L PLANETARY INERTIAL ORIENTATION USER=S PAGE NO. 1 E0 S3

```
P0001   ..... RP-TO-R SUBROUTINE .....
R0002   SUBROUTINE TO CONVERT RP (VECTOR IN PLANETARY COORDINATE SYSTEM,EITHER
R0003    EARTH-FIXED OR MOON-FIXED) TO R (SAME VECTOR IN THE BASIC REF. SYSTEM)

R0004    R=MT(T)*(RP+LPXRP)     MT= M MATRIX TRANSPOSE

R0005   CALLING SEQUENCE
R0006    L       CALL
R0007    L+1             RP-TO-R

R0008   SUBROUTINES USED
R0009    EARTHMX,MOONMX,EARTHL

R0010      ITEMS AVAILABLE FROM LAUNCH DATA
R0011       504LM= THE LIBRATION VECTOR L OF THE MOON AT TIME TIMSUBL,EXPRESSED
R0012       IN THE MOON-FIXED COORD. SYSTEM   RADIANS B0
R0013         ITEMS NECESSARY FOR SUBR. USED (SEE DESCRIPTION OF SUBR.)

R0014   INPUT
R0015    MPAC= 0 FOR EARTH,NON-ZERO FOR MOON
R0016    0-5D= RP VECTOR
R0017    6-7D= TIME

R0018   OUTPUT
R0019    MPAC= R VECTOR METERS B-29 FOR EARTH, B-27 FOR MOON

 0020   BSP   1              26,2000                        SETLOC PLANTIN
 0021                        26,3341                        BANK

 0022   BSP   1                                             COUNT* $$/LUROT

 0023                        26,3341   46020 1  RP-TO-R     STQ    BHIZ
 0024   BSP   1              26,3342   00050 1              RPREXIT
 0025   BSP   1              26,3343   55356 1              RPTORA
 0026                        26,3344   77624 1              CALL                 COMPUTE M MATRIX FOR MOON
 0027   BSP   1              26,3345   55416 1              MOONMX               LP=LM FOR MOON  RADIANS B0
 0028                        26,3346   77775 1              VLOAD
 0029   BSP   1              26,3347   02012 0              504LM
 0030                        26,3350   53235 0  RPTORB      VXV    VAD
 0031   BSP   1              26,3351   00001 0              504RPR
 0032   BSP   2  LAST 1213  26,3352   00001 0              504RPR
 0033                        26,3353   52105 1              VXM    GOTO
 0034   BSP   1              26,3354   00025 0              MMATRIX              MPAC=R=MT(T)*(RP+LPXRP)
 0035   BSP   1              26,3355   55404 1              RPRPXXXX             RESET PUSHLOC TO 0 BEFORE EXITING
 0036                        26,3356   77624 1  RPTORA      CALL                 EARTH COMPUTATIONS
 0037   BSP   1              26,3357   55570 0              EARTHMX              M MATRIX B-1
 0038                        26,3360   77624 1              CALL
 0039   BSP   1              26,3361   55622 1              EARTHL               L VECTOR RADIANS B0
 0040                        26,3362   76521 0              VSL1                 LP=M(T)*L  RAD B-0
 0041   BSP   2  LAST 1213  26,3363   00025 0              MMATRIX
```

```
0042                    26,3364   77650 1          GOTO
0043   REF  1           26,3365   55350 1                   RPTORB
```

L PLANETARY INERTIAL ORIENTATION USER=S PAGE NO. 3 E0 S3

```
P0044   ..... R-TO-RP SUBROUTINE .....
R0045   SUBROUTINE TO CONVERT R (VECTOR IN REFERENCE COORD. SYSTEM) TO RP
R0046    (VECTOR IN PLANETARY COORD SYSTEM) EITHER EARTH-FIXED OR MOON-FIXED

R0047    RP=M(T)*(R-LXR)

R0048   CALLING SEQUENCE
R0049    L       CALL
R0050    L+1             R-TO-RP

R0051   SUBROUTINES USED
R0052    EARTHMX,MOONMX,EARTHL

R0053   INPUT
R0054    MPAC= 0 FOR EARTH,NON-ZERO FOR MOON
R0055    0-5D= R VECTOR
R0056    6-7D= TIME

R0057      ITEMS AVAILABLE FROM LAUNCH DATA
R0058       504LM= THE LIBRATION VECTOR L OF THE MOON AT TIME TIMSUBL,EXPRESSED
R0059       IN THE MOON-FIXED COORD. SYSTEM   RADIANS B0
R0060         ITEMS NECESSARY FOR SUBROUTINES USED (SEE DESCRIPTION OF SUBR.)

R0061   OUTPUT
R0062    MPAC=RP VECTOR METERS B-29 FOR EARTH, B-27 FOR MOON

 0063                          26,3366  46020 1  R-TO-RP  STQ     BHIZ
 0064   REF  2  LAST 1213      26,3367  00050 1           RPREXIT
 0065   REF  1                 26,3370  55410 1           RTORPA
 0066                          26,3371  77624 1           CALL
 0067   REF  2  LAST 1213      26,3372  55416 1           MOONMX
 0068                          26,3373  61375 1           VLOAD   VXM
 0069   REF  2  LAST 1213      26,3374  02012 0           504LM           LP=LM
 0070   REF  3  LAST 1213      26,3375  00025 0           MMATRIX
 0071                          26,3376  77772 0           VSL1            L=MT(T)*LP  RADIANS B0
 0072                          26,3377  51235 1  RTORPB   VXV     BVSU
 0073   REF  3  LAST 1213      26,3400  00001 0           504RPR
 0074   REF  4  LAST 1215      26,3401  00001 0           504RPR
 0075                          26,3402  77721 0           MXV             M(T)*(R-LXR) B-2
 0076   REF  4  LAST 1215      26,3403  00025 0           MMATRIX
 0077                          26,3404  40372 0  RPRPXXXX VSL1    SETPD
 0078                          26,3405  00001 0           0D
 0079                          26,3406  77650 1           GOTO
 0080   REF  3  LAST 1215      26,3407  00050 1           RPREXIT
 0081                          26,3410  77624 1  RTORPA   CALL            EARTH COMPUTATIONS
 0082   REF  2  LAST 1213      26,3411  55570 0           EARTHMX
 0083                          26,3412  77624 1           CALL
 0084   REF  2  LAST 1213      26,3413  55622 1           EARTHL
 0085                          26,3414  77650 1           GOTO            MPAC=L=(-AX,-AY,0) RAD B-0
 0086   REF  1                 26,3415  55377 1           RTORPB
```

```
P0087   ..... MOONMX SUBROUTINE .....
R0088   SUBROUTINE TO COMPUTE THE TRANSFORMATION MATRIX M FOR THE MOON

R0089   CALLING SEQUENCE
R0090    L       CALL
R0091    L+1             MOONMX

R0092   SUBROUTINES USED
R0093    NEWANGLE

R0094   INPUT
R0095    8-9D= TIME
R0096      ITEMS AVAILABLE FROM LAUNCH DATA
R0097       BSUBO,BDOT
R0098       TIMSUBO,NODIO,NODDOT,FSUBO,FDOT
R0099       COSI= COS(I) B-1
R0100       SINI= SIN(I) B-1
R0101         I  IS THE ANGLE BETWEEN THE MEAN LUNAR EQUATORIAL PLANE AND THE
R0102         PLANE OF THE ECLIPTIC  (1 DEGREE  32.1 MINUTES)

R0103   OUTPUT
R0104    MMATRIX= 3X3 M MATRIX B-1   (STORED IN VAC AREA)

0105                        26,3416   40220 0  MOONMX   STQ     SETPD
0106    REP   1             26,3417   00051 0          EARTHMOX
0107                        26,3420   00011 1          8D
0108                        26,3421   77770 1          AXT,1                 B REQUIRES SL 0, SL 5 IN NEWANGLE
0109                        26,3422   00005 1          5
0110                        26,3423   65345 0          DLOAD   PDDL          PD 10D                8-9D=BSUBO
0111    REP   1             26,3424   15652 1          BSUBO                                       10-11D= BDOT
0112    REP   1             26,3425   15644 0          BDOT
0113                        26,3426   45006 0          PUSH    CALL          PD 12D
0114    REP   1             26,3427   55543 0          NEWANGLE              EXIT WITH PD 8D AND MPAC= B  REVS B0
0115                        26,3430   71406 0          PUSH    COS           PD 10D
0116    REP   1             26,3431   14041 1          STODL   COB           PD 8D    COS(B) B-1
0117                        26,3432   77756 0          SIN                             SIN(B) B-1
0118    REP   1             26,3433   14043 0          STODL   SOB                      SETUP INPUT FOR NEWANGLE
0119    REP   1             26,3434   15650 0          FSUBO                                       8-9D=FSUBO
0120                        26,3435   41525 0          PDDL    PUSH          PD 10D THEN 12D       10-11D=FDOT
0121    REP   1             26,3436   15642 0          FDOT
0122                        26,3437   45170 0          AXT,1   CALL          F REQUIRES SL 1, SL 6 IN NEWANGLE
0123                        26,3440   00004 0          4
0124    REP   2  LAST 1216  26,3441   55543 0          NEWANGLE              EXIT WITH PD 8D AND MPAC= F REVS B0
0125    REP   1             26,3442   14027 1          STODL   AVECTR +2     SAVE F TEMP
0126    REP   1             26,3443   15646 1          NODIO                                       8-9D=NODIO
0127                        26,3444   41525 0          PDDL    PUSH          PD 10D THEN 12D       10-11D=NODDOT
0128    REP   1             26,3445   15640 1          NODDOT                                      MPAC=T
0129                        26,3446   45170 0          AXT,1   CALL          NODE REQUIRES SL 0, SL 5 IN NEWANGLE
0130                        26,3447   00005 1          5
0131    REP   3  LAST 1216  26,3450   55543 0          NEWANGLE              EXIT WITH PD 8D AND MPAC= NODI REVS B0
```

L PLANETARY INERTIAL ORIENTATION


```
0132                                  26,3451  71406 0     PUSH   COS          PD 10D   8-9D= NODI  REVS  B0
0133                                  26,3452  77606 1     PUSH                PD 12D 10-11D= COS(NODI)  B-1
0134  REP   2  LAST 1216              26,3453  00025 0     STORE  AVECTR
0135                                  26,3454  76405 1     DMP    SL1R
0136  REP   2  LAST 1216              26,3455  00041 1            COB                                  COS(NODI)    B-1
0137  REP   1                        26,3456  14035 1     STODL  BVECTR +2    PD 10D   20-25D=AVECTR= COB*SIN(NODI)
0138                                  26,3457  76405 1     DMP    SL1R                                 SOB*SIN(NODI)
0139  REP   2  LAST 1216              26,3460  00043 0            SOB
0140  REP   2  LAST 1217              26,3461  14037 0     STODL  BVECTR +4    PD 8D
0141                                  26,3462  41556 1     SIN    PUSH         PD 10D                      -SIN(NODI)   B-1
0142                                  26,3463  77676 0     DCOMP                       26-31D=BVECTR= COB*COS(NODI)
0143  REP   3  LAST 1217              26,3464  14033 1     STODL  BVECTR       PD 8D                       SOB*COS(NODI)
0144  REP   3  LAST 1217              26,3465  00027 1            AVECTR +2    MOVE P FROM TEMP LOC. TO 504P
0145  REP   1                        26,3466  14007 0     STODL  504P
0146                                  26,3467  76405 1     DMP    SL1R
0147  REP   3  LAST 1217              26,3470  00041 1            COB
0148  REP   4  LAST 1217              26,3471  14027 1     STODL  AVECTR +2
0149  REP   1                        26,3472  00011 1            SINNODI      8-9D=SIN(NODI)  B-1
0150                                  26,3473  76405 1     DMP    SL1R
0151  REP   3  LAST 1217              26,3474  00043 0            SOB
0152  REP   5  LAST 1217              26,3475  14031 0     STODL  AVECTR +4                                0
0153  REP  26  LAST  893              26,3476  15332 1            HI6ZEROS                 8-13D= CVECTR= -SOB  B-1
0154                                  26,3477  57525 1     PDDL   DCOMP        PD 10D                      COB
0155  REP   4  LAST 1217              26,3500  00043 0            SOB
0156                                  26,3501  63325 0     PDDL   PDVL         PD 12D THEN PD 14D
0157  REP   4  LAST 1217              26,3502  00041 1            COB
0158  REP   4  LAST 1217              26,3503  00033 1            BVECTR
0159                                  26,3504  63361 0     VXSC   PDVL         PD 20D          BVECTR*SINI  B-2
0160  REP   1                        26,3505  15636 0            SINI
0161  REP   1                        26,3506  00011 1            CVECTR
0162                                  26,3507  53361 0     VXSC   VAD          PD 14D          CVECTR*COSI  B-2
0163  REP   1                        26,3510  15634 1            COSI
0164                                  26,3511  77772 0     VSL1
0165  REP   5  LAST 1215              26,3512  24041 1     STOVL  MMATRIX +12D PD 8D  M2=BVECTR*SINI+CVECTR*COSI  B-1
0166                                  26,3513  63361 0     VXSC   PDVL         PD 14D
0167  REP   2  LAST 1217              26,3514  15636 0            SINI                    CVECTR*SINI  B-2
0168  REP   5  LAST 1217              26,3515  00033 1            BVECTR
0169                                  26,3516  52361 1     VXSC   VSU          PD 8D           BVECTR*COSI  B-2
0170  REP   2  LAST 1217              26,3517  15634 1            COSI
0171                                  26,3520  65372 1     VSL1   PDDL         PD 14D
0172  REP   2  LAST 1217              26,3521  00007 0            504P        8-13D=DVECTR=BVECTR*COSI-CVECTR*SINI B-1
0173                                  26,3522  74346 0     COS    VXSC
0174  REP   1                        26,3523  00011 1            DVECTR
0175                                  26,3524  73525 1     PDDL   SIN          PD 20D  14-19D= DVECTR*COSP  B-2
0176  REP   3  LAST 1217              26,3525  00007 0            504P
0177                                  26,3526  52361 1     VXSC   VSU          PD 14D          AVECTR*SINP  B-2
0178  REP   6  LAST 1217              26,3527  00025 0            AVECTR
0179                                  26,3530  77772 0     VSL1
0180  REP   6  LAST 1217              26,3531  14033 1     STODL  MMATRIX +6   M1= AVECTR*SINP-DVECTR*COSP  B-1
0181  REP   4  LAST 1217              26,3532  00007 0            504P
```

```
 0182                        26,3533  74356 1        SIN     VXSC          PD 8D
 0183                        26,3534  71525 0        PDDL    COS           PD 14D  8-13D=DVECTR*SINF B-2
 0184  REF   5  LAST 1217    26,3535  00007 0                504F
 0185                        26,3536  53361 0        VXSC    VAD           PD 8D        AVECTR*COSF B-2
 0186  REF   7  LAST 1217    26,3537  00025 0                AVECTR
 0187                        26,3540  57572 0        VSL1    VCOMP
 0188  REF   7  LAST 1217    26,3541  34025 1        STCALL  MMATRIX       M0= -(AVECTR*COSF+DVECTR*SINF)  B-1
 0189  REF   2  LAST 1216    26,3542  00051 0                EARTHMXX
R0190  COMPUTE X=X0+(XDOT)(T+T0)
R0191  8-9D= X0 (REVS B-0),PUSHLOC SET AT 12D
R0192  10-11D=XDOT (REVS/CSEC) SCALED B+23 FOR WEARTH,B+28 FOR NODDOT AND BDOT
R0193                  AND B+27 FOR FDOT
R0194   X1=DIFFERENCE IN 23 AND SCALING OF XDOT,=0 FOR WEARTH,5 FOR NODDOT AND
R0195                                  BDOT AND 4 FOR FDOT
R0196  6-7D=T (CSEC B-28), TIMSUBO= (CSEC B-42 TRIPLE PREC.)

 0197                        26,3543  54345 1  NEWANGLE DLOAD  SR            ENTER PD 12D
 0198                        26,3544  00007 0                 6D
 0199                        26,3545  20617 0                 14D
 0200                        26,3546  72371 1          TAD    TLOAD         CHANGE MODE TO TP
 0201  REF   1              26,3547  01707 0                 TIMSUBO
 0202  REF 648  LAST 1183   26,3550  00155 0                 MPAC
 0203  REF   1              26,3551  14017 1          STODL  TIMSUBM       T+T0 CSEC B-42
 0204  REF   2  LAST 1218   26,3552  00020 0                 TIMSUBM +1
 0205                        26,3553  77605 1          DMP                  PD 10D  MULT BY XDOT IN 10-11D
 0206                        26,3554  43257 0          SL*    DAD           PD 8D   ADD X0 IN 8-9D AFTER SHIFTING
 0207                        26,3555  20206 1                 5,1                   SUCH THAT SCALING IS B-0
 0208                        26,3556  67206 1          PUSH   SLOAD         PD 10D SAVE PARTIAL (X0+XDOT*T) IN 8-9D
 0209  REF   3  LAST 1218   26,3557  00017 1                 TIMSUBM
 0210                        26,3560  41261 1          SL     DMP
 0211                        26,3561  20212 1                 9D
 0212                        26,3562  00013 0                 10D           XDOT
 0213                        26,3563  43257 0          SL*    DAD           PD 8D   SHIFT SUCH THAT THIS PART OF X
 0214                        26,3564  20213 0                 10D,1                 IS SCALED REVS/CSEC B-0
02141                        26,3565  77600 1          BOV                  TURN OFF OVERFLOW IF SET BY SHIFT
02142                        26,3566  55567 0                 +1           INSTRUCTION BEFORE EXITING
 0215                        26,3567  77616 0          RVQ                  MPAC=X= X0+(XDOT)(T+T0)  REVS B0
```

```
P0216   ..... EARTHMX SUBROUTINE .....
R0217   SUBROUTINE TO COMPUTE THE TRANSFORMATION MATRIX M FOR THE EARTH

R0218   CALLING SEQUENCE
R0219    L       CALL
R0220    L+1             EARTHMX

R0221   SUBROUTINES USED
R0222    NEWANGLE

R0223   INPUT
R0224      INPUT AVAILABLE FROM LAUNCH DATA     AZO  REVS B-0
R0225                                           TEPHEM  CSEC B-42
R0226    6-7D= TIME CSEC B-28

R0227   OUTPUT
R0228    MMATRIX= 3X3 M MATRIX B-1   (STORED IN VAC AREA)

 0229                          26,3570   40220 0  EARTHMX  STQ     SETPD        SET   8-9D=AZO
 0230   REF   3  LAST 1218    26,3571   00051 0                   EARTHMXX
 0231                          26,3572   00011 1                   8D           10-11D=WEARTH
 0232                          26,3573   77770 1            AXT,1
 0233                          26,3574   00000 1                   0            FOR SL 5, AND SL 10  IN NEWANGLE
 0234                          26,3575   65345 0            DLOAD   PDDL           LEAVING PD SET AT 12D FOR NEWANGLE
 0235   REF   1                26,3576   01712 1                   AZO
 0236   REF   1                26,3577   15654 1                   WEARTH
 0237                          26,3600   45006 0            PUSH    CALL
 0238   REF   4  LAST 1216    26,3601   55543 0                   NEWANGLE
 0239                          26,3602   41401 1            SETPD   PUSH         18-19D=504AZ
 0240                          26,3603   00023 0                   18D                        COS(AZ)  SIN(AZ)  0
 0241                          26,3604   65346 0            COS     PDDL         20-37D=  MMATRIX= -SIN(AZ)  COS(AZ)  0  B-1
 0242   REF   1                26,3605   00023 0                   504AZ                       0        0        1
 0243                          26,3606   65356 1            SIN     PDDL
 0244   REF  27  LAST 1217    26,3607   15332 1                   HI6ZEROS
 0245                          26,3610   73525 1            PDDL    SIN
 0246   REF   2  LAST 1219    26,3611   00023 0                   504AZ
 0247                          26,3612   65276 1            DCOMP   PDDL
 0248   REF   3  LAST 1219    26,3613   00023 0                   504AZ
 0249                          26,3614   63346 0            COS     PDVL
 0250   REF  28  LAST 1219    26,3615   15332 1                   HI6ZEROS
 0251                          26,3616   41525 0            PDDL    PUSH
 0252   REF  11  LAST  835    26,3617   15330 0                   HIDPHALF
 0253                          26,3620   77650 1            GOTO
 0254   REF   4  LAST 1219    26,3621   00051 0                   EARTHMXX
```

```
P0255   ..... EARTHL SUBROUTINE .....
R0256   SUBROUTINE TO COMPUTE L VECTOR FOR EARTH

R0257   CALLING SEQUENCE
R0258    L       CALL
R0259    L+1             EARTHL

R0260   INPUT
R0261    AXO,AYO SET AT LAUNCH TIME WITH AYO IMMEDIATELY FOLLOWING AXO IN CORE

R0262   OUTPUT
R0263              -AX
R0264     MPAC=    -AY    RADIANS B-0
R0265               0

 0266                        26,3622   57545 1  EARTHL   DLOAD   DCOMP
 0267   REF   2  LAST  618   26,3623   01716 0                   AXO
 0268   REF   1              26,3624   14017 1           STODL   504LPL
 0269   REF   2  LAST  618   26,3625   01714 1                   -AYO
 0270   REF   2  LAST 1220   26,3626   14021 1           STODL   504LPL +2
 0271   REF  29  LAST 1219   26,3627   15332 1                   HI6ZEROS
 0272   REF   3  LAST 1220   26,3630   24023 0           STOVL   504LPL +4
 0273   REF   4  LAST 1220   26,3631   00017 1                   504LPL
 0274                        26,3632   77616 0           RVQ
```

L PLANETARY INERTIAL ORIENTATION USER=S PAGE NO. 9 E0 S3

```
P0275  CONSTANTS AND ERASABLE ASSIGNMENTS
0276   REF  5  LAST 1210   04,3453           1B1     =     DP1/2          1  SCALED B-1
0277                       26,3633  17775 1  COSI    2DEC  .99984115 B-1  COS(1 DEG 32.1 MIN) B-1
0277                       26,3634  01734 0
0278                       26,3635  00333 1  SINI    2DEC  .02678760 B-1  SIN(1 DEG 32.1 MIN) B-1
0278                       26,3636  16153 1
0279   REF  38 LAST 1163     0050           RPREXIT =     S1             R-TO-RP AND RP-TO-R SUBR EXIT
0280   REF  13 LAST 1212     0051           EARTHMXX=     S2             EARTHMX,MOONMX SUBR. EXITS
0281                         0000           504RPR  =     0D             6 REGS  R OR RP VECTOR
0282                         0010           SINNODI =     8D             2       SIN(NODI)
0283                         0010           DVECTR  =     8D             6       D VECTOR MOON
0284                         0010           CVECTR  =     8D             6       C VECTR MOON
0285                         0022           504AZ   =     18D            2      AZ
0286                         0016           TIMSUBM =     14D            3       TIME SUB M (MOON) T+T0 IN GETAZ
0287                         0016           504LPL  =     14D            6       L OR LP VECTOR
0288                         0024           AVECTR  =     20D            6       A VECTOR (MOON)
0289                         0032           BVECTR  =     28D            6       B VECTOR (MOON)
0290                         0024           MMATRIX =     20D            18      M MATRIX
0291                         0040           COB     =     32D            2       COS(B) B-1
0292                         0042           SOB     =     34D            2       SIN(B) B-1
0293                         0006           504F    =     6D             2       F (MOON)
0297                       26,3637  77665 1  NODDOT  2DEC  -.457335143 E-2 REVS/CSEC B+28=-1.07047016 E-8  RAD/SEC
0297                       26,3640  42175 1
0298                       26,3641  22211 0  FDOT    2DEC  .570862491      REVS/CSEC B+27= 2.67240019 E-6  RAD/SEC
0298                       26,3642  00265 0
0299                       26,3643  77777 0  BDOT    2DEC  -3.07500412 E-8 REVS/CSEC B+28=-7.19756666 E-14 RAD/SEC
0299                       26,3644  77767 1
0300                       26,3645  41215 1  NODIO   2DEC  -.980101269      REVS B-0    = -6.03249419  RAD
0300                       26,3646  66331 0
0301                       26,3647  15237 0  FSUBO   2DEC  .415998375       REVS B-0    =  2.61379488  RAD
0301                       26,3650  26751 0
0302                       26,3651  02052 1  BSUBO   2DEC  .0651205006      REVS B-0    =  0.409164173 RAD
0302                       26,3652  35713 1
0303                       26,3653  37116 0  WEARTH  2DEC  .973561855       REVS/CSEC B+23=7.29211515 E-5 RAD/SEC
0303                       26,3654  32630 0
```

L MEASUREMENT INCORPORATION USER=S PAGE NO. 1 E0 S3

```
P0001   INCORP1--PERFORMS THE SIX DIMENSIONAL STATE VECTOR DEVIATION FOR POSITI
R0002   ON AND VELOCITY OR THE NINE DIMENSIONAL DEVIATION OF POSITION,VELOCITY,A
R0003   ND RADAR OR LANDMARK BIAS.THE OUTPUT OF THE BVECTOR ROUTINE ALONG WITH T
R0004   HE ERROR TRANSITION MATRIX(W) ARE USED AS INPUT TO THE ROUTINE.THE DEVIA
R0005   TION IS OBTAINED BY COMPUTING AN ESTIMATED TRACKING MEASUREMENT FROM THE
R0006   CURRENT STATE VECTOR AND COMPARING IT WITH AN ACTUAL TRACKING MEASUREMEN
R0007   T AND APPLYING A STATISTICAL WEIGHTING VECTOR.
R0008   INPUT
R0009      DMENFLG = 0 6DIMENSIONAL BVECTOR  1= 9DIMENSIONAL
R0010            W = ERROR TRANSITION MATRIX 6X6 OR 9X9
R0011      VARIANCE = VARIANCE (SCALAR)
R0012        DELTAQ = MEASURED DEVIATION(SCALAR)
R0013       BVECTOR = 6 OR 9 DIMENSIONAL BVECTOR

R0014   OUTPUT
R0015        DELTAX = STATE VECTOR DEVIATIONS 6 OR 9 DIMENSIONAL
R0016            ZI = VECTOR USED FOR THE INCORPORATION 6 OR 9 DIMENSIONAL
R0017       GAMMA = SCALAR
R0018       OMEGA = OMEGA WEIGHTING VECTOR 6 OR 9 DIMENTIONAL
R0019   CALLING SEQUENCE
R0020      L  CALL INCORP1

R0021   NORMAL EXIT

R0022      L+1 OF CALLING SEQUENCE

0023                          37,3676                    BANK   37
0024   REF   1                36,2000                    SETLOC MEASINC
0025                          36,3250                    BANK

0026   REF   1                                           COUNT* $$/INCOR

0027   REF  57  LAST  624     E5,1400                    EBANK= W

0028                          36,3250   77620 0  INCORP1 STQ
0029   REF  10  LAST  576     36,3251   02317 0          EGRESS
0030                          36,3252   66370 0          AXT,1  SSP
0031                          36,3253   00066 1                 54D
0032   REF  39  LAST 1221     36,3254   00051 0                 S1
0033                          36,3255   00022 1                 18D          IX1 = 54  S1= 18
0034                          36,3256   66374 1          AXT,2  SSP
0035                          36,3257   00022 1                 18D
0036   REF  14  LAST 1221     36,3260   00052 0                 S2
0037                          36,3261   00006 1                 6            IX2 = 18  S2=6
0038                          36,3262   63775 1  Z123    VLOAD  MXV*
0039   REF  20  LAST  616     36,3263   03502 0                 BVECTOR      BVECTOR (0)
0040   REF  58  LAST 1222     36,3264   02467 0                 W +54D,1
0041   REF   2  LAST   95     36,3265   12745 1          STORE  ZI +18D,2
0042                          36,3266   77775 1          VLOAD
0043   REF  21  LAST 1222     36,3267   03510 0                 BVECTOR +6   BVECTOR (1)
```

```
0044                        36,3270  52717 1          MXV*   VAD*
0045  REF  59  LAST 1222    36,3271  02555 0                 W +108D,1
0046  REF   3  LAST 1222    36,3272  75032 1                 ZI +18D,2
0047  REF   4  LAST 1223    36,3273  12745 1          STORE  ZI +18D,2
0048                        36,3274  77775 1          VLOAD
0049  REF  22  LAST 1222    36,3275  03516 0                 BVECTOR +12D    BVECTOR (2)
0050                        36,3276  52717 1          MXV*   VAD*
0051  REF  60  LAST 1223    36,3277  02643 1                 W +162D,1
0052  REF   5  LAST 1223    36,3300  75032 1                 ZI +18D,2       B(0)*W+B(1)*(W+54)+B(2)*(W+108)FIRST PAS
0053  REF   6  LAST 1223    36,3301  12745 1          STORE  ZI +18D,2       ZI THEN Z2 THEN Z3
0054                        36,3302  77700 0          TIX,1
0055  REF   1               36,3303  75304 1                 INCOR1
0056                        36,3304  43104 0  INCOR1  TIX,2  BON
0057  REF   1               36,3305  75262 0                 Z123            LOOP FOR Z1,Z2,Z3
0058  REF   8  LAST  617    36,3306  02706 1                 DMENFLG
0059  REF   1               36,3307  75313 1                 INCOR1A
0060                        36,3310  77775 1          VLOAD
0061  REF  20  LAST  624    36,3311  15332 1                 ZEROVECS
0062  REF   7  LAST 1223    36,3312  02737 0          STORE  ZI +12D
0063                        36,3313  77201 1  INCOR1A SETPD  VLOAD
0064                        36,3314  00001 0                 0
0065  REF   8  LAST 1223    36,3315  02723 0                 ZI
0066                        36,3316  47036 1          VSQ    RTB
0067  REF   7  LAST  873    36,3317  45562 1                 TPMODE
0068                        36,3320  47515 0          PDVL   VSQ
0069  REF   9  LAST 1223    36,3321  02731 0                 ZI +6
0070                        36,3322  76234 0          RTB    TAD
0071  REF   8  LAST 1223    36,3323  45562 1                 TPMODE
0072                        36,3324  47515 0          PDVL   VSQ
0073  REF  10  LAST 1223    36,3325  02737 0                 ZI +12D
0074                        36,3326  76234 0          RTB    TAD
0075  REF   9  LAST 1223    36,3327  45562 1                 TPMODE
0076                        36,3330  77171 0          TAD    AXT,2
0077  REF  12  LAST  617    36,3331  03526 0                 VARIANCE
0078                        36,3332  00000 1                 0
0079  REF   1               36,3333  01257 0          STORE  TRIPA           ZI*2 + Z2*2 + Z3*2 + VARIANCE
0080                        36,3334  40151 0          TLOAD  BOV
0081  REF  13  LAST 1223    36,3335  03526 0                 VARIANCE        CLEAR OVFIND
0082                        36,3336  75337 1                 +1
0083  REF   1               36,3337  01262 0          STORE  TEMPVAR         TEMP STORAGE FOR VARIANCE
0084                        36,3340  77654 0          BZE
0085  REF   1               36,3341  75350 0                 INCOR1C
0086                        36,3342  40112 1  INCOR1B SL2    BOV
0087  REF   2  LAST 1223    36,3343  75350 0                 INCOR1C
0088  REF   2  LAST 1223    36,3344  01262 0          STORE  TEMPVAR
0089                        36,3345  52114 1          INCR,2 GOTO
0090                        36,3346  00001 0          DEC    1
0091  REF   1               36,3347  75342 0                 INCOR1B
0092                        36,3350  61551 1  INCOR1C TLOAD  FOUND
0093  REF   2  LAST 1223    36,3351  01257 0                 TRIPA
```

```
0094
0095  BEP   3  LAST 1223   36,3352  75405 1          DMP   SQRT
                           36,3353  01262 0                TEMPVAR
0096
0097
                           36,3354  76257 0          SL*   TAD
                           36,3355  57576 1                0,2
0098  BEP   3  LAST 1223   36,3356  01257 0                TRIPA
0099
                           36,3357  63101 1          NORM  INCR,2
0100  BEP  27  LAST 1091   36,3360  00050 1                X2
0101
                           36,3361  77775 1          DEC   -2
0102
                           36,3362  77134 1          SXA,2 AXT,2
0103  BEP   2  LAST   87   36,3363  02215 0                NORMGAM      NORMALIZATION COUNT -2 FOR GAMMA
0104
                           36,3364  00242 0                162D
0105
                           36,3365  40265 1          BDDV  SETPD
0106  BEP   4  LAST  566   36,3366  15322 0                DP1/4TH
0107
                           36,3367  00001 0                0
0108  BEP   2  LAST  119   36,3370  03456 0          STORE GAMMA
0109
                           36,3371  60351 0          TLOAD NORM
0110  BEP   4  LAST 1224   36,3372  01257 0                TRIPA
0111  BEP  56  LAST 1163   36,3373  00047 1                X1
0112
                           36,3374  65345 0          DLOAD PDDL         PD 0-1 = NORM (A)
0113  BEP 649  LAST 1218   36,3375  00155 0                MPAC
0114  BEP   5  LAST  617   36,3376  03524 1                DELTAQ
0115
                           36,3377  77701 1          NORM
0116  BEP  40  LAST 1222   36,3400  00051 0                S1
0117
                           36,3401  70460 1          XSU,1 SR1
0118  BEP  41  LAST 1224   36,3402  00050 1                S1
0119
                           36,3403  41471 0          DDV   PUSH         PD 0-1 = DELTAQ/A
01193
                           36,3404  77650 1          GOTO
01196 BEP   1              36,3405  77676 0                NEWZCOMP
0120
                           36,3406  77731 1    -3    SSP
0121  BEP  15  LAST 1222   36,3407  00052 0                S2
0122
                           36,3410  00066 1                54D
0123
                           36,3411  60775 1  INCOR2 VLOAD VXM*          COMPUTE OMEGA1,2,3
0124  BEP  11  LAST 1223   36,3412  02723 0                ZI
0125  BEP  61  LAST 1223   36,3413  75134 0                W +162D,2
0126
                           36,3414  77206 0          PUSH  VLOAD
0127  BEP  12  LAST 1224   36,3415  02731 0                ZI +6
0128
                           36,3416  53303 1          VXM*  VAD
0129  BEP  62  LAST 1224   36,3417  75112 1                W +180D,2
0130
                           36,3420  77206 0          PUSH  VLOAD
0131  BEP  13  LAST 1224   36,3421  02737 0                ZI +12D
0132
                           36,3422  53303 1          VXM*  VAD
0133  BEP  63  LAST 1224   36,3423  75070 1                W +198D,2
0134
                           36,3424  61006 0          PUSH  TIX,2        PD 2-7=OMEGA1,8-13=OMEGA2,14-19=OMEGA3
0135  BEP   1              36,3425  75411 1                INCOR2
0136
                           36,3426  45575 1          VLOAD STADR
0137  BEP   2  LAST  119   36,3427  74303 1          STORE OMEGA +12D
0138
                           36,3430  45575 1          VLOAD STADR
0139  BEP   3  LAST 1224   36,3431  74311 1          STORE OMEGA +6
0140
                           36,3432  45575 1          VLOAD STADR
0141  BEP   4  LAST 1224   36,3433  74317 1          STORE OMEGA
```

```
0142                        36,3434  77214 0          BON     VLOAD
0143  REF   9  LAST 1223    36,3435  02706 1                  DMENFLG
0144  REF   1               36,3436  75441 1                  INCOR2AB
0145  REF  21  LAST 1223    36,3437  15332 1                  ZEROVECS
0146  REF   5  LAST 1224    36,3440  03474 0          STORE   OMEGA +12D
0147                        36,3441  66374 1  INCOR2AB AXT,2   SSP
0148                        36,3442  00022 1                  18D
0149  REF  16  LAST 1224    36,3443  00052 0                  S2
0150                        36,3444  00006 1                  6
0151                        36,3445  77773 1  INCOR3   VLOAD*
0152  REF   6  LAST 1225    36,3446  74275 1                  OMEGA +18D,2
0153                        36,3447  53761 1          VXSC    VSL*
0154                        36,3450  00001 0                  0                DELTAQ/A
0155                        36,3451  20201 0                  0,1
0156  REF  12  LAST  617    36,3452  11301 0          STORE   DELTAX +18D,2
0157                        36,3453  77304 0          TIX,2   VLOAD
0158  REF   1               36,3454  75445 0                  INCOR3
0159  REF  13  LAST 1225    36,3455  01265 1                  DELTAX +6
0160                        36,3456  77732 1          VSL3
0161  REF  14  LAST 1225    36,3457  01265 1          STORE   DELTAX +6
0162                        36,3460  77650 1          GOTO
0163  REF  11  LAST 1222    36,3461  02317 0                  EGRESS
```

```
R0164   INCORP2 -INCORPORATES THE COMPUTED STATE VECTOR DEVIATIONS INTO THE
R0165  ESTIMATED STATE VECTOR. THE STATE VECTOR UPDATED MAY BE FOR EITHER THE
R0166  LEM OR THE CSM.DETERMINED BY FLAG VEHUPFLG.(ZERO = LEM) (1 = CSM)
R0167  INPUT
R0168     PERMANENT STATE VECTOR FOR EITHER THE LEM OR CSM
R0169     VEHUPFLG = UPDATE VEHICLE 0=LEM  1=CSM
R0170     W =        ERROR TRANSITION MATRIX
R0171     DELTAX   =  COMPUTED STATE VECTOR DEVIATIONS
R0172     DMENPLG  =  SIZE OF W MATRIX (ZERO =6X6) (1=9X9)
R0173     GAMMA    =  SCALAR FOR INCORPORATION
R0174     ZI       =  VECTOR USED IN INCORPORATION
R0175     OMEGA    =  WEIGHTING VECTOR

R0176  OUTPUT
R0177     UPDATED PERMANENT STATE VECTOR

R0178  CALLING SEQUENCE
R0179     L  CALL INCORP2

R0180  NORMAL EXIT
R0181     L+1 OF CALLING SEQUENCE

 0182  REP   1              36,2000                    SETLOC MEASINC1
 0183                       36,3462                    BANK

 0184  REP  2 LAST 1222 TO 1226'   138   138*         COUNT* $$/INCOR

 0185                       36,3462   45020 1  INCORP2  STQ     CALL
 0186  REP  12  LAST 1225  36,3463   02317 0            EGRESS
 0187  REP  21  LAST  868  36,3464   27371 1            INTSTALL
 0188                       36,3465   74375 0            VLOAD   VXSC          CALC. GAMMA * OMEGA1,2,3
 0189  REP   7  LAST 1225  36,3466   03460 0            OMEGA
 0190  REP   3  LAST 1224  36,3467   03456 0            GAMMA
 0191  REP   2  LAST   95  36,3470   26643 1            STOVL   OMEGAM1
 0192  REP   8  LAST 1226  36,3471   03466 0            OMEGA +6
 0193                       36,3472   77761 1            VXSC
 0194  REP   4  LAST 1226  36,3473   03456 0            GAMMA
 0195  REP   2  LAST   95  36,3474   26651 1            STOVL   OMEGAM2
 0196  REP   9  LAST 1226  36,3475   03474 0            OMEGA +12D
 0197                       36,3476   77761 1            VXSC
 0198  REP   5  LAST 1226  36,3477   03456 0            GAMMA
 0199  REP   2  LAST   95  36,3500   02657 1            STORE   OMEGAM3
 0200                       36,3501   77776 1            EXIT
 0201  REP   1              36,3502   3 3763 0           CAF     54DD          INITIAL IX 1 SETTING FOR W MATRIX
 0202  REP   2  LAST   78  36,3503   55∝252 1           TS      WIXA
 0203  REP   2  LAST   78  36,3504   55∝253 0           TS      WIXB
 0204  REP 249  LAST 1201  36,3505   3 4714 1           CAF     ZERO
 0205  REP   2  LAST   78  36,3506   55∝254 1           TS      ZIXA          INITIAL IX 2 SETTING FOR Z COMPONENT
 0206  REP   2  LAST   78  36,3507   55∝255 0           TS      ZIXB
 0207  REP  91  LAST 1051  36,3510   0 5301 0  FAZA     TC      PHASCHNG
```

```
0208                                36,3511   04022 0          OCT     04022
0209   BNK  48  LAST  783           36,3512   0 5435 0         TC      UPFLAG
0210   BNK   2  LAST  503           36,3513    00236 0         ADRES   REINTFLG
0212   BNK   3  LAST 1226           36,3514   3 1253 1  FAZA1  CA      WIXB      START FIRST PHASE OF INCORP2
0213   BNK   3  LAST 1226           36,3515   55∝252 1         TS      WIXA      TO UPDATE 6 OR 9 DIM. W MATRIX IN TEMP
0214   BNK   3  LAST 1226           36,3516   3 1255 1         CA      ZIXB
0215   BNK   3  LAST 1226           36,3517   55∝254 1         TS      ZIXA
0216   BNK 228  LAST 1098           36,3520   0 6006 1         TC      INTPRET
0217                                36,3521    73150 1         LXA,1   LXA,2
0218   BNK   4  LAST 1227           36,3522    01252 0                 WIXA
0219   BNK   4  LAST 1227           36,3523    01254 0                 ZIXA
0220                                36,3524    70731 0         SSP     DLOAD*
0221   BNK  42  LAST 1224           36,3525    00051 0                 S1
0222                                36,3526    00006 1                 6
0223   BNK  14  LAST 1224           36,3527    75054 1                 ZI,2
0224                                36,3530    60276 1         DCOMP   NORM      CALC UPPER 3X9 PARTITION OF W MATRIX
0225   BNK  17  LAST 1225           36,3531    00052 0                 S2
0226                                36,3532    65161 1         VXSC    XCHX,2
0227   BNK   3  LAST 1226           36,3533    02643 1                 OMEGAM1
0228   BNK  18  LAST 1227           36,3534    00051 0                 S2
0229                                36,3535    57144 1         LXC,2   XAD,2
0230   BNK  28  LAST 1224           36,3536    00047 1                 X2
0231   BNK   3  LAST 1224           36,3537    02215 0                 NORMGAM
0232                                36,3540    65057 0         VSL*    XCHX,2
0233                                36,3541    57576 1                 0,2
0234   BNK  19  LAST 1227           36,3542    00051 0                 S2
0235                                36,3543    77653 1         VAD*
0236   BNK  64  LAST 1224           36,3544    02467 0                 W +54D,1
0237   BNK   2  LAST   95           36,3545    02665 0         STORE   HOLDW
0238                                36,3546    57543 1         DLOAD*  DCOMP     CALC MIDDLE 3X9 PARTITION OF W MATRIX
0239   BNK  15  LAST 1227           36,3547    75054 1                 ZI,2
0240                                36,3550    74301 0         NORM    VXSC
0241   BNK  20  LAST 1227           36,3551    00052 0                 S2
0242   BNK   3  LAST 1226           36,3552    02651 1                 OMEGAM2
0243                                36,3553    71124 0         XCHX,2  LXC,2
0244   BNK  21  LAST 1227           36,3554    00051 0                 S2
0245   BNK  29  LAST 1227           36,3555    00047 1                 X2
0246                                36,3556    53674 1         XAD,2   VSL*
0247   BNK   4  LAST 1227           36,3557    02215 0                 NORMGAM
0248                                36,3560    57576 1                 0,2
0249                                36,3561    52724 1         XCHX,2  VAD*
0250   BNK  22  LAST 1227           36,3562    00051 0                 S2
0251   BNK  65  LAST 1227           36,3563    02555 0                 W +108D,1
0252   BNK   3  LAST 1227           36,3564    02673 1         STORE   HOLDW +6
0253                                36,3565    77614 1         BOFF
0254   BNK  10  LAST 1225           36,3566    02746 0                 DMENFLG   BRANCH IF 6 DIMENSIONAL
0255   BNK   1                      36,3567    75607 1                 FAZB
0256                                36,3570    57543 1         DLOAD*  DCOMP     CALC LOWER 3X9 PARTITION OF W MATRIX
0257   BNK  16  LAST 1227           36,3571    75054 1                 ZI,2
0258                                36,3572    74301 0         NORM    VXSC
```

```
0259  REP  23  LAST 1227   36,3573   00052 0                 S2
0260  REP   3  LAST 1226   36,3574   02657 1                 OMEGAM3
0261                       36,3575   71124 0   XCHX,2  LXC,2
0262  REP  24  LAST 1228   36,3576   00051 0                 S2
0263  REP  30  LAST 1227   36,3577   00047 1                 X2
0264                       36,3600   53674 1   XAD,2   VSL*
0265  REP   5  LAST 1227   36,3601   02215 0                 NORMGAM
0266                       36,3602   57576 1                 0,2
0267                       36,3603   52724 1   XCHX,2  VAD*
0268  REP  25  LAST 1228   36,3604   00051 0                 S2
0269  REP  66  LAST 1227   36,3605   02643 1                 W +162D,1
0270  REP   4  LAST 1227   36,3606   02701 0   STORE   HOLDW +12D
0271                       36,3607   77624 1   PAZB    CALL
0272  REP  18  LAST  617   36,3610   56741 0                 GRP2PC
0273                       36,3611   77776 1   EXIT
0274  REP   5  LAST 1227   36,3612   3 1252 0  PAZB1   CA      WIXA      START 2ND PHASE OF INCORP2 TO TRANSFER
0275  REP   1              36,3613   6 3764 1          AD      6DD         TEMP REG TO PERM W MATRIX
0276  REP   4  LAST 1227   36,3614   55*253 0          TS      WIXB
0277  REP   5  LAST 1227   36,3615   3 1254 0          CA      ZIXA
0278  REP   2  LAST  186   36,3616   6 7715 0          AD      MINUS2
0279  REP   4  LAST 1227   36,3617   55*255 0          TS      ZIXB
0280  REP 229  LAST 1227   36,3620   0 6006 1          TC      INTPRET
0281                       36,3621   66350 1   LXA,1   SSP
0282  REP   6  LAST 1228   36,3622   01252 0                 WIXA
0283  REP  43  LAST 1227   36,3623   00051 0                 S1
0284                       36,3624   00006 1                 6
0285                       36,3625   77775 1   VLOAD
0286  REP   5  LAST 1228   36,3626   02665 0                 HOLDW
0287  REP  67  LAST 1228   36,3627   06467 1   STORE   W +54D,1
0288                       36,3630   77775 1   VLOAD
0289  REP   6  LAST 1228   36,3631   02673 1                 HOLDW +6
0290  REP  68  LAST 1228   36,3632   06555 1   STORE   W +108D,1
0291                       36,3633   77214 0   BOFF    VLOAD
0292  REP  11  LAST 1227   36,3634   02746 0                 DMENFLG
0293  REP   1              36,3635   75645 1                 PAZB5
0294  REP   7  LAST 1228   36,3636   02701 0                 HOLDW +12D
0295  REP  69  LAST 1228   36,3637   06643 0   STORE   W +162D,1
0296                       36,3640   52100 1   PAZB2   TIX,1   GOTO
0297                       36,3641   75643 1                 +2
0298  REP   1              36,3642   75653 0                 PAZC      DONE WITH W MATRIX. UPDATE STATE VECTOR
0299                       36,3643   77634 0   RTB
0300  REP   1              36,3644   75510 1                 PAZA
0301                       36,3645   43335 0   PAZB5   SLOAD   DAD
0302  REP   5  LAST 1228   36,3646   01256 1                 ZIXB
0303  REP   1              36,3647   35766 0                 12DD
0304                       36,3650   52030 0   BHIZ    GOTO
0305  REP   2  LAST 1228   36,3651   75653 0                 PAZC
0306  REP   1              36,3652   75640 1                 PAZB2
0307                       36,3653   77624 1   PAZC    CALL
0308  REP  19  LAST 1228   36,3654   56741 0                 GRP2PC
```

```
0309                                36,3655  53375 0            VLOAD  VAD          START 3RD PHASE OF INCORP2
0310  REP  8  LAST  600              36,3656  01701 0                   X789         7TH,8TH,9TH,COMPONENT OF STATE VECTOR
0311  REP 15  LAST 1225              36,3657  01273 0                   DELTAX +12D  INCORPORATION FOR X789
0312  REP  2  LAST  119              36,3660  03450 0            STORE  TX789
0313                                36,3661  47014 1            BON    RTB
0314  REP 13  LAST  617              36,3662  00707 1                   VEHUPFLG
0315  REP  1                        36,3663  75753 1                   DOCSM
0316  REP  1                        36,3664  26745 0                   MOVEPLEM
0317                                36,3665  77004 0  PAZAB     BOVB   AXT,2
0318  REP  9  LAST  879             36,3666  57343 1                   TCDANZIG
0319                                36,3667  00000 1                   0
0320                                36,3670  77014 1            BOFF   AXT,2
0321  REP  8  LAST  573             36,3671  04343 1                   MOONTHIS
0322                                36,3672  75674 0                   +2
0323                                36,3673  00002 0                   2
0324                                36,3674  53775 1            VLOAD  VSR*
0325  REP 16  LAST 1229             36,3675  01257 0                   DELTAX       B27 IF MOON ORBIT, B29 IF EARTH
0326                                36,3676  57205 1                   0 -7,2
0327                                36,3677  40055 0            VAD    BOV
0328  REP  4  LAST  284             36,3700  01521 0                   TDELTAV
0329  REP  1                        36,3701  75713 0                   PAZAB1
0330  REP  5  LAST 1229             36,3702  25521 0            STOVL  TDELTAV
0331  REP 17  LAST 1229             36,3703  01265 1                   DELTAX +6    B5 IF MOON ORBIT, B7 IF EARTH
0332                                36,3704  53257 1            VSR*   VAD
0333                                36,3705  57202 0                   0 -4,2
0334  REP  4  LAST  285             36,3706  01527 0                   TNUV
0335                                36,3707  77600 1            BOV
0336  REP  1                        36,3710  75717 1                   PAZAB2
0337  REP  5  LAST 1229             36,3711  35527 1            STCALL TNUV
0338  REP  1                        36,3712  75726 0                   PAZAB3
0339                                36,3713  53375 0  PAZAB1    VLOAD  VAD
0340  REP 12  LAST  868             36,3714  01535 0                   RCV
0341  REP 18  LAST 1229             36,3715  01257 0                   DELTAX
0342  REP 13  LAST 1229             36,3716  01535 0            STORE  RCV
0343                                36,3717  53375 0  PAZAB2    VLOAD  VAD
0344  REP 11  LAST  868             36,3720  01543 1                   VCV
0345  REP 19  LAST 1229             36,3721  01265 1                   DELTAX +6
0346  REP 12  LAST 1229             36,3722  01543 1            STORE  VCV
0347                                36,3723  45134 0            SXA,2  CALL
0348  REP  3  LAST  259             36,3724  02150 1                   PBODY
0349  REP  1                        36,3725  23344 0                   RECTIFY
03491                               36,3726  77624 1  PAZAB3    CALL
03492 REP 20  LAST 1228             36,3727  56741 0                   GRP2PC
0350                                36,3730  47014 1            BON    RTB
0351  REP 14  LAST 1229             36,3731  00707 1                   VEHUPFLG
0352  REP  1                        36,3732  75756 1                   DOCSM1
0353  REP  1                        36,3733  26724 1                   MOVEALEM
0354                                36,3734  77624 1            CALL
0355  REP  2  LAST  259             36,3735  20263 1                   SVDWN2       STORE DOWNLINK STATE VECTOR
0356                                36,3736  77624 1  PAZAB4    CALL
```

```
0357  REP  21  LAST 1229   36,3737   56741 0                GRP2PC    PHASE CHANGE
0358                       36,3740   77214 0          BOFF  VLOAD
0359  REP  12  LAST 1228   36,3741   02746 0                DMENFLG
0360  REP   1              36,3742   75745 0                PAZAB5    6 DIMENSIONAL
0361  REP   3  LAST 1229   36,3743   03450 0                TX789     9 DIMENSIONAL
0362  REP   9  LAST 1229   36,3744   01701 0          STORE X789
0363                       36,3745   66150 0  PAZAB5  LXA,1  SXA,1
0364  REP  13  LAST 1226   36,3746   02317 0                EGRESS
0365  REP  20  LAST 1166   36,3747   00052 0                QPRET
0366                       36,3750   77776 1          EXIT
0367  REP  60  LAST 1039   36,3751   0 4574 0         TC    POSTJUMP  EXIT
0368  REP   3  LAST  624   36,3752   27406 0          CADR  INTWAKE
0369                       36,3753   52034 1  DOCSM   RTB   GOTO
0370  REP   1              36,3754   26700 1                MOVEPCSM
0371  REP   1              36,3755   75665 0                PAZAB
0372                       36,3756   45034 1  DOCSM1  RTB   CALL
0373  REP   2  LAST   32   36,3757   26651 1                MOVEACSM
0374  REP   2  LAST  259   36,3760   20237 0                SVDWN1    STORE DOWNLINK STATE VECTOR
0375                       36,3761   77650 1          GOTO
0376  REP   1              36,3762   75736 1                PAZAB4
0377  REP  22  LAST 1225   26,3331             ZEROO  =      ZEROVECS
0378                       36,3763   00066 1  54DD   DEC   54
0379                       36,3764   77771 0  6DD    DEC   -6
0380                       36,3765   00014 1  12DD   DEC   12
0400  REP   2  LAST  562   37,2000            SETLOC RENDEZ
0401                       37,3676            BANK
0402  REP   1                                 COUNT* $$/INCOR

0403                       37,3676   51575 1  NEWZCOMP VLOAD  ABVAL
0404  REP  17  LAST 1227   37,3677   02723 0                ZI
0405  REP   1              37,3700   24045 0          STOVL NORMZI
0406  REP  18  LAST 1230   37,3701   02731 0                ZI +6
0407                       37,3702   41446 1          ABVAL PUSH
0408                       37,3703   50025 0          DSU   BMN
0409  REP   2  LAST 1230   37,3704   00045 0                NORMZI
0410                       37,3705   77710 1                +3
0411                       37,3706   45545 1          DLOAD STADR
0412  REP   3  LAST 1230   37,3707   77732 1          STORE NORMZI
0413                       37,3710   51575 1          VLOAD ABVAL
0414  REP  19  LAST 1230   37,3711   02737 0                ZI +12D
0415                       37,3712   45206 1          PUSH  DSU
0416  REP   4  LAST 1230   37,3713   00045 0                NORMZI
0417                       37,3714   71240 1          BMN   DLOAD
0418                       37,3715   77720 1                +3
0419                       37,3716   77626 0          STADR
0420  REP   5  LAST 1230   37,3717   77732 1          STORE NORMZI   LARGEST ABVAL
0421                       37,3720   66145 1          DLOAD SXA,1
0422  REP   6  LAST 1230   37,3721   00045 0                NORMZI
0423  REP   7  LAST 1230   37,3722   00044 1                NORMZI    SAVE X1
0424                       37,3723   62101 0          NORM  INCR,1
```

