DPS PRUGRAM (P4C)

REV 02 12/03/69

PURPOSE: (1) TO COMPLTE A PREFERRED IMU CRIENTATION AND A VEHICLE ATTITUDE FOR A LM DPS THRUSTING MANEUVER.

(2) IC DC THE VEHICLE MANEUVER TO THE THRUSTING ATTITUDE.

(3) TO CONTROL THE PONCS DURING COUNTDOWN, IGNITION, THRESTING, AND THRUST TERMINATION OF A PONCS CONTROLLED DPS MANEUVER.

ASSUMPTIONS: (1) THE TARGET PARAMETERS FAVE BEEN CALCULATED AND STORED IN THE LGC BY PRIOR EXECUTION OF A PRE-THRUSTING PROGRAM.

(2) THE REQUIRED STEERING EQUATIONS ARE IDENTIFIED BY THE PRIOR PRE-THRUST PROGRAM, WHICH EITHER RESET ("ASTEER") OR SET (EXT DELTA V) THE EXTERNAL DELTA V FLAG. FOR EXTERNAL DELTA V STEERING, VG IS CALCULATED ONCE FOR THE SPECIFIED TIME OF IGNITION. THEREAFTER BOTH DURING DPS THRUSTING AND UNTIL THE CREW NOTIFIES THE LGC THAT RCS TRIM THRUSTING HAS BEEN COMPLETED, THE LGC UPDATES VG ONLY AS A RESULT OF ACCELEROMETER INPUTS.

FOR STEERING CONTROL WHEN USING "ASTEER". THE VELOCITY REQUIRED IS CALCULATED FROM FIGURE 3.3-13A IN SECTION 5 OF R-567. THE LAMBERT ROUTINE PERIODICALLY RE-COMPUTES THE INTERCEPT TRAJECTORY SEMI-MAJOR AXIS FOR THE "ASTEER" CALCULATIONS. THE INTERVAL BETWEEN LAMBERT SOLUTIONS IS CONTROLLED BY AN ERASABLE LOADED VALUE (UT).

(3) THE INCLISION AND MUST BE AT A KNOWN CRIENTATION BEFORE THIS PROGRAM MAY BE COMPLETED. IT IS NORMALLY REQUIRED THAT THE ISS BE UN FOR A MINIMUM OF 15 MINUTES PRIOR TO A THRUSTING MANEUVER.

(4) THE EVENT TIMER IS SET TO COUNT TO ZERO AT TIG.

(5) ENGINE IGNITION MAY BE SLIPPED BEYOND THE ESTABLISHED TIG IF DESIRED BY THE CREW, OR IF STATE VECTOR INTEGRATION CANNOT BE COMPLETED IN TIME.

++ + 02

++

++

+

+

++

++

+02

+EDIT

++

++

+ 02

+EDIT

541

(6) IF A TERUSTING MANEUVER IS PERFORMED WITH THE GUIDANCE CONTROL SWITCH IN PENS AND THE MODE CONTROL SWITCH IN AUTO, THE PONCS WILL CENTROL THE TOTAL VEHICLE ATTITUDE AND GENERATE EITHER MUDE I OR MODE II ATTITUDE ERRORS AND +ED IT VEFICLE ATTITUDE RATES (SEE ASSUMPTION (7)) FOR DISPLAY ON THE FDAL. THE CREW MAY EXERCISE CONTROL AROUND THE YAW AXIS CNLY WITH THE ACA (X-AX IS CVERRIDE) IF THE X-AX IS OVERRIDE CAPABILITY IS PERMITTED BY THE PROGRAM IN PROCESS. THIS MANUAL CONTROL WILL BE IN THE RATE COMMAND/ATTITUDE HELD MEDE.

IF A THRUSTING MANEUVER IS PERFORMED WITH THE GUIDANCE CONTROL SWITCH IN PGNS AND THE MODE CONTROL SWITCH IN ATTITUDE HOLD THE PENCS WILL HOLD THE VEHICLE ATTITUDE AND WILL GENERATE EITHER MODE I OR MODE II ATTITUDE ERRORS FOR DISPLAY ON THE FDAI. THE CREW MAY EXERCISE MANUAL ATTITUDE CONTROL ABOUT ALL VEHICLE AXES WITH THE ACA IN + 02 EITHER THE RATE COMMAND OR MINIMUM IMPULSE MODE DEPENDING UPON THE STATUS OF THE PULSES FLAG. HOWEVER, IT IS STRONGLY RECOMMENDED THAT POWERED FLIGHT NOT BE ATTEMPTED IN THE MINIMUM IMPULSE MODE. THE PULSES FLAG IS SET OR RESET BY +EDIT EXTENDED VERBS 76 (MINIMUM IMPULSE) AND 77 (RATE COMMAND) RESPECTIVELY. THE PULSES FLAG IS ALSO RESET BY P12, P40, P41, P42, P63, P70, P71, AND R40 AT MAIN ENGINE IGNITION; WITH THE EXCEPTION OF THESE CASES, MODE SELECTION IS ALWAYS BASED UPON THE LAST ENTRY MADE IN THE DSKY. DURING A THRUSTING MANEUVER IN THE PONS/ATTITUDE HOLD MODE THE +02 PONCS WILL NOT BE RESPONSIBLE IF REGISTER OVERFLOWS OLCUR WITHIN THE LGC. IN THE EVENT THAT THE GUIDANCE CONTROL SWITCH IS CHANGED FROM PONS TO AGS DURING A THRUSTING MANEUVER, THE LGC WILL CONTINUE COMPUTATION OF POSITION, VELOCITY, THE DESIRED THALST VECTOR, AND THE DESIRED ATTITUDE ERRORS. HOWEVER, THE PENCE WILL NOT BE RESPONSIBLE IF REGISTER OVERFLOWS COOUR WITHIN THE LGC.

(7) THE PONCS CAN GENERATE TWO TYPES OF ATTITUDE ERRORS FOR DISPLAY ON THE FDAL;

MODE I - SELECTED BY EXTENDED VERB 61. AUTOPILOT FOLLOWING ERRORS USED AS A MONITOR OF THE DAP'S ABILITY TO TRACK AUTOMATIC STEERING COMMANDS.

- MODE II SELECTED BY EXTENDED VERB 62. TOTAL ATTITUDE ERRORS USED TO ASSIST CREW IN MANUALLY MANEUVERING THE VEHICLE.
- PONCS-DERIVED VEHICLE ATTITUDE FATES MAY ALSO BE DISPLAYED VIA SELECTIUN BY EXTENDED VERB 60.
- MUDE IT ATTITUDE ERROR DISPLAYS ARE AUTOMATICALLY SELECTED AT THE BEGINNING OF R60. WITH THE EXCEPTIONS INDICATED

IN ASSUMPTION (6) ABOVE, DISPLAY SELECTION IS ALWAYS BASED UPON THE LAST ENTRY MADE IN THE DSKY. FUR A MCRE DETAILED DESCRIPTION OF THESE DISPLAYS REFER TO SECTION 3 OF R567, PARA. 3.2.6

(8) THE X-AXIS OVERRIDE OPTION PROVIDES THE CREW WITH THE ABILITY TO EXERCISE MANUAL CONTROL ABOUT THE LM X AXIS WITH THE ATTITUDE CONTROLLER EVEN THOUGH THE PONCS ATTITUDE CONTROL MODE IS AUTO. WHEN THE CONTROLLER IS RETURNED TO DETENT THE PONCS DAMPS THE YAW RATE, STORES THE YAW ATTITUDE WHEN THE YAW RATE IS DAMPED, AND THEN MAINTAINS THAT ATTITUDE.

THE X-AXIS OVERRIDE UPTION IS ALWAYS AVAILABLE TO THE CREW, HOWEVER IT SHOULD NOT BE EXERCISED WHEN THE LGC IS SPECIFYING A DESIRED YAW ATTITUDE, I.E.: DURING THE ATTITUDE MANEUVER TO THE THRUSTING ATTITUDE (SEE R60).

(9) WHEN THE THRUST/TRANSLATION CONTROLLER IS SET TO MINIMUM THRUST POSITION AND THE LGC THROTTLE COMMAND IS ZERO THE DPS WILL START AT 10 PER CENT THRUST.

(10) THE LUAD DAP DATA ROUTINE (RO3) HAS BEEN PERFORMED PRIOR TO SELECTION OF THIS PROGRAM AND THE DPS ENGINE GIMBAL HAS BEEN PREVIOUSLY DRIVEN TO THE CORRECT TRIM POSITION.IF THIS BURN IS OF SUFFICIENT DURATION THAT VEHICLE TRANSIENTS AT IGNITION DUE TO CG/THRUST DOES NOT AFFECT ACCOMPLISHMENT OF MANEUVER AIM CUNDITIONS, THEN GIMBAL DRIVE TO TRIM POSITION NEED NOT BE DONE BEFORE TIG. GIMBAL DRIVE TO TRIM POSITION IN WORST CASE COULD REQUIRE 2 MINUTES.

++(11) DURING DPS BURNS ONLY, THE PITCH-ROLL RCS JET AUTOPILOT (U AND V JETS) MAY BE DISABLED (V55) OR ENABLED (V75) BY+C2EXTENDED VERB AS SHOWA. THIS CAPABILITY IS INTENDED TO BE USED TO PREVENT LM AND DESCENT STAGE THERMAL CONSTRAINT+EDITVIOLATIONS DURING CSM-DOCKED DPS BURNS (P40). THE CAPABILITY EXISTS DURING P63 AND P70 ALSO. PERFORMANCE OF FRESH++START (V36E) WILL ALWAYS ENABLE THE PITCH-ROLL JETS.

(12) FOR EACH BURN AN IGNITION TOTAL ALLOWABLE TIME DELAY WILL BE SPECIFIED IN THE MISSION RULES. THIS DELAY TIME IS THE TOTAL TIME WHICH THE THRUSTING MANEUVER MAY BE DELAYED BEYOND THE LGC CALCULATED TIME OF IGNITION. IF ENGINE RESTARTS ARE INVOLVED, THE ACCOUNTING OF THIS TOTAL TIME CELAY IS UP TO THE CREW.

(13) LGC AND GREW PROCEDURES IN CASES OF LGC-ASSUMED THRUST FAILURE ARE DEFINED BY THE DPS/APS THRUST FAIL ROUTINE (R4C). THIS ROUTINE IS CALLED AT DPS IGNITION BY THIS PROGRAM.

(14) THE LGC WILL NEITHER DESIGNATE NOR READ THE RENDEZVOUS RADAR (RR) DURING THIS PROGRAM.

(15) THIS PROGRAM SHOULD BE SELECTED BY THE ASTRONAUT BY CSKY ENTRY AT LEAST 5 MIN. BEFORE THE ESTIMATED TIME OF IGNITION.

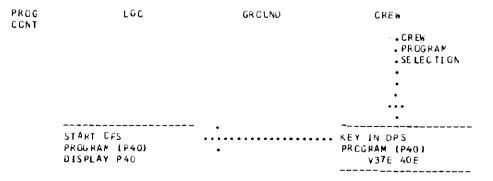
(16) THIS PROGRAM IS SELECTED MANUALLY BY DSKY ENTRY.

÷

+

+02

++



385 P 40/L UMINAR Y

(

.

.

211

				-	
				•	
				•	
				•	
			• • • • • • • • • • • • • • • • • • • •	MONITOR DSKY: OBSERVE DISPLAY	CF
			•	P 40	
		•		•	
		•		•	
		•		•	
	IS THE APS	5 FLAG SET?		•	
				•	
			• • •	•	
355	•	••	•	•	
LD 🗸	•		• •		
******		VERB-NOUN		DOES VERB-NOUN F	
AP .		CLEST RE-	• •	TO RECUEST RESPO	
		AND CIS-	•	AND DISPLAY OF A	
		TO INDICA-	•	CODE INDICATE TH	AT
		AT APS FLAG		APS FLAG SHOWS THAT DPS HAS BEE	k 1
		THAT DPS	•	STAGED?	14
	HAS BE	EN STAGED;	•	(NOTE:	
		N0 9	•	THIS ALARM CO	0E
		XXXXX	•	MAY BE DISPLAYED	
		XXXXX	•	EITHER R1, R2, O	
	• • • • • • •	-XXXXX	•	R3, DEPENDING ON	
	•	•	•	THE PRESENCE OR	
	•	•		ABSENCE OF OTHER ALARM CODES.)	
	•	•	•		
	•	•	•	• Y	• N
	•	•	•	•	
	•	٠	•	•	•
	•	•	•	•	•
			•	*	•
	WALT F	OR KEY-	•••••	KEY IN TERMINATE	•
	. BCARD	ENTRY	••	V34E	•
	- TERMIN	ATE FLAST	•	•-	•
	 UPCN R 	ECEIPT CF	•	•	•
	 TERMIN 		•	•	•
	. PRECEE		•	•	•
	•	•T Ρ.	•	•	•
		•T P• •E R•	•	•	•
		•C R.	•	•	•
	•		•	•	•
	•	• •	•	•	:
	•	• •	•	•	
	•	• •	•	•	•
	•	• •	•	•	•
	•	• •	•	•	•
	•	• •	•	•	•
	•	•••	•	•	•
	•	• •	•	•	•
	•	• •	-	•	•
	•	• •	•	•	•
		•	-	-	•

•

.

#20

#30

#40

#50

•	•	-		•	•	•
	•			•	•	
•	•	•		,	•	
	-			-		-
-		-		-	•	•
-	•R	ο.		•	-	•
•					•	•
•	•M	с.		•	•	
•	• 1	Ε.	•	•	•	
•	- N	Ε.			•	
	- A	С.			•	
	• T			-	-	•
_	•E	•			•	•
•	••	•	•		•	•
•	•	•	•		•	•
•	٠	•	•	•	•	•
•	•		•		•	•
•	DO FINAL AUTO	C			DO FINAL AUTO-	-
	MATIC REQUEST	r .			MATIC REQUEST	•
· ·]	TERMINATE	•		•	TERMINATE	•
•	ROUTINE (ROO)	•	•	•		•
•	NOUTINE LEVUI	•	•		ROUTINE (ROO)	•
•		•	•	•		
•	•		•	•	•	-
•	•		•		•	
	•					
				-	÷	•
-					• • •	•
•		•	•		_*	•
•	EX IT P40	•	•	•	EXIT P40	•
•		•	•			
•						•
•						-
			_			•
-	IS THE PRESEN	T				•
-	PROGRAM P427	••	•			•
•	PRUGRAM PHZY					•
•			•			•
٠	• Y	N.	•			•
•	•	•				•
•	•	•				
						-
_						-
						•
						•
				• •		
	IMU STATUS CHE	:UK	• •	**************	DO IMU STATUS CH	HECK
ROL	TINE (RO2)			• •	ROUTINE (RO2)	
					-	
	-				-	
	-				•	
					•	
6 F T	A5005001475 S				•	
	APPREPRIATE D				•	
	EL TA V THRE SHO				-	
FOR	USE BY RAD DA	S ED			•	
EN (CSM EGCKED BIT				-	
					_	
					•	

30

1.1

:

•

386 P40/LUMINARY

.....

#70

#80

#90

#100

#110

l

IN DAP.	
•	
SET DELTA V COUNTER=4 FOR USE BY R40	
•	
RESET NO THRUTTLE FLAG	
:	
CCMPUTE INITIAL THRUST DIRECTION AND INITIAL VALUE OF VG VECTOR AND STORE VG(LV) IN N81 AND N86 FOR POSSIBLE MANUAL SELECTION:	
R1-VGX(LV) R2-VGY(LV) R 3- VGZ(LV)	
VGX(LV)-COMPONENT OF VG AT TIG ALONG (RXV}XR. IN FPS TO NEAREST +1 FPS.	
VGY(LV)-COMPONENT OF VG AT TIG ALCNG VXR. IN FPS TO NEAREST -1 FPS.	
VGZ(LV)-COMPONENT OF VG AT TIG ALONG -R. IN FPS TC NEAREST .1 FPS.	

.

#120

#130

#140

#150

•

WHERE R IS GEC-CENTRIC LEARTH CRBITE CR SELENC-CENTRIC (LUNAR ORBIT) RACIUS VECTOR AND V IS VEHICLE INERTIAL VELOCITY VECTOR AT TIC. (NOTE: N81 WILL NOW DIFFER FROM N81 DIS-PLAY EF P30, P32, AND P33 BECAUSE CF ROTATION OF VG VECTCR}. ------٠ . • ------COMPUTE PREFERRED IFU CRIENTATION: X = UNIT(T)-S# -Y = UNIT (T X R)-S₩ - -Z = UNIT(X X Y)-S₩ -S₩ -SM WHERE: T = THE INITIAL- THRUST VECTOR AT TIG R = THE GEOCENTRIC-(EARTH GREIT) **CR SELENC-**CENTRIC ILUNAR ORBIT) RACIUS VECICR AT TIG. (NOTE: IF T X K IS

SMALL (REFER SECTION

211

.

- -

#160

#170

#180

#190

5.3.3.3.3 UF R567),
THEN Y = SM
UNIT (T X V)
WHERE V = VEHICLE -
INERTIAL VELOCITY
VECTOR AT TIG.)
•
•
•
•
STORE DESIRED ATTI-
TUDE SPECIFICATION
FOR USE BY ATTITUDE MANEUVER ROUTINE
(R60). THE FINAL
ATTITUDE WILL BE COMPUTED DURING R60
AND WILL POINT THE
LM +X AXIS IN THE
INITIAL THRUST DIRECTION. HOWEVER,
IN ORDER TO CONSERVE RCS FUEL AND NUT
RCS FUEL AND NUT CCNSTRAIN THE NON-
CRITICAL ATTITUDE
ABOUT THE THRUST
VECTOR, WINGS MAY NUT BE LEVEL IN THE
CCMPUTEC FINAL
ATTITUDE.
•
•
•
SET PREFERREC-ATTI- TUDE-COMPUTED FLAG
•
•
CUMMANE ZERU ATTI-
TUDE ERRCRS
•
•

.

2.75

.

٠

#210

#220

#230

#240

		•	390 P407 LUMINARY
:			
SET 1 CEGREE		•	427
DEACBANC.		•	#26
• • •		•	
RESET 3-AXIS FLAG		•	
:		•	#27
• •		•	
DO ATTITUDE MANEU Routine (R60)	VER	CO ATTITUDE MANEUVER RCUTINE (R60)	
:		•	
• • • ••			#28
• •			
• •			
HAVE PGNS CONTROL AND ALTO ATTITUDE CONTROL MODES BEEN SELECTED?	N	· · · · · · · · · · · · · · · · · · ·	
	NI.	• • •	*29
	•	: :	
LS THE APS FLAG SET?	•	• • •	
Y N.	•	• • • • •	
• •	•	: :	#3 O
• •	•	· · · · · · · · · · · · · · · · · · ·	
• •	•	• •	
•	•	• •	
· · ·	•	• • •	
•	•	· · · · · · · · · · · · · · · · · · ·	
• •	•	• •	P 407L UM TNAR Y
•	•	· · ((

21.11

.

5	• *	•	•	
5	• •	•		
	• • •	•		
	• • •	•	-	
	• • •	•		
	• • •	•		
,	• •	•	•	
	HAS THE AUTO	•	•	
	. THROTTLE MODE .	•	•	
	BEEN SELECTED? .	•	•	
	• •	• ••••	• • • • • •	
	• •Y N• •	• •	• •	
	•• • •	• •	• •	
	•• • •	• •	• •	
00.00		• •		
POSS	FLASH VERB-NCUN	• •	MONITUR DSKY:	
HOLD .	• TO REQUEST PLEASE	• • •	DOES VERB-NOUN	
*********	- PERFORM PGNS	***********	FLASH TO REQUEST	
SNAP .	CENTRGL, AUTG	• • •	PLEASE PERFORM	
	. ATTITUDE CONTROL,	• •	PGNS CONTROL, AU	
•	. AND AUTO THROTTLE	• •	ATTITUDE CONTROL	
•	MODE SELECTION:	• •	AND AUTO THROTTL	E
	• • V50 N25	• •	MODE SELECTION?	
•	• R1 - 00203	• •		-
	• R2 - BLANK	• •	• Y	• N
	• • R3 - BLANK	• •	•	•
•	• • • • • • • • • • • • • • • • • • • •	• •	•	•
	• • •	• •		- •
	••••	• •	HAVE REQUESTED	•
1	• • •	• •	MODES BEEN	•
	••••	• •	SELECTED?	-
	• • •	• •		
•	••••	• •	•N •	T •
		• •	• •	•
		• •	• •	•
		• •	• •	•
_		•	• • •	•
			DO I WISH TO	•
			HAVE THESE	•
			MODES SELECT-	•
	• •		ED DURING THE .	•
		• •	THRLSTING .	
	• •	• •	MANEUVER?	•
	• • •	•		•
		• •	•Y •N •	•
•	• •	• •	• • •	•
•	• • •	• •		•
•	• •	• •	• •••••	•
•	• •	• •	• •	•
•	• •	• •	• •	•
•	• •	• •	• •	•
•	• •	• •	• •	•
•	• •	• •	• •	•
•	• •	• •	• •	•
•	• •	• •	• •	•
•	• •	• •	• •	•
•	• •	• •	• •	•
•	• •	• •	• •	•
•	• •	• •	• •	•
•	• •	• •	• •	•
•	• •	• •	• •	•
•	• •	• •	• •	•
•	• •	• •	• •	•
-	• •	• •	• •	•

#310

#320

#330

#340

				•		
			•	9	*	٠
			•	*	•	•
			4	•	•	•
••			:	•	•	•
	•					
• •	•		•	•	SET GUIDANCE	
• •	•		•	•	CONTROL SWITC	
•••	•		•	•	TO PGNS, ATTI	
••	•		•	•	TUDE CONTROL	
• •	•		•	•	SWITCH TO	•
• •	•		•	•	ALTO, AND	•
•••	•		•	•	THROTTLE SWI-	•
••	WAIT FOR		•	•	TCH TO AUTO	•
•••	BCARC EN		•	•		- •
•	BEARD EN		•	•	•	•
			•	•	•	•
			•	•	•	•
				•	. KEY IN PROCEE	- • D
• •			• •	• • • • • • • • • • •	- KLT IN PROCEE	
•			•	•	-	•
•			•	•	•	-
•			•	•	•	
•			-	· · · · ·		
•	TERMINA TE		•			
•	UPON RECE		•			•
•	PROCEED (• •			
•	ENTER			• • • • • • • • • • • •	 KEY IN ENT 	ER
•	•E • f)	• •			
•	N F		•		•	
	-T - (•		•	
	E C		•		•	
	-R - E		•		•	
•	• • f		•		•	
•	• •0				•	
•	• ••					
•	•					
•	•				•	
٠	•				•	
•	•				•	
٠	•				•	
٠	•				•	
					•	
UMMU	ANC CPS O	ir F			•	
					•	
	•				•	
	•				•	
	•				•	
FRO	EPS AUTO				•	
	TTLE				•	
					•	
	-				•	
	•				•	
	•				-	
	•				•	
	•				•	
					•	
	•				•	
	•				-	
	•				-	
	• • •				•	
	• • •				•	
	• • • •				• • •	
	• • • • •				- - - -	,

214

• t

392 P40/LUM IN ARY

#360

#370

#380

#390

#400

P 407L UM INAR Y

(

(393 P40/LUM IN ARY

4			•	•	393 04071 UNITNADM
307			•	•	P40/LUN IN ARY
	•		•	•	
	•		•		
TEMP	•		•	•	
HOLD .				_	
MON .	DISPLAY CN DSKY: VC6 N40	•	MONITUR DSKY: OBSERVE DISPL	1V CE	
	R1-TF1		TFI; VG; AND		
	R2-VG	-	VM.		
	R3-DELTA VM				
			•		#410
	TFI - TIME FROM DPS IGNITION. IN		•		
	MIN, SEC TC NEAR-				
	EST SEC. MAX		UPDATE EVENT	TIMER	
	REACING IS 59859.		IF DESIRED.		
	SIGN IS - BEFCRE				
	NOMINAL TIG; + Thereafter -		•		
			•		
	VG - MAGNITUDE OF		•		#4 20
	THE VELOCITY TO BE		•		
	GAINED BY THRUST-		•		
	ING MANEUVER. IN FPS TU NEAREST .1		•		
	FPS		•		
			•		
	DELTA VM-MEASURED		•		
	DELTA V MAGNITUDE. IN FPS TO NEAREST		•		
	•1 FPS THIS CIS-		•		4430
	PLAY WILL BE COOOC		•		#430
	UNTIL TIG-30 SEC		•		
	AND THEN SHOULD		•		
	CHANGE CNLY DUE TO		•		
	PIPA BIAS UNTIL Ullage IS Startec.		•		
			•		
	•		•		
	•		•		
	•		•		#440
	•		•		
	SET TDEC1 = TIG -30		•		
	SECONDS		•		
	-		•		
	•		•		
	•		•		
	•		•		
	•		•		
	•		-		
	•		•		
	•		•		
	•		•		
	•		•		
	•		•		
	•		•		P40/LUM INARY

٠

.

٠ . .

,

#450

#460

.

#470

#480

#490

P40/LUM INARY

(

•			•
•			•
•			•
DO STATE VEC INTEGRATION AVE) REUTIN (NOTE: ENTER "A".)	(MID TO E (R41).	•	DG STATE VECTOR INTEGRATION (MID TO AVE) ROUTINE (R41) OBSERVE THAT THE COMPUTER ACTIVITY
•NO	TIG .		LIGHT IS ON UNTIL COMPLETION OF R41.
•TIG •SLIP	SLIP.		
•			•
•	•		•
•	•		•
•	٠		•
•	•		•
•	•		VERIFY/SET THRUST/
•	•		TRANSLATION CONTROL-
•	•		LER TO MINIMUM
•	•		THRUST POSITION.
•	•		ے وجہ میں میں وجد مطفقات کی
•			•
•	•		•
•	•		**************************************
•	•		ARN DPS LAUTO
•	•		THROTTLE SIGNAL IS Enabled to DPS and
•	•		THRUST INDICATOR.)
•	•		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
•	٠		•
•	•		•
•	•		•
•			CHECK THRUST INDICA-
•	•		TOR (RIGHT SIDE) TO
•	•		ENSURE AUTO THROTTLE
•	•		COMMAND IS ZEROED (C
•	•		PERCENT INDICATIONI.
•	•		•¥ •N
•	•		• •
•	•		• •
•	•		• •
•	•		• •
•	•		
•	•		• •
•	•		• •
•	•		• •
•	•		• •
•	•		• •
•	•		• •
_			-

:

٠

1

:

٠

1

٠

٠

.

•••••

		•	•		395 P40/LUMI NARY
•		•	•		
•		•	•		
•		•	•		
•					
• •		•	GU TC		
• •		•	BACKUP		#500
• •		•	PROCED-		
•		•	URE S.		
		•			
• •					
• •					
• •		CHECK STA C/W LAMPS	TUS OF		
• •					
•		•			#510
•		•			
		•			
. (NCTE: R41 WILL		•			
• DEFINE TIG TO BE		•			
 THE TIME TO WHICH R41 DID INTEGRATE 		•			
• THE LM STATE VEC-		•			
. TCR PLUS 30		•			
 SECENDS) 		•			#520
•		•			#520
• •		•			
••••		•			
		•			
WAIT UNTIL TIG -35		•			
SEC.		•			
		•			
•		•			
		•			#530
BLANK THE DSKY DIS- PLAY (V, N, R1, R2,	• • • • • • • • • • • • • • • • • • •	MONITOR D			
AND R3).		GBSERVE D	SKY DISPLAY		
		GO BLANK I	FOR 5		
•		SECONDS .			
		•			
WAIT UNTIL TIG -30		•			#540
SEC.		•			
		•			
•		•			
		•			
•		•			
•		•			
•		•			
•		•			
•		•			
•		•			
•					
•		-			
•		•			P40/LUMINARY

(

30

:

	•			•		
	•			•		
	•			•		
	RETURN VC6N4C DISPLAYS		•	MUNITOR DSKY: AT TFL = -00829		
	•			DBSERVE RETURN OF VO6N40 DISPLAYS TO INDICATE THAT		#55
	•			AVERAGE G INTEGRA~ TION HAS STARTED.		
	IS THE PRESENT PROGRAM P42?			(NOTE: IF TIG HAS BEEN SLIPPED BY R41,		
	•¥	N.		THE TFI DISPLAY (RI) AT THIS TIME WILL BE REFERRED TO THE NEW		
	•			FIG).		#56
	SET APS FLAG	- •		•		
	•	•		•		
	•	•		•		
	•			•		
	START AVERAGE G			•		#51
	INTEGRATION			•		
	•			•		
	•			MONITOR DSKY:		
	•			IN THE PERIOD FROM TFI =- 00830 UNTIL		
	•			TFI =-00815 DOES DELTA VM BECCME		
	•			GREATER THAN .5 FPS INDICATING EXCESSIVE		#51
	•			PIPA BIAS ERRCR?		
	•			•N •Y		
	•			• •		
	:			. GO TO BACKUP		
	:			PROCEDURES		#5 ^{<}
	•			•		
				AT TEL - 00007		
	AT TFI =-7.5 SE SET ULLAGE FLAG		•	AT TFI =-00807 MONITOR START OF +X TRANSLATION.		
	:			•		
	•			•		
	•			•		
	•			•		P 40/LUM INAR
٩	•			•		4
				(,	(

(

•

•

310

HAIT U	UNTIL 5 SEC.
	3 SEC.
•	
•	
•	
•	
•	n≓ II FRÙM
:	R40
•	•
•	•
:	•
•	•
ESET	IGNITION FLAG
	•
	•
	•
RE SE T	ASTRUNAUT FLAG
	•
	•
GALGUI JF BUR	LATE CURATICN RN
	•
	•
	•
	I#PULSE FLAG
RESET	
RESET	•
RESET	••••••

:

•

÷.

31

.

ł

#610

#600

#620

#630

THRUST?

٠

٠

•

.

•

٠

٠

IHKC212	
	Y.
•	•
•	•
. SET IPPULSE	E1 AC
- JET IFFULSE	FLAG
-	
•	•
•	. •
S TG LESS THAN	•
	N . SED .
5 SECONDS, BAS N ASSUMED 10%	
PS THREST?	-
	•
•N Y.	• •
• •	•
•	•
•	
	•
•	•
 SET NO THRON LE FLAG TE 	1.1
• LE FLAG TG • [NHIBIT THRO	0 1-
. TLE COMMAND	TO
. MAXIMUM AT	
• TIG +	
 "ZOOMT IME" SEC. 	
. (NGTE: THE	
SET NO THRON SET NO THRON LE FLAG TC (NHIBIT THRO TLE COMMAND MAXIMUM AT TIG + "200MTIME" SEC. (NCTE: THE VALUE "ZCCMTIME" J	
	[S
. IN ERASABLE	
 STORAGE HAVE BEEN LCADEC 	IN G
PRIOR TO	
. LAUNCH OR BY	,
• P271•	
•	
• •	
• •	
ALL VERB 99 DI	SPLAY
SEE MAM BELOWI)
•	
•	
AIT UNTIL TIG-	- C
•	

•

٠

:

ملحدي

1.

#650

#660

#670

#680

#690

#700

l

ي. م		•		•			399 P40/LUMINARY
<u>, -</u>		• •		•			
		TILN FLAG		•			
		•		• • •			
	IS ASTRU SET?	JNAUT FLAG		• •			#710
	•¥	N .		•			
	•	•		•			
	GU TO Men Belck	EXIT (NOTE: THIS IS NOT A P40 EXIT. REFER CISFLAY RES- PUNSE AT "A" BELOW.]		• • • • •			#720
		₩ <u>A</u> ₩ FROM ABCVE		• • • • •	и F и F R C M R 40		#73 0
HULD . MCN .	AND CISP R2, R3, NOUN TO PLEASE P	PRESENT NOUN PLAYS IN R1; FLASE VERB- REQUEST PERFORM IN ENABLE:	• • • • •	MONITOR DSKY AT TFI = -(CBSERVE VERB FLASH TO REQI PLEASE PERFOR ENGINE CN EN	DOBIC 5 -NGUN UEIST RM		#740
		· · · · · · · · · · · · · · · · · · ·		MCNITCR DSKY: MAIT FOR INC			#7 50
		•					
							DI DI LI LINT NA DI

٠ .

<u>گ</u>اری

(

P40/LUMENARY

•					
•		DELTA VM INDICA SUFFICIENT ULLA REQUIRED ULLAGE DELTA VISA	GE.		
MAIT FOR KEYBOARD ENTRY	-	FUNCTION OF VEH			
		•			
		•			
		•			
		•			
		•			
		•			
		SHALL I ATTEMPT COMPLETE THE THRUSTING MANEU WITH THE RCS?	VER		
		• Y	 N.		
		•	•		
	•	KEY IN ENTER	•		
	-	•	•		
		•	•		
		•••	•		
		GC TO MAN	•		
		BELOW	•		
			•		
		SHALL I PERMIT IGNITION?			
		• N	- Y		
		•	•		
	•	KEY IN PRUCE			
	•	•	•		
		•	•		
		•	•		
		•	•		
		•	•		
		•			P407LUM I
		•	•		
		(
		`			

:

2 : 1

			•	٠
			•	٠
			•	•
			•	٠
			•	
			•	•
			•	•
RMI	NATE FLASH	UPON		
	PT CF ENTE		TERM INATE	
	ED UR TERM			
ρ	•1	٠£	•	
R	•E	• N	•	
.0	• R	T		•
C	• M	E	•	•
			•	•
£	-1	• R	•	•
E	• N	•	•	•
D	• A	•	•	٠
	. T	•	•	٠
	• 8	•	•	•
	•	•	•	•
	•	•	•	•
	•	•	•	
			•	
	RESET		•	
	ULLAGE	-	-	
	FLAG			
			•	
		•	•	
	•	•	•	•
	•	•	•	•
	•	•	•	•
	•	•	•	•
		•	•	٠
	•	•	•	•
	•	•	•	•
	•	•	•	•
	•		•	
	-		•	•
		GC_TC	•	
	•	- тсч псч		
	•	BELOW	•	
	•	CLL UM	•	•
	•		•	•
	•		•	•
	•		•	•
				•
	FINAL AU		. DU FINAL AUTO-	•
	ATIC REQUE		••••• MATIC REQUEST	•
Ŧŧ	ERMINATE R	մե-	. TERMINATE RCU-	•
	INE (RGO).		TINE (RCO).	•
			*	
	•		•	
	-		•	
	•		•	
	•		•	
	•		•	.•
	•		•	•
	•		•	•
	•		•	•
	•		•	•
	•		•	•
	•		•	•
			•	
			•	
	-		•	
	•		•	
	•		•	
	•		•	-

2.5

#810

#820

#830

#840

•	:		•			402 P40/LUMINARY
•	•		• •	•		
	•		•	•		
•	•		•	•		
:	••••		•••	•		
•	EXIT P40		EXIT P40	•		
•				•		
SET	ASTRONAUT FLAG		•	•		
	•			•		#860
	•			•		
SE 1	IGNITION FLAG		MONITOR DSKY: IS R1 DISPLAY OF NEGATIVE AND	TF 1		
•	•N		NON-ZERO?			
•	•		•Y	 • N		# 870
•	•		•	•		# 6 1 0
•	•		:	•		
•						
•	RESUME STATIC DISPLAY OF		MONITOR DSKY: CBSERVE RE-	٠		
•	V06 N40	•	TURN OF STATIC	:		
•	•	·	VERB-NOUN (VC6N40)	•		
•	•			٠		#880
•	•		•	•		
•	• 		•	•		
•	EXIT INOTE: THIS IS		STANDBY FOR	•••		
•	NGT A P40 EXIT.		THRUST ON	•		
•	REFER TIG-0 LCGIC ABOVE-)		HEN TFI= -00 800	•		
•			•	•		
•	n 84		•	•		# 890
:	FRCM		•	- -		
•	ABO VE		 STANDBY FOR 			
•	•		. THRUST ON . I⊬MECIATELY			
-	•		•			
•	• • •		• •			
			• •			
COM	MANG DPS ON		• •			#900
	•		• •			
	•		• •			
	•		• •			
	•		• •			
	•		• •			
	•		• •			
	•		• •			P40/LUMINARY
	•		• •			
	•		• •		,	

مارد

	:		•	•		403 P40/LUMINARY
317	•		•	•		
	•		•	•		
	•		•	•		
			•	•		
	RESET PULSES FLAG		•	•		
			•	•		
TEMP	•		•	•		
HOLD .						#9 10
MON .	CHANGE TFI DISPLAY TO TFC IN R1;	•	MONITOR L			
	V06 N40	•		AY TO TEC		
	R1 - TFC			NOTE: TEC IS		
	R2 – VG R3 – DELTA VM			Y CALCULATED DISPLAYED		
	NJ - DEETA VA		BASED ON			
	TFC - TIME FROM		THRUST.	THIS DISPLAY		
	ENGINE CUTCEF. IN			NT DOWN WITH		*830
	MIN AND SEC TO NEAR- EST SEC. SIGN IS -			TIME UNTIL RING IS IN-		#920
	BEFORE, AND + AFTER			WHEN STEER		
	CUTOFF.			SET BY R40.1		
			RECALCUL	TIME TEC IS		
				DEVERY 2		
	•			BY THE GUID-		
	•		ANCE EQU	AILUNS.]		
				•		#930
	•			•		
	•			•		
	•		IS TEC A	T IGNITION		
	•		LESS THAT	N 6 SECONDS?		
	•		. N	Y.		
			•	•		
	•		•	•		
	•		•	• • •		#940
	•		•	GOTO		
	•		•	"En		
	•		•	BELOW		
	•					
	IS THE NO THROITLE FLAG SET?		LESS THA	T IGNITION N 95		
			SECONDS?			#950
	• Y N•					
	• •		•N	¥.		
	• •		•	•		
			•			
	 CALL FCR MAXIMUM THROTTLE COMMAND 		•	GCTC	、 、	
	• FROITER GURRANTU		•			
	•		•			
	•		•			
	•		•			P40/LUMINARY
	•					EVEN EVICINENT

#960

#970

#980

#990

#1000

- - - IN		•	
• •		•	
• • IN		•	
. IN			
	"ZUOMTIME"	• "6"	
 SEC 	ENDS FROM NOW.	. BELOW	
	E MDM BELCH)	_	
	TE: THE VALUE	•	
	CHTIME" IS IN	•	
		•	
	SABLE STORAGE,	•	
	ING BEEN LOAD-	•	
. ED	PRICR TO LAU-	•	
 NCH 	OR BY P271.	•	
		•	
•		•	
	•	•	
-			
•	•	•	
•	•	•	
•	•	•	
•	•	•	
•	•	•	
•	•	•	
•	•	•	
•	_	•	
-	•	•	
•	•	•	
•	•	•	
•	•	•	
•	•	•	
•	•	•	
IS IMP	JLSE FLAG SET?	•	
		•	
	Y.	:	
		•	
		•	
.N 	Y.		
.N	Y.	•	
N	Y. FOR ENGINE COMMANCAT		
N	Y.		
N CALI OFF CAL	Y. FOR ENGINE CUMMAND AT CULATED CUTCFF E { SEE "H"	• • • • • • • • • • • • • • • • • • •	
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE CUMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE:	• • • • • • • • • • • • • • • • • • •	
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE CUMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOT E: CS WILL CCMMAND		
N CALI OFF CAL TIM BEL PGN	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL CCMMAND RTIAL VEHICLE	• • • • • • • • • • • • • • • • • • • •	
N CALI OFF CAL TIM BEL PGN	Y. FOR ENGINE CUMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOT E: CS WILL CCMMAND	• • • • • • • • • • • • • • • • • • •	
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC		
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRLST-		
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRUST- MANEUVER).		
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRLST-		
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRUST- MANEUVER).		
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRUST- MANEUVER).		
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRUST- MANEUVER).		
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRUST- MANEUVER).		
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRUST- MANEUVER).		
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRUST- MANEUVER).		
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRUST- MANEUVER).		·
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRUST- MANEUVER).		
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRUST- MANEUVER).		
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRUST- MANEUVER).		
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRUST- MANEUVER).		
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRUST- MANEUVER).		
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRUST- MANEUVER).		
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRUST- MANEUVER).		
-N - - - - - - - - - - - - - - - - - -	Y. FOR ENGINE COMMAND AT CULATED CUTCFF E (SEE "H" DW) (NOTE: CS WILL COMMAND RTIAL VEHICLE ITUDE FOLC CUGHCUT THRUST- MANEUVER).		

(

•

:

 $_{\gamma}, \dot{\lambda}$

ų *

P40/LUMINARY

(

	• •
د .	• •
3	• •
	• •
	• •
	 RESET IGNITION FLAG
	• FLAG
	•
	• •
	• •

	• RESET ASTRUNAUT • FLAG
	• •
	• •
	-
	• •
	·
	. RESET IMPLLSE
•	• FLAG
	*
•	• •
	• •
•	• •
•	• •
•	•
•	WAIT 0.5 SECUNDS
	•
	•
	•
•	
•	RESET LLLAGE
•	FLAG
•	
•	•
-	•
-	-
	•
•	EX 11
•	(NCTE: THIS IS
•	NUT A PAC EXIT.
•	
•	
•	
•	
•	
•	
•	
•	
•	
•	
•	
•	

.

.

٠ .

#1020

#1010

#1030

#1040

#1050

٠

•		406 P40/LUMINA
RESET IGNITION FLAG	• • • • •	
•	• • • • • • • • • • • • •	*1
RESET ASTRUNAUT FLAG	• • • • • • • • • • • • • • • • • • • •	#1 (
RE SE T IDL E FLAG 	• • • • • • • • • • • • • • • • • • • •	#1(
CALL FOR RESET OF ULLAGE FLAG IN C.5 SECONDS. (SEE "D" BELOW.)		#1
EXIT (NOTE: THIS IS NOT A P40 EXIT. SEE "D" BELUN). "D"	• • • • • • • • • • • • • • • • • • • •	#1

P40/LUMINARY

(

(

:

•

•

•

 $_{\mu}\mathcal{F}^{3}$

1.

3	۲

		•		
		•		
FRCM		•		
ABEVE		•		
•		•		
		-		
•		-		
•		•		
• * •		•		
•		•		
			-	#1110
AT ACTUAL TIG PLUS		"ZOOMTIME" SECONDS		
"ZDONTIME" SEC		AFTER ACTUAL TIG		
COMMAND THROTTLE	•	OB SER VE THR UST		
TO MAXIMUM.		INCICATOR TO INCI-		
الله الله الله المالية الله الله الله الله الله الله الله الل	· · · ·	CATE XX PERCENT		
		AUTO THROTTLE COM-		
-		MAND (RIGHT SICE)		
•		AND 100 PERCENT		
•		CHAMBER PRESSURE		
•				
•		(LEFT SIDE).		#1120
•		(NOTE: THE VALUE		
•		"ZOOMTIME" IS IN		
•		ERASABLE STCRAGE		
•		HAVING BEEN LOADED		
•		PRIOR TO LAUNCH		
•		OR BY P271.		
•			-	
•				
-				
				#1130
•		-		#1150
•		- "G"		
•				
•		FROM		
•		. ABOVE		
•		• •		
•		• •		
•		• •		
-		• •••		
•		• •		
•			-	#1140
•		. MAXIMUM THROTTLE		
-		. WILL NOT BE		
-		. CUMMANDED.		
•			-	
•		-		
•		• •		
•		• •		
•		• •		
•		• •		
•		• •		
•		• •		
•		• •		
•				
•		• •		
		• •		
-				
•		-		
•		- •		
•		• •		
•		• •		
•		• •		
•		• •		P40/LUM INARY
•		• •		
•				

"E" FROM ABOVE THIS MANEUVER IS AN IMPULSE MANEUVER ANC WILL BE DONE AT AN INERTI- ALLY FIXED VEHICLE ATTITUDE.	FROM ABOVE ABOVE THIS MANEUVER THIS MANEUVER IS AN IMPULSE MANEUVER ANC WILL BE DONE AT AN INERTI- ALLY FIXEC VEHICLE			P
ABOVE ABOVE THIS MANEUVER IS AN IMPULSE MANEUVER ANC WILL BE DONE AT AN INERTI- ALLY FIXED VEHICLE	ABDVE ABDVE ABDVE ABDVE ABDVE ABDVE ABDVE ATAN IMPULSE MANEUVER ANC MANEUVER ANC MANEUVER ANC MANEUVER ANC ATAN INERTI- ALLY FIXEC VHICLE ATTITUDE. ATTITUDE. ATTITUDE. ATTITUDE. ATTITUDE.		•	
. IS AN IMPULSE . . MANEUVER ANC . . WILL BE DONE . . AT AN INERTI . ALLY FIXEC . . VEHICLE .	IS AN IMPULSE . MANEUVER ANC . WILL BE DONE . AT AN INERTI ALLY FIXED . VEHICLE . ATTITUDE. ON ITOR DP S HRU STING:	A80 V E	• • •	
, IS AN IMPULSE . MANEUVER ANC . WILL BE DONE . AT AN INERTI ALLY FIXED . VEHICLE .	IS AN IMPULSE . MANEUVER ANC . WILL BE DONE . AT AN INERTI ALLY FIXED . VEHICLE . ATTITUDE. DNITOR DPS HRUSTING:	THIS MANEUVER	•	
ALLY FIXED . VEHICLE .	ALLY FIXED . VEHICLE . ATTITUDE	IS AN IMPULSE MANEUVER ANC WILL BE DONE	•	
	HRUSTING:	ALLY FIXED VEHICLE	• • •	
	HRUSTING	:	•	
RI-TFC SHOULD BE DECREASING		R2-VG SHOULD B DECREASING	Ε	
R1-TFC SHOULD BE DECREASING R2-VG SHOULD BE				
R1-TFC SHOULD BE DECREASING R2-VG SHOULD BE DECREASING R3-DELTA VM SHOULD INCREASE	DECREASING R3-DELTA VM SHOULD INCREASE	DULD BE LESS TH EQUAL TO XX		
R1-TFC SHOULD BE DECREASING R2-VG SHOULD BE DECREASING R3-DELTA VM SHOULD INCREASE FDAI-ATT. ERRCRS HOULD BE LESS THAN R EQUAL TO XX	DECREASING R3-DELTA VM SHOULD INCREASE FDAI-ATT. ERRCRS HOULD BE LESS THAN R EQUAL TO XX	SS THAN OR EQUA		
R1-TFC SHOULD BE DECREASING R2-VG SHOULD BE DECREASING R3-DELTA VM	DECREASING R3-DELTA VM SHOULD INCREASE • FDAI-ATT. ERRCRS HOULD BE LESS THAN R EQUAL TO XX EGREE. TT RATES SHOULD BE ESS THAN OR EQUAL	THRUST INDICAT FT SIDE: XX PER NT MAX CHAMBER		

٠

.

•

•

^ر خن

1.1

P40/LUMINARY

(

	•					
	•					
	•					
	-					
	-		PRES	SINE	RIGHT SIDE:	
	•		1.60	THRO	TLE COMMAND	
	•				NT FULL	
	•	,	THRU			
	•		THE C			
	•		TDEN	TIEV	EARLY,	
	•				DR LATE	
	•		ENCT		JTOFF FROM	
	•				NT OF DSKY	
	•			LAYS	NT OF DON'T	
	•		013P	L AT 3	•	
	•					
	•			• N		
	•			•0		
	•			•R		
	•			•₩	۰E	
	•			•	•	
	•			• C		
	•			نا •		
	•			•T		
	•			• C	•0	
	•			۰E	٠F	
	•		۰,	۰F	•F	
	• ·		• F	•	•	
	•		•	•	•	
	•		•	٠	•	
	•		•	•		
	•		•	•	PUSH ENGINE	
	•		•	•	STOP PUSH	
	•		•	•	BUTTON	
	•		•	•		
	•		•	•	•	
	•		•	•	•	
	•		•	•	•	
	•		•	•		
	•		•	•	GO TC	
	•		•	•	BACKUP	
	•		•	•	PROCECURES .	
	•		•	•		
	• ••••	• • •	•	•		
	• •	•	•	•		
	• •	•	•	•		
	C TI AN /	•	•	•		
	SS THAN 4	•	•	•		
S⊨CS?		•	•	•		
	k	•	•	•		
• Y	N.+	•	•	•		
•	•	•	•	•		
•	•	•	•	•		
•	•	•	•	•		
•	•	•	•	•		
•	•	•	•	-		
•	•	•	•	•		
•	•	•	•	•		
•	•	*	•	•		
•	•	•	•	:		
•	•	•	•	•		
•	•	•	•	•		
•	•	*	•	•		
•	•	•	•	•		
•	•		•	•		
•	۸.	•	•	•		

32?

#1210

#1200

#1220

#1230

CALL ENGINE OFF COM- WANE AT COMPUTEE THRUST FAIL				
CALL ENGINE OFF COM- SEE DPS/APS MANC AT CCMPUTED CALL ENGINE OFF COM- MANC AT CCMPUTEL THR UST FAIL RECUIRED TIME. REQUIRED RESPONSE COMMAND ZERC ATTI- TUCE RATES COMMAND ZERC ATTI- TUCE FLAG		•	•	
CALL ENGINE OFF COM- SEE DPS/APS MANC AT CCMPUTED CALL ENGINE OFF COM- MANC AT CCMPUTEL THR UST FAIL RECUIRED TIME. REQUIRED RESPONSE COMMAND ZERC ATTI- TUCE RATES COMMAND ZERC ATTI- TUCE FLAG				
CALL ENGINE OFF COM- SEE DPS/APS MANC AT CCMPUTED CALL ENGINE OFF COM- MANC AT CCMPUTEL THR UST FAIL RECUIRED TIME. REQUIRED RESPONSE COMMAND ZERC ATTI- TUCE RATES COMMAND ZERC ATTI- TUCE FLAG	• • •	•		
CALL ENGINE OFF COM- SEE DPS/APS MANC AT CCMPUTED CALL ENGINE OFF COM- MANC AT CCMPUTEL THR UST FAIL RECUIRED TIME. REQUIRED RESPONSE COMMAND ZERC ATTI- TUCE RATES COMMAND ZERC ATTI- TUCE FLAG	• • •	• • •		
CALL ENGINE OFF COM- SEE DPS/APS MANC AT CCMPUTED CALL ENGINE OFF COM- MANC AT CCMPUTEL THR UST FAIL RECUIRED TIME. REQUIRED RESPONSE COMMAND ZERC ATTI- TUCE RATES COMMAND ZERC ATTI- TUCE FLAG	• • •	• •		
CALL ENGINE OFF COM- SEE DPS/APS MANC AT CCMPUTED CALL ENGINE OFF COM- MANC AT CCMPUTEL THR UST FAIL RECUIRED TIME. REQUIRED RESPONSE COMMAND ZERC ATTI- TUCE RATES COMMAND ZERC ATTI- TUCE FLAG	• •	•		
CALL ENGINE OFF COM- MANC AT CCMPUTEC THRUST FAIL KEQLIRED TIME. CALL ENGINE OFF COM- MAND AT CCMPUTEC THRUST FAIL REQUIRED REQUIRED REQUIRED RESPENSE SET IDLE FLAG AAIT UNTIL COMPUTED	CONTINUE GUIDANCE	• •	1	
CALL ENGINE OFF COM- MANC AT COMPUTED KE CUIRED TIME. KE CUIRED TIME. KE CUIRED TIME. KE CUIRED TIME. KE OUIRED RESPICASE SET IDLE FLAG KE OUTHED KE TIDLE FLAG		• •	•	
CALL ENGINE OFF COM- SEE DPS/APS MAND AT COMPUTEL KEGLIRED TIME. I (RAO) FOR REQUIRED REQUIRED COMMAND ZERU ATTI- TUDE RATES SET IDLE FLAG AAIT UNTIL COMPUTED	•	•		
CALL ENGINE OFF COM- MANE AT COMPUTED KE GUIRED TIME. KE GUIRED TIME. KE GUIRED KE GUIRED KE GUIRED KE SPCNSE SET IDLE FLAG KAIT UNTIL COMPUTED	• • •	• •		
CALL ENGINE OFF COM- MANE AT COMPUTED KE GUIRED TIME. KE GUIRED TIME. KE GUIRED KE GUIRED KE GUIRED KE SPCNSE SET IDLE FLAG KAIT UNTIL COMPUTED	• • •	•	,	
CALL ENGINE OFF COM- MANE AT COMPUTED KE GUIRED TIME. KE GUIRED TIME. KE GUIRED KE GUIRED KE GUIRED KE SPCNSE SET IDLE FLAG KAIT UNTIL COMPUTED	• • •	•	•	
CALL ENGINE OFF COM- WARD AT CCMPUTEC KEQUIRED TIME. REQUIRED TIME. REQUIRED REQUIRED REQUIRED RESPENSE SET IDLE FLAG	• • • • • • • • • • • • • • • • • • • •	• • •		
CALL ENGINE OFF COM- WARD AT CCMPUTEC KEQUIRED TIME. REQUIRED TIME. REQUIRED REQUIRED REQUIRED RESPENSE SET IDLE FLAG	•	•		
MARE AT COMPUTED THRUST FAIL REGUIRED TIME. ROUTINE	•	•	•	
MARE AT COMPUTED THRUST FAIL REGUIRED TIME. ROUTINE	•	• •	1	
MARE AT COMPUTED THRUST FAIL REGUIRED TIME. ROUTINE	•	•	•	
MARE AT COMPUTED THRUST FAIL REGUIRED TIME. ROUTINE	•	•	•	
MARE AT COMPUTED THRUST FAIL REGUIRED TIME. ROUTINE	•	• •		
MARE AT COMPUTED THRUST FAIL REGUIRED TIME. ROUTINE	•	•		
MARE AT COMPUTED THRUST FAIL REGUIRED TIME. ROUTINE	•	•	•	
MARE AT COMPUTED THRUST FAIL REGUIRED TIME. ROUTINE	• 	• • •		
REQUIRED RESPONSE	CALL ENGINE OFF COM- MAND AT COMPUTED Reguired time.	THRUST FAIL ROUTINE		
RESPONSE				
COMMAND ZERC ATTI- TUCE RATES	•		•	
AIT UNTIL COMPUTED	•	RESPURSE	•	
CUMMAND ZERU ATTI- TUCE RATES 		•		
SET IDLE FLAG	COMMAND ZERU ATTI- Tuce rates		•	
SET IDLE FLAG			•	
SET IDLE FLAG	•		•	
SET IDLE FLAG	•		•	
	•	•		
NAIT UNTIL COMPUTED				
WAIT UNTIL COMPUTED				
AAIT UNTIL COMPUTED TIME CF CUTOFF.			•	
NAIT UNTIL COMPUTED TIME CF CUTOFF.	•	•		
WAIT UNTIL COMPUTED TIME CF CUTCFF.	-		-	
MAIT UNTIL COMPUTED TIME CF CUT CFF.	-		-	
WAIT UNTIL COMPUTED TIME CF CUTOFF.	•			
A I I UN T I L COMPUTED I MÉ CF CUT CFF.				
TIME CF CUTOFF.	NAIT UNTIL COMPUTED		-	
	INE OF CUTOFF.		•	
	•			
	•			
	•		•	
	•			
	•		,	
	•		•	
	•			
	•			
	•		•	
	•			
	•		•	
	•			
	•			
: : (•			
(•			
(
			1	
			1	

324

#1250

#1260

#1270

#1280

#1290

P40/LUMINARY

(

*+"
FRCM
• ABOVE
· ABOVE
• •
• •
CUMMAND ENGINE CFF
•
•
•
ZERU DPS AUTU THRCTTLE
CUMMANE ZERU ATTI- Tude rates
•
•
•
SET DEADBAND
TU PREVICUS VALUE
DEFINED BY RO3.
•
•
•
MAINTAIN VG
CUMPUTATIONS AFTER
CUTCEE FCR PCSSIELE
NULLING BY RCS
TRIMMING MANEUVER
(NCTE: SEE ASSUMP-
TION (2) ABCVEL.
•
•
•
•
•

-

.

.

• • ٠ ٠

. . . .

