FEDERATION OF ASTRONOMICAL AND GEOPHYSICAL SERVICES

## BUREAU INTERNATIONAL DE L'HEURE

# ANNUAL REPORT FOR 1983

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**P A R I S — 1 9 8 4**

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**Table 9 - Offsets and step adjustments of UTC, until 1984 Nov. 30**

| Date (at 0h UTC) | Offsets | Steps |
|---|---|---|
| 1961 Jan. 1 | $-150 \times 10^{-10}$ | |
| Aug. 1 | " | + 0.050s |
| 1962 Jan. 1 | $-130 \times 10^{-10}$ | |
| 1963 Nov. 1 | " | - 0.100s |
| 1964 Jan. 1 | $-150 \times 10^{-10}$ | |
| April 1 | " | - 0.100s |
| Sept. 1 | " | - 0.100s |
| 1965 Jan. 1 | " | - 0.100s |
| March 1 | " | - 0.100s |
| July 1 | " | - 0.100s |
| Sept. 1 | " | - 0.100s |
| 1966 Jan. 1 | $-300 \times 10^{-10}$ | |
| 1968 Feb. 1 | " | + 0.100s |
| 1972 Jan. 1 | 0 | - 0.107 7580s |
| July 1 | " | - 1s |
| 1973 Jan. 1 | " | - 1s |
| 1974 Jan. 1 | " | - 1s |
| 1975 Jan. 1 | " | - 1s |
| 1976 Jan. 1 | " | - 1s |
| 1977 Jan 1 | " | - 1s |
| 1978 Jan. 1 | " | - 1s |
| 1979 Jan. 1 | " | - 1s |
| 1980 Jan. 1 | " | - 1s |
| 1981 July 1 | " | - 1s |
| 1982 July 1 | " | - 1s |
| 1983 July 1 | " | - 1s |

**Table 10 - Relationship between TAI and UTC, until 1984 Nov. 30**

| Limits of validity (at 0h UTC) | TAI - UTC |
|---|---|
| 1961 Jan. 1 - 1961 Aug. 1 | 1.422 818 0 s + (MJD - 37 300) x 0.001 296 s |
| Aug. 1 - 1962 Jan. 1 | 1.372 818 0 s + " " |
| 1962 Jan. 1 - 1963 Nov. 1 | 1.845 858 0 s + (MJD - 37 665) x 0.001 123 2 s |
| 1963 Nov. 1 - 1964 Jan. 1 | 1.945 858 0 s + " " |
| 1964 Jan. 1 - April 1 | 3.240 130 0 s + (MJD - 38 761) x 0.001 296 s |
| April 1 - Sept. 1 | 3.340 130 0 s + " " |
| Sept. 1 - 1965 Jan. 1 | 3.440 130 0 s + " " |
| 1965 Jan. 1 - March 1 | 3.540 130 0 s + " " |
| March 1 - July 1 | 3.640 130 0 s + " " |
| July 1 - Sept. 1 | 3.740 130 0 s + " " |
| Sept. 1 - 1966 Jan. 1 | 3.840 130 0 s + " " |
| 1966 Jan. 1 - 1968 Feb. 1 | 4.313 170 0 s + (MJD - 39 126) x 0.002 592 s |
| 1968 Feb. 1 - 1972 Jan. 1 | 4.213 170 0 s + " " |
| 1972 Jan. 1 - July 1 | 10.000 000 0 s |
| July 1 - 1973 Jan. 1 | 11.000 000 0 s |
| 1973 Jan. 1 - 1974 Jan. 1 | 12.000 000 0 s |
| 1974 Jan. 1 - 1975 Jan. 1 | 13.000 000 0 s |
| 1975 Jan. 1 - 1976 Jan. 1 | 14.000 000 0 s |
| 1976 Jan. 1 - 1977 Jan. 1 | 15.000 000 0 s |
| 1977 Jan. 1 - 1978 Jan. 1 | 16.000 000 0 s |
| 1978 Jan. 1 - 1979 Jan. 1 | 17.000 000 0 s |
| 1979 Jan. 1 - 1980 Jan. 1 | 18.000 000 0 s |
| 1980 Jan. 1 - 1981 July 1 | 19.000 000 0 s |
| 1981 July 1 - 1982 July 1 | 20.000 000 0 s |
| 1982 July 1 - 1983 July 1 | 21.000 000 0s |
| 1983 July 1 - | 22.000 000 0s |

TABLE 11 - Atomic time, collaborating laboratories

| | |
|---|---|
| AOS | Astronomical Latitude Observatory, Borowiec, Polska |
| APL | Applied Physics Laboratory, Laurel, USA |
| ASMW | Amt fur Standardisierung, Messwesen und Warenprüfung, Berlin, Deutsche Demokratische Republik |
| ATC | Australian Telecommunications Commission, Melbourne, Australia |
| AUS | Consortium of laboratories in Australia |
| BEV | Bundesamt für Eich-und, Vermessungswesen, Wien, Österreich |
| BO | Beijing Observatory, Beijing, China |
| CAO | Astronomical Observatory of Cagliari University, Cagliari, Italy |
| CSAO | Shaanxi Astronomical Observatory, Lintong, China |
| DDR | Consortium of laboratories in Deutsche Demokratische Republik |
| DHI | Deutsches Hydrographisches Institut,Hamburg,Bundesrepublik Deutschland |
| DNM | Division of National Mapping, Canberra, Australia |
| F | Commission Nationale de l'Heure, Paris, France |
| FTZ | Fernmeldetechnisches Zentralamt, Darmstadt,Bundesrepublik Deutschland |
| IEN | Istituto Elettrotecnico Nazionale, Torino, Italia |
| IFAG | Institut für Angewandte Geodäsie, Franfurt am Main, Bundesrepublik Deutschland |
| IGMA | Instituto Geografico Militar, Buenos-Aires, Argentina |
| ILOM | International Latitude Observatory, Mizusawa, Japan |
| KSRI | Korea Standards Research Institute, Korea |
| MSSD | Measurement Standards and Services Division, Colombo, Sri Lanka |
| NBS | National Bureau of Standards, Boulder, USA |
| NIM | National Institute of Metrology, Beijing, China |
| NIS | National Institute for Standards, Cairo, Arab Republic of Egypt |
| NML | National Measurement Laboratory, CSIRO, Australia |
| NPL | National Physical Laboratory, Teddington, U.K. |
| NPLI | National Physical Laboratory, New-Dehli, India |
| NPRL | National Physical Research Laboratory, Pretoria, South Africa |
| NRC | National Research Council of Canada, Ottawa, Canada |
| NRLM | National Research Laboratory of Metrology, Tsukuba, Japan |
| OAB | Observatoire Astronomique Bouzaréah, Alger, République Algérienne |
| OFM | Office Fédéral de Métrologie, Berne, Suisse |
| OMH | Orszagos Mérésügyi Hivatal, Budapest, Hungary |
| OMSF | Instituto y Observatorio de Marina, San Fernando, Espãna |
| ON | Observatoire de Neuchâtel, Neuchâtel, Suisse |
| ONBA | Observatorio Naval, Buenos-Aires, Argentina |
| ONRJ | Observatorio National, Rio de Janeiro, Brazil |
| OP | Observatoire de Paris, Paris, France |
| ORB | Observatoire Royal de Belgique, Bruxelles, Belgique |
| PAGA | Philippine Atmospheric, Geophysical and Astronomical Services Administration, Philippines |
| PEL | Physics and Engineering Laboratory, New-Zealand |
| PKNM | Polski Komitet Normalizacji i Miar, Warszawa, Polska |
| PTB | Physikalisch-Technische Bundesanstalt, Braunschweig, Bundesrepublik Deutschland |

TABLE 11 - Atomic time, collaborating laboratories (cont.)

| | |
|---|---|
| PTCH | Direction générale des PTT, Berne, Suisse |
| RGO | Royal Greenwich Observatory, Herstmonceux, U.K. |
| RO | Royal Observatory, Hong-Kong |
| RRL | Radio Research Laboratories, Tokyo, Japan |
| SIS | Singapore Institute of Standards and Industrial Research, Singapore |
| SO | Shanghaï Observatory, Shanghaï, China |
| STA | Swedish Telecommunications Administration, Stockholm, Sweden |
| SU | Laboratoire d'état de l'étalon de temps et de fréquences, URSS |
| TAO | Tokyo Astronomical Observatory, Tokyo, Japan |
| TL | Telecommunication Laboratories, Taiwan, China |
| TP(1) | Ústav Radiotechniky a Electroniky, Praha, Československo<br>Astronomický Ústav, Praha, Československo |
| TPC | Telecommunication Public Corporation, Indonesia |
| TUG | Technische Universität Graz, Österreich |
| USNO | U.S. Naval Observatory, Washington D.C., USA |
| VSL | Van Swinden Laboratorium, Den Haag, Nederland |
| ZIPE | Zentralinstitut Physik der Erde, Potsdam, Deutsche Demokratische Republik |

(1) Both laboratories cooperate in the derivation of UTC (TP).

TABLE 12 - Laboratories keeping an independent local atomic time

| Laboratory (i) | Equipment in atomic standards(1) | Information on TA(i)-UTC(i): Interval of validity (in MJD at 0h UT) | Information on TA(i)-UTC(i): TA(i)-UTC(i) in s |
|---|---|---|---|
| DDR | 4 Ind. Cs (2) | year 1983 | TA(DDR)-UTC(ASMW) is sent to BIH |
| F | 18 Ind. Cs (3) | year 1983 | TA(F)-UTC(OP) is published in Bulletin H by OP (LPTF) |
| NBS | 15 Ind. Cs<br>2 lab. Cs<br>1 H Maser<br>(4) | year 1983 | TA(NBS)-UTC(NBS) is published in the NBS T and F Bulletin |
| NRC | 1 Ind. Cs<br>1 2.1 m lab. Cs<br>3 1 m lab. Cs<br>(5) | 45355-45516<br>45516-45700 | 20.999 968 931<br>21.999 968 931 |
| OFM | 4 Ind. Cs<br>4 prototype Cs | 45335-45347<br>45347-45429<br>45429-45515<br>45515-45639<br>45639-45700 | 21.000 005 054<br>$+(20.417\times10^{-9})$(MJD-45335)<br>21.000 005 298<br>$+(13.549\times10^{-9})$(MJD-45347)<br>21.000 006 409<br>$+(17.562\times10^{-9})$(MJD-45429)<br>22.000 007 920<br>$+(17.562\times10^{-9})$(MJD-45515)<br>22.000 010 097<br>$+(19.72\times10^{-9})$ (MJD-45639) |
| PTB | 10 Ind. Cs<br>1 lab. Cs<br>(6) | 45355-45516<br>45516-45700 | 21.000 363 400<br>22.000 363 400 |
| RGO | 7 Ind. Cs | 45335-45516<br>45516-45700 | 20.999 926 09<br>21.999 926 09 |
| RRL | 1 lab. Cs<br>7 Ind. Cs<br>2 H Masers | year 1983 | published in RRL Standard Frequency and Time Service Bulletin |
| SO | 1 lab. Cs<br>Ind. Cs<br>H Masers | year 1983 | TA(SO)-UTC(SO) is published by the SO Atomic Time Bulletin |
| USNO | 35 Ind. Cs<br>2 H Masers | year 1983 | A.1(USNO,MEAN) - UTC(USNO,MC): final values in USNO series 11. (7) |

TABLE 12 - (cont.)

(1) Ind. Cs designates an industry made Cs standard ; lab. Cs a laboratory Cs standard and H Maser an Hydrogen Maser.

(2) The standards are located as follows:

ASMW 3 Cs
ZIPE 1 Cs

(3) The standards are located as follows (at the end of 1983).

| | |
|---|---|
| Centre Electronique de l'Armement (Rennes) | 1 Cs |
| Centre National d'Etudes Spatiales | 2 Cs |
| Centre National d'Etudes des Télécommunications | 3 Cs |
| Centre d'Etudes et de Recherches Géodynamiques et Astronomiques | 3 Cs |
| Electronique Marcel Dassault (Suresnes) | 1 Cs |
| Hewlett-Packard (Orsay) | 1 Cs |
| Observatoire de Paris : Laboratoire Primaire du Temps et des Fréquences (LPTF) | 5 Cs |
| Observatoire de Besançon | 1 Cs |
| Société Nationale Industrielle Aérospatiale (Toulouse) | 1 Cs |

They are intercompared by the TV method and linked to the foreign laboratories through OP (LPTF) (see Table 13).

(4) The laboratory primary standards control TA(NBS) via an accuracy algorithm. One of the two primary standards usually operates as a contributing member clock. Three of the commercial standards provide the reference for WWV and WWVB but do not contribute directly to TA(NBS) ; they are available for NBS time scales back-up and are compared to TA(NBS) to within 0.1 $\mu$s. The hydrogen masers are passively operated.

(5) The 2.1 meter primary cesium clock, CsV, operated continuously during 1983, producing the scale of proper time PT(NRC CsV). The time scales UTC(NRC) and TA(NRC) were derived from PT(NRC CsV) according to the following expressions given in microseconds :

$$UTC(NRC) = PT(NRC\ CsV) - (MJD - 43144) \times 0.000\ 97 + 52.041$$

$$TA(NRC) = PT(NRC\ CsV) - (MJD - 43144) \times 0.000\ 97 + 20.972$$

with integral seconds disregarded.

Three 1 meter laboratory cesium clocks, CsVIA, -B, and -C, operated continuously as primary standards during 1983 producing the scales of proper time PT(NRC CsVIA), PT(NRC CsVIB) and PT(NRC CsVIC).

(6) TA(PTB) and UTC(PTB) are derived directly from a local oscillator monitored by the primary clock CS1.
MEZ(D) = UTC(PTB) + 1h or MESZ(D) = UTC(PTB) + 2h (summer time) is the legal time of the Federal Republic of Germany.

(7) TA(USNO) is designated by A.1 (USNO,MEAN) in USNO publications.

Table 13 - Equipment and links of the collaborating laboratories in 1983

| Laboratory (i) | Equipment (1) | Source of UTC(i) | LORAN-C reception (2) | Television link with | GPS reception | Other sat.links |
|---|---|---|---|---|---|---|
| AOS | 1 Ind. Cs | 1 Cs,1 Rb | | TP,ZIPE,PKNM | | |
| APL(3) | 3 Ind. Cs<br>1 H Maser | 1 Cs +<br>microstepper | | USNO | | |
| ASMW | 3 Ind. Cs | corrected<br>mean of 3 Cs | 7970-W | ZIPE,TP,PTB | | |
| ATC | 7 Ind. Cs | 1 Cs +<br>microstepper | | other lab.<br>in Australia | (4) | |
| BEV | 1 Ind. Cs | 1 Cs | 7970-W<br>7990-M<br>7990-X<br>7990-Y<br>(5) | TUG,lab.in<br>Czechoslovakia | | |
| CAO | 2 Ind. Cs | 1 Cs | 7990-M<br>7990-X<br>7990-Z | IEN, other lab.<br>in Italy | | |
| CSAO | 4 Ind. Cs<br>3 H Masers | all the Cs | 9970-Y | lab. in China | | |
| DHI | 2 Ind. Cs | 1 Cs +<br>microstepper | 7970-W | PTB,TP,ZIPE | | |
| DNM(6) | 3 Ind. Cs | all the Cs | | other lab.<br>in Australia | (4) | |
| FTZ | 7 Ind. Cs | 1 Cs | 7970-W | | | |
| IEN | 7 Ind. Cs | 1 Cs +<br>microstepper | 7990-M<br>7990-X<br>7990-Z | CAO, other lab.<br>in Italy | | NPL, TUG<br>VSL, via<br>OTS-2(7) |
| IFAG | 3 Ind. Cs<br>1 H Maser | 1 Cs | 7970-W | | | |
| IGMA | 3 Ind. Cs | 1 Cs +<br>microstepper | | ONBA, other lab.<br>in Argentina | | |
| ILOM | 4 Ind. Cs | 1 Cs | 9970-M<br>9970-X | RRL,TAO,NRLM | | |
| NBS | see Table 12 | 12 Cs<br>1 lab. Cs<br>1 H Maser | 9940-M<br>9960-Z | | * | |
| NIM | 3 Ind. Cs | 1 Cs +<br>microstepper | 9970-Y | Lab. in China | | |

Table 13 - (cont.)

| Laboratory (i) | Equipment (1) | Source of UTC(i) | LORAN-C reception (2) | Television link with | GPS reception | Other sat.links |
|---|---|---|---|---|---|---|
| NML | 3 Ind. Cs<br>2 H Masers | all the Cs | | other lab. in Australia | (4) | |
| NPL | 7 Ind. Cs<br>1 lab. Cs | 1 Cs | 7970-W | transmitting station at Rugby | | IEN, TUG VSL, via OTS-2(7) |
| NPLI | 3 Ind. Cs | 1 Cs | | | | |
| NPRL(8) | 2 Ind. Cs | 1 Cs | | | | |
| NRC | see Table 12 | Cs V | 9960-M | | | |
| NRLM | 3 Ind. Cs<br>2 lab. Cs | 1 Cs | 9970-M | ILOM,RRL,TAO | | |
| OAB | 3 Ind. Cs | 1 Cs | 7990-Z | | | |
| OFM | see Table 12 | all the Cs | 7970-W<br>7990-Z | PTCH<br>other lab. in Switzerland | | |
| OMH | 1 Ind. Cs | 1 Cs | | TP,SU | | |
| OMSF | 6 Ind. Cs | all the Cs | 7990-Z | | | |
| ON | 5 Ind. Cs | all the Cs | 7970-W<br>7990-Z | | | |
| ONBA(8) | 2 Ind. Cs | 2 Cs | | IGMA<br>other lab. in Argentina | | |
| ONRJ(8) | 2 Ind. Cs | 2 Cs | | other lab. in Brasil | | NBS via GOES |
| OP | 5 Ind. Cs | 1 Cs | 7970-W<br>7990-Z | 19 lab. in France, ORB, Hewlett-Packard (Switzerland),PTCH | * | |
| ORB | 2 Ind. Cs | 1 Cs | 7970-W | OP | | |
| PKNM | 4 Ind. Cs | corrected mean of 4 Cs | 7970-W (5) | AOS | | |
| PTB | see Table 12 | Ind. Cs steered by PTB primary standard | 7970-W | ASMW,DHI,TP,ZIPE and other lab. | * | |

Table 13 - (cont.)

| Laboratory (i) | Equipment (1) | Source of UTC(i) | LORAN-C reception | Television link with | GPS reception | Other sat.links |
|---|---|---|---|---|---|---|
| PTCH | 2 Ind. Cs | 1 Cs | 7970-W | OFM,OP and other lab.in Switzerland | | |
| RGO | see Table 12 | selection of the Cs | 7930-X<br>7970-M<br>7970-W<br>7990-Z<br>9980-X | | | |
| RRL | see Table 12 | 1 Cs | 9970-M | ILOM,TAO,NRLM | | |
| SO | 1 lab. Cs<br>3 H Masers<br>2 Ind. Cs | 1 Cs + microstepper | 9970-Y | lab. in China | | |
| STA | 3 Ind. Cs | 1 Cs | 7970-W | other lab. in Sweden | | |
| SU | 1 lab. Cs<br>4 Ind. Cs<br>4 H Masers<br>4 H clocks | 1 lab. Cs<br>2 Cs<br>4 H Masers<br>4 H clocks | 7970-W<br>7990-X<br>7990-Y<br>9970-X | other lab. in URSS, TP,OMH | | |
| TAO | 5 Ind. Cs | 1 Cs + microstepper | 9970-M<br>9970-Y | ILOM,RRL,NRLM | * | |
| TL | 4 Ind. Cs | all the Cs | 9970-M | | | |
| TP | 1 Ind. Cs | 1 Cs + microstepper | | DHI,PTB,AOS,SU ZIPE,ASMW,OMH | | |
| TUG | 2 Ind. Cs | 1 Cs | 7970-W<br>7990-M | BEV | * | IEN,NPL, VSL,via OTS-2(7) |
| USNO (9) | see Table 12 | Cs | (10) | APL | * | |
| VSL | 4 Ind. Cs | Cs | 7970-M<br>7970-W<br>7930-X<br>9980-X | other lab. in Holland | * | IEN,NPL, TUG,via) OTS-2(7) |
| ZIPE | 1 Ind. Cs | 1 Cs | 7970-W | ASMW,DHI PTB,TP,AOS | | |

Notes

(1) Ind. Cs designates an industry made Cs standard ; lab. Cs a laboratory Cs standard and H.Maser an Hydrogen Maser. Rb designates a Rubidium standard

(2) LORAN-C stations :

| | | | |
|---|---|---|---|
| 7930-M | North Atlantic chain, | Angissog | until |
| 7930-X | ·· ·· | Ejde | 30 June 1983 |
| 7970-M | Norwegian Sea chain, | Ejde | |
| 7970-W | ·· ·· | Sylt | |
| 7990-M | Mediterranean chain, | Simeri Crichi | |
| 7990-X | ·· ·· | Lampedusa | |
| 7990-Y | ·· ·· | Kargabarun | |
| 7990-Z | ·· ·· | Estartit | |
| 9940-M | West Coast chain, | Fallon | |
| 9960-M | Northeast Coast chain, | Seneca | |
| 9960-X | ·· ·· | Nantucket | |
| 9960-Z | ·· ·· | Dana | |
| 9970-M | Northwest Pacific chain, | Iwo Jima | |
| 9970-X | ·· ·· | Hokkkaido | |
| 9970-Y | ·· ·· | Gesashi | |
| 9980-M | North Atlantic chain, | Angissog | from |
| 9980-X | ·· ·· | Ejde | 1 July 1983 |

(3) Weekly Cs clock transfers are carried out between APL and USNO

(4) ATC, DNM, NML, are linked by television to the Deep Space Communications Complex, where GPS receptions are made

(5) Reception of the Soviet Union LORAN chain 8000

(6) Microware link with Orroral facility of NASA (National Aeronautics and Space Administration).