L MEASUREMENT INCORPORATION USER=S PAGE NO. 10 E5 S3

```
0425  REP  57  LAST 1224   37,3724  00047 1            X1
0426                       37,3725  00002 0      DEC   2
0427                       37,3726  53775 1      VLOAD VSL*
0428  REP  20  LAST 1230   37,3727  02723 0            ZI
0429                       37,3730  20201 0            0,1
0430  REP  21  LAST 1231   37,3731  26723 0      STOVL ZI
0431  REP  22  LAST 1231   37,3732  02731 0            ZI +6
0432                       37,3733  77657 0      VSL*
0433                       37,3734  20201 0            0,1
0434  REP  23  LAST 1231   37,3735  26731 0      STOVL ZI +6
0435  REP  24  LAST 1231   37,3736  02737 0            ZI +12D
0436                       37,3737  66057 0      VSL*  SXA,1
0437                       37,3740  20201 0            0,1
0438  REP   8  LAST 1230   37,3741  00045 0            NORMZI +1      SAVE SHIFT
0439  REP  25  LAST 1231   37,3742  02737 0      STORE ZI +12D
0440                       37,3743  54150 1      LXA,1 XSU,1
0441  REP.  6  LAST 1228   37,3744  02215 0            NORMGAM
0442  REP   9  LAST 1231   37,3745  00045 0            NORMZI +1
0443                       37,3746  77660 1      XSU,1
0444  REP  10  LAST 1231   37,3747  00045 0            NORMZI +1
0445                       37,3750  70130 1      SXA,1 LXC,1
0446  REP   7  LAST 1231   37,3751  02215 0            NORMGAM
0447  REP  11  LAST 1231   37,3752  00045 0            NORMZI +1
0448                       37,3753  40270 0      XAD,1 SETPD
0449  REP  12  LAST 1231   37,3754  00044 1            NORMZI
0450                       37,3755  00003 1            2D
0451                       37,3756  77650 1      GOTO
0452  REP   2  LAST 1224   37,3757  75406 1            INCOR2 -3
0453                        0044           NORMZI =     36D
```

L CONIC SUBROUTINES USER=S PAGE NO. 1 E0 S3

P0001 PROGRAM DESCRIPTION - ENTIRE CONIC SUBROUTINE LOG SECTION DATE - 1 SEPTEMBER 1967
R0003 MOD NO. - 0 LOG SECTION - CONIC SUBROUTINES
R0005 MOD BY KRAUSE ASSEMBLY - COLOSSUS REVISION 88
R0007
R0008 FUNCTIONAL DESCRIPTION -

R0009 THE FOLLOWING SET OF SUBROUTINES SOLVE VARIOUS PROBLEMS INVOLVING THE TRAJECTORY PRODUCED BY A CENTRAL
R0011 INVERSE-SQUARE FORCE ACTING ON A POINT MASS, AS OUTLINED IN THE CMC AND LGC LUNAR LANDING MISSION GSOP, SECTION
R0013 5.5.1.2. A GENERAL USAGE POINT-OF-VIEW WAS TAKEN IN FORMULATING, MECHANIZING, AND SCALING THE SUBROUTINES,
R0015 RATHER THAN OPTIMIZING EACH FOR A PARTICULAR USE. THEREFORE, MULTIPLE USAGE CAN BE MADE OF THE SUBROUTINES
R0017 INVOLVING ANY REALISTIC SET OF CONSTRAINTS. IT SHOULD BE NOTED THAT ONLY ONE SET OF CODING IS USED, WHETHER THE
R0019 EARTH, MOON, OR ANY OTHER CELESTIAL BODY IS SPECIFIED AS THE CENTRAL BODY OF THE PROBLEM, PROVIDED ONE OBSERVES
R0021 THE INHERENT SCALE CHANGE REQUIRED IN POSITION, VELOCITY, MU, AND TIME, AS OUTLINED IN MISSION PROGRAMMING
R0023 DEFINITION MEMO NO. 10. THIS CAN BE ACCOMPLISHED BY SIMPLY ADDING TO THE MUTABLE AND INITIALIZING THE SUBROU-
R0025 TINES APPROPRIATELY.
R0026 DUE TO THE UNIFORMITY OF THE EQUATIONS INVOLVED, CODING WAS MINIMIZED BY TREATING INDIVIDUAL EQUATIONS AND
R0028 BLOCKS OF EQUATIONS AS SUBROUTINES OF LOWER RANK WHENEVER POSSIBLE. AS A RESULT, THREE BY-PRODUCTS SUBROUTINES,
R0030 DIRECTLY USABLE AS INDEPENDENT SUBROUTINES, WERE GENERATED.
R0031 RESTRICTIONS -

R0032 THE ONLY LIMITATION IN THE SCOPE OF PROBLEM WHICH CAN BE SOLVED BY A PARTICULAR SUBROUTINE IS THE SCALING
R0034 LIMIT OF EACH PARAMETER AS SPECIFIED IN THE GSOP. THESE SCALING LIMITS WERE CHOSEN SO THAT ALL FEASIBLE TRAJEC-
R0036 TORIES COULD BE HANDLED.
R0037 SINCE THE SUBROUTINES (EXCEPT KEPLER) USE COMMON SUBROUTINES OF LOWER RANK WHICH USE ERASABLE OTHER THAN
R0039 THE PUSHLIST (DUE TO ITS LIMITED SIZE) AND COMMON INTERPRETIVE SWITCHES, THE CONIC SUBROUTINES CANNOT BE ALLOWED
R0041 TO INTERRUPT EACH OTHER. IT IS UP TO THE USER TO GUARANTEE THIS CONDITION.
R0043

L CONIC SUBROUTINES

USER'S PAGE NO. 2 E0 S3

P0044 PROGRAM DESCRIPTION - KEPLER SUBROUTINE
R0046 MOD NO. -1
R0048 MOD BY KRAUSE
R0050

DATE - 11 OCTOBER 1967
LOG SECTION - CONIC SUBROUTINES
ASSEMBLY - COLOSSUS 103 AND SUNDANCE 222

R0051 FUNCTIONAL DESCRIPTION -

R0052 THIS SUBROUTINE, GIVEN AN INITIAL STATE VECTOR AND THE DESIRED TRANSFER TIME THROUGH WHICH THE STATE IS TO
R0054 BE UPDATED ALONG A CONIC TRAJECTORY, COMPUTES THE NEW, UPDATED STATE VECTOR. THE TRAJECTORY MAY BE ANY CONIC
R0056 SECTION - CIRCULAR, ELLIPTIC, PARABOLIC, HYPERBOLIC, OR RECTILINEAR WITH RESPECT TO THE EARTH OR THE MOON. THE
R0058 USE OF THE SUBROUTINE CAN BE EXTENDED USING OTHER PRIMARY BODIES BY SIMPLE ADDITIONS TO THE MUTABLE WITHOUT
R0060 INTRODUCING ANY CODING CHANGES, ACCEPTING THE INHERENT SCALE FACTOR CHANGES IN POSITION AND VELOCITY. AN ITERA-
R0062 TION TECHNIQUE IS UTILIZED IN THE COMPUTATION.
R0063 IF A NEGATIVE TIME-OF-FLIGHT IS INPUT, THE PROGRAM WILL SOLVE FOR THE STATE WHICH WOULD BE PRODUCED BY
R0065 EXTRAPOLATING THE POSITION BACKWARD IN TIME.
R00651 IF THE DESIRED TRANSFER TIME IS POSITIVE AND EXCEEDS THE ORBITAL PERIOD, THE SUBROUTINE, THROUGH A MODULAR
R00653 TECHNIQUE, WILL COMPUTE THE STATE CORRESPONDING TO THE DESIRED TIME AS USUAL.
R0066

R0067 THE RESTRICTIONS ARE -
R0068 1. A NEGATIVE DESIRED TIME MUST BE LESS THAN ONE PERIOD IN MAGNITUDE. IF GREATER, THE ONE-PERIOD- SOLUTION
R0070 WILL BE RETURNED.
R0071 2. THE PARAMETERS IN THE PROBLEM CANNOT EXCEED THEIR SCALING LIMITS AS SPECIFIED IN THE GSOP. IF
R0073 ANY OF THESE LIMITS ARE EXCEEDED, THE RESULTING SOLUTION WILL BE MEANINGLESS.
R0075

R0076 THE NUMBER OF ITERATIONS AND, THEREFORE, THE COMPUTATION SPEED IS DEPENDENT ON THE ACCURACY OF THE
R0078 GUESS, XKEPNEW. THE AGC COMPUTATION TIME IS APPROXIMATELY .061 SECONDS FOR INITIALIZATION, .065 SECONDS FOR THE
R0080 FINAL COMPUTATIONS, PLUS .083 SECONDS FOR EACH ITERATION.
R0081

R0082 REFERENCES -
R0083 R-479, MISSION PROGRAMMING DEFINITION MEMO NO. 10, LUNAR LANDING MISSION GSOP, SECTION 5.5, SGA
R0085 MEMO 67-4.
R0086

R0087 INPUT - ERASABLE INITIALIZATION REQUIRED

	VARIABLE	* SCALE FACTOR * IN POWERS OF 2	DESCRIPTION AND REMARKS
R0088		*	
R0089		*	
R0090		*	
R0091	RRECT	* +29 FOR EARTH	*DP INITIAL POSITION VECTOR IN METERS
R0092		* +27 FOR MOON	*
R0093	VRECT	* +7 FOR EARTH	*DP INITIAL VELOCITY VECTOR IN METERS/CENTISECOND
R0094		* +5 FOR MOON	*
R0095	X1 (38D)	* NONE	*INDEX REGISTER SET TO -2D OR -10D ACCORDING TO WHETHER THE EARTH OR MOON,
R0097		*	*RESPECTIVELY, IS THE CENTRAL BODY
R0098	TAU.	* +28	*DESIRED TRANSFER TIME IN CENTISECONDS (DP)

```
R0099   XKEPNEW * +17 FOR EARTH*GUESS OF X IN METERS-TO-THE-ONE-HALF FROM KEPPREP
R0101           * +16 FOR MOON *(DP)
R0102   TC       * +28          *DP PREV. VALUE OF TIME IN CENTISECS FROM KEPPREP
R0103   XPREV    * +17 FOR EARTH*PREVIOUS VALUE OF X IN METERS-TO-THE-ONE-HALF POWER FROM KEPPREP (DP)
R0105           * +16 FOR MOON *(DP)
R0106
R0107   SUBROUTINES CALLED -
R0108        DELTIME
R0109
R0110   CALLING SEQUENCE AND NORMAL EXIT MODES -

R0111   KEPRIN-2 GOTO                  MUST BE IN INTERPRETIVE MODE AND OVFIND MUST BE CLEAR
R0113   KEPRIN-1        KEPLER         RETURNS WITH XPREV IN MPAC. PL IS AT 0.
R0114   KEPRIN   ...                   CONTINUE

R0115   KEPLER MUST NOT BE CALLED DIRECTLY SINCE AN INTERRUPTION OF IT WOULD DESTROY THE ERASABLES IT NEEDS TO COMPLETE
R0117   THE INTERRUPTED JOB.  THEREFORE THE USER MUST CALL CSMCONIC OR LEMCONIC WHICH GUARANTEES NO INTERRUPTS AND WHICH
R0119   ALSO CALLS KEPPREP TO COMPUTE A GUESS OF XKEPNEW.
R0120
R0121   ABORT EXIT MODES -
R0122        NONE
R0123
R0124   OUTPUT -

R0125           * SCALE FACTOR *
R0126   VARIABLE*IN POWERS OF 2*                    DESCRIPTION AND REMARKS
R0127   --------*--------------*                    -----------------------
R0128   RCV      * +29 FOR EARTH*DP TERMINAL POSITION VECTOR IN METERS
R0129           * +27 FOR MOON *
R0130   VCV      * +7 FOR EARTH *DP TERMINAL VELOCITY VECTOR IN METERS/CENTISEC
R0131           * +5 FOR MOON  *
R0132   TC       * +28          *DP TRANSFER TIME IN CENTISECS TO WHICH KEPLER CONVERGED.
R0134   XPREV    * +17 FOR EARTH*DP X IN METERS-TO-THE-ONE-HALF-POWER TO WHICH KEPLER CONVERGED.
R0136           * +16 FOR MOON *(DP)
R0137   FOR OTHER OUTPUT WHICH MAY BE OF USE, SEE DEBRIS.
R0138
R0139   DEBRIS -

R0140        PARAMETERS WHICH MAY BE OF USE -
```

L CONIC SUBROUTINES USER'S PAGE NO. 4 E0 S3

```
R0141           * SCALE FACTOR *
R0142   VARIABLE*IN POWERS OF 2*                    DESCRIPTION AND REMARKS
R0143   --------*--------------*                    -----------------------
R0144   URRECT  * +1           *DP UNIT VECTOR OF INITIAL POSITION
R0145   R1      * +29 FOR EARTH*DP MAGNITUDE OF INITIAL POSITION IN METERS
R0146           * +27 FOR MOON *
R0147   ALPHA   * -22 FOR EARTH*DP INVERSE OF SEMIMAJOR AXIS IN 1/METERS
R0148           * -20 FOR MOON *
R01481  TMODULO * +28          *DP INTEGRAL NUMBER OF PERIODS IN  CENTISECS. WHICH WAS SUBTRACTED FROM TAU. TO PRODUCE A
R01483          *              *TAU. OF LESS THAN ONE PERIOD.

R0149       PARAMETERS OF NO USE -
R0150   DP PARAMETERS - EPSILONT, DELX, DELT, RCNORM, XMODULO, PLUS PUSHLIST REGISTERS 0 THROUGH 39D.
R0152
```

P0153 PROGRAM DESCRIPTION - LAMBERT SUBROUTINE DATE - 1 SEPTEMBER 1967
R0155 MOD NO. - 0 LOG SECTION - CONIC SUBROUTINES
R0157 MOD BY KRAUSE ASSEMBLY - COLOSSUS REVISION 88
R0159
R0160 FUNCTIONAL DESCRIPTION -

R0161 THIS SUBROUTINE CALCULATES THE INITIAL VELOCITY REQUIRED TO TRANSFER A POINT-MASS ALONG A CONIC TRAJECTORY
R0163 FROM AN INITIAL POSITION TO A TERMINAL POSITION IN A PRESCRIBED TIME INTERVAL. THE RESULTING TRAJECTORY MAY BE
R0165 A SECTION OF A CIRCLE, ELLIPSE, PARABOLA, OR HYPERBOLA WITH RESPECT TO THE EARTH OR THE MOON. THE USE OF THE
R0167 SUBROUTINE CAN BE EXTENDED USING OTHER PRIMARY BODIES BY SIMPLE ADDITIONS TO THE MUTABLE WITHOUT INTRODUCING ANY
R0169 CODING CHANGES, ACCEPTING THE INHERENT SCALE FACTOR CHANGES IN POSITION AND VELOCITY. AN ITERATION TECHNIQUE IS
R0171 UTILIZED IN THE COMPUTATION.
R0172

R0173 THE RESTRICTIONS ARE -
R0174 1. RECTILINEAR TRAJECTORIES CANNOT BE COMPUTED.
R0175 2. AN ACCURACY DEGRADATION OCCURS AS THE COSINE OF THE TRUE ANOMALY DIFFERENCE APPROACHES +1.0.
R0177 3. THE ANGLE BETWEEN ANY POSITION VECTOR AND ITS VELOCITY VECTOR MUST BE GREATER THAN 1 DEGREE 47.5 MINUTES
R0179 AND LESS THAN 178 DEGREES 12.5 MINUTES.
R0180 4. NEGATIVE TRANSFER TIME IS AMBIGUOUS AND WILL RESULT IN NO SOLUTION.
R0182 5. THE PARAMETERS IN THE PROBLEM MUST NOT EXCEED THEIR SCALING LIMITS SPECIFIED IN THE GSOP. IF THE
R0184 LIMITS ARE EXCEEDED, THE RESULTING SOLUTION WILL BE MEANINGLESS.
R0185 THE NUMBER OF ITERATIONS AND, THEREFORE, THE COMPUTATIONS SPEED IS DEPENDENT ON THE ACCURACY OF THE FIRST
R0187 GUESS OF THE INDEPENDENT VARIABLE, COGA. THE AGC COMPUTATION TIME IS APPROXIMATE-
R0189 LY .105 SECONDS FOR INITIALIZATION, .089 SECONDS FOR FINAL COMPUTATIONS, PLUS .205 SECONDS FOR EACH ITERATION.
R0191
R0192 REFERENCES -
R0193 R-479, MISSION PROGRAMMING DEFINITION MEMO NO. 10, LUNAR LANDING MISSION GSOP-SECTION 5.5, SGA MEMO 67-8,
R0195 SGA MEMO 67-4.
R0196
R0197 INPUT - ERASABLE INITIALIZATION REQUIRED

R0198 * SCALE FACTOR *
R0199 VARIABLE*IN POWERS OF 2* DESCRIPTION AND REMARKS
R0200 --------*--------------* ----------
R0201 R1VEC * +29 FOR EARTH*DP INITIAL POSITION VECTOR IN METERS
R0202 * +27 FOR MOON *
R0203 R2VEC * +29 FOR EARTH*DP TARGET OR TERMINAL POSITION VECTOR IN METERS
R0204 * +27 FOR MOON *
R0205 TDESIRED* +28 *DP DESIRED TRANSFER TIME IN CENTISECONDS
R0206 X1 (38D)* NONE *INDEX REGISTER SET TO -2D OR -10D ACCORDING TO WHETHER THE EARTH OR MOON,
R0208 * *RESPECTIVELY, IS THE CENTRAL BODY
R0209 GEOMSGN * NONE *SP +.5 IF DESIRED TRANSFER ANGLE IS LESS THAN 180 DEGREES, -.5 IF GREATER THAN 180 DEG.
R0211 GUESSW * NONE *AN INTERPRETER SWITCH TO BE SET IF NO GUESS OF COGA IS AVAILABLE, CLEAR IF A GUESS OF

L CONIC SUBROUTINES USER'S PAGE NO. 6 E0 S3

```
R0213           *               *COGA IS TO BE USED BY LAMBERT
R0214   COGA    * +5            *DP GUESS OF COTANGNT OF FLIGHT PATH ANGLE (MEASURED FROM VERTICAL).  THIS WILL BE
R0216                           *IGNORED IF GUESSW IS SET.
R0217   NORMSW  * NONE          *AN INTERPRETER SWITCH TO BE SET IF UN IS TO BE AN INPUT TO THE SUBROUTINE, CLEAR IF
R0219           *               *LAMBERT IS TO COMPUTE ITS OWN NORMAL (UN).
R0220   UN      * +1            *DP UNIT  NORMAL TO THE DESIRED ORBIT PLANE IN THE DIRECTION OF THE RESULTING ANGULAR
R0222           *               *MOMENTUM VECTOR.  THIS WILL BE IGNORED IF NORMSW IS CLEAR.
R0224   VTARGTAG* NONE          *A S.P. TAG TO BE SET TO ZERO IF LAMBERT IS TO COMPUTE THE VELOCITY AT R2VEC AS WELL AS
R0226           *               *AT R1VEC.
R0227
R0228   SUBROUTINES CALLED -
R0229        GEOM, GETX, DELTIME, ITERATOR, LAMENTER (PART OF NEWSTATE)
R0230
R0231   CALLING SEQUENCE AND NORMAL EXIT MODES -

R0232   L       CALL                    MUST BE IN INTERPRETIVE MODE AND OVFIND MUST BE CLEAR
R0234   L+1             LAMBERT         RETURNS WITH PL AT 0 AND WITH VVEC IN MPAC IF VTARGTAG WAS NON-ZERO OR VTARGET
R0236                                   IN MPAC IF VTARGTAG WAS ZERO
R0237   L+2     BON                     CONTINUE IF SOLNSW CLEAR SINCE SOLUTION IS ACCEPTABLE
R0239   L+3             SOLNSW
R0240   L+4             LAMABORT
R0241        IF A LAMBERT RESULT IS TO BE A FIRST GUESS FOR THE NEXT LAMBERT CALCULATION, COGA MUST BE PRESERVED AND
R0243   GUESSW MUST BE CLEAR FOR EACH SUCCEEDING LAMBERT CALL.
R0244
R0245   ABORT EXIT MODES -
R0246        IF SOLNSW WAS SET UPON EXITING, EITHER LAMBERT WAS ASKED TO COMPUTE A TRANSFER TOO NEAR 0 OR 360 DEG, OR T
R0248   WAS TOO SMALL TO PRODUCE A REALISTIC TRANSFER BETWEEN R1VEC AND R2VEC.  IN EITHER CASE THE FIX MUST BE MADE
R0250   ACCORDING TO THE NEEDS OF THE PARTICULAR USER.  THE ABORT EXIT MODE MAY BE CODED AS ...
R0252   LAMABORT DLOAD  ABS             A MEASURE OF PROXIMITY TO 0 OR
R0253                   1-CSTH          360 DEGREES.
R0254           DSU     BMN
R0255                   ONEBIT
R0256                   CHANGER2        CHANGE R2VEC DIRECTION SLIGHTLY.
R0257           DLOAD   DAD
R0258                   TDESIRED
R0259                   SOMETIME
R0260           STCALL  TDESIRED        INCREASE TDESIRED
R0261                   LAMBERT
R0262
R0263   OUTPUT -
R0264          * SCALE FACTOR *
R0265   VARIABLE*IN POWERS OF 2*                DESCRIPTION AND REMARKS
```

```
R0266  --------*--------------*                    ----------------------
R0267  VVEC    * +7 FOR EARTH *DP INITIAL VELOCITY VECTOR IN METERS/CENTISECOND REQUIRED TO SATISFY THE BOUNDARY VALUE
R0269          * +5 FOR MOON  *PROBLEM.
R0270  VTARGET * +7 FOR EARTH *DP RESULTANT VELOCITY VECTOR AT R2VEC IN METERS/CENTISECOND.
R0272          * +5 FOR MOON  *
R0273  SOLNSW  * NONE         *INTERPRETER SWITCH WHICH IS SET IF THE SUBROUTINE CANNOT SOLVE THE PROBLEM, CLEAR IF THE
R0275          *              *SOLUTION EXISTS.
R0276  FOR OTHER OUTPUT WHICH MAY BE OF USE, SEE DEBRIS.
R0277
R0278  DEBRIS -
R0279       PARAMETERS WHICH MAY BE OF USE -

R0280          * SCALE FACTOR *
R0281  VARIABLE*IN POWERS OF 2*                    DESCRIPTION AND REMARKS
R0282  --------*--------------*                    ----------------------
R0283  SNTH    * +1           *DP SIN OF ANGLE BETWEEN R1VEC AND R2VEC
R0284  CSTH    * +1           *DP COSINE OF ANGLE
R0285  1-CSTH  * +2           *DP 1-CSTH
R0286  COTA    * +5           *DP COTAN OF INITIAL REQUIRED FLIGHT PATH ANGLE MEASURED FROM VERTICAL
R0289  P       * +4           *DP RATIO  OF SEMILATUS RECTUM TO INITIAL RADIUS
R0290  R1A     * +6           *DP RATIO OF INITIAL RADIUS TO SEMIMAJOR AXIS
R0291  R1 (32D)* +29 FOR EARTH*DP INITIAL RADIUS IN METERS
R0292          * +27 FOR MOON *
R0293  UR1     * +1           *DP UNIT VECTOR OF R1VEC
R0294  U2      * +1           *DP UNIT VECTOR OF R2VEC

R0295       PARAMETERS OF NO USE
R0296  DP PARAMETERS - EPSILONL, CSTH-RHO, TPREV, TERRLAMB, R2, RTNLAMB (SP),  PLUS PUSHLIST REGISTER 0 THROUGH 41D
R0298  ADDITIONAL INTERPRETIVE SWITCHES USED - INFINFLG, 360SW, SLOPESW, ORDERSW
R0300
```

L CONIC SUBROUTINES

USER'S PAGE NO. 8 E0 S3

DATE - 1 SEPTEMBER 1967
LOG SECTION - CONIC SUBROUTINES
ASSEMBLY - COLOSSUS REVISION 88

P0301 PROGRAM DESCRIPTION - TIME-THETA SUBROUTINE
R0303 MOD NO. - 0
R0305 MOD BY KRAUSE
R0307
R0308 FUNCTIONAL DESCRIPTION -

R0309 THIS SUBROUTINE, GIVEN AN INITIAL STATE VECTOR AND A DESIRED TRUE-ANOMALY-DIFFERENCE THROUGH WHICH THE
R0311 STATE IS TO BE UPDATED ALONG A CONIC TRAJECTORY, CALCULATES THE CORRESPONDING TIME-OF-FLIGHT AND, IN ADDITION,
R0313 PROVIDES THE OPTION OF COMPUTING THE NEW UPDATED STATE VECTOR. THE RESULTING TRAJECTORY MAY BE A SECTION OF A
R0315 CIRCLE, ELLIPSE, PARABOLA, OR HYPERBOLA WITH RESPECT TO THE EARTH OR THE MOON. THE USE OF THE SUBROUTINE CAN BE
R0317 EXTENDED USING OTHER PRIMARY BODIES BY SIMPLE ADDITIONS TO THE MUBABLE WITHOUT INTRODUCING ANY CODING CHANGES,
R0319 ACCEPTING THE INHERENT SCALE FACTOR CHANGES IN POSITION AND VELOCITY.
R0320

R0321 THE RESTRICTIONS ARE -
R0322 1. THE ANGLE BETWEEN ANY POSITION VECTOR AND ITS VELOCITY VECTOR MUST BE GREATER THAN 1 DEGREE 47.5 MINUTES
R0324 AND LESS THAN 178 DEGREES 12.5 MINUTES.
R0325 2. THE PARAMETERS IN THE PROBLEM MUST NOT EXCEED THEIR SCALING LIMITS SPECIFIED IN THE GSOP. IF THE LIMITS
R0327 ARE EXCEEDED, THE RESULTING SOLUTION WILL BE MEANINGLESS.

R0328 THE AGC COMPUTATION TIME IS APPROXIMATELY .292 SECONDS.
R0329
R0330 REFERENCES -
R0331 R-479, MISSION PROGRAMMING DEFINITION MEMO NO. 10, LUNAR LANDING MISSION GSOP-SECTION 5.5, SGA MEMO 67-8.
R0333
R0334 INPUT - ERASABLE INITIALIZATION REQUIRED

R0335		* SCALE FACTOR *	
R0336	VARIABLE	*IN POWERS OF 2*	DESCRIPTION AND REMARKS
R0337	---------	*----------	----------
R0338	RVEC	* +29 FOR EARTH	*DP INITIAL POSITION VECTOR IN METERS
R0339		* +27 FOR MOON *	
R0340	VVEC	* +7 FOR EARTH	*DP INITIAL VELOCITY VECTOR IN METERS/CENTISECOND
R0341		* +5 FOR MOON *	
R0342	SNTH	* +1	*DP SINE OF TRUE-ANOMALY-DIFFERENCE THROUGH WHICH THE STATE IS TO BE UPDATED
R0344	CSTH	* +1	*DP COSINE OF THE ANGLE
R0345	RVSW	* NONE	*AN INTERPRETIVE SWITCH TO BE SET IF ONLY TIME IS TO BE AN OUTPUT, CLEAR IF THE NEW STATE
R0347		*	*IS TO BE COMPUTED ALSO.
R0348	X1 (38D)	*NONE	*INDEX REGISTER TO BE SET TO -2D OR -10D ACCORDING TO WHETHER THE EARTH OR MOON,
R0350		*	*RESPECTIVELY, IS THE CENTRAL BODY.

R0351
R0352 SUBROUTINES CALLED -

```
R0353        PARAM, GEOM, GETX, DELTIME, NEWSTATE
R0354
R0355   CALLING SEQUENCE AND NORMAL EXIT MODES -

R0356      IF ONLY TIME IS DESIRED AS OUTPUT -
R0357   L        SET    CALL          MUST BE IN INTERPRETIVE MODE AND OVFIND MUST BE CLEAR
R0359   L+1             RVSW
R0360   L+2             TIMETHET      RETURN WITH PL AT 0 AND T IN MPAC
R0361   L+3      ...                  CONTINUE
R0362

R0363      IF THE UPDATE STATE VECTOR IS DESIRED AS WELL -
R0364   L        CLEAR  CALL          MUST BE IN INTERPRETIVE MODE AND OVFIND MUST BE CLEAR
R0366   L+1             RVSW
R0367   L+2             TIMETHET      RETURNS WITH PL AT 6.  THE INITIAL POSITION VECTOR IS IN 0D OF THE PUSHLIST AND
R0369                                 THE INITIAL VELOCITY VECTOR IN MPAC.
R0370   L+3      STOVL  NEWVVEC
R0371   L+4      STADR
R0372   L+5      STORE  NEWRVEC              NEWVVEC AND NEWRVEC ARE SYMBOLIC REPRESENTATIONS OF THE USERS LOCATIONS.
R0374   L+6      ...                         CONTINUE
R0375
R0376   ABORT EXIT MODES -
R0377   L        CALL   BON
R0378   L+1             TIMETHET
R0379   L+2             COGAFLAG
R0380   L+3             COGABORT      RESTRICTION 1 HAS BEEN VIOLATED.
R0381   L+4      BON                  IF NEITHER FLAG IS SET AND RESTRICTION 2 HAS NOT BEEN VIOLATED, THE SOLUTION IS
R0383                                 GOOD, SO CONTINUE
R0384   L+5             INFINFLG
R0385   L+6             IMPOSSBL      NO SOLUTION EXISTS.
R0386
R0387   OUTPUT -
R0388           * SCALE FACTOR *
R0389   VARIABLE*IN POWERS OF 2*                    DESCRIPTION AND REMARKS
R0390   --------*--------------*                    -----------------------
R0391   T (3OD) * +28          *DP TRANSFER TIME IN CENTISECONDS
R0392   INFINFLG* NONE         *AN INTERPRETIVE SWITCH WHICH IS SET IF THE TRANSFER ANGLE REQUIRES CLOSURE THROUGH
R0394           *              *INFINITY (NO SOLUTION), CLEAR IF A PHYSICAL SOLUTION IS POSSIBLE.
R0396   COGAFLAG* NONE         *AN INTERPRETIVE SWITCH WHICH IS SET IF RESTRICTION 1 HAS BEEN VIOLATED (NO SOLUTION),
R0398           *              *CLEAR IF NOT.

R0399   IN ADDITION, IF VTARGTAG IS NON-ZERO, THE FOLLOWING ARE OUTPUT -
R0400   MPAC -  * +7 FOR EARTH *DP TERMINAL VELOCITY VECTOR IN METERS/CENTISEC.
R0401    MPAC +5* +5 FOR MOON  *
```

```
R0402   0D - 5D * +29 FOR EARTH+DP TERMINAL POSITION VECTOR IN METERS (PL AT 6D)
R0403           * +27 FOR MOON *

R0404   FOR OTHER OUTPUT WHICH MAY BE OF USE, SEE DEBRIS.
R0405
R0406   DEBRIS -

R0407        PARAMETERS WHICH MAY BE OF USE -

R0408           * SCALE FACTOR *
R0409   VARIABLE*IN POWERS OF 2*                          DESCRIPTION AND REMARKS
R0410   --------*--------------*                          -----------------------
R0411   R1 (32D)* +29 FOR EARTH+DP MAGNITUDE OF INITIAL POSITION VECTOR, RVEC, IN METERS
R0413           * +27 FOR MOON *
R0414   R1A     * +6            *DP RATIO OF R1 TO SEMIMAJOR AXIS (NEG. FOR HYPERBOLIC TRAJECTORIES)
R0416   P       * +4            *DP RATIO OF SEMILATUS RECTUM TO R1
R0417   COGA    * +5            *DP COTAN OF ANGLE BETWEEN RVEC AND VVEC
R0419   UR1     * +1            *DP UNIT VECTOR OF RVEC
R0420   U2      * +1            *DP UNIT VECTOR OF VVEC
R0421   UN      * +1            *DP UNIT VECTOR OF UR1*U2
R0422

R0423        PARAMETERS OF NO USE -
R0424   SP PARAMETERS -  RTNTT, GEOMSGN, RTNPRM, MAGVEC2=R2 (DP), PLUS PUSHLIST LOCATIONS 0-11D, 14D-21D, 24D-39D, 41D
R0426   ADDITIONAL INTERPRETIVE SWITCHES USED - NORMSW, 360SW
R0427
```

L CONIC SUBROUTINES

USER'S PAGE NO. 11 E0 53

P0428 PROGRAM DESCRIPTION - TIME-RADIUS SUBROUTINE
R0430 MOD NO. -1
R0432 MOD BY KRAUSE
R0434
R0435 FUNCTIONAL DESCRIPTION -

DATE - 11 OCTOBER 1967
LOG SECTION - CONIC SUBROUTINES
ASSEMBLY - COLOSSUS REVISION 88

R0436 THIS SUBROUTINE, GIVEN AN INITIAL STATE VECTOR AND A DESIRED RADIUS TO WHICH THE
R0438 STATE IS TO BE UPDATED ALONG A CONIC TRAJECTORY, CALCULATES THE CORRESPONDING TIME-OF-FLIGHT AND, IN ADDITION,
R0440 PROVIDES THE OPTION OF COMPUTING THE NEW UPDATED STATE VECTOR. THE RESULTING TRAJECTORY MAY BE A SECTION OF A
R0442 CIRCLE, ELLIPSE, PARABOLA, OR HYPERBOLA WITH RESPECT TO THE EARTH OR THE MOON. THE USE OF THE SUBROUTINE CAN BE
R0444 EXTENDED USING OTHER PRIMARY BODIES BY SIMPLE ADDITIONS TO THE MUTABLE WITHOUT INTRODUCING ANY CODING CHANGES,
R0446 ACCEPTING THE INHERENT SCALE FACTOR CHANGES IN POSITION AND VELOCITY.
R0447 IF THE DESIRED RADIUS IS BEYOND THE RADIUS OF APOCENTER OF THE CONIC OR BELOW THE RADIUS OF PERICENTER,
R0449 APSESW WILL BE SET AND THE SUBROUTINE WILL RETURN THE APOCENTER OR PERICENTER SOLUTION, RESPECTIVELY.
R0451

R0452 THE RESTRICTIONS ARE -
R0453 1. THE ANGLE BETWEEN ANY POSITION VECTOR AND ITS VELOCITY VECTOR MUST BE GREATER THAN 1 DEGREE 47.5 MINUTES
R0455 AND LESS THAN 178 DEGREES 12.5 MINUTES.
R0456 2. THE PARAMETERS IN THE PROBLEM MUST NOT EXCEED THEIR SCALING LIMITS SPECIFIED IN THE GSOP. IF THE LIMITS
R0458 ARE EXCEEDED, THE RESULTING SOLUTION WILL BE MEANINGLESS.
R0461 3. AN ACCURACY DEGRADATION OCCURS AS THE SENSITIVITIES OF TIME AND UPDATED STATE VECTOR TO CHANGES IN
R04583 RDESIRED INCREASE. THIS WILL OCCUR NEAR EITHER APSIS OF THE CONIC AND WHEN THE CONIC IS NEARLY CIRCULAR. IN
R04585 PARTICULAR, IF THE CONIC IS AN EXACT CIRCLE, THE PROBLEM IS UNDEFINED AND THE SUBROUTINE WILL ABORT.
R04587

R0459 THE AGC COMPUTATION TIME IS APPROXIMATELY .383 SECONDS
R0460
R0461 REFERENCES -
R0462 R-479, MISSION PROGRAMMING DEFINITION MEMO NO. 10, LUNAR LANDING MISSION GSOP-SECTION 5.5, SGA MEMO 67-8.
R0464
R0465 INPUT - ERASABLE INITIALIZATION REQUIRED

R0466		* SCALE FACTOR *	
R0467	VARIABLE	*IN POWERS OF 2*	DESCRIPTION AND REMARKS
R0468	---------	*------------*	----------
R0469	RVEC	* +29 FOR EARTH	DP INITIAL POSITION VECTOR IN METERS
R0470		* +27 FOR MOON *	
R0471	VVEC	* +7 FOR EARTH	DP INITIAL VELOCITY VECTOR IN METERS/CENTISECOND
R0472		* +5 FOR MOON *	
R0473	RDESIRED	* +29 FOR EARTH	DP TERMINAL RADIAL DISTANCE ON CONIC TRAJECTORY FOR WHICH TRANSFER TIME IS TO BE
R0475		* +27 FOR MOON	COMPUTED.
R0476	SGNRDOT	* NONE	SP TAG SET TO +.5 OR -.5 ACCORDING TO WHETHER THE RADIAL VELOCITY AT RDESIRED IS TO BE
R0478		*	POSITIVE OR NEGATIVE, RESPECTIVELY. THIS TAG REDUCES THE DOUBLE-VALUED PROBLEM TO A

```
R0480           *               *SINGLE-VALUED PROBLEM.
R0481   X1 (38D)*NONE            *INDEX REGISTER TO BE SET TO -2D OR -10D ACCORDING TO WHETHER THE EARTH OR MOON,
R0483           *               *RESPECTIVELY, IS THE CENTRAL BODY.
R0484   RVSW     * NONE          *AN INTERPRETIVE SWITCH TO BE SET IF ONLY TIME IS TO BE AN OUTPUT, CLEAR IF THE NEW STATE
R0486           *               *IS TO BE COMPUTED ALSO.
R0487
R0488   SUBROUTINES CALLED -
R0489        PARAM, GEOM, GETX, DELTIME, NEWSTATE
R0490
R0491   CALLING SEQUENCE AND NORMAL EXIT MODES -

R0492      IF ONLY TIME IS DESIRED AS OUTPUT -
R0493   L          SET     CALL            MUST BE IN INTERPRETIVE MODE AND OVFIND MUST BE CLEAR
R0495   L+1                RVSW
R0496   L+2                TIMERAD         RETURN WITH PL AT 0 AND T IN MPAC
R0497   L+3        ...                     CONTINUE
R0498

R0499      IF THE UPDATE STATE VECTOR IS DESIRED AS WELL -
R0500   L          CLEAR   CALL            MUST BE IN INTERPRETIVE MODE AND OVFIND MUST BE CLEAR
R0502   L+1                RVSW
R0503   L+2                TIMERAD         RETURNS WITH PL AT 6.  THE INITIAL POSITION VECTOR IS IN 0D OF THE PUSHLIST AND
R0505                                      THE INITIAL VELOCITY VECTOR IN MPAC.
R0506   L+3        STOVL   NEWVVEC
R0507   L+4        STADR
R0508   L+5        STORE   NEWRVEC                 NEWVVEC AND NEWRVEC ARE SYMBOLIC REPRESENTATIONS OF THE USERS LOCATIONS.
R0510   L+6        ...                             CONTINUE
R0511
R0512   ABORT EXIT MODES -
R0513   L          CALL    BON
R0514   L+1                TIMERAD
R0515   L+2                COGAFLAG
R0516   L+3                COGABORT        RESTRICTION 1 HAS BEEN VIOLATED.
R0517   L+4        BON     BON
R0520   L+5                INFINFLG
R0521   L+6                IMPOSSBL        NO SOLUTION EXISTS.
R05211  L+7                SOLNSW
R05212  L+8                IMPOSSBL        SOLUTION IS UNDEFINED SINCE CONIC IS A CIRCLE.  RESTRICTION 3 HAS BEEN VIOLATED.
R05214  L+9        ...                     IF ALL THREE OF THE FLAGS ARE CLEAR, A SOLUTION EXISTS, SO CONTINUE.
R0522
R0523   OUTPUT -
R0524           * SCALE FACTOR *
```

R0525 VARIABLE*IN POWERS OF 2* DESCRIPTION AND REMARKS
R0526 --------*--------------* ----------
R0527 T (30D) * +28 *DP TRANSFER TIME IN CENTISECONDS
R0528 INFINFLG* NONE *AN INTERPRETIVE SWITCH WHICH IS SET IF RDESIRED AND SGNRDOT REQUIRE CLOSURE THROUGH
R0530 * *INFINITY (NO SOLUTION), CLEAR IF A PHYSICAL SOLUTION IS POSSIBLE.
R0532 COGAFLAG* NONE *AN INTERPRETIVE SWITCH WHICH IS SET IF RESTRICTION 1 HAS BEEN VIOLATED (NO SOLUTION),
R0534 * *CLEAR IF NOT.
R0535 APSESW * NONE *AN INTERPRETIVE SWITCH WHICH IS SET IF RDESIRED WAS GREATER THAN RADIUS OF APOCENTER OR
R0537 * *LESS THAN RADIUS OF PERICENTER. THE APOCENTER OR PERICENTER SOLUTION, RESPECTIVELY,
R0539 * *WILL THEN BE RETURNED. THE SWITCH IS CLEAR IF RDESIRED WAS BETWEEN PERICENTER AND
R0541 * *APOCENTER.
R05411 SOLNSW * NONE *AN INTERPRETIVE SWITCH WHICH IS SET IF THE CONIC IS SO CLOSE TO A CIRCLE THAT THE TERMIN
R05413 *POINT IS AMBIGUOUS, VIOLATING RESTRICTION 3. IF ECCENTRICITY IS GREATER THAN 2-TO-THE-
R05415 *MINUS-18, THE SWITCH IS CLEAR.
R0542

R0543 IN ADDITION, IF VTARGTAG IS NON-ZERO, THE FOLLOWING ARE OUTPUT -

R0544 MPAC - * +7 FOR EARTH *DP TERMINAL VELOCITY VECTOR IN METERS/CENTISEC.
R0545 MPAC +5* +5 FOR MOON *
R0546 0D - 5D * +29 FOR EARTH*DP TERMINAL POSITION VECTOR IN METERS (PL AT 6D)
R0547 * +27 FOR MOON *

R0548 FOR OTHER OUTPUT WHICH MAY BE OF USE, SEE DEBRIS.
R0549
R0550 DEBRIS -

R0551 PARAMETERS WHICH MAY BE OF USE -

R0552 * SCALE FACTOR *
R0553 VARIABLE*IN POWERS OF 2* DESCRIPTION AND REMARKS
R0554 --------*--------------* ----------
R0555 R1 (32D)* +29 FOR EARTH*DP MAGNITUDE OF INITIAL POSITION VECTOR, RVEC, IN METERS
R0557 * +27 FOR MOON *
R0558 R1A * +6 *DP RATIO OF R1 TO SEMIMAJOR AXIS (NEG. FOR HYPERBOLIC TRAJECTORIES)
R0560 P * +4 *DP RATIO OF SEMILATUS RECTUM TO R1
R0561 COGA * +5 *DP COTAN OF ANGLE BETWEEN RVEC AND VVEC
R0563 UR1 * +1 *DP UNIT VECTOR OF RVEC
R0564 U2 * +1 *DP UNIT VECTOR OF VVEC
R0565 UN * +1 *DP UNIT VECTOR OF UR1*U2
R0566 CSTH * +1 *DP COSINE OF TRUE ANOMALY DIFFERENCE BETWEEN RVEC AND RDESIRED.
R0568 SNTH * +1 *DP SINE OF TRUE ANOMALY DIFFERENCE.
R0569

