

Comparison of Time Scales  
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The table on the following pages is derived from Appendix B of IEEE 1588-2002 (= IEC 61588:2004) and from a table from the IERS web site that shows the relationship between TAI and UTC. The columns in the table have the following meanings:

- MJD:** Modified Julian Day number, a count of days since 00 h 00m GMT on 17 November 1858.
- UTC:** Universal Coordinated Time, expressed in “YYYY-MM-DD hh:mm:ss” format.
- TAI:** International Atomic Time, also expressed in “YYYY-MM-DD hh:mm:ss” format.
- TAI-UTC:** The current offset between the TAI and UTC time scales, in seconds.
- GPS:** The GPS time scale, in GPS weeks of 604 800 seconds and the number of seconds since the start of the current GPS week.
- NTP:** The NTP time scale, a count of seconds since 1900-01-01 00:00:00 GMT. (When a leap second is inserted into the UTC time scale, the NTP time scale pauses for a second, thereby “forgetting” the leap second.)
- PTP:** The “Precise Time Protocol” time scale introduced by the IEEE 1588 (IEC 61588) standard. This is a count of seconds since 1970-01-01 00:00:00 UTC, assuming that each UTC second is an SI second. (That assumption is false, because prior to 1972-01-01 the UTC time scale was steered by rate adjustments and small step adjustments — “rubber seconds” and “leap milliseconds.”)

The following table, taken from Appendix B of IEEE 1588, contains formulae for converting between the PTP time scales and certain other time scales. In the table,

$$currentUTCOffset = (TAI - UTC) = \text{number of seconds TAI is ahead of UTC.}$$

To convert from	To	Use this formula
NTP seconds	PTP seconds	$PTP\ seconds = NTP\ seconds - 2\ 208\ 988\ 800 + currentUTCOffset$
PTP seconds	NTP seconds	$NTP\ seconds = PTP\ seconds + 2\ 208\ 988\ 800 - currentUTCOffset$
GPS seconds = $GPS\ weeks \times 604\ 800 + GPS\ secondsInLastWeek$	PTP seconds	$PTP\ seconds = GPS\ seconds + 315\ 964\ 819$
PTP seconds	GPS seconds	$GPS\ seconds = PTP\ seconds - 315\ 964\ 819$

