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Practical information about the BIPM Time Section

The Time Section of the BIPM issues two periodic publications. These are the monthly *Circular T* and the *Annual Report of the BIPM Time Section*. The complete text of *Circular T* and most tables of the present Annual Report are available through the INTERNET network (see Annex I, just before the yellow pages of this volume, for the log-on procedure).

La Section du temps du BIPM produit deux publications périodiques: la Circulaire T, *mensuelle, et le* Rapport annuel de la Section du temps du BIPM. *Les circulaires T et la plupart des tableaux de ce rapport annuel sont disponibles par utilisation du réseau INTERNET (voir l'annexe I, juste avant les pages jaunes de ce volume, pour la mise en oeuvre de la communication).*

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Leap seconds

Secondes intercalaires

Since 1 January 1988, the maintenance of International Atomic Time, TAI, and of Coordinated Universal Time, UTC (with the exception of decisions and announcements concerning leap seconds of UTC) has been the responsibility of the Bureau International des Poids et Mesures (BIPM) under the authority of the Comité International des Poids et Mesures (CIPM). The dates of leap seconds of UTC are decided and announced by the International Earth Rotation Service (IERS), which is responsible for the determination of Earth rotation parameters and for maintenance of the related celestial and terrestrial reference systems. The adjustments of UTC and the relationship between TAI and UTC are given in Tables 1 and 2 of this volume.

Depuis le 1^er^ janvier 1988, l'établissement du Temps atomique international, TAI, et du Temps universel coordonné, UTC, (à l'exception de l'annonce des secondes intercalaires de l'UTC) est placé sous la responsabilité du Bureau international des poids et mesures (BIPM) et du Comité international des poids et mesures (CIPM). Le choix des dates et l'annonce des secondes intercalaires de l'UTC constituent quelques-unes des missions du Service international de la rotation terrestre (IERS), qui est responsable de la détermination des paramètres de la rotation terrestre et de la conservation des systèmes de référence terrestre et céleste associés. Les ajustements de l'UTC et la relation entre le TAI et l'UTC sont donnés dans les tableaux 1 et 2 de ce volume.

Information on IERS can be obtained from:

Des renseignements sur l'IERS peuvent être obtenus à l'adresse suivante:

Central Bureau of IERS
Dr. Martine FEISSEL
Observatoire de Paris
61, avenue de l'Observatoire
75014 Paris, France

Telephone: + 33 1 40 51 22 26
Telex: OBS 270776 F
Telefax: + 33 1 40 51 22 91
INTERNET: iers@iap.fr
SPAN: iapobs::iers

Establishment of the International Atomic Time and the Coordinated Universal Time

1. Data and computation

The International Atomic Time, TAI, and the Coordinated Universal Time, UTC, are obtained from a combination of data from about 200 atomic clocks kept by 60 laboratories spread worldwide and regularly reported to the BIPM by 45 timing centres maintaining a local UTC, UTC(k) (list in Table 3). This data is in the form of time differences [UTC(k) - Clock] taken at 10-day intervals for Modified Julian Dates (MJD) ending in 9, at 0h UTC, dates designated here as 'standard dates'. The equipment maintained by these 45 timing centres is detailed in Table 4.

An iterative algorithm produces a free atomic time scale, EAL (Echelle atomique libre) defined as a weighted average of clock readings. The processing is done in deferred-time and treats two-month blocks of data [1] [2]. The weighting procedure and clock frequency prediction are chosen so that EAL is optimized for long-term stability. No attempt is made to ensure the conformity of the EAL scale interval with the second of the International System of Units.

2. Accuracy

The duration of the scale interval of EAL is evaluated by comparison with the data of primary caesium standards, after conversion on the rotating geoid. The TAI is then derived from EAL by adding a linear function of time with a convenient slope to ensure the accuracy of the TAI scale interval. The frequency offset between TAI and EAL is changed when necessary to maintain accuracy, the magnitude of the changes being of the same order as the frequency fluctuations resulting from the instability of EAL. This operation is referred to as the 'steering of TAI'. Table 5 gives the normalized frequency offsets between EAL and TAI: the relationship between TAI and EAL was modified once in 1993 by a frequency offset of $0{,}5 \times 10^{-14}$, in order to compensate a frequency drift of EAL with respect to the primary standards of the PTB. Measurements of TAI frequency and estimates of the mean duration of its scale interval are reported in Tables 6 and 7.

3. Availability

The TAI and UTC are made available in the form of time differences with respect to the local time scales UTC(k), which approximate UTC, and TA(k), which are independent local atomic time scales. These differences, [UTC - UTC(k)] and [TAI - TA(k)], reported in Tables 8 and 9, are computed for the standard dates.

The computation of TAI is carried out every two months. A provisional computation, however, is made every odd-numbered month (January, March, etc.) with the data which is available. In the following month, TAI is recomputed for the whole span of two months. The deviations between the provisional one-month and complete two-month solutions are usually smaller than 10 ns. This arrangement allows the monthly publication of results in Circular T. When preparing the Annual Report, the results shown in Circular T are revised taking into account any improvement in the data made known after its publication. The computation is then strictly made for the six two-month intervals of the year.

4. Time links

The network of time links used by the BIPM is non-redundant and mainly relies on the observation of GPS satellites. In 1993 nearly all national centres keeping a local UTC were equipped with GPS time receivers and followed the international tracking schedules published by the BIPM:

- Schedule n°21, reported in Table 10, implemented on 25 June 1993 (MJD 49163), and
- Schedule n°22, reported in Table 11, implemented on 13 December 1993 (MJD 49334).

Laboratories regularly send their GPS observations to the BIPM where they are processed following a unified procedure. Strict common views, synchronized to within 1 s, are used to remove the clock-dither noise brought about by the voluntary degradation, Selective Availability, of GPS signals.

The BIPM organizes the international GPS network which takes the form of local stars within a continent joined by two long-distance links, OP-NAOT and OP-NIST, chosen because measured ionospheric delays are routinely available for these three sites. Precise GPS satellites ephemerides, produced by the International Geodynamics Service with a delay of a few days, are also routinely used for these long-distance links. The ultimate precision of one single measurement of [UTC(k_1) - UTC(k_2)], obtained at the BIPM with these procedures, is about 2 ns for short distances and 8 ns for long distances. The BIPM also publishes an evaluation of [UTC - GPS time] which is reported in Table 12 of this volume.

No time link using GLONASS was used for the computation of TAI in 1993. However, the BIPM regularly publishes an evaluation of [UTC - GLONASS time], given here in Table 13, using current observations of both the GPS and GLONASS satellite systems provided by Prof. P. Daly, University of Leeds.

5. Time scales established in retrospect

For the most demanding applications, such as millisecond pulsar timing, the BIPM issues atomic time scales in retrospect. These are designated TT(BIPMxx) where 1900 + xx is the year of computation [3]. The successive versions of TT(BIPMxx) are both updates, and revisions: they may differ for common dates. These time scales are available on request from the BIPM or via the INTERNET network.

Notes

Tables 14 and 15 of this report give the rates relative to TAI and the weights of the contributing clocks to TAI in 1993.

The yellow pages, at the end of this volume, give indications about time signal emissions.

References

[1] B. Guinot and C. Thomas, 'Establishment of the International Atomic Time', Annual Report of the BIPM Time Section, 1988, pp. D3-D22.

[2] P. Tavella and C. Thomas, 'Comparative study of time scale algorithms', *Metrologia*, 1991, 28, 57-63.

[3] B. Guinot, 'Atomic time scales for pulsar studies and other demanding applications', *Astron. and Astrophys.*, 1988, 192, 370-373.

Etablissement du Temps atomique international et du Temps universel coordonné

1. *Données et mode de calcul*

Le Temps atomique international (TAI) et le Temps universel coordonné (UTC) sont obtenus par une combinaison de données provenant d'environ 200 horloges atomiques conservées par 60 laboratoires répartis dans le monde entier, et fournies régulièrement au BIPM par 45 laboratoires de temps qui maintiennent un UTC local, UTC(k) (liste donnée dans le tableau 3). Ces données prennent la forme de differences de temps [UTC(k) - Horloge] enregistrées de 10 jours en 10 jours pour les dates juliennes modifiées (MJD) se terminant par 9, à 0hUTC, 'dates normales'. L'équipement maintenu par ces 45 laboratoires de temps est décrit dans le tableau 4.

Un algorithme itératif qui traite en temps différé des blocs de 2 mois de données [1] [2], produit une échelle atomique libre, EAL, définie comme étant une moyenne pondérée de lectures d'horloges. Le choix de la pondération et du mode de prédiction de fréquence optimise la stabilité de l'EAL à long terme. Il n'est pas tenté d'assurer la conformité de l'intervalle unitaire de l'EAL avec la seconde du Système international d'unités.

2. *Exactitude*

La durée de l'intervalle unitaire de l'EAL est évaluée par comparaison aux données d'étalons de fréquence à césium primaires, après conversion sur le géoïde en rotation. Ensuite le TAI se déduit de l'EAL par l'addition d'une fonction linéaire du temps dont la pente est convenablement choisie pour assurer l'exactitude de l'intervalle unitaire du TAI. Le décalage de fréquence entre le TAI et l'EAL est changé quand c'est nécessaire pour maintenir l'exactitude, les changements ayant le même ordre de grandeur que les fluctuations de fréquence qui résultent de l'instabilité de l'EAL. Cette opération est désignée par l'expression 'pilotage du TAI'. Le tableau 5 donne les différences de fréquences normalisées entre l'EAL et le TAI: la relation les liant a été modifiée à une occasion en 1993, par un décalage de fréquence de 0,5 10^{-14}, afin de compenser une dérive de la fréquence de l'EAL par rapport aux étalons primaires de la PTB. Des mesures de la fréquence du TAI et des estimations de la durée moyenne de son intervalle unitaire sont données dans les tableaux 6 et 7.

3. *Disponibilité*

Le TAI et l'UTC sont disponibles sous forme de différences de temps avec les échelles locales de temps UTC(k), approximation de l'UTC, et TA(k), temps atomique local indépendant, reportées dans les tableaux 8 et 9.

Le calcul du TAI doit être fait, en principe, tous les deux mois. Mais un calcul provisoire est fait un mois sur deux (pour janvier, mars, etc.) avec les données disponibles. Le mois suivant, le calcul du TAI est repris pour une durée de deux mois. L'écart entre les résultats des calculs provisoire et complet est ordinairement inférieur à 10 ns. Cette organisation permet la publication mensuelle des résultats dans la Circulaire T du BIPM. Quand le Rapport annuel est préparé, les résultats de la circulaire T sont révisés, compte-tenu des améliorations de données, connues après la publication de la Circulaire T. Les calculs sont alors strictement faits par période de deux mois.

4. Liaisons horaires

Le système des liaisons horaires utilisé par le BIPM est non-redondant. Il repose principalement sur l'observation des satellites du GPS.

En 1993, pratiquement tous les laboratoires de temps qui maintiennent un UTC local, étaient équipés de récepteurs du temps du GPS et suivaient les programmes de poursuite des satellites du GPS, produits par le BIPM:

- *le programme n°21, reproduit dans le tableau 10, mis en oeuvre le 25 juin 1993 (MJD 49163), et*
- *le programme n°22, reproduit dans le tableau 11, mis en oeuvre le 13 décembre 1993 (MJD 49334).*

Les laboratoires envoient régulièrement leurs données au BIPM où les calculs sont effectués d'une manière unifiée. On utilise des observations en vues simultanées strictes, c'est-à-dire synchronisées à la seconde près, ceci afin de supprimer la dégradation des signaux des horloges embarquées, due à l'implantation de 'l'accés sélectif'.

Le BIPM organise le réseau international de comparaisons horaires utilisant le GPS selon un schéma en étoile au niveau des continents, et en deux liaisons à longue distance, OP-NAOT et OP-NIST, choisies parce que des données de retards ionosphériques mesurés sont disponibles pour ces trois sites. Des éphémérides précises des satellites du GPS, produites par l'IGS et accessibles en quelques jours, sont aussi utilisées de manière courante pour ces deux liaisons. La précision ultime d'une mesure unique [UTC(k_1) - UTC(k_2)] est alors d'environ 2 ns pour les liaisons à courte distance et d'environ 8 ns pour les liaisons à longue distance. Le BIPM publie aussi une évaluation de [UTC - temps du GPS], donnée dans le tableau 12 de ce volume.

Aucun lien horaire utilisant le GLONASS n'a été utilisé en 1993. Cependant, le BIPM publie régulièrement une évaluation de [UTC - temps du GLONASS], donnée dans le tableau 13 du présent volume et déduite des observations habituelles des deux systèmes GPS et GLONASS, réalisées par le Professeur P. Daly de l'Université de Leeds.

5. *Echelles de temps établies rétrospectivement*

Pour les applications les plus exigeantes, comme le chronométrage des pulsars milliseconde, le BIPM produit des échelles de temps rétrospectivement, désignées par TT(BIPMxx), 1900 + xx étant l'année du calcul [3]. Les versions successives de TT(BIPMxx) ne sont pas seulement des mises à jour, mais aussi des révisions, de sorte qu'elles peuvent différer pour les dates communes. Ces échelles de temps sont disponibles sur demande faite au BIPM ou par utilisation du réseau INTERNET.

Notes
Les tableaux 14 et 15 de ce rapport donnent les fréquences relatives au TAI et les poids des horloges qui ont contribué au calcul en 1993.
Les pages jaunes, à la fin de ce volume, concernent les émissions de signaux horaires.

Les références sont données dans le texte anglais, page 9.

List of the Tables included in the Annual Report of the BIPM Time Section for 1993

Tables indicated with ∗ are available through the INTERNET network (see Annex I, just before the yellow pages of this volume) under the file names given in this list.

TABLE 1. FREQUENCY OFFSETS AND STEP ADJUSTMENTS OF UTC, UNTIL 30 JUNE 1994

DATE (AT 0h UTC)	OFFSETS	STEPS
1961 Jan. 1	-150×10^{-10}	
1961 Aug. 1	"	+0.050 s
1962 Jan. 1	-130×10^{-10}	
1963 Nov. 1	"	-0.100 s
1964 Jan. 1	-150×10^{-10}	
1964 Apr. 1	"	-0.100 s
1964 Sep. 1	"	-0.100 s
1965 Jan. 1	"	-0.100 s
1965 Mar. 1	"	-0.100 s
1965 Jul. 1	"	-0.100 s
1965 Sep. 1	"	-0.100 s
1966 Jan. 1	-300×10^{-10}	
1968 Feb. 1	"	+0.100 s
1972 Jan. 1	0	-0.107 7580 s
1972 Jul. 1	"	-1 s
1973 Jan. 1	"	-1 s
1974 Jan. 1	"	-1 s
1975 Jan. 1	"	-1 s
1976 Jan. 1	"	-1 s
1977 Jan. 1	"	-1 s
1978 Jan. 1	"	-1 s
1979 Jan. 1	"	-1 s
1980 Jan. 1	"	-1 s
1981 Jul. 1	"	-1 s
1982 Jul. 1	"	-1 s
1983 Jul. 1	"	-1 s
1985 Jul. 1	"	-1 s
1988 Jan. 1	"	-1 s
1990 Jan. 1	"	-1 s
1991 Jan. 1	"	-1 s
1992 Jul. 1	"	-1 s
1993 Jul. 1	"	-1 s

TABLE 2. RELATIONSHIP BETWEEN TAI AND UTC, UNTIL 30 JUNE 1994

LIMITS OF VALIDITY (AT 0h UTC)	TAI - UTC (IN SECONDS)
1961 Jan. 1 - 1961 Aug. 1	1.422 8180 + (MJD - 37300) x 0.001 296
1961 Aug. 1 - 1962 Jan. 1	1.372 8180 + " "
1962 Jan. 1 - 1963 Nov. 1	1.845 8580 + (MJD - 37665) x 0.001 1232
1963 Nov. 1 - 1964 Jan. 1	1.945 8580 + " "
1964 Jan. 1 - 1964 Apr. 1	3.240 1300 + (MJD - 38761) x 0.001 296
1964 Apr. 1 - 1964 Sep. 1	3.340 1300 + " "
1964 Sep. 1 - 1965 Jan. 1	3.440 1300 + " "
1965 Jan. 1 - 1965 Mar. 1	3.540 1300 + " "
1965 Mar. 1 - 1965 Jul. 1	3.640 1300 + " "
1965 Jul. 1 - 1965 Sep. 1	3.740 1300 + " "
1965 Sep. 1 - 1966 Jan. 1	3.840 1300 + " "
1966 Jan. 1 - 1968 Feb. 1	4.313 1700 + (MJD - 39126) x 0.002 592
1968 Feb. 1 - 1972 Jan. 1	4.213 1700 + " "
1972 Jan. 1 - 1972 Jul. 1	10 (integral number of seconds)
1972 Jul. 1 - 1973 Jan. 1	11
1973 Jan. 1 - 1974 Jan. 1	12
1974 Jan. 1 - 1975 Jan. 1	13
1975 Jan. 1 - 1976 Jan. 1	14
1976 Jan. 1 - 1977 Jan. 1	15
1977 Jan. 1 - 1978 Jan. 1	16
1978 Jan. 1 - 1979 Jan. 1	17
1979 Jan. 1 - 1980 Jan. 1	18
1980 Jan. 1 - 1981 Jul. 1	19
1981 Jul. 1 - 1982 Jul. 1	20
1982 Jul. 1 - 1983 Jul. 1	21
1983 Jul. 1 - 1985 Jul. 1	22
1985 Jul. 1 - 1988 Jan. 1	23
1988 Jan. 1 - 1990 Jan. 1	24
1990 Jan. 1 - 1991 Jan. 1	25
1991 Jan. 1 - 1992 Jul. 1	26
1992 Jul. 1 - 1993 Jul. 1	27
1993 Jul. 1 -	28

TABLE 3. ACRONYMS AND LOCATIONS OF THE TIMING CENTRES WHICH MAINTAIN A LOCAL APPROXIMATION OF UTC, UTC(k), OR/AND AN INDEPENDENT LOCAL TIME SCALE, TA(k)

AOS	Astronomiczne Obserwatorium Szerokosciowe, Borowiec, Polska
APL	Applied Physics Laboratory, Laurel, MA, USA
AUS	Consortium of laboratories in Australia
BEV	Bundesamt für Eich - und Vermessungswesen, Wien, Oesterreich
CAO	Cagliari Astronomical Observatory , Cagliari, Italia
CH	Consortium of laboratories in Switzerland
CRL	Communications Research Laboratory, Tokyo, Japan
CSAO	Shaanxi Astronomical Observatory, Lintong, P.R. China
CSIR(1)	Council for Scientific and Industrial Research, Pretoria, South Africa
F	Commission Nationale de l'Heure, Paris, France
FTZ	Forschungs - und Technologiezentrum Darmstadt, Deutschland
IEN	Istituto Elettrotecnico Nazionale Galileo Ferraris, Torino, Italia
IFAG	Institut für Angewandte Geodäsie, Frankfurt am Main, Deutschland
IGMA	Instituto Geografico Militar, Buenos-Aires, Argentina
INPL	National Physical Laboratory, Jerusalem, Israel
JATC	Joint Atomic Time Commission, Lintong, P.R. China
KRIS	Korea Research Institute of Standards and Science, Taejon, Rep. of Korea
LDS	The University of Leeds, Leeds, United Kingdom
MSL	Measurement Standards Laboratory, Lower Hutt, New Zealand
NAOM	National Astronomical Observatory, Misuzawa, Japan
NAOT	National Astronomical Observatory, Tokyo, Japan
NIM	National Institute of Metrology, Beijing, P.R. China
NIST	National Institute of Standards and Technology, Boulder, CO, USA
NMC	National Metrological Center, Sofiya, Bulgaria
NPL	National Physical Laboratory, Teddington, United Kingdom
NPLI	National Physical Laboratory, New-Delhi, India
NRC	National Research Council of Canada, Ottawa, Canada
NRLM	National Research Laboratory of Metrology, Tsukuba, Japan
OMH	Orszagos Mérésügyi Hivatal, Budapest, Hungary
ONBA	Observatorio Naval, Buenos-Aires, Argentina
ONRJ	Observatorio Nacional, Rio de Janeiro, Brazil
OP	Observatoire de Paris, Paris, France
ORB	Observatoire Royal de Belgique, Bruxelles, Belgique

TABLE 3. ACRONYMS AND LOCATIONS OF THE TIMING CENTRES WHICH MAINTAIN A LOCAL APPROXIMATION OF UTC, UTC(k), OR/AND AN INDEPENDENT LOCAL TIME SCALE, TA(k) (CONT.)

PKNM	Polski Komitet Normalizacji Miar i Jakosci, Warszawa, Polska
PTB	Physikalisch-Technische Bundesanstalt, Braunschweig, Deutschland
RC	Comité Estatal de Normalizacion, Habana, Cuba
ROA	Real Instituto y Observatorio de la Armada, San Fernando, Espana
SCL	Standards and Calibration Laboratory, Hong Kong
SNT	Swedish National Time and Frequency Laboratory, Stockholm, Sweden
SO	Shanghai Observatory, Shanghai, P.R. China
SU	Institute of Metrology for Time and Space (IMVP), NPO "VNIIFTRI" Mendeleevo, Moscow Region, Russia
TL	Telecommunication Laboratories, Chung-Li, Taiwan, China
TP	Institute of Radio Engineering and Electronics, Academy of Sciences of Czech Republic - Czech Republic
TUG	Technische Universität, Graz, Oesterreich
USNO	U.S. Naval Observatory, Washington D.C., USA
VSL	Van Swinden Laboratorium, Delft, Nederland

(1) Formerly DPT

TABLE 4. LABORATORIES CONTRIBUTING TO TAI IN 1993 : EQUIPMENT, INDEPENDENT LOCAL TIME SCALE

(Ind. Cs : industrial Cs Standard, Lab. Cs : laboratory Cs standard,

		Information on TA(k) - UTC(k)	
Laboratory (k)	Equipment in atomic standards	Interval of validity (in MJD at 0hUTC)	TA(k) - UTC(k) in s
AOS	2 Ind. Cs		
APL	2 Ind. Cs 4 H-Masers	48987-49169 49169-49352	26.999 998 537 27.999 998 537
AUS	Ind. Cs H-Masers (3)	year 1993	TA(AUS)-UTC(AUS) is sent to the BIPM by ORR
BEV	1 Ind. Cs		
CAO	3 Ind. Cs		
CH	13 Ind. Cs (5)	year 1993	TA(CH)-UTC(CH) is sent to the BIPM by OFM
CRL	1 Lab. Cs 13 Ind. Cs 4 H-Masers	year 1993	TA(CRL)-UTC(CRL) is published in CRL Standard Frequency and Time Bulletins
CSAO	5 Ind. Cs 3 H-Masers	year 1993	TA(CSAO)-UTC(CSAO) is published in CSAO Time and Frequency Services Bulletins

TA(K), SOURCE OF UTC(K) AND RECEPTION OF TIME SIGNALS

H-Maser : Hydrogen Maser, * means 'yes')

	Information on time links					
source of UTC(k) (1)	GPS recept.	Iono. meas. syst.	GLONASS recept.	LORAN-C recept. (2)	Television link with	Two-way satellite time transfer
1 Cs + microstepper	*			7970-W	PKNM	
1 H-Maser	*					in an experi- mental stage
(4)	*				other labs in Australia	
1 Cs				7970-W	OMH, TUG, other labs in Slovak Republic	
1 Cs	*			7990-M 7990-X 7990-Z	IEN, other labs in Italy	
all the Cs	*			7970-W 7990-Z	PTT (5)	
7 Cs	*	*		9970-M	NAOT NRLM	*
all the Cs	*			9970-Y	other labs in China	

TABLE 4. LABORATORIES CONTRIBUTING TO TAI IN 1993 : EQUIPMENT, INDEPENDENT LOCAL TIME SCALE

(Ind. Cs : industrial Cs Standard, Lab. Cs : laboratory Cs standard,

		Information on TA(k) - UTC(k)	
Laboratory (k)	Equipment in atomic standards	Interval of validity (in MJD at 0hUTC)	TA(k) - UTC(k) in s
CSIR (6)	2 Ind. Cs		
FTZ	5 Ind. Cs		
IEN	6 Ind. Cs		(8)
IFAG	5 Ind. Cs 2 H-Masers		
IGMA	4 Ind. Cs		
INPL	5 Ind. Cs	year 1993	TA(INPL)-UTC(INPL) is sent to the BIPM
JATC	1 Lab. Cs 7 Ind. Cs 4 H-Masers (9)	year 1993	TA(JATC)-UTC(JATC) is sent to the BIPM
KRIS	5 Ind. Cs 1 H-Maser	year 1993	TA(KRIS)-UTC(KRIS) is sent to the BIPM
LDS	3 Ind. Cs		
MSL	4 Ind. Cs		

TA(k), SOURCE OF UTC(k) AND RECEPTION OF TIME SIGNALS (CONT.)

H-Maser : Hydrogen Maser, * means 'yes')

	Information on time links					
source of UTC(k) (1)	GPS recept.	Iono. meas. syst.	GLONASS recept.	LORAN-C recept. (2)	Television link with	Two-way satellite time transfer
1 Cs	*				RAO (7)	
1 Cs	*			7970-W		*
1 Cs + microstepper	*				CAO, other labs in Italy	in an experimental stage
1 Cs + microstepper	*					
1 Cs + microstepper	*				ONBA, other labs in Argentina	
4 Cs	*	*				
1 Cs + microstepper	*			9970-Y		
1 Cs + microstepper	*	*		9970-Y		
1 Cs	*		* (10)			
1 Cs	*				other labs in New Zealand	

TABLE 4. LABORATORIES CONTRIBUTING TO TAI IN 1993 : EQUIPMENT, INDEPENDENT LOCAL TIME SCALE

(Ind. Cs : industrial Cs Standard, Lab. Cs : laboratory Cs standard,

		Information on TA(k) - UTC(k)	
Laboratory (k)	Equipment in atomic standards	Interval of validity (in MJD at 0hUTC)	TA(k) - UTC(k) in s
NAOM	3 Ind. Cs		
NAOT	6 Ind. Cs		
NIM	3 Ind. Cs	year 1993	TA(NIM)-UTC(NIM) is sent to the BIPM
NIST	2 Lab. Cs 20 Ind. Cs 3 H-Masers	year 1993	(11)
NMC	1 Ind. Cs		
NPL	7 Ind. Cs 1 H-Maser		
NPLI	3 Ind. Cs		
NRC	3 Lab. Cs 1 Ind. Cs	48987-49169 49169-49352	26.999 983 931 27.999 983 931
NRLM	5 Ind. Cs 2 Lab. Cs		

TA(k), SOURCE OF UTC(k) AND RECEPTION OF TIME SIGNALS (CONT.)

H-Maser : Hydrogen Maser, * means 'yes')

	Information on time links					
source of UTC(k) (1)	GPS recept.	Iono. meas. syst.	GLONASS recept.	LORAN-C recept. (2)	Television link with	Two-way satellite time transfer
1 Cs + microstepper	*			9970-M 9970-X		
1 Cs + microstepper	*			9970-M 9970-Y	CRL, NAOM NRLM	
1 Cs + microstepper				9970-Y	other labs in China	
11 Cs 1 H-Maser	*	*		9940-M 8970-M		in an exper-mental stage (12)
1 Cs + microstepper				7990-Y		
1 H-Maser + microstepper	*	(13)		7970-W 8940-M	transmitting station at Rugby	*
1 Cs	*					
1 Lab. Cs (14)	*			9960-M		in an experi-mental stage (12)
1 Cs	*				CRL, NAOT	

TABLE 4. LABORATORIES CONTRIBUTING TO TAI IN 1993 : EQUIPMENT, INDEPENDENT LOCAL TIME SCALE

(Ind. Cs : industrial Cs Standard, Lab. Cs : laboratory Cs standard,

		Information on TA(k) - UTC(k)	
Laboratory (k)	Equipment in atomic standards	Interval of validity (in MJD at 0hUTC)	TA(k) - UTC(k) in s
OMH	1 Ind. Cs		
ONBA	2 Ind. Cs		
ONRJ	5 Ind. Cs		
OP	5 Ind. Cs 1 Lab. Cs (15) 1 H-Maser	year 1993	TA(F)-UTC(OP) is published in Bulletin H by LPTF (16)
ORB	3 Ind. Cs 1 H-Maser		
PKNM	3 Ind. Cs		
PTB	4 Lab. Cs 8 Ind. Cs 2 H-Masers	48987-49169 49169-49352	27.000 363 400 28.000 363 400
RC	5 H-Masers	year 1993	TA(RC)-UTC(RC) is sent to the BIPM
ROA	7 Ind. Cs		
SCL	2 Ind. Cs		

TA(K), SOURCE OF UTC(K) AND RECEPTION OF TIME SIGNALS (CONT.)

H-Maser : Hydrogen Maser,   * means 'yes')

	Information on time links					
source of UTC(k) (1)	GPS recept.	Iono. meas. syst.	GLONASS recept.	LORAN-C recept. (2)	Television link with	Two-way satellite time transfer
1 Cs	*					
2 Cs					IGMA other labs in Argentina	
5 Cs	*				other labs in Brasil	
1 Cs + microstepper (since 2 July 1993)	*	*		7970-W 7990-Z 8940-M	18 labs in France.	
3 Cs (17)	*			7970-W		
1 Cs + microstepper	*			7970-W (18)	AOS	
1 Lab. Cs (19)	*	*		7970-W	TP and other labs	*
3 H-Masers				7980-M 7980-Y		
all the Cs	*			7990-Z		
1 Cs + microstepper	*			9970-Y		

TABLE 4. LABORATORIES CONTRIBUTING TO TAI IN 1993 : EQUIPMENT, INDEPENDENT LOCAL TIME SCALE

(Ind. Cs : industrial Cs Standard, Lab. Cs : laboratory Cs standard,

		Information on TA(k) - UTC(k)	
Laboratory (k)	Equipment in atomic standards	Interval of validity (in MJD at 0hUTC)	TA(k) - UTC(k) in s
SNT	3 Ind. Cs		
SO	1 Lab. Cs 2 Ind. Cs 3 H-Masers	year 1993	TA(SO)-UTC(SO) is published in SO Atomic Time Bulletins
SU	2 Lab. Cs 10 H- Masers	48987-49169 49169-49352	24.172 750 000 25.172 750 000
TL	5 Ind. Cs		
TP	3 Ind. Cs		
TUG	3 Ind. Cs		
USNO	73 Ind. Cs 12 H-Masers 2 Prototype Mercury Ion Freq. Std.	year 1993	A.1(MEAN)-UTC(USNO,MC) is sent to the BIPM (21)
VSL	4 Ind. Cs		

TA(K), SOURCE OF UTC(K) AND RECEPTION OF TIME SIGNALS (CONT.)

H-Maser : Hydrogen Maser, * means 'yes')

	Information on time links					
source of UTC(k) (1)	GPS recept.	Iono. meas. syst.	GLONASS recept.	LORAN-C recept. (2)	Television link with	Two-way satellite time transfer
1 Cs	*			7970-W	other labs in Sweden	
1 Cs + microstepper	*			9970-Y	other labs in China	
6 H-Masers (20)	*		*	7990-Y 9970-X		
1 cs + microstepper	*	*		9970-Y		in an experimental stage
1 Cs + microstepper	*			7970-W		
1 Cs	*			7970-W 7990-M	BEV	*
UTC(USNO,MC) is an H-Maser + Freq. synthesizer steered to UTC(USNO) (21)	* (22)		under test	* (22)	*	* (12) (23)
1 Cs + microstepper	*			7970-M 7970-W 9980-X	15 Labs in Netherlands	*

NOTES

(1) When several clocks are indicated as source of UTC(k), laboratory k generally computes a software clock, steered to UTC. Often a physical realization of UTC(k) is obtained using a Cs clock and a microphase-stepper.

(2) LORAN-C stations :

7970-M	Norwegian Sea chain,	Ejde, Denmark
7970-W	" "	Sylt, Germany
7980-M	Southeast USA chain	Malone, Florida, USA
7980-Y	" "	Jupiter,Florida, USA
7990-M	Mediterranean chain,	Sellia Marina, Italy
7990-X	" "	Lampedusa, Italy
7990-Y	" "	Kargabarun, Turkey
7990-Z	" "	Estartit, Spain
8940-M	French chain,	Lessay, France
8970-M	Great Lakes chain,	Dana, Indiana, USA
9940-M	West Coast chain,	Fallon, Nevada, USA
9960-M	Northeast Coast chain,	Seneca, New York, USA
9970-M	Northwest Pacific chain,	Iwo Jima, Japan
9970-X	" "	Hokkaido, Japan
9970-Y	" "	Gesashi, Japan
9980-X	North Atlantic chain	Ejde, Denmark.