R0570 PARAMETERS OF NO USE -
R0571 SP PARAMETERS - RINTT, GEOMSGN, RINPRM, MAGVEC2=R2 (DP), PLUS PUSHLIST LOCATIONS 0-11D, 14D-21D, 24D-39D, 41D
R0573 ADDITIONAL INTERPRETIVE SWITCHES USED - NORMSW, 360SW
R0574

```
P0575  PROGRAM DESCRIPTION - APSIDES SUBROUTINE                    DATE - 1 SEPTEMBER 1967
R0577  MOD NO. - 0                                                 LOG SECTION - CONIC SUBROUTINES
R0579  MOD BY KRAUSE                                               ASSEMBLY - COLOSSUS REVISION 88
R0581
R0582  FUNCTIONAL DESCRIPTION -

R0583       THIS SUBROUTINE, GIVEN AN INITIAL STATE VECTOR CALCULATES THE RADIUS OF PERICENTER AND OF APOCENTER AND THE
R0585  ECCENTRICITY OF THE RESULTING CONIC TRAJECTORY, WHICH MAY BE A STRAIGHT LINE,
R0587  CIRCLE, ELLIPSE, PARABOLA, OR HYPERBOLA WITH RESPECT TO THE EARTH OR THE MOON.  THE USE OF THE SUBROUTINE CAN BE
R0589  EXTENDED USING OTHER PRIMARY BODIES BY SIMPLE ADDITIONS TO THE MUDABLE WITHOUT INTRODUCING ANY CODING CHANGES,
R0591  ACCEPTING THE INHERENT SCALE FACTOR CHANGES IN POSITION AND VELOCITY.
R0592

R0593  THE RESTRICTIONS ARE -
R0594       1.  IF APOCENTER IS BEYOND THE SCALING OF POSITION, THE SCALE FACTOR LIMIT (536,870,910 METERS WITH RESPECT
R0596  TO THE EARTH OR 134,217,727.5 METERS WITH RESPECT TO THE MOON) WILL BE RETURNED.
R0598       2. THE PARAMETERS IN THE PROBLEM MUST NOT EXCEED THEIR SCALING LIMITS SPECIFIED IN THE GSOP.  IF THE LIMITS
R0600  ARE EXCEEDED, THE RESULTING SOLUTION WILL BE MEANINGLESS.

R0601       THE AGC COMPUTATION TIME IS APPROXIMATELY .103 SECONDS.
R0602
R0603  REFERENCES -
R0604       MISSION PROGRAMMING DEFINITION MEMO NO. 10, LUNAR LANDING MISSION GSOP-SECTION 5.5
R0606
R0607  INPUT - ERASABLE INITIALIZATION REQUIRED

R0608          * SCALE FACTOR *
R0609  VARIABLE*IN POWERS OF 2*                          DESCRIPTION AND REMARKS
R0610  --------*--------------*                          -----------------------
R0611  RVEC    * +29 FOR EARTH*DP INITIAL POSITION VECTOR IN METERS
R0612          * +27 FOR MOON *
R0613  VVEC    * +7 FOR EARTH *DP INITIAL VELOCITY VECTOR IN METERS/CENTISECOND
R0614          * +5 FOR MOON  *
R0615  X1 (38D)*NONE           *INDEX REGISTER TO BE SET TO -2D OR -10D ACCORDING TO WHETHER THE EARTH OR MOON,
R0617          *               *RESPECTIVELY, IS THE CENTRAL BODY.
R0618
R0619  SUBROUTINES CALLED -
R0620       PARAM, GEOM
R0621
R0622  CALLING SEQUENCE AND NORMAL EXIT MODES -
```

```
R0623      IF ONLY TIME IS DESIRED AS OUTPUT -
R0624  L       CALL                MUST BE IN INTERPRETIVE MODE AND OVFIND MUST BE CLEAR.
R0626  L+1             APSIDES     RETURNS WITH PL AT 0, RADIUS OF APOCENTER IN MPAC AND RADIUS OF PERICENTER IN 0D
R0628  L+2     STODL   APOAPSE
R0629  L+3             0D
R0630  L+4     STORE   PERIAPSE            APOAPSE AND PERIAPSE ARE SYMBOLIC REPRESENTATIONS OF THE USERS LOCATIONS
R0632  L+5     ...                 CONTINUE
R0633
R0634  OUTPUT -
R0635          * SCALE FACTOR *
R0636  VARIABLE*IN POWERS OF 2*                    DESCRIPTION AND REMARKS
R0637  --------*--------------*                    -----------------------
R0638  MPAC    * +29 FOR EARTH*DP RADIUS OF APOCENTER IN METERS
R0639          * +27 FOR MOON *
R0640  0D-1D   * +29 FOR EARTH*DP RADIUS OF PERICENTER IN METERS
R0641          * +27 FOR MOON *
R0642  ECC     * +3            *DP ECCENTRICITY OF CONIC TRAJECTORY.

R0643  FOR OTHER OUTPUT WHICH MAY BE OF USE, SEE DEBRIS.
R0644
R0645  DEBRIS -

R0646      PARAMETERS WHICH MAY BE OF USE -

R0647          * SCALE FACTOR *
R0648  VARIABLE*IN POWERS OF 2*                    DESCRIPTION AND REMARKS
R0649  --------*--------------*                    -----------------------
R0650  R1 (32D)* +29 FOR EARTH*DP MAGNITUDE OF INITIAL POSITION VECTOR, RVEC, IN METERS
R0652          * +27 FOR MOON *
R0653  R1A     * +6            *DP RATIO OF R1 TO SEMIMAJOR AXIS (NEG. FOR HYPERBOLIC TRAJECTORIES)
R0655  P       * +4            *DP RATIO OF SEMILATUS RECTUM TO R1
R0656  COSA    * +5            *DP COSAN OF ANGLE BETWEEN RVEC AND VVEC
R0658  UR1     * +1            *DP UNIT VECTOR OF RVEC
R0659  U2      * +1            *DP UNIT VECTOR OF VVEC
R0660  UN      * +1            *DP UNIT VECTOR OF UR1*U2
R0661  MAGVEC2 * +7 FOR EARTH *DP MAGNITUDE OF VVEC
R0662          * +5 FOR MOON  *
R0663

R0664      PARAMETERS OF NO USE -
R0665  SP PARAMETERS - RTNAPSE, GEOMSGN, RTNPRM, PLUS PUSHLIST LOCATIONS 0-5,10D-11D, 14D-21D, 31D-38D.
R0667  ADDITIONAL INTERPRETIVE SWITCHES USED - NORMSW
R0668
 0669  REF  1          12,2000                SETLOC CONICS
```

```
0670                                12,2000                         BANK

0671  REF  1                                                         COUNT  12/CONIC

0672  REF  2  LAST   94   E5,1723                                    EBANK= UR1
0678                      12,2000   71201 1  KEPLERN  SETPD  DLOAD
0679                      12,2001   00001 0                  0
0680  REF  1              12,2002   11456 0                  KEPZERO
0681  REF  1              12,2003   01344 0           STORE  XMODULO
0682  REF  1              12,2004   31346 1           STOVL* TMODULO
0683  REF  5  LAST  548   12,2005   11631 0                  MUTABLE,1
0684                      12,2006   24017 1           STOVL  14D
0685  REF  3  LAST  503   12,2007   01503 0                  RRECT
0686                      12,2010   66256 0           UNIT   SSP
0687  REF  1              12,2011   00027 1                  ITERCTR
0688                      12,2012   00024 1                  20D
0689  REF  2  LAST   94   12,2013   16647 0           STODL  URRECT
0690                      12,2014   00045 0                  36D
0691  REF  2  LAST  861   12,2015   24041 1           STOVL  R1
0692  REF  4  LAST 1247   12,2016   01503 0                  RRECT
0693                      12,2017   76441 1           DOT    SL1R
0694  REF  2  LAST   83   12,2020   01511 0                  VRECT
0695                      12,2021   76405 1           DMP    SL1R
0696  REF  1              12,2022   00023 0                  1/ROOTMU        1/ROOTMU (-17 OR -14)
0697  REF  1              12,2023   24043 0           STOVL  KEPC1           C1=R.V/ROOTMU (+17 OR +16)

0698  REF  3  LAST 1247   12,2024   01511 0                  VRECT
0699                      12,2025   57236 1           VSQ    DMPR
0700  REF  1              12,2026   00017 1                  1/MU            1/MU (-34 OR -28)
0701                      12,2027   52405 1           DMP    SL3
0702  REF  3  LAST 1247   12,2030   00041 1                  R1
0703                      12,2031   61425 0           DSU    ROUND
0704  REF  1              12,2032   11500 1                  D1/64
0705  REF  1              12,2033   00045 0           STORE  KEPC2           C2=RV.V/MU -1 (+6)

0706                      12,2034   74421 0           BDSU   SR1R
0707  REF  2  LAST 1247   12,2035   11500 1                  D1/64
0708                      12,2036   77671 1           DDV
0709  REF  4  LAST 1247   12,2037   00041 1                  R1
0710  REF  1              12,2040   00011 1           STORE  ALPHA           ALPHA=(1-C2)/R1 (-22 OR -20)
0711                      12,2041   71244 0           BPL    DLOAD           MAXIMUM X DEPENDS ON TYPE OF CONIC
0712  REF  1              12,2042   24051 0                  1REV
0713  REF  1              12,2043   11516 0                  -50SC           -50SC (+12)
0714                      12,2044   40071 0           DDV    BOV
0715  REF  2  LAST 1247   12,2045   00011 1                  ALPHA
0716  REF  1              12,2046   24055 1                  STOREMAX
0717                      12,2047   52166 1           SQRT   GOTO
0718  REF  2  LAST 1247   12,2050   24055 1                  STOREMAX
```

```
0719                        12,2051  55366 1  1REV      SQRT    BDDV
0720  REP  2  LAST  549     12,2052  11520 0                    2PISC     2PISC (+6)
0721                        12,2053  77600 1            BOV
0722  REP  3  LAST 1247     12,2054  24055 1                    STORE2MAX
0723                        12,2055  50165 0  STORE2MAX SIGN    BMN
0724  REP  2  LAST   88     12,2056  02312 0                    TAU.
0725  REP  1                12,2057  24272 0                    BACKWARD
0726  REP  1                12,2060  00013 0            STORE   XMAX
0727                        12,2061  65205 0            DMP     PDDL                PL AT 2
0728  REP  2  LAST 1247     12,2062  00023 0                    1/ROOTMU
0729  REP  3  LAST 1247     12,2063  00011 1                    ALPHA
0730                        12,2064  65301 0            NORM    PDDL      DXCH WITH 0D.  0D=ALPHA   PL AT 0,2
0731  REP 58  LAST 1231     12,2065  00047 1                    X1
0732                        12,2066  56257 1            SL*     DDV                 PL AT 0
0733                        12,2067  20173 0                    0 -6,1
0734                        12,2070  50000 1  PERICDCH BOV      BMN
0735  REP  1                12,2071  24112 0                    MODDONE
0736  REP  2  LAST 1248     12,2072  24112 0                    MODDONE
0737                        12,2073  77606 1            PUSH                0D=PERICD (+28)
0738                        12,2074  50021 1            BDSU    BMN
0739  REP  3  LAST 1248     12,2075  02312 0                    TAU.
0740  REP  3  LAST 1248     12,2076  24112 0                    MODDONE
0741  REP  4  LAST 1248     12,2077  16312 0            STODL   TAU.
0742  REP  2  LAST 1248     12,2100  00013 0                    XMAX
0743                        12,2101  77615 0            DAD
0744  REP  2  LAST 1247     12,2102  01344 0                    XMODULO
0745  REP  3  LAST 1248     12,2103  15344 0            STODL   XMODULO
0746                        12,2104  00001 0                    0D
0747                        12,2105  77615 0            DAD
0748  REP  2  LAST 1247     12,2106  01346 1                    TMODULO
0749  REP  3  LAST 1248     12,2107  15346 1            STODL   TMODULO             PL AT 0
0750                        12,2110  77650 1            GOTO
0751  REP  1                12,2111  24070 0                    PERICDCH

0752                        12,2112  71201 1  MODDONE   SETPD   DLOAD
0753                        12,2113  00001 0                    0
0754  REP  2  LAST 1247     12,2114  11456 0                    KEPZERO
0755  REP  1                12,2115  14015 0            STODL   XMIN
0756  REP  2  LAST   87     12,2116  02306 0                    XKEPNEW
0757                        12,2117  77625 0            DSU
0758  REP  4  LAST 1248     12,2120  01344 0                    XMODULO
0759  REP  1                12,2121  00025 0            STORE   X
0760                        12,2122  50054 0            BZE     BMN
0761  REP  1                12,2123  24265 0                    BADX
0762  REP  2  LAST 1248     12,2124  24265 0                    BADX
0763                        12,2125  51025 1            DSU     BPL
0764  REP  3  LAST 1248     12,2126  00013 0                    XMAX
0765  REP  3  LAST 1248     12,2127  24265 0                    BADX
```

```
0766                                12,2130  57345 1  DXCOMP   DLOAD   DMPR
0767  REF   5  LAST 1248           12,2131  02312 0           TAU.
0768  REF   1                      12,2132  11511 1           BEE22
07685                              12,2133  77646 0           ABS
0769  REF   1                      12,2134  15350 0           STODL   EPSILONT
0770  REF   2  LAST   83           12,2135  01551 1           TC
0771                               12,2136  45254 0           BZE     DSU
0772  REF   1                      12,2137  24141 0           NEWTC
0773  REF   4  LAST 1248           12,2140  01346 1           TMODULO
0774  REF   3  LAST 1249           12,2141  15551 1  NEWTC    STODL   TC
0775  REF   1                      12,2142  01553 0           XPREV
0776                               12,2143  45254 0           BZE     DSU
0777  REF   1                      12,2144  24146 1           XDIFF
0778  REF   5  LAST 1248           12,2145  01344 0           XMODULO
0779                               12,2146  77621 1  XDIFF    BDSU
0780  REF   2  LAST 1248           12,2147  00025 0                   X
0781  REF   2  LAST   94           12,2150  02643 1           STORE   DELX
0782                               12,2151  63545 0  KEPLOOP  DLOAD   DSQ
0783  REF   3  LAST 1249           12,2152  00025 0                   X       X=XKEP
0784                               12,2153  41501 0           NORM    PUSH    OD=XSQ (+34 OR +32 -N1)      PL AT 2
0785  REF  59  LAST 1248           12,2154  00047 1                   X1
0786                               12,2155  53605 1           DMP     SR*     ALPHA
0787  REF   4  LAST 1248           12,2156  00011 1                   0 -6,1
0788                               12,2157  21573 0           STCALL  XI      XI=ALPHA XSQ (+6)
0789  REF   1                      12,2160  34031 1                   DELTIME
0790  REF   1                      12,2161  24426 1           BOV     BDSU
0791                               12,2162  44200 0                   TIMEOVFL        UNLIKELY
0792  REF   1                      12,2163  24312 1                   TAU.
0793  REF   6  LAST 1249           12,2164  02312 0           STORE   DELT    DELT=DELINDEP
0794  REF   2  LAST   94           12,2165  02645 1           ABS     BDSU
0795                               12,2166  44246 1                   EPSILONT
0796  REF   2  LAST 1249           12,2167  01350 0           BPL     DLOAD
0797                               12,2170  71244 0                   KEPCONVG
0798  REF   1                      12,2171  24334 0                   T
0799  REF  10  LAST  893           12,2172  00037 0           DSU     NORM
0800                               12,2173  60225 1                   TC
0801  REF   4  LAST 1249           12,2174  01551 1                   X1*
0802  REF  60  LAST 1249           12,2175  00047 1           PDDL    NORM
0803                               12,2176  60325 0                   DELX
0804  REF   3  LAST 1249           12,2177  02643 1                   X2*
0805  REF  31  LAST 1228           12,2200  00050 1           XSU,1   DMP
0806                               12,2201  41260 0                   X2*
0807  REF  32  LAST 1249           12,2202  00047 1                   DELT
0808  REF   3  LAST 1249           12,2203  02645 1           SL*     DDV
0809                               12,2204  56257 1                   1,1
0810                               12,2205  21202 1           SR1     PUSH    0D=TRIAL DELX                PL AT 2
0811                               12,2206  41542 1           BPL     DLOAD
0812                               12,2207  71244 0
```

```
0813  REF  1
0814  REF  4  LAST 1249      12,2210  24231 1                    POSDELX
0815  REF  4  LAST 1248      12,2211  00025 0                    X
0816                        12,2212  00013 0          STORE     XMAX      MOVE MAX BOUND IN
0817  REF  2  LAST 1248      12,2213  45221 1          BDSU      DSU
0818                        12,2214  00015 0                    XMIN      PL AT 0
0819  REF  1                12,2215  51000 0          BOV       BPL
0820  REF  2  LAST 1250      12,2216  24223 1                    NDXCHNGE
0821                        12,2217  24223 1                    NDXCHNGE
0822                        12,2220  52145 0          DLOAD     GOTO
0823  REF  1                12,2221  00001 0                    0D
0824                        12,2222  24243 1                    NEWDELX
0825  REF  3  LAST 1250     12,2223  45345 1  NDXCHNGE DLOAD     DSU
0826  REF  5  LAST 1250     12,2224  00015 0                    XMIN
0827                        12,2225  00025 0                    X
0828  REF  1                12,2226  52075 1          DMPR      GOTO      TO FORCE MPAC +2 TO ZERO
0829  REF  2  LAST 1250     12,2227  11514 1                    DP9/10
0830                        12,2230  24243 1                    NEWDELX
0831  REF  6  LAST 1250     12,2231  77745 1  POSDELX  DLOAD
0832  REF  4  LAST 1250     12,2232  00025 0                    X
0833                        12,2233  00015 0          STORE     XMIN      MOVE MIN BOUND IN
0834  REF  5  LAST 1250     12,2234  45221 1          BDSU      DSU
0835                        12,2235  00013 0                    XMAX      PL AT 0
0836  REF  1                12,2236  50000 1          BOV       BMN
0837  REF  2  LAST 1250     12,2237  24257 1                    PDXCHNGE
0838                        12,2240  24257 1                    PDXCHNGE
0839                        12,2241  77745 1          DLOAD
0840  REF  4  LAST 1249     12,2242  00001 0                    0D
0841                        12,2243  02643 1  NEWDELX  STORE     DELX
0842  REF  2  LAST 1249     12,2244  43254 0          BZE       DAD
0843  REF  7  LAST 1250     12,2245  24334 0                    KEPCONVG
0844  REF  8  LAST 1250     12,2246  00025 0                    X
0845  REF  11 LAST 1249     12,2247  14025 0          STODL     X
0846  REF  5  LAST 1249     12,2250  00037 0                    T
0847                        12,2251  01551 1          STORE     TC
0848  REF  1                12,2252  46034 1  BRNCHCTR RTB      BHIZ
0849  REF  3  LAST 1250     12,2253  24651 0                    CHECKCTR
0850                        12,2254  24334 0                    KEPCONVG
0851  REF  1                12,2255  77650 1          GOTO
0852                        12,2256  24151 1                    KEPLOOP   ITERATE
0853  REF  6  LAST 1250     12,2257  45345 1  PDXCHNGE DLOAD     DSU
0854  REF  9  LAST 1250     12,2260  00013 0                    XMAX
0855                        12,2261  00025 0                    X
0856  REF  2  LAST 1250     12,2262  52075 1          DMPR      GOTO      TO FORCE MPAC +2 TO ZERO
                            12,2263  11514 1                    DP9/10
```

L CONIC SUBROUTINES


```
0857  REF   3  LAST 1250   12,2284  24243 1                    NEWDELX
0858                       12,2285  70545 1  BADX     DLOAD    SR1
0859  REF   7  LAST 1250   12,2286  00013 0                    XMAX
0860  REF  10  LAST 1250   12,2287  00025 0           STORE    X
0861                       12,2270  77650 1           GOTO
0862  REF   1              12,2271  24130 0                    DXCOMP
0863  REF   5  LAST 1250   12,2272  14015 0  BACKWARD STODL    XMIN
0864  REF   3  LAST 1248   12,2273  11456 0                    KEPZERO
0865  REF   8  LAST 1251   12,2274  14013 0           STODL    XMAX
0866  REF   3  LAST 1248   12,2275  02306 0                    XKEPNEW
0867  REF  11  LAST 1251   12,2276  00025 0           STORE    X
0868                       12,2277  51054 1           BZE      BPL
0869  REF   1              12,2300  24305 1                    BADBKWDX
0870  REF   2  LAST 1251   12,2301  24305 1                    BADBKWDX
0871                       12,2302  51025 1           DSU      BPL
0872  REF   6  LAST 1251   12,2303  00015 0                    XMIN
0873  REF   2  LAST 1251   12,2304  24130 0                    DXCOMP
0874                       12,2305  70545 1  BADBKWDX DLOAD    SR1
0875  REF   7  LAST 1251   12,2306  00015 0                    XMIN
0876  REF  12  LAST 1251   12,2307  00025 0           STORE    X
0877                       12,2310  77650 1           GOTO
0878  REF   3  LAST 1251   12,2311  24130 0                    DXCOMP
0879                       12,2312  50145 1  TIMEOVFL DLOAD    BMN      X WAS TOO BIG
0880  REF  13  LAST 1251   12,2313  00025 0                    X
08805 REF   1              12,2314  24331 0                    NEGTOVFL
0881  REF   9  LAST 1251   12,2315  00013 0           STORE    XMAX
0882                       12,2316  70545 1  CNTOVFL  DLOAD    SR1
0883  REF   5  LAST 1250   12,2317  02643 1                    DELX
0884  REF   8  LAST 1251   12,2320  02643 1           STORE    DELX
0885                       12,2321  44254 1           BZE      BDSU
08855 REF   1              12,2322  02270 0                    KEPRTN
0886  REF  14  LAST 1251   12,2323  00025 0                    X
0887  REF  15  LAST 1251   12,2324  14025 0           STODL    X
0888  REF   6  LAST 1250   12,2325  01551 1                    TC
0889  REF  12  LAST 1250   12,2326  00037 0           STORE    T
0890                       12,2327  77650 1           GOTO
0891  REF   1              12,2330  24252 1                    BRNCHCTR
08911 REF   8  LAST 1251   12,2331  00015 0  NEGTOVFL STORE    XMIN
08912                      12,2332  77650 1           GOTO
08913 REF   1              12,2333  24316 0                    CNTOVFL
0892                       12,2334  44545 0  KEPCONVG DLOAD    SR4R
0893  REF   5  LAST 1247   12,2335  00041 1                    R1
0894                       12,2336  74225 1           DSU      VXSC
0895  REF   1              12,2337  00035 1                    XSQC(XI)
```

```
0896  REF   3  LAST 1247   12,2340  02647 0          URRECT
0897                       12,2341  65372 1  VSL1    PDDL      0D=(R1-XSCC(XI))URRECT (+33 OR +31)
0898  REF  16  LAST 1251   12,2342  00025 0          X
0899                       12,2343  60316 0  DSQ     NORM
0900  REF  61  LAST 1249   12,2344  00047 1          X1
0901                       12,2345  57275 0  DMPR    DMPR
0902  REF   3  LAST 1248   12,2346  00023 0          1/ROOTMU
0903  REF  17  LAST 1252   12,2347  00025 0          X
0904                       12,2350  53605 1  DMP     SRR+
0905  REF   1              12,2351  00033 1          S(XI)
0906                       12,2352  21572 1          0 -7,1
0907                       12,2353  77621 1  BDSU
0908  REF  13  LAST 1251   12,2354  00037 0          T
0909                       12,2355  74352 0  SL1     VXSC
0910  REF   4  LAST 1247   12,2356  01511 0          VRECT
0911                       12,2357  53372 1  VSL1    VAD                                   PL AT 0
0912                       12,2360  77712 0  VSL4
0913  REF  14  LAST 1229   12,2361  01535 0  STORE   RCV       RCV (+29 OR +27)
0914                       12,2362  60246 1  ABVAL   NORM
0915  REF  33  LAST 1249   12,2363  00050 1          X2
0916  REF   2  LAST   94   12,2364  16655 0  STODL   RCNORM
0917  REF   2  LAST 1249   12,2365  00031 0          XI
0918                       12,2366  45275 0  DMPR    DSU
0919  REF   2  LAST 1252   12,2367  00033 1          S(XI)
0920  REF   1              12,2370  11476 1          D1/128
0921                       12,2371  76405 1  DMP     SL1R
0922  REF   1              12,2372  00021 1          ROOTMU
0923                       12,2373  53605 1  DMP     SRR+
0924  REF  18  LAST 1252   12,2374  00025 0          X
0925                       12,2375  56601 0          0 -3,2
0926                       12,2376  74271 0  DDV     VXSC
0927  REF   3  LAST 1252   12,2377  02655 0          RCNORM
0928  REF   4  LAST 1252   12,2400  02647 0          URRECT
0929                       12,2401  65372 1  VSL1    PDDL      0D=URRECT(XI S(XI)-1)X ROOTMU/RCV (+15
0930  REF   2  LAST 1251   12,2402  00035 1          XSCC(XI)  OR +13)                       PL AT 6
0931                       12,2403  56257 1  SRR+    DDV
0932                       12,2404  56602 0          0 -4,2
0933  REF   4  LAST 1252   12,2405  02655 0          RCNORM
0934                       12,2406  74221 0  BDSU    VXSC
0935  REF   1              12,2407  11512 1          D1/256
0936  REF   5  LAST 1252   12,2410  01511 0          VRECT
0937                       12,2411  42455 0  VAD     VSL8                                  PL AT 0
0938                       12,2412  77626 0  STADR
0939  REF  13  LAST 1229   12,2413  62234 0  STODL   VCV       VCV (+7 OR +5)
0940  REF  14  LAST 1252   12,2414  00037 0          T
0941                       12,2415  77615 0  DAD
0942  REF   5  LAST 1249   12,2416  01346 1          TMODULO
0943  REF   7  LAST 1251   12,2417  15551 1  STODL   TC
```

```
0944   REF  19  LAST 1252   12,2420  00025 0          X
0945                        12,2421  77615 0   DAD
0946   REF   6  LAST 1249   12,2422  01344 0         XMODULO
0947   REF   2  LAST 1249   12,2423  01553 0   STORE XPREV
0948                        12,2424  77650 1   GOTO
0949   REF   2  LAST 1251   12,2425  02270 0         KEPRIN
```

```
0950                          12,2426   77776 1  DELTIME  EXIT                    MPAC=XI (+6), 0D=XSQ (+34 OR +32 -N1)
0951  REF   7  LAST 1160      12,2427   0 7171 1           TC      POLY
0952                          12,2430   00010 0            DEC     8
0953                          12,2431   02525 1            2DEC    .083333334
0953                          12,2432   12526 0
0954                          12,2433   67356 0            2DEC    -.266666684
0954                          12,2434   75666 0
0955                          12,2435   15001 1            2DEC    .406349155
0955                          12,2436   23771 1
0956                          12,2437   64342 0            2DEC    -.361198675
0956                          12,2440   43674 0
0957                          12,2441   06563 1            2DEC    .210153242
0957                          12,2442   04645 1
0958                          12,2443   75173 0            2DEC    -.086221951
0958                          12,2444   52672 0
0959                          12,2445   00656 1            2DEC    .026268812
0959                          12,2446   14331 0
0960                          12,2447   77633 1            2DEC    -.006163316
0960                          12,2450   40512 0
0961                          12,2451   00023 0            2DEC    .001177342
0961                          12,2452   11210 1
0962                          12,2453   77774 0            2DEC    -.000199055
0962                          12,2454   67506 0
0963  REF 230  LAST 1228      12,2455   0 6006 1           TC      INTPRET
0964  REF   3  LAST 1252      12,2456   14033 1            STODL   S(XI)
0965  REF   3  LAST 1252      12,2457   00031 0                    XI
0966                          12,2460   77776 1            EXIT
0967  REF   8  LAST 1254      12,2461   0 7171 1           TC      POLY
0968                          12,2462   00010 0            DEC     8
0969                          12,2463   01000 0            2DEC    .031250001
0969                          12,2464   00000 1
0970                          12,2465   72525 0            2DEC    -.166666719
0970                          12,2466   52506 0
0971                          12,2467   13301 1            2DEC    .355555413
0971                          12,2470   15337 1
0972                          12,2471   62776 0            2DEC    -.406347410
0972                          12,2472   54733 1
0973                          12,2473   11176 1            2DEC    .288962094
0973                          12,2474   13267 0
0974                          12,2475   73410 0            2DEC    -.140117894
0974                          12,2476   51674 0
0975                          12,2477   01446 0            2DEC    .049247387
0975                          12,2500   33641 1
0976                          12,2501   77451 1            2DEC    -.013081923
0976                          12,2502   65233 0
0977                          12,2503   00055 1            2DEC    .002806389
0977                          12,2504   37266 1
0978                          12,2505   77767 1            2DEC    -.000529414
0978                          12,2506   52336 0
0979  REF 231  LAST 1254      12,2507   0 6006 1           TC      INTPRET
```

```
0980                          12,2510  53605 1        DMP     SRR*                                    PL AT 0
0981                          12,2511  00001 0                0D
0982                          12,2512  21574 1                0 -5,1
0983  REF   3  LAST 1252     12,2513  00035 1        STORE   XSQC(XI)        XSQC(XI) (+33 OR +31)
0984                          12,2514  72405 0        DMP     SL1
0985  REF   2  LAST 1247     12,2515  00043 0                KEPC1
0986                          12,2516  65234 1        RTB     PDDL            XCH WITH PL. 0D=C1 XSQ C(XI) (+49 OR +46
0987  REF  10  LAST 1223     12,2517  45562 1                TPMODE                                  PL AT 0,3
0988                          12,2520  53605 1        DMP     SRR*
0989  REF   4  LAST 1254     12,2521  00033 1                S(XI)
0990                          12,2522  21574 1                0 -5,1
0991                          12,2523  72405 0        DMP     SL1
0992  REF   2  LAST 1247     12,2524  00045 0                KEPC2
0993                          12,2525  65234 1        RTB     PDDL            3D=C2 XSQ S(XI) (+35 OR +33)  PL AT 6
0994  REF  11  LAST 1255     12,2526  45562 1                TPMODE
0995  REF   6  LAST 1251     12,2527  00041 1                R1
0996                          12,2530  76261 0        SR      TAD                                     PL AT 3
0997                          12,2531  20607 1                6
0998                          12,2532  41301 0        NORM    DMP             TO PRESERVE SIGNIF.
0999  REF  62  LAST 1252     12,2533  00047 1                X1
1000  REF  20  LAST 1253     12,2534  00025 0                X
1001                          12,2535  76257 0        SR*     TAD             X(C2 XSQ S(XI) +R1) (+49 OR +46) PL AT 0
1002                          12,2536  20576 1                0 -3,1
1003                          12,2537  57232 0        SL4R    DMPR
1004  REF   4  LAST 1252     12,2540  00023 0                1/ROOTMU
1005  REF  15  LAST 1252     12,2541  00037 0        STORE   T
1006                          12,2542  77616 0        RVQ
```

```
1007                          12,2543  71214 0  ITERATOR BONCLR DLOAD
1008  REF  1                  12,2544  00614 1                  SLOPESW
1009  REF  1                  12,2545  24613 0                  FIRSTIME
1010  REF  1                  12,2546  00037 0                  DEP
1011                          12,2547  60225 1           DSU    NORM
1012  REF  2  LAST   94       12,2550  02764 0                  DEPREV
1013  REF  63 LAST 1255       12,2551  00047 1                  X1
1014                          12,2552  60325 0           PDDL   NORM
1015  REF  1                  12,2553  00015 0                  DELINDEP
1016  REF  34 LAST 1252       12,2554  00050 1                  X2
1017                          12,2555  41260 0           XSU,1  DMP
1018  REF  35 LAST 1256       12,2556  00047 1                  X2
1019  REF  3  LAST   94       12,2557  02762 0                  DELDEP
1020                          12,2560  56257 1           SLR*   DDV                    PL UP 2
1021                          12,2561  21202 1                  1,1
1022                          12,2562  43142 1           SR1    BOFF
1023  REF  1                  12,2563  04351 1                  ORDERSW
1024  REF  1                  12,2564  24567 0                  SGNCHECK
1025                          12,2565  75246 0           ABS    SIGN      IN CASE 2ND DERIV. CHANGED SIGN, MUST
1026  REF  4  LAST 1256       12,2566  02762 0                  DELDEP    DISREGARD IT TO FIND MIN.
1027                          12,2567  51006 0  SGNCHECK PUSH   BPL       TRIAL DELINDEP         PL DOWN 2
1028  REF  1                  12,2570  24625 0                  POSDEL
1029                          12,2571  43145 0           DLOAD  BON
1030  REF  1                  12,2572  03775 1                  INDEP
1031  REF  2  LAST 1256       12,2573  04311 0                  ORDERSW
1032  REF  1                  12,2574  24576 0                  MINCHECK
1033  REF  1                  12,2575  00017 1           STORE  MAX       IF NOT 2ND ORDER, CAN MOVE MAX BOUND IN.
1034                          12,2576  45221 1  MINCHECK BDSU   DSU
1035  REF  1                  12,2577  00011 1                  MIN
1036                          12,2600  51000 0           BOV    BPL
1037  REF  1                  12,2601  24605 1                  MODNGDEL
1038  REF  2  LAST 1256       12,2602  24605 1                  MODNGDEL
1039                          12,2603  77650 1           GOTO
1040  REF  1                  12,2604  24637 0                  DELOK
1041                          12,2605  45345 1  MODNGDEL DLOAD  DSU       TRIAL DELINDEP WOULD EXCEED MIN BOUND
1042  REF  2  LAST 1256       12,2606  00011 1                  MIN
1043  REF  2  LAST 1256       12,2607  03775 1                  INDEP
1044                          12,2610  52005 0           DMP    GOTO
1045  REF  3  LAST 1250       12,2611  11514 1                  DP9/10
1046  REF  1                  12,2612  24641 1                  NEWDEL
1047                          12,2613  41345 0  FIRSTIME DLOAD  DMP
1048  REF  3  LAST 1256       12,2614  00011 1                  MIN
1049  REF  1                  12,2615  00051 0                  TWEEKIT   DLOAD TWEEKIT(40D) SENSITIVE TO CHANGE.
1050                          12,2616  41325 0           PDDL   DMP       S2(41D) SHOULDNT CONTAIN HI ORDER ONES
```

```
1051  REP   2  LAST 1256   12,2617   00017 1                    MAX
1052  REP   2  LAST 1256   12,2620   00051 0                    TWERKIT
1053                        12,2621   77625 0          DSU
1054                        12,2622   52165 1          SIGN     GOTO
1055  REP   5  LAST 1256   12,2623   02762 0                    DELDEP
1056  REP   2  LAST 1256   12,2624   24567 0                    SGNCHECK
1057                        12,2625   43145 0  POSDEL  DLOAD    BCN
1058  REP   3  LAST 1256   12,2626   03775 1                    INDEP
1059  REP   3  LAST 1256   12,2627   04311 0                    ORDERSW
1060  REP   1               12,2630   24632 0                    MAXCHECK
1061  REP   4  LAST 1256   12,2631   00011 1          STORE    MIN        IF NOT 2ND ORDER, CAN MOVE MIN BOUND IN.
1062                        12,2632   45221 1  MAXCHECK BDSU    DSU
1063  REP   3  LAST 1257   12,2633   00017 1                    MAX
1064                        12,2634   50000 1          BOV      BNN
1065  REP   1               12,2635   24643 0                    MODPSDEL
1066  REP   2  LAST 1257   12,2636   24643 0                    MODPSDEL
1067                        12,2637   77745 1  DELOK   DLOAD
1068                        12,2640   00001 0                    0D
1069  REP   2  LAST 1256   12,2641   00015 0  NEWDEL  STORE    DELINDEP
1070                        12,2642   77616 0          RVQ
1071                        12,2643   45345 1  MODPSDEL DLOAD   DSU
1072  REP   4  LAST 1257   12,2644   00017 1                    MAX
1073  REP   4  LAST 1257   12,2645   03775 1                    INDEP
1074                        12,2646   52005 0          DMP      GOTO
1075  REP   4  LAST 1256   12,2647   11514 1                    DP9/10
1076  REP   2  LAST 1256   12,2650   24641 1                    NEWDEL
1077  REP 153  LAST 1200   12,2651  4 4712 0  CHECKCTR CS       ONE
1078  REP  36  LAST 1183   12,2652  50 120 1          INDEX    FIXLOC
1079  REP   2  LAST 1247   12,2653   6 0026 0          AD       ITERCTR
1080  REP  37  LAST 1257   12,2654  50 120 1          INDEX    FIXLOC
1081  REP   3  LAST 1257   12,2655  54 026 1          TS       ITERCTR
1082  REP 650  LAST 1224   12,2656  54 154 0          TS       MPAC
1083  REP  62  LAST 1169   12,2657  0 6030 1          TC       DANZIG
```

```
1084                          12,2660  44545 0  NEWSTATE DLOAD   SR4R
1085  REF   7  LAST 1255     12,2661  00041 1                   R1
1089                          12,2662  74225 1           DSU     VXSC
1090  REF   4  LAST 1255     12,2663  00035 1                   XSQC(XI)
1091  REF   3  LAST 1247     12,2664  02724 1                   UR1
1092                          12,2665  65372 1           VSL1    PDDL      0D=(R1-XSQC(XI))UR1 (+33 OR 31) PL AT 6
1093  REF  21  LAST 1255     12,2666  00025 0                   X
1094                          12,2667  60316 0           DSQ     NORM
1095  REF  64  LAST 1256     12,2670  00047 1                   X1
1096                          12,2671  57275 0           DMPR    DMPR
1097  REF   5  LAST 1255     12,2672  00023 0                   1/ROOTMU
1098  REF  22  LAST 1258     12,2673  00025 0                   X
1099                          12,2674  53605 1           DMP     SRR*
1100  REF   5  LAST 1255     12,2675  00033 1                   S(XI)
1101                          12,2676  21572 1                   0 -7,1
1102                          12,2677  77621 1           BDSU
1103  REF  16  LAST 1255     12,2700  00037 0                   T
1104                          12,2701  74352 0           SL1     VXSC
1105  REF  15  LAST  893     12,2702  02746 0                   VVEC
1106                          12,2703  53372 1           VSL1    VAD                          PL AT 0
1107                          12,2704  41512 1           VSL4    PUSH
1108                          12,2705  77646 0           ABVAL
1109                          12,2706  77701 1  LAMENTER NORM
1110  REF  65  LAST 1258      12,2707  00047 1                   X1
1111  REF   1                 12,2710  16722 1           STODL   R2
1112  REF   4  LAST 1254     12,2711  00031 0                   XI
1113                          12,2712  45205 1           DMP     DSU
1114  REF   6  LAST 1258     12,2713  00033 1                   S(XI)
1115  REF   2  LAST 1252     12,2714  11476 1                   D1/128
1116                          12,2715  76405 1           DMP     SL1R
1117  REF   2  LAST 1252     12,2716  00021 1                   ROOTMU
1118                          12,2717  53605 1           DMP     SLR*
1119  REF  23  LAST 1258     12,2720  00025 0                   X
1120                          12,2721  21176 1                   0 -3,1
1121                          12,2722  74271 0           DDV     VXSC
1122  REF   2  LAST 1258     12,2723  02722 1                   R2
1123  REF   4  LAST 1258     12,2724  02724 1                   UR1
1124                          12,2725  65372 1           VSL1    PDDL      6D=V2VEC PART (+15 OR 13)       PL AT 12
1125  REF   5  LAST 1258     12,2726  00035 1                   XSQC(XI)
1126                          12,2727  56257 1           SLR*    DDV
1127                          12,2730  21175 1                   0 -4,1
1128  REF   3  LAST 1258     12,2731  02722 1                   R2
1129                          12,2732  77621 1           BDSU
1130  REF   2  LAST 1252     12,2733  11512 1                   D1/256
1131                          12,2734  53361 0           VXSC    VAD                          PL AT 6
1132  REF  16  LAST 1258     12,2735  02746 0                   VVEC
1133                          12,2736  43412 1           VSL8    RVQ
R1134
```

L CONIC SUBROUTINES USER=S PAGE NO. 28 E5 S3

```
 1135  REP   1              04,2000                  SETLOC CONICS1
 1136                       04,3472                  BANK

 1137  REP   1                                       COUNT  04/CONIC
R1138  DO NOT DISTURB THE ORDER OF THESE CDS, OVERLAYS HAVE BEEN MADE.
 1139                       04,3472   00000 1  BEE17   DEC    0              KEEP WITH D1/8 2DEC 1.0B-17 (0000004000)
 1140                       04,3473   04000 0  D1/8     2DEC   1.0 B-3
 1140                       04,3474   00000 1
 1141                       04,3475   00200 0  D1/128   2DEC   1.0 B-7
 1141                       04,3476   00000 1
 1142                       04,3477   00400 0  D1/64    2DEC   1.0 B-6
 1142                       04,3500   00000 1
 1143                       04,3501   10000 0  D1/4     2DEC   1.0 B-2
 1143                       04,3502   00000 1
 1144                       04,3503   02000 0  D1/16    2DEC   1.0 B-4
 1144                       04,3504   00000 1
 1145                       04,3505   01000 0  D1/32    2DEC   1.0 B-5
 1145                       04,3506   00000 1
 1146                       04,3507   00020 0  D1/1024  2DEC   1.0 B-10
 1146                       04,3510   00000 1
 1147                       04,3511   00100 0  D1/256   2DEC   1.0 B-8
 1147                       04,3512   00000 1
 1148                       04,3513   34631 1  DP9/10   2DEC   .9
 1148                       04,3514   23146 0
 1149  REP   5 LAST  681    04,3455            KEPZERO  EQUALS LOCZEROS
 1150                       04,3515   77467 1  -50SC    2DEC   -50.0 B-12
 1150                       04,3516   77777 0
 1151                       04,3517   03110 1  2PISC    2DEC   6.28318530 B-6
 1151                       04,3520   17665 1
 1152  REP   2 LAST  549    04,3504            BEE19    EQUALS D1/32 -1        2DEC 1.0 B-19 (00000 01000)
 1153  REP   3 LAST 1258    04,3510            BEE22    EQUALS D1/256 -1       2DEC 1.0 B-22 (00000 00100)
 1154                       04,3521   00000 1  ONEBIT   2DEC   1.0 B-28
 1154                       04,3522   00001 0
 1155                       04,3523   37767 0  COSUPLIM 2DEC   .999511597
 1155                       04,3524   37737 0
 1156                       04,3525   40010 1  COSLOLIM 2DEC   -.999511597
 1156                       04,3526   40040 1
R1157
```

L CONIC SUBROUTINES USER=S PAGE NO. 29 E5 S3

```
1158  REP  2  LAST 1246   12,2000                      SETLOC CONICS
1159                      12,2737                      BANK

1160  REP  2 LAST 1247 TO 1259'   479   479*           COUNT  12/CONIC

1161
1162  REP  1               12,2737  40220 0 TIMETHET STO    SETPD          PL AT 0
1163                       12,2740  02712 1                 RINTT
1164                       12,2741  00001 0                 0
1165  REP 11  LAST  893    12,2742  63375 0          VLOAD  PDVL     SETUP FOR PARAM CALL   PL AT 6
1166  REP 17  LAST 1258    12,2743  02657 1                 RVEC
1167                       12,2744  02746 0                 VVEC
1168  REP  2  LAST  861    12,2745  77624 1          CALL
1169                       12,2746  11527 1                 PARAM
1170  REP  1               12,2747  45000 0          BOV    CALL           PL AT 0
1171  REP  1               12,2750  24767 1                 COGAOVFL
1172                       12,2751  24772 0                 GETX
1173  REP  5  LAST 1258    12,2752  43145 0 COMMNOUT DLOAD  BON
1174  REP  2  LAST  893    12,2753  00031 0                 XI
1175  REP  2  LAST 1260    12,2754  04310 1                 INFINFLG
1176                       12,2755  02712 1                 RINTT
1177  REP  2  LAST  893    12,2756  45014 0          CLEAR  CALL
1178  REP  2  LAST 1249    12,2757  04273 0                 COGAFLAG
1179                       12,2760  24426 1                 DELTIME
1180  REP  8  LAST  893    12,2761  45014 0          BON    CALL
1181  REP  3  LAST 1260    12,2762  03706 0                 RVSW
1182  REP  1               12,2763  02712 1                 RINTT
1183                       12,2764  24660 1                 NEWSTATE
1184  REP  4  LAST 1260    12,2765  77650 1          GOTO
1185                       12,2766  02712 1                 RINTT
1186  REP  3  LAST 1260    12,2767  77614 1 COGAOVFL SETGO
1187  REP  5  LAST 1260    12,2770  04033 0                 COGAFLAG
                           12,2771  02712 1                 RINTT
```

```
11872                          04,3527                    BANK   4
11874  REF   2  LAST 1259      04,2000                    SETLOC CONICS1
11876                          04,3527                    BANK
11878  REF   2 LAST 1259 TO 1260'    29    29*           COUNT* $$/CONIC
1188                           04,3527  43020 1  PARAM     STQ    CLEAR          MPAC=V1VEC, 0D=R1VEC          PL AT 6
1189   REF   2  LAST   94      04,3530  02755 1            RTNPRM
1190   REF   7  LAST  850      04,3531  03865 1            NORMSW
11901                          04,3532  77614 1  CLEAR
11902  REF   4  LAST 1260      04,3533  04273 0            COGAFLAG
1191                           04,3534  45131 0  SSP       CALL
1192   REF   3  LAST  481      04,3535  02675 1            GEOMSGN
1193                           04,3536  37777 0            37777          GAMMA ALWAYS LESS THAN 180DEG
1194   REF   1                 04,3537  11573 0            GEOM           MPAC=SNGA (+1), 0D=CSGA (+1)  PL AT 2
1195                           04,3540  14045 0  STODL     36D            36D=SIN GAMMA (+1)            PL AT 0
1196                           04,3541  56261 1  SR        DDV
1197                           04,3542  20606 0            5

1198                           04,3543  00045 0            36D
1199   REF   4  LAST  861      04,3544  33775 1  STOVL*    COGA
1200   REF   6  LAST 1247      04,3545  11631 0            MUTABLE,1
1201   REF   2  LAST 1247      04,3546  14017 1  STODL     1/MU
1202   REF   3  LAST   94      04,3547  02722 1            MAGVEC2
1203                           04,3550  60316 0  DSQ       NORM
1204   REF  66  LAST 1258      04,3551  00047 1            X1
1205                           04,3552  41275 1  DMPR      DMP
1206   REF   3  LAST 1261      04,3553  00017 1            1/MU
1207   REF   8  LAST 1258      04,3554  00041 1            R1
1208                           04,3555  77657 0  SRR*
1209                           04,3556  21576 0            0 -3,1
1210                           04,3557  44206 0  PUSH      BDSU           0D=R1 V1SQ/MU (+6)            PL AT 2
1211   REF   3  LAST 1259      04,3560  11506 1            D1/32
1212   REF   3  LAST  861      04,3561  16744 1  STODL     R1A            R1A (+6)                      PL AT 0

1213                           04,3562  60205 0  DMP       NORM
1214                           04,3563  00045 0            36D
1215   REF  67  LAST 1261      04,3564  00047 1            X1
1216                           04,3565  53605 1  DMP       SR*
1217                           04,3566  00045 0            36D
1218                           04,3567  20575 1            0 -4,1
1219   REF   3  LAST  861      04,3570  02742 1  STORE     P              P (+4)
1220                           04,3571  77650 1  GOTO
1221   REF   3  LAST 1261      04,3572  02755 1            RTNPRM
```

L CONIC SUBROUTINES USER=S PAGE NO. 31 E5 S3

```
1225                    04,3573  77656 1  GEOM    UNIT                    MPAC=V2VEC, 0D=R1VEC            PL AT 6
1226  REF  2  LAST  94  04,3574  16714 1           STODL   U2              U2 (+1)
1227                    04,3575  00045 0                   36D
1228  REF  4  LAST 1261 04,3576  26722 1           STOVL   MAGVEC2                                         PL AT 0
1229                    04,3577  77656 1           UNIT
1230  REF  5  LAST 1258 04,3600  02724 1           STORE   UR1             UR1 (+1)
1231                    04,3601  72441 0           DOT     SL1
1232  REF  3  LAST 1262 04,3602  02714 1                   U2
1233                    04,3603  77725 1           PDDL                    CD=CSTH (+1)                    PL AT 2
1234                    04,3604  00045 0                   36D
1235  REF  9  LAST 1261 04,3605  24041 1           STOVL   R1              R1 (+29 OR +27)
1236  REF  6  LAST 1262 04,3606  02724 1                   UR1
1237                    04,3607  76435 1           VXV     VSL1
1238  REF  4  LAST 1262 04,3610  02714 1                   U2
1239                    04,3611  75214 1           BOV     SIGN
1240  REF  8  LAST 1261 04,3612  03705 0                   NORMSW
1241  REF  1            04,3613  11625 0                   HAVENORM
1242  REF  4  LAST 1261 04,3614  02675 1                   GEOMSGN
1243                    04,3615  40056 0           UNIT    BOV
1244  REF  1            04,3616  11623 0                   COLINEAR
1245  REF  4  LAST  480 04,3617  16676 1  UNITNORM STODL   UN              UN (+1)
1246                    04,3620  00045 0                   36D
1247                    04,3621  43565 0           SIGN    RVQ             MPAC=SNTH (+1), 34D=SNTH.SNTH (+2)
1248  REF  5  LAST 1262 04,3622  02675 1                   GEOMSGN
1249                    04,3623  52162 0  COLINEAR VSR1    GOTO
1250  REF  1            04,3624  11617 1                   UNITNORM
1251                    04,3625  75246 0  HAVENORM ABVAL   SIGN
1252  REF  6  LAST 1262 04,3626  02675 1                   GEOMSGN
1253                    04,3627  77616 0           RVQ             MPAC=SNTH (+1), 34D=SNTH.SNTH (+2)
```

```
1254                        12,2772                 BANK    12
1255  REF  3  LAST 1260    12,2000                 SETLOC  CONICS
1256                        12,2772                 BANK

12565 REF  3  LAST 1260 TO 1261'   27   506*       COUNT   12/CONIC

1257                        12,2772  66374 1 GETX   AXT,2   SSP       ASSUMES P (+4) IN MPAC
1258                        12,2773  00003 1        3
1259  REF 26  LAST 1228    12,2774  00052 0        S2
1260                        12,2775  00001 0        1
1261                        12,2776  77614 1        CLEAR
1262  REF  1                12,2777  04276 0        360SW
1263                        12,3000  65386 1        SQRT    PDDL      0D=SQRT(P)                PL AT 2
1264  REF  9  LAST  892     12,3001  02734 0        CSIH
1265                        12,3002  44342 1        SR1     BDSU
1266  REF  2  LAST   32     12,3003  11502 0        D1/4
1267                        12,3004  54325 1        PDDL    SRR                               PL AT 4D
1268  REF 11  LAST  893     12,3005  02732 0        SNTH
1269                        12,3006  21607 0        6
1270                        12,3007  77671 1        DDV                                       PL AT 2
1271                        12,3010  77600 1        BOV
1272  REF  1                12,3011  25125 0        360CHECK
1273                        12,3012  41225 1        DSU     DMP
1274  REF  5  LAST 1261     12,3013  03775 1        COGA                                      PL AT 0
1275                        12,3014  40132 0        SL2R    BOV
1276  REF  2  LAST 1263     12,3015  25125 0        360CHECK
1277                        12,3016  63406 0 WLOOP  PUSH    DSQ       0D=W (+5)               PL AT 2
1278                        12,3017  65351 0        TLOAD   PDDL      2D=WSQ (+10)            PL AT 5
1279  REF 651  LAST 1257    12,3020  00155 0        MPAC
1280  REF  4  LAST 1261     12,3021  02744 1        R1A
1281                        12,3022  76202 0        SR4     TAD                               PL AT 2
1282                        12,3023  75440 0        BMN     SQRT
1283  REF  1                12,3024  25210 0        INFINITY
1284                        12,3025  43306 0        RCUND   DAD                               PL AT 0D
1285                        12,3026  61000 0        BOV     TIX,2
1286  REF  1                12,3027  25123 0        RESETX2
1287  REF  1                12,3030  25016 1        WLOOP
1288                        12,3031  40065 0        BDDV    BOV
1289  REF  3  LAST 1258     12,3032  11476 1        D1/128
1290  REF  2  LAST 1263     12,3033  25210 0        INFINITY
1291                        12,3034  41440 1 POLYCOEF BMN    PUSH      0D=1/W (+2) OR 16/W (+6)  PL AT 2
1292  REF  3  LAST 1263     12,3035  25210 0        INFINITY
1293                        12,3036  77716 1        DSQ
1294                        12,3037  41301 0        NORM    DMP
1295  REF 68  LAST 1261     12,3040  00047 1        X1
1296  REF  5  LAST 1263     12,3041  02744 1        R1A
1297                        12,3042  77457 1        SRR*    EXIT
1298                        12,3043  21567 0        0 -10D,1
```

```
1299  REP   9  LAST 1254   12,3044  0 7171 1          TC      POLY
1300                       12,3045   00005 1          DEC     5
1301                       12,3046   20000 0          2DEC    .5
1301                       12,3047   00000 1
1302                       12,3050   72525 0          2DEC    -.166666770
1302                       12,3051   52471 1
1303                       12,3052   03146 1          2DEC    .100000392
1303                       12,3053   15003 0
1304                       12,3054   75556 0          2DEC    -.071401086
1304                       12,3055   45210 0
1305                       12,3056   01615 1          2DEC    .055503292
1305                       12,3057   13553 0
1306                       12,3060   76371 0          2DEC    -.047264098
1306                       12,3061   63777 0
1307                       12,3062   01232 0          2DEC    .040694204
1307                       12,3063   27367 0
1308  REP 232  LAST 1254   12,3064  0 6006 1          TC      INTPRET
1309                       12,3065   76405 1          DMP     SL1R                              PL AT 0D
1310                       12,3066   43006 0          PUSH    BOV
1311  REP   2  LAST 1263   12,3067   04316 1                  360SW
1312  REP   1              12,3070   25175 0                  TRUE360X
1313                       12,3071   60316 0  XCOMMON DSQ     NORM
1314  REP  69  LAST 1263   12,3072   00047 1                  X1
1315                       12,3073   53605 1          DMP     SRR*
1316  REP   6  LAST 1263   12,3074   02744 1                  R1A
1317                       12,3075   21565 1                  0 -12D,1
1318  REP   6  LAST 1260   12,3076   14031 0          STODL   XI                XI (+6)
1319  REP  10  LAST 1262   12,3077   00041 1                  R1
1320                       12,3100   75542 0          SR1     SQRT
1321                       12,3101   41306 1          ROUND   DMP
1322                       12,3102   77632 0          SL4R                              PL AT 0
1323  REP  24  LAST 1258   12,3103   00025 0          STORE   X                 X (+17 OR +16)
1324                       12,3104   60316 0          DSQ     NORM
1325  REP  70  LAST 1264   12,3105   00047 1                  X1
1326                       12,3106   41325 0          PDDL    DMP               0D=XSQ (+34 OR +32 -N1)   PL AT 2
1327  REP   4  LAST 1261   12,3107   02742 1                  P
1328  REP  11  LAST 1264   12,3110   00041 1                  R1
1329                       12,3111   75452 0          SL3     SQRT
1330                       12,3112   56405 0          DMP     SL3R
1331  REP   6  LAST 1263   12,3113   03775 1                  COGA
1332  REP   3  LAST 1255   12,3114   14043 0          STODL   KEPC1
1333  REP   7  LAST 1264   12,3115   02744 1                  R1A
1334                       12,3116   43021 0          BDSU    CLEAR
1335  REP   3  LAST 1247   12,3117   11500 1                  D1/64
1336  REP   3  LAST 1260   12,3120   04270 0                  INPINFLG
1337  REP   3  LAST 1255   12,3121   00045 0          STORE   KEPC2
```

```
1338                          12,3122  77616 0          RVQ
1339                          12,3123  77774 0 RESETX2  AXT,2
1340                          12,3124  00003 1          3
1341                          12,3125  51001 1 360CHECK SETPD   BPL
1342                          12,3126  00001 0                  0D
1343  REF   1                 12,3127  25132 0                  INVRSEQN
1344                          12,3130  77614 1          SET
1345  REF   3  LAST 1264     12,3131  04076 1                  360SW
1346                          12,3132  75545 1 INVRSEQN DLOAD   SQRT
1347  REF   5  LAST 1264     12,3133  02742 1                  P
1348                          12,3134  41325 0          PDDL    DMP      0D=SQRT(P)  (+2)          PL AT 2
1349  REF  12  LAST 1263     12,3135  02732 0                  SNTH
1350  REF   7  LAST 1264     12,3136  03775 1                  COGA
1351                          12,3137  65352 0          SL1     PDDL     2D=SNTH COGA (+5)         PL AT 4
1352  REF  10  LAST 1263     12,3140  02734 0                  CSTH
1353                          12,3141  43202 0          SR4     DAD
1354  REF   4  LAST 1261     12,3142  11506 1                  D1/32
1355                          12,3143  41225 1          DSU     DMP                                PL AT 2,0
1356                          12,3144  55301 0          NORM    BDDV
1357  REF  71  LAST 1264     12,3145  00047 1                  X1
1358  REF  13  LAST 1265     12,3146  02732 0                  SNTH
1359                          12,3147  51457 0          SLR*    ABS      NOTE' NEAR 360 CASE TREATED DIFFERENTLY
1360                          12,3150  21174 0                  0 -5,1
1361                          12,3151  63406 0          PUSH    DSQ      0D=1/W (-1)               PL AT 2
1362                          12,3152  14043 0          STODL   34D
1363  REF   1                 12,3153  11504 0                  D1/16
1364                          12,3154  63406 0 1/WLOOP  PUSH    DSQ      2D=G (+4)                 PL AT 4
1365                          12,3155  65234 1          RTB     PDDL                               PL AT 7
1366  REF  12  LAST 1255     12,3156  45562 1                  TPMODE
1367  REF   8  LAST 1264     12,3157  02744 1                  R1A
1368                          12,3160  40405 1          DMP     SR4
1369                          12,3161  00043 0                  34D
1370                          12,3162  77771 0          TAD                                        PL AT 4
1371                          12,3163  75440 0          RVN     SQRT
1372  REF   4  LAST 1263     12,3164  25210 0                  INFINITY
1373                          12,3165  77615 0          DAD                                        PL AT 2
1374                          12,3166  60304 0          TIX,2   NORM
1375  REF   1                 12,3167  25154 0                  1/WLOOP
1376  REF  72  LAST 1265     12,3170  00047 1                  X1
1377                          12,3171  77665 1          BDDV                                       PL AT 0
1378                          12,3172  52057 1          SLR*    GOTO
1379                          12,3173  21172 0                  0 -7,1
1380  REF   1                 12,3174  25034 1                  POLYCOEF
```

```
1381                                12,3175  50145 1  TRUE360X DLOAD   BMN
1382  REP   9  LAST 1265           12,3176  02744 1                    R1A
1383  REP   5  LAST 1265           12,3177  25210 0                    INFINITY
1384                                12,3200  60366 1           SQRT     NORM
1385  REP  73  LAST 1265           12,3201  00047 1                    X1
1386                                12,3202  53665 1           BDDV     SL*
1387  REP   3  LAST 1248           12,3203  11520 0                    2PISC
1388                                12,3204  20176 0                    0 -3,1
1389                                12,3205  41425 1           DSU      PUSH
1390                                12,3206  77650 1           GOTO
1391  REP   1                       12,3207  25071 0                    XCOMMON
1392                                12,3210  40001 1  INFINITY SETPD    BOV
1393                                12,3211  00001 0                    0
1394  REP   1                       12,3212  25213 0                    OVFLCLR
1395                                12,3213  43414 1  OVFLCLR  SET      RVQ
1396  REP   4  LAST 1264           12,3214  04070 1                    INFINFLG
```

