JAWL/TM.98 Sèvres, 14 September 2000

15th BIPM TWSTFT Monthly Report

To: TWSTFT Participating Stations

Copy:

Prof. J. Kovalevsky, President of the CIPM
Prof. S. Leschiutta, President of the CCTF
Dr W.J. Klepczynski, Chairman of the CCTF WG on TWSTFT
Dr T. J. Quinn, Director of the BIPM

Dear Colleagues,

Introduction of NPL/PTB TWSTFT link into TAI

As announced previously, following the recommendations of the last CCTF meeting and the meeting of the CCTF WG on TWSTFT at the USNO on 13 and 14 December 1999, a new TWSTFT link NPL/PTB has been introduced into the computation of TAI from July 2000.

The following TWSTFT links are currently used in the construction of TAI: USNO/NPL, VSL/PTB and NPL/PTB. The corresponding GPS C/A-code common-view links are also computed and stored as back-up data. For the NIST/PTB link, the GPS data are used for the computation of TAI, and the corresponding TWSTFT data are stored as back-up.

For this report some selected TWSTFT links through INTELSAT 307° E are computed and compared with GPS C/A-code common-view data at the time of preparation of *Circular T*. We also introduce to this report the PTB/OCA link, including its data since 2 December 1999.

We have added two new sections to our report, the new format of which is as follows:

Section I: Results of the computation for eight time links are given in Tables 1 to 8. Plots showing the differences between the TWSTFT results and the GPS results are given in Figures 1 to 8. In order to compare easily the various plots, the same scale has been used for all, i.e. *y*-axis with an amplitude of 30 ns and *x*-axis spanning Modified Julian Dates 51500–51800.

Section II: Frequency stabilities of the TWSTFT and GPS CV links reported in Appendix I.

Section III: A brief description of the hardware equipment of the participating laboratories.

Section IV: Summary of the international time links.

Please note that the BIPM TWSTFT Monthly Reports are available by ftp (62.161.69.5, see the directory /Publication/), and are also accessible via the BIPM web site (www.bipm.org, see Scientific Work of the Time Section). Computer-readable data for all the TWSTFT links published in these monthly reports are available from the same address.

We will be pleased to receive your comments on this report.

Hoping to see you at the TWSTFT Participating Stations meeting at the BIPM on 5-6 October 2000,

Sincerely Yours,

Jacques Azoubib and Włodzimierz Lewandowski

Section I

Comparison of TWSTFT and GPS CV links computed at the BIPM

- TWSTFT links

Because the TWSTFT data are unevenly spaced by intervals of 2 or 3 days, they are linearly interpolated to give the data for the TAI standard dates at intervals of 5 days.

When TWSTFT sessions are missing and data are interpolated between TWSTFT sessions more than 5 days apart, results are printed in bold characters. The upper limit for interpolation is 10 days.

- GPS C/A-code common-view links

GPS C/A-code common-view links are computed using IGS precise ephemerides and IGS ionosphere maps.

Table 1. PTB/NIST link

Date 2000 (MJD)	[*UTC(PTB) – UTC(NIST)*] /ns		TWSTFT – GPS
	TWSTFT	GPS (*Circular T*)	
4 July (51729)	34	29	5
9 July (51734)	34	31	3
14 July (51739)	34	31	3
19 July (51744)	36	33	3
24 July (51749)	39	33	6
29 July (51754)	42	38	4

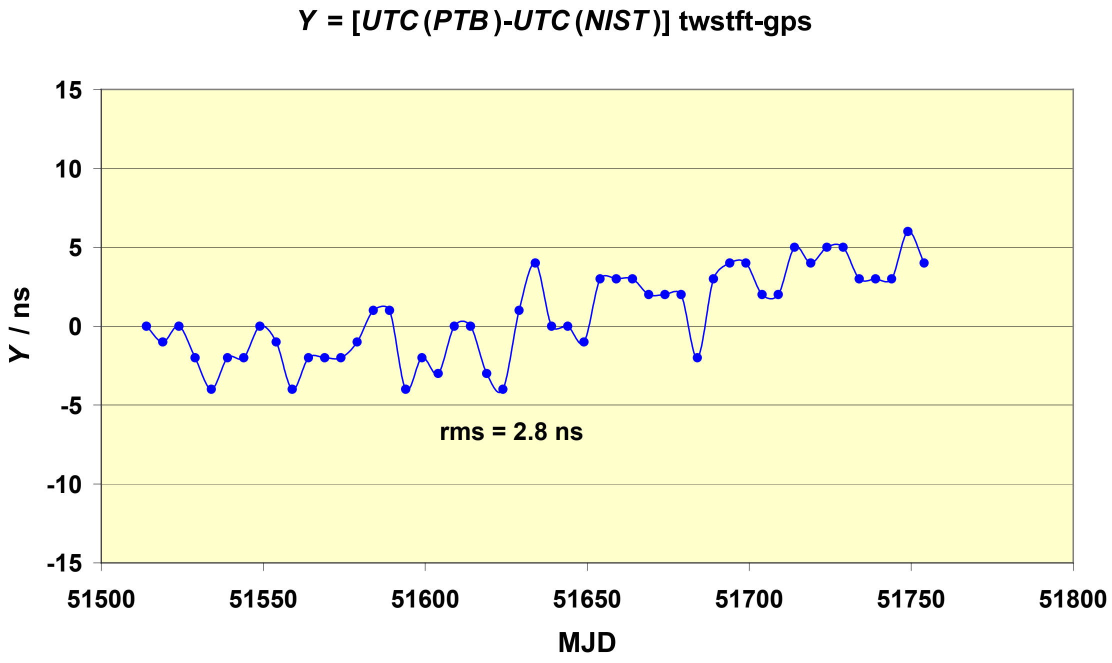

Figure 1. Differences between TWSTFT and GPS C/A-code common-view for PTB/NIST link

Notes: A new calibration of the PTB/NIST TWSTFT link derived from *Circular T* after July 1999 was applied starting from 29 November 1999 (MJD = 51511).

The PTB/NIST GPS C/A-code common-view link has been included in the computation of TAI since 1 January 2000 (MJD = 51544). The TWSTFT link between the NIST and the PTB computed in parallel is considered as back-up link and its data is kept in reserve.