. ٠ ٠

#1300

#1310

#1320

:			412 P40/LUMINARY
•		DISARM CPS	#1340
"С" F R С М А В О V Е		"A" FROM ABOVE	
· · · · · · · · · · · · · · · · · · ·		• • • • • • • • • • • •	#1350
CCMMANE ZERC ATTITUDE RATES			#1360
SET CEAC- BANC TO PREVIOUS VALUE DEFINED BY R03.			#1370
RESET ULLAGE FLAG			#1380
FLASH VERB-N FLASH VERB-N REWLEST PROC HOLD HOLD CISPLAY AT ITS FINAL MUN VIS N4C RI - THC R2 - VG	CUN TO EED OF THC . VALUE: .	MONITCR DSKY: OBSERVE VERB-NDUN FLASH TC RECUEST PROCEED AND DISPLAY OF TFC, VG AND DELTA VM.	#1390
κ2 → V6 R3 → 9ELT	A VM .	• • • •	P407LUMINARY

. *

(

3.5	•	'	
-----	---	---	--

:

	•	•			
	•	•			
		•			
NCTE: SEE ASSUMP-	•	•			
HON (2) ABOVE).		•			
	- •	•			
_	•	•			#140
•	•	•			#140
•	•	•			
•	•	•			
•	•	• 			
•	•				
•	•	RECORD THESE VALUES			
•	•	AS DESIRED.			
•	•				
•	•	•			
•	•	•			
•	•	•			#141
	´••				
WAIT FOR KEYEGARC	• • • • • • • • • • • • • • • • • • • •	KEY IN PROCEED			
ENTRY					
TERMINATE FLASH UPON	1 •	•			
RECEIPT OF PROCEEC,	•	•			
RECYCLE, CR TERMIN-	•	•			
AT E.	•	•			
	• •	•			
•P •Ť •8	•	•			
•R •E •E	•	-			#142
.ŭ .R .€	•	•	•		
.€ .M.Y	•	•			
•E •1 •C	•	•			
.E .N .L	•	•			
•D •A •E	•	-			
• • • • •	•	-			
• •E ••••		_			
• •					
• • •		•			
		•			
. GC TC		•			#143
• • • • • •		•			
. BELCW		•			
· CLEGN		•			
•		•			
CUMMAND ZERO ATTI-		•			
		•			
TUDE ERRORS		•			
		•			
•		•			
•		•			#144
•		•			
		•			
SET .3 DEGREE		•			
DEADBAND		•			
		•			
•		•			
•		•			
•		•			
•		•			
•		•			
•		•			
-		-			
•		<u>.</u>			
-		-			137 ALL MITER PRO
•		•			P407LUMINARY
•					

•

	:		•		414 P 40/L UMINAR Y
	•		•		
	•		•		
	•		•		
	• ••••	•	•		#1450
	· ·	•	•		
HOLD .	FLASH VERB-NCUN TO	•	MONITOR DSKY:		
• • • • • • • • • •	REQUEST RESPONSE AND	•	CBSERVE VERB-NCUN		
MGN 🖕	CISPLAY COMPONENTS	• •	FLASH TO REQUEST		
	OF VG(LM): V16 N85	•	RESPONSE AND DISPLAY		
	R1-VGX (LM)	•	COMPONENTS OF VG(LM)		
	R 2- VG Y (L M)	•	•		
	R 3-VGZ(LM)	•	•		#1460
	COMPONENTS OF THE	•	•		
	PRESENT VG VECTUR	•	•		
	RESCLVED ALONG THE	•	TO NUEL OUT VG		
	LM X, Y, AND Z AXES.	•	COMPONENTS COMMAND		
	THE VG VECTUR WILL Be upcated by The	•	MANUAL TRANSLATIONS		
	STEERING LOOPS	•	AND ROTATIONS. INOTE: THIS MANEUVER		
	CURING EACH COMPUTA-	•	IS AT THE OPTION OF		
	TIUN CYCLE. IN FPS	•	THE CREW.)		#1470
	TU NEAREST .1 FPS. (NCTE: SEE ASSUMP-	•			
	TIGN (2) ABGVE).	•	•		
		•	•		
	•	•	•		
	•	•			
	•	•	THE GRBITAL PARA- Meter Display		
	•	•	RCUTINE (H30) MAY BE		
	•	•	SELECTED AT THIS		#1480
	•	•	TIME (V82E) TO		
	•		MENITER CONTINUOUSLY UPDATED VALUES OF		
	•	•	APU ALT, PER ALT,		
	•	•	AND THE.		
	•	•			
	•	•	•		
	•	•	•		
		• •			#1490
	WAIT FOR KEYBUARD . ENTRY	• • • • • • • • • • • • • • • • • • • •	KEY IN PROCEED		
	TERMINATE FLASH UPCN .	•	•		
	RECEIPT OF PROCEED,	•	•		
	RECYCLE, UR TERMIN-	•	•		
		•	•		
		•	•		
		•	•		
		•	•		
	•		•		
		•	•		
		•	•		
	•	•	•		
. × 1		•	:		
			•	ł	P407LUM IN ARY
		•	•		
(*			(1
			`		1

#1500

#1510

#1520

#1530

#1540

			•		•
			•		•
			•		•
ATE.			•		•
			•		•
ĸ	• •	• R •E •C	•		•
.u	R	Ċ	•		•
٠С	_ M	. Y			•
۰Ł	• 1	•C •L •E			
٠É	•N	•L	•		
•D	. A	۰É	•		•
•			•		•
•	• E	••••	• • •		
•	•				•
•	•	мОн МОн			•
•		FROM			•
•		ABCVE			•
	•	•			•
•	•				•
•		••••			•
•		•			
	ENDEZ VO				•
TRACKI	NG MARK				•
COUNTER	R.				•
					•
	•				•
	•				•
	•				•
	•				•
	•				•
	•				•
	•				•
					-
SET DEA	DBAND				•
	/ICUS V				•
) BY RC				
					•
	•				•
	•				•
	•				•
	•				•
	•				•
REQUEST REQUEST	TERMI (RCO)	MATIC NATE	• •	DO FINA REQUEST	L AUTEMATIC TERMINATE (ROO)
			• •		
	•				•
	•				•
	•				•

.

•

•

•

٠

•

٠

.

A A A Z ', UME NARY



CHANGE CONTROL NOTES

 REV CC
 PCR
 3C,31

 REV 01
 PCR
 85,86,144,164,166,401,419,539,609,637

 REV 00 (LUM 1A)
 PCR 647,648

 REV 01(LUM 1B)
 PCR 838,841,EDITORIAL

 REV 02
 ECITURIAL

(

.

++

++ +02

+

+02 ++

+EDIF

RCS FREGRAM (P41)

REV 02 12/03/69

PURPOSE: (1) TO COMPUTE A PREFERRED IMU ORIENTATION AND A VEHICLE ATTITUDE FOR AN RCS THRUSTING MANEUVER.

- (2) TO PERFORM THE VEHICLE MANEUVER TO THE THRUSTING ATTITUDE.
- (3) TO PROVIDE SUITABLE DISPLAYS FOR MANUAL EXECUTION OF THE THRUSTING MANEUVER IN THE ATTITUDE HOLD MODE.

ASSUMPTIONS: (1) THE TARGET PARAMETERS HAVE BEEN CALCULATED AND STORED IN THE LGC BY PRIOR EXECUTION OF A PRE-THRUSTING PROGRAM.

(2) THE REQUIRED STEERING EQUATIONS ARE IGENTIFIED BY THE PRIOR PRE-THRUST PROGRAM, WHICH EITHER RESET ("ASTEER") OR SET (EXT DELTA V) THE EXTERNAL DELTA V FLAG. FOR EXTERNAL DELTA V STEERING, VG IS CALCULATED ONCE FOR THE SPECIFIED TIME OF IGNITION. THEREAFTER UNTIL THE CREW NOTIFIES THE LGC THAT ROS THRUSTING HAS BEEN COMPLETED, THE LGC UPDATES VG ONLY AS A RESULT OF ACCELEROMETER INPUTS.

+02 FOR STEERING CONTROL WHEN USING "ASTEER", THE VELOCITY REQUIRED IS CALCULATED FROM FIGURE 3.3-13A IN SECTION +EDIT 5 OF R-567. THE LAMBERT ROUTINE PERIODICALLY RE-COMPUTES THE INTERCEPT TRAJECTORY SEMI-MAJOR AXIS FOR THE "ASTEER" ++ CALCULATIONS. THE INTERVAL BETWEEN LAMBERT SOLUTIONS IS CONTROLLED BY AN ERASABLE LOADED VALUE (UT).

++ (3) WITH THE GUIDANCE CONTROL SWITCH IN PONS AND THE MODE CONTROL SWITCH IN ATTITUDE HOLD THE PONDS WILL HOLD THE +02 VEHICLE ATTITUDE AND WILL GENERATE EITHER MODE I OR MODE II ATTITUDE ERRORS AND VEHICLE ATTITUDE RATES (SEE +EDIT ASSUMPTION (4)) FOR DISPLAY ON THE FOAT. THE CREW MAY EXERCISE MANUAL ATTITUDE CONTROL ABOUT ALL VEHICLE AXES WITH THE ACA IN EITHER THE RATE COMMAND OR MINIMUM IMPULSE MODE DEPENDING UPON THE STATUS OF THE PULSES FLAG. HOWEVER, IT IS ٠ + STRONGLY RECUMMENDED THAT POWERED FLIGHT NOT BE ATTEMPTED IN THE MINIMUM IMPULSE MODE. THE PULSES FLAG IS SET OR RESET BY EXTENDED VERBS 76 (MINIMUM IMPULSE) AND 77 (RATE COMMAND) RESPECTIVELY. THE PULSES FLAG IS ALSO RESET BY P12, + P40, P41, P42, P63, P70, P71, AND R40 AT MAIN ENGINE IGNITION; WITH THE EXCEPTION OF THESE CASES, MODE SELECTION IS ALWAYS BASEC UPON THE LAST ENTRY MADE IN THE DSKY. DURING A THRUSTING MANEUVER IN THE PONS/ATTITUDE HOLD MODE THE +02 PGNCS WILL NOT BE RESPONSIBLE IF REGISTER OVERFLOWS DOCUR WITHIN THE LGC. ++

(4) THE PGNCS CAN GENERATE TWO TYPES OF ATTITUDE ERRORS FOR DISPLAY ON THE FDAI:

- MCDE I SELECTED BY EXTENDED VERB 61. AUTOPILOT FOLLOWING ERRORS USED AS A MONITOR OF THE DAP'S ABILITY TO TRACK AUTOMATIC STEERING COMMANDS.
- MODE II SELECTED BY EXTENDED VERB 62. TOTAL ATTITUDE ERRORS USED TO ASSIST CREW IN MANUALLY MANEUVERING THE VEHICLE.

PGNCS-DERIVED VEHICLE ATTITUDE RATES MAY ALSO BE DISPLAYED VIA SELECTION BY EXTENDED VERB 60. MODE II ATTITUDE ERROR DISPLAYS ARE AUTOMATICALLY SELECTED AT THE BEGINNING OF R60. WITH THE EXCEPTIONS INDICATED IN ASSUMPTION (3) ABOVE, DISPLAY SELECTION IS ALWAYS BASED UPON THE LAST ENTRY MADE IN THE DSKY. FOR A MORE DETAILED DESCRIPTION OF THESE DISPLAYS REFER TO SECTION 3 OF R-567, PARA 3.2.6.

(5) THE IMU IS UN AND MUST BE AT A KNOWN CRIENTATION BEFORE THIS PROGRAM MAY BE COMPLETED. IT IS NORMALLY REQUIRED THAT THE ISS BE ON FUR A MINIMUM OF 15 MINUTES PRIOR TO A THRUSTING MANEUVER.

(6) THE EVENT TIMER IS SET TO COUNT TO ZERO AT TIG.

(7) RCS IGNITION MAY BE SLIPPED BEYOND THE ESTABLISHED TIG IF DESIRED BY THE CREW, OR IF STATE VECTOR INTEGRATION CANNOT BE COMPLETED ON TIME.

(8) THE X - AXIS OVERRIDE OPTION PROVIDES THE CREW WITH THE ABILITY TO EXERCISE MANUAL CONTROL ABOUT THE LM X AXIS WITH THE ADILITUDE CONTROLLER EVEN THOUGH THE PONCS ATTITUDE CONTROL MODE IS AUTO. WHEN THE CONTROLLER IS RETURNED TO DETENT THE PONCS DAMPS THE YAW RATE, STORES THE YAW ATTITUDE WHEN THE YAW RATE IS DAMPED, AND THEN MAINTAINS THAT ATTITUDE.

THE X - WAS OVERRIDE OPTION IS ALWAYS AVAILABLE TO THE CREW, HOWEVER IT SHOULD NOT BE EXERCISED WHEN THE LGC IS SPECIFYING A MESTRED YAW ATTITUDE, I.E.: DURING THE ATTITUDE MANEUVER TO THE THRUSTING ATTITUDE (SEE R60).

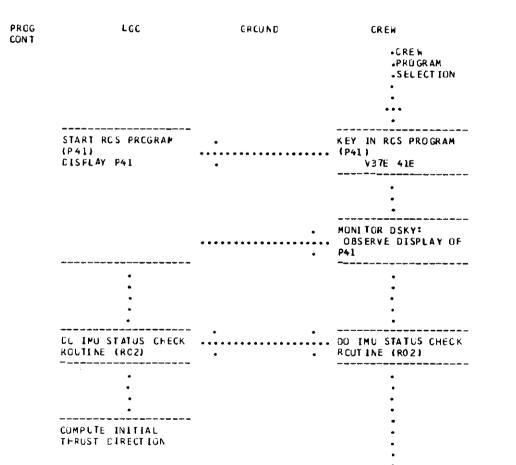
(S) THE LUAD DAP DATA ROUTINE (RO3) HAS BEEN PERFORMED PRIOR TO SELECTION OF THIS PROGRAM.

(10) THE LGC WILL NEITHER DESIGNATE NOR READ THE RENDEZVOUS RADAR (RR) DURING THIS PROGRAM.

++ +02 +EDIT

++

÷ د .



(11) THIS PROGRAM IS SELECTED MANUALLY BY DSKY ENTRY.

#10

#20

#30

P41/LUMINARY

#40

#50

#60

#70

#80

	•		
AND INITIAL VALUE	•		
OF VG VECTOR AND	•		
STORE VG(LV) IN N81	•		
AND N86 FCR POSSIBLE	•		
MANUAL SELECTION:	•		
MANUAL SELECTION:	•		
R1-VGX (LV)	•		
	•		
R2-VGY(LV)	•		
R3-VGZ(LV)	•		
VC YEL MA - CONDONENT OF	•		
VG X(LV)-COMPONENT OF	•		
G AT TIG ALONG	•	•	
(RXV)XR. IN FPS TO	•		
NEAREST +1 FPS.	•		
	•		
VGY (LV)-COMPENENT OF	•		
VG AT TIG ALONG VXR.	•		
IN FPS TO NEAREST	•		
I FPS.	•		
	•		
/GZ(LV)-COMPONENT OF	•		
VG AT TEG ALGNG -R.	•		
N FPS TU NEAREST	•		
.1 FPS.	•		
	•		
	•		
HERE R IS GEDCENT-	•		
RIC (EARTH CRBIT) OR	•		
SELENOCENTRIC (LUNAR	•		
GRBIT) RACIUS VECTOR	•		
AND V IS VEHICLE	•		
INERTIAL VELUCITY	•		
VECTOR AT TIG.	•		
ENGTE: NOI WILL NOW	•		
DIFFER FROM N81 DIS-	•		
FLAY CF P30, P32,	•		
AND P33 BECALSE OF	•		
RETATION OF VG	•		
VECTCR).	•		
	•		
•	•		
•	•		
•	•		
	•		
COMPUTE PREFERRED	-		
INU ORIENTATION:	•		
	-		

.

•

•

•

333

ŧ

X ÷ UNIT T -S₩ -
Y = UNIT (T X K) -SM
2 = UNIT (X X Y) -SM -SM -SM
WHER E =
T = THE INITIAL THRUST VECTOR.
R = THE GECCENTRIC
- (EARTH CRBIT) CR SELENDGENTRIC (LUNAR ORBIT) RADILS VECTCR AT TIG. (NCTE: IF T X R IS
SMALL (REFER SECTION 5.3.3.3.3 OF R567), THEN Y = -SM UNIT (T X V)
WHERE V = VEHICLE
INERTIAL VELCCITY VECTOR AT TIG.)
• • • •
STORE DESIRED ATTI- TUDE SPECIFICATION FOR USE BY ATTITUDE MANEUVER ROUTINE (R60). THE FINAL ATTITUDE WILL BE COMPUTED DURING R60

:

3,14

٠

90

#100

#110

#120

#130

P41/LUN INARY

AND WILL POINT THE LM +X AXIS IN THE INITIAL THRUST CI-

HOWEVER, IN ORDER TO CENSERVE RCS FUEL AND NOT CONSTRAIN THE NON-CRITICAL ATTITUCE AROUT THE

THRUST VECTOR, WINGS MAY NOT BE LEVEL IN THE COMPUTED FINAL

SET PREFERREC-ATT-

ITUDE-COMPUTED FLAG.

COMMAND ZERO ATTI-TUDE ERRORS

SET 0.3 DEGREE DEADBAND

:

•

RESET 3-AXIS FLAG

REC TI GN.

ATTITUDE.

#140

#150

#160

#170

.

.

.

٠

	•		•	424
	•		•	P41/LUMINARY
			•	
			•	
	-		•	
	•		•	
	•		•	
	•		•	
	•			
TEMP	•			
HOLD .		-		
MON .	DI SPLAY ON DSKY: V16 N85 R1-VGX(LM) R2-VGY(LM)	•	MCNITOR DSKY: OBSERVE DISPLAY OF VG COMPONENTS.	#190
	R3-VGZ(LM)		•	
			•	· · · · · ·
	(VGX(LM), VGY(LM)		•	
	VGZ(LM) - COMPON-		•	
	ENTS OF THE VG		•	
	VECTOR AT TIG RESOL-		•	
	VEC ALONG LM X, Y,		•	
	AND Z AXES RESPEC-		•	#200
	TIVELY. UPDATED		•	
	W.R.T. VEHICLE ATT I-		•	
	TUDE EVERY 1 SECOND.		•	
	IN FPS TO NEAREST		•	
	-1 FPS. (NCT E: SEE		•	
	ASSUMPTION (2)		•	
	ABOVE.)		٠	
	******************		•	
	•		•	
	•		•	#210
	•		•	
			•	
	SET TDEC 1=TIG-30 SEC.		•	
			•	
			•	
	•		•	
	•		•	
	•		•	
	•		•	
	CC STATE VECTOR INTEGRATION (MID TC AVE) ROUTINE (R41). (NCTE: ENTER R4) AT #A".)	· · · ·	DO STATE VECTOR INTEGRATION (MID TO AVE) RGUTINE (R41).	#220
	•NC TIG.		•	
	TIG SLIP.		•	
	• • • • • • • • • • • • • • • • • • • •		•	
	•		•	
	- •		-	
			-	
	• •			
	• •		•	
			•	
			•	
			•	
			•	
			• • • •	
			•	
			•	
			•	P41/LUMINARY
·			· · · ·	P41/LUMINARY

337

.

.

•

•

.

•

.

•	•		-
-	•		•
•			
-			_
SLEP	•		•
• SLIP	•		•
•	•		•
•	-		•
•	•		•
•	•		•
-			
•	•		•
•	•		•
			•
	INE TIG TO BE		•
	TIME TO WHICH		•
	DID INTEGRATE		•
• THE	LN STATE VEC-		•
	PLUS 30		
. SEC			•
			•
•			•
•	•		•
•	•		•
•	•		•
•	•		•
			•
HATT L	NTIL TIG		
- 35 SE			-
JZ JE	· •		•
			•
	•		•
	•		•
	•		•
BLANK	THE DSKY DIS-	_	MONITOR DSKY:
	V,N,R1,R2, AND		AT TIG-35 SEC CB-
R3)	THE THE AD		SER VE DSKY DI SPLA
~ ~ ~		•	
			TO GO BLANK FOR 5
	•		SECUNDS
	•		
	•		•
			•
WAIT U	NTIL TIG-30		-
SEC.			•
			•
			•
	•		•
	•		•
	•		•
RETHRN	V16N85 D15-		MONITOR DSKY:
	**0003 D19-	•	
PLAYS		• • • • • • • • • • • • • • • • • • • •	AT TIG-30 SEC DB-
	**	•	SERVE RETURN OF
	•		V16N85 DISPLAYS
	•		TO INDICATE THAT
	_		
	-		

(425 P41/LUMINARY

#240

#230

∉250

#260

#270

.

#280

#2 90

#300

#310

#320

•		426 P 41/L UMI
•		
• • •	AVERAGE G INTEGRAT- Ion has started. Gbserve computer AC-	
•	TIVITY LIGHT BLINKS CN EVERY 2 SECONDS DURING AVERAGE G.	
•	•	
START AVERAGE G INTEGRATICN	• •	
•	:	
:	•	
WAIT UNTIL TIG-5 SEC		
	•	
•	:	
•	:	
RESET LONITION FLAG.	:	
•	•	
•	•	
RESET ASTRUNAUT FLAG	•	
•	:	
•	:	
WAIT UNTIL TIG-O SEC	•	
	•	
•	•	
•	•	
SET IGNITION FLAG	•	
•		
•	•	
IS ASTRCNAUT FLAG SET?	•	

•

•

.

٠

•

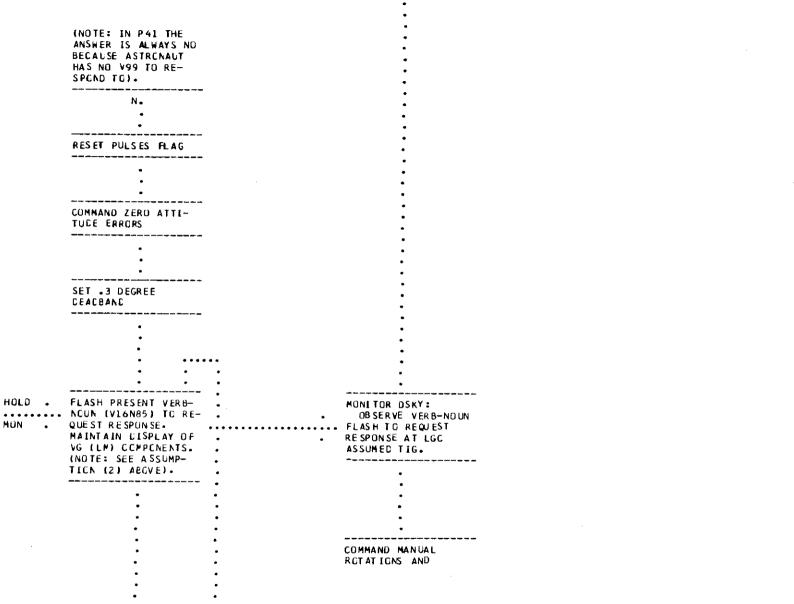
(

l

1 *

•

427 P41/LUMINARY



#330

.

#340

#350

#360

#380

#390

#400

#410

#420

	•		-	
	•		:	TRANSLATIONS TO NULL
	•		•	VG COMPONENTS
	-		•	
	•		•	•
	•		•	•
	•		•	•
	•		•	
	•		•	THE URBITAL PARAMET-
	•		•	ER DISPLAY ROUTINE
	-			(R30) MAY BE SELECT- ED AT THIS TIME
	•		•	(V82E) TO MONITOR
	•		•	CONTINUOUSLY UPDATED
	•		•	VALUES OF APO ALT,
	•		•	PER ALT, AND TEE.
	•		•	
	•		•	•
	•		•	•
	•		•	•
	-		:	•
			•	•
WALT FO	OR KEYBC	ARD	••	WHEN MANEUVER IS
ËN TR Y				 COMPLETE KEY IN
			••	PROCEED
			•	
TERNIN	ATE VICAA	LOLL.	•	•
	ATE VERB- UPGN Reci		•	•
GE PROM	CEEC, REG		•	•
CR TER	VINATE		:	•
				•
. ₽	۰.	•R		
• R	۰E	۰E		•
•0	•R	•C		•
•6	M	•Y		•
• E	• [• C	•	•
•E •C	•N	• L	•	•
• •	• A • T	•É	•	•
•	• E	•	•	•
•	•		- •	•
•	•			•
				•
	NCEZVOUS	,		•
TRACKIN				•
COUNTER				•
				•
	•			•
	•			•
	•			•
SET DEA	084ND			•
	IOUS VAL	UE		•
	ML			•
				•

•

•

l

(

.

4

•

•

•

{



		•	
DEFINED BY RO3.		•	
•		•	
•		•	#43
DD FINAL AUTOMATIC REQUEST TERMINATE RCUTINE (ROO).	• •	DO FINAL AUTOMATIC REQUEST TERMINATE ROUTINE (ROO).	
•		•	
•		•	. #44
EXIT P41		EX IT P41	

٠

CHANGE CENTREL NOTES

REV 01 PCR 85,86,164,4C1,605,637 REV 00 (LUM 1A) PCR 647 REV 01 (LUM 1B) PCR 838,841,EDITORIAL REV 02 ECITORIAL

.

THIS PAGE INTENTIONALLY LEFT BLANK

349

1.1

APS PROGRAM (P42)

PURPOSE: (1) TO COMPUTE A PREFERRED INU ORIENTATION AND A VEHICLE ATTITUDE FOR A LM APS THRUSTING MANEUVER.

(2) TO DO THE VEHICLE MANEUVER TO THE THRUSTING ATTITUDE.

(3) TO CONTROL THE PENCES DURING COUNTDOWN, IGNITION, THRUSTING, AND THRUST TERMINATION OF A PENCES CONTROLLED APS MANEUVER.

ASSUMPTIONS: (1) THE TARGET PARAMETERS HAVE BEEN CALCULATED AND STORED IN THE LGC BY PRIOR EXECUTION OF A PRE-THRUSTING PROGRAM.

(2) THE REQUIRED STEERING EQUATIONS ARE IDENTIFIED BY THE PRIOR PRE-THRUST PROGRAM, WHICH EITHER RESET ("ASTEER") OR SET (EXT DELTA V) THE EXTERNAL DELTA V FLAG. FOR EXTERNAL DELTA V STEERING, VG IS CALCULATED DAGE FOR THE SPECIFIED TIME OF IGNITION. THEREAFTER BOTH DURING APS THRUSTING AND UNTIL THE CREW NOTIFIES THE LGC THAT RCS TRIM THRUSTING HAS BEEN COMPLETED, THE LGC UPDATES VG ONLY AS A RESULT OF ACCELEROMETER INPUTS.

REV 02 12/03/69

FOR STEERING CONTROL WHEN USING "ASTEER", THE VELOCITY REQUIRED IS CALCULATED FROM FIGURE 3-3-13A IN SECTION 5 CF R-567. THE LAMBERT ROUTINE PERIODICALLY RE-COMPUTES THE INTERCEPT TRAJECTORY SEMI-MAJOR AXIS

FOR THE "ASTEER" CALCULATIONS. THE INTERVAL BETWEEN LAMBERT SOLUTIONS IS CONTROLLED BY AN ERASABLE LOADED VALUE (UT).

(3) THE INU IS ON AND MUST BE AT A KNOWN ORIENTATION BEFORE THIS PROGRAM MAY BE COMPLETED. IT IS NORMALLY REQUIRED THAT THE ISS BE ON FOR A MINIMUM OF 15 MINUTES PRIOR TO A THRUSTING MANEJVER.

(4) THE EVENT TIMER IS SET TO COUNT TO ZERO AT TIG.

(5) ENGINE IGNITION MAY BE SLIPPED BEYOND THE ESTABLISHED TIG IF DESIRED BY THE CREW OR IF STATE VECTOR INTEGRATION CANNOT BE COMPLETED IN TIME.

(6) IF A THRUSTING MANEUVER IS PERFORMED WITH THE GUIDANCE CONTROL SWITCH IN PGNS AND THE MODE CONTROL SWITCH IN AUTC, THE PGNCS WILL CONTROL THE TUTAL VEHICLE ATTITUDE AND GENERATE EITHER MODE I OR MODE II ATTITUDE ERRORS AND VEHICLE ATTITUDE RATES (SEE ASSUMPTION (7)) FOR CISPLAY ON THE FOAL. THE CREW MAY EXERCISE CONTROL AROUND THE YAW AXIS ONLY WITH THE ACA (X-AXIS OVERRIDE) IF THE X-AXIS OVERRIDE CAPABILITY IS PERMITTED BY THE PROGRAM IN PROCESS. THIS MANUAL CONTROL WILL BE IN THE RATE COMMAND/ATTITUDE HOLD MODE.

IF A THRUSTING MANEUVER IS PERFORMED WITH THE GUIDANCE CONTROL SWITCH IN PGNS AND THE MODE CONTROL SWITCH IN ATTITUDE HOLD THE PGNCS WILL HOLD THE VEHICLE ATTITUDE AND WILL GENERATE EITHER MODE I OR MODE II ATTITUDE ERRORS FOR DISPLAY ON THE FOAL. THE CREW MAY EXERCISE MANUAL ATTITUDE CONTROL ABOUT ALL VEHICLE AXES WITH THE ACA IN EITHER THE RATE COMMAND OR MINIMUM IMPULSE MODE DEPENDING UPON THE STATUS OF THE PULSES FLAG. HOWEVER IT IS STRONGLY RECOMMENCED THAT POWERED FLIGHT NOT BE ATTEMPTED IN THE MINIMUM IMPULSE MODE. THE PULSES FLAG IS SET OR RESET BY EXTENDED VERUS 76 (MINIMUM IMPULSE) AND 77 (RATE COMMAND) RESPECTIVELY. THE PULSES FLAG IS ALSO RESET BY P12, P40, P41, P42, P63, P7C, P71, AND R40 AT MAIN ENGINE IGNITION. WITH THE EXCEPTION OF THESE CASES, MODE SELECTION IS ALWAYS BASED UFON THE LAST ENTRY MADE IN DSKY. DURING A THRUSTING MANEUVER IN THE PGNS/ATTITUDE HOLD MODE THE PGNCS WILL NOT BE RESPONSIBLE IF REGISTER CVERFLOWS OCCUR WITHIN THE LGC.

IN THE EVENT THAT THE GUIDANCE CONTROL SWITCH IS CHANGED FRCM PGNS TO AGS DURING A THRUSTING MANEUVER, THE LGC WILL CONTINUE COMPUTATION OF POSITION AND VELOCITY, THE DESIRED THRUST VECTOR, AND THE DESIRED ATTITUDE ERRORS, HOWEVER THE PGNCS WILL NOT BE RESPONSIBLE IF REGISTER OVERFLOWS OCCUR WITHIN THE LGC.

(7) THE PGNCS CAN GENERATE TWO TYPES OF ATTITUDE ERRORS FOR DISPLAY ON THE FDAI;

MODE I - SELECTED BY EXTENDED VERB 61. AUTOPILOT FOLLOWING ERRORS USED AS A MONITOR OF THE DAP'S ABILITY TO TRACK AUTOMATIC STEERING COMMANDS.

MODE II - SELECTED BY EXTENDED VER^B 62. TOTAL ATTITUDE ERRORS USED TO ASSIST CREW IN MANUALLY MANEUVERING THE VEHICLE.

PGNCS-DERIVED VEHICLE ATTITUDE RATES MAY ALSO BE DISPLAYED VIA SELECTION BY EXTENDED VERB 60.

- ++ +02
- +EDIT

++

++

+ 02

++

+EDIT

+02 +EDIT

++

++ +02 +EDIT

++

343

MODE II ATTITUUE ERROR DISPLAYS ARE AUTOMATICALLY SELECTED AT THE BEGINNING OF R60. WITH THE EXCEPTIONS INDICATED In Assumption (6) Above, display selection is always based upon the last entry made in the DSKY. For a More detailed Description of these displays refer to section 3 of R567, para. 3.2.6.

[8] THE X-AXIS OVERRICE OPTION PROVIDES THE CREW WITH THE ABILITY TO EXERCISE MANUAL CONTROL ABOUT THE LM X AXIS WITH THE ATTITUDE CONTROLLER EVEN THOUGH THE PONCS ATTITUDE CONTROL MODE IS AUTO. WHEN THE CONTROLLER IS RETURNED TO DETENT THE PONCS DAMPS THE YAW RATE, STORES THE YAW ATTITUDE WHEN THE YAW RATE IS DAMPED, AND THEN MAINTAINS THAT ATTITUDE.

THE X-AXIS OVERRIDE CPTION IS ALWAYS AVAILABLE TO THE CREW, HOWEVER IT SHOULD NOT BE EXERCISED WHEN THE LGC IS SPECIFYING A DESIRED YAW ATTITUDE, I.E.: DURING THE ATTITUDE MANEUVER TO THE THRUSTING ATTITUDE (SEE R60).

(9) FOR EACH BURN AN IGNITION TOTAL ALLOWABLE TIME DELAY WILL BE SPECIFIED IN THE MISSION RULES. THIS DELAY TIME IS THE TOTAL TIME WHICH THE THRUSTING MANEUVER MAY BE DELAYED BEYOND THE LGC CALCULATED TIME OF IGNITION. IF ENGINE RE-STARTS ARE INVOLVED, THE ACCCUNTING OF THIS TOTAL TIME DELAY IS UP TO THE CREW.

(10) THE LOAD DAP DATA ROUTINE (RO3) MAY HAVE BEEN PERFORMED PRIOR TO SELECTION OF THIS PROGRAM.

(11) LGC AND CREW PROCEDURES IN CASES OF LGC-ASSUMED THRUST FAILURE ARE DEFINED BY THE DPS/APS THRUST FAIL ROUTINE (R40). THIS ROUTINE IS CALLED AT APS IGNITION BY THIS PROGRAM.

(12) THE LGC WILL NEITHER DESIGNATE NOR READ THE RENDEZVOUS RADAR (RR) DURING THIS PROGRAM.

(13) THIS PROGRAM SHOULD BE SELECTED BY THE ASTRONAUT BY DSKY ENTRY AT LEAST 5 MINUTES BEFORE THE ESTIMATED TIME OF IGNITION.

(14) THIS PREGRAM IS SELECTED MANUALLY BY DSKY ENTRY.

PROG LGC GREUND CREW CONT .CREW PROGRAM SELECTION -----------START APS PRUGRAM ***** KEY IN APS (P42) CISPLAY PROGRAM (P42) . P42 V37E 42E _____

#10

344

+

÷

+

+ 02

.

433 P42/LUMINARY

(

45				•	
				•	
				•	
				•	
			•	MONITOR DSKY: OBSERVE DISPLAY P42	o F
			•		
		•		•	
		•			
		•		•	
				•	
	IS THE APS SET?	5 FLAG		•	
				•	
	•¥	• N		•	
	•	•		•	
	•	•		•	
	•••••	•		•	
	•• •	•		•	
oss	•• •	•		•	
OLD .	- FLASE V	ERE-NCUN			
		EST RES-	•	DUES VER8-NOUN F TO REQUEST RESPO	
NAP .		ND DI SPLAY	•	AND DISPLAY OF A	
		ODE 01706		CODE INDICATE TH	
		CATE THAT		APS FLAG SHOWS	
	- APS FLA			THAT THE DPS HAS	NGT
	•• THAT TH •• HAS NO T			BEEN STAGED?	
	.ST AGED:			(NOTE:	-
	++ V05 N			THIS ALARM CODI MAY BE DISPLAYED	
	•• R 1- XX	XXX		EITHER RI, R2. O	
	•• R2-XX			R3, DEPENDING ON	
	•• R3-XX	ХХК		PRESENCE OR ABSE	NCE
	•••			OF OTHER ALARM	
	••	•		CODES.)	
	••	•		.Y	
	••	•		•	• N
	••	•		•	
	••	•			•
		•		DO I WISH TO	•
	••	•		CONT INUE WITH	•
	••	•		P42 ALTHOUGH THE DPS HAS NOT BEEN	
				STAGEC?	•
	••	•		(NOTE: IF CONTI-	
	••	•		NUATION IS	•
	••	•			•
	••	•			•
	••	•			•
	••	•			•
	••				•
	••	•			•
	••	•			
	•• •	,			•
	••	•			•
	••	•			•
		_			

345

• •

••

••

٠

٠

٠

.

٠

.

#20

#30

#40

#50

	•••••				
	•• •				
	•• •			SELECTED,	
	•• •			STAGING MUS	T 0 C
	•• •			PERFORMED A	FTFP
	•• •			TIG -30 SEC	GNDS
	•• •			ANC BEFORE	- 4
	•• •			[GNITION.]	
	** *				
	•• •			N	Y.
	**			•	•
	· · ·		•	•	•
	WAIT FUR KEYB	UARD		KEY IN	
	ENTRY		•	TERMINATE	
	••			V34E	
	••				
	••			•	•
	••			•	•
	••			-	•
	TERMINATE FLA		•	• • • • • • • • • • • • • • • • • • • •	
	.UPON RECEIPT	0 F	• • • • • • • • • • • • • • • • • • • •	KEY IN	
	••TERMINATE OR ••PROCEED		•	PROCEED	·
	••			•	-
	•• •P •• •R	T .		•	•
	•• •R •• •0	Е. К.		•	•
	••••0	к. М.		•	•
	•• •E	Ι.		•	•
	•• •E	N.		•	•
	•• •C	Α.		•	•
	•• •	Ι.		•	
	•• •	E.		•	•
	•• •	•		•	•
	** *	-		•	•
	.IS THE PRESEN	т :		•	•
	++PRUGRAM P42?			•	•
				•	:
	•• •N •Y	•		•	•
	••••	•		•	•
	•••••	•		•	•
		•		•	•
	•	•		•	•
	· · · · · · · · · · · · · · · · · · ·	:		•	•
	•				•
	•	•		•	
			-		
	. DC FINAL AUTUM	Δ	• • l	DU FINAL AUT	0-••
	• TIC REQUEST TE		· · · · · · · · · · · · · · · · · · ·	MATIC REQUES	T .
	 MINATE ROUTINE (ROO) 		• •	TERMINATE	•
				OUTINE (ROO) .
			-		
				•	•
	• •••			•	•
<i>p</i> 1	• •			•••	•
				•	•
	-				
	•			-	•

#70

#80

#90

#100

• •		435 P42/LUMIN/
EX IT P42	EXIT P42	•
	•••	
DC IMU STATUS CHECK Routine (RO2)	• DO IMU STATUS CHECK • ROUTINE (RO2)	
•	• • •	•
SET APS DELTA V THRESHOLD FOR USE BY R4C.	•	
 : :		
SET CELTA V COUNTER = 4 FCR USE BY R40		•
· · · · · · · · · · · · · · · · · · ·	• • •	
COMPLTE INITIAL THRUST CIRECTION AND INITIAL VALUE OF VG VECTOR AND STORE VECTOR AND STORE VECLVJ IN N81 AND N86 FCR PCSSIBLE MANUAL SELECTION:	• • • • •	4
R1-VGX (LV) R2-VG X(L V) R3-VGZ (L V)	•	
VGX(LV)-CCMPENENT OF VG AT TIG ALONG (RXV)XR. IN FPS TO NEAREST -1 FPS.		
	•	

• • • • • • •

•

347

P42/LUMINARY

ξ.

VGY(LV)-CCMPCNENT OF VG AT TIG ALONG VXR. IN FPS TC NEAREST .1 FPS. VG2(LV)-COMPENENT OF VG AT TIG ALCNG -R. IN FPS TO NEAREST •1 FFS. WHERE R IS GECCENT-RIC (EARTH GRBIT) GR SELENDCENTRIC ILUNAR CREIT) RACIUS VECTOR, AND V IS VEFICLE INERTIAL VELOCITY VECTOR AT TIG. (NOTE: N81 WILL NOW DIFFER FRCM N81 DISPLAY OF P30, P32, AND P33 BECAUSE OF RCTATION OF VG VECTOR). -----• . . COMPLIE PREFERRED IMU ORIENTATION: X = UNIT(T)-SM -Y = UNIT(T X R)- SM - -Z = UNIT(X X Y)-SM -SM -SM WHERE:

T = THE INITIAL - THRUST VECTOR

:

. ~?

#170

#180

#190

#200

AT IGNITICN R = THE GEOGENTRIC-(EARTH GRBIT) OR SELENDCENT-RIC (LUNAR ORBET) RADIUS VECTOR AT TIG. (NCTE: IF T X R IS SMALL (REFER SECTION 5.3.3.3.3 CF 85671, THEN Y = — S.M UNIT (T X V). _ -WHERE V = VEHICLE _ INERTIAL VELOCITY AT TIG.) ------. . . . STORE CESIREC ATTI-TUDE SPECIFICATION FOR USE BY ATTITUDE MANEUVER ROUTINE (R60). THE FINAL ATTITUDE WILL BE CCMPUTED CURING R60 AND WILL POINT THE LM +X AXIS IN THE INITIAL THRUST DIRECTION. HONE VER. IN ORDER TO CONSERVE RCS FLEL AND NOT CONSTRAIN THE NON-CRITICAL ATTITUCE ABOUT THE THRUST VECTOR, WINGS MAY NOT BE LEVEL IN THE CONPUTED FINAL ATT ITUCE. ------• ٠ • .

.

3*9

SET PREFERREC-ATTITUCE-CEMPUTEC #220

#230

#240

250

FLAG

COMMAND ZERO ATTI-TUCE ERRGRS

RESET 3-AXIS FLAG

•	•
•	•
•	•
•	•
•	•
•	•
•	•
•	•
•	•
•	•

ROUTINE (RCO)	•	• •		
		-		
•			•	
-			•	
•			•	
•			•	
•			•	
•			•	
•			•	
•			•	
•			•	
•			•	
•			•	
•	• •		•	
•	• •		•	
			•	

HAVE PGNS CONTRUL AND AUTO ATTITUDE

350

1

\$270

#280

#290

#300

#310

P42/LUM IN ARY

POSS HAS THE ALTO HAS THE ALTO HEEN SELECTED 7 Y N. Y N. HOLD HOLD FLASH VERB- HOLD HOLM TO RE- UES VERB-NOUN SNAP CONTROL AND CONTROL CONTROL AND CONTROL CONTROL AND AUTO AUTO ATT THUCE CONTROL AND AUTO CONTROL AND AUTO CONTROL AND AUTO CONTROL AND AUTO CONTROL AND AUTO CONTROL AND AUTO CONTROL AND CONTROL CONTROL AND AUTO AUTO CONTROL SELECTION: HAVE REQUESTED HAVE REQUESTED HAVE REQUESTED HAVE REQUESTED HAVE REQUESTED NO SELECTED ? DU I MISH TO HAVE THESE	POSS POSS 		CONTROL MODES BEEN SELECTED? .Y N. IS THE APS FLAG SET? .Y N.	:		
HGLD . FLASH VERB- MONITOR DSK Y: . NOUN TO RE- . DUES VERB-NOUN SNAP . QUEST PLEASE FLASH TO REQUEST . PERFORM PGNS . PLEASE PERFORM PGNS . CONTROL AND . CONTROL AND AUTO . AUTO ATTITUCE . ATTITUCE ONTROL . SELECTION:	H GLD FLASH VERB- NOWN TO RE- OUEST PLEASE		• THROTTLE MODE • • BEEN SELECTED? •		•	
HGLD . FLASH VERB- MONITOR DSK Y: . NOUN TO RE- . DUES VERB-NOUN SNAP . QUEST PLEASE FLASH TO REQUEST . PERFORM PGNS . PLEASE PERFORM PGNS . CONTROL AND . CONTROL AND AUTO . AUTO ATTITUCE . ATTITUCE ONTROL . SELECTION:	H GLD FLASH VERB- NOWN TO RE- OUEST PLEASE			· · · · · · · · · · · · · · · · · · ·	• • • •	
SELECTION:	. SELECTION:	HOLD .	NOUN TO RE- QUEST PLEASE PERFORM PGNS CONTROL AND AUTO ATTITUCE CONTROL MCDE	••••	DUES VERB-NOL FLASH TO REQUES PLEASE PERFORM CONTROL AND AUT ATTITUDE CONTRO	ST PGNS TC OL
MODES BEEN SELECTED?	MODES BEEN SELECTED? N N N V		• • V 50 N2 5 • R 1- 0 C 2 0 3 • R 2- BL ANK • R 3 ~ EL ANK	• •	***********	 . N
· · · · · · · · · · · · · · · · · · ·	 		•••		MODES BEEN SELEC TED ?	• •
••••••••••••••••••••••••••••••••••••••	• • • D0 I WISH T0 • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • •		· · · ·	• • • • • •		
	· · · · · · · · · · · · · · · · · · ·		• • •			• • • • • •

•

•

#330

#320

#340

#350

#360

•	•	•	•	•	•			• •
•	•	•	•		•			• •
•	•	•	•		•			• •
•	•	•	•		•			• •
•	•	•	•	•	•			• •
•	•	•	•		•	MOCES SE		• •
•	•	•	•		•	DURING T		• •
•	•	•	•		•	THRUSTIN		• •
•	•	•	•		•	MANEUVER		• •
•	•	•	•		•			• •
•	•	•	•		•	•Y	•N	• •
•	•	•	•		•	•	•	• •
-	•	•	•		•	•	•	• •
•	•	•	•		•	•	• • •	• •
•		•	•		•	•		
•	٠	•	•		•	-		• •
•	•	•	•		•			
٠	•	•				SET GUID/	ANCE	
•	•	•			•	CONTROL S	WITCH	
	•	•			•	TE PGNS A		
•		•			•	ATTI TUDE	CON-	
•	•	•			•	TROL SWIT		
•		•			-	AUTC.		
•								
		WAIT FOR KEY-			-	-		•••
	-				•			•••
			•			•		•••
					•	*		• •
					•	KEY IN PR		• •
						NET EN PP	ULEED	• •
			••		•			• •
•	•		•	·	•	•		• •
•	•		•	•	•	•		• •
•	•		•		•	•		• •
•	•		•			••		• •
•	•		•					• •
•	•		•					• •
•	•		•					• •
•	•		•					• •
•	•	***	•					• •
•	٠	TERMINATE	• •					• •
•	•	FLASH UPUN RE-				KEY IN EN	TER	•
•	•	CEIPT CF PRC-	• •					•
•	•	CEED OR ENTER	•			-		•
•	•		•			•		•
•	•	•E • P	•			•		•
•	•	∎N ⊪R	•			•		•
•	•	•T •O	•			-		•
•	•	•E •C	•			-		•
•	•	•R •E	•			•		•
		• •E	•			-		•
•		• •D	•			-		•
•	•					•		•
•		•				•		•
		•				-		•
COM	MAN	D APS CFF						
						-		
		•				-		•
		•				-		-
		-				-		
		-				-		
		-						-
		•						•
		-				•		•
		•				•		•
		•				•		•
		•				-	1	•
							(

٨

440 P42/LUM IN ARY

#380

#390

#400

#410

#420

ł

,

i				-			(
353	•			•	•		441
	•			•	•		P42/LUMINARY
	•			•	•		
	•			•	•		
TEMP	•			•	•		
HOLD . Mon .	DISPLAY ON DSKY: VC6 N40 R1 - TFI R2 - VG	• •	MONITOR OBSERVE TFI, VG	DSKY: DISPLAY CF AND DELTA	 VM		#430
	R3 - DELTA VM TF1 - TIME FRGM			•			
	APS IGNITION. IN			•			
	MIN, SEC TO NEAR- EST SEC. Max Reading is 59859.		UPDATE E IF DESIG				
	SIGN IS - BEFORE NOMINAL TIG, + THEREAFTER,			•			#440
				•			
	VG - MAGNITUDE OF THE VELOCITY TO BE			•			
	GAINED BY THRUSTING			•			
	MANEUVER. IN FPS TO NEAREST .1 FPS			•			
				•			
	DELTA VM-MEASURED DELTA V MAGNITUDE			•			#450
	IN FPS TO NEAREST •1 FPS• THIS			•			
	DISPLAY WILL BE			•			
	00000 UNTIL TIG-30			•			
	SEC AND THEN Should change only			•			
	DLE TO PIPA BIAS UNTIL ULLAGE IS			•			
	STARTEC.			•			
				•			#460
	•			•			
	SET TDEC 1 = T1G-30 SECONDS			•			
				•			
	•			•			
	•		•	•			
	•			•			#470
	•		•	•			
	•			•			
	•			•			
	•		•				
	•						
	•		•	,			
	•		•	•			
	•		•	•			P42/LUMI NARY
	•		•	•			
						,	

			44	2			
Ρ4	21	L	UM	IN	A	R	Y

	•		•	P42/LUMINARY
	•		•	
			•	
	•		•	
	DO STATE VECTOR INTEGRATION (MIC TO AVE) ROUTINE (R41) (NOTE: ENTER R41 AT MAM.)	• • • •	DO STATE VECTOR INTEGRATION (MID TO AVE) ROUTINE (R41) OBSERVE THAT THE COMPUTER ACTIVITY	
	•NG TIG• •TIG SLIP•		LIGHT IS ON UNTIL COMPLETION OF R41.	#480
	-SLIP .		•	
	• •		•	
	• •		•	
ţ			•	
	• (NOTE: R41 WILL • Define tig to be		ARM APS	
	. THE TIME TO WHICH . R41 DID INTEGRATE . THE LM STATE VEC-		• •	#490
	. TOR PLUS 30 . SECCNES.)		•	
	• •		•	
	• •		•	
	• •		•	
	· · ·		CHECK STATUS OF C/W	#500
,	WAIT UNTIL TIG		•	
	-35 SEC		•	
			•	
	•		•	
	•		•	
	•		•	#510
	•		• 	
	BLANK THE DS KY DIS- PLAY (V,N,R1,R2, AND R3).	•	MONITOR DSKY: AT TIG -35 SEC OB- SERVE DSKY DISPLAY TO GU BLANK FOR 5 SECONDS.	
	•			
	•		•	
	•		•	#5.20
	WAIT UNTIL TIG		•	
	-3C SEC.		٠	
			•	
	•		•	
			•	
			•	
,			•	
i			•	P42/LUMINARY
			•	
ų *			· ((

•

•

354

,

÷

_	
255	
3-	

PL AY S			OR DSKY: TFI = - 00829
	•		VE RETURN OF
	•		O DISPLAYS TO
	•		ATE THAT AVER-
IS THE	PRESENT		INTEGRATION
PROGRAM			IF TIG HAS
		BEEN	SLIPPED BY R41
• N	. Ү •		FI DISPLAY (R1
•	•		IS TIME WILL B RED TO THE NEW
		TIG. J	
	THE APS FLAG		
•	•		•
•	•		
•	•		
•	•		E PRESENT
	-		AM P42?
•	•	•Y	N -
•	•	-	•
•	•	•	•
INTEGRA			RM DPS . NG IF IT HAS .
	•	NOT A DONE	LREACY BEEN .
	•		•
	ACCS AND		• •
	IZE THE DAP. NORMALLY THE		• •
	I NI TI ALI ZED		• •
	SELECTED VIA		
103, WH	ERE THE APS		• •
CP THI	SET OR RESET. S PROGRAM,		• •
	FLAG IS SET,		• •
	THE CURRECT		• •
	TIALIZATIUN		• •
	BE SELECTED RECOURSE TO		• •
(03.)	KECUUKSE TU		• •
	•		• •
	•		• •
	•		•••
	•		• •
	•		• •
	•		• •
	•		• •
	•		•••
	-		• •
			•

:

. . .

•

:

#530

540

#550

#560

	•		•	•		444
	•		•	•		P42/LUMINARY
	•		•	•		
	•		•	•		
	•		•	•		
		MONET	OR DSKY:			#580
	•	IN TH	E PERIOD FRO	м		
	•	TFI =	-00830 UNITE			
	•	TFI =-	-00815			
	•		DELTA VH BEC	OME		
	•	UNCIC INCIC	ER THAN .5 F AT ING EXCESS	PS		
	•	PI PA	BLAS ERROR?	** C		
	•					
	•	• N	۰.			#590
	•	•	•			
	•	•				•
	•	•	GO TO BACK	JP		
	•	•	PROCED URE S			
	•	•				
	•	•				
	•	•				
	•	•				# 600
++	•	•				* 000
+02	WAIT UNTIL TIG	•				
+EDIT	-5 SEC.					
++		•				
	•	•				
	•	•				
	• ntu					
	• FROM	•				*(10
	- R40	-				#610
	• •	•				
		•				
	• •••	-				
	• •	•				
	RESET IGNITICN FLAG	•				
	RESET IGNITION FLAG	•				
	•					
	•	•				#620
	•	•				
	RESET ASTRONAUT FLAG	•			•	
		-				
	•	•				
	•	•				
	•	•				
	RESET IMPULSE FLAG	•				
		•				#630
	•	•				A 11
	•	•				
	•	•				
	•					

P42/LUMINARY

	•	
WILL AC	TIVE STEERING	
BE ATTE THIS MAN	MPTED DURING	
(REFER I	PARA. 5.3.3	
3.3 OF 1	SECTION 5 OF	
R 567 J		
- Y	N.	
•	•	
•		
• SET 1	LEPULSE FLAG	
•	•	
•	•	
• •	•	
CALL VEF	RB SS DIS-	
PLAYS (S BELCW)	SEE "A"	
	•	
CALL SET	OF ULLAGE	
FLAG AT	TIG-3.5 SEC	•••••
		•
	•	•
	•	•
	•	•
	•	
WAIT LNT	IL TIG -C	•
		•
	•	•
	•	
	•	•
SET IGNI	TION FLAG	•
	4	•
	•	•
	•	•
	•	•
	•	•
	•	•
	•	•
	•	•
	•	•
	•	•

Ł

35

#640

#650

#660

#670

#680

P42/LUMINARY

	•	•	•	446
	•	•	•	P42/LUMINARY
			•	
	•			
	•	•		
	•	•	•	
	•	•	•	•
			•	
	IS ASTRONAUT FLAG	•	•	
	SET?	•	•	
		•	•	
	• Y • N	•	•	# 690
	• •	•	•	
		•		
	• •		•	
	GC TC EXIT	•	•	
	"в" (NOTE: THI	5.	•	
	BELOW IS NOT A	•	•	
	P42 EXIT.	• •	•	
	REFER DIS	5	•	
	PLAY RE-	•	•	#700
	SPONSE AT MAM BELOI		•	
	"A" BELUI	• •	•	
		•	•	
		•	•	
			•	
		•	•	
		•	•	
		•	- ^н Ен	#710
	***	•	 FROM 	#110
	FRCM	•	∎ R40	
	ABU VE	•	• •	
	•	•	• •	
	•	•	• •	
	•	•	• •••	
		•	• •	
			MONITOR DSKY:	
	•		AT TFI = - 008C5	#720
		•	DBSERVE VERB-NOUN	#720
	CHANGE VERB BUT RE-		FLASH TO REQUEST	
-D •	TAIN PRESENT NOUN		PLEASE PERFORM	
	AND DISPLAYS IN RI.	• •	ENGINE ON ENABLE	
• •	R2, R3, FLASH VERB-	•		
	NEUN TO REQUEST	•	•	
	PLEASE PERFORM ENG-	•	•	
	INE ON ENABLE:	•	•	
	V99N40	•	•	
		•	•	#730
	•	•		
	•	•		
	•	•	•	
	•	•	•	
	•	•	•	
	•	•	•	
	•	•	•	
	•	•	•	
	•	•	•	P42/LUM IN ARY
	•	•	•	
1. *	•	•	• ((
			۰ ۱	1

.

нсьр MUN

3.5

•	•			44
•	•	•		P42/LUMINARY
•	•	•		
•	•	•		
	•	•		
WAIT FOR KEYBOARD Entry	•	•		
	•	•		
	•	•		
	•	•		
	•			# 740
	• • • ••••••••••••••••••••••••••••••••	AT TFI =-0080 TOR START OF TRANSLATION.	3 MONI- +X	
		•		
		•		
		MONITOR DSKY: WAIT FOR INCRE DELTA VM INDIG SUFFICIENT ULL	CATING	#750
		REQUIRED ULLAC DELTA V IS A FUNCTION OF VE WEIGHT.	HICLE	· · ·
		•		
		•		#760
		•		
		•		·
		•		
		•		
		SHALL I ATTEMP TO COMPLETE TH THRUSTING MANE ER WITH THE RC	IE IUV	#770
		.Y	 N•	
		٠	•	
		•		
•		KEY IN ENTER	•	
	•		- •	
		•		#780
		•	•	
		•••	•	
		GOTO	•	
			•	
			•	
			•	
			•	

•

351

P42/LUM INARY

				•		P421
			"A" Below	• • •		
			SHALL I PERMI	• • •		
			IGNITION?	 • Y		
			•	•		
		• • • • • • • • • • • • • • • • • • • •	KEY IN PRO			
			•	•		
			•			
EIPT OF	FLASH UPL ENTER	IN .	KEY IN	•		
ICEED CR	TERMI	•	TERM INAT E V34E	•		
· .	E E	•	•	- •		
•	•R •T •M •E •I •R		•	•		
	• N • •		•	•		
	• E •		• •	•		
RESET	· · · · · · · · · · · · · · · · · · ·		• •	•		
ULLAGI Flag	E •		•	•		
	•		• •	• •		
•			•	•	.*	
			•	•		
•	•		•	•		
•	•		•	•		
•	•		•	•		
•	•		•	•		P 42/L
•			•	•		* 42/1

ĺ

300

. .

