

TIME SIGNALS

The time signal emissions reported here follow the UTC system, in accordance with the Recommendation 460-4 of the Radiocommunication Bureau (RB) of the International Telecommunication Union (ITU) unless otherwise stated.

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

The following tables are based on information received at the BIPM between February and April 2014.

AUTHORITIES RESPONSIBLE FOR THE TIME SIGNAL EMISSIONS

| Signal | Authority |
|--------|--|
| BPM | National Time Service Center, NTSC Chinese Academy of Sciences 3 East Shuyuan Rd, Lintong District, Xi'an Shaanxi 710600, China |
| CHU | National Research Council of Canada Measurement Science and Standards Frequency and Time Standards Bldg M-36, 1200 Montreal Road Ottawa, Ontario, K1A 0R6, Canada |
| DCF77 | Physikalisch-Technische Bundesanstalt Time and Frequency Department, WG 4.42 Bundesallee 100 D-38116 Braunschweig Germany |
| EBC | Real Instituto y Observatorio de la Armada Cecilio Pujazón s/n 11.110 San Fernando Cádiz, Spain |
| HLA | Center for Time and Frequency Division of Physical Metrology Korea Research Institute of Standards and Science 267 Gajeong-Ro, Yuseong, Daejeon 305-340 Republic of Korea |
| JJY | Space-Time Standards Laboratory National Institute of Information and Communications Technology 4 -2- 1, Nukui-kitamachi Koganei, Tokyo 184-8795 Japan |
| LOL | Servicio de Hidrografía Naval Observatorio Naval Buenos Aires Av. España 2099 C1107AMA – Buenos Aires, Argentina |

| Signal | Authority |
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| MIKES | Centre for Metrology and Accreditation Tekniikantie 1 FI-02150 Espoo Finland |
| MSF | National Physical Laboratory Time Quantum and Electromagnetics Division Hampton Road Teddington, Middlesex TW11 0LW United Kingdom |
| RAB-99, RBU, RJH-63, RJH-69, RJH-77, RJH-86, RJH-90,RTZ,RWM | All-Russian Scientific Research Institute for Physical Technical and Radiotechnical Measurements FGUP "VNIIFTRI" Meendeleev, Moscow Region 141570 Russia |
| TDF | CFHM Chambre française de l'horlogerie et des microtechniques 22 avenue Franklin Roosevelt 75008 Paris, France and LNE Laboratoire national de métrologie et d'essais 1 rue Gaston Boissier 75724 Paris Cedex 15, France |
| WWV, WWVB, WWVH | Time and Frequency Division, 847.00 National Institute of Standards and Technology - 325 Broadway Boulder, Colorado 80305, U.S.A. |