Table 2. USNO/NPL link

Date 2000 (MJD)	[*UTC(USNO) – UTC(NPL)*] /ns		TWSTFT – GPS
	TWSTFT (*Circular T*)	GPS	
4 July (51729)	4	12	–8
9 July (51734)	5	11	–6
14 July (51739)	4	9	–5
19 July (51744)	2	8	–6
24 July (51749)	2	12	–10
29 July (51754)	3	8	–5

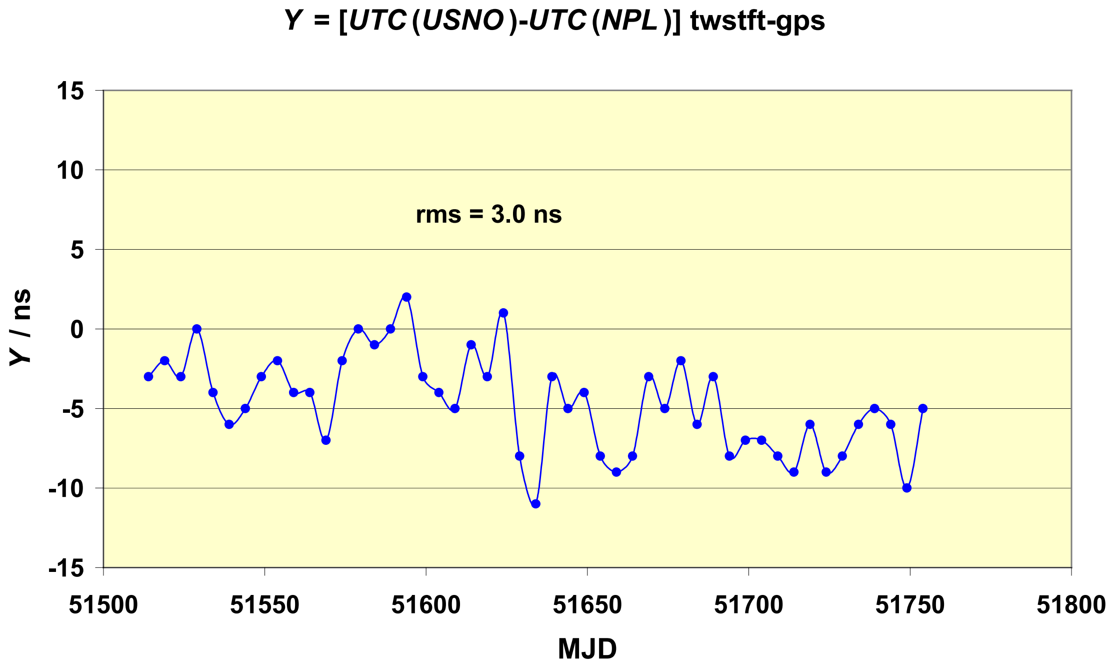

Figure 2. Differences between TWSTFT and GPS C/A-code common-view for USNO/NPL link

Notes: A new calibration of the USNO/NPL TWSTFT link derived from *Circular T* after June 1999 was applied starting from 29 November 1999 (MJD = 51511).

The USNO/NPL TWSTFT link has been included in the computation of TAI since 1 January 2000 (MJD = 51544).

Table 3. USNO/PTB link

Date 2000 (MJD)	[*UTC(USNO) – UTC(PTB)*] /ns		TWSTFT– GPS
	TWSTFT	GPS	
4 July (51729)	–11	1	–12
9 July (51734)	–12	–1	–11
14 July (51739)	–12	–3	–9
19 July (51744)	–14	–5	–9
24 July (51749)	–18	–4	–14
29 July (51754)	–19	–12	–7

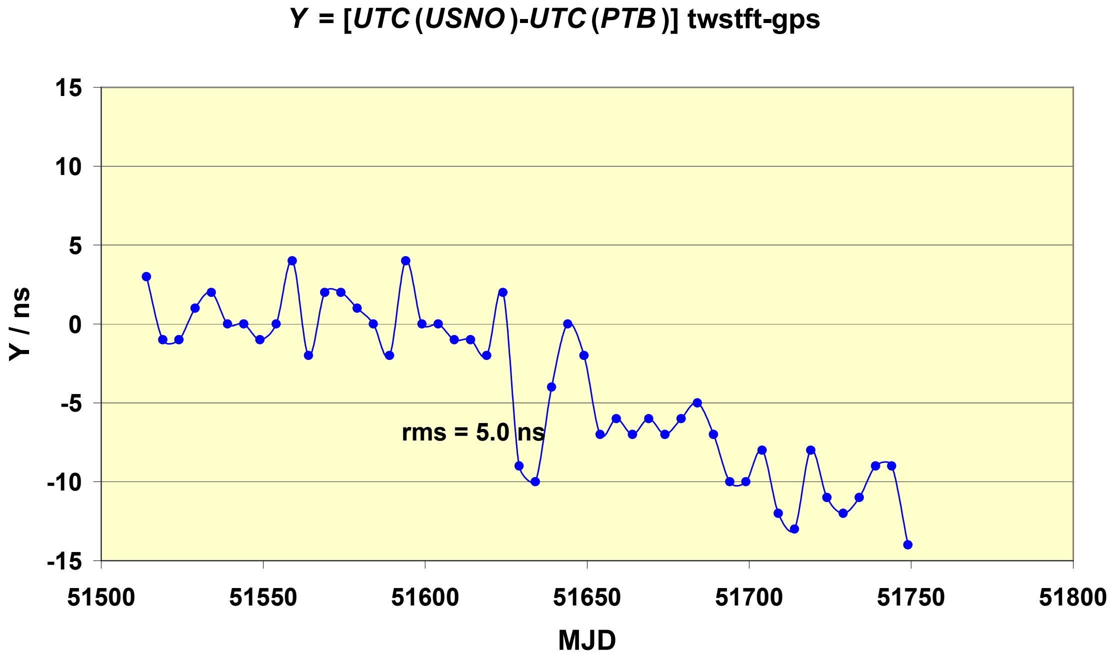

Table 3. Differences between TWSTFT and GPS C/A-code common-view for USNO/PTB link

Note: A calibration of the USNO/PTB TWSTFT link derived from *Circular T* values from July 1999 was applied starting from 29 November 1999 (MJD = 51511).

