output. An output of 34 V rms at 800 ± 8 cps, shall have less than 10% distortion.

3.1.2 Functional Requirements. The assembly shall perform as specified in this section (3.1.2) within the limits of the following constraints, after encapsulation:

a.	Supply voltage:	25 to 30 V dc
b.	Assembly temperature:	15° to 65°C
c.	Frequency:	800 ± 8 cps
d.	Output voltage:	28.0 ± 0.2 V rms
e.	Load:	56 Ω, 5%
f.	Signal ground connected to 0 V dc	

3.1.2.1 Gain. The voltage gain of the assembly shall be 21.6 ± 2.2 V/V.

3.1.2.2 Output to AAC. With a 7.5 kΩ, 5% resistor connected between the output to AAC and 0 V dc, the voltage at the output to AAC shall be 28.0 ± 0.2 V rms.

3.1.2.3 Monitor. With a 10 kΩ, 5% resistor connected between the monitor and 0 V dc, the voltage at the monitor shall be 14.0 ± 1.0 V rms.

3.1.2.4 Phase. The phase of the output voltage with respect to the input voltage shall be 180° ± 3°.

3.1.2.5 Harmonic Distortion. The harmonic distortion of the output voltage shall be less than 1%.

3.2 PRODUCT CONFIGURATION.

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007110 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. 1.5 lbs

3.2.3 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms. The resistance between pin 1 and the heat sink shall be less than or equal to 0.5 ohms.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 The failure of the end product to pass any examination or test of this section will automatically classify the unit as nonconforming. When nonconforming units are corrected by the contractor, the unit shall be reinspected. When corrective action has been taken, the reinspection of a nonconforming unit may be limited to the test or examination which defined the nonconformance, or when so directed by the cognizant inspector, a complete re-examination and retest of the unit may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.1.2 Environmental. Unless otherwise specified the assemblies shall be tested under the following ambient conditions:

a.	Temperature:	25 ± 10°C
b.	Relative Humidity:	90% max
c.	Barometric Pressure:	23 to 32 inches of Hg

4.2 PROCEDURE FOR SELECTION OF COMPONENTS.

4.2.1 Bias Resistor Selection. The selection of the bias resistor shall be performed within the limits of the following constraints:

a.	Supply voltage:	27.5 ± 0.1 V dc
b.	Assembly temperature:	40° ± 5°C
c.	Input shorted to 0 V dc	

4.2.1.1 Selection Procedure. Select the lowest value for R12 such that the bias current is less than 14mA. Then select the highest value for R13 such that the bias current is greater than 14 mA.

4.2.2 Loop Gain Resistor Selection. The selection of the loop gain resistor shall be performed within the limits of the following constraints:

a.	Supply voltage:	27.5 ± 0.1 V dc
b.	Assembly temperature:	40° ± 5°C
c.	Frequency:	800 ± 8 cps
d.	Output voltage:	28.0 ± 0.2 V rms
e.	Load:	56Ω, 5%
f.	Signal ground connected to 0 V dc	
g.	Open loop	

4.2.2.1 Selection Procedure. Select R2 such that the loop gain is 20 ± 1 dB.

4.3 TEST PROCEDURES.

4.3.1 Pre-Encapsulation Tests. The tests required by this section (4.3.1) shall be performed before encapsulation only and shall be performed within the limits of the following constraints:

a.	Supply voltage:	27.5 ± 0.1 V dc
b.	Assembly temperature:	40° ± 15°C
c.	Load:	56 Ω, 5%
d.	Signal ground connected to 0 V dc	
e.	Open loop	

4.3.1.1 Bias Current. With the input shorted to 0 V dc, measure the bias current (Ref. Para. 3.1.1.1).

4.3.1.2 DC Supply Current. With an output of 28.0 ± 0.2 V rms at 800 ± 8 cps, measure the DC supply current (Ref. Para. 3.1.1.2).

4.3.1.3 Phase Margin Crossover Frequency. With the input voltage such that the output is 14.0 ± 0.1 V rms at 800 ± 8 cps, measure the phase margin and the crossover frequency (Ref. Para. 3.1.1.3).

4.3.1.4 Gain Margin. With the input voltage such that the output is 14.0 ± 0.1 V rms at 800 ± 8 cps, measure the gain margin (Ref. Para. 3.1.1.4).

4.3.1.5 Loop Gain. With an output of 28.0 ± 0.2 V rms at 800 ± 8 cps, measure the loop gain (Ref. Para. 3.1.1.5).

4.3.1.6 Phase Shift. With an output of 28.0 ±0.2 V rms at 800 ± 8 cps, measure the phase shift (Ref. Para. 3.1.1.6).

4.3.1.7 Asymmetry. With an output of 28.0 ± 0.2 V rms at 800 ± 8 cps, measure the asymmetry (Ref. Para. 3.1.1.7).

4.3.1.8 Maximum Undistorted Output. With an output of 34.1 ± 0.1 V rms at 800 ± 8 cps, measure the distortion (Ref. Para. 3.1.1.8).

4.3.2 Functional Tests. The tests required by this section (4.3.2) shall be performed within the limits of the following constraints after encapsulation:

a. Supply voltage- tests shall be conducted twice, at 25.1 ± 0.1 V dc and at 29.9 ± 0.1 V dc.

b.	Assembly temperature:	40° ± 25°C
c.	Frequency:	800 ± 8 cps
d.	Output voltage:	28.0 ± 0.2 Vrms

e. Test setup as indicated in Figure 1

4.3.2.1 Electrical Performance Tests. Measure the following:

a. Gain (Ref. Para. 3.1.2.1)
b. Output to AAC (Ref. Para. 3.1.2.2)
c. Monitor (Ref. Para. 3.1.2.3)
d. Phase (Ref. Para. 3.1.2.4)
e. Harmonic distortion (Ref. Para. 3.1.2.5)

4.4 DRAWING COMPLIANCE. The assembly shall be visually examined for compliance to the requirements of APOLLO G&N Drawing 2007110. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulation defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.5 WORKMANSHIP VIBRATION TESTS. The workmanship vibration test shall be performed within the limits of the following electrical constaints:

a. Supply voltage: 27.5 ± 0.1 V dc
b. Assembly temperature: 15° to 65°C
c. Frequency: 800 ± 8 cps
d. Output voltage: 28.0 ± 0.2 V rms
e. Load: 56 Ω, 5%
f. Signal ground connected to 0 V dc

4.5.1 Subject the module to vibration along the axis shown in Figure 2. The vibration shall be simple harmonic motion swept from 10 to 2000 cps at a rate of one (1) octave per 15 seconds. The magnitude of the vibration shall be 6.0 grms limited to 0.4 inch PP constant displacement from 10 cps to the crossover frequency.

4.5.2 During vibration the output voltage shall not lie outside the range 28.0 ± 2.8 V rms for a period greater than 1 msec.

4.6 INSULATION RESISTANCE. The insulation resistance between pin 1 and the remaining assembly pins shall be as specified in Para. 3.2.3 when measured in accordance with method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output voltage of 225 ± 75 V dc limited to a short circuit current of 6.0 ua. The resistance between pin 1 and the heat sink shall be as specified in Para. 3.2.3 when measured in accordance with method 303 of Standard MIL-STD-202. To assure a good electrical connection the anodizing may be penetrated.

5. PREPARATION FOR DELIVERY.

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND 1002214.

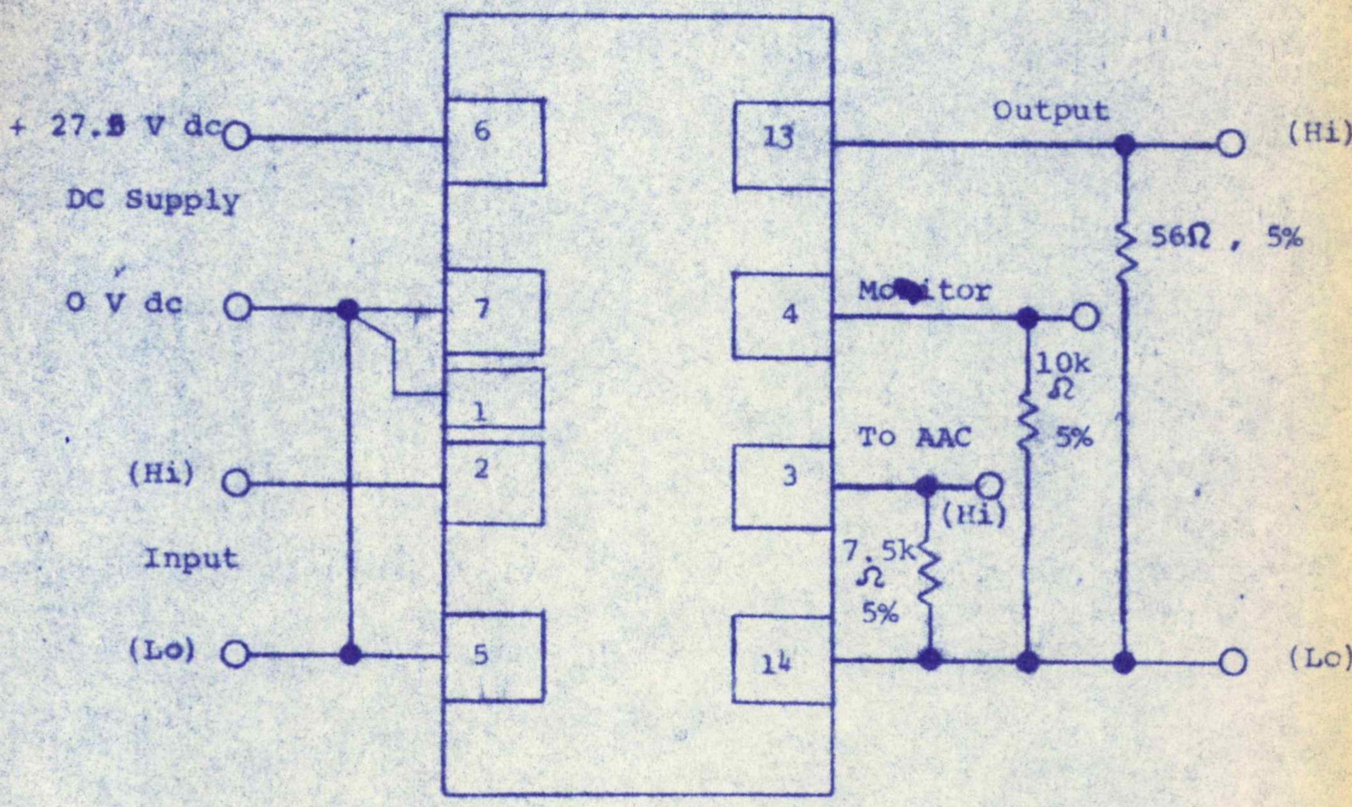

+ 27.5 V dc
DC Supply
0 V dc
(Hi)
Input
(Lo)
6
7
1
2
5
13
4
3
14
Output
(Hi)
56Ω , 5%
Monitor
10k Ω 5%
To AAC
(Hi)
7.5k Ω 5%
(Lo)

Figure 1

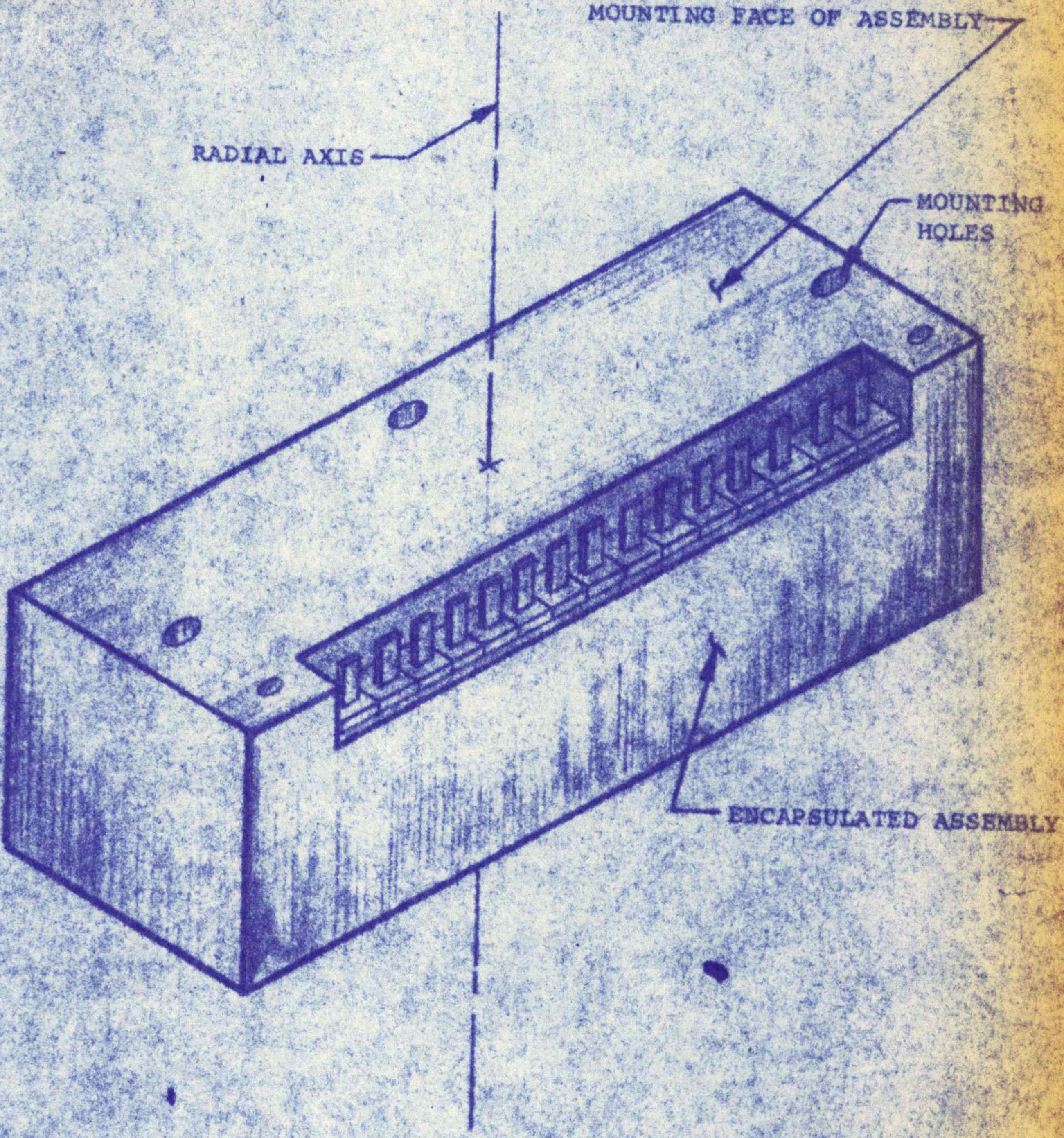

MOUNTING FACE OF ASSEMBLY
RADIAL AXIS
MOUNTING HOLES
ENCAPSULATED ASSEMBLY
RADIAL AXIS OF COMPONENTS

Figure 2

Apollo G&N Specification
PS 2007111 Rev B
Original Issue Date: 1/3/65
Release Authority: TDRR 21353
Class Release: A

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

AMPLIFIER 800 CPS 5% ASSEMBLY

DRAWING NO. 2007111

Date	Revision Letter	TDRR No.	Pages Revised	Approvals MIT	Approvals NASA
10/19/65	A	23291	3, 5, 6, 7, 9 RDG/AV	WK	TM
1/12/67	B	32626	4 RDG/AV	MGM EA	--

This specification consists of Pages 1 to 10 inclusive.

APPROVALS	NASA/MSC	MIT/IL	AC
	[illegible] 8/3/65	W [illegible] 8/?/65 Marcel Kramer 23 July 65	

3.1.2.1 Gain. The voltage gain of the assembly shall be 1.00 ± 0.04 V/V

3.1.2.2 Monitor. With a 10 kΩ, 5% resistor connected between the monitor and 0 V dc, the voltage at the monitor shall be 14.0 ± 1.4 V rms.

3.1.2.3 Phase. The phase lead of the output voltage with respect to the input voltage shall be 270° ± 3°.

3.1.2.4 Harmonic Distortion. The harmonic distortion of the output shall be less than 5%.

3.1.2.5 Continuity. The resistance between pins 2 and 3, between pins 11 and 12, between pins 13 and 14, and between pins 15 and 16 shall be less than 0.5 Ω, with input and loads removed.

3.2 PRODUCT CONFIGURATION.

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007111 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms. The resistance between pin 1 and the heat sink shall be less than or equal to 0.5 ohms.

Apollo G&N Specification
PS 2007111 Rev C
Original Issue Date: 1/13/65
Release Authority: TDRR 21353
Class Release: A

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

AMPLIFIER 800 CPS 5% ASSEMBLY

DRAWING NO. 2007111

768

NO ECO

Date	Revision Letter	TDRR No.	Pages Revised	Approvals MIT	NASA
10/19/65	A	23291	3, 5, 6, 7, 9 RDG/AV	WK	TM
1/12/67	B	32626	4 RDG/AC	MGM EA	--
7/24/68	C	36579	5 [illegible]/AC	MGM EA	--

This specification consists of Pages 1 to 10 inclusive.

APPROVALS	[signature] 8/3/65 NASA/MSC	W [signature] 8 Aug 65 Manuel Kramer 22 July 65 MIT/IL	AC

1. SCOPE

1.1 This specification establishes the detail requirements for complete identification and acceptance of the 800 cps 5% Amplifier Assembly PART NO. 2007111-011.

1.2 PRODUCT CONFIGURATION BASELINE ACCEPTANCE.

1.2.1 The product configuration baseline shall be established by F.A.C.I. of the end item Serial No.   . This unit and all subsequent units regardless of intended use shall be accepted to the configuration defined by Serial No. unless formally approved otherwise as required by ANA Bulletin No. 445.

2. APPLICABLE DOCUMENTS.

2.1 The following documents form a part of this specification to the extent specified herein.

2.1.2 Effective Issues. Unless otherwise specified herein, Military and Government Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATION

APOLLO G&N ND 1002214

STANDARDS

MIL-STD 202

DRAWINGS

APOLLO G&N 2007111

Copies of Specifications, Standards, Drawings, Bulletins and Publications required by suppliers in connection with specific procurement functions should be obtained from the Procuring Activity or as directed by the contracting office.

2.2 CONFLICTING REQUIREMENTS. In the event of conflict between the requirements of the contract, this specification and the documents listed in this section, the following order of precedence shall apply and the contractor shall notify MIT Apollo Management of the conflict as soon as it is determined.

a. The contract.
b. This specification.
c. Documents listed in this section.

3. REQUIREMENTS

3.1 PERFORMANCE.

3.1.1 Pre-Encapsulation Requirements. The assembly is required to conform to the following design margin specification before encapsulation only. The assembly shall perform as specified in this section (3.1.1) within the limits of the following constraints:

a.	Supply voltage:	27.5 ± 0.1 V dc
b.	Assembly temperature:	40° ± 15°C
c.	Load:	40 Ω, ±5%
d.	Signal ground connected to 0 V dc	
e.	Open loop	

3.1.1.1 Bias Current. With the input shorted to 0 V dc, the bias current shall be greater than 13 mA and less than 20 mA.

3.1.1.2 DC Supply Current. With an output of 28.0 ± 0.6 V rms at 800 ± 8 cps. the DC supply current shall be 1.3 ± 0.3 A.

3.1.1.3 Phase Margin and Crossover Frequency. With an input such that the output is 14.0 ± 0.3 V rms at 800 ± 8 cps, the phase margin shall be greater than 45° at a crossover frequency between 5 kc and 24 kc.

3.1.1.4 Gain Margin. With an input such that the output is 14.0 ± 0.3 V rms at 800 ± 8 cps, the gain margin shall be greater than 10 dB.

3.1.1.5 Loop Gain. With an output of 28.0 ± 0.6 V rms at 800 ± 8 cps, the loop gain shall be 24 ± 6 dB.

3.1.1.6 Phase Shift. With an output of 28.0 ± 0.6 V rms at 800 ± 8 cps, the phase of the output voltage with respect to the input voltage shall be 180° ± 30°.

3.1.1.7 Asymmetry. With an output of 28.0 ± 0.6 V rms at 800 ± 8 cps, the asymmetry between channels shall be less than 20%.

3.1.1.8 Maximum Undistorted Output. An output of 34 V rms shall have less than 10% distortion.

3.1.2 Functional Requirements. The assembly shall perform as specified in this section (3.1.2) within the limits of the following constraints unless otherwise noted after encapsulation:

a.	Supply voltage:	25 to 30 V dc
b.	Assembly temperature:	15° to 65°C
c.	Frequency:	800 ± 8 cps
d.	Input voltage:	28.0 ± 0.2 V rms
e.	Load:	40 Ω, ±5%
f.	Signal ground connected to 0 V dc	

3.1.2.1 Gain. The voltage gain of the assembly shall be 1.00 $\pm$ 0.04 V/V

3.1.2.2 Monitor. With a 10 kΩ, 5% resistor connected between the monitor and 0 V dc, the voltage at the monitor shall be 14.0 $\pm$ 1.4 V rms.

3.1.2.3 Phase. The phase lead of the output voltage with respect to the input voltage shall be 270° $\pm$ 3°.

3.1.2.4 Harmonic Distortion. The harmonic distortion of the output shall be less than 5%.

3.1.2.5 Continuity. The resistance between pins 2 and 3, between pins 11 and 12, between pins 13 and 14, and between pins 15 and 16 shall be less than 0.5 Ω, with input and loads removed.

3.2 PRODUCT CONFIGURATION.

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007111 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. 2.0 lbs

3.2.3 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms. The resistance between pin 1 and the heat sink shall be less than or equal to 0.5 ohms.

4. QUALITY ASSURANCE PROVISIONS.

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 The failure of the end product to pass any examination or test of this section will automatically classify the unit as nonconforming. When nonconforming units are corrected by the contractor, the unit shall be reinspected. When corrective action has been taken, the reinspection of a nonconforming unit may be limited to the test or examination which defined the nonconformance, or when so directed by the cognizant inspector, a complete re-examination and retest of the unit may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.1.2 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

a.	Temperature:	25 ± 10°C
b.	Relative Humidity:	90% max.
c.	Barometric Pressure:	23 to 32 inches of Hg

4.2 PROCEDURE FOR SELECTION OF COMPONENTS.

4.2.1 Bias Resistor Selection. The selection of the bias resistor shall be performed within the limits of the following constraints:

a.	DC supply voltage:	27.5 ± 0.1 V dc
b.	Assembly temperature:	40° ± 5°C
c.	Input shorted to 0 V dc	
d.	Resistor R8 shorted to 0 V dc	
e.	Resistor R9 shorted to 0 V dc	
f.	Resistor R3:	5600Ω, 5%
g.	Resistor R9:	3000Ω, 5%
h.	Open loop	

4.2.1.1 Selection Procedure. Select the lowest value for R6 and the highest value for R5 such that the bias current is greater than 17 mA. Select the highest value for R7 such that the bias current is less than 17 mA.

4.2.2 Loop Gain Resistor Selection. The selection of the loop gain resistor shall be performed within the limits of the following constraints:

a.	Supply voltage:	27.5 ± 0.1 V dc
b.	Assembly temperature:	40° ± 5°C
c.	Frequency:	800 ± 8 cps
d.	Output voltage:	28.0 ± 0.6 V rms
e.	Load:	40Ω, 5%
f.	Resistor R3:	5600Ω, 5%
g.	Resistor R9:	3000Ω, 5%
h.	Open loop	

4.2.2.1 Selection Procedure. Select the largest value for R10 such that the loop gain is less than 28 db.

4.2.3 Gain and Phase Resistor Selection. The selection of the gain and phase resistors shall be performed within the limits of the following constraints.

a.	Supply voltage:	27.5 ± 0.1 V dc
b.	Assembly temperature:	$40° \pm 5°$C
c.	Frequency:	800 ± 8 cps
d.	Input voltage:	28.0 ± 0.2 V rms
e.	Load:	40 Ω, 5%
f.	Closed loop	

4.2.3.1 Selection Procedure. Select R9 and R3 simultaneously such that the gain is 1.00 ± 0.02 V/V and the phase lead of the output voltage with respect to the input voltage is $270° \pm 1°$.

4.3 TEST PROCEDURES.

4.3.1 Pre-Encapsulation Tests. The tests required by this section (4.3.1) shall be performed before encapsulation only and shall be performed within the limits of the following constraints:

a.	Supply voltage:	27.5 ± 0.1 V dc
b.	Assembly temperature:	$40° \pm 15°$C
c.	Load:	40 Ω, 5%
d.	Signal ground connected to 0 V dc	
e.	Open loop	

4.3.1.1 Bias Current. With the input shorted to 0 V dc, measure the bias current (Ref. Para. 3.1.1.1).

4.3.1.2 DC Supply Current. With an output of 28.0 ± 0.6 V rms at 800 ± 8 cps, measure the DC supply current (Ref. Para. 3.1.1.2).

4.3.1.3 Phase Margin and Crossover Frequency. With an input such that the output is 14.0 ± 0.3 V rms at 800 ± 8 cps, measure the phase margin and the crossover frequency (Ref. Para. 3.1.1.3).

4.3.1.4 Gain Margin. With an input such that the output is 14.0 ± 0.3 V rms at 800 ± 8 cps, measure the gain margin (Ref. Para. 3.1.1.4).

4.3.1.5 Loop Gain. With an output of 28.0 ± 0.6 V rms at 800 ± 8 cps, measure the loop gain (Ref. Para. 3.1.1.5).

4.3.1.6 Phase Shift. With an output of 28.0 ± 0.6 V rms at 800 ± 8 cps, measure the phase shift (Ref. Para. 3.1.1.6).

4.3.1.7 Asymmetry. With an output of 28.0 ± 0.6 V rms at 800 ± 8 cps, measure the asymmetry (Ref. Para. 3.1.1.7).

4.3.1.8 Maximum Undistorted Output. With an output of 34.1 ± 0.1 V rms, measure the distortion (Ref. Para. 3.1.1.8).

4.3.2 Functional Tests. The tests required by this section (4.3.2) shall be performed within the limits of the following constraints unless otherwise noted, after encapsulation.

a. Supply voltage - tests shall be conducted twice, at 25.1 ± 0.1 V dc and at 29.9 ± 0.1 V dc

b. Assembly temperature: 40° ± 25°C

c. Frequency: 800 ± 8 cps

d. Input voltage: 28.0 ± 0.2 V rms

e. Test setup as indicated in Figure 1

4.3.2.1 Electrical Performance Tests. Measure the following:

a. Gain (Ref. Para. 3.1.2.1)
b. Monitor (Ref. Para. 3.1.2.2)
c. Phase (Ref. Para. 3.1.2.3)
d. Harmonic distortion (Ref. Para. 3.1.2.4)
e. Continuity (with inputs and load removed) (Ref. Para. 3.1.2.5)

4.4 DRAWING COMPLIANCE. The assembly shall be visually examined for compliance to the requirements of APOLLO G&N Drawing 2007111. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulation defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.5 WORKMANSHIP VIBRATION TEST. The workmanship vibration test shall be performed within the limits of the following constraints:

a. Supply voltage: 27.5 ± 0.1 V dc
b. Assembly temperature: 40° ± 25°C
c. Frequency: 800 ± 8 cps
d. Input voltage: 28.0 ± 0.2 V rms
e. Load: 10 Ω, ±5%
f. Signal ground connected to 0 V dc

4.5.1 Subject the module to vibration along the axis shown in Figure 2. The vibration shall be simple harmonic motion swept from 10 to 2000 cps at a rate of one (1) octave per 15 seconds. The magnitude of the vibration shall be 6.0 grms limited to 0.4 inch PP constant displacement from 10 cps to the crossover frequency.

4.5.2 During vibration the output shall not lie outside the range 28.0 ± 2.8 V rms for a period greater than 1 msec.

4.6 Insulation Resistance. The insulation resistance between pin 1 and the remaining assembly pins shall be as specified in Para. 3.2.3 when measured in accordance with method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output voltage of 225 ± 75 V dc limited to a short circuit current of 6.0 ua. The resistance between pin 1 and the heat sink shall be as specified in Para. 3.2.3 when measured in accordance with method 303 of Standard MIL-STD-202. To assure a good electrical connection the anodizing may be penetrated.

5. PREPARATION FOR DELIVERY.

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND 1002214.

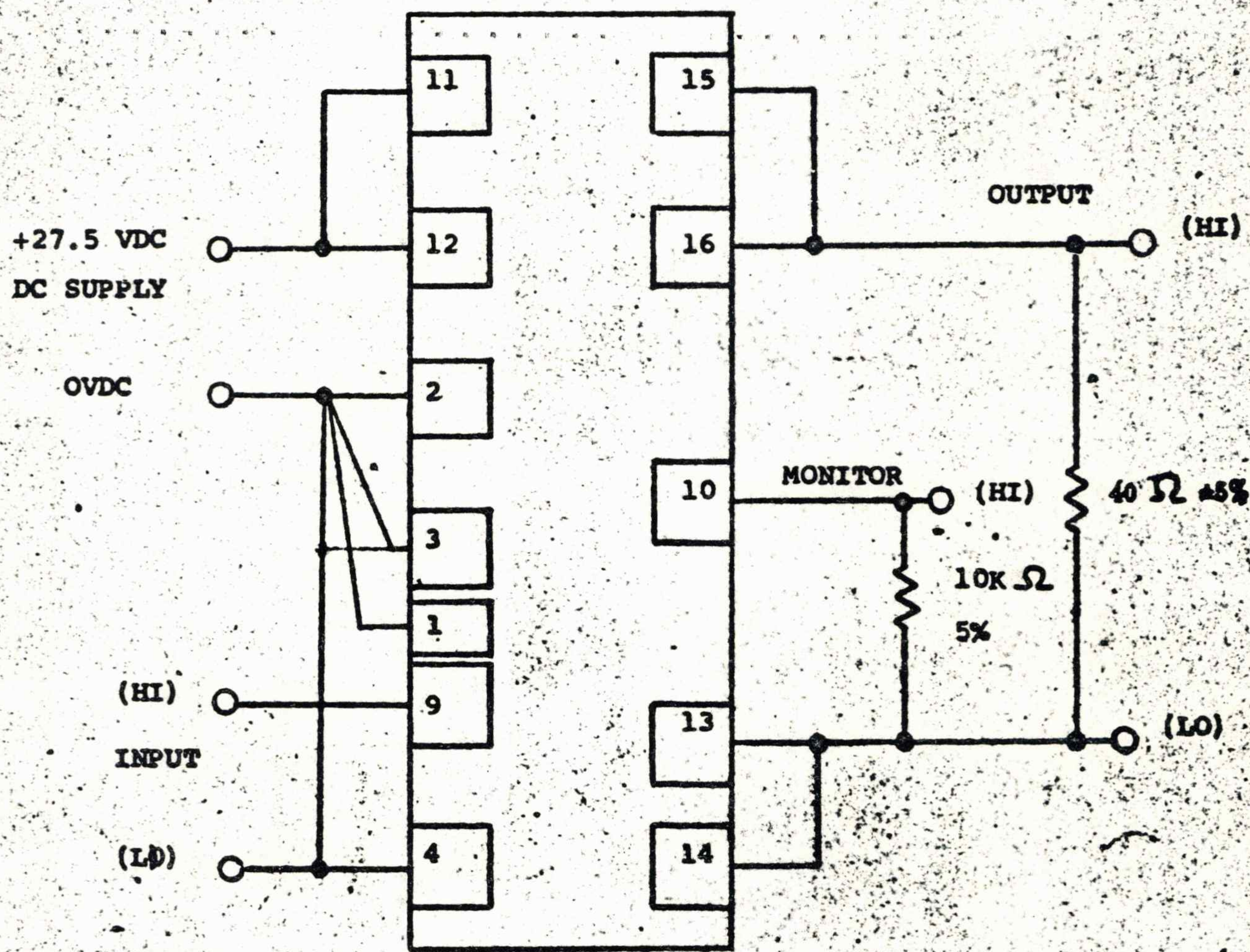
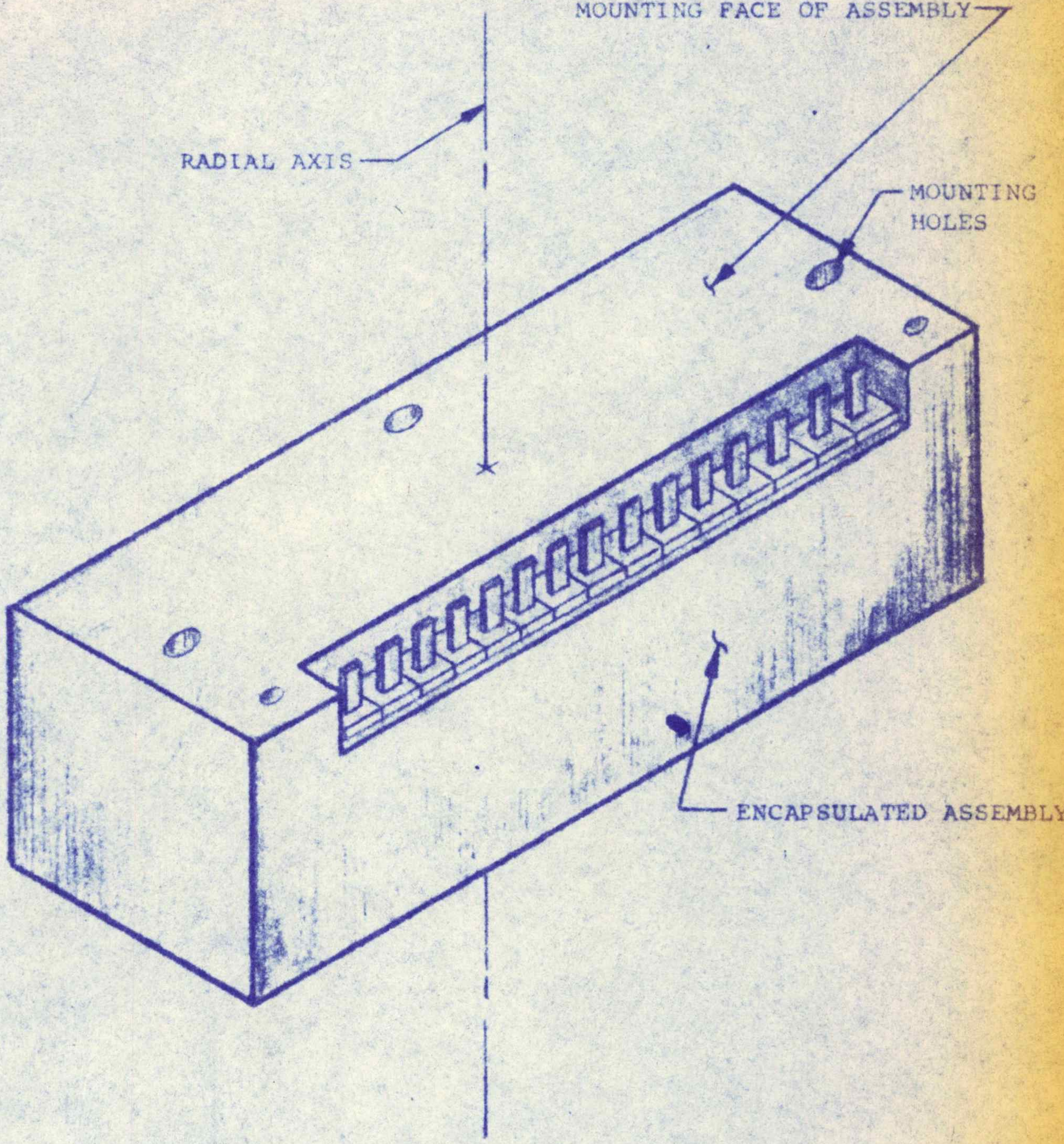

11
12
2
3
1
9
4
15
16
10
13
14
+27.5 VDC
DC SUPPLY
OVDC
(HI)
INPUT
(LO)
OUTPUT
(HI)
MONITOR
(HI)
10K Ω
5%
40 Ω ±5%
(LO)

FIGURE 1



RADIAL AXIS OF COMPONENTS

FIGURE 2

Apollo G&N Specifications
PS 2007112 REV D
Original Issue Date: 8/3/65
Release Authority: TDRR 21353
Class Release: A

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

AAC, FILTER AND MULTIVIBRATOR 800 CPS ASSEMBLY

DRAWING NO. 2007112

Date	Revision Letter	TDRR No.	Pages Revised		Approvals AC	NASA
M 9-8-65	A	22340	3,7	RD/AC	MGM	TM
M 9-14-65	B	22460	11	RH/AC	MGM	ACM
M 11-30-65	C	24453	4	RDG/AC	WK	TM
M 1/12/67	D	32626	4	RDG/AC	MGM EA	--

This specification consists of Pages 1 to 12 inclusive.

APPROVALS	NASA/MSC 8/3/65	MIT/IL	AC

c. Operation: The assembly shall perform as specified herein when the output of the assembly drives NASA Part No. 2007110 or equivalent, hereinafter called the amplifier, and the output of the amplifier drives the 800 cps 1% input of the assembly.

d. Synchronizing input: 0 and π phase 800 ± 1 pps, 7 ± 3 V peak, 3.0 ± 0.5 μ sec. pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec. max.

3.1.2.1 Controlled Voltage Setting. The voltage at the 800 cps 1% input of the assembly shall be 28.00 ± 0.28 V rms with a synchronizing input and 28.0 ± 1.4 V rms without a synchronizing input.

3.1.2.2 Non-synchronized Frequency. With synchronizing input removed the frequency of the output voltage shall be **755±35 cps.**

3.1.2.3 Harmonic Distortion. The harmonic distortion of the filter output voltage shall be less than 0.75% with a synchronizing input and less than 2% without a synchronizing input.

3.1.2.4 Phase Shift. The phase shift between the zero phase synchronizing input and the filter output voltage shall be 180 ± 7°.

3.1.2.5 Monitor Voltage. With a 51 kΩ ± 5% resistance connected between the Test Point and 800 cps Lo, the voltage between these points shall be 0.657 ± 0.12 V rms.

3.2 PRODUCT CONFIGURATION.

3.2.1 Drawings. The configuration of the assembly shall be in accordance with Apollo G&N Drawing 2007112 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. **Not applicable.**

3.2.3 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms. The resistance between pin 1 and the heat sink shall be less than or equal to 0.5 ohms.

