ISSN 1143-1393

# BUREAU INTERNATIONAL DES POIDS ET MESURES

*Circular T* 115 (1997 August 12)
*Circulaire T* 115

1 - Coordinated Universal Time UTC. Computed values of *UTC-UTC(k)*.

(From 1996 January 1, 0h UTC, to 1997 July 1, 0h UTC, *TAI-UTC* = 30 s)
(From 1997 July 1, 0h UTC, until further notice, *TAI-UTC* = 31 s)

| Date 1997 0h UTC | Jun 30 | Jul 5 | Jul 10 | Jul 15 |
|---|---|---|---|---|
| MJD | 50629 | 50634 | 50639 | 50644 |
| Laboratory k | *UTC-UTC(k)* (Unit is one nanosecond) | | | |
| AOS (Borowiec) | 207 | 156 | 78 | -33 |
| APL (Laurel) | 2118 | 2175 | 2229 | 2290 |
| AUS (Canberra) | 266 | 278 | 251 | 269 |
| BEV (Wien) | - | - | - | - |
| BIRM (Beijing) | -6221 | -6272 | -6324 | -6379 |
| CAO (Cagliari) | -951 | -985 | -1018 | -1059 |
| CH (Bern) | -184 | -184 | -170 | -155 |
| CNM (Queretaro) | -2784 | -2739 | -2680 | -2619 |
| CRL (Tokyo) | 14 | 15 | 7 | 10 |
| CSAO (Lintong) | -3 | -11 | -12 | -11 |
| CSIR (Pretoria) (1) | 9675 | 826 | 711 | 606 |
| DLR (Oberpfaffenhofen) | -111 | -151 | -191 | -236 |
| DTAG (Darmstadt) | -675 | -669 | -651 | -647 |
| GUM (Warszawa) | 520 | 538 | 583 | 601 |
| IEN (Torino) | 580 | 593 | 600 | 600 |
| IFAG (Wettzell) | -1473 | -1406 | -1364 | -1324 |
| IGMA (Buenos Aires) (2) | 343 | 41 | 29 | 40 |
| INPL (Jerusalem) | -2770 | -2691 | -2632 | -2564 |
| IPQ (Monte de Caparica) | 533 | 540 | 548 | 565 |
| JATC (Lintong) | 3501 | 3479 | 3468 | 3467 |
| KRIS (Taejon) | -167 | -159 | -140 | -131 |
| LDS (Leeds) | -74 | -67 | -73 | -57 |
| MSL (Lower Hutt) | -5673 | -5718 | -5762 | -5726 |
| NAO (Mizusawa) | -2335 | -2269 | -2195 | -2146 |
| NIM (Beijing) | -1844 | -1851 | -1898 | -1917 |
| NIST (Boulder) | 0 | 4 | 8 | 12 |
| NML (Sydney) | 512 | 530 | 543 | 562 |
| NPL (Teddington) | 63 | 64 | 65 | 59 |
| NRC (Ottawa) | 64 | 48 | 36 | 32 |
| NRLM (Tsukuba) | 110 | 117 | 121 | 126 |
| OMH (Budapest) | 826 | 865 | 881 | 904 |
| ONBA (Buenos Aires) | -5240 | -6136 | -6833 | -7454 |
| ONRJ (Rio de Janeiro) (3) | 46802 | -330 | -308 | -300 |
| OP (Paris) | 75 | 84 | 84 | 86 |
| ORB (Bruxelles) | 285 | 290 | 273 | 281 |
| PTB (Braunschweig) | 1703 | 1706 | 1707 | 1705 |
| ROA (San Fernando) | -54 | -46 | -43 | -50 |
| SCL (Hong Kong) | - | - | - | - |
| SO (Shanghai) | 967 | 976 | 930 | 931 |
| SP (Boras) | 347 | 358 | 364 | 360 |
| SU (Moskva) | 668 | 663 | 649 | 644 |
| TL (Chung-Li) | 771 | 762 | 749 | 738 |
| TP (Praha) | 120 | 128 | 131 | 126 |
| TUG (Graz) | 2467 | 2503 | 2543 | 2573 |
| UME (Gebze-Kocaeli) | 572 | 582 | 593 | 602 |
| USNO (Washington DC)(USNO MC) | 8 | 10 | 9 | 10 |
| VSL (Delft) | -264 | -258 | -258 | -255 |