Table 4. VSL/PTB link

Date 2000 (MJD)	[*UTC(VSL)* – *UTC(PTB)*] /ns		TWSTFT – GPS
	TWSTFT (*Circular T*)	GPS	
4 July (51729)	**0**	–1	1
9 July (51734)	**–3**	–8	5
14 July (51739)	**–6**	–6	0
19 July (51744)	**–10**	–8	–2
24 July (51749)	–18	–19	1
29 July (51754)	–24	–29	5

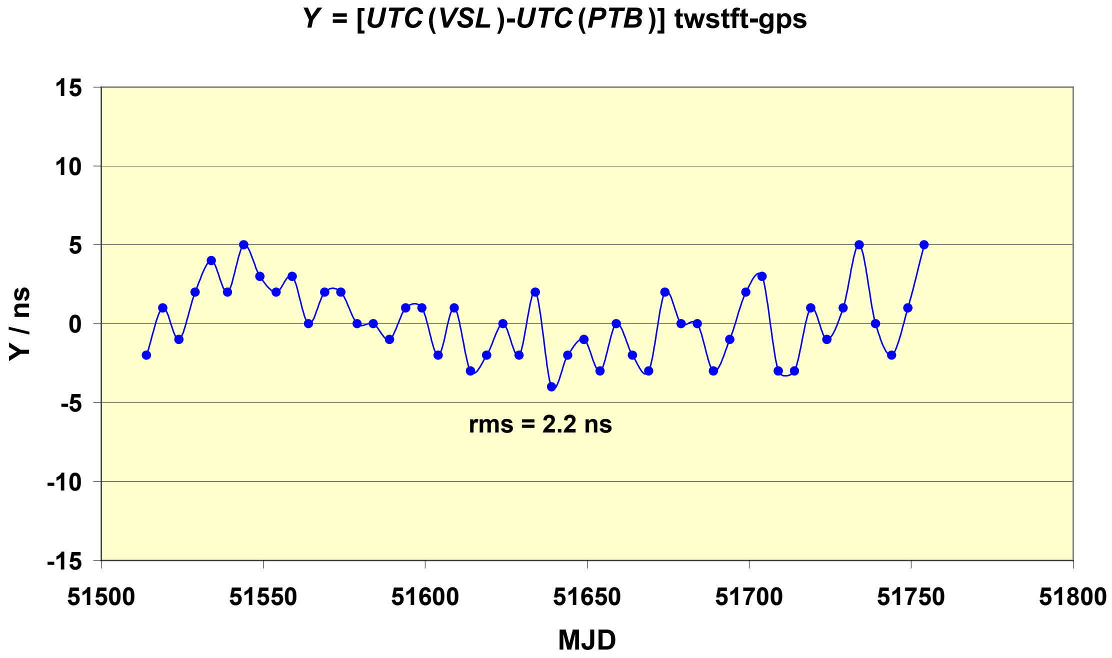

Figure 4. Differences between TWSTFT and GPS C/A-code common-view for VSL/PTB link

Notes: The VSL/PTB TWSTFT link was calibrated by Circular *T*.

The VSL/PTB TWSTFT link has been included in the computation of TAI since 1 January 2000 (MJD = 51544).

Table 5. NPL/NIST link

Date 2000 (MJD)	[*UTC(NPL) – UTC(NIST)*] /ns		TWSTFT – GPS
	TWSTFT	GPS	
4 July (51729)	17	19	–2
9 July (51734)	18	19	–1
14 July (51739)	17	21	–4
19 July (51744)	19	21	–2
24 July (51749)	18	19	–1
29 July (51754)	19	20	–1

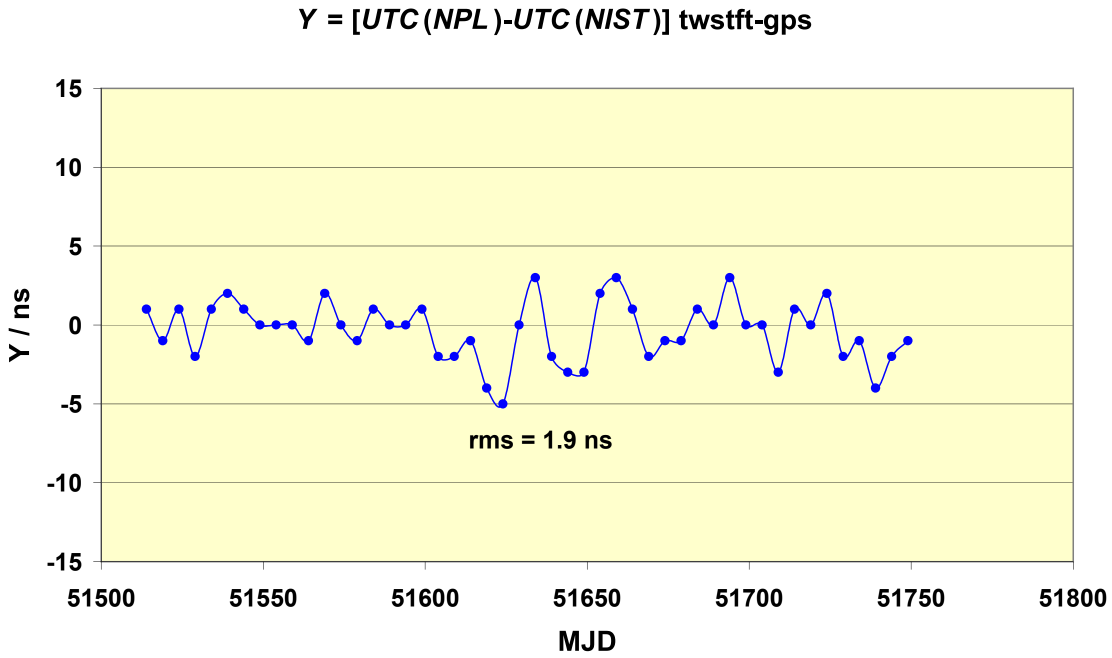

Figure 5. Differences between TWSTFT and GPS C/A-code common-view for NPL/NIST link

Note: The NPL/NIST TWSTFT link was calibrated using *Circular T* values dating from July 1999, and the calibration value was applied at the beginning of September 1999 (MJD = 51429).

