	ATM-930 D
Command List (Array E)	PAGE OF
	DATE 8 March 1972

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

- #1 Lunar Mass Spectrometer
- #2 Lunar Ejecta and Meteorites
- #3 Heat Flow

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- #4 Lunar Surface Gravimeter
- #5 Lunar Seismic Profiling

Prepared by: D. J. Thomas

Approved by: Hiltian

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### TABLE 1

Symbol	Command Nomenclature	Octal Command	Terminati Point	0 <b>n</b>
Symbol	Command Nomenciature	Command		
CD-32	DP Formatting ON <sup>1, 3</sup>	005	Data Proc	essor
CD-33	Normal Bit Rate <sup>1,3</sup>	006	11 11	
CD-34	Slow Bit Rate <sup>3</sup>	007	· n n	
CD-38	LSP Formatting ON <sup>3</sup>	003	11  1	
CD-39	Transmitter A ON <sup>22</sup>	012	Power Dis	t. Unit
CD-40	Transmitter A OFF	013	11 11	11
CD-41	Transmitter B OFF <sup>2</sup>	014	11 71	11
CD-42	Transmitter B ON	015	11 58	11
CD-5	PDR #1 ON	017	11 11	11
CD-6	PDR #1 OFF <sup>2</sup>	021	11 11	FT
CD-7	PDR #2 ON	022	11 - 11	11
CD-8	PDR $\#2$ OFF $^2_2$	023	19 19	11
CD-43	ADP X Select <sup>2</sup>	024	11 11	11
CD-44	ADP Y Select	025	11 11	11
			95 6.	
CD-47	Ripple-off Reset <sup>1</sup>	032	Command	Decoder
CD-11	DDP X Select <sup>2</sup>	034	Power Dis	st. Unit
CD-12	DDP Y Select	035	11 11	11
CD-13	Experiment 1 Power ON	036	17 11	11
CD-14	Experiment 1 Power Standby	037	11 11	11
CD-15	Experiment 1 Power OFF <sup>2</sup>	041	11 11	17
CD-16	Experiment 2 Power ON	042	11 11	11
CD-17	Experiment 2 Power Standby	043	11 11	11

<sup>1</sup> Automatically selected at turn-on.

<sup>2</sup>Lunar surface initial conditions preset by latching relays during final system checkout.

<sup>3</sup>Change occurs at end of ALSEP frame during which command is executed.

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# TABLE 1 (CONT)

Symbol	Command Nomenclature	Octal Command	Termin Poi		
CD-18	Experiment 2 Power OFF <sup>2</sup>	044	Power		- Unit
CD-19	Experiment 3 Power ON	045			11
CD-20	Experiment 3 Power Standby	046	11	11	. 11
CD-21	Experiment 3 Power OFF <sup>2</sup>	050	11	11	11
CD-22	Experiment 4 Power ON	052	11	11	11
CD-23	Experiment 4 Power Standby	053	11	51	11
CD-24	Experiment 4 Power OFF <sup>2</sup>	054	11	11	11
CD-25	Experiment 5 Power ON	055	11	11	11
CD-26	Experiment 5 Power STANDBY <sup>2</sup>	05 <b>6</b>	11	11	11
CD-27	Experiment 5 Power OFF	05 <b>7</b>	11	11	17
CD-36	Periodic Commands Enable <sup>1</sup>	104	Comm	and D	ecod <b>er</b>
CD-37	Periodic Commands Inhibit	105	11		11
CD-51	ADP Power Relay X Select	107	Power	Dist.	Unit
CD-50	Uplink/ADP Power Relay W Select <sup>2</sup>	110	11	11	11
CD-48	Switch Uplink 9	122	Comm	and D	ecoder
CD-49	Delay Uplink Switchover <sup>2</sup>	174	. 11		13
CU-1	APM #1 ON <sup>1</sup>	027	Power	Cond	. Unit
CU-2	APM #1 OFF	031	5.8	11	11
C <b>U-3</b>	APM #2 ON <sup>1</sup>	115	11	11	11
<b>CU-4</b>	APM #2 OFF	113	11	TE	11
CU-5	PC #1 Select <sup>2</sup>	060	11	11	11
CU-6	PC #2 Select	062	11	13	11
CU-7	PC #2 Select 2, 6 PC Auto Select #1	120	11	11	11
CU-8	PC Auto Select #2	121	11	11	11
CG-1	Slave Heater Power ON	63		Surfa	ce Gravimeter
CG-2	Slave Heater Power OFF	64	11	11	
CG-3	Command Execute <sup>4</sup>	67	11	11	11
CG-4	Command Decoder Power ON <sup>10</sup>	. 70	11	11	11
<sup>1,2</sup> See F		), 10 See Page 4.			

