

LM

ORIENTATION

COURSE NO. 30005-012

For Training Purposes Only

DATE: April 12, 1966
REVISED: November 1966

Prepared by:

Product Support Department

LESSON PLAN

I. Introduction

A. Objective

To provide the student with an orientation of the LM spacecraft. Included will be a brief functional description of each LM operational subsystems to a block diagram level with emphasis on the major signal flow paths.

B. Motivation

In order to provide adequate operational support to the Apollo Mission one must have a basic functional knowledge of LM operational subsystems and the associated subsystem interfaces.

II. Presentation

A. Film - Apollo Lunar Mission Profile

B. LM Basic Design Concept

1. Ascent Stage

- a. Cabin area
- b. Aft equipment bay

2. Descent Stage

3. Summary

C. Crew Station

1. Controls and Display Panels

D. Propulsion Subsystem

1. General Configuration

- a. Descent
- b. Ascent
- c. Reaction Control

2. Descent Propulsion
 - a. Propellant Pressurization
 - b. Propellant Feed
 - c. Engine Control
3. Ascent Propulsion
 - a. Propellant Pressurization
 - b. Propellant Feed
 - c. Thrust Control
 - d. RCS Crossfeed
4. Reaction Control
 - a. Cluster Configuration
 - b. Attitude and Translational Control
 - c. Propellant Pressurization
 - d. Propellant Feed
5. Controls and Displays
6. Summary

E. Environmental Control Subsystem

1. Atmosphere Revitalization Section
 - a. Pressure Schedules
 - b. Closed Suit Loop Operation
 - c. Open Suit Loop Operation
2. Oxygen Supply and Cabin Pressure Control Section
 - a. Tankage
 - b. Descent Feed
 - c. Ascent Feed
3. Water Management Section
 - a. Tankage
 - b. Descent Feed
 - c. Ascent Feed

- 4. Heat Transport Section
 - a. Primary Loop Operation
 - b. Secondary Loop Operation
- 5. Controls and Displays
- 6. Summary
- F. Electrical Power Subsystem
 - 1. General Configuration
 - a. Ascent Stage
 - b. Descent Stage
 - 2. System Functional Description
 - a. Batteries
 - b. Electrical Control Assembly (ECA)
 - c. Relay Junction Box (RJB)
 - d. Deadface Relay Box (DFRB)
 - e. Inverters
 - f. Electroexplosive Devices
 - 3. Controls and Displays
 - 4. Summary
- G. Guidance, Navigation, and Control Subsystem *AI MASA*
 - 1. System Concept
 - 2. Functional Description
 - a. Hand Controllers
 - b. Primary Guidance and Navigation Section (PGNS)
 - c. Abort Guidance Section (AGS)
 - d. Control Electronics Section (CES)
 - 3. Controls and Displays
 - 4. Summary

H. Instrumentation

1. System Concept
2. Functional Description
 - a. Signal Conditioning Electronics Assembly (SCEA)
 - b. Caution and Warning Electronics Assembly (CWEA)
 - c. Pulse Code Modulation Timing Electronics Assembly (PCMTEA)
 - d. Data Storage Electronics Assembly (DSEA)
3. Controls and Displays

I. Communications

1. Operational Capabilities
 - a. IN FLIGHT
 - b. LUNAR STAY
2. System Concept
3. Functional Description
 - a. SIGNAL PROCESSOR ASSEMBLY
 - b. S-Band
 - c. VHF
4. Controls and Displays

J. Final Summary

LM ORIENTATION

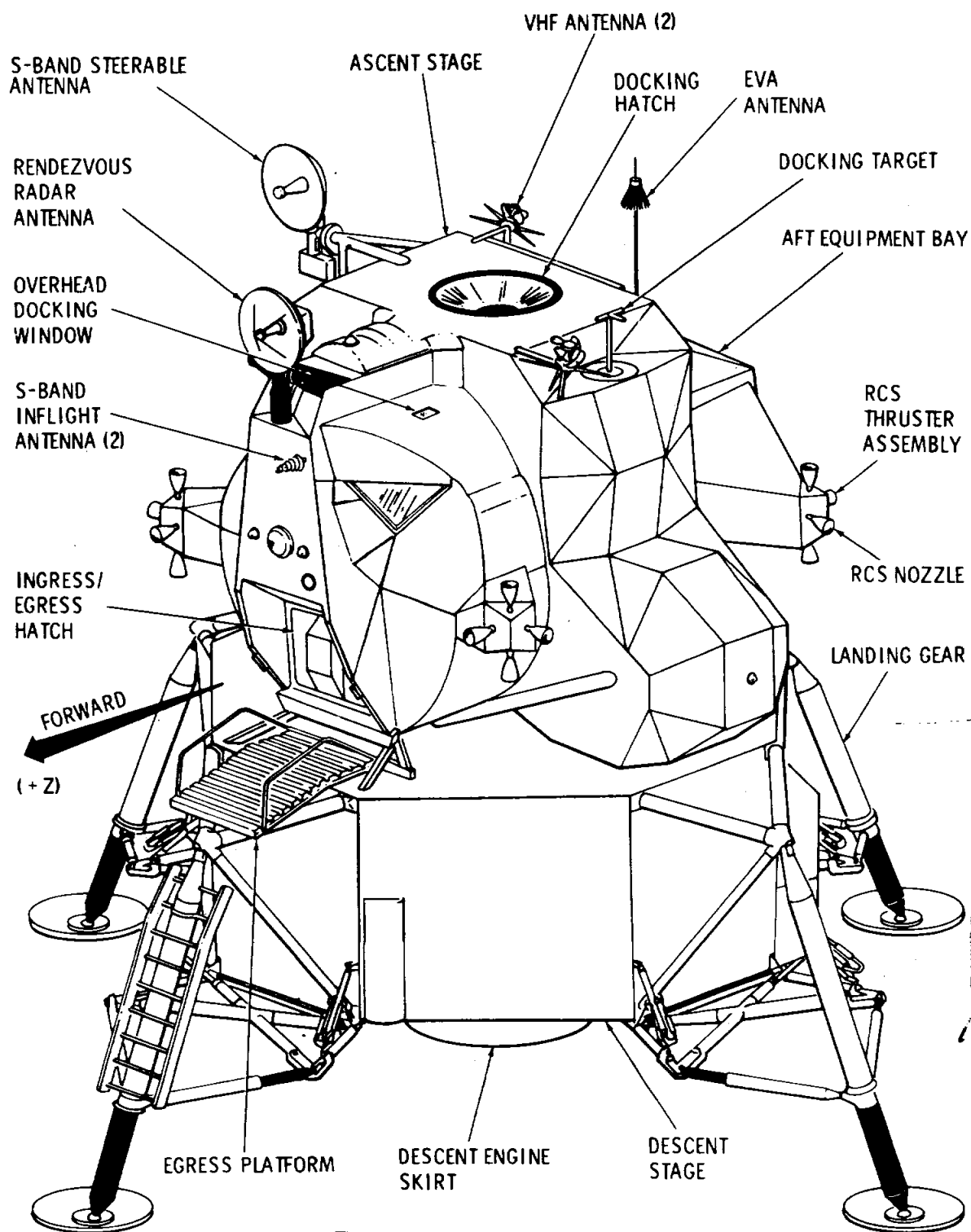
Abbreviation Document

AEA	Abort Electronics Assembly
AGS	Abort Guidance Section
AOT	Alignment Optical Telescope
ARS	Atmospheric Revitalization Section
ASA	Abort Sensor Assembly
ATCA	Attitude and Translation Control Assembly
CES	Control Electronic Section
CM	Command Module
CSM	Command and Service Module
C/W	Caution/Warning
CWEA	Caution and Warning Electronics Assembly
DECA	Descent Engine Control Assembly
DEDA	Data Entry and Display Assembly
DFRB	Deadface Relay Box
DSEA	Data Storage Electronics Assembly
DSKY	Display and Keyboard
ECA	Electric Control Assembly
ECS	Environmental Control Subsystem
EPS	Electrical Power Subsystem
EVA	Extravehicular Astronaut
GN&C	Guidance, Navigation and Control Subsystem

GOX	Gaseous Oxygen
He	Helium
H ₂ O	Water
HTS	Heat Transport Section
IMU	Inertial Measuring Unit
LM	Lunar Module
LGC	LM Guidance Computer
LR	Landing Radar
LUT	Launch Umbilical Tower
MSC	Manned Spacecraft Center (Houston)
MSFN	Manned Space Flight Network
OSCPS	Oxygen Supply and Cabin Pressure Section
Ox	Oxidizer
PCM	Pulse Code Modulation
PCMTEA	Pulse Code Modulation and Timing Electronics Assembly
PGNS	Primary Guidance and Navigation Section
PLSS	Portable Life Support System
RCS	Reaction Control Subsystem
RJB	Relay Junction Box
RR	Rendezvous Radar
S & C	Stabilization and Control
SCA	Signal Conditioner Assembly
SCEA	Signal Conditioning Electronics Assembly

SM	Service Module
TEA	Timing Electronics Assembly
TV	Television
VHF	Very High Frequency (30-300 mc)
WMS	Water Management Section

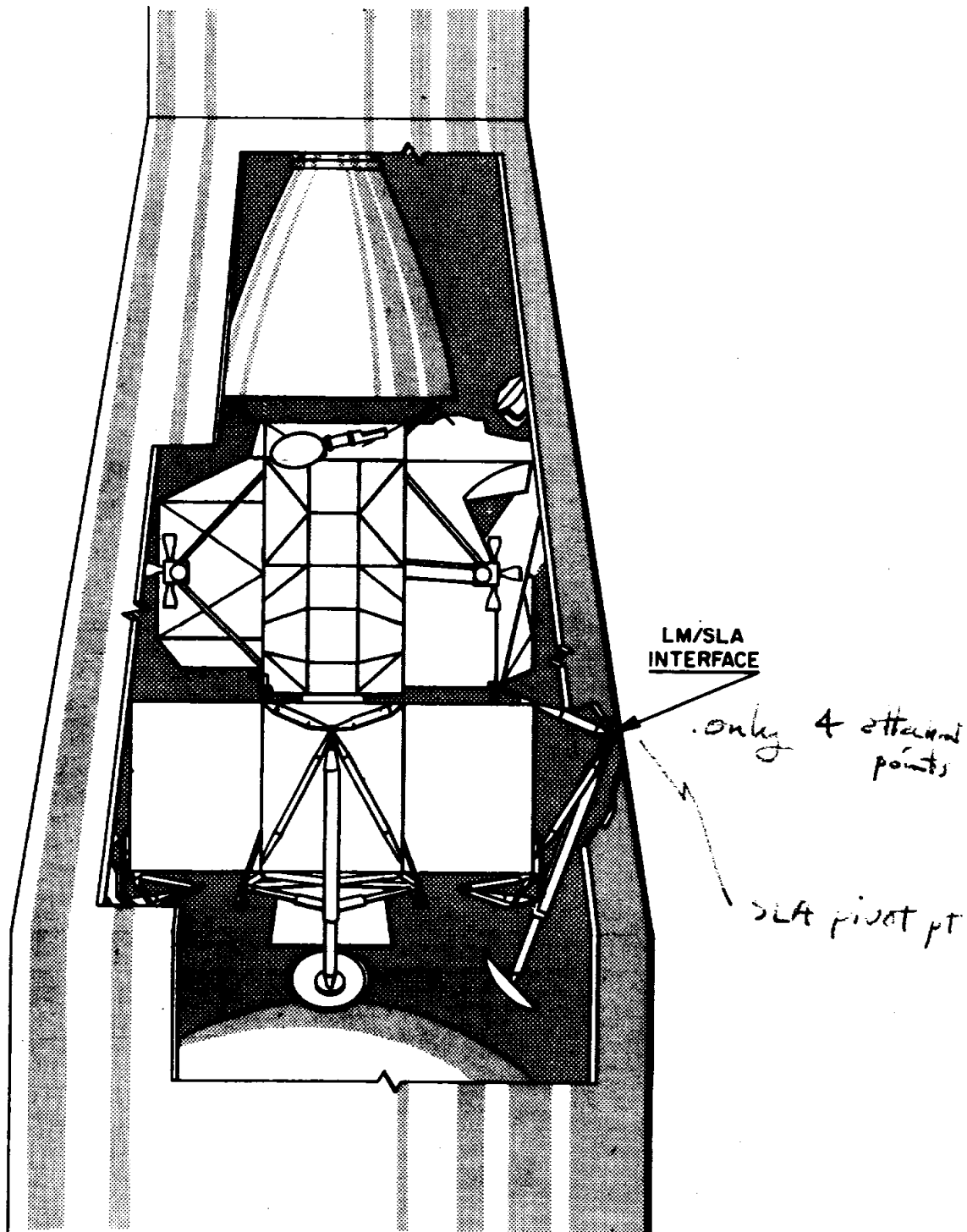
This does not constitute a complete list of IM abbreviations. Grumman document LLI-790-1 may be consulted for abbreviations not listed here.



LM VEHICLE

T30005-15
DEC 66

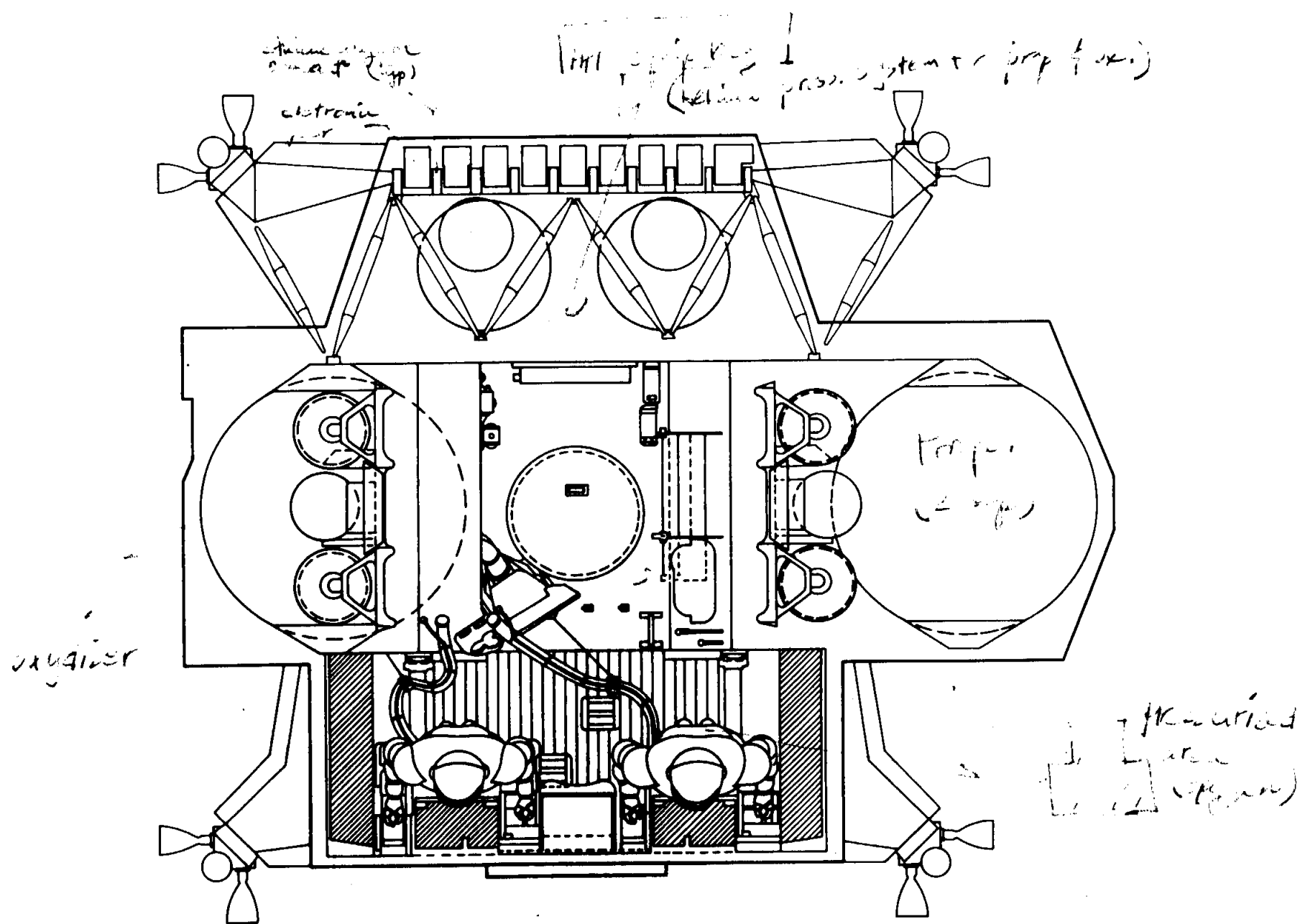
u. det



LM SIVB BOOSTER INTERFACE

T30005-14
DEC 66

How long for transposition & docking?

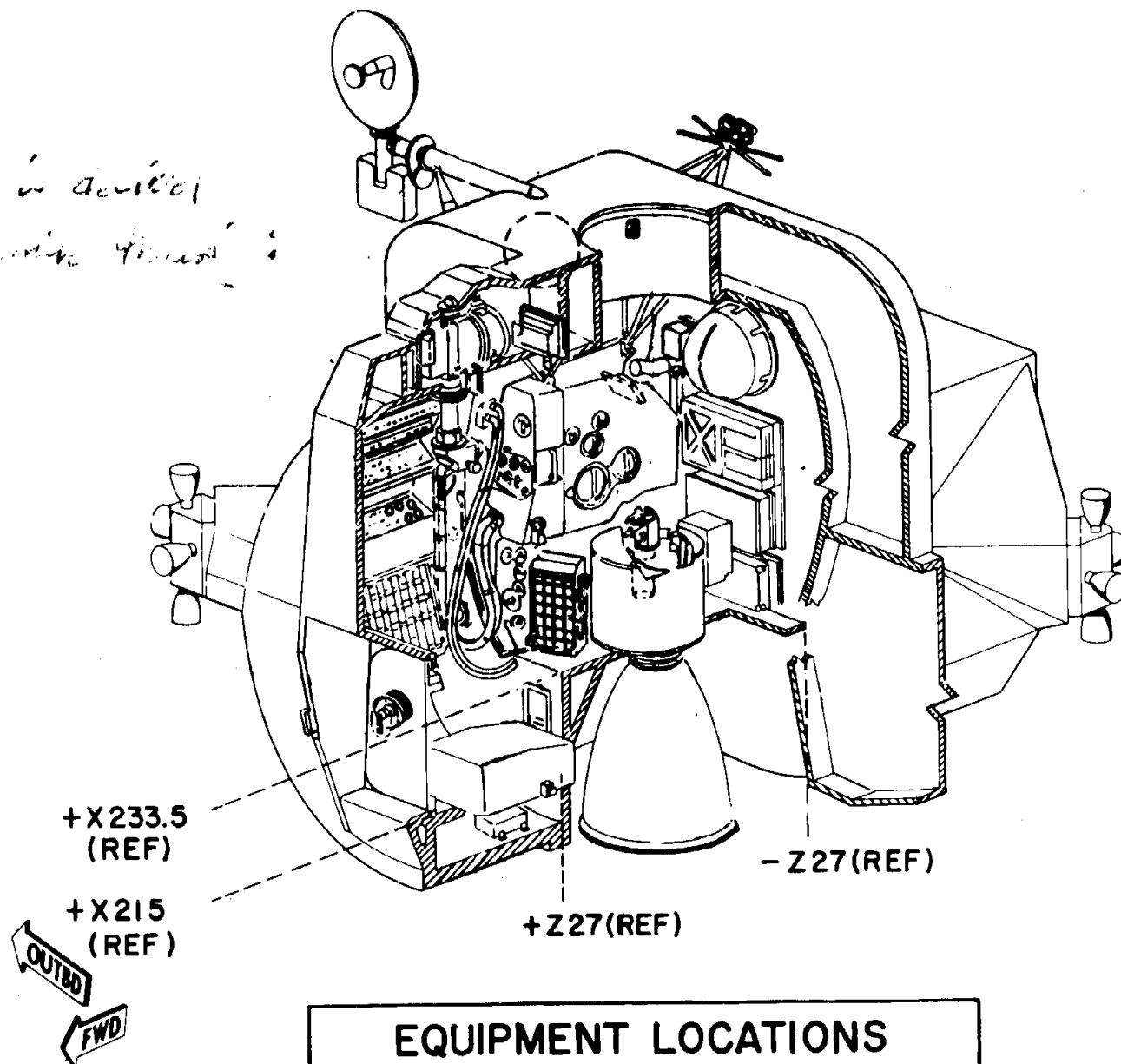


ASCENT STAGE PLAN VIEW

Top View

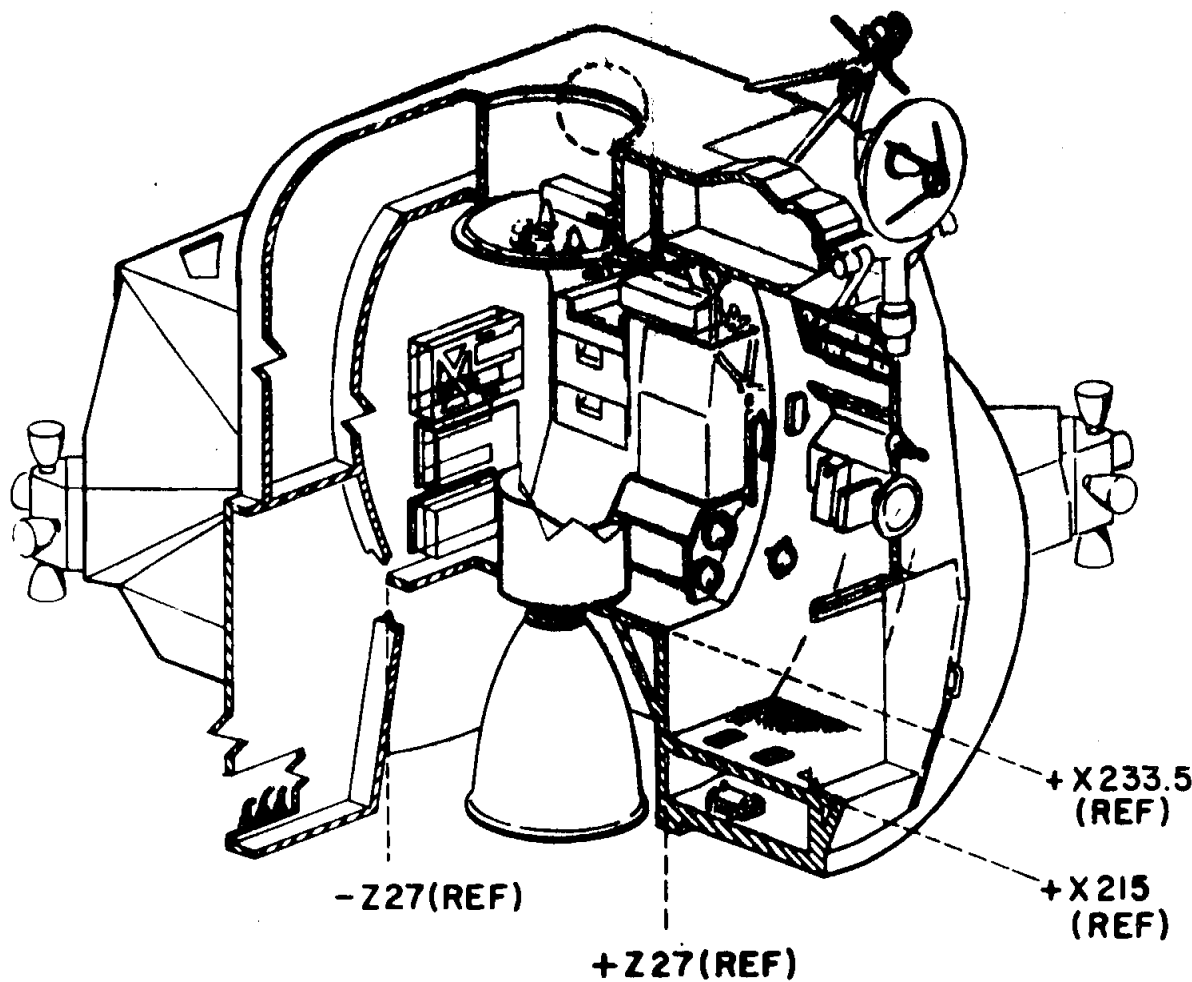
T30005-131
MAP 66

What is device
and what it does?