(7) Experimental time link

(8) NPRL, ONBA, ONRJ are linked to the other laboratories by VLF receptions.

(9) USNO Time Service Publication, Series 16, entitled Precise Time Transfer Report , lists UTC(USNO MC) - UTC (Reference Clock). Difference from Satellite Communication terminals as well as many international timing centers are reported. USNO Time Service Publication, Series 17, entitled Transit Satellite Reports, lists UTC(USNO MC) - UTC (Satellite Clock) and also the frequency offset of each satellite. Series 17 is available via the Automated Data Service only.

(10) The daily phase values Series 4 of USNO gives the values of UTC(USNO MC) - transmitting station for :

the LORAN-C chains
the OMEGA stations A, H, L, ND
the VLF station GBR
the US TV Network NBC
the NNSS and GPS satellite systems

TABLE 14 - TIME COMPARISONS BETWEEN LABORATORIES BY CLOCK TRANSPORTATION IN 1983

UNLESS OTHERWISE STATED,THE TRANSPORTATION WAS CARRIED OUT BY THE FIRST MENTIONED LABORATORY

| DATE | MJD | TIME COMPARISONS | | UNCERT. | SOURCE | |
|---|---|---|---|---|---|---|
| 1983 | | (UNIT : 1 MICROSECOND) | | | | |
| JAN 20 | 45354.3 | UTC(ILOM) - UTC(RRL ) = | 4.27 | 0.1 | ILOM LETTER | |
| JAN 28 | 45362.3 | UTC(USNO) - UTC(OMSF) = | -0.76 | 0.06 | USNO DPV 839 | (1) |
| JAN 28 | 45362.3 | UTC(USNO) - UTC(NBS ) = | -1.70 | 0.01 | USNO DPV 839 | |
| JAN 31 | 45365.7 | UTC(USNO) - UTC(CAO ) = | 15.02 | 0.09 | USNO DPV 839 | |
| FEB 3 | 45368.5 | UTC(USNO) - UTC(IEN ) = | -12.8 | 0.1 | USNO DPV 839 | |
| FEB 3 | 45368.8 | UTC(USNO) - UTC(ATC ) = | 4.0 | 0.1 | USNO DPV 850 | |
| FEB 6 | 45371.2 | UTC(USNO) - UTC(DNM ) = | 0.2 | 0.1 | USNO DPV 856 | |
| FEB 7 | 45372.0 | UTC(USNO) - UTC(NML ) = | -36.00 | 0.1 | NML LETTER | (2) |
| FEB 11 | 45376.4 | UTC(USNO) - UTC(NPL ) = | 1.32 | 0.05 | USNO DPV 839 | |
| MAR 30 | 45423.97 | UTC(USNO) - UTC(NRC ) = | -8.88 | 0.07 | USNO DPV 857 | |
| APR 20 | 45444.4 | UTC(USNO) - UTC(OP ) = | -0.5 | 0.2 | USNO DPV 850 | |
| APR 26 | 45450.3 | UTC(USNO) - UTC(NPL ) = | 0.38 | 0.07 | USNO DPV 850 | |
| APR 26 | 45450.5 | UTC(USNO) - UTC(ON ) = | 10.90 | 0.05 | ON LETTER | |
| APR 28 | 45452.3 | UTC(USNO) - UTC(BEV ) = | -6.3 | 0.1 | USNO DPV 856 | |
| APR 29 | 45453.3 | UTC(USNO) - UTC(TUG ) = | -0.4 | 0.2 | USNO DPV 850 | |
| MAY 4 | 45458.3 | UTC(USNO) - UTC(DHI ) = | 0.2 | 0.1 | USNO DPV 850 | |
| MAY 4 | 45458.4 | UTC(USNO) - UTC(PTB ) = | -0.5 | 0.1 | USNO DPV 856 | |
| MAY 6 | 45460.3 | UTC(USNO) - UTC(FTZ ) = | 2.26 | 0.04 | USNO DPV 856 | |
| MAY 13 | 45467.2 | UTC(USNO) - UTC(NBS ) = | -1.95 | 0.01 | USNO DPV 856 | |
| MAY 31 | 45485.5 | UTC(PKNM) - UTC(SU ) = | 29.435 | | PKNM LETTER | |
| JUN 6 | 45491.1 | UTC(TAO ) - UTC(NRLM) = | -22.94 | 0.01 | TAO LETTER | |
| JUN 7 | 45492.0 | UTC(TAO ) - UTC(RRL ) = | -4.99 | 0.01 | TAO LETTER | |
| JUN 14 | 45499.0 | UTC(TAO ) - UTC(ILOM) = | -11.03 | 0.05 | TAO LETTER | |
| JUN 27 | 45512.4 | UTC(USNO) - UTC(NML ) = | 0.86 | 0.1 | NML LETTER | (2) |
| JUL 21 | 45536.3 | UTC(ILOM) - UTC(RRL ) = | 5.35 | 0.1 | ILOM LETTER | |
| JUL 28 | 45543.3 | UTC(ON ) - UTC(OFM ) = | -11.46 | 0.1 | OFM LETTER | (3) |
| AUG 11 | 45557.4 | UTC(USNO) - UTC(NBS ) = | -2.0 | 0.2 | USNO DPV 867 | |
| AUG 29 | 45575.6 | UTC(USNO) - UTC(RGO ) = | -14.98 | 0.04 | USNO DPV 869 | |
| AUG 30 | 45576.3 | UTC(USNO) - UTC(NPL ) = | 0.02 | 0.06 | USNO DPV 869 | |
| SEP 5 | 45582.2 | UTC(USNO) - UTC(VSL ) = | 2.8 | 0.2 | USNO DPV 869 | |
| SEP 7 | 45584.0 | UTC(OMH ) - UTC(TP ) = | 0.0 | 0.1 | OMH LETTER | |
| SEP 7 | 45584.3 | UTC(USNO) - UTC(OSO ) = | 0.0 | 0.1 | USNO DPV 869 | (4) |
| SEP 8 | 45585.1 | UTC(USNO) - UTC(STA ) = | 0.5 | 0.1 | STA LETTER | |
| SEP 9 | 45586.3 | UTC(USNO) - UTC(ORB ) = | -15.6 | 0.1 | USNO DPV 869 | |
| SEP 10 | 45587.3 | UTC(USNO) - UTC(OP ) = | 1.08 | 0.06 | USNO DPV 869 | |
| SEP 12 | 45589.6 | UTC(USNO) - UTC(NRC ) = | -8.6 | 0.1 | USNO DPV 874 | |
| SEP 19 | 45596 | UTC(ASMW) - UTC(TP ) = | 0.533 | 0.020 | ASMW LETTER | |
| SEP 27 | 45604.0 | UTC(USNO) - UTC(NML ) = | 1.51 | 0.1 | NML LETTER | (2) |
| SEP 30 | 45607.6 | UTC(USNO) - UTC(NBS ) = | -1.88 | 0.02 | USNO DPV 870 | |
| OCT 19 | 45626.3 | UTC(USNO) - UTC(IEN ) = | -13.18 | 0.01 | USNO DPV 883 | |
| NOV 17 | 45655.0 | UTC(TAO ) - UTC(ILOM) = | -3.34 | 0.05 | TAO LETTER | |
| NOV 17 | 45655.0 | UTC(USNO) - UTC(ILOM) = | -4.50 | 0.08 | USNO DPV 886 | |
| NOV 19 | 45657.1 | UTC(TAO ) - UTC(RRL ) = | -4.55 | 0.01 | TAO LETTER | |
| NOV 19 | 45657.1 | UTC(USNO) - UTC(TAO ) = | -1.15 | 0.07 | USNO DPV 883 | |
| NOV 20 | 45658.8 | UTC(USNO) - UTC(RRL ) = | -5.80 | 0.04 | USNO DPV 883 | |
| NOV 21 | 45659.1 | UTC(TAO ) - UTC(NRLM) = | -11.52 | 0.01 | TAO LETTER | |
| NOV 21 | 45659.3 | UTC(USNO) - UTC(NRLM) = | -12.73 | 0.04 | USNO DPV 883 | |
| NOV 22 | 45660 | UTC(SU ) - UTC(ZIPE) = | -29.6 | 0.05 | SU LETTER | |
| NOV 23 | 45661 | UTC(SU ) - UTC(ASMW) = | -28.0 | 0.05 | SU LETTER | |
| DEC 7 | 45675 | UTC(SU ) - UTC(TP ) = | -28.6 | 0.05 | SU LETTER | |
| DEC 14 | 45682.5 | UTC(PKNM) - UTC(ASMW) = | 3.429 | | PKNM LETTER | |
| DEC 15 | 45683.3 | UTC(ILOM) - UTC(RRL ) = | -2.19 | 0.1 | ILOM LETTER | |
| DEC 21 | 45689 | UTC(SU ) - UTC(OMH ) = | -27.7 | 0.1 | SU LETTER | |
| DEC 21 | 45689.6 | UTC(ONBA) - UTC(USNO) = | -6.794 | 0.005 | USNO LETTER | |

(1) UTC(USNO) STANDS FOR UTC(USNO MC)
DPV : DAILY PHASE VALUES , SERIES 4 , PUBLISHED BY USNO .
(2) CARRIED OUT BY BENDIX FIELD ENGINEERING CORPORATION .
(3) CARRIED OUT BY PTCH .
(4) OSO DESIGNATES ONSALA SPACE OBSERVATORY , ONSALA , SWEDEN .

TABLE 15 - INDEPENDENT ATOMIC TIMES

TA(I) DENOTES THE ATOMIC TIME OF THE LABORATORY I

UNIT IS ONE MICROSECOND

| DATE 1983 | MJD | TAI - TA(I) DDR | F | NBS | NRC | OFM |
|---|---|---|---|---|---|---|
| JAN 5 | 45339 | | -32.62 | -45063.57 | 23.18 | -4.89 |
| JAN 15 | 45349 | | -32.25 | -45063.70 | 23.14 | -5.06 |
| JAN 25 | 45359 | | -31.83 | -45063.70 | 23.17 | -5.17 |
| FEB 4 | 45369 | | -31.49 | -45063.74 | 23.26 | -5.32 |
| FEB 14 | 45379 | | -30.99 | -45063.91 | 23.07 | -5.26 |
| FEB 24 | 45389 | | -30.67 | -45063.89 | 23.23 | -5.50 |
| MAR 6 | 45399 | | -30.28 | -45063.73 | 23.39 | -5.85 |
| MAR 16 | 45409 | | -29.88 | -45063.86 | 23.42 | -5.94 |
| MAR 26 | 45419 | | -29.54 | -45063.89 | 23.42 | -6.11 |
| APR 5 | 45429 | | -29.07 | -45063.95 | 23.46 | -6.30 |
| APR 15 | 45439 | | -28.67 | -45064.07 | 23.46 | -6.54 |
| APR 25 | 45449 | | -28.27 | -45064.14 | 23.51 | -6.73 |
| MAY 5 | 45459 | | -27.98 | -45064.16 | 23.62 | -6.79 |
| MAY 15 | 45469 | | -27.63 | -45064.16 | 23.68 | -7.02 |
| MAY 25 | 45479 | | -27.27 | -45064.18 | 23.74 | -7.16 |
| JUN 4 | 45489 | | -26.95 | -45064.28 | 23.76 | -7.47 |
| JUN 14 | 45499 | | -26.58 | -45064.39 | 23.72 | -7.69 |
| JUN 24 | 45509 | -0.81 | -26.15 | -45064.47 | 23.65 | -7.88 |
| JUL 4 | 45519 | -0.83 | -25.68 | -45064.64 | 23.50 | -7.96 |
| JUL 14 | 45529 | -0.87 | -25.26 | -45064.70 | 23.44 | -8.18 |
| JUL 24 | 45539 | -0.97 | -24.84 | -45064.72 | 23.40 | -8.37 |
| AUG 3 | 45549 | -1.02 | -24.45 | -45064.79 | 23.31 | -8.58 |
| AUG 13 | 45559 | -1.10 | -24.08 | -45064.82 | 23.25 | -8.71 |
| AUG 23 | 45569 | -1.16 | -23.70 | -45064.86 | 23.21 | -8.88 |
| SEP 2 | 45579 | -1.26 | -23.25 | -45064.96 | 23.16 | -9.06 |
| SEP 12 | 45589 | -1.45 | -22.77 | -45065.09 | 23.09 | -9.27 |
| SEP 22 | 45599 | -1.43 | -22.36 | -45065.20 | 23.07 | -9.49 |
| OCT 2 | 45609 | -1.48 | -21.96 | -45065.30 | 23.04 | -9.70 |
| OCT 12 | 45619 | -1.74 | -21.51 | -45065.39 | 23.08 | -9.96 |
| OCT 22 | 45629 | -1.85 | -21.13 | -45065.54 | 23.09 | -10.15 |
| NOV 1 | 45639 | -1.91 | -20.83 | -45065.69 | 23.07 | -10.37 |
| NOV 11 | 45649 | -1.90 | -20.44 | -45065.82 | 23.08 | -10.60 |
| NOV 21 | 45659 | -1.87 | -20.12 | -45066.02 | 23.09 | -10.81 |
| DEC 1 | 45669 | -1.91 | -19.72 | -45066.14 | 23.08 | -11.02 |
| DEC 11 | 45679 | -1.73 | -19.41 | -45066.39 | 23.05 | -11.14 |
| DEC 21 | 45689 | -1.84 | -18.99 | -45066.51 | 22.96 | -11.45 |
| DEC 31 | 45699 | -1.92 | -18.56 | -45066.68 | 22.90 | -11.54 |

TABLE 15 - (CONT.)

UNIT IS ONE MICROSECOND

| DATE 1983 | MJD | TAI - TA(I) PTB | RGO | RRL | SO | USNO |
|---|---|---|---|---|---|---|
| JAN 5 | 45339 | -363.40 | 58.54 | 8.16 | -33.78 | -34472.92 |
| JAN 15 | 45349 | -363.32 | 58.59 | 7.75 | -34.98 | -34473.37 |
| JAN 25 | 45359 | -363.25 | 58.65 | 7.69 | -35.95 | -34473.74 |
| FEB 4 | 45369 | -363.21 | 58.65 | 7.60 | -36.79 | -34474.13 |
| FEB 14 | 45379 | -363.11 | 58.57 | 7.55 | -37.34 | -34474.64 |
| FEB 24 | 45389 | -363.05 | 58.64 | 7.56 | -37.40 | -34474.98 |
| MAR 6 | 45399 | -362.98 | 58.70 | 7.61 | -37.34 | -34475.29 |
| MAR 16 | 45409 | -362.90 | 58.71 | 7.53 | -37.73 | -34475.66 |
| MAR 26 | 45419 | -362.84 | 58.75 | 7.63 | -37.96 | -34476.06 |
| APR 5 | 45429 | -362.79 | 58.82 | 7.42 | -38.36 | -34476.46 |
| APR 15 | 45439 | -362.74 | 58.96 | 7.28 | -39.12 | -34476.87 |
| APR 25 | 45449 | -362.67 | 59.01 | 7.14 | -39.95 | -34477.24 |
| MAY 5 | 45459 | -362.58 | 59.05 | 7.20 | -40.33 | -34477.56 |
| MAY 15 | 45469 | -362.57 | 59.01 | 7.22 | -40.77 | -34477.89 |
| MAY 25 | 45479 | -362.51 | 59.13 | 7.28 | -41.22 | -34478.23 |
| JUN 4 | 45489 | -362.56 | 59.21 | 7.18 | -41.27 | -34478.63 |
| JUN 14 | 45499 | -362.53 | 59.32 | 7.02 | -41.28 | -34479.04 |
| JUN 24 | 45509 | -362.48 | 59.31 | 6.93 | -41.72 | -34479.39 |
| JUL 4 | 45519 | -362.40 | 59.43 | 6.72 | -41.90 | -34479.84 |
| JUL 14 | 45529 | -362.41 | 59.58 | 6.54 | -42.24 | -34480.23 |
| JUL 24 | 45539 | -362.44 | 59.61 | 6.50 | -42.57 | -34480.59 |
| AUG 3 | 45549 | -362.46 | 59.68 | 6.51 | -43.03 | -34480.99 |
| AUG 13 | 45559 | -362.40 | 59.73 | 6.43 | -43.22 | -34481.37 |
| AUG 23 | 45569 | -362.36 | 59.62 | 6.34 | -43.11 | -34481.76 |
| SEP 2 | 45579 | -362.32 | 59.65 | 6.32 | -42.96 | -34482.15 |
| SEP 12 | 45589 | -362.32 | 59.82 | 6.23 | -42.94 | -34482.54 |
| SEP 22 | 45599 | -362.27 | 59.52 | 6.22 | -43.12 | -34482.90 |
| OCT 2 | 45609 | -362.29 | 59.41 | 6.15 | -43.07 | -34483.30 |
| OCT 12 | 45619 | -362.31 | 59.44 | 6.10 | -43.05 | -34483.63 |
| OCT 22 | 45629 | -362.29 | 59.42 | 6.04 | -43.19 | -34484.01 |
| NOV 1 | 45639 | -362.30 | 59.44 | 5.88 | -43.57 | -34484.41 |
| NOV 11 | 45649 | -362.31 | 59.44 | 5.77 | -43.73 | -34484.78 |
| NOV 21 | 45659 | -362.29 | 59.42 | 5.62 | -44.10 | -34485.20 |
| DEC 1 | 45669 | -362.25 | 59.30 | 5.55 | -44.49 | -34485.57 |
| DEC 11 | 45679 | -362.26 | 59.33 | 5.31 | -44.55 | -34486.02 |
| DEC 21 | 45689 | -362.16 | 59.37 | 5.21 | -44.44 | -34486.34 |
| DEC 31 | 45699 | -362.09 | 59.56 | 5.07 | -44.44 | -34486.74 |

TABLE 16 - PRIMARY STANDARDS USED AS CLOCKS

UNIT IS ONE MICROSECOND

| DATE 1983 | MJD | TAI-LAB.STD. PTB CS1 | NRC CSV | NRC CSVI A | NRC CSVI B | NRC CSVI C |
|---|---|---|---|---|---|---|
| JAN 5 | 45339 | 0.00 | 42.02 | 33.41 | 39.77 | 37.63 |
| JAN 15 | 45349 | 0.08 | 41.97 | 33.18 | 39.50 | 37.30 |
| JAN 25 | 45359 | 0.14 | 42.00 | 33.09 | 39.30 | 37.10 |
| FEV 4 | 45369 | 0.19 | 42.07 | 33.08 | 39.24 | 37.16 |
| FEV 14 | 45379 | 0.29 | 41.87 | 32.77 | 39.00 | 36.97 |
| FEV 24 | 45389 | 0.35 | 42.02 | 32.83 | 39.16 | 37.12 |
| MAR 6 | 45399 | 0.42 | 42.18 | 32.83 | 39.29 | 37.26 |
| MAR 16 | 45409 | 0.50 | 42.19 | 32.62 | 39.31 | 37.27 |
| MAR 26 | 45419 | 0.56 | 42.19 | 32.55 | 39.38 | 37.24 |
| APR 5 | 45429 | 0.60 | 42.22 | 32.55 | 39.43 | 37.27 |
| APR 15 | 45439 | 0.66 | 42.21 | 32.51 | 39.44 | 37.23 |
| APR 25 | 45449 | 0.73 | 42.25 | 32.48 | 39.47 | 37.25 |
| MAY 5 | 45459 | 0.82 | 42.35 | 32.48 | 39.57 | 37.32 |
| MAY 15 | 45469 | 0.83 | 42.39 | 32.47 | 39.68 | 37.34 |
| MAY 25 | 45479 | 0.89 | 42.45 | 32.44 | 39.75 | 37.37 |
| JUN 4 | 45489 | 0.84 | 42.45 | 32.38 | 39.81 | 37.35 |
| JUN 14 | 45499 | 0.87 | 42.41 | 32.27 | 39.87 | 37.30 |
| JUN 24 | 45509 | 0.91 | 42.33 | 32.10 | 39.95 | 37.20 |
| JUL 4 | 45519 | 1.03 | 42.17 | 31.90 | 39.97 | 37.03 |
| JUL 14 | 45529 | 1.00 | 42.10 | 31.74 | 40.05 | 36.92 |
| JUL 24 | 45539 | 0.97 | 42.05 | 31.63 | 40.13 | 36.87 |
| AUG 3 | 45549 | 0.98 | 41.95 | 31.46 | 40.17 | 36.76 |
| AUG 13 | 45559 | 1.01 | 41.88 | 31.28 | 40.25 | 36.64 |
| AUG 23 | 45569 | 1.03 | 41.83 | 31.15 | 40.23 | 36.53 |
| SEP 2 | 45579 | 1.10 | 41.77 | 31.08 | 40.15 | 36.40 |
| SEP 12 | 45589 | 1.09 | 41.69 | 30.96 | 40.05 | 36.28 |
| SEP 22 | 45599 | 1.13 | 41.67 | 30.87 | 39.96 | 36.16 |
| OCT 2 | 45609 | 1.09 | 41.62 | 30.82 | 39.86 | 36.02 |
| OCT 12 | 45619 | 1.12 | 41.65 | 30.82 | 39.81 | 35.97 |
| OCT 22 | 45629 | 1.10 | 41.64 | 30.76 | 39.77 | 35.90 |
| NOV 1 | 45639 | 1.09 | 41.62 | 30.67 | 39.65 | 35.82 |
| NOV 11 | 45649 | 1.11 | 41.62 | 30.63 | 39.60 | 35.76 |
| NOV 21 | 45659 | 1.11 | 41.62 | 30.54 | 39.53 | 35.69 |
| DEC 1 | 45669 | 1.12 | 41.60 | 30.44 | 39.51 | 35.62 |
| DEC 11 | 45679 | 1.13 | 41.56 | 30.39 | 39.50 | 35.59 |
| DEC 21 | 45689 | 1.23 | 41.46 | 30.27 | 39.35 | 35.46 |
| DEC 31 | 45699 | 1.29 | 41.40 | 30.19 | 39.24 | 35.32 |

See notes, p. B-36

NOTES

(1) The time scale under the headline PTB CS 1 is a coordinate time scale at sea level derived from the scale of proper time applying a gravitational frequency correction of - 0.00066 $\mu$s/d.

