Characteristics of standard frequency and time signal emissions in allocated bands and characteristics of stations emitting with regular schedules with  
stabilized frequencies outside of allocated bands

The information below is a supplement Recommendation ITU-R TF.768 “Standard frequencies and time signals”.

The characteristics of standard frequency and time signal emissions are listed in two tables. Table 1 contains information about emissions in the allocated bands, and table 2 contains information about emissions in additional bands. The characteristics of some navigational aids are given in table 3.

The information is available for download from the web site of Study Group 7 (Science services) of the ITU Radiocommunication Sector at: <http://www.itu.int/oth/R0A08000007/en>

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TABLE 1

Characteristics of standard frequency and time signal emissions in the allocated bands

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Station | | | Type of antenna and polarization | Carrier power  (kW) | Number of simulta- neous trans-missions | Period of  operation | | Standard  frequencies used | | Duration of emission | | Fractional uncertainty  of carrier frequency (parts in 1012) (1) | Method of  DUT1 indication |
| Call sign | Approximate location | Latitude Longitude | Days/ week | Hours/ day | Carrier (MHz) | Modu-lation tones (Hz) | Time signal  (min) | Audio-modulation (min) |
| BPM(2) | Pucheng,  China | 35 00 N 109 31 E | Omni-directional | 10-20 | 2 | 7 | 24(3) | 2.5,  5,  10,  15 | 1, 1 000 | 20/30 (UTC) 4/30 (UT1) | Nil |  10 | Direct emission of UT1 time signal |
| HLA | Taejon,  Taedok Science Town, Republic of Korea | 36 23 N 127 22 E | Vertical (conical monopole) | 2 | 1 | 5 (4) | 7 (5) | 5 | 1 | Continuous | Continuous |  10 | ITU-R code by double pulse |
| LOL(6) | Buenos Aires, Argentina | 34 37 N 58 21 E | Horizontal  3-wire  folded dipole | 2 | 1 | 5 | 1 | 10 | 1,  440, 1 000 | Continuous | 3/5 |  20 | ITU-R code by lengthening |
| MIKES | Espoo,  Finland | 60° 11' N  24° 50' E | Omni-directional | 0.2 | 1 | 7 | 24 | 25 | 1**(10)** | Continuous | Nil |  1 | No DUTI transmission |
| RWM(6) | Moscow | 56 44 N 37 38 E | Horizontal dipole | 10 10 10 | 3 | 7 | 24 | 4.996, 9.996, 14.996 | 1/60, 1, 10 | 40/60 | Nil |  10 | ITU-R code by double pulse, additional information dUT1 (7) |
| WWV(6) | Fort Collins, Colorado, United States | 40 41 N 105 02 W | Vertical  /2 dipoles | 2.5-10 | 5 | 7 | 24 | 2.5,  5,  10,  15,  20,  25 | 1,  440, 500, 600 | Continuous  (8) | Continuous  (9) |  10 | ITU-R code by double pulse, additional information on UT1 corrections |
| WWVH(6) | Kekaha, Kauai, Hawaii, United States | 21 59 N 159 46 W | Vertical  /2 dipole  arrays | 2.5-10 | 4 | 7 | 24 | 2.5,  5,  10,  15 | 1,  440, 500, 600 | Continuous  (8) | Continuous  (9) |  10 | ITU-R code by double pulse, additional information on UT1 corrections |
| YVTO | Caracas,  Venezuela | 10 30 N 66 55 W |  |  | 1 | 7 | 24 | 5 |  |  |  |  |  |
| Notes to Table 1:  (1) This value applies at the transmitter. To realize the quoted uncertainty at the point of reception it will be necessary to observe the received phase time or frequency over a sufficiently long period in order to eliminate noise and random effects.  (2) Call sign in Morse and language.  (3) 2.5 MHz: 07:30-01:00 UTC; 15 MHz: 01:00-09:00 UTC; 5 MHz and 10 MHz: continuous.  (4) Monday to Friday (except national holidays in Korea).  (5) 01:00 to 08:00 UTC. Pulses of 9 cycles of 1800 Hz modulation. 59th and 29th second pulses omitted. Hour identified by 0.8 s long 1500 Hz tone. Beginning of each minute identified by a 0.8 s long 1800 Hz tone. Voice announcement of hours and minutes each minute following 52nd second pulse. BCD time code given on 100 Hz sub-carrier.  (6) These stations have indicated that they follow the UTC system as specified in Recommendation ITU-R TF.460.  (7) The additional information about the value of the difference UT1 – UTC is transmitted by code dUT1. It provides more precisely the difference UT1 – UTC in multiples of 0.02 s. The total value of the correction is DUT1  dUT1. Possible values of dUT1 are transmitted by marking of p second pulses between the 21st and 24th seconds of the minute, so that dUT1   0.02 s  p. Negative values of dUT1 are transmitted by marking of q second pulses between the 31st and 34th second of the minute, so that dUT1  –0.02 s  q.  (8) In addition to other timing signals and time announcements, a modified IRIG-H time code is produced at a 1-pps rate and radiated continuously on a 100 Hz sub‑carrier on all frequencies. A complete code frame is 1 min. The 100 Hz sub-carrier is synchronous with the code pulses, so that 10 ms resolution is obtained. The code contains DUT1 values; UTC time expressed in year, day of year, hour and minute; and status indicators relating to impending leap seconds and Daylight Saving Time.  (9) Except for voice announcement periods and the 5 min semi-silent period each hour.  (10) Modulation as in DCF77, but without pseudo-random phase shift keying of the carrier. Time code in UTC. | | | | | | | | | | | | | |

