

BUREAU INTERNATIONAL DES POIDS ET MESURES  
ORGANISATION INTERGOUVERNEMENTALE DE LA CONVENTION DU METRE

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1 - Coordinated Universal Time UTC and its local realizations UTC(k). Computed values of  $[UTC-UTC(k)]$ .  
From 1999 January 1, 0h UTC,  $TAI-UTC = 32$  s.

Date 2004	0h UTC	JAN 30	FEB 4	FEB 9	FEB 14	FEB 19	FEB 24	FEB 29
MJD		53034	53039	53044	53049	53054	53059	53064
Laboratory k		$[UTC-UTC(k)]/ns$						
AOS (Borowiec)		-27.0	-35.2	-35.0	-28.8	-26.2	-25.2	-23.5
APL (Laurel)		-208.1	-194.7	-176.7	-146.6	-121.6	-103.3	-90.0
AUS (Sydney)		-461.1	-449.1	-452.4	-456.3	-447.0	-445.0	-454.5
BEV (Wien)		27.0	37.2	40.1	48.1	54.7	61.1	69.7
BIRM (Beijing)		1671.5	1687.6	1703.8	1713.8	1736.0	1755.7	1765.7
CAO (Cagliari)		-4073.7	-4066.4	-4055.1	-4043.2	-4031.8	-4019.3	-4026.6
CH (Bern)		-1.8	-0.5	-4.6	-2.1	2.4	4.9	5.5
CNM (Queretaro)		1.9	-5.0	-0.6	-3.9	4.4	1.2	1.2
CNMP (Panama)		-2217.8	-2286.6	-2345.4	-2432.6	-2473.3	-2535.6	-2603.2
CRL (Tokyo)		-12.8	-8.5	-10.4	-9.2	-7.3	-5.6	-6.1
CSIR (Pretoria)		2947.5	2886.1	2817.6	2760.6	2686.4	2614.3	2539.0
DLR (Oberpfaffenhofen)		17.0	10.2	13.3	13.3	18.3	29.9	31.4
DTAG (Darmstadt)		221.6	230.3	236.7	222.6	226.9	223.3	222.3
IEN (Torino)		-26.9	-22.0	-15.1	-12.5	-18.9	-15.1	-23.3
IFAG (Wetzell)		-2658.1	-2680.2	-2692.4	-2703.4	-2718.5	-2738.7	-2751.9
IGMA (Buenos Aires)		-83.6	-81.4	-86.7	-86.2	-77.3	-81.2	-92.3
INPL (Jerusalem)		-9348.9	-9391.6	-9433.0	-9450.8	-9484.9	-9510.4	-9533.8
JATC (Lintong)		-11080.5	-11065.6	-11061.6	-11063.2	-11057.8	-11049.7	-11039.0
JV (Kjeller)		-9864.9	-9852.0	-9808.6	-9762.2	-9745.8	-9687.1	-9616.8
KRIS (Daejeon)		18.0	11.0	13.9	8.3	1.5	0.6	0.2
LDS (Leeds)		4893.2	4929.4	4962.6	5006.2	5021.4	5034.9	5051.4
LT (Vilnius)		124.7	130.6	122.3	122.2	137.9	142.9	134.3
MSL (Lower Hutt)		-80.8	-96.9	-68.2	-33.5	-14.4	-13.5	-7.7
NAO (Mizusawa)		-30.1	-35.8	-34.3	-55.2	-69.7	-72.4	-79.7
NIM (Beijing)		-2658.1	-2648.6	-2655.6	-2652.6	-2647.3	-2652.5	-2657.6
NIMB (Bucharest)		-324.1	-312.4	-305.1	-299.2	-291.8	-282.6	-294.8
NIMT (Bangkok)		-882.4	-902.2	-914.4	-936.9	-952.3	-973.6	-990.3
NIST (Boulder)		-3.1	-4.5	-1.5	-2.0	-0.5	1.2	1.1
NMC (Sofiya)		-3584.3	-3595.5	-3601.7	-3606.8	-3631.3	-3663.2	-3667.4
NMIJ (Tsukuba)		88.7	97.3	98.9	102.5	105.6	110.0	112.9

