George Silver

APOLLO MISSION 204

- AGC PROGRAMS
- NOUN CODES
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- INPUT/OUTPUT BIT ASSIGNMENTS
- AGC DOWNLINK FORMAT
- ANALOG DATA TELEMETRY AND RECORDING

TRAINING

AC ELECTRONICS
Division of General Motors Corporation
Milwaukee, Wisconsin 53201

MATERIAL

FOR USE AS EDUCATIONAL AID ONLY

16 MARCH 1966

AGC PROGRAMS

Mission Phase	Program Number	Program Title
	00	AGC IDLING
PRELAUNCH	01	G&N STARTUP AND CHECKOUT
	02	INITIALIZATION
	03	GYROCOMPASSING
	04	OPTICAL VERIFICATION OF AZIMUTH
	05	INERTIAL REFERENCE
	06	*
	07	*
BOOST MONITOR	11	PRE LET JETTISON
	12	POST LET JETTISON
	13	*
	14	*
	15	*
	16	*
	17	LET ABORT
COAST	21	CSM LOCAL VERTICAL
	22	LANDMARK TRACKING
	23	STAR-LANDMARK OR HORIZON NAVIGATION MEASUREMENT
	24	*
	25	*
	26	*
	27	AGC UPDATE
PRE-THRUSTING	31	ORBIT CHANGE
	32	RETURN TO EARTH
	33	SPS MINIMUM IMPULSE
	34	*
	35	*
	36	*
	37	*
THRUSTING	41	ORBIT CHANGE
	42	RETURN TO EARTH

* This PROGRAM does not exist for Mission 204.

AGC PROGRAMS

Mission Phase	Program Number	Program Title
THRUSTING (cont)	43	SPS MINIMUM IMPULSE
	44	*
	45	*
	46	G&N STANDBY SPS MONITOR
	47	G&N STANDBY RCS MONITOR
INFLIGHT ALIGNMENT	51	IMU ORIENTATION DETERMINATION
	52	SIVB/IMU ALIGN
	53	CSM/IMU ALIGN
	54	*
	55	*
	56	*
	57	*
ENTRY	61	MANEUVER TO CM/SM SEPARATION ATTITUDE
	62	CM/SM SEPARATION AND PRE-ENTRY MANEUVER
	63	INITIALIZATION
	64	POST 0.05 G
	65	UPCONTROL
	66	BALLISTIC
	67	FINAL PHASE
CSM ABORT	71	FIRST ABORT BURN
	72	ABORT MODE SELECTION
	73	THRUST TO DISCRETE RECOVERY AREA
	74	CONTINGENCY ORBIT INSERTION - 1ST BURN
	75	CONTINGENCY ORBIT INSERTION - 2ND BURN
	76	*
	77	*

* This PROGRAM does not exist for Mission 204.

BREL204 VERB/NOUN CODES

01	DISPLAY OCTAL COMP 1 (R1)	01	SPECIFY ADDRESS (FRACTIONAL)	1	.XXXXX
02	DISPLAY OCTAL COMP 2 (R1)	02	SPECIFY ADDRESS (WHOLE)	1	XXXXX.
03	DISPLAY OCTAL COMP 3 (R1)	03	SPARE		
04	DISPLAY OCT COMP 1, 2 (R1, R2)	04	SPARE		
05	DISPLAY OCT COMP 1, 2 (R1, R2, R3)	05	ANGULAR ERROR	1	XXX.XX°
06	DECIMAL DISPLAY	06	SPARE		
07	DP DECIMAL DISPLAY (R1, R2)	07	CHANGE OF PROGRAM (WITH VERB 50)	1	OCTAL
10	REQUEST WAITLIST	10	SPARE		
11	MONITOR OCT COMP 1	11	ENGINE ON ENABLE (WITH VERB 50)		
12	MONITOR OCT COMP 2	12	GIMBAL ANGLES	3	XXX.XX°
13	MONITOR OCT COMP 3	13	DELTA VELOCITY MEASURED (VECTOR MAG)	1	XXXXX. FT/SEC
14	MONITOR OCT COMP 1, 2	14	DELTA VELOCITY COUNTER SETTING	1	XXXXX. FT/SEC
15	MONITOR OCT COMP 1, 2, 3	15	INCREMENT ADDRESS	1	OCTAL
16	MONITOR DECIMAL	16	AGC CLOCK TIME	3	00XXX. HRS 000XX. MIN 0XX. XX SEC
17	MONITOR DP DECIMAL	17	FINAL ICDU ANGLES	3	XXX.XX°
20	REQUEST EXECUTIVE	20	ICDU	3	XXX.XX°
21	LOAD COMP 1	21	PIPAS	3	XXXXX. PULSES
22	LOAD COMP 2	22	NEW ANGLES I	3	XXX.XX°
23	LOAD COMP 3	23	DELTA ANGLES I	3	XXX.XX°
24	LOAD COMP 1, 2	24	DELTA TIME FOR AGC CLOCK	3	00XXX. HRS 000XX. MIN 0XX. XX SEC
25	LOAD COMP 1, 2, 3	25	CHECKLIST (WITH VERB 50)	1	XXXXX.
26	SPARE	26	PRIORITY OR DELAY	1	XXXXX.
27	SPARE	27	SELF TEST ON/OFF SWITCH	1	XXXXX.
30	SPARE	30	STAR NUMBERS	3	XXXXX.
31	BANK DISPLAY	31	FAIL REG. SFAIL, ERCOUNT	3	OCTAL
32	SPARE	32	SPARE		
33	PROCEED WITHOUT DATA	33	TIME OF IGNITION	3	00XXX. HRS 000XX. MIN 0XX. XX SEC
34	TERMINATE	34	EVENT TIME	3	00XXX. HRS 000XX. MIN 0XX. XX SEC
35	RELEASE DSKY	35	DELTA EVENT TIME	3	00XXX. HRS 000XX. MIN 0XX. XX SEC
36	FRESH START	36	DELTA EVENT TIME	1	XXBXX MIN/SEC
37	CHANGE MAJOR MODE	37	SIGHTING IDENTIFICATION	1	OCTAL
40	ZERO ICDU	40	GAMMA INERTIAL VELOCITY (VI) ALTITUDE ABOVE LAUNCH PAD (HPAD)	3	XXX.XX° XXXXX. FT/SEC XXXX.X NAUT MI
41	COARSE ALIGN (ICDU OR OCDU)	41	MAX ACCELERATION (GMAX) PERIGEE ALTITUDE (HP) FREE-FALL TIME (TFF)	3	XXX.XX G XXXX.X NAUT MI XXBXX MIN/SEC
42	FINE ALIGN IMU	42	MISS DISTANCE (DELTA R) PERIGEE ALTITUDE (HP) FREE-FALL TIME (TFF)	3	XXXX.X NAUT MI XXXX.X NAUT MI XXBXX MIN/SEC
43	LOCK IMU	43	APOGEE ALTITUDE (HA) PERIGEE ALTITUDE (HP) FREE-FALL TIME (TFF)	3	XXXX.X NAUT MI XXXX.X NAUT MI XXBXX MIN/SEC
44	ATTITUDE CONTROL	44	LATITUDE LONGITUDE ALTITUDE (ABOVE FISCHER ELLIPSOID)	3	XXX.XX° XXX.XX° XXXX.X NAUT MI
45	RE-ENTRY CONTROL	45	APOGEE ALTITUDE (HA) PERIGEE ALTITUDE (HP) DELTA VELOCITY REQUIRED (DELTA VREQ)	3	XXXX.X NAUT MI XXXX.X NAUT MI XXXXX. FT/SEC