(3) Some of the standards are located as follows (at the end of 1993) :

* Australian Telecommunications Commission (Melbourne) (ATC) 7 Cs
* National Measurements Laboratory, CSIRO (Sydney) (NML) 3 Cs, 2 H-Masers
* Orroral Observatory (Belconnen) (ORR) 5 Cs.

Australian laboratories are intercompared by GPS and by the TV method.

(4) In 1993, UTC(AUS) was the output from a GPS receiver, located at NML, corrected by the time difference [UTC(USNO,MC) - GPS time] (as given in the GPS message) in order to get in real-time UTC(AUS) = UTC(USNO,MC).

(5) The standards are located as follows (at the end of 1993) :

* Office Fédéral de Métrologie (Bern) (OFM) 8 Cs
* Observatoire de Neuchâtel (Neuchâtel) (ON) 3 Cs
* Direction Générale des PTT (Bern) (PTT) 2 Cs.

They are intercompared by LORAN-C (OFM-ON) and the TV method (OFM-PTT) and linked to the foreign laboratories through the Swiss Federal Office of Metrology.

(6) Council for Scientific and Industrial Research, formerly DPT.

(7) RAO : Radio Astronomical Observatory, Johannesburg, South Africa.

NOTES (CONT.)

(8) The implementation of an algorithm for computation of TA(IEN) is under test. Values of [TA(IEN) - UTC(IEN)] are not yet reported to the BIPM.

(9) The standards are located at

* Shaanxi Astronomical Observatory (CSAO)
* Shanghai Astronomical Observatory (SO)
* Beijing Astronomical Observatory
* Wuhan Time Observatory.
* Beijing Institute of Radio Metrology and Measurement.

The link [UTC(JATC) - UTC(CSAO)] is obtained by internal connection.

(10) Reception of GPS and GLONASS signals on a common custom-built receiver allowing the observation of [GPS time - GLONASS time].

(11) [TA(NIST) - UTC(NIST)] was published in the NIST Time and Frequency Bulletins through 31 October 1993. NIST discontinued computing TA(NIST) at that time. Another independent local time scale is called AT1. It appears in the BIPM publications as TA(NISA). NIST will continue to publish the equations which are used to define [UTC(NIST) - AT1] in the NIST Time and Frequency Bulletins.

(12) For experimental purposes, two-way satellite time transfer operates between NIST and NRC, and between NIST and USNO.

(13) A dual-frequency P-Code GPS receiver in under test at NPL.

(14) In 1993, UTC(NRC) was derived from NRC Cs VI C.

(15) The LPTF, located at the Paris Observatory (OP), has developed a primary frequency standard which uses optical pumping and which is named JPO (Jet à pompage Optique). Its first accuracy evaluation has been used by the BIPM for TAI computation in May 1993.

(16) TA(F) is the French atomic time scale computed by LPTF with data from 24 industrial caesium located as follows (at the end of 1993) :

* Centre Electronique de l'Armement (CELAR, Rennes)	2 Cs
* Centre National d'Etudes Spatiales (CNES)	2 Cs
* Centre National d'Etudes des Télécommunications	3 Cs
* Observatoire de la Côte d'Azur (OCA)	3 Cs
* Electronique Serge Dassault (Trappes)	1 Cs
* Hewlett-Packard (Orsay)	2 Cs
* Observatoire de Paris : Laboratoire Primaire du Temps et des Fréquences (LPTF)	5 Cs
* Observatoire de Besançon (OB)	3 Cs
* Laboratoire de Physique et de Métrologie des Oscillateurs (Besançon) (LPMO)	1 Cs
* Ecole Nationale Supérieure de Mécanique et des Microtechniques (Besançon) (ENSMM)	1 Cs
* Société d'Etudes, Recherches et Constructions Electroniques (Carquefou) (SERCEL).	1 Cs

Links by GPS : OP-OB, OP-SERCEL, OP-OCA, OP-CNES, OP-CELAR.
Cable links : OB-LPMO, OB-ENSMM.
Other national links by the TV method.

NOTES (CONT.)

(17) The source of UTC(ORB) is a Rb clock kept in phase with a mathematical clock, this latter being the mean of 3 Cs corrected for their drift.

(18) Reception of the Russian LORAN chain 8000.

(19) Two Laboratory Cs, PTB CS1 and PTB CS2, are operated continuously as clocks. TA(PTB) and UTC(PTB) were derived directly from PTB CS2 in 1993. The accuracy of PTB CS3 and PTB CS4 is being evaluated.

(20) UTC(SU) is a free running time scale obtained as the simple average of a selected number of hydrogen-masers.

(21) The time scale A.1 (MEAN), designated as TA(USNO) in BIPM publications, and UTC(USNO) are computed by USNO. They rely on a number of Cs clocks and H-masers. A.1 (MEAN) is a free atomic time scale while UTC(USNO) is closely steered on UTC.

(22) Daily time differences of [UTC(USNO,MC) - transmitting station] are published weekly (Series 4 of USNO) for the LORAN-C chains and the GPS satellite system. This data is also available via the Automated Data Service (ADS) of USNO.

(23) Regular two-way satellite time transfer operates between USNO Washington DC and USNO sub-station in Richmond, Florida.

TABLE 5. DIFFERENCES BETWEEN THE NORMALIZED FREQUENCIES OF EAL AND TAI, UNTIL JANUARY 1994

(File available via INTERNET under the name EALTAI93.AR)

Date	MJD	f(EAL) - f(TAI) in 10^{-13}
until 1977 Jan 1	until 43144	0
1977 Jan 1 - 1977 Apr 26	43144 - 43259	10.0
1977 Apr 26 - 1977 Jun 25	43259 - 43319	9.8
1977 Jun 25 - 1977 Aug 24	43319 - 43379	9.6
1977 Aug 24 - 1977 Oct 23	43379 - 43439	9.4
1977 Oct 23 - 1978 Oct 28	43439 - 43809	9.2
1978 Oct 28 - 1979 Jun 25	43809 - 44049	9.0
1979 Jun 25 - 1979 Aug 24	44049 - 44109	8.8
1979 Aug 24 - 1979 Oct 23	44109 - 44169	8.6
1979 Oct 23 - 1982 Apr 30	44169 - 45089	8.4
1982 Apr 30 - 1982 Jun 29	45089 - 45149	8.2
1982 Jun 29 - 1982 Aug 28	45149 - 45209	8.0
1982 Aug 28 - 1984 Feb 29	45209 - 45759	7.8
1984 Feb 29 - 1987 Apr 24	45759 - 46909	8.0
1987 Apr 24 - 1987 Dec 30	46909 - 47159	8.0125
1987 Dec 30 - 1989 Jun 22	47159 - 47699	8.0
1989 Jun 22 - 1989 Dec 29	47699 - 47889	7.95
1989 Dec 29 - 1990 Feb 27	47889 - 47949	7.90
1990 Feb 27 - 1990 Apr 28	47949 - 48009	7.85
1990 Apr 28 - 1990 Jun 27	48009 - 48069	7.80
1990 Jun 27 - 1990 Aug 26	48069 - 48129	7.75
1990 Aug 26 - 1991 Feb 22	48129 - 48309	7.70
1991 Feb 22 - 1991 Apr 23	48309 - 48369	7.625
1991 Apr 23 - 1991 Aug 31	48369 - 48499	7.55
1991 Aug 31 - 1991 Oct 30	48499 - 48559	7.50
1991 Oct 30 - 1992 Apr 27	48559 - 48739	7.45
1992 Apr 27 - 1992 Jun 26	48739 - 48799	7.40
1992 Jun 26 - 1993 Apr 22	48799 - 49099	7.35
1993 Apr 22 -	49099	7.40

As the time scales UTC and TAI differ by an integral number of seconds (see Tables 1 and 2), UTC is necessarily subjected to the same intentional frequency adjustment as TAI.

TABLE 6. MEASUREMENTS OF TAI FREQUENCY

(File available via INTERNET under the name FTAI93.AR)

The following table gives the differences of frequencies, measured in 1987-1993, between TAI, and the laboratory caesium standards: CRL Cs1, NIST 6, NRC CsV, NRC CsVI A, B, C, PTB CS1, PTB CS2, SU MCsR 101, SU MCsR 102, LPTF JPO. The frequencies are expressed at sea level (gravitational corrections applied).

The standard CRL Cs1 (previously RRL Cs1) performs discontinuous calibrations of UTC(CRL) which are transferred to TAI by linear adjustment of [UTC - UTC(CRL)] over 60 days.

The standard NIST 6 (previously NBS 6) is operated in discontinuous mode. The calibration data, referred to UTC(NIST), are transferred to TAI by a linear adjustment of [UTC - UTC(NIST)] over 80 days.

The standard NRC Cs VI C has been working as a clock since the end of 1979. The TAI calibrations result from a linear adjustment of [TAI-standard] over 60-day intervals.
The standards NRC Cs V , Cs VI A and Cs VI B were used as clock, from May 1975 until the end of 1992 for Cs V, from the end of 1979 until the end of 1992 for Cs VI A, and from the end of 1979 until the beginning of 1988 for Cs VI B. The calibration data have been transferred to TAI as for NRC Cs VI C.

The standard PTB CS1 was used as a frequency reference operating discontinuously until July 1978. Since then, it has been running as a clock, and the calibrations are obtained from linear adjustment of [TAI-standard] over 60 day intervals. The standard PTB CS2 runs as a clock. The data, starting from August 1986, have been used in the same way as those of PTB CS1.

The standards SU MCsR 101 and 102 provide the frequency of TA(SU) and UTC(SU). The transfer to TAI is made by averaging the frequency difference of TA(SU) and TAI over several months.

The LPTF optically pumped cesium frequency standard LPTF JPO, operates in discontinuous mode. The calibration data, referred to UTC(OP), are transferred to TAI by linear adjustment of [UTC - UTC(OP)] over 10 days.

TABLE 6. (CONT.)

Interval MJD	Central date	NRC CsV	NRC CsVIA	NRC CsVIB	NRC CsVIC	PTB CS1	PTB CS2
		f(TAI) - f(Standard) in 10^{-13}					
46789-46849	1987 Jan 24	-0.02	0.00	1.17	0.89	0.17	-0.04
46849-46909	1987 Mar 25	0.32	0.12	0.40	0.64	0.35	-0.10
46909-46969	1987 May 24	-0.99	-0.55	0.69	0.25	-0.03	-0.32
46969-47029	1987 Jul 23	-1.61	-1.01	0.37	-1.01	0.19	-0.37
47029-47099	1987 Sep 26	-1.51	-0.22	-0.46	-1.58	-0.19	-0.34
47099-47159	1987 Nov 30	-0.91	0.77	2.46	-1.14	0.02	-0.23
47159-47219	1988 Jan 29	1.71	2.70	-	0.18	-0.03	-0.15
47219-47279	1988 Mar 29	0.56	-0.22	-	-0.52	0.16	-0.21
47279-47339	1988 May 28	0.16	-0.84	-	-0.41	0.11	-0.24
47339-47399	1988 Jul 27	1.14	-2.02	-	-0.61	-0.20	-0.36
47399-47459	1988 Sep 25	-3.53	-3.09	-	-0.78	-0.18	-0.38
47459-47519	1988 Nov 24	-3.21	-3.87	-	-3.23	-0.13	-0.24
47519-47579	1989 Jan 23	-1.23	-2.83	-	-2.07	0.21	-0.13
47579-47639	1989 Mar 24	-0.36	-2.29	-	1.12	0.14	-0.28
47639-47699	1989 May 23	-1.07	-2.52	-	-1.76	-0.20	-0.41
47699-47769	1989 Jul 27	-3.77	-3.22	-	-1.33	-0.29	-0.53
47769-47829	1989 Sep 30	-3.17	-3.49	-	-2.27	-0.31	-0.41
47829-47889	1989 Nov 29	-3.43	-2.29	-	-0.96	-0.10	-0.34
47889-47949	1990 Jan 28	-2.84	-1.01	-	0.16	-0.08	-0.35
47949-48009	1990 Mar 29	0.59	-0.45	-	0.37	-0.08	-0.36
48009-48069	1990 May 28	1.82	0.15	-	-9.89	0.02	-0.27
48069-48129	1990 Jul 27	0.20	-0.25	-	-2.01	0.08	-0.13
48129-48189	1990 Sep 25	-1.04	0.00	-	-0.32	-0.01	-0.49
48189-48249	1990 Nov 24	-0.05	0.79	-	-0.61	-0.19	-0.10
48249-48309	1991 Jan 23	0.67	-1.38	-	-1.17	-0.20	-0.39
48309-48369	1991 Mar 24	1.07	2.01	-	-1.70	-0.22	-0.53
48369-48429	1991 May 23	0.79	2.52	-	-0.51	-0.08	-0.17
48429-48499	1991 Jul 27	0.23	1.22	-	-0.21	-0.01	-0.27
48499-48559	1991 Sep 30	-0.35	0.74	-	-0.49	-0.07	-0.36
48559-48619	1991 Nov 29	-1.06	1.25	-	0.06	-0.03	-0.17
48619-48679	1992 Jan 28	-0.95	1.56	-	-0.04	0.20	-0.04
48679-48739	1992 Mar 28	-1.33	2.03	-	0.00	0.09	-0.09
48739-48799	1992 May 27	-1.22	2.22	-	0.60	0.03	-0.26
48799-48859	1992 Jul 26	-0.76	2.06	-	1.46	0.15	-0.24
48859-48919	1992 Sep 24	0.55	1.45	-	2.02	0.09	-0.17
48919-48979	1992 Nov 23	-	-	-	2.03	-0.10	-0.01
48979-49039	1993 Jan 22	-	-	-	1.90	-0.04	0.03
49039-49099	1993 Mar 23	-	-	-	1.18	-0.12	0.11
49099-49159	1993 May 22	-	-	-	1.31	0.08	-0.07
49159-49229	1993 Jul 26	-	-	-	0.90	0.03	-0.04
49229-49289	1993 Sep 29	-	-	-	0.94	-0.07	-0.12
49289-49349	1993 Nov 28	-	-	-	1.26	0.23	-0.06

TABLE 6. (CONT.)

Interval MJD	Central date	CRL Cs1	NIST NBS6	SU MCsR 101	SU MCsR 102	LPTF JPO
		f(TAI) - f(Standard) in 10^{-13}				
46801-46816	1987 Jan 14				-2.94	
46859-46919	1987 Apr 5	0.73				
46886-46914	1987 Apr 14			-2.64		
46919-46941	1987 May 15			-2.34		
46947-46976	1987 Jun 15			-1.09		
46959-47019	1987 Jul 13		1.64			
46977-46998	1987 Jul 11			-1.92		
47061-47063	1987 Sep 24			-2.42		
47083-47097	1987 Oct 21				-2.26	
47098-47124	1987 Nov 13				-2.26	
47130-47150	1987 Dec 11				-2.66	
47164-47173	1988 Jan 9				-2.63	
47215-47222	1988 Feb 28			-2.55		
47256-47278	1988 Apr 16				-2.13	
47286-47288	1988 May 6				-2.33	
47354-47361	1988 Jul 16				-2.23	
47416-47433	1988 Sep 20				-2.43	
47437-47439	1988 Oct 4				-2.36	
47949-48009	1990 Apr 5	0.19				
48499-48559	1991 Sep 27	-0.13				
48949-49009	1992 Dec 23	0.26				
49119-49129	1993 May 17					-1.16

Table 7. Mean duration of the TAI scale interval in SI second on the rotating geoid

(File available via INTERNET under the name SITAI93.AR)

The estimate of the mean duration of the TAI scale interval in SI second on the rotating geoid, is computed by the BIPM according to the method described in ' Azoubib J., Granveaud M., Guinot B., Metrologia 13, 1977, pp. 87-93 ' and is based on the calibrations of Table 6.
In the BIH Annual Reports from 1984 to 1987, the uncertainty was conservatively estimated to 5×10^{-14} since 1979. In the table below, the uncertainty is strictly the output of the computation and is based on the uncertainties reported by the laboratories.

For the months	Mean duration	Uncertainty
1987 Jan - Feb	$1 - 0.4 \times 10^{-14}$	1.3×10^{-14}
1987 Mar - Apr	- 0.1	1.3
1987 May - Jun	+ 2.1	1.3
1987 Jul - Aug	+ 2.6	1.3
1987 Sep - Oct	+ 2.7	1.3
1987 Nov - Dec	+ 1.5	1.3
1988 Jan - Feb	$1 + 0.9 \times 10^{-14}$	1.3×10^{-14}
1988 Mar - Apr	+ 1.0	1.3
1988 May - Jun	+ 1.5	1.3
1988 Jul - Aug	+ 2.6	1.3
1988 Sep - Oct	+ 3.0	1.3
1988 Nov - Dec	+ 2.7	1.3
1989 Jan - Feb	$1 + 0.8 \times 10^{-14}$	1.3×10^{-14}
1989 Mar - Apr	+ 1.9	1.3
1989 May - Jun	+ 3.5	1.3
1989 Jul - Aug	+ 4.5	1.3
1989 Sep - Oct	+ 3.8	1.3
1989 Nov - Dec	+ 3.0	1.3
1990 Jan - Feb	$1 + 2.9 \times 10^{-14}$	1.3×10^{-14}
1990 Mar - Apr	+ 2.8	1.3
1990 May - Jun	+ 1.9	1.3
1990 Jul - Aug	+ 1.1	1.3
1990 Sep - Oct	+ 3.3	1.3
1990 Nov - Dec	+ 1.2	1.3
1991 Jan - Feb	$1 + 3.2 \times 10^{-14}$	1.3×10^{-14}
1991 Mar - Apr	+ 4.2	1.3
1991 May - Jun	+ 1.6	1.3
1991 Jul - Aug	+ 2.3	1.3
1991 Sep - Oct	+ 2.9	1.3
1991 Nov - Dec	+ 1.0	1.3
1992 Jan - Feb	$1 + 0.1 \times 10^{-14}$	1.3×10^{-14}
1992 Mar - Apr	+ 0.6	1.3
1992 May - Jun	+ 1.9	1.3
1992 Jul - Aug	+ 1.6	1.3
1992 Sep - Oct	+ 1.1	1.3
1992 Nov - Dec	+ 0.1	1.3
1993 Jan - Feb	$1 - 0.4 \times 10^{-14}$	1.3×10^{-14}
1993 Mar - Apr	- 0.9	1.3
1993 May - Jun	+ 0.2	1.3
1993 Jul - Aug	+ 0.2	1.3
1993 Sep - Oct	+ 0.8	1.3
1993 Nov - Dec	+ 0.0	1.3

TABLE 8 - INDEPENDENT LOCAL ATOMIC TIME SCALES

(File available via INTERNET under the name TAI93.AR)

The following table gives the values of [TAI - TA(k)], where TA(k) denotes the independent atomic time scale established by laboratory k. The values are given within ± 1 ns for the most accurate time links.
Corresponding stability graphs are shown on the following pages when data is available for the whole year 1993.

Unit is one microsecond.

Date 1993 0h UTC	MJD	TAI - TA(k) APL	AUS	CH	CRL *	CSAO
Jan 2	48989	1.252	-43.930	-75.118	19.192	20.623
Jan 12	48999	1.257	-43.921	-75.200	19.544	20.575
Jan 22	49009	1.302	-44.078	-75.291	19.890	20.456
Feb 1	49019	1.355	-44.290	-75.381	20.237	20.341
Feb 11	49029	1.398	-44.426	-75.470	20.595	20.265
Feb 21	49039	1.427	-44.561	-75.560	20.945	20.194
Mar 3	49049	1.474	-44.663	-75.627	21.293	20.091
Mar 13	49059	1.540	-44.825	-75.701	21.659	20.066
Mar 23	49069	1.582	-44.937	-75.781	22.009	19.919
Apr 2	49079	1.582	-45.114	-75.853	22.370	19.787
Apr 12	49089	1.613	-45.193	-75.929	22.733	19.763
Apr 22	49099	1.610	-45.340	-76.001	23.100	19.715
May 2	49109	1.602	-45.515	-76.064	23.460	19.601
May 12	49119	1.596	-45.671	-76.116	23.822	19.513
May 22	49129	1.618	-45.762	-76.155	24.175	19.436
Jun 1	49139	1.712	-45.994	-76.192	24.539	19.355
Jun 11	49149	1.774	-46.129	-76.247	24.892	19.272
Jun 21	49159	1.724	-46.342	-76.291	25.290	19.106
Jul 1	49169	1.742	-46.441	-76.320	25.645	18.994
Jul 11	49179	1.723	-46.537	-76.366	26.056	18.888
Jul 21	49189	1.697	-46.694	-76.389	26.445	18.744
Jul 31	49199	1.654	-46.905	-76.418	26.824	18.590
Aug 10	49209	1.704	-47.046	-76.438	27.318	18.444
Aug 20	49219	1.774	-47.244	-76.443	27.729	18.267
Aug 30	49229	1.842	-47.487	-76.455	28.136	18.062
Sep 9	49239	1.911	-47.613	-76.457	28.537	17.898
Sep 19	49249	1.986	-47.806	-76.464	28.958	17.941
Sep 29	49259	2.061	-47.943	-76.477	29.366	17.609
Oct 9	49269	2.156	-48.148	-76.476	29.774	17.500
Oct 19	49279	2.231	-48.325	-76.478	30.190	17.326
Oct 29	49289	2.300	-48.531	-76.469	30.582	17.187
Nov 8	49299	2.374	-48.723	-76.432	30.980	17.080
Nov 18	49309	2.447	-48.883	-76.401	31.349	16.771
Nov 28	49319	2.462	-49.074	-76.397	31.723	16.637
Dec 8	49329	2.481	-49.223	-76.391	32.082	16.497
Dec 18	49339	2.506	-49.302	-76.368	32.481	16.336
Dec 28	49349	2.540	-49.413	-76.351	32.895	16.152

* Apparent time step of TAI-TA(CRL) of 84 ns between MJD = 49199 and MJD = 49209 due to the recalibration of the GPS time link.

TABLE 8. (CONT.)

Unit is one microsecond.

Date 1993 0h UTC	MJD	TAI - TA(k) F	INPL	JATC	KRIS	NIM
Jan 2	48989	110.633	-114.663	4.352	-0.458	-9.64
Jan 12	48999	111.029	-116.341	4.419	-0.534	-9.66
Jan 22	49009	111.416	-118.054	4.681	-0.619	-9.59
Feb 1	49019	111.819	-119.749	4.982	-0.727	-9.66
Feb 11	49029	112.235	-121.477	5.235	-0.882	-9.68
Feb 21	49039	112.622	-123.230	5.570	-1.004	-9.61
Mar 3	49049	113.023	-124.986	5.898	-1.196	-9.53
Mar 13	49059	113.392	-126.736	6.368	-1.371	-9.56
Mar 23	49069	113.799	-128.507	6.576	-1.641	-9.49
Apr 2	49079	114.195	-130.269	7.037	-1.754	-9.52
Apr 12	49089	114.598	-132.032	7.696	-1.950	-9.54
Apr 22	49099	114.977	-133.823	8.423	-2.279	-9.57
May 2	49109	115.355	-135.622	8.840	-2.568	-9.48
May 12	49119	115.756	-137.397	9.188	-2.931	-9.59
May 22	49129	116.150	-139.133	9.531	-3.287	-9.62
Jun 1	49139	116.540	-140.880	9.420	-3.689	-9.64
Jun 11	49149	116.896	-142.609	9.249	-4.090	-9.61
Jun 21	49159	117.260	-144.302	8.824	-4.428	-9.60
Jul 1	49169	117.647	-145.994	8.230	-4.766	-9.66
Jul 11	49179	118.016	-147.659	8.119	-5.024	-9.60
Jul 21	49189	118.396	-149.332	8.046	-5.314	-9.60
Jul 31	49199	118.758	-151.017	8.124	-5.608	-9.49
Aug 10	49209	119.116	-152.706	7.827	-5.863	-9.53
Aug 20	49219	119.484	-154.373	7.997	-5.927	-9.60
Aug 30	49229	119.847	-156.098	8.525	-5.947	-9.59
Sep 9	49239	120.214	-157.808	9.013	-6.058	-9.63
Sep 19	49249	120.585	-159.541	9.144	-6.133	-9.53
Sep 29	49259	120.956	-161.294	9.295	-6.215	-9.46
Oct 9	49269	121.335	-163.069	9.439	-6.296	-9.44
Oct 19	49279	121.728	-164.831	9.648	-6.188	-9.51
Oct 29	49289	122.111	-166.577	9.376	-6.024	-9.40
Nov 8	49299	122.498	-168.343	9.365	-5.886	-9.46
Nov 18	49309	122.878	-170.117	9.085	-5.823	-9.52
Nov 28	49319	123.261	-171.907	8.786	-5.564	-9.17
Dec 8	49329	123.650	-173.701	8.563	-5.374	-8.91
Dec 18	49339	124.034	-175.514	8.512	-5.166	-8.89
Dec 28	49349	124.411	-177.342	8.480	-5.006	-8.94

TABLE 8. (CONT.)

Unit is one microsecond.

Date 1993 0h UTC	MJD	TAI - TA(k) NISA *	NIST	NRC	PTB
Jan 2	48989	-45094.634	-45204.353	16.742	-360.571
Jan 12	48999	-45094.991	-45204.968	16.919	-360.566
Jan 22	49009	-45095.332	-45205.567	17.088	-360.570
Feb 1	49019	-45095.682	-45206.175	17.268	-360.558
Feb 11	49029	-45096.033	-45206.787	17.431	-360.560
Feb 21	49039	-45096.384	-45207.398	17.546	-360.560
Mar 3	49049	-45096.732	-45208.009	17.662	-360.548
Mar 13	49059	-45097.086	-45208.625	17.761	-360.544
Mar 23	49069	-45097.439	-45209.241	17.878	-360.531
Apr 2	49079	-45097.796	-45209.863	17.969	-360.516
Apr 12	49089	-45098.149	-45210.480	18.070	-360.509
Apr 22	49099	-45098.506	-45211.098	18.159	-360.510
May 2	49109	-45098.866	-45211.719	18.267	-360.512
May 12	49119	-45099.220	-45212.324	18.394	-360.521
May 22	49129	-45099.578	-45212.946	18.518	-360.517
Jun 1	49139	-45099.940	-45213.577	18.630	-360.514
Jun 11	49149	-45100.311	-45214.210	18.743	-360.537
Jun 21	49159	-45100.687	-45214.851	18.821	-360.547
Jul 1	49169	-45101.043	-45215.472	18.924	-360.548
Jul 11	49179	-45101.413	-45216.105	19.021	-360.560
Jul 21	49189	-45101.774	-45216.729	19.094	-360.550
Jul 31	49199	-45102.138	-45217.355	19.167	-360.544
Aug 10	49209	-45102.509	-45217.991	19.253	-360.553
Aug 20	49219	-45102.884	-45218.628	19.315	-360.564
Aug 30	49229	-45103.261	-45219.266	19.372	-360.582
Sep 9	49239	-45103.643	-45219.914	19.434	-360.593
Sep 19	49249	-45104.023	-45220.559	19.511	-360.600
Sep 29	49259	-45104.397	-45221.201	19.591	-360.619
Oct 9	49269	-45104.777	-45221.848	19.672	-360.627
Oct 19	49279	-45105.153	-45222.487	19.758	-360.630
Oct 29	49289	-45105.533	-45223.128	19.861	-360.642
Nov 8	49299	-45105.912	-	19.965	-360.653
Nov 18	49309	-45106.280	-	20.065	-360.652
Nov 28	49319	-45106.657	-	20.194	-360.659
Dec 8	49329	-45107.030	-	20.311	-360.674
Dec 18	49339	-45107.405	-	20.420	-360.672
Dec 28	49349	-45107.782	-	20.496	-360.670

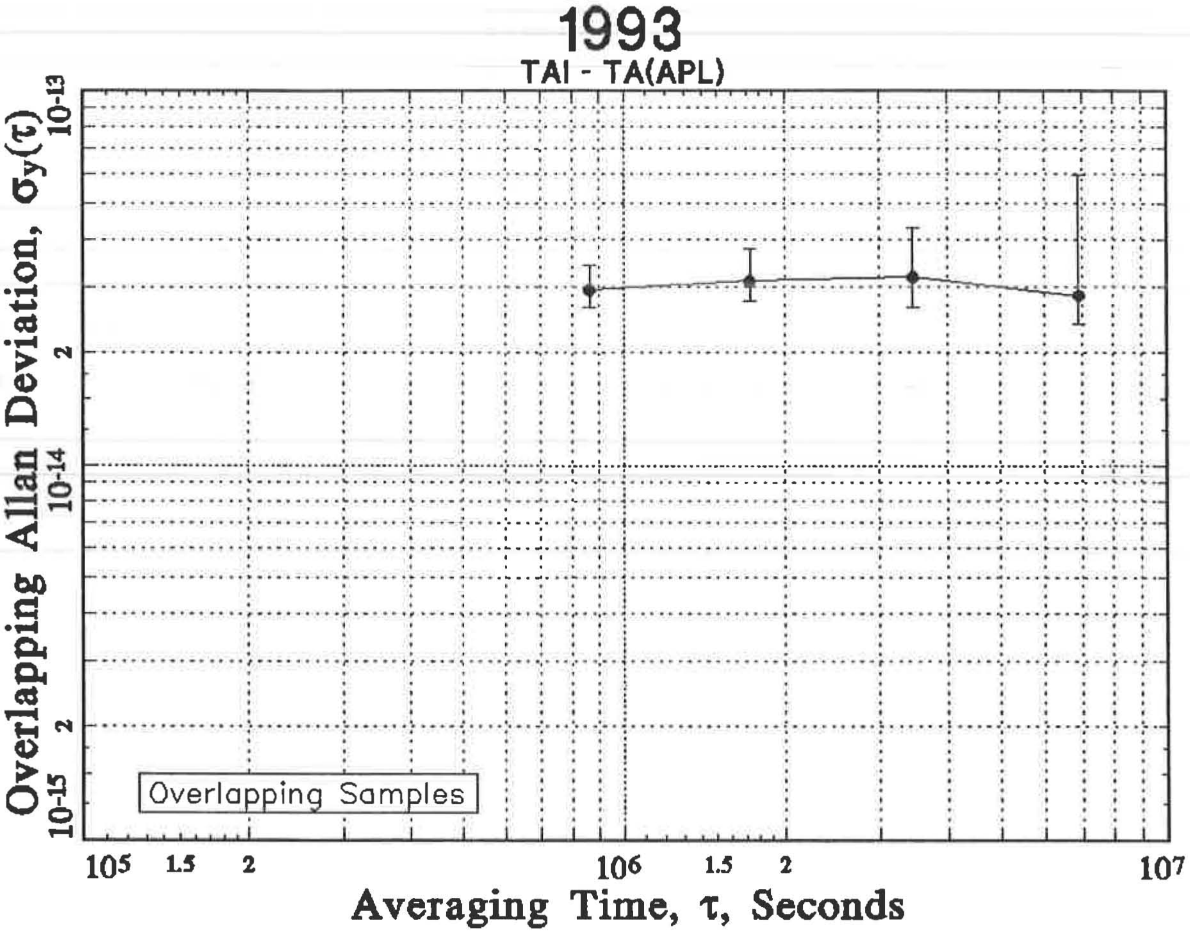
* TA(NISA) designates the scale AT1 of NIST.

