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1 REM *****
2 REM >> LOOK << - STI-22-L  COPYRIGHT (C) 1979 SAT TRAK
3 REM BY WILLIAM N BARKER AND DAVID G COOKE
4 REM ALL RIGHTS RESERVED MOD 10 FEB 80
5 REM *****
10 CLEAR 4000:REM RA/DEC MOD
20 CLS:PRINT CHR$(23):PRINT@280,"LOOK ANGLE GENERATOR"
22 PRINT@344,"COPYRIGHT (C) 1979"
25 PRINT@408,"SAT TRAK INT'L"
30 DIM N$(9)
240 DIM TLC(9,3):DIM DB(9,13)
250 DATA 77,1.737371,4.879062,-.05227522
260 DATA 78,1.733205,4.874896,-.05674153
270 DATA 79,1.729039,4.870730,-.061208
280 DATA 80,1.724872,4.866563,-.0656743
290 DATA 81,1.737908,4.879601,-.05293787
300 DATA 82,1.733742,4.875434,-.05740420
310 DATA 83,1.729576,4.871268,-.06187052
320 DATA 84,1.725409,4.867101,-.06633684
330 DATA 85,1.738446,4.880138,-.05360119
340 DATA 86,1.734279,4.875971,-.05806752
350 FORI=0TO9:FORJ=0TO3:READTL(I,J):NEXTJ:NEXTI
360 OPEN"I",1,"WKFILE"
380 FOR I=0TO9
385 PRINT@450,"*** INPUT SATELLITE FILES ***"
390 INPUT#1,N$(I)
400 FOR J=0TO13
410 INPUT#1,DB(I,J)
415 DB(I,0)=I+1
420 NEXT J
425 PRINT@450,"
430 NEXT I
440 CLOSE
570 CR=57.29578:R9=1.570796:ER=6378.145
580 FF=3.352892E-3:E2=6.694542E-3:PI=3.1415926
590 RP=1.7453292E-2:QJ2=8.119117E-4:MJ2=-1.623823E-3
600 KE=1.070882E2:RR=6.283185:CV=7.905368
610 S0=.17365:TD=5.883366E-2
620 C6=4.778819E-8:ME=.9933055
630 C2=3.34462E-2:C4=4.50104E-2:C5=.4336428
640 TM=.01388889
650 CLS:PRINT:PRINT:PRINT"ENTER OBSERVATION SITE COORDINATES AS-"
655 PRINT"LATITUDE LONGITUDE ALTITUDE"
660 PRINT"N/S,DEGREES,E/W,DEGREES, FEET ABOVE MSL (USE COMMMAS)"
665 J$="":K$=""
670 INPUT J$,GL,K$,LN,S8:P1=GL:P2=LN
680 IF J$="N" THEN 700
685 IF J$="S" THEN 710
690 PRINT">>>ERROR ON INPUT<<<":GOTO670
700 GL=GL/CR:GOTO720
710 GL=-(GL/CR)
720 IF K$="E" THEN 740
730 IF K$="W" THEN 750

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735 GOTO690
740 LN=LN/CR:GOTO850
750 LN=(360-LN)/CR
850 ST=SIN(GL):COT=COS(GL)
860 S8=S8*C6:S1=1/SQR(1-(E2*ST2)):S2=S1*ME
870 S3=(S1+S8)*COT: SX=S3*COS(LN):SY=S3*SIN(LN)
880 SZ=(S2+S8)*ST:R=SQR(SX2+SY2+SZ2)
890 R1=S3:SP0=SZ/R:CP0=R1/R:TP=ATN(SZ/R1):AB=ABS(TP)
900 CLS:PRINT:PRINT'***** SATELLITE DATA BASE *****:
    ***'
910 PRINT' # OBJ # NAME PERIOD INCLIN';