Apollo G&N Specifications
PS 2007112 REV C
Original Issue Date: 8/3/65
Release Authority: TDRR 21353
Class Release: A

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

AAC, FILTER AND MULTIVIBRATOR 800 CPS ASSEMBLY

DRAWING NO. 2007112

Date	Revision Letter	TDRR No.	Pages Revised	Approvals MIT	Approvals NASA
9-8-65	A	22340	3, 7	MGM	TM
9-14-65	B	22460	11	MGM	ACM
11-30-65	C	24453	4	WK	TM

This specification consists of Pages 1 to 12 inclusive.

APPROVALS	NASA/MSC 8/3/65	MIT/IL 3 Aug 65	ACED

1. SCOPE

1.1 This specification establishes the detail requirements for complete identification and acceptance of the **AAC**, Filter and Multivibrator 800 CPS Assembly.**PART NO.** 2007~~109~~ 011. 2007112-011

1.2 PRODUCT CONFIGURATION BASELINE ACCEPTANCE

1.2.1 The product configuration baseline shall be established by F.A.C.I. of the end item Serial No. . This unit and all subsequent units regardless of intended use shall be accepted to the configuration defined by Serial No. unless formally approved otherwise as required by ANA Bulletin No. 445.

2. APPLICABLE DOCUMENTS

2.1 The following documents form a part of this specification to the extent specified herein.

2.1.2 Effective issues. Unless otherwise specified herein, Military and Government Standards and specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&N ND 1002214

STANDARDS

MIL-STD 202

DRAWINGS

APOLLO G&N 2007112

Copies of Specifications, Standards, Drawings, Bulletins and Publications required by suppliers in connection with specific procurement functions should be obtained from the Procuring Activity or as directed by the contracting office.

2.2 CONFLICTING REQUIREMENTS. In the event of conflict between the requirements of the contract, this document and the documents listed in this section, the following order of precedence shall apply and the contractor shall notify MIT Apollo Management of the conflict as soon as it is determined.

a. The contract.

b. This specification.

c. Documents listed in this section.

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Pre-Encapsulation Requirements. The assembly is required to conform to the following requirements before encapsulation only. The assembly shall perform as specified in this section (3.1.1) within the limits of the following constraints unless otherwise noted:

a.	Supply voltage:	27.5 ± 0.1 V dc
b.	Assembly temperature:	15° to 40°C
c.	Operation:	The output of the assembly drives NASA PN 2007110 or equivalent, hereinafter called the amplifier, and the output of the amplifier drives the 800 cps 1% input of the assembly.
d.	Synchronizing input:	0 and π phase 800 ± 1 pps, 7 ± 3 V peak, 3.0 ± 0.5 μ sec pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec. max.

3.1.1.1 Linear Dynamic Range. The controlled voltage shall change less than 0.5% for a change in amplifier gain from 21.6 ± 1.5 V/V to 14.4±1.0V/V and from 21.6 ± 1.5 V/V to 43.2 ± 3.0 V/V.

14.4

3.1.1.2 Asymmetry. With the synchronizing input removed, the asymmetry at the multivibrator collector which drives the chopper shall be less than 10%. With the synchronizing input present asymmetry shall be less than 2%.

3.1.1.3 Synchronization Level. Synchronizing inputs having an amplitude greater than 2 V peak shall synchronize both sides of the multivibrator. Synchronizing inputs having an amplitude less than 0.5 V peak shall not synchronize either side of the multivibrator.

3.1.1.4 Nominal DC Supply Current. The DC supply current shall be 30 ± 10 ma.

3.1.2 Functional Requirements. The assembly shall perform as specified in this section (3.1.2) within the limits of the following constraints unless otherwise noted, after encapsulation:

a.	Supply voltage:	25 to 30 V dc
b.	Assembly temperature:	15°C to 40°C

c. Operation: The assembly shall perform as specified herein when the output of the assembly drives NASA Part No. 2007110 or equivalent, hereinafter called the amplifier, and the output of the amplifier drives the 800 cps 1% input of the assembly.

d. Synchronizing input: 0 and π phase 800 ± 1 pps, 7 ± 3 V peak, 3.0 ± 0.5 μ sec. pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec. max.

3.1.2.1 Controlled Voltage Setting. The voltage at the 800 cps 1% input of the assembly shall be 28.00 ± 0.28 V rms with a synchronizing input and 28.0 ± 1.4 V rms without a synchronizing input.

3.1.2.2 Non-synchronized Frequency. With synchronizing input removed the frequency of the output voltage shall be 755±35 cps.

3.1.2.3 Harmonic Distortion. The harmonic distortion of the filter output voltage shall be less than 0.75% with a synchronizing input and less than 2% without a synchronizing input.

3.1.2.4 Phase Shift. The phase shift between the zero phase synchronizing input and the filter output voltage shall be 180 ± 7°.

3.1.2.5 Monitor Voltage. With a 51 kΩ ± 5% resistance connected between the Test Point and 800 cps Lo, the voltage between these points shall be 0.657 ± 0.12 V rms.

3.2 PRODUCT CONFIGURATION.

3.2.1 Drawings. The configuration of the assembly shall be in accordance with Apollo G&N Drawing 2007112 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. 0.5 Lbs.

3.2.3 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms. The resistance between pin 1 and the heat sink shall be less than or equal to 0.5 ohms.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 The failure of an end product to pass any examination or test of this section will automatically classify the unit as nonconforming. When nonconforming units are corrected by the contractor, the unit shall be reinspected. When corrective action has been taken, the reinspection of a nonconforming unit may be limited to the test or examination which defined the nonconformance or, when so directed by the cognizant inspector, a complete re-examination and retest of the unit may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.1.2 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

a. Temperature:	25 ± 10°C
b. Relative Humidity:	90% max
c. Barometric Pressure:	23 to 32 inches of Hg

4.2 PROCEDURES FOR SELECTION OF COMPONENTS.

4.2.1 Selection of Controlled Voltage Setting Resistors. Selection of the controlled voltage setting resistors shall be performed within the limits of the following constraints:

a. Supply voltage:	27.5 ± 0.1 V dc
b. Assembly temperature:	25 ± 5°C
c. Synchronizing input:	0 and π phase 800 ± 1 pps, 7 ± 3 V peak, 3.0 ± 0.5 μ sec pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec max.

d. Test setup as indicated in Figure 1. The amplifier shall be NASA Part No. 2007110 or equivalent.

4.2.1.1 Selection Procedure. With R3 not connected, select the lowest value for R2 such that the controlled voltage is less than 27.72 V rms. With R2 connected, select a value for R3 such that the controlled voltage is 28.00 ± 0.06 V rms.

4.2.2 Selection of Non-synchronized Frequency Setting Capacitors. Selection of the capacitors that determine non-synchronized frequency shall be performed within the limits of the following constraints:

a. Supply voltage:	27.5 ± 0.1 V dc
b. Assembly temperature:	25 ± 5°C
c. Synchronizing input:	none
d. Test setup as indicated in Figure 1.	The amplifier shall be NASA Part No. 2007110 or equivalent.

4.2.2.1 Selection Procedure. Select identical value capacitors C7 and C10 for a filter output frequency of 760^{+15}_{-30} cps. 75 x 20, 25

4.2.3 Selection of Phase Setting Capacitor. Selection of the output filter capacitor shall be performed within the limits of the following constraints:

a. Supply voltage:	27.5 ± 0.1 Vdc
b. Assembly temperature:	15° to 40°C
c. Synchronizing input:	0 and π phase 800 ± 1 pps, 7 ± 3 V peak, 3.0 ± 0.5 μ sec. pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec max.
d. Test setup as indicated in Figure 1.	The amplifier shall be NASA Part No. 2007110 or equivalent.

4.2.3.1 Selection Procedure. Select a value for capacitor C5 such that the phase shift between the 0 phase synchronizing pulse and the filter output is 180° ± 5°.

4.3 TEST PROCEDURES.

4.3.1 Pre-Encapsulation Tests. The tests required by this section (4.3.1) shall be performed before encapsulation only and shall be performed within the limits of the following constraints unless otherwise noted:

a. Supply voltage:	27.5 ± 0.1 V dc
b. Assembly temperature:	15°C to 40°C
c. Synchronizing input:	0 and π phase 800 ± 1 pps, 7 ± 3 V peak 3.0 ± 0.5 μ sec pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec max.
d. Test setup as indicated in Figure 1.	The amplifier shall be NASA Part No. 2007110 or equivalent.

4.3.1.1 Linear Dynamic Range. With the synchronizing input present, measure the controlled voltage under the following conditions (Ref. Para. 3.1.1.1):

a. Amplifier gain: 21.6 ± 1.5 V/V

b. Amplifier gain: 14.4±1.0 V/V/V

c. Amplifier gain: 43.2 ± 3.0 V/V

4.3.1.2 Asymmetry. Measure asymmetry at the multivibrator collector which drives the chopper, under the following conditions. (Ref. Para. 3.1.1.2):

a. Synchronizing input present

b. Synchronizing input removed

4.3.1.3 Synchronization Level. The synchronizing input used for these tests shall differ from the input specified in 4.3.1 c only with respect to peak amplitude. Observe whether each side of the multivibrator is synchronized under the following conditions (Ref. Para. 3.1.1.3):

a. Synchronizing input amplitude: 0.4 ± 0.1 V peak

b. Synchronizing input amplitude: 2.1 ± 0.1 V peak.

4.3.1.4 Nominal DC Supply Current. With the synchronizing input present, measure the DC supply current (Ref. Para. 3.1.1.4).

4.3.2 Functional Tests. The tests required by this section (4.3.2) shall be performed within the limits of the following constraints unless otherwise noted, after encapsulation:

a. Supply voltage:	Tests shall be conducted twice (at 25.1 ± 0.1 Vdc and at 29.9 ± 0.1 Vdc).
b. Assembly temperature:	15°C to 40°C
c. Synchronizing Input:	0 and π phase 800 ± 1 pps, 7 ± 3 V peak, 3.0 ± 0.5 μ sec. pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec. max.
d. Test setup as indicated in Figure 1.	The amplifier shall be NASA Part No. 2007110 or equivalent.

4.3.2.1 With the synchronizing input present, measure the following.

a. Controlled voltage (Ref. Para. 3.1.2.1)

b. Harmonic distortion (Ref. Para. 3.1.2.3)

c. Phase shift (Ref. Para. 3.1.2.4)

d. Monitor voltage (Ref. Para. 3.1.2.5). This measurement need be made only once.

4.3.2.2 With the synchronizing input removed, measure the following:

a. Controlled voltage (Ref. Para. 3.1.2.1)

b. Frequency (Ref. Para. 3.1.2.2)

c. Harmonic distortion (Ref. Para. 3.1.2.3)

4.4 DRAWING COMPLIANCE. The assembly shall be visually examined for compliance to the requirements of APOLLO G&N Drawing 2007112. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulation defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.5 WORKMANSHIP VIBRATION TEST. The workmanship vibration test shall be performed within the limits of the following constraints:

a.	Supply voltage:	27.5 ± 0.1 V dc
b.	Assembly temperature:	15° to 40°C
c.	Operation:	The assembly shall perform as specified herein when the output of the assembly drives NASA Part No. 2007110 or equivalent, called the amplifier, and the output of the amplifier drives the 800 cps 1% input of the assembly.
d.	Synchronizing input:	0 and π phase 800 ± 8 pps, 7 ± 3 V peak, 3.0 ± 0.5 μ sec. pulse width at half amplitude, risetime (10 to 90%) 0.5 μ sec. max.

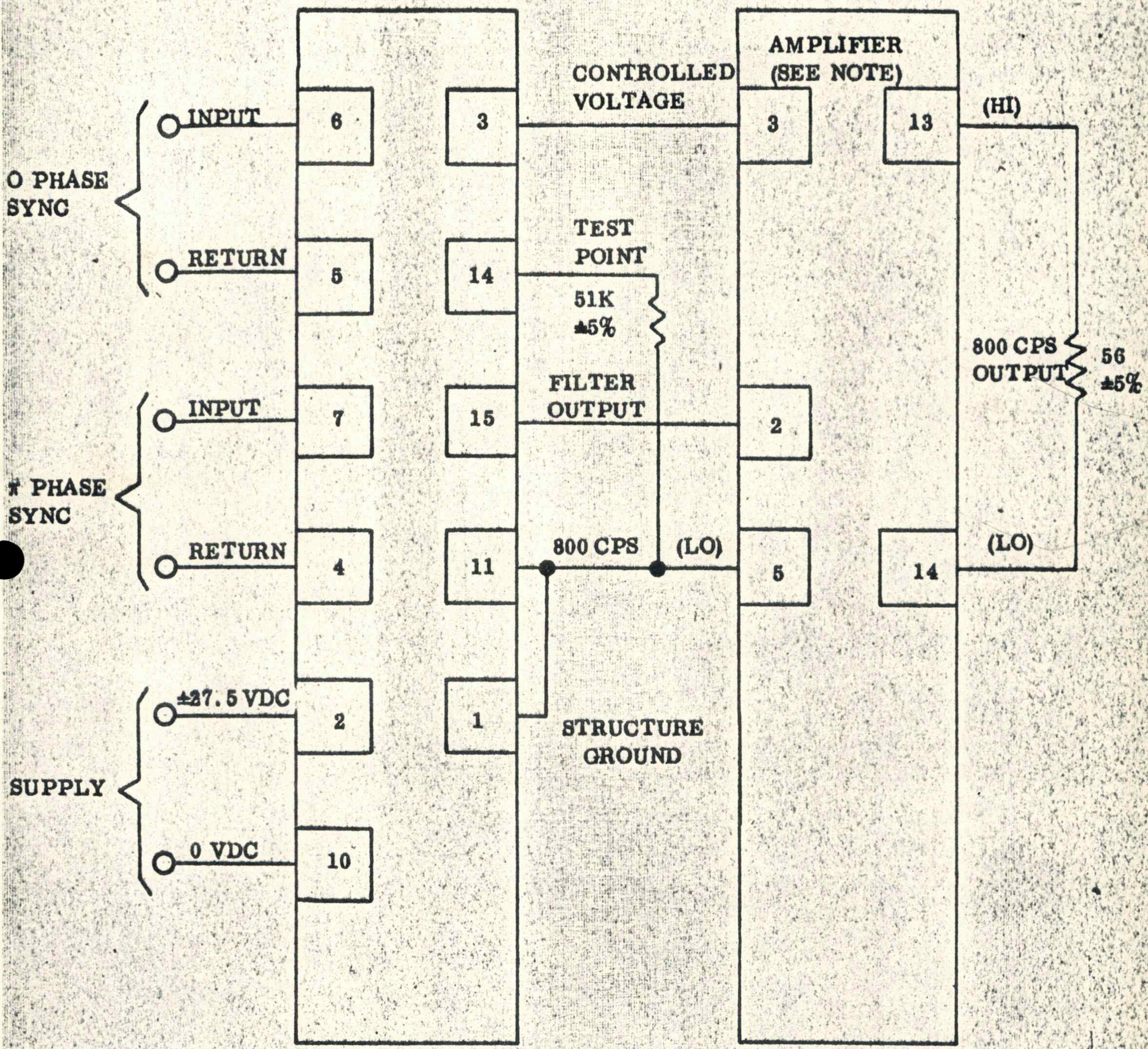
4.5.1 Subject the module to vibration along the axis shown in Figure 2. The vibration shall be simple harmonic motion swept from 10 to 2000 cps at a rate of one (1) octave per 15 seconds. The magnitude of the vibration shall be 6.0 grms limited to 0.4 inch PP constant displacement from 10 cps to the crossover frequency.

4.5.2 During vibration the 800 cps 1% input voltage shall not be outside the range of 28.0 ± 2.8 V rms for a period greater than 1 msec.

4.6 INSULATION RESISTANCE. The insulation resistance between pin 1 and the remaining assembly pins shall be as specified in para. 3.2.3 when measured in accordance with method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output voltage of 225 ± 75 VDC limited to a short circuit current of 6.0 μa. The resistance between pin 1 and the heat sink shall be as specified in para. 3.2.3 when measured in accordance with method 303 of Standard MIL-STD-202. To assure a good electrical connection the anodizing may be penetrated.

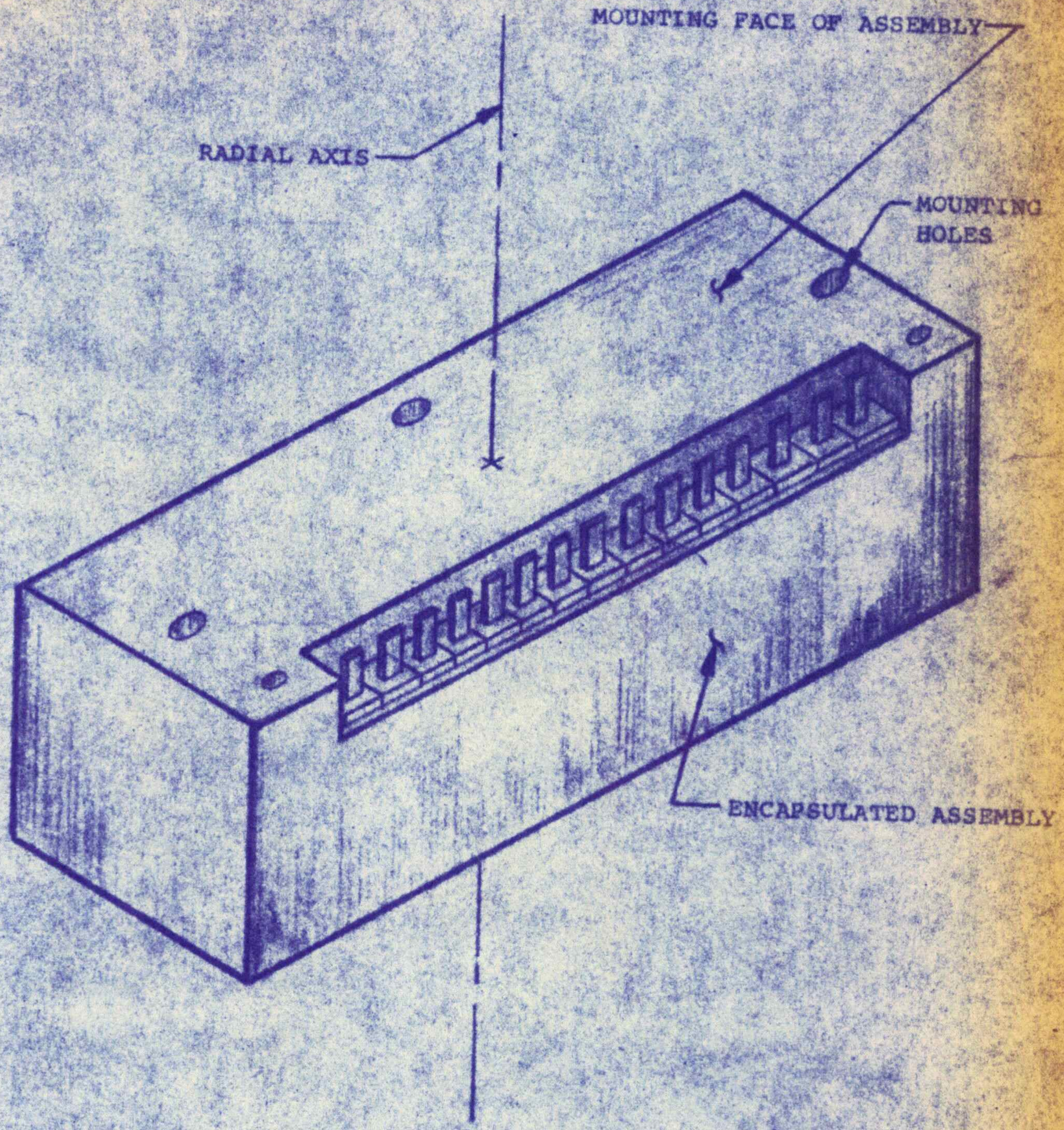
5. PREPARATION FOR DELIVERY.

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND 1002214.



NOTE: AMPLIFIER PIN NUMBERS REFER TO NASA PART NO. 2007110.

FIGURE 1



RADIAL AXIS OF COMPONENTS

FIGURE 2

APOLLO G&N Specification
PS2007113 REV B
Original Issue Date: 23 NOV 1965
Release Authority: TDRR 24299
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

G&N SUBSYSTEM SUPPLY FILTER MODULE ASSEMBLY

DRAWING NO. 2007113

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				MIT	NASA
12/28/65	A	24944	5	WK	--
1/18/66	B	25373	6	WK	--

This specification consists of page 1 to 9 inclusive.

APPROVALS	NASA/MSC	MIT/IL	ACSP

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of the G&N Subsystem Supply Filter Module Assembly, hereafter called the assembly, Part No. 2007113-011.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwsie specified, Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&N

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Sub-assemblies, Parts and Associated Ground Support Equipment.

STANDARDS

Military

MIL-STD-202	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&N

2007113	G&N Subsystem Supply Filter Module Assembly

(Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In event of a conflict between requirements, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this specification

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Inputs. The Supply Filter Module Assembly hereinafter referred to as the assembly, shall perform as specified herein when supplied with a voltage supply of 30.0 ± 0.1 vdc.

3.1.2 Characteristics

3.1.2.1 Telemetry Resistor. The telemetry resistor within the assembly shall have a resistance of 10.0 ± 0.1K ohms.

3.1.2.2 Isolation. Electrical isolation shall be maintained between the two input terminals when either input supplies current to the output terminal.

3.1.2.3 Filtering. The shunt capacitance from the output terminal to the 0 vdc terminal of the assembly shall be 550 μf +50 percent -15 percent.

3.2 PRODUCT CONFIGURATIONS

3.2.1 Drawings. The configuration of the assembly shall be in accordance with Drawing 2007113 and all drawings and engineering data referenced thereon.

3.2.2 Standards of Manufacturing, Manufacturing Process and Production

3.2.2.1 Continuity and DC Resistance. The continuity and dc resistance of the assembly shall be as specified in Table I.

3.2.2.2 Insulation Resistance. The insulation resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms.

TABLE I

CONTINUITY RESISTANCE

TERMINALS		RESISTANCE REQUIRED (Ohms)
From	To	
3	9	10.0 ± 0.1K
9	10	0.5 max
9	11	
9	12	
9	13	
9	14	
9	15	0.5 max

TABLE I (Continued)

TERMINALS		RESISTANCE REQUIRED
From	To	(Ohms)
16	17	0.5 max
16	18	
16	19	
16	20	
16	21	
16	22	
23	24	
23	25	
23	26	
23	27	
23	28	
23	29	
30	31	
30	32	
30	33	
30	34	
30	35	
30	36	
1	Heatsink	0.5 max.

4. QUALITY ASSURANCE PROVISIONS

4.1 PRODUCT PERFORMANCE AND CONFIGURATION REQUIREMENTS/ QUALITY VERIFICATION CROSS REFERENCE INDEX

Test/Examination	Requirement	Method
Telemetry Resistor	3.1.2.1	4.3.5
Isolation	3.1.2.2	4.3.6
Filtering	3.1.2.3	4.3.7
Drawings	3.2.1	4.3.1
Continuity and DC Resistance	3.2.2.1	4.3.3
Insulation Resistance	3.2.2.2	4.3.4

4.2 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.2.1 Test Conditions

4.2.1.1 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

a. Temperature: 25° ±10°C.
b. Relative Humidity: 90% max.
c. Barometric Pressure: 28 to 32 inches of Hg.

4.2.2 Nonconforming Units. Failure of the unit to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or, when directed by the cognizant inspector, a complete retest and reexamination may be required. Nonconforming Units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

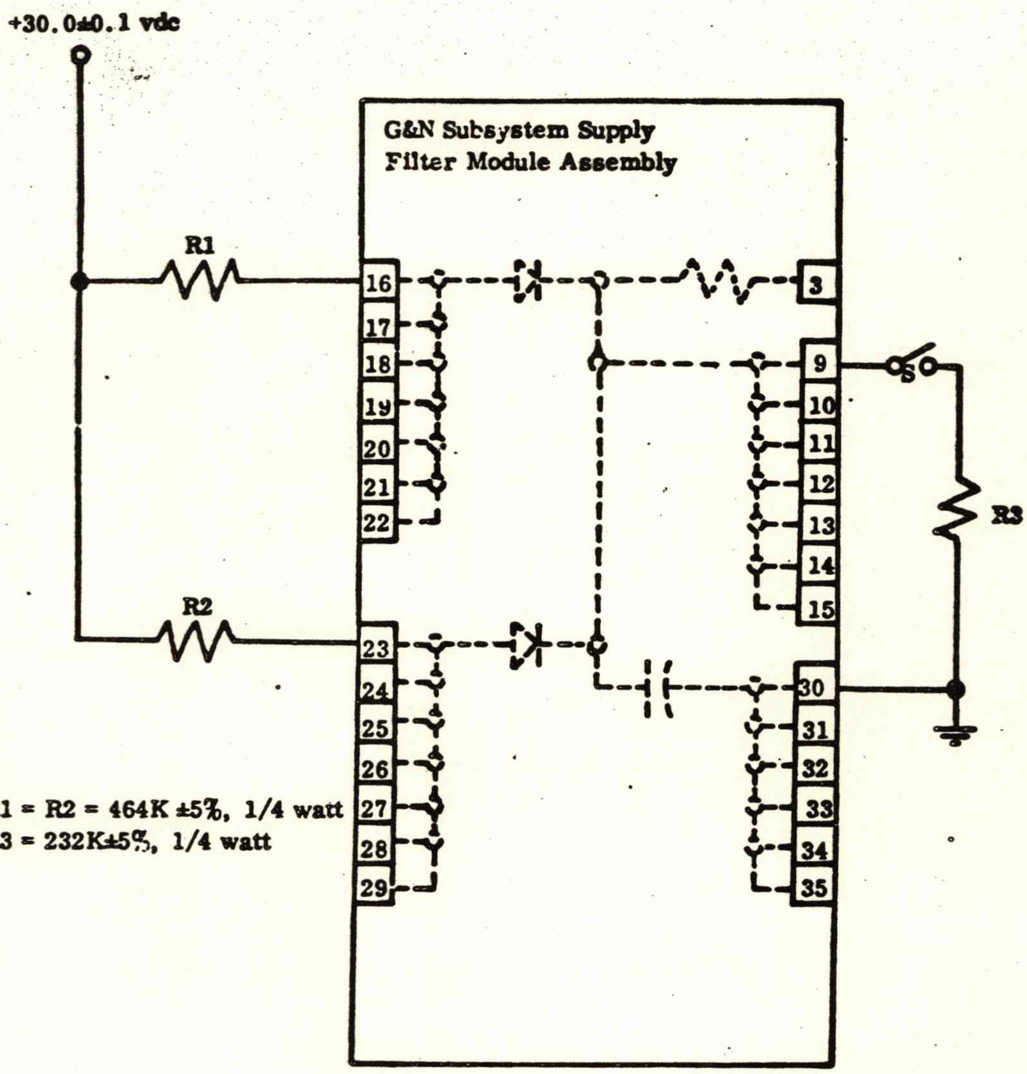
4.3 TESTS

4.3.1 Drawing Compliance. The assembly shall be visually examined for compliance to the requirements of Drawing 2007113. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.3.2 Workmanship-Vibration. With the assembly connected as shown in Figure 1, and switch S closed, the voltage across pins 9 (Hi) and pin 30 (Lo) shall be monitored. When the voltage monitored is 14.25±0.75 vdc switch S shall be opened, and vibration of the assembly shall begin within five seconds after the opening of switch S. The assembly shall be vibrated along an axis perpendicular to the mounting face of the assembly with simple harmonic motion swept from 10 to 2000 cps at a rate of one octave/15 sec. The magnitude of vibration shall be 6.0g rms limited to a 0.4 inch pp constant displacement from 10 cps to the crossover frequency. During vibration the voltages from pins 3, 9, 16, and 23 to ground shall not be outside the range of 13.5 vdc through 26.0 vdc for a period greater than one microsecond. After vibration, the assembly shall be visually examined as specified in 4.3.1.

4.3.3 Continuity and DC Resistance. Resistance between the pins listed in Table I shall be as specified when measured with a low voltage resistance measuring device using Method 303 of Standard MIL-STD-202. To assure a good electrical connection, the anodizing may be penetrated.

4.3.4 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be as specified in 3.2.2.2 when measured using Method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output of 225 ±75 vdc, limited to a short circuit current of 6.0 μa.



R1 = R2 = 464K ±5%, 1/4 watt
R3 = 232K±5%, 1/4 watt

VIBRATION TEST SETUP

FIGURE 1

4.3.5 Telemetry Resistor. Resistance of the telemetry resistor shall be as specified in 3.1.2.1 when measured from terminal 3 to 9 with a low voltage resistance measuring device using Method 303 of Standard MIL-STD-202.

4.3.6 Isolation. With the assembly connected as illustrated in Figure 2, and the conditions present as indicated in Table I, the voltages specified in Table I shall be present.

TABLE I

ISOLATION TEST

S1 POSITION	TERMINALS MEASURED	REQUIRED DC VOLTAGE
A	16 to 9	1.0 max
A	across R2	5.0 max
A	across R3	6.0 max
B	23 to 9	1.0 max
B	across R2	5.0 max

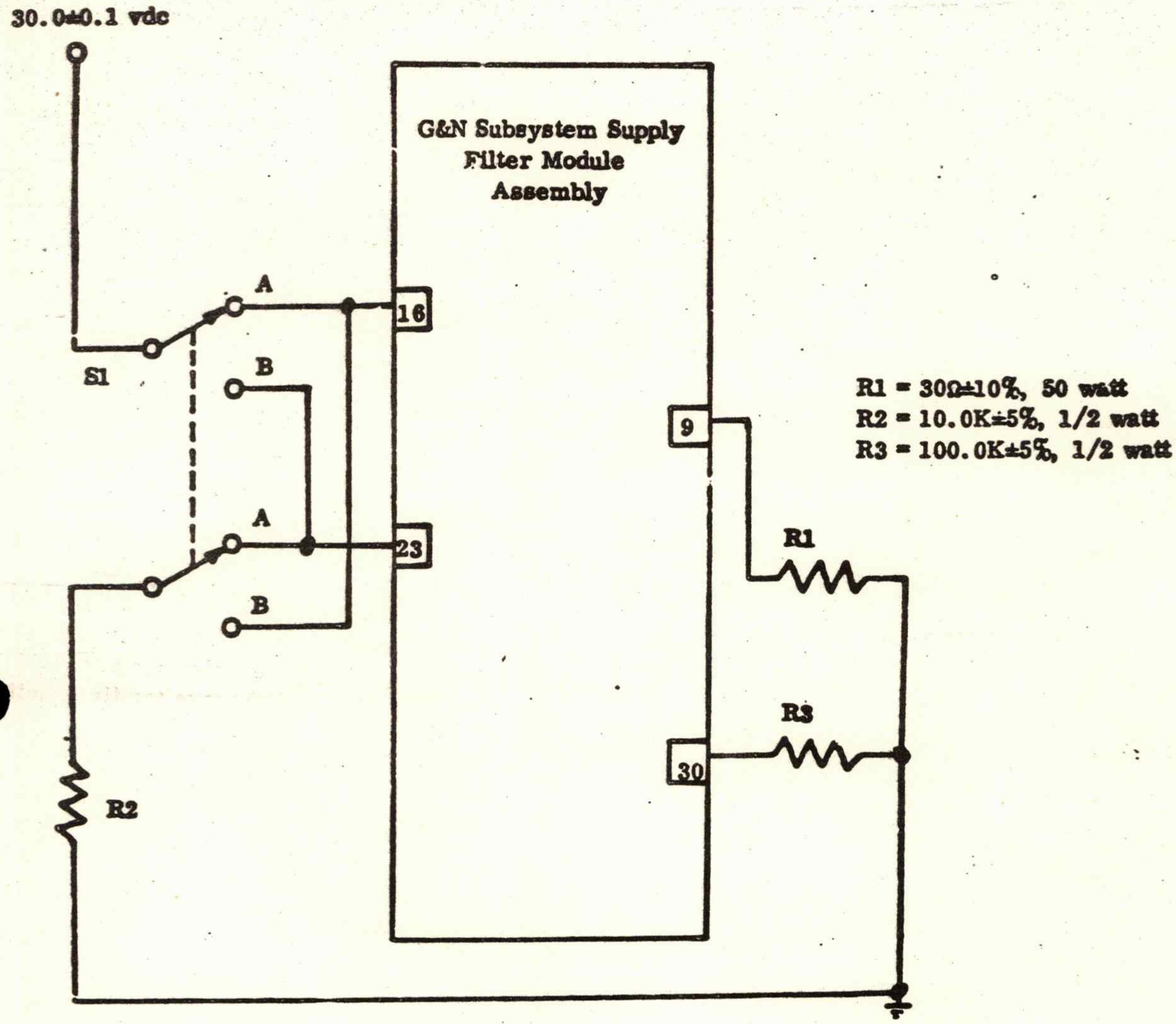
4.3.7 Filtering. With a dc polarizing voltage of 30.0±0.1 vdc connected to pin 9 (Hi), the capacitance between pin 9 (Hi) and 30 (Lo) shall be measured at 120 cps in accordance with Method 305 of Standard MIL-STD-202. The peak ac voltage applied shall not exceed 5 vac. The capacitance shall be as specified in 3.1.2.3.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None

GK/dmh



ISOLATION TEST SETUP

FIGURE 2

Apollo G&N Specification
PS 2007114 Rev - C
Original Issue Date: 30 Nov 65
Release Authority: TDRR 24454
Class Release: A

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

GIMBAL SERVO AMPLIFIER

DRAWING NO. 2007114

Date	Revision Letter	TDRR No.	Pages Revised	Approvals AC	Approvals NASA
2/23/66	A	26595	6	WK	--
11/8/66	B	32031	2, 5, 7, 10	MGM EA	--
1/12/67	C	32626	7	MGM EA	--

This specification consists of Pages 1 to 13 inclusive.

APPROVALS	A. C. METZGER			
	NASA/MSC	MIT/IL		AC

In Mode II, using Feedback III, and with an 800 cps input of 10 V rms OUT OF PHASE with the demodulator reference, the torque motor current shall be in NEGATIVE saturation. When the input is shorted, the torque motor current shall saturate in the opposite direction for a time duration between 250 and 400 milliseconds.

3.1.2.4 Saturation. In Mode I, using Feedback I, the maximum output between pins 12 and 9 shall be at least $\pm$ 23.5 V dc.

3.1.2.5 Offset. In Mode I, using each of the three Feedbacks, and with a 3200 cps input such that the torque motor current is 0 $\pm$ 5 ma, the input shall be less than 15 mv rms.

In Mode II, using each of the three Feedbacks, and with an 800 cps input such that the torque motor current is 0 $\pm$ 5 ma, the input shall be less than 25 mv rms.

3.1.2.6 Test Input Responce. (Type I Only). In Mode I, using Feedback I, without the demodulator reference, and with a 5 cps test input of 3.0 V peak, the torque motor current current shall be 280 $\pm$ 40 ma peak.

3.1.2.7 Continuity. The resistance between pins 23 and 20 shall be 20 $\pm$ 4 K. The resistance between pins 11 and 12 shall be 510 $\pm$ 102Ω. The resistance between pins 7 and 8 shall be 100 $\pm$ 20 Ω. The resistance between pins 19 and 18 shall be less than 1 ohm.

3.1.2.8 Test Input Response. (Type II Only). In Mode I, using Feedback I, without the demodulator reference, and with a 5 cps test input of 1.0V peak, the torque motor current shall be 93±13 ma peak.

3.1.2.9 Demodulator Unbalance (Type II Only). In Mode I, using Feedback I and with the input shorted, the dc voltage at pin 16 (Hi) and pin 9 (Lo) shall be $\frac{50 \text{ mv dc}}{1+\frac{510K}{R}}$ max

R = meter impedance

3.2 PRODUCT CONFIGURATION.

3.2.1 Drawings. The configuration of the assembly shall be in accordance with Apollo G&N Drawing 2007114 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall not be less than 100 megohms. The resistance between pin 1 and the heat sink shall be less than or equal to 0.5 ohms.

GIMBAL SERVO AMP.
2007114

Apollo G&N Specification
PS 2007117 Rev C
Original Issue Date: 11-15-65
Release Authority: TDRR 21139
Class Release: A

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

IMU AUXILIARY ASSEMBLY

DRAWING NO. 2007117

Date	Revision Letter	TDRR No.	Pages Revised	Approvals AC	Approvals NASA
M 3/22/66	A	27423	3 RDG/AC	WK	--
M 6/7/66	B	29471	9 RDG/AC	MGM	--
M 1/12/67	C	32626	4 RDG/AC	MGM EA	--

This specification consists of Pages 1 to 10 inclusive.

APPROVALS	A. C. METZGER NASA/MSC	Manuel Kramer MIT/IL 11/3/65		AC

1. SCOPE

1.1 This specification establishes the detail requirements for complete identification and acceptance of the IMU Auxiliary Assembly PART NO. 2007117-011.

1.2 PRODUCT CONFIGURATION BASELINE ACCEPTANCE.

1.2.1 The product configuration baseline shall be established by F.A.C.I. of the end item Serial No. . This unit and all subsequent units regardless of intended use shall be accepted to the configuration defined by Serial No. unless formally approved otherwise as required by ANA Bulletin No. 445.

2. APPLICABLE DOCUMENTS

2.1 The following documents form a part of this specification to the extent specified herein.

2.1.2 Effective Issues. Unless otherwise specified herein, Military and Government Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATION

APOLLO G&N ND 1002214

STANDARDS

MIL-STD-202

DRAWINGS

APOLLO G&N 2007117

BULLETIN

ANA Bulletin No. 445

Copies of Specifications, Standards, Drawings, Bulletins and Publications required by suppliers in connection with specific procurement functions should be obtained from the Procuring Activity or as directed by the contracting office.

2.2 CONFLICTING REQUIREMENTS. In the event of conflict between the requirements of the contract, this document and the documents listed in this section, the following order of precedence shall apply and the contractor shall notify MIT Apollo Management of the conflict as soon as it is determined.

a. The contract.
b. This specification.
c. Documents listed in this section.

