Bendix
Aerospace Systems Division

NO.	REV. NO.
AL 510100	

PAGE 1 OF 29

DATE 11 August 197

R. MILEY
B x A / MSC

PERFORMANCE/DESIGN

AND

PRODUCT CONFIGURATION REQUIREMENTS

FOR

POWER CONDITIONING UNIT

FOR

APOLLO LUNAR SURFACE EXPERIMENTS PACKAGE

ARRAY E

Prepared by: J. E. Staley
J. E. Staley

Approvals:

J. E. Staley
J. E. Staley, ALSEP
PCU Project Engineer

R. J. Dallaire
ALSEP Reliability

D. H. Fithian
D. H. Fithian, ALSEP
Design Integration

M. J. Cabrera
ALSEP System Support

M. G. O'Mara
M. G. O'Mara, ALSEP
Quality Assurance Manager

L. Deck 8-12-71
L. P. Deck, ALSEP
Configuration Manager

F. L. Warren
F. L. Warren, ALSEP
Specification Engineering

D. Z. Douthat
D. Z. Douthat, ALSEP
Electrical Design

1.0 PURPOSE AND SCOPE

1.1 PURPOSE

The purpose of this document is to define the operating and storage characteristics and capabilities of the ALSEP Power Conditioning Unit, herein designated the PCU.

1.2 SCOPE

This document specifies the operating and storage environment to which the subject PCU can be subjected. Operating input and output parameters are defined and specified as applicable within the limits specified for operating environment and defined operational interfaces.

2.0 APPLICABLE DOCUMENTS

The following documents, of exact issue shown, form a part of this specification to the extent specified herein.

SPECIFICATIONS

NASA/MSC Exhibit "B" of Contract NAS 9-5829 ALSEP Technical Specification

MIL-E-5272C (1) (Section 3)	Environmental Testing, Aeronautical and Associated Equipment, General Specification
MIL-W-6858C	Welding, Resistance, Aluminum, Magnesium, Non-hardening Steels or Alloys, and Titanium Alloys, Spot and Seam
MIL-STD-826	Interference Control Requirements Aeronautical Equipment
LED 520-1	Design Criteria and Environments for the LM
LIS 360-22302	Environmental Conditions Induced by LM on Scientific Equipment in the Descent Stage

ARD 503	Transmitter Specification
AL 770000	Electromagnetic Interference Control Requirements for ALSEP

NASA

NHB-5300.4(3A)	Quality Requirements for Hand Soldering of Electrical Connections
MSC-ASPO-EMI-10A 17 October 1963	NASA Addendum to Specification MIL-I-26600

NASA/MSC CRITERIA AND STANDARDS

DS-1	System Accessibility for Maintenance
DS-4	Separation of Redundant Paths
DS-5	Transistors - Selection of Types
DS-12	Single Point Failure
DS-13	Electrical and Electronic Devices Protection from Reverse Polarity and/or Other Improper Electrical Connectors
DS-21	Meteoroid Environment - Near Earth to Lunar Surface
DS-22	Flammability of Wire Bundles
DS-25	Wire Bundles - Protective Coatings
PS-5	Protection of Electrical/Electronics Assemblies from Moisture Damage
PS-6	Ultrasonic Cleaning, Electrical and Electronic Assemblies
PS-8	Application of Previous Qualification Tests
PS-11	Direct Procurement of Parts

(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

STANDARDS

MIL-STD-130C	Identification of U.S. Military Property
MIL-STD-810B	Environmental Test Methods for Aerospace and Ground Equipment
MIL-STD-721	Reliability and Maintainability
MIL-STD-889	Metals, Definition of Dissimilar

OTHER PUBLICATIONS

The Bendix Corporation, Aerospace Systems Division

ATM-241E	Acceptable Parts List
ATM-242E	Approved Materials List
AL 210100	Central Station Subsystem Specification
AL 310210	Power Distribution Unit Specification
AL 310810	Command Decoder Specification
AL 270000	Passive Seismic Experiment
IC 314103	Magnetometer Experiment
AL 280000	Heat Flow Experiment
AL 310910	Data Processor Specification
IC 314130	Lunar Ejecta and Meteorite Experiment
IC 314106	Lunar Passive Seismic Experiment
IC 314132	Mass Spectrometer Experiment
IC 314133	Lunar Surface Gravimeter Experiment
IC 314131	Lunar Seismic Profiling Experiment
IC 314119	Interface Control Specification for Electrical Power Subsystem (GFE Items) for ALSEP

3.0 REQUIREMENTS

3.1 PERFORMANCE

The PCU shall consist of redundant units which are compatible with the designated power source (see specification IC 314119) in providing conditioned power to all electrical subsystems of the ALSEP system. The design goal shall be such that single point failure modes are eliminated. A functional block diagram of the PCU is illustrated in Figure 1.

3.1.1 Operational Characteristics

3.1.1.1 Source Characteristics

The PCU shall be capable of operating from an RTG source of the following characteristics:

Source Voltage, Instantaneous Open Circuit	32 VDC Minimum 36 VDC Maximum
Source Impedance	3.2 ohms min.
Peak Power	68 to 80 watts @ 16.3±0.5V at PCU terminals

The above characteristics apply one hour after fuel capsule insertion and continuously thereafter for two years.

3.1.1.2 Input (RTG)

The PCU shunt regulator in conjunction with the APM, shall maintain the RTG output voltage between 15.8 and 16.8 VDC (measured at the input terminals of the PCU with an average responding meter) providing the source power capability does not exceed the maximum range of the regulator plus the minimum PCU load and losses. The maximum range of the regulator is determined by the external resistance affixed between the emitter of the regulator transistor and power return. A thermal plate heater resistance (measured at the appropriate pins of the PCU connector) of 3.70 ohms permits an active shunt regulator range of 65 watts.

