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10th 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,

Please find enclosed the 10th BIPM TWSTFT Monthly Report. As usual we present some selected TWSTFT links which are computed and compared to GPS at the time of preparation of *Circular T*. The results of the computation of nine such links are given in Tables 1 to 9 of the Appendix.

Introduction of new TWSTFT links into TAI

As announced in the previous report, following the recommendations of the last CCTF meeting and meeting of the CCTF WG on TWSTFT at the USNO on December 13 and 14, two new TWSTFT links have been inroduced into the computation of TAI from January 2000.

These two TWSTFT links:

- a transatlantic link NPL/USNO,
- a European link VSL/PTB

are computed in parallel with the best GPS links, which continue to provide data to be kept in reserve.

In addition another transatlantic link (PTB/NIST) has been inroduced into TAI at the same time. For this link, however, the primary technique remains classical GPS C/A-code common-view, and TWSTFT is used as a back-up technique.

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

Hoping to see you at the TWSTFT Participating Stations meeting in Torino,
Sincerely Yours,

Jacques Azoubib and Włodzimierz Lewandowski

Appendix to
10th BIPM TWSTFT Monthly Report

TWSTFT links computed at the BIPM

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.

Note: When TWSTFT sessions are missing and data are interpolated between TWSTFT sessions more than 5 days apart, results are printed in bold characters. Upper limit for interpolation is 12 days.

Table 1. TUG/PTB link

BIPM Report No.	Date 1999 (MJD)	**[*UTC(TUG) – UTC(PTB)*] /ns**		
		TWSTFT	*Circular T* (GPS)	TWSTFT–*Circular T*
2	1 May (51299)	193	217	–24
	6 May (51304)	196	217	–21
	11 May (51309)	205	231	–26
	16 May (51314)	222	242	–20
	21 May (51319)	236	258	–22
	26 May (51324)	248	271	–23
	31 May (51329)	266	288	–22
3	5 June (51334)	286	307	–21
	10 June (51339)	293	314	–21
	15 June (51344)	308	331	–23
	20 June (51349)	322	341	–19
	25 June (51354)	331	352	–21
	30 June (51359)	342	368	–26

Introduction of TUG/PTB TWSTFT link into TAI

BIPM Report No.	Date 1999 (MJD)	**[*UTC(TUG) – UTC(PTB)*] /ns**		
		*Circular T (*TWSTFT)	GPS	*Circular T* – GPS
4	5 July (51364)	358	360	–2
	10 July (51369)	370	372	–2
	15 July (51374)	379	379	0
	20 July (51379)	385	388	–3
	25 July (51384)	391	390	1
	30 July (51389)	410	411	–1
5	4 August (51394)	426	431	–5
	9 August (51399)	439	441	–2
	14 August (51404)	454	455	–1
	19 August (51409)	462	462	0
	24 August (51414)	481	485	–4
	29 August (51419)	500	502	–2

Note 1: The TUG/PTB TWSTFT link was calibrated by the transport of a TWSTFT station in May-June 1998. Until 30 June 1999 the *Circular T* GPS data for TUG were calibrated using an outdated value; this is the reason for the offset of about –22 ns between the two techniques.

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Table 1. TUG/PTB link (cont.)

BIPM Report No.	Date 1999/2000 (MJD)	**[*UTC(TUG) – UTC(PTB)*] /ns**		
		Circular T (TWSTFT)	GPS	*Circular T* – GPS
6	3 September (51424)	517	521	–4
	8 September (51429)	525	527	–2
	13 September (51434)	550	552	–2
	18 September (51439)	562	565	–3
	23 September (51444)	576	580	–4
	28 September (51449)	588	590	–2
7	3 October (51454)	602	599	3
	8 October (51459)	613	614	–1
	13 October (51464)	624	628	–4
	18 October (51469)	636	637	–1
	23 October (51474)	658	658	0
	28 October (51479)	681	683	–2
8	2 November (51484)	700	697	3
	7 November (51489)	724	726	–2
	12 November (51494)	739	739	0
	17 November (51499)	747	747	0
	22 November (51504)	771	771	0
	27 November (51509)	794	795	–1
9	2 December (51514)	805	806	–1
	7 December (51519)	819	817	2
	12 December (51524)	843	841	2
	17 December (51529)	863	862	1
	22 December (51534)	878	878	0
	27 December (51539)	900	898	2
10	1 January (51544)	925	928	–3
	6 January (51549)	960	964	–4
	11 January (51554)	981	983	–2
	16 January (51559)	995	991	4
	21 January (51564)	1008	1008	0
	26 January (51569)	1021	1019	2
	31 January (51574)	1045	1043	2