	•	-				
•	•			٠	•	
•	•	•		•	•	
•	•	•		•	•	
•	•	•		•	•	
•	•	•				
•				•		
•	TERMINATE	•		•	•	
•	CALL FOR	٠		•	•	
•	SET CF	•		•	•	
•	LLLAGE Flag at	•		•	•	
-	FIG-3.5	•		•	•	
	SEC IF	•		•	•	
•	CALL NOT	•		•	•	
•	YET DONE			•	•	
				•	•	
•	•	•		•	•	
•	•	•		•	•	
•	•			•	•	
•	•			•		
•	•	• • •			•	
•	•	·		•	•	
•	•	60 T 0		•	•	
•	•	*C*		•	-	
-	•	BELOW		•	•	
•	•			•	•	
:	•			•	•	
				•	•	
	DO FINAL AU	10-	_	DO FINAL AUTO	·- •	
•	MATIC REQUE	ST		MATIC REQUEST	•	
•	TERMINATE		*	TERMINATE	•	
٠	RULTINE (RC	(0)	-	ROUTINE (ROO)	•	
•						
-	•			•	-	
•	•			•		
•	•			•	•	
•	•••			•••	•	
•	• •	2		•	•	
•	EXIT P4	۷		EXIT P4	2.	
•					•	
					٠	
SE T	ASTRONAUT F	LAG			•	
					•	
	•				•	
	•				•	
	•				•	
	•				•	
IS I	GNITION FLA	G		MENITOR DSKY:		
SET?				IS RI DISPLAY	CET	FT
				NEGATIVE AND		••
• Y		• N		NGN-ZERC?		
•		•	•			
•		•		• Y		•N
•		•		•		•
•		•		•		•
•		•		•		•
•			•			•
• R	ESUME STATIC	-10	•	MONITOR DSKY		•
•						•
•						•
•						•
•						-

#8 40

#850

#860

#870

#880

P427LUMINARY

• •		450 P 42/L UM INAR Y
• SPLAY CF V06N40	UBSERVE RETURN OF STATIC VERB- NCUN DISPLAY (VOGN40)	#890
EXIT INDTE: THIS IS NUT A P42 EXIT. REFER TIG - C LOUIC		# 900
• ABOVE.)	STANCBY FOR THRUST CN WHEN TFI = -00BCC	#910
	STANDBY FOR STANDBY FOR THRUST ON IMMEDIATELY	#920
ABOVE	• • • • • • • • • • • • • • • • • • • •	#93 0
RESET PULSES FLAG		#940
		₽42/LUMINARY

#950

#960

	•		•	•
363	•		•	•
	•		•	
	•		_	-
	•		-	•
	-		•	•
TEMP -			•	•
HOLD .	CHANGE TEL DISPLAY			
********	TO THE IN RI	•	MONITOR	
			C8S £ RV E	CHANGE OF
	106 N40	•		LAY TO TFO
	R1 - TEC		IN RI	
F	R2 - VG		(NCTE: T	FC IS IN-
l l	R3 - DELTA VM		I TI ALLY	CALCULATED
				DISPLAYED.
1	FFC - TIME FROM		THIS DIG	PLAY WILL
	ENGINE CUTOFF.			PLAT WILL
	IN MIN AND SEC TO		COUNT DO	NN NITH
N	EAREST SEC. SIGN IS		ELAPSED	TIME UNTIL
	- BEFERE AND + AFTER		TVC STEE	RING IS
r	TOCC		INITIATED) (STEER
L L	LTOFF.		FLAG IS S	ET BY R40)
-			AT WHICH	TIME TEC IS
	•		REC AL CUL	ATED AND
	•		DISPLAYE	N EVERY 2
	•		SECOND'S E	
	•		CUICANCE	EQUATIONS 1
	-		GUIDANCE	EVUATIONS 1
	-		•	•
	•		•	•
	•		•	•
	•			
	•		IS TEC AT	IGNITION
	٠		LESS THAN	6 SECONDS?
	•			
	•		• N	Υ.
	•		-	
	•		-	•
	•		•	•
	•		•	•
			•	•
	-		•	•
	•		•	•
	•		•	•
	•		•	•
	•		•	•
	•		•	٠
	•		•	
	•		•	
	•		•	-
	•			•
	•			•
	-		-	•
19	S IMPULSE FLAG SET?		•	•
			•	•
	N Y.		•	•
•	N Y.		•	•
•	• •		•	•
•	•		•	•.
•			•	•
•	CALL FER ENGINE		•	•
•	OFF CCMMAND AT		•	•
				•
-			-	•
			•	•
•			•	•
•			•	•
•			•	•
•			• •	•
•			• • •	•
•			• • •	

363

#970

#980

	•
	•
	•
	•
CALCULATED CUTCEF	
TIME. (SEE NUM	-
EELOW)	•
INCTE: PGNCS WILL	•
	•
COMMAND INERTIAL	•
VEHICLE ATTITUDE	•
HOLD THROUGHOUT	•
THRUSTING MAN-	•
EUVER.)	•
	•
•	
•	_
	•
RESET IGNITION	•
	•
FLAG	•
************	•
•	•
•	•
•	•
RESET ASTRUNAUT	
FLAG	
	•
	•
•	•
•	•
•	•
	•
RESET IMPULSE	•
FLAG	•
•	•
•	•
•	•
WAIT 0.5 SECUNDS	
_	
-	•
•	•
•	•
•	•
•	•
•	•
•	•
•	-
RESET ULLAGE	
FLAG	-
	-
	•
•	•
•	•
•	•
•	•
•	•
•	•
•	•
•	
	•
•	•
:	• • •

٠

364

٠

.

.

#1000

#1010

.

#1020

#1030

-

٠

•

:

•

.

#1 050

• •	
• •	
• •	
• •••	
• •	
EXIT EXIT	
(NCTE: THIS IS NOT A DIG SHIT	
 NOT A P42 EXIT. SEE "C" BELOW). 	
• SEE "L" BELUW).	
•	
RESET IGNITION FLAG	
•	
•	
•	
RESET ASTRONAUT FLAG	
•	
•	
•	
•	
•	
RESET ICLE FLAG	
•	
•	
•	
•	
•	
•	
•	
CALL FCR RESET OF ULLAGE FLAG IN C.5 Sec.	
•	
•	
•	
•	
•	
•	
•	
•	
•	
•	
•	
•	
•	
•	
•	
-	

THIS BURN IS A MINIMUM IMPULSE MANEUVER ANC WILL BE DONE AT AN INERTIALLY FIXED VEHICLE ٠ ATTITUDE -----------٠ .

:

.

.

#1060

.

#1070

#1080

#1090

P42/LUMINARY

•		•	P42/LUMIN
•		•	
•		•	
•		•	
•		•	
THRU 1. D R	TOR AP STING: SKY: 1-TFC HCULD		
	ECREAS		*
	2 VG S ECREAS	HCULD BE ING.	
	3-DELT HOULD	A VM INCREASE.	
SHOUL	D BE	T. ERRCR LESS THAT	
DEGRE	CUAL T EE.	UXX	#
			*
LE SS	THAN	SHOULD BI OR EQUAL EE/SEC	
3. AF SURE NORMA	(PC)	MBER PRES Should be	
NORMA GINE	C UTOFI	ARLY, LATE EN- F FROM AS F DSKY	#1
 •E			
. A	•C	• A	
•R	•R	• T	
۰L	₽W	•E	
. Y	•	•	# 1
•	•C	•C	- 1
• C	.U	•U	
∙li T	•T	•T	
• 1	•0	• 0	
•0 E	. F	۰F	
•F	۰F	•F	
۰F	•	•	
•	•	•	
•	*	•	
•	•	•	
•	•	•	,
•	•	•	
•		•	
•	•		
	•	•	
•	•	•	
•	• • •	• • •	
• •	• • •	• • •	
• • •			
	• • • •	• • • •	
	• • • • •	• • • •	P42/LUMINA

,

366

٨

•

٠

•

٠

.

•

•

: : :

367 PUSH ENGINE STOP PUSH- BUTTON	455 42/LUMINARY #1140
PUSH ENGINE STOP PUSH-	
• • • PUSH ENGINE • • • • • • • • • • • • • • • • • • •	#1140
• • • PUSH ENGINE • • • • • • • • • • • • • • • • • • •	#1140
• • • PUSH ENGINE • • • • • • • • • • • • • • • • • • •	#1140
• • • PUSH ENGINE • • • • • • • • • • • • • • • • • • •	#1140
• • • STOP PUSH	
• • • • BUTTON	
• • • • • • • • • • • • • • • • • • • •	
• • • •	
• • • •	
	#1150
· GO TO BACK-	
• • UP PRCCE-	
• • • • D URE S	
• • • • • • • • • • • • • • • • • • • •	
• • • • • • • • • • • • • • • • • • •	#1160
• • • • • • • • • • • • • • • • •	
for required	
IS TG LESS THAN 4 . RESPONSE . SECONDS ?	
·································	
• Y N• • •	
	#1170
• CONTINUE GUIDANCE • •	#1170
• CENTREL .	
· · · ·	
• • • • • • • • • • • • • • • • • • • •	
• •	
	#1180
·	
•	
CALL ENGINE (FF CDN-	
CALLENGINE CFF COM- • Mand at computed •	
•	
•	
•	
•	

•

•

P42/LUMI NARY

(*

•
SET DEACBAND
TO PREVICUS VALUE

•
•
•

TLDE RATES _____

_____ COMMAND ZERO ATTI-

_____ . • .

. ------COMPAND ENGINE CFF

. . иΩи . FROM ABOVE • . .

...

TIME OF CUTOFF ------٠

• -----WALT UNTIL COMPLTED

.

------• .

SET IDLE FLAG

• • ------

•

CUMMAND ZERU ATTI-TUCE RATES

.

.

------.

RECUIRED TIME

456 P42/LUMINARY

#1190

#1200

#1240

#1220

#1210

#1230

P42/LUMINARY

	•
DEFINED BY RO3.	•
	•
•	•
•	•
•	•
•	•
	•
MAINTAIN VG	•
CCMPUTATIONS AFTER	•
CUTOFF FOR POSSIBLE	•
NULLING BY RCS TRIMMING MANEUVER	•
	•
(NOTE: SEE ASSUMP- TION (2) ABOVEJ.	•
	•
	•
•	•
•	•
*C n .	•
FROM	DI SARM APS
ABCVE .	UL SAKM APS
• •	
• •	•
• •	•
• • • •	
• •	
····· .	
COMMAND .	•
ZERD ATT	•
ITUDE .	•
RATES .	•
· · · · · · · · ·	•
• •	•
• •	•
• •	•
	•
SET DEAD	•
BAND TO .	•
PREVIOUS	•
VALLE DE- •	•
FINED BY .	•
R03 .	•
•	•
• •	•
• •	•
	•
RESET .	•
LLLAGE .	
•	•
•	•
•	•
•	•
•	•
•	•
•	•
•	•
•	•
•	•
•	6 •

.

.

•

369

.

#1250

.

#1260

#1270

#1280

P427LUMINARY

	•			
	•		•	458
	-		•	P42/LUMI
	•		•	
	•		•	
	•			
	FLAG .		•	
			-	
	•		•	
	• •		•	
	• •		•	
	• •			
			-	
	TERM INA TE		•	
	FUNDINA LE L		•	
	CALL FOR .		•	
	SET CF .			
	LLLAGE .			
	FLAG AT .		•	
			•	
	TIG-3.5 .		•	
	SEC IF .			
	CALL NOT .		-	
	YET DONE .		•	
	ILI DENL .		•	
			•	
	• •		•	
			п дн .	
	-			
	• •		FRUM .	
	• •		ABGVE .	
	• •		• •	
				i de la constante de la constan
			• •	
	• •		• •	
	• • •	• • •	••• •	
	• • •	•		
GLD .	• • •	•		
		- -		
ION		- • •	MONITOR DSKY	
UN .	FLASH VERB-NOUN TO	• • • • • • • • • • • • • • • • • • • •	OBSERVE VERB	N
	REQUEST PROCEED.	• •	FLASH TO REQ	
	HOLD DISPLAY OF TH	•	PROCEEC AND	
	AT ITS FINAL VALUE:	-	CE TEC MC	
	V16 N40	•	OF TEC, VG,	1
	410 140	•	DELTA VM	
	R1 - TFC	•		
	R2 - VG	•		
	R3 - DELTA VM		•	
	DELLA VE	•	•	
	(NOTE: SEE ASSUMP-	•	•	
			•	
			•	
	TICN (2) ABOVE).	•	•	
	TICN (2) ABOVE).	- - -	RECORD THESE	 J£\$
	TICN (2) ABOVE).	 		
	TICN (2) ABOVE).		RECORD THESE AS DESIRED	 UES
	TICN (2) ABOVE).			
	TICN (2) ABOVE).			
	TICN (2) ABOVE).	- - - - -		
	TICN (2) ABOVE).	- • • • • •		
	TICN (2) ABOVE).	-		
	TICN (2) ABOVE).	- • • • • • • •	AS DESIRED.	
	TICN (2) ABOVE).	- • • • • • • • •		
	TICN (2) ABOVE).		AS DESIRED.	
	TICN (2) ABOVE).	Ν.	AS DESIRED.	
	TICN (2) ABOVE).	Ν.	AS DESIRED.	
	TICN (2) ABOVE).	Ν.	AS DESIRED.	
	TICN (2) ABOVE).	Ν.	AS DESIRED.	
	TICN (2) ABOVE).	Ν.	AS DESIRED.	
	TICN (2) ABOVE).	Ν.	AS DESIRED.	
	TICN (2) ABOVE).	Ν.	AS DESIRED.	
	TICN (2) ABOVE).	Ν.	AS DESIRED.	
	TICN (2) ABOVE).	Ν.	AS DESIRED.	
	TICN (2) ABOVE).	Ν.	AS DESIRED.	
	TICN (2) ABOVE).	Ν.	AS DESIRED.	
	TICN (2) ABOVE).	Ν.	AS DESIRED.	
	TICN (2) ABOVE).	Ν.	AS DESIRED.	
	TICN (2) ABOVE).	Ν.	AS DESIRED.	⁴
	TICN (2) ABOVE).	Ν.	AS DESIRED.	

•

370

. *

	RECYCLE Termina	ΤE		• •			• •
	•P	.T .E		•			•
	• R	٠£	۰E				•
	•0	• K	۰C	•			
	•C	.∎M	•Y	•			
	•E		+C	•			•
	•E	•N	• L				•
	.∎D	• A	۰E				•
	•	• T	•	•			•
	•	•E		• •			•
	•	•					•
	•	•					•
	•	•••					•
	•	· · · · ·					•
	•	GG TC					•
	•	и Ен					· •
	•	BELOW					•
	•						•
	•						•
	•						•
							•
	I TUDE E	ZERO ATT RRCRS	-				•
		•					•
		•					•
		•					•
							•
	DEADBAN	CEGREES D					•
							•
							•
		-					•
		-					•
		•					•
		•					-
		•	•	•			-
				•			
HOLD . MGN .	REQUEST DISPLAY OF VGILM	COMPONEN	AND	• • • • • •	•••••	• • • • • • •	MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLA
	V16 NE			•			OF VG(LM) COMPENENT
	R1-VGX			•			
	R 2- VG 1			•			•
	R3-VGZ	([M])		•			•
				•			•
				•			•
				•			•
				•			•

٠ •

٠

٠

٠

•

•

٠

٠ :

•

•

٠

•

#1340

#1350

#1360

#1370

P422.UMINAAY						•		•	46.0
COPERCENTS CF THE IU ALL OUT MS RESERVE RUNGE THE IU ALL OUT MS RESERVE RUNGE THE MANUAL TRANSLATION THE US VECUR ATLE MANUAL TRANSLATION REFERENCE CODES MANUAL TRANSLATION DURING EACH COPPUTATION IS AT THE (FILE ADARAGE) THE US VECUR ATLE MANUE TRANSLATION REFERENCE CODES MANUE TRANSLATION THE US VECUR ATLE MANUE TRANSLATION THE US VECUR ATLE MANUE TRANSLATION THE US VECUR ATLE IS AT THE (FILE ADARAGE) TIT IN ALL OUT MS IS AT THE (FILE ADARAGE) TIT IN ALL OUT MS THE ORDITAL DARAGE TIT IN ALL OUT MS THE COMPUTATION THE US VECUR ATLE THE COMPUTATION TIT IN ALL OUT MS THE COMPUTATION TIT IN ALL OUT MS THE COMPUTATION THE US VECUR ATLE THE COMPUTATION THE ORDITAL DARAGE						•		•	
CCPECHATS CF 1FE						•		•	
CCPECHATS CF 1FE						•		•	
CCPECHATS CF 1FE						•		•	
PALSINT US VECTOR TO INALL DUT VS RESCURE AND GOTE COMPARITS COMMADS DE UDENTIS UP THE AND ROTATIONS DE UDENTIS COMMADS STEERING COURS STERING COURS CONTRE THIS MANUVER DIRING EACH OPPTIA IS AT THE CPTICL OF TIC NEWSST. 1 FPS. THE CREW.1 TIC NEWSST. THE CREW.1 TIC NEWSST. THE CREW.1 TIC R (21 ALW E). THE PROJECT CONTROL CREW.1 TIC R (21 ALW E). THE CREW.1 TIC R (21 ALW E). THE PROJECT CONTROL CREW.1 TIC REVIEWS THE CREW.1			CONCENSES		.	•		•	#1390
RESCUE ALUNG THE						•		•	
Le K XY, AND Z AKES COMPONENTS COMMAND THE VOY OC NOTE: A AND TITUNS. STEATING LCUPS . AND TITUNS. STEATING LCUPS . AND TITUNS. STEATING LCUPS . THE CREW.) TICK COLL IN PSS . THE CREW.) TICK (2) ALWYER						•	TO DITE		
He vor VC IOR NILL MANUAL TRANSLATIONS BU VC ALLE VT I- ADD ROTATIONS SUBING 2 ADD VIA - IS CALL ILC VTCLL, IN FPS IS CALL						•			
Be UPCATEC BY TFE - AND ROTATIONS. STREAME LOOPS TAKE - INTER ANALOVER DITON (YEEK LIK PP) - INTER ANALOVER DITON (YEEK LIK PP) - INTER CONTINUES - INTER			THE VG VI	FC TOR	HALU.	•			
372 INDEE THIS MANUVER 1140 IS AT THE OPTION OF TICK OFCEL IN F85 IS AT THE OPTION OF TICK OFCEL IN F85 INDEE SEE ASSUMPTION INDEE SEE A			BE UPCAT	EC RY	THE	•			
OURING EACH COMPORA 15 AT THE CAPTION OF THE CARL THE CARLON OF INTO CONCENT THE CARLON OF INTO CONTROL OF THE CARLON OF INTO CONTROL OF THE CARLON OF INTO CONTROL OF THE CARLON OF INTO CONTROL OF						•			
TO MEAREST 11 FPS. #1400 TICK 12 / ALVES.			DURING E	ACH CO	MPUTA-	•			
INDET: SEE ASSUMP-						•			
TICK (2) ABUVES.						•			#1400
The ORBITAL PARAME- TER ORBITAL PARAME- TER ORBITAL PARAME- TER DISLAR ROUTINE ED AT THIS TIME UNIT NOLLY UPDATED YALUES OF APO ALT, PER ALT, AND TFF. #1410 THE ORBITAL PARAME- ED AT THIS TIME UNIT NOLLY UPDATED YALUES OF APO ALT, PER ALT, AND TFF. #1420 TERMINIT FLASH UPCA ENTRY ENTR			(NOT E: SI	EE ASSI	UMP-	•		•	
			TICN(2)	A BCV E).	•		•	
Image: Stress of the stress						•		•	
Image: Stress of the stress				•		•		•	
Image: Stress of the stress				•		•	·	•	
Image: Stress of the stress				•		•		•	
Image: Stress of the stress				•		•	THE DEPT		
1 1830 MAY BE SELECT- #1+10 1 100 MAY BE SELECT- #1+10 1 100 MAY DE SELECT- 100 MAY DE SELECT-				•		•			
i E0 AT THIS TIME i CONTINUSLY UPCATED i YAUUS OF AND TFE. i PER ALT, AND TFE. i I walt for Keryboard KEY IN PROCEED i I walt for Keryboard KEY IN PROCEED i I walt for Keryboard I i<				:		•			#1.410
1000000000000000000000000000000000000				•					#1410
S ¹²⁻ CONTINUUSLY UPCREED VALUES OF APD ALT, PER ALT, AND TFF. VALUES OF APD ALT, VALUES OF				•		•			
PER ALT, AND TFF. 				•		•			
wait FOR KEYBOARD				•		•			
wait For Kev Yoldard				•		•	PER ALT.	AND TEE.	
wait For Kev Yoldard				•		•			
wait For Kev Yoldard				•		•		•	
wait For Kev Yoldard				•		•		•	
wait For Kev Yoldard				•		•	•	•	
ENTRY			WATT FOR	KE VBO	ARD	• •			#1420
IRR#INATE FLASH UPCN . . RECEIPT UF PRUCEED, . . RECTICLE, OR . IERMINATE .				NE 100/	ANU				
RECEIPT OF PROCEED, . RECYCLE, OR IERPINATE				E FLASI	H UPEN				
RECYCLE, OR . IERPINATE . .P .I .R .R .E . .0 .R .C .0 .R .C .C .M .Y .E .I .C .E .N .L .E .N .L .C .A .E .E .N .L .C .A .E .C .A						•			
IERPLINATE .						•		-	
3 ⁷² · T · R ·						•		• •	
.R .E .E . #1430 .D .R .C . #1430 .E .I .C . . .E .N .L . . .E E . . .						•			
1430 						•	•	,	
S ⁷²						•		•	
f^{2} f^{2						•		•	#1430
						•	•	•	
2 ¹² . A .E								•	
а ⁷⁷ -						•		•	
3 ⁷² · ···· · · · · · · · · · · · · · · ·			•••		• •		·		
3 ⁷² P42/LUMI NARY			-		•	-			
3 ⁷ 2 Berline 1 Berline 1				•		-		-	
3 ⁷ 2 3 ⁷ 2 1 1 1 1 1 1 1 1 1 1 1 1 1			•	•				•	
3 ⁷ 2 P42/LUMI NARY			•	•				•	
3 ⁷ 2 P42/LUMI NARY			•	•					#1440
· · · P42/LUMINARY			•	•					<i></i>
· · · P42/LUMINARY			•	•				•	
· · · P42/LUMINARY			•	•				,	
· · · P42/LUMI NARY			•	•				•	
· · · P42/LUMI NARY			•	•				•	
· · · P42/LUMI NARY			•	•			•	,	
· · · P42/LUMINARY	372		•	•				•	
			•	•				•	P 42/LUMI NARY
			•	•					
	1	•	•	•				• (
								Ň	, , , , , , , , , , , , , , , , , , ,

3 13

	•				
•	•				•
•	•				•
•	•				•
:	•	۳E۳			•
•	•	FROM			•
•	•	ABOVE			•
•	•	•			•
•	•	•			•
•	•	•			•
•	•	•			•
					•
ZERC RE TRACKIN	NDE ZVCL	5			•
COUNTER					•
					•
	•				•
	•				•
	•				•
	•				•
	•				•
	•				•
	•				•
					•
SET DEA	DBAND				•
TO PREV	IOUS VAL	UE .			•
DEFINED	BY RO3.				•
	•				•
	•				•
	•				•
	•				•
	•				•
DO FINAL	L AUTOMA	110	•		AUTOMATIC
REQUEST	TERM IN A	TE		REQUEST	TERMINATE
ROLTINE	(ROO)		• •	ROUTINE	(R00)
					•
	•				•
	• • •			• •	••
	• EVIT 04				•
	EXIT P4	4		EX	IT P42

#1480

#1450

#1460

#1470

CHANGE CENTREL NOTES

REV 00 PCR 31 REV 01 PCR 85,86,114,144,164,186,401,419,609,637 REV 00(LUM 1A) PCR 647,648 REV 01(LUM 12) PCR 833,841, ECITORIAL REV C2 EDITORIAL

THIS PAGE INTENTIONALLY LEFT BLANK

l

374

•

THRUST MONITUR PROGRAM (P47)

PURPOSE: (1) TO MONITOR VEHICLE ACCELERATION CURING A NON-PONCS CONTROLLED THRUSTING MANEUVER.

ASSUMPTIENS: (1) THE IMU IS UN AND MUST BE AT A KNOWN CRIENTATION BEFORE THIS PROGRAM MAY BE COMPLETED. IT IS NORMALLY REQUIRED THAT THE ISS BE ON FUR A MINIMUM OF 15 MINUTES PRIOR TO A THRUSTING MANEUVER.

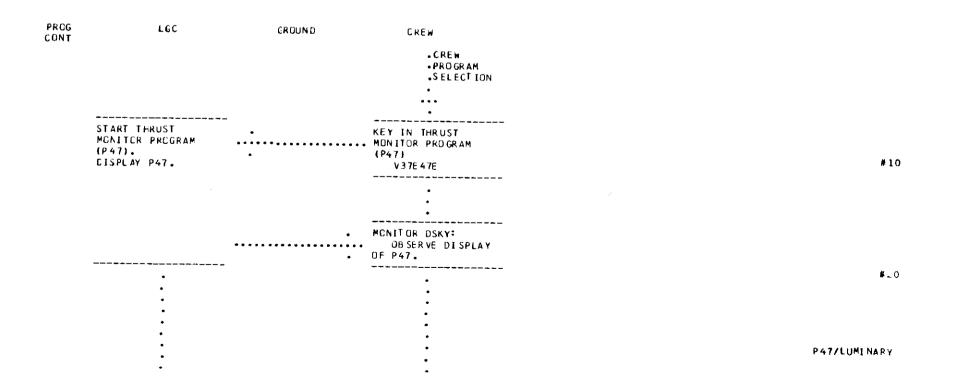
12) THE RESPONSIBILITY OF AVOIDING GIMBAL LOCK DURING EXECUTION OF THIS PROGRAM IS JPON THE ASTRONAUT.

(3) THIS PREGRAM IS NERMALLY USED DURING RENDEZVOUS FINAL PHASE. IF THE GREW DESIRES TO DO ANY FINAL PHASE THRUSTING +02 FREGRAM (P34) AND THEN THE OPS THRUSTING PROGRAM (P4C) OR THE APS THRUSTING PROGRAM (P42). +EDIT ++ (4) PANCE DANCE DATE: IND WETE W

(4) RANGE, RANGE RATE, AND THETA MAY BE DISPLAYED DURING THIS PROGRAM BY CALLING THE RENDEZVOUS PARAMETER DISPLAY RELITINE (R31).

REV 02 08/07/69

(5) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY. THE PROGRAM SHOULD BE TURNED ON JUST PRIOR TO THE PLANNED THRUSTING MANEUVER AND TERMINATED AS SOON AS POSSIBLE AFTER THE MANEUVER IN CROER TO KEEP ERRORS ASSOCIATED WITH AVERAGE G INTEGRATION AT A MINIMUM.



•		•
DE IMU STATUS CHECK REUTINE (RC2)	· · · · · · · · · · · · · · · · · · ·	DO IMU STATUS CHECK ROUTINE (RO2)
•		•
DU STATE VECTOR INT- EGRATION (MIDTUAVE) RCUTINE (R41) (NOTE: ENTER R41 AT "8")		ROUTINE (R41). OB- SERVE THAT THE COM- PUTER ACTIVITY LIGHT
• •		IS UN UNTIL COMPLE- TICN CF R41.
START A VERAGE G		• • •
INTEGRATION		• • •
		• • • • • • •
HGLD FLASH VERB-NOUN TO REQLEST RESPONSE AND MON DISPLAY DELTA V (LM): VIGN83 R1-DELTA VX(LM) R2-DELTA VY(LM) K3-DELTA VZ(LM)	• •	MONITOR DSKY: DBSERVE FLASHING VERB-NOUN TO RECUEST RESPONSE AND DISPLAY OF EACH COMPONENT OF DELTA V(LM).
DELTA VX(LP) - CCM- PONENT OF INTEGRATED ACCELERATION ALONG LM +X AXIS. IN FPS TO NEAREST .1 FPS.		
•		
•		
• • •		
i *		• (

• • •

376

•

#30

#40

#50

#60

P 47/L UM INAR Y

DELTA VY(LM) - COM-PENENT OF INTEGRATED ACCELERATION ALCIG LM +Y AXIS. IN FPS TC NEAREST -1 FPS. . DELTA VZ(LM) - COM-PENENT OF INTEGRATED . ACCELERATION ALONG . LM +2 AX IS. IN FPS . TO NEAKEST +1 FPS. NETE: R1,2, AND 3 • WILL READ 00000 IN-. ITIALLY AND WILL RE-. MAIN SC EXCEPT FOR . PIPA BIAS ACCUMULAT-. LONS UNTIL A THRUST-• ING MANELVER IS STARTED. THEY WILL . BE UPCATEC EVERY . 2 SEC. . ____ WAIT FOR KEYEDARD ٠ EN TR Y

PERFORM THRUSTING MANEUVER(S) AS DESIRED. MONITOR FDAT BALL TO AVOID GIMBAL LOCK . . THE CRBITAL PARAMET-ER DISPLAY ROUTINE . . (R30) MAY BE SELECT- . . ED AT THIS TIME (V82E) TO MONITOR CONTINUOUSLY UPDATED . . VALUES OF APO ALT. . . PER ALT AND TEF. SHALL I TERMINATE THIS PROGRAM? -----.γ •N • . SHALL I ZERO THE DISPLAY IN . ORDER TO MONIT- . . GR ANOTHER . BURN? ٠Y KEY IN RECY-CLE (V32E) -----

#70

#80

#90

#100

#110

#120

P47/LUMINARY

• • • • • • • • • • • • • • • • • • •	
TERMINATE FLASH UPON KEY IN PROCEED OR RECEIPT OF PROCEED, TERMINATE (V34E) TERMINATE OR RECYCLE.	#130
• • • • • • • • • • • • • • • • • • •	
• • E R•	
• • • C • C • C • • • • • • • • • • • •	
· · · · · · · · · · · · · · · · · · ·	
• •C E.	
• •L E.	
• • • • • • • • • • • • • • • • • • •	
• • /•	
• • T.	#140
• • E• •	
• • R.	
• • M.	
• • • •	
· · · ·	
• A.	
• • • •	
• • É. •	
	#150
• • •	
• REINITIALIZE	
ACCELERCHETER	
• INTEGRATION	
	#160
CO FINAL AUTOMATIC CO FINAL AUTOMATIC	
REQUEST TERMINATE	
RCUTINE (ROO) . ROUTINE (ROO)	
• •	
• •	
• •	
• •	#170
•••	#170
• •	
EXIT P47 EXIT P47	

(

P 477L UM INAR Y

.

1. *

CHANGE CENTREL NETES

LOGIC REV 01 PCK 401,437 REV C2 EDITCRIAL

THIS PAGE INTENTIONALLY LEFT BLANK

1

1294

. •

IMU URIENTATION DETERMINATION PROGRAM (P51)

REV 02 08/07/69

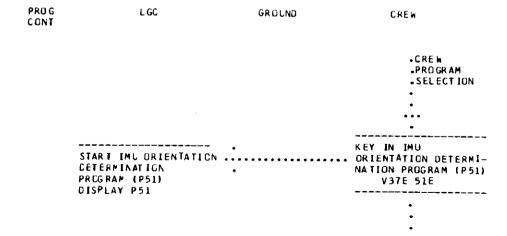
- PURPOSE: (1) TO DETERMINE THE INERTIAL DRIENTATION OF THE IMU USING SIGHTINGS ON TWO CELESTIAL BODIES WITH THE ADT OR & BACKUP OPTICAL SYSTEM.
- ASSUMPTIONS: (1) THIS PROGRAM MAY ONLY BE PERFORMED WHILE THE LM IS IN FLIGHT.
 - (2) THE ISS MAY BE:
 - (A) CFF (STANCEY)

(B) ON, AND ALIGNED OR NOT ALIGNED SINCE TURN ON.

IF (A) IS TRUE, THE IMU MUST BE TURNED ON BEFORE THIS PRUGRAM CAN BE PERFORMED. IF (B) IS TRUE THIS PROGRAM CAN BE COMPLETED.

(3) THERE ARE NO RESTRAINTS UPON THE LM ATTITUDE CONTROL MODES UNTIL THE CREW WISHES TO MANUALLY MANEUVER THE VEHICLE.

- (4) TIME AND RCS FLEL MAY BE SAVED, AND SUBSEQUENT IMU ALIGNMENT DECISIONS GREATLY SIMPLIFIED IF THIS PROGRAM IS PERFORMED IN SUCH A WAY AS TO LEAVE THE IMU INERTIALLY STABILIZED AT AN ORIENTATION AS CLOSE AS POSSIBLE TO THE OPTIMUM ORIENTATION REQUIRED BY FUTURE LGC PROGRAMS.
- (5) EXTENDED VERBS SHOLLD NOT BE EXERCISED DURING THIS PROGRAM BECAUSE OF POSSIBLE INTERFERENCE WITH R 53.
- (6) THE PROGRAM IS SELECTED BY THE ASTRCNAUT BY ESKY ENTRY.



			•		470 P 51/L UM INAR Y
			•		
		•	MONITOR DSKY: CBSERVE DISPLA P51	Y OF	#20
	•	-	•		
	•		•		
	TE THE ICC ON 3	-	•		
	IS THE ISS UN?	-	•		
	•Y •N		•		#30
	• •		•		
++ +02	SET IMUSE FLAG		•		
+ ED I T	······································		•		
++	• •		•		
	•		•		
	TURN EN PREGRAM ALARM LIGHT AND STORE ALARM CODE (NCTE: IF CALLEC, ALARM CODE WILL BE 00210.)	•	MONITOR DSKY: CGES PROGRAM A LIGHT COME ON ATING THAT THE IS NOT ON?	INDIC-	#40
			•¥ •	 N	
	•••		• •		
	• •		• •		
			TURN ON IMU .		# 50
	• •		AND RESELECT .		
	• •		P51 VIA ROO .		
	• •		• •		
	• •		• •		
	DU FINAL ALTOMATIC RECUEST TERMINATE RCLTINE (ROO).	• • • • • • •	DO FINAL AUTOMATIC REQUEST TER- MINATE ROU-		#60
	• •		TINE (R00)		
	• •		• •		
	•••		• •		
	• •		• •		
	• •		• •		
	• •		• •		
	• •		• •		
	• •		• •		
2	• •		• •		P51/LUMINARY
	• •		• •		1917EUNINART
· ·	• •				1
Υ			(x	(

3. ⁷	• •		•	•		471
<u>A</u> C	• •		•	•		P 517L UM INARY
	• •		•	•		
	• •		•	•		
	• •		•	•		
			• • •	•		
	. EXIT		EXIT	•		#70
	• P51		P51	•		
	•			•		
	• • • • • • • • • • • • • • • • • • • •	••		• • • • • • •		
	• •	•		• •	•	
		•			•	
HULD .	FLASH VERB-NOUN TO RECUEST PLEASE PER-	• •	MONITOR DSKY: OBSERVE VERB-		•	
SNAP .	FORM CELESTIAL BCDY		FLASH TC REQ		•	
	ACCUISITION:	•	PLEASE PERFOR	RM	•	#80
	V50 N25	•	CELESTIAL BOL) Y	•	
	R 1- CCC15 R2-BL ANK	•	ACCUISITION		•	
	R3-BLANK	•	•			
		•	•		•	
	•	•	•	••••	•	
	•	•	•	• •	•	
	•	•			•	
	•	•	SHALL I MANEL		٠	#90
	•	•	CONTINUE TO I		•	
	•	•	VER) THE LM 1 TION THE IMU		•	
	-	-	GIMBAL AXIS			
	•	•	PREFERRED DIF		•	
	•	•			•	
	•	•	• N •	Y •	•	
	•	•			•	
	•	•	•	•	•	#100
	•	•	• WITH THE P • Control Ri		•	
	•	•	. THE LM UN		•	
	•	•	. PITCH AXIS	SISIN .	•	
	•	•	• THE PREFER	RRED .	•	
	•	•	 DIRECTION 		•	
	•	•	•		•	
	•	•	•		•	
	•	•	•	• •	•	#110
	•	•	ARE 2 CELESTI		•	
	-	•	BODIES VISIBU	.E 1N	•	
	•	•			•	
	•	•		• •	•	
		•			•	
	•	•		• •	•	
	•	•			•	
	•	*		• •	•	
	•	•		• •	•	
	•	•			•	
	•	•			•	
	•	•			•	P51/LUMINARY
	•	•		• •	•	
	•	•		• •	•	

(

			· .
•	•		• • 472
•	•	••	• • P51/LUMINARY
•	•	•••	• •
•	•	• •	• •
•	• THE OPTICAL SYS- • TEM FIELD OF	• •	• •
•	• VIEw ?	•••	• •
•	•	• •	• •
•	• •Y •N	••	• •
•	• • •	••	
		•••	#120
•	• • •		• •
•	• • • • • • • • • • • • • • • • • • • •	• •	• •
•	WITH THE ROTA TION CONTROL	• •	• •
	ORIENT THE LM		
•	• UNTIL 2 CELES	• •	• •
•	• • TIAL BODIES .	• • •	•
•	• • • ARE VISIBLE IN • • • • • • • • • • • • • • • • • •	• •	* * * *
•	. SYSTEM	••	• • * *120
•		• •	• •
•	• • •	• •	
•	• • • •	• •	
•	• • • •	•••	· •
•	• • •	•	•
•		• •	• •
•	SHALL I COARSE ALIGN IMU TO	• •	#140
	• 0,0,0 GIMBAL .		•••
•	• ANGLES? •	• •	• •
•	•	• •	• •
•	• • • • • •	•••	
•	• • • •		
•			• •
•	MONITOR FDAL BAI IS GIMBAL LOCK	LL +	• •
•	• • • • • • • • • • • • • • • • • • •	•	* • * *150
•	• • • • • • • • • • • • • • • • • • • •	•	• •
•	Y .N	vi .	• •
•	• •• ••	•	• •
•	• • • •		••
•	• • • •		•
•	• • • •		• *
	· · · · · · · · · · · · · · · · · · ·		#160
NAIT FOR KEYBOARD Entry			•
			•
			•
	· · ·		
	• • •		•
			•
	• • •		•
			•
			• P51/LUMINARY
	• • •		•
	• • • • • • • • • • • • • • • • • • • •		• (
	((

. *

		•	•	•
		•	•	•
	TERMINATE FLASH UPON	•	•	•
	RECEIPT OF PROCEED		KEV I	N PROCEED
	CR ENTER			
			_	•
	•P •E		•	•
	•P •E •R •N		•	•
	•0 •T	•		•
	•C •E		•	•
	•E •R	•		•
	•E •	•		•
	• U		•	•
	• •			•
	• •	•	-	•
TEMP	•	•		
нGLD .	DISPLAY ON DSKY:	•	-	MONITOR DSKY:
	 V41 N22 	•		OBSERVE DISPLAY
SNAP .	 R1-00000 			OF COARSE ALIGN
	 R2-00000 	•		VERB AND ICDU
	 R 3-00000 			ANGLES (ALL
	•		•	00000) FOR COARSE
	 WHERE R1, R2, 	•	-	ALIGNMENT
	ANC R3 REPRESENT	•		
	 ICDU/GIMEAL ANG- 			_
	LES TO BE COARSE	•		
	. ALIGNED TO LOG;	•		-
	. IG, MG, RESPEC-	•		
	. TIVELY).	•		-
	 IN DEGREES TO 	•		
	 NEAREST .01 DE- 	•		-
	• GREE	•		
		•		
	• •	•	•	
	• •	•	•	
	• •	•		
	•	•	•	•
	COMMAND ISS TO	•	•	•
	 CCARSE ALIGN 	•	•	•
	MCDE	•	•	•
		•	•	•
	• •	•	•	•
	• •	•	•	•
	• •	•		•
	•	•	•	
	. TURN ON MNU ATTM	•	• •	CBSERVE "NO ATT"
	• LIGHT	• • • • • • • • • • • • • • • • • • •	• • • • •	LIGHT TO INDICATE
	•	•	• •	THAT INU IS IN
	• •	•	•	COARSE ALIGN MODE
	• •	•	•	
	• •	•	•	•
	• •	•	•	•
	• •	•	•	•
		•	•	•
	DISABLE CAP	•	•	•
	•	•	•	•
	• •	•	•	•
	• •	•	•	•
	• •	•	•	•
	• •	•	•	•
	• •	•	•	•

•

.

•

.

.

٠

•

.

٠ ٠

٠

.

#180

#190

#200

#210

•	•	• •	•	• 474
•	•	• •	•	• P51/LUNI NARY
٠	•	• •	•	•
•	•	• •	•	•
•	•	• •	•	•
•	•	• •	•	•
•	•	• •	•	•
•		• •	•	•
•	RESET TRACK FLAG	• •	•	•
•		• •	•	•
•	•	• •	•	•
•	•	• •	•	•
•	•	• •	•	•
•	RESET CRIFT FLAG	• •	•	• #230
•	RESET CRIFT FLAG	• •	•	•
•	····	• •	•	•
	•	• •	•	•
	•	• •	•	•
Ī		• •	•	•
	RESET REFSMMAT	• •	•	•
	FLAG	•	•	•
	****		•	•
	•		•	•
-		•	•	• #240
			•	•
			•	•
	COARSE ALIGN ISS			•
	****		•	
•	•		•	•
	•			
•	•			•
•	,			
•	(NOTE: IF, AT		(NOTE: IF, AT THE	-
•	THE END OF COAR-	• • •	END DF COAR SE	#250
•	SE ALIGNMENT,	• •	ALIGNMENT, THE	
•	THE GIMBALS ARE .		GIMBALS ARE NOT	•
•	NOT WITHIN 2 DE	• •	WITHIN 2 DEGREES	•
•	GREES OF 0,0,0,	•	OF 0,0,0, THE LGC	•
•	THE LGC WILL	• •	WILL TURN ON THE	•
•	TURN ON THE PRO-	• •	PROGRAM ALARM	•
•	GRAM ALARM LIGHT	• •	LIGHT AND STORE	•
•	AND STORE ALARM	• •	ALARM CODES	•
•	CODES CO211 AND .	•	00211 AND 00217.)	• #260
•	00217.)	• •		•
•		• •	•	•
•	• •	•	•	•
•	•	• •	•	•
•	• •	•	•	•
•	TERMINATE COARSE	• •	•	
•	ALL REALL ALL REAL REAL REAL		•	•
•	ALIGN MODE IN .	•	•	•
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•
	•	•	•	•
		• •	•	•
-	•	•	•	
:	•	•	•	•
		•	•	
	•		•	•
	•	•	•	
	•	• •	•	
	•	• •	-	• P51/LUMI NARY
	•	•	•	
		-	· (· (
			`	(

. •

•	•	•	•
• •	•	•	٠
•	•	•	٠
• •	•	•	•
	· ·	•	•
*	•	•	•
		•	•
		•	•
		•	•
•			
•	•	•	
•	•	•	
• •	• •		•
• .	•	•	•
• •	,	•	
• .	• •	•	
• •	•	•	•
• •	• • •		٠
			•
•			٠
• •	. LIGHT TO I	(NDICATE	•
• •		IS NOW	•
•			٠
• •			•
• •	•	•	٠
	•	•	•
• •	• •	•	•
•	• •	•	٠
• •	•	,	٠
• •	•		• •
•	1		•
• •	1		٠
• •	•		٠
•	,		•
• •			•
• -	•		٠
•	i		•
• •		6	•
· •	•		-
•	• • • •		-
•	•	(•
,	•		٠
1			•
• • •	DO AUT MARK P		•
	. (R53) FOR CEL	ESTIAL	•
• •	BCDY #1		٠
•		·	•
1	•		٠
	•		٠
•	•		•
	•		•
,	•		•
,	•		•
	•		
,	•		•
٠	•		•
	•		٠
د	•		•
,	•		•
	•		•
,	•		٠
1	•		•
	•		•
1	•		٠
1	•		•
		DD AOT MARK F	DO AOT MARK ROUTINE (R53) FOR CELESTIAL

475 51/LUMINARY

(

270

#280

#290

#300

#310

			•		•	476 P51/LUMINARY
•	•	•	•		•	P 917 L OH MAR I
•	•	•	•		•	
		•			•	
	·	•	~~~~~~~~~~		•	
DU CELESTIA			CO CELESTIAL		•	
CEFINITIEN			DEFINITION RO		•	
(R58) FOR (CELESTIAL	••••	(R58) FCR Ctl	LESTIAL	•	# 320
BODY USED.		•	BODY USED.		•	# 320
		•			•	
•	•	•	•		•	
	•	•	•		•	
	•	•			•	
CC AOT MARK		•••	DO ADT MARK P	ROLTINE	•	
(R53) FOR ((R53) FOR CEL	LESTIAL	•	
BUDY #2		••••••	BODY #2		•	
		•			•	#220
•	•	•	•		•	#330
	•	•	•		•	
	•	•	•		•	
•	•	•			•	
DC CELESTI.	AL BOCY	•	DO CELESTIAL	800 Y	•	
DEFINITION		• • •	DEFINITION R			
(R58) FOR 1		•••	(R58) FOR CE		•	
BODY USEC.		•	BOCY USED.		•	
		•			•	
	•	•	•		•	#340
	•	•	•		•	
	•	•	•		•	
DO SIGHTIN		• • •	CO SIGHTING		•	
DISPLAY RO			DI SPLAY ROUT			
{R54}	011112		(854)		•	
		•			•	
•E	• E	•	• E	•٤	•	
• X	• X	•	• X	• X	•	
•1	• I	•	• [• <u>I</u>	•	# 350
•1	•T	•	. T	.1	•	
•	•	•	. ***	• • #8"	•	
• ⁴¹ A ¹¹	• "8"	•	• "A "	• • •	•	
•		•	•			
•			•			
			•			
CALCULATE	INU INERTIA	۱L	•			
OR I EN TATIO			•			* > (0
CELESTIAL			•			#360
ATES AS CE			•			
CELESTIAL	8001552 % 1		•			
			•			
			•			
			•			
			•			
			•			
			•			
			•			
			•			
			•			
			•			P 517L UM INAR Y
			•			A CONTRACTOR OF

٠ •

٠

(

. •

(

AND # 2 . STORE AS PRESENT PLATFORM GRIENTATION (REFSMMAT)	• • • • •
•	
•	:
SET REFSHMAT FLAG	•
• •	
DC FINAL AUTOMATIC REQUEST TERMINATE ROUTINE (RCO).	DO FINAL AUTOMATIC
•	•
• • •	• • •
EXIT P51	EX IT P51

٠

•

•

#370

#380

CHANGE CENTREL NOTES

21

LOGIC REV 00 PCR 7 REV 01 EDITORIAL REV C2 EDITORIAL

THIS PAGE INTENTIONALLY LEFT BLANK

IMU REALION PROGRAM (P52)

í

.

29

REV 32 12/03/69

PURPOSE: (1) TO ALIGN THE IMU FROM A "KNOWN" (SEE ASSUMPTION 5) CRIENTATION TO ONE OF FOUR ORIENTATIONS SELECTED BY THE ASTRONAUT USING SIGHTINGS ON TWO CELESTIAL BODIES WITH THE AGT OR A BACKUP OPTICAL SYSTEM.

(A) PREFERRED URIENTATION (OPTION COOOL)

AN OPTIMUM CRIENTATION FOR A PREVIOUSLY CALCULATED MANEUVER. THIS ORIENTATION MUST BE CALCULATED AND STORED BY A PREVIOUSLY SELECTED PROGRAM.

(B) LANDING SITE CRIENTATION (OPTICN 00004)

X = UNIT (R)-SM -LS Y = UNIT (Z X X)-SM -SM -SM Z = UNIT (H X X)

-SM -CSM -SM

where:

THE CRIGIN IS THE CENTER OF THE MOON.

 $\hat{\kappa}$ = THE POSITION VECTOR OF THE LM ON THE LUNAR SURFACE AT A LANDING SITE AND A TIME -LS T(ALIGN) SELECTED BY THE CREW.

H = THE ANGULAR MOMENTUM VECTOR OF THE CSM (R X V). -CSM -CSM

A SPECIAL CASE OF THE LANDING SITE ORIENTATION OCCURS WHEN T(ALIGN) IS DEFINED AS THE TIME OF LUNAR LANDING T(LAND). THIS CASE CCCURS GNLY IF T(LAND) HAS BEEN DEFINED BY THE MSFN, TRANSMITTED TO THE CREW, AND THE GREW HAS THEN DEFINED T(ALIGN) TO BE T(LAND) IN THIS PROGRAM.

(C) NUMERAL GRIENTATION (OPTION 00002)

```
x = UNIT(R)
- SM -
Y = UNIT(V X R)
- SM - -
Z = UNIT(X X Y)
- SM - SM - SM
```

whERE:

```
R = THE SECCENTRIC (EARTH OREIT) OR SELENCCENTRIC (LUNAR URBIT) RADIUS VECTUR AT TIME T(ALIGN)
-
SELECTED BY THE ASTRONAUT.
```

V = THE INERTIAL VELOCITY VECTOR AT TIME T(ALIGN) SELECTED BY THE ASTRONAUT.

(E) REFSMMAT (GPTION 00003)

SEE ASSUMPTION (5)

ASSUMPTIONS: (1) THIS PROGRAM MAY ONLY BE PERFORMED WHILE THE LM IS IN FLIGHT.

(2) THE CUNFIGURATION MAY BE COCKED (LM/CSM) OR UNDOCKED (LM ALONE). THE PRESENT CONFIGURATION SHOULD HAVE BEEN ENTERED INTO THE LGC BY COMPLETION OF THE DAP DATA LCAD ROUTINE (R03).

13) THERE AKE NO RESTRAINTS UPON THE LM ATTITUDE CONTROL MODES UNTIL A PONCS CONTROLLED MANEUVER IS CALLED BY A PRO-GRAM OR THE GREW WISHES TO MANUALLY MANEUVER THE VEHICLE. THE GUIDANCE CUNTROL SWITCH MAY BE AT PONS OR AGS AND IF AT PONS, THE MODE MAY BE AUTO OK ATTITUDE HOLD. PRIOR TO PONCS CONTROLLED MANEUVERS THE LOC WILL REQUEST THE CORRECT MODE IF IT IS NOT IN EFFECT. FOR MANUALLY CONTROLLED MANEUVERS THE CREW MUST SELECT THE CORRECT MODES.

(4) THIS PROGRAM MAKES NO PROVISION FOR AN ATTITUDE MANEUVER TO RETURN THE VEHICLE TO A SPECIFIC ATTITUDE. SUCH A MAN-EUVER, IF DESIRED, MUST BE CONE MANUALLY. AN OPTION IS PROVIDED HOWEVER TO ALLOW POINTING OF THE AOT AT ASTRONAUT OR LGC SELECTED STARS EITHER MANUALLY BY THE CREW OR AUTOMATICALLY BY AN LGC CONTROLLED ATTITUDE MANEUVER.

15) THE ISS IS ON AND HAS BEEN ALIGNED TO A "KNOWN" ORIENTATION WHICH IS STORED IN THE LGC (REFSMMAT). THE PRESENT IMU URIENTATION DIFFERS FROM THAT TO WHICH IT WAS LAST ALIGNED ONLY DUE TO GYRD DRIFT (I.E. NEITHER GIMBAL LOCK NOR IMU POWER INTERRUPTION FAS OCCURRED SINCE THE LAST ALIGNMENT).

(6) AN OPTION IS PROVIDED TO REALIGN THE IMU TO THE PREFERRED, NOMINAL, OR LANDING SITE DRIENTATIONS WITHOUT MAKING CELESTIAL BODY SIGHTINGS (SEE LOGID FLOW).

(7) EXTENDED VERBS SHOULD NET BE EXERCISED DURING THIS PREGRAM BECAUSE OF POSSIBLE INTERFERENCE WITH R53.

(8) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG Cont	LGC	GR UUND	CREW
00117			• CREW • PROGRAM • SELECTION
			•
			• • •
			•
	START IMU REALIUN	•	KEY IN IMU REALIGN PROGRAM (P52)
	PREGRAM (P52)	•	V37E 52E
	DISPLAY P52		

#10

1 *

a ĵ			MONITCR DSKY: OBSERVE DISPLAY OF P52	
	•		· · · · · · · · · · · · · · · · · · ·	
	CC INU STATUS CHECK RLUTINE (RC2) 		DU INU STATUS CHECK RCUTINE (RC2)	
	FLAG SET? .Y N.		• • • • •	
	SET LGC ASSUMED CPTICN TC 00003.		•	
	· · · · · · · · · · · · · · · · · · ·		• • • • • •	
HULD .	FLASH VERE-NCUN TO	···· · ·	MUNITOR DISKY:	
SNAF .	REQLEST RESPONSE AND DISPLAY OPTION CODE FOR ASSUMED IMU CR- TENTATION SELECTION:	• • • •	CESERVE VERE-HOUN FLASH TO PEQUEST RESPONSE AND DISPLAY CF CPTICN COLF FOR	

• ٠

.

•

٠

.

#20

#40

#30

#50

		•		
		•		
	4 NOE -00001		SUMED IMU OR ON SELECTION	
	-0000X	•		
R 3-	BLANK	•	•	
81 15	5 ТНЕ	•	•	
	IN CODE	•		
	ASSUMED	•	•	
	CRIENTATION CTION•		THIS THE IM TATION I DES	
	S THE ASSUMED OPTION:	•	 •Y	
	L-PREFERRED	•	• (• N
	2-NEMINAL	•	•	•
	3-REFSMMAT F-LANDING SITE	•	•	•
		•	•	•
	•	•	•	•
	•	•	•	•
WAIT	FOR KEYBOARD	• KE	Y IN	- • •
ENTRY	r	•••••• ••• ••• ••• ••• ••• ••	DCEED	•
				- •
		•	•	•
		•	•	•
		•	•	•
		•	•	•
		•	•	•
		•	•	•
		•	•	• • •
	NATE FLASH UPUN			• • •
RECEI OR NE	PT GF PROCEED		KEY IN V2 AND LEAC	
RECEI OR NE	PT GF PROCEED W DATA	••••	 AND LEAD DESIRED 0 	THE RIEN-
RECEI OR NE	NEW	•••••••••••••••••••••••••••••••••••••••	 AND LEAD Desired o Tation Co 	THE RIEN-
RECEI OR NE	NEW	•••••••••••••••••••••••••••••••••••••••	 AND LEAD DESIRED 0 	THE RIEN-
RECEI OR NE • P • R • C • C	NEW CODE	•••••••••••••••••••••••••••••••••••••••	 AND LEAD DESIRED 0 TATION CO R2 	THE RIEN- DE IN
RECEI OR NE .P .R .C .C .E	PT CF PRCCED N DATA .NEW .CODE	•••••••••••••••••••••••••••••••••••••••	AND LEAD DESIRED O TATION CO R2	THE RIEN- DE IN
RECEI OR NE • P • R • C • C	NEW CODE	•••••••••••••••••••••••••••••••••••••••	AND LOAD DESIRED O TATION CO R2	THE RIEN- DE IN
RECEI OR NE .P .R .C .C .E .E	PT CF PRCCED N DATA .NEW .CODE	•••••••••••••••••••••••••••••••••••••••	AND LOAD DESIRED O TATION CO R2	THE RIEN- DE IN
RECEI OR NE .P .R .C .C .E .E	PT CF PRCCED N DATA .NEW .CODE	•••••••••••••••••••••••••••••••••••••••	AND LOAD DESIRED O TATION CO R2	THE RIEN- DE IN
RECEI OR NE .P .R .C .C .E .E	PT CF PRCCED N DATA .NEW .CODE	•••••••••••••••••••••••••••••••••••••••	AND LOAD DESIRED O TATION CO R2	THE RIEN- DE IN
RECEI OR NE .P .R .C .C .E .E	PT CF PRCCED N DATA .NEW .CODE	•••••••••••••••••••••••••••••••••••••••	AND LOAD DESIRED O TATION CO R2	THE RIEN- DE IN
RECEI OR NE .P .R .C .C .E .E	PT CF PRCCED N DATA .NEW .CODE	•••••••••••••••••••••••••••••••••••••••	AND LOAD DESIRED O TATION CO R2	THE RIEN- DE IN
RECEI OR NE .P .R .C .C .E .E	PT CF PRCCED N DATA .NEW .CODE	•••••••••••••••••••••••••••••••••••••••	AND LOAD DESIRED O TATION CO R2	THE RIEN- DE IN
RECEI OR NE .P .R .C .C .E .E	PT CF PRCCED N DATA .NEW .CODE	•••••••••••••••••••••••••••••••••••••••	AND LOAD DESIRED O TATION CO R2	THE RIEN- DE IN
RECEI OR NE .P .R .C .C .E .E	PT CF PRCCED N DATA .NEW .CODE	•••••••••••••••••••••••••••••••••••••••	AND LOAD DESIRED O TATION CO R2	THE RIEN- DE IN
RECEI OR NE .P .R .C .C .E .E	PT CF PRCCED N DATA .NEW .CODE	•••••••••••••••••••••••••••••••••••••••	AND LOAD DESIRED O TATION CO R2	THE RIEN- DE IN
RECEI OR NE .P .R .C .C .E .E	PT CF PRCCED N DATA .NEW .CODE	•••••••••••••••••••••••••••••••••••••••	AND LOAD DESIRED O TATION CO R2	THE RIEN- DE IN
RECEI OR NE .P .R .C .C .E .E	PT CF PRCCED N DATA .NEW .CODE	•••••••••••••••••••••••••••••••••••••••	AND LOAD DESIRED O TATION CO R2	THE RIEN- DE IN

.

