



TRW No. 70:7254.2-16

Re: ASPO 81-3

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. M. Contella, CF24

Subject: LM PGNS/AGS Training Card

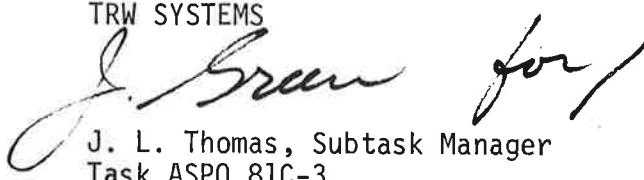
Reference: TRW Letter 70:6840.JLT.26, "Final Preliminary LM PGNS/AGS Training Card," Dated 7 October 1970

Gentlemen:

Attached are 100 copies of the complete and final version of the PGNS (LUM 178)/AGS (PROG 7) Training Card. Included with each card is TRW Memo No. 70:7252.3-63 which provides a user guide to the Training Card. These attachments supercede all previous preliminary versions of the LM PGNS/AGS Training Card and were prepared under Task ASPO 81C-3.

Very truly yours,

TRW SYSTEMS



J. L. Thomas, Subtask Manager
Task ASPO 81C-3



W. J. McKenzie

Assistant Project Manager
Apollo Spacecraft Program Support
Spacecraft Systems Analysis Project

JG/ms

cc: R. Albon, PD7
S. P. Grega, CF24
R. H. Kohrs, PD7
P. C. Kramer, CF24
C. O. Lewis, CF24
J. W. O'Neill, CF34
W. R. Pogue, CB

KB
KLB



70:7252.3-63

INTEROFFICE CORRESPONDENCE

TO:

Distribution

DATE: 22 October 1970

SUBJECT: LM PGNS/AGS Training Card
(Task ASPO 81C-3)

FROM: J B Hill *ABN*
BLDG. H4 ROOM 2116a EXT.2671

Reference: "Apollo 14 LM-8 Flight Crew G&N Dictionary" 15 June 1970

The attached LM PGNS/AGS training card, generated under MSC/TRW Task ASPO 81C-3, was prepared under the direction of Lt Col W R Pogue. The card, hopefully, provides a supplemental tool in the flight-crew simulator training; it is not intended to modify or supersede any officially released publication.

The training card consists of both PGNS (LUMINARY, Rev 178) and AGS (Flight Program 7) operationally-oriented data. A topical summary of the data is presented in Table 1. Crew checklist operations, however, are not generally covered by the card.

The card format was developed under the assumption that the user possesses some familiarity of the PGNS and AGS operational modes. Because of space limitations, abbreviations, acronyms, and mnemonics were employed extensively. The acronyms are standard, and most of the abbreviations and mnemonics are self-explanatory*. Table 2 provides a list of those terms which might not be immediately evident to the user.

*Review of the complete list of abbreviations, acronyms, and mnemonics by non-technically oriented personnel revealed that a very large percentage of the abbreviations were recognizable. The acronyms were not generally recognized (as one might suspect). The star ID mnemonics were recommended by Lt Col W R Pogue. Should the card notation be unclear to the user, it is recommended that the referenced document be consulted.

Table 1
 PGNS/AGS Training Card Topical Summary

<u>PGNS Summary</u>	<u>AGS Summary</u>
Verb List	DEDA Address
Noun List	Orbit Insertion
Alarm Codes	Direct Rendezvous/Midcourse Correction
V50 Checklist	CSI
Star ID	CDH
N49 Acceptance Criteria	TPI
Nominal Sequencing for following LUMINARY Programs:	External ΔV
P06 P27 P35 P51 P66	Burn (common logic)
P12 P30 P40 P52 P68	RR Auto Update (spare)
P20 P32 P41 P57 P70	RR Manual Update
P21 P33 P42 P63 P71	AGS/PGNS
P25 P34 P47 P64 P76	Alignment/Calibration
Thrust	AGS Abort
No Ignition Engine Fail (97 XX)	Reference Frame (External ΔV)
DAP Data Load	Engine Select
Rapid IMU Align	Ordeal
RR Antenna	Descent
Rendezvous	DEDA state Vector Update
Ascent	Orbit Parameters
Descent	LM/CSM
Attitude	Times
Times	ΔV Monitor
Orbit/Flight Path	Attitude/Steering
Cross-Pointer	
FDAI	

- Notes: • The nominal flow for LUMINARY routines was omitted due to space limitations
- P22 program sequencing was deleted (per Lt Col Pogue) due to space limitations. This decision was felt justified in view of the fact that P22 is not performed under time-critical conditions.
 - P72 through P75 were not listed since their program logic is identical respectively to P32 through P35.
 - The card presents only those DEDA addressable quantities that are of operational interest.
 - The AGS rendezvous logic is presented assuming the AGS solutions are to be burned. Should either the PGNS or ground solution be burned, the user would retarget via the "EXT ΔV " logic prior to executing the maneuver.

