APOLLO LUNAR SURFACE EXPERIMENTS PACKAGE

ALSEP POWER BUDGET

ATM-449

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by

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Summary

This issue of the ALSEP power budget provides the information available at the end of November 1970 on the power requirements of the major ALSEP components and the resulting composite system power usage for the deliverable systems. The data reflect measurements made during testing of qualification and flight equipment.

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ALSEP Equipment Power Demands

The power requirements of the various equipment subsystems are presented in Tables I through VI. All values are given in watts.

Table I lists the measurements of input power required by the Data Subsystem components.

Tables II Through VI present the latest information on experiment power demands grouped by flight system. The power values are tabulated for both operational and standby modes under headings having the following meanings:

Operate Mode (i.e., when the operational power line is energized)

1. Functional power - that power required to perform the normal (routine) scientific data-gathering functions of the instrument. If this power requirement is not constant, the highest instantaneous demand at any point in the operational cycle is listed under "Maximum Instantaneous" and the lowest value is listed under "Minimum Instantaneous".

2. Thermal support power - that power which must be provided upon demand to an instrument solely for purposes of thermal control or support of the sensors and electronics. This power demand varies in accordance with

   - The temperature of the equipment being thermally controlled,

   - the technique of thermal control, e.g., proportional, bang-bang, time-share, etc.

   The maximum and minimum values of this power are both listed, together with the control temperatures.

3. Total power - represents the power demand during "normal" operation when full thermal support power is being used. The values listed represent the maximum instantaneous values of power demand under these conditions.

4. Intermittent Modes - the largest of the peak power demands associated with the intermittent (commandable, non-normal) operational modes of an experiment. Any increment of power required by an experiment during an intermittent mode in excess of that listed under (3) may be borrowed on a time-shared basis from some other item of equipment.

5. Power on Transient - the instantaneous peak value of the transient power demand associated with switching on the experiment. The value listed under "duration" is normally the length of time the transient demand exceeds the value under heading (3) for that equipment.

Standby Mode (i.e., when the Standby power line is energized)

If the Standby power demand of an instrument is not constant, the limits of variation are listed under "maximum" and minimum". Any variation in this power is usually a function of ambient temperature. Where relevant, the control temperature is listed.

ALSEP System Power Balance

For budgetary purposes, the power required by ALSEP at lunar midnight represents the maximum continuous load on the power source. This value is shown in Table VII for each ALSEP flight system together with other important operational and intermittent modes. All values are given in watts and include PCU Conversion losses, estimated at 9% of PCU load plus 2.42 watts.

TABLE 1

DATA SUBSYSTEM POWER USAGE

Equipment	Operating Mode	Power Demand (watts)			
		A, C	A2	D(Est)	E(Est)
Receiver	Operating	0.70	0.82	1.80	0.90
Command Decoder	Operating	1.20	1.28	1.25	1.10
Data Processor Analog	Operating	1.20	1.75	1.40	**
Data Processor Digital	Operating	0.50	0.51	0.50	2.31
PDU	Unloaded (expts Off)	1.4	1.68	1.75	1.63
	Mean (Day) *	1.7	1.90	1.83	2.54
	Full Load (Night) *	2.0	2.58	2.28	3.16
Dust Detector or DTREM	Operating	0.2	0.2	---	---
	Non-Operating	0.05	0.05	---	---
Transmitter	Operating				
	- Night	7.5	10.40	10.40	10.40
	- Day	8.5	11.20	11.20	11.20
	Both Transmitters Inactive (Heater ON)	8.4	8.4	8.4	8.4
Diplexer Switch (Xmtr B only)		0.1	0.1	0.1	0.10
Timer		0.0	0.24	0.24	---
Operating Total	Day	14.0	17.9	18.2	18.0
	Night	13.2	17.6	17.9	17.9

* Includes breaker and harness losses
** Included in Digital Data Processor

TABLE II EXPERIMENT POWER ARRAY A (FLT 1)

