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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO LUNAR SURFACE EXPERIMENTS PACKAGE SYSTEMS HANDBOOK

ALSEP 4

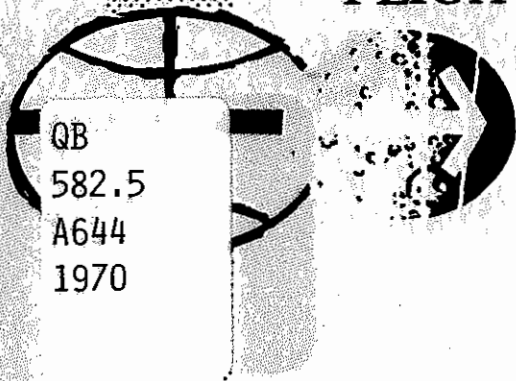
AUGUST 1, 1970

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PREPARED BY

FLIGHT CONTROL DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS



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1 INTRODUCTOR
INFORMATION

2 GENERAL
DESCRIPTION

3 STRUCTURAL
THERM CONTR
SUBSYSTEM

4 ELECTRICAL
POWER
SUBSYSTEM

5 COMMAND
SUBSYSTEM

6 TELEMETRY
SUBSYSTEM

7 DTREM
SUBSYSTEM

8 PASSIVE
SEISMIC
EXPERIMENT

9 ACTIVE
SEISMIC
EXPERIMENT

10 SIDE/CCGE
EXPERIMENT

11 CHARGED
PARTICLE
EXPERIMENT

12 LRRR
EXPERIMENT

13 LUNAR
PORTABLE
MAGNETOMETE

*

APOLLO LUNAR SURFACE EXPERIMENTS PACKAGE SYSTEMS HANDBOOK

ALSEP 4

PREFACE

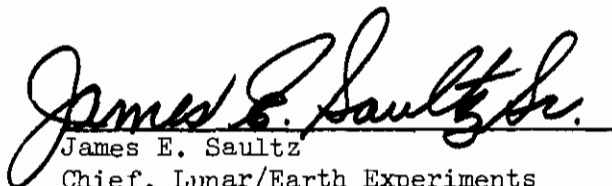
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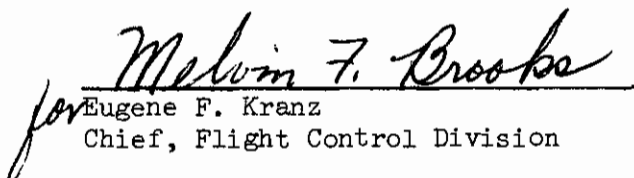
This document is intended for specialized use by Experiment Flight Controllers in real-time and near-real-time operations. This document, in conjunction with the ALSEP Familiarization Handbook, ALSEP MT-03, Rev B, will provide the Experiment Flight Controller with a thorough knowledge of ALSEP 4.

Comments regarding this handbook should be directed to the Experiments Systems Branch. Revisions will be issued as required prior to the flight date.

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Approved by:


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**I INTRODUCTORY
INFORMATION**

SECTION 1
INTRODUCTORY INFORMATION

1.1 ALSEP'S 1, 3, AND 4 ABBREVIATIONS AND ACRONYMS

NOTE

Due to reduction requirements, acronyms which would normally be in lower case, for example, "dc," will appear in upper case on drawings. The text will, however, conform to NASA standards.

ac	alternating current
ACCPT	accept
ACK	acknowledge
A/DC	analog-to-digital converter
Adc	amperes dc
ADD	address
AGC	automatic gain control
ALIGN	alignment
ALSEP	Apollo Lunar Surface Experiments Package
A/F	automatic/forced
AMPS	amperes
ANT	antenna
APP	approximate, approximately
ARM	armed
ASC	ascent
ASE	Active Seismic Experiment
ASI	Apollo standard initiator
AUTO	automatic
AZ	azimuth
B1	bottom location of structure temperature
BAS	base
BER	bit error rate
BPS	bits per second
C	centigrade
CAL	calibrate
CALC	calculated
CB	circuit breaker
CBL	cable
CCGE	Cold Cathode Gage Experiment (part of SIDE on ALSEP 1 and 4, separate MSC experiment on ALSEP 3)
CCGE/A }	analog and digital ID readout from CCGE
CCGE/D }	
CCIG	Cold Cathode Ion Gage (instrument portion of CCGE)
CCW	counterclockwise
CH	channel
CH	change
CHAN	Channeltron; used in CPE as: CHAN/1 Channeltron P/S #1 CHAN/2 Channeltron P/S #2 CHAN/HI Channeltron Voltage Increase ON CHAN/LO Channeltron Voltage Increase OFF
CLD	cold
CMD	command
CNT	count

CNTS	counts
CNTR	counter
COMM	communications
CONV	converter
CPLEE or CPE	Charged-Particle Experiment (full name is Charged-Particle Lunar Environment Experiment)
CPS	cycles per second
CS	central station
CTL	control
CUR	current
CVR	cover
CVR/S	cover and seal (used on SIDE)
CVW	command verification word
CW	clockwise
db	decibels
dbm	decibels with respect to one milliwatt
dc	direct current
DEC	decoder
DECR	decrease
DEF	deflection
DEG	degrees
DESC	descent
DET	detector
DIG	digital
DIR	direction
DIR/V	direction and speed (used on PSE)
DISSIP	dissipation
DLAY	delay
D/P	data processor
DPLY	deploy
DRT	dome removal tool
DSS	Data Subsystem
DSS/A	Analog Data Processor
DSS/D	Digital Data Processor
DSS/PROC	Complete Data Processor (Redundant)
DTREM	Dust, Thermal, and Radiation Engineering Measurements Package
EGFU	Electronics/Gimbal-Flip Unit
ENBL	enable
EPS	Electrical Power System
eV	electron volts
EXP	experiment
EXT	external
F	fuse
F	Fahrenheit
FET	field effect transistor
FILT	filter
FLD	field
FREQ	frequency
FTT	fuel transfer tool
FWD	forward

GDT	gradient sensor delta temperatures (HFE)
GEO	geophone
GLA	Grenade Launch Assembly (a component of ASE)
GMBL	gimbal
GND	ground
GT	gradient sensor ambient temperatures (HFE)
HBR	high bit rate
HE	high explosive (ASE grenades)
HECPA	High-Energy Curved-Plate Analyzer (a component of SIDE)
HFE	Heat Flow Experiment
HI	high
HTR	heater: On HFE there are two cases: HTR/HK High Conductivity Heater HTR/LK Low Conductivity Heater
HS	heat sink
HV	high voltage
Hz	hertz
ID	identification
IN	input
INCR	increase
IND	indication
INHIB	inhibit
INIT	initiate
INST	instrument
INSUL	insulation
INT	internal
K	Kelvin
kbps	kilobits per second
kc	kilocycles
kHz	kilohertz
kV	kilovolts
LAT	latitude
LBR	low bit rate
LECPA	Low-Energy Curved-Plate Analyzer (a component of SIDE)
LDM	limit
LM	Lunar Module
LO	low
LONG	longitude
L/O	local oscillator
LOS	loss of signal
LP	long period (PSE sensors)
LSB	least significant bit
LSD	least significant data
LSM	Lunar Surface Magnetometer
LVL	level
mA	milliampere
mAdc	milliamperes dc
MAP	message acceptance pulse

