BUREAU INTERNATIONAL DES POIDS ET MESURES

BIPM Annual Report on Time Activities

Volume 7

2012

Pavillon de Breteuil
F-92312 SÈVRES Cedex, France

ISBN 978-92-822-2251-5
ISSN 1994-9405

Contents

Practical information about the BIPM Time Department

The Time Department of the BIPM issues two periodic publications. These are the monthly *Circular T* and the *BIPM Annual Report on Time Activities*.

Address: Time Department
Bureau International des Poids et Mesures
Pavillon de Breteuil
F-92312 Sèvres Cedex, France

Telephone: BIPM Switchboard: + 33 1 45 07 70 70

Telefax: BIPM Time Department: + 33 1 45 07 70 59
BIPM General: + 33 1 45 34 20 21

Internet: http://www.bipm.org/en/scientific/tfg/

FTP server: http://www.bipm.org/jsp/en/TimeFtp.jsp?TypePub=data

Staff of the Time Department as of January 2013:

Dr Elisa Felicitas ARIAS, Director,	Principal Research Physicist
Dr Zhiheng JIANG,	Principal Physicist
Dr Włodzimierz LEWANDOWSKI,	Principal Physicist
Dr Gianna PANFILO,	Physicist
Dr Gérard PETIT,	Principal Physicist
Dr Lennart ROBERTSSON,	Principal Physicist
Miss Aurélie HARMEGNIES,	Assistant
Ms Hawaï KONATÉ,	Principal Technician
Mr Laurent TISSERAND,	Principal Technician

For individual contact details, please refer to the BIPM staff directory

BIPM Time Department

Director: E.F. Arias

(1 January 2012 to 31 December 2012)

1. International Atomic Time (TAI) and Coordinated Universal Time (UTC) (E.F. Arias, A. Harmegnies, Z. Jiang, H. Konaté, W. Lewandowski, G. Panfilo, G. Petit and L. Tisserand)

The reference time scales, International Atomic Time (TAI) and Coordinated Universal Time (UTC), are computed from data reported regularly to the BIPM by the various timing centres that maintain a local UTC; monthly results are published in *Circular T*. The *BIPM Annual Report on Time Activities for 2011*, volume 6, provides the definitive results for 2011 and is available electronically on the BIPM website www.bipm.org/en/publications/time_activities.html.

2. Algorithms for time scales (Z. Jiang, W. Lewandowski, G. Panfilo and G. Petit)

The algorithm ALGOS used for the calculation of the time scales is an iterative process that starts by producing a free atomic scale (*Échelle atomique libre*, EAL) from which TAI and UTC are derived. Research into time-scale algorithms continues in the Department with the aim of improving the long-term stability of EAL and the accuracy of TAI.

Since September 2011 the clock frequency prediction model in ALGOS takes into account the frequency drift which affects most of the participating atomic clocks. The frequency drift of each clock is estimated with respect to Terrestrial Time (TT) computed at the BIPM and which represents the best reference for frequency. As a consequence, the drift of -1.3×10^{-17} /day observed in EAL with respect to TAI has been completely removed, with an improvement in the long-term stability of EAL.

2.1 EAL stability

Some 87 % of the clocks used in the calculation of time scales are either commercial caesium clocks of the Symmetricom/HP/Agilent 5071A type or active, auto-tuned hydrogen masers. To improve the stability of EAL, a weighting procedure is applied to clocks where the maximum relative weight each month depends on the number of participating clocks. On average during 2011, about 15 % of the participating clocks were at the maximum weight. The change of the frequency prediction model has no impact on the weight of clocks. In order to allow a correct weighting of the hydrogen masers, and for better distribution of the weight among the caesium clocks and hydrogen masers, studies were undertaken to develop a new weighting procedure based on the concept that a good clock is not a stable clock but instead is a predictable clock. At the end of 2012 this procedure had been tested on six previous years of collected data and proved to establish a good distribution of weights; as a consequence, the stability of EAL will be improved. This new prediction model will be implemented in ALGOS during the first few months of 2013. The stability of EAL, expressed in terms of an Allan deviation, is about 3 parts in 10^{16} for averaging times of one month.

2.2 TAI accuracy

To characterize the accuracy of TAI, estimates are made of the relative departure, and its uncertainty, of the duration of the TAI scale interval from the SI second, as produced on the rotating geoid, by primary frequency standards. Since January 2012, individual measurements of the TAI frequency have been provided by ten primary frequency standards, including eight caesium fountains (LNE-SYRTE FO1, LNE-SYRTE FO2, LNE-SYRTE FOM, NIST F1, NPL CSF1, NPL CSF2, PTB CSF1 and PTB

CSF2). Reports on the operation of the primary frequency standards are regularly published on the BIPM website and collated in the *BIPM Annual Report on Time Activities*.

Since 2012, measurements of the TAI frequency by secondary frequency standards have been reported in *Circular T*. They have not been used for TAI steering so far, but will be after the implementation of the CIPM 2012 recommendations.

Since January 2012, the global treatment of individual measurements has led to a relative departure of the duration of the TAI scale unit from the SI second on the geoid ranging from $+3.5 \times 10^{-15}$ to -0.3×10^{-15}, with a standard uncertainty of maximum 0.5×10^{-15}. Between January and December 2012, ten steering corrections have been applied, giving a total correction to $[f(EAL) - f(TAI)]$ of -4.3×10^{-15}. Since the introduction of the new prediction algorithm in September 2011, monthly steering corrections of -5×10^{-16} and -3×10^{-16} have been applied. Since the drift affecting EAL has completely disappeared no corrections to the frequency of EAL have been applied since November 2012.

2.3 Independent atomic time scales: TT(BIPM)

Because TAI is computed in 'real-time' and has operational constraints, it does not provide an optimal realization of TT, the time coordinate of the geocentric reference system. The BIPM therefore computes an additional realization, TT(BIPM), in post-processing, which is based on a weighted average of the evaluation of the TAI frequency by the primary frequency standards. The Time Department provided an updated computation of TT(BIPM), named TT(BIPM11), valid until December 2011, which had an estimated accuracy of about 3 parts in 10^{16} over recent years. Moreover, the Time Department provides a monthly extension of TT(BIPM11) based on the most recent TAI computation. Such an extension is useful for pulsar analysis pending the yearly updates of TT(BIPM). Studies aimed at improving the computation of TT(BIPM) are ongoing, in order to keep it in line with improvements in the primary and secondary frequency standards.

2.4 Local representations of UTC in national laboratories as broadcast by the GNSS

The Time Department continues to calculate and publish the differences between the predictions of UTC(USNO) and UTC(SU) (as broadcast by GPS and GLONASS) and UTC in BIPM *Circular T*.

3. **Primary frequency standards and secondary representations of the second** (E.F. Arias, G Panfilo, G. Petit and L. Robertsson)

Members of the BIPM Time Department actively participate in the work of the CCL/CCTF Frequency Standards Working Group (WGFS), and the CCTF Working Group on Primary Frequency Standards (WGPFS), seeking to encourage comparisons, knowledge-sharing between laboratories, the creation of better documentation, and the use of high-accuracy primary frequency standards (Cs fountains) for TAI.

The CCL/CCTF Frequency Standards Working Group maintains a list of recommended values of standard frequencies for applications including secondary representations of the second. At its meeting in September 2012 it proposed additions and updates to microwave and optical atomic transitions in the list. The latest changes to the list, containing frequency values and uncertainties for transitions in Rb, Hg^+, Yb^+, Yb, Sr^+, Sr and Al^+ were recommended by the CCTF in September 2012 as secondary representations of the second.

Secondary representations of the second reported in BIPM Circular T

Since January 2012 the LNE-SYRTE has reported frequency measurements of the Rb microwave transition obtained with a double Cs-Rb fountain (FO2Rb). Reports with data since November 2009 onwards have been reviewed and approved by the CCTF WGPFS only for comparison via *Circular T* with the frequency of TAI. From May 2012 a new table has been included in *Circular T*; 21 measurement reports of FO2Rb were submitted in 2012.

Advanced time and frequency transfer

The Time Department has not particularly developed activities in this field, but instead has followed the evolution of the techniques for optical clock comparison by contributing to the CCTF WG on Coordination of the Development of Advanced Time and Frequency Transfer Techniques (WGATFT) and by participating in meetings of experts, mainly on the use of optical fibres.

4. **Time links** (E.F. Arias, A. Harmegnies, Z. Jiang, H. Konaté, W. Lewandowski, G. Panfilo, G. Petit, and L. Tisserand)

At the end of 2012, 72 time laboratories participated in the calculation of TAI at the BIPM. The laboratories are equipped with GNSS receivers and/or operating two-way satellite time and frequency transfer (TWSTFT) stations.

Significant improvements have been made within the Time Department to the time links used for the calculation of TAI; data from three independent techniques are included in the process of comparison of laboratories' clocks based on tracking GPS and GLONASS satellites, and TWSTFT.

The GPS all-in-view method is widely used and takes advantage of the increasing quality of the International GNSS Service (IGS) products (clocks and IGS time). Clock comparisons are possible using C/A code measurements from GPS single-frequency receivers, or dual-frequency, multi-channel GPS geodetic-type receivers (P3). The older GPS single-channel single-frequency receivers have almost disappeared, replaced by either multi-channel single- or dual-frequency receivers. The GPS phase and code data provided by time laboratories is processed each month using the Precise Point Positioning (PPP) technique. Fifteen TWSTFT links are officially submitted for use in the computation of TAI, representing 21 % of the time links. Since 2011, the combination of TWSTFT and PPP (so called TWPPP) is used whenever possible. This generally concerns about a dozen links for which the two techniques are available.

Since January 2011 the Time Department started computing combined GPS/GLONASS links resulting in improved link uncertainty. About four GPS/GLONASS links are regularly computed for *Circular T*.

Testing continues on other time and frequency comparison methods and techniques.

Comparisons of the different possible links on a baseline linking two contributing laboratories are computed and published monthly on the Time Department's ftp server.

Geodetic-type receivers also provide raw phase measurements which may be used, along with the code measurements, to compute time links. Since October 2007, the BIPM has computed its own solutions for such time links, using GPSPPP software from Natural Resources Canada (NRCan), and these links have been introduced into the TAI regular computation since September 2009. In 2011 a new version of the NRCan PPP software was installed. It is capable of processing both GPS and GLONASS data. Comparisons with other PPP software have been carried out. Studies are continuing to improve long-term stability, using new processing techniques, in collaboration with software developers at NRCan, the *Observatoire Royal de Belgique* (ORB), the *Centre National d'Études Spatiales* (CNES) and also with other institutes.

4.1 Global Positioning System (GPS) and Global Navigation Satellite System (GLONASS) code measurements

All GNSS links are corrected for satellite positions using IGS and IAC post-processed, precise satellite ephemerides, and those links using single-frequency receivers are corrected for ionospheric delays using IGS maps of the total electron content of the ionosphere.

4.2 Phase and code measurements from geodetic-type receivers

Techniques using dual-frequency, GNSS carrier-phase measurements in addition to the codes, are widely used by the geodetic community, and have been adapted to the needs of time and frequency transfer. A study is being conducted under the framework of the IGS Working Group on Clock Products, which has a physicist from the Time Department as a member.

The method developed to perform absolute calibration of the Ashtech Z12-T hardware delays allows the BIPM to use this receiver for differential calibrations of similar receivers world-wide; calibration campaigns began in January 2001. Calibration results have also been issued for other receivers: the Septentrio PolaRx2 since 2006 and the Dicom GTR50 and Javad JPS E-GGD since 2009. Other types of receivers are being investigated in collaboration with the laboratories equipped with them. Since 2009, the BIPM travelling receiver for differential calibrations is a GTR50. In all cases, at least two receivers remain at the BIPM to serve as a local reference to which the travelling receiver is compared between calibration trips. Results of the differential calibration exercises are made available on a dedicated web page (www.bipm.org/jsp/en/TimeCalibrations.jsp), where past calibration results are also provided.

Data from geodetic-type receivers world-wide are collected for TAI computation, using procedures and software developed in collaboration with the ORB. These P3 time links are now routinely computed and compared to other available techniques, notably two-way time transfer. After one year of work, the software producing GPS P3 (iono-free) data has been upgraded and is now able to produce GLONASS P3. It will be implemented in some receivers to automatically produce both formatted GPS and GLONASS P3 code results. In the future, these newly available data are likely to be used in multi-GNSS system time links, but further studies on inter-frequency biases have to be carried out.

4.3. Two-way time transfer

Two meetings of the TWSTFT participating stations were held during 2012. The annual meeting of the CCTF WG on TWSTFT was held at the BIPM headquarters in September 2012.

The TWSTFT technique is currently operational in eleven European, two North American and nine Asia-Pacific time laboratories. Fifteen TWSTFT links are routinely used in the computation of TAI; thirteen of them are combined with GPS PPP solutions. Some of them are used for particular studies such as the Time Transfer by Laser Link (T2L2) experiment. The TWSTFT technique applied to clock comparisons in TAI is at present reaching its maximum potential with sessions scheduled every two hours.

The BIPM is also involved in the calibration of two-way time-transfer links by comparison with GPS.

Results of time links and link comparison using GNSS single-frequency, dual-frequency and TW observations are published monthly on the Time Department's ftp server (ftp://tai.bipm.org/TimeLink/LkC).

4.4 Uncertainties of TAI time links

The values of Type A and Type B uncertainties of TAI time links are published in *Circular T*, together with information on the time links used in each monthly calculation. The values of u_A have been individually updated when deemed necessary, depending on the noise level present in the links. Due to upgrading of time transfer equipment at participating laboratories, the Time Department has refined the methods for clock comparison, and a global re-evaluation of u_A values, using the latest evaluation tools, has been made and published in *Circular T* of December 2011.

4.5 Calibration of delays of time-transfer equipment

The BIPM continues to organize and run campaigns for measuring the relative delays of GPS time equipment in time laboratories that contribute to TAI. The BIPM also supports TWSTFT calibration trips, using a GPS receiver from its time laboratory.

Work on the absolute calibration of GNSS receivers has been carried out by a Ph.D. student through a collaboration co-financed with the CNES, and involving the LNE-SYRTE. The doctoral thesis "Contribution to the absolute calibration of a GNSS reception chain" was defended in November 2011, completing the planned programme of work. It focused on the development and optimization of a method of absolute calibration to independently determine the electrical delay of each element in a GNSS reception chain (time receiver, antenna and antenna cable) with an overall uncertainty of less than one nanosecond. The absolute calibration method can be used to characterize performance and environmental sensitivity of each component of the acquisition system.

Cooperation continued with EURAMET to obtain regional support for GNSS equipment calibration in contributing laboratories. This action follows a Recommendation of the CCTF (2009) and opens up the possibility of future interaction with other RMOs.

5. **Key comparisons** (E.F. Arias, H. Konaté, Z. Jiang, W. Lewandowski, G. Panfilo, G. Petit, L. Tisserand, A. Harmegnies and L. Robertsson)

Key comparison in Time CCTF-K001.UTC

Results of the key comparison in time, CCTF-K001.UTC, involving the time laboratories participating in the CIPM MRA, are published regularly in the form of the monthly BIPM *Circular T*. The CCTF approved updates to the existing guidelines and new guidelines on the evaluation of the uncertainty in frequency and on the evaluation of the uncertainty in the prediction of [*UTC*-*UTC*(*k*)] in September 2012. These guidelines had been prepared by staff of the Time Department to support the CCTF Working Group on the CIPM MRA (WGMRA).

Key comparison of stabilized lasers CCL-K11.UTC

The BIPM continues to support the CCL-K11 key comparison in terms of participation in measurement campaigns as well as by providing general advice. This follows a decision at the 98th meeting of the CIPM in 2009. During 2012, staff from the Time Department were only involved in the reporting of measurement results and no BIPM presence for measurement campaigns took place.

Key comparison of absolute gravimeters CCM.G-K1

The campaign of comparison of absolute gravimeters ICAG-2009 concluded the contribution of the BIPM to the maintenance of the world global gravity network. Since then the key comparison CCM.G-K1 has been defined as part of the ICAG. This activity has been transferred to the NMIs, and the next ICAG in 2013 will take place in Luxembourg piloted by the METAS. As agreed, the BIPM provided support to the organization of the future ICAG during 2012 and staff from the Time Department contributed to the CCM Working Group on Gravimetry (WGG). A series of relevant publications related to ICAG-2009 have been published, including the reports of the key comparison and a scientific article. Studies based on gravity measurements on the BIPM watt balance site were ongoing at the end of 2012, and a scientific article on the characterization of gravity for the watt balance experiment is expected to be published in the first three months of 2013.

6. **Rapid UTC** (F. Arias, A. Harmegnies, G. Panfilo, G. Petit, L. Tisserand)

At the end of 2011 the Time Department called for expressions of interest to participate in a pilot experiment for producing a "rapid UTC" (UTCr), that is, daily values of [UTCr – UTC(k)] evaluated on a weekly solution. With the full support of the time laboratories and of the CCTF, the pilot experiment started in January 2012 with the participation of about 40 laboratories that contribute approximately 60 % of the clocks in UTC. The first results (ftp://tai.bipm.org/UTCr) were published at the end of February 2012. Since then, the weekly solutions have been published every Wednesday without interruption.

A report was submitted to the CCTF in September 2012 and the pilot experiment is expected to become operational in 2013.

The new product does not change the procedures for the monthly calculation of UTC, which remains the only key comparison on time.

7. **New proposed definition of UTC** (F. Arias, W. Lewandowski)

The BIPM has actively participated, since 2000, in discussions about a possible redefinition of UTC without leap seconds. This proposal is in favour of systems that need precise time synchronization and does not allow a discontinuity in the time scale that they use as a reference.

The actions of BIPM delegates during this process have been critical at the International Telecommunication Union (ITU), and also in disseminating information and promoting decision making at the level of national representatives. A delegate from the BIPM attended the Radiocommunication Assembly 2012 (RA-12) which was held in Geneva, Switzerland, on 16 to 20 January 2012, where the ITU member states discussed the adoption of modified UTC. It was decided to postpone the decision until the World Radiocommunication Conference 2015 (WRC-15) to be held in Geneva on 2 to 27 November 2015. In the meantime investigations will continue on the feasibility of a continuous timescale to be used as the international time reference. Staff from the Time Department contributed to two Radiocommunication Seminars in St Petersburg, Russian Federation (June 2012) and Manta, Ecuador (September 2012), respectively. Staff from the Time Department attended regular meetings of Study Group 7 and Working Party 7A of the ITU-R.

8. **Pulsars** (G. Petit)

Collaboration continues with radioastronomy groups observing pulsars and analyzing pulsar data to study the potential capability of using millisecond pulsars as a means of sensing the very long-term stability of atomic time. The Time Department provides these groups with its post-processed realization of Terrestrial Time, TT(BIPM) and participates in a Working group on pulsars and time scales established by the International Astronomical Union (IAU).

9. Space-time references (E.F. Arias and G. Petit)

The BIPM maintains the web and ftp sites for the *IERS Conventions* (tai.bipm.org/iers/). The Conventions describe the latest realizations of the celestial and terrestrial reference frames, and of the model for the transformation between them. They also describe conventional models for the gravitational field, the displacement of markers on the Earth's crust and for the propagation of electromagnetic signals. In addition, the *Conventions* now provide a complete set of associated conventional software. These tasks are carried out with the help of the Advisory Board for the *IERS Conventions* updates, including representatives from all groups involved in the International Earth Rotation and Reference Systems Service (IERS). After the completion of the new reference edition, *IERS Conventions* (2010) in December 2010, work is continuing to provide updates to the *Conventions* (2010) which are regularly posted on the website (tai.bipm.org/iers/convupdt).

Activities related to the realization of reference frames for astronomy and geodesy are being developed in cooperation with the IERS. In these domains, improvements in accuracy will increase the need for a full relativistic treatment and it is essential to continue to participate in international working groups on these matters. Cooperation continues for the maintenance of the international celestial reference system within the framework of the activities of a working group created by the IAU in August 2012.

10. Comb activities (L. Robertsson)

As a result of the reorganization of activities in the Time Department, BIPM comb activities are limited to the maintenance of the BIPM frequency comb for internal use related to laser applications only and in other sections when needed.

11. Publications

External publications

1. Arias E.F., Jiang Z., Robertsson L., Vitushkin L., Ruess D., Ullrich C., Inglis D., Liard J., Robinson I., Ji W., Shuqing W., Lee C., Palinkas V., Mäkinen J., Pereira Dos Santos F., Bodart Q., Merlet S., Mizushima S., Choi I.-M., Baumann H., Karaböce B., Final report of key comparison CCM.G-K1: International comparison of absolute gravimeters ICAG2009, *Metrologia*, 2012, **49**, *Tech. Suppl.*, 07011.

2. Arias F., Harmegnies A., Jiang Z., Konaté H., Lewandowski W., Panfilo G., Petit G., Tisserand L., UTCr: a rapid realization of UTC, *Proc. EFTF 2012*, 2012, 24-27.

3. Bauch A., Beutler G., Petit G., Time and Frequency Metrology and its use for Navigation: Status and Proposed Future Research Themes, Galileo Science Advisory Committee, 2012.

4. Francis O, Rothleitner Ch., Jiang Z., Accurate determination of the Earth Tidal Parameters at the BIPM to support the Watt balance project, *Proc. IAG Symposium*, **139**, 2012.

5. Jiang Z., Becker M., Jousset P., Coulomb A., Tisserand L., Boulanger P., Lequin D., Lhermitte F., Houillon J.L., Dupont F., High precision levelling supporting the International Comparison of Absolute Gravimeters, *Metrologia*, 2012, **49**(1), 41-48.

6. Jiang Z., Lewandowski W., Use of GLONASS for UTC time transfer, *Metrologia*, 2012, **49**(1), 57-61.

7. Jiang Z., Lewandowski W., Accurate GLONASS time transfer for the generation of Coordinated Universal Time, *Int. Journal of Navigation and Observation*, 2012, **2012**, Article ID 353961, 14pp.

8. Jiang Z., Matsakis D., Mitchell S., Breakiron L., Bauh A., Piester D., Maeno H., Bernier L.G. Long-term Instability of GPS-based Time Transfer and Proposals for Improvements, *Proc. 43rd PTTI Meeting 2011*, 2012, 387-406.

9. Jiang Z., Lewandowski W., Panfilo G., Petit G., Reevaluation of the Measurement Uncertainty of the UTC Time Transfer, *Proc. 43rd PTTI Meeting 2011*, 2012, 133-140.

10. Jiang Z., Lewandowski W. Use of multi-technique combinations in UTC/TAI time and frequency transfer, *Proc. EFTF 2012*, 2012, 335-339.

11. Jiang Z, Lewandowski W., Inter-comparison of the UTC time transfer links, *Proc. EFTF 2012*, 2012, 126-132.

12. Jiang Z., Pálinkáš V., Francis O., Jousset P., Mäkinen J., Merlet S., Becker M., Coulomb A., Kessler-Schulz K.U., Schulz H.R., Rothleitner Ch., Tisserand L., Lequin D., Relative Gravity Measurement Campaign during the 8th International Comparison of Absolute Gravimeters (2009), *Metrologia*, 2012, **49**(1), 95-107.

13. Jiang Z., Pálinkáš V., Arias F.E., Liard J., Merlet S., Wilmes H., Vitushkin L., Robertsson L., Tisserand L., Pereira Dos Santos F., Bodart Q., Falk R., Baumann H., Mizushima S., Mäkinen J., Bilker-Koivula M., Lee C., Choi I.M., Karaboce B., Ji W., Wu Q., Ruess D., Ullrich C., Kostelecký J., Schmerge D., Eckl M., Timmen L., Le Moigne N., Bayer R., Olszak T., Ågren J., Del Negro C., Greco F., Diament M., Deroussi S., Bonvalot S., Krynski J., Sekowski M., Hu H., Wang L.J., Svitlov S., Germak A., Francis O., Becker M., Inglis D., Robinson I, The 8th International Comparison of Absolute Gravimeters 2009: the first Key Comparison (CCM.G-K1) in the field of absolute gravimetry, *Metrologia*, 2012, **49**(6), 666-684.

14. Jiang Z., Pálinkáš V., Francis O., Merlet S., Baumann H., Becker M., Jousset P., Mäkinen J., Schulz H.R., Kessler-Schulz K.U., Svitlov S., Coulomb A., Tisserand L., Hu H., Rothleitner Ch., Accurate gravimetry at the BIPM Watt Balance site, *Proc. IAG Symposium*, **139**, 2012.

15. Matus M., del Mar Pérez M., Zelenika S., Dauletbayev A., Kuanbayev C., Hussein H., Robertsson L., The CCL-K11 ongoing key comparison. Final report for the year 2011, *Metrologia*, 2012, **49**, *Tech. Suppl.*, 04009.

16. Pálinkáš V., Liard J., Jiang Z., On the effective position of the free-fall solution and the self-attraction effect of the FG5 gravimeters, *Metrologia*, 2012, **49**(4), 552-559.

17. Panfilo G., The new prediction algorithm for UTC: application and results, *Proc. EFTF 2012*, 2012, 242-246.

18. Panfilo G., Harmegnies A., Tisserand L., A new prediction algorithm for the generation of International Atomic Time, *Metrologia*, 2012, **49**(1), 49-56.

19. Petit G., Panfilo G., Comparison of frequency standards used for TAI, *IEEE T. Instrum. Meas.*, 2012, **99**, 1-6.

BIPM publications

20. BIPM Annual Report on Time Activities for 2011, **6**, 105 pp., available only at www.bipm.org/en/publications/time_activities.html.

21. *Circular T* (monthly), 8 pp.

22. Liard J., Pálinkáš V., Jiang Z., The self-attraction effect in absolute gravimeters and its influence on CIPM key comparisons, *Rapport BIPM*-2012/01, 12 pp.

12. Activities related to the work of Consultative Committees

E.F. Arias is Executive Secretary of the Consultative Committee for Time and Frequency (CCTF). She is a member of the CCTF Working Group on Two-Way Satellite Time and Frequency Transfer (TWSTFT), the CCTF Working Group on Primary Frequency Standards (WGPFS) and the CCTF Working Group on TAI (WGTAI).

Z. Jiang is a member of the CCTF Working Group on TWSTFT.

W. Lewandowski is Secretary of the CCTF Working Group on TWSTFT and Secretary of the CCTF Working Group on Global Navigation Satellite Systems Time-Transfer Standards (CGGTTS).

G. Panfilo is a member of the CCTF Working Group on Primary Frequency Standards (WGPFS) and of the Sub-Group on Algorithms of the CCTF Working Group on TAI and collaborates with the CCTF Working Group on the CIPM MRA (WGMRA).

G. Petit is a member of the CCTF Working Group on TAI and its Sub-Group on Algorithms, of the WGPFS, and of the CGGTTS.

L. Robertsson is Executive Secretary of the Consultative Committee for Length (CCL) and a member of the CCL Working Group on Strategic Planning (WG-S) and of the Discussion group DG-11 (Lasers). He is the BIPM representative on the CCM Working Group on Gravimetry (WGG).

13. Activities related to external organizations

E.F. Arias is a member of the IAU and participates in its working group on the International Celestial Reference System, she co-chairs the working group on the redefinition of UTC. She is an associate member of the IERS, a member of its International Celestial Reference System Centre, and of the Conventions Centre of the IERS. She is a member of the International VLBI Service (IVS), and of its Analysis Working Group on the International Celestial Reference Frame. She is the BIPM representative to the Governing Board of the IGS. She is the BIPM representative to the International Committee for GNSS and she is the chairperson of the Task Force on Time References. She is a member of the Global Geodetic Observing System (GGOS) Steering Committee representing the BIPM. She is a member of the Argentine Council of Research (CONICET) and an associated astronomer at the LNE-SYRTE, Paris Observatory. She is a corresponding member of the *Bureau des longitudes*. She is the BIPM representative to the Working Party 7A of the Study Group 7 of the International Telecommunication Union – Radiocommunication Sector (ITU-R).

W. Lewandowski is the BIPM representative to the Civil GPS Service Interface Committee and chairman of its Timing Sub-Committee. He is a member of the Scientific Council of the Space Research Centre of the Polish Academy of Sciences. He is also a member of a consultative Group on the Reform of Metrology at the Polish Ministry of Economy, an adviser to a Parliamentary Group on Space, and a member of the Committee on Research on Space Techniques of the Polish Academy of Sciences. He is member of European Commission Advisory Group on Galileo Time Infrastructure. Together with E.F. Arias, he is the BIPM representative to the Working Party 7A of the Study Group 7 of the ITU-R, and the UN International Committee on GNSS (ICG).

G. Petit is co-director of the Conventions Centre of the IERS. He is president of the IAU Commission 52 ‘Relativity in Fundamental Astronomy’, member of the IAU Working Group on Numerical Standards in Fundamental Astronomy, of the IGS Working Group on Clock Products, of the GNSS Science Advisory Committee of the ESA, and of the Fundamental Physics Group of the CNES.

G. Panfilo collaborates with the Working Group 1 (WG1) on the Expression of uncertainty in Measurement (GUM) of the Joint Committee for Guides in Metrology (JCGM) to provide an example for the new version of the GUM.

14. Travel (conferences, lectures and presentations, visits)

E.F. Arias to:

- Geneva (Switzerland), 16-20 January 2012, for the Radiocommunication Assembly 2012 at the International Telecommunication Union;
- La Plata (Argentina), 19-23 March 2012, for the ADeLa 2012 meeting as invited lecturer and to organize a panel discussion on the future of UTC;
- Gothenburg (Sweden), 24 to 27 April 2012, for the European Frequency and Time Forum (EFTF) and for the meetings of the CCTF WGs on Strategic Planning (as the secretary), on Coordination of the Development of Advanced Time and Frequency Transfer Techniques and on TWSTFT;
- Baltimore (USA), 22 to 24 May 2012, for the IEEE-IFCS 2012 and to give an invited lecture;
- Beijing (China), 22 to 31 August 2012, for the XXVIII General Assembly of the International Astronomical Union, including the Joint Discussion 7 on Reference Systems, and meetings of Commissions 8, 19 and 30, and to visit the NTSC (Lintong) and the NIM;
- Manta (Ecuador), 20 to 29 September 2012, for the ITU Seminar for the Americas, invited to give a lecture and for the meeting of the Working Party 7A as delegate of the BIPM;

Z. Jiang to:

- Vienna (Austria), 13-15 February 2012, for the Joint discussion meeting of IAG JWG2.1 and JWG2.2 at the BEV, with a presentation on the ICAG 2009;
- Gothenburg (Sweden), 24 to 27 April 2012, for the European Frequency and Time Forum (EFTF) with oral and poster presentations, and for the meeting of the CCTF WG on TWSTFT, (acting as secretary);
- Istanbul (Turkey), 29 and 30 May 2012, for the CCM-WGG meeting;
- Reston (USA), 26-29 November 2012, for the 44th PTTI, invited presentations and for a meeting of TW participant laboratories;

W. Lewandowski to:

- Vienna (Austria), 13 February 2012, for the preparatory meeting of the 7th ICG;
- Braunschweig (Germany), 17 April 2012, for the meeting of the Galileo FOC Timing Interface Working Group;
- Warsaw (Poland), 28 June to 3 July 2012, to the Space Research Centre and Space Commission;
- Nashville (Tennessee, USA), 17 to 21 September 2012, for the ION meeting and for the meeting of the Civil GPS Interface Committee (CGSIC) acting as chair of the Timing Sub-committee;
- Beijing (China), 5-9 November 2012, for the 7th Meeting of the ICG and to chair the meeting of the WG D Task Force on Timing References;
- Warsaw (Poland), 19 to 21 November, for meetings on the Galileo system, organized by the European Commission;
- Reston (USA), 26-29 November 2012, for the 44th PTTI, invited presentations and for a meeting of TW participant laboratories;

G. Panfilo to:

- Gothenburg (Sweden), 24 to 27 April 2012, for the European Frequency and Time Forum (EFTF) to give an invited lecture and for the meetings of the CCTF WGs on Coordination of the Development of Advanced Time and Frequency Transfer Techniques and on TWSTFT;
- Turin (Italy), 11-12 October 2012, invited to give a lecture on “Algorithms for the International Atomic Time” at the University of Turin;

G. Petit to:

- Bern (Switzerland), 18-19 January 2012, to attend the IGS workshop on GNSS biases, with oral presentations;
- Paris (France), 1 February 2012, for the meeting of the *Groupe de travail de Physique Fondamentale* of the CNES;
- Paris (France), 8 February 2012, to attend the kick-off meeting of the Labex First-TF network;
- Paris (France), 23 March and 4 October 2012, to attend meetings of the GNSS Science Advisory Committee;
- Vienna (Austria), 20-22 April 2012, to attend a workshop of the IERS Global Geophysical Fluid Center and a meeting of the Directing board of the IERS;
- Gothenburg (Sweden), 24-27 April 2012, to attend the European Frequency and Time Forum, and presentation;
- Alicante (Spain), 11-12 May 2012, to chair a PhD jury;
- Washington DC (USA), 1-5 July 2012, to attend the Conference on Precision Electromagnetic Measurements, to give a presentation, and to visit the USNO and NRL time laboratories;
- Paris (France), 14 November 2012, to attend the *Rencontres de l'Observatoire de Paris*;
- Hoofddorp (The Netherlands), 20-21 November 2012, to attend the workshop 'Optical networks for accurate time and frequency transfer'.

L. Robertsson to:

- Gothenburg (Sweden), 24 to 27 April 2012, for the European Frequency and Time Forum (EFTF) and for the meeting of the CCTF WG on Coordination of the Development of Advanced Time and Frequency Transfer Techniques and on TWSTFT (as the secretary);
- Hoofddorp (The Netherlands), 20-21 November 2012, for the Workshop on Optical Networks for Accurate Time and Frequency Transfer.

15. Visitors

- P. Lejba, Space Research Centre of the Polish Academy of Sciences (Poland), for activities on GNSS time transfer and calibration, under the supervision of W. Lewandowski, 6 to 9 February 2012;
- L.S. Ma, State Key Laboratory of Precision Spectroscopy East China Normal University (China), for discussions on optical frequency activities, 9 to 18 September 2012;
- M. Zucco, INRIM (Italy), for discussions on optical frequency activities, 9 to 18 September 2012;
- Y. Almleaky, Makkah Time Centre (Saudi Arabia), for discussions about the contribution to UTC;
- J. Davis, NPL (UK), for an external audit of the Time Department, 6 December 2012.

Access to electronic files on the FTP server of the BIPM Time Department.

The files related to the BIPM Time Activities are available from the website.
(http://www.bipm.org/en/scientific/tai/time_ftp.html)

The files are found in the four subdirectories **data**, **publications**, **scales and links**.
Data, **publications** and **scales** are available by ftp (62.161.69.5 or ftp2.bipm.org, user anonymous, e-mail address as password, cd pub/tai).
Links is available by ftp (62.161.69.131 or tai.bipm.org, user anonymous, e-mail address as password, cd TimeLink/LkC).

Data- Reports of evaluation of primary frequency standards and all clock and time transfer data files used for the computation of TAI, arranged in yearly directories, starting January 2005.
See readme.txt for details.

Rapid UTC **-** Starting in February 2012 results of the Pilot Experiment on Rapid UTC (UTCr).

Publications **-** the latest issues on time activities

In the following directories XY represents the last two digits of the year number (19XY or 20XY); WW equals 01 for week 1, …. 52 for week 52, ZT equals 01 for Jan., 02 for Feb. ….12 for Dec.; XX, XXX are ordinal numbers; results of the computation of TAI over the two-month interval Z of the year (Z =1 for Jan.-Feb., 2 for Mar.- Apr., etc…) until Nov.-Dec. 1997.

publications	**filename**
Acronyms of laboratories	acronyms.pdf
Leap seconds	leaptab.pdf
Circular T	cirt.XXX
Fractional frequency of EAL from primary frequency standards	etXY.ZT
Weights of clocks participating in the computation of TAI	wXY.ZT
Rates relative to TAI of clocks participating in the computation of TAI	rXY.ZT
Frequency drifts of clocks participating in the computation of TAI	dXY.ZT
Values of the differences between TAI and the local atomic scale of the given laboratory, including relevant notes	TAI - lab
Values of the differences between UTC and its local representation by the given laboratory, including relevant notes	UTC - lab
Values of the differences between TAI and UTC and the respective local scales, evaluated for two-month periods until the end of 1997	TAIXYZ
[*UTC*(*lab1*) - *UTC*(*lab2*)] obtained by the TWSTFT link	lab1 - lab2.tw
BIPM Two-Way Satellite Time and Frequency Transfer Reports (until February 2003)	twstftXX.pdf
Most recent schedules for common-view observations of GPS and	schgps.XX
GLONASS satellites (until April 2008)	schglo.XX

Older files can be accessed directly from the ftp site (62.161.69.5 or ftp2.bipm.org).

Scale- time scales data

Content	filename
Time Dissemination Services	TIMESERVICES.DOC
Time Signals	TIMESIGNALS.DOC
Rates of clocks contributing to TAI	RTAIXY.ar
Weights of clocks contributing to TAI	WTAIXY.ar
Drifts of clocks contributing to TAI	DTAIXY.ar
TT(BIPMXY) computation ending in 19XY or 20XY	TTBIPM.XY
Starting 1993:	
Difference between the normalized frequencies of EAL and TAI	EALTAIXY.ar
TAI frequency	FTAIXY.ar (for 1993,1994)
Measurements of the duration of the TAI scale interval	UTAIXY.ar (starting 1995)
Mean duration of TAI scale interval	SITAIXY.ar (1993-1999)
Mean fractional deviation of the TAI scale interval from that of TT duration of TAI scale interval	SITAIXY.ar (starting 2000)
[*TAI* - *GPS time*] and [*UTC* - *GPS time*] (until March 2003)	UTCGPSXY.ar
[*TAI* - *GLONASS time*] and [*UTC* - *GLONASS time*] (until March 2003)	UTCGLOXY.ar
[*TAI* - *GPS time*] and [*UTC* - *GPS time*], [*TAI* - *GLONASS time*] and [*UTC* - *GLONASS time*] (starting April 2003)	UTCGPSGLOXY.ar
Local representations of UTC: Values of [*UTC* - *UTC*(*lab*)]	UTCXY.ar (1993-1998)
Independent local atomic time scales: values of [*TAI* - *TA*(*lab*)]	TAIXY.ar (1993-1998)
Until 1992:	
Local representations of UTC: Values of [*UTC* - *UTC*(*lab*)]	UTC.XY
Local values of [*TAI* - *TA*(*lab*)]	TA.XY

Links - Results of link comparison, arranged in yearly directories, starting January 2005. See readme.txt for details.

Rapid UTC - Results of the Pilot Experiment on Rapid UTC.

UTCr	UTCr_XYWW
Daily values of the differences between UTCr and its local presentation by the given laboratory.	UTCr - lab

Starting with the BIPM Time Section Annual Report for 1999, some tables traditionally included in the printed version are only available in electronic form. From the BIPM Annual Report on Time Activities for 2009, only electronic files are available.

For any comment or query send a message to: tai@bipm.org

Leap seconds

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 International Bureau of Weights and Measures (BIPM) under the authority of the International Committee for Weights and Measures (CIPM). The dates of leap seconds of UTC are decided and announced by the International Earth Rotation and Reference Systems Service (IERS), which is responsible for the determination of Earth rotation parameters and the 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.

Further information about leap seconds can be obtained from the IERS:

IERS Earth Orientation Product Centre
Dr Daniel GAMBIS
Observatoire de Paris
61, avenue de l'Observatoire
75014 Paris, France

Telephone: + 33 1 40 51 22 26
Telefax: + 33 1 40 51 22 91
iers@obspm.fr
http://hpiers.obspm.fr
Anonymous ftp://hpiers.obspm.fr or ftp://145.238.100.28

Establishment of International Atomic Time and of Coordinated Universal Time

1. Data and computation

International Atomic Time (TAI) and Coordinated Universal Time (UTC) are obtained from a combination of data from some 400 atomic clocks kept by more than 70 timing centres which maintain a local UTC, UTC(*k*) (see Table 3). The data are in the form of time differences [*UTC*(*k*) - *Clock*] taken at 5 day intervals for Modified Julian Dates (MJD) ending in 4 and 9, at 0 h UTC; these dates are referred to here as “standard dates”. The equipment maintained by the timing centres is detailed in Table 4.

An iterative algorithm produces a free atomic time scale, EAL (Échelle Atomique Libre), defined as a weighted average of clock readings. The processing is carried out and, subsequently, treats one month batches of data [1] and [2]. The weighting procedure and clock frequency prediction [3] are chosen such 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 frequency caesium standards, correcting their proper frequency as needed to account for known effects (e.g. general relativity, blackbody radiation). TAI is then derived from EAL by adding a linear function of time with an appropriate 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. Measurements of the duration of the TAI scale interval and estimates of its mean duration are reported in Table 6 and Table 7.

3. Availability

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*), the independent local atomic time scales. These differences, [*TAI - TA(k)*] and [*UTC - UTC(k)*], are computed for the standard dates including uncertainties of [*UTC – UTC*(*k*)] [4].

The computation of TAI is carried out every month and the results are published monthly in *Circular T*.

In the frame of a Pilot Experiment and with the participation of about forty laboratories already contributing to TAI, a rapid solution called rapid UTC (UTCr) has been published weekly since February 2012.

4. Time links

The BIPM organizes the international network of time links to compare local realizations of UTC in contributing laboratories and uses them in the formation of TAI. The network of time links used by the BIPM is non-redundant and relies on observation of GNSS satellites and on two-way satellite time and frequency transfer (TWSTFT).

Most time links are based on GPS satellite observations. Data from multi-channel dual-frequency GPS geodetic-type receivers are regularly used in the calculation of time links, in addition to that acquired by a few single-frequency (single- or multi-channel) GPS time receivers. For those links realized using more than one technique, one of them is considered official for TAI and the others are calculated as back-ups. Single-frequency GPS data are corrected using the ionospheric maps produced by the Centre for Orbit Determination in Europe (CODE); all GPS data are corrected using precise satellite ephemerides and clocks produced by the International GNSS Service (IGS).

GPS links are computed with the method called “GPS all in view” [5], with a network of time links that uses the PTB as a unique pivot laboratory for all the GPS links. Since September 2009, links equipped with geodetic-type receivers are computed with the “Precise Point Positioning” method GPS PPP [6].

Clock comparisons using GLONASS C/A (L1C frequency) satellite observations with multi-channel receivers have been introduced since October 2009 [7]. These links are computed using the “common-view” [8] method; data are corrected using the ESA ephemerides SP3 files and the IGS ionospheric maps.

Combination of individual TWSTFT and GPS PPP links and of individual GPS and GLONASS links were introduced in January 2011 and are currently used in the calculation of TAI [9, 10].

A figure showing the time link techniques in the contributing laboratories can be downloaded from the BIPM website. For more detailed information on the equipment refer to [Table 4] and to Section 6 of BIPM *Circular T* for the techniques and methods of time transfer officially used.

The uncertainty of [$UTC(k_1)$ - $UTC(k_2)$], obtained at the BIPM with these procedures is given in *Circular T*, section 6. The BIPM publishes in *Circular T* an evaluation of [*UTC - GPS time*] based on GPS data provided by Paris Observatory (LNNE-SYRTE), and also an evaluation of [*UTC - GLONASS time*] based on ongoing observations of the GLONASS system at the Astrogeodynamical Observatory (AOS), Poland.

The BIPM also publishes in *Circular T* daily values of [*UTC – UTC(USNO)_GPS*] and [*UTC – UTC(SU)_GLONASS*] where *UTC(USNO)_GPS* and *UTC(SU)_GLONASS* are respectively, UTC(USNO) and UTC(SU) as predicted by USNO and SU; and broadcast by GPS and GLONASS.

International GPS tracking schedules are published by the BIPM about every six months.

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 19xx or 20xx is the year of computation [11, 12, 13]. The successive versions of TT(BIPMxx) are both updates and revisions; they may differ for common dates.

Starting with TT(BIPM09), an extrapolation for the current year of the latest realization TT(BIPMxx) is provided in the file TTBIPMxx.ext. It is updated each month after the TAI computation.

Notes

Tables 8 and 9 of this report give the rates relative to TAI and the weights of the clocks contributing to TAI in 2012.

A full list of time signals and time dissemination services is compiled by the BIPM from the information provided by the time laboratories. The report on the scientific work of the BIPM on time activities for the period January - December 2012 is extracted from the *Director's Report on the Activity and Management of the BIPM (1 January − 31 December 2012)*. All the publications mentioned in this report are available on request from the BIPM.

References

[1] Thomas C. and Azoubib J., TAI computation: study of an alternative choice for implementing an upper limit of clock weights, *Metrologia*, 1996, **33** (3), 227-240.

[2] Azoubib J., A revised way of fixing an upper limit to clock weights in TAI computation, Document CCTF/01-14 presented to the 15th meeting of the CCTF (2001).

[3] Panfilo G., Harmegnies A., Tisserand L., A new prediction algorithm for the generation of International Atomic Time, *Metrologia*, 2012, **49** (1), 49-56.

[4] Lewandowki W., Matsakis D.; Panfilo G. and Tavella P., The evaluation of uncertainties in [UTC –UTC(k)], *Metrologia*, 2006, **43**, 278-286.

[5] Petit G., Jiang Z., GPS All in View time transfer for TAI computation, *Metrologia*, 2008, **45** (1), 35-45.

[6] Petit G., Jiang Z., Precise point positioning for TAI computation, IJNO, Article ID 562878, doi:10.1155/2008/562878, 2008.

[7] Lewandowski W. and Jiang Z., Use of GLONASS at the BIPM, *Proc. 41st PTTI Systems and Applications Meeting*, 2010, 5-14.

[8] Allan D.W., Weiss, A.M., Accurate time and frequency transfer during common-view of a GPS satellite**,** *Proc. 34th Ann. Symp. Frequency Control (1980)*, 1980, 334-346.