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1 - Coordinated Universal Time UTC. (Cont.)

| Date 1997 0h UTC | Jul 20 | Jul 25 | Jul 30 |
|---|---|---|---|
| MJD | 50649 | 50654 | 50659 |
| Laboratory k | *UTC-UTC(k)* | (Unit is one | nanosecond) |
| AOS (Borowiec) | -96 | -177 | -346 |
| APL (Laurel) | 2332 | 2395 | 2455 |
| AUS (Canberra) | 262 | 251 | 271 |
| BEV (Wien) | - | - | - |
| BIRM (Beijing) | -6451 | -6502 | -6555 |
| CAO (Cagliari) | -1088 | -1114 | -1145 |
| CH (Bern) | -141 | -126 | -110 |
| CNM (Queretaro) | -2570 | -2512 | -2450 |
| CRL (Tokyo) | 16 | 13 | 11 |
| CSAO (Lintong) | -20 | 0 | -25 |
| CSIR (Pretoria) | 502 | 410 | 344 |
| DLR (Oberpfaffenhofen) | -277 | -321 | -357 |
| DTAG (Darmstadt) | -634 | -638 | -629 |
| GUM (Warszawa) | 626 | 646 | 669 |
| IEN (Torino) | 598 | 592 | 600 |
| IFAG (Wettzell) | -1271 | -1217 | -1115 |
| IGMA (Buenos Aires) | 55 | 39 | 48 |
| INPL (Jerusalem) | -2507 | -2453 | - |
| IPQ (Monte de Caparica) | 582 | 597 | 610 |
| JATC (Lintong) | 3457 | 3469 | 3434 |
| KRIS (Taejon) | -142 | -135 | -130 |
| LDS (Leeds) | -37 | -53 | -40 |
| MSL (Lower Hutt) | -5730 | -5817 | -5828 |
| NAO (Mizusawa) | -2079 | -2018 | -1954 |
| NIM (Beijing) | -1935 | -1951 | -1957 |
| NIST (Boulder) | 16 | 18 | 18 |
| NML (Sydney) | 577 | 575 | 584 |
| NPL (Teddington) | 60 | 59 | 61 |
| NRC (Ottawa) | 20 | 6 | -18 |
| NRLM (Tsukuba) | 134 | 138 | 138 |
| OMH (Budapest) | 935 | 945 | 958 |
| ONBA (Buenos Aires) | -8141 | -8672 | -9130 |
| ONRJ (Rio de Janeiro) | -281 | -254 | -222 |
| OP (Paris) | 88 | 82 | 82 |
| ORB (Bruxelles) | 294 | 281 | 291 |
| PTB (Braunschweig) | 1710 | 1715 | 1723 |
| ROA (San Fernando) | -42 | -28 | -23 |
| SCL (Hong Kong) | - | - | - |
| SO (Shanghai) | 948 | 954 | 950 |
| SP (Boras) | 373 | 375 | 399 |
| SU (Moskva) | 636 | 631 | 624 |
| TL (Chung-Li) | 726 | 717 | 707 |
| TP (Praha) | 141 | 148 | 144 |
| TUG (Graz) | 2609 | 2642 | 2686 |
| UME (Gebze-Kocaeli) | 610 | 615 | 623 |
| USNO (Washington DC)(USNO MC) | 11 | 8 | 8 |
| VSL (Delft) | -247 | -244 | -236 |

## 2 - International Atomic Time TAI and local atomic time scales TA(k).

The following tables give the computed values of *TAI-TA(k)*.