0D=2PI/SQRT(R1A) -X PL AT 0,2

NO SOLUTION EXISTS SINCE CLOSURE THROUGH INFINITY IS REQUIRED

```
1397                        12,3215  40220 0  LAMBERT  STQ     SETPD
1398  REP  5  LAST  94      12,3216  02712 1           RTNLAMB
1399                        12,3217  00001 0           0D
1400                        12,3220  76731 0           SSP     VLOAD*
1401  REP  4  LAST 1257     12,3221  00027 1                   ITERCTR
1402                        12,3222  00024 1                   20D
1403  REP  7  LAST 1261     12,3223  11631 0                   MUTABLE,1
1404  REP  4  LAST 1261     12,3224  14017 1           STODL   1/MU
1405  REP  3  LAST  480     12,3225  02673 1                   TDESIRED
1406                        12,3226  77675 0           DMPR
1407  REP  1                12,3227  11505 1                   BBE19
1408  REP  1                12,3230  03777 0           STORE   EPSILONL
1409                        12,3231  77214 0           SET     VLOAD
1410  REP  2  LAST 1256     12,3232  00474 0                   SLOPESW
1411  REP  6  LAST  481     12,3233  02657 1                   R1VEC
1412                        12,3234  45115 0           PDVL    CALL        0D=R1VEC (+29 OR +27)        PL AT 6
1413  REP 10  LAST  482     12,3235  02665 0                   R2VEC       MPAC=R2VEC (+29 OR +27)
1414  REP  2  LAST 1261     12,3236  11573 0                   GEOM
1415  REP 14  LAST 1265     12,3237  16732 0           STODL   SNTH        0D=CSTH (+1)                 PL AT 2
1416  REP  5  LAST 1262     12,3240  02722 1                   MAGVEC2
1417                        12,3241  65301 0           NORM    PDDL                                     PL AT 4
1418  REP 74  LAST 1266     12,3242  00047 1                   X1
1419  REP 12  LAST 1264     12,3243  00041 1                   R1
1420                        12,3244  56342 1           SR1     DDV                                      PL AT 2
1421                        12,3245  65257 1           SL*     PDDL        DXCH WITH 0D, 0D=R1/R2 (+7)  PL AT 0,2
1422                        12,3246  20173 0                   0 -6,1
1423                        12,3247  77626 0           STADR
1424  REP 11  LAST 1265     12,3250  75043 1           STORE   CSTH        CSTH (+1)
1425                        12,3251  44342 1           SR1     BDSU
1426  REP  3  LAST 1263     12,3252  11502 0                   D1/4
1427  REP  2  LAST  94      12,3253  02736 1           STORE   1-CSTH      1-CSTH (+2)

1428                        12,3254  53106 0           ROUND   BZE
1429  REP  1                12,3255  25465 1                   360LAMB
1430                        12,3256  65301 0           NORM    PDDL                                     PL AT 4
1431  REP 75  LAST 1267     12,3257  00047 1                   X1
1432                        12,3260  00001 0                   0D
1433                        12,3261  56342 1           SR1     DDV                                      PL AT 2
1434                        12,3262  75457 0           SL*     SQRT
1435                        12,3263  20176 0                   0 -3,1
1436                        12,3264  54325 1           PDDL    SR          2D=SQRT(2R1/R2(1-CSTH)) (+5) PL AT 4
1437  REP 15  LAST 1267     12,3265  02732 0                   SNTH
1438                        12,3266  20607 1                   6
1439                        12,3267  43271 1           DDV     DAD                                      PL AT 2
1440  REP  3  LAST 1267     12,3270  02736 1                   1-CSTH
14401                       12,3271  77626 0           STADR
14402 REP  1                12,3272  77760 0           STORE   COGAMAX
1441                        12,3273  50000 1           BOV     PMN         IF OVFL, COGAMAX=COGUPLIM
1442  REP  1                12,3274  25301 1                   UPLIM       IF NEG, USE EVEN IF LT COGLOLIM, SINCE
14421 REP  1                12,3275  25304 1                   MAXCOGA       THIS WOULD BE RESET IN LAMBLOOP
```

```
14422
14423  REP   1
14424  REP   2  LAST 1267
14425
14426  REP   2  LAST 1268
14427  REP   2  LAST 1267
1443
1444   REP  12  LAST 1267
1445
1446
1447
1448   REP   2  LAST   94
1449   REP   7  LAST 1262
1450
1451   REP   1
1452   REP   3  LAST 1268
1453
1454   REP  16  LAST 1267
1455
1456   REP   2  LAST 1268
1457   REP   1
1458
1459   REP   4  LAST  679
1460   REP   1
1461   REP   3  LAST 1257
1462
1463
1464   REP   8  LAST 1265
1465
1466   REP  17  LAST 1268
1467
1468   REP   4  LAST 1268
1469
1470   REP  76  LAST 1267
1471   REP   4  LAST 1267
1472
1473
1474
1475   REP   1
1476   REP   2  LAST 1268
1477   REP   6  LAST 1265
1478   REP   9  LAST 1268
1479
1480   REP   1
1481
1482   REP  77  LAST 1268
1483   REP   7  LAST 1268
1484

12,3276  50025 0          DSU   BMN     IF COGAMAX GT COGUPLIM, COGAMAX=COGUPLIM
12,3277  11524 1                COGUPLIM
12,3300  25304 1                MAXCOGA  OTHERWISE OK, SO GO TO MAXCOGA
12,3301  77745 1  UPLIM   DLOAD
12,3302  11524 1                COGUPLIM COGUPLIM=.999511597 = MAX VALUE OF COGA
12,3303  00017 1          STORE COGAMAX   NOT CAUSING OVFL IN R1A CALCULATION
12,3304  77745 1  MAXCOGA DLOAD
12,3305  02734 0                CSTH
12,3306  45261 0          SR    DSU                              PL AT 0
12,3307  20607 1                6
12,3310  77626 0          STADR
12,3311  61037 1          STODL CSTH-RHO
12,3312  02675 1                GEOMSGN
12,3313  71240 1          BMN   DLOAD
12,3314  25505 0                LOLIM
12,3315  02740 0                CSTH-RHO
12,3316  56352 0          SL1   DDV
12,3317  02732 0                SNTH
12,3320  77600 1          BOV
12,3321  25505 0                LOLIM
12,3322  00011 1  MINCOGA STORE COGAMIN  COGAMIN (+5)
12,3323  66214 0          BON   SSP
12,3324  00715 1                GUESSW
12,3325  25471 1                NOGUESS
12,3326  00051 0                TWEEKIT
12,3327  00001 0                00001
12,3330  77745 1          DLOAD
12,3331  03775 1                COGA
12,3332  77605 1  LAMBLOOP DMP
12,3333  02732 0                SNTH
12,3334  45342 0          SR1   DSU
12,3335  02740 0                CSTH-RHO
12,3336  65301 0          NORM  PDDL    0D=SNTH COGA-(CSTH-RHO) (+7+C(X1)) PL=2
12,3337  00047 1                X1
12,3340  02736 1                1-CSTH
12,3341  56257 1          SL*   DDV     1-CSTH (+2)                  PL AT 0
12,3342  20170 0                0 -9D,1
12,3343  53040 0          BMN   BZE
12,3344  25421 1                NEGP
12,3345  25421 1                NEGP
12,3346  16742 1          STODL P       P=(1-CSTH)/(SNTH COGA-(CSTH-RHO)) (+4)
12,3347  03775 1                COGA
12,3350  43316 1          DSQ   DAD
12,3351  11510 0                D1/1024
12,3352  41301 0          NORM  DMP
12,3353  00047 1                X1
12,3354  02742 1                P
12,3355  44257 1          SR*   BDSU
```

```
1485                        12,3356  20571 0                  0 -8D,1
1486  REF   5  LAST 1265   12,3357  11506 1                  D1/32
1487  REF  10  LAST 1266   12,3360  16744 1          STODL   R1A          R1A=2-P(1+COGA COGA) (+6)

1488  REF   8  LAST 1268   12,3361  02742 1                  P
1489                        12,3362  45000 0          BOV     CALL
1490  REF   1               12,3363  25424 1                  HIENERGY
1491  REF   2  LAST 1260   12,3364  24772 0                  GETX
1492                        12,3365  77745 1          DLOAD
1493  REF  17  LAST 1258   12,3366  00037 0                  T
1494  REF   1               12,3367  16764 0          STODL   TPREV
1495  REF   7  LAST 1264   12,3370  00031 0                  XI
1496                        12,3371  45014 0          BON     CALL
1497  REF   5  LAST 1266   12,3372  04310 1                  INFINFLG
1498  REF   3  LAST 1268   12,3373  25421 1                  NEGP         HAVE EXCEEDED THEORETICAL BOUNDS
1499  REF   3  LAST 1260   12,3374  24426 1                  DELTIME
1500                        12,3375  44200 0          BOV     BDSU
1501  REF   1               12,3376  25441 1                  BIGTIME
1502  REF   4  LAST 1267   12,3377  02673 1                  TDESIRED
1503  REF   1               12,3400  02762 0          STORE   TERRLAMB
1504                        12,3401  44246 1          ABS     BDSU
1505  REF   2  LAST 1267   12,3402  03777 0                  EPSILONL
1506                        12,3403  47044 1          BPL     RTB
1507  REF   1               12,3404  25510 1                  INITV
1508  REF   2  LAST 1250   12,3405  24651 0                  CHECKCTR
1509                        12,3406  45030 0          BHIZ    CALL
1510  REF   1               12,3407  25452 0                  SUFFCHEK
1511  REF   1               12,3410  24543 0                  ITERATOR
1512                        12,3411  53145 1          DLOAD   BZE
1513  REF 652  LAST 1263   12,3412  00155 0                  MPAC
1514  REF   2  LAST 1269   12,3413  25452 0                  SUFFCHEK
1515                        12,3414  77615 0          DAD
1516  REF  10  LAST 1268   12,3415  03775 1                  COGA
1517  REF  11  LAST 1269   12,3416  03775 1          STORE   COGA
1518                        12,3417  77650 1          GOTO
1519  REF   1               12,3420  25332 1                  LAMBLOOP
1520                        12,3421  51145 0  NEGP    DLOAD   BPL          IMPOSSIBLE TRAJECTORY DUE TO INACCURATE
1521  REF   1               12,3422  00015 0                  DCOGA        BOUND CALCULATION. TRY NEW COGA.
1522  REF   1               12,3423  25444 1                  LOENERGY
1523                        12,3424  71201 1  HIENERGY SETPD  DLOAD        HIGH ENERGY TRAJECTORY RESULTED
1524                        12,3425  00001 0                  0
1525  REF  12  LAST 1269   12,3426  03775 1                  COGA         IN OVFL OF P OR R1A, OR XI EXCEEDING 50.
1526  REF   2  LAST 1268   12,3427  00011 1          STORE   COGAMIN      THIS IS THE NEW BOUND.
1527                        12,3430  70545 1  COMMONLM DLOAD  SR1
1528  REF   2  LAST 1269   12,3431  00015 0                  DCOGA
1529  REF   3  LAST 1269   12,3432  00015 0          STORE   DCOGA        USE DCOGA/2 AS DECREMENT
```

L CONIC SUBROUTINES


```
1530
15301  REP  3  LAST 1269      12,3433  44254 1                BZE   BDSU
1531   REP 13  LAST 1269      12,3434  25452 0                      SUPPCHEK
1532   REP 14  LAST 1270      12,3435  03775 1                      COGA
1533                           12,3436  03775 1          STORE COGA
1534   REP  2  LAST 1269      12,3437  77650 1          GOTO
1535                           12,3440  25332 1                      LAMBLOOP
1536   REP  2  LAST 1269      12,3441  77745 1  BIGTIME DLOAD
1537   REP 18  LAST 1269      12,3442  02764 0                      TPREV
1538                           12,3443  00037 0          STORE T
1539                           12,3444  71201 1  LOENERGY SETPD DLOAD
1540   REP 15  LAST 1270      12,3445  00001 0                      0
1541   REP  3  LAST 1268      12,3446  03775 1                      COGA
1542                           12,3447  00017 1          STORE COGAMAX
1543   REP  1                  12,3450  77650 1          GOTO
1544                           12,3451  25430 1                      COMMONLM
1545   REP  2  LAST 1269      12,3452  51545 1  SUPPCHEK DLOAD ABS
1546                           12,3453  02762 0                      TERMLAMB
1547   REP  5  LAST 1269      12,3454  41325 0          PDDL  DMP
1548   REP  4  LAST 1267      12,3455  02873 1                      TDESIRED
1549                           12,3456  11502 0                      D1/4
1550   REP  1                  12,3457  45215 0          DAD   DSU
1551                           12,3460  11522 1                      ONEBIT
1552   REP  2  LAST 1269      12,3461  43044 0          BPL   SETGO
1553   REP  1                  12,3462  25510 1                      INITV
1554   REP  6  LAST 1267      12,3463  02434 0                      SOLNSW
1555                           12,3464  02712 1                      RTNLAMB
1556                           12,3465  43001 1  360LAMB SETPD SETGO
1557   REP  2  LAST 1270      12,3466  00001 0                      0
1558   REP  7  LAST 1270      12,3467  02434 0                      SOLNSW
1559                           12,3470  02712 1                      RTNLAMB
1560   REP  4  LAST 1268      12,3471  71331 0  NOGUESS SSP   DLOAD
1561                           12,3472  00051 0                      TWOPKIT
1562   REP  3  LAST 1269      12,3473  10000 0                      20000
1563                           12,3474  00011 1                      COGAMIN
1564   REP  4  LAST 1270      12,3475  65342 1          SR1   PDDL
1565                           12,3476  00017 1                      COGAMAX
1566                           12,3477  43342 0          SR1   DAD
1567   REP 16  LAST 1270      12,3500  77626 0          STADR
1568   REP  4  LAST 1269      12,3501  74002 0          STORE COGA
                               12,3502  00015 0          STORE DCOGA
```

RESTART THIS LOOP

LOW ENERGY TRAJECTORY RESULTED

IN OVERFLOW OF TIME.
THIS IS THE NEW BOUND.

PL AT 2D

PL AT 0D

LAMBERT CANNOT HANDLE CSTH=1

PL AT 2

PL AT 0

```
1569                          12,3503  77650 1          GOTO
1570  REF  3  LAST 1270       12,3504  25332 1                LAMBLOOP
1574                          12,3505  52145 0  LOLIM   DLOAD  GOTO
1575  REF  1                  12,3506  11526 0                COGLOLIM      COGLOLIM=-.999511597
1576  REF  1                  12,3507  25322 0                MINCOGA
1577                          12,3510  60345 0  INITV   DLOAD  NORM
1578  REF 13  LAST 1267       12,3511  00041 1                R1
1579  REF 78  LAST 1268       12,3512  00047 1                X1
1580                          12,3513  70525 1          PDDL  SR1                                   PL AT 2
1581  REF  9  LAST 1269       12,3514  02742 1                P
1582                          12,3515  77671 1          DDV                                         PL AT 0
1583                          12,3516  75457 0          SL*   SQRT
1584                          12,3517  20175 0                0 -4,1
1585                          12,3520  72405 0          DMP   SL1
1586  REF  3  LAST 1258       12,3521  00021 1                ROOTMU
1587                          12,3522  41206 0          PUSH  DMP     0D=VTAN (+7)                  PL AT 2
1588  REF 17  LAST 1270       12,3523  03775 1                COGA
1589                          12,3524  74261 1          SL    VXSC
1590                          12,3525  20206 1                5
1591  REF  7  LAST 1262       12,3526  02724 1                UR1
1592                          12,3527  77725 1          PDDL  XCH WITH 0D                           PL AT 0,6
1593                          12,3530  76561 1          VXSC  VSL1
1594  REF  5  LAST 1262       12,3531  02676 1                UN
1595                          12,3532  53235 0          VXV   VAD                                   PL AT 0
1596  REF  8  LAST 1271       12,3533  02724 1                UR1
1597                          12,3534  43172 1          VSL1  CLEAR
1598  REF  3  LAST 1270       12,3535  02674 0                SOLNSW
1599  REF 18  LAST 1260       12,3536  02746 0          STORE VVEC
1600                          12,3537  53135 0          SLOAD BZE
1601  REF  5  LAST  482       12,3540  02704 0                VTARGTAG
1602  REF  1                  12,3541  25544 0                TARGETV
1603                          12,3542  77650 1          GOTO
1604  REF  8  LAST 1270       12,3543  02712 1                RTNLAMB
1605                          12,3544  45145 0  TARGETV DLOAD  CALL
1606  REF  6  LAST 1267       12,3545  02722 1                MAGVEC2
1607  REF  1                  12,3546  24706 0                LAMENTER
1608  REF  4  LAST  482       12,3547  02705 1          STORE VTARGET
1609                          12,3550  77650 1          GOTO
1610  REF  9  LAST 1271       12,3551  02712 1                RTNLAMB
```

```
1611                                12,3552  40220 0  TIMERAD  STQ     SETPD                                  PL AT 0
1612  REP   1                      12,3553  02712 1                   RTNTR
1613                                12,3554  00001 0                   0
1614                                12,3555  63375 0           VLOAD   PDVL                                   PL AT 6
1615  REP  12  LAST 1260           12,3556  02657 1                   RVEC
1616  REP  19  LAST 1271           12,3557  02746 0                   VVEC
1617                                12,3560  77624 1           CALL
1618  REP   3  LAST 1260           12,3561  11527 1                   PARAM
1619                                12,3562  71200 0           BOV     DLOAD                                  PL AT 0
1620  REP   2  LAST 1260           12,3563  24767 1                   COGAOVPL
1621  REP   6  LAST 1269           12,3564  11506 1                   D1/32
1622                                12,3565  41225 1           DSU     DMP
1623  REP  11  LAST 1269           12,3566  02744 1                   R1A
1624  REP  10  LAST 1271           12,3567  02742 1                   P
1625                                12,3570  41366 1           SQRT    DMP
1626  REP  18  LAST 1271           12,3571  03775 1                   COGA
1627                                12,3572  74212 0           SL4     VXSC
1628  REP   5  LAST 1262           12,3573  02714 1                   U2
1629                                12,3574  45325 1           PDDL    DSU                                    PL AT 6
1630  REP   4  LAST 1264           12,3575  11500 1                   D1/64
1631  REP  12  LAST 1272           12,3576  02744 1                   R1A
1632                                12,3577  52361 1           VXSC    VSU                                    PL AT 0
1633  REP   9  LAST 1271           12,3600  02724 1                   UR1
1634                                12,3601  53512 1           VSL4    UNIT
16345                               12,3602  77600 1           BOV
16346 REP   2  LAST 1267           12,3603  25465 1                   360LAMB      NO SOLUTION SINCE CONIC IS A CIRCLE
1635                                12,3604  60325 0           PDDL    NORM         0D=UNIT(ECC) (+3)          PL AT 6
1636  REP   5  LAST  863           12,3605  02760 1                   RDESIRED     36D=ECC (+3)
1637  REP  79  LAST 1271           12,3606  00047 1                   X1
1638                                12,3607  41325 0           PDDL    DMP                                    PL AT 8
1639  REP  14  LAST 1271           12,3610  00041 1                   R1
1640  REP  11  LAST 1272           12,3611  02742 1                   P
1641                                12,3612  56257 1           SL*     DDV                                    PL AT 6
1642                                12,3613  20201 0                   0,1
1643                                12,3614  56225 1           DSU     DDV
1644  REP   2  LAST 1265           12,3615  11504 0                   D1/16
1645                                12,3616  00045 0                   36D          36D=ECC (+3)
1646  REP   1                      12,3617  00031 0           STORE   COSF
1647                                12,3620  63400 0           BOV     DSQ
1648  REP   1                      12,3621  25661 1                   BADR2
1649                                12,3622  50021 1           BDSU    BMN
1650  REP   5  LAST 1270           12,3623  11502 0                   D1/4
16505 REP   2  LAST 1272           12,3624  25661 1                   BADR2
1651                                12,3625  75366 0           SQRT    SIGN
1652  REP   4  LAST  863           12,3626  02757 0                   SGNRDOT
16525                               12,3627  77614 1           CLEAR
1653  REP   1                      12,3630  04272 1                   APSESW

1654                                12,3631  76561 1  TERMNVEC VXSC    VSL1
1655  REP   6  LAST 1271           12,3632  02676 1                   UN
```

```
1656                        12,3633  63235 0          VXV   PDVL    VXCH WITH 0D                  PL AT 0,6
1657                        12,3634  00001 0                0D
1658                        12,3635  53361 0          VXSC  VAD                                  PL AT 0
1659  REP  2  LAST 1272    12,3636  00031 0                COSP
1660                        12,3637  41572 1          VSL1  PUSH    0D=U2                        PL AT 6

1661                        12,3640  56241 0          DOT   DDV     LIMITS RESULT TO POSMAX OR NEGMAX
1662  REP 10  LAST 1272    12,3641  02724 1                UR1
16622 REP  1                12,3642  23701 0                DP1/4
16624                       12,3643  40142 1          SR1   BOV     SCALE BACK DOWN TO NORMAL
16625                       12,3644  25645 1                +1      CLEAR OVFIND IF SET
1663  REP 13  LAST 1268    12,3645  26734 0          STOVL CSTH    CSTH (+1)
1664  REP 11  LAST 1273    12,3646  02724 1                UR1
1665                        12,3647  76435 1          VXV   VSL1
1666                        12,3650  72441 0          DOT   SL1
1667  REP  7  LAST 1272    12,3651  02676 1                UN
1668  REP 18  LAST 1268    12,3652  16732 0          STODL SNTH    SNTH (+1)
1669  REP 12  LAST 1272    12,3653  02742 1                P
1670                        12,3654  77624 1          CALL
1671  REP  3  LAST 1269    12,3655  24772 0                GETX
1672                        12,3656  77614 1          CLRGO
16725 REP  4  LAST 1271    12,3657  02634 1                SOLNSW
1673  REP  1                12,3660  24752 1                COMMNOUT
1674                        12,3661  75345 1 BADR2    DLOAD SIGN
16741 REP  2  LAST  676    12,3662  11454 1                LODPHALF
16742 REP  3  LAST 1273    12,3663  00031 0                COSP
16743 REP  4  LAST 1273    12,3664  14031 0          STODL COSP
1675  REP  4  LAST 1251    12,3665  11456 0                KEPZERO
16755                       12,3666  77614 1          SETGO
1676  REP  2  LAST 1272    12,3667  04032 1                APSESW
1677  REP  1                12,3670  25631 1                TERMNVEC
1678                        12,3671  40220 0 APSIDES  STQ   SETPD                               PL AT 0
1679  REP  1                12,3672  02712 1                RTNAPSE
1680                        12,3673  00001 0                0D
1681                        12,3674  63375 0          VLOAD PDVL                                 PL AT 6
1682  REP 13  LAST 1272    12,3675  02657 1                RVEC
1683  REP 20  LAST 1272    12,3676  02746 0                VVEC
1684                        12,3677  77624 1          CALL
1685  REP  4  LAST 1272    12,3700  11527 1                PARAM
1686                        12,3701  77600 1          BOV                                        PL AT 0
1687  REP  1                12,3702  25703 1                GETECC
1688                        12,3703  42405 0 GETECC   DMP   SL4
1689  REP 13  LAST 1272    12,3704  02744 1                R1A
1690                        12,3705  75421 1          BDSU  SQRT
1691  REP  5  LAST 1272    12,3706  11500 1                D1/64
1692  REP  2  LAST   94     12,3707  02754 0          STORE ECC
1693                        12,3710  65215 1          DAD   PDDL                                 PL AT 2
1694  REP  1                12,3711  11474 0                D1/8
```

46_8	add	2-1ws	1-1ws	Stop
38	25	13	5	4
	25	18		4
	18			

```
1695  REF  15  LAST 1272   12,3712  00041 1                 R1
1696                       12,3713  72405 0          DMP    SL1
1697  REF  13  LAST 1273   12,3714  02742 1                 P
1698                       12,3715  77671 1          DDV
1699                       12,3716  60325 0          PDDL   NORM      0D=RP (+29 OR +27)          PL AT 0
1700  REF  14  LAST 1273   12,3717  02744 1                 R1A                                   PL AT 2
1701  REF  80  LAST 1272   12,3720  00047 1                 X1
1702                       12,3721  53725 1          PDDL   SL*                                   PL AT 4
1703  REF  16  LAST 1274   12,3722  00041 1                 R1
1704                       12,3723  20174 1                 0 -5,1
1705                       12,3724  45271 1          DDV    DSU                                   PL AT 2,0
1706                       12,3725  50000 1          BOV    BMN
1707  REF   1              12,3726  25732 0                 INFINAPO
1708  REF   2  LAST 1274   12,3727  25732 0                 INFINAPO
1709                       12,3730  77650 1          GOTO
1710  REF   2  LAST 1273   12,3731  02712 1                 RTNAPSE
1711                       12,3732  52145 0  INFINAPO DLOAD  GOTO      RETURNS WITH APOAPSIS IN MPAC,PERIAPSIS
1712  REF   1              12,3733  11467 1                 LDPOSMAX
1713  REF   3  LAST 1274   12,3734  02712 1                 RTNAPSE   THAT PL IS AT 0.
```

L CONIC SUBROUTINES USER=S PAGE NO. 44 E5 S3

```
1714  REF  3  LAST 1261   04,2000                    SETLOC CONICS1
1715                      04,3630                    BANK

1716  REF  3 LAST 1261 TO 1263'    65    94*        COUNT  04/CONIC

1717                      04,3630   22437 1  MUTABLE  2DEC*  3.986032 E10 B-36*     MUE
1717                      04,3631   16087 1
1718                      04,3632   15625 1          2DEC*  .25087606 E-10 B+34*   1/MUE
1718                      04,3633   21042 1
1719                      04,3634   30276 1          2DEC*  1.99650495 E5 B-18*    SQRT(MUE)
1719                      04,3635   04773 0
1720                      04,3636   25004 1          2DEC*  .50087529 E-5 B+17*    1/SQRT(MUE)
1720                      04,3637   06702 1

1721                      04,3640   16471 1          2DEC   4.902778 E8 B-30        MUM
1721                      04,3641   01352 1
1722                      04,3642   21412 0          2DEC   .203966 E-8 B+28       1/MUM
1722                      04,3643   20500 0
1723                      04,3644   25477 1          2DEC*  2.21422176 E4 B-15*    SQRT(MUM)
1723                      04,3645   03387 0
1724                      04,3646   27533 1          2DEC*  .45162595 E-4 B+14*    1/SQRT(MUM)
1724                      04,3647   07571 0
1725  REF  2  LAST  495   04,3466          LDPOSMAX EQUALS LCDPMAX        DPPOSMAX IN LOW MEMORY.

R1727  ERASABLE ASSIGNMENTS
R1728  KEPLER SUBROUTINE

R1729     INPUT -
R1730  RRECT    ERASE  +5
R1731  VRECT    ERASE  +5
R1732  TAU.     ERASE  +1
R1733  XKEP     ERASE  +1
R1734  TC       ERASE  +1
R1735  XPREV    ERASE  +1
 1736                          0016          1/MU     EQUALS 14D
 1737                          0020          ROOTMU   EQUALS 16D
 1738                          0022          1/ROOTMU EQUALS 18D
R1739     OUTPUT -
R1740  RCV      ERASE  +5
R1741  VCV      ERASE  +5
R1742  RC       ERASE  +1
R1743  XPREV    ERASE  +1

R1744  DEBRIS -
 1745                          0010          ALPHA    EQUALS 8D
 1746                          0012          XMAX     EQUALS 10D
```

```
 1747                                   0014          XMIN    EQUALS 12D
 1748                                   0024          X       EQUALS 20D
 1749                                   0030          XI      EQUALS 24D
 1750                                   0032          S(XI)   EQUALS 26D
 1751                                   0034          XSQC(XI) EQUALS 28D
 1752                                   0036          T       EQUALS 30D
 1753                                   0040          R1      EQUALS 32D
 1754                                   0042          KEPC1   EQUALS 34D
 1755                                   0044          KEPC2   EQUALS 36D
R1756  DELX      ERASE  +1
R1757  DELT      ERASE  +1
R1758  URRECT    ERASE  +5
R1759  RCNORM    ERASE  +1
R1760  XPREV     EQUALS XKEP
R1761  LAMBERT SUBROUTINE

R1762     INPUT-
R1763  R1VEC     ERASE  +5
R1764  R2VEC     ERASE  +5
R1765  TDESIRED  ERASE  +1
R1766  GEOMSGN   ERASE  +0
R1767  GUESSW
R1768  COGA      ERASE  +1          0 IF COGA GUESS AVAILABLE, 1 IF NOT
                                    INPUT ONLY IF GUESSW IS ZERO.
R1769  NORMSW                      0 IF UN TO BE COMPUTED, 1 IF UN INPUT
R1770  UN        ERASE  +5          ONLY USED IF NORMSW IS 1
R1771  VTARGTAG  ERASE  +0
R1772  TWEAKIT   EQUALS 40D        ONLY USED IF GUESSW IS 0

R1773     OUTPUT -
R1774  VTARGET   ERASE  +5         AVAILABLE ONLY IF VTARGTAG IS ZERO.
R1775  V1VEC     EQUALS MPAC

R1776     DEBRIS -
R1777  RTNLAMB   ERASE  +0
R1778  U2        ERASE  +5
R1779  MAGVEC2   ERASE  +1
R1780  UR1       ERASE  +5
R1781  R1        EQUALS 31D
R1782  UN        ERASE  +5
R1783  SNTH      ERASE  +1
R1784  CSTH      ERASE  +1
R1785  1-CSTH    ERASE  +1
R1786  CSTH-RHO  ERASE  +1
 1787                                  0016          COGAMAX EQUALS 14D      CLOBBERS 1/MU
 1788                                  0010          COGAMIN EQUALS 8D
 1789                                  0014          DCOGA   EQUALS 12D
R1790  TWEAKIT   EQUALS 40D
R1791  P         ERASE  +1
```

L CONIC SUBROUTINES USER=S PAGE NO. 46 E5 S3

```
R1792   COGA        ERASE  +1
R1793   R1A         ERASE  +1
R1794   X           EQUALS 20D
R1795   XSQ         EQUALS 22D
R1796   XI          EQUALS 24D
R1797   S(XI)       EQUALS 26D
R1798   XSQC(XI)    EQUALS 28D
R1799   T           EQUALS 30D
R1800   KEPC1       EQUALS 34D
R1801   KEPC2       EQUALS 36D
R1802   SLOPESW
R1803   SOLNSW
R1804   OTHERS -

R1805   RVEC        EQUALS R1VEC
R1806   VVEC        ERASE  +5
R1807   COGAFLAG
R1808   RVSW
R1809   INFINFLG
R1810   APSESW
R1811   360SW
R1812   RINTT       EQUALS RINLAMB
R1813   ECC         ERASE  +1
R1814   RINTR       EQUALS RINLAMB
R1815   RINAPSE     EQUALS RINLAMB
R1816   R2          EQUALS MAGVEC2
 1817                       0030          COSP      EQUALS 24D
R1818   RINPRM      ERASE  +0
R1819   SGNRDOT     ERASE  +0
R1820   RDESIRED    ERASE  +1
R1821   ITERATOR SUBROUTINE

R1822   ORDERSW
 1823                       0016          MAX       EQUALS 14D        CLOBBERS 1/MU
 1824                       0010          MIN       EQUALS 8D
R1825   INDEP       ERASE  +1
 1826                       0014          DELINDEP  EQUALS 12D
 1827                       0026          ITERCTR   EQUALS 22D
 1828                       0036          DEP       EQUALS 30D
R1829   DELDEP      ERASE  +1
R1830   DEPREV      ERASE  +1
 1831                       0050          TWEAKIT   EQUALS 40D
R1832   MORE KEPLER

R1833   EPSILONT    ERASE  +1
```

```
R1834   MORE LAMBERT

R1835   TERRLAMB EQUALS DELDEP
R1836   TPREV    EQUALS DEPREV
R1837   EPSILONL EQUALS EPSILONT +2     DOUBLE PRECISION WORD
```

L INTEGRATION INITIALIZATION USER=S PAGE NO. 1 E0 S3

R0006 1.0 INTRODUCTION
R0007 ----------
R0008
R0009 FROM A USERS POINT OF VIEW, ORBITAL INTEGRATION IS ESSENTIALLY THE SAME AS THE 278 INTEGRATION
R0011 PROGRAM. THE SAME ENTRANCES TO THE PROGRAM WILL BE MAINTAINED, THE SAME STALLING ROUTINE WILL BE USED AND
R0013 OUTPUT WILL STILL BE VIA THE PUSHLIST. THE PRIMARY DIFFERENCES TO A USER INVOLVE THE ADDED CAPABILITY OF
R0015 TERMINATING INTEGRATION AT A SPECIFIC FINAL RADIUS AND THE DIFFERENCE IN STATE VECTOR SCALING INSIDE AND OUT-
R0017 SIDE THE LUNAR SPHERE OF INFLUENCE.
R0018
R0019 IN ORDER TO MAKE THE CSM(LEM)PREC AND CSM(LEM)CONIC ENTRANCES SIMILAR TO FLIGHT 278, THE INTEGRATION PROGRAM
R0021 WILL ITSELF SET THE FINAL RADIUS (RFINAL) TO 0 SO THAT REACHING THE DESIRED TIME ONLY WILL TERMINATE
R0023 INTEGRATION. THE DP REGISTER RFINAL MUST BE SET BY USERS OF INTEGRVS AND INTEGRV, AND MUST BE DONE AFTER THE
R0025 CALL TO INTSTALL.
R0026
R0027 WHEN THE LM IS ON THE LUNAR SURFACE (INDICATED BY LUNAR SURFACE FLAG SET) CALLS TO LEMCONIC, LEMPREC, AND
R0029 INTEGRV WITH VINFLAG = 0 WILL RESULT IN THE USE OF THE PLANETARY INERTIAL ORIENTATION SUBROUTINES TO PROVIDE
R0031 BOTH THE LMS POSITION AND VELOCITY IN THE REFERENCE COORDINATE SYSTEM.
R0032 THE PROGRAM WILL PROVIDE OUTPUT AS IF INTEGRATION WAS USED. THAT IS, THE PUSHLIST WILL BE SET AS NOTED BELOW AND
R0034 THE PERMANENT STATE VECTOR UPDATED WHEN SPECIFIED BY AN INTEGRV CALL.
R0035
R0036 USERS OF INTEGRVS DESIRING INTEGRATION (INTYPFLG = 0) SHOULD NOTE THAT THE OBLATENESS PERTURBATION COMPUTATION
R0038 IN LUNAR ORBIT IS TIME DEPENDENT. THEREFORE, THE USER SHOULD SUPPLY AN INITIAL STATE VECTOR VALID AT SOME REAL
R0040 TIME AND THE DESIRED TIME (TDEC1) ALSO AT SOME REAL TIME. FOR CONIC ,,INTEGRATION,, THE USER MAY STILL USE ZERO
R0042 AS THE INITIAL TIME AND DELTA TIME AS THE DESIRED TIME.
R0043
R0044 2.0 GENERAL DESCRIPTION
R0045 ----------
R0046
R0047 THE INTEGRATION PROGRAM OPERATES AS A CLOSED INTERPRETIVE SUBROUTINE AND PERFORMS THESE FUNCTIONS---
R0049 1) INTEGRATES (PRECISION OR CONIC) EITHER CSM OR LM STATE VECTOR
R0050 2) INTEGRATES THE W-MATRIX
R0051 3) PERMANENT OR TEMPORARY UPDATE OF THE STATE VECTOR
R0052
R0053 THERE ARE SIX ENTRANCES TO THE INTEGRATION PROGRAM. FOUR OF THESE (CSMPREC, LEMPREC, CSMCONIC, LEMCONIC) SET
R0055 ALL THE FLAGS REQUIRED IN THE INTEGRATION PROGRAM ITSELF TO CAUSE THE PRECISION OR CONIC INTEGRATION (KEPLER) OF
R0057 THE LM OR CSM STATE VECTOR, AS THE NAMES SUGGEST. ONE ENTRANCE (INTEGRVS) PERMITS THE CALLING PROGRAM TO
R0059 PROVIDE A STATE VECTOR TO BE INTEGRATED. THE CALLING PROGRAM MUST SET THE FLAGS INDICATING (1) PRECISION OR
R0061 CONIC INTEGRATION, (2) IN OR OUT OF LUNAR SPHERE, (3) MIDCOURSE OR NOT, AND THE INTEGRATION PROGRAM COMPLETES
R0063 THE FLAG SETTING TO BYPASS W-MATRIX INTEGRATION. THE LAST ENTRANCE (INTEGRV, USED IN GENERAL BY THE
R0065 NAVIGATION PROGRAMS) PERMITS THE CALLER TO SET FIVE FLAGS (NOT MOONFLAG OR MIDFLAG) BUT NOT TO INPUT A STATE
R0067 VECTOR. ANY PROGRAM WHICH CALLS INTEGRVS OR INTEGRV MUST CALL INTSTALL BEFORE IT SETS THE INTEGRATION FLAGS
R0069 AND/OR STATE VECTOR.
R0070
R0071 THREE SETS OF 42 REGISTERS AND 2 FLAGS ARE USED FOR THE STATE VECTORS. TWO SETS, WHICH MAY NOT BE OVERLAYED, ARE
R0073 USED FOR THE PERMANENT STATE VECTORS FOR THE CSM AND LM. THE THIRD SET, WHICH MAY BE OVERLAYED WHEN INTEGRATION
R0075 IS NOT BEING DONE, IS USED IN THE COMPUTATIONS.
R0076
R0077 THE PERMANENT STATE VECTORS WILL BE PERIODICALLY UPDATED SO THAT THE VECTORS WILL NOT BE OLDER THAN 4 TIMESTEPS.
R0079 THE PERMANENT STATE VECTORS WILL ALSO BE UPDATED WHENEVER THE W-MATRIX IS INTEGRATED OR WHEN A CALLER OF INTEGRV
R0081 SETS STATEFLG (THE NAVIGATION PROGRAMS P20, P22.)

R0082 APPENDIX B OF THE USERS GUIDE LISTS THE STATE VECTOR QUANTITIES.
R0083
R0084 2.1 RESTARTS
R0085
R0086 PHASE CHANGES WILL BE MADE IN THE INTEGRATION PROGRAM ONLY FOR THE INTEGRV ENTRANCE (I.E., WHEN THE W-MATRIX IS
R0088 INTEGRATED OR PERMANENT STATE VECTOR IS UPDATED.) THE GROUP NUMBER USED WILL BE THAT FOR THE P20-25 PROGRAMS
R0090 (I.E., GROUP2) SINCE THE INTEGRV ENTRANCE WILL ONLY BE USED BY THESE PROGRAMS. IF A RESTART OCCURS DURING AN
R0092 INTEGRATION OF THE STATE VECTOR ONLY, THE RECOVERY WILL BE TO THE LAST PHASE IN THE CALLING PROGRAM. CALLING
R0094 PROGRAMS WHICH USE THE INTEGRV OR INTEGRVS ENTRANCE OF INTEGRATION SHOULD ENSURE THAT IF PHASE CHANGING IS DONE
R0096 THAT IT IS PRIOR TO SETTING THE INTEGRATION INPUTS IN THE PUSHLIST.
R0097 THIS IS BECAUSE THE PUSHLIST IS LOST DURING A RESTART.
R0098
R0099 2.2 SCALING
R0100
R0101 THE INTEGRATION ROUTINE WILL MAINTAIN THE PERMANENT MEMORY STATE VECTORS IN THE SCALING AND UNITS DEFINED IN
R0103 APPENDIX B OF THE USERS GUIDE. THE SCALING OF THE OUTPUT POSITION VECTORDEPENDS ON THE ORIGIN OF THE COORDINATE
R0105 SYSTEM AT THE DESIRED INTEGRATION TIME. THE COORDINATE SYSTEM TRANSFORMATION WILL BE DONE AUTOMATICALLY ON
R0107 MULTIPLE TIMESTEP ENCKE INTEGRATION ONLY. THUS IT IS POSSIBLE TO HAVE OUTPUT FROM SUCCESSIVE INTEGRATIONS IN
R0109 DIFFERENT SCALING.
R0110 HOWEVER, RATT, VATT WILL ALWAYS BE SCALED THE SAME.
R0111
R0112 3.0 INPUT/OUTPUT
R0113 ----------
R0114
R0115 PROGRAM INPUTS ARE THE FLAGS DESCRIBED IN APPENDIX A AND THE PERMANENT STATE VECTOR QUANTITIES DESCRIBED IN AP-
R0117 PENDIX B OF THE USERS GUIDE, PLUS THE DESIRED TIME TO INTEGRATE TO IN $TDEC_1$ (A PUSH LIST LOCATION).
R0119 FOR INTEGRVS, THE RCV,VCV, TET OF THE TEMPORARY STATE VECTOR MUST BE SET, PLUS MOONFLAG AND MIDFLAG
R0121
R0122 FOR SIMULATION THE FOLLOWING QUANTITIES MUST BE PRESET ---
R0123
R0124

			EARTH	MOON
R0125			29	27
R0126 RRECTCSM(LEM)	- RECTIFIED POSITION VECTOR	METERS	2	2
R0127				
R0128			7	5
R0129 VRECTCSM(LEM)	- RECTIFIED VELOCITY VECTOR	M/CSEC	2	2
R0130				
R0131			28	28
R0132 TETCSM(LEM)	- TIME STATE VECTOR IS VALID	CSEC	2	2
R0133	CUSTOMARILY 0, BUT NOTE LUNAR			
R0134	ORBIT DEPENDENCE ON REAL TIME.			
R0135				
R0136			22	18
R0137 DELTAVCSM(LEM)	- POSITION DEVIATION	METERS	2	2
R0138	0 IF TCCSM(LEM) = 0			
R0139				
R0140			3	-1
R0141 NUVCSM(LEM)	- VELOCITY DEVIATION	M/CSEC	2	2
R0142	0 IF TCCSM(LEM) = 0			

R0143

R0144						
R0145	RCVCSM(LEM)	- CONIC POSITION	METERS	2^{29}	2^{27}	
R0146		EQUALS RRECTCSM(LEM) IF				
R0147		TCCSM(LEM) = 0				
R0148						
R0149						
R0150	VCVCSM(LEM)	- CONIC VELOCITY	M/CSEC	2^{7}	2^{5}	
R0151		EQUALS VRECTCSM(LEM) IF				
R0152		TCCSM(LEM) = 0				
R0153						
R0154						
R0155	TCCSM(LEM)	- TIME SINCE RECTIFICATION	CSECS	2^{28}	2^{28}	
R0156		CUSTOMARILY 0				
R0157						
R0158						
R0159	XKEPCSM(LEM)	- ROOT OF KEPLERS EQUATION	$M^{1/2}$	2^{17}	2^{16}	
R0160		0 IF TCCSM(LEM) = 0				
R0161						
R0162	CMOONFLG	- PERMANENT FLAGS CORRESPONDING		0	0	
R0163	CMIDFLAG	TO MOONFLAG AND MIDFLAG		0,1	0,1	
R0164	LMOONFLG	C = CSM, L = LM		0	0	
R0165	LMIDFLG			0,1	0,1	
R0166						
R0167	SURFFLAG	- LUNAR SURFACE FLAG		0,1	0,1	
R0168						

R0169 IN ADDITION, IF (L)CMIDFLAG IS SET, THE INITIAL INPUT VALUES FOR LUNAR
R0170 SOLAR EPHEMERIDES SUBROUTINE AND PLANETARY INERTIAL ORIENTATION SUB-
R0171 ROUTINE MUST BE PRESET.
R0172
R0173 OUTPUT
R0174 AFTER EVERY CALL TO INTEGRATION

					EARTH	MOON
R0175						
R0176					2^{29}	2^{29}
R0177	0D	RATT	POSITION	METERS	2	2
R0178					2^{7}	2^{7}
R0179	6D	VATT	VELOCITY	M/CSEC	2	2
R0180					2^{28}	2^{28}
R0181	12D	TAT	TIME		2	2
R0182					2^{29}	2^{27}
R0183	14D	RATT1	POSITION	METERS	2	2
R0184					2^{7}	2^{5}
R0185	20D	VATT1	VELOCITY	M/CSEC	2	2
R0186					3^{2} 2^{36}	2^{30}
R0187	26D	MU(P)	MU	M^{3}/CS^{2}	2	2
R0188						
R0189	X1		MUTABLE ENTRY		-2	-10^{D}
R0190						
R0191	X2		COORDINT			
R0192	X2		COORDINATE SYSTEM ORIGEN		0	2
R0193			(THIS, NOT MOONFLAG, SHOULD BE			

```
R0194                  USED TO DETERMINE ORIGIN.)
R0195
R0196   IN ADDITION TO THE ABOVE, THE PERMANENT STATE VECTOR IS UPDATED WHENEVER
R0197   STATEFLG WAS SET AND WHENEVER A W-MATRIX IS TO BE INTEGRATED. THE PUSH
R0198   COUNTER IS SET TO 0 AND OVERFLOW IS CLEARED BEFORE RETURNING TO THE
R0199   CALLING PROGRAM.
R0200
R0201   4.0 CALLING SEQUENCES AND SAMPLE CODE
R0202   ------------------------------------
R0203
R0204      A) PRECISION ORBITAL INTEGRATION. CSMPREC,LEMPREC ENTRANCES
R0205           L-X     STORE TIME TO 95T5791T5 T  95 PUS  L9ST (T4531)
R0206           L       CALL
R0207           L+1             CSMPREC (OR LEMPREC)
R0208           L+2     RETURN
R0209         INPUT                                                    28
R0210           TDEC1 (PD 32D) TIME TO INTEGRATE TO...CENTISECONDS SCALED 2
R0211         OUTPUT
R0212           THE DATA LISTED IN SECTION 3.0 PLUS
R0213           ROVV    POSITION VECTOR OF VEHICLE WITH RESPECT TO SECONDARY
R0214           BODY... METERS B-29 ONLY IF MIDFLAG = DIMOFLAG = 1
R0215      B) CONIC INTEGRATION. CSMCONIC, LEMCONIC ENTRANCES
R0216           L-X     STORE TIME IN PUSH LIST (TDEC1)
R0217           L       CALL
R0218           L+1             CSMCONIC (OR LEMCONIC)
R0219         INPUT/OUTPUT
R0220           SAME AS PRECISION INTEGRATION, EXCEPT ROVV NOT SET
R0221      C) INTEGRATE GIVEN STATE VECTOR. INTEGRVS ENTRANCE
R0222                   CALL
R0223                           INTSTALL
R0224                   VLOAD
R0225                           POSITION VECTOR
R0226                   STOVL   RCV
R0227                           VELOCITY VECTOR
R0228                   STODL   VCV
R0229                           TIME STATE VECTOR VALID
R0230                   STODL   TET
R0231                           FINAL RADIUS
R0232                   STORE   RFINAL
R0233                   SET(CLEAR)  SET(CLEAR)
R0234                               INTYPFLAG
R0235                               MOONFLAG
R0236                   SET(CLEAR)  DLOAD
R0237                               DESIRED TIME
R0238                   STCALL      TDEC1
R0239                               INTEGRVS
R0240         INPUT
R0241           RCV     POSITION VECTOR                 METERS
R0242           VCV     VELOCITY VECTOR                 M/CSEC
R0243           TET     TIME OF STATE VECTOR(MAY = 0)   CSEC B-28
```

```
R0244           TDEC1  TIME TO INTEGRATE TO            CSEC B-28 (PD 32D)
R0245                  (MAY BE INCREMENT IF TET=0)
R0246       OUTPUT
R0247          SAME AS FOR PRECISION OR CONIC INTEGRATION,
R0248          DEPENDING ON INTYPFLG.
R0249     D) INTEGRATE STATE VECTOR. INTGRV ENTRANCE
R0250          L-X    STORE TIME IN PUSH LIST (TDEC1)(MAY BE DONE AFTER CALL TO INTSTALL)
R0252          L-8    CALL
R0253          L-7
R0254          L-6    SET(CLEAR) SET(CLEAR)
R0255          L-5               VINTFLAG   1=CSM, 0=LM
R0256          L-4               INTYPFLAG  1=CONIC, 0=PRECISION
R0257          L-3    SET(CLEAR) SET(CLEAR)
R0258          L-2               DIMOFLAG   1=W-MATRIX, 0=NO W-MATRIX
R0259          L-1               D6OR9FLG   1=9X9, 0=6X6
R0260          L      SET        DLOAD
R0261          L+1               STATEFLG   DESIRE PERMANENT UPDATE
R0262          L+2               FINAL RAD. OF STATE VECTOR
R0263          L+3    STCALL     RFINAL
R0264          L+4               INTGRV
R0265          L      CALL                  NORMAL USE-- WILL UPDATE STATE
R0266          L+1               INTGRV     VECTOR IF DIMOFLAG=1.(STATEFLG IS
R0267          L+2    RETURN                ALWAYS RESET IN INTEGRATION AFTER
R0268                                        IT IS USED.)
R0269       INPUT
R0270          TDEC1 (PD 32D) TIME TO INTEGRATE TO    CSEC B-28
R0271       OUTPUT
R0272          SAME AS FOR PRECISION OR CONIC INTEGRATION
R0273       THE PROGRAM WILL SET MOONFLAG, MIDFLAG DEPENDING ON
R0274       THE PERMANENT STATE VECTOR REPRESENTATION.

02741                          11,2310                          BANK   11
02742  REF   2  LAST  203      13,2000                          SETLOC INTINIT
02743                          13,2561                          BANK
02744  REF   5  LAST  207      E3,1554                          EBANK= RRECTCSM
02745  REF   2 LAST  203 TO  206'    30    30*                 COUNT  13/INTIN

02775  REF  92  LAST 1226      13,2561  0 5301 0  STATEINT TC     PHASCHNG
02776                          13,2562   00052 0            OCT    00052
02777  REF   7  LAST  261      13,2563  3 4754 0            CAF    PRIO5
02778  REF  30  LAST  779      13,2564  0 5042 1            TC     FINDVAC
02779  REF   6  LAST 1283      E3,1554                      EBANK= RRECTCSM
02780  REF   2  LAST  207      13,2565   02570 1            2CADR  STATINT1
02780                          13,2566   26063 0
02781  REF  64  LAST 1205      13,2567  0 5213 1            TC     TASKOVER
02782  REF 233  LAST 1264      13,2570  0 6006 1  STATINT1  TC     INTPRET
02783                          13,2571   47014 1            BON    RTB
02831  REF   2  LAST  261      13,2572   04712 1                   QUITFLAG
02832  REF   1                  13,2573   26630 0                   NOINT          NO STATEINT IF V96
0284   REF  26  LAST  889      13,2574   45505 0                   LOADTIME
```

L INTEGRATION INITIALIZATION

```
0286  REP  48  LAST  889   13,2575   00041 1            STORE  TDEC1
0323                       13,2576   77624 1            CALL
0324  REP  22  LAST 1226   13,2577   27371 1                   INTSTALL
0325                       13,2600   45014 0            SET    CALL
03251 REP   2  LAST  204   13,2601   01076 1                   NODOFLAG
0326  REP   2  LAST  204   13,2602   26621 0                   SETIFLGS
0327                       13,2603   77650 1            GOTO
0328  REP   1              13,2604   26000 0                   STATEUP
0356                       13,2605   00003 1  600SECS   2DEC   60000
0356                       13,2606   25140 0
0404                       13,2607   77414 0  ENDINT    CLEAR  EXIT
0405  REP   3  LAST  601   13,2610   01672 0                   STATEFLG
0408  REP  93  LAST 1283   13,2611   0 5301 0           TC     PHASCHNG
0409                       13,2612    20032 1           OCT    20032
0411                       13,2613   0 0006 1           EXTEND
0412  REP   2  LAST  207   13,2614   3 2606 0           DCA    600SECS
0413  REP   3  LAST  642   13,2615   0 5231 1           TC     LONGCALL
0414  REP   6  LAST  260   E3,1554                      EBANK= RRECTHIS
0415  REP   3  LAST  207   13,2616    02561 1           2CADR  STATEINT
0415                       13,2617    26063 0
0416  REP 108  LAST 1009   13,2620   0 5112 0           TC     ENDOFJOB
0426                       13,2621    43014 0  SETIFLGS SET    CLEAR
0427  REP   4  LAST 1284   13,2622    01472 1                   STATEFLG
0428  REP  13  LAST  868   13,2623    01673 1                   INTYPFLG
0429                       13,2624    43014 0           CLEAR  CLEAR
0430  REP  11  LAST  614   13,2625    01676 1                   DIM0FLAG
04301 REP   5  LAST  601   13,2626    01675 1                   D6OR9FLG
04302                      13,2627    77616 0           RVQ
04303                      13,2630    77776 1  NOINT    EXIT
04304 REP  94  LAST 1284   13,2631   0 5301 0           TC     PHASCHNG
04305                      13,2632    00002 0           OCT    2

04306 REP  54  LAST 1037   13,2633   0 5447 0           TC     DOWNFLAG
04307 REP   3  LAST 1283   13,2634    00221 0           ADRES  QUITFLAG

04308 REP 109  LAST 1284   13,2635   0 5112 0           TC     ENDOFJOB
```

R0431 ATOPCSM TRANSFERS RRECT TO RRECT +41 TO RRECTCSM TO RRECTCSM +41

R0432 CALLING SEQUENCE
R0433 L CALL
R0434 L+1 ATOPCSM

R0435 NORMAL EXIT AT L+2

```
0436                       13,2636   47020 0  ATOPCSM  STO    RTB
0437  REP  27  LAST 1263   13,2637    00051 0                  S2
0438  REP   3  LAST 1230   13,2640    26651 1                  MOVEACSM
0439                       13,2641    45014 0           SET    CALL
0440  REP  21  LAST  621   13,2642    04063 0                  CMOONFLG
```

L INTEGRATION INITIALIZATION USER'S PAGE NO. 7 E3 53

```
 0441   REF   3  LAST 1230   13,2643   20237 0                    SVDWN1
 0442                        13,2644   43014 0          BON       CLRGO
 0443   REF  12  LAST  869   13,2645   00303 1                    MOONFLAG
 0444   REF  28  LAST 1284   13,2646   00051 0                    S2
 0445   REF  22  LAST 1284   13,2647   04223 0                    CMOONFLG
 0446   REF  29  LAST 1285   13,2650   00051 0                    S2
 0447   REF   1              13,2651   0 3015 0  MOVEACSM TC      SETBANK
 0448   REF   2  LAST   83   13,2652   55#500 1         TS        DIFEQCNT       INITIALIZE INDEX
 0449   REF   3  LAST 1285   13,2653   51#500 0         INDEX     DIFEQCNT
 0450   REF   5  LAST 1247   13,2654   3 1502 1         CA        RRECT
 0451   REF   4  LAST 1285   13,2655   51#500 0         INDEX     DIFEQCNT
 0452   REF   7  LAST 1283   13,2656   55#554 0         TS        RRECTCSM
 0453   REF   5  LAST 1285   13,2657   11#500 1         CCS       DIFEQCNT       IS TRANSFER COMPLETE
 0454   REF   4  LAST 1284   13,2660   1 2652 0         TCF       MOVEACSM +1    NO-LOOP
 0455   REF  63  LAST 1257   13,2661   0 6030 1         TC        DANZIG         COMPLETE- RETURN
R0456   PTOACSM TRANSFERS RRECTCSM TO RRECTCSM +41 TO RRECT TO RRECT +41

R0457   CALLING SEQUENCE
R0458      L   CALL
R0459              PTOACSM

R0460   NORMAL EXIT AT L+2
 0461                        13,2662   43034 1  PTOACSM  RTB       BON
 0462   REF   2  LAST 1230   13,2663   26700 1                    MOVEPCSM
 0463   REF  23  LAST 1285   13,2664   04303 0                    CMOONFLG
 0464   REF   1              13,2665   26673 1                    SETMOON
 0465                        13,2666   66214 0  CLRMOON  CLEAR     SSP
 0466   REF  13  LAST 1285   13,2667   00263 0                    MOONFLAG
 0467   REF   4  LAST 1229   13,2670   02151 0                    PBODY
 0468                        13,2671   00000 1                    0
 0469                        13,2672   77616 0          RVQ
 0470                        13,2673   66214 0  SETMOON  SET       SSP
 0471   REF  14  LAST 1285   13,2674   00063 1                    MOONFLAG
 0472   REF   5  LAST 1285   13,2675   02151 0                    PBODY
 0473                        13,2676   00002 0                    2
 0474                        13,2677   77616 0          RVQ
 0475   REF   2  LAST 1285   13,2700   0 3015 0  MOVEPCSM TC       SETBANK
 0476   REF   6  LAST 1285   13,2701   55#500 1         TS        DIFEQCNT
 0477   REF   7  LAST 1285   13,2702   51#500 0         INDEX     DIFEQCNT
 0478   REF   8  LAST 1285   13,2703   3 1554 1         CA        RRECTCSM
 0479   REF   8  LAST 1285   13,2704   51#500 0         INDEX     DIFEQCNT
 0480   REF   6  LAST 1285   13,2705   55#502 0         TS        RRECT
 0481   REF   9  LAST 1285   13,2706   11#500 1         CCS       DIFEQCNT
 0482   REF   3  LAST 1285   13,2707   1 2701 1         TCF       MOVEPCSM +1
 0483   REF  64  LAST 1285   13,2710   0 6030 1         TC        DANZIG
R0484   ATOPLEM  TRANSFERS RRECT TO RRECT +41 TO RRECTLEM TO RRECTLEM +41
```

```
0485                          13,2711   47020 0  ATOPLEM  STQ     RTB
0486  REP  30 LAST 1285      13,2712   00051 0            S2
0487  REP   2 LAST 1229      13,2713   26724 1            MOVEALEM
0488                          13,2714   45014 0     SET    CALL
0489  REP   3 LAST  578      13,2715   04064 1            LMOONFLG
0490  REP   3 LAST 1229      13,2716   20263 1            SVDWN2
0491                          13,2717   43014 0     BON    CLRGO
0492  REP  15 LAST 1285      13,2720   00303 1            MOONFLAG
0493  REP  31 LAST 1286      13,2721   00051 0            S2
0494  REP   4 LAST 1286      13,2722   04224 1            LMOONFLG
0495  REP  32 LAST 1286      13,2723   00051 0            S2
0496  REP   3 LAST 1285      13,2724   0 3015 0 MOVEALEM  TC      SETBANK
0497  REP  10 LAST 1285      13,2725   55∝500 1           TS      DIFEQCNT
0498  REP  11 LAST 1286      13,2726   51∝500 0           INDEX   DIFEQCNT
0499  REP   7 LAST 1285      13,2727   3 1502 1           CA      RRECT
0500  REP  12 LAST 1286      13,2730   51∝500 0           INDEX   DIFEQCNT
0501  REP   2 LAST   84      13,2731   55∝626 0           TS      RRECTLEM
0502  REP  13 LAST 1286      13,2732   11∝500 1           CCS     DIFEQCNT
0503  REP   3 LAST 1286      13,2733   1 2725 1           TCF     MOVEALEM +1
0504  REP  65 LAST 1285      13,2734   0 6030 1           TC      DANZIG
R0505 PTOALEM TRANSFERS RRECTLEM TO RRECTLEM +41 TO RRECT TO RRECT +41

0506                          13,2735   47014 1  PTOALEM  BON     RTB
0507  REP   4 LAST  261      13,2736   04307 1            SURFFLAG
0508  REP   1                13,2737   26756 1            USEPIOS
0509  REP   2 LAST 1229      13,2740   26745 0            MOVEPLEM
0510                          13,2741   52014 0     BON    GOTO
0511  REP   5 LAST 1286      13,2742   04304 1            LMOONFLG
0512  REP   2 LAST 1285      13,2743   26673 1            SETMOON
0513  REP   1                13,2744   26666 0            CLRMOON
0514  REP   4 LAST 1286      13,2745   0 3015 0 MOVEPLEM  TC      SETBANK
0515  REP  14 LAST 1286      13,2746   55∝500 1           TS      DIFEQCNT
0516  REP  15 LAST 1286      13,2747   51∝500 0           INDEX   DIFEQCNT
0517  REP   3 LAST 1286      13,2750   3 1626 1           CA      RRECTLEM
0518  REP  16 LAST 1286      13,2751   51∝500 0           INDEX   DIFEQCNT
0519  REP   8 LAST 1286      13,2752   55∝502 0           TS      RRECT
0520  REP  17 LAST 1286      13,2753   11∝500 1           CCS     DIFEQCNT
0521  REP   3 LAST 1286      13,2754   1 2746 1           TCF     MOVEPLEM +1
0522  REP  66 LAST 1286      13,2755   0 6030 1           TC      DANZIG
0523                          13,2756   77201 1  USEPIOS  SETPD   VLOAD
0524                          13,2757   00001 0            0
0525  REP  10 LAST 1212      13,2760   02026 1            RLS
0526                          13,2761   41525 0     PDDL   PUSH
0527  REP  49 LAST 1284      13,2762   00041 1            TDEC1
0528  REP  12 LAST  868      13,2763   15517 0     STODL  TET
0529  REP   1                13,2764   27756 0            5/8
```

L INTEGRATION INITIALIZATION USER=S PAGE NO. 9 E3 S3

```
0530                          13,2765   77624 1          CALL
0531  REP   8 LAST 1208      13,2766   55341 1                RP-TO-R
0532  REP  15 LAST 1252      13,2767   25535 0          STOVL RCV
0533  REP   2 LAST   32      13,2770   11450 0                ZUNIT
0534                          13,2771   14001 0          STODL 0D
0535  REP  13 LAST 1286      13,2772   01517 0                TET
0536                          13,2773   14007 0          STODL 6D
0537  REP   2 LAST 1286      13,2774   27756 0                5/8
0538                          13,2775   45014 0          SET   CALL          NEEDED FOR SETTING X1 ON EXIT
05381 REP  16 LAST 1286      13,2776   00063 1                MOONFLAG
0539  REP   9 LAST 1287      13,2777   55341 1                RP-TO-R
0540                          13,3000   74235 0          VXV   VXSC
0541  REP  16 LAST 1287      13,3001   01535 0                RCV
0542  REP   1                13,3002   27014 1                OMEGMOON
0543  REP  14 LAST 1252      13,3003   25543 1          STOVL VCV
0544  REP   8 LAST 1208      13,3004   11456 0                ZEROVEC
0545  REP   6 LAST 1229      13,3005   01521 0          STORE TDELTAV
0546                          13,3006   67174 1          AXT,2 SXA,2
0547                          13,3007   00002 0                2
0548  REP   6 LAST 1285      13,3010   02150 1                PBODY
0549  REP   6 LAST 1229      13,3011   35527 1          STCALL TNUV
0550  REP   1                13,3012   27136 0                A-PCHK
0551                          13,3013   07112 1 OMEGMOON 2DEC* 2.66169947 E-8 B+23*
0551                          13,3014   06620 0
0552  REP   1                13,3015   3 3021 1 SETBANK CAF   INTBANK
0553  REP  30 LAST 1202      13,3016   54 006 0         TS    BBANK
0554  REP   1                13,3017   3 3436 0         CAF   FORTYONE
0555  REP 302 LAST 1204      13,3020   0 0002 0         TC    Q
0556  REP   9 LAST 1285      E3,1554                    EBANK= RRECTCSM
0557  REP  10 LAST  614      13,3021   26063 0 INTBANK  BBCON INTEGRV
```

R0558 SPECIAL PURPOSE ENTRIES TO ORBITAL INTEGRATION. THESE ROUTINES PROVIDE ENTRANCES TO INTEGRATION WITH
R0560 APPROPRIATE SWITCHES SET OR CLEARED FOR THE DESIRED INTEGRATION.

