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All communications should be addressed to :
M. le Directeur, Bureau International de l'Heure - 61, avenue de l'Observatoire - 75014 Paris

Table 8 - Offsets and step adjustments of UTC, until 1973 Dec. 31

Date (at 0h UT)	Offsets	Steps
1961 Jan. 1	-150×10^{-10}	
Aug. 1	"	$+0.050^{S}$
1962 Jan. 1	-130×10^{-10}	
1963 Nov. 1	"	-0.100^{S}
1964 Jan. 1	-150×10^{-10}	
April 1	"	-0.100^{S}
Sept. 1	"	-0.100^{S}
1965 Jan. 1	"	-0.100^{S}
March 1	"	-0.100^{S}
July 1	"	-0.100^{S}
Sept. 1	"	-0.100^{S}
1966 Jan. 1	-300×10^{-10}	
1968 Feb. 1	"	$+0.100^{S}$
1972 Jan. 1	0	$-0.107\ 7580^{S}$ *
July 1	"	-1^{S}
1973 Jan. 1	"	-1^{S}

* Corrected value, see p. A-9.

Table 9 - Relationship between TAI and UTC, until 1973 Dec. 31

Limits of validity (at 0 h UT)	TAI-UTC (J.D. : Julian Day Number)
1961 Jan. 1 - 1961 Aug. 1	$1.422\ 818\ 0^{S} + (J.D.-2437\ 300.5) \times 0.001\ 296^{S}$
Aug. 1 - 1962 Jan. 1	$1.372\ 818\ 0^{S} +$ "
1962 Jan. 1 - 1963 Nov. 1	$1.845\ 858\ 0^{S} + (J.D.-2437\ 665.5) \times 0.001\ 123\ 2^{S}$
1963 Nov. 1 - 1964 Jan. 1	$1.945\ 858\ 0^{S} +$ "
1964 Jan. 1 - April 1	$3.240\ 130\ 0^{S} + (J.D.-2438\ 761.5) \times 0.001\ 296^{S}$
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	$4.313\ 170\ 0^{S} + (J.D.-2439\ 126.5) \times 0.002\ 592^{S}$
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 -	$12.000\ 000\ 0^{S}$

Table 10 - Atomic time, collaborating laboratories.

ABBREVIATION	LABORATORY
DHI	Deutsches Hydrographisches Institut, Hamburg, Bundesrepublik Deutschland.
F	Commission Nationale de l'Heure, Paris, France.
FOA	Research Institute of National Defence, Stockholm, Sweden.
IEN	Istituto Elettrotecnico Nazionale, Torino, Italia.
IGMA	Instituto Geographico Militar, Buenos Aires, Argentina.
ILOM	International Latitude Observatory, Mizusawa, Japan.
MSO	Mount Stromlo Observatory, Canberra, Australia.
NBS	National Bureau of Standards, Boulder, USA.
NIS	National Institute for Standards, Cairo. U.A.R.
NPL	National Physical Laboratory, Teddington, U.K.
NPRL	National Physical Research Laboratory, Pretoria, South Africa.
NRC	National Research Council of Canada, Ottawa, Canada.
OMSF	Instituto y Observatorio de Marina, San Fernando, Spain.
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.
PTB	Physikalisch-Technische Bundesanstalt, Braunschweig, Bundesrepublik Deutschland.
PTCH	Direction générale des PTT, Berne, Suisse.
RGO	Royal Greenwich Observatory, Herstmonceux, U.K.
RRL	Radio Research Laboratories, Tokyo, Japan.
TAO	Tokyo Astronomical Observatory, Tokyo, Japan.
TCL	Telecommunication Laboratories, Taiwan, Rep. of China.
URE	Ustav Radiotechniky a Electroniky, Prag, Československo.
URSS	Laboratoire d'état de l'étalon de temps et de fréquence, URSS.
USNO	U.S. Naval Observatory, Washington, USA.
ZIPE	Zentralinstitut Physik der Erde, Potsdam, Deutsche Demokratische Republik.

Table 11 - Laboratories keeping an independent local atomic time and contributing to TAI.

Equipment and information on AT(i) - UTC(i) for 1972.

Laboratory i	Equipment in atomic standards *	Information on AT(i)-UTC(i)
F(1)	9 HP Cs st. 1 HP Cs tube with lab. electronics	AT(F)-UTC(OP) is published in Bull. H by OP
NBS	8 HP Cs St. (1 lab. primary St. not used for AT(NBS))	AT(NBS)-UTC(NBS) = 0.045 199 487 6^{s} $-(86.4 \times 10^{-9}$ s/d) (J.D.-2441317.5 d) + n seconds (3)
NRC	3 HP Cs St. 1 lab. primary st. (2)	AT(NRC)-UTC(NRC) = n seconds (3)
ON	1 E Cs St. 2 HP Cs St.	AT(ON)-UTC(ON) = n seconds (3)
PTB	6 HP Cs St. 1 lab. primary St. (4)	AT(PTB)-UTC(PTB) is published in PTB Time Service Bull.
RGO	5 HP Cs.St.	$GA2\text{-}UTC_G$ [≡ AT(RGO) - UTC(RGO)] = n seconds (3)
USNO	16 HP Cs St.(5) 2 Hydrogen Masers	A1(USNO, MEAN) [≡ AT(USNO)] - UTC(USNO,MC) is given by the USNO series 7

Notes * HP Cs St. = Hewlett-Packard cesium standards 5060A or 5061A,
E Cs St. = Ebauches S.A. cesium standard
The nominal number of standards is given. Except for USNO the number of effectively operating standards is often smaller.

(1) The standards are located as follows : Centre National d'Etudes Spatiales 1, Centre National d'Etudes des Télécommunications 3, Centre d'Etudes et de Recherches Géodynamiques et Astronomiques 1, Observatoires de Paris 3 et de Besançon 1, Laboratoire de Physique et de Métrologie des Oscillateurs 1. They are intercompared by the TV method and linked to the foreign laboratories through OP (see Table 12).

(2) The HP Cs St. are calibrated twice a week against the laboratory standard (2.1m) with a precision 2 σ of about 1×10^{-12}.

(3) n = TAI-UTC(integer number of seconds).

(4) AT(PTB) results from a reading of the 6 HP Cs St. considering the comparisons with the primary freq. st. CS1 of PTB. Precautions are taken in order to ensure the best uniformity of the scale. The AT(PTB) second is about 1×10^{-12}s shorter than the CS1 second. UTC(PTB) + 1 h = MEZ (PTB) is called the Official Time Scale (in Central European Time) which is disseminated, e.g., by the LF transmitter DCF77.

(5) Two of which being equipped with the new "super" tube.

Table 12 - Equipment and links of the collaborating laboratories

Laboratory (i)	Equipment (1)	Source of UTC(i)	LORAN-C receptions	VLF and LF receptions	Television link with
DHI	1 HP Cs St.	Cs St.	Sylt (Norw.S.)	DCF77	PTB, URE, ZIPE
FOA	2 HP Cs St.	mean of 2 Cs St.	Sylt (Norw.S.)	GBR, WWL, NAA, OMEGA Haiku	
IEN	4 HP Cs St.	2 Cs St. and other clocks	Sylt (Norw.S.) Estartit (Med.S.)	GBR, OMA, NAA, HBG, MSF60, OMEGA Aldra	
IGMA	1 E Cs St.	Cs St.		OMEGA Trinidad	
ILOM	1 HP Cs St.	Cs St.	Iwo-Jima(NW Pac.)		
MSO	1 HP Cs St.	Cs St.		GBR, NLK, NWC	
NBS	see Table 11	All the Cs St.	Dana (East Coast)	NAA, NLK, WWVB	
NPL	4 HP Cs St. 1 lab. Cs St. 1 Hydro. Mas.	The 4 HP Cs St..	Sylt (Norw.S.)	GBR, MSF60	
NPRL	1 HP Cs St.	Cs St.		GBR, NAA, NBA, NWC	
NRC	see Table 11	All the Cs St.	Nantucket (East Coast)		
OMSF	2 E Cs St.	1 Cs St.	Estartit (Med.S.)		
ON	see Table 11	All the Cs St.	Sylt (Norw.S.) Estartit (Med.S.)		
ONBA	2 Cs St.	2 Cs St.		NAA OMEGA Trinidad	
OP	3 HP Cs St.	1 Cs St.	Sylt (Norw.S.) Estartit (Med.S.)		other laboratories in France
PTB	see Table 11		Sylt (Norw.S.)	GBR, NAA OMEGA Trinidad	
PTCH	1 E Cs St.	Cs St.	Sylt (Norw.S.)		

Table 12 - (cont.)

Laboratory i	Equipment (1)	Source of UTC(i)	LORAN-C receptions	VLF and LF receptions	Television link with
RGO	see Table 11	Selection of the Cs St.	Sylt (Norw.S.) Ejde (Norw.S.) Estartit (Med.S.)	GBR, MSF60 OMEGA Trinidad OMEGA Aldra	
RRL	several HP Cs St.	1 Cs St.	Iwo-Jima (NW Pac.)	NLK	
TAO	3 HP Cs St.	1 Cs St.	Iwo-Jima (NW Pac.)	GBR, NLK, NWC	
TCL	2 HP Cs St.	All the Cs St.	Iwo-Jima (NW Pac.) Tan-My (SE Asia)	NDT, NWC	
URE	1 HP Cs St.	Cs St.		GBR, NAA,	DHI, PTB, ZIPE
URSS	Hydrogen Masers			RBW, GBR, OMA NAA	
USNO	see Table 11	Cs St.	(2)	(2)	

Notes

(1) HP Cs St. = Hewlett-Packard cesium standards 5060A or 5061A.
E Cs St. = Ebauches S.A. cesium standard

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

the LORAN-C chains NW Pac., Central Pac., East Coast USA, Norwegian S., Mediterranean S., North Atlantic ;
the OMEGA stations ND(10.2, 13.6 kHz), T(12 kHz), H(13,6 kHz) ;
the VLF stations GBR, NAA, NLK, NBA.