920 PRINT' ELSET# REV # EPOCH'
930 FOR I=0TO9
960 PRINTDB(I,0);TAB(3)DB(I,1);TAB(11)N$(I);TAB(22)24/DB(I,12)*60;
970 PRINTTAB(31)DB(I,7);
980 PRINTTAB(40)DB(I,6);TAB(47)DB(I,13);TAB(54)DB(I,3)+DB(I,4)
1000 NEXT I
1010 FOR I=1 TO 64: PRINT'*':; NEXT I
1020 INPUT'SELECT SATELLITE';S
1030 IF (S<1 OR S>10) THEN 1020
1050 S=S-1:YY=DB(S,2):DD=DB(S,3):FD=DB(S,4):M0=DB(S,11)*RP
1060 RI=DB(S,8)*RP:AP=DB(S,10)*RP:E0=DB(S,9):I0=DB(S,7)*RP
1070 N0=DB(S,12)*RR:ND0=DB(S,5)*RR
1080 FOR I=0TO9:IFTL(I,0)=YYTHEN 1100
1090 NEXTI:PRINT:PRINT'>>>EPOCH YEAR';YY;'NOT IN ALMANAC<<<':INPUT'PRESS
    ';D:GOTO 900 <ENTER>
1100 T1=TLC(I,1):SN=TLC(I,2):M0=TLC(I,3)
1110 A=(T1+DD*1.720279E-2+FD*6.300388)
1120 Z=A:A=A/RR:X=A(ABS(A))*INT(ABS(A)):T2=Z-X*RR
1130 IY=YY:MY=YY-1:YF=0:DI=365:LY=48
1140 FORJ=1 TO 12:LY=LY+4
1150 IF MY=LY THEN YF=1
1160 IF IY=LY THEN 1190
1170 NEXT J
1180 GOTO 1200
1190 DI=366
1200 A0=(KE/N0)C.6666667:Q2=A0*(1-E0)
1210 V$='V':HI=0:MR=0:CLS:PRINT N$(S):PRINT
1220 INPUT 'SET MAX RANGE (KILOMETERS) <DEFAULT INFINITY>';MR:MR=MR/ER
1230 INPUT'SELECT <ALL> PASSES <DEFAULT VISIBLE PASSES ONLY>';V$
1240 VF=1:IF V$='ALL' THEN VF=0
1250 INPUT'SET MINIMUM PASS ELEVATION <DEFAULT 10 DEG.>';HI
1260 HI=HI/CR:IF HI=0THEN HI=.1745329
1270 CH=COS(HI):SM=SIN(HI):I1=I0
1280 IF I0>R9THEN I1=PI-I0
1290 IF I1>=A8THEN 1332
1300 D=CH/COS(HI+AB-I1):IF D<Q2THEN 1344
1310 PRINT'>>>SATELLITE NOT VISIBLE FROM INPUT LATITUDE';GL*CR;<<<'
1320 INPUT'PRESS <ENTER>';D:GOTO 900
1332 REM
1344 PRINT'ENTER TIME OF INTEREST AS-'
1346 PRINT:PRINT'YY,DDD,HH,DDD,HH'
1350 INPUT Y1,D1,H1,D2,H2

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1390 IF(YY<Y1 AND D2<D1) THEN PRINT">>>ERROR ON INPUT<<<":GOTO1344
1400 DT=0:INPUT"OUTPUT INTERVAL (DEFAULT 1 MIN.)":DT
1410 DT=DT/1440:IF DT=0 THEN DT=6.94444E-4
1420 MN=DT*1440:CLS
1430 FOR J=1 TO 64:PRINT"-":NEXT
1440 PRINT"OBSERVATION SITE ";J#:P1;K#:P2;
1450 PRINT"ALT";S8/C6;"FT MSL"
1460 FOR J=1 TO 64:PRINT"-":NEXT
1470 PRINT"LOOK ANGLES FOR ";N#:DB(S,1);TAB(35);"EPOCH DAY";
1480 PRINTDD;TAB(49)"AT";TAB(51)FD*24;TAB(60)"HRS"
1490 PRINTTAB(35);"START DAY";D1;TAB(49)"AT";TAB(51)H1;TAB(60)"HRS"
1500 PRINT"PERIOD";TAB(13)24/DB(S,12)*60;TAB(22)"MIN.";