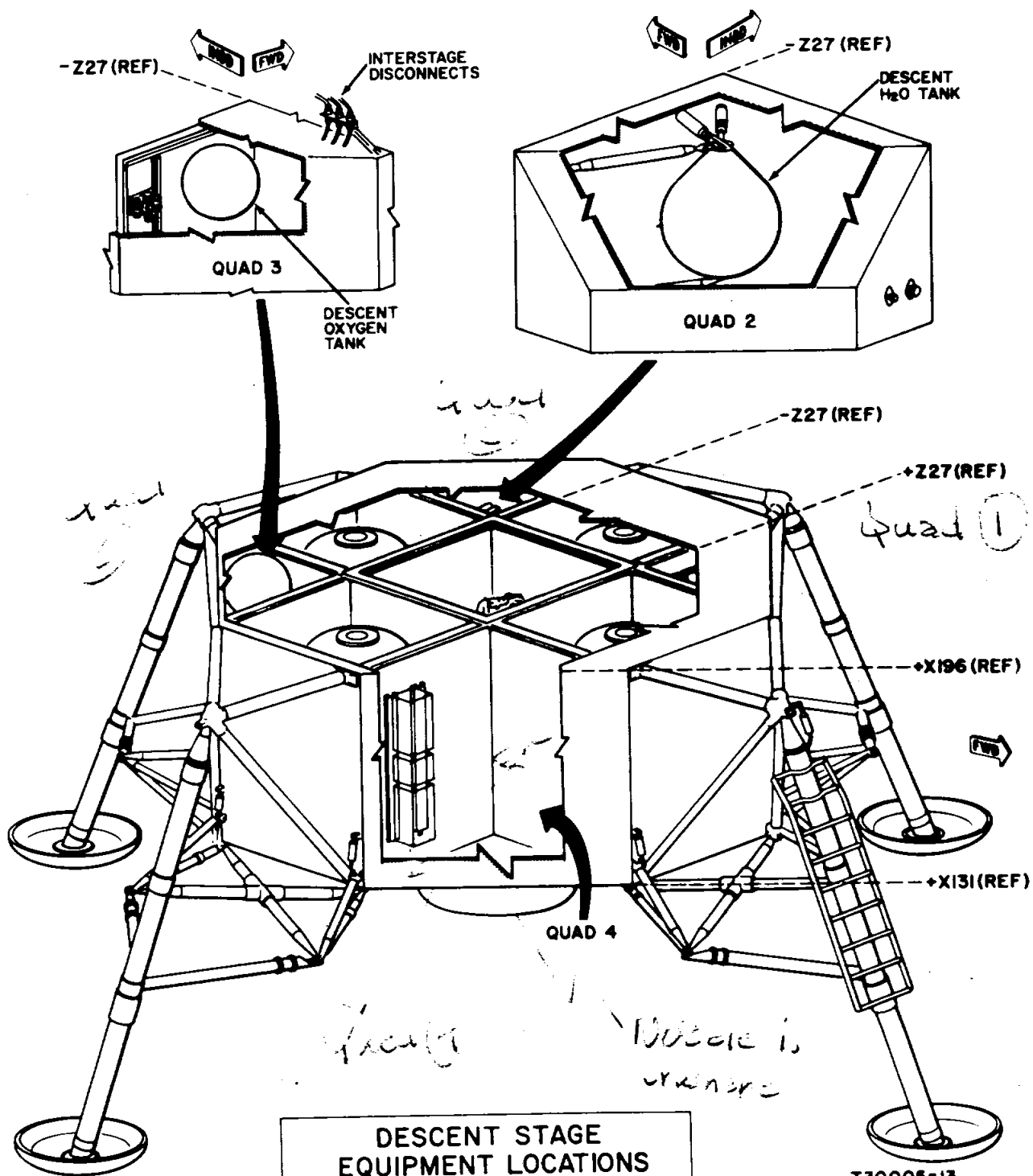
EQUIPMENT LOCATIONS ASCENT STAGE-R/H SIDE

T30005-32
NOV 66

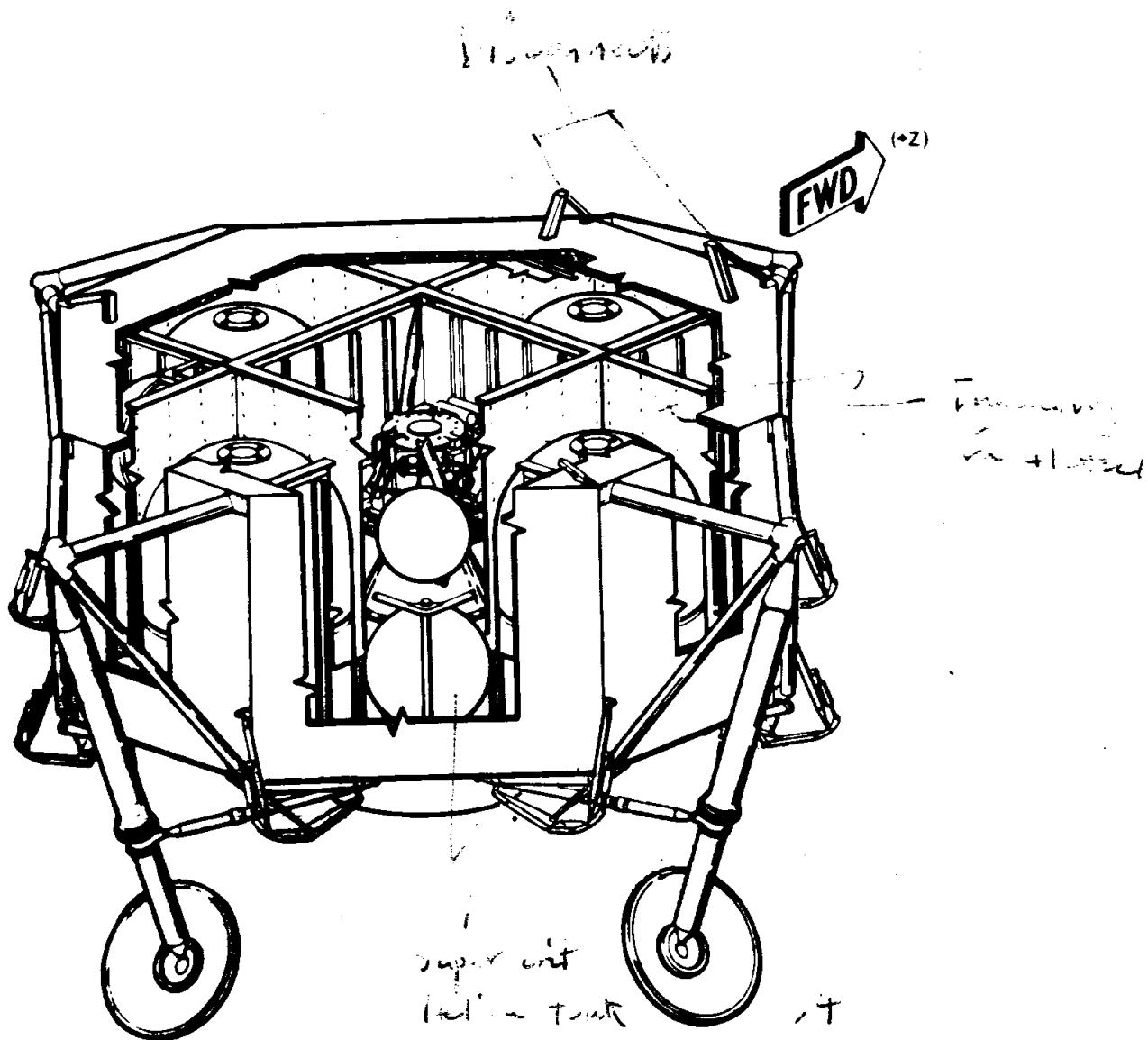


**EQUIPMENT LOCATIONS
ASCENT STAGE-L/H SIDE**

T30005- 31
NOV 66



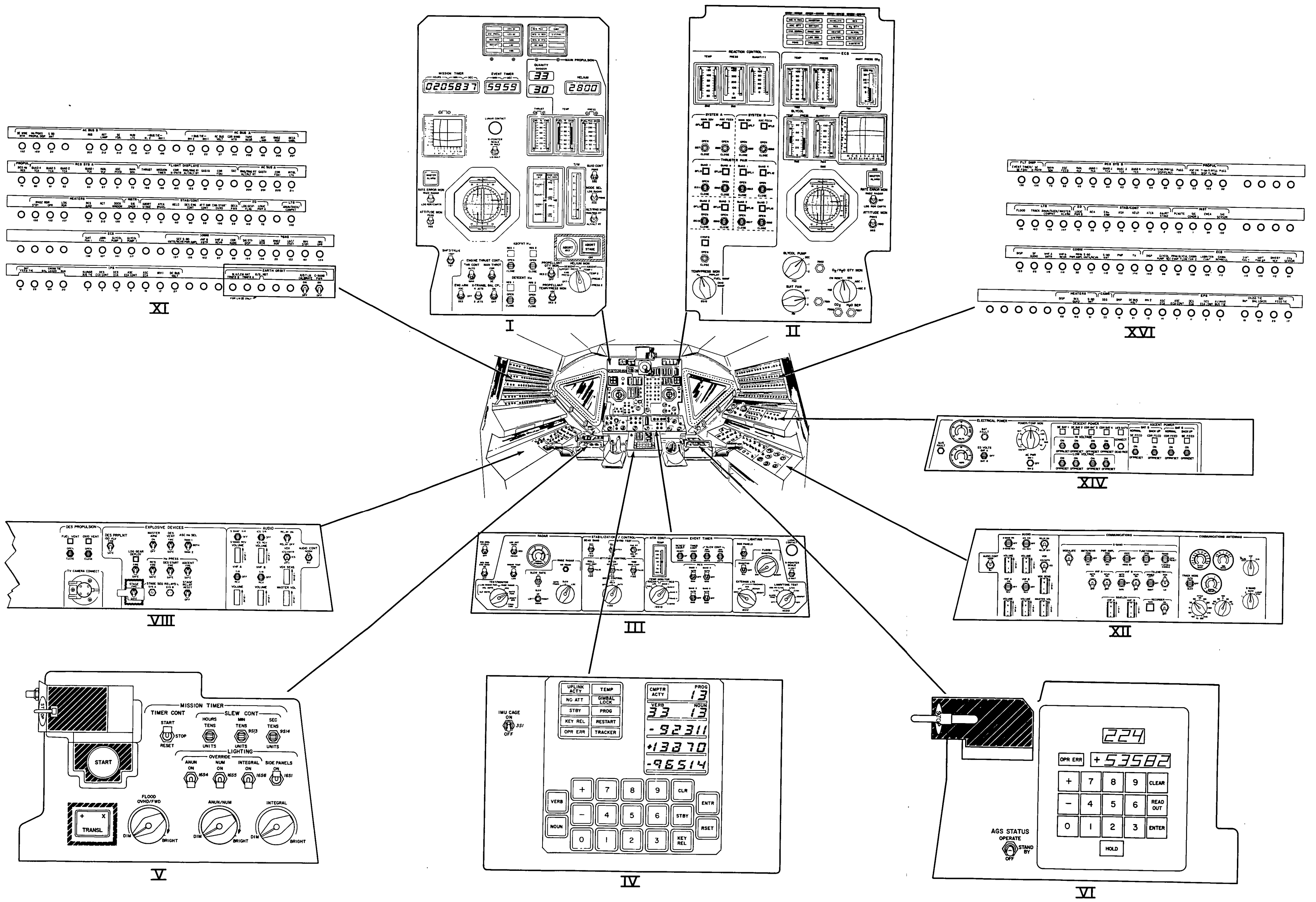
T30005-13
NOV 66



Gasoline helium used to start
then switch to oxygen. Hel.

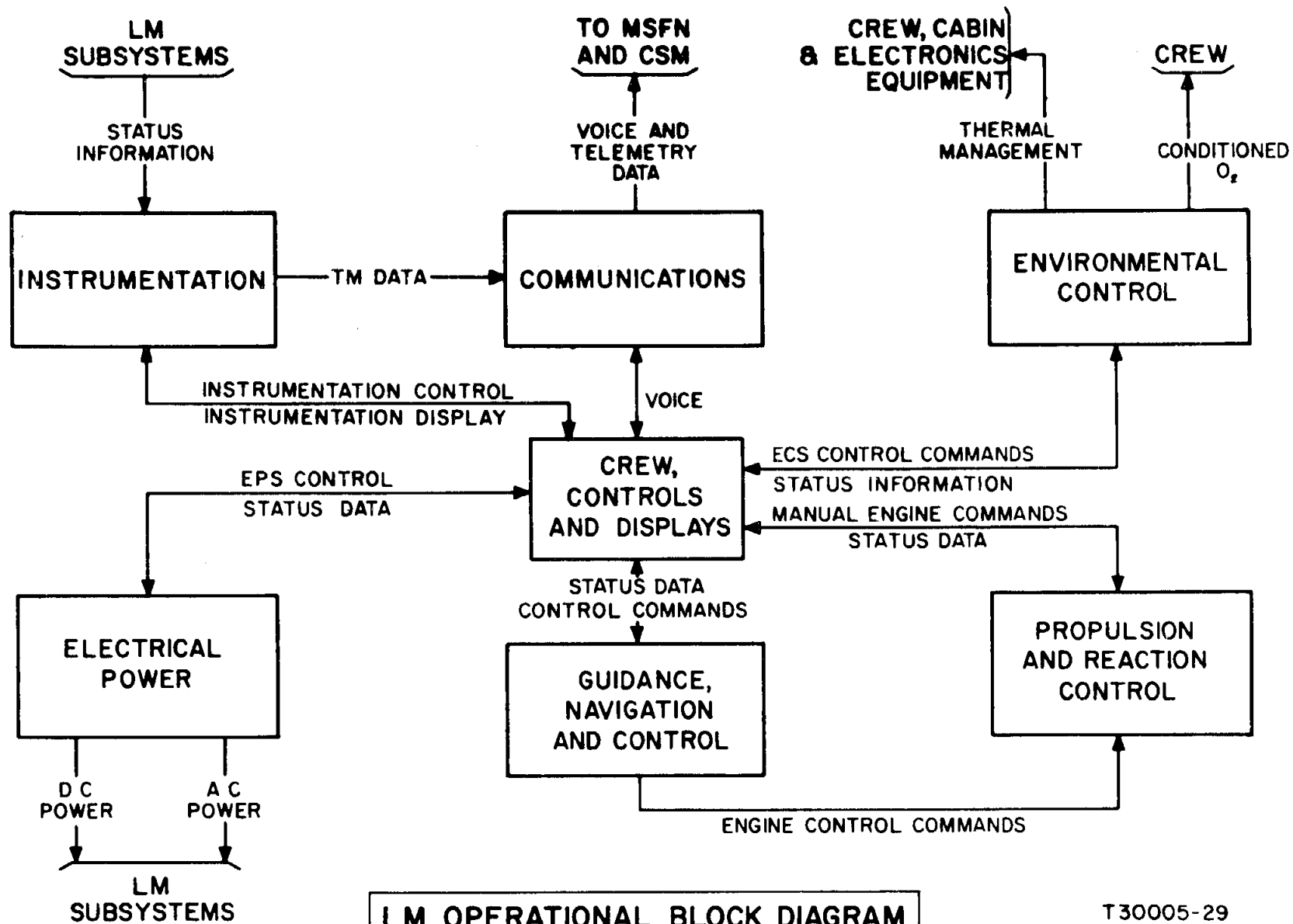
LM DESCENT STAGE

T30005-18
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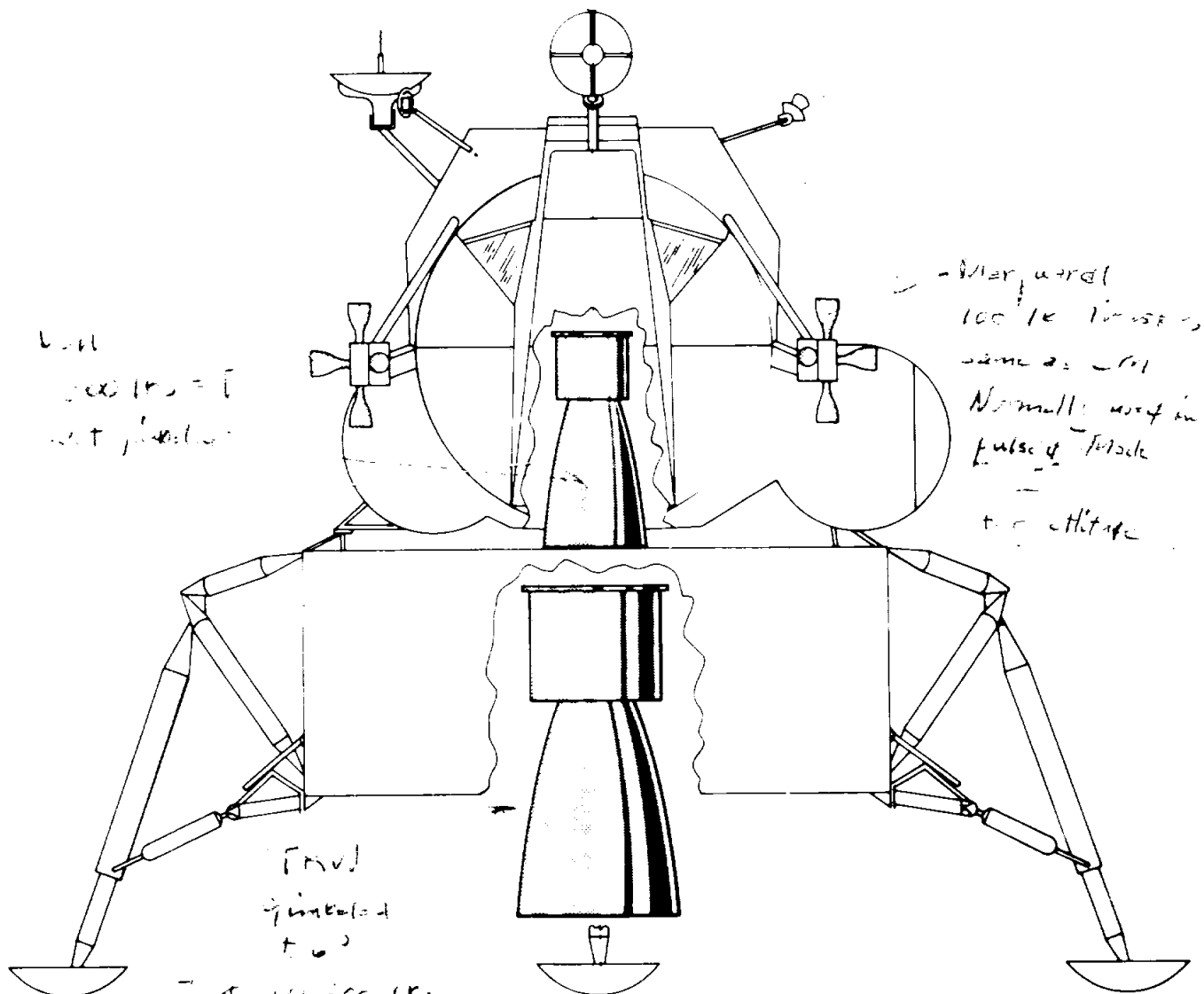


LM DISPLAYS AND CONTROLS

T30005-28
DEC 66



T30005-29
NOV 66



Weight = 10,000 lbs

Can be modified 1000 lbs

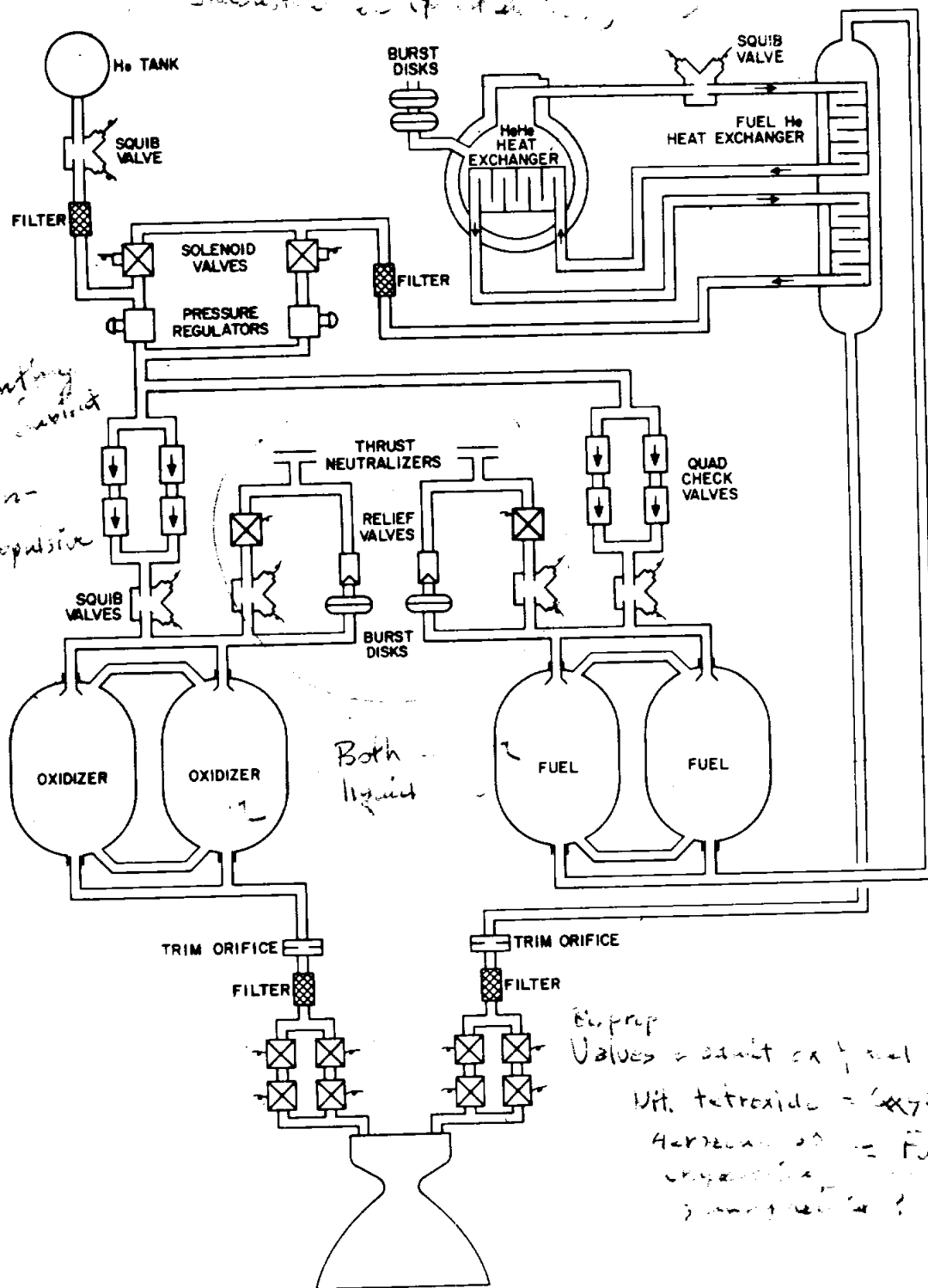
Variable

Continuous

(Not illustrated)

LEM PROPULSION

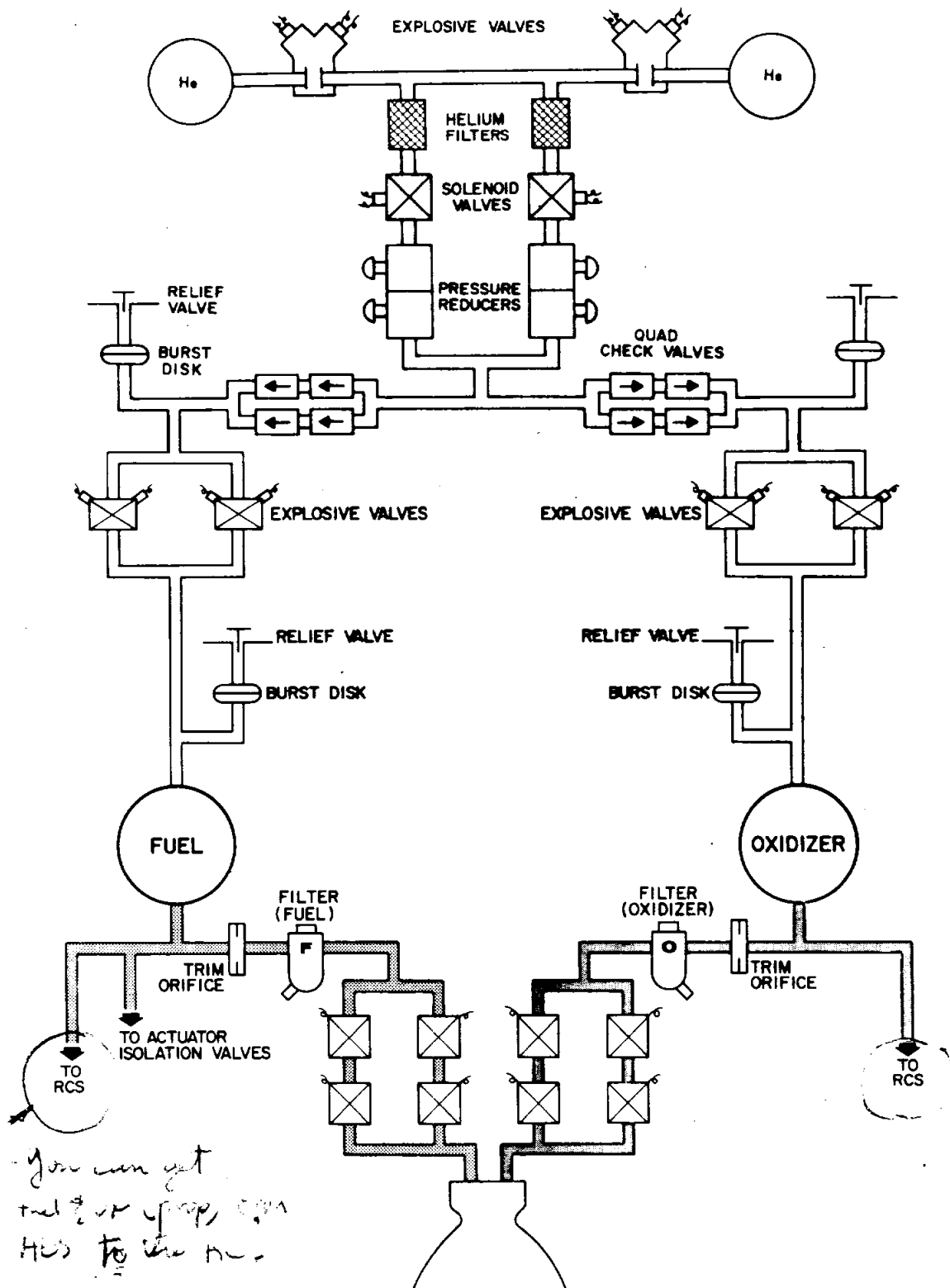
T30005-66
FEB 66



DESCENT PROPULSION SCHEMATIC

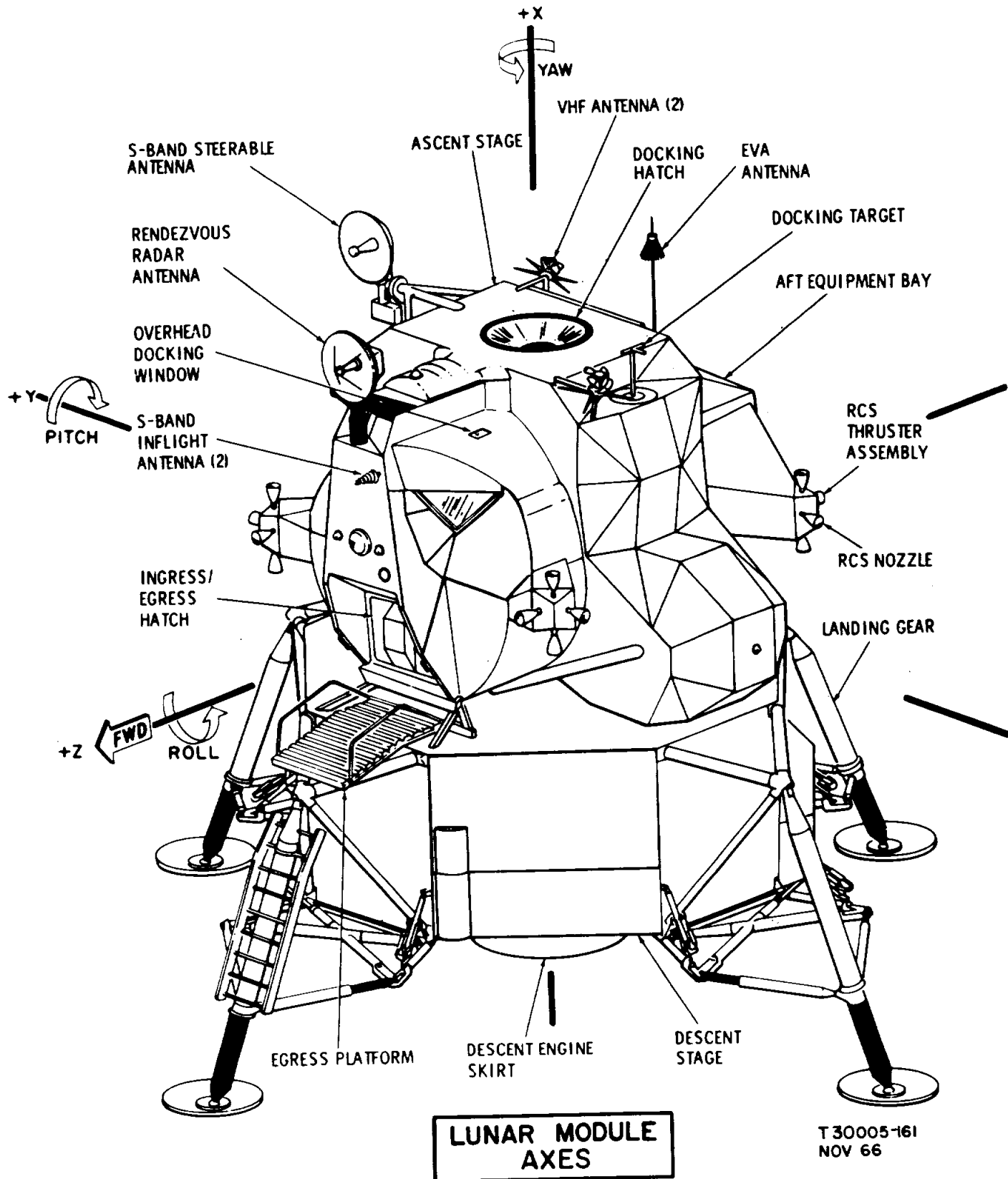
T 30005-154
NOV 66

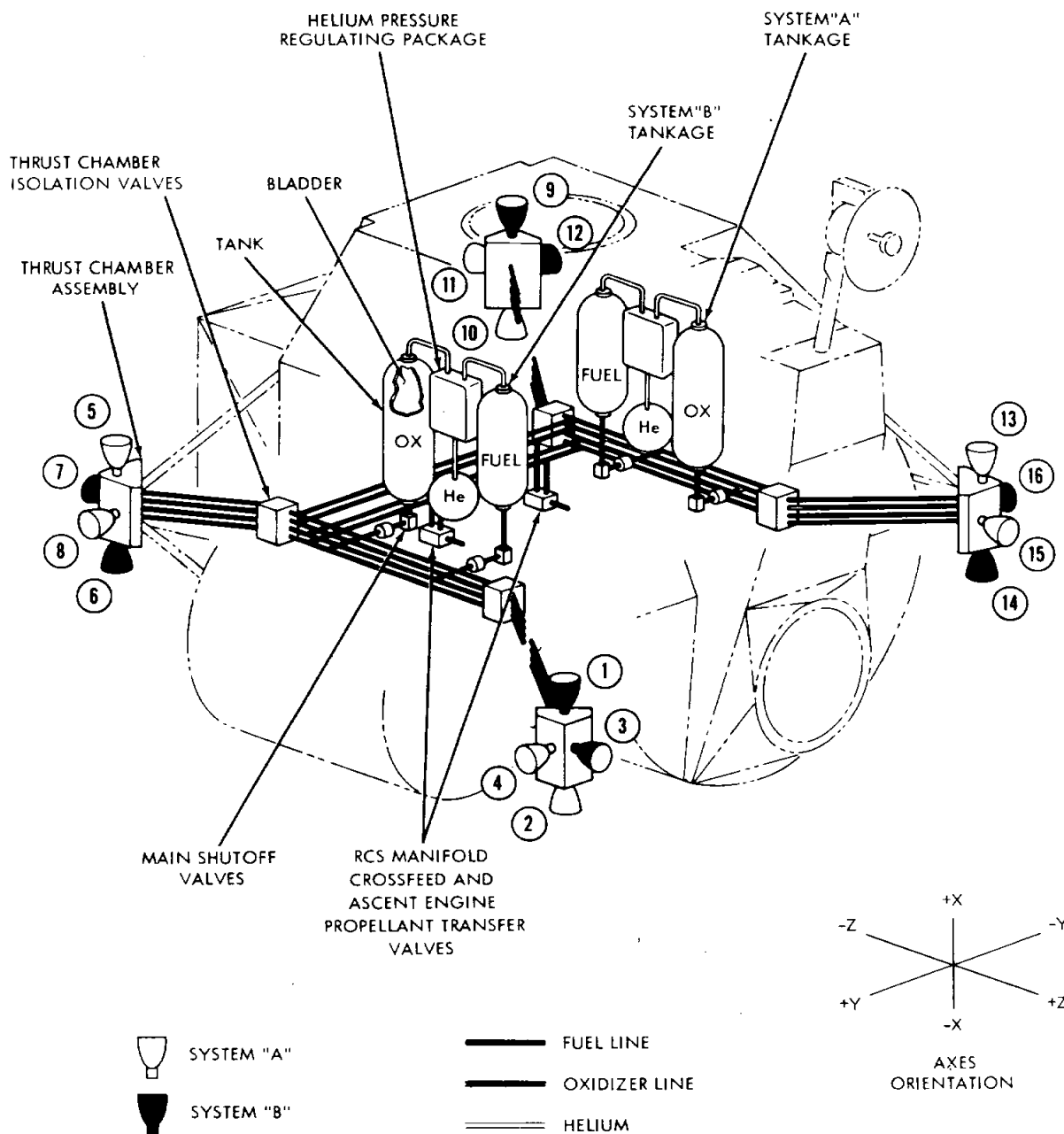
Bl. prop
Valves admit ox & fuel
H₂ tetroxide = oxidizer
Hydrogen = fuel
upstroke
downstroke