See Rev. A

3. REQUIREMENTS

3.1 PERFORMANCE.

3.1.1 Functional Requirements. The assembly shall perform as specified in the section (3.1.1) within the limits of the following constraints unless otherwise noted, after encapsulation:

a. Supply voltage: 25 to 30 V dc

b. Assembly temperature: 15° to 40°C

c. Loads

Gimbal Servo Out of Limits Load	22 kΩ, 5%
AGC Load	2 kΩ, 5%
Cage Relay Load	28 kΩ, 5%
IMU Temp OOL Load	34 kΩ, 5%

d. Test setup as indicated in Figure 1

3.1.1.1 IMU Temperature Out of Limit Supply Current and Output Voltage. At a supply voltage of 36 ± 0.1 V dc, with a 4 ± 0.04 V dc input applied between IMU Temperature Out of Limits input and 0 V dc, the current drawn from the DC supply shall be less than 100 μ a with the load removed; with the load connected the output voltage shall be 25 ± 2 V dc. With an 18 ± 0.1 V dc input, the output voltage shall be less than 1.0 V dc with the load removed. (Note - A meter with an input impedance greater than 1 megohm shall be used in this test.)

3.1.1.2 Output to AGC. The voltage across the 2 kΩ, 5% load shall be greater than 11.3 V dc when the relay is unenergized.

3.1.1.3 Output to Cage Relays. The voltage across the 28kΩ 5% load shall be greater than 24 V dc when the relay is unenergized and when the relay is energized by connecting the caging input to the high of the DC supply.

3.1.1.4 Continuity. When the relay is unenergized, the resistance between pins 16 and 17 shall be less than 1 Ω and the resistance between pins 14 and 16 shall be greater than 100 megohms. When the relay is energized, the resistance between pins 17 and 16 shall be greater than 100 megohms and the resistance between pins 14 and 17 shall be less than 1 Ω.

3.1.1.5 Input from AGC Mode. When the input from AGC is connected to 0 V dc, the relay shall energize. When the input from AGC is removed from 0 V dc, the relay shall remain energized.

3.1.1.6 Caging Mode. When the caging input is connected to the high of theDC supply the relay s hall energize. When the caging input is removed from the high of the DC supply, the relay shall remain energized.

3.1.1.7 Relay Drop Out Time. When the DC Supply Voltage is removed from the +28 V IMU pin, the relay drop out time shall be greater than 500 msec.

3.1.1.8 Threshold Detection Test. The assembly shall perform as specified by Table 1.

TABLE 1

Input	Non-Fail Condition	Fail Condition	Fail Indication	Fail Time Constant
Wheel Phase B 28 V rms, 5% 800 cps	> 20 V rms	< 10 V rms	> 11 V dc across load 1	1.25 ± 0.5 sec
AAC remote sense 28 V rms, 1% 3.2 KC	> 20 V rms	< 10 V rms	> 11 V dc across load 1	1.25 ± 0.5 sec
Gimbal Error Signal 3.2 KC	< 5.5 V rms	> 7.5 V rms	> 11 V dc across load 1	1.25 ± 0.5 sec.

3.2 PRODUCT CONFIGURATION.

3.2.1 Drawings. The configuration of the assembly shall be in accordance with Apollo G&N Drawing 2007117 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms. The resistance between pin 1 and the heat sink shall be less than or equal to 0.5 ohms.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 The failure of an end product to pass any examination or test of this section will automatically classify the unit as nonconforming. When nonconforming units are corrected by the contractor, the unit shall be reinspected. When corrective action has been taken, the reinspection of a nonconforming unit may be limited to the test or examination which defined the nonconformance, or when so directed by the cognizant inspector, a complete re-examination and retest of the unit may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.1.2 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

a.	Temperature:	$25 \pm 10°C$
b.	Relative humidity:	90% max.
c.	Barometric pressure:	23 to 32 inches of Hg

4.2 PROCEDURE FOR SELECTION OF COMPONENT.

4.2.1 Threshold Level Resistor Selection. The selection of the threshold level resistor shall be performed within the limits of the following constraints:

a.	Supply voltage:	27.5 ± 0.1 V dc
b.	Assembly temperature:	15° to 40°C
c.	Inputs	
	1 Wheel Phase	28.0 ± 0.2 V rms 800 ± 8 cps
	2 AAC Remote Sense	28.0 ± 0.2 V rms 3200 ± 32 cps
d.	Test setup as indicated in Figure 1.	

4.2.1.1 Selection Procedure. R17 shall be the smallest resistor such that a signal of 6.75 ± 0.07 V rms applied sequentially to the inner, middle, and outer gimbal error inputs shall cause a failure indication across the Gimbal Servo OOI load.

4.3 TEST PROCEDURES.

4.3.1 Functional Tests. The tests required by this section (4.3.1) shall be performed within the limits of the following constraints unless otherwise noted, after encapsulation:

a. Supply voltage - tests shall be conducted twice, at 25.1 ± 0.1 V dc and at 29.9 ± 0.1 V dc.

b. Assembly temperature: 15° to 40°C

c. Test setup as indicated in Figure 1

4.3.1.1 Electrical Performance Tests. Measure the following:

a. IMU Temperature Out of Limits DC Supply Current and Output Voltage (Ref. Para. 3.1.1.1).

b. Output to AGC (Ref. Para. 3.1.1.2)

c. Output to Cage Relays (Ref. Para. 3.1.1.3)

d. Continuity (Ref. Para. 3.1.1.4)

e. Relay Drop Out Time (Ref. Para. 3.1.1.7)

4.3.1.2 Verify that the relay energizes when the input from AGC is grounded and remains energized when grounding input is removed (Ref. Para. 3.1.1.5).

4.3.1.3 Verify that the relay energizes when the caging input is connected to the high of the DC supply and remains energized when the caging input is removed (Ref. Para. 3.1.1.6).

4.3.1.4 Apply all non-fail conditions and verify that there is no fail indication. Keeping all other non-fail conditions, sequentially apply fail conditions to each input and verify fail indication and time constant (Ref. Para. 3.1.1.8).

4.4 DRAWING COMPLIANCE. The assembly shall be visually examined for compliance to the requirements of Apollo G&N Drawing 2007117. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulation defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.5 WORKMANSHIP VIBRATION TEST. The workmanship vibration test shall be performed within the limits of the following constraints:

a. Supply voltage: 27.5 ± 0.1 V dc

b. Assembly temperature: 15° to 40°C

c. Inputs

1.	Wheel Phase B	Non-fail condition
2.	AAC Remote Sense	Non-fail condition
3.	Inner Gimbal Error	Non-fail condition
4.	Middle Gimbal Error	Non-fail condition
5.	Outer Gimbal Error	Fail condition
6.	Cage Switch	27.5 ± 0.1 V dc
7.	IMU Temperature Out of Limits	20.0 ± 0.2 V dc

d. The low of inputs 1 through 5 shall be connected to 0 V dc.

e. Test setup as indicated in Figure 1.

4.5.1 Subject the module to vibration along the axis shown in Figure 2. The vibration shall be simple harmonic motion swept from 10 to 2000 cps at a rate of one (1) octave per 15 seconds. The magnitude of the vibration shall be 6.0 grms limited to 0.4 inch PP constant displacement from 10 cps to the crossover frequency.

4.5.2 During vibration the following signals shall not lie outside the indicated ranges for a period greater than 1 msec.

a.	Fail Indication:	25 ± 4 V dc
b.	Cage Relay Output:	26.8 ± 2.7 V dc
c.	IMU Temperature Out Of Limit Output Voltage (Note Z_{IN} of meter > 1 meg)	0.5 ± 0.5 V dc

4.6 INSULATION RESISTANCE. The insulation resistance between pin 1 and the remaining assembly pins shall be as specified in Para. 3.2.3 when measured in accordance with method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output voltage of 225 ± 75 V dc limited to a short circuit current of 6.0 µa. The resistance between pin 1 and the heat sink shall be as specified in Para. 3.2.3 when measured in accordance with method 303 of Standard MIL-STD-202. Th assure good electrical connection the anodizing may be penetrated.

5. PREPARATION FOR DELIVERY.

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND 1002214

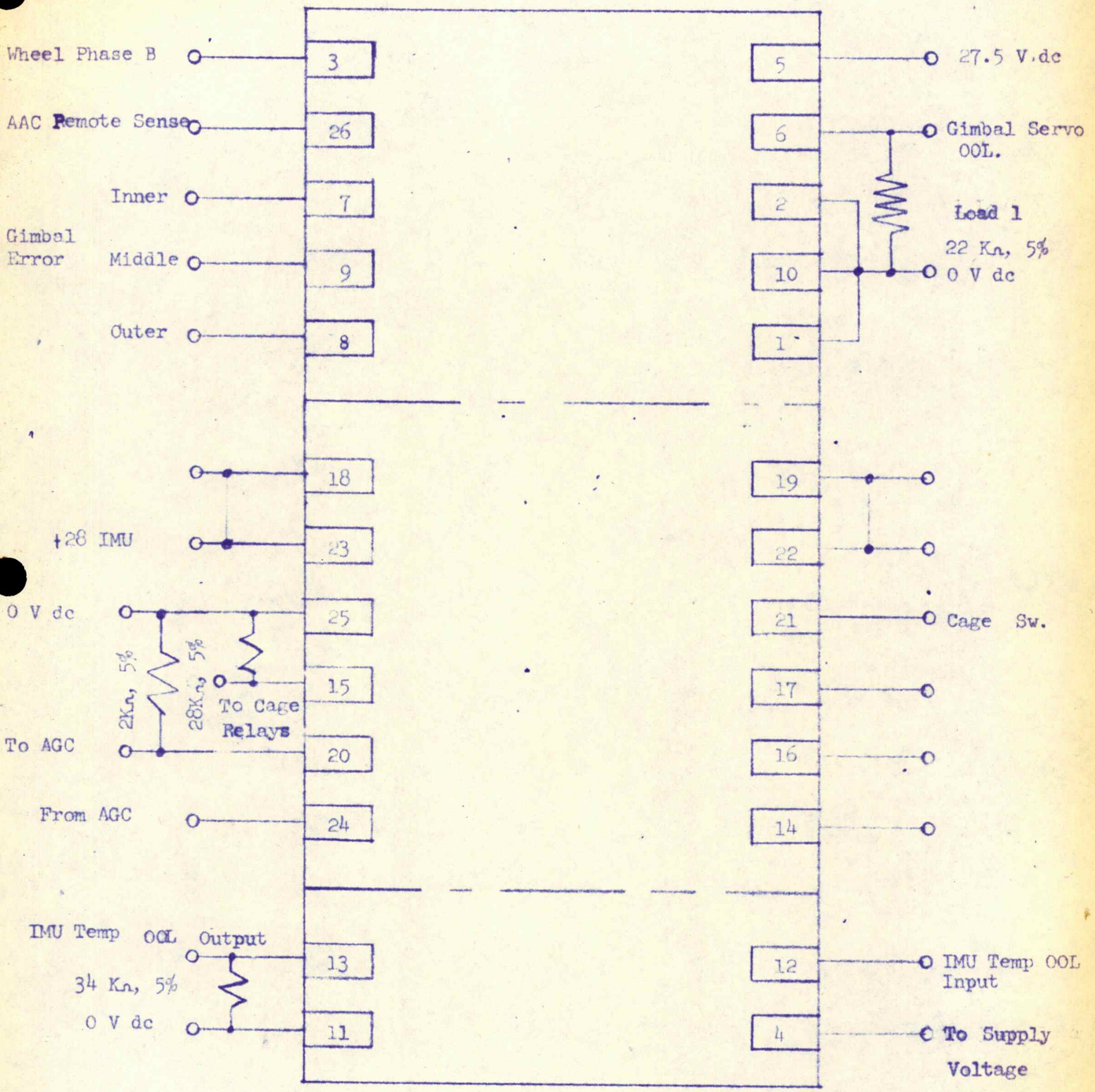
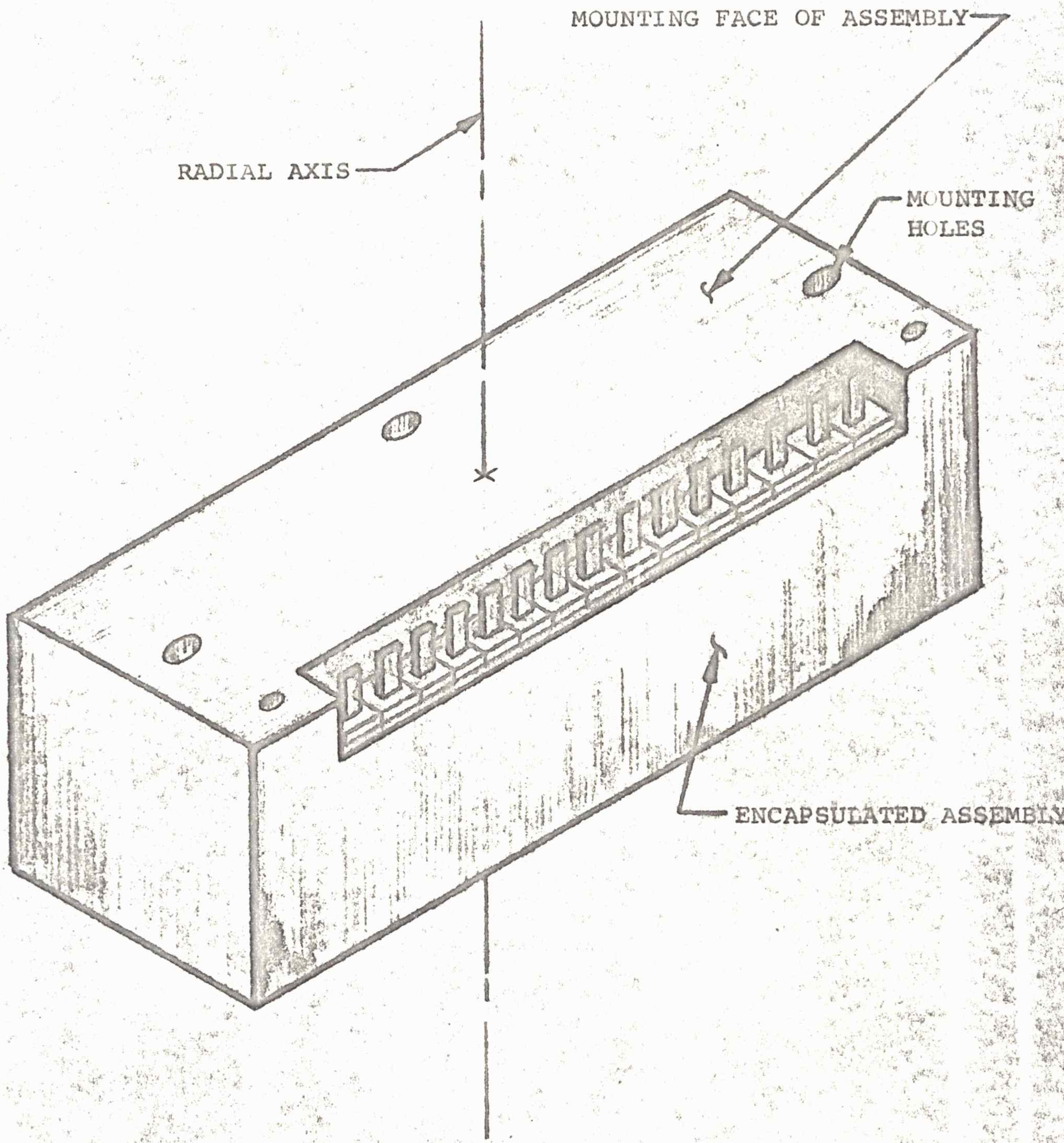

Wheel Phase B
3
AAC Remote Sense
26
Gimbal Error
Inner
7
Middle
9
Outer
8
5
27.5 V.dc
6
Gimbal Servo OOL.
2
Load 1
22 Kn, 5%
10
0 V dc
1
18
+28 IMU
23
0 V dc
25
2Kn, 5%
28Kn, 5%
15
To Cage Relays
To AGC
20
From AGC
24
19
22
21
Cage Sw.
17
16
14
IMU Temp OOL Output
13
34 Kn, 5%
0 V dc
11
12
IMU Temp OOL Input
4
To Supply Voltage

FIGURE 1



RADIAL AXIS OF COMPONENTS

FIGURE 2

APOLLO G&N Specification
PS2007118 REV D
Original Issue Date: 8 SEPT 65
Release Authority: TDRR 22324
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

MOTOR DRIVE AMPLIFIER ASSEMBLY

DRAWING NO. 2007118

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
M 2/23/66	A	26593	8, 14 RDG/AC	WK	TM
M 3/22/66	B	27422	4 RDG/AC	WK	--
M 11/3/66	C	31783	5,6,7,11,12,13,14 RDG/AC	MGM EA	--
M 1/12/67	D	32626	8, 14 RDG/AC	MGM EA	--

This specification consists of page 1 to 15 inclusive.

APPROVALS	NASA/MSC	MIT/IL	AC
		S R Hyrgy / M J Mirley 8-4-65	J. Dannenberger / R. Greenwood

NOT REQUIRED PER LETTER
NASA PP7-65-612

3.1.2.16 Tach Monitor. The gain from input to output shall be 0.082 V/V ±10 percent under the following conditions:

a. A nominal supply voltage.

b. An 800 cps signal applied to pins 17 (hi) and 21 (lo), and adjusted to provide an output of 0.3V ±10 percent between pins 19 (hi) and 10 (lo).

3.2 PRODUCTION CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007118 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 DC Resistance. DC resistance shall be as specified in Table IV.

TABLE IV

DC RESISTANCES

From	To	Resistance (ohms)
Pin 9	Pin 10	<0.5
↑ 9	Pin 11	<0.5
9	Pin 12	<0.5
↓ 1	Frame	<0.5
Pin 25	Pin 24	4.7K ±0.3K

3.2.3.2 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms.

4.2.15 Feedback Compensation Gain Linearity. With the conditions specified below established, the gains from input to output shall be within ±10 percent of the gain obtained for item "a" in Table II of 4.2.14.

a. Nominal dc supply voltage applied to terminals 22 (hi) and 20 (lo).

b. Reference voltage applied to terminals 2 (hi) and 5 (lo).

c. An 800 cps suppressed carrier signal with 10 cps modulation applied to terminals 17 (hi) and 21 (lo) and adjusted to provide a 0.4V pp and then a 8V pp output between terminals 13 (hi) and 12 (lo).

4.2.16 Feedback Compensation Phase Shift. With the following conditions established, the phase shift of the output with respect to the reference shall be $\leq 15°$.

a. Conditions "a" and "b" of 4.2.15 repeated.

b. An 800 cps suppressed carrier input signal with 10 cps modulation applied to terminals 17 (hi) and 21 (lo), and adjusted to provide an output of 3V pp between terminals 13 (hi) and 12 (lo).

4.2.17 Feedback Compensation Frequency Response. With the conditions specified below established, the phase shift and input signal ratio shall be as specified in Table III.

a. Conditions "a" and "b" of 4.2.15 repeated.

b. An 800 cps suppressed carrier input signal with 10 cps modulation applied to terminals 17 (hi) and 21 (lo) and adjusted in amplitude to provide an output of 3V pp between terminals 13 (hi) and 12 (lo) at each modulation frequency specified in Table III.

4.2.18 Preamp Monitor. With the following conditions established, the gain from input to output shall be 2.40±0.36 V/V.

a. Conditions "a" and "b" of 4.2.15 repeated.

b. Terminals 6, 7 and 8 connected to terminal 10.

c. An 800 cps input signal applied to terminals 4 (hi) and 10 (lo) and adjusted to provide an output of 0.30±0.03V between terminals 3 (hi) and 10 (lo).

4.2.19 Tach Monitor. With conditions "a" and "b" of 4.2.15 established and with an 800 cps input signal applied to terminals 17 (hi) and 21 (lo) and adjusted to provide an output of 0.30±0.03V between terminals 19 (hi) and 10 (lo), the gain from input to output shall be 0.0820±0.0082 V/V.

4.2.20 Weight. **Not applicable.**

APOLLO G&N Specification
PS2007118 REV
Original Issue Date:
Release Authority: TDRR
Class Release
CODE IDENT NO. 80230

MX113219

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

MOTOR DRIVE AMPLIFIER ASSEMBLY

DRAWING NO. 2007118

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				MIT	NASA

This specification consists of page 1 to 15 inclusive.

APPROVALS	NASA/MSC	MIT/IL	ACSP
			[signature] R. Greenwood

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of the Motor Drive Amplifier Assembly, Part Number 2007118-011.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&N

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment

STANDARDS

Military

MIL-STD-202C	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&N

2007118	Motor Drive Amplifier Assembly

(Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In event of a conflict between requirements, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this section.

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Inputs. The assembly shall perform as specified herein with the following electrical inputs:

3.1.1.1 DC Supply Voltage. The dc supply voltage shall be as follows:

a. Nominal: 27.50±0.25 vdc
b. Degraded: 23.0±0.2 vdc
c. Enhanced: 32.0±0.3 vdc

3.1.1.2 Reference Voltage. Reference voltage shall be 28.0±0.5V rms, 800±2 cps sinusoidal wave with a maximum distortion of 5 percent.

3.1.1.3 Input Signals. The following three required input signals shall be phase locked with respect to the reference voltage:

a. 800±2 cps, 0 to 10V rms, both in-phase (0° ±1.0°) and out-of-phase (180.0° ±1.0°) with respect to the reference voltage.

b. 800±2 cps suppressed carrier, modulated from 0.16 to 20 cps, 0 to 48V pp.

c. 800±2 cps, 0 to 100 mv rms, both $+\pi/2$ phase (+90.0° ±0.5°) and $-\pi/2$ phase (-90.0° ±0.5°) with respect to the reference voltage.

3.1.2 Characteristics. Unless otherwise specified, the following characteristics are based upon the assembly being loaded as shown in Figure 1.

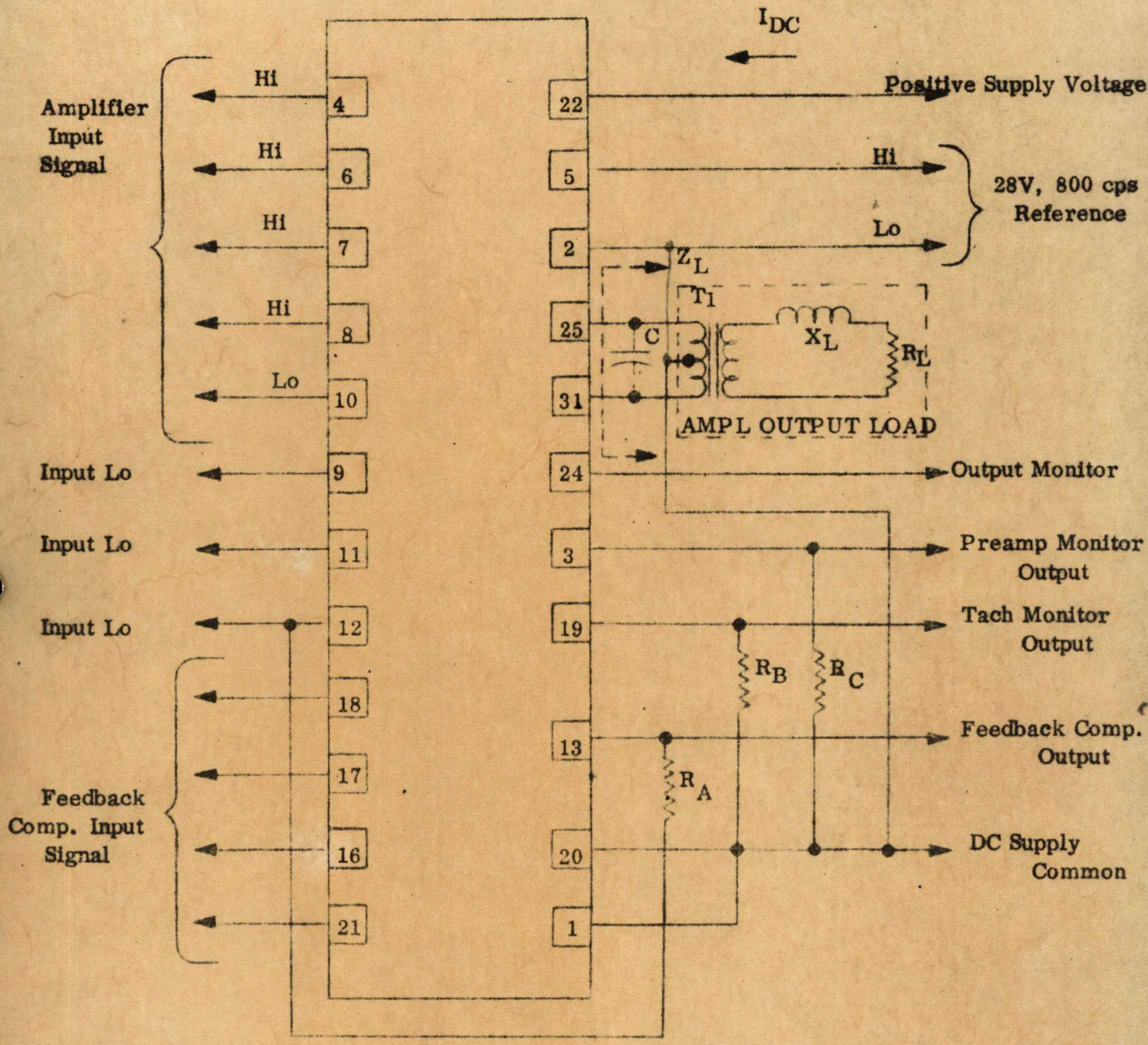
3.1.2.1 Current Drain - Nominal DC Supply Voltage. Current drain from the dc power supply shall be as follows when the supply voltage is nominal:

a. A maximum of 75 ma when there is no amplifier input.

b. A maximum of 360 ma when the 800 cps signal is applied between any amplifier input hi and amplifier input lo with the input adjusted to provide a 30V output to the amplifier output load.

3.1.2.2 Current Drain - Enhanced DC Supply Voltage. Current drain from the dc power supply shall be 40±4 ma when the supply voltage is enhanced and the amplifier output load is disconnected.

3.1.2.3 Amplifier Noise. The output noise shall not exceed 0.5V (0° or π phase) for the 800 cps component and 1V total when the supply voltage is nominal.



R_A = 165KΩ ±5%, R_B = 10KΩ ±5%, R_C = 10KΩ ±5%, R_L = Approx. 230Ω, X_L = Approx. 33mh.
T1 primary dc resistance = 20Ω±20%. Center tap within 2.5% of true center tap.
X_L and R_L shall be adjusted so that Z_L = 333Ω±10%$\angle$±5° @ 800 cps and 87Ω max at 2400 cps and above with C = 1.0 ufd ±1%. Module tests shall be made with C removed.

RECOMMENDED TEST SETUP

FIGURE 1

3.1.2.4 Amplifier Gain. The amplifier 0° and π phase gain shall be as specified below when the supply voltage is nominal and the input amplitude is adjusted to provide an 800 cps component output of 10V.

a. A gain of 2200 V/V ±20 percent when an 800 cps signal is applied to pins 4, 7, and 8 taken one at a time.

b. A gain of 645 V/V ±20 percent when an 800 cps signal is applied to pin 6.

3.1.2.5 Amplifier Gain Linearity. When the following conditions exist, the 0° phase gain at each output voltage shall be within ±10 percent of the 800 cps component 0° phase gain in 3.1.2.4.

a. A nominal supply voltage.
b. An 800 cps, 0° phase input signal to pin 4.
c. The input adjusted for 800 cps component outputs of 3V and 30V.

3.1.2.6 Amplifier Phase Shift. The phase shift of the output with respect to the input shall be 180° ±15° for both 0° and π phase input signals under the following conditions:

a. A nominal supply voltage.

b. An 800 cps input signal to pins 4.

c. The input amplitude adjusted for an output of 5V from the output hi to dc supply common.

3.1.2.7 Amplifier Minimum Output. The output of the amplifier shall be a minimum of 30V for both 0° and π phase input signals when the following conditions exist:

a. A degraded supply voltage.
b. A 10V input signal to pin 4.

3.1.2.8 Amplifier Frequency Response. When the following conditions exist, the frequency response of the amplifier shall be as specified in Table I. When an unbalance occurs at the output, the output determination shall be an average value.

a. A nominal supply voltage.

b. An 800 cps suppressed carrier input signal to pin 4 which has been adjusted in amplitude at various modulation frequencies to provide an output of 10V pp.

TABLE I

FREQUENCY RESPONSE

Modulation Frequency (cps) ± 5%	Input Signal Ratio		Phase Shift* (degrees)
	Minimum	Maximum	
0.1 (Reference)	--	--	
0.8	0.630	0.794	
20.0	--	--	25±10

*With respect to the modulation frequency

3.1.2.9 Amplifier Quadrature Rejection. When the following conditions exist, the 800 cps (0° or π phase) component of the output shall be less than 12V rms when the input quadrature signal is leading the reference voltage by 90.0°±0.5°, and when it is lagging the reference voltage by 90.0° ±0.5°.

a. A nominal supply voltage.
b. A 100 mv, 800 cps quadrature input to pin 4.

3.1.2.10 Feedback Compensation Noise. When the following conditions exist, the output noise shall not exceed 2 mv of the 0° phase or π phase, 800 cps component, nor shall it exceed 10 mv total.

a. A nominal supply voltage.
b. Inputs to the feedback compensation shorted to signal lo.

3.1.2.11 Feedback Compensation Gain. Gain shall be as specified in Table II under the following conditions:

a. A nominal supply voltage.

b. An 800 cps suppressed carrier signal with 10 cps modulation applied to the inputs as specified in Table II, and adjusted in amplitude to provide an output of 3V pp.

TABLE II

GAIN

Item	Signal Input		Jumper		Gain* (±15%)
	Hi	Lo	From	To	
a	17	21	--	--	0.26
b	18	21	--	--	0.128
c	18	21	16	17	0.0735

*Gain = pp output/pp input. (When an unbalance occurs at the output, the output measurement shall be an average value.)

3.1.2.12 Feedback Compensation Gain Linearity. When the following conditions exist, the gain at each output voltage shall be within ±10 percent of the gain for item "a" in Table II.

a. A nominal supply voltage.

b. An 800 cps suppressed signal with 10 cps modulation applied to pins 17 (hi) and 21 (lo), and adjusted in amplitude to provide outputs of 0.4V pp and 8V pp.

3.1.2.13 Feedback Compensation Phase Shift. When the following conditions exist, the phase shift of the side-band frequencies shall be 15° maximum.

a. A nominal supply voltage.

b. An 800 cps suppressed carrier signal with 10 cps modulation applied to pins 17 (hi) and 21 (lo), and adjusted in amplitude to provide an output of 3V pp.

3.1.2.14 Feedback Compensation Frequency Response. Frequency response shall be as specified in Table III when the following conditions exist:

a. A nominal supply voltage.

b. An 800 cps suppressed carrier signal applied to pins 17 (hi) and 21 (lo), and adjusted in amplitude at various modulation frequencies to provide an output of 3V pp.

TABLE III

FEEDBACK COMPENSATION FREQUENCY RESPONSE

Modulation Frequency (cps) ± 5%	Input Signal Ratio *		Phase Shift ** (degrees)
	Min.	Max.	
10 (reference)	--	--	--
0.16	0.4	0.5	--
0.32	--	--	45±10

*Where input signal ratio = input signal at 10 cps / input signal at 0.16 cps.

** With respect to ~~10 cps~~ modulation, frequency.

3.1.2.15 Preamp Monitor. The gain from input to output shall be 2.4 V/V ±15 percent when the following conditions exist.

a. A nominal supply voltage.

b. An 800 cps signal applied to pins 4 (hi) and 10 (lo).

c. The input adjusted to provide an output of 0.3V ± 10 percent between pins 3 (hi) and 10 (lo).

3.1.2.16 Tach Monitor. The gain from input to output shall be 0.082 V/V ±10 percent under the following conditions:

a. A nominal supply voltage.

b. An 800 cps signal applied to pins 17 (hi) and 21 (lo), and adjusted to provide an output of 0.3V ±10 percent between pins 19 (hi) and 10 (lo).

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007118 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. The maximum weight of the assembly shall be .

3.2.3 Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 DC Resistance. DC resistance shall be as specified in Table IV.

TABLE IV

DC RESISTANCES

From	To	Resistance (ohms)
Pin 9	Pin 10	<0.5
9	Pin 11	<0.5
9	Pin 12	<0.5
1	Frame	<0.5
Pin 25	Pin 24	4.7K ±0.3K

3.2.3.2 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 Test Conditions

4.1.1.1 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

- a. Temperature: 25° ±10°C
- b. Relative Humidity: 90% max
- c. Barometric Pressure: 28 to 32 inches of Hg

4.1.1.2 Unless otherwise specified, the following characteristics are based upon the assembly being loaded as shown in Figure 1.

4.1.1.~~2~~3 Supply Voltage. Unless otherwise specified, the assemblies shall be tested with a supply voltage having the characteristics specified in 3.1.1.

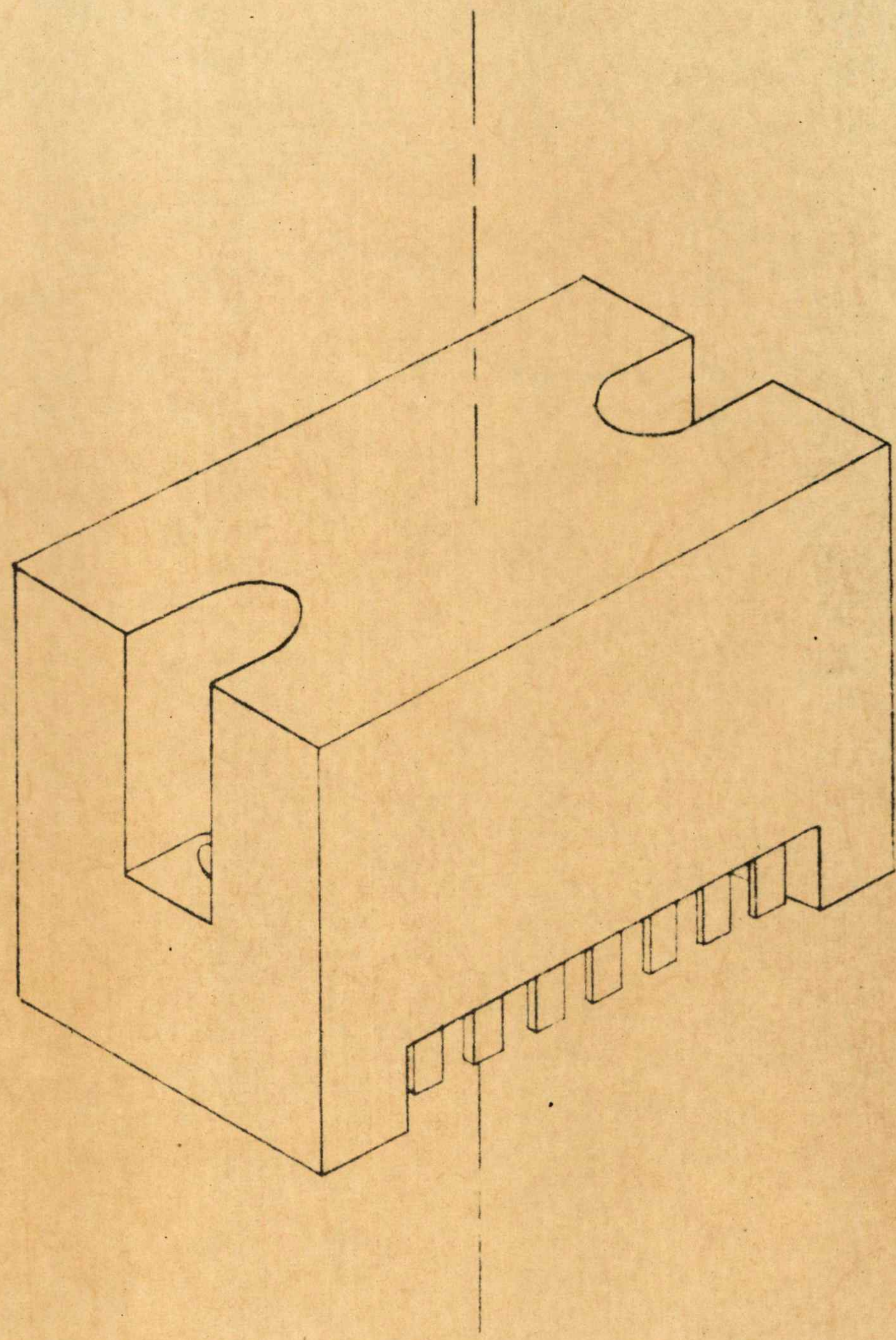
4.1.1.~~3~~4 Precaution. Whenever test power is applied to the assembly, the assembly shall be mounted on a heatsink. Unless otherwise specified, the temperature shall be maintained at 25° ±10°C. The thermal resistance between the assembly and the heatsink shall be 5°C/watt max.

4.1.2 Nonconforming Units. Failure of the unit to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or, when directed by the cognizant inspector, a complete retest and reexamination may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.2 TESTS

4.2.1 Drawing Compliance. The assembly shall be visually examined for compliance to the requirements of APOLLO G&N Drawing 2007118. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.2.2 Workmanship-Vibration. With reference and nominal dc supply voltages applied, pins 6, 7, 8, and 18 connected to pin 10 and the inputs specified in Table V applied simultaneously, the assembly shall be vibrated along the axis shown in Figure 2. The vibration shall be a simple harmonic motion swept from 10 to 1000 cps at a rate of 1 octave/15 seconds. The magnitude of vibration shall be 6.0g rms limited to a 0.4 inch pp constant displacement from 10 cps to the crossover frequency. Any out of tolerance condition of the outputs specified in Table V which exists for 1 msec or more shall constitute a failure. After vibration, the assembly shall be visually examined as specified in 4.2.1.



VIBRATION AXIS OF ASSEMBLY

FIGURE 2

TABLE V

WORKMANSHIP-VIBRATION INPUTS & OUTPUTS

Input Terminals		Input Signal	Output Terminals		Output Before Vibration	Output Deviation Tolerance During Vibration
Hi	Lo		Hi	Lo		
4	10	800 cps, 0°phase	25	31	10V±10%	±15%
17	21	800 cps suppressed carrier, 10 cps modulation	13	12	3V pp±10%	±10%

4.2.3 DC Resistance. The dc resistance between the pins listed in Table IV shall be as specified therein when measured in accordance with method 303 of Standard MIL-STD-202. To assure a good electrical connection, the anodizing may be penetrated.

4.2.4 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be as specified in 3.2.3.2 when measured in accordance with Method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output of 225±75 vdc, limited to a short circuit current of 6 microamps.

4.2.5 Current Drain. Current drain shall be checked as follows:

a. With the conditions listed below established, dc current drain (I_{DC}) shall be 75 ma max.