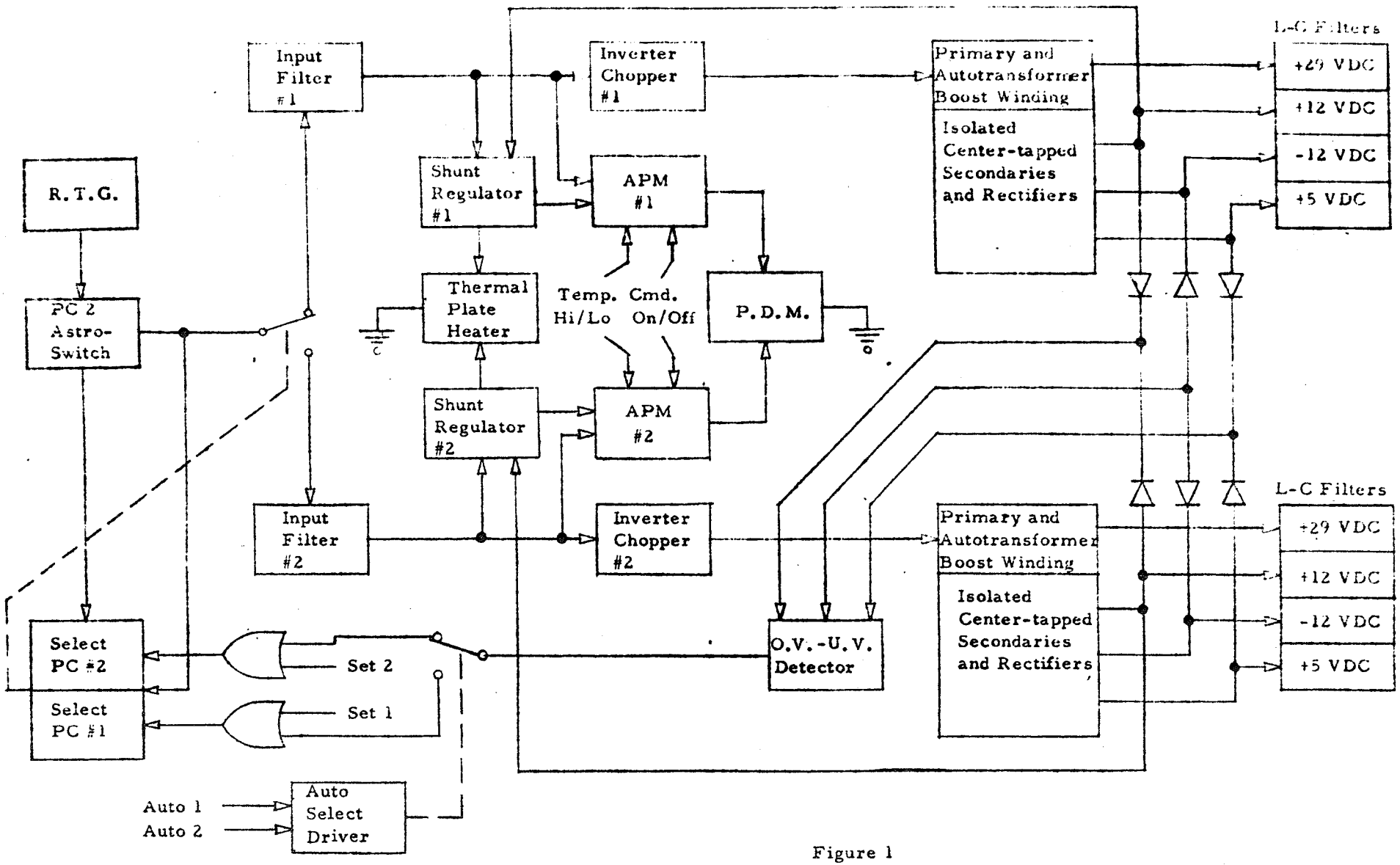


Figure 1

Block Diagram of the

Array E

Power Conditioning Unit

3.1.1.3 Automatic Power Management (APM)

The APM shall be ground enabled, with local reserve power and temperature inputs. The APM shall distribute excess reserve power up to 25 watts, to an external dump resistor, when the thermal plate temperature exceeds 80 ± 5 degrees fahrenheit. The APM shall turn off when the thermal plate temperature drops below 60 ± 5 degrees fahrenheit. The maximum dissipation of the APM is determined by the P.D.M. resistance affixed to the emitter circuit of the APM transistor. The APM turn-on point shall not exceed 2.5 watts reserve power.

3.1.1.4 PCU Output(s) (Power)

3.1.1.4.1 Regulation

The PCU provides 4 output voltages regulated to the limits as specified in Table 1 when measured with an average responding meter and with the specified range of loads applied.

TABLE I

PCU OUTPUT VOLTAGE LIMITS (AVERAGE)

	Voltage Range (AVG)	Range of Loads	Nominal Loads	Max Ripple 0 to 100 kHz
Output #1	29.31 to 30.31 VDC	10.07 to 54.0 watts	48.0 watts	150 mv p-p
Output #2	12.64 to 12.74 VDC	1.45 to 2.04 watts	1.75 watts	100 mv p-p
Output #3	5.75 to 5.95 VDC	1.75 to 2.11 watts	1.93 watts	100 mv p-p
Output #4	-12.30 to -13.10 VDC	0.40 to 0.64 watts	0.57 watts	100 mv p-p

3.1.1.4.2 Ripple

The total PCU output ripple to any load, including converter noise and the effect of all other loads working at their specification power noise feedback limits shall be as specified in Table 1.

3.1.1.4.3 Conversion Efficiency

The conversion efficiency of the PCU shall be equal to or greater than 85% with nominal loads applied as per Table I, section 3.1.1.4.1 and

with the shunt regulator at cut-off. The input power shall be adjusted to achieve regulator and APM cut-off.

3.1.1.4.4 Output Impedances

The maximum output impedance of the +29 volt line at frequencies from 100 Hz to 100 KHz shall be as shown in Figure 1A.

3.1.1.4.5 Transient Characteristic

The transient characteristic shall be as shown in Figure 1B. This figure shows the worst-case output during PCU switch-over by command, at nominal loading. For power reset reference, outputs will fall to 50% ±25% of nominal within 5 msec.

3.1.1.4.6 Automatic Switchover Circuit

The Automatic Switchover Circuit shall provide the capability to automatically select the non-operating PCU should the operating PCU fail, providing the selector relay has been set in the proper position by previous command. Should the non-operating side be desired for reasons other than an operating side failure, the sequence of commands shall be AUTO 1 followed by SET 2 or AUTO 2 followed by SET 1, depending on which unit is desired. Elapsed time between these two commands shall be kept to a minimum.