46	RETURN IMU TO COARSE ALIGN	46	TIME TO EVENT VELOCITY TO BE GAINED (VG) PERIGEE ALTITUDE (HP)	3 XXBXX MIN/SEC XXXXX. FT/SEC XXXX.X NAUT MI
47	SPARE	47	GAMMA AT EI MISS DISTANCE (DELTAR) INERTIAL VELOCITY (VI AT EI)	3 XXX.XX° XXXX.X NAUT MI XXXXX. FT/SEC
50	PLEASE PERFORM	50	TIME TO EVENT DELTA TIME BURN DELTA VELOCITY MEASURED	3 XXBXX MIN/SEC XXBXX MIN/SEC XXXXX. FT/SEC
51	PLEASE MARK	51	TIME TO EVENT VELOCITY TO BE GAINED (VG) MEASURED VELOCITY CHANGE ALONG XSC	3 XXBXX MIN/SEC XXXXX. FT/SEC XXXXX. FT/SEC
52	MARK REJECT	52	TIME TO EVENT VELOCITY TO BE GAINED (VG) FREE-FALL TIME (TFF)	3 XXBXX MIN/SEC XXXXX. FT/SEC XXBXX MIN/SEC
53	FREE	53	MAX ACCELERATION (GMAX) GAMMA AT EI FREE-FALL TIME (TFF)	3 XXX.XX G XXX.XX° XXBXX MIN/SEC
54	PULSE TORQUE GYROS	54	COMMAND ROLL ANGLE (BETA) PRESENT ACCELERATION (G) RANGE TO TARGET	3 XXX.XX° XXX.XX G XXXX.X NAUT MI
55	ALIGN TIME	55	OCDU X SHAFT Y TRUNNION	2 XXX.XX° XXX.XX° or XX.XXX
56	PERFORM BANKSUM	56	MARK DATA X SHAFT Y TRUNNION	2 XXX.XX° XXX.XX° or XX.XXX
57	DO SYSTEM TEST	57	NEW ANGLES OCDU X SHAFT Y TRUNNION	2 XXX.XX° XXX.XX° or XX.XXX
60	PREPARE FOR STANDBY	60	IMU MODE STATUS (IN3, WASKSET, OLDERR)	3 OCTAL
61	RECOVER FROM STANDBY	61	TARGET AZIMUTH TARGET ELEVATION	2 XXX.XX° XX.XXX°
62	ILLEGAL	62	IMPACT LATITUDE IMPACT LONGITUDE HEADS UP/DOWN	3 XXX.XX° XXX.XX° ±00001
63	ILLEGAL	63	LATITUDE LONGITUDE/2 ALTITUDE (ABOVE FISCHER ELLIPSOID)	3 XX.XXX° XX.XXX° XXX.XX NAUT MI
64	DISPLAY ORBITAL PARAMETERS	64	IMPACT LATITUDE IMPACT LONGITUDE FREE-FALL TIME (TFF)	3 XXX.XX° XXX.XX° XXBXX MIN/SEC
65	CALCULATE TIME OF ARRIVAL AT LONGITUDE	65	SAMPLED AGC CLOCK TIME	3 00XXX.HRS 000XX.MIN 0XX.XX SEC
66	CALCULATE LAT AND LONG AT SPECIFIED TIME	66	SYSTEM TEST RESULTS	3 XXXXX.
67	CALCULATE TIME OF ARRIVAL AT MAXIMUM DECLINATION	67	DELTA GYRO ANGLES	3 XX.XXX
70	PERFORM MANUAL ATTITUDE MANEUVER	70	PITCH TRIM YAW TRIM DELTA TIME TAIL-OFF	3 XXX.XX° XXX.XX° XXX.XX° SEC
71	ILLEGAL	71	COMMAND ROLL ANGLE (BETA) PRESENT ACCELERATION (G) PREDICTED RANGE-RANGE TO TARGET	3 XXX.XX° XXX.XX G XXXX.X NAUT MI
72	UPDATE MIN IMPULSE TARGETTING	72	DELTA POSITION	3 XXXX.X KM
73	UPDATE RETURN TO EARTH TARGETTING	73	DELTA VELOCITY	3 XXXX.X M/SEC
74	UPDATE ORBITAL CHANGE TARGETTING	74	DELTA VELOCITY ALLOWABLE DELTA TIME TAIL-OFF	2 XXXXX. FT/SEC XXX.XX SEC
75	PERFORM BACK-UP LIFTOFF	75	DELTA POSITION MAGNITUDE DELTA VELOCITY MAGNITUDE MULTIPLE MARK COUNTER	3 XXXX.X NAUT MI XXXXX. FT/SEC XXXXX.
76	PERFORM STATE VECTOR (RVT) UPDATE	76	SPARE	
77	UPDATE LIFTOFF TIME	77	SPARE	

Prepared by O.H.Cerbins

AC ELECTRONICS

NOUN CODES

Number	Description		Scale	Units
01	Specify machine address		.XXXXX	undetermined
02	Specify machine address		XXXXX.	undetermined
03				
04				
05	Angular Error		XXX.XX	degrees
06	Pitch angle		XXX.XX	degrees
	Heads up/down		± 00001	none
07	Change of Program - used with Please Perform Only			
10				
11	Engine on enable - used with Please Perform Only			
12	ΔV allowable		XXXXX.	ft/sec
13	ΔV measured (vector magnitude)		XXXXX.	ft/sec
14	ΔV counter setting		XXXXX.	ft/sec
15*	Increment machine address			(octal only)
16	AGC clock time		00XXX	hours
			000XX	minutes
			0XX.XX	seconds
17	Desired future ICDU's	Outer	XXX.XX	degrees
		Inner	XXX.XX	degrees
		Middle	XXX.XX	degrees
20	Present ICDU's	Outer	XXX.XX	degrees
		Inner	XXX.XX	degrees
		Middle	XXX.XX	degrees
21	PIPA counters	X	XXXXX.	pulses
		Y	XXXXX.	pulses
		Z	XXXXX.	pulses
22	Desired Present ICDU's	Outer	XXX.XX	degrees
		Inner	XXX.XX	degrees
		Middle	XXX.XX	degrees
23	Delta Angles I	Outer	XXX.XX	degrees
		Inner	XXX.XX	degrees
		Middle	XXX.XX	degrees
24	Delta time for AGC Clock		00XXX	hours
			000XX	minutes
			0XX.XX	seconds

* For Non-Flight Use Only.

NOUN CODES

Number	Description	Scale	Units
25	Checklist - used with Please Perform Only	XXXXX.	
26*	Prior/Delay	XXXXX.	
27	Self-test ON/OFF switch	XXXXX.	
30	Star number	XXXXX.	
31	Failure register code	(octal only)	
	Self-test diagnostic information	(octal only)	
	Self-test diagnostic information	(octal only)	
32*	Decision time		
33*	Ephemeris time		
34	Event time	00XXX	hours
		000XX	minutes
		0XX. XX	seconds
35	Delta-event time	00XXX	hours
		000XX	minutes
		0XX. XX	seconds
36	Delta-event time (display only)	XXΔXX	mins. Δsecs. (Δ Blank)
37			
40	Gamma (γ) - inertial flight path angle	XXX. XX	degrees
	Inertial velocity (VI)	XXXXX.	ft/sec.
	Altitude above launch pad (h_{pad})	XXXX. X	n. m.
41	Maximum acceleration (G_{max})	XXXX. X	G's
	Perigee altitude (h_p)	XXXX. X	n. m.
	Free-fall time (t_{ff})	XXΔXX	min, sec.
42	Miss Distance (ΔR)	XXXX. X	n. m.
	Perigee altitude (h_p)	XXXX. X	n. m.
	Free-fall time (t_{ff})	XXΔXX	min, sec.
43	Perigee altitude (h_p)	XXXX. X	n. m.
	Apogee altitude (h_a)	XXXX. X	n. m.
	Free-fall time (t_{ff})	XXΔXX	min, sec.
44	Latitude	XXX. XX	degrees
	Longitude	XXX. XX	degrees
	Altitude (above the mean equatorial radius)	XXXX. X	n. m.

* For Non-Flight Use Only.

