BIPM

BUREAU INTERNATIONAL DES POIDS ET MESURES

Circular T 19 (1989 September 1)

1 - COORDINATED UNIVERSAL TIME UTC. Computed values of UTC-UTC(k)

(From 1988 January 1, 0h UTC, to 1990 January 1, 0h UTC, TAI-UTC = 24 s)
(From 1990 January 1, 0h UTC, until further notice, TAI-UTC = 25 s)

| Date 1989 (0h UTC) | | JUN 22 | JUL 2 | JUL 12 | JUL 22 |
|---|---|---|---|---|---|
| MJD | | 47699 | 47709 | 47719 | 47729 |
| Laboratory k | | UTC-UTC(k) | (Unit = 1 microsecond) | | |
| AOS (Borowiec) | (1) | 6.57 | 7.95 | 9.22 | 10.75 |
| APL (Laurel) | | - | - | -1.52 | -1.76 |
| ASMW (Berlin) | | -0.17 | -0.22 | -0.42 | -0.40 |
| AUS (Canberra) | | -0.95 | -0.96 | -0.97 | -0.98 |
| BEV (Wien) | | 3.57 | 2.55 | 1.32 | 0.84 |
| CAO (Cagliari) | | 9.01 | 9.15 | 9.34 | 9.46 |
| CH (Berne) | | 0.13 | 0.09 | 0.06 | 0.01 |
| CRL (Tokyo) | | -1.39 | -1.38 | -1.36 | -1.34 |
| CSAO (Shaanxi) | | -0.19 | -0.44 | -0.49 | -0.42 |
| FTZ (Darmstadt) | | 17.11 | 17.10 | 17.11 | 17.17 |
| IEN (Torino) | | -0.53 | -0.48 | -0.43 | -0.37 |
| IFAG (Wettzell) | | -1.77 | -1.87 | -1.94 | -2.24 |
| INPL (Jerusalem) | | 121.27 | 122.99 | 124.34 | 125.71 |
| JATC (Xian) | | -3.10 | -3.49 | -3.76 | -3.94 |
| KSRI (Taejon) | | -10.44 | -10.26 | -10.11 | -9.88 |
| NAOM (Mizusawa) | | -35.64 | -35.60 | -35.67 | -35.73 |
| NIM (Beijing) | | 5.73 | 5.54 | 5.35 | 5.38 |
| NIST (Boulder) | | -0.51 | -0.49 | -0.48 | -0.46 |
| NPL (Teddington) | | -1.03 | -1.00 | -0.97 | -0.92 |
| NPLI (New-Delhi) | | -12.55 | -12.88 | -13.22 | -13.51 |
| NRC (Ottawa) | | -13.98 | -14.04 | -14.14 | -14.25 |
| NRLM (Tsukuba) | (2) | -40.19 | -40.65 | -41.09 | -41.57 |
| OMH (Budapest) | | -9.24 | -9.45 | -9.40 | -9.31 |
| ONRJ (Rio de Janeiro) | (3) | - | 16.32 | 15.71 | 15.01 |
| OP (Paris) | | -1.62 | -1.51 | -1.35 | -1.25 |
| ORB (Bruxelles) | | 4.17 | 4.31 | 4.44 | 3.23 |
| PEL (Lower Hutt) | (4) | 2.45 | - | 2.27 | 2.24 |
| PKNM (Warsaw) | | 5.42 | 5.14 | 4.78 | 4.44 |
| PTB (Braunschweig) | | 4.16 | 4.16 | 4.14 | 4.10 |
| ROA (San Fernando) | | 7.64 | 7.72 | 7.85 | 8.01 |
| SO (Shanghai) | | 2.55 | 2.55 | 2.60 | 2.63 |
| STA (Stockholm) | | 1.55 | 1.39 | 1.20 | 1.03 |
| SU (Moscow) | (5) | - | - | - | - |
| TAO (Tokyo) | | -3.38 | -3.43 | -3.50 | -3.57 |
| TL (Taiwan) | | 2.61 | 2.87 | 2.87 | 2.85 |
| TP (Praha) | | -1.15 | -1.28 | -1.22 | -1.13 |
| TUG (Graz) | | -0.03 | 0.21 | 0.51 | 0.77 |
| USNO (Washington) | (USNO MC) | -0.95 | -0.96 | -0.97 | -0.98 |
| VSL (Delft) | | 1.17 | 1.15 | 1.25 | 1.34 |
| YUZM (Beograd) | | 10.73 | 11.89 | 13.32 | 14.20 |
| ZIPE (Potsdam) | | -0.30 | -0.36 | -0.44 | -0.44 |

PAVILLON DE BRETEUIL F - 92312 SÈVRES CEDEX
TÉL. (CENTRAL) : + 33 1 45 07 70 70 TELEX : BIPM 201067 F TÉLÉCOPIE : + 33 1 45 34 20 21