1510 PRINTTAB(35)"END DAY";D2;TAB(49)"AT";TAB(51);H2;TAB(60)"HRS"
1520 PRINT"INCLINATION";TAB(13)I0*CR;TAB(22)"DEG.";
1530 PRINTTAB(35)"OUTPUT INTERVAL";TAB(51)MN;TAB(60)"MIN"
1540 FOR J=1 TO 64:PRINT"-":NEXT
1550 V=0:GOSUB 4240
1560 IF T1=0 THEN 1640
1570 IF YY=Y1THEN 1640
1580 IF YY>Y1THEN 1610
1590 DA=D1-DD+DI
1600 BD=D2-DD+DI:GOTO 1680
1610 DA=D1-DD-365-YF:IF D2>=D1 THEN 1630
1620 BD=D2-DD:GOTO 1680
1630 BD=D2-DD-365-YF:GOTO 1680
1640 DA=D1-DD
1650 IFD2>=D1THEN 1670
1660 BD=D2-DD+DI:GOTO 1680
1670 BD=D2-DD
1680 HA=(H1/24)-FD:IF T1=0 THEN 1700
1690 T1=DA+HA
1700 BH=(H2/24)-FD:TF=BD+BH
1710 FS=0:T=T1-TM
1715 TE=9E9
1720 FBDT=1:LAF=0
1730 T=T+TM
1740 IF POINT(64,47) THEN 1750 ELSE 1760
1750 RESET(64,47):GOTO 1770
1760 SET(64,47)
1770 IF T<=TF THEN 1820
1780 IF LAF=1 THEN 3170
1810 PRINT">>NO SUITABLE PASS FOUND<<":GOTO 3180
1820 GOSUB 3310
1825 GOSUB 3620
1830 IF VF=0 THEN 1890
1840 ZX=COT*C9A
1850 ZY=COT*SIA
1860 GOSUB 3350
1870 DOTZ=ZX*XS+ZY*YS+ST*ZS
1880 IF((DOTZ+S0)>0)THEN 1730
1890 XFDT=FBDT
1892 GOSUB 3740
1893 GOSUB 3670
1894 IF RS<=1.5 THEN 1920
1895 IF(RBDZ<0ORHBTST<0)THEN 1730
1896 TS=T:T=T-TM
1898 IF (T>=T1ANDTM>DT)THEN 1900
1899 T=TS-DT:GOTO2460
1900 FORN=1TO40

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1902 T=T+DT
1904 GOSUB 3310
1906 GOSUB 3740
1908 GOSUB 3620
1910 GOSUB 3670
1912 IF HBTST>=0 THEN 1918
1914 NEXTN
1916 T=TS-DT:GOTO2460
1918 T=T-DT:GOTO2460
1920 IF(XFDT<0 OR FBDT>0 OR RBDZ<0) THEN 1730
1930 WX=UY*VZ-UZ*VY:WY=UZ*VX-UX*VZ
1940 WZ=UX*VY-UY*VX:ZW=ZX*WX+ZY*WY+ST*WZ
1950 QA=AI*(1+ET):D9=QA*SQR(1-ZW*ZW)
1960 F9=(SM/CH)*QA*ZW: IF (D9<(R+ABS(F9))) THEN 1730
1970 TS=T:JJ=0
1980 FORN=1TO4
1990 T=T-.0035
2000 GOSUB 3310
2010 GOSUB 3740
2020 GOSUB 3620
2030 GOSUB 3670
2040 IF FBDT>0 THEN 2110
2050 NEXT N
2060 T=TS+.02777778
2070 FBDT=-1:GOTO 1730
2080 GOSUB 3740
2090 GOSUB 3620
2100 GOSUB 3670
2110 IF RBTZ<0 THEN 2060
2120 JJ=JJ+1
2130 A4=RSC3
2140 A5X=-(RX/A4)
2150 A6Y=-(RY/A4)
2160 A7Z=-(RZ/A4)
2170 Z5X=-ZX*3.461399E-3
2180 Z6Y=-ZY*3.461399E-3
2190 F6=A5X*ZX+A6Y*ZY+A7Z*ST
2200 F6=F6+2*(XDT*DX+YDT*DY)+RX*Z5X+RY*Z6Y
2210 T8=FBDT/(F6*KE)
2220 T9=ABS(T8)
2230 IF T9<=3.472222E-3 THEN 2250
2240 TK=T-(T8/T9)*3.472222E-3:GOTO 2260
2250 TK=T-T8