MAX	maximum
Mc	megacycle
MCC	Mission Control Center
MDE	mode
MEAS	measurement
MeV	million electron volts
MHz	megahertz
MIN	minimum
MOCR	Mission Operations Control Room
MOD	module
MODE	operating modes are defined as follows: <u>For HFE</u> MODE/G gradient mode MODE/HK high conductivity mode MODE/LK low conductivity mode
ms	millisecond
MSB	most significant bit
MSD	most significant data
MSFN	Manned Space Flight Network
MTR	motor; on PSE, the three motors are MTRX, MTRY, and MTRZ
MUX	multiplex or multiplexer
mV	millivolts
mW/cm ²	milliwatts per square centimeter
nA	nanoamperes
N/A	not applicable
NBR	normal bit rate
NEG	negative
NORM	normal
NRZC	Non-Return to Zero Type C (Change)
OPER	operate
O/S	offset
OSC	oscillator
O/T	one-time
OUT	output
PA	power amplifier
pA	picoamperes
PCM	pulse code modulation
PCT	percent
PCU	Power Conditioning Unit
PDM	Power Dissipation Module
PDR	power dissipation resistor
PDU	Power Distribution Unit
PEP	package elapsed time
PHYS	physical; on CPE used as follows: PHYS/AN Physical Analyzer (sensor assembly)
PKG	package
PL	plane
PLT	plate
PM	phase modulation
POS	positive

POSM position
 PRE/LIM prelimiting
 PRE/REG preregulator (a component of the SLIDE power supply)
 PRI primary; on ALSEP used as follows:
 PRI/ST primary structure
 P/S power supply
 PSE Passive Seismic Experiment; also:
 PSE/LP long-period sensors
 PSE/SP short-period sensors
 PSE/LP/SP long- and short-period sensors
 Long-period sensors are further defined as PSE/X, PSE/Y, and PSE/Z, while
 PSE/XY denotes the two horizontal long-period sensors
 PWR power

 R resistor (used as R1 and R2)
 RCVD received
 RCVR receiver
 RDT ring sensor delta temperature (HFE)
 REF reference
 REG regulator (also used as "register" on ALSEP)
 REV reverse
 RF radio frequency
 RLY relay
 R/S remote site
 RST reset
 RT rate (as in BIT RT, CNT RT, etc.)
 RT ring sensor ambient temperatures (HFE)
 RTC real-time command
 RTE real-time event
 RTG Radioisotope Thermoelectric Generator

 SCI scientific
 SEC second
 SEL select
 SEQ sequence, sequential; used on HFE as:
 SEQ/FUL Full Sequence
 SEQ/P1 Probe 1 Sequence
 SEQ/P2 Probe 2 Sequence
 Used on ASE as:
 SEQ/S Sequential Single
 SEQ scientific equipment
 SIDE Suprathermal Ion Detector Experiment; also:
 SIDE/A } analog and digital voltages
 SIDE/D } or readings
 SIDE/HE high-energy data
 SIDE/LE low-energy data
 SIDE/LHE least significant high-energy digital data
 SIDE/LLE least significant low-energy digital data
 SIDE/MHE most significant high-energy digital data
 SIDE/MLE most significant low-energy digital data

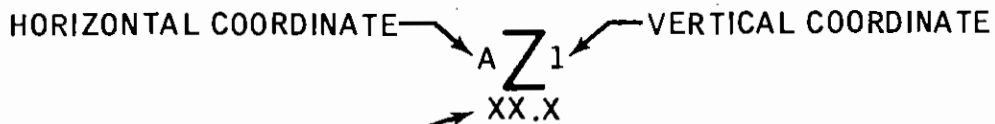
 SIG signal
 SLA Spacecraft Lunar Module Adapter
 SNSR sensor

SP	short period (PSE sensor)
SPST	single pole single throw
STA	status
STBY	standby
S/S	samples per second, signal strength
S/T	structural/thermal
SWS	Solar Wind Spectrometer
SYNC	synchronization
SW	switch
SUP	supply
SYS	system
T	temperature (also used as "thermal" on ALSEP)
TC	thermocouple (on HFE, four cable ambient temperatures are read on each probe)
T/D	time delay
TEMP	temperature
THERM	thermal
TM	telemetry
UHT	Universal Handling Tool
USE	unified S-band
V	volts, velocity (used to indicate "speed" on PSE in "LVL DIR/V")
Vac	volts ac
Vdc	volts dc
VCO	voltage controlled oscillator
V/FILT	Velocity Filter, a component of SLDE
W	watts
W1, W2, W3	wall locations of structure temperature sensors
XMTR	transmitter
XTAL	crystal
XYZ }	axes of LSM, where XYO indicates
XYO }	X, or Y, or neither
φ	phase

1.2 DRAWING SYMBOL STANDARDS

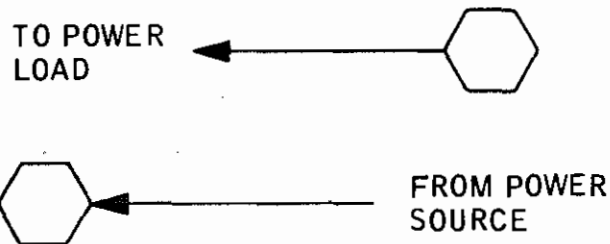
1.2.1 GENERAL DRAWING INFORMATION

A. ZONE REFERENCE

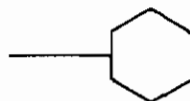


WHEN THIS NUMBER APPEARS IT REFERS TO ANOTHER DRAWING. WHEN THERE IS NO NUMBER THE ZONE REFERS TO ANOTHER AREA ON THE SAME DRAWING.

B. POWER INTRA-DRAWING ZONE REFERENCE



C. SYSTEM INTERCONNECT

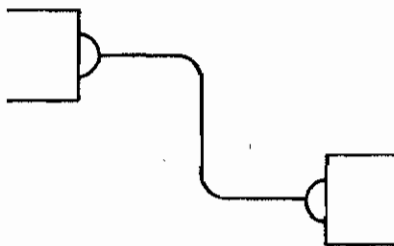


D. DRAWING NOTE REFERENCE



1.2.2 LINE LEGEND

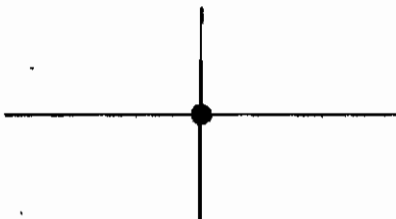
A. RF CABLE



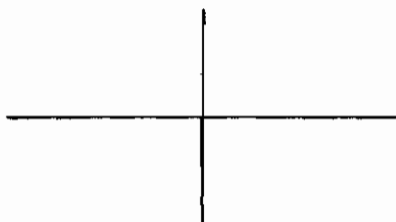
B. ELECTRICAL LINE , POWER AND CONTROL



1. ELECTRICAL , CONNECTED



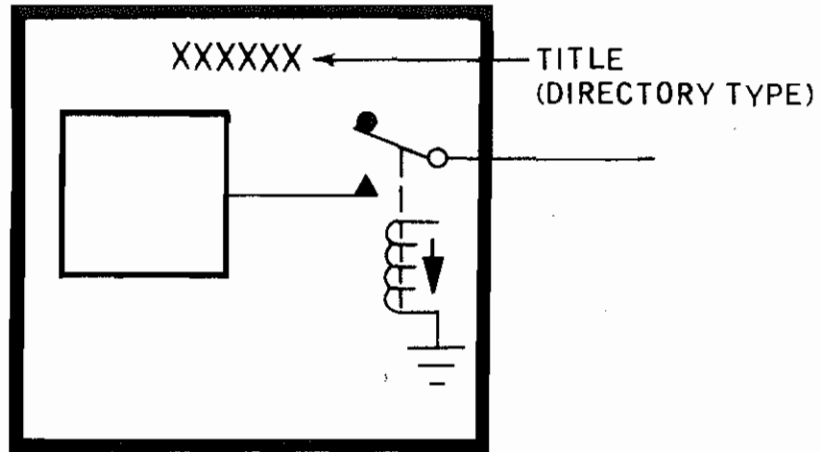
2. ELECTRICAL , CROSSOVER



C. DIRECTIONAL FLOW ARROWS



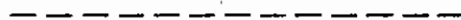
D. COMPONENT ENCLOSURES (TYPICAL)