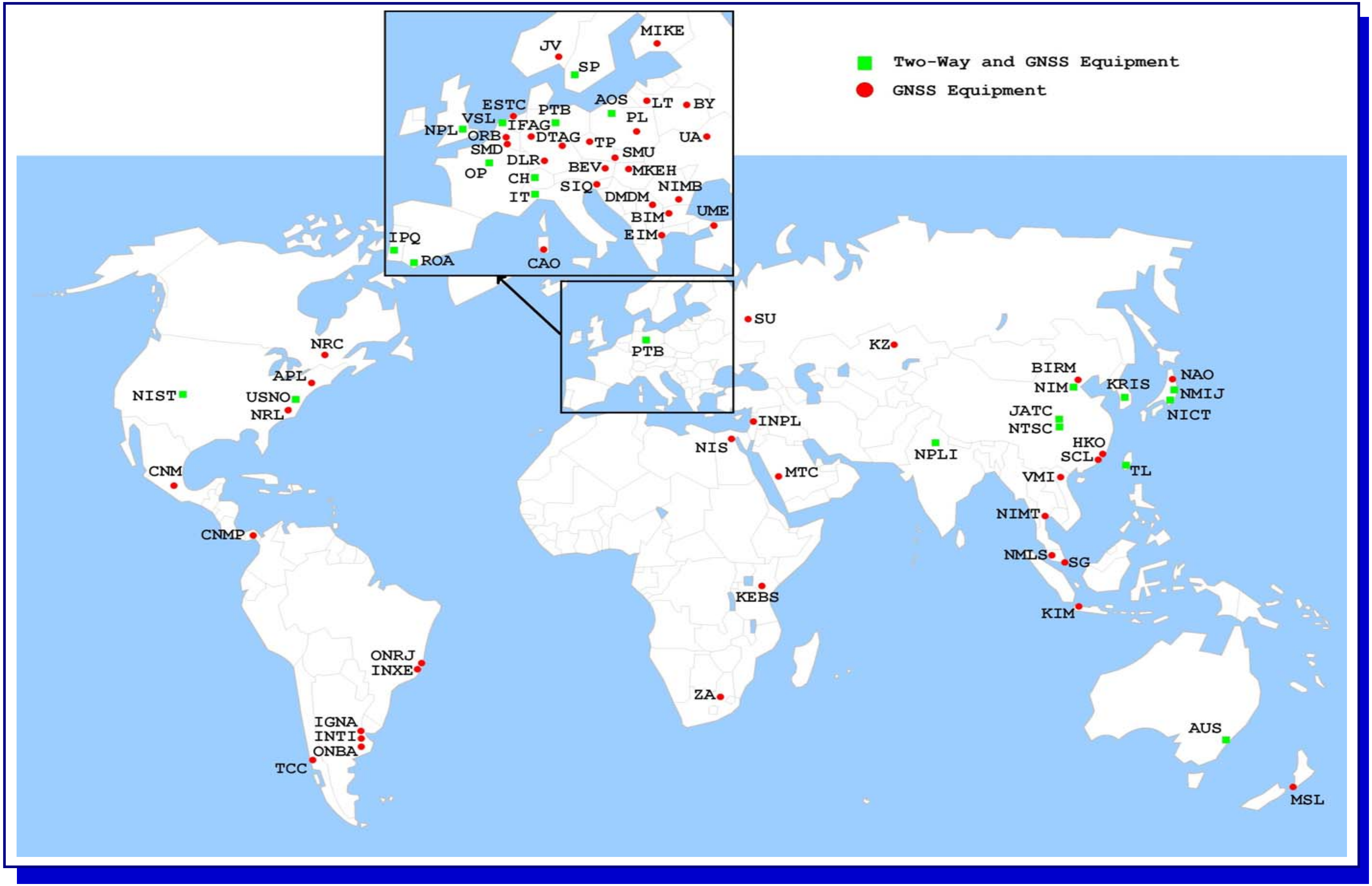
[9] Jiang Z., Lewandowski W., Use of GLONASS for UTC time transfer, *Metrologia*, 2012, **49** (1), 57-61

[10] Jiang Z., Petit G., Combination of TWSTFT and GNSS for accurate UTC time transfer *Metrologia*, 2009, **46** (3), 305-314

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

[12] Petit G., A new realization of Terrestrial Time, *Proc. 35th PTTI*, 2003, 307-317.

[13] Petit G., Atomic time scales TAI and TT(BIPM): present status and prospects, *Proc. 7th Symposium on frequency standards and metrology*, L. Maleki (Ed.), World Scientific, 2009, 475-482,



Geographical distribution of the laboratories that contribute to TAI and time transfer equipment (April 2013)

Table 1. Relative frequency offsets and step adjustments of UTC, up to 30 June 2014

Date (at 0 h UTC)	Offsets	Steps/s
1961 Jan. 1	-150×10^{-10}	
1961 Aug. 1	"	+0.050
1962 Jan. 1	-130×10^{-10}	
1963 Nov. 1	"	-0.100
1964 Jan. 1	-150×10^{-10}	
1964 Apr. 1	"	-0.100
1964 Sep. 1	"	-0.100
1965 Jan. 1	"	-0.100
1965 Mar. 1	"	-0.100
1965 Jul. 1	"	-0.100
1965 Sep. 1	"	-0.100
1966 Jan. 1	-300×10^{-10}	
1968 Feb. 1	"	+0.100
1972 Jan. 1	0	-0.107 7580
1972 Jul. 1	"	-1
1973 Jan. 1	"	-1
1974 Jan. 1	"	-1
1975 Jan. 1	"	-1
1976 Jan. 1	"	-1
1977 Jan. 1	"	-1
1978 Jan. 1	"	-1
1979 Jan. 1	"	-1
1980 Jan. 1	"	-1
1981 Jul. 1	"	-1
1982 Jul. 1	"	-1
1983 Jul. 1	"	-1
1985 Jul. 1	"	-1
1988 Jan. 1	"	-1
1990 Jan. 1	"	-1
1991 Jan. 1	"	-1
1992 Jul. 1	"	-1
1993 Jul. 1	"	-1
1994 Jul. 1	"	-1
1996 Jan. 1	"	-1
1997 Jul. 1	"	-1
1999 Jan. 1	"	-1
2006 Jan. 1	"	-1
2009 Jan. 1	"	-1
2012 Jul. 1	"	-1

Table 2. Relationship between TAI and UTC, up to 30 June 2014

Limits of validity (at 0 h UTC)	[*TAI* - *UTC*] / s
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 - 1994 Jul. 1	28
1994 Jul. 1 - 1996 Jan. 1	29
1996 Jan. 1 - 1997 Jul. 1	30
1997 Jul. 1 - 1999 Jan. 1	31
1999 Jan. 1 - 2006 Jan. 1	32
2006 Jan. 1 - 2009 Jan. 1	33
2009 Jan. 1 - 2012 Jul. 1	34
2012 Jul. 1 -	35

Table 3. Acronyms and locations of the timing centres which maintain a local approximation of UTC, UTC(*k*), and/or an independent local time scale, TA(*k*)

AMC	Alternate Master Clock station, Colorado Springs, Colo., USA
AOS	Astrogeodynamical Observatory, Space Research Centre P.A.S., Borowiec, Poland
APL	Applied Physics Laboratory, Laurel, Maryland, USA
AUS	Consortium of laboratories in Australia
BEV	Bundesamt für Eich- und Vermessungswesen, Vienna, Austria
BIM	Bulgarian Institute of Metrology, Sofiya, Bulgaria
BIRM	Beijing Institute of Radio Metrology and Measurement, Beijing, P. R. China
BY	Belarussian State Institute of Metrology, Minsk, Belarus
CAO	Stazione Astronomica di Cagliari (Cagliari Astronomical Observatory), Cagliari, Italy
CH	Federal Institute of Metrology (METAS), Bern-Wabern, Switzerland
CNM	Centro Nacional de Metrología, Querétaro, Mexico (CENAM)
CNMP	Centro Nacional de Metrología, de Panamá, Panama
DLR	Deutsche Zentrum für Luft- und Raumfahrt (German Aerospace Centre) Oberpfaffenhofen, Germany
DMDM	Directorate of Measures and Precious Metals, Belgrade, Serbia
DTAG	Deutsche Telekom AG, Frankfurt/Main, Germany
EIM	Hellenic Institute of Metrology, Thessaloniki, Greece
ESTC(1)	European Space Research and Technology Centre, Noordwijk, The Netherlands
F	Commission Nationale de l'Heure, Paris, France
GUM	Glówny Urząd Miar (Central Office of Measures), Warsaw, Poland
HKO	Hong Kong Observatory, Hong Kong, China
IFAG	Bundesamt für Kartographie und Geodäsie (Federal Agency for Cartography and Geodesy), Fundamental station, Wettzell, Kötzting, Germany
IGNA	Instituto Geográfico Nacional, Buenos Aires, Argentina
INPL	National Physical Laboratory, Jerusalem, Israel
INTI	Instituto Nacional de Tecnología Industrial, Buenos Aires, Argentina
INXE(2)	INMETRO - National Institute for Metrology and Technology - Time and Frequency Laboratory, Rio de Janeiro, Brazil.
IPQ	Instituto Português da Qualidade, Monte de Caparica, Portugal
IT	Istituto Nazionale di Ricerca Metrologica (INRIM), Italy
JATC	Joint Atomic Time Commission, Lintong, P.R. China
JV	Justervesenet, Norwegian Metrology and Accreditation Service, Kjeller, Norway
KEBS(3)	Kenya Bureau of Standards, Nairobi, Kenya
KIM	Research Centre for Calibration, Instrumentation and Metrology The Indonesian Institute of Sciences, Serpong-Tangerang, Indonesia
KRIS	Korea Research Institute of Standards and Science, Daejeon, Rep. of Korea
KZ	Kazakhstan Institute of Metrology, Astana, Kazakhstan
LT	Center for Physical Sciences and Technology, Vilnius, Lithuania
LV(4)	SA Latvian National Metrology Centre, Riga, Latvia
MIKE	Center for Metrology and Accreditation, Finland
MKEH	Hungarian Trade Licensing Office, Hungary
MSL	Measurement Standards Laboratory, Lower Hutt, New Zealand
MTC(1)	MAKKAH Time Centre - King Abdulah Centre for Crescent Observations and Astronomy, Makkah, Saudi Arabia

(1) ESTC, MTC Participation since November 2012

(2) INXE Participation since September 2012.

(3) KEBS Participation since January 2012.

(4) LV Time activities are suspended since February 2011 for an undertermined period.

Table 3. Acronyms and locations of the timing centres which maintain a local approximation of UTC, UTC(*k*), and/or an independent local time scale, TA(*k*) (Cont.)

NAO	National Astronomical Observatory, Misuzawa, Japan
NICT	National Institute of Information and Communications Technology, Tokyo, Japan
NIM	National Institute of Metrology, Beijing, P.R. China
NIMB	National Institute of Metrology, Bucharest, Romania
NIMT	National Institute of Metrology, Bangkok, Thailand
NIS	National Institute for Standards, Cairo, Egypt
NIST	National Institute of Standards and Technology, Boulder, Colo., USA
NMIA	National Measurement Institute, Australia, Sydney, Australia
NMIJ	National Metrology Institute of Japan, Tsukuba, Japan
NMLS	National Metrology Laboratory of SIRIM Berhad, Shah Alam, Malaysia
NPL	National Physical Laboratory, Teddington, United Kingdom
NPLI	National Physical Laboratory, New Delhi, India
NRC	National Research Council of Canada, Ottawa, Canada
NRL	U.S. Naval Research Laboratory, Washington D.C., USA
NTSC	National Time Service Center of China, Lintong, P.R. China
ONBA	Observatorio Naval, Buenos Aires, Argentina
ONRJ	Observatório Nacional, Rio de Janeiro, Brazil
OP	Observatoire de Paris (Paris Observatory), Paris, France
ORB	Observatoire Royal de Belgique (Royal Observatory of Belgium), Brussels, Belgium
PL	Consortium of laboratories in Poland
PTB	Physikalisch-Technische Bundesanstalt, Braunschweig, Germany
ROA	Real Instituto y Observatorio de la Armada, San Fernando, Spain
SCL	Standards and Calibration Laboratory, Hong Kong, China
SG	National Metrology Centre - Agency for Science, Technology and Research (A*STAR)
SIQ	Slovenian Institute of Quality and Metrology, Ljubljana, Slovenia
SMD	Metrology Division of the Quality and Safety Department - Scientific Metrology Brussels, Belgium
SMU	Slovenský Metrologičký Ústav (Slovak Institute of Metrology), Bratislava, Slovakia
SP	Sveriges Provnings- och Forskningsinstitut (Swedish National Testing and Research Institute), Borås, Sweden
SU	Institute of Metrology for Time and Space (IMVP), NPO "VNIIFTRI" Mendeleevo, Moscow Region, Russian Federation
TCC	TIGO Concepción Chile, Chile
TL	Telecommunication Laboratories, Chung-Li, Chinese Taipei
TP	Institute of Photonics and Electronics, Czech Academy of Sciences, Praha, Czech Republic
UA	National Science Center "Institute of Metrology", Kharkhov, Ukraine
UME	Ulusai Metroloji Enstitüsü, Marmara Research Centre, (National Metrology Institute), Gebze Kocaeli, Turkey
USNO	U.S. Naval Observatory, Washington D.C., USA
VMI	Vietnam Metrology Institute, Ha Noi, Vietnam
VSL	VSL, Dutch Metrology Institute, Delft, the Netherlands
ZA	National Metrology Institute of South Africa, Pretoria, South Africa

Note: Most of the timing centres in the table can be accessed through the BIPM website, at "Useful links".

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2012

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab *k*	Equipment	Source of UTC(*k*) (1)	TA(*k*)	Time Links			
				GPS		GLONASS	Two-Way
				SF	DF		
AOS	3 Ind. Cs 2 H-masers	1 H-maser (2) + microphase-stepper	* (9)	*	*	*	*
APL	3 Ind. Cs 3 H-masers	1 H-maser + frequency synthesizer steered to UTC(APL)		*	*		
AUS	5 Ind. Cs 2 H-masers	1 Cs		*	*	*	*
BEV	3 Ind. Cs 1 H-maser	1 Cs		*	*	*	
BIM	3 Ind. Cs	1 Cs		*	*		
BIRM	2 Ind. Cs 3 H-masers	1 Cs		*	*		
BY (a)	6 H-masers	3-4 H-masers		*		*	
CAO (a)	2 Ind. Cs	1 Cs		*	*	*	
CH	4 Ind. Cs (3) 1 H-maser	all the Cs 1 H-maser	*		*		*
CNM	2 Ind. Cs 1 H-maser	2 Ind. Cs 1 H-maser + microphase-stepper			*	*	
CNMP	2 Ind. Cs	1 Cs + frequency offset generator		*			
DLR	3 Ind. Cs 4 H-masers	1 Cs			*		
DMDM	2 Ind. Cs	1 Cs + microphase-stepper		*	*		
DTAG	3 Ind. Cs	1 Cs		*	*		
EIM (a)	4 Ind. Cs	1 Cs		*			
ESTC	4 Ind. Cs 1 H-maser	1 H-maser + microphase-stepper			*		
HKO	2 Ind. Cs	1 Cs		*			
IFAG (a)	5 Ind. Cs 2 H-masers	1 Cs + microphase-stepper		*	*		

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2012 (Cont.)

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab *k*	Equipment	Source of UTC(*k*) (1)	TA(*k*)	Time Links			
				GPS		GLONASS	Two-Way
				SF	DF		
IGNA	2 Ind. Cs	1 Cs		*			
INPL	2 Ind. Cs	1 Cs			*	*	
INTI	1 Ind. Cs	1 Cs		*			
INXE	1 Ind. Cs	1 Cs			*		
IPQ (a)	3 Ind. Cs	1 Cs + microphase-stepper			*	*	*
IT	6 Ind. Cs 3 H-masers 2 Lab. Cs	1 H-maser + microphase-stepper	*	*	*	*	*
JATC	(4)	1 Cs + microphase-stepper	*				
JV	3 Ind. Cs	1 Cs + microphase-stepper		*			
KEBS	3 Ind. Cs	1 Cs + reference generator			*	*	
KIM	2 Ind. Cs	1 Cs		*	*	*	
KRIS	5 Ind. Cs 3 H-masers	1 H-maser + microphase-stepper	*	*	*	*	*
KZ	4 Ind. Cs	1 Cs + microphase-stepper			*	*	
LT	2 Ind. Cs	1 Cs		*			
MIKE	2 Ind. Cs 3 H-masers	1 H-maser + microphase-stepper		*	*		
MKEH	1 Ind. Cs	1 Cs		*			
MSL	3 Ind. Cs	1 Cs + microphase-stepper		*	*		
MTC (b)	5 Ind. Cs	1 Cs		*			
NAO	4 Ind. Cs 1 H-maser	1 Cs + microphase-stepper		*			

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2012 (Cont.)

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab *k*	Equipment	Source of UTC(*k*) (1)	TA(*k*)	Time Links GPS SF	Time Links GPS DF	GLONASS	Two-Way
NICT	29 Ind. Cs 7 H-masers (5) 1 Lab. Cs	18 Cs	*	*	*		*
NIM	7 Ind. Cs 6 H-masers	1 H-maser + microphase-stepper		*	*		*
NIMB	2 Ind. Cs	1 Cs		*	*		
NIMT	2 Ind. Cs	1 Cs + microphase-stepper		*	*		
NIS (a)	3 Ind. Cs	1 Cs		*	*	*	
NIST	10 Ind. Cs 2 Lab. Cs 6 H-masers	4 Cs 6 H-masers + microphase-stepper	*	*	*		*
NMIJ (a)	4 Ind. Cs 1 Lab. Cs 4 H-masers	1 H-maser + microphase-stepper		*	*		*
NMLS	2 Ind. Cs	1 Cs			*		
NPL	3 Ind. Cs 4 H-masers	1 H-maser		*	*		*
NPLI	5 Ind. Cs 1 H-maser	1 H-maser + microphase-stepper		*	*		*
NRC	6 Ind. Cs 2 Lab. Cs 4 H-masers	1 Cs + microphase-stepper	*		*		
NRL	4 Ind. Cs 2 H-masers	1 H-maser + frequency synthesizer steered to UTC(NRL)			*		
NTSC	18 Ind. Cs 3 H-masers	1 Cs + microphase-stepper	*	*	*		*
ONBA	2 Ind. Cs	1 Cs		*			
ONRJ	7 Ind. Cs 2 H-maser	7 Cs 2 H-masers + frequency offset generator	* (6)		*	*	
OP	8 Ind. Cs 3 Lab. Cs 1 Lab. Rb 6 H-masers	1 H-maser + microphase-stepper (7)	* (8)	*	*	*	*

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2012 (Cont.)

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab *k*	Equipment	Source of UTC(*k*) (1)	TA(*k*)	Time Links GPS SF	Time Links GPS DF	GLONASS	Two-Way
ORB	5 Ind. Cs 1 H-masers	1 H-maser + femtostepper			*	*	
PL	12 Ind. Cs 4 H-masers	1 Cs (9) + microphase-stepper	* (10)	*			
PTB	3 Ind. Cs 4 Lab. Cs (11) 3 H-masers	1 H-maser (12) + microphase-stepper	* (13)	*	*	*	*
ROA	6 Ind. Cs (14) 1 H-maser	1 H-maser + frequency synthesizer steered to UTC(ROA) (15)		*	*	*	*
SCL (a)	2 Ind. Cs	1 Cs + microphase-stepper		*			
SG	4 Ind. Cs 1 H-maser	1 H-maser + microphase-stepper	*	*	*	*	
SIQ	1 Ind. Cs	1 Cs		*			
SMD	4 Ind. Cs 1 H-maser	1 Cs + microphase-stepper (16)		*			
SMU (a)	1 Ind. Cs	1 Cs + output frequency steering		*	*	*	
SP	13 Ind. Cs (17) 7 H-masers	1 H-maser + microphase-stepper			*		*
SU	1 Lab. Cs 8 H-masers	4-8 H-masers	*		*	*	
TCC	3 Ind. Cs 3 H-masers	1 Cs		*	*		
TL	13 Ind. Cs 3 H-masers	1 H-maser + microphase-stepper	* (18)		*		*
TP	4 Ind. Cs	1 Cs + output frequency steering			*		
UA	1 Ind. Cs 3 H-masers	3 H-masers + microphase-stepper		*	*	*	
UME	5 Ind. Cs	1 Cs			*	*	
USNO	82 Ind. Cs 31 H-masers 5 Lab. Rb	1 H-maser + frequency synthesizer steered to UTC(USNO) (19)	* (19)	*	*		*

Table 4. Equipment and source of UTC(*k*) of the laboratories contributing to TAI in 2012 (Cont.)

Ind. Cs: industrial caesium standard
Ind. Rb: industrial rubidium standard
Lab. Cs: laboratory caesium standard
Lab. Rb: laboratory rubidium standard
H-maser: hydrogen maser
SF: single frequency receiver
DF: dual frequency receiver
* means 'yes'

Lab *k*	Equipment	Source of UTC(*k*) (1)	TA(*k*)	Time Links			
				GPS		GLONASS	Two-Way
				SF	DF		
VMI	3 Ind. Cs	1 Cs + microphase-stepper			*		
VSL	4 Ind. Cs	1 Cs + microphase-stepper			*		*
ZA	4 Ind. Cs	1 Cs			*		

Notes

(a) Information based on the Annual Report for 2011, not confirmed by the laboratory.

(b) Information not confirmed by the laboratory.

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

(2) AOS The UTC(AOS) is formed technically using 1 hydrogen maser and microstepper, it is steered using TA(PL) data as a reference.

(3) CH All the standards are located in Bern at METAS (Federal Office of Metrology).
Since November 2007, UTC(CH) is defined in real time by a hydrogen maser steered to the paper time scale UTC(CH.P) which is defined as a weighted average of all the clocks, steered to UTC.
TA(CH) is also a weighted average of all the clocks, but free running.

(4) JATC The standards are located at National Time Service Centre (NTSC).
The link between UTC(JATC) and UTC(NTSC) is obtained by internal connection.

(5) NICT The standards are located as follows (at the end of 2012):

* Koganei Headquarters	19 Cs, 7 H-masers
* Ohtakadoya-yama LF station	4 Cs
* Hagane-yama LF station	5 Cs
* Advanced ICT Research Institute in Kobe	2 Cs

(6) ONRJ The Brazilian atomic time scale TA(ONRJ) is computed by the National Observatory Time Service Division in Rio de Janeiro with data from 7 industrial caesium clocks and 2 hydrogen masers.

(7) OP Since MJD 56218 UTC(OP) is based on the output signal of a H-maser frequency steered towards UTC using the SYRTE fountains calibrations.

(8) OP The French atomic time scale TA(F) is computed by the LNE-SYRTE with data from 27 industrial caesium clocks located as follows (at the end of 2012) :

* Centre Electronique de l'Armement (CELAR, Rennes)	2 Cs
* Centre National d'Etudes Spatiales (CNES, Toulouse)	4 Cs
* France Telecom Recherche et Developpement (Lannion)	2 Cs
* Agilent Technologies France (Massy)	1 Cs
* Observatoire de la Côte d'Azur (OCA, Grasse)	2 Cs
* Observatoire de Paris (LNE-SYRTE, Paris)	8 Cs
* Observatoire de Besançon (OB, Besançon)	3 Cs
* Direction des Constructions Navales (DCN, Brest)	4 Cs
* Spectracom, Orolia (Les Ulis)	1 Cs

All laboratories are linked via GPS receivers.

The TA(F) frequency steering, based on the LNE-SYRTE PFS data, is published in OP Time Service Bulletin.

(9) PL The Polish official timescale UTC(PL) is maintained by the GUM.

Notes (Cont.)

(10) PL The Polish atomic timescale TA(PL) is computed by the AOS and GUM with data from 14 caesium clocks and 4 hydrogen masers located as follows:

* Central Office of Measures (GUM, Warsaw)	
* Astrogeodynamical Observatory, Space Research Center P.A.S.	3 Cs, 1 H-maser
(AOS, Borowiec)	2 Cs, 2 H-masers
* National Institute of Telecommunications (IŁ, Warsaw)	
* Polish Telecom (TPSA, Warsaw)	2 Cs
* Military Primary Standards Laboratory (CWOM, Warsaw and	3 Cs
Poznan)	2 Cs, 1 H-maser
and additionally	
* Time and Frequency Standard Laboratory of the Semiconductor Physics Institute, a guest laboratory from Lithuania (LT, Vilnius, Lithuania)	2 Cs

All laboratories are linked via MC GPS-CV, except for two clocks of TPSA and two clocks of NIT linked via a two-directional optical fibre connection.

(11) PTB The laboratory Cs, PTB CS1 and PTB CS2 are operated continuously as clocks.
PTB CSF1 and CSF2 are fountain frequency standards using laser cooled caesium atoms. Both are intermittently operated as frequency standards. Contributions to TAI are made through comparisons with one of PTB's hydrogen masers.

(12) PTB UTC(PTB) is based on the output of an active hydrogen maser steered in frequency since MJD 55224 (February 2010).

(13) PTB Starting MJD 56079 0:00 UTC TA(PTB) is generated from an active hydrogen maser, steered in frequency so as to follow PTB caesium fountains as close as possible. The deviation *d* between the fountains and the TAI second is not taken into account.
TAI-TA(PTB) has an initial arbitrary offset from TAI without continuity to the data reported in previous months.
TA(PTB)-UTC(PTB) is published in PTB Time Service Bulletin.

(14) ROA The standards are located as follows:

* Real Observatorio de la Armada en San Fernando	5 Cs, 1 H-maser
* Centro Español de Metrología	1 Cs

(15) ROA Since March 2009, UTC(ROA) is defined in real time by a hydrogen maser, steered to the paper time scale UTC(ROA) which is defined as a weighted average of all the clocks, steered to UTC.

(16) SMD Time activities are temporarily suspended since November 2012

(17) SP The standards are located as follows (at the end of 2012):

* SP Technical Research Institute of Sweden (SP, Borås)	4 Cs, 2 H-masers
* STUPI AB (Stockholm)	8 Cs, 3 H-masers
* Onsala Space Observatory (Onsala)	1 Cs, 2 H-masers

(18) TL TA(TL) is generated from a 13-caesium-clock ensemble.

(19) USNO The time scales A.1(MEAN) and UTC(USNO) are computed by USNO. They are determined by a weighted average of Cs clocks, hydrogen masers, and rubidium fountains located at the USNO. A.1(MEAN) is a free atomic time scale, while UTC(USNO) is steered to UTC. Included in the total number of USNO atomic standards are the clocks located at the USNO Alternate Master Clock in Colorado Springs, CO.

Table 5. Differences between the normalized frequencies of EAL and TAI, up to March 2013

(File containing values since the beginning of the steering is available at ftp://62.161.69.5/pub/tai/scale/ealtai12.ar)

Date	MJD	[f(EAL) - f(TAI)] x 10^{-13}
2009 Jan 28 - 2009 Feb 27	54859 - 54889	6.726
2009 Feb 27 - 2009 Mar 29	54889 - 54919	6.721
2009 Mar 29 - 2009 Apr 28	54919 - 54949	6.716
2009 Apr 28 - 2009 May 28	54949 - 54979	6.711
2009 May 28 - 2009 Jun 27	54979 - 55009	6.706
2009 Jun 27 - 2009 Jul 27	55009 - 55039	6.701
2009 Jul 27 - 2009 Aug 31	55039 - 55074	6.696
2009 Aug 31 - 2009 Sep 30	55074 - 55104	6.691
2009 Sep 30 - 2009 Oct 30	55104 - 55134	6.686
2009 Oct 30 - 2009 Nov 29	55134 - 55164	6.681
2009 Nov 29 - 2009 Dec 29	55164 - 55194	6.676
2009 Dec 29 - 2010 Jan 28	55194 - 55224	6.671
2010 Jan 28 - 2010 Feb 27	55224 - 55254	6.666
2010 Feb 27 - 2010 Mar 29	55254 - 55284	6.661
2010 Mar 29 - 2010 Apr 28	55284 - 55314	6.656
2010 APR 28 - 2010 MAY 28	55314 - 55344	6.651
2010 MAY 28 - 2010 JUN 27	55344 - 55374	6.645
2010 JUN 27 - 2010 JUL 27	55374 - 55404	6.639
2010 JUL 27 - 2010 AUG 26	55404 - 55434	6.633
2010 AUG 26 - 2010 SEP 30	55434 - 55469	6.626
2010 SEP 30 - 2010 OCT 30	55469 - 55499	6.619
2010 OCT 30 - 2010 NOV 29	55499 - 55529	6.612
2010 NOV 29 - 2010 DEC 29	55529 - 55559	6.605
2010 DEC 29 - 2011 JAN 28	55559 - 55589	6.598
2011 JAN 28 - 2011 FEB 27	55589 - 55619	6.591
2011 FEB 27 - 2011 MAR 29	55619 - 55649	6.584
2011 MAR 29 - 2011 APR 28	55649 - 55679	6.577
2011 APR 28 - 2011 MAY 28	55679 - 55709	6.570
2011 MAY 28 - 2011 JUN 27	55709 - 55739	6.563
2011 JUN 27 - 2011 JUL 27	55739 - 55769	6.556
2011 JUL 27 - 2011 AUG 31	55769 - 55804	6.551
2011 AUG 31 - 2011 SEP 30	55804 - 55834	6.546
2011 SEP 30 - 2011 OCT 30	55834 - 55864	6.541
2011 OCT 30 - 2011 NOV 29	55864 - 55894	6.536
2011 NOV 29 - 2011 DEC 29	55894 - 55924	6.531
2011 DEC 29 - 2012 JAN 28	55924 - 55954	6.526
2012 JAN 28 - 2012 FEB 27	55954 - 55984	6.521
2012 FEB 27 - 2012 MAR 28	55984 - 56014	6.516
2012 MAR 28 - 2012 APR 27	56014 - 56044	6.511
2012 APR 27 - 2012 MAY 27	56044 - 56074	6.506
2012 MAY 27 - 2012 JUN 26	56074 - 56104	6.501
2012 JUN 26 - 2012 JUL 31	56104 - 56139	6.496
2012 JUL 31 - 2012 AUG 30	56139 - 56169	6.491
2012 AUG 30 - 2012 SEP 29	56169 - 56199	6.486
2012 SEP 29 - 2013 MAR 28	56199 - 56379	6.483

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 the duration of the TAI scale interval

(File available at ftp://62.161.69.5/pub/tai/scale/utai12.ar)

TAI is a realization of coordinate time TT. The following tables give the fractional deviation *d* of the scale interval of TAI from that of TT (in practice the SI second on the geoid), i.e. the fractional frequency deviation of TAI with the opposite sign: $d = -y_{TAI}$.

In Table 6A, *d* is obtained on the given periods of estimation by comparison of the TAI frequency with that of the individual primary frequency standards (PFS) NIST-F1, NPL-CSF2, PTB-CS1, PTB-CS2, PTB-CSF1, PTB-CSF2, SYRTE-FO1, SYRTE-FO2 and SYRTE-FOM for the year 2012.
Previous calibrations are available in the successive BIPM annual reports of the BIPM Time Section volumes 1 to 18 and in the BIPM annual report on time activities volume 1 to 6.
In Table 6B, *d* is obtained on the given periods of estimation by comparison of the TAI frequency with that of the individual secondary frequency standard (SFS) SYRTE-FORb for the year 2012. Calibrations for earlier periods, that were submitted in 2012, are also included.

Each comparison is provided with the following information:
u_A is the uncertainty originating in the instability of the PFS,
u_B is the combined uncertainty from systematic effects,
$u_{link/lab}$ is the uncertainty in the link between the PFS and the clock participating to TAI, including the uncertainty due to dead-time,
$u_{link/TAI}$ is the uncertainty in the link to TAI, computed using the standard uncertainty of [*UTC-UTC*(*k*)],
u is the quadratic sum of all four uncertainty values.

In addition, Table 6B includes the following information:
u_{SRep} is the recommended uncertainty of the secondary representation of the second, as specified in the CIPM Recommendation identified under Ref(u_S).

In these tables, a frequency over a time interval is defined as the ratio of the end-point phase difference to the duration of the interval.

The typical characteristics of the calibrations of the TAI frequency provided by the different primary and secondary standards over 2012 are indicated below. Reports of individual evaluations may be found at ftp://62.161.69.5/pub/tai/data/PFS_reports. Ref(u_B) is a reference giving information on the value of u_B as stated in the 2012 reports, u_B(Ref) is the u_B value stated in this reference. Note that the current u_B values are generally not the same as the peer reviewed values given in Ref(u_B).

Primary Standard	Type /selection	Type B std. uncertainty	u_B(Ref)/10^{-15}	Ref(u_B)	Comparison with	Number/typical duration of comp.
NIST-F1	Fountain	0.31	0.35	[1]	H maser	5 / 25 d to 30 d
NPL-CSF2	Fountain	0.23	0.23	[2]	H maser	10 / 10 d to 35 d
PTB-CS1	Beam /Mag.	8	8.	[3]	TAI	12 / 30 d
PTB-CS2	Beam /Mag.	12	12.	[4]	TAI	12 / 30 d
PTB-CSF1	Fountain	0.74	1.4	[5]	H maser	9 / 15 d to 30 d
PTB-CSF2	Fountain	(0.34 to 0.44)	0.41	[6]	H maser	7 / 15 d to 25 d
SYRTE-FO1	Fountain	(0.42 to 0.55)	0.72	[7]	H maser	11 / 15 d to 30 d
SYRTE-FO2	Fountain	(0.24 to 0.33)	0.65	[7]	H maser	13 / 15 d to 30 d
SYRTE-FOM	Fountain	0.60	0.80	[8]	H maser	6 / 15 d to 30 d

Secondary Standard	Type /selection	Type B std. uncertainty	u_B(Ref)/10^{-15}	Ref(u_B)	Comparison with	Number/typical duration of comp.
SYRTE-FORb	Fountain	(0.32 to 0.43)	0.45	[9]	H maser	14 / 15 d to 30 d

More detailed information on the characteristics and operation of individual PFS and SFS may be found in the annexes supplied by the individual laboratories.

Table 6. (Cont.)

Standard	Period of estimation		$d/10^{-15}$	$u_A/10^{-15}$	$u_B/10^{-15}$	$u_{link/lab}$ $/10^{-15}$	$u_{link/TAI}$ $/10^{-15}$	$u/10^{-15}$	Notes
NIST-F1	56009	56039	2.37	0.34	0.31	0.18	0.20	0.53	
NIST-F1	56089	56114	2.07	0.34	0.31	0.25	0.23	0.57	
NIST-F1	56134	56159	0.81	0.29	0.31	0.14	0.23	0.50	
NIST-F1	56189	56214	-0.04	0.40	0.31	0.16	0.23	0.58	
NIST-F1	56229	56254	0.01	0.32	0.31	0.21	0.23	0.54	
NPL-CsF2	55914	55939	3.18	0.23	0.23	0.12	0.27	0.44	
NPL-CsF2	55944	55954	4.36	0.34	0.23	0.03	0.53	0.67	
NPL-CsF2	55959	55974	3.08	0.26	0.23	0.03	0.37	0.50	
NPL-CsF2	55999	56014	4.38	0.26	0.23	0.04	0.37	0.51	
NPL-CsF2	56019	56044	2.90	0.20	0.23	0.01	0.23	0.38	
NPL-CsF2	56049	56074	2.95	0.21	0.23	0.05	0.23	0.39	
NPL-CsF2	56074	56104	2.76	0.19	0.23	0.05	0.20	0.36	
NPL-CsF2	56184	56219	0.57	0.18	0.23	0.07	0.17	0.35	
NPL-CsF2	56224	56254	-0.36	0.20	0.23	0.04	0.20	0.36	
NPL-CsF2	56264	56289	0.26	0.22	0.23	0.02	0.23	0.39	
PTB-CS1	55924	55954	-9.99	6.00	8.00	0.00	0.13	10.00	(1)
PTB-CS1	55954	55984	-7.52	6.00	8.00	0.00	0.13	10.00	
PTB-CS1	55984	56014	-6.67	6.00	8.00	0.00	0.10	10.00	
PTB-CS1	56014	56044	-5.20	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56044	56074	-8.06	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56074	56104	-10.48	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56104	56139	-14.58	6.00	8.00	0.00	0.06	10.00	
PTB-CS1	56139	56169	-10.67	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56169	56199	-10.67	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56199	56229	-2.02	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56229	56259	-3.03	6.00	8.00	0.00	0.07	10.00	
PTB-CS1	56259	56289	-10.55	6.00	8.00	0.00	0.07	10.00	
PTB-CS2	55924	55954	-0.19	3.00	12.00	0.00	0.13	12.37	(1)
PTB-CS2	55954	55984	-0.73	3.00	12.00	0.00	0.13	12.37	
PTB-CS2	55984	56014	-0.15	3.00	12.00	0.00	0.10	12.37	
PTB-CS2	56014	56044	1.74	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56044	56074	-3.50	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56074	56104	-3.96	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56104	56139	-0.93	3.00	12.00	0.00	0.06	12.37	
PTB-CS2	56139	56169	0.90	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56169	56199	-2.61	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56199	56229	3.30	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56229	56259	-8.62	3.00	12.00	0.00	0.07	12.37	
PTB-CS2	56259	56289	-8.27	3.00	12.00	0.00	0.07	12.37	
PTB-CSF1	55919	55949	4.34	0.20	0.74	0.05	0.13	0.78	
PTB-CSF1	55954	55974	3.52	0.24	0.73	0.05	0.19	0.79	
PTB-CSF1	55999	56014	4.62	0.18	0.74	0.02	0.12	0.77	
PTB-CSF1	56014	56044	3.07	0.17	0.74	0.02	0.07	0.76	
PTB-CSF1	56144	56169	1.77	0.22	0.74	0.02	0.08	0.78	
PTB-CSF1	56169	56199	0.99	0.22	0.74	0.01	0.07	0.77	
PTB-CSF1	56199	56214	0.50	0.26	0.74	0.02	0.12	0.79	
PTB-CSF1	56224	56244	0.04	0.14	0.74	0.10	0.09	0.77	
PTB-CSF1	56264	56279	-0.70	0.14	0.73	0.04	0.12	0.75	

Table 6. (Cont.)

Standard	Period of estimation		$d/10^{-15}$	$u_A/10^{-15}$	$u_B/10^{-15}$	$u_{link/lab}$ $/10^{-15}$	$u_{link/TAI}$ $/10^{-15}$	$u/10^{-15}$	Notes
PTB-CSF2	55919	55939	4.96	0.21	0.44	0.17	0.19	0.55	
PTB-CSF2	56004	56019	3.42	0.20	0.34	0.10	0.12	0.42	
PTB-CSF2	56024	56049	2.43	0.16	0.34	0.03	0.08	0.38	
PTB-CSF2	56089	56104	2.44	0.21	0.36	0.02	0.12	0.43	
PTB-CSF2	56124	56139	1.99	0.21	0.39	0.02	0.12	0.46	
PTB-CSF2	56149	56169	0.23	0.20	0.35	0.02	0.09	0.41	
PTB-CSF2	56214	56229	-0.80	0.22	0.38	0.02	0.12	0.46	
SYRTE-FO1	55929	55949	2.11	0.20	0.44	0.41	0.28	0.69	
SYRTE-FO1	55954	55969	1.82	0.40	0.43	0.29	0.37	0.75	
SYRTE-FO1	56014	56029	2.46	0.20	0.44	0.23	0.37	0.65	
SYRTE-FO1	56044	56074	2.28	0.20	0.43	0.23	0.20	0.56	
SYRTE-FO1	56089	56104	2.19	0.25	0.44	0.20	0.37	0.66	
SYRTE-FO1	56104	56129	2.05	0.30	0.55	0.12	0.23	0.68	
SYRTE-FO1	56139	56169	0.48	0.20	0.42	0.14	0.20	0.52	
SYRTE-FO1	56169	56199	0.18	0.40	0.43	0.10	0.20	0.63	
SYRTE-FO1	56199	56229	-0.40	0.30	0.43	0.11	0.20	0.57	
SYRTE-FO1	56229	56259	-0.17	0.30	0.43	0.11	0.20	0.57	
SYRTE-FO1	56259	56289	-0.68	0.30	0.42	0.11	0.20	0.56	
SYRTE-FO2	55924	55949	3.23	0.20	0.29	0.12	0.23	0.44	
SYRTE-FO2	55954	55969	2.64	0.20	0.28	0.14	0.37	0.52	
SYRTE-FO2	55969	55984	4.02	0.20	0.28	0.30	0.37	0.58	
SYRTE-FO2	55984	56014	4.08	0.30	0.29	0.10	0.20	0.47	
SYRTE-FO2	56014	56044	2.53	0.25	0.26	0.14	0.20	0.43	
SYRTE-FO2	56044	56074	2.25	0.20	0.27	0.12	0.20	0.41	
SYRTE-FO2	56074	56094	2.49	0.20	0.25	0.12	0.28	0.44	
SYRTE-FO2	56099	56119	1.52	0.25	0.24	0.23	0.28	0.50	
SYRTE-FO2	56119	56139	1.25	0.20	0.24	0.14	0.28	0.44	
SYRTE-FO2	56139	56169	0.46	0.20	0.26	0.12	0.20	0.40	
SYRTE-FO2	56174	56199	0.00	0.40	0.26	0.10	0.23	0.54	
SYRTE-FO2	56234	56259	-0.52	0.40	0.33	0.12	0.23	0.58	
SYRTE-FO2	56264	56289	-0.71	0.26	0.33	0.12	0.23	0.49	
SYRTE-FOM	55924	55949	2.63	0.30	0.60	0.20	0.23	0.74	
SYRTE-FOM	55954	55969	1.97	0.30	0.60	0.30	0.37	0.82	
SYRTE-FOM	55969	55984	3.38	0.25	0.60	0.30	0.37	0.80	
SYRTE-FOM	55984	56014	3.57	0.20	0.60	0.11	0.20	0.67	
SYRTE-FOM	56014	56044	2.22	0.25	0.60	0.16	0.20	0.70	
SYRTE-FOM	56154	56169	0.92	0.30	0.60	0.22	0.37	0.79	

Notes:

(1) Continuously operating as a clock participating to TAI.

Table 6B. Measurements of the duration of the TAI scale interval by Secondary Frequency Standards

Standard	Period of estimation		$d/10^{-15}$	$u_A/10^{-15}$	$u_B/10^{-15}$	$u_{link/lab}$ $/10^{-15}$	$u_{link/TAI}$ $/10^{-15}$	$u/10^{-15}$	u_{SRep}	Ref(u_S)
SYRTE-FORb	55164	55194	2.68	0.20	0.46	0.12	0.36	0.63	3.00	[10]
SYRTE-FORb	55194	55224	3.98	0.40	0.46	0.11	0.43	0.75	3.00	[10]
SYRTE-FORb	55224	55254	2.97	0.20	0.44	0.11	0.46	0.67	3.00	[10]
SYRTE-FORb	55254	55274	2.80	0.30	0.53	0.11	0.66	0.90	3.00	[10]
SYRTE-FORb	55354	55374	4.59	0.35	0.57	0.11	0.66	0.94	3.00	[10]
SYRTE-FORb	55409	55429	3.17	0.20	0.46	0.11	0.66	0.83	3.00	[10]
SYRTE-FORb	55854	55894	3.04	0.20	0.46	0.17	0.15	0.55	3.00	[10]
SYRTE-FORb	55894	55924	1.66	0.20	0.44	0.11	0.20	0.53	3.00	[10]
SYRTE-FORb	55924	55949	1.15	0.30	0.39	0.10	0.23	0.55	3.00	[10]
SYRTE-FORb	55954	55969	0.63	0.30	0.38	0.14	0.37	0.62	3.00	[10]
SYRTE-FORb	55969	55984	2.03	0.40	0.38	0.25	0.37	0.71	3.00	[10]
SYRTE-FORb	55984	56014	2.38	0.30	0.43	0.11	0.20	0.57	3.00	[10]
SYRTE-FORb	56014	56044	0.96	0.20	0.41	0.14	0.20	0.52	3.00	[10]
SYRTE-FORb	56044	56074	0.80	0.20	0.32	0.11	0.20	0.44	3.00	[10]
SYRTE-FORb	56074	56094	0.84	0.20	0.35	0.11	0.28	0.50	3.00	[10]
SYRTE-FORb	56099	56119	-0.14	0.20	0.34	0.18	0.28	0.52	3.00	[10]
SYRTE-FORb	56119	56139	-0.55	0.20	0.34	0.12	0.28	0.50	3.00	[10]
SYRTE-FORb	56139	56169	-1.51	0.20	0.33	0.12	0.20	0.45	3.00	[10]
SYRTE-FORb	56169	56199	-1.49	0.30	0.32	0.10	0.20	0.49	3.00	[10]
SYRTE-FORb	56199	56229	-2.25	0.20	0.36	0.14	0.20	0.48	3.00	[10]
SYRTE-FORb	56229	56259	-2.09	0.30	0.36	0.11	0.20	0.52	3.00	[10]
SYRTE-FORb	56259	56289	-2.37	0.20	0.36	0.11	0.20	0.47	3.00	[10]

References:

[1] Heavner T.P. *et al*., *Metrologia* **42**, 411, 2005. Parker T.E. *et al*., *Metrologia* **42**, 423, 2005.
[2] Li R., Gibble K. and Szymaniec K., *Metrologia* **48**, 283-289, 2011.
[3] Bauch A. *et al*., *Metrologia* **35**, 829, 1998; Bauch A., *Metrologia* **42**, S43, 2005.
[4] [8] Bauch A. *et al*., *IEEE Trans. IM* **36**, 613, 1987; Bauch A., *Metrologia* **42**, S43, 2005.
[5] Weyers S. *et al*., *Metrologia* **38**(4), 343, 2001; Weyers S. *et al*., *Proceedings of the 6th Symposium on Frequency Standards and Metrology, University of St Andrews, World Scientific Pub*., 64-71, 2001.
[6] Weyers S. *et al*., *Metrologia* **49**, 82-87, 2012.
[7] Vian C. *et al*., *IEEE Trans. IM* **54**, 833, 2005 ; Vian C. *et al*., *Proc 19th EFTF*, **53**, 2005.
[8] Marion H. *et al*. *Phys. Rev. Lett*. **90**, 150801, 2003.
[9] Guéna J. *et al*., "Demonstration of a Dual Alkali Rb/Cs Fountain Clock", *IEEE Trans*. *Ultrason*. *Ferroelectr*. *Freq*. *Control*, 57 (3), 647–653, 2010.
[10] CIPM Recommendation 1 (CI-2006) "Concerning secondary representations of the second" in *Procès-Verbaux des Séances du Comité International des Poids et Mesures*, 95th meeting (2006), 2007, 258 pp.