Date 2004	0h UTC	JAN 30	FEB 4	FEB 9	FEB 14	FEB 19	FEB 24	FEB 29
MJD		53034	53039	53044	53049	53054	53059	53064
Laboratory	<i>k</i>	[UTC-UTC( <i>k</i> )]/ns						
NMLS	(Shah Alam)	336.2	334.0	329.3	327.5	343.2	337.4	333.5
NPL	(Teddington)	61.7	59.2	58.0	57.1	53.8	52.1	50.1
NPLI	(New-Delhi)	6495.5	6532.7	6578.9	6610.9	6656.1	6696.9	6738.0
NRC	(Ottawa)	59.1	43.0	38.8	40.4	38.8	32.6	31.3
NTSC	(Lintong)	4.2	0.2	-18.9	-26.3	-30.7	-28.6	-30.9
OMH	(Budapest)	8779.1	8790.3	8798.8	8801.6	8832.1	8840.2	8874.4
ONBA	(Buenos Aires)	-902.7	-859.0	-624.5	-534.8	-413.0	-232.6	-232.7
ONRJ	(Rio de Janeiro)	5434.2	5360.8	5272.6	5176.5	5070.6	4969.6	4875.8
OP	(Paris)	35.1	34.5	40.0	42.7	39.7	38.1	38.5
ORB	(Bruxelles)	-33.4	-32.9	-32.1	-32.4	-34.1	-35.7	-38.5
PL	(Warszawa)	-72.9	-81.0	-87.5	-99.5	-101.7	-111.4	-123.2
PTB	(Braunschweig)	-0.3	-6.4	-6.7	-11.3	-8.0	-5.9	-9.1
ROA	(San Fernando)	10.1	11.9	17.6	7.6	3.8	6.2	1.7
SCL	(Hong Kong)	-51.7	-48.0	-40.7	-32.9	-28.1	-29.4	-22.0
SG	(Singapore)	99.0	103.7	100.4	99.8	103.8	96.7	91.2
SMU	(Bratislava)	-9410.6	-9427.7	-9463.0	-9474.9	-9507.2	-9528.2	-9541.4
SP	(Boras)	174.7	188.6	193.1	201.8	206.7	227.5	231.1
SU	(Moskva)	-28.1	-27.0	-27.4	-28.0	-27.9	-24.6	-27.3
TCC	(Concepcion)	-5958.6	-6012.3	-6059.0	-6140.0	-6179.3	-6263.5	-6325.9
TL	(Chung-Li)	12.7	24.8	21.8	14.3	11.9	12.8	11.9
TP	(Praha)	14.5	9.5	12.2	11.8	11.0	13.6	15.0
UME	(Gebze-Kocaeli)	140.0	139.0	135.7	137.9	152.5	165.3	169.4
USNO	(Washington DC)	12.6	10.5	10.5	10.1	10.3	9.6	7.7
VSL	(Delft)	-42.7	-45.3	-41.6	-39.5	-47.7	-44.9	-49.7

2 - International Atomic Time TAI and Local atomic time scales TA(k). Computed values of  $[TAI-TA(k)]$ .

Date 2004	0h UTC	JAN 30	FEB 4	FEB 9	FEB 14	FEB 19	FEB 24	FEB 29
MJD		53034	53039	53044	53049	53054	53059	53064
Laboratory	k	$[TAI-TA(k)]/ns$						
CH	(Bern)	40499.6	40644.5	40784.0	40927.4	41068.6	41207.9	41345.2
CRL	(Tokyo)	183248.7	183451.6	183652.0	183855.3	184059.3	184261.5	184461.9
F	(Paris)	169365.1	169363.8	169365.9	169364.7	169361.0	169361.9	169360.0
IEN	(Torino)	33447.3	33563.5	33688.0	33813.5	33925.2	34045.0	34161.9
JATC	(Lintong)	-34056.5	-34044.6	-34095.6	-34136.2	-34179.8	-34217.7	-34249.0
KRIS	(Taejon)	6730.1	6746.2	6770.9	6788.4	6804.5	6825.9	6847.9
NIST	(Boulder)	-45259887.7	-45260086.8	-45260281.6	-45260479.8	-45260676.1	-45260872.1	-45261070.0
NRC	(Ottawa)	28785.0	28773.1	28773.2	28779.0	28781.7	28779.9	28782.9
NTSC	(Lintong)	414.1	425.0	424.4	421.3	426.4	431.6	435.9
PL	(Warszawa)	-2074.9	-2088.0	-2103.5	-2119.5	-2130.7	-2141.4	-2156.2
PTB	(Braunschweig)	-359245.4	-359247.0	-359242.0	-359241.8	-359233.2	-359226.5	-359224.8
SU	(Moskva)	27240971.9	27240973.0	27240972.6	27240972.0	27240972.1	27240975.4	27240972.7
USNO	(Washington DC)	-34925100.1	-34925409.2	-34925715.8	-34926022.6	-34926331.9	-34926639.3	-34926948.2

- Note on section 2:

(1) SU : Listed values are  $TAI-TA(SU) - 2.80$  seconds.