(2) The time scales under the headline NRC Cs V, Cs VI A, Cs VI B, Cs VI C are the scales of proper time PT (NRC Cs V), PT (NRC Cs VI A), PT (NRC Cs VI B), PT (NRC Cs VI C) produced directly by the primary frequency standards Cs V, Cs VI A, Cs VI B, Cs VI C of NRC used as clocks. The gravitational frequency correction to these time scales of proper time to obtain coordinate times at sea level is - 0.00097 $\mu$s/d.

TABLE 17 - COORDINATED UNIVERSAL TIME

UTC(I) DENOTES THE APPROXIMATION TO UTC KEPT BY THE LABORATORY I

UNIT IS ONE MICROSECOND

| DATE 1983 | | MJD | UTC - UTC(I) AOS | APL (1) | ASMW | AUS (2) | BEV | CAO (3) |
|---|---|---|---|---|---|---|---|---|
| JAN | 5 | 45339 | 0.65 | 4.02 | -0.14 | -6.31 | -5.52 | 16.20 |
| JAN | 15 | 45349 | 0.95 | 4.23 | -0.03 | -6.60 | -5.54 | 16.35 |
| JAN | 25 | 45359 | 0.83 | 4.52 | 0.10 | -6.77 | -5.47 | 16.41 |
| FEB | 4 | 45369 | 1.09 | 4.81 | 0.13 | -6.97 | -5.51 | 16.50 |
| FEB | 14 | 45379 | 1.48 | 4.96 | 0.21 | -7.30 | -5.32 | 16.73 |
| FEB | 24 | 45389 | 1.66 | 5.22 | 0.11 | -7.48 | -5.37 | 16.79 |
| MAR | 6 | 45399 | 1.59 | 5.27 | 0.22 | -7.60 | -5.51 | 16.75 |
| MAR | 16 | 45409 | 1.89 | 5.19 | 0.32 | -7.82 | -5.62 | 16.73 |
| MAR | 26 | 45419 | 1.94 | 5.15 | 0.30 | -8.04 | -5.59 | 17.04 |
| APR | 5 | 45429 | 2.03 | 5.06 | 0.19 | -8.27 | -5.42 | 17.22 |
| APR | 15 | 45439 | 1.96 | 4.95 | 0.02 | -8.51 | -5.22 | 17.50 |
| APR | 25 | 45449 | 2.47 | 4.91 | -0.09 | -8.71 | -5.05 | 17.40 |
| MAY | 5 | 45459 | 2.54 | 4.91 | -0.23 | -8.85 | -4.91 | 2.35 |
| MAY | 15 | 45469 | 3.56 | 4.64 | -0.42 | -9.00 | -4.97 | 2.35 |
| MAY | 25 | 45479 | 3.34 | 4.35 | -0.52 | -9.17 | -5.06 | 2.38 |
| JUN | 4 | 45489 | 3.03 | -0.38 | -0.66 | -9.40 | -5.25 | 2.68 |
| JUN | 14 | 45499 | 3.38 | -0.41 | -0.76 | -9.64 | -5.32 | 2.72 |
| JUN | 24 | 45509 | 2.37 | -0.42 | -0.81 | -9.82 | -5.42 | 2.81 |
| JUL | 4 | 45519 | 2.14 | -0.53 | -0.82 | -10.09 | -5.37 | 2.77 |
| JUL | 14 | 45529 | 2.08 | -0.58 | -0.79 | -10.31 | -5.26 | 2.78 |
| JUL | 24 | 45539 | 2.12 | -0.59 | -0.71 | -10.47 | -5.08 | 2.74 |
| AUG | 3 | 45549 | 2.31 | -0.60 | -0.57 | -10.70 | -4.91 | 2.76 |
| AUG | 13 | 45559 | 2.15 | -0.69 | -0.49 | -10.90 | -4.65 | 2.67 |
| AUG | 23 | 45569 | 1.99 | -0.74 | -0.36 | -11.12 | -4.38 | 2.63 |
| SEP | 2 | 45579 | 1.92 | -0.64 | -0.30 | -11.34 | -3.92 | 2.50 |
| SEP | 12 | 45589 | 1.89 | -0.68 | -0.30 | -11.56 | -3.61 | 2.50 |
| SEP | 22 | 45599 | 2.01 | -0.61 | -0.06 | -11.77 | -3.40 | 2.38 |
| OCT | 2 | 45609 | 2.18 | -0.55 | 0.10 | -11.98 | -3.40 | 2.07 |
| OCT | 12 | 45619 | 1.93 | -0.47 | 0.05 | -12.17 | -3.69 | 1.89 |
| OCT | 22 | 45629 | 1.58 | -0.44 | 0.17 | -12.36 | -3.76 | 1.79 |
| NOV | 1 | 45639 | 1.50 | -0.47 | 0.36 | -12.60 | -3.85 | 1.76 |
| NOV | 11 | 45649 | 2.53 | -0.49 | 0.63 | -12.79 | -3.85 | 1.72 |
| NOV | 21 | 45659 | 2.73 | -0.53 | 0.77 | -13.03 | -3.89 | 1.84 |
| DEC | 1 | 45669 | 3.18 | -0.54 | 0.87 | -13.22 | – | 1.87 |
| DEC | 11 | 45679 | 3.30 | -0.67 | 1.22 | -13.49 | -3.88 | 1.85 |
| DEC | 21 | 45689 | 2.56 | -0.61 | 1.29 | -13.66 | -3.95 | 1.73 |
| DEC | 31 | 45699 | 2.56 | -0.62 | 1.37 | -13.87 | -4.12 | 1.90 |

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

| DATE 1983 | MJD | UTC - UTC(I) CSAO | DHI | FTZ | IEN | IFAG | IGMA |
|---|---|---|---|---|---|---|---|
| | | | | | | (4) | (5) |
| JAN 5 | 45339 | 1.06 | 0.56 | 2.08 | -10.82 | -49.19 | 28 |
| JAN 15 | 45349 | 0.80 | 0.73 | 2.26 | -10.83 | -48.44 | 29 |
| JAN 25 | 45359 | 0.82 | 0.83 | 2.41 | -10.97 | -47.46 | 37 |
| FEB 4 | 45369 | 0.67 | 0.68 | 2.55 | -11.11 | -46.68 | 41 |
| FEB 14 | 45379 | 0.56 | 0.60 | 2.76 | -11.12 | -45.53 | 37 |
| FEB 24 | 45389 | 0.56 | 0.56 | 2.85 | -11.29 | -44.76 | 41 |
| MAR 6 | 45399 | 0.62 | 0.63 | 2.90 | -11.68 | -44.14 | 33 |
| MAR 16 | 45409 | 0.60 | 0.65 | 3.06 | -11.94 | -43.29 | 32 |
| MAR 26 | 45419 | 0.66 | 0.59 | 3.15 | -11.86 | -42.65 | 32 |
| APR 5 | 45429 | 0.49 | 0.55 | 3.20 | -11.92 | -41.99 | 36 |
| APR 15 | 45439 | 0.81 | 0.57 | 3.34 | -12.04 | -41.39 | 32 |
| APR 25 | 45449 | 0.95 | 0.62 | 3.44 | -12.22 | -40.78 | 35 |
| MAY 5 | 45459 | 1.29 | 0.77 | 3.59 | -12.49 | -40.21 | 36 |
| MAY 15 | 45469 | 1.68 | 0.85 | 3.63 | -12.66 | -39.83 | 35 |
| MAY 25 | 45479 | 2.10 | 0.88 | 3.71 | -12.82 | -39.48 | 32 |
| JUN 4 | 45489 | 2.49 | 0.82 | 3.81 | -12.61 | -39.11 | 34 |
| JUN 14 | 45499 | 2.91 | 0.72 | 3.87 | -12.48 | -38.56 | 31 |
| JUN 24 | 45509 | 3.29 | 0.75 | 3.89 | -12.48 | -38.04 | 31 |
| JUL 4 | 45519 | 3.65 | 0.89 | 4.00 | -12.52 | -37.57 | 32 |
| JUL 14 | 45529 | 4.02 | 0.92 | 4.13 | -12.44 | -37.15 | 33 |
| JUL 24 | 45539 | 4.68 | 0.75 | 4.13 | -12.39 | -36.78 | 35 |
| AUG 3 | 45549 | 5.36 | 0.60 | 4.07 | -12.30 | -36.46 | 33 |
| AUG 13 | 45559 | 5.61 | 0.58 | 4.03 | -12.50 | -35.72 | 30 |
| AUG 23 | 45569 | 5.76 | 0.61 | 4.05 | -12.58 | -35.44 | 32 |
| SEP 2 | 45579 | 5.91 | 0.42 | 4.09 | -12.66 | -35.20 | 35 |
| SEP 12 | 45589 | 6.14 | 0.33 | 4.09 | -12.74 | -34.88 | 35 |
| SEP 22 | 45599 | 6.32 | 0.34 | 4.02 | -12.82 | -34.55 | 35 |
| OCT 2 | 45609 | 6.64 | 0.15 | 3.97 | -12.99 | -34.20 | 34 |
| OCT 12 | 45619 | 6.74 | -0.11 | 3.80 | -12.89 | -33.86 | 35 |
| OCT 22 | 45629 | 6.79 | -0.22 | 3.72 | -12.83 | -33.46 | 34 |
| NOV 1 | 45639 | 6.90 | -0.28 | 3.69 | -12.76 | -33.00 | 37 |
| NOV 11 | 45649 | 7.02 | -0.21 | 3.68 | -12.91 | -32.39 | 37 |
| NOV 21 | 45659 | 6.94 | -0.07 | 3.65 | -12.89 | -31.52 | 34 |
| DEC 1 | 45669 | 6.93 | -0.04 | 3.57 | -12.99 | -31.08 | 41 |
| DEC 11 | 45679 | 7.01 | 0.00 | 3.57 | -13.07 | -30.13 | 45 |
| DEC 21 | 45689 | 7.04 | 0.07 | 3.53 | -13.30 | -29.49 | 42 |
| DEC 31 | 45699 | 6.28 | 0.18 | 3.50 | -13.32 | -28.79 | 44 |

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

| DATE 1983 | | MJD | UTC - UTC(I) ILOM (6) | NBS | NIM | NPL | NPRL (7) | NRC |
|---|---|---|---|---|---|---|---|---|
| JAN | 5 | 45339 | -9.14 | 0.13 | -6.84 | 3.24 | -53.0 | -7.89 |
| JAN | 15 | 45349 | -9.53 | 0.01 | -7.38 | 3.18 | -54.1 | -7.93 |
| JAN | 25 | 45359 | -9.58 | 0.01 | -7.76 | 3.15 | -20.9 | -7.90 |
| FEB | 4 | 45369 | -9.64 | -0.03 | -8.25 | 3.06 | -19.6 | -7.81 |
| FEB | 14 | 45379 | -9.77 | -0.21 | -8.90 | 2.81 | -18.8 | -8.00 |
| FEB | 24 | 45389 | -9.81 | -0.22 | -9.68 | 2.62 | -19.2 | -7.84 |
| MAR | 6 | 45399 | -9.78 | -0.20 | -10.40 | 2.47 | -20.4 | -7.68 |
| MAR | 16 | 45409 | -9.82 | -0.27 | -11.17 | 2.36 | -21.2 | -7.65 |
| MAR | 26 | 45419 | -9.72 | -0.32 | -11.93 | 2.22 | -20.8 | -7.65 |
| APR | 5 | 45429 | -9.88 | -0.40 | -12.15 | 2.09 | -20.5 | -7.61 |
| APR | 15 | 45439 | -10.03 | -0.53 | -11.90 | 1.99 | -19.9 | -7.61 |
| APR | 25 | 45449 | -10.22 | -0.62 | -11.88 | 1.89 | -19.1 | -7.56 |
| MAY | 5 | 45459 | -10.24 | -0.65 | -11.96 | 2.01 | -17.5 | -7.45 |
| MAY | 15 | 45469 | -10.29 | -0.65 | -11.83 | 1.98 | -16.0 | -7.39 |
| MAY | 25 | 45479 | -10.35 | -0.67 | -11.44 | 1.99 | -13.8 | -7.33 |
| JUN | 4 | 45489 | -10.48 | -0.75 | -11.19 | 2.23 | -11.3 | -7.31 |
| JUN | 14 | 45499 | -10.62 | -0.83 | -11.04 | 2.45 | -9.7 | -7.35 |
| JUN | 24 | 45509 | -10.76 | -0.88 | -10.91 | 2.47 | -10.0 | -7.42 |
| JUL | 4 | 45519 | -10.78 | -1.02 | -10.67 | 2.33 | -9.1 | -7.57 |
| JUL | 14 | 45529 | -10.41 | -1.04 | -10.46 | 2.10 | -7.9 | -7.63 |
| JUL | 24 | 45539 | -10.07 | -1.03 | -10.26 | 1.90 | -6.9 | -7.67 |
| AUG | 3 | 45549 | -9.92 | -1.06 | -10.13 | 1.63 | -5.8 | -7.76 |
| AUG | 13 | 45559 | -9.77 | -1.07 | -9.84 | 1.40 | -4.7 | -7.82 |
| AUG | 23 | 45569 | -9.34 | -1.07 | -9.59 | 1.08 | -3.6 | -7.85 |
| SEP | 2 | 45579 | -8.96 | -1.10 | -9.40 | 0.88 | -2.1 | -7.90 |
| SEP | 12 | 45589 | -8.60 | -1.16 | -9.07 | 0.61 | -2.2 | -7.98 |
| SEP | 22 | 45599 | -8.20 | -1.19 | -8.82 | 0.40 | -1.7 | -7.99 |
| OCT | 2 | 45609 | -7.66 | -1.23 | -8.52 | 0.17 | -1.1 | -8.03 |
| OCT | 12 | 45619 | -6.96 | -1.26 | -8.20 | -0.04 | 0.2 | -7.99 |
| OCT | 22 | 45629 | -6.15 | -1.35 | -7.92 | -0.20 | 2.3 | -7.98 |
| NOV | 1 | 45639 | -5.38 | -1.46 | -7.70 | -0.33 | 4.2 | -8.00 |
| NOV | 11 | 45649 | -4.57 | -1.53 | -7.39 | -0.48 | 7.1 | -7.99 |
| NOV | 21 | 45659 | -3.79 | -1.64 | -7.13 | -0.60 | 10.9 | -7.98 |
| DEC | 1 | 45669 | -3.02 | -1.68 | -6.88 | -0.79 | 11.4 | -7.99 |
| DEC | 11 | 45679 | -3.20 | -1.81 | -6.68 | -0.98 | 11.3 | -8.02 |
| DEC | 21 | 45689 | -3.32 | -1.82 | -6.33 | -1.07 | 11.7 | -8.11 |
| DEC | 31 | 45699 | -3.49 | -1.88 | -5.87 | -1.14 | 11.9 | -8.16 |

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

| DATE 1983 | | MJD | UTC - UTC(I) NRLM | OAB | OFM | OMH | OMSF | ON |
|---|---|---|---|---|---|---|---|---|
| JAN | 5 | 45339 | -32.10 | -146.84 | 0.24 | 0.29 | 0.33 | 12.32 |
| JAN | 15 | 45349 | -31.71 | -145.95 | 0.27 | 0.16 | 0.71 | 12.40 |
| JAN | 25 | 45359 | -31.08 | -144.26 | 0.29 | 0.13 | 0.82 | 12.28 |
| FEB | 4 | 45369 | -30.43 | -142.97 | 0.28 | 0.10 | 1.02 | 12.32 |
| FEB | 14 | 45379 | -29.81 | -141.96 | 0.47 | 0.49 | 1.29 | 12.43 |
| FEB | 24 | 45389 | -29.04 | -141.61 | 0.37 | 1.60 | 1.06 | 12.40 |
| MAR | 6 | 45399 | -28.36 | -140.95 | 0.15 | 1.45 | 1.05 | 12.14 |
| MAR | 16 | 45409 | -27.69 | -141.07 | 0.20 | – | 1.01 | 12.03 |
| MAR | 26 | 45419 | -26.85 | -140.99 | 0.16 | 1.86 | 1.27 | 12.20 |
| APR | 5 | 45429 | -26.28 | -141.03 | 0.11 | 1.82 | 1.30 | 12.21 |
| APR | 15 | 45439 | -25.69 | -140.77 | 0.05 | 1.79 | 1.49 | 12.20 |
| APR | 25 | 45449 | -25.12 | -140.93 | 0.03 | 2.07 | 1.49 | 12.08 |
| MAY | 5 | 45459 | -24.41 | -140.95 | 0.14 | 1.57 | 1.24 | 11.95 |
| MAY | 15 | 45469 | -23.68 | -140.77 | 0.09 | 1.29 | 1.27 | 11.72 |
| MAY | 25 | 45479 | -22.98 | -140.59 | 0.13 | 1.38 | 1.17 | 11.73 |
| JUN | 4 | 45489 | -22.37 | -139.86 | -0.01 | 2.09 | 1.49 | 11.85 |
| JUN | 14 | 45499 | -21.81 | -138.96 | -0.05 | 3.48 | 1.54 | 11.81 |
| JUN | 24 | 45509 | -21.23 | -138.39 | -0.07 | 1.91 | 1.81 | 11.79 |
| JUL | 4 | 45519 | -20.74 | -138.18 | 0.03 | 1.82 | 1.84 | 11.74 |
| JUL | 14 | 45529 | -20.17 | -137.82 | -0.02 | 2.28 | 1.92 | 11.74 |
| JUL | 24 | 45539 | -19.53 | -136.26 | -0.03 | 1.90 | 1.80 | 11.65 |
| AUG | 3 | 45549 | -18.96 | -134.32 | -0.06 | 1.55 | 1.79 | 11.54 |
| AUG | 13 | 45559 | -18.36 | -133.11 | -0.02 | 1.61 | 1.82 | 11.48 |
| AUG | 23 | 45569 | -17.74 | -131.55 | -0.01 | 1.91 | 1.94 | 11.41 |
| SEP | 2 | 45579 | -17.10 | – | -0.02 | 0.78 | 1.97 | 11.31 |
| SEP | 12 | 45589 | -16.56 | -129.22 | -0.05 | 0.85 | 2.06 | 11.31 |
| SEP | 22 | 45599 | -15.91 | -127.68 | -0.10 | 1.01 | 2.01 | 11.29 |
| OCT | 2 | 45609 | -15.26 | -126.74 | -0.13 | 1.13 | 2.07 | 11.30 |
| OCT | 12 | 45619 | -14.61 | -125.56 | -0.21 | 1.20 | 2.11 | 11.39 |
| OCT | 22 | 45629 | -13.95 | -124.31 | -0.22 | 1.22 | 2.05 | 11.54 |
| NOV | 1 | 45639 | -13.39 | -123.28 | -0.27 | 1.22 | 2.20 | 11.68 |
| NOV | 11 | 45649 | -12.80 | -122.60 | -0.31 | 1.06 | 2.20 | 11.73 |
| NOV | 21 | 45659 | -12.19 | -121.84 | -0.31 | 0.75 | 2.40 | 11.97 |
| DEC | 1 | 45669 | -11.54 | -122.15 | -0.33 | 1.09 | 2.45 | 12.09 |
| DEC | 11 | 45679 | -10.86 | -122.53 | -0.26 | 1.56 | 2.79 | 12.25 |
| DEC | 21 | 45689 | -10.30 | -123.11 | -0.37 | 1.52 | 2.77 | 12.17 |
| DEC | 31 | 45699 | -9.89 | -123.27 | -0.26 | 1.32 | 2.68 | 12.27 |