Table 13 - Rate and frequency corrections applied to the AT(i)

Laboratory	Date	Bi μ s/d	Equivalent of Bi in relative frequency 10^{-13}	Remarks
PTB	1969 Jan. 1	+0.015	+1.7	initial set
USNO	1969 Jan. 1	-0.040	-4.6	
F	1969 Jan. 1	+0.065	+7.5	
RGO	1969 April 8	-0.035	-4.1	introduction
NRC	1969 May 18	-0.035	-4.1	introduction
	1969 Aug. 6	-0.025	-2.9	change of weight
	1971 Jan. 1	+0.015	+1.7	corr. of frequency (1)
NBS	1969 June 27	-0.075	-8.7	introduction
	1970 Aug. 11	0.063	-7.3	interruption (2)
	1970 Sept. 30	-0.063	-7.3	reintroduction
	1971 April 8	-0.080	-9.3	interruption (3)
	1971 July 7	-0.080	-9.3	reintroduction
ON	1969 Dec. 4	-0.055	-6.4	introduction
	1972 Jan. 3	+0.010	+1.2	removed from the mean (4)
	1972 Aug. 30	-0.001	-0.1	reintroduction

(1) Following a study of the second order Doppler effect, NRC modified the evaluation of the frequency of its primary standard CSIII. B_{NRC} was modified accordingly, on 1971 Jan. 1, in order to avoid a frequency change in TAI.

(2) From 1970 Aug. 14 to 1970 Sept. 23, interruption of the LORAN-C receptions. At the date of interruption, we applied B_{NBS} = -0.063 μ s/d, a value deduced from the 2 month-data before the interruption. The same value of B_{NBS} was applied when the LORAN-C receptions were resumed.

(3) From 1971 April 19 to 1971 May 10, interruption of the LORAN-C receptions: B_{NBS} = -0.080 μ s/d was applied both for the interruption and the re-introduction.

(4) On 1972 Jan. 1, the rate of TAI-AT(ON) changed by about 7×10^{-13}. ON was removed from the mean (null weight) from 1972 Jan. 3 to 1972 Aug. 20.
B_{ON} =+0.010 μ s/d before the interruption ; and B_{ON} = -0,001 μs/d for the reintroduction.

Table 14 - Time comparisons between laboratories by clock transportations in 1972 (for abbreviations, see p. B-24).

Date 1972	J.D. 2400000.5 +	Time comparisons (unit : 1 microsecond)		Authority	
Jan. 25	41341.8	UTC(USNO) - UTC(APO) (1)	= + 0.9 ± 1.0	USNO, DPV (4)	267
26	41342.0	UTC(USNO) - UTC(MSO)	= + 382.4 ± 1.0	"	"
28	41344.2	UTC(USNO) - UTC(CSIRO) (2)	= + 51.9 ± 1.0	"	"
Feb. 11	41358.7	UTC(USNO) - UTC(NBS)	= + 5.9 ± 0.3	"	"
17	41364.1	UTC(USNO) - UTC(RRL)	= - 0.2 ± 0.3	"	"
17	41364.2	UTC(USNO) - UTC(TAO)	= + 10.5 ± 0.3	"	"
24	41371.1	UTC(USNO) - UTC(TCL)	= - 11.2 ± 0.3	"	"
Apr. 11	41418.4	UTC(USNO) - UTC(OP)	= + 9.1 ± 0.3	"	274
11	41418.6	UTC(USNO) - UTC(NRC)	= + 6.3 ± 0.3	"	279
12	41419.3	UTC(USNO) - UTC(ORB)	= + 1.4 ± 0.3	"	274
14	41421.4	UTC(USNO) - UTC(PTB)	= + 10.1 ± 0.3	"	274
15	41422.5	UTC(OP) - UTC(OMSF) (3)	= - 23.8 ± 1.3	OP	
17	41424.3	UTC(USNO) - UTC(DHI)	= - 12.7 ± 0.3	USNO, DPV	274
19	41426.2	UTC(USNO) - UTC(RGO)	= + 7.9 ± 0.3	"	"
19	41426.4	UTC(USNO) - UTC(NPL)	= + 1.7 ± 0.3	"	"
May 2	41439.1	UTC(USNO) - UTC(TAO)	= + 11.3 ± 1.0	"	277
2	41439.2	UTC(USNO) - UTC(RRL)	= + 1.4 ± 1.0	"	"
11	41448.6	UTC(USNO) - UTC(NBS)	= + 5.8 ± 0.3	"	280
June 17	41485.1	UTC(USNO) - UTC(APO)	= - 2.6 ± 0.2	"	284
July 3	41501.1	UTC(USNO) - UTC(RRL)	= + 1.2 ± 0.4	"	286
3	41501.1	UTC(USNO) - UTC(TAO)	= + 11.4 ± 0.4	"	"
6	41504.1	UTC(USNO) - UTC(TCL)	= - 2.0 ± 0.4	"	"
Oct. 18	41608.6	UTC(USNO) - UTC(NRC)	= + 3.5 ± 0.3	"	310
Nov. 30	41651.4	UTC(USNO) - UTC(RGO)	= + 11.8 ± 0.3	"	"
Dec. 1	41652.3	UTC(USNO) - UTC(NPL)	= - 18.2 ± 0.3	"	"
4	41655.3	UTC(USNO) - UTC(DHI)	= + 2.8 ± 0.3	"	"
7	41658.3	UTC(USNO) - UTC(OP)	= + 4.0 ± 0.3	"	"
11	41662.3	UTC(USNO) - UTC(IEN)	= - 2.0 ± 0.3	"	"

(1) APO : Australian Post Office, Research Laboratories, Melbourne, Australia.

(2) CSIRO : Commonwealth Scientific and Industrial Research Organization, Australia.

(3) The measurement was carried out with respect to clock n° 016.

(4) DPV : : Daily Phase Values, Series 4, published by the USNO.

Note : To complete the Table 11 of the Annual Report for 1971, the following result must be added :

1971 Dec. 9 (J.D. 2441295.3), UTC(USNO) - UTC(IGMA) = + 365.7 ± 0.5

TABLE 15 - INDEPENDENT ATOMIC TIMES

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

UNIT IS ONE MICROSECOND

DATE 1972	J.D. 2400000.5 +	F	TAI - AT(I) NBS (1)	NRC	ON	PTB	RGO	USNO
JAN 3	41319	-55.6	-45204.0	-2.1	14.0	-377.8	-1.8	-34398.6
JAN 13	41329	-55.9	-45202.9	-1.7	14.6	-377.7	-1.7	-34398.6
JAN 23	41339	-56.1	-45201.7	-1.1	15.5	-377.7	-1.6	-34398.7
FEB 2	41349	-56.2	-45200.9	-1.2	16.5	-377.4	-1.4	-34398.5
FEB 12	41359	-56.4	-45199.7	-1.4	17.5	-377.3	-1.0	-34398.5
FEB 22	41369	-56.6	-45198.4	-1.3	18.5	-377.0	-0.6	-34398.8
MAR 3	41379	-56.7	-45197.5	-1.2	19.3	-376.9	0.0	-34398.8
MAR 13	41389	-56.7	-45196.3	-1.3	19.5	-376.7	0.5	-34399.0
MAR 23	41399	-56.9	-45195.5	-1.2	19.8	-376.5	1.0	-34399.0
APR 2	41409	-57.0	-45194.5	-1.1	19.8	-376.5	1.4	-34399.2
APR 12	41419	-56.9	-45193.3	-0.7	20.1	-376.3	1.6	-34399.4
APR 22	41429	-56.6	-45192.7	-0.4	20.3	-375.9	2.0	-34399.6
MAY 2	41439	-56.5	-45191.8	-0.2	20.4	-375.7	2.4	-34399.9
MAY 12	41449	-56.8	-45190.7	0.0	20.3	-375.7	2.3	-34399.7
MAY 22	41459	-57.0	-45189.5	0.2	20.3	-375.7	2.6	-34399.7
JUN 1	41469	-56.9	-45188.7	0.4	20.6	-375.4	3.1	-34399.8
JUN 11	41479	-57.1	-45187.9	0.8	20.6	-375.3	3.5	-34399.9
JUN 21	41489	-57.2	-45187.1	0.9	20.7	-375.1	4.1	-34400.0
JUL 1	41499	-57.4	-45186.4	1.2	20.6	-375.0	4.7	-34400.1
JUL 11	41509	-57.6	-45185.6	1.3	20.6	-374.7	5.2	-34400.1
JUL 21	41519	-58.1	-45184.6	1.5	20.3	-374.8	5.4	-34399.8
JUL 31	41529	-58.4	-45184.1	1.8	20.1	-374.8	5.7	-34399.7
AUG 10	41539	-58.2	-45183.7	1.7	20.5	-374.4	6.4	-34399.8
AUG 20	41549	-58.2	-45182.8	1.3	20.6	-374.3	6.8	-34399.7
AUG 30	41559	-58.6	-45181.8	1.3	20.4	-374.2	7.2	-34399.5
SEP 9	41569	-58.8	-45180.9	1.3	20.3	-374.0	7.6	-34399.4
SEP 19	41579	-59.2	-45179.9	1.7	20.3	-374.1	7.8	-34399.3
SEP 29	41589	-59.3	-45178.8	1.4	20.4	-373.8	8.3	-34399.5
OCT 9	41599	-59.2	-45177.9	1.1	20.5	-373.5	8.8	-34399.4
OCT 19	41609	-59.5	-45177.1	1.2	20.6	-373.3	9.2	-34399.4
OCT 29	41619	-59.8	-45175.6	1.4	20.3	-373.2	9.6	-34399.4
NOV 8	41629	-59.8	-45174.9	1.2	20.3	-372.9	9.9	-34399.3
NOV 18	41639	-59.7	-45174.4	0.9	20.5	-372.4	10.4	-34399.4
NOV 28	41649	-59.8	-45173.7	1.1	20.4	-372.0	10.9	-34399.3
DEC 8	41659	-59.8	-45172.8	1.5	20.1	-371.7	11.2	-34399.3
DEC 18	41669	-59.9	-45172.0	1.3	20.0	-371.4	11.8	-34399.3
DEC 28	41679	-59.8	-45171.4	1.1	20.1	-370.9	12.4	-34399.4

(1) NBS Corrected values for 1971 41 259 -45 210.5
41 269 -45 209.7
41 279 -45 208.7

Table 16 - UTC(i) steps of the laboratories on 1972 Jan. 1st 0 h UTC.