(1) Nominal dc supply voltage applied to terminals 22 (hi) and 20 (lo).
(2) Reference voltage applied to terminals 5 (hi) and 2 (lo).
(3) Terminals 4, 6, 7 and 8 connected to terminal 10.

b. With the conditions listed below established, dc current drain (I_{DC}) shall be 360 ma max.

(1) Nominal dc supply voltage applied to terminals 22 (hi) and 20 (lo).
(2) Reference voltage applied to terminals 5 (hi) and 2 (lo).
(3) 800 cps signal applied between terminals 4 (hi) and 10 (lo).
(4) Terminals 6, 7 and 8 connected to terminal 10.
(5) The input adjusted to provide a 30V output between terminals 25 (hi) and 31 (lo).

c. Under the following conditions, dc current drain I_{DC} shall be 40±4 ma.

(1) Enhanced dc supply voltage applied to terminals 22 (hi) and 20 (lo).
(2) Reference voltage applied to terminals 5 (hi) and 2 (lo).
(3) The amplifier output load disconnected from terminals 25 and 31.
(4) Terminals 4, 6, 7 and 8 connected to terminal 10.

4.2.6 Amplifier Noise. With the following conditions established, the voltage measured between terminals 25 (hi) and 31 (lo) shall not exceed 0.5V for the 0° or π phase, 800 cps component, or 1v total.

a. Nominal dc supply voltage applied to terminals 22 (hi) and 20 (lo).
b. Reference voltage applied to terminals 5 (hi) and 2 (lo).
c. Terminals 4, 6, 7 and 8 connected to terminal 10.

4.2.7 Amplifier Gain. With the conditions below established, the gain from input to output shall be as specified in Table VI.

a. Conditions "a" and "b" of 4.2.6 repeated.

b. An 800 cps 0° or π phase (as required) input signal applied sequentially to the terminals specified in Table VI while connecting the unused input terminals to terminal 10.

c. The 0° or π phase, 800 cps output component between terminals 25 (hi) and 31 (lo) adjusted to 10V.

TABLE VI

AMPLIFIER GAIN

Test	Input Terminal		Input Phase	Gain Required (10 V/V IN)	
	Hi	Lo		Min.	Max.
a	4	10	0°	1760	2640
b	4	10	π	1760	2640
c	6	10	0°	516	774
d	7	10	0°	1760	2640
e	8	10	0°	1760	2640

4.2.8 Amplifier Gain Linearity. Amplifier gain linearity shall be checked as follows:

a. With the following conditions established, the 0° phase gain shall be within ±10 percent of the 800 cps, 0° phase gain obtained in test "a" of Table VI (above):

(1) Conditions "a" and "b" of 4.2.6 repeated.
(2) Terminals 6, 7 and 8 connected to terminal 10.
(3) An 800 cps input signal applied to terminals 4 (hi) and 10 (lo) and adjusted to provide an 800 cps output component of 3V between terminals 25 (hi) and 31 (lo).

b. With the conditions in "a" (above) established except with the 800 cps input signal adjusted to provide an 800 cps output component of 30V, the 0° phase gain shall be within ±10 percent of the 800 cps, 0° phase gain obtained in test "a" of Table VI.

4.2.9 Amplifier Phase Shift. With the conditions specified below established, the phase shift of the 800 cps output component with respect to the input shall be 180° ±15° for both 0° and π phase inputs.

a. Conditions "a" and "b" of 4.2.6 repeated.

b. Terminals 6, 7 and 8 connected to terminal 10.

c. An 800 cps 0° phase input signal applied to terminals 4 (hi) and 10 (lo) and adjusted to provide an output of 5.0±0.5V between terminal 25 and dc supply common.

d. Condition "c" (above) repeated with an 800 cps, π phase input signal.

4.2.10 Amplifier Minimum Output. With the following conditions established, the minimum output between terminals 25 (hi) and 31 (lo) shall be 30V for 0° and π phase input signals.

a. Degraded dc supply voltage applied to terminals 22 (hi) and 20 (lo).
b. Reference voltage applied to terminals 5 (hi) and 2 (lo).
c. A 10V, 800 cps signal applied to terminals 4 (hi) and 10 (lo).

4.2.11 Amplifier Frequency Response. With the conditions specified below established, the ratio of the input signal required at 0.1 cps to the input signal required at 0.8 cps shall be 0.63 min, 0.794 max. When an unbalance occurs at the output, the output measurement shall be an average value. The phase shift of the output with respect to the input at 20 cps shall be 25° ±10°.

a. Nominal dc supply voltage applied to terminals 22 (hi) and 20 (lo).
b. Reference voltage applied to terminals 5 (hi) and 2 (lo).
c. Terminals 6, 7 and 8 connected to terminal 10.
d. An 800 cps suppressed carrier input signal applied to terminals 4 (hi) and 10 (lo) and adjusted in amplitude, at each modulation frequency specified in Table I, to provide 10V pp output between terminals 25 (hi) and dc supply common (lo).

4.2.12 Amplifier Quadrature Rejection. With the following conditions established, the 0° or π phase, 800 cps component of the output voltage between terminals 25 (hi) and 31 (lo) shall be less than 12V for leading and lagging quadrature inputs.

a. Conditions "a" and "b" of 4.2.11 repeated.
b. A 100 mv, 800 cps quadrature input signal applied to terminals 4 (hi) and 10 (lo).

4.2.13 Feedback Compensation Noise. With condition "a" and "b" of 4.2.11 established and terminals 17 and 21 connected, the 0° or π phase, 800 cps component between terminals 13 (hi) and 12 (lo) shall not exceed 2 mv, and the total voltage shall not exceed 10 mv.

4.2.14 Feedback Compensation Gain. With conditions "a" and "b" of 4.2.11 established and with an 800 cps suppressed carrier input signal with 10 cps modulation applied to the terminals specified in Table II, taken one at a time and adjusted to provide a 3V pp output between terminals 13 (hi) and 12 (lo), the gains shall be as specified in Table II.

4.2.15 Feedback Compensation Gain Linearity. With the conditions specified below established, the gains from input to output shall be within ±10 percent of the gain obtained for item "a" in Table II of 4.2.14.

a. Nominal dc supply voltage applied to terminals 22 (hi) and 20 (lo).

b. Reference voltage applied to terminals 5 (hi) and 2 (lo).

c. An 800 cps suppressed carrier signal with 10 cps modulation applied to terminals 17 (hi) and 21 (lo) and adjusted to provide a 0.4V pp and then a 8V pp output between terminals 13 (hi) and 12 (lo).

4.2.16 Feedback Compensation Phase Shift. With the following conditions established, the phase shift of the output with respect to the reference shall be $\leq 15°$.

a. Conditions "a" and "b" of 4.2.15 repeated.

b. An 800 cps suppressed carrier input signal with 10 cps modulation applied to terminals 17 (hi) and 21 (lo), and adjusted to provide an output of 3V pp between terminals 13 (hi) and 12 (lo).

4.2.17 Feedback Compensation Frequency Response. With the conditions specified below established, the phase shift and input signal ratio shall be as specified in Table III.

a. Conditions "a" and "b" of 4.2.15 repeated.

b. An 800 cps suppressed carrier input signal with 10 cps modulation applied to terminals 17 (hi) and 21 (lo) and adjusted in amplitude to provide an output of 3V pp between terminals 13 (hi) and 12 (lo) at each modulation frequency specified in Table III.

4.2.18 Preamp Monitor. With the following conditions established, the gain from input to output shall be 2.40±0.36 V/V.

a. Conditions "a" and "b" of 4.2.15 repeated.

b. Terminals 6, 7 and 8 connected to terminal 10.

c. An 800 cps input signal applied to terminals 4 (hi) and 10 (lo) and adjusted to provide an output of 0.30±0.03V between terminals 3 (hi) and 10 (lo).

4.2.19 Tach Monitor. With conditions "a" and "b" of 4.2.15 established and with an 800 cps input signal applied to terminals 17 (hi) and 21 (lo) and adjusted to provide an output of 0.30±0.03V between terminals 19 (hi) and 10 (lo), the gain from input to output shall be 0.0820±0.0082 V/V.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

JD:efo

APOLLO G&C Specification
PS2007120 REV B
Original Issue Date: 9-14-65
Release Authority: TDRR 22483
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

OPTICS LOAD COMPENSATION ASSEMBLY

DRAWING NO. 2007120

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals AC	Approvals NASA
A 3/22/66	A	27421	3, 6 RDG/MC	WK	---
B 1/12/67	B	32626	3, 6 RDG/MC	MGM EA	---

This specification consists of page 1 to 6 inclusive.

APPROVALS	NASA/MSC	MIT/IL	AC
		S Rogorzy MG Whaley 2-18-9/14/65	E.T. Powers M. S. Johnson

NOT REQUIRED PER LETTER
NASA PP7 65-612

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Characteristics

3.1.1.1 Capacitance. The assembly capacitance shall be 5.5 μf ±5.5 percent from pin 3 to 4 and 4.5 μf ±5.5 percent from pin 2 to 5.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&C Drawing 2007120 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 Continuity and DC Resistance. The resistance between pin 1 and the frame shall be $\leq$0.5 ohm.

3.2.3.2 Insulation Resistance. The insulation resistance between pin 1 and the remaining assembly pins shall not be less than 100 megohms.

4.2.5 Capacitance. The assembly capacitance shall be as follows when measured in accordance with Standard MIL-STD-202, method 305 at 1 KC.

a. 5.5 μf ±5.5% from pin 3 to pin 4.
b. 4.5 μf ±5.5% from pin 2 to pin 5.

4.2.6 Weight. Not applicable.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

ETP/jls

APOLLO G&C Specification
PS2007121 REV B
Original Issue Date: 9-14-65
Release Authority: TDRR 22482
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

TWO SPEED SWITCH ASSEMBLY

DRAWING NO. 2007121

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals AC	Approvals NASA
3/22/66	A	27421	5, 10 RD6/KL	WK	---
1/12/67	B	32626	5, 10 RD6/KL	MGM EA	---

This specification consists of page 1 to 10 inclusive.

APPROVALS	NASA/MSC	S R Gregg / M C Ulersky CCB 9-14-65 MIT/IL	C.F. Powers / M J Johnson AC

NOT REQUIRED PER LETTER
NASA PP7-65-612

3.2.2 Maximum Weight. Not applicable.

3.2.3 Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 Continuity and DC Resistance. Continuity and dc resistance shall be as shown in Table III.

TABLE III

CONTINUITY AND DC RESISTANCE

PINS		RESISTANCE (ohms)	PINS		RESISTANCE (ohms)
From	To		From	To	
24	4	$\geq$5 meg	15	19	$\geq$5 meg
22	4	$\geq$5 meg	1	*Frame	$\leq$0.5
8	19	$\geq$5 meg			

* To assure electrical connection the anodizing may be penetrated

3.2.3.2 Insulation Resistance. The insulation resistance between pin 1 and the remaining assembly pins shall not be less than 100 megohms.

4.2.6 Fine Channels. With the test setup shown in Figure 1, the output of the fine channels shall be as follows:

NOTE: Coarse input signals shall be grounded during fine channels test.

a. SXT Trunnion 64X Fine Channel. With the input signal specified in Table II applied to pins 21 (Hi) and 22 (Lo) and varied in accordance with Table II the output signal magnitude shall be as specified in Table II. The output signal shall be measured from, pin 6 (Hi) to pin 4 (Lo) for three diodes, pin 6 (Hi) to pin 5 (Lo) with pin 5 connected to pin 4 for two diodes, and pin 5 (Hi) to pin 4 (Lo) with pin 5 connected to pin 6 for one diode in the output circuit. The dc supply voltage shall be applied to pin 10 (Hi) and pin 9 (Lo) in accordance with Table II.

b. SXT Shaft Fine 16X Channel. With the input signal specified in Table II applied to pin 7 (Hi) and pin 8 (Lo) and varied in accordance with Table II, the output signal magnitude shall be as specified in Table II. The output signal shall be measured from, pin 18 (Hi) to pin 19 (Lo) for three diodes, pin 18 (Hi) to pin 16 (Lo) with pin 16 connected to pin 19 for two diodes, and pin 16 (Hi) to pin 19 (Lo) with pin 16 connected to pin 18 for one diode in the output circuit. The dc supply voltage shall be applied to pin 10 (Hi) and pin 9 (Lo) in accordance with Table II.

4.2.7 Relays K1 and K2. The relays shall be energized for any of the following voltages applied to pin 10 (Hi) and pin 9 (Lo).

a. 27.5±0.25 vdc, nominal
b. 32.0±0.3 vdc, enhanced
c. 23.0±0.2 vdc, degraded

4.2.8 DC Current Drain. With 32.0±0.3 vdc supply voltage (enhanced) applied to pin 10 (Hi) and pin 9 (Lo) the current drawn shall be $\leq$40 ma.

4.2.9 Rectifier Forward Drop. With a 240 ohm ±5 percent resistor connected in series with the positive dc supply lead and 23.0±0.2 vdc (degraded) applied to pin 9 (Hi) and pin 10 (Lo), the voltage between 9 (Hi) and pin 10 (Lo) shall be <2 vdc.

4.2.10 Weight. Not applicable.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

ETP:efo

APOLLO G&C Specification
PS2007121 REV —
Original Issue Date: 9-14-65
Release Authority: TDRR 22482
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

TWO SPEED SWITCH ASSEMBLY

DRAWING NO. 2007121

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals MIT	Approvals NASA

This specification consists of page 1 to 10 inclusive.

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APPROVALS	NASA/MSC	MIT/IL	ACSP
		S. R. Gorgy / M. G. Ulaskey CCD 9-14-65	E. F. Powers / M. S. Johnson

NOT REQUIRED PER LETTER
NASA PP7-65-612

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of the two Speed Switch Assembly, Part Number 2007121-011.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&C

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment.

STANDARDS

Military

MIL-STD-202C	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&C

2007121	2 Speed Switch Assembly

(Copies of specifications, standards, drawings, bulletins and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In the event of a conflict between requirements, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this section

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Inputs. The assembly shall perform as specified herein with the following electrical inputs:

3.1.1.1 DC Supply Voltage. The required dc supply voltage shall be as follows:

a. 27.5±0.25 vdc nominal
b. 32.0±0.3 vdc enhanced
c. 23.0±0.2 vdc degraded

3.1.1.2 Input Signals. The required input signal shall be 0 to 80V pp, adjustable, with frequency characteristics as follows:

a. 800±2 cps nominal
b. 800±2 cps enhanced
c. 700±2 cps degraded

3.1.2 Characteristics

3.1.2.1 Sextant Trunnion 1 X Coarse Channel. The sextant trunnion 1X coarse channel output signal characteristics shall be as specified in Table I.

TABLE I

COARSE CHANNEL CHARACTERISTICS

INPUT SIGNAL		OUTPUT SIGNAL		DC SUPPLY VOLTAGE
MAGNITUDE (V pp)	FREQ. (cps)	MAGNITUDE	FREQ. (cps)	
0.1	800±2	≤2 mv pp	800	Nominal
0.4	800±2	≤ 5 mv pp	800	Nominal
1.56	800±2	0.53±0.16V pp	800	Nominal
30.0	800±2	27.0±3.0V pp	800	Nominal
70.0	800±2	27.0±3.0V pp	800	Nominal
1.56	700±2	0.5±0.15V pp	700	Degraded
1.56	800±2	0.53±0.16V pp	800	Enhanced

3.1.2.2 Sextant Shaft 1/2 X Coarse Channel. The sextant shaft 1/2 X coarse channel output signal characteristics shall be as specified in Table I.

3.1.2.3 Sextant Trunnion 64 X Fine Channel. The sextant trunnion 64 X fine channel output signal characteristics shall be as specified in Table II.

TABLE II

FINE CHANNEL CHARACTERISTICS

INPUT SIGNAL		OUTPUT SIGNAL (V pp)		NUMBER OF LINEARITY RANGING DIODES IN OUTPUT	DC SUPPLY VOLTAGE
MAGNITUDE (V pp)	FREQ. (cps)	SEXTANT TRUNNION 64X Fine Channel	SEXTANT SHAFT 16 X Fine Channel		
0.3	800±2	0.24±0.03	0.26±0.03	3	Nominal
0.6	800±2	0.47±0.06	0.53±0.06	3	Nominal
1.0	800±2	0.78±0.09	0.86±0.09	3	Nominal
1.5	800±2	1.18±0.12	1.3±0.13	3	Nominal
2.5	800±2	1.98±0.2	2.28±0.23	3	Nominal
13.0	800±2	3.6±1.2	3.6±1.2	3	Nominal
13.0	800±2	2.4±0.8	2.4±0.8	2	Nominal
13.0	800±2	1.2±0.4	1.2±0.4	1	Nominal
1.0	700±2	0.8±0.09	0.9±0.09	3	Degraded
1.0	800±2	0.78±0.09	0.86±0.09	3	Enhanced

3.1.2.4 Sextant Shaft 16 X Fine Channel. The sextant shaft 16X fine channel output signal characteristics shall be as specified in Table II.

3.1.2.5 Relays K1 and K2. Relays K1 and K2 shall be energized for nominal, enhanced and degraded dc supply voltage inputs.

3.1.2.6 DC Current Drain. The dc current drain shall be 40 ma maximum for an enhanced dc supply voltage input.

3.1.2.7 Rectifier Forward Drop. With a degraded dc supply voltage input applied (reversed polarity) current limited to 105 ma, the forward voltage drop across the relay diode shall be ≤2 vdc.

3.2 PRODUCT CONFIGURATION

3.2.1 DRAWINGS. The configuration of the assembly shall be in accordance with APOLLO G&C Drawing 2007121 and all drawings and engineering data referenced thereon.

3.2.2 Standards of Manufacturing, Manufacturing Process and Production

3.2.2.1 Continuity and DC Resistance. Continuity and dc resistance shall be as shown in Table III.

TABLE III

CONTINUITY AND DC RESISTANCE

PINS		RESISTANCE (ohms)	PINS		RESISTANCE (ohms)
From	To		From	To	
24	4	$\geq$5 meg	15	19	$\geq$5 meg
22	4	$\geq$5 meg	1	*Frame	$\leq$0.5
8	19	$\geq$5 meg			

* To assure electrical connection the anodizing may be penetrated

3.2.2.2 Insulation Resistance. The insulation resistance between pin 1 and the remaining assembly pins shall not be less than 100 megohms.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 Test Conditions

4.1.1.1 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

a. Temperature: 25° ±10°C
b. Relative Humidity: 90% max
c. Barometric Pressure: 28 to 32 inches of Hg.

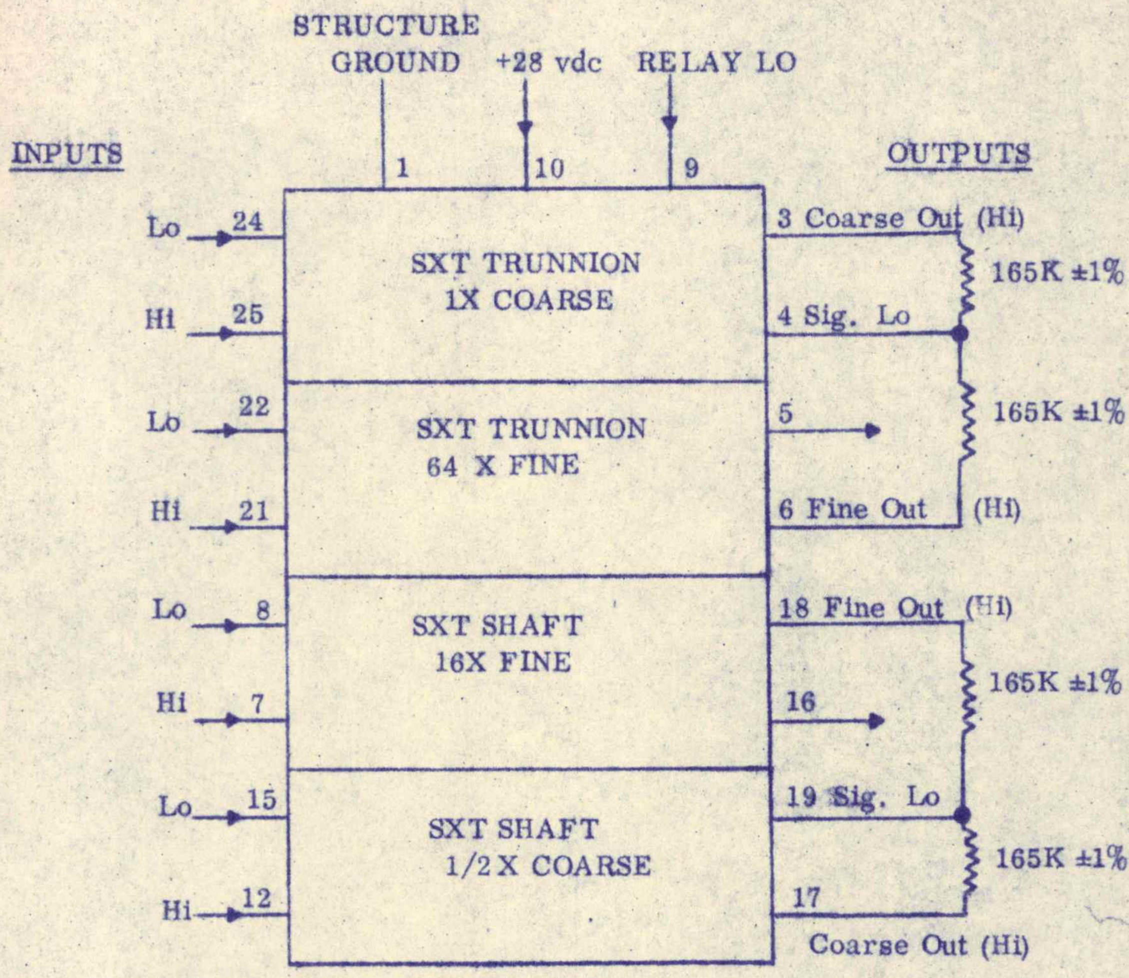
4.1.1.2 Loads. External loads shall be connected to the assembly outputs for each channel as shown in Figure 1.

4.1.2 Nonconforming Units. Failure of the unit to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or, when directed by the cognizant inspector, a complete retest and reexamination may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.2 TESTS

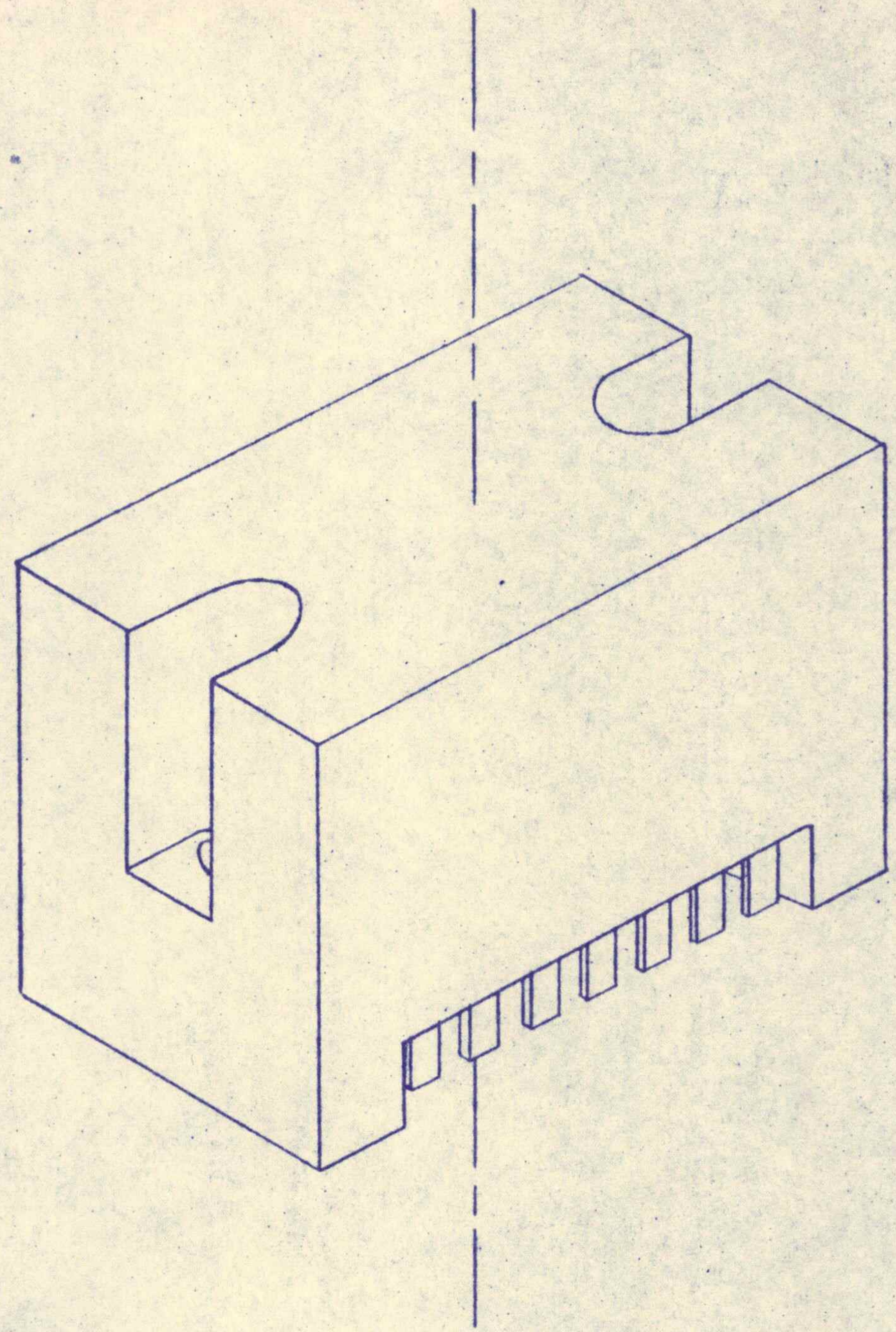
4.2.1 Drawing Compliance. The assembly shall be visually examined for compliance to the requirements of APOLLO G&C Drawing 2007121. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment and legibility and appearance of markings.

4.2.2 Workmanship - Vibration. With the conditions specified in Table IV established, the assembly shall be vibrated along the axis shown in Figure 2. The vibration shall be a simple harmonic motion swept from 10 to 2000 cps at a rate of 1 octave /15 sec. The magnitude of vibration shall be 6.0g rms limited to 0.4 inch pp constant displacement from 10 cps to the crossover frequency. The outputs specified in Table IV shall be monitored with equipment capable of measuring any out of tolerance voltages existing for more than 1 millisecond. An out of tolerance condition is any change in output ≥ 10 percent of the value established prior to vibration and shall constitute a failure.



LOAD CONNECTIONS AND CHANNEL IDENTIFICATION

FIGURE 1



VIBRATION AXIS OF ASSEMBLY

FIGURE 2

TABLE IV

VIBRATION CONDITIONS

INPUT		OUTPUTS TO BE MONITORED	
		PINS	
PINS	CONDITION	(Hi)	(Lo)
24, 22, 8 & 15	Connected together	3	4
25, 21, 7 & 12	Connected together	6	4
10 (Hi) & 9 (Lo)	27.5±0.25 vdc applied	18	19
7 (Hi), 8 (Lo)	1.56V pp, 800 cps applied	17	19

4.2.3 Continuity and DC Resistance. Continuity and dc resistance shall be as specified in Table III when measured in accordance with method 303 of Standard MIL-STD-202.

4.2.4 Insulation Resistance. The insulation resistance between pin 1 and the remaining assembly pins shall not be less than 100 megohms when measured in accordance with method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output of 225±75 vdc, limited to a short circuit current of 6.0 μa.

4.2.5 Coarse Channels. With the test setup shown in Figure 1, the output of the coarse channels shall be as follows:

a. SXT Trunnion 1X Coarse Channel. With the input signal specified in Table I applied to pins 25 (Hi) and 24 (Lo) and varied in accordance with Table I, the output signal magnitude shall be as specified in Table I at pins 3 (Hi) and 4 (Lo). The dc supply voltage shall be applied in accordance with Table I to pins 10 (Hi) and 9 (Lo).

b. SXT Shaft 1/2X Coarse Channel. With the input signal specified in Table I applied to pins 12 (Hi) and 15 (Lo) and varied in accordance with Table I, the output signal magnitude shall be as specified in Table I at pins 17 (Hi) and 19 (Lo). The dc supply voltage shall be applied in accordance with Table I at pins 10 (Hi) and 9 (Lo).

4.2.6 Fine Channels. With the test setup shown in Figure 1, the output of the fine channels shall be as follows:

NOTE: Coarse input signals shall be grounded during fine channels test.

a. SXT Trunnion 64X Fine Channel. With the input signal specified in Table II applied to pins 21 (Hi) and 22 (Lo) and varied in accordance with Table II the output signal magnitude shall be as specified in Table II. The output signal shall be measured from, pin 6 (Hi) to pin 4 (Lo) for three diodes, pin 6 (Hi) to pin 5 (Lo) with pin 5 connected to pin 4 for two diodes, and pin 5 (Hi) to pin 4 (Lo) with pin 5 connected to pin 6 for one diode in the output circuit. The dc supply voltage shall be applied to pin 10 (Hi) and pin 9 (Lo) in accordance with Table II.

b. SXT Shaft Fine 16X Channel. With the input signal specified in Table II applied to pin 7 (Hi) and pin 8 (Lo) and varied in accordance with Table II, the output signal magnitude shall be as specified in Table II. The output signal shall be measured from, pin 18 (Hi) to pin 19 (Lo) for three diodes, pin 18 (Hi) to pin 16 (Lo) with pin 16 connected to pin 19 for two diodes, and pin 16 (Hi) to pin 19 (Lo) with pin 16 connected to pin 18 for one diode in the output circuit. The dc supply voltage shall be applied to pin 10 (Hi) and pin 9 (Lo) in accordance with Table II.

4.2.7 Relays K1 and K2. The relays shall be energized for any of the following voltages applied to pin 10 (Hi) and pin 9 (Lo).

a. 27.5±0.25 vdc, nominal
b. 32.0±0.3 vdc, enhanced
c. 23.0±0.2 vdc, degraded

4.2.8 DC Current Drain. With 32.0±0.3 vdc supply voltage (enhanced) applied to pin 10 (Hi) and pin 9 (Lo) the current drawn shall be $\leq$40 ma.

4.2.9 Rectifier Forward Drop. With a 240 ohm ±5 percent resistor connected in series with the positive dc supply lead and 23.0±0.2 vdc (degraded) applied to pin 9 (Hi) and pin 10 (Lo), the voltage between 9 (Hi) and pin 10 (Lo) shall be <2 vdc.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

ETP:efo

APOLLO G&C Specification
PS2007122 REV E
Original Issue Date: 9-14-65
Release Authority: TDRR 22481
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

COSECANT GENERATOR ASSEMBLY

DRAWING NO. 2007122

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
M 12/28/65	A	24916	3, 4, 9 RD6/AC	WK	--
M 3/22/66	B	27421	4, 10 RD6/AC	WK	--
M 8/11/66	C	30631	5 RD6/AC	EA	--
M 9/22/66	D	31236	3 RD6/AC	MGM/EA	--
M 1/12/67	E	32626	4, 10 RD6/AC	MGM EA	--

This specification consists of page 1 to 10 inclusive.

APPROVALS	NASA/MSC	MIT/IL	AC
		E R Jergy / M G Kleinberg CCD 9-14-65	O. J. Rygaard / M. J. Johnson

NOT REQUIRED PER LETTER
NASA PP7-65-612

TABLE I

FEEDBACK GAINS AND PHASE SHIFTS

OUTPUT LEVEL (e_o of Figure 1) (V rms ±2%)	FREQUENCY (cps ±2%)	GAIN (V/V)	PHASE SHIFT
0.6	100	≤ 12.5	215° ±10°
20.0	800	≥ 185	—
0.3	8,000	≤ 2.25	≥ 45°
0.15	35,000	≤ 0.3	80° ±10°

3.1.2.7 Distortion. The allowable distortion at 800 cps shall be as specified in Table II.

TABLE II

DISTORTION

B+ CONDITION	OUTPUT CONDITION (e_o of Figure 1) (V rms)	ALLOWABLE DISTORTION (% max)
Nominal	20	5
Enhanced	23	5
Degraded	17	5

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings, The configuration of the assembly shall be in accordance with APOLLO G&C Drawing 2007122 and all drawings and engineering data referenced thereon.

3.2.2. Maximum Weight. Not applicable.

3.2.3 Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 Continuity and DC Resistance. The continuity and dc resistance of the assembly shall be as specified in Table III.

3.2.3.2 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be at least 100 megohms.

3.2.3.3 Capacitance. The capacitance of the assembly shall be as specified in Table IV.

4.2.13 Weight. **Not applicable.**

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

OJR:dmh

APOLLO G&C Specification
PS2007122 REV –
Original Issue Date: 9-14-65
Release Authority: TDRR 22481
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

COSECANT GENERATOR ASSEMBLY

DRAWING NO. 2007122

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Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals MIT	Approvals NASA

This specification consists of page 1 to 10 inclusive.

APPROVALS	NASA/MSC	E R Yergy / M G Miniley CCB 9-14-65 MIT/IL	O. J. Rysgaard ACSP M. J. Johnson

NOT REQUIRED PER LETTER
NASA PP7-65-612

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of the Cosecant Generator Assembly, Part No. 2007122-011.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&C

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment

STANDARDS

Military

MIL-STD-202C	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&C

2007122	Cosecant Generator Assembly

(Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In event of a conflict between requirements, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this section

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Electrical Inputs. The Cosecant Generator Assembly, hereafter referred to as the assembly, shall be capable of performing as specified herein when supplied with the following electrical inputs:

3.1.1.1 DC Supply Voltage. The dc supply voltage will be as follows:

a. Nominal: 27.50±0.25 vdc
b. Enhanced: 32.00±0.30 vdc
c. Degraded: 23.00±0.20 vdc

3.1.1.2 Twenty-Eight VAC Source. The 28-vac source will be as follows:

a. Voltage: 28.00±0.28V rms
b. Frequency: 800±2 cps
c. Current: 10 ma rms max

3.1.1.3 Input Signal Source. The input signal source will be as follows:

a. Voltage: 0 to 2V rms, sine wave
b. Frequency: Variable from 100 cps to 35 kc
c. Output Impedance: $\leq$1K ohm

3.1.2 Characteristics

3.1.2.1 DC Current Drain. The assembly's current drain with the enhanced B+ condition shall be $\leq$20 ma dc.

3.1.2.2 Output Noise. The output noise (10 to 10,000 cps) with the nominal B+ condition shall not exceed 10 mv rms.

3.1.2.3 Forward Gain. The 800 cps forward gain shall be $\geq$75 V/V.

3.1.2.4 Feedback Gains and Phase Shifts. The feedback gains of the outputs with respect to the inputs shall be as specified in Table I. The phase shifts of the outputs with respect to the inputs shall be as specified in Table I.

3.1.2.5 Gain Ratio and Relative Phase Shift. The ratio of the feedback gain to the forward gain (800 cps gains) shall be 2.83±4 percent. The relative phase shift (forward phase shift at 800 cps minus the feedback phase shift at 800 cps) shall be +9° ±3°.

3.1.2.6 Output Impedance. The unloaded output impedance at 800 cps shall be $\leq$25K ohms.

TABLE I

FEEDBACK GAINS AND PHASE SHIFTS

OUTPUT LEVEL (e_o of Figure 1) (V rms ±2%)	FREQUENCY (cps ±2%)	GAIN (V/V)	PHASE SHIFT
0.6	100	≤12.5	215° ±10°
20.0	800	≥210	---
0.3	8,000	≤2.25	≥45°
0.15	35,000	≤0.3	80° ±10°

3.1.2.7 **Distortion.** The allowable distortion at 800 cps shall be as specified in Table II.

TABLE II

DISTORTION

B+ CONDITION	OUTPUT CONDITION (e_o of Figure 1) (V rms)	ALLOWABLE DISTORTION (% max)
Nominal	20	5
Enhanced	23	5
Degraded	17	5

3.2 PRODUCT CONFIGURATION

3.2.1 **Drawings.** The configuration of the assembly shall be in accordance with APOLLO G&C Drawing 2007122 and all drawings and engineering data referenced thereon.

3.2.2 Standards of Manufacturing, Manufacturing Process and Production

3.2.2.1 **Continuity and DC Resistance.** The continuity and dc resistance of the assembly shall be as specified in Table III.

3.2.2.2 **Insulation Resistance.** The resistance between pin 1 and the remaining assembly pins shall be at least 100 megohms.

3.2.2.3 **Capacitance.** The capacitance of the assembly shall be as specified in Table IV.