BREL204 VERB/NOUN CODES

01	DISPLAY OCTAL COMP 1 (R1)	01	SPECIFY ADDRESS (FRACTIONAL)	1	.XXXXX
02	DISPLAY OCTAL COMP 2 (R1)	02	SPECIFY ADDRESS (WHOLE)	1	XXXXX.
03	DISPLAY OCTAL COMP 3 (R1)	03	SPARE		
04	DISPLAY OCT COMP 1, 2 (R1, R2)	04	SPARE		
05	DISPLAY OCT COMP 1, 2 (R1, R2, R3)	05	ANGULAR ERROR	1	XXX.XX°
06	DECIMAL DISPLAY	06	SPARE		
07	DP DECIMAL DISPLAY (R1, R2)	07	CHANGE OF PROGRAM (WITH VERB 50)	1	OCTAL
10	REQUEST WAITLIST	10	SPARE		
11	MONITOR OCT COMP 1	11	ENGINE ON ENABLE (WITH VERB 50)		
12	MONITOR OCT COMP 2	12	GIMBAL ANGLES	3	XXX.XX°
13	MONITOR OCT COMP 3	13	DELTA VELOCITY MEASURED (VECTOR MAG)	1	XXXXX. FT/SEC
14	MONITOR OCT COMP 1, 2	14	DELTA VELOCITY COUNTER SETTING	1	XXXXX. FT/SEC
15	MONITOR OCT COMP 1, 2, 3	15	INCREMENT ADDRESS	1	OCTAL
16	MONITOR DECIMAL	16	AGC CLOCK TIME	3	00XXX. HRS 000XX. MIN 0XX. XX SEC
17	MONITOR DP DECIMAL	17	FINAL ICDU ANGLES	3	XXX.XX°
20	REQUEST EXECUTIVE	20	ICDU	3	XXX.XX°
21	LOAD COMP 1	21	PIPAS	3	XXXXX. PULSES
22	LOAD COMP 2	22	NEW ANGLES I	3	XXX.XX°
23	LOAD COMP 3	23	DELTA ANGLES I	3	XXX.XX°
24	LOAD COMP 1, 2	24	DELTA TIME FOR AGC CLOCK	3	00XXX. HRS 000XX. MIN 0XX. XX SEC
25	LOAD COMP 1, 2, 3	25	CHECKLIST (WITH VERB 50)	1	XXXXX.
26	SPARE	26	PRIORITY OR DELAY	1	XXXXX.
27	SPARE	27	SELF TEST ON/OFF SWITCH	1	XXXXX.
30	SPARE	30	STAR NUMBERS	3	XXXXX.
31	BANK DISPLAY	31	FAIL REG. SFAIL, ERCOUNT	3	OCTAL
32	SPARE	32	SPARE		
33	PROCEED WITHOUT DATA	33	TIME OF IGNITION	3	00XXX. HRS 000XX. MIN 0XX. XX SEC
34	TERMINATE	34	EVENT TIME	3	00XXX. HRS 000XX. MIN 0XX. XX SEC
35	RELEASE DSKY	35	DELTA EVENT TIME	3	00XXX. HRS 000XX. MIN 0XX. XX SEC
36	FRESH START	36	DELTA EVENT TIME	1	XXBXX MIN/SEC
37	CHANGE MAJOR MODE	37	SIGHTING IDENTIFICATION	1	OCTAL
40	ZERO ICDU	40	GAMMA INERTIAL VELOCITY (VI) ALTITUDE ABOVE LAUNCH PAD (HPAD)	3	XXX.XX° XXXXX. FT/SEC XXXX.X NAUT MI
41	COARSE ALIGN (ICDU OR OCDU)	41	MAX ACCELERATION (GMAX) PERIGEE ALTITUDE (HP) FREE-FALL TIME (TFF)	3	XXX.XX G XXXX.X NAUT MI XXBXX MIN/SEC
42	FINE ALIGN IMU	42	MISS DISTANCE (DELTA R) PERIGEE ALTITUDE (HP) FREE-FALL TIME (TFF)	3	XXXX.X NAUT MI XXXX.X NAUT MI XXBXX MIN/SEC
43	LOCK IMU	43	APOGEE ALTITUDE (HA) PERIGEE ALTITUDE (HP) FREE-FALL TIME (TFF)	3	XXXX.X NAUT MI XXXX.X NAUT MI XXBXX MIN/SEC
44	ATTITUDE CONTROL	44	LATITUDE LONGITUDE ALTITUDE (ABOVE FISCHER ELLIPSOID)	3	XXX.XX° XXX.XX° XXXX.X NAUT MI
45	RE-ENTRY CONTROL	45	APOGEE ALTITUDE (HA) PERIGEE ALTITUDE (HP) DELTA VELOCITY REQUIRED (DELTA VREQ)	3	XXXX.X NAUT MI XXXX.X NAUT MI XXXXX. FT/SEC

6	RETURN IMU TO COARSE ALIGN	46	TIME TO EVENT VELOCITY TO BE GAINED (VG) PERIGEE ALTITUDE (HP)	3	XXBXX MIN/SEC XXXXX. FT/SEC XXXX.X NAUT MI
7	SPARE	47	GAMMA AT EI MISS DISTANCE (DELTAR) INERTIAL VELOCITY (VI AT EI)	3	XXX.XX° XXXX.X NAUT MI XXXXX. FT/SEC
0	PLEASE PERFORM	50	TIME TO EVENT DELTA TIME BURN DELTA VELOCITY MEASURED	3	XXBXX MIN/SEC XXBXX MIN/SEC XXXXX. FT/SEC
1	PLEASE MARK	51	TIME TO EVENT VELOCITY TO BE GAINED (VG) MEASURED VELOCITY CHANGE ALONG XSC	3	XXBXX MIN/SEC XXXXX. FT/SEC XXXXX. FT/SEC
2	MARK REJECT	52	TIME TO EVENT VELOCITY TO BE GAINED (VG) FREE-FALL TIME (TFF)	3	XXBXX MIN/SEC XXXXX. FT/SEC XXBXX MIN/SEC
3	FREE	53	MAX ACCELERATION (GMAX) GAMMA AT EI FREE-FALL TIME (TFF)	3	XXX.XX G XXX.XX° XXBXX MIN/SEC
4	PULSE TORQUE GYROS	54	COMMAND ROLL ANGLE (BETA) PRESENT ACCELERATION (G) RANGE TO TARGET	3	XXX.XX° XXX.XX G XXXX.X NAUT MI
5	ALIGN TIME	55	OCDU X SHAFT Y TRUNNION	2	XXX.XX° XXX.XX° or XX.XXX°
6	PERFORM BANKSUM	56	MARK DATA X SHAFT Y TRUNNION	2	XXX.XX° XXX.XX° or XX.XXX°
7	DO SYSTEM TEST	57	NEW ANGLES OCDU X SHAFT Y TRUNNION	2	XXX.XX° XXX.XX° or XX.XXX°
0	PREPARE FOR STANDBY	60	IMU MODE STATUS (IN3, WASKSET. OLDERR)	3	OCTAL
1	RECOVER FROM STANDBY	61	TARGET AZIMUTH TARGET ELEVATION	2	XXX.XX° XX.XXX°
2	ILLEGAL	62	IMPACT LATITUDE IMPACT LONGITUDE HEADS UP/DOWN	3	XXX.XX° XXX.XX° ±00001
3	ILLEGAL	63	LATITUDE LONGITUDE/2 ALTITUDE (ABOVE FISCHER ELLIPSOID)	3	XX.XXX° XX.XXX° XXX.XX NAUT MI
4	DISPLAY ORBITAL PARAMETERS	64	IMPACT LATITUDE IMPACT LONGITUDE FREE-FALL TIME (TFF)	3	XXX.XX° XXX.XX° XXBXX MIN/SEC
5	CALCULATE TIME OF ARRIVAL AT LONGITUDE	65	SAMPLED AGC CLOCK TIME	3	00XXX. HRS 00XX. MIN 0XX.XX SEC
6	CALCULATE LAT AND LONG AT SPECIFIED TIME	66	SYSTEM TEST RESULTS	3	XXXXX.
7	CALCULATE TIME OF ARRIVAL AT MAXIMUM DECLINATION	67	DELTA GYRO ANGLES	3	XX.XXX
0	PERFORM MANUAL ATTITUDE MANEUVER	70	PITCH TRIM YAW TRIM DELTA TIME TAIL-OFF	3	XXX.XX° XXX.XX° XXX.XX° SEC
1	ILLEGAL	71	COMMAND ROLL ANGLE (BETA) PRESENT ACCELERATION (G) PREDICTED RANGE-RANGE TO TARGET	3	XXX.XX° XXX.XX G XXXX.X NAUT MI
2	UPDATE MIN IMPULSE TARGETTING	72	DELTA POSITION	3	XXXX.X KM
3	UPDATE RETURN TO EARTH TARGETTING	73	DELTA VELOCITY	3	XXXX .X M/SEC
4	UPDATE ORBITAL CHANGE TARGETTING	74	DELTA VELOCITY ALLOWABLE DELTA TIME TAIL-OFF	2	XXXXX. FT/SEC XXX.XX SEC
5	PERFORM BACK-UP LIFTOFF	75	DELTA POSITION MAGNITUDE DELTA VELOCITY MAGNITUDE MULTIPLE MARK COUNTER	3	XXXX.X NAUT MI XXXXX. FT/SEC XXXXX.
6	PERFORM STATE VECTOR (RVT) UPDATE	76	SPARE		
7	UPDATE LIFTOFF TIME	77	SPARE		