Table 6. NPL/PTB link

Date 2000 (MJD)	[*UTC(NPL) – UTC(PTB)*] /ns		TWSTFT – GPS
	TWSTFT (*Circular T*)	GPS	
4 July (51729)	–16	–12	–4
9 July (51734)	–15	–12	–3
14 July (51739)	–16	–12	–4
19 July (51744)	–16	–13	–3
24 July (51749)	–20	–16	–4
29 July (51754)	–22	–18	–4

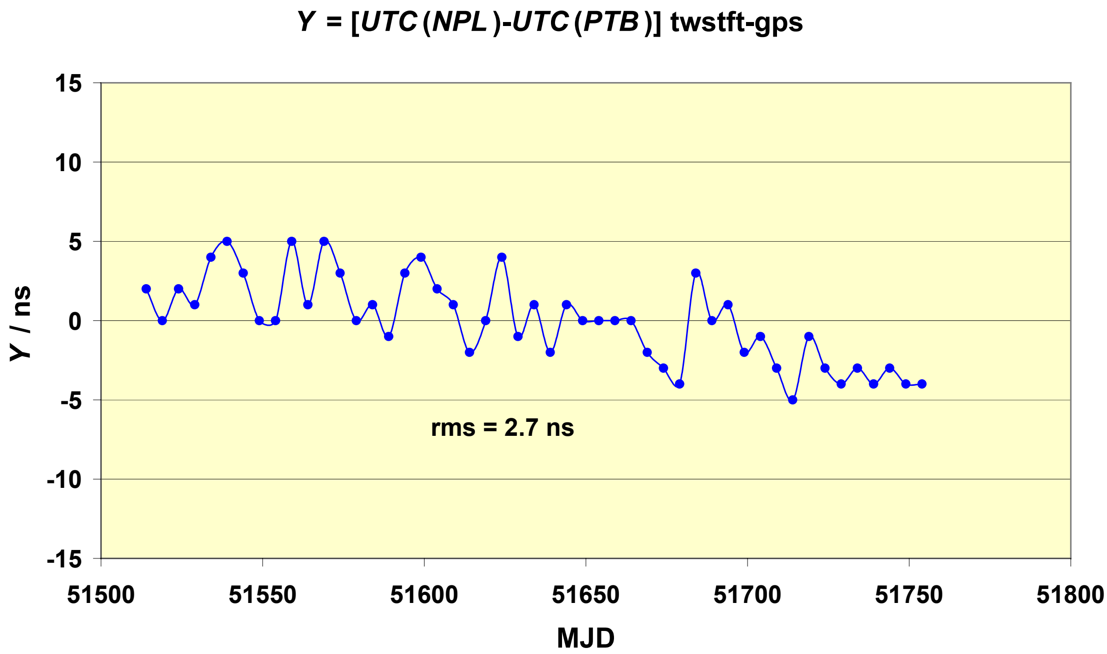

Figure 6. Differences between TWSTFT and GPS C/A-code common-view for NPL/PTB link

Notes: A new calibration of the NPL/PTB TWSTFT link using *Circular T* was applied on 29 November 1999 (MJD = 51511).

The NPL/PTB TWSTFT link has been included in the computation of TAI since 4 July 2000 (MJD = 51729).

Table 7. NPL/VSL link

Date 2000 (MJD)	[*UTC(NPL) – UTC(VSL)*] /ns		TWSTFT – GPS
	TWSTFT	GPS	
4 July (51729)	–16	–10	–6
9 July (51734)	–10	–4	–6
14 July (51739)	–13	–6	–7
19 July (51744)	–8	–5	–3
24 July (51749)	–3	3	–6
29 July (51754)	4	10	–6

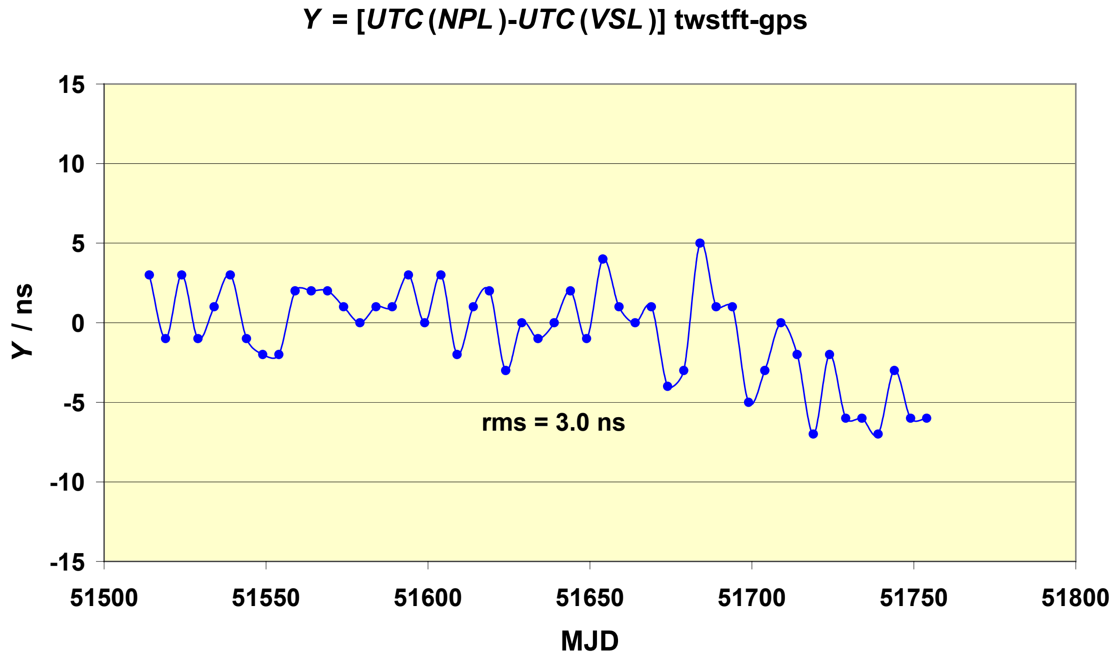

Figure 7. Differences between TWSTFT and GPS C/A-code common-view for NPL/VSL link

Note: A new calibration of the NPL/VSL TWSTFT link using *Circular T* was applied on 29 November 1999 (MJD = 51511).