Operation of NIST-F1 in 2012

NIST-F1, the Cs fountain primary frequency standard at the National Institute of Standards and Technology (NIST), has been in operation since November 1998, and the first formal report to the BIPM was made in November 1999 [1]. Two papers updating the operation of NIST-F1 were later published in 2005 [2, 3]. During a formal evaluation the average frequency of one of the hydrogen masers at NIST is measured by NIST-F1 and the results, along with all relevant biases and uncertainties, are reported to the BIPM for publication in Circular T. NIST-F1 is not operated as a clock and is run only intermittently. The standard is constantly evolving, and both hardware and software improvements are continually being made. These improvements now tend to be aimed more at increasing the fountain run time and reliability, rather than decreasing the uncertainty. In addition there is always an improved understanding of how the standard operates [4]. In all formal evaluations a range of atom densities were used along with a weighted linear least squares fit to determine the frequency at zero density. The average frequency shift from the lowest measured density to zero density in 2012 was about 6×10^{-16}. Each formal evaluation also includes mapping the magnetic field, and measurements of possible biases due to such things as microwave amplitude and light leaks.

Five formal NIST-F1 evaluations were carried out in 2012. All were made with a range of atom densities to determine the spin exchange shift. NIST-F1 has also been used in comparisons to NIST-F2, a new cryogenic cesium fountain frequency standard. This cryogenic operation will ultimately lead to an improved measurement of the blackbody shift and a lower Type B uncertainty. Four new comparisons of NIST-F2 with NIST-F1 were made in 2012 (bringing the total to 8) and agreement between the two standards continues to fall within the comparison uncertainty which is now approximately 5×10^{-16}. Much of the effort put into NIST-F2 operation this year was directed at reducing its Type B uncertainty. NIST-F2 is now very close to being ready for formal reports to the BIPM.

The Type B uncertainties in NIST-F1 for the five runs in 2012 are substantially the same as those given in Table 1 of [2], and are dominated by the blackbody and microwave amplitude shifts. Reference 2 is the source for u_B(Ref) given in Circular T. The density shift uncertainty is included in the Type A uncertainty. The total Type B uncertainty for all of the runs in 2012 was 3.1×10^{-16}, dominated by the blackbody shift with an uncertainty of 2.8×10^{-16}. The Type A uncertainties ranged from 2.9×10^{-16} to 4.0×10^{-16} for the five runs. The uncertainties due to the spin exchange shift ranged from 1.4×10^{-16} to 2.1×10^{-16}. Total uncertainties, including frequency transfer and dead time uncertainties, ranged from 5.0×10^{-16} to 5.8×10^{-16}.

REFERENCES

1 S.R. Jefferts, J. Shirley, T.E. Parker, T.P. Heavner, D.M. Meekhof, C. Nelson, F. Levi, G. Costanzo, A. De Marchi, R. Drullinger, L. Hollberg, W.D. Lee, and F.L. Walls, “Accuracy Evaluation of NIST-F1,” *Metrologia*, vol. **39**, pp 321-336, 2002.

2 T.P. Heavner, S.R. Jefferts, E.A. Donley, J.H. Shirley, and T.E. Parker, “NIST-F1: Recent Improvements and Accuracy Evaluations,” *Metrologia*, vol. **42**, pp 411-422, 2005.

3 T.E. Parker, S.R. Jefferts, T.P. Heavner, and E.A. Donley, “Operation of the NIST-F1 Caesium Fountain Primary Frequency Standard with a Maser Ensemble, Including the Impact of Frequency Transfer Noise,” *Metrologia*, vol. **42**, pp 423-430, 2005.

4 J.H. Shirley, “Weight Functions for Biases in Atomic Frequency Standards”, *IEEE Transactions on Ultrasonics, Ferroelectrics and Frequency Control*, vol. **57**, No. 3, pp 746-756, March 2010.

Operation of the NPL-CsF2 primary frequency standard in 2012

The caesium fountain NPL-CsF2 is the primary frequency standard for UK maintained by National Physical Laboratory. It was made operational and first characterised in 2009. In 2011 a major reassessment of the uncertainty budget was performed [1]. In 2012 the major systematic frequency shifts were verified. These included the AC Stark effects due to residual laser light and blackbody radiation, second order Zeeman effect and cold collisions. The table below summarises the current accuracy evaluation.

Type B uncertainty evaluation	Uncertainty / 10^{-16}
Second order Zeeman	0.8
Blackbody radiation	1.1
AC Stark (lasers)	0.1
Microwave spectrum	0.1
Gravity	0.5
Cold collisions (typically)	0.4[a]
Collisions with background gas	1.0
Rabi, Ramsey pulling	0.1
Cavity phase (distributed)	1.1
Cavity phase (dynamic)	0.1
Cavity pulling	0.2
Microwave leakage	0.6
Microwave lensing	0.3
Second-order Doppler	0.1
Total u_B (1σ)	2.3
Type A uncertainty evaluation	
u_A (1σ for 25-day campaign)	2.0[b]
Total uncertainty	3.1

[a] An average value of the type B contribution to the uncertainty obtained from the 2012 evaluations.
[b] A value quoted for a typical 25 day measurement campaign (including dead time).

During the calendar year 2012, the NPL-CsF2 standard was used 9 times to evaluate the TAI step interval. The measurement procedure was the same as in the previous year, with the fountain operating in the vicinity of the zero-collisional frequency shift point. The residual collisional shift was continuously evaluated and the standard frequency extrapolated to the zero-density value.

References:

[1] R. Li, K. Gibble and K. Szymaniec, Metrologia, 48 (2011) 283-289.

Operation of the PTB primary clocks in 2012

PTB's primary clocks with a thermal beam

During 2012 PTB's primary clocks CS1 and CS2 [1] were operated continuously. Time differences UTC(PTB) - clock in the standard ALGOS format were reported to BIPM, so that $u_{l/lab}$ is zero. The mean relative frequency offset between the two clocks amounted to about 6.4×10^{-15}, which is compliant with the stated u_B values.

The clocks' operational parameters were checked periodically and validated to estimate the clock uncertainty. These parameters are the Zeeman frequency, the temperature of the beam tube (vacuum enclosure), the line width of the clock transition as a measure of the mean atomic velocity, the microwave power level, the spectral purity of the microwave excitation signal, and some characteristic signals of the electronics.

CS1

Based on continuous comparison with an active hydrogen maser, the CS1 relative frequency instability was found to vary between 71×10^{-15} and 89×10^{-15} for an averaging time of 1 hour, in agreement with the prediction based on the beam flux, clock transition signal and line width. With reference to TAI, the standard deviation of *d*(CS1) (Circular T Section 4) was well within the value $u_A(\tau = 30\text{ d, CS1}) = 6 \times 10^{-15}$ stated in Circular T. During 2012, only two reversals of the beam direction were performed on CS1. No findings call for a modification of the previously stated relative frequency uncertainty u_B, which is 8×10^{-15} for CS1 [2].

CS2

The relative CS2 frequency instability of $\sigma_y(\tau = 1\text{ hour})$ was measured between 62×10^{-15} and 72×10^{-15} during 2012. This range of values would justify the estimate of the uncertainty contributions u_A as $u_A(\tau = 30\text{ d, CS2}) = 3 \times 10^{-15}$. The standard deviation of the 12 *d*- values reported in Circular T of 2012 was, however, higher by 20%.

Three reversals of the beam direction were performed during 2012, and the beam reversal frequency shift values (due to end-to-end cavity phase difference) agreed within 3×10^{-15}, with an estimated statistical uncertainty of 5×10^{-15}. The uncertainty estimate as detailed in [1, 2] is considered as still valid, and the CS2 u_B is thus estimated as 12×10^{-15}.

PTB's caesium fountain clock CSF1

A detailed description of the PTB fountain CSF1 is given in Refs. [3] and [4]. In 2012 CSF1 provided a primary clock signal during 362 days of the year. The high degree of availability supported the steering of a hydrogen maser output frequency by CSF1 to realize UTC(PTB).

Nine measurements of the TAI scale unit of 15 (3×), 20 (2×), 25 (1×) and 30 (3×) days duration, respectively, were performed in 2012 and reported to the BIPM. Due to the performance and reliability of the laser systems, dead times are routinely kept below 1.5% of the nominal measurement duration. The resulting clock link uncertainty $u_{l/lab}$ was thus usually below 0.1×10^{-15}. The statistical uncertainty of CSF1 measurements was calculated with the assumption of white frequency noise during the measurement intervals. Including a small statistical uncertainty contribution due to the measurement instrumentation, we arrived at statistical uncertainties $u_A \leq 0.3 \times 10^{-15}$ for the nine TAI contributions in 2012.

Below we compile typical frequency biases and type B uncertainties of CSF1.

Physical effect	Bias / 10^{-15}	Type B uncertainty / 10^{-15}
Quadratic Zeeman shift	46.20	0.10
Black body radiation shift	- 16.54	0.10
Cold collisions	- 1.11	0.23
Gravitational red shift	8.58	0.10
Cavity phase		0.10
Majorana transitions		0.10
Rabi and Ramsey pulling		0.10
Microwave leakage		0.10
Electronics		0.20
Light shift		0.10
Background gas collisions		0.10
Microwave power dependence		0.60
Total type B uncertainty		0.74

Table 1: Typical frequency biases and type B uncertainties of PTB-CSF1 in 2012

PTB's caesium fountain clock CSF2

A detailed description of the PTB fountain CSF2 is given in Refs. [5] and [6]. In 2012 seven measurements of the TAI scale unit of 15 (4×), 20 (2×) and 25 (1×) days duration, respectively, were performed and reported to the BIPM. The dead times of these measurements were in most cases below 3% (in one case 9%), so that the resulting clock link uncertainty $u_{l/lab}$ was clearly below 0.1×10^{-15} (in one case 0.17×10^{-15}).

For all these TAI scale unit measurements the atoms were loaded from the background gas into the molasses. The method of "rapid adiabatic passage" was routinely utilized for controlling the collisional shift during the measurement periods. The utilization of a new microwave synthesis setup [7] provides a better suppression of sidebands compared to the previously employed synthesis. Therefore the estimate of the uncertainty due to the electronics was reduced to 0.1×10^{-15}. The statistical uncertainty of CSF2 measurements was calculated with the assumption of white frequency noise for the total measurement intervals. For the seven TAI contributions in 2012 we arrived at statistical uncertainties $u_A < 0.3\times10^{-15}$.

Below we compile typical frequency biases and type B uncertainties of CSF2.

Physical effect	Bias / 10^{-15}	Type B uncertainty / 10^{-15}
Quadratic Zeeman shift	100.173	0.010
Black body radiation shift	- 16.565	0.057
Cold collisions	- 0.82	0.28
Gravitational red shift	8.567	0.006
Cavity phase	0.044	0.133
Microwave lensing	0.083	0.042
Majorana transitions		0.0001
Rabi pulling		0.0002
Ramsey pulling		0.001
Microwave leakage		0.10
Electronics		0.10
Light shift		0.001
Background gas collisions		0.05
Total type B uncertainty		0.35

Table 2: Typical frequency biases and type B uncertainties of PTB-CSF2 in 2012.

We also note that in 2012 both fountains, CSF1 and CSF2, were utilized for optical frequency measurements of the 436 nm quadrupole and the 467 nm octupole transition in a single $^{171}Yb^{+}$-ion and of the 698 nm optical clock transition in a ^{87}Sr lattice clock [8].

References

[1] A. Bauch, Metrologia **42**, S43–S54 (2005)

[2] T. Heindorff, A. Bauch, P. Hetzel, G. Petit, S. Weyers, Metrologia **38**, 497–502 (2001)

[3] S. Weyers, U. Hübner, R. Schröder, Chr. Tamm, A. Bauch, Metrologia **38**, 343–352 (2001)

[4] S. Weyers, A. Bauch, R. Schröder, Chr. Tamm, in: Proceedings of the 6th Symposium on Frequency Standards and Metrology 2001, University of St Andrews, Fife, Scotland, pp. 64–71, ISBN 981-02-4911-X (World Scientific)

[5] V. Gerginov, N. Nemitz, S. Weyers, R. Schröder, D. Griebsch and R. Wynands, Metrologia **47,** 65–79 (2010)

[6] S. Weyers, V. Gerginov, N. Nemitz, R. Li and K. Gibble, Metrologia **49,** 82–87 (2012)

[7] A. Sen Gupta, R. Schröder, S. Weyers and R. Wynands, 21st European Frequency and Time Forum (EFTF), Geneva, pp. 234–237 (2007)

[8] to be published

Operation of the SYRTE fountain clocks in 2012

FO1, FO2Cs and FOM primary frequency standards

In 2012 we have sent to BIPM 11, 13 and 6 calibrations performed by the 3 SYRTE cesium fountains FO1, FO2Cs and FOM.

The nominal operation of the FO1, FO2 and FOM fountains is the same as in 2011. The microwave synthesizers are referenced to the signal provided by a cryogenic sapphire oscillator (CSO) phase locked to a hydrogen Maser, to take the benefit of the ultra-low phase noise of the CSO. The relative frequency instabilities are routinely $\sigma_y(\tau) \sim 5 \times 10^{-14}\ \tau^{-1/2}$ for the FO1 and FO2Cs fountains and $\sigma_y(\tau) \sim 8 \times 10^{-14}\ \tau^{-1/2}$ for FOM. The instabilities result from the combination of low and high atomic density operations required for the real time evaluation of the cold collisions frequency shift. These levels correspond to the quantum projection noise of the clocks.

Table 1 gives the typical uncertainty budgets for the three SYRTE fountain clocks in 2012. The value and the uncertainty of the frequency shifts, which depend on the operating parameters, are updated for each TAI contribution.

Fountain	FO1		FO2-Cs		FOM	
Physical origin	Correction	Uncertainty	Correction	Uncertainty	Correction	Uncertainty
2nd order Zeeman	-1273.9	0.2	-1917.0	0.3	-305.6	1.2
Blackbody Radiation	173.2	0.6	167.2	0.6	165.6	0.6
Cold Collisions + cavity pulling	72.7	1.5	92.6	1.5	28.6	5.0
First order Doppler	0	<3.2	-0.9	0.93	-0.7	1.6
Microwave Leaks, spectral purity	0	<1	0	0.5	0	1.8
Ramsey & Rabi pulling	0	<1	0	<0.1	0	<0.1
Microwave lensing	0	<1.4	-0.7	0.7	-0.9	<0.9
Second order Doppler	0	<0.1	0	<0.1	0	<0.1
Background gas collisions	0	<0.3	0	<1	0	<1
Red shift	-69.3	1	-65.4	1	-68.7	1
Total (1σ) uncertainty u_B		**4.2**		**2.5**		**6.0**

Table 1: Typical accuracy budgets for the 3 SYRTE cesium fountains. (Values given in units of 10^{-16})

The accuracy budgets of FO2Cs and FOM have been updated in May 2012 to include the distributed cavity phase shift (DCP) and the microwave lensing shift, as evaluated in [1] (May 2011 for the DCP in FO2Cs). These corrections are taken into account in FO1 since January 2013. The black body radiation also uses the most recent evaluation of the coefficient [1, 2], for the 3 cesium fountains since January 2013.
We have also proposed to update the publication describing the type B uncertainty of the fountains (Ref(uB) column of table 4 in the Circular T) to reference [1].

FO2Rb secondary frequency standard

Calibrations of the reference maser by FO2Rb have been submitted to the BIPM and evaluated by the Working Group on Primary Frequency Standards (WG-PFS). For that purpose, 8 reports corresponding to measurements performed in 2010 – 2011 were transmitted. These contributions have been accepted. FO2Rb contributions are now regularly published in the Circular T, but currently with no weight in the steering of TAI. In total 22 reports have already been transmitted up to December 2012. Table 2 gives the typical accuracy budget of FO2Rb. The fountain stability is typically $5 \times 10^{-14}\ \tau^{-1/2}$ when combining low and high atomic density measurements. For each calibration, in addition to the type A (typically 1 - 2 x 10^{-16}), the type B (typically 3 - 4 x 10^{-16}), and the uncertainty due to the link between the reference maser and the standard (typically 1 - 2 x 10^{-16}), the uncertainty on the secondary representation of the second, of 3 x 10^{-15} is accounted for.
In addition, based on recent comparisons of FO2Rb against FO2Cs and FOM, performed between January and August 2012, a new value for the secondary representation of the second based on the rubidium hyperfine splitting frequency has been proposed at the last CCTF held in September 2012.

Physical origin	Correction	Uncertainty
2^{nd} order Zeeman	-3466.0	0.7
Blackbody Radiation	121.4	1.4
Cold Collisions + cavity pulling	7.6	2.2
First order Doppler	0.4	1.0
Microwave Leaks, spectral purity	0	<0.5
Ramsey & Rabi pulling	0	<0.1
Microwave lensing	-0.7	0.7
Second order Doppler	0	<0.1
Background gas collisions	0	<1.0
Red shift	-65.4	1
Total (1σ) uncertainty u_B		**3.3**

Table 2: Typical accuracy budget for the SYRTE FO2Rb fountain. (Values given in units of 10^{-16})

References

[1] J. Guéna, *et al*, IEEE Trans. Ultr. Ferr. Freq. Contr. **59** (3), 391-410 (2012)
[2] P. Rosenbusch, S. Zhang, A. Clairon, Proceedings to IFCS/EFTF 2007, page 1060

Table 7. Mean fractional deviation of the TAI scale interval from that of TT

(File available at ftp://62.161.69.5/pub/tai/scale/sitai12.ar)

The fractional deviation *d* of the scale interval of TAI from that of TT (in practice the SI second on the geoid), and its relative uncertainty, are computed by the BIPM for all the intervals of computation of TAI, according to the method described in 'Azoubib J., Granveaud M., Guinot B., *Metrologia* 1977, **13**, 87-93', using all available measurements from the most accurate primary frequency standards (PFS) IT-CSF1, KRISS-1, NICT-CSF1, NIST-F1, NMIJ-F1, NPL-CSF1, NPL-CSF2, PTB-CS1, PTB-CS2, PTB-CSF1, PTB-CSF2, SYRTE-FO1, SYRTE-FO2, SYRTE-FOM and SYRTE-JPO, consistently corrected for the black-body radiation shift.
In this computation, the uncertainty of the link to TAI has been computed using the standard uncertainty of [UTC-UTC(*k*)], following the recommendation of the CCTF working group on PFS.
The model for the instability of EAL has been expressed as the quadratic sum of three components: a white frequency noise $1.7 \times 10^{-15}/\sqrt{(\tau)}$, a flicker frequency noise 0.35×10^{-15} and a random walk frequency noise $0.55 \times 10^{-16} x\sqrt{(\tau)}$, with τ in days. The relation between EAL and TAI is given in Table 5.

Month	Interval	$d/10^{-15}$	uncertainty/10^{-15}
Jan. 2010	55194-55224	+4.7	0.3
Feb. 2010	55224-55254	+4.5	0.4
Mar. 2010	55254-55284	+4.8	0.4
Apr. 2010	55284-55314	+5.3	0.4
May 2010	55314-55344	+5.6	0.4
Jun. 2010	55344-55374	+6.6	0.4
Jul. 2010	55374-55404	+5.7	0.4
Aug. 2010	55404-55439	+5.6	0.3
Sep. 2010	55439-55469	+6.7	0.4
Oct. 2010	55469-55499	+6.5	0.4
Nov. 2010	55499-55529	+6.7	0.5
Dec. 2010	55529-55559	+6.0	0.4
Jan. 2011	55559-55589	+6.5	0.4
Feb. 2011	55589-55619	+6.2	0.5
Mar. 2011	55619-55649	+5.8	0.3
Apr. 2011	55649-55679	+6.0	0.3
May 2011	55679-55709	+5.7	0.3
Jun. 2011	55709-55739	+6.2	0.3
Jul. 2011	55739-55769	+5.9	0.4
Aug. 2011	55769-55804	+5.4	0.3
Sep. 2011	55804-55834	+5.0	0.3
Oct. 2011	55834-55864	+4.6	0.4
Nov. 2011	55864-55894	+3.9	0.2
Dec. 2011	55894-55924	+3.0	0.3
Jan. 2012	55924-55954	+3.5	0.2
Feb. 2012	55954-55984	+3.2	0.2
Mar. 2012	55984-56014	+3.8	0.3
Apr. 2012	56014-56044	+2.6	0.2
May 2012	56044-56074	+2.5	0.2
Jun. 2012	56074-56104	+2.5	0.2
Jul. 2012	56104-56139	+1.6	0.3
Aug. 2012	56139-56169	+0.6	0.2
Sep. 2012	56169-56199	+0.3	0.3
Oct. 2012	56199-56229	-0.2	0.3
Nov. 2012	56229-56259	-0.3	0.3
Dec. 2012	56259-56289	-0.3	0.3

Independent local atomic time scales

Local atomic time scales are established by the time laboratories which contribute with the appropriate clock data to the BIPM. The differences between TAI and the atomic scale maintained by each laboratory are available on the Publications page of the Time Department's FTP Server. For each time laboratory 'lab' a separate file TAI-lab is provided; it contains the respective values of the differences [*TAI - TA(lab)*] in nanoseconds, for the standard dates, starting on 1 January 1998.

The file NOTES.TAI provides information concerning the time laboratories contributing to the calculation of TAI since 1 January 1998. This file should be considered as complementary to the individual files TAI-lab.

For dates between April 1996 and December 1997, the values of [*TAI - TA(lab)*] are given in yearly files, each one also gives values of [*UTC - UTC(lab)*].

Local representations of UTC

The time laboratories which submit data to the BIPM keep local representations of UTC. The computed differences between UTC and each local representation are available on the Publications page of the Time Department's FTP Server. For each time laboratory 'lab' a separate file UTC-lab is provided; it contains the values of the differences [*UTC - UTC(lab)*] in nanoseconds, for the standard dates, starting on 1 January 1998.

The file NOTES.UTC provides information concerning the time laboratories since 1 January 1998. This file should be considered as complementary to the individual files UTC-lab.

For dates between April 1996 and December 1997, the values of [*UTC - UTC(lab)*] are given in yearly files, each one also gives values of [*TAI - TA(lab)*].

International GPS Tracking Schedules

(Files available at ftp://62.161.69.5/pub/tai/publication/schgps/)

GPS Schedule no 58 File SCHGPS.58	implemented on MJD = 56047 (2012 April 30) at 0 h UTC	Reference date MJD = 50722 (1997 October 1)
GPS Schedule no 59 File SCHGPS.59	implemented on MJD = 56231 (2012 October 31) at 0 h UTC	Reference date MJD = 50722 (1997 October 1)

Relations of UTC and TAI with GPS time, GLONASS time, UTC(USNO)_GPS and UTC(SU)_GLONASS

(File available at ftp://62.161.69.5/pub/tai/scale/UTCGPSGLO/utcgpsglo12.ar)

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

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

$$[TAI - GPS\ time] = 19\ \text{s} + C_0,$$

where the time difference of 19 seconds is kept constant and C_0 is a quantity of the order of tens 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 2009 January 1, 0 h UTC, until 2012 July 1, 0 h UTC:

$$[UTC - GPS\ time] = -15\ \text{s} + C_0,$$

from 2012 July 1, 0 h UTC, until further notice, $[UTC - GPS\ time] = -16\ \text{s} + C_0$,

Here C_0 is given at 0 h UTC every day.

C_0 is computed as follows. The GPS data recorded at the Paris Observatory for highest-elevation satellites are first corrected for precise satellite ephemerides and for ionospheric delays derived from IGS maps, and then smoothed to obtain the values of [*UTC*(*OP*) - *GPS time*]. Daily values of C_0 are then derived by linear interpolation of [*UTC* - *UTC*(*OP*)] at 0 h UTC.

The standard deviation σ_0 characterizes the dispersion of individual measurements for a month. The actual uncertainty of user's access to GPS time may differ from these values. N_0 is the number of measurements.

[*TAI – UTC(USNO)_GPS*] and [*UTC – UTC(USNO)_GPS*]

The GPS satellites broadcast a prediction of UTC(USNO) calculated at the USNO, indicated by UTC(USNO)_GPS. The relation between UTC(USNO)_GPS and TAI involves a variable number of seconds as a consequence of the leap seconds of the UTC system, and is as follows:

From 2009 January 1, 0 h UTC, until 2012 July 1, 0 h UTC: $[TAI – UTC(USNO)\_GPS] = 34\ \text{s} + C_0'$

From 2012 July 1, 0 h UTC, until further notice, $[TAI – UTC(USNO)\_GPS] = 35\ \text{s} + C_0'$

Here C_0' is given at 0 h UTC every day.

C_0' is computed using the values of [*UTC* - *UTC*(*OP*)] similarly than the computation of C_0.

The relation between UTC(USNO)_GPS and UTC is $[UTC– UTC(USNO)\_GPS] = 0\ \text{s} + C_0'$

The standard deviation σ_0' characterizes the dispersion of individual measurements for a month. The actual uncertainty of user's access to UTC(USNO)_GPS may differ from these values. N_0' is the number of measurements.

Relations of UTC and TAI with GPS time, GLONASS time, UTC(USNO)_GPS and UTC(SU)_GLONASS (Cont.)

(File available at ftp://62.161.69.5/pub/tai/scale/UTCGPSGLO/utcgpsglo12.ar

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

The GLONASS satellites disseminate a common time scale designated 'GLONASS time'. The relation between GLONASS time and UTC is

$$[UTC - GLONASS\ time] = 0\ \text{s} + C_1,$$

where the time difference 0 s is kept constant by the application of leap seconds so that GLONASS time follows the UTC system, and C_1 is a quantity of the order of hundred nanoseconds (tens of microseconds until 1997 July 1), which varies with time.

The relation between GLONASS time and TAI involves a variable number of seconds and is as follows:

From 2009 January 1, 0 h UTC, until 2012 July 1, 0 h UTC, [*TAI* - *GLONASS time*] = 34 s + C_1,

from 2012 July 1, 0 h UTC, until further notice, [*TAI* - *GLONASS time*] = 35 s + C_1.

Here C_1 is given at 0 h UTC every day.

C_1 is computed as follows. The GLONASS data recorded at the Astrogeodynamical Observatory, Borowiec, Poland for the highest-elevation satellites are smoothed to obtain the values of [*UTC*(*AOS*) - *GLONASS time*]. Daily values of C_1 are then derived by linear interpolation of [*UTC* - *UTC*(*AOS*)] at 0 h UTC.

To ensure the continuity of C_1 estimates, the following corrections are applied:

+1285 ns from 1997 January 1 (MJD 50449) to 1999 March 22 (MJD 51259)
+107 ns for 1999 March 23 and March 24 (MJD 51260 and MJD 51261)
0 ns since 1999, March 25 (MJD 51262).

The standard deviation σ_1 characterizes the dispersion of individual measurements for a month. The actual uncertainty of user's access to GLONASS time may differ from these values. N_1 is the number of measurements.

[*TAI – UTC(SU)_GLONASS*] and [*UTC – UTC(SU)_GLONASS*]

The satellites broadcast a prediction of UTC(SU) calculated at the SU, indicated by UTC(SU)_GLONASS. The relation between UTC(SU)_GLONASS and TAI involves a variable number of seconds as a consequence of the leap seconds of the UTC system, and is as follows:

From 2009 January 1, 0 h UTC, until 2012 July 1, 0 h UTC: [*TAI – UTC(SU)_GLONASS*] = 34 s + C_1'

From 2012 July 1, 0 h UTC, until further notice, [*TAI – UTC(SU)_GLONASS*] = 35 s + C_1'

Here C_1' is given at 0 h UTC every day.

C_1' is computed using the values of [*UTC* - *UTC*(*AOS*)] similarly than the computation of C_1.

The relation between UTC(SU)_GLONASS and UTC is [*UTC– UTC(SU)_GLONASS*] = 0 s + C_1'

The standard deviation σ_1' characterizes the dispersion of individual measurements for a month. The actual uncertainty of user's access to UTC(SU)_GPS may differ from these values. N_1' is the number of measurements.

Table 8. Rates relative to TAI of contributing clocks in 2012

(File is available at ftp://62.161.69.5/pub/tai/scale/RTAI/rtai12.ar)

Mean clock rates relative to TAI are computed for one-month intervals ending at the MJD 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 8 gives homogeneous rates for the whole year 2012. For studies including the clock rates of previous years, corrections must be brought to the data published in the Annual Report for the previous years. These corrections are available from the TFG section under request. Unit is ns/day, "   -" denotes that the clock was not used, "*" denotes that the related rate was influenced by a frequency jump.

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
15 DATUM/SYMMETRICOM Cs III
18 DATUM/SYMMETRICOM Cs 4000
19 RHODES AND SCHWARZ XSC
4x HYDROGEN MASERS
9x PRIMARY CLOCKS AND PROTOTYPES
21 OSCILLOQUARTZ 3210
22 OSCILLOQUARTZ OSA 3230B
23 OSCILLOQUARTZ EUDICS 3020
24 OSCILLOQUARTZ OSA 3235B
25 HEWLETT_PACKARD 5062C
30 HEWLETT-PACKARD 5061B
31 HEWLETT-PACKARD 5061B OPT. 4
34 H-P 5061A/B with 5071A tube
35 H-P/AGILENT/SYMMETRICOM 5071A High perf.
36 H-P/AGILENT/SYMMETRICOM 5071A Low perf.
50 FREQ. AND TIME SYSTEMS INC. 4065A
51 DATUM/SYMMETRICOM 4065 B
52 DATUM/SYMMETRICOM 4065 C
53 DATUM/SYMMETRICOM 4310 B

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
APL	35 904	-	-	-	27.80	28.66	-	-	-	-	-	-	30.68
APL	35 1264	-	-	-	21.24	21.82	-	-	-	-	-	-	22.25
APL	40 3107	-	-	-	27.37	27.50	-	-	28.12	28.30	-	-	28.91
APL	40 3108	-	-	-	384.73	388.34	-	-	399.60	402.90	-	-	-
APL	40 3109	-	-	-	44.73	44.88	-	-	44.83	44.54	-	-	43.83
AUS	35 2269	-1.33	-1.16	-2.16	-1.17	-1.85	-0.79	-0.93	-0.82	-0.23	-1.17	-0.03	0.59
AUS	36 299	11.10	11.97	10.78	11.50	12.99	-	14.35	11.72	12.77	11.20	12.13	13.33
AUS	36 340	1.67	2.94	3.18	2.23	1.75	0.87	1.47	1.58	1.73	2.80	0.30	1.26
AUS	36 654	-11.90	-11.13	-10.36	-10.14	-11.08	-12.49	-9.90	-10.88	-10.63	-11.67	-9.80	-11.07
AUS	36 1141	13.40	10.84	6.68	6.30	9.45	9.17	7.87	8.02	13.23	12.10	7.73	12.46

Table 8. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
AUS	40 5401	-	-	-	-	-	-	-7.30	-6.75	-	-	-	-
AUS	40 5402	-	-6.31*	2.19*	2.68*	3.54*	-	-	-10.20*	-	-9.15*	-	-
BEV	35 1065	-1.52*	-1.61	-2.47	1.92	1.82	1.29	0.90	1.38	2.21	2.50	1.68	1.99
BEV	35 1793	0.47*	0.18*	0.47*	0.60*	-0.84*	-2.38*	-1.50*	-1.89*	0.69*	-1.31*	-1.86*	-2.11
BEV	40 3452	-50.29*	-42.60*	-34.95*	-27.21	-19.39	-11.82	-3.53	4.78	12.32	19.79	26.90	-5.13
BIM	18 8058	0.62	1.65	1.56	-0.84	1.67	0.90	1.63	2.01	1.66	1.12	1.99	1.41
BY	40 4222	5.89*	6.74*	-1.07*	5.27*	6.26*	4.48*	10.25*	4.32*	4.77*	2.37	0.59	1.35
BY	40 4260	-	-	0.15*	1.97*	6.53*	5.42*	4.20*	1.07*	-0.27*	-1.87	-4.82	-5.54
BY	40 4278	2.05*	2.90*	7.51*	6.67*	7.96*	7.83*	10.12*	9.51*	8.86*	7.88	6.43	5.40
CAO	35 939	-2.57	-1.40	-2.67	-	-	-	-	-	-	-	-	-
CAO	35 1270	6.22	6.32	6.77	-	-	-	-	-	-	-	-	-
CH	22 112	-	-	-	-	-	-	-	-	-	5.59	10.87	11.93
CH	35 771	7.00	8.28	-	-	-	-	-	-	-	-	-	-
CH	35 2117	2.01	2.31	2.02	1.52	1.01	2.91	1.65	2.53	1.70	1.80	2.12	2.60
CH	35 2743	-4.40	-4.39	-4.06	-4.21	-3.49	-3.64	-3.11	-2.82	-3.57	-3.04	-1.66	-3.47
CH	36 354	41.03	42.40	42.94	41.64	42.49	41.57	43.12	41.96	42.86	42.12	40.92	42.30
CH	40 5701	-18.36	-18.61	-19.10	-19.19	-19.62	-19.89	-20.13	-	-6.50	-8.92	-10.99	-13.29
CNM	35 1815	-1.30	0.14	-0.16	-	-	-	-	-	-	-	-	-
CNM	35 2708	-4.83	-2.91	-4.57	-	-	0.39	-0.64	-0.09	0.12	-	-	-0.59
CNM	35 2709	-0.48	1.48	-0.23	-	6.77	6.04	6.24	6.84	7.02	-	-	5.86
CNM	40 7301	-8.45	-6.51	-8.94	-	-3.99	-4.39	-4.04	-4.37	-4.44	-	-	-6.06
CNMP	36 1752	6.58	-	7.13	6.38	6.93	7.22	6.58	7.21	7.13	7.43	8.71	6.69
CNMP	36 1806	-0.97	-	1.08	0.13	-0.03	0.86	0.80	0.31	-0.22	0.42	0.09	0.36
DLR	35 1714	-1.17	0.42	0.98	-0.94	1.55	-2.12	0.51	1.04	-2.04	1.03	0.25	0.12
DMDM	35 2191	19.34	19.28	19.41	19.94	19.67	20.22	19.62	19.92	20.14	21.02	20.52	20.29
DMDM	36 2033	6.50	6.50	7.04	6.06	6.99	7.17	6.95	6.78	6.85	7.25	7.01	6.04
DTAG	35 2635	-0.35*	-0.45*	0.21	-0.50	2.14	1.20	-	1.89	1.28	0.88	0.78	0.66
DTAG	35 2865	-	-	-	-	-	-	-	-	-	-	-1.62	-1.45
DTAG	36 2370	0.65	0.50	1.36	-2.04	0.76	0.73	-	1.14	1.45	-	-	-
DTAG	36 2794	1.58	0.76	1.26	-1.24	-0.36	0.40	-	-1.26	-0.04	-0.58	0.44	-0.43
ESTC	22 132	-	-	-	-	-	-	-	-	-	-	-	7.07
ESTC	35 1615	-	-	-	-	-	-	-	-	-	-	-	11.62
ESTC	35 2353	-	-	-	-	-	-	-	-	-	-	-	-13.53
ESTC	40 2551	-	-	-	-	-	-	-	-	-	-	-	-4.13
F	35 124	9.48	8.99	10.19	9.30	8.28	8.96	8.73	7.88	9.27	8.33	8.56	8.31

Table 8. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
F	35 157	-	-	-	-	-	-	-	-	-	-	12.97	11.93
F	35 158	11.37	11.74	11.56	11.54	10.45	10.32	11.20	11.48	10.62	10.94	10.14	10.56
F	35 355	0.18	-	-	-	-	-	-	2.83	3.29	1.76	2.01	1.86
F	35 385	21.10	21.24	21.15	20.30	21.24	20.82	20.78	21.28	20.68	19.50	19.02	20.56
F	35 396	-1.28	-1.60	-1.06	-1.15	-0.40	-0.45	-1.42	-1.09	-1.60	-1.79	-1.88	-1.67
F	35 469	0.68	0.76	-4.96	-5.11	-4.88	-5.25	-5.72	-4.05	-5.32	-4.46	-2.29	-1.67
F	35 489	13.94	14.34	14.30	15.04	14.44	14.34	12.58	13.80	-	-	-	-
F	35 520	19.68	19.02	20.28	20.25	17.44	16.34	16.90	16.04	14.09	14.79	14.69	14.15
F	35 536	2.07	1.32	1.23	2.05	-	-	1.34	1.66	1.63	1.64	-	-
F	35 609	-22.98	-22.72	-22.80	-23.45	-23.28	-23.74	-23.84	-23.53	-23.21	-23.41	-24.03	-24.41
F	35 700	-14.39	-14.52	-14.82	-13.98	-13.67	-13.96	-12.90	-12.62	-13.29	-13.63	-15.52	-16.95
F	35 770	-7.27	-7.45	-7.42	-7.87	-6.84	-6.06	-6.65	-7.03	-7.04	-6.67	-7.39	-7.25
F	35 774	27.78	27.82	27.94	28.12	27.46	26.52	28.00	27.25	28.07	27.50	27.15	27.31
F	35 781	-	7.68	7.04	7.22	5.58	6.33	4.90	6.73	7.41	8.72	9.47	10.85
F	35 819	8.49	8.31	10.27	9.48	10.63	11.14	11.02	11.52	10.29	9.63	9.68	9.86
F	35 859	5.43	6.51	4.46	5.76	4.94	5.55	4.56	3.77	4.70	5.33	5.70	-
F	35 909	-	-11.87	-11.79	-11.76	-12.42	-12.19	-13.55	-13.68	-11.99	-10.18	-8.08	-
F	35 1177	-2.63	-3.33	-2.91	-2.53	-3.07	-2.19	-2.09	-2.26	-2.41	-0.96	-1.47	-2.77
F	35 1222	-	1.92	2.46	2.38	1.90	1.75	1.78	1.62	1.42	2.08	2.73	3.39
F	35 1321	3.95	3.50	4.32	3.08	4.10	3.99	4.80	3.77	3.61	3.53	4.69	4.44
F	35 1556	-4.67	-5.27	-4.60	-4.79	-4.34	-2.99	-3.62	-3.24	-3.43	-3.98	-3.45	-3.60
F	35 1644	11.23	11.52	10.69	11.06	11.22	9.74	9.19	9.83	9.24	9.81	10.11	10.28
F	35 2027	3.28	2.65	2.64	2.38	1.85	2.21	3.46	2.18	2.67	2.82	3.28	2.46
F	35 2388	0.88	0.91	-0.08	1.96	2.35	0.30	-0.69	0.06	0.27	0.87	0.03	1.29
F	35 2609	5.40	5.20	5.93	6.32	6.09	6.80	6.51	7.06	7.43	7.21	6.92	6.11
F	35 2647	7.51	8.64	9.07	9.86	10.90	11.14	12.70	12.77	13.89	13.99	14.71	14.85
F	35 2804	-	-	-	-	0.81	0.88	0.96	0.66	0.43	0.24	0.25	0.27
F	40 805	69.39	80.84	-	-	-	-	-	-	-	-	-	-
F	40 809	-	-	-	-	8.35	8.21	8.10	8.41	8.68	9.15	9.60	10.13
F	40 810	-	-	-	-	10.13	10.04	9.97	10.57	11.17	12.04	12.89	13.66

Table 8. (Cont.)

Lab.	Clock		55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
F	40	816	-1.70	0.29	-0.78	-1.20	-2.49	-3.42	-4.62	-4.81	-4.61	-	-	-
F	40	889	-	7.64	8.92	10.05	10.92	11.63	12.46	13.17	13.63	14.13	14.44	14.78
F	40	890	6.91	-	-	-	10.35	10.54	10.89	11.27	11.44	11.72	11.92	12.17
HKO	35	1893	1.17	0.48	1.29	1.14	0.90	2.18	1.98	1.50	2.09	2.26	2.96	3.76
HKO	35	2425	-0.75*	-0.53*	-0.29*	-0.66*	-1.07	-1.32	-1.51	-1.18	-0.79	-1.15	-0.79	-1.12
IFAG	36	1167	-5.85	-2.74	-2.53	-2.32	1.47	-1.89	-0.95	2.18	0.83	0.59	0.47	-0.41
IFAG	36	1173	9.60	7.78	10.42	11.28	14.03	13.93	15.01	14.88	16.18	17.15	16.01	13.76
IFAG	36	1629	12.69	15.19	12.58	12.65	14.22	13.78	16.52	14.83	14.87	12.97	13.16	13.69
IFAG	36	1732	14.44	14.46	14.51	15.81	15.35	14.91	15.26	15.90	15.87	16.19	15.28	15.47
IFAG	36	1798	-2.28	-2.35	-2.88	-2.52	-2.00	-2.85	-1.97	-2.92	-1.77	-2.92	-2.93	-2.62
IFAG	40	4418	10.79	11.26	11.31	11.82	12.18	12.40	10.15	-0.52	0.20	0.43	0.74	1.23
IFAG	40	4439	8.39*	7.76*	6.86*	5.68*	4.76*	3.81*	4.02*	2.58*	2.34*	1.40*	0.74*	0.40
IGNA	35	1196	-	-	11.83	12.37	12.70	14.52	13.68	13.07	13.27	12.75	13.76	15.29
INPL	35	2480	-	-1.34	-0.79	-1.35	-1.60	-0.40	0.39	-	-1.04	-1.29	-2.20	-2.02
INPL	35	2481	-	0.65	1.29	1.12	1.30	1.29	1.86	-	0.77	1.51	0.73	0.33
INTI	35	2377	1.96	-4.32	-2.38	3.10	0.17	1.39	-1.46	-2.17	4.06	4.61	-5.56	2.61
INXE	35	2393	-	-	-	-	-	-	-	-	-	0.24	0.01	-0.51
IPQ	35	1797	-3.81	-3.88	-3.71	-4.96	-6.33	-6.89	-7.32	-	-	-	-	-
IPQ	35	2012	8.04	7.68	8.00	9.05	7.55	8.95	7.39	-	8.71	-	-	-
IPQ	35	2169	1.10	-1.16	-0.98	-1.91	-1.80	-0.17	-0.70	-	0.72	-	-	-
IT	35	219	1.31	1.14	1.31	1.42	1.10	1.22	0.74	1.10	1.14	1.65	1.47	1.38
IT	35	505	-25.83	-25.94	-25.88	-26.57	-25.59	-26.51	-26.42	-26.79	-26.12	-25.36	-24.89	-24.89
IT	35	1115	17.61	18.23	19.64	19.11	18.63	19.09	19.88	20.26	20.67	20.96	21.02	19.28
IT	35	1373	-3.57	-3.80	-3.84	-4.06	-3.25	-4.07	-4.04	-4.56	-5.60	-5.60	-5.54	-5.65
IT	35	2118	-	11.46	11.46	11.20	12.65	13.64	13.67	14.69	14.75	15.30	14.74	-
IT	35	2487	-9.60	-9.83	-9.48	-9.77	-9.43	-9.47	-9.31	-9.81	-10.31	-9.37	-9.30	-8.19
IT	40	1101	43.01	49.21	55.25	61.57	67.61	73.84	80.64	87.62	93.57	99.51	105.38	111.17
IT	40	1102	132.15	139.50	146.26	153.28	159.96	166.40	173.20	180.80	187.67	193.82	200.31	206.01
IT	40	1103	-13.50	-12.15	-10.78	-9.35	-8.22	-6.63	-5.00	-2.56	0.10	2.26	3.92	5.36
JV	21	216	61.09	61.97	68.20	63.99	65.82	67.74	64.22	66.98	71.31	69.34	81.43	78.88
JV	36	1277	-17.57	-17.16	-16.91	-16.19	-14.78	-15.55	-14.24	-15.48	-14.90	-16.85	-14.15	-17.48
JV	36	2629	-7.10	-6.82	-7.00	-6.40	-4.75	-4.13	-4.92	-4.78	-4.09	-5.43	-4.97	-4.20
KEBS	35	2518	-	21.45	20.96	18.98	-	19.59	18.38	20.36	19.97	-	-	19.69
KIM	36	618	1.64	1.41	-0.05	-0.77	0.17	1.59	1.32	4.35	1.80	1.06	0.80	1.84
KRIS	35	321	7.29	7.67	8.52	8.47	8.95	9.49	10.11	10.55	10.35	11.33	11.04	11.70

Table 8. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
KRIS	35 739	-1.80	-1.28	-2.36	-2.91	-1.99	-2.24	-1.19	-1.84	-0.34	-0.37	0.19	-0.63
KRIS	35 1135	19.13	19.01	19.56	19.12	19.63	20.14	20.02	20.58	22.50	22.90	23.60	24.83
KRIS	35 1693	8.47	8.29	7.96	7.79	7.89	8.10	8.43	8.87	8.69	9.26	9.10	8.54
KRIS	35 1783	22.53	21.73	22.22	21.27	21.23	22.55	21.13	21.60	21.97	22.65	21.48	20.73
KRIS	40 5624	-48.60	-48.61	-48.67	-48.49	-48.45	-48.34	-48.22	-48.00	-47.89	-47.51	-47.36	-47.28
KRIS	40 5625	0.74	0.57	0.37	0.39	0.25	0.18	0.24	0.40	0.35	0.49	0.39	0.41
KRIS	40 5626	-14.99	-14.68	-14.53	-14.32	-14.05	-13.72	-13.36	-12.90	-12.49	-12.16	-11.86	-9.56
KZ	35 2202	-4.37	-7.73	-4.10	-3.86	-3.34	-6.42	-2.94	-0.93	-0.51	-1.79	-	-
KZ	35 2665	4.47	3.95	1.86	2.37	2.93	0.47	3.21	4.79	4.41	3.38	-	-
KZ	35 2667	1.40	0.67	0.56	0.51	1.76	-1.45	2.16	5.14	3.39	3.46	-	-
LT	35 1362	1.69	-1.23	-	-	-	-	-0.51	-	2.55	1.86	-1.18	0.32
LT	35 1868	0.03	-1.34	-	-	-	-0.94	-0.70	-	-0.59	-0.42	-0.24	-1.45
MIKE	35 1171	-0.46	-0.86	-0.76	-1.71	-0.48	0.00	-	0.84	-	0.47	-1.48	-0.86
MIKE	36 986	0.70	1.41	0.52	2.61	1.58	0.69	-	2.76	-	2.57	0.92	1.55
MIKE	40 4108	6.41*	6.95*	7.32*	7.92*	8.44*	1.46	-	-1.86	-	-0.69	-0.17	0.33
MKEH	36 849	-41.09	-40.61	-40.86	-41.08	-41.09	-40.20	-43.50	-43.32	-42.71	-40.51	-40.91	-40.44
MSL	12 933	-41.66	-41.98	-54.03	-48.23	-40.23	-43.35	-50.04	-42.68	-38.89	-31.66	-23.88	-30.72
MSL	36 274	-8.53	-14.74	-13.68	-14.40	-14.17	-13.27	-16.29	-15.01	-14.22	-1.94	0.33	-1.74
MSL	36 1025	-4.03	-12.47	-10.04	-	86.46	91.93	-	-	-	-	-	-
NAO	35 779	-	-	-	-	1.17	1.84	1.10	1.14	1.31	1.80	1.86	2.21
NAO	35 1206	0.00	0.31	0.40	1.20	1.51	1.00	-0.24	-0.03	0.20	-0.30	-5.11	-0.50
NAO	35 1214	0.72	0.19	1.38	1.43	2.36	2.61	2.16	3.41	3.09	6.17	-3.31	-4.64
NAO	35 1689	1.92	0.71	0.12	0.31	0.72	1.83	1.09	0.50	1.44	2.91	2.01	2.87
NAO	40 1301	-	-	-	3.55	4.90	6.37	7.56	4.57	2.33	1.09	-3.79	-
NICT	35 112	-5.44	-5.21	-8.13	-9.83	-10.15	-10.16	-10.70	-10.57	-10.36	-10.53	-9.82	-9.49
NICT	35 332	7.87	6.94	7.63	7.55	8.01	7.49	7.28	7.44	6.17	6.94	5.83	7.14
NICT	35 342	50.19	49.95	50.28	49.64	50.12	50.31	50.51	50.35	50.41	50.16	50.09	50.54
NICT	35 343	7.61	7.40	8.69	8.47	7.53	7.90	7.98	8.61	7.68	8.53	8.68	8.12
NICT	35 715	10.79	10.23	10.61	9.74	10.89	10.13	10.98	10.40	10.50	10.58	10.68	10.45
NICT	35 732	-4.81	-5.20	-5.09	-5.66	-4.52	-4.39	-4.97	-4.94	-4.76	-5.26	-5.58	-5.80
NICT	35 907	19.45	19.86	19.68	19.69	20.13	20.74	20.21	21.09	20.88	20.28	20.64	21.52
NICT	35 913	-15.84	-16.64	-15.84	-16.87	-16.80	-17.64	-16.78	-16.48	-17.54	-17.56	-15.11	-13.99
NICT	35 916	-0.16	-0.57	0.09	-0.32	-0.36	0.01	-0.34	0.49	0.51	0.27	0.15	-0.01
NICT	35 1225	4.47	5.58	5.62	6.18	4.85	5.20	5.96	5.30	5.23	6.03	5.79	5.99
NICT	35 1226	9.72	9.27	10.75	11.43	12.36	12.83	12.85	12.81	13.03	11.45	11.34	12.29

Table 8. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
NICT	35 1611	2.79	26.51	28.64	27.03	25.26	25.23	23.75	21.39	21.18	20.48	19.37	20.70
NICT	35 1778	-26.14	-25.86	-25.41	-24.94	-25.42	-25.32	-26.18	-26.28	-24.65	-23.23	-22.82	-22.17
NICT	35 1789	-6.98	-6.79	-7.05	-7.18	-7.50	-7.06	-7.58	-7.25	-7.71	-7.04	-6.83	-8.00
NICT	35 1790	9.17	8.85	9.23	9.83	9.16	9.17	9.62	9.64	10.00	10.54	10.19	11.03
NICT	35 1866	2.08	2.80	2.80	2.56	3.46	2.84	3.12	3.33	3.75	2.76	3.70	3.12
NICT	35 1882	-0.12	-0.16	-0.29	0.23	0.06	0.08	0.14	0.61	0.42	1.09	0.18	0.26
NICT	35 1887	1.46	1.70	1.86	1.82	2.20	1.58	1.68	2.40	1.95	2.01	1.84	0.46
NICT	35 1944	3.25	3.89	2.95	3.73	2.15	3.72	3.20	3.26	3.86	2.95	3.42	4.22
NICT	35 2010	5.45	6.54	5.18	4.19	4.46	3.77	4.88	7.35	6.10	6.54	5.81	7.14
NICT	35 2011	-26.96	-	-	-	-2.45	-2.03	-1.66	-1.53	-0.86	-0.52	-0.66	-0.85
NICT	35 2056	9.30	-	-	-25.22	-24.56	-24.86	-24.35	-24.14	-23.74	-23.57	-23.77	-23.67
NICT	35 2113	-30.68	-	-	-	-	-	-	-	-	-	-	-
NICT	35 2116	14.04	14.23	14.65	13.82	13.23	14.29	14.42	14.82	14.46	15.17	13.96	13.72
NICT	35 2570	6.82	6.99	7.05	8.12	7.73	8.00	8.62	8.97	8.79	9.37	9.28	9.18
NICT	35 2574	-1.88	-2.67	-2.99	-2.73	-2.84	-2.35	-2.80	-2.55	-1.62	-2.45	-2.09	-2.60
NICT	35 2627	0.94	1.15	1.26	1.59	1.58	1.43	1.87	1.58	1.68	1.30	1.14	1.57
NICT	35 2628	5.48	6.21	5.86	6.15	6.24	6.17	5.68	6.42	5.71	6.58	6.40	6.40
NICT	35 2784	-	-	-	0.57	0.78	1.29	2.15	2.52	3.20	3.31	4.15	3.14
NICT	36 1217	3.61	3.18	5.22	6.52	7.96	6.83	7.18	7.97	8.06	6.11	6.18	6.96
NICT	40 2002	29.14	30.03	30.72	31.77	32.66	-	-	-	-	-	-	-
NICT	40 2003	22.18	23.04	-	-	-	-	-	-	-8.34	-12.11	-15.97	-18.91
NICT	40 2004	-	1.82	0.65	0.17	-0.19	-0.12	0.11	0.60	1.41	2.37	3.49	4.80
NICT	40 2005	53.78	56.27	58.76	61.33	64.42	66.52	68.46	70.59	72.65	-	73.91	76.16
NICT	40 2006	-	-	-	-	-	-	5.35	6.55	7.58	8.46	9.71	11.04
NIM	35 1235	10.46	10.61	8.87	8.41	7.40	10.33	11.22	10.83	11.03	12.10	11.84	13.20
NIM	35 2239	2.22	2.19	2.31	2.80	3.01	2.90	2.32	2.72	2.16	3.21	3.01	1.94
NIM	35 2256	-	-	-	-	-	-	-	-	-	-	12.35	12.75
NIM	35 2483	-	-	-	-	-	-	-	-	-	-	0.80	1.16
NIM	35 2643	-	-	-	-	-	-	-	-	-	-	-8.23	-7.82
NIM	35 2744	-	-	-	-	-	-	-	-	-	-	-	-12.87
NIM	35 2767	-	-	-	-	-	-	-	-	-	-	-31.18	-30.93
NIM	40 4832	-	-	-	-	-	-	-	-	-	-	96.98	99.28
NIM	40 4835	167.48	170.21	172.40	174.83	177.78	180.37	183.16	185.83	188.54	191.25	193.44	197.26
NIM	40 4871	-	-	-	-	-	-	-	-	-	-	125.06	129.39
NIM	40 4878	-	-	-	-	-	-	-	-	-	-	14.34	18.44

Table 8. (Cont.)