Prepared by O. H. Cerbins

AC ELECTRONICS

MISSION DESCRIPTION AND TEST OBJECTIVES

APOLLO MISSION SA-202

FIELD SERVICE AC TRAINING

FEB. 28,1966

WE HAVE PRIDE IN PERFORMANCE

FOR USE AS EDUCATIONAL AID ONLY

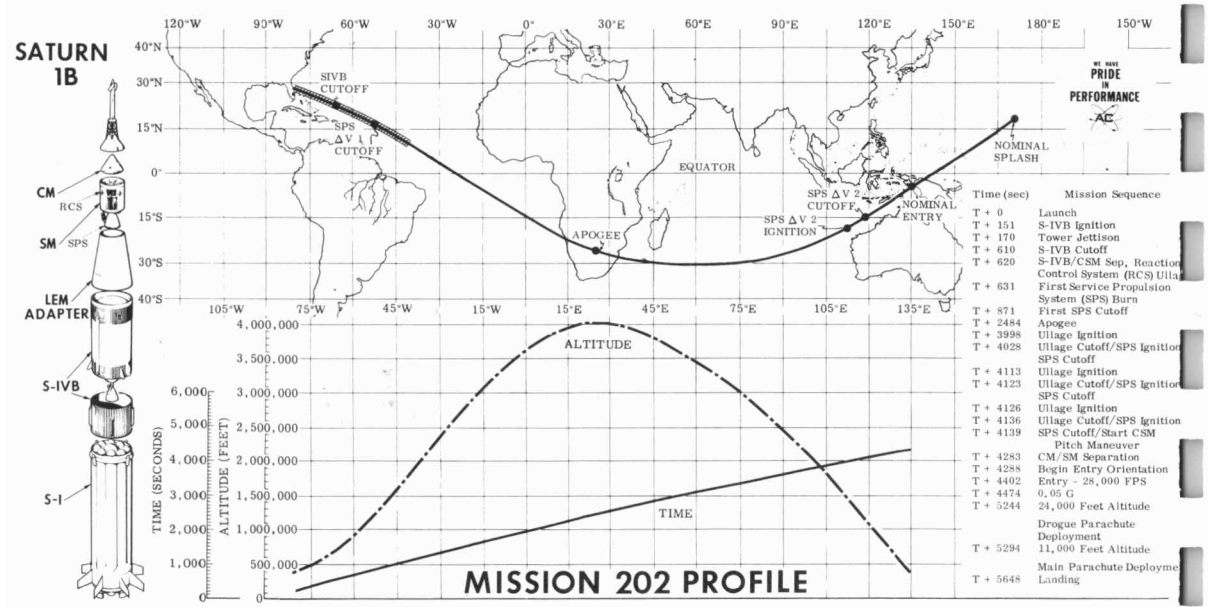
MISSION DESCRIPTION

1. UNMANNED.
2. SUBORBITAL BALLISTIC PATH TO ALTITUDE OF 670 NM.
3. TIME OF FLIGHT APPROXIMATELY 94 MINUTES.
4. DISTANCE DOWNRANGE APPROXIMATELY 16,000 NM.
5. BLOCK I (SERIES 50) G&N SYSTEM NO. 17.
6. COMMAND AND SERVICE MODULE NO. 011 WITH ALL SPACECRAFT SYSTEMS ABOARD.
7. SATURN 1B LAUNCH VEHICLE.

TEST OBJECTIVES

1. SPACECRAFT TEST OBJECTIVES WHICH REQUIRE PROPER OPERATION OF THE G&N SYSTEM.
   - A. EVALUATE THE THERMAL PERFORMANCE OF THE COMMAND MODULE (CM) HEAT SHIELD DURING A HIGH HEAT LOAD, LONG DURATION ENTRY.
   - B. DEMONSTRATE COMMAND MODULE ADEQUACY FOR MANNED ENTRY FROM LOW EARTH ORBIT.
   - C. DETERMINE NOMINAL MODE SEPARATION CHARACTERISTICS OF THE COMMAND/SERVICE MODULE (CSM) FROM THE SIVB (LAUNCH VEHICLE SECOND STAGE) AND THE COMMAND MODULE (CM) FROM THE SERVICE MODULE (SM).
   - D. DEMONSTRATE MULTIPLE SERVICE PROPULSION SYSTEM (SPS) RESTART.
   - E. DETERMINE PERFORMANCE OF THE CSM SYSTEMS.
2. DETAILED G&N TEST OBJECTIVES.
   - A. EVALUATE PERFORMANCE OF THE FOLLOWING INTEGRATED G&N/SPACECRAFT MODES OF OPERATION.
     1) BOOST MONITOR.
     2) THRUST VECTOR CONTROL.
     3) ORBIT ALTITUDE CONTROL.
     4) LIFT VECTOR CONTROL.
     5) UNMANNED SPACECRAFT CONTROL.
   - B. DETERMINE ACCURACY OF G&N SYSTEM IN COMPUTATION OF SPACECRAFT POSITION AND VELOCITY DURING ALL MISSION PHASES.

AC ELECTRONICS
Division of General Motors, Milwaukee, Wisconsin



Time (sec)	Mission Sequence
T + 0	Launch
T + 151	S-IVB Ignition
T + 170	Tower Jettison
T + 610	S-IVB Cutoff
T + 620	S-IVB/CSM Sep, Reaction Control System (RCS) Ullage
T + 631	First Service Propulsion System (SPS) Burn
T + 871	First SPS Cutoff
T + 2484	Apogee
T + 3998	Ullage Ignition
T + 4028	Ullage Cutoff/SPS Ignition SPS Cutoff
T + 4113	Ullage Ignition
T + 4123	Ullage Cutoff/SPS Ignition SPS Cutoff
T + 4126	Ullage Ignition
T + 4136	Ullage Cutoff/SPS Ignition
T + 4139	SPS Cutoff/Start CSM Pitch Maneuver
T + 4283	CM/SM Separation
T + 4288	Begin Entry Orientation
T + 4402	Entry - 28,000 FPS
T + 4474	0.05 G
T + 5244	24,000 Feet Altitude
	Drogue Parachute Deployment
T + 5294	11,000 Feet Altitude
	Main Parachute Deployment
T + 5648	Landing

NOUN CODES

Number	Description	Scale	Units
45	Perigee altitude (h_p)	XXXX. X	n. m.
	Apogee altitude (h_a)	XXXX. X	n. m.
	Delta-velocity-required (ΔV_{req})	XXXXX.	ft/sec
46	Time-to-event	XXΔXX	min, sec.
	Velocity-to-be-gained (V_g)	XXXXX.	ft/sec
	Perigee altitude (h_p)	XXXX. X	n. m.
47	Flight path angle (γ)	XXX. XX	degrees
	Miss distance (ΔR)	XXXX. X	n. m.
50	Time-to-event	XXΔXX	min, sec.
	Delta-T-burn	XXΔXX	min, sec.
51	Time-to-event	XXΔXX	min, sec.
	Velocity-to-be-gained (V_g)	XXXXX.	ft/sec
	Measured velocity change along X_{SC}	XXXXX.	ft/sec
52	Time-to-event	XXΔXX	min, sec.
	Velocity-to-be-gained (V_g)	XXXXX.	ft/sec
	Free-fall-time (t_{ff})	XXΔXX	min, sec.
53	Maximum acceleration (G_{max})	XXXX. X	G's
	Free-fall-time (t_{ff})	XXΔXX	min, sec.
54	Commanded roll angle (β)	XXX. XX	degrees
	Present acceleration (G)	XXXX. X	G's
	Altitude (h)	XXXX. X	n. m.
55	OCDU X (SDA)	XXX. XX	degrees
	Y (PDA)	XX. XXX	degrees
56	Uncalled mark data X (SDA)	XXX. XX	degrees
	Y (PDA)	XX. XXX	degrees
57	New Angles OCDU X (SDA)	XXX. XX	degrees
	Y (PDA)	XX. XXX	degrees
60*	IMU mode status IN3 WASKSET OLDERR	(octal only)	
61*	Target Azimuth	XXX. XX	degrees
	Target Elevation	XX. XXX	degrees

* For Non-Flight Use Only.

