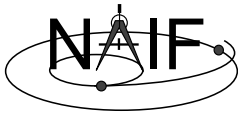




# Time Conversion and Time Formats

October 2007



## Overview

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Navigation and Ancillary Information Facility

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  - Defaults
  - Adjustments
- Pictorial layout of the Time System

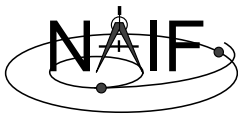
\*DOY = Day Of Year



# Time Systems and Kernels

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- **Three time systems are commonly used in SPICE for inputs and outputs in SPICE application programs:**
  - Coordinated Universal Time (UTC)
  - Spacecraft Clock (SCLK)
  - Ephemeris Time (ET, also referred to as Barycentric Dynamical Time, TDB)
- **Two time systems are commonly used in SPICE for kernel data look-ups or for computations**
  - Ephemeris Time (ET, TDB)
    - » Used in SPK, frames, PCK
    - » Used in high-level geometry interfaces
  - Encoded Spacecraft Clock (Ticks)
    - » Used in the intermediate level CK interfaces
- **The SPICE Leapseconds Kernel and Spacecraft Clock Kernel capture the relationships between**
  - UTC and ET (Leapseconds Kernel)
  - UTC or ET and SCLK (SCLK Kernel)
  - The long-term relationships between these systems cannot be accurately predicted



# Converting Time Strings

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- **UTC, TDB, or TDT (TT) String to Ephemeris Time**
  - STR2ET ( *string*, ET )
    - » Converts any string in a format recognized by SPICE, excepting SCLK
    - » Requires Leapseconds Kernel (LSK)
- **Spacecraft Clock String to Ephemeris Time**
  - SCS2E ( *scid*, *string*, ET )
    - » Requires Spacecraft Clock Kernel (SCLK)
    - » Normally requires Leapseconds Kernel (LSK) as well
      - To handle a very small (~2 msec.) difference between TDB and TT
- **Spacecraft Clock String to Encoded Spacecraft Clock (used in the mid-level interfaces of the C-kernel system)**
  - SCENCD ( *scid*, *string*, SCLKDP )
    - » Requires Spacecraft Clock Kernel (SCLK)



# Converting Numeric Times - 1

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- **Ephemeris Time to Calendar, DOY or Julian Date String**
  - **TIMOUT ( *et*, *fmtpic*, STRING )**
    - » The input *fmtpic* is a specification giving the user great flexibility in setting the appearance of the output time string, and the time system used (UTC, TDB, TDT).
      - YYYY Mon DD, HR:MN:SC.### ::UTC
        - 1999 Jan 12, 23:28:28.289
      - YYYY Mon DD, AP:MN:SC.### ampm ::UTC-8 (PST)
      - 1999 Jan 12, 03:28:28.289 p.m. (PST)
      - See the header for the TIMOUT module
      - The module TPICTR may be useful in constructing a format picture specification from a sample string
    - » Requires Leapseconds Kernel
  - **ET2UTC ( *et*, *format*, *prec*, UTCSTR )**
    - » The *format* input specifies calendar, DOY, or Julian Date format for UTCSTR
    - » Requires Leapseconds Kernel
  - **ETCAL ( *et*, STRING )**
    - » **STRING**, fixed format ephemeris calendar time string
    - » No Leapseconds Kernel is required.

Time Conversion and Formats

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# Converting Numeric Times - 2

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## Example Time Strings and the Corresponding Format Pictures

Time String	Format Picture Used ( <i>fmtpic</i> )
1999-283T12:28:29 (UTC)	YYYY-DOYTHR:MN:SC (UTC)
1999-283T12:29:33 (TDB)	YYYY-DOYTHR:MN:SC (TDB) ::TDB
Wed Nov 03, 19:29:05 1999	Wkd Mon DD, HR:MN:SC YYYY
465 B.C. Jan 12 03:15:23 p.m.	YYYY ERA Mon DD AP:MN:SC ampm
1987-11-03T04:29:58	YYYY-MM-DDTHR:MN:SC
04:28:55 A.M. June 12, 1982	AP:MN:SC AMPM Month DD, YYYY
Thursday November 04, 1999	Weekday Month DD, YYYY
DEC 31, 15:59:60.12 1998 (PST)	MON DD, HR:MN:SC YYYY (PST) ::UTC-8
2450297.1994 JDUTC	JULIAND.#### JDUTC

Time Conversion and Formats

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## Converting Numeric Times - 3

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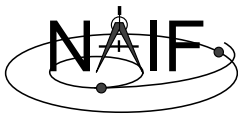
- **Ephemeris Time to Spacecraft Clock String**
  - SCE2S (*scid*, *et*, SCLKCH )
    - » Requires both LSK and SCLK
- **Encoded Spacecraft Clock to Spacecraft Clock String**
  - SCDECD (*scid*, *sclmdp*, SCLKCH )
    - » Requires SCLK
    - » SCLK string examples\*:
      - 1/1487147147.203 (Cassini, MGS)
      - 1/05812:00:001 (Voyager 1 and 2)
- **Ephemeris Time to Local Solar Time String**
  - ET2LST( *et*, *body*, *long*, *type*, HR, MN, SC, TIME, AMPM )
    - » Requires SPK, PCK

\* When literal clock strings are used as arguments in modules they must be contained in quotes:

- Single quotes for Fortran
- Double quotes for C
- Single quotes for IDL to be safe
- Single or double quotes for MATLAB

Time Conversion and Formats

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## Conversion Between Uniform Time Systems

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- **Conversion between numeric representations of TAI, TDB(ET), TDT, JDTDB(JED), JDTDT**
  - Return value = UNITIM (*epoch*, *insys*, *outsys* )

Time Conversion and Formats

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# Customizing the Time System

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- **Defaults**
  - Two digit year (a bad idea but supported): 1969-2068
  - Time System: UTC
  - Calendar: Gregorian
- **Adjustments**
  - The one hundred year interval to which two digit years belong may be set. For example 1980-2079
  - Time Systems: UTC, TDB, TT (Terrestrial Time)
  - Calendar: Gregorian, Julian, or Mixed.
- **See TIMDEF or *Time Required Reading* (time.req) for details**



# Layout of the Time System

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