ASCENT PROPELLANT SYSTEM

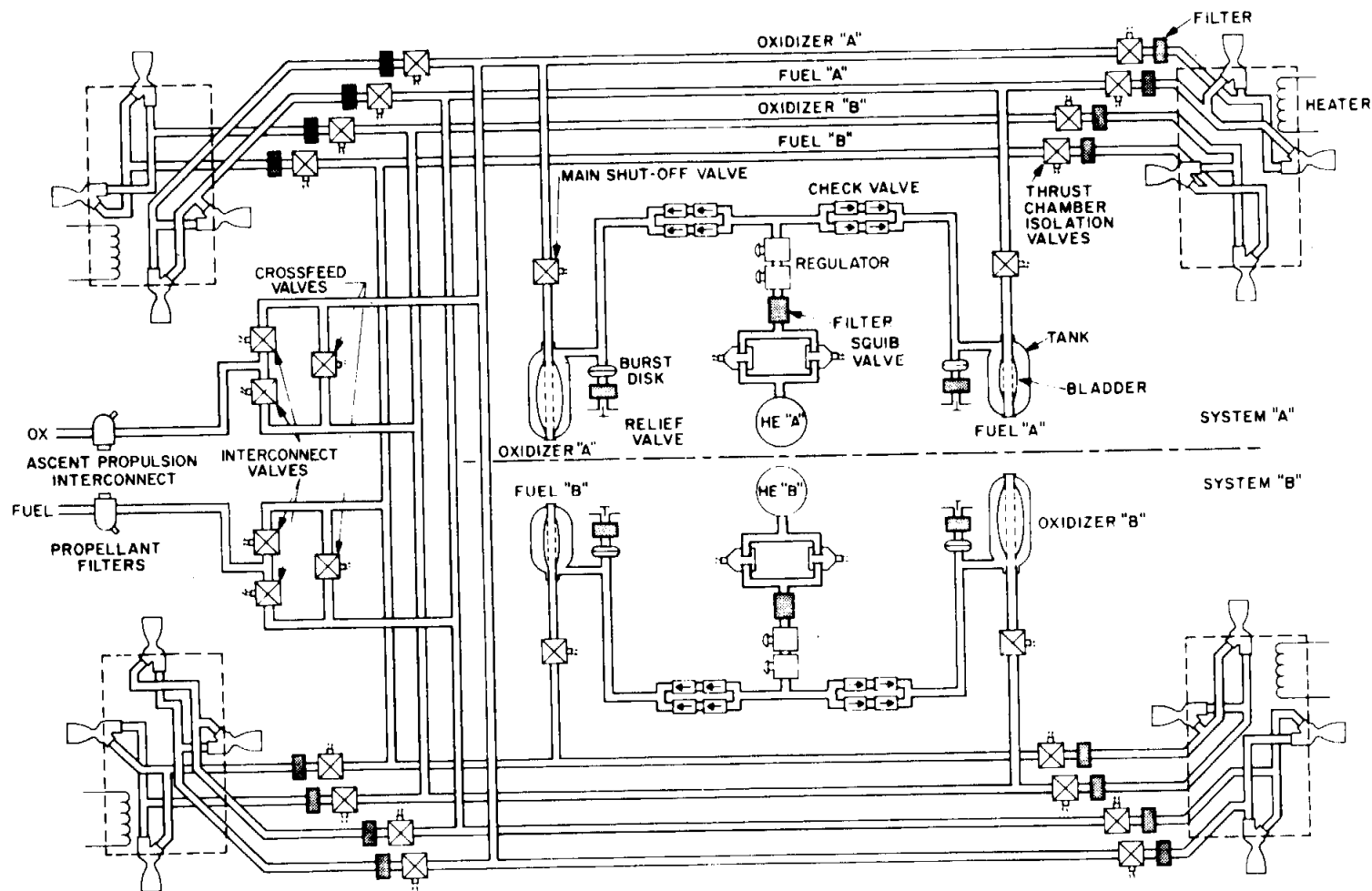
T30005-155
NOV 66





RCS INSTALLATION

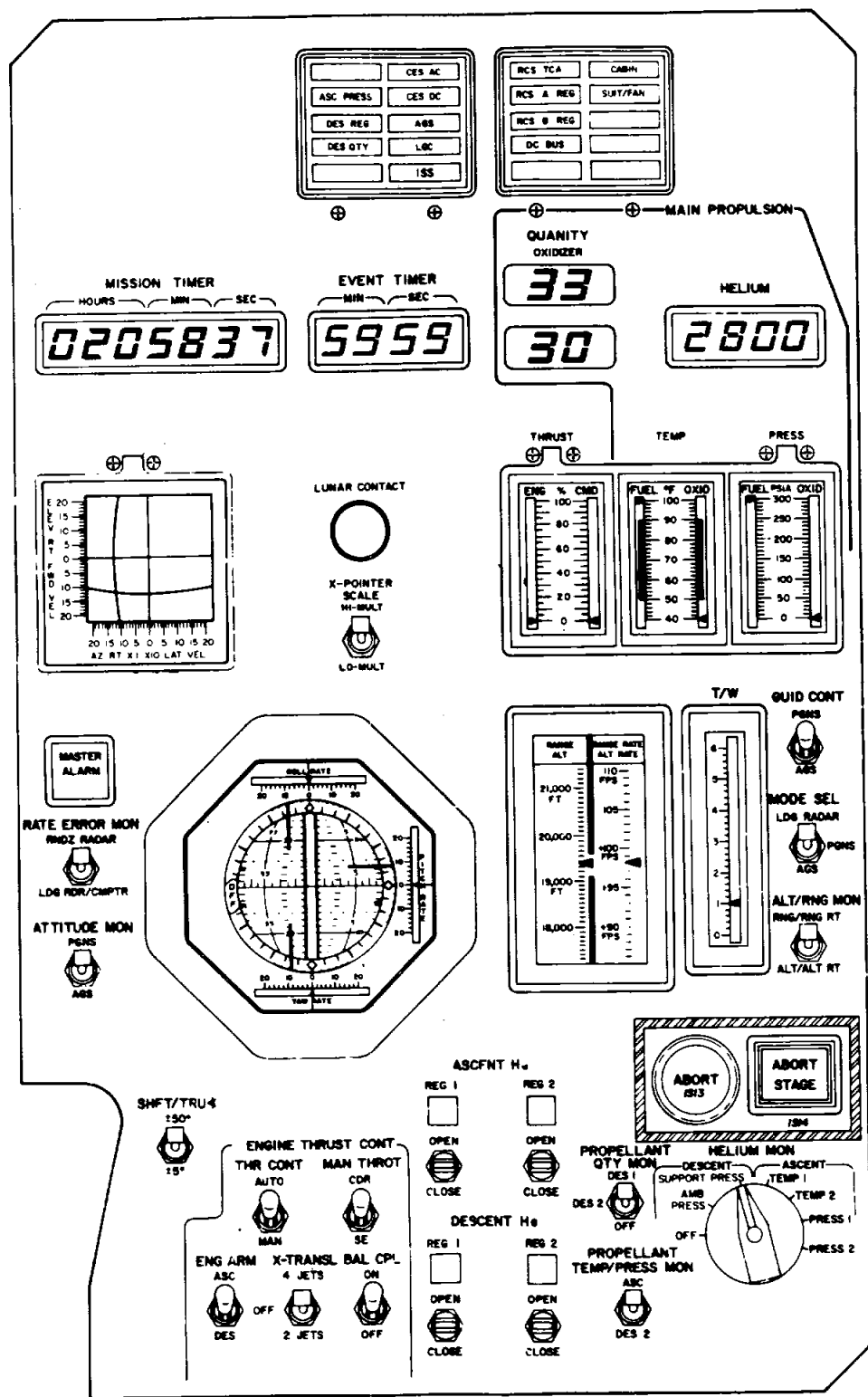
T30005-149
NOV 66



**REACTION CONTROL
SUBSYSTEM SCHEMATIC**

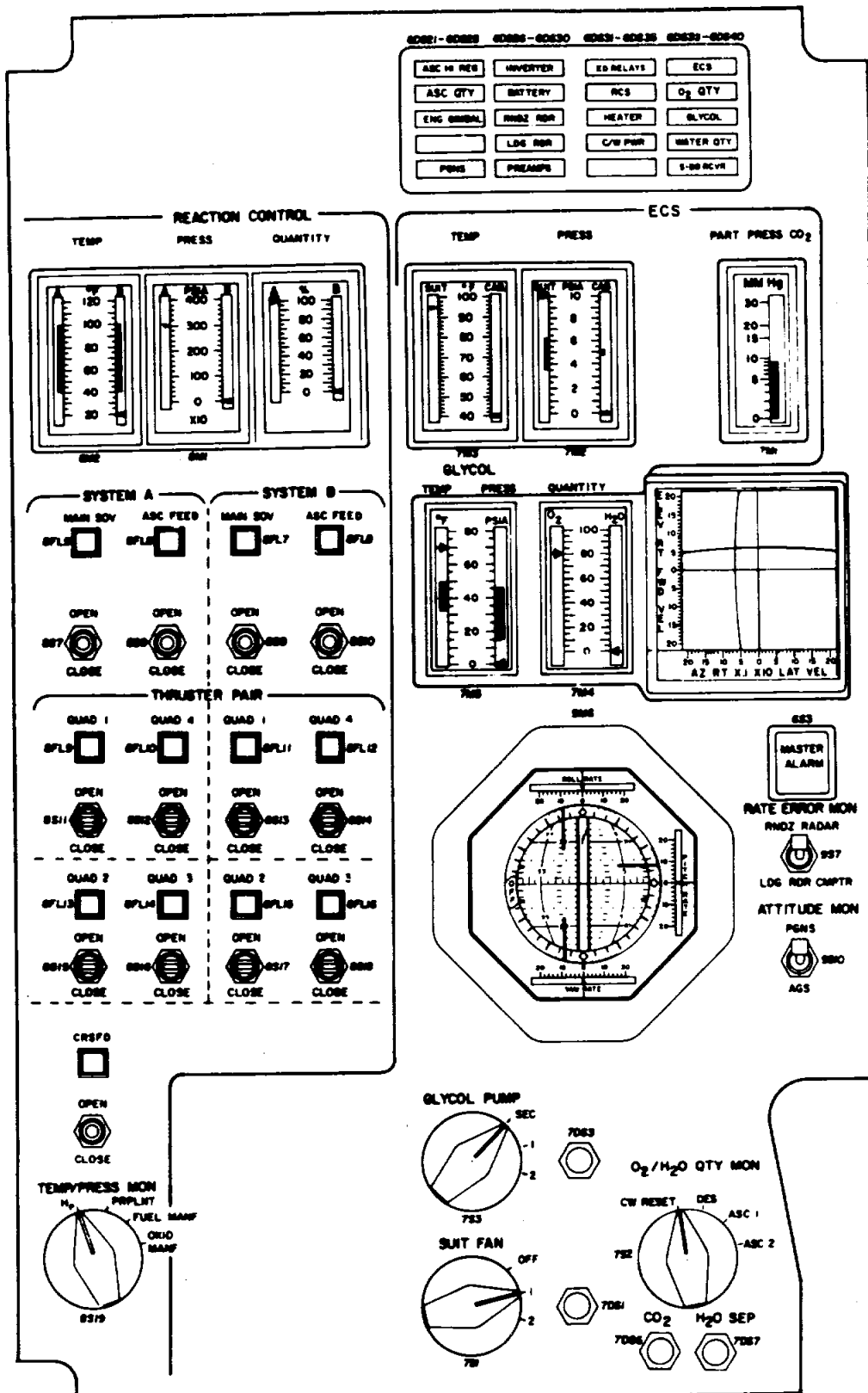
T30005-151
NOV 68

Descent 11/2-16.07
 Prop 45



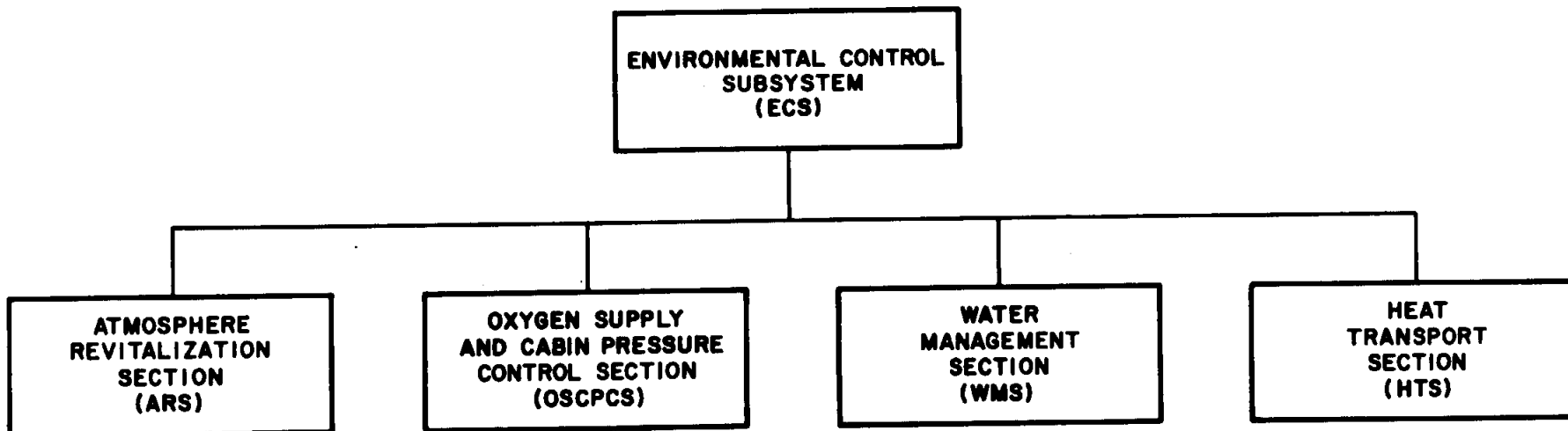
PANEL I

T30005-152
 DEC 66

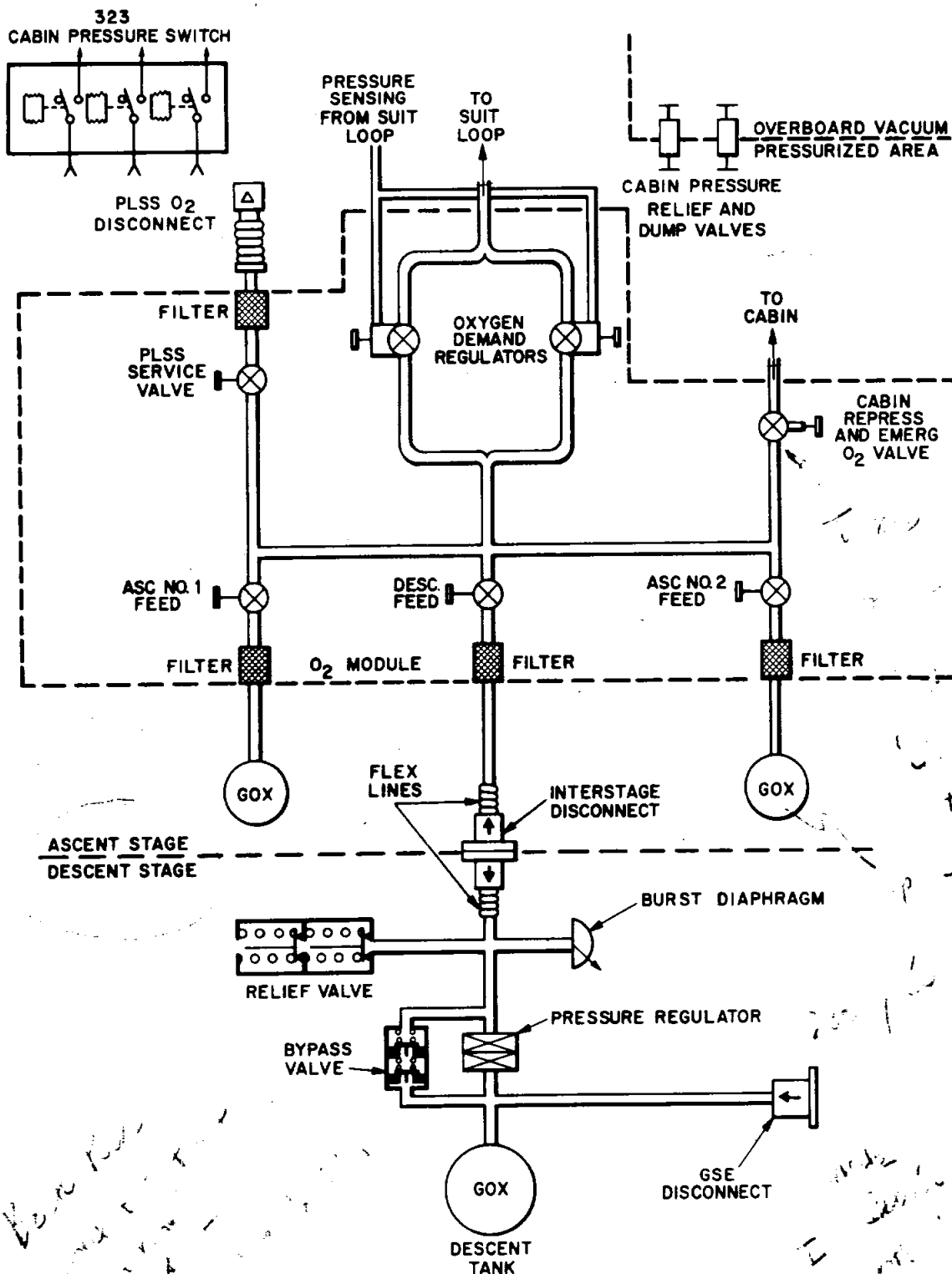


PANEL II

T30005-160
DEC 66

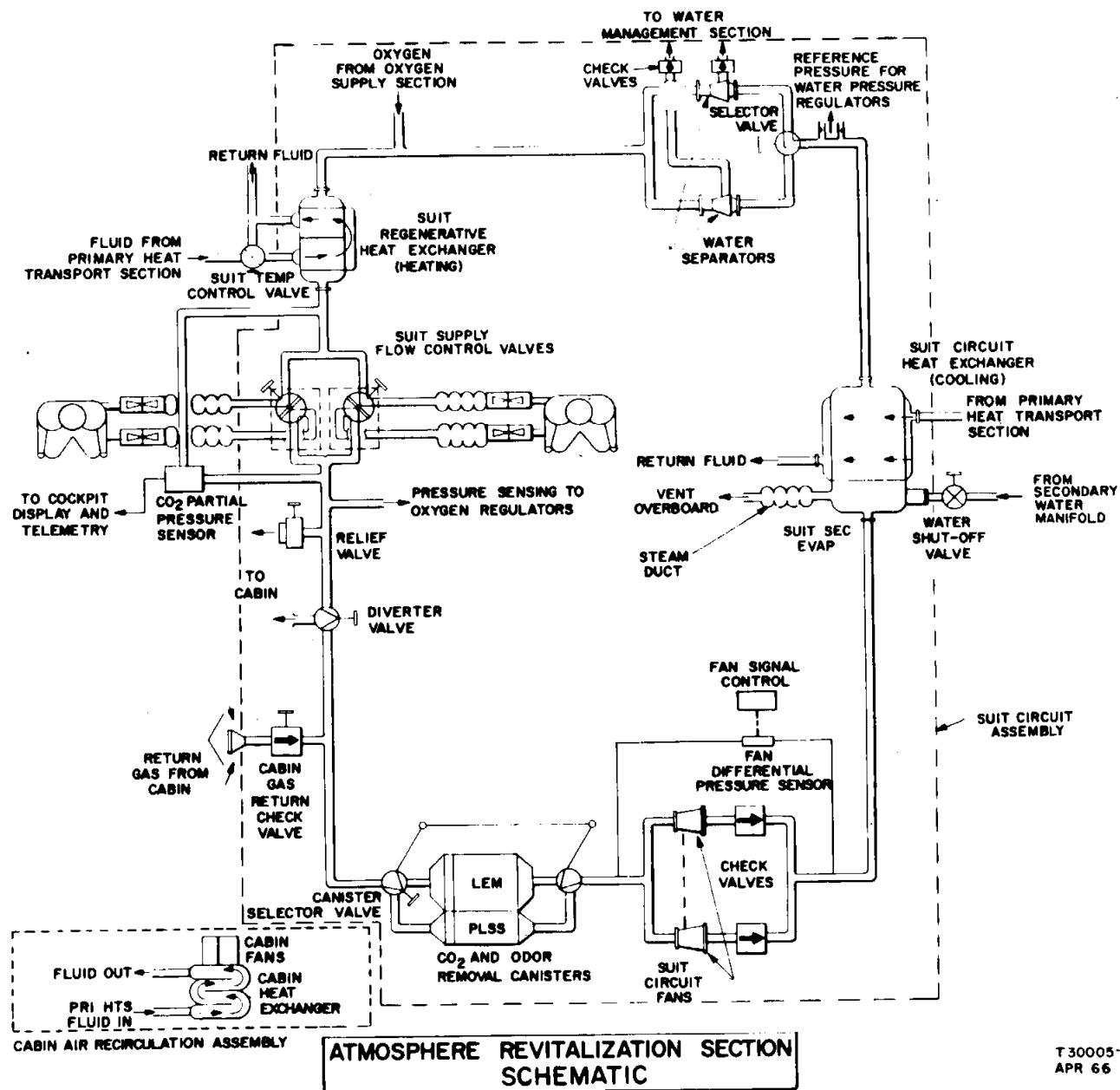


LM ECS BASIC BLOCK DIAGRAM

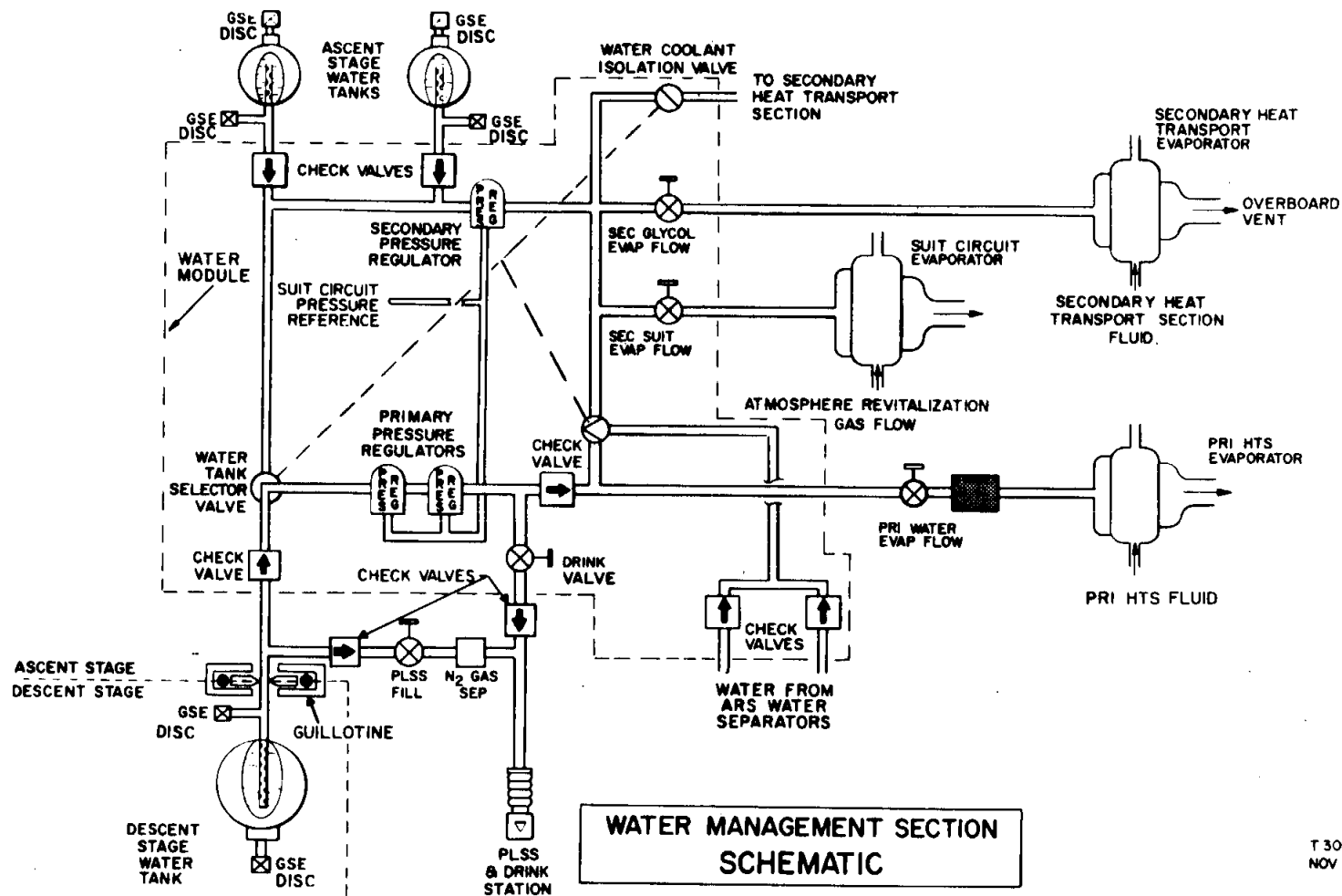


**OXYGEN SUPPLY AND CABIN PRESSURE
CONTROL SECTION SCHEMATIC**

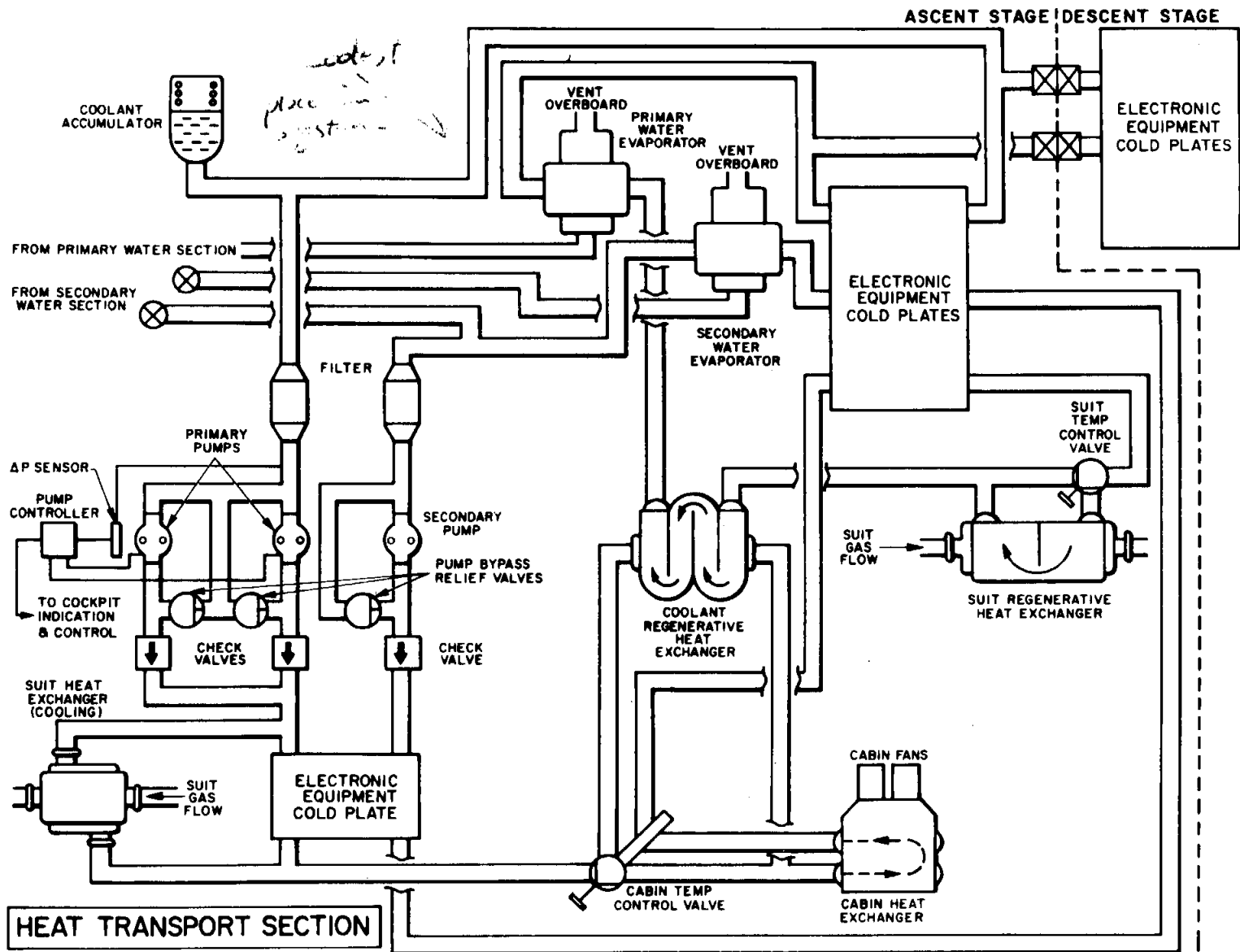
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APR 66