UTC		TAI		TAI-UTC	GPS			NTP seconds (Forgets leap seconds!)	PTP seconds	Comment
MJD	YYYY-MM-DD hh:mm:ss	YYYY-MM-DD hh:mm:ss	Seconds since GPS epoch		Wk #	Sec # in Wk				
15 020.0	1900-01-01 00:00:00						0		NTP Epoch	
40 587.0	1970-01-01 00:00:00						2 208 988 800	0	PTP Epoch	
41 317.0	1972-01-01 00:00:00	1972-01-01 00:00:10	10				2 272 060 800	63 072 010	UTC Epoch	
	1972-06-30 23:59:59	1972-07-01 00:00:09	10				2 287 785 599	78 796 809		
	23:59:60	00:00:10	10				2 287 785 600	78 796 810	1 <sup>st</sup> LS	
41 499.0	1972-07-01 00:00:00	00:00:11	11				2 287 785 600	78 796 811		
	1972-12-23 23:59:59	1973-01-01 00:00:10	11				2 303 683 199	94 694 410		
	23:59:60	00:00:11	11				2 303 683 200	94 694 411	2 <sup>nd</sup> LS	
41 683.0	1973-01-01 00:00:00	00:00:12	12				2 303 683 200	94 694 412		
	1973-12-23 23:59:59	1974-01-01 00:00:11	12				2 335 219 199	126 230 411		
	23:59:60	00:00:12	12				2 335 219 200	126 230 412	3 <sup>rd</sup> LS	
42 048.0	1974-01-01 00:00:00	00:00:13	13				2 335 219 200	126 230 413		
	1974-12-23 23:59:59	1975-01-01 00:00:12	13				2 366 755 199	157 766 412		
	23:59:60	00:00:13	13				2 366 755 200	157 766 413	4 <sup>th</sup> LS	
42 413.0	1975-01-01 00:00:00	00:00:14	14				2 366 755 200	157 766 414		
	1975-12-23 23:59:59	1976-01-01 00:00:13	14				2 398 291 199	189 302 413		
	23:59:60	00:00:14	14				2 398 291 200	189 302 414	5 <sup>th</sup> LS	
42 778.0	1976-01-01 00:00:00	00:00:15	15				2 398 291 200	189 302 415		
	1976-12-23 23:59:59	1977-01-01 00:00:14	15				2 429 913 599	220 924 814		
	23:59:60	00:00:15	15				2 429 913 600	220 924 815	6 <sup>th</sup> LS	
43 144.0	1977-01-01 00:00:00	00:00:16	16				2 429 913 600	220 924 816		
	1977-12-23 23:59:59	1978-01-01 00:00:15	16				2 461 449 599	252 460 815		
	23:59:60	00:00:16	16				2 461 449 600	252 460 816	7 <sup>th</sup> LS	
43 509.0	1978-01-01 00:00:00	00:00:17	17				2 461 449 600	252 460 817		
	1978-12-23 23:59:59	1979-01-01 00:00:16	17				2 492 985 599	283 996 816		
	23:59:60	00:00:17	17				2 492 985 600	283 996 817	8 <sup>th</sup> LS	
43 874.0	1979-01-01 00:00:00	00:00:18	18				2 492 985 600	283 996 818		
	1979-12-23 23:59:59	1980-01-01 00:00:17	18				2 524 521 599	315 532 817		
	23:59:60	00:00:18	18				2 524 521 600	315 532 818	9 <sup>th</sup> LS	
44 239.0	1980-01-01 00:00:00	00:00:19	19				2 524 521 600	315 532 819		
44 244.0	1980-01-06 00:00:00	1980-01-06 00:00:19	19		0	0	2 524 953 600	315 964 819	GPS Epoch	
	1981-06-30 23:59:59	1981-07-01 00:00:18	19	46 828 799		259 199	2 571 782 399	362 793 618		
	23:59:60	00:00:19	19	46 828 800		259 200	2 571 782 400	362 793 619	10 <sup>th</sup> LS	
44 786.0	1981-07-01 00:00:00	00:00:20	20	46 828 801		259 201	2 571 782 400	362 793 620		
	1982-06-30 23:59:59	1982-07-01 00:00:19	20	78 364 800		345 600	2 603 318 399	394 329 619		
	23:59:60	00:00:20	20	78 364 801		345 601	2 603 318 400	394 329 620	11 <sup>th</sup> LS	
45 151.0	1982-07-01 00:00:00	00:00:21	21	78 364 802		345 602	2 603 318 400	394 329 621		