3.1.1.4.7 Ripple-Off Logic

The ripple-off signal shall be logic '1' when there is sufficient reserve power to operate the experiments and logic '0' when the reserve power falls below 1.8 watts. Logic '1' and logic '0' are defined as follows:

Logic '1': 2.4V to 5.5V with a maximum source current of 5.1 mA

Logic '0': 0V to +0.4 with a maximum sink current of 3.1 mA

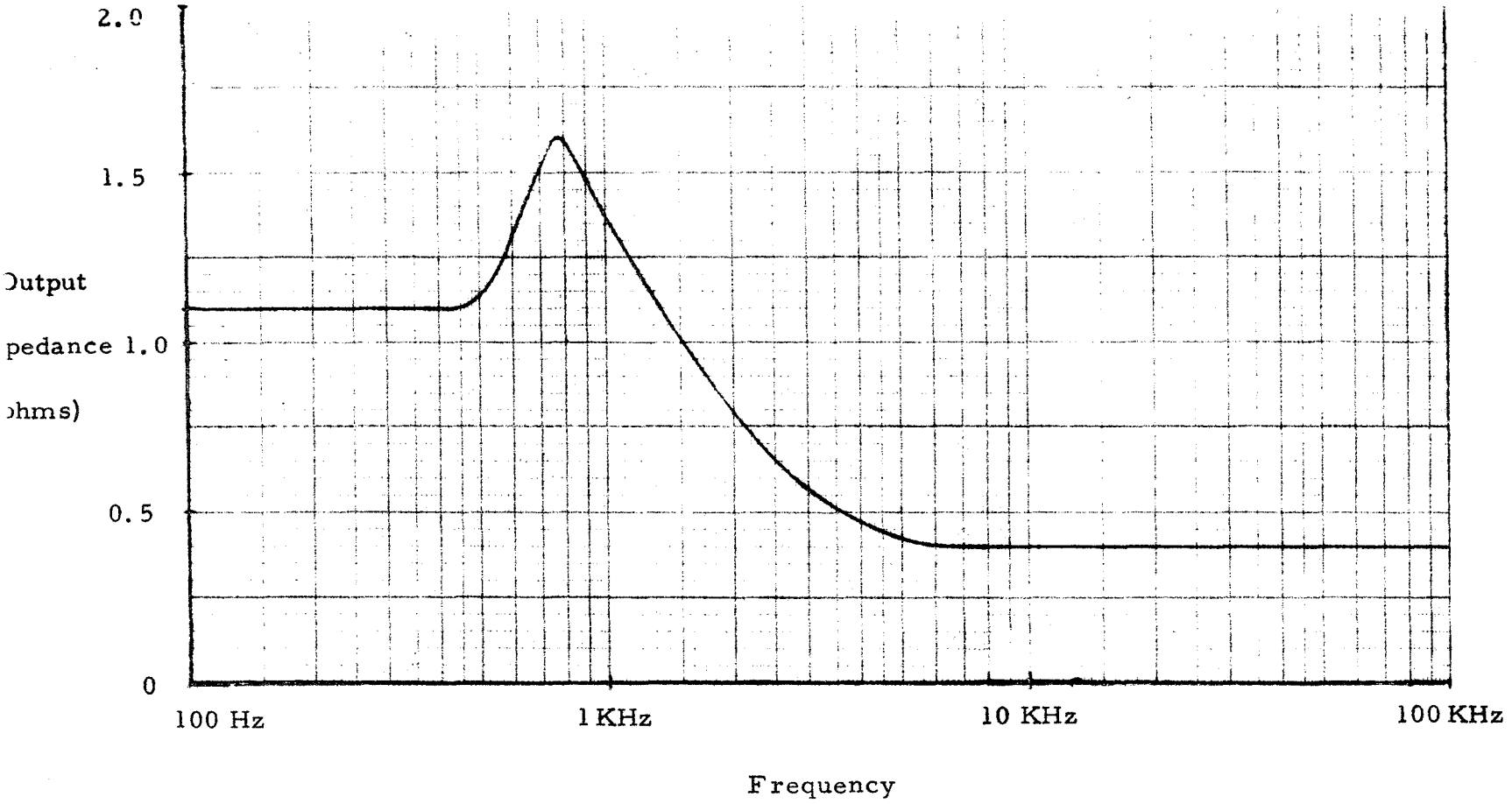


Figure 1A - Output Impedance of PCU +29 Volt Supply

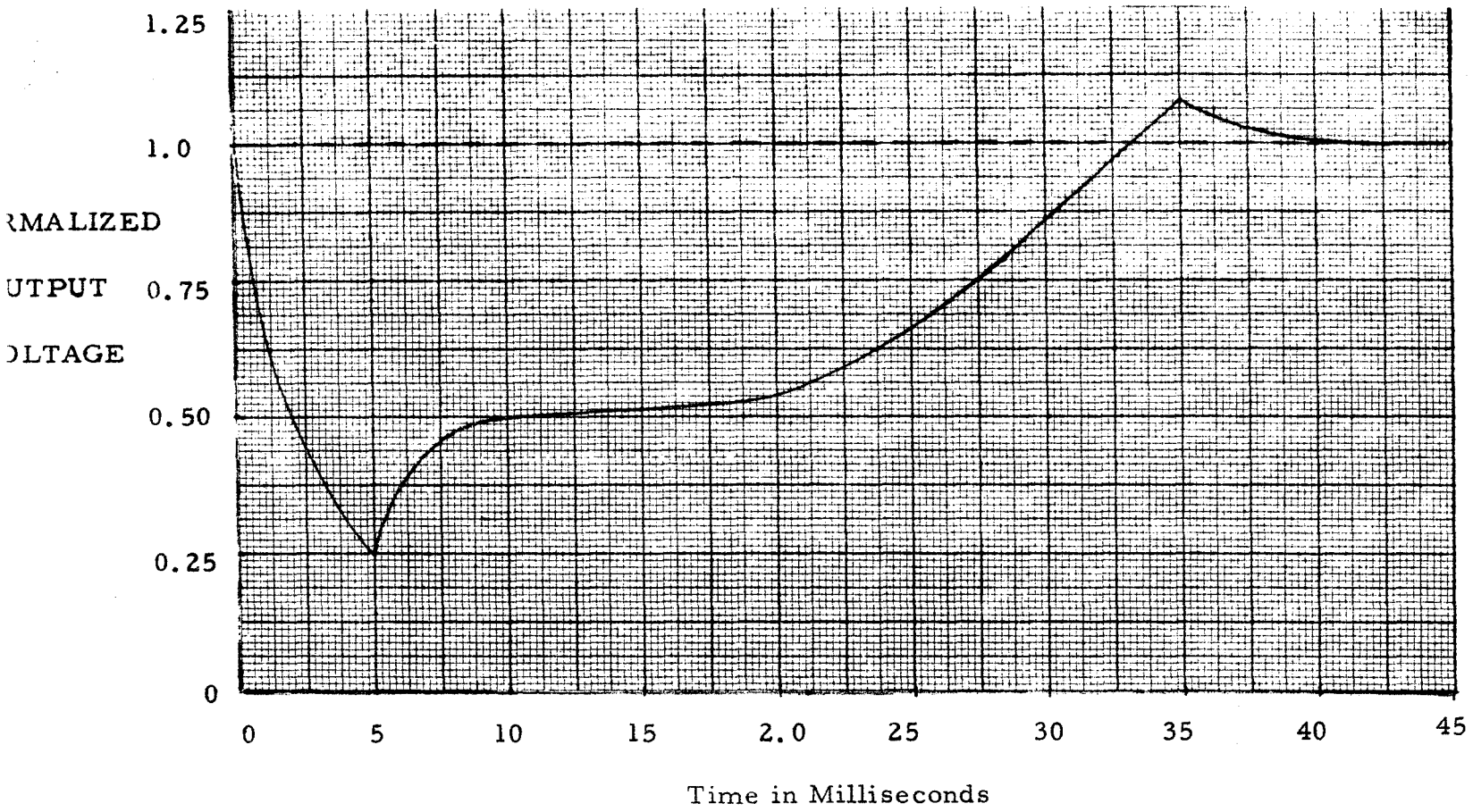


Figure 1B - PCU Switchover Characteristic

3.1.1.4.8 **Signal Noise**

The PCU objective shall be to keep reflected digital signal line noise less than 100 mV peak-to-peak and analog signal ripple less than 20 mV peak-to-peak during the sampling time of 135 μsec.

3.1.2 **Operability**

3.1.2.1 **Reliability**

Reliability shall be a prime consideration in design, development, and fabrication. Redundancy will be utilized to the greatest practical extent in achieving the reliability goal. As a design goal, the PCU shall have a 0.99908 probability of surviving launch, translunar flight, and lunar surface operation (including deployment) in the specified environment of paragraph 3.1.2.4 herein. The requirements of DS-4, DS-12, and DS-13 shall apply.

3.1.2.2 Commands

The PCU shall respond to commands with the following characteristics. The command pulse shall be Logic '0' lasting 20 ± 2msec. Normal no command condition shall be Logic '1'. Logic '1' and Logic '0' are defined as follows:

Logic '1': 2.4V to 5.5V with a maximum source current of 75 uA

Logic '0': 0V to 0.4V with a maximum sink current of 1.5 mA

3.1.2.3 Useful Life

The PCU shall be capable of performing as specified for a period of two (2) years after a maximum earth storage period of three (3) years.

3.1.2.4 Environmental Requirements
(Ref. Spec. MIL-E-5272C, MIL-STD-810B)

The worst case environmental conditions to which the PCU shall be subjected to in its operational and non-operational duty cycle are as specified in Figures 2 and 3. Additional detail on vibration, shock acceleration and EMI are provided in the following paragraphs.