Table 2

Partial List of Abbreviations used in PGNS/AGS Training Card

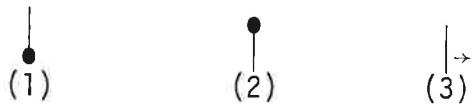
⊥	Perpendicular to (see N77)	RLM	LM position vector (see N59)
	Parallel to (see DEDA 623, BURN 623, OI 623)	ROD	Rate-of-descent (see P64,P66)
✖	Angle; boresight if alone (see RR MAN UPDT N59)	RTN	Return (see P20)
A/T	Alignment technique (see P57,alarm 00701)	S-MAJ	Semi-major (see DEDA 224, 662R, OI 224, 662)
ALN	Align (typically,CRS ALN)	SPFY	Specify
CCS	AGC Instruction "count, compare, & skip" (see alarm 21103)	SQRT	Square-root (see alarm 21302)
CO	Cutoff (see N40)	STO ATT	Stored attitude (see P57)
CTR	Counter (see DEDA 616, OI 616)	T-RAD	Time-radius conic solution (see alarm 20607)
CTRL	Control	TG	Time-to-go to specified condition (see N61,N77)
DEL	Delay (see N26)	THRST	Thrust (see BURN 507)
DES	Designate (see P63:50 25 (00500)"LDG ANT-DES")	TK ATT	Tracking attitude (see P20)
DSPY	Display	TOT	Total (see FDAI "TOT ATT-V62")
DSRD	Desired (also DESRD)	TPER	Time from perigee (see ORB/FLT PATH)
ENC	Encoder (see alarm 00206)	TR	Remaining redesignate time (see N64,P64)
IMAG	Imaginary (see alarm 00600)	VAC	AGC "scratch pad" locations i.e."vector accumulator" (see alarm 31201)
INPT	Input		
ITER	Iterations (see alarm 00605)		
KREL	DSKY "KEY REL"		
M:S	Minutes:Seconds		
MRAD	Milli-radian (see N99)		
NDLS	Needles (see alarm 01466)		
PER	Period (see DEDA 416)		
PL	Plane (see DEDA 623, BURN 623, OI 623)		
PR	Pair (see P51,P52)		
PRPR	Proper (see NO IGN ENG FAIL)		
PTH	Path (see N91)		

The training card should be essentially self-explanatory providing the user has some knowledge of the PGNS/AGS operational modes. However, the format used to describe the program logic probably deserves some explanation. Presented for each program are the nominal sequencing, possible alarms and/or displays for non-nominal sequencing, and pertinent displays that are available to the user whenever the specific program is selected. Certain notational techniques described below were also adopted for purposes of clarity.

At virtually every flashing DSKY display, a V34E represents a "terminate the program in progress" operation. This standard crew response, therefore, has been omitted from the card except for P20 (after 06 49) and P63 (after V57E) where V34 has a special significance.

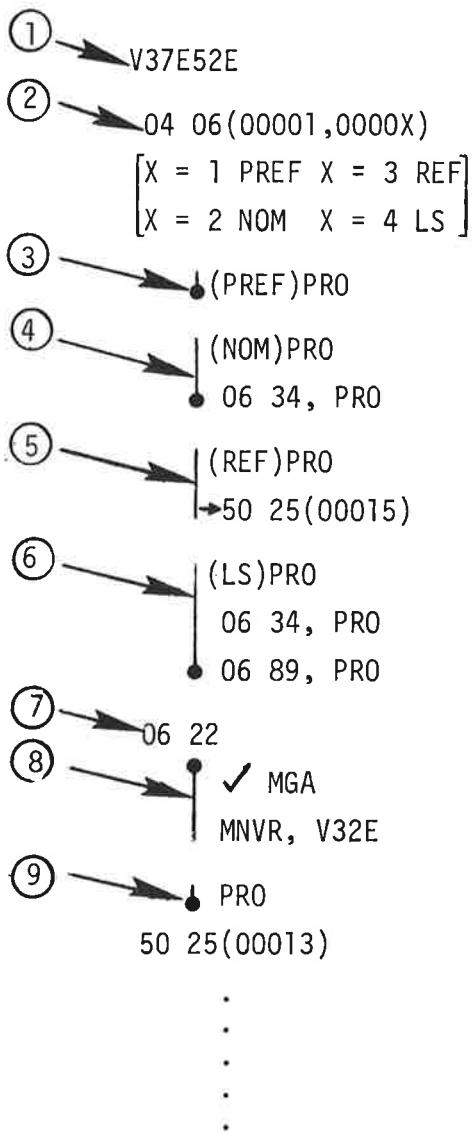
In most programs, certain input parameters must be specified either via pad load or crew DSKY entries during the program sequencing. Although the training card defines which parameters are loadable (see "Noun List"), the card does not specify such data loading operations as part of the nominal sequencing.