Table 8. PTB/OCA link

Date 1999/2000 (MJD)	[*UTC(PTB) – OCA clock*] /ns		TWSTFT – GPS
	TWSTFT	GPS	
2 December (51514)	767	560	207
7 December (51519)	**864**	653	211
12 December (51524)	958	747	211
17 December (51529)	**1054**	846	208
22 December (51534)	**1149**	942	207
27 December (51539)	**1243**	1034	209
1 January (51544)	**1336**	1128	208
6 January (51549)	**1430**	1218	212
11 January (51554)	1528	1316	212
16 January (51559)	1630	1416	214
21 January (51564)	1732	1522	210
26 January (51569)	**1833**	1613	220
31 January (51574)	**1935**	1703	232
5 February (51579)	**2037**	1806	231
10 February (51584)	2141	1929	212
15 February (51589)	2270	2052	218
20 February (51594)	2395	2187	208
25 February (51599)	2519	2305	214
1 March (51604)	2646	2436	210
6 March (51609)	2755	2542	213
11 March (51614)	2866	2648	218
16 March (51619)	2984	2765	219
21 March (51624)		2880	
26 March (51629)	–2552	–2763	211
31 March (51634)	–2428	–2644	216
5 April (51639)	–2306	–2521	215
10 April (51644)	–2184	–2398	214
15 April (51649)	–2069	–2282	213
20 April (51654)	**–1944**	–2159	215
25 April (51659)	**–1825**	–2040	215
30 April (51664)	**–1708**	–1919	211
5 May (51669)	**–1588**	–1802	214
10 May (51674)	**–1459**	–1671	212
15 May (51679)	–1334	–1540	206
20 May (51684)	–1217	–1420	203
25 May (51689)	–1088	–1299	211
30 May (51694)	–970	–1175	205
4 June (51699)	**–856**	–1066	210
9 June (51704)	–741	–950	209
14 June (51709)	–628	–834	206
19 June (51714)	–504	–715	211
24 June (51719)	**–384**	–593	209
29 June (51724)		–464	

Table 8. PTB/OCA link (cont.)

Date 2000 (MJD)	[*UTC(PTB) – OCA clock*] /ns		TWSTFT – GPS
	TWSTFT	GPS	
4 July (51729)	**–151**	–372	221
9 July (51734)	–47	–269	222
14 July (51739)	55	–155	210
19 July (51744)	**173**	–43	216
24 July (51749)	**294**	77	217
29 July (51754)	413	196	217

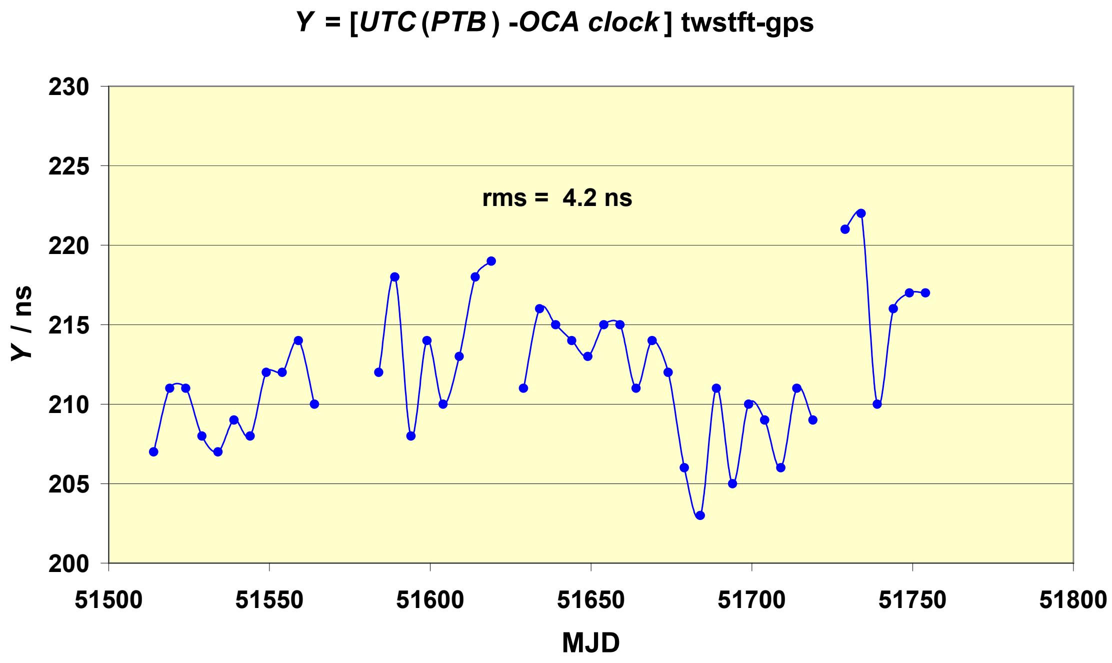

Figure 8. Differences between TWSTFT and GPS C/A-code common-view for PTB/OCA link

Section II

Frequency stability of the
TWSTFT and GPS CV links
reported in Appendix I

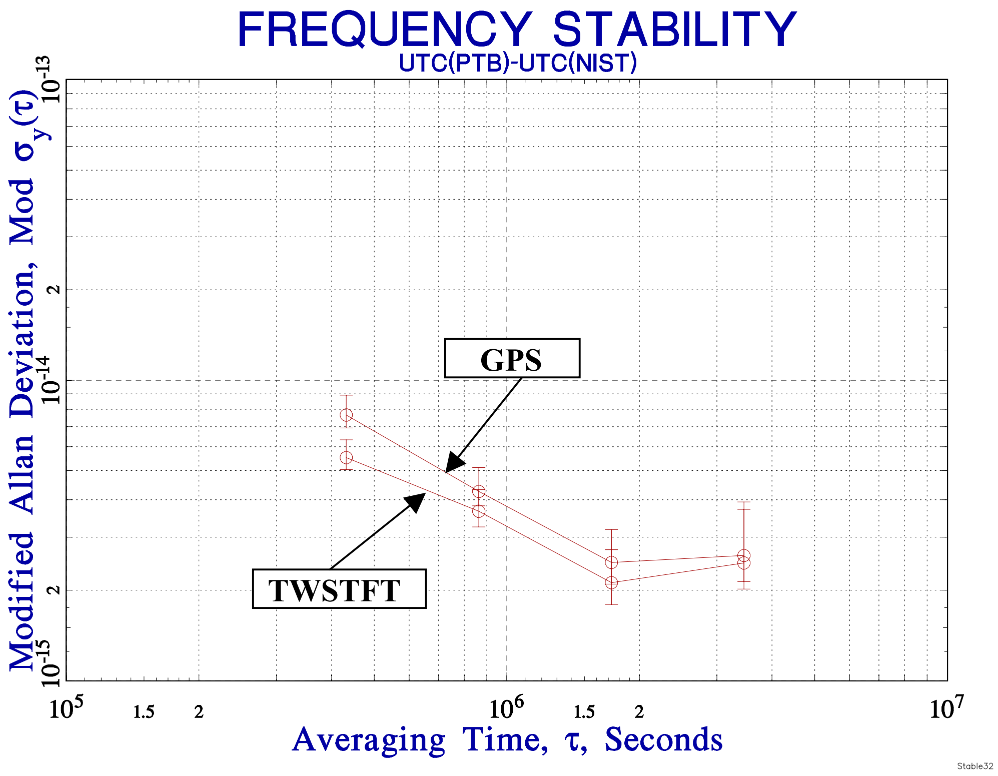

Figure 1. Frequency stability of [*UTC(PTB) – UTC(NIST)*] by GPS CV and by TWSTFT.