The PCU shall operate according to its specification under all or any combination of these environmental conditions.

3.1.2.4.1 Non Operational Vibration Shock and Acceleration

FIGURE 2

SYSTEM ENVIRONMENTS
ALSEP MISSION PHASE

Environmental Parameter	Storage Packaged	Checkout	Movement to the Pad	Launch Pad Environment	Flight	Lunar Operations
Relative Humidity	15-90%	50% Max.	15-100% rel.	50% Max.	N/A	N/A
Sand & Dust	N/A	N/A	N/A	N/A	N/A	N/A
E.M.I.	N/A	AL770000	N/A	AL770000	N/A	AL770000
Acceleration	LED520-1	N/A	LED520-1	N/A	Para. 3.1.2.4.1	N/A
Vibration	LED520-1	N/A	LED520-1	N/A	Para. 3.1.2.4.1	Para. 3.1.2.4.2
Shock	LED520-1	N/A	LED520-1	N/A	LIS-360-22302	12 inch free fall onto a hard surface under lunar gravity
Temperature	-55°C to +85°C	+50°F +100°F	+50°F to +100°F	+50°F to +100°F	LED520-1	LED520-1
Nuclear Radiation	N/A	Negligible	N/A	Negligible	Less than lunar oper.	LED520-1

FIGURE 2 (CONT.)

Environmental Parameter	Storage Packaged	Checkout	Movement to the Pad	Launch Pad Environment	Flight	Lunar Operations
Solar Radiation	N/A	N/A	N/A	N/A	N/A	LED520-1
Meteoroids	N/A	N/A	N/A	N/A	N/A	DS-21
Pressure	LED520-1	Ambient	Ambient	Ambient	1×10^{-8} mm Hg	LED520-1
Acoustics	N/A	N/A	N/A	N/A	LED520-1	N/A

Environment Considered	Storage Unpackaged	Storage Packaged	Movement to Pad	Factory & KSC Checkout	Launch Pad Environment	Flight	Lunar Operations
Humidity	3 Days	90 Days	1 Day	180 Days	13 Days	N/A	N/A
Acceleration	N/A	N/A	N/A	N/A	N/A	Approx* 25 min	N/A
Vibration	N/A	1 Day	1 Day	N/A	N/A	25 min*	N/A
Shock	Single Shock	Single Shock	N/A	N/A	N/A	One Shock	N/A
Temperature	3 Days	90 Days	1 Day	180 Days	13 Days	3.5 Days	365 High Days 365 Low Days
Radiation	N/A	N/A	N/A	Negligible	Negligible	3.5 Days	730 Days
Solar Radiation	6 hr/Day 3 Days	N/A	N/A	N/A	N/A	N/A	365 Days
Meteroroids	N/A	N/A	N/A	N/A	N/A	N/A	730 Days
Pressure	90 Days		1 Day	180 Days	13 Days	3.5 Days	730 Days
Acoustics	N/A	N/A	N/A	N/A	N/A	5 Min	N/A

*Includes lunar descent.