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#### TABLE 1 (CONT)

Symbol	Command Nomenclature	Octal Command	Termin Poin		
CG-5	Command Decoder Power OFF	71	11	н	11
CG-6	Step Command Counter UP	72	11	H	11
CG-7_	Step Command Counter DOWN	74		11	11
CJ-1	LEAM Calibrate HIGH/LOW (Periodic Command)	111	LEAM		
CJ-2	LEAM Mirror Cover Release	112	11		
CJ-3	LEAM Sensor Cover Release	114	**		
CJ-4	LEAM Heater ON/OFF/AUTO	117	11		

4 See NOTE 1, page 7, for details of encoded LSG commands.

<sup>5</sup>Automatic reset at turn-on ensures that CD-49 (Octal 174) is not effective until commanded.

<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 3.5 minutes apart, every 15.4 hours, unless inhibited by execution of CD-37 (Octal 105).

<sup>9</sup>Also generated automatically within ALSEP 7.6 hours after turn-on, then every 61.8 hours, unless each potential switch is inhibited by the prior transmission of CD-49 (Octal 174). It is not possible to permanently inhibit the automatic generation of CD-48 (Octal 122) except by the regular transmission of CD-49 at intervals not exceeding 61.8 hours.

<sup>10</sup>Transmission of command CG-4 will also clear the LSG command counter to 00000 (binary).

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## TABLE 1 (CONT)

Symbol	Command Nomenclature	Octal Command		ination oint	n
CM(-1 <sup>8</sup>	LMS Load Command #1	123	LMS	Experi	iment
CM-2	LMS Load Command #2	124	H	-	17
CM-3	LMS Load Command #3	125	11		11
CM-4	LMS Load Command #4	127	11		11
CM-5	LMS Load Command #5	132	11		H
CM-6	LMS Load Command #6	133	H		11
CM-7	LMS Execute and Clear	134	11		11
CH-1	Normal (G <b>rad</b> ient) Mode Select <sup>1</sup>	135	Heat	Flow I	Experiment
CH-2	Low Conductivity Mode Select (Ring Source)	136	11	11	- 11
CH-3	High Conductivity Mode Select (Heat Pulse)	i 4 <b>140</b>	11	11	, H
CH-4	HF Full Sequence Select <sup>1</sup>	141	11	11	11
CH-5	HF Probe #1 Sequence Select	142	11	п	11
CH-6	HF Probe #2 Sequence Select	143	11	11	11
CH-7	HF Subsequence #1 Command	144	11	11	11
CH-8	HF Subsequence #2 Functions as shown	145	11	11	11
CH-9	HF Subsequence #3 J in Note 3	146	13	11	11

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

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				Octal	Terminat	ion	
	Symbol	Command Nomenclature		Command	Point		
	CH-10	HF Heater Advance (Steps 16-step sequence, one step	p per command)	152	Heat Flow	v Experiment	
		All heaters off Probe #1 heater #2 ON All heaters off	All heaters off Probe #2 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	Probe #2 heater #4 ON All heaters off Probe #2 heater #1 ON All heaters off Probe #2 heater #3 ON				
			repeat				
	CS-1 CS-2 CS-3 CS-4 CS-5	Transmitter Pulses ON Transmitter Pulses OFF Amplifier Gain Normal Amplifier Gain Low Geophone Calibrate		156 162 163 164 170	LSP Expe '' '' ''	riment	
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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:

Command Symbol	Binary Count	Command Function		
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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Command List (Array E)

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## LSG ELECTRONICS COMMAND ASSIGNMENT (CONT)

Symbol	Binary Count	Command Function
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 & Press Trans. OF
CG-20	01101	Pressure Tranducer ON
CG-21	01110	Mass Change Increment
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	Tem <b>perat</b> ure Relay #1
CG-30	10111	Temperature Relay #2
CG-31	11000	Temperature Relay #3
CG-32	11001	Temperature Relay #4
CG-33	11010	Temperature Relay #5
CG-34	11011	Temperature Relay #6
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

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#### 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:

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

\* Preset Turn-On Operating Mode.

- 1 This command is inhibited if CA-1 is on, 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.

3 Mutually inhibited. CA-4 must be sent to switch filaments.

Entry Into the Cyclic Mode in which the filament bias is cycled through -70, -25, -20 and -18 Volt D. C; send the command sequence:

CA -4; CA -9; CA -10; CA -5 or CA--6; CA -1.

CA -4 is only necessary if the filaments are initially ON.

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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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#### Command Availability and Usage, and Test Commands

Command usage is summarized in Table 2, and is also displayed for all the 128 potential commands, which could be derived from the seven bit command word, in Table 3. The command functions shown in Table 3 are determined by the Command Decoder design; 104 commands are physically decoded, of which 79 are currently used to control the system.

All 25 spare command outputs are available at the Command Decoder connectors and 19 of these spares could be used without restriction. The remaining six spares have the following limitations:

> (a) Unless inhibited, Octal Commands 065 and 131 are pulsed automatically once every 15.4 hours, in addition to any ground transmissions. (See Octal Command 111, Page 4.)

(b) Octal Commands 157, 167, 173 and 176 are primarily intended to be test commands (see below). They will not be used for system control until all other spares have been used.

All the spare outputs, except those for Octal Commands 011, 033 and 106, are rise- and fall-time controlled to between 2 microseconds and 10 microseconds.

Test commands are the fourteen Octal numbers which in their binary equivalents have only one '1' or one '0', in all the possible positions. They can be transmitted, as required, to diagnose possible faults in the parity check and CVW circuits. Since most of the test commands are not physically decoded, and the four that are decoded are not used, there is no possibility of a test command in normal fault-free operation causing a system status change.

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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 4 7 7 10 5		
Data Processor				
Lunar Surface Gravimet	er Experiment			
Mass Spectrometer Exp	eriment			
Heat Flow Experiment				
Seismic Profiling Exper	iment			
Lunar Ejecta and Meteo	roid Experiment	4		
	Total	79		
Function	Octal Code		Number	
Test Commands	1, 2, 4, 10, 20, 40, 100, 77 173 <sup>1</sup> , 175, 176 <sup>1</sup>	10	14	
ALSEP Addresses	130, 30, 116, 16, 151 <sup>2</sup> , 25 47, 147, 61, 161, 26, 152 <sup>3</sup>	$^{3}, 65^{4}, 62^{3}, 144^{3}$	9	
Address Complements	47, 147, 61, 161, 26, 152 <sup>3</sup>	$112^3$ $115^3$ $33^4$	9	
Never used as command	0, 177		2	
Commands Assigned to A			79	
Commands Exclusively I	Reserved for Other Usag	e or not Decoded	24	
Available Commands No			25_	
Total Available En		128		

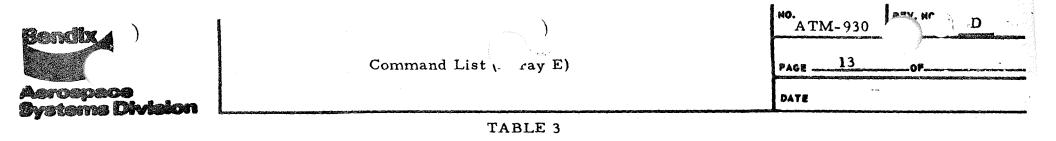
1157, 167, 173 and 176 are also spare commands.