R0561 CSMPREC AND LEMPREC PERFORM ORBIT INTEGRATION BY THE ENCKE METHOD TO THE TIME INDICATED IN TDEC1
R0563 ACCELERATIONS DUE TO OBLATENESS ARE INCLUDED. NO W-MATRIX INT. IS DONE.
R0564 THE PERMANENT STATE VECTOR IS NOT UPDATED.
R0565 CSMCONIC AND LEMCONIC PERFORM ORBIT INTEG. BY KEPLERS METHOD TO THE TIME INDICATED IN TDEC1
R0567 NO DISTURBING ACCELERATIONS ARE INCLUDED. IN THE PROGRAM FLOW THE GIVEN
R0568 STATE VECTOR IS RECTIFIED BEFORE SOLUTION OF KEPLERS EQUATION

R0569 THE ROUTINES ASSUME THAT THE CSM (LEM) STATE VECTOR IN P-MEM IS VALID.
R0570 SWITCHES SET PRIOR TO ENTRY TO THE MAIN INTEG. PROG ARE AS FOLLOWS

R0571		CSMPREC	CSMCONIC	LEMPREC	LEMCONIC
R0572	VINTFLAG	SET	SET	CLEAR	CLEAR
R0573	INTYPFLG	CLEAR	SET	CLEAR	SET
R0574	DIM0FLAG	CLEAR	CLEAR	CLEAR	CLEAR

L INTEGRATION INITIALIZATION

R0575 CALLING SEQUENCE
R0576 L-X STORE $TDEC_1$
R0577 L CALL (STCALL $TDEC_1$)
R0578 L+1 CSMPREC (CSMCONIC, LEMPREC, LEMCONIC)

R0579 NORMAL EXIT TO L+2
R0580 SUBROUTINES CALLED
R0581 INTEGRV1
R0582 PRECOUT FOR CSMPREC AND LEMPREC
R0583 CONICOUT FOR CSMCONIC AND LEMCONIC
R0584 OUTPUT - SEE PAGE 2 OF THIS LOG SECTION
R0585 INPUT
R0586 $TDEC_1$ TIME TO INTEGRATE TO . CSECS B-28

```
0587                          13,3022  45020 1  CSMPREC  STQ     CALL
0588  REF  81  LAST 1274     13,3023  00046 0                    X1
0589  REF  23  LAST 1284     13,3024  27371 1                    INTSTALL
0590                          13,3025  43130 1           SXA,1   SET
0591  REF   2  LAST   87     13,3026  02214 1                    IRETURN
0592  REF  10  LAST  601     13,3027  01474 1                    VINTFLAG

0593                          13,3030  43014 0  IFLAGP   SET     CLEAR
0594  REF   3  LAST  204     13,3031  01467 0                    PRECIFLG
0595  REF  12  LAST 1284     13,3032  01676 1                    DIM0FLAG
0596                          13,3033  77614 1           CLRGO
05961 REF  14  LAST 1284     13,3034  01633 0                    INTYPFLG
05962 REF   1                13,3035  27115 1                    INTEGRV1
0597                          13,3036  45020 1  LEMPREC  STQ     CALL
0598  REF  82  LAST 1288     13,3037  00046 0                    X1
0599  REF  24  LAST 1288     13,3040  27371 1                    INTSTALL
0600                          13,3041  43130 1           SXA,1   CLRGO
0601  REF   3  LAST 1288     13,3042  02214 1                    IRETURN
0602  REF  11  LAST 1288     13,3043  01634 1                    VINTFLAG
0603  REF   1                13,3044  27030 1                    IFLAGP

0604                          13,3045  45020 1  CSMCONIC STQ     CALL
0605  REF  83  LAST 1288     13,3046  00046 0                    X1
0606  REF  25  LAST 1288     13,3047  27371 1                    INTSTALL
0607                          13,3050  43130 1           SXA,1   SET
0608  REF   4  LAST 1288     13,3051  02214 1                    IRETURN
0609  REF  12  LAST 1288     13,3052  01474 1                    VINTFLAG
0610                          13,3053  43014 0  IFLAGC   CLEAR   SETGO
0611  REF  13  LAST 1288     13,3054  01676 1                    DIM0FLAG
0612  REF  15  LAST 1288     13,3055  01433 1                    INTYPFLG
0613  REF   2  LAST 1288     13,3056  27115 1                    INTEGRV1
0614                          13,3057  45020 1  LEMCONIC STQ     CALL
0615  REF  84  LAST 1288     13,3060  00046 0                    X1
```

```
 0616   REF  26  LAST 1288   13,3061   27371 1                 INTSTALL
 0617                        13,3062   43130 1          SXA,1  CLRGO
 0618   REF   5  LAST 1288   13,3063   02214 1                 IRETURN
 0619   REF  13  LAST 1288   13,3064   01634 1                 VINTFLAG
 0620   REF   1              13,3065   27053 1                 IFLAGC

 0621                        13,3066   66214 0  INTEGRVS SET   SSP
 0622   REF   4  LAST 1288   13,3067   01467 0                 PRECIFLG
 0623   REF   7  LAST 1287   13,3070   02151 0                 PBODY
 0624                        13,3071   00000 1                 0
 0625                        13,3072   66214 0          BOF    SSP
 0626   REF  17  LAST 1287   13,3073   00343 0                 MOONFLAG
 0627                        13,3074   27077 1                 +3
 0628   REF   8  LAST 1289   13,3075   02151 0                 PBODY
 06281                       13,3076   00002 0                 2
 0629                        13,3077   77220 1          STQ    VLOAD
 0630   REF   6  LAST 1289   13,3100   02214 1                 IRETURN
 0631   REF   9  LAST 1287   13,3101   11456 0                 ZEROVEC
 0632   REF   7  LAST 1287   13,3102   01521 0          STORE  TDELTAV
 0633   REF   7  LAST 1287   13,3103   35527 1          STCALL TNUV
 0634   REF   2  LAST 1229   13,3104   23344 0                 RECTIFY
 0635                        13,3105   43014 0          CLEAR  SET
 0636   REF  14  LAST 1288   13,3106   01676 1                 DIM0FLAG
 0637   REF   1              13,3107   04062 1                 NEWIFLG
 06371                       13,3110   77614 1          SETGO
 06372  REF   1              13,3111   04020 1                 RPQFLAG
 0638   REF   1              13,3112   27127 0                 ALOADED
R0639   INTEGRV IS AN ENTRY TO ORBIT INTEGRATION WHICH PERMITS THE CALLER ,
R0640   NORMALLY THE NAVIGATION PROGRAM ,TO SET THE INTEG. FLAGS. THE ROUTINE
R0641   IS ENTERED AT INTEGRV1 BY CSMPREC ET.AL. AND AT ALOADED BY INTEGRVS.
R0642   THE ROUTINE SETS UP A-MEMORY IF ENTERED AT INTEGRV,1 AND SETS THE INTEG.
R0643   PROGRAM FOR PRECISION OR CONIC

R0644   THE CALLER MUST FIRST CALL INTSTALL TO CHECK IF INTEG. IS IN USE BEFORE
R0645   SETTING ANY FLAGS.
R0646   THE FLAGS WHICH SHOULD BE SET OR CLEARED ARE
R0647     VINTFLAG    (IGNORED WHEN ENTERED FROM INTEGRVS)
R0648     INTYPFLG
R0649     DIM0FLAG
R0650     D6OR9FLG
R0651   CALLING SEQUENCE
R0652     L-X    CALL
R0653     L-Y          INTSTALL
R0654     L-1    SET OR CLEAR ALL FOUR FLAGS. ALSO CAN SET STATEFLG IF DESIRED
R0655            AND DIM0FLAG IS CLEAR.
R0656     L      CALL
R0657     L+1          INTEGRV
R0658   INITIALIZATION
R0659     FLAGS AS ABOVE
R0660     STORE TIME TO INTEGRATE TO IN TDEC1
```

```
R0661   OUTPUT
R0662     RATT    AS
R0663     VATT          DEFINED
R0664     TAT                   BEFORE
 0665                             13,3113   77620 0  INTEGRV   STQ
 0666   REF    7   LAST 1289     13,3114   02214 1                    IRETURN
 0667                             13,3115   43014 0  INTEGRV1  SET      SET
 0668   REF    2   LAST 1289     13,3116   04060 0                    RPQFLAG
 0669   REF    2   LAST 1289     13,3117   04062 1                    NEWIFLG
 0670                             13,3120   77731 1  INTEGRV2  SSP
 0671   REF   21   LAST 1230     13,3121   00053 1                    QPRET
 0672   REF    2   LAST 1289     13,3122   27127 0                    ALOADED
 0673                             13,3123   52014 0           BON      GOTO
 0674   REF   14   LAST 1289     13,3124   01714 1                    VINTFLAG
 0675   REF    2   LAST  259     13,3125   26662 1                    PTOACSM
 0676   REF    1                 13,3126   26735 1                    PTOALEM
 0677                             13,3127   77745 1  ALOADED  DLOAD
 0678   REF   50   LAST 1286     13,3130   00041 1                    TDEC1
 0679   REF    2   LAST   76     13,3131   01101 0           STORE    TDEC
 0680                             13,3132   52014 0           BOFF     GOTO
 0681   REF   16   LAST 1288     13,3133   01753 1                    INTYPFLG
 0682   REF    1                 13,3134   27234 1                    TESTLOOP
 0683   REF    1                 13,3135   27220 1                    RVCON
 0684                             13,3136   77414 0  A-PCHK   BOFCLR   EXIT
 0685   REF    5   LAST 1284     13,3137   01652 1                    STATEFLG
 0686   REF    1                 13,3140   27157 1                    RECTOUT
 0687   REF   95   LAST 1284     13,3141   0 5301 0          TC       PHASCHNG
 0688                             13,3142    04022 0         OCT      04022
 0689   REF   49   LAST 1227     13,3143   0 5435 0          TC       UPFLAG      PHASE CHANGE HAS OCCURRED BETWEEN
 0690   REF    3   LAST 1227     13,3144    00236 0         ADRES    RENTFLG     INTSTALL AND INTWAKE
 0692   REF  234   LAST 1283     13,3145   0 6006 1          TC       INTPRET
 0693                             13,3146   77731 1          SSP
 0694   REF   22   LAST 1290     13,3147   00053 1                    QPRET
 0695   REF    1                 13,3150   27155 0                    PHEXIT
 0696                             13,3151   52014 0           BON      GOTO
 0697   REF   15   LAST 1290     13,3152   01714 1                    VINTFLAG
 0698   REF    2   LAST   32     13,3153   26636 0                    ATOPCSM
 0699   REF    2   LAST   32     13,3154   26711 1                    ATOPLEM
 0700                             13,3155   77624 1  PHEXIT   CALL
 0701   REF   22   LAST 1230     13,3156   56741 0                    GRP2PC
 0702                             13,3157   45001 1  RECTOUT  SETPD    CALL
 0703                             13,3160   00001 0                    0
 0704   REF    3   LAST 1289     13,3161   23344 0                    RECTIFY
 0705                             13,3162   53775 1           VLOAD    VSL*
 0706   REF    9   LAST 1286     13,3163   01503 0                    RRECT
 0707                             13,3164   57576 1                    0,2
 0708                             13,3165   53715 1           PDVL     VSL*        RATT TO PD0
 0709   REF    6   LAST 1252     13,3166   01511 0                    VRECT
```

L INTEGRATION INITIALIZATION USER'S PAGE NO. 13 E3 S3

```
0710                          13,3167  57576 1                  0,2
0711                          13,3170  63325 0          PDDL    PDVL          VATT TO PD6     TAT TO PD12
0712  REF  14  LAST 1287     13,3171  01517 0                  TET
0713  REF  10  LAST 1290     13,3172  01503 0                  RRECT
0714                          13,3173  64715 0          PDVL    PDDL*
0715  REF   7  LAST 1290     13,3174  01511 0                  VRECT
0716  REF   2  LAST  480     13,3175  50041 1                  MUEARTH,2
0717                          13,3176  76006 0          PUSH    AXT,1
0718                          13,3177  77765 0          DEC     -10
0719                          13,3200  76014 0          BON     AXT,1
0720  REF  18  LAST 1289     13,3201  00303 1                  MOONFLAG
0721                          13,3202  27204 1                  +2
0722                          13,3203  77775 1          DEC     -2
0723                          13,3204  40001 1  INTEXIT  SETPD   BOV
0724                          13,3205  00001 0                  0
0725                          13,3206  27207 1                  +1
07251                         13,3207  43014 0          CLEAR   CLEAR
07252 REF   2  LAST  284      13,3210  04676 1                  AVEMIDSW      ALLOW UPDATE OF DOWNLINK STATE VECTOR
07253 REF   5  LAST 1289      13,3211  01667 1                  PRECIFLG
0726                          13,3212  77535 1          SLOAD   EXIT
0727  REF   8  LAST 1290     13,3213  02215 0                  IRETURN
0728  REF 653  LAST 1289     13,3214  3 0154 1         CA      MPAC
0729  REF  38  LAST 1257     13,3215  50 120 1         INDEX   FIXLOC
0730  REF  23  LAST 1290     13,3216  54 052 1         TS      QPRET
0731  REF   4  LAST 1230     13,3217  0 3406 0         TC      INTWAKE
R0732 RVCON SETS UP ORBIT INTEGRATION TO DO A CONIC SOLUTION FOR POSITION AND
R0733 VELOCITY FOR THE INTERVAL (TET-TDEC)

0734                          13,3220  45345 1  RVCON   DLOAD   DSU
0735  REF   3  LAST 1290     13,3221  01101 0                  TDEC
0736  REF  15  LAST 1291     13,3222  01517 0                  TET
0737  REF   7  LAST 1249     13,3223  36312 1          STCALL  TAU
0738  REF   4  LAST 1290     13,3224  23344 0                  RECTIFY
0739                          13,3225  77624 1          CALL
0740  REF   1                 13,3226  22310 0                  KEPPREP
0741                          13,3227  43345 1          DLOAD   DAD
0742  REF   8  LAST 1252     13,3230  01551 1                  TC
0743  REF  16  LAST 1291     13,3231  01517 0                  TET
0744  REF  17  LAST 1291     13,3232  35517 1          STCALL  TET
0745  REF   2  LAST 1290     13,3233  27157 1                  RECTOUT
```

P07455 TESTLOOP

0746				13,3234	43014 0	TESTLOOP	BOF	CLRGO	
07462	REP	4	LAST 1284	13,3235	04752 0			QUITFLAG	
07463				13,3236	27241 0			+3	
07464	REP	6	LAST 1290	13,3237	01632 1			STATEFLG	
07465	REP	1		13,3240	27204 1			INTEXIT	STOP INTEGRATION
07466				13,3241	73001 1	+3	SETPD	LXA,2	
0747				13,3242	00013 0			10D	
0748	REP	9	LAST 1289	13,3243	02150 1			PBODY	
0749				13,3244	51575 1		VLOAD	ABVAL	
0750	REP	17	LAST 1287	13,3245	01535 0			RCV	
0751				13,3246	43006 0		PUSH	CLEAR	RC TO 10D
0752	REP	1		13,3247	00262 1			MIDFLAG	
0753				13,3250	50023 0		DSU*	RMN	MIDFLAG=0 IF R G.T. RMP
0754	REP	1		13,3251	67241 1			RME,2	
0755				13,3252	27255 0			+3	
0756				13,3253	77614 1		SET		
0757	REP	2	LAST 1292	13,3254	00062 0			MIDFLAG	
0758				13,3255	41345 0	NORPINAL	DLOAD	DMP	
0759				13,3256	00013 0			10D	
0760				13,3257	00043 0			34D	
0761				13,3260	55762 1		SR1R	DDV*	
0762	REP	3	LAST 1291	13,3261	50041 1			MUEARTH,2	
0763				13,3262	41366 1		SQRT	DMP	
0764	REP	1		13,3263	23675 1			.3D	
0765				13,3264	40442 1		SR3	SR4	DT IS TRUNCATED TO A MULTIPLE
0766				13,3265	54345 1		DLOAD	SL	
0767	REP	654	LAST 1291	13,3266	00155 0			MPAC	
0768				13,3267	20220 0			15D	OF 128 CSECS.
0769				13,3270	40006 0		PUSH	BOV	
0770	REP	1		13,3271	27316 0			MAXDT	
0771				13,3272	50021 1		BDSU	RMN	
0772	REP	1		13,3273	27370 0			DT/2MAX	
0773	REP	2	LAST 1292	13,3274	27316 0			MAXDT	
0774				13,3275	45345 1	DT/2COMP	DLOAD	DSU	
0775	REP	4	LAST 1291	13,3276	01101 0			TDEC	
0776	REP	18	LAST 1291	13,3277	01517 0			TET	
0777				13,3300	54234 0		RTB	SL	
0778	REP	4	LAST 715	13,3301	45541 0			SGNAGREE	
0779				13,3302	20211 1			8D	
0780	REP	2	LAST 88	13,3303	02314 0		STORE	DT/2	B-19
0781				13,3304	51400 1		BOV	ABS	
0782	REP	1		13,3305	27322 1			GETMAXDT	
0783				13,3306	50025 0		DSU	RMN	IS TIME TO INTEG. TO GR THAN MAXTIME
0784				13,3307	00015 0			12D	
0785	REP	1		13,3310	27326 0			P00HCHK	
0786				13,3311	75345 1	USEMAXDT	DLOAD	SIGN	
0787				13,3312	00015 0			12D	
0788	REP	3	LAST 1292	13,3313	02314 0			DT/2	

```
0789   REF   4  LAST 1292   13,3314   36314 1            STCALL DT/2
0790   REF   2  LAST 1292   13,3315   27326 0                   P00HCHK
0791                        13,3316   65345 0  MAXDT     DLOAD  PDDL       EXCHANGE DT/2MAX WITH COMPUTED MAX.
0792   REF   2  LAST 1292   13,3317   27370 0                   DT/2MAX
0793                        13,3320   77650 1            GOTO
0794   REF   1              13,3321   27275 1                   DT/2COMP
0795                        13,3322   77634 0  GETMAXDT  RTB
0796   REF  15  LAST  826   13,3323   45707 0                   SIGNMPAC
0797   REF   5  LAST 1293   13,3324   36314 1            STCALL DT/2
0798   REF   1              13,3325   27311 1                   USEMAXDT
0799                        13,3326   51545 1  P00HCHK   DLOAD  ABS
0800   REF   6  LAST 1293   13,3327   02314 0                   DT/2
0801                        13,3330   50025 0            DSU    BMN
0802   REF   1              13,3331   27366 1                   DT/2MIN
0803   REF   2  LAST 1287   13,3332   27136 0                   A-PCHK
0804                        13,3333   46135 1            SLOAD  BHIZ
0805   REF  13  LAST  711   13,3334   01012 0                   MODREG
0806                        13,3335   27340 0                   +3
0807                        13,3336   77650 1            GOTO
0808   REF   1              13,3337   23155 1                   TIMESTEP
08081                       13,3340   77614 1            BON                 WAS THIS CALL VIA CSM(LEM)PREC
08082  REF   6  LAST 1291   13,3341   01707 0                   PRECIFLG
08083  REF   2  LAST 1293   13,3342   23155 1                   TIMESTEP    YES
0809                        13,3343   45345 1            DLOAD  DSU
0810   REF   7  LAST 1293   13,3344   02314 0                   DT/2
0811                        13,3345   00015 0                   12D
0812                        13,3346   43040 1            BMN    BOFCLR
0813   REF   3  LAST 1293   13,3347   27136 0                   A-PCHK
0814   REF   3  LAST 1290   13,3350   04242 1                   NEWIFLG
0815   REF   3  LAST 1293   13,3351   23155 1                   TIMESTEP
0816                        13,3352   45345 1            DLOAD  DSU
0817   REF   5  LAST 1292   13,3353   01101 0                   TDEC
0818   REF  19  LAST 1292   13,3354   01517 0                   TET
08181                       13,3355   77640 0            BMN                 NO BACKWARD INTEGRATION
08182  REF   2  LAST 1292   13,3356   27204 1                   INTEXIT
0819                        13,3357   40525 1            PDDL   SR4
0820   REF   8  LAST 1293   13,3360   02314 0                   DT/2        IS 4(DT) LS(TDEC - TET)
0821                        13,3361   44322 1            SR2R   BDSU        NO
0822                        13,3362   52040 1            BMN    GOTO
0823   REF   3  LAST 1293   13,3363   27204 1                   INTEXIT
0824   REF   4  LAST 1293   13,3364   23155 1                   TIMESTEP
0825                        13,3365   00000 1  DT/2MIN   2DEC   3 B-20
0825                        13,3366   01400 1
0826                        13,3367   14152 1  DT/2MAX   2DEC   4000 E2 B-20
0826                        13,3370   00000 1
0828                        13,3371   77776 1  INTSTALL  EXIT
0829   REF 250  LAST 1226   13,3372   3 4714 1           CAF    ZERO
0830   REF 209  LAST 1201   13,3373   54 001 1 ALLSTALL  TS     L
0831   REF   5  LAST  184   13,3374   3 0106 0           CA     RASFLAG
0832   REF 210  LAST 1293   13,3375   50 001 0           INDEX  L
```

```
0833  REF   1                 13,3376  7 3467 0            MASK    INTBITAB      IS THIS STALL AREA FREE
0834                          13,3377  0 0006 1            EXTEND
0835  REF   1                 13,3400  1 3445 0            BZF     OKTOGRAB      YES
0836  REF 211  LAST 1293      13,3401  50 001 0            INDEX   L
0837  REF   1                 13,3402  3 3464 1            CAF     WAKESTAL
0838  REF   4  LAST  417      13,3403  0 5070 0            TC      JOBSLEEP
0839                          13,3404   77776 1  INTWAKE0  EXIT
08395 REF   2  LAST  504      13,3405  1 3428 0            TCF     INTWAKE1

0840  REF   6  LAST 1293      13,3406  4 0106 1  INTWAKE   CS      RASFLAG       IS THIS INTSTALLED ROUTINE TO BE
0841  REF   1                 13,3407  7 4704 1            MASK    REINTBIT          RESTARTED
0842  REF 340  LAST 1199      13,3410  10 000 0            CCS     A
0843  REF   3  LAST 1294      13,3411  0 3428 1            TC      INTWAKE1      NO

0844  REF  39  LAST 1291      13,3412  50 120 1            INDEX   FIXLOC
0845  REF  24  LAST 1291      13,3413  3 0052 0            CA      QPRET
0848  REF   1                 13,3414  55=055 1            TS      TBASE2        YES, DONT RESTART WITH SOMEONE ELSES Q

0849  REF  96  LAST 1290      13,3415  0 5301 0            TC      PHASCHNG
0850                          13,3416   04022 0            OCT     04022

0851  REF   2  LAST 1294      13,3417  3 1055 0            CA      TBASE2
0852  REF  40  LAST 1294      13,3420  50 120 1            INDEX   FIXLOC
0853  REF  25  LAST 1294      13,3421  54 052 1            TS      QPRET

0854  REF   2  LAST 1294      13,3422  3 4704 0            CAF     REINTBIT
0855  REF   7  LAST 1294      13,3423  7 0106 1            MASK    RASFLAG
0856                          13,3424  0 0006 1            EXTEND
0857  REF   1                 13,3425  1 3450 1            BZF     GOBAC         DONT INTWAKE IF WE CAME HERE VIA RESTART

0858  REF 251  LAST 1293      13,3426  3 4714 1  INTWAKE1  CAF     ZERO
0859  REF   1                 13,3427  54 154 0  WAKE      TS      STALTEM       INDEX OF ANY STALL USER
0860  REF   2  LAST 1294      13,3430  50 154 1  WAKE1     INDEX   STALTEM
0861  REF   2  LAST 1294      13,3431  3 3464 1            CAF     WAKESTAL
0862                          13,3432  0 0004 0            INHINT
0863  REF   5  LAST  417      13,3433  0 5074 1            TC      JOBWAKE
0864  REF  22  LAST 1186      13,3434  10 064 1            CCS     LOCCTR
0865  REF   1                 13,3435  1 3430 1            TCF     WAKE1         MAY BE MORE TO WAKE UP
0866                          13,3436   00051 0  FORTYONE  DEC     41
0867  REF   3  LAST 1294      13,3437  50 154 1            INDEX   STALTEM
0868  REF   2  LAST 1294      13,3440  4 3467 0            CS      INTBITAB
0869  REF   8  LAST 1294      13,3441  7 0106 1            MASK    RASFLAG
0870  REF   9  LAST 1294      13,3442  54 106 1            TS      RASFLAG       RELEASE STALL AREA
0871                          13,3443  0 0003 1            RELINT
0872  REF   2  LAST 1294      13,3444  1 3450 1            TCF     GOBAC
0873  REF 212  LAST 1294      13,3445  50 001 0  OKTOGRAB  INDEX   L             NO, WAIT UNTIL AVAILABLE
0874  REF   2  LAST  183      13,3446  3 4675 1            CAF     INTFLBIT
0875  REF  10  LAST 1294      13,3447  26 106 1            ADS     RASFLAG
0876  REF 235  LAST 1290      13,3450  0 6006 1  GOBAC     TC      INTPRET
0877                          13,3451   77616 0            RVQ
```

```
0878                                13,3452   77776 1  ERASTAL1 EXIT
0879   REP 154  LAST 1257           13,3453   3 4712 1           CAP    ONE
0880   REP   1                     13,3454   1 3373 1           TCP    ALLSTALL
0881                                13,3455   77776 1  ERASTAL2 EXIT
0882   REP  66  LAST 1204          13,3456   3 4711 1           CAP    TWO
0883   REP   2  LAST 1295          13,3457   1 3373 1           TCP    ALLSTALL
0884   REP 155  LAST 1295          13,3460   3 4712 1  ERASWAK1 CAP    ONE
0885   REP   1                     13,3461   1 3427 1           TCP    WAKE
0886   REP  67  LAST 1295          13,3462   3 4711 1  ERASWAK2 CAP    TWO
0887   REP   2  LAST 1295          13,3463   1 3427 1           TCP    WAKE
0888   REP  27  LAST 1289          13,3464   27372 1   WAKESTAL CADR   INTSTALL +1
0889   REP   1                     13,3465   27453 0            CADR   ERASTAL1 +1
0890   REP   1                     13,3466   27456 0            CADR   ERASTAL2 +1
0891   REP 655  LAST 1292             0154              STALTEM EQUALS MPAC
0892                                13,3467   20100 1   INTBITAB OCT   20100
0893                                13,3470   10040 1            OCT    10040
0894                                13,3471   04020 1            OCT    04020
```

```
P0895   AVETOMID

R0896   THIS ROUTINE PERFORMS THE TRANSITION FROM A THRUSTING PHASE TO THE COAST
R0897   PHASE BY INITIALIZING THIS VEHICLES PERMANENT STATE VECTOR WITH THE
R0898   VALUES LEFT BY THE AVERAGEG ROUTINE IN RN,VN,PIPTIME.

R0899   BEFORE THIS IS DONE THE W-MATRIX, IF ITS  VALID (ORWFLAG OR RENDWFLG IS
R0900   SET) IS INTEGRATED FORWARD TO PIPTIME WITH THE PRE-THRUST STATE VECTOR.

R0901   IN ADDITION, THE OTHER VEHICLE IS INTEGRATED (PERMANENT) TO PIPTIME.

R0902   FINALLY TRKMKCNT IS ZEROED
 0903   REF   3 LAST 1283    13,2000                    SETLOC  INTINIT
 0904                        13,3472                    BANK

 0905   REF   3 LAST 1283 TO 1296'   457   487*         COUNT*  $$/INTIN
 0906                        13,3472   43020 1 AVETOMID STQ     BQN
 0907   REF  14 LAST 1230    13,3473   02317 0                  EGRESS
 0908   REF  10 LAST  624    13,3474   02716 0                  RENDWFLG
 0909   REF   1              13,3475   27550 1                  INT/W          W-MATRIX VALID ,GO INTEGRATE IT
 0910                        13,3476   77614 1          BQN
 0911   REF  12 LAST  623    13,3477   01711 1                  ORBWFLAG
 0912   REF   2 LAST 1296    13,3500   27550 1                  INT/W          W-MATRIX VALID ,GO INTEGRATE IT

 0913                        13,3501   77614 1 OTHERS   BQN                                  FOR
 0913.1 REF   5 LAST 1286    13,3502   04307 1                  SURFFLAG                        CSM
 0913.2 REF   1              13,3503   27520 0                  SETCOAST       DONT DO LM              ONLY
 0913.3                      13,3504   45145 0          DLOAD   CALL           GET SET FOR NON W-MAT PERMANENT INTEG.
 0914   REF  16 LAST 1039    13,3505   01205 1                  PIPTIME        DESIRED TIME
 0915   REF  28 LAST 1295    13,3506   27371 1                  INTSTALL
 0916                        13,3507   45014 0          SET     CALL
 0917   REF  16 LAST 1290    13,3510   01474 1                  VINTFLAG       CM
 0918   REF   3 LAST 1284    13,3511   26621 0                  SETIFLGS       SETS UP NONE W-MAT. PERMANENT INTEG.
 0919                        13,3512   43014 0          BOF     CLEAR
 0920   REF   3 LAST  485    13,3513   02747 1                  COMPUTER
 0921                        13,3514   27516 0                  +2             COMPUTER IS LM ,INTEG CM
 0922   REF  17 LAST 1296    13,3515   01674 0                  VINTFLAG       COMPUTER IS CM ,INTEG LM
 0923   REF  51 LAST 1290    13,3516   34041 0          STCALL  TDEC1
 0924   REF  11 LAST 1287    13,3517   27113 1                  INTEGRV

 0925                        13,3520   45174 1 SETCOAST AXT,2   CALL           NOW MOVE PROPERLY SCALED RN,VN AND
 0926                        13,3521   00002 0                  2              PIPTIME TO INTEGRATION ERASABLES.
 0927   REF  29 LAST 1296    13,3522   27371 1                  INTSTALL
 0928                        13,3523   77014 1          BQN     AXT,2
 0929   REF   9 LAST 1229    13,3524   04303 0                  MOONTHIS
 0930                        13,3525   27527 1                  +2
 0931                        13,3526   00000 1                  0
 0932                        13,3527   53775 1          VLOAD   VSR*
```

```
0933  REF  18  LAST  790   13,3530  01171 1                 RN
0934                       13,3531  57176 0                 0,2
0935  REF  11  LAST 1291   13,3532  01503 0        STORE    RRECT
0936  REF  18  LAST 1292   13,3533  15535 0        STODL    RCV
0937  REF  17  LAST 1296   13,3534  01205 1                 PIPTIME
0938  REF  20  LAST 1293   13,3535  25517 0        STOVL    TET
0939  REF  18  LAST  841   13,3536  01177 1                 VN
0940                       13,3537  45057 1        VSR*     CALL
0941                       13,3540  57176 0                 0,2
0942  REF   2  LAST  503   13,3541  23360 0                 MINIRECT      FINISH SETTING UP STATE VECTOR
0943                       13,3542  66234 1        RTB      SSP
0944  REF   1              13,3543  20651 1                 MOVATHIS      PUT TEMP STATE VECTOR INTO PERMANENT
0945  REF   8  LAST  850   13,3544  01127 1                 TRKMKCNT
0946                       13,3545  00000 1                 0
0947                       13,3546  77650 1        GOTO
0948  REF   2  LAST 1230   13,3547  75745 0                 FAZAB5

0949                       13,3550  45145 0  INT/W  DLOAD    CALL
0950  REF  18  LAST 1297   13,3551  01205 1                 PIPTIME       INTEGRATE W THRU BURN
0951  REF  30  LAST 1296   13,3552  27371 1                 INTSTALL
0952                       13,3553  43014 0        SET      SET
0953  REF  15  LAST 1289   13,3554  01476 0                 DIM0FLAG      DO W-MATRIX
0954  REF   3  LAST 1291   13,3555  04476 0                 AVEMIDSW      SO WONT CLOBBER RN,VN,PIPTIME
0955                       13,3556  43014 0        SET      CLEAR
0956  REF   6  LAST 1284   13,3557  01475 0                 D6OR9FLG      9X9 FOR LM
0957  REF  18  LAST 1296   13,3560  01674 0                 VINTFLAG      LM
0958                       13,3561  43014 0        BOF      SET
0959  REF   4  LAST 1296   13,3562  02747 1                 COMPUTER
0960                       13,3563  27567 0                 +4            LM TO DO
0961  REF  19  LAST 1297   13,3564  01474 1                 VINTFLAG
0962                       13,3565  77614 1        CLEAR
0963  REF   7  LAST 1297   13,3566  01675 1                 D6OR9FLG      6X6 FOR CM
0964  REF  52  LAST 1296   13,3567  34041 0        STCALL   TDEC1
0965  REF  12  LAST 1296   13,3570  27113 1                 INTEGRV
0966                       13,3571  77650 1        GOTO
0967  REF   1              13,3572  27501 0                 OTHERS        NOW GO DO THE OTHER VEHICLE
```

L INTEGRATION INITIALIZATION

P0968 MIDTOAV$_1$

R0969 THIS ROUTINE INTEGRATES (PRECISION) TO THE TIME SPECIFIED IN TDEC$_1$.
R0970 IF, AT THE END OF AN INTEGRATION TIME STEP, CURRENT TIME PLUS A DELTA
R0971 TIME (SEE TIMEDELT.....BASED ON THE COMPUTATION TIME FOR ONE TIME STEP)
R0972 IS GREATER THAN THE DESIRED TIME, ALARM 1703 IS SET AND THE INTEGRATION
R0973 IS DONE TO THE CURRENT TIME.
R0974 RETURN IS IN BASIC TO THE RETURN ADDRESS PLUS ONE.

R0975 IF THE INTEGRATION IS FINISHED TO THE DESIRED TIME, RETURN IS IN BASIC
R0976 TO THE RETURN ADDRESS

R0977 IN EITHER CASE , BEFORE RETURNING, THE EXTRAPOLATED STATE VECTOR IS TRAN
R0978 FERRED FROM R,VATT TO R,VN$_1$-PIPTIME$_1$ IS SET TO THE FINISHING INTEGRA-
R0979 TION TIME AND MPAC IS SET TO THE DELTA TIME---
R0980 TAT MINUS CURRENT TIME.
R0981 MIDTOAV$_2$

R0982 THIS ROUTINE INTEGRATES THIS VEHICLES STATE VECTOR TO THE CURRENT TIME.
R0983 NO INPUTS ARE REQUIRED OF THE CALLER. RETURN IS IN BASIC TO THE RETURN
R0984 ADDRESS WITH THE ABOVE TRANSFERS TO R,VN$_1$-PIPTIME$_1$-AND MPAC DONE

```
0985  REF   2  LAST   76    1127                          EBANK=  IRETURN1
0986                      13,3573   43020 1  MIDTOAV2   STQ     CLRGO        INTEGRATE TO PRESENT TIME PLUS TIMEDELT
0987  REF   3  LAST 1298  13,3574   01127 1              STQ     IRETURN1
0988  REF   1             13,3575   04634 1              STQ     MID1FLAG
0989  REF   1             13,3576   27612 1              STQ     ENTMID2

0990                      13,3577   43020 1  MIDTOAV1   STQ     SET          INTEGRATE TO TDEC1
0991  REF   4  LAST 1298  13,3600   01127 1              STQ     IRETURN1
0992  REF   2  LAST 1298  13,3601   04474 1              STQ     MID1FLAG
0993                      13,3602   43234 0              RTB     DAD          INITIAL CHECK, IS TDEC1 IN THE FUTURE
0994  REF  27  LAST 1283  13,3603   45505 0              RTB     LOADTIME
0995  REF   1             13,3604   27714 0              RTB     TIMEDELT
0996                      13,3605   51021 0              RTB     BDSU
0997  REF  53  LAST 1297  13,3606   00041 1              RTB     BPL
0998  REF   1             13,3607   27616 0              RTB     TDEC1
0999                      13,3610   77624 1              RTB     ENTMID1      Y5S
1000  REF   1             13,3611   27702 1              RTB     CALL
                                                         RTB     NOTIME       NO, SET ALARM, SWITCH TO MIDTOAV2
1001                      13,3612   43234 0  ENTMID2    RTB     DAD
1002  REF  28  LAST 1298  13,3613   45505 0              RTB     LOADTIME
1003  REF   2  LAST 1298  13,3614   27714 0              RTB     TIMEDELT
1004  REF  54  LAST 1298  13,3615   00041 1              RTB     STORE TDEC1

1005                      13,3616   77624 1  ENTMID1    RTB     CALL
1006  REF  31  LAST 1297  13,3617   27371 1              RTB     INTSTALL
1007                      13,3620   45014 0              RTB     CLEAR CALL
```

L INTEGRATION INITIALIZATION USER=S PAGE NO. 21 E2 S3

```
1008  REF  16  LAST 1297  13,3621  01676 1                DIM0FLAG      NO W-MATRIX
1009  REF   1              13,3622  26034 1                THISVINT
1010                       13,3623  43014 0        CLEAR   SET
1011  REF  17  LAST 1290  13,3624  01673 1                INTYPFLG
1012  REF   1              13,3625  04475 0                MIDAVFLG      LET INTEG. KNOW THE CALL IS FOR MIDTOAV.
1013                       13,3626  77624 1        CALL
1014  REF  13  LAST 1297  13,3627  27113 1                INTEGRV       GO INTEGRATE
1015                       13,3630  77214 0        CLEAR   VLOAD
1016  REF   2  LAST 1299  13,3631  04675 1                MIDAVFLG
1017  REF  37  LAST  887  13,3632  00001 0                RATT
1018  REF   9  LAST  790  13,3633  25232 0        STOVL   RN1
1019  REF  24  LAST  869  13,3634  00007 0                VATT
1020  REF   4  LAST  790  13,3635  15240 0        STODL   VN1
1021  REF  11  LAST  889  13,3636  00015 0                TAT
1022  REF   8  LAST  786  13,3637  01246 0        STORE   PIPTIME1
10221                      13,3640  66134 1        SXA,2   SXA,1
10222 REF  15  LAST  789  13,3641  03746 1                RTX2
10223 REF  11  LAST  668  13,3642  03745 1                RTX1
1023                       13,3643  77776 1        EXIT

1024                       13,3644  0 0004 0       INHINT
1025                       13,3645  0 0006 1       EXTEND
1026  REF  28  LAST 1066  13,3646  4 0025 1       DCS     TIME2
1027  REF 656  LAST 1295  13,3647  20 155 1       DAS     MPAC
1028  REF  10  LAST 1132  13,3650  0 7226 0       TC      TPAGREE

1029  REF   5  LAST 1298  13,3651  3 1127 1       CA      IRETURN1
1030  REF   7  LAST  565  13,3652  0 4577 0       TC      BANKJUMP
1031                       13,3653  47014 1  CKMID2 BOF     RTB
1032  REF   3  LAST 1298  13,3654  04754 0                MID1FLAG
1033  REF   1              13,3655  27672 1                MID2
1034  REF  29  LAST 1298  13,3656  45505 0                LOADTIME
1035                       13,3657  44215 1        DAD     BDSU
1036  REF   3  LAST 1298  13,3660  27714 0                TIMEDELT
1037  REF   6  LAST 1293  13,3661  01101 0                TDEC
1038                       13,3662  45044 0        BPL     CALL
1039  REF   2  LAST 1290  13,3663  27234 1                TESTLOOP      YES
1040  REF   2  LAST 1298  13,3664  27702 1                NOTIME

1041                       13,3665  43234 0  TIMEINC RTB     DAD
1042  REF  30  LAST 1299  13,3666  45505 0                LOADTIME
1043  REF   4  LAST 1299  13,3667  27714 0                TIMEDELT
1044  REF   7  LAST 1299  13,3670  35101 1        STCALL  TDEC
1045  REF   3  LAST 1299  13,3671  27234 1                TESTLOOP

1046                       13,3672  45345 1  MID2   DLOAD   DSU
1047  REF   8  LAST 1299  13,3673  01101 0                TDEC
1048  REF  21  LAST 1297  13,3674  01517 0                TET
1049                       13,3675  45246 0        ABS     DSU
1050  REF   1              13,3676  27712 0                3CSECS
```

```
1051                          13,3677   52040 1          BMN     GOTO
1052  REP   4  LAST 1293      13,3700   27136 0                  A-PCHK
1053  REP   1                 13,3701   27665 1                  TIMEINC

1054                          13,3702   77414 0  NOTIME  CLEAR   EXIT          TOO LATE
1055  REP   4  LAST 1299      13,3703   04674 0                  MID1FLAG
1056  REP   6  LAST 1299      13,3704   25«127 1         INCR    IRETURN1      SET ERROR EXIT (CALLOC +2)
1057  REP  34  LAST 1161      13,3705   0 5537 0         TC      ALARM         INSUFFICIENT TIME FOR INTEGRATION --
1058                          13,3706   01703 1          OCT     1703             TIG WILL BE SLIPPED...
1059  REP 236  LAST 1294      13,3707   0 6006 1         TC      INTPRET
1060                          13,3710   77616 0          RVQ

1061                          13,3711   00000 1  3CSECS  2DEC    3
1061                          13,3712   00003 1
1062                          13,3713   00000 1  TIMEDELT 2DEC   1250
1062                          13,3714   02342 0
1063                          27,2662             BANK    27
1064  REP   1                 27,2000             SETLOC  UPDATE2
1065                          27,2662             BANK
1066  REP   1                   0330              EBANK=  INTWAKUQ
1067  REP   1                                     COUNT*  $$/INTIN

1068  REP   1                   0330      INTWAKUQ =      INTWAK1Q      TEMPORARY UNTIL NAME OF INTWAK1Q IS CHNG

1069                          27,2662   0 0003 1 INTWAKEU RELINT
1070                          27,2663   0 0006 1         EXTEND
1071  REP   2  LAST 1300      27,2664   22 330 1         QXCH    INTWAKUQ      SAVE Q FOR RETURN

1072  REP 237  LAST 1300      27,2665   0 6006 1         TC      INTPRET

1073                          27,2666   53135 0          SLOAD   BZE           IS THIS A CSM/LEM STATE VECTOR UPDATE
1074  REP   3  LAST  179      27,2667   01502 1                  UPSVFLAG      REQUEST. IF NOT GO TO INTWAKUP.
1075  REP   1                 27,2670   56727 0                  INTWAKUP

1076                          27,2671   77775 1          VLOAD                 MOVE RRECT(6) AND VRECT(6) INTO
1077  REP  12  LAST 1297      27,2672   01503 0                  RRECT            RCV(6)   AND VCV(6)   RESPECTIVELY.
1078  REP  19  LAST 1297      27,2673   25535 0          STOVL   RCV
1079  REP   8  LAST 1291      27,2674   01511 0                  VRECT         NOW GO TO «RECTIFY +13D« TO
1080                          27,2675   77624 1          CALL                  STORE VRECT INTO VCV  AND ZERO OUT
1081  REP   5  LAST 1291      27,2676   23361 1                  RECTIFY +13D  TDELTAV(6),TNUV(6),TC(2) AND XKEP(2)
1082                          27,2677   51535 0          SLOAD   ABS           COMPARE ABSOLUTE VALUE OF «UPSVFLAG«
1083  REP   4  LAST 1300      27,2700   01502 1                  UPSVFLAG      TO «UPDATE MOON STATE VECTOR CODE«
1084                          27,2701   53025 0          DSU     BZE           TO DETERMINE WHETHER THE STATE VECTOR TO
1085  REP   1                 27,2702   16740 0                  UPMNSVCD      BE UPDATED IS IN THE EARTH OR LUNAR
1086  REP   1                 27,2703   56710 1                  INTWAKEM      SPHERE OF INFLUENCE.....
1087                          27,2704   43174 1          AXT,2   CLRGO         EARTH SPHERE OF INFLUENCE.
1088                          27,2705   00000 1          DEC     0
1089  REP  19  LAST 1291      27,2706   00223 1                  MOONFLAG
```

```
1090  REP  1                27,2707  56713 1                    INTWAKEC
1091                        27,2710  43174 1  INTWAKEM AXT,2    SET
1092                        27,2711  00002 0           DEC      2
1093  REP 20  LAST 1300     27,2712  00063 1                    MOONFLAG
1094                        27,2713  50135 0  INTWAKEC SLOAD    RMN
A1095
1096  REP  5  LAST 1300     27,2714  01502 1                    UPSVFLAG
1097  REP  1                27,2715  56723 1                    INTWAKLM
1098                        27,2716  77624 1           CALL
1099  REP  3  LAST 1290     27,2717  26636 0                    ATOPCSM

1100                        27,2720  52014 0           CLEAR    GOTO
1101  REP 13  LAST 1296     27,2721  01671 0                    ORBWFLAG
1102  REP  1                27,2722  56725 1                    INTWAKEX

1103                        27,2723  77624 1  INTWAKLM CALL
1104  REP  3  LAST 1290     27,2724  26711 1                    ATOPLEM

1105                        27,2725  77614 1  INTWAKEX CLEAR
1106  REP 11  LAST 1296     27,2726  02676 1                    RENDWFLG

1107                        27,2727  45131 0  INTWAKUP SSP      CALL
1108  REP  6  LAST 1301     27,2730  01502 1                    UPSVFLAG
1109                        27,2731  00000 1                    0
1110  REP  2  LAST  635     27,2732  27404 1                    INTWAKE0
1111                        27,2733  77776 1           EXIT

1112  REP 97  LAST 1294     27,2734  0 5301 0          TC       PHASCHNG
1113                        27,2735  04026 1           OCT      04026
1114  REP  3  LAST 1300     27,2736  0 0330 1          TC       INTWAKUQ

1115                        27,2737  00002 0  UPMNSVCD OCT      2
1116                        27,2740  00000 1           OCT      0
1117                        27,2741  77420 1  GRP2PC   STQ      EXIT
1118  REP  3  LAST  120     27,2742  03536 1                    GRP2SVQ
1119  REP 98  LAST 1301     27,2743  0 5301 0          TC       PHASCHNG
1120                        27,2744  04022 0           OCT      04022
1121  REP 238  LAST 1300    27,2745  0 6006 1          TC       INTPRET
1122                        27,2746  77650 1           GOTO
1123  REP  4  LAST 1301     27,2747  03536 1                    GRP2SVQ
```

LUNAR SPHERE OF INFLUENCE.