Figure 3 Environmental Duty Cycles

Vibration - Sinusoidal

X-Axis:	5-20 Hz	0.20 in. d.a.
	20-34	4.0 g-peak
	34-50	0.07 in. d.a.
	50-65	9.0 g-peak
	65-100	4.0 g-peak
Y & Z-Axes:	5-17 Hz	0.20 in. d.a.
	17-54	3.0 g-peak
	54-80	0.02 in. d.a.
	80-100	6.5 g-peak

Sweep: 5-100-5 Hz
Sweep Rate: 3 oct/min
Tolerances: ±10% (g &d.a.)
±5 Hz at step discontinuities

Launch & Boost Random

X-Axis:	20-40 Hz	+6db/oct
	40-150	0.08 g^2/Hz
	150-270	-6 db/oct
	270-2000	0.025 g^2/Hz
Y-Axis:	20-60 Hz	+6 db/oct
	60-200	0.06 g^2/Hz
	200-285	-6 db/oct
	285-2000	0.03 g^2/Hz
Z-Axis:	20-50 Hz	+9 db/oct
	50-150	0.035 g^2/Hz
	150-210	-3 db/oct
	210-2000	0.025 g^2/Hz

Duration: 1.0 min/axis

Tolerances: ±3 db (PSD)
±10% (G_{rms})

Vibration: Lunar Decent

X-Axis:	20-40 Hz	+6 db/oct
	40-60	0.10 g^2/Hz
	60-135	-6 db/oct
	135-2000	0.02 g^2/Hz
Y-Axis:	20-90 Hz	+3 db/oct
	90-100	0.08 g^2/Hz
	100-175	-9 db/oct
	175-2000	0.015 g^2/Hz
Z-Axis:	20-70 Hz	+3 db/oct
	70-120	0.07 g^2/Hz
	120-380	-6 db/oct
	380-2000	0.007 g^2/Hz

Duration: 12-1/2 min/axis

Tolerances: ±3 db (PSD)
±10% (G_{rms})

Shock: 20 g's for 11 milliseconds saw tooth wave from Procedure I (± X, ± Y, ± Z ALSEP axes)

3.1.2.4.2 Operating Vibration

Vibration: Random, 5.0 minute duration, X, Y, Z axes vibration spectrum per Figure 4.

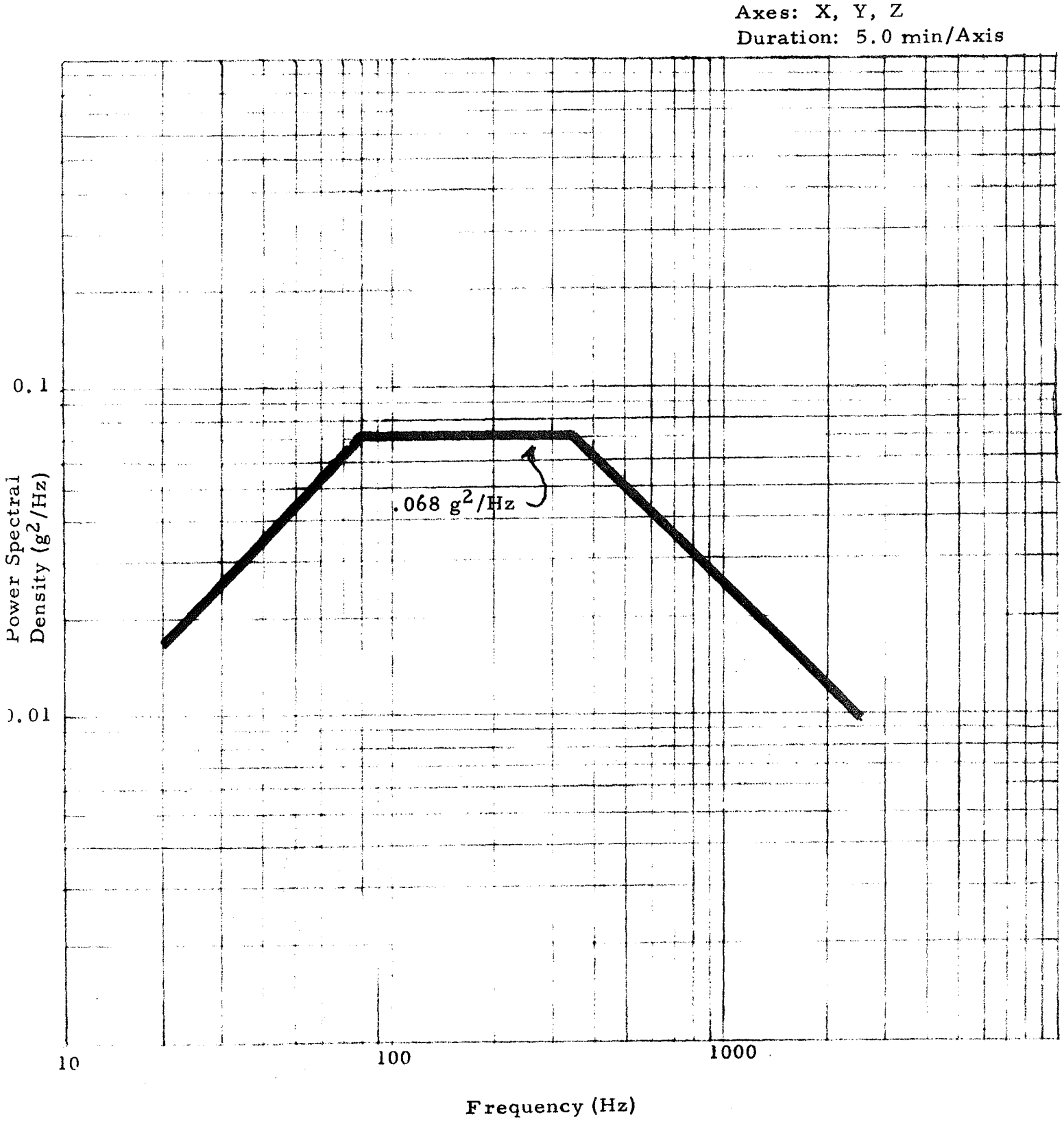


Figure 4 - Operating Random Vibration Spectrum

3.1.2.5 Safety

Safety requirements shall comply with the following:

3.1.2.5.1 Personnel Safety

The PCU shall be designed to avoid sharp edges, corners, and protuberances.

3.1.2.5.2 Hazard Proofing

The design of the PCU shall minimize the hazard of fire, explosion and toxicity to the crew, launch area personnel and facilities. The hazards to be avoided include accumulation or leakage of combustible gases, the hazard of spark or ignition sources including static electricity discharge, and toxicity due to inhalation or spillage of volatile or poisonous expendables. The requirements of DS-22 shall apply.

