LGC - ASTRONAUT INTERFACES DURING RENDEZVOUS

LGC - ASTRONAUT INTERFACES DURING P20

Key V37E20E
Key V80E or V81E or V95E

This initiates the rendezvous radar tracking program. V80, or V81 selects the state vector to be updated by setting the vehicle update flag to LM or CSM respectively. Normally the LM state vector will be updated unless it is known that the LM state vector is more accurate than the CSM state vector. The initial selection of P20 will reset this flag to update the LM state vector. V95 will reset the update flag so that RR will not update either state vector. The update flag is normally set by selection of P20, P30, P32-35, and P72-75. It is reset during the computations of these programs so that the state vectors are not updated during computations.

PROG alarm light possible
V05N09 flashing
R1 00526

This alarm will occur if the LGC computes the range to be greater than 400 nautical miles.

Key V16N54E if desired
R1 - RANGE xxx.xx n.mi.
R2 - RDOT xxxx.x fps
R3 - 00000

Keying V16N54E will display the current computed range and range rate (updated at 5 sec. intervals). If the range rate is negative, wait until range is less than 400 nautical miles at which point the LGC will terminate display and continue. If range rate is positive terminate P20.

V50N18 flashing
R1 - ROLL xxx.xx deg
R2 - PITCH xxx.xx deg
R3 - YAW xxx.xx deg

If the present LM attitude is greater than 15 deg from the preferred tracking attitude, R61 will display a request for a maneuver to the FDAI angles shown on the DSKY. For an auto maneuver, MODE CONT to AUTO and PROCEED. The DSKY will blank and

then return to the flashing V50N18 at the completion of the maneuver. PROCEED for auto trim or ENTER to terminate maneuver. If the required maneuver is less than 15 degrees then R61 will perform the maneuver without displaying the request.

V50V25 flashing possible
R1 00201

This display will occur if the RR MODE switch is not set to LGC. For auto acquisition set switch to LGC and PROCEED. Manual acquisition is possible only if P20 is the only program running. ENTER for manual acquisition (calls manual acquisition routine - R23).

N50N25 flashing
R1 00205

This display only occurs if the manual acquisition option from above was selected. It is a request to SLEW for lockon. If lockon is obtained, switch RR MODE to LGC, wait until 10 seconds after NO TRACK lite has gone off and PROCEED. ENTER will cause a return to the preferred tracking attitude routine (R61).

PROG alarm light possible
V05N09 flashing
R1 00503

This alarm indicates that the RR Designate Routine (R21) failed to obtain a data good. (This alarm will also occur if the data good signal is absent for 30 sec.). V32E will cause a return to R21 for another attempt at designation. PROCEED will activate the RR Search Routine (R24).

V16 N80 R1 SEARCH CODE R2 LOS/+2 xxx.xx deg	This display occurs only on a PROCEED response to alarm code 00503. The search code will be 00000 until lockon occurs and 11111 if lockon occurs. The search pattern takes 42 sec.
N50N72 flashing R1 RR TRUN xxx.xx deg R2 RR SHAFT xxx.xx deg	This indicates that a data good discrete is being received. The astronaut should use the shaft and trunnion angles along with the signal strength meter to confirm that main lobe lockon was obtained, to accept, PROCEED. does this start NAV MARK 5 TRKS R 22
NO TRACK light out	Indicates that data good is being received. RR taking marks.
Key V16N78E if desired R1 RANGE xxx.xx n.mi. R2 RDOT xxxx.x fps R3 TFI xxbxx min-sec	This display can be called by the astronaut to monitor the raw RR data. The time from ignition (TFI) display has no meaning unless a targeting program is running.
PROG alarm light possible V05N09 flashing R1 00525	This Alarm will occur if the difference between the computed line of sight and RR measured line of sight is greater than 3 degrees. A PROCEED response will cause the angular difference to be displayed.
V06N05 flashing R1 - ANG ERR xxx.xx deg	A V32E response will cause the LGC to return to V50N72 display to recheck for main lobe lockon. A PROCEED response will accept the data for updating.

V06N49 Flashing possible

R1 DELTAR xxx.xx n.mi.