TABLE 2

Characteristics of standard frequency and time signal emissions in additional bands

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Station | | | Type of antenna and polarization | Carrier power  (kW) | Number of simulta- neous trans-missions | Period of  operation | | Standard  frequencies used | | Duration of emission | | Fractional uncertainty  of carrier frequency (parts in 1012) (1) | Method of DUT1 indication |
| Call sign | Approximate location | Latitude Longitude | Days/ week | Hours/ day | Carrier (kHz) | Modu-lation tones (Hz) | Time signal  (min) | Audio-modulation (min) |
| CHU(2) | Ottawa, Canada | 45 18 N 75 45 W | Omni- directional | 3, 5, 3 | 3 | 7 | 24 | 3 330,  7 850, 14 670 | 1 (3) | Continuous | Nil |  5 | ITU-R code by split pulses |
| DCF77(2) | Mainflingen, F.R. of  Germany | 50 01 N 09 00 E | Omni- directional | 30 (4) | 1 | 7 | 24 | 77.5 | 1 | Continuous (5) | Nil (6) |  2 (7) | No DUT1 transmission |
|  | Droitwich,  United  Kingdom | 52 16 N 02 09 W | Omni- directional | 400 (4) | 1 | 7 | 22 | 198 (8) | Nil | Nil | A3E  broadcast continuously |  20 | No DUT1 transmission |
|  | Westerglen, United  Kingdom | 55 58 N 03 50 W | Omni- directional | 50 | 1 | 7 | 22 | 198 (8) | Nil | Nil | A3E  broadcast continuously |  20 | No DUT1 transmission |
|  | Burghead, United  Kingdom | 57 42 N 03 28 W | Omni- directional | 50 | 1 | 7 | 22 | 198 (8) | Nil | Nil | A3E  broadcast continuously |  20 | No DUT1 transmission |
| EBC | San Fernando, Cadiz, Spain | 36 28 N  06 12 W | Omni-directional | 1 | 1 | 5 | 1 | 15006   4998 | (9) | 25 | J3E |  100 | ITU-R code by double pulse |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Station** | | | **Type of antenna and polarization** | **Carrier power  (kW)** | **Number of simulta- neous trans-missions** | **Period of  operation** | | **Standard  frequencies used** | | **Duration of emission** | | **Fractional uncertainty  of carrier frequency (parts in 1012) (1)** | **Method of DUT1 indication** |
| **Call sign** | **Approximate location** | **Latitude Longitude** | **Days/ week** | **Hours/ day** | **Carrier (kHz)** | **Modu-lation tones (Hz)** | **Time signal  (min)** | **Audio-modulation (min)** |
| JJY | Fukushima, Japan | 37 22 N 140 51 E | Omni-directional | 10 | 1 | 7 | 24 | 40 | 1 | Continuous | Nil |   | No DUTI transmission |
| JJY | Saga,  Japan | 33°, 28' N 130° 11' E | Omni-directional | 10 | 1 | 7 | 24 | 60 | 1 | Continuous | Nil |  1 | No DUTI transmission |
| MSF | Anthorn,  United  Kingdom | 54 55 N  03 15 W | Omni- directional | 15 (4) | 1 | 7 | 24 (11) | 60 | 2 (12) | Continuous | Nil |  2 | ITU-R code by double pulse |
|  | Milano, Italy | 45 20 N  09 12 E | Omni- directional | 600 | 1 | 7 | 24 | 900 | Nil | Nil | A3E  broadcast continuous-ly |  2 |  |
| NAA  (3) (13) (14) | Cutler, Maine, United States | 44 39 N  67 17 W | Omni- directional | 1 000 (4) | 1 | 7 | 24 (15) | 24 (16) | Nil | Nil | Nil |  10 |  |
| NAU  (3) (13) (14) | Aguada, Puerto Rico | 18 23 N  67 11 W | Omni- directional | 100 (17) | 1 | 7 | 24 | 28.5 | Nil | Nil | Nil |  10 |  |
| NLK  (3) (13) (14) | Jim Creek, Washington, United States | 48 12 N 121 55 W | Omni- directional | 125 (4) | 1 | 7 | 24 (19) | 24.8 | Nil | Nil | Nil |  10 |  |