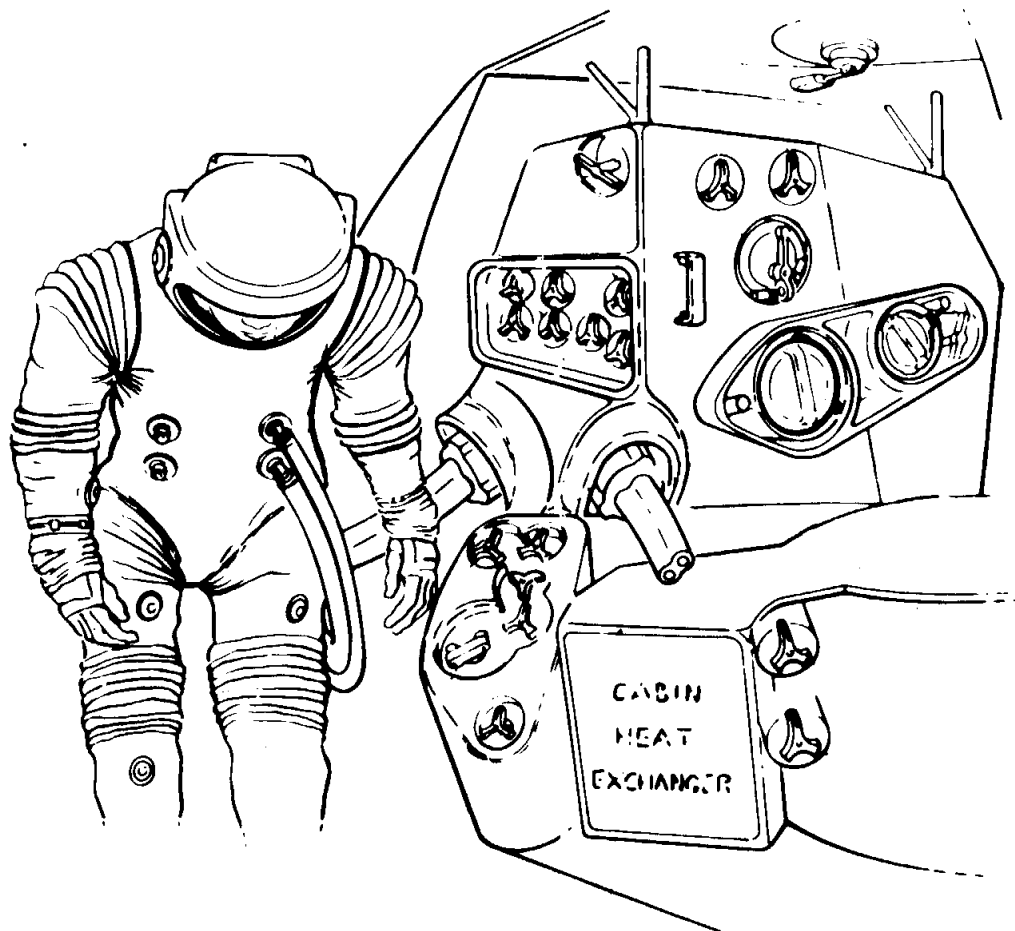
T30005-157
APR 66



T 30005-156
NOV 66

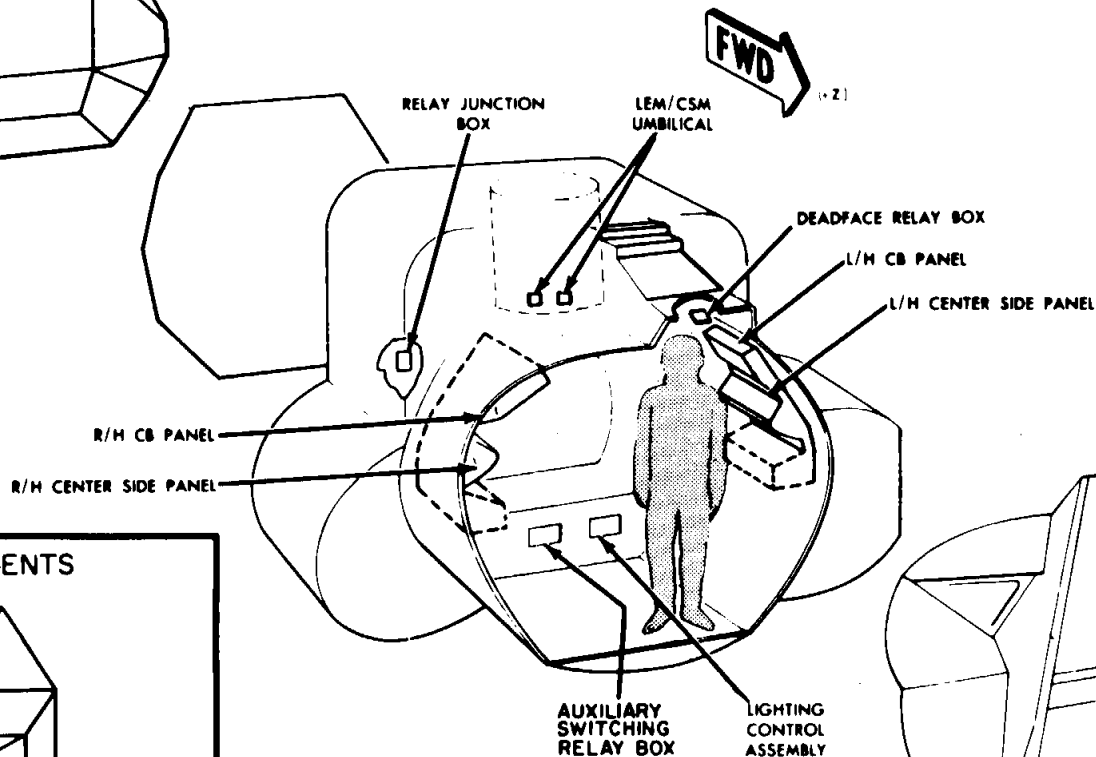
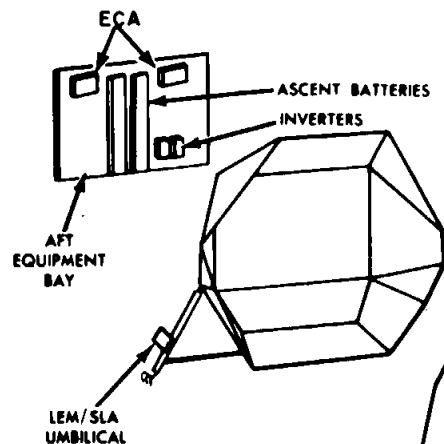


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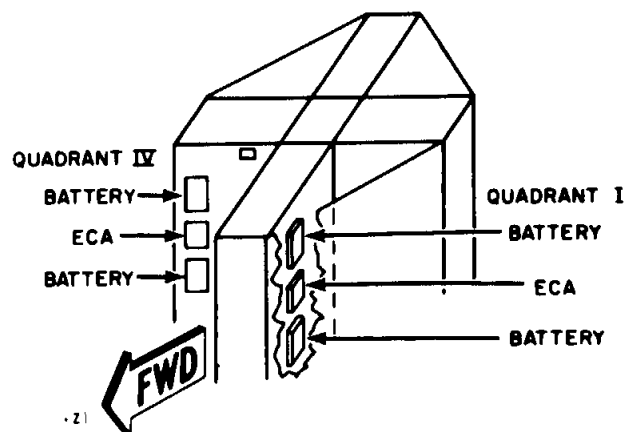


ECS-SPACE SUIT INTERFACE

T30005-33
NOV 66

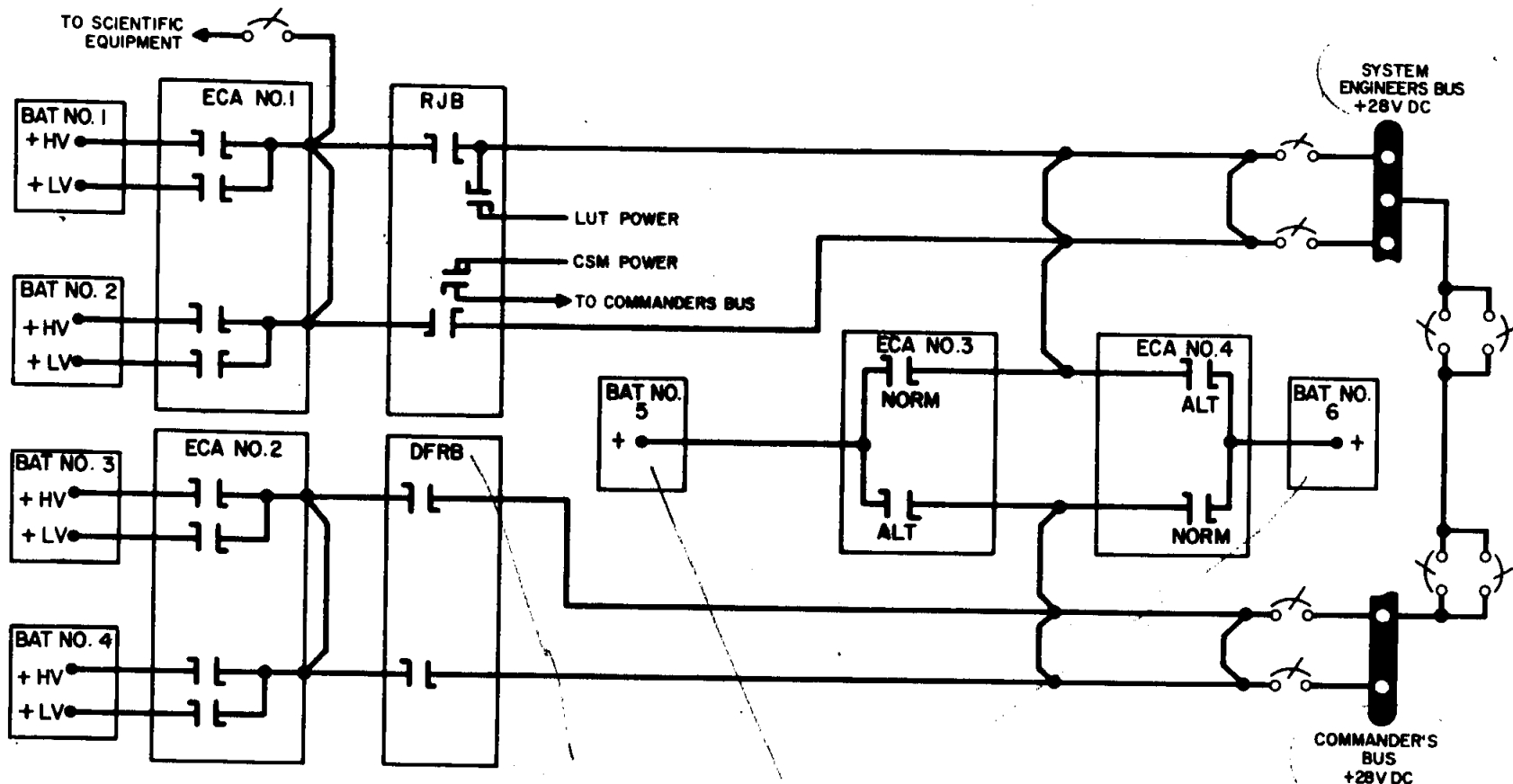


DESCENT COMPONENTS



EPS COMPONENT LOCATION

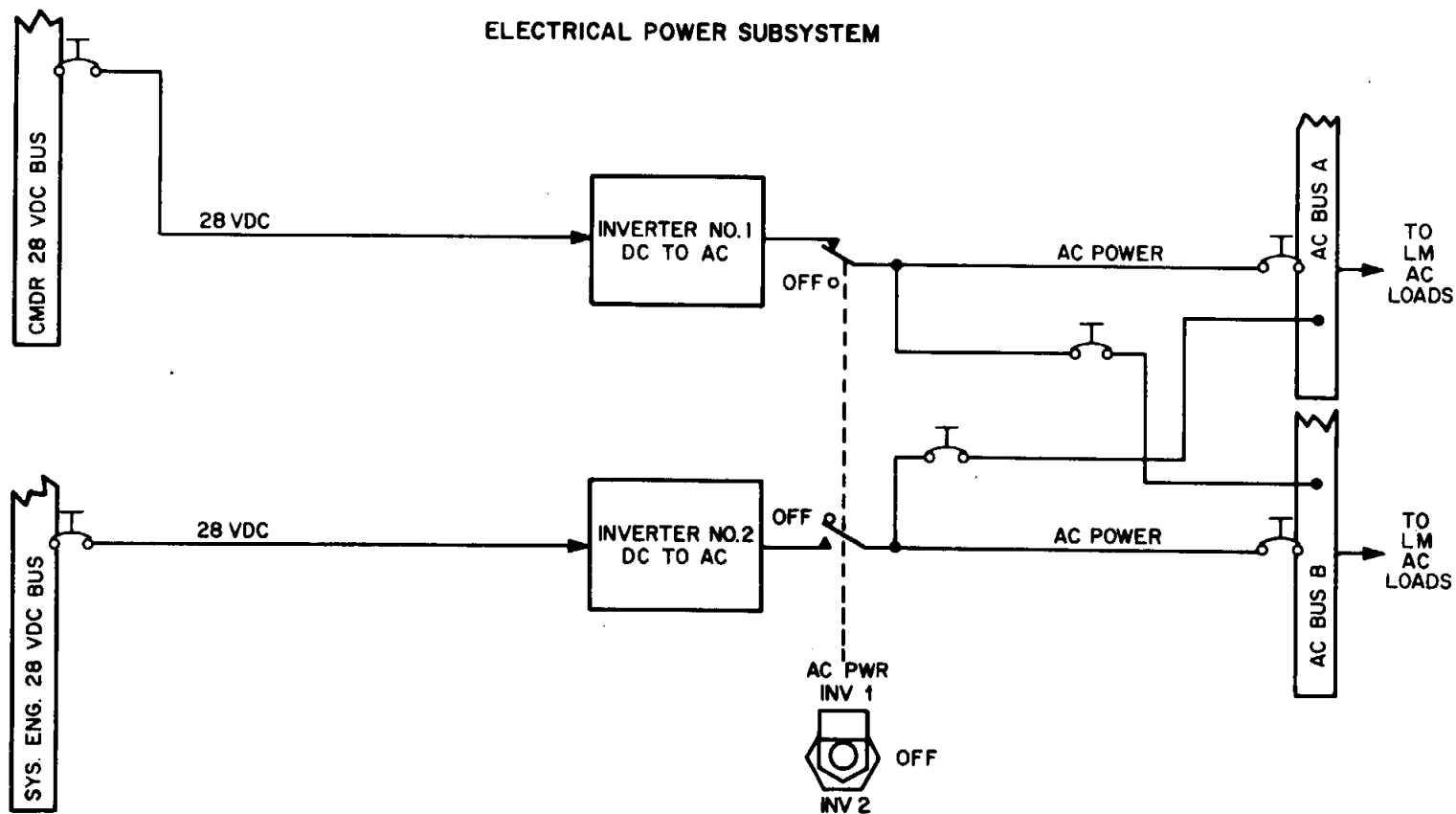
T30005-19
DEC 66



EPS FEEDER SYSTEM

T30005-126
NOV 66

ELECTRICAL POWER SUBSYSTEM

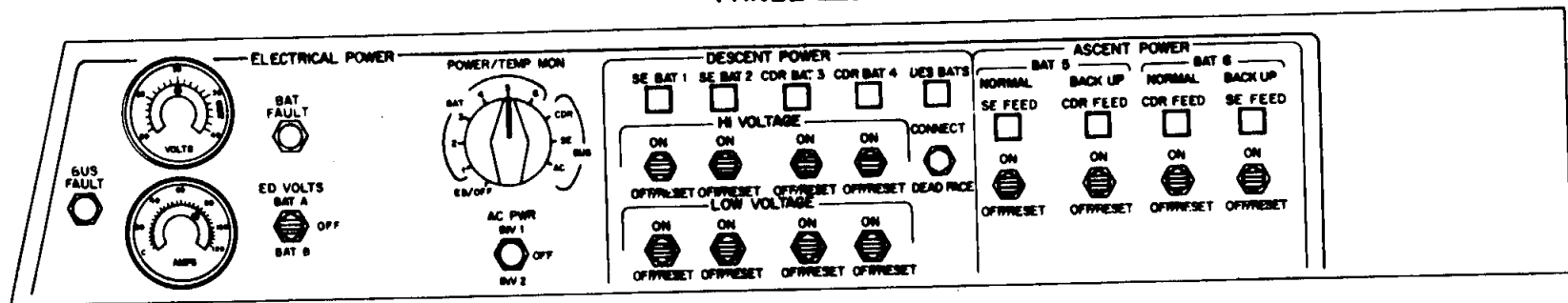


AC DISTRIBUTION BLOCK DIAGRAM

T30005-21
NOV 66

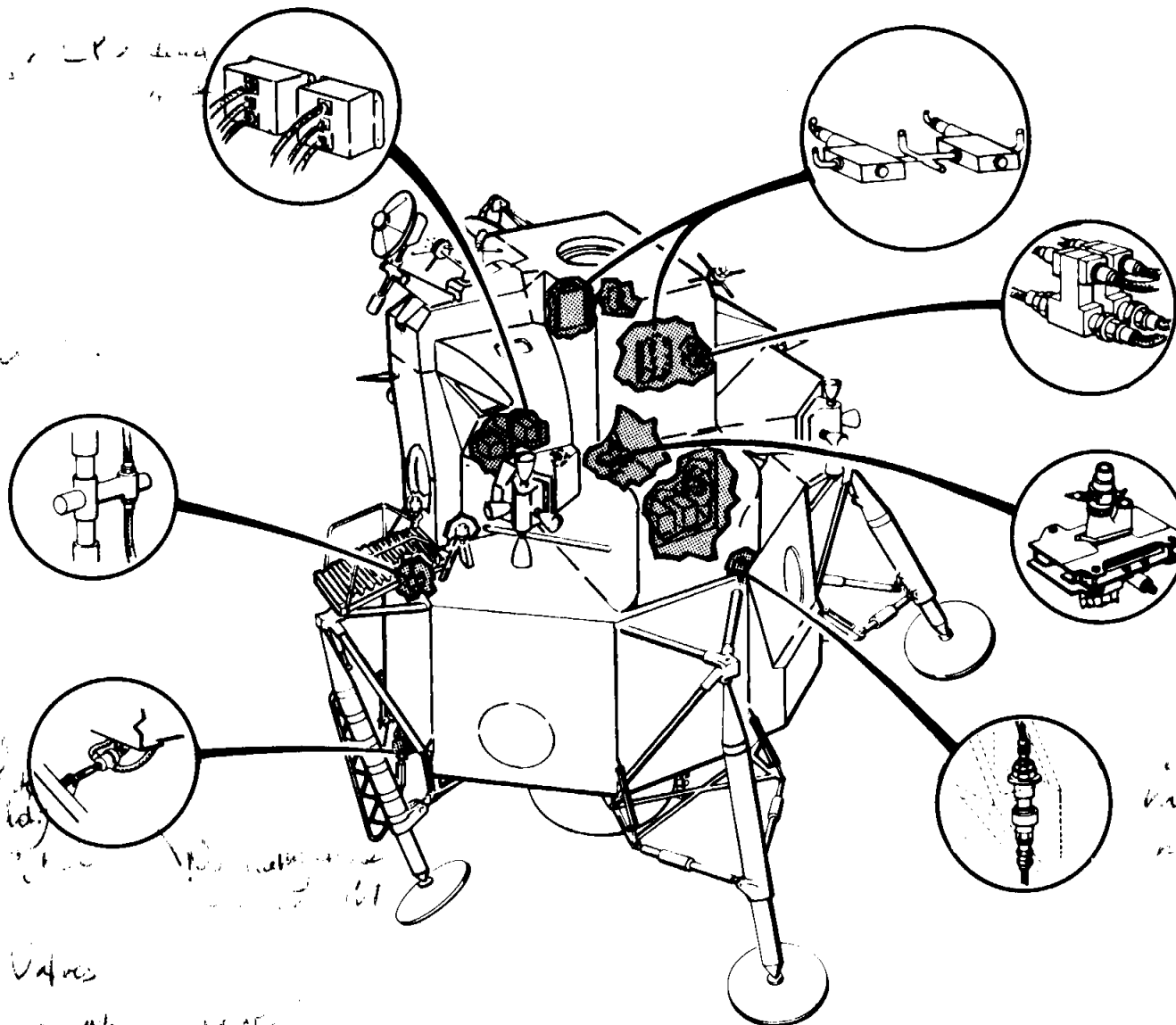
ELECTRICAL POWER SUBSYSTEM

PANEL XIV



CONTROLS AND DISPLAYS

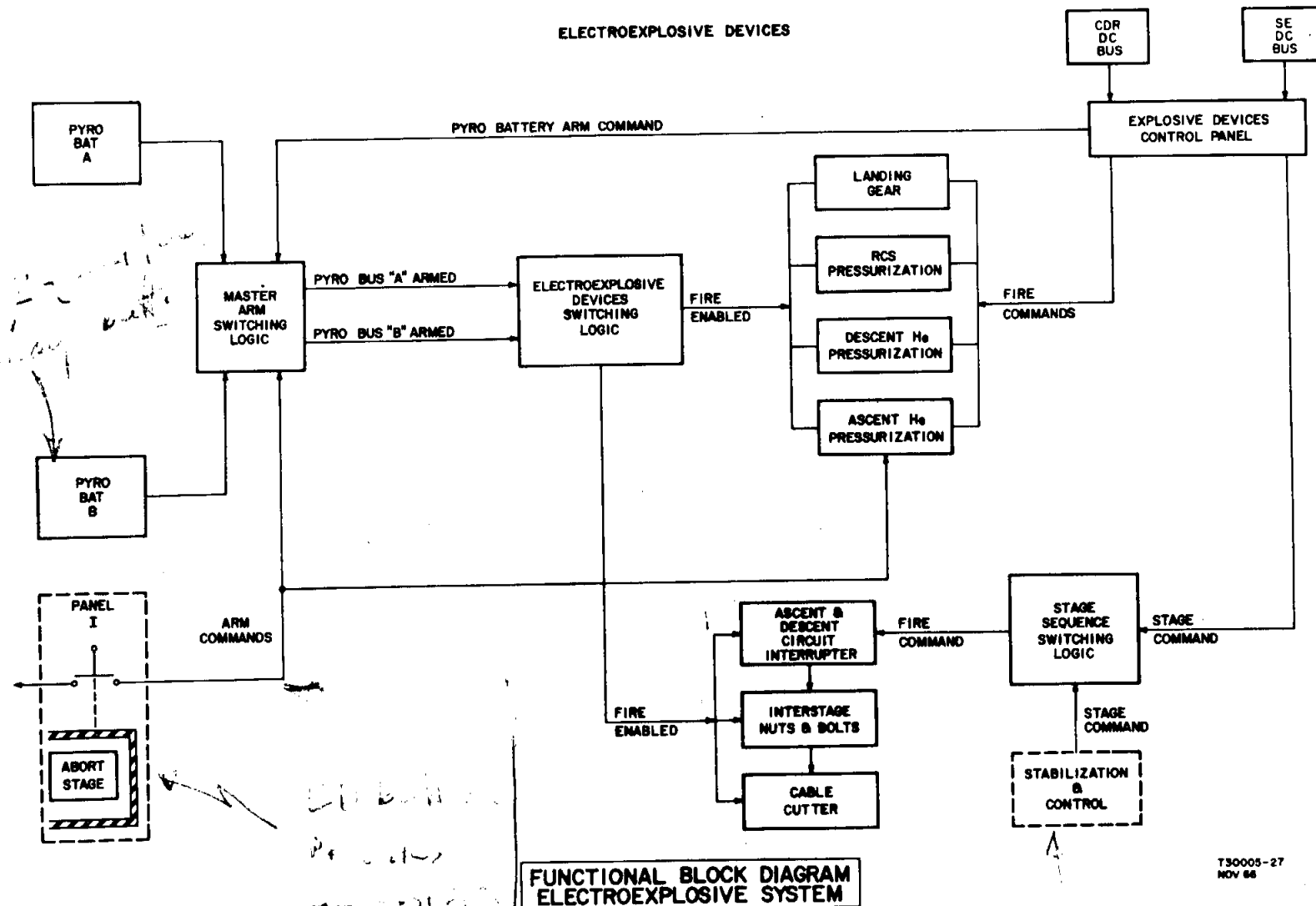
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DEC 66



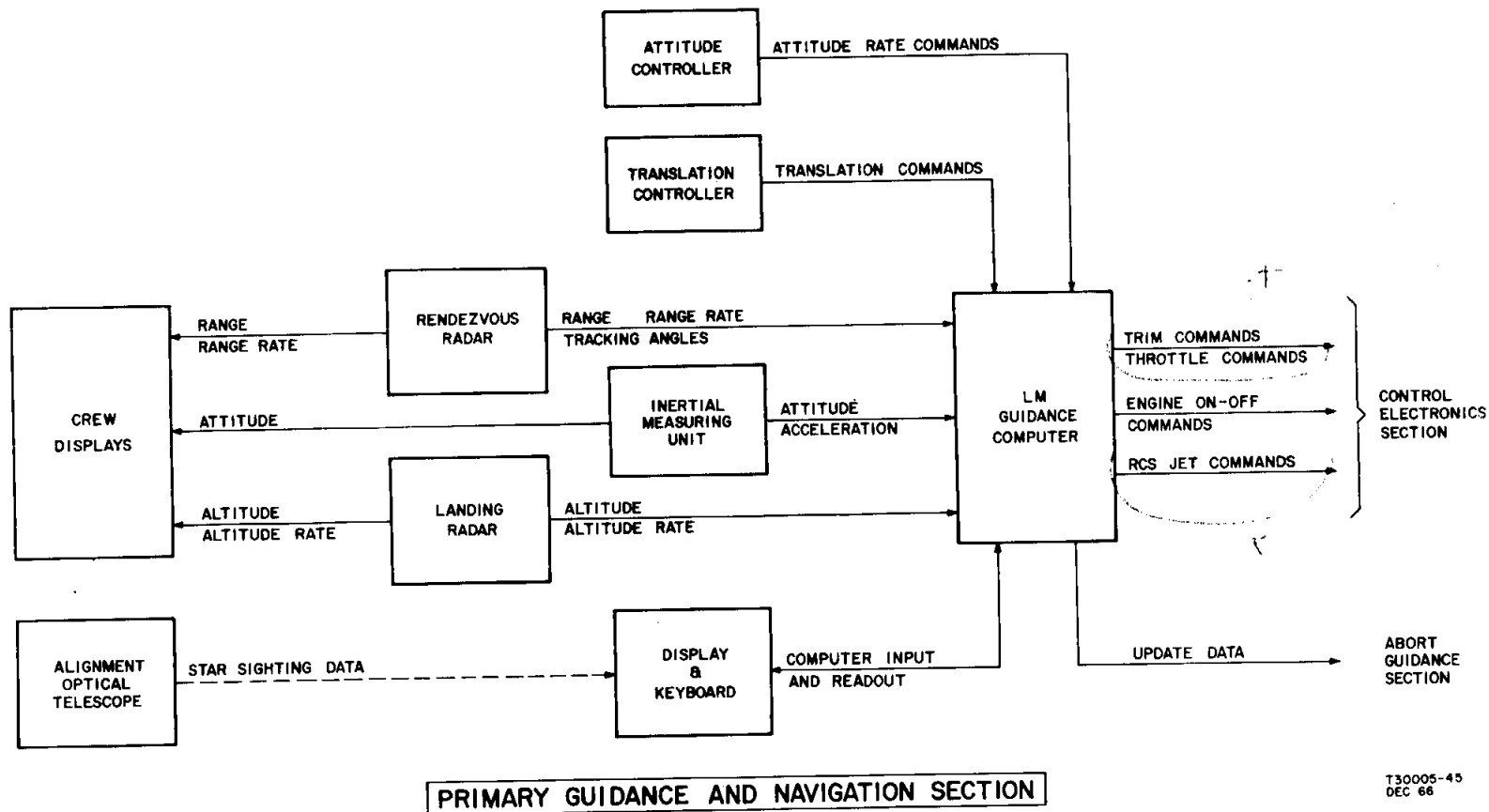
EXPLOSIVE DEVICES-LOCATIONS

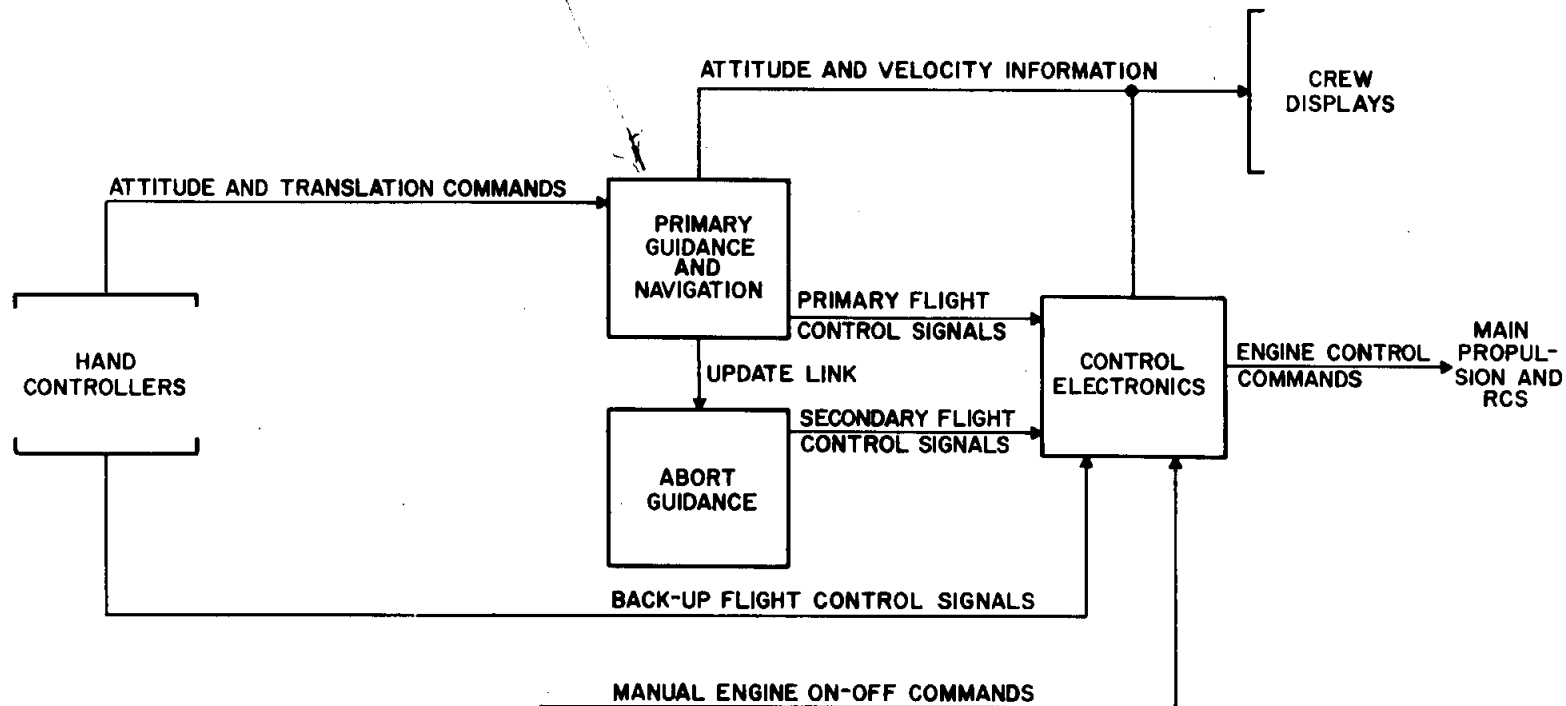
T30005-26
JUNE 66

ELECTROEXPLOSIVE DEVICES



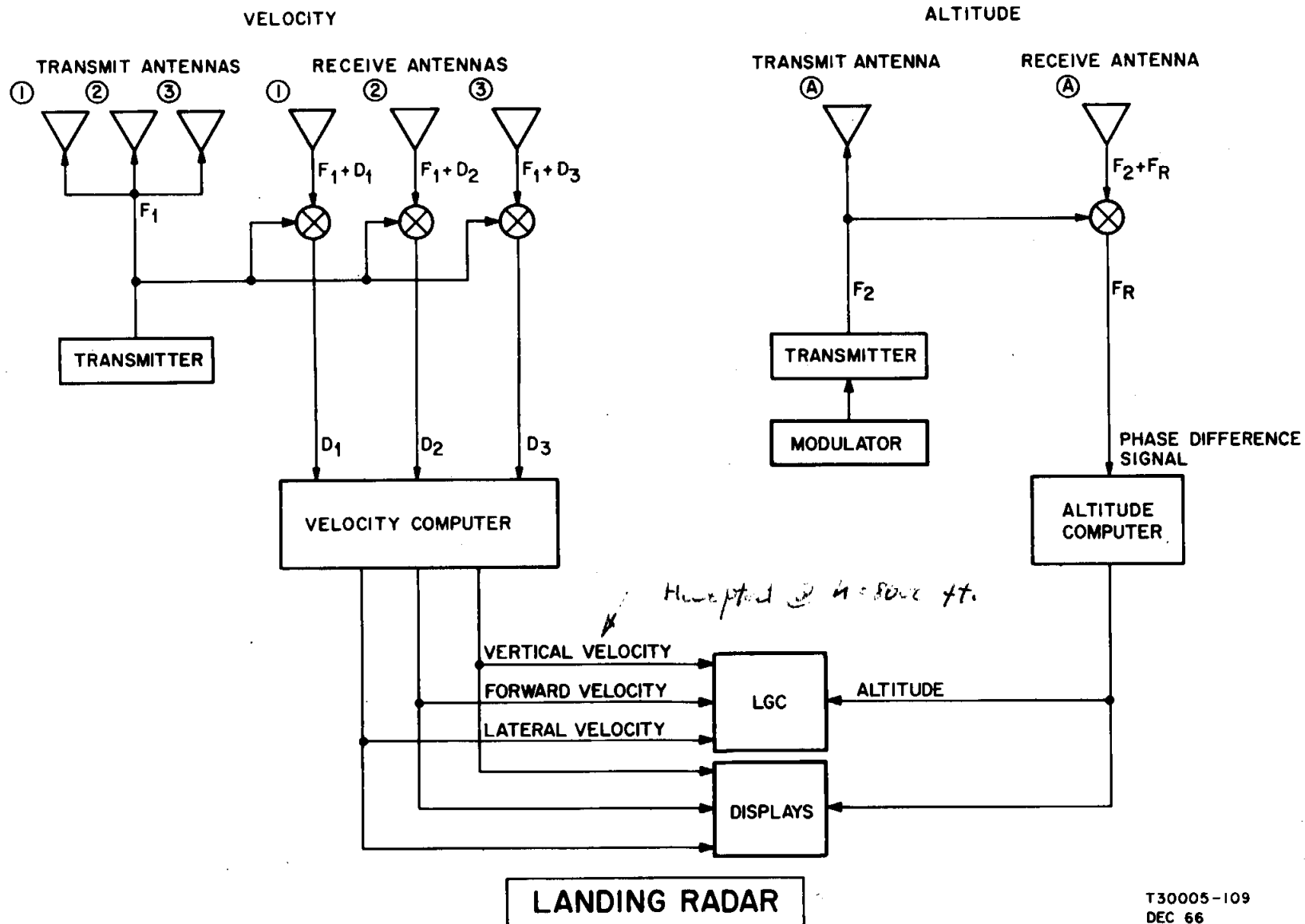
Switch
com. master
2/4/8





Don't ...