Lab.	Clock		55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
NIM	40	4879	-	-	-	-	-	-	-	-	-	-	26.67	33.89
NIM	40	4880	-	-	-	-	-	-	-	-	-	-	19.27	26.12
NIMB	35	600	-1.75	-0.92	-3.27	-0.59	-1.19	-0.47	-	-	2.78	3.35	2.47	2.14
NIMT	35	2246	4.47	4.94	5.37	5.47	5.06	4.88	6.30	5.52	5.78	5.96	6.23	5.65
NIMT	35	2247	8.51	2.49	8.81	0.39	-9.30	-15.85	-12.38	-0.47	1.31	-0.01	-0.40	-0.10
NIS	35	1126	-1.03	-1.39	-1.65	-1.61	-1.25	-0.86	-0.73	-0.92	-0.73	-0.82	-	-
NIST	35	182	2.36	1.04	1.11	1.63	1.53	1.72	0.74	0.26	-	-	-	-
NIST	35	282	4.78	4.38	5.47	6.26	5.22	6.41	7.22	7.22	8.05	7.73	8.64	8.07
NIST	35	408	-20.50	-20.29	-20.33	-20.11	-19.94	-20.34	-20.48	-20.25	-21.28	-21.27	-21.58	-21.48
NIST	35	1074	-18.80	-17.40	-17.74	-16.14	-15.66	-19.62	-21.71	-22.13	-22.20	-21.72	-20.47	-19.21
NIST	35	2031	-8.13	-9.87	-10.23	-9.46	-10.23	-10.78	-9.68	-9.90	-10.17	-9.73	-9.93	-9.80
NIST	35	2032	-4.16	-4.66	-3.17	-3.71	-4.15	-4.28	-2.91	-4.22	-4.06	-5.63	-4.20	-
NIST	35	2034	-8.90	-9.47	-9.12	-8.72	-9.27	-9.06	-9.67	-9.68	-9.78	-9.45	-9.52	-9.64
NIST	35	2579	-1.63	-2.01	-1.22	-0.84	-1.37	-0.70	-0.35	-0.46	-0.61	-0.65	-0.17	-0.68
NIST	35	2672	-4.02	-3.82	-3.77	-3.61	-2.19	-2.61	-1.02	-1.64	-1.32	-0.42	-0.95	0.22
NIST	36	1661	-16.85	-17.51	-17.41	-17.18	-16.90	-18.75	-19.17	-14.76	-16.37	-17.12	-15.42	-13.56
NIST	40	203	165.13	166.33	167.51	168.87	169.96	171.00	172.31	173.65	174.81	176.05	177.24	178.36
NIST	40	204	33.34	33.57	33.71	34.00	34.35	34.69	34.86	35.24	35.45	35.72	36.12	36.36
NIST	40	205	-25.73	-25.58	-25.64	-25.52	-25.40	-25.40	-25.31	-25.24	-25.19	-25.16	-25.11	-25.06
NIST	40	206	-54.62	-53.97	-53.66	-52.98	-52.48	-52.00	-51.10	-50.15	-49.46	-48.84	-48.32	-47.83
NIST	40	222	30.64	30.81	30.85	31.09	31.13	31.31	31.43	31.62	-	-	32.34	32.30
NMIJ	35	224	-8.94	-8.75	-9.50	-8.38	-8.71	-9.66	-9.26	-9.92	-9.89	-9.99	-10.82	-10.14
NMIJ	35	523	10.79	11.74	11.39	12.57	13.17	12.55	13.38	13.94	13.87	13.98	13.80	15.07
NMIJ	35	1273	19.04	19.04	19.17	18.64	19.90	20.04	19.40	19.76	19.27	20.44	19.55	19.56
NMIJ	35	2057	-8.65	-8.70	-8.92	-8.60	-7.75	-8.60	-	-	-	-	-	-
NMIJ	40	5002	-0.08	0.14	0.32	0.78	1.07	1.57	2.50	2.76	2.14	2.48	2.77	4.17
NMIJ	40	5003	5.14	5.09	4.83	5.07	5.04	5.13	5.17	2.34	0.69	0.96	0.82	0.74
NMIJ	40	5015	10.94	15.48	19.95	24.38	28.54	32.72	37.03	40.80	44.25	48.01	52.05	56.13
NMLS	35	328	-2.79	-2.04	-0.42	-2.59	-3.91	-3.32	-0.54	4.91	4.56	4.06	3.17	3.25
NPL	35	1275	5.40	5.40	6.66	7.36	6.20	6.43	7.49	6.98	6.51	4.60	4.64	4.24
NPL	36	784	9.06	10.09	8.58	8.89	8.40	6.64	7.85	9.55	8.64	6.53	6.20	6.22
NPL	40	1701	14.44	14.43	14.84	15.24	15.51	15.70	15.55	15.91	16.29	16.88	17.07	17.23
NPL	40	1708	-1.23*	-1.09*	-0.83*	-1.81*	-1.53*	-1.25*	-0.96*	-1.49*	-1.23*	-0.92*	-0.75*	-0.43
NPLI	35	57	-	-	-	-	92.19	-	94.25	95.57	94.83	94.06	93.48	92.85
NPLI	35	140	-	-	-	-	14.05	-	18.14	17.66	15.96	15.59	15.96	14.52

Table 8. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
NPLI	35 1324	-	-	-	-	-3.45	-	-2.90	-3.45	-2.45	-3.29	-2.75	-2.03
NPLI	35 2245	-	-	-	-	-2.07	-	-1.12	-2.10	-2.19	-2.11	-1.66	-1.79
NPLI	35 2257	-1.86	-	0.91	-	-	-	-	-	-	-	-	-
NPLI	35 2796	-	-	-	-	-27.86	-	-27.97	-27.61	-27.16	-26.80	-27.18	-27.14
NPLI	40 5201	-	-	-	-	0.78	-	8.98	-2.32	-10.18	-4.02	2.42	9.03
NRC	35 2148	11.20	10.15	11.14	11.03	10.19	10.07	10.50	9.86	10.71	10.04	10.20	10.35
NRC	35 2150	-2.80	-3.65	-3.24	-3.32	-3.13	-2.85	-3.20	-2.91	-3.19	-3.34	-2.50	-2.97
NRC	35 2152	-4.25*	-3.94*	-3.94*	-5.37*	-4.21*	-3.69*	-4.32*	-3.35*	-4.31*	-4.53*	-4.44*	-4.74
NRL	35 714	0.09	-0.15	-1.15	-1.34	-1.44	-1.92	-	-	22.02	24.78	24.50	-
NRL	35 719	3.50	4.04	3.19	3.58	3.80	4.42	-	-	25.26	28.71	28.60	-
NRL	35 1245	-2.69	-3.14	-2.38	-1.86	-2.29	-2.52	-	-	17.51	18.50	22.93	-
NRL	36 387	-2.68	-2.34	-2.52	-1.73	-2.86	-1.53	-	-	19.21	23.10	23.30	-
NRL	40 1001	118.53	120.78	122.97	125.35	127.14	128.99	-	-	156.83	161.45	163.56	-
NRL	40 1003	16.42	16.62	15.93	14.53	12.35	-	-	-	20.09	6.36	12.18	-
NTSC	35 1007	5.87	6.16	6.36	9.07	6.66	7.35	8.88	8.15	6.21	4.85	4.60	4.81
NTSC	35 1008	3.70	3.65	4.07	3.38	3.68	3.16	3.88	3.51	4.59	3.71	3.58	2.57
NTSC	35 1011	-3.15	-2.07	-1.29	-0.78	-0.28	0.51	1.49	2.05	4.05	4.31	5.35	5.67
NTSC	35 1016	13.70	13.74	13.27	13.54	13.30	13.55	13.15	13.32	13.32	13.54	13.95	13.64
NTSC	35 1018	-10.87	-11.02	-11.49	-10.94	-10.51	-10.23	-10.74	-10.65	-10.44	-10.92	-9.55	-9.83
NTSC	35 1818	-22.80	-20.65	-20.30	-19.09	-17.74	-15.71	-15.77	-16.15	-16.56	-18.00	-17.03	-15.17
NTSC	35 1820	9.56	9.75	9.27	9.01	8.26	8.72	9.53	9.53	10.50	10.58	11.15	10.83
NTSC	35 1823	12.54	12.92	13.05	13.30	13.43	13.44	13.93	14.89	14.36	14.93	14.73	15.56
NTSC	35 2096	-5.22	-5.49	-4.79	-5.55	-5.27	-4.48	-5.30	-3.85	-4.81	-5.24	-3.96	-4.66
NTSC	35 2098	6.55	7.63	7.88	8.48	7.30	7.64	7.38	7.14	7.99	7.05	6.82	7.07
NTSC	35 2131	-13.17	-12.78	-11.67	-12.29	-12.48	-	-	-	11.03	11.04	11.99	11.78
NTSC	35 2141	33.86	33.47	28.95	30.28	32.39	34.14	-	-	6.87	6.85	9.67	17.16
NTSC	35 2142	-12.38	-12.08	-12.86	-12.31	-12.79	-12.35	-12.17	-12.78	-12.70	-12.11	-13.30	-12.69
NTSC	35 2143	8.24	7.99	7.69	7.88	8.48	7.44	8.14	8.09	7.73	9.07	8.53	8.20
NTSC	35 2144	-4.50	-3.77	-3.44	-2.81	-2.93	-3.53	-3.23	-3.35	-2.40	-2.51	-3.46	-4.40
NTSC	35 2145	-2.49	-2.40	-2.56	-2.59	-2.28	-1.99	-1.50	-1.16	-0.54	-0.62	-1.21	-1.07
NTSC	35 2147	8.71	9.46	9.01	10.18	7.97	8.72	8.49	8.90	9.93	8.70	9.13	8.76
NTSC	35 2573	3.43	3.50	3.54	4.63	4.58	4.12	4.73	4.97	5.59	5.77	5.13	4.95
NTSC	35 2576	0.10	0.82	1.00	0.85	-	-	-	-	-	-	-	-
NTSC	35 2831	-	-	-	-	-	-	-	-	3.08	2.65	3.19	4.81
NTSC	35 2855	-	-	-	-	-	-	-	-	13.85	13.84	14.17	14.50

Table 8. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
NTSC	40 4926	477.63	482.52	487.86	-	-	516.60	523.26	529.07	534.52	540.34	544.64	549.89
NTSC	40 4927	481.73	484.98	489.22	497.40	502.44	506.93	511.30	513.54	516.75	519.48	522.34	524.57
ONBA	36 2228	-	-	-	-4.43	-2.63	-3.82	-3.26	-	-	-2.27	-2.64	-2.42
ONRJ	35 102	-2.56	-3.89	-2.39	-3.93	-3.89	-3.87	-3.04	-3.75	-3.30	-4.16	-2.96	-3.43
ONRJ	35 103	-0.88	-1.43	-0.07	0.33	0.27	1.87	2.05	1.70	1.76	0.90	2.85	3.57
ONRJ	35 111	-6.56	-7.44	-5.53	-7.20	-6.85	-	-	-	-	-	-	-
ONRJ	35 123	30.40	31.85	31.42	30.68	32.02	31.56	32.90	32.17	32.78	32.22	32.12	34.02
ONRJ	35 129	5.76	3.05	5.47	6.61	5.78	5.71	6.35	5.92	6.57	7.30	7.38	7.20
ONRJ	35 147	3.36	2.33	3.86	3.98	4.12	3.93	4.55	4.28	5.00	4.84	4.37	4.84
ONRJ	35 1153	0.64	-0.86	1.25	1.40	1.35	1.44	2.49	1.84	2.52	2.63	2.53	2.44
ONRJ	35 1942	10.32	8.91	10.88	9.79	11.01	10.82	11.30	11.73	11.15	10.47	11.02	10.28
ONRJ	40 1950	-0.41	2.29	4.77	3.43	-6.17	-2.85	31.10	29.66	21.61	31.80	-	34.08
ONRJ	40 1958	-	-	-	-	-	-	35.10	32.40	32.41	33.41	34.63	33.58
ORB	35 2722	-0.27	0.07	0.41	0.32	0.17	0.05	-0.07	0.64	1.09	0.39	0.24	0.80
ORB	35 2723	5.10	4.83	4.85	5.20	4.21	4.86	4.58	5.78	5.71	6.00	6.58	6.68
ORB	35 2724	-0.40	-0.79	-0.47	-1.02	-	-	-	2.64	3.14	3.85	3.57	-
ORB	36 202	-	-	-	-	-	-	1.72	3.29	3.24	2.53	2.71	1.63
ORB	36 593	83.52	84.29	82.86	81.85	83.13	81.42	84.45	83.47	81.01	83.33	82.98	82.44
ORB	40 2602	-	1.70	1.72	1.59	2.06	2.95	-	5.07	5.87	6.49	7.21	7.98
PL	25 124	5.58	16.53	13.65	10.01	7.66	13.81	26.78	34.51	26.16	16.13	-4.94	-
PL	25 125	10.36	15.42	14.27	11.68	10.28	13.20	19.02	21.99	18.63	12.97	0.83	4.63
PL	35 441	-0.50*	-0.95	0.11	-0.29	-0.07	0.63	0.87	1.08	1.08	1.53	1.47	1.26
PL	35 502	5.07	5.73	6.44	6.36	4.49	3.81	3.85	5.30	5.60	7.50	7.71	6.81
PL	35 745	1.86	1.64	0.70	0.39	1.34	1.51	1.48	-0.13	1.29	-1.09	-2.49	-4.98
PL	35 761	0.01	0.80	0.62	0.95	-0.03	2.50	0.85	0.04	2.49	0.42	2.63	4.33
PL	35 1120	-1.53	-0.65	-0.34	-1.79	-2.37	-2.62	-1.96	-1.61	-2.49	-1.99	-2.26	-1.40
PL	35 1746	-	-	-	-	-	-	-	-	-	-	-3.09	-8.25
PL	35 1934	1.42	1.01	1.83	2.27	2.18	2.30	2.06	1.47	1.91	1.94	-	-
PL	35 2175	-	-	-	-	-7.71	-8.67	-6.90	-7.61	-6.43	-6.92	-7.25	-7.11
PL	35 2394	3.49	4.18	4.25	5.30	4.68	4.49	4.75	4.77	3.44	5.52	4.84	4.46
PL	40 4002	-62.74	-60.78	-64.83	-67.22	-72.72	-78.51	-69.98	-76.07	-76.85	-80.12	-78.52	-77.14
PL	40 4004	-	-	-	-	-	2.85	1.46	-2.96	-2.81	-2.20	-	-
PL	40 4601	29.82	30.76	-	-	-	2.32	3.16	4.19	3.92	7.02	6.75	7.55
PL	40 4602	380.31	386.19	393.80	407.96	419.64	429.80	440.11	451.36	461.57	473.68	482.42	492.13
PTB	35 128	2.77	3.72	2.78	3.31	3.48	4.07	4.05	3.62	5.31	4.45	4.50	5.09

Table 8. (Cont.)

Lab.	Clock		55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
PTB	35	415	1.62	1.65	2.46	2.18	2.36	2.11	2.46	2.09	1.67	3.05	3.08	2.86
PTB	35	1072	10.80	11.79	10.56	11.75	11.80	11.61	11.10	11.42	12.64	12.50	12.64	12.20
PTB	40	506	-41.65*	-43.07*	-44.64*	-28.38*	-20.73*	-18.89*	-17.01*	-15.00*	-13.27*	-11.27*	-7.96	-5.12
PTB	40	508	-21.27*	-16.51*	-38.42*	-34.27*	-29.62*	-25.31*	-20.99*	-15.97*	-11.58*	-8.00	-3.92	-0.03
PTB	40	590	-16.19*	-15.63*	-15.21*	-14.57*	-14.31*	-13.79*	-12.88*	-12.03*	-11.51*	-10.99	-10.32	-9.31
PTB	92	1	2.33	2.12	2.04	1.92	2.16	2.38	2.73	2.39	2.39	1.65	1.73	2.38
PTB	92	2	1.48	1.53	1.48	1.32	1.77	1.81	1.55	1.39	1.69	1.19	2.21	2.18
ROA	35	583	7.36	7.47	7.38	6.81	6.41	7.11	6.33	6.72	6.65	6.54	6.46	6.28
ROA	35	718	7.32	6.93	7.34	7.63	7.44	8.08	7.74	8.03	8.18	7.37	8.18	8.13
ROA	35	1699	8.92	8.62	9.74	8.70	9.27	8.48	8.51	8.35	8.60	8.31	8.52	8.87
ROA	35	2270	-5.46	-4.40	-5.03	-5.68	-5.15	-7.15	-5.36	-5.27	-5.33	-5.08	-4.87	-6.41
ROA	36	1488	11.24	10.84	9.12	9.96	11.34	10.57	9.30	11.73	6.71	11.25	10.76	9.03
ROA	36	1490	9.95	9.10	11.07	8.65	10.46	10.42	10.91	10.58	9.72	9.33	8.36	10.83
ROA	40	1436	132.75	135.95	138.76	142.42	145.53	148.29	151.45	154.83	157.87	161.36	164.49	166.99
SCL	35	2178	4.88	4.48	3.23	4.62	4.12	5.05	-	-	4.89	4.15	5.37	4.94
SCL	35	2525	2.69	2.75	1.88	2.39	2.52	2.38	-	-	1.91	1.30	0.92	0.63
SG	35	475	-3.44	-2.99	-3.91	-3.59	-	-	-	-	-2.93	-2.26	-2.11	-2.61
SG	35	476	8.66	7.86	8.56	8.05	-	-	-	-	9.73	10.47	10.56	10.91
SG	35	1889	18.84	18.92	18.54	19.58	-	-	-	-	17.87	18.35	18.28	18.32
SG	36	522	1.58	0.83	1.52	3.55	-	-	-	-	3.06	2.44	1.21	3.00
SG	40	7701	222.92	237.40	251.68	266.44	-	-	-	-	-	-	-	-
SIQ	36	1268	-1.72	-1.11	1.65	0.30	-0.43	0.37	0.99	0.13	-0.26	-1.39	-1.64	-2.75
SMD	25	2543	-	-	-	-	-	-	-	-	9.50	-	-	-
SMD	35	810	-11.04	-13.14	-11.85	-11.15	-12.36	-	-	-	-9.86	-	-	-
SMD	35	1766	-	-	-	-	9.82	-	-	-	9.36	-	-	-
SMD	35	2003	11.27	10.99	10.72	10.81	10.11	-	-	-	10.38	-	-	-
SMD	35	2543	8.40	8.83	8.45	8.95	9.50	-	-	-	-	-	-	-
SMU	36	1193	1.44	0.74	3.04	0.68	0.59	-0.68	-0.12	0.08	-1.05	0.41	-0.15	0.89
SP	35	572	18.71	19.15	19.14	19.59	19.17	19.33	19.02	19.26	19.93	19.22	19.04	19.32
SP	35	641	6.44	6.09	5.31	4.47	4.10	3.33	4.36	4.81	4.40	4.32	4.43	5.00
SP	35	1188	20.39	19.87	19.18	18.69	17.25	15.73	14.31	14.39	13.75	13.64	13.78	13.50
SP	35	1642	-0.22	-0.48	-0.89	-0.30	-0.31	-0.63	-0.15	-0.63	-0.12	-0.78	-0.46	-0.41
SP	35	2166	4.53	5.33	5.10	5.14	5.02	4.20	5.14	4.68	-	-	-	-
SP	36	223	8.83	9.17	9.81	9.71	9.55	9.49	10.61	11.57	9.64	10.87	8.95	10.52
SP	36	1175	2.87	1.73	2.06	2.26	2.31	3.92	1.31	1.07	2.31	2.39	2.20	4.17

Table 8. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
SP	36 1187	-	-	-	-61.05	-61.99	-61.02	-61.64	-61.06	-58.98	-57.70	-57.55	-56.73
SP	36 1531	-	-	-	74.48	74.87	73.15	73.32	73.45	73.02	73.87	74.48	74.46
SP	36 2068	1.92	2.95	5.02	2.98	3.27	3.70	5.81	5.04	3.51	6.09	5.72	5.08
SP	36 2218	24.65	22.75	23.37	23.44	23.23	23.62	23.98	23.41	25.12	23.98	23.35	24.82
SP	36 2295	9.62	7.65	8.24	10.24	7.47	9.19	8.10	8.52	8.39	10.00	10.67	9.81
SP	36 2297	-6.40	-6.40	-7.50	-6.87	-6.04	-7.30	-6.71	-6.89	-5.79	-6.62	-6.28	-6.46
SP	40 7201	145.78	147.70	149.75	152.63	155.18	157.66	160.34	163.22	165.77	168.31	171.02	173.87
SP	40 7203	20.25	21.31	22.17	23.13	23.98	24.87	25.91	26.99	27.91	28.87	29.76	30.80
SP	40 7210	150.55	154.30	156.78	159.30	162.43	165.06	169.03	172.52	174.52	177.50	179.99	183.24
SP	40 7211	39.34	41.04	42.45	43.98	45.53	47.03	48.54	50.19	51.66	53.10	54.41	56.07
SP	40 7212	16.78	17.51	17.91	18.45	19.02	19.50	20.09	20.82	21.36	21.87	22.27	22.95
SP	40 7218	-47.79	-48.67	-49.92	-51.96	-52.32	-61.00	-71.11	-	-42.44	-43.06	-43.66	-43.74
SP	40 7221	-42.91	-42.68	-42.62	-42.36	-42.21	-42.02	-41.80	-41.58	-41.08	-40.91	-40.81	-40.52
SU	40 3809	11.34	11.72	11.98	12.44	12.73	-	-	-	-	-	-	-
SU	40 3810	-1.69*	-1.50*	-1.38*	-1.35	-1.36	-1.17	-0.96	-0.60	-0.49	-0.24	0.00	0.11
SU	40 3811	50.07*	51.50*	52.71*	53.93*	54.96*	56.15*	57.00*	58.38	59.46	60.62	61.70	62.76
SU	40 3812	-	-	-	8481.31*	8481.55*	8481.99*	-	3.51	3.74	4.07	4.40	4.64
SU	40 3814	16.77	17.37	18.21	20.09	20.75	21.31	22.18	23.28	24.05	24.91	25.81	26.63
SU	40 3815	-50.87*	-50.28*	-49.67*	-48.98*	-48.31*	-47.49*	-46.73*	-45.84*	-45.31*	-44.74*	-44.12*	-43.57
SU	40 3816	34.33	34.74	35.18	35.86	36.46	37.33	38.01	38.86	39.41	40.05	40.75	41.38
TCC	35 768	3.43	6.41	7.38	5.25	6.23	3.82	5.75	5.79	6.76	5.62	5.49	9.07
TCC	35 1881	3.28	3.51	3.51	3.63	2.40	3.80	4.06	3.04	3.44	3.06	2.78	2.97
TCC	40 8620	5.16	8.34	8.78	9.62	10.08	8.00	9.31	9.82	9.98	10.51	10.64	11.02
TCC	40 8624	-	-8.47	-8.53	-8.67	-8.87	-8.56	-8.20	-8.33	-8.67	-8.77	-9.01	-9.29
TCC	40 8650	-9.56	-9.79	-11.05	-11.77	-12.86	-13.64	-12.52	-13.46	-14.40	-14.93	-15.78	-16.32
TL	35 1012	3.16	3.33	3.47	4.04	3.72	4.16	4.28	3.43	2.90	2.88	2.80	3.53
TL	35 1104	17.50	17.10	15.96	15.01	16.67	-	-	-	-	-	-	-
TL	35 1132	-2.19	-2.37	-1.65	-2.26	-2.33	-3.08	-3.01	-0.75	-1.12	-0.29	-0.83	-0.90
TL	35 1498	1.28	1.22	1.41	1.37	2.07	2.30	1.77	1.96	1.93	2.18	1.93	1.23
TL	35 1500	15.60	15.44	15.52	16.30	15.64	15.53	16.06	18.58	15.71	16.75	15.66	15.39
TL	35 1712	-11.96	-10.48	-10.87	-10.36	-9.10	-9.79	-9.00	-9.05	-	-	-	-
TL	35 2365	4.65	5.57	5.15	5.09	4.82	4.85	4.41	4.79	4.75	4.34	5.06	4.47
TL	35 2366	-8.05	-7.47	-8.14	-7.69	-7.32	-7.27	-6.68	-5.86	-6.14	-6.89	-6.57	-5.90
TL	35 2367	8.96	9.07	8.91	8.87	9.78	8.75	9.78	9.99	9.98	10.43	9.05	10.12
TL	35 2368	0.53	0.42	1.07	1.21	0.45	0.64	-0.31	-0.13	0.34	-0.16	0.47	-0.36

Table 8. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
TL	35 2630	-15.23	-15.81	-15.41	-14.55	-14.69	-14.22	-14.22	-14.48	-13.75	-13.96	-13.94	-13.56
TL	35 2634	7.25	5.41	7.18	5.65	9.95	8.02	6.71	7.67	9.24	9.56	8.71	10.71
TL	35 2636	13.11	12.82	13.09	13.58	12.93	13.24	12.71	13.13	12.15	12.44	12.08	12.34
TL	35 2853	-	-	-	-	-4.46	-4.61	-4.67	-4.10	-3.67	-3.03	-3.03	-3.34
TL	40 57	-4.23	-6.09	-8.18	-10.31	-11.44	-13.16	-15.39	-17.56	-19.76	-21.70	-23.70	-25.77
TL	40 3052	65.80	65.42	64.85	65.36	64.94	64.80	64.54	64.48	64.98	65.28	65.27	65.26
TL	40 3053	5.97	-	-	-	-	-	-	-	-	-	-	-
TP	35 163	-	-	-	2.62	2.87	3.01	3.30	2.64	4.21	3.51	3.28	2.21
TP	35 1227	14.05	13.94	14.25	13.95	14.73	14.83	14.90	14.17	14.08	14.16	14.67	13.72
TP	35 2476	6.64	6.50	6.57	6.73	6.73	6.66	7.00	6.38	6.66	6.74	6.86	6.07
TP	36 154	8.91	10.29	10.58	9.80	10.43	8.86	9.45	9.96	10.07	9.59	8.86	10.81
UA	35 2465	-5.26	-5.56	-5.64	-6.03	-5.47	-4.74	-3.17	-3.44	-2.81	-5.47	-3.23	-3.67
UA	40 7854	-0.15	-0.13	-1.57	-0.10	0.51	0.75	-0.58	0.14	3.09	0.16	-0.46	-1.87
UA	40 7881	-2.83	-1.27	-0.34	0.63	1.49	2.47	-0.32	-0.70	0.83	-0.97	-0.21	-0.75
UA	40 7882	2.48	1.28	1.17	1.64	0.92	0.65	1.09	1.40	1.60	0.46	-0.38	-0.04
UME	35 251	0.15	0.30	0.50	0.71	0.83	0.67	0.81	1.19	1.18	1.19	1.71	2.22
UME	35 252	0.12	0.13	0.41	0.04	0.73	1.46	1.92	3.28	1.61	1.55	1.64	0.92
UME	35 710	0.97	0.71	1.24	1.68	1.05	1.46	1.88	2.31	2.36	2.17	2.04	3.04
UME	35 2703	0.93	0.80	1.12	1.59	1.83	2.16	2.46	2.42	2.75	2.51	2.40	2.48
USNO	35 101	8.52	8.62	6.70	5.96	6.53	7.49	7.40	9.05	9.82	9.64	10.35	7.79
USNO	35 104	22.47	22.33	21.99	20.62	18.68	18.40	19.27	18.28	18.19	19.23	19.62	18.47
USNO	35 106	-	-	-	-	-	-	-	-	-	-	-2.36	-1.51
USNO	35 108	2.07	1.20	1.97	2.65	1.85	0.66	2.14	2.17	2.50	2.53	1.81	2.48
USNO	35 114	1.43	-0.05	1.71	1.24	0.00	-0.28	0.71	0.10	1.21	2.02	-0.97	-
USNO	35 120	24.17	24.83	25.46	24.73	24.85	24.87	25.27	24.44	25.04	25.22	25.11	24.92
USNO	35 142	-9.07	-8.72	-9.61	-9.94	-11.02	-10.01	-9.96	-10.34	-9.82	-10.38	-9.61	-9.87
USNO	35 145	20.15	-	-	-	-	-	-	-	-	-	22.24	22.24
USNO	35 146	-1.01	-1.50	-1.00	-0.64	-0.20	-0.26	0.05	-0.59	-0.06	-0.49	0.16	-
USNO	35 148	9.40	10.10	10.65	11.08	11.25	11.45	11.76	11.80	11.54	12.00	12.58	12.99
USNO	35 150	-2.59	-2.66	-2.50	-3.36	-3.53	-3.89	-2.88	-4.05	-2.73	-2.83	-2.06	-2.57
USNO	35 152	4.77	2.82	2.61	2.90	2.80	2.92	3.86	4.18	4.21	3.59	3.03	2.40
USNO	35 153	-	-	-	-	-	-	-	-	-	-	2.85	2.82
USNO	35 156	10.49	10.31	10.20	10.35	10.45	10.45	9.97	10.24	10.20	10.73	10.78	10.67
USNO	35 161	6.42	6.56	6.90	6.85	6.77	7.41	8.67	7.29	5.87	7.57	8.15	9.04
USNO	35 165	9.01	9.22	7.57	8.43	9.97	9.84	10.22	10.02	10.16	10.39	11.13	9.59

Table 8. (Cont.)

Lab.	Clock		55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
USNO	35	166	51.75	51.98	52.80	51.41	52.57	54.20	54.52	54.24	54.43	55.97	54.93	53.96
USNO	35	169	-18.52	-18.61	-17.74	-17.48	-17.98	-16.91	-17.63	-16.99	-17.28	-16.99	-16.46	-16.45
USNO	35	173	-5.06	-5.72	-5.99	-5.51	-6.12	-5.85	-5.65	-5.63	-6.06	-5.60	-5.46	-5.57
USNO	35	213	10.33	11.60	10.80	10.97	12.02	11.10	11.14	11.56	11.17	10.09	11.54	12.59
USNO	35	217	-1.05	-1.37	-0.95	-0.91	-0.95	-1.44	-0.56	-0.57	-0.58	-0.20	-	-
USNO	35	226	10.50	10.62	11.23	10.91	9.51	8.26	8.25	8.21	9.28	9.62	8.73	8.22
USNO	35	227	26.42	27.22	27.22	26.72	27.12	28.28	28.24	28.74	29.80	28.34	28.98	30.03
USNO	35	231	-1.94	-2.75	-2.36	-2.54	-2.68	-2.21	-2.98	-2.59	-2.65	-1.93	-2.16	-2.54
USNO	35	233	16.44	16.19	16.26	16.01	16.26	15.64	14.93	13.29	13.25	13.22	13.42	12.69
USNO	35	242	13.76	13.12	13.21	13.55	14.91	14.13	14.10	14.91	14.09	15.02	13.74	14.46
USNO	35	244	8.39	9.43	9.60	9.15	10.57	8.91	7.37	8.01	8.40	8.34	7.78	7.37
USNO	35	253	-22.58	-23.35	-22.19	-23.60	-22.80	-23.06	-22.87	-23.43	-23.30	-22.53	-23.58	-22.87
USNO	35	254	8.64	9.20	8.62	8.91	8.68	8.83	8.92	9.14	8.76	9.22	8.34	8.61
USNO	35	255	25.23	25.15	25.35	25.00	25.32	25.52	25.78	25.96	26.03	25.63	25.40	25.91
USNO	35	256	19.68	19.29	20.05	20.21	20.43	21.00	20.56	20.40	21.61	21.13	21.09	21.16
USNO	35	260	-	-	-	-	-	-	-	-	-	-	-	11.80
USNO	35	266	24.23	23.78	24.15	24.48	24.66	24.94	23.66	24.54	24.30	24.16	23.54	24.00
USNO	35	268	-0.79	-0.54	-1.03	-1.01	-0.49	-0.27	-0.23	-0.20	-0.57	-0.76	-0.20	-0.50
USNO	35	270	15.61	15.81	16.57	16.64	16.79	16.87	16.86	17.35	17.04	18.01	17.92	16.97
USNO	35	279	24.46	24.88	25.18	24.30	25.28	26.23	26.32	26.66	26.80	25.60	25.42	25.09
USNO	35	389	-25.60	-25.23	-24.58	-24.17	-24.47	-23.11	-23.63	-23.61	-22.42	-22.28	-21.79	-21.86
USNO	35	392	11.79	16.43	13.21	14.51	15.61	16.09	16.54	16.47	16.63	-	-	-
USNO	35	394	-	-	-	-	-	-33.19	-35.14	-35.91	-34.81	-35.10	-35.43	-36.78
USNO	35	416	-5.51	-5.30	-4.60	-4.52	-4.90	-3.63	-4.01	-2.31	-2.84	-3.02	-3.30	-2.97
USNO	35	417	-7.79	-7.80	-8.75	-7.69	-6.18	-5.65	-4.67	-5.85	-5.90	-5.28	-5.21	-5.66
USNO	35	703	-4.37	-4.51	-2.99	-3.31	-3.00	-2.16	-1.37	-1.15	-1.21	-0.92	-0.31	-0.31
USNO	35	717	-	-	-14.11	-14.90	-15.43	-15.13	-14.70	-14.24	-14.52	-14.04	-13.22	-12.89
USNO	35	762	0.73	0.58	-0.12	1.00	0.09	0.78	0.79	1.18	1.11	1.15	1.24	1.32
USNO	35	763	-14.12	-13.31	-13.23	-13.20	-14.25	-13.49	-13.05	-13.19	-13.22	-13.06	-12.63	-13.15
USNO	35	765	-42.46	-41.60	-41.19	-42.36	-43.05	-42.77	-42.18	-41.57	-41.17	-41.30	-41.10	-40.90

Table 8. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
USNO	35 1096	15.66	15.62	15.16	15.82	16.24	15.63	16.06	16.27	16.11	16.18	16.23	16.51
USNO	35 1097	8.91	8.82	9.09	7.81	5.55	5.56	6.43	6.41	6.34	6.94	6.24	7.29
USNO	35 1125	-15.21	-14.19	-14.32	-15.35	-14.83	-9.47	-0.70	-1.12	0.45	0.77	0.58	0.45
USNO	35 1327	-5.91	-6.48	-5.00	-4.96	-6.01	-5.87	-6.47	-6.06	-6.34	-5.53	-5.37	-5.48
USNO	35 1328	1.09	1.88	2.66	3.20	4.10	3.63	3.30	3.28	3.33	3.82	3.81	4.67
USNO	35 1331	-39.38	-38.71	-40.39	-39.17	-38.90	-38.50	-39.98	-39.62	-39.68	-39.78	-40.22	-39.79
USNO	35 1438	-1.66	-	-	-	-	-	-	-	-	-	-3.91	-5.11
USNO	35 1459	-1.80	-1.00	-0.06	0.74	3.60	-0.47	-3.28	0.52	-1.77	-2.89	-3.70	-3.81
USNO	35 1462	-2.47	-2.37	-2.99	-2.24	-2.47	-1.62	-2.71	-1.31	-2.93	-1.90	-1.54	-2.08
USNO	35 1463	13.89	14.48	14.18	14.19	11.57	11.32	11.54	11.82	12.25	12.19	11.61	12.27
USNO	35 1468	11.04	10.22	10.91	11.29	-	-	-	-	-	-	8.22	-
USNO	35 1481	-20.95	-21.64	-21.41	-21.14	-21.27	-21.92	-21.21	-21.22	-21.77	-21.58	-21.76	-21.26
USNO	35 1543	3.19	3.74	4.57	3.72	4.47	5.01	5.06	5.36	5.31	5.05	4.72	4.80
USNO	35 1573	15.63	16.27	16.60	15.71	15.75	16.11	14.95	14.80	16.25	15.41	15.33	15.21
USNO	35 1575	-5.05	-5.64	-5.02	-4.62	-5.04	-4.37	-4.92	-4.81	-4.18	-4.59	-4.35	-4.63
USNO	35 1580	-20.05	-19.04	-20.70	-19.64	-18.69	-19.21	-18.78	-18.92	-18.58	-19.49	-18.28	-19.03
USNO	35 1585	21.71	21.69	21.58	22.93	23.27	23.44	23.16	24.21	24.09	25.12	25.28	25.32
USNO	35 1598	1.19	0.65	-0.25	-2.61	-9.86	-11.09	-10.50	-10.68	-10.30	-9.94	-10.31	-10.21
USNO	35 1658	19.92	19.82	18.59	18.82	19.65	19.13	19.56	19.35	20.33	20.52	20.77	21.06
USNO	35 1692	-1.32	-2.02	-2.75	-1.60	-1.91	-2.44	-1.98	-2.30	-1.94	-2.98	-3.00	-2.61
USNO	35 1694	20.43	21.30	21.09	20.77	21.23	20.61	21.57	21.30	21.73	21.31	21.62	21.58
USNO	35 1696	11.97	11.60	11.82	12.13	12.27	11.84	11.41	11.45	11.13	10.97	10.60	9.67
USNO	35 1697	22.93	23.20	23.31	23.11	23.46	23.87	23.72	24.17	24.45	24.07	24.20	24.40
USNO	40 702	-10.49	-10.47	-10.39	-10.17	-10.12	-10.08	-9.92	-9.54	-9.52	-9.49	-9.54	-9.31
USNO	40 704	32.92	33.10	33.16	33.33	33.41	33.38	33.42	33.64	33.87	34.12	33.58	33.67
USNO	40 705	-75.62	-75.96	-75.83	-75.57	-75.57	-75.47	-75.25	-74.89	-74.64	-74.38	-74.10	-74.13
USNO	40 710	-541.82	-543.63	-544.43	-544.43	-544.33	-544.08	-536.59	-526.79	-517.18	-508.00	-498.99	-489.96
USNO	40 711	337.07	340.14	343.04	346.06	350.69	354.66	358.04	360.98	365.29	369.69	374.29	377.79
USNO	40 712	50.03	50.08	50.10	50.19	50.39	50.35	50.26	50.40	50.49	50.47	50.58	50.57
USNO	40 713	26.28	26.79	27.16	27.68	28.09	28.60	29.13	29.79	30.30	30.82	31.32	31.78