| NPM  (3) (13) (14) | Lualualei, Hawaii,  United States | 21 25 N 158 09 W | Omni- directional | 600 (4) | 1 | 7 | 24 (20) | 23.4 | Nil | Nil | Nil |  10 |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Station** | | | **Type of antenna and polarization** | **Carrier power  (kW)** | **Number of simulta- neous trans-missions** | **Period of  operation** | | **Standard  frequencies used** | | **Duration of emission** | | **Fractional uncertainty  of carrier frequency (parts in 1012) (1)** | **Method of DUT1 indication** |
| **Call sign** | **Approximate location** | **Latitude Longitude** | **Days/ week** | **Hours/ day** | **Carrier (kHz)** | **Modu-lation tones (Hz)** | **Time signal  (min)** | **Audio-modulation (min)** |
| NWC  (3) (13) (14) | Exmouth, Australia | 21 49 S 114 10 E | Omni- directional | 1 000 (4) | 1 | 7 | 24 (22) | 22.3 | Nil | Nil | Nil |  10 |  |
| RAB-99 | Khabarovsk,  Russia | 48° 30 N 134° 50 E | Omni- directional | 300 | 1 | 7 (23) | 1.1 | 25.0, 25.1, 25.5, 23.0, 20.5 | 1/60, 1/10, 1, 10, 40 (24) | 11 min 2 times per day (25) | Nil |  5 |  |
| RBU(2) | Moskva,  Russia | 56° 44 N  37° 40 E | Omni- directional | 50 | 1 | 7 | 24 | 200/3 | 10, 100, 312.5 | Continuous DXXXW (26) | Nil |  2 | (27) |
| RJH-63 | Krasnodar,  Russia | 44° 46 N  39° 34 E | Omni- directional | 300 | 1 | 7 (28) | 1 | 25.5, 25.1, 25.0, 23.0, 20.5 | 1/60, 1/10, 1, 10, 40 (24) | 11 min (29) | Nil |  5 |  |
| RJH-69 | Molodechno,  Russia | 54° 28 N  26° 47 E | Omni- directional | 300 | 1 | 7 (30) | 1 | 25.5, 25.1, 25.0, 23.0, 20.5 | 1/60, 1/10, 1, 10, 40 (24) | 15 min (31) | Nil |  5 |  |
| RJH-77 | Arkhangelsk,  Russia | 64° 22 N  41° 35 E | Omni- directional | 300 | 1 | 7 (32) | 1 | 25.5, 25.1, 25.0, 23.0, 20.5 | 1/60, 1/10, 1, 10, 40 (24) | 15 min (33) | Nil |  5 |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Station** | | | **Type of antenna and polarization** | **Carrier power  (kW)** | **Number of simulta- neous trans-missions** | **Period of  operation** | | **Standard  frequencies used** | | **Duration of emission** | | **Fractional uncertainty  of carrier frequency (parts in 1012) (1)** | **Method of DUT1 indication** |
| **Call sign** | **Approximate location** | **Latitude Longitude** | **Days/ week** | **Hours/ day** | **Carrier (kHz)** | **Modu-lation tones (Hz)** | **Time signal  (min)** | **Audio-modulation (min)** |
| RJH-86 | Bishkek,  Kyrgyzstan | 43° 03 N  73° 37 E | Omni- directional | 300 | 1 | 7 (34) | 2 | 25.5,  25.1,  25.0,  23.0,  20.5 | 1/60, 1/10, 1, 10, 40 (24) | 15 min twice per day (35) | Nil |  5 |  |
| RJH-90 | Nizhni Novgorod,  Russia | 56° 11 N  43° 57 E | Omni- directional | 300 | 1 | 7 (36) | 1 | 25.0,  25.1,  25.5,  23.0,  20.5 | 1/60, 1/10, 1, 10, 40 (24) | 15 min (37) | Nil |  5 |  |
| RTZ(2) | Irkutsk,  Russia | 52° 25 N 103° 42 E | Omni- directional | 10 | 1 | 7 | 23 | 50 | 1/60,  1, 10 | Continuous DXXXW (26) | Nil |  5 | (27) |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SAJ | Stockholm, Sweden | 59 15 N  18 06 E | Omni- directional | 0.02 (e.r.p.) | 1 | 3 (38) | 2 (39) | 150 000 | Nil | 10 (40) |  |  2 |  |
| STFS | Sikandrabad  India | 28 28 N  77 13 E | Satellite |  | 1 | 7 | 24 | 2599675 |  | Continuous |  |  10 |  |
| ALS162 | Allouis,  France | 47 10 N 02 12 E | Omni- directional | 2 000 | 1 | 7 | 24 | 162 | 1 (41) | Continuous | G2B |  2 | No DUT1 transmission |
| WWVB(2) | Fort Collins, Colorado, United States | 40 40 N 105 03 W | Two top-loaded vertical | 50 | 1 | 7 | 24 | 60 | 1 (42) | Continuous | Nil |  10 | Modified ITU-R code |