TIME SIGNALS EMITTED IN THE UTC SYSTEM

| Station | Location Latitude Longitude | Frequency (kHz) | Schedule (UTC) | Form of the signal |
|---------|-----------------------------------|--------------------|-------------------------|---|
| BPM | Pucheng | 2 500 | 7 h 30 m to 1 h | The BPM time signals are generated by NTSC and are in accordance with UTC(NTSC)+8 h. Signals emitted in advance on UTC by 20 ms. Second pulses of 10 ms duration with 1 kHz modulation. Minute pulses of 300 ms duration with 1 kHz modulation. UTC time signals are emitted from minute 0 to 10, 15 to 25, 30 to 40, 45 to 55. UT1 time signals are emitted from minute 25 to 29, 55 to 59. |
| | China | 5 000 | continuous | |
| | 35° 0'N | 10 000 | continuous | |
| | 109° 31'E | 15 000 | 1 h to 9 h | |
| CHU | Ottawa | 3 330 | 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 0.5 s long. Hour pulses are 1.0 s long, with the following 1st to 9th pulses omitted. A bilingual (Fr. Eng.) announcement of time (UTC) is made each minute following the 50th second pulse. FSK code (300 bps, Bell 103) after 10 cycles of 1 kHz on seconds 31 to 39. Year, DUT1, leap second information, TAI-UTC and Canadian daylight saving time format on 31, and time code on 32-39. Broadcast is single sideband; upper sideband with carrier reinsert. DUT1 : ITU-R code by double pulse. |
| | Canada | 7 850 | | |
| | 45° 18'N | 14 670 | | |
| | 75° 45'W | | | |
| DCF77 | Mainflingen | 77.5 | continuous | The DCF77 time signals are generated by PTB and are in accordance with the legal time of Germany which is UTC(PTB)+1 h or UTC(PTB)+2 h. At the beginning of each second (except in the last second of each minute) the carrier amplitude is reduced to about 15% for a duration of 0.1 or 0.2 s corresponding to "binary 0" or "binary 1", respectively, referred to as second marks 0 to 59 in the following. The number of the minute, hour, day of the month, day of the week, month and year are transmitted in BCD code using second marks 20 to the 58, including overhead. Information emitted during minute n is valid for minute n+1. The information transmitted during the second marks 1 to the 14 is provided by third parties. Information on that additional service can be obtained from PTB. To achieve a more accurate time transfer and a better use of the frequency spectrum available an additional pseudo-random phase shift keying of the carrier is superimposed on the AM second markers. No transmission of DUT1. |
| | Germany | | | |
| | 50° 1'N | | | |
| | 9° 0'E | | | |
| EBC | San Fernando | 15006 | 10 h 00 m to 10 h 25 m | Second pulses of 0.1 s duration of a 1 kHz modulation. Minute pulses of 0.5 s duration of 1 250 Hz modulation. DUT1: ITU-R code by double pulse. |
| | Spain | 4998 | 10 h 30 m to 10 h 55 m | |
| | 36° 28'N | | except Saturday, Sunday | |
| | 6° 12'W | | and national holidays. | |

| Station | Location Latitude Longitude | Frequency (kHz) | Schedule (UTC) | Form of the signal |
|---------|---|--------------------|--|---|
| HLA (1) | Daejeon Rep. of Korea 36° 23'N 127° 22'E | 5 000 | continuous | Second pulses of 9 cycles of 1 800 Hz tones. 29th and 59th second pulses omitted. Hour identified by 0.8 s long 1 500 Hz tones. Beginning of each minute identified by 0.8 s long 1 800 Hz tones. BCD time code given on 100 Hz subcarrier. |
| JJY | Tamura-shi Fukushima Japan 37° 22'N 140° 51'E | 40 | Continuous | A1B type 0.2 s, 0.5 s and 0.8 s second pulses, spacings are given by the reduction of the amplitude of the carrier. Coded announcement of hour, minute, day of the year, year, day of the week and leap second. Transmitted time refers to UTC(NICT) + 9 h. |
| JJY | Saga-shi Saga Japan 33° 28'N 130° 11'E | 60 | Continuous | A1B type 0.2 s, 0.5 s and 0.8 s second pulses, spacings are given by the reduction of the amplitude of the carrier. Coded announcement of hour, minute, day of the year, year, day of the week and leap second same as JJY(40). Transmitted time refers to UTC(NICT) + 9 h. |
| LOL | Buenos Aires Argentina 34° 37'S 58° 21'W | 10 000 | 11 h to 12 h except Saturday, Sunday and national holidays. | Second pulses of 5 cycles of 1000 Hz modulation. Second 59 is omitted. Announcement of hours and minutes every 5 minutes, followed by 3 minutes of 1000 Hz or 440 Hz modulation. DUT1: ITU-R code by lengthening. |
| MIKES | Espoo Finland 60° 11'N 24° 50'E | 25 000 | Continuous | Modulation as in DCF77, but without pseudo-random phase shift keying of the carrier. Time code in UTC. |
| MSF | Anthorn United Kingdom 54° 54'N 3° 16'W | 60 | Continuous, except for interruptions for maintenance from 10 h 0 m to 14 h 0 m on the second Thursday of December and March, and from 09 h 0 m to 13 h 0 m on the second Thursday of June and September. A longer period of maintenance during the summer is announced annually. | The carrier is interrupted for 0.1 s at the start of each second, except during the first second of each minute (second 0) when the interruption is 0.5 s. Two data bits are transmitted each second (except second 0): data bit "A" between 0.1 and 0.2 s after the start of the second and data bit "B" between 0.2 and 0.3 s after the start of the second. Presence of the carrier represents "binary 0" and an interruption represents "binary 1". The values of data bit "A" provide year, month, day of the month, day of the week, hour and minute in BCD code. The time represented is UTC(NPL) in winter and UTC(NPL)+1h when DST is in effect. The values of data bit "B" provide DUT1 and an indication whether DST is in effect. The information transmitted applies to the following minute. DUT1: ITU-R code by double pulse. |