In many programs, the logic is such that the crew must specify one of several possible program sequences available at a given display. A special notational technique has been developed to describe these potential alternatives. Combinations of the following symbols are employed to represent the available options (one symbol per option):



For a selected option, the sequence to the right of the vertical bar of each symbol is to be performed. For symbol (1), the "ball" indicates the subsequent display (or action) to occur immediately following the series of options. For symbol (2), the "ball" indicates the sequence will recycle to the display present when the option was selected. For symbol (3), the absence of a "ball" indicates the sequence will jump to some other point (specified by the "arrow") in the program. The card notation is best illustrated by the example in Table 3.

Table 3
Explanation of PGNS/AGS Training Card Program Flow



- ① Select Inflight Realignment Program P52
- ② Load alignment option code X:
1 = Preferred (PREF)
2 = Nominal (NOM)
3 = REFSMMAT (REF)
4 = Landing Site (LS)
- ③ If PREF option selected, PRO; the next display will be 06 22
- ④ If NOM option selected, PRO; the next display will be 06 34(T ALIGN); the crew must load the correct alignment time for nominal alignment; when correct value, PRO; the subsequent display will be 06 22
- ⑤ If REF option selected, PRO; the next display will be 50 25(R1 = 00015)
- ⑥ If LS option selected, PRO; the next display will be 06 34(T ALIGN); The crew must load the correct alignment time for a landing site alignment; when correct value, PRO; the next display will be 06 89 (LS LAT, LONG/2, ALT), the computed landing site selenographic coordinates; if the values are satisfactory, PRO; the next display will be 06 22.
- ⑦ The 06 22 values represent the inertial gimbal angles (Y,P,R) for the desired stable member alignment; the crew will check the predicted middle gimbal angle (MGA)
- ⑧ Should the resulting MGA be unsatisfactory the crew should maneuver (MNVR) the spacecraft and then key V32E; this results in a recomputation and display of the 06 22 values
- ⑨ If the 06 22 values are satisfactory, PRO; the next display will be 50 25(R1=00013)

Specific extended verbs are called and/or nouns are monitored as a matter of course during certain programs (e.g., V16N85 during P12; V90 during P32 and P33; V57 during P63). It was considered desirable to present such sequencing and yet indicate which displays were not part of the basic program logic. This has been accomplished by enclosing such displays in brackets.

Of the various PGNS programs, P20 is probably the most difficult to follow. P20 may be grouped operationally into four semi-autonomous sequences:

- Tracking attitude maneuver TRACK ATT
- CSM manual acquisition RR MAN
- RR antenna designate via LGC RR AUTO
- Automatic state vector updating (rendezvous navigation)

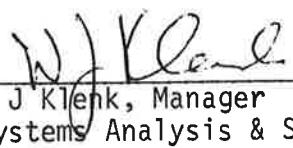
The training card is similarly organized except that the automatic state vector updating is included with the "RR MAN" or "RR AUTO" sequences. After selection of P20 via V37E20E, the subsequent display is dependent upon several factors.

1. Unless the LM is in attitude hold, a tracking attitude maneuver is required. Assuming the tracking attitude maneuver is to be performed, the crew will observe a 50 18 display only if the angle between the LM/CSM LOS and the LM +Z axis exceeds 15 degrees. otherwise, the tracking attitude maneuver will be executed automatically without a DSKY display.
2. Upon completion of the tracking attitude maneuver (assuming one was required), the subsequent program flow is governed by the RR mode select switch position (AUTO TRACK/SLEW/LGC).
 - If the RR mode select switch is at "LGC," an RR antenna designation is attempted by the LGC. If successful, the RR trunnion and shaft angles are displayed via 50 72. After verifying CSM acquisition, the crew keys PRO and rendezvous navigation is automatic without DSKY displays (DSKY blanks) unless excessive updates are incurred.

