STANDARD FREQUENCY AND TIME SIGNAL STATIONS ON LONGWAVE AND SHORTWAVE

Compiled by Klaus Betke, DL4BBL. This revision: 19 May 2007

Station list

Freq. in kHz	Call sign	Station	Mode	Transmission time (UTC)	Remarks
25	RJH63	Krasnodar, RUS	CW + FSK	Winter 1106 - 1140, summer 1006 - 1040. No operation on the 3., 13. ,23. xx06 - xx20: 25.0 kHz, xx21 - xx23: 25.1 kHz, xx24 - xx26: 25.5 kHz, xx27 - xx31: 23.0 kHz, xx32 - xx40: 20.5 kHz	At xx36-xx40 unknown FSK mode on 20.5 kHz. 50 Baud, 100 Hz shift, 10 bit word length, 100 bit block length.
	RJH66	Bishkek, KGZ	CW	Winter 0406-0447, 1006-047, summer 0306-0347, 0906-0947. No operation on the 6., 16., 26. xx06-xx25: 25.0 kHz, xx27-xx30: 25.1 kHz, xx32-xx35: 25.5 kHz, xx38-xx41: 23.0 kHz, xx44-xx47: 20.5 kHz	
	RJH69	Molodecno, BLR	CW	Winter 0706-0747, summer 0606-0647. No operation on the 2., 12., 22. of each month. Details see RJH66	
	RJH77	Arkhangelsk, RUS	CW	Winter 0906-0947, summer 0806-0847. No operation on the 4., 14., 24. of each month. Details see RJH66	
	RJH99	Nizhniy Novgorod, RUS	CW	Winter 0506-0547, summer 0406-0447. No operation on the 8., 18., 28. of each month. Details see RJH66	
	RAB99	Khabarovsk, RUS	CW	Winter 0206-0240, 0606-0640, summer ???. No operation on the 10., 20., 30. of each month. Details see RJH63	
40	JJY	Mt. Otakadoya, Fukushima, J	CW	Continuous	
50	RTZ	Irkutsk, RUS	CW	22-21h (01-24h Moscow Time; winter)	No logs after early 2004
60	JJY	Mt. Hagane, Kyushu Isl., J	CW	Continuous	
	MSF	Rugby, G	CW	Continuous	
	WWVB	Ft. Collins, CO, USA	CW	Continuous	
66.67	RBU	Moskva, RUS	AM	Continuous	
68.5	BPC	Lintong, CHN	?	0800-1200, 2200-2330	Proprietary (commercial) time code
75	HBG	Prangins, SUI	CW	Continuous	
77.5	DCF77	Mainflingen, D	CW + PSK	Continuous	
100		Worldwide		Continuous	Loran-C navigation system. Some chains are synchronized to UTC
100	BPL	Lintong, CHN		time-shared with BPC on 68.5 kHz	Loran-C station for standard time & frequency dissemination. GRI = 6000
162		Allouis, F	PSK	Continuous	Radio France broadcast station
198		Droitwich, G	PSK	Continuous	BBC broadcast station. Commercial data & time code
1510	HD2IOA	Guayaquil, EQA	AM	Continuous	
2500	BPM	Lintong, CHN	AM	0900-0100	
	WWV	Ft. Collins, CO, USA	AM	Continuous	
	WWVH	Kekaha, HWA	AM	Continuous	
3330	CHU	Ottawa, CAN	AM (USB)	Continuous	
3810	HD2IOA	Guayaquil, EQA	AM (LSB)	0000-1200	
4996	RWM	Moskva, RUS	CW	Continuous except minute 08 and 38	
5000	BPM	Lintong, CHN	AM	Continuous	
	BSF	Chung-Li, TWN	AM	Continuous except minutes 35-39	Status uncertain
	HLA	Taejon, KOR	AM	Continuous?	Status unknown. Closure "in the future" announced in 2003
	LOL	Buenos Aires,	AM	1100-1200, 1400-1500, 1700-1800,	