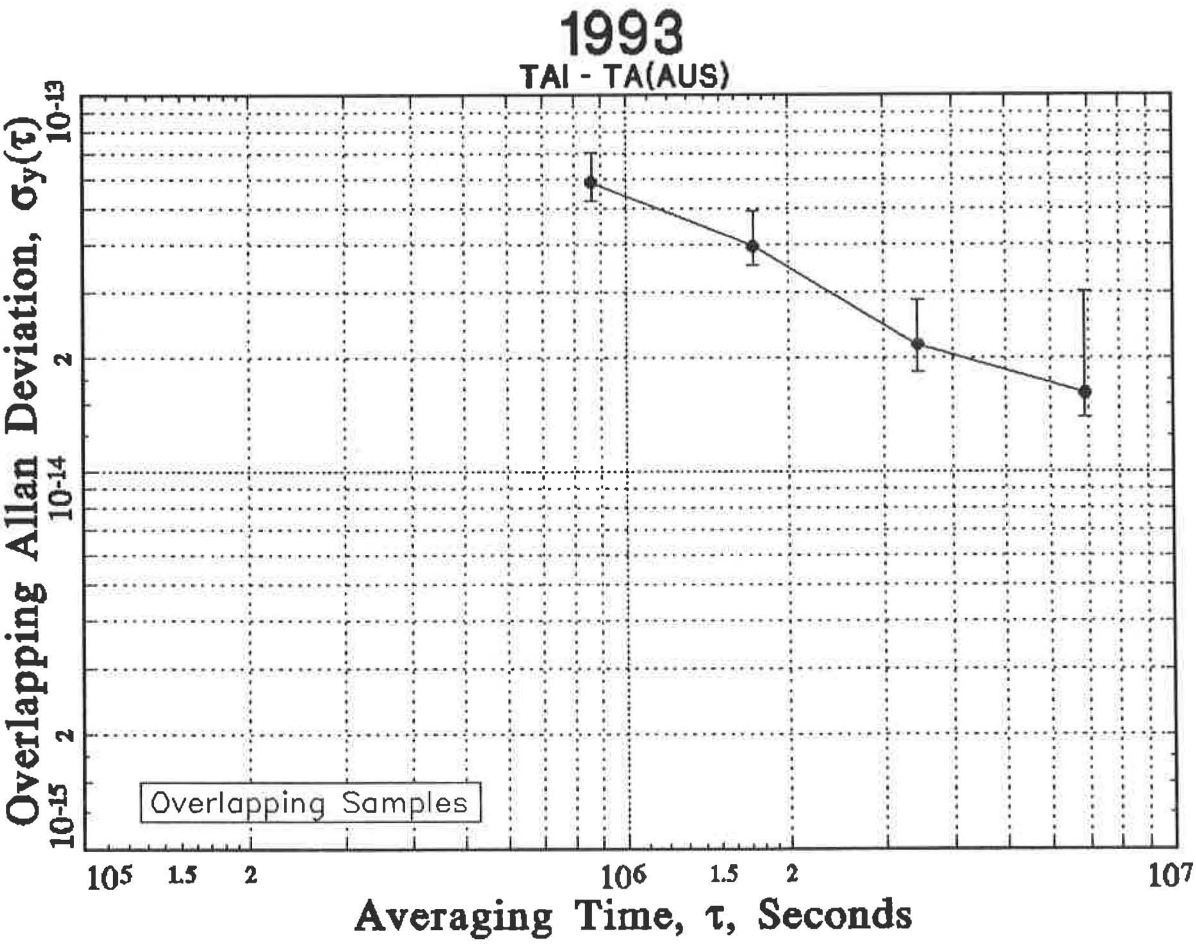
TABLE 8. (CONT.)

Unit is one microsecond.

Date 1993 0h UTC	MJD	TAI - TA(k) RC	SO	SU	USNO *
Jan 2	48989	17999683.10	-45.38	2827250.736	-34665.225
Jan 12	48999	17999682.89	-45.48	2827250.650	-34665.902
Jan 22	49009	17999682.77	-45.48	2827250.566	-34666.563
Feb 1	49019	17999682.69	-45.40	2827250.489	-34667.227
Feb 11	49029	17999682.31	-45.53	2827250.414	-34667.905
Feb 21	49039	17999682.01	-45.48	2827250.328	-34668.580
Mar 3	49049	17999681.75	-45.34	2827250.238	-34669.250
Mar 13	49059	17999681.44	-45.19	2827250.151	-34669.936
Mar 23	49069	17999681.25	-45.39	2827250.077	-34670.610
Apr 2	49079	17999680.96	-45.48	2827249.998	-34671.286
Apr 12	49089	17999681.09	-45.43	2827249.909	-34671.955
Apr 22	49099	17999680.89	-45.24	2827249.821	-34672.631
May 2	49109	17999680.51	-45.27	2827249.730	-34673.309
May 12	49119	17999680.09	-45.32	2827249.651	-34673.983
May 22	49129	17999679.69	-45.32	2827249.557	-34674.662
Jun 1	49139	17999679.19	-45.26	2827249.475	-34675.345
Jun 11	49149	17999678.85	-45.21	2827249.366	-34676.038
Jun 21	49159	17999678.57	-45.22	2827249.267	-34676.729
Jul 1	49169	-	-45.39	2827249.175	-34677.406
Jul 11	49179	-	-45.52	2827249.074	-34678.091
Jul 21	49189	-	-45.52	2827248.983	-34678.771
Jul 31	49199	-	-45.42	2827248.883	-34679.456
Aug 10	49209	-	-45.44	2827248.786	-34680.144
Aug 20	49219	-	-45.44	2827248.691	-34680.837
Aug 30	49229	-	-45.52	2827248.583	-34681.529
Sep 9	49239	-	-45.60	2827248.475	-34682.224
Sep 19	49249	-	-45.61	2827248.374	-34682.915
Sep 29	49259	-	-45.60	2827248.268	-34683.608
Oct 9	49269	-	-45.68	2827248.168	-34684.284
Oct 19	49279	-	-45.60	2827248.072	-34684.966
Oct 29	49289	-	-45.55	2827247.975	-34685.657
Nov 8	49299	-	-45.52	2827247.883	-34686.346
Nov 18	49309	17999674.32	-45.57	2827247.790	-34687.022
Nov 28	49319	17999674.01	-45.45	2827247.697	-34687.704
Dec 8	49329	17999673.53	-45.42	2827247.607	-34688.382
Dec 18	49339	17999673.60	-45.45	2827247.516	-34689.061
Dec 28	49349	17999673.40	-45.38	2827247.420	-34689.743

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


1993
TAI - TA(APL)
Overlapping Allan Deviation, σy(τ)
10-13
2
10-14
2
10-15
Overlapping Samples
105
1.5
2
106
1.5
2
107
Averaging Time, τ, Seconds


1993
TAI - TA(AUS)
Overlapping Allan Deviation, σy(τ)
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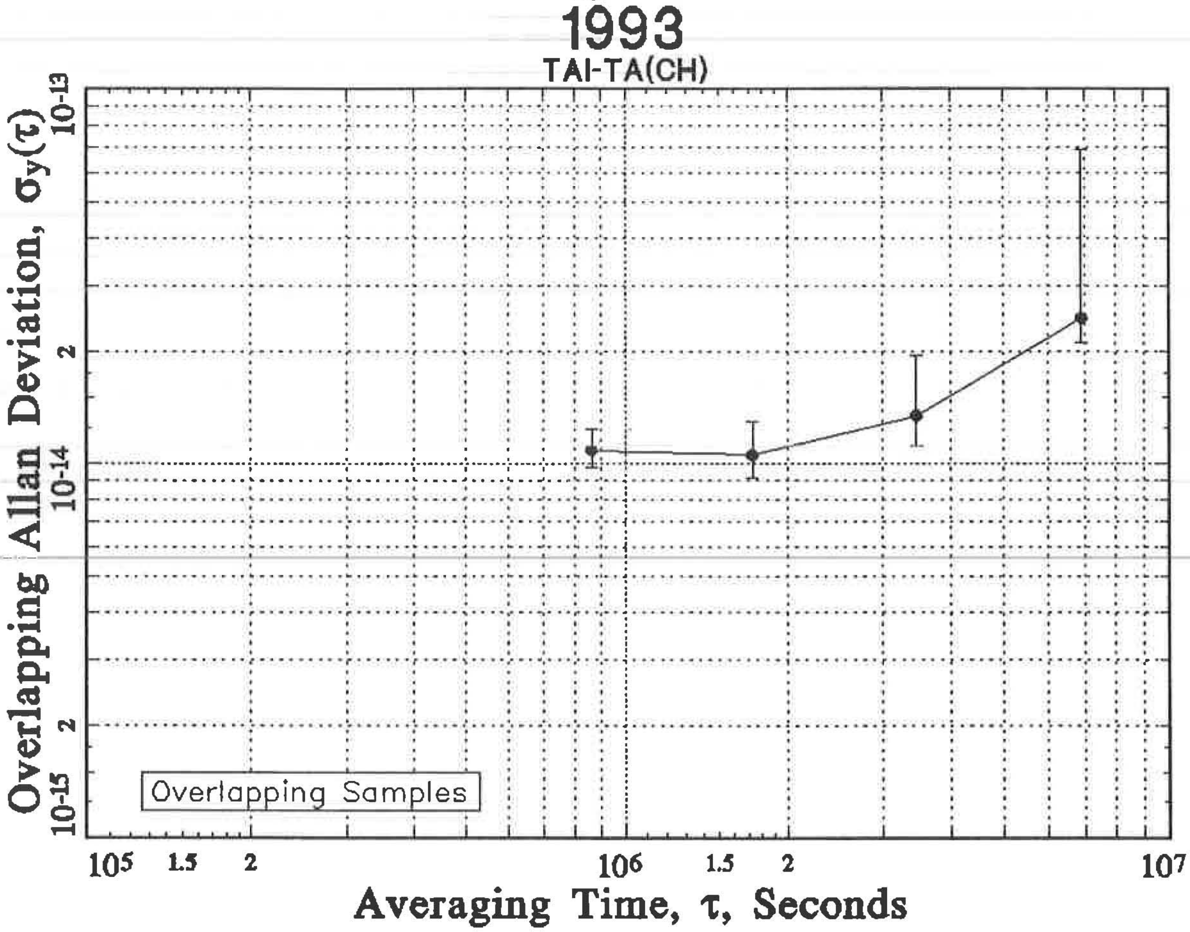
2
10-14
2
10-15
Overlapping Samples
105
1.5
2
106
1.5
2
107
Averaging Time, τ, Seconds


1993
TAI-TA(CH)
Overlapping Allan Deviation, σy(τ)
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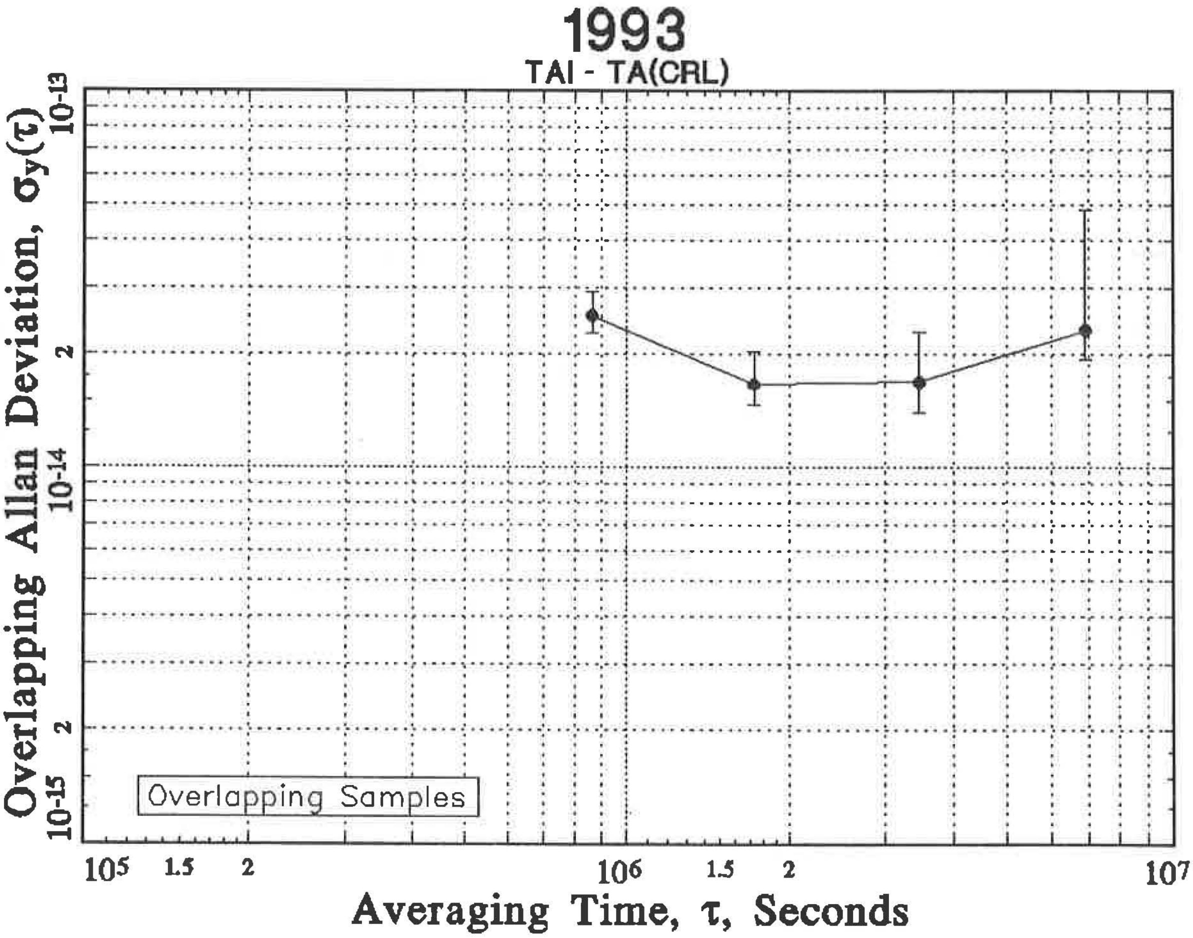
2
10-14
2
10-15
Overlapping Samples
105
1.5
2
106
1.5
2
107
Averaging Time, τ, Seconds


1993
TAI - TA(CRL)
Overlapping Allan Deviation, σy(τ)
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2
10-14
2
10-15
Overlapping Samples
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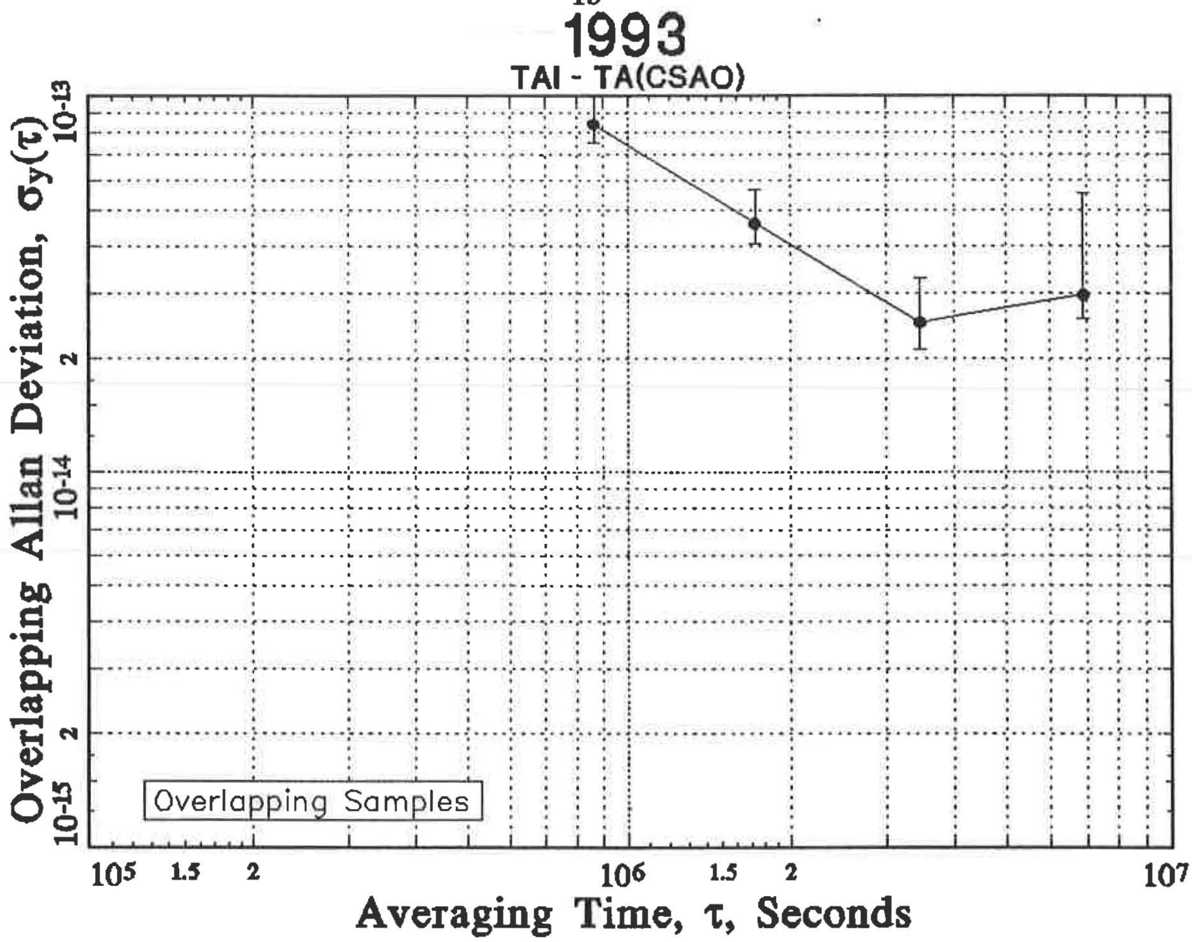
1.5
2
106
1.5
2
107
Averaging Time, τ, Seconds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TAI - TA(CSAO)
Overlapping Allan Deviation, $\sigma_y(\tau)$
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2
10^{-14}
2
10^{-15}
Overlapping Samples
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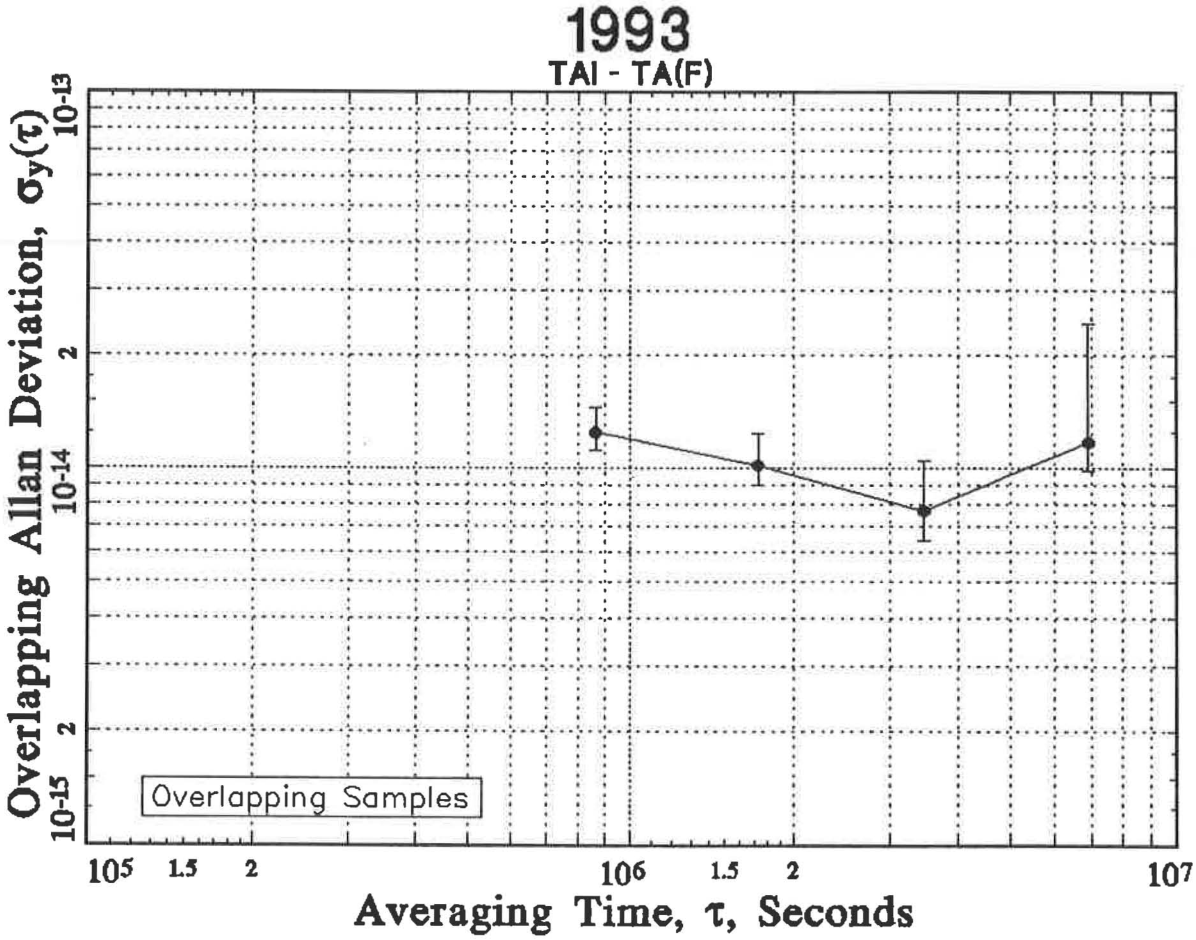
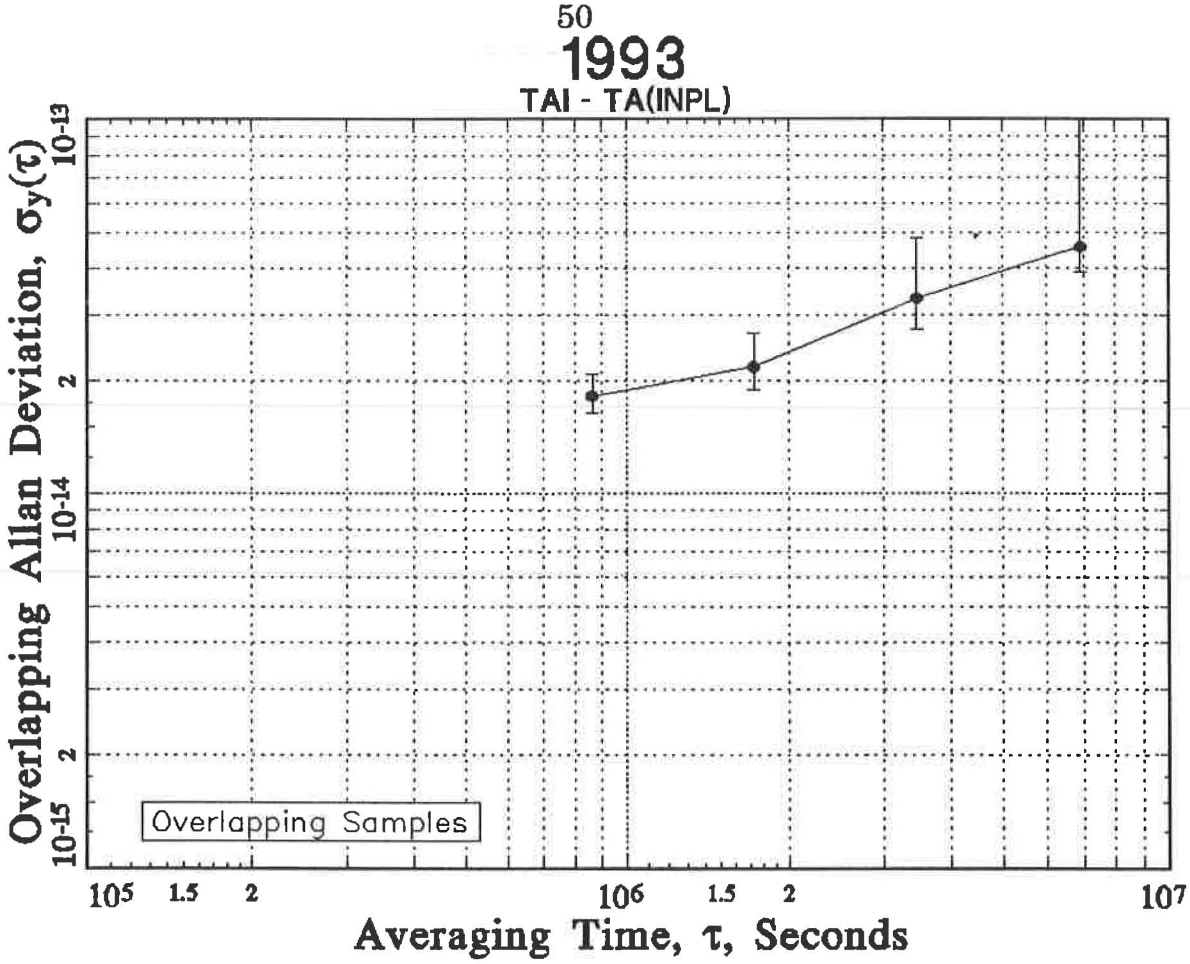
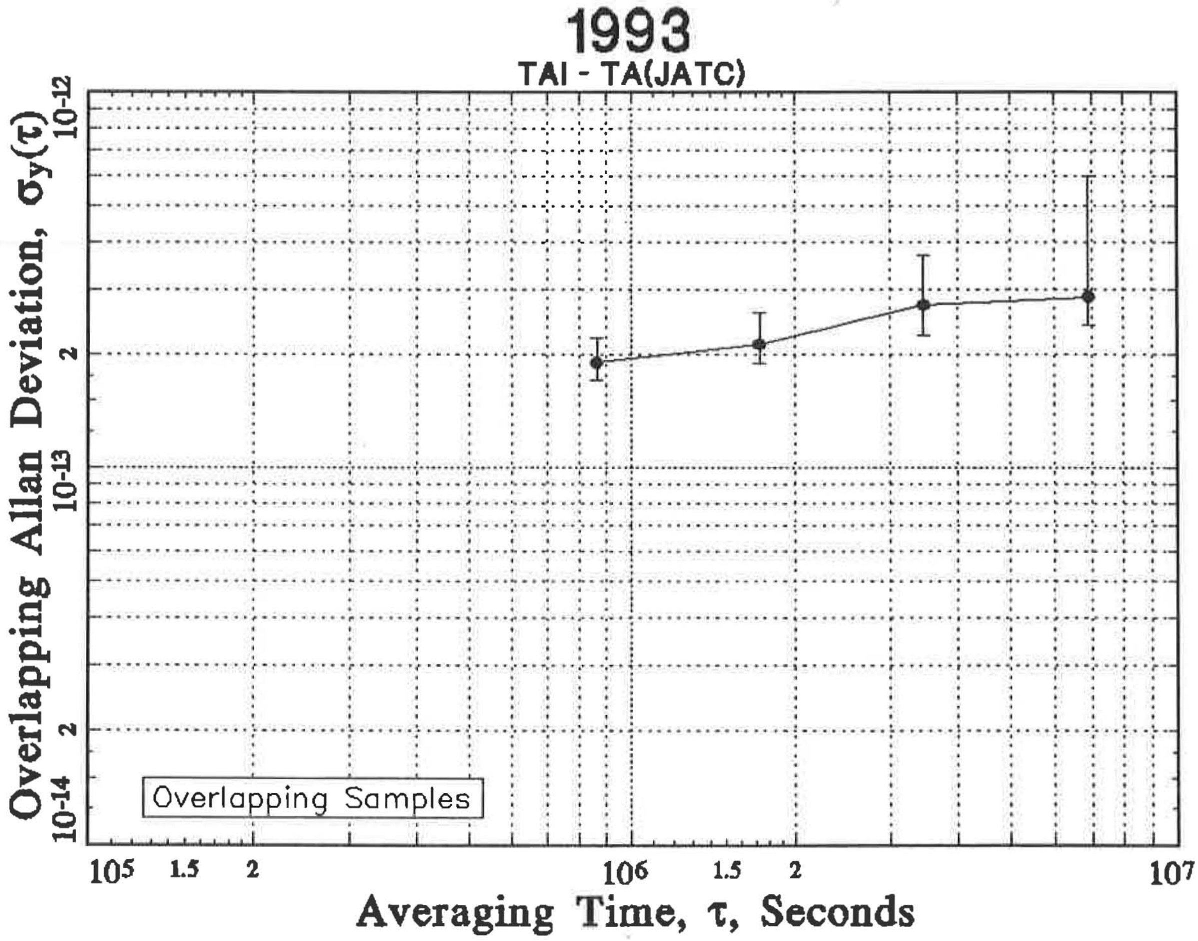
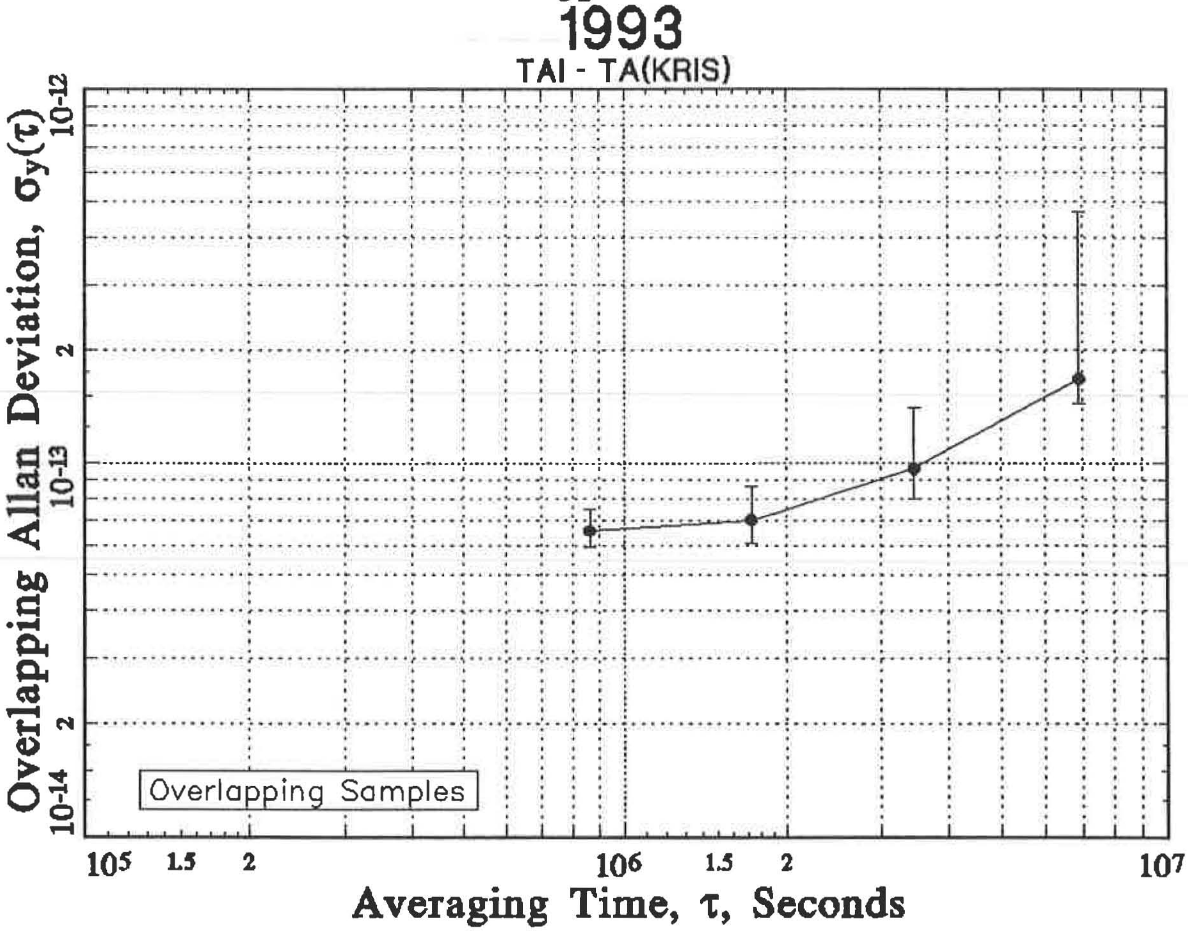
1.5
2
10^6
1.5
2
10^7
Averaging Time, τ, Seconds


1993
TAI - TA(F)
Overlapping Allan Deviation, $\sigma_y(\tau)$
10^{-13}
2
10^{-14}
2
10^{-15}
Overlapping Samples
10^5
1.5
2
10^6
1.5
2
10^7
Averaging Time, τ, Seconds


1993
TAI - TA(INPL)
Overlapping Allan Deviation, $\sigma_y(\tau)$
10-13
2
10-14
2
10-15
Overlapping Samples
105
1.5
2
106
1.5
2
107
Averaging Time, τ, Seconds