•

#89

#70

#90

#100

#119

P52/LUMINARY

(

#120

#130

#140

#150

#150

	-			P 52 / L U
•	• •	•		
•	• •	•		
•	• •	•		
•	• •	•		
•	• •	•		
•	····	•		
•		•		
•		•		
CHECK ST	CRED OPTION	WAS NOMINAL	OR LAN-	
CODE		CING SITE OR	I ENT A-	
		TECN SELECTE		
.0 .0	.0 .0	(NOTE: AN JR		
•0 •C	.0 .0	TICN CODE OF		
		WILL BE INTE		
.0 .0	•• ••			
•0 •0	•0 •0	AS LANDING S		
•2 •C	.1 .3	GPTION BY TH		
• •	• •			
- •C	• •	•Y	N .	
C	• •	•	•	
0	• •	•	•	
0	• •	•	•	
• •4	• •	•	•	
• •	• • • •	-		
		•		
•••	ເວັ້າວ ເວົ້າປ	- WAS THE P	REEERRED	
	иди и Ви 2011 2010	. DRIENTATI		
• •		• CTEC?		
• •	BELCH BELCH			
• •		•		
• •		• •Y	N •	
•		• •	•	
	T(LANG) IN	• . •	•	
. TIALI	GN)	• •	•	
			• • •	
-	-	• •	•	
-	-	. GO TO	GO .TO	
-	•	• •• • • •	"B "	
•	•	BELON	BELOW	
•	•	• 0220#	52 20	
•	•	•		
		•		
STCRE 00		•		
00000.00		•		
DISPLAY		•		
T(ALIGN)	•	•		
		•		
		•		
		*		
	· ·			
	* •		· ·	
	v 11	,		
	19 e			
	0 1 1 9 1 7	×	19. m. m	
	· · · ·	ð.	с	
	v e a •		4 ···	
	* * * *	•	н — я	
	• • • • 3	¢	e x.	
			٠ •	
		~		
	• •	-	-	
	• • •	*	• •	
		•	• •	
	• • • •	•	• •	
	• • • •	•	• •	
		•	• •	P527LU

• •

٠

-

•

•

•

•

: :

٠

٠

• .

٠

•

•

٠

2.35

P52/LUMI NARY

HOLD FLASH VERB-RUN TC HOLD FLASH VERB-RUN TC SNAP USUEST REPORTER AND USSERVE VERB-RUN R1- TIALIGNI-HIS R2- TIALIGNI-HIS R3- TIALIGNI-HIS R3- TIALIGNI-SECS TIALIGNI-TIPETOETI AT WHICH LN POSITION AAR VUECTIVY VECTORS ARE TO BE OFFINED FOR OFFINED FOR OFFINE SECS. TO FOR OFFINE SECS. TO					-
AND			-		
AND				• •	•
AND		•••	•	• •	•
AND		• • •	•	• •	•
AND		• • •	•	• •	•
AND		• • •	•	• •	•
AND			• •		•
SNAP . CISPLAY T(ALIGN): V0634 R1 - T(ALIGN)-HRS R2 - T(ALIGN)-HRS R3 - T(ALIGN)-HRS R3 - T(ALIGN)-SECS T(ALIGN) - TIME(GET) AT WHICH KN POSITION ANC VELCCITY VECTORS ARE TO BE DEFINED FOR A NOMINAL OR HRS, MINS, SECS, TO NEAREST .01 SEC. 	HOLD .	FLASH VERB-NOUN TO		MONITOR DSKY:	•
SNAP CISPLAY T(ALIGN): V0634 R1 - T(ALIGN)-HAS R2 - T(ALIGN)-HAS R3 - T(ALIGN)-HAS R3 - T(ALIGN)-SECS T(ALIGN) - TIMEIGET) AT WHICH IN POSITION AND VELOCITY VECTORS ARE TO BE DEFINED FOR A NOMINAL OR LANCING SITE IMU ONIENTATICN. IN MRS, MINS, SECS, TO NEAREST .01 SEC.		REQUEST RESPONSE AND	• •	OBSERVE VERB-NCUN	•
VOCK34 R1 - TIALIGNI-HINS R2 - TIALIGNI-HINS R3 - TIALIGNI-SECS TIALIGNI-SECS TIALIGNI-TIPEGET1 AT WHICH LW POSITION AAC VELECTIV VECTORS ARE TO BE DEFINED FOR A NONIMAL OR UNIENTATION. IN DRIENTATION. IN WEAKST .01 SEC.	SNAP .	CISPLAY T(ALIGN);	•		
RI- TIALIGNI-HRS R2- TIALIGNI-HRS R3- TIALIGNI-SECS TIALIGNI-TIMEGETI AT WHICH MPOSITION AAC VELCCITY VECTORS ARE TO BE DEFINED FOR A NOMINAL OR LANCING STE IMU ORIENTATICN. IN MRS, MINS, SECS, TO NEAREST .01 SEC.					•
R2- T (ALIGN)-HINS R3- T (ALIGN)-SECS T(ALIGN)- TIPE(GET) AT WHCH LM POSITION AAC VELCCITY VECTORS ARE TO BE DEFINED FOR A NONINAL OR LARCING SITE IMU ORIENTATION. IN MRS, MINS, SECS. TO MEAREST .01 SEC. 			•		•
R3- T(ALIGN)-SECS . I(ALIGN)-TIMEGET) AT WHICH NPOSITION AAC VELCCITY VECTORS ARE TO BO GEFINED FOR A NONINAL OR LANGING SITE INU ORIGHTATION. IN WRS. MINS. SECS. TO NEAREST .01 SEC.			•	UP ITALIGNI.	•
TIALIGN)- TIME(GET) AT WHICH LM POSITION ARC VELOCITY VECTORS ARE TO BE DEFINED FOR A MONINAL OR LANGING SITE HW ORIENTATION. IN MRS.MINS, SECS. TO NEAREST .01 SEC.			•		•
AT WHICH LM POSITION . ARE TO BE DEFINED FOR A NOWINAL OR FOR A NOWINAL OR UANCING SITE HW ORIENTATION. IN MRS, MINS, SECS. TO NEAREST .01 SEC. 		R 3- T(ALIGN) - SEC S	•	•	•
AT WHICH LM POSITION . ARE TO BE DEFINED FOR A NOWINAL OR FOR A NOWINAL OR UANCING SITE HW ORIENTATION. IN MRS, MINS, SECS. TO NEAREST .01 SEC. 			•	•	•
ARE YO BE DEFINED ARE YO BE DEFINED FOR A NOMINAL OR LANGING SITE IMU OKIENTATION. IN MRS. MINS. SECS. TO NEAREST JOLSEC.		T(ALIGN)- TIME(GET)	•	•	•
ARE TO BE DEFINED FOR A NONINAL OR LANCING SITE IMU DATEENTATION. IN MRS, MINS, SECS, TO NEAREST JOI SEC.		AT WHICH LM POSITION	•	•	
ARE TO BE DEFINED FOR A NONINAL OR LANCING SITE IMU DATEENTATION. IN MRS, MINS, SECS, TO NEAREST JOI SEC.		AND VELOCITY VECTORS	•	•	-
FOR A NOMINAL OR LANGING SITE IMU ORIENTATIGN. IN MRS, MINS, SECS, TU NEAREST JOI SEC.				•	•
LANCING SITE INU ORIENTATION. IN HRS, MINS, SECS. TO NEAREST JOI SEC. 			•	•	•
ORIENTATION IN WRS, MINS, SECS, TO NEAREST.JOISEC.			•	•	•
HRS, MINS, SECS, TO NEAREST .01 SEC. FCR OPTION 2 TIALIGNI WILL APPEAR HERE AS 00000, 000000, 00000, which IF ACCEPTED MILL INDICATE THAT THE NOTINL OR LANDING SITE ORIENTATION MILL BE DIFINED FOR A TIALIGNI AUTCHAT- ICALLY SELECTED AS THE PRESENT TIME. FOR OPTION 4, TIALIGNI WILL BE DEFINED AS TILANOL. DO I WISH TO ALIGN THE IML TO AN			•	•	•
NEAREST .01 SEC. FCR OPTION 2 TIALIGNI WILL APPEAR HERE AS 00000, 000000, 00000, wHICH IF ACCEPTED WILL INDICATE THAT THE NCHINAL OR LANDING SITE ORIENTATION WILL BE DIFINED FOR A TIALIGNI WILL BE DIFINED FOR THE PRESENT TIME. FOR OPTION 4, ICALLY SELECTED AS OPTION 4, TIALIGNI WILL BE OPTION 4, TO I WISH TO ALIGN THE IML TO AN			•	-	•
FCR OPTION 2 TIALIGNI WILL APPEAR HERE AS 00000, 000000, 00000, WHICH IF ACCEPTED WILL INDICATE THAT THE NCMINAL OR LANDING SITE ORIENTATION WILL BE DIFINED FOR A TIALIGNI AUTCMAT- ICALLY SELECTED AS THE PRESENT TIME. FOR OPTION 4, TIALIGNI WILL BE DEFINED AS TILAND.		HRS, MINS, SECS, TO	•	•	•
T(ALIGN) WILL APPEAR HERE AS 0000, 00000, 00000, WHICH IF ACCEPTED WILL IF ACCEPTED WILL NOTINAL OR LANDING SITE ORIENTATION WILL BE DIFINED FOR A T(ALIGN) WILL BE DIFINED FOR ICALLY SELECTED AS THE PRESENT TIME. FOR OPTION 4, T(ALIGN) WILL BE DEFINED AS T(LANC). OO I WISH TO ALIGN THE IML TO AN		NEAREST .01 SEC.	•	•	•
T(ALIGN) WILL APPEAR HERE AS 0000, 00000, 00000, WHICH IF ACCEPTED WILL IF ACCEPTED WILL NOTINAL OR LANDING SITE ORIENTATION WILL BE DIFINED FOR A T(ALIGN) WILL BE DIFINED FOR ICALLY SELECTED AS THE PRESENT TIME. FOR OPTION 4, T(ALIGN) WILL BE DEFINED AS T(LANC). OD I WISH TO ALIGN THE IML TO AN			•	•	•
T(ALIGN) WILL APPEAR HERE AS 0000, 00000, 00000, WHICH IF ACCEPTED WILL IF ACCEPTED WILL NOTINAL OR LANDING SITE ORIENTATION WILL BE DIFINED FOR A T(ALIGN) WILL BE DIFINED FOR ICALLY SELECTED AS THE PRESENT TIME. FOR OPTION 4, T(ALIGN) WILL BE DEFINED AS T(LANC). OD I WISH TO ALIGN THE IML TO AN		•			-
T(ALIGN) WILL APPEAR HERE AS 0000, 00000, 00000, WHICH IF ACCEPTED WILL IF ACCEPTED WILL NOTINAL OR LANDING SITE ORIENTATION WILL BE DIFINED FOR A T(ALIGN) WILL BE DIFINED FOR ICALLY SELECTED AS THE PRESENT TIME. FOR OPTION 4, T(ALIGN) WILL BE DEFINED AS T(LANC). OD I WISH TO ALIGN THE IML TO AN		-		•	-
T(ALIGN) WILL APPEAR HERE AS 0000, 00000, 00000, WHICH IF ACCEPTED WILL IF ACCEPTED WILL NOTINAL OR LANDING SITE ORIENTATION WILL BE DIFINED FOR A T(ALIGN) WILL BE DIFINED FOR ICALLY SELECTED AS THE PRESENT TIME. FOR OPTION 4, T(ALIGN) WILL BE DEFINED AS T(LANC). OD I WISH TO ALIGN THE IML TO AN		•	•	•	•
T(ALIGN) WILL APPEAR HERE AS 0000, 00000, 00000, WHICH IF ACCEPTED WILL IF ACCEPTED WILL NOTINAL OR LANDING SITE ORIENTATION WILL BE DIFINED FOR A T(ALIGN) WILL BE DIFINED FOR ICALLY SELECTED AS THE PRESENT TIME. FOR OPTION 4, T(ALIGN) WILL BE DEFINED AS T(LANC). OD I WISH TO ALIGN THE IML TO AN		•	•	•	•
TIALIGN) WILL APPEAR HERE AS 0000, 00000, 00000, WHICH IF ACCEPTED WILL IF ACCEPTED WILL NOTINAL OR LANDING NOTINAL OR LANDING SITE ORIENTATION A TIALIGN JUC MAT- ICALLY SELECTED AS ICALLY SELECTE		•	•	•	•
TIALIGNI WILL APPEAR - HERE AS 0000, 00000, WHICH - IF ACCEPTED WILL IF ACCEPTED WILL NOTATE THAT THE NOTIAL OR LANDING SITE ORIENTATION A TIALIGNI UTCMAT- IGALLY SELECTED AS IGALLY SELECTED AS IGALLY SELECTED AS THE PRESENT TIME, FOR OPTION 4, TIALIGNI WILL BE DEFINED AS TILANO).		•	•		•
<pre>HERE AS 00000, 00000,00000, which IF ACCEPTED WILL NDICATE THAT THE NOMINAL OR LANDING SITE ORIENTATION WILL BE DIFINED FOR A T(ALIGN) AUTCMAT- ICALLY SELECTED AS THE PRESENT TIME. FOR OPTION 4, ICALIGN) WILL BE DEFINED AS TILANOJ.</pre>		•	•	FCR OPTION 2	•
OOOOO, WHICH IF ACCEPTED WILL INDICATE THAT THE NGMINAL OR LANDING SITE ORIENTATION UILL BE DIFINED FOR A T(ALIGN) AUTCMAT- IGALLY SELECTED AS THE PRESENT TIME. FOR OPTION 4, IGALLY SELECTED AS THE INL TO ALIGN OO I WISH TO ALIGN THE IML TO AN INDICATE IDDICATE		•	•	T(ALIGN) WILL APPEAR	•
OOOOO, WHICH IF ACCEPTED WILL INDICATE THAT THE NGMINAL OR LANDING SITE ORIENTATION UILL BE DIFINED FOR A T(ALIGN) AUTCMAT- IGALLY SELECTED AS THE PRESENT TIME. FOR OPTION 4, IGALLY SELECTED AS THE INL TO ALIGN OO I WISH TO ALIGN THE IML TO AN INDICATE IDDICATE		•		HERE AS 00000.	-
IF ACCEPTED WILL INDICATE THAT THE NOTINAL OR LANDING SITE ORIENTATION ILL BE DIFINED FOR A T(ALIGN) AUTCMAT- ICALLY SELECTED AS ICALLY SELECTED AS THE PRESENT TIME. FOR OPTION 4, T(ALIGN) WILL BE DEFINED AS T(LANO). DO I WISH TO ALIGN THE IML TO AN INTERVIEW AN INTE		•	_		-
INDICATE THAT THE NOMINAL OR LANDING SITE ORIENTATION WILL BE DIFINED FOR A T(ALIGN AUTCMAT- ICALLY SELECTED AS THE PRESENT TIME. FOR OPTION 4, T(ALIGN) WILL BE DEFINED AS T(LANO).		•	•		-
NGMINAL OR LANDING SITE DRIENTATION HILL BE DIFINED FOR A T(ALIGN) AUTCMAT- ICALLY SELECTED AS THE PRESENT I IME. FOR OPTION 4, T(ALIGN) WILL BE DEFINED AS T(LANC).		•	•		•
SITE ORIENTATION WILL BE DIFINED FOR A T(ALIGN) AUTCMAT- ICALLY SELECTED AS THE PRESENT TIME. FOR OPTION 4, T(ALIGN) WILL BE OEFINED AS T(LAND).		•	•	-	•
<pre>WILL BE DIFINED FOR A T(ALIGN) AUTCMAT- IGALLY SELECTED AS IGALLY SELECTED AS THE PRESENT TIME. FOR OPTION 4, IGALLY SELECTED AS THE INCLIGN DEFINED AS T (LANO).</pre>		•	•		•
A T(ALIGN) AUTCMAT- ICALLY SELECTED AS THE PRESENT TIME. FOR OPTION 4, T(ALIGN) WILL BE DEFINED AS T (LAND). DEFINED AS T (LAND). DO I WISH TO ALIGN THE IML TO AN IMAGE INCLUSION IMAGE INCLUSION IMAG		•	•		•
ICALLY SELECTED AS THE PRESENT TIME. FOR OPTION 4, T(ALIGN) WILL BE DEFINED AS T(LAND). T(ALIGN) WILL BE DEFINED AS T(LAND). THE INL TO AN THE IML TO AN THE IML TO AN		•	•	WILL BE DIFINED FOR	•
THE PRESENT TIME. FOR OPTION 4, T(ALIGN) WILL BE DEFINED AS T(LANO). DEFINED AS T(LANO). DO I WISH TO ALIGN THE IML TO AN THE IML TO AN		•	•	A T(ALIGN) AUTCMAT-	•
THE PRESENT TIME. FOR OPTION 4, T(ALIGN) WILL BE DEFINED AS T(LANO). DEFINED AS T(LANO). DO I WISH TO ALIGN THE IML TO AN THE IML TO AN		•	•	ICALLY SELECTED AS	-
FOR OPTION 4. T(ALIGN) WILL BE DEFINED AS T(LAND). DEFINED AS T(LAND). DO I WISH TO ALIGN THE IML TO AN		•	-		
T(ALIGN) WILL BE DEFINED AS T(LAND).		•	-		•
DEFINED AS T (LAND).		-	•		•
DO I WISH TO ALIGN THE IML TO AN		•	•		•
THE IML TO AN		•	•	VEFINEU AS I (LANU).	•
THE LML TO AN		•	•		•
THE IML TO AN		•	•	•	•
THE LML TO AN		•	•	•	•
THE LML TO AN		•	•	•	•
THE LML TO AN		•	•		
THE LML TO AN		-		DO I WISH TO AFTON	
		-	-		-
		•	-	THE ATTO TO MIL	•
		•	•		•
		•	•		•
		•	•		•
		•	•		•
		•	•		•
		•	•		•
		•			•
		•	•		•
		•	•		•
		•			•
		•	•		•
		•	•		•
	<i>.</i>	•	•		
		-	-		•
		•	-		•
	, *	•	-	(•

#170

#180

#190

#200

#210

,

(

•		•	OBTENTATIC	N DEFINED
•		•	BY THE T(A	
-		•		DISPLAYED?
•		•		
•		•	• Y	• N
•		•		•
•		•	•	•
		• •		• •
WAIT FOR KEYE	BUARD	• • • • • • • • • • • • • • • • • •		
ENTRY		••		•
		•	•	•
		•	•	•
TERMINATE FL	ASH UPON			
RECEIPT OF PE		*********		V25E AND
OR NEW CATA		••		E DESIRED
		•	. T (AL I GN) IN R1,
<pre>.PROCEED</pre>	• NE 🖌	•	. R2, AND	R3.
•	• DAT A	•	•	
•	•	•	• •	
•	•	•	• •	
. STORE DATA		•	• ••	• • • • • • • • • • • •
•		•	•	
•	•	•	•	
•	•	•	•	
•	•	•	•	
•	•	•	•	
•	•	•	• •	
• • •	•	•	• • •	
• • • •		.:	• • •	
		.:	• • • • • • •	
TO BE ZERC CF		.:	• • • • • • • • • • • • • • • • • • • •	
TO BE ZERC CF TIVE?		.:	• • • • • • • • • • • • • • • • • • • •	
TO BE ZERC CF TIVE?		.:	• • • • • • • • • • • • • • • • • • • •	
TO BE ZERC CF TIVE?	R NEGA-	.:	• • • • • • • • • • • • • • • • • • • •	
TO BE ZERC CF TIVE? .Y	R NEGA- N.	.:	• • • • • • • • • • • • • • • • • • • •	
TO BE ZERC CF TIVE? • Y •	R NEGA- N.	.:	• • • • • • • • • • • • • • • • • • • •	
TO BE ZERC OF TIVE? .Y DEFINE TALIG	R NEGA- N. 	.:		
TO BE ZERC OF TIVE? .Y DEFINE TALIG	R NEGA- N. SN}	.:	• • • • • • • • • • • • • • • • • • • •	
TO BE ZERC OF TIVE? .Y DEFINE T{ALIG T PRESENT	R NEGA- N. SN}	.:	• • • • • • • • • • • • • • • • • • • •	
TO BE ZERC OF TIVE? .Y DEFINE T{ALIG T PRESENT	R NEGA- N. SN}	.:		
TO BE ZERC OF TIVE? .Y DEFINE T(ALIG = T PRESENT	R NEGA- N. SN}	.:		
TO BE ZERC OF TIVE? .Y DEFINE T(ALIG = T PRESENT	R NEGA- N. SN}	.:		
TO BE ZERC OF TIVE? .Y DEFINE T{ALIG T PRESENT	R NEGA- N. SN}			
TO BE ZERC OF TIVE? .Y DEFINE T(ALIG = T PRESENT	R NEGA- N. SN}	.:		
TO BE ZERC OF TIVE? .Y DEFINE T(ALIG = T PRESENT	R NEGA- N. SN}	.:		
TO BE ZERC OF TIVE? .Y DEFINE T{ALIG T PRESENT	R NEGA- N. SN}	.:		
TO BE ZERC OF TIVE? .Y DEFINE T(ALIG = T PRESENT	R NEGA- N. SN}	.:		
TO BE ZERC OF TIVE? .Y DEFINE T(ALIG = T PRESENT	R NEGA- N. SN}	.:		
TO BE ZERC OF TIVE? .Y DEFINE T{ALIG T PRESENT	R NEGA- N. SN}	.:		
.Y 	R NEGA- N. SN}			
TO BE ZERC OF TIVE? .Y DEFINE T(ALIG = T PRESENT	R NEGA- N. SN}			
TO BE ZERC OF TIVE? .Y DEFINE T(ALIG = T PRESENT	R NEGA- N. SN}	.:		

.

٠

•

٠

•

g ^{an}

++ τ(1... + + + + + + + + + +

+ + +

+

٠

٠

.

٠

٠

•

:

•

.

:

#220

#230

.

#240

+ +	• •		486 P52/LUM IN ARY
+ +	• •	•	
+ +ED1T +	· · ·	•	#260
+ + +	· · ·		
+ + +	IS STORED GRIENTATION CODE CCCC2?	WAS NOMINAL IMU CRIENTATION SELEC- TED?	
+ + +	.N .Y .(L.S.) .(NOM)	• N • • • • • • • • • • • • • • • • • •	#270
+ + + + + +	STORE THÉ VALLE OF T(ALIGN) IN THE T(LANC) LOCATION.	GO TO "A" Belcw	
**	CCMPUTE NCMINAL		#280
	 ORIENTATION FOR THE PREVIOUSLY DEFINED T(ALIGN). SELECT THIS ORI- ENTATION FOR GIMEAL ANGLE COMPUTATIONS. 	• • • • •	
	• CONFERENCESS • INOTE: AT THIS • TIME ANY PREFERR- • ED ORIENTATION • STORED IN THE LGC • IS LCST).		#290
	- 		#300
	. "Д" . ВЕLОW		
	COMPUTE LAT: LONG/2, AND ALT FROM	• • • •	

(

P 52/L UNINARY

,

(

4

99				
			•	
			•	
	STORED LANDING SITE		•	
			•	
	VECTOR (IN "PRIMARY"		•	
	STORAGE) AND SPEC-		•	
	IFIED T(ALIGN).		•	
	(NOTE: THE "PRIMARY"		•	
	STGRAGE OF THE LAN-			
	DING SITE CAN BE		•	
++	MOCIFIED ONLY BY		•	
+ 02	PRELAUNCH ERASABLE		•	
			•	
+EDIT	LOAD, P27, P57, OR		•	
++	P68. SHOULD THE CREW		•	
	WRITE OVER THE		•	
	FOLLOWING DISPLAY,			
	THE NEWLY DEFINED			
	LANDING SITE IS		•	
	EFFECTIVE ONLY TO		•	
	DEFINE A LANCING		•	
			•	
	SITE ORIENTATION FOR		•	
	THE IMU.)		•	
			•	
	•		•	
	•		-	
			•	
	-		•	
	• •••	• • •	• •••	**
	• •	•	• •	•
	• •	•	• •	•
	• •	•	• •	•
HOLD		• •		
*******	FLASH VERB-NOUN TO		MONITOR DSKY:	•
SNAP .	REQUEST RESPONSE AND			•
		•		
		• •	OBSERVE VERB-NOUN	•
	DISPLAY THE LGC-	•	FLASH TO REQUEST	•
	DISPLAY THE LGC- Stored or the Newly-	•	FLASH TO REQUEST RESPONSE AND DISPLAY	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OR	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES.	•	FLASH TO REQUEST RESPONSE AND DISPLAY	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COURDINATES. VOGN89	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OR	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES.	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR-	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COURDINATES. VOGN89	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 RI-LAT	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR-	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VO6N89 RI-LAT R2~LONG/2	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR-	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VO6N89 RI-LAT R2~LONG/2	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR-	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COURDINATES. VOGN89 RI-LAT R2~LONG/2 R3-ALT	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR-	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2~LONG/2 R3-ALT	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR-	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VO6N89 R 1-LAT R2~LONG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR-	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VO6N89 RI-LAT R2~LONG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE DESIGNATEC LANDING	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR-	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2-LONG/2 R3-ALT LAT-SELENGGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR-	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2-LONG/2 R3-ALT LAT-SELENGGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY	•	FLASH TG REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR- DINATES.	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R1-LAT R2~LONG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY INDICATES NORTH(+)	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR- DINATES.	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2-LGNG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY INDICATES NORTH(+) OR SOUTH(-). IN	•	FLASH TG REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR- DINATES.	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2~LONG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY INDICATES NORTH(+) OR SOUTH(-). IN DEGREES TO NEAREST	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR- DINATES. ARE THESE THE DESIRED LANDING SITE COORDINATES?	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2-LGNG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY INDICATES NORTH(+) OR SOUTH(-). IN	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR- DINATES.	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2~LONG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY INDICATES NORTH(+) OR SOUTH(-). IN DEGREES TO NEAREST	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR- DINATES. ARE THESE THE DESIRED LANDING SITE COORDINATES?	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2~LONG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY INDICATES NORTH(+) OR SOUTH(-). IN DEGREES TO NEAREST	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR- DINATES. ARE THESE THE DESIRED LANDING SITE COORDINATES?	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2~LONG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY INDICATES NORTH(+) OR SOUTH(-). IN DEGREES TO NEAREST	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR- DINATES. ARE THESE THE DESIRED LANDING SITE COORDINATES?	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2~LONG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY INDICATES NORTH(+) OR SOUTH(-). IN DEGREES TO NEAREST	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR- DINATES. ARE THESE THE DESIRED LANDING SITE COORDINATES?	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2~LONG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY INDICATES NORTH(+) OR SOUTH(-). IN DEGREES TO NEAREST	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR- DINATES. ARE THESE THE DESIRED LANDING SITE COORDINATES?	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2~LONG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY INDICATES NORTH(+) OR SOUTH(-). IN DEGREES TO NEAREST	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR- DINATES. ARE THESE THE DESIRED LANDING SITE COORDINATES?	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2~LONG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY INDICATES NORTH(+) OR SOUTH(-). IN DEGREES TO NEAREST	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR- DINATES. ARE THESE THE DESIRED LANDING SITE COORDINATES?	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2~LONG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY INDICATES NORTH(+) OR SOUTH(-). IN DEGREES TO NEAREST	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR- DINATES. ARE THESE THE DESIRED LANDING SITE COORDINATES?	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2~LONG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY INDICATES NORTH(+) OR SOUTH(-). IN DEGREES TO NEAREST	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR- DINATES. ARE THESE THE DESIRED LANDING SITE COORDINATES?	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2~LONG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY INDICATES NORTH(+) OR SOUTH(-). IN DEGREES TO NEAREST	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR- DINATES. ARE THESE THE DESIRED LANDING SITE COORDINATES?	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2~LONG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY INDICATES NORTH(+) OR SOUTH(-). IN DEGREES TO NEAREST	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR- DINATES. ARE THESE THE DESIRED LANDING SITE COORDINATES?	
	DISPLAY THE LGC- STORED OR THE NEWLY- DEFINED LANDING SITE COORDINATES. VG6N89 R 1-LAT R2~LONG/2 R3-ALT LAT-SELENCGRAPHIC LATITUDE OF THE BESIGNATEC LANDING SITE. POLARITY INDICATES NORTH(+) OR SOUTH(-). IN DEGREES TO NEAREST	•	FLASH TO REQUEST RESPONSE AND DISPLAY OF THE LGC-STORED OF THE NEWLY-DEFINED LANDING SITE COOR- DINATES. ARE THESE THE DESIRED LANDING SITE COORDINATES?	

:

:

.

•

٠

• . (

#310

#320

#330

#340

Wolkart Functions Street Figure 1 POLARIT INDICATES Figure 1 EASTIT OR REST TO REAR- Figure 1 EST JOOL CEGREE. Figure 1 ALT-THE ALTITUDE OF Figure 1 THE LCC-STORED OR Figure 1 THE REALY-DEFINED Figure 1 LANDING SITE ABOVE Figure 1 DE SIGNATED Figure 1 LANDING SITE ABOVE Figure 1 THE REALY-DEFINED Figure 1 LANDING SITE ABOVE Figure 1 MAIT FOR KEYBOARD Figure 1 WAIT FOR KEYBOARD Figure 1 TERMINATE FLASH UPON Figure 1 RECEIPT OF PROCEED KEY IN V25E AND OR NEW GATA LOAD THE CORRECT PROCEED Figure 1 PROCEED Figure 1			P	488 52/LUMINARY
ALT-THE ALTITUDE OF THE LGC-STORED OR THE NEWLY-DEFINED LANDING SITE ABOVE THE RADUUS AT THE DE SIGNATED LANDING SITE . IN NAUTICAL MILES TO NEAREST . CI NM. TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA PROCEED .NEW 	LONGITUDE TWO OF THE RED CR THE DEFINED LA POLARITY I EAST(+) OR IN DEGREES	DIVIDED BY LGC-STD- NEWLY- NDING SITE. NDICATES WEST(-). TO NEAR-		#3 69
WAIT FOR KEYBOARD KEY IN PROCEED ENTRY KEY IN PROCEED TERMINATE FLASH UPON KEY IN V25E AND RECEIPT OF PROCEED KEY IN V25E AND OR NEW CATA LOAD THE CORRECT PROCEED NE h	ALT-THE AL THE LEC-ST THE NEWLY- LANDING SI THE RADIUS DESIGNATED LANDING SI NAUTICAL M	TITUDE OF ORED OR DEFINED TE ABOVE AT THE TE. IN ILES TO		#370
RECEIPT OF PROCEED	WAIT FOR KI	•	KEY IN PROCEED	#380
	RECEIPT OF OR NEW CATA .PROCEED	PROCEED A .NE h .CAT A	•• • LOAD THE CORRECT .	#390
COMPUTE LANDING SITE GRIENTATION FOR THE			• • •	#400

	LGC-STGRED CR THE NEWLY-DEFINED LANDING SITE COOR- DINATES AND T(ALIGN). SELECT THIS ORIENTA- TICN FCR GIMEAL ANGLE COMPLTATICN. (NOTE: AT THIS TIME ANY FREFERREC ORIEN- TATION PREVIOUSLY STOREC IN THE LGC IS LOST)				
	"A" FROM ACOVE		•		
	READ PRESENT VEHICLE ATTITUDE FROM THE PRESENT GIMBAL ANGLES		• • • • • • • •		
•	COMPUTE GIMBAL ANGLES AT DESIRED IMU ORIENTATION AND PRESENT VEHICLE ATTITUDE		• • • • • • • • • • • • • • • • • • • •	"A" FRCM ABOVE	
HOLD	FLASH VERE-NCUN TO REQUEST RESPONSE AND . DISPLAY THE RESULT-	•	CBSER	OR DSKY VE VERB TC REC	-NOUN
	ING ICDU/GIMEAL Angles:			NSE AND DU/GIMB	DI SPLAY

•

٠ .

٠

. • #410

#420

#430

.

#440

#450

#460

٠

.

	•
V06 N22 R1-CG	ANGLES AFTER PRO- POSED LM/IMU ALIGN- MENT
R 2 IG R3-NG	PENI
ALL GIMBAL ANGLES IN DEGREES TO NEAREST	· · ·
.C1 DEGREE	• •
	• •
•	• •
•	
•	• •
•	• •
•	• •
•	· · ·
•	• •
•	• •
•	• •
•	• •
•	• •
WAIT FOR KEYBOARD	• •
ENTRY	• •
	• •
	• •
	•
	DO I WISH TO
	MANEUVER VEHICLE .
	TO AN ATTITUDE .
	WHICH WILL PRO
	VIDE A MORE • SUITABLE MGA? •
	.N .Y .
	• • •
	•• •
	MANEUVER VEH-
	. ICLE WITH .
	. ROTATION .
	• CONTROLLER •
	• • •
	• • •
	. UPDATE THE .
	DISPLAY OF
	• •
	• •
	• •
	• •
	• •
	• •
•	· ·
	,

٠

.

40 X

•

.

#470

#480

#490

#500

#510

P 52/LUMINARY

#520

#530

#540

#550

#560

03		•	RESULTING GIMBAL ANGLES: KEYIN RECYCLE V32E
· · · · · · · · · · · · · · · · · · ·	TERMINATE FLASH UPUN RECEIPT CF PRGCEED UR RECYCLE .R .P .E .R .C .O .Y .C .C .E .L .E .L .E .E .D	•	KEY IN PROCEED
HOLD . SNAP .	FLASH VERB NOUN TO REQUEST PLEASE PER- FORM NORMAL OR CYRO TORCUE COARSE ALIGN; V5CN25 R1-00013 R2-PLANK R3-BLANK	•	MONITOR DSKY: CBS ERVE VERB NOUN FLASH TO REQUEST PLEASE PERFORM NORMAL CR GYRO TOR- QUE COARSE ALIGN THE NORMAL METHCD OF ACHIEVING IMU REALIGNMENT IS TO ACCEPT THIS REQUEST BY KEYING IN PROCEED

WHICH WILL CAUSE THE LGC TO COARSE ALIGN THE STABLE MEMBER TO THE GINBAL ANGLES APPROXIMATING THE NEW GRIENTATION AND THEN TO PROCEED THROUGH OPTICAL SIGHTINGS AND PULSE TORQUING TO ACHIEVE PRECISE ALIGNMENT. AN ALTERNATE METHOD OF ACHIEVING IMU REALIGNMENT IS TO **KEY IN ENTER WHICH** WILL CAUSE THE LGC TO COMPUTE THE NUM-BER OF TOROUING PULSES REQUIRED BY EACH IRIG (X+Y+Z) IN ORDER TO ACHIEVE PRECISE ALIGNMENT. AND ISSUE THESE PULSES. THIS ALTER-NATE METHOD INTRO-DUCES A PREDICTABLE ERROR INTO THE LGC'S KNCWLEDGE OF THE STABLE MEMBER ORIEN-TATION AND TAKES A PREDICT ABLE PERIOD OF TIME FOR COMPLET-ION. AN APPROXIMATION OF THIS ERROR AND THE TIME TO TORQUE CAN BE MADE BY CALCULA-TING THE SUM OF THE GIMBAL ANGLE CHAN-GES, MULTIPLYING BY 2 FOR TIME TO TORQUE IN SECONDS, AND MUL-TIPLYING BY .002 FCR ERROR IN DEGREES. SHALL I REALIGN IN THE NORMAL WAY? -------γ • N •

WAIT FOR KEYBOARD

ENTRY

404

#570

#580

#590

#600

			•	•
			٠	•
			•	•
			KEY	IN PROCEED
		•		
			•	•
			•	•
	ATE ELACTI LIGAN		•	•
	ATE FLASH UPON T GF PROCEED	•	•	
RENT		**********	•	KEY IN ENTER
		•	•	
• P	.ENTER		•	•
-R	•			
•C	•			
٠Ç	•		•	•
•E	•	·	•	•
• E	•		•	•
• D	•		•	•
•	•		•	•
	•		•	•
CCM	PUTE TORQUING		•	•
	LES RECLIRED		•	•
	ACHIEVE NEW			•
CRI	ENT AT LCN.			
			•	
,	•		•	•
	•		•	•
	•		•	•
8551	T REFSMMAT		٠	•
FLAG			•	•
			•	•
	•			•
•	•		•	
	•		•	•
			•	•
RE SE	T DRIFT FLAG		•	-
,			•	•
•	•		•	•
	•		•	•
·	•		•	•
ANGL	E IRIGS NUCH TORQUING ES AND DIS- PRESENT ICDU ES UNTIL	······································	• 0 • 0 • 5	IONITOR DSKY: BSERVE VERB-NOUN ISPLAY DF PRE- ENT GIMBAL NGLES UNTIL CCM-
			•	
			•	
			•	
			•	
			•	
			•	
			•	
			•	
			•	
			•	

٠

• ٠

40⁵

:

#630

.

.

#620

#640

.

#650

#660

#670

#680

#690

#700

P52/LUMINARY

	•
	•
POSS	• COMPLETION.
TEMP HOLD .	• V16N20
	 R1-GG R2-IG
MON	• R3-MG
	 ALL GIMBAL ANGLES
	IN DEGREES TO
	• NEAREST .Cl • DEGREE.
	·
	• •
	• •
	• •
	• •
	• •
•	•
	•
	• •
•	•
	•
	•
	•
•	•
•	•
	•
-	•
•	
•	DEFINE REFSMMAT
•	TO BE THE DESIRED IMU ORIENTATION
•	•
•	•
•	•
•	RESET PREFERRED
•	ATTITUDE-COMPUTED
•	FLAG.
•	
	•
-	•
•	•
•	•
•	•
•	
•	•
•	•
•	•
•	•
•	•

. PLETION OF PULSE

. INOTE: UNLESS THE

. DAP IS OFF ("MODE

. HIGH PROBABILITY . THAT RCS JETS . WILL BE FIRED AS . THE INERTIAL RE-- FERENCE IS CHANG-- ED (GYROS TCR-• QUED). HOWEVER, . THE GYRDS MAY BE . TORQUED SO AS TO . DRIVE THE GIMBALS

. INTO GIMBAL LOCK. • THEREFORE THE . CREW SHOULD MAN-. UALLY MANEUVER . THE SPACECRAFT IN . THE MINIMUM IM-. PULSE MODE OR UNDER CONTROL OF • THE AGS TO AVDID GIMBAL LOCK.)

CONTROL-PGNS# - SWITCH TO "OFF") - OR IN A MODE - WHERE IT DOES NOT MAINTAIN ATTITUDE . (I.E.: MINEMUM . IMPULSE MODE VIA . V76E) THERE IS A

. TORQUING.

1

• •

#710

720

#730

#740

#750

A.

I			
	• •		• •
07	• •		• •
0	• •		
	• •		• •
			• •
	•		• •
	• •		• •
	•		• .
	 SET REFSMMAT FLAG 		- •
			• •
			• •
	• •		• •
	• •		• •
	• •		
			- ¥
	 SET DRIFT FLAG 		•
			• •
	•		• •
	• •		•
	• •		
	• •		
	• •		• •
POSS			• •
HOLD		•	•
	- FLASH VERB-NOUN	********************	MONITOR DSKY:
*******	 TC REQUEST PLEASE 	•	OBSERVE VERB-NOUN
SNAP .	PERFORM FINE		. FLASH TO REQUEST
	ALIGN:		
	 V50 N25 	•	PLEASE PERFORM
	- R1-00014		FINE ALIGN
	R2-BLANK		•
	 R3-BLANK 		_
			•
	•	•	• •
	• •	. •	
	• •		DO I WISH TO AT-
	• •		TEMPT TO FINE
	•	-	ALIGN THE IMU?
	 WALT FOR KEYBOARD 	•	ACTON INC THOI
	. ENTRY	•	
		•	• • Y • • • •
	• .	•	• •
	•		
	•		
			KEY IN PROCEED .
			KET IN PROCEED .
	•	• •	•
	•	•	•
	•	•	• •
	•		
	TERMINATE FLASH	•	
	• UPEN RECEIPT OF	•	
	· PROCEED OR ENTER	*******************	••••• KEY IN ENTER
	· FROCEED OR ENTER	• •	•
		•	• •
	••P •E		• •
	• •R •N	-	
	• •C •T	•	•
	••C •E	•	••• •••
		•	• • •
	• •E •R	•	GO TO GO TO
	• • •	•	
	•••••	•	
	• • -	•	
		•	
		•	
	•••••	•	
	•••••	•	
	• • •	-	
	· · ·	•	
	••••	•	
	••••	•	
	•••••	•	
	• • •	-	
		•	
	•	•	
	•••••	•	

••	•	496
•••••	•	P52/LUMI
• •		
• •		
• •E	- #84 n.Cn -	
0 .		
• •L •	• BELOW BELOW	
• • •	•	
• • •	•	
• • • • • • • • •	• •	
• • •		
. GC TC GC	το .	
• иви ис		
BELOW BEL		
0 0000 0000	•	
•	•	
•	•	
•	٠	
•	•	
•	•	
•		
•	,	
O COARSE ALIGN		-
OUTINE (R 50)	CONTINE ADEAN	
	• • • RCUTINE (R50)	
		-
•	•	
•	•	
•	•	
	•	
SET REFEMMAT FLAG		
_	•	
•	•	
•	•	
•	•	
	•	
RESET PREFERRED-		
TTITUDE-COMPUTED		
LAG	•	
	•	
•	•	
•	•	
•	•	
#B # •	• и Вн	
FROM .	FROM	
ABCVE .		
	• ABD VE	
• •	• •	
• •	• •	
• •	• •	
••• •	<i>.</i>	
		-
O FINE ALIGN	DC FINE ALIGN	
GUTINE (R51)	DOLTINE (DELL	
	 ROUTINE (R51) 	
		-
•	•	
-	•	
•	•	
-		
•	•	
•	•	
•	•	
•	•	
	•	
•		
-		
-	•	
•	•	P52/LUM IN
-		

:

+08

#810

#820

	•		•	
	•		•	
	•		•	
•• Си	•		•	чС н
FRGM	•		•	FROM
ABOVE	•		•	ABCVE
•	•		•	•
•	•		•	•
-	•		•	•
* * *	•		•	
•	•		•	•
DC FINAL	AUTOMATIC		DO FINAL AU	TOMATIC
REQUEST	TERMINATE		REQUEST TER	
ROUTINE		• •	ROUTINE (RO	
		• •		
		• •		
		-		
		-		
		-		
ROUT INE		- • •		

I.

٠

.

.

409

CHANGE CONTROL NOTES

REV 01 PCR 134,439 REV OC(LUM 1A) PCR 740 REV 01(LUM 1B) PCR 825.2 REV 02 ECITCRIAL

THIS PAGE INTENTIONALLY LEFT BLANK

	LUN	AR SURFACE ALIGN PROGRAM (P 57) REV 03 12/03/69
++ +03 PURPOSE: +EDIT ++	(1)	WHILE ON THE SURFACE OF THE MOON TO ALIGN OR REALIGN THE IMU TO ONE OF THREE TYPES OF ORIENTATIONS:
		(A) LANDING SITE ORIENTATION
		X = UNIT (R) -SM -LS
		Y = UNIT {Z X X } SMSMSM
		Z = UNIT (H X X) -SM -CSM -SM
		WHERE:
		(1) THE ORIGIN IS THE CENTER OF THE MOON
		(2) R = THE POSITION VECTOR OF THE LM ON THE LUNAR SURFACE AT THE MOST RECENTLY DESIGNATED LANDING -LS SITE AND A TIME T(ALIGN) SELECTED BY THE CREW.
		<pre>(3) H = THE ANGULAR MCMENTUM VECTOR OF THE CSM (R X V). -CSM →CSM →CSM</pre>
		(E) PREFERRED OR IENTATION
++		AN IMU ORIENTATION SPECIFIED BY THE GROUND AND LOADED INTO THE LGC BY THE LGC UPDATE PROGRAM (P27).
+ 03 +EDIT ++		(C) PRESENT REFSHMAT
ASSUMPTICNS:	(1)	THERE ARE SEVERAL TECHNIQUES AVAILABLE TO THE CREW FOR COMPLETING AN IMU ALIGNMENT. THE RESULTANT ACCURACY OF THE IMU TO THE SPECIFIED DESIRED ORIENTATION (I.E. THAT ERIENTATION DEFINED BY THE FINAL REFSMMAT) IS DEPENDENT UPON THE ALIGNMENT TECHNIQUE WHICH THE CREW SELECTS. THIS SELECTION WILL BE DICTATED BY THE CIRCUMSTANCES AT THE TIME OF ALIGNMENT.
	(2)	THE LM HAS LANDED ON THE LUNAR SURFACE. THE LM YAW ANGLE WITH RESPECT TO THE INERTIAL ORIENTATION OF THE IMU AT LANDING WAS NOT CONSTRAINED DURING LANDING.
	(3)	ALL POSSIBLE EFFORTS HAVE BEEN MADE BY THE CREW TO ENSURE THAT THE LM WILL NOT SHIFT ITS POSITION WITH RESPECT TO THE LUNAR SURFACE, NO PROVISION HAS BEEN MADE TO INCORPORATE IN THE LGC ANY MEASUREMENT OF LM SETTLING ON THE LUNAR SURFACE, HOWEVER A SHIFTING OF THE LM WILL RESULT IN A MISALIGNED HUD ONLY IN THE CASE WHERE AN ALIGNMENT IS MADE FROM A STORED LM ATTITUDE WITH RESPECT TO THE LUNAR SUBFACE (DUTION CODES DOODS WHERE AN ALIGNMENT

.

(4) THE ISS IS ON AND MAY BE:

(A) AT AN INERTIAL CRIENTATION "UNKNOWN" TO THE LGC; I+E+: IT MAY HAVE BEEN SHUT DOWN AND RESTARTED SINCE

IS MADE FROM A STORED LM ATTITUDE WITH RESPECT TO THE LUNAR SURFACE (DPTION CODES 00000 AND 00001; SEE LOGIC BELCW), AND THE IMU IS NOT SUBSEQUENTLY ALIGNED BY REFERENCE TO CELESTIAL BODIES AND/OR LUNAR GRAVITY.

P57/LUNINARY

LANDING WITHOUT SUBSEQUENT CRIENTATION DETERMINATION.

- (E) AT AN INERTIAL CRIENTATION "KNOWN" BY THE LGC; I.E.: NEITHER GIMBAL LOCK NOR IMU POWER INTERRUPTION HAS OCCURRED SINCE THE LAST IMU ALIGNMENT OR ORIENTATION DETERMINATION. THEREFORE THE PRESENT DRIENTATION DIFFERS FROM THAT STORED IN REFSMMAT ONLY BECAUSE OF GYRO DRIFT AND/OR THE INITIAL MISALIGNMENT OF THE INU TO THE STORED REFSMMAT.
- (5) NO MONITOR OR CONTROL OF THE RENDEZVOUS RADAR (RR) WILL BE EXERCISED BY THE LGC DURING THIS PROGRAM EXCEPT AS DEFINED BY THE RR MONITOR ROUTINE (R25).
- (6) THE LM ATTITUDE WITH RESPECT TO THE LUNAR SURFACE IS AVAILABLE IN LGC STORAGE, I.E.: IT WILL HAVE BEEN STORED BY THE LANDING CONFIRMATION PROGRAM (P68). ONCE THIS ATTITUDE HAS BEEN STORED IT WILL BE PRESERVED BY THE LGC UNTIL IT IS REPLACED BY A MORE RECENT VALUE.
- (7) EXTENDED VERBS SHOULD NOT BE EXERCISED DURING THE R59 PORTION OF THIS PROGRAM BECAUSE OF POSSIBLE INTERFERENCE WITH R53.
- ++ +03 +EDIT ++

412

- (8) THE DAP SHOULD BE OFF OR IN ATT HOLD ("MODE CONTROL-PONS" SWITCH TO "OFF" OR "ATT HOLD") DURING GYRD TORQUING BY THIS PROGRAM TO PRECLUDE ROS JET FIRINGS DUE TO REALIGNMENT OF THE IMU CAUSING ATTITUDE ERRORS EXCEEDING THE MAXIMUM DEADBAND.
- (9) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY. IT WILL NORMALLY BE SELECTED TO PERFORM AN ALIGNMENT OF THE IMU IMMEDIATELY AFTER LANDING ON THE LUNAR SURFACE, PRIOR TO SELECTION OF THE RR LUNAR SURFACE NAVIGATION PROGRAM (P22), PRICE TO AGS INITIALIZATION AND APPROXIMATELY 15 MINUTES PRIOR TO ASCENT. THIS PROGRAM MAY ALSO BE USED TO PROVIDE AN IMU ALIGNMENT IN TIME-CRITICAL EMERGENCIES PRIOR TO ASCENT.

(1C) A DETERMINATION OF THE LH POSITION VECTOR WHILE ON THE LUNAR SURFACE (R ...) CAN BE ACCOMPLISHED ONLY IN

-1.5

CONJUNCTION WITH IMU ALIGNMENT TECHNIQUE OPTION #2 (USING ADT SIGHTINGS TO TWO CELESTIAL BODIES). IT IS VALID ONLY IF THE LUNAR GRAVITY VECTOR HAS BEEN PREVIOUSLY DEFINED, DURING P57, USING IMU ALIGNMENT TECHNIQUE OPTION #1 (USING REFSMMAT OR STORED LM ATTITUDE AND DETERMINATION OF LUNAR GRAVITY VECTOR) OR OPTION #3 (USING SINGLE CELESTIAL BODY SIGHTING AND DETERMINATION OF LUNAR GRAVITY VECTOR).

PROG CONT	LGC	GREUNE	CREN
			.CRE₩ •PROGRAM •SELECTION
			•
	START LUNAR SURFACE ALIGN PRUGRAM (P57). DISFLAY P57	•	KEY IN LUNAR SURFACE ALIGN PROGRAM (P57) v37E57E
			•
			•
			•
			•

#10

501 P57/LUMINARY

l



			•	
			•	
			•	
			• •	
		•	MONITCR DSKY:	
		•	OBSERVE DISPLA	4 7
			CF FST.	
			•	
			•	
			•	
IS THE I:	SS ON?		•	
			•	
₊Υ	• N		-	
•	•		-	
•	•			
SET IMUSE	EFLAG .			
			•	
•	•		•	
•	•		•	
•	•		•	
	CN PROGRAM	-	MONITOR DSKY:	
. ALARM	LIGHT BUT		DOES PROGRAM	
 DC NOT 	CHANGE	•	ALARM LIGHT INDIC	ATE
PRESEN	IT DISPLAY		THAT INU IS NOT C	
PROGR	RAM ALARM		INDTE: ALARM CODE	
 DISPLA 	Y IF CALLED		MAY BE DISPLAYED	•
. IS CC2			IN R1 R2 OR R3	
. V05N			DEPENDING ON PRE-	
	XXXX			
	XXXX		SENCE OR ABSENCE	
	XXXX		OTHER ALARM CODES	• }
•			•Y	Ν.
•	•		•	•
	•		•	•
-	-		•	•
-	-		•	•
-	•		•	٠
-	•		•	•
•	•		•	•
•	•			•
•	•		CALL PREGRAM	•
•	•		ALARM DISPLAY	٠
•	•		(V05N09) TO ID-	•
•	•		ENTIFY ABNORMAL-	•
•	•		ITY. WHEN FINISH-	•
•	•		-	•
•	•			•
•	•			
•	•			
•	•			•
•	•			•
•	•			•
	•			•
	•			•
-				•
-	-			•
•	•			•
•	•			٠
•	•			•
•	•			•

.

• ٠

#30

#20

#40

#50

#60

•	•		
•	•		
•	•		
٠	•		
•	٠		ED PUSH KEY
•	•		RELEASE.
:	:		
•	•		-
٠	•		•
•	•		
•	.		PRESS ALARM RESET To reset program
			ALARM.
•	•		
•	•		•
٠	•		•
•	•	_	•
:	DO FINAL AUTO-		DO FINAL AUTO-
-	MATIC REQUEST	• •	MATIC REQUEST
٠	TERMINATE ROUTINE		TERMINATE ROUTINE
•	(R00)		(R00)
	•		
•	•		•
٠	• • •		* • •
٠	EXIT P57		EXIT P57
:	EATI PDI		EXILEDI
٠			
	T LGC ASSUMED Tion Code For		
	UDRIENTATION		
	= COOO3		
(R I	EFSMMAT)		
	•		
	•		
	٠		
	•		
		• • •	•••
		•	•
		•	
	SH VERB-NOUN TO	•	MONITOR DSKY:
	CUEST RESPONSE AND	•	OBSERVE VERB-NOU FLASH TC REQUEST
	SPLAY CPTICN CCDE R ASSUMED IMU OR-	•	RESPONSE AND DISPLA
	- Hosoneo Ino ok-	•	ACCOUNTE AND DISPLA
		•	
		•	
		-	
		•	
		•	

HOLD . SNAP .

414

1

#70

.

#80

#90

#100

P57/LUMINARY

{

415	
-----	--

•

•

		•	
		•	
	TION SELECTION	• 0F	OPTION CODE FOR
	NG6		SUMED INU OR IENTA-
	CCCC1	• T10	ON SELECTION
	0000X Blank	•	
	DERIK	•	•
RI IS	THE CPTION		•
	FOR ASSUMED		•
	RIENTATION	• 15	THIS THE DESIRED
SELEC	TICN.	• IML	J ORIENTATION?
00 FC	*** · · · ·	•	
	THE LGC		۲ N-
	ED INU GRIEN- N SELECTION	• •	•
CPT IO		• •	•
	L-PREFERRED	• •	•
	2-NOMINAL	• •	•
	B-REFS MMAT		•
	4-LANDING SITE	•	•
		•	•
	•	•	•
	•	•	•
	•	• •	•
	•	• •	•
	•	• •	•
	•	• •	•
ATT F	OR KEYBOARD	••	
ENTRY			IN PROCEED
		•	•
			•
		•	• •
		•• •	KEY IN V22E
		••• • • • • • • • • • • • • • • • • •	AND LOAD THE
		•• •	DESIRED OR IENTA-
ERMIN	ATE FLASH UPON	• •	TION OPTION IN
(ECE18	T GF PROCEEC	• •	R 2
		• •	
۰P		• •	•
R	NEW . DATA.	• •	•
•0			•
• C	STORE	• •	**********
•E	NE 🕷	•	
- E	OPTION	• •	
• D		•	
•	•	• ₩AS	THE NOMINAL
•	•		ION SELECTED?
•	•	•	
•	• • • • • • • •	N	Υ.
-		• •	• •
-		• •	•
-		• •	•
•		• •	• •
•		• •	• •
•		- •	• •
•		• •	• •
•		- •	• •
-		•	• •

٠

•

1

٠

.

#110

#120

#130

≇140

#150

#160

P57/LUMINARY

,

	-		
•		•	• •
•	•		
•	•	•	• •
•	•	•	
•	•	٠	• • • •
IS THE LGC CPTICN = 00		•	
		•	
•N	Y	•	
•	• •	•	
•	• •	•	
•	*****	•	
•		•	
•		•	
IS THE LGC CPTION = 00		WAS THE REFS Option selec	T E C ?
••••••••••••••••••••••••••••••••••••••	N.		 N.
•	•	•	•
•	•	•	•
DEFINE THE	•	•••	•
ED IMU ORIE		cu •r o	•
TICN TO BE		GU. TO # EN	•
REFSMMAT.	•	BELCW	•
		UCE OR	•
•	•		
•	•		
•	•		•
••			•
GG	•		•
*E			•
BEL	-		•
DEL			•
	•		•
	•		•
IS THE LGC CPTIGN = 00	 ASSUMEC 0C1?	WAS THE PREFI	
•••	N.		 N•
•	•	•	•
•	•	•	•
•	-	NOTE: IF CRE	•
GO.TO	•	SELECTS ALIG	
"E"	•	TO A PREFERRI	ED .
	•		·- ·
	•		•
	•		•
	•		•
	•		•
	•		•

504 P 57/L UM INAR Y

#170

.