3.2 INTERFACE REQUIREMENTS

3.2.1 Electrical Interfaces

The PCU electrical interface is illustrated in Figure 5.

3.2.1.1 Power Distribution Unit Interface
(Ref. Spec. AL 310210)

The interface between the PDU and PCU involves 16 wires, external to the PCU/PDU case, which route the power outputs of the PCU to the PDU. The following table provides the pin functions:

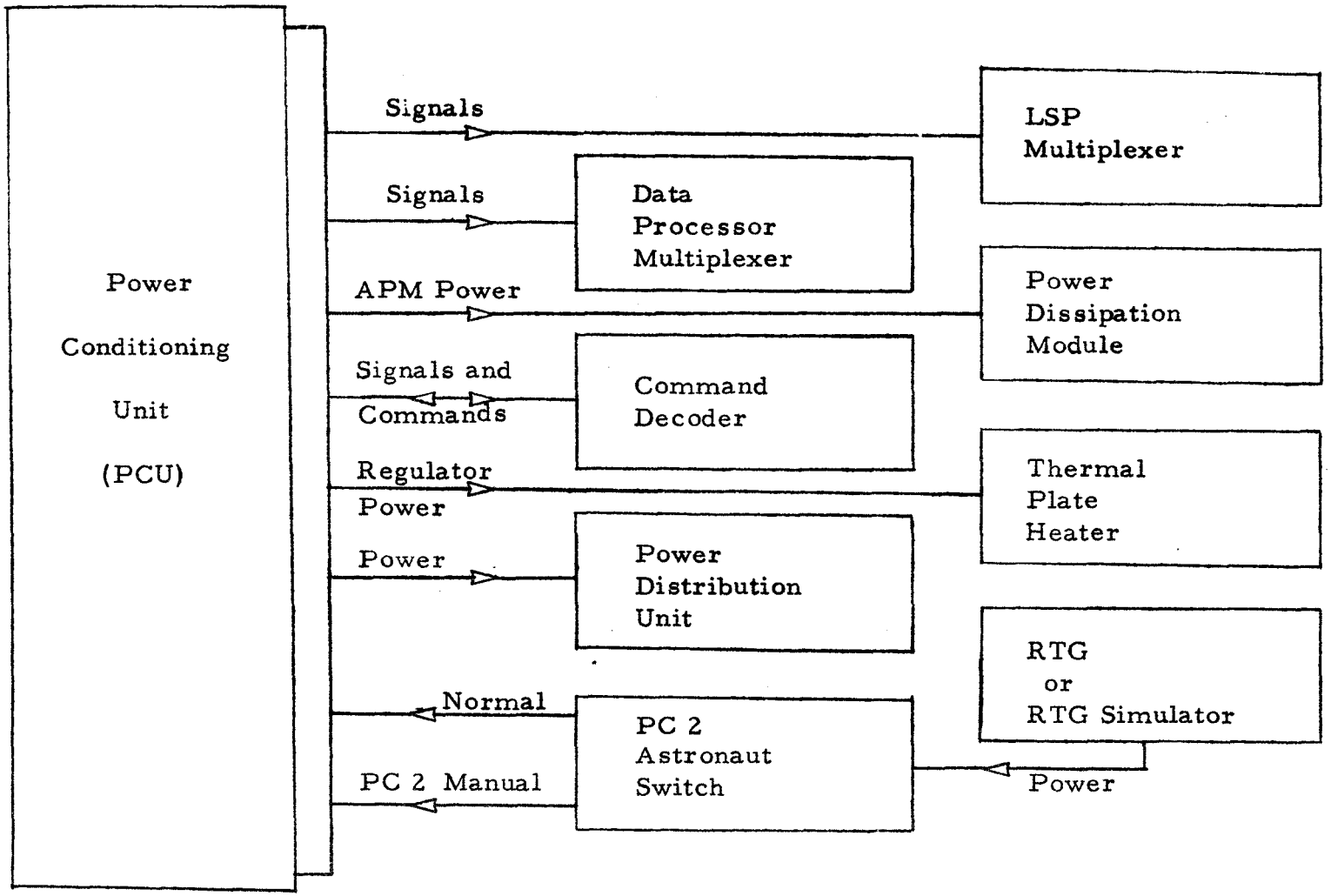


Figure 5

PCU Electrical Interface
Block Diagram

From PCU JP12 Pin #	To PDU JP13 Pin #	Function
" 30	" 3	Power 29 VDC (1)
" 31	" 2	Power 29 VDC (1)
" 32	" 1	Power 29 VDC (1)
" 48	" 4	Power 12 VDC (1)
" 49	" 5	Power -12 VDC (1)
" 64	" 8	Power 5 VDC (1)
" 65	" 7	Power 5 VDC (1)
" 66	" 6	Power 5 VDC (1)
" 34	" 25	Power 29 VDC (2)
" 35	" 24	Power 29 VDC (2)
" 36	" 23	Power 29 VDC (2)
" 51	" 26	Power 12 VDC (2)
" 52	" 27	Power -12 VDC (2)
" 68	" 30	Power 5 VDC (2)
" 69	" 29	Power 5 VDC (2)
" 70	" 28	Power 5 VDC (2)

3.2.1.1.1 **Power Return Interface**

The power return shall be thru the PCU/PDU chassis. Chassis ground pins shall be provided to prevent damage during test. The following table provides the PCU connector pin numbers.

From PCU JP12 Pin #	To TB2 Pin #	Function
" 28	182	Chassis Ground
" 3	55B	Chassis Ground

3.2.1.2 Power Source Interface

The electrical interface between the PCU and the RTG Central Station connector JP22 is tabulated below:

From PCU JP12 Pin #		To P/J22 (RTG) JP22	Pin #	Function
"	5	"	(see fig. 6 - par. 3.2.1.8)	RTG Power Input (+)
"	6	"	"	RTG Power Input (+)
"	7	"	"	RTG Power Input (+)
"	23	"	"	RTG Power Input (+)
"	24	"	"	RTG Power Input (+)
"	25	"	"	RTG Power Input (+)
"	71	"	24	Set 1 Sense
"	80	"	25	Set 2 Sense

3.2.1.3 Test Connector Interface

The following table provides the list of sense lines connecting to the test connector J27.