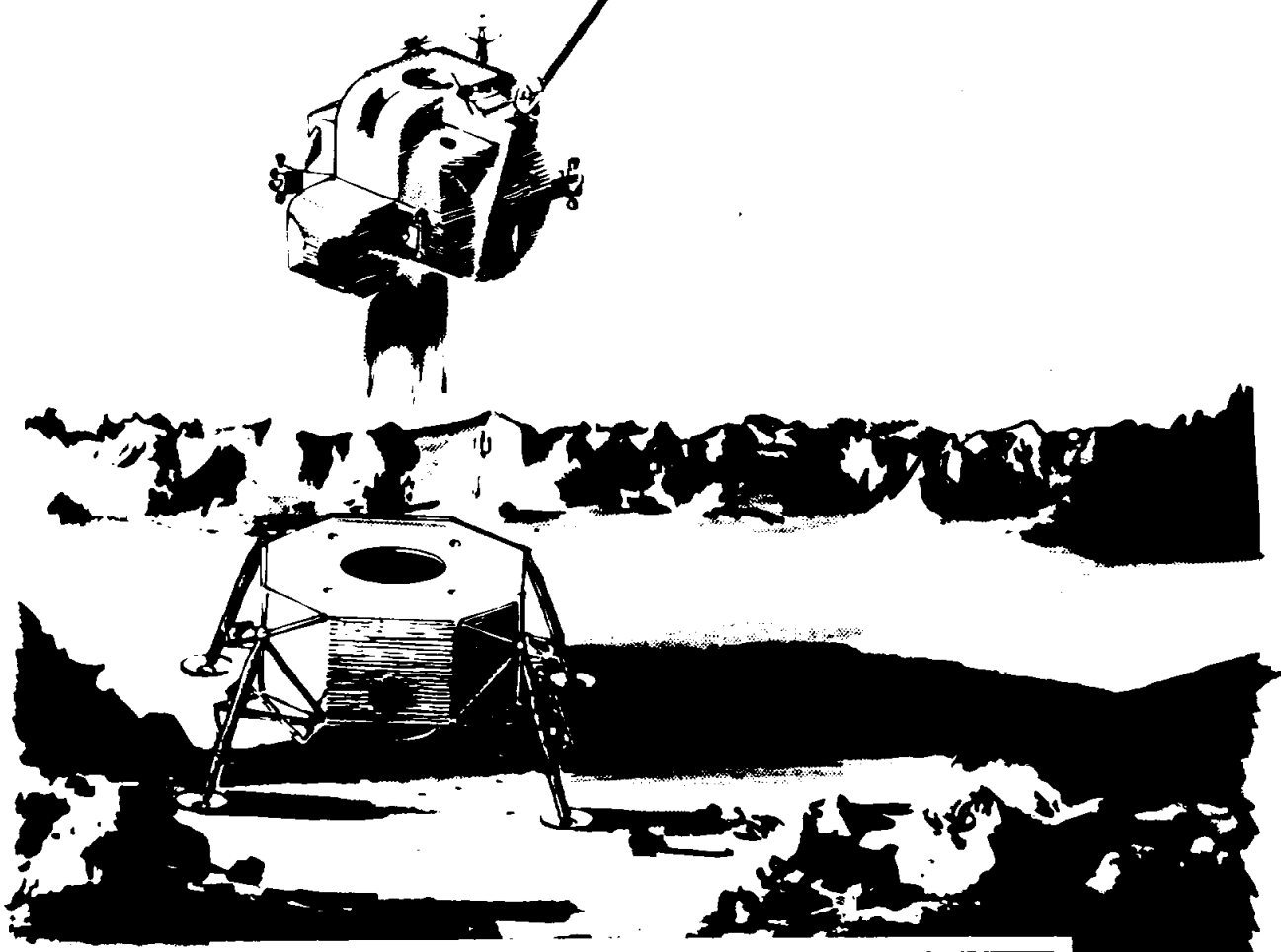
**LM GUIDANCE, NAVIGATION
AND CONTROL SUBSYSTEM**



CM - transponder sends,
each constant reply
to the signal sent out
by CM RA

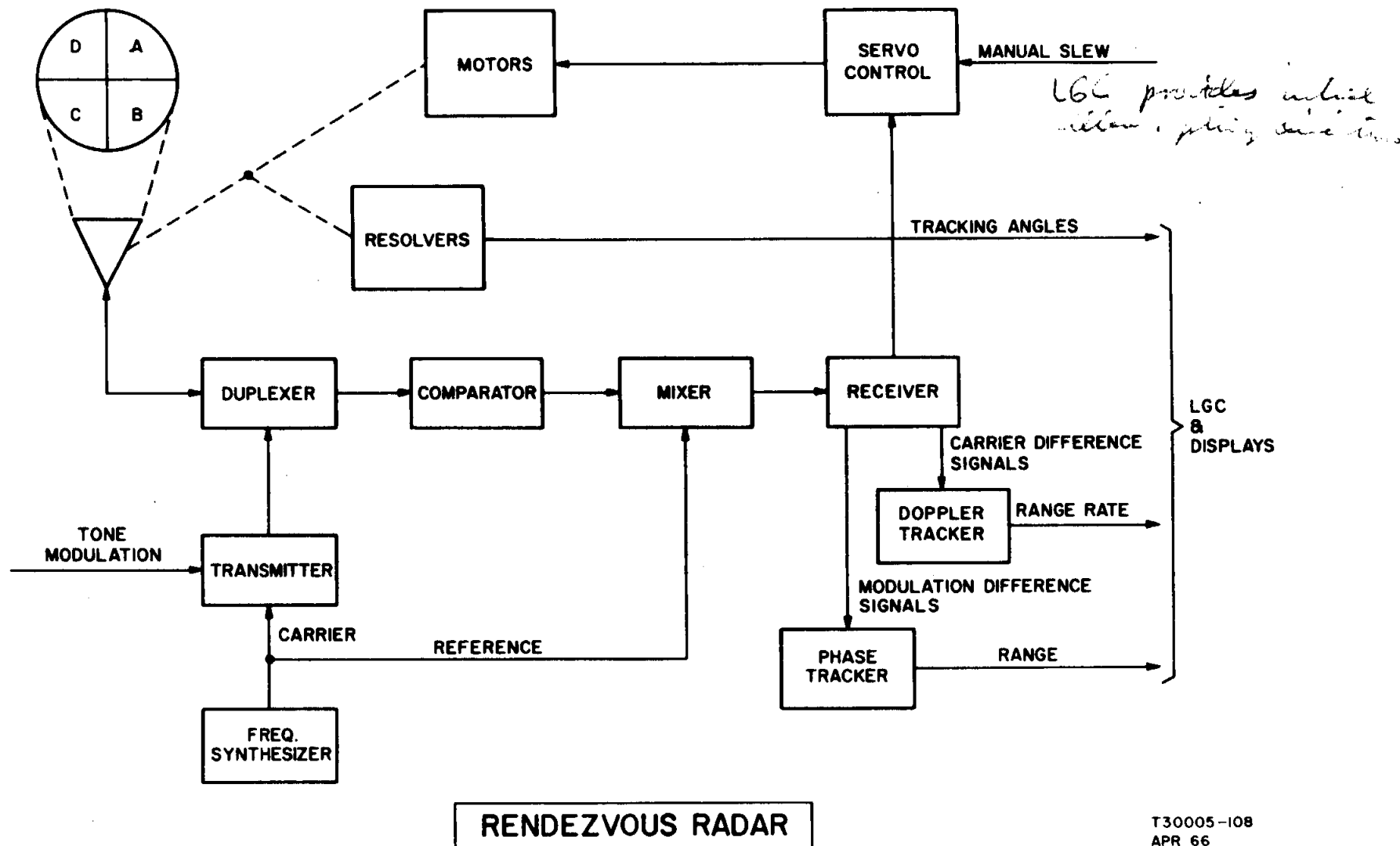
Search for Transponder
up to 400 miles

RANGE
RANGE RATE
TRACKING ANGLES



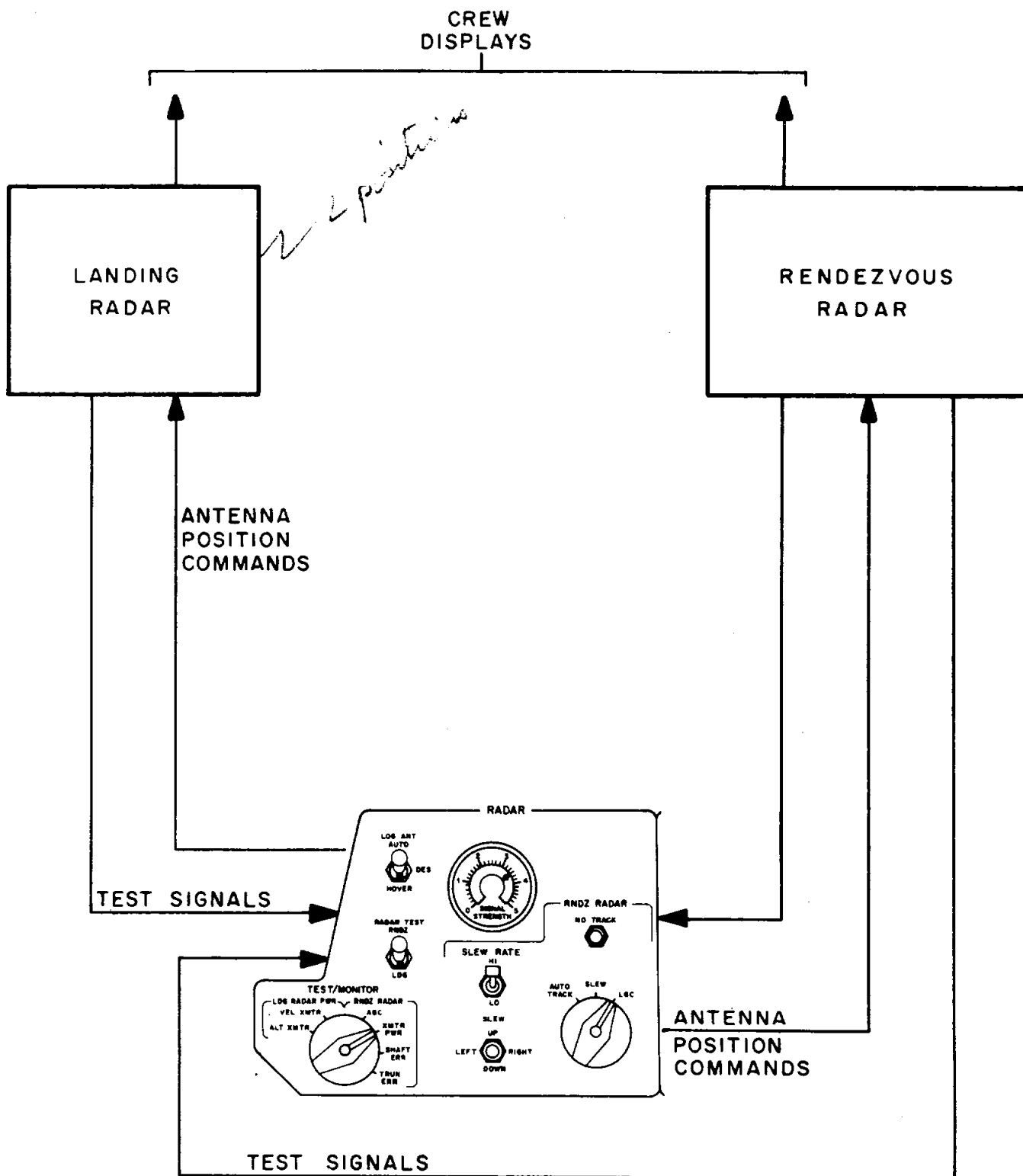
RENDEZVOUS RADAR OPERATION

T 30005-103
APR 66

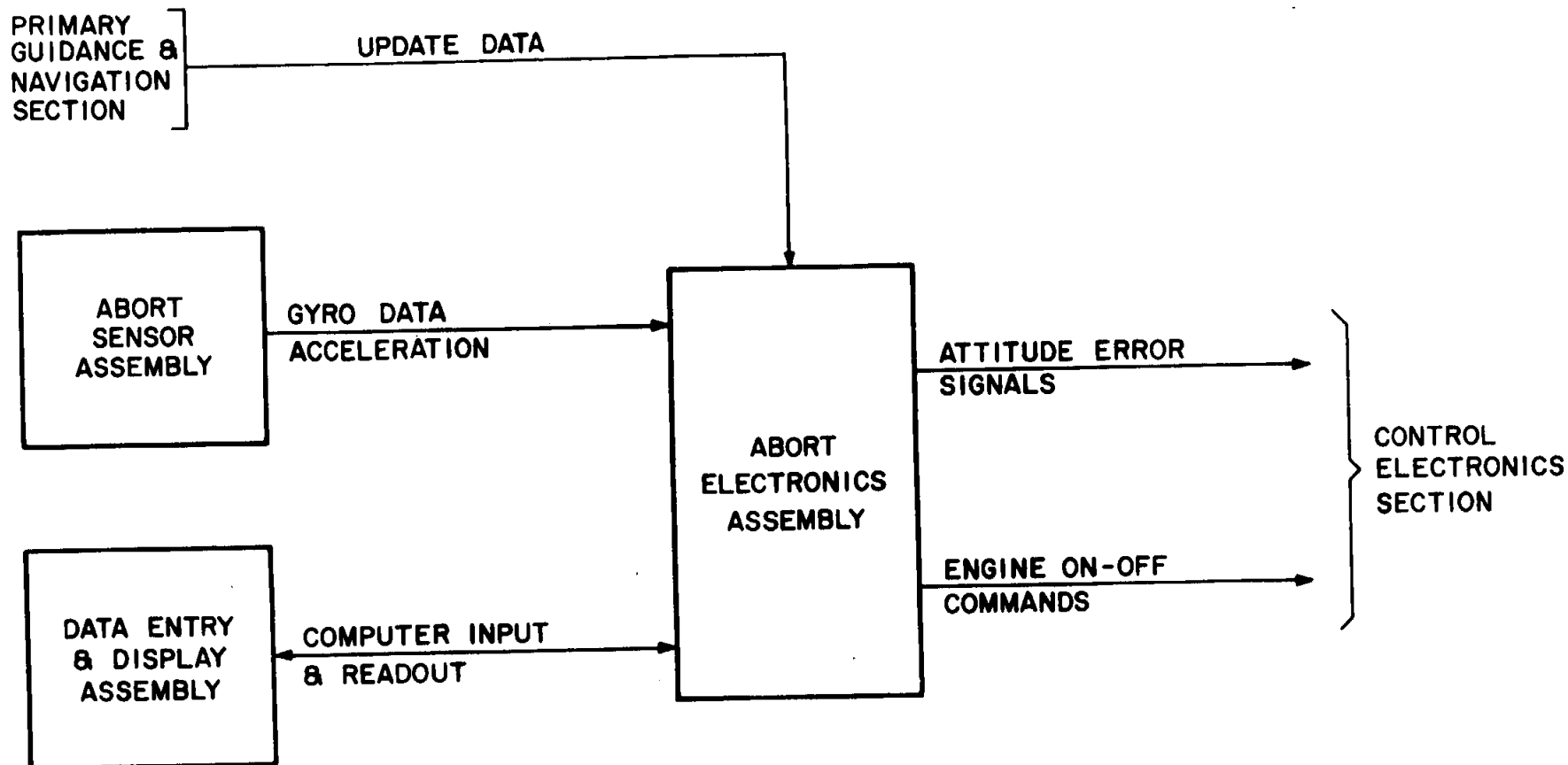


*LGC provides initial
align. giving some time*

*And also
HTL in p.h.
If ant. is misaligned on M, will + negative
in the + the no. will be +ve*



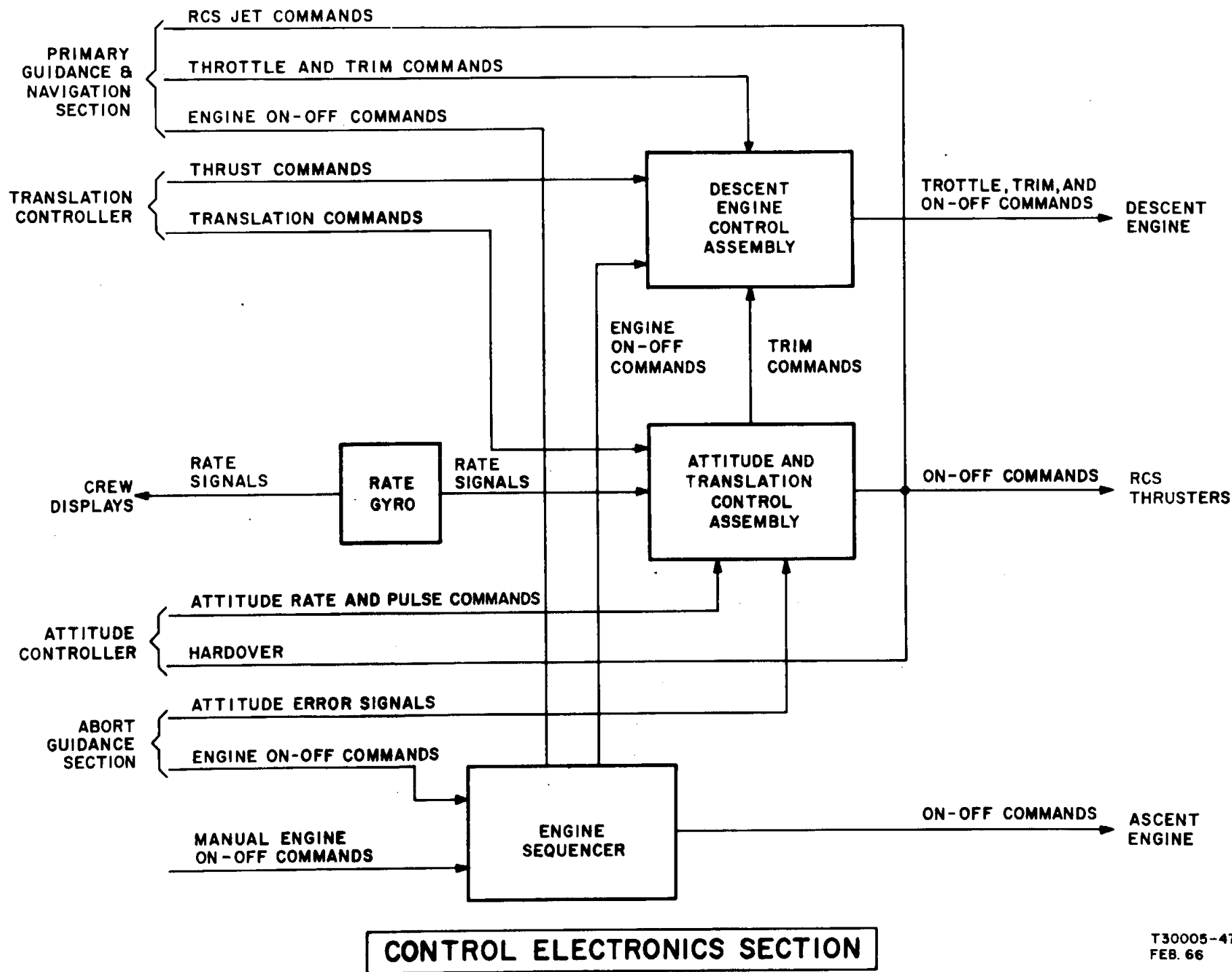
**PANEL III
RADAR CONTROL**

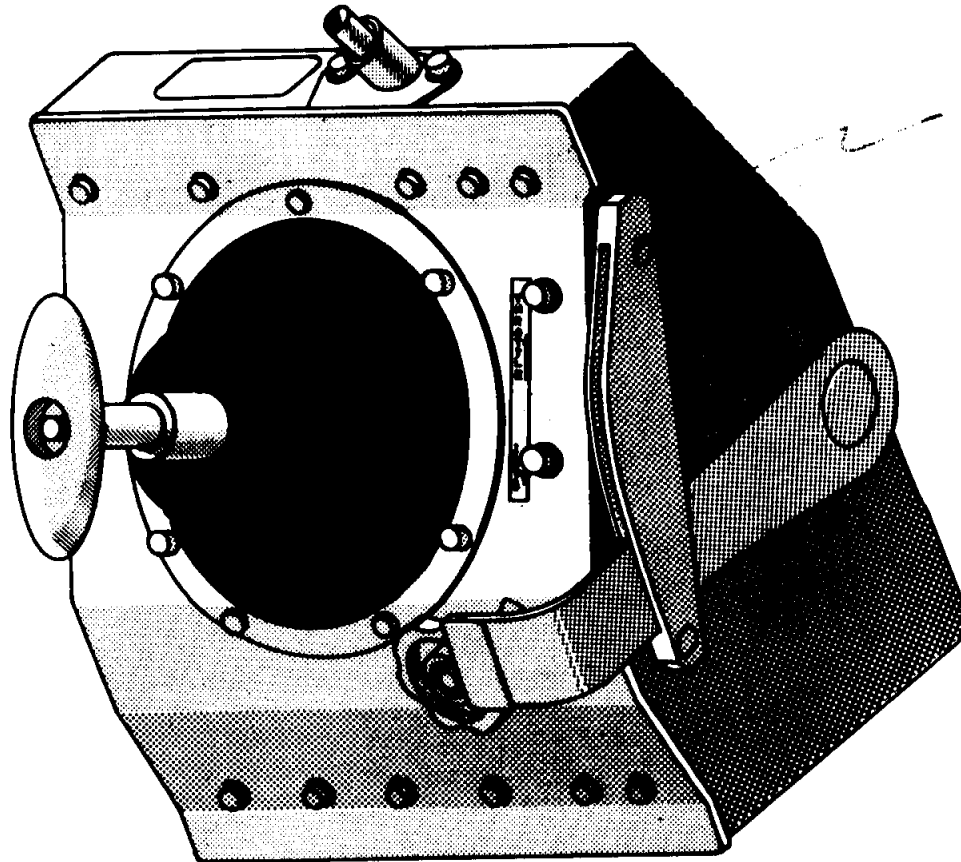


ABORT GUIDANCE SECTION

T30005-46
FEB 66

Descent eng. may be used for an abort starting descent.
in this case the eng. fuel unit



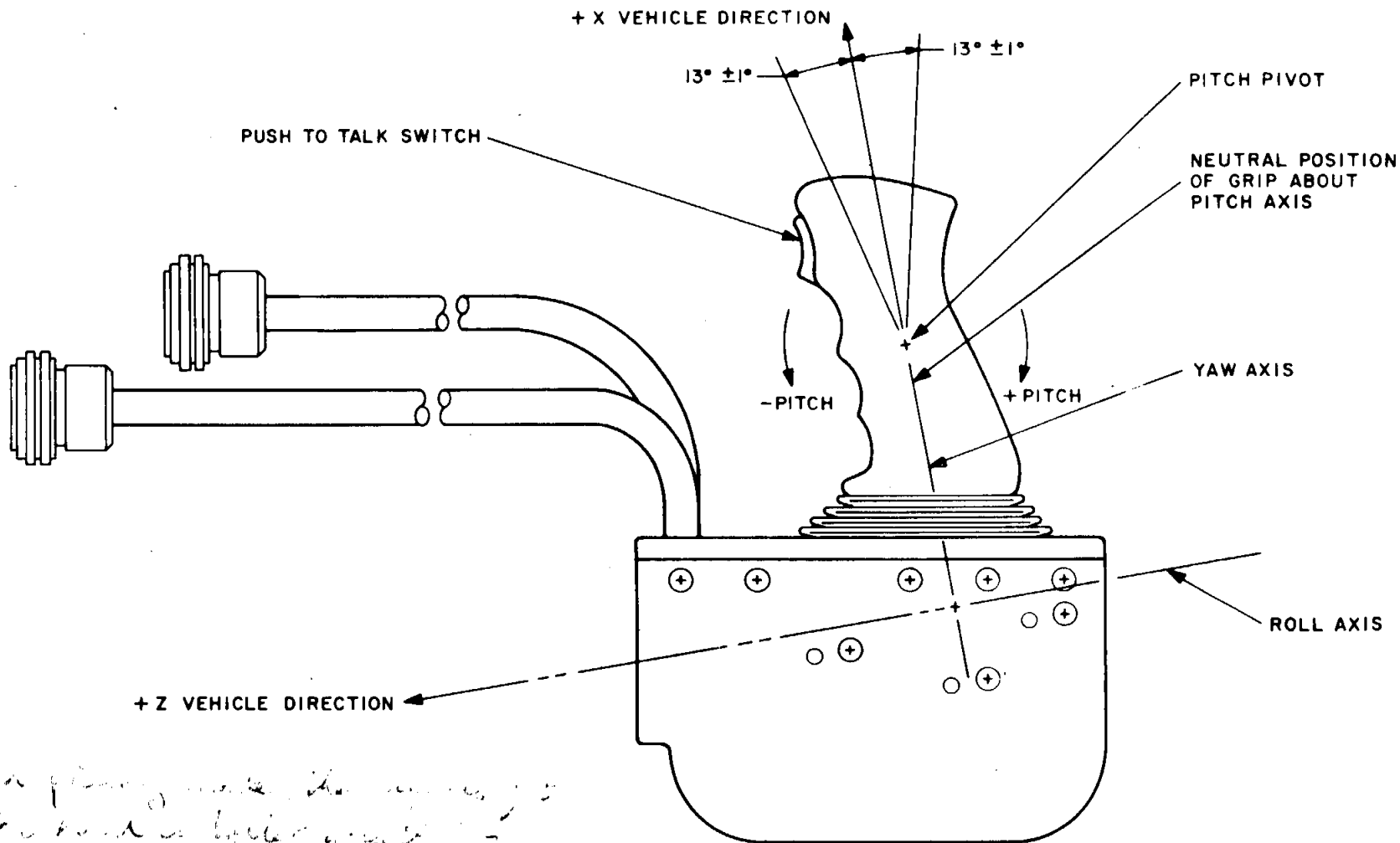


in this position
 & y-axis for
 the main thrust
 bottle

THRUST TRANSLATION CONTROLLER ASSEMBLY

T30005-51
 DEC 66

PC
 L X 4
 L 3
 L 1

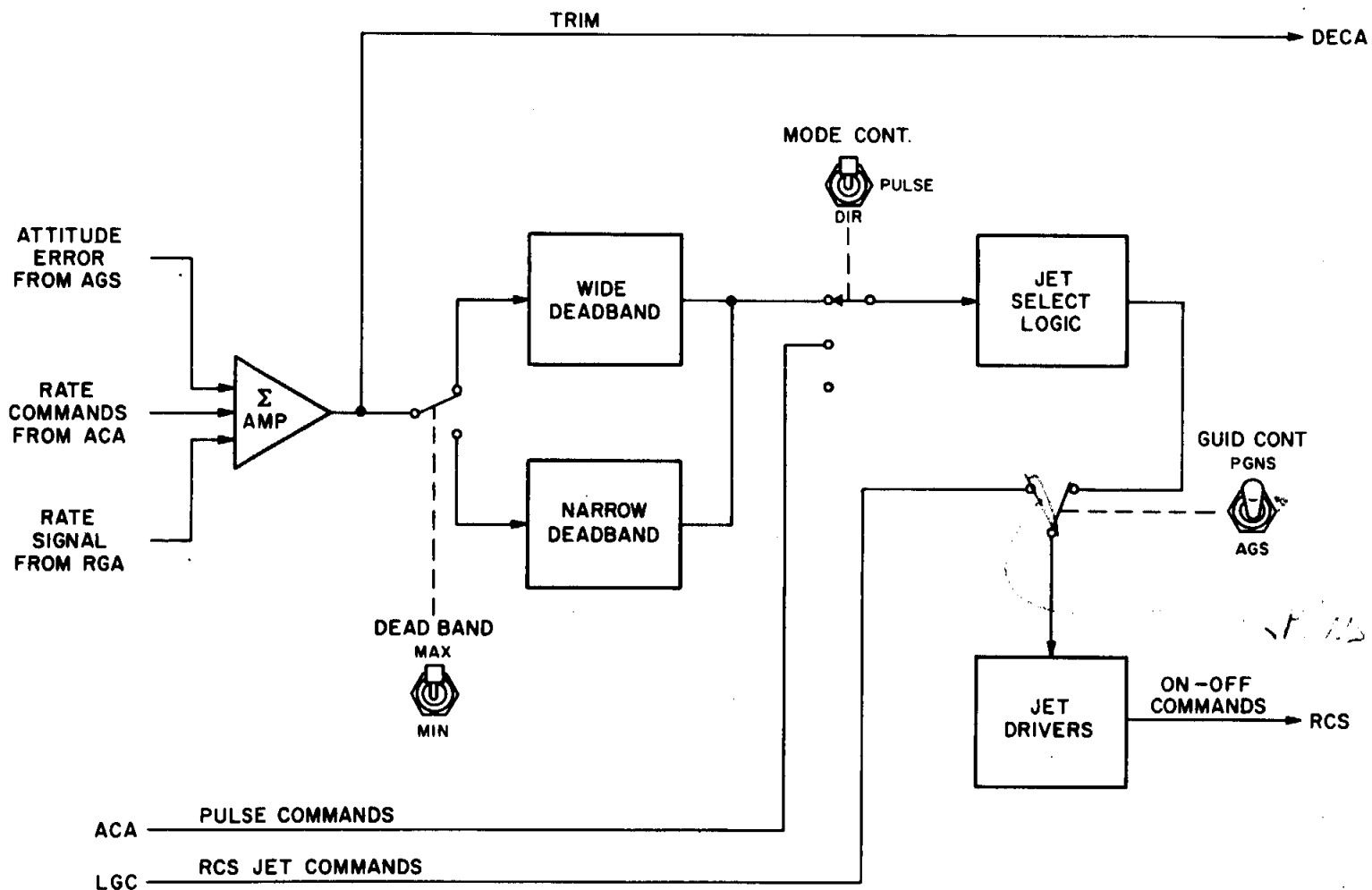


In place of the original
 the hand is held in the
 1.5 ft. H2O to a 2000 ft.
 low volume of water to the
 bottom of the column,
 the