70:7252.3-63

Page 7
22 October 1970

- If the RR mode select switch is at "AUTO TRACK" or "SLEW" the crew is requested via display 50 25(R1=00201) to select "LGC" (the RR auto mode). If the crew desires automatic CSM acquisition, the mode switch is set to "LGC" and PRO is keyed. However, if a manual CSM acquisition is to be performed, the crew keys ENTR. The program then requests via 50 25(R1=00205) the crew to perform the acquisition. When acquisition is accomplished, the crew sets the RR mode switch to "LGC" and keys PRO. State vector updating is automatic thereafter without DSKY displays (DSKY blanks) unless excessive updates are incurred.

Approved: 
W J Klenk, Manager
Systems Analysis & Software Dept.

JBH/jlh

ALARM CODES

** P-PROCEDURAL I-INPUT DATA H-HARDWARE **

00107 P	>5MK PRS (FLT) OR 5 MKS (SURF)	CONT-NO MORE MKS
00111 P	MK MISSING	RESTART MK SEQUENCE
00112 P	MK/MK REJ NOT ACC	CONT-DON'T MK/MK REJ
00113 H	NO INBITS	CONT
00114 P	DUPL MK MADE (FLT)	CONT-MAKE CORRECT MK
00115 P	MK REJ ATTMDP BUT NO MKS	CONT-MAKE CORRECT MK
00206 P	ZERO ENC IS NO-NO WITH CRS ALN + GMBL LOK	CRS ALN TO 0,0 AND THEN V40N20E
00207 P/H	ISS TURN-ON REQST NOT PRSNT 90 SEC	PNL 11 CB IMU OPR-OPEN; WT 3 MIN, RECLOSE, ALM RECURS, NO ISS WRN, CNT PNL 11 CB IMU OPR-OPEN; WT 3 MIN, RECLOSE, V36E
00210 P/H	IMU NOT ON (TERM VIA FL V37)	NOTIFY MSFN, CNT IF 41 20, REDUCE S/C DFT & CONT; IF P51, P52, P57 RECDR TORQ * & PERFORM P52, P57 FINE ALN CHK SEE ISS MALFUNCTION PROCEDURES
00211 H	CRS ALN ERROR	IF 41 20, REDUCE S/C DFT & CONT; IF P51, P52, P57 RECDR TORQ * & PERFORM P52, P57 FINE ALN CHK SEE ISS MALFUNCTION PROCEDURES
00212 H	PIPA FAIL BUT PIPAS NOT USED	SEE ISS MALFUNCTION PROCEDURES
00213 H	TURN-ON REQST BUT NO IMU OPER SIG	TERMINATE PROGRAM
00214 P/H	PROG USING IMU	RESEL PROG; ISS MODE SW FAILURE IF ALM RECURS ALM IMU; SET REFSMMAT FLAG IF ALIGNED
00217 H	BAD RETURN FROM IMU STALL	REALIGN IMU OR CALL N22 & MNVR TO REDUCE MGA SET GUID CONT-AGS PRO (CREW SPFY STAR) OR V32E (LGC CALC N79)
00220 P	IMU NOT ALIGNED (TERM VIA FL V37)	PRO (CREW SPFY STAR) OR MNVR & V32E (PICAPAR) NOTIFY MSFN
00401 I	DSRD GMBL * YIELD	V32E(MNVR), V34E, OR V56E
00402 P	DAP STEERING LOST	RR OUT MODE LMTS
00404 P	STAR NOT AVAIL IN ANY DETENT AVAILABLE	RR ANT DESIGNATE FAIL
00405 I	TWO STARS NOT AVAILABLE	RR MODE-LGC, CNT; PNL 11 CB RR(2)-CLOSE LDG ANT-HOVER; CNT
00421 I	W-MATRIX OVERFLOW	RR MODE-LGC OR V56E NOTIFY MSFN, CNT
00501 P	RR OUT MODE LMTS	RR SHFT RT, TRUN RT, RADAR
00502 P	RR POSN CHANGE	PWD/LAT VEL (ANALOG) PWD/LAT VEL (PGNS) LAT VEL (AGS)
00503 I	RR ANT DESIGNATE FAIL	LR/CMPTR LR/CMPTR LR/CMPTR
00510 P	NO RR AUTO DSCR	RT/ERR MON PMTRS MON SW SEL SW
00511 P	NEITHER/BOTH LR ANT POSN DSCRSTS PRSNT 10 SEC (20 SEC, HIGATE)	ATT ELEV RT AZ RT
00514 P	NOT RR AUTO MODE	RR MODE-LGC OR V56E NOTIFY MSFN, CNT