#180

#190

#200

t

		(
	•	505
÷11		P 57/L UMI NAR Y
	•	
BELOW	• ORIENTATION •	#210
	 (00001), AND NDNE HAS BEEN DEFINED, 	#210
	• NO ALARM WILL .	
	 RESULT, BUT THE RESULTING ALIGN- 	
	• MENT WILL BE . • WORTHLESS.	
	• • • • • • •	

	•	#220
	• GL.TO • • • • •	
	• BELOW	
GBTAIN CONTENTS O		
TIG REGISTER FROM STORAGE FOR DISPL	- -	
AS T (ALIGN)	•	#230
(NOTE: IF P12 WAS Partially Perform	• •	
IMMECIATELY AFTER The lunar landing		
TIG WILL CONTAIN	•	
TIG(AS).		
•	•	
		#240
•	•	
•	• • • • • • • • • • • • •	
•		
•	• • • • • • • • • • • • • • • • • • • •	
•		
HOLD . FLASH VERB-NOUN T	MONITOR DSKY:	#250
••••• REQUEST RESPONSE	NE OB SER VE VERB-NOUN .	
SNAP . DISPLAY T(ALIGN): VO6N34	FLASH TO REQUEST RESPONSE AND DISPLAY	
R1-T(ALIGN)-HRS R2-T(ALIGN)-MIN	• OF T(ALIGN) WHICH IS .	
	• EQUAL TC THE PRES- •	
	•	
	•	
	• •	
	•	P 57/LUMI NARY
	•	

•	•		
R3-T (ALIGN)-SECS	ENTLY DEFINED TIG . (AS).		
T (ALIGN)-TIME(GET) . AT WHICH LM POSITION .	(NOTE: IT IS ASSUMED . THAT P12 WAS PAR-		#260
VECTOR IS DEFINED .	TIALLY PERFORMED		
FOR A LANCING SITE . ORIENTATION. IN HRS .	IMMEDIA TELY AFTER . THE LUNAR LANDING.		
NINS AND SECS TO	AT THAT TIME TIG(AS) .		
NEAREST +01 SEC.	WAS DEFINED.)		
······································	· · · · · · · · · · · · · · · · · · ·		
• •	• •	·	
• •	• •		
	• •		#270
• •	• •		#210
	• •		
WAIT FOR KEYBOARD .	• •		
ENTRY .	• •		
•	• •		
•	• •		
•	• •		
•	• •		#280
•	• •		
	• •		
•			
•	• •		
•	• •		
•	• •		
•	• •		
•			#290
•	• •		#270
•	• •		
•	• •		
•	• • •		
	IF T (ALIGN) IS		
•	DEFINED TO BE		
•	00000, 00000, .		
•	00000, THE LAND		
•	ING SITE .		#300
•	ORIENTATION . WILL BE DE		
•	FINED FOR A		
•			
•	•		
•	•		
•	<u>.</u>		
•	•		
•	•		
•	•		
•	•		
•	•		
•	•		

:

•

.

·+18

		•		•
		•		•
		•	T(ALIGN)	•
		•	AUTOMATICALLY	•
		•	SELECTED BY	•
		•	THE LGC AS THE	•
		•	PRESENT TIME.	•
		•		
		•	•	•
		•	•	•
		•	•	•
		•	DO I WISH TO	- •
		•	ALIGN THE IMU TO	•
			A LANDING SITE	•
			ORIENTATION DE-	•
			FINEC BY THE T	•
		•	(ALIGN) PRESENTL	. -
		•	DISPLAYED?	••
		•		
		•	• Y •	N -
		•	•	•
		* =	•	
			 KEY IN V25E 	•
		••	AND LOAD THE	•
		•	 DESIRED T 	•
		•	• (ALIGN) IN R1	, .
		•	• R2 AND R3	-
		•	•	
		•	• •	•
		•	• •	. •
		•	• •	•
		•	• •	•
		•	• •	•
		•	• •	•
		•		
		•	-	
TE R ME NA	TE FLASH UPON	•	•	
	OF PROCEED	••		-
	DATA		KEY IN PROCEED	
		* *		-
•P	• N E W	•	•	
.R .C	. CAT A	•	•	
•0	•	•	•	
• E	STORE DATA	•	•	
, Ē		• •	•	
• C	•		•	
•	•	•	•	
•	•			
•	•	•	•	
•	•	•	•	
•	•	•	•	
-	•	•	•	
•	•	•	•	
•	•	•	•	
•	•	•	•	
•	•	•	•	
•	•	•	•	
•	•	•	•	
•	•	-	•	

.

٠

. .

.

#310

#320

#330

#340

#350

•	• •	•		508
•	• •	•	P5	508 7/LUMINARY
•	• •	•		
•	• •	•		
•	• •	•		
•	• •	•		
	• •	-		
•	********	•		
•		-		
		•		
		•		
		•		
		•		
		•		#360
•		•		
		•		
•		•		
•		•		
•		•		
•		•		
		•		
IS TEALIG	NJ DE-	•		
FINED TO	8E = 07	•		
		•		#370
•N	¥.	•		
•	•	•		
•	•	•		
		٠		
. DEFINE	т	•		
- (ALIGN) = PRE-	•		
. SENT T	IME	•		
		•		
•	•	•		
•	-	•		#380
•	-	•		
		•		
IS TEALIGN		•		
CEFINED TO	385 .	•		
GREATER TH	tan .	•		
THE PRESEN	NT .	•		
TIME?	•	•		
		•		
" Ν	Y			
•		•		#390
•	• •	•		
	·			
 STORE 	•			
 TEALIGN 	• (V	•		
IN TIG	•	•		
REGISTE	ER .	•		
FOR POS	551	•		
•				
•	•			
•	•		·	
•	•			
•	•			
•	•			
•	•			
•	•	•		
•	•			
•	•			
•	•			
•	•	•		
•	-	•	P51	//LUMINARY
	-	•		
	-	•	1	1
				١

.

420

ι.

٠

ţ

#410

#400

#4 20 .

#430

#440

	• 	USE	•						•	
	• P12		•						•	
	. TIG	(AS).	• •							
			•						•	
	•	:	:							
	•	٠	•						•	
	COMPUT	ELAN	DING						•	
	SITE C									
	FOR DE) 1						•	
	(NCTE:		THIS						•	
	TIME A								•	
	FERREC TION P								•	
	STORED			2					:	
	IS LCS	T.)							•	
				-					•	
		•							•	
		:							•	
	" E"	•								
	FRCM ABOVE	•							•	
	400 IL	•							:	
	•	•							-	
	•	•							•	
	•••	•							:	
	SET LG								•	
	ALIGNM	ent t	ECHNI	ωE					•	
	EPTICN	CODE	TG						•	
	00000	(SEE	BELOW)-					•	
		•						"E" FRCM	•	
		•						ABOVE		
		•						•	•	
				•••	•••••			•	•	••••••
		•		•	•			•••	•	•
		•		•	•				•	•
HOLD .	FLASH				•		•	MONITO	R DSK V	':
SNAP .	REQUEST				••••	• • • • • •	 			ASFING
SILME +	FOR AS:	SUMED	ALIGN	16 E (•			REQUEST DISPLAY
	-				•					PROTEM
					•					
					•					
					•					

. ٠ • ٠ • .

• . .

		· ·	
	MENT TECHNIQUE TO BE		
	EMPLOYED, AND STORED	• CF OPTION CODE FOR .	
		 ASSUMED ALIGNMENT . 	
	DATCODE :	TECHNIQUE TO BE	#450
	V05N06	 EMPLCYED, AND STORED . 	#+50
	81-00010	DATCODE	
	R2-CCCGX	•	
•	R3-00CC0	•	
		• • •	
		• • •	
	R1 IS THE OPTION	• • •	
	CODE FOR ASSUMED	•	
	ALIGNMENT TECHNIQUE	THE PREREQUISITES	
	TO BE EMPLOYED.		
		• FOR SELECTION OF AN .	
		ALIGNMENT TECHNIQUE	#460
	R2 IS THE LGC-ASSUN-	OPTION CODE (R2) ARE	
	ED ALIGNMENT TECHNI-	AS FOLLOWS:	
	QUE OPTION CODE:	•	
		•	
	00000: TIME CRIT-	• 00000-(A)	
		• 00001-(A)	
	ICAL ANYTIME ALIGN	• 00002-{8}	
	TO THE DESIRED	• 00003-(C)	
++	OR LENT AT ION	•	
+ 03	PREVIOUSLY SEL-		
+EDIT		• WHERE: •	
++	ECTED USING	• •	#470
**	STORED LM ATTITUDE	 (A) A LM ATTITUDE 	* 110
	WITH RESPECT TC	• WITH RESPECT TO .	
	THE LUNAR SURFACE	• THE LUNAR SURFACE	
	CR PRESENT REFS-		
	MMAT.	• OR REFSMMAT IS DE- •	
	AMA .	 FINED. (REFER TO 	
		 ASSUMPTION (4)(B) 	
	00001-ALIGN TU	 ABOVE.) 	
++	THE DESIRED	•	
+03	ORIENTATION		
+ EDI T	PREVICUSLY SEL-	• (B) TWO CELESTIAL .	
		 BODIES ARE VISIBLE 	#480
++	ECTED USING	 FOR SIGHTING (TWC . 	**00
	PRESENT REFSMMAT	 NAV STARS/PLANETS, 	
	CR A STCRED LM		
	ATTITUDE WITH	• OR ONE NAV STAR/ .	
		PLANET AND THE	
	RESPECT TO	• SUN).	
	THE LUNAR SURFACE)	•	
	ANC DETERMINATION	• (C) ONE CELESTIAL .	
	CF THE LUNAR		
		 BODY IS VISIBLE 	
	GRAVITY VECTUR.	 FUR SIGHTING (NAV . 	
	_	 STAR/PLANET OR 	
	CUOC2-ALIGN TC	• SUN).	#490
++	THE DESIRED		
+03	CRIENT AT ION	•	
+EDIT	PREVICUSLY SEL-	• • • • • • • • • • • • • • • • • • • •	
	FAC 41 GGGET SEC-	• • •	
+		• • •	
+		•	
+		· · ·	
+		•	
		• •	
•		• • •	
+		• • •	
+		•	
+		· · ·	
+		• •	
		• • •	
+		• • •	
₂ 2 +		•	
4 +		• •	
+		• •	P57/LUMINARY
		• • •	
Ŧ		• • •	
			1
(*)		(1
r.		l l	1

•

•

						(
+		•				51 1
423 +			•		•	
40- +		•	•		•	P 577L UMINARY
		•	•		•	
+		•	•		•	
+		•	•			
++	ECTED USING AUT	-			•	
	SIGHTINGS TO THO	-	•		•	
		•	•		•	
	CELESTIAL BUDIES.	•	•		•	
		•	•		•	
	GCCC3-ALIGN TO	•			_	
++	THE DESIRED	_	-		•	****
+ 03		•	•		•	#500
		•	•		•	
+EC		•	•		•	
++	ECTED USING AGT	•	•			
	SIGHTINGS TO ONE	•				
	CELESTIAL BODY AND	-			•	
	DETERMINATION OF	•	•		•	
		•	•		•	
	THE LUNAR GRAVITY	•	•		•	
	VECTOR.	•	•			
	R3 IS DATCODE-A		•		•	
		•	•		•	#510
	TWO DIGIT CODE. R3	•	•		•	
	WILL CENTAIN A "1"	•	•		•	
	IN THE "C" DIGIT IF	•	•			
	A REFSMMAT IS	•	-		-	
	DEFINED, CR	•	•		•	
	A "O" IF NO REFSMMAT	•	•		•	
	A "U" IF NU KEFSMMAT	•	•		•	
	IS DEFINED.	•	-		•	
	R3 WILL CONTAIN A	•	•		-	
	"1" IN THE "D"				-	
	DIGIT TO INDICATE	•	•		•	
	THAT A STORED LM	•	•		•	#520
		•	•		•	
	ATTITUDE IS AVAIL-	•	•		•	
	A8LE, OR A "O" IF IT					
	IS NOT AVAILABLE.		•		•	
	OPTIMALLY DATCODE	•	•		•	
		•	•		•	
	SHOULD THEREFORE	•	•		•	
	READ 00110.	•	-		•	
	_	_	•		•	
	-	•	•		•	
	•	•	•		•	#530
	•	•	•		•	
	•	•			•	
	•		IS THE LGC-ASSU	MED		
		_	ALIGNMENT TECHN			
	-	•			•	
	•	•	CPTIEN CODE COR	RELI	•	
	•	•	(R2)?		•	
	•	•			•	
	•	•	Υ.	Ν.	-	
	•				_	
	_	-	•	•	•	
		•	•	•	•	#5.40
		••		•	•	
	WALT FOR KEYBOARD		KEY IN PROCEED		•	
	ENTRY	••			•	
		•	•	•		
					-	
		-	-	•	•	
		•	•	٠	•	
		•	•	•	•	
		•	•	•	•	
		•	•	-	•	
			-	-	-	
		-	-	•	•	
		•	•	•	•	
		•	•	•	•	
		•	•	•	•	P 57/LUM INARY
			-	•	•	
		-	*	•	•	

(

	•	•	•	512
		• •	•	P577LUMINARY
	•	•	•	
	•			
	•	•	•	
	••		•	
••	• • • • • • • • • • • • • • • • • • • •	KEY IN V22E AND	•	
	••	LOAD THE DESIRED	•	
	• •	LGC-ASSUMED ALL-	•	# 550
	•	GNMENT TECHNIQUE	•	
	•	97	•	
			•	
	•	_	•	
	•	•		
	•	• •	•	
	•	• • • • • • •		
	•	•	•	
	• •		•	#560
: FLASH UPUN 16 DOMESS	•	•	•	
AT A	•	•	•	
	• •		•	
	- -		•	
	-	,	•	
•	•	,	•	
•	•	,	•	
•	•		•	
•	•		•	#570
•	• •		•	
•	•		•	
•	• •		•	
STORE DATA	• •		•	
STERE DATA	•		•	
•	•		•	
•	•		•	
•	•		•	
********	• •		•	#580
	• •		•	• > 00
	• •		•	
AT FLAG	•		•	
AI TEAU			•	
	• SEI	1	•	
- N	 • V -	 ki	•	
•	• •	•11	•	
•	• •	•		
	• •		•	AF OD
TITUDE FLAG	• •	IS ATTITUDE FLAG	•	#590
	• •	SET?	•	
	• •		•	
N .	• •	Y• • N	•	
•	• •	• •	•	
•	• •	• •	•	
•	• •	• •	•	
•	• •	•	•	
•	• •	• •	•	
•	•	• •		
•	•	•	•	
•	• •	• •	•	
		•		
•	• •	• •	•	DS77LIMENTAL AND
:	•••••	• •	•	P57/LUMI NARY
•	· · ·	• •	• •	P57/LUMINARY
	. NE h . CAT A	AT FLAG	AT FLAG	LGAC THE DESTRED LGACASSUMED ALI- GNMENT TECHNIQUE CPTION CODE IN R2.

424

2. *

						•	
	•				1		1
/	• •	•	•		• •	•	•
H25	• •	•	•		• •	•	
	• •	•	•		• -		-
	• •		_		•	•	•
		-	•		• •	•	•
	• •	•	•		• •	•	•
	• •	•	•		• •	•	
	• •••	•	•			_	
	• •		-		••	•	•
	• GO TO		-		•	•	•
	. #8#	•	•		•	•	•
	-	•	•		•	•	•
	 BELGW 	•	•		•	•	
	•	•	•			_	_
	•					•	•
			-		•	•	•
	IS ALIGNM		•		•		•
			•	•	IS ALIGN		•
	TECHNIQUE		•		TECHNIQU	E OPTION	•
	• CODE = OCC	002	•		0 = 3000	0002	
	 OR 00003? 				OR 00003		•
			-	•		t.	•
	• •Y	A (•	•			•
	• • • •	- N	•		Y	• N	•
	• •	•	•			-	
	• •	•					•
		-			- •	•	•
		•	•		••••	•	•
	- cc.tc	•	•	•	•	• •	•
	• GE TC	•	•	•	•	•	•
	• ** 8*	•	•			•	
	BELGW	•	•	-			•
	•			•	•	•	•
		•	•	•	•	•	•
	•	•	•	•		• •	•
	•	•	•	-	,	•	•
	•	•	•	-			-
POSS .			-				•
	FLASH VERB-	-NECLOS	•	• •			•
HOLD			• • • • • • • • • • •	***********	MONITOR		•
	TO REQUEST		•	• •	CISPLA	(OF,	•
SNAP	 SPENSE AND 		•		ALARM COE	DE INDIC-	
	PLAY ALARM	CODE	•		AT ES THAT		
	. 00701:			•	00000 OR		•
	. V05N09		•	•			•
			•	•		SELECTED .	•
	• R1->XXXX		•	•	BUT THE I	_GC_CAN- ,	•
	 R2-XXXXX 		•	•	NOT CONT	INUE .	
	 R3-XXXXX 		•	-	BECAUSE N	ETTHER	-
	. (NOTE: ALAR	M CODE	-	•	PRESENT		•
	. MAY BE CISP		•	•			•
			•	•	NUR A STO	•	•
	- IN R1, R2,		•	•	ATT ITUDE	ARE .	
	 DEPENDING 0 		•	•	AVAILABLE		
	. SENCE OR AB	SENCE	•	•	DO I WISH	TO SEL-	
	. OF OTHER AL	ARM			ECT ANOT I		
			-	•		ILN •	•
	• COCES • 1						
	• CODES.)		•	•	OPTION?		
	• COCES.)	-	•	•			•
	. CODES.)		• • •	•	•N	.Y	•
	. COCES.}		• • •	•		.Y	•
	. COCES.)	-	•	• • •		.Y	•
	CODES.)		• • • •	• • • •		••••••••••••••••••••••••••••••••••••••	•
	·	· · · · · · · · · · · · · · · · · · ·	• • • •	• • • •	- N 	••••	•
	WAIT FOR KE	 Y 80 AR D	•	• • • •		EY IN	•
	·	Y 80 AR D	•	• • • • •		••••	•
	WAIT FOR KE	 Y 80 AR D	•	• • • • • •		EY IN ECYCLE	•
	WAIT FOR KE	Y BO AR D	•	• • • • • • • • • • • •		EY IN	•
	WAIT FOR KE	 Y 60 AR D	•	• • • • • • • • • • •		EY IN ECYCLE	•
	WAIT FOR KE	 Y BO AR D	• • • • • • •	• • • • • • • • • • • • • • •		EY IN ECYCLE	• • •
	WAIT FOR KE	Y BO AR D	• • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • •		EY IN ECYCLE	•
	WAIT FOR KE	Υ 60 AR D	• • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • •		EY IN ECYCLE	•
	WAIT FOR KE	 Y 60 AR D	· · · · · ·	• • • • • • • • • • • • • • • • • • •		EY IN ECYCLE	• • •
	WAIT FOR KE	Y 80 AR D	• • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • •		EY IN ECYCLE	•
	WAIT FOR KE	Y BO AR D	• • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • •		EY IN ECYCLE	
	WAIT FOR KE	 Y 60 AR D	• • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • •		EY IN ECYCLE	
	WAIT FOR KE	Y 80 AR D	• • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • •		EY IN ECYCLE	•
	WAIT FOR KE	Y BO AR D	• • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • •		EY IN ECYCLE	•
	WAIT FOR KE	90 AR D	· · · · · · · · · · · · · · · · · · ·	• • • • • • • • • • • • • • • • • • •		EY IN ECYCLE	

(513 P57/LUM INARY

#600

#610

#6 20

#630

#640

P57/LUMINARY

#650

#660

.

#670

#680

#690

P57/LUMINARY

	•
LP ATTITUCE IN HOON-	•
FIXED COGRDINATES	•
USING REFSMMAT	_
	•
	•
•	•
•	•
•	•
•	•
•	•
•	_
	-
•	•
•	•
•	•
•	•
•	
•	-

• TERMINATE FLASH • UPON RECEIPT OF

. DC FINAL AUTO-

. NATIC REQUEST

COMPUTE AND STORE

. TERMINATE ROUTINE

EXIT P57

RECYCLE DR

TERMINATE

Τ.

Ε.

R .

м.

1.

Ν.

Α.

Τ. Ε.

. (R00)

.

•

. .

• •

٠

.

.

•

. . . .

• R

۰E

•C

٠Y

• C

۰L

E

KEY IN TERMINATE

V34E

. DO FINAL AUTO-

. TERMINATE ROUTINE

•

EXIT P57

MATIC REQUEST

. (ROO)

.

.

٠

....

•

426

, **.**

____ SET ATTITUDE FLAG ------. • юgн FROM ABO VE ٠ • . SET INITIAL ALIGN FLAG . IS ALIGNMENT TECH-NIQUE CPTICN CODE = CCOC1 DR CCOC3? • N ٠Y ٠ ٠ . . . GC TO HC N BELOW . SET DESIRED GIMBAL ANGLES AS FOLLOWS:

427

------IS ALIGNMENT TECH-NIQUE OPTION CODE = 00001 GR 00003? _____ • Y -N ٠ GO TO нСн BELCW

#700

#710

#7 20

#730

#740

	•	•		
OG = +42 DEG	•	•		
IG = -42 DEG	•	•		
MG = +35.25 DEG	•	•		
	•	•		
•	•	•		
•	•	•		#750
	•	•		
COMMAND ISS TO	•	•		
COARSE ALIGN MODE.	•	•		
**	•	•		
•	• • • • • •	••••		
-	• •	• •		
	•			`
TURN EN "NG ATT"	• ••	DBSERVE "NO ATT"		#760
LIGH T	• • • • • • • • • • • • • • • • • • • •	• LIGHT TO INDICATE		#180
	• • •	THAT IMU IS IN		
•	• •	COARSE ALIGN MODE		
-	•	FOR ALIGNMENT TO THE FIRST POSITION FOR		
	• •	LUNAR GRAVITY DETER-		
RESET TRACK FLAG	•	MINATION		
	• •			
•	• •	•		
•	• •	•		# 770
*	• •	•		
RESET DRIFT FLAG	•	•		
	•			
•	• •	•		
•	• •	•		
•	• •	•		
RESET REFSMMAT FLAG	• •	•		
		•		
•	•	•		#780
•	• •	•		
•	• •	•		
COARSE ALIGN ISS.	• •	•		
	• •	•		
•	•	•		
•	• •	•		
•	• •	•		
(NOTE: IF AT THE END	• •			#790
CF CCARSE ALIGNMENT,	· · ·	INCTE: IF AT THE END OF COARSE ALIGNMENT,		
THE GIMBALS ARE NOT	• • • • • •	THE GIMBALS ARE NOT		
WITHIN 2 DEGREES OF	• •	WITHIN 2 DEGREES OF		
	• •			
	• •			
	• •			
	• •			
	• •			
	•			

•

٠

٠

:

•

. . .

.

٠ •

• .

1

.

r

	•			(51 7
	•••••			P 577L UMINARY
THE DESIRED VALUES, The LGC WILL TURN CN	· · ·	THE DESIRED VALUES, THE LGC WILL TURN ON		
THE PRUGRAM ALARM LIGHT AND STORE ALARM CODES CO211 AND OO217).	· · · · · · · · · · · · · · · · · · ·	THE PROGRAM ALARM LIGHT AND STORE ALARM CCDES 00211 AND 002171.		#B00
•	· · ·	•		
•	• •	•		
TERMINATE COARSE ALIGN MODE IN ISS.	• •	•		
•	••••	•		
•	• •	•		#810
TURN OFF "NO ATT" LIGHT	•	OBSERVE TERMINATION		
	• •	OF "NO ATT" LIGHT TO INDICATE THAT IMU IS NOW INERTIAL.		
•	••••	•		,
•	• •	•		
•	• •	•		#8 20
DETERMINE GRAVITY VECTOR, G, BY READ-	· · ·	•		
ING ACCELERCMETER OUTPUTS	• •	•		
•	• •	•		
•	• •	•		#830
STORE 1/2 UNIT (G)	• •	•		
IN NAV BASE -	· · ·	•		
COORDINATES AS G1	• •	•		
	• •	•		
•	•	•		# 840
•		•		
•	•	•		
•	• •	•		
• •	•	•		
•		•		
•	•	•		
• •	•	•		
•	•	•		P57/LUM IN ARY
• •	•	•		
			·	

	•	• •	•		518
	•	• •	•	·	P57/LUMINARY
	:	• •	•		
	•	• •	•		
	• 	• •	•		
	CALCULATE DESIRED	• •	•		
	ICDU/GIMBAL ANGLES	• •	•		
	TO ROTATE INU STABLE Member 180 degrees	• •	•		
	ABOUT G	•	•		
	-	• •	•		
	•	••••	:		#850
	•	• •	•		
	•	• •	•		
		• •	•		
	COMMAND ISS TO	• •	• .		·
	COARSE ALIGN MODE.	• •	•		
	•	•	•		
	•	• •	•		#860
	•	• •	•		
	TURN CN "NO ATT" Light	• • •	OBSERVE "NO ATT" LIGHT TO INDICATE		
		• •	THAT IMU IS IN COARSE ALIGN MODE,		,
	•	• •	FOR ALIGNMENT TO THE		
	•	• •	SECOND POSITION FOR		
	RESET TRACK FLAG	• •	LUNAR GRAVITY DETER- MINATION.		
		• •			#870
	•	• •	•		
	•	• •			
		• •	•		
	RESET DRIFT FLAG	• •	•		
	•	• •	•		
	•	• •	•		
	•	• •	•		#880
	RESET REFSMMAT FLAG	• •	•		
		• •	•		
	•	• •	•		
	•	• •	•		
	COARSE ALIGN ISS.	• •	•		
		• •	•		
	-	• •	•		#890
	•	• •	•		
	• .	• •	•		
	•	• •	•		
	•	• •	•		
	•	• •	•		
^	•	• •	•		
113	•	• •	•		P57/LUMINARY
	•	• •	•		1 2 17 CONTIANT
	•	• •	• ((
·			`		۹.

 900

#910

#920

#930

(NOTE: IF AT THE END . INCTE: IF AT THE END • • GF COARSE AL IGNMENT, OF COARSE ALIGNMENT. THE GIMBALS ARE NCT . THE GIMBALS ARE NOT . . WITHIN 2 DEGREES OF . . WITHIN 2 DEGREES OF THE DESIRED VALUES, THE DESIRED VALUES, • THE LGC WILL TURN ON . THE LGC WILL TURN ON . THE PROGRAM ALARM . THE PROGRAM ALARM • LIGHT AND STORE LIGHT AND STORE . ALARM CODES G0211 . ALARM CODES 00211 . AND 002171. AND 00217). ____ -----TERMINATE COARSE ALIGN MODE IN ISS. TURN OFF "NO ATT" OBSERVE TERMINATION LIGHT OF "NO ATT" LIGHT TO . . -----INDICATE THAT INU IS • NOW INERTIAL. DETERMINE NEW GRA-VITY VECTOR G BY -REACING ACCELERD-METER CUTPUTS STORE 1/2 UNIT (G)

P577LUMINARY

	•	•	•	520 P57/LUM IN ARY
	•	•	•	
IN NAV BASE	•	•	•	#940
COORDINATES AS	62 .	•	•	
	· •	•	•	
•	•	•	•	
•	•	•	•	
DEFINE THE 1/2 Lunar gravity v	ECTOR .	•	• •	
TG BE THE UNITI Sum of G1 and G	ZEC .	•	•	#9 50
		•	•	
•	•	•	•	
:	•	•	•	
POSS			IT OR DSKY:	
SNAP . AND DISPLAY GRA			OBSERVE VERB-NOUN	
AN GL E :	•	 RES 	SH TO REQUEST PONSE AND DISPLAY	#960
VO6 NO4 R1-GRAV ERR	ANGLE .		GRAVERR ANGLE. TE: UNTIL THIS	
R2-BLANK R3-BLANK	•		GRAMIS PERFORMED FIRST TIME THE	
GRAV ERR ANGLE	- ТНЕ .	• LGC	WILL ASSUME THE AR GRAVITY VECTOR	
ANGULAR CIFFERE BETWEEN PRESENT	NCE .	• T O	BE PARALLEL TO	
ANY PREVIDUSLY	DE	• THE	LM X AXIS.)	#970
FINED GRAVITY V Polarity is alw	AYS +	•	•	
IN DEGREES TO N EST .C1 DEGREES	•	•	•	
(NOTE: UNTIL TH Program is perf		•	•	
THE FIRST TIME LGC WILL ASSUME	THE .	•	•	
LUNAR GRAVITY V	ECTOR .	•	•	
TO BE PARALLEL THE LM X AXIS I	F P68 .	•	•	#980
WAS PREVIOUSLY Pleted. IF P68		•	•	
NCT PREVIOUSLY PLETED, THIS DI	CGM Splay .	•	•	
IS MEANINGLESS		•	•	
	•	•	•	
	•	•	•	
	•	•	•	
	•	•	•	
	•	•	•	
2-	•	•	•	
7	•	•	•	P 57/LUH INARY
	-	-	• (. (
			(``

*

	• •	•	
	• •	•	
THE FIRST PASSI.	• •	•	
(NOTE: A PREVIOUSLY	• •	•	
DEFINED GRAVITY	• •	•	
VECTOR HAS ONLY BEEN	• •	•	
RETAINED FOR COMPA-	• •	•	
RISCN IF THIS DIS-	• •	•	
PLAY WAS NOT TERMI-	• •	•	
NATED AT THAT TIME	• •	•	
BY V34E).	• •	•	
	• •	•	
•	• •	•	
•	• •	•	
•	• •	•	
•	• . •	--	
•	• •	DO E WISH TO COM	-
•	• •	PLETE ALIGNMENT	NOW ?
•	• •		
•	• •	↓ Ν	• Y
•	• •	•	
•	• •	•	
•	• •		
•	• •	DO I WISHTO	
•	• •	REMEASURE THE	•
•	• •	LUNAR GRAVITY	
•	• •	VECTOR?	
•	• •		•
•	• •	.Y N.	•
•	• •	• •	•
•	• •	• •	•
	•••••	•	•
WAIT FOR KEYBOARD ENTRY	• • • • • • • • • • • • • • • • • • • •	KEY IN .	•
ENIKT	••••••	RECYCLE .	•
	• •	V32E .	•
	• •		•
	• •	• •	•
	• •	• •	•
	• •	• •	•
	• •••••	•••	•
	•	•	•
	•	•	•
	•		•
	• •	KEY IN	•
		TERMINATE	•
	• •	V34E	•
	•		•
	•	•	•
•	•	•	•
	•	•	•
	•	•	•
	•	•	•
•		•	•
	-	•	•
	-	•	•
•		•	•
•		•	•
	-		
•	•	•	•
	•	•	•
	•	• •	•
-	•		• • •
-		• • • •	• • • •

٠

:

٠

•

•

•

#990

#1000

#1010

#1020

#1030

,

			•	•		•
TERMI	NATE FLASH U	DCA	•	•		•
	PT OF PROCEE		• •	•	VEV IN	
	LE, OR		• •		KEY IN I	-RUCEEU
TERMI				•		
-			•	•		•
• P	.T	•R		•		•
. R		• E		•		•
•0	•R	•Č	•	•		•
C		•C	•	•		•
E			•	•		•
ε.		•L	•	•		•
D			•	•		•
	+	• E	•	•		•
•	~	•	•	•		•
•	• 5	•	•	•		•
•	• •	• • • •	•	•		•
•	•			•		•
•	-			•		•
•	•			•		•
•	•			•		•
•	٠			•		•
•						•
	FINAL AUTO-		• •	DO FI	NAL AUTO	
	IC REQUEST		*****	MATIC	REQUEST	•
	MINATE ROLTI	I NE	• •	TERMJ	INATE ROU	TINE.
• (R(001			(R00)		•
•						
•	•				•	
•	•				•	•
•	•				•	
•	•			нСн		
•	•			FROM		
•				ABOVE		
•	•			•	•	
•	EXIT P57			-	EXIT PS	7
•				-		
•						
•						•
•	4C4					
	FROM ABO) VE		CONST	DER THIS	TC BE
	-				IRST PAS	
					GH THE A	
					PROGRAM.	
	•				STORED	
	•••				UDE OR R	
IS THE	ATTITUDE FL	۸.C			ABLE AT OF THIS	
SET?		MC		PREGR		
				-	AM(
. Y	۸.	-				
	R.			-	. N	· Y.
•	•				•	•
•	•				•	•
•	•				•	•
•	•				•	•
•	•				•	•
•	•				•	•
•	•				•	•
•	•				•	•
•	•				•	•
•	•				•	
•	-				•	-
					-	1 -

43⁴

- í

÷

•

•
•
•

.

•

.

#1040

.

#1050

#1060

#1070

#1080

P57/LUMINARY

(

.

•			
•			• 523
•		•	• P57/LUM IN AR
•		-	•
		•	•
		•	•
• • • • • • •		•	•
		•	•
•		•	•
•		•	•
•		•	•
•		•	• #10
•		•	•
• ••			
• •	•	•	
• •	•		
		•	•
RESET THE INITIAL	-	•	•
ALIGN FLAG.	•	•	•
ACTON ICAG.	•	•	•
	•	•	•
•	• ••		•
•	• •	• •	• #11
•	• •	• •	•
	• •		
CHECK THE TECHNI-	• •	CHECK THE TECHNI-	•
QUE OPTION CODE	• •	QUE OPTION CODE	•
			•
.000000	• •		•
.00001 .0 .0	• •	.00002 00000.	•
	• •	.00003 00001.	•
.(NOTE: .C.C	• •	. (NOTE: ON .	•
.ON THE .0 .0	• •	 THE FIRST 	
•FIRST •2•3	• •	PASS THIS .	
-PASS	• •	. LEGIC PATH .	* #11!
•THIS • •		• EXISTS IN .	
• LCGIC • •	•	- THE PROGRAM .	
•PATH			•
EXISTS .			
IN THE	• •	. IT IS NEVER .	•
	• •	USED HOWEVER.	•
•PROGRAM	• •	- ASITHAS	
•AS SHO- • •	• •	BEEN PRE-	
- in N	• •	CLUDED BY	
•IT IS •••	• •	 PREVIOUS 	• • • • • • • • • • • • • • • • • • • •
•NEVER • •		. LOGIC. SEE .	#11.
•USED • •	•	. ABGVE)	•
HOWEVER	-		•
AS IT	• •	• • •	
HAS BEEN	• •	• • •	•
000010	• •	• • •	•
PRECLU-	• •	• • • •	•
DED BY .	• •	• ••••••	•
•PREVIOUS • •	• •	• • • •	
•LCGIC• • •	• •	•	
•SEE • •	• •		
•ABCVE)	· ·		*11:
		•	
	• •	•	
	• •	•	
• • • •	• •	• .	,
• • • •	• •	•	
• • • •	• •	• •	
· · · ·	• •	•	
· · · <u>·</u>	• •	•	
• • • -		- -	
	• •	-	
	• •	•	
• • • •	• •	•	
• • • •			0577111MTN A0V
• • • •	•	•	P57/LUMINARY

· ·			
• • • • •	•	• •	• 524
• • • • •	•	• •	P57/LUNI NARY
• • • • •	•	• •	•
• • • • •	•	• •	•
• • • • •	•	• •	•
• • • • •	•	• •	•
• • • • • •	•	• • •	•
• • • • • • •	•	• •	•
• • • • •	•	• •	•
• • • •	•	• •	•
• • • •	•	• •	•
DEFINE UNIT	•	• •	•
LOS VECTORS IC	•	• •	• #1140
LOS VECTORSAS DESCRIBED IN	•	• •	•
SECTION	•	• • •	•
5. 6. 2. 2 OF	•	• •	•
R567.	•	• •	•
	•	• • •	•
······································	• .	• •	•
• • •	• •	• •	•
• • •	•	• • •	
· · · ·	•	• • •	•
• SET STAR INDI- •	• •	• •	* #1150
• CATOR = 0.	• •	• •	· · · · · · · · · · · · · · · · · · ·
	• •	• •	•
•	• •	• • •	
• • •	•	• • •	
•••••••	• •	••••	
• •	• •	• •	•
	•	• • •	
••••	• •	· • •	•
	• •	• •	
		• •	#1160
· · · · ·	•••	• •	•
	••••	• •	
SET STAR INDI-	•••	• •	
- CATOR = 1	•••	• •	
		• •	
• •	••••••	• •	
• • •		• •	
•••	•••••	• •	
	•••••	•	
. CO LUNAR SURFACE	••••	DO LUNAR SURFACE	#1170
• SIGHTING MARK	••••	DU LUNAR SURFACE .	
• ROUTINE (R 59)			
·	••••		
	••••••	• CELESTIAL DUDY #1 •	
• •	••••••	• • • • • • • • •	
• •	•••	• • •	
•	••••••	- • •	
	•••	• • • •	
DO CELESTIAL BODY		. DO CELESTIAL BODY .	
DEFINITION ROU-	** * *	DEFINITION ROUTINE .	#1180
. TINE (R58) FOR			
. CELESTIAL BODY	•••••	••••••••••••••••••••••••••••••••••••••	
•	•••••		
•	•••••	•••••••	
	-	••••••	
•	•••••	• • •	
•	••••••	•••••••••••••••••••••••••••••••••••••••	
-	•••••	•••	
-	••••	• •	
•	••••	• •	
-	•••••	•• •	P57/LUM INARY
•	••••	• • •	
•	••••	•• , •	
		1	1

(

(

436

1 .

•		• •	• • •		
•		••	• • •		
•		• •			
•		• •			
•		• •			
 ACTU 	ALLY USEC			LSED.	
			• • •		
-	•	••	• • •	-	
•	•	• •	• • •	•	•
•	•	• •	• • •	•	-
		• •	• • •		
- 15 S	TAR INDICATOR	• •		IS TECHNIQUE	0P
 GREA 	TER THAN			TION CODE	
 2 ER0 				= 00002?	•
					•
• •Y	• N	••	• • •		•
• • •	• 11	• •		٠Y	N
• •	•	• •	• • •	•	• •
• •	•	• •		-	
• •	•••	• • • • •		•	
• •				-	
		-		-	• •
		•	• • •	•	• •
DEFL	NE UNIT LOS	•	• • •	•	• •
		•		•	
	CR AS DESCRI-	•		•	
- BED J	IN SECTION	•		•	
. 5 .6 .2	2.2 OF R567			-	•••
		_		-	• •
-	_	•	• • •	•	• •
-	•	•	• • •	•	• •
•	•	•	• • • •		
•	•	•		• DO R59 FOR	
•	•	•		CELESTIAL BOD	Y
•	•			#2	•••
	-	_			• •
-	•	•	• •		• •
•	•	•	••	-	• •.
•	•	•	• •	•	• •
•	•	•	• •	•	
•	•	•	• •		
•	•	•		DO R58 FOR CE	1 F
•	•	_		STIAL BODY #2	
-		-		ACTUALLY LOOP	• •
-	•	•	• •	ACTUALLY USED	• • •
•	•	•	•		• •
•	•	•	•	•	
		-	•	•	
TRANSFOR	IN LOS VEC-			_	
	REFERENCE	-	-	•	••
	TES TO CE-	-	•	•	• •
	L COCR-	•	•	•	• •
	UUUK-	-	•	•	• •
DINATES		•	•	•	• •
		•	•	-	
	•	•	•	•	
	•	-	-	-	
		-	-	•	• •
	-	-	•	•	• •
	M. M. Low	•	•		
IS INITI	AL ALIGN	•	•	IS THIS THE F	
LAG SET	?	•	•	PASS THROUGH	THE
	--	•	•	ALIGNMENT PRO	GRAM?
•Y	Ν.	•			
•	•			•N	Υ.
-	_	-	-		• •
-	•	•	•	•	•
-					

٠

٠

•

.

.

٠

٠

•

•

. .

. . .

.

43⁷

#1190

#1200

#1210

#1220

#1230

.

		52	6	
Ρ	57/L	UM	INA	RΥ

#1240

#1250

#1260

#1270

#1280

P57/LUN IN ARY

	•	•	•	•	•	•
	•	•	•	•	•	•
	•	•	•	•	•	•
	•	•	•	•	•	•
	•	•	•	•	•	•
	•	•	•	•	•	•
	DO SIGHTI DI SPLAY RI (R54)		• • •	• •	DO SIGHTING D DISPLAY ROUT	
	• • • • • • • • • • • • • • • • • • • •		••	• •	(R54)	•
	• •E	۰É	•	•	•E	Ε
	• •X	•x	•	•	• X	X
	1	• I	-		1.	î
	• •1	• T	•	•	•1	T
	• •		•	•	•	
	*	• *	•	•	•"	н
	• • A	•8	•	•	• B	A
	• • *	."	• .	•	.*	"• •
	• •	•	-	•	•	• •
	••	•	•	•	•	• •
	• •	•	•	•	•	• •
	• •	•••	•	•	•••	•••
		GGTC	•	•	60 T O	• •
	• •	трн .			10 H	• •
	• •	BELOW	•	-	BELOW	•••
	• •		•			
	• •		•	•		• •
**	• •		•	•		
+03	• •		•	•		
+EDIT	• •		•	•		• •
+	• •		•	•		• •
÷.	•••		•	•		• •
+						• •
+	COMPUTE DESIG	RED GYRO	•	•		
+	TORQUING ANG	LES .	•	•		• •
+			•	•		• •
•	•		•	•		• •
+	•		•	•		• •
*	•		•	•		• •
+	IS INITIAL AL	IGN	•	•	IS THIS THE F	1051
+	FLAG SET?		•	•	PASS THROUGH	
+			•	•	ALIGNMENT PRO	
+	•Y	N	•	•		
+	•	•	-	•	• N	Υ.
+	•	•	•	•	•	•
+ POSS	•	•	•	•	•	•
HOLD .	. FLASH VERE		•	•	MONITOR DSKY:	•
	TO REQUEST		• • • • • • • • • •	• •	OBSERVE VERB	
SNAP .	. NSE AND DE				FLASH TO REQU	
+	. GYRO TORQU		•	•	RESPONSE AND	DIS-
+	•		•	•		•
+	•		•	•		•
+	•		•	•		-
•	•		•	•		•
+	•		•	•		•
T	•		•	•		-
*	•		•	•		•
•	•		•	•		•
+	-		•	•		•
+	-		•	•		•

438 +

-			•	•		
•			•	•		
:			•	•		
•	ANGL ES:		•	•	ΡΙΔΥ	OF GYRD TOP
٠	V06N93	,	•	•		GANGLES.
٠	R 1- X G		•	•		ANGLES WIL
٠	R2-Y (•	•	BE AF	PLIED TO TH
٠	R3-Z G	YRC	•	•	IMU L	INLESS I REC
٠			•	•		DC I WISH T
	IN DEGRE	• CO1 DEG-	•	•		T GYRD TOR-
	REE.	• COI DEG-	•	•	CUINC	57
			•	•	•¥	
•	•				•••	N
•	-	،	•	•	•	
٠	•		•	•		
٠			• •	•		
		KEYBOARD	******	• • • • • • • • •		N PROCEED
•	ENTRY		••	•		
:			٠	.•	•	
			•	•	•	
					•	
•			-		- KF	Y IN RECYCL
•			•	•	• V3	
•			•	•		*
	TERMINAT		•	•	•	•
	UPON REC		•	•	•	•
	PROCEED CYCLE	UK KE-	•	•	•	•
•			•	•	•	•
	•P	• R	•	•	•	•
	• R	• E		•	•	•
	.0	•C	•			•
•	•C	.۲	•	•	•	
	•E	• C	•	-	•	•
	•E	-L_	•	•	•	•
•	• D	۰E	•	•	-	•
•	•	•	•	•	•	•
	•	•	•	•	•	•
		•••	•	•	•	•••
•	•	GOTO	-			GOTO
•	-	41 D 14	•	•	-	"D"
•	•	BELOW	•	•	•	BELOW
•	•		•	•	•	
•	•		•	•	-	
<u>s</u>		TORCUING	•	•		
	LE GREAT		*	•		NY GYRO TORO
	VALAN		•	•	ING A	NGLE GREATE
			•	•		
			-	•		
			•	•		
			•	•		
			•	•		
			•	•		
			•	•		
			•	•		
			•	•		
			•	•		

•

+

٠

++

+ +

++

439

.

.

#1290

#1300

#1310

#1320

#1330

,

+			•	•		
+	5 DEGREES	57	•	•	THAN 5 DEGREES	52
+	•N	Y.	•	•		
+	•	•		•	• *	• N
+	•	•	•	•	•	•
+	•	•	•	•	•	•
+	•	•	•	•	•	•
+	•	•	•	•	•	•
+	•	•	•	•	•	•
+	•	•	•	•	•	•
+			•	•	•	•
+	. CALCUL	ATE DESIRED	•	•	•	•
+		INBAL ANG-	•	•	•	•
+	• LES TO	ALIGN THE	•	•	•	•
+	. RED GR	IENTATION	:		•	•
+	•		•	•	•	:
+	•	•	•	•	•	•
+	•	•	•	•	•	•
+			•	•		
+		INI TI AL	•	•	IS THIS THE FI	
*		FLAG SET?	•	•	PASS THROUGH T	
+	• •N	Y.		•	ALIGNMENT PRD- GRAM?	•
+	• •	•	•	•		:
+	• •	-	•	•	•Y	N
*	••	•	•	•	•	••
+	•••	•	•	•	•	• •
+	• •		•	•		
HOLD .		H VERBNOUN Equest Re	•	• •	MONITOR DSKY:	••
S NAP		SE AND DIS-	••••••••	• •	OBSERVE VER NOUN FLASH TO	8
+		THE RESUL-	•	•	REQUEST RESPON	SE.
+		ICDU GIMB-	•	•	AND DISPLAY OF	• •
+		NGLES: 6 N22	•	•	ICDU GIMBAL AN	
+		- 06	•	•	GLES AFTER PRO- POSED LM IMU	•••
+	• • R <u>2</u>	- IG	•	•	ALIGNMENT	•••
* *	•• R3	- MG	•	•		
+	•••	GIMBAL AN-	•	•	•	• •
+	• • GLES	IN DEGREES	•	-	•	•••
+	TO N	EAREST .01	•	•	•	
+ +	• •		•	•	•	••
+	- •		•	•	•	••
+	••		•	•	•	••
+	• •		•	•	-	• •
+	•••		•	•	•	• •
•	• •		•	•	•	••
+			•	•	•	••
+	••		•	•	•	• •
+	•••		•	•	•	••
+	• •		•	•	•	••
+			•	•	•	•••
, *					(

.

•

.

•

.

٠

٠

440

#1340

#1350

#1360

#1370

#1380

P 57/L UH INAR Y

-					
· •	• •	•	•	•	
•	• •	•	•	•	• •
•	• •	•	•	•	• •
		•	•	•	• •
	• DEGREE	•	•	•	••
			•	•	••
•	• • •	•	•		•••
•	• • •	•	•	•	
•	• • •	•	•	•	• •
•	AIT FOR KEY-	••	•		•••
	BCARC ENTRY	• • •	•	• KEY IN PROCEED	• •
•	•		•		••
•	• •	•	•		•••
•	• •	•	•	•	
•	• TERMINATE FLASH	-	•	•	• •
•	PROCEED	•	•	•	••
		•	•	•	••
-	• •P		•	•	•••
-	• •R	•	•	•	•••
•	0	•	•	•	
•	••• <u>•</u>	•	•	•	• •
•	• • • £ • • • E	•	•	•	• •
	• •D	•	•	•	• •
•	• •	•	•	•	••
•	• •	•		•	• •
•		•	•		•••
•	COMMAND ISS TC	•	•	•	•••
•	COARSE ALIGN MODE	-	•	•	
•		•	•	•	••
		•	•	•	••
•	•			•	• •
•		• •	• •		
•	TURN ON "NO ATT"	•••••	• • • • • • • • • • • • •	OBSERVE "NO ATT"	
•	LIGHT	••	• •	LIGHT TO INDICAT	Έ.
•		•	•	THAT IMU IS IN	•
	•	•	•	COAR SE ALIGN MOD	t.
•	•	•	:		- •
•	•	•	•	•	
٠	•	•	•	•	•
•	RESET TRACK FLAG.	•	•	•	•
	TESET TRACK FEAG.	•	•	•	•
•	•	•	•	•	•
•	•	•	•		•
•	•	•	•	•	
٠		•	•	•	•
•	RESET DRIFT FLAG.	•	•	•	•
	•	•	•	•	•
	•			•	•
•	•	•	•	•	
•	•	•	•	•	•
•	•	•	•	•	•
•	•	•	•	•	•
•	•	•	•	•	•
	•	•	•	•	•
•	•	•	•	•	•
-	•	٠	•	•	•
-	•	•	•	•	

+

++++

++++

+ +

ايدرم

(529 P57/LUM INARY

#1390

#1400

#1410

#1420

#1430

•	•	•		•
•	•	-		
•	-			-
	•	•		•
-	•	•		•
•	•	•		•
•	•	•		•
	•	•		
RESET REFSMMAT		-		-
FLAG.	_	-		•
	•	•		•
------- -	•	•		•
•	•	•		•
•	•	-		
•		-		
	_	-		•
CCARSE ALIGN ISS	•	•		•
CONSE ALIGN 133	•	•		•
	•	•		•
•	•	•		•
•	•			
•	_	-		•
	•	•		•
INCLES IN AT THE	•	•		
INCTE: IF AT ENC	•	•	٠	(NOTE: IF AT END
OF COARSE ALIGN-				OF CCARSE ALIGN-
MENT THE GIMBALS	_	-	-	MENT THE GIMBALS
ARE NOT WITHIN 2	•	•	•	
DEGREES OF THE	•	•		ARE NOT WITHIN 2
	•	-		DEGREES OF THE
DESIRED VALUES,	•			DESIRED VALUES,
THE LGC WILL TURN	-	-		THE LGC WILL TURN
ON THE PROGRAM	•	•		
	•	•		ON THE PROGRAM
ALARM LIGHT AND	•	•		ALARM LIGHT AND
STORE ALARM CODES	•	•		STORE ALARM CODES
00211 AND 00217).	-	-		00211 AND 002171.
	-			00211 AND 002111.
		•		
•	•	-		•
•	•	•		•
•	•	•		-
		-		_
TERMINATE COARSE	-	-		•
ALIGN MODE IN ISS	•	•		•
ALION HODE IN 135	•	•		•
	-	•		•
•	•			
•	-	-		•
	•	-		•
• •	•	•		-
	•	•	•	
TURN OFF "NO ATT"	********			OBSERVE TERMINA-
L IGHT		-		TION OF "NO ATT"
	-	-	-	LIGHT TO INDICATE
-	•	•		
•	•	•		THAT INU IS NOW
•	•	•		INERTIAL
•	•			
	•	-		_
SET CRIFT FLAG.	-	-		•
	•	•		•
	•	•		•
•	•	•		•
•	•	•		•
•		•		-
-	-	-		•
•	•	•		•
•	•	•		•
•	•	•		•
•	•	•		
_		-		•
•	•	•		•
•	•	•		•
•	•	-		•
•		-		-
-	-	•		•
•	•	•		•
•	-	•		•
	-			
•	•	-		_

+

.

442

#1440

#1450

#1460

#1470

#1480

P 57/L UMI NARY

+	•	•	•		\ 531
44t3 +	• •	• •	•	•	P57/LUMINARY
+	• •	• •	•	:	
+	•	• •	•	•	
+	• • •	• •	•	•	
+	 COMPLTE DESIRED GYRO TORQUING 	• •	•	•	
+	• ANGLES •	• •	•	•	
+	•	• •	•	•	
+	• •	• •	•	•	
+ +	• •	• •	•	-	#1490
+ 03	• •	• •	•	•	
++	• •	• •	•	•	
	PULSE GYRUS THROUGH	• •	•	•	
	DESIRED ANGLES TO	• •	•		
	ALIGN IMU.		•	•	
	•	• •	•	•	
	•	• •	•	•	#1500
		• •	•	•	
	SET THE REFSMMAT Flag	• •	•	•	
		• •	•	•	
	•	• •	•	•	
	•	• •		•	
	•	• •	•	•	
		• •	•	•	#1510
	DEFINE REFSIMMAT TO BE THE DESIRED INU	• •	•	•	
	ORIENTATION.	• •	•	•	
	•	• •	•	•	
	•	• •	•	•	
	•	• •		•	
	IS TECHNIQUE OPTION CODE = 00000?	• •	IS TECHNIQ CODE ≠ 0000	07	#1520
	• N •Y	• •	.Y	N.	
	• •	• •	•	•	
	• •	• •	•	•	
	. GO TO	• •	601 0	•	
	• 60.10	• •	GO TO	•	
	•	• •		•	
	•	• •		•	
	•	• •		•	
	•	• •		•	
	•	• •		•	
	•	•••		•	
	•			•	
		• •		•	P 57/LUM INARY
	•	• •		-	

	•			•	•		•
	•			•	•		•
	•			•	•		•
	•			•			
	•			•	•		•
	•		*D *	-	-	нСн	•
	•		BELOW	-		BELOW	•
	-		DEEGN	•	•	DELUM	•
	-			•	•		•
	•			•	•		•
				•	•		
	IS INIT FLAG SE		LIGN	•	•	WAS THIS THE Pass through	THE
				•	•	ALIGNMENT PR	DGRAM?
	<u>-</u> N		¥•	•	•		
	•		•	•	•	.Y	Ν.
	•		•	•	•	•	
	•		•	•	•	•	-
	•		•	•	•	•	
	•		•	-	-	-	•
					•	•	•
	-				•		•
	-			•	•		•
	•			•	•	THE NEXT PAS	515.
	•			•	•	THE SECOND P.	ASS
	•			•	•		
				•	•	•	•
	COMPLITE			•		-	-
	PRESENT			•	•	•	•
	IN MOON			-			•
	DINATES			-			•
		-		•	•		•
				•	•		•
		•		•	•		•
		•		•	•		-
		•		•	•		•
				•	•		
	SET ATT	ITUDE	FLAG.	•	•		
		•			-		•
							•
		-		•	•		•
		•	#D#	•	•		•
		•		•	-	** D**	•
		٠	FROM	•	•	FROM ABOVE	•
		•	A BOV E	•	•	•	•
		•	•	•	•	•	•
		•	•	•	•	•	-
				-	-	-	•
		-	***	-	-	•	•
		•		•	-	• • •	•
			•	•	•	•	•
LD .	ELAGU NO	00 10		•	-		
	FLASH VE	: KD-NC	UN IU	•	•	MONITOR DSKY:	
	REQUEST	PLEAS	E PER-			OBSERVE VER	
AP .	FORM FIN V5CN2		GNMENT:	•	•	 FLASH TO REQU PLEASE PERFORM 	
				•	•		
				•	•		
				-	-		
				•	-		
				•	•		
				•	٠		
				•	•		
				•	•		
				•	•		
				•	•		
				•	•		
				•	•		

:

:

yyyt

.

