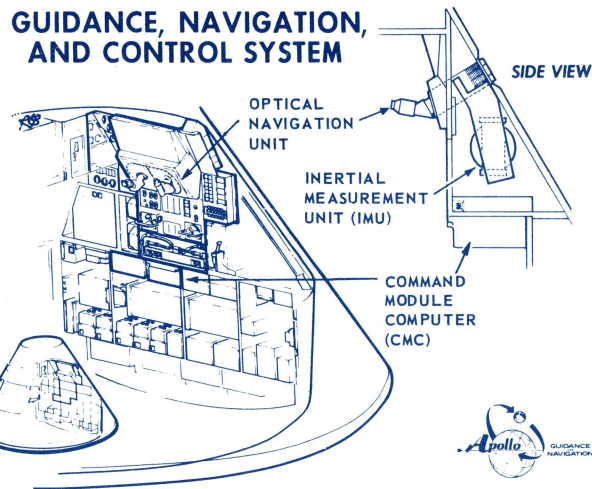


## GUIDANCE, NAVIGATION, AND CONTROL SYSTEM

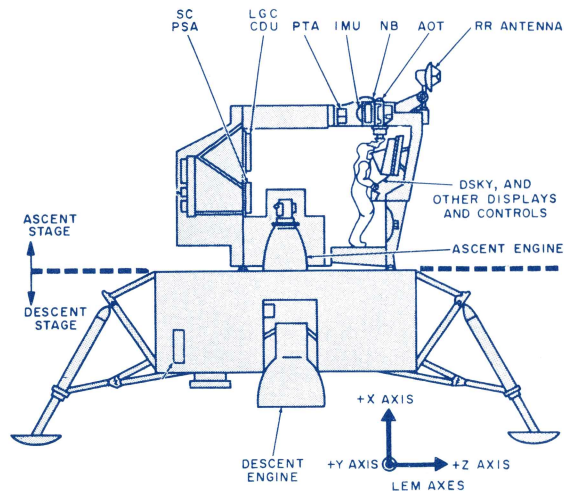


THE APOLLO GUIDANCE AND NAVIGATION SYSTEM IS COMPOSED OF THREE BASIC SUBSYSTEMS: INERTIAL, OPTICAL AND COMPUTER.

1. The inertial guidance subsystem is composed of inertial measurement unit (IMU) and associated equipment. This subsystem performs three major functions: (A) Measures changes in spacecraft attitude; (B) Measures spacecraft velocity due to thrust; and (C) Assists in generating steering signals.
2. The optical navigation subsystem is composed of a space sextant and a scanning telescope. Sightings on celestial bodies and landmarks on the moon and earth are used by the computer subsystem to determine the spacecraft's position and velocity and to align the inertial reference within the IMU.
3. The command module computer (CMC) provides five major functions: (A) Calculates steering signals and engine discharges necessary to keep the spacecraft on the required trajectory; (B) Positions the stable member in the IMU to a coordinate system defined by precise optical measurements; (C) Positions the optical unit to celestial objects; (D) Conducts limited malfunction isolation of the G&N system by monitoring the level and rate of system signals; and (E) Supplies pertinent spacecraft condition information to the display and control panel.



## GUIDANCE AND NAVIGATION EQUIPMENT LOCATION AND DESCRIPTION



**INERTIAL MEASUREMENT UNIT (IMU)** and associated equipment performs three major functions: (A) Measures changes in LM attitude; (B) Assists in generating steering commands; and (C) Measures LM velocity changes due to thrust. This unit manufactured by AC Electronics.

**ALIGNMENT OPTICAL TELESCOPE (AOT)** - Provides star sighting data which is manually inserted into the LM Guidance Computer for establishing the inertial reference. This unit manufactured by Kollsman Instrument Company.

**NAVIGATION BASE (NAV BASE)** - Provides an accurate mounting base for the Alignment Optical Telescope (AOT) and the Inertial Measurement Unit. This unit manufactured by AC Electronics.

**LM GUIDANCE COMPUTER (LGC)** - Performs four major functions: (A) Calculates steering signals and engine discharges necessary to keep the LM on the required trajectory; (B) Positions the stable member in the IMU to a coordinate system defined by precise optical measurements; (C) Conducts limited malfunction isolation of the PGNCSS by monitoring the level and rate of system signals; and (D) Supplies pertinent LM condition information to the display and control panels. This unit manufactured by Raytheon.

**DISPLAY AND KEYBOARD (DSKY)** - Provides a two-way communication link between the operator and the LGC and the following functions may be performed: (A) Loading of data into the LGC; (B) Display of data and system configuration to the operator. This unit manufactured by Raytheon.

**COUPLING DATA UNIT (CDU)** - The CDU, an all-electronic device, is used as an interface element between the following: (A) The inertial subsystem and computer subsystem; (B) and the computer subsystem and the controls. This unit functions primarily as an analog to digital or digital to analog converter. This unit manufactured by AC.