Table 8. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
USNO	40 714	-8.71	-8.42	-8.20	-7.90	-7.77	-7.36	-7.08	-6.75	-6.17	-6.00	-5.77	-5.52
USNO	40 715	99.15	99.71	100.12	100.70	101.18	101.68	102.27	104.33	105.48	105.99	106.35	106.82
USNO	40 716	213.72	213.88	213.98	214.14	214.25	214.46	214.64	214.93	215.06	215.22	215.34	215.42
USNO	40 718	176.71	178.12	179.38	180.81	182.16	183.60	185.21	186.91	188.42	190.00	191.49	192.97
USNO	40 719	74.18	75.33	76.29	77.52	78.61	79.68	80.94	82.14	83.24	84.41	85.36	86.41
USNO	40 720	148.71	151.07	153.46	155.83	158.24	160.51	162.96	165.30	167.67	170.09	-	-
USNO	40 721	126.85	133.64	138.69	146.54	153.08	157.72	164.45	172.35	178.68	184.26	190.13	201.28
USNO	40 722	429.62	432.66	435.73	438.90	442.08	445.10	448.51	451.67	454.67	457.86	460.82	463.82
USNO	40 723	-72.61	-72.52	-72.55	-72.39	-72.29	-72.10	-71.86	-70.40	-69.70	-69.50	-69.37	-69.24
USNO	40 724	-106.83	-106.95	-107.20	-107.42	-107.61	-107.89	-108.10	-107.54	-102.38	-102.03	-102.33	-102.40
USNO	40 725	-42.34	-42.14	-41.86	-41.82	-41.73	-41.51	-41.22	-40.82	-40.72	-40.71	-39.90	-40.11
USNO	40 728	275.39	278.69	281.78	285.18	288.46	291.62	295.24	298.94	302.16	305.45	307.79	312.07
USNO	40 730	159.40	162.80	166.21	169.80	173.25	176.76	180.62	184.52	187.98	191.40	194.80	198.15
USNO	40 731	-164.95	-165.53	-165.98	-166.54	-166.89	-167.28	-167.87	-168.17	-168.59	-168.99	-169.51	-169.71
USNO	40 732	-82.71	-80.62	-78.53	-76.23	-73.79	-71.19	-68.77	-65.49	-62.89	-60.22	-57.58	-55.00
USNO	40 734	-	-	-	-	-	411.15	420.49	427.38	431.47	434.39	435.49	435.99
USNO	40 735	64.02	65.16	66.46	68.45	70.31	72.36	74.84	77.57	80.16	82.76	85.22	87.77
USNO	93 2	-6.34	-6.26	-6.30	-6.19	-6.16	-6.14	-6.06	-5.93	-5.89	-5.85	-5.87	-5.85
USNO	93 3	-6.09	-6.11	-6.15	-6.13	-6.10	-6.11	-6.02	-5.94	-5.89	-5.83	-5.86	-5.84
USNO	93 4	-6.11	-6.10	-6.14	-6.08	-6.03	-6.00	-5.97	-5.85	-5.81	-5.73	-5.76	-5.77
USNO	93 5	-6.13	-6.12	-6.17	-6.09	-6.11	-6.03	-6.01	-5.89	-5.84	-5.78	-5.80	-5.79
VMI	35 2230	-24.01	-24.03	-24.00	-24.17	-24.59	-25.69	-	-24.39	-25.21	-22.96	-21.93	-
VMI	36 1233	-1.40	-2.78	-3.08	-4.25	-4.97	-5.11	-	-3.60	-6.24	-3.17	-4.01	-
VMI	36 2314	23.00	23.12	20.56	22.40	22.27	21.55	-	21.39	21.67	23.61	23.29	-
VSL	35 179	-27.25	-27.27	-27.22	-28.03	-27.25	-26.92	-27.40	-27.15	-27.48	-26.67	-26.70	-27.52
VSL	35 456	-5.43	-4.95	-4.68	-4.14	-4.03	-3.69	-3.36	-3.20	-3.06	-2.98	-4.16	-2.48
VSL	35 548	22.94	22.54	22.75	22.96	22.60	22.32	22.12	21.67	22.03	22.12	21.88	21.47
VSL	35 731	-	-	-7.57	-8.16	-8.00	-7.64	-7.53	-7.16	-7.21	-7.92	-7.56	-7.54
ZA	35 2232	-5.83	-5.41	-	-	-	-	-	-	-	-	-	-
ZA	35 2233	-14.66	-14.88	-15.41	-15.21	-15.48	-15.36	-14.69	-14.59	-15.00	-14.58	-15.33	-
ZA	36 1034	-	-	-20.76	-23.11	-23.44	-23.62	-23.95	-22.76	-23.37	-18.24	-16.19	-
ZA	36 1821	-8.97	-7.41	-7.88	-7.63	-8.78	-7.55	-9.13	-6.91	-7.69	-6.80	-6.59	-
ZA	36 2232	-	-	-	-	-	-	-	-	-	-	10.82	-

Table 9A. Relative weights (in percent) of contributing clocks in 2012

(File is available at ftp://62.161.69.5/pub/tai/scale/WTAI/wtai12.ar)

Clock weights are computed for one-month intervals ending at the MJD dates given in the table.
"-" denotes that the clock was not used

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
15 DATUM/SYMMETRICOM Cs III
18 DATUM/SYMMETRICOM Cs 4000
19 RHODES AND SCHWARZ XSC
4x HYDROGEN MASERS
9x PRIMARY CLOCKS AND PROTOTYPES
21 OSCILLOQUARTZ 3210
22 OSCILLOQUARTZ OSA 3230B
23 OSCILLOQUARTZ EUDICS 3020
24 OSCILLOQUARTZ OSA 3235B
25 HEWLETT_PACKARD 5062C
30 HEWLETT-PACKARD 5061B
31 HEWLETT-PACKARD 5061B OPT. 4
34 H-P 5061A/B with 5071A tube
35 H-P/AGILENT/SYMMETRICOM 5071A High perf.
36 H-P/AGILENT/SYMMETRICOM 5071A Low perf.
50 FREQ. AND TIME SYSTEMS INC. 4065A
51 DATUM/SYMMETRICOM 4065 B
52 DATUM/SYMMETRICOM 4065 C
53 DATUM/SYMMETRICOM 4310 B

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
APL	35 904	-	-	-	0.000	0.000	-	-	-	-	-	-	0.000
APL	35 1264	-	-	-	0.000	0.000	-	-	-	-	-	-	0.000
APL	40 3107	-	-	-	0.000	0.000	-	-	0.000	0.000	-	-	0.000
APL	40 3108	-	-	-	0.000	0.000	-	-	0.000	0.000	-	-	-
APL	40 3109	-	-	-	0.000	0.000	-	-	0.000	0.000	-	-	0.000
AUS	35 2269	0.253	0.232	0.222	0.235	0.231	0.379	0.595	0.589	0.483	0.495	0.414	0.303
AUS	36 299	0.159	0.154	0.151	0.205	0.208	-	0.000	0.000	0.000	0.000	0.035	0.049
AUS	36 340	0.234	0.164	0.122	0.121	0.145	0.146	0.147	0.149	0.196	0.242	0.161	0.160
AUS	36 654	0.157	0.189	0.132	0.095	0.087	0.087	0.076	0.080	0.077	0.114	0.121	0.210
AUS	36 1141	0.038	0.039	0.035	0.033	0.032	0.033	0.033	0.033	0.024	0.023	0.022	0.021

Table 9A. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
AUS	40 5401	-	-	-	-	-	-	0.000	0.000	-	-	-	-
AUS	40 5402	-	0.000	0.000	0.000	0.000	-	-	0.000	-	0.000	-	-
BEV	35 1065	0.448	0.574	0.520	0.000	0.058	0.051	0.049	0.048	0.041	0.040	0.045	0.054
BEV	35 1793	0.313	0.367	0.520	0.615	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
BEV	40 3452	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BIM	18 8058	0.000	0.000	0.184	0.071	0.085	0.114	0.141	0.160	0.187	0.231	0.234	0.244
BY	40 4222	0.000	0.000	0.004	0.003	0.003	0.004	0.005	0.006	0.006	0.006	0.005	0.005
BY	40 4260	-	-	0.000	0.000	0.000	0.000	0.007	0.006	0.005	0.005	0.004	0.004
BY	40 4278	0.000	0.000	0.028	0.042	0.049	0.061	0.080	0.097	0.099	0.087	0.000	0.035
CAO	35 939	0.128	0.172	0.183	-	-	-	-	-	-	-	-	-
CAO	35 1270	0.591	0.606	0.687	-	-	-	-	-	-	-	-	-
CH	22 112	-	-	-	-	-	-	-	-	-	0.000	0.000	0.000
CH	35 771	0.261	0.000	-	-	-	-	-	-	-	-	-	-
CH	35 2117	0.706	0.704	0.687	0.685	0.670	0.606	0.563	0.546	0.492	0.486	0.500	0.489
CH	35 2743	0.000	0.704	0.687	0.685	0.670	0.670	0.635	0.478	0.558	0.595	0.000	0.296
CH	36 354	0.090	0.102	0.100	0.089	0.089	0.082	0.087	0.208	0.229	0.229	0.181	0.262
CH	40 5701	0.055	0.059	0.064	0.069	0.071	0.074	0.078	-	0.000	0.000	0.000	0.000
CNM	35 1815	0.119	0.247	0.250	-	-	-	-	-	-	-	-	-
CNM	35 2708	0.000	0.000	0.071	-	-	0.000	0.000	0.000	0.000	-	-	0.000
CNM	35 2709	0.000	0.000	0.061	-	0.000	0.000	0.000	0.000	0.339	-	-	0.000
CNM	40 7301	0.026	0.048	0.038	-	0.000	0.000	0.000	0.000	0.687	-	-	0.000
CNMP	36 1752	0.447	-	0.000	0.000	0.000	0.000	0.372	0.529	0.687	0.687	0.000	0.315
CNMP	36 1806	0.368	-	0.000	0.000	0.000	0.000	0.216	0.293	0.245	0.335	0.396	0.510
DLR	35 1714	0.037	0.052	0.063	0.071	0.072	0.059	0.073	0.087	0.066	0.067	0.068	0.089
DMDM	35 2191	0.224	0.233	0.218	0.214	0.296	0.338	0.444	0.566	0.589	0.417	0.685	0.696
DMDM	36 2033	0.414	0.432	0.455	0.434	0.490	0.515	0.595	0.630	0.661	0.687	0.685	0.696
DTAG	35 2635	0.484	0.516	0.687	0.685	0.000	0.198	-	0.000	0.000	0.000	0.000	0.202
DTAG	35 2865	-	-	-	-	-	-	-	-	-	-	0.000	0.000
DTAG	36 2370	0.099	0.112	0.111	0.067	0.065	0.067	-	0.000	0.000	-	-	-
DTAG	36 2794	0.000	0.000	0.000	0.000	0.033	0.050	-	0.000	0.000	0.000	0.000	0.151
ESTC	22 132	-	-	-	-	-	-	-	-	-	-	-	0.000
ESTC	35 1615	-	-	-	-	-	-	-	-	-	-	-	0.000
ESTC	35 2353	-	-	-	-	-	-	-	-	-	-	-	0.000
ESTC	40 2551	-	-	-	-	-	-	-	-	-	-	-	0.000
F	35 124	0.292	0.194	0.198	0.192	0.128	0.122	0.128	0.128	0.135	0.144	0.206	0.253

Table 9A. (Cont.)

Lab.	Clock		55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
F	35	157	-	-	-	-	-	-	-	-	-	-	0.000	0.000
F	35	158	0.115	0.093	0.082	0.081	0.070	0.068	0.084	0.121	0.158	0.178	0.313	0.321
F	35	355	0.000	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.117
F	35	385	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.000	0.000	0.208
F	35	396	0.241	0.196	0.248	0.256	0.353	0.366	0.370	0.359	0.336	0.347	0.478	0.451
F	35	469	0.176	0.164	0.000	0.031	0.023	0.019	0.016	0.017	0.016	0.016	0.019	0.024
F	35	489	0.706	0.704	0.687	0.573	0.529	0.534	0.000	0.283	-	-	-	-
F	35	520	0.225	0.263	0.257	0.268	0.151	0.000	0.064	0.048	0.028	0.027	0.024	0.022
F	35	536	0.096	0.091	0.091	0.107	-	-	0.000	0.000	0.000	0.000	-	-
F	35	609	0.706	0.704	0.687	0.685	0.670	0.654	0.446	0.435	0.459	0.599	0.479	0.369
F	35	700	0.044	0.055	0.054	0.064	0.067	0.065	0.087	0.117	0.122	0.129	0.109	0.000
F	35	770	0.706	0.610	0.482	0.316	0.321	0.318	0.341	0.438	0.418	0.434	0.487	0.665
F	35	774	0.584	0.704	0.687	0.685	0.651	0.000	0.314	0.325	0.323	0.318	0.378	0.480
F	35	781	-	0.000	0.000	0.000	0.000	0.065	0.048	0.069	0.084	0.075	0.062	0.045
F	35	819	0.135	0.123	0.122	0.115	0.114	0.114	0.120	0.112	0.112	0.134	0.147	0.154
F	35	859	0.114	0.085	0.105	0.119	0.141	0.167	0.166	0.138	0.142	0.199	0.201	-
F	35	909	-	0.000	0.000	0.000	0.000	0.436	0.000	0.090	0.116	0.089	0.000	-
F	35	1177	0.464	0.271	0.294	0.355	0.346	0.418	0.429	0.451	0.524	0.000	0.391	0.396
F	35	1222	-	0.000	0.000	0.000	0.000	0.404	0.472	0.478	0.417	0.556	0.555	0.394
F	35	1321	0.181	0.189	0.232	0.207	0.240	0.270	0.282	0.268	0.246	0.237	0.355	0.540
F	35	1556	0.321	0.282	0.225	0.223	0.205	0.123	0.108	0.096	0.098	0.115	0.244	0.353
F	35	1644	0.706	0.704	0.687	0.685	0.670	0.000	0.000	0.160	0.121	0.134	0.138	0.164
F	35	2027	0.325	0.297	0.345	0.342	0.312	0.368	0.305	0.373	0.427	0.475	0.467	0.534
F	35	2388	0.020	0.020	0.018	0.021	0.025	0.032	0.037	0.046	0.057	0.105	0.137	0.160
F	35	2609	0.706	0.704	0.641	0.468	0.413	0.293	0.266	0.277	0.266	0.287	0.324	0.384
F	35	2647	0.142	0.081	0.063	0.049	0.037	0.033	0.026	0.025	0.021	0.021	0.021	0.024
F	35	2804	-	-	-	-	0.000	0.000	0.000	0.000	0.687	0.534	0.554	0.649
F	40	805	0.002	0.002	-	-	-	-	-	-	-	-	-	-
F	40	809	-	-	-	-	0.000	0.000	0.000	0.000	0.687	0.605	0.319	0.200
F	40	810	-	-	-	-	0.000	0.000	0.000	0.000	0.260	0.115	0.068	0.050
F	40	816	0.078	0.066	0.074	0.073	0.072	0.068	0.055	0.047	0.042	-	-	-
F	40	889	-	0.000	0.000	0.000	0.000	0.022	0.021	0.021	0.021	0.022	0.023	0.025
F	40	890	0.049	-	-	-	0.000	0.000	0.000	0.000	0.329	0.308	0.289	0.272
HKO	35	1893	0.000	0.000	0.000	0.000	0.474	0.225	0.257	0.351	0.379	0.412	0.313	0.000
HKO	35	2425	0.000	0.000	0.000	0.000	0.483	0.324	0.268	0.327	0.411	0.485	0.602	0.696

Table 9A. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
IFAG	36 1167	0.000	0.026	0.027	0.028	0.028	0.028	0.031	0.026	0.026	0.028	0.028	0.029
IFAG	36 1173	0.040	0.035	0.037	0.036	0.032	0.030	0.027	0.025	0.021	0.018	0.016	0.017
IFAG	36 1629	0.064	0.062	0.048	0.040	0.043	0.057	0.061	0.089	0.100	0.093	0.089	0.092
IFAG	36 1732	0.706	0.704	0.687	0.000	0.520	0.576	0.638	0.480	0.423	0.456	0.489	0.525
IFAG	36 1798	0.324	0.292	0.257	0.317	0.391	0.422	0.653	0.560	0.687	0.635	0.533	0.632
IFAG	40 4418	0.111	0.084	0.073	0.063	0.055	0.055	0.070	0.000	0.006	0.005	0.004	0.004
IFAG	40 4439	0.008	0.008	0.009	0.009	0.010	0.011	0.012	0.013	0.013	0.014	0.015	0.017
IGNA	35 1196	-	-	0.000	0.000	0.000	0.000	0.050	0.076	0.105	0.138	0.168	0.120
INPL	35 2480	-	0.000	0.000	0.000	0.000	0.230	0.128	-	0.000	0.000	0.000	0.000
INPL	35 2481	-	0.000	0.000	0.000	0.000	0.670	0.594	-	0.000	0.000	0.000	0.000
INTI	35 2377	0.012	0.008	0.010	0.011	0.013	0.016	0.019	0.022	0.018	0.015	0.011	0.012
INXE	35 2393	-	-	-	-	-	-	-	-	-	0.000	0.000	0.000
IPQ	35 1797	0.056	0.052	0.166	0.104	0.000	0.039	0.033	-	-	-	-	-
IPQ	35 2012	0.064	0.062	0.495	0.410	0.364	0.361	0.307	-	0.000	-	-	-
IPQ	35 2169	0.078	0.074	0.153	0.151	0.145	0.148	0.152	-	0.000	-	-	-
IT	35 219	0.028	0.024	0.025	0.029	0.032	0.037	0.050	0.080	0.222	0.687	0.685	0.696
IT	35 505	0.146	0.122	0.121	0.145	0.187	0.238	0.278	0.419	0.580	0.617	0.448	0.378
IT	35 1115	0.151	0.326	0.290	0.266	0.271	0.266	0.213	0.180	0.134	0.108	0.115	0.144
IT	35 1373	0.706	0.704	0.619	0.572	0.599	0.632	0.658	0.440	0.000	0.135	0.119	0.132
IT	35 2118	-	0.000	0.000	0.000	0.000	0.052	0.055	0.045	0.045	0.045	0.052	-
IT	35 2487	0.706	0.615	0.564	0.583	0.540	0.670	0.694	0.666	0.573	0.687	0.685	0.596
IT	40 1101	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IT	40 1102	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IT	40 1103	0.000	0.013	0.011	0.009	0.008	0.007	0.006	0.005	0.004	0.004	0.004	0.003
JV	21 216	0.000	0.000	0.000	0.005	0.006	0.007	0.009	0.011	0.009	0.010	0.000	0.004
JV	36 1277	0.000	0.000	0.000	0.123	0.050	0.061	0.052	0.066	0.074	0.087	0.087	0.095
JV	36 2629	0.000	0.000	0.000	0.282	0.086	0.059	0.072	0.087	0.087	0.110	0.132	0.125
KEBS	35 2518	-	0.000	0.000	0.000	-	0.000	0.000	0.000	0.000	-	-	0.000
KIM	36 618	0.126	0.115	0.123	0.112	0.113	0.104	0.106	0.000	0.067	0.072	0.074	0.089
KRIS	35 321	0.706	0.482	0.000	0.160	0.111	0.088	0.069	0.061	0.060	0.056	0.069	0.078
KRIS	35 739	0.706	0.604	0.652	0.529	0.541	0.596	0.471	0.481	0.283	0.228	0.177	0.182
KRIS	35 1135	0.084	0.073	0.065	0.068	0.069	0.074	0.085	0.082	0.066	0.058	0.050	0.038
KRIS	35 1693	0.480	0.392	0.376	0.386	0.422	0.449	0.463	0.696	0.687	0.564	0.685	0.696
KRIS	35 1783	0.227	0.368	0.353	0.337	0.380	0.385	0.337	0.403	0.418	0.393	0.381	0.297
KRIS	40 5624	0.208	0.282	0.409	0.619	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696

Table 9A. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
KRIS	40 5625	0.024	0.033	0.047	0.068	0.097	0.139	0.203	0.296	0.439	0.687	0.685	0.696
KRIS	40 5626	0.203	0.199	0.201	0.214	0.213	0.212	0.204	0.185	0.158	0.150	0.137	0.000
KZ	35 2202	0.032	0.000	0.014	0.014	0.015	0.015	0.017	0.019	0.023	0.027	-	-
KZ	35 2665	0.000	0.022	0.018	0.020	0.025	0.021	0.027	0.033	0.038	0.043	-	-
KZ	35 2667	0.000	0.033	0.042	0.051	0.066	0.044	0.054	0.039	0.042	0.041	-	-
LT	35 1362	0.065	0.068	-	-	-	-	0.000	-	0.000	0.000	0.000	0.000
LT	35 1868	0.609	0.429	-	-	-	0.000	0.000	-	0.000	0.000	0.000	0.000
MIKE	35 1171	0.312	0.446	0.602	0.343	0.350	0.369	-	0.000	-	0.000	0.000	0.000
MIKE	36 986	0.258	0.280	0.263	0.199	0.206	0.202	-	0.000	-	0.000	0.000	0.000
MIKE	40 4108	0.013	0.013	0.015	0.020	0.030	0.000	-	0.000	-	0.000	0.000	0.000
MKEH	36 849	0.084	0.088	0.091	0.093	0.103	0.108	0.000	0.080	0.068	0.076	0.077	0.097
MSL	12 933	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.004	0.004	0.003	0.002	0.002
MSL	36 274	0.000	0.000	0.000	0.000	0.007	0.011	0.012	0.015	0.019	0.000	0.004	0.004
MSL	36 1025	0.000	0.000	0.000	-	0.000	0.000	-	-	-	-	-	-
NAO	35 779	-	-	-	-	0.000	0.000	0.000	0.000	0.483	0.587	0.683	0.600
NAO	35 1206	0.000	0.000	0.220	0.261	0.257	0.346	0.248	0.253	0.275	0.269	0.000	0.044
NAO	35 1214	0.000	0.000	0.190	0.249	0.165	0.144	0.174	0.136	0.136	0.000	0.000	0.016
NAO	35 1689	0.000	0.000	0.107	0.124	0.163	0.179	0.235	0.264	0.311	0.226	0.218	0.174
NAO	40 1301	-	-	-	0.000	0.000	0.000	0.000	0.022	0.017	0.014	0.007	-
NICT	35 112	0.041	0.043	0.058	0.062	0.049	0.042	0.035	0.032	0.029	0.027	0.028	0.033
NICT	35 332	0.348	0.413	0.546	0.612	0.559	0.566	0.668	0.696	0.000	0.392	0.229	0.248
NICT	35 342	0.369	0.376	0.456	0.449	0.635	0.657	0.694	0.696	0.687	0.687	0.685	0.696
NICT	35 343	0.201	0.173	0.293	0.525	0.615	0.638	0.659	0.682	0.665	0.687	0.667	0.691
NICT	35 715	0.706	0.704	0.687	0.685	0.670	0.587	0.592	0.611	0.587	0.687	0.685	0.696
NICT	35 732	0.131	0.120	0.111	0.094	0.105	0.172	0.321	0.334	0.433	0.565	0.522	0.553
NICT	35 907	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.487
NICT	35 913	0.050	0.047	0.041	0.040	0.042	0.053	0.066	0.091	0.112	0.199	0.202	0.117
NICT	35 916	0.312	0.253	0.275	0.247	0.237	0.403	0.416	0.583	0.664	0.687	0.685	0.696
NICT	35 1225	0.623	0.435	0.391	0.297	0.291	0.326	0.287	0.320	0.340	0.516	0.585	0.596
NICT	35 1226	0.365	0.568	0.000	0.000	0.000	0.072	0.061	0.057	0.056	0.064	0.079	0.100
NICT	35 1611	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.003
NICT	35 1778	0.080	0.081	0.074	0.070	0.072	0.093	0.146	0.260	0.396	0.000	0.114	0.080
NICT	35 1789	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.667
NICT	35 1790	0.040	0.038	0.042	0.045	0.054	0.072	0.093	0.156	0.213	0.327	0.543	0.458
NICT	35 1866	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696

Table 9A. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
NICT	35 1882	0.490	0.569	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
NICT	35 1887	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.000
NICT	35 1944	0.476	0.512	0.534	0.518	0.320	0.416	0.481	0.554	0.517	0.488	0.509	0.452
NICT	35 2010	0.586	0.522	0.415	0.000	0.195	0.135	0.137	0.113	0.117	0.114	0.116	0.109
NICT	35 2011	0.005	-	-	-	0.000	0.000	0.000	0.000	0.185	0.155	0.178	0.231
NICT	35 2056	0.233	-	-	0.000	0.000	0.000	0.000	0.389	0.304	0.294	0.354	0.418
NICT	35 2113	0.067	-	-	-	-	-	-	-	-	-	-	-
NICT	35 2116	0.209	0.201	0.195	0.243	0.204	0.349	0.368	0.391	0.629	0.519	0.548	0.518
NICT	35 2570	0.000	0.704	0.687	0.471	0.515	0.515	0.367	0.284	0.276	0.218	0.199	0.212
NICT	35 2574	0.589	0.697	0.647	0.642	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
NICT	35 2627	0.481	0.587	0.535	0.499	0.512	0.653	0.569	0.695	0.679	0.687	0.685	0.696
NICT	35 2628	0.663	0.456	0.534	0.456	0.461	0.432	0.625	0.582	0.643	0.660	0.685	0.696
NICT	35 2784	-	-	-	0.000	0.000	0.000	0.000	0.087	0.068	0.071	0.061	0.077
NICT	36 1217	0.027	0.023	0.022	0.030	0.029	0.029	0.038	0.040	0.039	0.047	0.049	0.059
NICT	40 2002	0.026	0.023	0.022	0.020	0.018	-	-	-	-	-	-	-
NICT	40 2003	0.000	0.000	-	-	-	-	-	-	0.000	0.000	0.000	0.000
NICT	40 2004	-	0.000	0.000	0.000	0.000	0.064	0.093	0.133	0.148	0.123	0.080	0.051
NICT	40 2005	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	-	0.000	0.000
NICT	40 2006	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.020	0.016
NIM	35 1235	0.182	0.167	0.170	0.182	0.121	0.121	0.099	0.097	0.087	0.076	0.070	0.057
NIM	35 2239	0.706	0.688	0.639	0.675	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
NIM	35 2256	-	-	-	-	-	-	-	-	-	-	0.000	0.000
NIM	35 2483	-	-	-	-	-	-	-	-	-	-	0.000	0.000
NIM	35 2643	-	-	-	-	-	-	-	-	-	-	0.000	0.000
NIM	35 2744	-	-	-	-	-	-	-	-	-	-	-	0.000
NIM	35 2767	-	-	-	-	-	-	-	-	-	-	0.000	0.000
NIM	40 4832	-	-	-	-	-	-	-	-	-	-	0.000	0.000
NIM	40 4835	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002
NIM	40 4871	-	-	-	-	-	-	-	-	-	-	0.000	0.000
NIM	40 4878	-	-	-	-	-	-	-	-	-	-	0.000	0.000
NIM	40 4879	-	-	-	-	-	-	-	-	-	-	0.000	0.000
NIM	40 4880	-	-	-	-	-	-	-	-	-	-	0.000	0.000
NIMB	35 600	0.054	0.051	0.043	0.048	0.100	0.095	-	-	0.000	0.000	0.000	0.000
NIMT	35 2246	0.000	0.000	0.000	0.000	0.402	0.523	0.263	0.356	0.422	0.496	0.507	0.631
NIMT	35 2247	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002

Table 9A. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
NIS	35 1126	0.000	0.000	0.000	0.319	0.461	0.587	0.694	0.696	0.687	0.687	-	-
NIST	35 182	0.146	0.147	0.151	0.161	0.196	0.348	0.480	0.331	-	-	-	-
NIST	35 282	0.029	0.034	0.033	0.034	0.040	0.048	0.057	0.065	0.066	0.078	0.065	0.082
NIST	35 408	0.294	0.380	0.560	0.685	0.670	0.670	0.694	0.696	0.616	0.435	0.338	0.291
NIST	35 1074	0.252	0.204	0.205	0.000	0.070	0.067	0.043	0.032	0.025	0.023	0.022	0.023
NIST	35 2031	0.519	0.000	0.151	0.129	0.098	0.075	0.081	0.095	0.103	0.157	0.216	0.280
NIST	35 2032	0.199	0.163	0.243	0.243	0.265	0.328	0.369	0.445	0.432	0.000	0.235	-
NIST	35 2034	0.234	0.185	0.174	0.222	0.203	0.335	0.293	0.394	0.308	0.325	0.594	0.689
NIST	35 2579	0.212	0.240	0.392	0.345	0.571	0.579	0.490	0.515	0.528	0.672	0.631	0.683
NIST	35 2672	0.514	0.500	0.600	0.504	0.000	0.160	0.000	0.086	0.080	0.075	0.080	0.076
NIST	36 1661	0.082	0.094	0.093	0.093	0.090	0.079	0.082	0.065	0.064	0.073	0.077	0.059
NIST	40 203	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.008
NIST	40 204	0.265	0.260	0.270	0.280	0.264	0.266	0.269	0.254	0.231	0.223	0.193	0.175
NIST	40 205	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
NIST	40 206	0.030	0.025	0.022	0.021	0.021	0.022	0.024	0.026	0.026	0.028	0.028	0.028
NIST	40 222	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	-	-	0.000	0.000
NMIJ	35 224	0.000	0.000	0.000	0.318	0.462	0.293	0.353	0.277	0.255	0.256	0.193	0.201
NMIJ	35 523	0.509	0.301	0.295	0.174	0.107	0.099	0.101	0.091	0.091	0.096	0.114	0.108
NMIJ	35 1273	0.706	0.704	0.687	0.685	0.670	0.665	0.692	0.696	0.687	0.521	0.534	0.696
NMIJ	35 2057	0.081	0.074	0.071	0.066	0.072	0.080	-	-	-	-	-	-
NMIJ	40 5002	0.000	0.000	0.000	0.487	0.334	0.223	0.121	0.099	0.110	0.121	0.126	0.098
NMIJ	40 5003	0.475	0.506	0.491	0.685	0.670	0.670	0.694	0.000	0.000	0.036	0.030	0.028
NMIJ	40 5015	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
NMLS	35 328	0.002	0.003	0.003	0.005	0.014	0.127	0.118	0.000	0.015	0.013	0.012	0.013
NPL	35 1275	0.183	0.200	0.181	0.148	0.180	0.244	0.228	0.229	0.297	0.000	0.133	0.102
NPL	36 784	0.170	0.433	0.471	0.600	0.494	0.000	0.153	0.149	0.148	0.100	0.077	0.065
NPL	40 1701	0.383	0.351	0.285	0.221	0.178	0.156	0.175	0.201	0.216	0.213	0.195	0.196
NPL	40 1708	0.359	0.333	0.310	0.284	0.251	0.236	0.227	0.221	0.200	0.191	0.189	0.181
NPLI	35 57	-	-	-	-	0.000	-	0.000	0.000	0.000	0.000	0.082	0.070
NPLI	35 140	-	-	-	-	0.000	-	0.000	0.000	0.000	0.000	0.038	0.035
NPLI	35 1324	-	-	-	-	0.000	-	0.000	0.000	0.000	0.000	0.338	0.259
NPLI	35 2245	-	-	-	-	0.000	-	0.000	0.000	0.000	0.000	0.237	0.369
NPLI	35 2257	0.000	-	0.000	-	-	-	-	-	-	-	-	-
NPLI	35 2796	-	-	-	-	0.000	-	0.000	0.000	0.000	0.000	0.330	0.497
NPLI	40 5201	-	-	-	-	0.000	-	0.000	0.000	0.000	0.000	0.001	0.001

Table 9A. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
NRC	35 2148	0.081	0.085	0.111	0.316	0.516	0.416	0.462	0.357	0.426	0.422	0.442	0.453
NRC	35 2150	0.088	0.070	0.064	0.069	0.073	0.076	0.099	0.201	0.687	0.687	0.685	0.696
NRC	35 2152	0.706	0.704	0.687	0.000	0.572	0.576	0.448	0.474	0.403	0.333	0.361	0.341
NRL	35 714	0.000	0.000	0.000	0.000	0.083	0.081	-	-	0.000	0.000	0.000	-
NRL	35 719	0.000	0.000	0.000	0.000	0.486	0.389	-	-	0.000	0.000	0.000	-
NRL	35 1245	0.000	0.000	0.000	0.000	0.268	0.393	-	-	0.000	0.000	0.000	-
NRL	36 387	0.000	0.000	0.000	0.000	0.268	0.246	-	-	0.000	0.000	0.000	-
NRL	40 1001	0.000	0.000	0.000	0.000	0.004	0.004	-	-	0.000	0.000	0.000	-
NRL	40 1003	0.000	0.000	0.000	0.000	0.015	-	-	-	0.000	0.000	0.000	-
NTSC	35 1007	0.008	0.010	0.018	0.027	0.029	0.035	0.043	0.111	0.117	0.082	0.063	0.055
NTSC	35 1008	0.436	0.340	0.322	0.342	0.299	0.243	0.241	0.226	0.230	0.403	0.685	0.000
NTSC	35 1011	0.000	0.168	0.089	0.068	0.056	0.046	0.037	0.033	0.023	0.020	0.017	0.017
NTSC	35 1016	0.124	0.123	0.125	0.146	0.179	0.407	0.694	0.696	0.687	0.687	0.685	0.696
NTSC	35 1018	0.490	0.404	0.418	0.365	0.358	0.276	0.294	0.311	0.366	0.539	0.675	0.647
NTSC	35 1818	0.671	0.000	0.124	0.068	0.039	0.000	0.016	0.015	0.014	0.016	0.022	0.027
NTSC	35 1820	0.193	0.150	0.117	0.100	0.074	0.077	0.082	0.088	0.092	0.116	0.218	0.210
NTSC	35 1823	0.154	0.174	0.193	0.191	0.238	0.256	0.250	0.216	0.239	0.261	0.256	0.199
NTSC	35 2096	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.598	0.614	0.605	0.501	0.529
NTSC	35 2098	0.276	0.296	0.293	0.296	0.411	0.507	0.507	0.521	0.554	0.501	0.413	0.404
NTSC	35 2131	0.145	0.163	0.161	0.159	0.164	-	-	-	0.000	0.000	0.000	0.000
NTSC	35 2141	0.012	0.011	0.009	0.010	0.012	0.012	-	-	0.000	0.000	0.000	0.000
NTSC	35 2142	0.706	0.704	0.486	0.442	0.316	0.320	0.342	0.294	0.290	0.453	0.433	0.696
NTSC	35 2143	0.531	0.507	0.488	0.497	0.470	0.396	0.537	0.696	0.687	0.576	0.685	0.696
NTSC	35 2144	0.268	0.255	0.410	0.368	0.364	0.365	0.395	0.435	0.608	0.551	0.529	0.352
NTSC	35 2145	0.620	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.000	0.289	0.325	0.323
NTSC	35 2147	0.508	0.510	0.442	0.453	0.000	0.201	0.193	0.190	0.198	0.226	0.321	0.338
NTSC	35 2573	0.706	0.704	0.619	0.000	0.199	0.186	0.185	0.181	0.144	0.159	0.199	0.305
NTSC	35 2576	0.409	0.345	0.319	0.293	-	-	-	-	-	-	-	-
NTSC	35 2831	-	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000
NTSC	35 2855	-	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000
NTSC	40 4926	0.000	0.000	0.000	-	-	0.000	0.000	0.000	0.000	0.001	0.001	0.001
NTSC	40 4927	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001
ONBA	36 2228	-	-	-	0.000	0.000	0.000	0.000	-	-	0.000	0.000	0.000
ONRJ	35 102	0.146	0.111	0.115	0.105	0.113	0.127	0.171	0.248	0.341	0.303	0.331	0.344
ONRJ	35 103	0.103	0.068	0.072	0.076	0.080	0.124	0.119	0.127	0.117	0.122	0.094	0.072

Table 9A. (Cont.)

Lab.	Clock		55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
ONRJ	35	111	0.055	0.036	0.035	0.032	0.032	-	-	-	-	-	-	-
ONRJ	35	123	0.513	0.460	0.455	0.382	0.342	0.450	0.284	0.282	0.237	0.241	0.301	0.176
ONRJ	35	129	0.511	0.000	0.260	0.163	0.152	0.149	0.134	0.134	0.129	0.113	0.102	0.118
ONRJ	35	147	0.706	0.459	0.441	0.398	0.355	0.385	0.340	0.332	0.254	0.267	0.272	0.345
ONRJ	35	1153	0.182	0.211	0.158	0.138	0.139	0.137	0.120	0.139	0.135	0.127	0.127	0.165
ONRJ	35	1942	0.111	0.141	0.190	0.225	0.206	0.265	0.240	0.206	0.200	0.214	0.221	0.281
ONRJ	40	1950	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-	0.000
ONRJ	40	1958	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.035	0.054
ORB	35	2722	0.000	0.350	0.451	0.608	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
ORB	35	2723	0.000	0.168	0.231	0.263	0.294	0.379	0.474	0.411	0.405	0.481	0.319	0.281
ORB	35	2724	0.000	0.704	0.687	0.685	-	-	-	0.000	0.000	0.000	0.000	-
ORB	36	202	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.142	0.132
ORB	36	593	0.000	0.080	0.051	0.036	0.033	0.029	0.030	0.040	0.036	0.058	0.078	0.111
ORB	40	2602	-	0.000	0.000	0.000	0.000	0.198	-	0.000	0.000	0.000	0.000	0.046
PL	25	124	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	-
PL	25	125	0.015	0.000	0.007	0.006	0.006	0.006	0.005	0.004	0.005	0.007	0.000	0.004
PL	35	441	0.706	0.704	0.687	0.685	0.670	0.642	0.483	0.411	0.340	0.274	0.237	0.274
PL	35	502	0.037	0.043	0.061	0.108	0.128	0.152	0.141	0.159	0.160	0.114	0.088	0.086
PL	35	745	0.382	0.360	0.498	0.506	0.496	0.544	0.552	0.318	0.317	0.000	0.000	0.000
PL	35	761	0.201	0.158	0.135	0.114	0.128	0.080	0.088	0.091	0.071	0.091	0.088	0.000
PL	35	1120	0.317	0.000	0.121	0.119	0.115	0.123	0.129	0.132	0.133	0.168	0.175	0.222
PL	35	1746	-	-	-	-	-	-	-	-	-	-	0.000	0.000
PL	35	1934	0.137	0.274	0.261	0.214	0.196	0.196	0.285	0.602	0.687	0.687	-	-
PL	35	2175	-	-	-	-	0.000	0.000	0.000	0.000	0.079	0.116	0.164	0.226
PL	35	2394	0.304	0.297	0.372	0.326	0.410	0.431	0.422	0.472	0.346	0.339	0.350	0.391
PL	40	4002	0.004	0.005	0.005	0.005	0.004	0.000	0.003	0.003	0.002	0.002	0.002	0.003
PL	40	4004	-	-	-	-	-	0.000	0.000	0.000	0.000	0.007	-	-
PL	40	4601	0.015	0.014	-	-	-	0.000	0.000	0.000	0.000	0.018	0.019	0.019
PL	40	4602	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PTB	35	128	0.198	0.181	0.196	0.391	0.366	0.298	0.263	0.299	0.216	0.328	0.313	0.274
PTB	35	415	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.634	0.693
PTB	35	1072	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.484	0.440	0.372	0.376
PTB	40	506	0.007	0.011	0.014	0.000	0.000	0.002	0.001	0.001	0.001	0.001	0.001	0.001
PTB	40	508	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.001	0.001
PTB	40	590	0.025	0.024	0.025	0.026	0.028	0.033	0.035	0.034	0.032	0.033	0.033	0.031

Table 9A. (Cont.)

Lab.	Clock		55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
PTB	92	1	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
PTB	92	2	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
ROA	35	583	0.231	0.172	0.151	0.164	0.266	0.385	0.447	0.642	0.585	0.548	0.500	0.454
ROA	35	718	0.087	0.094	0.148	0.230	0.465	0.346	0.369	0.615	0.687	0.687	0.685	0.696
ROA	35	1699	0.416	0.402	0.347	0.402	0.389	0.357	0.329	0.294	0.271	0.270	0.527	0.559
ROA	35	2270	0.249	0.345	0.387	0.332	0.338	0.000	0.176	0.182	0.211	0.283	0.289	0.235
ROA	36	1488	0.108	0.114	0.107	0.107	0.096	0.106	0.134	0.120	0.000	0.059	0.060	0.064
ROA	36	1490	0.253	0.231	0.185	0.176	0.226	0.229	0.241	0.242	0.242	0.215	0.144	0.158
ROA	40	1436	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
SCL	35	2178	0.000	0.347	0.368	0.318	0.324	0.285	-	-	0.000	0.000	0.000	0.000
SCL	35	2525	0.706	0.704	0.687	0.685	0.670	0.670	-	-	0.000	0.000	0.000	0.000
SG	35	475	0.706	0.704	0.687	0.685	-	-	-	-	0.000	0.000	0.000	0.000
SG	35	476	0.706	0.704	0.687	0.611	-	-	-	-	0.000	0.000	0.000	0.000
SG	35	1889	0.298	0.209	0.186	0.136	-	-	-	-	0.000	0.000	0.000	0.000
SG	36	522	0.128	0.102	0.156	0.148	-	-	-	-	0.000	0.000	0.000	0.000
SG	40	7701	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-	-
SIQ	36	1268	0.051	0.052	0.053	0.053	0.076	0.075	0.074	0.091	0.090	0.125	0.107	0.079
SMD	25	2543	-	-	-	-	-	-	-	-	0.000	-	-	-
SMD	35	810	0.000	0.000	0.009	0.008	0.007	-	-	-	0.000	-	-	-
SMD	35	1766	-	-	-	-	0.000	-	-	-	0.000	-	-	-
SMD	35	2003	0.194	0.237	0.281	0.316	0.354	-	-	-	0.000	-	-	-
SMD	35	2543	0.706	0.704	0.687	0.685	0.664	-	-	-	-	-	-	-
SMU	36	1193	0.018	0.021	0.023	0.027	0.028	0.083	0.074	0.086	0.084	0.104	0.100	0.104
SP	35	572	0.649	0.625	0.661	0.636	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
SP	35	641	0.158	0.184	0.242	0.270	0.196	0.116	0.108	0.108	0.105	0.106	0.128	0.152
SP	35	1188	0.429	0.385	0.292	0.205	0.000	0.000	0.000	0.020	0.016	0.015	0.015	0.017
SP	35	1642	0.706	0.583	0.406	0.368	0.359	0.419	0.577	0.608	0.687	0.687	0.685	0.696
SP	35	2166	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	-	-	-	-
SP	36	223	0.308	0.334	0.334	0.401	0.426	0.480	0.343	0.000	0.252	0.226	0.198	0.230
SP	36	1175	0.210	0.205	0.277	0.270	0.288	0.236	0.186	0.147	0.208	0.217	0.226	0.163
SP	36	1187	-	-	-	0.000	0.000	0.000	0.000	0.273	0.000	0.034	0.030	0.027
SP	36	1531	-	-	-	0.000	0.000	0.000	0.000	0.078	0.089	0.129	0.159	0.200
SP	36	2068	0.117	0.112	0.107	0.148	0.144	0.144	0.101	0.098	0.095	0.077	0.080	0.084
SP	36	2218	0.409	0.350	0.337	0.363	0.385	0.418	0.426	0.491	0.312	0.340	0.330	0.290
SP	36	2295	0.250	0.237	0.236	0.161	0.139	0.136	0.135	0.144	0.190	0.166	0.126	0.128

Table 9A. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
SP	36 2297	0.325	0.345	0.364	0.437	0.388	0.375	0.401	0.418	0.464	0.497	0.526	0.600
SP	40 7201	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
SP	40 7203	0.011	0.010	0.010	0.010	0.010	0.011	0.011	0.012	0.012	0.012	0.012	0.012
SP	40 7210	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
SP	40 7211	0.005	0.005	0.005	0.005	0.004	0.004	0.005	0.005	0.004	0.005	0.005	0.005
SP	40 7212	0.040	0.037	0.035	0.034	0.032	0.032	0.034	0.035	0.035	0.036	0.038	0.039
SP	40 7218	0.005	0.005	0.005	0.005	0.005	0.000	0.000	-	0.000	0.000	0.000	0.000
SP	40 7221	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.638	0.448	0.378	0.338	0.297
SU	40 3809	0.118	0.112	0.116	0.113	0.107	-	-	-	-	-	-	-
SU	40 3810	0.000	0.000	0.001	0.002	0.002	0.003	0.004	0.005	0.006	0.007	0.651	0.558
SU	40 3811	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.008
SU	40 3812	-	-	-	0.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.298
SU	40 3814	0.000	0.000	0.075	0.029	0.022	0.020	0.019	0.017	0.015	0.014	0.014	0.014
SU	40 3815	0.021	0.021	0.021	0.022	0.022	0.023	0.023	0.023	0.022	0.023	0.023	0.025
SU	40 3816	0.028	0.027	0.028	0.029	0.032	0.033	0.034	0.032	0.029	0.029	0.027	0.026
TCC	35 768	0.065	0.070	0.059	0.058	0.073	0.063	0.074	0.076	0.071	0.094	0.108	0.065
TCC	35 1881	0.128	0.704	0.687	0.685	0.670	0.661	0.676	0.627	0.687	0.650	0.526	0.510
TCC	40 8620	0.017	0.018	0.017	0.016	0.016	0.020	0.024	0.024	0.024	0.030	0.041	0.062
TCC	40 8624	-	0.000	0.000	0.000	0.000	0.670	0.694	0.696	0.687	0.687	0.685	0.696
TCC	40 8650	0.007	0.007	0.007	0.008	0.008	0.010	0.012	0.015	0.018	0.021	0.023	0.025
TL	35 1012	0.312	0.343	0.334	0.431	0.494	0.493	0.530	0.492	0.325	0.304	0.264	0.443
TL	35 1104	0.164	0.131	0.080	0.055	0.056	-	-	-	-	-	-	-
TL	35 1132	0.138	0.128	0.098	0.091	0.098	0.111	0.205	0.144	0.127	0.105	0.177	0.185
TL	35 1498	0.318	0.443	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
TL	35 1500	0.320	0.229	0.215	0.280	0.287	0.332	0.397	0.000	0.161	0.192	0.187	0.179
TL	35 1712	0.216	0.126	0.126	0.116	0.081	0.084	0.079	0.081	-	-	-	-
TL	35 2365	0.581	0.590	0.562	0.685	0.670	0.670	0.574	0.585	0.556	0.476	0.485	0.696
TL	35 2366	0.671	0.690	0.603	0.607	0.591	0.631	0.584	0.373	0.335	0.362	0.355	0.298
TL	35 2367	0.468	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.575	0.527	0.524
TL	35 2368	0.277	0.261	0.208	0.195	0.198	0.234	0.279	0.356	0.463	0.393	0.447	0.375
TL	35 2630	0.706	0.688	0.651	0.509	0.501	0.429	0.390	0.426	0.354	0.390	0.479	0.410
TL	35 2634	0.051	0.052	0.048	0.050	0.031	0.036	0.039	0.049	0.044	0.058	0.057	0.054
TL	35 2636	0.706	0.704	0.687	0.685	0.670	0.670	0.623	0.674	0.370	0.343	0.317	0.421
TL	35 2853	-	-	-	-	0.000	0.000	0.000	0.000	0.388	0.194	0.186	0.235
TL	40 57	0.000	0.000	0.000	0.005	0.005	0.005	0.004	0.004	0.003	0.003	0.003	0.003