ACA MANIPULATION

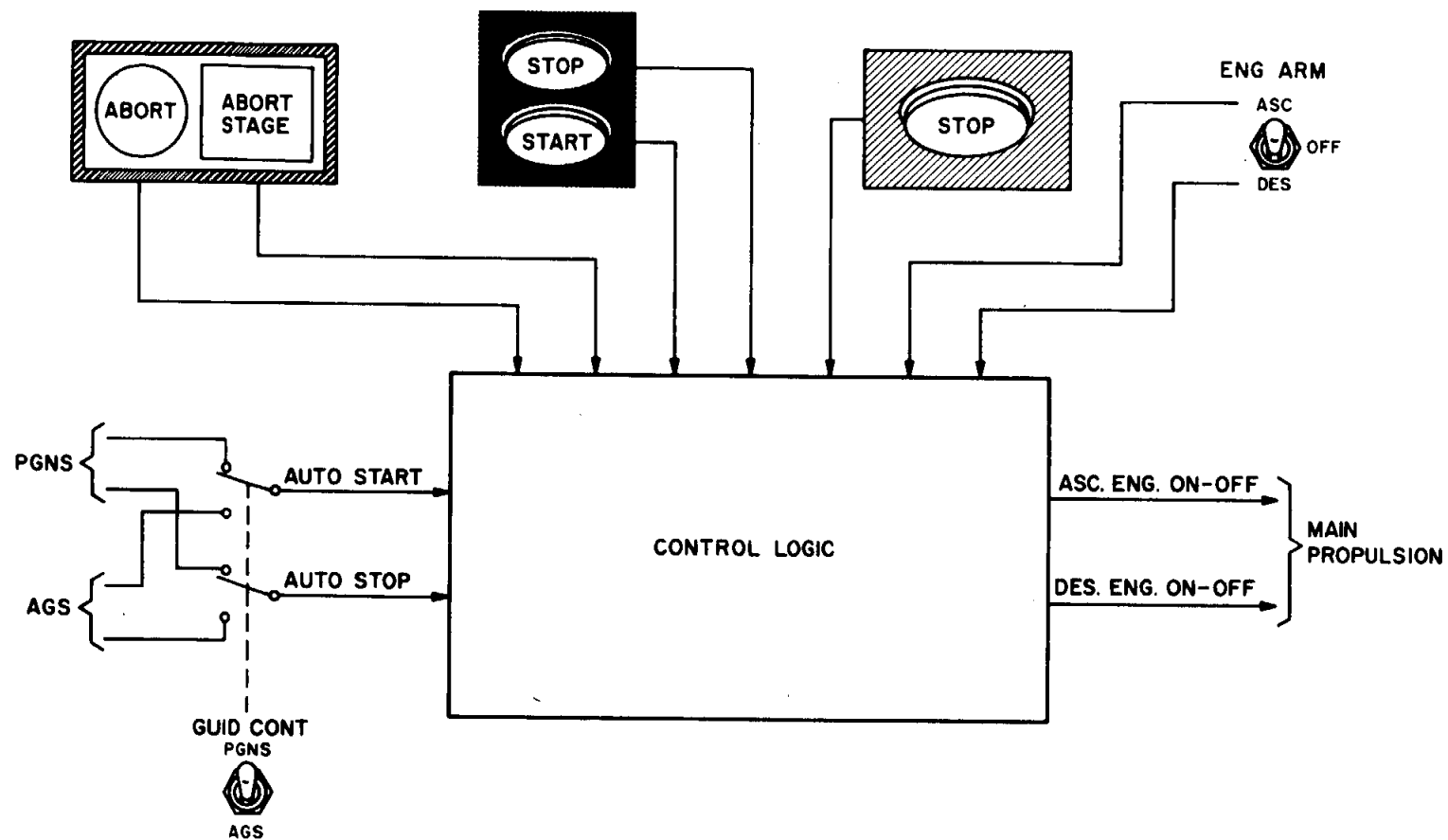
Att. to Area H2O

T30005-52
 DEC 66

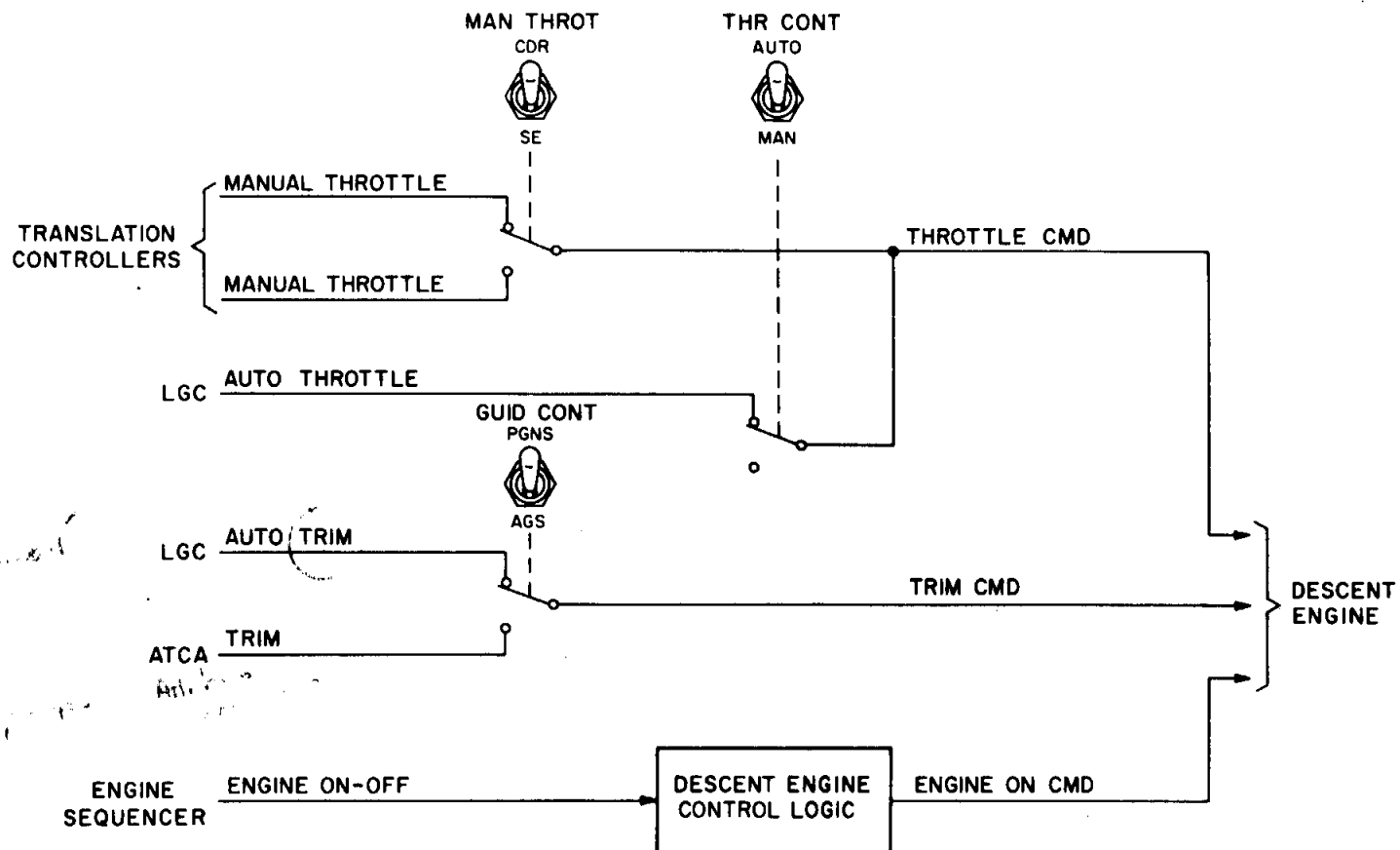


ATTITUDE AND TRANSLATION CONTROL ASSEMBLY

T30005-107
APR 66

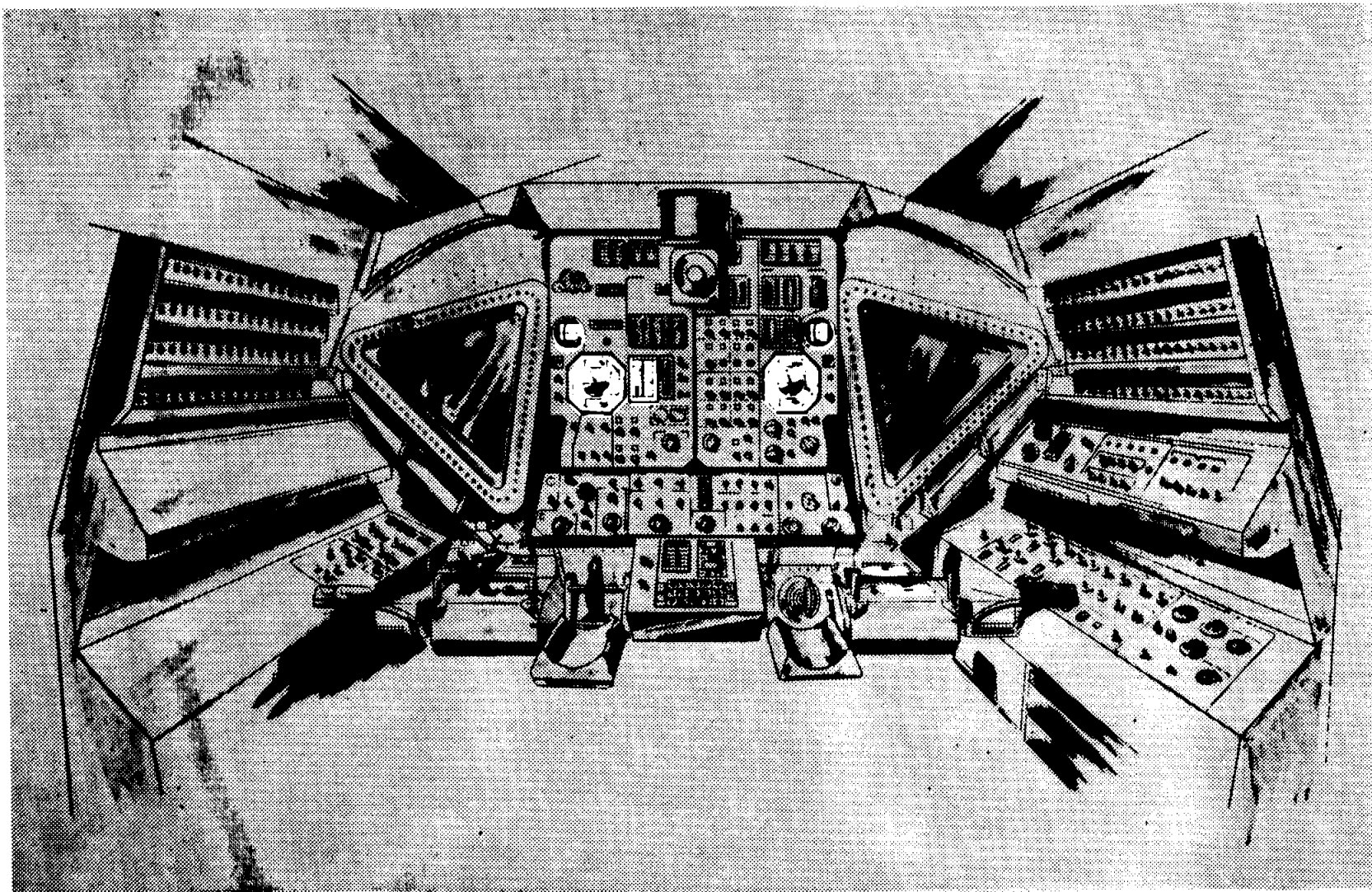


ENGINE SEQUENCER



DESCENT ENGINE CONTROL ASSEMBLY

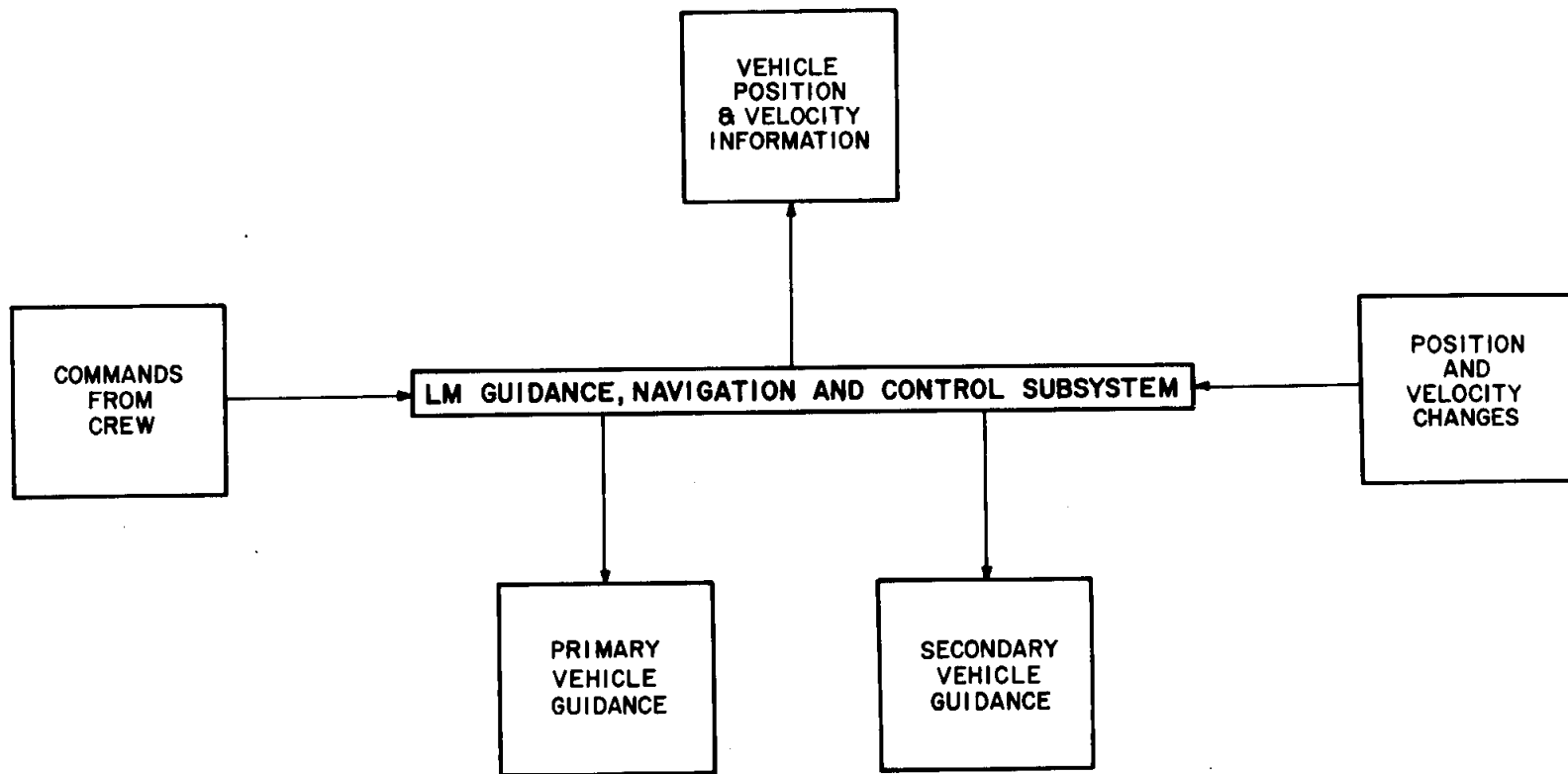
T30005-106
APR 66



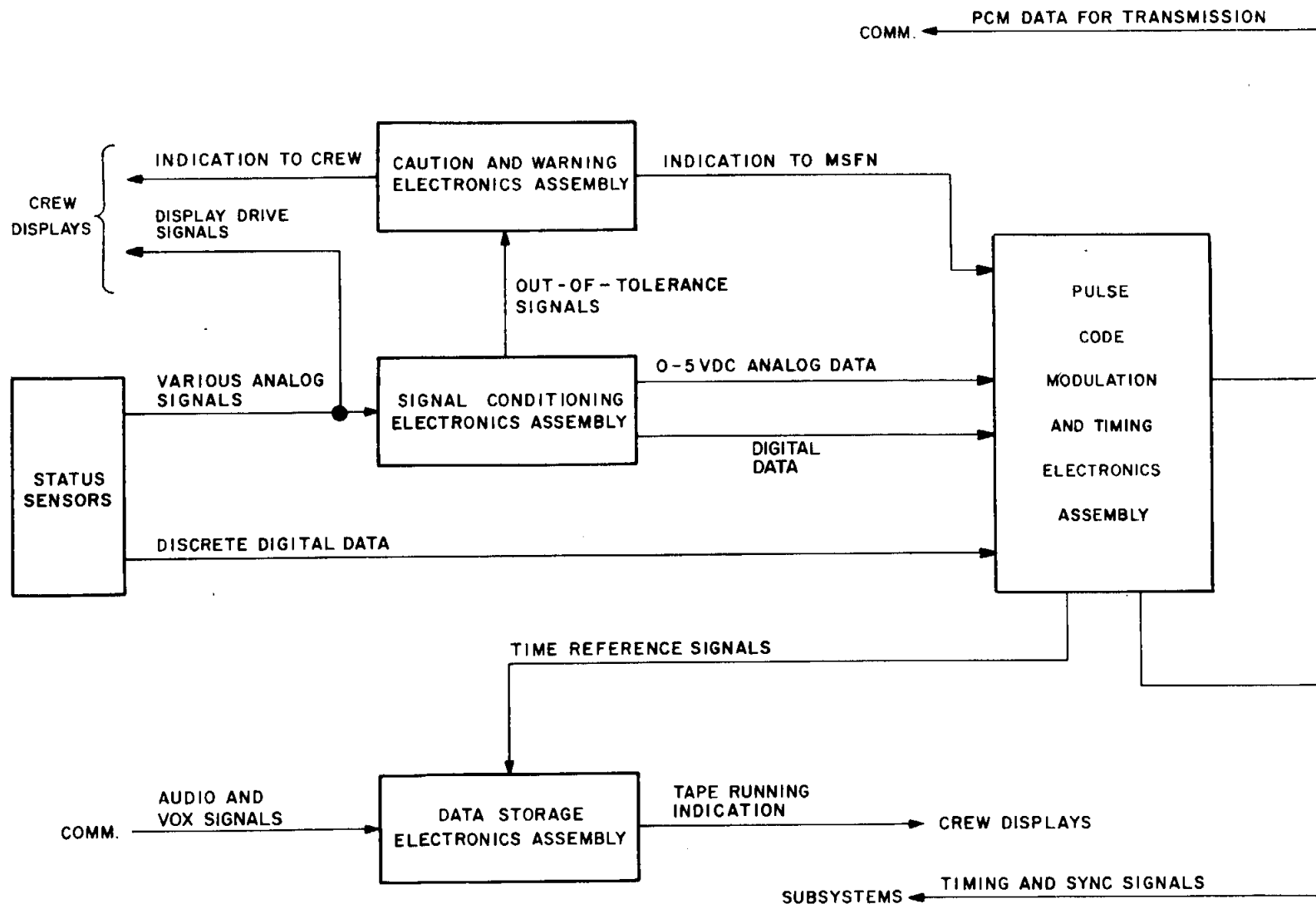
White noise

G.N. AND C. ASSOCIATED DISPLAYS

T 30005-50
APR 66

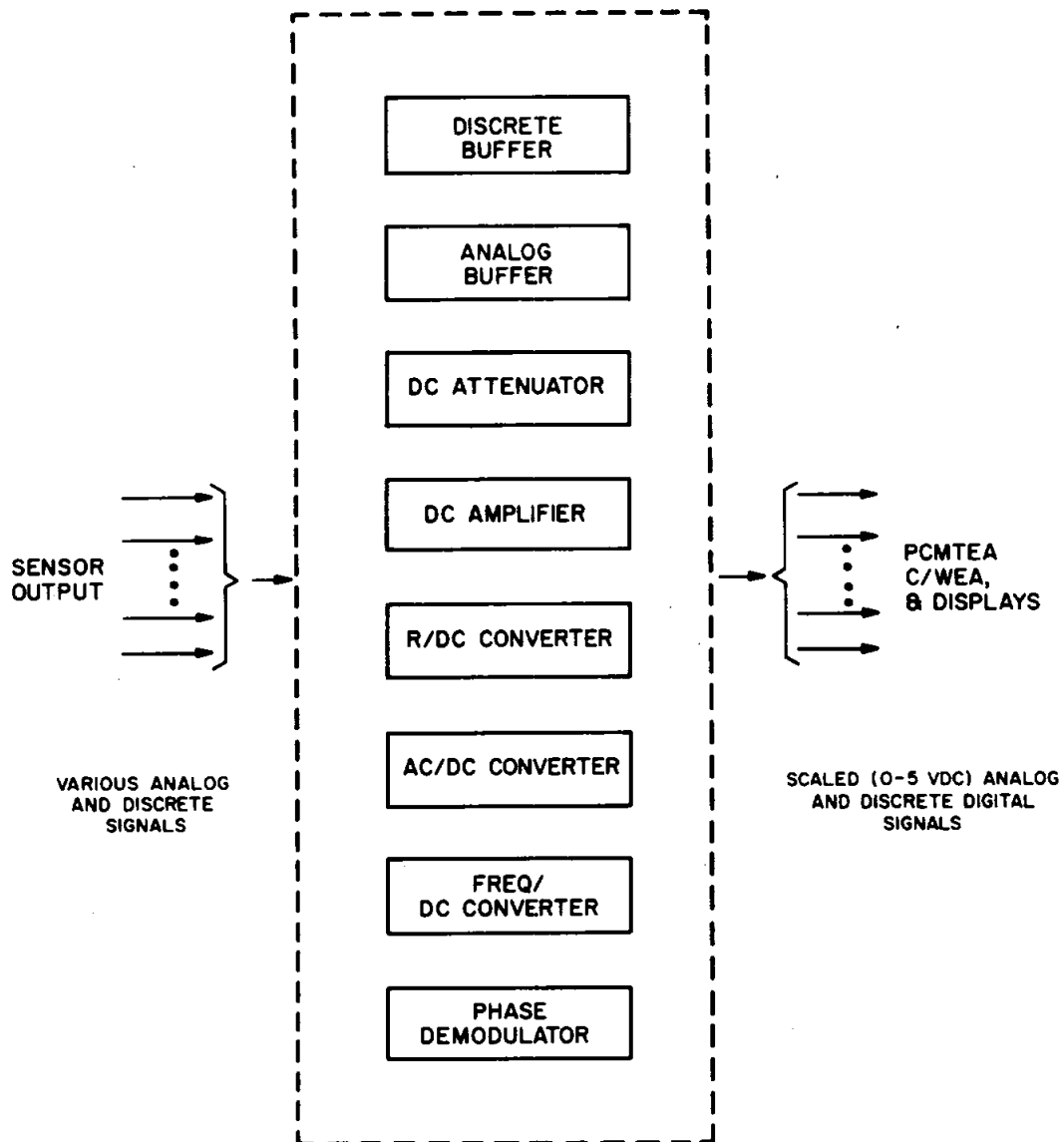


T30005-43
DEC 66



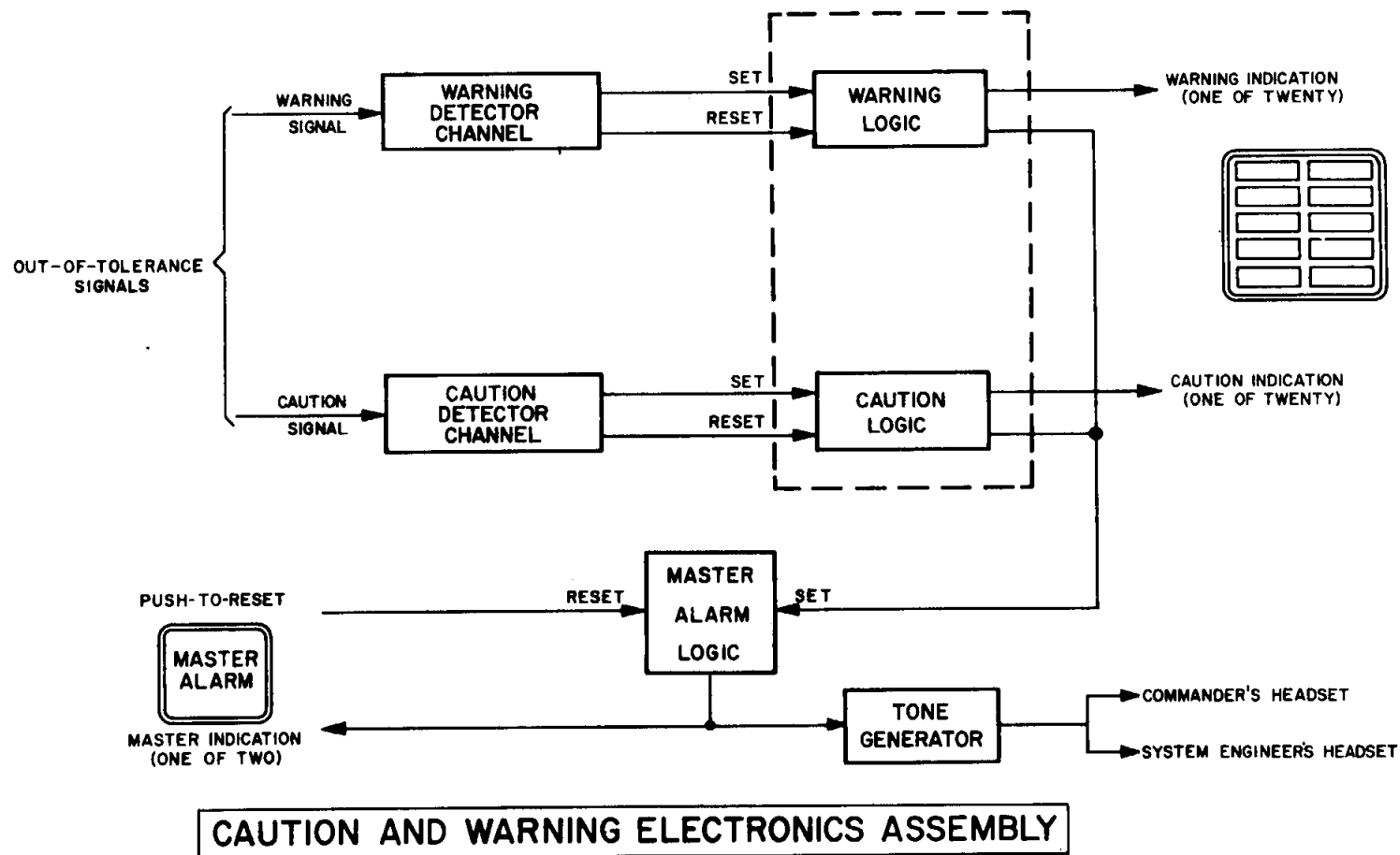
LM INSTRUMENTATION SUBSYSTEM

T30005-57
DEC 66

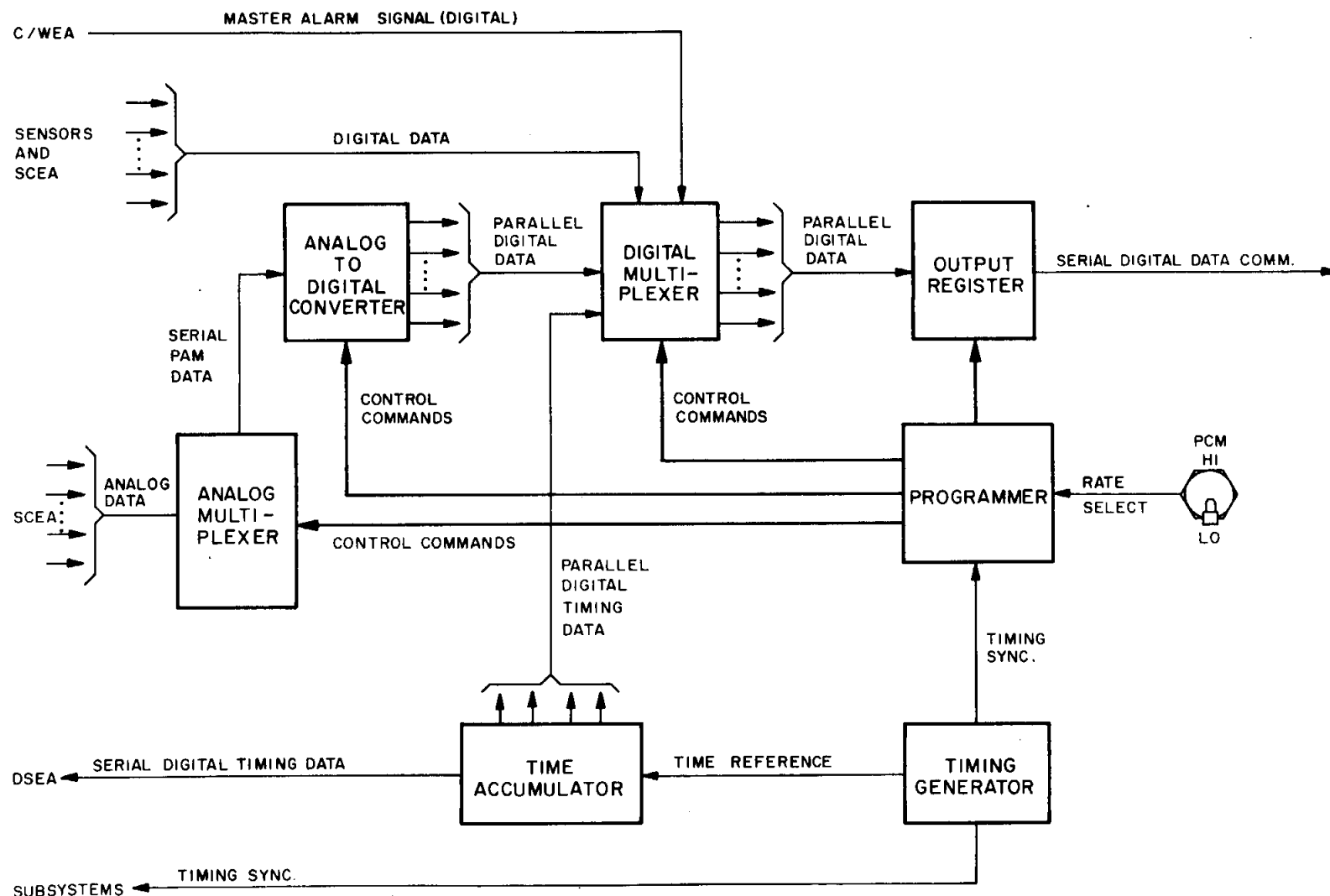