		ARG		2000-2100, 2300-2400	
	WWV	Ft. Collins, CO, USA	AM	Continuous	
	WWVH	Kekaha, HWA	AM	Continuous	
	YVTO	Caracas, VEN	AM	Continuous	
	HD2IOA	Guayaquil, EQA	AM (LSB)	1200-1300	
7335	CHU	Ottawa, CAN	AM (USB)	Continuous	
7600	HD2IOA	Guayaquil, EQA	AM	1300-2400	
9996	RWM	Moskva, RUS	CW	Continuous except minute 08 and 38	
10000	BPM	Lintong, CHN	AM	Continuous	
	LOL	Buenos Aires, ARG	AM	1100-1200, 1400-1500, 1700-1800, 2000-2100, 2300-2400	Status uncertain
	WWV	Ft. Collins, CO, USA	AM	Continuous	
	WWVH	Kekaha, HWA	AM	Continuous	
14670	CHU	Ottawa, CAN	AM (USB)	Continuous	
14996	RWM	Moskva, RUS	CW	Continuous except minute 08 and 38	
15000	BPM	Lintong, CHN	AM	0100 - 0900	
	BSF	Chung-Li, TWN	AM	Continuous except minutes 35-39	Status uncertain
	LOL	Buenos Aires, ARG	AM	1100-1200, 1400-1500, 1700-1800, 2000-2100, 2300-2400	"Temporary inactive"
	WWV	Ft. Collins, Co, USA	AM	Continuous	
	WWVH	Kekaha, HWA	AM	Continuous	
20000	WWV	Ft. Collins, CO, USA	AM	Continuous	

Some former stations

Call sign	Station	Frequencies [kHz]	Closure	Remarks
ATA	New Delhi, IND	5000, 10000, 15000		Still active on 10000 kHz?
EBC	San Fernando (Cadiz), E	6840, 12008		
FFH	Paris, F	2500		
FTH42, FTK77, FTN87	Paris, F	7428, 10775, 13873	March 1985	
GBR	Rugby, G	16	December 1986	
IAM	Rome, I	5000	early 1998	Closed after transmitter breakdown
IBF	Torino, I	5000	early 1990s	
LOL2, LOL3	Buenos Aires, ARG	4856, 8030, 17180		LOL still on 5000, 10000 , 15000 kHz?
JG2AS	Sanwa, J	40	1999	
JJY	Sanwa, J	2500, 5000, 8000, 10000, 15000	1996 (2500 & 15000), March 2001	Now on 40 and 60 kHz
MSF	Rugby, G	2500, 5000, 10000	February 1988	Now on 60 kHz
OLB5	Prague (Liblice), CZR	3170		
OMA	Prague (Liblice), CZR	50, 2500	December 1995 (50 kHz)	
RID	Irkutsk, RUS	5004, 10004, 15004	December 1996	
RTA	Novosibirsk, RUS	10000, 15000	mid-1990s	
ULA4	Tashkent, UZB	2500, 5000, 10000	May 1999	Call sign RCH until 1996
VNG	Llandilo, AUS	2500, 5000, 8638, 12984, 16000	June / December 2002	
WWVL	Fort Collins, CO, USA	20	1972	
Y3S	Nauen, DDR	4525	June 1990	
ZUO	Pretoria, AFS	2500, 5000		

BPM, Lintong, China

Frequencies:	2500, 5000, 10000, 15000 kHz
Carrier accuracy:	$\Delta f / f < 10^{-11}$
Call sign:	BPM
Location:	Pucheng County, 70 km NE Lintong, China. Approx. 35° 00' n, 109° 30' e
Operating hours:	0730-1100 on 2500 kHz, 0100-0900 on 15000 kHz, continuous on 5000 and 10000 kHz
Power:	Unknown
Modulation:	AM; tones and voice. UTC time signals are broadcast 20 ms in advance of UTC.
Identification signal:	Call sign in morse and voice announcement in Chinese in minute 29 and 59
Programme:	Repeats every 30 minutes, see Table 3
Time code:	None, but NTSC has announced in 2003 that "BPM will disseminate the standard time code after a technical reconstruction"
Further information:	National Time Service Center (NTSC) http://kyc.ntsc.ac.cn/, http://www.time.ac.cn/

00m - 10m	UTC second pulses, 10 ms duration; UTC minute pulses, 300 ms duration
10m - 15m	No modulation; carrier only
15m - 25m	UTC second pulses, 10 ms duration; UTC minute pulses, 300 ms duration
25m - 29m	UT1 second pulses, 100 ms duration; UT1 minute pulses, 300 ms duration
29m00s - 29m40s	Call sign BPM in morse
29m40s - 30m00s	Station identification in Chinese (female voice)
30m - 40m	UTC second pulses 10 ms duration, UTC minute pulses 300 ms duration
40m - 45m	No modulation; carrier only
45m - 55m	UTC second pulses, 10 ms duration; UTC minute pulses, 300 ms duration
55m - 59m	UT1 second pulses, 100 ms duration; UT1 minute pulses, 300 ms duration
59m00s - 59m40s	Call sign BPM in morse
59m40s - 60m00s	Station identification in Chinese (female voice)

