

XTIME -- Extended Time routines
for the HP49G(++)
Version 2.1

Extended Time, Date, Calendar and Astronomical routines for the HP48G(X) and HP49G(+). Part of these routines are ported from the invaluable *HP-41C CALENDARS Users' Library Solutions*. The astronomical routines include calculation of times of sunrise, transit and sunset, moon phases, and seasons.

Version 2 is more user friendly than version 1.1 in that INFORM and INPUT forms and a CHOOSE list have been written for the most important data. The separate subroutines have been maintained for those who want to use them for their own calculations. All calendar calculations have been grouped together in the **Calendar** routine.

The program sets and clears some system flags to account for user mode and date format settings which could be incompatible. The user settings are restored at the end of the program, using PUSH and POP. This version is no longer compatible with the HP48, unless the PUSH and POP instructions are replaced by RCLF and STOF

References:

1. Jean Meeus, Astronomical formulae for calculators (M)
2. HP-41C User's library solutions -- Calendars (HP)

Auxilliary Subroutines

used by the other date conversions

SEASONS

- >AD** To Astronomical Date format
INPUT: DATE TIME
OUTPUT: YYYY.MMDDdd
- AD-->** Astronomical Date to HP48 DATE/TIME format
INPUT: YYY.MMDDdd
OUTPUT: MM.DDYYYY HH.MMSSss
- YMD-->** Unpack YearMonthDay (AD) to stack
INPUT: YYYY.MMDDdd
OUTPUT: YYYY. MMDDdd
- >YMD** Convert stack to YMD (AD)
INPUT: YYYY MM DDdd
OUTPUT: YYYY. MM DDdd
- FM** Adjust month for MM =< 2
INPUT: MM
OUTPUT: MM (corrected)
- GYM** Adjust year for MM =< 2
INPUT: YYYY. MM
OUTPUT: YYYY (corrected)
- DMDY** Calculate Century Days (HP, p. 13)
INPUT: YYYY MM DD
OUTPUT: D
- D-->N** Convert a Day of Week string (SUN..SAT) to DOW number (0=SUN..6=SAT)
INPUT: "DOW"
OUTPUT: N (DOW number)
- LEAP** Test for Leap Year
INPUT: YYYY or YYYY>MMDDdd
OUTPUT: 1 (Leap year) / 0 (no Leap year)
- DIM** Determine the number of Days In Month

INPUT: YYYY MM
 OUTPUT: N (days)

D-->DT Convert a Date to Date and Time
 INPUT: YYYY.MMDDdd
 OUTPUT: YYYY.MMDD HH.MMSSss

FUND Compute Fundamental Arguments and Heliocentric Position of the Sun (Van Flandern and Pulkinen: The Astrophysical Journal Supplement Series, 41.391-411,1979)
 INPUT: Julian Day Number (JDN)
 OUTPUT: True Longitude of the Sun

Calendar Conversion Routines

CALENDAR All calendar and time calculations are grouped together using a CHOOSE box. Input all values following the self-explanatory prompts. Day of Week (MON...SUN) doesn't have to be input within parentheses, alpha mode is set by the program.

D-->J Date to Julian Day Number (JDN) (M, p.23-24)
 INPUT: YYYY.MMDDdd
 OUTPUT: JDN

J-->D Julian Day Number (JDN) to Date (M, p.26-27)
 INPUT: JDN
 OUTPUT YYYY.MMDDdd

DOW Day of Week number
 INPUT: YYYY.MMDDdd
 OUTPUT: DOW (0 = SUN...7 = SAT)

DOWS Day of Week String
 INPUT: YYYY.NINIDdd
 OUTPUT: "DOW" ("SUN"... "SAT") -->

--> DOY Date to Day of Year number
 INPUT: YYYY.MM.DDdd
 OUTPUT: DOY

DOY--> Day of Year number to Date
 INPUT: YYYY DOY
 OUTPUT: YYYY.MMDD(dd)

WEEK Calculate what Week Number the date is in
 INPUT: YYYY.MMDD(dd)
 OUTPUT: Week Number

RD Calculate the Remaining Days in the year
 INPUT: YYYY.MMDD(dd)
 OUTPUT: DDD

DD Difference in Days between two dates
 (Saturdays and Sundays included)
 INPUT: YYYY.MMDD (2) YYYY.MMDD (1)
 OUTPUT: Number of days

NWKD Number of Week Days between two dates (HP, p. 13)
 (Saturdays and Sundays excluded)
 INPUT: YYYY.MMDD(2) YYYY.MMDD(1)
 OUTPUT: N (Number of W-days)