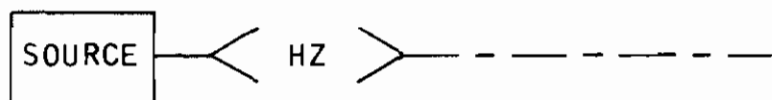
- 1. MAIN ENCLOSURE —————
1/16-INCH SOLID BLACK LINE
- 2. SUB ENCLOSURE —————
1/32-INCH SOLID BLACK LINE
- 3. COMPONENT ENCLOSURE WITH CREW (MANUAL CONTROL) - - - - -
1/16-INCH DASHED BLACK LINE
- 4. EXPERIMENT INTERFACE - - - - -
1/8-INCH DASHED BLACK LINE

EXPERIMENT **ALSEP**

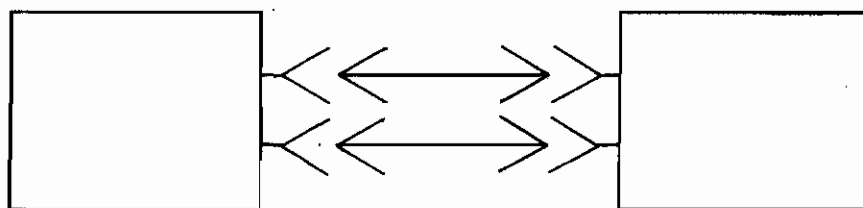
E. MECHANICAL LINKAGE



F. TIMING PULSES

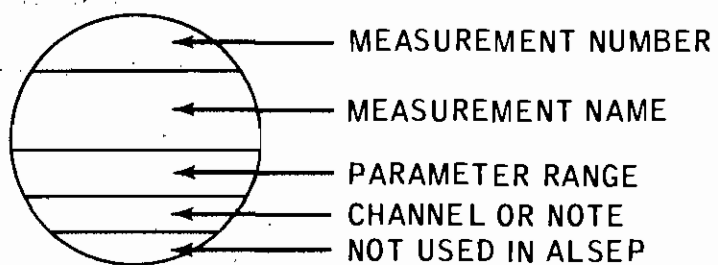


G. TWO-UNIT INTERFACE

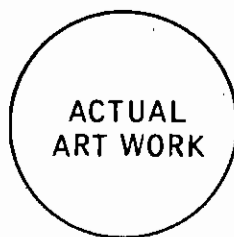


1.2.3 TELEMETRY SYMBOLS

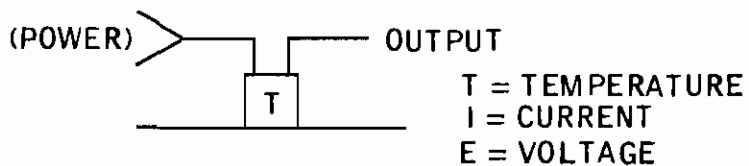
A. MEASUREMENTS TELEMETERED



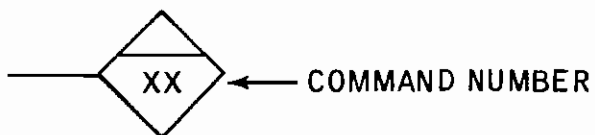
B. METERS



C. SINGLE SOURCE SENSOR



D. COMMANDS



1.2.4 ELECTRICAL SYMBOLS

A. SWITCHES

1. MOMENTARY CONTACT

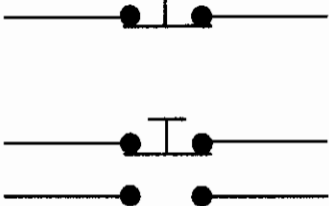


2. LATCHING CONTACT

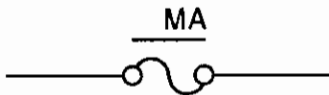


3. SOLID PUSHBUTTON

(PUSH TO OPEN)

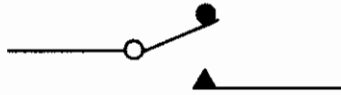


B. FUSES



C. RELAYS

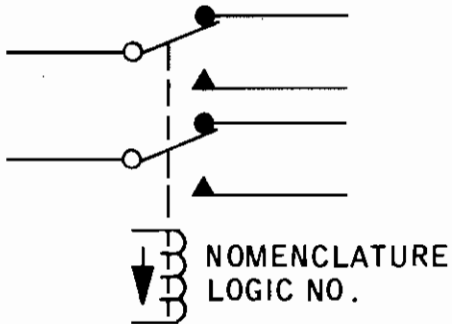
1. MOMENTARY CONTACTS



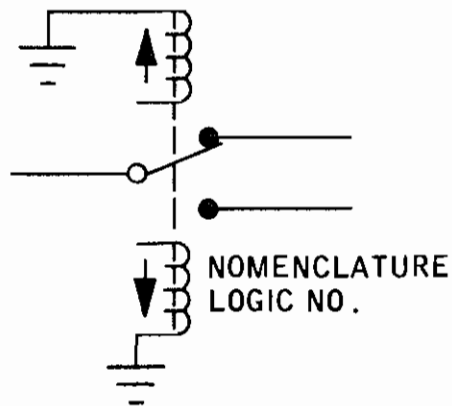
2. LATCHING CONTACTS



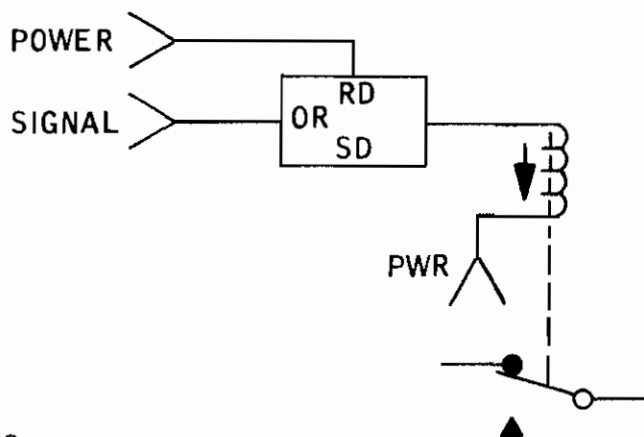
3. NON-LATCHING RELAY SHOWN IN DE-ENERGIZED POSITION



4. LATCHING RELAY

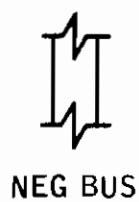
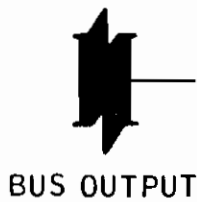


D. RELAY OR SOLENOID DRIVER



E. BUSES

1. SYMBOL (LENGTH MAY VARY)



2. DESIGNATION

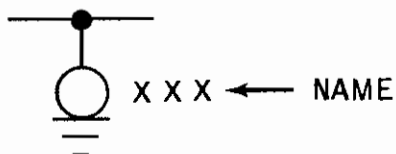


F. GROUNDS

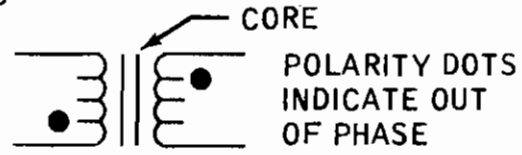
1. SYSTEM



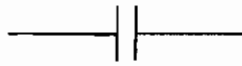
2. FLOATING OR CONTROLLED



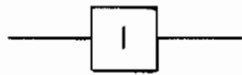
G. TRANSFORMERS



H. CAPACITOR

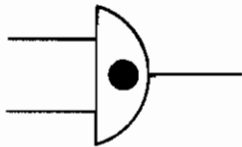


I. DIGITAL INVERTER

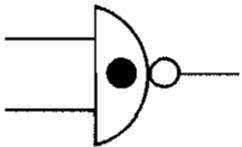


J. GATES

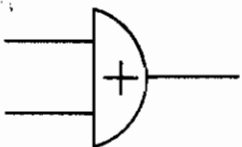
1. AND



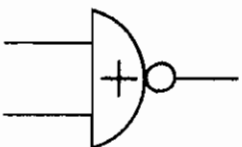
2. NAND



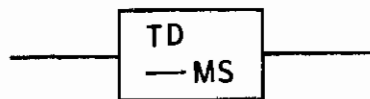
3. OR



4. NOR



K. TIME DELAY



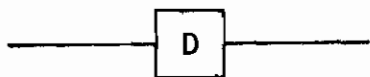
L. ELECTRICAL FILTER



M. MODULATOR

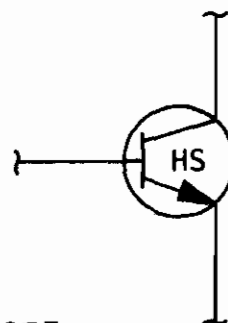


N. DEMODULATOR



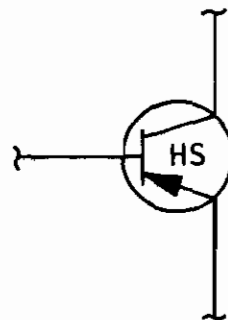
O. TRANSISTORS

1. NPN



NOTE: WHEN SHOWN, HS DENOTES HEAT SINK MOUNTED.