| Date 1997 0h UTC | | Jun 30 | Jul 5 | Jul 10 | Jul 15 |
|---|---|---|---|---|---|
| MJD | | 50629 | 50634 | 50639 | 50644 |
| Laboratory k | | *TAI-TA(k)* (Unit is one nanosecond) | | | |
| AMC (Col. Springs) | | -364987 | -364987 | -364990 | -364991 |
| APL (Laurel) | | 3581 | 3638 | 3692 | 3753 |
| AUS (Canberra) | | -79107 | -79225 | -79346 | -79441 |
| CH (Bern) | | -46316 | -46141 | -45972 | -45801 |
| CRL (Tokyo) | | 86512 | 86727 | 86937 | 87154 |
| CSAO (Lintong) | | -107 | -180 | -246 | -309 |
| F (Paris) | | 163032 | 163024 | 163013 | 162998 |
| IEN (Torino) | | 3534 | 3584 | 3634 | 3681 |
| INPL (Jerusalem) | | -395227 | -395945 | -396685 | -397419 |
| JATC (Lintong) | | 13323 | 13269 | 13212 | 13179 |
| KRIS (Taejon) | | 5355 | 5352 | 5355 | 5357 |
| NIST (Boulder) | (4) | -45162391 | -45162602 | -45162813 | -45163024 |
| NML (Sydney) | | 549 | 567 | 580 | 599 |
| NRC (Ottawa) | | 27081 | 27074 | 27071 | 27075 |
| PTB (Braunschweig) | | -361697 | -361694 | -361693 | -361695 |
| SO (Shanghai) | | -46584 | -46575 | -46618 | -46608 |
| SU (Moskva) | (5) | 27241668 | 27241663 | 27241649 | 27241644 |
| USNO (Washington DC) | | -34774501 | -34774819 | -34775139 | -34775457 |

| Date 1997 0h UTC | | Jul 20 | Jul 25 | Jul 30 |
|---|---|---|---|---|
| MJD | | 50649 | 50654 | 50659 |
| Laboratory k | | *TAI-TA(k)* (Unit is one nanosecond) | | |
| AMC (Col. Springs) | | -364991 | -364995 | -364999 |
| APL (Laurel) | | 3795 | 3858 | 3918 |
| AUS (Canberra) | | -79537 | -79655 | -79736 |
| CH (Bern) | | -45632 | -45461 | -45290 |
| CRL (Tokyo) | | 87368 | 87579 | 87793 |
| CSAO (Lintong) | | -383 | -428 | -518 |
| F (Paris) | | 162989 | 162978 | 162970 |
| IEN (Torino) | | 3727 | 3769 | 3823 |
| INPL (Jerusalem) | | -398159 | -398902 | |
| JATC (Lintong) | | 13125 | 13101 | 13051 |
| KRIS (Taejon) | | 5337 | 5321 | 5313 |
| NIST (Boulder) | (4) | -45163235 | -45163448 | -45163663 |
| NML (Sydney) | | 614 | 612 | 620 |
| NRC (Ottawa) | | 27072 | 27066 | 27052 |
| PTB (Braunschweig) | | -361690 | -361685 | -361677 |
| SO (Shanghai) | | -46582 | -46570 | -46573 |
| SU (Moskva) | (5) | 27241636 | 27241631 | 27241624 |
| USNO (Washington DC) | | -34775775 | -34776098 | -34776418 |

3 - Notes on sections 1 and 2.

(1) CSIR. Change of master clock and GPS receiver on MJD = 50630

(2) IGMA. Time step of UTC(IGMA) of + 300 ns on MJD = 50630.0

(3) ONRJ. Change of master clock on MJD = 50630.0

(4) NIST. TA(NIST) was previously called TA(NISA).

(5) SU . Listed values are *TAI-TA(SU)* - 2,80 seconds.