## 2 - INTERNATIONAL ATOMIC TIME TAI AND LOCAL ATOMIC TIME SCALES TA(k)

Computed values of TAI-TA(k)

| Date 1989 (0h UTC) | | JUN 22 | JUL 2 | JUL 12 | JUL 22 |
|---|---|---|---|---|---|
| MJD | | 47699 | 47709 | 47719 | 47729 |
| Laboratory k | | TAI-TA(k) | (Unit = 1 microsecond) | | |
| APL (Laurel) | | - | - | -1.12 | -1.36 |
| AUS (Canberra) | | -20.88 | -21.14 | -21.42 | -21.71 |
| CH (Berne) | | -57.87 | -58.09 | -58.30 | -58.54 |
| CRL (Tokyo) | | -2.78 | -2.76 | -2.73 | -2.69 |
| CSAO (Shaanxi) | | 38.80 | 38.54 | 38.49 | 38.56 |
| DDR (Berlin) | | -28.00 | -28.04 | -28.19 | -28.27 |
| F (Paris) | | 70.52 | 70.87 | 71.20 | 71.52 |
| JATC (Xian) | | -0.78 | -0.91 | -0.92 | -0.97 |
| NIM (Beijing) | | -11.38 | -11.55 | -11.68 | -11.74 |
| NISA (Boulder) | (6) | -45057.30 | -45057.53 | -45057.78 | -45058.02 |
| NIST (Boulder) | | -45126.79 | -45127.21 | -45127.65 | -45128.08 |
| NRC (Ottawa) | | 17.09 | 17.03 | 16.93 | 16.82 |
| PTB (Braunschweig) | | -359.24 | -359.24 | -359.26 | -359.30 |
| SO (Shanghai) | | -44.61 | -44.58 | -44.53 | -44.56 |
| SU (Moscow) | (5) | - | - | - | - |
| USNO (Washington) | (7) | -34581.23 | -34581.78 | -34582.36 | -34582.90 |

## 3 - NOTES ON SECTIONS 1 AND 2

(1) AOS . MJD = 47689 UTC-UTC(AOS) = 5.21

(2) NRLM. Corrected values of UTC-UTC(NRLM) for MJD = 47689 and 47699 are respectively -39.76 and -40.19 (there was no time step on MJD = 47685).

(3) ONRJ. Observatorio Nacional, Rio de Janeiro, Brazil.

(4) PEL . Physics and Engineering Laboratory, Lower Hutt, New Zealand. MJD = 47689 UTC-UTC(PEL) = 2.49

(5) SU .

| MJD | UTC-UTC(SU) | TAI-TA(SU) |
|---|---|---|
| 47619 | 15.59 | 2827265.59 |
| 47629 | 15.46 | 2827265.46 |
| 47639 | 15.24 | 2827265.24 |
| 47649 | 15.17 | 2827265.17 |
| 47659 | 14.92 | 2827264.92 |
| 47669 | 14.78 | 2827264.78 |

(6) TA(NISA) designates the scale AT1 of NIST.

(7) TA(USNO) designates the scale A1(MEAN) of USNO.

4 - UTC-GPS TIME and TAI-GPS TIME

UTC-GPS TIME = -5 seconds + Co ; TAI-GPS TIME = 19 seconds + Co.

Co is obtained from measurements made at Paris Observatory, usually corrected for the measured ionospheric delay, and from linear interpolation of UTC-UTC(OP).
DC is the synchronization offset between satellites, as measured at Paris Observatory at the instant T of the tracking. T is given for the middle of the tracking period of 13 minutes, for the first tabular date and must be decremented by 4 minutes per day (8 minutes when moving from 0h.. to 23h..).
For most of the applications it is sufficient to derive UTC from the observations of any of the listed satellites, at any time, by interpolating Co. However, in case of large values of DC, one might obtain better values of UTC by using, instead of Co, C=Co+DC.

| Date 1989 | MJD | Co (ns) 0hUTC | DC(ns) PRN11 NAV 8 2h10m | PRN 6 NAV 3 7h22m | PRN 9 NAV 6 8h22m | PRN13 NAV 9 10h46m | PRN12 NAV10 11h 2m | PRN 3 NAV11 11h42m |
|---|---|---|---|---|---|---|---|---|
| JUN 22 | 47699 | -1081 | 0 | -6 | -8 | 4 | 10 | 17 |
| JUN 23 | 47700 | -1069 | 12 | -3 | 2 | 9 | -1 | 13 |
| JUN 24 | 47701 | -1064 | 2 | -14 | 0 | 17 | -5 | 13 |
| JUN 25 | 47702 | -1068 | 2 | -23 | -24 | -4 | -5 | 9 |
| JUN 26 | 47703 | -1071 | 1 | -12 | -1 | 9 | -4 | 23 |