532 P57/LUMINARY

#1530

#1540

#1550

#1560

#1570

P57/LUMENARY

	•	•		
R1 - 00014	•	•		
R2 - BLANK	•	•	AL IGNMENT	
R3 – BLANK	•	•		
		•	•	
•	•	•	•	
•	•	•	•	
	•	•	•	
•	•	:	00 I WANT 1	
•	•	-	DO I WANT 1 ALIGNMENT A	IU IKY IHE Ngata og
•	•	•	CHECK THE	TINE
•	•	•	ALIGNMENT?	
•	•	•		
	•	•	• Y	N.
•		•	•	•
			•	•
AIT FOR KEY BOARD	• • • • • • • • • • •		. KEY IN PROC	FFD .
NTRY	• •	•		
	•	•	•	•
	•	•	-	•
	•	•	•	•
	•		*******	•
	•			•
	•			
	•			•
	•			•
	•			
			DO I WISH T MINE THE LM	U DETER-
	•		SURFACE POS	
	•		VEC TOR?	** 104
	•		(NOTE: THIS	IS ONLY
	•		APPLICABLE	IF IN
	•		OPTION #2, /	AND THIS
	•		PROGRAM (P5	7) HAS
			BEEN PREVIOU PLETED USING	JSLY CCM-
	•		OPTION #1 OF	P CITHER
	•		#3.)	OPTION
	•			
	•		• N	Υ.
	•		•	-
	•••		•	•
	*********	•••••	-	
	••		•	
	•		•	•
	•		•	•
	•		•	•
	•		•	•
	•		•	•
	•		•	•
	•		•	•
	•		•	•
	•		•	-
	•		•	•
	•		•	•
	•		•	•
			-	•

•

•

#1580

#1590

#1600

#1610

#1620

			•	•		•
T 60M 11	NATE FLAS		•	•		•
	PT GF PRO		• •		IN TERM	•
	OR TERM				ATE, V34E	
			••	111	AIC: 434C	•
•E	• T	• P	-			•
-N	۰E	• R		•		•
•T	• R	.0				•
•E	• M			•		•
.R	-1	•E	•			
•	-N	•E	•			
•	• A	• D	•	-		
•	•T	•	•			
•	۰E	•	•	•		
•	•			•		•
•	•			•		•
•	•			•		•
•						
	FINAL AUT		•	• DO	FINAL AU	T0
	IC REQUES				IC REQUE:	ST 🔒
	MINATE RO	DUTINE	•	• TEF	RMINATE	•
. (RC	90)			ROL	ITINE (RO	0) _
•						•
•	•				-	•
•	•				•	•
•	•				•	•
•					***	•
•	EXIT PS				•	•
•	EALC P3	• 1			EX IT (•57 •
•						•
•						•
IS TEC	HNIQUE OF				TECHNICON	- corler
	000027	1104			TECHNIQUE = 00002	
				CUU		<u> </u>
•N	Υ.				N	Υ.
•	•					
•	•				,	
	•				•	•
•	•					•
GO TO	•			GO	TO	•
н Ти	•			"A	Ħ	•
BELCW	•			8EL	0W	•
	•					•

٠

•

٠

٠

•

•

• CALCULATE THE PRES-ENT LM LUNAR SURFACE

446

#1630

#1640

#1650

#1660

#1670

P 57/LUMINARY

447

PCSITICN VECTOR REFERENCE COCRDI NATES FROM THE STCRED LUNAR GRA VECTOR, LATEST R MAGNITUDE, AND T JUST-COMPUTED REFSMMAT	- VITY LS	• • • • • • • • • • • • • • • • • • •		#168 0
• • • •		• • • •	••••	#1690
HOLD . FLASH VERB-NOUN SNAP . TO REQUEST RES- PONSE AND DIS- PLAY STORED LANDING SITE COORD INA TES.		MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF COMPUTED LANDING	•	• •
VO6 NB9 R1 - LAT R2 - LONG/2 R3 - ALT LAT-SELENOGRA- PHIC LATITUDE	MON ITOR LGC CONNLINK	COORDINATE EVALU- ATION OF THE LGC-	• • • • • • • • • • • • • • • • • • • •	#1700
TION VECTOR. POLARITY INDIC- ATES NORTH (+) OR SOLTH (). IN DEGREES TO	LAT, LONG/2, ADD ALT. CO- ORDINATE EVALUATIONS OF LGC-CCM- PUTED PARA- METERS WITH	CCMPUTED PARAMETERS WITH THE GROUND.	• • • • • •	#1710
LONG/2-SELENO- GRAPHIC LONGI- TUDE (DIVIDED BY TWG) OF THE LM LUNAR SUR- FACE POSITION		IS THE CISPLAYEC DATA ACCEPTABLE? .Y N.	• • · · · · · · · · · · · · · · · · · ·	#1720
•			•	
		• •	• • •	P 57/LUN INARY

:

			•	-	•		•	•	536 P57/LUMINARY
			•		•		•	•	
VEC	TOR.		•		•		•	•	
PGL	ARITY	INCIC			• • - ·				
OR DEG					• D	D I HAVE BETTE ATA FRGM ANCTH DURCE?		:	
	REE.		•	•	• •	N Y	•	•	#173
AL T	– THE	ALTI-	•		: :		•	•	
TUD	E OF	THE LM	•	•			•	•	
		RFACE VEC TO	· ·				•	•	
A80	VE TH	E RAD-	•					•	
		HE MCS		•	• •		•	•	
	LANDI		•				•	•	
SI T	E. IN	NAUT-	•		• •		•	•	#1740
		ES TO .01 NM	•	•	•		•	•	
				•	•••		•	•	
		•	•	•	•		•	•	
		•	-	•	••		•	•	
							•	•	
	T FOR RD EN	KEY-	•	•	• •		•	•	
OU AF	NU EN	18.1	•	•	•		•	•	
			• •			KEY IN V25E		•	#1750
			*** *********	• • • • • • • • • • • • • • • • • • • •	••	AND LOAD THE		•	
			• •	•	•	CORRECT CO- ORDINATES		•	
			•	•	•			•	
			•	•	•	٠		•	
			•		•	•		•	
			•	•	•			•	
			•	•	•				#1760
		E FLAS			, <u> </u>				
		EIPT OF TERM-		• • • • • • • • • • • • • • • • •	KI	Y IN TERMINAT	E,		
		R NEW	• •	•	V	34E 			
DATA	4		•	•			•		
			•	•		•	•		
			•	• 			•		
			•••••	••••• KE	Y I	N PROCEED	•		#1770
			••				•		
• P	.1	NEW		•		-	-		
• K	•E	DATA.	•	•			•		
•			•	•		•	•		
•	•	•	•	•			•		
•	•	•	•	•		-	•		
•	•		•	•		•			
•	•	•	•	•			•		
•	:	•	•	•		•	_		P57/LUM INARY
•	-			•		-			
						((
						``			`

•

448

. *

· · ·	
• • • •	• •
• • • •	• •
• • • •	• •
	• •
-0 -R	• •
•C •N	• •
•E •1	•
•E •N STORE •	
-D -A CATA -	•
• •] •	• •
• •E • •	• •
• • • •	• •
	• •
	• •
• • • •	
• • • •	
• • • •	• •
• • • •	• •
• • • • • • •	• •
• •	• •
	•
 MATIC REQUEST TERMINATE ROUTINE (ROO) 	 MATIC REQUEST TERMINATE ROUTINE (ROO)
· ····································	
• •	• • •
·	• • •
· · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·
· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·
· · · · · · · · · · · · · · · · · · ·	·
· · · · · · · · · · · · · · · · · · ·	·
EXIT P57	
EXIT P57 CALCULATE (BASEC ON	
CALCULATE (BASEC ON CREW-APPROVED N89)	
CALCULATE (BASEC ON CREW-APPROVED N89) AND STORE NEW VALUE	
CALCULATE (BASEC ON CREW-APPROVED N89) AND STORE NEW VALUE OF PRESENT R IN	
CALCULATE (BASEC ON CREW-APPROVED N89) AND STORE NEW VALUE OF PRESENT R IN -LS MCCN-FIXEC CCORDI-	
CALCULATE (BASEC CN CALCULATE (BASEC CN CREW-APPROVED N89) AND STORE NEW VALUE OF PRESENT R IN -LS MCCN-FIXEC CCORDI- NATES IN PLACE CF	
CALCULATE (BASEC ON CALCULATE (BASEC ON CREW-APPROVED N89) AND STORE NEW VALUE OF PRESENT R IN -LS MCCN-FIXEC CCORCI- NATES IN PLACE CF PREVIOUS R .	
CALCULATE (BASEC ON CALCULATE (BASEC ON CREW-APPROVED N&9) AND STORE NEW VALUE OF PRESENT R IN -LS MCCN-FIXEC CCORDI- NATES IN PLACE CF PREVIOUS R . -LS	
CALCULATE (BASEC ON CREW-APPROVED N89) AND STORE NEW VALUE OF PRESENT R IN -LS MCCN-FIXED CCORDI- NATES IN PLACE OF PREVIOUS R -LS TRANSFORM R TC	
CALCULATE (BASEC ON CALCULATE (BASEC ON CREW-APPROVED N89) AND STORE NEW VALUE OF PRESENT R IN -LS MCCN-FIXEC CCORCI- NATES IN PLACE CF PREVIOUS R . -LS TRANSFORM R TC -LS	
CALCULATE (BASEC ON CREW-APPROVED N89) AND STORE NEW VALUE OF PRESENT R IN -LS MCCN-FIXED CCORDI- NATES IN PLACE OF PREVIOUS R -LS TRANSFORM R TC	

:

.

449

7

#1790

#1780

(537 P57/LUMI NARY

#1800

#1810

#1820

,

STORE FOR TH LINK IN THE STATE VECTOR LOCATION, WI OF TRANSFORM	"LM # TH TIME		• • • •				
•			• •				
	₩A# Frgm Abcve		•	"A" FROM ABOVE			
•	•		•	•			
•	•		• •	•			
DO FINAL AUTO REQUEST TERM ROUTINE (ROO)	INATE	•	REQUEST ROUT INE	L AUTOMATIC TERMINATE (ROO)			i
:				•			
•				•			
EXIT P57				хIт 57			1

٠

•

.

#1850

CHANGE CONTROL NOTES

REV 01 PCR 106,138,234,439,469,489,608 REV 00(LLM 1A) PCR 696,698 REV 01(LLM 1A) PCR 754,755 REV 02 EDITORIAL REV 03 EDITORIAL

P577 LUMINARY

. .

REV 03 12/03/69

- PURPOSE: (1) TO CALCULATE THE REQUIRED TIME OF DPS IGNITION (TIG) AND OTHER INITIAL CONDITIONS REQUIRED BY THE LGC FOR A PGNCS-CONTROLLED, DPS-EXECUTED, BRAKING PHASE OF THE POWERED LANDING MANEUVER.
 - (2) TG PROVIDE OPTION TO FINE ALIGN THE IMU TO AN EXISTING REFSMMAT.
 - (3) TO ALIGN THE LN TO THE THRUSTING IGNITION ATTITUDE.
 - (4) TO CONTROL THE PENCS DURING COUNTDOWN, IGNITION, AND THRUSTING OF THE POWERED LANDING MANEUVER UNTIL HI GATE.

(5) TO INDICATE THAT HI GATE HAS BEEN REACHED (TGO LESS THAN TENDBRAK) BY AUTOMATIC SELECTION OF THE APPROACH PHASE PROGRAM (P64).

ASSUMPTIONS: (1) THE LM IS ON A DESCENT COAST ORBIT (HCHMANN TRANSFER) APPROACHING THE BRAKING IGNITION POINT WHICH IS NOMINALLY 50,000 FT. ABOVE THE LUNAR RADIUS AT THE DESIGNATED LANDING SITE. THE DESCENT COAST ORBIT IS APPROXIMATELY COPLANAP WITH THE CSM ORBITAL PLANE. IF THE DESIGNATED LANDING SITE IS NOT IN THE DESCENT COAST PLANE AT THE NUMINAL TIME OF LANDING THE PLANE CHANGE WILL BE ACCOMPLISHED BY THE POWERED LANDING MANEUVER (BRAKING PROGRAM (P63) AND APPROACH PROGRAM (P64)].

> (2) THE CSM IS IN A NEAR-CIRCULAR ORBIT AROUND THE MOON AT A NOMINAL ALTITUDE OF 60 NAUTICAL MILES. THE CSM IS MAINTAINING A PREFERRED TRACKING ATTITUDE FOR OPTICAL TRACKING OF THE LM.

(3) THE INU IS ON AND ALIGNED TO A LANDING SITE ORIENTATION DEFINED FOR THE DESIGNATED LANDING SITE AND THE NOMINAL TIME OF LANDING (T(LAND)), BUT SHOULD BE FINE ALIGNED TO THIS DRIENTATION AS CLOSELY AS POSSIBLE PRIOR TO DPS IGNITION. THE LM HAS NOT YET BEEN ALIGNED TO THE CORRECT ATTITUCE FOR IGNITION FOR THE POWERED LANDING MANEUVER.

(4) THE LANDING RADAR (LR) WAS ENERGIZED AND CHECKED OUT, AND MADE READY AT LR POSITION #1 PRIOR TO SELECTION OF THIS PROGRAM. RADAR DATA WILL NOT BE INCORPORATED INTO THE LM STATE VECTOR UNTIL THE ASTRONAUT SETS THE LR PERMIT FLAG VIA V57E INDICATING HE IS SATISFIED WITH THE QUALITY OF THE DATA (THE LR PERMIT FLAG IS RESET BY RCC, OR BY EXTENDED VERBS V57 GR V58).

(5) THE LGC WILL NEITHER DESIGNATE NOR READ THE RENDEZVOUS RADAR (RR) DURING THIS PROGRAM.

(6) THE LANDING ANALOG DISPLAYS ROUTINE (R10) IS ENABLED AT DPS IGNITION AND IS TERMINATED UPON TERMINATION OF AVERAGE G. THE POWERED FLIGHT DESIGNATE ROUTINE (R29) IS NOT ENABLED DURING THE LUNAR DESCENT.

(7) THE ENTIRE POWERED LANDING MANEUVER (BRAKING, APPRCACH, AND LANDING) WILL BE ACCOMPLISHED USING THE DPS ENGINE.

(8) THE AIM CONDITIONS FOR THE BRAKING PHASE ARE STORED IN THE LGC.

(9) THE FOLLOWING PARAMETERS REQUIRED BY THIS PROGRAM HAVE BEEN STORED BY THE LGC SINCE LGC INITIALIZATION BY ERASABLE REGISTER LCAD.

(A) THE LM AND CSM STATE VECTORS. THE LGC HAS UPDATED THESE AS REQUIRED. NO FURTHER STATE VECTOR UPDATES FROM ANY EXTERNAL SOURCE OTHER THAN THE LR WILL BE ACCEPTED BY THIS PROGRAM.

(B) THE NOMINAL LANDING TIME AT THE DESIGNATED LANDING SITE (T(LAND)) AND THE POSITION (RLS)

(10) THE DPS IS NOT THROITLABLE OVER THE WHOLE RANGE FROM O TO MAXIMUM. IT MUST BE OPERATED EITHER AT MAXIMUM THROITLE OR OVER A SPECIFIC THROTTLE RANGE OF LOWER SETTINGS. THESE THROITLE SETTINGS ARE SPECIFIED IN SECTION 5.3.4 OF R567 AND ARE TOTAL THROITLE SETTINGS, 1.E.: THE SUM OF THE MANUAL SETTING (WHOSE MINIMUM IS ABOUT 10 PERCENT) AND

541

THE PGNCS COMMANDED SETTING.

THIS PROGRAM ASSUMES THE THROTTLE CONTROL TO BE IN "AUTO" (THE DPS RECEIVES THE SUM OF THE MANUAL AND PONCS COMMANDED SETTINGS) AND THE MANUAL THROTTLE TO BE SET AT MINIMUM FOR "ZOOMTIME" SECONDS OF THRUSTING, AND THEREAFTER AT A LEVEL LESS THAN THAT REQUIRED BY THE LGC. THE VALUE "ZCOMTIME" IS IN ERASABLE STORAGE, HAVING BEEN LOADED PRIOR TC LAUNCH_OR BY P27.

DLE TO THE REGION OF FORBICCEN THROTTLING, THRUST COMMAND LOGIC IN CONJUNCTION WITH THE INTERIM TERMINAL CONDI-TIONS (SEE ASSUMPTION (8)) ASSURE THAT THE COMMANDED THROTTLE REMAINS AT MAXIMUM UNTIL THE GUIDANCE EQUATIONS FIRST REQUIRE IT TO BE WITHIN THE ALLOWABLE THROTTLE RANGE. THEREAFTER IT SHOULD REMAIN WITHIN THE ALLOWABLE THRUTTLE RANGE. THIS PRINCIPLE IS DESCRIBED IN MORE CETAIL IN SECTION 5.3.4 DF R567. THE RESULT IS A SMOOTH AND EFFICIENT THRUST ATTITUDE PROFILE THROUGHOUT THE BRAKING PHASE.

FURTHERMORE THE DPS MUST BE STARTED IN THE FOLLOWING SEQUENCE: +X AXIS 2 JET ULLAGE FOR 7.5 SEC; IGNITION AT MINIMUM THROTTLE; ULLAGE OFF 0.5 SECONDS AFTER IGNITICN: MINIMUM THRUST UNTIL TIG(AS DEFINED BY R41) + "ZOOMTIME"; AND THEN MAXIMUM THROTTLE. THE THROTTLE SETTING THEN BECOMES CONTROLLED BY THE GUIDANCE EQUATIONS.

(11) DURING THE POWERED LANDING MANEUVER, THE LGC WILL MENITER THE PRESENCE OR ABSENCE OF THE "NON-ATTITUDE HOLD" DISCRETE. THIS DISCRETE IS ISSUED TO THE LGC WHEN THE ATTITUDE MODE CONTROL SWITCH IS IN THE AUTO POSITION.

SHOULD THIS DISCRETE AFPEAR DURING THE POWERED LANDING MANEUVER, THE LGC ASSUMES THAT IT NO LONGER HAS COMPLETE AUTOMATIC CONTROL OF THE MANEUVER.

THE MONITOR AND THE ASSOCIATED LGC LOGIC IS INCLUDED IN THE LANDING AUTO MODES MONITOR ROUTINE (R13) WHICH WILL BE CALLED BY THIS PROGRAM.

(12) THE X-AXIS OVERRIDE OPTION PROVIDES THE CREW WITH THE ABILITY TO EXERCISE MANUAL CONTROL ABOUT THE LM X AXIS WITH THE ATTITUDE CONTROLLER EVEN THOUGH THE PONCS ATTITUDE CONTROL MODE IS AUTO, WHEN THE CONTROLLER IS RETURNED TO DETENT THE PONCS DAMPS THE YAW RATE, STORES THE YAW ATTITUDE WHEN THE YAW RATE IS DAMPED, AND THEN MAINTAINS THAT ATTITUDE.

THE X-AXIS OVERRIDE OPTION IS AVAILABLE TO THE CREW (UNTIL THE ESTIMATED ALTITUDE IS BELOW 30,000 FEET), HOWEVER IT SHOULD NOT BE EXERCISED WHEN THE LGC IS SPECIFYING A DESIRED YAW ATTITUDE, I.E.: OURING THE ATTITUDE MANEUVER TO THE THRUSTING ATTITUDE (SEE R60). THE OPTION IS INHIBITED BY THIS PROGRAM FROM MIDWAY IN THE PROGRAM (SEE ASSUMPTION (13) BELOW) TO THE END.

(13) THE LGC SPECIFIES LM ATTITUDE DURING THE POWERED LANDING MANEUVER BASED UPON THE REQUIREMENTS OF THRUST VECTOR CONTROL, LANDING SITE VISIBILITY, AND LR ORIENTATIEN. AFTER DPS IGNITION, THRUST VECTOR CONTROL IS REQUIRED THROUGH THE REMAINDER OF THIS PROGRAM. THE LANDING SITE BECOMES VISIBLE AT THE BEGINNING OF THE APPROACH PHASE.

THRUST VECTOR CONTROL COES NOT CONSTRAIN THE LM ORIENTATION ABOUT THE THRUST AXIS (YAW ATTITUDE). ROTATION ABOUT THE LM Y AND LM Z AXES IS USED TO POINT THE MEASURED THRUST VECTOR ALONG THE DESIRED THRUST VECTOR.

THE FIRST RESTRAINT UPON THE LM YAW ATTITUDE TO UCCUR IS THAT OF LR ORIENTATION. THE LGC WILL NOT ATTEMPT TO USE LR DATA UNTIL THE LGC ESTIMATICN OF ALTITUDE IS 30,000 FF.. AUTOMATIC X-AXIS OVERRIDE LOCKOUT (DONE BY R12) AND YAW ATTITUDE SPECIFICATION BY THE LGC WILL NOT OCCUR UNTIL THE LGC ESTIMATED ALTITUDE IS 30,000 FT.. BEFORE THIS TIME, THE ASTRONAUT MUST MANEUVER TO A ROUGHLY-WINDOW-UP YAW ORIENTATION TO PREVENT SUBSEQUENT LOSS OF S-BAND LOCK-ON. THE LGC WILL THEN COMMAND THE VEHICLE TO THE LGC-SPECIFIED YAW ATTITUDE.

SUBSEQUENT TO X-AXIS OVERRIDE LOCKOUT, CONTROL OF THE VEHICLE ABOUT THE LM X AXIS IS GOVERNED BY LR ORIENTATION REQUIREMENTS DURING THIS PROGRAM. THE LANDING SITE BECOMES VISIBLE TO THE COMMAND PILOT IF THE LOOK ANGLE (THE ANGLE BETWEEN THE LM -X AXIS AND THE LOS TO THE LANDING SITE) IS GREATER THAN 25 DEGREES AND THE LOS IS IN OR NEAR THE LM X/Z PLANE.

AT ANY TIME DURING P63, P64 CR P65, THE MAGNITUDE OF THE LOOK ANGLE AND THE ORIENTATION OF THE LOOK ANGLE PLANE (THAT PLANE CONTAINING THE LOS AND THE LM X AXIS) ARE DEFINED BY THE INERTIAL ORIENTATION OF THE LM X AXIS AND THE PCSITIGN OF THE LM WITH RESPECT TO THE LANDING SITE.

(14) THE CREW HAS THE CAPABILITY TO DISPLAY LGC CALCULATED VALUES OF FORWARD VELOCITY, LATERAL VELOCITY, ALTITUDE AND ALTITUDE RATE ON CERTAIN LM METERS DURING THIS PROGRAM. THE CALCULATION OF THESE PARAMETERS IS UNDER THE CONTROL OF THE LANDING ANALOG DISPLAYS ROUTINE (R10) WHICH IS ENABLED AT DPS IGNITION.

(15) THE RATE OF DESCENT (ROD) MODE IS NOT ENABLED DURING THIS PROGRAM (SEE LANDING (ROD) PROGRAM (P66), ASSUMPTION 12 FOR DEFINITION OF RGD MCDE).

(16) AN ABORT FROM THE LUNAR DESCENT MAY BE REQUIRED AT ANY TIME DURING THE DESCENT GRBIT INJECTION, THE DESCENT C^CAST, or the powered descent (P63), (P64), (P65), or (P66).

++ + 03 +ED I T

++

++

03 + مو_{کد}

++

+ 03

++

++

+03

++

+285 +03

+EDIT

P63/LUMINARY

+ +285

++ + 03

++++

٠

+03

++

+ ED IT

45³

++

FOR ABORTS AFTER DPS IGNITION FOR THE POWERED LANDING MANEUVER, TIME IS CRITICAL. DURING THIS PERIOD AN ABORT IS NOMINALLY COMMANDED BY PUSHING ONE OF TWO BUTTONS IN THE LM. THE ABORT MAY BE COMMANDED TO USE THE DESCENT STAGE (ABORT BUTTON) OR THE ASCENT STAGE (ABORT STAGE BUTTON). IF THE DESCENT STAGE IS SELECTED, AND THE DPS PROPELLANT APPROACHES EXHAUSTION, CONTROL MUST BE SWITCHED TO THE ASCENT STAGE BY THE CREW BY ASCENT STAGE SELECTION (ABORT STAGE BUTTON).

DURING THE POWERED LANDING MANEUVER THE LGC WILL CONTINUOUSLY MONITOR THE ABORT AND ABORT STAGE DISCRETES, AND UPON RECEIPT OF EITHER WILL TERMINATE THE PROGRAM IN PROCESS AND CALL THE APPROPRIATE ABORT PROGRAM (DPS ABORT PROGRAM (P70) CR APS ABORT PROGRAM (P71)). BOTH ABORT PROGRAMS WILL GUIDE THE LM TO AN ORBIT AS SPECIFIED IN SECTION 5.4.3 OF R567.

THE MONITOR OF THE ABORT AND ABORT STAGE PUSHBUTTONS IS CONTROLLED BY THE ABORT DISCRETES MONITOR ROUTINE (R11) WHICH WILL BE ENABLED BY THIS PROGRAM.

(17) IF A THRUSTING MANEUVER IS PERFORMED WITH THE GUIDANCE CONTROL SWITCH IN PGNS AND THE MODE CONTROL SWITCH IN AUTC, THE PGNCS WILL CONTROL THE TOTAL VEHICLE ATTITUDE AND GENERATE EITHER MODE I OR MODE II ATTITUDE ERRORS AND VEHICLE ATTITUDE RATES (SEE ASSUMPTION (19)) FOR DISPLAY ON THE FDAL. THE CREW MAY EXERCISE CONTROL AROUND THE YAW AXIS ONLY WITH THE ACA (X-AXIS OVERRIDE) IF THE X-AXIS OVERRIDE CAPABILITY IS PERMITTED BY THE PROGRAM IN PROCESS. THIS MANUAL CONTROL WILL BE IN RATE COMMAND/ATTITUDE HOLD MODE.

IF A THRUSTING MANEUVER IS PERFORMED WITH THE GUIDANCE CONTROL SWITCH IN PGNS AND THE MODE CONTROL SWITCH IN ATTITUDE HOLD THE PGNCS WILL HOLD THE VEHICLE ATTITUDE AND WILL GENERATE EITHER MODE I OR MODE II ATTITUDE ERRORS FOR DISPLAY ON THE FDAI. THE CREW MAY EXERCISE MANUAL ATTITUDE CONTROL ABOUT ALL VEHICLE AXES WITH THE ACA IN EITHER THE RATE COMMAND OR MINIMUM IMPULSE MODE DEPENDING UPON THE STATUS OF THE PULSES FLAG. THIS FLAG IS RESET BY P12, P40 P41, P42, P63, P70, P71 AND R40 AT MAIN ENGINE IGNITION. IT IS STRONGLY RECOMMENDED THAT POWERED FLIGHT NOT BE ATTEMPTED IN THE MINIMUM IMPULSE MODE. THE PULSES FLAG IS ALSO SET OR RESET BY EXTENDED VERBS 76 (MINIMUM IMPULSE) AND 77 (RATE COMMAND) RESPECTIVELY. DURING A THRUSTING MANEUVER IN THE PGNS/ATTITUDE HOLD MODE THE ASTRONAUT IS RESPONSIBLE FOR MAINTAINING SMALL ENOUGH ATTITUDE ERRORS TO ACHIEVE GUIDANCE OBJECTIVES.

(18) CONTROL OF THE LM DPS, RCS AND APS IS TRANSFERRED FROM THE PGNCS TO THE ABORT GUIDANCE SYSTEM (AGS) BY PLODING THE GUID CONT SWITCH FROM PGNS TO AGS.

THE AGS WILL BE CAPABLE OF TAKING OVER CONTROL OF THE LM DURING ANY PORTION OF THE LUNAR DESCENT OR ASCENT OR DURING EITHER OF THE ABORT PROGRAMS (PTO DR PT1). THE AGS WILL GUIDE THE LM TO A SAFE ORBIT.

THE AGS MAY BE INITIALIZED BY THE LGC AT ANY TIME BY MANUAL SELECTION OF THE AGS INITIALIZATION ROUTINE (R47). IN THE EVENT THAT THE GUIDANCE CONTROL SWITCH IS CHANGED FROM PGNS TO AGS DURING A THRUSTING MANEUVER, THE LGC WILL CONTINUE COMPUTATION OF POSITION AND VELOCITY, THE DESIRED THRUST VECTOR, AND THE DESIRED ATTITUDE ERRORS. HOWEVER THE PGNCS WILL NOT BE RESPONSIBLE IF REGISTER OVERFLOWS OCCUR WITHIN THE LGC.

(19) THE PGNCS CAN GENERATE TWO TYPES OF ATTITUDE ERRORS FOR DISPLAY ON THE FDAI;

- MODE I SELECTED BY EXTENDED VERB 61. AUTCPILCT FOLLOWING ERRORS USED AS A MONITOR OF THE DAP'S ABILITY TO TRACK AUTOMATIC STEERING COMMANDS.
- MODE II SELECTED BY EXTENDED VERE 62. TOTAL ATTITUDE ERRORS USED TO ASSIST CREW IN MANUALLY MANEUVERING THE VEHICLE.

PGNCS - DERIVED VEHICLE ATTITUDE RATES MAY ALSO BE DISPLAYED VIA SELECTION BY EXTENDED VERB 60.

- MODE II ATTITUDE ERROR DISPLAYS ARE AUTOMATICALLY SELECTED AT THE BEGINNING OF ROO. WITH THE EXCEPTIONS IN ICATED
 - IN ASSUMPTION (17) ABOVE, DISPLAY SELECTION IS ALWAYS BASED UPON THE LAST ENTRY MADE IN THE DSKY.
 - FOR A MORE DETAILED DESCRIPTION OF THESE DISPLAYS REFER TO SECTION 3 OF 8567, PARA. 3.2.6

(20) THE EVENT TIMER WAS SET PRIOR TO SELECTION OF THIS PROGRAM TO COUNT TO ZERO AT T BRAK BASED ON A TIME FROM IGNITION PROVIDED BY THE GROUND.

(21) THE LOAD DAP DATA ROUTINE (RO3) HAS BEEN PERFORMED PRIOR TO SELECTION OF THIS PROGRAM. AT THAT TIME THE DPS ENGINE GIMBAL SHOULD HAVE BEEN DRIVEN TO THE CORRECT TRIM POSITION.

(22) CURING CPS BURNS CNLY, THE PITCH-ROLL RCS JET AUTOPILOT (U AND V JETS) MAY BE DISABLED (V65) OR ENABLED (V75) BY EXTENDED VERB AS SHOWN. THIS CAPABILITY IS INTENDED TO BE USED TO PREVENT LM AND DESCENT STAGE THERMAL CONSTRAINT VIOLATIONS DURING CSM-DOCKED DPS BURNS (P40). THE CAPABILITY EXISTS DURING P63 AND P70 ALSO. PERFORMANCE OF FRESH START (V36E) WILL ALWAYS ENABLE THE PITCH-RULL JETS.

+03 +EDIT + +03 ++

++

++

+03 (23) THE ASTRONAUT MAY MENITOR THE FELLOWING ADDITIONAL PARAMETERS DURING THIS PROGRAM (AFTER COMPLETION OF THE +EDIT IGNITION ALGORITHM) BY KEYING IN V57E (SEE LOGIC DESCRIPTION OF V57);

> (A) VC6 N68 R1-RANGE R2-TG R3-DELTA H

RANGE - SLANT RANGE FROM THE LM TO THE DESIGNATED LANDING SITE. IN NAUTICAL MILES TO NEAREST .1 NM.

TG - THE ESTIMATED TIME OF FLIGHT FROM THE PRESENT TIME TO THE ACCOMPLISHMENT OF THE CURRENT AIM CONDITIONS. IN MINS AND SECS TO NEAREST SEC. MAX READING IS 59859. SIGN IS -.

DELTA H - THE PRESENT LR INDICATED ALTITUDE MINUS THE LGC CALCULATED ALTITUDE OF THE LM ABOVE THE LUNAR RADIUS AT THE DESIGNATED LANDING SITE. IN FEET TO THE NEAREST FOOT. (NOTE: DELTA H IS INITIALLY SET TO 99999 WHERE IT WILL REMAIN UNTIL RIZ CALCULATES A VALUE BASED ON LR DATAI

(24) LGC AND CREW PROCECURES IN CASES OF LGC-ASSUMED THRUST FAILURE ARE DEFINED BY THE DPS/APS THRUST FAIL ROUTINE (R40). THIS ROUTINE IS ENABLED AT DPS IGNITION BY THIS PROGRAM.

(25) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY. IT SHOULD BE SELECTED AT LEAST 20 MINUTES BEFORE THE NOMINAL TIME OF IGNITIEN FOR THE POWERED LANDING MANEUVER (T BRAK).

(26) IT IS NORMALLY REQUIRED THAT THE ISS BE ON FOR A MINIMUM OF 15 MINUTES PRIOR TO A THRUSTING MANEUVER.

(27) ENGINE IGNITION MAY BE SLIPPED BEYOND THE ESTABLISHED TIG IF DESIRED BY THE CREW OR IF STATE VECTOR INTEGRATION CANNOT BE COMPLETED IN TIME. FOR A SUCCESSFUL LANDING, NO SLIP SHOULD BE PERMITTED.

[28] THO ALARM CONDITIONS MAY BE GRIGINATED BY THE PONCS POWERED LANDING EQUATIONS:

++ +03 +EDIT (A) IF SUBRCUTINE ROOTPSRS IN THE RG/VG CALCULATION FAILS TO CONVERGE IN 8 PASSES THE LGC WILL TURN ON THE PROGRAM ALARM LIGHT, STORE PROGRAM ALARM 1406, STOP ALL VEHICLE ATTITUDE RATES, AND CONTINUE. THIS ALARM COULD ONLY OCCUR IN P63 OR P64. (NOTE: IF THIS CONDITION OCCURS BEFORE IGNITION DURING THE IGNITION ALGCRITHM, THE RESULT WILL BE A POODOO ALARM, 21406).

(B) IF AN OVERFLOW OCCURS ANYWHERE IN THE LANDING EQUATIONS THE LGC WILL TURN ON THE PROGRAM ALARM LIGHT, STORE ALARM CODE 1410, STOP ALL VEHICLE ATTITUDE RATES AND CONTINUE. THIS ALARM COULD ONLY OCCUR IN P63,P64, P65.

(29) THIS PROGRAM ALLOWS MANUAL CONTROL OF LM ATTITUDE AND THE SELECTION OF P66.

DURING P63 (AND P64 AND P65) THE ASTRONAUT CAN DISPLAY THE PGNCS TOTAL GUIDANCE ERROR ON THE FDAI ERROR NEEDLES (ATTITUDE MON SWITCH IN PGNCS) BY HAVING KEYED IN V62 THRU THE DSKY. HE CAN THEN STEER OUT THE PGNCS P63 ATTITUDE ERRORS WITH THE AGS MANUALLY (GUID CCNT IN AGS AND AGS MODE CONTROL IN ATT HOLD); OR WITH THE PGNCS NANUALLY (GUID CONT IN PGNCS AND PGNCS MODE CONTROL IN ATT HGLD) OR AUTOMATICALLY (PGNCS MCDE CONTROL IN AUTO). THUS THERE ARE THREE ATTITUDE CONTRGL SUBMODES IN P63 (AND P64 AND P65); AGS MANUAL; PGNCS MANUAL; OR PGNCS AUTO.

A CAUTIONARY NOTE: IF THE ASTRENAUT HITS THE ROE (RATE-OF-DESCENT) SWITCH WHILE HE IS IN PONCS ATT HOLD, THE LGC WILL IRREVOCABLY TRANSFER HIM OUT OF THE AUTO GUIDANCE PROGRAM MODES INTO THE ROD PROGRAM MODE, P66.

(3C) THE ASTRONAUT MAY MONITOR THE FOLLOWING PARAMETERS BY KEYING IN V16 N92E:

+03 +285

++

45⁴

(A) V16 N92

- R1- THRCMD R2- HCOT
- R3- H

THRCMD- THE PERCENT THRDTTLE DESIRED BY THE LGC, BASED ON THE DPS RATED THRUST OF 10,500 POUNDS. IN PERCENT

P63/LUMI NARY

TO NEAREST PERCENT. (NOTE: IN P63 MORE THRUST IS CESIRED THAN CAN BE DELIVERED BY THE DPS; THEREFORE, R1 MAY SHOW MORE THAN 100 PERCENT (WHILE THROTTLE IS AT 100 PERCENT DELIVERED). AT THROTTLE RECOVERY (THROTTLE DOWN) RI WILL DISPLAY +00055; AT HALF-THROTTLE, R1 WILL DISPLAY +00050).

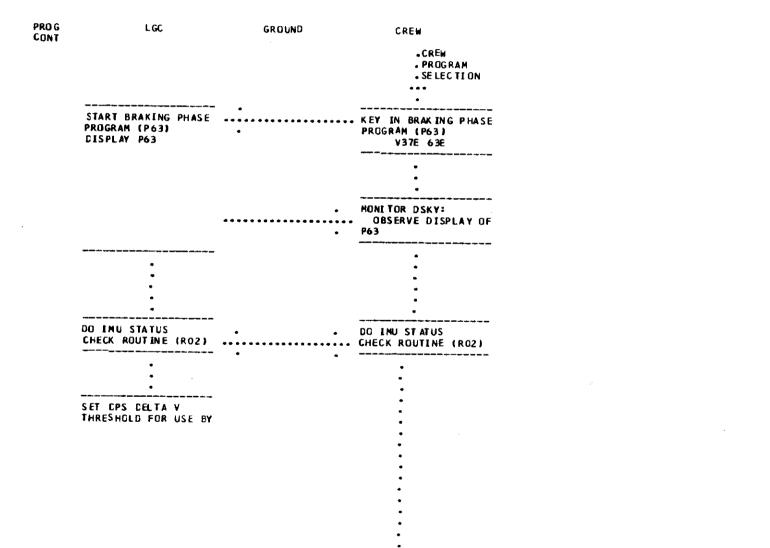
HCCT - THE PRESENT RATE OF CHANGE OF ALTITUDE (H). IN FPS TO NEAREST .1 FPS.

45S

+ +03

++

HT THE PRESENT ALTITUDE OF THE LM ABOVE THE LUNAR RADIUS AT THE INITIALLY DESIGNATED LANDING SITE. IN FEET TO NEAREST FOOT.



#10

#20

#30

R40 ٠ . • . SET DELTA V COUNTER = 4 FCR LSE BY R40 _____ . . • _____ REMOVE RR TRACK ENABLE DISCRETE FROM THE RR. _____ _____ ٠ • . -----RESET NO THROTTLE FLAG --------• ____ RESET REDESIGNATION FL AG . ٠ ٠ ------RESET LR BYPASS FLAG _____ . . . _____ SET MUNFLAG ____ . ٠ ٠ ______ RESET P25 FLAG . • • ------RESET RENDEZVOUS FLAG -------.

454

+ *

#40

#50

#60

#70

#80

#90

P63/LUMINARY

54. P63/LUMINARY

#100

#110

#120

#130

#140

CALL IGNITION ALGO-	••	N69 PROVIDES THREE-
RITHM TO DEFINE		COMPONENT CORREC-
NOMINAL TIME OF	••	TIONS TO THE LANDING
IGNITION (TIG) FOR		SITE VECTOR IN
THE POWERED LANDING	-	STABLE MEMBER COOR-
MANEUVER, TIME TO GO		
(TG) FROM DPS FULL	•	DINATES. IF THE NEUN
THRUST INDMINAL TIG	•	IS LOADED BEFORE THE
+"ZOONT [NE" SEC) TO	•	IGNITION ALGORITHM,
	•	THE CHANGE WILL BE
THE AIM CONDITIONS	•	INCORPORATED IN THE
(HI GATE), AND THE	•	IGNITION ALGORITHM,
THRUST VECTOR ALIGN-	•	THUS INFLUENCING
MENT AT TIG.	•	LIGHT-UP TIME; IF
REFER SECTION	•	THE NOUN IS LOADED
5.3.4 OF R567)	•	BETWEEN THE IGNITION
(NOTE: IF THE IGNI-	•	ALGORITHM AND THE
TION ALGORITHM DOES	•	START OF GUIDANCE.
NET CENVERGE, A PRO-	•	THE CORRECTION WILL
GRAM ALARM (01412)		BE INCORPORATED AT
WILL RESULT.)		THE START OF GUL-
		DANCE; IF THE NOUN
.GOOD ALARM.		IS LEADED AFTER THE
-EXIT EXIT.	•	START OF GUIDANCE
	•	
	•	(AT THROTTLE-UP),
• •	•	THE CORRECTION WILL
• •	•	BE INCORPORATED
•	•	IMMEDIATELY.
•	•	INGTE: SINCE RLS IS
• •	•	NOT CHANGED, RESEL-
• •	•	ECTION OF P63 WILL
• •	•	DESTROY ANY CHANGES
• •	•	MADE USING THIS
• •	•	TECHNIQUE.)
• •	•	
• •	•	•
• •	•	•
• •	•	•
•	• •	*_*
 TURN ON PROGRAM 		DOES PROGRAM ALARM
- ALARM LIGHT AND	• •	LIGHT INDICATE PRO-
 STORE ALARM 	•	GRAM ABNORMALITY?
 CODE 01412 	•	
•	•	.¥ N.
• •	•	
• •	•	•
• •	•	• -
• •	•	•
• •	•	• -
• •	•	
• •	•	- •
• •	-	• •
• •	-	• •
· ·	•	• •
- •	•	• •
• •	•	• •
• •	•	• •
• •	•	• •
_		

N69 PROVIDES THREE-

457

.

CALL IGNITION ALGO-

-

•

.

.

P63/LUMINARY -

				·
	4			
	• •	_		
	•	-	•	• 548
	• •	•	•	• P63/LUMINARY
	• •	•	•	
	• •	•	•	
	•	_	•	•
	•	•	•	•
	• •	•	•	
	• •••••	*****	•	
	•		_	
			•	•
	•		•	
	•		•	
		-		
	STORE THE CESIRED			•
			KEY IN VOSNO9	
	ATTITUDE SPECIFI-		AND IDENTIFY	
	CATION FOR USE		ALARM CODE. CODE	
	BY THE ATTITUDE			
			01412 INDICATES	#150
	MANEUVER ROUTINE		THAT THE IGNI-	
	(R6C).		TION ALGORITHM	
	THE FINAL ATTITUDE			
	WILL BE COMPUTED TO		WILL NOT CON-	
	HALL DE CUFFUIEU IU	· ·	VERGE. CRÉW MUST	
	POINT THE LM +X AXI	5	RESPOND WITH	
	IN THE INITIAL		V96E OR NEW PRO-	
	THRUST DIRECTION.			
			GRAM SELECTION	
	HOWEVER, IN ORDER TO	J	(V37EXXE). CON-	
	CCNSERVE RCS FUEL		SULT BACKUP PRO-	
	AND NOT CONSTRAIN			
			CEDURES.	* 160
	THE NON-CRITICAL			
	ATTITUDE ABOUT THE			
	THRUST VECTOR: WING:	2		
		2	•	
	MAY NOT BE LEVEL			
	IN THE COMPUTED			
	FINAL ATTITUDE.			
			•	
			•	
	•			
	•			
	·		4	
	•		-	#170
	•			*1:0
	•			
	-		•	· · · · · · · · · · · · · · · · · · ·
	•		•	
	•			
	•			
HOLD .	ELACH VEDRAMMENTO			-
HULU .	FLASH VERB-NOUN TO	•	MONITOR DSKY:	
*******	REQUEST RESPONSE AND		OBSERVE VERB-	
MGN .	DISPLAY MANEUVER		NOUN FLASH TO	
	PARAMETERS COMPUTED	•		
			REQUEST RESPONSE	#180
	FOR IGNITION TIME:		AND DISPLAY OF	F160
	V06 N6 1		TG, TFI, AND CROSS-	
	R1 – TG			
			RANGE.	
	R 2 TF I			_
	R3-CROSSRANGE		•	
			-	
	TOUTHE COTTANTON		•	
	TG-THE ESTIMATED		•	
			•	
			•	
			•	
			•	

:

•

• ٠

• ĺ

4⁵⁸

•

THE ACCOMPLISHMENT OF THE AIM CONDI-TIONS (HI GATE). IN MINS AND SECS TO NEAREST SEC. MAX READING IS 59859. SIGN -. THIS VALUE WILL INI-TIALLY BE THE TIME FROM FULL THRUST TO HI GATE, AND WILL REMAIN UNCHANGED UNTIL FUEL THRUST IS COMMANDED. TFI-TIME FROM NOMINAL DPS IGNITION (TIG). IN MINS AND SECS TO NEAREST SEC. MAX READING IS 59859. SIGN IS - BEFORE NOMINAL TIG: + THEREAFTER.

TIME OF FLIGHT TO

4⁵⁹

CROSSRANGE-THE CUT-OF-PLANE DISTANCE BETHEEN THE INITIAL LN ORBITAL PLANE AND THE PRE-SENTLY DESIGNATED LANDING SITE. POLAR-ITY INDICATES THE DESIGNATED SITE IS NORTH {+} OR SOUTH (-) OF THE ORBITAL PLANE. IN NAUTICAL MILES TO THE NEAREST .1 NM. _____ ٠ .

RESET EVENT TIMER

WETH TEL.

#200

#1.90

#210

#220

#230

			•			
	TERMINATE FLASH UPON		•			
	RECEIPT OF PROCEEC.		•			
	RECEIPT OF FRACEED.		•			
			-			
	•		•			#240
	•		•			
	•		•			
	•		•			
HOLD .						
	FLASH VERB-NOUN TO	•	MONITOR DSKY:			
SNAP .	REQUEST PLEASE PER-	****	OB SER VE VE			
	FORM INU FINE ALIGN-	•	FLASH TO REQU			
	MENT:	•				
	V50 N25		PLEASE PERFOR			
	R1-00014		FINE ALIGNMEN	(F•		
						#250
	R 2-BLANK		•			
	R3-ELANK		•			
			•			
	•					
	•					
			•			
	-		•			
	•					
	•		DO I WISH TO			
	•		THE ALIGNMENT	?		
	•					#260
	-		• N	Υ.		2200
	•	•				
	•	-		-		
		_		•		
	WAIT FOR KEYBOARD	•	KEY IN PROCEE	- •		
	ENTRY	••••••		U •		
	EN IK I	•		•		
			-	•		
			•	•		
		•	•	•		
	TERMINATE FLASH UPON			EY IN		
	TERMINATE FLASH UPON RECEIPT OF PROCEEC	•		EY IN		#270
	RECEIPT OF PROCEEC	•	• E	EY IN NTER		#270
			• E	N TËR		#270
	RECEIPT GF PROCEEC Or Enter		• E	N TËR		#270
	RECEIPT OF PROCEEC OR ENTER .ENTER .PROCEEC	• • •	• E	N TËR		#270
	RECEIPT OF PROCEEC OR ENTER .ENTER .PROCEEC	•	• E	N TËR		#270
	RECEIPT OF PROCEEC OR ENTER .ENTER .PROCEEC		• E	N TËR		#270
	RECEIPT OF PROCEEC OR ENTER .ENTER .PROCEEC		• E	N TËR		#270
	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 	• •	• E	N TËR		#270
	RECEIPT OF PROCEEC OR ENTER .ENTER .PROCEEC 		• E	N TËR		#270
	RECEIPT OF PROCEEC OR ENTER .ENTER .PROCEEC 		• E	N TËR		
	RECEIPT OF PROCEEC OR ENTER .ENTER .PROCEEC 		• E	N TËR		#270
	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 	• •	• E	N TËR		
	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 		• E	N TËR		
	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 		• E	N TËR		
	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 		• E	N TËR	÷	
	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 		• E	N TËR		
	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 		• E	N TËR	÷	
	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 		• E	N TËR		
	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 		• E	N TËR		
	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 		• E	N TËR		
	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 		• E	N TËR	÷	
	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 		• E	N TËR		
	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 		• E	N TËR		
	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 		• E	N TËR		
2	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 		• E	N TËR		
2	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 		• E	N TËR		
2	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 		• E	N TËR		#280
2	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 		• E	N TËR		
2	RECEIPT OF PROCEEC OR ENTER ENTER .PROCEEC 		• E	N TËR		#280

.

	ŧ
нe	

CESIGNATED LAND

ING SITE AND THE

LANDING(T(LAND)))

AS FINAL CESIREC

IML ORIENTATION.

.

CO INFLIGHT FINE ...

.

ALIGN ROUTINE

.

(R51)

NOMINAL TIME OF

.

.

٠

.

•

٠

٠

•

.

#290

#300

#310

#320

#330

P63/LUMINARY

.

.

SUN/MOON LINE SUN/MOON LINE TO LUNAR SUR- FACE) BELOW THIS POINT IN THE TRAJECTORY IS NEARLY 9C DEGREES. (B) THE EDGE OF THE ADT FIELC OF VIEW MUST BE AT LEAST 15 DEG- REES FRGM THE SUNLIT SURFACE OF THE MOON TO ELIMINATE	• • • • • •	
LIGHT REFLEC- TIONS FOR SAT- ISFACTORY STAR		
	•	
	•	
	•	
	•	
	•	
	•	
	•	

DO INFLIGHT FINE

(NOTE: THERE ARE

A LIMITED NUMBER

(A) THE SUN . ANGLE OF INCI- . DENCE (FROM .

OF STARS WHICH MAY BE USED AT THIS TIME WHEN THE FCLLOWING CONSTRAINTS ARE CONSIDERED:

ALIGN ROUTINE

(R51)

SIGHT ING. (C) THE MOON SUBTENCS AN ANGLE GREATER THAN 140 DEG AT THE PRESENT . ALTITUDE OF THE LM. (D) THE EARTH SUBTENDS AN ANGLE OF ABOUT . 2 DEG AT THE PRESENT RANGE OF THE LM. (E) THE SUN ANGLE OF INCI- . CENCE (FROM SUN ADT LINE TO EXTERNAL AUT PRISM FACE) UPON THE AOT MUST BE LESS THAN 0 DEGREES UNLESS THE ADT . IS SHADED BY THE LM STRUCT-URE . THE ABOVE CONS-TRAINTS, COUPLED WITH THE DESIRA-BILITY OF ALIGN-ING THE IMU AS SHORTLY BEFORE DPS IGNITION AS FEAS IBLE, RESULT IN A LIMITED NUM-. BER OF ACCEPTABLE . STARS. IT IS ASSUMED THAT THE CREW HAVE THE IDENTIFICATION OF . THO OR MORE OF

#340

#350

#360

#370

P63/LUM IN ARY

462

	2
110	$\boldsymbol{\omega}$

#380

#390

#400

#410

#420

(

					-	
1						
463	• •			•		
	• •			•		
	• •			•		
	• •			•		
	• •		THESE STARS. THE			
			IDENTITY OF TWC	•		
	•		OF THESE STARS MAY HAVE BEEN	•		
	• •		LOADED INTO THE	•		
	• •		LGC PRIOR TO	•		
	• •		LAUNCH BY P27.			
	• •		OR MAY BE	•		
			LOADED DUR ING THE	•		
	• •		AUTO OPTICS POST-	- •		
	• •		TIDNING ROUTINE (R52) (CALLED BY	•		
	• •		THE FINE ALIGN	•		
	• •		ROUTINE (R51)),	•		
	• •		OR DURING THE LCC			
			UPDATE PROGRAM	•		
			(P27).	•		
	• •			•		
	• •			•		
	• •		•	•		
	• •		•	•		
			•	•		
	*		•	•		
	COMMAND ZERG ATT -		•	•		
	TUDE ERRORS		•			
			•	•		
	•		•	•		
	•		•	•		
			•	•		
	SET 1 DEGREE DEAD-		•	•		
	BAND.		•	-		
			•	•		
	•		•			
	•		•	•		
			•	•		
	•		•	•		
	•		•	•		
	•		•			
	•		•	•		
	•		•	•		
	•		•	•		
	(NOTE: THE 3-AXIS	• • • • • • • • • •	DO ATTITUDE MANEUV REUTINE (R60)	/E R		
	FLAG WAS ASSUMED TO		•			
	BE RESET BY RCO AND		•			
			•			
			•			
			•			

٠ • ٠

#430

#440 .

#450

к Y:		
KY: RB-NGUN FQUFST		
EQUEST Form Lr Siticn		
• N .		
_ `		

#460

#470

P63/LUMI NARY

(

						•	
	ыты	NOT BE RESET				•	
		NOT DE RESET				•	
		THIS MANEUVER)				•	
						•	
		•					
		•				•	
		•				•	
		•				•	
		• •••••	• • •			•	
		• •	•			•	
		•••				•	
	IS T	HE LANDENG RADAR				•	
	POSI	TION #1 DISCRETE	•				
	PRES	ENT ?	•			•	
			•			•	
	۰۲	- N	•			•	
	•	•	٠	• •	• • • • • •	•	
	•	•	•	•	•	•	
POSS	-		•	•	•	•	
HOLO .	•	FLASH VERB-NCUN			MON ITOR	DSK Y:	
*******	•	TO REQUEST			DOES	VERB-NGU	IN
SNAP .	•	PLEASE PERFORM		••	FLASH T	D REQUEST	r
	•	LR DESCENT POS-	-	••	PLEASE	PERFORM L	R
	•	ITION SELEC-	•		DE SCENT		i
	•	TION: V50N25	•	٠	SELECTIO		
	•	R1-00500	•	•			
		R2-BLANK	:	•	• •		• N
	•	R 3-BLANK	-		•		•
	•			•	•		
	•	•	•	•			
	•	•	٠	•	HAS LR		•
	•	•	•	•		Y COMMAN-	
	•	•	•	•		DESCENT	•
		•	•	•	POSI TI O		•
	•	•			. N		•
	•	•		•	•		
	•	•	•	•	•	•	•
	•	•	•	•	٠	•	•
	•	•	•	•	•	•	•
	•	•	•	•	•	•	•
		•	1	•	MOMENTAR		•
	•				PUT LDG		
	•	•	•	•		•	
	•	•	•	•		•	•
	•	•	•	•		-	•
	٠	•	•	•		•	•
	•	•	•	•		•	•
	•	•	•	•		•	•
		•		•		•	•
	•	-		•		•	•
	•	•		•		•	
464	•	•	•			-	-
	•	•	•				•
	•	•	•	•		•	•
	•	•	•	•		-	-

464

. *

•

(

55	5
P63/LUM	INARY

.

(

-	•							
	•	•	•		•		•	•
	•	•	•		•			
	-	•	•		•		•	
	•	•	•		•			÷
							-	
	•				-	SWITCH TO	•	•
	-	_			•	"DES" THEN	•	•
	-	-	•	•			•	٠
•	•	,	•		•	PUT IN "AUTO"	•	٠
•	•	•	•		•	PCSITION	•	•
•	•	•	•	•	•			•
•	•		•		•	•		•
•	•		•			•		
•	•	,	•			-		÷
					-		•	•
	WAIT FOR	KEY-			•	KEY IN	•	1
	BEARD EN			•••••••••••••	••		•	•
	DEALD CA		••		•	PROCEED	•	•
			•	•	•		•	٠
			•	•	•	•	•	•
•			•		•	•	•	•
•			•			•		
			•				Ē	-
			•				•	•
			-				•	•
			•				•	•
			••					•
			* * * *	• • • • • • • • • • • • • • • • • • • •	••	KEY IN ENTER		•
			••					•
•			•			•		•
	TERMI NAT		•			•		•
•	UPON REC	ELPT OF	•			-		
	PRCCEED		•			-		
	ENTER		-			•		•
			•			•		•
-		0	•			•		•
•		• P	•			•		٠
•	- N	• R	•			•		
		• 0	•			•		
	۰E	•C	•			•		
		•E				-		
	•	•E	•			•		•
	•	• D	•			•		•
	•	+ U	•			•		•
	•	•	•			•		•
	•		••			•		•
	•					ē		
	•					-		-
						•		•
	-					•		•
	•					•		•
						•		•
	STILLBADH					•		•
	STILLBADV					•		•
GIS	STERS = 2					-		
	JSE BY					•		•
2	~ • •					•		•
÷						•		٠
				·		•		•
	•					•		•
	•					•		•
	•					•		
	•							
	•					-		
						•		•
	-					•		•
	•					•		•
	•					•		•

٠

•

.