TABLE III

CONTINUITY AND DC RESISTANCE

FROM PIN	TO PIN	RESISTANCE (ohms)	
		Minimum	Maximum
1	Frame	0	0.5
5	6	0	0.5
15	14	146.25	153.75
5	17	0	0.5

TABLE IV

CAPACITANCE

FROM PIN	TO PIN	CAPACITANCE (mmfd)	
		Minimum	Maximum
3	2	0.0529	0.0591
4	5	0.0529	0.0591

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 Test Conditions

4.1.1.1 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

a. Temperature: 25° ±10°C
b. Relative Humidity: 90% max
c. Barometric Pressure: 28 to 32 inches of Hg

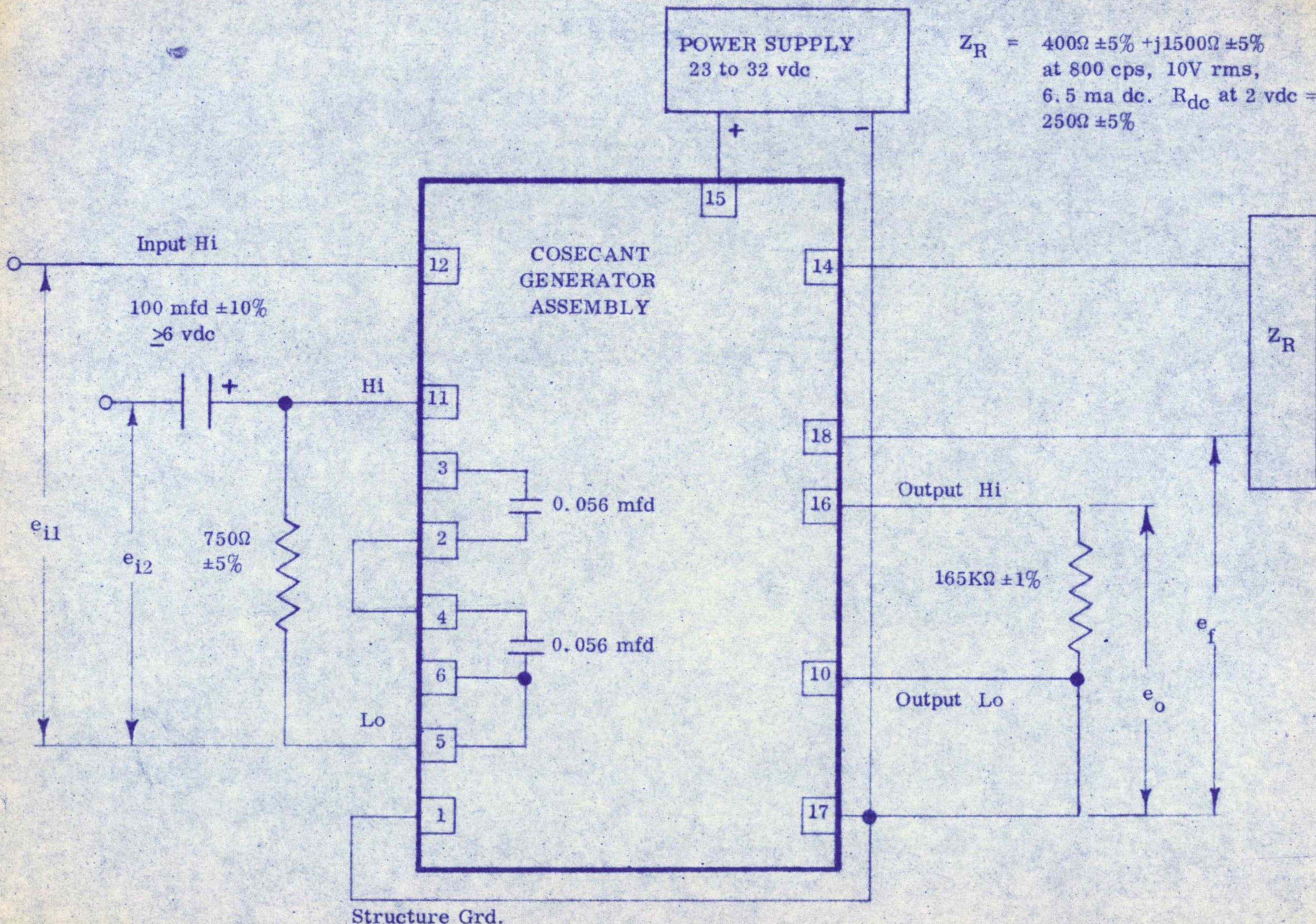
4.1.2 Nonconforming Units. Failure of the unit to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or, when directed by the cognizant inspector, a complete retest and reexamination may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.2 TESTS

4.2.1 Drawing Compliance. The assembly shall be visually examined for compliance to the requirements of APOLLO G&C Drawing 2007122. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of markings.

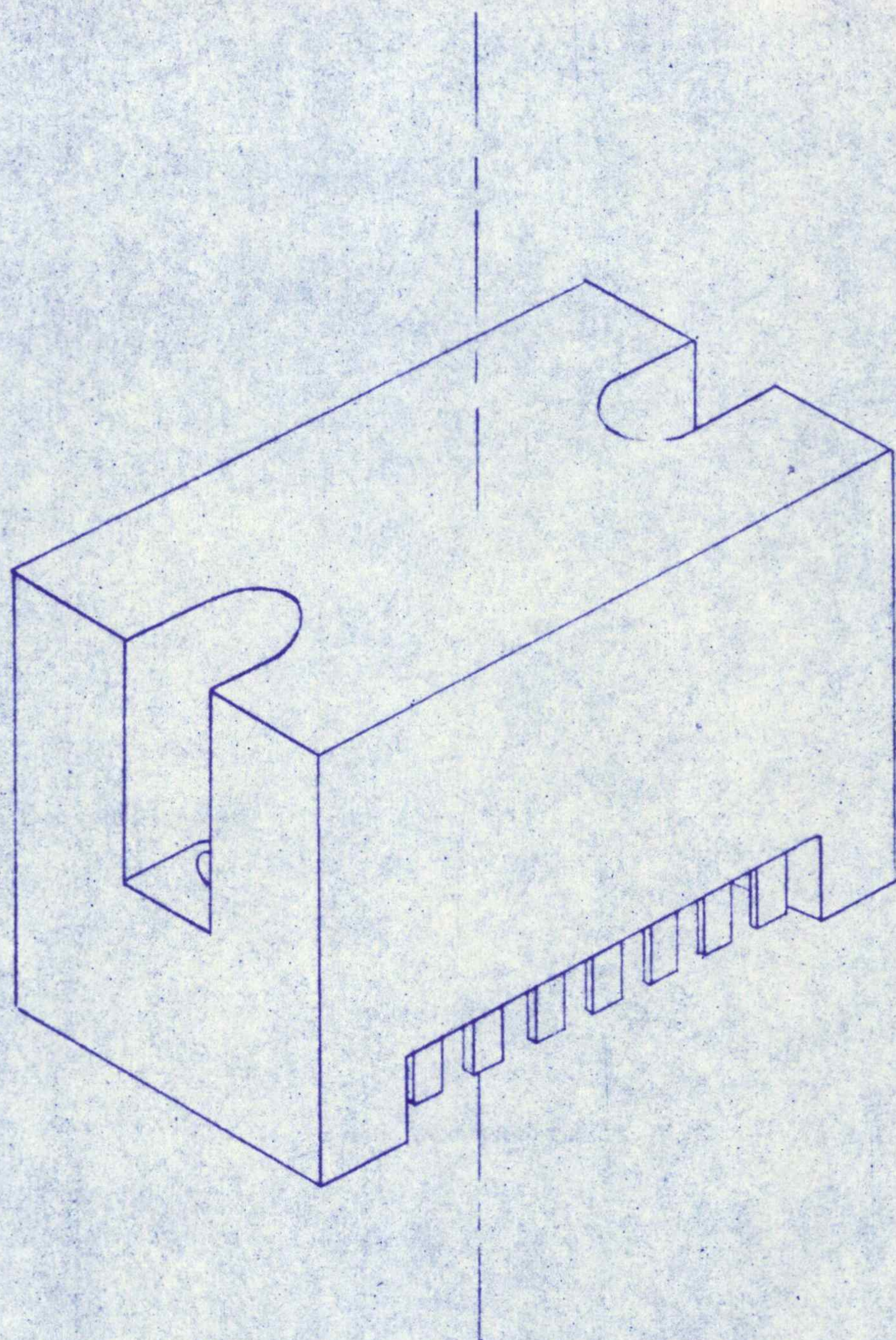
4.2.2 Workmanship-Vibration. With the assembly connected as shown in Figure 1, the nominal dc supply voltage applied, 28V rms at 800 cps applied to pins 3 (hi) and 6 (lo), and the input signal adjusted to give a 10V rms output signal (e_o), the assembly shall be vibrated along the axis shown in Figure 2. The current drawn from the 28V rms supply shall be monitored. The vibration shall be simple harmonic motion swept from 10 to 2000 cps at a rate of 1 octave/15 sec. The magnitude of vibration shall be 6.0g rms limited to a 0.4-inch pp constant displacement from 10 cps to the crossover frequency. The output voltage (e_o of Figure 1) or the current drawn from the 28V rms source, as established prior to vibration, shall not change more than 10 percent for a period $\geq$1 msec during vibration.

4.2.3 Continuity and DC Resistance. The continuity and dc resistance shall be as specified in Table III when measured with a low-voltage, resistance-measuring device using Method 303 of Standard MIL-STD-202. To assure a good electrical connection, the anodizing may be penetrated.



RECOMMENDED TEST SETUP

FIGURE 1



VIBRATION AXIS OF ASSEMBLY

FIGURE 2

4.2.4 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be as specified in 3.2.2.2 when measured in accordance with Method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output of 225±75 vdc, limited to a short circuit of 6 microamps.

4.2.5 Capacitance. The capacitance between the pins specified in Table III shall be measured using Method 305 at 1 kc of Standard MIL-STD-202. The capacitances shall be as specified in Table III.

4.2.6 DC Current Drain. With the assembly connected as shown in Figure 1, the B+ supply voltage enhanced and pin 12 connected to pin 5, the dc current drawn from the power supply (into pin 15) with respect to pin 17 shall be $\leq$20 ma.

4.2.7 Output Noise. With the assembly connected as shown in Figure 1 and the B+ supply voltage nominal, and pin 12 connected to pin 5, the output noise (in e_o) shall be $\leq$10 mv rms when measured with an indicating device having a bandwidth of 10 cps to 10 kc.

4.2.8 Forward Gain. With the assembly connected as shown in Figure 1, the B+ supply voltage nominal, the output signal (e_o) adjusted to 20V rms by adjusting the 800 cps input signal e_{i1}, the forward gain (e_o/e_{i1}) shall be $\geq$75 V/V. With the conditions established above, the phase shift of the output signal (e_o) with respect to the input signal (e_{i1}) shall be measured with a phase angle voltmeter and recorded.

4.2.9 Feedback Gains and Phase Shifts. With the assembly connected as shown in Figure 1, the B+ supply voltage at nominal, pins 12 and 5 connected together, an input signal (e_{i2}) ac coupled through a 100 mfd ±10 percent capacitor applied between pins 11 (Hi) and 5 (Lo) and adjusted until e_o equals the values specified in Table I, the feedback gains (e_f/e_{i2}) and phase shifts shall be as specified in Table I. With the conditions established above, the phase shifts of the output signals (e_f) with respect to the input signals (e_{i2}) shall be as specified in Table I. The 800 cps phase shift of e_f with respect to the input signal (e_{i2}) shall be measured with a phase angle voltmeter and recorded.

4.2.10 Gain Ratio and Relative Phase Shift. The gain ratio and relative phase shift shall be computed as follows and shall be the following values:

$$\text{gain ratio} = \frac{\text{800 cps feedback gain (recorded in para. 4.2.9)}}{\text{800 cps forward gain (recorded in para. 4.2.8)}} = 2.83 \pm 0.11$$

relative phase shift = 800 cps phase angle of forward output (e_o) (recorded in para. 4.2.8) -

800 cps phase angle of feedback signal (e_f) (recorded in para. 4.2.9) = +9° ±3°

4.2.11 Output Impedance. With the assembly connected as shown in Figure 1, the B+ supply voltage nominal, pins 12 and 5 connected together and the 165K-ohm resistor removed, the 800 cps output impedance measured between pins 16 and 10 shall be $\leq$25K ohms.

4.2.12 Distortion. With the assembly connected as shown in Figure 1, the conditions specified in Table II established, an 800-cps input signal applied between pins 12 and 5, the distortion of the output signal shall not exceed 5 percent.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

APOLLO G&C Specification
PS2007123 REV B
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CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

RELAY ASSEMBLY

DRAWING NO. 2007123

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals AC	Approvals NASA
M 12/21/65	A	24786	4 RDG/AC	WK	--
M 1/12/67	B	32626	4 RDG/AC	MGM EA	--

This specification consists of page 1 to 8 inclusive.

APPROVALS	NASA/MSC	MIT/IL	AC
		S R ~Gragg; M B Muslig; ee B 9-14-65	Oxenburger; R.C. Greenwood

NOT REQUIRED PER LETTER
NASA PP7-65-612

3.1.2.3 Spiking Suppressor. The amplitude at one half the time of the positive transient at the terminals specified in Table III shall be equal to or less than 5V, zero to peak, when a negative enhanced voltage is applied to and then removed from the terminals specified in Table III.

TABLE III

SPIKING SUPPRESSOR

GROUNDED TERMINAL	− ENHANCED VOLTAGE APPLIED TO TERMINAL	TRANSIENT OBSERVED AT TERMINAL
34	21	31
34	33	35
34	26	46
34	41	39
28	30	51
28	14	48

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&C Drawing 2007123 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 Insulation Resistance. The resistance between terminal 1 and the remaining assembly terminals shall be not less than 100 megohms.

3.2.3.2 Continuity and DC Resistance. Continuity and dc resistance shall be as specified in Table IV.

3.2.3.3 Continuity. The resistance between terminal 1 and the frame shall be less than or equal to 0.5 ohm.

TABLE IV

CONTINUITY AND DC RESISTANCE

TEST POWER OR CURRENT	FROM TERMINAL (+)	TO TERMINAL (−)	RESISTANCE (Ohms)	
			Assy. Deenergized	Assy. Energized
90 ma dc ±10%	4	2	<1.2	-
	4	3	-	<1.2
	5	7	<1.2	-
	5	6	-	<1.2
	11	8	<1.2	-
	11	9	-	<1.2
	10	13	<1.2	-
90 ma dc ±10%	10	12	-	<1.2

APOLLO G&C Specification
PS2007124 REV B
Original Issue Date: 9-14-65
Release Authority: TDRR 22479
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

ANTI-CREEP ASSEMBLY

DRAWING NO. 2007124

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
3-22-66	A	27421	3, 8	WK	- -
1/12/67	B	32626	3, 8	MGM EA	- -

This specification consists of page 1 to 8 inclusive.

APPROVALS	NASA/MSC	MIT/IL	AC
			E.J. Powers R Greenwood

NOT REQUIRED PER LETTER
NASA PP7-65-612

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Inputs. The assembly shall perform as specified herein with the following electrical inputs:

a. DC Supply Voltages. The dc supply voltage shall be as follows:

(1) +27.5±0.25 vdc nominal
(2) +32.0±0.03 vdc enhanced
(3) +23.0±0.2 vdc degraded

b. Input Signals. The input signals shall be 0 to 1.4 vac rms variable, 800±5 cps, sinusoidal with less than 5 percent distortion.

3.1.2 Characteristics

3.1.2.1 DC Current Drain. With nominal dc supply voltage applied, the dc current drain shall be 40±4 ma.

3.1.2.2 Input Trigger Level. With nominal dc supply voltage applied and the input signals increased to 550±55 mv, 800±5 cps, the output of each relay control shall increase from <1.2 vdc to >26 vdc.

3.1.2.3 Time Delay. With nominal dc supply voltage applied, the output of each relay control shall decrease from >26 vdc to <1.2 vdc in 0.28±0.10 sec after the corresponding input signal is decreased from 1.4 vac to 0 mv.

3.1.2.4 Hysteresis. With nominal dc supply voltage applied, the output of each relay control shall decrease from >26 vdc to <1.2 vdc before the corresponding input signal is reduced 50 mv below the input trigger level.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&C Drawing 2007124 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall not be less than 100 megohms.

3.2.3.2 DC Resistance. The dc resistance from pin 1 to the frame shall be $\leq$0.5 ohm.

4.2.9 Weight. Not applicable.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

ETP/dmh

Raney

APOLLO G&C Specification
PS2007125 REV -
Original Issue Date:
Release Authority: TDRR
Class Release
CODE IDENT NO. 80230

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PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

MODULATOR AND LOOP COMPENSATION ASSEMBLY

DRAWING NO. 2007125

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				MIT	NASA

This specification consists of page 1 to 11 inclusive.

APPROVALS	NASA/MSC	MIT/IL			ACSP
					J F Dannenberg R. Greenwood

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of all units of the Modulator and Loop Compensation Assembly, Part Number 2007125-011.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&C

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Sub-assemblies, Parts and Associated Ground Support Equipment

STANDARDS

Military

MIL-STD-202C	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&C

2007125	Modulator and Loop Compensation Assembly

(Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In event of a conflict between requirements, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this section

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Inputs. The assembly shall perform as specified herein with the following electrical inputs:

3.1.1.1 DC Supply Voltage. The dc supply voltage shall be as follows. Unless otherwise specified, the dc supply voltage shall be assumed to be nominal in describing performance characteristics.

a. Nominal: 27.50±0.25 vdc
b. Degraded: 23.0±0.2 vdc
c. Enhanced: 32.0±0.3 vdc

3.1.1.2 Reference Voltage. The reference voltage required shall be a 28.0±0.3V rms, 800±2 cps sinusoidal wave with a maximum distortion of 5 percent.

3.1.1.3 Input Signals. Input signals required shall be as follows:

a. Plus and minus dc voltage, variable from 0 to 11 vdc.
b. 12.00±0.25 cps, variable from 0 to 11V pp.
c. 800±2 cps, variable from 0 to 1V rms.

3.1.2 Characteristics

3.1.2.1 Current Drain. The dc current drain shall be 22±4 ma when the supply voltage is enhanced.

3.1.2.2 Noise. Noise on the X, AxX, Y and Ay Y channel outputs shall be as follows.

a. The 800 cps 0° or 180° phase component shall be less than 2 mv.
b. The 800 cps quadrature component shall be less than 25 mv.

3.1.2.3 X and Y Gain. The gain (0° or 180° phase, 800 cps component V rms/vdc) from the X input to the X and AxX outputs and from the Y input to the Y and AyY outputs shall be 0.13 V/V ±15 percent for positive and negative dc inputs of 3 volts.

3.1.2.4 X and Y Gain Linearity. The X and Y channel gains for positive dc inputs which produce outputs of 1.20V rms and 0.15V rms shall both be within 10 percent of the gains measured with a positive 3 vdc input.

3.1.2.5 X and Y Phase Shift. The phase shift from the reference to the X, A_xX and Y outputs shall be 0° ±20° when positive 3 vdc is applied to the X and Y inputs simultaneously and 180° ±20° when negative 3 vdc is applied to the X and Y inputs simultaneously. The phase shift from the reference to the A_yY output shall be 0° ±20° when negative 3 vdc is applied to the Y input and 180° ±20° when positive 3 vdc is applied to the Y input.

3.1.2.6 A_xX and A_yY Gain. The gain from the A_xX input to A_yY output and from the A_yY input to the A_xX output shall be 0.390±0.039 V/V for an input of 1V rms, 800±2 cps.

3.1.2.7 A_xX and A_yY Phase Shift. The phase shift from the A_xX input to the A_yY output and from the A_yY input to the A_xX output shall be 180° ±5° with an input of 1V rms, 800±2 cps.

3.1.2.8 Frequency Response. The gain from the X input to X output and Y input to Y output shall be greater than 0.707 of the average value of the corresponding X and Y gains obtained with positive and negative dc inputs of 3 volts when 3V peak, 12.00±0.25 cps is applied to the X and Y inputs simultaneously.

3.1.2.9 Output Impedance. The output impedance of the X, A_xX, Y and A_yY channels shall be less than 2000 ohms.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&C Drawing 2007125 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. The weight of the assembly shall be

3.2.3 Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 Continuity. The resistance between terminal 1 and the frame shall be less than or equal to 0.5 ohm.

3.2.3.2 Insulation Resistance. The resistance between terminal 1 and the remaining assembly terminals shall be not less than 100 megohms.

3.2.3.3 Resistor Selection. The resistors used for R14 and R38 shall be Part Number 1010364-651, 121K ohms.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 Test Conditions

4.1.1.1 Environmental. Unless otherwise specified, the assembly shall be tested under the following ambient conditions:

a. Temperature: 25° ±10°C
b. Relative Humidity: 90% max
c. Barometric Pressure: 28 to 32 inches of Hg.

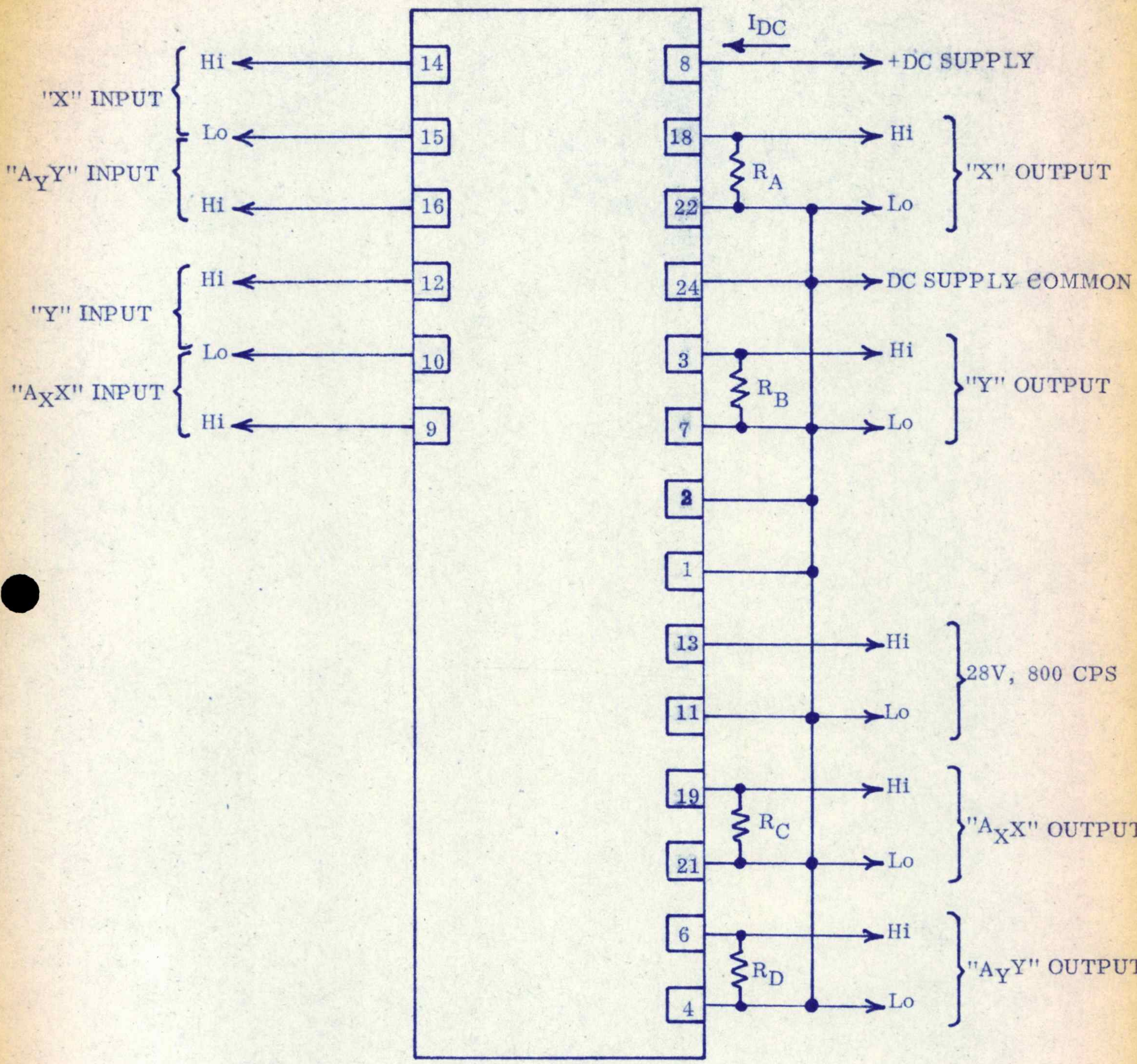
4.1.1.2 Test Setup. Unless otherwise specified, the recommended test setup shall be as specified in Figure 1.

4.1.2 Nonconforming Units. Failure of the unit to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or, when directed by the cognizant inspector, a complete retest and reexamination may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.2 TESTS

4.2.1 Drawing Compliance. The assembly shall be visually examined for compliance to the requirements of APOLLO G&C Drawing 2007125. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.2.2 Workmanship-Vibration. With the conditions listed below established, the assembly shall be subjected to vibration along the radial axis of the encapsulated components (refer to Figure 2). The vibration shall consist of simple harmonic motion swept from 10 to 2000 cps at a rate of 1 octave/15 seconds. The magnitude of vibration shall be 6.0g rms limited to a 0.4 inch pp constant displacement from 10 cps to the crossover frequency. During vibration the X output at terminals 18 (Hi) and 22 (Lo) and the Y output at terminals 3 (Hi) and 7 (Lo) shall be monitored simultaneously. Any output deviation greater than 10 percent of the output established before vibration that exists for a period greater than 1 millisecond shall constitute an out-of-tolerance condition. After vibration the assembly shall be visually examined as specified in 4.2.1.

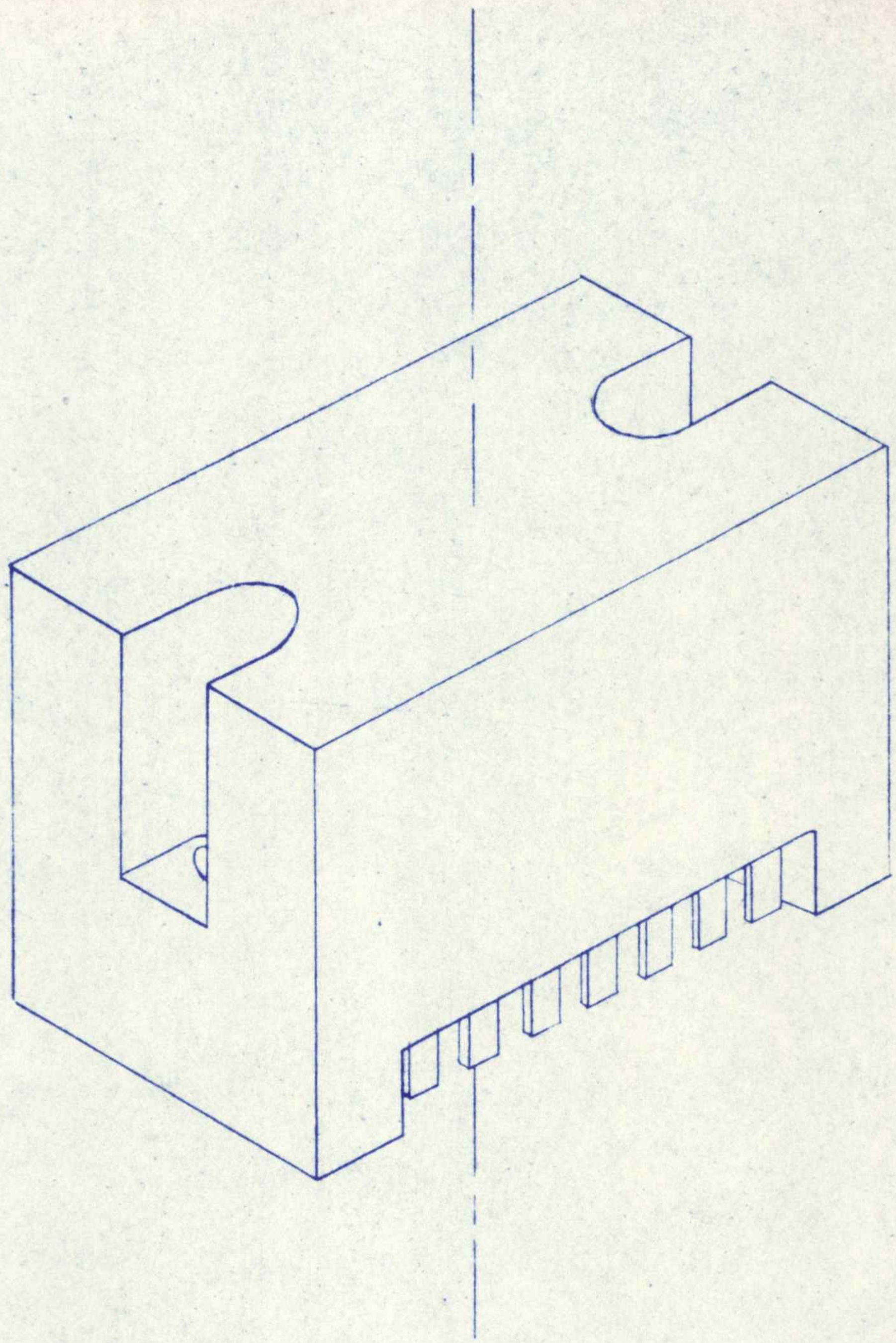


R_A and R_B = 165K Ω ±5%

R_C and R_D = 237K Ω ±5%

MODULATOR AND LOOP COMPENSATION ASSEMBLY

FIGURE 1



VIBRATION AXIS OF ASSEMBLY

FIGURE 2

a. Terminals electrically connected as follows: 9 to 10; and 15 to 16.

b. Nominal dc supply voltage applied at terminals 8 (Hi) and 24 (Lo).

c. Reference voltage applied at terminals 13 (Hi) and 11 (Lo).

d. Positive dc input signals applied simultaneously at terminals 12 (Hi) and 19 (Lo) and 14 (Hi) and 15 (Lo), and adjusted for an output of 1.20±0.12V rms at terminals 18 (Hi) and 22 (Lo).

4.2.3 Continuity. The resistance between terminal 1 and the frame shall be as specified in 3.2.3.1 when measured in accordance with Method 303 of Standard MIL-STD-202. To assure a good electrical connection, the anodizing may be penetrated.

4.2.4 Insulation Resistance. The resistance between terminal 1 and the remaining assembly terminals shall be as specified in 3.2.3.2 when measured in accordance with Method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output of 225±75 vdc, limited to a short circuit current of 6 microamps.

4.2.5 Current Drain. With the conditions listed below established, the current drain (I_{dc}) shall be 22±4 ma dc.

a. Terminals electrically connected as follows: 9 to 10, 12 to 10, 14 to 15, and 16 to 15.

b. Enhanced dc supply voltage applied at terminals 8 (Hi) and 24 (Lo).

c. Reference voltage applied at terminals 13 (Hi) and 11 (Lo).

4.2.6 Noise. With the conditions listed below established, the outputs at terminals 6 (Hi) and 4 (Lo), 3 (Hi) and 7 (Lo), 19 (Hi) and 21 (Lo), and 18 (Hi) and 22 (Lo) shall each have noise components less than 2 mv, 800 cps, 0° or 180° and 25 mv, 800 cps quadrature.

a. Terminals electrically connected as follows: 9 to 10, 12 to 10, 14 to 15, and 16 to 15.

b. Nominal dc supply voltage applied at terminals 8 (Hi) and 24 (Lo).

c. Reference voltage applied at terminals 13 (Hi) and 11 (Lo).

4.2.7 X and Y Gain. With the conditions listed below established, the gains between the input pins specified in Table I and the corresponding output pins shall be 0.13 V/V ±15 percent for dc inputs of plus and minus 3 volts where gain is calculated as follows:

$$\text{Gain} = \frac{V\ out}{|V\ in|}\ ;\quad \begin{array}{l} V\ out = \text{the measured } 0° \text{ or } 180° \text{ phase, 800 cps rms component.} \\ V\ in = + \text{ or } -3 \text{ vdc, as applicable.} \end{array}$$

a. Terminals electrically connected as follows: 9 to 10, and 16 to 15.

b. Nominal dc supply voltage applied at terminals 8 (Hi) and 24 (Lo).

c. Reference voltage applied at terminals 13 (Hi) and 11 (Lo).

TABLE I

INPUT AND OUTPUT TERMINALS

ITEM	INPUT TERMINALS		OUTPUT TERMINALS	
	Hi	Lo	Hi	Lo
a	14	15	18	22
b	14	15	19	21
c	12	10	3	7
d	12	10	6	4

4.2.8 X and Y Gain Linearity. With the conditions listed below established and a positive dc input applied at the input pins specified in Table II and adjusted for the corresponding output voltages specified therein, the gains measured shall be within 10 percent of the gain for a +3 vdc input where gain is calculated as follows:

$$\text{Gain} = \frac{V\ out}{|V\ in|}\ ;\quad \begin{array}{l} V\ out = \text{voltage specified in Table II} \\ V\ in = \text{measured dc input voltage.} \end{array}$$

a. Terminals electrically connected as follows: 9 to 10, and 15 to 16.
b. Nominal dc supply voltage applied at terminals 8 (Hi) and 24 (Lo).
c. Reference voltage applied at terminals 13 (Hi) and 11 (Lo).

TABLE II

X AND Y GAIN LINEARITY

INPUT TERMINALS		OUTPUT TERMINALS		OUTPUT VOLTAGE
Hi	Lo	Hi	Lo	
14	15	18	22	1.20V rms, 800 cps, $\angle 0°$
14	15	18	22	0.15V rms, 800 cps, $\angle 0°$
12	10	3	7	1.20V rms, 800 cps, $\angle 0°$
12	10	3	7	0.15V rms, 800 cps, $\angle 0°$

4.2.9 X and Y Phase Shift. With the conditions listed below established and a 3 vdc input applied simultaneously at terminals 14 (Hi) and 15 (Lo) and 12 (Hi) and 10 (Lo), the phase shift from the reference to the first three output terminal pairs (Items "a", "b" and "c") listed in Table I shall be 0° ±20° for a positive dc input and 180° ±20° for a negative dc input. The phase shift from the reference to the last pair of output terminals (Item "d") in Table I shall be 0° ±20° for a negative dc input and 180° ±20° for a positive dc input.

a. Terminals electrically connected as follows: 9 to 10, and 15 to 16.
b. Nominal dc supply voltage applied at terminals 8 (Hi) and 24 (Lo).
c. Reference voltage applied at terminals 13 (Hi) and 11 (Lo).

4.2.10 $A_X X$ and $A_Y Y$ Gain. With the conditions listed below established, the gain from terminals 16 (Hi) and 15 (Lo) to 19 (Hi) and 21 (Lo) and the gain from terminals 9 (Hi) and 10 (Lo) to 6 (Hi) and 4 (Lo) shall be 0.390±0.039 V/V where gain as calculated as follows:

$\text{Gain} = \frac{V\ out}{V\ in}$; V out = measured output voltage
V in = 1 V rms

a. Terminals electrically connected as follows: 10 to 12, and 14 to 15.

b. Nominal dc supply voltage applied at terminals 8 (Hi) and 24 (Lo).

c. Input signal of 1.00±0.01 V rms, 800 cps applied at terminals 9 (Hi) and 10 (Lo) and at terminals 16 (Hi) and 15 (Lo).

4.2.11 $A_X X$ and $A_Y Y$ Phase Shift. With the conditions listed below established, the phase shift from terminals 16 (Hi) and 15 (Lo) to 19 (Hi) and 21 (Lo) shall be 180° ±5°. The phase shift from terminals 9 (Hi) and 10 (Lo) to 6 (Hi) and 4 (Lo) shall be 0° ±15°.

a. Terminals electrically connected as follows: 10 to 12, and 14 to 15.

b. Nominal dc supply voltage applied at terminals 8 (Hi) and 24 (Lo).

c. Input signal of 1.00±0.01 V rms, 800 cps applied at terminals 9 (Hi) and 10 (Lo) and at terminals 16 (Hi) and 15 (Lo).

4.2.12 Frequency Response. With the conditions listed below established, the gain from terminals 14 (Hi) and 15 (Lo) to 18 (Hi) and 22 (Lo) and the gain from terminals 12 (Hi) and 10 (Lo) to 3 (Hi) and 7 (Lo) shall be greater than the average of the gains obtained with positive and negative 3 vdc inputs (refer to 4.2.7). Gain is calculated as follows:

$$\text{Gain} = \frac{\text{V out}}{\text{V in}};$$ V out = peak-to-peak suppressed carrier output voltage (average value, if waveform is unbalanced).
V in = 6 V peak-to-peak.

a. Terminals electrically connected as follows: 9 to 10, and 15 to 16.

b. Nominal dc supply voltage applied at terminals 8 (Hi) and 24 (Lo).

c. Reference voltage applied at terminals 13 (Hi) and 11 (Lo).

d. Input signal of 6V peak-to-peak, 12.00±0.25 cps applied simultaneously at terminals 14 (Hi) and 15 (Lo) and at terminals 12 (Hi) and 10 (Lo).

4.2.13 Output Impedance. With the conditions listed below established and an 800 cps variable test voltage applied individually to each pair of output terminals listed in Table I and adjusted to provide a current of 0.5 ma into the applicable terminals, the output impedance shall be less than 2000 ohms where output impedance is calculated as follows:

$$\text{Output impedance} = \frac{\text{V out}}{I_S};$$ V out = Voltage across output terminals with I_S flowing into terminals
$I_S = 0.5$ ma

a. Terminals electrically connected as follows: 9 to 10, 12 to 10, 14 to 15, and 16 to 15.
b. Nominal dc supply voltage applied at terminals 8 (Hi) and 24 (Lo).
c. Reference voltage applied at terminals 13 (Hi) and 11 (Lo).
d. Loads specified in 4.1.1.2 removed.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

JD:efo

APOLLO G&C Specification
PS2007126 REV C
Original Issue Date: 9-14-65
Release Authority: TDRR 22478
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

OPTICS AUTOMATIC OPERATE RELAY ASSEMBLY

DRAWING NO. 2007126

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals AC	Approvals NASA
M 3/22/66	A	27421	3, 7 RDG/AL	WK	--
M 8/11/66	B	30632	7 RDG/AL	EA	--
M 1/12/67	C	32626	3, 7 RDG/AL	MGM EA	--

This specification consists of page 1 to 7 inclusive.

APPROVALS	NASA/MSC	MIT/IL	ACSP
		S R Ferguson / M G Meeks CCB 9-14-65	O. J. Rygaard / R. J. Olson

NOT REQUIRED PER LETTER
NASA PP7-65-612

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Input Power. The Optics Automatic Operate Relay Assembly, hereafter referred to as the assembly, shall be capable of performing as specified herein when supplied with the following input power.

3.1.1.1 Voltage. The supply voltage shall be as follows:

a. Nominal: 27.5 vdc
b. Degraded: 23.0 vdc
c. Enhanced: 32.0 vdc

3.1.1.2 Current. The supply current shall be 90 ma dc ±10 percent (6 vdc open circuit).

3.1.2 Characteristics

3.1.2.1 Continuity and DC Resistance. The assembly shall provide the continuity as stated in Table I when the degraded dc supply voltage is applied for the stated input conditions (reference Drawing 2010026). Caution shall be exercised so that contact does not switch the measuring load.

3.1.2.2 Current Drain. The dc current drawn from the enhanced dc power supply shall be $\leq$100 ma when the input pins are connected to the power supply lo.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&C Drawing 2007126 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Standards of Manufacturing

3.2.3.1 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be not less than 100 megohms.

3.2.3.2 Continuity. The dc resistance from pin 1 to the frame shall be $\leq$0.5 ohm.

4.2.3 Continuity. The resistance between the pins specified in Table I shall be measured using Method 307 of Standard MIL-STD-202 when the degraded dc supply is connected between pins 28 (hi) and 33 (lo) and the assembly energized or de-energized as specified in Table I. The dc resistance between pin 1 and the frame shall be as specified in 3.2.3.2 when measured with a low-voltage, resistance-measuring device using Method 303 of Standard MIL-STD-202. To assure a good electrical connection, the anodizing may be penetrated.