***Notes to Table 2:***

1. This value applies at the transmitter. To realize the quoted uncertainty at the point of reception it will be necessary to observe the received phase time or frequency over a sufficiently long period in order to eliminate noise and random effects.
2. These stations have indicated that they follow the UTC system as specified in Recommendation ITU-R TF.460.
3. Pulses of 300 cycles of 1000 Hz tone: the first pulse in each minute is prolonged.
4. Figures give the estimated radiated power.
5. The time signals are generated by the Physikalisch-Technische Bundesanstalt (PTB) and are in accordance with the legal time of the Federal Republic of Germany which is UTC (PTB)+ 1 h (Central European Time, CET) or UTC (PTB)+ 2 h (Central European Summer Time, CEST). At the beginning of each second (except in the last second of each minute) the carrier amplitude is reduced to 25% for a duration of 0.1 s 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. The current zone time, CET or CEST, is indicated by a “binary 1” in the second marks 18 or 17, respectively. Information emitted during minute n is valid for minute n+1. The information transmitted during the second marks 1 to 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 transmitted during each second.
6. Compliant with the Radio Regulations, the call sign DCF77 is not transmitted as the identification of the service is possible due to its unambiguous signal structure.
7. The uncertainty refers to one day averaging and approximately 95% coverage factor (k = 2).
8. No coherence between carrier frequency and time signals.
9. Seconds pulses of a duration of 0.1 s, modulated at 1000 Hz.  
   Minutes pulses of a duration of 0.5 s, modulated at 1250 Hz.
10. Suppressed
11. The transmission is interrupted during occasional maintenance periods, typically from 10:00 to 14:00 local time on the first Tuesday of January, May and September.
12. The carrier is interrupted for 500 ms during the first second of each minute, and for 100 ms during other seconds followed by two data bits of 100 ms duration. The BCD time code gives year, month, day-of-month, day-of-week, hour and minute, Summer Time in effect, parity checking and DUT1.
13. MSK (minimum shift keying) in use: a phase-stable carrier can be recovered after suitable multiplication and mixing in the receiver. The use of minimum shift keying means that no discrete component exists at the respective carrier frequencies that are given in the table. For the transmission to be used as a frequency reference it is necessary to recover a phase coherent carrier free from the /2 increments introduced by the modulation.
14. This station is primarily used for communication purposes.
15. From 12:00 to 20:00 UTC each Sunday while NSS is off the air (until 15 July).
16. As of 23 January 1984, until further notice.
17. Became operational on 14 August 1984, 74 kW.
18. Suppressed
19. Except from 16:00 to 24:00 UTC each Thursday. During Daylight Saving Time 15:00 to 23:00 UTC each Thursday.
20. 2.5 MHz: 00:00-10:00 UTC; 5 MHz: 09:00-01:00 UTC; 10 MHz: continuous; 15 MHz: 01:00-09:00 UTC.
21. Off the air until 21:00 UTC on 15 July, except for 14 hours each Sunday to cover the period when NAA is off the air.
22. From 00:00 to 08:00 UTC usually each Monday.
23. Daily, except the 10th, 20th and 30th days of each month.
24. Two types of signal are transmitted during a duty period:   