Laboratory i	$UTC(i)_{new} - UTC(i)_{old}$ (μ s)	$[UTC-UTC(i)]_{new} - [UTC-UTC(i)]_{old}$ (μ s)
APO(1)	-107 580.0	-178.0
DHI	-107 757.7	- 0.3
FOA	-107 662.0	- 96.0
IEN	-107 695.0	- 63.0
NBS	-107 600.0	-158.0
NRC(2)	-107 440.0	-318.0
ON	-107 757.7	- 0.3
OP	-107 744.7	- 13.3
PTB(3)	-107 941.0	+183.0
RGO	-107 583.0	-175.0
RRL	-107 620.0	-138.0
TAO	-107 757.7	- 0.3
TCL	-107 650.0	-108.0
USNO	-107 600.0	-158.0
ZIPE	-107 790.0	+ 32.0

(1) Australian Post Office, Research Laboratories, Melbourne, Australia.

(2) The old scale was UTA(NRC).

(3) The old scale was TUA(PTB).

TABLE 17 - COORDINATED UNIVERSAL TIME

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

UNIT IS ONE MICROSECOND

DATE 1972		J.D. 2400000 +	UTC - UTC(I) CHI	FOA	IEN	ILOM (1)	NBS (2)	NPL (3)	NRC
JAN	3	41319	-12.3	-11.5		-110.6	-4.7	0.8	-2.1
JAN	13	41329	-12.8	-9.6	3.9	-108.3	-4.5	0.4	-1.7
JAN	23	41339	-13.3	-8.5	3.1	-105.3	-4.1	-0.2	-1.1
FEB	2	41349	-13.8	-6.5	2.0	-102.8	-4.1	-0.6	-1.2
FEB	12	41359	-14.4	-4.4	1.1	-100.0	-3.8	-1.1	-1.4
FEB	22	41369	-14.7	-2.5	0.1	-97.9	-3.5	-1.6	-1.3
MAR	3	41379	-15.3	-0.6	-0.5	-95.8	-3.3	-2.3	-1.2
MAR	13	41389	-15.8	1.7	-1.4	-93.1	-3.0	-2.9	-1.3
MAR	23	41399	-16.5	4.1	-2.5	-91.2	-3.1	-3.7	-1.2
APR	2	41409	-17.3	6.5	-3.2	-89.0	-2.9	-4.6	-1.1
APR	12	41419	-18.8	9.1	-3.7	-86.6	-2.7	-5.5	-0.7
APR	22	41429	-20.5	11.8	-5.1	-84.7	-2.9	-5.8	-0.4
MAY	2	41439	-22.7	14.2	-6.6	-81.9	-2.8	-6.6	-0.2
MAY	12	41449	-21.3	16.4	-6.5	-78.9	-2.6	-7.5	0.0
MAY	22	41459	-19.5	18.8	-6.7		-2.3	-8.4	0.2
JUN	1	41469	-17.9	21.5	-6.1		-2.4	-9.1	0.4
JUN	11	41479	-16.9	23.9	-5.8		-2.4	-9.9	0.8
JUN	21	41489	-15.3	26.3	-5.2		-2.5	-10.4	0.9
JUL	1	41499	-13.9	28.6	-4.5	-57.6	-2.7	-11.4	1.2
JUL	11	41509	-12.7	31.1	-4.1	-55.2	-2.7	-12.0	1.3
JUL	21	41519	-12.0	32.7	-3.7	-53.2	-2.6	-12.8	1.5
JUL	31	41529	-11.9	34.3	-3.9	-51.0	-3.0	-13.7	1.8
AUG	10	41539	-9.6	36.4	-3.5	-48.9	-3.4	-14.0	1.7
AUG	20	41549	-7.5	38.0	-3.4	-46.9	-3.4	-14.6	1.3
AUG	30	41559	-5.6	39.3	-3.1	-44.5	-3.2	-15.4	1.3
SEP	9	41569	-3.9	40.6	-2.7	-42.9	-3.2	-16.0	1.3
SEP	19	41579	-2.0	42.0	-2.7	-40.6	-3.0	-16.7	1.7
SEP	29	41589	-0.6	43.4	-2.7	-38.7	-2.8	-17.1	1.4
OCT	9	41599	-0.8	44.6	-2.8	-37.6	-2.8	-17.7	1.1
OCT	19	41609	-0.7	45.8	-2.7	-36.3	-2.8	-18.1	1.2
OCT	29	41619	-0.7	46.7	-3.0	-35.5	-2.5	-18.8	1.4
NOV	8	41629	-0.9	47.9	-3.0	-34.0	-2.3	-19.3	1.2
NOV	18	41639	-0.5	49.2	-2.9	-33.0	-2.7	-19.4	0.9
NOV	28	41649	1.0	50.3	-2.9	-31.8	-2.9	-19.8	1.1
DEC	8	41659	1.8	51.6	-3.1	-30.4	-2.8	-20.4	1.5
DEC	18	41669	3.1	52.9	-3.4	-29.5	-2.9	-20.8	1.3
DEC	28	41679	4.6	54.2	-3.3	-28.0	-3.2	-21.0	1.1

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1972	J.D. 2400000 +	UTC - UTC(I) GMSF (4)	ON	CP	PTB	RGO	RRL (5)	TAO (6)
JAN 3	41319		14.0	0.0	2.2	-1.8	-9.2	1.8
JAN 13	41329		14.6	0.1	2.3	-1.7	-7.9	1.5
JAN 23	41339	-1.3	15.5	0.3	2.4	-1.6	-8.4	1.8
FEB 2	41349	-1.9	16.5	0.7	2.7	-1.4	-8.0	1.9
FEB 12	41359	-3.6	17.5	1.1	2.8	-1.0	-7.1	2.6
FEB 22	41369	-5.7	18.5	1.4	2.9	-0.6	-7.0	2.5
MAR 3	41379	-8.2	19.3	1.6	2.9	0.0	-7.0	2.3
MAR 13	41389	-11.8	19.5	1.9	2.9	0.5	-6.6	2.4
MAR 23	41399	-15.6	19.8	2.1	2.9	1.0	-6.7	2.1
APR 2	41409	-19.3	19.8	2.2	2.8	1.4	-6.8	2.1
APR 12	41419	-21.0	20.1	2.2	2.8	1.6	-7.2	1.8
APR 22	41429	-22.3	20.3	2.4	3.1	2.0	-7.6	1.4
MAY 2	41439	-22.2	20.4	2.2	3.1	2.4	-7.5	1.4
MAY 12	41449	-23.2	20.3	1.8	2.9	2.3	-7.4	1.6
MAY 22	41459	-23.9	20.3	1.6	2.8	2.6		
JUN 1	41469	-23.6	20.6	1.7	3.0	3.1		
JUN 11	41479	-24.0	20.6	1.6	2.9	3.5		
JUN 21	41489	-23.6	20.7	1.6	3.0	4.1		
JUL 1	41499	-22.6	20.6	1.6	2.9	4.7	-5.0	5.3
JUL 11	41509	-21.6	20.6	1.5	3.0	5.2	-5.0	5.0
JUL 21	41519	-20.7	20.3	1.2	2.8	5.4	-5.2	4.7
JUL 31	41529	-20.6	20.1	1.3	2.5	5.7	-5.0	4.8
AUG 10	41539	-19.5	20.5	1.8	2.7	6.4	-4.9	5.1
AUG 20	41549	-18.4	20.6	2.1	2.5	6.8	-4.9	5.3
AUG 30	41559	-16.8	20.4	2.2	2.4	7.2	-4.4	5.9
SEP 9	41569	-14.9	20.3	2.2	2.3	7.6	-4.6	5.8
SEP 19	41579	-13.4	20.3	2.1	2.1	7.8	-3.6	6.4
SEP 29	41589	-11.6	20.4	2.3	2.2	8.3	-3.4	6.5
OCT 9	41599	-10.5	20.5	2.4	2.2	8.8	-3.7	6.3
OCT 19	41609	-9.3	20.6	2.4	2.2	9.2	-3.6	6.4
OCT 29	41619	-9.1	20.3	2.3	2.0	9.6	-3.5	6.2
NOV 8	41629	-8.4	20.3	2.5	2.1	9.9	-3.5	6.9
NOV 18	41639	-7.4	20.5	3.0	2.4	10.4	-3.8	6.9
NOV 28	41649	-6.9	20.4	3.2	2.5	10.9	-3.7	7.1
DEC 8	41659	-5.5	20.1	3.5	2.6	11.2	-3.0	7.9
DEC 18	41669	-4.4	20.0	4.1	2.7	11.8	-3.0	8.1
DEC 28	41679	-2.8	20.1	4.8	3.0	12.4	-2.6	8.9