4.2.4 Insulation Resistance. The insulation resistance between pin 1 and the remaining assembly pins shall be as specified in 3.2.3.1 when measured in accordance with Method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output voltage of 225±75 vdc limited to a short circuit of 6.0 μa.

4.2.5 DC Current Drain. With the enhanced dc power supply connected between pins 28 (hi) and 33 (lo) and pins 8, 9, 26 and 27 connected to pin 33, the current drain shall be $\leq$100 ma dc.

4.2.6 Weight. Not applicable.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

WS:efo

APOLLO G&C Specification
PS2007128 REV B
Original Issue Date: 9-15-65
Release Authority: TDRR 22520
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

SCT MODING ASSEMBLY

DRAWING NO. 2007128

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
(A) 3-22-65	A	27421	4, 11 ROG/AC	WK	- - -
(B) 1/12/67	B	32626	4, 11 ROG/AC	MGM EA	- - -

This specification consists of page 1 to 11 inclusive.

APPROVALS	NASA/MSC	MIT/IL	AC
		S R Ferazzi / M G Munley / CC [illegible] 9/15/65	W Sutherland / R. Greenwood

NOT REQUIRED PER LETTER
NASA PP7-65-612

TABLE II

RECTIFIER FORWARD DROP

TERMINALS		VOLTAGE
From (+)	To (-)	(vdc max)
22	23	2
10	23	2

3.1.2.5 Excitation Current. With the input signal applied between terminals 5 (Hi) and 14 (Lo), the input current shall be equal to or less than 9.35 ma.

3.1.2.6 Polarity. With the input signal applied between terminals 5 and 14, relay K2 energized and terminal 21 connected to terminal 5, the total voltage from terminal 24 to terminal 14 shall be 34.21V ±5 percent.

3.1.2.7 Voltage Ratio. With a 1K ohm ±5 percent resistor connected between terminals 24 and 21 relay K2 energized, the following voltage ratio shall be obtained:

$$\frac{E_{24-21}}{E_{5-14}} = 0.2217 \pm 1\%$$

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&C Drawing 2007128 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3. Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 Insulation Resistance. The resistance between terminal 1 and the remaining assembly pins shall be not less than 100 megohms.

3.2.3.2 Continuity and DC Resistance. The continuity and dc resistance of the assembly shall be as specified in Table III. The dc resistance from terminal 1 to the frame shall be ≤0.5 ohm.

TABLE VI

RELAY CONNECTIONS

RELAY	APPLY + DC TO TERMINAL	APPLY – DC TO TERMINAL
K1	23	18
K2	23	22
K3	23	10

4.2.8 Insulation Resistance. The insulation resistance between terminal 1 and the remaining assembly pins shall be as specified in 3.2.2.1 when measured in accordance with Method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output voltage of 225±75 vdc limited to a short circuit of 6.0 μa. The resistance between terminal 1 and the frame shall be as specified in 3.2.2.1 when measured in accordance with Method 303 of Standard MIL-STD-202. To assure an electrical connection the anodizing may be penetrated.

4.2.9 Excitation Current.

a. Apply the input signal between terminals 5 (Hi) and 14 (Lo).
b. The input current shall be $\leq$9.35 ma.

4.2.10 Polarity

a. Apply 24±1 vdc between terminals 23 (+) and 22 (-).
b. Connect terminal 5 to terminal 21.
c. Apply the input signal between terminals 5 (Hi) and 14 (Lo).
d. The voltage between terminals 24 (Hi) and 14 (Lo) shall be 34.21V ±5 percent.

4.2.11 Voltage Ratio

a. Connect a 1K ohm ±5 percent resistor between terminals 24 and 21.

b. Apply the input signal between terminals 5 (Hi) and 14 (Lo).

c. Apply 24±1 vdc between terminals 23 (+) and 22 (-).

d. Measure the voltage between terminals 24 (Hi) and 21 (Lo) and calculate the voltage ratio by dividing the voltage measured between terminals 24 and 21 by the voltage applied between terminals 5 and 14, the ratio $\left(\frac{E_{24-21}}{E_{5-14}}\right)$ shall be 0.2217±1 percent.

4.2.12 **Weight.** Not applicable.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

WS:pz

APOLLO G&N Specification
PS2007131 REV –
Original Issue Date:
Release Authority: TDRR
Class Release
CODE IDENT NO. 80230

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PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

PHOTOMETER ELECTRONICS ASSEMBLY

DRAWING NO. 2007131

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				MIT	NASA

This specification consists of page 1 to [illegible] inclusive.

APPROVALS						
	NASA/MSC		MIT/IL			ACSP

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of the Photometer Electronics Assembly Part Number 2007131-011.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&N

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment

STANDARDS

Military

MIL-STD-202C	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&N

1010353-7	Relay, Electromagnetic, Sensitive (For reference only)
2007131	Photometer, Electronics Assembly

(Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In event of a conflict between requirements, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract.
b. This specification.
c. Documents listed in this section.

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Inputs. The assembly shall perform as specified herein with the following electrical inputs:

a. DC Supply Voltage: The supply voltage shall be as follows:

(1) Nominal: 27.5±0.25 vdc
(2) Degraded: 23.0±0.2 vdc
(3) Enhanced: 32.0±0.3 vdc

b. Reference Voltage: 28±0.5V rms, 800±10 cps, sinusoidal, 5% max distortion
c. Star Presence Signal: 0 to 15 vdc
d. Photometer Input Signal: 550±2 cps sinusoidal waveform, 5% max distortion, 0 to 2V rms.
e. Current Supply: 90 ma ±10% (6 vdc open circuit)

3.1.2 Characteristics

3.1.2.1 Current Drain. The current drain (I_{dc}) from the enhanced dc supply shall be
73±8 ~~80±10~~ ma. with the dc supply relay energized. With the dc supply relay deenergized no current shall flow.

3.1.2.2 Photometer Mark. With the nominal dc and reference voltages applied, and after a short has been applied to the manual reset terminals for at least 3 seconds and then removed, the photometer output voltage shall be as follows:

a. ≥27 vdc when a 2.0±0.1V photometer input signal is applied, for a maximum of 10 seconds.

b. ≤1 vdc when the input signal is smoothly reduced to 1/2 +8, -2 percent of the voltage applied in step a.

c. ≥27 vdc, when the manual reset terminals are shorted for at least 3 seconds after completing b.

d. ≥27 vdc after the input signal has been reduced to 0.5±0.025V, and after a short has been applied to the manual reset terminals for at least 3 seconds and then removed. The input shall be applied for a maximum of 10 seconds after the short is removed.

e. ≤1 vdc, when the input signal is smoothly reduced to 1/2 +8, -2 percent of the voltage in d.

3.1.2.3 Star Presence Level Detector. With nominal dc voltage applied, the star presence detector output shall change from ≥27 vdc to ≤1 vdc, when the star presence input is increased from ≤1 vdc to 15±0.5 vdc.

3.1.2.4 Monitor Gain. With nominal dc supply voltage applied and 1.0±0.05V rms, 550±2 cps applied to the photometer input, the gain from photometer input to the monitor output shall be ~~0.048~~ 0.063 ±20 percent.

3.1.2.5 Monitor Output Isolation. The resistance between the monitor output terminals and the electrical interconnection of all other assembly terminals shall be no less than 100 megohms.

3.1.2.6 ~~Reversed Diode Impedance~~ Relay Control Diode Forward Drop and Reverse Impedance. The diode impedance between terminals 8 and 9 and between terminals 9 and 10 shall be greater than 1 megohm in both directions. The voltage between the terminals specified in Table I shall not exceed 2 Vdc with the current supply applied to the terminals specified in Table I.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007131 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not Applicable.

3.2.3 Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 Insulation Resistance. The resistance between terminal 1, and the remaining assembly terminals shall be at least 100 megohms.

3.2.3.2 Continuity and DC Resistance. ~~Continuity and DC resistance shall be in accordance with Table I.~~ The dc resistance between terminal 1 and the frame and between terminals 2 and 18 and between 2 and 17 shall be ≤0.5 ohm.

TABLE I

CONTINUITY AND DC RESISTANCE

RELAY CONTROL VOLTAGE (VOLTS)	RELAY CONTROL VOLTAGE APPLIED TO TERMINALS		TEST POWER OR CURRENT	FROM TERM. (+)	TO TERM. (-)	RESISTANCE (OHMS)
	Hi	Lo				
0	7	8	6 vdc max	5	3	>5M
degraded dc	7	8	90 ma dc ±10%	5	3	<1.2
0	7	9	6 vdc max	5	3	>5M
degraded dc	7	9	90 ma dc ±10%	5	3	<1.2
0	7	10	6 vdc max	5	3	>5M
degraded dc	7	10	90 ma dc ±10%	5	3	<1.2
0	7	8	6 vdc max	7	12	>5M
degraded dc	7	8	90 ma dc ±10%	7	12	<1.2
0	7	9	6 vdc max	7	12	>5M
degraded dc	7	9	90 ma dc max	7	12	<1.2
0	7	10	6 vdc max	7	12	>5M
degraded dc	7	10	90 ma dc ±10%	7	12	<1.2

TABLE I

CURRENT DRAIN

TERMINALS		CURRENT
FROM(+)	TO (−)	(ma)
7	8	16.5±5.0
7	9	16.5±5.0
7	10.	16,5±5.0

4. QUALITY ASSURANCE PROVISIONS

4.1 PRODUCT PERFORMANCE AND CONFIGURATION REQUIREMENTS/QUALITY VERIFICATION CROSS REFERENCE INDEX

Test/Examination	Requirement	Method
Insulation Resistance and Output Isolation	3.1.2.5, 3.2.3.1	4.3.3
Continuity and DC Resistance	3.2.3.2	4.3.4
Current Drain	3.1.2.1	4.3.5
Photometer Mark	3.1.2.2	4.3.6
Star Presence Level Detector	3.1.2.3	4.3.7
Monitor Gain	3.1.2.4	4.3.8
Reverse Diode Impedance	3.1.2.6	4.3.9

4.2 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.2.1 Test Conditions

4.2.1.1 Environmental. Unless otherwise specified, the amplifier shall be tested under the following ambient conditions:

a. Temperature: 25° ±10°C
b. Relative Humidity: 90% max
c. Barometric Pressure: 28 to 32 inches of Hg

4.2.1.2 Electrical Inputs

a. DC Supply Voltage: The dc supply voltage shall be as follows:

(1) Nominal: 23.0±0.2V
(2) Degraded: 27.5±0.25V
(3) Enhanced: 32.0±0.3V

b. Reference Voltage: 28.0±0.5V rms, 800±10 cps sinusoidal waveform, 5 percent max distortion.

c. Photometer Input Signal: 550±2 cps sinusoidal waveform, 5 percent max distortion, 0 to 2V rms.

d. Star Presence Signal: 0 to 15 vdc.

e. Current Supply: A current supply of 0.09 amp dc ±10 percent (6 vdc open circuit) shall be used in testing the assembly.

4.2.1.3 Test Setup. Unless otherwise specified, loads shall be connected as shown in the recommended test setup (Figure 1).

4.2.2 Nonconforming Units. Failure of the unit to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or, when directed by the cognizant inspector, a complete retest and reexamination may be required. Nonconforming amplifiers which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.3 TESTS

4.3.1 Drawing Compliance. The assembly shall be visually examined for compliance with the requirements of APOLLO G&N Drawing 2007131. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.3.2 Workmanship-Vibration. With the conditions listed below established, the assembly shall be vibrated. The vibration shall be simple harmonic motion swept from 10 to 2000 cps at a rate of 1 octave per 15 seconds. The magnitude of the vibration shall be 6.0g rms limited to 0.4 inch pp constant displacement from 10 cps to the crossover frequency. During vibration the voltage between terminals 25 (Hi) and 2 (Lo), and the voltage between terminal 14 (Hi) and 0 volts (Lo) shall be monitored. An output voltage greater than 1 volt, between terminals 25 (Hi) and 2 (Lo) or 14 (Hi) and 2 (Lo) lasting more than 1 msec shall constitute a failure.

a. Degraded dc supply voltage applied to terminals 7 (Hi) and 2 (Lo).

b. Reference voltage applied to terminals 5 (Hi) and 4 (Lo)..

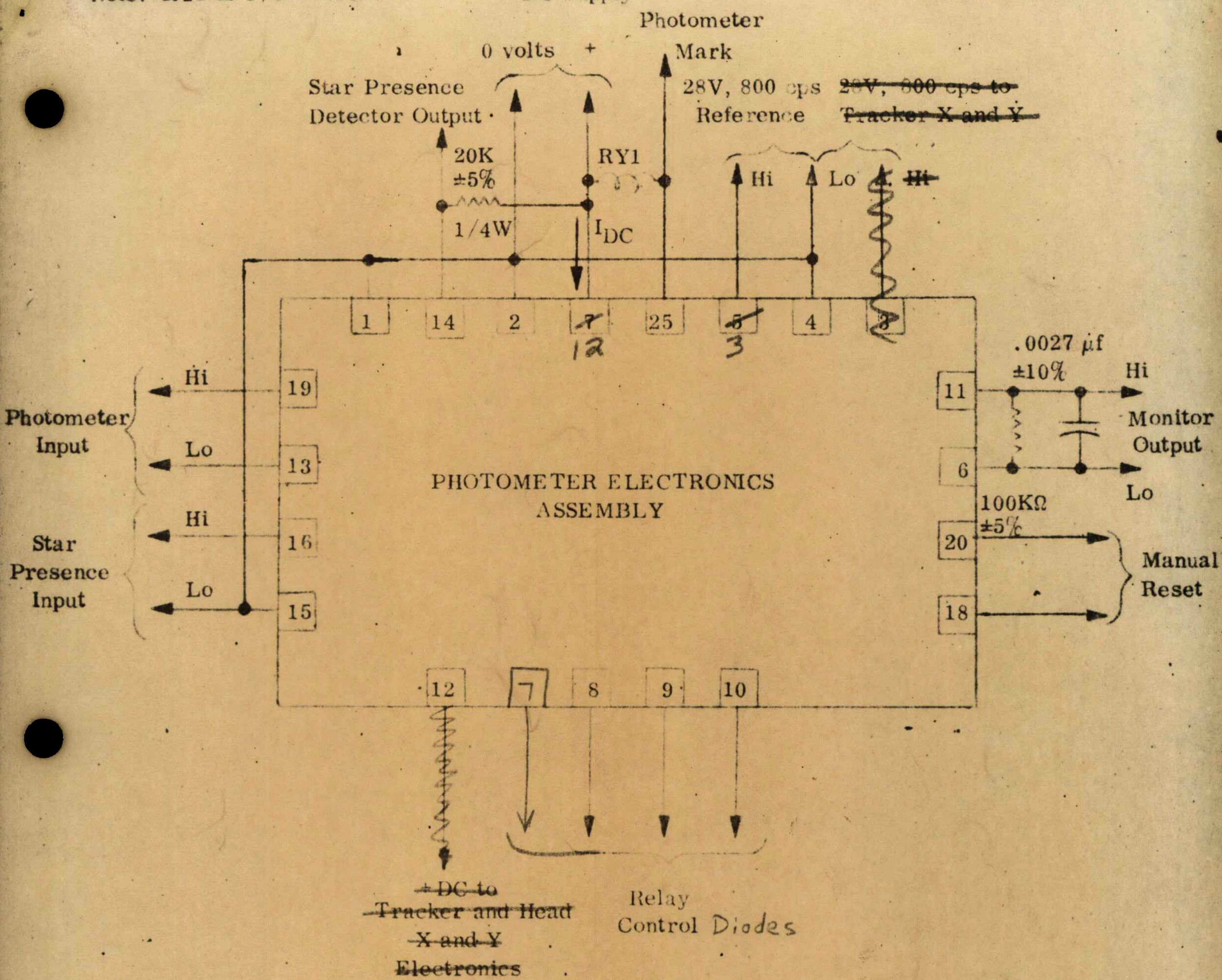
~~c. Terminal 8 connected to terminal 2.~~

c ~~d.~~ 15 vdc signal applied to terminals 16 (Hi) and 15 (Lo).

d ~~e.~~ A 2.5±0.1 volt photometer signal applied to terminals 19 (Hi) and 13 (Lo) and then reduced to 0.5±0.05 volt such that the vibration test is completed within 5 minutes after the input is reduced to 0.5±0.05 volt.

4.3.3 Insulation Resistance and Output Isolation. The following resistance measurements shall be as specified in 3.2.3.1 and 3.1.2.6, when measured in accordance with Method 302 of Standard MIL-STD-202 with a megohmmeter having an output of 225±75 vdc limited to a short circuit current of 6 μa.

Note: RY1 is P/N 1010353-7



TEST SETUP

FIGURE 1

a. Between terminal 1 and the remaining assembly pins.

b. Between the electrical interconnection of all terminals and terminal 6, except terminal 11.

4.3.4 Continuity and DC Resistance

~~a.~~ The dc resistance between terminal 1 and the frame, terminals 2 and 18, and 2 and 17 shall be as specified in 3.2.3.2 when measured in accordance with Method 303 of Standard MIL-STD-202. To assure a good electrical connection to the frame, the anodizing may be penetrated.

~~b. The continuity and dc resistance shall be as specified in Table I when measured in accordance with Method 307 of Standard MIL-STD-202.~~

4.3.5 Current Drain. With the following conditions established the dc supply current drain (I_{dc}) shall be as specified in 3.1.2.1.

a. Enhanced dc supply voltage applied to terminals ~~7~~ 12 (Hi) and 2 (Lo).

b. Reference voltage applied to terminals ~~5~~ 3 (Hi) and 4 (Lo).

c. The following terminals are connected to each other: 19 and 13; 16 and 15; ~~8 and 2. When terminals 8 and 2 are disconnected there shall be no dc current drain (I_{dc})~~.

4.3.6 Photometer Mark With nominal dc supply voltage applied to terminals ~~7~~ 12 (Hi) and 2 (Lo), and reference voltage applied to terminals ~~5~~ 3 (Hi) and 4 (Lo) ~~and terminals 8 and 2 connected together~~, the photometer mark output shall be as follows:

a. With terminals 20 and 18 connected for at least 3 seconds and then disconnected, the voltage between terminals 25 (Hi) and 2 (Lo) shall be as specified in 3.1.2.2.a when a 2.0±0.1V rms, 550±2 cps photometer input signal is applied to terminals 19 (Hi) and 13 (Lo) for a maximum of 10 seconds.

b. With the photometer input signal at terminals 13 and 19 smoothly reduced to 1/2 +8, -2 percent of the value in 4.3.6.a, the voltage between terminals 25 (Hi) and 2 (Lo) shall be as specified in 3.1.2.2.b.

c. With terminals 20 and 18 connected for at least 3 seconds and the disconnected, the voltage between terminals 25 (Hi) and 2 (Lo) shall be as specified in 3.1.2.1.c.

d. With terminals 20 and 18 connected for at least 3 seconds and then disconnected, the photometer input at terminals 13 and 19 reduced to 0.5±0.5V rms and applied for 10 seconds maximum, the voltage between terminals 25 (Hi) and 2 (Lo) shall be as specified in 3.1.2.2.d.

e. Within 3 minutes after completion of 4.3.6.d, the voltage at terminals 25 (Hi) and 2 (Lo) shall be as specified in 3.1.2.2.e, with the photometer input signal reduced to 1/2 +8,-2 percent of the value specified in 4.3.6.d.

4.3.7 Star Presence Level Detector. With nominal dc supply voltage applied to terminals 14 (Hi)(through a 20K resistor)and 15 (Lo), the voltage between terminal 14 (Hi) and 0 volts (Lo) shall change from $\geq$27 vdc to $\leq$1 vdc as specified in 3.1.2.3, when the input between terminals 16 (Hi) and 5 (Lo) is increased from $\leq$1 vdc to 15.0$\pm$0.5 vdc.

4.3.8 Monitor Gain. With the following conditions established, the voltage gain from input to the output between terminals 11 (Hi) and 6 (Lo) shall be as specified in 3.1.2.4.

a. Nominal dc supply voltage applied to terminals 7 (Hi) and 2 (Lo).
b. Terminal 8 connected to terminal 2.
c. A 1.00$\pm$0.05 rms photometer input signal applied to terminals 19 (Hi) and 13 (Lo).

Relay [illegible] Reverse [illegible] Diode [illegible] Impedance

4.3.9 ~~Reverse Diode Impedance~~. The dc resistance between terminals 8 and 9 and between terminals 9 and 10, when measured in accordance with Method 303 of Standard MIL-STD-202, successively and in both directions, with a resistance measuring device having an open circuit voltage $\geq$3 vdc but $\leq$50 vdc shall be as specified in 3.1.2.6 in each instance.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

b. With the current [illegible] the terminals specified in Table I, the maximum volt[illegible] the terminals shall be 2 vdc.

APOLLO G&N Specification
PS2007132 REV B
Original Issue Date: 8-3-65
Release Authority: TDRR 21311
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

IMU LOAD-COMPENSATION MODULE

DRAWING NO. 2007132

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals AC	Approvals NASA
6/21/66	A	29719	5 RDG/AL	MGM	--
1/12/67	B	32626	4 RDG/AL	MGM EA	--

This specification consists of page 1 to 6 inclusive.

APPROVALS	NASA/MSC		MIT/IL		AC
	G. C. Mfg	W Kupfer 3 Aug 65		E.A. Sptz 8-2-65	E Conger 6-28-65 J. Harding

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of all units of the IMU Load Compensation Module, Part Number 2007132-011.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&N

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment

STANDARDS

Military

MIL-STD-202C	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&N

2007132	IMU Load Compensation Module

(Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In event of a conflict between requirements, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this section

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Capacitance. The capacitance at 1000 cps shall be as specified in Table I.

TABLE I

CAPACITANCE

PINS		CAPACITANCE
Hi	Lo	
2	10	2.4 μf ±8%
3	9	1.24 μf ±8%
4	8	2.4 μf ±8%

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007132 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable

3,2,3 Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 Continuity. The resistance between pin 1 and the frame shall be 0.5 ohm maximum.

3.2.3.2 Insulation Resistance. The insulation resistance between each of pins 2 through 10 and pin 1 shall be at least 100 megohms.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 Test Conditions

4.1.1.1 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

a. Temperature: 25° ±10°C
b. Relative Humidity: 90% max
c. Barometric Pressure: 28 to 32 inches of Hg

4.1.2 Nonconforming Units. Failure of the unit to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or, when directed by the cognizant inspector, a complete retest and reexamination may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.2 TESTS

4.2.1 Drawing Compliance. The assembly shall be visually examined for compliance to the requirements of APOLLO G&N Drawing 2007132. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.2.2 Workmanship-Vibration. With 28.0±0.3 V rms, 800±8 cps applied between pins 2 (Hi) and 10 (Lo), 3 (Hi) and 9 (Lo), and 4 (Hi) and 8 (Lo), the assembly shall be subjected to vibration. The vibration shall be a simple harmonic motion along an axis ⊥ to the mounting face of the assy and swept from 10 to 2000 cps at a rate of 1 octave/15 sec. The magnitude of vibration shall ~~along an axis ⊥ to~~ be 6.0g rms limited to a 0.4 inch pp constant displacement from 10 cps to the crossover frequency. Prior to vibration, the current drawn at each set of input pins shall be measured and recorded. During vibration, the current drawn shall be monitored, and any deviation of 10 percent existing for more than 1 millisecond shall constitute a failure.

4.2.3 Continuity. The resistance between pin 1 and the frame shall be 0.5 ohm maximum when measured with a low voltage resistance measuring device using method 303 of Standard MIL-STD-202. To assure an electrical connection the anodizing may be penetrated.

4.2.4 Insulation Resistance. The insulation resistance between each of pins 2 through 10 and pin 1 shall be measured using method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output of 225±75 vdc, limited to a short circuit current of 6.0 μa. The resistance indicated shall be a minimum of 100 megohms.

4.2.5 Capacitance. With a 1000±10 cps input applied between the pins specified in Table I, the capacitance shall be measured using method 305 of Standard MIL-STD-202 and shall meet the corresponding requirements specified in Table I.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

PP:jls

APOLLO G&N Specification
PS2007161 REV B
Original Issue Date: 5 OCT '65
Release Authority: TDRR 23024
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

RETICLE LIGHT DIMMER ASSEMBLY

DRAWING NO. 2007161

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
2/8/66	A	26011	3, 4, 7	WK	TM
1/12/67	B	32626	3, 7	MGM EA	—

This specification consists of page 1 to 7 inclusive.

APPROVALS	NASA/MSC	E A Woodin 9-30-65	J J Kevin MIT/IL	W Kupfer 10/5/65	R E Kraemer	R. Mina AC

NOT REQUIRED PER LETTER
NASA PP7-65-612

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Supply Voltage. The assembly shall operate as specified herein with a supply voltage of 115±1V rms, 400±4 cps.

3.1.2 Characteristics

3.1.2.1 Reticle Light Dimmer Output. The output voltage of the assembly with a 5 ohm load shall be adjustable from 0.0 +0.3V rms, -0 0V rms to 4.0±0.5V rms and shall be 4.9±0.3V rms when pin 6 is shorted to pin 4.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007161 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be greater than 100 megohms.

3.2.3.2 Continuity and DC Resistance. The continuity and dc resistance of the assembly shall be as specified in Table I.

TABLE I

CONTINUITY AND DC RESISTANCE

From Pin (+)	To Pin (-)	Resistance (Ohms)
1	Heatsink	0.5 max
2	3	20 max
6	8	10K min
2	8	100 meg min
2	1	100 meg min
8	1	100 meg min

4.2.4 Continuity and DC Resistance. - The resistance between the points listed in Table I shall be as specified when measured with a low voltage resistance measuring device using Method 303 of Standard MIL-STD-202. To assure a good electrical connection to the heatsink, the anodizing may be penetrated.

4.2.5 Weight. Not applicable.

4.2.6 Reticle Light Dimmer Output. With the assembly connected as shown in Figure 2 and 115±1V rms, 400±4 cps applied to pins 2 and 3, and switches S1 and S2 positioned as specified in Table II, the output voltage (E_o) shall be as specified in Table II.

TABLE II

OUTPUT VOLTAGE

S1 POSITION	S2 POSITION	OUTPUT VOLTAGE (Vrms)
1	Open	4.0±0.5
2	Open	2.5±1.0
3	Open	0.3 max
1, 2, or 3	Closed	4.9±0.3

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

RJM:dh

APOLLO G&N Specification
PS2007161 REV A
Original Issue Date: 5 OCT. '65
Release Authority: TDRR 23024
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

RETICLE LIGHT DIMMER ASSEMBLY

DRAWING NO. 2007161

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				MIT	NASA
2/8/66	A	26011	3, 4, 7	WK	TM

This specification consists of page 1 to 7 inclusive.

APPROVALS	NASA/MSC	E A Woodin 9-30-65	J I Venn MIT/IL	WK 11/5	ACSP

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of all units of the Reticle Light Dimmer Assembly, Part Number 2007161-011.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&C

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment

STANDARDS

Military

MIL-STD-202C	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&C

2007161	Reticle Light Dimmer Assembly

(Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In event of a conflict between requirements, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract.
b. This specification.
c. Documents listed in this section.

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Supply Voltage. The assembly shall operate as specified herein with a supply voltage of 115±1V rms, 400±4 cps.

3.1.2 Characteristics

3.1.2.1 Reticle Light Dimmer Output. The output voltage of the assembly with a 5 ohm load shall be adjustable from 0.0 +0.3V rms, -0 0V rms to 4.0±0.5V rms and shall be 4.9±0.3V rms when pin 6 is shorted to pin 4.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007161 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. The maximum weight of the assembly shall be 0.706 lb.

3.2.3 Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be greater than 100 megohms.

3.2.3.2 Continuity and DC Resistance. The continuity and dc resistance of the assembly shall be as specified in Table I.

TABLE I

CONTINUITY AND DC RESISTANCE

From Pin (+)	To Pin (-)	Resistance (Ohms)
1	Heatsink	0.5 max
2	3	20 max
6	8	10K min
2	8	100 meg min
2	1	100 meg min
8	1	100 meg min

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 Test Conditions

4.1.1.1 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

a. Temperature: 25° ±10°C
b. Relative Humidity: 90% max
c. Barometric Pressure: 28 to 32 inches of Hg

4.1.2 Nonconforming Units. Failure of the units to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or, when so directed by the cognizant inspector, a complete retest and reexamination may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

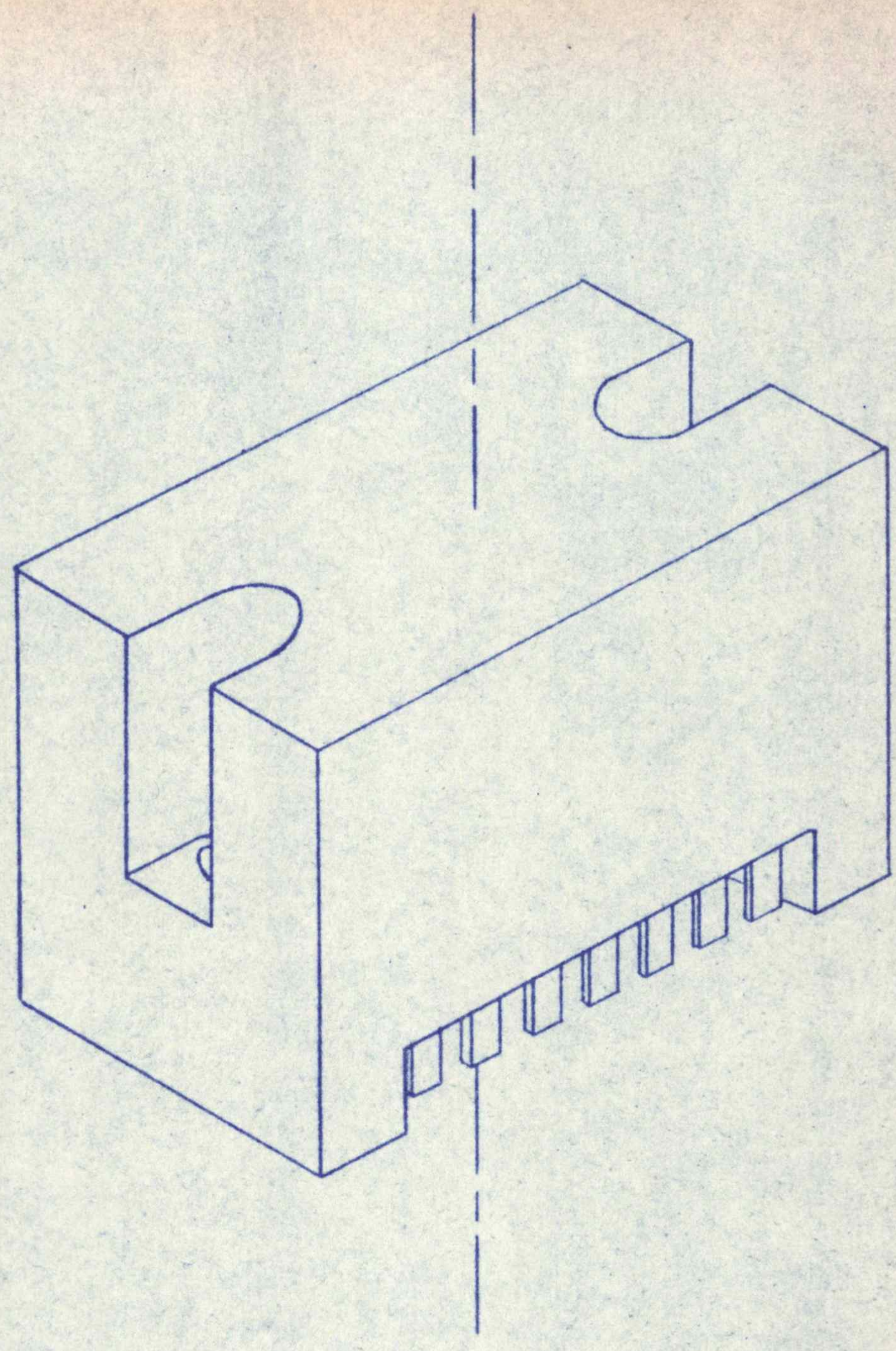
4.2 TESTS

4.2.1 Drawing Compliance. The assembly shall be visually examined for compliance to the requirements of APOLLO G&C Drawing 2007161. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.2.2 Workmanship-Vibration. The assembly shall be mounted on a vibration fixture and vibrated parallel to the vibration axis as shown in Figure 1. The vibration shall be simple harmonic motion swept from 10 to 2000 cps at a rate of 1 octave per 15 sec. The magnitude of vibration shall be 6.0g rms limited to a 0.4 inch pp constant displacement from 10 cps to the crossover frequency. During vibration the assembly shall be electrically tested in accordance with 4.2.2.1 and any out-of-tolerance conditions which exists for 1 msec or more shall constitute failure.

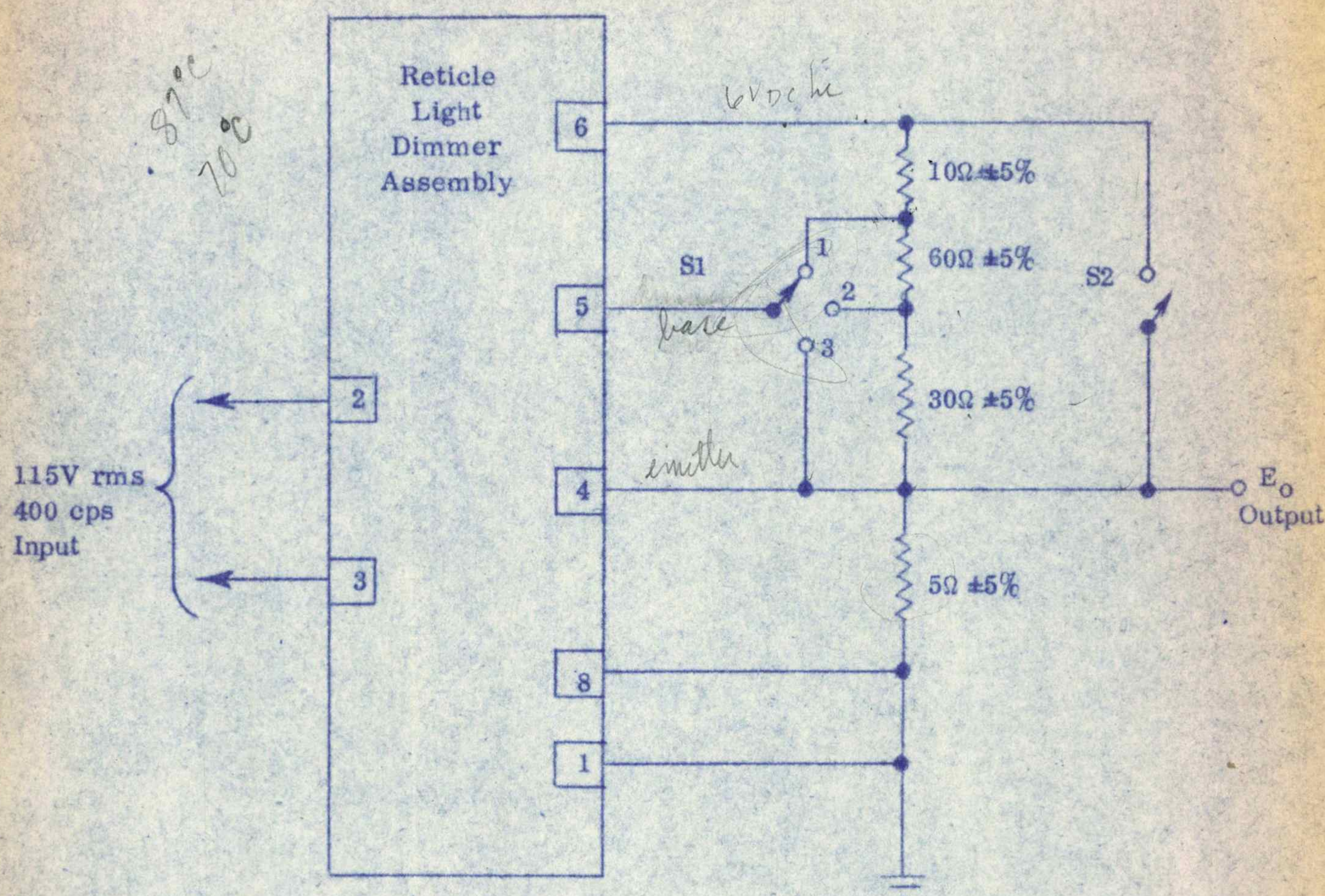
4.2.2.1 Electrical. With 115±1V rms, 400±4 cps applied to pins 2 and 3 and the assembly connected as shown in Figure 2, S1 placed in position 2 and S2 open, the output voltage (E_o) shall be 2.5±1.0 vrms.

4.2.3 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be greater than 100 megohms when tested in accordance with Method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output of 225±75 vdc limited to a short circuit current of 6.0 μa.



VIBRATION AXIS OF ASSEMBLY

FIGURE 1



RECOMMENDED TEST CIRCUIT

FIGURE 2

4.2.4 Continuity and DC Resistance. - The resistance between the points listed in Table I shall be as specified when measured with a low voltage resistance measuring device using Method 303 of Standard MIL-STD-202. To assure a good electrical connection to the heatsink, the anodizing may be penetrated.

4.2.5 Weight. The assembly shall be weighed to determine that the weight of the assembly is less than 0.706 lb.

4.2.6 Reticle Light Dimmer Output. With the assembly connected as shown in Figure 2 and 115±1V rms, 400±4 cps applied to pins 2 and 3, and switches S1 and S2 positioned as specified in Table II, the output voltage (E_o) shall be as specified in Table II.

TABLE II

OUTPUT VOLTAGE

S1 POSITION	S2 POSITION	OUTPUT VOLTAGE (Vrms)
1	Open	4.0±0.5 .9
2	Open	2.5±1.0
3	Open	0.3 max
1, 2, or 3	Closed	4.9±0.3

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

RJM:db

APOLLO G&N Specification
PS 2007170 Rev D
Original Issue Date: 7 Jul 65
Release Authority: TDRR 20665
Class A Release

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

TEMPERATURE ALARM MODULE ASSY

DRAWING NO. 2007170

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals MIT	Approvals NASA
8/17/65	A	21657	5	WR	ACM
11-30-65	B	24427	4-7 RDG/AC	WK	TM
2/23/66	C	26563	5, 6, 7 JH/AC	WK	--
5/18/66	D	29030	7, 8 RDG/AC	MGM	--

This specification consists of Pages 1 to 8 inclusive.