COMMON CODING AFTER X2 INITIALIZED AND MOONFLAG SET(OR CLEARED).
IS THIS A REQUEST FOR A LEM OR CSM STATE VECTOR UPDATE.....
UPDATE CSM STATE VECTOR

UPDATE LM STATE VECTOR

REMOVE 'UPDATE STATE VECTOR INDICATOR'

RELEASE 'GRAB' OF ORBIT INTEG

L ORBITAL INTEGRATION

```
R0001          DELETE
 0002
 0003  REP  1                 13,3715                    BANK   13
 0004                         11,2000                    SETLOC ORBITAL
 0005  REP  1                 11,2310                    BANK
R0006          DELETE                                   COUNT  11/ORBIT
 0007
 0008  REP 10  LAST 1292      11,2310  40354 1  KEPPREP  LXA,2  SETPD
 0009                         11,2311  02150 1           PBODY
 0010                         11,2312  00001 0           0
 0011  REP  4  LAST 1292      11,2313  75543 1           DLOAD*  SQRT
 0012                         11,2314  50041 1                   MUEARTH,2
 0013  REP 20  LAST 1300      11,2315  53515 0           PDVL    UNIT
 0014                         11,2316  01535 0                   RCV
 0015                         11,2317  60325 0           PDDL    NORM
 0016  REP 85  LAST 1288      11,2320  00045 0                   36D
 0017                         11,2321  00047 1                   X1
 0018                         11,2322  77715 1           PDVL
 0019  REP 15  LAST 1287      11,2323  65241 0           DOT     PDDL
 0020  REP  8  LAST 1291      11,2324  01543 1                   VCV
 0021                         11,2325  02312 0                   TAU.
 0022  REP  9  LAST 1291      11,2326  60225 1           DSU     NORM
 0023  REP 44  LAST 1228      11,2327  01551 1                   TC
 0024                         11,2330  00051 0                   S1
 0025                         11,2331  77742 0           SR1
 0026                         11,2332  65271 0           DDV     PDDL
 0027                         11,2333  00003 1                   2D
 0028                         11,2334  41405 0           DMP     PUSH
 0029                         11,2335  00005 1                   4D
 0030                         11,2336  65316 0           DSQ     PDDL
 0031                         11,2337  00005 1                   4D
 0032  REP  5  LAST 1302      11,2340  64716 0           DSQ     PDDL*
 0033                         11,2341  50041 1                   MUEARTH,2
 0034                         11,2342  40442 1           SR3     SR4
 0035  REP 16  LAST 1302      11,2343  47515 0           PDVL    VSQ
 0036                         11,2344  01543 1                   VCV
 0037                         11,2345  44205 0           DMP     BDSU
 0038                         11,2346  00045 0                   36D
 0039                         11,2347  41271 0           DDV     DMP
 0040                         11,2350  00003 1                   2D
 0041  REP  1                 11,2351  53605 1           DMP     SL*
 0042                         11,2352  23717 1                   DP2/3
 0043                         11,2353  20176 0                   0 -3,1
 0044  REP 45  LAST 1302      11,2354  43260 1           XSU,1   DAD
 0045                         11,2355  00050 1                   S1
 0046                         11,2356  45257 0           SL*     DSU
 0047                         11,2357  20211 1                   8D,1
 0048                         11,2360  41205 0           DMP     DMP
 0049                         11,2361  00001 0                   0D
 0050                         11,2362  00005 1                   4D
                              11,2363  53657 0           SL*     SL*
```

SQRT(MU) (+18 OR +15) 0D PL 2D

PL 8D

NORM R (+29 OR +27 - N1) 2D PL 4D

P*SQRT(MU)(+7 OR+5) 4D PL 6D

(+28)

PS(+6 +N1-N2) 6D PL 8D

(PS)SQ(+12 +2(N1-N2)) 8D PL 10D

SSQ/MU(-2OR +2(N1-N2)) 10D PL 12D

PREALIGN MU (+43 OR +37) 12D PL 14D

PL 12D

PL 10D

-(1/R-ALPHA)(+12 +3N1-2N2)

10L(1/R-ALPHA)(+13 +2(N1-N2))
2(PS)SQ - ETCETRA PL 8D
X1 = N2-N1
-PS+2(PS)SQ ETC (+6 +N1-N2) PL 6D

L ORBITAL INTEGRATION USER=S PAGE NO. 2 E0 S3

```
0051                          11,2364  20211 1          8D,1
0052                          11,2365  20201 0          0,1          S(-PS(1-2PS)-1/6...)(+17 OR +16)
0053                          11,2366  65215 1    DAD   PDDL                                      PL  8D
0054   REP  2  LAST  94       11,2367  01553 0          XKEP
0055                          11,2370  53605 1    DMP   SL*          S(+17 OR +16)
0056                          11,2371  00001 0          0D
0057                          11,2372  20202 0          1,1
0058                          11,2373  43204 0    BOVB  DAD
0059   REP 10  LAST 1229      11,2374  57343 1          TCDANZIG
0060                          11,2375  77626 0    STADR
0061   REP  4  LAST 1251      11,2376  75471 1    STORE XKEPNEW
0062                          11,2377  74020 0    STQ   AXC,1
0063   REP  3  LAST 1253      11,2400  02270 0          KEPRTN
0064                          11,2401  00012 1    DEC   10
0065                          11,2402  74014 1    BCN   AXC,1
0066   REP 21  LAST 1301      11,2403  00303 1          MOONFLAG
0067   REP  1                 11,2404  24000 1          KEPLERN
0068                          11,2405  00002 0    DEC   2
0069                          11,2406  77650 1    GOTO
0070   REP  2  LAST 1303      11,2407  24000 1          KEPLERN
```

```
0071                          11,2410  66350 1  FBR3    LXA,1   SSP
0072   REF  18  LAST 1286     11,2411  01500 0           DIPEQCNT
0073   REF  46  LAST 1302     11,2412  00051 0           S1
0074                          11,2413  77762 1  DEC     -13
0075                          11,2414  54345 1  DLOAD   SR
0076   REF   9  LAST 1293     11,2415  02314 0           DT/2
0077                          11,2416  20612 0           9D
0078                          11,2417  61500 0  TIX,1   ROUND
0079                          11,2420  22421 0           +1
0080                          11,2421  43206 1  PUSH    DAD
0081   REF  10  LAST 1302     11,2422  01551 1           TC
0082   REF   9  LAST 1302     11,2423  16312 0  STODL   TAU.
0083                          11,2424  77615 0  DAD
0084   REF  22  LAST 1299     11,2425  01517 0           TET
0085   REF  23  LAST 1304     11,2426  35517 1  STCALL  TET
0086   REF   2  LAST 1291     11,2427  22310 0           KEPPREP
```

```
P0087   AGC ROUTINE TO COMPUTE ACCELERATION COMPONENTS.
 0088                          11,2430   73150 1  ACCOMP   LXA,1   LXA,2
 0089   BEP  11  LAST 1302     11,2431   02150 1           PBODY
 0090   BEP  12  LAST 1305     11,2432   02150 1           PBODY
 0091                          11,2433   77775 1           VLOAD
 0092   BEP  10  LAST 1289     11,2434   11456 0                 ZEROVEC
 0093   BEP   2  LAST   87     11,2435   26202 0           STOVL  PV
 0094   BEP  32  LAST 1209     11,2436   02152 0                 ALPHAV
 0095                          11,2437   53257 1           VSL*   VAD
 0096                          11,2440   57605 0                 0 -7,2
 0097   BEP  21  LAST 1302     11,2441   01535 0                 RCV
 0098   BEP   2  LAST   87     11,2442   02160 1           STORE  BETAV
 0099                          11,2443   65014 1           BOF    XCHX,2
 0100   BEP  17  LAST 1299     11,2444   01756 1                 DIM0FLAG
 0101                          11,2445   22452 1                 +5
 0102   BEP  19  LAST 1304     11,2446   01500 0                 DIFFCNT
 0103   BEP   7  LAST   87     11,2447   12217 0           STORE  VECTAB,2
 0104                          11,2450   77724 0           XCHX,2
 0105   BEP  20  LAST 1305     11,2451   01500 0                 DIFFCNT
 0106                          11,2452   53575 0           VLOAD  UNIT
 0107   BEP  33  LAST 1305     11,2453   02152 0                 ALPHAV
 0108   BEP  34  LAST 1305     11,2454   16152 0           STODL  ALPHAV
 0109                          11,2455   00045 0                 36D
 0110   BEP   4  LAST 1207     11,2456   02310 1           STORE  ALPHAM
 0111                          11,2457   77624 1           CALL
 0112   BEP   1                11,2460   22562 0                 GAMCOMP
 0113                          11,2461   66175 1           VLOAD  SXA,1
 0114   BEP   3  LAST 1305     11,2462   02160 1                 BETAV
 0115   BEP  33  LAST 1286     11,2463   00051 0                 S2
 0116   BEP  35  LAST 1305     11,2464   16152 0           STODL  ALPHAV
 0117   BEP   2  LAST   87     11,2465   02210 0                 BETAM
 0118   BEP   5  LAST 1305     11,2466   02310 1           STORE  ALPHAM
 0119                          11,2467   71214 0           BOF    DLOAD
 0120   BEP   3  LAST 1292     11,2470   00342 1                 MIDFLAG
 0121   BEP   1                11,2471   22725 1                 OBLATE
 0122   BEP  24  LAST 1304     11,2472   01517 0                 TET
 0123                          11,2473   77624 1           CALL
 0124   BEP   2  LAST  704     11,2474   54110 0                 LSPOS
 0125                          11,2475   72174 0           AXT,2  LXA,1
 0126                          11,2476   00002 0                 2
 0127   BEP  34  LAST 1305     11,2477   00051 0                 S2
 0128                          11,2500   77614 1           BOF
 0129   BEP  22  LAST 1303     11,2501   00343 0                 MOONFLAG
 0130                          11,2502   22505 1                 +3
 0131                          11,2503   77076 0           VCOMP  AXT,2
 0132                          11,2504   00000 1                 0
 0133   BEP   4  LAST 1305     11,2505   02160 1           STORE  BETAV
 0134   BEP   3  LAST   87     11,2506   26263 1           STOVL  RPOV
```

```
0135                                11,2507  00003 1                 2D
0136  REP  2  LAST  87             11,2510  02300 0           STORE RPSV
0137                                11,2511  45335 0           SLOAD DSU
0138  REP  14 LAST 1293            11,2512  01012 0                 MODREG
0139  REP  1                       11,2513  23721 1                 OCT27
0140                                11,2514  43030 0           BHIZ  BOF
0141                                11,2515  22520 0                 +3
0142  REP  18 LAST 1305            11,2516  01756 1                 DIM0FLAG
0143  REP  1                       11,2517  22534 0                 GETRPSV
0144                                11,2520  74375 0           VLOAD VXSC
0145  REP  36 LAST 1305            11,2521  02152 0                 ALPHAV
0146  REP  6  LAST 1305            11,2522  02310 1                 ALPHAM
0147                                11,2523  52257 0           VSR*  VSU
0148                                11,2524  57175 0                 1,2
0149  REP  5  LAST 1305            11,2525  02160 1                 BETAV
0150                                11,2526  77724 0           XCHX,2
0151  REP  21 LAST 1305            11,2527  01500 0                 DIFEQCNT
0152  REP  8  LAST 1305            11,2530  12225 1           STORE VECTAB +6,2
0154  REP  5  LAST  614            11,2531  02272 1           STORE RQVV
0155                                11,2532  77724 0           XCHX,2
0156  REP  22 LAST 1306            11,2533  01500 0                 DIFEQCNT
0157                                11,2534  62175 0 GETRPSV  VLOAD INCR,1
0158  REP  4  LAST 1305            11,2535  02263 1                 RPQV
0159                                11,2536  00004 0                 4
0160                                11,2537  43014 0           CLEAR BOF
0161  REP  3  LAST 1290            11,2540  04260 1                 RPQFLAG
0162  REP  23 LAST 1305            11,2541  00343 0                 MOONFLAG
0163                                11,2542  22547 1                 +5
0164                                11,2543  53261 1           VSR   VAD
0165                                11,2544  20612 0                 9D
0166  REP  3  LAST 1306            11,2545  02300 0                 RPSV
0167  REP  4  LAST 1306            11,2546  02300 0           STORE RPSV
0168                                11,2547  77624 1           CALL
0169  REP  2  LAST 1305            11,2550  22562 0                 GAMCOMP
0170                                11,2551  62174 1           AXT,2 INCR,1
0171                                11,2552  00004 0                 4
0172                                11,2553  00004 0                 4
0173                                11,2554  77775 1           VLOAD
0174  REP  5  LAST 1306            11,2555  02300 0                 RPSV
0175  REP  6  LAST 1306            11,2556  36160 0           STCALL BETAV
0176  REP  3  LAST 1306            11,2557  22562 0                 GAMCOMP
0177                                11,2560  77650 1           GOTO
0178  REP  2  LAST 1305            11,2561  22725 1                 OBLATE
0179                                11,2562  74575 0 GAMCOMP  VLOAD VSR1
0180  REP  7  LAST 1306            11,2563  02160 1                 BETAV
0181                                11,2564  40236 1           VSQ   SETPD
0182                                11,2565  00001 0                 0
0183                                11,2566  61501 1           NORM  ROUND
0184                                11,2567  00040 0                 31D
0185                                11,2570  60325 0           PDDL  NORM      NORMED R SQUARED TO PD LIST
```

```
0186  REP  7  LAST 1306   11,2571  02310 1          ALPHAM      NORMALIZE (LESS ONE) LENGTH OF ALPHA
0187                      11,2572  00041 1          32D         SAVING NORM SCALE FACTOR IN X1
0188                      11,2573  63342 1  SR1     PDVL
0189  REP  8  LAST 1306   11,2574  02160 1          BETAV       C(PDL+2) = ALMOST NORMED ALPHA
0190                      11,2575  77656 1  UNIT
0191  REP  9  LAST 1307   11,2576  16160 1  STODL   BETAV
0192                      11,2577  00045 0          36D
0193  REP  3  LAST 1305   11,2600  02210 0  STORE   BETAM
0194                      11,2601  55301 0  NORM    BDDV        FORM NORMALIZED QUOTIENT ALPHAM/BETAM
0195                      11,2602  00042 1          33D
0196                      11,2603  41562 0  SR1R    PUSH        C(PDL+2) = ALMOST NORMALIZED RHO.
0197                      11,2604  77743 1  DLOAD*
0198  REP  1              11,2605  27730 0          ASCALE,1
0199  REP  47 LAST 1304   11,2606  00051 0  STORE   S1
0200                      11,2607  57124 1  XCHX,2  XAD,2
0201  REP  48 LAST 1307   11,2610  00050 1          S1
0202                      11,2611  00040 0          32D
0203                      11,2612  71264 1  XSU,2   DLOAD
0204                      11,2613  00041 1          33D
0205                      11,2614  00003 1          2D
0206                      11,2615  65057 0  SR*     XCHX,2
0207                      11,2616  57177 1          0 -1,2
0208  REP  49 LAST 1307   11,2617  00050 1          S1
0209                      11,2620  74406 0  PUSH    SR1R        RHO/4 TO 4D
0210                      11,2621  50315 0  PDVL    DOT
0211  REP  37 LAST 1306   11,2622  02152 0          ALPHAV
0212  REP  10 LAST 1307   11,2623  02160 1          BETAV
0213                      11,2624  44372 1  SL1R    BDSU        (RHO/4) - 2(ALPHAV/2.BETAV/2)
0214                      11,2625  57206 1  PUSH    DMPR        TO PDL+6
0215                      11,2626  00005 1          4
02155                     11,2627  77752 1  SL1
0216                      11,2630  43206 1  PUSH    DAD
0217  REP  1              11,2631  23701 0          DQUARTER
0218                      11,2632  75406 1  PUSH    SQRT
0219                      11,2633  41475 1  DMPR    PUSH
0220                      11,2634  00013 0          10D
0221                      11,2635  43352 1  SL1     DAD
0222  REP  2  LAST 1307   11,2636  23701 0          DQUARTER
0223                      11,2637  43325 1  PDDL    DAD         (1/4)+2((Q+1)/4)    TO PD+14D
0224                      11,2640  00013 0          10D
0225  REP  1              11,2641  11454 1          HALFDP
0226                      11,2642  72475 1  DMPR    SL1
0227                      11,2643  00011 1          8D
0228                      11,2644  56215 1  DAD     DDV
0229  REP  1              11,2645  23673 1          THREE/8
0230                      11,2646  00017 1          14D
0231                      11,2647  74275 1  DMPR    VXSC
0232                      11,2650  00007 0          6
0233  REP  11 LAST 1307   11,2651  02160 1          BETAV
0234                      11,2652  64515 1  PDVL    VSR3        (G/2)(C(PD+4))B/2 TO PD+16D
```

```
0235  REP  38  LAST 1307   11,2653  02152 0                ALPHAV
0236                       11,2654  41455 0          VAD   PUSH      A12 + C(PD+16D) TO PD+16D
0237                       11,2655  41345 0          DLOAD DMP
0238                       11,2656  00001 0                0
0239                       11,2657  00015 0                12D
0240                       11,2660  61501 1          NORM  ROUND     -
0241                       11,2661  00037 0                30D
0242                       11,2662  40665 0          BDDV  DMP*
0243                       11,2663  00003 1                2
0244  REP   6  LAST 1302   11,2664  50041 1                MUEARTH,2
0245                       11,2665  74276 1          DCOMP VXSC
0246                       11,2666  57124 1          XCHX,2 XAD,2
0247  REP  50  LAST 1307   11,2667  00050 1                S1
0248  REP  35  LAST 1305   11,2670  00051 0                S2
0249                       11,2671  55064 0          XSU,2 XSU,2
0250                       11,2672  00036 1                30D
0251                       11,2673  00037 0                31D
02513                      11,2674  77600 1          BOV                CLEAR OVIND
02516                      11,2675  22676 0                +1
0252                       11,2676  65057 0          VSR*  XCHX,2
0253                       11,2677  57177 1                0 -1,2
0254  REP  51  LAST 1308   11,2700  00050 1                S1
0255                       11,2701  77655 1          VAD
0256  REP   3  LAST 1305   11,2702  02202 0                PV
0257  REP   4  LAST 1308   11,2703  02202 0          STORE PV
025805                     11,2704  43400 1          BOV   RVQ        RETURN IF NO OVERFLOW
02581                      11,2705  22706 0                +1
025815                     11,2706  54345 1 GOBAQUE  DLOAD SR
02582 REP   2  LAST   87   11,2707  02212 1                H
025825                     11,2710  20612 0                9D
02583                      11,2711  44206 0          PUSH  BDSU
025835 REP  11  LAST 1304  11,2712  01551 1                TC
02584 REP  10  LAST 1304   11,2713  16312 0          STODL TAU
025845 REP  25  LAST 1305  11,2714  01517 0                TET
02585                      11,2715  45425 0          DSU   STADR
025855 REP  28  LAST 1308  11,2716  42260 0          STCALL TET
02586 REP   3  LAST 1304   11,2717  22310 0                KEPPREP
025865                     11,2720  77624 1          CALL
02587 REP   6  LAST 1300   11,2721  23344 0                RECTIFY
025875                     11,2722  77614 1          SETGO
02588 REP   4  LAST 1308   11,2723  04020 1                RPQFLAG
025885 REP  4  LAST 1299   11,2724  27234 1                TESTLOOP
```

```
P0259  THE OBLATE ROUTINE COMPUTES THE ACCELERATION DUE TO OBLATENESS. IT USES THE UNIT OF THE VEHICLE
R0261  POSITION VECTOR FOUND IN ALPHAV AND THE DISTANCE TO THE CENTER IN ALPHAM. THIS IS ADDED TO THE SUM OF THE
R0263  DISTURBING ACCELERATIONS IN PV AND THE PROPER DIFEQ STAGE IS CALLED VIA X1.
 0265                          11,2725  71354 0  OBLATE  LXA,2   DLOAD
 0266  REF  13  LAST 1305     11,2726  02150 1           BODY
 0267  REF   8  LAST 1307     11,2727  02310 1           ALPHAM
 0268                          11,2730  44601 0           SETPD    DSU*
 0269                          11,2731  00001 0                    0
 0270  REF   1                 11,2732  50007 0                    RDE,2
 0271                          11,2733  43044 0           BPL      BOF              GET URPV
 0272  REF   1                 11,2734  23135 1                    NBRANCH
 0273  REF  24  LAST 1306     11,2735  00343 0                    MOONFLAG
 0274  REF   1                 11,2736  23144 1                    COSPHIE
 0275                          11,2737  65375 0           VLOAD    PDDL
 0276  REF  39  LAST 1308     11,2740  02152 0                    ALPHAV
 0277  REF  27  LAST 1308     11,2741  01517 0                    TET
 0278                          11,2742  45125 0           PDDL     CALL
 0279  REF   1                 11,2743  23671 0                    3/5
 0280  REF   4  LAST 1206     11,2744  55366 1                    R-TO-RP
 0284  REF   1                 11,2745  00017 1           STORE    URPV
 0285                          11,2746  47375 0           VLOAD    VXV
 0286  REF   3  LAST 1215     11,2747  02012 0                    504LM
 0287  REF   3  LAST 1287     11,2750  11450 0                    ZUNIT
 0288                          11,2751  61255 1           VAD      VXM
 0289  REF   4  LAST 1309     11,2752  11450 0                    ZUNIT
 0290  REF   8  LAST 1218     11,2753  00025 0                    MMATRIX
 0291                          11,2754  77656 1           UNIT                      POSSIBLY UNNECESSARY
 0292  REF   1                 11,2755  00025 0  COMTERM  STORE    UZ
 0293                          11,2756  57345 1           DLOAD    DMPR
 0294  REF   1                 11,2757  00023 0                    COSPHI/2
 0295  REF   1                 11,2760  23703 1                    3/32
 0296                          11,2761  63525 0           PDDL     DSQ              P2/64 TO PD0
 0297  REF   2  LAST 1309     11,2762  00023 0                    COSPHI/2
 0298                          11,2763  45275 0           DMPR     DSU
 0299  REF   1                 11,2764  23705 1                    15/16
 0300  REF   1                 11,2765  23677 0                    3/64
 0301                          11,2766  57206 1           PUSH     DMPR             P3/32 TO PD2
 0302  REF   3  LAST 1309     11,2767  00023 0                    COSPHI/2
 0303                          11,2770  76405 1           DMP      SL1R
 0304  REF   1                 11,2771  23711 1                    7/12
 0305                          11,2772  57325 1           PDDL     DMPR
 0306                          11,2773  00001 0                    0
 0307  REF   1                 11,2774  23717 1                    2/3
 0308                          11,2775  41421 0           BDSU     PUSH             P4/128 TO PD4
 0309                          11,2776  57275 0           DMPR     DMPR
 0310  REF   4  LAST 1309     11,2777  00023 0                    COSPHI/2         BEGIN COMPUTING P5/1024
 0311  REF   1                 11,3000  23713 0                    9/16
 0312                          11,3001  57325 1           PDDL     DMPR
 0313                          11,3002  00003 1                    2
 0314  REF   1                 11,3003  23715 0                    5/128
```

```
0315                          11,3004  77621 1   BDSU
0316                          11,3005  77603 1   DMP*
0317  REP   1                 11,3006  50035 1             J4REQ/J3,2
0318                          11,3007  43271 1   DDV       DAD                  -3
0319  REP   9  LAST 1309     11,3010  02310 1             ALPHAM     (((P5/256)B 2 /R+P4/32)  /R+P3/8)ALPHAV
0320                          11,3011  00005 1             4                   4              3
0321                          11,3012  56273 1   DMPR*     DDV
0322  REP   1                 11,3013  50031 0             2J3RE/J2,2
0323  REP  10  LAST 1310     11,3014  02310 1             ALPHAM
0324                          11,3015  74215 1   DAD       VXSC
0325                          11,3016  00003 1             2
0326  REP  40  LAST 1309     11,3017  02152 0             ALPHAV
0327  REP   1                 11,3020  14033 1   STODL     TVEC
0328                          11,3021  70403 1   DMP*      SR1
0329  REP   2  LAST 1310     11,3022  50035 1             J4REQ/J3,2
0330                          11,3023  43271 1   DDV       DAD
0331  REP  11  LAST 1310     11,3024  02310 1             ALPHAM                -3
0332                          11,3025  50473 1   DMPR*     SR3
0333  REP   2  LAST 1310     11,3026  50031 0             2J3RE/J2,2      3     4
0334                          11,3027  43271 1   DDV       DAD
0335  REP  12  LAST 1310     11,3030  02310 1             ALPHAM
0336                          11,3031  76561 1   VXSC      VSL1
0337  REP   2  LAST 1309     11,3032  00025 0             UZ
0338                          11,3033  77645 0   BVSU
0339  REP   2  LAST 1310     11,3034  00033 1             TVEC
0340  REP   3  LAST 1310     11,3035  14033 1   STODL     TVEC
0341  REP  13  LAST 1310     11,3036  02310 1             ALPHAM
0342                          11,3037  63501 0   NORM      DSQ
0343  REP  86  LAST 1302     11,3040  00047 1             X1
0344                          11,3041  60316 0   DSQ       NORM
0345  REP  52  LAST 1308     11,3042  00051 0             S1                  4
0346                          11,3043  54606 0   PUSH      BDDV*     NORMED R  TO 0D
0347  REP   1                 11,3044  50025 0             J2REQSQ,2
0348                          11,3045  77761 1   VXSC
0349  REP   4  LAST 1310     11,3046  00033 1             TVEC
0350  REP   5  LAST 1310     11,3047  00033 1   STORE     TVEC
0351                          11,3050  56070 0   XAD,1     XAD,1
0352  REP  87  LAST 1310     11,3051  00046 0             X1
0353  REP  88  LAST 1310     11,3052  00046 0             X1
0354                          11,3053  43070 1   XAD,1     BOF
0355  REP  53  LAST 1310     11,3054  00050 1             S1
0356  REP  25  LAST 1309     11,3055  00343 0             MOONFLAG
0357  REP   1                 11,3056  23125 0             NBRANCH1
0358                          11,3057  63545 0   DLOAD     DSQ                 2
0359  REP   2  LAST 1309     11,3060  00017 1             URPV      X  B-2 TO 2D
0360                          11,3061  63525 0   PDDL      DSQ
0361  REP   3  LAST 1310     11,3062  00021 1             URPV +2           2  2
0362                          11,3063  65215 1   DAD       PDDL      Y +X  B-2 TO 2D
0363                          11,3064  00003 1             2D
0364                          11,3065  45352 1   SL1       DSU
```

```
0365                                11,3066  00003 1                    2D
0366                                11,3067  41525 0          PDDL      PUSH          X -Y  B-2 TO 4D  COSPHI 2 TO 6D
0367  REP   5  LAST 1309           11,3070  00023 0                    COSPHI/2
0368                                11,3071  65361 0          VXSC      PDDL          2COSPHI(UZ) B-3 TO 6D
0369  REP   3  LAST 1310           11,3072  00025 0                    UZ
0370                                11,3073  45316 1          DSQ       DSU
0371  REP   2  LAST 1309           11,3074  23671 0                    3/5                 2   2       2
0372                                11,3075  52405 1          DMP       SL3           (X -Y)((5COS (PHI)-3)UR 2COS(PHI)UZ)
0373  REP   3  LAST 1287           11,3076  27756 0                    5/8
0374                                11,3077  52361 1          VXSC      VSU                 B-3 TO 4D
0375  REP  41  LAST 1310           11,3100  02152 0                    ALPHAV
0376                                11,3101  72561 0          VXSC      VSL2
0377                                11,3102  77725 1          PDDL
0378  REP   4  LAST 1310           11,3103  00017 1                    URPV
0379                                11,3104  63205 0          DMP       PDVL          XY B-2 TO 10D
0380  REP   5  LAST 1311           11,3105  00021 1                    URPV +2
0381  REP  42  LAST 1311           11,3106  02152 0                    ALPHAV
0382                                11,3107  74235 0          VXV       VXSC
0383  REP   4  LAST 1311           11,3110  00025 0                    UZ
0384                                11,3111  53332 0          VSL3      VAD           4XY(UR X UZ) + D( 4D) B-3
0385                                11,3112  77725 1          PDDL
0386                                11,3113  41301 0          NORM      DMP
03861 REP  36  LAST 1256           11,3114  00050 1                    X2
0387                                11,3115  00001 0                    0D            3J22R2MU/(X +Y )R
03871                               11,3116  74265 0          BDDV      VXSC
0388  REP   1                      11,3117  27754 1                    3J22R2MU
0389                                11,3120  53257 1          VSL*      VAD
0390                                11,3121  57605 0                    0 -7,2
0391  REP   6  LAST 1310           11,3122  00033 1                    TVEC
03911                               11,3123  77754 1          LXA,2
03912 REP  14  LAST 1309           11,3124  02150 1                    PBODY
03913                               11,3125  77600 1  NBRANCH1 BOV
03916                               11,3126  23127 1                    +1
0392                                11,3127  53257 1          VSL*      VAD
0393                                11,3130  20153 1                    0 -22D,1
0394  REP   5  LAST 1308           11,3131  02202 0                    PV
0395  REP   6  LAST 1311           11,3132  02202 0          STORE     PV
03953                               11,3133  77600 1          BOV
03956 REP   1                      11,3134  22706 0                    GOBAQUE
0396                                11,3135  72135 0  NBRANCH   SLOAD  LXA,1
0397  REP  23  LAST 1306           11,3136  01501 1                    DIFEQCNT
0398  REP 657  LAST 1299           11,3137  00154 1                    MPAC
0399                                11,3140  73205 1          DMP       GOTO
0400  REP   1                      11,3141  27760 0                    -1/12
0401  REP 658  LAST 1311           11,3142  00155 0                    MPAC
0402  REP   1                      11,3143  23152 0                    DIFEQTAB
0403                                11,3144  77745 1  COSPHIE   DLOAD
0404  REP  43  LAST 1311           11,3145  02156 1                    ALPHAV +4
0405  REP   6  LAST 1311           11,3146  24023 0          STOVL     COSPHI/2
0406  REP   5  LAST 1309           11,3147  11450 0                    ZUNIT
```

```
0407
0408  REF   1
0409  REF   1
0410  REF   1
0411  REF   1
0412
0413  REF   4   LAST 1305
0414  REF   1
0415  REF   22  LAST 1305
0416
04162 REF   17  LAST 1302
04163 REF   10  LAST 1304
04164
04166 REF   2   LAST 1312
0417
0418  REF   26  LAST 1310
0419  REF   1
0420  REF   5   LAST 1308
0421  REF   1
0422
0423  REF   28  LAST 1309
0424  REF   3   LAST 1305
0425  REF   5   LAST 1306
04253
04256 REF   15  LAST 1311
0426
0427  REF   23  LAST 1312
0428
0429  REF   1
0430  REF   1
0434
04345 REF   8   LAST 1289
04346
04347 REF   1
0435
04355 REF   2   LAST  32
0436  REF   2   LAST 1312
04365
0437  REF   3   LAST 1312
04375
0438
04385
0439  REF   1
04395
0440  REF   3   LAST 1312
0441  REF   8   LAST 1289
0442
0443  REF   4   LAST 1312
04431
04432 REF   4   LAST 1312

11,3150  77650 1          GOTO
11,3151  22755 0                COMTERM
11,3152  23371 0  DIFEQTAB CADR  DIFEQ+0
11,3153  23375 1          CADR  DIFEQ+1
11,3154  23406 1          CADR  DIFEQ+2
11,3155  77214 0  TIMESTEP BOF   VLOAD
11,3156  00342 1                MIDFLAG
11,3157  23206 1                RECTEST
11,3160  01535 0                RCV
11,3161  41241 0          DOT   DMP
11,3162  01543 1                VCV
11,3163  02314 0                DT/2          (R,V) X (DELTA T)
11,3164  77640 0          BMN
11,3165  23206 1                RECTEST
11,3166  43014 0          BOF   BOF
11,3167  00303 1                MOONFLAG
11,3170  23263 1                LUNSPH
11,3171  04340 1                RPQFLAG
11,3172  23260 1                EARSPH
11,3173  45145 0          DLOAD CALL
11,3174  01517 0                TET
11,3175  54110 0                LSPOS         RPOV IN MPAC
11,3176  02263 1          STORE RPOV          RPOV
11,3177  77754 1          LXA,2
11,3200  02150 1                PBODY
11,3201  51445 0  INLUNCHK BVSU  ABVAL
11,3202  01535 0                RCV
11,3203  50025 0          DSU   BMN
11,3204  27764 1                RSPHERE
11,3205  23300 0                DOSWITCH
11,3206  51575 1  RECTEST VLOAD  ABVAL         RECTIFY IF
11,3207  01521 0                TDELTAV
11,3210  77600 1          BOV
11,3211  23234 0                CALLRECT
11,3212  51025 1          DSU   BPL
11,3213  23707 0                3/4
11,3214  23234 0                CALLRECT
11,3215  53615 0          DAD   SL*
11,3216  23707 0                3/4
11,3217  57605 0                0 -7,2
11,3220  45271 1          DDV   DSU
11,3221  00013 0                10D
11,3222  27762 1                RECRATIO
11,3223  77244 0          BPL   VLOAD
11,3224  23234 0                CALLRECT
11,3225  01527 0                TNUV
11,3226  45246 0          ABVAL DSU
11,3227  23707 0                3/4
11,3230  77600 1          BOV
11,3231  23234 0                CALLRECT
```

1) EITHER TDELTAV OR TNUV EQUALS OR EXCEEDS 3/4 IN MAGNITUDE

OR

2) ABVAL(TDELTAV) EQUALS OR EXCEEDS .01(ABVAL(RCV))

```
0444                          11,3232  77640 0          BMN
0445  REP  1                 11,3233  23236 1                   INTGRATE
04453                         11,3234  77624 1  CALLRECT CALL
04456 REP  7  LAST 1308       11,3235  23344 0                   RECTIFY
0446                          11,3236  77775 1  INTGRATE VLOAD
0447  REP  9  LAST 1312       11,3237  01527 0                   TNUV
0448  REP  1                 11,3240  25120 0          STOVL    ZV
0449  REP  9  LAST 1312       11,3241  01521 0                   TDELTAV
0450  REP  2  LAST   76       11,3242  01112 1          STORE    VV
0451                          11,3243  77614 1          CLEAR
0452  REP  1                 11,3244  00261 1                   JSWITCH
0453                          11,3245  66375 0  DIPEQ0    VLOAD    SSP
0454  REP  3  LAST 1313       11,3246  01112 1                   VV
0455  REP 24  LAST 1311       11,3247  01501 1                   DIPEQCNT
0456                          11,3250  00000 1                   0
0457  REP 44  LAST 1311       11,3251  16152 0          STODL    ALPHAV
0458  REP  3  LAST 1210       11,3252  11456 0                   DPZERO
0459  REP  3  LAST 1308       11,3253  02212 1          STORE    H          START H AT ZERO. GOES 0(DELT/2)DELT.
0460                          11,3254  52014 0          BON      GOTO
0461  REP  2  LAST 1313       11,3255  00301 0                   JSWITCH
0462  REP  1                 11,3256  23610 1                   DOW..
0463  REP  1                 11,3257  22430 0                   ACCOMP
0464                          11,3260  52175 0  EARSPH   VLOAD    GOTO
04641 REP  6  LAST 1312       11,3261  02263 1                   RPQV
04642 REP  1                 11,3262  23201 0                   INLUNCHK
04643                         11,3263  60545 0  LUNSPH   DLOAD    SR2
04644                         11,3264  00013 0                   10D
04645                         11,3265  50025 0          DSU      BMN
04646 REP  2  LAST 1312       11,3266  27764 1                   RSPHERE
04647 REP  3  LAST 1312       11,3267  23206 1                   RECTEST
04648                         11,3270  71214 0          BOF      DLOAD
04649 REP  6  LAST 1312       11,3271  04340 1                   RPQFLAG
0465  REP  2  LAST 1312       11,3272  23300 0                   DOSWITCH
04651 REP 29  LAST 1312       11,3273  01517 0                   TET
04652                         11,3274  77624 1          CALL
0466  REP  2  LAST  887       11,3275  54115 0                   LUNPOS
0467                          11,3276  77676 0          VCOMP
0468  REP  7  LAST 1313       11,3277  02263 1          STORE    RPQV
0469                          11,3300  77624 1  DOSWITCH CALL
0470  REP  1                 11,3301  23304 1                   ORIGCHNG
0471                          11,3302  77650 1          GOTO
0472  REP  2  LAST 1313       11,3303  23236 1                   INTGRATE
0473                          11,3304  45020 1  ORIGCHNG STQ      CALL
0474  REP  3  LAST   87       11,3305  02270 0                   ORIGEX
0475  REP  8  LAST 1313       11,3306  23344 0                   RECTIFY
0476                          11,3307  53775 1          VLOAD    VSL*
0477  REP 24  LAST 1312       11,3310  01535 0                   RCV
0478                          11,3311  57576 1                   0,2
0479                          11,3312  53651 0          VSU      VSL*
0480  REP  8  LAST 1313       11,3313  02263 1                   RPQV
```

```
0481                          11,3314  57574 0          2,2
0482  REP  13  LAST 1300     11,3315  01503 0   STORE  RRECT
0483  REP  25  LAST 1313     11,3316  15535 0   STODL  RCV
0484  REP  30  LAST 1313     11,3317  01517 0          TST
0485                          11,3320  77624 1   CALL
0486  REP   1                 11,3321  54120 0          LUNVEL
0487                          11,3322  57414 1   BOF    VCOMP
0488  REP  27  LAST 1312     11,3323  00343 0          MOONFLAG
0489                          11,3324  23325 1          +1
0490                          11,3325  53715 1   PDVL   VSL*
0491  REP  18  LAST 1312     11,3326  01543 1          VCV
0492                          11,3327  57576 1          0,2
0493                          11,3330  77651 0   VSU
0494                          11,3331  77657 0   VSL*
0495                          11,3332  57574 0          0 +2,2
0496  REP   9  LAST 1300     11,3333  01511 0   STORE  VRECT
0497  REP  19  LAST 1314     11,3334  01543 1   STORE  VCV
0498                          11,3335  67154 0   LXA,2  SXA,2
0499  REP   4  LAST 1313     11,3336  02270 0          ORIGEX
0500  REP  26  LAST 1294     11,3337  00052 0          QPRET
0501                          11,3340  52014 0   BON    GOTO
0502  REP  28  LAST 1314     11,3341  00303 1          MOONFLAG
0503  REP   2  LAST 1286     11,3342  26666 0          CLRMOON
0504  REP   3  LAST 1286     11,3343  26673 1          SETMOON
```

```
P0505   THE RECTIFY SUBROUTINE IS CALLED BY THE INTEGRATION PROGRAM AND OCCASIONALLY BY THE MEASUREMENT INCORPORATION
R0507   ROUTINES TO ESTABLISH A NEW CONIC.
 0508                          11,3344  77354 0  RECTIFY  LXA,2   VLOAD
 0509   REF  16  LAST 1312     11,3345  02150 1                    PBODY
 0510   REF  10  LAST 1313     11,3346  01521 0                    TDELTAV
 0511                          11,3347  53257 1           VSL*     VAD
 0512                          11,3350  57605 0                    0 -7,2
 0513   REF  26  LAST 1314     11,3351  01535 0                    RCV
 0514   REF  14  LAST 1314     11,3352  01503 0           STORE    RRECT
 0515   REF  27  LAST 1315     11,3353  25535 0           STOVL    RCV
 0516   REF  10  LAST 1313     11,3354  01527 0                    TNUV
 0517                          11,3355  53257 1           VSL*     VAD
 0518                          11,3356  57602 1                    0 -4,2
 0519   REF  20  LAST 1314     11,3357  01543 1                    VCV
 0520   REF  10  LAST 1314     11,3360  01511 0  MINIRECT STORE    VRECT
 0521   REF  21  LAST 1315     11,3361  25543 1           STOVL    VCV
 0522   REF  11  LAST 1305     11,3362  11456 0                    ZEROVEC
 0523   REF  11  LAST 1315     11,3363  01521 0           STORE    TDELTAV
 0524   REF  11  LAST 1315     11,3364  15527 0           STODL    TNUV
 0525   REF  12  LAST 1315     11,3365  11456 0                    ZEROVEC
 0526   REF  12  LAST 1308     11,3366  01551 1           STORE    TC
 0527   REF   3  LAST 1303     11,3367  01553 0           STORE    KKEP
 0528                          11,3370  77616 0           RVQ
```

P0529 THE THREE DIFEQ ROUTINES - DIFEQ+0, DIFEQ+12, AND DIFEQ+24 - ARE ENTEREDTO PROCESS THE CONTRIBUTIONS AT THE
R0531 BEGINNING, MIDDLE, AND END OF THE TIMESTEP, RESPECTIVELY. THE UPDATING IS DONE BY THE NYSTROM METHOD.

```
0533                          11,3371   64575 1  DIFEQ+0  VLOAD   VSR3
0534  REP   7 LAST 1311      11,3372   02202 0           PV
0535  REP   2 LAST   87      11,3373   36166 0           STCALL  PHIV
0536  REP   1                11,3374   23551 1           DIFEQCOM
0537                          11,3375   74575 0  DIFEQ+1  VLOAD   VSR1
0538  REP   8 LAST 1316      11,3376   02202 0           PV
0539                          11,3377   53206 0           PUSH    VAD
0540  REP   3 LAST 1316      11,3400   02166 1           PHIV
0541  REP   2 LAST   87      11,3401   26174 1           STOVL   PSIV
0542                          11,3402   53362 0           VSR1    VAD
0543  REP   4 LAST 1316      11,3403   02166 1           PHIV
0544  REP   5 LAST 1316      11,3404   36166 0           STCALL  PHIV
0545  REP   2 LAST 1316      11,3405   23551 1           DIFEQCOM
0546                          11,3406   57345 1  DIFEQ+2  DLOAD   DMPR
0547  REP   4 LAST 1313      11,3407   02212 1           H
0548  REP   2 LAST 1302      11,3410   23717 1           DP2/3
0549                          11,3411   74206 0           PUSH    VXSC
0550  REP   6 LAST 1316      11,3412   02166 1           PHIV
0551                          11,3413   53372 1           VSL1    VAD
0552  REP   2 LAST 1313      11,3414   01120 0           ZV
0553                          11,3415   53361 0           VXSC    VAD
0554  REP   5 LAST 1316      11,3416   02212 1           H
0555  REP   4 LAST 1313      11,3417   01112 1           YV
0556  REP   5 LAST 1316      11,3420   25112 1           STOVL   YV
0557  REP   9 LAST 1316      11,3421   02202 0           PV
0558                          11,3422   53322 1           VSR3    VAD
0559  REP   3 LAST 1316.     11,3423   02174 1           PSIV
0560                          11,3424   76561 1           VXSC    VSL1
0561                          11,3425   77655 1           VAD
0562  REP   3 LAST 1316      11,3426   01120 0           ZV
0564  REP   4 LAST 1316      11,3427   01120 0           STORE   ZV
0565                          11,3430   45014 0           BOFF    CALL
0566  REP   3 LAST 1313      11,3431   00341 1           JSWITCH
0567  REP   1                11,3432   23502 1           ENDSTATE
0568  REP  23 LAST 1290      11,3433   56741 0           GRP2PC
0569                          11,3434   77354 0           LXA,2   VLOAD
0570  REP   2 LAST   76      11,3435   01102 0           COLREG
0571  REP   5 LAST 1316      11,3436   01120 0           ZV
0572                          11,3437   77732 1           VSL3                    ADJUST W-POSITION FOR STORAGE
0573  REP  70 LAST 1228      11,3440   12467 1           STORE   W +54D,2
0574                          11,3441   77775 1           VLOAD
0575  REP   6 LAST 1316      11,3442   01112 1           YV
0576                          11,3443   40132 0           VSL3    BOV
0577  REP   1                11,3444   23574 0           WMATEND
0578  REP  71 LAST 1316      11,3445   12401 1           STORE   W,2

0579                          11,3446   77624 1           CALL
0580  REP  24 LAST 1316      11,3447   56741 0                   GRP2PC
```

```
0581                          11,3450  66354 0          LXA,2  SSP
0582  REP   3  LAST 1316      11,3451  01102 0                 COLREG
0583  REP  36  LAST 1308      11,3452  00052 0                 S2
0584                          11,3453  00000 1                 0
0585                          11,3454  67114 1          INCR,2 SXA,2
0586                          11,3455  00006 1                 6
0587  REP   7  LAST 1316      11,3456  01111 1                 YV
0588                          11,3457  45104 0          TIX,2  CALL
0589  REP   1                 11,3460  23545 1                 RELOADSV
0590  REP  25  LAST 1316      11,3461  56741 0                 GRP2PC
0591                          11,3462  67154 0          LXA,2  SXA,2
0592  REP   8  LAST 1317      11,3463  01111 1                 YV
0593  REP   4  LAST 1317      11,3464  01102 0                 COLREG

0594                          11,3465  77624 1  NEXTCOL CALL
0595  REP  26  LAST 1317      11,3466  56741 0                 GRP2PC
0596                          11,3467  76754 0          LXA,2  VLOAD*
0597  REP   5  LAST 1317      11,3470  01102 0                 COLREG
0598  REP  72  LAST 1316      11,3471  75376 1                 W,2
0599                          11,3472  77722 0          VSR3                  ADJUST W-POSITION FOR INTEGRATION
0600  REP   9  LAST 1317      11,3473  01112 1          STORE  YV
0601                          11,3474  76173 0          VLOAD* AXT,1
0602  REP  73  LAST 1317      11,3475  75310 1                 W +54D,2
0603                          11,3476  00000 1                 0
0604                          11,3477  77722 0          VSR3                  ADJUST W-VELOCITY FOR INTEGRATION
0605  REP   6  LAST 1316      11,3500  35120 1          STCALL ZV
0606  REP   1                 11,3501  23245 0                 DIFEQ0

0607                          11,3502  77200 0  ENDSTATE BOV    VLOAD
06071 REP   2  LAST 1311      11,3503  22706 0                 GOBAQUE
0608  REP   7  LAST 1317      11,3504  01120 0                 ZV
0609  REP  12  LAST 1315      11,3505  25527 0          STOVL  TNUV
0610  REP  10  LAST 1317      11,3506  01112 1                 YV
0611  REP  12  LAST 1315      11,3507  01521 0          STORE  TDELTAV
0612                          11,3510  43014 0          BON    BOFF
06121 REP   3  LAST 1299      11,3511  04715 0                 MIDAVFLG
06122 REP   1                 11,3512  27653 1                 CKMID2                CHECK FOR MID2 BEFORE GOING TO TIMEINC
0613  REP  19  LAST 1306      11,3513  01756 1                 DIM0FLAG
0614  REP   5  LAST 1308      11,3514  27234 1                 TESTLOOP
06141                         11,3515  77776 1          EXIT
0615  REP  99  LAST 1301      11,3516  0 5301 0         TC     PHASCHNG
0616                          11,3517  04022 0          OCT    04022                 PHASE 1
0617  REP  50  LAST 1290      11,3520  0 5435 0         TC     UPFLAG                PHASE CHANGE HAS OCCURRED BETWEEN
0618  REP   4  LAST 1290      11,3521  00236 0          ADRES  REINTFLG              INTSTALL AND INTWAKE
0620  REP 239  LAST 1301      11,3522  0 6006 1         TC     INTPRET
0621                          11,3523  77731 1          SSP
06215 REP  27  LAST 1314      11,3524  00053 1                 QPRET
0622  REP   1                 11,3525  23532 1                 AMOVED
0623                          11,3526  52014 0          BON    GOTO
0624  REP  20  LAST 1297      11,3527  01714 1                 VINTFLAG
```

```
0625  REP   4  LAST 1301   11,3530   26636 0                    ATOPCSM
0626  REP   4  LAST 1301   11,3531   26711 1                    ATOPLEM
0627                       11,3532   66214 0  AMOVED    SET     SSP
0628  REP   4  LAST 1316   11,3533   00061 0                    JSWITCH
0629  REP   6  LAST 1317   11,3534   01103 1                    COLREG
0630                       11,3535   77741 0           DEC      -30
0631                       11,3536   66214 0           BOFF     SSP
0632  REP   8  LAST 1297   11,3537   01755 1                    D6OR9FLG
0633  REP   1              11,3540   23465 1                    NEXTCOL
0634  REP   7  LAST 1318   11,3541   01103 1                    COLREG
0635                       11,3542   77717 0           DEC      -48
0636                       11,3543   77650 1           GOTO
0637  REP   2  LAST 1318   11,3544   23465 1                    NEXTCOL
0638                       11,3545   77745 1  RELOADSV DLOAD
0639  REP   9  LAST 1299   11,3546   01101 0                    TDEC
0640  REP  55  LAST 1298   11,3547   34041 0           STCALL   TDEC1
0641  REP   1              11,3550   27120 1                    INTEGRV2
0642                       11,3551   43345 1  DIFEQCOM DLOAD   DAD
0643  REP  11  LAST 1312   11,3552   02314 0                    DT/2
0644  REP   6  LAST 1316   11,3553   02212 1                    H
0645                       11,3554   66110 1           INCR,1   SXA,1
0646                       11,3555   77763 0           DEC      -12
0647  REP  25  LAST 1313   11,3556   01500 0                    DIFEQCNT
0648  REP   7  LAST 1318   11,3557   02212 1           STORE    H
0649                       11,3560   74561 0           VXSC     VSR1
0650  REP  10  LAST 1316   11,3561   02202 0                    PV
0651                       11,3562   74255 0           VAD      VXSC
0652  REP   8  LAST 1317   11,3563   01120 0                    ZV
0653  REP   8  LAST 1318   11,3564   02212 1                    H
0654                       11,3565   77655 1           VAD
0655  REP  11  LAST 1317   11,3566   01112 1                    VV
0656  REP  45  LAST 1313   11,3567   02152 0           STORE    ALPHAV
0657                       11,3570   52014 0           BON      GOTO
0658  REP   5  LAST 1318   11,3571   00301 0                    JSWITCH
0659  REP   2  LAST 1313   11,3572   23610 1                    DOW..
0660  REP   1              11,3573   22410 1                    FBR3
0661                       11,3574   43014 0  WMATEND  CLEAR    CLEAR
0662  REP  20  LAST 1317   11,3575   01676 1                    DIM0FLAG
0663  REP  14  LAST 1301   11,3576   01671 0                    ORPWFLAG
06631                      11,3577   77614 1           CLEAR
06632 REP  12  LAST 1301   11,3600   02676 1                    RENDWFLG
0664                       11,3601   77414 0           SET      EXIT
0665  REP   7  LAST 1292   11,3602   01472 1                    STATEFLG
0666  REP  35  LAST 1300   11,3603   0 5537 0          TC       ALARM
0667                       11,3604    00421 0          OCT      421
0668  REP 240  LAST 1317   11,3605   0 6006 1          TC       INTPRET
```

RELOAD TEMPORARY STATE VECTOR
FROM PERMANENT IN CASE OF
BY STARTING AT INTEGRV2.
INCREMENT H AND DIFEQCNT.

DIFEQCNT SET FOR NEXT ENTRY.

DONT INTEGRATE W THIS TIME
INVALIDATE W

PICK UP STATE VECTOR UPDATE

```
0669                        11,3606   77650 1          GOTO
0670   REF   6  LAST 1317   11,3607   27234 1               TESTLOOP      FINISH INTEGRATING STATE VECTOR
```

P0671 ORBITAL ROUTINE FOR EXTRAPOLATION OF THE W MATRIX. IT COMPUTES THE SECOND DERIVATIVE OF EACH COLUMN POSITION
R0673 VECTOR OF THE MATRIX AND CALLS THE NYSTROM INTEGRATION ROUTINES TO SOLVETHE DIFFERENTIAL EQUATIONS. THE PROGRAM
R0675 USES A TABLE OF VEHICLE POSITION VECTORS COMPUTED DURING THE INTEGRATION OF THE VEHICLES POSITION AND VELOCITY.