00515 H	RR CDU FAIL DSCRT	RNDZ RADAR
00520 P/H	UNEXPECT RADARUT	RR SHFT RT, TRUN RT, RADAR
00522 P	LR POSN CHANGE	LR/CMPTR
00523 P	LR ANT NOT POSN 2	LR/CMPTR
00525 I	SV/RR LOS > 3 DEG	PGNS
00526 I	RR RANGE > 400 NM	FWD VEL
00527 I	MNVR REQ(P20); LOS OUT MODE 2 (P22)	PGNS
00530 I	LOS NOT IN MODE 2 IN NEXT 10 MIN	FWD VEL
00600 I	IMAG ROOTS	PGNS
00601 P	POST CSI HP < 35K	PGNS
00602 P	POST CDH HP < 35K	PGNS
00603 P	CSI/CDH DT < 10 MIN	PGNS
00604 P	CDH/TI DT < 10 MIN	PGNS
00605 P	15 TITER & NO SOLN	PGNS
00606 P	CSI ΔV > 1000 FPS	PGNS
00611 I	NO TIG FOR ELEV *	PGNS
00701 I	ILLEGAL A/T OPTN	REF [EXT AV] LV REF 407-0 FREEZE LV 407+1
00777 H	ISS WARN:PIPA FAIL	ORDEAL HP, LM ALT LM ALT
01102 H	LGC SELF TEST ERROR	400+1; ATT-MODE [3] DB-MIN-BGS/AUTO GUID CONT-AGS DPS:ABORT PB OR APS:ABORT-STAGE
01105 H	DOWNLINK TOO FAST	DESENT ALT UPDT 223
01106 H	UPLINK TOO FAST	DEDA SV UPDT LM CSM
01107 H	PHASE TABLE FAIL (RESTART)	ORB PMTRS VI HA HP H HDOT T TO HP
01301 I	EXCES ARC SIN/COS	LM/CSM TIMES
01406 I	BAD RTN-ROOTPSRS (DURING AVERAGE-G)	REF [EXT AV] LV REF 407-0 FREEZE LV 407+1
01407 P	VG INCREASING	AGS/PGNS ALN 400-3
01410 P/I	G/SN OVERFLOW	SV UPDT(DNLNK) VFY LM PCM SW-HI
01412 I	NO IGN ALGORITHM	SET AGS CLK V16N65E 377-(IGET-8IAS T) [LENTR-CORR GET]
01466 P	INSUFFICIENT THRTL SERVICING	RANGE RATE TM OR N78(R2/FPS) 415+1 503=RDOT(< 30 SEC) 503(WHEN=0, CONT)
01520 P	V37 NOT ALLOWED	RR MODE-LGC OR V56E NOTIFY MSFN, CNT
01703 P	TIG SLIPPED	CONT
01706 P	P40 SEL/LM STAGED OR P42 SEL/LM NOT STAGED	CONT
02001 I	JET FAIL:Y-Z TRANS	RESELECT P22
02002 I	JET FAIL:X TRANS	V32E & ADJ INPUT PMTR
02003 I	JET FAIL:P ROT	SEE ALM 00600
02004 I	JET FAIL: U-V ROT	SEE ALM 00600
03777 H	ISS WARN:ICDU FAIL	SEE ALM 00600
04777 H	ISS WARN:ICDU, PIPIAS	SEE ALM 03777
07777 H	ISS WARN:IMU FAIL	SEE ALM 03777
13777 H	ISS WARN:IMU, PIPIAS	SEE ALM 03777
14777 H	ISS WARN:IMU, ICDU, PIPA FAILS	SEE ALM 03777
00407 P	AOT MK IN USE	POODOO ALARMS (XXXXX)
20430 I	INTEG-ACCEL OVRFLW	RESELECT PROGRAM
20607 I	NO T-THETA OR T-RAD SOLN	NOTIFY MSFN RESET
21103 I	UNUSED CCS BRANCH	COPY N08 FOR MSFN, CNT
21204 P/I	SCHEDULE JOB, TASK	SEE ALM 21103
21302 I	ZERO OR NEG AT	COPY N08 FOR MSFN, CNT
21406 I	CALL SQRT-NEG ARG	CONSULT MSFN
21408 I	BAD RTN-ROOTPSRS (P63 IGN ALGORITHM)	COPY N08 FOR MSFN, CNT
21501 P	ILLEGAL PINBALL	POODOO ALARMS (XXXXX)
31104 H	DELAY ROUTINE BUSY	ALARMS (XXXXX)
31201 P	EXEC-NO VAC AREAS	RESEL EXT VTB
31202 P	EXEC-NO CORE SETS	RESEL EXT VB-CONT PROG
31203 P/I	TOO MANY TASKS	SEE ALM 31201
31206 P	TWO JOBS TO SLEEP	SEE ALM 31201
31207 P	NO VAC AREAS(MKS)	SEE ALM 31201
31210 P	2 ROUTINES USING DEVICE AT SAME TIME	RESELECT PROGRAM
31211 P	ILLEGAL INTRPT OF EXT VTB	COPY N08 FOR MSFN, CNT
31502 P	ILLEGAL FLASH DSPY	IF ALM RECURS, V36E AND REINITIALIZE LGC
32000 P	DAP STILL ON AT NEXT TIMES RPT	RESEL EXT VTB