Note 2: The TUG/PTB TWSTFT link has been included in the computation of TAI since July 1999. This link was calibrated by the transport of a TWSTFT station in May-June 1998. The GPS link between the TUG and the PTB is also computed as a check and the data kept in reserve; this link was calibrated by the transport of a GPS receiver in May-June 1998 (4th BIPM GPS calibration trip).

It is notable that, for the TUG/PTB link, the TWSTFT and GPS techniques were independently calibrated, and the results agree to within the associated uncertainties.

Table 2. PTB/NIST link

BIPM Report No.	Date 1999/2000 (MJD)	**[*UTC(PTB) – UTC(NIST)*] /ns**		
		TWSTFT	*Circular T* (GPS)	TWSTFT–*Circular T*
5	4 August (51394)	21	25	– 4
	9 August (51399)	26	34	–8
	14 August (51404)	32	38	–6
	19 August (51409)	33	40	–7
	24 August (51414)	37	42	–5
	29 August (51419)	41	46	–5
6	3 September (51424)	42	50	–8
	8 September (51429)	42	51	–9
	13 September (51434)	35	47	–12
	18 September (51439)	40	46	–6
	23 September (51444)	40	45	–5
	28 September (51449)	39	47	–8
7	3 October (51454)	41	48	–7
	8 October (51459)	48	57	–9
	13 October (51464)	48	54	–6
	18 October (51469)	50	58	–8
	23 October (51474)	47	55	–8
	28 October (51479)	46	53	–7
8	2 November (51484)	47	60	–13
	7 November (51489)	46	54	–8
	12 November (51494)	45	53	–8
	17 November (51499)	46	56	–10
	22 November (51504)	44	53	–9
	27 November (51509)	46	51	–5
9	2 December (51514)	50	50	0
	7 December (51519)	45	46	–1
	12 December (51524)	38	38	0
	17 December (51529)	32	34	–2
	22 December (51534)	29	33	–4
	27 December (51539)	30	32	–2
10	1 January (51544)	28	30	–2
	6 January (51549)	24	24	0
	11 January (51554)	21	22	–1
	16 January (51559)	21	25	–4
	21 January (51564)	21	23	–2
	26 January (51569)	20	22	–2
	31 January (51574)	13	15	–2

Notes: Since July 1999 the GPS link between Europe and North America has been corrected by ionospheric delays derived from an IGS map rather than, as previously, by direct ionospheric measurements. This is the reason for the step of about 8 ns at the beginning of July 1999 between the TWSTFT and GPS values.

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

Table 3. USNO/NPL link

BIPM Report No.	Date 1999 (MJD)	**[*UTC(USNO) – UTC(NPL)*] /ns**		
		TWSTFT	*Circular T* (GPS)	TWSTFT–*Circular T*
7	3 October (51454)	62	52	10
	8 October (51459)	62	49	13
	13 October (51464)	**64**	54	10
	18 October (51469)	**65**	57	8
	23 October (51474)	67	56	11
	28 October (51479)	71	64	7
8	2 November (51484)	76	63	13
	7 November (51489)	82	74	8
	12 November (51494)	87	77	10
	17 November (51499)	92	84	8
	22 November (51504)	96	87	9
	27 November (51509)	97	90	7
9	2 December (51514)	89	92	–3
	7 December (51519)	90	92	–2
	12 December (51524)	95	98	–3
	17 December (51529)	100	100	0
	22 December (51534)	102	106	–4
	27 December (51539)	101	107	–6