SIGNAL CONDITIONING ELECTRONICS ASSEMBLY

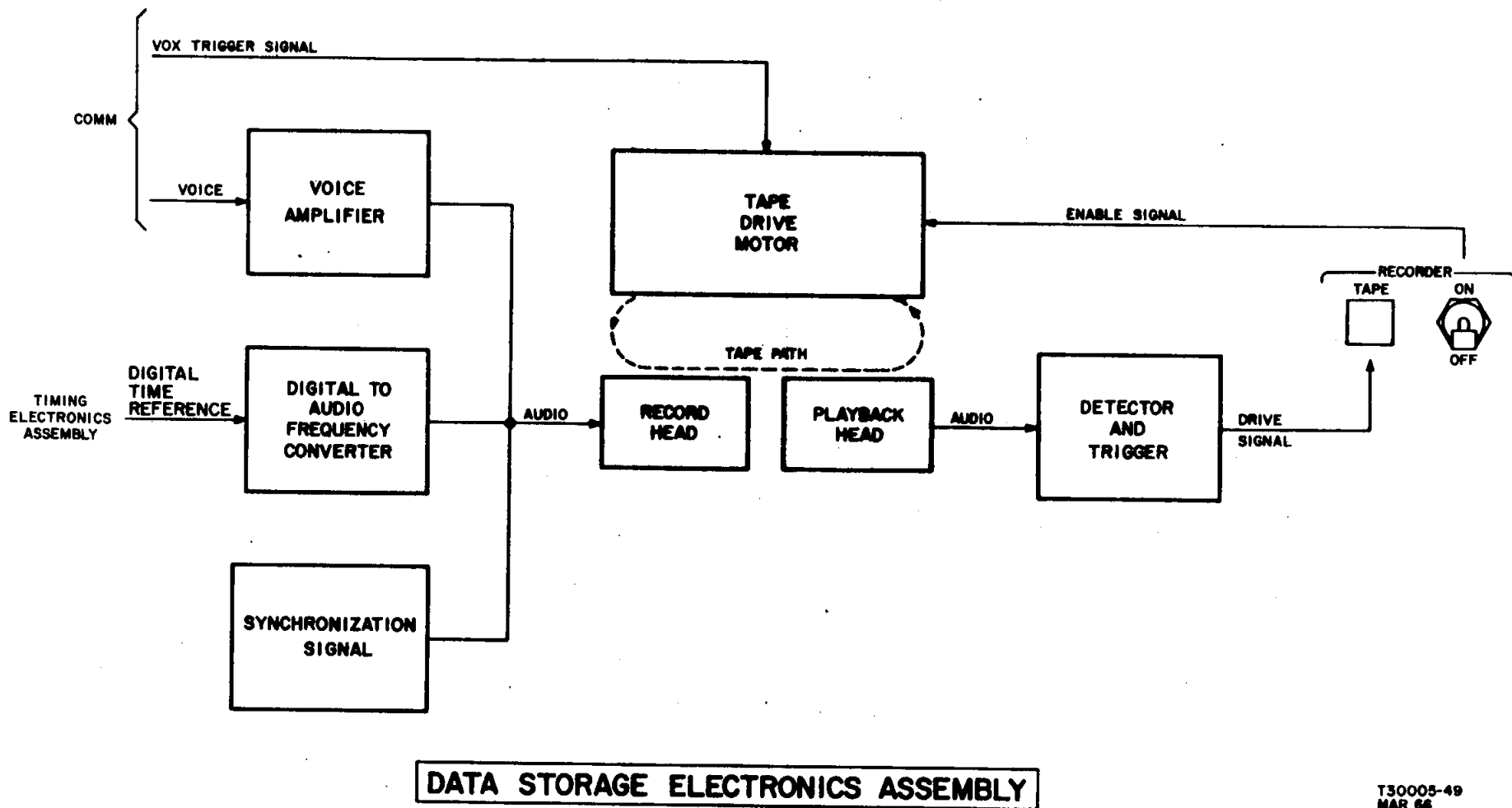
T30005-59
MAR 66

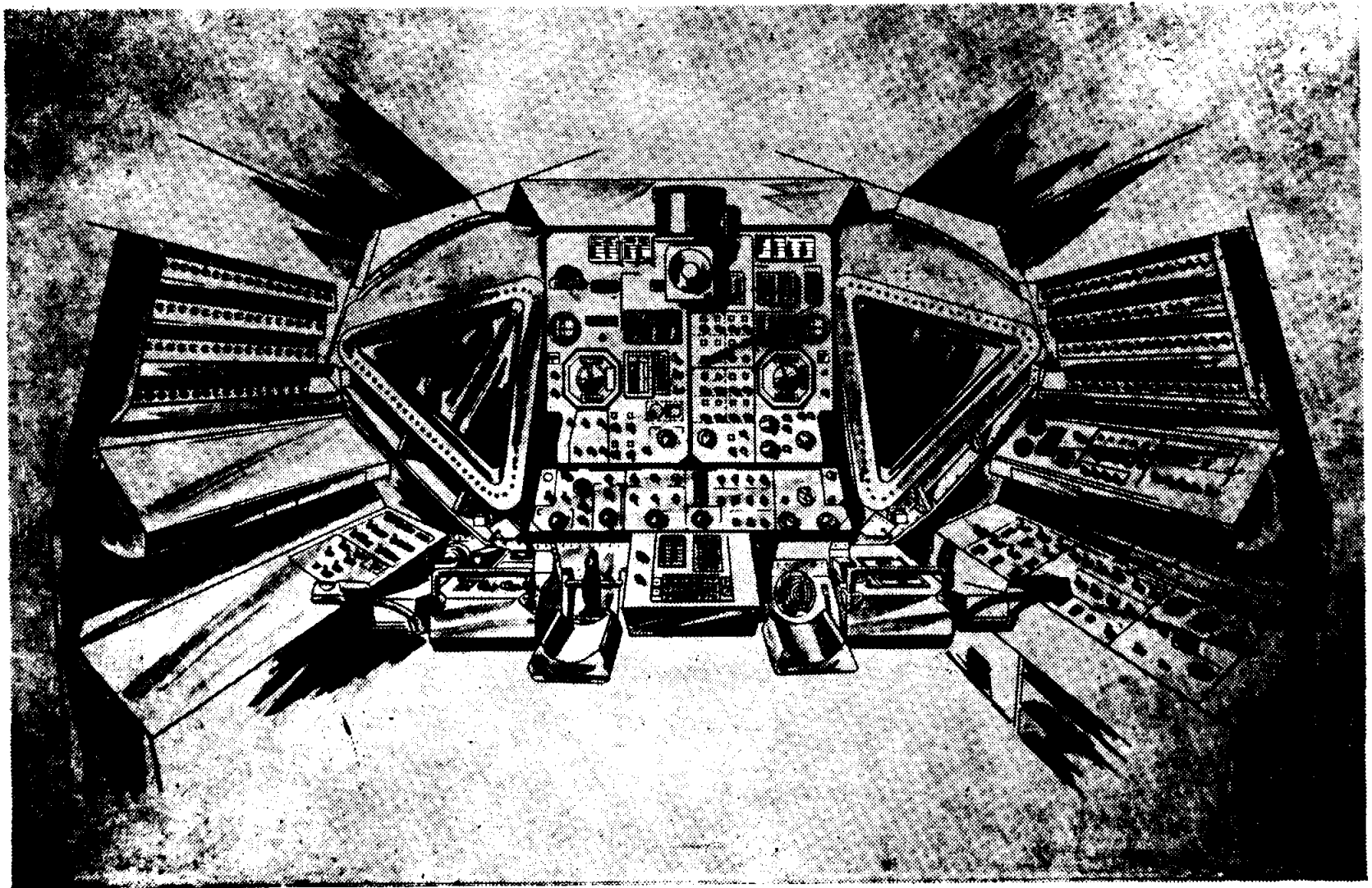


T30005-48
DEC 66



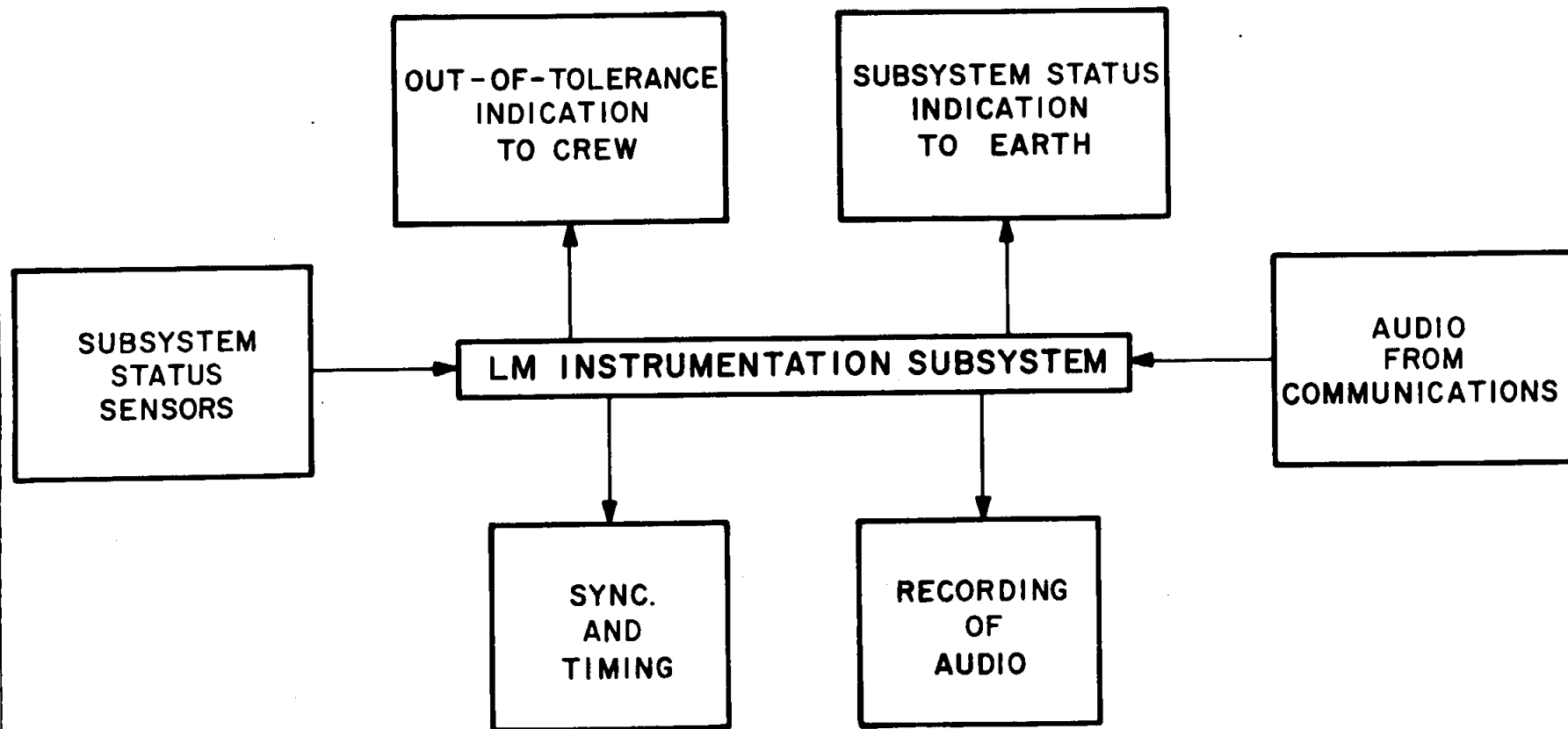
PULSE CODE MODULATION AND TIMING ELECTRONICS ASSEMBLY

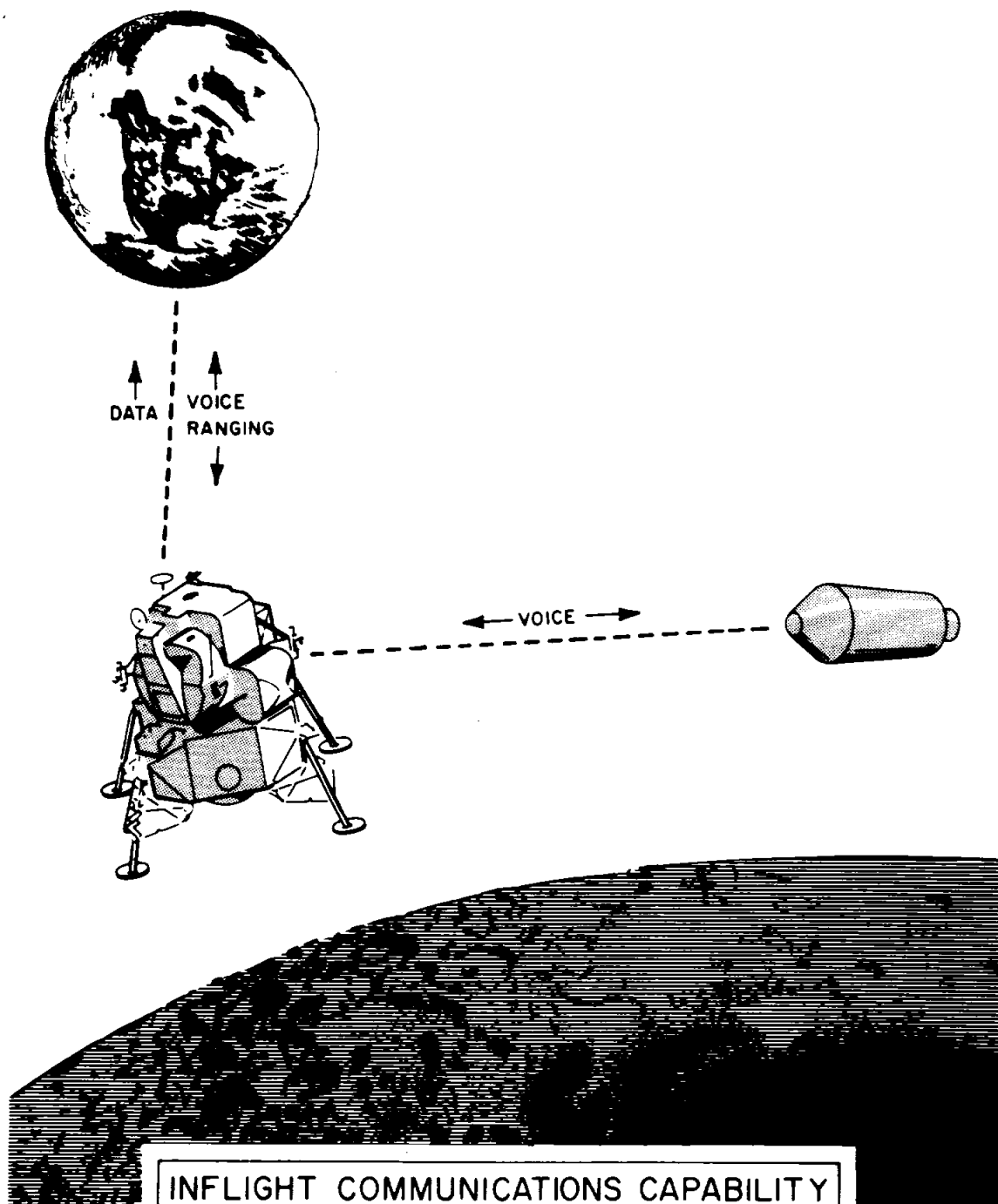




INSTRUMENTATION ASSOCIATED DISPLAYS

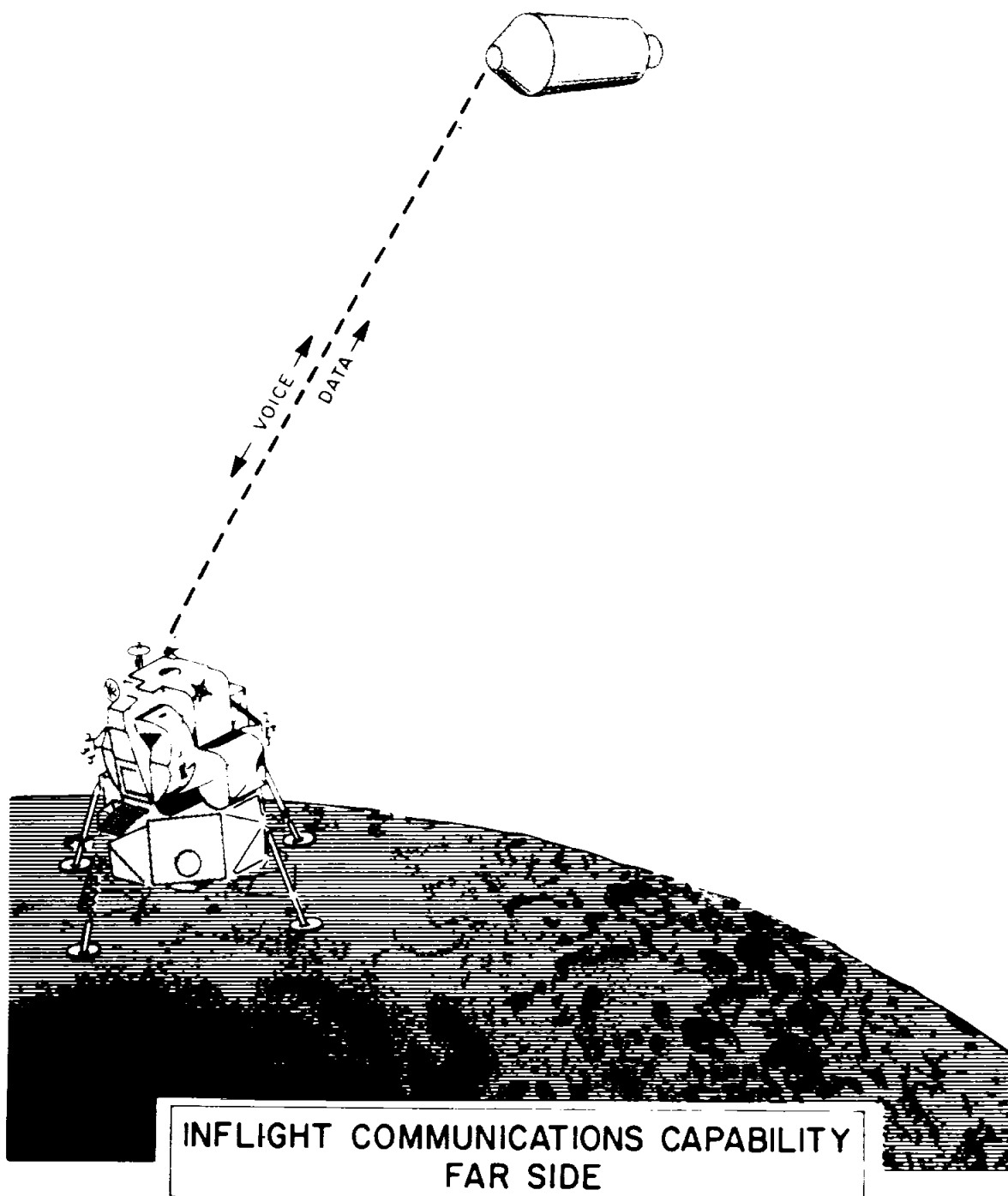
T30005-112
APR 66



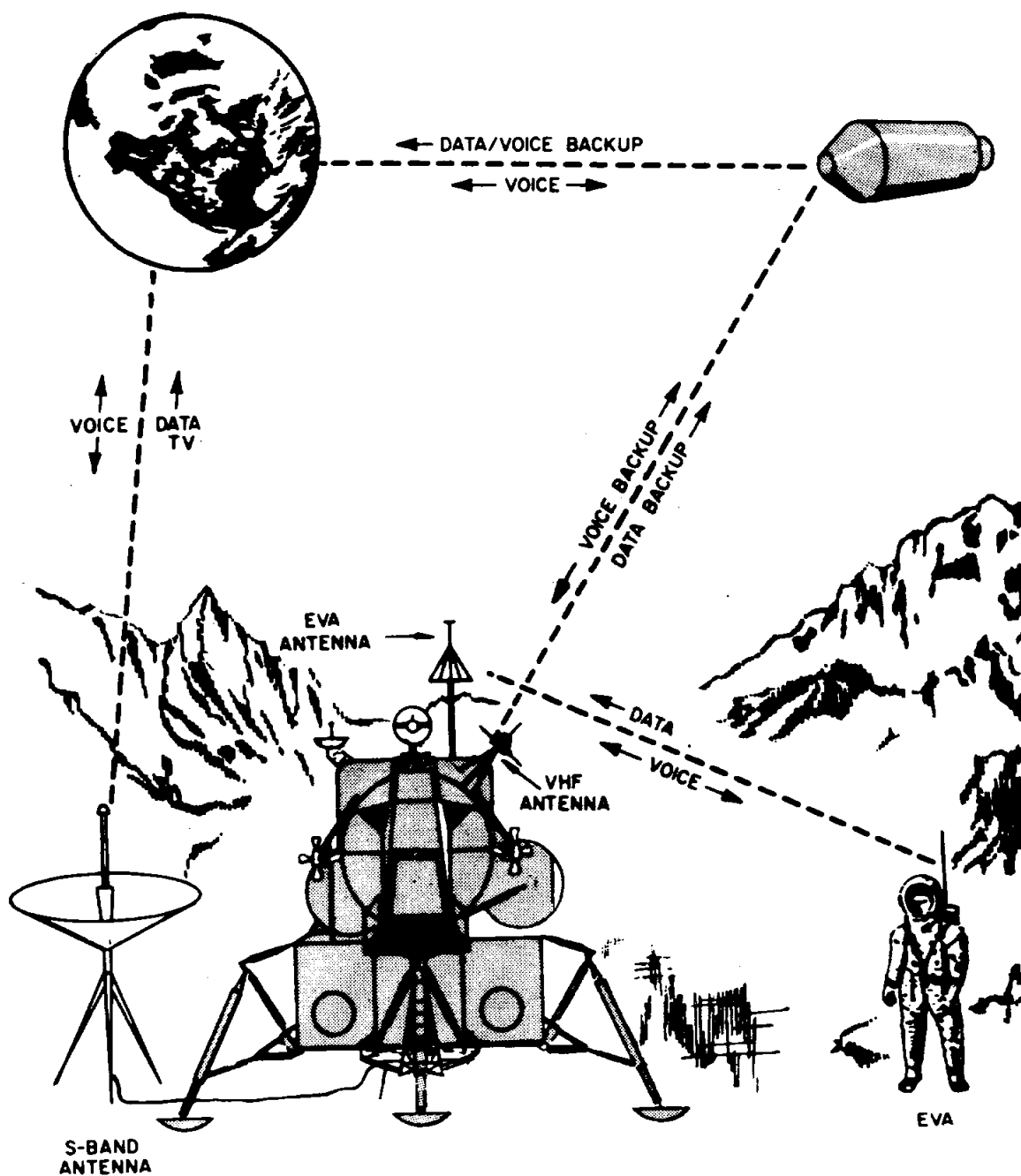


INFLIGHT COMMUNICATIONS CAPABILITY
EARTH SIDE

T30005-38
FEB 66

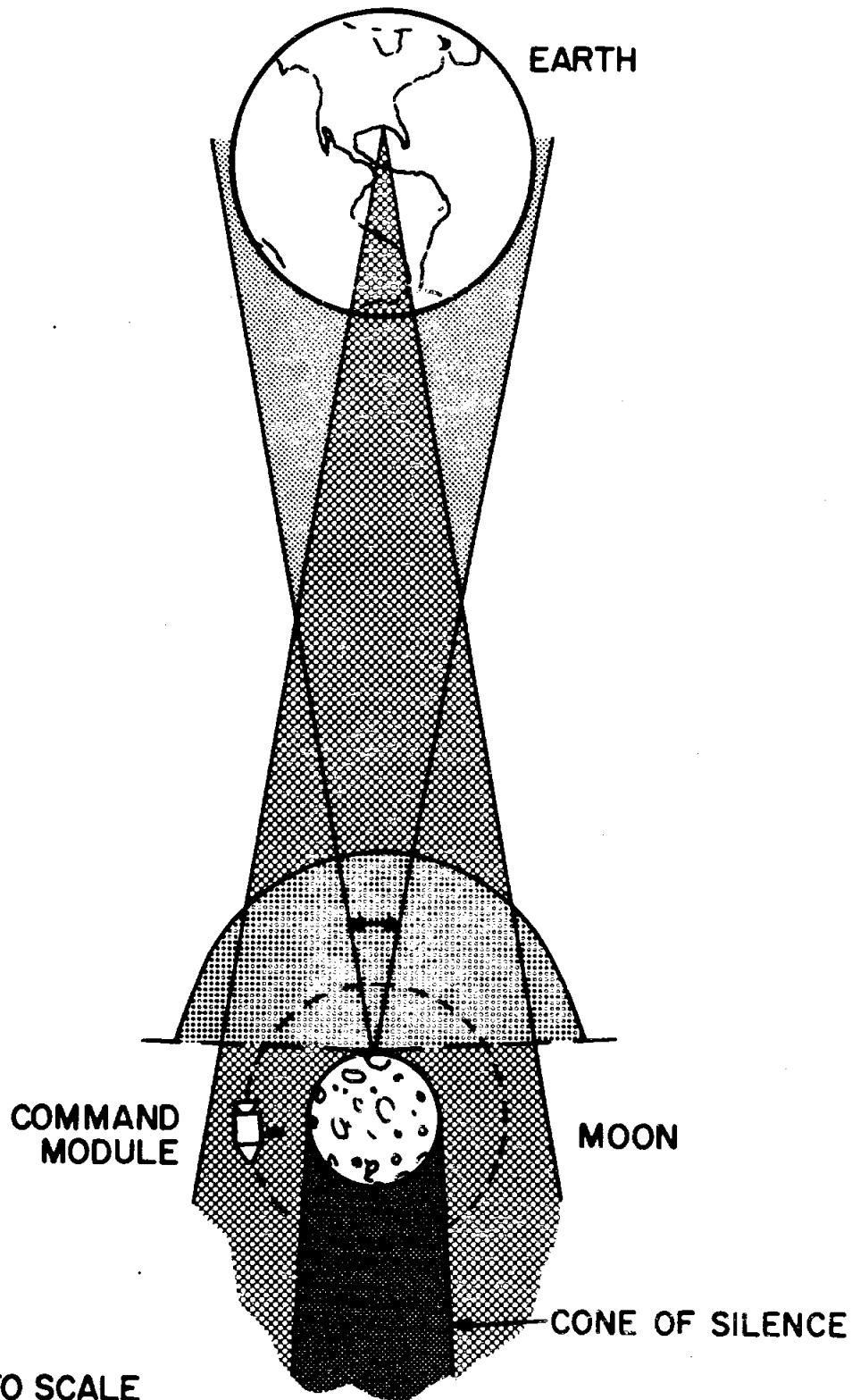


T30005-39
JULY 66



LUNAR SURFACE COMMUNICATIONS CAPABILITY

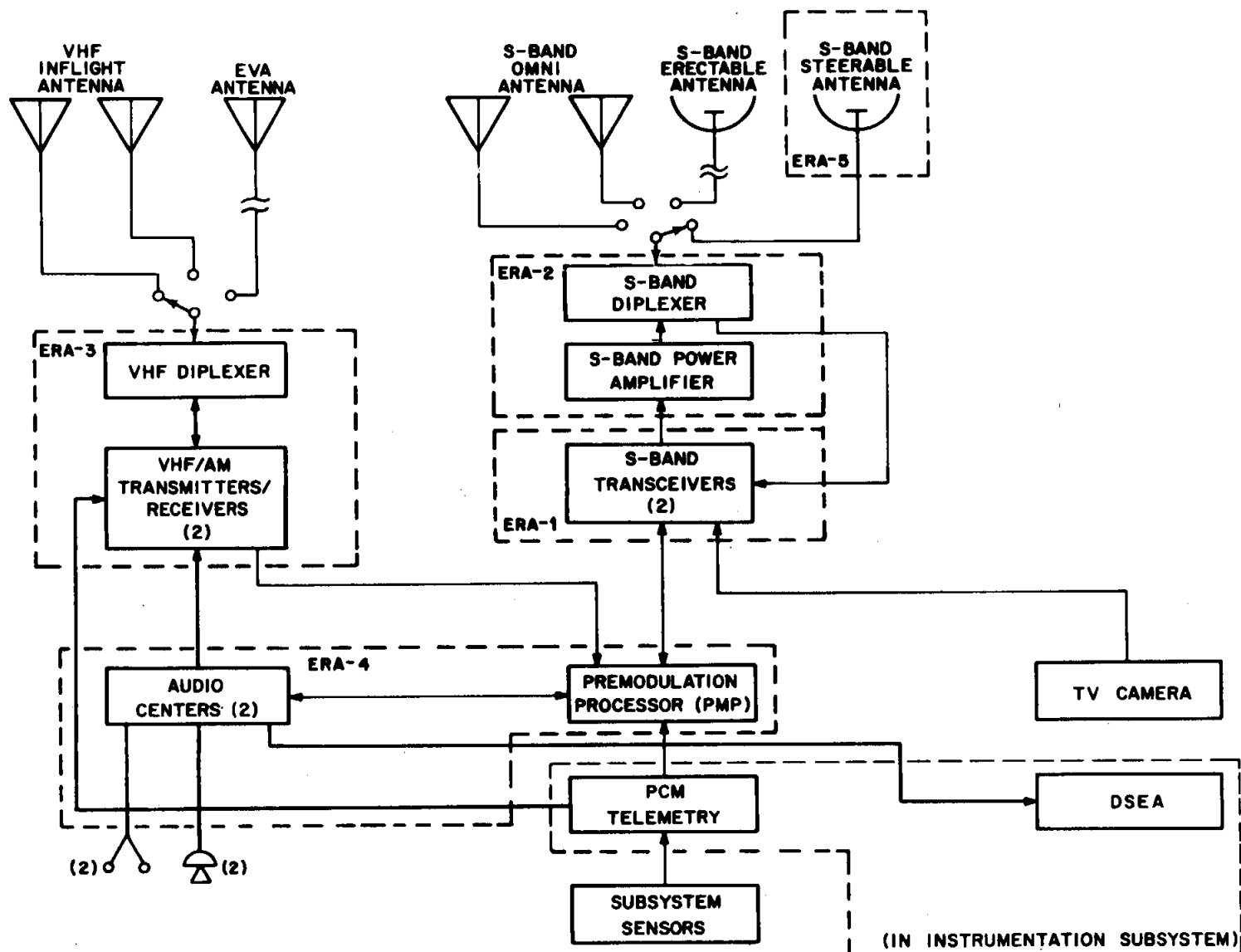