Experiment No. / Designation:	Experiment Subsystem 1 PSE	2 LSM	3 SWS	4 SIDE	TOTAL	NOTES
Operate Mode						
1. Functional Power						
(a) Maximum	4.4*	5.5	6.2	6.5	22.6	(1) Leveling
(b) Minimum	4.4*	3.5	3.2	5.7	16.8	(2) Survey mode
						(3) Heaters time shared
						(4) Dust cover OFF
2. Thermal Support						
(a) Minimum	0.2	0.0	0.0	0.0	0.2	*3.6 watts of this dissipated
(b) Maximum	2.4	5.3	3.6	4.0	15.3	in Central Station
(c) Control Temp. (°F)	126±1	95	77	32±15	—	
3. Total Power						**3.8 watts of this dissipated
1(a) + 2(b)	6.8	10.8	6.0(3)	10.5	34.1	in the Central Station
4. Intermittent Modes						
(a) Maximum	8.0(1)	10.3(2)	8.7(4)	12.0(4)	—	
(b) Duration of Max. (Secs)	VAR	3	4±2	2.5	—	
5. Power On Transient						
(a) Maximum	11.6	11.0	10.5	13.0	—	
(b) Duration (Secs)	0.002	0.12	0.14	0.05	—	
Standby Mode						
. Minimum	4.5**	—	3.6	2.0	10.1	
. Maximum	4.5**	—	3.6	6.0	14.1	
. Control Temp. (°F)	—	—	—	32±15	—	

TABLE III EXPERIMENT POWER ARRAY C (FLT 4)

Experiment No. / Designation:	Experiment Subsystem 1 PSE	2 ASE	3 SIDE	4 CPLEE	TOTAL	NOTES
Operate Mode						
1. Functional Power						
(a) Maximum	4.4*	5.5	6.5	3.0	14.2	
(b) Minimum	4.4*	3.5	5.7	2.5	12.9	
2. Thermal Support						
(a) Minimum	0.04	-	0.0	0.0	0.3(3)	
(b) Maximum	5.7	-	4.0	2.9	15.7(3)	
(c) Control Temp. (°F)	126± 1	-	32± 15	32± 18	-	
3. Total Power						
1. (a) + 2(b)	10.1	5.5	10.5	5.9	29.6(3)	
4. Intermittent Modes						
(a) Maximum	10.2(1)	7.0(4)	12.0(2)	-	-	
(b) Duration of Max. (Secs)	Var.	Var.	2.5	-	-	
5. Power On Transient						
(a) Maximum	11.6	7.6	13	7.0	-	
(b) Duration (Secs)	0.090	0.002	0.05	0.037	-	
Standby Mode						
1. Minimum	5.0**	0.3	2.0	0.0	7.3	
2. Maximum	5.0**	3.1	6.0	4.5	18.6	
3. Control Temp. (°F)	-	-4± 4	32± 15	32± 18	-	

(1) Forced Heater On
(2) Dust Cover Off
(3) ASE on Standby
(4) ASE Warm Up

*3.6 watts of this dissipated in Central Station

**4.4 watts of this dissipated in Central Station

TABLE IV EXPERIMENT POWER ARRAY A2 (FLT 2A)

Experiment No. / Designation:	Experiment Subsystem 1 PSE	2 LSM	3 SWS	4 SIDE	5 HFE	TOTAL	NOTES
Operate Mode							
1. Functional Power							
(a) Maximum	4.3*	5.5	6.2	6.5	5.1(5)	27.6	
(b) Minimum	4.3*	3.6	3.2	5.7	3.5(5)	20.3	
2. Thermal Support							
(a) Minimum	0.04	0.0	0.0	0.0	0.0	0.04	
(b) Maximum	5.0	5.8	3.6	4.0	4.7	23.1	
(c) Control Temp. (°F)	126 ± 1	95	77	32 ± 15	32	-	
3. Total Power							(1) Leveling
1. (a) + 2(b)	9.3	11.3	6.0(3)	10.5	9.8	46.9	(2) Survey Mode (Heater ON)
4. Intermittent Modes							(3) Heaters time Shared
(a) Maximum	7.4(1)	12.2(2)	8.7(4)	12.0(4)	10.2(6)	-	(4) Dust Cover Off
(b) Duration of Max. (Secs)	Var.	3	4±2	2.5	Var.	-	(5) Mode I
							(6) Mode II Lunar Night
5. Power On Transient							
(a) Maximum	11.6	11.0	10.5	13.0	8.7	-	
(b) Duration (Secs)	0.09	0.12	0.14	0.05	0.06	-	
Standby Mode							
. Minimum	5.0**	-	3.6	2.0	4.2	14.8	**4.4 watts of this dissipated in central station
. Maximum	5.0**	-	3.6	6.0	4.2	18.8	
. Control Temp. (°F)	-	-	-	32 ± 15	-	-	*3.6 watts of this dissipated in central station

TABLE V EXPERIMENT POWER, ARRAY D (FLT 5)