Introduction of USNO/NPL TWSTFT link into TAI

BIPM Report No.	Date 2000 (MJD)	**[*UTC(USNO) – UTC(NPL)*] /ns**		
		Circular T (TWSTFT)	GPS	*Circular T* – GPS
10	1 January (51544)	100	105	–5
	6 January (51549)	99	102	–3
	11 January (51554)	100	102	–2
	16 January (51559)	99	103	–4
	21 January (51564)	99	103	–4
	26 January (51569)	94	101	–7
	31 January (51574)	91	93	–2

Notes: From 25 July 1999 to 29 November 1999 the USNO/NPL TWSTFT link has been calibrated by a value derived from *Circular T* data of June 1999.

Since July 1999 the GPS link between Europe and North America has been corrected by ionospheric delays derived from an IGS map rather than, as previously, by direct ionospheric measurements. This is the reason for the step of about 8 ns at the beginning of July 1999 between the TWSTFT and GPS values.

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

The USNO/NPL TWSTFT link has been included in the computation of TAI since January 2000.

Table 4. USNO/PTB link

BIPM Report No.	Date 1999/2000 (MJD)	**[*UTC(USNO) – UTC(PTB)*] /ns**		
		TWSTFT	*Circular T* (GPS)	TWSTFT–*Circular T*
6	3 September (51424)	–33	–45	12
	8 September (51429)	–30	–41	11
	13 September (51434)	–22	–35	13
	18 September (51439)	–23	–33	10
	23 September (51444)	–25	–34	9
	28 September (51449)	**–23**	–34	11
7	3 October (51454)	**–25**	–37	12
	8 October (51459)	**–34**	–47	13
	13 October (51464)	–36	–44	8
	18 October (51469)	–40	–48	8
	23 October (51474)	–36	–46	10
	28 October (51479)	–33	–41	8
8	2 November (51484)	–33	–46	13
	7 November (51489)	–31	–40	9
	12 November (51494)	–31	–39	8
	17 November (51499)	–31	–40	9
	22 November (51504)	–30	–39	9
	27 November (51509)	–33	–41	8
9	2 December (51514)	–40	–43	3
	7 December (51519)	–43	–42	–1
	12 December (51524)	–38	–37	–1
	17 December (51529)	–34	–35	1
	22 December (51534)	–32	–34	2
	27 December (51539)	–30	–30	0
10	1 January (51544)	–26	–30	4
	6 January (51549)	–19	–21	2
	11 January (51554)	–14	–15	1
	16 January (51559)	–14	–20	6
	21 January (51564)	–13	–14	1
	26 January (51569)	–7	–14	7
	31 January (51574)	3	–1	4

Notes: Since July 1999 the GPS link between Europe and North America has been corrected by ionospheric delays derived from an IGS map rather than, as previously, by direct ionospheric measurements. This is the reason for the step of about 8 ns at the beginning of July 1999 between the TWSTFT and GPS values.

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

Table 5. PTB/DTAG link

BIPM Report No.	Date 1999 (MJD)	**[*UTC(PTB) – UTC(DTAG)*] /ns**		
		TWSTFT	*Circular T* (GPS)	TWSTFT–*Circular T*
5	4 August (51394)	–128	–133	5
	9 August (51399)	–125	–123	–2
	14 August (51404)	–129	–130	1
	19 August (51409)	–142	–149	7
	24 August (51414)	–143	–147	4
	29 August (51419)	–166	–181	15
6	3 September (51424)	–184	–190	6
	8 September (51429)	–198	–206	8
	13 September (51434)	–204	–207	3
	18 September (51439)	–217	–220	3
	23 September (51444)	–234	–237	3
	28 September (51449)	–250	–253	3
7	3 October (51454)	–283	–279	–4
	8 October (51459)	**–295**	–297	2
	13 October (51464)	–296	–299	3
	18 October (51469)	–306	–309	3
	23 October (51474)	–320	–323	3
	28 October (51479)	–357	–356	–1
8	2 November (51484)	–363	–365	2
	7 November (51489)	–367	–373	6
	12 November (51494)	–373	–377	4
	17 November (51499)	–398	–400	2
	22 November (51504)	–407	–412	5
	27 November (51509)	–421	–423	2
9	2 December (51514)	–427	–427	0
	7 December (51519)	–429	–428	–1
	12 December (51524)	–446	–448	2
	17 December (51529)	–442	–442	0
	22 December (51534)	–442	–443	1
	27 December (51539)	–	–	–