| Station | Location Latitude Longitude | Frequency (kHz) | Schedule (UTC) | Form of the signal |
|---------|---|--------------------|------------------------|---|
| RAB-99 | Khabarovsk Russia 48° 30'N 134° 50'E | 25.0 | 01 h 06 m to 01 h 36 m | A1N type signals are transmitted between minutes 9 and 20 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 9 and 11; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 11 and 20. |
| | | 25.1 | 05 h 06 m to 05 h 36 m | |
| | | 25.5 | | |
| | | 23.0 | | |
| | | 20.5 | | |
| RBU | Moscow Russia 56° 44'N 37° 40'E | 200/3 | Continuous | DXXXW type 0.1 s signals. The numbers of the minute, hour, day of the month, day of the week, month, year of the century, difference between the universal time and the local time, TJD and DUT1+dUT1 are transmitted each minute from the 1st to the 59th second. DUT1+dUT1 : by double pulse. |
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| RJH-63 | Krasnodar Russia 44° 46'N 39° 34'E | 25.0 | 10 h 06 m to 10 h 40 m | A1N type signals are transmitted between minutes 9 and 20 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 9 and 11 ; 0.1 second pulses of 25 ms duration, 10 second pulses of 1 s duration and minute pulses of 10 s duration are transmitted between minutes 11 and 20. |
| | | 25.1 | | |
| | | 25.5 | | |
| | | 23.0 | | |
| | | 20.5 | | |
| RJH-69 | Molodechno Belarus 54° 28'N 26° 47'E | 25.0 | 06 h 06 m to 06 h 47 m | A1N type signals are transmitted between minutes 10 and 22 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 10 and 13; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 13 and 22. |
| | | 25.1 | | |
| | | 25.5 | | |
| | | 23.0 | | |
| | | 20.5 | | |
| RJH-77 | Arkhangelsk Russia 64° 22'N 41° 35'E | 25.0 | 08 h 06 m to 08 h 47 m | A1N type signals are transmitted between minutes 10 and 22 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 10 and 13; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 13 and 22. |
| | | 25.1 | | |
| | | 25.5 | | |
| | | 23.0 | | |
| | | 20.5 | | |
| RJH-86 | Bishkek Kirgizstan 43° 03'N 73° 37'E | 25.0 | 03 h 06 m to 03 h 47 m | A1N type signals are transmitted between minutes 10 and 22 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 10 and 13; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 13 and 22. |
| | | 25.1 | 09 h 06 m to 09 h 47 m | |
| | | 25.5 | | |
| | | 23.0 | | |
| | | 20.5 | | |