R2 DELTAV xxxx.x fps

R3 CODE 0000X

X=1 RANGE
X=2 RDOT
X=3 SHAFT
X=4 TRUN

N49 LIMITS

PRE TPI/CSI
RANGE = 2.0 n.mi.
RDOT = 12.0 fps

POST-TPI/CSI
RANGE = 0.8 n.mi.
RDOT = 5.0 fps

If the magnitude of the update from any or all of the four components it is comprised of is greater than a preset value (stored in erasable memory) the magnitudes will be displayed along with the code for which measurement caused the excessive update. A V32E response will reject the update from that measurement. A V34E response will reject the entire mark. A PROCEED response will accept the update. Note that it is possible to get as many as four V06N49 displays per mark.

W-MATRIX REINITIALIZATION

Key V93E

This will cause a reinitialization to the previously stored value

Key V67E

V06N99

R1 POS xxxxx ft

R2 VEL xxxx.x fps

R3 ANG xxxxx millirad.

This will cause the current values of the W-matrix components to be displayed. Reloading this display via V25E will cause new values for the W-matrix to be stored and will reinitialize the W-matrix to these values

LGC ASTRONAUT INTERFACES
DURING RENDEZVOUS

A. SHORT RENDEZVOUS

Key V37E34E
V06N37 flashing
R1 TIG (TPI) 00xxx hr
R2 TIG (TPI) 000xx min
R3 TIG (TPI) 0xx.xx sec

Selecting P34 (transfer phase targeting program) will cause the TIG of TPI to be displayed. In the short rendezvous, the value for TIG of TPI must be loaded PROCEED after loading the correct value.

V06N55
R1 NN xxxxx code
R2 E xxx.xx deg
R3 CENTANG xxx.xx deg

R1 of N55 of P34 is used to indicate whether conic or precision integration should be used. To use the faster conic integration, load with 00000. To use precision integration, load with any positive number (+00002 recommended). It is recommended that conic integration be used in lunar rendezvous. R2 may be loaded either with the desired deviation angle at which the transfer phase should be initiated or with 00000 in which case the elevation angle be computed for the given TIG of TPI. If the elevation angle was loaded the TIG will be computed using the loaded TIG as an initial approximation. R3 is the central angle of transfer. It is set according to mission procedures (normally 130.00 deg) PROCEED after loading the desired values.

V06N45 flashing
R1 MARKS xxxxx
R2 TFI xxbxx min-sec
R3 MGA xxx.xx deg

R1 is the current number of marks incorporated into the state vector. R2 is the time from ignition R3 is the middle gimbal angle only if this is the the last past thru this program. If it is the last pass and no REFSMMAT is set - 00002 will be

displayed. If this is not the final pass -00001 will be displayed. A V32E will recycle thru the targeting computations. A PROCEED will cause the final calculations to be made and will terminate state vector updating. A PROCEED on the final pass will cause a flashing V37

PROG alarm light possible
V05N09
R1 00611

This alarm will occur if the LGC cannot compute a TIG for the given elevation angle. A PROCEED response will cause the LGC to return to the N37 display for a possible new input. This alarm will not occur if the elevation angle was loaded as 00000.

V06N37 flashing
R1 TIG (TPI) 00xxx hr
R2 TIG (TPI) 000xx min
R3 TIG (TPI) 0xx.xx sec

This is the computed value for the TIG of TPI if the elevation angle was loaded. If the elevation angle is to be computed this display is omitted. PROCEED to accept data and continue.

V06N55 flashing
R1 NN xxxxx
R2 E xxx.xx deg
R3 CENTANG xxx.xx deg

This will displayed instead of the previous display if the elevation angle was to be computed (R2 loaded as 00000). R1 and R3 will be as loaded PROCEED to accept data and continue.

V06N58 flashing
R1 PER ALT xxxx.x n.mi.
R2 ΔV(TPI) xxxx.x fps
R3 ΔV(TPF) xxxx.x fps

R1 is the computed value for the perilune after TPI in nautical miles above the landing site. R2 is the impulsive change in velocity for TPI and R3 is the impulsive change in velocity for TPF or braking. PROCEED to accept data and continue

V06N81

R1 ΔVX(LV) xxxx.x fps

R2 ΔVY(LV) xxxx.x fps

R3 ΔVZ(LV) xxxx.x fps

These values are the components in the local vertical coordinate system of the impulsive change in velocity needed for the TPI burn. They may be overwritten if desired. PROCEED to accept data and continue. The LGC will return to the V06N45 display.