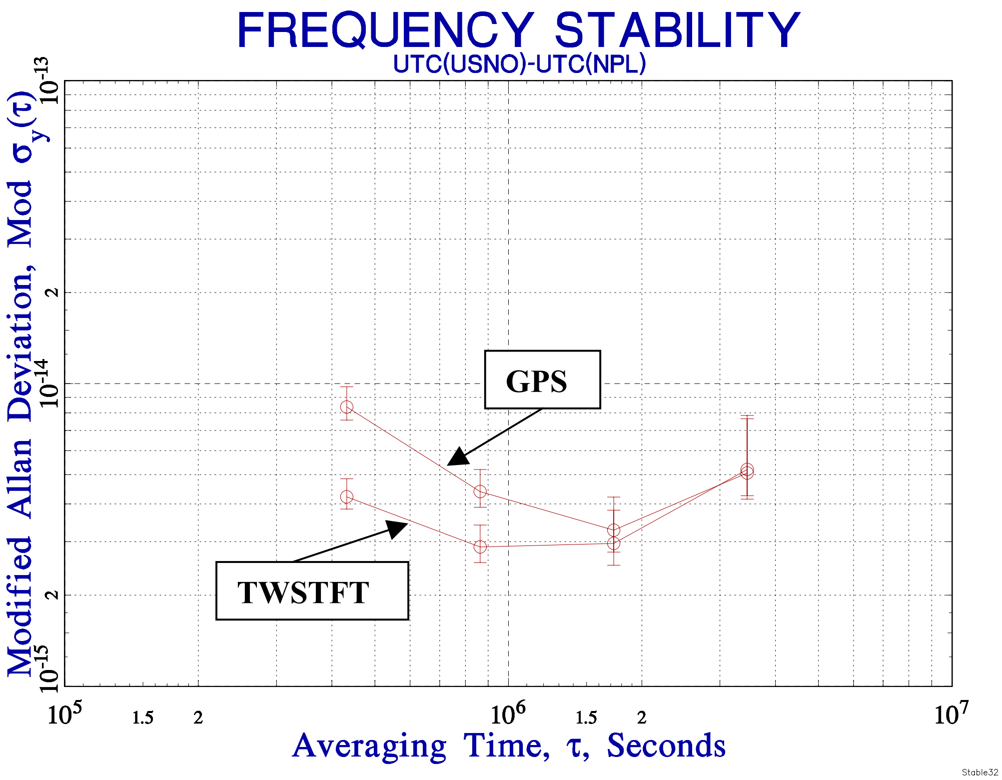

Figure 2. Frequency stability of [*UTC(USNO) – UTC(NPL)*] by GPS CV and by TWSTFT.

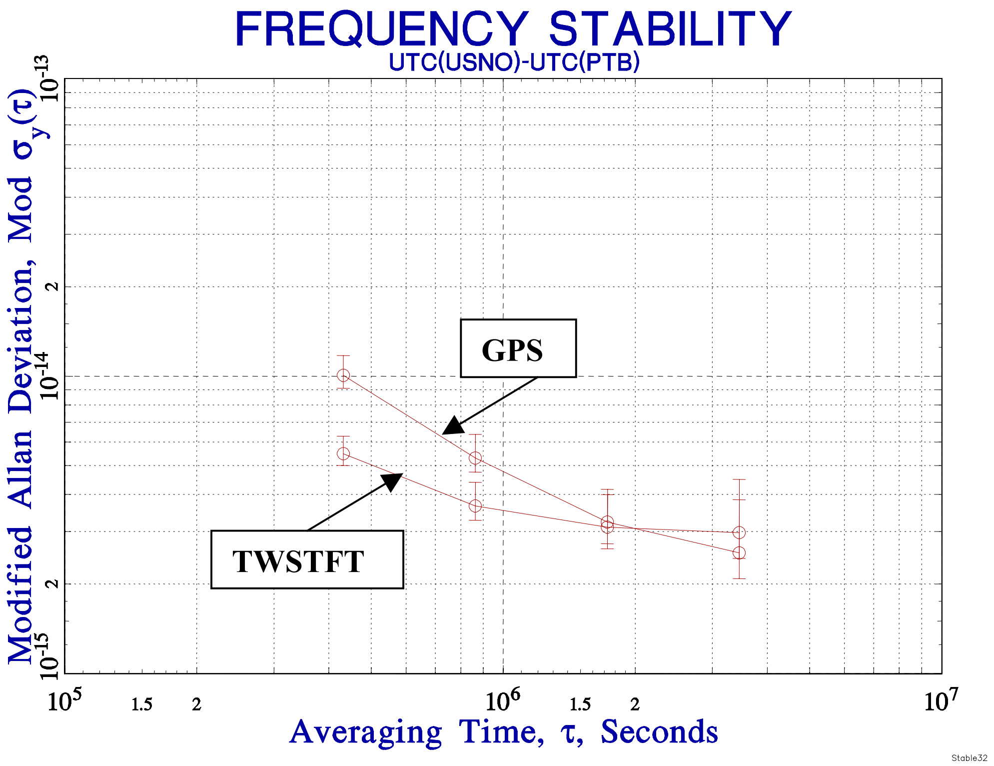

Table 3. Frequency stability of [*UTC(USNO) – UTC(PTB)*] by GPS CV and by TWSTFT.