| Station | Location Latitude Longitude | Frequency (kHz) | Schedule (UTC) | Form of the signal |
|---------|--|--------------------------------------|---|--|
| RJH-90 | Nizhni Novgorod Russia 56° 11'N 43° 57'E | 25.0 25.1 25.5 23.0 20.5 | 07 h 06 m to 07 h 47 m | A1N type signals are transmitted between minutes 10 and 22 : 0.025 second pulses of 12.5 ms duration are transmitted between minutes 10 and 13; second pulses of 0.1 s duration, 10 second pulses of 1 s duration, 0.1 second pulses of 25 ms and minute pulses of 10 s duration are transmitted between minutes 13 and 22. |
| RTZ | Irkutsk Russia 52° 26'N 103° 41'E | 50 | 00 h 00 m to 18 h 00 m 19 h 00 m to 24 h 00 m | DXXXW type 0.1 s signals. The numbers of the minute, hour, day of the month, day of the week, month, year of the century, difference between the universal time and the local time, TJD and DUT1+dUT1 are transmitted each minute from the 1st to the 59th second. DUT1+dUT1: by double pulse. |
| RWM (2) | Moscow Russia 56° 44'N 37° 38'E | 4 996 9 996 14 996 | The station operates simultaneously on the three frequencies. | A1X type second pulses of 0.1 s duration are transmitted between minutes 10 and 20, 40 and 50. The pulses at the beginning of the minute are prolonged to 0.5 s. A1N type 0.1 s second pulses of 0.02 s duration are transmitted between minutes 20 and 30. The pulses at the beginning of the second are prolonged to 40 ms and of the minute to 0.5 ms. DUT1+dUT1: by double pulse. |
| TDF | Allouis France 47° 10'N 2° 12'E | 162 | continuous, except every Tuesday from 1 h to 5 h | Phase modulation of the carrier by +1 and -1 rd in 0.1 s every second except the 59 th second of each minute. This modulation is doubled to indicate binary 1. The numbers of the minute, hour, day of the month, day of the week, month and year are transmitted each minute from the 21 st to the 58 th second, in accordance with the French legal time scale. In addition, a binary 1 at the 17 th second indicates that the local time is 2 hours ahead of UTC (summer time); a binary 1 at the 18 th second indicates that the local time is 1 hour ahead of UTC (winter time); a binary 1 at the 14 th second indicates that the current day is a public holiday (Christmas, 14 July, etc...); a binary 1 at the 13 th second indicates that the current day is a day before a public holiday. |

- (2) RWM is the radiostation emitting DUT1 information in accordance with the ITU-R code and also giving an additional information, dUT1, which 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 the marking of p second markers within the range between the 21st and 24th second so that $dUT1 = +p \times 0.02$ s.

Negative values of dUT1 are transmitted by the marking of q second markers within the range between the 31st and 34th second, so that $dUT1 = -q \times 0.02$ s.

| Station | Location Latitude Longitude | Frequency (kHz) | Schedule (UTC) | Form of the signal |
|---------|---|--|----------------|---|
| WWV | Fort-Collins CO, USA 40° 41'N 105° 3'W | 2 500 5 000 10 000 15 000 20 000 | continuous | Second pulses are 1 000 Hz tones, 5 ms in duration. 29 th and 59 th 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 tones. DUT1: ITU-R code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction. |
| WWVB | Fort-Collins CO, USA 40° 41'N 105° 3'W | 60 | continuous | Second pulses given by reduction of the amplitude, reversal of phase, and by binary phase shift keying of the carrier, AM, PM and BPSK coded announcement of the date, time, DUT1 correction, daylight saving time in effect, leap year and leap second. |
| WWVH | Kauai HI, USA 21° 59'N 159° 46'W | 2 500 5 000 10 000 15 000 | continuous | Second pulses are 1 200 Hz tones, 5 ms in duration. 29 th and 59 th 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 1 200 Hz tones. DUT1: ITU-R code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction. |

ACCURACY OF THE CARRIER FREQUENCY

| Station | Relative uncertainty of the carrier frequency in 10^{-10} |
|-----------------------|--|
| BPM | 0.01 |
| CHU | 0.05 |
| DCF77 | 0.02 |
| EBC | 0.1 |
| HLA | 0.02 |
| JJY | 0.01 |
| LCL | 0.1 |
| M KES | 0.01 |
| MSF | 0.02 |
| RAB-99, RJH-63 | 0.05 |
| RBU, RTZ | 0.02 |
| RJH-69, RJH-77 | 0.05 |
| RJH-86, RJH-90 | 0.05 |
| RWM | 0.05 |
| TDF | 0.02 |
| WWV | 0.01 |
| WWB | 0.01 |
| WWH | 0.01 |