0677				11,3610	70754 0	DOW..	LXA,2	DLOAD*
0678	REF	17	LAST 1315	11,3611	02150 1			PBODY
0679	REF	7	LAST 1308	11,3612	50041 1			MUEARTH,2
0680	REF	4	LAST 1307	11,3613	36210 1		STCALL	BETAM
0681	REF	1		11,3614	23636 0			DOW..1
0682	REF	11	LAST 1318	11,3615	02202 0		STORE	PV
0683				11,3616	62014 0		BOF	INCR,1
0684	REF	5	LAST 1312	11,3617	00342 1			MIDFLAG
0685	REF	2	LAST 1309	11,3620	23135 1			NBRANCH
0686				11,3621	77771 0		DEC	-6
0687				11,3622	70744 1		LXC,2	DLOAD*
0688	REF	18	LAST 1320	11,3623	02150 1			PBODY
0689	REF	8	LAST 1320	11,3624	50043 0			MUEARTH -2,2
0690	REF	5	LAST 1320	11,3625	36210 1		STCALL	BETAM
0691	REF	2	LAST 1320	11,3626	23636 0			DOW..1
0692				11,3627	50414 0		BON	VSR6
0693	REF	29	LAST 1314	11,3630	00303 1			MOONFLAG
0694				11,3631	23632 1			+1
0695				11,3632	77655 1		VAD	
0696	REF	12	LAST 1320	11,3633	02202 0			PV
0697	REF	13	LAST 1320	11,3634	36202 1		STCALL	PV
0698	REF	3	LAST 1320	11,3635	23135 1			NBRANCH
0699				11,3636	60575 0	DOW..1	VLOAD	VSR4
0700	REF	46	LAST 1318	11,3637	02152 0			ALPHAV
0701				11,3640	53513 0		PDVL*	UNIT
0702	REF	9	LAST 1306	11,3641	02217 1			VECTAB,1
0703				11,3642	46315 1		PDVL	VPROJ
0704	REF	47	LAST 1320	11,3643	02152 0			ALPHAV
0705				11,3644	52361 1		VXSC	VSU
0706	REF	5	LAST 1312	11,3645	23707 0			3/4
0707				11,3646	60325 0		PDDL	NORM
0708				11,3647	00045 0			36D
0709	REF	37	LAST 1317	11,3650	00052 0			S2
0710				11,3651	63406 0		PUSH	DSQ
0711				11,3652	77605 1		DMP	
0712				11,3653	65301 0		NORM	PDDL
0713				11,3654	00043 0			34D
0714	REF	6	LAST 1320	11,3655	02210 0			BETAM
0715				11,3656	56342 1		SR1	DDV
0716				11,3657	77761 1		VXSC	
0717				11,3660	57154 0		LXA,2	XAD,2
0718	REF	38	LAST 1320	11,3661	00051 0			S2
0719	REF	39	LAST 1320	11,3662	00051 0			S2
0720				11,3663	57074 0		XAD,2	XAD,2
0721	REF	40	LAST 1320	11,3664	00051 0			S2
0722				11,3665	00042 1			34D
0723				11,3666	43457 0		VSL*	RVQ

```
0724                        11,3667   57606 0                  0 -8D,2
0725  REF   1               11,2000                  SETLOC ORBITAL1
0726                        11,3670                  BANK

0727                        11,3670   04631 1  3/5     2DEC   .6 B-2
0727                        11,3671   23146 0
0728                        11,3672   14000 1  THREE/8 2DEC   .375
0728                        11,3673   00000 1
0729                        11,3674   02314 0  .3D     2DEC   .3 B-2
0729                        11,3675   31463 1
0730                        11,3676   01400 1  3/64    2DEC   3 B-6
0730                        11,3677   00000 1
0731                        11,3700   10000 0  DP1/4    2DEC   .25
0731                        11,3701   00000 1
0732  REF   2  LAST 1273   11,3700            DQUARTER EQUALS DP1/4
0733  REF   3  LAST 1321   11,3700            POS1/4   EQUALS DP1/4
0734                        11,3702   03000 1  3/32    2DEC   3 B-5
0734                        11,3703   00000 1
0735                        11,3704   36000 1  15/16   2DEC   15. B -4
0735                        11,3705   00000 1
0736                        11,3706   30000 1  3/4     2DEC   3.0 B -2
0736                        11,3707   00000 1
0737                        11,3710   22525 0  7/12    2DEC   .5833333333
0737                        11,3711   12525 0
0738                        11,3712   22000 1  9/16    2DEC   9 B -4
0738                        11,3713   00000 1
0739                        11,3714   01200 1  5/128   2DEC   5 B-7
0739                        11,3715   00000 1
0740  REF  13  LAST 1315   04,3455            DPZERO   EQUALS ZEROVEC
0741                        11,3716   25252 0  DP2/3    2DEC   .6666666667
0741                        11,3717   25253 1
0742  REF   3  LAST 1316   11,3716            2/3      EQUALS DP2/3
07455                       11,3720   00027 1  OCT27    OCT    27
R0746 LM504 IS TEMPORARY
07462                       13,3715                  BANK   13
07463 REF   1               13,2000                  SETLOC ORBITAL2
07464                       13,3715                  BANK
R0747 IT IS VITAL THAT THE FOLLOWING CONSTANTS NOT BE SHUFFLED
0748                        13,3715   77764 1                DEC    -11
0749                        13,3716   77775 1                DEC    -2
0750                        13,3717   77766 0                DEC    -9
0751                        13,3720   77771 0                DEC    -6
0752                        13,3721   77775 1                DEC    -2
0753                        13,3722   77775 1                DEC    -2
0754                        13,3723   00000 1                DEC    0
0755                        13,3724   77763 0                DEC    -12
0756                        13,3725   77766 0                DEC    -9
0757                        13,3726   77773 1                DEC    -4
0758                        13,3727   77770 1  ASCALE        DEC    -7
0759                        13,3730   77771 0                DEC    -6
```

```
0760                    13,3731  27446 1          2DEC*  1.32715445 E16 B-54*     S
0760                    13,3732  14620 0
0761                    13,3733  16471 1          2DEC*  4.9027780 E8 B-30*       M
0761                    13,3734  01352 1
0762                    13,3735  22437 1 MUEARTH  2DEC*  3.986032 E10 B-36*
0762                    13,3736  16067 1
0763                    13,3737  00000 1          2DEC   0
0763                    13,3740  00000 1
0764                    13,3741  02302 1 J4REQ/J3 2DEC*  .4991607391 E7 B-26*
0764                    13,3742  24736 0
0765                    13,3743  00000 1          2DEC   0
0765                    13,3744  00000 1
0766                    13,3745  77776 1 2J3RE/J2 2DEC*  -.1355426363 E5 B-27*
0766                    13,3746  53032 0
0767                    13,3747  10407 0          2DEC*  .3087493316 E18 B-60*
0767                    13,3750  05344 1
0768                    13,3751  13710 0 J2REQSQ  2DEC*  1.75501139 E21 B-72*
0768                    13,3752  35320 0
0769                    13,3753  12160 0 3J22R2MU 2DEC*  9.20479048 E16 B-58*
0769                    13,3754  12124 0
0770                    13,3755  24000 1 5/8      2DEC   5 B-3
0770                    13,3756  00000 1
0771                    13,3757  74631 0 -1/12    2DEC   -.1
0771                    13,3760  63145 1
0772 REP 9 LAST 1320    13,3733          MUM      =      MUEARTH -2
0773                    13,3761  00243 1 RECRATIO 2DEC   .01
0773                    13,3762  32703 1
0774                    13,3763  03654 0 RSPHERE  2DEC   64373 76 E3 B-29
0774                    13,3764  21000 1
0775                    13,3765  03654 0 RDM      2DEC   16093.44 E3 B-27
0775                    13,3766  21000 1
0776                    13,3767  04627 0 RDE      2DEC   80467.20 E3 B-29
0776                    13,3770  25200 1
0777                       0000          RATT     EQUALS 0D
0778                       0006          VATT     EQUALS 6D
0779                       0014          TAT      EQUALS 12D
0780                       0016          RATT1    EQUALS 14D
0781                       0024          VATT1    EQUALS 20D
0782                       0032          MU(P)    EQUALS 26D
0783                       0040          TDEC1    EQUALS 32D
0784                       0016          URPV     EQUALS 14D
0785 REP 6 LAST 1311       0022          COSPHI/2 EQUALS URPV +4
0786                       0024          UZ       EQUALS 20D
0787                       0032          TVEC     EQUALS 26D
```

```
0001                        22,3505                 BANK    22
0002  REF  1                23,2000                 SETLOC  INFLIGHT
0003                        23,3140                 BANK

0004  REF  34  LAST  772    E5,1671                 EBANK=  XSM
R0005 CALCGTA COMPUTES THE GYRO TORQUE ANGLES REQUIRED TO BRING THE STABLE MEMBER INTO THE DESIRED ORIENTATION.

R0007 THE INPUT IS THE DESIRED STABLE MEMBER COORDINATES REFERRED TO PRESENT STABLE MEMBER COORDINATES. THE THREE
R0009 HALF-UNIT VECTORS ARE STORED AT XDC, YDC, AND ZDC.

R0010 THE OUTPUTS ARE THE THREE GYRO TORQUING ANGLES TO BE APPLIED TO THE Y, Z, AND X GYROS AND ARE STORED DP AT IGC,
R0012 MGC, AND OGC RESPECTIVELY.

0013  REF  1                                       COUNT   23/INFLT

0014                        23,3140  71220 1  CALCGTA  ITA     DLOAD           PUSHDOWN  00-03,16D-27D,34D-37D
0015  REF  41  LAST 1320    23,3141  00051 0           S2                      XDC = (XD1 XD2 XD3)
0016  REF  5   LAST  724    23,3142  02714 1           XDC                     YDC = (YD1 YD2 YD3)
0017                        23,3143  65325 0           PDDL    PDDL            ZDC = (ZD1 ZD2 ZD3)
0018  REF  30  LAST 1220    23,3144  15332 1           HI6ZEROS
0019  REF  6   LAST 1323    23,3145  02720 0           XDC +4
0020                        23,3146  55476 1           DCOMP   VDEF
0021                        23,3147  77656 1           UNIT
0022  REF  1                23,3150  14027 1           STODL   ZPRIME          ZP = UNIT(-XD3 0 XD1) = (ZP1 ZP2 ZP3)
0023  REF  2   LAST 1323    23,3151  00027 1           ZPRIME

0024                        23,3152  77742 0           SR1
0025  REF  10  LAST 1210    23,3153  14023 0           STODL   SINTH           SIN(IGC) = ZP1
0026  REF  3   LAST 1323    23,3154  00033 1           ZPRIME +4
0027                        23,3155  77742 0           SR1
0028  REF  9   LAST 1210    23,3156  34021 0           STCALL  COSTH           COS(IGC) = ZP3
0029  REF  5   LAST  838    23,3157  47211 0           ARCTRIG

0030  REF  3   LAST  528    23,3160  16762 0           STODL   IGC             Y GYRO TORQUING ANGLE   FRACTION OF REV.
0031  REF  7   LAST 1323    23,3161  02716 0           XDC +2
0032                        23,3162  77742 0           SR1
0033  REF  11  LAST 1323    23,3163  14023 0           STODL   SINTH           SIN(MGC) = XD2
0034  REF  4   LAST 1323    23,3164  00027 1           ZPRIME

0035                        23,3165  65205 0           DMP     PDDL
0036  REF  8   LAST 1323    23,3166  02720 0           XDC +4          PD00 = (ZP1)(XD3)
0037  REF  5   LAST 1323    23,3167  00033 1           ZPRIME +4

0038                        23,3170  45205 1           DMP     DSU
0039  REF  9   LAST 1323    23,3171  02714 1           XDC             MPAC = (ZP3)(XD1)
0040                        23,3172  77626 0           STADR
0041  REF  10  LAST 1323    23,3173  43756 1           STCALL  COSTH           COS(MGC) = MPAC - PD00
0042  REF  6   LAST 1323    23,3174  47211 0           ARCTRIG
```

```
0043  REP   3  LAST  528   23,3175  26764 0        STOVL  MGC          Z GYRO TORQUING ANGLE  FRACTION OF REV.
0044  REP   6  LAST 1323   23,3176  00027 1               ZPRIME
0045                        23,3177  77641 1        DOT
0046  REP   4  LAST  534   23,3200  02730 1               ZDC
0047  REP  11  LAST 1323   23,3201  24021 1        STOVL  COSTH         COS(OGC) = ZP . ZDC
0048  REP   7  LAST 1324   23,3202  00027 1               ZPRIME
0049                        23,3203  77641 1        DOT
0050  REP   4  LAST  534   23,3204  02722 1               YDC
0051  REP  12  LAST 1323   23,3205  34023 1        STCALL SINTH         SIN(OGC) = ZP . YDC
0052  REP   7  LAST 1323   23,3206  47211 0               ARCTRIG

0053  REP  17  LAST  714   23,3207  36760 0        STCALL OGC           X GYRO TORQUING ANGLE  FRACTION OF REV.
0054  REP  42  LAST 1323   23,3210  00051 0               S2
```

L INFLIGHT ALIGNMENT ROUTINES

R0055 ARCTRIG COMPUTES AN ANGLE GIVEN THE SINE AND COSINE OF THIS ANGLE.

R0056 THE INPUTS ARE SIN/4 AND COS/4 STORED DP AT SINTH AND COSTH.

R0057 THE OUTPUT IS THE CALCULATED ANGLE BETWEEN +.5 AND -.5 REVOLUTIONS AND STORED AT THETA. THE OUTPUT IS ALSO
R0059 AVAILABLE AT MPAC.

```
0060                        23,3211  51545 1  ARCTRIG  DLOAD   ABS          PUSHDOWN  16D-21D
0061  REP  13  LAST 1324    23,3212  00023 0           SINTH
0062                        23,3213  50025 0           DSU     BMN
0063  REP   1               23,3214  07427 1                   OTSN45       ABS(SIN/4) - SIN(45)/4
0064  REP   1               23,3215  47224 0                   TRIG1        IF (-45,45) OR (135,-135)
0065                        23,3216  72545 0           DLOAD   SL1          (45,135) OR (-135,-45)
0066  REP  12  LAST 1324    23,3217  00021 1                   COSTH
0067                        23,3220  75326 1           ACOS    SIGN
0068  REP  14  LAST 1325    23,3221  00023 0                   SINTH
0069  REP   7  LAST 1210    23,3222  00025 0           STORE   THETA        X = ARCCOS(COS) WITH SIGN(SIN)
0070                        23,3223  77616 0           RVQ
0071                        23,3224  72545 0  TRIG1    DLOAD   SL1          (-45,45) OR (135,-135)
0072  REP  15  LAST 1325    23,3225  00023 0                   SINTH
0073                        23,3226  77736 0           ASIN
0074  REP   8  LAST 1325    23,3227  14025 0           STODL   THETA        X = ARCSIN(SIN) WITH SIGN(SIN)
0075  REP  13  LAST 1325    23,3230  00021 1                   COSTH
0076                        23,3231  77640 0           BMN
0077  REP   1               23,3232  47235 0                   TRIG2        IF (135,-135)

0078                        23,3233  43545 1           DLOAD   RVQ
0079  REP   9  LAST 1325    23,3234  00025 0                   THETA        X = ARCSIN(SIN)    (-45,45)
0080                        23,3235  75345 1  TRIG2    DLOAD   SIGN         (135,-135)
0081  REP  12  LAST 1219    23,3236  15330 0                   HIDPHALF
0082  REP  16  LAST 1325    23,3237  00023 0                   SINTH
0083                        23,3240  77625 0           DSU
0084  REP  10  LAST 1325    23,3241  00025 0                   THETA
0085  REP  11  LAST 1325    23,3242  00025 0           STORE   THETA        X = .5 WITH SIGN(SIN) - ARCSIN(SIN)
0086                        23,3243  77616 0           RVQ                                (+) - (+) OR (-) - (-)
```

L INFLIGHT ALIGNMENT ROUTINES

R0087 SMNB, NBSM, AND AXISROT, WHICH USED TO APPEAR HERE, HAVE BEEN
R0088 COMBINED IN A ROUTINE CALLED AX*SR*T, WHICH APPEARS AMONG THE POWERED
R0089 FLIGHT SUBROUTINES.

```
R0090   CALCGA COMPUTES THE CDU DRIVING ANGLES REQUIRED TO BRING THE STABLE MEMBER INTO THE DESIRED ORIENTATION.

R0092   THE INPUTS ARE  1) THE NAVIGATION BASE COORDINATES REFERRED TO ANY COORDINATE SYSTEM. THE THREE HALF-UNIT
R0094   VECTORS ARE STORED AT XNB,YNB, AND ZNB.  2) THE DESIRED STABLE MEMBER COORDINATES REFERRED TO THE SAME
R0096   COORDINATE SYSTEM ARE STORED AT XSM, YSM, AND ZSM.

R0097   THE OUTPUTS ARE THE THREE CDU DRIVING ANGLES AND ARE STORED SP AT THETAD, THETAD +1, AND THETAD +2.
 0099                          23,3244  77601 0  CALCGA   SETPD                PUSHDOWN  00-05, 16D-21D, 34D-37D
 0100                          23,3245  00001 0           0
 0101                          23,3246  47375 0           VLOAD   VXV
 0102   REF  10  LAST  772     23,3247  02714 1           XNB                  XNB = OGA (OUTER GIMBAL AXIS)
 0103   REF   5  LAST  772     23,3250  02700 1           YSM                  YSM = IGA (INNER GIMBAL AXIS)
 0104                          23,3251  41456 0           UNIT    PUSH         PD0 = UNIT(OGA X IGA) = MGA

 0105                          23,3252  44041 1           DOT     ITA
 0106   REF   7  LAST  772     23,3253  02730 1           ZNB
 0107   REF  43  LAST 1324     23,3254  00051 0           S2
 0108   REF  14  LAST 1325     23,3255  24021 1           STOVL   COSTH        COS(OG) = MGA . ZNB
 0109                          23,3256  00001 0           0
 0110                          23,3257  77641 1           DOT
 0111   REF   7  LAST  772     23,3260  02722 1           YNB
 0112   REF  17  LAST 1325     23,3261  34023 1           STCALL  SINTH        SIN(OG) = MGA . YNB
 0113   REF   8  LAST 1324     23,3262  47211 0           ARCTRIG
 0114   REF  18  LAST 1324     23,3263  26760 1           STOVL   OGC
 0115                          23,3264  00001 0           0

 0116                          23,3265  50235 0           VXV     DOT          PROVISION FOR MG ANGLE OF 90 DEGREES
 0117   REF  11  LAST 1327     23,3266  02714 1           XNB
 0118   REF   6  LAST 1327     23,3267  02700 1           YSM
 0119                          23,3270  77752 1           SL1
 0120   REF  15  LAST 1327     23,3271  24021 1           STOVL   COSTH        COS(MG) = IGA . (MGA X OGA)
 0121   REF   7  LAST 1327     23,3272  02700 1           YSM
 0122                          23,3273  77641 1           DOT
 0123   REF  12  LAST 1327     23,3274  02714 1           XNB
 0124   REF  18  LAST 1327     23,3275  34023 1           STCALL  SINTH        SIN(MG) = IGA . OGA
 0125   REF   9  LAST 1327     23,3276  47211 0           ARCTRIG
 0126   REF   4  LAST 1324     23,3277  02764 0           STORE   MGC

 0127                          23,3300  45246 0           ABS     DSU
 0128   REF   1                23,3301  07431 0           .166...
 0129                          23,3302  77644 1           BPL
 0130   REF   1                23,3303  47324 1           GIMLOCK1             IF ANGLE GREATER THAN 60 DEGREES

 0131                          23,3304  50375 0  CALCGA1  VLOAD   DOT
 0132   REF   4  LAST  772     23,3305  02706 1           ZSM
 0133                          23,3306  00001 0           0
 0134   REF  16  LAST 1327     23,3307  24021 1           STOVL   COSTH        COS(IG) = ZSM . MGA
 0135   REF  35  LAST 1323     23,3310  02672 0           XSM
```

```
0136                          23,3311   45441 1          DOT     STADR
0137   REF  19  LAST 1327     23,3312   43754 0          STCALL  SINTH      SIN(IG) = XSM . MGA
0138   REF  10  LAST 1327     23,3313   47211 0                  ARCTRIG

0139   REF   4  LAST 1323.    23,3314   26762 0          STOVL   IGC
0140   REF  19  LAST 1327     23,3315   02760 1                  CGC
0141                          23,3316   43034 1          RTB     BONCLR
01415  REF   5  LAST  535     23,3317   45547 0                  V1STO2S
0142   REF   2  LAST  772     23,3320   00200 0                  CPHIFLAG
01425  REF  44  LAST 1327     23,3321   00051 0                  S2
0143   REF  20  LAST  722     23,3322   35156 0          STCALL  THETAD
0144   REF  45  LAST 1328     23,3323   00051 0                  S2

0145                          23,3324   77776 1  GIMLOCK1 EXIT
0146   REF  36  LAST 1318     23,3325   0 5537 0         TC      ALARM
0147                          23,3326   00401 1          CCT     00401
0148   REF  51  LAST 1317     23,3327   0 5435 0         TC      UPFLAG     GIMBAL LOCK HAS OCCURED
0149   REF   2  LAST  417     23,3330   00056 1          ADRES   GLOKFAIL

0150   REF 241  LAST 1318     23,3331   0 6006 1         TC      INTPRET
0151                          23,3332   77650 1          GOTO
0152   REF   1                23,3333   47304 0                  CALCGA1
```

L INFLIGHT ALIGNMENT ROUTINES USER=S PAGE NO. 1 E5 S3

R0153 AXISGEN COMPUTES THE COORDINATES OF ONE COORDINATE SYSTEM REFERRED TO ANOTHER COORDINATE SYSTEM.

R0155 THE INPUTS ARE 1) THE STAR1 VECTOR REFERRED TO COORDINATE SYSTEM A STORED AT STARAD. 2) THE STAR2 VECTOR
R0157 REFERRED TO COORDINATE SYSTEM A STORED AT STARAD +6. 3) THE STAR1 VECTOR REFERRED TO COORDINATE SYSTEM B STORED
R0159 AT LOCATION 6 OF THE VAC AREA. 4) THE STAR2 VECTOR REFERRED TO COORDINATE SYSTEM B STORED AT LOCATION 12D OF
R0161 THE VAC AREA.

R0162 THE OUTPUT DEFINES COORDINATE SYSTEM A REFERRED TO COORDINATE SYSTEM B. THE THREE HALF-UNIT VECTORS ARE STORED
R0164 AT LOCATIONS XDC, XDC +6, XDC +12D, AND STARAD, STARAD +6, STARAD +12D.

```
0165                        23,3334  66370 0  AXISGEN  AXT,1    SSP          PUSHDOWN  00-30D,34D-37D
0166  REF  11  LAST  738    23,3335  02743 0              STARAD +6
0167  REF  54  LAST 1310    23,3336  00051 0              S1
0168  REF  12  LAST 1329    23,3337  02727 1              STARAD -6

0169                        23,3340  77601 0          SETPD
0170                        23,3341  00001 0              0
0171                        23,3342  46773 0  AXISGEN1 VLOAD*  VXV*          06D   UA = S1
0172  REF  13  LAST 1329    23,3343  02752 0              STARAD +12D,1          STARAD +00D   UB = S1
0173  REF  14  LAST 1329    23,3344  02760 1              STARAD +18D,1
0174                        23,3345  77656 1          UNIT                   12D   VA = UNIT(S1 X S2)
0175  REF  15  LAST 1329    23,3346  06760 0          STORE   STARAD +18D,1        STARAD +06D   VB = UNIT(S1 X S2)
0176                        23,3347  77773 1          VLOAD*
0177  REF  16  LAST 1329    23,3350  02752 0              STARAD +12D,1

0178                        23,3351  76433 1          VXV*    VSL1
0179  REF  17  LAST 1329    23,3352  02760 1              STARAD +18D,1   18D   WA = UA X VA
0180  REF  18  LAST 1329    23,3353  06766 0          STORE   STARAD +24D,1        STARAD +12D   WB = UB X VB

0181                        23,3354  77700 0          TIX,1
0182  REF   1               23,3355  47342 1              AXISGEN1

0183                        23,3356  66160 0          AXC,1   SXA,1
0184                        23,3357  00006 1              6
0185                        23,3360  00036 1              30D

0186                        23,3361  66370 0          AXT,1   SSP
0187                        23,3362  00022 1              18D
0188  REF  55  LAST 1329    23,3363  00051 0              S1
0189                        23,3364  00006 1              6

0190                        23,3365  66374 1          AXT,2   SSP
0191                        23,3366  00006 1              6
0192  REF  46  LAST 1328    23,3367  00052 0              S2
0193                        23,3370  00002 0              2

0194                        23,3371  78720 0  AXISGEN2 XCHX,1 VLOAD*
0195                        23,3372  00036 1              30D          X1=-6 X2=+6   X1=-6 X2=+4   X1=-6 X2=+2
0196                        23,3373  00001 0              0,1
```

L INFLIGHT ALIGNMENT ROUTINES


```
0197
0198  REP  19  LAST 1329   23,3374  62757 0          VXSC*  PDVL*          J=(UA)(UB1)  J=(UA)(UB2)  J=(UA)(UB3)
0199                       23,3375  75033 0                 STARAD +6,2
0200                       23,3376  00007 0                 6,1
0201  REP  20  LAST 1330   23,3377  77757 1          VXSC*
0202                       23,3400  75025 1                 STARAD +12D,2
0203                       23,3401  30031 0          STOVL* 24D          K=(VA)(VB1)  J=(VA)(VB2)  J=(VA)(VB3)
                           23,3402  00015 0                 12D,1
0204
0205  REP  21  LAST 1330   23,3403  53357 0          VXSC*  VAD
0206                       23,3404  75017 0                 STARAD +18D,2  L=(WA)(WB1)  J=(WA)(WB2)  J=(WA)(WB3)
0207                       23,3405  76455 1          VAD    VSL1
0208                       23,3406  00031 0                 24D
0209                       23,3407  53520 0          XCHX,1 UNIT
0210  REP  10  LAST 1323   23,3410  00036 1                 30D
                           23,3411  06736 0          STORE  XDC +18D,1      XDC = L+J+K  YDC = L+J+K  ZDC = L+J+K
0211
0212  REP  1               23,3412  77700 0          TIX,1
                           23,3413  47414 0                 AXISGEN3
0213
0214  REP  1               23,3414  77704 1  AXISGEN3 TIX,2
                           23,3415  47371 1                 AXISGEN2
0215
0216  REP  11  LAST 1330   23,3416  77775 1          VLOAD
0217  REP  22  LAST 1330   23,3417  02714 1                 XDC
0218  REP  5   LAST 1324   23,3420  26736 1          STOVL  STARAD
0219  REP  23  LAST 1330   23,3421  02722 1                 YDC
0220  REP  5   LAST 1324   23,3422  26744 1          STOVL  STARAD +6
0221  REP  24  LAST 1330   23,3423  02730 1                 ZDC
                           23,3424  02752 0          STORE  STARAD +12D
0222
                           23,3425  77616 0          RVQ
```

```
0281                    23,3426   05520 0  QTSN45   2DEC    .1768
0281                    23,3427   26075 1
0282                    23,3430   05252 1  .166...  2DEC    .1666666667
0282                    23,3431   25253 1
```

L POWERED FLIGHT SUBROUTINES USER=S PAGE NO. 1 E0 S3

```
0001                    14,3405          BANK   14          SAME FBANK AS THE FINDCDUD SUB-PROGRAM
0002  REF  1            23,2000          SETLOC POWFLITE
0003                    23,3432          BANK

0004  REF  1              0142           EBANK= DEXDEX
0005  REF  1                             COUNT* $$/POWFL
```

R0006 CDUTRIG, CDUTRIG$_1$, CDUTRIG$_2$, AND CD*TR*GS ALL COMPUTE THE SINES AND
R0007 COSINES OF THREE 2=S COMPLEMENT ANGLES AND PLACE THE RESULT, DOUBLE
R0008 PRECISION, IN THE SAME ORDER AS THE INPUTS, AT SINCDU AND COSCDU. AN
R0009 ADDITIONAL OUTPUT IS THE 1=S COMPLEMENT ANGLES AT CDUSPOT. THESE
R0010 ROUTINES GO OUT OF THEIR WAY TO LEAVE THE MPAC AREA AS THEY FIND IT,
R0011 EXCEPT FOR THE GENERALLY UNIMPORTANT MPAC +2. THEY DIFFER ONLY IN
R0012 WHERE THEY GET THE ANGLES, AND IN METHOD OF CALLING.

R0013 CDUTRIG (AND CDUTRIG$_1$, WHICH CAN BE CALLED IN BASIC) COMPUTE THE
R0014 SINES AND COSINES FROM THE CURRENT CONTENTS OF THE CDU REGISTERS.
R0015 THE CONTENTS OF CDUTEMP, ETC., ARE NOT TOUCHED SO THAT THEY MAY
R0016 CONTINUE TO FORM A CONSISTENT SET WITH THE LATEST PIPA READINGS.

R0017 CDUTRIG$_1$ IS LIKE CDUTRIG EXCEPT THAT IT CAN BE CALLED IN BASIC.

R0018 CD*TR*GS FINDS CDU VALUES IN CDUSPOT RATHER THAN IN CDUTEMP. THIS
R0019 ALLOWS USERS TO MAKE TRANSFORMATIONS USING ARBITRARY ANGLES, OR REAL
R0020 ANGLES IN AN ORDER OTHER THAN X Y Z. A CALL TO THIS ROUTINE IS
R0021 NECESSARY IN PREPARATION FOR A CALL TO AX*SR*T IN EITHER OF ITS TWO
R0022 MODES (SMNB OR NBSM). SINCE AX*SR*T EXPECTS TO FIND THE SINES AND
R0023 COSINES IN THE ORDER Y Z X THE ANGLES MUST HAVE BEEN PLACED IN CDUSPOT
R0024 IN THIS ORDER. CD*TR*GS NEED NOT BE REPEATED WHEN AX*SR*T IS CALLED
R0025 MORE THAN ONCE, PROVIDED THE ANGLES HAVE NOT CHANGED. NOTE THAT SINCE
R0026 IT CLOBBERS BUF$_2$ (IN THE SINE AND COSINE ROUTINES) CD*TR*GS CANNOT BE
R0027 CALLED USING BANKCALL. SORRY.

R0028 CD*TR*G IS LIKE CD*TR*GS EXCEPT THAT IT CAN BE CALLED IN
R0029 INTERPRETIVE.

```
0030                    23,3432   77776 1  CDUTRIG  EXIT
0031  REF  1            23,3433   0 3442 0           TC      CDUTRIGS
0032  REF 242  LAST 1328 23,3434   0 6006 1           TC      INTPRET
0033                    23,3435    77616 0           RVQ

0034                    23,3436   77776 1  CD*TR*G  EXIT
0035  REF  1            23,3437   0 3450 0           TC      CD*TR*GS
0036  REF 243  LAST 1333 23,3440   0 6006 1           TC      INTPRET
0037                    23,3441    77616 0           RVQ

0038  REF  28  LAST 1034 23,3442   3 0032 0  CDUTRIGS CA      CDUX
0039  REF   6  LAST  535 23,3443   54 772 1           TS      CDUSPOT +4
0040  REF  16  LAST 1034 23,3444   3 0033 1           CA      CDUY
0041  REF   7  LAST 1333 23,3445   54 766 1           TS      CDUSPOT
```

```
0042  REF  22  LAST 1034   23,3446  3 0034 0          CA    CDUZ
0043  REF   8  LAST 1333   23,3447  54 770 0          TS    CDUSPOT +2

0044                       23,3450  0 0006 1  CD*TR*GS EXTEND
0045  REF   4  LAST   69   23,3451  22 142 0          QXCH  TEM2
0046  REF  17  LAST 1152   23,3452  3 4710 0          CAF   FOUR
0047  REF  37  LAST 1122   23,3453  7 6211 1  TR*GL**P MASK  SIX          MAKE IT EVEN AND SMALLER
0048  REF   3  LAST   69   23,3454  54 143 0          TS    TEM3
0049  REF   4  LAST 1334   23,3455  50 143 1          INDEX TEM3
0050  REF   9  LAST 1334   23,3456  3 0766 0          CA    CDUSPOT
0051  REF 659  LAST 1311   23,3457  52 155 1          DXCH  MPAC         STORING 2*S COMP ANGLE, LOADING MPAC
0052  REF  53  LAST 1148   23,3460  52 127 1          DXCH  VBUF +4      STORING MPAC FOR LATER RESTORATION
0053  REF   1              23,3461  0 4652 1          TC    USPRCADR
0054  REF  10  LAST  837   23,3462   45510 1          CADR  CDULOGIC
0055                       23,3463  0 0006 1          EXTEND
0056  REF 660  LAST 1334   23,3464  3 0155 0          DCA   MPAC
0057  REF   5  LAST 1334   23,3465  50 143 1          INDEX TEM3
0058  REF  10  LAST 1334   23,3466  52 767 0          DXCH  CDUSPOT      STORING 1*S COMPLEMENT ANGLE
0059  REF   2  LAST 1334   23,3467  0 4652 1          TC    USPRCADR
0060  REF   2  LAST 1088   23,3470   01516 1          CADR  COSINE
0061  REF 661  LAST 1334   23,3471  52 155 1          DXCH  MPAC
0062  REF   6  LAST 1334   23,3472  50 143 1          INDEX TEM3
0063  REF   4  LAST   72   23,3473  52 745 0          DXCH  COSCDU       STORING COSINE
0064                       23,3474  0 0006 1          EXTEND
0065  REF   7  LAST 1334   23,3475  5 0143 1          INDEX TEM3
0066  REF  11  LAST 1334   23,3476  3 0767 1          DCA   CDUSPOT      LOADING 1*S COMPLEMENT ANGLE
0067  REF   3  LAST 1334   23,3477  0 4652 1          TC    USPRCADR
0068  REF   2  LAST 1088   23,3500   01530 0          CADR  SINE +1      SINE +1 EXPECTS ARGUMENT IN A AND L
0069  REF  54  LAST 1334   23,3501  52 127 1          DXCH  VBUF +4      BRINGING UP PRIOR MPAC TO BE RESTORED
0070  REF 662  LAST 1334   23,3502  52 155 1          DXCH  MPAC
0071  REF   8  LAST 1334   23,3503  50 143 1          INDEX TEM3
0072  REF   4  LAST   72   23,3504  52 737 0          DXCH  SINCDU
0073  REF   9  LAST 1334   23,3505  10 143 0          CCS   TEM3
0074  REF   1              23,3506  1 3453 1          TCF   TR*GL**P
0075  REF   5  LAST 1334   23,3507  0 0142 0          TC    TEM2
```

F0076 **********

R0078 QUICTRIG, INTENDED FOR GUIDANCE CYCLE USE WHERE TIME IS CRITICAL, IS A MUCH FASTER VERSION OF CD*TR*GS.
R0080 QUICTRIG COMPUTES AND STORES THE SINES AND COSINES OF THE 2=S COMPLEMENT ANGLES AT CDUSPOT, CDUSPOT +2,
R0082 AND CDUSPOT +4. UNLIKE CD*TR*GS, QUICTRIG DOES NOT LEAVE THE 1=S COMPLEMENT VERSIONS OF THE ANGLES IN
R0084 CDUSPOT. QUICTRIG=S EXECUTION TIME IS 4.1 MS

02036 CALLED FROM INTERPRETIVE AS AN RTB OP-CODE, OR FROM BASIC VIA BANKCALL OR IBNKCALL.

```
02039                          23,3510  0 0004 0  QUICTRIG INHINT                INHINT SINCE DAP USES THE SAME TEMPS
02041                          23,3511  0 0006 1           EXTEND
02042  REF  11  LAST  225      23,3512  22 061 0           QXCH   ITEMP1
02091  REF  18  LAST 1334      23,3513  3 4710 0           CAF    FOUR
02092  REF  38  LAST 1334      23,3514  7 6211 1     +4    MASK   SIX
02093  REF  10  LAST  223      23,3515  54 062 1           TS     ITEMP2
02094  REF  11  LAST 1335      23,3516  50 062 0           INDEX  ITEMP2
02095  REF  12  LAST 1334      23,3517  3 0766 0           CA     CDUSPOT
02096  REF   8  LAST 1044      23,3520  0 4770 0           TC     SPSIN
02097                          23,3521  0 0006 1           EXTEND
02098  REF  73  LAST 1205      23,3522  7 4675 0           MP     BIT14              SCALE DOWN TO MATCH INTERPRETER OUTPUTS
02099  REF  12  LAST 1335      23,3523  50 062 0           INDEX  ITEMP2
02100  REF   5  LAST 1334      23,3524  52 737 0           DXCH   SINCDU
02101  REF  13  LAST 1335      23,3525  50 062 0           INDEX  ITEMP2
02102  REF  13  LAST 1335      23,3526  3 0766 0           CA     CDUSPOT
02103  REF   7  LAST 1044      23,3527  0 4767 0           TC     SPCOS
02104                          23,3530  0 0006 1           EXTEND
02105  REF  74  LAST 1335      23,3531  7 4675 0           MP     BIT14
02106  REF  14  LAST 1335      23,3532  50 062 0           INDEX  ITEMP2
02107  REF   5  LAST 1334      23,3533  52 745 0           DXCH   COSCDU
02108  REF  15  LAST 1335      23,3534  10 062 1           CCS    ITEMP2
02109  REF   2  LAST  661      23,3535  1 3514 0           TCF    QUICTRIG +4
02091  REF  12  LAST 1335      23,3536  3 0061 0           CA     ITEMP1
02110                          23,3537  0 0003 1           RELINT
02111  REF 341  LAST 1294      23,3540  0 0000 1           TC     A
```

```
R0111  ********************************************************************************************************************
R0113      THESE INTERFACE ROUTINES MAKE IT POSSIBLE TO CALL AX*SR*T, ETC., IN
R0114  INTERPRETIVE.  LATER, WHERE POSSIBLE, THEY WILL BE ELIMINATED.

R0115      NBSM WILL BE THE FIRST TO GO.  IT SHOULD NOT BE USED.

 0116                          23,3541  77620 0  NBSM    STQ
 0117  REF  37  LAST 1311     23,3542  00047 1           X2
 0118                          23,3543  76740 0          LXC,1  VLOAD*
 0119  REF  56  LAST 1329     23,3544  00050 1           S1          BASE ADDRESS OF THE CDU ANGLES IS IN S1
 0120                          23,3545  00001 0           0,1
 0121  REF  14  LAST 1335     23,3546  24767 1          STOVL  CDUSPOT
 0122                          23,3547  00041 1           32D         VECTOR TO BE TRANSFORMED IS IN 32D
 0123                          23,3550  77624 1          CALL
 0124  REF   2  LAST  447     23,3551  47572 1           TRG*NBSM
 0125                          23,3552  34041 0          STCALL 32D    SINCE THERE'S NO STGOTO
 0126  REF  38  LAST 1336     23,3553  00047 1           X2

R0127      THESE INTERFACE ROUTINES ARE PERMANENT.  ALL RESTORE USER'S EBANK
R0128  SETTING.  ALL ARE STRICT INTERPRETIVE SUBROUTINES, CALLED USING 'CALL',
R0129  RETURNING VIA QPRET.  ALL EXPECT AND RETURN THE VECTOR TO BE TRANSFOR-
R0130  MED INTERPRETER-STYLE IN MPAC
```

R0131 TRG*SMNB AND TRG*NBSM BOTH EXPECT TO SEE THE 2*S COMPLEMENT ANGLES
R0132 AT CDUSPOT (ORDER Y Z X, AT CDUSPOT, CDUSPOT +2, AND CDUSPOT +4

R0133 LOCATIONS NEED NOT BE ZEROED). TRG=NBSM DOES THE NB TO SM TRANSFOR-
R0134 MATION

```
R0135       CDU*NBSM DOES ITS TRANSFORMATION USING THE PRESENT CONTENTS OF
R0136   THE CDU COUNTERS.   OTHERWISE IT IS LIKE TRG*NBSM.

R01361      CDU*SMNB IS THE COMPLEMENT OF CDU*NBSM.

01362                          23,3554   77776 1  CDU*SMNB EXIT
01363   REP   2  LAST 1333    23,3555   0 3442 0           TC     CDUTRIGS
01364   REP   1                23,3556   1 3561 1           TCF    C*M*N1

0137                           23,3557   77776 1  TRG*SMNB EXIT
0138    REP   2  LAST 1333    23,3560   0 3450 0           TC     CD*TR*GS
0139    REP   3  LAST 1145    23,3561   0 7501 1  C*M*N1   TC     MPAC,VBUF     AX*SR*T EXPECTS VECTOR IN VBUF
0140    REP  42  LAST 1174    23,3562   4 6214 1           CS     THREE         SIGNAL FOR SM TO NB TRANSFORMATION
0141    REP   1                23,3563   0 3603 1  C*M*N2   TC     AX*SR*T
0142    REP 244  LAST 1333    23,3564   0 6006 1           TC     INTPRET
0143                           23,3565   43575 1           VLOAD  RVQ
0144    REP  55  LAST 1334    23,3566    00123 1                  VBUF

0145                           23,3567   77776 1  CDU*NBSM EXIT
0146    REP   3  LAST 1336    23,3570   0 3442 0           TC     CDUTRIGS
```

```
0147  REF  1                23,3571  1 3574 0          TCF    C*M*M*N3

0148                        23,3572   77776 1  TRG*NBSM EXIT
0149  REF  3  LAST 1336    23,3573   0 3450 0          TC     CD*TR*GS
0150  REF  4  LAST 1336    23,3574   0 7501 1  C*M*M*N3 TC     MPACVBUF      FOR AX*SR*T
0151  REF  43 LAST 1336    23,3575   3 6214 0          CA     THREE         SIGNAL FOR NB TO SM TRANSFORMATION
0152  REF  1               23,3576   1 3563 0          TCF    C*M*M*N2

R0153      *NBSM* AND *SMNB* EXPECT TO SEE THE SINES AND COSINES (AT SINCDU
R0154  AND COSCDU) RATHER THAN THE ANGLES THEMSELVES.  OTHERWISE THEY ARE
R0155  LIKE TRG*NBSM AND TRG*SMNB.

R0156      NOTE THAT JUST AS CD*TR*GS NEED BE CALLED ONLY ONCE FOR EACH SERIES
R0157  OF TRANSFORMATIONS USING THE SAME ANGLES, SO TOO ONLY ONE OF TRG*NBSM
R0158  AND TRG*SMNB NEED BE CALLED FOR EACH SERIES.  FOR SUBSEQUENT TRANSFOR-
R0159  MATIONS USE *NBSM* AND *SMNB*.

0160                        23,3577   77776 1  *SMNB*  EXIT
0161  REF  2  LAST 1336    23,3600   1 3561 1          TCF    C*M*M*N1

0162                        23,3601   77776 1  *NBSM*  EXIT
0163  REF  2  LAST 1337    23,3602   1 3574 0          TCF    C*M*M*N3

R0164      AX*SR*T COMBINES THE OLD SMNB AND NBSM.  FOR THE NB TO SM
R0165  TRANSFORMATION, ENTER WITH +3 IN A.  FOR SM TO NB, ENTER WITH -3.
R0166  THE VECTOR TO BE TRANSFORMED ARRIVES, AND IS RETURNED, IN VBUF.
R0167  AX*SR*T EXPECTS TO FIND THE SINES AND COSINES OF THE ANGLES OF ROTATION
R0168  AT SINCDU AND COSCDU, IN THE ORDER Y Z X.  A CALL TO CD*TR*GS, WITH
R0169  THE 2*S COMPLEMENT ANGLES (ORDER Y Z X) AT CDUSPOT, WILL TAKE CARE OF
R0170  THIS.  HERE IS A SAMPLE CALLING SEQUENCE'-

R0171                              TC     CDUTRIGS
R0172                              CS     THREE      (βCA  THREEβ FOR NBSM)
R0173                              TC     AX*SR*T

R0174  THE CALL TO CD*TR*GS NEED NOT BE REPEATED, WHEN AX*SR*T IS CALLED MORE
R0175  THAN ONCE, UNLESS THE ANGLES HAVE CHANGED.

R0176      AX*SR*T IS GUARANTEED SAFE ONLY FOR VECTORS OF MAGNITUDE LESS THAN
R0177  UNITY.  A LOOK AT THE CASE IN WHICH A VECTOR OF GREATER MAGNITUDE
R0178  HAPPENS TO LIE ALONG AN AXIS OF THE SYSTEM TO WHICH IT IS TO BE TRANS-
R0179  FORMED CONVINCES ONE THAT THIS IS A RESTRICTION WHICH MUST BE ACCEPTED.

0180  REF  2  LAST 1333    23,3603  54 142 1  AX*SR*T  TS     DEXDEX        WHERE IT BECOMES THE INDEX OF INDEXES
0181                        23,3604  0 0006 1           EXTEND
0182  REF  1               23,3605  22 145 1           QXCH   RTNSAVER

0183  REF  3  LAST 1337    23,3606  10 142 1  R*TL**P  CCS    DEXDEX              +3 --δ 0    -3 --δ 2
0184  REF  4  LAST 1337    23,3607  4 0142 1           CS     DEXDEX      THUS'   +2 --δ 1    -2 --δ 1
0185  REF  44 LAST 1337    23,3610  6 6214 0           AD     THREE               +1 --δ 2    -1 --δ 0
```

```
0186
0187  REF 342  LAST 1335    23,3611  0 0006 1          EXTEND
0188  REF   1               23,3612  5 0000 1          INDEX  A
0189  REF   1               23,3613  3 3672 1          DCA    INDEXI
                            23,3614  52 144 1          DXCH   DEXI

0190  REF 156  LAST 1295    23,3615  3 4712 1          CA     ONE
0191  REF 122  LAST 1189    23,3616  54 130 1          TS     BUF
0192                        23,3617  0 0006 1          EXTEND
0193  REF   2  LAST  69     23,3620  5 0143 1          INDEX  DEX1
0194  REF  56  LAST 1336    23,3621  4 0123 0          DCS    VBUF
0195  REF   1               23,3622  1 3624 0          TCF    LOOP1          REALLY BE A SUBTRACT, AND VICE VERSA

0196  REF 123  LAST 1338    23,3623  52 131 0  LOOP2    DXCH   BUF            LOADING VECTOR COMPONENT, STORING INDEX

0197  REF 663  LAST 1334    23,3624  52 155 1  LOOP1    DXCH   MPAC
0198  REF   1               23,3625  3 3670 0          CA     SINESLOC
0199  REF   3  LAST 1338    23,3626  6 0143 1          AD     DEX1
0200  REF  78  LAST 1151    23,3627  54 116 0          TS     ADDRWD

0201  REF  21  LAST 1160    23,3630  0 7056 0          TC     DMPSUB         MULTIPLY BY SIN(CDUANGLE)
0202  REF   5  LAST 1337    23,3631  10 142 1          CCS    DEXDEX
0203  REF 664  LAST 1338    23,3632  52 155 1          DXCH   MPAC           NBSM CASE
0204                        23,3633  1 3636 0          TCF    +3
0205                        23,3634  0 0006 1          EXTEND                SMNB CASE
0206  REF 665  LAST 1338    23,3635  4 0155 1          DCS    MPAC
0207  REF   1               23,3636  52 134 0          DXCH   TERM1TMP

0208  REF  39  LAST 1335    23,3637  3 6211 0          CA     SIX            SINCDU AND COSCDU (EACH 6 WORDS) MUST
0209  REF  79  LAST 1338    23,3640  26 116 0          ADS    ADDRWD           BE CONSECUTIVE AND IN THAT ORDER

0210                        23,3641  0 0006 1          EXTEND
0211  REF 124  LAST 1338    23,3642  5 0130 0          INDEX  BUF
0212  REF   4  LAST 1338    23,3643  5 0143 1          INDEX  DEX1
0213  REF  57  LAST 1338    23,3644  3 0123 1          DCA    VBUF
0214  REF 666  LAST 1338    23,3645  52 155 1          DXCH   MPAC
0215  REF  22  LAST 1338    23,3646  0 7056 0          TC     DMPSUB         MULTIPLY BY COS(CDUANGLE)
0216  REF 667  LAST 1338    23,3647  52 155 1          DXCH   MPAC
0217  REF   2  LAST 1338    23,3650  20 134 0          DAS    TERM1TMP
0218  REF   3  LAST 1338    23,3651  52 134 0          DXCH   TERM1TMP
0219                        23,3652  20 001 1          DDOUBL
0220  REF 125  LAST 1338    23,3653  50 130 0          INDEX  BUF
0221  REF   5  LAST 1338    23,3654  50 143 1          INDEX  DEX1
0222  REF  58  LAST 1338    23,3655  52 123 0          DXCH   VBUF
0223  REF 126  LAST 1338    23,3656  52 131 0          DXCH   BUF            LOADING INDEX, STORING VECTOR COMPONENT

0224  REF 343  LAST 1338    23,3657  10 000 0          CCS    A              'CAUSE THAT'S WHERE THE INDEX NOW IS
0225  REF   1               23,3660  1 3623 1          TCF    LOOP2

0226                        23,3661  0 0006 1          EXTEND
0227  REF   6  LAST 1338    23,3662  26 142 1          DIM    DEXDEX         DECREMENT MAGNITUDE PRESERVING SIGN
```

L POWERED FLIGHT SUBROUTINES USER=S PAGE NO. 7 E0 83

```
0228  REF  7  LAST 1338   23,3663  10 142 1  TSTPOINT CCS    DEXDEX     ONLY THE BRANCHING FUNCTION IS USED
0229  REF  1              23,3664  1 3606 0            TCF    R*TL**P
0230  REF  2  LAST 1337   23,3665  0 0145 1            TC     RINSAVER
0231  REF  2  LAST 1339   23,3666  1 3606 0            TCF    R*TL**P
0232  REF  3  LAST 1339   23,3667  0 0145 1            TC     RINSAVER
0233  REF  6  LAST 1335   23,3670   00736 0  SINESLOC ADRES  SINCDU     FOR USE IN SETTING ADDRWD
0234                       23,3671   00004 0  INDEXI   DEC    4          ********** DON=T **********
0235                       23,3672   00002 0           DEC    2          ********** TOUCH **********
0236                       23,3673   00000 1           DEC    0          ********** THESE **********
0237                       23,3674   00004 0           DEC    4          ********** CONSTANTS **********
R0238  ************************************************************************************************************
```

```
P0240   THIS SUBROUTINE COMPUTES INCREMENTAL CHANGES IN CDU(GIMBAL) ANGLES FROM INCREMENTAL CHANGES ABOUT SM AXES. IT
R0242   REQUIRES SM INCREMENTS AS A DP VECTOR SCALED AT ONE REVOLUTION(DTHETASM,+2,+4). SIN,COS(CDUY,Z,X) ARE IN
R0244   SINCDU,+2,+4 AND COSCDU,+2,+4 RESPECTIVELY,SCALED TO ONE HALF. CDU INCREENTS ARE PLACED IN DCDU,+2,+4 SCALED TO
R0246   ONE REVOLUTION.

R0247           *  COS(IGA)SEC(MGA)          0        -SIN(IGA)SEC(MGA) *
R0248           *                                                        *
R0249           * -COS(IGA)TAN(MGA)          1         SIN(IGA)TAN(MGA) *
R0250           *                                                        *
R0251           *       SIN(IGA)            0             COS(IGA)      *

0252                                  14,3405                   BANK    14
0253    REP   1                       23,2000                   SETLOC  POSFLIT1
0254                                  23,3675                   BANK
0255                                  23,3675   41345 0 SMCDURES DLOAD   DMP
0256    REP   7  LAST  584            23,3676   03212 0                  DTHETASM
0257    REP   4  LAST  718            23,3677   00745 1                  COSCDUY

0258                                  23,3700   41325 0          PDDL    DMP
0259    REP   8  LAST 1340            23,3701   03216 1                  DTHETASM +4
0260    REP   4  LAST  718            23,3702   00737 1                  SINCDUY

0261                                  23,3703   77621 1          BDSU
0262                                  23,3704   77671 1          DDV
0263    REP   7  LAST  930            23,3705   00747 0                  COSCDUZ
0264    REP   6  LAST  586            23,3706   03204 1          STORE   DCDU

0265                                  23,3707   72405 0          DMP     SL1             SCALE
0266    REP   4  LAST  718            23,3710   00741 0                  SINCDUZ
0267                                  23,3711   77621 1          BDSU

0268    REP   9  LAST 1340            23,3712   03214 0                  DTHETASM +2
0269    REP   7  LAST 1340            23,3713   17206 0          STODL   DCDU +2
0270    REP  10  LAST 1340            23,3714   03212 0                  DTHETASM

0271                                  23,3715   65205 0          DMP     PDDL
0272    REP   5  LAST 1340            23,3716   00737 1                  SINCDUY
0273    REP  11  LAST 1340            23,3717   03216 1                  DTHETASM +4

0274                                  23,3720   43205 1          DMP     DAD
0275    REP   5  LAST 1340            23,3721   00745 1                  COSCDUY
0276                                  23,3722   77752 1          SL1
0277    REP   8  LAST 1340            23,3723   03210 1          STORE   DCDU +4
0278                                  23,3724   77616 0          RVQ
```

L TIME OF FREE FALL USER=S PAGE NO. 1 E0 S3

R0001 THE TFF SUBROUTINES MAY BE USED IN EITHER EARTH OR MOON CENTERED COORDINATES. THE TFF ROUTINES NEVER
R0003 KNOW WHICH ORIGIN APPLIES. IT IS THE USER WHO KNOWS, AND WHO SUPPLIES RONE, VONE AND 1/SQRT(MU) AT THE
R0005 APPROPRIATE SCALE LEVEL FOR THE PROPER PRIMARY BODY.