| Date 1989 | MJD | Co (ns) 0hUTC | DC(ns) PRN11 NAV 8 0h24m | PRN14 NAV14 2h48m | PRN 6 NAV 3 6h32m | PRN 9 NAV 6 7h52m | PRN12 NAV10 10h48m | PRN13 NAV 9 11h52m | PRN 3 NAV11 13h12m |
|---|---|---|---|---|---|---|---|---|---|
| JUN 27 | 47704 | -1074 | -4 | 4 | -9 | -5 | -14 | -7 | 0 |
| JUN 28 | 47705 | -1077 | -6 | -2 | 2 | -6 | 7 | -6 | 7 |
| JUN 29 | 47706 | -1082 | 5 | 25 | 10 | -4 | -5 | -7 | 0 |
| JUN 30 | 47707 | -1092 | -2 | 10 | 11 | 6 | 12 | -2 | -10 |
| JUL 1 | 47708 | -1107 | -5 | 2 | -1 | -4 | 0 | -15 | 5 |
| JUL 2 | 47709 | -1124 | - | - | 0 | -2 | 8 | 8 | 6 |
| JUL 3 | 47710 | -1138 | -8 | - | 20 | 35 | -13 | -17 | 11 |
| JUL 4 | 47711 | -1150 | 1 | - | -1 | 6 | -4 | 4 | 7 |
| JUL 5 | 47712 | -1163 | 0 | - | -8 | 9 | 3 | 6 | 3 |
| JUL 6 | 47713 | -1175 | -4 | - | 4 | -1 | -2 | -3 | 4 |
| JUL 7 | 47714 | -1188 | -8 | - | -13 | -3 | -1 | -7 | 5 |
| JUL 8 | 47715 | -1198 | 1 | - | 1 | 5 | 1 | -2 | 9 |
| JUL 9 | 47716 | -1208 | -6 | - | 9 | -3 | -2 | -5 | 9 |
| JUL 10 | 47717 | -1218 | -7 | - | -7 | 7 | 3 | 3 | 5 |
| JUL 11 | 47718 | -1228 | -3 | - | 0 | -12 | 0 | 8 | 2 |
| JUL 12 | 47719 | -1237 | -6 | - | -7 | 0 | -11 | -10 | 4 |
| JUL 13 | 47720 | -1250 | -5 | - | -1 | 0 | 7 | 4 | 5 |
| JUL 14 | 47721 | -1267 | -1 | - | 9 | 5 | 10 | 5 | 7 |
| JUL 15 | 47722 | -1286 | -2 | - | -3 | -3 | -22 | -16 | -4 |
| JUL 16 | 47723 | -1306 | -16 | -6 | -2 | 3 | 5 | -10 | 4 |
| JUL 17 | 47724 | -1327 | -15 | 26 | 7 | 13 | -12 | -11 | 4 |
| JUL 18 | 47725 | -1344 | 9 | -9 | 3 | 6 | 6 | 3 | -1 |
| JUL 19 | 47726 | -1359 | 0 | 11 | 1 | 1 | 3 | -5 | 3 |
| JUL 20 | 47727 | -1374 | 0 | 11 | -9 | -8 | -22 | -7 | 1 |
| JUL 21 | 47728 | -1389 | 30 | 44 | 5 | 4 | 9 | -6 | 15 |
| JUL 22 | 47729 | -1402 | 6 | -10 | -12 | -9 | -2 | -1 | 2 |

5 - MEASUREMENT OF UTC(j)-UTC(k)

| Date 1989 | MJD | Time comparisons (Unit : 1 microsecond) | uncert. | source | meth. (1) |
|---|---|---|---|---|---|
| JUL 25 | 47732.50 | UTC(SU ) - UTC(STA ) = -12.55 | 0.02 | SU telex | CT |

(1) method : CT Clock Transportation.

6 - DURATION OF THE TAI SCALE INTERVAL : 1 second + D

D and its standard deviation s are expressed in 1*10**-14 second.

The following data are given :
- for continuously operating primary standards (primary clocks), the average of D for the two previous months, with the last available estimate of the inaccuracy of the standard;
- for occasional measurements, the value D for the measurement interval, as computed by BIPM (the BIPM uncertainty may be larger that the reported uncertainty on account of the time comparisons);
- the BIPM evaluation from all available measurements (from CRL, NIST, NRC, PTB, SU), with the uncertainty based on those of individual measurements, as reported.

| Standards, | Interval(MJD) | D | s |
|---|---|---|---|
| NRC-CsV | 47669-47729 | +28.3 | 10.0 |
| PTB-CS1 | 47669-47729 | +2.3 | 3.0 |
| PTB-CS2 | 47669-47729 | +4.5 | 1.5 |
| BIPM estimate | 47669-47729 | +4 | 2 |

7 - INFORMATION, UTC time step on the 1st of January 1990.

Bulletin C1 of the International Earth Rotation Service informs that a positive leap second will be introduced at the end of December 1989. The sequence of dates of the UTC second markers will be :

1989 December 31, 23 h 59 m 59 s
1989 December 31, 23 h 59 m 60 s
1990 January 1, 0 h 0 m 0 s

The difference between UTC and the International Atomic Time TAI is

from 1988 January 1, 0h UTC, to 1990 January 1, 0h UTC,
TAI-UTC = 24 s,
from 1990 January 1, 0h UTC, until further notice,
TAI-UTC = 25 s.