•

•

465

٠

•

٠

٠ •

#480

490

#500

#510

#520

,

	•		• •	556 P63/LUM INARY
	SET L,M,R, AND S CCUNT- ERS = C FCR		· · · · · · · · · · · · · · · · · · ·	#5 30
	USE BY R12		• • • • • • • • • •	
	HAVE PGNS CONTROL AND ALTC ATTITUDE Control Nodes Been Selected?		· · · · · · · · · · · · · · · · · · ·	# 540
	.Y N.	• • • •	· · · · · · · · · · · · · · · · · · ·	#550
	IS THE APS FLAG . SET? . .Y N.	• • • •	· · · · · · · · · · · · · · · · · · ·	
	HAS THE AUTO THROTTLE MCDE BEEN SELECTED?	· · · ·	· · · · · · · · · · · · · · · · · · ·	#560
	· · Y N. ·	• • • • • •	• • • • • • • • • •	
POSS HOLD SNAP	FLASH VERB- NCUN TO RE- QLEST PLEASE	MONITOR ODES VER	B-NOUN	# 570
JIIMF +	QLEST PLEASE PERFORM PGNS 	• • FLASH TO • • PLEASE P • • • • • • • • •	ERFORM	
مار	· · · · · · · · · · · · · · · · · · ·			P63/LUMINARY
-	• •	• • • •		P63/LUMINARY

(

(

466

. *****

-	-				
	•				
		-			
			•		
-	-	•	•		
-	•	•	•		
•		•	•	BOND CONTROL	
:	. CONTROL, AUTO	•	•	PGNS CENTROL, A	
-	ATTITUCE CON-	•	•	ATTITUDE CONTRO	
•	- TROL, AND AUTC	•	•	AND AUTC THROTT	L E
•	THROTTLE MODE	•	•	MODE SELECTION	7
•	- SELECTION:	•	٠		
•	 V50 N25 	•	٠	• Y	Ν.
•	• R1-00203	•	•	•	•
•	R2-BLANK	•	-	•	•
•	• RJ-BLANK	•	•	•	•
•	•	•	•	•	•
•	• •	•	٠	•	•
•	• •	•	•	-	•
•	• •	•	•		·
•		•	•	HAVE REQUESTED	•
•	• •	•	•	MODES BEEN SELF	
•	• •	•		CTED?	
-	• •	•	-		
•	• •	•	•	• N	.Y.
•		•		•	• •
•		•	•	•	• •
-	• •	•	•		
•	• •		-	DO I WISH TO	
•	• •	•	-	HAVE THESE	
•		•		MODES SELECTED	
		-		DURING THE	•••
		-		THRUSTING	•••
-		-	•	MANEUVER?	•••
-			•		• •
		•	•	.Y .N	• •
		•	•	• • • • •	• •
•		•	•		•••
-	• •	•	•	• •	•••
•		•	•	• •••	• •
•		•	•	•	• •
•		•	•	•	• •
•	• •	•	•	SET GUIDANCE	• •
-	• •	•	•	SEL GUIDANCE	• •
•	• •	•	•	CONTROL SWITCH	
•	•••	•	•	TO PGNS, ATT-	• •
•	- •	•	•	ITUDE CONTROL SWITCH TO	• •
•	• •	•	•		• •
-		•	•	AUTO, AND	• •
•	• •	•	•	THROTTLE	• •
•		•	•	SWITCH TO AUTO	•••
•	• •	•	•		•••
• •		•	•	•	• •
•	• •	•	•	•	• •
•	• •	•	•	•	• •
• •	• •	•	٠	•	• •
•	• •	•	•	•	•
•	• •	•	•	•	• •
	• •	•	•	•	• •
-		•	•	•	••
	• •	•	•	•	• •
	• •	•	•	•	••
	• •	•	•	•	• •
	• •	•	٠	•	•••
	• •	•	•	•	• •
		•	•	•	• •
• •	• •	•	•	•	• •
• •	• •	•	•	•	
•		•	•	•	• •

467

#580

#590

6,00

#610

#620

P63/LUMINARY

and the second				
• • •	• •	•		•
• • •	• •	•	•	•
• • •	• •	•	•	•
• • •	••••	•	•	•
••••	• •	•	•	•
HALT FOR KEY-	••••••••••••••••••••••••••••••••••••••	KEY IN PROCI	EED -	:
	•• •			•
• •	• •	•	•	•
• •	• •	•	•	•
• •	• •••	* * * * *	•	•
- • • •	•		•	•
 TERMINATE 	••		-	•
 FLASH UPON 		KEY IN ENTER	ર	•
 RECEIPT OF 	• •			•
	•	•		•
	•	•		•
• • •E •P	•	•		•
N 0	•	•		•
• • •T •0	•	•		•
• • •E •C	•	•		•
	•	•		•
~	•	•		•
* * * *L	•	•		•
• • •	•	•		•
• • •		-	•	•
• • •		•		•
• • •		•		•
• • •		•		•
• • •		•		•
		•		• .
COMMAND CPS OFF				•
		•		•
•		•		•
•		•		•
•		•		•
ZERO CPS AUTO		•		•
THRCTTLE		•	•	-
		•		•
•		•		•
•		•		•
•		•		•
•		•	•	•
•		•	4	•
•				•
•		•		•
•		•		•
•		•	•	•
SET TDEC1 = TIG		•	•	•
-30 SEC		•	•	•
		•	•	
•		•		•
•		•		
•		•		•
•		•	•	•
•		•	•	
•		•	•	•
•		•	•	•
-		•	•	
			(

(

468

558 P63/LUMI NARY

#630

#640

#650

#660

#670

#680

(

io ^a	•		559 P63/LUMI NARY
	•		
++ +03 +EDIT ++	INTEGRATE CSM STATE VECTOR TO TDEC1	· · · · · · · · · · · · · · · · · · ·	
	•		
	DO STATE VECTOR IN- TEGRATION (MIDTCAVE ROUTINE (R41) (NCTE: ENTER R41 AT "A")	ROUTINE (R41) OB SER VE THAT THE COMPUTER ACTIVITY	#690
	.NC TIG. .TIG SLIP. .SLIP	LIGHT IS ON UNTIL Completion of R41 	
	• •		#700
	• (NOTE: R41 WILL • DEFINE TIG TC BE • THE TIME TO WHICH • R41 CIO INTEGRATE • THE LM STATE • VECTOR PLUS 30 • SECONCS.J		\$710
	· · · · · · · · · · · · · · · · · · ·		
	CALL BLANKING OF DSKY AT TIG-35 SEC. (SEE "A" BELCW)	• • •	
	•		#7 2 0
TEMP HOLD . Non .	• DISPLAY ON DSKY: V06 N62 R1 - VI R2 - IFI	MCNITOR DSKY: OBSERVE DISPLAY OF VI, TFI, AND DELTA VM.	#730

i

(

560 P63/LUM INARY

R3 - CELTA VM VI - MAGNITUCE OF LM INERTIAL VELCCITY WITH RESPECT TO THE REFERENCE COORDINATE SYSTEM. IN FPS TC NEAREST .1 FPS. (NOTE: THIS CISPLAY	(NOTE: IF TIG HAS BEEN SLIPPED BY R41, THE TFI DISPLAY (R2) AT THIS TIME WILL BE REFERREC TO THE NEW TIG.)	
(R1) REMAINS CON-	•	\$740
STANT AT THE VALUE		*1+0
APPRCPRIATE TO AVER- AGE-G INITIATICN; UNTIL TIG-30 THE	UPDATE EVENT TIMER IF DESIRED.	
VALUE IS AN EXTRA-	•	
POLATED VALUE GOOD	•	
AT TIG-30.)	•	
TFI-SEE DEFINITION	•	
ABOVE		
	•	#750
DEL TA VM-MEA SURED DELTA V MAGN ITUDE.	•	
IN FPS TO NEAREST	•	
.1 FPS. THIS DIS-	•	
PLAY WILL BE 00000	•	
UNTIL TIG-30 SEC AND	•	
THEN SHOULD CHANGE CNLY DUE TO PIPA	•	
BIAS INTIL ULLAGE IS		
STARTED.	•	#760
	•	
•	•	
•	•	
• • •	•	
•	•	
EXIT	•	
(NGTE: THIS IS NCT A P63 EX[T.	•	
SEE NAM BELOW.)	•	#770
	•	
	VERIFY/SET THRUST/ TRANSLATION CONTROL- LER TO MINIMUM THRUST POSITION.	
	•	
	•	
	•	
	•	
	•	

•

.

:

4

•

.

(

	•	561
	•	P63/LUMINARY
	•	
	•	#780
	ARM DPS. (AUTO THROTTLE SIGNAL IS ENABLED TO DPS AND THRUST INDICATOR).	
	•	
	•	
	CHECK THRUST INDICA- TOR (RIGHT SIDE) TO ENSURE AUTO THROTTLE COMMAND IS ZERGED (O PERCENT INDICA- TIGN).	#790
	 .Y .N	
	• •	
	• •	#800
	GO TC BACKUP PROCED- URES.	
	•	
	CHECK STATUS OF C/W LAMPS	#610
	•	
** A **	•	
FRGM ABO VE	•	
•	•	# 820
•	•	
•••	•	
BLANK THE DSKY DIS- PLAY (V, N, RI, R2 AND R 3),	MONITOR DSKY: AT TFI = -00835 CBSERVE DSKY DISPLAY	
•	TO GO BLANK FOR 5 SECONDS.	#830
:		
•	•	
•	•	
•	•	P63/LUM IN ARV
•	•	PO J/LUM IN ANY

Ę.

	•		•		
	WAIT UNTIL TIG -30 SEC.		•		
	•				#8 40
	-		•		
	RETURN VC6N62 CISPLAYS	•	MGNITOR OSKY: At the = -00829		
			OBSERVE RETURN OF VO6N62 DISPLAYS TO INDICATE THAT		
	•		AVERAGE G INTEGRA- TION HAS STARTED.		
	•				# 850
	•		•		
	•		•		
	•		•		
	•		•		
	START AVERAGE G		•		
	INTEGRATION (NOTE:		•		
	THE R10/R11/R12		•		#860
	SERVICE ROUTINE (RCS) AND THE DE-		•		
	SCENT STATE VECTOR		•		
	UPDATE ROUTINE (R12) WILL BE CALLED ONCE		•		
	EVERY 2 SECONDS BY		•		
**	AVERAGE G DURING		•		
+03	P63,P64,P65 AND P66. However the		•		
+285	OPERATION OF RIC		•		#870
++	AND R11 IS NOT Enabled until		•		
	IGNITION.		•		
			•		
	•		•		
	•		•		
	•		•		
	•		•	.*	#880
	•		•		
	•		•		
	•		•		
	•		•		
	•		•		
	•		•		
	•		•		
12	•		•		
	•		•		P63/LUMI NARY
	•		•		

(

•

.

•

٠

•

•

472

. A

#890

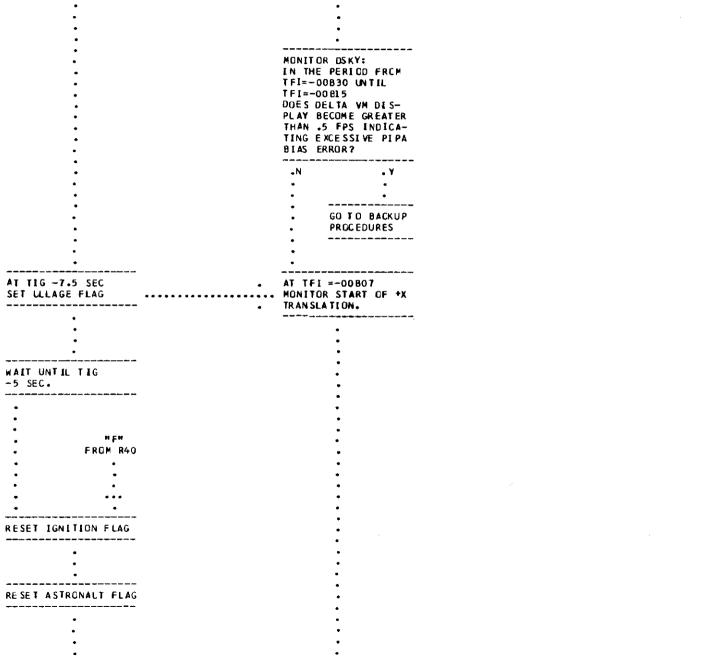
#900

#910

#920

#930

413



P63/LUMINARY

•	•	564 P6 3/ LUMINARY
• •		
CALL VERB 99 DISPLAY (SEE "B" BELCW)	•	# 940
• • •	• • •	
MAIT UNTIL TIG - C	• •	
•	• •	# 950
SET IGNITION FLAG		•
 • •	• •	
	• •	
	• •	#960
IS ASTRONAUT FLAG SET?	•	
	•	
• • •••	•	# 970
GO TO EXIT "C" (NOTE: THIS BELCW IS NOT A	•	
P63 E×1T. REFER CISPLAY	• •	
R E SPONSE AT # B* BELOW).	• •	#980
"B#	 ● ● ■ 	
FRGM Above	- ₩F₩ - FRCM R40 -	
	• • •	
	• •	
	• •	
	•	

٠

474

t

P 63/L UH INAR Y

í

#990

#1000

#1010

#1020

#1030

			•	
			•	
			•	
			•	-
	•		•	•
	•		•	•
	• ••••	•	•	•
	••• •	•	•	
	• •	•	•	•
	• •	•		
		•	MONITOR DSK	
.	CHANGE VERB BUT MA-	•	AT TFI = -0	
OLD .	INTAIN PRESENT NOUN	• •	OBSERVE VER	
	AND DISPLAY IN RI.	•••••	FLASH TO RE	
ON .	R2, AND R3, FLASH	• •	PLEASE PERF	
	VERB-NGUN TO REQUEST Please perform Eng-		ENGINE ON E	NADLE
	INE CN ENABLE:	•		
	VSSN62	•	•	
			•	
		-		
	-	•	-	
	•	•	•	
	•	•	•	
	•	•	-	
	•	•	•	
	•	•		
	•	•	MONITOR DSK	
	•	•	WAIT FOR IN	
	•	•	DELTA VM EN	
	•	•	SUFF IC LENT	
	•	•	RECUIRED UL	
	•	•	DELTA VIS	
	•	•	FUNCTION OF	VEHICLE
	•	•	WEIGHT.	
	•	•		
	•	•	•	
			•	
		-		
		-	•	
		•		
	WAIT FOR KEYBOARD	•	SHALL I PERI	MIT
	EN TR Y	•	IGNITION?	
		•		
		•	•N	•Y
		•	•	•
		•	•	•
		••	*	
		•••••	••• KEY IN P	RUCEEU
		• •	•	
		•	•	•
		•	•	•
		•	•	•
		•	•	•
			-	•
		-		•
		•	-	•
		•	•	•
		-	•	-
		-		-
		-	-	•
		-	-	•
		•	•	-

475

:

:

		•	• •
		•	• •
		•	
		•	•
		•	• •
		•	• •
		-	
TERM	AINATE FLASH UPEN		KEY IN
	EIPT OF PROCEED,		TERMINATE .
	ER, CR TERMINATE	•	V34E .
		•	
۰.Ρ	•T •E	•	
R	• E • N	-	
.0	-R -T		
.0	•M •E		
• E	•1 •R	•	
Ē	• N		
• D	•A •	•	
•	•1 •••		• •
•	• E		
•			
•	•		
•	•		
•			
	RESET ULLAGE		• •
•	FLAG		• •
			• •
•			• •
•	•		• •
•	•		• •
•			•
•	DO FINAL AUTO-		DO FINAL AUTO
•	MATIC REQUEST	• •	MATIC REQUEST .
•	TERMINATE ROU-		TERMINATE ROU-
•	TINE (ROO)		TINE (ROO) .
•			 •
٠	•		• •
•	•		• •
•	•		• •
٠	•		• •
•	• • •		• • • •
•	•		• •
•	EXIT P63		EXIT P63 .
•			•
•			-
			•
S ET	ASTRONAUT FLAG		-

• ٠

•

476

. ٠

.

.

#1040

#1050

#1060

#1070

#1080

P63/LUMINARY (

í

	:			•	, ,	567 963/LUMI NARY
	• •			• • •		
	•			•		
SE1			MONITOR DSKY: IS R2 DISPL TFI NEGATIVE	AY OF		
• •	ť N.		NON-ZERC?			
•	•		.Y	N.		#1 090
•	•		•	•		
•	RESUME STATIC CISPLAY CF VCENE2	••••••	MONITOR DSKY: OBSERVE RE- TURN CF STATI VERB-NOUN			• •
•	•		(V06N62).			#1100
•	•		•	•		
•	EXIT		•	•		
:	(NCTE: THIS IS NOT A P63 EXIT.		•	•		
•	REFER TIG - O LOGIC ABOVE.)		•	•		
:	LUGIC ADDVE.		•	•		
•			•	- :		#1110
•			STANDBY FOR THRUST ON	•		
•			WHEN TEL =	•		
•			-00800	- :		
:			•	•		
:			•	•		#1100
•			• STANCBY FO • THRUST ON : • IATELY •			#1120
•	псп		• •			
•	FROM		• •			
•	A 8 OV 8 •		• •			
:	•		• •			#1130
•	•••		•			
	•		• •			
сом 	MAND UPS CN		• •			
	•		• •			
	•		• •			
	•		• •		ρ	63/LUMINARY
	•		• •			

• •

:

	•	•	•		568 P63/LUMINARY
	:	•	• •		#1140
	RESET PULSES FLAG	•	•		r 2 x 40
		•	•		
TEMP HCLD	CHANGE VERB-NOUN AND	MONITOR D	SK Y:		
MON -	CHANGE DISPLAY OF TFI IN R2 TO H COT AND DELTA VM IN R3 TO H; VO6 N63 R1-VI R2-H COT	 OBSERVE	VERB-NCUN D CHANGE OF TO H COT		#1150
	R3-H VI - SEE CEFINITION	•			
	ABCVE.	•			#1160
	H DOT-THE PRESENT RATE OF CHANGE OF ALTITUDE (H). POL- ARITY INCICATES DES- CENT (-) OR ASCENT (+). IN FPS TO NEAR- EST .1 FPS.	• • • • •			
	H - THE PRESENT AL- TITUGE OF THE LM ABOVE THE LUNAR RADIUS AT THE DESIG- NATEC LANDING SITE. POLARITY IS + FCR ALTITUDES GREATER THAN THE ABOVE RADIUS. IN FEET TC	•			#1170
	NEAREST FOOT.	•			#1 180
	•	•		<i></i>	
	•	•			
	• •	•			
	•	•			
478	•	•			P63/LUNI NARY
(*	•	•	(l

569 P63/LUMINARY

ł

#1190

#1200

.

. #1210

#1220

.

#1230

#1240

	•	
0	•	
	•	
	•	
	•	
	•	
	SET ABORT ENABLE	
	FLAG	
	•	
	•	
	•	
	•	
	•	
	SET LANDING ANALOG	
	DI SPLAYS FLAG	
	•	
	-	
++	•	
+03	•	
+EDIT	•	
	•	
++	•	
	•	
	•	
	RESET IDLE FLAG	
	*	
	•	
	•	
	•	
	IS IMPULSE FLAG SET?	
	INOTE: ANSWER WILL	
	ALWAYS BE NO FOR	
	P63)	
	. N	
	•	
	•	
	•	
	RESET IGNITION FLAG	
	-	
	•	
	•	
	RESET ASTRONAUT FLAG	
	•	
	•	
	•	
	CALL FOR RESET OF	
	LLLAGE FLAG	
	CELADE I LAU	

470

P63/LUMINARY

IN C.5 SEC.		•
14 UEJ JLUS 		•
•		•
•		•
•		•
•		•
-		
•		•
•		
•		START MONITOR OF
•		BRAKING PHASE OF POWERED LANDING
		MANEUVER AS INCI-
•		CATED BY LM AND
•		DSKY DISPLAYS
•		
•		•
•		· ·
•		
•		START MONITOR OF THE
•		LGC/LR OPERATION AS
•		DESCRIBED IN THE
•		DESCENT STATE VECTOR UPDATE ROUTINE (R12)
•		
•		•
•		•
•		•
T TIG (AS DEFINED		"ZCGMT IME" SECONDS
BY R411 + "ZOOMTIME"		AFTER TIG (AS DEFIN-
SEC COMMAND THRETTLE	-	ED 8Y R41) D8-
TO MAXINUM.		SERVE THRUST IN-
(NCTE: THE VALUE	•	DICATOR TO INDICATE
"ZOGMTIME" IS IN		XX PERCENT AUTO
ERASABLE STORAGE,		THROTTLE COMMAND (RIGHT SIDE) AND 10C
HAVING BEEN LOADED PRIOR TO LAUNCH OR		PERCENT CHAMBER
BY P27.)		PRESSURE (LEFT SIDE)
		INOTE: THE VALUE
•		WZCONTIMEM IS IN
•		ERA SABLE STORAGE
•		HAVING BEEN LOADED PRIGR TO
CALL LANCING AUTC		LAUNCH OR BY P27).
MODES MENITOR		(NOTE: IF IGNITION

. A

.

•

#1250

.

.

#1260

#1270

#1280

(

.

1

ROUTINE (R13)	HAS NOT BEEN AUTHOR-
*************************	IZED BY THE CREW
•	UNTIL AFTER TIG (AS
•	DEFINED BY R41)
•	+ "ZOOMTINE", THE
•	ENGINE WILL THROTTLE
•	UP AT IGNITION).
•	
•	•
•	•
•	•
COMMENCE POWERED	•
	•
LANDING GUIDANCE	•
TO ATTALN BRAKING	•
PHASE AIM CON-	•
DITICNS.	*****
	SOMETIME BEFORE
•	AL TI TUDE REACHES
•	30,000 FEET, YAN THE
•	LM TO A ROUGHLY
•	WINDOW-UP ORIENTA-
•	TION TAKING THE
•	ROUTE ABOUT THE
•	X-AXIS THAT DOES NOT
•	RESULT IN LOSS OF
•	S-BAND LOCK-ON
•	
•	
•	-
•	
•	WHEN H IS EQUAL
•	TO + 30000 THE
•	
•	X-AXIS OVERRIDE
•	OPTION IS REMOVED
•	BY R12. THE LGC WILL
•	AUTOMATICALLY COM-
•	MAND THE LM TO AN
•	ATTITUDE AROUND THE
•	LM X AXIS AS SPECIF-
•	IED BY THE GUICANCE
•	EQUATIONS. THE CREW
•	NO LONGER HAS ANY
•	MANUAL ATTITUDE
•	CONTROL OF THE LM
•	WHILE IN THE AUTO
•	ATTITUDE CONTROL
•	· · · · · · · · · · · · · · · · · · ·

#1300

#1290

#1310 .

#1 330

#1320

481

٠

.

•	MODE.
•	*- *
•	•
•	•
•	•
•	•
•	•
WAIT UNTIL TG	WALT UNTIL TO IS
IS LESS THAN	
"TENDBRAK".	LESS THAN "TENDBRAK"
(NOTE: THE VALUE	(NOT E: THE VALUE
"TENDERAK" IS IN	"TENDBRAK" IS IN ER-
	ASABLE STORAGE HAV-
ERASABLE STURAGE	ING BEEN LOADED
HAVING BEEN LOADED	PRIOR TO LAUNCH OR
PRIOR TO LAUNCH OR	BY P271.
BY P271.	*
	•
•	•
•	•
•	•
•	•
•	•
•	•
GG TC APPRGACH PHASE	GO TO APPROACH PHASE
PROGRAM (P64)	
PRUGRAM (P64)	PROGRAM (P64)
•	•
•	•
•	•
•	•
***	•••
•	•
EXIT P63	EXLT P63

Ł

CHANGE CONTROL NOTES

.

LUGIC REV 00 PCR 13,30,31 LUGIC REV 01 PCR 65,86,118,144,164,186,234,246,253,401,419,437, 497,535,542,566,637 LUGIC REV DO(LLW 1A) PCR 670, 737, 751 REVS 01,C2(LLW 1B) PCR 814,838,841,854, EDITORIAL REV 03(LUW 1C) PCK 235, EDITORIAL

30

· ·

APPROACH PHASE PROGRAM (P64)

REV 02 12/03/69

PURPOSE: (1) TO CONTROL THE PONCS DURING THE THRUSTING OF THE POWERED LANDING MANEUVER BETWEEN HI GATE AND LO GATE.

(2) TO CONTROL THE OPS THRUST AND ATTITUDE BETWEEN HI GATE AND LO GATE.

(3) TO PROVIDE THE CREW WITH THE CAPABILITY OF REDESIGNATING THE LANDING SITE TO WHICH THE PGNCS IS GUIDING THE LM.

(4) TO SELECT P65 AUTEMATICALLY WEEN TO IS LESS THAN TENDAPPR (TIME-TO-END-APPROACH-PHASE).

ASSUMPTIONS: (1) THE LM IS ON THE POWERED LANDING DESCENT BETWEN HI GATE AND LO GATE (SEE BRAKING PHASE PROGRAM (P53), AND SECTION 5.3.4 OF R567).

(2) THE CSM IS IN A NEAR CIRCULAR ORBIT AROUND THE MOON AT A NOMINAL ALTITUDE OF 60 NAUTICAL MILES. THE CSM IS MAINTAINING A PREFERRED TRACKING ATTITUDE FOR OPTICAL TRACKING OF THE LM.

(3) THE IMU IS ON AND ACCURATELY ALIGNED TO A LANDING SITE ORIENTATION DEFINED FOR THE DESIGNATED LANDING SITE AND THE NOMINAL TIME OF LANDING (T(LAND)). THE MOST RECENT IMU ALIGNMENT TOOK PLACE DURING THE BRAKING PHASE PROGRAM (P63) PRIOR TO DPS IGNITION.

(4) THE LANDING RADAR (LR) IS ON, CHECKED OUT, AND SHOULD HAVE BEEN PROVIDING TO THE LGC VELOCITY AND RANGE INFORMATION WITH RESPECT TO THE MOON. THIS INFORMATION SHOULD HAVE BEEN INCORPORATED INTO THE LM STATE VECTOR. THE LGC/LR OPERATION IS UNCER THE CONTROL OF THE DESCENT STATE VECTOR UPDATE ROUTINE (R12) WHICH IS ALREADY IN PROCESS.

(5) THE LGC WILL NEITHER DESIGNATE NOR READ THE RENDEZVEUS RADAR (RR) DURING THIS PROGRAM.

(6) THE ENTIRE POWERED LANDING MANEUVER (BRAKING, APPROACH AND LANDING) WILL BE ACCOMPLISHED USING THE DPS ENGINE.

(7) THE AIM CONCITIONS (LO GATE) FOR THE APPROACH PHASE ARE STORED IN THE LGC.

(8) THE FOLLOWING PARAMETERS REQUIRED BY THIS PROGRAM HAVE BEEN STORED IN THE LGC SINCE LGC INITIALIZATION BY ERASABLE REGISTER LOAD.

(A) THE LM STATE VECTOR. THE LGC HAS UPDATED THIS AS REQUIRED DURING THRUSTING. ND FURTHER STATE VECTOR UPDATES FROM ANY SOURCE OTHER THAN THE LR WILL BE ACCEPTED BY THIS PROGRAM.

(9) THE DPS IS NOT THRCTTLABLE OVER THE WHOLE RANGE FROM O TO MAXIMUM. IT MUST BE OPERATED EITHER AT MAXIMUM THROTTLE OR OVER A SPECIFIC THROTTLE RANGE OF LOWER SETTINGS. THESE THROTTLE SETTINGS ARE SPECIFIED IN SECTION 5*3*4 OF R567 AND ARE TOTAL THROTTLE SETTINGS: I.E.: THE SUM OF THE MANUAL SETTING (WHOSE MINIMUM IS ABOUT 10 PERCENT) AND THE PGNCS COMMANDED SETTING.

THIS PROGRAM ASSUMES THE THROTTLE CONTROL TO BE IN AUTO (THE DPS RECEIVES THE SUM OF THE MANUAL AND PGNCS COMMANDED SETTINGS) AND THE MANUAL THROTTLE TO BE SET AT A LEVEL LESS THAN THAT REQUIRED BY THE LGC.

NOMINALLY, IF THE APPROACH PHASE PROGRAM IS COMPLETED WITHOUT ANY REDESIGNATION OF THE LANDING SITE (SEE ASSUMP-TICN (12)), THE THROTTLE WILL REMAIN WITHIN THE ALLOWABLE THROTTLE RANGE THROUGHOUT THE PHASE. EXCESSIVE TARGET REDES-IGNATIONS DURING THIS PROGRAM HOWEVER MAY RESULT IN REQUIRED THROTTLE EXCURSIONS OUTSIDE THE ALLOWABLE RANGE. IN SUCH CASES THE LGC WILL COMMAND MAXIMUM THROTTLE FOR AT LEAST 2 SEC, AND UNTIL THE REQUIRED THROTTLE SETTING RETURNS TO THE PERMITTED THROTTLE REGIEN.

(10) DURING THE POWERED LANDING MANEUVER, THE LGC WILL MONITCR THE PRESENCE OR ABSENCE OF THE "NON-ATTITUDE HOLD" DISCRETE. THIS DISCRETE IS ISSUED TO THE LGC WHEN THE ATTITUDE MODE CONTROL SWITCH IS IN THE AUTO POSITION. SHOULD THIS DISCRETE APPEAR DURING THE POWERED LANDING MANEUVER, THE LGC ASSUMES THAT IT NO LONGER

FAS COMPLETE AUTOMATIC CUNTROL OF THE MANEUVER.

++

+02 + +

P64/LUMI NARY

THE MUNITUR AND THE ASSOCIATED LGC LOGIC IS INCLUDED IN THE LANDING AUTO MODES MONITOR ROUTINE (R13) WHICH IS ALREADY IN PROCESS.

(11) THE X-AXIS OVERRIDE OPTION IS NOT PROVIDED THE CREW WHENEVER THE LGC-ESTIMATED ALTITUDE IS LESS THAN 30,000 FT. (REFER R12 AND ASSUMPTION 13 OF P63).

(12) DURING MOST OF THE APPROACH PHASE, THE LGC PROVIDES THE CREW THE CPTION TO REDESIGNATE THE LANDING SITE TO WHICH THE PGNCS IS GUIDING THE LM. THIS OPTION IS CALLED THE LANDING POINT DESIGNATOR (LPD) MODE. IT IS WORTH NOTING THAT THE PGNCS MODE CONTROL SWITCH MUST BE IN AUTC FOR THE ACA TO FUNCTION AS A LANDING SITE RE-DESIGNATOR. IF THIS SWITCH IS IN ATT HOLD THE ACA FUNCTIONS AS A RATE COMMAND/ATTITUDE HOLD STICK.

THE LANDING POINT REDESIGNATION, IF EXERCISED, IS BASED UPON VISUAL ASSESSMENT OF THE LUNAR TERRAIN WITH RESPECT TO THE PRESENTLY DESIGNATED LANDING SITE. DURING THE LPD MODE THE PRESENT LANDING SITE IS DISPLAYED ON THE DSKY IN TERMS OF COORDINATES ON THE LPD SIGHTING GRID ON THE LEFT HAND LM WINDOW (LPD ANGLE). LANDING SITE REDESIGNATIONS ARE MANUALLY PUT INTO THE COMPUTER VIA THE ATTITUDE CONTROLLER ON AN INCREMENTAL BASIS, I.E.: A LIMIT SWITCH ACTUATION IN THE ATTITUDE CONTROLLER CAUSES THE LGC TO REDESIGNATE THE LANDING SITE A FIXED ANGULAR INCREMENT (1/2 DEGREE IN ELEVATION, 2 DEGREES IN AZIMUTH) FROM THE PRESENT LM/LANDING SITE LDS. THE APPLICABLE ATTITUDE CONTROLLER POLARITIES ARE:

(A) - PITCH RCT AT ION GIVES - LPD ELEVATION (NEW SITE BEYOND PRESENT SITE) (B) + PITCH ROTATION GIVES + LPD ELEVATION (NEW SITE SHORT OF PRESENT SITE) (C) + ROLL ROTATION GIVES + LPD AZIMUTH (NEW SITE TO RIGHT OF PRESENT SITE) (D) - RCLL RCTATION GIVES - LPD AZIMUTH (NEW SITE TO LEFT OF PRESENT SITE)

THE LPC MODE IS MURE COMPLETELY DESCRIBED IN SECTION 5.3.4 OF R567.

(13) THE INITIAL MANEUVER CF THE APPROACH PHASE IS THE LM ATTITUDE TRANSITION FROM THE LM ATTITUDE AT THE START OF P64 TO A SATISFACTORY ATTITUDE FOR LANDING SITE VISIBILITY. AFTER THE COMPLETION OF THIS MANEUVER THE LM ATTITUDE IS CONSTRAINED BY THRUST POINTING REQUIREMENTS AND IS CONTROLLED ABOUT THE THRUST AXIS SO AS TO MAINTAIN THE CURRENT LANDING SITE IN THE LM X/Z PLANE. THE CONDITIONS ACHIEVED BY THE START OF P64 SHOULD BE SUCH THAT THE THRUST POINTING RECUIREMENTS OF THE APPROACH PHASE WILL YIELD SATISFACTORY VISIBILITY AND RADAR ORIENTATIONS.

THE LANDING SITE BECCMES VISIBLE TO THE COMMAND PILOT IF THE LOOK ANGLE (THE ANGLE BETWEEN THE LM -X AXIS AND THE LOS TO THE LANDING SITE) IS LESS THAN 65 DEGREES AND THE LOS IS IN OR NEAR THE LM X/Z PLANE.

AT ANYTIME DURING P63, P64 OR P65, THE MAGNITUDE OF THE LOOK ANGLE AND THE ORIENTATION OF THE LOOK ANGLE PLANE (THAT PLANE CONTAINING THE LOS AND THE LM X AXIS) ARE DEFINED BY THE INERTIAL ORIENTATION OF THE LM X AXIS AND THE PCSITION OF THE LM WITH RESPECT TO THE LANDING SITE.

THE INERTIAL CRIENTATION OF THE LM X AXIS IS CONTROLLED BY REQUIREMENTS OF THRUST VECTOR CONTROL. THE ORIENTATION OF THE LM WINDOWS WITH RESPECT TO THE LOOK ANGLE PLANE IS CONTROLLED BY ROTATION OF THE VEHICLE ABOUT THE LM X AXIS. THIS CONTROL IS EXERCISED AS SHOWN IN SECTION 5.3.4 OF R567.

(14) THE CREW HAS THE CAPABILITY TO DISPLAY LGC CALCULATED VALUES OF FORMARE VELOCITY, LATERAL VELOCITY, ALTITUDE AND ALTITUDE RATE ON CERTAIN LM METERS DURING THIS PRUGRAM. THE CALCULATION OF THESE PARAMETERS IS UNDER THE CONTROL OF THE LANDING ANALOG DISPLAYS ROUTINE (R10) WHICH IS ALREADY IN PROCESS.

(15) THE RATE OF DESCENT (ROD) MODE IS NOT ENABLED DURING THIS PROGRAM (SEE LANDING PHASE (RCD) PROGRAM (P66), ASSUMPTION (12) FOR DEFINITION OF RCD MODE).

++ + C2 +285

++

+++

+02

++

+02

+EDIT

+285

+02

++

++

(16) AN ABORT FROM THE LUNAR DESCENT MAY BE REQUIRED AT ANY TIME DURING THE DESCENT ORBIT INJECTION, THE DESCENT COAST, OR THE POWERED DESCENT (P63), (P64), (P65), OR (P66).

FOR ABORTS FROM THE DESCENT ORBIT INJECTION OR THE DESCENT COAST IT IS ASSUMED THAT SUFFICIENT TIME EXISTS TO PERFORM A TPI MANEUVER (SEE TERMINAL PHASE INITIATION (TPI) PROGRAM (P34)) TO INTERCEPT THE CSM DIRECTLY.

FOR ABORTS AFTER DPS IGNITION FOR THE POWERED LANDING MANEUVER, TIME IS CRITICAL. DURING THIS PERIOD AN ABORT IS NCMINALLY COMMANDED BY PUSHING ONE OF TWO BUTTONS IN THE LM. THE ABORT MAY BE COMMANDED TO USE THE DESCENT STAGE (ABORT BUTTON) OR THE ASCENT STAGE (ABORT STAGE BUTTON). IF THE DESCENT STAGE IS SELECTED, AND THE OPS PROPELLANT APPROACHES EXHALSTION, CUNTROL MUST BE SWITCHED TO THE ASCENT STAGE BY THE CREW BY ASCENT STAGE SELECTION (ABORT STAGE BUTTON).

DURING THE POWERED LANDING MANEUVER THE LGC WILL CONTINUOUSLY MONITUR THE ABORT AND THE ABORT STAGE DISCRETES, AND UPON RECEIPT OF EITHER WILL TERMINATE THE PROGRAM IN PROCESS AND CALL THE APPROPRIATE ABORT PROGRAM (DPS ABORT PRUGRAM (P70) OR APS ABORT PROGRAM (P71)). BOTH ABORT PROGRAMS WILL GUIDE THE LM TO AN ORBIT AS SPECIFIED IN SECTION 5.4.3 CF R567.

THE MUNITUR OF THE ABORT AND ABORT STAGE PUSHBUTTONS IS CONTROLLED BY THE ABORT DISCRETES MONITOR ROUTINE (R11) WHICH IS ALREADY IN PROCESS.

(17) IF A THRUSTING MANEUVER IS PERFORMED WITH THE GUIDANCE CONTROL SWITCH IN PGNS AND THE MODE CONTROL SWITCH IN AUTC, THE PGNCS WILL CONTROL THE TOTAL VEHICLE ATTITUDE AND GENERATE EITHER MODE I OR MODE II ATTITUDE ERRORS AND VEHICLE ATTITUDE RATES (SEE ASSUMPTICN (19)) FOR DISPLAY ON THE FDAI. THE CREW MAY EXERCISE CONTROL AROUND THE YAW AXIS ONLY WITH THE ACA (X-AXIS OVERRIDE) IF THE X-AXIS OVERRIDE CAPABILITY IS PERMITTED BY THE PROGRAM IN PROCESS. THIS MANUAL CONTROL WILL IN THE RATE COMMAND/ATTITUDE HOLD MODE.

IF A THRUSTING MANEUVER IS PERFORMED WITH THE GUIDANCE CONTROL SWITCH IN PGNS AND THE MODE CONTROL SWITCH IN ATTITUDE HOLD THE PGNCS WILL HOLD THE VEHICLE ATTITUDE AND WILL GENERATE EITHER MODE I OR MODE II ATTITUDE ERRORS FOR DISPLAY ON THE FDAI. THE CREW MAY EXERCISE MANUAL ATTITUDE CONTROL ABOUT ALL VEHICLE AXES WITH THE ACA IN EITHER THE RATE COMMAND UR MINIMUM IMPULSE MODE DEPENDING UPON THE STATUS OF THE PULSES FLAG. IT IS STRONGLY RECOMMENDED THAT POWERED FLIGHT NOT BE ATTEMPTED IN THE MINIMUM IMPULSE MODE. THE PULSES FLAG IS SET OR RESET BY EXTENDED VERBS 76 (MINIMUM IMPULSE) AND 77 (RATE COMMAND) RESPECTIVELY. THE PULSES FLAG IS ALSO RESET BY P12,P40,P41,P42,P63,P70,P71 AND R40 AT MAIN ENGINE IGNITION. WITH THE EXCEPTION OF THESE CASES, MODE SELECTION IS ALWAYS BASED UPON THE LAST ENTRY MACE IN THE DSKY. CURING A THRUSTING MANEUVER IN THE PGNS/ATTITUDE HOLD MODE THE PGNCS WILL NOT BE RESPONSIBLE IF REGISTER OVERFLOWS CCCUR WITHIN THE LGC.

(18) CONTROL OF THE LM DPS, RCS, AND APS IS TRANSFERRED FROM THE PGNCS TO THE ABORT GUIDANCE SYSTEM (AGS) BY PLACING THE GUID CONT SWITCH FROM PGNS TO AGS.

THE AGS WILL BE CAPABLE OF TAKING OVER CONTROL OF THE LM DURING ANY PORTION OF THE LUNAR DESCENT OR ASCENT OR CURING EITHER OF THE ABORT PROGRAMS (PTC OR PT1). THE AGS WILL GUIDE THE LM TO A SAFE ORBIT.

THE AGS MAY BE INITIALIZED BY THE LGC AT ANY TIME DURING THIS PROGRAM BY MANUAL SELECTION OF THE AGS INITIALIZA-TION ROUTINE (R47).

IN THE EVENT THAT THE GUIDANCE CONTROL SWITCH IS CHANGED FROM PGNS TO AGS DURING A THRUSTING MANEJVER, THE LG WILL CONTINUE COMPUTATION OF POSITION AND VELOCITY, THE DESIRED THRUST VECTOR AND THE DESIRED ATTITUDE ERRORS, HOWEVER THE PGNCS WILL NOT BE RESPONSIBLE IF REGISTER OVERFLOWS OCCUR WITHIN THE LGC.

(19) THE PGNCS CAN GENERATE TWG TYPES OF ATTITUDE ERRORS FOR DISPLAY ON THE FDAI;

+02 ABILITY TO TRACK AUTOMATIC STEERING COMMANDS. +EDIT MODE II - SELECTED BY EXTENDED VERB 62. TOTAL ATTITUDE ERRORS USED TO ASSIST CREW IN MANUALLY + MANEUVERING THE VEHICLE.	
+ MANELY FRING THE VEHICLE.	
+ PGNCS-DERIVED VEHICLE ATTITUDE RATES MAY ALSO BE DISPLAYED VIA SELECTION BY EXTENDED VERB 60.	
+ MODE II ATTITUDE ERROR DISPLAYS ARE AUTOMATICALLY SELECTED AT THE BEGINNING OF R60. WITH THE EXCEPTIONS	
+ INDICATED IN ASSUMPTION (17) ABOVE, DISPLAY SELECTION IS ALWAYS BASED UPON THE LAST ENTRY MADE IN THE DSKY. FOR	A
+ MURE DETAILED DESCRIPTION OF THESE DISPLAYS REFER TO SECTION 3 OF R567, PARA. 3.2.6.	
+02	
**	

(20) THE LOAD DATA ROUTINE (RO3) HAS BEEN PERFORMED PRIOR TO THE START OF THE POWERED LANDING MANEUVER AND SHOULD NOT BE REQUIRED DURING THIS PROGRAM.

(21) LGC AND CKEW PROCEDURES IN CASES OF LGC-ASSUMED THRUST FAILURE ARE DEFINED BY THE DPS/APS THRUST FAIL ROUTINE (R4C). THIS RELITE IS IN EFFECT CURING THIS PROGRAM, HAVING BEEN BNABLED BY P63.

(22) THIS PREGRAM IS AUTOMATICALLY SELECTED BY THE BRAKING PHASE PROGRAM (P63) WHEN TO DURING THE PHASE BECOMES LESS THAN TENDBRAK (TIME-TO-END-BRAKING-PHASE).

++

+ 02

٠

٠

+

٠

٠

+02 ++

+EDIT

(23) TWO ALARM CONDITIONS MAY BE ERIGINATED BY THE PONCS POWERED LANDING EQUATIONS:

486

	(A) IF SUBROUTINE ROOTPSRS IN THE TIME-TO-GO CALCULATION FAILS TO CONVERGE IN 8 PASSES THE LGC WILL The program alarm light, store program alarm 1406, stop all vehicle attitude rates, and continue. T Alarm could occur only in P63 and P64.	TURN ON HIS
++ +02 +EDIT ++	(B) IF AN OVERFLOW OCCURS ANYWHERE IN THE LANDING EQUATIONS THE LGC WILL TURN ON THE PROGRAM ALARM (STORE ALARM CODE 1410, STOP ALL VEHICLE ATTITUDE RATES AND CONTINUE. THIS ALARM COULD ONLY OCCUR IN OR P65.	LIGHT, P63,P64,
	(24) THIS PROGRAM ALLOWS MANUAL CONTROL OF THE LM ATTITUDE. IF MANUAL CONTROL IS DESIRED, PUT THE MODE CONTROL SWITCH IN ATT HOLD AND USE THE ACA TO CONTROL THE LM ATTITUDE. IF P66 IS DESIRED, CLICK THE ROD SWITCH WHILE THE MODE CONTROL SWITCH IS IN ATT HOLD. THE ACA DOES NOT RE-DESIGNATE THE LANDING SITE WHILE THE MODE CONTROL SWITCH IS IN ATT HOLD. TO USE THE ACA TO RE-DESIGNATE THE LANDING SITE, PUT THE MODE CONTROL SWITCH IN AUTO AND ROTATE THE ACA IN THE DESIRED DIRECTION. ONCE CONTROL IS TRANSFERRED FROM P64 TO P66, P64 CANNOT BE RE-ENTERED.	F
++ + 02 +EDIT +	(25) THE ASTRCNAUT MAY MONITOR THE FOLLOWING ADDITIONAL PARAMETERS DURING THIS PROGRAM (AFTER COMPLETION OF T Ignition Algorithm) by Keying in V57e; (see logic description of V57)	HE
+ +02 ++	(A) VOG NG8 R1-RANGE R2→TG R3-DELTA H RANGE - SLANT RANGE FROM THE LM TO THE DESIGNATED LANDING SITE. IN NAUTICAL MILES TO NEAREST .1 NM.	
	TG - THE ESTIMATED TIME OF FLIGHT FROM THE PRESENT TIME TO THE ACCOMPLISHMENT OF THE CURRENT AIM CO In mins and secs to nearest sec. Max reading is 59859. Sign is	NDITIONS -
	DELTA H - THE PRESENT LR INDICATED ALTITUDE MINUS THE LGC CALCULATED ALTITUDE OF THE LM ABOVE THE LU Radius at the designated landing site. In feet to the nearest foot.	JNAR
	(NCTE: CELTA H IS INITIALLY SET TO 99999 WHERE IT WILL REMAIN UNTIL R12 CALCULATES A VALUE BASED ON LK DATA).	
++ +02 +285 + +	(26) THE ASTRONAUT MAY MONITOR THE FULLOWING PARAMETERS BY KEYING IN VIG N92E: (A) VIG N92 RI - THRCMD R2 - FCGT R3 - H	
+ +	THREMD - THE PERCENT THROTTLE DESIRED BY THE LGC, BASED ON THE DPS RATED THRUST OF 10,500 POUNDS. IN PER- To nearest percent.	CENT
+ + +	HOOT - THE PRESENT RATE OF CHANGE OF ALTITUDE (H). IN FPS TO NEAREST .1 FPS.	
+02 + +	F - THE PRESENT ALTITUDE OF THE LM ABOVE THE LUNAR RADIUS AT THE INITIALLY DESIGNATED LANDING SITE. IN FI TO NEAREST FOOT.	EET
PROG	LGC GROUND CREW	

CONT

٠

.

LGC		
.PROGRAM		
. S EL ECT ION		
•		
•		
START APPROACH PHASE PROGRAM (P64).	•	MCNITOR DSKY: OBSERVE DISPLAY
DISPLAY P64		OF P64
•		•
•		•
•		
SET 0.3 DEGREE		•
DEADBAND		-
		•
•		•
•		•
		•
RESET RECESIGNATION FLAG		•
		•
•		•
•		•
•		•
•		•
•		•
		•
COMMENCE POWERED		•
LANDING GUIDANCE USING P64 AIM		•
CONDITIONS .		•
(TG WILL BE COM-		•
PUTED TO BE THE TIME		•
TO GO TO ACCOMPLISH- MENT OF THE P64 ALM	•	•
CONCITIONS WHICH ARE		
REFERRED TO THE		•
DESIGNATED LANDING		•
SITE).		•
•		•
•		•
•		•
•		•
•		•
•		•
•		•
•		•
•		•
•		•

•

i

			:	
	•			
	•		•	
	•		•	
	•		•	
	•		•	
	•		•	
	CALCULATE LPD FOR THE CESIGNATED		• •	
	LANDING SITE.		•	
	•		•	
	•		•	
	•		•	
	•		•	
HOLD .	* 		•	
MON .	FLASH VERB-NOUN TO REQUEST RESPONSE AND	•	MONITOR DSKY:	
NUN .	DISPLAY PRESENT	***************************************	COSERVE VERB-NOUN FLASH TO REQUEST	
	VALUE OF TR/LPC, H		RESPONSE AND DISPLAY	
	DOT AND H: VO6N64		OF TR/LPD: H DOT AND H.	
	R1-TR/LPD			
	R 2 H DOT R3-+		•	
			•	
	TR/LPD - A SPLIT		•	
	DISPLAY WITH TR IN THE LEFT THE DIGITS.		•	
	THE MIDDLE DIGIT		•	
++ +02	ALWAYS BLANK, AND LPD IN THE RIGHT TWO		MENITOR FDAT AND OUT	
+ ED IT	DIGITS.		THE KINDOW:	
++	WHERE:		OB SERVE ATTITUDE	
	TR-THE ESTIMATED		TRANSIENT TO BRING LM TO A SATISFACTORY	
	TIME REMAINING		ATTITUDE FOR LANDING	
	UNTIL END OF RECESIONATION		SITE VISIBILITY	
	CAPABILITY. IN		•	
	SECOND 5 TO NEAR- EST SECOND. PO-		•	
	LARITY IS ALWAYS		•	
	+. MAXIMUM		•	-
	REACING IS 99, For example:		•	
	a agent an either i frances i		•	
			•	
			•	

•

.

•

(

488

1 *

580 64/LUMINARY

#60

#50

#70

#80

#90

(

.

DISPLAYED AS 99. (NOTE: TR IS A POSITIVE NUMBER ECUAL TC: - TG- (TCGFAPPR+4) , WHERE TOGRAPPR IS THE TIME-TC-GC AT WHICH ERECTION OF THE GUIDANCE CO-ORDINATE FRAME IS SUSPENDED. LPD-THE ANGLE BE-LOW THE LM +Z AXIS TO THE LOS TO THE PRESENTLY DESIGNATED LAND-ING SITE. IN CE-GREES TC NEAREST DEGREE. (NOTE: THE DISPLAY IN R1 APPEARS AS XXBYY WHERE: XX IS TR AND YY IS LPD). H DOT - THE PRESENT RATE OF CHANGE CF ALTITUDE (H). POLAR-ITY INDICATES DES-CENT (-) CR ASCENT {+}. IN FT/SEC TO NEAREST +1 FT/SEC. H - THE PRESENT ALTITUDE OF THE LM ABOVE THE LUNAR RADIUS AT THE INIT-IALLY DESIGNATED LANDING SITE. POLARITY IS + FOR

ALTITUDES GREATER THAN THE ABOVE RACIUS. IN FEET TO

NEAREST FOCT.

130 SECONDS IS

489

#100

#110

#120

#130

		• *			•		582 P64/LUMINARY
		•			•		
		•			•		
		•			•		
		•			•		
		•			•		
		•				یند کا ان میں کا من میں کا من میں کا من مقد اللہ م	#150
		• •			DO I WISH EXERCISE TI CAPABILITY	HE LPD	
		•				•N	
		•			•	٠	
	MAIT FCR K	EY BO	ARC	•		•	
	ENTRY OR F	OR TI	ξ=0		KEY IN	•	*1.(0
				•	PROCEED	•	#160
					•	•	
					•	•	
	TERMINATE	FLAS	4			•	
	UPON RECEI	PT O			•	•	
	PROCEED CR	NG D	SPLAY		•	•	
	IF TR=0				•	•	4170
		_ P	.TR=C		•	•	\$170
		"R	•		•	•	
		а. С	•		•	•	
		•E	•		•	•	
••	• • • • • •	• E	•		•	•	
•	•	•D	•		•	•	
•		•	•		•	•	****
•	CONT INUE PCWEREC	•	•		•	•	#180
•	LANDING	:	:		-	•	
•	GUIDANCE USING P64	•	•		•	•	
:	AIN PO4	•	•		•	•	
•	CONDITIONS	•	•		•	•	
•	REFERRED To the	:	•		•	•	
•	PRESENTLY	•	•		•	•	
•	DE SIGNA TED L'ANCING	•	•		•	•	#190
	LANCING	:	•			•	
•		•	•		•	•	
•		•	•		•	•	
•		•	•		•	•	
•		•	•		•	•	
•		•	•		•	•	
•		•	•		•		
•		•	•		•	•	
•		٠	•		•	•	P64/LUMINARY
• :		•	•		•	(, (
						ì	

490

.

ł

#2.00

#210

#220

#230

.

q1 •			•		
		-			
-			•	•	•
			•	•	•
•		•	•	•	•
	SI TE.		•	•	•
	,	•	•	•	•
			_	-	
-	-	-	-	-	•
-	• •		•	•	•
•	• •	•	•	•	•
•		•	•	•	•
	CALCULATE	•	•	•	
	LPC FCR	•	•	-	
	THE PRE-	-		•	•
•			•	•	•
•	SENTLY DE-	,	•	-	•
•	SIGNATEC .	•	•	•	•
•	LANDING .		•	•	
	SITE.		•	•	
-		-	•	•	•
•	• •	•	•	•	•
•	•	•	•	•	•
TEMP .	• •		•	•	•
HOLD	,		•		•
	DISPLAY CN		_	USING LPD	-
	DISKY:		- •	(R1) AND THE LPD	•
MON			• • • • • • • • • • • • • • • • • • • •		•
•	V06N64 .	•	• •	SCALE ON THE COM-	•
•	R1-TR/LPD	•	•	MAND PILOT'S WIN-	•
	R2-H DOT .		•	DOW OBSERVE THE	
	R3-+	_		PRESENTLY	-
•		•	•		•
•			•	CES IGNATED	•
•	NGTE: FOR	•	•	LANDING SITE.	•
•	DEFINITIONS		•		
-	SEE ABOVE .		•	USING THE ATTI-	•
			-	TUDE CONTROLLER	-
•		•	•	REDESIGNATE THE	•
•	•	•	•		•
•	• •	,	•	LANCING SITE.	•
		•	•	THIS WILL INCRE-	•
			•	MENT THE APPRO	
-			-	PRIATE REDESIGNA-	-
	• •		•		•
•	• •	•	•	TION COUNTER IN	•
•	• •		•	THE LGC.	•
		•	•	OBSERVE THE	•
-			•	FOLLOWING GROUND	•
•				RULES:	-
•	• •		-		•
•	•	•	•	(A) CITE OFFERS	•
•	• •		•	(A) SITE REDESIC-	•
		•	•	NATION TOWARDS	•
-	• •		•	THE LM (+ PITCH	•
-			•	ROTATION WILL	
-		_		REDUCE THIS SITE	-
•	• •	•	•		•
-	•	•	•	VISIBILITY CLEAR-	•
•		•	•	ANCE WHICH IS	•
-	• •	•	•		•
-			•		•
•					
•	· • •		-		-
•	• •	,	•		•
•	• •		•		•
•			•		•
-		,	•		•
•		_	-		
•	• •	,	•		•
•	• •	•	•		•
-	• •		•		•
	• •	,	•		•
-			•		•
•	-				
•			-		•

•

٠

.

• •

	• •	•••		584 P64/LUMI NARY
		• •		
	•••	•••	ORIGINALLY ONLY . 10 CEGREES	#240
	• • • •	• •	(B) LARGE REDES- IGNATIONS SHOULD . BE MADE AS EARLY . IN THE APPRDACH . DUASE AS POSS	
		• • • • • •	PHASE AS POSS- IBLE TO CONSERVE FUEL AND MINIMIZE ATTITUDE TRANS- IENTS.	#250
	· · · · · ·		(C) WHEN TR IS . Equal to 0	
	• IS TR =	07 .	SEC THE LGC . WILL NO LONGER . RESPOND TO LPD . REDESIGNATIONS	
++ +02 +968 +	· · ·	• • • • • •	(NOTE: DISPLAYED LPD ANGLES AND VEFICLE YAW MAY BE. BIASED TO MAKE UP .	#260
+ + +	• • • • • • • • •	• •	FOR ERRORS IN THE . ALIGNMENT OF . THE LPD RETICLE . AND FOR WINDOW .	
+ + + +		•••	BENDING WHEN THE . LM IS PRESSURIZED THAT PART OF . WINDOW ERROR . WHICH CANNOT BE .	* #270
+ + +		• • • • • •	RESOLVEC INTO . RESOLVEC INTO . ROTATIONS ABOUT . THE BODY Y AND X . AXES WILL REMAIN .	
+ + + +	· · · · · · · · ·	• • • • • •	UNCOMPENSATED, Except at a chosen. Spot along the Reticle- the mean.	
+02 ++	• • • • • •	• •	LPC ANGLE OF THE . Approach phase).	#280
	• • • • • • • • •	••••	• • • • • •	
	•••	•••	• • • • • • •	
	• •	•••		
	• •	• •		
492	• •	• •		P64/LUMINARY
, !			: (:	· (

493			•	585 P64/LUMINARY
++	· · · · · · · · · · · · · · · · · · ·		•	
+02 +ECIT +	ZERO AZI- MUTH AND ELEVATION RECESIG-		•	#290
* + +02 *+	NATION REG- ISTERS		•	
	SET RECES-		•	#300
			• • •	
	HAVE ANY MANU-	• •	•	#3,10
	BEEN ISSUED SINCE THE LAST PASS?		•	
	· · · · · · · · · · · · · · · · · · ·		•	#320
	·····			
	- US ING PERTUR- - BATION EQUA- - TIONS AND LPD - CCMMANCS ACCU- - MULATED SINCE - LAST PASS,	•	• • •	#330
	. LAST PASS, . CCMPUTE POSIT-		•	
	• •		•	
	- · ·		•	P64/LUMI NARY
	• •	•	•	

(

					•		
	-		-		-		
	• •		•				
-			•		•		
					•		
-	ION OF NEW AIM		•				
	PCINT. (REFER		•		•		
	TO SECTION .				•		
-	5.3.4 OF R567 .		•		•		
			•		•		
	DESCRIPTION)		•		•		
-			•		•		
			•		•		
			•		•		
			•		•		
					•		
	TRANSFER AIM				•		
	CONDITIONS TO		•		•		
•	NEW AIM POINT.				•		
					•		
-			•		•		
-			•		•		
•			•		•		
•			•		•		
•	ZERO THE		•		•		
•	REDESIGNATION		•		•		
•	COUNTER .		•		•		
•			•		•		
•			•		•		
			•		•		
-			•				
					•		
-	WAIT 2 SEC						
•			•				
•	• •		•		•		
-	• • •		•		•		
•			•		•		
	•		•		•		
	•		•		•		
			•		•		
	•		•		•		
	•		•		•		
			•		•		
	RESET RECESSIONATION	N	•		•		
	FLAG		•		•		
		**	•		•		
	•		•		•		
	•		•		•		
	•		•		•		
	•		•		•		
	WAIT FOR TO TO BE		•		•		
	LESS THAN TENDAPPR		-		•		
			•				
	-						
	-						
	-		•				
	•						
	•						
			•				
	•		•		•		
	•		•		•		
	•		•		•		
	•		•		•		
	•		•	,	•		
•	•		•	(•		
				`			

586 P64/LUM IN ARY

#340

#350

#360

#370

.

#380

GO TO LANDING PHASE (ALTC) PROGRAM (P65). GO TO LANDING PHASE (ALTC) PROGRAM (P65). GO TO LANDING PHASE (AUTO) PROGRAM (P65)				
(ALTC) PROGRAM (P65). 		_		
(ALTC) PROGRAM (P65). 	•	•	•	
(ALTC) PROGRAM (P65). 	•			
(ALTC) PROGRAM (P65). 				
(ALTC) PROGRAM (P65). 				
(ALTC) PROGRAM (P65). 				
(ALTC) PROGRAM (P65). 				
(ALTC) PROGRAM (P65). 				
(ALTC) PROGRAM (P65). 				
(ALTC) PROGRAM (P65). 			•	
(ALTC) PROGRAM (P65). 	•	•		
(ALTC) PROGRAM (P65). 				
(ALTC) PROGRAM (P65). 				
(ALTC) PROGRAM (P65). 	GO TO LANDING PHASE	GO TO LANDING PH	A SE	
		== _		
	•	•		
	•	•		
•••	•	•		
		•••		
• •	•	•		
EXIT P64 EXIT P64	EXIT P64	EXIT P64		

CHANGE CENTROL NOTES

495

RE V	00 PI	CR 31			
RE V	01 PC	CR 85,	164 .2	246,542	
REV	00 (LUM	14)	P CR	670,737,751	
REV	01 (LUM	18)	PCR	838,840,841, EDITO	JRIAL
REV	02(LUM	1C J	PCR	285,968, EDITERIAL	_

,

(

THIS PAGE INTENTIONALLY LEFT BLANK

496

1.