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

| DATE 1983 | | MJD | UTC - UTC(I) ONBA (8) | OP | ORB | PKNM | PTB | PTCH (9) |
|---|---|---|---|---|---|---|---|---|
| JAN | 5 | 45339 | 51 | 0.75 | -8.56 | -7.22 | 0.00 | -54.90 |
| JAN | 15 | 45349 | 53 | 0.71 | -8.64 | -7.05 | 0.08 | -55.47 |
| JAN | 25 | 45359 | 63 | 0.70 | -9.12 | -6.60 | 0.15 | -55.89 |
| FEB | 4 | 45369 | 68 | 0.64 | -10.02 | -6.07 | 0.19 | -56.35 |
| FEB | 14 | 45379 | 64 | 0.73 | -10.63 | -5.51 | 0.29 | -56.84 |
| FEB | 24 | 45389 | 70 | 0.66 | -10.32 | -4.99 | 0.35 | -57.16 |
| MAR | 6 | 45399 | 62 | 0.67 | -10.74 | -4.59 | 0.42 | -57.88 |
| MAR | 16 | 45409 | 61 | 0.68 | -11.20 | -4.10 | 0.50 | -58.58 |
| MAR | 26 | 45419 | 62 | 0.63 | -11.32 | -3.74 | 0.56 | -59.32 |
| APR | 5 | 45429 | 67 | 0.73 | -11.78 | -3.29 | 0.61 | -59.88 |
| APR | 15 | 45439 | 64 | 0.76 | -11.98 | -2.70 | 0.66 | -60.69 |
| APR | 25 | 45449 | 68 | 0.80 | -12.03 | -2.25 | 0.73 | -61.42 |
| MAY | 5 | 45459 | 69 | 0.75 | -12.51 | -1.95 | 0.82 | -62.10 |
| MAY | 15 | 45469 | 68 | 0.75 | -12.83 | -1.81 | 0.82 | -63.01 |
| MAY | 25 | 45479 | 67 | 0.73 | -12.95 | -1.63 | 0.88 | -63.80 |
| JUN | 4 | 45489 | 69 | 0.65 | -13.36 | -1.44 | 0.84 | -64.73 |
| JUN | 14 | 45499 | 67 | 0.69 | -13.69 | -1.29 | 0.87 | -65.72 |
| JUN | 24 | 45509 | 67 | 0.74 | -13.59 | -1.38 | 0.92 | -66.66 |
| JUL | 4 | 45519 | 68 | 0.89 | -13.45 | -1.50 | 1.01 | -67.64 |
| JUL | 14 | 45529 | 70 | 1.03 | -13.85 | -1.74 | 0.99 | -68.79 |
| JUL | 24 | 45539 | 73 | 1.20 | -13.97 | -1.90 | 0.96 | -69.83 |
| AUG | 3 | 45549 | 71 | 1.38 | -14.07 | -1.96 | 0.94 | -70.76 |
| AUG | 13 | 45559 | 69 | 1.56 | -14.21 | -2.13 | 1.00 | -71.70 |
| AUG | 23 | 45569 | 72 | 1.70 | -14.66 | -2.17 | 1.04 | -72.77 |
| SEP | 2 | 45579 | 75 | 1.83 | -14.71 | -2.34 | 1.08 | -73.91 |
| SEP | 12 | 45589 | 76 | 1.74 | -14.98 | -2.57 | 1.08 | -74.79 |
| SEP | 22 | 45599 | 77 | 1.56 | -15.05 | -2.74 | 1.13 | -75.68 |
| OCT | 2 | 45609 | 75 | 1.34 | -15.04 | -2.86 | 1.11 | -76.70 |
| OCT | 12 | 45619 | 76 | 1.19 | -14.96 | -3.13 | 1.09 | -77.63 |
| OCT | 22 | 45629 | 75 | 0.91 | -14.94 | -3.34 | 1.11 | -78.12 |
| NOV | 1 | 45639 | 79 | 0.62 | -15.02 | -3.11 | 1.10 | -78.46 |
| NOV | 11 | 45649 | 78 | 0.44 | -15.15 | -3.06 | 1.09 | -78.85 |
| NOV | 21 | 45659 | 75 | 0.20 | -15.29 | -2.73 | 1.11 | 61.82 |
| DEC | 1 | 45669 | 82 | 0.04 | -15.50 | -2.46 | 1.15 | 62.51 |
| DEC | 11 | 45679 | 10 | -0.08 | -15.70 | -2.48 | 1.14 | 63.46 |
| DEC | 21 | 45689 | 7 | 0.06 | -15.57 | -2.84 | 1.24 | 64.17 |
| DEC | 31 | 45699 | 10 | 0.17 | -15.79 | -2.96 | 1.31 | 64.57 |

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

| DATE 1983 | | MJD | UTC - UTC(I) RGO | RRL | SO | STA (10) | SU | TAO |
|---|---|---|---|---|---|---|---|---|
| JAN | 5 | 45339 | -15.36 | -4.93 | -8.18 | 0.06 | 26.50 | -2.54 |
| JAN | 15 | 45349 | -15.32 | -5.20 | -8.38 | 0.18 | 26.47 | -2.46 |
| JAN | 25 | 45359 | -15.26 | -5.16 | -8.35 | 0.07 | 26.63 | -2.07 |
| FEB | 4 | 45369 | -15.26 | -5.16 | -8.39 | 0.04 | 26.29 | -1.73 |
| FEB | 14 | 45379 | -15.34 | -5.10 | -8.64 | -0.13 | 26.99 | -1.40 |
| FEB | 24 | 45389 | -15.27 | -4.94 | -8.70 | -0.22 | 27.14 | -0.95 |
| MAR | 6 | 45399 | -15.21 | -4.76 | -8.64 | -0.32 | 27.20 | -0.53 |
| MAR | 16 | 45409 | -15.20 | -4.69 | -8.63 | -0.54 | 27.24 | -0.19 |
| MAR | 26 | 45419 | -15.16 | -4.44 | -8.46 | -0.63 | 27.18 | 0.33 |
| APR | 5 | 45429 | -15.09 | -4.51 | -8.56 | -0.70 | 27.23 | 0.59 |
| APR | 15 | 45439 | -14.95 | -4.53 | -8.42 | -0.81 | 27.31 | 0.78 |
| APR | 25 | 45449 | -14.90 | -4.58 | -8.45 | -0.93 | 27.72 | 0.79 |
| MAY | 5 | 45459 | -14.86 | -4.47 | -8.23 | -0.98 | 27.44 | 0.78 |
| MAY | 15 | 45469 | -14.90 | -4.41 | -7.97 | -0.95 | 28.57 | 0.77 |
| MAY | 25 | 45479 | -14.78 | -4.31 | -7.52 | -1.14 | 28.94 | 0.75 |
| JUN | 4 | 45489 | -14.70 | -4.36 | -6.97 | -1.22 | 28.82 | 0.64 |
| JUN | 14 | 45499 | -14.59 | -4.44 | -6.88 | -1.23 | 29.65 | 0.59 |
| JUN | 24 | 45509 | -14.60 | -4.49 | -7.12 | -0.97 | 28.60 | 0.55 |
| JUL | 4 | 45519 | -14.48 | -4.61 | -7.40 | -0.66 | 28.86 | 0.40 |
| JUL | 14 | 45529 | -14.33 | -4.73 | -7.84 | -0.23 | 29.37 | 0.32 |
| JUL | 24 | 45539 | -14.30 | -4.74 | -8.27 | -0.01 | 28.96 | 0.26 |
| AUG | 3 | 45549 | -14.23 | -4.73 | -8.83 | 0.25 | 28.51 | 0.15 |
| AUG | 13 | 45559 | -14.18 | -4.75 | -8.92 | 0.56 | 28.50 | 0.02 |
| AUG | 23 | 45569 | -14.29 | -4.80 | -8.71 | 0.81 | 28.65 | -0.06 |
| SEP | 2 | 45579 | -14.26 | -4.81 | -8.36 | 1.06 | 28.76 | -0.19 |
| SEP | 12 | 45589 | -14.09 | -4.86 | -8.24 | 1.26 | 29.02 | -0.30 |
| SEP | 22 | 45599 | -14.39 | -4.82 | -8.32 | 1.50 | 28.61 | -0.42 |
| OCT | 2 | 45609 | -14.50 | -4.86 | -8.27 | 1.76 | 28.98 | -0.56 |
| OCT | 12 | 45619 | -14.47 | -4.91 | -8.25 | 1.81 | 29.21 | -0.56 |
| OCT | 22 | 45629 | -14.49 | -4.96 | -8.39 | 1.91 | 28.89 | -0.60 |
| NOV | 1 | 45639 | -14.47 | -5.09 | -8.77 | 1.76 | 28.90 | -0.62 |
| NOV | 11 | 45649 | -14.47 | -5.16 | -8.93 | 1.50 | 28.67 | -0.65 |
| NOV | 21 | 45659 | -14.49 | -5.28 | -9.30 | 1.23 | 28.77 | -0.68 |
| DEC | 1 | 45669 | -14.61 | -5.30 | -9.69 | 0.92 | 28.93 | -0.66 |
| DEC | 11 | 45679 | -14.58 | -5.45 | -9.75 | 0.42 | 29.03 | -0.73 |
| DEC | 21 | 45689 | -14.54 | -5.44 | -9.74 | -0.33 | 28.36 | -0.68 |
| DEC | 31 | 45699 | -14.35 | -5.49 | -9.75 | -0.93 | 28.92 | -0.69 |

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

| DATE 1983 | | MJD | UTC - UTC(I) TL | TP | TUG | USNO | VSL | ZIPE |
|---|---|---|---|---|---|---|---|---|
| | | | | | (11) | | (12) | |
| JAN | 5 | 45339 | 27.26 | -0.62 | -4.40 | 1.84 | 0.12 | -0.35 |
| JAN | 15 | 45349 | 28.70 | -1.01 | — | 1.71 | 0.23 | -0.19 |
| JAN | 25 | 45359 | 31.06 | -0.58 | 4.22 | 1.71 | 0.37 | -0.08 |
| FEB | 4 | 45369 | 30.99 | -0.05 | 3.88 | 1.67 | 0.45 | 0.03 |
| FEB | 14 | 45379 | 31.46 | 0.28 | 3.43 | 1.51 | 0.42 | 0.16 |
| FEB | 24 | 45389 | 32.73 | 0.70 | 3.07 | 1.49 | 0.54 | 0.12 |
| MAR | 6 | 45399 | 33.72 | 0.94 | 2.87 | 1.54 | 0.72 | 0.18 |
| MAR | 16 | 45409 | 34.90 | 1.24 | 2.51 | 1.49 | 0.75 | 0.31 |
| MAR | 26 | 45419 | 36.62 | 1.46 | 2.11 | 1.43 | 0.79 | 0.43 |
| APR | 5 | 45429 | 37.85 | 1.34 | 1.75 | 1.37 | 0.82 | 0.48 |
| APR | 15 | 45439 | 39.41 | 1.44 | 1.40 | 1.29 | 0.86 | 0.46 |
| APR | 25 | 45449 | 40.84 | 1.47 | 1.07 | 1.27 | 0.95 | 0.48 |
| MAY | 5 | 45459 | 42.21 | 1.71 | 0.74 | 1.29 | 1.10 | 0.41 |
| MAY | 15 | 45469 | 43.99 | 1.74 | 1.60 | 1.30 | 1.23 | 0.24 |
| MAY | 25 | 45479 | 45.21 | 1.61 | 3.12 | 1.30 | 1.37 | 0.19 |
| JUN | 4 | 45489 | 46.96 | 1.61 | 4.50 | 1.23 | 1.54 | 0.18 |
| JUN | 14 | 45499 | 47.95 | 1.48 | 5.87 | 1.16 | 1.69 | 0.09 |
| JUN | 24 | 45509 | 49.17 | 1.33 | -4.64 | 1.14 | 1.89 | 0.10 |
| JUL | 4 | 45519 | 49.92 | 0.94 | -3.35 | 1.04 | 2.16 | 0.10 |
| JUL | 14 | 45529 | 50.84 | 1.14 | -1.95 | 0.99 | 2.49 | 0.03 |
| JUL | 24 | 45539 | 51.65 | 1.55 | -0.53 | 0.99 | 2.72 | -0.10 |
| AUG | 3 | 45549 | 52.63 | 1.54 | 0.84 | 0.93 | 2.96 | -0.19 |
| AUG | 13 | 45559 | 53.49 | 1.46 | 2.23 | 0.89 | 3.19 | -0.17 |
| AUG | 23 | 45569 | 54.39 | 1.25 | 3.61 | 0.85 | 3.41 | -0.18 |
| SEP | 2 | 45579 | 55.37 | 0.96 | 4.98 | 0.79 | 3.61 | -0.20 |
| SEP | 12 | 45589 | 56.35 | 0.60 | -1.17 | 0.73 | 3.81 | -0.34 |
| SEP | 22 | 45599 | 57.20 | 0.51 | -0.79 | 0.69 | 4.06 | -0.37 |
| OCT | 2 | 45609 | 57.97 | 0.26 | -0.44 | 0.64 | 4.33 | -0.45 |
| OCT | 12 | 45619 | 59.33 | 0.25 | -0.07 | 0.62 | 4.57 | -0.66 |
| OCT | 22 | 45629 | 60.84 | 0.48 | 0.25 | 0.59 | 4.78 | -0.77 |
| NOV | 1 | 45639 | 61.47 | 0.84 | 0.60 | 0.52 | 5.03 | -0.87 |
| NOV | 11 | 45649 | 62.19 | 1.31 | 1.00 | 0.49 | 5.26 | -0.81 |
| NOV | 21 | 45659 | 63.21 | 0.50 | 1.34 | 0.42 | 5.60 | -0.77 |
| DEC | 1 | 45669 | 64.34 | 0.23 | 1.77 | 0.40 | 5.86 | -0.89 |
| DEC | 11 | 45679 | 65.49 | 0.26 | 2.11 | 0.29 | 6.17 | -0.79 |
| DEC | 21 | 45689 | 66.55 | 0.49 | 2.55 | 0.30 | 6.51 | -0.99 |
| DEC | 31 | 45699 | 67.61 | 1.22 | 2.97 | 0.24 | 6.90 | -0.88 |

TABLE 17 - (cont.)

NOTES

In general, the uncertainties are about ten times larger than the unit of the last reported digit. See Table 18.

(1) APL.(a) Time step of UTC (APL) of 4.69 $\mu$s on MJD = 45489
(b) The following Table gives revised values of UTC - UTC(APL) from MJD = 44909

| MJD | UTC-UTC(APL) | MJD | UTC-UTC(APL) | MJD | UTC-UTC(APL) |
|---|---|---|---|---|---|
| 44909 | 1.66 | 45059 | 0.71 | 45209 | 0.53 |
| 44919 | 1.57 | 45069 | 0.65 | 45219 | 0.51 |
| 44929 | 1.49 | 45079 | 0.52 | 45229 | 0.78 |
| 44939 | 1.44 | 45089 | 0.51 | 45239 | 1.03 |
| 44949 | 1.47 | 45099 | 0.46 | 45249 | 1.18 |
| 44959 | 1.53 | 45109 | 0.44 | 45259 | 1.66 |
| 44969 | 1.55 | 45119 | 0.40 | 45269 | 2.00 |
| 44979 | 1.57 | 45129 | 0.43 | 45279 | 2.33 |
| 44989 | 1.49 | 45139 | 0.40 | 45289 | 2.68 |
| 44999 | 1.33 | 45149 | 0.42 | 45299 | 3.03 |
| 45009 | 1.32 | 45159 | 0.46 | 45309 | 3.33 |
| 45019 | 1.13 | 45169 | 0.43 | 45319 | 3.60 |
| 45029 | 1.01 | 45179 | 0.45 | 45329 | 3.77 |
| 45039 | 0.88 | 45189 | 0.46 | | |
| 45049 | 0.73 | 45199 | 0.41 | | |

(2) AUS. UTC - UTC(AUS) was directly computed from the values UTC(USNO MC) - UTC(AUS) of DNM Bulletin E.

(3) CAO. Time step of UTC(CAO) of 15 $\mu$s on MJD = 45455

(4) IFAG. Time steps of UTC(IFAG) of - 0.294 $\mu$s and - 0.384 $\mu$s, respectively on MJD = 45498.50 and MJD = 45557.18

(5) IGMA. Results obtained by VLF. The origin of UTC - UTC(IGMA) was improved using the clock transportation result between ONBA and USNO on MJD = 45689.6 and the TV link between IGMA and ONBA.

(6) ILOM. Change of master clock on MJD = 45669.514

(7) NPRL. UTC - UTC(NPRL) was directly computed from the values of UTC(USNO MC) - UTC(NPRL) given by NPRL

(8) ONBA.(a) UTC - UTC(ONBA) is derived from UTC - UTC(IGMA) using the TV link between ONBA and IGMA. The origins have been obtained from the clock transportation between ONBA and USNO on MJD = 45689.6
(b) Time step of UTC(ONBA) of 77 $\mu$s on MJD = 45677

(9) PTCH. Change of master clock on MJD = 45654

(10) STA. Time step of UTC(STA) of - 6 $\mu$s on MJD = 45335

(11) TUG.(a) The shift from LORAN-C to GPS resulted in an apparent step of about 0.5 $\mu$s of UTC - UTC(TUG) on MJD = 45359
(b) Real time steps of UTC(TUG) are :
-9 $\mu$s on MJD = 45344
12 $\mu$s on MJD = 45502.66
(c) Change of master clock on MJD = 45583.73

(12) VSL. Time step of UTC(VSL) of 7 $\mu$s on MJD = 45335.

TABLE 18 - COMPARISONS BETWEEN THE CLOCK TRANSPORTATIONS AND THE BIH RESULTS

THE TABLE GIVES THE DIFFERENCES BETWEEN THE CLOCK TRANSPORTATION RESULTS AND THOSE DERIVED FROM THE DATA OF TABLE 17 (BEFORE ROUNDING-OFF)

| DATE 1983 | MJD | TIME COMPARISONS | DIFFERENCE CLOCK TR. - BIH (UNIT : 1 MICROSECOND) |
|---|---|---|---|
| JAN 20 | 45354.3 | UTC(ILOM) - UTC(RRL ) | -0.10 |
| JAN 28 | 45362.3 | UTC(USNO) - UTC(OMSF) | 0.05 |
| JAN 28 | 45362.3 | UTC(USNO) - UTC(NBS ) | 0.00 |
| JAN 31 | 45365.7 | UTC(USNO) - UTC(CAO ) | 0.24 |
| FEB 3 | 45368.5 | UTC(USNO) - UTC(IEN ) | 0.0 |
| FEB 11 | 45376.4 | UTC(USNO) - UTC(NPL ) | 0.00 |
| MAR 30 | 45423.97 | UTC(USNO) - UTC(NRC ) | 0.15 |
| APR 20 | 45444.4 | UTC(USNO) - UTC(OP ) | 0.0 |
| APR 26 | 45450.3 | UTC(USNO) - UTC(NPL ) | -0.25 |
| APR 26 | 45450.5 | UTC(USNO) - UTC(ON ) | 0.11 |
| APR 28 | 45452.3 | UTC(USNO) - UTC(BEV ) | 0.0 |
| APR 29 | 45453.3 | UTC(USNO) - UTC(TUG ) | 0.0 |
| MAY 4 | 45458.3 | UTC(USNO) - UTC(DHI ) | 0.7 |
| MAY 4 | 45458.4 | UTC(USNO) - UTC(PTB ) | 0.0 |
| MAY 6 | 45460.3 | UTC(USNO) - UTC(FTZ ) | -0.04 |
| MAY 13 | 45467.2 | UTC(USNO) - UTC(NBS ) | 0.00 |
| MAY 31 | 45485.5 | UTC(PKNM) - UTC(SU ) | -0.936 |
| JUN 6 | 45491.1 | UTC(TAO ) - UTC(NRLM) | -0.06 |
| JUN 7 | 45492.0 | UTC(TAO ) - UTC(RRL ) | 0.02 |
| JUN 14 | 45499.0 | UTC(TAO ) - UTC(ILOM) | 0.18 |
| JUL 21 | 45536.3 | UTC(ILOM) - UTC(RRL ) | -0.08 |
| JUL 28 | 45543.3 | UTC(ON ) - UTC(OFM ) | 0.18 |
| AUG 11 | 45557.4 | UTC(USNO) - UTC(NBS ) | 0.0 |
| AUG 29 | 45575.6 | UTC(USNO) - UTC(RGO ) | 0.10 |
| AUG 30 | 45576.3 | UTC(USNO) - UTC(NPL ) | -0.10 |
| SEP 5 | 45582.2 | UTC(USNO) - UTC(VSL ) | -0.1 |
| SEP 7 | 45584.0 | UTC(OMH ) - UTC(TP ) | 0.0 |
| SEP 8 | 45585.1 | UTC(USNO) - UTC(STA ) | 0.1 |
| SEP 9 | 45586.3 | UTC(USNO) - UTC(ORB ) | 0.0 |
| SEP 10 | 45587.3 | UTC(USNO) - UTC(OP ) | 0.07 |
| SEP 12 | 45589.6 | UTC(USNO) - UTC(NRC ) | 0.1 |
| SEP 19 | 45596 | UTC(ASMW) - UTC(TP ) | -0.134 |
| SEP 30 | 45607.6 | UTC(USNO) - UTC(NBS ) | 0.00 |
| OCT 19 | 45626.3 | UTC(USNO) - UTC(IEN ) | 0.27 |
| NOV 17 | 45655.0 | UTC(TAO ) - UTC(ILOM) | 0.10 |
| NOV 17 | 45655.0 | UTC(USNO) - UTC(ILOM) | 0.14 |
| NOV 19 | 45657.1 | UTC(TAO ) - UTC(RRL ) | 0.03 |
| NOV 19 | 45657.1 | UTC(USNO) - UTC(TAO ) | -0.05 |
| NOV 20 | 45658.8 | UTC(USNO) - UTC(RRL ) | -0.10 |
| NOV 21 | 45659.1 | UTC(TAO ) - UTC(NRLM) | -0.02 |
| NOV 21 | 45659.3 | UTC(USNO) - UTC(NRLM) | -0.14 |
| NOV 22 | 45660 | UTC(SU ) - UTC(ZIPE) | 0.0 |
| NOV 23 | 45661 | UTC(SU ) - UTC(ASMW) | 0.0 |
| DEC 7 | 45675 | UTC(SU ) - UTC(TP ) | 0.1 |
| DEC 14 | 45682.5 | UTC(PKNM) - UTC(ASMW) | -0.425 |
| DEC 15 | 45683.3 | UTC(ILOM) - UTC(RRL ) | 0.00 |
| DEC 21 | 45689 | UTC(SU ) - UTC(OMH ) | -0.9 |
| DEC 21 | 45689.6 | UTC(ONBA) - UTC(USNO) | 0.006 |