<sup>2</sup>Address for Array E is 151. (Only one address is used on Array E)

<sup>3</sup> These ALSEP Addresses and Address complements are also used as assigned Array E commands.

<sup>4</sup>33 and 65 are also decoded spare commands, not currently assigned.

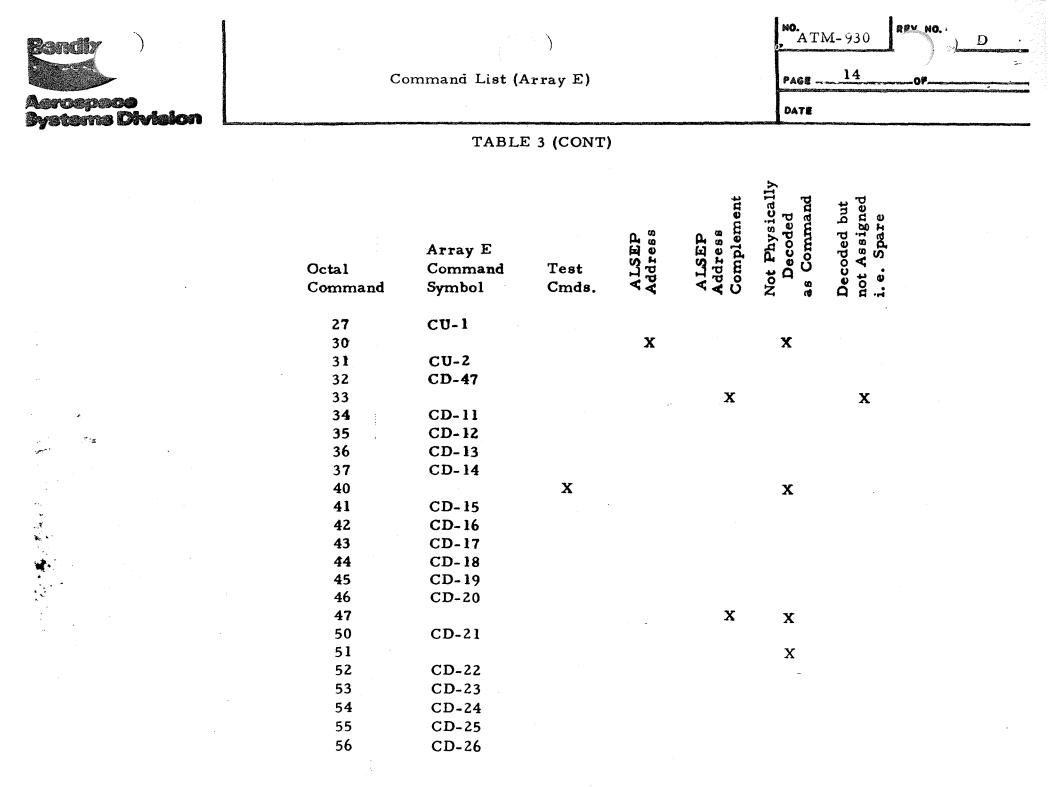
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## CROSS REFERENCE OF COMMAND NUMBER TO COMMAND FUNCTION

Octal Command	Array E Command Symbol	Test Cmds.	ALSEP Address	ALSEP Address Complement	Not Physically Decoded as Command Decoded but Not Assigned	i.e. Spare
1		x			х	
2 3		X			X	
3	CD-38					
4		x			x	
5 6 7	CD-32					
6	CD-33					
	CD-34					
10		х			x	
11					x	
12	CD-39					
13	CD-40					
14	CD-41					
15	CD-42					
16			Х		х	
17	CD-5			•		
20		X			х	
21	CD-6					
22	CD-7					
23	CD-8					
24	CD-43					
25	CD-44		Х			
26				X	X	

