ISSN 1143-1393

# BUREAU INTERNATIONAL DES POIDS ET MESURES

Circular T 105 (1996 October 14)

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

(From 1996 January 1, 0h UTC, TAI-UTC = 30 s)

| Date 1996 0h UTC | | Aug 29 | Sep 3 | Sep 8 | Sep 13 |
|---|---|---|---|---|---|
| MJD | | 50324 | 50329 | 50334 | 50339 |
| Laboratory k | | UTC-UTC(k) (Unit is one nanosecond) | | | |
| AOS (Borowiec) | | -231 | -206 | -210 | -110 |
| APL (Laurel) | | -378 | -402 | -424 | -450 |
| AUS (Canberra) | | 69 | 51 | 44 | 3 |
| BEV (Wien) | | - | - | - | - |
| BIRM (Beijing) | | -2725 | -2779 | -2827 | -2881 |
| CAO (Cagliari) | | - | - | - | - |
| CH (Bern) | | 154 | 142 | 133 | 133 |
| CNM (Mexico) | | -2118 | -2280 | -2410 | -2554 |
| CRL (Tokyo) | | -77 | -73 | -68 | -72 |
| CSAO (Lintong) | | -7 | 2 | 3 | 1 |
| CSIR (Pretoria) | | 6846 | 6857 | 6869 | 6901 |
| DLR (Oberpfaffenhofen) | | -2298 | -2299 | -2303 | -2302 |
| DTAG (Darmstadt) | | -455 | -466 | -475 | -463 |
| GUM (Warszawa) | | -220 | -216 | -221 | -225 |
| IEN (Torino) | | 381 | 380 | 378 | 381 |
| IFAG (Wettzell) | | -4571 | -4583 | -4598 | -4580 |
| IGMA (Buenos Aires) | | 117 | 124 | 129 | 143 |
| INPL (Jerusalem) | | 817 | 811 | 785 | 768 |
| IPQ (Monte de Caparica) | | 116 | 118 | 119 | 121 |
| JATC (Lintong) | | 3345 | 3368 | 3372 | 3379 |
| KRIS (Taejon) | | -4 | -24 | -26 | -24 |
| LDS (Leeds) | | 123 | 115 | 115 | 97 |
| MSL (Lower Hutt) | | -5094 | -5102 | -5124 | -5169 |
| NAOM (Mizusawa) | | -2712 | -2704 | -2695 | -2694 |
| NAOT (Tokyo) | | -9 | 32 | 82 | 140 |
| NIM (Beijing) | | 8653 | 8656 | 8659 | 8672 |
| NIST (Boulder) | | -14 | -7 | -5 | -3 |
| NPL (Teddington) | | -3 | -1 | 0 | 5 |
| NRC (Ottawa) | | 14 | 12 | -4 | -18 |
| NRLM (Tsukuba) | | -2074 | -2009 | -1949 | -1877 |
| OMH (Budapest) | | - | - | - | - |
| ONBA (Buenos Aires) | | -9212 | -9642 | -10279 | -10812 |
| ONRJ (Rio de Janeiro) | | 22477 | 22881 | 23287 | 23708 |
| OP (Paris) | | -1 | 2 | -2 | 3 |
| ORB (Bruxelles) | | 64 | 45 | 81 | 78 |
| PTB (Braunschweig) | | 1982 | 1984 | 1980 | 1977 |
| ROA (San Fernando) | | 88 | 89 | 89 | 94 |
| SCL (Hong Kong) | | -510 | -549 | -582 | -602 |
| SO (Shanghai) | | 1217 | 1219 | 1227 | 1234 |
| SP (Boras) | (1) | -8730 | -8818 | -8897 | -44 |
| SU (Moskva) | | -7832 | -7840 | -7850 | -7858 |
| TL (Chung-Li) | | 241 | - | - | - |
| TP (Praha) | | -28 | -2 | 15 | 35 |
| TUG (Graz) | | 578 | 598 | 614 | 641 |
| UME (Gebze-Kocaeli) | | 232 | 240 | 247 | 258 |
| USNO (Washington DC)(USNO MC) | | -10 | -8 | -9 | -6 |
| VSL (Delft) | | -402 | -396 | -396 | -389 |