TABLE 19 - INTERNATIONAL ATOMIC TIME , BI-MONTHLY RATES OF TAI-CLOCK FOR 1983

THE RATES ARE AVERAGED OVER INTERVALS OF TWO MONTHS ENDING AT THE GIVEN DATES

UNIT IS NS/DAY , 0.0 DENOTES THAT THE CLOCK WAS NOT USED

| LAB. | CLOCK | 45389 | 45449 | 45509 | 45569 | 45629 | 45699 |
|---|---|---|---|---|---|---|---|
| AOS | 19 7 | 67.57 | 61.83 | 53.07 | 49.14 | 46.89 | 0.0 |
| APL | 14 121 | -103.18 | -93.38 | 0.0 | 0.0 | 0.0 | 0.0 |
| APL | 14 773 | -74.03 | -88.12 | -96.15 | -102.98 | -107.09 | -121.15 |
| APL | 14 793 | 217.45 | 223.86 | 230.44 | 225.44 | 234.94 | 227.11 |
| APL | 42 6 | 0.0 | 0.0 | 0.0 | 0.0 | -11.44 | -22.65 |
| ASMW | 13 29 | -87.31 | -123.17 | -131.32 | -125.12 | -128.72 | -111.56 |
| ASMW | 16 76 | -22.71 | -25.64 | -50.86 | -59.09 | -59.54 | -32.02 |
| ASMW | 16 165 | -14.78 | -17.43 | -26.64 | -21.80 | -22.51 | -8.16 |
| BEV | 16 71 | 4.69 | 6.25 | -7.78 | 17.49 | 9.22 | -4.18 |
| CAO | 16 52 | 10.95 | 9.60 | -2.84 | -7.94 | -17.47 | 8.76 |
| CAO | 16 183 | 11.29 | 13.76 | 8.18 | -2.77 | -14.86 | 1.32 |
| F | 12 158 | 0.0 | 0.0 | 0.0 | 0.0 | -224.62 | -256.52 |
| F | 12 195 | 271.62 | 266.93 | 260.31 | 266.63 | 265.07 | 287.09 |
| F | 12 347 | -90.33 | -86.23 | -71.26 | -33.48 | -48.93 | -88.82 |
| F | 12 439 | -37.54 | -43.89 | -61.17 | -71.32 | -67.93 | -53.34 |
| F | 14 51 | -228.02 | -235.53 | -247.70 | -243.46 | -243.40 | 0.0 |
| F | 14 134 | -6.79 | -7.73 | 0.0 | -2.09 | 0.63 | -2.33 |
| F | 14 500 | 0.0 | 0.0 | -22.62 | -15.26 | -15.97 | -21.94 |
| F | 14 594 | -228.15 | -225.27 | -228.95 | -211.39 | -213.53 | -214.25 |
| F | 14 753 | -30.66 | -32.02 | 0.0 | -23.01 | -8.82 | -2.65 |
| F | 22 120 | -19.55 | -22.03 | 0.0 | 0.0 | -10.20 | -33.49 |
| F | 24 407 | 0.0 | 0.0 | 0.0 | -110.35 | -112.51 | -128.37 |
| F | 24 645 | -49.77 | -43.57 | -54.23 | -58.67 | -51.88 | 0.0 |
| F | 24 842 | 0.0 | 0.0 | -123.80 | -119.64 | -109.63 | -113.88 |
| FTZ | 14 312 | 19.26 | 15.94 | 10.63 | -2.07 | -5.85 | -3.36 |
| FTZ | 14 895 | 30.24 | 24.22 | 29.27 | 49.05 | 0.0 | 0.0 |
| FTZ | 16 130 | 28.37 | 15.17 | 5.62 | 0.0 | 0.0 | 0.0 |
| FTZ | 24 217 | 16.05 | 10.08 | 7.54 | 1.77 | -6.03 | -3.25 |
| FTZ | 24 482 | 25.17 | 12.01 | 10.60 | 2.63 | -4.97 | -1.28 |
| FTZ | 24 656 | 0.0 | 0.0 | 0.0 | 0.0 | -10.56 | -3.73 |
| FTZ | 24 674 | 36.98 | 9.34 | 8.10 | 3.40 | -5.53 | -3.01 |
| IEN | 12 469 | -3.65 | 6.04 | 32.13 | 54.40 | 48.28 | 0.0 |
| IEN | 12 609 | -108.61 | -112.66 | -102.63 | -100.58 | 0.0 | 0.0 |
| IEN | 14 893 | 50.35 | 48.87 | 43.99 | 45.40 | 42.74 | 40.70 |
| IEN | 16 84 | 165.92 | 154.10 | 144.03 | 128.84 | 0.0 | 0.0 |
| IFAG | 16 131 | 0.0 | 0.0 | 128.93 | 119.72 | 114.77 | 132.44 |
| IFAG | 16 138 | -29.11 | -47.20 | -48.78 | -51.24 | -43.56 | -54.38 |
| IFAG | 16 173 | 88.62 | 66.91 | 38.62 | 36.63 | 33.28 | 68.43 |
| IFAG | 41 1 | 62.23 | 0.0 | 0.0 | 0.0 | 0.0 | 142.74 |
| ILOM | 11 176 | 0.0 | 0.0 | 0.0 | 0.0 | 896.50 | 1087.98 |
| ILOM | 14 614 | 0.0 | 0.0 | 0.0 | 0.0 | -161.72 | 0.0 |
| ILOM | 14 885 | 0.0 | 0.0 | 0.0 | 0.0 | 25.37 | 45.28 |
| ILOM | 24 315 | 0.0 | 0.0 | 0.0 | 0.0 | -29.44 | -44.92 |
| NBS | 11 137 | -136.25 | -162.46 | -164.66 | -177.39 | -189.21 | 0.0 |
| NBS | 11 167 | -565.22 | -562.76 | -560.99 | -564.74 | 0.0 | 0.0 |
| NBS | 12 352 | -561.50 | -554.25 | -559.28 | -560.14 | -550.03 | -537.11 |
| NBS | 13 61 | -127.90 | -133.95 | -170.16 | -183.22 | -152.68 | -118.92 |
| NBS | 14 316 | 5.95 | 13.68 | 19.55 | 10.43 | 0.0 | 0.0 |
| NBS | 14 323 | -107.36 | -104.03 | -101.99 | -74.03 | -80.52 | -87.32 |
| NBS | 14 601 | -70.77 | -69.56 | -64.96 | -70.76 | -82.23 | -83.82 |

TABLE 19 - (CONT.)

| LAB. | CLOCK | 45389 | 45449 | 45509 | 45569 | 45629 | 45699 |
|---|---|---|---|---|---|---|---|
| NBS | 18 8 | 0.0 | 0.0 | 250.17 | 258.63 | 271.58 | 252.64 |
| NBS | 18 113 | -994.31 | -997.26 | -1037.41 | -1119.51 | -1096.50 | -1052.30 |
| NBS | 40 4 | -757.25 | 0.0 | -758.88 | -762.01 | 0.0 | 0.0 |
| NPL | 12 316 | -163.65 | -217.01 | -231.64 | -264.80 | -227.07 | -219.96 |
| NPL | 12 418 | -68.20 | -70.96 | -49.11 | -81.34 | -80.34 | -83.16 |
| NPL | 12 832 | 290.13 | 283.23 | 256.89 | 330.08 | 308.18 | 0.0 |
| NPL | 24 334 | 0.0 | 0.0 | -33.48 | -13.60 | -19.32 | 0.0 |
| NRC | 14 267 | -33.38 | -26.70 | -16.93 | -14.54 | -13.02 | -19.93 |
| NRC | 90 5 | -0.82 | 2.73 | 1.53 | -7.88 | -3.13 | -3.22 |
| NRC | 90 61 | -12.91 | -6.27 | -5.89 | -15.58 | -6.45 | -8.12 |
| NRC | 90 62 | -15.08 | 4.90 | 7.76 | 5.50 | -7.95 | -6.51 |
| NRC | 90 63 | -12.82 | 1.23 | -0.54 | -10.55 | -10.59 | -7.57 |
| NRLM | 12 363 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.81 |
| NRLM | 24 632 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 62.14 |
| OAB | 16 189 | 108.26 | 8.75 | 44.67 | 122.03 | 135.00 | 9.64 |
| OFM | 16 69 | -82.03 | -94.49 | -96.71 | -93.08 | -99.30 | 0.0 |
| OFM | 16 77 | -94.62 | -103.64 | -105.57 | -99.00 | 0.0 | 0.0 |
| OFM | 17 206 | 29.72 | 22.86 | 25.71 | 27.26 | 28.90 | 36.70 |
| OFM | 17 208 | -170.72 | -179.73 | -175.34 | -171.63 | -172.52 | -171.33 |
| OFM | 99 1 | 93.44 | 84.39 | 75.58 | 64.77 | 33.18 | 8.02 |
| OFM | 99 2 | 132.22 | 123.35 | 131.28 | 125.93 | 121.83 | 125.54 |
| OFM | 99 4 | 122.37 | 120.13 | 118.60 | 123.79 | 123.45 | 130.71 |
| OFM | 99 5 | -143.21 | -150.28 | -149.10 | -132.10 | -124.97 | -129.62 |
| OMH | 22 67 | 18.00 | 7.91 | 14.75 | -4.10 | -3.35 | 4.84 |
| OMSF | 14 896 | 16.38 | 16.20 | 16.51 | 10.78 | 14.24 | 25.85 |
| OMSF | 16 113 | 26.28 | 0.0 | 0.0 | 0.0 | -42.31 | -74.61 |
| OMSF | 16 121 | -58.38 | -61.35 | -50.93 | 0.0 | 0.0 | 0.0 |
| OMSF | 16 177 | 29.39 | 31.38 | 21.19 | 63.43 | 54.14 | 68.87 |
| OMSF | 22 223 | 225.62 | 219.28 | 227.36 | 224.38 | 214.44 | 225.48 |
| OMSF | 24 569 | -23.60 | -7.44 | 2.91 | 0.65 | -10.12 | 18.30 |
| ON | 12 285 | -19.53 | -24.92 | -29.65 | -35.29 | -27.01 | -18.42 |
| ON | 12 863 | -14.86 | -24.07 | 3.91 | -6.58 | 0.0 | 0.0 |
| ON | 13 14 | -20.74 | -7.23 | -2.67 | 16.79 | -6.71 | 4.08 |
| ON | 16 114 | 16.45 | 1.39 | 3.03 | -18.75 | -15.21 | 12.28 |
| ON | 24 796 | 0.0 | 0.0 | 0.0 | 5.78 | 0.28 | -1.45 |
| ORB | 12 205 | -120.52 | -109.42 | -110.26 | -105.75 | -93.00 | -88.63 |
| ORB | 12 804 | 6.51 | 20.94 | 23.33 | 32.91 | 45.14 | 37.67 |
| PKNM | 16 125 | 0.0 | 0.0 | 40.60 | 41.18 | 45.18 | 72.59 |
| PKNM | 16 154 | -9.01 | -11.62 | -75.94 | -52.18 | -67.11 | -10.20 |
| PKNM | 24 144 | 15.88 | 12.31 | 2.99 | -0.22 | -5.51 | -7.35 |
| PTB | 12 320 | -19.68 | -26.77 | -34.63 | -30.31 | -34.05 | -34.49 |
| PTB | 12 462 | 4.90 | -1.97 | -5.04 | 3.66 | 4.59 | 4.30 |
| PTB | 14 394 | -39.75 | -42.31 | -42.98 | -38.42 | -37.81 | -39.32 |
| PTB | 14 395 | -40.08 | -40.86 | -43.52 | -48.31 | -50.35 | -50.36 |
| PTB | 14 867 | -199.62 | -200.71 | -202.69 | -198.87 | -203.12 | -203.13 |
| PTB | 16 119 | -97.73 | -88.85 | -96.73 | -97.73 | -94.21 | -82.16 |
| PTB | 24 103 | -13.29 | -12.86 | -17.88 | -14.51 | -17.32 | -19.69 |
| PTB | 92 1 | 7.55 | 6.23 | 2.30 | 1.21 | 0.89 | 2.54 |
| PTCH | 16 64 | -45.64 | -70.32 | -88.03 | -101.51 | -90.54 | 0.0 |
| PTCH | 16 140 | 100.59 | 84.20 | 28.44 | -18.90 | -14.72 | 66.63 |

TABLE 19 - (CONT.)

| LAB. | CLOCK | 45389 | 45449 | 45509 | 45569 | 45629 | 45699 |
|---|---|---|---|---|---|---|---|
| RGO | 11 123 | -175.54 | -169.23 | -172.31 | -167.68 | -169.45 | -175.09 |
| RGO | 11 199 | -90.19 | -84.56 | -85.16 | -81.22 | 0.0 | 0.0 |
| RGO | 12 484 | -128.24 | -137.07 | -132.82 | -59.24 | -152.23 | -217.83 |
| RGO | 14 202 | -358.72 | -376.54 | -396.65 | -406.75 | -428.27 | -456.98 |
| RGO | 14 560 | -92.91 | -81.89 | -68.78 | -77.98 | -88.71 | -95.12 |
| RGO | 14 868 | -128.15 | -128.74 | -129.18 | -124.33 | -128.09 | -131.02 |
| RGO | 20 133 | -169.35 | -203.34 | -198.11 | -212.74 | -235.68 | -225.79 |
| STA | 14 900 | -228.62 | -232.16 | -242.35 | 0.0 | 0.0 | 0.0 |
| STA | 16 137 | 8.04 | -25.16 | -45.49 | -41.07 | 0.0 | 0.0 |
| STA | 24 376 | -27.76 | -34.65 | -31.89 | -19.54 | -29.72 | -53.09 |
| TAO | 14 390 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -80.37 |
| TAO | 24 75 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -65.12 |
| TAO | 24 498 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -96.07 |
| TP | 12 335 | -459.18 | -496.11 | -511.80 | -542.78 | -593.73 | -684.47 |
| TUG | 12 524 | 154.83 | 147.22 | 146.69 | 138.20 | 164.05 | 152.57 |
| TUG | 24 654 | -29.23 | -34.55 | 0.0 | 0.0 | 40.57 | 38.80 |
| USNO | 12 57 | 0.0 | 0.0 | 0.0 | -389.34 | 0.0 | 0.0 |
| USNO | 12 147 | -215.96 | -220.66 | 0.0 | 0.0 | 0.0 | 0.0 |
| USNO | 12 150 | -1.25 | -2.99 | 5.01 | 6.12 | 0.0 | 0.0 |
| USNO | 12 532 | 26.19 | 23.89 | 59.05 | 101.93 | 106.52 | 0.0 |
| USNO | 12 573 | -72.46 | -67.47 | -60.24 | -46.00 | -63.98 | -98.12 |
| USNO | 12 752 | -140.67 | -139.40 | -142.23 | -154.79 | -148.87 | -157.53 |
| USNO | 12 778 | 224.51 | 229.05 | 234.58 | 233.17 | 234.48 | 233.44 |
| USNO | 12 873 | -0.26 | 8.95 | 12.03 | 3.83 | 6.63 | 14.76 |
| USNO | 14 345 | 162.66 | 174.21 | 178.99 | 156.27 | 164.47 | 172.28 |
| USNO | 14 571 | -96.89 | -94.61 | -94.46 | -77.65 | -76.04 | -87.26 |
| USNO | 14 591 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -411.92 |
| USNO | 14 783 | 25.78 | 41.47 | 47.51 | 53.92 | 0.0 | 0.0 |
| USNO | 14 834 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -90.06 |
| USNO | 14 862 | 0.0 | 0.0 | 217.58 | 225.43 | 230.50 | 225.32 |
| USNO | 14 871 | 94.27 | 103.64 | 108.95 | 99.61 | 94.68 | 93.86 |
| USNO | 14 875 | 0.0 | 0.0 | -112.94 | -133.91 | -142.51 | -139.44 |
| USNO | 16 78 | 0.0 | 0.0 | 120.91 | 108.93 | 124.65 | 122.56 |
| USNO | 18 107 | 834.95 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| USNO | 18 108 | 0.0 | 494.84 | 0.0 | 0.0 | 0.0 | 0.0 |
| USNO | 18 133 | 167.14 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| USNO | 18 159 | 32.71 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| USNO | 22 114 | 60.00 | 66.37 | 75.35 | 79.40 | 82.76 | 73.19 |
| USNO | 22 535 | -62.17 | -53.93 | -57.56 | 0.0 | 0.0 | 0.0 |
| USNO | 22 946 | 0.0 | 449.00 | 221.47 | -638.60 | 0.0 | 0.0 |
| USNO | 24 25 | 0.0 | 0.0 | -249.62 | -263.75 | -253.53 | 0.0 |
| USNO | 24 28 | -129.96 | -116.84 | -99.58 | -99.37 | -104.05 | -114.75 |
| USNO | 24 33 | 61.09 | 64.76 | 75.79 | 75.39 | 88.22 | 75.56 |
| USNO | 24 35 | -140.74 | -142.32 | 0.0 | 0.0 | 0.0 | -81.17 |
| USNO | 24 94 | -64.31 | -63.18 | -55.49 | -25.03 | -30.43 | -35.65 |
| USNO | 24 117 | -97.83 | -93.03 | -94.37 | -95.24 | -91.78 | -91.57 |
| USNO | 24 118 | -186.60 | -178.31 | -189.76 | -192.02 | 0.0 | 0.0 |
| USNO | 24 300 | -237.50 | -238.25 | -233.04 | -226.04 | -224.43 | -247.69 |
| USNO | 24 301 | 0.0 | 0.0 | -120.86 | -120.68 | -128.71 | -128.98 |
| USNO | 24 305 | -2.53 | 9.92 | 13.95 | 17.43 | 11.79 | 29.90 |

TABLE 19 - (CONT.)

| LAB. | CLOCK | 45389 | 45449 | 45509 | 45569 | 45629 | 45699 |
|---|---|---|---|---|---|---|---|
| USNO | 24 343 | 0.0 | 0.0 | 0.0 | -37.59 | -39.95 | -40.54 |
| USNO | 24 368 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 8.44 |
| USNO | 24 377 | -125.59 | -125.51 | -120.11 | -117.30 | -112.12 | -133.82 |
| USNO | 24 423 | 0.0 | -37.11 | -39.04 | -42.68 | -39.12 | -38.85 |
| USNO | 24 452 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -5.14 |
| USNO | 24 586 | -79.80 | -78.26 | -75.96 | -76.34 | -74.44 | -77.39 |
| USNO | 24 605 | 27.12 | 30.52 | 32.84 | 29.26 | 33.48 | 23.02 |
| USNO | 24 653 | 47.65 | 48.85 | 60.27 | 60.86 | 62.89 | 58.12 |
| USNO | 24 688 | -46.12 | -48.13 | 0.0 | -52.41 | -44.55 | -39.13 |
| USNO | 24 846 | -44.02 | -33.39 | -31.00 | -19.18 | -22.88 | -30.18 |
| USNO | 34 81 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -116.53 |
| USNO | 34 98 | 0.0 | 0.0 | 0.0 | -34.06 | -33.11 | -32.60 |
| VSL | 14 503 | -219.64 | -220.99 | -204.04 | -194.17 | -195.98 | -189.39 |
| VSL | 22 34 | 13.84 | 8.86 | -10.93 | -13.07 | -16.39 | -10.13 |
| VSL | 22 489 | 61.03 | 71.79 | 100.91 | 105.47 | 114.49 | 115.86 |
| VSL | 24 190 | 0.0 | 0.0 | 109.73 | 108.35 | 114.64 | 0.0 |
| ZIPE | 12 979 | 41.90 | 37.05 | 26.03 | 21.42 | 7.32 | -6.58 |