1993
TAI - TA(JATC)
Overlapping Allan Deviation, $\sigma_y(\tau)$
10-12
2
10-13
2
10-14
Overlapping Samples
105
1.5
2
106
1.5
2
107
Averaging Time, τ, Seconds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TAI - TA(KRIS)
Overlapping Allan Deviation, σy(τ)
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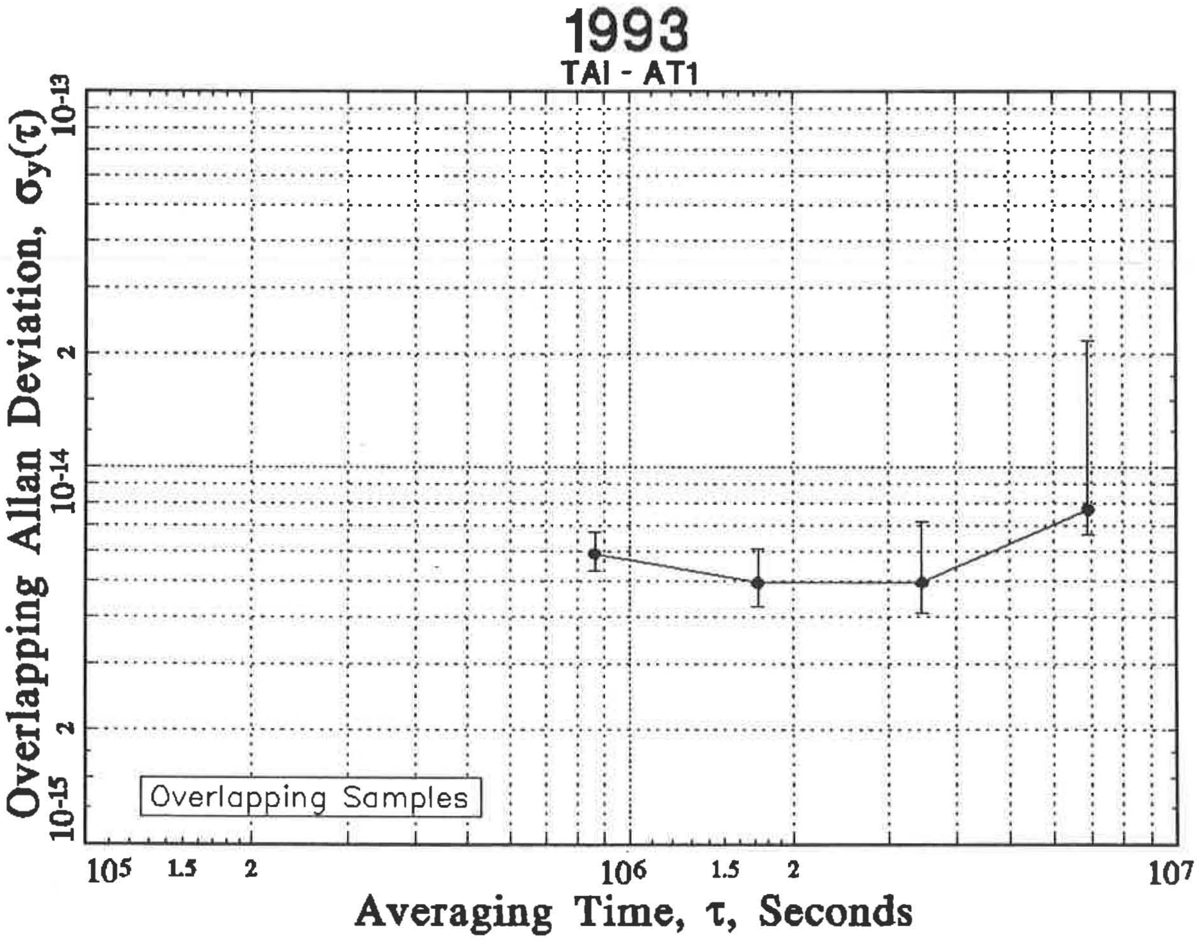
10-13
2
10-14
Overlapping Samples
105
1.5
2
106
1.5
2
107
Averaging Time, τ, Seconds


1993
TAI - AT1
Overlapping Allan Deviation, σy(τ)
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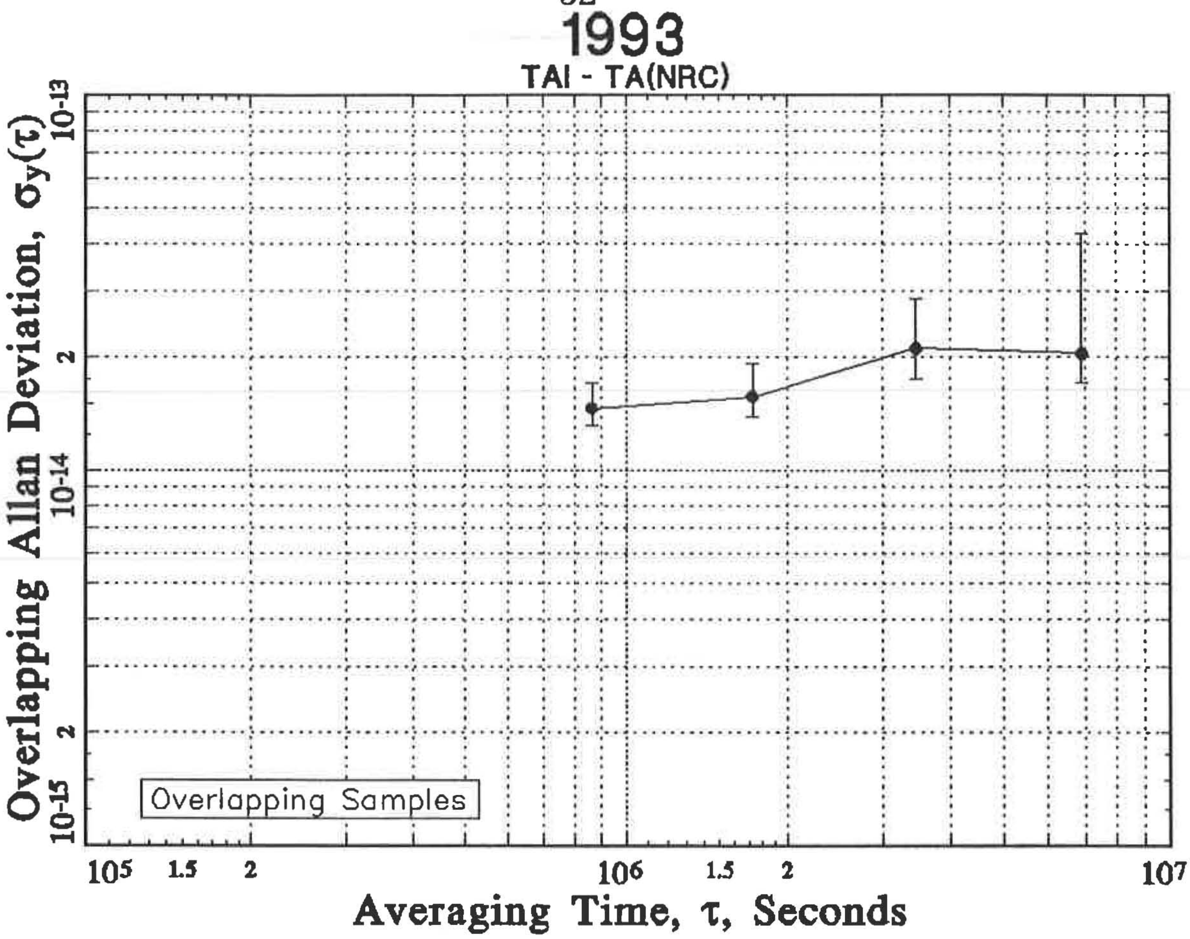
2
10-14
2
10-15
Overlapping Samples
105
1.5
2
106
1.5
2
107
Averaging Time, τ, Seconds


1993
TAI - TA(NRC)
Overlapping Allan Deviation, $\sigma_y(\tau)$
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10-14
2
10-15
Overlapping Samples
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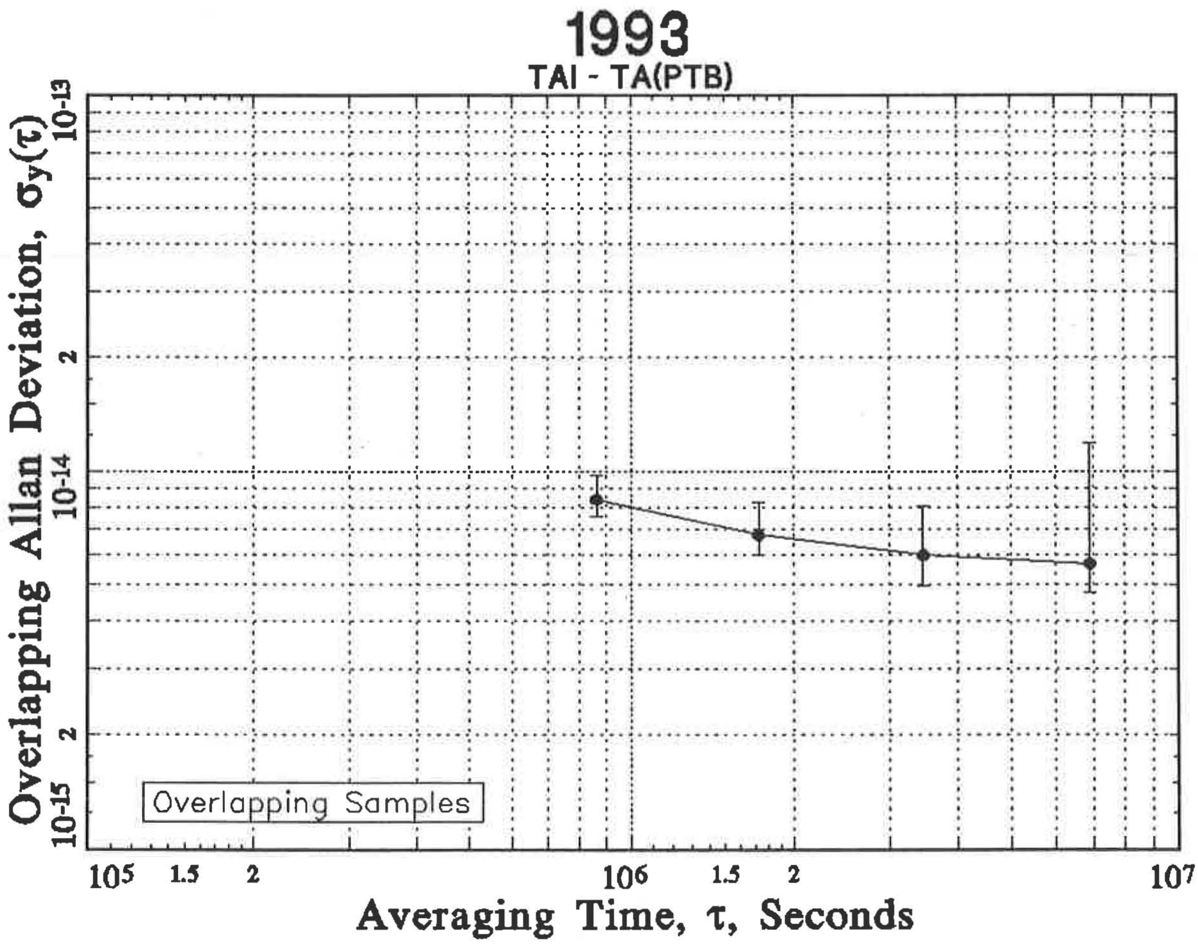
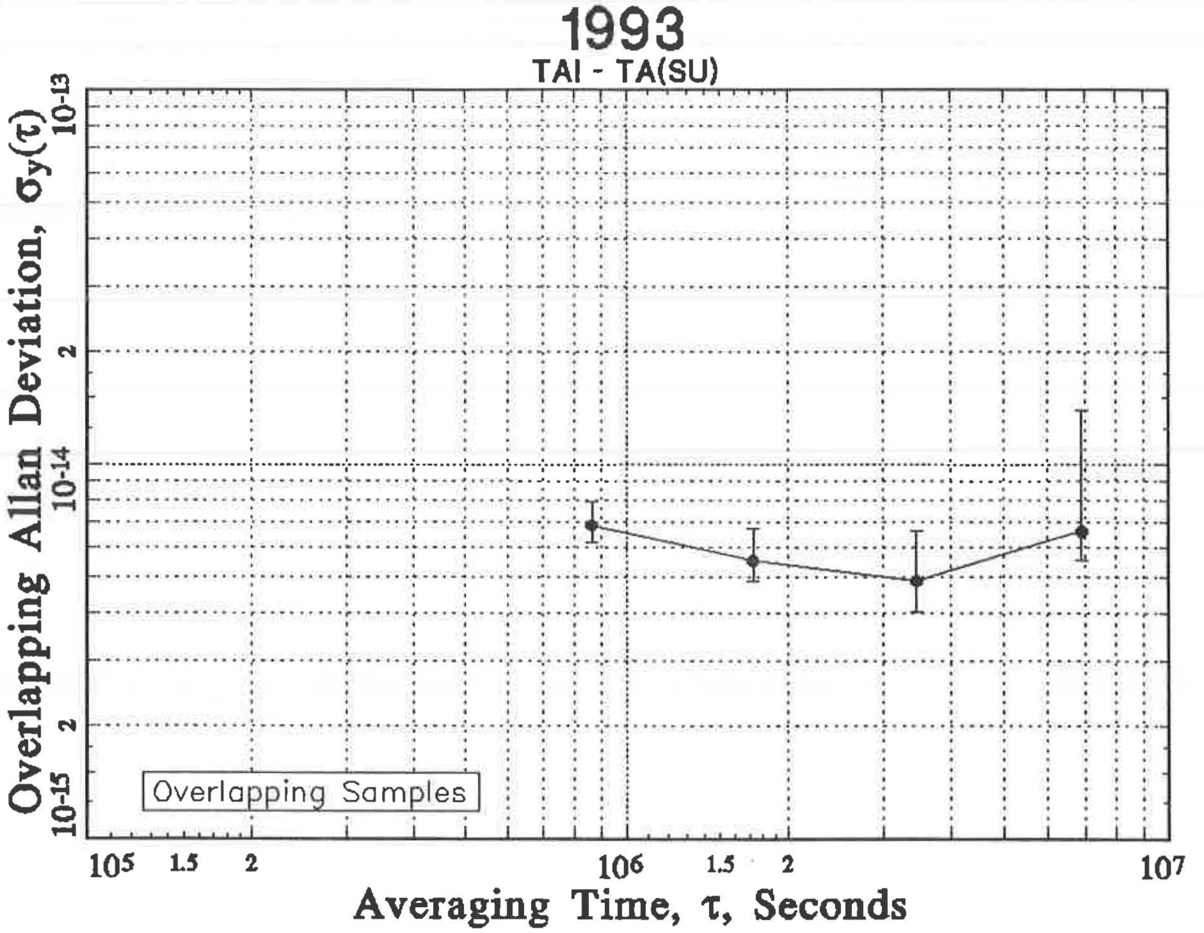
1.5
2
106
1.5
2
107
Averaging Time, τ, Seconds


1993
TAI - TA(PTB)
Overlapping Allan Deviation, $\sigma_y(\tau)$
10-13
2
10-14
2
10-15
Overlapping Samples
105
1.5
2
106
1.5
2
107
Averaging Time, τ, Seconds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TAI - TA(SU)
Overlapping Allan Deviation, $\sigma_y(\tau)$
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2
10^{-14}
2
10^{-15}
Overlapping Samples
10^5
1.5
2
10^6
1.5
2
10^7
Averaging Time, τ, Seconds

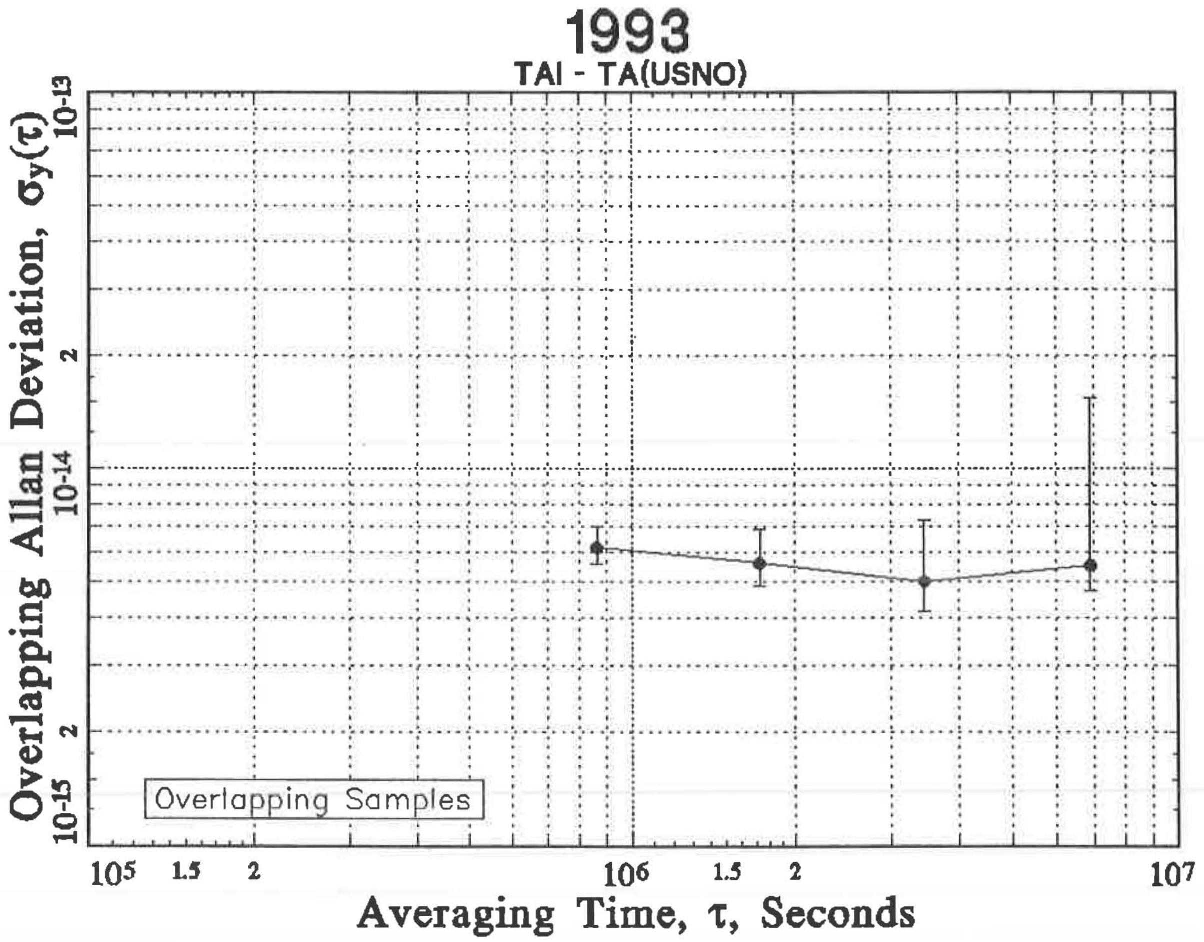
1993
TAI - TA(USNO)
Overlapping Allan Deviation, $\sigma_y(\tau)$
10^{-13}
2
10^{-14}
2
10^{-15}
Overlapping Samples
10^5
1.5
2
10^6
1.5
2
10^7
Averaging Time, τ, Seconds

TABLE 9A. LOCAL REPRESENTATIONS OF UTC : VALUES OF [UTC - UTC(k)]

(File available via INTERNET under the name UTC93.AR)

The following table gives the values of [UTC - UTC(k)], where UTC(k) denotes the approximation to UTC kept by laboratory k. The values are given within ± 1 ns for the most accurate time links.

Unit is one microsecond.

Date 1993 0h UTC	MJD	UTC - UTC(k) AOS (1)	APL	AUS	BEV (2)	CAO (3)	CH
Jan 2	48989	0.877	-0.211	-0.020	2.78	-26.730	-0.231
Jan 12	48999	1.295	-0.206	-0.015	1.34	-27.187	-0.228
Jan 22	49009	1.832	-0.161	0.011	0.17	-27.585	-0.232
Feb 1	49019	1.717	-0.108	0.035	-	-27.986	-0.239
Feb 11	49029	2.644	-0.065	0.032	-4.92	-28.405	-0.245
Feb 21	49039	2.587	-0.036	0.030	-6.09	-28.762	-0.250
Mar 3	49049	2.299	0.011	0.031	-7.20	-29.135	-0.239
Mar 13	49059	1.470	0.077	0.025	-8.42	-29.536	-0.230
Mar 23	49069	0.993	0.119	0.016	-9.34	-29.884	-0.231
Apr 2	49079	0.204	0.119	0.006	-10.13	-30.298	-0.222
Apr 12	49089	-0.566	0.150	0.006	-11.02	-30.685	-0.216
Apr 22	49099	-0.542	0.147	-0.006	7.99	-31.029	-0.206
May 2	49109	-0.448	0.139	-0.015	6.88	-31.367	-0.182
May 12	49119	-0.279	0.133	-0.021	5.80	-31.760	-0.145
May 22	49129	-0.554	0.155	-0.028	4.80	-32.155	-0.093
Jun 1	49139	-0.505	0.249	-0.038	3.81	-32.407	-0.041
Jun 11	49149	-0.622	0.311	-0.060	2.77	-32.656	-0.004
Jun 21	49159	-0.748	0.261	-0.076	1.75	-32.917	0.044
Jul 1	49169	-0.815	0.279	-0.082	0.81	-33.240	0.106
Jul 11	49179	-0.893	0.260	-0.095	-0.21	-0.361	0.148
Jul 21	49189	-1.137	0.234	-0.098	-1.29	-0.677	0.213
Jul 31	49199	-1.423	0.191	-0.101	-	-0.979	0.275
Aug 10	49209	-1.832	0.241	-0.105	-3.48	-	0.343
Aug 20	49219	-0.959	0.311	-0.094	-4.57	-1.765	0.397
Aug 30	49229	-1.385	0.379	-0.083	-5.83	-2.073	0.425
Sep 9	49239	-1.537	0.448	-0.076	-7.06	-2.280	0.463
Sep 19	49249	-1.431	0.523	-0.067	-8.16	-2.568	0.496
Sep 29	49259	-1.338	0.598	-0.061	-9.40	-2.773	0.523
Oct 9	49269	-1.279	0.693	-0.042	-10.68	-3.041	0.564
Oct 19	49279	-1.154	0.768	-0.036	-11.99	-3.317	0.602
Oct 29	49289	-1.140	0.837	-0.030	-13.20	-3.567	0.651
Nov 8	49299	-1.133	0.911	-0.018	-14.36	-3.805	0.728
Nov 18	49309	-1.247	0.984	0.005	-15.47	-4.056	0.799
Nov 28	49319	-1.131	0.999	0.023	-16.40	-4.233	0.843
Dec 8	49329	-1.079	1.018	0.038	-17.93	-4.435	0.889
Dec 18	49339	-1.177	1.043	0.052	10.70	-4.666	0.952
Dec 28	49349	-1.267	1.077	0.058	9.64	-4.846	1.009

TABLE 9A. (CONT.)

Unit is one microsecond.

Date 1993 0h UTC	MJD	UTC - UTC(k) CRL (4)	CSAO	CSIR (5)	FTZ (6)	IEN	IFAG
Jan 2	48989	2.407	-0.550	-18.973	-	0.134	3.312
Jan 12	48999	2.441	-0.512	-18.871	-	0.147	3.255
Jan 22	49009	2.458	-0.545	-18.835	-	0.128	3.250
Feb 1	49019	2.478	-0.573	-18.756	-	-0.483	3.210
Feb 11	49029	2.506	-0.563	-18.721	-	-0.501	3.113
Feb 21	49039	2.529	-0.547	-18.606	-	-0.522	2.983
Mar 3	49049	2.549	-0.564	-18.463	-	-0.502	2.870
Mar 13	49059	2.587	-0.502	-18.382	-	-0.506	2.750
Mar 23	49069	2.620	-0.563	-18.240	-	-0.504	2.696
Apr 2	49079	2.653	-0.608	-18.075	-	-0.471	2.633
Apr 12	49089	2.690	-0.546	-17.892	0.048	-0.456	2.616
Apr 22	49099	2.689	-0.508	-17.728	0.088	-0.422	2.640
May 2	49109	2.662	-0.534	-17.591	0.208	-0.399	2.753
May 12	49119	2.640	-0.536	-17.498	0.251	-0.386	2.898
May 22	49129	2.615	-0.527	-17.451	0.171	-0.376	3.085
Jun 1	49139	2.594	-0.521	-17.352	0.322	-0.361	3.327
Jun 11	49149	2.570	-0.518	-17.259	0.184	-0.361	3.618
Jun 21	49159	2.595	-0.597	-17.109	0.295	-0.358	3.895
Jul 1	49169	2.576	-0.623	-4.076	0.457	-0.323	4.167
Jul 11	49179	2.602	-0.643	-4.126	0.526	-0.304	4.438
Jul 21	49189	2.617	-0.700	-4.156	0.650	-0.268	4.626
Jul 31	49199	2.617	-0.768	-4.125	0.769	-0.247	4.663
Aug 10	49209	2.734	-0.788	-4.078	0.896	-0.238	4.779
Aug 20	49219	2.768	-0.836	-4.017	0.979	-0.213	4.907
Aug 30	49229	2.799	-0.911	-3.864	1.102	-0.212	4.999
Sep 9	49239	2.822	-0.911	-3.773	1.198	-0.199	4.991
Sep 19	49249	2.797	-0.895	-3.662	1.331	-0.190	5.003
Sep 29	49259	2.763	-0.854	-3.559	1.259	-0.174	5.030
Oct 9	49269	2.733	-0.791	-3.582	1.116	-0.160	5.015
Oct 19	49279	2.709	-0.792	-3.593	0.971	-0.153	4.979
Oct 29	49289	2.657	-0.758	-3.529	0.815	-0.127	4.801
Nov 8	49299	2.610	-0.692	-3.546	0.700	-0.097	4.568
Nov 18	49309	2.539	-0.828	-3.521	0.569	-0.103	4.363
Nov 28	49319	2.469	-0.789	-3.506	0.466	-0.085	4.030
Dec 8	49329	2.387	-0.757	-3.516	0.360	-0.076	3.698
Dec 18	49339	2.354	-0.745	-3.481	0.258	-0.089	3.401
Dec 28	49349	2.320	-0.756	-3.401	0.113	-0.080	3.076

TABLE 9A. (CONT.)

Unit is one microsecond.

Date 1993 0h UTC	MJD	UTC - UTC(k) IGMA (7)	INPL	JATC	KRIS	LDS (8)	MSL (9)
Jan 2	48989	-2.07	-0.416	-1.784	-0.348	-0.497	-3.481
Jan 12	48999	-1.87	-0.432	-1.923	-0.414	-1.924	-3.531
Jan 22	49009	-1.67	-0.490	-2.100	-0.449	-3.224	-3.459
Feb 1	49019	-1.41	-0.539	-2.266	-0.547	-4.465	-3.386
Feb 11	49029	-1.18	-0.612	-2.046	-0.632	-5.704	-3.331
Feb 21	49039	-0.94	-0.698	-1.774	-0.694	-6.891	-3.338
Mar 3	49049	-0.75	-0.780	-1.621	-0.806	-8.049	-3.199
Mar 13	49059	-0.55	-0.835	-1.320	-0.781	-9.029	-3.053
Mar 23	49069	-0.36	-0.886	-1.154	-0.831	-10.216	-3.041
Apr 2	49079	-0.13	-0.909	-0.921	-0.684	-11.345	-3.116
Apr 12	49089	0.02	-0.913	-0.622	-0.630	-12.241	-3.076
Apr 22	49099	0.03	-0.922	-0.392	-0.709	-13.338	-3.029
May 2	49109	0.00	-0.919	-0.275	-0.688	-14.824	-3.092
May 12	49119	-0.01	-0.866	-0.311	-0.691	-16.342	-3.227
May 22	49129	-0.06	-0.752	-0.274	-0.657	-17.750	-3.144
Jun 1	49139	-0.04	-0.635	-0.330	-0.649	-19.367	-3.412
Jun 11	49149	-0.05	-0.487	-0.377	-0.660	-20.428	-3.325
Jun 21	49159	-0.08	-0.299	-0.656	-0.598	-21.866	-3.393
Jul 1	49169	-0.12	-0.114	-0.829	-0.566	-22.822	-3.623
Jul 11	49179	-0.17	0.085	-0.676	-0.524	-23.680	-3.874
Jul 21	49189	-0.22	0.263	-0.691	-0.524	-24.709	-3.919
Jul 31	49199	-0.28	0.412	-0.656	-0.548	-	-3.956
Aug 10	49209	-0.36	0.533	-0.935	-0.573	-	-3.972
Aug 20	49219	-0.49	0.649	-0.935	-0.277	-	-0.152
Aug 30	49229	-0.47	0.681	-0.779	0.063	-	-0.384
Sep 9	49239	-0.55	0.703	-0.614	-0.018	-	-0.512
Sep 19	49249	-0.62	0.676	-0.822	-0.073	0.205	-0.707
Sep 29	49259	-0.66	0.602	-0.852	-0.155	0.185	-0.760
Oct 9	49269	-0.67	0.481	-0.843	-0.236	0.157	-0.809
Oct 19	49279	-0.70	0.348	-0.897	-0.048	0.126	-0.963
Oct 29	49289	-0.73	0.212	-1.217	0.276	0.125	-1.029
Nov 8	49299	-0.75	0.064	-1.597	0.354	0.108	-0.982
Nov 18	49309	-0.76	-0.071	-1.933	0.047	0.046	-1.185
Nov 28	49319	-0.78	-0.201	-2.337	-0.044	0.147	-
Dec 8	49329	-0.81	-0.313	-2.760	-0.124	0.151	-
Dec 18	49339	-0.86	-0.418	-2.641	-0.156	-0.012	-1.314
Dec 28	49349	-0.98	-0.512	-2.857	-0.206	-0.036	-1.168

TABLE 9A. (CONT.)

Unit is one microsecond.

Date 1993 0h UTC	MJD	UTC - UTC(k) NAOM	NAOT	NIM	NIST	NMC	NPL
Jan 2	48989	-0.094	-0.742	7.69	-0.304	-1.28	0.228
Jan 12	48999	-0.287	-0.852	7.67	-0.281	-2.05	0.260
Jan 22	49009	-0.368	-0.963	7.71	-0.242	-3.04	0.297
Feb 1	49019	-0.411	-1.062	7.62	-0.212	-3.41	0.343
Feb 11	49029	-0.464	-1.171	7.59	-0.173	-3.73	0.375
Feb 21	49039	-0.534	-1.281	7.64	-0.134	-3.84	0.374
Mar 3	49049	-0.605	-1.381	7.69	-0.095	-	0.381
Mar 13	49059	-0.667	-1.431	7.64	-0.069	-	0.373
Mar 23	49069	-0.743	-1.466	7.70	-0.042	-	0.379
Apr 2	49079	-0.815	-1.566	7.64	-0.019	-	0.383
Apr 12	49089	-0.875	-1.670	7.61	0.008	-	0.379
Apr 22	49099	-0.954	-1.788	7.56	0.031	-	0.365
May 2	49109	-1.016	-1.940	7.63	0.049	-	0.349
May 12	49119	-1.083	-2.091	7.51	0.055	-	0.330
May 22	49129	-1.153	-2.252	7.46	0.057	-	0.310
Jun 1	49139	-1.212	-2.419	7.44	0.055	-	0.285
Jun 11	49149	-1.286	-2.624	7.45	0.034	-	0.250
Jun 21	49159	-1.339	-2.817	7.44	0.008	-	0.214
Jul 1	49169	-1.423	-2.997	7.36	0.002	-	0.188
Jul 11	49179	-1.460	-3.113	7.40	-0.023	-	0.165
Jul 21	49189	-1.512	-3.270	7.39	-0.039	-	0.151
Jul 31	49199	-1.584	-3.443	7.47	-0.058	-	0.127
Aug 10	49209	-1.620	-3.603	7.41	-0.075	-	0.114
Aug 20	49219	-1.681	-3.798	7.33	-0.095	-	0.112
Aug 30	49229	-1.738	-4.023	7.31	-0.117	-	0.104
Sep 9	49239	-1.800	-4.231	7.25	-0.132	-	0.093
Sep 19	49249	-1.833	-4.393	7.33	-0.142	-	0.092
Sep 29	49259	-1.814	-4.606	7.38	-0.146	-	0.074
Oct 9	49269	-1.742	-4.805	7.38	-0.140	-	0.072
Oct 19	49279	-1.667	-4.975	7.29	-0.126	-	0.071
Oct 29	49289	-1.606	-5.124	7.38	-0.116	-	0.066
Nov 8	49299	-1.523	-5.254	7.30	-0.098	-	0.065
Nov 18	49309	-1.486	-5.396	7.22	-0.066	-	0.067
Nov 28	49319	-1.427	-4.544	7.56	-0.043	-	0.072
Dec 8	49329	-1.396	-3.695	7.79	-0.016	-	0.086
Dec 18	49339	-1.374	-2.916	7.79	0.009	-	0.088
Dec 28	49349	-1.354	-2.184	7.73	0.032	-	0.097

TABLE 9A. (CONT.)