,

LANDING PHASE (AUTO) PROGRAM (P65)

REV 02 12/03/69

PURPOSE: (1) TO CONTROL THE PONCS DURING THE THRUSTING OF THE POWERED LANDING MANEUVER FROM THE PERIOD IMMEDIATELY AFTER COMPLETION OF THE APPROACH PHASE AIM CONDITIONS (LO GATE) UNTIL TOUCHDOWN ON THE LUNAR SURFACE. ++

+02

A SSUMPTIONS: (1) THE LM IS ON THE POWERED LANDING DESCENT HAVING JUST ARRIVED AT THE LO GATE CONDITIONS (SEE APPROACH PHASE +EDIT PROGRAM (P64) AND SECTION 5.3.4 OF 8567).

++

(2) THE CSM IS IN A NEAR CIRCULAR ORBIT AROUND THE MODN AT A NOMINAL ALTITUDE OF 60 NAUTICAL MILES. THE CSM'S POSITION WITH RESPECT TO THE LM IS APPROXIMATELY O DEGREES CENTRAL ANGLE ABOVE THE LM. THE CSM IS MAINTAINING A PREFERRED TRACKING ATTITUDE FOR OPTICAL TRACKING OF THE LM.

(3) THE IMU IS ON AND ACCURATELY ALIGNED TO A LANDING SITE ORIENTATION DEFINED FOR THE DESIGNATED LANDING SITE AND THE NOMINAL TIME OF LANDING (T(LAND)). THE MOST RECENT IMU ALIGNMENT (FINE) TOOK PLACE DURING THE BRAKING PROGRAM (P63) PRIER TO CPS IGNITION.

(4) THE LANDING RACAR (LR) IS ON, CHECKED OUT, AND SHOULD HAVE BEEN PROVIDING TO THE LGC VELOCITY AND RANGE INFORMATION WITH RESPECT TO THE MOON. THIS INFORMATION SHOULD HAVE BEEN INCORPORATED INTO THE LM STATE VECTOR. THE LGC/LR OPERATION IS UNDER THE CONTROL OF THE DESCENT STATE VECTOR UPDATE ROUTINE (R12) WHICH IS ALREADY IN PROCESS.

(5) THE LGC WILL NEITHER CESIGNATE NCR REAC THE RENCEZVOUS RADAR (RR) DURING THIS PROGRAM.

(6) THE ENTIRE POWERED LANDING MANEUVER (BRAKING, APPROACH AND LANDING) WILL BE ACCOMPLISHED USING THE DPS ENGINE.

(7) THE FOLLOWING PARAMETERS REQUIRED BY THIS PROGRAM HAVE BEEN STORED IN THE LGC SINCE LGC INITIALIZATION BY ERASABLE REGISTER LOAD.

(A) THE LM STATE VECTOR. THE LGC HAS UPDATED THIS AS REQUIRED DURING THRUSTING. NO FURTHER STATE VECTOR UPDATES FROM ANY SOURCE OTHER THAN THE LR WILL BE ACCEPTED BY THIS PROGRAM.

(8) THE DPS IS NOT THRETTLABLE EVER THE WHOLE RANGE FROM O PERCENT TO MAXIMUM. IT MUST BE OPERATED EITHER AT MAXIMUM THROTTLE OR OVER A SPECIFIC THROTTLE RANGE OF LOWER SETTINGS. THESE THROTTLE SETTINGS ARE SPECIFIED IN SECTION 5.3.4 OF #567 AND ARE TOTAL THROTTLE SETTINGS. I.E.: THE SUM OF THE MANUAL SETTING (WHOSE MINIMUM IS ABOUT 10 PERCENT) AND THE PONC'S COMMANDED SETTING.

THIS PROGRAM ASSUMES THE THROTTLE CONTROL TO BE IN AUTO (THE DPS RECEIVES THE SUM OF THE MANUAL AND PGNCS COMMANDED SETTINGS) AND THE MANUAL THROTTLE TO BE SET AT A LEVEL LESS THAN THAT REQUIRED BY THE LGC. NOM INALLY THE THROTTLE WILL REMAIN WITHIN THE ALLOWABLE THROTTLE RANGE THROUGHOUT THIS PROGRAM.

(5) DURING THE POWERED LANDING MANEUVER, THE LGC WILL MONITOR THE PRESENCE OR ABSENCE OF THE MAUTO STABILIZATION DISCRETE. THIS DISCRETE IS ISSUED TO THE LGC WHEN THE ATTITUDE MODE CONTROL SWITCH IS IN THE AUTO POSITION. SHOULD THIS CISCRETE APPEAR DURING THE POWERED LANDING MANEUVER, THE LCC ASSUMES THAT IT NO LONGER

HAS COMPLETE AUTOMATIC CONTROL OF THE MANEUVER.

THE MONIFOR AND THE ASSOCIATED LGC LOGIC IS INCLUDED IN THE LANDING AUTO MODES MONITOR ROUTINE (R13) WHICH IS ALREADY IN PROCESS.

(10) THE X-AXIS OVERRIDE OPTION PROVIDES THE CREW WITH THE ABILITY TO EXERCISE MANUAL CONTROL ABOUT THE LM X AXIS WITH THE ATTITUDE CONTROLLER EVEN THOUGH THE PONCS ATTITUDE CONTROL MODE IS AUTO. WHEN THE CONTROLLER IS RETURNED TU DETENT THE PONCS DAMPS THE YAW RATE, STORES THE YAW ATTITUDE WHEN THE YAW RATE IS DAMPED, AND THEN MAINTAINS THAT ATT ITUDE.

THE X-AXIS OVERRIDE OPTION IS ALWAYS AVAILABLE TO THE CREW EXCEPT WHEN THE LGC IS SPECIFYING A DESIRED YAW ATTITUCE. THUS THE OPTION IS NOT INHIBITED BY THIS PROGRAM.

++ +02 +285 + + +02 ++

(11) THE LPD UPTION IS NOT PROVIDED THE CREW DURING THIS PROGRAM.

(12) THE INITIAL MANEUVER OF THE AUTO LANDING PHASE IS THE LM ATTITUDE TRANSIENT FROM THE LM ATTITUDE AT LO GATE TO THE HOVER ATTITUDE (LM X AXIS ALONG THE LOCAL VERTICAL). THE FINAL DESIGNATED LANCING SITE REMAINS IN THE LM X/Z PLANE DURING THIS TRANSIENT.

THE LM ALTITUDE RATE IS MAINTAINED AT A CONSTANT RATE UNTIL TOUCHDOWN (NORMALLY 3 FT/SEC DOWNWARD).

(13) THE CREW HAS THE CAPABILITY TO DISPLAY LGC CALCULATED VALUES OF FORWARD VELOCITY, LATERAL VELOCITY, ALTITUDE AND ALTITUDE RATE ON CERTAIN LM METERS DURING THIS PROGRAM. THE CALCULATION OF THESE PARAMETERS IS UNDER THE CONTROL OF THE LANDING ANALOG DISPLAYS ROUTINE (RIC) WHICH IS ALREADY IN PROCESS.

(14) THE RATE OF DESCENT (RCD) MEDE IS NOT ENABLED DURING THIS PROGRAM (SEE LANDING PHASE (RDD) PROGRAM (P66), FOR DEFINITION OF ROD MODEL.

(15) AN ABORT FROM THE LUNAR DESCENT MAY BE REQUIRED AT ANY TIME DURING THE DESCENT ORBIT INJECTION, THE CESCENT COAST. OR THE POWERED DESCENT (P63), (P64), (P65), OR (P66).

FOR ABORTS FROM THE DESCENT ORBIT INJECTION OR THE DESCENT COAST IT IS ASSUMED THAT SUFFICIENT TIME EXISTS TO PERFORM A TPI MANEUVER (SEE TERMINAL PHASE INITIATION (TPI) PROGRAM (P34)) TO INTERCEPT THE CSM DIRECTLY.

FOR ABORTS AFTER EPS IGNITION FOR THE POWERED LANDING MANEUVER, TIME IS CRITICAL. DURING THIS PERIOD AN ABORT IS COMMANDED BY PUSHING ONE OF TWO BUTTONS IN THE LM. THE ABORT MAY BE COMMANDED TO USE THE DESCENT STAGE (ABORT BUTTON) OR THE ASCENT STAGE (ABORT STAGE BUTTON). IF THE DESCENT STAGE IS SELECTED, AND THE DPS PROPELLANT APPROACHES EXHAUS-TICN, CONTROL MUST BE SWITCHED TO THE ASCENT STAGE BY THE CREW BY ASCENT STAGE SELECTION (ABORT STAGE BUTTON).

DURING THE POWERED LANDING MANEUVER, THE LGC WILL CONTINUOUSLY MONITOR THE ABORT AND ABORT STAGE DISCRETES, AND UPON RECEIPT OF EITHER WILL TERMINATE THE PROGRAM IN PROCESS AND CALL THE APPROPRIATE ABORT PROGRAM (DPS ABORT PREGRAM (P70) OR APS ABORT PROGRAM (P71)). BOTH ABORT PROGRAMS WILL GUIDE THE LM TO AN ORBIT AS SPECIFIED IN SECTION 5.4.3 OF R567.

THE MCNITUR OF THE ABORT AND ABORT STAGE PUSHBUTTONS IS CONTROLLED BY THE ABORT DISCRETES MONITOR ROUTINE (R11) WHICH IS ALREADY IN PRECESS.

(16) IF A THRUSTING MANEUVER IS PERFORMED WITH THE GUIDANCE CONTROL SWITCH IN PENS AND THE MODE CONTROL SWITCH IN AUTC, THE PONCS WILL CONTROL THE TOTAL VEHICLE ATTITUDE AND GENERATE EITHER NODE I OR MODE II ATTITUDE ERRORS AND VEHICLE ATTITUDE RATES (SEE ASSUMPTION (18)) FOR DISPLAY ON THE FDAI. THE CREW MAY EXERCISE CONTROL AROUND THE YAW AXIS CNLY WITH THE ACA (X-AXIS OVERRIDE) IF THE X-AXIS OVERRIDE CAPABILITY IS PERMITTED BY THE PROGRAM IN PROCESS. THIS MANUAL CUNTROL WILL BE IN THE RATE COMMAND ATT ITUDE HOLD MODE.

IF A THRUSTING MANEUVER IS PERFORMED WITH THE GUIDANCE CONTROL SWITCH IN PGNS AND THE MODE CONTROL SWITCH IN ATTITUDE HOLD THE PEACS WILL HOLD THE VEHICLE ATTITUDE AND WILL GENERATE EITHER MODE I OR MODE II ATTITUDE ERRORS FOR DISPLAY ON THE FDAI. THE CREW MAY EXERCISE MANUAL ATTITUDE CONTROL ABOUT ALL VEHICLE AXES WITH THE ACA IN EITHER THE RATE COMMAND OR MINIMUM IMPULSE MODE DEPENDING UPON THE STATUS OF THE PULSES FLAG. IT IS STRONGLY RECOMMENDED THAT POWERED FLIGHT NOT BE ATTEMPTED IN THE MINIMUM IMPULSE MODE. THE PULSES FLAG IS SET OR RESET BY EXTENDED VERBS 76(MINIMUM IMPULSE) AND 77 (RATE COMMAND) RESPECTIVELY. THE PULSES FLAG IS ALSO RESET BY P12,P40,P41, P42, F63, P70, P71 AND R40 AT MAIN ENGINE IGNITION. WITH THE EXCEPTION OF THESE CASES MCDE SELECTION IS ALWAYS BASED UPON THE LAST ENTRY MADE IN THE DSKY. DURING A THRUSTING MANEUVER IN THE PGNS/ATTITUDE HOLD MODE THE PGNCS WILL +02 NOT BE RESPONSIBLE IF REGISTER OVERFLOWS OCCUR WITHIN THE LGC. ++

> (17) CONTROL OF THE LM UPS, RCS AND APS IS TRANSFERRED FROM THE PONCS TO THE ABURT GUIDANCE SYSTEM (AGS) BY PLACING THE GUID CONT SWITCH FROM PGNS TO AGS.

THE AGS WILL BE CAPABLE OF TAKING OVER CONTROL OF THE LM DURING ANY PORTION OF THE LUNAR DESCENT OR ASCENT OR DURING EITHER OF THE ABORT PROGRAMS (PTO OR PTI). THE AGS WILL GUIDE THE LM TO A SAFE ORBIT.

THE AGS MAY BE INITIALIZED BY THE LGC AT ANY TIME BY MANUAL SELECTION OF THE AGS INITIALIZATION ROUTINE (R47). IN THE EVENT THAT THE GUIDANCE CONTROL SWITCH IS CHANGED FROM PONS TO AGS DURING A THRUSTING MANEUVER, THE LGC WILL CONTINUE CUMPUTATION OF POSITION AND VELOCITY, THE DESIRED THRUST VECTOR AND THE DESIRED ATTITUDE ERRORS, HOWEVER THE PONCS WILL NOT BE RESPONSIBLE IF REGISTER OVERFLOWS OCCUR WITHIN THE LCC.

(18) THE PGNCS CAN GENERATE TWO TYPES OF ATTITUDE ERRORS FOR DISPLAY ON THE FDA1;

MCDE I - SELECTED BY EXTENDED VERB 61. AUTOPILOT FOLLOWING ERRORS USED AS A MONITOR OF THE DAP'S ABILITY TO TRACK AUTOMATIC STEERING COMMANDS.

++ +02 +285

++

++

++

+02

+EDIT

++ +02

+

÷

÷

٠

+EDIT

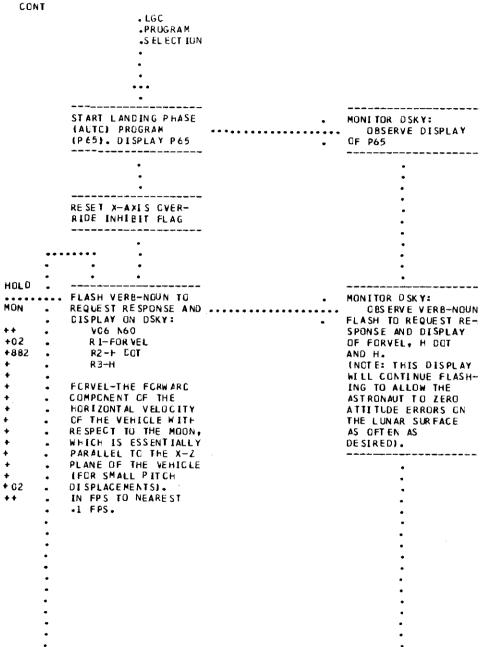
591 P65/LUHINARY

(

++	MODE II - SELECTED BY EXTENDED VERB 62. TOTAL ATTITUDE ERRORS USED TO ASSIST CREW IN MANUALLY MANEUVERING
+02	THE VEHICLE.
+EDII	
+	PGNCS-DERIVED VEHICLE ATTITUDE RATES MAY ALSO BE DISPLAYED VIA SELECTION BY EXTENDED VERB 60.
+02	MODE II ATTITUDE ERROR DISPLAYS ARE AUTOMATICALLY SELECTED AT THE BEGINNING OF ROO. WITH THE EXCEPTIONS
++	INDICATED IN ASSUMPTION (16) ABOVE, DISPLAY SELECTION IS ALWAYS BASED UPON THE LAST ENTRY MADE IN THE DSKY.
	FOR A MORE DETAILED DESCRIPTION OF THESE DISPLAYS REFER TO SECTION 3 OF R567, PARA. 3.2.6.
	(19) THE LOAD DAP DATA ACUTINE (RO3) HAS BEEN PERFORMED PRIOR TO THE START OF THE POWERED LANDING MANEUVER AND SHOULD
	NOT BE REQUIRED DURING THIS PROGRAM.
	(20) LGC AND CREW PROCECURES IN CASES OF LGC-ASSUMED THRUST FAILURE ARE DEFINED BY THE DPS/APS THRUST FAIL ROUTINE
	(R40). THIS ROUTINE IS IN EFFECT DURING THIS PROGRAM UNTIL P68 SELECTION (VIA R00), HAVING BEEN ENABLED BY P63.
++	·
+ 02	(21) THIS PROGRAM IS AUTCHATICALLY SELECTED BY THE APPROACH PHASE PROGRAM (P64) AT THE COMPLETION OF THE LO GATE
+EDIT	A IM CONDITIONS-TE LESS THAN TENDAPPR (TIME-TO-END-APPROACH-PHASE).
+	
+	(22) TWO ALARM CONDITIONS MAY BE ORIGINATED BY THE PONCS POWERED LANDING EQUATIONS:
+	(A) IF SUBROUTINE ROOTPSRS IN THE RG/VG CALCULATION FAILS TO CONVERGE IN 8 PASSES THE LGC WILL TURN ON
+	THE PROGRAM ALARM LIGHT, STORE PROGRAM ALARM 21406 AND GO IMMEDIATELY TO THE FINAL AUTOMATIC REQUEST
+	TERMINATE ROUTINE (ROO). THIS ALARM COULD ONLY OCCUR IN P63 DURING IGNITION COMPUTATIONS.
+	(B) IF AN OVERFLOW OCCURS ANYWHERE IN THE LANDING EQUATIONS THE LGC WILL TURN ON THE PROGRAM ALARM LIGHT,
+ 02	STORE ALARM CODE 1410, STOP ALL VEHICLE ATTITUDE RATES AND CONTINUE. THIS ALARM COULD OCCUR IN P63, P64,
++	OR P65.
	(23) THIS PROGRAM ALLOWS MANUAL CONTROL OF LM ATTITUDE AND THE SELECTION OF P66.
	DURING P65 (AND P63 AND P64) THE ASTRONAUT CAN DISPLAY THE PONCS TOTAL GUIDANCE ERROR ON THE FDAI ERROR
	NEEDLES (ATTITUDE MON SWITCH IN PGNCS) BY HAVING KEYED IN V62 THRU THE DSKY. HE CAN THEN STEER OUT THE PGNCS P63 ATTITUDE ERRORS WITH THE AGS MANUALLY (GUID CONT IN AGS AND AGS MODE CONTROL IN ATT HOLD); OR WITH THE PGNCS
	MANUALLY (GUID CONT IN PENCS AND PENCS HEDE CONTROL IN ATT HOLD) OR AUTOMATICALLY (PENCS MODE CONTROL IN AUTO). THUS
	THERE ARE THREE ATTITUDE CONTROL SUBNODES IN P65 (AND P63 AND P64): AGS MANUAL; PGNCS MANUAL; OR PGNCS AUTO.
	A CAUTICNARY NOTE: IF THE ASTRONAUT HITS THE ROD (RATE-OF-DESCENT) SWITCH WHILE HE IS IN PONCS ATT HOLD,
	THE LGC WILL IRREVOCABLY TRANSFER HIM OUT OF THE AUTO GUIDANCE PROGRAM MODES INTO THE ROD PROGRAM MODE (P66).
++	THE ESS WEEL TREE TO THE HOUSE FROM THE ADD STEARCE FROM HOUES INTO THE ROD FROM AN HOUE (P66).
+02	(24) THE ASTRONAUT MAY MENITOR THE FELLEWING PARAMETERS BY KEYING IN V16 N92E:
+285	
+	(A) V16 N92
+	RI-THRCMC
+	R 2- HDO T
+	R3-H
+	
+	THRCMD-THE PERCENT THROTTLE DESIRED BY THE LGC BASED ON THE DPS RATED THRUST OF 10,500 PDUNDS. IN PERCENT
+	TG NEAREST PERCENT.
+	
+	HDOT-THE PRESENT RATE OF CHANGE OF ALTITUDE (H). IN FPS TO NEAREST .1 FPS.
+	
+	H-THE PRESENT ALTITUDE OF THE LM ABOVE THE LUNAR RADIUS AT THE INITIALLY DESIGNATED LANDING SITE. IN FEET
+02	TO NEAREST FOOT.
++	

PROG LGC GREUND CREW

499



#10

#20

#30

H DCT-THE PRESENT RATE OF CHANGE CF ALTITUCE (H). POLA-RITY INCICATES CES-CENT (-) OR A SCENT (+). POLARITY IS NOMINALLY - DURING THIS PROGRAM. IN FPS • TC NEAREST .1 FPS . H-THE PRESENT ALTI-. TUDE OF THE LM ABOVE . THE LUNAR RADIUS AT THE INITIALLY DESIG-. NATED LANDING SITE. ٠ POLARITY IS + FOR . ALTITUDES GREATER . THAN THE ABOVE . RADILS. IN FEET TO . NEAREST FOOT. ____ ----------MONITOR FDAL AND OUT THE WINDOW: **OBSERVE ATTITUDE** TRANSIENT TO BRING LN TO LOCAL VERTICAL ATTITUDE WITH LM +Z AXIS DOWNRANGE. START AUTOMATIC CES-MONITOR AUTOMATIC CENT. NULL THE HORI-DESCENT USING ALL ٠ ZONTAL VELOCITY RE-PGNCS AND LM DIS-. . . . LATIVE TO THE . PLAYS AND DUT THE SURFACE AND MAINTAIN WINDOW REFERENCES RATE OF DESCENT AT 3 AS DESIRED. . FEET PER SECOND. COSERVE H DOT _____ TO BE -00030. THIS PRUGRAM DOES NOT ALLOW MANUAL

#50

#60

₽70

#80

CONTROL OF LM ATTI-TUDE OR THROTTLE. IF MANUAL ATTI-TUDE CUNTROL IS DE-SIREC PUT ATTITUDE CONTROL MODE SWITCH IN ATTITUDE HOLD.

THE LGC WILL AUTOMA-TICALLY SELECT LAND-ING PHASE (ROD) PRO-GRAM (P66) AND MAIN-TAIN THE PRESENT RATE OF DESCENT AND PRESENT LM ATTITUDE. ATTITUDE AND RATE OF DESCENT MAY THEN BE

MOCIFIED BY MANUAL

ATTITUDE ERROR

NEEDLES WILL

₽65.

CONTROL. THE MUDE II

CONTINUE TO DISPLAY

THE LAST ERROR WHEN

IF MANUAL THROT-TLE CONTROL IS DES-IRED, ADVANCE THRUST

EXIT WAS MADE FREM

/TRANSLATION CONT-ROLLER UNTIL LGC CONTRIBUTION TO TCTAL THRUST IS ZERO (THRUST INDICATOR-RIGHT SIDE), AND PUT

THROTTLE CONTROL IN

MANUAL. THE LGC WILL

PRESENT LM INEFTIAL

RATE OF DESCENT MAY THEN BE MOCIFIED BY MANUAL THROTILE CONTROL. LM ATTITUDE

ATTITUDE. THRUTTLE CCNTRCL WILL REVERT TU THE LEVEL CCMMAN-DED BY THE THRUST/-TRANSLATION CONTRUL-

MAINTAIN THE

LER.

++

÷

+

÷

+02

++

++

+02

+ 285

+02

++

1.

+02

+ EDIT .

#100

#110

#120

#130

++ + 02 +285

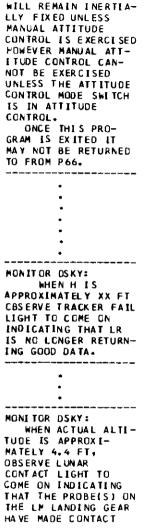
503

++

#160

#150

#170



	• • • • • •		WITH THE LUNAR SUR- FACE.	
	• •		•	#190
	• •		•	
	• •		PUSH ENGINE STOP SWITCH TO TERMINATE DPS THRUST	
	• • • •		•	#200
++	• •		•	
+02 +EDIT + +	· · · · · · · · · · · · · · · · · · ·		WITH ₩CDE CGNTRCL SWITCH IN "ATT HGLD", KEY IN PRO- CEED OR V32€ (TC COMMAND ZERU ATTI-	
+ + +	· · · ·	• • • • • • • • • • • • • • • • • • •	TUDE ERRORS AND RATES. THIS WILL PREVENT RCS JET FIR-	#210
+ + + +	· · · · · · · · · · · · · · · · · · ·	•	INGS ON THE LUNAR SURFACE UNTIL P68 PLACES THE DAP IN THE MINIMUM IMPULSE MODE)	
+ +02 ++	• • • •	•	•	
	• •	•	•	#220
	· · · · · · · · · · · · · · · · · · ·	•	CHECK THRUST INDICA- TOR (LEFT SIDE) TO INDICATE O PERCENT CHAMBER PRESSURE.	•220
	• •	•	•	
	• •	•	•	
	• • • • • • • • •	•	STANCEY ABORT STAGE PUSHBUTTON IN CASE LM STARTS TO TIP DVER WHILE LANDING.	#230
	• • •	•	•	
	• •	•	•	
	• •	•	•	
	• •	•	•	
	• •	•	•	
	• •	•	•	
514	• •	•	•	
5	• •	٠	•	P65/LUMINARY
	••••	•	•	

(

. . .

•
•
•

\ *****

505	•	•		•		597 P65/LUMINARY
	•	•	•	•		
		•	•	AM I FINISHED WITH THE DISPLAY?	-	#240
4	++	WALT FOR KEYEGARC		•N •Y	-	
	+EDIT .	ENTRY	•	KEY IN TERNINATE		
4	+ . + .		•			#250
•	• •			WHEN LANDING HAS BEEN SUCCESSFULL	- •	
4 4 4 4	•	TERMINATE FLASH UPON RECEIPT OF V37E68E	N . 	COMPLETED, KEY I V37E68E TO SELEC THE LANDING CON- FIRMATION PROGRA (P68).	N T	#240
+		•P•V••T•V •R•3•E•3 •D•2•R•7 •C•E•M•E	·	•	-	#260
+		•C •E •M •E •E • •I •6 •E • •N •8 •D • •A •E		• • •		
+		••••• •••• ••••		• •		#270
+		COMMAND ZERO AT-		•		
+		TITUCE ERRORS		.• •		
+				• • •		#280
+ + + +		COMMAND		•		
+				• •		
+ + +		• •		•		
+		• • • • • •		• • •		P65/LUMI NARY
+ +	•	•••		•		POPEURARY

(

+ +	: :	•	•	598 P65/LUM IN AR Y
+	• •	•	•	
+	• •	•	•	
+	• •	•	•	
+	 ATTITUDE . 	•	•	
+	 RATES 	•	•	
+	· ····· ·	•	۲	
+	• • •	•	•	
+	• • •	•	•	
+	• • •	•	v	#290
+		•	•	
+		•	•	
+02		•	•	
++		•	•	
		•	•	
	TED VIA ROO	SELEC	GO TO PROGRAM SELECTED	
	•		•	#3 00
	•		•	
	•		•	
	•••		* * *	

EXIT P65

-

ſ

CHANGE CONTROL NOTES

RE V	CC	PC	R 31		
R EV	01	PC	R 85,	164,4	470,542
REV	00 (1	LUM	1A)	PCR	737
RE V	01(LLM	18)	PCR	838,841, ECITCRIAL
REV	02(1	LUM	161	P CR	285,882,EDITORIAL

EX 11 P65

•

LANCING PHASE (ROD) PROGRAM (P66)

REV 02 12/03/69

PURPOSE: (1) TO MODIFY THE RATE OF DESCENT OF THE LM (WITH RESPECT TO THE LUNAR SURFACE) IN RESPONSE TO ASTRONAUT DRIGINATED INPUTS TO THE LGC VIA THE LM RATE OF DESCENT SWITCH.

(2) TO MODIFY THE INERTIAL ATTITUDE OF THE LM IN RESPONSE TO ASTRONAUT ORIGINATED INPUTS VIA THE ATTITUDE CONTROLLER ONLY IF THE ATTITUDE CONTROL SWITCH IS IN ATTITUDE HOLD.

(3) TO MAINTAIN A CONSTANT RATE OF DESCENT AND LM INERTIAL ATTITUDE IN THE ABSENCE OF MANUAL CONTROL INPUTS.

(4) TO UPDATE THE LM STATE VECTOR WITH VEHICLE ACCELERATION AND LANDING RADAR (LR) DATA.

ASSUMPTICAS: (1) THE LM IS IN THE LATE STAGES OF LANDING, WITH A RELATIVELY LOW INERTIAL VELOCITY.

(2) THE IMU IS ON AND ACCURATELY ALIGNED TO A LANDING SITE DRIENTATION DEFINED FOR THE DESIGNATED LANDING SITE AND THE NOMINAL TIME OF LANDING (T(LAND)).

(3) THE LANDING RADAR (LR) IS ON, CHECKED OUT, AND SHOULD HAVE BEEN PROVIDING TO THE LGC VELOCITY AND RANGE INFORMATION WITH RESPECT TO THE MOON. THIS INFORMATION SHOULD HAVE BEEN INCORPORATED INTO THE LM STATE VECTOR. THE LGC/LR OPERATION IS UNDER THE CONTROL OF THE CESCENT STATE VECTOR UPDATE ROUTINE (R12) WHICH IS ALREADY IN PROCESS.

(4) THE LGC WILL NEITHER DESIGNATE NOR READ THE RENDEZVOUS RADAR (RR) DURING THIS PROGRAM.

(5) THE ENTIRE POWERED LANDING MANEUVER (BRAKING, APPRGACH AND LANDING) WILL BE ACCOMPLISHED USING THE DPS ENGINE.

(6) THE FOLLCHING PARAMETERS RECUIRED BY THIS PROGRAM HAVE BEEN STORED IN THE LGC SINCE LGC INITIALIZATION BY ERASABLE REGISTER LOAD.

(A) THE LP STATE VECTOR. THE LGC HAS UPDATED THIS AS REQUIRED DURING THRUSTING. NO FURTHER STATE VECTOR UPDATES FROM ANY SOURCE OTHER THAN THE LR WILL BE ACCEPTED BY THIS PROGRAM.

(7) THE DPS IS NOT THRETTLABLE OVER THE WHELE RANGE FROM O PERCENT TO MAXIMUM. IT MUST BE OPERATED EITHER AT MAXIMUM THROTTLE OR OVER A SPECIFIC THROTTLE RANGE OF LOWER SETTINGS. THESE THROTTLE SETTINGS ARE SPECIFIED IN SECTION 5.3.4 CF R567 AND ARE TOTAL THROTTLE SETTINGS, I.E.: THE SUM OF THE MANUAL SETTING (WHOSE MINIMUM IS 10 PERCENT), AND THE PGNCS COMMANDED SETTING.

THIS PROGRAM ASSUMES THE THROTTLE CONTROL TO BE IN AUTO (THE DPS RECEIVES THE SUM OF THE MANUAL AND PONCS COMMANDED SETTINGS) AND THE MANUAL THROTTLE TO BE SET AT A LEVEL LESS THAN THAT REQUIRED BY THE LGC. Nominally the Throttle Will Remain within the Allowable throttle range throughout this program.

(8) CURING THE POWERED LANDING MANEUVER, THE LGC WILL MONITOR THE PRESENCE OR ABSENCE OF THE "NON-ATTITUDE FOLD" DISCRETE. THIS DISCRETE IS ISSUED TO THE LGC WHEN THE ATTITUDE MODE CONTROL SWITCH IS IN THE AUTO POSITION. SHOULD THIS DISCRETE APPEAR DURING THE POWERED LANDING MANEUVER, THE LGC ASSUMES THAT IT NO

LONGER HAS COMPLETE AUTOMATIC CONTROL OF THE MANEUVER... THE MONITOR AND THE ASSOCIATED LGC LOGIC IS INCLUDED IN THE LANDING AUTO MODES MONITOR ROUTINE (R13) WHICH IS ALREADY IN PROCESS.

(9) THE LPD OPTION IS NOT PROVIDED THE CREW DURING THIS PROGRAM.

(10) THE LGC ASSUMES ALL ATTITUDE CHANGES TO BE MANUAL THROUGHOUT THIS PROGRAM. THE LGC WILL HOLD INERTIAL ATTITUDE IN EITHER MODE, HOWEVER ONLY IN THE ATTITUDE HOLD MODE MAY THE ATTITUDE BE CHANGED BY MANUAL CONTROL VIA THE ATTITUDE CONTROLLER.

+ 02 +285 + + +02 ++

++

(11) THE GREW HAS THE CAPABILITY TO DISPLAY LGC CALCULATED VALUES OF FORWARD VELOCITY, LATERAL VELOCITY, ALTITUDE AND ALTITUDE RATE ON CERTAIN LM METERS DURING THIS PROGRAM. THE CALCULATION OF THESE PARAMETERS IS UNDER THE CONTROL OF THE LANDING ANALOG DISPLAYS ROUTINE (RIC) WHICH IS ALREADY IN PROCESS.

(12) DURING THIS PREGRAM THE LGE MENITERS THE OUTPUT OF THE RATE OF DESCENT (ROD) SWITCH IN THE LM. THIS SWITCH IS OPERATED BY THE ASTRUNAUT IN RESPONSE TO HIS ASSESSMENT OF THE PRESENT LM RATE OF DESCENT BASED ON OUT-THE-WINDOW REFERENCES AND LM/CSKY CISPLAYS.

SWITCH OPERATION IS ON AN INCREMENTAL BASIS, EITHER - (INCREASE ROD) OR + (DECREASE ROD). EACH COMMAND RESULTS IN AN LGC-COMMANDED CHANGE OF "RODSCALE" FIJSEC IN THE LM RATE OF DESCENT. ("RODSCALE" IS A VALUE LOADED INTO ERASABLE STORAGE PRICE TO FLIGHT)

(13) AN ABORT FROM THE LUNAR DESCENT MAY BE REQUIRED AT ANY TIME DURING THE POWERED DESCENT (P63), (P64), (P65), GR (P66).

FOR ABORTS AFTER DPS IGNITION FOR THE POWERED LANDING MANEUVER, TIME IS CRITICAL. DURING THIS PERIOD AN ABORT IS COMMANDED BY PUSHING UNE OF TWO BUTTONS IN THE LM. THE ABORT MAY BE COMMANDED TO USE THE DESCENT STAGE (ABORT BUTTON) OR THE ASCENT STAGE (ABORT STAGE BUTTON). IF THE DESCENT STAGE IS SELECTED, AND THE DPS PROPELLANT APPROACHES EXHAUS-TION, CUNTROL MUST BE SWITCHED TO THE ASCENT STAGE BY THE CREW BY ASCENT STAGE SELECTION (ABORT STAGE BUTTON).

DURING THE POWEREC LANCING MANEUVER, THE LGC WILL CONTINUOUSLY MONITOR THE ABORT AND ABORT STAGE DISCRETES, AND UPON RECEIPT OF EITHER WILL TERMINATE THE PROGRAM IN PROCESS AND CALL THE APPROPRIATE ABORT PROGRAM (DPS ABORT PROGRAM (P70) OR APS ABORT PROGRAM (P71)). BOTH ABORT PROGRAMS WILL GUIDE THE LM TO AN ORBIT AS SPECIFIED IN SECTION 5.4.3 OF R567.

THE MONITOR OF THE ABORT AND ABORT STAGE PUSHBUTTONS IS CONTROLLED BY THE ABORT DISCRETES MONITOR ROUTINE (R11) WHICH IS ALREADY IN PROCESS.

(14) IF A THRUSTING MANEUVER IS PERFORMED WITH THE GUIDANCE CONTROL SWITCH AT PGNS AND THE MODE CONTROL SWITCH AT ATTITUDE HOLD THE PGNCS WILL HOLD THE VEHICLE ATTITUDE AND WILL GENERATE EITHER MODE I GR MODE II ATTITUDE ERRORS AND VEHICLE ATTITUDE RATES FOR DISPLAY ON THE FDAI. THE CREW MAY EXERCISE MANUAL ATTITUDE CONTROL ABOUT ALL VEHICLE AXES WITH THE ACA IN EITHER THE RATE COMMAND OR MINIMUM IMPULSE MODE DEPENDING UPON THE STATUS OF THE PULSES FLAG. IT IS STRONGLY RECOMMENDED THAT POWERED FLIGHT NOT BE ATTEMPTED IN THE MINIMUM IMPULSE MODE. THE PULSES FLAG IS SET OR RESET BY EXTENDED VERBS 76 (MINIMUM IMPULSE) AND 77 (RATE COMMAND) RESPECTIVELY. THE PULSES FLAG IS ALSO RESET BY P12;P40;P41;P42;P63;P70;P71 AND R40 AT MAIN ENGINE IGNITION. WITH THE EXCEPTION OF THESE CASES, MODE SELECTION IS ALWAYS BASED UPON THE LAST ENTRY MADE IN THE DSKY. DURING A THRUSTING MANEUVER IN THE PGNS/ATTITUDE HOLD MODE, THE PGNCS WILL NOT BE RESPONSIBLE IF REGISTER OVERFLOWS OCCUR WITHIN THE LGC.

(15) CONTRUL OF THE LM DPS, RCS, AND APS IS TRANSFERRED FROM THE PGNCS TO THE ABORT GUIDANCE SYSTEM (AGS) BY PLACING THE GUID CONT SWITCH FROM PGNS TO AGS.

THE AGS WILL BE CAPABLE OF TAKING OVER CONTROL OF THE LM DURING ANY PORTION OF THE LUNAR DESCENT OR ASCENT OR DURING EITHER OF THE ABORT PROGRAMS (PTO OR PTI). THE AGS WILL GUIDE THE LM TO A SAFE ORBIT.

THE AGS MAY BE INITIALIZED BY THE LGC AT ANY TIME BY MANUAL SELECTION OF THE AGS INITIALIZATION ROUTINE (R47). IN THE EVENT THAT THE GUIDANCE CONTROL SWITCH IS CHANGED FROM PGNS TO AGS DURING A THRUSTING MANEJVER, THE LGC WILL CONTINUE COMPUTATION OF POSITION AND VELOCITY, THE DESIRED THRUST VECTOR, AND THE DESIRED ATTITUDE ERRORS; HOWEVER THE PGNCS WILL NOT BE RESPONSIBLE IF REGISTER OVERFLOWS COCUR WITHIN THE LGC BECAUSE THE AGS IS NOT MAINTAINING REASCHABLE ATTITUDE CONTROL.

(16) THE LOAD DAP DATA ROUTINE IRC3) HAS BEEN PERFORMED PRIOR TO THE START OF THE POWERED LANDING MANEUVER AND Should not be required during this program.

(17) LGC AND GREW PROCEDURES IN CASES OF LGC-ASSUMED THRUST FAILURE ARE DEFINED BY THE DPS/APS THRUST FAIL ROUTINE (R40). THIS RGUTINE IS IN EFFECT DURING THIS PROGRAM UNTIL SELECTION (VIA ROO) OF THE LANDING CONFIRMATION PROGRAM (P68), HAVING BEEN ENABLED BY P63.

(18) THIS PROGRAM AS AUTOMATICALLY SELECTED BY THE LANDING AUTO MODES MONITOR ROUTINE (R13) DURING THE POWERED LANDING MANEUVER WHEN:

(A) ATTITUDE CUNTROL IS FIRST TRANSFERRED TO MANUAL (ATTITUDE CONTROL SWITCH TO ATTITUDE HOLD) IF THE THRUTTLE CONTROL REMAINS AUTG (THROTTLE SWITCH IN AUTO) AND THE ASTRONAUT COMMANDS A NET CHANGE IN THE RATE OF DESCENT BY MEANS OF THE ROD SWITCH.

+02 +EDIT + + + 02 ++

++

50

1.1

++ +02

++

+285

P66/LUMINARY

++	
+02	(19) THE ASTRUNAUT MAY MONITOR THE FOLLOWING PARAMETERS BY KEYING IN VIG N92E:
+285	
+	(A) V16 N52
+	R1-THRCMC
+	R2-HDQT
+	R 3 H
+	
+	THRCMD-THE PERCENT THROTTLE DESIRED BY THE LGC BASED ON THE DPS RATED THRUST OF 10,500 POUNDS. IN PERCENT
+	TO NEAREST PERCENT.
+	
+	HDOT-THE PRÉSENT RATE OF CHANGE OF ALTITUDE (H). IN FPS TO NEAREST .1 FPS.
+	
+	H-THE PRESENT ALTITUDE OF THE LM ABOVE THE LUNAR RADIUS AT THE INITIALLY DESIGNATED LANDING SITE. IN FEET
+02	TO NEAREST FCCT.
++	

.

PROG CONT	LGC	GROUND	CREW		
	• LGC • PRO GR AM • SELECT ION • • • • •	·			
	START LANCING PHASE (ROD) PROGRAM (P66). DISPLAY P66	•	MONITOR DSKY: OBSERVE DISPLAY OF P66		
	•		•	-	
	SET DESIRED H DOT EQUAL TC ACTUAL H DOT		• • •		
			• • • • • • • • • • • • • • • • • • • •		
	• • • •		• • • • • •		
	•		•		

#10

#20

,

	•
	•
	•
	•
	•
	• • • • • • • • • • • • • • • • • • • •
	STOPRATE TO TER-
	ATE MANEUVER (IF) IN PROCESS
ANT	7 IN PROCESS
	•
	•
	•
	ET X-AX IS OVER-
	E INHIBIT FLAG.
	TE: DEPENDING UP-
	THE TIME OF SELE- ON OF THIS PROG-
	THE X-AXIS OVER-
	E CPTION MAY NOT
	INHIBITED AND
	S FUNCTION IS RE-
	DANT.)
	•
	•
	•
	•
	•
	-
	•
	•
• •	•
• •	•
	PUTE FORVEL,
• 5 U	СТ, ANC н
•	•
•	•
•	•
•	•
•	•

•

.

.

(

++ +02 + 285 +882

ŧ ÷ +

> ٠ ŧ

٠ ÷ +02 + ŧ + ÷

+

ŧ ŧ

+

+

÷

+ +

 51° ŧ ٠

.

•

.

.

.

.

.

٠ 1

#30

.

#40

#50

#60

#70

P66/LUM IN ARY

	•	•		•
+	•	•		•
+	•	•		•
++	•	•		•
	•	•		•
				-
		• •		•
	•••			•
HOL D		• •		•
	••	FLASH VERB-NCUN TO		
***** MON			•	MONITOR DSKY:
MON	••	REQUEST RESPONSE AND	•••••	OBSERVE VERB-NOUN
		DISPLAY ON DSKY:	•	FLASH TO REQUEST RE-
++	• •	V06 N60		SPONSE AND DISPLAY
+02	••	R 1-FOR VEL		OF FORVEL, H DOT
+882	••	R2-H COT		AND H.
+	••	R3-H		(NOTE: THIS DISPLAY
+	••			WILL CONTINUE FLASH-
+		FORVEL-THE FORWARD		ING TO ALLOW THE
+	••	COMPONENT OF THE		ASTRONAUT TO ZERO
+	••	HORIZONTAL VELOCITY		ATTITUDE ERRORS ON
+		OF THE VEHICLE WITH		THE LUNAR SURFACE AS
+		RESPECT TO THE MCCN		OFTEN AS DESIRED).
	••	WHICH IS ESSENTIALLY		OTTER AS DESTREDT.
		PARALLEL TO THE X-Z		
• •	••			•
	**	PLANE OF THE VEHICLE		•
+02	••	LFOR SMALL PITCH		•
++	••	DI SPLACEMENTS .		•
		IN FPS TO NEAREST .1		•
	••	FPS		•
	••			•
		H DOT-THE PRESENT		•
	+.	RATE OF CHANGE OF		•
	••	ALTITUDE (H). PCLA-		_
	••	RITY INCICATES DES-		•
	••	CENT (-), OR ASCENT		-
		(+). POLARITY IS		
		NOMINALLY - DURING		-
		THIS PROGRAM. IN FPS		•
		TO NEAREST .1 FPS		•
	••	IO NEAREST 11 FPS		•
	••	H-THE PRESENT RACAR		•
	••			•
	••	UPDATED ALTITUDE OF		•
	••	THE LK ABOVE THE		•
	••	LUNAR SURFACE.		•
	••	POLARITY IS +		•
	••	FGR ALTITUDES		•
	••	GREATER THAN THE		•
	••	ABOVE RACIUS. IN		•
	••	FEET TO NEAREST		•
	••			•
	••			•
	••			•
	••		÷	-
				-
				•
	••			•
	••			•
	••			•
	••			•
	••			•
	••			•

:

+ 5¹¹ +

.

•••

•

٠

#80

#90

#100

#110

,

••			•		606 66/L UM INAR Y
••			•	F	BUT OF MART
••			•		
••	FCCT.		*		#120
••			•		
••	•		•		
••	•		•		
••	•		•		
•••	•		•		
••	MCNITOR RATE OF DESCENT INPUTS TO THE LGC	• •	MCNITOR PROGRESS CF POWERED LANDING MANEUVER USING LM DISPLAYS, DSKY DIS-		#130
••	•		PLAYS AND WINDOW.		
••	•		USING RATE OF		
••	•		DESCENT SWITCH, COMMAND DESIRED RATE		
••			OF DESCENT.		
••	CENPUTE REQUIRED		IF MANUAL ATTIT- UDE CONTROL IS CE-		
••	CHANGE IN THROTTLE SETTING FOR PRESENT-		SIRED USE ATTITUDE		
••	LY GESIREC ROC.		CONTROLLER .		#140
• •			MONITOR THRUST INDICATOR (RIGHT		
••	•		SIDE) TO ENSURE THAT		
••	•		LGC THROTTLE COMMAND		
••	COMMAND REQUIRED		DOES NOT EXCEED XX PERCENT. (NOTE: THE		
	THROTTLE SETTING		LGC WILL NOT INTEN-		
••			TIONALLY COMMAND A		
••	• •		THRUST LEVEL LARGER THAN THAT SPECIFIED		#150
••	• •		BY A PAD-LOADED		
••	WAIT ONE		LIMIT (NOMINALLY 60 PERCENT) NO MATTER		
••	SECOND .		WHAT THE CIRCUM-		
••	•		STANCES ARE.		
••	• •		IF MANUAL THROTT- LE CONTROL IS DESIR-		
	• •		ED, ADVANCE THRUST/		
• • •	••••		TRANSLATION CONTROL-		
•	•		LER UNTIL LGC CON- TRIBUTION TO TOTAL		#160
•	•		THRUST IS ZERO		
•	•		(THRUST INDICATOR-		
:	•		RIGHT SIDE), AND PUT THROTTLE SWITCH TO		
•	•		MANUAL. THE LGC WILL		
•	•				
•	•				

(

++ + + +

÷

+ ŧ

÷ ŧ

÷

ŧ

ŧ

+

2 ٠ .

.

a

.

.

. (* •

٠

٠

.

•

٠

•

(

MAINTAIN THE PRESENT LM INERTIAL ATTIT-UDE. THROTTLE CON-TROL WILL REVERT TO THE LEVEL COMMANDED BY THE THRUST/TRANS-LATION CONTROLLER. RATE OF DESCENT MAY THEN BE MODIFIED BY MANUAL THROTTLE CONTROL. LM ATTITUDE WILL REMAIN INER-TIALLY FIXED UNLESS MANUAL ATTITUDE CON-TROL IS EXERCISED, HOWEVER MANUAL ATTITUDE CONTROL CANNOT BE EXERCISED UNLESS THE ATTITUDE CONTROL MODE SWITCH IS IN ATTITUDE HOLD. ONCE THIS PROGRAM IS EXITED IT MAY BE RETURNED TO BY PLAC-ING THE THROTTLE SWITCH IN AUTO. • _____ MONITOR DSKY: WHEN H IS APPROXIMATELY XX FT OBSERVE TRACKER FAIL LIGHT TO COME ON INDICATING THAT LR IS NO LONGER RETURN-ING GOOD DATA. ____ MONITOR DSKY:

513

+02

+285

+ C2

++

WHEN ACTUAL ALTI-

#170

#180

#190

#200

l

٠

. •

٠

++ . + C2 . +EDIT .

.

÷

÷ + ÷ ÷ ÷ ÷ + +02 ++

5"

1.1

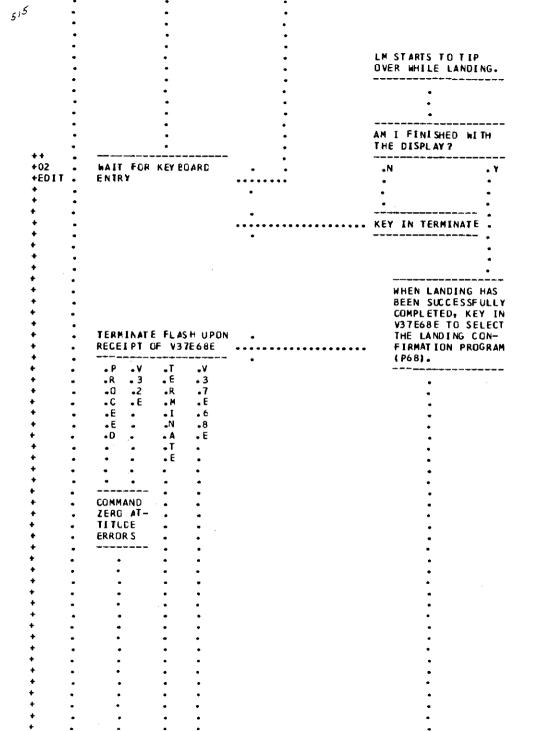
#220

#230

#240

#250

#260



#270

#280

#290

+ + +	•	•	•	•	610 P66/LUMINARY
+ + +	•	• •	•		#310
+ + +	- - -	•	• •	• • • • •	
+ + + +	•	COMMAND ZERC ATT ITUDE RATES	• • •	• • • • • • • • • • • • • • • • • • •	
+ + +	•	•			# 320
+ +02 ++		• • • • • • • • • • • •	•••	• • • • • • • • • • • • • • • • • • •	
		GO TC PRO TED VIA R	IGRAM S	ELEC	#3 30
			•	· · · · · · · · · · · · · · · · · · ·	
			(IT P66	•	

CHANGE CENTREL NOTES

1.14

•

REV CC PCR 31 REV 01 PCR 85,210,470,542 REV 00(LLM 1A) PCR 700,737 REV 01(LUM 1B) PCR 838,841, EDITORIAL REV 02(LUM 1C) PCR 285,882, EDITORIAL

(

LANDING CONFIRMATION PROGRAM (P68)

REV 03 12/03/69

.

PURPOSE:

(1) TO TERMINATE LANDING PROGRAM AND CAP FUNCTIONS.

- (2) TO INITIALIZE THE LCC FOR LUNAR SURFACE OPERATION.
- (3) TO PERMIT THE ASTRONAUT TO PREVENT RCS JET FIRINGS ON THE LUNAR SURFACE.

ASSUMPTIONS: (1) THE FOLLOWING DISPLAY IS AVAILABLE DURING THE PROGRAM BY KEYING IN V85E (SEE EXTENDED VERBS).

VIEN5E R1 - RR LOS AZIMUTH R2 - RR LOS ELEVATION R3 - BLANK

WHERE: RR LOS AZIMUTH - THE ANGLE BETWEEN THE LM X/2 PLANE AND THE RR LOS VECTOR. POSITIVE ROTATION IS FROM THE LM +Z AXIS TO THE LM +Y AXIS. IN DEGREES TO THE NEAREST .01 DEGREE.

++ RR LOS ELEVATION - THE ANGLE BETWEEN THE LM +Z AXIS AND THE PROJECTION OF THE RR LOS VECTOR ON +03 THE LM X/Z PLANE. POSITIVE ROTATION IS POSITIVE ROTATION ABOUT THE LM +Y AXIS.

- (2) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY. IT IS TO BE SELECTED ONLY AFTER THE LM HAS LANDED ON THE LUNAR SURFACE (P65 OR P66).
 - (3) V37E68E SELECTION OF P68 WILL TERMINATE AVERAGE G AND COMMAND THE ENGINE OFF (REFER TO ROO).

- (4) THE SELECTION OF THIS PROGRAM PLACES THE DAP IN THE MINIMUM IMPULSE COMMAND MODE. AS LONG AS THE ASTRONAUT KEEPS THE MODE CONT SWITCH IN ATT HOLD, RCS JET FIRINGS WILL NOT OCCUR, EVEN WHILE THE PLATFORM IS BEING GYRD TORQUED (IN P57).
- ++ + C3 +EDIT

+285

++

++

PRO G LGC GROUND CREW CONT .CREW . PROGRAM SELECTION START LANDING KEY IN LANDING . CONFIRMATION CONFIRMATION PROGRAM PROGRAM (P68) (P68) ٠ DISPLAY P68 V37E68E • ٠ .

			MGNITOR DSKY DISPLAY OF P68	
	•	•	•	#20
	•			
	COMMAND ZERC	-	•	
	ATTITUDE ERRORS	-	•	
	•		•	
	•		•	#30
	SET PULSES	-	(AT THIS TIME THE DAP IS PLACED IN THE	
	FLAG	-	MINIMUM IMPULSE	
	•		COMMAND MODE). PLACE THE MODE CONT	
	•		SWITCH IN ATT HELD AND THE DAP WILL NOT	
	•		FIRE RCS JETS. P12 WILL AUTEMATICALLY	#40
			PLACE THE DAP BACK	-
++	•		INTO RATE COMMAND/ ATTITUDE HOLD MODE	
+ 03 +EDIT	•		AT MAIN ENGINE Ignition.	
++	•		•	
	•		•	#50
	SET SURFACE FLAG	-	•	
		-	•	
	•		•	
	•	-	•	
	RESET ABORT ENABLE Flag		•	
		-	•	#60
	•		•	
	•		•	
	•		•	
	•		•	
	•		•	
	•		•	
	•		•	
. · [*]	•		•	P68/LUMINARY

ĺ

•

_____ SET APS FLAG _____ . ٠ RESET LANCING ANALCG DISPLAYS FLAG SET LR BYPASS FLAG -----STCRE PRESENT POSI-TION VECTOR AS LAND-ING SITE IN LUNAR FIXED COORDINATES **IREFER TO SECTION** 5.3.4 CF R567). ------٠ HOLD . ---------..... FLASH VERB-NOUN TO **GBSERVE VERB-NCUN** . SNAP . RECUEST RESPONSE AND FLASH TO REQUEST DISPLAY LGC CALCUL-RESPONSE AND DISPLAY . ATEC LANCING SITE OF LGC CALCULATED COORDINATES: LANDING SITE COURDI-VC6N43 NATES. R1-LAT -----R2-LONG R 3- AL T LA T- SELE NCG RAPHIC LATITUDE OF THE LGC------ASSUNEC PRESENT RECORD THE SE VALUES. LANDING SITE. PCLA-------RITY INCICATES NURTH (+) CR SGUTH (-).

÷

625 P68/LUMINARY

#70

#80

#90

#100

		•	P68	626 8/LUMINARY
		•		
IN DEGREES TO NEAR- EST .01 DEGREES.		• •		
LONG-SELENUGRAPHIC LONGITUCE OF THE LGC-ASSUMED FRESENT LANDING SITE. POLA- RITY INCICATES EAST (+) OR WEST (-). IN DEGREES TO NEARE ST		• • • •		#12(
.01 DEGREES.		•		
ALT-THE PRESENT ALTITUDE OF THE LM ABOVE THE LUNAR RADIUS AT THE		•		#13
INITIALLY CESIGNATED LANDING SITE (IF RE- START OCCURS-ABOVE		• • •		* 131
THE LUNAR RACIUS AT THE LGC-ASSUMED PRESENT LANGING SITE, I.E. = 0}.		• •		
THIS VALUE SHOULD NOMINALLY BE 00000		•		•
EXCEPT FOR ACCRUED ERRORS FROM THE LR		•		#140
IN THE LAST PHASES OF THE LANDING. IN NAUTICAL MILES TO		•		
NEAREST .1 NM.		•		
•		ENSURE THAT THE LM	-	
•		IS STABILIZED UPON THE SURFACE OF THE MOON AS WELL AS		# 15
:		POSSIBLE.	-	
•		•		
WAIT FOR KEYBOARD ENTRY	•	KEY IN PROCEEC	-	#16
TERMINATE FLASH LPON		•		
		•		
		•		
		•		
		•		
		•	868	87LUMENARY
		•		

(

520

(*

62	۱	

RECEIPT OF PROCEED	
--------------------	--

RECE	IPT OF PROCEED	
	•P	
	• R	
	•0	
	•C	
	• E	
	• E	
	•0	
	•	
	•	
	•	
	•	
	•	
	•	
	•	
	•	
SENT ANGLE STORE LM A1 SP EC1 SURF/ DEFIN VECTO PARAL	NE LUNAR GRAVITY NR TO BE LLEL TC THE AXIS FOR USE	
	•	
	•	
	•	
	•	
	•	

++	
+03	
+EDI	1

#180

.

#190

#200

____ -----NOTE: THE ASTRONAUT MUST SWITCH ATTITUDE CONTROL FROM AUTO TO ATT HOLD TO TURN OFF THE DAP IN CROER TO PREVENT SPURIOUS

.

.

•	JET FIRINGS	#210
•		
	•	
	•	
•		
•	•	
SET ATTITUDE FLAG	• •	
•	•	#220
•	•	
	•	
•		·
•	•	
•	•	
•	•	
•	•	
CO FINAL AUTOMATIC REQLEST TERMINATE ROUTINE (ROO)		#230
•	•	
•	•	
* * *		
•	•	
EX IT P68	EXIT P68	

#240

CHANGE CONTROL NOTES

.

520

(*

LOGIC KEV OC PCR 47C REV 01 PCR 99,419,546,547,623 REV 02(LUM 18) PCR 838, ECITORIAL REV 03(LUM 1C) PCR 285, EDITORIAL

٠