THRUST

N40
THRTL CMD,HDOT,H(P63,P64,P66) N92

NO IGN ENG FAIL (97 XX)

- IMPR CORR THE CONFIG (ENG CONFIG 5TRTS); THEN PRO
- PPR ENTR (REATMPT); PRO ON F99 (AUTO IGN)
- TERM V34E

DAP DATA LOAD

- +X ACA FATTI MNVR
CONFIG TRAIN SCALE DB RT
- 0 --- 21/A 1 ASC 21/B 2 DSC 3 DOK
- 1 --- 21/A 1 ASC 21/B 2 DSC 3 DOK
- 2 --- 21/A 1 ASC 21/B 2 DSC 3 DOK
- 3 --- 21/A 1 ASC 21/B 2 DSC 3 DOK
- IF DOCK CONFG, ATT DB=1,°
• FINE/NORM ACA SCALING DEFN
FINE: 4°/5 LM, 4°/5 DOK
NORM: 20°/5 LM, 20°/5 DOK
• DON'T PRO ON 06 48

X-POINTER

MON PMTRS	RT/ERR	MON SW	ATT	ERR
MON SW				*
SEL SW				*
RR SHFT RT, TRUN RT, RADAR	RNDZ RADAR			*
PWD/LAT VEL (ANALOG)	LR/CMPTR			*
PWD/LAT VEL (PGNS)	LR/CMPTR			*
LAT VEL (AGS)	LR/CMPTR			*

RR ANTEENNA

- MODE 1 (OPERATIONAL)
TRUN 305° TO 55°
SHFT 290° TO 59°
RT-LEFT
- MODE 2 (OPERATIONAL)
TRUN 125° TO 235°
SHFT 41° TO 155°
SHFT ROT UP-DN
- COARSE ALIGN RR
P2, P57 (0, 283)
DOCK (0, 320)
+X ACQ (180, 90)
+Z ACQ (0, 0)
- TERMINATE RR DESIGNATE
RR LOS AZ (+/Z), EL (+/Y)
PRSN RT TRUN, SHFT

RAPID IMU ALIGN

V41,N20E, E,E,E (CRS ALN)
FLY 0,0,0 A35 BALL
V10N20E, ZERO ICUS, RLEAS IMU
V371,51E, PRO (DFTLGL), P00
V25N0E, 77E, 1000E, IE(RFSMS)

RENDEZVOUS

APSIS, ELEV *, CENTRL *

POST TPI ΔV, ΔV, ΔV

CDH ΔH, ΔT'S (SEE TIMES)

N 55

N 58

N 75

V 57

CDH ΔH, ΔT'S (SEE TIMES)

V 57

V 58

LR TO POSN 2

V 59

U-V JETS: YES

V 75

U-V JETS: NO

V 65

ASCENT

V(HORIZ), V(VERT), XR
TG (CUTOFF), YDOT (LCSM)
VG XYZ (LM)

N 76

N 85

</

NOUN LIST

- LEGIT LOADABLE NOUN
V - VALID DATA CALLABLE ANYTIME
- CALLABLE ANYTIME & LOADABLE

01 * SPFY ADRS-FRACT [.XXXXX]

02 * SPFY ADRS-AHSLW(.XXXXX.)

03 * SPFY ADRS-DEG [.01°]

04 GRAV ERR [.01°(R1)]

05 SIGHT-DIFF [.01°(R1)]

06 L OPTN(P1,P2,P5,P7)[OCT]

07 L CHNL/E-MEMORY OPER[OCT]

(IDENTIFIER, BIT ID, ACTION)

08 V ALARM DATA[OCT]

(ADRES, BBCON, ERCOUNT)

09 V ALARM[1ND,2ND,LAST][OCT]

10 * SPFY CHNL[OCT|R1]

11 L TCSIS OR TAPI(OH,M,.01\$)

12 L OPTN(41,T2,V63,V82,V89)

[OCT(0000X,0000Y)]

13 L T(CDH)(H,M,.01\$)

15 * INCRMTR ADRS[OCT(R1)]