Table 9A. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
TL	40 3052	0.201	0.196	0.266	0.339	0.378	0.447	0.388	0.346	0.338	0.366	0.424	0.672
TL	40 3053	0.337	-	-	-	-	-	-	-	-	-	-	-
TP	35 163	-	-	-	0.000	0.000	0.000	0.000	0.696	0.210	0.293	0.397	0.318
TP	35 1227	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
TP	35 2476	0.683	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
TP	36 154	0.117	0.122	0.138	0.147	0.247	0.186	0.178	0.187	0.200	0.297	0.264	0.281
UA	35 2465	0.102	0.072	0.057	0.045	0.041	0.048	0.050	0.065	0.116	0.121	0.113	0.114
UA	40 7854	0.007	0.010	0.019	0.051	0.090	0.091	0.086	0.155	0.088	0.090	0.089	0.090
UA	40 7881	0.016	0.015	0.014	0.014	0.014	0.014	0.013	0.014	0.018	0.034	0.051	0.074
UA	40 7882	0.212	0.213	0.237	0.259	0.284	0.257	0.258	0.317	0.331	0.270	0.165	0.177
UME	35 251	0.680	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.606
UME	35 252	0.547	0.668	0.687	0.685	0.670	0.000	0.000	0.000	0.126	0.139	0.161	0.183
UME	35 710	0.461	0.564	0.583	0.491	0.568	0.670	0.649	0.513	0.633	0.628	0.630	0.419
UME	35 2703	0.519	0.636	0.687	0.635	0.538	0.380	0.311	0.324	0.322	0.404	0.421	0.439
USNO	35 101	0.315	0.298	0.000	0.093	0.080	0.111	0.113	0.116	0.102	0.093	0.074	0.076
USNO	35 104	0.377	0.368	0.289	0.000	0.000	0.040	0.038	0.032	0.030	0.033	0.037	0.044
USNO	35 106	-	-	-	-	-	-	-	-	-	-	0.000	0.000
USNO	35 108	0.167	0.136	0.147	0.161	0.275	0.212	0.322	0.351	0.452	0.449	0.441	0.447
USNO	35 114	0.308	0.240	0.260	0.311	0.269	0.199	0.202	0.189	0.185	0.181	0.136	-
USNO	35 120	0.383	0.391	0.411	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
USNO	35 142	0.276	0.282	0.210	0.152	0.112	0.128	0.120	0.114	0.116	0.146	0.192	0.298
USNO	35 145	0.217	-	-	-	-	-	-	-	-	-	0.000	0.000
USNO	35 146	0.477	0.348	0.384	0.428	0.401	0.412	0.517	0.674	0.687	0.687	0.685	-
USNO	35 148	0.336	0.329	0.294	0.241	0.212	0.194	0.204	0.180	0.177	0.174	0.186	0.178
USNO	35 150	0.553	0.390	0.321	0.216	0.180	0.129	0.133	0.123	0.130	0.190	0.284	0.361
USNO	35 152	0.161	0.142	0.126	0.181	0.177	0.217	0.240	0.223	0.210	0.218	0.274	0.229
USNO	35 153	-	-	-	-	-	-	-	-	-	-	0.000	0.000
USNO	35 156	0.000	0.126	0.154	0.196	0.244	0.305	0.311	0.362	0.392	0.687	0.685	0.696
USNO	35 161	0.198	0.274	0.285	0.306	0.382	0.418	0.000	0.249	0.212	0.214	0.210	0.178
USNO	35 165	0.000	0.000	0.000	0.119	0.119	0.142	0.154	0.183	0.204	0.230	0.177	0.183
USNO	35 166	0.558	0.704	0.424	0.394	0.425	0.000	0.119	0.118	0.097	0.072	0.069	0.079
USNO	35 169	0.000	0.000	0.254	0.209	0.277	0.204	0.261	0.272	0.311	0.350	0.394	0.382
USNO	35 173	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
USNO	35 213	0.271	0.350	0.364	0.389	0.380	0.390	0.421	0.597	0.630	0.421	0.434	0.308
USNO	35 217	0.626	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	-	-

Table 9A. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
USNO	35 226	0.272	0.325	0.384	0.461	0.291	0.000	0.082	0.065	0.061	0.069	0.073	0.088
USNO	35 227	0.167	0.286	0.362	0.406	0.670	0.000	0.383	0.272	0.000	0.145	0.135	0.122
USNO	35 231	0.000	0.000	0.000	0.452	0.538	0.670	0.574	0.696	0.687	0.687	0.685	0.696
USNO	35 233	0.121	0.128	0.143	0.151	0.165	0.170	0.193	0.000	0.069	0.057	0.058	0.052
USNO	35 242	0.408	0.378	0.366	0.464	0.000	0.438	0.543	0.396	0.398	0.368	0.365	0.411
USNO	35 244	0.280	0.207	0.183	0.205	0.146	0.174	0.163	0.172	0.162	0.161	0.144	0.124
USNO	35 253	0.044	0.063	0.116	0.272	0.258	0.267	0.425	0.396	0.383	0.447	0.371	0.548
USNO	35 254	0.063	0.069	0.095	0.317	0.319	0.670	0.694	0.696	0.687	0.687	0.685	0.696
USNO	35 255	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
USNO	35 256	0.219	0.266	0.266	0.266	0.256	0.302	0.330	0.376	0.266	0.284	0.438	0.432
USNO	35 260	-	-	-	-	-	-	-	-	-	-	-	0.000
USNO	35 266	0.075	0.070	0.067	0.064	0.063	0.062	0.092	0.109	0.137	0.236	0.341	0.652
USNO	35 268	0.706	0.704	0.687	0.685	0.670	0.620	0.679	0.696	0.687	0.687	0.685	0.696
USNO	35 270	0.088	0.085	0.075	0.078	0.070	0.129	0.457	0.368	0.347	0.300	0.273	0.388
USNO	35 279	0.706	0.704	0.687	0.685	0.670	0.576	0.382	0.264	0.201	0.217	0.225	0.241
USNO	35 389	0.041	0.042	0.042	0.053	0.070	0.084	0.104	0.143	0.112	0.118	0.102	0.100
USNO	35 392	0.110	0.000	0.038	0.038	0.030	0.024	0.023	0.022	0.022	-	-	-
USNO	35 394	-	-	-	-	-	0.000	0.000	0.000	0.000	0.050	0.069	0.061
USNO	35 416	0.000	0.173	0.177	0.197	0.251	0.184	0.204	0.000	0.113	0.138	0.135	0.156
USNO	35 417	0.478	0.693	0.652	0.638	0.000	0.162	0.093	0.088	0.083	0.089	0.083	0.097
USNO	35 703	0.155	0.159	0.110	0.099	0.115	0.090	0.073	0.064	0.060	0.066	0.059	0.075
USNO	35 717	-	-	0.000	0.000	0.000	0.000	0.183	0.240	0.328	0.383	0.259	0.206
USNO	35 762	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
USNO	35 763	0.706	0.704	0.687	0.644	0.564	0.559	0.627	0.622	0.655	0.687	0.685	0.696
USNO	35 765	0.023	0.023	0.021	0.025	0.038	0.084	0.134	0.284	0.344	0.361	0.334	0.303
USNO	35 1096	0.620	0.555	0.551	0.581	0.479	0.513	0.506	0.540	0.532	0.687	0.685	0.696
USNO	35 1097	0.248	0.372	0.421	0.411	0.000	0.065	0.058	0.053	0.051	0.055	0.055	0.073
USNO	35 1125	0.097	0.106	0.122	0.134	0.217	0.000	0.000	0.005	0.003	0.003	0.002	0.003
USNO	35 1327	0.268	0.226	0.353	0.522	0.418	0.370	0.284	0.284	0.294	0.321	0.359	0.463
USNO	35 1328	0.244	0.228	0.208	0.188	0.101	0.099	0.107	0.110	0.125	0.153	0.175	0.179
USNO	35 1331	0.170	0.106	0.115	0.112	0.111	0.142	0.144	0.148	0.153	0.189	0.293	0.315
USNO	35 1438	0.130	-	-	-	-	-	-	-	-	-	0.000	0.000
USNO	35 1459	0.321	0.704	0.000	0.000	0.000	0.049	0.041	0.041	0.039	0.036	0.030	0.027
USNO	35 1462	0.467	0.377	0.395	0.327	0.303	0.252	0.294	0.234	0.228	0.329	0.511	0.538
USNO	35 1463	0.512	0.503	0.488	0.515	0.000	0.077	0.062	0.062	0.058	0.058	0.058	0.079

Table 9A. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
USNO	35 1468	0.347	0.403	0.469	0.477	-	-	-	-	-	-	0.000	-
USNO	35 1481	0.265	0.268	0.306	0.364	0.408	0.609	0.694	0.696	0.631	0.687	0.685	0.696
USNO	35 1543	0.144	0.216	0.600	0.685	0.670	0.540	0.429	0.348	0.297	0.314	0.384	0.399
USNO	35 1573	0.706	0.704	0.539	0.642	0.670	0.670	0.495	0.352	0.377	0.374	0.353	0.334
USNO	35 1575	0.706	0.704	0.687	0.613	0.670	0.607	0.694	0.696	0.676	0.687	0.685	0.696
USNO	35 1580	0.000	0.000	0.135	0.197	0.169	0.220	0.250	0.305	0.323	0.391	0.353	0.371
USNO	35 1585	0.130	0.126	0.138	0.104	0.085	0.076	0.080	0.080	0.091	0.090	0.091	0.088
USNO	35 1598	0.150	0.150	0.193	0.000	0.000	0.000	0.005	0.004	0.004	0.004	0.004	0.005
USNO	35 1658	0.136	0.169	0.217	0.219	0.270	0.254	0.278	0.275	0.278	0.269	0.253	0.281
USNO	35 1692	0.706	0.704	0.581	0.685	0.670	0.670	0.694	0.696	0.687	0.460	0.357	0.349
USNO	35 1694	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
USNO	35 1696	0.496	0.395	0.364	0.362	0.428	0.478	0.429	0.666	0.571	0.538	0.354	0.000
USNO	35 1697	0.127	0.125	0.172	0.522	0.492	0.399	0.415	0.493	0.393	0.502	0.522	0.696
USNO	40 702	0.210	0.263	0.397	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
USNO	40 704	0.004	0.005	0.009	0.332	0.350	0.488	0.694	0.696	0.687	0.687	0.685	0.696
USNO	40 705	0.073	0.069	0.071	0.073	0.105	0.143	0.174	0.189	0.223	0.392	0.516	0.461
USNO	40 710	0.009	0.012	0.015	0.019	0.023	0.028	0.000	0.000	0.000	0.000	0.001	0.000
USNO	40 711	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
USNO	40 712	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
USNO	40 713	0.062	0.058	0.055	0.053	0.051	0.051	0.053	0.053	0.050	0.050	0.048	0.047
USNO	40 714	0.223	0.215	0.213	0.216	0.224	0.236	0.212	0.193	0.149	0.160	0.152	0.147
USNO	40 715	0.047	0.043	0.041	0.040	0.038	0.039	0.041	0.032	0.024	0.021	0.019	0.019
USNO	40 716	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.667	0.573	0.610	0.607	0.624
USNO	40 718	0.007	0.006	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
USNO	40 719	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.009	0.008	0.008	0.008	0.009
USNO	40 720	0.000	0.000	0.004	0.003	0.003	0.003	0.002	0.002	0.002	0.002	-	-
USNO	40 721	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
USNO	40 722	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
USNO	40 723	0.706	0.704	0.687	0.685	0.670	0.670	0.694	0.000	0.000	0.113	0.090	0.080
USNO	40 724	0.250	0.328	0.415	0.432	0.409	0.327	0.239	0.229	0.000	0.033	0.026	0.022
USNO	40 725	0.002	0.003	0.006	0.678	0.670	0.670	0.660	0.515	0.475	0.540	0.325	0.311
USNO	40 728	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
USNO	40 730	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
USNO	40 731	0.022	0.023	0.025	0.026	0.026	0.028	0.031	0.035	0.036	0.040	0.042	0.047
USNO	40 732	0.004	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002

Table 9A. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
USNO	40 734	-	-	-	-	-	0.000	0.000	0.000	0.000	0.001	0.001	0.001
USNO	40 735	0.078	0.061	0.043	0.026	0.017	0.010	0.006	0.005	0.003	0.003	0.002	0.002
USNO	93 2	0.000	0.000	0.000	0.000	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
USNO	93 3	0.000	0.000	0.000	0.000	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
USNO	93 4	0.000	0.000	0.000	0.000	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
USNO	93 5	0.000	0.000	0.000	0.000	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
VMI	35 2230	0.058	0.064	0.072	0.077	0.104	0.098	-	0.000	0.000	0.000	0.000	-
VMI	36 1233	0.023	0.026	0.031	0.036	0.055	0.059	-	0.000	0.000	0.000	0.000	-
VMI	36 2314	0.047	0.053	0.055	0.055	0.069	0.084	-	0.000	0.000	0.000	0.000	-
VSL	35 179	0.702	0.670	0.687	0.685	0.670	0.670	0.694	0.696	0.687	0.687	0.685	0.696
VSL	35 456	0.203	0.247	0.303	0.334	0.357	0.344	0.332	0.259	0.211	0.199	0.230	0.233
VSL	35 548	0.530	0.502	0.580	0.681	0.670	0.670	0.589	0.000	0.359	0.378	0.378	0.368
VSL	35 731	-	-	0.000	0.000	0.000	0.000	0.694	0.646	0.687	0.687	0.685	0.696
ZA	35 2232	0.382	0.645	-	-	-	-	-	-	-	-	-	-
ZA	35 2233	0.706	0.653	0.687	0.685	0.670	0.670	0.679	0.696	0.687	0.687	0.685	-
ZA	36 1034	-	-	0.000	0.000	0.000	0.000	0.029	0.044	0.058	0.000	0.013	-
ZA	36 1821	0.591	0.373	0.355	0.460	0.406	0.367	0.297	0.272	0.265	0.227	0.211	-
ZA	36 2232	-	-	-	-	-	-	-	-	-	-	0.000	-

Table 9B. Statistical data on the weights attributed to the clocks in 2012

Interval		Number of Clocks			Number of clocks with a given weight									
					Weight = 0*			Weight = 0**			Max weight			Max relative weight
		HM	5071A	Total	HM	5071A	Total	HM	5071A	Total	HM	5071A	Total	
2012	Jan.	88	267	408	12	29	54	10	3	15	6	46	55	0.706
2012	Feb.	91	267	409	16	25	54	10	8	19	6	49	58	0.704
2012	Mar.	89	267	410	10	21	46	10	6	16	6	49	58	0.687
2012	Apr.	92	266	414	13	22	49	10	9	20	8	46	56	0.685
2012	May	96	270	422	16	26	49	9	13	22	10	50	66	0.670
2012	June	92	260	407	11	16	34	11	12	24	11	42	59	0.670
2012	July	92	256	398	13	20	38	10	8	19	11	38	55	0.694
2012	Aug.	97	254	405	19	20	46	11	6	19	7	43	56	0.696
2012	Sep.	98	271	425	17	35	61	12	4	18	8	43	59	0.687
2012	Oct.	94	264	415	13	29	52	6	7	15	7	46	61	0.689
2012	Nov.	97	269	424	15	35	59	6	6	15	7	46	60	0.685
2012	Dec.	99	265	416	16	36	57	7	7	14	7	43	57	0.696

Wmax=A/N, here N is the number of clocks, excluding those with a priori null weight, A=2.50.
* A priori null weight (test interval of new clocks).
** Null weight resulting from the statistics.
HM designates hydrogen masers and 5071A designates Hewlett-Packard 5071A units with high performance tube.
Clocks with missing data during an one-month interval of computation are excluded.

Table 10. Relative drifts of contributing clocks in 2012

(File is available at ftp://62.161.69.5/pub/tai/scale/DTAI/dtai12.ar)

Clock drifts are computed using a monthly realization of TT(BIPM) as reference for 4-month intervals ending at the MJD dates given in the table. "-" denotes that the clock was not used. Unit is ns/day/30days.

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
15 DATUM/SYMMETRICOM Cs III
18 DATUM/SYMMETRICOM Cs 4000
19 RHODES AND SCHWARZ XSC
4x HYDROGEN MASERS
9x PRIMARY CLOCKS AND PROTOTYPES

21 OSCILLOQUARTZ 3210
22 OSCILLOQUARTZ OSA 3230B
23 OSCILLOQUARTZ EUDICS 3020
24 OSCILLOQUARTZ OSA 3235B
25 HEWLETT_PACKARD 5062C
30 HEWLETT-PACKARD 5061B
31 HEWLETT-PACKARD 5061B OPT. 4
34 H-P 5061A/B with 5071A tube
35 H-P/AGILENT/SYMMETRICOM 5071A High perf.
36 H-P/AGILENT/SYMMETRICOM 5071A Low perf.

50 FREQ. AND TIME SYSTEMS INC. 4065A
51 DATUM/SYMMETRICOM 4065 B
52 DATUM/SYMMETRICOM 4065 C
53 DATUM/SYMMETRICOM 4310 B

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
APL	35 0904	-	-	-	0.7738	0.7092	-	-	-	-	-	-	0.0218
APL	35 1264	-	-	-	0.1052	0.3467	-	-	-	-	-	-	0.5703
APL	40 3107	-	-	-	0.1254	0.0641	-	-	-0.0237	0.0866	-	-	-0.0118
APL	40 3108	-	-	-	2.3094	2.9187	-	-	1.8883	2.6538	-	-	-
APL	40 3109	-	-	-	0.3254	0.0859	-	-	-0.2877	-0.3207	-	-	-0.0278
AUS	35 2269	0.1635	-0.0089	-0.5027	-0.1523	-0.1444	0.3310	0.1486	0.1654	-0.0143	-0.1855	-0.0737	0.2018
AUS	36 0299	-0.5612	-0.0021	-0.1323	-0.0109	0.4227	-	0.4945	-1.5278	-0.7779	-0.8224	-0.0392	0.1871
AUS	36 0340	0.3947	0.3840	0.3310	0.0705	-0.5529	-0.7406	-0.1966	0.0667	0.2968	0.4201	-0.3533	-0.3137
AUS	36 0654	0.3477	0.4800	0.7693	0.3700	-0.0823	-0.8184	-0.1182	0.2577	0.3457	-0.4873	0.2728	0.1694
AUS	36 1141	1.4251	1.1765	-0.9624	-2.3274	-0.3343	1.0599	0.3185	-0.4300	1.2236	1.8342	0.1549	-0.4165
AUS	40 5401	-	-	-	-	-	-	-4.3456	0.7971	-	-	-	-
AUS	40 5402	-	10.1126	6.4822	4.9272	3.7339	-	-	-1.4077	-	-2.6952	-	-
BEV	35 1065	0.1154	0.1707	-0.1308	0.8762	1.3345	1.0524	-0.3221	-0.1587	0.2849	0.4860	0.0979	-0.1707
BEV	35 1793	0.1059	-0.0266	0.1642	0.0664	0.0564	-0.0660	0.1703	0.1994	0.1133	0.0391	0.0054	0.1034
BEV	40 3452	9.7036	7.0965	7.0240	7.0212	7.0497	6.9797	7.0496	6.9606	6.8953	6.8719	6.6925	-7.0039

Table 10. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
BIM	18 8058	0.3468	0.3922	0.3726	-0.1742	-0.0522	0.2083	0.6325	-0.0173	0.1352	-0.2258	-0.0697	0.0809
BY	40 4222	1.2535	0.6165	3.1544	2.2183	1.4139	0.5492	-1.8073	-2.7594	-1.8647	-3.3964	-0.9945	-0.9761
BY	40 4260	-	-	0.5518	1.2706	2.3302	0.5962	-0.6230	-2.1928	-3.1080	-2.1381	-1.9023	-1.8491
BY	40 4278	1.3570	0.5417	0.4918	0.3922	-0.1861	-0.0125	-0.1046	-0.2094	-0.6014	-1.0048	-0.6780	-1.3170
CAO	35 0939	-0.0645	0.7324	0.4626	-	-	-	-	-	-	-	-	-
CAO	35 1270	-0.2880	-0.2590	-0.1222	-	-	-	-	-	-	-	-	-
CH	22 0112	-	-	-	-	-	-	-	-	-	3.7924	3.9012	3.0372
CH	35 0771	0.3453	0.6371	-	-	-	-	-	-	-	-	-	-
CH	35 2117	-0.0719	0.1005	0.0424	-0.0983	-0.3479	0.2315	0.1285	0.2547	-0.2297	-0.0579	-0.0768	0.3138
CH	35 2743	0.1200	0.0235	0.0357	0.1081	0.2843	0.2304	0.2975	0.2048	0.0234	-0.0646	0.3486	0.1594
CH	36 0354	-0.4103	-0.4909	-0.0750	0.2531	-0.0517	-0.2953	0.2818	-0.2057	0.0396	-0.2921	-0.4314	-0.3135
CH	40 5701	-0.2877	-0.3017	-0.3517	-0.2564	-0.3061	-0.2560	-0.2780	-	-1.4578	-2.0108	-2.0091	-2.0909
CNM	35 1815	-0.6374	-0.2603	0.0709	-	-	-	-	-	-	-	-	-
CNM	35 2708	-0.7031	-0.0238	-0.0478	-	-	1.0046	-0.8833	-0.2618	-0.0841	-	-	2.9292
CNM	35 2709	0.1962	0.6313	0.3439	-	0.8803	-0.1645	-0.2523	-0.0049	0.2491	-	-	1.7429
CNM	40 7301	-0.9051	-0.4409	-0.0108	-	1.9264	0.5463	-0.0258	0.1273	-0.0414	-	-	1.5722
CNMP	36 1752	0.0434	-	6.5491	0.4174	0.1547	0.1387	0.0443	0.0080	0.0282	0.2372	0.4531	-0.0359
CNMP	36 1806	-0.4458	-	0.2302	-0.1264	-0.4577	-0.0897	0.2052	-0.1188	-0.4700	-0.3014	-0.0774	0.1072
DLR	35 1714	-0.0956	0.0245	-0.0702	-0.0587	0.2459	-0.5571	0.1348	0.2205	0.0382	-0.2658	0.0596	0.5915
DMDM	35 2191	0.2475	0.1945	-0.1388	0.1932	0.1935	0.1854	-0.0620	-0.0045	0.0045	0.4209	0.2926	-0.0032
DMDM	36 2033	-0.0485	-0.3161	0.2032	-0.1426	0.0422	0.1301	0.1489	-0.2395	-0.2399	-0.0430	0.0650	-0.1669
DTAG	35 2635	0.0494	0.1018	0.1069	-0.0425	0.5228	0.3859	-	-2.4951	-0.6926	-0.5523	-0.3969	-0.1775
DTAG	35 2865	-	-	-	-	-	-	-	-	-	-	-3.3091	-0.3015
DTAG	36 2370	-0.9103	-0.6596	0.3177	-0.8725	-0.4335	-0.0254	-	-4.5523	-0.6128	-	-	-
DTAG	36 2794	3.4048	-0.4987	-0.0697	-0.8908	-0.7582	-0.3550	-	-3.5477	0.8641	0.1033	0.3558	0.0117
ESTC	22 0132	-	-	-	-	-	-	-	-	-	-	-	0.8138
ESTC	35 1615	-	-	-	-	-	-	-	-	-	-	-	5.5178
ESTC	35 2353	-	-	-	-	-	-	-	-	-	-	-	3.8995
ESTC	40 2551	-	-	-	-	-	-	-	-	-	-	-	2.8122
HKO	35 1893	-3.0410	-0.8331	-0.0604	-0.0111	0.0970	0.2330	0.3343	0.1302	-0.0660	0.0626	0.3896	0.5018
HKO	35 2425	0.5282	0.2859	0.2901	0.1012	-0.1409	-0.2700	-0.2323	-0.0770	0.1298	0.0622	-0.0273	-0.1717
IFAG	36 1167	-1.5686	-0.5066	-0.1571	1.0074	1.2041	0.5248	0.1273	0.3559	1.0712	0.3565	-0.5681	-0.3596
IFAG	36 1173	-1.4045	-1.7621	-0.5425	0.7315	1.8734	1.2859	1.0717	0.3353	0.5832	0.6745	0.3299	-0.9166
IFAG	36 1629	-0.4103	0.1994	-0.0819	-0.3050	-0.2826	0.4959	1.0447	0.3974	0.0280	-1.1005	-0.7408	-0.4342
IFAG	36 1732	0.1283	-0.1129	-0.1086	0.3609	0.3226	0.0876	-0.1381	0.2144	0.3570	0.2721	-0.2081	-0.2604

Table 10. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
IFAG	36 1798	0.0517	0.0564	-0.1958	-0.0585	0.1292	0.0849	0.0407	-0.2105	0.1578	-0.2337	-0.1837	-0.2747
IFAG	40 4418	0.5384	0.5209	0.2779	0.3609	0.2696	0.2797	-1.3397	-3.1778	-3.0797	-3.1098	0.3620	0.3091
IFAG	40 4439	-0.7660	-0.6896	-0.7795	-0.7521	-0.8852	-0.9412	-0.5530	-0.6361	-0.5264	-0.7298	-0.5284	-0.5622
IGNA	35 1196	-	-	-0.7263	0.7543	0.5402	0.8430	0.5712	-0.0122	-0.4714	-0.3311	0.0509	0.5990
INPL	35 2480	-	-0.7648	0.0211	-0.1198	-0.1564	0.0591	0.5998	-	2.1375	-0.2805	-0.5314	-0.3335
INPL	35 2481	-	0.9701	0.5120	0.2359	0.2367	0.0670	0.2722	-	-1.8053	0.4861	-0.0913	-0.2166
INTI	35 2377	1.3034	-0.7767	-2.1038	0.7166	1.7878	0.8302	-1.1974	-0.9322	0.4348	2.2252	-0.8270	-1.3975
INXE	35 2393	-	-	-	-	-	-	-	-	-	0.8301	-0.3575	-0.5730
IPQ	35 1797	-0.5894	-0.3214	-0.0610	-0.3966	-0.8775	-1.1008	-0.7386	-	-	-	-	-
IPQ	35 2012	-0.3125	-0.1416	-0.2227	0.2661	-0.0010	0.0212	-0.4468	-	3.6461	-	-	-
IPQ	35 2169	0.8824	0.3049	-0.3044	-0.9416	-0.3477	0.1285	0.3629	-	5.2918	-	-	-
IT	35 0219	-0.6305	0.0042	-0.0819	0.0344	-0.0259	-0.0546	-0.2067	-0.0811	-0.0257	0.2403	0.1780	0.0735
IT	35 0505	0.3883	0.1466	-0.0056	-0.2088	0.0817	-0.0870	-0.1222	-0.4080	-0.0701	0.2060	0.5146	0.3135
IT	35 1115	-0.2965	0.2471	0.5904	0.4999	0.0436	-0.1903	0.3224	0.6032	0.5307	0.3825	0.2650	-0.4078
IT	35 1373	0.0675	-0.1846	-0.3172	-0.1940	0.0764	-0.0330	-0.1230	-0.3771	-0.4882	-0.5547	-0.3057	0.0145
IT	35 2118	-	0.4283	0.0261	-0.0136	0.3539	0.8209	0.8116	0.5527	0.3646	0.4270	0.0756	-
IT	35 2487	-0.2097	-0.1284	-0.0193	-0.0041	0.1189	0.0725	0.0604	-0.1269	-0.3234	-0.1246	0.2684	0.6099
IT	40 1101	5.5366	5.5313	5.4500	5.6305	5.6122	5.6014	5.7670	5.7706	5.6153	5.6652	5.3672	5.3283
IT	40 1102	6.5854	6.5539	6.3753	6.4322	6.2452	6.0866	5.9270	6.0623	6.0186	6.0702	5.9255	5.5161
IT	40 1103	1.1523	1.1974	1.1631	1.2462	1.2139	1.2327	1.2720	1.7072	1.8470	2.0186	1.9899	1.6013
JV	21 0216	3.6481	1.4413	2.5688	1.3103	0.3794	-0.0585	0.0278	-0.0632	1.3372	1.8111	4.0024	3.1485
JV	36 1277	0.9020	0.7111	0.3704	0.2526	0.6653	0.5922	0.6581	0.2412	0.2032	-0.7871	-0.0313	-0.8811
JV	36 2629	0.8709	0.2089	-0.1307	0.0529	0.4732	0.9648	0.5450	0.2255	0.1856	-0.2351	-0.5133	-0.3686
KEBS	35 2518	-	4.8169	0.1424	-0.9195	-	-6.7783	-1.3257	0.0539	0.1219	-	-	1.1052
KIM	36 0618	0.4490	0.4877	-0.0749	-1.1486	-0.5239	0.5954	0.7893	1.1002	0.2201	-0.3325	-1.0444	0.0563
KRIS	35 0321	0.3837	0.6253	0.5973	0.4377	0.3874	0.3044	0.4978	0.4750	0.2306	0.2910	0.2120	0.3454
KRIS	35 0739	0.2817	0.5406	0.1023	-0.3375	-0.1826	0.1812	0.5026	0.1636	0.4251	0.2997	0.4573	-0.1412
KRIS	35 1135	0.7445	0.6559	0.4366	0.0906	0.1832	0.2553	0.3118	0.2755	0.7350	1.0506	0.9809	0.8268
KRIS	35 1693	0.2200	0.3938	-0.0731	-0.2670	-0.1375	0.0472	0.2002	0.2704	0.1535	0.1789	0.0994	-0.0763
KRIS	35 1783	-0.0067	-0.0166	0.1745	-0.3554	-0.3016	0.0845	0.0661	-0.0740	-0.0832	0.5329	0.1219	-0.3057
KRIS	40 5624	-0.0720	-0.0496	-0.0856	0.0323	0.0365	0.0866	0.0670	0.0806	0.0770	0.1886	0.1412	0.1439
KRIS	40 5625	-0.2147	-0.1922	-0.2456	-0.1121	-0.0956	-0.0682	-0.0563	0.0073	-0.0014	0.0619	-0.0310	-0.0074
KRIS	40 5626	0.2566	0.2374	0.1405	0.1992	0.1983	0.2240	0.2637	0.2972	0.2986	0.3186	0.2751	0.9509
KZ	35 2202	-1.4353	-1.9411	0.0187	0.7437	1.8174	-0.0441	0.4338	1.1964	1.7300	0.2673	-	-
KZ	35 2665	-0.4493	-0.9062	-0.4875	-0.6713	0.1596	0.2786	0.5104	1.0851	1.3121	0.0121	-	-

Table 10. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
KZ	35 2667	-0.2887	-0.8945	-0.0935	-0.1026	0.7210	0.1618	0.6226	1.5663	1.7598	0.3137	-	-
LT	35 1362	1.2380	-0.2053	-	-	-	-	0.5288	-	-1.2362	-1.3185	-1.9201	-1.0930
LT	35 1868	0.1434	-0.2423	-	-	-	0.4080	-0.0149	-	-2.7790	-0.2427	-0.0889	-0.3287
MIKE	35 1171	-0.0114	-0.3326	-0.3238	-0.4379	-0.0395	0.2364	-	3.5323	-	3.5627	-1.3620	-0.6011
MIKE	36 0986	-0.5254	0.1351	0.3991	0.5033	0.3436	0.0599	-	2.5757	-	-1.2339	-1.2798	-0.5412
MIKE	40 4108	0.4027	0.4200	0.3509	0.4531	0.4522	-2.6790	-	0.2483	-	0.3288	0.4081	0.4349
MKEH	36 0849	-0.0228	0.2339	-0.3311	-0.0611	-0.1033	0.1890	-0.5963	-0.9117	-0.7110	0.7821	0.7481	0.5444
MSL	12 0933	-7.2101	-2.9163	-7.0056	-3.7394	0.3553	3.7612	-0.8618	-1.1646	2.5480	5.4659	6.0871	3.1847
MSL	36 0274	-14.9381	-6.5197	-2.9609	-1.8321	0.0169	0.0914	-0.5100	-0.5814	-0.0270	3.9629	5.5410	3.8941
MSL	36 1025	-22.4570	-9.3048	-3.9474	-	37.9500	13.4161	-	-	-	-	-	-
NAO	35 0779	-	-	-	-	1.5900	0.1250	-0.0173	-0.0686	-0.1484	0.2381	0.2245	0.2380
NAO	35 1206	-0.4999	-0.3422	-0.2321	0.3471	0.4598	0.2068	-0.4164	-0.4858	-0.1827	0.0306	-1.5000	-0.6854
NAO	35 1214	-0.1149	-0.3023	-0.1542	0.2368	0.6291	0.4174	0.2083	0.2363	0.2430	1.1252	-1.6473	-3.1153
NAO	35 1689	0.3448	-0.0782	-0.3728	-0.5617	0.0028	0.5060	0.3144	-0.0406	-0.0642	0.6690	0.6303	0.3656
NAO	40 1301	-	-	-	1.9014	1.2569	1.0567	1.2503	-0.8994	-1.0947	-1.8948	-3.7127	-
NICT	35 0112	1.0366	0.9968	-0.4540	-1.6997	-1.6513	-0.7177	-0.3074	-0.2336	-0.1358	0.0281	0.2152	0.3330
NICT	35 0332	0.0813	-0.1674	-0.1059	-0.0902	0.2705	0.0346	-0.1246	-0.1955	-0.3450	-0.2593	-0.4669	0.1443
NICT	35 0342	0.0078	-0.0851	0.0479	-0.1908	-0.0141	0.0555	0.3469	0.1435	0.0897	-0.0326	-0.0950	0.0179
NICT	35 0343	0.0329	-0.3084	0.1372	0.2950	-0.0746	-0.3592	-0.1689	0.2213	-0.0458	0.0171	0.0300	0.1107
NICT	35 0715	-0.1719	-0.1922	-0.0425	-0.2979	0.0490	-0.0728	0.1510	-0.1519	-0.0153	-0.1626	0.1598	0.0455
NICT	35 0732	-0.2993	-0.3181	-0.2965	-0.2344	0.1506	0.2839	0.1556	-0.2073	-0.1296	-0.0909	-0.2382	-0.3119
NICT	35 0907	-0.1305	-0.0242	0.0060	0.0179	0.0522	0.2861	0.1267	0.1209	0.0696	-0.0329	-0.2517	0.1559
NICT	35 0913	0.9181	-0.2051	0.1867	-0.3162	-0.2056	-0.5272	-0.0629	0.1204	0.0161	-0.3457	0.4379	1.3311
NICT	35 0916	-0.2297	-0.3644	-0.0761	0.0446	0.0783	0.0042	0.0361	0.1640	0.1716	0.1726	-0.0801	-0.1040
NICT	35 1225	0.1183	0.1751	0.2848	0.5565	-0.0456	-0.1425	0.0379	0.1675	-0.0915	-0.0257	0.1550	0.1460
NICT	35 1226	0.1966	0.1511	0.4616	0.7550	1.0313	0.7290	0.4572	0.0927	0.0019	-0.3924	-0.6582	-0.2621
NICT	35 1611	-6.7087	1.4596	11.7416	7.4456	-0.4243	-1.1838	-1.0267	-1.2940	-1.4061	-1.0635	-0.6888	-0.3128
NICT	35 1778	0.1103	0.2242	0.3421	0.4284	0.2171	-0.0140	-0.3594	-0.3689	0.1736	0.9884	1.1778	0.8202
NICT	35 1789	0.0960	0.0431	-0.0089	-0.0735	-0.1944	-0.0551	-0.1014	-0.0284	-0.1951	0.0400	0.1185	-0.1217
NICT	35 1790	0.6698	0.3963	0.1801	0.1904	0.1055	-0.0934	-0.0611	0.1040	0.1481	0.2143	0.2187	0.3173
NICT	35 1866	-0.3182	-0.0141	0.0369	0.0372	0.1360	0.0570	0.0559	-0.0525	0.1738	-0.1144	-0.0617	-0.1565
NICT	35 1882	0.1385	0.0224	-0.1815	0.1208	0.1411	0.0835	-0.0752	0.0797	0.0840	0.2210	-0.0748	-0.1302
NICT	35 1887	-0.0443	-0.1058	-0.1576	0.0545	0.1141	-0.0748	-0.1258	0.0022	0.0853	-0.0048	-0.2296	-0.5107
NICT	35 1944	0.1495	0.1753	-0.0585	0.0448	-0.4617	-0.0102	-0.0605	0.1204	-0.0720	-0.0743	-0.1037	0.1347
NICT	35 2010	0.1995	0.2966	-0.1879	-0.4937	-0.6765	-0.3785	0.1962	0.8911	0.8575	0.3496	-0.5020	0.1796

Table 10. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
NICT	35 2011	0.4927	-	-	-	2.0700	0.5081	0.3475	0.2529	0.2941	0.3602	0.3216	0.0625
NICT	35 2056	-0.2069	-	-	-1.0400	0.4881	0.1551	0.1998	0.1502	0.2857	0.2274	0.0977	-0.0031
NICT	35 2113	-0.8609	-	-	-	-	-	-	-	-	-	-	-
NICT	35 2116	0.0384	0.3914	0.4628	0.1409	-0.2753	-0.0559	0.3268	0.4360	0.0367	0.0551	-0.3213	-0.4350
NICT	35 2570	-0.0449	-0.0327	-0.0321	0.3139	0.2628	0.1848	0.1452	0.2910	0.1501	0.0925	0.0571	0.0892
NICT	35 2574	0.2061	0.0013	-0.1285	-0.3082	-0.0287	0.1364	-0.0284	-0.0228	0.1591	0.1721	0.0125	-0.2565
NICT	35 2627	0.2835	0.0034	0.0857	0.1596	0.1024	-0.0270	0.0040	-0.0529	-0.0517	-0.2179	-0.2020	-0.0392
NICT	35 2628	0.0952	0.3197	0.3176	0.0923	0.0133	0.1098	-0.1324	0.0032	-0.0500	0.1665	0.0426	0.1717
NICT	35 2784	-	-	-	0.4069	0.2225	0.3290	0.4505	0.4634	0.4676	0.3410	0.4863	0.1149
NICT	36 1217	-1.6442	-1.0925	0.3636	1.1642	1.6047	0.6174	-0.0097	-0.0211	0.3492	-0.3025	-0.6134	-0.2219
NICT	40 2002	0.5801	0.6809	0.6483	0.7557	0.7913	-	-	-	-	-	-	-
NICT	40 2003	2.8464	1.0311	-	-	-	-	-	-	-0.5778	-2.8108	-3.0655	-3.0196
NICT	40 2004	-	-0.8394	-0.9578	-0.7787	-0.6382	-0.2699	-0.0513	0.1589	0.4036	0.6152	0.8246	1.0326
NICT	40 2005	1.8462	1.9435	2.0292	2.3053	2.4870	2.2431	2.1254	1.7589	1.7036	-	1.2937	1.8520
NICT	40 2006	-	-	-	-	-	-	0.9277	0.8705	0.9464	0.9069	0.9238	1.0500
NIM	35 1235	0.6653	0.7632	0.1389	-0.6432	-0.7613	0.5068	1.2580	1.2736	0.3465	0.4013	0.6062	0.8136
NIM	35 2239	-0.1104	-0.1855	-0.1421	0.0937	0.1815	0.1279	-0.1999	-0.1895	-0.2065	0.1050	0.0892	-0.1304
NIM	35 2256	-	-	-	-	-	-	-	-	-	-	0.7846	0.4563
NIM	35 2483	-	-	-	-	-	-	-	-	-	-	0.3526	0.4219
NIM	35 2643	-	-	-	-	-	-	-	-	-	-	-0.6279	0.2356
NIM	35 2744	-	-	-	-	-	-	-	-	-	-	-	1.0778
NIM	35 2767	-	-	-	-	-	-	-	-	-	-	-0.9022	-0.2142
NIM	40 4832	-	-	-	-	-	-	-	-	-	-	1.5177	1.8266
NIM	40 4835	2.4097	2.3313	2.2222	2.2705	2.2887	2.3927	2.4404	2.3006	2.3686	2.3452	2.2490	3.7961
NIM	40 4871	-	-	-	-	-	-	-	-	-	-	2.4617	3.4520
NIM	40 4878	-	-	-	-	-	-	-	-	-	-	2.5257	3.2775
NIM	40 4879	-	-	-	-	-	-	-	-	-	-	2.5897	5.5284
NIM	40 4880	-	-	-	-	-	-	-	-	-	-	4.0857	5.5611
NIMB	35 0600	-0.4994	0.5245	0.2377	0.1743	0.2876	0.8041	-	-	-5.4431	-0.6602	-0.5949	-0.5225
NIMT	35 2246	1.3236	1.1582	0.5629	0.3707	0.0525	-0.2212	0.2753	0.2652	0.1937	-0.0650	0.1193	-0.0706
NIMT	35 2247	-4.6181	-5.2261	0.1096	-1.7423	-4.3645	-8.1700	-3.9850	2.4818	5.7583	3.9205	-0.1620	-0.4134
NIS	35 1126	-0.3610	-0.3031	-0.3239	-0.2560	-0.0252	0.1692	0.2014	0.0151	-0.0328	-0.0238	-	-
NIST	35 0182	0.3752	-0.0189	-0.3177	-0.2198	0.1982	0.1536	-0.3088	-0.5314	-	-	-	-
NIST	35 0282	0.4156	0.0606	0.5216	0.5560	0.3263	0.1615	0.3741	0.5722	0.4019	0.1894	0.3334	0.0611
NIST	35 0408	0.0930	-0.1087	0.0271	0.0770	0.0973	-0.0155	-0.1804	-0.1567	-0.3122	-0.3991	-0.4795	-0.1567

Table 10. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
NIST	35 1074	0.2793	0.7684	0.5315	0.6857	0.6185	-0.5308	-2.0135	-2.0731	-0.8809	-0.1372	0.5456	0.9919
NIST	35 2031	-0.1155	-0.2556	-0.3682	-0.3417	0.0810	-0.1229	-0.1180	0.1003	0.0317	-0.1805	0.0176	0.1257
NIST	35 2032	0.0094	-0.0892	0.5129	0.2682	0.0972	-0.3354	0.1951	0.0192	-0.1561	-0.7960	-0.1958	-
NIST	35 2034	0.0877	-0.2163	-0.0102	0.0568	0.0737	-0.0415	-0.2178	-0.1418	-0.1882	0.0488	0.0764	0.0572
NIST	35 2579	0.1292	-0.1065	0.0153	0.3103	0.2139	0.1055	0.2277	0.2544	0.0074	-0.1204	0.0640	0.0390
NIST	35 2672	0.3584	0.2936	0.1819	0.0640	0.4645	0.4767	0.6905	0.2528	0.1885	0.0469	0.1473	0.3076
NIST	36 1661	-0.4459	-0.0722	0.6797	-0.0180	0.2470	-0.2982	-0.7033	0.4732	0.9705	0.4791	-0.2438	1.1265
NIST	40 0203	1.0810	1.0983	0.9961	1.1227	1.0835	1.0501	1.0287	1.0022	1.0453	1.0702	1.0438	1.0430
NIST	40 0204	0.1714	0.1504	0.1040	0.2009	0.2418	0.2675	0.2220	0.2156	0.1570	0.2019	0.2246	0.2170
NIST	40 0205	0.0167	0.0409	-0.0056	0.0583	0.0557	0.0484	0.0520	0.0106	0.0136	-0.0031	-0.0119	0.0083
NIST	40 0206	0.6967	0.6270	0.4205	0.4688	0.4731	0.4657	0.5637	0.6139	0.6636	0.6519	0.4925	0.4726
NIST	40 0222	0.0723	0.0844	0.0257	0.1140	0.0887	0.1196	0.0820	0.0856	-	-	0.0297	-0.0389
NMIJ	35 0224	-0.1646	0.0026	-0.2007	0.0529	0.1299	-0.0847	-0.3259	-0.3180	-0.1796	-0.2297	-0.2646	-0.1524
NMIJ	35 0523	0.1014	0.3142	0.2195	0.4463	0.5146	0.3826	0.2112	0.3040	0.4520	0.1862	-0.1112	0.2992
NMIJ	35 1273	-0.0948	0.0015	0.1496	-0.1349	0.1538	0.3053	0.0825	-0.2560	-0.2697	0.1220	-0.0025	-0.0232
NMIJ	35 2057	-0.8219	-0.3422	-0.0329	-0.0532	0.2712	0.1770	-	-	-	-	-	-
NMIJ	40 5002	0.0381	0.0805	0.1022	0.2427	0.2852	0.3579	0.6537	0.2389	0.1270	0.1719	-0.1997	0.5978
NMIJ	40 5003	-0.0616	-0.1017	-0.1952	-0.0060	0.0122	0.0640	0.0220	-1.1527	-1.1647	-1.0914	-0.9145	0.0378
NMIJ	40 5015	2.8370	3.2809	3.7161	4.0740	3.9878	3.8744	3.7304	3.5056	3.2886	3.2919	3.3881	3.5526
NMLS	35 0328	0.0703	0.1984	0.8300	0.1516	-0.7765	-0.9596	0.8613	2.7885	2.7479	1.4994	-0.5888	-0.4901
NPL	35 1275	-0.2643	-0.5211	0.2037	0.6160	0.2685	-0.1926	0.0474	0.2656	-0.0888	-0.9503	-0.9675	-0.7184
NPL	36 0784	0.0489	0.5038	0.3182	-0.1064	-0.4135	-0.5843	-0.3247	0.4443	0.6764	-0.4466	-1.2650	-0.8296
NPL	40 1701	0.3140	0.1504	0.2466	0.2149	0.2939	0.2953	0.1087	0.0639	0.1686	0.3119	0.2977	0.3039
NPL	40 1708	0.1973	0.1942	0.1480	0.2009	0.2447	0.2374	0.2239	0.2204	0.1962	0.2212	0.1978	0.2159
NPLI	35 0057	-	-	-	-	1.0620	-	-1.1469	0.7238	0.1040	-0.2339	-0.7211	-0.6385
NPLI	35 0140	-	-	-	-	0.1843	-	-4.5240	-1.0347	-1.2800	-1.0982	-0.5793	-0.5500
NPLI	35 1324	-	-	-	-	3.0780	-	0.4517	-0.3529	0.2198	0.0021	0.2119	0.3260
NPLI	35 2245	-	-	-	-	0.3832	-	1.1288	-0.3661	-0.4396	-0.3147	0.0917	0.0863
NPLI	35 2257	-0.0806	-	-1.5389	-	-	-	-	-	-	-	-	-
NPLI	35 2796	-	-	-	-	1.5832	-	0.7517	0.3078	0.3397	0.3286	0.1425	-0.0308
NPLI	40 5201	-	-	-	-	-2.6976	-	3.4611	-10.8395	-5.4047	-2.4414	-1.5110	5.7961
NRC	35 2148	0.0113	-0.1757	0.1351	0.0446	-0.0098	-0.3692	-0.1884	-0.0803	0.0796	-0.1356	-0.0224	-0.1341
NRC	35 2150	0.1395	0.1532	-0.0584	-0.1504	0.1518	0.1474	0.0633	0.0748	-0.0471	-0.0661	0.0983	0.0871
NRC	35 2152	-0.0093	-0.1169	-0.0027	-0.3887	-0.2956	0.0124	0.1272	0.0375	-0.0672	-0.1768	-0.4259	-0.2303
NRL	35 0714	-0.7815	-0.2922	-0.6644	-0.5772	-0.4234	-0.2598	-	-	12.1318	3.6220	1.6312	-