Unit is one microsecond.

Date 1993 0h UTC	MJD	UTC - UTC(k) NPLI	NRC	NRLM (10)	OMH	ONBA (11)	ONRJ
Jan 2	48989	-6.882	0.673	-12.431	-	-73.58	-1.569
Jan 12	48999	-6.864	0.850	-13.227	-	-74.50	-1.411
Jan 22	49009	-6.775	1.019	-14.062	-	-75.85	-1.222
Feb 1	49019	-6.737	1.199	-14.901	-	-77.18	-0.895
Feb 11	49029	-6.566	1.362	-15.784	-	-78.40	-0.759
Feb 21	49039	-6.518	1.477	-16.683	-	-79.04	-0.640
Mar 3	49049	-6.361	1.593	-17.609	-	-78.85	-1.072
Mar 13	49059	-6.276	1.692	-18.519	-	-79.92	-1.503
Mar 23	49069	-6.158	1.809	0.269	-	-81.28	-1.995
Apr 2	49079	-6.054	1.900	0.048	-	-83.65	-2.308
Apr 12	49089	-5.973	2.001	-0.176	-	-84.68	-2.257
Apr 22	49099	-5.917	2.090	-0.405	-	-84.62	-2.011
May 2	49109	-5.822	2.198	-0.636	-	-84.74	-1.919
May 12	49119	-5.747	2.325	-0.858	-	-83.97	-1.954
May 22	49129	-5.684	2.449	-1.091	-	-84.44	-2.380
Jun 1	49139	-5.602	2.561	-1.313	-	-85.56	-3.033
Jun 11	49149	-5.549	2.674	-1.565	-	-86.53	-3.653
Jun 21	49159	-5.541	2.752	-1.794	-	-88.00	-4.213
Jul 1	49169	-5.555	2.855	-2.067	3.964	-88.60	-4.794
Jul 11	49179	-5.560	2.952	-2.296	3.979	-90.22	-5.335
Jul 21	49189	-5.357	3.025	-2.554	4.006	-91.35	-5.773
Jul 31	49199	-5.226	3.098	-2.817	4.063	-92.86	-6.191
Aug 10	49209	-5.144	3.184	-3.085	4.164	-94.09	-6.660
Aug 20	49219	-5.044	3.246	-3.348	4.224	-95.49	-7.049
Aug 30	49229	-4.976	3.303	-3.630	4.335	-96.71	-7.539
Sep 9	49239	-4.916	3.365	-3.911	4.375	-98.12	-7.767
Sep 19	49249	-4.843	3.442	-4.183	4.446	-99.53	-8.178
Sep 29	49259	-4.779	3.522	-4.474	4.549	-101.15	-8.532
Oct 9	49269	-4.697	3.603	-4.740	4.547	-	-8.780
Oct 19	49279	-4.605	3.689	-5.014	4.654	-	-8.617
Oct 29	49289	-	3.792	-5.300	4.797	-	-8.860
Nov 8	49299	-4.452	3.896	-5.574	4.971	1.42	-9.010
Nov 18	49309	-4.363	3.996	-5.851	5.095	1.71	-9.161
Nov 28	49319	-4.250	4.125	-6.138	5.191	2.00	-9.444
Dec 8	49329	-4.116	4.242	-6.418	5.335	2.37	-9.582
Dec 18	49339	-4.034	4.351	-6.699	5.484	2.70	-9.783
Dec 28	49349	-3.875	4.427	-6.973	5.614	3.13	-9.889

TABLE 9A. (CONT.)

Unit is one microsecond.

Date 1993 0h UTC	MJD	UTC - UTC(k) OP (12)	ORB	PKNM	PTB	RC	ROA
Jan 2	48989	-0.675	0.321	0.178	2.829	-3.82	3.433
Jan 12	48999	-0.453	-0.018	0.048	2.834	-3.78	3.349
Jan 22	49009	-0.390	-0.179	-0.018	2.830	-3.78	3.244
Feb 1	49019	-0.426	-0.095	0.232	2.842	-3.76	3.107
Feb 11	49029	-0.454	-0.091	0.218	2.840	-3.77	3.062
Feb 21	49039	-0.504	-0.156	0.092	2.840	-3.68	3.024
Mar 3	49049	-0.516	-0.041	-0.178	2.852	-3.54	2.949
Mar 13	49059	-0.602	-0.008	0.207	2.856	-3.46	2.917
Mar 23	49069	-0.652	-0.349	0.116	2.869	-3.30	2.938
Apr 2	49079	-0.786	-0.466	-0.090	2.884	-3.29	2.939
Apr 12	49089	-0.694	-0.535	-0.358	2.891	-2.94	2.935
Apr 22	49099	-0.619	-0.617	-0.282	2.890	-2.97	2.883
May 2	49109	-0.485	-0.725	-0.091	2.888	-3.18	2.813
May 12	49119	-0.376	-0.802	0.139	2.879	-3.34	2.796
May 22	49129	-0.328	-0.873	0.346	2.883	-3.48	2.757
Jun 1	49139	-0.294	-0.990	0.297	2.886	-3.63	2.758
Jun 11	49149	-0.284	-0.993	0.414	2.863	-3.62	2.754
Jun 21	49159	-0.223	-0.988	0.492	2.853	-3.56	2.728
Jul 1	49169	-0.166	-1.052	0.458	2.852	-	2.728
Jul 11	49179	-0.168	-1.230	0.276	2.840	-	2.732
Jul 21	49189	-0.172	-1.361	0.142	2.850	-	2.744
Jul 31	49199	-0.183	-1.441	0.209	2.856	-	2.762
Aug 10	49209	-0.200	-1.481	0.237	2.847	-	2.758
Aug 20	49219	-0.209	-1.534	0.268	2.836	-	2.720
Aug 30	49229	-0.231	-1.595	0.341	2.818	-	2.655
Sep 9	49239	-0.257	-1.562	0.294	2.807	-	2.569
Sep 19	49249	-0.266	-1.547	0.152	2.800	-	2.513
Sep 29	49259	-0.288	-1.598	-0.078	2.781	-	2.532
Oct 9	49269	-0.300	-1.616	-0.196	2.773	-	2.557
Oct 19	49279	-0.290	-1.565	0.030	2.770	-	2.594
Oct 29	49289	-0.270	-1.487	-0.181	2.758	-	2.592
Nov 8	49299	-0.248	-1.525	-0.368	2.747	-	2.591
Nov 18	49309	-0.232	-1.538	-0.221	2.748	-3.15	2.479
Nov 28	49319	-0.203	-1.470	-0.119	2.741	-3.21	2.435
Dec 8	49329	-0.194	-1.585	0.010	2.726	-3.43	2.455
Dec 18	49339	-0.181	-1.583	0.083	2.728	-3.32	2.530
Dec 28	49349	-0.166	-1.601	0.076	2.730	-3.49	2.592

TABLE 9A. (CONT.)

Unit is one microsecond.

Date 1993 0h UTC	MJD	UTC - UTC(k) SCL (13)	SNT	SO	SU	TL	TP
Jan 2	48989	-27.201	-0.146	2.16	0.736	0.415	-0.950
Jan 12	48999	-28.792	-0.145	2.07	0.650	0.322	-1.049
Jan 22	49009	-30.400	-0.086	2.07	0.566	0.284	-1.020
Feb 1	49019	1.059	0.018	2.17	0.489	0.186	-1.016
Feb 11	49029	2.237	0.050	2.07	0.414	0.050	-1.028
Feb 21	49039	3.416	0.079	2.11	0.328	-0.100	-1.023
Mar 3	49049	4.597	0.211	2.22	0.238	-0.245	-1.019
Mar 13	49059	5.781	0.323	2.38	0.151	-0.419	-1.041
Mar 23	49069	6.923	0.241	2.20	0.077	-0.623	-1.060
Apr 2	49079	-0.018	0.164	2.11	-0.002	-0.798	-1.066
Apr 12	49089	-0.101	0.279	2.13	-0.091	-0.831	-1.100
Apr 22	49099	-0.176	0.390	2.32	-0.179	-0.864	-1.035
May 2	49109	-0.229	0.374	2.28	-0.270	-0.767	-1.029
May 12	49119	-0.260	0.319	2.25	-0.349	-0.667	-1.004
May 22	49129	-0.306	0.313	2.25	-0.443	-0.677	-0.991
Jun 1	49139	-0.336	0.205	2.32	-0.525	-0.720	-0.965
Jun 11	49149	-0.084	0.364	2.37	-0.634	-0.773	-0.943
Jun 21	49159	-0.078	0.334	2.37	-0.733	-0.624	-0.932
Jul 1	49169	-0.153	0.230	2.17	-0.825	-0.755	-0.903
Jul 11	49179	-0.307	0.104	2.04	-0.926	-0.779	-0.873
Jul 21	49189	-0.479	0.096	2.03	-1.017	-0.847	-0.866
Jul 31	49199	-0.697	0.389	2.13	-1.117	-0.973	-0.882
Aug 10	49209	-0.883	0.574	2.13	-1.214	-1.201	-0.906
Aug 20	49219	-1.110	0.530	2.14	-1.309	-1.309	-0.965
Aug 30	49229	-1.311	0.446	2.10	-1.417	-1.460	-1.056
Sep 9	49239	-1.541	0.507	2.04	-1.525	-1.589	-1.135
Sep 19	49249	-1.756	0.443	2.04	-1.626	-1.806	-1.184
Sep 29	49259	-1.977	0.499	2.05	-1.732	-2.061	-1.246
Oct 9	49269	-0.088	0.536	1.97	-1.832	-2.295	-1.315
Oct 19	49279	-0.217	0.477	2.03	-1.928	-2.397	-1.407
Oct 29	49289	-0.351	0.352	2.04	-2.025	-2.356	-1.530
Nov 8	49299	-0.484	0.196	2.09	-2.117	-2.253	-1.593
Nov 18	49309	-0.613	0.031	2.01	-2.210	-2.148	-1.527
Nov 28	49319	-	0.096	2.10	-2.303	-1.965	-1.498
Dec 8	49329	0.091	0.100	2.12	-2.393	-1.912	-1.449
Dec 18	49339	0.016	0.109	2.09	-2.484	-2.040	-1.383
Dec 28	49349	-0.062	0.138	2.17	-2.580	-2.192	-1.268

TABLE 9A. (CONT.)

Unit is one microsecond.

Date 1993 0h UTC	MJD	UTC - UTC(k) TUG (14)	USNO	VSL
Jan 2	48989	1.199	-0.020	-0.347
Jan 12	48999	1.214	-0.015	-0.351
Jan 22	49009	1.216	0.011	-0.306
Feb 1	49019	1.239	0.035	-0.301
Feb 11	49029	1.248	0.032	-0.194
Feb 21	49039	1.263	0.030	-0.089
Mar 3	49049	1.289	0.031	-0.024
Mar 13	49059	1.312	0.025	0.014
Mar 23	49069	1.335	0.016	0.039
Apr 2	49079	1.354	0.006	0.054
Apr 12	49089	1.379	0.006	0.061
Apr 22	49099	1.404	-0.006	0.108
May 2	49109	1.425	-0.015	0.156
May 12	49119	1.450	-0.021	0.223
May 22	49129	1.473	-0.028	0.243
Jun 1	49139	1.498	-0.038	0.302
Jun 11	49149	1.510	-0.060	0.383
Jun 21	49159	1.529	-0.076	0.449
Jul 1	49169	1.568	-0.082	0.525
Jul 11	49179	1.573	-0.095	0.570
Jul 21	49189	1.613	-0.098	0.736
Jul 31	49199	1.630	-0.101	0.850
Aug 10	49209	1.634	-0.105	1.041
Aug 20	49219	1.654	-0.094	1.206
Aug 30	49229	1.668	-0.083	1.362
Sep 9	49239	3.090	-0.076	1.512
Sep 19	49249	3.162	-0.067	1.600
Sep 29	49259	3.219	-0.061	1.707
Oct 9	49269	3.280	-0.042	1.520
Oct 19	49279	3.356	-0.036	1.019
Oct 29	49289	3.421	-0.030	0.572
Nov 8	49299	3.500	-0.018	0.150
Nov 18	49309	3.575	0.005	-0.129
Nov 28	49319	3.648	0.023	-0.176
Dec 8	49329	3.716	0.038	-0.283
Dec 18	49339	3.788	0.052	-0.384
Dec 28	49349	3.859	0.058	-0.309

TABLE 9A. (CONT.)

NOTES

(1) AOS . Change of master clock between MJD = 49199 and MJD = 49209.
Time step of UTC(AOS) of -1.3 microseconds on MJD = 49210.43

(2) BEV . Time step of UTC(BEV) of -20.0 microseconds on MJD = 49092.26
Time step of UTC(BEV) of -30.0 microseconds on MJD = 49335.50

(3) CAO . Time step of UTC(CAO) of -33.0 microseconds on MJD = 49170.31

(4) CRL . Apparent time step of [UTC - UTC(CRL)] of 84 nanoseconds between MJD = 49199 and MJD = 49209 due to the recalibration of the GPS time link.

(5) CSIR. Council for Scientific and Industrial Research. Formerly DPT.
Time step of UTC(CSIR) of -13.0 microseconds on MJD = 49163.28

(6) FTZ . Change of master clock on MJD = 49140.52

(7) IGMA. Apparent time step of [UTC - UTC(IGMA)] between MJD = 48979 and MJD = 48989.

(8) LDS . Change of master clock on MJD = 49236.

(9) MSL . Time step of UTC(MSL) of -4.1 microseconds on MJD = 49211.

(10) NRLM. Change of master clock on MJD = 49068.99

(11) ONBA. Apparent time step of [UTC - UTC(ONBA)] between MJD = 48979 and MJD = 48989.

(12) OP . Change of master clock on MJD = 49170.52

(13) SCL . Change of master clock on MJD = 49015.17
Time step of UTC(SCL) of 7.6 microseconds on MJD = 49076.22
Time step of UTC(SCL) of -0.3 microseconds on MJD = 49146.12
Time step of UTC(SCL) of -2.0 microseconds on MJD = 49259.288

(14) TUG . Time step of UTC(TUG) of -1.367 microseconds on MJD=49231.5 due to change of master clock.

TABLE 9B. ABSOLUTE TIME COMPARISONS, AGREEMENT WITH THE BIPM RESULTS

ABSOLUTE TIME COMPARISONS

The reported time comparison experiments were carried out by the first mentioned laboratory.

Date 1993	MJD	Time comparison (Unit is one microsecond)	Uncert.	Source of report	meth.
Oct 19	49279.05	UTC(CRL) - UTC(NAOT) = -7.682	0.005	CRL	(1)
Dec 17	49338.625	UTC(IGMA) - UTC(ONBA) = 3.4698	0.0005	IGMA	(1)

(1) Clock Transportation.

AGREEMENT WITH THE BIPM RESULTS

The following table gives the differences between absolute time comparison values and the BIPM data deduced from Table 9A (before rounding-off).

Date 1993	MJD	Time comparison	Difference Absolute Meas.-BIPM (Unit is one microsecond)
Oct 19	49279.050	UTC(CRL) - UTC(NAOT)	0.002
Dec 17	49338.625	UTC(IGMA) - UTC(ONBA)	-0.07

TABLE 10. INTERNATIONAL GPS TRACKING SCHEDULE N°21, FOR MJD = 49163 (1993 JUNE 25) AT 0hUTC

This is a suggested tracking schedule for international time comparisons in common view of GPS satellites between ten areas of the globe.

Area		Participating laboratories
Europe	E	AOS, CAO, CH, FTZ, IEN, IFAG, LDS, Mad*, NPL, OP, ORB, PKNM, PTB, ROA, SNT, SU, TP, TUG, VSL
East North America	ENA	AO*, APL, NRC, USNO
West North America	WNA	Gold*, NIST, WWV*
Hawaii	H	WWVH*
East Asia	EA	CRL, CSAO, KRIS, NAOM, NAOT NIM, NRLM, SCL, SO, TL
Australia & New Zealand	A	Can*, ATC*, ORR*, MSL, NML*
India	I	NPLI
Middle East	ME	INPL
South Africa	SAF	CSIR
South America	SAM	IGMA, ONBA, ONRJ, Kou*

* Mad, Gold, Can : JPL Deep Space Network, Madrid, Goldstone, Canberra
WWV, WWVH : NIST stations in Colorado and Hawaii
AO : Arecibo Observatory
Kou: CNES Kourou Center
ATC, ORR and NML: Australian laboratories (see AUS in Table 4)

Other laboratories are designated by their usual acronyms.

The start times of the tracks are referenced to UTC. The suggested track duration is 15 minutes. Data taking is to start 2 minutes after the start of the track to allow time to lock on to the satellite signal. The data length is therefore 13 minutes; it has been chosen in order to ensure use of the most current ionospheric correction which is transmitted every 12.5 min. All the track time should be decremented 4 minutes each day, to account for the GPS sidereal orbits. The track times were chosen to maximize elevation angles between pairs of stations. The class bytes are such that in association with the satellite number they form a unique identifyer for each common view.

The European area having numerous possible connections has a heavy schedule. The establishment of sub-schedules permits the sharing of the work. European laboratories are contacted to ensure the coordination of sub-schedules.

TABLE 10. SCHEDULE N°21, 1993 JUNE 25 (CONT.)

*** Europe ***

Class	PRN	Start h	Start m	Connects	Subschedules E1	E2	E3	E4
08	16	01	04	WNA,ENA	*	*	*	*
08	3	01	20	WNA,ENA		*		
10	19	02	08	EA,ME,I	*	*	*	*
08	26	02	56	WNA,ENA	*	*	*	*
10	27	03	28	EA,ME,I	*	*	*	*
10	1	03	44	EA,ME,I	*	*	*	*
68	12	05	04	ENA,SAM		*		
10	2	05	20	EA,ME,I	*	*	*	*
00	23	05	36	ENA,WNA		*		
4C	13	06	08	SAF,ME,I				*
08	12	06	24	WNA,ENA,ME		*		
E4	12	07	44	E	*	*	*	*
48	13	08	00	ME,I,EA	*	*	*	*
19	20	08	16	ENA,WNA,ME,SAM	*	*	*	*
10	24	09	04	EA,ME,I			*	
4C	12	09	20	SAF,ME,I				*
4C	3	09	36	SAF,ME				*
00	25	10	24	ENA,WNA	*	*	*	*
00	3	11	12	ENA,ME	*	*	*	*
10	16	11	44	EA,ME,I			*	
00	22	12	16	ENA,WNA,ME	*	*	*	*
A0	3	13	04	ME,I,EA			*	
18	28	13	20	ENA,WNA,SAM		*		
4C	23	13	36	SAF,ME,I			*	
10	17	14	24	EA,ME,I	*	*	*	*
4C	21	14	40	SAF,ME	*	*	*	*
4C	22	14	56	SAF				*
00	31	15	28	ENA,WNA,ME	*	*	*	*
10	23	15	44	EA,ME,I	*	*	*	*
08	15	16	48	WNA,ENA,SAM	*	*	*	*
4C	28	17	04	SAF,ME,I	*	*	*	*
18	2	17	36	ENA,WNA,H		*		
10	21	17	52	EA,ME,I			*	
4C	31	18	24	SAF				*
00	14	19	44	ENA,WNA,SAM	*	*	*	*
10	25	20	32	EA,ME,I			*	
4C	15	20	48	SAF,ME,I				*
54	18	21	04	SAM,SAF,ME				*
08	13	22	08	WNA,ENA,SAM,ME		*		
10	14	22	24	EA,ME,I			*	
00	18	22	40	ENA,ME	*	*	*	*
10	29	22	56	EA,ME,I	*	*	*	*
4C	19	23	12	SAF,ME				*
08	24	23	28	WNA,ENA	*	*	*	*

TABLE 10. SCHEDULE N°21, 1993 JUNE 25 (CONT.)

*** E. North America ***

Class	PRN	Start h	Start m	Connects
20	3	00	16	EA,WNA,H
28	17	00	48	WNA,EA,H
08	16	01	04	E,WNA
08	3	01	20	E,WNA
08	26	02	56	E,WNA
68	3	03	44	SAM,WNA
34	28	04	00	H,WNA,EA
18	17	04	16	WNA,SAM
18	21	04	48	WNA,H
68	12	05	04	SAM,E
00	23	05	36	E,WNA
08	12	06	24	E,WNA,ME
20	15	07	12	EA,WNA,H
19	20	08	16	WNA,E,ME,SAM
28	14	08	48	EA,WNA,H
00	25	10	24	E,WNA
00	3	11	12	E,ME
28	18	11	28	EA,WNA,H
00	22	12	16	E,WNA,ME
68	31	12	32	SAM,WNA
18	29	12	48	WNA,SAM
18	18	13	04	WNA
18	28	13	20	WNA,E,SAM
18	19	13	36	WNA,H
20	1	13	52	EA,WNA,H
18	27	14	08	WNA,H,EA
68	18	14	56	SAM,WNA
00	31	15	28	E,WNA,ME
08	15	16	48	E,WNA,SAM
18	2	17	36	WNA,H,E
34	13	19	12	WNA,H
20	12	19	28	EA,WNA,H
00	14	19	44	E,WNA,SAM
18	24	20	48	WNA,H
28	20	21	52	WNA,EA,H
08	13	22	08	E,WNA,SAM,ME
00	18	22	40	E,ME
08	24	23	28	E,WNA
18	16	23	44	WNA

*** W. North America ***

Class	PRN	Start h	Start m	Connects
20	3	00	16	ENA,EA,H
28	17	00	48	EA,H,ENA
08	16	01	04	E,ENA
08	3	01	20	E,ENA
80	22	02	40	A,EA,H
08	26	02	56	E,ENA
68	3	03	44	ENA,SAM
34	28	04	00	H,ENA,EA
18	17	04	16	ENA,SAM
18	21	04	48	ENA,H
00	23	05	36	E,ENA
08	12	06	24	E,ENA,ME
20	15	07	12	EA,ENA,H
19	20	08	16	ENA,E,ME,SAM
28	14	08	48	EA,ENA,H
00	25	10	24	E,ENA
28	18	11	28	EA,ENA,H
00	22	12	16	E,ENA,ME
68	31	12	32	ENA,SAM
18	29	12	48	ENA,SAM
18	18	13	04	ENA
18	28	13	20	ENA,E,SAM
18	19	13	36	ENA,H
20	1	13	52	EA,ENA,H
18	27	14	08	ENA,H,EA
68	18	14	56	ENA,SAM
00	31	15	28	E,ENA,ME
08	15	16	48	E,ENA,SAM
28	26	17	04	EA,H
18	2	17	36	ENA,H,E
34	13	19	12	H,ENA
20	12	19	28	ENA,EA,H
00	14	19	44	E,ENA,SAM
18	24	20	48	ENA,H
28	20	21	52	EA,H,ENA
08	13	22	08	E,ENA,SAM,ME
80	17	23	12	A,H
08	24	23	28	E,ENA
18	16	23	44	ENA

*** East Asia ***

Class	PRN	Start h	Start m	Connects
20	3	00	16	ENA,WNA,H
98	25	00	32	A,H
28	17	00	48	WNA,H,ENA
98	29	01	52	A,I
10	19	02	08	E,ME,I
80	22	02	40	WNA,A,H
10	27	03	28	E,ME,I
10	1	03	44	E,ME,I
34	28	04	00	H,WNA,ENA
10	2	05	20	E,ME,I
98	14	05	52	A
98	31	06	24	A,H
98	1	06	40	A,I
20	15	07	12	ENA,WNA,H
36	14	07	44	H
48	13	08	00	E,ME,I
98	2	08	16	A
28	14	08	48	WNA,ENA,H
10	24	09	04	E,ME,I
ED	13	10	08	EA
98	13	11	12	A
28	18	11	28	WNA,ENA,H
10	16	11	44	E,ME,I
98	26	12	16	A,I
A0	3	13	04	ME,I,E
20	1	13	52	ENA,WNA,H
18	27	14	08	ENA,WNA,H
10	17	14	24	E,ME,I
10	23	15	44	E,ME,I
98	12	16	00	A
28	26	17	04	WNA,H
10	21	17	52	E,ME,I
98	20	18	24	A
20	12	19	28	ENA,WNA,H
10	25	20	32	E,ME,I
98	22	20	48	A
28	20	21	52	WNA,H,ENA
10	14	22	24	E,ME,I
10	29	22	56	E,ME,I
98	28	23	28	A,I

TABLE 10. SCHEDULE N°21, 1993 JUNE 25 (CONT.)

*** Hawaii ***

Class	PRN	Start h	Start m	Connects
20	3	00	16	ENA,EA,WNA
98	25	00	32	EA,A
28	17	00	48	WNA,EA,ENA
80	22	02	40	WNA,A,EA
34	28	04	00	WNA,ENA,EA
18	21	04	48	ENA,WNA
98	31	06	24	EA,A
20	15	07	12	EA,ENA,WNA
36	14	07	44	EA
28	14	08	48	EA,WNA,ENA
3C	19	10	08	A
28	18	11	28	EA,WNA,ENA
18	19	13	36	ENA,WNA
20	1	13	52	EA,ENA,WNA
18	27	14	08	ENA,WNA,EA
28	26	17	04	WNA,EA
18	2	17	36	ENA,WNA,E
34	13	19	12	WNA,ENA
20	12	19	28	ENA,EA,WNA
18	24	20	48	ENA,WNA
28	20	21	52	WNA,EA,ENA
80	17	23	12	WNA,A

*** Australia ***

Class	PRN	Start h	Start m	Connects
98	25	00	32	EA,H
98	29	01	52	EA,I
80	22	02	40	WNA,EA,H
98	14	05	52	EA
98	31	06	24	EA,H
98	1	06	40	EA,I
F9	19	07	44	A
98	2	08	16	EA
F9	27	09	36	A
3C	19	10	08	H
98	13	11	12	EA
98	26	12	16	EA,I
F9	13	13	04	A
F9	12	14	56	A
98	12	16	00	EA
98	20	18	24	EA
F9	3	19	44	A
F9	23	20	32	A
98	22	20	48	EA
80	17	23	12	WNA,H
98	28	23	28	EA,I

*** India ***

Class	PRN	Start h	Start m	Connects
98	29	01	52	EA,A
10	19	02	08	E,EA,ME
10	27	03	28	E,EA,ME
10	1	03	44	E,EA,ME
10	2	05	20	E,EA,ME
4C	13	06	08	E,SAF,ME
98	1	06	40	EA,A
48	13	08	00	E,ME,EA
10	24	09	04	E,EA,ME
4C	12	09	20	E,SAF,ME
10	16	11	44	E,EA,ME
98	26	12	16	EA,A
A0	3	13	04	ME,E,EA
4C	23	13	36	E,SAF,ME
10	17	14	24	E,EA,ME
10	23	15	44	E,EA,ME
4C	28	17	04	E,SAF,ME
10	21	17	52	E,EA,ME
10	25	20	32	E,EA,ME
4C	15	20	48	E,SAF,ME
10	14	22	24	E,EA,ME
10	29	22	56	E,EA,ME
98	28	23	28	EA,A

TABLE 10. SCHEDULE N°21, 1993 JUNE 25 (CONT.)

*** Middle East ***

Class	PRN	Start h m	Connects
10	19	02 08	E,EA,I
10	27	03 28	E,EA,I
10	1	03 44	E,EA,I
10	2	05 20	E,EA,I
4C	13	06 08	E,SAF,I
08	12	06 24	E,WNA,ENA
48	13	08 00	E,I,EA
19	20	08 16	ENA,WNA,E,SAM
10	24	09 04	E,EA,I
4C	12	09 20	E,SAF,I
4C	3	09 36	E,SAF
00	3	11 12	E,ENA
10	16	11 44	E,EA,I
00	22	12 16	E,ENA,WNA
A0	3	13 04	I,E,EA
4C	23	13 36	E,SAF,I
10	17	14 24	E,EA,I
4C	21	14 40	E,SAF
00	31	15 28	E,ENA,WNA
10	23	15 44	E,EA,I
4C	28	17 04	E,SAF,I
10	21	17 52	E,EA,I
10	25	20 32	E,EA,I
4C	15	20 48	E,SAF,I
54	18	21 04	E,SAM,SAF
08	13	22 08	E,WNA,ENA,SAM
10	14	22 24	E,EA,I
00	18	22 40	E,ENA
10	29	22 56	E,EA,I
4C	19	23 12	E,SAF
BC	14	23 44	SAF

*** South Africa ***

Class	PRN	Start h m	Connects
4C	13	06 08	E,ME,I
4C	12	09 20	E,ME,I
4C	3	09 36	E,ME
4C	23	13 36	E,ME,I
4C	21	14 40	E,ME
4C	22	14 56	E
4C	28	17 04	E,ME,I
4C	31	18 24	E
CA	19	20 00	SAM
4C	15	20 48	E,ME,I
54	18	21 04	E,SAM,ME
4C	19	23 12	E,ME
BC	14	23 44	ME

*** South America ***

Class	PRN	Start h m	Connects
F8	13	00 00	SAM
68	3	03 44	ENA,WNA
F8	12	04 00	SAM
18	17	04 16	ENA,WNA
68	12	05 04	ENA,E
19	20	08 16	ENA,WNA,E,ME
68	31	12 32	ENA,WNA
18	29	12 48	ENA,WNA
18	28	13 20	ENA,WNA,E
68	18	14 56	ENA,WNA
08	15	16 48	E,WNA,ENA
00	14	19 44	E,ENA,WNA
CA	19	20 00	SAF
54	18	21 04	E,SAF,ME
08	13	22 08	E,WNA,ENA,ME

TABLE 11. INTERNATIONAL GPS TRACKING SCHEDULE N°22, FOR MJD = 49334 (1993 DECEMBER 13) AT 0hUTC

This is a suggested tracking schedule for international time comparisons in common view of GPS satellites between ten areas of the globe.

Area		Participating laboratories
Europe	E	AOS, CAO, CH, FTZ, IEN, IFAG, LDS, Mad*, NPL, OP, OMH, ORB, PKNM, PTB, ROA, SNT, SU, TP, TUG, VSL
East North America	ENA	AO*, APL, NRC, USNO
West North America	WNA	Gold*, NIST, WWV*
Hawaii	H	WWVH*
East Asia	EA	CRL, CSAO, KRIS, NAOM, NAOT NIM, NRLM, SCL, SO, TL
Australia & New Zealand	A	Can*, ATC*, ORR*, MSL, NML*
India	I	NPLI
Middle East	ME	INPL
South Africa	SAF	CSIR
South America	SAM	IGMA, ONBA, ONRJ, Kou*

* Mad, Gold, Can : JPL Deep Space Network, Madrid, Goldstone, Canberra
WWV, WWVH : NIST stations in Colorado and Hawaii
AO : Arecibo Observatory
Kou: CNES Kourou Center
ATC, ORR and NML: Australian laboratories (see AUS in Table 4)

Other laboratories are designated by their usual acronyms.

The start times of the tracks are referenced to UTC. The suggested track duration is 15 minutes. Data taking is to start 2 minutes after the start of the track to allow time to lock on to the satellite signal. The data length is therefore 13 minutes; it has been chosen in order to ensure use of the most current ionospheric correction which is transmitted every 12.5 min. All the track time should be decremented 4 minutes each day, to account for the GPS sidereal orbits. The track times were chosen to maximize elevation angles between pairs of stations. The class bytes are such that in association with the satellite number they form a unique identifyer for each common view.

The European area having numerous possible connections has a heavy schedule. The establishment of sub-schedules permits the sharing of the work. European laboratories are contacted to ensure the coordination of sub-schedules.

TABLE 11. SCHEDULE N°22, 1993 DECEMBER 13 (CONT.)