     a) A1A signals with carrier frequency 25 kHz, duration 0.0125; 0.025; 0.1; 1 and 10 s with repetition periods of 0.025; 0.1; 1; 10 and 60 s respectively;   
     b) N0N signals with carrier frequencies 25.0; 25.1; 25.5; 23.0; 20.5 kHz. The phases of these signals are matched with the time markers of the transmitted scale.
25. From 02:06 to 02:40 and 06:06 to 06:40 UTC.  
    From 01:06 to 01:40 and 05:06 to 05:40 UTC during daylight saving time.
26. DXXXW signals are made up of carrier sine-wave oscillations with the frequency of 662/3 kHz, which are interrupted for 5 ms every 100 ms; 10 ms after an interruption the carrier oscillations are narrow-band phase-modulated for 80 ms by sine-wave signals with sub-carriers of 100 or 312.5 Hz and a modulation index of 0.698. Amplitude-modulated signals with a repetition frequency of 10 Hz are used to transmit time markers. Signals with a sub-carrier of 312.5 Hz are used to indicate second and minute markers, and also “1s” in the binary coded decimal code for the transmission of time-scale information and in the position code where UT1 – UTC time-scale difference information is being transmitted; signals with a frequency of 100 Hz are used to mark “0s” in the binary coded decimal code for the transmission of time-scale information, as well as to fill in all the other 80 ms intervals in which there is no information transmission of any kind. For the transmission of time-scale information, the first two 80 ms intervals after the second marker are used.
27. Described in RBU/RTZ code format.
28. Daily, except the 3rd, 13th and 23rd days of each month.
29. From 11:06 to 11:40 UTC. From 10:06 to 10:40 UTC during daylight saving time.
30. Daily, except the 2nd, 12th and 22nd days of each month.
31. From 07:06 to 07:47 UTC. From 06:06 to 06:47 UTC during daylight saving time.
32. Daily, except the 4th, 14th, and 24th days of each month.
33. From 09:06 to 09:47 UTC. From 08:06 to 08:47 UTC during daylight saving time.
34. Daily, except the 6th, 16th and 26th days of each month.
35. From 04:06 to 04:47 and 10:06 to 10:47 UTC. From 03:06 to 03:47 and 09:06 to 09:47 UTC during daylight saving time.
36. Daily, except the 8th, 18th and 28th days of each month.
37. From 05:06 to 05:47 UTC. From 04:06 to 04:47 UTC during daylight saving time.
38. Each Monday, Wednesday and Friday.
39. From 09:30 to 11:30 UTC. When summer time, add one hour to the times given.
40. Second pulses of 8 cycles of 1 kHz modulation during 5 min beginning at 11:00 UTC and 11:25 UTC. When summer time is in effect, add one hour to the instants given.
41. Phase modulation of the carrier by + 1 and – 1 radian in 0.1 s every second except the 59th 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 21st to the 58th second, in accordance with the French legal time scale. In addition, a “binary 1” at the 17th second indicates that the local time is 2 h ahead of UTC (summer time), a “binary 1” at the 18th second indicates when the local time is one hour ahead of UTC (winter time); a “binary 1” at the 14th second indicates the current day is a public holiday (Christmas, 14 July, etc.), a “binary 1” at the 13th second indicates that the current day is the eve of a public holiday.
42. Time code modulation reduces the carrier amplitude by 10 dB at the beginning of each second. The code contains information on the year, day of year, hour, minute, UT1 value and status indicators for impending leap seconds and Daylight Saving Time.