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1 - Coordinated Universal Time UTC. (Cont.)

| Date 1996 0h UTC | Sep 18 | Sep 23 | Sep 28 |
|---|---|---|---|
| MJD | 50344 | 50349 | 50354 |
| Laboratory k | UTC-UTC(k) | (Unit is | one nanosecond) |
| AOS (Borowiec) | -85 | -39 | -41 |
| APL (Laurel) | -472 | -488 | -515 |
| AUS (Canberra) | -5 | -16 | -35 |
| BEV (Wien) | - | - | - |
| BIRM (Beijing) | -2919 | -2973 | -3021 |
| CAO (Cagliari) | - | - | - |
| CH (Bern) | 124 | 103 | 98 |
| CNM (Mexico) | -2692 | -2843 | -2989 |
| CRL (Tokyo) | -70 | -65 | -58 |
| CSAO (Lintong) | -6 | -21 | -4 |
| CSIR (Pretoria) | 6903 | 6908 | 6912 |
| DLR (Oberpfaffenhofen) | -2299 | -2300 | -2294 |
| DTAG (Darmstadt) | -470 | -489 | -493 |
| GUM (Warszawa) | -217 | -209 | -197 |
| IEN (Torino) | 389 | 383 | 388 |
| IFAG (Wettzell) | -4542 | -4509 | -4462 |
| IGMA (Buenos Aires) | 128 | 138 | 132 |
| INPL (Jerusalem) | 714 | 652 | 592 |
| IPQ (Monte de Caparica) | 123 | 129 | 143 |
| JATC (Lintong) | 3381 | 3371 | 3391 |
| KRIS (Taejon) | -38 | -43 | -39 |
| LDS (Leeds) | 101 | 84 | 80 |
| MSL (Lower Hutt) | -5136 | -5183 | -5172 |
| NAOM (Mizusawa) | -2704 | -2721 | -2742 |
| NAOT (Tokyo) | 196 | 244 | 266 |
| NIM (Beijing) | 8651 | 8602 | 8551 |
| NIST (Boulder) | -2 | -2 | 0 |
| NPL (Teddington) | 6 | 10 | 16 |
| NRC (Ottawa) | -34 | -48 | -85 |
| NRLM (Tsukuba) | -1816 | -1768 | -1696 |
| OMH (Budapest) | - | - | - |
| ONBA (Buenos Aires) | -11084 | -11713 | -12230 |
| ONRJ (Rio de Janeiro) | 24147 | 24610 | 25005 |
| OP (Paris) | 7 | 9 | 10 |
| ORB (Bruxelles) | 67 | 66 | 67 |
| PTB (Braunschweig) | 1974 | 1971 | 1970 |
| ROA (San Fernando) | 91 | 91 | 96 |
| SCL (Hong Kong) | -646 | -628 | -614 |
| SO (Shanghai) | 1224 | 1198 | 1195 |
| SP (Boras) | -39 | -36 | -40 |
| SU (Moskva) | -7868 | -7880 | -7886 |
| TL (Chung-Li) | - | - | - |
| TP (Praha) | 42 | 37 | 46 |
| TUG (Graz) | 658 | 671 | 694 |
| UME (Gebze-Kocaeli) | 264 | 258 | 265 |
| USNO (Washington DC)(USNO MC) | -5 | 0 | -1 |
| VSL (Delft) | -388 | -383 | -388 |

