

**Aerospace  
Systems Division**

Command List (Array E)

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This listing of command allocations is applicable to ALSEP Array E,  
with the following complement of experiments:

Lunar Surface Gravimeter  
Lunar Ejecta and Meteorite  
Lunar Seismic Profiling  
Lunar Mass Spectrometer  
Heat Flow

R. MILEY  
BxA/MS

In the alternative Array E PSE is substituted for LSG; the commands  
for PSE are listed in Appendix I.

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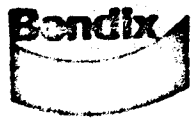
TABLE 1

<u>Symbol</u>	<u>Command Nomenclature</u>	<u>Octal Command</u>	<u>Termination Point</u>
CD-32	DP Formatting ON <sup>1</sup>	005	Data Processor
CD-33	Normal Bit Rate <sup>1, 3</sup>	006	" "
CD-34	Slow Bit Rate <sup>3</sup>	007	" "
CD-38	LSP Formatting ON	011	" "
CD-39	Transmitter A ON <sup>2</sup>	012	Power Dist. Unit
CD-40	Transmitter A OFF	013	" " "
CD-41	Transmitter B OFF <sup>2</sup>	014	" " "
CD-42	Transmitter B ON	015	" " "
CD-5	PDR #1 ON	017	" " "
CD-6	PDR #1 OFF <sup>2</sup>	021	" " "
CD-7	PDR #2 ON	022	" " "
CD-8	PDR #2 OFF <sup>2</sup>	023	" " "
CD-43	SELECT ADP X <sup>2</sup>	024	" " "
CD-44	SELECT ADP Y	025	" " "
CD-47	Ripple OFF Reset <sup>1</sup>	032	Command Decoder
CD-11	DDP X Select <sup>2</sup>	034	Power Dist. Unit
CD-12	DDP Y Select	035	" " "
CD-13	Experiment 1 Power ON	036	" " "
CD-14	Experiment 1 Power Standby	037	" " "
CD-15	Experiment 1 Power OFF <sup>2</sup>	041	" " "
CD-16	Experiment 2 Power ON	042	" " "
CD-17	Experiment 2 Power Standby	043	" " "

<sup>1</sup> Preset turn-on operating mode.

<sup>2</sup> Lunar surface initial conditions programmed in during final system checkout.

<sup>3</sup> Changes bit rate at end of ALSEP frame during which command is executed.



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<u>Symbol</u>	<u>Command Nomenclature</u>	<u>Octal Command</u>	<u>Termination Point</u>
CD-18	Experiment 2 Power OFF <sup>2</sup>	044	Power Dist. Unit
CD-19	Experiment 3 Power ON	045	" " "
CD-20	Experiment 3 Power Standby	046	" " "
CD-21	Experiment 3 Power OFF <sup>2</sup>	050	" " "
CD-22	Experiment 4 Power ON	052	" " "
CD-23	Experiment 4 Power Standby	053	" " "
CD-24	Experiment 4 Power OFF <sup>2</sup>	054	" " "
CD-25	EXP 5 Power ON	055	" " "
CD-26	EXP 5 Power STANDBY	056	" " "
CD-27	EXP 5 Power OFF <sup>2</sup>	057	" " "
CD-36	Periodic Commands Enable <sup>1</sup>	104	Command Decoder
CD-37	Periodic Commands Inhibit	105	" "
CD-51	ADP Relay Reset <sup>2</sup>	107	Power Dist. Unit
CD-50	Uplink/ADP Relay Reset <sup>2</sup>	110	" " "
CD-48	Switch Uplink	122	Command Decoder
CD-49	Delay Uplink Switchover <sup>5</sup>	174	" "
CU-1	APM #1 ON <sup>1</sup>	027	Power Cond. Unit
CU-2	APM #1 OFF	031	" " "
CU-3	APM #2 ON <sup>1</sup>	115	" " "
CU-4	APM #2 OFF <sup>2</sup>	113	" " "
CU-5	Select PC #1	060	" " "
CU-6	Select PC #2	062	" " "
CU-7	Select PC Auto Switch #1 <sup>2, 6</sup>	120	" " "
CU-8	Select PC Auto Switch #2	121	" " "
CG-1	Slave Heater Power ON	63	Lunar Surface Gravimeter
CG-2	Slave Heater Power OFF	64	" " "
CG-3	Command Execute <sup>4</sup>	67	" " "
CG-4	Command Decoder Power ON	70	" " "