THE CLOCKS ARE DESIGNATED BY THEIR MODEL (2 DIGITS) AND SERIAL NO.
THE CODES FOR THE MODELS ARE

```
11         HEWLETT-PACKARD 5060A
12 OR 22   HEWLETT-PACKARD 5061A        (22 001 EQUIVALENT TO 12 1001)
13 OR 23   EBAUCHES , OSCILLATOM B5000 (23 001 EQUIVALENT TO 13 1001)
14 OR 24   HEWLETT-PACKARD 5061A OPT.4 (24 001 EQUIVALENT TO 14 1001)
   OR 34   HEWLETT-PACKARD 5061A OPT.4 (34 001 EQUIVALENT TO 14 2001)
16 OR 26   OSCILLOQUARTZ 3200           (26 001 EQUIVALENT TO 16 1001)
17 OR 27   OSCILLOQUARTZ 3000           (27 001 EQUIVALENT TO 17 1001)
18 OR 28   FREQ. AND TIME SYSTEMS INC. 4000
19         ROHDE AND SCHWARZ XSC
20         FREQ. AND TIME SYSTEMS INC. 5000
25         HEWLETT-PACKARD 5062C        (ADD 1000 TO THE SERIAL NO.)
40 HYDROGEN MASERS (NBS TYPE)          41 HYDROGEN MASERS (OSCILLOQUARTZ)
42 HYDROGEN MASERS (NASA RESEARCH)     43 HYDROGEN MASERS(APL TYPE)
90 LABORATORY CS STANDARD NRC          91 LABORATORY CS STANDARD NBS
92 LABORATORY CS STANDARD PTB          99 PROTOTYPE CS
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TABLE 20 - INTERNATIONAL ATOMIC TIME . WEIGHTS OF THE CLOCKS FOR 1983

THE WEIGHTS ARE GIVEN FOR INTERVALS OF TWO MONTHS ENDING AT THE GIVEN DATES

*** DENOTES THAT THE CLOCK WAS NOT USED

| LAB. | CLOCK | 45389 | 45449 | 45509 | 45569 | 45629 | 45699 |
|---|---|---|---|---|---|---|---|
| AOS | 19 7 | 72 | 81 | 86 | 124 | 89 | *** |
| APL | 14 121 | 200 | 184 | *** | *** | *** | *** |
| APL | 14 773 | 0 | 63 | 57 | 52 | 52 | 37 |
| APL | 14 793 | 45 | 55 | 69 | 200 | 185 | 193 |
| APL | 42 6 | *** | *** | *** | *** | 0 | 0 |
| ASMW | 13 29 | 118 | 15 | 12 | 14 | 16 | 37 |
| ASMW | 16 76 | 79 | 155 | 53 | 28 | 21 | 35 |
| ASMW | 16 165 | 200 | 200 | 186 | 200 | 200 | 161 |
| BEV | 16 71 | 79 | 200 | 162 | 109 | 129 | 118 |
| CAO | 16 52 | 22 | 24 | 32 | 43 | 80 | 74 |
| CAO | 16 183 | 116 | 97 | 124 | 117 | 82 | 87 |
| F | 12 158 | *** | *** | *** | *** | 0 | 12 |
| F | 12 195 | 133 | 119 | 94 | 96 | 200 | 115 |
| F | 12 347 | 66 | 101 | 109 | 24 | 19 | 18 |
| F | 12 439 | 89 | 85 | 73 | 51 | 48 | 55 |
| F | 14 51 | 200 | 195 | 81 | 88 | 132 | *** |
| F | 14 134 | 200 | 200 | *** | 0 | 200 | 200 |
| F | 14 500 | *** | *** | 0 | 197 | 200 | 200 |
| F | 14 594 | 200 | 200 | 200 | 146 | 139 | 153 |
| F | 14 753 | 200 | 200 | *** | 0 | 62 | 66 |
| F | 22 120 | 167 | 122 | *** | *** | 0 | 23 |
| F | 24 407 | *** | *** | *** | 0 | 200 | 74 |
| F | 24 645 | 0 | 200 | 179 | 190 | 198 | *** |
| F | 24 842 | *** | *** | 0 | 200 | 136 | 200 |
| FTZ | 14 312 | 27 | 25 | 34 | 168 | 93 | 84 |
| FTZ | 14 895 | 9 | 9 | 18 | 103 | *** | *** |
| FTZ | 16 130 | 179 | 167 | 106 | *** | *** | *** |
| FTZ | 24 217 | 200 | 200 | 200 | 200 | 159 | 140 |
| FTZ | 24 482 | 154 | 155 | 179 | 191 | 122 | 107 |
| FTZ | 24 656 | *** | *** | *** | *** | 0 | 198 |
| FTZ | 24 674 | 200 | 192 | 200 | 200 | 135 | 137 |
| IEN | 12 469 | 17 | 21 | 20 | 17 | 16 | *** |
| IEN | 12 609 | 123 | 121 | 131 | 192 | *** | *** |
| IEN | 14 893 | 161 | 200 | 200 | 200 | 200 | 200 |
| IEN | 16 84 | 56 | 52 | 54 | 62 | *** | *** |
| IFAG | 16 131 | *** | *** | 0 | 141 | 140 | 123 |
| IFAG | 16 138 | 0 | 39 | 60 | 78 | 117 | 124 |
| IFAG | 16 173 | 32 | 51 | 26 | 24 | 19 | 20 |
| IFAG | 41 1 | 0 | *** | *** | *** | *** | 0 |
| ILOM | 11 176 | *** | *** | *** | *** | 0 | 0 |
| ILOM | 14 614 | *** | *** | *** | *** | 0 | *** |
| ILOM | 14 885 | *** | *** | *** | *** | 0 | 32 |
| ILOM | 24 315 | *** | *** | *** | *** | 0 | 52 |
| NBS | 11 137 | 0 | 7 | 6 | 6 | 7 | *** |
| NBS | 11 167 | 152 | 180 | 170 | 143 | *** | *** |
| NBS | 12 352 | 101 | 89 | 123 | 166 | 182 | 117 |
| NBS | 13 61 | 16 | 27 | 19 | 15 | 15 | 15 |
| NBS | 14 316 | 100 | 116 | 200 | 186 | *** | *** |
| NBS | 14 323 | 182 | 200 | 200 | 70 | 53 | 52 |
| NBS | 14 601 | 94 | 76 | 97 | 146 | 176 | 173 |

TABLE 20 - (CONT.)

| LAB. | CLOCK | 45389 | 45449 | 45509 | 45569 | 45629 | 45699 |
|---|---|---|---|---|---|---|---|
| NBS | 18 8 | *** | *** | 0 | 187 | 62 | 88 |
| NBS | 18 113 | 6 | 8 | 11 | 0 | 4 | 4 |
| NBS | 40 4 | 0 | *** | 0 | 0 | *** | *** |
| NPL | 12 316 | 17 | 0 | 3 | 2 | 5 | 9 |
| NPL | 12 418 | 200 | 155 | 125 | 72 | 69 | 60 |
| NPL | 12 832 | 14 | 11 | 13 | 0 | 14 | *** |
| NPL | 24 334 | *** | *** | 0 | 33 | 69 | *** |
| NRC | 14 267 | 200 | 199 | 184 | 200 | 145 | 160 |
| NRC | 90 5 | 200 | 200 | 200 | 184 | 200 | 200 |
| NRC | 90 61 | 200 | 199 | 200 | 183 | 187 | 200 |
| NRC | 90 62 | 151 | 134 | 148 | 131 | 124 | 116 |
| NRC | 90 63 | 168 | 163 | 200 | 181 | 200 | 200 |
| NRLM | 12 363 | *** | *** | *** | *** | *** | 0 |
| NRLM | 24 632 | *** | *** | *** | *** | *** | 0 |
| OAB | 16 189 | 0 | 0 | 3 | 0 | 3 | 0 |
| OFM | 16 69 | 175 | 171 | 200 | 200 | 200 | *** |
| OFM | 16 77 | 200 | 188 | 200 | 200 | *** | *** |
| OFM | 17 206 | 200 | 198 | 200 | 200 | 200 | 193 |
| OFM | 17 208 | 200 | 188 | 200 | 200 | 200 | 200 |
| OFM | 99 1 | 50 | 73 | 92 | 71 | 19 | 9 |
| OFM | 99 2 | 175 | 188 | 193 | 200 | 200 | 200 |
| OFM | 99 4 | 101 | 122 | 157 | 200 | 200 | 196 |
| OFM | 99 5 | 200 | 197 | 200 | 149 | 95 | 86 |
| OMH | 22 67 | 103 | 103 | 90 | 117 | 109 | 119 |
| OMSF | 14 896 | 196 | 200 | 200 | 200 | 200 | 174 |
| OMSF | 16 113 | 140 | *** | *** | *** | 0 | 12 |
| OMSF | 16 121 | 197 | 200 | 180 | *** | *** | *** |
| OMSF | 16 177 | 180 | 200 | 181 | 94 | 56 | 55 |
| OMSF | 22 223 | 200 | 200 | 192 | 200 | 183 | 177 |
| OMSF | 24 569 | 186 | 152 | 92 | 94 | 103 | 50 |
| ON | 12 285 | 200 | 200 | 200 | 200 | 191 | 189 |
| ON | 12 863 | 59 | 34 | 33 | 39 | *** | *** |
| ON | 13 14 | 64 | 67 | 67 | 44 | 55 | 63 |
| ON | 16 114 | 67 | 84 | 63 | 58 | 97 | 127 |
| ON | 24 796 | *** | *** | *** | 0 | 200 | 200 |
| ORB | 12 205 | 72 | 141 | 175 | 200 | 125 | 71 |
| ORB | 12 804 | 40 | 40 | 42 | 58 | 59 | 52 |
| PKNM | 16 125 | *** | *** | 0 | 200 | 200 | 35 |
| PKNM | 16 154 | 8 | 13 | 0 | 11 | 10 | 0 |
| PKNM | 24 144 | 54 | 51 | 66 | 76 | 139 | 112 |
| PTB | 12 320 | 128 | 159 | 193 | 200 | 200 | 200 |
| PTB | 12 462 | 57 | 128 | 200 | 190 | 200 | 200 |
| PTB | 14 394 | 200 | 200 | 200 | 200 | 200 | 200 |
| PTB | 14 395 | 200 | 200 | 200 | 200 | 200 | 200 |
| PTB | 14 867 | 200 | 200 | 200 | 200 | 200 | 200 |
| PTB | 16 119 | 200 | 188 | 193 | 200 | 200 | 172 |
| PTB | 24 103 | 197 | 200 | 200 | 200 | 200 | 200 |
| PTB | 92 1 | 200 | 200 | 200 | 200 | 200 | 200 |
| PTCH | 16 64 | 17 | 19 | 19 | 20 | 20 | *** |
| PTCH | 16 140 | 3 | 3 | 0 | 0 | 4 | 0 |

TABLE 20 - (CONT.)

| LAB. | CLOCK | 45389 | 45449 | 45509 | 45569 | 45629 | 45699 |
|---|---|---|---|---|---|---|---|
| RGO | 11 123 | 200 | 147 | 152 | 162 | 200 | 200 |
| RGO | 11 199 | 79 | 75 | 77 | 71 | *** | *** |
| RGO | 12 484 | 71 | 96 | 117 | 0 | 7 | 0 |
| RGO | 14 202 | 18 | 14 | 11 | 11 | 10 | 8 |
| RGO | 14 560 | 200 | 126 | 54 | 66 | 84 | 99 |
| RGO | 14 868 | 200 | 200 | 200 | 200 | 200 | 200 |
| RGO | 20 133 | 14 | 22 | 32 | 38 | 21 | 18 |
| STA | 14 900 | 104 | 118 | 182 | *** | *** | *** |
| STA | 16 137 | 81 | 69 | 31 | 24 | *** | *** |
| STA | 24 376 | 64 | 57 | 66 | 172 | 182 | 79 |
| TAO | 14 390 | *** | *** | *** | *** | *** | 0 |
| TAO | 24 75 | *** | *** | *** | *** | *** | 0 |
| TAO | 24 498 | *** | *** | *** | *** | *** | 0 |
| TP | 12 335 | 3 | 2 | 2 | 3 | 0 | 0 |
| TUG | 12 524 | 200 | 124 | 117 | 112 | 105 | 129 |
| TUG | 24 654 | 92 | 125 | *** | *** | 0 | 200 |
| USNO | 12 57 | *** | *** | *** | 0 | *** | *** |
| USNO | 12 147 | 13 | 24 | *** | *** | *** | *** |
| USNO | 12 150 | 57 | 79 | 78 | 82 | *** | *** |
| USNO | 12 532 | 188 | 200 | 47 | 10 | 7 | *** |
| USNO | 12 573 | 32 | 38 | 42 | 78 | 112 | 33 |
| USNO | 12 752 | 183 | 200 | 200 | 105 | 145 | 167 |
| USNO | 12 778 | 0 | 200 | 200 | 200 | 200 | 200 |
| USNO | 12 873 | 183 | 137 | 86 | 90 | 158 | 192 |
| USNO | 14 345 | 66 | 39 | 26 | 42 | 76 | 139 |
| USNO | 14 571 | 0 | 200 | 200 | 105 | 87 | 119 |
| USNO | 14 591 | *** | *** | *** | *** | *** | 0 |
| USNO | 14 783 | 150 | 81 | 57 | 58 | *** | *** |
| USNO | 14 834 | *** | *** | *** | *** | *** | 0 |
| USNO | 14 862 | *** | *** | 0 | 194 | 169 | 200 |
| USNO | 14 871 | 200 | 186 | 200 | 185 | 200 | 200 |
| USNO | 14 875 | *** | *** | 0 | 28 | 31 | 46 |
| USNO | 16 78 | *** | *** | 0 | 85 | 107 | 163 |
| USNO | 18 107 | 85 | *** | *** | *** | *** | *** |
| USNO | 18 108 | *** | 0 | *** | *** | *** | *** |
| USNO | 18 133 | 0 | *** | *** | *** | *** | *** |
| USNO | 18 159 | 46 | *** | *** | *** | *** | *** |
| USNO | 22 114 | 64 | 80 | 110 | 132 | 138 | 140 |
| USNO | 22 535 | 200 | 191 | 200 | *** | *** | *** |
| USNO | 22 946 | *** | 0 | 0 | 0 | *** | *** |
| USNO | 24 25 | *** | *** | 0 | 61 | 135 | *** |
| USNO | 24 28 | 76 | 76 | 70 | 66 | 60 | 69 |
| USNO | 24 33 | 107 | 85 | 99 | 150 | 107 | 108 |
| USNO | 24 35 | 24 | 22 | *** | *** | *** | 0 |
| USNO | 24 94 | 51 | 55 | 100 | 49 | 35 | 33 |
| USNO | 24 117 | 0 | 200 | 200 | 200 | 200 | 200 |
| USNO | 24 118 | 200 | 191 | 175 | 200 | *** | *** |
| USNO | 24 300 | 200 | 200 | 200 | 199 | 200 | 117 |
| USNO | 24 301 | *** | *** | 0 | 200 | 192 | 200 |
| USNO | 24 305 | 56 | 78 | 200 | 189 | 200 | 89 |

TABLE 20 - (CONT.)

| LAB. | CLOCK | 45389 | 45449 | 45509 | 45569 | 45629 | 45699 |
|---|---|---|---|---|---|---|---|
| USNO | 24 343 | *** | *** | *** | 0 | 200 | 200 |
| USNO | 24 368 | *** | *** | *** | *** | *** | 0 |
| USNO | 24 377 | 200 | 200 | 200 | 200 | 200 | 125 |
| USNO | 24 423 | *** | 0 | 200 | 200 | 200 | 200 |
| USNO | 24 452 | *** | *** | *** | *** | *** | 0 |
| USNO | 24 586 | 176 | 200 | 200 | 200 | 200 | 200 |
| USNO | 24 605 | 200 | 200 | 200 | 200 | 200 | 180 |
| USNO | 24 653 | 200 | 200 | 176 | 200 | 200 | 200 |
| USNO | 24 688 | 200 | 200 | *** | 0 | 193 | 162 |
| USNO | 24 846 | 200 | 179 | 200 | 143 | 116 | 131 |
| USNO | 34 81 | *** | *** | *** | *** | *** | 0 |
| USNO | 34 98 | *** | *** | *** | 0 | 200 | 200 |
| VSL | 14 503 | 200 | 200 | 141 | 70 | 60 | 55 |
| VSL | 22 34 | 0 | 200 | 42 | 43 | 47 | 62 |
| VSL | 22 489 | 200 | 151 | 41 | 25 | 17 | 19 |
| VSL | 24 190 | *** | *** | 0 | 200 | 200 | *** |
| ZIPE | 12 979 | 37 | 39 | 32 | 31 | 37 | 30 |

THE CLOCKS ARE DESIGNATED BY THEIR MODEL (2 DIGITS) AND SERIAL NO.
THE CODES FOR THE MODELS ARE

```
11         HEWLETT-PACKARD 5060A
12 OR 22   HEWLETT-PACKARD 5061A        (22 001 EQUIVALENT TO 12 1001)
13 OR 23   EBAUCHES , OSCILLATOM B5000  (23 001 EQUIVALENT TO 13 1001)
14 OR 24   HEWLETT-PACKARD 5061A OPT.4  (24 001 EQUIVALENT TO 14 1001)
   OR 34   HEWLETT-PACKARD 5061A OPT.4  (34 001 EQUIVALENT TO 14 2001)
16 OR 26   OSCILLOQUARTZ 3200           (26 001 EQUIVALENT TO 16 1001)
17 OR 27   OSCILLOQUARTZ 3000           (27 001 EQUIVALENT TO 17 1001)
18 OR 28   FREQ. AND TIME SYSTEMS INC. 4000
19         ROHDE AND SCHWARZ XSC
20         FREQ. AND TIME SYSTEMS INC. 5000
25         HEWLETT-PACKARD 5062C        (ADD 1000 TO THE SERIAL NO.)
40 HYDROGEN MASERS (NBS TYPE)          41 HYDROGEN MASERS (OSCILLOQUARTZ)
42 HYDROGEN MASERS (NASA RESEARCH)     43 HYDROGEN MASERS(APL TYPE)
90 LABORATORY CS STANDARD NRC          91 LABORATORY CS STANDARD NBS
92 LABORATORY CS STANDARD PTB          99 PROTOTYPE CS
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TABLE 21 - MEASUREMENTS OF THE EAL AND TAI FREQUENCY

GRAVITATIONAL FREQUENCY CORRECTIONS ARE APPLIED . THE FREQUENCIES ARE EXPRESSED AT SEA LEVEL .

| INTERVAL MJD | CENTRAL DATE | F(EAL)-F(NBS6) IN 10**-13 | F(EAL)-F(NRC CSV) IN 10**-13 | F(EAL)-F(PTB CS1) IN 10**-13 |
|---|---|---|---|---|
| 44229_44309 | 1980 JAN31 | | 8.84 | 9.31 |
| 44249_44329 | 1980 FEB20 | 8.60 | | |
| 44309_44389 | 1980 APR20 | | 9.57 | 8.99 |
| 44389_44469 | 1980 JUL 9 | | 8.98 | 8.45 |
| 44469_44549 | 1980 SEP27 | | 8.35(1) | 8.04 |
| 44549-44629 | 1980 DEC16 | | 8.52 | 8.67 |
| 44629-44709 | 1981 MAR 6 | | 9.16 | 9.12 |
| 44709-44789 | 1981 MAY25 | | 8.63 | 8.42 |
| 44789-44869 | 1981 AUG13 | | 7.92 | 7.86 |
| 44889-44969 | 1981 NOV21 | | 7.99(1) | 7.98 |
| 44969-45049 | 1982 FEB 9 | | 8.93 | 8.39(2) |
| 45029-45109 | 1982 APR10 | 7.35 | | |
| 45049-45129 | 1982 APR30 | | 8.15 | 8.28 |
| 45149-45229 | 1982 AUG 8 | | 7.47(1) | 7.71 |
| 45229-45309 | 1982 OCT27 | | 8.18 | 7.62 |
| 45309-45389 | 1983 JAN15 | | 7.86 | 8.62 |
| 45389-45469 | 1983 APR 5 | | 8.32 | 8.52 |
| 45469-45549 | 1983 JUN24 | | 7.15 | 8.06 |
| 45489-45569 | 1983 JUL14 | 7.34 | | |
| 45549-45629 | 1983 SEP12 | | 7.44 | 7.98 |

| INTERVAL MJD | CENTRAL DATE | F(TAI)-F(NBS6) IN 10**-13 | F(TAI)-F(NRC CSV) IN 10**-13 | F(TAI)-F(PTB CS1) IN 10**-13 |
|---|---|---|---|---|
| 44229_44309 | 1980 JAN31 | | 0.44 | 0.91 |
| 44249_44329 | 1980 FEB20 | 0.20 | | |
| 44309_44389 | 1980 APR20 | | 1.17 | 0.59 |
| 44389_44469 | 1980 JUL 9 | | 0.58 | 0.05 |
| 44469_44549 | 1980 SEP27 | | -0.05(1) | -0.36 |
| 44549-44629 | 1980 DEC16 | | 0.12 | 0.27 |
| 44629-44709 | 1981 MAR 6 | | 0.76 | 0.72 |
| 44709-44789 | 1981 MAY25 | | 0.23 | 0.02 |
| 44789-44869 | 1981 AUG13 | | -0.48 | -0.54 |
| 44889-44969 | 1981 NOV21 | | -0.41(1) | -0.42 |
| 44969-45049 | 1982 FEB 9 | | 0.53 | -0.01(2) |
| 45029-45109 | 1982 APR10 | -1.00 | | |
| 45049-45129 | 1982 APR30 | | -0.15 | -0.02 |
| 45149-45229 | 1982 AUG 8 | | -0.48(1) | -0.24 |
| 45229-45309 | 1982 OCT27 | | 0.38 | -0.18 |
| 45309-45389 | 1983 JAN15 | | 0.06 | 0.82 |
| 45389-45469 | 1983 APR 5 | | 0.52 | 0.72 |
| 45469-45549 | 1983 JUN24 | | -0.65 | 0.26 |
| 45489-45569 | 1983 JUL14 | -0.46 | | |
| 45549-45629 | 1983 SEP12 | | -0.36 | 0.18 |