Notes: The PTB/DTAG TWSTFT link was calibrated by the transport of a TWSTFT station. The observed discrepancy between the TWSTFT data and the *Circular T* values in this table might be explained by an inaccuracy of the DTAG GPS time-receiving equipment.

The DTAG has stopped TWSTFT operations at the end of December 1999.

Table 6. VSL/PTB link

BIPM Report No.	Date 1999 (MJD)	**[*UTC(VSL) – UTC(PTB)*] /ns**		
		TWSTFT	*Circular T* (GPS)	TWSTFT–*Circular T*
6	3 September (51424)	–3	–3	0
	8 September (51429)	–10	–9	–1
	13 September (51434)	–10	–9	–1
	18 September (51439)	–25	–25	0
	23 September (51444)	–37	–33	–4
	28 September (51449)	–47	–46	–1
7	3 October (51454)	–42	–39	–3
	8 October (51459)	–47	–47	0
	13 October (51464)	–54	–55	1
	18 October (51469)	–50	–49	–1
	23 October (51474)	–42	–41	–1
	28 October (51479)	–37	–39	2
8	2 November (51484)	–43	–39	–4
	7 November (51489)	–40	–37	–3
	12 November (51494)	–47	–47	0
	17 November (51499)	–57	–59	2
	22 November (51504)	–61	–58	–3
	27 November (51509)	–55	–55	0
9	2 December (51514)	–54	–52	–2
	7 December (51519)	–48	–49	1
	12 December (51524)	–37	–36	–1
	17 December (51529)	–31	–33	2
	22 December (51534)	–28	–32	4
	27 December (51539)	–29	–31	2

Introduction of VSL/PTB TWSTFT link into TAI

BIPM Report No.	Date 2000 (MJD)	**[*UTC(VSL) – UTC(PTB)*] /ns**		
		Circular T (TWSTFT)	GPS	*Circular T* – GPS
10	1 January (51544)	–31	–36	5
	6 January (51549)	–26	–29	3
	11 January (51554)	–20	–22	2
	16 January (51559)	–16	–19	3
	21 January (51564)	–13	–13	0
	26 January (51569)	–16	–18	2
	31 January (51574)	–2	–4	2

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 January 2000.

Table 7. NPL/NIST link

BIPM Report No.	Date 1999/2000 (MJD)	**[*UTC(NPL) – UTC(NIST)*] /ns**		
		TWSTFT	*Circular T* (GPS)	TWSTFT–*Circular T*
5	4 August (51394)	39	–54	93
	9 August (51399)	40	–51	91
	14 August (51404)	44	–46	90
	19 August (51409)	46	–46	92
	24 August (51414)	49	–43	92
	29 August (51419)	**52**	–37	89
6	3 September (51424)	53	–37	90
	8 September (51429)	–39	–35	–4
	13 September (51434)	–39	–35	–4
	18 September (51439)	–37	–38	1
	23 September (51444)	–38	–38	0
	28 September (51449)	–37	–37	0
7	3 October (51454)	–40	–41	1
	8 October (51459)	–41	–39	–2
	13 October (51464)	**–44**	–44	0
	18 October (51469)	**–47**	–47	0
	23 October (51474)	–49	–47	–2
	28 October (51479)	–50	–52	–2
8	2 November (51484)	–54	–49	–5
	7 November (51489)	–59	–60	1
	12 November (51494)	–65	–63	–2
	17 November (51499)	–70	–68	–2
	22 November (51504)	–74	–73	–1
	27 November (51509)	–79	–80	1
9	2 December (51514)	–84	–85	1
	7 December (51519)	–89	–88	–1
	12 December (51524)	–96	–97	1
	17 December (51529)	–103	–101	–2
	22 December (51534)	–108	–107	–1
	27 December (51539)	–103	–105	2
10	1 January (51544)	–100	–100	0
	6 January (51549)	–97	–96	–1
	11 January (51554)	–95	–93	–2
	16 January (51559)	–94	–94	0
	21 January (51564)	–92	–90	–2
	26 January (51569)	–84	–86	2
	31 January (51574)	–77	–77	0