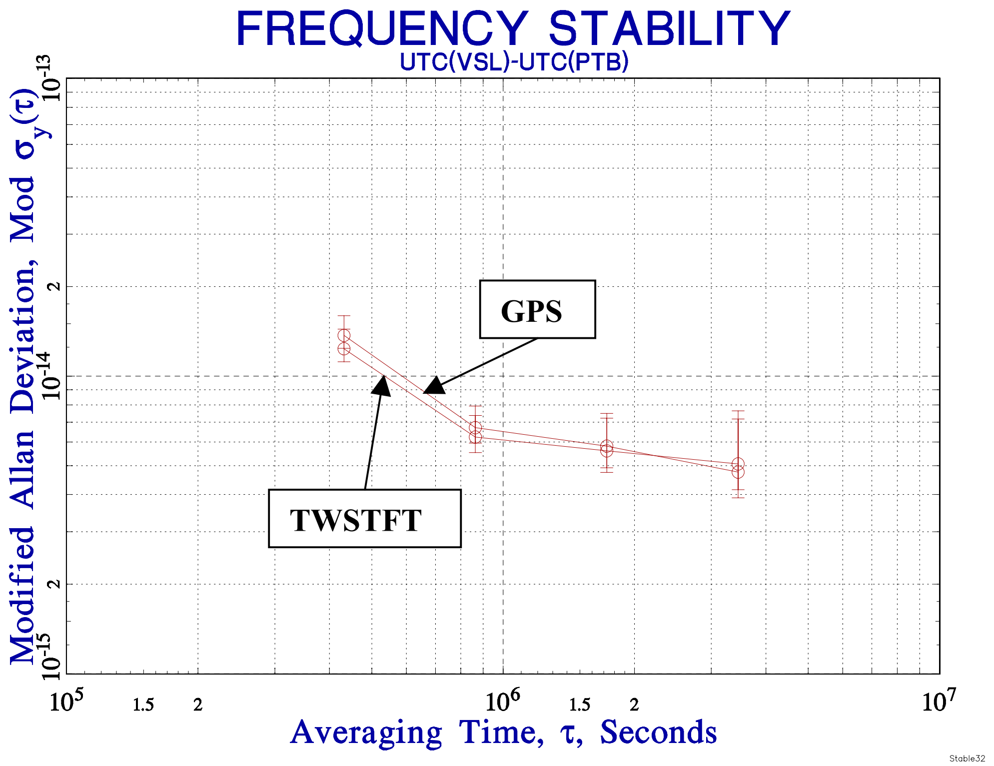

Figure 4. Frequency stability of [*UTC(VSL) – UTC(PTB)*] by GPS CV and by TWSTFT.

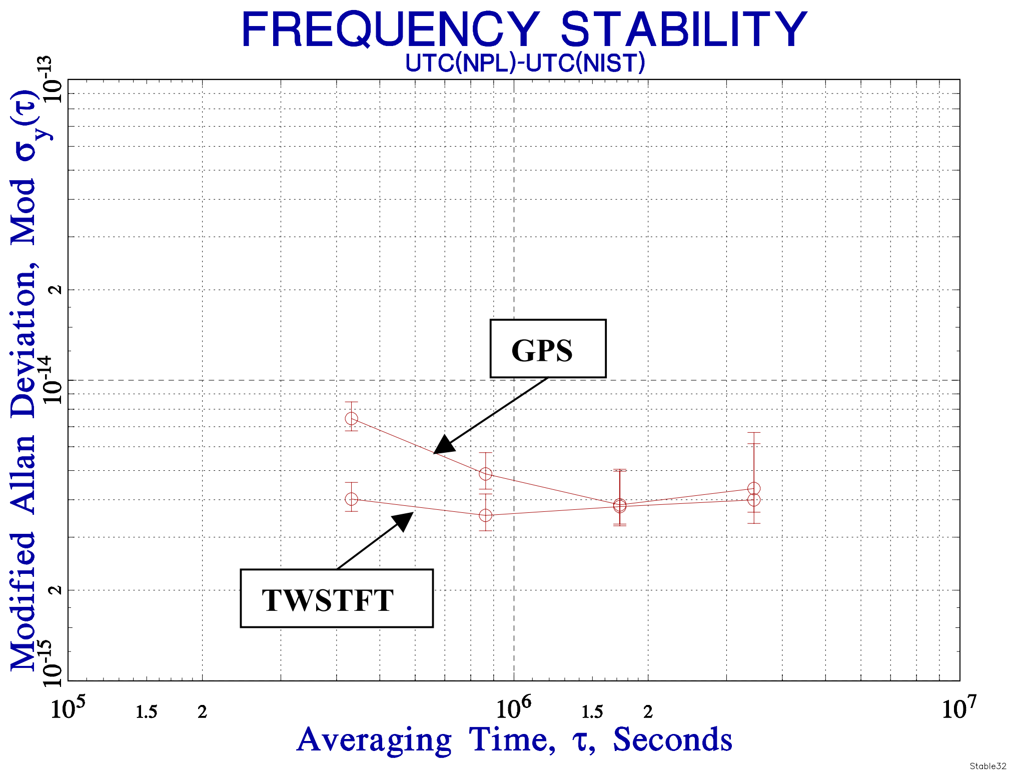

Figure 5. Frequency stability of [*UTC(NPL) – UTC(NIST)*] by GPS CV and by TWSTFT.

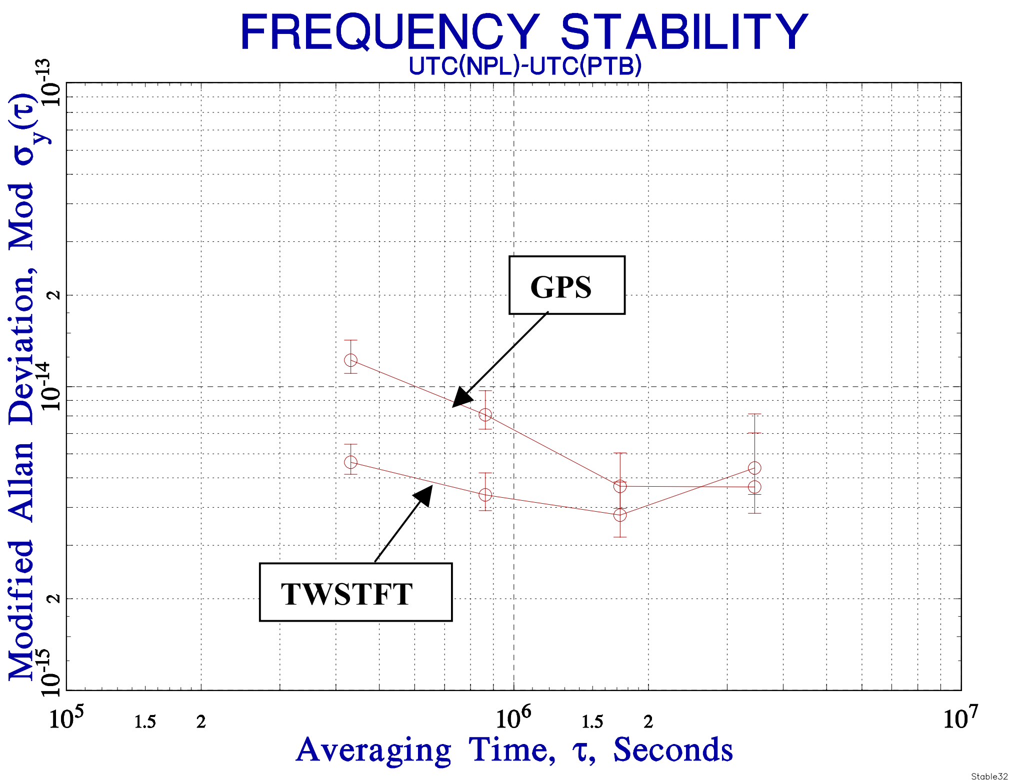

Figure 6. Frequency stability of [*UTC(NPL) – UTC(PTB)*] by GPS CV and by TWSTFT.