3 - Difference between the normalized frequencies of EAL (free atomic time scale) and TAI.

	Interval of validity	$f(EAL)-f(TAI)$
Steering correction	53034 - 53094	$6.930 \times 10^{-13}$ (2004 JAN 30 - 2004 MAR 30)
New correction foreseen	53094 - 53124	$6.920 \times 10^{-13}$ (2004 MAR 30 - 2004 APR 29)

4 - Duration of the TAI scale interval.

TAI is a realization of coordinate time TT. The following tables give the fractional deviation  $d$  of the scale interval of TAI from that of TT (the SI second on the geoid), i.e. the fractional frequency deviation of TAI with the opposite sign:  $d = -y_{TAI}$ . In this section, a frequency over a time interval is defined as the ratio of the end-point phase difference to the duration of the interval. Whenever needed, the instability of EAL should be expressed as the quadratic sum of three components with  $\tau$  in days: (1) a white frequency noise of  $6.0 \times 10^{-15} / \sqrt{\tau}$ , (2) a flicker frequency noise of  $0.6 \times 10^{-15}$  and (3) a random walk frequency noise of  $1.6 \times 10^{-16} \times \sqrt{\tau}$ . The relation between EAL and TAI is given in *Circular T* and the *Annual Report of the BIPM Time Section*.

In the first table,  $d$  is obtained, on the given periods of estimation by comparison of the TAI frequency with that of the given individual Primary Frequency Standards (PFS). In this table:  $u_A$  is the uncertainty originating in the instability of the PFS,  $u_B$  is the combined uncertainty from systematic effects,  $Ref(u_B)$  is a reference giving information on the stated value of  $u_B$  or is the *Circular T* where this reference was first given,  $u_{1/Lab}$  is the uncertainty in the link between the PFS and the clock participating to TAI, including the uncertainty due to the dead-time,  $u_{1/TAI}$  is the uncertainty in the link to TAI,  $u$  is the quadratic sum of all four uncertainty values. All values are expressed in  $10^{-15}$ .

Standard	Period of Estimation	$d$	$u_A$	$u_B$	Ref( $u_B$ )	$u_{1/Lab}$	$u_{1/TAI}$	$u$	Note
SYRTE-F02	53014 53044	7.5	0.2	0.8	T183	0.5	1.0	1.4	(1)
SYRTE-FOM	53019 53049	6.6	0.3	1.1	T183	0.7	1.0	1.7	(1)
SYRTE-JPO	53034 53059	17.7	0.5	6.5	T160	0.3	1.2	6.6	(2)
IEN-CSF1	53034 53044	2.6	0.4	1.2	T191	0.4	3.0	3.3	(3)
PTB-CS1	53034 53064	4.3	5.0	8.0	T148	0.0	1.0	9.5	(4)
PTB-CS2	53034 53064	8.8	3.0	12.0	T148	0.0	1.0	12.4	(4)

Notes:

- (1) Report 5 March 2004 by BNM-SYRTE.
- (2) Report 4 March 2004 by BNM-SYRTE.
- (3) Report 2 March 2004 by IEN.
- (4) Continuously operating as a clock participating to TAI.

The second table gives the BIPM estimate of  $d$ , based on all available PFS measurements over the period MJD 52674-53064, taking into account their individual uncertainties and characterizing the instability of EAL as noted above.  $u$  is the computed standard uncertainty of  $d$

Period of estimation	$d$	$u$
53034-53064	$7.1 \times 10^{-15}$	$1.6 \times 10^{-15}$ (2004 JAN 30 - 2004 FEB 29)

5 - Relations of UTC and TAI with GPS time and GLONASS time.

$$\begin{aligned}
 [UTC-GPS\ time] &= -13\ s + C_0, & [TAI-GPS\ time] &= 19\ s + C_0, & \text{global uncertainty is of order } 10\ \text{ns.} \\
 [UTC-GLONASS\ time] &= 0\ s + C_1, & [TAI-GLONASS\ time] &= 32\ s + C_1, & \text{global uncertainty is of order hundreds ns.}
 \end{aligned}$$

The  $C_0$  values are obtained using the values  $[UTC-UTC(OP)]$  and the GPS data taken at the Paris Observatory, corrected for IGS precise orbits, clocks and ionosphere maps. The  $C_1$  values are obtained using the values  $[UTC-UTC(VSL)]$  and the GLONASS data taken at the NMI Van Swinden Laboratorium (VSL).  $N_0$  and  $N_1$  are the numbers of measurements. The standard deviations  $\sigma_0$  and  $\sigma_1$  characterize the dispersion of individual measurements. The actual uncertainty of user's access to GPS and GLONASS times may differ from these values. For this circular,  $\sigma_0 = 2.0\ \text{ns}$ ,  $\sigma_1 = 26.6\ \text{ns}$