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TABLE 1 (CONT)

<u>Symbol</u>	<u>Command Nomenclature</u>	<u>Octal Command</u>	<u>Termination Point</u>	
CG-5	Command Decoder Power OFF	71	" "	"
CG-6	Step Command Counter UP	72	" "	"
CG-7	Step Command Counter DOWN	74	" "	"
CJ-1 <sup>7</sup>	LEAM Calibrate HIGH/ LOW (Periodic Command)	111	LEAM	
CJ-2	LEAM Mirror Cover Release	112	"	
CJ-3	LEAM Sensor Cover Release	114	"	
CJ-4	LEAM Heater ON/OFF/AUTO	117	"	

<sup>4</sup> See NOTE 1, page 7, for details of encoded LSG commands.

<sup>5</sup> Preset turn-on condition ensures that CD-49 (Octal 174) is not effective.

<sup>6</sup> This violates normal operating requirements. CU-8 (Octal 121) will be transmitted after satisfactory PC#1 turn-on.

<sup>7</sup> Also generated automatically within ALSEP as a pair of commands 4 minutes apart every 15.4 hours, unless inhibited by execution of CD-37 (Octal 105).

TABLE 1 (CONT)

<u>Symbol</u>	<u>Command Nomenclature</u>	<u>Octal Command</u>	<u>Termination Point</u>
CM-1 <sup>8</sup>	LMS Load Command #1	123	LMS Experiment
CM-2	LMS Load Command #2	124	" "
CM-3	LMS Load Command #3	125	" "
CM-4	LMS Load Command #4	127	" "
CM-5	LMS Load Command #5	132	" "
CM-6	LMS Load Command #6	133	" "
CM-7	LMS Execute and Clear	134	" "
CH-1	Normal (Gradient) Mode Select <sup>1</sup>	135	Heat Flow Experiment
CH-2	Low Conductivity Mode Select (Ring Source)	136	" " "
CH-3	High Conductivity Mode Select (Heat Pulse)	140	" " "
CH-4	HF Full Sequence Select <sup>1</sup>	141	" " "
CH-5	HF Probe #1 Sequence Select	142	" " "
CH-6	HF Probe #2 Sequence Select	143	" " "
CH-7	HF Subsequence #1	144	" " "
CH-8	HF Subsequence #2	145	" " "
CH-9	HF Subsequence #3	146	" " "

<sup>8</sup>Encoding of the CM series is described in Note 2, page 9.

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TABLE 1 (CONT)

<u>Symbol</u>	<u>Command Nomenclature</u>	<u>Octal Command</u>	<u>Termination Point</u>
CH-10	HF Heater Advance (Steps through following 16-step sequence, one step per command) All heaters off Probe #1 heater #2 ON All heaters off Probe #1 heater #4 ON All heaters off Probe #1 heater #1 ON All heaters off Probe #1 heater #3 ON	152	Heat Flow Experiment
	All heaters off Probe #2 heater #2 ON All heaters off Probe #2 heater #4 ON All heaters off Probe #2 heater #1 ON All heaters off Probe #2 heater #3 ON repeat		
CS-1	Transmitter Pulses ON	156	LSP Experiment
CS-2	Transmitter Pulses OFF	162	" "
CS-3	Amplifier Gain Normal	163	" "
CS-4	Amplifier Gain Low	164	" "
CS-5	Geophone Calibrate	170	" "



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Note 1

LSG Commands

An expanded command capability is accomplished in the LSG experiment by decoding a 5-Stage, "Up-Down" Command Counter. Thirty of the possible thirty-two states of the counter are used to generate command functions. State of the Counter is read out through the telemetry link.