2. PNP



P. NON-AMPLIFYING DEVICE, IDENTIFIED



Q. DIODES

1. GENERAL



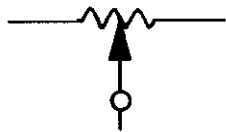
2. ZENER



3. CONTROL RECTIFIER



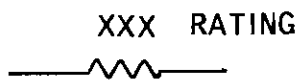
R. POTENTIOMETER



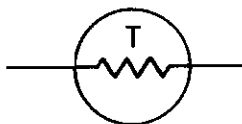
S. HEATER



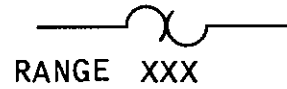
T. FIXED RESISTOR



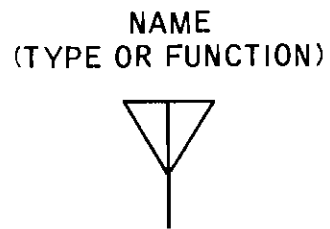
U. THERMISTOR



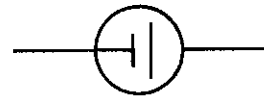
V. THERMOSTAT



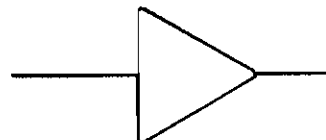
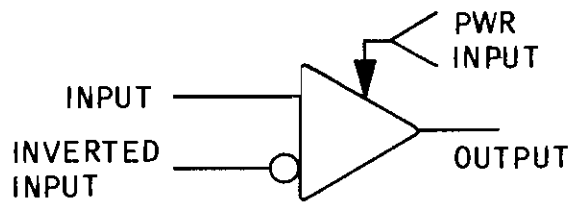
W. ANTENNA



X. PHOTOELECTRIC CELL

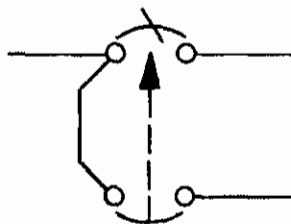


Y. AMPLIFIER



DC, PRE OR BUFFER
AS INDICATED

Z. TWO-POLE, DOUBLE-THROW,
AUTOMATIC CIRCUIT BREAKER



1.2.5 PYROTECHNIC SYMBOLS

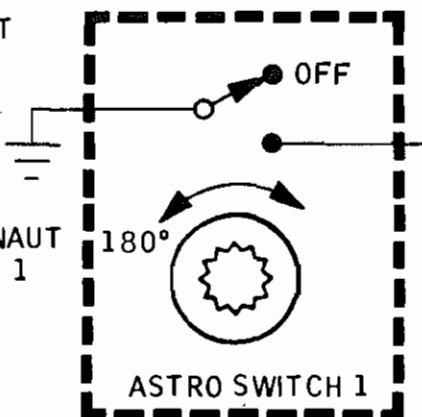
A. EXPLOSIVE INITIATOR



1.2.6 SPECIAL ALSEP SYMBOLS

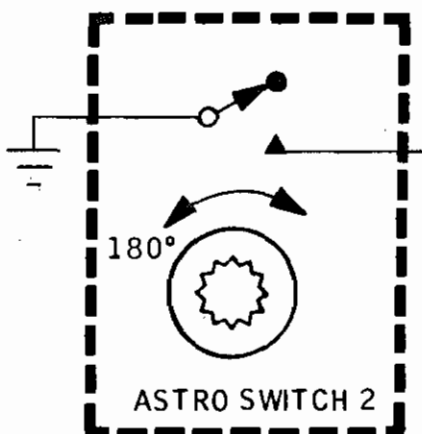
A. ASTRONAUT SWITCHES

1. ASTRONAUT SWITCH 1



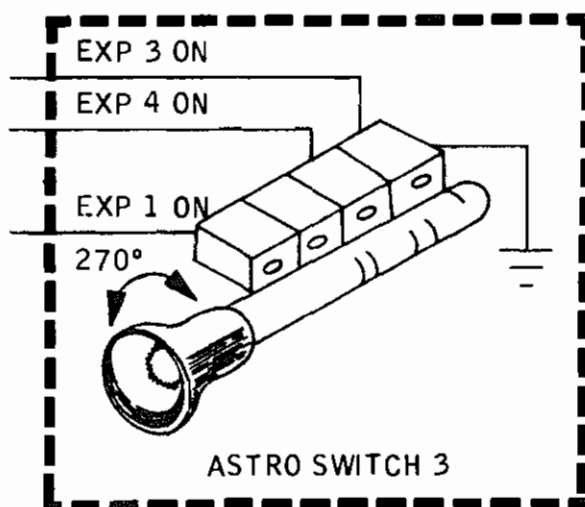
BY-PASSES PCU 1
HOLD OFF CIRCUIT.
SHOWN IN CCW
POSITION

2. ASTRONAUT SWITCH 2



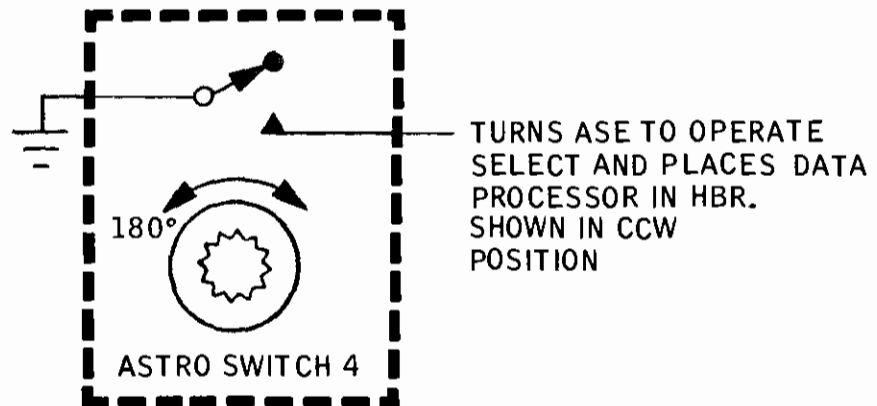
TURNS ON XMTR B, DATA
PROCESSOR Y AND RESETS
COMMAND RECEIVER
CIRCUIT BREAKER.
SHOWN IN CCW
POSITION