Date 2004	0h UTC	MJD	$C_0/\text{ns}$	$N_0$	$C_1/\text{ns}$	$N_1$
	JAN 30	53034	0.2	43	205.5	29
	JAN 31	53035	-1.8	43	200.2	0
	FEB 1	53036	-1.0	42	197.1	0
	FEB 2	53037	1.2	40	195.0	5
	FEB 3	53038	4.7	42	195.7	55
	FEB 4	53039	6.3	43	204.9	49
	FEB 5	53040	4.4	42	192.5	63
	FEB 6	53041	1.0	42	173.2	60
	FEB 7	53042	0.8	43	168.0	75
	FEB 8	53043	-0.8	43	176.7	71
	FEB 9	53044	-3.1	43	170.2	76
	FEB 10	53045	-3.0	42	165.6	81
	FEB 11	53046	-6.9	42	182.4	56
	FEB 12	53047	-6.6	43	199.5	58
	FEB 13	53048	-4.4	44	208.0	63
	FEB 14	53049	-1.6	44	204.7	65
	FEB 15	53050	-3.1	44	199.4	46
	FEB 16	53051	-3.6	45	185.3	65
	FEB 17	53052	-0.8	42	170.4	40
	FEB 18	53053	2.4	42	168.2	35
	FEB 19	53054	5.4	40	184.9	71
	FEB 20	53055	4.9	42	201.9	58
	FEB 21	53056	3.7	41	212.1	69
	FEB 22	53057	2.2	42	205.4	59
	FEB 23	53058	0.1	40	214.6	22
	FEB 24	53059	0.7	40	217.3	72
	FEB 25	53060	1.0	40	209.7	80
	FEB 26	53061	-3.7	39	215.6	69
	FEB 27	53062	-5.9	42	226.4	60
	FEB 28	53063	-8.2	41	222.6	29
	FEB 29	53064	-8.2	40	219.9	39

6 - Time links used for the computation of TAI and their uncertainties.

The time links used in the elaboration of this *Circular T* are listed in this section. The technique for the link is indicated as follows: GPS SC for GPS common-view single-channel C/A data; GPS MC for GPS common-view multi-channel C/A data; GPS P3 for GPS common-view multi-channel dual-frequency P1/P2 data; GPS GT for 'GPS time' observations; INT LK for internal cable link and TWSTFT for two-way satellite time and frequency transfer data.

For each link, the following uncertainties are provided:  $u_A$  is the statistical uncertainty evaluated by taking into account the level of phase noise in the raw data, the interpolation interval between data points and the effects with typical duration between 5 and 30 days.  $u_B$  is the uncertainty on the calibration, estimated by the BIPM.

The calibration type of the link is indicated as: GPS EC for GPS equipment calibration; TW EC for two-way equipment calibration; LC (technique) for a link calibrated using 'technique'; BC (technique) for a link calibrated using 'technique' to transfer a past equipment calibration through a discontinuity of link operation.

The calibration dates indicate: the most recent calibration results for the two laboratories in the case of EC and the most recent calibration of the link in the case of LC and BC, NA stands for not available, in this case estimated values are provided

Link	Type	$u_A$ /ns	$u_B$ /ns	Calibration Type	Calibration Dates
AOS /PTB	GPS MC	1.5	5.0	GPS EC /GPS EC	2001 Oct/2003 Aug
APL /USNO	GPS MC	1.5	20.0	NA /GPS EC	NA /2002 Apr
AUS /CRL	GPS MC	3.0	5.0	GPS EC/GPS EC	2002 Sep/2002 Aug
BEV /PTB	GPS MC	1.5	5.0	GPS EC/GPS EC	2001 Dec/2003 Aug
BIRM/CRL	GPS MC	2.5	20.0	NA /GPS EC	NA /2002 Aug
CAO /PTB	GPS SC	7.0	20.0	NA /GPS EC	NA /2003 Aug
CH /PTB	GPS SC	2.5	20.0	NA /GPS EC	NA /2003 Aug
CNM /NIST	GPS SC	5.0	20.0	NA /GPS EC	NA /2003 Jul
CNMP/USNO	GPS MC	4.0	7.0	GPS EC/GPS EC	2002 Oct/2002 Apr
CRL /PTB	GPS MC	2.0	5.0	GPS EC/GPS EC	2003 Oct/2003 Aug
CSIR/PTB	GPS MC	3.0	20.0	NA /GPS EC	NA /2003 Aug
DLR /PTB	GPS P3	0.7	5.0	GPS EC/GPS EC	2003 Apr/2003 Aug
DTAG/PTB	GPS SC	3.0	10.0	GPS EC/GPS EC	1998 May/2003 Aug
IEN /PTB	TWSTFT	1.0	5.0	LC(GPS SC)	2002 Feb
IFAG/PTB	GPS P3	0.7	5.0	GPS EC/GPS EC	2003 Jun/2003 Aug
IGMA/NIST	GPS GT	5.0	20.0	NA /GPS EC	NA /2003 Jul
INPL/PTB	GPS SC	4.0	10.0	GPS EC/GPS EC	1987 Jun/2003 Jun
JATC/NTSC	INT LK	0.2	20.0	NA	NA
JV /PTB	GPS GT	5.0	20.0	NA /GPS EC	NA /2003 Jun
KRIS/CRL	GPS MC	2.5	20.0	NA /GPS EC	NA /2002 Aug