2260 IF T9<=1.157407E-5 THEN 2300
2270 T=TK
2280 GOSUB 3310
2290 IF JJ<=5 THEN 2080
2300 IFABS(TK-TE)>6.9444E-3 THEN 2304
2302 TS=TK+TM:GOTO2060
2304 TE=TK:T=TK
2310 GOSUB 3310
2320 GOSUB 3740
2330 GOSUB 3620
2340 GOSUB 3670
2350 IF HBTST<0 THEN 2060
2360 IF MR<=0 THEN 2380
2370 IF RHO>MR THEN 2060
2380 FOR NN=1TO15
2390 T=T-DT

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2400 GOSUB 3310
2410 GOSUB 3740
2420 GOSUB 3620
2430 GOSUB 3670
2440 IF HBTST<0 THEN 2460
2450 NEXT NN
2460 J4=0:J5=0:J6=0:ZF=0
2465 IF RS>1.5 THEN ZF=1
2470 T=T+DT
2480 GOSUB 3310
2482 IF RS<1.5 THEN 2490
2484 GOTO 2530
2490 IF J6>0 THEN 2060
2500 IF J4>0 THEN 2530
2510 IF T<TE THEN 2530
2520 J5=1
2530 GOSUB 3740
2540 GOSUB 3620
2550 GOSUB 3670
2552 IF ZF=0 THEN 2560
2554 IF HBTST<=0 THEN 2792
2556 GOTO 2570
2560 IF HBTST<=0 THEN 2610
2570 IF MR<=0 THEN 2670
2580 IF RH<=MR THEN 2670
2582 IF ZF=1 THEN 2470
2590 IF T>=TE THEN 3130
2600 GOTO 2470
2610 IF J4>0 THEN 3130
2620 IF J5 <=0 THEN 2470
2630 IF J6>0 THEN 3130
2640 T=TE: J6=1
2650 GOSUB 3310
2660 GOTO 2530
2670 IF VF=0 THEN 2800
2680 GOSUB 3350
2690 DOTZ=ZX*XS+ZY*YS+ST*ZS
2700 IF ((DOTZ+S0)<=0) THEN 2740
2702 IF ZF=1 THEN 2470
2710 IF J6>0 THEN 3130
2720 IF J4>0 THEN 3130
2730 GOTO 2470
2740 RTLS=RX*XS+RY*YS+RZ*ZS
2750 IF ((RT/RS)>=0) THEN 2800
2760 IF ((RSC2-RTC2-1)>=0) THEN 2800
2762 GOTO 2702
2792 IF J4=0 THEN 1730
2794 V=V+1:FOR J=1 TO 64:PRINT "-*";:NEXT J
2796 GOTO 1730
2800 IF T>TF THEN 1780
2804 J4=1
2810 U1X=ROX/RH
2820 U2Y=R2Y/RH
2830 U3Z=R3Z/RH

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2840 Q1=U1X*C9A+U2Y*SIA
2850 U4X=Q1*ST-U3Z*COT
2860 U5Y=-U1X*SIA+U2Y*C9A
2870 U6Z=Q1*COT+U3Z*ST
2880 E8=(ATN(U6Z/SQR(1-U6Z*U6Z)))
2890 IF (ABS(U5Y)>1E-6)THEN 2910
2900 U5Y=1E-6
2910 A8=ATN(U4X/U5Y)
2920 IF U5Y>0THEN 2940
2930 A8=A8+4.712389;GOTO 2950
2940 A8=A8+1.570796
2950 IF U1=0THEN U1=1E-6
2960 IF U3=1THEN U3=.999999
2970 AL=ATN(U2/U1)
2980 IF(U1>0 AND U2>0)THEN 3000
2990 AL=AL+PI;IF(U1>0ANDU2<0)THEN AL=AL+PI
3000 DC=(ATN(U3/SQR(1-U3*U3)))
3010 GOSUB 3410
3020 A8=A8*CR;E8=E8*CR;AL=AL*CR;DC=DC*CR
3030 RG=RHO*ER
3040 PRINTSTR$(YI);TAB(3)STR$(ID);
3050 PRINTTAB(7)STR$(IH);TAB(10)STR$(IM);
3060 PRINTTAB(13)STR$(IS);