16 L TEVENT(H,M,.01\$)

18 MNVR DSRD FAIR,R,Y,01°]

20 V PRNST ICUD(Y,P,01°)

21 V PIPA PULSES X,Y,Z[XXXXX.]

22 L DRSS ICUD(Y,P,01°)

24 L LGC CLOCK AT[H,M,.01\$]

SEE V50 CHECKLIST[OCT(R1)]

26 L PRIOD/DEL,ADRES,BBCON,[OCT]

* SELF-TEST ON/OFF[X,(R1)]

32 T FROM PERIGEE[H,M,.01\$]

33 L TIG(H,M,.01\$)

34 L TEVENT(H,M,.01\$)

35 TF(H,M,.01\$)

V LGC CLOCK TIME[H,M,.01\$]

37 L TTPI(H,M,.01\$)

38 V SV INTEG TIME[H,M,.01\$]

40 TFC/OV,AVM

[M:S,,1FPS,,1FPS]

42 HA,HP,VGL,INNM,,INNM,,1FPS]

LAT(+N),LONG(+E),ALT

[.01°,.01°,.01M]

44 HA,HP,TFF,1NM,,INNM,M:S]

(TF= -59.59 IF HP 35K FT)

45 V MKS,TFI,CODE[X,,M:S,Y]

(RI VALID ANYTIME)

Y=1-NOT LAST PASS

Y=2-LAST PASS,NO ALN

Y=+MGA [.01°]:LAST

PASS WITH MU ALN

* SEE DAP DATA LOAD[OCT(R1)]

47 * LM WT,CSM WT[LBM(R1,R2)]

49 R,+TRM,+R TRME,.01°(R1,R2)]

49 R,AV,M: [INNM,,1FPS,X]

X=1 RANGE X=3 SHFT

X=2 RDOT X=4 TRUN

51 S-BAND P-Y *[.01°(R1,R2)]

52 ACT VEH CENTR[,01°(R1)]

54 RANGE, RDOT, B(+Z/HORZ)

[.01NM,,1FPS,.01°]

55 L P32:APSIS,ELEV,*,CODE

[XXXXX,,.01°,Y]

Y=0:CDH AT APSIDAL

CROSSING SPFY BY RI

Y=1:CDH AT (R1)(Y|0)

L P34:CODE,ELEV,*,CENTRAL,

[X,.01°,.01°]

INTEG(X=0 CONIC,X=0 PREC)

ELEV #=0:1PI TIME OPTN

RR LOS AZ,ELEV [.01°(R1,R2)]

+ AZ ABOUT Z;+ ELL ABOUT Y)

POST-TPI HP,TP,AV,TPF AV

[.1NM,,1FPS,,1FPS]

59 LOS AV(X,Y,Z,1FPS)

[X=LOS,Y=LOS,MLD,Z=X-Y]

FWD,RT,DN IF =1N-PL,HD UP]

60 VI+,Z+,HDOT,H,,1FPS,,1FPS,FT]

61 TG(AIM,PT),TFI,XR(+L,S,N/C)

[M:S,M:S,,1NM]

62 VI,TFLAVM[,1FPS,,1FPS]

63 VI,HDOT,H,,1FPS,,1FPS,FT]

64 TR/LPD,HDOT,H,,1FPS,,1FPS]

65 V SAMPLED LGC TIME[H,M,.01\$]

V LR SR,LR AND POSN[FT,X(R1,R2)]

X=1,2 (R2 VALID ANYTIME)

67 LR VV,VY,VZ[1FPS]

68 SR TO LS,TG(BRK),AH

[.1NM,M:S,FT]

69 L LS CORR COMP Z,Y,X[FT]

70 L AOT DTNT/STAR CODE[00XXYY]

(SEE NOUJ 70 ABOVE)

72 V RR TRUN,SHFT [.01°(R1,R2)]

73 L DSRD RR TRUN,SHFT [.01°(R1,R2)]

74 TFI,DSR,Y,P,[.01°,.01°]

75 P32:CDH AH,CSI/CDH AT,

CDH/TP1/AT[,INNM,M:S]

P33:CDH AH,CDH/TP1/AT,NOM

TP1/TP1/AT[,INNM,M:S]

76 L V(FNL),HDOT(FNL),XR

[.1FPS,,1FPS,,1NM]

77 TG(CUTOFF),YDOT (± CSM)

[M:S,,1FPS,(R1,R2)]

78 RR RANCE, RDOT,TFI

[.01NM,PS,M:S]

79 L CRSLRSPDLDTNT,.01°,.01°,X]

X=1-6 AOT(L,F,R,RR,CL,LR)