T30005-40
SEPT 66



NOT DRAWN TO SCALE

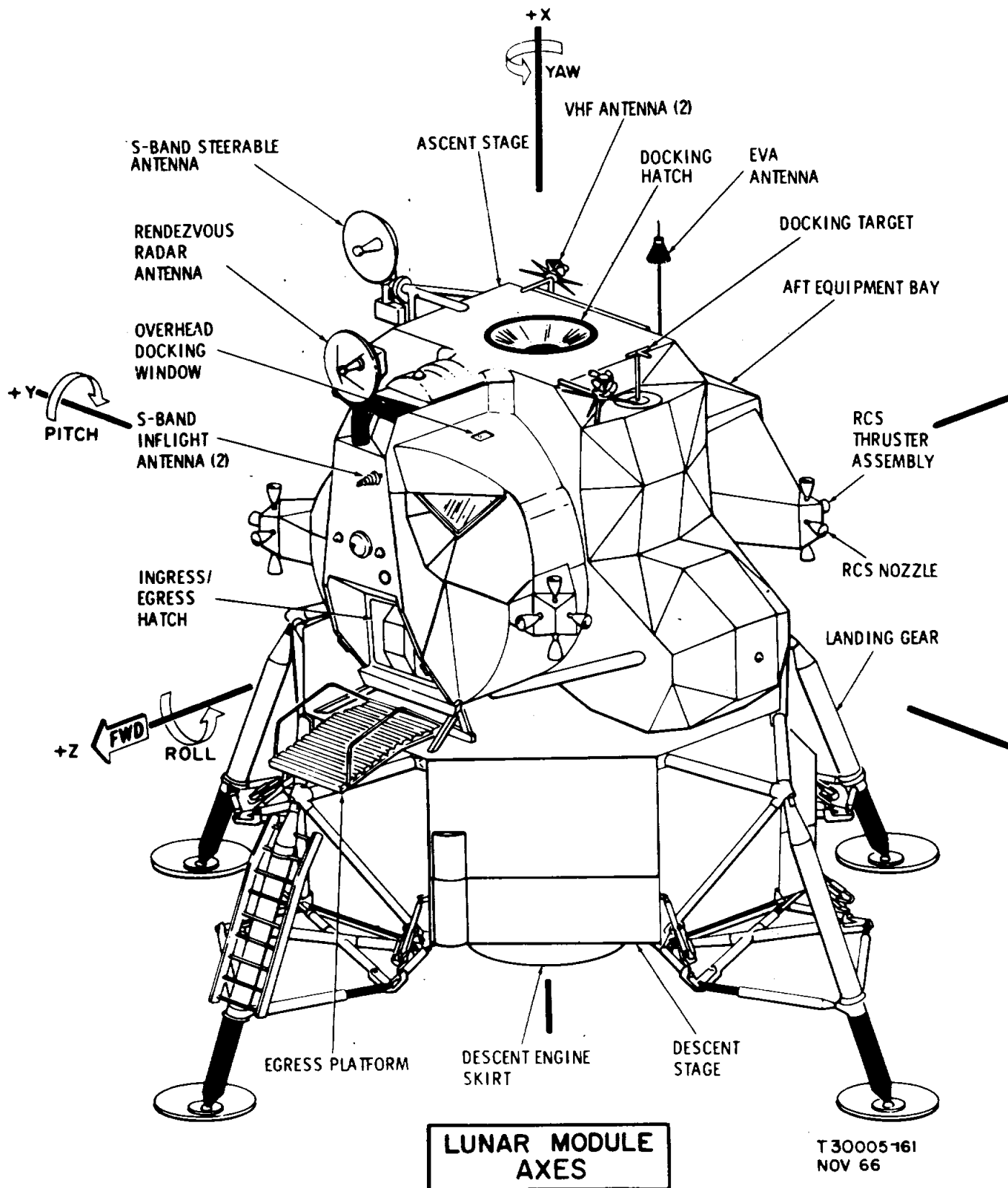
COMMUNICATIONS DURING LUNAR STAY

T30005-101
MAR 66

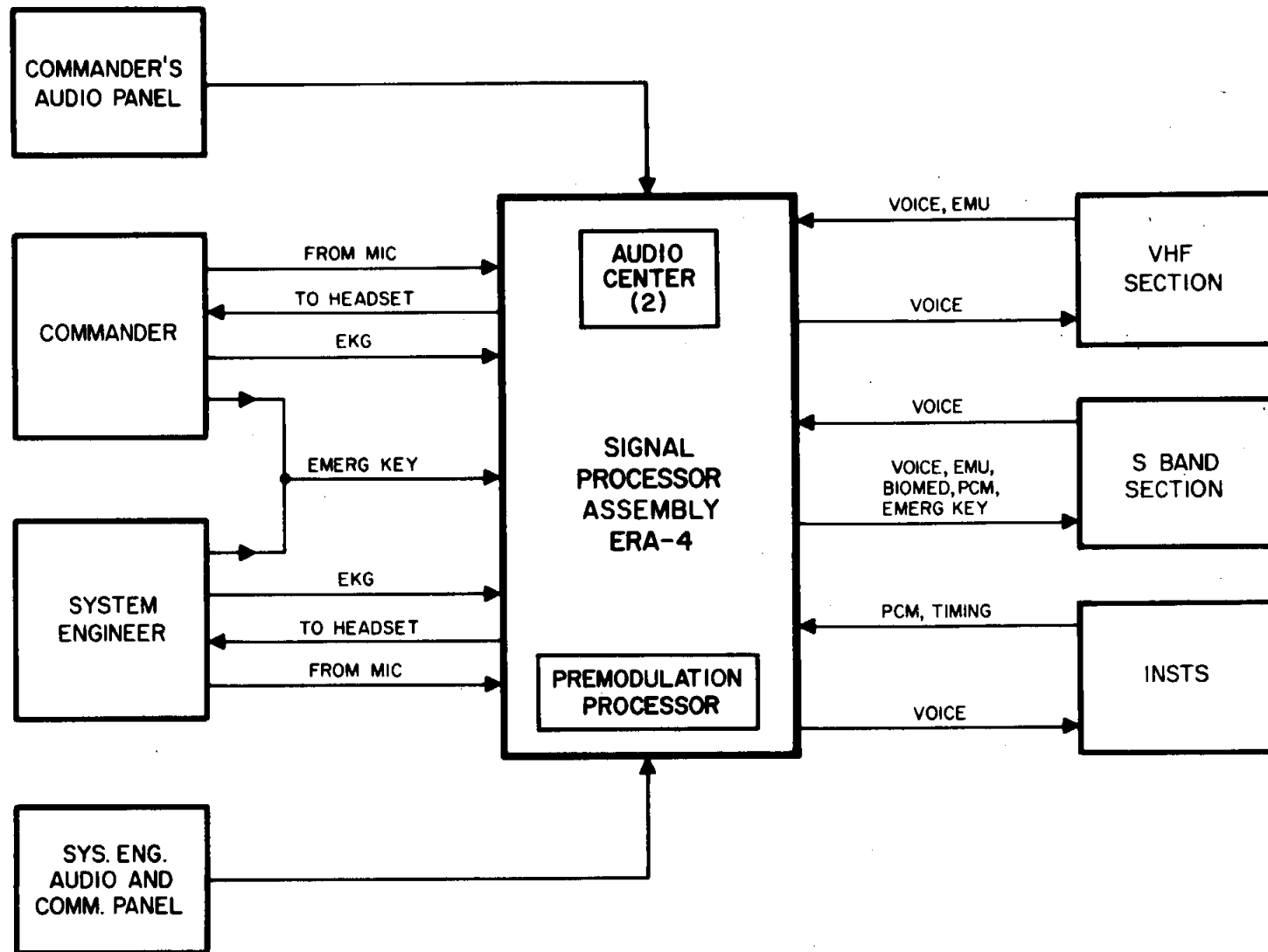


LM COMMUNICATIONS SUBSYSTEM

T30005-37
DEC 66

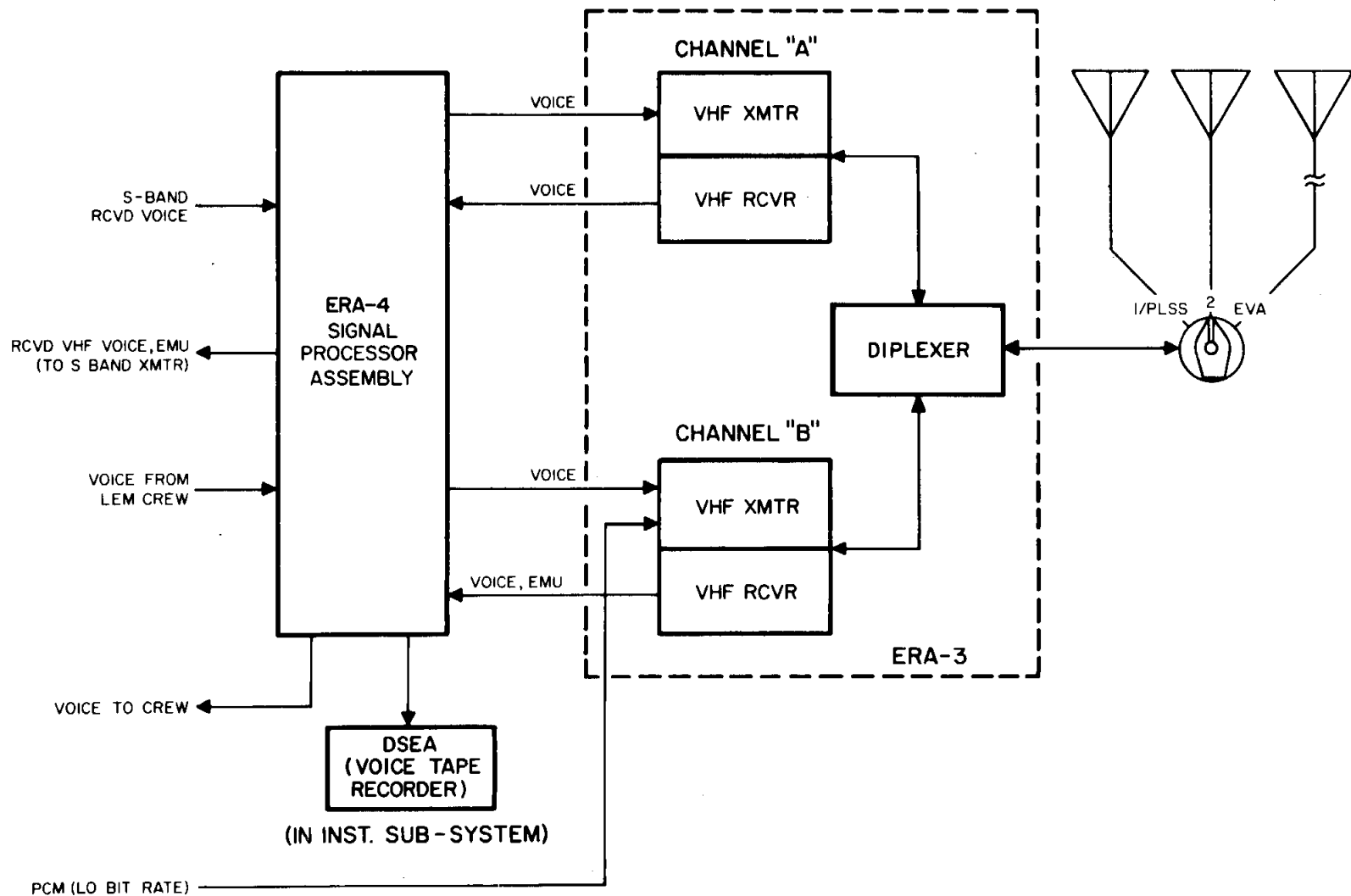


T 30005-161
NOV 66



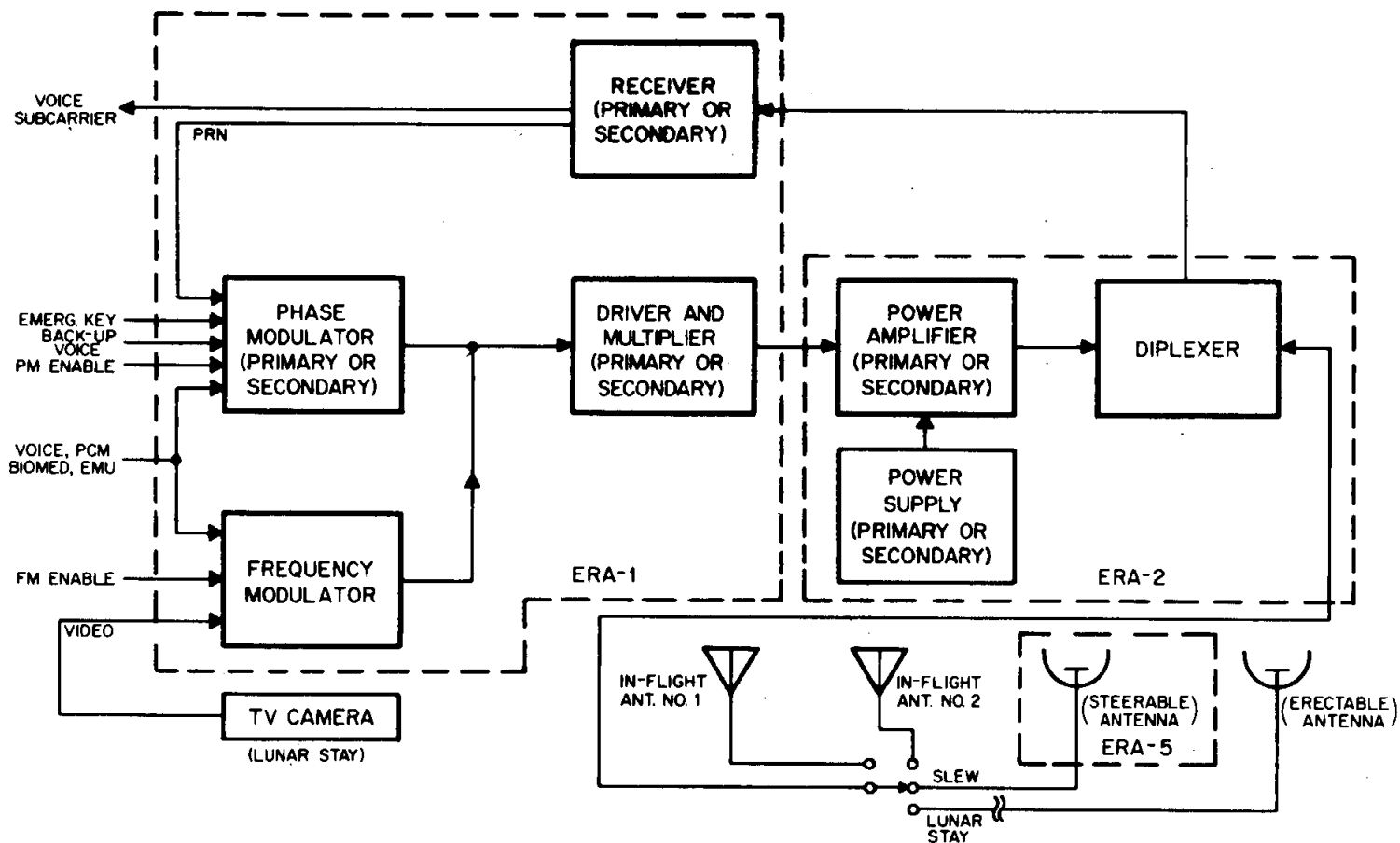
**SIGNAL PROCESSOR ASSEMBLY
INTERFACE**

T30005-53
DEC 66



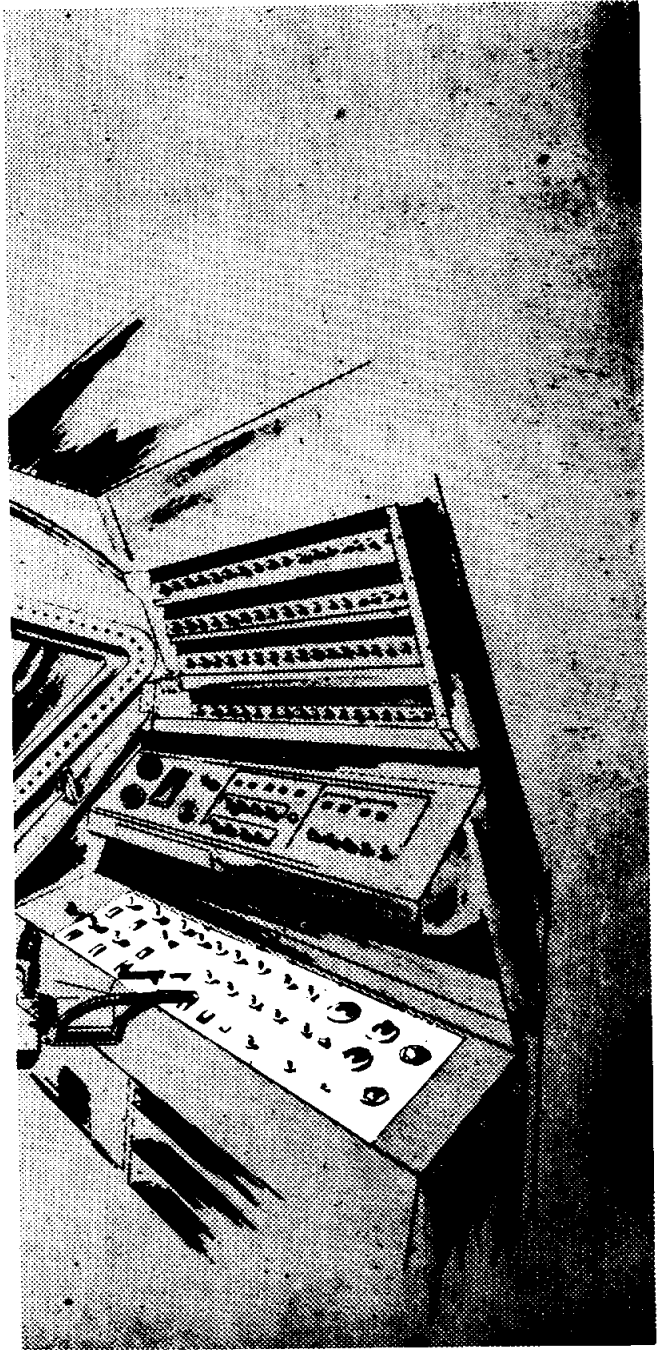
VHF-SECTION

T 30005-55
DEC 66



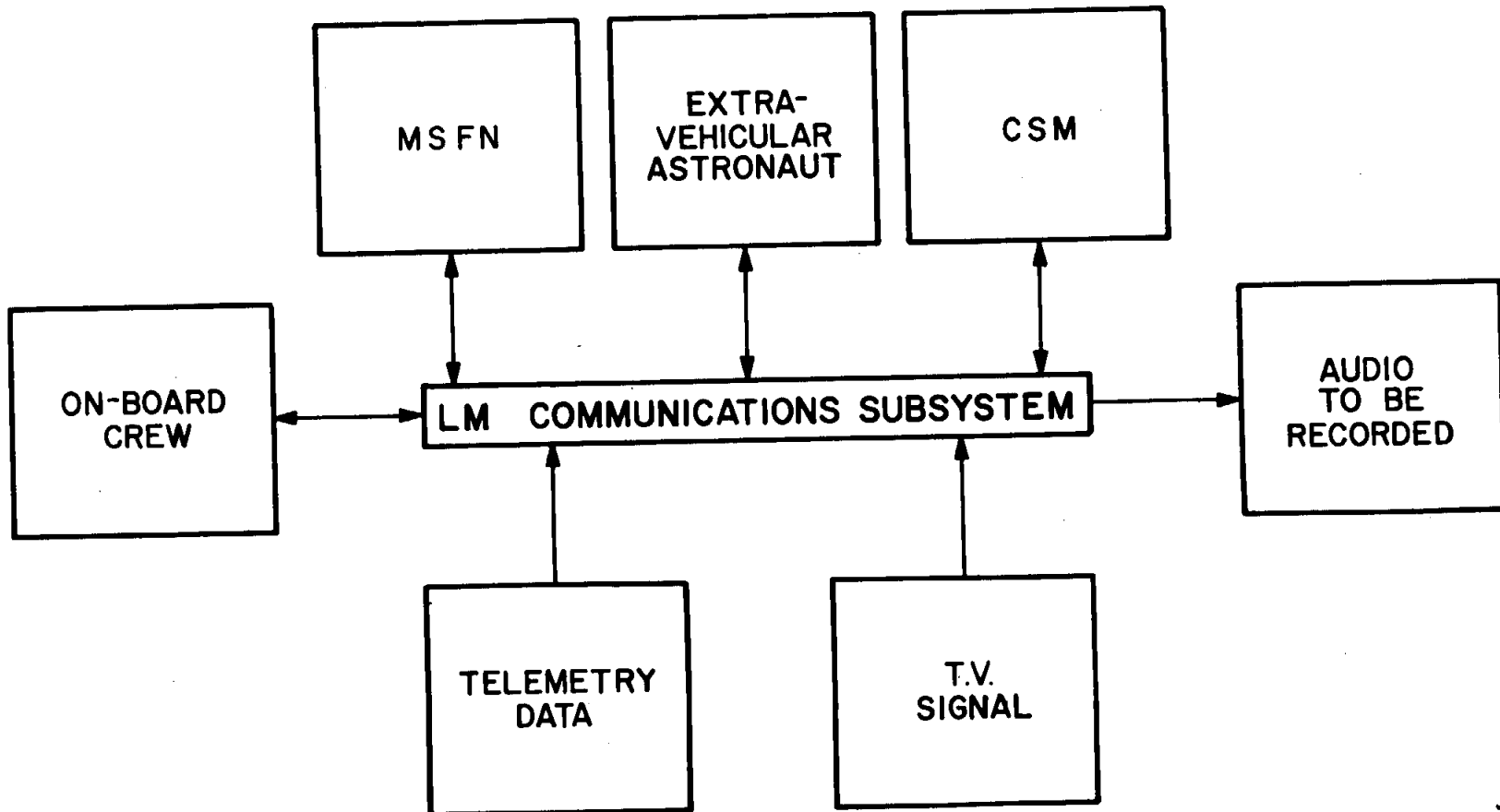
S-BAND SECTION

T30005-56
DEC 66

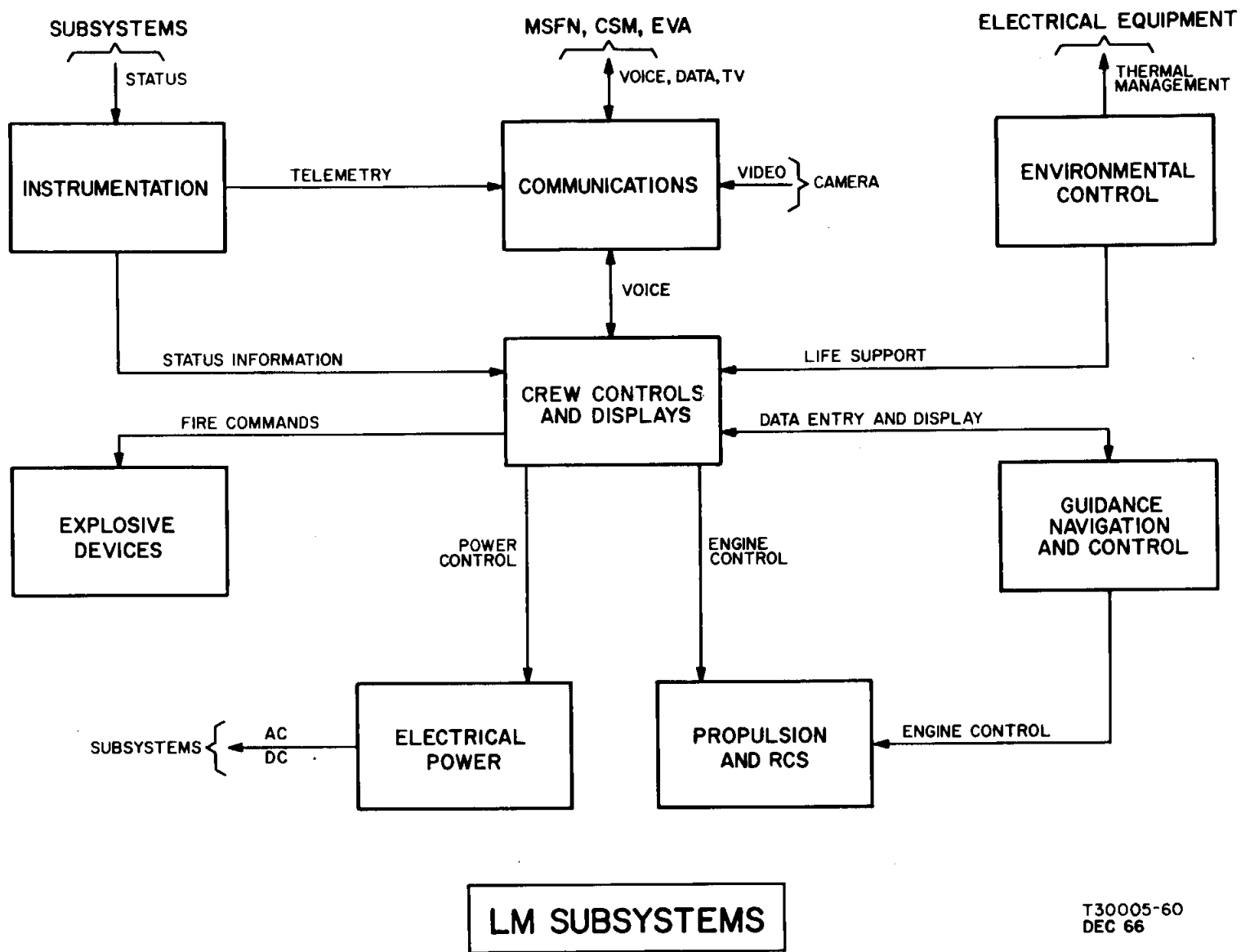


CONTROLS

T 30005-113
APR 66



T30005-41
DEC 66



T30005-60
DEC 66