3070 PRINTTAB(17)(A8);TAB(26)(E8);TAB(36)AL;TAB(45)DC;
3080 PRINTTAB(54)RG
3090 V=V+1;IF V<13 THEN 3120
3100 INPUT'PRESS ENTER TO CONTINUE';D
3110 V=0;GOSUB 4240
3120 LAF=1;GOTO 2470
3130 IF J4=0THEN 2060
3140 V=V+1
3150 FOR J=1 TO 64;PRINT"-";:NEXT
3160 GOTO 2060
3170 PRINT'CALCULATION COMPLETE FOR ";N$;' FOR ";D1;H1;D2;H2
3180 INPUT'NEW PASS LIMITS AND TIME OF INTEREST Y/N';Q$
3190 IF Q$="Y" THEN 1210
3200 IF Q$="N" GOTO 3220
3210 IF Q$<>"N" THEN PRINT"<Y> OR <N> ONLY";GOTO 3180
3220 INPUT'NEW SATELLITE Y/N';Q$
3230 IF Q$="Y" THEN 900
3240 IF Q$="N" GOTO 3260
3250 IF Q$<>"N" THEN PRINT"<Y> OR <N> ONLY";GOTO 3220
3260 INPUT'NEW OBSERVATION SITE Y/N';Q$
3270 IF Q$="Y" THEN 650
3280 IF Q$="N" THEN 3300
3290 IF Q$<>"N" THEN PRINT "<Y> OR <N> ONLY";GOTO 3260
3300 PRINT'END OF PROGRAM';RUN'CONTROL'
3310 IF ABS(T)<1E-6 THEN 3340
3320 IT=(T/ABS(T))*INT(ABS(T));FT=T-IT
3330 RETURN
3340 IT=0;FT=0;RETURN
3350 ID=DD+IT;FX=FD+FT
3360 CT=ID*1.720279E-2+FX*1.720279E-2

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3370 SL=SN+CT+C2*SIN(CT+M0)
3380 AS=SLT-(C4*SIN(2*SL))/(1+C4*(1+COS(2*SL)))
3390 DS=ATN(C5*SIN(AS));YS=COS(DS);XS=YS*COS(AS)
3400 YS=YS*SIN(AS);ZS=SIN(DS);RETURN
3410 ID=DD+IT;FX=FD+FT
3420 IF ABS(FX)<1E-6 THEN FX=0
3430 IF ABS(FX)<1 THEN 3450
3440 HR=(FX/ABS(FX))*INT(ABS(FX));ID=ID+HR;FX=FX-HR
3450 IF FX>=0 THEN 3470
3460 FX=FX+1;ID=ID-1
3470 HR=FX*24;IH=INT(HR);MI=(HR-IH)*60;IM=INT(MI)
3480 SD=(MI-IM)*60;IS=INT(SD);FR=SD-IS
3490 IF FR>=.5 THEN IS=IS+1
3500 IF ABS(IS-60)<.5 THEN 3520
3510 IF IS<60 THEN 3530
3520 IS=0;IM=IM+1
3530 IF IM<60 THEN 3550
3540 IM=0;IH=IH+1
3550 IF IH<24 THEN 3570
3560 IH=0;ID=ID+1
3570 IF ID>0 THEN 3590
3580 ID=ID+365+YF;YI=IY-1;RETURN
3590 IF ID>DI THEN 3610
3600 YI=IY;RETURN
3610 ID=ID-DI;YI=IY+1;RETURN
3620 TG=T2+IT*1.720218E-2+FT*6.300387
3630 Z=TG;TG=TG/RR;X=(TG/ABS(TG))*INT(ABS(TG));TG=Z-X*RR
3640 A=TG+LN;Z=A;A=A/RR;X=A(ABS(A))*INT(ABS(A));AF=Z-X*RR
3650 SIA=SIN(AF);C9A=COS(AF)
3660 X2S=R1*C9A;Y2S=R1*SIA;Z2S=SZ;RETURN
3670 ZX=COT*C9A;ZY=COT*SIA;DX=-ZY*TD;DY=ZX*TD
3680 ROX=RX-X2S;R2Y=RY-Y2S;R3Z=RZ-Z2S
3690 RHO=SQR(ROX2+R2Y2+R3Z2)
3700 RBDTZ=RX*ZX+RY*ZY+RZ*ST
3710 FBDT=XDT*ZX+YDT*ZY+ZDT*ST+RX*DX+RY*DY