(1) COMPUTED JUST AFTER A FULL EVALUATION OF NRC-CSV

(2) THIS FREQUENCY WAS COMPUTED USING TWO INTERPOLATED VALUES (SEE NOTE (1) ,P. B-45 ,ANNUAL REPORT FOR 1982)

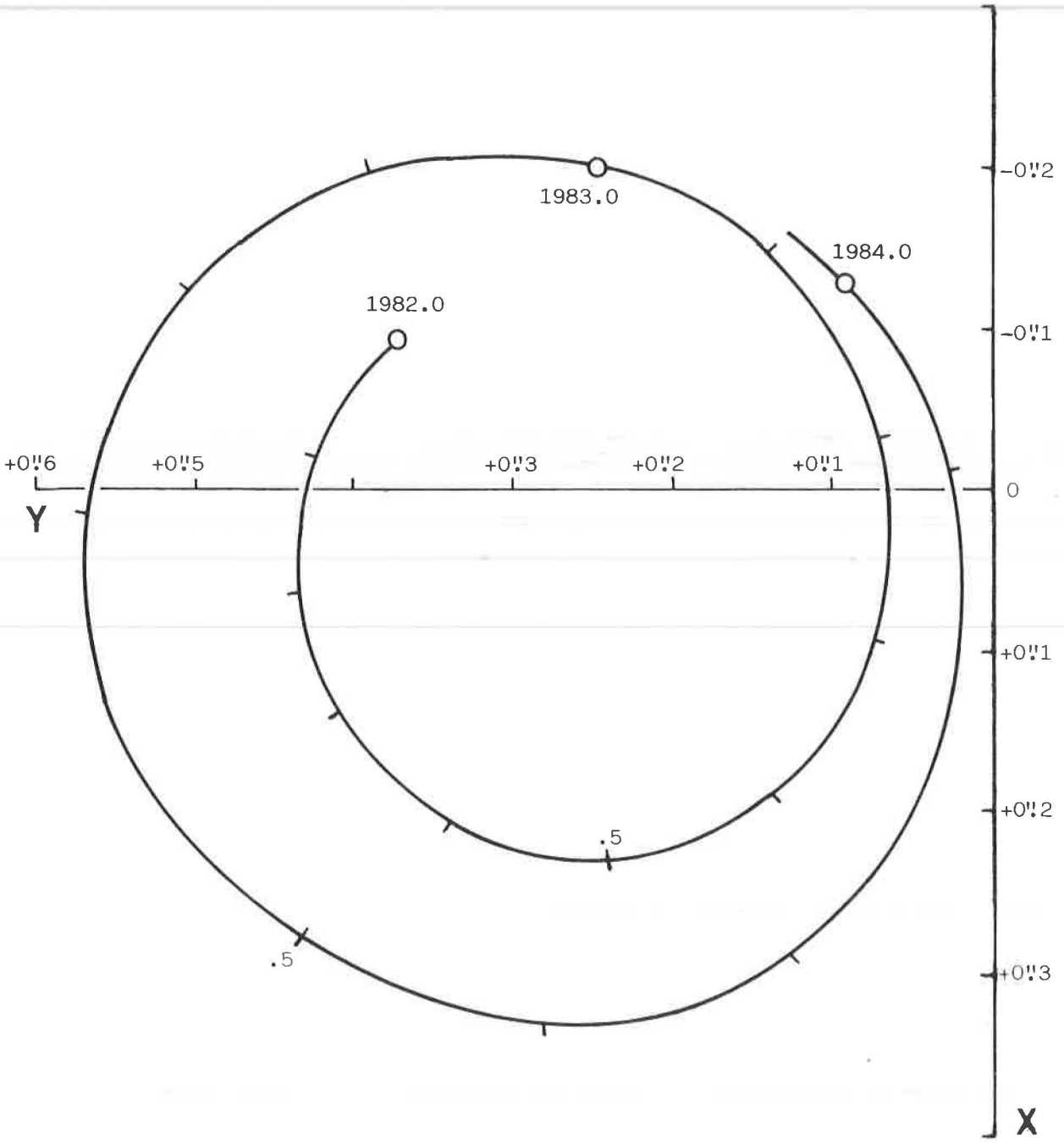


Figure 1. Path of the pole from 1982.0 to 1984.0
Smoothed values of Table 6 , obtained by
the Vondrak's method, with the coefficient
of smoothing which equalizes the internal
and external standard deviations in x and y.

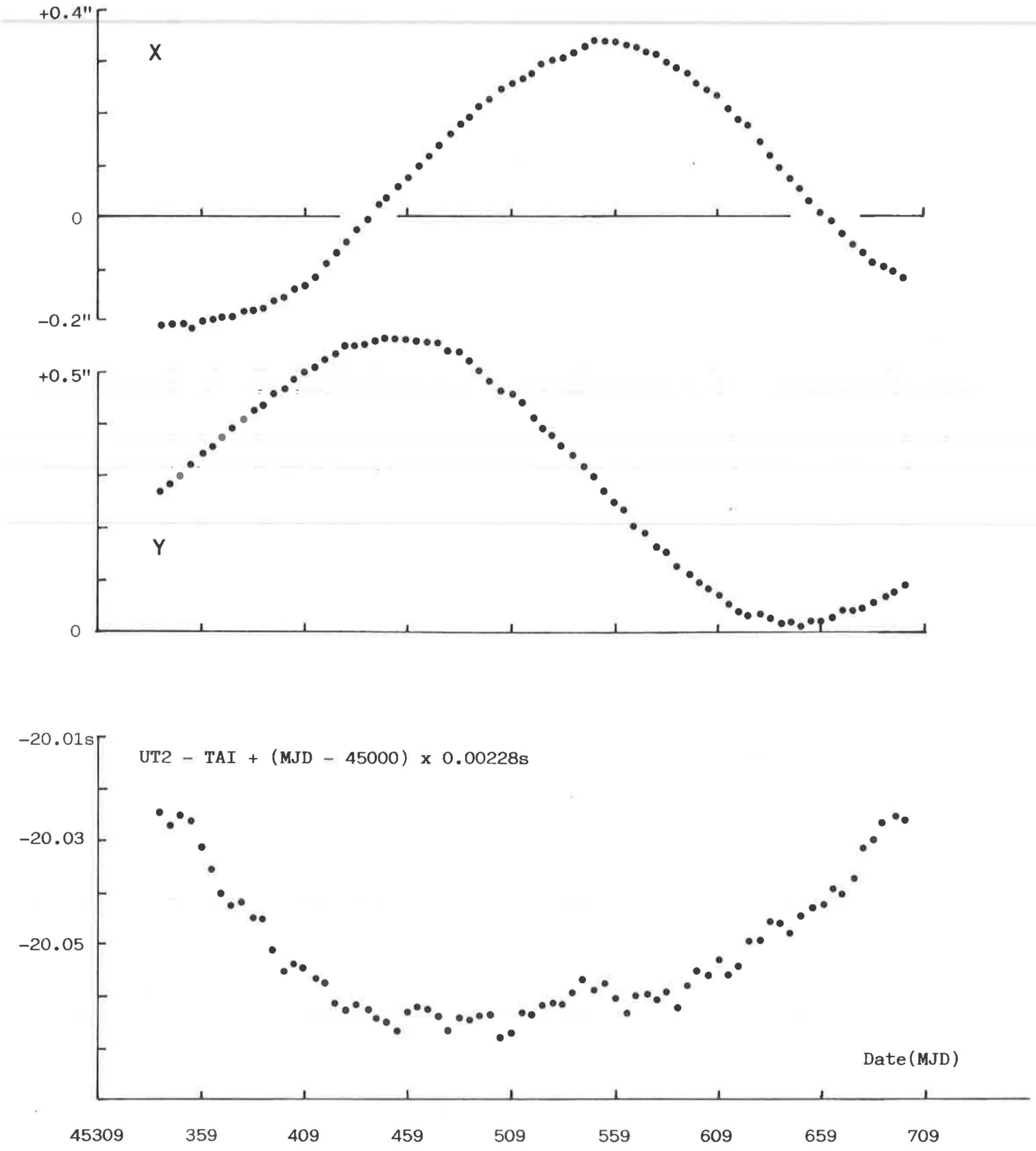


Figure 2. Raw values of x, y, UT2-TAI (Table 6 for 1983), 5-days means.

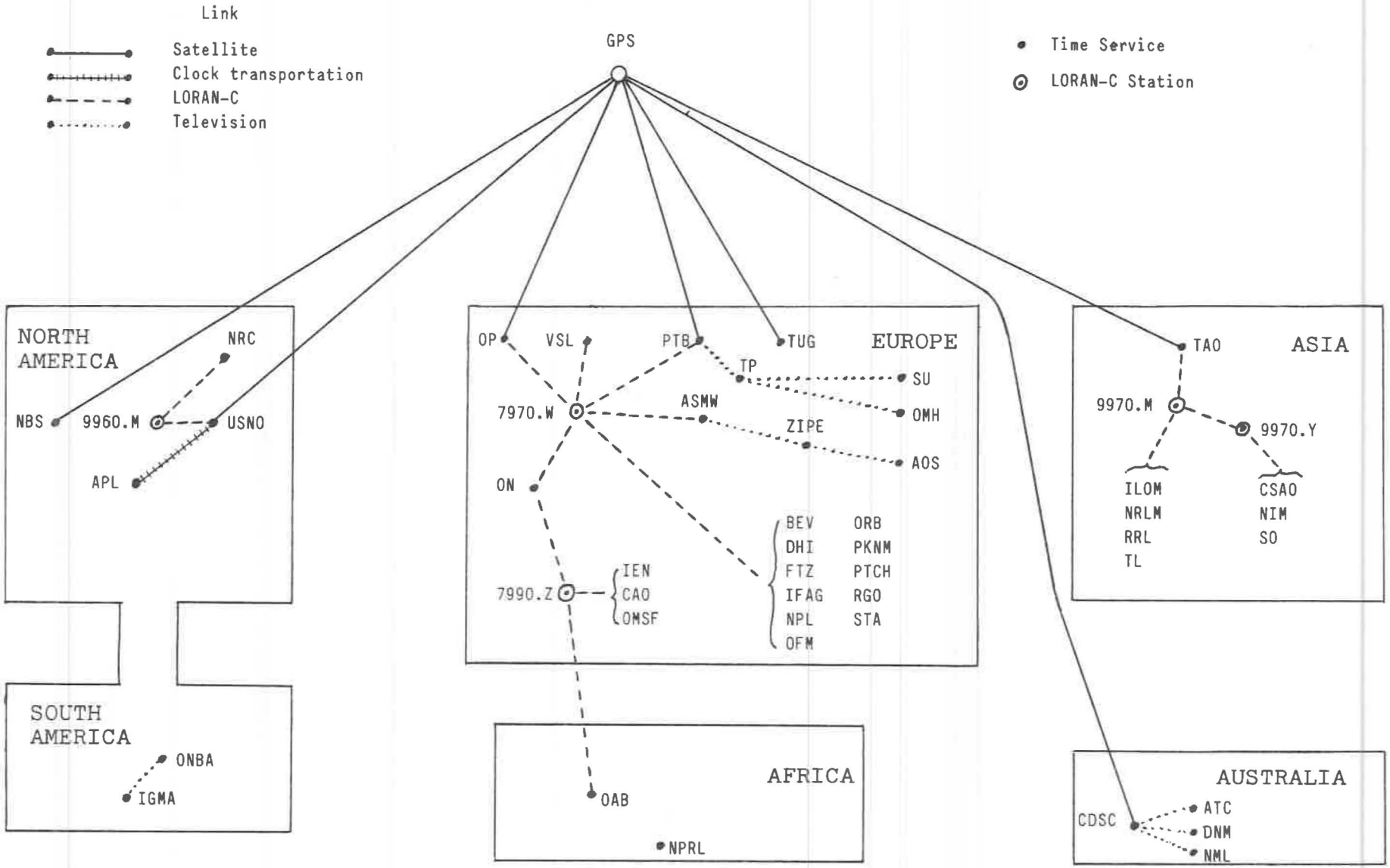


Fig. 3. Time links used by the BIH (end 1983)

The links GPS-7970W via OP and PTB are averaged (starting with 1984,0, the average includes also the link via VSL).
In Australia, CDSC stands for Canberra Deep Space Communication Complex.
For ONBA, IGMA, and NPRL, VLF and clock transportations provide the link with other laboratories.

# PART C

## TIME SIGNALS (1984)

The time signal emissions reported thereafter follow the UTC system, in accordance with the Recommandations 460-3 of the International Radio Consultative Committee (CCIR), unless otherwise stated.

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

## AUTHORITIES RESPONSIBLE FOR THE TIME SIGNAL EMISSIONS

| Signal | Authority |
|---|---|
| ATA | National Physical Laboratory<br>Hillside Road<br>New Dehli – 110012, India |
| BPM | Shaanxi Astronomical Observatory<br>Academia Sinica<br>P. O. Box 18 – Lintong<br>Shaanxi , China |
| BSF | Telecommunication Laboratories<br>Directorate General of Telecommunications<br>Ministry of Communications<br>P. O. Box 71 – Ching-Li<br>320 Taiwan, China |
| CHU | National Research Council, Time and Frequency Section<br>Physics Division (M-36)<br>Ottawa K1A OS 1, Ontario, Canada<br>Attn : Dr. C. C. Costain |
| DAM, DAN, DAO | Deutsches Hydrographisches Institut<br>Postfach 220<br>2000 Hamburg 4, Federal Republic of Germany |
| DCF77 | Physikalisch-Technische Bundesanstalt, Laboratorium 1-21<br>Federal Republic of Germany<br>Bundesallee 100<br>D33 Braunschweig |
| DGI, Y3S | Amt für Standardisierung, Messwesen und Warenprüfung<br>Fachabteilung Elektrizität und Magnetismus<br>Fachgebiet Zeit und Frequenz<br>Fürstenwalder Damm 388<br>DDR 1162 Berlin |
| EBC | Instituto y Observatorio de Marina<br>San Fernando<br>Cadiz, Spain |

| Signal | Authority |
|---|---|
| FTH42, FTK77, FTN87 | Laboratoire Primaire du Temps et des Fréquences<br>Observatoire de Paris<br>61, avenue de l'Observatoire<br>75014 Paris, France |
| GBR | 1/ Time information :<br>Royal Greenwich Observatory<br>Herstmonceux Castle<br>Hailsham, East Sussex BN27 1 RP,<br>United Kingdom<br><br>2/ Standard Frequency information :<br>National Physical Laboratory<br>Electrical Science Division<br>Teddington, Middlesex TW11 OLW,<br>United Kingdom |
| HBG | Service horaire HBG<br>Observatoire Cantonal<br>CH – 2000 Neuchâtel, Suisse |
| IAM | Istituto Superiore delle Poste e delle Telecomunicazioni<br>Ufficio 8°, Rep. 3° - Viale Europa<br>00100 – Roma, Italy |
| IBF | Istituto Elettrotecnico Nazionale Galileo Ferraris<br>Strada delle Cacce, 91<br>10135 – Torino, Italy |
| JJY, JG2AS | Frequency Standard Division<br>The Radio Research Laboratories<br>Ministry of Posts and Telecommunications<br>Koganei, Tokyo 184, Japan |
| LOL | Director<br>Observatorio Naval<br>Av. España 2099<br>1107 – Buenos-Aires, Republica Argentina |
| LQB9, LQC20 | Instituto Geografico Militar (IGMA)<br>Servicio internacional de la Hora<br>Seccion Conservacion de la Hora<br>Calle 38 Gral Savio 865<br>1650 Villa Maipu, San Martin<br>Pcia de Buenos-Aires<br>Republica Argentina |

| Signal | Authority |
|---|---|
| MSF | National Physical Laboratory<br>Electrical Science Division<br>Teddington, Middlesex TW11 OLW<br>United Kingdom |
| OLB5, OMA | 1/ Time information :<br>Astronomický Ústav ČSAV, Budečská 6,<br>120 23 Praha 2, Vinohrady, Czechoslovakia. TELEX : 122 486<br><br>2/ Standard frequency information :<br>Ústav radiotechniky a elektroniky ČSAV, Lumumbova 1,<br>182 51 Praha 8, Kobylisy, Czechoslovakia. TELEX : 122 646 |
| PPE, PPR | Serviço da Hora<br>Observatório Nacional (CNPq)<br>Rua General Bruce, 586<br>20921 Rio de Janeiro – RJ, Brasil |
| RBU, RCH, RID,<br>RTA,RTZ,RWM,<br>UNW3, UPD8, UQC3,<br>USB2, UTR3 | Comité d'État des Normes<br>Conseil des Ministre de l'URSS<br>Moscou 117049, URSS, Leninski prosp., 9 |
| VNG | Telecom Australia Research Laboratories<br>Reference Measurements Section<br>Box 249<br>Clayton, Victoria 3168, Australia |
| WWV, WWVH<br>WWVB | Time and Frequency Services Group<br>Time and Frequency Division, 524.00<br>325 Broadway<br>National Bureau of Standards<br>Boulder, Colorado 80303, U.S.A. |
| YVTO | Direccion de Hidrografia y Navegacion<br>Observatori Cagigal<br>Apartado Postal N°6745<br>Caracas, Venezuela |
| Y3S | See DGI |
| ZUO | National Physical Research Laboratory<br>P. O. Box 395<br>Pretoria<br>South Africa |

## TIME - SIGNALS EMITTED IN THE UTC SYSTEM

| Station | Location<br>Latitude<br>Longitude | Frequency (kHz) | Schedule (UT) | Form of time signals |
|---|---|---|---|---|
| ATA | Greater Kailash<br>Delhi<br>India<br>28° 34'N<br>77° 19'E | 5 000<br>10 000<br>15 000 | 3h 30 m to 14h 30 m<br>on Monday to Saturday<br>no transmission on Sundays<br>and Govt Holidays,<br>continuous operation<br>projected. | Second pulses of 5 cycles of a 1 kHz modulation.<br><br>Minute pulses of 100 ms duration. |
| BPM | Pucheng<br>China<br>35° 0'N<br>139° 31'E | 5 000<br><br>10 000<br><br>15 000 | from 14h to 24h<br><br>continuous<br><br>from 0h to 14h | UTC time signals (the signals are emitted in advance on UTC by 20ms). Second pulses of 10ms of 1 kHz modulation. Minute pulses of 300ms of 1 kHz modulation. From minutes 0 to 10, 15 to 25, 30 to 40, 45 to 55.<br><br>UT1 time signals are emitted from minutes 25 to 29, 55 to 59. |
| BSF | Chung-Li<br>Taiwan<br>China<br>24° 57'N<br>121° 9'E | 5 000<br>15 000 | continuous<br>except<br>interruption<br>between<br>minutes 35<br>and 40 | (a) From min. 5 to 10, 15 to 20, 25 to 30, 45 to 50, 55 to 60, second pulses of 5ms duration without 1 kHz modulation.<br>(b) From min. 0 to 5, 10 to 15, ..., 50 to 55, second pulses of 5ms duration with 1 kHz modulation. The 1 kHz modulation is interrupted 40ms before and after the pulses.<br>(c) Minute pulses are extended to 300ms.<br>(d) DUT1, CCIR code by lengthening. |
| CHU | Ottawa<br>Canada<br>45° 18'N<br>75° 45'W | 3 300<br>7 335<br>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 0.5s long. Hour pulses are 1.0s long, with the following 1st to 10th pulses omitted. A bilingual (Fr. Eng.) announcement of time is made each minute following the 50th second pulse. FSK time code after 10 cycles on the 31st to 39th seconds. Broadcast is single side band ; upper side band with carrier reinserted: DUT1 : CCIR code by split pulses. |
| DAM | Elmshorn<br>Germany, F.R.<br>53° 46'N<br>9° 40'E | 8 638.5<br>16 980.4<br>4 265<br>8 638.5<br>6 475.5<br>12 763.5 | 11h 55 m to 12h 06m<br><br>23h 55m to 24h 06m<br>from 21 Oct. to 31 March<br>23h 55m to 24h 06m<br>from 1 April to 20 Oct. | New international system, then second pulses from minutes 0.5 to 6.0 (minute pulses prolonged).<br>A1 Type<br>DUT1 : CCIR code by doubling,<br>after minute pulses 1 to 5 |
| DAN | Osterloog<br>Germany, F.R.<br>53° 38'N<br>7° 12'E | 2 614 | 11h 55m to 12h 06m<br>23h 55m to 24h 06m | As DAM (see above) |
| DAO | Kiel<br>Germany, F.R.<br>54° 26'N<br>10° 8'E | 2 775 | 11h 55m to 12h 06m<br>23h 55m to 24h 06m | As DAM (see above) |
| DCF77 | Mainflingen<br>Germany, F.R.<br>50° 1'N<br>9° 0'E | 77.5 | continuous | At the beginning of each second (except the 59th second) the carrier amplitude is reduced to about 25% for a duration of 0.1s or 0.2s respectively.<br>Coded transmission of year, month, day, hour, minute and day of the week in a BCD code from second marker N° 20 to N° 58 (the second marker durations of 0.1s or 0.2s correspond to a binary 0 or a binary 1 respectively).<br>Zonal time code by the second markers N° 16 to 18.<br>Second marker N° 15 with a duration of 0.2s indicates that the reserve antenna is in use.<br>No transmission of DUT1. |