R0006	EARTH ORIGIN	POSITION	-29	METERS
R0007		VELOCITY	-7	METERS/CENTISECOND
R0009		1/SQRT(MU)	+17	SQRT(CS SQ/METERS CUBED)
R0011	MOON ORIGIN	POSITION	-27	METERS
R0012		VELOCITY	-5	METERS/CENTISECONDS
R0014		1/SQRT(MU)	+14	SQRT(CS SQ/METERS CUBED)

R0016 ALL DATA PROVIDED TO AND RECEIVED FROM ANY TFF SUBROUTINE WILL BE AT ONE OF THE LEVELS ABOVE. IN ALL CASES,
R0018 THE FREE FALL TIME IS RETURNED IN CENTISECONDS AT (-28). PROGRAM TFF/CONIC WILL GENERATE VONE/RTMU AND
R0020 LEAVE IT IN VONE AT (+10) IF EARTH ORIGIN AND (+9) IF MOON ORIGIN.
R0021 THE USER MUST STORE THE STATE VECTOR IN RONE, VONE AND MU IN THE FORM 1/SQRT(MU) IN TFF/RTMU
R0023 AT THE PROPER SCALE BEFORE CALLING TFF/CONIC. SINCE RONE, VONE ARE IN THE EXTENDED VERB STORAGE AREA,
R0025 THE USER MUST ALSO LOCK OUT THE EXTENDED VERBS, AND RELEASE THEM WHEN FINISHED.
R0027 PROGRAMS CALC/TFF AND CALC/TPER ASSUME THAT THE TERMINAL RADIUS IS LESS THAN THE PRESENT
R0029 RADIUS. THIS RESTRICTION CAN BE REMOVED BY A 15 W CODING CHANGE, BUT AT PRESENT IT IS NOT DEEMED NECESSARY.
R0031
R0032 THE FOLLOWING ERASABLE QUANTITIES ARE USED BY THE TFF ROUTINES, AND ARE LOCATED IN THE PUSH LIST.
R0034

A0035 BELOW E' IS USED FOR EARTH ORIGIN SCALE
A0036 M' IS USED FOR MOON ORIGIN SCALE

A0037		TFFSW	=	11$_{9}$D	BIT1	0 = CALCTFF 1 = CALCTPER
0038	0012	TFFDELQ	=	10D		Q_2-Q_1 E' (-16) M' (-15)
0039	0014	RMAG$_1$	=	12D		ABVAL(RN) M E' (-29) M' (-27)
A0040		RPER	=	14D		PERIGEE RADIUS M E' (-29) M' (-27)
0041	0016	TFFQ$_1$	=	14D		R.V / SQRT(MUE) E' (-16) M' (-15)
A0042		SDELP/2				SIN(THETA) /2
0043	0016	CDELP/2	=	14D		COS(THETA) /2
A0044		RAPO	=	16D		APOGEE RADIUS M E' (-29) M' (-27)
0045	0020	NRTERM	=	16D		TERMINAL RADIUS M E' (-29+NR) M' (-27+NR)
A0046						
0047	0022	RTERM	=	18D		TERMINAL RADIUS M E' (-29) M' (-27)
0048	0024	TFFVSQ	=	20D		-(V SQUARED/MU) 1/M E' (20) M' (18)
0049	0026	TFF$_1$/ALF	=	22D		SEMI MAJ AXIS M E' (-22-2 NA) M' (-20-2 NA)
A0050						
0051	0030	TFFRTALF	=	24D		SQRT(ALFA) E' (10+NA) M' (9+NA)
0052	0032	TFFALFA	=	26D		ALFA 1/M E' (26-NR) M' (24-NR)
0053	0034	TFFNP	=	28D		SEMI LATUS RECTUM M E' (-38+2 NR) M' (-36+2 NR)
A0054						
0055	0036	TFF/RTMU	=	30D		1/SQRT(MU) E' (17) M' (14)
0056	0040	NRMAG	=	32D		PRESENT RADIUS M E' (-29+NR) M' (-27+NR)
A0057						
0058	0042	TFFX	=	34D		
0059	0044	TFFTEM	=	36D		TEMPORARY

```
A0060                   REGISTERS S1, S2 ARE UNTOUCHED BY ANY TFF SUBROUTINE
A0061                   INDEX REGISTERS X1, X2 ARE USED BY ALL TFF SUBROUTINES. THEY ARE ESTAB-
A0062                   LISHED IN TFF/CONIC AND MUST BE PRESERVED BETWEEN CALLS TO SUBSEQUENT
A0063                   SUBROUTINES.
A0064                   -NR                     C(X1) = NORM COUNT OF RMAG
A0065                   -NA                     C(X2)= NORM COUNT OF SQRT(ABS(ALFA))
```

```
P0066

R0067  SUBROUTINE NAME'      TFFCONIC                                          DATE'    01.29.67
R0069  MOD NO'  0                                                              LOG SECTION'    TIME OF FREE FALL
R0071  MOD BY'  RR BAIRNSFATHER
R0072  MOD NO'  1            MOD BY'  RR BAIRNSFATHER      DATE'  11 APR 67
R0073  MOD NO'  2            MOD BY'  RR BAIRNSFATHER      DATE'  21 NOV 67    ADD MOON MU.
R0075  MOD NO'  3            MOD BY'  RR BAIRNSFATHER      DATE'  21 MAR 68    ACCEPT DIFFERENT EARTH/MOON SCALES
R0077  FUNCTIONAL DESCRIPTION'      THIS SUBROUTINE IS CALLED TO COMPUTE THOSE CONIC PARAMETERS REQUIRED BY THE TFF
R0079          SUBROUTINES AND TO ESTABLISH THEM IN THE PUSH LIST AREA. THE PARAMETERS ARE LISTED UNDER OUTPUT.
R0081          THE EQUATIONS ARE
R0082                  - - -
R0083                H = RN*VN                                                 ANGULAR MOMENTUM
R0085                    - -
R0086                LCP = H.H / MU                                            SEMI LATUS RECTUM
R0088                          - -
R0089                ALFA = 2/RN - VN.VN / MU                                  RECIPROCAL SEMI MAJ AXIS, SIGNED

R0091          AND ALFA IS POS FOR ELLIPTIC  ORBITS
R0092                      0  FOR PARABOLIC ORBITS
R0093                    NEG FOR HYPERBOLIC ORBITS.
R0094          SUBROUTINE ALSO COMPUTES AND SAVES  RMAG.
R0095  CALLING SEQUENCE'
R0096          TFFCONIC  EXPECTS CALLER TO ENTER WITH CORRECT GRAVITATIONAL CONSTANT IN MPAC, IN THE FORM
R0098          1/SQRT(MU). PROGRAM WILL SAVE IN  TFF/RTMU  . THE SCALE IS DETERMINED BY WHETHER EARTH OR MOON
R0100          ORIGIN IS USED.  THE CALLER MUST LOCK OUT THE EXTENDED VERBS BEFORE PROVIDING STATE VECTOR IN RONE,
R0102          VONE  AT PROPER SCALE. THE EXTENDED VERBS MUST BE RESTORED WHEN THE CALLER IS FINISHED USING THE
R0104          TFF ROUTINES.
R0105          ENTRY POINT  TFFCONMU  EXPECTS THAT  TFF/RTMU  IS ALREADY LOADED.
R0107          TO SPECIFY MU'      DLOAD  CALL                IF MU ALREADY STORED'   CALL
R0109                                     YOURMU      1/RTMU  E' (17)  M' (14)          TFFCONMU
R0111                                     TFFCONIC
R0112          PUSHLOC = PDL+0, ARBITRARY IF LEQ 18D

R0113  SUBROUTINES CALLED'  NONE
R0114  NORMAL EXIT MODES'   RVQ
R0115  ALARMS'  NONE
R0116  OUTPUT'  THE FOLLOWING ARE STORED IN THE PUSH LIST AREA.
R0117          RMAG1  E'(-29) M'(-27) M  RN, PRESENT RADIUS LENGTH.
R0118          NRMAG  E' (-29+NR)     M  RMAG, NORMALIZED
R0119                 M' (-27+NR)
R0120          X1                        -NR, NORM COUNT
R0121          TFFNP  E' (-38+2NR)    M  LCP, SEMI LATUS RECTUM, WEIGHTED BY NR.      FOR VGAMCALC
R0123                 M' (-36+2NR)
R0124          TFF/RTMU  E'(17)  M'(14)       1/SQRT(MU)
R0125          TFFVSQ E'(20)  M'(18)  1/M   -(V SQ/MU)' PRESENT VELOCITY,NORMLIZED.   FOR VGAMCALC
R0127          TFFALFA  E' (26-NR)    1/M   ALFA, WEIGHTED BY NR
R0128                   M' (24-NR)
R0129          TFFRTALF  E' (10+NA)   SQRT(ALFA), NORMALIZED
R0130                    M' (9+NA)
```

```
R0131           X2                      -NA, NORM COUNT
R0132           TPF1/ALF  E' (-22-2NA) SIGNED SEMI MAJ AXIS, WEIGHTED BY NA
R0133                     M' (-20-2NA)
R0134           PUSHLOC AT PDL+0
R0135           THE FOLLOWING  IS STORED IN GENERAL ERASABLE
R0136           VONE=  E'(10)  M'(9)   V/RT(MU), NORMALIZED VELOCITY
R0137  ERASABLE INITIALIZATION REQUIRED'
R0138           RONE   E'(-29)  M'(-27)  M      STATE VECTOR                    LEFT BY CALLER
R0140           VONE   E'(-7)   M'(-5)   M/CS   STATE VECTOR                    LEFT BY CALLER
R0142           TPF/RTMU  E'(17)  M'(14)       1/RT(CS SQ/M CUBE)              IF ENTER VIA  TPFCONMU.
R0144  DEBRIS'  QPRET,    PDL+0 ... PDL+3
R0145
 0146                              33,3772                 BANK   33
 0147  REF  1                     27,2000                 SETLOC TOP-PP
 0148                              27,2750                 BANK
 0149  REF  1                                              COUNT* $$/TPF
 0150  REF  5  LAST  768  27,2750  00037 0  TPFCONIC STORE  TPF/RTMU      1/SQRT(MU)      E' (17)  M' (14)
 0151                     27,2751  53575 0  TPFCONMU VLOAD  UNIT         COME HERE WITH TPFRTMU LOADED.
 0152  REF 16  LAST  744  27,2752  02327 0                  RONE         SAVED RN.  M    E' (-29)  M' (-27)
 0153                     27,2753  77725 1           PDDL
 0154                     27,2754  00045 0                  36D          UR/2 TO PDL+0, +5
 0155  REF  1             27,2755  00015 0           STORE  RMAG1        MAGNITUDE
                                                                         M    E' (-29)   M' (-27)
 0156                     27,2756  77701 1           NORM
 0157  REF 89  LAST 1310  27,2757  00047 1                  X1           -NR
 0158  REF  4  LAST  769  27,2760  24041 1           STOVL  NRMAG        RMAG  M   E' (-29+NR)  M' (-27+NR)
 0159  REF 11  LAST  744  27,2761  02335 0                  VONE         SAVED VN.  M/CS   E' (-7)   M' (-5)
 0160                     27,2762  77761 1           VXSC
 0161  REF  6  LAST 1344  27,2763  00037 0                  TPF/RTMU     E' (17)   M' (14)
 0162  REF  2  LAST   90  27,2764  02372 0           STORE  VONE=        VN/SQRT(MU)   E' (10)   M' (9)
 0163                     27,2765  47361 0           VXSC   VXV
 0164  REF  5  LAST 1344  27,2766  00041 1                  NRMAG
A0165                                                                    E' (-29+NR)  M' (-27+NR)
 0166                     27,2767  47572 1           VSL1   VSQ          UR/2 FROM PDL
 0167  REF  2  LAST  768  27,2770  14035 1           STODL  TPFNP        BEFORE'  E'(-19+NR)  M'(-18+NR)
A0168                                                                    LC P  M   E'(-38+2NR)  M'(-36+2NR)
 0169  REF  1             27,2771  15322 0                  TPF1/4       SAVE ALSO FOR VGAMCALC
 0170                     27,2772  63271 0           DDV    PDVL
 0171  REF  6  LAST 1344  27,2773  00041 1                  NRMAG        (2/RMAG)  1/M   E'(26-NR)   M'(24-NR)
 0172  REF  3  LAST 1344  27,2774  02372 0                  VONE=        RMAG  M   E'(-29+NR)  M'(-27+NR)
 0173                     27,2775  57436 1           VSQ    DCOMP        SAVED VN.   E' (10)   M' (9)
 0174  REF  2  LAST  768  27,2776  00025 0           STORE  TPFVSQ       KEEP MPAC+2 HONEST FOR SQRT.
A0175                                                                    -(V SQ/MU)   E'(20)   M'(18)
 0176                     27,2777  43257 0           SR*    DAD          SAVE FOR VGAMCALC
```

L TIME OF FREE FALL USER=S PAGE NO. 5 E0 S3

```
 0177                          27,3000  20573 1                0 -6,1      GET -VSQ/MU   E'(26-NR)   M'(24-NR)
 0178                          27,3001  77626 0          STADR
A0179                                                                     2/RMAG   FROM PDL+2
 0180  REF   1                27,3002  77744 0          STORE  TPFALPA    ALPA  1/M   E'(26-NR)   M'(24-NR)
 0181                          27,3003  41457 1          SL*    PUSH       TEMP SAVE ALPA    E'(20)   M'(18)
 0182                          27,3004  20173 0                 0 -6,1
 0183                          27,3005  75446 0          ABS    SQRT       E'(10)   M'(9)
 0184                          27,3006  77701 1          NORM
 0185  REF  39  LAST 1336      27,3007  00050 1                 X2         X2 = -NA
 0186  REF   1                27,3010  00031 0          STORE  TPFRTALP   SQRT( ABS(ALPA) )  E'(10+NA)   M'(9+NA)
 0187                          27,3011  75316 1          DSQ    SIGN       NOT SO ACCURATE, BUT OK
A0188                                                                     ALPA FROM PDL+2   E'(20)   M'(18)
 0189                          27,3012  55254 1          BZE    BDDV       SET 1/ALPA =0, TO SHOW SMALL ALPA
 0190                          27,3013  57015 1                 +2
 0191  REF   2  LAST 1344      27,3014  15322 0                 TPF1/4
 0192  REF   1                27,3015  00027 1  +2     STORE  TPF1/ALP   1/ALPA   E'(-22-2 NA)   M'(-20-2 NA)
 0193                          27,3016  77616 0  DUMPCNIC RVQ

A0194                                                                                                  39 W
```

L TIME OF FREE FALL USER'S PAGE NO. 6 Eo 53

```
P0195  SUBROUTINE NAME'     TFFRP/RA                                   DATE'  01.17.67
R0197  MOD NO'  0                                                      LOG SECTION'    TIME OF FREE FALL
R0199  MOD BY'  RR BAIRNSFATHER
R0200  MOD NO'  1           MOD BY'  RR BAIRNSFATHER     DATE'  11 APR 67
R0201  MOD NO'  2           MOD BY'  RR BAIRNSFATHER     DATE'  21 MAR 68   ACCEPT DIFFERENT EARTH/MOON SCALES
R0203                                                                  ALSO IMPROVE ACCURACY OF RAPO.
R0205  FUNCTIONAL DESCRIPTION'         USED BY CALCTPER AND TFF DISPLAYS TO CALCULATE PERIGEE RADIUS AND ALSO
R0207          APOGEE RADIUS FOR A GENERAL CONIC.
R0208          PROGRAM GIVES PERIGEE RADIUS AS              APOGEE RADIUS IS GIVEN BY
R0210                RP = P /(1+E)                                 RA = (1+E) / ALFA
R0212          WHERE  2
R0213                E  = 1 - P ALFA
R0214          IF RA IS NEGATIVE OR SHOWS DIVIDE OVERFLOW, THEN RA = POSMAX BECAUSE
R0216                1. APOGEE RADIUS IS NOT MEANINGFUL FOR HYPERBOLA
R0217                2. APOGEE RADIUS IS NOT DEFINED FOR PARABOLA
R0218                3. APOGEE RADIUS EXCEEDS THE SCALING FOR ELLIPSE.
R0219          THIS SUBROUTINE REQUIRES THE SIGNED  RECIPROCAL SEMI MAJ AXIS,  ALFA,  AND SEMI LATUS RECTUM AS DATA.
R0221  CALLING SEQUENCE'  CALL
R0222                     TFFRP/RA
R0223          PUSHLOC = PDL+0, ARBITRARY IF LEQ 10D
R0224          C(MPAC) UNSPECIFIED

R0225  SUBROUTINES CALLED'  NONE
R0226  NORMAL EXIT MODE'    RVQ
R0227          IF ELLIPSE, WITHIN NORMAL SCALING, RAPO IS CORRECT.
R0228          OTHERWISE, RAPO = POSMAX.
R0229  ALARMS'  NONE
R0230  OUTPUT'  STORED IN PUSH LIST AREA. SCALE OF OUTPUT AGREES WITH DATA SUPPLIED TO  TFF/CONIC.
R0232          RPER   E'(-29)  M'(-27)  M     PERIGEE RADIUS          DESTROYED BY CALCTFF/CALCTPER, TFFTRIG.
R0234          RAPO   E'(-29)  M'(-27)  M     APOGEE  RADIUS          WILL BE DESTROYED BY CALCTFF/CALCTPER
R0236          PUSHLOC AT PDL+0
R0237  ERASABLE INITIALIZATION REQUIRED'
R0238          TFFALFA E'(26-NR)      M   1/SEMI MAJ AXIS             LEFT BY TFFCONIC
R0240                  M'(24-NR)
R0241          TFFNP  E' (-38+2NR)    M  LC P, SEMI LATUS RECTUM      LEFT BY TFFCONIC
R0243                 M' (-36+2NR)
R0244          X1                     -NR, NORM COUNT OF RMAG         LEFT BY TFFCONIC
R0246          X2                     -NA, NORM COUNT OF ALFA         LEFT BY TFFCONIC
R0248  DEBRIS'  QPRET,    PDL+0 ... PDL+1
```

L TIME OF FREE FALL USER=S PAGE NO. 7 E0 83

```
P0249
 0250                          0020          RAPO    =       16D         APOGEE RADIUS  M  E'(-29)  M'(-27)
 0251                          0016          RPER    =       14D         PERIGEE RADIUS  M  E'(-29)  M'(-27)
A0252
 0253                    27,3017  41345 0  TFFRP/RA DLOAD   DMP
 0254  REP  2  LAST 1345 27,3020  00033 1           TFFALFA             ALFA  1/M  E'(26-NR)   M'(24-NR)
 0255  REP  3  LAST 1344 27,3021  00035 1           TFFNP               LC P  M   E'(-38+2NR)   M'(-36+2NR)
 0256                    27,3022  57457 0           SR*     DCOMP       ALFA P (-12+NR)
 0257                    27,3023  20571 0                   0 -8D,1     ALFA P  (-4)
 0258                    27,3024  51415 0           DAD     ABS         (DCOMP GIVES VALID TP RESULT FOR SQRT)
A0259                                                                   (ABS PROTECTS SQRT IF E IS VERY NEAR 0)
 0260  REP  4  LAST  833 27,3025  17357 0                   DP2(-4)
 0261                    27,3026  43386 0           SQRT    DAD         E SQ = (1- P ALFA)   (-4)
 0262  REP  3  LAST 1345 27,3027  15322 0                   TPF1/4
 0263                    27,3030  55206 0           PUSH    BDDV        (1+E)  (-2)  TO PDL+0
 0264  REP  4  LAST 1347 27,3031  00035 1                   TFFNP       LCP  M E'(-38+2NR)   M'(-36+2NR)
 0265                    27,3032  53657 0           SR*     SR*         (DOES SR THEN SL TO AVOID OVFL)
 0266                    27,3033  20601 1                   0,1         X1=-NR
 0267                    27,3034  20572 0                   0 -7,1      (EFFECTIVE SL)
 0268  REP  3  LAST  514 27,3035  14017 1           STODL   RPER        PERIGEE RADIUS  M  E'(-29)   M'(-27)
A0269                                                                   (1+E)  (-2)   FROM PDL+0
 0270                    27,3036  41005 1           DMP     BOVB
 0271  REP  2  LAST 1345 27,3037  00027 1                   TPF1/ALF    E'(-22-2NA)  M'(-20-2NA)
 0272  REP 11  LAST 1303 27,3040  57343 1                   TCDANZIG    CLEAR OVFIND, IF ON.
 0273                    27,3041  53654 0           BZE     SL*
 0274  REP  1            27,3042  57051 1                   MAXRA       SET POSMAX, IF ALFA=0
 0275                    27,3043  57603 0                   0 -5,2      -5+NA
 0276                    27,3044  40057 1           SL*     BOV
 0277                    27,3045  57576 1                   0,2
 0278  REP  2  LAST 1347 27,3046  57051 1                   MAXRA       SET POSMAX IF OVFL.
 0279                    27,3047  77644 1           BPL                 CONTINUE WITH VALID RAPO.
 0280                    27,3050  57053 0                   +3
 0281                    27,3051  77745 1  MAXRA    DLOAD               RAPO CALC IS NOT VALID.  SET RAPO =
 0282  REP  4  LAST  833 27,3052  17363 1                   NEARONE     POSMAX AS A TAG.
 0283  REP  1            27,3053  00021 1  +3       STORE   RAPO        APOGEE RADIUS  M   E'(-29)   M'(-27)
 0284                    27,3054  77616 0  DUMPRPRA RVQ

A0285                                                                                                  30 W
```

L TIME OF FREE FALL USER=8 PAGE NO. 8 E0 S3

```
P0286  SUBROUTINE NAME'     CALCTPER  /  CALCTFF                    DATE'    01.29.67
R0288  MOD NO'  0                                                   LOG SECTION'    TIME OF FREE FALL
R0290  MOD BY'  RR BAIRNSFATHER
R0291  MOD NO'  1           MOD BY'  RR BAIRNSFATHER      DATE'  21 MAR 67
R0292  MOD NO'  2           MOD BY'  RR BAIRNSFATHER      DATE'  14 APR 67
R0293  MOD NO'  3           MOD BY'  RR BAIRNSFATHER      DATE'  8JUL 67      NEAR EARTH MUE AND NEG TFF (CONEPAST)
R0295  MOD NO'  4           MOD BY'  RR BAIRNSFATHER      DATE'  21 NOV 67    ADD VARIABLE MU.
R0297  MOD NO'  5           MOD BY'  RR BAIRNSFATHER      DATE'  21 MAR 68    ACCEPT DIFFERENT EARTH/MOON SCALES
R0299  FUNCTIONAL DESCRIPTION'      PROGRAM CALCULATES THE FREE-FALL TIME OF FLIGHT FROM PRESENT POSITION  RN  AND
R0301          VELOCITY  VN  TO A RADIUS LENGTH SPECIFIED BY  RTERM  , SUPPLIED BY THE USER. THE POSITION VECTOR
R0303          RN  MAY BE ON EITHER SIDE OF THE CONIC, BUT  RTERM  IS CONSIDERED ON THE INBOUND SIDE.
R0305          THE EQUATIONS ARE

R0306                Q2 = -SQRT(RTERM (2-RTERM ALPHA) - LCP)    (INBOUND SIDE))      LEQ +- LCE/SQRT(ALPHA)
R0308                      - -
R0309                Q1 = RN.VN / SQRT(MU)                                           LEQ +- LCE/SQRT(ALPHA)

R0311                Z = NUM / DEN                                                   LEQ +- 1/SQRT(ALPHA)

R0313          WHERE, IF INBOUND
R0314                NUM = RTERM - RN                                                LEQ +- 2 LCE/ALPHA
R0316                DEN = Q2+Q1                                                     LEQ +- 2 LCE/SQRT(ALPHA)

R0318          AND, IF OUTBOUND
R0319                NUM = Q2-Q1                                                     LEQ +- 2 LCE/SQRT(ALPHA)
R0321                DEN = 2 - ALPHA (RTERM + RN) .                                  LEQ +- 2 LCE

R0323          IF    ALPHA ZZ  ±  1.0          (FOR ALL CONICS EXCEPT ELLIPSES HAVING ABS(DEL ECC ANOM) G 90 DEG)

R0325          THEN  X = ALPHA Z Z
R0326          AND   TFF = (RTERM +RN -2 ZZ T(X) ) Z/SQRT(MU)

R0327                EXCEPT IF ALPHA PNZ, AND IF TFF NEG,
R0328                THEN   TFF = 2 PI /(ALPHA SQRT(ALPHA)) + TFF

R0329          OR IF ALPHA ZZ  GEQ  1.0          (FOR ELLIPSES HAVING ABS(DEL ECC ANOM) GEQ 90 DEG)

R0331          THEN  X = 1/ALPHA Z Z
R0332          AND   TFF = (PI/SQRT(ALPHA) -Q2 +Q1 +2(X T(X) -1) /ALPHA Z) /ALPHA SQRT(MU)

R0334          WHERE  T(X) IS A POLYNOMIAL APPROXIMATION TO THE SERIES
R0335                                2     3                    2
R0336                1/3 -X/5 +X /7 -X /9 ...              (X   ±  1.0)

R0337  CALLING SEQUENCE'  TIME TO RTERM                        TIME TO PERIGEE
R0339                     CALL                                 CALL
R0340                          CALCTFF                              CALCTPER
R0342                     C(MPAC) = TERMNL RAD  M              C(MPAC) = PERIGEE RAD  M
R0344          FOR EITHER,    E' (-29)     M' (-27)
R0345          FOR EITHER, PUSHLOC = PDL+0 , ARBITRARY IF LEQ 8D.
```

L TIME OF FREE FALL USER=S PAGE NO. 9 E0 S3

```
R0346   SUBROUTINES CALLED'  T(X),  VIA RTB
R0347   NORMAL EXIT MODE'  RVQ
R0348           HOWEVER, PROGRAM EXITS WITH ONE OF THE FOLLOWING VALUES FOR TFF (-28) CS  IN MPAC. USER MUST STORE.
R0350                 A.  TFF= FLIGHT TIME. NORMAL CASE FOR POSITIVE FLIGHT TIME LESS THAN ONE ORBITAL PERIOD.
R0352                 B.  (THIS OPTION IS NO LONGER USED.)
R0353                 C.  TFF = POSMAX.  THIS INDICATES THAT THE CONIC FROM THE PRESENT POSITION WILL NOT RETURN TO
R0355                     THE SPECIFIED ALTITUDE.  ALSO INDICATES OUTBOUND PARABOLA OR HYPERBOLA.
R0357   OUTPUT'  C(MPAC)  (-28)  CS     TIME OF FLIGHT, OR TIME TO PERIGEE
R0358           TFFX     (0)           X,                                  LEFT FOR ENTRY DISPLAY TFF ROUTINES
R0360           NRTERM   E' (-29+NR)   M  RTERM, WEIGHTED BY NR            LEFT FOR ENTRY DISPLAY TFF ROUTINES
R0362                    M' (-27+NR)
R0363           TFFTEM   E' (-59+2NR)  LCP Z Z SGN(SDELF)                  LEFT FOR ENTRY DISPLAY TFF ROUTINES
R0365                    M' (-55+2NR)  LCP /ALFA SGN(SDELF)                LEFT FOR ENTRY DISPLAY TFF ROUTINES
R0367           NOTE'  TFFTEM = PDL 38D AND WILL BE DESTROYED BY .'UNIT'.
R0368           RMAG1  E'(-29)  M'(-27)  PDL 12 NOT TOUCHED.
R0369           TFFQ1  E'(-16)  M'(-15)  PDL 14D
R0370           TFFDELQ E'(-16) M'(-15)  PDL 10D
R0371           PUSHLOC AT PDL+0
R0372   ERASABLE INITIALIZATION REQUIRED'
R0373           RONE   E'(-29)  M'(-27)  M   STATE VECTOR                  LEFT BY USER
R0375           VONE   E'(+10)  M'(+9)   VN/SQRT(MU)                       LEFT BY TFF/CONIC
R0377           RMAG1  E'(-29)  M'(-27)  PRESENT RADIUS,  M                LEFT BY TFFCONIC
R0379           C(MPAC)E'(-29)  M'(-27)  RTERM, TERMINAL RADIUS LENGTH, M  LEFT BY USER

R0381           THE FOLLOWING ARE STORED IN THE PUSH LIST AREA.
R0382           TFF/RTMU  E'(17)  M'(14)  1/SQRT(MU)                       LEFT BY TFFCONIC.
R0384           NRMAG  E' (-29+NR)  M  RMAG, NORMALIZED                    LEFT BY TFFCONIC
R0386                  M' (-27+NR)
R0387           X1                     -NR, NORM COUNT                     LEFT BY TFFCONIC
R0389           TFFNP  E' (-38+2NR)  M  LCP, SEMI LATUS RECTUM, WEIGHT  NR LEFT BY TFFCONIC
R0391                  M' (-38+2NR)
R0392           TFFALFA  E' (26-NR)    1/M  ALFA, WEIGHT  NR               LEFT BY TFFCONIC
R0394                    M' (24-NR)
R0395           TFFRTALF  E'(10+NA)    SQRT(ALFA), NORMALIZED              LEFT BY TFFCONIC
R0397                     M'(9+NA)
R0398           X2                     -NA, NORM COUNT                     LEFT BY TFFCONIC
R0400           TFF1/ALF  E' (-22-2NA)  SIGNED SEMIMAJ AXIS, WEIGHTED BY NA LEFT BY TFFCONIC
R0402                     M' (-20-2NA)
R0403   DEBRIS'  QPRET,   PDL+0 ... PDL+3
R0404           RTERM  E'(-29)  M'(-27)  RTERM, TERMINAL RADIUS LENGTH
R0405           RAPO   E'(-29)  M'(-27)  PDL 16D  (=NRTERM)
R0406           RPER   E'(-29)  M'(-27)  PDL 14D   (=TFFQ1)
```

```
P0407
 0408
 0409  REP  1                27,3055  77614 1  CALCTPER SETGO                ENTER WITH RPER  IN MPAC
 0410                        27,3056  03436 0                 TPFSW
 0411                        27,3057  57062 1                 +3
 0412  REP  2  LAST 1350     27,3060  77614 1  CALCTPF  CLEAR                 ENTER WITH RTERM IN MPAC
 0413  REP  3  LAST  764     27,3061  03676 0                 TPFSW
 0414                        27,3062  00023 0  +3      STORE  RTERM           E' (-29)  M' (-27)
 0415                        27,3063  77657 0          SL*
                             27,3064  20201 0                 0,1
 0416  REP  6  LAST  769     27,3065  00021 1          STORE  NRTERM          X1=-NR
 0417                        27,3066  44205 0          DMP    BDSU            RTERM  E' (-29+NR)  M' (-27+NR)
 0418  REP  3  LAST 1347     27,3067  00033 1                 TPFALFA
 0419  REP  4  LAST 1347     27,3070  15322 0                 TPF1/4          ALPA  E' (28-NR)  M' (24-NR)
 0420                        27,3071  41206 0          PUSH   DMP
 0421  REP  7  LAST 1350     27,3072  00021 1                 NRTERM          (2-ALPA RTERM)  (-3)  TO PDL+0
 0422                        27,3073  53725 1          PDDL   SR*             E' (-29+NR)  M' (-27+NR)
A0423                                                                        RTERM(2-ALPA RTERM) TO PDL+2
 0424  REP  5  LAST 1347     27,3074  00035 1                 TPFNP           E' (-32+NR)  M' (-30+NR)
 0425                        27,3075  20573 1                 0 -6,1          LC P  E'(-38+2NR)  M'(-36+2NR)
 0426                        27,3076  43276 0          DCOMP  DAD             X1 = -NR
A0427                                                                        DUE TO SHIFTS, KEEP PRECISION FOR SQRT
A0428                                                                        RTERM(2-ALPA RTERM) FROM PDL+2
 0429                        27,3077  77657 0          SR*                    E' (-32+NR)  M' (-30+NR)
 0430                        27,3100  20601 1                 0,1             LEAVE  E' (-32)  M' (-30)
 0431                        27,3101  71214 0          BOFF   DLOAD           X1 = -NR
 0432  REP  3  LAST 1350     27,3102  03756 0                 TPFSW           CHECK TPF / TPER SWITCH
 0433                        27,3103  57105 1                 +2
 0434  REP  1                27,3104  15332 1                 TPFZEROS        IF TPF, CONTINUE
 0435                        27,3105  75440 0  +2      RMN    SQRT            IF TPER, SET O2 = 0
                                                                             E' (-16)  M' (-15)
 0436  REP  1                27,3106  57240 0                 MAXTPF1         NO FREE FALL CONIC TO RTERM FROM HERE
A0437                                                                        RESET PDL, SET TPF=POSMAX, AND EXIT.
 0438
                             27,3107  41076 0          DCOMP  BOVB            RT IS ON INBOUND SIDE.  ASSURE OVFIND=0
 0439  REP 12  LAST 1347     27,3110  57343 1                 TCDANZIG        ANY PORT IN A STORM.
 0440  REP  3  LAST  770     27,3111  24045 0          STOVL  TPFTEM          O2  E' (-16)  M' (-15)
 0441  REP  4  LAST 1344     27,3112  02372 0                 VONE            VN/SQRT(MU) E' (10)  M' (9)
 0442                        27,3113  52441 1          DOT    SL3
 0443  REP 17  LAST 1344     27,3114  02327 0                 RONE            SAVED RN.  E' (-29)  M' (-27)
 0444  REP  1                27,3115  00017 1          STORE  TPFO1           O1, SAVE FOR GONEPAST TEST.
A0445                                                                        E' (-16)  M' (-15)
 0446
                             27,3116  44240 1          RMN    BDSU
 0447  REP  1                27,3117  57140 0                 INBOUND         USE ALTERNATE Z
 0448  REP  4  LAST 1350     27,3120  00045 0                 TPFTEM          O2  E' (-16)  M' (-15)
A0449                                        OUTBOUND  Z CALC CONTINUES HERE
 0450  REP  2  LAST  769     27,3121  14043 0          STODL  TPFX            NUM=O2-O1  E' (-16)  M' (-15)
 0451  REP  4  LAST 1350     27,3122  00033 1                 TPFALFA         ALPA  E' (26-NR)  M' (24-NR)
 0452                        27,3123  44205 0          DMP    BDSU
```

```
 0453  REF  7  LAST 1344   27,3124   00041 1                    NRMAG     RMAG  E' (-29+NR)  M' (-27+NR)
A0454                                                                     (2-RTERM ALFA)  (-3) FROM PDL+0
 0455                      27,3125   51406 1  SAVEDEN  PUSH     ABS       DEN TO PDL+0  E' (-3) OR (-16)
A0456                                                                                     M' (-3) OR (-15)
 0457                      27,3126   40015 1           DAD      BOV       INDETERMINANCY TEST
 0458  REF  1             27,3127   17351 0                    LIM(-22)  =1.0-B(-22)
 0459  REF  1             27,3130   57151 0                    TPFXTEST  GO IF DEN =/= B(-22)
 0460                     27,3131   65345 0           DLOAD    PDDL      SET DEN=0  OTHERWISE
 0461  REF  2  LAST 1350  27,3132   15332 1                    TPFZEROS
A0462                                                                    XCH ZERO WITH PDL+0
 0463                      27,3133   57545 1           DLOAD    DCOMP
 0464  REF  5  LAST 1350  27,3134   00033 1                    TPFALFA   ALFA  E' (26-NR)  M' (24-NR)
 0465                     27,3135   71240 1           BMN      DLOAD     FOR TPER' Z INDET AT DELE/2=0 AND 90.
 0466  REF  1             27,3136   57245 0                    TPFEL1    ASSUME 90, AND LEAVE 0 IN PDL' 1/Z=D/N
A0467                                                                    Z INDET. AT PERIGEE FOR PARAB OR HYPERB.
 0468                      27,3137   77616 0  DUMPTPF1 RVQ               RETURN  TPF =0
A0469                                         INBOUND  Z  CALC CONTINUES HERE
 0470                      27,3140   77745 1  INBOUND  DLOAD             RESET PDL+0
 0471                      27,3141   45345 1           DLOAD    DSU       ALTERNATE Z CALC
 0472  REF  4  LAST 1350  27,3142   00023 0                    RTERM     E' (-29)  M' (-27)
 0473  REF  2  LAST 1344  27,3143   00015 0                    RMAG1     E' (-29)  M' (-27)
 0474  REF  3  LAST 1350  27,3144   14043 0           STODL    TPFX      NUM=RTERM-RN  E' (-29)  M' (-27)
 0475  REF  5  LAST 1350  27,3145   00045 0                    TPFTEM    Q2  E' (-16)  M' (-15)
 0476                     27,3146   52015 1           DAD      GOTO
 0477  REF  2  LAST 1350  27,3147   00017 1                    TPFQ1     Q1  E' (-16)  M' (-15)
 0478  REF  1             27,3150   57125 0                    SAVEDEN   DEN = Q2+Q1  E' (-16)  M' (-15)
 0479                     27,3151   65215 1  TPFXTEST DAD      PDDL       (ABS(DEN) TO PDL+2))  E' (-3) OR (-16)
A0480                                                                                          M' (-3) OR (-15)
 0481  REF  1             27,3152   17353 1                    DP(-22)   RESTORE ABS(DEN) TO MPAC
 0482  REF  4  LAST 1351  27,3153   00043 0                    TPFX      NUM E'(-16) OR (-29)  M'(-15) OR (-27)
 0483                     27,3154   53605 1           DMP      SR*
 0484  REF  2  LAST 1345  27,3155   00031 0                    TPFRTALF  SQRT(ALFA)  E' (10+NA)  M' (9+NA)
 0485                     27,3156   57201 0                    0 -3,2    X2=-NA
 0486                     27,3157   77671 1           DDV                C(MPAC) =NUM SQRT(ALFA)  E'(-3) OR (-16)
A0487                                                                                          M'(-3) OR (-15)
A0488                                                                    ABS(DEN) FROM PDL+2  E'(-3) OR (-16)
A0489                                                                                          M'(-3) OR (-15)
 0490                      27,3160   40145 0           DLOAD    BOV       (THE DLOAD IS SHARED WITH TPFELL)
 0491  REF  5  LAST 1351  27,3161   00043 0                    TPFX      NUM  E' (-16) OR (-29)  M'(-15) OR (-27)
 0492  REF  1             27,3162   57243 0                    TPFELL    USE EQN FOR DELE GEQ 90, LEQ -90
A0493                                         OTHERWISE, CONTINUE FOR GENERAL CONIC FOR TPF EQN
 0494                      27,3163   45471 1           DDV      STADR
A0495                                                                    DEN FROM PDL+0  E' (-3) OR (-16)
A0496                                                                                    M' (-3) OR (-15)
 0497  REF  6  LAST 1351  27,3164   77732 1           STORE    TPFTEM    Z  SAVE FOR SIGN OF SDELF.
```

```
A0498                                                          E' (-13)  M' (-12)
 0499                    27,3165  63406 0        PUSH  DSQ     Z TO PDL+0
 0500                    27,3166  41206 0        PUSH  DMP     Z SQ TO PDL+2  E' (-26)  M' (-24)
 0501  REF  6  LAST 1350 27,3167  00035 1              TPFNP   LC P  E' (-38+2NR)  M' (-38+2NR)
 0502                    27,3170  75261 0        SL    SIGN
 0503                    27,3171  20206 1              5
 0504  REF  7  LAST 1351 27,3172  00045 0              TPFTEM  APFIX SIGN FOR SDELF (ENTRY DISPLAY)
 0505  REF  8  LAST 1352 27,3173  14045 0        STODL TPFTEM  P ZSQ  E' (-59+2NR)  M' (-55+2NR)
A0506                                                          (ARG IS USED IN TPF/TRIG)
A0507                                                          ZSQ FROM PDL+2  E' (-26)  M' (-24)
 0508                    27,3174  41206 0        PUSH  DMP     RESTORE PUSH LOC
 0509  REF  6  LAST 1351 27,3175  00033 1              TPFALFA ALFA  E' (26-NR)  M' (24-NR)
 0510                    27,3176  77657 0        SL*
 0511                    27,3177  20201 0              0,1     X1=-NR
 0512  REF  6  LAST 1351 27,3200  00043 0        STORE TPFX    X
 0513                    27,3201  41234 1        RTB   DMP
 0514  REF  1            27,3202  57325 1              T(X)
A0515                                                           POLY
 0516                    27,3203  44302 0        SR2   BDSU    ZSQ FROM PDL+2  E' (-26)  M' (-24)
 0517  REF  5  LAST 1351 27,3204  00023 0              RTERM   2 ZSQ T(X)  E' (-29)  M' (-27)
 0518                    27,3205  41215 1        DAD   DMP     RTERM  E' (-29)  M' (-27)
 0519  REF  3  LAST 1351 27,3206  00015 0              RMAG1
A0520                                                          E' (-29)  M' (-27)
 0521                    27,3207  51042 0        SR3   BPL     Z FROM PDL+0  E' (-13)  M' (-12)
 0522  REF  1            27,3210  57231 0              ENDTPF  TPF SQRT(MU)  E' (-45)  M' (-42)
 0523                    27,3211  75206 1        PUSH  SIGN    (NO PUSH UP)
 0524  REF  3  LAST 1351 27,3212  00017 1              TPFQ1   TPF SQRT(MU)  TO PDL+0
 0525                    27,3213  71244 0        BPL   DLOAD   Q1 FOR GONEPAST TEST
 0526  REF  1            27,3214  57235 1              NEGTPF  GONE PAST π
 0527  REF  3  LAST 1347 27,3215  00027 1              TPF1/ALF YES. TPF ± 0 .
 0528                    27,3216  51076 1        DCOMP BPL     1/ALFA  E' (-22-2NA)  M' (-20-2NA)
 0529  REF  2  LAST 1352 27,3217  57235 1              NEGTPF  ALFA δ 0 π
                                                               NO. TPF IS NEGATIVE.
A0530                                  CORRECT FOR ORBITAL PERIOD.
 0531                    27,3220  77676 0        DCOMP         YES. CORRECT FOR ORB PERIOD.
 0532                    27,3221  56205 0        DMP   DDV
 0533  REF  1            27,3222  17347 1              PI/16   2 PI (-5)
 0534  REF  3  LAST 1351 27,3223  00031 0              TPFRTALF SQRT(ALFA)  E' (10+NA)  M' (9+NA)
 0535                    27,3224  53657 0        SL*   SL*
 0536                    27,3225  57602 1              0 -4,2  X2=-NA
 0537                    27,3226  57602 1              0 -4,2
 0538                    27,3227  43257 0        SL*   DAD
 0539                    27,3230  57576 1              0,2
A0540                                                          TPF SQRT(MU) FROM PDL+0  E'(-45) M'(-42)
 0541                    27,3231  40005 0 ENDTPF DMP    BOV     TPF SQRT(MU) IN MPAC     E'(-45) M'(-42)
 0542  REF  7  LAST 1344 27,3232  00037 0              TPF/RTMU E' (17)  M' (14)
 0543  REF  1            27,3233  57241 1              MAXTPF  SET POSMAX IF OVFL.

 0544                    27,3234  77616 0 DUMPTPF2 RVQ          RETURN  TPF  (-28) CS IN MPAC.
```

L TIME OF FREE FALL

```
 0545                          27,3235  77745 1  NEGTPF   DLOAD                 TPF SQRT(MU)  FROM PDL+0, NEGATIVE.
A0546
 0547                          27,3236  77650 1           GOTO
 0548  REP   2  LAST 1352     27,3237  57231 0                  ENDTPF

 0549                          27,3240  77745 1  MAXTPF1  DLOAD                 RESET PDL
 0550                          27,3241  43545 1  MAXTPF   DLOAD  RVQ
 0551  REP   5  LAST 1347     27,3242  17363 1                 NEARONE

B0552  TIME OF FLIGHT ELLIPSE WHEN DEL (ECCENTRIC ANOM) GEQ 90 AND LEQ -90.

A0553                                                                        NUM FROM TPFX.  E' (-16) OR (-29)
A0554                                                                                        M' (-15) OR (-27)
 0555                          27,3243  77712 0  TPFELL   SL2                 NUM  E'(-14) OR (-27)  M'(-13) OR (-25)
 0556                          27,3244  41465 0           BDDV   PUSH         TEMP SAVE D/N IN PDL+0
A0557                                                                        DEN FROM PDL+0 E'(-3)/( 16) M'(-3)/(-15)
A0558                                                                        N/D TO PDL+0  E' (11)  M' (10)
 0559                          27,3245  45345 1  TPFEL1   DLOAD  DSU          (ENTER WITH D/N=0 IN PDL+0)
 0560  REP   9  LAST 1352     27,3246  00045 0                 TPFTEM         Q2  E' (-16)  M' (-15)
 0561  REP   4  LAST 1352     27,3247  00017 1                 TPFQ1          Q1  E' (-16)  M' (-15)
 0562  REP   1                27,3250  14013 0           STODL  TPFDELQ       Q2-Q1  E' (-16)  M' (-15)
A0563                                                                        D/N FROM PDL+0
 0564                          27,3251  77626 0           STADR
 0565  REP  10  LAST 1353     27,3252  77732 1           STORE  TPFTEM        D/N  E' (11)  M' (10)
 0566                          27,3253  53805 1           DMP    SL*
 0567  REP   4  LAST 1352     27,3254  00027 1                  TPF1/ALF      1/ALFA E' (-22-2NA)  M' (-20-2NA)
 0568                          27,3255  57576 1                  0,2           1/ALFA Z  E' (-11-NA)  M' (-10-NA)
 0569                          27,3256  41206 0           PUSH   DMP           TO PDL+0
 0570  REP  11  LAST 1353     27,3257  00045 0                  TPFTEM         1/Z  E' (11)  M' (10)
 0571                          27,3260  41057 0           SL*    BOVB
 0572                          27,3261  57576 1                  0,2           X2= -NA
 0573  REP  16  LAST 1293     27,3262  45707 0                  SIGNMPAC      IN CASE X= 1.0, CONTINUE
 0574  REP   7  LAST 1352     27,3263  00043 0           STORE  TPFX          X=1/ALFA ZSQ
 0575                          27,3264  41234 1           RTB    DMP
 0576  REP   2  LAST 1352     27,3265  57325 1                  T(X)          POLY
 0577  REP   8  LAST 1353     27,3266  00043 0                  TPFX
 0578                          27,3267  45242 1           SR3    DSU
 0579  REP   1                27,3270  17355 1                  DP2(-3)
 0580                          27,3271  41405 0           DMP    PUSH          2(X T(X)-1) /Z ALFA  E' (-15-NA)
A0581                                                                                             M' (-14-NA)
A0582                                                                        1/ALFA Z FROM PDL+0  E' (-11-NA)
A0583                                                                                             M' (-10-NA)
 0584                          27,3272  41345 0           DLOAD  DMP           GET SIGN FOR SDELF
 0585  REP  12  LAST 1353     27,3273  00045 0                  TPFTEM         1/Z  E' (11)  M' (10)
 0586  REP   4  LAST 1352     27,3274  00015 0                  RMAG1          E' (-29)  M' (-27)
 0587                          27,3275  43312 0           SL2    DAD
 0588  REP   5  LAST 1353     27,3276  00017 1                  TPFQ1          Q1  E' (-16)  M' (-15)
 0589  REP  13  LAST 1353     27,3277  14045 0           STODL  TPFTEM         (Q1+R 1/Z)  =SGN OF SDELF E'(-16) M'(-15
 0590  REP   7  LAST 1352     27,3300  00035 1                  TPFNP          LC P E' (-38+2NR) M' (-36+2NR)
 0591                          27,3301  53805 1           DMP    SL*            CALC FOR ARG FOR TPF/TRIG.
```

L TIME OF FREE FALL

```
 0592  REP   5  LAST 1353   27,3302  00027 1          TPF1/ALF
 0593                       27,3303  57575 1          1,2
 0594                       27,3304  53765 0  SIGN    SL*
 0595  REP  14  LAST 1353   27,3305  00045 0          TPFTEM
 0596                       27,3306  57576 1          0,2
 0597  REP  15  LAST 1354   27,3307  14045 0  STODL   TPFTEM
A0598
 0599  REP   6  LAST 1354   27,3310  00027 1          TPF1/ALF
 0600                       27,3311  41366 1  SQRT    DMP
 0601  REP   2  LAST 1352   27,3312  17347 1          PI/16
 0602                       27,3313  77615 0  DAD
A0603
A0604
 0605                       27,3314  45257 0  SL*     DSU
 0606                       27,3315  57577 0          0 -1,2
 0607  REP   2  LAST 1353   27,3316  00013 0          TPFDELQ
 0608                       27,3317  53805 1  DMP     SL*
 0609  REP   7  LAST 1354   27,3320  00027 1          TPF1/ALF
 0610                       27,3321  57601 1          0 -3,2
 0611                       27,3322  52057 1  SL*     GOTO
 0612                       27,3323  57602 1          0 -4,2
 0613  REP   3  LAST 1353   27,3324  57231 0          ENDTPF
```

```
1/ALFA   E'(-22-2NA)  M'(-20-2NA)
X2=-NA

APPIX SIGN FOR SDELF

P/ALFA  E'(-59+2NR)  M'(-55+2NR)
(ARG FOR USE IN TPF/TRIG)
1/ALFA E'(-22-2NA)  M'(-20-2NA)

PI (-4)

2(XT(X)-1)/Z ALFA FROM PDL E'(-15-NA)
                           M'(-14-NA)


Q2-Q1  E' (-16)  M' (-15)

1/ALFA  E'(-22-2NA)  M'(-20-2NA)


TPF SQRT(MU) IN MPAC E'(-45) M'(-42)
```

USER=S PAGE NO. 14 E0 S3

L TIME OF FREE FALL USER=S PAGE NO. 15 E0 S3

```
R0614   PROGRAM NAME'      T(X)                                          DATE'    01.17.67
R0616   MOD NO'  0                                                      LOG SECTION'    TIME OF FREE FALL
R0618   MOD BY'  RR BAIRNSFATHER
R0619   FUNCTIONAL DESCRIPTION'      THE POLYNOMIAL T(X) IS USED BY TIME OF FLIGHT SUBROUTINES  CALCTFF AND
R0621           CALCTPER TO APPROXIMATE THE SERIES
R0622                                  2     3
R0623                   1/3 -X/5 +X /7 -X /9 ...

R0624           WHERE  X = ALPA Z Z        IF ALPA Z Z  LEQ 1
R0625                  X = 1/(ALPA Z Z )   IF ALPA Z Z   G  1

R0626           ALSO   X IS NEG FOR HYPERBOLIC ORBITS
R0627                  X = 0 FOR PARABOLIC ORBITS
R0628                  X IS POSITIVE FOR ELLIPTIC ORBITS
R0629           FOR FLIGHT 278, THE POLYNOMIAL  T(X) IS FITTED OVER THE RANGE  (0,+1)  AND HAS A MAXIMUM
R0631           DEVIATION FROM THE SERIES OF  2 E-5        (T(X) IS A CHEBYCHEV  TYPE FIT AND WAS OBTAINED USING
R0633           MAC PROGRAM AUTCURFIT294RR8  AND IS VALID TO THE SAME TOLERANCE OVER THE RANGE  (-.08,+1). )
R0635   CALLING SEQUENCE'  RTB
R0636                        T(X)
R0637           C(MPAC) = X

R0638   SUBROUTINES CALLED'  NONE
R0639   NORMAL EXIT MODE'    TC   DANZIG
R0640   ALARMS'  NONE
R0641   OUTPUT'  C(MPAC) = T(X)
R0642   ERASABLE INITIALIZATION REQUIRED'
R0643           C(MPAC)  =  X
R0644   DEBRIS'  NONE

 0645   REP  10  LAST 1264   27,3325  0 7171 1  T(X)      TC     POLY
 0646                        27,3326   00004 0             DEC    4                  N-1
 0647                        27,3327   12525 0             2DEC   3.333333333 E-1
 0647                        27,3330   12525 0
 0648                        27,3331   71463 0             2DEC*  -1.999819135 E-1 *
 0648                        27,3332   57703 1
 0649                        27,3333   04423 0             2DEC*  1.418148467  E-1 *
 0649                        27,3334   17645 0
 0650                        27,3335   74604 0             2DEC*  -1.01310997  E-1 *
 0650                        27,3336   43667 1
 0651                        27,3337   01626 1             2DEC*  5.609004986  E-2 *
 0651                        27,3340   37256 1
 0652                        27,3341   77404 1             2DEC*  -1.536156925 E-2 *
 0652                        27,3342   52071 0
 0653   REP  67  LAST 1286   27,3343  0 6030 1  ENDT(X)   TC     DANZIG

 0654   REP  1               27,3343            TCDANZIG =      ENDT(X)
```

```
P0655   TPF CONSTANTS
 0656                    32,3755                 BANK   32

 0657   REF   1          27,2000                 SETLOC TOP-FF1
 0658                    27,3344                 BANK

A0659                                                    NOTE   NOTE   ADJUSTED MUE FOR NEAR EARTH TRAJ.

A0660                                           MUE     =      3.990 815 471 E10  M CUBE/CS SQ
A0661                                           RTMUE   =      1.997702549 E5 B-18*     MODIFIED EARTH MU

 0662                    27,3344   24775 1       1/RTMU  2DEC*  .5005750271 E-5 B17*     MODIFIED EARTH MU
 0662                    27,3345   30424 0
A0663                                                    NOTE   NOTE   ADJUSTED MUE FOR NEAR EARTH TRAJ.

A0664                                           MUM     =      4.902 778  E8     M CUBE /CS SQ

A0665                                           RTMUM   2DEC*  2.21422176 E4 B-18*
 0666                    27,3346   06220 1       PI/16   2DEC   3.141592653 B-4
 0666                    27,3347   37553 0
 0667                    27,3350   37777 1       LIM(-22) 2OCT  37777 37700      1.0 -B(-22)
 0667                    27,3351   37700 1
 0668                    27,3352   00000 1       DP(-22) 2OCT   00000 00100      B(-22)
 0668                    27,3353   00100 0
 0669                    27,3354   04000 0       DP2(-3) 2DEC   1  B-3
 0669                    27,3355   00000 1
 0670                    27,3356   02000 0       DP2(-4) 2DEC   1 B-4            1/16
 0670                    27,3357   00000 1
R0671   RPAD1    2DEC   6373338 B-29    M  (-29)  =20 909 901.57 FT

 0672   REF   5  LAST  536    22,3310                 RPAD1   =      RPAD
 0673                    27,3360   00305 1       R300K   2DEC   6464778 B-29      (-29)  M
 0673                    27,3361   11205 0
 0674                    27,3362   37777 1       NEARONE 2DEC   .999999999
 0674                    27,3363   37777 1
 0675   REF  31  LAST 1323    26,3331                 TPFZEROS EQUALS HI6ZEROS
 0676   REF   4  LAST  888    26,3321                 TPF1/4   EQUALS HIDP1/4
```