Table 3. BPM hourly transmission schedule

BSF, Chung-Li, Taiwan

Frequencies:	5000, 15000 kHz
Carrier accuracy:	$\Delta f / f < 2 \times 10^{-11}$
Call sign:	BSF
Location:	Chung-Li, 24° 57’ n, 121° 09’ e
Operating hours:	Continuous except from xx35 - xx40 each hour
Power:	Unknown
Modulation:	AM; 1000 Hz tones and voice
	DUT1 code is transmitted by emphasized (lengthened) pulses. When the emphasis is on seconds 1 through 8, DUT1 is positive; and when DUT1 is negative, seconds 9 through 16 are used (DUT1 is the difference between the astronomical time scale UT1 and the atomic time scale UTC, in 0.1 s steps. Range is ±0.8 s).
Identification signal:	Call sign in morse and announcement in minute 09, 19, 29, 49, 59 (not in 39)
Programme:	See Table 4
Time code:	None

Further information: National Standard Time Service. Chungghwa Telecom Co. Ltd.
http://www.stdtime.gov.tw

00m - 05m	Second pulses of 5 ms duration, minute pulses of 300 ms duration. 1000 Hz tone is tranmitted continuously except for a period of from 40 ms before to 40 ms after each pulse
05m - 09m	As 00m - 05m but without 1000 Hz tone transmissions
09m	Call sign and time in morse and announcement in Chinese
10m - 15m	As 00m - 05m
15m - 19m	As 00m - 05m but without 1000 Hz tone transmissions
19m	Call sign and time in morse and announcement in Chinese
20m - 25m	As 00m - 05m
25m - 29m	As 00m - 05m but without 1000 Hz tone transmissions
29m	Call sign and time in morse and announcement in Chinese
30m - 35m	As 00m - 05m
35m - 40m	Silence
40m - 45m	As 00m - 05m
45m - 49m	As 00m - 05m but without 1000 Hz tone transmissions
49m	Call sign and time in morse and announcement in Chinese
50m - 55m	As 00m - 05m
55m - 59m	As 00m - 05m but without 1000 Hz tone transmissions
59m	Call sign and time in morse and announcement in Chinese

Table 4. Schedule

CHU, Ottawa, Canada

Frequencies:	3330, 7335, 14670 kHz
Carrier accuracy:	$\Delta f / f < 5 \times 10^{-12}$
Call sign:	CHU
Location:	Ottawa, 45° 18' n, 75° 45' w
Operating hours:	Continuous
Power:	3 kW on 3330 and 14670 kHz, 10 kW on 7335 kHz
Modulation:	AM (USB only), tones and voice
	The first minute of each hour commences with a 1 s pulse of 1000 Hz tone, followed by 9 s of silence, and then the normal pattern of 0.3 s pulses of 1000 Hz at one-second intervals. The normal pattern for each of the next 59 minutes starts with a 0.5 s 1000 Hz pulse.
	DUT1 code is transmitted in seconds 1 through 16 (DUT1 is the difference between the astronomical time scale UT1 and the atomic time scale UTC, rounded to 0.1 s. The range of DUT1 is -0.8 s to +0.8 s). The DUT1 code consists of emphasized (split) seconds markers, so that a double tone is heard. When the emphasis is on seconds 1 through 8, DUT1 is positive; and when DUT1 is negative, seconds 9 through 16 are used.
	The pulse in second 29 is omitted. Following the normal pulse at 30 seconds, for a 9 s period, 1000 Hz pulses of 0.01 s occur, each followed by the CHU time code (see below). The pulses between 40 and 50 seconds are of normal length.
Identification signal:	Alternating French/English station identification in the last 10 seconds of each minute, followed by UTC time announcement, valid for the following minute. During the announcement period, the 1000 Hz seconds pulses are shortened to “ticks”.
Time code:	A time code is sent in seconds 31 through 39. The data is in the form of an FSK data stream, with 2225 Hz mark and 2025 Hz space. Each packet consists of ten bytes. There are two formats, format B for second 31 and format A for seconds 32 through 39. See Tables 5 and 6 for details.
Further information:	INMS Time Services. http://inms-ienm.nrc-cnrc.gc.ca/