Link	Type	$u_A$ /ns	$u_B$ /ns	Calibration Type	Calibration Dates
LDS /PTB	GPS SC	3.0	20.0	NA /GPS EC	NA /2003 Jun
LT /PTB	GPS MC	1.5	5.0	GPS EC/GPS EC	2001 Nov/2003 Jun
MSL /CRL	GPS MC	3.0	20.0	NA /GPS EC	NA /2002 Aug
NAO /CRL	GPS SC	3.0	20.0	NA /GPS EC	NA /2002 Aug
NIM /CRL	GPS SC	3.0	20.0	NA /GPS EC	NA /2002 Aug
NIMB/PTB	GPS SC	15.0	20.0	NA /GPS EC	NA /2003 Jun
NIMT/CRL	GPS MC	3.0	20.0	NA /GPS EC	NA /2002 Aug
NIST/PTB	TWSTFT	0.5	5.0	LC(GPS SC)	2003 Sep
NMC /PTB	GPS GT	5.0	20.0	NA /GPS EC	NA /2003 Aug
NMIJ/CRL	TWSTFT	1.5	5.0	LC(GPS SC)	2001 Oct
NMLS/CRL	GPS MC	3.0	20.0	NA /GPS EC	NA /2002 Aug
NPL /PTB	TWSTFT	0.5	5.0	LC(GPS SC)	1999 Nov
NPLI/PTB	GPS SC	3.0	20.0	NA /GPS EC	NA /2003 Aug
NRC /USNO	GPS SC	3.0	15.0	GPS EC/GPS EC	1982 /2002 Apr
NTSC/CRL	TWSTFT	1.5	5.0	LC(GPS SC)	2001 Oct
OMH /PTB	GPS SC	2.5	20.0	NA /GPS EC	NA /2003 Aug
ONBA/USNO	GPS MC	5.0	7.0	GPS EC/GPS EC	2000 Oct/2002 Apr
ONRJ/NIST	GPS SC	5.0	20.0	NA /GPS EC	NA /2003 Jul
OP /PTB	GPS SC	2.5	5.0	GPS EC/GPS EC	2004 Jan/2003 Aug
ORB /PTB	GPS P3	0.7	5.0	GPS EC/GPS EC	2003 Jul/2003 Aug
PL /PTB	GPS MC	1.5	5.0	GPS EC/GPS EC	2001 Oct/2003 Aug
ROA /PTB	TWSTFT	1.0	5.0	LC(GPS SC)	2001 Dec
SCL /CRL	GPS SC	4.0	10.0	GPS EC/GPS EC	1993 May/2002 Aug
SG /CRL	GPS MC	3.0	20.0	NA /GPS EC	NA /2002 Aug
SMU /PTB	GPS SC	5.0	20.0	NA /GPS EC	NA /2003 Aug
SP /PTB	GPS SC	3.0	10.0	GPS EC/GPS EC	1997 Oct/2003 Aug
SU /PTB	GPS SC	3.0	5.0	GPS EC/GPS EC	2003 Apr/2003 Jun
TCC /NIST	GPS SC	5.0	20.0	NA /GPS EC	NA /2003 Jul
TL /CRL	TWSTFT	1.5	5.0	LC(GPS SC)	2001 Oct
TP /PTB	GPS SC	2.5	5.0	GPS EC/GPS EC	2001 Oct/2003 Jun
UME /PTB	GPS SC	15.0	20.0	NA /GPS EC	NA /2003 Jun
USNO/PTB	TWSTFT	0.5	3.0	BC(GPS P3)	2003 Sep
VSL /PTB	TWSTFT	1.0	5.0	LC(GPS SC)	1999 Dec