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1972	J.D. 2400000 +	UTC - UTC(I) TCL (7)	TP (8)	USNO (9)
JAN 3	41319		-0.1	-9.1
JAN 13	41329		-0.3	-8.8
JAN 23	41339		-0.5	-8.6
FEB 2	41349		-0.7	-8.5
FEB 12	41359		-0.9	-8.0
FEB 22	41369		-1.2	-8.0
MAR 3	41379		-1.3	-7.9
MAR 13	41389		-1.4	-7.7
MAR 23	41399		-1.5	-7.5
APR 2	41409		-1.5	-7.4
APR 12	41419		-1.5	-7.5
APR 22	41429		-1.5	-7.4
MAY 2	41439		-1.6	-7.4
MAY 12	41449		-1.6	-7.0
MAY 22	41459		-1.6	-6.8
JUN 1	41469		-1.7	-6.7
JUN 11	41479		-1.7	-6.6
JUN 21	41489		-1.8	-6.5
JUL 1	41499	1.9	-1.8	-6.2
JUL 11	41509	2.0	-1.9	-6.0
JUL 21	41519	2.3	-2.1	-5.6
JUL 31	41529	3.2	-2.4	-4.9
AUG 10	41539	4.0	-2.7	-4.7
AUG 20	41549	5.8	-3.1	-4.5
AUG 30	41559	7.7	-3.5	-4.0
SEP 9	41569	8.6	-4.0	-3.8
SEP 19	41579	10.5	-4.5	-3.2
SEP 29	41589	12.1	-5.0	-2.9
OCT 9	41599	12.4	-5.8	-3.0
OCT 19	41609	13.2	-6.2	-2.5
OCT 29	41619	13.8	-6.7	-2.4
NOV 8	41629	15.2	-6.8	-2.2
NOV 18	41639	16.4	-6.2	-2.3
NOV 28	41649	17.8	-7.0	-2.1
DEC 8	41659	19.2	-7.5	-1.5
DEC 18	41669	20.5	-7.5	-1.3
DEC 28	41679	22.1	-6.8	-1.2

TABLE 17 - (CONT.)

NOTES

(1) ILOM The revised values UTC(USNO MC) - LORAN-C Northwest Pacific published in the "Daily Phase Values" 267 and 312 were used to obtain the UTC - UTC(ILOM) values.

(2) NBS Corrected values for 1971 : 41 259 +150.5
41 269 +150.9
41 279 +151.3

(3) NPL Origin given by the clock transportation carried out on 1972 April 12.

(4) OMSF Origin given by the clock transportation carried out on 1972 April 15.

(5) RRL See ILOM.
The clock transportation carried out on 1972 July 3 was taken into account.

(6) TAO See ILOM.
On 1972 Jan. 1, change of master clock. Origin given by the clock transportation carried out on 1972 Feb. 17.
The clock transportation carried out on 1972 July 3 was taken into account.

(7) TCL Origin given by the clock transportation carried out on 1972 July 6.

(8) TP Until 1972 Sept. 29 : the published values of UTC - UTC(TP) were computed by the Astronomický Ústav ČSAV (Prag) for the standard of URE. After this date the values were computed by the BIH.

(9) USNO The data refer to UTC(USNO MC).

TABLE 18 - COORDINATED UNIVERSAL TIME (FROM VLF MEASUREMENTS)

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

UNIT IS ONE MICROSECOND

DATE 1972	J.D. 2400000 +	IGMA	UTC - UTC(I) MSO	NPRL	URSS
JAN 3	41319	0*	365		
JAN 13	41329	0	366		0*
JAN 23	41339	1	376		-5
FEB 2	41349	2	368		-10
FEB 12	41359	2	386		-5
FEB 22	41369	0	381		-3
MAR 3	41379	-1	385		
MAR 13	41389	-2	390		
MAR 23	41399	-5	383		0*
APR 2	41409	-7	377		3
APR 12	41419	-10	377		1
APR 22	41429	-14	374		
MAY 2	41439	-16	375		0*
MAY 12	41449	-17	374		4
MAY 22	41459	-19	385		11
JUN 1	41469	-22	385		20
JUN 11	41479	-25	391		0
JUN 21	41489	-19	395		11
JUL 1	41499	-21	396		16
JUL 11	41509	-23	398		27
JUL 21	41519	-23	400		39
JUL 31	41529	-24	404		
AUG 10	41539	-28	401		
AUG 20	41549	-29	403		0*
AUG 30	41559	-33	408		1
SEP 9	41569	-34	409		0
SEP 19	41579	-37	409	0*	-3
SEP 29	41589	-41	411	-4	-4
OCT 9	41599	-41	416	-7	-7
OCT 19	41609	-43	420	-6	-7
OCT 29	41619	-47	423	-5	-12
NOV 8	41629	-51	420	-7	-18
NOV 18	41639	-52	418	-9	-12
NOV 28	41649	-52		-6	-12
DEC 8	41659	-57		-9	-15
DEC 18	41669	-61		-11	-15
DEC 28	41679	-64			-18

* Arbitrary origin.

Table 19 - Comparisons between the clock transportations and the LORAN-C or VLF links.

The table gives the differences between the clock transportation results and those obtained by LORAN-C or VLF for some pairs of laboratories. The clock transportations used to fix the origins are denoted by *.

This table is following on the Table 13 of the annual Report for 1971.

Time comparisons	Date	J.D. 2400000.5 +	Difference in μ s clock tr. - LORAN-C or VLF
UTC (USNO) - UTC DHI)	1972 Apr. 17	41424.3	- 0.4
	1972 Dec. 4	41655.3	- 0.4
UTC (IEN)	1971 Sept. 20	41214	0.0*
	1972 Dec. 11	41662.3	- 0.3
UTC (MSO)	1972 Jan. 26	41342.0	0*
UTC (NBS)	1972 Feb. 11	41358.7	+ 1.6
	1972 May 11	41448.6	+ 1.4
UTC (NPL)	1972 Apr. 19	41426.4	0.0*
	1972 Dec. 1	41652.3	- 0.1
UTC (NRC)	1972 Apr. 11	41418.6	- 0.3
	1972 Oct. 18	41608.6	- 0.2
UTC (OP)	1972 Apr. 11	41418.4	- 0.6
	1972 Dec. 7	41658.3	- 1.0
UTC (PTB)	1972 Apr. 14	41421.4	- 0.2
UTC (RGO)	1972 Apr. 19	41426.2	- 1.4
	1972 Nov. 30	41651.4	- 1.3
UTC (RRL)	1972 Feb. 17	41364.1	- 1.2
	1972 May 2	41439.2	+ 1.5
	1972 Jul. 3	41501.1	0.0*
UTC (TAO)	1972 Feb. 17	41364.2	0.0*
	1972 May 2	41439.1	+ 2.5
	1972 Jul. 3	41501.1	0.0*

Table 19 (cont.)

Time comparisons		Date	J.D. 2400000.5 +	Difference in μ s clock tr. - LORAN-C or VLF
UTC (OP) -	UTC (DHI)	1972 Apr. 17	41424.3	+ 0.2
		1972 Dec. 4	41655.3	+ 0.6
	UTC(PTB)	1972 Apr. 14	41421.4	+ 0.4
	UTC (RGO)	1972 Apr. 19	41426.2	- 0.6
		1972 Nov. 30	41651.4	- 0.4
UTC (PTB) -	UTC (DHI)	1972 Apr. 17	41424.3	- 0.2
UTC (RGO) -	UTC (DHI)	1972 Apr. 17	41424.3	+ 0.7
		1972 Dec. 4	41655.3	+ 0.7
	UTC (PTB)	1972 Apr. 14	41421.4	+ 0.9
	UTC (NPL)	1972 Apr. 19	41426.4	+ 1.1
		1972 Dec. 1	41652.3	+ 1.1
UTC (RRL) -	UTC (TAO)	1972 Feb. 17	41364.2	+ 1.1
		1972 May 2	41439.1	+ 1.0
		1972 Jul. 3	41501.1	+ 0.9

Table 20 - Coordinated universal time, complementary values of UTC - UTC(i).

Laboratory	Time scale	Date	UTC - UTC(i) (μ s)	Remarks
PMG Research Lab. (Australian Post Office) Melbourne, Australia	UTC(APO) (1)	1972 Jan. 25	- 7.7	USNO clock transportation
		1972 June 17	- 9.1	"
CSIRO National Standards Lab. University of Sydney, Sydney, Australia	UTC(CSIRO) (2)	1972 Jan. 28	+43.4	"
Zentralinstitut Physik der Erde Potsdam D.D.R.	UTC(ZIPE)	1972 Jan. 3	+ 8	Data obtained
		Feb. 2	+ 8	
		March 3	+ 9	by television
		April 2	+ 9	
		May 2	+ 9	links with DHI
		June 1	+ 9	
		July 1	+ 9	
		Aug. 10	+ 7	
		Sept. 9	+ 6	
		Oct. 9	+ 5	
		Nov. 8	+ 5	
		Dec. 8	+ 3	

(1) UTC(APO) $\equiv$ UTC(PMG APO2)
(2) UTC(CSIRO) $\equiv$ UTC(CSIRO CS201)