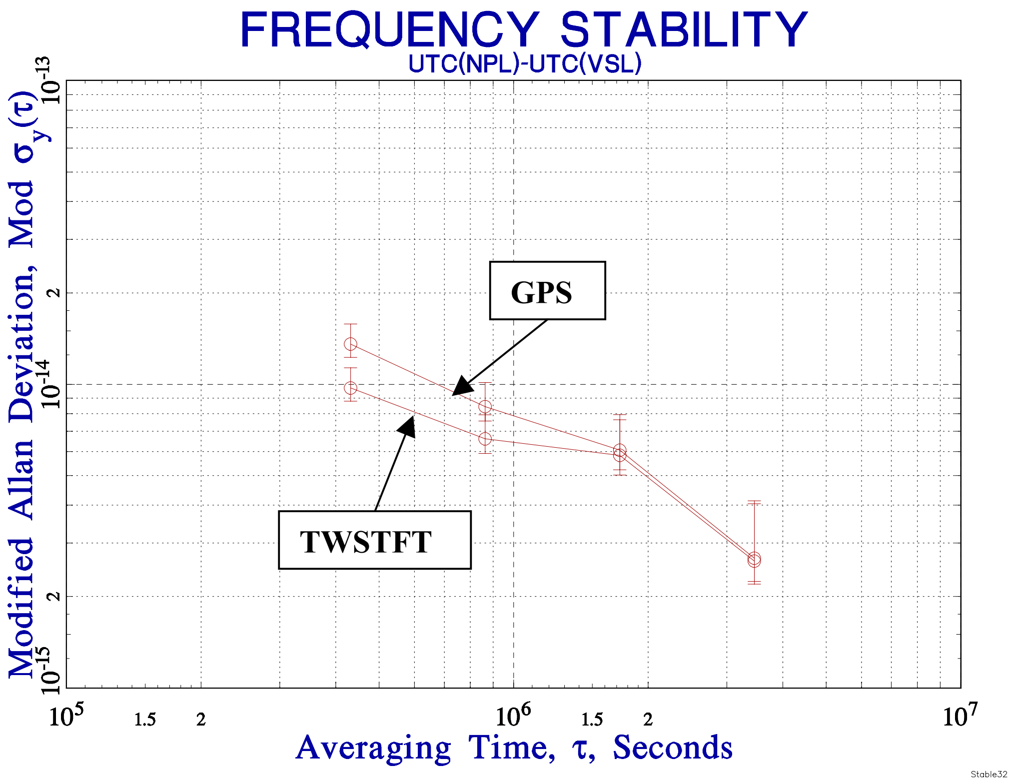

Figure 7. Frequency stability of [*UTC(NPL) – UTC(VSL)*] by GPS CV and by TWSTFT.

Section III: Description of equipment providing data for this report.

Lab.	GPS CV	TWSTFT (through INTELSAT 307° E)
NIST	Receiver type: NBS/TTR5 Receiver serial no: 010 Internal delay: 53.0 ns Reference name: UTC(NIST) Reference type: ensemble of 4 Cs + 5 H-masers	Modem type: University of Stuttgart/MITREX 2500 Modem serial no: Antenna: 3.7 m – steerable Degree of automation: 85 % Reference name: UTC(NIST) Reference type: ensemble of 4 Cs + 5 H-masers
OCA	Receiver type: AOA/TTR5 Receiver serial No: Internal delay: Reference name: OCA clock Reference type: 1 Cs	Modem type: University of Stuttgart/MITREX 2500 Modem serial no: Antenna: 1.8 m – VSAT Andrew Degree of automation: Reference name: OCA clock Reference type: 1 Cs
NPL *	Receiver type: AOA/TTR5A Receiver serial No: 276 Internal delay: 68.5 ns Reference name: UTC(NPL) Reference type: 1 H-maser	Modem type: TimeTech/SATRE Modem serial no: 038 Antenna: 2.4 m – VSAT Degree of automation: Reference name: UTC(NPL) Reference type: 1 H-maser
PTB	Receiver type: Rockwell Collins/TTR5 Receiver serial No: Internal delay: 77 ns Reference name: UTC(PTB) Reference type: 1 Lab. Cs	Modem type: TimeTech/SATRE Modem serial no: 037 Antenna: 1.8 m – VSAT Degree of automation: Reference name: UTC(PTB) Reference type: 1 Lab. Cs
TUG *	Receiver type: NBS/TTR5 Receiver serial No: 012 Internal delay: 55.6 ns Reference name: UTC(TUG) Reference type: 1 Cs	Modem type: TimeTech/SATRE Modem serial no: 043 Antenna: 1.8 m – VSAT-1 Degree of automation: full Reference name : UTC(TUG) Reference type: 1 Cs
USNO *	Receiver type: AOA/TTR6 Receiver serial no: 440 Internal delay: Reference name: UTC(USNO MC) Reference type: 1 H-maser + freq. syntent.	Modem type: University of Stuttgart/MITREX 2500 Modem serial no: 85006 Antenna: 4.6 m – steerable Degree of automation: Reference name: UTC(USNO MC) Reference type: 1 H-maser + freq. syntent.
VSL	Receiver type: VSL/TTR5 Receiver serial no: VSL01 Internal delay: 63.9 ns Reference name: UTC(VSL) Reference type: 1 Cs + micro-phase-stepper	Modem type: Univerity of Stuttgart/MITREX 2500 Modem serial no: 85008 Antenna: 3 m – steerable Degree of automation: Reference name: UTC(VSL) Reference type: 1 Cs + micro-phase-stepper

Notes

* The NPL, TUG and USNO are also equipped with TWSTFT back-up stations.
The TUG back-up station is portable and fully automated.

Section IV: Summary of the international time links.