TABLE 3

Characteristics of some navigational aids

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Station** | | | **Type of antenna and polarization** | **Carrier power  (kW)** | **Number of simultaneous transmissions** | **Period of  operation** | | **Standard  frequencies used** | | **Duration of emission** | | **Fractional uncertainty  of carrier frequency (parts in 1012)** |
| **Call sign** | **Approximate location** | **Latitude Longitude** | **Days/ week** | **Hours/ day** | **Carrier (kHz)** | **Pulse repetition (s)** | **Time signal** | **Audio-modulation** |
| Loran-C | Anthorn,  United Kingdom | 54 55 N  03 16 W | Omni- directional | Transmission suspended | 1 | 7 | 24 | 100 |  | Continuous  eLoran(11) (Eurofix) | Nil |  1 |
| Loran-C (7970-W) | Sylt,  Germany | 54 48.5 N  8 17.6 E | Omni- directional | Transmission suspended | 1 | 7 | 24 | 100 | 79 700 (3) | Continuous (4) | Nil |  1 |

TABLE 3 (*continued*)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Station** | | | **Type of antenna and polarization** | **Carrier power  (kW)** | **Number of simultaneous transmissions** | **Period of  operation** | | **Standard  frequencies used** | | **Duration of emission** | | **Fractional uncertainty  of carrier frequency (parts in 1012)** |
| **Call sign** | **Approximate location** | **Latitude Longitude** | **Days/ week** | **Hours/ day** | **Carrier (kHz)** | **Pulse repetition (s)** | **Time signal** | **Audio-modulation** |
| Loran-C(1)(13) (8970-M,  9960-Z) | Dana,  Indiana,  United States | 39 51.1 N  87 29.2 W | Omni- directional | Transmission suspended | 1 | 7 | 24 | 100 | 89 700 (3) 99 600 | Continuous (4)  eLoran(11) (LDC)(12) | Nil |  1 |
| Loran-C(1)(13) (9990-Z, 7960-X) | Narrow Cape, Alaska | 57 26.3 N 152 22.2 W | Omni- directional | Transmission suspended | 1 | 7 | 24 | 100 | 99 900     79 600 (3) | Continuous (4) | Nil |  1 |
| Loran-C(1)(13) (5990-Y, 9940-W) | George, Washington, United States | 47 03.8 N 119 44.6 W | Omni- directional | Transmission suspended | 1 | 7 | 24 | 100 | 59 900     99 400 (3) | Continuous (4)  eLoran(11) (LDC)(12) | Nil |  1 |
| Loran-C(13) (9940-M) | Fallon, Nevada, United States | 39 33.1 N 118 49.9 W | Omni- directional | Transmission suspended | 1 | 7 | 24 | 100 | 99 400 (3) | Continuous (4) | Nil |  1 |
| Loran-C(13) (8290-M) | Havre, ND, United States | 48 44.6 N 109 58.9 W | Omni- directional | Transmission suspended | 1 | 7 | 24 | 100 | 82 900 | Continuous | Nil |  1 |
| Loran-C(1)(13) (8290-X,  9610-V) | Gillette, WY, United States | 44 00.2 N 105 37.4 W | Omni- directional | Transmission suspended | 1 | 7 | 24 | 100 | 82 900   96 100 | Continuous  eLoran(11) (LDC)(12) | Nil |  1 |
| Loran-C(1)(13) (8970-Z,  9610-M) | Boise City, ID, United States | 36 30.3 N 102 54.0 W | Omni- directional | Transmission suspended | 1 | 7 | 24 | 100 | 89 700   96 100 | Continuous | Nil |  1 |
| Loran-C(13) (9610-X) | Las Cruces,  NM,  United States | 32 04.3 N 106 52.1 W | Omni- directional | Transmission suspended | 1 | 7 | 24 | 100 | 96 100 | Continuous  eLoran(11) (LDC) | Nil |  1 |

TABLE 3 (*continued*)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Station** | | | **Type of antenna and polarization** | **Carrier power  (kW)** | **Number of simultaneous transmissions** | **Period of  operation** | | **Standard  frequencies used** | | **Duration of emission** | | **Fractional uncertainty  of carrier frequency (parts in 1012)** |
| **Call sign** | **Approximate location** | **Latitude Longitude** | **Days/ week** | **Hours/ day** | **Carrier (kHz)** | **Pulse repetition (s)** | **Time signal** | **Audio-modulation** |
| RNS-E(A) | Bryansk,  Russia | 53 08 N 34 55 E | Omni- directional | 800 | 1 | 7 (5) | 10 (6) | 100 | 80 000 (7) | Continuous (4) | Nil |  5 |
| RNS-E(D) | Syzran,  Russia | 53 18 N  49 07 E | Omni- directional | 800 | 1 | 6 (5) | 10 (6) | 100 | 80 000 (7) | (8) | Nil |  5 |
| RNS-V(A) | Alexandrovsk- Sakhalinsky,  Russia | 51 05 N 142 42 E | Omni- directional | 800 | 1 | 7 (9) | 12 (10) | 100 | 89 500 | Continuous | Nil |  5 |