Three command lines are used to step the command counter (up or down) and to generate a command execute function.

A list of all LSG experiment command counter states and the associated functional command assignments is provided below:

<u>Command Symbol</u>	<u>Binary Count</u>	<u>Command Function</u>
CG-8	00001	Read Shaft Encoder
CG-9	00010	Mass Change Motor ON
CG-10	00011	Bias In
CG-11	00100	Bias Out
CG-12	00101	Integrator, Normal Mode
CG-13	00110	Integrator, Short Mode



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LSG ELECTRONICS COMMAND ASSIGNMENT (CONT)

<u>Symbol</u>	<u>Binary Count</u>	<u>Command Function</u>
CG-14	00111	Seismic Low Gain
CG-15	01000	Seismic High Gain
CG-16	01001	Sensor Beam Caged
CG-17	01010	Sensor Beam Uncaged
CG-18	01011	Coarse Screw Servo ON
CG-19	01100	Tilt, Mass Chg., & Screw Servo OFF
CG-20	01101	Mass Change Increment
CG-21	01110	Pressure Transducer ON
CG-22	01111	Gross Slew Up/ Tilt Increment Up
CG-23	10000	Gross Slew Down/ Tilt Incr. Down
CG-24	10001	Vernier Slew Up
CG-25	10010	Vernier Slew Down
CG-26	10011	Fine Screw Servo ON
CG-27	10100	North/South Tilt Servo ON
CG-28	10101	East/West Tilt Servo ON
CG-29	10110	Temperature Increment
CG-30	10111	Temperature Increment
CG-31	11000	Temperature Increment
CG-32	11001	Temperature Increment
CG-33	11010	Temperature Increment
CG-34	11011	Temperature Increment
CG-35	11100	Temperature Reset
CG-36	11101	Post Amp. Gain Increment
CG-37	11110	Post Amp. Gain Reset





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Note 2

Mass Spectrometer Command Structure

Octal commands 123 through 125, 127, and 132 through 134 inclusive, are encoded in specific sequences to provide 15 discrete commands for the Mass Spectrometer Experiment, as follows:

<u>Symbol</u>	<u>Function</u>	<u>Sequence</u>						
		123	124	125	127	132	133	134
CA-1	Step Mult, Sweep HV ON & Back-up Htr OFF	X	X					X
CA-2	Lock (Sweep Hold) & J- Plate Voltage Step	X		X				X
CA-3	One-Step (Sweep Advance)	X			X			X
CA-4	*Emission/Filaments OFF	X				X		X
CA-5	Filament #1 ON	X					X	X
CA-6	Filament #2 ON		X	X				X
CA-7	Mult High & Back-up Htr ON		X		X			X
CA-8	*Mult Low		X			X		X
CA-9	Disc High & J-Plate Voltage Step Enable		X				X	X
CA-10	*Disc Low & J-Plate Voltage Step Inhibit			X	X			X
CA-11	Bakeout Enable <sup>2</sup>			X		X		X
CA-12	*Bakeout Disable			X			X	X
CA-13	Dust Cover Removal				X	X		X
CA-14	Ion Pump ON <sup>1</sup>				X		X	X
CA-15	*Ion Pump, Mult, and Sweep HV OFF					X	X	X

\* Preset Turn-On Operating Mode.

1 This command is inhibited if CA-1 is one, and CA-15 command must precede CA-14 in this case. CA-1 is not inhibited if CA-14 is on.

2 After this command the LMS must be commanded to standby to perform bakeout.



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Note 3

Heat Flow Command Structure

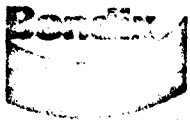
Octal commands 144 through 146 are used to select subsets of the full heat flow measurement sequence as follows:

Command 144 selects a subset consisting of the four high sensitivity gradient measurements only.

Command 144 followed by command 145 selects a subset consisting of the four low sensitivity gradient measurements only.

Command 144 followed by command 146 selects a subset consisting of probe ambient temperature measurements only.