X=7 COAS

71 L AOT DTNT/STAR CODE[00XXYY]

(SEE NOUJ 70 ABOVE)

72 V RR TRUN,SHFT [.01°(R1,R2)]

73 L DSRD RR TRUN,SHFT [.01°(R1,R2)]

74 TFI,DSR,Y,P,[.01°,.01°]

75 P32:CDH AH,CSI/CDH AT,

CDH/TP1/AT[,INNM,M:S]

P33:CDH AH,CDH/TP1/AT,NOM

TP1/TP1/AT[,INNM,M:S]

76 L V(FNL),HDOT(FNL),XR

[.1FPS,,1FPS,,1NM]

77 TG(CUTOFF),YDOT (± CSM)

[.01°(R1,R2)]

78 RR RANCE, RDOT,TFI

[.01NM,PS,M:S]

79 L CRSLRSPDLDTNT,.01°,.01°,X]

X=1-6 AOT(L,F,R,RR,CL,LR)

X=7 COAS

80 DATA IND,RL,LOS/LM + Z

[XXXXX,,.01°(R1,R2)]

81 L LV AV(FWD,RT,DN),1FPS]

82 LV AV(FWD,RT,DN),1FPS]

83 LM AV(UP,RT,DV),1FPS]

84 L OTHER VEH A+,X,Y,Z[1FPS]

85 LM V(GP,RT,DV),1FPS]

86 LV VG(FWD,RT,DN),1FPS]

87 L COAS Z(+RT),ELEV(+ UP)

[.01°(R1,R2)]

88 L CELEST BODY UNIT VEC[,XXXXXX]

[.001°,.001°,.01NM]

89 Y, YDOT,PSI[,01NM,1FPS,.01°]

90 ALTV,VI,PTLTH[10NM,PS,.01°]

91 THRTL,HDOT,H,,1FPS,FT]

92 GYRO TORQ * XYZ[,001°]

93 W-MAT RMS POSN,VEL,RR,BIAS

[FT,.1FPS,MRAD]

VERB LIST

01-05 DISPLAY OCT
06,07 DISPLAY AUTO
11-15 MONITOR OCT
16,17 MONITOR DEC
21-25 DATA LOAD

DISPLAY FIXED
MEMORY

EXECUTIVE (POO)

WAITLIST (POO)

RECYCLE

PROCEED(V21-23)

TERMINATE

TEST LITES (POO)

FRESH START

CHANGE PROG

ZERO ICDUS

IMU CRS ALN

GYRO TORQ

DAI BIAS

CHK (POO)

TERM RM DESIGNATE

INITIALIZE AGS

DAP DATA LOAD

CREW MNVR (POO)

PLEASE PERFORM

PLEASE MARK X

PLEASE MARK Y

INCRMTR LGC

CLOCK (DEC)

TERM TRACKING

CALL LR UPDATE

INHIBIT LR UPDATE

DAP VEP RATES

ATT ERROR (MODE 1)

DAP FOLLOWING

ATT ERROR (MODE 2)

TOTAL ATT ERROR

(N22-N20) (MODE II)

RR LOS DLR

RR LOS AZ,ELEV

RR LOS DLR MNVR (POO)

OUT-OF-PLANET DSPY

DSRY BANKSUM (POO)

INITIALIZE W-MATRIX

INHIBIT SV UPOTS

STOP SV INTEG

PLEASE PERFORM

ENG FAIL PROC

PLEASE ENABLE

ENG IGNITION

PERFM CRS ALN:

NORM (PRO)

PLS TORQ (E)

RECHK OR EXIT

FINE ALN

ACQUIRE STAR

PLS DOWN LGC

SEL RR AUTO

SEL PGNS, AUTO

ATT(PIRS,FT,P71)

SEL PGNS, AUTO

ATT(PIRS,FT,P71)

SEL RR FOR

MAN ACQUIRE

SW LR ANT

TO POSN 1

PRO

AVAILABLE

06 91

POSSIBLE

05 09(0611)

IF NOT PGNS, AUTO

06 18

50 18, E

99 74 (TIG-5)

(AUTO IGN) PRO

(CONT) RCS E

- 16 63

06 63

N76

16 76

16 77

16 78

16 79

16 80

16 81

16 82

16 83

16 84

16 85

16 86

16 87

16 88

16 89

16 90

16 91

16 92

16 93

16 94

16 95

16 96

16 97

16 98

16 99

16 100

16 101

16 102

16 103

16 104

16 105

16 106

16 107

16 108

16 109

16 110

16 111

16 112

16 113

16 114

16 115

16 116

16 117

16 118

16 119

16