Table 10. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
NRL	35 0719	0.1408	0.5134	-0.1262	-0.0507	0.0073	0.4199	-	-	12.6598	4.2875	2.0052	-
NRL	35 1245	-0.0684	-0.2389	0.1375	0.2513	0.2387	-0.1465	-	-	8.0484	1.5879	2.7714	-
NRL	36 0387	1.5465	0.2474	0.0092	0.2303	-0.0964	0.1866	-	-	12.3718	4.3425	2.2762	-
NRL	40 1001	1.4624	1.8638	1.9344	2.0740	1.7948	1.8849	-	-	7.5582	4.4983	3.6545	-
NRL	40 1003	0.2224	0.1257	-0.2397	-0.5904	-1.2887	-	-	-	-22.1857	-11.5490	-5.7244	-
NTSC	35 1007	-0.2585	-0.1756	-0.0355	0.8954	0.4253	0.0961	0.0684	0.5431	-0.4159	-1.3176	-1.1448	-0.4584
NTSC	35 1008	-0.6075	-0.5036	-0.1565	-0.1196	-0.0844	-0.2622	0.0837	0.0014	0.3512	0.0536	-0.1182	-0.6218
NTSC	35 1011	0.0959	0.4622	0.6131	0.7858	0.6515	0.6212	0.7648	0.7180	1.0128	1.0079	1.0249	0.6523
NTSC	35 1016	0.0329	0.1195	-0.0773	-0.1674	-0.0815	0.0886	-0.0735	-0.0513	-0.0725	0.0451	0.1433	0.0424
NTSC	35 1018	0.4440	0.4221	0.0313	0.0224	0.3058	0.5060	0.0821	-0.1265	-0.0821	-0.0724	0.2309	0.2776
NTSC	35 1818	0.0952	1.0228	1.0840	1.4202	1.2794	1.6206	1.2072	0.4051	-0.2490	-0.7273	-0.4552	0.3294
NTSC	35 1820	-0.7741	-0.7995	-0.2722	-0.2113	-0.3960	-0.1926	0.2153	0.3839	0.4650	0.3890	0.5257	0.2773
NTSC	35 1823	0.2253	0.0529	0.0644	0.1857	0.1560	0.1228	0.2016	0.4235	0.3513	0.2410	0.0056	0.3414
NTSC	35 2096	-0.1381	-0.1762	-0.0080	-0.0536	0.0364	0.0893	0.0531	0.2572	-0.0253	-0.1300	-0.1154	0.1379
NTSC	35 2098	-0.1008	0.1395	0.2594	0.6209	0.0046	-0.2131	-0.3051	-0.1287	-0.0099	-0.1053	-0.2635	-0.3827
NTSC	35 2131	-0.0012	-0.2330	0.3839	0.4427	0.0767	-	-	-	-2.2750	0.1265	0.4448	0.2806
NTSC	35 2141	-1.7785	-1.8849	-1.8404	-1.4963	-0.2456	1.6140	-	-	14.5455	4.3987	2.5905	3.4456
NTSC	35 2142	-0.3545	-0.2508	-0.3893	-0.1055	-0.1839	0.0340	-0.0037	-0.0582	-0.2369	-0.0629	-0.0922	-0.1141
NTSC	35 2143	0.0027	-0.2180	-0.0270	-0.0536	0.2490	0.0444	-0.0447	-0.0955	0.0187	0.1904	0.2694	0.1103
NTSC	35 2144	-0.2523	-0.1620	0.0555	0.4928	0.3136	-0.0752	-0.1216	-0.1219	0.1927	0.2132	-0.0334	-0.5437
NTSC	35 2145	0.1301	0.0950	-0.1156	-0.0578	0.0307	0.2067	0.3552	0.3301	0.4210	0.3108	-0.0367	-0.1825
NTSC	35 2147	-0.5312	-0.3086	-0.0238	0.3373	-0.3309	-0.3534	-0.4909	0.1399	0.2952	0.1101	-0.0274	-0.2668
NTSC	35 2573	0.3508	0.2572	0.2240	0.3762	0.4765	0.2223	0.0197	0.1205	0.3703	0.3133	0.0494	-0.2156
NTSC	35 2576	0.0340	0.2047	0.2311	0.2367	-	-	-	-	-	-	-	-
NTSC	35 2831	-	-	-	-	-	-	-	-	0.5809	-0.5045	0.0067	0.4971
NTSC	35 2855	-	-	-	-	-	-	-	-	0.5227	-0.1198	0.1396	0.2118
NTSC	40 4926	4.5836	4.7591	4.9753	-	-	4.3385	5.1215	5.1609	5.2953	4.9886	4.6786	4.8326
NTSC	40 4927	3.5906	3.3417	3.4153	4.6775	5.0226	5.3266	4.0403	3.1873	2.9486	2.3036	2.6490	2.3735
ONBA	36 2228	-	-	-	-0.5977	0.7998	0.0158	0.1074	-	-	-1.3333	-0.1339	0.0202
ONRJ	35 0102	0.3826	-0.3046	0.0432	-0.4563	-0.3046	-0.4432	0.1540	-0.0094	-0.0820	-0.4561	-0.0038	-0.0275
ONRJ	35 0103	-0.4505	-0.7708	-0.1530	0.3655	0.4465	0.6218	0.5948	0.2975	-0.1505	-0.4235	0.2320	0.7144
ONRJ	35 0111	-0.5857	-0.5745	0.0167	-0.0573	-0.1057	-	-	-	-	-	-	-
ONRJ	35 0123	-0.0660	0.2588	0.0150	-0.0316	-0.0836	0.1275	0.4835	0.0293	0.0682	-0.2679	-0.2184	0.2751
ONRJ	35 0129	0.2797	-0.4774	-0.0149	0.2328	0.7055	-0.0638	-0.1378	0.0309	0.0794	0.1958	0.4180	0.1577
ONRJ	35 0147	0.1209	-0.4501	0.2124	0.2222	0.3934	0.0584	0.0820	0.0167	0.2055	0.0629	-0.0008	-0.0721

Table 10. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
ONRJ	35 1153	0.1449	-0.2654	0.2433	0.2926	0.5669	0.1076	0.2854	0.1677	0.1232	-0.0191	0.1697	-0.0431
ONRJ	35 1942	-0.1570	-0.2407	0.2672	-0.0646	0.4357	0.1424	0.3467	0.1135	-0.0429	-0.4744	-0.3854	-0.2007
ONRJ	40 1950	-70.9677	-87.5713	2.9770	1.0844	-3.5878	2.0953	6.7870	7.1873	9.5153	0.9252	-	-3.3397
ONRJ	40 1958	-	-	-	-	-	-	-1.2989	-2.0429	-1.1513	-0.6448	0.2473	0.3352
OP	35 0124	-0.3817	-0.5184	0.0229	0.0285	-0.3186	-0.5534	-0.2113	-0.2612	-0.1290	-0.1079	0.0290	-0.3277
OP	35 0157	-	-	-	-	-	-	-	-	-	-	0.1641	-0.7047
OP	35 0158	-0.4475	-0.4731	0.0202	-0.0178	-0.3985	-0.5164	-0.1250	0.2792	-0.0120	-0.2359	-0.4793	-0.1650
OP	35 0355	-2.1750	-	-	-	-	-	-	-2.4608	-0.0468	-0.5930	-0.4467	-0.3620
OP	35 0385	0.1164	0.1579	0.0434	-0.3170	-0.2046	-0.1657	-0.0325	-0.1180	-0.0976	-0.4956	-0.8827	-0.1545
OP	35 0396	-0.5122	-0.5512	-0.0653	0.0013	0.2518	0.1988	-0.0771	-0.2824	-0.2788	-0.1655	-0.3273	-0.1156
OP	35 0469	0.5549	0.2167	-1.5551	-2.2567	-1.6690	-0.1751	-0.2340	0.0658	0.0148	0.1577	0.5446	1.3074
OP	35 0489	0.0803	0.2745	0.3185	0.2699	0.0771	-0.0740	-0.7709	-0.4290	-	-	-	-
OP	35 0520	-0.2083	0.1221	0.3769	0.0949	-0.7290	-1.6229	-1.2197	-0.4863	-0.7661	-0.9201	-0.4024	-0.0465
OP	35 0536	-0.0795	-0.2941	-0.3243	-0.1479	-	-	-0.2469	0.1429	0.0358	0.0133	-	-
OP	35 0609	-0.1229	0.0463	0.0117	-0.2292	-0.3208	-0.3211	-0.2291	-0.1475	0.1095	0.0914	-0.1797	-0.3878
OP	35 0700	-0.2830	-0.8757	-0.9586	0.0571	0.3034	0.2424	0.2199	0.2759	0.1082	-0.3520	-0.8962	-1.2377
OP	35 0770	-0.0692	-0.4482	-0.4254	-0.2042	0.1262	0.4730	0.4165	-0.1463	-0.3678	-0.0881	-0.1874	-0.1752
OP	35 0774	0.0682	-0.3360	-0.1399	0.0810	-0.1139	-0.4972	-0.1415	0.0347	0.3093	-0.0706	-0.0798	-0.2173
OP	35 0781	-	-1.2757	-0.8411	-0.2910	-0.6305	-0.4341	-0.6160	0.0950	0.3841	1.1103	0.9041	1.0675
OP	35 0819	-0.9589	-0.7557	0.2904	0.5479	0.6682	0.4195	0.4994	0.2003	-0.1760	-0.5315	-0.6132	-0.1747
OP	35 0859	0.8027	0.5847	-0.2480	-0.1486	-0.3511	0.1582	-0.4109	-0.5176	-0.4253	0.1791	0.5775	-
OP	35 0909	-	1.1895	0.0849	0.0088	-0.1466	-0.2136	-0.4879	-0.4811	-0.0173	1.0610	1.7087	-
OP	35 1177	-0.3518	-0.4635	-0.4085	-0.0227	0.1160	0.1678	0.2434	0.2216	-0.0913	0.2435	0.2866	-0.2494
OP	35 1222	-	-1.7317	0.0089	0.1345	-0.0648	-0.2814	-0.1824	-0.1377	-0.1725	0.0039	0.3818	0.6414
OP	35 1321	0.0964	-0.5760	-0.2540	-0.2198	0.0208	-0.0577	0.4437	-0.0558	-0.2581	-0.4167	0.1450	0.2672
OP	35 1556	0.5181	0.6350	0.2555	-0.0167	0.2401	0.5127	0.3944	0.1543	-0.1581	-0.1796	-0.1408	0.0031
OP	35 1644	-0.1352	0.1497	-0.1873	-0.1474	-0.0871	-0.3250	-0.7272	-0.5267	-0.1523	0.0904	0.1133	0.3181
OP	35 2027	0.4717	0.1735	-0.1943	-0.2906	-0.3100	-0.3076	0.2168	0.0636	-0.0950	-0.2012	0.3160	0.0107
OP	35 2388	-1.0541	-0.5906	-0.5708	0.2193	0.6130	0.1640	-0.9250	-0.7949	-0.0028	0.4221	0.0475	0.2322
OP	35 2609	0.1293	-0.0416	0.1110	0.2562	0.2254	0.1575	0.0567	0.1501	0.1313	0.1686	-0.1231	-0.4335
OP	35 2647	0.2601	0.5518	0.8341	0.7958	0.8122	0.7300	0.8223	0.6008	0.6831	0.4629	0.5304	0.3427
OP	35 2804	-	-	-	-	-0.1585	-0.0814	-0.0422	-0.1179	-0.2449	-0.3055	-0.1710	-0.0409
OP	40 0805	5.3419	7.7835	-	-	-	-	-	-	-	-	-	-
OP	40 0809	-	-	-	-	-0.0656	-0.1300	-0.0903	-0.0211	0.0803	0.2836	0.3255	0.4187
OP	40 0810	-	-	-	-	0.0464	-0.0246	-0.0236	0.1039	0.2853	0.5552	0.6525	0.7213

Table 10. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
OP	40 0816	0.7210	1.0565	0.3214	0.2218	-0.8035	-0.8334	-0.8447	-0.6594	-0.3614	-	-	-
OP	40 0889	-	0.8886	1.0350	1.0589	1.0052	0.8066	0.7154	0.6056	0.5136	0.4586	0.3481	0.3143
OP	40 0890	0.3506	-	-	-	0.1824	0.1609	0.2253	0.2139	0.1953	0.2236	0.1533	0.1891
ORB	35 2722	0.0935	-0.1191	0.0278	0.2222	0.0428	-0.0947	-0.1224	0.0385	0.2784	0.1676	-0.1918	-0.0590
ORB	35 2723	0.3841	0.1639	0.1778	0.0608	-0.1007	-0.0549	-0.1192	0.3229	0.2783	0.3598	0.2396	0.3765
ORB	35 2724	0.0500	-0.0290	-0.0020	-0.2099	-	-	-	0.0386	0.6438	0.6161	0.3388	-
ORB	36 0202	-	-	-	-	-	-	3.3274	1.2467	0.6859	0.2941	-0.1786	-0.3497
ORB	36 0593	-0.9749	-0.4803	-0.5351	-0.6959	-0.5543	-0.3218	0.5948	0.4627	-0.1124	-0.5836	-0.0436	0.2087
ORB	40 2602	-	0.1206	0.0095	-0.0305	0.1583	0.3510	-	0.3363	0.4429	0.5930	0.6246	0.5578
PL	25 0124	3.1598	4.1245	3.7010	0.8331	-2.8822	-0.1833	5.9104	8.5548	4.0276	-3.5638	-13.0114	-
PL	25 0125	1.7519	2.1230	1.9532	0.1650	-1.7330	-0.5034	2.6164	3.6950	1.6496	-1.9550	-6.9753	-5.2582
PL	35 0441	-0.1389	-0.2952	0.2234	0.1300	0.1870	0.1303	0.3586	0.2990	0.0886	0.1129	0.1014	0.0181
PL	35 0502	0.0845	0.1417	0.2992	0.3660	-0.4374	-0.9804	-0.7292	0.1947	0.6146	1.0446	0.8262	0.3299
PL	35 0745	0.2128	0.3970	-0.0954	-0.5959	-0.1900	0.3665	0.2914	-0.4406	-0.2896	-0.7272	-1.0308	-2.0578
PL	35 0761	0.1858	0.5325	0.7538	0.2324	-0.0100	0.6022	0.1092	-0.2814	-0.2016	0.0011	0.5177	0.9168
PL	35 1120	0.5301	0.8358	0.9306	-0.0971	-0.6823	-0.7965	-0.1013	0.2355	0.0678	-0.0329	-0.1543	0.2577
PL	35 1746	-	-	-	-	-	-	-	-	-	-	-6.0828	-5.3100
PL	35 1934	0.0708	-0.1428	0.0626	0.3516	0.4059	0.1011	-0.1360	-0.3056	-0.3162	-0.1339	-	-
PL	35 2175	-	-	-	-	0.2700	-0.8157	0.2972	0.1466	0.4264	-0.0299	-0.0549	-0.3452
PL	35 2394	0.0823	0.1128	0.2741	0.5366	0.2646	-0.0029	-0.2036	-0.0360	-0.4459	-0.1462	-0.0114	0.0081
PL	40 4002	-0.8912	-0.2965	-0.9447	-1.1069	-3.3217	-5.2056	-0.7313	-0.5394	-0.7330	-2.3464	0.2281	-0.0439
PL	40 4004	-	-	-	-	-	-1.5255	-1.7552	-2.3346	-1.6147	-0.9948	-	-
PL	40 4601	0.7106	0.6687	-	-	-	0.5225	0.6581	0.6987	0.3303	0.8002	0.7255	0.9143
PL	40 4602	13.6828	12.2617	12.5770	8.5922	9.2366	10.9666	9.6803	9.1006	9.0836	9.4936	9.4786	9.1248
PTB	35 0128	0.2252	0.0418	-0.0676	0.0223	-0.0289	0.3996	0.2055	-0.0799	0.1687	0.1201	0.0760	-0.0591
PTB	35 0415	-0.2083	-0.1396	0.2199	0.1909	0.1313	-0.0646	0.0252	-0.0605	-0.1565	0.0466	0.4251	0.3148
PTB	35 1072	-0.2678	0.0433	-0.1941	0.0754	0.0951	0.3153	-0.2441	-0.1828	0.2276	0.3911	0.2517	-0.2140
PTB	40 0506	-1.4178	-1.4217	-1.4960	5.0149	5.8348	6.7144	4.5837	1.6189	1.5603	1.6636	2.3464	2.3387
PTB	40 0508	4.1141	4.1452	3.8692	3.9105	3.9165	3.8793	3.9620	3.8739	3.8986	3.9319	3.7029	3.4483
PTB	40 0590	0.5732	0.5696	0.4518	0.5105	0.4139	0.4379	0.5053	0.6156	0.5886	0.5354	0.4681	0.5543
PTB	92 0001	0.0234	-0.0511	-0.2438	-0.2632	-0.1123	0.0421	0.1560	0.0211	-0.1274	-0.3619	-0.2750	0.0017
PTB	92 0002	-0.0551	0.2107	0.1457	-0.0384	0.0583	0.1156	0.0267	-0.1943	-0.1278	-0.1505	0.1364	0.2344
ROA	35 0583	0.2152	0.3145	0.2339	-0.2166	-0.3918	-0.1381	-0.1089	-0.0356	-0.1610	-0.0065	-0.1574	-0.2135
ROA	35 0718	0.0909	0.1033	0.0928	0.0774	0.1728	0.1981	0.0405	0.1026	0.0188	-0.1113	-0.0449	0.0687
ROA	35 1699	-0.3545	-0.4319	0.3341	0.0140	0.0920	-0.3191	-0.1636	-0.2901	-0.0483	-0.0493	0.0101	0.0933

Table 10. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
ROA	35 2270	-0.3405	0.2207	0.2246	-0.1828	-0.2339	-0.5284	-0.0728	0.0769	0.3732	-0.0638	0.0198	-0.3494
ROA	36 1488	0.9057	0.1351	-0.5504	-0.3790	0.2743	0.5367	-0.1815	0.0175	-0.6979	0.1766	0.1999	0.6414
ROA	36 1490	0.2057	-0.3190	-0.1375	-0.3448	0.1058	-0.0306	0.5728	0.0520	-0.2895	-0.5579	-0.7456	0.0869
ROA	40 1436	2.7297	2.6548	2.6779	2.9227	2.8748	2.8310	2.6937	2.6389	2.6886	2.9119	2.7794	2.7422
SCL	35 2178	0.1893	0.3126	-0.1814	-0.1655	0.0726	0.5168	-	-	-1.5482	-0.8352	0.1661	0.1523
SCL	35 2525	-0.0069	0.0394	-0.2403	-0.1232	0.0424	0.1796	-	-	-1.2808	-0.6871	-0.5403	-0.4433
SG	35 0475	-0.1598	-0.0998	-0.1913	-0.2095	-	-	-	-	1.6061	0.5776	0.3217	0.0718
SG	35 0476	-0.2138	-0.4384	-0.2374	-0.1992	-	-	-	-	-0.7493	0.4601	0.3455	0.2833
SG	35 1889	0.7109	0.7381	0.1122	0.0374	-	-	-	-	-4.3391	-0.5083	-0.2452	-0.0637
SG	36 0522	-0.3514	-1.0412	-0.7091	0.4554	-	-	-	-	-3.3688	-1.0542	-1.2789	-0.3662
SG	40 7701	12.0584	12.5087	12.8344	13.2392	-	-	-	-	-	-	-	-
SIQ	36 1268	0.3229	0.0771	1.0811	0.8680	0.0166	-0.6851	-0.0078	0.0523	-0.3526	-0.8376	-0.5961	-0.7119
SMD	25 2543	-	-	-	-	-	-	-	-	-0.3276	-	-	-
SMD	35 0810	-2.1825	-3.1940	-2.0299	-0.0518	0.1792	-	-	-	0.5227	-	-	-
SMD	35 1766	-	-	-	-	2.0255	-	-	-	-1.0819	-	-	-
SMD	35 2003	0.2039	0.3243	0.0536	-0.1752	-0.2456	-	-	-	-1.8842	-	-	-
SMD	35 2543	0.0114	0.1670	-0.0631	0.1216	0.2802	-	-	-	-	-	-	-
SMU	36 1193	-0.1616	0.2489	0.7743	0.1447	-0.1543	-0.8980	-0.1907	-0.0838	-0.0859	-0.0743	-0.0180	0.4743
SP	35 0572	-0.2600	-0.1409	0.0806	0.1741	-0.0043	-0.0548	-0.1860	-0.0399	0.1519	0.0993	-0.1301	-0.1981
SP	35 0641	0.1891	-0.0824	-0.2022	-0.7159	-0.6921	-0.6188	-0.1171	0.2329	0.2582	-0.0699	-0.1878	0.1331
SP	35 1188	0.1419	-0.0722	-0.5036	-0.5674	-0.8641	-1.1936	-1.4257	-0.9971	-0.5807	-0.2545	-0.1612	-0.0580
SP	35 1642	-0.1459	-0.1286	-0.3802	-0.1537	0.0577	0.0569	0.0113	-0.0645	0.0591	-0.1463	-0.0002	-0.0416
SP	35 2166	0.1522	0.2713	0.2349	0.1363	-0.0881	-0.2611	-0.1111	-0.0746	-	-	-	-
SP	36 0223	-0.2872	-0.0082	0.4631	0.1912	0.0791	-0.1213	0.2462	0.7360	0.1318	-0.0852	-0.7074	0.0272
SP	36 1175	0.1057	-0.0357	-0.2861	-0.2835	0.1393	0.5017	-0.2068	-0.6532	-0.5267	0.3306	0.2273	0.4949
SP	36 1187	-	-	-	-0.5531	-0.5638	0.0146	-0.1114	0.1323	0.5765	1.2613	1.1544	0.7136
SP	36 1531	-	-	-	-0.8720	0.0937	-0.6413	-0.4542	-0.3568	0.0099	0.1727	0.3556	0.4687
SP	36 2068	-0.1426	-0.1219	0.2275	0.6529	0.0207	-0.2545	0.8616	0.5697	-0.1601	-0.0900	0.4344	0.4425
SP	36 2218	0.3645	-0.2073	-0.2218	-0.3509	0.0738	-0.0011	0.2112	0.1062	0.3579	0.1340	-0.1256	-0.1756
SP	36 2295	0.2427	-0.1338	-0.1817	0.3073	0.2317	0.0515	-0.4943	0.0750	-0.2884	0.4453	0.7228	0.4610
SP	36 2297	0.1365	0.0542	-0.1002	-0.3191	0.0560	0.0094	-0.2119	-0.2735	0.2762	0.1033	0.1278	-0.1268
SP	40 7201	2.0984	1.9974	1.8918	2.0236	2.2661	2.4066	2.3104	2.2673	2.2870	2.3302	2.3377	2.4204
SP	40 7203	0.8723	0.8722	0.8170	0.8583	0.7983	0.8084	0.8220	0.8139	0.8220	0.8569	0.8090	0.8396
SP	40 7210	2.9506	2.9243	2.6762	2.7714	2.4435	2.5249	2.9670	2.8189	2.7053	2.5936	2.2751	2.5091
SP	40 7211	1.3001	1.3348	1.3561	1.4062	1.3792	1.3875	1.3553	1.3406	1.2820	1.3202	1.2577	1.2309

Table 10. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
SP	40 7212	0.5349	0.5070	0.4831	0.5105	0.4661	0.4814	0.4903	0.5156	0.4753	0.4986	0.4246	0.4135
SP	40 7218	-1.0999	-1.1574	-1.0438	-1.2217	-1.0574	-4.9847	-4.9280	-	0.5903	-0.2508	-0.4161	-0.3117
SP	40 7221	0.1054	0.1226	0.0727	0.1610	0.1896	0.1718	0.1637	0.1556	0.2086	0.2236	0.1620	0.1335
SU	40 3809	0.2532	0.2878	0.2883	0.3088	0.3078	-	-	-	-	-	-	-
SU	40 3810	-5.1945	-3.7633	0.1266	0.0525	0.0620	0.0843	0.0781	0.1723	0.1470	0.1819	0.1394	0.1718
SU	40 3811	0.9575	1.1830	1.1278	1.1378	1.0913	1.0518	0.9803	1.0229	0.9835	1.0449	0.9688	0.9752
SU	40 3812	-	-	-	0.3574	0.2678	0.3131	-	0.1763	0.1556	0.2377	0.2299	0.2656
SU	40 3814	0.3930	0.4814	0.5631	1.0322	0.9009	0.9475	0.7337	0.6122	0.7470	0.7886	0.7290	0.7787
SU	40 3815	0.5556	0.5850	0.6260	0.5435	0.6209	0.6727	0.6537	0.6939	0.5820	0.5736	0.4873	0.5178
SU	40 3816	0.5627	0.2687	0.4501	0.4479	0.5652	0.6379	0.6154	0.6806	0.5553	0.5769	0.5429	0.5891
TCC	35 0768	-1.0426	0.3975	0.7869	0.6799	-0.1636	-0.9036	-0.0482	0.0968	0.8682	0.1903	-0.1120	0.5885
TCC	35 1881	0.0367	0.1208	0.1162	0.1207	-0.3183	-0.0860	0.2220	0.1610	-0.1850	-0.2467	-0.0918	-0.1125
TCC	40 8620	0.2845	1.0652	1.0292	1.1696	0.5096	-0.0056	-0.0413	-0.0644	0.6586	0.2819	0.1881	0.3335
TCC	40 8624	-	0.3366	-0.0305	-0.0563	-0.0713	-0.0386	0.0653	0.0656	-0.0730	-0.2164	-0.2588	-0.1796
TCC	40 8650	-0.9120	-0.6774	-0.7221	-0.6756	-0.9374	-0.4525	-0.3446	-0.2844	0.0070	-0.7914	-0.7493	-0.5622
TL	35 1012	-0.1837	-0.2803	-0.3087	0.2511	0.1420	0.2018	0.1174	-0.0828	-0.4580	-0.5880	-0.3317	0.1036
TL	35 1104	-0.0630	-0.3201	-0.8726	-0.9449	-0.3134	-	-	-	-	-	-	-
TL	35 1132	0.4930	0.7882	0.3220	-0.0235	-0.0833	-0.4489	-0.2588	0.4676	0.7974	0.8088	0.0754	-0.0095
TL	35 1498	0.1038	-0.0016	-0.0320	0.0287	0.1936	0.2861	0.0671	-0.1412	-0.1261	0.0952	0.0034	-0.2303
TL	35 1500	-0.5228	-0.2725	-0.1486	0.1716	0.1009	-0.1179	-0.1220	0.8385	0.3516	0.0203	-0.6460	-0.1891
TL	35 1712	0.1348	0.4582	0.2642	0.4235	0.4881	0.4660	0.3290	0.0786	-	-	-	-
TL	35 2365	-0.0739	0.1309	-0.0509	0.1146	-0.1575	-0.0945	-0.1681	-0.0547	-0.0115	-0.0319	-0.0203	-0.0457
TL	35 2366	-0.3422	-0.1851	-0.2368	-0.0008	0.0878	0.3186	0.2717	0.3743	0.2996	-0.1450	-0.3256	0.0707
TL	35 2367	-0.0488	-0.0855	-0.0225	-0.1078	0.1991	0.0544	0.1540	0.1738	0.3177	0.1685	-0.2142	-0.0537
TL	35 2368	0.1294	-0.1004	0.1995	0.2412	-0.0066	-0.2296	-0.4730	-0.3534	-0.1638	-0.0136	0.0124	-0.2462
TL	35 2630	0.2879	0.0103	-0.1738	0.2455	0.4290	0.3494	0.1556	0.0703	0.1050	0.1270	0.1222	0.0584
TL	35 2634	0.7861	-0.2726	0.2947	-0.3007	1.1963	0.6844	0.1182	-0.6705	0.4728	0.9440	0.3621	0.4105
TL	35 2636	-0.1489	-0.3725	-0.2586	0.1287	0.0713	-0.0163	-0.2827	-0.1216	-0.3989	-0.3217	-0.3640	-0.0433
TL	35 2853	-	-	-	-	-2.4694	-0.3592	-0.1622	0.0255	0.2731	0.4660	0.3508	0.1140
TL	40 0057	-1.2274	-1.5383	-1.7273	-1.8217	-1.6643	-1.6125	-1.6213	-1.8194	-1.9664	-1.8931	-1.9493	-1.9274
TL	40 3052	0.0393	-0.0878	-0.3639	-0.1765	-0.1878	-0.0612	-0.2630	-0.2344	-0.0097	0.1152	0.0803	0.0656
TL	40 3053	0.1088	-	-	-	-	-	-	-	-	-	-	-
TP	35 0163	-	-	-	-0.1382	0.1574	0.1908	0.2263	0.0170	0.2873	0.2160	0.0854	-0.6370
TP	35 1227	-0.0908	-0.0403	0.0935	-0.0350	0.1795	0.1873	0.2200	-0.1763	-0.3167	-0.2876	0.0864	-0.0978
TP	35 2476	0.2212	-0.1679	-0.2347	-0.0424	0.0158	-0.0068	0.0818	-0.0555	-0.0428	-0.0529	0.1264	-0.1520

Table 10. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
TP	36 0154	-0.8042	-0.3298	0.0259	0.2166	-0.1303	-0.4393	-0.2604	-0.1559	0.2611	0.0346	-0.2941	0.2944
UA	35 2465	-0.4366	-0.4613	-0.4140	-0.2769	-0.0307	0.3563	0.9294	0.6668	0.4642	-0.5928	-0.2540	-0.0258
UA	40 7854	-0.0199	0.2130	-1.0682	0.2549	0.2922	0.9057	-0.1263	-0.4894	0.6270	-0.0981	-0.6432	-1.6700
UA	40 7881	-2.8755	-1.0826	-1.2021	0.6548	0.8678	0.7249	-0.4180	-0.6694	-0.5080	-0.6348	-0.0658	-0.6370
UA	40 7882	0.6097	-0.4009	-0.4543	-0.0269	-0.6174	-0.0856	0.0337	0.1123	0.3570	-0.4148	-0.5214	-0.5100
UME	35 0251	-0.1948	-0.1927	-0.0266	0.1621	0.1532	0.0699	0.0732	0.1281	0.1890	0.1192	0.0922	0.2967
UME	35 0252	0.2139	0.2110	0.1508	-0.0197	0.1600	0.4223	0.6034	0.7706	0.1877	-0.2428	-0.4852	-0.2528
UME	35 0710	-0.0098	-0.1415	0.0180	0.2322	0.1526	0.0324	0.1157	0.3788	0.2693	0.0873	-0.1271	0.1098
UME	35 2703	0.1551	-0.1170	-0.0520	0.2376	0.3781	0.3361	0.2705	0.1465	0.1303	0.0201	-0.0279	-0.0637
USNO	35 0101	0.0070	0.2326	-0.2901	-0.9048	-0.6863	0.2447	0.4548	0.6457	0.7910	0.7062	0.2704	-0.6040
USNO	35 0104	-0.0905	-0.0057	-0.2693	-0.7125	-1.2860	-1.2907	-0.4504	-0.0812	-0.1932	-0.0331	0.5377	0.1652
USNO	35 0106	-	-	-	-	-	-	-	-	-	-	1.3606	0.7399
USNO	35 0108	0.1773	-0.0883	-0.0370	0.2593	0.2600	-0.4802	-0.2454	0.1052	0.3900	0.0638	-0.1685	-0.1025
USNO	35 0114	-0.0645	-0.5686	-0.1265	0.0902	-0.0189	-0.6746	-0.1967	0.0264	0.2300	0.3397	-0.2487	-
USNO	35 0120	-0.1364	0.0263	0.1661	0.1632	-0.1120	-0.1742	0.1304	-0.1183	-0.0683	-0.0275	0.1726	-0.0347
USNO	35 0142	-0.2743	-0.1063	-0.2720	-0.2970	-0.6413	-0.2087	0.0868	0.1402	-0.0556	-0.1430	0.1008	0.0774
USNO	35 0145	0.2885	-	-	-	-	-	-	-	-	-	1.8509	0.0073
USNO	35 0146	-0.1782	-0.3324	-0.1493	0.0779	0.3329	0.1357	0.1825	-0.1063	-0.0604	-0.0791	0.1279	-
USNO	35 0148	-0.0293	0.2002	0.3129	0.5223	0.3823	0.2581	0.1549	0.1315	-0.0184	-0.0190	0.2473	0.4390
USNO	35 0150	-0.4987	-0.4105	-0.1321	-0.2381	-0.3858	-0.4730	0.1409	-0.0186	0.2175	0.1133	0.4998	0.0941
USNO	35 0152	0.5372	0.3659	-0.3026	-0.4716	0.1462	0.2077	0.4152	0.5132	0.4271	-0.0467	-0.3587	-0.5231
USNO	35 0153	-	-	-	-	-	-	-	-	-	-	3.7915	0.3975
USNO	35 0156	-0.4219	-0.0968	-0.1417	-0.0706	0.0605	0.0570	-0.1031	-0.1385	-0.0939	0.1454	0.1336	0.1015
USNO	35 0161	-0.0706	0.0945	0.2158	0.1092	0.0109	0.0974	0.5204	0.1891	-0.6189	-0.4414	0.4587	0.9497
USNO	35 0165	-0.1582	-0.0838	-0.5136	-0.3615	0.2886	0.8045	0.4779	0.0377	0.0152	0.0043	0.2730	-0.1168
USNO	35 0166	0.1213	0.0082	0.3183	-0.0076	0.0575	0.5389	1.0403	0.5039	0.0585	0.3904	0.3075	-0.2369
USNO	35 0169	0.2257	0.0942	0.1305	0.3482	0.2147	0.2087	0.0702	0.1840	-0.0577	0.1788	0.2002	0.3033
USNO	35 0173	0.1471	0.0196	-0.2046	-0.1698	-0.0804	-0.0065	-0.0563	0.0625	-0.2122	-0.1857	0.0013	0.1099
USNO	35 0213	-0.0581	0.2855	0.0741	0.0854	0.1018	0.1144	-0.0932	-0.1723	0.0243	-0.2969	-0.0954	0.5477
USNO	35 0217	0.3387	0.0814	-0.0409	0.0508	0.1190	-0.1634	0.0053	0.0878	0.1110	-0.0040	-	-
USNO	35 0226	-0.2457	-0.3052	-0.0875	0.1677	-0.3146	-1.2177	-1.0042	-0.5543	-0.0017	0.3780	0.0446	-0.4359
USNO	35 0227	-0.3895	0.0139	0.2673	0.0129	-0.1590	0.3178	0.5239	0.4196	0.4370	0.1385	-0.0797	0.2033
USNO	35 0231	0.9733	0.0602	0.0143	-0.1561	-0.0412	-0.0432	-0.1324	-0.0871	-0.1224	0.2702	0.1640	0.0029
USNO	35 0233	-0.0559	-0.2130	0.0388	-0.1250	0.0249	-0.1536	-0.3931	-0.9068	-0.9048	-0.5773	-0.0016	-0.1544
USNO	35 0242	0.1634	-0.0982	-0.1193	-0.0848	0.5305	0.3891	0.0652	-0.0718	0.0294	0.1810	-0.2714	0.0469

Table 10. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
USNO	35 0244	-0.0267	0.1377	0.4196	0.1862	0.2208	-0.1432	-0.7732	-0.9510	-0.1849	0.2369	-0.0958	-0.3531
USNO	35 0253	0.1058	-0.1732	-0.1682	-0.2753	-0.0866	-0.2351	0.0996	-0.2829	-0.2216	0.0264	-0.0011	0.0055
USNO	35 0254	-0.3898	-0.0231	0.0167	-0.0334	-0.1304	0.0246	-0.0286	0.0454	-0.1032	-0.0389	-0.2546	-0.1683
USNO	35 0255	0.0189	0.0455	0.1105	-0.0267	0.0006	0.0682	0.1585	0.0989	0.0718	-0.0922	-0.2196	-0.0820
USNO	35 0256	0.2340	0.0557	-0.0916	0.1737	0.2731	0.2029	0.0292	-0.1938	0.0189	0.1751	0.1034	-0.1714
USNO	35 0260	-	-	-	-	-	-	-	-	-	-	-	1.2869
USNO	35 0266	0.7668	0.6252	0.4263	0.1398	0.2591	0.2469	-0.1900	-0.1061	-0.0636	0.1282	-0.3308	-0.1722
USNO	35 0268	0.0655	0.2566	-0.0632	-0.1638	-0.0158	0.2271	0.1714	-0.0070	-0.1495	-0.2208	-0.0353	0.0404
USNO	35 0270	-0.0066	-0.0418	0.2816	0.3043	0.2381	0.0670	0.0008	0.0449	-0.0137	0.1928	0.2191	-0.0452
USNO	35 0279	-0.0927	-0.0160	0.1562	-0.0788	-0.0294	0.3826	0.6232	0.3296	0.1578	-0.2358	-0.4894	-0.4721
USNO	35 0389	0.3172	0.1307	0.3141	0.5122	0.3232	0.4193	0.2700	0.1709	0.1451	0.4522	0.4916	0.1816
USNO	35 0392	0.3572	1.8199	1.3401	0.6564	-0.0353	0.9574	0.7228	0.2598	0.0807	-	-	-
USNO	35 0394	-	-	-	-	-	-0.9805	-1.7734	-1.3122	-0.5895	0.0410	0.0875	-0.5645
USNO	35 0416	0.1375	-0.1636	0.2645	0.3153	0.1078	0.2615	0.2383	0.5966	0.3435	0.2046	-0.3030	-0.0461
USNO	35 0417	0.1646	-0.0821	-0.1549	-0.0572	0.6013	1.0402	0.9094	0.1876	-0.1578	-0.1829	0.2720	0.1367
USNO	35 0703	0.2383	0.0215	0.6481	0.4298	0.3658	0.2432	0.5299	0.4812	0.2217	0.0736	0.2789	0.3406
USNO	35 0717	-	-	-0.8772	-0.7092	-0.6038	-0.3684	0.0570	0.3156	0.1527	0.1306	0.3254	0.5084
USNO	35 0762	0.0801	0.1592	-0.1106	-0.0057	-0.0268	0.1421	-0.0561	0.2348	0.0479	0.0364	0.0174	0.0335
USNO	35 0763	0.0561	0.2618	0.2310	0.3232	-0.1772	-0.1255	0.1348	0.3072	-0.0051	-0.0556	0.1275	-0.0245
USNO	35 0765	0.1693	0.2686	0.4334	0.0804	-0.4653	-0.5211	0.0514	0.4251	0.4426	0.3006	0.1278	0.0747
USNO	35 1096	0.3781	0.3245	-0.1699	-0.0270	0.2385	0.1076	-0.0256	-0.0162	0.0340	-0.0178	-0.0456	0.1222
USNO	35 1097	0.1046	0.0333	-0.0985	-0.2808	-1.0439	-1.1949	-0.3669	0.1916	0.1249	0.0037	-0.0508	0.1966
USNO	35 1125	-0.7451	-0.2345	0.3040	-0.1189	-0.3275	1.7119	4.8970	4.7573	2.9035	0.5580	0.4948	-0.0174
USNO	35 1327	-0.1166	-0.3691	0.0353	0.4473	0.1950	-0.3148	-0.3928	-0.0804	-0.1116	0.2423	0.3083	0.2868
USNO	35 1328	0.0601	0.0701	0.3445	0.6008	0.6663	0.3168	-0.0648	-0.3206	-0.1796	0.1026	0.1606	0.4209
USNO	35 1331	0.5797	0.8398	0.0220	-0.1632	0.0264	0.5247	-0.2385	-0.4004	-0.3505	0.0093	-0.2083	-0.0856
USNO	35 1438	0.0523	-	-	-	-	-	-	-	-	-	3.2875	-0.4269
USNO	35 1459	0.0863	0.1913	0.6478	0.8795	1.4117	0.0625	-1.7342	-1.3242	-0.2152	-0.1074	-1.2563	-0.7195
USNO	35 1462	0.5625	0.4223	-0.1580	-0.0740	-0.0256	0.3341	-0.1340	0.1199	-0.3093	0.0259	0.0328	0.3059
USNO	35 1463	0.1421	-0.0395	-0.2098	-0.0138	-0.8002	-1.0492	-0.7129	0.0906	0.2394	0.1925	-0.1040	-0.1141
USNO	35 1468	0.0679	-0.2465	-0.1224	0.0743	-	-	-	-	-	-	1.1001	-
USNO	35 1481	0.0556	0.0518	-0.2071	-0.0240	0.1266	-0.1814	-0.0992	0.0422	0.0139	-0.1745	-0.1810	0.0692
USNO	35 1543	-0.0988	-0.0557	0.1010	0.2137	0.0963	0.1496	0.3648	0.1676	0.0335	-0.0635	-0.2586	-0.2324
USNO	35 1573	-0.0602	0.1930	0.3809	-0.0092	-0.3139	-0.1946	-0.3056	-0.4791	-0.0352	0.2024	0.1125	-0.2324
USNO	35 1575	0.2186	0.1690	-0.0071	0.1388	0.2101	0.1174	-0.1043	-0.1094	-0.0712	0.0593	0.0755	-0.0614

Table 10. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
USNO	35 1580	0.0779	0.2630	-0.2262	-0.0174	0.1539	0.4688	0.1535	-0.0802	0.1185	-0.1870	0.0952	0.0107
USNO	35 1585	0.5327	0.2847	-0.0539	0.3104	0.5276	0.5304	0.0837	0.1831	0.2645	0.5447	0.3555	0.3644
USNO	35 1598	-0.0852	0.0022	-0.1595	-1.3815	-3.4123	-3.9415	-2.3423	-0.2169	0.1425	0.1071	0.0792	-0.0299
USNO	35 1658	0.1382	-0.2103	-0.7660	-0.5898	-0.0873	0.1993	0.1782	-0.0420	0.2552	0.3098	0.3739	0.2131
USNO	35 1692	0.1234	0.0029	-0.2949	-0.1642	0.1239	0.0383	-0.2048	-0.1581	0.0156	-0.3105	-0.3186	-0.2134
USNO	35 1694	-0.1236	0.0756	0.2023	-0.0210	-0.0852	-0.0871	0.1634	0.0781	0.1965	-0.1187	-0.0294	-0.0783
USNO	35 1696	-0.0672	0.0790	-0.0912	0.0098	0.1926	-0.0122	-0.2867	-0.2845	-0.2624	-0.2204	-0.3218	-0.5529
USNO	35 1697	0.0938	0.1541	0.2920	0.0384	0.0498	0.1686	0.1899	0.1386	0.1852	0.1376	-0.0306	0.0313
USNO	40 0702	0.1575	0.0844	0.0396	0.1262	0.0818	0.0536	0.0737	0.1172	0.0836	0.1202	0.0160	0.0465
USNO	40 0704	0.0810	0.1417	0.0396	0.1105	0.0835	0.0466	0.0454	0.0306	0.0970	0.1619	-0.0536	-0.0248
USNO	40 0705	-0.5886	-0.5383	-0.3465	-0.0652	0.1235	0.0953	0.1120	0.1589	0.1920	0.2552	0.1951	0.1422
USNO	40 0710	0.5749	-0.2130	-0.7778	-0.8895	-0.2539	0.0762	2.6987	4.9106	7.3203	8.4286	8.4073	8.3439
USNO	40 0711	3.0271	3.2304	3.3196	2.9070	3.1809	3.4449	3.4453	3.0722	3.1220	3.3486	4.0994	3.8170
USNO	40 0712	0.0149	-0.0043	-0.0195	0.0531	0.0661	0.0327	0.0037	-0.0377	-0.0164	0.0252	0.0038	0.0256
USNO	40 0713	0.4132	0.3818	0.3335	0.4096	0.4365	0.3927	0.4137	0.4822	0.4103	0.4636	0.3986	0.4152
USNO	40 0714	0.4080	0.2113	0.1509	0.2462	0.2435	0.2066	0.2370	0.2856	0.2920	0.2752	0.2316	0.2274
USNO	40 0715	0.5001	0.4774	0.4083	0.4514	0.4330	0.4414	0.4504	0.9722	0.9486	0.9736	0.7220	0.3909
USNO	40 0716	0.1784	0.1313	0.1057	0.1192	0.1583	0.1092	0.1354	0.1956	0.0886	0.1369	0.0786	0.0761
USNO	40 0718	1.2340	1.2322	1.1666	1.2392	1.2348	1.2570	1.2937	1.3306	1.3386	1.3836	1.3551	1.3856
USNO	40 0719	0.9767	0.9696	0.9196	1.0218	0.9704	1.0031	0.9970	0.9689	0.9686	0.9936	0.9464	0.9509
USNO	40 0720	2.0465	2.0826	2.0918	2.1818	2.1583	2.1301	2.0870	2.0023	2.0370	2.0602	-	-
USNO	40 0721	5.7175	5.6530	5.3440	6.0688	5.7531	5.7770	5.4353	5.5989	5.8270	5.5802	5.4820	7.5526
USNO	40 0722	2.8758	2.7696	2.7544	2.8131	2.8487	2.8223	2.8187	2.7323	2.7136	2.7436	2.6925	2.7526
USNO	40 0723	0.0810	0.0635	-0.0073	0.0601	0.0765	0.1110	0.1420	0.5856	0.5603	0.5886	0.3898	0.1144
USNO	40 0724	-0.1225	-0.2044	-0.2560	-0.1886	-0.2226	-0.2438	-0.2213	0.0806	1.4653	1.4386	1.4507	0.1439
USNO	40 0725	0.1888	0.0200	0.0970	0.1436	0.1079	0.1023	0.1654	0.1939	0.1753	0.1202	0.1933	0.1126
USNO	40 0728	2.6549	2.7591	2.8205	2.9366	2.9513	2.9771	2.9903	2.9856	2.9853	3.0019	2.7255	3.0709
USNO	40 0730	3.0862	3.0739	3.0466	3.1331	3.1670	3.1788	3.2020	3.2106	3.1686	3.1786	3.0855	3.0796
USNO	40 0731	-0.5103	-0.5226	-0.5204	-0.4930	-0.4417	-0.4438	-0.4280	-0.4111	-0.4530	-0.3881	-0.3962	-0.3743
USNO	40 0732	1.9610	1.9800	1.8692	1.9731	2.1061	2.1736	2.0720	2.3639	2.3420	2.3952	2.3412	2.3926
USNO	40 0734	-	-	-	-	-	5.7865	7.0881	6.5720	5.8236	4.2102	2.4681	1.3683
USNO	40 0735	0.6827	0.6965	0.9283	1.3436	1.5113	1.7857	1.8820	2.0256	2.2086	2.2952	2.2699	2.2987
USNO	93 0002	0.1133	0.0631	0.0034	0.0119	0.0311	0.0401	0.0162	0.0235	0.0242	0.0140	-0.0208	-0.0114
USNO	93 0003	0.0208	-0.0430	-0.0555	-0.0487	-0.0134	0.0007	0.0044	0.0056	0.0103	0.0062	-0.0107	-0.0059
USNO	93 0004	0.1168	0.0069	-0.0387	-0.0267	0.0061	0.0257	0.0035	0.0030	0.0058	0.0205	-0.0033	-0.0063

Table 10. (Cont.)