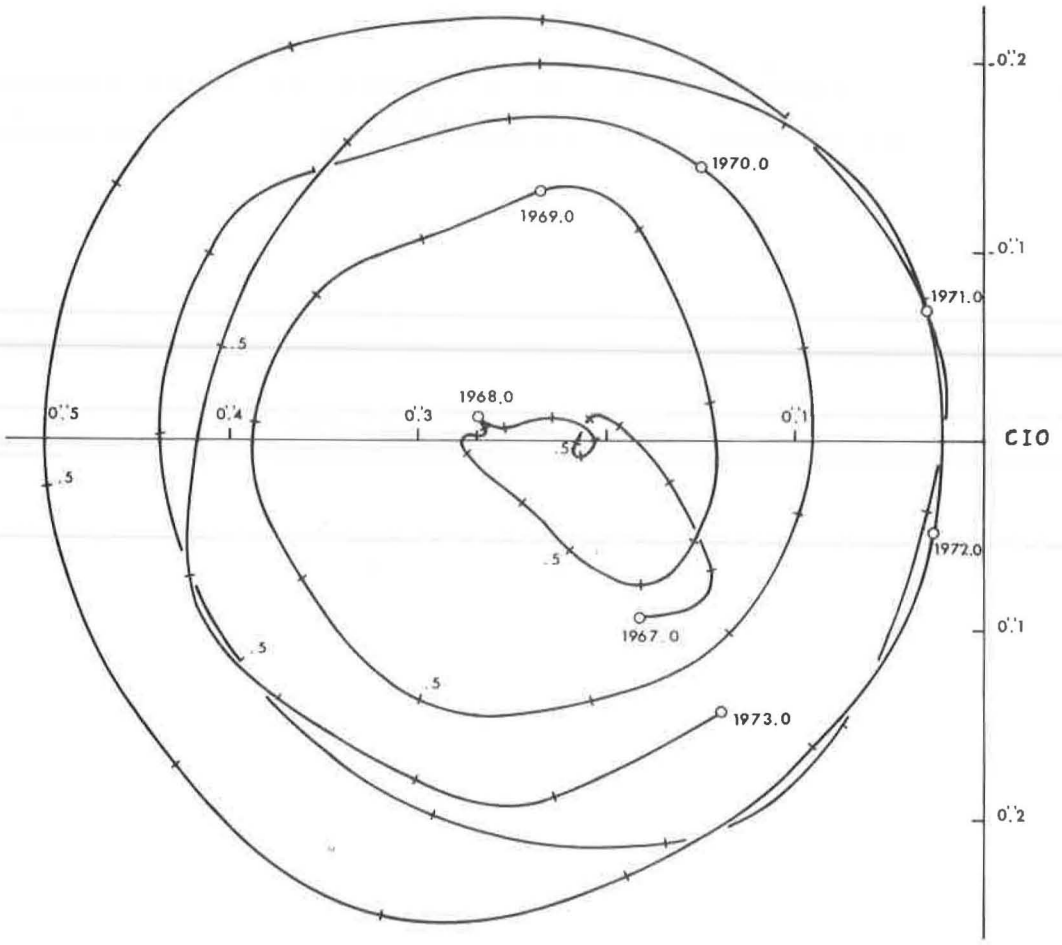


Fig. 1 - Path of the pole from 1967.0 to 1973.0
Smoothed values of Tables 6, obtained by the Vondrak's method, with the coefficient of smoothing which equilizes the internal and external standard deviations in x and y.

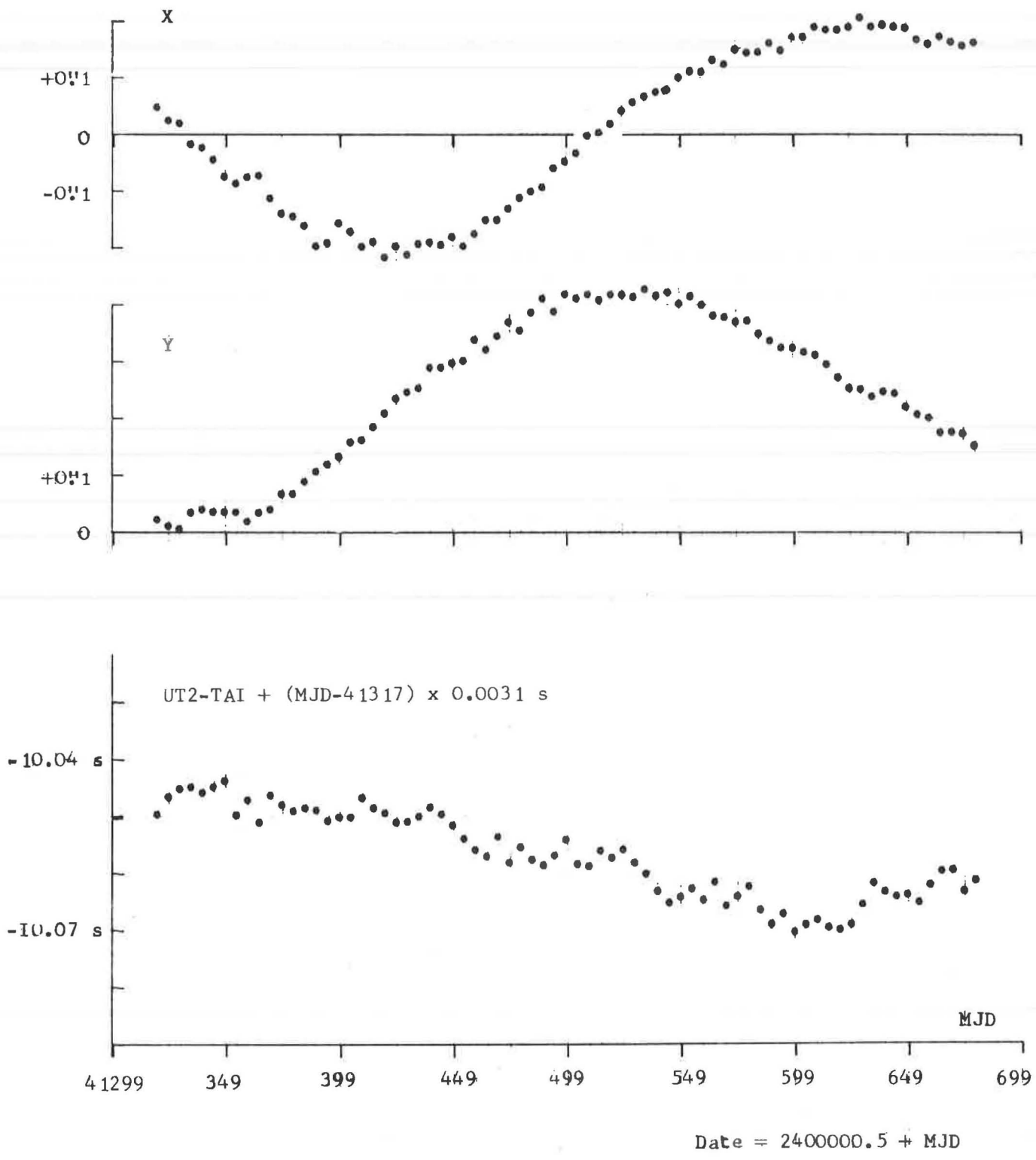


Fig. 2 - Raw data of x, y, UT2-UTC (table 6C for 1972), for every 5 days.

PART C

TIME SIGNALS

In the following tables, characteristics of the main time signal emissions are shown. They are established with all information received until April 1973. The addresses of the authorities responsible for the emissions are given next pages.

The carriers of the following time signals are standard frequencies.

Station	Accuracy of the carrier frequency in 10^{-10}
CHU	0.2
DCF77	0.02
FFH	0.2
GBR	0.2
HBG	0.02
IAM	0.5
IBF	0.1
JJY, JG2AE, JG2AS	0.5
LOL1	0.2
MSF (60 kHz)	0.2
MSF (h.f.)	1
NBA (V.L.F.), NDT	0.1
NSS (V.L.F.), NWC	0.1
OMA (all frequencies)	0.5
VNG	1
WWV	0.1
WWVB	0.1
WWVH	0.1
ZUO	0.5

CODE FOR THE TRANSMMISSION OF DUTI

Most of the time signals disseminate the difference UTI-UTC in integral multiples of 0.1 s. This correction is called DUT1.

CCIR code

A positive value of DUT1 is indicated by emphasizing a number (n) of consecutive seconds markers following the minute marker from seconds markers one to seconds marker (n) inclusive ; (n) being an integer from 1 to 7 inclusive.

$$DUT1 = (n \times 0.1)\,s$$

A negative value of DUT1 is indicated by emphasizing a number (m) of consecutive seconds markers following the minute marker from seconds marker nine to seconds marker (8 + m) inclusive ; (m) being an integer from 1 to 7 inclusive.

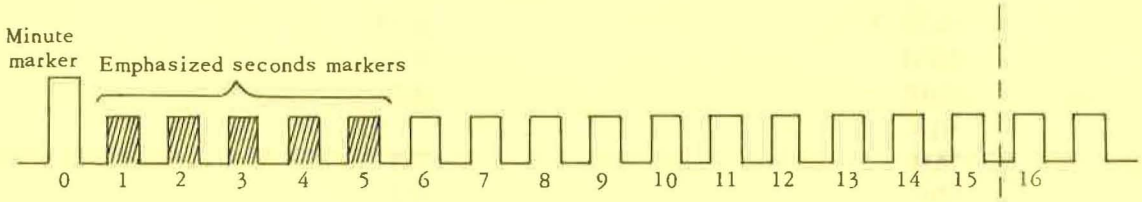
$$DUT1 = -(m \times 0.1)\,s$$

A zero value of DUT1 is indicated by the absence of emphasized seconds markers.

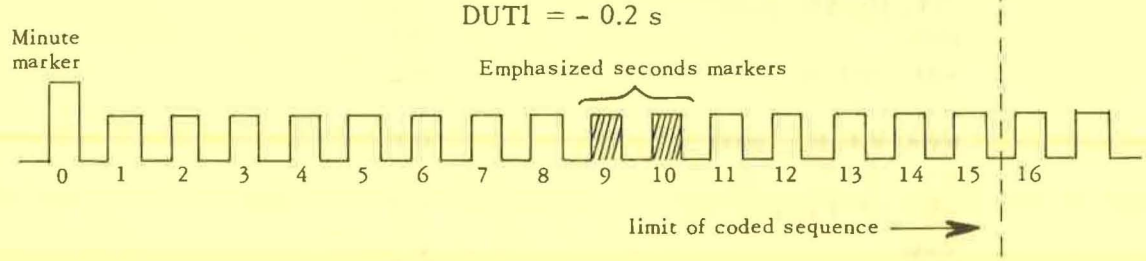
The appropriate seconds markers are emphasized by lengthening, doubling, splitting, or tone modulation of the normal seconds markers, as stated in following pages.