4 - Difference between the normalized frequencies of EAL and TAI.

| Interval of validity | | *f(EAL)-f(TAI)* |
|---|---|---|
| 1997 June 30 - 1997 Aug. 29 | 50629-50689 | $7{,}210 \times 10^{-13}$ |

New steering correction foreseen for September-October 1997

| | | |
|---|---|---|
| 1997 Aug. 29 - 1997 Oct. 28 | 50689-50749 | $7{,}190 \times 10^{-13}$ |

5 - Duration of the TAI scale interval.

The following table gives the duration $u_{TAI}$ of the TAI scale interval expressed as its relative departure $d$ from the SI second on the rotating geoid, $u_0$, together with its uncertainty $\sigma$ : $d = (u_{TAI} - u_0)/u_0$. This is obtained, on the given period of estimation, by comparison of the TAI frequency :

- with the frequency, corrected for the black-body radiation shift, of a given individual primary frequency standard ($\sigma$ is then the last communicated estimate of the uncertainty of the standard frequency), and

- with a combination computed by the BIPM of all available measurements from PTB CS2, PTB CS3, NIST-7 and LPTF-FO1 consistently corrected for the black-body radiation shift ($\sigma$ is then estimated by the BIPM taking into account the individual uncertainties and parameters characteristic of TAI stability).

| Standard | Period of estimation | $d$ ($10^{-14}$) | $\sigma$ ($10^{-14}$) |
|---|---|---|---|
| PTB-CS2 | 50629-50659 | +1,1 | 1,5 |
| PTB-CS3 | 50629-50659 | +3,2 | 1,4 |
| BIPM estimate | 50599-50659 | +1,8 | 1,0 |

6 - [*UTC-GPS time*] and [*TAI-GPS time*].

[*UTC-GPS time*] = -11 s + $C_0$ (until 1997 July 1, 0h UTC)
[*UTC-GPS time*] = -12 s + $C_0$ (from 1997 July 1, 0h UTC)
[*TAI-GPS time*] = 19 s + $C_0$.

Daily values of $C_0$ are given in the following table. They are obtained as follows: the GPS data taken at the Paris Observatory, for highest elevation, are first corrected for precise satellite ephemerides and for measured ionospheric delays, and then smoothed to obtain daily values of [*UTC(OP)-GPS time*] at 0h UTC; daily values of $C_0$ are derived from them using linear interpolation of [*UTC-UTC(OP)*]. The global uncertainty of daily $C_0$ values is of order 10 ns.

In the following table, the standard deviation $\sigma$ characterizes the dispersion of individual measurements, and $N$ is the number of measurements used on a given day for estimation of the corresponding daily $C_0$ value.

| Date 1997 0h UTC | MJD | $C_0$ (ns) | $\sigma$ (ns) | $\sigma/\sqrt{N}$ (ns) |
|---|---|---|---|---|
| Jun 30 | 50629 | 40 | 49 | 10 |
| Jul 1 | 50630 | 35 | 36 | 9 |
| Jul 2 | 50631 | 32 | 44 | 9 |
| Jul 3 | 50632 | 36 | 41 | 8 |
| Jul 4 | 50633 | 32 | 45 | 9 |
| Jul 5 | 50634 | 24 | 45 | 9 |
| Jul 6 | 50635 | 24 | 50 | 10 |
| Jul 7 | 50636 | 25 | 51 | 11 |
| Jul 8 | 50637 | 22 | 49 | 10 |
| Jul 9 | 50638 | 22 | 37 | 8 |
| Jul 10 | 50639 | 24 | 49 | 11 |
| Jul 11 | 50640 | 21 | 44 | 9 |
| Jul 12 | 50641 | 16 | 44 | 9 |
| Jul 13 | 50642 | 9 | 32 | 6 |
| Jul 14 | 50643 | 11 | 41 | 8 |
| Jul 15 | 50644 | 18 | 39 | 8 |
| Jul 16 | 50645 | 22 | 41 | 8 |
| Jul 17 | 50646 | 25 | 36 | 7 |
| Jul 18 | 50647 | 27 | 48 | 10 |
| Jul 19 | 50648 | 28 | 42 | 8 |
| Jul 20 | 50649 | 27 | 37 | 7 |
| Jul 21 | 50650 | 28 | 47 | 9 |
| Jul 22 | 50651 | 30 | 43 | 9 |
| Jul 23 | 50652 | 20 | 43 | 9 |
| Jul 24 | 50653 | 6 | 50 | 10 |
| Jul 25 | 50654 | 1 | 49 | 10 |
| Jul 26 | 50655 | 3 | 47 | 9 |
| Jul 27 | 50656 | 11 | 38 | 8 |
| Jul 28 | 50657 | 15 | 65 | 13 |
| Jul 29 | 50658 | 19 | 51 | 11 |
| Jul 30 | 50659 | 20 | 40 | 9 |