Notes: The NPL/NIST TWSTFT link was calibrated using *Circular T* values dating from July 1999. New calibration value was applied at the beginning of September 1999.

Table 8. NPL/PTB link

BIPM Report No.	Date 1999/2000 (MJD)	**[*UTC(NPL) – UTC(PTB)*] /ns**		
		TWSTFT	*Circular T* (GPS)	TWSTFT–*Circular T*
6	3 September (51424)	–500	–87	–413
	8 September (51429)	–76	–86	10
	13 September (51434)	–70	–82	12
	18 September (51439)	–72	–84	12
	23 September (51444)	–74	–83	9
	28 September (51449)	–72	–84	12
7	3 October (51454)	–76	–89	13
	8 October (51459)	–84	–96	14
	13 October (51464)	–88	–98	10
	18 October (51469)	–91	–105	14
	23 October (51474)	–91	–104	13
	28 October (51479)	–92	–105	13
8	2 November (51484)	–97	–109	12
	7 November (51489)	–100	–114	14
	12 November (51494)	–106	–116	10
	17 November (51499)	–112	–124	12
	22 November (51504)	–114	–126	12
	27 November (51509)	–122	–131	9
9	2 December (51514)	–133	–135	2
	7 December (51519)	–134	–134	0
	12 December (51524)	–133	–135	2
	17 December (51529)	–134	–135	1
	22 December (51534)	–136	–140	4
	27 December (51539)	–132	–137	5
10	1 January (51544)	–127	–130	3
	6 January (51549)	–120	–120	0
	11 January (51554)	–115	–115	0
	16 January (51559)	–114	–119	5
	21 January (51564)	–112	–113	1
	26 January (51569)	–103	–108	5
	31 January (51574)	–89	–92	3

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

Table 9. NPL/VSL link

BIPM Report No.	Date 1999/2000 (MJD)	**[*UTC(NPL) – UTC(VSL)*] /ns**		
		TWSTFT	*Circular T* (GPS)	TWSTFT–*Circular T*
6	3 September (51424)	–88	–84	–4
	8 September (51429)	–84	–77	–7
	13 September (51434)	–78	–73	–5
	18 September (51439)	–64	–59	–5
	23 September (51444)	**–53**	–50	–3
	28 September (51449)	–43	–38	–5
7	3 October (51454)	–51	–50	–1
	8 October (51459)	–54	–49	–5
	13 October (51464)	–51	–43	–8
	18 October (51469)	**–59**	–56	–3
	23 October (51474)	–67	–61	–6
	28 October (51479)	–72	–66	–6
8	2 November (51484)	–71	–70	–1
	7 November (51489)	–77	–77	0
	12 November (51494)	–75	–69	–6
	17 November (51499)	–72	–65	–7
	22 November (51504)	–69	–68	–1
	27 November (51509)	–80	–76	–4
9	2 December (51514)	–80	–83	3
	7 December (51519)	–86	–85	–1
	12 December (51524)	–96	–99	3
	17 December (51529)	–103	–102	–1
	22 December (51534)	–107	–108	1
	27 December (51539)	–103	–106	3
10	1 January (51544)	–96	–99	3
	6 January (51549)	–93	–94	1
	11 January (51554)	–95	–95	0
	16 January (51559)	–97	–103	6
	21 January (51564)	–99	–100	1
	26 January (51569)	–87	–92	5
	31 January (51574)	–87	–90	3

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