*** Europe ***

Class	PRN	Start h	Start m	Connects	Subschedules E1	E2	E3	E4
10	16	00	32	EA,ME,I			*	
00	22	00	48	ENA,WNA,ME	*	*	*	*
A0	3	01	36	ME,I,EA			*	
18	28	01	52	ENA,WNA,SAM	*	*	*	*
4C	23	02	08	SAF,ME,I			*	
10	17	02	40	EA,ME,I	*	*	*	*
4C	21	02	56	SAF,ME	*	*	*	*
4C	22	03	28	SAF				*
00	31	03	44	ENA,WNA,ME	*	*	*	*
10	23	04	00	EA,ME,I	*	*	*	*
08	15	05	04	WNA,ENA,SAM	*	*	*	*
10	21	05	52	EA,ME,I			*	
18	2	06	08	ENA,WNA,H		*		
10	1	06	40	EA,ME,I			*	
4C	31	06	56	SAF				*
00	14	08	00	ENA,WNA,SAM	*	*	*	*
00	7	08	32	ENA,WNA,SAM	*	*	*	*
4C	15	08	48	SAF,ME,I				*
10	25	09	04	EA,ME,I			*	
54	18	09	20	SAM,SAF,ME				*
08	13	10	40	WNA,ENA,SAM,ME		*		
10	14	10	56	EA,ME,I			*	
00	18	11	12	ENA,ME	*	*	*	*
10	29	11	28	EA,ME,I	*	*	*	*
4C	19	11	44	SAF,ME				*
08	24	12	00	WNA,ENA	*	*	*	*
08	16	13	20	WNA,ENA	*	*	*	*
08	3	13	36	WNA,ENA		*		
10	19	14	40	EA,ME,I	*	*	*	*
08	26	15	12	WNA,ENA	*	*	*	*
10	27	15	44	EA,ME,I	*	*	*	*
68	12	17	20	ENA,SAM		*		
10	2	17	36	EA,ME,I	*	*	*	*
00	23	17	52	ENA,WNA		*		
4C	13	18	24	SAF,ME,I				*
08	12	18	40	WNA,ENA,ME		*		
10	7	18	56	EA,ME,I			*	
00	5	19	12	ENA,ME,SAM	*	*	*	*
E4	12	20	00	E	*	*	*	*
48	13	20	16	ME,I,EA	*	*	*	*
19	20	20	32	ENA,WNA,ME,SAM	*	*	*	*
7C	1	20	48	WNA,SAM,ENA	*	*	*	*
10	24	21	36	EA,ME,I			*	
4C	12	21	52	SAF,ME,I				*
4C	3	22	08	SAF,ME				*
10	5	22	24	EA,ME,I				*
00	25	22	40	ENA,WNA	*	*	*	*
00	3	23	28	ENA,ME	*	*	*	*

TABLE 11. SCHEDULE N°22, 1993 DECEMBER 13 (CONT.)

*** E. North America ***

Class	PRN	Start h m	Connects
00	22	00 48	E,WNA,ME
68	31	01 04	SAM,WNA
18	29	01 20	WNA,SAM
18	18	01 36	WNA
18	28	01 52	WNA,E,SAM
18	19	02 08	WNA,H
18	27	02 24	WNA,H,EA
68	18	03 28	SAM,WNA
00	31	03 44	E,WNA,ME
08	15	05 04	E,WNA,SAM
18	2	06 08	WNA,H,E
34	13	07 28	WNA,H
20	12	07 44	EA,WNA,H
00	14	08 00	E,WNA,SAM
00	7	08 32	E,WNA,SAM
20	5	08 48	EA,WNA,H
18	24	09 04	WNA,H
28	20	10 24	WNA,EA,H
08	13	10 40	E,WNA,SAM,ME
00	18	11 12	E,ME
08	24	12 00	E,WNA
18	16	12 16	WNA
20	3	12 32	EA,WNA,H
28	17	13 04	WNA,EA,H
08	16	13 20	E,WNA
08	3	13 36	E,WNA
08	26	15 12	E,WNA
68	3	16 00	SAM,WNA
34	28	16 16	H,WNA,EA
18	17	16 32	WNA,SAM
18	21	17 04	WNA,H
68	12	17 20	SAM,E
00	23	17 52	E,WNA
08	12	18 40	E,WNA,ME
00	5	19 12	E,ME,SAM
20	15	19 28	EA,WNA,H
19	20	20 32	WNA,E,ME,SAM
7C	1	20 48	WNA,SAM,E
28	14	21 04	EA,WNA,H
00	25	22 40	E,WNA
00	3	23 28	E,ME
28	18	23 44	EA,WNA,H

*** W. North America ***

Class	PRN	Start h m	Connects
00	22	00 48	E,ENA,ME
68	31	01 04	ENA,SAM
18	29	01 20	ENA,SAM
18	18	01 36	ENA
18	28	01 52	ENA,E,SAM
18	19	02 08	ENA,H
18	27	02 24	ENA,H,EA
68	18	03 28	ENA,SAM
00	31	03 44	E,ENA,ME
08	15	05 04	E,ENA,SAM
28	26	05 20	EA,H
18	2	06 08	ENA,H,E
34	13	07 28	H,ENA
20	12	07 44	ENA,EA,H
00	14	08 00	E,ENA,SAM
00	7	08 32	E,ENA,SAM
20	5	08 48	ENA,EA,H
18	24	09 04	ENA,H
28	20	10 24	EA,H,ENA
08	13	10 40	E,ENA,SAM,ME
80	17	11 28	A,H
08	24	12 00	E,ENA
18	16	12 16	ENA
20	3	12 32	ENA,EA,H
28	17	13 04	EA,H,ENA
08	16	13 20	E,ENA
08	3	13 36	E,ENA
80	22	14 56	A,EA,H
08	26	15 12	E,ENA
68	3	16 00	ENA,SAM
34	28	16 16	H,ENA,EA
18	17	16 32	ENA,SAM
18	21	17 04	ENA,H
00	23	17 52	E,ENA
08	12	18 40	E,ENA,ME
20	15	19 28	EA,ENA,H
19	20	20 32	ENA,E,ME,SAM
7C	1	20 48	SAM,E,ENA
28	14	21 04	EA,ENA,H
00	25	22 40	E,ENA
28	18	23 44	EA,ENA,H

*** East Asia ***

Class	PRN	Start h m	Connects
10	16	00 32	E,ME,I
98	26	00 48	A,I
A0	3	01 36	ME,I,E
18	27	02 24	ENA,WNA,H
10	17	02 40	E,ME,I
10	23	04 00	E,ME,I
98	12	04 16	A
28	26	05 20	WNA,H
10	21	05 52	E,ME,I
10	1	06 40	E,ME,I
98	20	06 56	A
20	12	07 44	ENA,WNA,H
20	5	08 48	ENA,WNA,H
10	25	09 04	E,ME,I
98	22	09 20	A
28	20	10 24	WNA,H,ENA
98	1	10 40	A
10	14	10 56	E,ME,I
10	29	11 28	E,ME,I
98	28	12 00	A,I
20	3	12 32	ENA,WNA,H
98	25	12 48	A,H
28	17	13 04	WNA,H,ENA
98	29	14 24	A,I
10	19	14 40	E,ME,I
80	22	14 56	WNA,A,H
10	27	15 44	E,ME,I
34	28	16 16	H,WNA,ENA
10	2	17 36	E,ME,I
98	14	18 08	A
98	31	18 40	A,H
10	7	18 56	E,ME,I
20	15	19 28	ENA,WNA,H
36	14	20 00	H
48	13	20 16	E,ME,I
98	2	20 32	A
28	14	21 04	WNA,ENA,H
10	24	21 36	E,ME,I
10	5	22 24	E,ME,I
ED	13	22 40	EA
98	13	23 28	A
28	18	23 44	WNA,ENA,H

TABLE 11. SCHEDULE N°22, 1993 DECEMBER 13 (CONT.)

*** Hawaii ***

Class	PRN	Start	Connects
		h m	
18	19	02 08	ENA,WNA
18	27	02 24	ENA,WNA,EA
28	26	05 20	WNA,EA
18	2	06 08	ENA,WNA,E
34	13	07 28	WNA,ENA
20	12	07 44	ENA,EA,WNA
20	5	08 48	ENA,EA,WNA
18	24	09 04	ENA,WNA
28	20	10 24	WNA,EA,ENA
80	17	11 28	WNA,A
20	3	12 32	ENA,EA,WNA
98	25	12 48	EA,A
28	17	13 04	WNA,EA,ENA
80	22	14 56	WNA,A,EA
34	28	16 16	WNA,ENA,EA
18	21	17 04	ENA,WNA
98	31	18 40	EA,A
20	15	19 28	EA,ENA,WNA
36	14	20 00	EA
28	14	21 04	EA,WNA,ENA
3C	19	22 40	A
28	18	23 44	EA,WNA,ENA

*** Australia ***

Class	PRN	Start	Connects
		h m	
98	26	00 48	EA,I
F9	13	01 36	A
F9	12	02 56	A
98	12	04 16	EA
98	20	06 56	EA
F9	3	08 00	A
F9	23	08 48	A
98	22	09 20	EA
98	1	10 40	EA
80	17	11 28	WNA,H
98	28	12 00	EA,I
98	25	12 48	EA,H
98	29	14 24	EA,I
80	22	14 56	WNA,EA,H
98	14	18 08	EA
98	31	18 40	EA,H
F9	19	20 00	A
98	2	20 32	EA
F9	27	21 36	A
3C	19	22 40	H
98	13	23 28	EA

*** India ***

Class	PRN	Start	Connects
		h m	
10	16	00 32	E,EA,ME
98	26	00 48	EA,A
A0	3	01 36	ME,E,EA
4C	23	02 08	E,SAF,ME
10	17	02 40	E,EA,ME
10	23	04 00	E,EA,ME
BC	1	04 16	ME,SAF
10	21	05 52	E,EA,ME
10	1	06 40	E,EA,ME
4C	15	08 48	E,SAF,ME
10	25	09 04	E,EA,ME
10	14	10 56	E,EA,ME
10	29	11 28	E,EA,ME
98	28	12 00	EA,A
98	29	14 24	EA,A
10	19	14 40	E,EA,ME
10	27	15 44	E,EA,ME
10	2	17 36	E,EA,ME
4C	13	18 24	E,SAF,ME
10	7	18 56	E,EA,ME
48	13	20 16	E,ME,EA
10	24	21 36	E,EA,ME
4C	12	21 52	E,SAF,ME
10	5	22 24	E,EA,ME

TABLE 11. SCHEDULE N°22, 1993 DECEMBER 13 (CONT.)

*** Middle East ***

Class	PRN	Start		Connects
		h	m	
10	16	00	32	E,EA,I
00	22	00	48	E,ENA,WNA
A0	3	01	36	I,E,EA
4C	23	02	08	E,SAF,I
10	17	02	40	E,EA,I
4C	21	02	56	E,SAF
00	31	03	44	E,ENA,WNA
10	23	04	00	E,EA,I
BC	1	04	16	SAF,I
10	21	05	52	E,EA,I
10	1	06	40	E,EA,I
4C	15	08	48	E,SAF,I
10	25	09	04	E,EA,I
54	18	09	20	E,SAM,SAF
08	13	10	40	E,WNA,ENA,SAM
10	14	10	56	E,EA,I
00	18	11	12	E,ENA
10	29	11	28	E,EA,I
4C	19	11	44	E,SAF
BC	14	12	00	SAF
10	19	14	40	E,EA,I
10	27	15	44	E,EA,I
BC	7	16	16	SAF
10	2	17	36	E,EA,I
4C	13	18	24	E,SAF,I
08	12	18	40	E,WNA,ENA
10	7	18	56	E,EA,I
00	5	19	12	E,ENA,SAM
48	13	20	16	E,I,EA
19	20	20	32	ENA,WNA,E,SAM
10	24	21	36	E,EA,I
4C	12	21	52	E,SAF,I
4C	3	22	08	E,SAF
10	5	22	24	E,EA,I
00	3	23	28	E,ENA

*** South Africa ***

Class	PRN	Start		Connects
		h	m	
4C	23	02	08	E,ME,I
4C	21	02	56	E,ME
4C	22	03	28	E
BC	1	04	16	ME,I
4C	31	06	56	E
CA	19	08	16	SAM
4C	15	08	48	E,ME,I
54	18	09	20	E,SAM,ME
4C	19	11	44	E,ME
BC	14	12	00	ME
BC	7	16	16	ME
4C	13	18	24	E,ME,I
4C	12	21	52	E,ME,I
4C	3	22	08	E,ME

*** South America ***

Class	PRN	Start		Connects
		h	m	
68	31	01	04	ENA,WNA
18	29	01	20	ENA,WNA
18	28	01	52	ENA,WNA,E
68	18	03	28	ENA,WNA
08	15	05	04	E,WNA,ENA
00	14	08	00	E,ENA,WNA
CA	19	08	16	SAF
00	7	08	32	E,ENA,WNA
54	18	09	20	E,SAF,ME
08	13	10	40	E,WNA,ENA,ME
F8	13	12	32	SAM
68	3	16	00	ENA,WNA
F8	12	16	16	SAM
18	17	16	32	ENA,WNA
68	12	17	20	ENA,E
00	5	19	12	E,ENA,ME
19	20	20	32	ENA,WNA,E,ME
7C	1	20	48	WNA,E,ENA

TABLE 12. [TAI - GPS time] AND [UTC - GPS time]

(File available via INTERNET under the name UTCGPS93.AR)

GPS satellites disseminate a common time scale designated as 'GPS time'. The relation between GPS time and TAI is :

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

where the time difference of 19 seconds is kept constant and C0 is a quantity of the order of a few hundreds of nanoseconds, varying with time.

The relation between GPS time and UTC involves a variable number of seconds as a consequence of the leap seconds of the UTC system and is as follows :

from 1992 July 1, 0h UTC, until 1993 July 1, 0h UTC :

[UTC - GPS time] = -8 s + C0.

from 1993 July 1, 0h UTC, until 1994 July 1, 0h UTC :

[UTC - GPS time] = -9 s + C0.

Here C0 is given at 0h UTC every day.

C0 is computed as follows: the GPS Block I satellite data taken at the Paris Observatory are first corrected for precise satellite ephemerides and for measured ionospheric delays. Then they are 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)] from Table 9A.
This procedure also allows the computation of daily standard deviations, σ, obtained from Block I and Block II data from Paris Observatory according to the International GPS Common-View Schedule. They are given in the following tables in order to show the quality of the dissemination of GPS time from Block I and Block II satellites.

TABLE 12. (CONT.)

Date 1993 0h UTC	MJD	C0 (ns)	σ(ns) Block I	Block II
Jan 1	48988	56	6	27
Jan 2	48989	60	7	39
Jan 3	48990	70	5	60
Jan 4	48991	77	9	47
Jan 5	48992	76	9	51
Jan 6	48993	65	7	46
Jan 7	48994	56	2	39
Jan 8	48995	52	5	33
Jan 9	48996	46	4	50
Jan 10	48997	38	6	37
Jan 11	48998	27	5	44
Jan 12	48999	14	5	40
Jan 13	49000	-15	4	37
Jan 14	49001	-38	7	42
Jan 15	49002	-56	6	37
Jan 16	49003	-62	8	41
Jan 17	49004	-54	7	44
Jan 18	49005	-34	5	43
Jan 19	49006	-12	5	40
Jan 20	49007	6	2	27
Jan 21	49008	26	4	47
Jan 22	49009	48	7	46
Jan 23	49010	64	6	34
Jan 24	49011	79	4	36
Jan 25	49012	89	2	43
Jan 26	49013	95	3	39
Jan 27	49014	97	4	63
Jan 28	49015	98	5	45
Jan 29	49016	103	4	39
Jan 30	49017	109	7	32
Jan 31	49018	113	4	32

TABLE 12. (CONT.)

Date 1993 0h UTC	MJD	CO (ns)	σ(ns) Block I	Block II
Feb 1	49019	114	6	36
Feb 2	49020	117	5	38
Feb 3	49021	118	8	37
Feb 4	49022	114	7	22
Feb 5	49023	106	5	24
Feb 6	49024	100	4	33
Feb 7	49025	95	3	48
Feb 8	49026	88	6	50
Feb 9	49027	80	6	24
Feb 10	49028	70	6	45
Feb 11	49029	60	7	44
Feb 12	49030	52	2	37
Feb 13	49031	47	3	51
Feb 14	49032	39	3	36
Feb 15	49033	29	6	51
Feb 16	49034	24	6	29
Feb 17	49035	26	7	43
Feb 18	49036	30	8	26
Feb 19	49037	32	7	32
Feb 20	49038	32	6	41
Feb 21	49039	32	4	35
Feb 22	49040	26	7	41
Feb 23	49041	20	12	46
Feb 24	49042	23	12	59
Feb 25	49043	38	20	48
Feb 26	49044	55	7	31
Feb 27	49045	74	5	42
Feb 28	49046	95	11	60

TABLE 12. (CONT.)

Date 1993 0h UTC	MJD	CO (ns)	σ(ns) Block I	Block II
Mar 1	49047	115	5	23
Mar 2	49048	133	10	52
Mar 3	49049	154	15	44
Mar 4	49050	169	8	56
Mar 5	49051	183	7	50
Mar 6	49052	193	15	15
Mar 7	49053	205	5	13
Mar 8	49054	215	8	24
Mar 9	49055	220	10	41
Mar 10	49056	227	14	41
Mar 11	49057	235	14	25
Mar 12	49058	237	13	48
Mar 13	49059	233	18	44
Mar 14	49060	230	11	46
Mar 15	49061	222	17	48
Mar 16	49062	205	17	29
Mar 17	49063	188	8	47
Mar 18	49064	180	21	47
Mar 19	49065	177	6	45
Mar 20	49066	175	9	66
Mar 21	49067	169	11	59
Mar 22	49068	148	20	84
Mar 23	49069	107	12	42
Mar 24	49070	61	6	46
Mar 25	49071	42	-	45
Mar 26	49072	39	5	35
Mar 27	49073	29	8	45
Mar 28	49074	15	8	34
Mar 29	49075	7	5	45
Mar 30	49076	1	4	42
Mar 31	49077	-7	6	59

TABLE 12. (CONT.)

Date 1993 0h UTC	MJD	CO (ns)	σ(ns) Block I	Block II
Apr 1	49078	-19	9	50
Apr 2	49079	-32	11	45
Apr 3	49080	-27	4	52
Apr 4	49081	-31	10	44
Apr 5	49082	-34	9	31
Apr 6	49083	-29	7	42
Apr 7	49084	-19	9	48
Apr 8	49085	-10	9	30
Apr 9	49086	-1	12	30
Apr 10	49087	8	4	37
Apr 11	49088	11	13	45
Apr 12	49089	13	7	57
Apr 13	49090	18	14	36
Apr 14	49091	24	10	41
Apr 15	49092	32	4	36
Apr 16	49093	42	11	49
Apr 17	49094	58	7	53
Apr 18	49095	72	5	61
Apr 19	49096	83	7	37
Apr 20	49097	88	3	41
Apr 21	49098	89	4	46
Apr 22	49099	87	6	60
Apr 23	49100	89	8	22
Apr 24	49101	92	4	44
Apr 25	49102	95	6	35
Apr 26	49103	94	8	45
Apr 27	49104	84	12	44
Apr 28	49105	71	4	50
Apr 29	49106	61	11	48
Apr 30	49107	53	7	54

TABLE 12. (CONT.)

Date 1993 0h UTC	MJD	C0 (ns)	σ(ns) Block I	Block II
May 1	49108	46	12	52
May 2	49109	41	4	35
May 3	49110	35	5	47
May 4	49111	23	12	65
May 5	49112	6	8	43
May 6	49113	-10	10	55
May 7	49114	-22	0	45
May 8	49115	-26	3	48
May 9	49116	-23	8	40
May 10	49117	-19	5	28
May 11	49118	-15	3	46
May 12	49119	-6	5	48
May 13	49120	9	8	61
May 14	49121	20	7	45
May 15	49122	23	5	29
May 16	49123	21	9	50
May 17	49124	17	8	39
May 18	49125	12	10	42
May 19	49126	10	5	54
May 20	49127	13	12	59
May 21	49128	18	4	55
May 22	49129	18	5	34
May 23	49130	12	6	40
May 24	49131	-1	8	30
May 25	49132	-18	11	34
May 26	49133	-27	5	37
May 27	49134	-37	7	56
May 28	49135	-47	8	33
May 29	49136	-48	4	51
May 30	49137	-47	6	38
May 31	49138	-50	10	41

TABLE 12. (CONT.)

Date 1993 0h UTC	MJD	C0 (ns)	σ(ns) Block I	Block II
Jun 1	49139	-49	9	54
Jun 2	49140	-32	9	45
Jun 3	49141	-4	5	39
Jun 4	49142	19	2	42
Jun 5	49143	35	9	63
Jun 6	49144	51	5	44
Jun 7	49145	68	6	46
Jun 8	49146	80	11	44
Jun 9	49147	85	4	48
Jun 10	49148	87	10	57
Jun 11	49149	90	7	46
Jun 12	49150	104	-	-
Jun 13	49151	112	-	-
Jun 14	49152	115	5	33
Jun 15	49153	115	6	32
Jun 16	49154	114	8	36
Jun 17	49155	114	2	54
Jun 18	49156	111	6	57
Jun 19	49157	101	5	40
Jun 20	49158	86	5	52
Jun 21	49159	73	4	51
Jun 22	49160	63	6	42
Jun 23	49161	55	3	34
Jun 24	49162	49	7	57
Jun 25	49163	44	9	37
Jun 26	49164	42	12	54
Jun 27	49165	29	11	42
Jun 28	49166	14	7	31
Jun 29	49167	-5	1	29
Jun 30	49168	-20	10	35

TABLE 12. (CONT.)

Date 1993 0h UTC	MJD	CO (ns)	σ(ns) Block I	σ(ns) Block II
Jul 1	49169	-26	11	44
Jul 2	49170	-39	8	64
Jul 3	49171	-56	7	29
Jul 4	49172	-72	6	53
Jul 5	49173	-82	5	48
Jul 6	49174	-89	17	59
Jul 7	49175	-99	20	36
Jul 8	49176	-108	13	47
Jul 9	49177	-113	18	42
Jul 10	49178	-120	14	32
Jul 11	49179	-129	16	38
Jul 12	49180	-132	11	40
Jul 13	49181	-129	20	39
Jul 14	49182	-130	17	52
Jul 15	49183	-138	6	34
Jul 16	49184	-142	13	49
Jul 17	49185	-138	15	24
Jul 18	49186	-132	14	39
Jul 19	49187	-126	15	55
Jul 20	49188	-115	15	39
Jul 21	49189	-102	16	47
Jul 22	49190	-91	12	54
Jul 23	49191	-84	17	27
Jul 24	49192	-79	9	42
Jul 25	49193	-72	10	60
Jul 26	49194	-64	13	57
Jul 27	49195	-57	-	-
Jul 28	49196	-57	-	-
Jul 29	49197	-65	11	48
Jul 30	49198	-76	8	31
Jul 31	49199	-79	4	55

TABLE 12. (CONT.)

Date 1993 0h UTC	MJD	C0 (ns)	σ(ns) Block I	Block II
Aug 1	49200	-71	12	47
Aug 2	49201	-66	5	33
Aug 3	49202	-64	3	44
Aug 4	49203	-64	14	47
Aug 5	49204	-67	10	44
Aug 6	49205	-67	11	32
Aug 7	49206	-61	8	42
Aug 8	49207	-54	8	44
Aug 9	49208	-51	15	26
Aug 10	49209	-55	12	47
Aug 11	49210	-62	8	27
Aug 12	49211	-66	9	45
Aug 13	49212	-68	5	59
Aug 14	49213	-70	11	38
Aug 15	49214	-73	8	47
Aug 16	49215	-69	6	57
Aug 17	49216	-68	5	56
Aug 18	49217	-73	6	43
Aug 19	49218	-84	7	57
Aug 20	49219	-94	17	46
Aug 21	49220	-105	10	61
Aug 22	49221	-114	-	-
Aug 23	49222	-119	15	17
Aug 24	49223	-126	7	26
Aug 25	49224	-131	7	23
Aug 26	49225	-133	4	20
Aug 27	49226	-134	11	45
Aug 28	49227	-134	7	35
Aug 29	49228	-133	8	46
Aug 30	49229	-132	8	48
Aug 31	49230	-128	8	35

TABLE 12. (CONT.)

Date 1993 0h UTC	MJD	C0 (ns)	σ(ns) Block I	σ(ns) Block II
Sep 1	49231	-119	3	32
Sep 2	49232	-108	7	45
Sep 3	49233	-94	12	38
Sep 4	49234	-84	8	41
Sep 5	49235	-75	5	45
Sep 6	49236	-62	8	53
Sep 7	49237	-51	1	41
Sep 8	49238	-45	2	56
Sep 9	49239	-44	5	38
Sep 10	49240	-42	3	32
Sep 11	49241	-43	4	57
Sep 12	49242	-43	6	45
Sep 13	49243	-44	2	36
Sep 14	49244	-50	11	46
Sep 15	49245	-58	10	42
Sep 16	49246	-66	6	39
Sep 17	49247	-66	7	49
Sep 18	49248	-64	5	48
Sep 19	49249	-63	2	32
Sep 20	49250	-65	5	42
Sep 21	49251	-62	2	44
Sep 22	49252	-55	9	53
Sep 23	49253	-47	4	35
Sep 24	49254	-38	4	46
Sep 25	49255	-29	5	59
Sep 26	49256	-26	5	46
Sep 27	49257	-27	3	71
Sep 28	49258	-31	3	46
Sep 29	49259	-35	8	37
Sep 30	49260	-36	7	47

TABLE 12. (CONT.)

Date 1993 0h UTC	MJD	C0 (ns)	σ(ns) Block I	Block II
Oct 1	49261	-34	5	34
Oct 2	49262	-35	4	31
Oct 3	49263	-37	3	51
Oct 4	49264	-37	4	38
Oct 5	49265	-36	3	30
Oct 6	49266	-33	3	42
Oct 7	49267	-32	6	53
Oct 8	49268	-32	3	48
Oct 9	49269	-36	5	42
Oct 10	49270	-40	3	33
Oct 11	49271	-43	6	56
Oct 12	49272	-43	7	43
Oct 13	49273	-37	5	57
Oct 14	49274	-30	5	42
Oct 15	49275	-26	10	36
Oct 16	49276	-26	7	44
Oct 17	49277	-28	3	44
Oct 18	49278	-32	11	43
Oct 19	49279	-34	8	55
Oct 20	49280	-29	5	42
Oct 21	49281	-21	10	60
Oct 22	49282	-17	9	42
Oct 23	49283	-19	10	37
Oct 24	49284	-25	6	45
Oct 25	49285	-28	4	48
Oct 26	49286	-25	6	56
Oct 27	49287	-16	8	59
Oct 28	49288	-7	8	43
Oct 29	49289	-4	7	40
Oct 30	49290	-6	8	41
Oct 31	49291	-7	4	47

TABLE 12. (CONT.)

Date 1993 0h UTC	MJD	C0 (ns)	σ(ns) Block I	Block II
Nov 1	49292	-2	9	47
Nov 2	49293	0	8	60
Nov 3	49294	1	2	38
Nov 4	49295	1	8	44
Nov 5	49296	5	3	31
Nov 6	49297	14	6	40
Nov 7	49298	22	7	45
Nov 8	49299	27	3	30
Nov 9	49300	28	5	52
Nov 10	49301	26	4	25
Nov 11	49302	26	4	42
Nov 12	49303	27	5	31
Nov 13	49304	30	6	42
Nov 14	49305	32	4	44
Nov 15	49306	32	5	60
Nov 16	49307	30	2	36
Nov 17	49308	26	1	42
Nov 18	49309	26	1	21
Nov 19	49310	28	2	26
Nov 20	49311	30	2	37
Nov 21	49312	31	1	41
Nov 22	49313	34	5	42
Nov 23	49314	39	3	37
Nov 24	49315	46	9	43
Nov 25	49316	53	6	41
Nov 26	49317	55	3	47
Nov 27	49318	55	5	32
Nov 28	49319	57	5	45
Nov 29	49320	58	2	50
Nov 30	49321	55	4	50

TABLE 12. (CONT.)

Date 1993 0h UTC	MJD	CO (ns)	σ(ns) Block I	σ(ns) Block II
Dec 1	49322	50	4	25
Dec 2	49323	45	3	34
Dec 3	49324	41	5	48
Dec 4	49325	42	3	43
Dec 5	49326	47	0	41
Dec 6	49327	52	9	28
Dec 7	49328	58	7	23
Dec 8	49329	68	3	53
Dec 9	49330	76	6	61
Dec 10	49331	78	5	47
Dec 11	49332	79	4	42
Dec 12	49333	78	1	48
Dec 13	49334	83	9	36
Dec 14	49335	76	6	43
Dec 15	49336	74	3	44
Dec 16	49337	74	6	40
Dec 17	49338	75	6	34
Dec 18	49339	76	7	35
Dec 19	49340	80	7	45
Dec 20	49341	85	6	39
Dec 21	49342	85	3	55
Dec 22	49343	84	4	42
Dec 23	49344	86	8	44
Dec 24	49345	88	3	41
Dec 25	49346	91	4	59
Dec 26	49347	92	6	58
Dec 27	49348	96	4	41
Dec 28	49349	98	7	40
Dec 29	49350	99	6	39
Dec 30	49351	101	7	32
Dec 31	49352	100	7	55
Jan 1	49353	89	4	36

Table 13. [UTC - GLONASS time]

(File available via INTERNET under the name UTCGLO93.AR)

The GLONASS satellites disseminate a common time scale designated as 'GLONASS time'. The relation between UTC and GLONASS time can be written as : [UTC - GLONASS time] = C1 (modulo 1 s).

From his current observation of both the GPS and GLONASS satellite systems Prof. P. Daly, University of Leeds, establishes and reports [GPS time - GLONASS time] at ten-day intervals, together with the standard deviation σ of his daily GLONASS data. C1 is then derived using [UTC - GPS time] of Table 12.

Date 1993 0h UTC	MJD	C1 (μs)	σ (μs)
Jan 2	48989	-12.99	0.05
Jan 12	48999	-13.11	0.05
Jan 22	49009	-13.07	0.05
Feb 1	49019	-13.15	0.04
Feb 11	49029	-13.22	0.04
Feb 21	49039	-13.34	0.05
Mar 3	49049	-13.40	0.05
Mar 13	49059	-13.46	0.07
Mar 23	49069	-13.53	0.04
Apr 2	49079	-13.68	0.04
Apr 12	49089	-13.81	0.04
Apr 22	49099	-13.94	0.10
May 2	49109	-14.12	0.05
May 12	49119	-14.29	0.05
May 22	49129	-14.43	0.06
Jun 1	49139	-14.62	0.05
Jun 11	49149	-14.71	0.05
Jun 21	49159	-14.81	0.04
Jul 1	49169	-14.88	0.05
Jul 11	49179	-14.98	0.04
Jul 21	49189	-15.00	0.15
Jul 31	49199	-15.09	0.05
Aug 10	49209	-15.17	0.04
Aug 20	49219	-15.33	0.04
Aug 30	49229	-15.57	0.10
Sep 9	49239	-15.69	0.03
Sep 19	49249	-15.84	0.03
Sep 29	49259	-16.00	0.04
Oct 9	49269	-16.15	0.04
Oct 19	49279	-16.45	0.04
Oct 29	49289	-16.78	0.04
Nov 8	49299	-17.08	0.04
Nov 18	49309	-17.43	0.03
Nov 28	49319	-17.84	0.04
Dec 8	49329	-18.29	0.04
Dec 18	49339	-18.50	0.04
Dec 28	49349	-18.92	0.04

TABLE 14A. RATES RELATIVE TO TAI OF CONTRIBUTING CLOCKS IN 1993

(File available via INTERNET under the name RTAI93.AR)

Mean clock rates relative to TAI are computed for two-month intervals ending at the dates given in the table.
When an intentional frequency adjustment has been applied to a clock, the data prior to this adjustment are corrected, so that Table 14A gives homogeneous rates for the whole year 1993. For studies including the clock rates of previous years, corrections must be brought to the data published in the Annual Reports for 1988, 1989, 1990, 1991 and 1992 and in the BIH Annual Reports for the previous years. These corrections are given in Table 14B.
Unit is ns/day, *** denotes that the clock was not used.