NMDAY Number of MDAYS (a DOW: SUN...SAT) between two dates (HP, p. 22)
 INPUT: YYYY.MMDD (2) YYYY.MMDD (1) "DOW"
 OUTPUT: N (number of DOW's)

EASTER Determine the date of Easter in the year (M p. 29)

INPUT: YYYY(.MMDDdd)
 OUTPUT: YYYY.MMDD

NMD (NthMDAY) Determine on what date the Nth occurrence of a DOW is (HP, p. 22)
 INPUT: YYYY MM "DOW" N
 OUTPUT: YYYY.MMDD

MDAY Determine in what year(s) a DOW falls on the given date (HP, p. 18)
 Valid from Mar. 1, 1900 to Feb. 28, 2 100)
 INPUT: YYYY.MMDD (where YYYY is the start year) "DOW"
 OUTPUT: YYYY.MMDD

DATES Convert Date into Datestring in the format (using a GROB):
 "DOW MONTH Day, Year (DOY - WeekNo.)"

INPUT: YYY.MMDD

OUTPUT: Date String

EQUI Compute date and time of Equinoxes and Solstices (M, p. 85)
 INPUT: YYYY K (0 for spring, 1 summer, 2 autumn, 3 winter) TD
 (Time difference relative to UT or Greenwich time)
 Output: YYYY.MMDD HH.MMSS

GlobalVariables

FA Contains list of the Fundamental Arguments for the present astronomical computation (used by EQUI)

LSUN Contains the True Longitude of the Sun for the present astronomical computation (used by EQUI)

ET Universal Time(UT) - Ephemeris Time (ET) for 1997 expressed in fractional days (62.8" / 3600 / 24)
 Used by EQUI and MOON

ASTRO - Some Astronomical Routines for the HP48 G(X) and HP49G(++)

Needs subroutines from the **XTIME** collection

Reference:

Jean Meeus, Astronomical Algorithms (M)

ATN2 Computes Arc Tangent (ATAN) in the correct quadrant
 INPUT: Y X
 OUTPUT: ATAN (Y / X)

POPT Computes T, T² and T³ for the Epoch J2000
 INPUT: Julian Day Number (JDN)
 OUTPUT: T T² T³

NUT Nutation Subroutine: Computes the Longitude of the Moon's Ascending node (Ω or O), the nutation in Longitude ($\Delta\Psi$ or DL) and the nutation in Obliquity ($\Delta\epsilon$ or DE) - M, p.131-135
 INPUT: JDN
 OUTPUT: O. DL DE

SOL Computes the Sun's Apparent Longitude (L), Right Ascension (α or RA), Declination (δ or DEC) and the True Obliquity of the Eccliptic (ϵ or OBL) - M, p. 151-154
 INPUT: JDN
 OUTPUT: L RA DEC

IPOL Interpolation Subroutine for Rising, Transit and Setting - M, p. 23-25
INPUT: n (interpolation factor) Y3, Y2, Y1(the function values)
OUTPUT: y (the interpolated value)

ST0 Computes the Sidereal Time at 0 hr UT at Greenwich - M, p. 83-84
INPUT: JDN
OUTPUT: SO

SUN Computes the Rising, Transit and Setting times of the SUN
INPUT: Date Geographical Longitude (LON) Geographical Latitude (LAT)
Time Difference from Greenwich (TD)
OUTPUT: DISP Rise Transit Set

MOON Compute date and time of Full and New Moon phases of the month (M, p.149)
INPUT: YYYY MM TD (Time difference relative to UT)
OUTPUT: YYYY.MMDD HH.MM (2 to 3 values for the month)

SEASONS Compute date and time of The beginning of the 4 seasons of the year (M, p.149)
INPUT: YYYY TD (Time difference relative to UT)
OUTPUT: YYYY.MMDD HH.MM (4 values for the year)

HOLIDAYS Computes the Holidays in a year
INPUT: YYYY.MMDD
OUTPUT: DISP holidays

Global Variables

LON Contains the last Longitude value used by SUN and given as default value for SUN's data entry (INFORM)

LAT Contains the last Latitude value used by SUN and given as default value for SUN's data entry (INFORM)

TD Contains the last Time Difference value used by SUN and given as default value for SUN's data entry (INFORM)

FA Contains a list of the Fundamental Arguments last used by SOL, computed by FUND in subdirectory XTIME

LSUN Contains the last True Longitude of the Sun used by SOL, computed by FUND

RSUN Contains the last Radius Vector of the Sun computed by FUND