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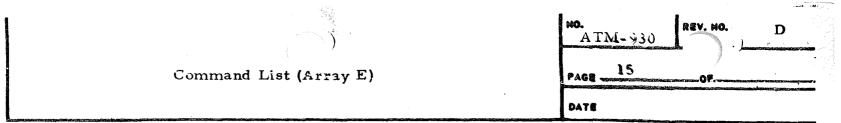
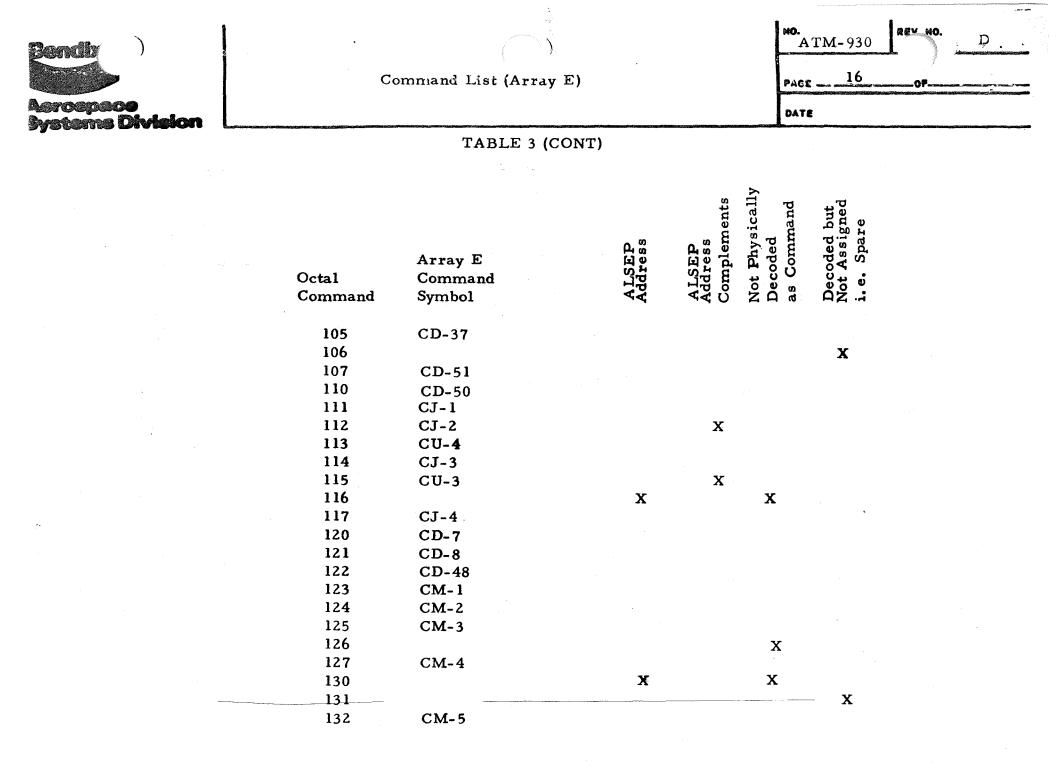
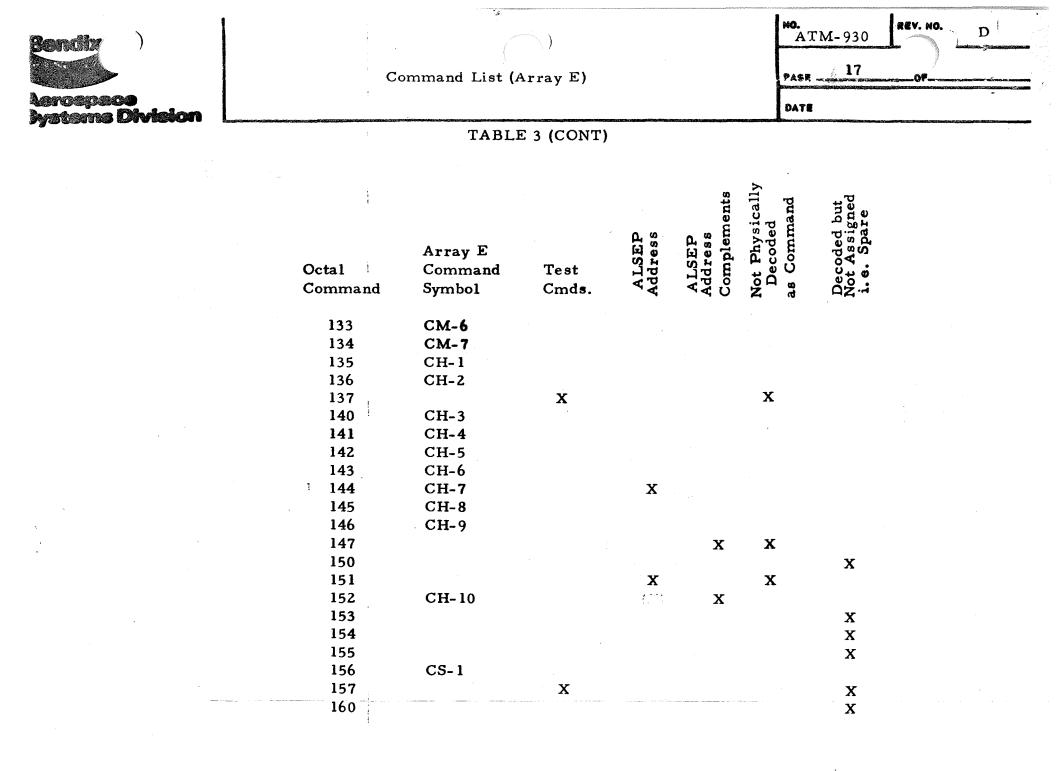