NOUN CODES

Number	Description		Scale	Units
62	Delta-velocity-insert (ΔV_{ins})		XXXXX.	ft/sec
	Miss distance (ΔR)		XXXX.X	n.m.
	Free-fall-time (t_{ff})		XXΔXX	min, sec.
63	Lat Landmark Load		XX.XXX	degrees
	Long/2		XX.XXX	"
	Alt		XXX.XX	n.m.
64	Lat, Splash		XXX.XX	degrees
	Long, Splash		XXX.XX	degrees
	T_{FF}		XXΔXX	min, sec.
65	Sampled time (fetched in interrupt)		00XXX	hours
			000XX	minutes
			0XX.XX	seconds
66*	System test results			
67	Delta gyro angles	X	XX.XXX	degrees
		Y	XX.XXX	degrees
		Z	XX.XXX	degrees
70	Pitch trim		XXX.XX	degrees
	Yaw trim		XXX.XX	degrees
	Delta-velocity-tail-off		XXX.XX	ft/sec
71				
72*	Delta position			
73*	Delta velocity			
74				
75	Delta position magnitude		XXXX.X	n.m.
	Delta velocity magnitude		XXXXX.	ft/sec
	Measurement Angle Deviation		XXX.XX	degrees
76*	R			
77*	V			

* For Non-Flight Use Only.

VERB CODES

Verbs	Description
01	Display Octal Component 1 (R1)
02	Display Octal Component 2 (R1)
03	Display Octal Component 3 (R1)
04	Display Octal Component 1, 2 (R1, R2)
05	Display Octal Component 1, 2, 3 (R1, R2, R3)
06	Decimal Display
07	DP Decimal Display (R1, R2)
10	Request Waitlist (For Non-Flight Use Only)
11	Monitor Octal Component 1 (R1)
12	Monitor Octal Component 2 (R1)
13	Monitor Octal Component 3 (R1)
14	Monitor Octal Component 1, 2 (R1, R2)
15	Monitor Octal Component 1, 2, 3 (R1, R2, R3)
16	Monitor Decimal
17	Monitor DP Decimal (R1, R2)
20	Request Executive (For Non-Flight Use Only)
21	Load Component 1 (R1)
22	Load Component 2 (R2)
23	Load Component 3 (R3)
24	Load Component 1, 2 (R1, R2)
25	Load Component 1, 2, 3 (R1, R2, R3)
26	
27	
30	
31	Bank Display (Fixed Memory)
32	
33	Proceed without Data
34	Terminate
35	
36	Fresh Start
37	Change Program (Major Mode)
40	Zero (used with noun ICDU or OCDU)
41	Coarse Align (used with noun ICDU or OCDU)
42	Fine Align IMU

VERB CODES

Verbs	Description
43	Lock IMU
44	Set IMU to Attitude Control
45	Set IMU to Entry Control
46	Return IMU to Coarse Align
47	
50	Please Perform
51	Please Mark
52	Mark Reject (in lieu of Button)
53	Free (used with noun ICDU or OCDU)
54	Pulse Torque Gyros
55	Align Time
56	Perform Banksum
57	Do System Test (For Non-Flight Use Only)
60	Prepare for Standby
61	Recover from Standby
62	
63	
64	Calculate Orbital Parameters
65	Calculate Time of Arrival at Longitude
66	Calculate Lat. and Long. at Specified Time
67	Calculate Max. Declination and Time of Arrival There
70	Manual Attitude Maneuver
71	MTVC Takeover
72	Minimum Impulse Aim Point Update
73	Return-to-earth Aim Point Update
74	Orbit Change Aim Point Update
75	Manual L/O for Flights
76	R, V, T Update (state vector)

CHECKLIST AND ERROR CODES

Checklist Codes (Appear in R1 with noun 25)

00001 SCS Mode to G&N Attitude Control
00002 SCS Mode to G&N Delta-V
00003 SCS Mode to G&N Entry
00004 SCS Mode to SCS Attitude Control
00007 Attitude Trim Maneuver Enable
00011 Automatic Optics Positioning
00012 Target Data Entry
00013 Switch OSS to Computer Control
00014 Fine Align Check
00015 Perform Star Acquisition
00031 Engine On
00035 Prepare AGC for Thrust
00036 Thrust Terminate
00041 CM/SM Sep

Error Codes (Appear in R1 with Noun 31)

OSS Errors

00101 Optics mode control switched from ZERO OPTICS before end of 30 second wait.
00102 AGC unable to achieve desired optics mode.
00103 SEXTANT POWER switch turned on when optics is not in zero optics mode.
00104 No vacant area available for marks.
00105 Internal mark request while mark system is busy.
00106 SXT not on at mark time or mark received with all requested marks accepted.
00107 Mark Reject while mark system is not in use.
00110 Mark Reject with all requested marks accepted or no marks since initiating last Mark Reject.
00120 Too many Marks.

CHECKLIST AND ERROR CODES

Error Codes (Appear in R1 with Noun 31)

ISS Errors

00201 Zero encode ended before end of 30 second wait.
00202 AGC unable to achieve desired ISS mode.
00203 No ISS mode indicated to AGC.
00204 ISS mode changed while TRANSFER switch is in COMPUTER position, but AGC did not command mode change.

Procedural Difficulties

00401 Desired gimbal angles will produce gimbal lock (middle gimbal angle greater than 60^{o}).
00402 Star out of field of view.
00403 Same as 00402.
00404 IMU orientation unknown.
00405 SCS mode monitor failure.
00406 Navigation prog. busy.
00407 Navigation prog. needed internally.
00410 AGC update not allowed.

AGC Hardware Malfunctions

01101 Unused interrupt (RUPT 2) occurred.
01102 AGC self test error.
01103 Unused count, compare, and skip (CCS) branch executed.
01104 C-relay failed during C-relay test.
01105 Star Search Failure.
01106 IMU orientation no good for entry.

BREL204 ERROR CODES

OPTICS SUBSYSTEM

00101 ZERO CDU SWITCH ALTERED BEFORE EXPIRATION OF 30 SEC WAIT
00102 AGC UNABLE TO ACHIEVE DESIRED OPTICS MODE
00103 SXT-ON SWITCH TURNED ON WITH OPTICS NOT IN ZERO CDU MODE
00104 AGC HAS NO DESIRED OPTICS ANGLES
00105 INTERNAL MARKS REQUESTED WITH MARK SYSTEM BUSY
00106 SXT-ON SWITCH NOT IN DESIRED STATE AT MARK TIME OR MARK WITH ALL REQUESTED MARKS ACCEPTED
00107 MARK ACCEPT WITH MARK SYSTEM NOT IN USE
00110 MARK ACCEPT WITH ALL REQUESTED MARKS ACCEPTED
00112 NO MARK EXPECTED
00120 TOO MANY MARKS
00121 NO MARKS
00122 ONLY ONE MARK FOR UNKNOWN LANDMARK
00123 MARK DATA UNAVAILABLE AFTER RESTART

IMU SUBSYSTEM

00201 CDU ZERO SWITCH ALTERED BEFORE EXPIRATION OF 30 SEC WAIT
00202 AGC UNABLE TO ACHIEVE DESIRED MODE
00203 NO IMU MODE INDICATED TO AGC
00204 MODE SWITCH WITH TRNSW IN COMPUTER, BUT COMPUTER NOT COMMANDING