3. ASTRONAUT SWITCH 3 (ALSEP 4)

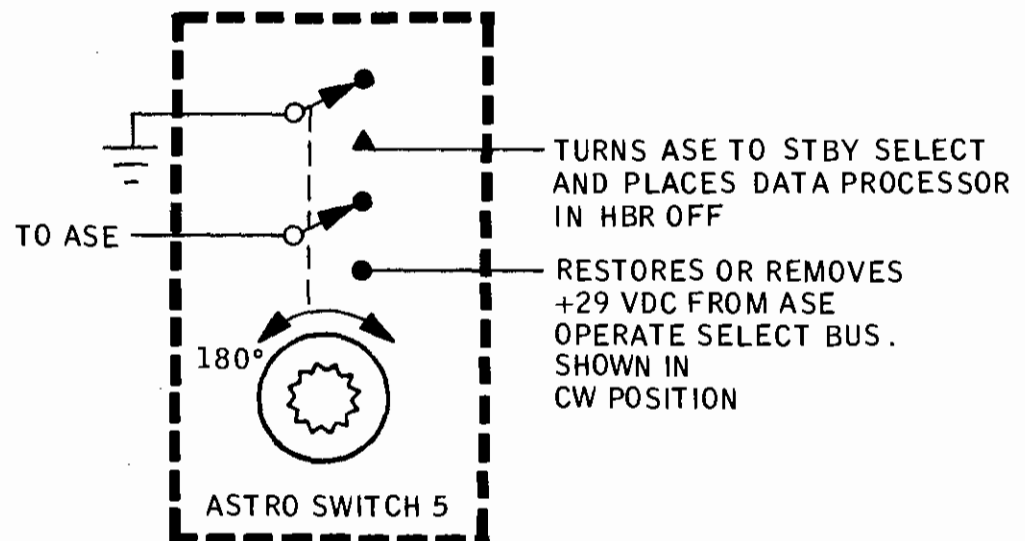


TURNS TO OPERATE
EXP 1 (PSE), EXP 4 (CPLEE),
AND EXP 3 (SIDE), IN THAT
ORDER
(MOMENTARY CONTACTS)

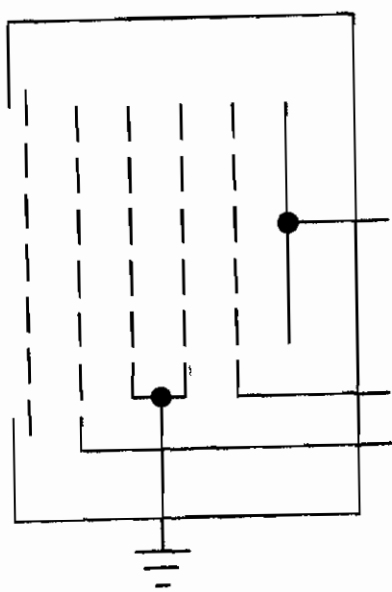
4. ASTRONAUT SWITCH 4 (ALSEP 4 ONLY)



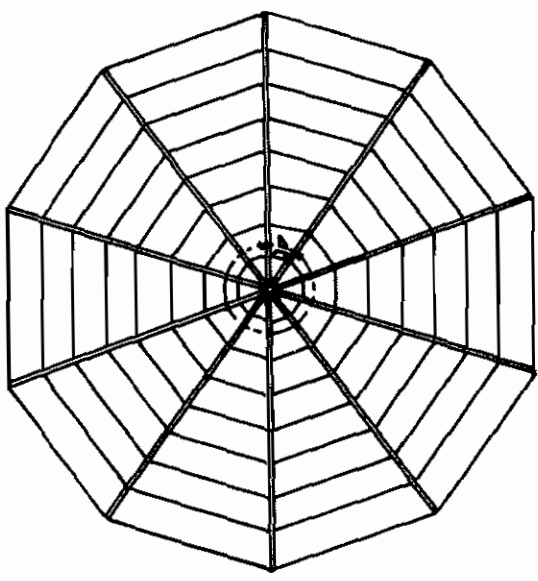
5. ASTRONAUT SWITCH 5 (ALSEP 4 ONLY)



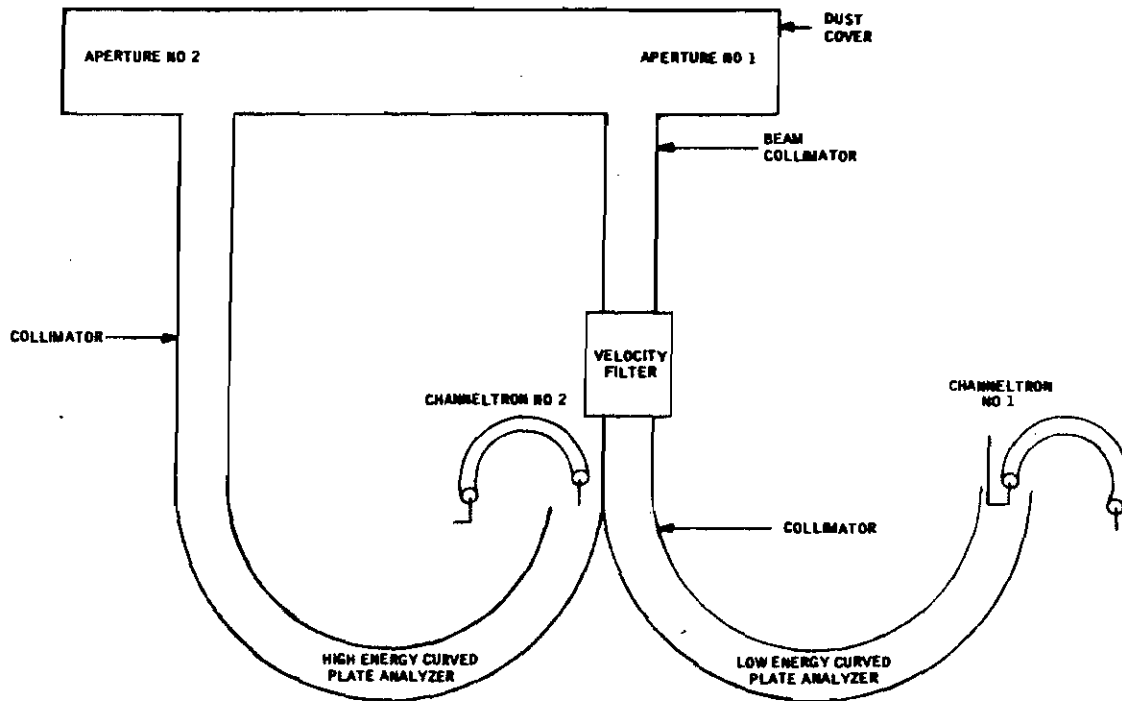
B. FARADAY CUP (SWS SENSOR)



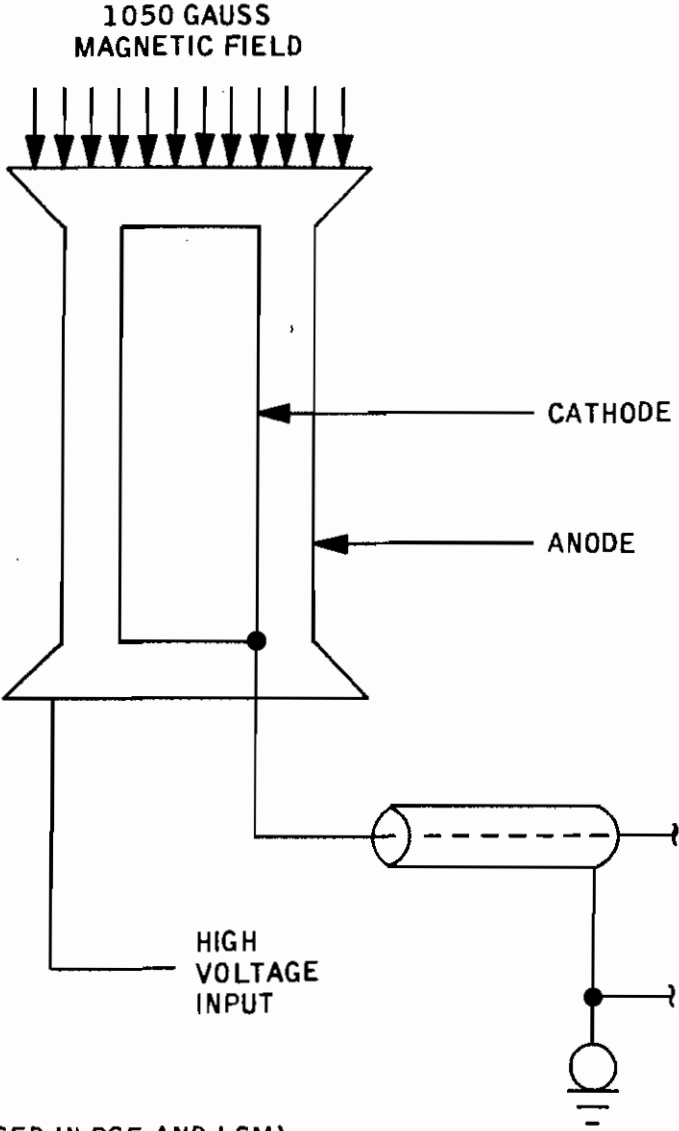
C. GROUND PLANE (USED ON SIDE)