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

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

| Date 1996 0h UTC | | Aug 29 | Sep 3 | Sep 8 | Sep 13 |
|---|---|---|---|---|---|
| MJD | | 50324 | 50329 | 50334 | 50339 |
| Laboratory k | | TAI-TA(k) (Unit is one nanosecond) | | | |
| APL (Laurel) | | 1085 | 1061 | 1039 | 1013 |
| AUS (Canberra) | | -72403 | -72536 | -72636 | -72775 |
| CH (Bern) | | -56604 | -56456 | -56303 | -56138 |
| CRL (Tokyo) | | 73775 | 73986 | 74192 | 74400 |
| CSAO (Lintong) | | 3844 | 3788 | 3724 | 3657 |
| F (Paris) | | 158900 | 159082 | 159263 | 159449 |
| IEN (Torino) | | 894 | 932 | 979 | 1025 |
| INPL (Jerusalem) | | -350537 | -351177 | -351831 | -352469 |
| JATC (Lintong) | | 13765 | 13759 | 13751 | 13747 |
| KRIS (Taejon) | | 4470 | 4508 | 4552 | 4596 |
| NIM (Beijing) | | -5420 | -5407 | -5383 | -5363 |
| NISA (Boulder) | (2) | -45149227 | -45149442 | -45149663 | -45149883 |
| NRC (Ottawa) | | 26849 | 26877 | 26892 | 26908 |
| PTB (Braunschweig) | | -361418 | -361416 | -361420 | -361423 |
| SO (Shanghai) | | -46285 | -46284 | -46280 | -46274 |
| SU (Moskva) | (3) | 27242168 | 27242160 | 27242150 | 27242142 |
| USNO (Washington DC) | (4) | -34754736 | -34755063 | -34755393 | -34755719 |

| Date 1996 0h UTC | | Sep 18 | Sep 23 | Sep 28 |
|---|---|---|---|---|
| MJD | | 50344 | 50349 | 50354 |
| Laboratory k | | TAI-TA(k) (Unit is one nanosecond) | | |
| APL (Laurel) | | 991 | 975 | 948 |
| AUS (Canberra) | | -72881 | -72987 | -73104 |
| CH (Bern) | | -55981 | -55836 | -55675 |
| CRL (Tokyo) | | 74605 | 74810 | 75027 |
| CSAO (Lintong) | | 3586 | 3506 | 3458 |
| F (Paris) | | 159637 | 159819 | 160006 |
| IEN (Torino) | | 1079 | 1122 | 1175 |
| INPL (Jerusalem) | | -353138 | -353807 | -354469 |
| JATC (Lintong) | | 13732 | 13705 | 13707 |
| KRIS (Taejon) | | 4629 | 4665 | 4715 |
| NIM (Beijing) | | -5362 | -5397 | -5422 |
| NISA (Boulder) | (2) | -45150105 | -45150327 | -45150548 |
| NRC (Ottawa) | | 26922 | 26939 | 26933 |
| PTB (Braunschweig) | | -361426 | -361429 | -361430 |
| SO (Shanghai) | | -46284 | -46305 | -46303 |
| SU (Moskva) | (3) | 27242132 | 27242120 | 27242114 |
| USNO (Washington DC) | (4) | -34756047 | -34756372 | -34756703 |

3 - Notes on sections 1 and 2.

(1) SP . Time step of UTC(SP) of - 8900 ns on MJD = 50336.31

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

(3) SU . Listed values are TAI-TA(SU) - 2.80 seconds.

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

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

| Interval of validity | | f(EAL)-f(TAI) |
|---|---|---|
| 1996 Aug. 29 - 1996 Oct. 28 | 50324-50384 | $7.295 \times 10^{-13}$ |

New steering correction foreseen for November-December 1996

| | | |
|---|---|---|
| 1996 Oct. 28 - 1996 Dec. 27 | 50384-50444 | $7.280 \times 10^{-13}$ |

5 - [UTC - GPS time] and [TAI - GPS time].

[UTC - GPS time] = -11 s + C0, [TAI - GPS time] = 19 s + C0.

Daily values of C0 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 C0 are derived from them using linear interpolation of [UTC - UTC(OP)].