APPROVALS	NASA/MSC	MIT/IL	ACSP
	[signature]	[signature] 6/24/65 [signature] 7 July 65	[signature] 24 June 65

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of the Temperature Alarm Module, Part No. 2007170-011.

1.2 PRODUCT CONFIGURATION BASELINE ACCEPTANCES. The product configuration baseline shall be established by the FACI of CEI Serial No. . This unit and all subsequent units, regardless of intended use, shall be accepted to the configuration defined by Serial No. unless formally approved otherwise as required by ANA Bulletin No. 445.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&N

ND 1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment

STANDARDS

Military

MIL-STD-202	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&N

2007170	Temperature Alarm Module Assy

(Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In the event of a conflict between requirements of the contract, this specification and the documents listed in this section, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this section

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Test Environment. The module shall function as specified herein when the temperature of the heatsink is in the range of 15° to 65°C.

3.1.2 Electrical Input. The module shall function as specified herein when supplied with an electrical input from 22.0 to 33.5 vdc.

3.1.3 "On" Mode of Operation. With a voltage from 22.0 to 33.5 vdc applied to the excitation terminals and a load resistor of 22K ohms ±1% connected to the load terminal, the output transistor ~~saturation voltage~~ (V_{CE}) shall be less than 0.5 vdc.

3.1.4 "Off" Mode of Operation. With the conditions established as specified in 3.1.3 and the input shorted to 22.0 to 33.5 vdc (open circuit), the load voltage drop shall not exceed 1.0 vdc.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the module shall be in accordance with the APOLLO G&N Drawing 2007170 and all the drawings and engineering data referenced thereon.

3.2.1.1 Weight. The maximum weight of the module shall not exceed 7 grams.

3.2.2 Insulation Resistance. The insulation resistance between each module pin and the module mounting screws shall be equal to or greater than 100 megohms.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 Nonconforming Units. Failure of the unit to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or, when directed by the cognizant inspector, a complete retest and reexamination may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.1.2 Test Conditions

4.1.2.1 Environmental. Unless otherwise specified, the module shall be tested under the following ambient conditions:

a. Temperature: 25° ±10°C
b. Relative Humidity: 90% max
c. Barometric Pressure: 28 to 32 inches of Hg

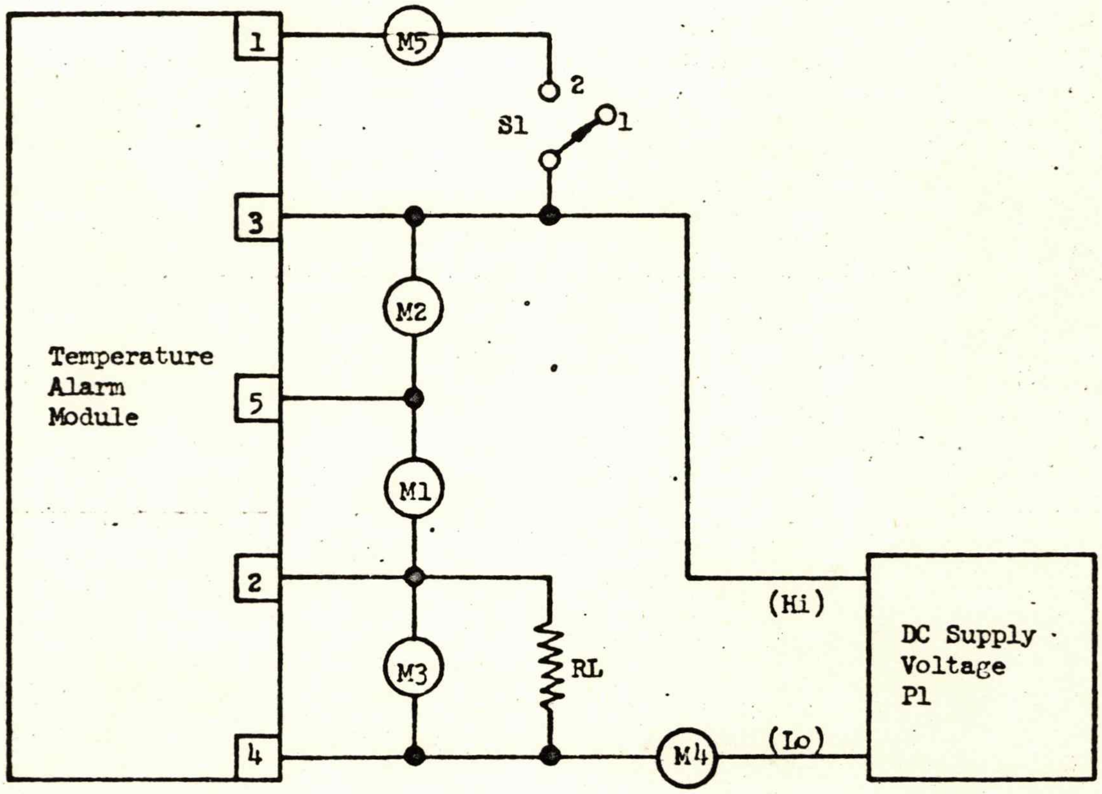
4.1.2.2 Test Power. An electrical input from 22.0 to 33.5 vdc is necessary to perform the tests specified herein.

4.1.2.3 Test Setup. Prior to performing the tests specified in 4.2.3 through 4.2.7, the module shall be set up for test as shown in Figure 1.

4.2 TESTS

4.2.1 Drawing Compliance. The module shall be visually examined for compliance to the requirements of the APOLLO G&N Drawing 2007170. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.2.1.1 Weight. The weight of the module shall not exceed 7 grams.



P1 - Variable DC Power Supply, 22.0 to 33.5 vdc, 0 to 50 ma capacity
RL - Load Resistor, 22K ohms ±1%, 0.5 W.
S1 - Switch
M1, M2, & M3 - Digital Voltmeter, Weston Model 1420 or equivalent
M4 - Clipon Ammeter, Hewlett-Packard Model 428 or equivalent
M5 - DC Ammeter, 0 to 50 ma, Weston Model 622 or equivalent

TEST SETUP

FIGURE 1

4.2.2 Insulation Resistance. With the module mounted by its mounting screws on a metal plate, the insulation resistance shall be tested in accordance with Method 302 of Standard MIL-STD-202. The insulation resistance as measured between the pins and the mounting bracket shall be 100 megohms or greater. The megohmmeter used shall have an output voltage of 225±75 vdc limited to a short circuit current of 6.0 μa.

4.2.3 Workmanship-Vibration. With the module mounted on a heatsink and connected as shown in Figure 1 and a supply voltage between 22.0 and 33.5 vdc applied, the module shall be vibrated along the vibration axis as shown in Figure 2. The vibration shall be simple harmonic from 10 to 2000 cps swept at a rate of one octave per 15 sec with an input of 6.0g rms limited to 0.4 inch pp constant displacement from 10 cps to crossover frequency. During vibration the module shall be monitored in accordance with the requirements of 4.2.4, 4.2.5 and 4.2.6. Any out-of-tolerance condition which exists for a period greater than 1 msec shall be cause for rejection of the module. Perform this test in both modes of operation: "on" mode and "off" mode. After vibration the module shall be visually examined as specified in 4.2.1.

4.2.4 "On" Mode of Operation. With the power supply P1 adjusted to 33.5±0.3 vdc and switch S1 set to position "1" (open), the following shall occur:

a. The voltage between pins 3 and 5 as indicated on meter M2 shall be less than 0.5 vdc.

b. The voltage between pins 2 and 5 as indicated on meter M1 shall be 4.0±0.3 vdc.

4.2.5 "Off" Mode of Operation. With the power supply adjusted to 33.5±0.3 vdc and switch S1 set to position "2" (closed), the following shall occur:

a. The current flowing to pin 1 as indicated on meter M5 shall be 4.1±0.2 ma.

b. The voltage between Pins 2 and 4 as indicated on meter M3 shall be a maximum of 1.0 vdc.

4.2.6 Current Drain. With the conditions established as specified in 4.2.4, the current drain from the power supply shall be between 5.0 and 5.8 ma as indicated on meter M4.

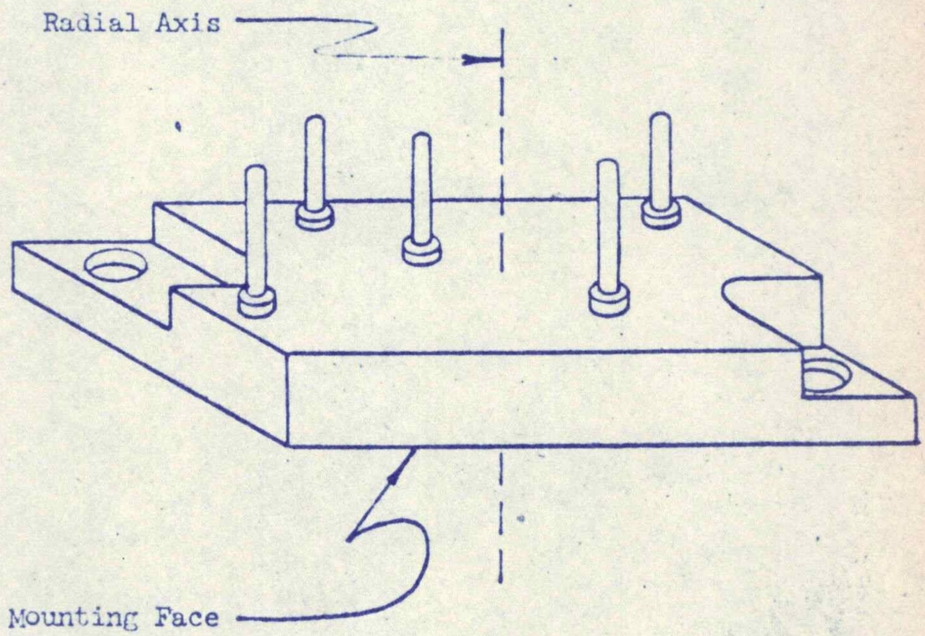
4.2.7 High Temperature. Repeat 4.2.4 through 4.2.6 with the module at an ambient temperature of 65° ±3°C.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

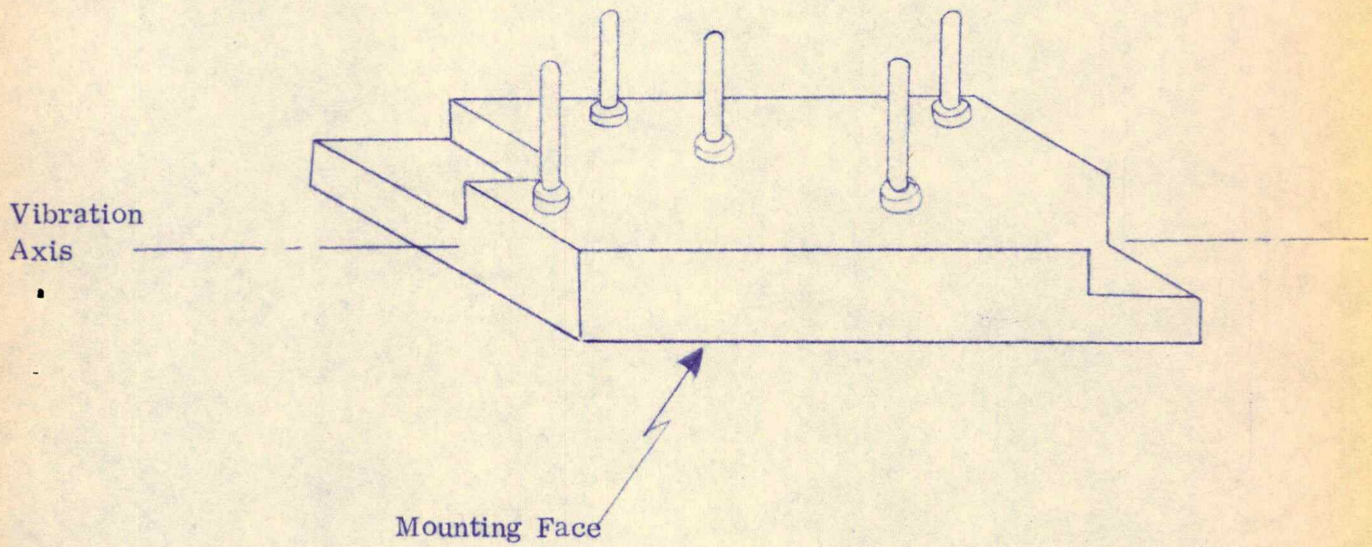
6. NOTES. None.

WS:efo



VIBRATION AXIS OF MODULE

FIGURE 2



VIBRATION AXIS OF MODULE

FIGURE 2

APOLLO G&N Specification
PS 2007171 Rev E
Original Issue Date: 7 Jul 65
Release Authority: TDRR 20665
Class A Release

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

BLOWER CONTROL MODULE ASSY

DRAWING NO. 2007171

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				MIT	NASA
8/17/65	A	21657	5	WK	ACM
11/30/65	B	24428	4, 5, 6, 7 RD6/AC	WK	TM
2/8/66	C	25944	7 RD6/AC	WK	---
2/23/66	D	26563	5, 7 RD6/AC	WK	--
5/24/66	E	29031	7, 8 RD6/AC	MGM	---

This specification consists of Pages 1 to 8 inclusive.

APPROVALS	NASA/MSC	MIT/IL	ACSP
	6/24/65		17 Jul 65

First Article Customer Inspection

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of the Blower Control Module, Part No. 2007171-011.

1.2 PRODUCT CONFIGURATION BASELINE ACCEPTANCES. The product configuration baseline shall be established by the FACI of CEI Serial No. . This unit and all subsequent units, regardless of intended use, shall be accepted to the configuration defined by Serial No. unless formally approved otherwise as required by ANA Bulletin No. 445.

Contract End Item

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&N

ND 1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment

STANDARDS

Military

MIL-STD-202	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&N

2007171	Blower Control Module Assy

(Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In the event of a conflict between requirements of the contract, this specification and the documents listed in this section, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this section

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Test Environment. The module shall function as specified herein when the temperature of the heatsink is in the range of 15° to 65°C.

3.1.2 Electrical Input. The module shall function as specified herein when supplied with an electrical input from 24.5 to 33.5 vdc.

3.1.3 "On" Mode of Operation. With a voltage from 24.5 to 33.5 vdc applied to the excitation terminals and a load resistor of 3100±620 ohms connected to the load terminal, the output transistor saturation voltage (V_{CE}) shall be less than 100 mv dc.

3.1.4 "Off Mode of Operation. With the conditions established as specified in 3.1.3 and the input shorted to 0 vdc, the load voltage drop shall not exceed 0.1 vdc.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the module shall be in accordance with the APOLLO G&N Drawing 2007171 and all the drawings and engineering data referenced thereon.

3.2.1.1 Weight. The maximum weight of the module shall not exceed 2.5 grams.

3.2.2 Insulation Resistance. The insulation resistance between each module pin and the module mounting screws shall be equal to or greater than 100 megohms.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 Nonconforming Units. Failure of the unit to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or, when directed by the cognizant inspector, a complete retest and reexamination may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.1.2 Test Conditions

4.1.2.1 Environmental. Unless otherwise specified, the module shall be tested under the following ambient conditions:

a. Temperature: 25°±10°C

b. Relative Humidity: 90% max

c. Barometric Pressure: 28 to 32 inches of Hg

d. [illegible]

4.1.2.2 Test Power. An electrical input from 24.5 to 33.5 vdc is necessary to perform the tests specified herein:

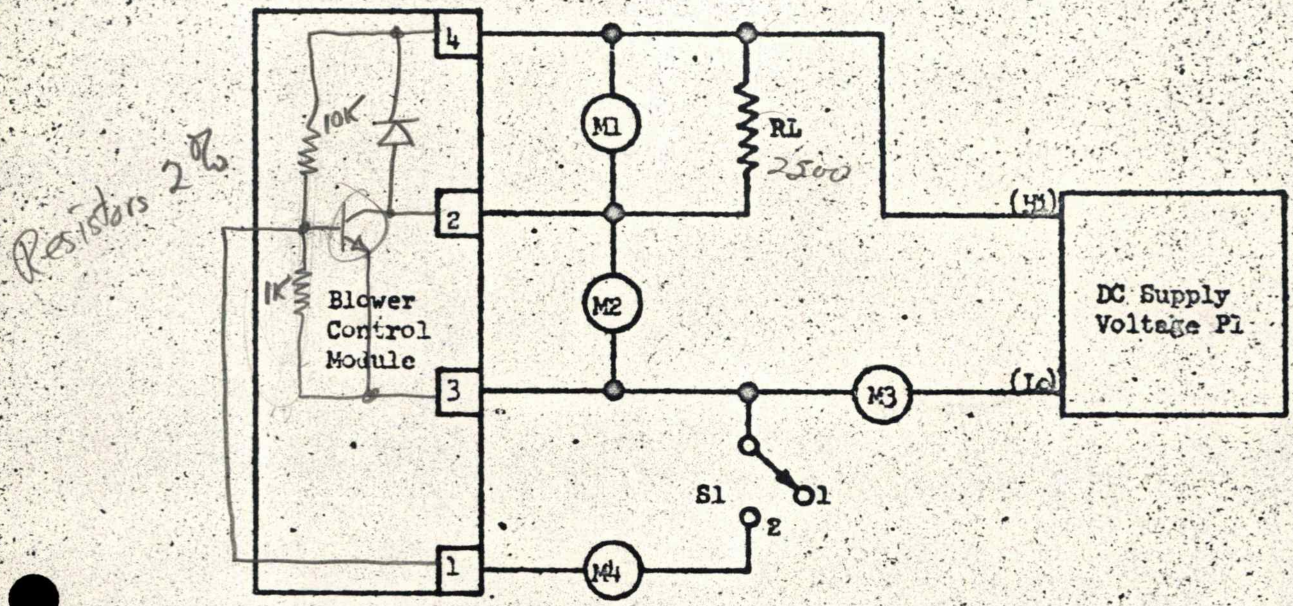
a. [illegible]
b. [illegible]

4.1.2.3 Test Setup. Prior to performing the tests specified in 4.2.3 through 4.2.7, the module shall be set up for test as shown in Figure 1.

4.2 TESTS

4.2.1 Drawing Compliance. The module shall be visually examined for compliance to the requirements of the APOLLO G&N Drawing 2007171. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.2.1.1 Weight. The weight of the module shall not exceed 5.5 grams.



P1 - Variable DC Power Supply, 24.5 to 33.5 vdc
RL - Load Resistor, 2500 ohms ±1%
S1 - Switch, SPST
M1 & M2 - Digital Voltmeter, Weston Model 1420 or equivalent
M3 - DC Ammeter, 0 to 50 ma, Weston Model 622 or equivalent
M4 - DC Ammeter, 0 to 10 ma, Weston Model 622 or equivalent

$\frac{33.0}{2500} = 13.2$ ma

$\frac{32.8}{10,000} = 3.28$ ma

16.48

TEST SETUP

FIGURE 1

4.2.2 Insulation Resistance. With the module mounted by its mounting screws on a metal plate, the insulation resistance shall be tested in accordance with Method 302 of Standard MIL-STD-202. The insulation resistance as measured between the pins and the mounting bracket shall be 100 megohms or greater. The megohmmeter used shall have an output voltage of 225±75 vdc limited to a short circuit current of 6.0 μa.

4.2.3 Workmanship-Vibration. With the module mounted on a heatsink and connected as shown in Figure 1 and a supply voltage **between 24.5 and 33.5 vdc applied, the module shall be vibrated along the vibration axis as shown in Figure 2. The vibration** shall be simple harmonic from 10 to 2000 cps swept at a rate of one octave per **15 sec** with an input of 6.0g rms limited to 0.4 inch pp constant displacement from 10 cps to crossover frequency. During vibration the module shall be monitored **in accordance with the requirements of 4.2.4, 4.2.5, and 4.2.6. Any** out-of-tolerance condition which exists for a period greater than 1 msec shall be cause for rejection of the module. Perform this test in both modes of operation: "on" mode and "off" mode. After vibration the module shall be visually examined as specified in 4.2.1.

4.2.4 "On" Mode of Operation. With the power supply P1 adjusted to **33.5±0.3 vdc** and switch S1 set to position "1" (open), the voltage between pins 2 and 3 as indicated on meter M2 shall be less than 100 mv dc.

4.2.5 "Off" Mode of Operation. With the power supply adjusted to **33.5±0.3 vdc** and switch S1 set to position "2" (closed), the following shall occur:

a. The current flowing to pin 1 as indicated on meter M4 shall be **3.3±0.2 ma.**

b. The voltage between pins 2 and 4 as indicated on meter M1 shall be a maximum of 100 mv dc.

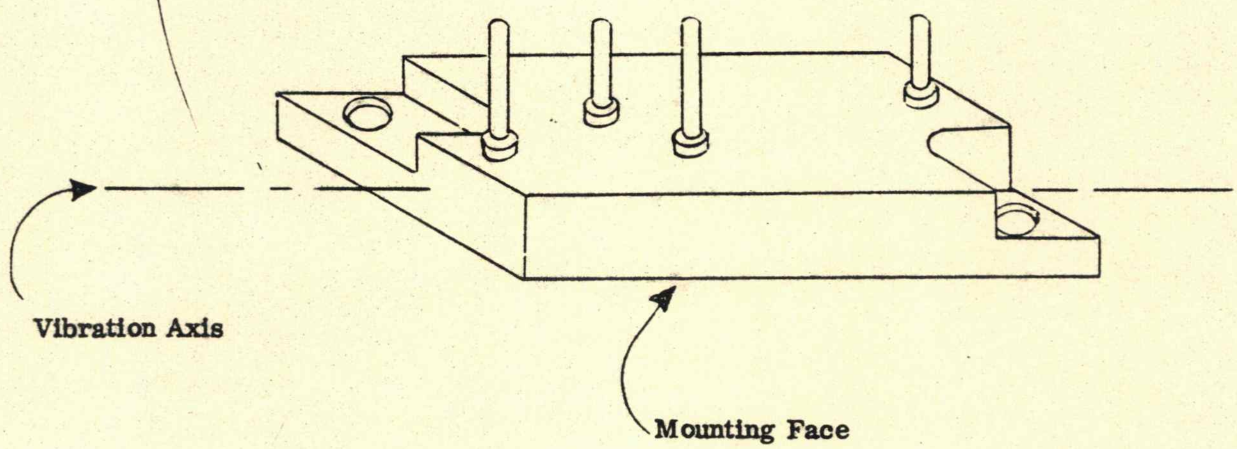
4.2.6 Current Drain. With the conditions established as specified in 4.2.4, the current drain from the power supply shall be between **16.2** and **17.2** ma as indicated on meter M3.

4.2.7 High Temperature. Repeat 4.2.4 through 4.2.6 with the module at an ambient temperature of 65°±3°C.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.



VIBRATION AXIS OF MODULE

FIGURE 2

APOLLO G&N Specification
PS 2007172 Rev C
Original Issue Date: 16 NOV 65
Release Authority: TDRR 24024
Class A Release

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

BLOWER CONTROL MODULE ASSY

DRAWING NO. 2007172

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals MIT	Approvals NASA
1/30/65	A	24429	4, 5, 6, 7	WK	TM
2-8-66	B	25945	7	WK	---
2/23/66	C	26563	5, 7	WK	---

This specification consists of Pages 1 to 8 inclusive.

APPROVALS	NASA/MSC	MIT/IL	ACSP
	A. C. METZGER	11/15/65 John E. Miller 11/15/65	3 Nov 65

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of the Blower Control Module Assy, Part No. 2007172-011.

1.2 PRODUCT CONFIGURATION BASELINE ACCEPTANCES. The product configuration baseline shall be established by FACI of the end item Serial No. . This unit and all subsequent units, regardless of intended use, shall be accepted to the configuration defined by Serial No. , unless formally approved otherwise as required by ANA Bulletin No. 445.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the estent specified herein. Unless otherwise specified herein, Military and Government Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&N

ND 1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment

STANDARDS

Military

MIL-STD-202	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&N

2007172	Blower Control Module Assy

(Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In the event of a conflict between requirements of the contract, this specification and the documents listed in this section, the following order of precedence shall apply. and the contractor shall notify MIT/IL APOLLO Configuration Management Office of the conflict as soon as it is determined:

a. The contract
b. This specification
c. Documents listed in this section

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Test Environment. The unit shall function as specified herein when the temperature of the heatsink is between 15° and 65°C.

3.1.2 Electrical Input. The unit shall function as specified herein when supplied with an electrical input between 23.5 and 33.5 vdc.

3.1.3 "On" Mode of Operation. With a voltage between 23.5 and 33.5 vdc applied to the excitation terminals and a load resistor of 3100±620 ohms connected to the load terminals, the output transistor saturation voltage (V_{CE}) shall be less than 100 mv dc.

3.1.4 "Off" Mode of Operation. With the conditions established as specified in 3.1.3 and the input open, the load voltage drop shall be less than 100 mv dc.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the unit shall be in accordance with the APOLLO G&N Drawing 2007172 and all the drawings and engineering data referenced thereon.

3.2.1.1 Weight. The maximum weight of the unit shall not exceed 5.5 grams.

3.2.2 Insulation Resistance. The insulation resistance of the unit between each pin and the mounting screws shall be equal to or greater than 100 megohms.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 Nonconforming Units. The failure of an end product to pass any examination or test of this section will automatically classify the unit as nonconforming. When nonconforming units are corrected by the contractor, the unit shall be reinspected. When corrective action has been taken, the reinspection of a nonconforming unit may be limited to the test or examination which defined the nonconformance or, when so directed by the cognizant inspector, a complete reexamination and retest of the unit may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.1.2 Test Conditions

4.1.2.1 Environmental. Unless otherwise specified, the unit shall be tested under the following ambient conditions:

a. Temperature: 25°±10°C
b. Relative Humidity: 90% max
c. Barometric Pressure: 28 to 32 inches of Hg

4.1.2.2 Test Power. An electrical input from 23.5 to 33.5 vdc is necessary to perform the tests specified herein:

a. [illegible]
b. [illegible]

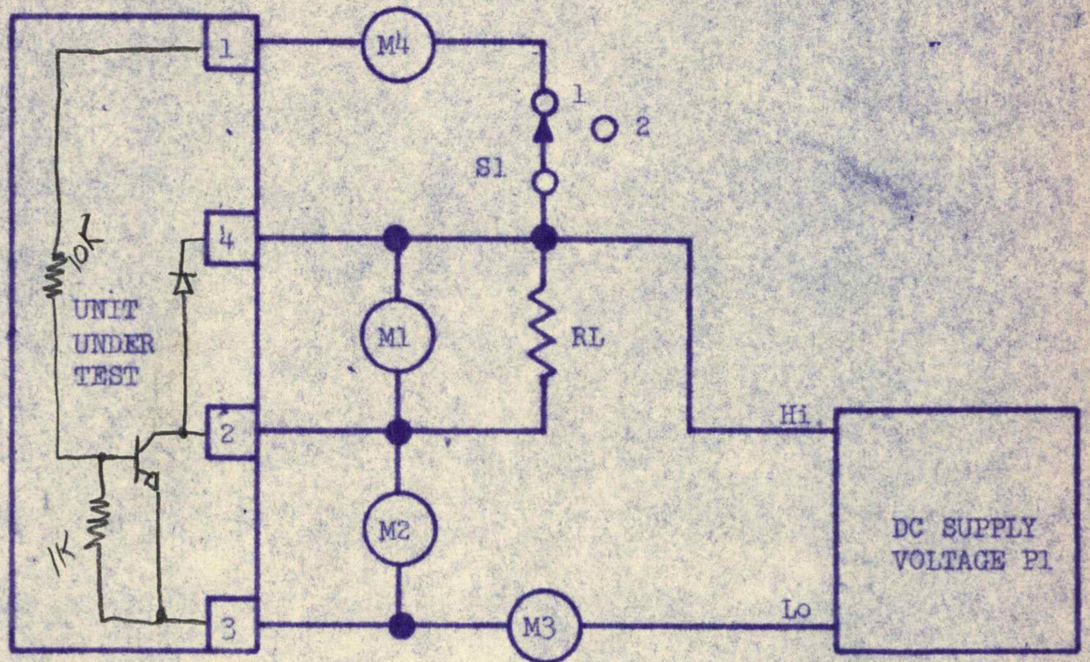
4.1.2.3 Test Setup. Prior to performing the tests specified in 4.2.3 through 4.2.7, the unit shall be set up for test as shown in Figure 1.

4.2 TESTS

4.2.1 Drawing Compliance. The unit shall be visually examined for compliance to the requirements of the APOLLO G&N Drawing 2007172. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.2.1.1 Weight. The weight of the unit shall not exceed 5.5 grams.

4.2.2 Insulation Resistance. With the unit mounted by its mounting screws on a metal plate, the insulation resistance shall be tested in accordance with Method 302 of Standard MIL-STD-202. The insulation resistance, as measured between the pins and the mounting bracket, shall be equal to or greater than 100 megohms. The megohmmeter used shall have an output voltage of 225±75 vdc limited to a short circuit current of 6.0 μa.



P1 - Variable DC Power Supply, 23.5 to 33.5 vdc
RL - Load Resistor, 2500 ohms ±1%
S1 - Switch, SPST
M1 & M2 - Digital Voltmeter, Weston Model 1420 or equivalent
M3 - DC Ammeter, 0 to 50 ma, Weston Model 622 or equivalent
M4 - DC Ammeter, 0 to 10 ma, Weston Model 622 or equivalent

$$\frac{33.5-0.7}{10K} = 3.28 \text{ ma}$$

$$\frac{33.5-0.4}{2.5K} = 13.23 \text{ ma}$$

$$16.51 \pm 0.5$$

6

TEST SETUP

FIGURE 1

4.2.3 Workmanship-Vibration. With the unit mounted on a heatsink and connected as shown in Figure 1 and a supply voltage between 23.5 and 33.5 vdc applied, the unit shall be vibrated along the radial axis as shown in Figure 2. The vibration shall be simple harmonic motion swept from 10 to 2000 cps at a rate of 1 octave per 15 seconds. The magnitude of the vibration shall be 6.0g rms limited to 0.4 inch constant displacement from 10 cps to the crossover frequency. During vibration the unit shall be monitored in accordance with the requirements of 4.2.4, 4.2.5, and 4.2.6. Any out-of-tolerance condition which exists for a period greater than 1 msec shall be cause for rejection of the unit. Perform this test in both modes of operation: "on" mode and "off" mode. After vibration the unit shall be visually examined as specified in 4.2.1.

4.2.4 <u>"On" Mode of Operation</u>. With the power supply P1 adjusted to 33.5±0.3 vdc and switch S1 set to position "1" (closed), the following shall occur:

a. The current flowing to pin 1, as indicated on meter M4, shall be 3.3±0.2.
b. The voltage between pins 2 and 3, as indicated on meter M2, shall be less than 100 mv dc.

4.2.5 <u>"Off" Mode of Operation</u>. With the power supply P1 adjusted to 33.5±0.3 vdc and switch S1 set to position "2" (open), the voltage between pins 2 and 4, as indicated on meter M1, shall be less than 100 mv dc.

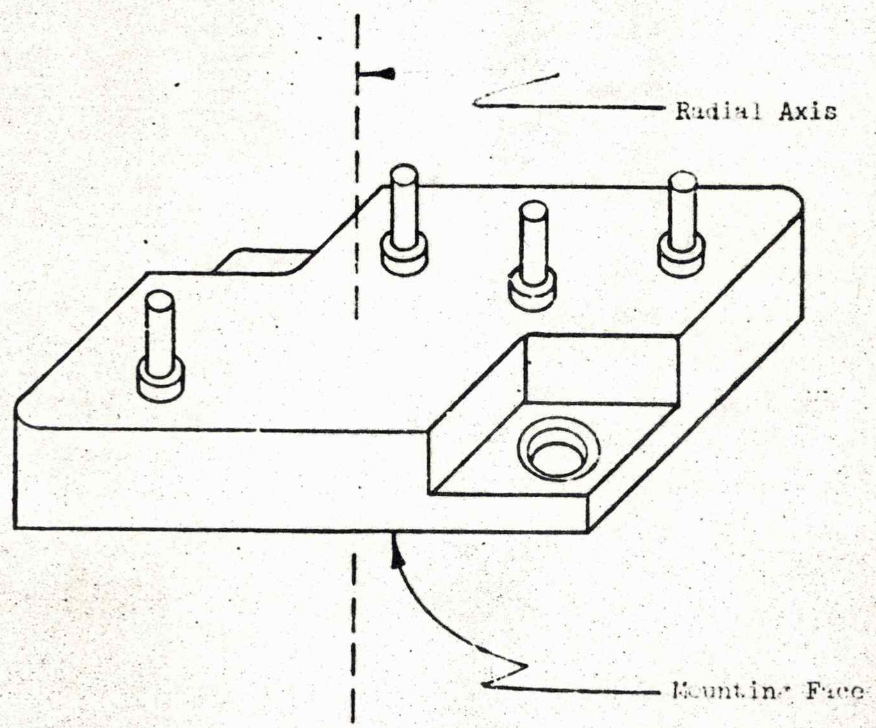
4.2.6 <u>Current Drain</u>. With the conditions established as specified in 4.2.4, the current drain from the power supply shall be between 16.2 and 17.2 ma, as indicated on meter M3.

4.2.7 High Temperature. Repeat 4.2.4 through 4.2.6 with the unit at an ambient temperature of 65° ±3°C.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.



VIBRATION AXIS OF MODULE

FIGURE 2

APOLLO G&N Specification
PS2007204 REV A
Original Issue Date: 7-21-65
Release Authority: TDRR 21075
Class A Release

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

PRECISION RESOLVER ALIGNMENT ASSEMBLY

DRAWING NO. 2007204

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals MIT	Approvals NASA
4/26/66	A	28331	3	WK	--

This specification consists of page 1 to 6 inclusive.

APPROVALS	NASA/MSC	MIT/IL	ICE
	[illegible signature]	[illegible signature] 7-21-65, R. J. Therrien 7/14/65	E. Coxgel [illegible], R. [illegible]

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of all units of the Precision Resolver Alignment Assembly, Part Number 2007204-011.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&N

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment

STANDARDS

Military

MIL-STD-202C	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&N

2007204	Precision Resolver Alignment Assembly

(Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in conjunction with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In the event of a conflict between requirements, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this section

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Inputs. The assembly shall perform as specified herein with 28V rms ±1 percent, 800 cps applied to pins 3 (Hi) and 2 (Lo).

3.1.2 Characteristics

3.1.2.1 Output Voltage and Phase Shift

3.1.2.1.1 Adjustment O. Adjustment O shall vary the output voltage between pins 4 (Hi) and 6 (Lo) smoothly and continuously throughout the range of adjustment. Setting adjustment O to its maximum ccw position shall produce an output of 1.2V rms ±3 percent having a 0.0° ±0.5° phase shift with respect to the input. Setting adjustment O to its maximum cw position shall produce an output of 1.2V rms ±3 percent having a 180.0° ±0.5° phase shift.

3.1.2.2 Adjustment M. Adjustment M shall vary the output voltage between pins 5 (Hi) and 6 (Lo) smoothly and continuously throughout the range of adjustment. Setting adjustment M to its maximum ccw position shall produce an output of 1.2V rms ±3 percent having a 0.0° ±0.5° phase shift with respect to the input. Setting adjustment M to its maximum cw position shall produce an output of 1.2V rms ±3 percent having a 180.0° ±0.5° phase shift.

3.1.2.3 Adjustment I. Adjustment I shall vary the output voltage between pins 1 (Hi) and 6 (Lo) smoothly and continuously throughout the range of adjustment. Setting adjustment I to its maximum ccw position shall produce an output of 1.2V rms ±3 percent having a 0.0° ±0.5° phase shift with respect to the input. Setting adjustment I to its maximum cw position shall produce an output of 1.2V rms ±3 percent having a 180.0° ±0.5° phase shift.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 2007204 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. The maximum weight of the assembly shall be 69.0 grams.

3.2.3 DC Resistance. The dc resistance between pins 2 and 6 shall be ≤0.5 ohm.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 Test Conditions

4.1.1.1 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

a. Temperature: 25° ±10°C
b. Relative Humidity: 90% max
c. Barometric Pressure: 28 to 32 inches of Hg

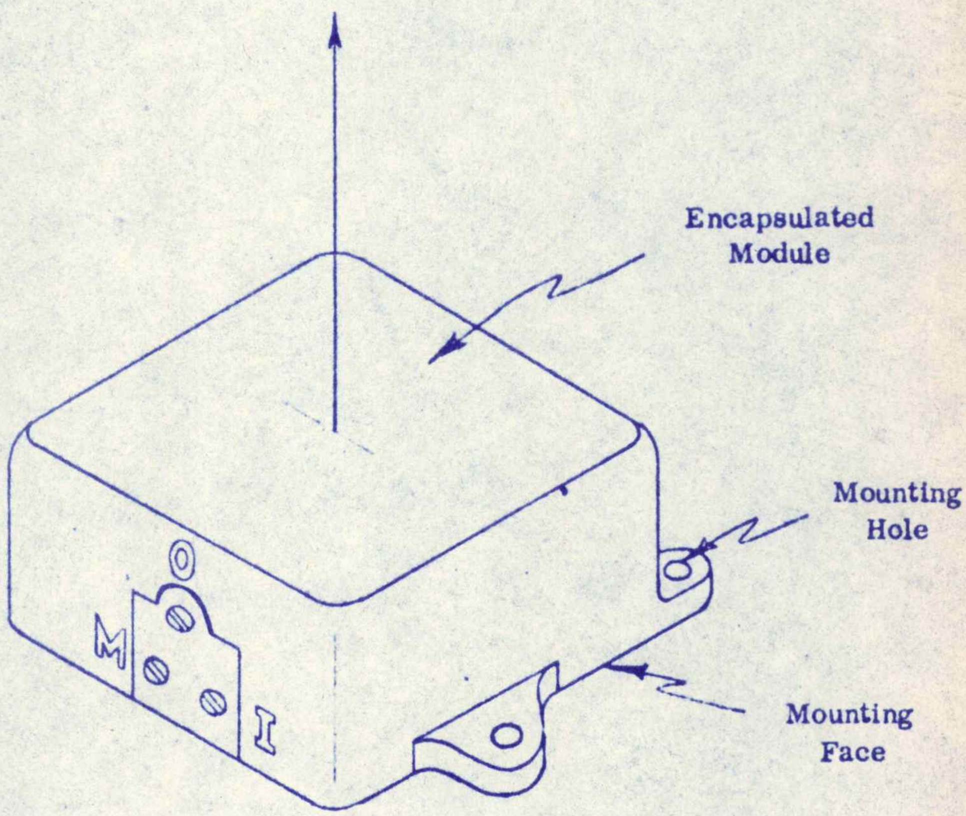
4.1.2 Nonconforming Units. Failure of the unit to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or, when directed by the cognizant inspector, a complete retest and reexamination may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

4.2 TESTS

4.2.1 Drawing Compliance. The assembly shall be visually examined for compliance to the requirements of APOLLO G&N Drawing 2007204. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of marking.