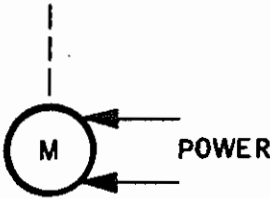
D. SIDE SENSOR ASSEMBLY



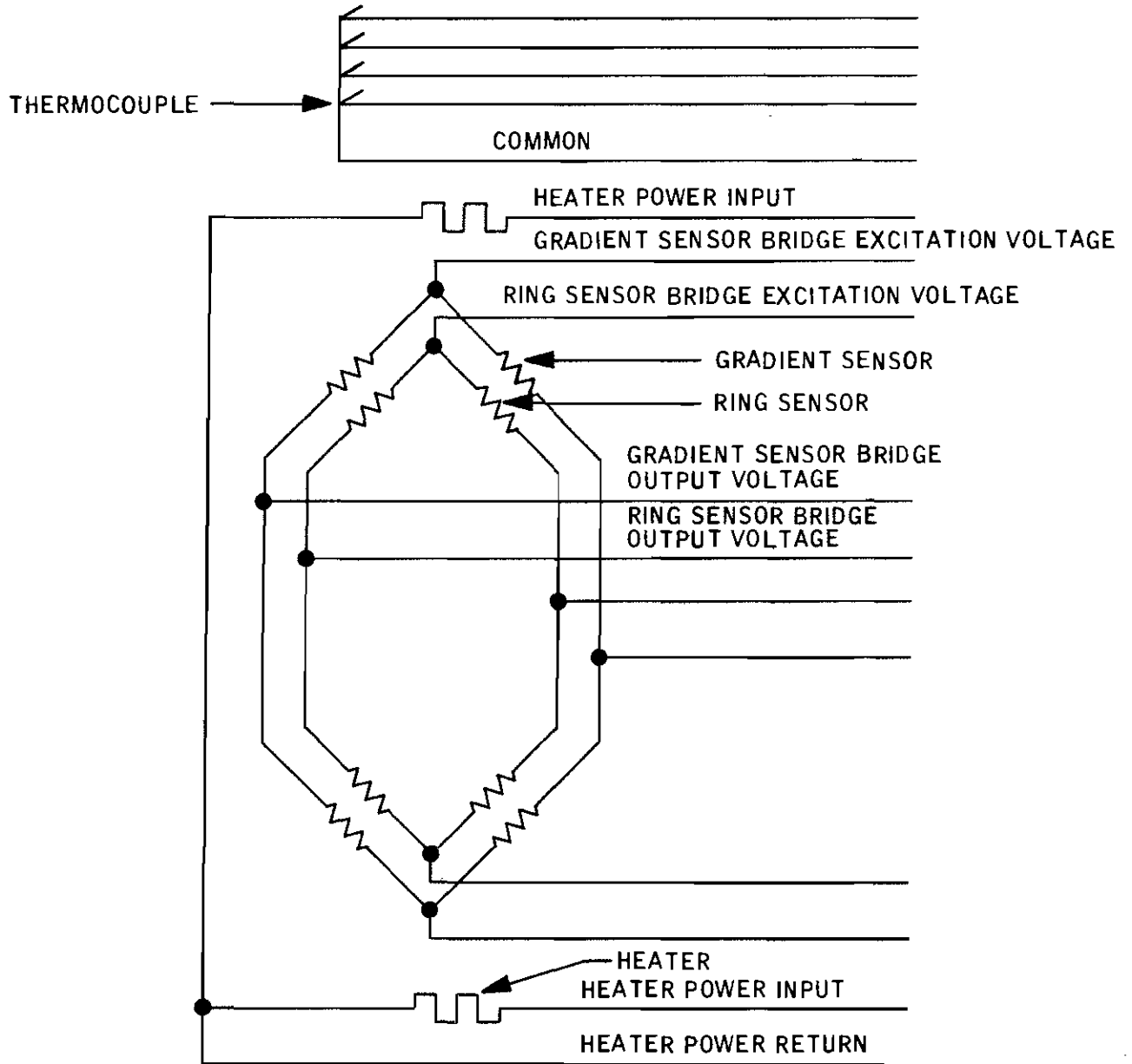
E. COLD CATHODE ION GAGE



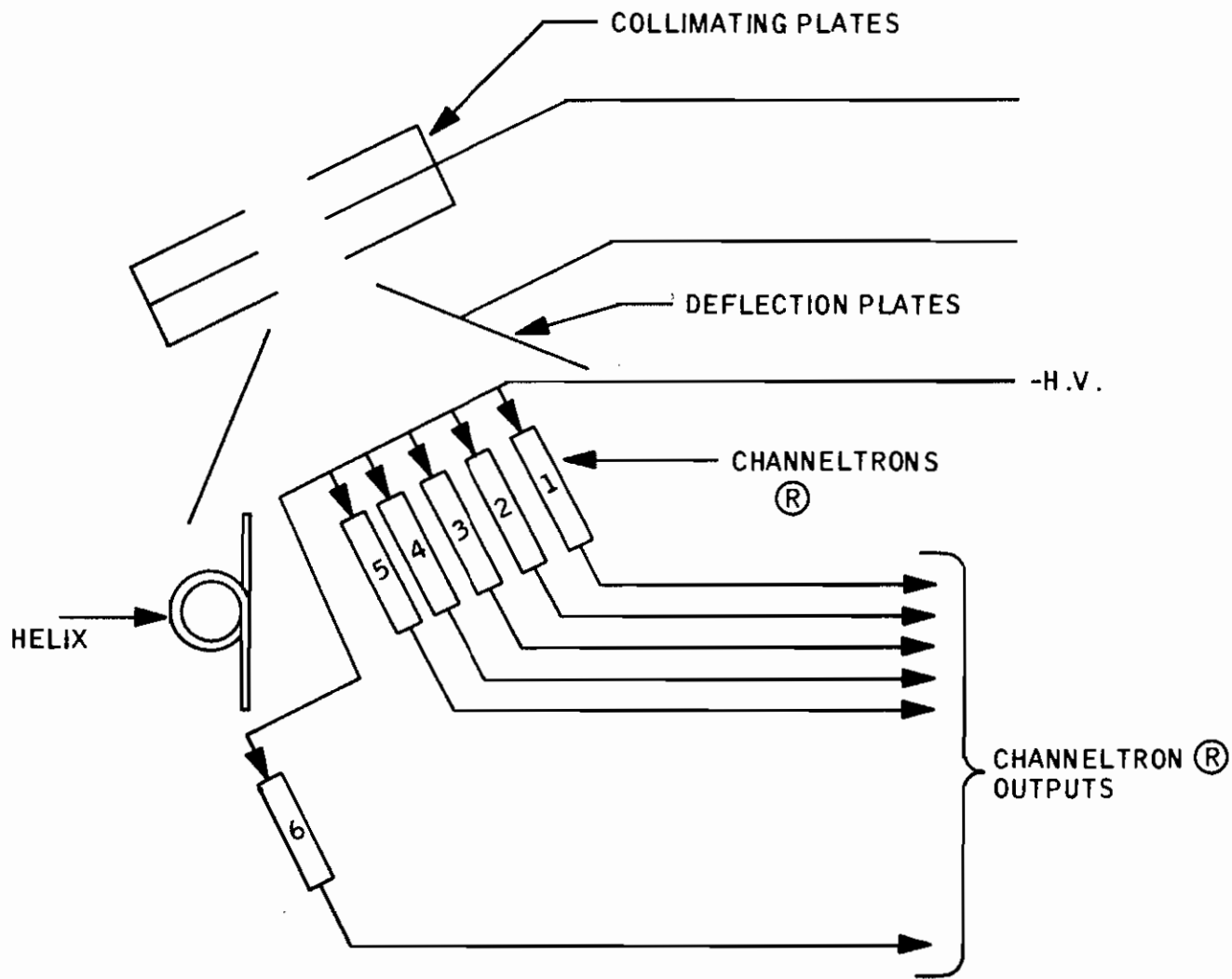
F. MOTOR (USED IN PSE AND LSM)