Notes : see p. C-11

| Station | Location<br>Latitude<br>Longitude | Frequency (kHz) | Schedule (UT) | Form of time signals |
|---|---|---|---|---|
| DGI | Oranienburg<br>Germ. Dem. Rep.<br>52° 48'N<br>13° 24'E | 182 | 5h 59m 30s to 6h 00m<br>11h 59m 30s to 12h 00m<br>17h 59m 30s to 18h 00m | A2 type second pulses of 0.1s duration for seconds 30-40, 45-50, 55-60.<br>The last pulse is prolonged.<br>(one hour earlier in summer time) |
| EBC | San Fernando<br>Spain<br>36° 28'N<br>6° 12'W | 12 008<br><br>6 840 | 10h 00m to 10h 25m<br><br>10h 30m to 10h 55m | Second pulses of 0.1s duration of a 1 kHz modulation.<br>Minute pulses of 0.5s duration of 1 250 Hz modulation<br>DUT1, CCIR code, double pulse. Type A3H |
| FTH42<br>FTK77<br>FTN87 | Ste Assise<br>France<br>48° 33'N<br>2° 34'E | 7 428<br>10 775<br>13 873 | at 9h and 21h<br>at 8h and 20h<br>at9h 30m, 13h, 22h 30m, | A1 type second pulses during the 5 minutes preceding the indicated times. Minute pulses are prolonged.<br>DUT1 : in morse code. |
| GBR<br>(2) | Rugby<br>United Kingdom<br>52° 22'N<br>1° 11'W | 16 | 2h 55m to 3h 00m<br>8h 55m to 9h 00m<br>14h 55m to 15h 00m<br>20h 55m to 21h 00m | A1 type second pulses lasting 100ms, lengthened to 500 ms at the minute. The reference point is the start of carrier rise.<br>Uninterrupted carrier is transmitted for 24s from 54m 30s and from 0m 6s.<br>DUT1 : CCIR code by double pulses. |
| HBG | Prangins<br>Switzerland<br>46° 24'N<br>6° 15'E | 75 | continuous | Interruption of the carrier at the beginning of each second, during 100ms. The minutes are identified by a double pulse, the hours by a triple pulse.<br>No transmission of DUT1. |
| IAM<br>(1) | Rome<br>Italy<br>41° 47'N<br>12° 27'E | 5 000 | 7h 30m to 8h 30m<br>10h 30m to 11h 30m<br>except Sat. afternoon, Sund., and national holidays.<br>Advanced by 1h in summer. | Second pulses of 5 cycles of 1 kHz modulation.<br>Minute pulses of 20 cycles (Announcements 5m before the emission of time signals). |
| IBF | Torino<br>Italy<br>45° 2'N<br>7° 42'E | 5 000 | During 15m preceding 7h, 9h, 10h, 11h, 12h, 13h, 14h, 15h, 16h, 17h, 18h. Advanced by 1 hour in summer. | Second pulses of 5 cycles of 1 kHz modulation.<br>These pulses are repeated 7 times at the minute. Voice announcements at the beginning and end of each emission. Time announcement (C.E.T.) by Morse code every ten minutes beginning at 0h 0m.<br>DUT1 : CCIR code by double pulse. |
| JG2AS | Sanwa<br>Ibaraki<br>Japan<br>36° 11'N<br>139° 51'E | 40 | continuous, except interruptions during communications. | A1 type second pulses of 0.5s duration.<br>Second 59 is of 0.1s.<br>No DUT1 code. |
| JJY | Sanwa<br>Ibaraki<br>Japan<br>36° 11'N<br>139° 51'E | 2 500<br>5 000<br>8 000<br>10 000<br>15 000 | continuous, except interruption between minutes 35 and 39. | Second pulses of 8 cycles of 1 600 Hz modulation.<br>Minute pulses are preceded by a 600 Hz modulation.<br>DUT1 : CCIR code by lengthening. |

Notes : see p. C-11

| Station | Location<br>Latitude<br>Longitude | Frequency (kHz) | Schedule (UT) | Form of time signals |
|---|---|---|---|---|
| LOL1 | Buenos-Aires<br>Argentina<br>34° 37'S<br>58° 21'W | 5 000<br>10 000<br>15 000 | 11h to 12h, 14h to 15h, 17h to 18h, 20h to 21h, 23h to 24h | Second pulses of 5 cycles of 1 000 Hz modulation. Second 59 is omitted. Announcement of hours and minutes every 5 minutes, followed by 3m of 1 000 Hz or 440 Hz modulation.<br>DUT1 : CCIR code by lengthening. |
| LOL2<br>LOL3 | Buenos-Aires<br>Argentina<br>34° 37'S<br>58° 21'W | 4 856<br>8030<br>17 180 | 1h 13h, 21h, | A1 second pulses during the 5 minutes preceding the indicated times. Second 29 is omitted. Minute pulses are prolonged.<br>DUT1 : CCIR code by double pulse. |
| LQB9<br>(1) | Planta Gral<br>Pacheco | 8 167.5 | 22h 5m, 23h 50m | A1 second pulses during the 5 minutes preceding the indicated times. Second 59 is omitted, second 60 is prolonged. After the emission, OK is transmitted if the emission is correct, NV if not correct.<br>DUT1 : CCIR code by double pulse. |
| LQC20<br>(1) | 34° 26'S<br>58° 37'W | 17 550 | 10h 5m, 11h 50m | |
| MSF | Rugby<br>United Kingdom<br>52° 22'N<br>1° 11'W | 60 | continuous except for an interruption for maintenance from 10h 0m to 14h 0m on the first Tuesday in each month. | Interruptions of the carrier of 100ms for the second pulses, of 500ms for the minute pulses. The signal is given by the beginning of the interruption. BCD NRZ code, 100 bits/s (month, day of month, hour, minute), during minute interruptions. BCD PWM code, 1 bit/s (year, month, day of month, day of week, hour, minute) from seconds 17 to 59 in each minute. DUT1 : CCIR code by double pulse. |
| MSF | Rugby<br>United Kingdom<br>52° 22'N<br>1° 11'W | 2 500<br>5 000<br>10 000 | between minutes 0 and 5, 10 and 15, 20 and 25, 30 and 35, 40 and 45, 50 and 55. | Second pulses of 5 cycles of 1 kHz modulation. Minute pulses are prolonged.<br>DUT1 : CCIR code by double pulse. |
| OLB5 | Poděbrady<br>Czechoslovakia<br>50° 9'N<br>15° 9'E | 3 170 | continuous except from 6h to 12h on the first Wednesday of every month | A1 type, second pulses.<br><br>No transmission of DUT1. |
| OMA<br>(3) | Liblice<br>Czechoslovakia<br>50° 4'N<br>14° 53'E | 50 | continuous (from 6h to 12h on the first Wednesday in each month, emitted from Poděbrady with reduced power) | Interruption of the carrier of 100ms at the beginning of every second, of 500ms at the beginning of every minute. The precise time is given by the beginning of the interruption.<br><br>Phase coded announcement of date, UT and local civil time. No DUT1 code. |
| OMA | Liblice<br>Czechoslovakia<br>50° 4'N<br>14° 53'E | 2 500 | between minutes 1 and 15 16 and 30, 31 and 45, 46 and 60 of every hour except from 6h to 12h on the first Wednesday of every month. | Pulses of 5 cycles of 1 kHz modulation (prolonged for the minutes).<br><br>No transmission of DUT1. |
| PPE | Rio-de-Janeiro<br>Brasil<br>22° 54'S<br>43° 13'W | 8 721 | 0h 30m, 11h 30m, 13h 30m, 19h 30m, 20h 30m, 23h 30m | Second ticks, of A1 type, during the five minutes preceding the indicated hours. The minute ticks are longer.<br><br>DUT1 : CCIR code by double pulse. |

Notes : see p. C-11

| Station | Location<br>Latitude<br>Longitude | Frequency (kHz) | Schedule (UT) | Form of the time signals |
|---|---|---|---|---|
| PPR | Rio-de-Janeiro<br>Brasil<br>22° 59' S<br>43° 11' W | 435<br>4 244<br>8 634<br>13 105<br>17 194.4<br>22 603 | 1h 30m, 14h 30m,<br>21h 30m | Second ticks, of A1 type, during the five minutes preceding the indicated hours.<br>The minute ticks are longer. |
| RBU<br>(4) | Moscow<br>USSR<br>55° 48' N<br>38° 18' E | 66 2/3 | continuous | A1X type second pulses. The pulses at beginning of the minute are prolonged to 0.5 s. |
| RCH<br>(4) | Tashkent<br>USSR<br>41° 19' N<br>69° 15' E | | between minutes 0 and 10, 30 and 40 | A1X type second pulses. The pulses at the beginning of the minute are prolonged to 0.5 s. |
| | | 2 500 | 0h to 3h 40m<br>5h 30m to 23h 40m | |
| | | 5 000 | 0h to 3h 40m<br>14h to 23h 40m | |
| | | 10 000 | 5h 30m to 13h 10m | |
| RID<br>(4) | Irkutsk<br>USSR<br>52° 26' N<br>104° 2' E | 5 004<br>10 004<br>15 004 | The station simultaneously operates on three frequencies between minutes 20 and 30 50 and 60. | A1X type second pulses. The pulses at the beginning of the minute are prolonged to 0.5s. |
| RTA<br>(4) | Novosibirsk<br>USSR<br>55° 4' N<br>82° 58' E | | between minutes 0 and 10, 30 and 40 | A1X type second pulses. The pulses at the beginning of the minute are prolonged to 0.5s. |
| | | 10 000 | 0h to 5h 10m<br>14h to 23h 40m | |
| | | 15 000 | 6h 30m to 13h 10m | |
| RWM<br>(4) | Moscow<br>USSR<br>55° 48' N<br>38° 18' E | 4 996<br>9 996<br>14 996 | The station simultaneously operates on three frequencies between minutes 10 and 20, 40 and 50 | A1X type second pulses. The pulses at the beginning of the minute are prolonged to 0.5s. |
| RTZ<br>(4) | Irkutsk<br>USSR<br>52° 26' N<br>104° 2' E | 50 | between minutes 0 and 5,<br>from 0h to 20h 05<br>from 22h to 23h 05<br>in winter (10 Oct. to 31 March)<br><br>from 0h to 19h 05<br>from 21h to 23h 05<br>in summer (1 April to 30 Sept.) | A1X type second pulses. The pulses at the beginning of the minute are prolonged to 0.5s. |

Notes : see p. C-11

| Station | Location<br>Latitude<br>Longitude | Frequency (kHz) | Schedule (UT) | Form of the time signals |
|---|---|---|---|---|
| UNW3 | Molodechno<br>USSR<br>54° 26' N<br>26° 48' E | 25 | from 7h 43m to 7h 52m<br>from 19h 43m to 19h 52m<br>in winter (1 Oct. to 31 March)<br><br>from 7h 43m to 7h 52m<br>from 20h 43m to 20h 52m<br>in summer (1 April to 30 Sept.) | A1N type 0.1 second pulses of 0.025s duration.<br>Second pulses are prolonged to 0.1s.<br>10 second pulses are prolonged to 1s and minute pulses are prolonged to 10s.<br>No transmission of DUT1 code. |
| UPD8 | Arkhangelsk<br>USSR<br>64° 24'N<br>41° 32'E | 25 | from 8h 43m to 8h 52m<br>from 11h 43m to 11h 52m | A1N type 0.1 second pulses of 0.025 duration.<br>Second pulses are prolonged to 0.1s.<br>10 second pulses are prolonged to 1s and minute pulses are prolonged to 10s.<br>No transmission of DUT1 code. |
| UQC3 | Chabarovsk<br>USSR<br>48° 30' N<br>134° 51' E | 25 | From 0h 43m to 0h 52m,<br>from 6h 43m to 6h 52m<br>from 17h 43m to 17h 52m<br>in winter (1 Oct. to 31 March)<br><br>from 2h 43m to 2h 52m<br>from 6h 43m to 6h 52m<br>from 18h 43m to 18h 52m<br>in summer (1 April to 30 Sept.) | A1N type 0.1 second pulses of 0.025s duration.<br>Second pulses are prolonged to 0.1s ;<br>10 second pulses are prolonged to 1s and minute pulses are prolonged to 10s.<br>No transmission of DUT1 code. |
| USB2 | Frunze<br>USSR<br>43° 04'N<br>73° 39'E | 25 | from 4h 43m to 4h 52m<br>from 9h 43m to 9h 52m<br>from 21h 43m to 21h 52m<br>in winter (1 Oct. to 31 March)<br><br>from 4h 43m to 4h 52m<br>from 10h 43m to 10h 52m<br>from 22h 43m to 22h 52m<br>in summer (1 April to 30 Sept.) | A1N type 0.1 second pulses of 0.025s duration.<br>Second pulses are prolonged to 0.1s.<br>10 second pulses are prolonged to 1s and minute pulses are prolonged to 10s.<br>No transmission of DUT1 code. |
| UTR3 | Gorki<br>USSR<br>56° 11' N<br>43° 58' E | 25 | from 5h 43m to 5h 52m<br>from 13h 43m to 13h 52m<br>from 18h 43m to 18h 52m<br>in winter (1 Oct. to 31 March)<br><br>from 7h 43m to 7h 52m<br>from 14h 43m to 14h 52m<br>from 19h 43m to 19h 52m<br>in summer (1 April to 30 Sept.) | A1N type 0.1 second pulses of 0.025s duration.<br>Second pulses are prolonged to 0.1s ;<br>10 second pulses are prolonged to 1s and minute pulses are prolonged to 10s.<br>No transmission of DUT1 code. |

Notes : see p. C-11

| Station | Location<br>Latitude<br>Longitude | Frequency (kHz) | Schedule (UT) | Form of the time signals |
|---|---|---|---|---|
| VNG | Lyndhurst<br>Australia<br>38° 3' S<br>145° 16' E | 4 500<br>7 500<br><br>12 000 | 9h 45m to 21h 30m<br>continuous except 22h 30m to 22h 45m<br>21h 45m to 9h 30m | Second markers of 50 cycles of 1 kHz modulation; 5 cycles only for second markers 55 to 58 ; second marker 59 is omitted ; 500 cycles for minute markers. During the 5th, 10th, 15th, etc... minutes, 5 cycles for second markers 50 to 58. Identification by voice announcement during 15th, 30th, 45th and 60th minutes. DUT1 : CCIR code by 45 cycles of 900 Hz modulation immediately following the normal second markers. |
| WWV | Fort-Collins<br>USA<br>40° 41' N<br>105° 2' W | 2 500<br>5 000<br>10 000<br>15 000<br>20 000 | continuous | Pulses of 5 cycles of 1 kHz modulation. 59th and 29th second pulses omitted. Hour is identified by 0.8 second long 1 500 Hz tone. Beginning of each minute identified by 0.8 second long 1 000 Hz tone. DUT1 : CCIR code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction. |
| WWVB | Fort-Collins<br>USA<br>40° 40' N<br>105° 3' W | 60 | continuous | Second pulses given by reduction of the amplitude of the carrier. Coded announcement of the date, time, correction to obtain UT1, daylight savings time in effect, and leap year. No CCIR code. |
| WWVH | Kauai<br>USA<br>21° 59' N<br>159° 46' W | 2 500<br>5 000<br>10 000<br>15 000 | continuous | Pulses of 6 cycles of 1 200 Hz modulation. 59th and 29th second pulses omitted. Hour identified by 0.8 second long 1 500 Hz tone. Beginning of each minute identified by 0.8 second long 1 200 Hz tone.<br>DUT1 : CCIR code by double pulse.<br>BCD time code given on 100 Hz subcarrier, includes DUT1 correction. |
| YVTO | Caracas<br>Venezuela<br>10° 30' N<br>66° 56' W | 6 100 | continuous | Second pulses of 1 kHz modulation with 0.1s duration. The minute is identified by a 800 Hz tone and a 0.5s duration. Second 30 is omitted. Between seconds 40 and 50 of each minute, voice announcement of the identification of the station. Between seconds 52 and 57 of each minute, voice announcement of hour, minute and second. |
| Y3S<br>(5) | Nauen<br>Germ. Dem. Rep.<br>52° 39' N<br>12° 55' E | 4 525 | continuous except from 8h 15m to 9h 45m for maintenance if necessary | A1 type second pulses of 0.1s duration.<br>Minute pulses prolonged to 0.5s.<br>DUT1 : CCIR code by double pulse. |
| ZUO | Olifantsfontein<br>South Africa<br>25° 58' S<br>28° 14' E | 2 500<br>5 000 | 18h to 4h<br>continuous | Pulses of 5 cycles of 1 kHz modulation.<br>Second 0 is prolonged.<br>DUT1 : CCIR code by lengthening. |
| ZUO | Johannesburg<br>South Africa<br>26° 11' S<br>28° 4' E | 100 000 | continuous | Pulses of 5 cycles of 1 kHz modulation.<br>Second 0 is prolonged.<br>DUT1 : CCIR code by lengthening. |

Notes : see p. C-11

NOTES ON THE CHARACTERISTICS OF TIME SIGNALS

(1) No recent information on these time signals.

(2) The modulation system used by GBR outside the time-signals is likely to change to a form of minimum-shift keying sometime after the end of 1984. Some standard-frequency and phase-tracking receivers may not work without modification. Details of the new system are not yet available. More information should be available later in 1983.

(3) OMA, 50 kHz

a. The main transmitter in Liblice radiates approx. 7 kW and the stand-by transmitter in Poděbrady approx. 50 W.

b. The details of the time code were published in Nomenclature des stations de radiorepérage et des stations effectuant des services spéciaux - Liste VI, Volume I, édition 7 de U.I.T. in Geneva in July 1980.

(4) The radiostations of the USSR emit UT1 information in accordance with the CCIR code. Furthermore they give an additional information dUT1 specifying more precisely the difference UT1 - UTC down to multiples of 0.02s, the total value of the correction being DUT1 + dUT1. Positive values of dUT1 are transmitted by the marking of p second markers within the range between the 21th an 24th second so that dUT1 = + 0.02s x p. Negative values of dUT1 are transmitted by the marking of q second markers within the range between the 31th and the 34th second, so that dUT1 = - 0.02s x p.

(5) Y3S

DUT1 information in CCIR code.
dUT1 information. This additional information specifies more precisely the difference UT1 - UTC down to multiples of 0.02s, the total value of the correction being DUT1 + dUT1.

A positive value of dUT1 is indicated by doubling a number (p) of consecutive seconds markers from seconds marker 21 to seconds marker (20 + p) inclusive ; (p) being an integer from 1 to 5 inclusive.

$$dUT1 = p.0.02s.$$

A negative value of dUT1 is indicated by doubling a number (q) of consecutive seconds markers following the minute marker from seconds marker 31 to seconds marker (30 + q) inclusive ; (q) being an integer from 1 to 5 inclusive.

$$dUT1 = -(q.0.02)s.$$

The seconds marker 28 following the minute marker is doubled as parity bit, if the value of (p) or (q) is an even number or if dUT1 = 0.

Time-information. During the last 20 seconds of each minute in a BCD-Code an information about the value "minute" and "hour" in the UTC time scale of the following minute marker is given.

## UNCERTAINTY OF THE CARRIER FREQUENCY

The carriers of the following time signals are standard frequencies.

| Station | Relative uncertainty of the carrier frequency in $10^{-10}$ |
|---|---|
| ATA | 0.1 |
| BPM | 1 |
| BSF | 0.2 |
| CHU | 0.05 |
| DCF77 | 0.005 |
| GBR | 0.02 |
| HBG | 0.005 |
| IAM | 0.5 |
| IBF | 0.5 |
| JJY,JG2 AS | 0.1 |
| LOL1 | 0.1 |
| MSF(60kHz) | 0.02 |
| MSF(h.f.) | 0.02 |
| OMA(all frequencies) | 0.5 |
| RBU,RTZ | 0.05 |
| RCH,RID,RTA,RWM | 0.5 |
| UNW3,UPD8,UQC3,USB2,UTR3 | 0.1-0.2 |
| VNG | 0.1 |
| WWV | 0.1 |
| WWVB | 0.1 |
| WWVH | 0.1 |
| ZUO | 0.1 |

## TIME OF EMISSION OF THE TIME SIGNALS IN THE UTC SYSTEM, IN 1983

The following deviations of the time of emission of time signals, from UTC, have been reported to the BIH, or observed.

| | |
|---|---|
| BPM | UTC-BPM = -0.0200 |
| OLB5 | UTC-OLB5= 0.0008s |