7 - [*UTC-GLONASS time*] and [*TAI-GLONASS time*].

[*UTC-GLONASS time*] = 0 s + $C_1$
[*TAI-GLONASS time*] = +30 s + $C_1$ (until 1997 July 1, 0h UTC)
[*TAI-GLONASS time*] = +31 s + $C_1$ (from 1997 July 1, 0h UTC)

Daily values of $C_1$ are given in the following table. They are obtained as follows: the GLONASS data taken at the NMi Van Swinden Laboratorium, Delft, The Netherlands, for highest elevation, are smoothed to obtain daily values of [*UTC(VSL)-GLONASS time*] at 0h UTC; daily values of $C_1$ are then derived from them using linear interpolation of [*UTC-UTC(VSL)*]. A time correction of + 1285 ns is also applied in order to ensure continuity of $C_1$ estimates on 1997, January 1 (MJD = 50449). The global uncertainty of daily $C_1$ values is of order several hundreds of nanoseconds.

In the following table, the standard deviation $\sigma$ characterizes the dispersion of individual measurements, and $N$ is the number of measurements used on a given day for estimation of the corresponding daily $C_1$ value.

| Date 1997 0h UTC | MJD | $C_1$ (ns) | $\sigma$ (ns) | $\sigma/\sqrt{N}$ (ns) |
|---|---|---|---|---|
| Jun 30 | 50629 | -35007 | 22 | 7 |
| Jul 1 | 50630 | 299 | - | - |
| Jul 2 | 50631 | 307 | 19 | 4 |
| Jul 3 | 50632 | 309 | 20 | 5 |
| Jul 4 | 50633 | 302 | 17 | 6 |
| Jul 5 | 50634 | 291 | 24 | 6 |
| Jul 6 | 50635 | 283 | 55 | 39 |
| Jul 7 | 50636 | 280 | - | - |
| Jul 8 | 50637 | 277 | - | - |
| Jul 9 | 50638 | 269 | 28 | 9 |
| Jul 10 | 50639 | 251 | 18 | 4 |
| Jul 11 | 50640 | 231 | - | - |
| Jul 12 | 50641 | 227 | 22 | 5 |
| Jul 13 | 50642 | 239 | - | - |
| Jul 14 | 50643 | 245 | - | - |
| Jul 15 | 50644 | 244 | - | - |
| Jul 16 | 50645 | 233 | - | - |
| Jul 17 | 50646 | 206 | 15 | 4 |
| Jul 18 | 50647 | 182 | 15 | 4 |
| Jul 19 | 50648 | 177 | 18 | 4 |
| Jul 20 | 50649 | 181 | 22 | 6 |
| Jul 21 | 50650 | 172 | 21 | 6 |
| Jul 22 | 50651 | 161 | 17 | 5 |
| Jul 23 | 50652 | 163 | 16 | 5 |
| Jul 24 | 50653 | 161 | 15 | 5 |
| Jul 25 | 50654 | 149 | 29 | 8 |
| Jul 26 | 50655 | 140 | 21 | 6 |
| Jul 27 | 50656 | 135 | 17 | 5 |
| Jul 28 | 50657 | 127 | 17 | 4 |
| Jul 29 | 50658 | 121 | 23 | 6 |
| Jul 30 | 50659 | 133 | 23 | 7 |