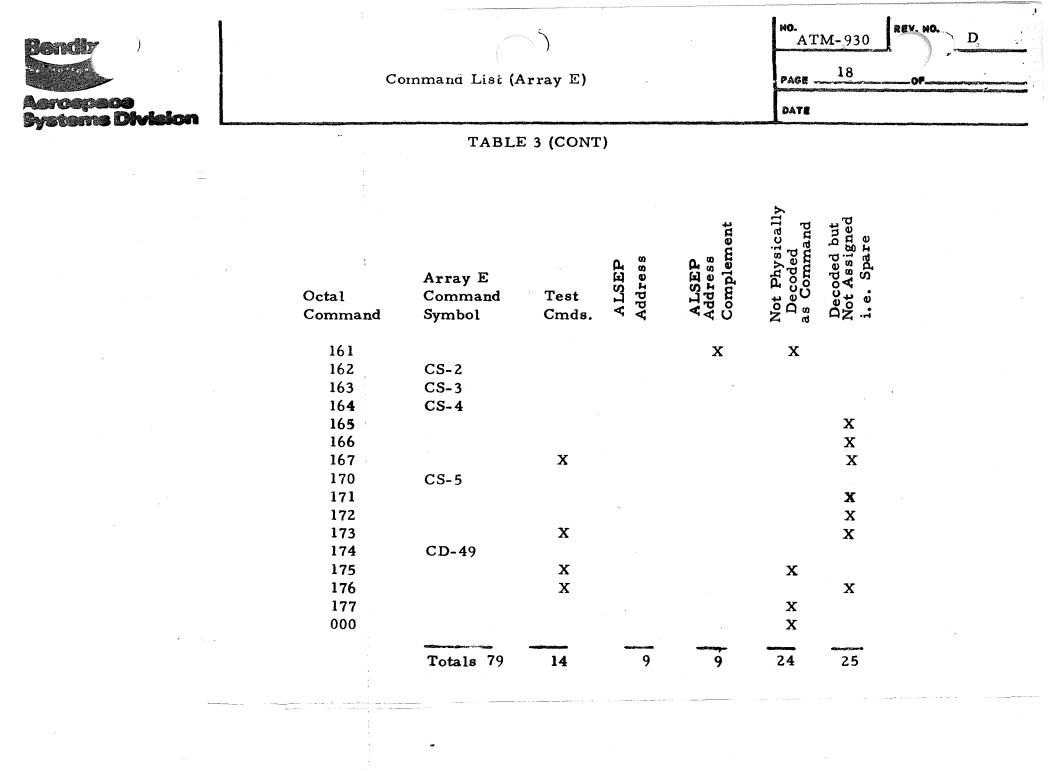
TABLE 3 (CONT)