Command 145 followed by command 146 selects a subset consisting of thermocouple measurements only.



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TABLE 2

COMMAND SUMMARY

Termination Point	Number of Commands
Power Distribution Unit (Power Switching)	29
Power Conditioning Unit	8
Command Decoder	5
Data Processor	4
Lunar Surface Gravimeter Experiment	7
Mass Spectrometer Experiment	7
Heat Flow Experiment	10
Seismic Profiling Experiment	5
Lunar Ejecta and Meteoroid Experiment	4
Total	79

<u>Function</u>	<u>Octal Code</u>	<u>Number</u>
Test Commands	1, 2, 4, 10, 20, 40, 100, 77, 137, 157 <sup>1</sup> , 167 <sup>1</sup> , 173 <sup>1</sup> , 175, 176 <sup>1</sup>	14
ALSEP Addresses	130, 30, 116, 16, 151 <sup>2</sup> , 25 <sup>3</sup> , 65 <sup>3</sup> , 62 <sup>3</sup> , 144 <sup>3</sup>	9
Address Complements	47, 147, 61, 161, 26, 152 <sup>4</sup> , 112 <sup>4</sup> , 115 <sup>4</sup> , 33 <sup>5</sup>	9
No Command	0, 177, 51 <sup>6</sup> , 126 <sup>6</sup>	4
Commands Assigned to Array E		79
Commands Exclusively Reserved for Other Usage		27
Available Commands Not Assigned in Array E <sup>7</sup>		<u>22</u>
Total Available Encodings of 7-Bits		128

<sup>1</sup> 157, 167, 173 and 176 are contingency spare commands, not current assigned.  
<sup>2</sup> Address for Array E is 151. (Only one address is used on Array E)  
<sup>3</sup> 25, 65, 62 and 144 are assigned Array E commands.  
<sup>4</sup> 152, 112 and 115 are assigned Array E commands.  
<sup>5</sup> 33 is a contingency spare command, not currently assigned.  
<sup>6</sup> 051 is an unused ALSEP address, 126 its complement.  
<sup>7</sup> Fourteen of these 22 available commands can be assigned without restriction. The remaining 8 can be used as spares in the prime array, but must be used for PSE in the alternative Array E. (See Appendix I)



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TABLE 3

CROSS REFERENCE OF COMMAND NUMBER TO COMMAND FUNCTION

Octal Command	Array E Command Symbol	Test Cmds.	Address	Address Complement	No Command	Not Assigned	Reserved for alternative array
1		X					
2		X					
3							
4		X					X
5	CD-32						
6	CD-33						
7	CD-34						
10		X					
11	CD-38						
12	CD-39						
13	CD-40						
14	CD-41						
15	CD-42						
16			X				
17	CD-5						
20		X					
21	CD-6						
22	CD-7						
23	CD-8						
24	CD-43						
25	CD-44		(X)				
26					X		

NOTE: (X) denotes dual usage



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TABLE 3 (CONT)

Octal Command	Array E Command Symbol	Test Cmds.	Address	Address Complement	No Command	Not Assigned	Reserved for alternative array
27	CU-1						
30			X				
31	CU-2						
32	CD-47						
33				(X)		(X)	
34	CD-11						
35	CD-12						
36	CD-13						
37	CD-14						
40		X					
41	CD-15						
42	CD-16						
43	CD-17						
44	CD-18						
45	CD-19						
46	CD-20						
47				X			
50	CD-21						
51						X	
52	CD-22						
53	CD-23						
54	CD-24						
55	CD-25						
56	CD-26						



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TABLE 3 (CONT)

Octal Command	Array E Command Symbol	Test Cmds.	Address	Address Complement	No Command	Not Assigned	Reserved for alternative array
57	CD-27						
60	CU-5						
61				X			
62	CU-6		(X)				
63	CG-1						
64	CG-2						
65			(X)				(X)
66						X <sup>1</sup>	
67	CG-3						
70	CG-4						
71	CG-5						
72	CG-6						
73						X <sup>1</sup>	
74	CG-7						
75						X <sup>1</sup>	
76						X <sup>1</sup>	
77		X					
100		X					
101						X <sup>1</sup>	
102						X <sup>1</sup>	
103						X <sup>1</sup>	
104	CD-36						