LAB.	CLOCK		49039	49099	49159	49229	49289	49349
AOS	19	7	32.39	-58.50	-4.26	***	***	***
AOS	23	67	***	***	***	***	5.91	-1.07
APL	14	793	3.15	4.89	6.61	13.15	11.39	0.91
APL	31	571	1.96	11.28	4.13	4.43	1.23	-0.38
APL	40	3101	3.29	3.11	2.86	1.05	7.80	3.64
APL	40	3102	4.40	1.87	2.81	2.22	8.48	1.99
APL	40	3106	4.70	1.82	2.22	3.27	9.38	0.44
AUS	12	590	***	***	***	86.14	74.88	***
AUS	12	1708	***	***	***	-33.36	***	***
AUS	12	1823	92.73	***	***	***	***	***
AUS	14	902	71.22	***	***	***	***	***
AUS	14	1307	26.65	***	***	***	***	***
AUS	14	1695	***	***	0.42	-10.18	-2.31	***
AUS	14	1717	***	***	-40.52	-15.33	-10.59	***
AUS	14	1844	91.54	81.34	***	71.82	86.52	87.99
AUS	14	2010	-111.03	-108.98	***	-114.11	-118.10	-109.16
AUS	21	258	***	***	***	***	***	56.26
AUS	36	207	***	***	-4.07	-1.85	-0.54	3.28
AUS	40	5401	24.60	28.48	25.18	28.87	25.87	28.97
AUS	44	2	56.23	60.72	56.57	60.47	56.50	58.53
BEV	16	71	***	-96.83	-103.32	***	-123.23	-120.75
CAO	16	183	-40.81	-38.08	-31.75	***	-25.10	-21.20
CAO	23	62	-55.76	-63.64	-81.02	***	-46.81	***
CAO	30	384	176.59	178.13	128.17	***	-117.77	***
CH	12	285	10.47	***	114.43	126.58	121.87	130.29
CH	16	64	-70.93	-71.68	-71.85	-76.39	-69.76	-62.55
CH	16	69	-156.55	-150.16	-152.07	-153.08	-180.67	-186.59
CH	16	77	-65.42	-64.31	-63.53	-64.13	-54.49	-61.81
CH	16	140	38.56	34.82	24.16	20.01	25.34	37.68
CH	17	206	-53.91	-58.47	-42.48	-38.68	-32.77	-26.96
CH	21	179	19.33	21.39	20.27	23.95	34.56	51.99
CH	21	194	-96.99	-94.49	-84.68	-85.73	-93.09	-91.90
CH	21	217	46.78	45.78	64.09	62.44	59.43	60.06
CH	21	243	16.12	29.24	5.53	11.27	13.94	64.75
CH	31	403	-16.62	-13.73	-15.56	-12.41	-12.24	-16.27

TABLE 14A. (CONT.)

LAB.	CLOCK		49039	49099	49159	49229	49289	49349
CRL	14	764	3.72	3.25	1.19	8.03	11.83	2.98
CRL	14	865	-40.15	-41.15	-42.37	***	***	***
CRL	14	932	-276.23	-272.86	-269.70	-269.36	-267.27	-269.50
CRL	14	1729	-46.31	-46.04	-40.12	-31.83	-36.22	-64.79
CRL	14	2456	24.48	25.65	25.37	28.04	30.67	28.27
CRL	31	305	62.44	78.07	***	***	***	***
CRL	34	131	-291.57	-286.37	-291.97	-298.41	-289.84	-290.87
CRL	35	144	1.50	2.01	2.15	2.29	2.09	2.78
CSAO	12	1646	-83.03	-80.19	-96.09	-110.05	-131.92	-164.81
CSAO	12	1648	57.69	60.18	59.42	49.57	47.31	42.49
CSAO	12	2068	178.10	137.38	118.33	101.35	113.62	97.00
CSAO	40	4902	-98.07	-81.75	-68.83	-35.84	-69.23	3.25
F	12	206	-258.65	-261.32	-249.81	-238.39	***	***
F	12	2405	98.18	108.58	112.30	98.96	99.37	102.98
F	14	51	-124.39	-130.29	-130.58	-132.77	-131.88	-132.60
F	14	134	105.81	96.89	106.46	85.45	72.12	61.98
F	14	158	64.89	68.23	65.84	81.03	91.03	93.41
F	14	195	-111.78	-114.79	-119.26	-127.54	-126.39	-123.70
F	14	347	-93.82	-90.04	-105.53	-142.69	***	***
F	14	475	-39.95	-40.12	-43.03	-45.55	-43.02	-39.18
F	14	500	-8.02	-9.72	-9.99	-3.19	-7.13	-6.80
F	14	560	-90.10	-87.80	-87.63	-88.45	-84.40	-85.33
F	14	594	-62.06	-53.59	-65.97	-71.47	-66.68	***
F	14	753	-34.60	-34.93	-35.65	-42.45	-41.51	-38.78
F	14	1120	-56.55	-57.69	-54.37	-50.81	-53.37	-54.31
F	14	1407	-47.88	-48.89	-45.85	-46.35	-48.06	-50.06
F	14	1645	32.49	***	***	31.03	33.18	32.95
F	14	1712	-79.71	***	***	***	***	***
F	14	1842	-5.47	-5.27	***	***	***	***
F	16	106	-15.19	-14.30	***	***	***	-8.77
F	16	187	-5.82	-12.40	-10.19	-7.25	-11.64	***
F	17	489	31.87	27.51	28.03	42.75	43.78	51.02
F	35	124	***	***	0.87	1.38	1.11	***
F	35	131	***	***	***	***	***	15.35
F	35	158	***	***	***	10.00	9.33	10.72
F	35	172	***	***	-2.27	-2.80	-2.78	-1.71
IEN	12	303	***	***	***	***	-95.79	-96.46
IEN	14	469	-253.86	-238.14	-239.17	-238.02	-238.82	-239.51
IEN	14	893	1.59	1.61	4.60	19.33	21.17	19.54
IEN	31	659	-54.96	-52.49	-56.12	-49.16	-50.29	-48.33
IEN	35	219	***	***	***	3.36	3.58	3.60
IFAG	14	1105	-19.38	-18.42	8.15	2.37	-14.97	-42.03
IFAG	16	131	-11.99	-10.98	-14.72	-16.69	-19.54	-16.01
IFAG	16	138	132.61	128.96	78.47	51.96	68.72	132.31
IFAG	16	173	153.61	145.73	90.33	97.76	124.52	166.89

TABLE 14A. (CONT.)

LAB.	CLOCK	49039	49099	49159	49229	49289	49349
IGMA	14 2407	-113.34	-82.11	-96.07	-100.58	-101.73	-102.97
IGMA	16 112	-10.13	-7.23	-23.48	-25.82	-34.96	-20.48
IGMA	17 127	60.42	66.88	52.78	41.06	32.85	30.85
INPL	14 2308	***	-28.64	-18.32	2.15	0.69	-2.12
INPL	14 2426	-38.77	-52.08	-66.12	***	14.81	22.66
INPL	31 145	-40.60	-54.98	-49.68	-48.00	-75.87	-78.94
INPL	31 619	-15.54	-15.27	-15.56	-16.23	-19.37	-27.95
KRIS	12 1406	-29.20	-29.40	-56.36	-59.49	-51.51	-36.99
KRIS	12 1902	-28.95	-21.87	-9.40	5.39	8.24	16.87
KRIS	12 1903	-34.70	-48.30	-50.47	-44.55	-22.12	-14.81
KRIS	21 280	66.80	68.60	54.39	44.32	50.84	59.73
KRIS	21 282	24.08	19.27	0.61	***	***	***
LDS	12 202	103.77	116.20	111.75	***	***	***
LDS	14 868	-128.67	-107.28	-142.21	***	***	***
LDS	35 289	***	***	***	***	***	-2.20
MSL	12 381	***	-10.37	-18.28	-31.79	-11.08	***
MSL	12 933	***	3.97	-6.23	-13.23	-10.49	***
MSL	12 1770	***	-401.54	-396.51	-301.98	-27.71	***
MSL	36 274	***	***	***	***	14.49	***
NAOM	14 885	-42.65	-44.74	-43.41	***	***	-6.16
NAOM	14 1315	-55.00	-57.05	-56.57	-55.62	-47.52	-46.04
NAOM	34 2146	***	***	***	-80.57	-80.05	-76.44
NAOT	14 614	-201.94	-233.13	***	***	***	***
NAOT	14 1498	-137.29	-138.91	-139.72	-139.45	***	***
NAOT	31 283	-141.34	-146.25	-154.60	***	***	***
NAOT	31 284	-178.27	-175.58	-184.68	-184.40	-186.20	-184.33
NAOT	34 1075	6.69	-5.62	-18.40	-20.28	-20.16	-21.11
NAOT	34 2494	6.71	13.76	16.09	14.85	-5.61	-24.27
NIM	12 1615	-471.07	-477.18	-473.75	-467.12	-464.76	-456.69
NIM	12 1633	7.91	6.73	5.61	7.89	9.03	17.46
NIM	12 1640	-2.69	-3.96	-4.86	-3.02	-0.74	7.55
NIST	13 61	-98.52	-96.38	-97.14	-93.69	-90.06	-90.10
NIST	14 324	-53.28	-55.90	-58.03	-59.60	-30.74	-34.65
NIST	14 601	10.05	8.31	12.66	11.92	10.49	9.80
NIST	14 1316	-40.75	-40.72	-41.63	-40.75	-40.56	-35.68
NIST	16 217	31.33	28.27	25.43	26.63	20.53	36.30
NIST	18 1007	-129.22	-126.52	-124.02	-123.26	-123.57	-122.67
NIST	31 569	-107.59	-108.59	-110.44	-112.64	-115.13	-116.19
NIST	34 493	-81.08	-82.34	-84.15	-84.45	-83.93	-85.87
NIST	35 132	-6.30	-5.85	-6.08	-6.17	-7.33	-6.34
NIST	35 182	***	-3.99	-5.40	-5.50	-6.73	-5.93
NIST	40 201	3.84	4.12	***	***	4.06	5.40
NMC	30 2740	-60.20	***	***	***	***	***
NPL	12 316	-68.21	-41.07	-44.68	-39.82	-60.32	-33.65
NPL	14 418	-17.23	-11.33	-11.81	-14.71	-18.18	-20.03

TABLE 14A. (CONT.)

LAB.	CLOCK		49039	49099	49159	49229	49289	49349
NPL	14	1334	-151.76	-151.67	-151.42	-150.32	-155.31	-156.68
NPL	14	1813	-24.44	-24.57	-24.55	-22.77	-15.53	-23.44
NPL	14	2064	-22.19	-27.44	-23.24	-20.11	-17.69	-23.63
NPL	31	328	-63.55	-61.88	86.32	57.94	10.69	-49.40
NPL	35	123	***	***	2.03	1.63	1.43	2.51
NPL	40	1701	-0.12	-0.86	-2.50	-3.91	-4.60	-4.18
NRC	14	267	-288.50	-310.76	-316.17	-301.67	-316.56	-335.46
NRC	35	234	***	***	3.02	3.72	2.93	3.81
NRC	90	63	15.50	9.26	10.36	6.86	7.16	9.97
NRLM	14	1632	-22.43	-24.38	-23.15	-26.06	-27.76	-27.98
NRLM	31	310	-83.72	***	***	***	***	***
NRLM	31	312	236.14	265.99	246.18	262.54	296.25	295.72
NRLM	35	224	***	***	15.55	15.40	14.73	13.61
OMH	12	1067	***	***	***	***	7.31	13.28
ONBA	12	227	-121.63	-114.79	-54.68	-129.30	***	***
ONBA	12	540	273.25	326.85	215.77	202.28	***	***
ORB	12	205	***	***	***	***	***	-25.79
ORB	21	312	-0.19	-3.47	8.49	12.78	17.78	13.79
ORB	35	201	***	2.13	-2.84	-1.64	-3.55	-2.70
ORB	35	202	***	2.83	3.96	-1.93	7.86	2.23
ORB	40	2601	***	***	***	***	-21.31	***
PKNM	14	1144	-40.40	-49.81	-44.45	-33.43	-25.90	-35.30
PKNM	30	652	-67.36	-71.45	-41.29	-48.53	-50.47	-55.95
PKNM	30	664	-173.43	-160.88	-150.47	-161.02	-171.02	-181.66
PTB	14	394	-32.20	-35.54	-30.37	-21.33	-24.04	-23.84
PTB	14	1103	-68.15	-67.23	-61.28	-57.56	-59.77	-63.69
PTB	14	2379	-54.34	-58.12	-54.14	-48.18	-51.05	-57.19
PTB	35	128	17.08	17.44	16.75	16.01	15.28	15.96
PTB	35	271	***	***	***	0.30	-1.80	-1.26
PTB	40	502	11.83	12.26	11.35	11.05	10.49	11.56
PTB	40	505	11.90	12.55	11.99	11.80	13.76	13.21
PTB	40	537	***	***	***	***	-28.44	-23.44
PTB	92	1	-0.31	-1.08	0.66	0.24	-0.62	2.02
PTB	92	2	0.24	0.92	-0.56	-0.36	-1.00	-0.51
RC	40	6477	***	-11.78	-40.25	***	***	***
RC	40	6482	-9.66	-3.11	-26.49	***	***	***
RC	40	6483	-71.67	-71.54	-92.21	***	***	***
ROA	14	896	-11.16	-11.52	-12.23	-10.55	-10.34	-15.06
ROA	14	1569	70.85	76.12	***	***	***	***
ROA	16	113	35.77	32.70	29.78	35.30	39.46	48.72
ROA	16	121	130.32	122.93	114.84	115.47	124.11	110.38
ROA	16	177	-22.66	-14.71	-12.04	***	***	***
ROA	31	422	-10.30	-13.38	-12.55	-11.83	-11.56	-8.39
SNT	14	900	-48.47	-44.03	-51.34	-68.63	-66.51	-61.95
SNT	14	1376	-124.90	-123.44	-120.05	-119.68	-110.81	-109.64

TABLE 14A. (CONT.)

LAB.	CLOCK		49039	49099	49159	49229	49289	49349
SNT	16	137	-22.97	-17.90	-26.03	-27.93	-24.99	-24.40
SO	12	2067	-62.08	-60.11	-67.83	-70.46	-63.16	-73.09
SO	16	180	83.34	82.14	93.57	***	***	***
SO	40	5101	***	-102.40	-25.20	-104.42	-61.84	-59.87
SU	40	3803	4.43	4.52	4.06	4.41	4.63	5.21
SU	40	3804	-20.38	-20.11	-21.82	-21.74	-20.99	-19.84
SU	40	3805	-27.25	-27.11	-27.42	-27.52	-27.66	-27.08
SU	40	3806	-9.47	-8.57	-8.87	-8.65	-8.12	-7.04
SU	40	3807	***	***	-4.59	-3.14	***	***
SU	40	3808	***	***	6.20	5.51	***	***
TL	12	1455	-208.90	-208.62	-209.48	10.39	-120.65	-84.01
TL	12	2276	-49.79	***	***	***	***	***
TL	31	317	-35.47	-39.60	-23.62	-37.35	-43.00	-30.95
TL	35	160	***	***	4.83	6.17	6.19	6.04
TP	12	335	-88.60	-90.98	-92.96	-96.44	-102.25	-104.20
TP	17	101	73.70	83.54	61.60	6.97	***	***
TP	36	154	***	***	***	***	14.17	13.01
TP	36	163	***	***	***	***	8.59	9.65
TUG	14	1654	28.40	29.49	26.54	29.07	30.54	29.26
TUG	18	108	579.63	595.38	601.38	622.91	637.69	661.76
TUG	35	107	1.26	2.31	2.11	1.91	***	***
TUG	35	247	***	***	***	8.44	6.67	7.26
USNO	14	444	49.98	37.62	***	***	***	***
USNO	14	532	-225.16	-272.20	***	***	-178.16	-195.00
USNO	14	583	***	***	47.91	***	***	***
USNO	14	654	-90.97	-95.09	-91.50	-87.27	-75.05	-76.73
USNO	14	656	45.53	43.92	45.28	***	***	101.36
USNO	14	752	***	112.65	128.14	***	103.31	112.12
USNO	14	783	104.41	108.84	99.24	***	***	***
USNO	14	837	***	***	***	***	***	-132.84
USNO	14	862	8.21	-0.13	-3.76	-6.72	-22.17	***
USNO	14	1035	-67.12	-68.34	-68.80	-72.25	***	***
USNO	14	1094	-80.63	-70.05	-71.02	-73.18	-75.93	***
USNO	14	1100	-130.37	-131.85	-135.50	-144.43	-151.00	-153.79
USNO	14	1114	-120.83	36.51	***	***	***	***
USNO	14	1255	-43.74	-45.77	-40.17	***	-50.69	-48.35
USNO	14	1264	58.91	64.50	***	***	***	61.61
USNO	14	1300	-164.65	-145.30	-144.23	-151.23	-139.90	-137.36
USNO	14	1301	-106.58	-111.30	***	***	***	-34.18
USNO	14	1423	-44.64	-43.68	-47.53	-46.46	-26.81	-29.69
USNO	14	1653	14.88	13.42	***	***	***	-43.13
USNO	14	1809	-102.50	-100.83	***	***	***	***
USNO	14	1846	-53.46	-54.01	***	***	***	***
USNO	14	2312	127.84	159.02	***	***	***	***
USNO	14	2314	23.99	21.18	16.36	11.91	2.15	1.05

TABLE 14A. (CONT.)

LAB.	CLOCK	49039	49099	49159	49229	49289	49349
USNO	14 2481	-34.27	-22.29	-27.41	-41.00	-61.84	-69.91
USNO	14 2482	-359.26	-372.69	-381.95	-401.51	***	-86.89
USNO	14 2483	42.81	46.67	49.27	53.92	55.76	***
USNO	14 2484	-66.21	-68.30	-79.57	***	***	-74.98
USNO	14 2485	48.22	33.69	41.81	***	***	40.64
USNO	31 333	-8.74	-11.38	-19.93	***	***	***
USNO	31 335	63.94	***	***	***	***	***
USNO	31 336	-200.99	***	***	***	***	-157.96
USNO	31 337	57.78	66.17	76.44	83.26	76.14	***
USNO	31 338	31.88	-7.49	***	***	***	***
USNO	31 340	-10.95	-13.87	-16.28	-24.77	-23.81	-20.08
USNO	31 341	***	***	***	***	***	-35.75
USNO	31 426	-115.46	-116.10	***	***	***	***
USNO	31 527	-63.78	***	***	***	***	1.13
USNO	34 651	***	-37.57	-37.39	-36.91	-46.11	-66.41
USNO	34 653	***	***	***	***	***	-27.14
USNO	34 2100	***	***	***	***	***	2.01
USNO	34 2313	***	47.56	46.37	43.74	40.30	***
USNO	34 2315	***	***	***	***	***	-6.16
USNO	34 2486	***	***	***	-3.62	0.26	1.18
USNO	34 2488	***	***	***	***	***	-58.58
USNO	35 101	-4.28	-4.18	-5.47	***	***	***
USNO	35 104	21.42	23.49	22.05	***	***	***
USNO	35 106	17.76	15.40	14.33	14.15	13.10	***
USNO	35 108	14.57	15.71	15.56	15.32	13.89	14.50
USNO	35 114	16.62	17.37	16.06	15.91	15.21	16.15
USNO	35 142	-0.67	-0.74	1.30	1.95	2.67	3.19
USNO	35 145	-2.59	-2.89	-3.14	-2.57	-1.64	-0.21
USNO	35 146	2.99	2.10	1.17	0.49	0.08	1.11
USNO	35 148	-15.24	-14.24	-15.48	-16.01	-17.76	-15.94
USNO	35 150	23.89	23.07	21.09	21.38	21.06	22.52
USNO	35 152	5.03	3.90	3.10	2.73	2.12	4.31
USNO	35 153	***	***	17.77	17.66	18.48	19.11
USNO	35 156	13.69	8.78	6.05	5.60	5.29	6.16
USNO	35 161	***	3.97	2.93	2.77	2.91	3.19
USNO	35 164	***	6.50	5.60	4.93	5.83	6.19
USNO	35 165	***	***	19.30	19.68	19.16	19.80
USNO	35 166	***	-2.92	-4.42	-3.83	-3.93	-3.94
USNO	35 167	***	12.15	10.93	10.66	11.06	11.17
USNO	35 169	***	***	-8.17	-8.12	-9.31	-8.12
USNO	35 171	***	13.72	13.10	12.49	11.84	12.73
USNO	35 213	***	***	-10.52	-10.88	-11.86	-10.27
USNO	35 217	***	***	-6.35	-7.49	-8.02	-6.89
USNO	35 225	***	***	***	***	7.87	7.17
USNO	35 226	***	***	***	***	-1.58	-1.28

TABLE 14A. (CONT.)

LAB.	CLOCK	49039	49099	49159	49229	49289	49349
USNO	35 227	***	***	***	***	7.94	8.21
USNO	35 229	***	***	***	***	11.17	11.75
USNO	35 231	***	***	***	***	-26.56	-25.86
USNO	35 233	***	***	***	***	-0.80	-0.54
USNO	35 242	***	***	***	***	12.49	13.24
USNO	35 244	***	***	***	***	13.31	13.93
USNO	35 249	***	***	***	***	-7.12	-6.34
USNO	35 253	***	***	***	***	-9.93	-9.23
USNO	35 254	***	***	***	***	-0.79	-1.25
USNO	35 255	***	***	***	***	-8.28	-9.48
USNO	35 256	***	***	***	***	***	-16.52
USNO	35 260	***	***	***	***	6.31	5.82
USNO	35 266	***	***	***	***	1.14	***
USNO	35 268	***	***	***	***	2.89	2.65
USNO	35 270	***	***	***	***	12.73	9.78
USNO	35 279	***	***	***	***	***	-16.91
USNO	40 702	***	0.26	-2.34	***	***	0.87
USNO	40 703	***	1.82	0.31	0.03	2.14	3.74
USNO	40 704	-54.10	-54.17	-55.20	-55.70	-56.10	-55.11
USNO	40 705	-30.70	-30.95	-31.55	-31.45	-31.66	-30.40
USNO	40 708	-7.65	-10.27	***	***	-17.75	***
USNO	40 709	***	***	***	***	***	-40.34
USNO	40 710	***	***	***	***	-23.44	-24.61
USNO	40 718	-3.98	-7.27	-9.30	-10.00	-15.71	-20.40
USNO	40 719	***	-5.75	-10.98	-16.22	-21.24	-23.25
USNO	40 722	6.38	1.29	-5.43	-12.73	***	***
USNO	40 723	41.35	36.28	30.18	24.15	18.17	12.86
USNO	40 6201	***	***	***	8.04	***	8.43
VSL	12 1489	-64.39	-37.57	-37.22	-57.83	-64.35	-45.75
VSL	14 1034	-57.58	-59.34	-56.65	-48.91	-55.34	-60.86
VSL	21 125	57.42	63.82	61.57	***	61.06	68.46
VSL	31 288	-44.75	-47.22	-44.37	-43.08	-43.64	-23.86
VSL	35 179	***	22.84	23.43	23.47	23.04	23.55

The clocks are designated by their type (2 digits) and serial number in the type. The codes for the types are:

12 HEWLETT-PACKARD 5061A
13 EBAUCHES, OSCILLATOM B5000
14 HEWLETT-PACKARD 5061A OPT. 4
16 OSCILLOQUARTZ 3200
17 OSCILLOQUARTZ 3000
18 FREQ. AND TIME SYSTEMS INC. 4000
19 RHODE AND SCHWARZ XSC
4x HYDROGEN MASERS
21 OSCILLOQUARTZ 3210
23 OSCILLOQUARTZ EUDICS 3020
30 HEWLETT-PACKARD 5061B
31 HEWLETT-PACKARD 5061B OPT. 4
34 H-P 5061A/B WITH 5071A TUBE
35 HEWLETT-PACKARD 5071A High perf.
36 HEWLETT-PACKARD 5071A Low. perf.
9x PRIMARY CLOCKS AND PROTOTYPES

TABLE 14B. CORRECTIONS FOR AN HOMOGENEOUS USE OF THE CLOCK RATES PUBLISHED IN THE CURRENT AND PREVIOUS ANNUAL REPORTS.

Each line refers to the same clock working without interruption.

	1993	1992		1991		1990	
	clock n°	clock n°	corr. (ns/d)	clock n°	corr. (ns/d)	clock n°	corr. (ns/d)
APL	40 3101	40 3101		40 3101	+18.00	40 3101(1)	+7.00
	40 3102	40 3102		40 3102	+12.00	40 3102	+8.00
	40 3106	40 3106		40 3106	+10.00	40 3106(2)	+10.00
CH	16 69	16 69		16 69	-28.00	16 69(3)	-28.00
CRL	14 764	14 764		14 764		14 764(4)	+40.02
	14 1729	14 1729		14 1729		14 1729(5)	+51.40
	14 865	14 865	+23.39	14 865	+23.39	14 865(6)	+23.39
CSAO	12 1646	12 1646		12 1646	+31.60	12 1646(7)	+31.60
	12 1648	12 1648		12 1648		12 1648(8)	
IFAG	14 1105	14 1105	+27.00				
NIST	13 61	13 61		13 61	-25.32	13 61(9)	-25.32
	14 324	14 324		14 324		14 324	+17.07
	14 601	14 601		14 601	+17.28		
	14 1316	14 1316		14 1316		14 1316(10)	+10.70
	16 217	16 217		16 217		16 217(11)	+58.63
NPL	40 1701	40 1701		40 1701	+27.00		
ROA	14 1569	14 1569		14 1569		14 1569(12)	
	16 177	16 177		16 177		16 177(13)	
SNT	14 900	14 900	+14.00	14 900	+14.00	14 900(14)	+14.00
SU	40 3806	40 3806	-13.00	40 3806	-13.00		
VSL	31 288	31 288		31 288	-30.00		

(1) A correction of +7.0 ns/d has to be applied for the last two-month interval of 1989.
(2) A correction of +10.0 ns/d has to be applied for the last two-month interval of 1989.
(3) A correction of -28.00 ns/d has to be applied in 1989.
(4) A correction of +40.02 ns/d has to be applied for the last five two-month intervals of 1989.
(5) A correction of +51.40 ns/d has to be applied in 1989, 1988 and for the last two-month interval of 1987.
(6) A correction of +23.39 ns/d has to be applied in 1989, 1988 and for the last two-month interval of 1987.
(7) A correction of +31.60 ns/d has to be applied in 1989 and 1988.
A correction of +73.20 ns/d has to be applied in 1987 and for the last three two-month intervals of 1986.
(8) A correction of +98.60 ns/d has to be applied in 1988, 1987, 1986 and 1985.
(9) A correction of -25.32 ns/d has to be applied in 1989.

(10) A correction of +27.63 ns/d has to be applied in 1989, 1988, 1987, 1986, 1985 and for the last three two-month intervals of 1984.
(11) A correction of +52.50 ns/d has to be applied in 1989 and 1988.
(12) A correction of -13.00 ns/d has to be applied in 1987 and 1986.
(13) A correction of +46.00 ns/d has to be applied in 1987, 1986, 1985 and for the last two-month interval of 1984.
(14) A correction of +14.00 ns/d has to be applied in 1989, 1988, 1987, 1986, 1985 and 1984.

TABLE 15A. WEIGHTS OF CONTRIBUTING CLOCKS IN 1993

(File available via INTERNET under the name WTAI93.AR)

Clock weights are computed for two-month intervals ending at the dates given in the table.
Since 1988 January 1st, the absolute weight of a given clock cannot exceed the value 100. For the year 1993, it corresponds to a maximum relative weight of about 1.4 %.

*** denotes that the clock was not used.

LAB.	CLOCK		49039	49099	49159	49229	49289	49349
AOS	19	7	1	1	1	***	***	***
AOS	23	67	***	***	***	***	0	0
APL	14	793	5	5	5	12	11	42
APL	31	571	6	7	8	12	17	63
APL	40	3101	6	6	15	100	100	100
APL	40	3102	5	5	14	100	100	100
APL	40	3106	4	4	14	100	100	98
AUS	12	590	***	***	***	0	0	***
AUS	12	1708	***	***	***	0	***	***
AUS	12	1823	20	***	***	***	***	***
AUS	14	902	0	***	***	***	***	***
AUS	14	1307	23	***	***	***	***	***
AUS	14	1695	***	***	0	0	17	***
AUS	14	1717	***	***	0	0	2	***
AUS	14	1844	16	19	***	0	0	6
AUS	14	2010	94	100	***	0	0	25
AUS	21	258	***	***	***	***	***	0
AUS	36	207	***	***	0	0	100	70
AUS	40	5401	100	100	100	100	100	100
AUS	44	2	100	100	100	100	100	100
BEV	16	71	***	0	0	***	0	0
CAO	16	183	12	50	33	***	0	0
CAO	23	62	3	3	3	***	0	***
CAO	30	384	13	20	0	***	0	***
CH	12	285	1	***	0	0	13	14
CH	16	64	2	6	100	100	100	0
CH	16	69	65	97	100	100	0	4
CH	16	77	7	14	38	100	0	59
CH	16	140	0	59	19	15	21	17
CH	17	206	67	86	0	17	9	7
CH	21	179	100	100	100	100	0	0
CH	21	194	0	0	0	16	26	39
CH	21	217	100	98	0	9	11	15
CH	21	243	3	2	2	2	11	0
CH	31	403	100	100	100	100	100	100

TABLE 15A. (CONT.)

LAB.	CLOCK		49039	49099	49159	49229	49289	49349
CRL	14	764	83	100	100	100	47	61
CRL	14	865	100	100	100	***	***	***
CRL	14	932	38	37	40	65	70	86
CRL	14	1729	100	100	100	0	22	0
CRL	14	2456	52	49	88	100	100	100
CRL	31	305	2	1	***	***	***	***
CRL	34	131	0	3	5	6	9	68
CRL	35	144	0	0	100	100	100	100
CSAO	12	1646	3	4	3	3	2	1
CSAO	12	1648	56	49	43	27	23	19
CSAO	12	2068	19	0	1	1	1	1
CSAO	40	4902	9	10	9	0	2	1
F	12	206	26	23	31	15	***	***
F	12	2405	0	18	16	22	29	29
F	14	51	100	100	100	100	99	100
F	14	134	1	1	2	2	5	3
F	14	158	100	100	100	0	9	6
F	14	195	0	6	7	7	9	26
F	14	347	14	42	28	0	***	***
F	14	475	31	28	27	64	100	100
F	14	500	100	100	100	94	100	100
F	14	560	100	100	100	100	100	100
F	14	594	52	18	20	24	29	***
F	14	753	100	100	100	100	84	93
F	14	1120	100	100	100	100	100	100
F	14	1407	22	49	100	100	100	100
F	14	1645	80	***	***	0	0	100
F	14	1712	27	***	***	***	***	***
F	14	1842	11	14	***	***	***	***
F	16	106	100	100	***	***	***	0
F	16	187	0	11	10	8	23	***
F	17	489	5	4	5	12	17	10
F	35	124	***	***	0	0	100	***
F	35	131	***	***	***	***	***	0
F	35	158	***	***	***	0	0	100
F	35	172	***	***	0	0	100	100
IEN	12	303	***	***	***	***	0	0
IEN	14	469	0	18	19	23	24	25
IEN	14	893	47	46	46	0	11	10
IEN	31	659	100	100	100	100	100	93
IEN	35	219	***	***	***	0	0	100
IFAG	14	1105	3	3	3	5	7	3
IFAG	16	131	57	100	100	100	100	100
IFAG	16	138	1	1	1	1	1	1
IFAG	16	173	1	1	1	1	1	1

Table 15A. (Cont.)

LAB.	CLOCK	49039	49099	49159	49229	49289	49349
IGMA	14 2407	0	0	0	0	0	0
IGMA	16 112	0	0	0	0	0	0
IGMA	17 127	0	0	0	0	0	0
INPL	14 2308	***	0	0	2	3	4
INPL	14 2426	5	4	4	***	0	0
INPL	31 145	6	3	4	5	3	4
INPL	31 619	0	0	100	100	100	0
KRIS	12 1406	0	0	0	2	4	6
KRIS	12 1902	0	0	5	3	3	3
KRIS	12 1903	0	0	7	14	6	5
KRIS	21 280	0	0	0	5	8	12
KRIS	21 282	0	0	0	***	***	***
LDS	12 202	0	0	12	***	***	***
LDS	14 868	0	0	2	***	***	***
LDS	35 289	***	***	***	***	***	0
MSL	12 381	***	0	0	4	7	***
MSL	12 933	***	0	0	7	12	***
MSL	12 1770	***	0	0	0	0	***
MSL	36 274	***	***	***	***	0	***
NAOM	14 885	100	100	100	***	***	0
NAOM	14 1315	100	80	66	80	72	40
NAOM	34 2146	***	***	***	0	0	99
NAOT	14 614	0	0	***	***	***	***
NAOT	14 1498	100	100	100	100	***	***
NAOT	31 283	4	5	8	***	***	***
NAOT	31 284	61	84	42	36	61	61
NAOT	34 1075	0	13	6	7	8	8
NAOT	34 2494	66	66	48	38	0	0
NIM	12 1615	0	0	52	35	32	18
NIM	12 1633	0	0	100	100	100	0
NIM	12 1640	0	0	100	100	100	0
NIST	13 61	22	22	31	68	52	70
NIST	14 324	42	71	49	59	0	6
NIST	14 601	100	100	100	100	100	100
NIST	14 1316	0	32	32	42	88	100
NIST	16 217	47	49	46	54	37	35
NIST	18 1007	4	5	6	11	23	100
NIST	31 569	100	100	100	100	100	91
NIST	34 493	100	100	100	100	100	100
NIST	35 132	100	100	100	100	100	100
NIST	35 182	***	0	0	100	100	100
NIST	40 201	100	100	***	***	0	0
NMC	30 2740	0	***	***	***	***	***
NPL	12 316	8	0	2	1	3	6
NPL	14 418	52	67	83	100	100	83

TABLE 15A. (CONT.)