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Octal Command	Array E Command Symbol	Test Cmds.	ALSEP Address	ALSEP Address Complement	Not Physically Decoded as Command	Decoded but Not Assigned i.e. Spare
57	CD-27					
60	CU-5					
61				X	х	
62	. CU-6		х			
63	CG-1					
64	CG-2					
65			Х			X
66						Х
67	CG-3					
70	CG-4					
71	CG-5					
72	CG-6					
73						Х
74	CG-7					
75		•				Х
76						X
77		X			X	
100		X			х	
101						X
102						x
103						X
104	CD-36					









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#### Command List (Array E)

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#### Command Verification Word Generation

In the Data Processor Formatting Mode, with a few exceptions, bits 8 thru 14 following the Array E address will always be transmitted via the downlink as a CVW. This applies even if the contents of the command register are not capable of being decoded to give an Array E command. The parity bit downlinked as part of the CVW (i.e. Message Acceptance Pulse, MAP) simply shows that bits 1 thru 7 following the address were the complement of bits 8 thru 14. It is no way dependent upon whether the command word is physically decoded or has executed to cause a system change.

The exceptions to the normal CVW rule are as follows:

#### Octal Command

1.	003	LSP Formatting ON	CVW will <u>never</u> be transmitted.
2.	005 006 007	DP Formatting ON Normal Bit Rate Slow Bit Rate	CVW are <u>always</u> transmitted but will not be observed unless the ground system is already in lock i.e., the system is a lready in the required mode or bit rate.
3.	012 013 014 015	Transmitter A ON Transmitter A OFF Transmitter B OFF Transmitter B ON	Any change from "RF carrier" to "no RF carrier", or vice versa, will not give a CVW. If A is ON, and B is switched ON or OFF, then a CVW will be received if the ground system can ride over the random RF carrier phase change. If B is ON, then a CVW should always be received for A ON or A OFF.
4.	in part	switching commands, icular PDR, APM and ment power commands.	Power transients in excess of approximately 10 watts may sometimes cause a loss of CVW, particularly if the Reserve Power is very high or very low. Under normal time- line and operating rules it is possible that no CVW will be lost. Most likely, but not the only candidates are:

022	PDR #2 ON
023	PDR #2 OFF
036)	LMS Power
037 \$	Commands
041	

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	4.			027 031 APM ON/OFF C 115 113 Tendency to CVW loss ten low temperatures.	ration
	5.	034 035	DDP X Select DDP Y Select	If the DDP is already in t then a CVW will always b DDP changeover actually it may be assumed that a received, since the proba change without sync loss less than 1 in 1500.	e received. If a takes place, then CVW will not be bility of a DDP
	6.	122	Switch Uplink	If the uplink actually swite will not be received. If the switch, then a CVW will be	he uplink does not
	7.	060 062	PC #1 Select PC #2 Select	Although it is theoreticall CVW to be received under a PC changeouer will norn CVW. The most likely re a CVW is that the system required state.	c certain conditions, mally not give a eason for receiving

No CVW will be transmitted for any command while the ALSEP System is in LSPE Formatting Mode.