For a given day, where N measurements are used for estimation of C0 :
- the dispersion of individual measurements is characterized by a standard deviation $\sigma$,
- the daily C0 value is characterized by the standard deviation of the mean $\sigma/\sqrt{N}$.

| Date 1996 0h UTC | MJD | C0 (ns) | $\sigma$ (ns) | $\sigma/\sqrt{N}$ (ns) |
|---|---|---|---|---|
| Aug 29 | 50324 | 26 | 43 | 9 |
| Aug 30 | 50325 | 18 | 51 | 10 |
| Aug 31 | 50326 | 15 | 34 | 7 |
| Sep 1 | 50327 | 16 | 46 | 10 |
| Sep 2 | 50328 | 14 | 33 | 7 |
| Sep 3 | 50329 | 12 | 44 | 9 |
| Sep 4 | 50330 | 10 | 43 | 9 |
| Sep 5 | 50331 | 11 | 46 | 9 |
| Sep 6 | 50332 | 14 | 43 | 9 |
| Sep 7 | 50333 | 19 | 44 | 9 |
| Sep 8 | 50334 | 24 | 45 | 9 |
| Sep 9 | 50335 | 29 | 40 | 8 |
| Sep 10 | 50336 | 30 | 36 | 7 |
| Sep 11 | 50337 | 27 | 46 | 9 |
| Sep 12 | 50338 | 25 | 43 | 9 |
| Sep 13 | 50339 | 26 | 54 | 11 |
| Sep 14 | 50340 | 26 | 51 | 10 |
| Sep 15 | 50341 | 28 | 38 | 8 |
| Sep 16 | 50342 | 31 | 54 | 11 |
| Sep 17 | 50343 | 33 | 39 | 8 |
| Sep 18 | 50344 | 33 | 42 | 9 |
| Sep 19 | 50345 | 28 | 36 | 7 |
| Sep 20 | 50346 | 20 | 52 | 11 |
| Sep 21 | 50347 | 13 | 46 | 9 |
| Sep 22 | 50348 | 13 | 50 | 10 |
| Sep 23 | 50349 | 15 | 39 | 8 |
| Sep 24 | 50350 | 15 | 48 | 10 |
| Sep 25 | 50351 | 11 | 50 | 10 |
| Sep 26 | 50352 | 8 | 41 | 8 |
| Sep 27 | 50353 | 10 | 45 | 9 |
| Sep 28 | 50354 | 16 | 56 | 11 |

## 6 - [UTC - GLONASS time].

[UTC - GLONASS time] = C1 (modulo 1 s).

From his current observations of both the GPS and GLONASS satellite systems Prof. P. Daly, University of Leeds, establishes and reports [GPS time - GLONASS time] at five-day intervals, together with the standard deviation σ of his daily GLONASS data. C1 is then derived using [UTC - GPS time] of section 5.

| Date 1996 0h UTC | MJD | C1 (ns) | σ (ns) |
|---|---|---|---|
| Aug 29 | 50324 | -31404 | 42 |
| Sep 3 | 50329 | -31543 | 35 |
| Sep 8 | 50334 | -31669 | 36 |
| Sep 13 | 50339 | -31820 | 38 |
| Sep 18 | 50344 | -31954 | 43 |
| Sep 23 | 50349 | -32081 | 41 |
| Sep 28 | 50354 | -32241 | 41 |

## 7 - Duration of the TAI scale interval.

The following table gives the duration uTAI of the TAI scale interval expressed as its departure d from the SI second on the rotating geoid, together with its relative uncertainty σ : uTAI = 1 + d in SI second. 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 (σ 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, NIST-7, SU MCsR 102 and LPTF-F01 consistently corrected for the black-body radiation shift (σ is then estimated by the BIPM taking into account the individual uncertainties and parameters characteristic of TAI stability).

| Standard | Period of estimation | d ($10^{-14}$ s) | σ ($10^{-14}$) |
|---|---|---|---|
| PTB-CS3 | 50264-50324 | +5.6 | 1.4 |
| NIST-7 | 50319-50329 | +1.8 | 0.5 |
| PTB-CS2 | 50324-50354 | +2.4 | 1.5 |
| PTB-CS3 | 50324-50354 | +1.7 | 1.4 |
| BIPM estimate | 50294-50354 | +2.0 | 1.0 |