From PCU JP12 Pin #		To J27 Pin #	Function
"	58	2	+12 VDC (1) Sense
"	78	3	+12 VDC (2) Sense
"	21	1	Reserve Power B Sense

3.2.1.4 **Special Test Connections**

The following is a tabulation of JP12 pins function which are used for test purposes only:

From PCU JP12	Pin	Function
"	75	RTG + Sense
"	57	29 VDC Sense (1)
"	61	Return Sense
"	58	12 VDC Sense (1)
"	60	-12 VDC Sense (1)
"	59	5 VDC Sense (1)
"	79	+29 VDC Sense (2)
"	78	+12 VDC Sense (2)
"	77	+5 VDC Sense (2)
"	76	-12 VDC Sense (2)
"	71	Set 1 Sense
"	80	Set 2 Sense
"	21	Reserve Power B TM Sense

3.2.1.5 Central Station Heater Interface

From PCU JP12 Pin	Function
46	Shunt REG #1 Resistor(s) (+)
47	Shunt REG #1 Resistor(s) (+)
62	Shunt REG #2 Resistor(s) (+)
81	Shunt REG #2 Resistor(s) (+)

3.2.1.6 Command Decoder Interface
(Ref. Spec. AL 310810)

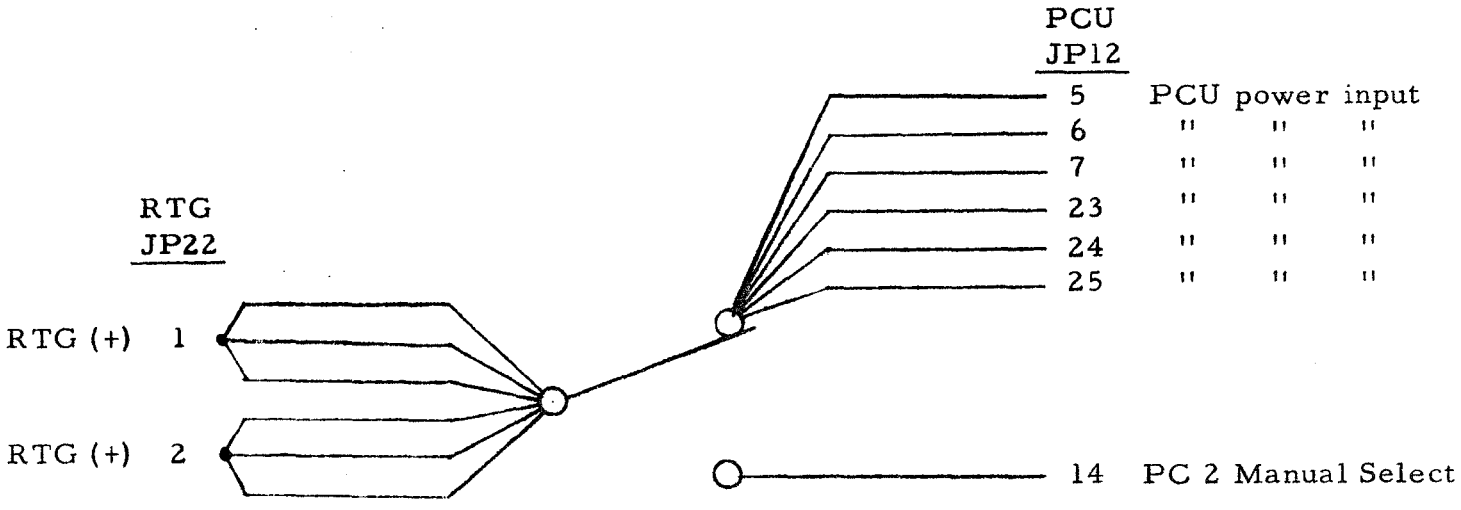
From PCU JP12 Pin	To Command Decoder JP14 Pin	Function
" 83	" 85	Select Power Converter #1 060
" 82	" 86	Select Power Converter #2 062
" 63	" 34	APM 1 On 027
" 17	" 4	APM 2 On
" 84	" 33	APM 1 OFF 031
" 18	" 5	APM 2 OFF
" 11	" 3	Auto 1
" 10	" 2	Auto 2
" 12	" 116	Ripple-Off Logic Signal (RESZP)

3.2.1.7 Power Dissipation Module Interface

From PCU JP12	Pin #	To PDM J24	Pin #	Function
"	87	"	4	APM (1)
"	88	"	3	APM (1)
"	85	"	6	APM (2)
"	86	"	5	APM (2)

3.2.1.8 **Astronaut Switch Interface**

The RTG Power Input Pins (5, 6, 7, 23, 24, 25) and Pin 14 are connected to the PC 2 Astronaut Switch which provides manual selection of PC 2 should PC 1 fail to start. Upon PC 1 failure to start, operation is to switch the arm to PCU contact 14, which causes switchover to PC 2, and then return the switch arm to the normal position to apply power.



NOTE: Functional Diagram Only
Switch is double pole, double throw

Figure 6

Astronaut Switch Connections
(Shown for Normal Conditions)

3.2.1.9 Data Processor (Analog Multiplexer) Interface (Ref. Spec. AL 310910)

From PCU JP12	Pin	To Analog Multiplexer JP16	Pin	Function
"	42	"	49	Regulator (1) Temperature AT-38
"	53	"	17	Regulator (2) Temperature AT-39
"	9	"	45	PCU Input Voltage (1) AE-3
"	40	"	51	PCU Input Voltage (2) AE-23
"	27	"	46	RTG Current A AE-4
"	41	"	50	Reserve Power A (DA-08 or AE-24)
"	38	"	53	APM (1) Power AE-21
"	37	"	54	APM (2) Power AE-22
"	43	"	48	APM 1 Temperature AT-41
"	39	"	52	APM 2 Temperature AT-42
"	44	"	47	APM Status - AB-13
"	74	"	83	Auto Switch Status - AB-16

3.2.1.10 Lunar Seismic Profile Experiment Interface (Ref. Spec. AL 900131)

Provisions shall be made within the PCU such that the LSP Data Processor can be utilized to monitor certain critical PCU functions. The following table lists functions and pin connections of the PCU connector to be used for this purpose.

JP12	Pin	Function
"	55	RTG V 1B
"	56	Reserve Power B
"	54	RTG Current B

3.2.2 Mechanical Interface

The PCU shall mount to a flat, thermally conductive surface. Thermal Control shall be in its entirety maintained by thermal conduction to the mounting surface.