UTC		TAI		TAI-UTC	GPS			NTP seconds (Forgets leap seconds!)	PTP seconds	Comment
MJD	YYYY-MM-DD hh:mm:ss	YYYY-MM-DD hh:mm:ss	Seconds since GPS epoch		Wk #	Sec # in Wk				
	1983-06-30 23:59:59	1983-07-01 00:00:19	21	109 900 801	181	432 001	2 634 854 399	425 865 620		
	23:59:60	00:00:21	21	109 900 802		432 002	2 634 854 400	425 865 621	12 <sup>th</sup> LS	
45 516.0	1983-07-01 00:00:00	00:00:22	22	109 900 803		432 003	2 634 854 400	425 865 622		
	1985-06-30 23:59:59	1985-07-01 00:00:21	22	173 059 202	286	86 402	2 698 012 799	489 024 021		
	23:59:60	00:00:22	22	173 059 203		86 403	2 698 012 800	489 024 022	13 <sup>th</sup> LS	
46 247.0	1985-07-01 00:00:00	00:00:23	23	173 059 204		86 404	2 698 012 800	489 024 023		
	1987-12-23 23:59:59	1988-01-01 00:00:22	23	252 028 803	416	432 003	2 776 982 399	567 993 622		
	23:59:60	00:00:23	23	252 028 804		432 004	2 776 982 400	567 993 623	14 <sup>th</sup> LS	
47 161.0	1988-01-01 00:00:00	00:00:24	24	252 028 805		432 005	2 776 982 400	567 993 624		
	1989-12-23 23:59:59	1990-01-01 00:00:23	24	315 187 204	521	86 404	2 840 140 799	631 152 023		
	23:59:60	00:00:24	24	315 187 205		86 405	2 840 140 800	631 152 024	15 <sup>th</sup> LS	
47 892.0	1990-01-01 00:00:00	00:00:25	25	315 187 206		86 406	2 840 140 800	631 152 025		
	1990-12-23 23:59:59	1991-01-01 00:00:24	25	346 723 205	573	172 805	2 871 676 799	662 688 024		
	23:59:60	00:00:25	25	346 723 206		172 806	2 871 676 800	662 688 025	16 <sup>th</sup> LS	
48 257.0	1991-01-01 00:00:00	00:00:26	26	346 723 207		172 807	2 871 676 800	662 688 026		
	1992-06-30 23:59:59	1992-01-01 00:00:25	26	393 984 006	651	259 206	2 918 937 599	709 948 825		
	23:59:60	00:00:26	26	393 984 007		259 207	2 918 937 600	709 948 826	17 <sup>th</sup> LS	
48 804.0	1992-07-01 00:00:00	00:00:27	27	393 984 008		259 208	2 918 937 600	709 948 827		
	1993-06-30 23:59:59	1993-07-01 00:00:26	27	425 520 006	703	345 606	2 950 473 599	741 484 826		
	23:59:60	00:00:27	27	425 520 007		345 607	2 950 473 600	741 484 827	18 <sup>th</sup> LS	
49 169.0	1993-07-01 00:00:00	00:00:28	28	425 520 008		345 608	2 950 473 600	741 484 828		
	1994-06-30 23:59:59	1994-07-01 00:00:27	28	457 056 008	755	432 008	2 982 009 599	773 020 827		
	23:59:60	00:00:28	28	457 056 009		432 009	2 982 009 600	773 020 828	19 <sup>th</sup> LS	
49 534.0	1994-07-01 00:00:00	00:00:29	29	457 056 010		432 010	2 982 009 600	773 020 829		
	1995-12-31 23:59:59	1996-01-01 00:00:28	29	504 489 609	834	86409	3 029 443 199	820 454 428		
	23:59:60	00:00:29	29	504 489 610		86410	3 029 443 200	820 454 429	20 <sup>th</sup> LS	
50 083.0	1996-01-01 00:00:00	00:00:30	30	504 489 611		86411	3 029 443 200	820 454 430		
	1997-06-30 23:59:59	1997-07-01 00:00:29	30	551 750 410	912	172 810	3 076 703 999	867 715 229		
	23:59:60	00:00:30	30	551 750 411		172 811	3 076 704 000	867 715 230	21 <sup>st</sup> LS	
50 630.0	1997-07-01 00:00:00	00:00:31	31	551 750 412		172 812	3 076 704 000	867 715 231		
	1998-12-31 23:59:59	1999-01-01 00:00:30	31	599 184 011	990	432 011	3 124 137 599	915 148 830		
	23:59:60	00:00:31	31	599 184 012		432 012	3 124 137 600	915 148 831	22 <sup>nd</sup> LS	
51 179.0	1999-01-01 00:00:00	00:00:32	32	599 184 013		432 013	3 124 137 600	915 148 832		
	2005-12-31 23:59:59	2006-01-01 00:00:00	32	820 108 812	1 356		3 345 062 399	1 136 073 631		
	23:59:60	00:00:00	32	820 108 813			3 345 062 400	1 136 073 632	23 <sup>rd</sup> LS	
53 736.0	2006-01-01 00:00:00	00:00:00	33	820 108 814			3 345 062 400	1 136 073 633		