NOTE: (X) denotes dual usage

<sup>1</sup>Spare in primary array only. Use for PSE in alternative array



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TABLE 3 (CONT)

Octal Command	Array E Command Symbol	Address	Address Complements	No Command	Not Assigned	Reserved for alternative array
105	CD-37					
106					X	
107	CD-51					
110	CD-50					
111	CJ-1					
112	CJ-2		(X)			
113	CU-4					
114	CJ-3					
115	CU-3		(X)			
116		X				
117	CJ-4					
120	CD-7					
121	CD-8					
122	CD-48					
123	CM-1					
124	CM-2					
125	CM-3					
126				X		
127	CM-4					
130		X				
131						X
132	CM-5					

NOTE: (X) denotes dual usage



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TABLE 3 (CONT)

Octal Command	Array E Command Symbol	Test Cmds.	Address	Address Complements	No Command	Not Assigned	Reserved for alternative array
133	CM-6						
134	CM-7						
135	CH-1						
136	CH-2						
137		X					
140	CH-3						
141	CH-4						
142	CH-5						
143	CH-6						
144	CH-7		(X)				
145	CH-8						
146	CH-9						
147				X			
150						X	
151			X				
152	CH-10		(X)	(X)			
153						X	
154						X	
155						X	
156	CS-1						
157		(X)				(X) <sup>2</sup>	
160						X	

NOTE: (X) denotes dual usage

<sup>2</sup>Contingency spare.





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TABLE 3 (CONT)

Octal Command	Array E Command Symbol	Test Cmds.	Address	Address Complement	No Command	Not Assigned	Reserved for alternative array	
161				X				
162	CS-2							
163	CS-3							
164	CS-4							
165						X		
166						X		
167		(X)				(X) <sup>2</sup>		
170	CS-5							
171						X		
172						X <sup>1</sup>		
173		(X)				(X) <sup>2</sup>		
174	CD-49							
175		X						
176		(X)				(X) <sup>2</sup>		
177					X			
000					X			
<u>Totals</u>		<u>79</u>	<u>14</u>	<u>9</u>	<u>9</u>	<u>4</u>	<u>22</u>	<u>3</u>

NOTE: (X) denotes dual usage.

<sup>2</sup>Contingency spare.





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APPENDIX 1 (CONT.)

<u>Symbol</u>	<u>Command Nomenclature</u>	<u>Octal Command</u>	<u>Termination Point</u>
CL-15	Leveling Mode <sup>2</sup> Auto <sup>1</sup> /Manual	103	Passive Seismic Exp.
CL-16	Redundant CL-3 and CL-9 <sup>5</sup>	172	" " "

<sup>1</sup> Preset turn-on operating mode.

<sup>2</sup> Manual leveling sequence is as follows: Send CL-15 to change from auto to manual leveling mode, change direction, and speed by CL-10 and CL-11 as necessary, and then execute leveling operation by sending appropriate leveling motor commands, CL-6, CL-7, or CL-8. Leveling operation is terminated by retransmission of CL-6, CL-7, or CL-8.

<sup>3</sup> Sequence of command is auto on<sup>1</sup>/auto off/manual on/manual off.

<sup>4</sup> Calibration and Uncage steps are initiated automatically at 15.4-hour intervals by the periodic command counter, unless this feature has been inhibited by execution of CD-37 (Octal 105).

<sup>5</sup> CL-16 (Octal 172) is used to provide a suitable termination for the unused timer input. In normal operation Octal 172 will not be transmitted. In the event that CL-3 (Octal 065) and/or CL-9 (Octal 073) fail then CL-16 (Octal 172) provides a redundant command route.

NOTE: In the alternative Array E, with PSE in place of LSG, there are fourteen spare commands, of which four are primarily test commands and should be used only when all others have been allocated (See Note 7, Page 11 and Table 3, Pages 14 and 17).