Examples :

DUT1 = + 0.5 s



DUT1 = - 0.2 s



Other transmissions of DUT1 :

by voice announcement or in Morse Code.

Reference : CCIR Report 517, Geneva (1971).

AUTHORITIES RESPONSIBLE FOR THE TIME SIGNAL EMISSIONS

Signal	Authority
CHU	National Research Council, Time and Frequency Section Physics Division (M-36) **Ottawa K1A 0S1**, Ontario, Canada, Attn : Dr. C.C. Costain
DAM, DAN, DAO	Deutsches Hydrographisches Institut **2 Hamburg 4**, Federal Republic of Germany.
DCF77	Physikalisch-Technische Bundesanstalt, Laboratorium 1.22 **33 Braunschweig** Bundesallee 100, Federal Republic of Germany.
DGI	Amt für Standardisierung, Messwesen und Warenprüfung Fachabteilung Elektrizität Arbeitsgebiet Zeit und Frequenznormale **DDR 102 Berlin** Wallstrasse 16
DIZ	Central Earth Physics Institute Time Service DDR **15 Potsdam** Telegraphenberg A 17
FFH	Centre National d'Etudes des Télécommunications Groupement Etudes spatiales et Transmissions Département Dispositifs et Ensembles fonctionnels 38, rue du Général Leclerc **92130 Issy-les-Moulineaux**, France.
FTA91, FTH42 FTK77, FTN87	Observatoire de Paris, Service de l'Heure, 61, avenue de l'Observatoire, **75014 Paris**, France.
GBR MSF	National Physical Laboratory, Electrical Science Division **Teddington**, Middlesex, United Kingdom.
HBG	Service horaire HBG Observatoire Cantonal, CH - **2000 Neuchâtel**, Suisse.
IAM	Istituto Superiore Poste e Telecomunicazioni Viale di Trastevere, 189 00100 - **Roma**, Italy
IBF	Istituto Elettrotecnico Nazionale Galileo Ferraris Corso Massimo d'Azeglio, 42 10125 - **Torino**, Italy
JJY, JG2AE,	Frequency Standard Division The Radio Research Laboratories Ministry of Posts and Telecommunications Midori-cho, Koganei, **Tokyo 184**, Japon

Signal	Authority
LOL	Director Observatorio Naval Av. Costanera Sur, 2099 **Buenos Aires**, Republica Argentina.
LQB9, LQC20	Servicio internacional de la Hora Gral. Savio 865 Villa Maipú **San Martin**, Pcia. de Buenos Aires Republica Argentina.
NBA, NDT, NPG, NPM, NPN, NSS, NWC	Superintendant U.S. Naval Observatory **Washington**, D.C. 20390 U.S.A.
OLB5, OMA	1° - Time information : Astronomický Ústav ČSAV, Budečska 6, 120 23 **Praha 2**, Vinohrady, Czechoslovakia. 2° - Standard frequency information : Ústav radiotechniky a elektroniky ČSAV, Lumumbova 1, 180 88 **Praha 8**, Kobylisy, Czechoslovakia.
PPE, PPR	Serviço da Hora Observatorio Nacional Rua General Bruce, 586 **2000 Rio de Janeiro**. GB.ZC. -08, Brasil.
RAT, RCH, RES RID, RIM, RKM RWM	Comité d'Etat des Normes Conseil des Ministres de l'URSS **Moscou**, USSR, Leninski prosp., 9.
VNG	Time and Frequency Standards Section A.P.O. Research Laboratories 59 Little Collins Street **Melbourne**, VIC. 3000, Australia
WWV, WWVH WWVB	Frequency-Time Broadcast Services Section Time and Frequency Division National Bureau of Standards **Boulder**, Colorado 80302, U.S.A.
YVTO	Direccion de Hidrografia y Navegacion Observatorio Cagigal Apartado Postal N° 6745 **Caracas**, Venezuela
ZUO	National Physical Research Laboratory P.O. Box 395 **Pretoria** South Africa

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of the time signals
CHU	Ottawa Canada +45° 18' +75° 45'	3330 7335 14670	continuous	Second pulses of 300 cycles of a 1 kHz modulation. Minute pulses are 0.5 s long. A bilingual (Fr.-Eng.) announcement of time is made each minute. DUT1 : CCIR code by split pulses
DAM	Elmshorn Germany, F.R. +53° 46' - 9° 40'	8638.5 16980.4 4625 8638.5 6475.5 12763.5	11 h 55 m to 12 h 6 m 23 h 55 m to 24 h 6 m from 21 Sept. to 20 March 23 h 55 m to 24 h 6 m from 21 March to 20 Sept.	New international system, then second pulses from minutes 0.5 to 6.0 (minute pulses prolonged). A1 type. DUT1 : CCIR code by doubling, after minute pulses 1 to 5
DAN	Osterloog Germany, F.R. +53° 38' - 7° 12'	2614	11 h 55 m to 12 h 6 m 23 h 55 m to 24 h 6 m	As DAM (see above)
DAO	Kiel Germany, F.R. +54° 26' -10° 8'	2775	11 h 55 m to 12 h 6 m 23 h 55 m to 24 h 6 m	As DAM (see above)
DCF77	Mainflingen Germany, F.R. +50° 1' - 9° 0'	77.5	continuous, except second Tuesday of every month from 4 h to 8 h	The second marks are reduction to 1/4 of the carrier's amplitude of 0.1 s duration ; the reference point is the beginning of the pulse modulation. The second 59 marker is omitted DUT1 : CCIR code by lengthening to 0.2 s
DGI	Oranienburg Germ.Dem.Rep. +52° 48' -13° 24'	185	5 h 59 m 30 s to 6 h 00 m 11 h 59 m 30 s to 12 h 00 m 17 h 59 m 30 s to 18 h 00 m	A2 type second pulses of 0.1 s duration for seconds 30-40, 45-50, 55-60. The last pulse is prolonged.
DIZ (1) see p. C-12	Nauen Germ.Dem.Rep. +52° 39' -12° 55'	4525	continuous except from 8 h 15 m to 9 h 45 m for maintenance if necessary	A1 type second pulses of 0.1s duration. Minute pulses prolonged to 0.5 s. Hour pulses marked by prolonged pulses for seconds 58, 59, 60. DUT1 : CCIR code by double pulse
FFH	Chevannes France +48° 32' - 2° 27'	2500	continuous from 8 h to 16 h 25 except Saturday and Sunday.	Second pulses of 5 cycles of 1 kHz modulation. Minute pulses prolonged to 0.5 s. DTU1 : CCIR code by lengthening to 0.1 s.
FTA91	Saint-André-de-Corcy France +45° 55' - 4° 55'	91.15	at 8 h, 9 h, 9 h 30 m, 13 h, 20 h, 21 h, 22 h 30 m.	A1 type second pulses during the 5 minutes preceding the indicated times. Minute pulses are prolonged. DTU1 : in Morse code
FTH42 FTK77 FTN87	Pontoise France +49° 4' - 2° 7'	7428 10775 13873	at 9 h and 21 h at 8 h and 20 h at 9 h 30 m, 13 h, 22 h 30 m	A1 type second pulses during the 5 minutes preceding the indicated times. Minute pulses are prolonged. DUT1 : in Morse code.
GBR	Rugby United Kingdom +52° 22' + 1° 11'	16	at 3 h, 9 h, 15 h, 21 h	A1 type second pulses during the 5 minutes preceding the indicated times. DUT1 : CCIR code by double pulse

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of the time signals
HBG	Prangins Switzerland +46° 24' - 6° 15'	75	continuous	Interruption of the carrier at the beginning of each second, during 100 ms. The minutes are identified by a double pulse, the hours by a triple pulse. No transmission of DUT1
IAM	Rome Italy +41° 52' -12° 27'	5000	10 m every 15 m from 7 h 30 m to 8 h 30 m and from 13 h to 14 h except Sat. afternoon and Sun. Advanced by 1 hour in summer.	Second pulses of 5 cycles of 1 kHz modulation. Minute pulses of 20 cycles (Announcements and 1 kHz modulation, 5 m before the emission of time signals).
IBF	Torino Italy +45° 2' - 7° 42'	5000	During 15 m preceding 7 h, 9 h, 10 h, 11 h, 12 h, 13 h, 14 h, 15 h, 16 h, 17 h, 18 h. Advanced by 1 hour in summer.	Second pulses of 5 cycles of 1 kHz modulation. These pulses are repeated 7 times at the minute. Voice announcements at the beginning and end of each emission. DUT1 : CCIR code by double pulse.
JG2AE	Koganei Japan +35° 42' - 139° 31'	8000	from 20 h 59 m to 10 h 59 m.	Second pulses of 1600 Hz modulation. Minute pulses are preceded by a 600 Hz modulation. DUT1 : CCIR code by lengthening
JG2AS	Chiba Japan + 35° 38' -140° 4'	40	from 23 h 30 m to 8 h (exc. Sun.) and from 8 h to 23 h 30 on Monday. Interruptions during communications.	A1 type second pulses of 0.5 sec. duration. Second 59 is omitted. No DUT1 code.
JJY	Koganei Japan +35° 42' - 139° 31'	2500 5000 10000 15000	continuous, except interruptions between minutes 25 and 34.	Second pulses of 8 cycles of 1600 Hz modulation. Minute pulses are preceded by a 600 Hz modulation. DUT1 : CCIR code by lengthening
LOL1	Buenos-Aires Argentina -34° 37' + 58° 21'	5000 10000 15000	11 h to 12 h, 14 h to 15 h, 17 h to 18 h, 20 h to 21 h 23 h to 24 h	Second pulses of 5 cycles of 1000 Hz modulation. Second 59 is omitted. Announcement of hours and minutes every 5 minutes, followed by 3 m of 1000 Hz and 440 Hz modulation. DUT1 : CCIR code by lengthening
LOL2 LOL3	Buenos-Aires Argentina -34° 37' +58° 21'	8030 17180	1 h, 13 h, 21 h	A1 second pulses during the 5 minutes preceding the indicated times. Minute pulses are prolonged. DUT1 : CCIR code by lengthening
LQB9 LQC20	Planta Gral Pacheco -34° 26' +58° 37'	8167.5 17551.5	22 h 5 m, 23 h 50 m 10 h 5 m, 11 h 50 m	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. DUT1 : CCIR code by omission of second markers
MSF	Rugby United Kingdom +52° 22' + 1° 11'	60	continuous except for an interruption for maintenance from 10 h 0 m to 14 h 0 m on the first Tuesday in each month	Interruptions of the carrier of 100 ms for the second pulses, of 500 ms for the minute pulses. The signal is given by the beginning of the interruption. DUT1 : CCIR code by double pulse