Experiment No. / Designation:	Experiment Subsystem 1 PSE	2 ASE	3 LSM	4 HFE	TOTAL	NOTES
Operate Mode						
1. Functional Power						
(a) Maximum	4.3*	5.5	5.5	5.1(3)	15.2	
(b) Minimum	4.3*	3.5	3.6	3.5(3)	11.7	
2. Thermal Support						
(a) Minimum	0.04	-	0.0	0.0	0.3(5)	
(b) Maximum	5.0	-	5.8	4.7	18.6(5)	
(c) Control Temp. (°F)	126 ± 1	-	95	32	-	
3. Total Power						(1) Leveling
1. (a) + 2(b)	9.3	5.5	11.3	9.8	33.5(5)	(2) Survey Mode (Heaters ON)
4. Intermittent Modes						(3) Mode I
(a) Maximum	7.4(1)	7.0(6)	12.2(2)	10.2(4)	-	(4) Mode II Lunar Night
(b) Duration of Max. (Secs)	Var.	Var.	3	Var.	-	(5) ASE on Standby
5. Power On Transient						(6) ASE Warm Up
(a) Maximum	11.6	7.6	11.0	8.7	-	**4.4 watts of this dissipated in central station
(b) Duration (Secs)	0.090	0.002	0.12	0.06	-	
Standby Mode						
1. Minimum	5.0**	0.3	-	4.2	9.5	
2. Maximum	5.0**	3.1	-	4.2	12.3	*3.6 watts of this dissipated in central station
3. Control Temp. (°F)	-	-4± 4	-	-	-	

TABLE VI EXPERIMENT POWER, ARRAY E (FLIGHT 6)

Experiment	LSG	LMS	LEAM	LSP	HFE	TOTALS
Operate Mode						
1. Functional Power	2.5	14.0	3.0	9.0	5.1	24.6
2. Thermal Support	6.5	----	3.3	----	4.7	14.5
3. Total Power	9.0	14.0	6.3	9.0	9.8	39.1
4. Intermittent Modes	11.2	----	----	---	10.2(2)	----
Standby Mode	4.3	8.1 12.0(3)	3.0	0.0	4.2	19.6

1. LSP is normally OFF while other experiments are operating.
2. Mode II Night
3. Bake-Out Mode
4. Beam Adjustment

TABLE VII ALSEP SYSTEM POWER DEMANDS

System Mode		Array A	Array C	Array A2	Array D	Array E
Initial Turn On (Expts. Stby, Day only)						
Transmitter Off		28.4	25.3	37.6	32.6	42.5
Transmitter On		28.3	25.2	34.5	29.5	39.4
Normal Operation (Peak)						
Lunar Day		42.3	33.2	52.0	38.8	48.9
Lunar Night		54.0	49.1	72.7	58.5	64.6
Intermittent Modes - Change in Power*						
LSM						
(a) Flip (Lunar Day)		+4.3	----	----	+2.4	+2.4
(b) Flip (Lunar Night)		-1.3	----	----	+2.4	+2.4
(c) Survey (Lunar Day)		+4.5	----	----	+1.0	+1.0
(d) Survey (Lunar Night)		-0.6	----	----	+1.0	+1.0
HFE						
(a) Mode II (Lunar Day)		----	----	+0.5	+0.5	+0.5
(b) Mode II (Lunar Night)		----	----	+0.4	+0.4	+0.4
(c) Mode III (Lunar Day)		----	----	+1.8	+1.8	+1.8
ASE**						
(a) Warm up (Lunar Night)	All other Expts	----	-6.6	----	-6.5	
(b) Operate (Lunar Night)	on standby	----	-9.4	----	-8.2	
(c) Operate (Lunar Day)	except LSM	----	-1.9	----	+5.4	
(d) Warm up (Lunar Night)	All	----	+4.3	----	+4.3	
(e) Operate (Lunar Night)	Expts	----	+2.6	----	+2.6	
(f) Operate (Lunar Day)	operating	----	+5.7	----	+5.7	

TABLE VII ALSEP SYSTEM POWER DEMANDS (CONTINUED)

System Mode	Array A	Array C	Array A2	Array D	Array E
PSE					
(a) Leveling (Lunar Night)	+1.3	-2.3	-2.1	-2.1	
(b) Leveling (Lunar Day)	+3.9	+3.9	+3.4	+3.4	
LSG					
(a) Beam Adjustment (Lunar Day)	----	----	----	----	+2.4
(b) Beam Adjustment (Lunar Night)	----	----	----	----	+2.4

*'Intermittent Mode 'minus' Normal Operation"

** ASE is always in standby and all other expts operating except as noted in ASE Intermittent Modes.