GENERAL MISSION PROGRAM ERRORS

00301 CURTAINS PROGRAM

PROCEDURAL DIFFICULTY

00401 DESIRED GIMBAL ANGLES YIELD GIMBAL LOCK
00402 STAR OUT OF FIELD OF VIEW
00403 STAR OUT OF FIELD OF VIEW
00404 IMU ORIENTATION UNKNOWN
00405 SCS MODE NOT IN DESIRED STATE
00410 UPDATE NOT ALLOWED AT THIS TIME
00411 MANEUVER IN PROGRESS
00412 TIME AND LONGITUDE TOO FAR APART

COMPUTER HARDWARE MALFUNCTIONS

01101 RUPT2 OCCURRED
01102 AGC SELF CHECK ERROR (Q IN S FAIL)
01103 UNUSED CCS BRANCH EXECUTED
01104 C-RELAY FAILED DURING C-RELAY TEST
01105 STAR SEARCH FAILED

LIST OVERFLOWS (ALL ABORTS)

01201 NO VAC AREAS
01202 NO JOB AREAS
01203 A VALID TASK HAS BEEN PUSHED OUT OF THE WAITLIST
01204 NO PLACE ON THE WAITLIST IS AVAILABLE INTO WHICH A VALID TASK CAN BE ENTERED
01205 NO PLACE IS AVAILABLE ON THE PWTCADR TABLE INTO WHICH A MISSION FUNCTION CAN BE ENTERED – TOO MANY JOBS WAITING
01206 SECOND JOB ATTEMPTS TO GO TO SLEEP VIA KEYBOARD AND DISPLAY PROGRAM
01207 NO VAC AREA FOR MARKS
01210 SOMETHING ALREADY WAITING IN IMUSTALL

INTERPRETER ERRORS

01301 ARCCOS – ARCSIN INPUT ANGLE TOO LARGE
01302 SQRT CALLED WITH NEGATIVE ARGUMENT

DISPLAY ALARMS

01401 THRUST MISALIGNMENT EXCEEDS 90 DEGREES
01402 (DELV) TOO LOW – ENGINE NOT ON
01403 ACTUAL SPLASH POINT NOW BEYOND DESIRED
01404 ENTRY POINT GAMMA NOT COMPUTABLE
01405 NOW LESS THAN 5 MINS TO DESIRED IGNITION TIME
01406 ATTITUDE MANEUVER HAS ABORTED
01407 COMMANDED CDUZ EXCEEDS 60 DEGREES
01410 SMA LESS THAN RE/2
01411 TARGET LAT EXCEEDS DECLINATION OF ORBIT
01421 NAVIGATION PROG (AVERAGE G) NOT RUNNING
01426 IMU ORIENTATION UNSATISFACTORY FOR ENTRY
01427 IMU ORIENTATION REVERSED FOR ENTRY
01430 CM/SM SEP DISCRETE RECEIVED BUT NOT IN P11 OR P62

KEYBOARD AND DISPLAY PROGRAM

01501 KEYBOARD AND DISPLAY ALARM DURING INTERNAL USE (NVSUB). ABORT

MAJOR MODES FOR FLIGHT 204

IDLE	00	AGC IDLING
PRELAUNCH	01	G & N START UP AND CHECKOUT
	02	INITIALIZATION
	03	GYROCOMPASSING
	04	OPTICAL VERIFICATION OF AZIMUTH
	05	INERTIAL REFERENCE
	07	SYSTEM TEST
BOOSTER MONITOR	11	PRE-LET JETTISON
	12	POST-LET JETTISON
	17	LET ABORT
COASTING PHASE	21	CSM LOCAL VERTICAL
	22	LANDMARK TRACKING
	23	STAR/LANDMARK SIGHTING
	27	AGC UPDATE
PRE-THRUSTING	31	ORBIT CHANGE
	32	RETURN TO EARTH
	33	SPS MINIMUM IMPULSE
THRUSTING	41	ORBIT CHANGE
	42	RETURN TO EARTH
	43	SPS MINIMUM IMPULSE
	46	G & N STANDBY SPS MONITOR
	47	G & N STANDBY RCS MONITOR
ALIGNMENT	51	IMU ORIENTATION DETERMINATION
	52	SIVB/IMU ALIGNMENT
	53	CSM/IMU ALIGNMENT
ENTRY	61	MANEUVER TO CM/SM SEPARATION ATTITUDE
	62	CM/SM SEPARATION AND PRE-ENTRY MANEUVER
	63	INITIATE ENTRY STEERING
	64	0.05 G INDICATION
	65	UP-CONTROL PHASE
	66	BALLISTIC PHASE
	67	FINAL PHASE
ABORT	71	FIRST ABORT BURN
	72	ABORT MODE SELECTION
	73	THRUST TO DISCRETE RECOVERY AREA
	74	CONTINGENCY ORBIT INSERTION – FIRST BURN
	75	CONTINGENCY ORBIT INSERTION – SECOND BURN

ERASABLE REGISTERS

0000	A	0027	QRUPT
0001	Q	0030	BANKRUPT
0002	Z	0031	OVRUPT
0003	LP	0032	LPRUPT
0004	IN0	0033	DSRUPTSW
0005	IN1	0034	OVCTR
0006	IN2	0035	TIME2
0007	IN3	0036	TIME1
0010	OUT0	0037	TIME3
0011	OUT1	0040	TIME4
0012	OUT2	0041	UPLINK
0014	OUT4	0042	OUTCR1
0015	BANKREG	0043	OUTCR2
0016	RELINT	0044	PIPAX
0017	INHINT	0045	PIPAY
0020	CYR	0046	PIPAZ
0021	SR	0047	CDUX
0022	CYL	0050	CDUY
0023	SL	0051	CDUZ
0024	ZRUPT	0052	OPTX
0025	BRUPT	0053	OPTY
0026	ARUPT		

Prepared by O. H. Cerbins

AC ELECTRONICS

CHECKLIST AND ERROR CODES

Error Codes (Appear in R1 with Noun 31)

List Overflows

01201 Executive overflow-no vacant areas (abort).
01202 Executive overflow-no core sets (abort).
01203 Waitlist overflow-too many tasks (abort).
01204 Same as 01203.
01205 Master control overflow-too many jobs waiting (abort).
01206 DSKY waiting line overflow (abort).
01207 No vacant area for marks (abort).
01210 Something already waiting in IMU stall (abort).

Interpreter Errors

01301 Arccos-arcsin input angle too large (abort).
01302 Square root called for with a negative argument (abort).

Display Alarms

01401 VG increasing-loss of control.
01402 Delta V too low-engine not on.

Keyboard and Display Program Errors

01501 Check fail alarm during internal use (abort).

BIT / REGISTER	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
INO		MARK	N.C.	G/N ENTRY MODE	G/N ΔV MODE	G/N ATT. CONT. MODE	N.C.	N.C.	N.C.	IHIBIT UPSYNC	BLOCK UPLINK	KEY CODE 5	KEY CODE 4	KEY CODE 3	KEY CODE 2	KEY CODE 1
IN1		2	4		H	O	U	R		C	O	U	N	T	E	R
IN2		PARITY FAIL	N.C.	N.C.	IMU FAIL	PIPA FAIL	CDU FAIL	SM/CM SEP	SIVB SEP	N.C.	GUID REL	LIFT OFF	F T 200PPS	I I 400PPS	N M 800PPS	E E 1600PPS
IN3		OR OF CI-C33	COMP. CONTR. OPT.	NC	ZERO OPT	N.C.		NC	NC	K5 ENTRY	TRN SW	KI2 ATT. CONTR	K4 FINE ALIGN	K3 MANUAL CDU	K2 COARSE ALIGN	K1 ZERO ENCODE
OUT O		RELAY WORD 4	RELAY WORD 3	RELAY WORD 2	RELAY WORD 1	RELAY BIT 11	RELAY BIT 10	RELAY BIT 9	RELAY BIT 8	RELAY BIT 7	RELAY BIT 6	RELAY BIT 5	RELAY BIT 4	RELAY BIT 3	RELAY BIT 2	RELAY BIT 1
OUT 1		NC	NC	ENG ON	NC	NC	BLOCK END PULSE	ID WORD	NC	RUPT 2 TRAP RESET	NC	CHECK FAIL	TEL ALARM	KEY RELEASE	COMP ACT.	PROG ALARM
OUT 2		−	+	CDU	GYRO	X	Y	Z	−	+	OPT X	OPT Y	THRUST	N.C.	N.C.	N.C.
		← USE OUT COUNTER 1 →							← USE OUT COUNTER 2 →							
OUT 3						S	P	A	R	E	S					
OUT 4					D T	O E	W L	N E	L M	I E	N T	K R	Y			