Key V37E35E

V06N45 flashing
R1 MARKS
R2 TFI
R3 MGA

Calling P35 (transfer phase midcourse targeting program) will cause N45 to be displayed as there are no values to be loaded. R1 is the current number of marks incorporated into the state vector. R2 is the time from ignition. In P35 prior to a recycle or the final computation this register will contain a positive time counting up from the last computer ignition time (TIG TPI for the first midcourse correction, TIG MCC1 for the second midcourse correction). The midcourse correction will normally be targeted for three minutes after either a V32E or a PROCEED response to this display. (This value is pad loaded into the erasable memory). R3 is the middle gimbal angle only if this is the last pass thru this program. If it is the last pass and no REFSMMAT is set - 00002 will be displayed . If this is not the final pass - 00001 will be displayed. A V32E will recycle thru the targeting computations. A PROCEED will cause the final calculations to be made and will terminate state vector updating. A PROCEED response on the final pass will cause a flashing V37.

V06N81 flashing
R1 ΔVX(LV) xxxx.x fps
R2 ΔVY(LV) xxxx.x fps
R3 ΔVZ(LV) xxxx.x fps

These values are the components in the local vertical coordinate system of the impulsive change in velocity needed for the midcourse correction burn. They may be overwritten if desired. PROCEED to accept data and continue. The LGC will return to the V06N45 display.

B. LONG RENDEZVOUS

Key V37E32E
V06N11 flashing
R1 TIG(CSI) 00xxx hr
R2 TIG(CSI) 000xx min
R3 TIG(CSI) 0xx.xx sec

Selecting P32 (coelliptical sequence initiation targeting program) will cause the TIG of CSI to be displayed. This must be loaded with the desired value for CSI or with 00000. If it is loaded with 00000 a PROCEED response will cause the LGC to compute the time of the next apsidal crossing and display it in V06N11. PROCEED to accept data and continue.

V06N55 flashing
R1 N xxxxx
R2 E xxx.xx deg
R3 Y 0000x

N is the future of apsidal crossing from CSI for the active vehicle at which the CDH will occur, if the code in R3 is non zero. If Y=0, then TIG of CDH will be 180^{o} from TIG of CSI. R2 is the elevation angle for TPI. PROCEED to accept data and continue.

V06N37 flashing
R1 TIG(TPI) 00xxx hr
R2 TIG(TPI) 000xx min
R3 TIG(TPI) 0xx.xx sec

The expected time of TPI must be loaded into this display. PROCEED to accept this data and to continue.

V06N45 flashing
R1 MARKS xxxxx
R2 TFI xxbxx min.-sec
R3 MGA xxx.xx deg

R1 is the current number of marks incorporated into the state vector. R2 is the time from ignition. R3 is the middle gimbal angle only if this is the last pass thru this program. If it is the last pass thru and no REFSMMAT is set -00002 will be displayed. If this is not the final pass -00001 will be displayed. A V32E will recycle thru the targeting computations. A PROCEED will cause the final calculations to be made and will terminate

state vector updating. A PROCEED on the final pass will cause a flashing V37 (R00).

PROG alarm light possible
R05N09 flashing
R1 = 006XX

These various alarms will occur if the inputs to P32 are bad.

00600	Imaginary Roots on first iteration.
00601	Post CSI perilune attitude < 35,000 ft.
00602	Post CDH perilune attitude < 35,000 ft.
00603	CSI to CDH time < 10 min.
00604	CDH to TPI time < 10 min or TIG CDH>TIG TPI
00605	Number of iterations greater than 15
00606	ΔV (CSI) > 1000 fps on two consecutive iterations

V32E response will cause a return to the V06N11 display to adjust the input values.

V06N75 flashing
R1 ΔH(CDH) xxxx.x n.mi.
R2 ΔT(CDH-CSI) xxbxx min-s
R3 ΔT(TPI-CDH) xxbxx min-s

R1 is the difference in the height between the LM and CSM orbits. R2 and R3 are the times between CSI and CDH and between CDH and TPI respectively. If these times are greater than 59 min 59 sec then only the time in excess of the number of hours will be displayed, i.e., 1 hour 12 min 26 sec becomes 12b26. PROCEED to accept these values and continue.