TABLE 3 (*continued*)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Station** | | | **Type of antenna and polarization** | **Carrier power  (kW)** | **Number of simultaneous transmissions** | **Period of  operation** | | **Standard  frequencies used** | | **Duration of emission** | | **Fractional uncertainty  of carrier frequency (parts in 1012)** |
| **Call sign** | **Approximate location** | **Latitude Longitude** | **Days/ week** | **Hours/ day** | **Carrier (kHz)** | **Pulse repetition (s)** | **Time signal** | **Audio-modulation** |
| Loran-C (5970-M) | Pohang, Korea | 36 11.1 N 129 20.5 E | Omni- directional | 35 | 1 | 7 | 24 | 100 | 59 700 | Continuous | Nil |  1 |
| Loran-C (5970-X) | Kwangju,  Korea | 35 02.4 N 126 32.5 E | Omni- directional | 35 | 1 | 7 | 24 | 100 | 59 700 | Continuous | Nil |  1 |
| Loran-C (6930-M) | Xindu, China | 23 58.1 N 111 43.1 E | Omni- directional | 1 000 | 1 | 7 | 24 | 100 | 69 300 | Continuous | Nil |  1 |
| Loran-C (6930-1) | Xinhe, China | 22 25.0 N 107 21.0 E | Omni- directional | 1 000 | 1 | 7 | 24 | 100 | 69 300 | Continuous | Nil |  1 |
| Loran-C (6930-2) | Zhangxi, China | 23 43.7 N 116 53.8 E | Omni- directional | 1 000 | 1 | 7 | 24 | 100 | 69 300 | Continuous | Nil |  1 |

TABLE 3 (*continued*)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Station** | | | **Type of antenna and polarization** | **Carrier power  (kW)** | **Number of simultaneous transmissions** | **Period of  operation** | | **Standard  frequencies used** | | **Duration of emission** | | **Fractional uncertainty  of carrier frequency (parts in 1012)** |
| **Call sign** | **Approximate location** | **Latitude Longitude** | **Days/ week** | **Hours/ day** | **Carrier (kHz)** | **Pulse repetition (s)** | **Time signal** | **Audio-modulation** |
| Loran-C(1) (7170-X,  8990-M) | Afif,  Saudi Arabia | 23 48.6 N  42 51.3 E | Omni- directional | 800 | 1 | 7 | 24 | 100 | 71 700 89 900 | Continuous | Nil |  1 |
| Loran-C(1) (7170-Y,  8990-Y) | Al Lith,  Saudi Arabia | 20 13.9 N  40 12.5 E | Omni- directional | 200 | 1 | 7 | 24 | 100 | 71 700 89 900 | Continuous | Nil |  1 |
| Loran-C (8990-W) | Ar Ruqi,  Saudi Arabia | 29 01.1 N  46 37.4 E | Omni- directional | 200 | 1 | 7 | 24 | 100 | 71 700 | Continuous | Nil |  1 |
| Loran-C (8990-X) | Ash Shaykh Humayd, Saudi Arabia | 28 09.3 N  34 45.9 E | Omni- directional | 400 | 1 | 7 | 24 | 100 | 71 700 | Continuous | Nil |  1 |
| Loran-C(1) (7170-W,  8990-V) | Salwa, Saudi Arabia | 24 50.0 N  50 34.2 E | Omni- directional | 800 | 1 | 7 | 24 | 100 | 71 700 89 900 | Continuous | Nil |  1 |

*Notes to Table 3:*

(1) Dual-rated stations.

(2) Peak radiated power.

(3) Time pulses appear in groups of 9 for the master station (M) and groups of 8 for the secondary stations (W, X, Y, Z).

(4) Maintained within  5 s of UTC. Time of Coincidence (TOC) with the UTC second changes with the recurrence of leap-seconds and is designated in TOC Tables issued to interested users by the US Naval Observatory, Washington DC, USA.

(5) No transmission on 23-26 January, 18-21 February, 23-26 March, 23-26 April, 9-23 May, 23‑26 June, 23-26 July, 23-26 August, 15-23 September, 23-26 October, 23-26 November, 23‑26 December.

(6) From 2100 to 0200 h and 0800 to 1500 h UTC.