3.2.3 Thermal Interface

The PCU shall be constructed such that internal heat rise within the PCU is less than 30°C when mounted to a thermal plate maintained between -30°C and +70°C.

3.3 DESIGN AND CONSTRUCTION

The PCU shall be designed and constructed such as to meet all the requirements of this specification and yet be of minimum size and weight.

3.3.1 Size

The PCU shall be packaged within a volume not exceeding 120 cubic inches. The total height above the thermal plate shall be less than 3 inches including PDU, electrical connector and cable routing.

3.3.2 Weight

The PCU/PDU combined weight shall be 8.0 pounds or less.

3.3.3 Form Factor

The form factor of the PCU/PDU combination shall be a maximum of 2.98" H x 6.98" x 10.40" including connector.

3.3.4 Parts and Materials

Materials shall be selected from the ALSEP Approved Materials List - ATM-241. Parts shall be selected from the Acceptable Parts List - ATM-242. All parts and materials shall be compatible with the intended use and environment requirements specified in 3.1.2.4 herein.

3.3.4.1 Materials

Materials used in the fabrication of all components shall be of the highest quality compatible with design requirements specified herein. In general, the following types of materials shall not be used without prior written approval of NASA:

a. Flammable materials

b. Toxic materials

c. Unstable materials

d. Plastic - (only epoxy resin-based compounds, teflon, and mylar shall be used).

e. Dissimilar metals in direct contact which tend toward active electrolytic or galvanic corrosion.

3.3.4.2 Standard Processes

3.3.4.2.1 Protective Treatment

All materials used which are not inherently corrosive-resistant shall be treated to resist any corrosive effects resulting from environmental conditions specified herein. Protective coatings shall not crack, chip, peel, or scale with age when subject to the environmental extremes specified. The requirements of PS-5 shall apply to protective treatment. DS-25 shall apply.

3.3.4.2.2 Soldering

NASA Publication NHB-5300.4(3A) shall apply for hand soldering of all electrical connections.

3.3.4.2.3 Welding

Resistance welding (spot and seam) shall conform to Specification MIL-W-6858C.

3.3.4.2.4 Ultrasonic Cleaning

The requirements of PS-6 shall apply.

3.3.5 Standard Parts

NASA Standard Parts, Air-Force-Navy (AN) or Military Standards (MS) or joint Air Force-Navy (JAN) shall be used where applicable.

3.3.5.1 Standardization

Maximum economic standardization of parts and components shall be provided. Where identical or similar functions are performed in more than one application within the system, effort shall be made to use only one item design for all system applications.

3.3.5.2 Parts Procurement

The requirements of PS-8 and PS-11 (excluding part C) shall apply. Bendix shall be capable of identifying at any time the manufacturers lot from which parts have been procured.

3.3.5.3 Transistors

The requirements of DS-5 shall apply.

3.3.6 Moisture and Fungus Resistance

Materials which are not nutrients for fungus shall be used whenever possible. The use of materials which are nutrients for fungus shall not be prohibited in hermetically sealed assemblies and in other accepted and qualified uses such as paper capacitors and treated transformers. If it is necessary to use fungus nutrient materials in other than such qualified application, these materials shall be treated with a process which will render the resulting exposed surface fungus resistant.

3.3.7 Corrosion of Metal Parts

Metals shall be corrosion-resistant type or suitably treated to resist corrosive conditions likely to be met in storage or normal service. Unless suitably protected against electrolytic corrosion, dissimilar metals as defined in MIL-STD-889, shall not be used in direct physical contact.

3.3.8 Workmanship

The PCU shall be constructed, finished, and assembled in accordance with highest standards.

3.3.9 Electromagnetic Interference (EMI)

All items furnished shall have as a design goal the intent of meeting the requirements of electromagnetic interference. (See Spec. AL 770000).

3.3.9.1 Operation

Electrical and electronic equipment shall perform as specified herein when operating either independently or in conjunction with other equipment with which there are electrical connections, or which may be installed nearby. This requires that the operation of such equipment shall not be adversely affected by interference voltages and fields reaching it from external sources and also requires that such equipment shall not, in itself, be a source of interference which might adversely affect the operation of other equipments. These general criteria ensure that the system will meet the requirements of the overall system acceptance criteria, and electromagnetic compatibility as specified in the performance specifications. In addition to these general requirements, the system shall satisfy the requirements of paragraph 3.1.2.4 and Specification MIL-I-26600, and NASA Addendum MSC-ASPO-EMI-10A.

3.3.9.2 Transient Interference

Transient or short duration interference resulting from the operation of electrical or electromechanical devices shall not compromise the performance requirements as specified herein.

3.3.9.3 Interference-Free Design (Ref. Spec. MIL-STD-826)

Interference control shall be considered in the basic design of all subsystem electronic and electrical equipment and specialized equipment such as simulation sources and GSE. The design shall be such that before interference control components are applied, the amount of interference internally generated and propagated shall be the minimum achievable. The application of interference control components (e.g., filtering, shielding, bonding) shall conform to good engineering practice and, wherever practical, shall be an integral part of the subsystem or component.

3.3.9.4 Filtering

Filters shall be provided at each component or subsystem, as required, to prevent internally generated electrical interference signals being conducted out of the component or subsystem.

3.3.10 Identification and Marking

The PCU shall be marked for identification in accordance with Standard MIL-STD-130.

3.3.10.1 Identification and Marking Data

The identification and marking shall include but not be limited to the following data.

a. Item nomenclature
b. Item part number
c. Item serial number
d. Item identification number

3.3.11 Storage

The PCU shall have a shelf life of 3 years. Shelf life is defined as a storage period in a controlled environment of 50°F to 80°F and a relative humidity of no more than 50 percent following acceptance and prior to installation in the LM for flight.

3.3.12 Maintainability

Component arrangement, and accessibility features shall be incorporated into the design, to allow efficient maintenance. The requirements of DS-1 and MIL-STD-721 shall apply.

3.3.13 Bendix Performance and Interface Specifications

The following specifications are listed as a guide for additional information on the experiments and contract items for ALSEP: ARD-503, AL 210100, AL 310810, AL 270000, IC 314131, AL 280000, IC 314103, IC 314130, IC 314106, IC 314132, and IC 314133. In the event of conflict between documents referenced in this specification and the detail content of Sections 3, 4, and 5, the detail requirement of NASA/MSC Exhibit 'B' shall be considered a superseding requirement.