LAB.	CLOCK		49039	49099	49159	49229	49289	49349
NPL	14	1334	100	79	75	100	100	100
NPL	14	1813	14	11	10	16	52	76
NPL	14	2064	57	30	30	63	86	84
NPL	31	328	1	0	0	0	0	0
NPL	35	123	***	***	0	0	100	100
NPL	40	1701	79	100	100	100	100	100
NRC	14	267	13	0	2	3	5	4
NRC	35	234	***	***	0	0	100	100
NRC	90	63	20	44	98	61	63	100
NRLM	14	1632	100	100	100	100	100	100
NRLM	31	310	2	***	***	***	***	***
NRLM	31	312	1	0	0	1	1	2
NRLM	35	224	***	***	0	0	100	100
OMH	12	1067	***	***	***	***	0	0
ONBA	12	227	0	0	0	0	***	***
ONBA	12	540	0	0	0	0	***	***
ORB	12	205	***	***	***	***	***	0
ORB	21	312	1	1	2	28	15	14
ORB	35	201	***	0	0	90	100	100
ORB	35	202	***	0	0	53	41	67
ORB	40	2601	***	***	***	***	0	***
PKNM	14	1144	10	10	10	10	13	13
PKNM	30	652	20	26	0	4	4	7
PKNM	30	664	8	8	6	10	9	8
PTB	14	394	100	100	100	0	23	30
PTB	14	1103	60	58	53	50	44	52
PTB	14	2379	27	27	26	39	80	67
PTB	35	128	100	100	100	100	100	100
PTB	35	271	***	***	***	0	0	100
PTB	40	502	100	100	100	100	100	100
PTB	40	505	100	100	100	100	100	100
PTB	40	537	***	***	***	***	0	0
PTB	92	1	100	100	100	100	100	100
PTB	92	2	100	100	100	100	100	100
RC	40	6477	***	0	0	***	***	***
RC	40	6482	3	3	4	***	***	***
RC	40	6483	3	4	4	***	***	***
ROA	14	896	71	100	100	100	100	100
ROA	14	1569	5	4	***	***	***	***
ROA	16	113	0	5	4	9	19	0
ROA	16	121	0	7	8	12	24	19
ROA	16	177	10	22	18	***	***	***
ROA	31	422	100	94	85	80	88	100
SNT	14	900	13	14	14	0	10	10
SNT	14	1376	45	54	65	100	0	23

TABLE 15A. (CONT.)

LAB.	CLOCK		49039	49099	49159	49229	49289	49349
SNT	16	137	0	19	25	27	62	95
SO	12	2067	26	39	34	31	52	41
SO	16	180	20	28	23	***	***	***
SO	40	5101	***	0	0	0	0	1
SU	40	3803	100	100	100	100	100	100
SU	40	3804	100	100	100	100	100	100
SU	40	3805	100	100	100	100	100	100
SU	40	3806	100	100	100	100	100	100
SU	40	3807	***	***	0	0	***	***
SU	40	3808	***	***	0	0	***	***
TL	12	1455	0	100	100	0	0	0
TL	12	2276	100	***	***	***	***	***
TL	31	317	34	28	28	31	22	21
TL	35	160	***	***	0	0	100	100
TP	12	335	100	76	82	76	34	27
TP	17	101	1	1	1	0	***	***
TP	36	154	***	***	***	***	0	0
TP	36	163	***	***	***	***	0	0
TUG	14	1654	100	100	100	100	100	100
TUG	18	108	2	2	2	2	1	1
TUG	35	107	100	100	100	100	***	***
TUG	35	247	***	***	***	0	0	100
USNO	14	444	2	1	***	***	***	***
USNO	14	532	0	0	***	***	0	0
USNO	14	583	***	***	0	***	***	***
USNO	14	654	16	41	100	100	0	14
USNO	14	656	0	3	3	***	***	0
USNO	14	752	***	0	0	***	0	0
USNO	14	783	0	12	12	***	***	***
USNO	14	837	***	***	***	***	***	0
USNO	14	862	0	21	27	28	0	***
USNO	14	1035	0	0	100	100	***	***
USNO	14	1094	0	0	22	35	52	***
USNO	14	1100	9	9	14	16	14	10
USNO	14	1114	20	0	***	***	***	***
USNO	14	1255	100	100	74	***	0	0
USNO	14	1264	0	8	***	***	***	0
USNO	14	1300	0	0	5	8	8	10
USNO	14	1301	38	24	***	***	***	0
USNO	14	1423	0	0	100	100	0	12
USNO	14	1653	23	27	***	***	***	0
USNO	14	1809	7	5	***	***	***	***
USNO	14	1846	100	100	***	***	***	***
USNO	14	2312	0	0	***	***	***	***
USNO	14	2314	0	0	38	25	12	11

TABLE 15A. (CONT.)

LAB.	CLOCK	49039	49099	49159	49229	49289	49349
USNO	14 2481	50	0	18	16	5	3
USNO	14 2482	0	0	4	2	***	0
USNO	14 2483	100	83	53	33	27	***
USNO	14 2484	6	6	5	***	***	0
USNO	14 2485	5	5	10	***	***	0
USNO	31 333	0	100	31	***	***	***
USNO	31 335	7	***	***	***	***	***
USNO	31 336	14	***	***	***	***	0
USNO	31 337	13	8	5	4	6	***
USNO	31 338	15	0	***	***	***	***
USNO	31 340	21	24	79	36	34	35
USNO	31 341	***	***	***	***	***	0
USNO	31 426	22	36	***	***	***	***
USNO	31 527	0	***	***	***	***	0
USNO	34 651	***	0	0	100	35	0
USNO	34 653	***	***	***	***	***	0
USNO	34 2100	***	***	***	***	***	0
USNO	34 2313	***	0	0	100	70	***
USNO	34 2315	***	***	***	***	***	0
USNO	34 2486	***	***	***	0	0	77
USNO	34 2488	***	***	***	***	***	0
USNO	35 101	100	100	100	***	***	***
USNO	35 104	100	100	100	***	***	***
USNO	35 106	90	100	100	100	100	***
USNO	35 108	11	16	100	100	100	100
USNO	35 114	100	100	100	100	100	100
USNO	35 142	0	0	100	100	100	100
USNO	35 145	0	0	100	100	100	100
USNO	35 146	0	0	100	100	100	100
USNO	35 148	0	0	100	100	100	100
USNO	35 150	0	0	100	100	100	100
USNO	35 152	0	0	100	100	100	100
USNO	35 153	***	***	0	0	100	100
USNO	35 156	0	0	37	54	76	100
USNO	35 161	***	0	0	100	100	100
USNO	35 164	***	0	0	100	100	100
USNO	35 165	***	***	0	0	100	100
USNO	35 166	***	0	0	100	100	100
USNO	35 167	***	0	0	100	100	100
USNO	35 169	***	***	0	0	100	100
USNO	35 171	***	0	0	100	100	100
USNO	35 213	***	***	0	0	100	100
USNO	35 217	***	***	0	0	100	100
USNO	35 225	***	***	***	***	0	0
USNO	35 226	***	***	***	***	0	0

TABLE 15A. (CONT.)

LAB.	CLOCK		49039	49099	49159	49229	49289	49349
USNO	35	227	***	***	***	***	0	0
USNO	35	229	***	***	***	***	0	0
USNO	35	231	***	***	***	***	0	0
USNO	35	233	***	***	***	***	0	0
USNO	35	242	***	***	***	***	0	0
USNO	35	244	***	***	***	***	0	0
USNO	35	249	***	***	***	***	0	0
USNO	35	253	***	***	***	***	0	0
USNO	35	254	***	***	***	***	0	0
USNO	35	255	***	***	***	***	0	0
USNO	35	256	***	***	***	***	***	0
USNO	35	260	***	***	***	***	0	0
USNO	35	266	***	***	***	***	0	***
USNO	35	268	***	***	***	***	0	0
USNO	35	270	***	***	***	***	0	0
USNO	35	279	***	***	***	***	***	0
USNO	40	702	***	0	0	***	***	0
USNO	40	703	***	0	0	100	100	100
USNO	40	704	100	100	100	100	100	100
USNO	40	705	100	100	100	100	100	100
USNO	40	708	100	100	***	***	0	***
USNO	40	709	***	***	***	***	***	0
USNO	40	710	***	***	***	***	0	0
USNO	40	718	0	0	81	100	49	30
USNO	40	719	***	0	0	20	16	17
USNO	40	722	38	23	15	10	***	***
USNO	40	723	12	12	12	11	10	9
USNO	40	6201	***	***	***	0	***	0
VSL	12	1489	28	0	6	6	6	6
VSL	14	1034	100	100	100	0	43	55
VSL	21	125	0	0	46	***	0	0
VSL	31	288	2	2	3	100	100	0
VSL	35	179	***	0	0	100	100	100

The clocks are designated by their type (2 digits) and serial number in the type. The codes for the types are:

12 HEWLETT-PACKARD 5061A
13 EBAUCHES, OSCILLATOM B5000
14 HEWLETT-PACKARD 5061A OPT. 4
16 OSCILLOQUARTZ 3200
17 OSCILLOQUARTZ 3000
18 FREQ. AND TIME SYSTEMS INC. 4000
19 RHODE AND SCHWARZ XSC
4x HYDROGEN MASERS
21 OSCILLOQUARTZ 3210
23 OSCILLOQUARTZ EUDICS 3020
30 HEWLETT-PACKARD 5061B
31 HEWLETT-PACKARD 5061B OPT. 4
34 H-P 5061A/B WITH 5071A TUBE
35 HEWLETT-PACKARD 5071A High perf.
36 HEWLETT-PACKARD 5071A Low. perf.
9x PRIMARY CLOCKS AND PROTOTYPES

TABLE 15B. STATISTICAL DATA ON THE WEIGHTS ATTRIBUTED TO THE CLOCKS IN 1993

Interval 1993	Total number of clocks	Number of clocks with a given weight							
		weights 0*	0**	weight 1-19	weight 20-39	weight 40-59	weight 60-79	weight 80-99	weight 100
Jan-Feb	207	39	17	58	21	11	7	4	50
Mar-Apr	217	50	17	56	19	12	5	7	51
May-Jun	215	40	15	58	19	11	5	6	61
Jul-Aug	198	29	18	46	18	6	6	4	71
Sep-Oct	220	46	16	47	18	9	7	6	71
Nov-Dec	225	56	16	46	12	6	10	9	70

* A priori null weight (test interval of new clocks).
** Null weight resulting from the statistics.
Clocks with missing data during a two-month interval of computation are excluded.

ANNEX I

Access to the BIPM Time Section data via anonymous FTP

The BIPM Time section is making available several publications and data files via anonymous ftp. To access it, one should use the following procedure (precise syntax may depend on the machine one is running):

```
ftp 145.238.2.2                ! to connect
user anonymous                 ! no password required
cd [anonymous.tai]             ! to access the [.tai] subdirectory
get read.me                    ! the read.me file is listed below
cd [.subdirectory]             ! to go to one of the subdirectories
```

Of course, when logged on, one can go directly to the proper subdirectory by issuing the command:
cd [anonymous.tai.subdirectory]
or just,
cd [.tai.subdirectory]
and get the files needed.

Listing of the READ.ME file:

```
last update: 31 March 1994

                BUREAU INTERNATIONAL DES POIDS ET MESURES
                              TIME SECTION

The [.tai] subdirectory offers via ANONYMOUS FTP (node 145.238.2.2)
informations of interest for the time & frequency community. This
service is under development. It presently contains 3 subdirectories:

    [.tai.gps]              A selection of recent GPS time data
                            (presently upon request)

    [.tai.publication]      Latest issue of Time Section publications
        Circular T#xx in file cirt.xx
        GPS schedule #xx in file schgps.xx

    [.tai.scale]            Time scales data (most recent year or update)
                            (previous years upon request)
        TT(BIPMxx) in file TTBIPM.xx
        For year xx until 92:
            UTC-UTC(labs) in file UTC.xx
            TAI-TA(labs) in file TA.xx
        For year xx starting with 93:
        Files issued from tables of the Annual Report
            Frequency difference of EAL and TAI in file EALTAIxx.AR
            TAI frequency in file FTAIxx.AR
            Duration of TAI scale interval in file SITAIxx.AR
            TAI-TA(labs) in file TAIxx.AR
            UTC-UTC(labs) in file UTCxx.AR
```

UTC-GPStime in file UTCGPSxx.AR
UTC-GLONASStime in file UTCGLOxx.AR
Rates of clocks in file RTAIxx.AR
Weights of clocks in file WTAIxx.AR

For any comment or query send a message to:

17671::bipm	NSI/SPAN/DECNET
bipm@mesiob.obspm.circe.fr	INTERNET
bipm@frmeu51	EARN/BITNET

TIME SIGNALS

The time signal emissions reported here follow the UTC system, in accordance with the Recommendation 460-4 of the Radiocommunication Bureau (RB) of the International Telecommunication Union (ITU), formerly International Radio Consultative Committee (CCIR), unless otherwise stated.

Their maximum departure from the Universal Time UT1 is thus 0.9 second.

The following tables are based on information received at the BIPM in January and February 1994.

AUTHORITIES RESPONSIBLE FOR THE TIME SIGNAL EMISSIONS

Signal	Authority
ATA	National Physical Laboratory Dr. K.S. Krishnan Road New Delhi - 110012, India
BPM	Shaanxi Astronomical Observatory Chinese Academy of Sciences P.O. Box 18 - Lintong Shaanxi, China
BSF	Telecommunication Laboratories Ministry of Transportation and Communications P.O. Box 71 - Chung-Li 320 Taiwan, Rep. of China
CHU	National Research Council of Canada Institute for National Measurement Standards - Time Standards Ottawa, Ontario, K1A OR6, Canada
DCF77	Physikalisch-Technische Bundesanstalt, Lab. Zeiteinheit Bundesallee 100 W-38116 Braunschweig Germany
EBC	Real Instituto y Observatorio de la Armada - San Fernando Cadiz, Spain
HBG	Service horaire HBG Observatoire Cantonal CH - 2000 Neuchâtel, Suisse
HLA	Time and Frequency Laboratory Korea Research Institute of Standards and Science Yusong P.O. Box 102, Taejon 305-600 Republic of Korea

Signal	Authority
IAM	Istituto Superiore delle Poste e delle Telecomunicazioni Viale Europa 190 00144 - Roma, Italia
JG2AS, JJY	Standards and Measurements Division Communications Research Laboratory 2-1, Nukui-kitamachi 4-chome Koganei-shi, Tokyo 184 Japan
LOL	Servicio de Hidrográfica Naval Observatorio Naval Av. España 2099 1107 - Buenos-Aires, Argentina
MSF	National Physical Laboratory Division of Electrical Science Teddington, Middlesex TW11 0LW United Kingdom
OMA	Institute of Radio Engineering and Electronics - Academy of Sciences of Czech Republic - Chaberská 57 182 51 Praha 8 - Kobylisy, Czech Republic
PPE, PPR	Departemento Serviço da hora Observatorio Nacional (CNPq) Rua General Bruce, 586, Sao Cristovao 20921-030 - Rio de Janeiro, Brasil
RBU, RCH, RID, RTZ, RWM,UNW3, UPD8,UQC3, USB2,UTR3	Institute of Metrology for Time and Space (IMVP), NPO "VNIIFTRI" Mendeleevo, Moscow Region 141570 Russia

Signal	Authority
TDF	France Telecom Centre National d'Etudes des Télécommunications - PAB - STC Etalons de fréquence et de temps 196 avenue Henri Ravera 92220 - Bagneux, France
VNG	National Standards Commission P.O. Box 282 North Ryde NSW 2113 Australia
WWV,WWVH WWVB	Time and Frequency Division, 847.00 National Institute of Standards and Technology - 325 Broadway Boulder, Colorado 80303, U.S.A.
YVTO	Direccion de Hidrografia y Navegacion Observatorio Cagigal Apartado Postal No 6745 Caracas, Venezuela

Note

The emission of time signals by LOL3, Buenos-Aires, Argentina, and by PPE, Rio-de-Janeiro, Brazil, are momentaneouly interrupted.

TIME SIGNALS EMITTED IN THE UTC SYSTEM

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
ATA	Greater Kailash New Delhi India 28° 34'N 77° 19'E	5 000 10 000 15 000	12 h 30 m to 3 h 30 m continuous 3 h 30 m to 12 h 30 m	Second pulses of 5 cycles of a 1 kHz modulation. Minute pulses of 100 ms duration. (The time signals are advanced by 50 ms on UTC).
BPM	Pucheng China 35° 0'N 109° 31'E	2 500 5 000 10 000 15 000	7 h 30 m to 1 h continuous continuous 1 h to 9 h	Signals emitted in advance on UTC by 20 ms. Second pulses of 10 ms of 1 kHz modulation. Minute pulses of 300 ms of 1 kHz modulation. UTC time signals are emitted from minutes 0 to 10, 15 to 25, 30 to 40, 45 to 55. UT1 time signals are emitted from minutes 25 to 29, 55 to 59.
BSF	Chung-Li Taiwan Rep. of China 24° 57'N 121° 9'E	5 000 15 000	continuous except interruption between minutes 35 and 40	From min. 5 to 10, 15 to 20, 25 to 30, 45 to 50, 55 to 60, second pulses of 5 ms duration without 1 kHz modulation. From min. 0 to 5, 10 to 15, ..., 50 to 55, second pulses of 5 ms duration with 1 kHz modulation. The 1 kHz modulation is interrupted 40 ms before and after the pulses. Minute pulses are extended to 300 ms. DUT1: CCIR code by pulse lengthening.
CHU	Ottawa Canada 45° 18'N 75° 45'W	3 330 7 335 14 670	continuous	Second pulses of 300 cycles of a 1 kHz modulation, with 29th and 51st to 59th pulses of each minute omitted. Minute pulses are 0.5 s long. Hour pulses are 1.0 s long, with the following 1st to 10th pulses omitted. A bilingual (Fr. Eng.) announcement of time (UTC) is made each minute following the 50th second pulse. FSK time code after 10 cycles of 1 kHz on the 31st to 39th seconds. Broadcast is single sideband; upper sideband with carrier reinsert. DUT1 : CCIR code by double pulse.
DCF77	Mainflingen Germany 50° 1'N 9° 0'E	77.5	continuous	At the beginning of each second (except the 59th second) the carrier amplitude is reduced to about 25 % for a duration of 0.1 s or 0.2 s. Coded transmission of year, month, day, hour, minute and day of the week in a BCD code from second marker No 21 to No 58 (The second marker durations of 0.1 s or 0.2 s correspond to a binary 0 or a binary 1 respectively). The coded time information is related to legal time of Germany and second markers 17 and 18 indicate if the transmitted time refers to UTC(PTB) + 2 h (summer time) or UTC(PTB) + 1 h. Second marker No 15 is prolonged to 0.2 s, if the reserve antenna is in use. To achieve a more accurate time transfer and better use of the frequency spectrum available, an additional pseudo random phase - shift keying of the carrier is superimposed to the AM second markers. No transmission of DUT1.

TIME SIGNALS EMITTED IN THE UTC SYSTEM

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
EBC	San Fernando Spain 36° 28'N 6° 12'W	12 008 6 840	10 h 00 m to 10 h 25 m 10 h 30 m to 10 h 55 m	Second pulses of 0.1 s duration of a 1 kHz modulation. Minute pulses of 0.5 s duration of 1 250 Hz modulation. DUT1: CCIR code by double pulse.
HBG	Prangins Switzerland 46° 24'N 6° 15'E	75	continuous	Interruption of the carrier at the beginning of each second, during 100 ms. The minutes are identified by a double pulse, the hours by a triple pulse. No transmission of DUT1. Time code and other coded information.
HLA	Taedok Science Town Republic of Korea 36° 23'N 127° 22'E	5 000	Continuous	Pulses of 9 cycles of 1800 Hz modulation. 29th and 59th second pulses omitted. Hour identified by 0.8 second long 1500 Hz tone. Beginning of each minute identified by 0.8 second long 1800 Hz tone. Voice announcement of hours and minutes each minute following 52nd second pulse. BCD time code given on 100 Hz subcarrier. DUT1 : CCIR code by double pulse.
IAM	Rome Italy 41° 47'N 12° 27'E	5 000	7 h 30 m to 8 h 30 m 10 h 30 m to 11 h 30 m except sunday and national holidays. Advance by 1 hour in summer.	Second pulses of 5 cycles of 1 kHz modulation. Minute pulses of 20 cycles. Voice announcements every 15 m beginning at 0 h 0 m. DUT1 : CCIR code by double pulse.
JG2AS	Sanwa Ibaraki Japan 36° 11'N 139° 51'E	40	continuous, except interruptions during communications.	During experimental coded transmission of the total day, hour, minute and DUT1, second pulses are 0.2 s, 0.5 s and 0.8 s duration. In case of no coded transmission, A1A type second pulses of 0.5 s duration.
JJY	Sanwa Ibaraki Japan 36° 11'N 139° 51'E	2 500 5 000 8 000 10 000 15 000	continuous, except interruption between minutes 35 and 39.	Second pulses of 8 cycles of 1 600 Hz modulation. Minute pulses are preceded by a 600 Hz modulation. DUT1 : CCIR code by lengthening.
LOL1	Buenos-Aires Argentina 34° 37'S 58° 21'W	5 000 10 000 15 000	11 h to 12 h, 17 h to 18 h, 23 h to 24 h	Second pulses of 5 cycles of 1 000 Hz modulation. Second 59 is omitted. Announcement of hours and minutes every 5 minutes, followed by 3 m of 1 000 Hz or 440 Hz modulation. DUT1 : CCIR code by lengthening.

TIME SIGNALS EMITTED IN THE UTC SYSTEM

Location Station	Frequency Latitude Longitude	Schedule (UTC) (kHz)	Form of the signal	
LOL2	Buenos-Aires Argentina 34° 37'S 58° 21'W	4 856 8 030 17 180	1 h, 13 h, 21 h	A1 second pulses during the 5 minutes preceding the indicated times. Second 29 is omitted. Minute pulses are prolonged. DUT1 : CCIR code by double pulse.
MSF	Rugby United Kingdom 52° 22'N 1° 11'W	60	continuous except for an interruption for maintenance from 10 h 0 m to 14 h 0 m on the first Tuesday of each month. A longer period of maintenance during summer is announced annually.	Interruptions of the carrier of 100 ms for the second pulses, of 500 ms for the minute pulses. The signal is given by the beginning of the interruption. BCD NRZ code, 100 bits/s (month, day of month, hour, minute), during minute interruption. BCD NRZ code, 1 bit/s (year, month, day of month, day of week, hour, minute) from seconds 17 to 59 in each minute, following the seconds interruption. DUT1 : CCIR code by double pulse.
OMA	Liblice Czech Republic 50° 4'N 14° 53'E	50	continuous, interrupted on the first Tuesday of each month.	Interruption of the carrier of 100 ms at the beginning of every second, of 500 ms at the beginning of every minute. The precise time is given by the beginning of the interruption. Phase coded announcement of date, UTC and local civil time, leap second and civil time change. No DUT1 code.
PPR	Rio-de-Janeiro Brazil 22° 59'S 43° 11'W	435 4 244 8 634 13 105 17 194.4	1 h 30 m, 14 h 30 m, 21 h 30 m	Second ticks, of A1 type, during the five minutes preceding the indicated times. The minute ticks are longer.
RBU (*)	Moscow Russia 55° 48'N 38° 18'E	66.66	continuous	DXXXW type signals. The time of day in hours, minutes and seconds is transmitted in BCD code. From 9 h to 11 h, 19 h to 23 h, NON type signals.
RCH (*)	Tashkent Uzbekistan 41° 19'N 69° 15'E	 2 500 5 000 10 000	between minutes 0 and 10, 30 and 40 0 h to 4 h 40 m 6 h to 23 h 40 m 0 h to 4 h 40 m 15 h to 23 h 40 m 6 h to 14 h 10 m	A1X type second pulses. The pulses at the beginning of the minute are prolonged to 0.5 s.

(*) CIS radiostation emitting DUT1 information in accordance with the CCIR code and also giving an additional information, dUT1, which specifies more precisely the difference UT1-UTC down to multiples of 0,02 s, the total value of the correction being DUT1 + dUT1. Positive values of dUT1 are transmitted by the marking of p second markers within the range between the 21th and 24th second so that dUT1 = +p.0,02 s. Negative values of dUT1 are transmitted by the marking of q second markers within the range between the 31th and the 34th second, so that dUT1 = -q.0,02 s.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
RID (*)	Irkutsk Russia 52° 26'N 104° 2'E	5 004 10 004 15 004	The station simultaneously operates on three frequencies between minutes 20 and 30, 50 and 60	A1X type second pulses. The pulses at the beginning of the minute are prolonged to 0.5 s.
RTZ (*)	Irkutsk Russia 52° 26'N 104° 2'E	50	between minutes 0 and 5 0 h to 21 h 05 m 23 h to 23 h 05 m	A1X type second pulses. The pulses at the beginning of the minute are prolonged to 0.5 s.
RWM (*)	Moscow Russia 55° 48'N 38° 18'E	4 996 9 996 14 996	The station simultaneously operates on three frequencies between minutes 10 and 20, 40 and 50	A1X type second pulses. The pulses at the beginning of the minute are prolonged to 0.5 s.
TDF	Allouis France 47° 10'N 2° 12'E	162	continuous except every Tuesday from 1 h to 5 h	Phase modulation of the carrier by + and - 1 radian in 0.1 s every second except the 59th second of each minute. This modulation is doubled to indicate binary 1. The numbers of the minute, hour, day of the month, day of the week, month and year are transmitted each minute from the 21st to the 58th second, in accordance with the French legal time scale. In addition a binary 1 at the 17th second indicates that the local time is 2 hours ahead of UTC(summer time); a binary 1 at the 18th second indicates that the local time is one hour ahead of UTC(winter time); a binary 1 at the 14th second indicates that the current day is a public holiday (Christmas, 14 July, etc...); a binary 1 at the 13th second indicates that the current day is a day before a public holiday.
UNW3	Molodechno Belarus 54° 26'N 26° 48'E	25	Winter schedule : 7 h 13 m to 7 h 22 m 13 h 13 m to 13 h 22 m Summer schedule : 6 h 13 m to 6 h 22 m 12 h 13 m to 12 h 22 m	A1N type 0.1 second pulses of 0.025 s duration. Second pulses are prolonged to 0.1 s. 10 second pulses are prolonged to 1 s and minute pulses are prolonged to 10 s. No transmission of DUT1 code.
UPD8	Arkhangelsk Russia 64° 24'N 41° 32'E	25	Winter schedule : 11 h 13 m to 11 h 22 m 21 h 13 m to 21 h 22 m Summer schedule : 2 h 13 m to 2 h 22 m 8 h 13 m to 8 h 22 m	A1N type 0.1 second pulses of 0.025 s duration. Second pulses are prolonged to 0.1 s. 10 second pulses are prolonged to 1 s and minute pulses are prolonged to 10 s. No transmission of DUT1 code.

(*) CIS radiostation emitting DUT1 information in accordance with the CCIR code and also giving an additional information, dUT1, which specifies more precisely the difference UT1-UTC down to multiples of 0,02 s, the total value of the correction being DUT1 + dUT1. Positive values of dUT1 are transmitted by the marking of p second markers within the range between the 21th and 24th second so that dUT1 = +p.0,02 s. Negative values of dUT1 are transmitted by the marking of q second markers within the range between the 31th and the 34th second, so that dUT1 = -q.0,02 s.

TIME SIGNALS EMITTED IN THE UTC SYSTEM

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
UQC3	Chabarovsk Russia 48° 30'N 134° 51'E	25	Winter schedule : 2 h 13 m to 2 h 22 m 8 h 13 m to 8 h 22 m 14 h 13 m to 14 h 22 m Summer schedule : 1 h 13 m to 1 h 22 m 7 h 13 m to 7 h 22 m 13 h 13 m to 13 h 22 m	A1N type 0.1 second pulses of 0.025 s duration. Second pulses are prolonged to 0.1 s. 10 second pulses are prolonged to 1 s and minute pulses are prolonged to 10 s. No transmission of DUT1 code.
USB2	Bishkek Kirgizstan 43° 04'N 73° 39'E	25	Winter schedule : 4 h 13 m to 4 h 22 m 10 h 13 m to 10 h 22 m 16 h 13 m to 16 h 22 m Summer schedule : 3 h 13 m to 3 h 22 m 9 h 13 m to 9 h 22 m 19 h 13 m to 19 h 22 m	A1N type 0.1 second pulses of 0.025 s duration. Second pulses are prolonged to 0.1 s. 10 second pulses are prolonged to 1 s and minute pulses are prolonged to 10 s. No transmission of DUT1 code.
UTR3	Nizhni Novgorod Russia 56° 11'N 43° 58'E	25	Winter schedule : 5 h 13 m to 5 h 22 m 19 h 13 m to 19 h 22 m Summer schedule : 4 h 13 m to 4 h 22 m 18 h 13 m to 18 h 22 m	A1N type 0.1 second pulses of 0.025 s duration. Second pulses are prolonged to 0.1 s. 10 second pulses are prolonged to 1 s and minute pulses are prolonged to 10 s. No transmission of DUT1 code.
VNG	Llandilo New South Wales Australia 33° 43'S 150° 48'E	2 500 5 000 8 638 12 984 16 000	continuous continuous continuous continuous 22 h to 10 h	Second pulses of 50 ms of 1 kHz modulation. Second pulses 55 to 58 of 5 ms of 1 kHz. Second pulse 59 omitted. Minute pulses of 0.5 seconds of 1 kHz modulation. During minutes 5, 10, 15,... second pulses 50 to 58 are 5 ms of 1 kHz. BCD time code giving day of year, hour and minute at the next minute is given between seconds 20 and 46. Voice announcement on 2 500, 5 000 and 16 000 kHz during minutes 15, 30 ,45 and 60. Morse station identification on 8 638 and 12 984 kHz during minutes 15, 30, 45 and 60. DUT1 : CCIR code by double.
WWV	Fort-Collins, CO USA 40° 41'N 105° 2'W	2 500 5 000 10 000 15 000 20 000	continuous	Pulses of 5 cycles of 1 kHz modulation. 29th and 59th second pulses omitted. Hour is identified by 0.8 second long 1 500 Hz tone. Beginning of each minute identified by 0.8 second long 1 000 Hz tone. DUT1 : CCIR code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction.
WWVB	Fort-Collins, CO USA 40° 40'N 105° 3'W	60	continuous	Second pulses given by reduction of the amplitude of the carrier. Coded announcement of the date, time, DUT1 correction, daylight savings time in effect, leap year and leap second.

TIME SIGNALS EMITTED IN THE UTC SYSTEM

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
WWVH	Kauai, HI USA 21° 59'N 159° 46'W	2 500 5 000 10 000 15 000	continuous	Pulses of 6 cycles of 1 200 Hz modulation. 29th and 59th second pulses omitted. Hour identified by 0.8 second long 1 500 Hz tone. Beginning of each minute identified by 0.8 second long 1 200 Hz tone. DUT1 : CCIR code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction.
YVTO	Caracas Venezuela 10° 30'N 66° 56'W	5 000	continuous	Second pulses of 1 kHz modulation with 0.1 s duration. The minute is identified by a 800 Hz tone and a 0.5 s duration. Second 30 is omitted. Between seconds 40 and 50 of each minute, voice announcement of the identification of the station. Between seconds 52 and 57 of each minute, voice announcement of hour, minute and second.

ACCURACY OF THE CARRIER FREQUENCY

Station	**Relative uncertainty of the carrier frequency in 10^{-10}**
ATA	0.1
BPM	0.1
BSF	0.1
CHU	0.05
DCF77	0.005 (10d-mean)
EBC	0.1
HBG	0.005
HLA	0.1
IAM	0.5
JG2AS, JJY	0.1
LOL	0.1
MSF	0.02
OMA	0.5
RBU, RTZ	0.05
RCH, RID, RWM	0.5
TDF	0.02
UNW3, UPD8, UQC3,	0.05
USB2, UTR3	0.05
WWV	0.1
WWVB	0.1
WWVH	0.1

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