(7) The signals of primary stations (A) are marked by the transmission of an additional ninth pulse in each group. Each pulse group coinciding with a UTC second marker is marked by the transmission of an additional (tenth) pulse. In the event of coincidence with the minute marker, the subsequent ten groups are additionally marked, and in the event of coincidence with the 5 min marker after 12 s, the subsequent 11 groups are also marked. The UTC second markers are accompanied by characteristic points situated at the leading edges of the eighth pulses at a level of 0.6 of the maximum signal value.

(8) Generally operates without a second marker. In individual cases operates with a second marker shifted in relation to UTC.

(9) No transmission on the 20th or 21st of each month.

(10) From 2300 to 2400 h and 0000 to 1100 h UTC.

(11) eLoran: enhanced Loran (eLoran) services are being implemented on a number of Loran-C transmitters. These services are currently considered to be for research purposes and may be subject to change. There are two different formats in use, both providing additional data channels that include (or are intended to include) a UTC time code. The eLoran format implemented at some Loran stations in the USA is designated LDC, for Loran Data Channel. The eLoran format implemented at some Loran stations in Europe is designated Eurofix.

1. From 08:00 to 15:00 local time, Monday to Friday.
2. Transmissions from all Loran-C stations operated by the United States Coast Guard and the Canadian Coast Guard were terminated with effect from 03 August 2010, but discussions are continuing about the possibility of re-starting some transmissions. The Port Clarence station was demolished in April 2010 and the Attu Island station was demolished in August 2010.

Authorities responsible for stations appearing in Tables 1 and 2

*Station* *Authority*

BPM Time and Frequency Division  
National Time Service Center, NTSC  
Chinese Academy of Sciences  
PO Box 18 - Lintong  
Shaanxi 710600, China

CHU National Research Council  
Metrology   
Frequency and Time Group  
Bldg M-36, 1200 Montreal Road  
Ottawa K1A 0R6, Ontario, Canada

DCF77 Physikalisch-Technische Bundesanstalt  
Time and Frequency Department, WG 4.42  
Bundesallee 100  
D-38116 Braunschweig  
Germany

Droitwich, Westerglen, Burghead Arqiva  
Jagger Lane  
Huddersfield, Yorkshire HD8 9TQ  
UK

EBC Real Instituto y Observatorio de la Armada  
Cecilio Pujazón s/n  
11.110 San Fernando  
Cádiz, Spain

HLA Time and Frequency Group  
Korea Research Institute of Standards and Science  
P.O. Box 102, Yuseong Daejeon 305-340  
Republic of Korea

JJY Space-Time Standards Group  
National Institute of Information and Communications Technology  
4-2-1, Nukui-kitamachi  
Koganei, Tokyo  
184-8795 Japan

LOL Servicio de Hidrografia Naval  
Observatorio Naval Buenos Aires  
Av. España 2099  
C1107AMA - Buenos Aires, Argentina

MIKES Centre for Metrology and Accreditation  
Tekniikantie 1  
FI-02150 Espoo  
Finland

MSF National Physical Laboratory  
Hampton Road  
Teddington, Middlesex, TW11 OLW  
United Kingdom

NAA, NDT, NLK, NPM, Superintendent  
NSS, NWC, NMO, NPN US Naval Observatory  
 Washington, DC 20390  
 United States of America

RBU, RTZ, Federal Agency on Technical Regulations   
RWM and Metrology  
 Moscow, Presnenskaya naberezhnaya 10, build.2

RAB-99, RJH-63, RJH-69, Ministry of Defence

RJH-77, RJH-86, RJH-90

RAT, RCH, State Committee of Standards of the Russian Federation  
RWM Lenisky Prospect 9  
 117049 Moscow, Russia

SAJ Swedish Telecommunications Administration  
Radio Services  
S-123 86 Farsta, Sweden

STFS National Physical Laboratory  
Dr. K. S. Krishnan Road  
New Delhi – 110012, India

ALS162 (formerly TDF) France Horlogerie (formerly CFHM)  
22 avenue Franklin Roosevelt  
75008 Paris, France

and

ANFR  
Agence nationale des fréquences  
78, avenue du général de Gaulle  
94704 Maisons-Alfort, 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  
United States of America  
WWV: http://tf.nist.gov/stations/wwv.html  
WWVB: http://tf.nist.gov/timefreq/stations/wwvb.htm  
WWVH: http://tf.nist.gov/timefreq/stations/wwvh.htm

YVTO Dirección de Hidrografia y Navegación  
Observatorio Naval Cagigal  
Apartado Postal No 6745   
Caracas, Venezuela