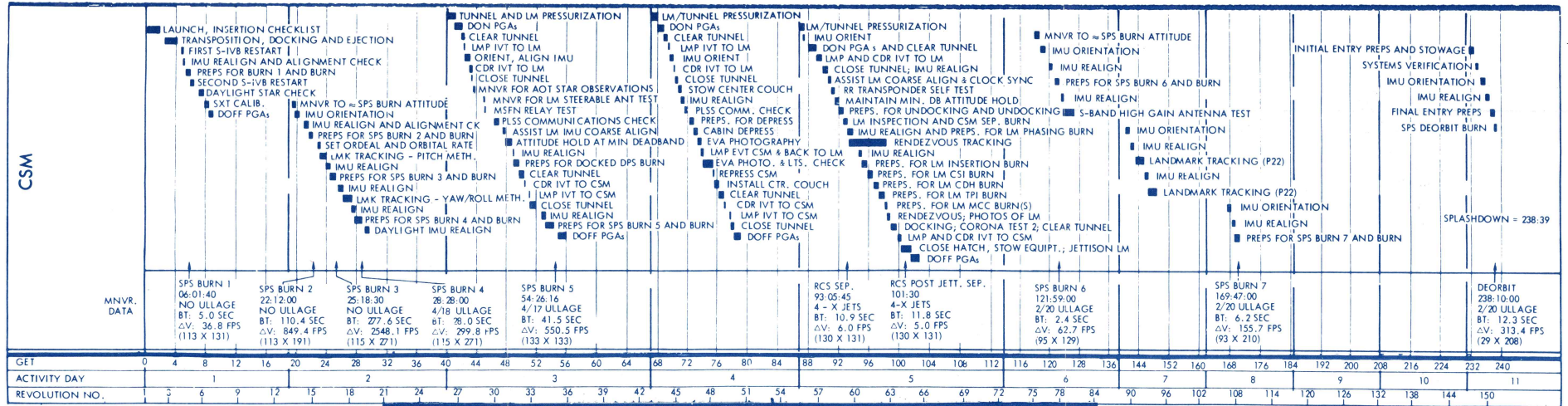
# APOLLO 9



**AC ELECTRONICS**  
DIVISION OF GENERAL MOTORS CORPORATION  
MILWAUKEE, WISCONSIN 53201



# APOLLO 9 SUMMARY FLIGHT PLAN (D MISSION)



## APOLLO 9 MISSION DESCRIPTION

### 1. MANNED

#### PRIME CREW

James A. McDivitt  
Richard F. Gordon, Jr.  
Russell L. Schweickart

COMMANDER  
COMMAND MODULE PILOT  
LUNAR MODULE PILOT

#### BACKUP CREW

Charles Conrad, Jr.  
Richard F. Gordon, Jr.  
Alan L. Bean

COMMANDER  
COMMAND MODULE PILOT  
LUNAR MODULE PILOT

### 2. SECOND MANNED SATURN V MISSION

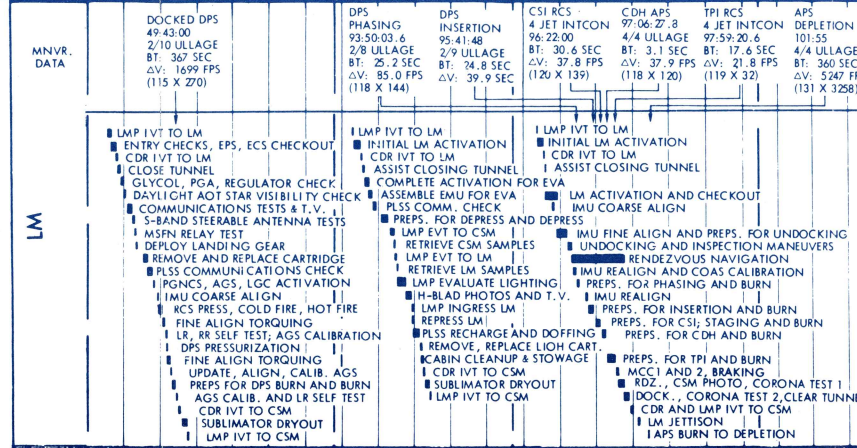
### 3. COMBINED CSM AND L/M EARTH ORBIT

### 4. PLANNED DURATION - 10 DAYS

### 5. BOOSTER - SATURN V BOOSTER NO. 504

### 6. SPACECRAFT - CSM #104 AND LUNAR MODULE #3

### 7. BLOCK II G&N SYSTEM 209 L/M G&N SYSTEM 605



## ABBREVIATIONS

ACN	Ascension Tracking Station	HAW	Hawaii Tracking Station
AGS	abort guidance system	IVT	intraveicular transfer
ANG	Antigua Tracking Station	LM	lunar module
APS	ascent propulsion system (LM)	LMP	Lunar Module Pilot
BDA	Bermuda Tracking Station	LOS	loss of signal
CAL	California Tracking Station	MER	Mercury Tracking Ship
CDH	constant differential height	MIL	Merritt Island Tracking Station
CDR	Commander	MSFN	Manned Space Flight Network
CES	control electronics system	PGNCS	primary guidance and navigation control subsystem
CRO	Carnarvon Tracking Station		
CSI	concentric sequence initiation	PLSS	portable life support system
CMP	Command Module Pilot	PRE	Pretoria Tracking Station
CSM	command and service module	RCS	reaction control subsystem
DAP	digital autopilot	SLA	spacecraft LM adapter
DPS	descent propulsion system (LM)	SPS	service propulsion system
EMU	extraveicular mobility unit	S-IC	Saturn IC, LV first stage
EVA	extraveicular activity	S-II	Saturn II, LV second stage
EVT	extraveicular transfer	S-IVB	Saturn IVB, LV third stage
FTP	fixed throttle point	TAN	Tanarive Tracking Station
GBM	Grand Bahama Tracking Station	T&D	transposition and docking
GDS	Goldstone Tracking Station	TEX	Corpus Christi Tracking Station
g.c.t.	ground elapsed time	TLI	translunar injection
G.m.t.	Greenwich mean time	TPI	terminal phase initialization
G&N	guidance and navigation	TPF	terminal phase finalization
GNCS	Guidance Navigation & Control System	VAN	Vanguard Tracking Ship
GYM	Guaymas Tracking Station		