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of the time signals
MSF	Rugby United Kingdom +52° 22' + 1° 11'	2500 5000 10000	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. DUT1 : CCIR code by double pulse
NBA	Balboa USA + 9° 3' +79° 39'	24 :147.85 5448.5 11080 17697.5	Every even hour except 24 h and during Monday maintenance (12 h to 18 h) 5 h, 11 h, 17 h, 23 h	Experimental FSK second pulses on 24 kHz. See (2), p. C-12. CW second pulses during the 5 minutes preceding the indicated times on the American Code time format. DUT1 : by Morse Code, each minute between seconds 56 and 59
NDT	Yosami Japan +34° 58' - 137° 1'	17.4	to be determined	To be determined
NPG	San Francisco USA + 38° 22' +121° 46'	3268 6428.5 9277.5 12966	6 h, 12 h, 18 h, 24 h	CW second pulses during 5 minutes preceding the indicated times on the American Code time format DUT1 : by Morse Code, each minute between seconds 56 and 59
NPM	Honolulu USA +21° 25' +158° 9'	4525 9050 13655 16457.5 22593	6 h, 12 h, 18 h, 24 h	CW second pulses during 5 minutes preceding the indicated times on the American Code time format DUT1 : by Morse Code, each minute between seconds 56 and 59
NPN	Guam USA + 13° 30' - 144° 48'	4955 8150 13380 21760	6 h, 12 h, 18 h, 24 h	CW second pulses during 5 minutes preceding the indicated times on the American Code time format DUT1 : by Morse Code, each minute between seconds 56 and 59
NSS	Annapolis USA +38° 59' +76° 27'	21.4 88 5870 8090 12135 16180 20225 25590	 5 h, 11 h, 17 h, 23 h (on Tuesday 17 h the frequency 134.9 kHz replaces 88 kHz) 17 h, 23 h	Experimental FSK second pulses on 21.4 kHz when transmissions resume. See (2) p. C-12. CW second pulses during 5 minutes preceding the indicated times on the American Code time format. DUT1 : by Morse Code, each minute between seconds 56 and 59

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of the time signals
NWC	Exmouth Australia - 21° 49' -114° 9'	22.3	Keyed from 28 to 30 minutes after every other even hour beginning 0 h UT	Experimental FSK second pulses during the indicated times on the American Code time format. DUT1 : by Morse Code, between seconds 56 and 58. See(1) p. C-12
OLB5	Podebrady Czechoslovakia + 50° 9' - 15° 8'	3170	continuous except from 5 h to 11 h on the first Wednesday of every month	A1 type, second pulses No transmission of DUT1
OMA	Liblice Czechoslovakia + 50° 4' - 14° 53'	50	continuous except from 5 h to 11 h on the first Wednesday of every month	Interruption of the carrier of 100 ms at the beginning of every second, of 500 ms at the beginning of every minute. The precise time is given by the beginning of the interruption.
		2500	between minutes 5 and 15 25 and 30, 35 and 40, 50 and 60 of every hour except from 5 h to 11 h on the first Wednesday of every month	Pulses of 5 cycles of 1 kHz modulation (prolonged for the minutes). The first pulse of the 5th minute is prolonged to 500 cycles. No transmission of DUT1.
PPE	Rio de Janeiro Brasil - 22° 54' + 43° 13'	8721	0 h 30 m, 11 h 30 m, 13 h 30 m, 19 h 30 m, 20 h 30 m, 23 h 30 m	Second ticks, of A1 type, during the five minutes preceding the indicated hours. The minute ticks are longer DUT1 : CCIR Code by double pulse.
PPR	Rio de Janeiro Brasil - 22° 59' + 43° 11'	435 8634 13105 17194.4	01 h 30 m, 14 h 30 m, 21 h 30 m	Second ticks, of A1 type, during the five minutes preceding the indicated hours. The minute ticks are longer
RAT (3) see p. C-12	Moscow USSR + 55° 19' - 38° 41'	2500	between minutes 30 and 35, 41 and 45, 50 and 60 from 17 h 50 m to 24 h	Second pulses* at the beginning of the minute are prolonged to 0.5 s.
		5000	between minutes 30 and 35, 41 and 45, 50 and 60 from 1 h 30 m to 17 h	DUT1 + dUT1 by Morse Code each hour between minutes 11 and 12.
RBU (3)	Moscow USSR + 55° 19' - 38° 41'	$66\frac{2}{3}$	between minutes 0 and 5 from 0 h to 22 h 5 m	A1 type. Second pulses*. The pulses at beginning of the minute are prolonged to 0.5 s. DUT1 + dUT1 : by Morse Code each hour between minutes 6 and 7.

* The information about the value and the sign of the DUT1 + dUT1 difference is transmitted after each minute signal by the marking of the corresponding second signals by additional impulses. It addition, in is transmitted in Morse Code as indicated.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of the time signals
RCH (3) see p. C-12	Tashkent USSR + 41° 19' - 69° 15'	2500	between minutes 15 and 20; 25 and 30, 35 and 40, 45 and 50 from 0 h to 3 h 50 m from 5 h 35 m to 9 h 30 m from 10 h 15 m to 13 h 30 m from 14 h 15 m to 24 h	Second pulses*. The pulses at the beginning of the minute are prolonged to 0.5 s. DUT1 + dUT1 : by Morse Code each hour between minutes 51 and 52.
RID (3)	Irkutsk USSR + 52° 46' - 103° 39'	5004	between minutes 5 and 10, 15 and 20, 25 and 30, 51 and 60 from 0 h to 1 h 10 m from 13 h 51 m to 24 h	Second pulses*. The pulses at the beginning of the minute are prolonged to 0.5 s. DUT1 + dUT1 : by Morse Code each hour between minutes 31 and 32.
		10004	between minutes 5 and 10, 15 and 20, 25 and 30, 51 and 60 from 1 h 51 m to 13 h 10 m	
RIM (3)	Tashkent USSR + 41° 19' - 69° 15'	5000	between minutes 15 and 20, 25 and 30, 35 and 40, 45 and 50 from 0 h to 1 h 30 m from 2 h 15 m to 3 h 50 m from 18 h 15 m to 24 h	Second pulses*. The pulses at the beginning of the minute are prolonged to 0.5 s. DUT1 + dUT1 : by Morse Code each hour between minutes 51 and 52.
		10000	between minutes 15 and 20, 25 and 30, 35 and 40, 45 and 50 from 5 h 35 m to 9 h 30 m from 10 h 15 m to 13 h 30 m from 14 h 15 m to 17 h 30 m	
RKM (3)	Irkutsk USSR + 52° 46' - 103° 39'	10004	between minutes 5 and 10, 15 and 20, 25 and 30, 51 and 60 from 0 h to 1 h 10 m, from 13 h 51 m to 24 h	Second pulses*. The pulses at the beginning of the minute are prolonged to 0.5 s. DUT1 + dUT1 : by Morse Code each hour between minutes 31 and 32.
		15004	between minutes 5 and 10, 15 and 20, 25 and 30, 51 and 60 from 1 h 51 to 13 h 10 m	

* The information about the value and the sign of the DUT1 + dUT1 difference is transmitted after each minute signal by the marking of the corresponding second signals by additional impulses. It addition, in is transmitted in Morse Code as indicated.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of the time signals
RTA (3) see p.C-12	Novossibirsk USSR + 55° 04' - 82° 58'	4996	between minutes 5 and 10, 15 and 20, 25 and 29, 35 and 39 from 0 h to 1 h 29 m from 18 h 5 m to 24 h	Second pulses*. The pulses at the beginning of the minute are prolonged. DUT1 + dUT1 : by Morse Code each hour between minutes 45 and 46.
		9996	between minutes 5 and 10, 15 and 20, 25 and 29, 35 and 39 from 3 h 5 m to 4 h 39 from 14 h 5 m to 17 h 29 m	
		14996	between minutes 5 and 10, 15 and 20, 25 and 29, 35 and 39 from 5 h 35 m to 9 h 29 m from 10 h 5 m to 13 h 29 m	
RWM (3)	Moscow USSR + 55° 19' - 38° 41'	10000	between minutes 30 and 35, 41 and 45, 50 and 60 from 1 h 30 m to 3 h from 17 h 50 m to 24 h	Second pulses*. The pulses at the beginning of the minute are prolonged to 0.5 s. DUT1 + dUT1 : by Morse Code each hour between minutes 11 and 12.
		15000	between minutes 30 and 35, 41 and 45, 50 and 60 from 3 h 50 m to 17 h	
RTZ (3)	Irkutsk USSR + 52° 18' - 104° 18'	50	between minutes 0 and 5 from 0 h to 22 h 5 m	A1 type second pulses*. The pulses at the beginning of the minute are prolonged. DUT1 + dUT1 : by Morse Code each hour between minutes 6 and 7.
VNG	Lyndhurst Australia - 38° 3' -145° 16'	4500 7500 12000	9 h 45 m to 21 h 30 m continuous except 22 h 30 m to 22 h 45 m 21 h 45 m to 9 h 30 m	Seconds markers of 50 cycles of 1 kHz modulation ; 5 cycles only for seconds markers 55 to 58 ; seconds marker 59 is omitted ; 500 cycles for minute markers. During the 5th, 10th, 15th, etc... minutes, 5 cycles for seconds 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 seconds markers.