3720 HBTEST=(ROX*ZX+R2Y*ZY+R3Z*ST)-RH*SMIN
3730 RETURN
3740 IF FST=1 GOTO 3860
3750 FS=1;A0=(KE/N0)[.6666667;DP=(COS(I0))[2
3760 IF E0=0 THEN E0=1E-6
3770 DE=(QJ2/A0[2)*(3*DP-1)/(1-E0[2)[1.5
3780 A0=A0*(1-.3333333*DE-DE[2-1.654321*DE[3)
3790 P0=A0*(1-E0[2);CCI=COS(I0);SCI=SIN(I0);Q0=A0*(1-E0)
3800 IF I0<=R9 GOTO 3820
3810 L0=M0+AP-RI;GOTO 3830
3820 L0=M0+AP+RI
3830 RD=(MJ2/P0[2)*N0*CCI;OD=(QJ2/P0[2)*N0*(5*DP-1)
3840 A2=E0*COS(AP);A3=E0*SIN(AP);AC=ABS(CC)
3850 DP=-((MJ2/P0[2)*(2-2.5*(SIN(I0)[2)-ACCI)
3860 NT=N0+2*(ND*T);AI=A0*(N0/NT)[.6666667
3870 IF AI>Q0 GOTO 3890
3880 ET=1E-6;GOTO 3900
3890 ET=1-Q0/AI
3900 PT=AI*(1-ET[2);RA=RI+RD*T;SA=SIN(RA);CA=COS(RA)

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3910 DW=OD*T:SW=SIN(DW):CW=COS(DW)
3920 AX=(ET/E0)*(A2*CW-A3*SW)
3930 AYN=(ET/E0)*(A2*SW+A3*CW)+(1.124660E-3*SCI/P0)
3940 XM=-SA*CC:YM=CA*CC:ZM=SC:XM=CA:YN=SA
3950 L3=(.5623302E-3/P0)*AXN*SCI*(3+5*ACCI)/(1+ACCI)
3960 XL=L0+N0*(1+DP)*T+L3+ND0*TL2
3970 IF I0<=R9 GOTO 3990
3980 U=XL+RA:GOTO 4000
3990 U=XL-RA
4000 K=0:EW=U:DF=1E9
4010 FOR J=1TO10
4020 IF POINT(64,47) THEN 4030 ELSE 4040
4030 RESET(64,47):GOTO 4050
4040 SET(64,47)
4050 EP=U+AXN*SIN(EW)-AYN*COS(EW)
4060 A1=ABS(EP-EW)
4070 IF A1<=1.0E-6 GOTO 4150
4080 IF A1>DF GOTO 4100
4090 DF=A1:HOLD=EP
4100 DL=(EP-EW)/(1-AXN*COS(EW)-AYN*SIN(EW))
4110 D=ABS(DL):IF D<1THEN 4130
4120 DL=DL/D
4130 EW=EW+DL:NEXT J
4140 K=1:EP=HO
4150 EW=EP:CEW=COS(EW):SEW=SIN(EW):EC=AX*CE+AY*SE
4160 ES=AX*SE-AY*CE:RS=AI*(1-EC):AA=ES/(1+SQR(1-ETL2))
4170 CU=AI/RS:SU=CU*(SE-AY-AX*AA)
4180 CU=CU*(CE-AX+AY*AA)
4190 UX=XN*CU+XM*SU:UY=YN*CU+YM*SU:UZ=ZM*SU
4200 RX=RS*UX:RY=RS*UY:RZ=RS*UZ
4210 VE=SQR(AI)*ES/RS:VX=-XN*SU+XM*CU:VY=-YN*SU+YM*CU
4220 VZ=ZM*CU:RV=SQR(PT)/RS:XD=VE*UX+RV*VX
4230 YD=VE*UY+RV*VY:ZD=VE*UZ+RV*VZ:RETURN
4240 PRINT "      TIME      AZIMUTH  ELEVATION";
4250 PRINTTAB(37)" RA      DEC      RANGE "
4260 PRINT " YY DDD HH MM SS  DEGREES  DEGREES ";
4270 PRINTTAB(37)"DEGREES  DEGREES  KM"
4280 RETURN
5000 M=M1:D=D1:GOSUB5020:D1=D
5010 M=M2:D=D2:GOSUB5020:D2=D:RETURN
5020 A1=INT((275*M)P9):A2=INT((M+9)/12):A3=4*INT(Y1/4)
5030 A4=Y1-A3+2:A5=INT(A4/3)+1:D=A1-A2*A5+D-30:RETURN

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