G. HEAT FLOW EXPERIMENT PROBE SECTION



H. CHARGED PARTICLE LUNAR ENVIRONMENT EXPERIMENT



2 GENERAL
DESCRIPTION

GENERAL DESCRIPTION

2.1 ALSEP DESCRIPTION

The Apollo Lunar Surface Experiments Package (ALSEP) system consists of a set of scientific instruments to be placed on the moon's surface by the Apollo flight crew. These instruments will remain on the moon to collect and transmit data for approximately 2 years. For self-sufficient operations, the ALSEP system includes a nuclear power supply, mechanical support, thermal protection, and data handling equipment. These supporting subsystems provide a flexible central station, containing the electrical power, command, telemetry, and structural/thermal subsystems, to operate with various combinations of the following scientific experiment subsystems: Passive Seismic, Active Seismic, Magnetometer, Solar Wind Spectrometer, Suprathermal Ion Detector/Cold Cathode Gage, Heat Flow, Charged-Particle Lunar Environment, and Cold Cathode Gage. Weight and volume restrictions of the Lunar Module preclude carrying all eight experiment subsystems on one flight. This ALSEP Systems Handbook deals with the ALSEP 4 package containing the PSE, ASE, SIDE, and CPLEE (Figures 2-1, 2-2, and 2-3).

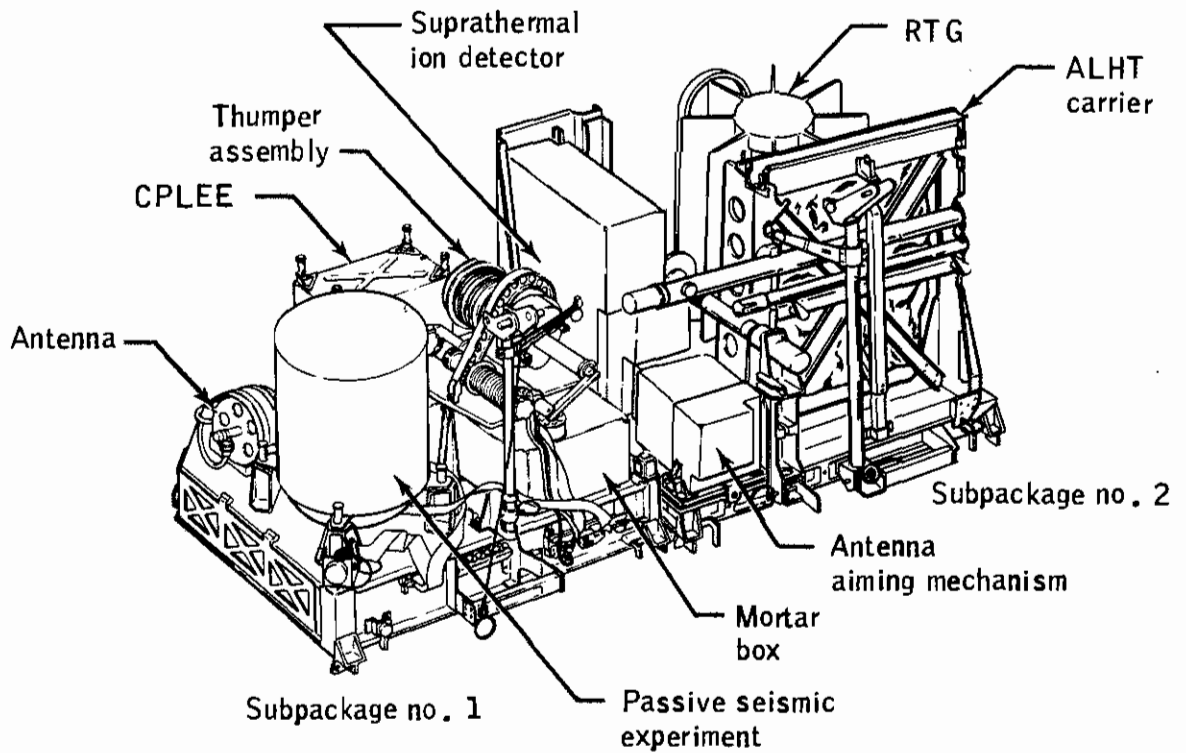
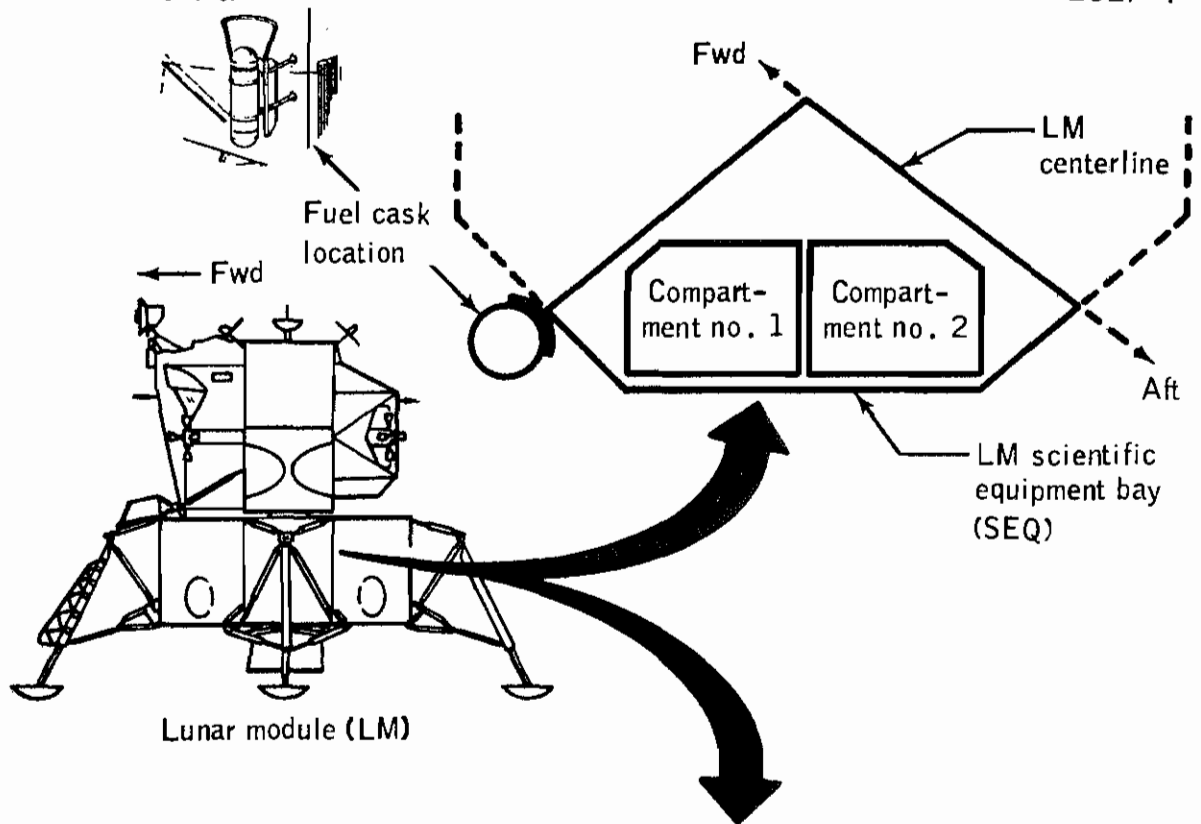


Figure 2-1 . - ALSEP 4/LM interface .