* The information about the value and the sign of the DUT1 + dUT1 difference is transmitted after each minute signal by the marking of the corresponding second signals by additional impulses. It addition, in is transmitted in Morse Code as indicated.

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of the time signals
WWV	Fort-Collins USA + 40° 41' +105° 2'	2500 5000 10000 15000 20000 25000	continuous	Pulses of 5 cycles of 1 kHz modulation. 59th and 29th second pulse omitted. Hour is identified by 0.8 second long, 1500 Hz tone. Beginning of each minute identified by 0.8 second long, 1000 Hz tone. DUT1 : CCIR code by double pulse. Additional information on corrections
WWVB	Fort Collins USA + 40° 40' +105° 3'	60	continuous	Second pulses given by reduction of the amplitude of the carrier. Coded announcement of the date and time and of the correction to obtain UT1. No CCIR code.
WWVH	Kauai USA + 21° 59' +159° 46'	2500 5000 10000 15000 20000	continuous	Pulses of 6 cycles of 1200 Hz modulation. 59th and 29th seconds pulse omitted. Hour identified by 0.8 second long 1500 Hz tone. Beginning of each minute identified by 0.8 second long, 1200 Hz tone. DUT1 : CCIR code by double pulse. Additional information on UT1 corrections.
YVTO	Caracas Venezuela + 10° 30' + 66° 56'	6100	12 h to 20 h 0 h 30 m to 1 h 30 m	Second pulses of 1 kHz modulation with 0.1 s duration. The minute is identified by a 800 Hz tone and a 0.5 s duration Between seconds 52 and 57 of each minute, voice announcement of hour, minute and second.
ZUO	Olifantsfontein South Africa - 25° 58' - 28° 14'	2500 5000 100000	18 h to 4 h continuous continuous	Pulses of 5 cycles of 1 kHz modulation. Second 0 is prolonged. DUT1 : CCIR code by lengthening

OTHER TIME SIGNALS

BPV, XSG, Shanghaï, China, P.R.
Latitude : + 31° 12', longitude : -121° 26'.
Characteristics and schedule not known.
For some emissions, see the time of emission, p. C-14 and C-15.

Notes on the characteristics of time signals

(1) DIZ is emitted in accordance with the CCIR code. Furthermore an additional information dUT1 specifies more precisely the difference UT1 - UTC down to multiples of 0.02 s, the total value of the correction being DUT1 + dUT1. Positive values of dUT1 are transmitted by doubling p consecutive second makers of seconds 21 to 25 of every minute, beginning with second 21, so that dUT1 = + (p × 0.02) s. Negative values of dUT1 are transmitted by doubling q consecutive second markers of seconds 31 to 35 of every minute, beginning with second 31, so that dUT1 = -(q × 0.02) s. When dUT1 = 0, the marker of second 40 is doubled.

(2) NBA, NSS, NWC - Several U.S. Naval VLF stations transmit time signals on an experimental FSK format (NWC, NBA, NSS).

Both frequencies, MARK (assigned frequency) and SPACE (plus 50 Hz), are phase stabilized.

50 baud frequency shift keying will be employed with bit lengths of 20 ms.

Transition between frequencies will require approximately 2 ms.

The time of the halfway point of the transition will be maintained within ±10 μs of the station clock.

This point will also be identical with the phase coincident point between the two carriers.

The zero crossing of the positive slope of the assigned carrier cycle will be controlled in time to ± 1 μs of the station clock.

The one second pulses for the American Code will consist of 300 ms of 20 ms reversals followed by 700 ms of steady signal of the assigned carrier cycle + 50 Hz (SPACE). The beginning of the second will occur at the half transition point at the start of the reversals (SPACE ⟶ MARK).

(3) 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 0.02 s, the total value of the correction being DUT1+dUT1. Positive values of dUT1 are transmitted by the marking of p second markers within the range between the 20th and 25th second so that dUT1 = +0.02 s × p. Negative values of DUT1 are transmitted by the marking of q second markers within the range between the 35th and the 40th second, so that dUT1 = -0.02 s × q.

Time of emission of the time-signals in 1972

Unless otherwise stated, the values of UTC-signal are valid for the whole year 1972. The asterisk * denotes that the error is less than 0.0002 s.

Signal	UTC-Signal (unit : 0.0001 s)	Remarks
CHU	−3* then 0*	−3* until the end of March
DAM, DAN, DAO	0*	− 1000 on Oct. 25
DCF77	0*	
DGI	+3* then 0*	+ 3* until the end of May
DIZ	0*	
FFH	0*	
FTA91	0	
FTH42, FTK77, FTN87	0*	
GBR	+ 1	Replaced by GBZ from April 9 to July 31.
GBZ	− 3	from April 9 to June 30
	+ 1	for July
HBG	0*	
IAM	0	
IBF	0	
JJY	0*	
LOL (all emissions)	− 2	
LQB9	+ 9	
LQC20	+ 5	
MSF	+2* then + 1*	+2* until the end of May
NSS(h f)	+ 2	
OLB5	+ 8*	
OMA	0*	
PPE	−3 then +20	+20 for Nov. and Dec.
RWM (and other t.s. from USSR)	0	
VNG	0	
WWV, WWVB, WWVH	0*	
ZUO	0	

Time of emission of BPV on 9351 kHz, 13h UT.

The missing data can be interpolated, except when a step adjustment occurs (marked by — in the following table).

Date	1972 Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	UTC - BPV (9351 kHz) (unit : 0.0001s)											
1	+ 638	+1420	+2357	+3323		+5267	-3460*	-2785	-1964	-1069	- 8	+ 916
2	666	1444	2385	3338	+4264	5302	3429	2761		1032	+ 21	947
3	691	1466	2411	3373	4295	5338	3401	2738	1900	995	58	975
4	721	1498	2443	3410	4328	5372	3371	2711	1873	969	95	1011
5	745	1523	2463	3440	4360	5406	3341	2687	1837	928	130	1042
6	770	1550	2499		4391	5444	3312	2657	1799	901		1071
7	794	1579	2530	3510	4434	5478	3282	2634	1770	869	200	1105
8	823	1605	2565		4452	5516	3257	-	-	833	240	1136
9		1628		3562	4479	5553	3219	2580	1701	800	270	1168
10	880	1658	2612		4520	5589	3190	2558	1664	762	302	1197
11	850	1749	2656	3638	4551	5627	3308	2549	1635	754	313	1231
12	877	1772	2679	3667	4584	5662	3282	2513	1602	726	346	1265
13	906	1801	2707	3700	4614	5695	3249	2490	1567	677	384	1294
14		1827		3732	4654	5732	3220	2465	1536	653	419	1329
15	951	1852		3763	4686		3198	2443	1506	618	453	1360
16	983	1879		3790	4719	5800	3169	2415	1468	575	486	1382
17	1012	1910	2832	3828	4754	5831	3141	2397	1421	542	522	1428
18	1036	1942		3858	4787	5868	3112	2371	1403	503	560	1454
19	1060	1965	2897	3883	4819	5911		2348	1372	466	588	1487
20	1091	2005	2924	3919	4852	5932	3059	2319	1345	433	629	1522
21	1121	2091	2949	3959	4888	5975	3031	2296	1374	395	664	1552
22	1148	2126	2973	3972	4922	6007	3000	2263	1366	365	697	1584
23	1179	2148	3010	3996	4953		2971	2235	1340	330	731	1611
24	1203	2183	3052		4984	6080	2942	2203	1299	292	770	1654
25		2216	3084	4065	5018	6119	2911	2182	1269	256	802	1676
26	1253	2238			5061	6154	2881	2137	1235	225	839	1708
27	1284	2265		4115	5092	6196	2845	2114	1200	191	870	1741
28	1309	2305	3182	4148		6234	2818	2083	1164	156	908	1766
29	1339	2326	3215	4176	5160	6270	2788	2054	1134	120	939	1802
30	1366		3252	4200	5191	6306	2757	2024	1095	85	971	1831
31	1393				5227		2710	1994		53		1865

* UTC was retarded by 1s on 1972 July 1st, 0^h UTC. There was probably a step adjustment of BPV on the 30th of June 1972.

Time of emission of BPV on 10000 and 15000 kHz, 0h UT

Date	UTC-BPV (0.0001 s)	Date	UTC-BPV (0.0001 s)
1972 Jan. 3	+ 810	1972 July 1	-3463
8	+ 936	6	-3310
13	+1064	11	-3172
18	+1195	16	-
23	+1323	21	-
28	+1449	26	-2878
Feb. 2	+1576	31	-2800
7	+1706	Aug. 5	-
12	+1832	10	-2563
17	+1958	15	-2448
22	+2083	20	-2333
27	+2204	25	-2180
March 3	+2337	30	-2041
8	+2468	Sept. 4	-1872
13	+2602	9	-
18	+2722	14	-
23	+2852	19	-1386
28	+2991	24	-1318
April 2	+3102	29	-
7	+3234	Oct. 4	-
12	+3360	9	-
17	+3487	14	-
22	+3609	19	- 486
27	+3746	24	- 306
May 2	+3860	29	- 138
7	+3988	Nov. 3	+ 43
12	+4119	8	+ 223
17	+4253	13	+ 368
22	+4377	18	+ 544
27	+4506	23	+ 711
June 1	+4638	28	+ 900
6	+4773	Dec. 3	+ 967
11	-	8	+1121
16	-	13	+1287
21	+5159	18	+1441
26	+5288*	23	+1600
		28	+1756

* UTC was retarded by 1 s on 1972 July 1st, 0h UTC.