V06N81 flashing
R1 ΔVX(LV) xxxx.x fps
R2 ΔVY(LV) xxxx.x fps
R3 ΔVZ(LV) xxxx.x fps

This display gives the components of the computed CSI burn in the local vertical coordinate system. They may be overwritten by the astronaut if desired. Normally this would be done for R2 if a large out of plane component was computed for the TIG (CSI). PROCEED to accept data and continue.

V06N82 flashing R1 ΔVX(LV) xxxx.x fps R2 ΔVY(LV) xxxx.x fps R3 ΔVZ(LV) xxxx.x fps	This display gives the components of the computed CDH maneuver in the local vertical coordinate system. PROCEED to accept data and continue. The LGC will return to the V06N45 display.

Key V37E33E

V06N13 flashing

R1 TIG(CDH) 00xxx fps

R2 TIG(CDH) 000xx fps

R3 TIG(CDH) 0xx.xx fps

Selecting P33 (Constant Delta H Targeting Program) will cause V06N13 to be displayed. This will contain the value for TIG(CDH) that was computed on P32. (This program assumes the successful completion of P32). TIG(CDH) may be overwritten if desired. PROCEED to accept data and continue.

V06N45 flashing

R1 MARKS xxxxx

R2 TFI xxbxx min-sec

R3 MGA xxx.xx deg

R1 is the current number of marks incorporated into the state vector. R2 is the time from ignition. R3 is the middle gimbal angle only if this is the last pass thru this program. If it is the last pass and no REFSMMAT is set -00002 will be displayed. If this is not the final pass -00001 will be displayed. A V32E will recycle thru the targeting computations. A PROCEED will cause the final calculations to be made and will terminate state vector updating. A PROCEED response on the last pass will cause a flashing V37 (R00) to be displayed.

V06N75 flashing

R1 ΔH(CDH) xxxx.x n.mi.

R2 ΔT(TPI-CDH) xxbxx min-s

R3 ΔT(TPI-NOM TPI) xxbxx min-sec

This display is similar to V06N75 in P32 except that R2 is the difference between TIG(CDH) and the computed TIG(TPI). R3 is the difference between the computed TIG(TPI) and the value for TIG(TPI) loaded in P32. A negative value indicates that it will occur earlier than was loaded. PROCEED to accept data and continue.

V06N81 flashing

R1 ΔVX(LV) xxxx.x fps

R2 ΔVY(LV) xxxx.x fps

R3 ΔVZ(LV) xxxx.x fps

This display gives the components of the computed CDH burn in the local vertical coordin te system. This should be compared to the V06N82 display of P32. The values may be overwritten if desired. PROCEED to accept data and continue. The LGC will return to the V06N45 display.

Key V37E34

V06N37 flashing

R1 TIG (TPI)

R2 TIG (TPI)

R3 TIG (TPI)

If this program is entered after P33 has been completed then V06N37 will contain the last value for TIG(TPI) that was computed in P33. This time may be overwritten if desired. Other than this the remaining procedures are the same as for the short rendezvous.

OUT OF PLANE ROUTINE (R36)

Key V90E

V06N16 flashing

R1 GET EVENT 00xxx hr

R2 GET EVENT 00Cxx min

R3 GET EVENT 0xx.xx sec

Keying V90E will cause V06N16 to be displaye This may either be loaded with the time that it is desired to perform the out of plane correction or with all zeros. If it is loaded with zeros, the out of plane computations are made for the present time.

V06N90 flashing

R1 Y xxx.xx n.mi.

R2 YDOT xxxx.x fps

R3 PSI xxx.xx deg

R1 is the computed out of plane displacement at the desired time. R2 is the computed out of plane velocity at the desired time. The negative of this value should be loaded into the N81 display of a targeting program if an out of plane correction burn is to be performed. R3 is the angular difference between the line of sight to the CSM and the current LM orbital plane. A V32E response will recycle the routine back to the V06N16 display. A PROCEED response will terminate the routine

Notes:

1. R36 does not interfere with the operation of P20.
2. R36 will not run concurrent with other extended verb routines. An operator error signal will be generated.

Early liftoff TIG - 10 go to P47
let on for 3 min. then go for
Nominal L/O - Even if they go to orbit
in P47