Lab.	Clock	55954	55984	56014	56044	56074	56104	56139	56169	56199	56229	56259	56289
USNO	93 0005	0.0756	-0.0044	-0.0436	-0.0251	-0.0042	0.0204	0.0028	0.0118	0.0077	0.0203	-0.0062	-0.0055
VMI	35 2230	-0.1028	0.7120	1.1078	-0.0420	-0.1487	-0.4640	-	1.8386	-1.4910	0.3677	0.8266	-
VMI	36 1233	0.2959	0.9021	1.0122	-0.6886	-0.6334	-0.5601	-	7.4580	-3.0099	-0.0644	0.0921	-
VMI	36 2314	-0.1067	0.3830	0.4269	-0.3663	-0.0296	0.3620	-	-1.6791	-2.1229	0.2398	0.4257	-
VSL	35 0179	-0.1430	-0.2480	-0.1274	-0.2552	-0.0866	0.1539	0.1280	-0.0819	-0.2128	0.0682	0.1453	-0.0512
VSL	35 0456	-0.0725	0.1024	0.2890	0.3924	0.3565	0.3486	0.2218	0.2314	0.1340	0.0671	-0.2500	0.0685
VSL	35 0548	-0.1155	-0.1845	-0.1501	0.0232	0.0398	-0.1784	-0.2919	-0.3186	-0.2092	-0.0499	-0.0020	-0.2456
VSL	35 0731	-	-	-0.6269	-0.6329	-0.1660	-0.0083	0.1771	0.1679	0.0349	-0.1992	-0.2282	-0.0633
ZA	35 2232	-0.1234	-0.0031	-	-	-	-	-	-	-	-	-	-
ZA	35 2233	0.1290	0.0549	0.0407	-0.2993	-0.2153	-0.0146	0.1897	0.2829	0.0839	-0.0404	-0.2329	-
ZA	36 1034	-	-	-1.9709	-2.0183	-1.2882	-0.9398	-0.3474	0.0080	0.0965	1.6005	2.4888	-
ZA	36 1821	-0.1370	0.3802	0.3700	0.3222	-0.4054	-0.0964	-0.4595	0.2384	0.1417	0.5743	0.2446	-
ZA	36 2232	-	-	-	-	-	-	-	-	-	-	1.0658	-

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) 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 February and March 2013.

AUTHORITIES RESPONSIBLE FOR THE TIME SIGNAL EMISSIONS

Signal	Authority
BPM	National Time Service Center, NTSC Chinese Academy of Sciences 3 East Shuyuan Rd, Lintong District, Xi'an Shaanxi 710600, China
CHU	National Research Council of Canada Measurement Science and Standards Frequency and Time Standards Bldg M-36, 1200 Montreal Road Ottawa, Ontario, K1A 0R6, Canada
DCF77	Physikalisch-Technische Bundesanstalt Time and Frequency Department, WG 4.42 Bundesallee 100 D-38116 Braunschweig Germany
EBC	Real Instituto y Observatorio de la Armada Cecilio Pujazón s/n 11.110 San Fernando Cádiz, Spain
HLA	Center for Time and Frequency Division of Physical Metrology Korea Research Institute of Standards and Science 267 Gajeong-Ro, Yuseong, Daejeon 305-340 Republic of Korea
JJY	Space-Time Standards Laboratory National Institute of Information and Communications Technology 4 -2- 1, Nukui-kitamachi Koganei, Tokyo 184-8795 Japan
LOL	Servicio de Hidrografía Naval Observatorio Naval Buenos Aires Av. España 2099 C1107AMA – Buenos Aires, Argentina

Signal	Authority
MIKES	Centre for Metrology and Accreditation Tekniikantie 1 FI-02150 Espoo Finland
MSF	National Physical Laboratory Time Quantum and Electromagnetics Division Hampton Road Teddington, Middlesex TW11 0LW United Kingdom
RAB-99, RBU, RJH-63, RJH-69, RJH-77, RJH-86, RJH-90,RTZ,RWM	All-Russian Scientific Research Institute for Physical Technical and Radiotechnical Measurements FGUP “VNIIFTRI” Meendeleevo, Moscow Region 141570 Russia
STFS	National Physical Laboratory Dr. K.S. Krishnan Road New Delhi - 110012, India
TDF	CFHM Chambre française de l’horlogerie et des microtechniques 22 avenue Franklin Roosevelt 75008 Paris, France and LNE Laboratoire national de métrologie et d'essais 1 rue Gaston Boissier 75724 Paris Cedex 15, France
WWV, WWVB, WWVH	Time and Frequency Division, 847.00 National Institute of Standards and Technology - 325 Broadway Boulder, Colorado 80305, U.S.A.

TIME SIGNALS EMITTED IN THE UTC SYSTEM

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
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	The BPM time signals are generated by NTSC and are in accordance with UTC(NTSC)+8 h. Signals emitted in advance on UTC by 20 ms. Second pulses of 10 ms duration with 1 kHz modulation. Minute pulses of 300 ms duration with 1 kHz modulation. UTC time signals are emitted from minute 0 to 10, 15 to 25, 30 to 40, 45 to 55. UT1 time signals are emitted from minute 25 to 29, 55 to 59.
CHU	Ottawa Canada 45° 18'N 75° 45'W	3 330 7 850 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 9th pulses omitted. A bilingual (Fr. Eng.) announcement of time (UTC) is made each minute following the 50th second pulse. FSK code (300 bps, Bell 103) after 10 cycles of 1 kHz on seconds 31 to 39. Year, DUT1, leap second information, TAI-UTC and Canadian daylight saving time format on 31, and time code on 32-39. Broadcast is single sideband; upper sideband with carrier reinsert. DUT1 : ITU-R code by double pulse.
DCF77	Mainflingen Germany 50° 1'N 9° 0'E	77.5	continuous	The DCF77 time signals are generated by PTB and are in accordance with the legal time of Germany which is UTC(PTB)+1 h or UTC(PTB)+2 h. At the beginning of each second (except in the last second of each minute) the carrier amplitude is reduced to about 15% for a duration of 0.1 or 0.2 s corresponding to “binary 0” or “binary 1”, respectively, referred to as second marks 0 to 59 in the following. The number of the minute, hour, day of the month, day of the week, month and year are transmitted in BCD code using second marks 20 to the 58, including overhead. Information emitted during minute n is valid for minute n+1. The information transmitted during the second marks 1 to the 14 is provided by third parties. Information on that additional service can be obtained from PTB. To achieve a more accurate time transfer and a better use of the frequency spectrum available an additional pseudo-random phase shift keying of the carrier is superimposed on the AM second markers. No transmission of DUT1.
EBC	San Fernando Spain 36° 28'N 6° 12'W	15006 4998	10 h 00 m to 10 h 25 m 10 h 30 m to 10 h 55 m except Saturday, Sunday and national holidays.	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: ITU-R code by double pulse.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
HLA	Daejeon Rep. of Korea 36° 23'N 127° 22'E	5 000	continuous	Second pulses of 9 cycles of 1 800 Hz tones. 29th and 59th second pulses omitted. Hour identified by 0.8 s long 1 500 Hz tones. Beginning of each minute identified by 0.8 s long 1 800 Hz tones. BCD time code given on 100 Hz subcarrier.
JJY	Tamura-shi Fukushima Japan 37° 22'N 140° 51'E	40	Continuous	A1B type 0.2 s, 0.5 s and 0.8 s second pulses, spacings are given by the reduction of the amplitude of the carrier. Coded announcement of hour, minute, day of the year, year, day of the week and leap second. Transmitted time refers to UTC(NICT) + 9 h.
JJY	Saga-shi Saga Japan 33° 28'N 130° 11'E	60	Continuous	A1B type 0.2 s, 0.5 s and 0.8 s second pulses, spacings are given by the reduction of the amplitude of the carrier. Coded announcement of hour, minute, day of the year, year, day of the week and leap second same as JJY(40). Transmitted time refers to UTC(NICT) + 9 h.
LOL	Buenos Aires Argentina 34° 37'S 58° 21'W	10 000	14 h to 15 h except Saturday, Sunday and national holidays.	Second pulses of 5 cycles of 1000 Hz modulation. Second 59 is omitted. Announcement of hours and minutes every 5 minutes, followed by 3 minutes of 1000 Hz or 440 Hz modulation. DUT1: ITU-R code by lengthening.
MIKES	Espoo Finland 60° 11'N 24° 50'E	25 000	Continuous	Modulation as in DCF77, time code in UTC.
MSF	Anthorn United Kingdom 54° 54'N 3° 16'W	60	Continuous, except for interruptions for maintenance from 10 h 0 m to 14 h 0 m on the second Thursday of December and March, and from 09 h 0 m to 13 h 0 m on the second Thursday of June and September. A longer period of maintenance during the summer is announced annually.	The carrier is interrupted for 0.1 s at the start of each second, except during the first second of each minute (second 0) when the interruption is 0.5 s. Two data bits are transmitted each second (except second 0): data bit “A” between 0.1 and 0.2 s after the start of the second and data bit “B” between 0.2 and 0.3 s after the start of the second. Presence of the carrier represents “binary 0” and an interruption represents “binary 1”. The values of data bit “A” provide year, month, day of the month, day of the week, hour and minute in BCD code. The time represented is UTC(NPL) in winter and UTC(NPL)+1h when DST is in effect. The values of data bit “B” provide DUT1 and an indication whether DST is in effect. The information transmitted applies to the following minute. DUT1: ITU-R code by double pulse.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
RAB-99	Khabarovsk Russia 48° 30'N 134° 50'E	25.0 25.1 25.5 23.0 20.5	01 h 06 m to 01 h 36 m 05 h 06 m to 05 h 36 m	A1N type signals are transmitted between minutes 9 and 20 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 9 and 11; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 11 and 20.
RBU	Moscow Russia 56° 44'N 37° 40'E	200/3	Continuous	DXXXW type 0.1 s signals. The numbers of the minute, hour, day of the month, day of the week, month, year of the century, difference between the universal time and the local time, TJD and DUT1+dUT1 are transmitted each minute from the 1st to the 59th second. DUT1+dUT1 : by double pulse.
RJH-63	Krasnodar Russia 44° 46'N 39° 34'E	25.0 25.1 25.5 23.0 20.5	10 h 06 m to 10 h 40 m	A1N type signals are transmitted between minutes 9 and 20 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 9 and 11 ; 0.1 second pulses of 25 ms duration, 10 second pulses of 1 s duration and minute pulses of 10 s duration are transmitted between minutes 11 and 20.
RJH-69	Molodechno Belarus 54° 28'N 26° 47'E	25.0 25.1 25.5 23.0 20.5	06 h 06 m to 06 h 47 m	A1N type signals are transmitted between minutes 10 and 22 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 10 and 13; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 13 and 22.
RJH-77	Arkhangelsk Russia 64° 22'N 41° 35'E	25.0 25.1 25.5 23.0 20.5	08 h 06 m to 08 h 47 m	A1N type signals are transmitted between minutes 10 and 22 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 10 and 13; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 13 and 22.
RJH-86	Bishkek Kirgizstan 43° 03'N 73° 37'E	25.0 25.1 25.5 23.0 20.5	03 h 06 m to 03 h 47 m 09 h 06 m to 09 h 47 m	A1N type signals are transmitted between minutes 10 and 22 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 10 and 13; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 13 and 22.
RJH-90	Nizhni Novgorod Russia 56° 11'N 43° 57'E	25.0 25.1 25.5 23.0 20.5	07 h 06 m to 07 h 47 m	A1N type signals are transmitted between minutes 10 and 22 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 10 and 13; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 13 and 22.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
RTZ	Irkutsk Russia 52° 26'N 103° 41'E	50	00 h 00 m to 18 h 00 m 19 h 00 m to 24 h 00 m	DXXXW type 0.1 s signals. The numbers of the minute, hour, day of the month, day of the week, month, year of the century, difference between the universal time and the local time, TJD and DUT1+dUT1 are transmitted each minute from the 1st to the 59th second. DUT1+dUT1: by double pulse.
RWM (2)	Moscow Russia 56° 44'N 37° 38'E	4 996 9 996 14 996	The station operates simultaneously on the three frequencies.	A1X type second pulses of 0.1 s duration are transmitted between minutes 10 and 20, 40 and 50. The pulses at the beginning of the minute are prolonged to 0.5 s. A1N type 0.1 s second pulses of 0.02 s duration are transmitted between minutes 20 and 30. The pulses at the beginning of the second are prolonged to 40 ms and of the minute to 0.5 ms. DUT1+dUT1: by double pulse.
STFS	Sikandrabad India 28° 28'N 77° 13'E	2 599 675	continuous	Pulse width modulated binary coded 5 kHz pulses carrying information on Indian Standard Time – IST (UTC + 5 h 30 m), Time of Day and current position coordinates of the satellite. Pulse repetition rate is 100 pps. The above format is frequency modulated on the carrier.
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 +1 and -1 rd 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 1 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.

(2) RMW is the radiostation emitting DUT1 information in accordance with the ITU-R 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 21st and 24th second so that dUT1 = +*p* x 0.02 s.
Negative values of dUT1 are transmitted by the marking of *q* second markers within the range between the 31st and 34th second, so that dUT1 = -*q* x 0.02 s.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UTC)	Form of the signal
WWV	Fort-Collins CO, USA 40° 41'N 105° 3'W	2 500 5 000 10 000 15 000 20 000	continuous	Second pulses are 1 000 Hz tones, 5 ms in duration. 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 tones. DUT1: ITU-R code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction.
WWVB	Fort-Collins CO, USA 40° 41'N 105° 3'W	60	continuous	Second pulses given by reduction of the amplitude and by binary phase shift keying of the carrier, AM and BPSK coded announcement of the date, time, DUT1 correction, daylight saving time in effect, leap year and leap second.
WWVH	Kauai HI, USA 21° 59'N 159° 46'W	2 500 5 000 10 000 15 000	continuous	Second pulses are 1 200 Hz tones, 5 ms in duration. 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 1 200 Hz tones. DUT1: ITU-R code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction.

ACCURACY OF THE CARRIER FREQUENCY

Station	Relative uncertainty of the carrier frequency in 10^{-10}
BPM	0.01
CHU	0.05
DCF77	0.02
EBC	0.1
HBG	0.02
HLA	0.02
JJY	0.01
LOL	0.1
MIKES	0.01
MSF	0.02
RAB-99,RJH-63	0.05
RBU,RTZ	0.02
RJH-69, RJH-77	0.05
RJH-86, RJH-90	0.05
RWM	0.05
STFS	0.1
TDF	0.02
WWV	0.01
WWVB	0.01
WWVH	0.01

TIME DISSEMINATION SERVICES

The following tables are based on information received at the BIPM between February and April 2013.

AUTHORITIES RESPONSIBLE FOR THE TIME DISSEMINATION SERVICES

AOS	Astrogeodynamical Observatory Borowiec near Poznan Space Research Centre P.A.S. PL 62-035 Kórnik - Poland
AUS	Electricity Section National Measurement Institute PO Box 264 Lindfield NSW 2070 - Australia
BelGIM	Belarussian State Institute of Metrology National Standard for Time, Frequency and Time-scale of the Republic of Belarus Minsk, Minsk Region – 220053 Belarus
BEV	Bundesamt für Eich- und Vermessungswesen Arltgasse 35 A-1160 Wien , Vienna - Austria
CENAM	Centro Nacional de Metrología km. 4.5 Carretera a Los Cués El Marqués, Querétaro, C.P. 76246 - México
CENAMEP	Centro Nacional de Metrología de Panamá AIP CENAMEP AIP Ciudad del Saber Edif. 215 Panamá
DMDM	Directorate of Measures and Precious Metals Group for Time, Frequency and Time Dissemination. Mike Alasa 14 11000 Belgrade Serbia
EIM	Hellenic Institute of Metrology Electrical Measurements Department Block 45, Industrial Area of Thessaloniki PO 57022, Sindos Thessaloniki, Greece
GUM	Time and Frequency Laboratory Electricity Department Główny Urząd Miar – Central Office of Measures ul. Elektoralna 2 PL 00 – 950 Warszawa P–10, Poland
HKO	Hong Kong Observatory 134A, Nathan Road Kowloon, Hong Kong, China
IGNA	Instituto Geográfico Nacional Argentino Servicio Internacional de la Hora General Manual N. Savio 1898 B1650KLP – Villa Maipú, Provincia de Buenos Aires, Argentina

INPL	National Physical Laboratory Danciger A bldg Givat - Ram, The Hebrew university 91904 Jerusalem, Israel
INRIM	Istituto Nazionale di Ricerca Metrologica Strada delle Cacce, 91 I – 10135 Torino, Italy
KIM	Puslit Kalibrasi, Instrumentasi dan Metrologi -- Lembaga Ilmu Pengetahuan Indonesia Research Centre for Calibration, Instrumentation and Metrology -- Indonesian Institute of Sciences (Puslit KIM – LIPI) Kawasan PUSPIPTEK Serpong Tangerang 15314 Banten - Indonesia
KRISS	Center for Time and Frequency Division of Physical Metrology Korea Research Institute of Standards and Science 267 Gajeong-Ro, Yuseong Daejeon 305-340 Republic of Korea
KZ	Kazakhstan Institute of Metrology Orynbor str., 11 Astana, Republic of Kazakhstan
LNE-SYRTE	Laboratoire National de Métrologie et d’Essais Systèmes de Référence Temps-Espace Observatoire de Paris 61, avenue de l’Observatoire, 75014 Paris – France
LT	Time and Frequency Standard Laboratory Center for Physical Sciences and Technology – State Metrology Service A. Goštauto 11 Vilnius LT01108, Lithuania
METAS	Federal Office of Metrology Length, Optics and Time Section Lindenweg 50 CH-3003 Bern-Wabern Switzerland
MIKES	Centre for Metrology and Accreditation Tekniikantie 1 FI-02150 Espoo - Finland
MSL	Measurement Standards Laboratory Callaghan Innovation 69 Gracefield Road PO Box 31-310 Lower Hutt – New Zealand
NAO	Time Keeping Office Mizusawa VLBI Observatory National Astronomical Observatory of Japan 2-12, Hoshigaoka, Mizusawa, Oshu, Iwate 023-0861 Japan

NICT	Space-Time Standards Laboratory National Institute of Information and Communications Technology 4 -2 -1, Nukui-kitamachi Koganei, Tokyo 184-8795 - Japan
NIM	Time & Frequency Laboratory National Institute of Metrology No. 18, Bei San Huan Dong Lu Beijing 100013 - People's Republic of China
NIMB	Time and Frequency Laboratory National Institute of Metrology Sos. Vitan - Barzesti, 11 042122 Bucharest, Romania
NIMT	Time & Frequency Laboratory National Institute of Metrology (Thailand) 3/5 Moo 3, Klong 5, Klong Luang, Pathumthani 12120, Thailand
NIST	National Institute of Standards and Technology Time and Frequency Division, 847.00 325 Broadway Boulder, Colorado 80305, USA
NMIJ	Time and Frequency Division National Metrology Institute of Japan (NMIJ), AIST Umezono 1-1-1, Tsukuba, Ibaraki 305-8563, Japan
NMISA	Time and Frequency Laboratory National Metrology Institute of South Africa Private Bag X34 Lynnwood Ridge 0040, Pretoria - South Africa
NMLS	Time and Frequency Laboratory National Metrology Laboratory SIRIM Berhad, Lot PT 4803, Bandar Baru Salak Tinggi, 43900 Sepang - Malaysia
NPL	National Physical Laboratory Time Quantum and Electromagnetics Division Hampton Road Teddington, Middlesex TW11 0LW United Kingdom
NPLI	Time and Frequency Section National Physical Laboratory Dr.K.S.Krishnan Road New Delhi 110012 - India
NRC	National Research Council of Canada Measurement Science and Standards Frequency and Time Standards Bldg M-36, 1200 Montreal Road Ottawa, Ontario, K1A 0R6, Canada

NSC IM	Time and Frequency Section National Scientific Center "Institute of Metrology" Kharkov - Ukraine Region – 61002 Ukraine
NTSC	National Time Service Center Chinese Academy of Sciences 3 East Shuyuan Rd, Lintong District, Xi'an Shaanxi 710600, China
ONBA	Servicio de Hidrografía Naval Observatorio Naval Buenos Aires Servicio de Hora Av. España 2099 C1107AMA – Buenos Aires, Argentina
ONRJ	Observatorio Nacional (MCTI) Divisão Serviço da Hora Rua General José Cristino, 77 São Cristovão 20921-400 Rio de Janeiro, Brazil
ORB	Royal Observatory of Belgium Avenue Circulaire, 3 B-1180 Brussels, Belgium
PTB	Physikalisch-Technische Bundesanstalt Time and Frequency Department, WG 4. 42 Bundesallee 100 D-38116 Braunschweig, Germany
ROA	Real Instituto y Observatorio de la Armada Cecilio Pujazón s/n 11.100 San Fernando Cádiz, Spain
SG	National Metrology Centre Agency for Science, Technology and Research (A*STAR) 1 Science Park Drive 118221 Singapore
SIQ	Slovenian Institute of Quality and Metrology Metrology department Trzaska ul. 2 1000 Ljubljana Slovenia
SP	SP Technical Research Institute of Sweden Box 857 S-501 15 Borås Sweden
TL	National Standard Time and Frequency Laboratory Telecommunication Laboratories Chunghwa Telecom. Co., Ltd. No. 99, Dianyan Road Yang-Mei, Taoyuan, 32601 Taiwan Chinese Taipei

TP	Institute of Photonics and Electronics Academy of Sciences of the Czech Republic Chaberská 57, 182 51 Praha 8 Czech Republic
UME	Ulusal Metroloji Enstitüsü TUBITAK Gebze Yerleskesi, National Metrology Institute Gebze Kocaeli Turkey
USNO	U.S. Naval Observatory 3450 Massachusetts Ave., N.W. Washington, D.C. 20392-5420 USA
VMI	Laboratory of Time and Frequency (TFL) Vietnam Metrology Institute (VMI) No 8, Hoang Quoc Viet Rd, Cau Giay Dist., Hanoi Vietnam.
VNIIFTRI	All-Russian Scientific Research Institute for Physical Technical and Radiotechnical Measurements, Moscow Region 141570 Russia
VSL	VSL Dutch Metrology Institute Postbus 654 2600 AR Delft Netherlands

TIME DISSEMINATION SERVICES

AOS	AOS Computer Time Service: vega.cbk.poznan.pl (150.254.183.15) Synchronization: NTP V3 primary (Caesium clock), PC Pentium, RedHat Linux Service Area: Poland/Europe Access Policy: open access Contact: Jerzy Nawrocki (nawrocki@cbk.poznan.pl) Robert Diak (kondor@cbk.poznan.pl) Full list of time dissemination services is available on: http://www.eecis.udel.edu/~mills/ntp/clock1.htm
AUS	Network Time Service Computers connected to the Internet can be synchronized to UTC(AUS) using the NTP protocol. The NTP servers are referenced to UTC(AUS) either directly or via a GPS common view link. Please see www.measurement.gov.au/time for information on access or contact time@measurement.gov.au Dial-up Computer Time Service Computers can also obtain time via a modem connection to our dial-up timeserver. For further information, please see our web pages as above.
BelGIM (1)	Internet Time Service: BelGIM operates one time server Stratum 1 using the "Network Time Protocol" (NTP). The server host name is: http://www.belgim.by (Stratum 1)
BEV	3 NTP servers are available; addresses: bevtime1.metrologie.at bevtime2.metrologie.at time.metrologie.at more information on http://www.metrologie.at Provides a time dissemination service via phone and modem to synchronize PC clocks. Uses the Time Distribution System from TUG. It has a baud rate of 1200 and everyone can use it with no cost. Access phone number is +43 (0) 1 211106381 The system will be updated periodically (DUT1, Leap Second…).
CENAM	CENAM operates a voice automatic system that provides the local time for three different time zones for Mexico; Central Time, Pacific Time and Northwest Time as well the UTC(CNM). The access numbers are: +52 442 211 0506: Central Time +52 442 211 0507: Pacific Time +52 442 211 0508: Northwest Time +52 442 215 3902: UTC(CNM) Telephone Code CENAM provides a telephone code for setting time in computers. More information about this service please contact J. Mauricio López at jlopez@cenam.mx

(1) Information based on the Annual Report 2011, not confirmed by the Laboratory.

	Network Time Protocol Operates one time server using the "Network Time Protocol", it is located at the Centro Nacional de Metrología, Querétaro, México. Further information at http://www.cenam.mx/hora_oficial/ Web-based time-of-day clock that displays local time for México time zones. Referenced to CENAM Internet Time Service. Available at http://www.cenam.mx/hora_oficial/ Transmission of voice by radio in Mexico City to more than 20 million inhabitants. The voice messages are transmitted every minute, 24 hours a day, every day of the year, by the radio station XEQK, whose signal is at 1350 kHz amplitude modulated (AM).
CENAMEP	Network Time Server A Stratum 1 time server is used to synchronize computer networks of the government institutions and companies in the private sector using the NTP protocol. To access the Network time service send an email to servicios@cenamep.org.pa Web Clock A web clock is used to display the time of day in real time. To access the Web Clock, enter the link http://horaexacta.cenamep.org.pa/ Voice Time Server An assembly of computers provides the local time. To access the voice time service, call the telephone numbers (507) 5173201 (507) 5173202 and (507) 5173203
DMDM	Internet Time Service (ITS) DMDM operates two Stratum 1 time servers using the “Network Time Protocol” (NTP v.4.), synchronized to UTC(DMDM). Access for paying organizations and institutions. DMDM also operates two Stratum 2 NTP servers: vreme1.dmdm.rs or vreme1.dmdm.gov.rs vreme2.dmdm.rs or vreme2.dmdm.gov.rs Access is free. More information on: http://www.dmdm.rs/en/GrupaZaVremeFrekfencijuIDistribucijuVremena.php Web-based time-of-day clock that displays local time for Serbia referenced to the DMDM ITS. Available at the web page as above.
EIM (1)	Internet Time Service EIM operates a time server using the "Network Time Protocol" (NTP). The address hercules.eim.gr is also accessible through IP address 79.129.72.250. This route is offered under an open policy. The server uses the 10 MHz signal from our primary standard as reference and is synchronized with UTC(EIM). The same server is accessible under restrictions through a different IP address by using a dedicated internet connection, for specific organizations.
GUM	Telephone Time Service providing the European time code by telephone modem for setting time in computers. Includes provision for compensation of propagation time delay. Access phone number : +48 22 654 88 72

(1) Information based on the Annual Report 2011, not confirmed by the Laboratory.

	Network Time Service Two NTP servers are available: tempus1.gum.gov.pl tempus2.gum.gov.pl with an open access policy. It provides synchronization to UTC(PL). Contact: timegum@gum.gov.pl
HKO	Internet Clock Services HKO operates time-of-day clocks that display Hong Kong Standard Time (=UTC(HKO) + 8 h) Available as: 1. Web Clock (Flash): http://www.hko.gov.hk/gts/time/HKSTime.htm 2. Web Clock (HTML): http://www.hko.gov.hk/gts/time/clock_e.html 3. Palm Clock: http://pda.weather.gov.hk/clocke.htm
	Speaking Clock Service HKO operates an automatic "Dial-a-weather System" that provides voice announcement of Hong Kong Standard Time. Access phone number: +852 1878200 (when connected, press "3", "6", "1" in sequence)
	Network Time Service HKO operates network time service using Network Time Protocol (NTP). Host names of the NTP servers: stdtime.gov.hk; time.hko.hk (for IPv6 users) Further information at http://www.hko.gov.hk/nts/ntime.htm
IGNA	GPS common-view data GPS common-view data using CGGTTS format referred to UTC(IGNA) is available as requested by users.
INPL	Time dissemination service is performed in Israel by telecommunication companies, whose time and frequency standards are traceable to local UTC(INPL) time and are calibrated regularly once a year against the Israeli Time and Frequency National Standard kept by INPL .
INRIM	CTD Telephone Time Code Time signals dissemination, according to the European Time code format, available via modem on regular dial-up connection. Access phone numbers : 0039 011 3919 263 and 0039 011 3919 264. Provides a synchronization to UTC(IT) for computer clocks without compensation for the propagation time. Software for the synchronization of computer clocks is available on INRIM home page (www.inrim.it).
	Internet Time Service INRIM operates two time servers using the "Network Time Protocol" (NTP); host names of the servers are ntp1.inrim.it and ntp2.inrim.it. More information on this service can be found on the web pages: www.inrim.it/ntp/index_i.shtml.
	SRC (Segnale RAI Codificato) coded time signal broadcast 20 – 30 times per day by "Radio Uno" and "Radio Tre" FM radio stations of the national broadcasting company RAI.
	Web-based time-of-day clock that displays UTC or local time for Italy (Central Europe Time), referenced to INRIM Internet Time Service. Provides snapshot of time with any web browser. A continuous time display requires a web browser with Java plug-in installed. Service available at www.inrim.it/ntp/webclock_i.shtml.

KIM (1)	Network Time Protocol (NTP) Service The NTP time information referenced to UTC(KIM) is generated by Stratum-1 NTP server at URL: ntp.kim.lipi.go.id or IP: 203.160.128.178 The server also provide time service using Daytime Protocol, and Time Protocol.
KRISS	Telephone Time Service Provides digital time code to synchronize computer clocks to Korea Standard Time (=UTC(KRIS) + 9 h) via modem. Access phone number: + 82 42 868 5116
	Network Time Service KRISS operates three time servers using the NTP to synchronize computer clocks to Korea Standard Time via the Internet. Host name of the server : time.kriss.re.kr (210.98.16.100) Software for the synchronization of computer clocks is available at http://www.kriss.re.kr
KZ	Network Time Service Stratum-1 time server using the "Network Time Protocol" (NTP). Restricted access. Startum-2 time server using the "Network Time Protocol" (NTP). Free access. Stratum-2 is available: uakyt.kz Web-based Time Services: A real-time clock aligned to UTC(KZ) and corrected for internet transmission delay. “Six-pip time signals” are broadcasted by FM radio stations hourly every day.
LNE-SYRTE	LNE-SYRTE operates one primary time server using the “Network Time Protocol” (NTP) : Hostname: ntp-p1.obspm.fr Futher information at: http://syrte.obspm.fr/informatique/ntp_infos.php
LT	Network Time Service via NTP protocol NTP v3 DNS: laikas.pfi.lt Port 123 Synchronization from caesium clock (1 pps) System: Datum TymeServe 2100 NTP server Access policy: free Contact: Rimantas Miškinis Mail: Laikas@pfi.lt http://www.pfi.lt/metrology/
METAS	Telephone Time Service The coded time string (compliant to the European Time Code format) is referenced to UTC(CH) and generated by a TUG type time code generator. Access phone numbers: +41 31 323 32 25, +41 31 323 47 00.

(1) Information based on the Annual Report 2011, not confirmed by the Laboratory.

	Network Time Protocol METAS operates public NTP servers in free access. Host names: ntp.metas.ch ntp11.metas.ch ntp12.metas.ch More information at http://www.metas.ch and http://www.ntp.org
MIKES	MIKES provides an official stratum-1 level service to paying organizations and institutions. Stratum-2 level service, which MIKES acquires from a commercial service provider, is freely available for everyone. MIKES does not take responsibility for the public service, but servers providing the public service are syncronized to the stratum-1 level servers of MIKES.

Stratum-1 NTP servers (official service)

ntp2.mikes.fi	194.100.49.132	Synchronized to UTC(MIKE)
ntp4.mikes.fi	194.100.49.134	Synchronized to UTC(GPS)
ntp1.mikes.funet.fi	193.166.4.49	Synchronized to UTC(MIKE)
ntp2.mikes.funet.fi	193.166.4.50	Synchronized to UTC(GPS)

Stratum-2 NTP servers (public service)
time1.mikes.fi
time2.mikes.fi
Further information can be found from www.mikes.fi.

MSL	Network Time Service Computers connected to the Internet can be synchonized to UTC(MSL) using the NTP protocol. Access is available for users within New Zealand. Two servers are available at msltime1.irl.cri.nz and msltime2.irl.cri.nz Speaking Clock A speaking clock gives New Zealand time. Because it is a pay service, access is restricted to callers within New Zealand. Further information about these services can be found at http://msl.irl.cri.nz/services/time-and-frequency
NAO	Network Time Service Three stratum 2 NTP servers are available. The NTP servers internally refer stratum 1 NTP server that is linked to UTC(NAO). One of the three stratum 2 NTP servers are selected automatically by a round-robin DNS server to reply for an NTP access. The server host name is s2csntp.miz.nao.ac.jp.
NICT	Telephone Time Service (TTS) NICT provides digital time code accessible by computer at 300/1200/2400 bps, 8 bits, no parity. Access number to the lines: + 81 42 327 7592. Network Time Service (NTS) NICT operates a Stratum 1 NTP time server linked to UTC(NICT) through a leased line. Internet Time Service (ITS) NICT operates five Stratum 1 NTP time servers linked to UTC(NICT) through the Internet. Host name of the servers: ntp.nict.jp (Round robin).

	GPS common view data NICT provides the GPS common view data based on UTC(NICT) to the time business service in Japan.
NIM	Telephone Time Service The coded time information generated by NIM time code generator, referenced to UTC(NIM). Telephone Code provides digital time code at 1200 to 9600 bauds, 8 bits, no parity, 1 stop bit. Access phone number: 8610 6422 9086. Network Time Service Provides digital time code across the Internet using NTP.
NIMB	1 NTP server is available: Address: ntp.inm.ro (STRATUM 1) with an open access policy Server is referenced to UTC(NIMB).
NIMT	Internet Time Service NIMT operates 3 NTP servers at: time1.nimt.or.th time2.nimt.or.th time3.nimt.or.th The NTP servers are referenced to UTC(NIMT) Telephone Time Service The time code is generated and disseminated through the telephone lines. Computers and displayed clocks are able to access UTC(NIMT) by dialling +66 (0) 2 551 0332. FM/RDS Radio Transmission The time code is applied to the sub-carrier frequency of 57 kHz using the Radio Data System protocol. The accuracy of time transmission is around 1 s of UTC(NIMT). The time code is broadcast via 40 radio stations across the country.
NIST	Automated Computer Time Service (ACTS) Provides digital time code by telephone modem for setting time in computers. Free software and source code available for download from NIST. Includes provision for calibration of telephone time delay. Access phone numbers : +1 303 494 4774 (12 phone lines) and +1 808 335 4721 (4 phone lines). Further information at http://www.nist.gov/pml/div688/grp40/acts.cfm Internet Time Service (ITS) Provides digital time code across the Internet using three different protocols: Network Time Protocol (NTP), Daytime Protocol, and Time Protocol. (Time Protocol is not supported by all servers) Geographically distributed set of 38 time servers at 26 locations within the United States of America. Free software and source code available for download from NIST.Further information at http://www.nist.gov/pml/div688/grp40/its.cfm Web-based time-of-day clock that displays UTC or local time for United States time zones. Referenced to NIST Internet Time Service. Provides snapshot of time with any web browser, but continuously running time display requires web browser with Java plug-in installed. Available at http://www.time.gov (in cooperation with the United States Naval Observatory), and at http://nist.time.gov Telephone voice announcement: Audio portions of radio broadcasts from time and frequency stations WWV and WWVH can be heard by telephone: +1 303 499 7111 for WWV and +1 808 335 4363 for WWVH

NMIJ	GPS common-view data GPS common-view data using CGGTTS format referred to UTC(NMIJ) are available through the NMIJ's web site for the remote frequency calibration service.
NMISA	Network Time Service One open access NTP server is available at address time.nmisa.org. More information is available at http://time.nmisa.org/
NMLS	Web-based time-of-day clock A web clock is used to display the local time for Malaysia. The service is available at http://mst.sirim.my and http://time.sirim.my Network Time Service The NTP time information is referenced to UTC(NMLS) and is currently generated by Stratum-1 NTP servers, made available for public freely. The NTP server host names are ntp1.sirim.my and/or ntp2.sirim.my.
NPL	Telephone Time Service A TUG time code generator provides the European Telephone Time Code, referenced to UTC(NPL), by telephone modem. Software for synchronising computers is available from the NPL web site at www.npl.co.uk/time. The service telephone number is 0906 851 6333. Note: this is a premium rate number and can only be accessed from within the UK. Internet Time Service Two servers referenced to UTC(NPL) provide Network Time Protocol (NTP) time code across the internet. More information is available from the NPL web site at www.npl.co.uk/time. The server host names are: ntp1.npl.co.uk ntp2.npl.co.uk
NPLI	Telephone Time Service The coded time information generated by time code generator of NPLI, referenced to UTC(NPLI). Telephone Code provides digital time code (for the current time of Indian standard Time) at 1200 bauds, 8 bits, no parity, 1 stop bit. This service is known as TELECLOCK Service. Accessible by : a. an NPLI-developed Teleclock Receiver already available in the market. b. a Computer through Telephone Modem and NPLI-developed software. One-way Geostationary Satellite Time Service.
NRC	Telephone Code Provides digital time code by telephone modem for setting time in computers. Access phone number : +1 613 745 3900. http://www.nrc-cnrc.gc.ca/eng/services/time/time_date.html Talking Clock Service Voice announcements of Eastern Time are at ten-second interval followed by a tone to indicate the exact time. The service is available to the public in English at +1 613 745 1576 and in French at +1 613 745 9426. For more information see: http://www.nrc-cnrc.gc.ca/eng/services/time/talking_clock.html

Web Clock Service
The Web Clock shows dynamic clocks in each Canadian Time zone, for both Standard time and daylight saving time. The web page is at: http://www.nrc-cnrc.gc.ca/eng/services/time/web_clock.html.

Network Time Protocol
Operates two time servers using the " Network Time Protocol ", each one being on different location and network. Host names : time.nrc.ca and time.chu.nrc.ca. Further information at: http://www.nrc-cnrc.gc.ca/eng/services/time/network_time.html

NSC IM

Network Time Service.
Computers connected to the Internet can be synchronized to UTC(UA) using NTP protocol. NTP servers are referenced to UTC(UA) directly.
Link to Time server: ntpd.metrology.kharkov.ua
or IP address: 81.17.128.133.
More information on http://www.metrology.kharkov.ua.

NTSC

Network Time Service (NTS)
NTSC operates a time server directly referenced to UTC(NTSC) + 8 h. Software for the synchronization of computer clocks is available on the NTSC Time and Frequency
web page : http://time.ntsc.ac.cn
Access Policy: free
Contact: Shaowu DONG (sdong@ntsc.ac.cn).

ONBA

Speaking clock access phone number 113 (only accessible in Argentina).
Hourly and half hourly radio-broadcast time signal.
Internet time service at web site www.hidro.gov.ar/hora/hora.asp

ONRJ

Telephone Voice Announcer (55) 21 25806037.
Telephone Code (55) 21 25800677 provides digital time code at 300 bauds, 8 bits, no parity, 1 stop bit (Leitch CSD5300)

Internet Time Service at the address : 200.20.186.75 and 200.20.186.94
SNTP at port 123
Time/UDP at port 37
Time/TCP at port 37
Daytime/TCP at port 13

WEB-based Time Services:
1) A real-time clock aligned to UTC(ONRJ) and corrected for internet transmission delay.
Further information at: http://200.20.186.71/asp/relogio/horainicial.asp
2) Voice Announcer, in Portuguese, each ten seconds, after download of the Web page at: http://200.20.186.71.

Broadcast Brazilian legal time (UTC – 3 hours) announced by a voice starting with “Observatório Nacional” followed by the current time (hh:mm:ss) each ten seconds with a beep for each second with a 1KHz modulation during 5ms and a long beep with 1KHz modulation during 200ms at the 58 , 59 and 00 seconds. The signal is transmitted every day of the year by the radio station PPE, whose signal is at 10 MHz with kind of modulation A3H and HF transmission power of 1 kW.

ORB

Network Time Service via NTP protocol
Hostname : ntp1.oma.be and ntp2.oma.be
Access policy : free
Synchronization to UTC(ORB)
Contact : f.roosbeek@oma.be
Information on the web pages
http://www.observatoire.be/D1/TIME/ntp_en.php/

ORB provides a time dissemination via phone and modem to synchronize PC clocks on UTC(ORB). The system used is the Time Distribution System from TUG, which produces the telephone time code mostly used in Europe.
The baud rate used is 1200. The access phone number is 32 (0) 2 373 03 20. The system is updated periodically with DUT1 and leap seconds

PTB

Telephone Time Service
The coded time information is referenced to UTC(PTB) and generated by a TUG type time code generator using an ASCII-character code.
The time protocols are sent in a common format, the " European Telephone Time Code ". Access phone number : +49 531 51 20 38 .

Internet Time Service
The PTB operates three time servers using the " Network Time Protocol " (NTP), see http://www.ptb.de/en/org/q/q4/q42/_index.htm for details and explanations.

Host names of the servers:
ptbtime1.ptb.de
ptbtime2.ptb.de
ptbtime3.ptb.de

ROA

Telephone Code
The coded time information is referenced to UTC(ROA) and generated by a TUG type time code generator using an ASCII-character code. The time protocols are sent in a common format, the "European Telephone Time Code". Access phone number : +34 956 599 429
Network Time Protocol
Server : hora.roa.es
Synchronized to UTC(ROA) better than 10 microseconds
Service policy : free

Server : ntp0.roa.es
Synchronized to UTC(ROA) better than 10 microseconds
Service policy : restricted
Note : server used as prototype to check new software, hardware, etc.

SG

Website: http://www.SingaporeStandardTime.org.sg.

Automated Computer Time Service (ACTS)
Transmits digital time code (NIST format) via telephone modem for setting time in computers. The coded time information is referenced to UTC(SG). Includes provision for correcting telephone time delay.
Free software available for downloading from the website.
Access phone number : +65 67799978.
Network Time Service (NeTS)
Transmits digital time code via the Internet using three protocols - Time Protocol, Daytime Protocol and Network Time Protocol.
Free software available for downloading from the website. Operates two

time servers at addresses nets.org.sg and 203.117.180.35.

Web-based time service:
Displays a real time clock referenced to NeTS. User-selectable display of local time (adjusted for daylight saving) of any major city worldwide and time difference information between any two cities.
Further information is available on the website.

SIQ (1)

Internet Time Service (Network Time Protocol)
One server referenced to UTC(SIQ) provides Network Time Protocol (NTP) time code across the internet.
There is a free access to the server for all users.
The server host names are:ntp.siq.si or time.siq.si
(two URL's for the same server; IP: 194.249.234.70)

SP

Telephone Time Service
The coded time information is referenced to UTC(SP) and generated by two TUG type time code generators using an ASCII-character code.
The time protocols are sent in a common format, the "European Telephone Time Code".
Access phone number: +46 33 41 57 83

Internet Time Service
The coded time information is referenced to UTC(SP) and generated by two NTP servers using the Network Time Protocol (NTP). Access host names : ntp1.sp.se and ntp2.sp.se

Speaking Clock
The speaking clock service is operated by Telia AB in Sweden.
The time announcement is referenced to UTC(SP) and disseminated from a computer based system operated and maintained at SP.
Access phone number : 90510 (only accessible in Sweden).
Access phone number : +4633 90510 (from outside Sweden).

More information about these services are found on the web site www.sp.se

TL

Speaking Clock Service
Traceable to UTC(TL). Broadcast through PSTN (Public Switching Telephone Network) automatically and provides accurate voice time signal to public users.

The Computer Time Service
Provides digital time code by telephone modem for setting time in computers. Access phone number : +886 3 4245117.

NTP Service
TL operates a time server using the "Network Time Protocol" (NTP).
Host name of the server : time.stdtime.gov.tw, further information at http://www.stdtime.gov.tw/english/e-home.aspx

TP

Internet Time Service
IPE operates time servers directly referenced to UTC(TP).
Time information is accessible through Network Time Protocol (NTP).
Server host name: time.ufe.cz, ntp1.ufe.cz, ntp2.ufe.cz
More information at http://www.ufe.cz/time

(1) Information based on the Annual Report 2011, not confirmed by the Laboratory.

UME	Telephone Time Service Providing the European time code that is referenced to UTC(UME) by telephone modem for setting computer time. Includes compensation of propagation time delay. More information for this service please contact to eml@ume.tubitak.gov.tr. Access phone number : +90 262 679 50 24 Network Time Service UME operates an NTP server referenced to UTC(UME). Host server name : time.ume.tubitak.gov.tr
USNO	Telephone Voice Announcer +1 202 762-1401 Backup voice announcer: +1 719 567-6742 Telephone Code +1 202 762-1594 provides digital time code at 1200 baud, 8 bits, no parity GPS via subframe 4 page 18 of the GPS broadcast navigation message Web site for time and for data files: http://tycho.usno.navy.mil/ Network Time Protocol (NTP) see http://www.usno.navy.mil/USNO/time/ntp for software and site closest to you.
VMI	Network Time Service VMI operates one time server Stratum 1 using the Network Time Protocol (NTP). For information on access the website, please contact to email bangn@vmi.gov.vn. The server host name is: http://standardtime.vmi.gov.vn/
VNIIFTRI	Internet Time Service VNIIFTRI operates three time servers Stratum 1and one time server Stratum 2 using the “Network Time Protocol” (NTP). The server host names are: ntp1.vniiftri.ru (Stratum 1) ntp2.vniiftri.ru (Stratum 1) ntp3.vniiftri.ru (Stratum 1) ntp21.vniiftri.ru (Stratum 2).
VSL	Internet Time Service VSL operates a time server directly referenced to UTC(VSL). Time information is accessible through Network Time Protocol (NTP). The URL for the NTP server is: ntp.vsl.nl