NC= NOT CONNECTED

INPUT/OUTPUT BIT ASSIGNMENTS

AGC DOWNLINK FORMAT

	LIST 1	LIST 2 (V76)
1	ID	ID
2	DSPTAB+0	DSPTAB+0
3	DSPTAB+1	DSPTAB+1
4	DSPTAB+2	DSPTAB+2
5	DSPTAB+3	DSPTAB+3
6	DSPTAB+4	DSPTAB+4
7	DSPTAB+5	DSPTAB+5
8	DSPTAB+6	DSPTAB+6
9	DSPTAB+7	DSPTAB+7
10	DSPTAB+8D	DSPTAB+8D
11	DSPTAB+9D	DSPTAB+9D
12	DSPTAB+10D	DSPTAB+10D
13	DSPTAB+11D	DSPTAB+11D
14	DSPTAB+12D	DSPTAB+12D
15	DSPTAB+13D	DSPTAB+13D
16	TIME2	TIME2
17	TIME1	TIME1
18	IN0	IN0
19	IN2	IN2
20	IN3	IN3
21	ϕUT1	ϕUT1
22	STATE	STATE
23	FLAGWRD1	FLAGWRD1
24	FLAGWRD2	FLAGWRD2
25	CDUX	CDUX
26	CDUY	CDUY
27	CDUZ	CDUZ
28	DNSPARE	STBUFF+0
29	DELVX+0	STBUFF+1
30	DELVY+2 (MKR 1)	STBUFF+2
31	DELVZ+4	STBUFF+3
32	THETAD+0	STBUFF+4
33	THETAD+1 (MKR 3)	STBUFF+5
34	THETAD+2	STBUFF+6
35	RRECT+0	STBUFF+7

AGC DOWNLINK FORMAT

	LIST 1	LIST 2 (V76)
36	RRECT+1	STBUFF+8D
37	RRECT+2	STBUFF+9D
38	RRECT+3	STBUFF+10D
39	RRECT+4	STBUFF+11D
40	RRECT+5	STBUFF+12D
41	VRECT+0	STBUFF+13D
42	VRECT+1	DNSPARE
43	VRECT+2	DNSPARE
44	VRECT+3	DNSPARE
45	VRECT+4	DNSPARE
46	VRECT+5	DNSPARE
47	TFF	DNSPARE
48	TFF+1 (MKR 3)	STCNTR
49	TMMARKER	TMMARKER
50	TMMARKER	TMMARKER
51	TMMARKER	TMMARKER
52	DSPTAB+0	DSPTAB+0
53	DSPTAB+1	DSPTAB+1
54	DSPTAB+2	DSPTAB+2
55	DSPTAB+3	DSPTAB+3
56	DSPTAB+4	DSPTAB+4
57	DSPTAB+5	DSPTAB+5
58	DSPTAB+6	DSPTAB+6
59	DSPTAB+7	DSPTAB+7
60	DSPTAB+8D	DSPTAB+8D
61	DSPTAB+9D	DSPTAB+9D
62	DSPTAB+10D	DSPTAB+10D
63	DSPTAB+11D	DSPTAB+11D
64	DSPTAB+12D	DSPTAB+12D
65	DSPTAB+13D	DSPTAB+13D
66	RN+0	DNSPARE
67	RN+1	DNSPARE
68	RN+2 (MKR 2)	TCUTOFF+0
69	RN+3	TCUTOFF+1

AGC DOWNLINK FORMAT

	LIST 1	LIST 2 (V76)
70	RN+4	RAVEGON+0
71	RN+5	RAVEGON+1
72	VN+0	RAVEGON+2
73	VN+1	RAVEGON+3
74	VN+2 (MKR 2)	RAVEGON+4
75	VN+3	RAVEGON+5
76	VN+4	VAVEGON+0
77	VN+5	VAVEGON+1
78	PIPTIME (MKR 1)	VAVEGON+2
79	PIPTIME+1	VAVEGON+3
80	SPARE	VAVEGON+4
81	SPARE	VAVEGON+5
82	TCUTOFF+0	TAVEGON+0
83	TCUTOFF+1	TAVEGON+1
84	RAVEGON+0	STBUFF+0
85	RAVEGON+1	STBUFF+1
86	RAVEGON+2	STBUFF+2
87	RAVEGON+3	STBUFF+3
88	RAVEGON+4	STBUFF+4
89	RAVEGON+5	STBUFF+5
90	VAVEGON+0	STBUFF+6
91	VAVEGON+1	STBUFF+7
92	VAVEGON+2	STBUFF+8D
93	VAVEGON+3	STBUFF+9D
94	VAVEGON+4	STBUFF+10D
95	VAVEGON+5	STBUFF+11D
96	TAVEGON+0	STBUFF+12D
97	TAVEGON+1	STBUFF+13D
98	TMMARKER	TMMARKER
99	TMMARKER	TMMARKER
100	TMMARKER	TMMARKER

ANALOG DATA TELEMETRY AND RECORDING

Identification	Function	Sample Rate/sec
CG0001 V	Computer Digital Data (DIGITAL DOWNLINK)	50
CG1101 V	-28 VDC Supply	1
CG1110 V	2.5 VDC TM Bias	1
CG1503 X	+28 VDC IMU Operate	10
CG1513 X	+28 VDC IMU Standby	10
CG1523 X	+28 VDC AGC Operate	10
CG1533 X	+28 VDC OPTICS Operate	10
CG2110 V	IGA Torque Motor Input	10
CG2112 V	IGA 1X Res. Output, sine, in phase	10
CG2113 V	IGA 1X Res. Output, cos, in phase	10
CG2117 V	IGA Servo Error, in phase	100
CG2140 V	MGA Torque Motor Input	10
CG2142 V	MGA 1X Resolver Output, sine, in phase	10
CG2143 V	MGA 1X Resolver Output, cos, in phase	10
CG2147 V	MGA Servo Error, in phase	100
CG2170 V	OGA Torque Motor Input	10
CG2172 V	OGA 1X Resolver Output, sine, in phase	10
CG2173 V	OGA 1X Resolver Output, cos, in phase	10
CG2177 V	OGA Servo Error, in phase	100
CG2206 V	IGA CDU 1X Res. Error, in phase	10
CG2236 V	MGA CDU 1X Res. Error, in phase	10
CG2266 V	OGA CDU 1X Res. Error, in phase	10
CG2300 T	PIPA Temp.	1
CG2301 T	IRIG Temp.	1
CG2302 C	IMU Heater Current	1
CG2303 C	IMU Blower Current	1
CG3102 V	SXT Trun. Motor Drive, in phase	10
CG3112 V	SXT Shaft Motor Drive, in phase	10
CG3133 V	SCT Trun. Motor Drive	10
CG3141 V	Trun. CDU 16X Res. Error, in phase	10
CG3200 V	Trun. CDU Motor Drive, in phase	10
CG3220 V	Shaft CDU Motor Drive, in phase	10
CG4300 T	AGC Temp.	1

ANALOG DATA TELEMETRY AND RECORDING

Identification	Function	Sample Rate/sec
*CG5000 X	PIPA FAIL	10
*CG5001 X	IMU FAIL	10
*CG5002 X	CDU FAIL	10
CG5003 X	Gimbal Lock Light	10
CG5005 X	G&N Error Light	10
CG5006 X	IMU Temp. Light	10
CG5007 X	Zero Encoder Light	10
CG5008 X	IMU Delay Light	10
*CG5020 X	AGC Alarm #1 (program)	10
*CG5021 X	AGC Alarm #2 (AGC Activity)	10
*CG5022 X	AGC Alarm #3 (T/M)	10
*CG5023 X	AGC Alarm #4 (PROG CHK FAIL)	10
*CG5024 X	AGC Alarm #5 (Scaler FAIL)	10
*CG5025 X	AGC Alarm #6 (Parity FAIL)	10
*CG5026 X	AGC Alarm #7 (Counter FAIL)	10
*CG5027 X	AGC Alarm #8 (Key Release)	10
*CG5028 X	AGC Alarm #9 (RUPT Lock)	10
*CG5029 X	AGC Alarm #10 (TC Trap)	10
CG5030 X	AGC Power Fail Light	10
CG6000 P	IMU Pressure	1
CG6020 T	PSA Temp., 1 Tray 3	1
CG6021 T	PSA Temp., 2 Tray 2	1
CG6022 T	PSA Temp., 3 Tray 4	1
CG2010 V	X PIPA SG Output, in phase	To flight qualification tape recorder 2000 CPS
CG2030 V	Y PIPA SG Output, in phase	
CG2050 V	Z PIPA SG Output, in phase	

* No Signal Conditioning.