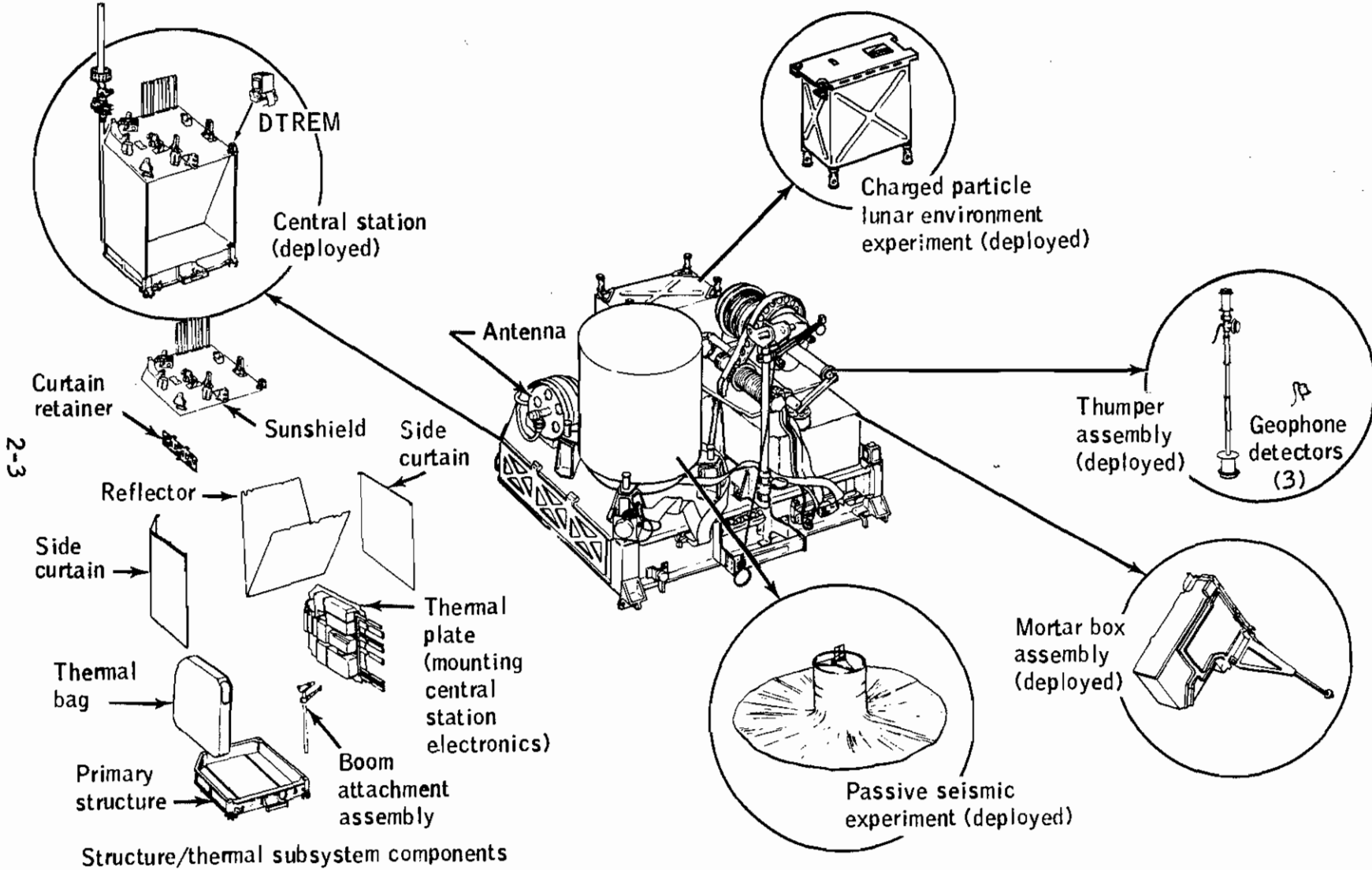


Figure 2-2. - ALSEP 4 subpackage no. 1.

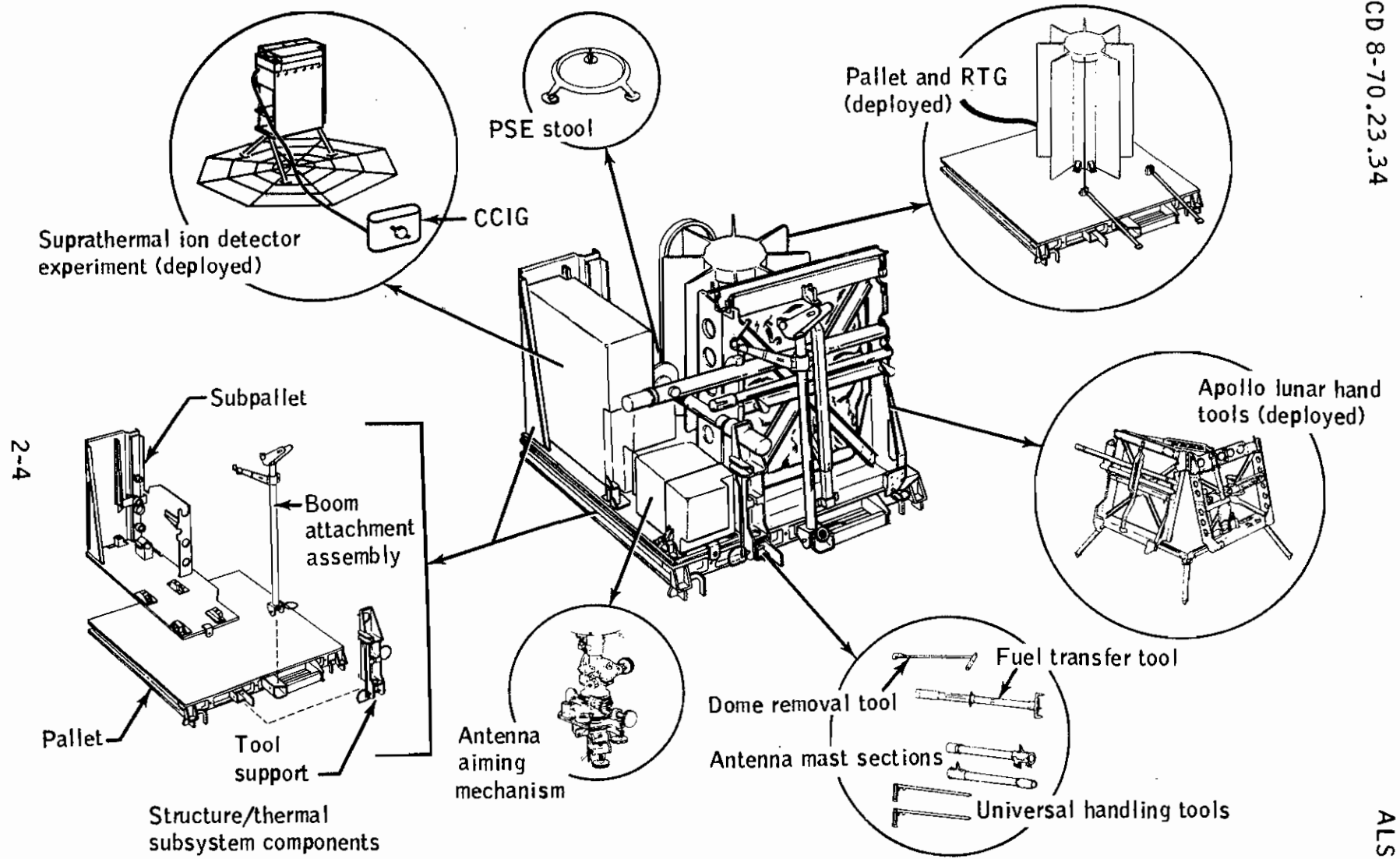


Figure 2-3. - ALSEP 4 subpackage no. 2.

3 STRUCTURAL
THERM CONTROL
SUBSYSTEM