4.2.2 Workmanship-Vibration. With the assembly placed on a vibration fixture, a 28.0V rms ±1 percent, 800 cps ±1 percent signal applied to the input and O, M and I adjusted to provide +0.60±0.03V rms at their respective outputs, the assembly shall be vibrated along the vibration axis as shown in Figure 1 with simple harmonic motion swept from 10 to 2000 cps at a rate of one octave per 15 seconds. The magnitude of the vibration shall be 6.0g rms limited to a 0.4 inch pp constant displacement from 10 cps to the crossover frequency. Any change in output voltages >10 percent for a period >1 msec shall be cause for rejection.

4.2.3 Output Voltages and Phase Shifts. With 28V rms ±1 percent, 800 cps ±1 percent applied to pins 3 (Hi) and 2 (Lo) and adjustments O, M and I adjusted fully ccw, the output voltages shall be 1.2V rms ±3 percent and have a phase shift of 0.0° ±0.5° with respect to the input. With adjustments O, M, and I adjusted fully cw, the output voltages shall be 1.2V rms ±3 percent and have a phase shift of 180.0° ±0.5° with respect to the input. Between the extreme ends of adjustment, each output voltage shall vary smoothly and continuously in accordance with the rotation of its associated adjustment.



VIBRATION AXIS OF ASSEMBLY

FIGURE 1

4.2.4 DC Resistance. The resistance between pins 2 and 6 shall be ≤ 0.5 ohms when tested in accordance with Method 303 of Standard MIL-STD-202.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

RM:jls

APOLLO G&N Specification
PS2010734 REV C
Original Issue Date: 3 May 1966
Release Authority: TDRR 28453
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

MOTOR DRIVE AMPLIFIER ASSEMBLY

DRAWING NO. 2010734

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals AC	Approvals NASA
M 6/7/66	A	29474	4, 14 RDG/ar	MGM	ACM
M 11/3/66	B	31784	3, 4, 6, 13 RDG/ar	MGM EA	--
M 1/12/67	C	32626	6, 16 RDG/ar	MGM EA	--

This specification consists of page 1 to 16 inclusive.

APPROVALS	A. C. METZGER NASA/MSC	S R Yorgy MIT/IL	W Kupfer 3 May 66	E. T. Powers R. Greenwood AC

TABLE III

FEEDBACK COMPENSATION FREQUENCY RESPONSE

MODULATION FREQUENCY (cps) ±5%	INPUT SIGNAL RATIO*1		PHASE SHIFT *2 (Degrees)
	Min	Max	
10 (reference)	--	--	--
0.16	0.4	0.53	--
0.32	--	--	45±10

*1 Where input signal ratio = $\frac{\text{input signal at 10 cps}}{\text{input signal at 0.16 cps}}$

*2 With respect to 10 cps modulation.

3.1.15 Preamp Monitor. The gain from input to output shall be 2.4 V/V ±15 percent when the following conditions exist.

a. A nominal supply voltage.

b. An 800 cps signal applied and adjusted to provide a preamp monitor output of 0.3V ±10 percent.

3.1.16 Tach Monitor. The gain from input to output shall be 0.082 V/V ±10 percent under the following conditions:

a. A nominal supply voltage applied.

b. An 800 cps signal applied to, and adjusted to provide a tach monitor output of 0.3V ±10 percent.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with Drawing 2010734 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 DC Resistance. DC resistance shall be as specified in Table IV.

c. An 800 cps suppressed carrier input signal with 10 cps modulation applied to terminals 17 (Hi) and 21 (Lo) and adjusted in amplitude to provide an output of 3V pp between terminals 13 (Hi) and 12 (Lo) at each modulation frequency specified in Table III.

4.3.19 Preamp Monitor. With the following conditions established, the gain from input to output shall be 2.40±0.36 V/V.

a. Nominal dc supply voltage applied to terminals 22 (Hi) and 20 (Lo).

b. Reference voltage applied to terminals 2 (Hi) and 5 (Lo).

c. Terminals 6, 7 and 8 connected to terminal 10.

d. An 800 cps input signal applied to terminals 4 (Hi) and 10 (Lo) and adjusted to provide an output of 0.30±0.03V between terminals 3 (Hi) and 10 (Lo).

4.3.20 Tach Monitor. With conditions a and b of 4.3.19 established and with an 800 cps input signal applied to terminals 17 (Hi) and 21 (Lo) and adjusted to provide an output of 0.30±0.03V between terminals 19 (Hi) and 10 (Lo), the gain from input to output shall be 0.0820±0.0082 V/V.

4.3.21 Weight. Not applicable.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None

ETP:ims

APOLLO G&N Specification
PS6007005 REV B
Original Issue Date: 24 Aug 1965
Release Authority: TDRR 21802
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

PULSE TORQUE ISOLATION TRANSFORMER ASSEMBLY

DRAWING NO. 6007005

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals AC	Approvals NASA
(A) 3/8/66	A	26938	3	WK	----
(M) 1/12/67	B	32625	5	MGM EA	----

This specification consists of page 1 to 11 inclusive.

APPROVALS				
NASA/MSC	8/20/65	MIT/IL 24 Aug 65	7/29/65	AC

3.1.2.2 1:1 Transformer Output. The output of the 1:1 transformers (T7 through T10) shall be as specified in Table III.

TABLE III

1:1 TRANSFORMER OUTPUT

PARAMETER	REQUIREMENTS
Amplitude	5.5±0.5V
Risetime	200±100 nsec
Decay Time	600±300 nsec
Pulse Width	3.0±0.3 μsec

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 6007005 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 Insulation Resistance. The resistance between the transformer primaries and secondaries shall be $\geq$100 megohms. The resistance between pin 1 and the remaining assembly pins shall be $\geq$100 megohms. The resistance between pin 1 and the heatsink shall be $\leq$0.5 ohm.

APOLLO G&N Specification
PS6007105 REV – C
Original Issue Date: 24 Aug 1965
Release Authority: TDRR 21801
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

LEM PIPA CALIBRATION MODULE

DRAWING NO. 6007105

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals AC	Approvals NASA
M 7-5-66	A	30021	5	MGM	----
8-4-66	B	30365	4	EA	----
M 1-12-67	C	32625	4	MGM EA	----

This specification consists of page 1 to 9 inclusive.

APPROVALS	NASA/MSC	8/20/65	MIT/IL		AC

3. REQUIREMENTS. Description. The assembly contains the torque generator compensation, bias and scale factor networks necessary to normalize the associated accelerometer for pulse torque operation.

3.1 PERFORMANCE

3.1.1 Supply Voltage. The assembly shall perform as specified herein with an ac supply voltage having the following characteristics. In addition, the supply shall be double-ended and capable of simultaneously supplying 0° phase, 180° phase and ground reference.

a. Magnitude: 17 ± 1V rms
b. Frequency: 12 Kc $\pm$ 2%
c. Output Impedance: 60 Ω max
d. Total Harmonic Distortion: 2.0% max

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with APOLLO G&N Drawing 6007105 and all drawings and engineering data referenced thereon.

3.2.2 Maximum Weight. Not applicable.

3.2.3 Standards of Manufacturing, Manufacturing Process and Production

3.2.3.1 DC Resistance. The dc resistance between the assembly pins shall be as specified in Table I.

3.2.3.2 Insulation Resistance. The insulation resistance between pin 6 and the remaining assembly pins shall not be less than 100 megohms.

3.2.3.3 Special Selection of Components of the assembly denoted as C3, C4, R5, R6, R11, R12, R13, and R14 shall be selected to mate with a preassigned accelerometer assembly as specified in Specification PS2010607.

3.2.3.4 Encapsulation. The assembly shall be encapsulated by a process whereby the maximum temperature to which it is subjected is no greater than +150°F for a period not exceeding 5 hours as specified in Specification ND1002002, Curing Cycle 2.

APOLLO G&N Specification
PS6007114 REV F
Original Issue Date: 23 NOV 1965
Release Authority: TDRR 24298
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

G&N SUBSYSTEM SUPPLY FILTER MODULE ASSEMBLY

DRAWING NO. 6007114

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals AC	Approvals NASA
M 11/30/65	A	24376	8 RDG/AC	WK	TM
M 12/28/65	B	24944	5 RDG/AC	WK	--
M 1/25/66	C	25491	5 RDG/AC	MGM	--
M 5/3/66	D	28493	4 RDG/AC	WK	--
M 6/7/66	E	29465	5 RDG/AC	MGM	---
M 1/12/67	F	32626	4 RDG/AC	MGM EA	—

This specification consists of page 1 to 9 inclusive.

APPROVALS	A. C. METZGER NASA/MSC	MIT/IL	AC
		[signatures] 23 Nov 65	[signatures]

TABLE I (Continued)

TERMINALS		RESISTANCE REQUIRED
From	To	(Ohms)
24	25	0.5 max
33	34	
33	35	
33	36	
33	37	
33	38	
33	39	
33	40	
33	41	
33	42	
33	43	
33	44	
33	45	
33	46	
33	47	0.5 max

3.2.3 **Weight.** Not applicable.

APOLLO G&C Specification
PS6007113 REV —
Original Issue Date:
Release Authority: TDRR
Class Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

G&C SUBSYSTEM SUPPLY FILTER MODULE ASSEMBLY

DRAWING NO. 6007113

COORDINATION COPY ONLY
Subject to Change without Notice

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				MIT	NASA

This specification consists of page 1 to 8 inclusive.

APPROVALS	NASA/MSC	MIT/IL	L W Krier D Danzeland ACSP

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of all units of the G&C Subsystem Supply Filter Module Assembly, Part Number 6007113-011.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&C

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment

STANDARDS

Military

MIL-STD-202C	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&C

6007113	G&C Subsystem Supply Filter Module Assembly
6010004	Schematic, G&C Subsystem Supply Filter (For Reference Only)

(Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In event of a conflict between requirements, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this section

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Inputs. The Supply Filter Module Assembly, hereinafter referred to as the assembly, shall perform as specified herein when supplied with a voltage supply of 30.0±0.1 vdc.

3.1.2 Characteristics

3.1.2.1 Filtering. The assembly shall provide a 550 μf +50 percent, -15 percent shunt capacitance shunted by a diode and a 44 μf ±10 percent capacitance across the IMU Operate input. The assembly shall provide a 44 μf ±10 percent capacitance across the LGC input.

3.1.2.2 Isolation. The assembly shall provide electrical isolation between the IMU Operate and LGC inputs while permitting either input to supply current to the 3200 cps Power Supply output.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawing. The configuration of the assembly shall be in accordance with APOLLO G&C Drawing 6007113 and all drawing and engineering data referenced thereon.

3.2.2 Standards of Manufacturing, Manufacturing Process and Production

3.2.2.1 Continuity. The dc resistance of the assembly shall be as specified in Table I.

3.2.2.2 Insulation Resistance. The insulation resistance between all assembly pins, except pin 1, and the assembly heatsink shall be $\geq$100 megohms.

OK for 6007114 also

TABLE I

CONTINUITY RESISTANCE

TERMINALS		RESISTANCE REQUIRED
From	To	(Ohms)
1	Heatsink	0.5 max
2	3	
9	10	
9	11	
9	12	
9	13	
9	14	
9	15	
9	16	
9	17	
9	18	
9	19	
9	20	
9	21	
9	22	
9	23	0.5 max

TABLE I (Continued)

TERMINALS		RESISTANCE REQUIRED
From	To	(Ohms)
24	25	0.5 max
33	34	
33	35	
33	36	
33	37	
33	38	
33	39	
33	40	
33	41	
33	42	
33	43	
33	44	
33	45	
33	46	
33	47	0.5 max

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4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.1.1 Test Conditions

4.1.1.1 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

a. Temperature: 25° ±10°C
b. Relative Humidity: 90% max
c. Barometric Pressure: 28 to 32 inches of Hg

4.1.2 Nonconforming Units. Failure of the unit to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or, when directed by the cognizant inspector, a complete retest and reexamination may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

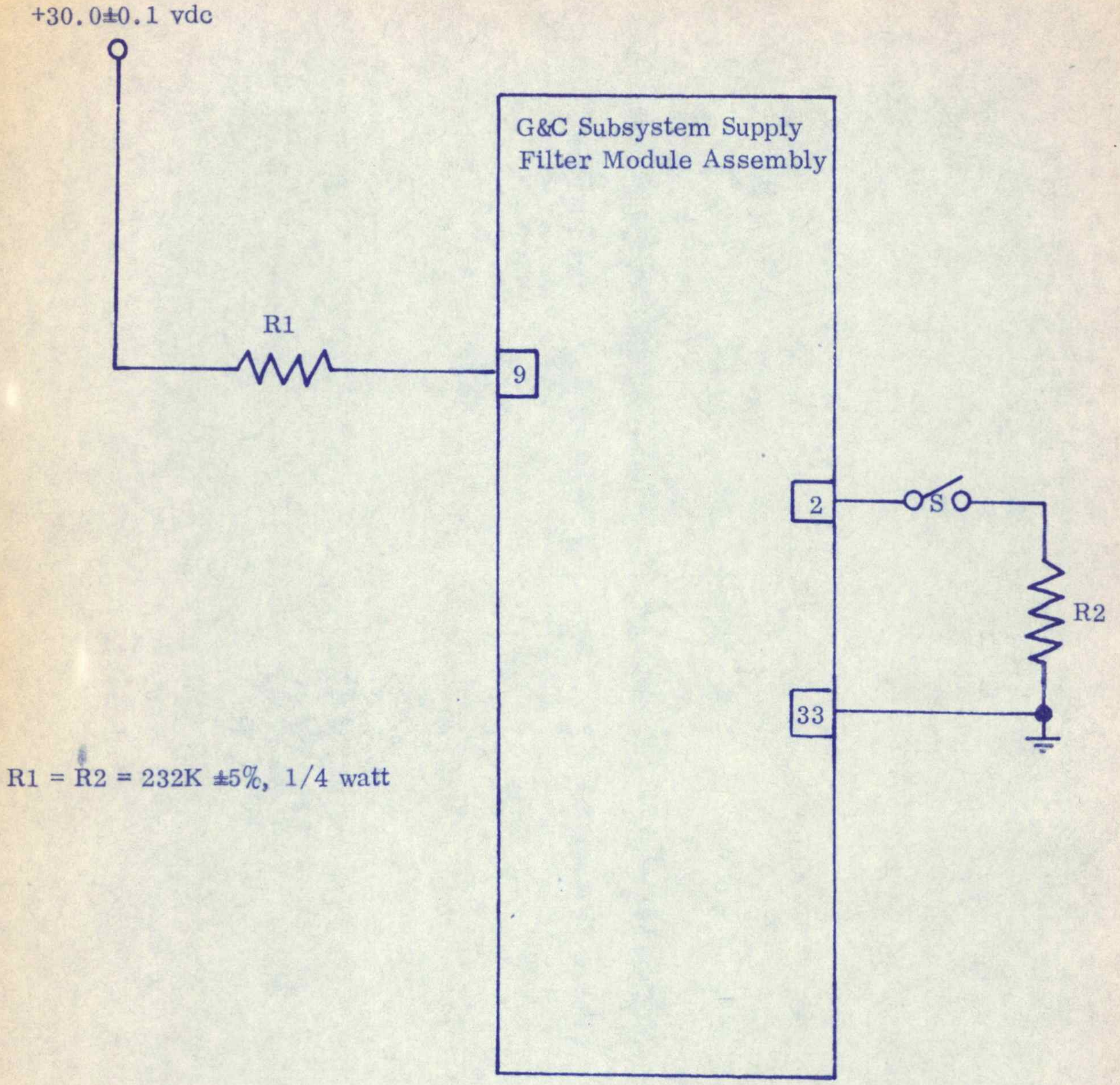
4.2 TESTS

4.2.1 Drawing Compliance. The assembly shall be visually examined for compliance to the requirements of APOLLO G&C Drawing 6007113. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.2.2 Workmanship-Vibration. With the assembly connected as shown in Figure 1, and switch S closed, the voltage across pins 2 (Hi) and pin 33 (Lo) shall be monitored. When the voltage monitored is 15.0±0.5 vdc switch S shall be opened, and vibration of the assembly shall begin within five seconds after the opening of switch S. The assembly shall be vibrated along an axis perpendicular to the mounting face of the assembly with simple harmonic motion swept from 10 to 2000 cps at a rate of one octave/15 sec. The magnitude of vibration shall be 6.0g rms limited to a 0.4 inch pp constant displacement from 10 cps to the crossover frequency. During vibration, the voltages from pins 2 and 9 to ground shall not be outside the range of 14.0 vdc through 26.0 vdc for a period greater than one microsecond. The vibration shall be repeated to demonstrate that continuity is maintained according to Table I during vibration, without the requirement of verifying specific resistance values. There shall be no interruption of continuity of greater than one microsecond. After vibration, the assembly shall be visually examined as specified in 4.2.1.

4.2.3 Continuity and DC Resistance. Resistance between the pins listed in Table I shall be as specified when measured with a low voltage resistance measuring device using Method 303 of Standard MIL-STD-202. To assure a good electrical connection, the anodizing may be penetrated.

4.2.4 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be as specified in 3.2.2.2 when measured using Method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output of 225±75 vdc, limited to a short circuit current of 6.0 μa.



VIBRATION TEST SETUP

FIGURE 1

4.2.5 Isolation Test. The voltages specified in Table II shall be present under the conditions indicated in Table II when the assembly is connected as illustrated in Figure 2.

TABLE II

ISOLATION TEST

S1 POSITION	TERMINALS MEASURED	REQUIRED DC VOLTAGE
A	24 to 2	1.0 max
A	across R2	5.0 max
A	across R3	6.0 max
B	9 to 2	1.0 max
B	across R2	5.0 max

4.2.6 Filtering Test. A 40.0±0.5 vdc voltage shall be applied between pins 2 (Hi) and 33 (Lo). The capacitance between pin 9 (Hi) and pin 33 (Lo) shall be measured at 120 cps with a dc polarizing voltage of 30.0±0.1 vdc connected with pin 9 (Hi) in accordance with Method 305 of Standard MIL-STD-202. The peak ac voltage applied shall not exceed 5 vac. The capacitance shall be 467.5 μf min to 825.0 μf max.. The capacitance between pins 2 (Hi) and 33 (Lo) shall be measured at 10 kcps with a dc polarizing voltage of 30.0±0.1 vdc connected with pin 2 (Hi) in accordance with Method 305 of Standard MIL-STD-202. The peak ac voltage applied shall not exceed 5 vac. The capacitance shall be 37.4 μf min to 50.6 μf max.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

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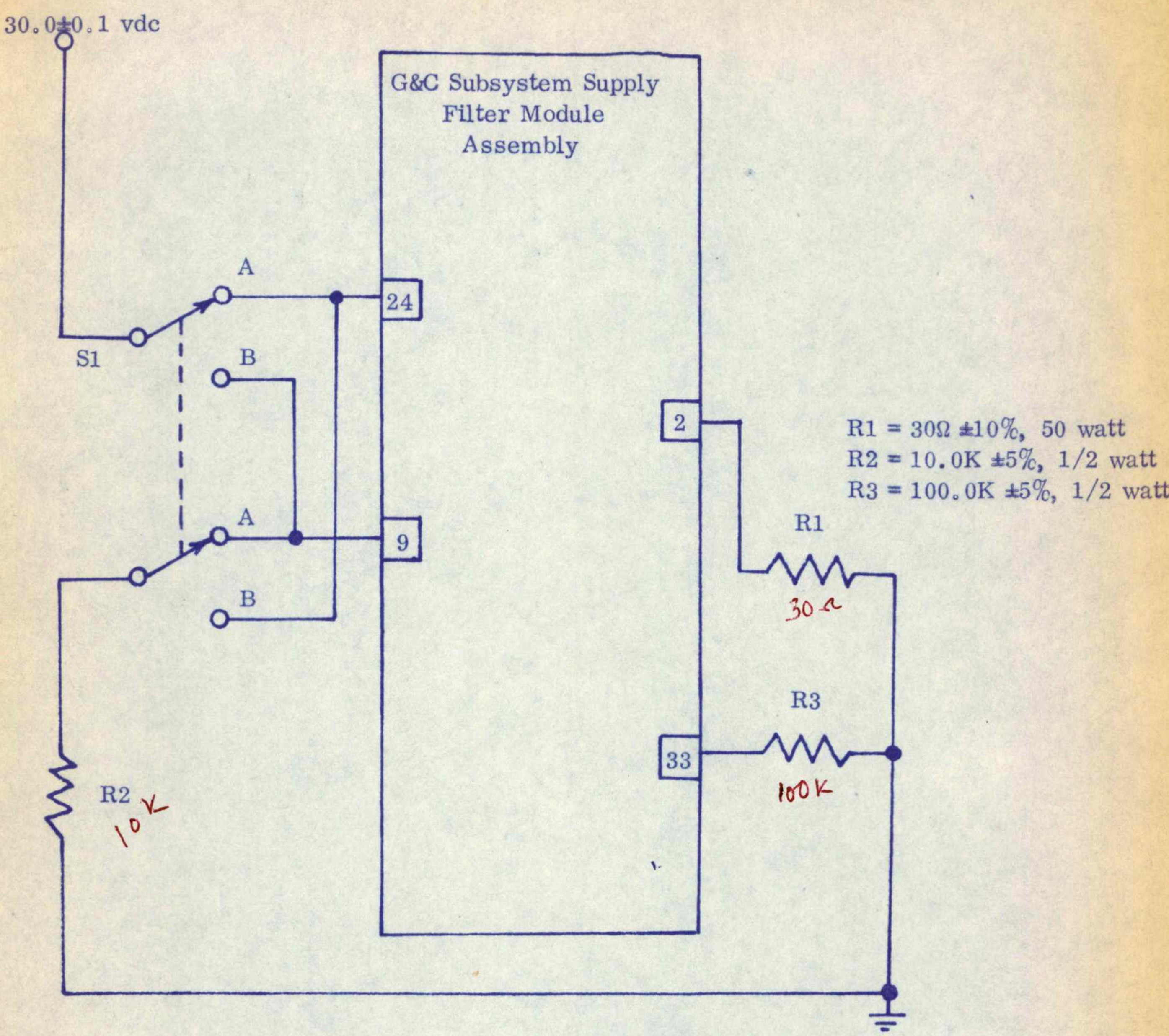


ISOLATION TEST SETUP

FIGURE 2

APOLLO G&N Specification
PS6007114 REV E
Original Issue Date: 23 NOV. 1965
Release Authority: TDRR 24298
Class A Release
CODE IDENT NO. 80230

PROCUREMENT SPECIFICATION

PRODUCT CONFIGURATION AND ACCEPTANCE TEST REQUIREMENTS

G&N SUBSYSTEM SUPPLY FILTER MODULE ASSEMBLY

DRAWING NO. 6007114

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals MIT	Approvals NASA
M 11/30/65	A	24376	8 RDG/AL	WK	TM
M 12/28/65	B	24944	5 RDG/AL	WK	--
M 1/25/66	C	25491	5 RDG/AL	MGM	--
M 5/3/66	D	28493	4 RDG/AL	WK	--
M 6/7/66	E	29465	5 RDG/AL	MGM	---

This specification consists of page 1 to 9 inclusive.

APPROVALS	A. C. METZGER NASA/MSC	John E. Miller 11/23/65 MIT/IL	W Kupfer 23 Nov 65	G. A. Kriee / D. Vanzuland ACSP

1. SCOPE

1.1 PURPOSE. This specification establishes the detail requirements for complete identification and acceptance of all units of the G&N Subsystem Supply Filter Module Assembly, hereafter called the assembly, Part Number 6007114-011.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, Military Standards and Specifications shall be the issue in effect on the date of request for proposal or invitation to bid.

SPECIFICATIONS

APOLLO G&N

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment

STANDARDS

Military

MIL-STD-202	Test Methods for Electronic and Electrical Component Parts

DRAWINGS

APOLLO G&N

6007114	G&N Subsystem Supply Filter Module Assembly

(Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In event of a conflict between requirements, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this section

3. REQUIREMENTS

3.1 PERFORMANCE

3.1.1 Inputs. The Supply Filter Module Assembly, hereinafter referred to as the assembly, shall perform as specified herein when supplied with a voltage supply of 30.0 ±0.1 vdc.

3.1.2 Characteristics

3.1.2.1 Isolation. Electrical isolation shall be maintained between the IMU Operate and LGC inputs when either input supplies current to the 3200 cps Power Supply output.

3.1.2.2 Filtering. The capacitance across the IMU Operate input shall be 550 µf +50 percent, -15 percent, and 44 µf ±10 percent across the 3200 cps Power Supply output.

3.2 PRODUCT CONFIGURATION

3.2.1 Drawings. The configuration of the assembly shall be in accordance with Drawing 6007114 and all drawing and engineering data referenced thereon.

3.2.2 Standards of Manufacturing, Manufacturing Process and Production

3.2.2.1 Continuity and DC Resistance. The continuity and dc resistance of the assembly shall be as specified in Table I.

3.2.2.2 Insulation Resistance. The insulation resistance between all assembly pins, except pin 1, and the assembly heatsink shall be ≥ 100 megohms.

TABLE I

CONTINUITY RESISTANCE		
TERMINALS		RESISTANCE REQUIRED
From	To	(Ohms)
1	Heatsink	0.5 max
2	3	
9	10	
9	11	
9	12	
9	13	
9	14	
9	15	
9	16	
9	17	
9	18	
9	19	
9	20	
9	21	
9	22	
9	23	0.5 max

TABLE I (Continued)

TERMINALS		RESISTANCE REQUIRED
From	To	(Ohms)
24	25	0.5 max
33	34	↑
33	35	
33	36	
33	37	
33	38	
33	39	
33	40	
33	41	
33	42	
33	43	
33	44	
33	45	
33	46	↓
33	47	0.5 max

3.2.3 Weight. The weight of the module shall be 235 grams maximum.

4. QUALITY ASSURANCE PROVISIONS

4.1 PRODUCT PERFORMANCE AND CONFIGURATION REQUIREMENTS/QUALITY VERIFICATION CROSS REFERENCE INDEX.

Test/Examination	Requirement	Method
Isolation	3.1.2.1	4.3.5
Filtering	3.1.2.2	4.3.6
Drawings	3.2.1	4.3.1
Continuity and DC Resistance	3.2.2.1	4.3.3
Insulation Resistance	3.2.2.2	4.3.4

4.2 GENERAL. The contractor responsible for the manufacture of the assembly shall be responsible for the accomplishment of each test required herein.

4.2.1 Test Conditions

4.2.1.1 Environmental. Unless otherwise specified, the assemblies shall be tested under the following ambient conditions:

a. Temperature: $25^{\circ} \pm 10^{\circ}C$
b. Relative Humidity: 90% max
c. Barometric Pressure: 28 to 32 inches of Hg

4.2.2 Nonconforming Units. Failure of the units to pass any examination or test of this specification shall automatically classify the unit as nonconforming. Each nonconforming unit corrected by the contractor shall be reinspected. Reinspection may be limited to the test or examination which defined the nonconformance, or, when directed by the cognizant inspector, a complete retest and reexamination may be required. Nonconforming units which have not been corrected will be considered for acceptance only upon formal application by the contractor to the cognizant NASA representative.

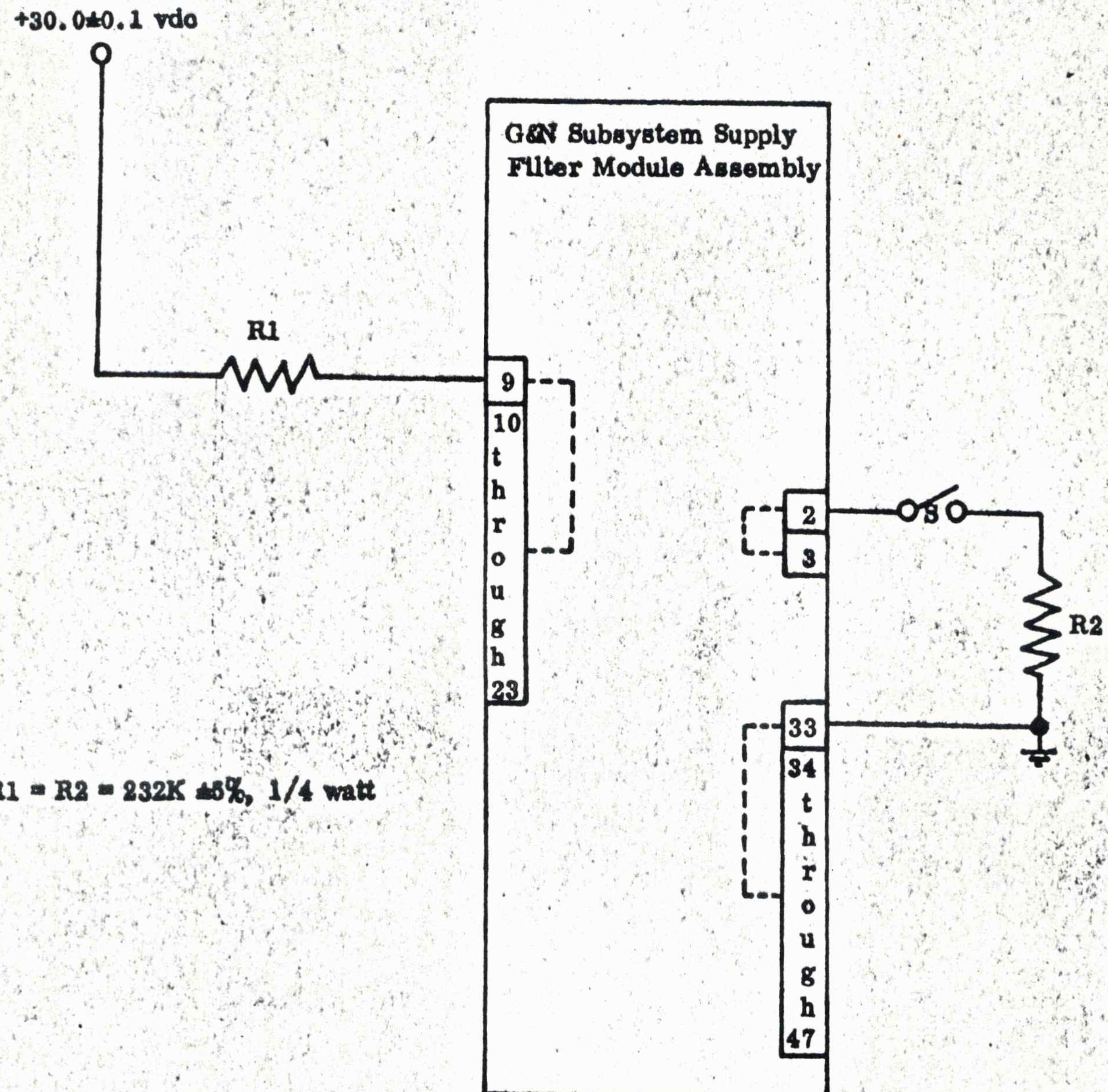
4.3 TESTS

4.3.1 Drawing Compliance. The assembly shall be visually examined for compliance to the requirements of drawing 6007114. Particular attention shall be given to inspection for nicks, scratches, burrs, dents, encapsulant defects, contaminants, pin misalignment, and legibility and appearance of markings.

4.3.2 Workmanship-Vibration. With the assembly connected as shown in Figure 1, and switch S closed, the voltage across pins 2 (Hi) and pin 33 (Lo) shall be monitored. When the voltage monitored is 14.25±0.75 vdc switch S shall be opened, and vibration of the assembly shall begin within five seconds after the opening of switch S. The assembly shall be vibrated along an axis perpendicular to the mounting face of the assembly with simple harmonic motion swept from 10 to 2000 cps at a rate of one octave/15 sec. The magnitude of vibration shall be 6.0g rms limited to a 0.4 inch pp constant displacement from 10 cps to the crossover frequency. During vibration, the voltages from pins 2 and 9 to ground shall not be outside the range of 13.5 vdc through 26.0 vdc for a period greater than one millisecond. After vibration, the assembly shall be visually examined as specified in 4.3.1.

4.3.3 Continuity and DC Resistance. Resistance between the pins listed in Table I shall be as specified when measured with a low voltage resistance measuring device using Method 303 of Standard MIL-STD-202. To assure a good electrical connection, the anodizing may be penetrated.

4.3.4 Insulation Resistance. The resistance between pin 1 and the remaining assembly pins shall be as specified in 3.2.2.2 when measured using Method 302 of Standard MIL-STD-202. The megohmmeter used shall have an output of 225 ±75 vdc, limited to a short circuit current of 6.0 μa.



R1 = R2 = 232K ±5%, 1/4 watt

VIBRATION TEST SETUP

FIGURE 1

4.3.5 Isolation. With the assembly connected as illustrated in Figure 2, and the conditions present as indicated in Table II, the voltages specified in Table I shall be present.

TABLE II

ISOLATION TEST

S1 POSITION	TERMINALS MEASURED	REQUIRED DC VOLTAGE
A	24 to 2	1.0 max
A	across R2	5.0 max
A	across R3	6.0 max
B	9 to 2	1.0 max
B	across R2	5.0 max

4.3.6 Filtering. The filtering capacitance of the assembly shall be verified as follows:

a. With 40.0±0.5 vdc applied between pins 2 (Hi) and 33 (Lo), and a dc polarizing voltage of 30.0±0.1 vdc connected to pin 9 (Hi), the capacitance between pins 9 (Hi) and 33 (Lo) shall be measured at 120 cps in accordance with Method 305 of Standard MIL-STD-202. The peak ac voltage applied shall not exceed 5 vac. The capacitance shall be 550 μf +50 percent, −15 percent.

b. With a dc polarizing voltage of 30.0±0.1 vdc connected to pin 2 (Hi) the capacitance between pins 2 (Hi) and 33 (Lo) shall be measured at 1 kcps in accordance with Method 305 of Standard MIL-STD-202. The peak ac voltage applied shall not exceed 5 vac. The capacitance shall be 44 μf ±10 percent.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None.

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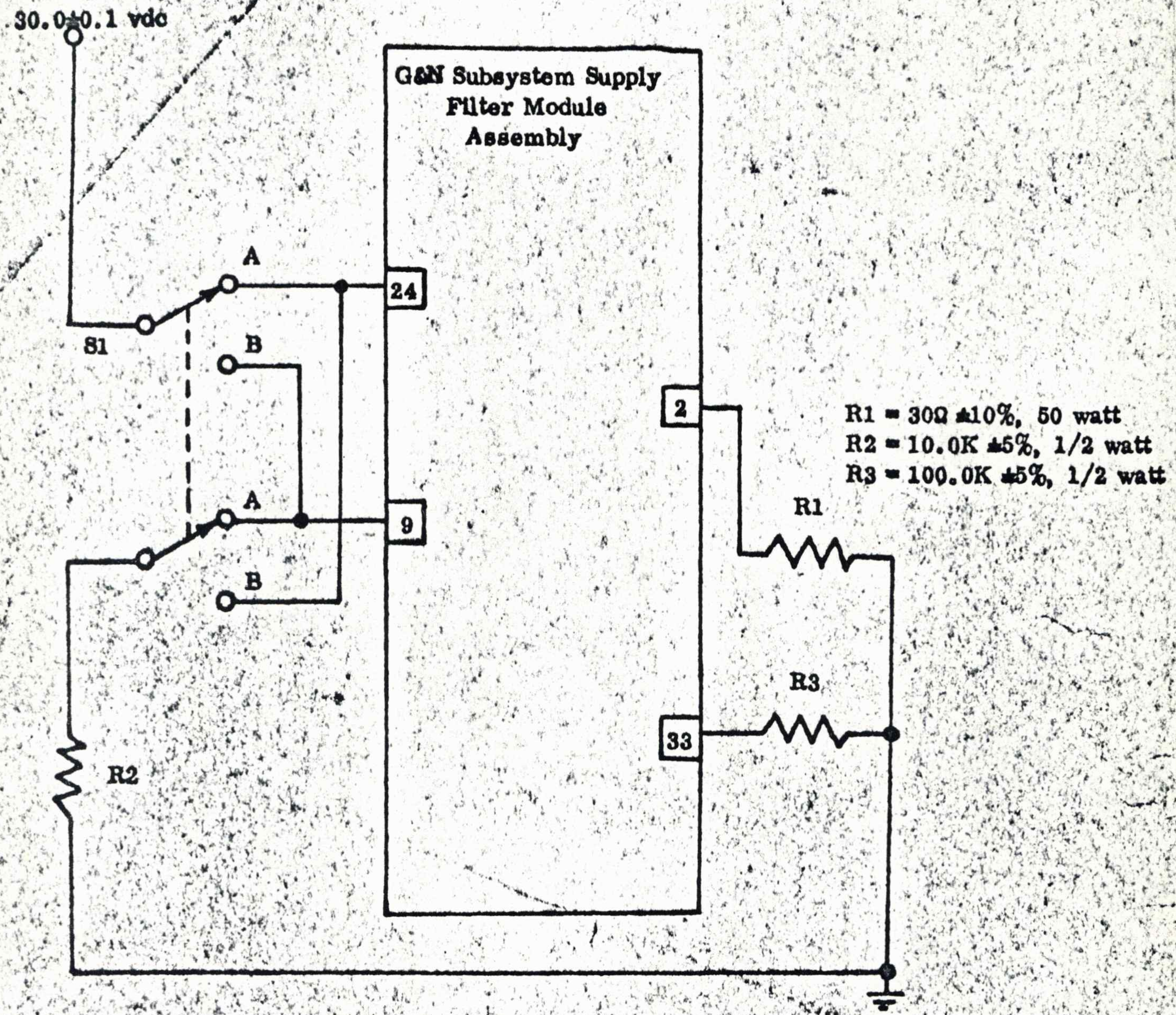

ISOLATION TEST SETUP

FIGURE 2