1612G Printer Codes.

Downlink file Printouts

Char		Char		Char			
Blank	16	E	53	T	19	¢	27
0	10	F	54	U	20	:	0
1	1	G	55	V	21	≠	12
2	2	H	56	W	22	≤	13
3	3	I	57	X	23	%	14
4	4	J	33	Y	24	[	15
5	5	K	34	Z	25	]	26
6	6	L	35	•	59	→	27
7	7	M	36	—	32	≡	28
8	8	N	37	+	48	~ Δ	29
9	9	O	38	=	11	∨	42
A	49	P	39	(	28	⌐	43
B	50	Q	40	)	60	↑	45
C	51	R	41	/	17	↓	46
D	52	S	18	*	44	>	47
						<	58

SUNRISE 69 ERROR CODES

OPTICS SUBSYSTEM

00101	ZERO OCDU SWITCH ALTERED BEFORE EXPIRATION OF 60 SECOND WAIT
00102	a) A RELAY IN RELAY BANK 15 OF THE NAV DSKY FAILED b) AGC UNABLE TO ACHIEVE DESIRED OPTICS MODE
00103	SXT-ON SWITCH TURNED ON WITH OPTICS NOT IN ZERO CDU MODE
00104	a) OCDU'S NOT RESERVED b) NO VAC AREAS AVAILABLE FOR MARK. ABORT
00105	AN INTERNAL MARK REQUEST HAS BEEN MADE WITH THE MARK SYSTEM BUSY
00106	a) SXT-ON SWITCH NOT IN DESIRED STATE AT MARK TIME b) MARK WITH ALL REQUESTED MARKS ACCEPTED
00107	MARK'S NOT ACCEPTED SINCE MARK SYSTEM HAS BEEN RELEASED.
00110	TWO CONSECUTIVE MARK ACCEPTS WITHOUT A MARK BETWEEN.

IMU SUBSYSTEM

00201	THE ZERO ENCODER SWITCH WAS TURNED OFF DURING MANUAL ZERO ENCODE BEFORE END OF 40 SECONDS.
00202	AGC UNABLE TO ACHIEVE DESIRED MODE
00203	NO IMU MODE INDICATED TO AGC
00204	MODE SWITCH WITH TRNSW IN AGC CONTROL BUT AGC NOT COMMANDING

MAJOR MODE CONFLICT

00301	TWO PROGRAMS TRYING TO USE THE IMU

PROCEDURAL DIFFICULTY

00401	DESIRED GIMBAL ANGLES YIELD GIMBAL LOCK
00402	STAR OUT OF FIELD OF VIEW

COMPUTER HARDWARE MALFUNCTIONS

01101	RUPT2 OCCURRED
01102	AGC SELF TEST ERROR
01103	C-RELAY TEST ERROR

LIST OVERFLOWS (ABORT)

00104	NO JOB AREA TO STORE MARK'S
01201	NO VAC AREAS
01202	NO JOB AREAS
01203	A VALID TASK HAS BEEN PUSHED OUT OF THE WAITLIST
01204	NO PLACE ON THE WAITLIST IS AVAILABLE INTO WHICH A VALID TASK CAN BE ENTERED
01205	NO PLACE IS AVAILABLE IN THE PWTCADR TABLE INTO WHICH A MISSION FUNCTION CAN BE ENTERED
01206	DSKY WAITING LIST OVERFLOW

SUNRISE 69 VERB/NOUN CODES

VERBS	CODE	NOUNS
ILLEGAL	00	NOT IN USE
DISPLAY OCTAL COMP 1	01	SPECIFY ADDRESS (FRACTIONAL)
DISPLAY OCTAL COMP 2	02	SPECIFY ADDRESS (WHOLE)
DISPLAY OCTAL COMP 3	03	SPECIFY ADDRESS (DEGREES)
DISPLAY OCTAL COMP 1, 2	04	SPECIFY ADDRESS (HOURS)
DISPLAY OCTAL COMP 1, 2, 3	05	SPECIFY ADDRESS (SECONDS)
DECIMAL DISPLAY	06	SPECIFY ADDRESS (GYRO DEGREES)
DP DECIMAL DISPLAY	07	SPECIFY ADDRESS (Y OPTICS DEGREES)
ENTER REQUEST TO WAITLIST	10	SPARE
MONITOR OCT COMP 1	11	SPARE
MONITOR OCT COMP 2	12	SPARE
MONITOR OCT COMP 3	13	SPARE
MONITOR OCT COMP 1, 2	14	SPARE
MONITOR OCT COMP 1, 2, 3	15	INCREMENT ADDRESS
MONITOR DECIMAL	16	TIME SECONDS
MONITOR DP DECIMAL	17	TIME HOURS
ENTER REQUEST TO EXECUTIVE	20	ICDU
LOAD COMP 1	21	PIPA
LOAD COMP 2	22	NEW ANGLES 1
LOAD COMP 3	23	DELTA ANGLES 1
LOAD COMP 1, 2	24	DELTA TIME (SECONDS)
LOAD COMP 1, 2, 3	25	CHECKLIST
SPARE	26	PRIORITY/DELAY
SPARE	27	SELF CHECK ON/OFF SWITCH
SPARE	30	STAR NUMBER
FIXED MEMORY DISPLAY	31	FAILREG
c(R2) INTO R3, c(R1) INTO R2	32	SPARE
PROCEED WITHOUT DATA	33	SPARE
TERMINATE	34	SPARE
RELEASE DSKY	35	SPARE
FRESH START	36	SPARE
CHANGE MAJOR MODE	37	SPARE
ZERO (ICDU)	40	SPARE
COARSE ALIGN	41	SPARE
FINE ALIGN IMU	42	SPARE
LOCK IMU	43	SPARE
ATTITUDE CONTROL	44	SPARE
ENTRY CONTROL	45	SPARE
RETURN TO COARSE ALIGN	46	SPARE
SPARE	47	SPARE
PLEASE PERFORM	50	SPARE
PLEASE MARK	51	SPARE
MARK ACCEPT	52	SPARE
FREE (ICDU OR OCDU)	53	SPARE
PULSE TORQUE GYROS	54	SPARE
SPARE	55	OCDU'S (OPTX, OPTY)
SPARE	56	UNCALLED MARK (OPTX, OPTY, & TIME)
SPARE	57	NEW OCDU ANGLES
SPARE	60	ICDUX & TIME (SEC.)
SPARE	61	ICDUY & TIME (SEC)
SPARE	62	ICDUZ & TIME (SEC)
SPARE	63	OPTX & TIME (SEC)
SPARE	64	OPTY & TIME (SEC)
SPARE	65	SAMPLED TIME (HOURS & SECONDS)
SPARE	66	SYSTEM TEST RESULTS
SPARE	67	DELTA GYRO ANGLES
PERFORM GYRO DRIFT TEST	70	SPARE
PERFORM PIPA SF TEST	71	SPARE
SPARE	72	SPARE
SPARE	73	SPARE
SPARE	74	SPARE
SPARE	75	SPARE
SPARE	76	SPARE
SPARE	77	SPARE