0 - 10 ms	Ticking noise (10 cycles of 1000 Hz)
10 - 123.33 ms	2225 Hz mark tone
123.33 - 500 ms	Ten bytes of data at 300 bits per second. Each byte is encoded as one start bit, eight data bits and two stop bits
500 - 510 ms	2225 Hz mark tone for 10 ms
510 ms - 1000 ms	Silence until the end of the second

Table 5. Structure of seconds 31 through 39

Byte	Data	Meaning of data
1	$D_3$6	$D_3D_2D_1$ is the day of the year. 6 is a constant.
2	D_1D_2	
3	H_1H_2	H_2H_1 = UTC hour
4	M_1M_2	M_2M_1 = UTC minute
5	S_1S_2	S_2S_1 = UTC second
6	Byte 1…5 repeated	Redundancy bytes
7		
8		
9		
10		

Table 6a. Format A, transmitted in seconds 32 through 39. Each nibble is a BCD digit. Note that the nibbles are transmitted in swapped order.

Byte	Data	Meaning of data
1	ZX	Z is the absolute value of DUT1 in tenths of a second. X is encoded as follows: Bit 0 (rightmost; transmitted first): Sign of DUT1 (0 = +). Bit 1: Leap second warning. One second will be added. Bit 2: Leap second warning. One second will be subtracted. Bit 3: Even parity bit for this nibble.
2	Y_3Y_4	$Y_4Y_3Y_2Y_1$ = year
3	Y_1Y_2	
4	T_1T_2	T_2T_1 = Difference between TAI and UTC in seconds. The International Atomic Time TAI does not use leap seconds. Some other technical time scales are based on TAI, to avoid leap seconds. TAI can be calculated from UTC by: TAI = UTC + TT.
5	A_1A_2	A_2A_1 is the code number for the daylight saving time pattern in effect at this time across all time zones of Canada. The current serial number is 01, effective since 1988.
6	Byte 1…5 inverted (1's complement)	Redundancy bytes
7		
8		
9		
10		

Table 6b. Format B, transmitted in second 31. Each nibble, except X, is a BCD digit. Note that the nibbles are transmitted in swapped order.

Droitwich, United Kingdom

Frequency:	198 kHz
Carrier accuracy:	$\Delta f / f < 1 \times 10^{-11}$
Call sign:	None
Location:	Wychbold, Worcestershire, England, 57° 19' n, 02° 06' w
Operating hours:	Continuous
Power:	400 kW
Antenna	T-antenna; two 210 m high masts spaced 180 m
Modulation:	AM boadcast (BBC Radio 4 and BBC World Service) with additional phase-shift keying of ±22.5 degrees at a bit rate of 25/s for transmitting commercial data like electricity meter switching and of time code. The data is partitioned into blocks of 50 bits; there are exactly 30 blocks per minute. Each block consists of a prefix bit, a 4-bit block type identifier specifying the application of the block, 32 message bits and a 13-bit CRC word for error protection.
Time code:	Transmitted in the last block in every minute with block type identifier = 0000

Further information:
http://www.bbc.co.uk/rd/pubs/reports/1984-19.pdf
http://tx.mb21.co.uk/gallery/droitwich/droitwich-lf-data.shtml
http://en.wikipedia.org/wiki/Droitwich_transmitting_station

DCF77, Mainflingen, Germany

Frequency:	77.5 kHz
Carrier accuracy:	$\Delta f / f < 1 \times 10^{-12}$ (1 d average), $< 2 \times 10^{-13}$ (100 d average)
Call sign:	DCF77
Location:	Mainflingen, near Frankfurt, Germany, 50° 01' n, 09° 00' e
Operating hours:	Continuous
Power:	50 kW. Estimated radiated power 30 kW
Antenna	Top-loaded vertical, 150 m high. The backup antenna is 200 m high.
Modulation:	Amplitude keying. The amplitude is reduced to 25% for 100 ms or 200 ms, starting with the full second, except for second 59 (60 in case of a positive leap second). A carrier reduction of 200 ms corresponds to a logical 1. Pseudorandom phase shift keying (PRPSK), see Figure 1. At the receiver side the second markers can be determined by a cross correlation technique, which is much more accurate than measuring the arrival time of the amplitude-keyed time signals. This modulation causes the "noisy" sound of the DCF77 signal.
Identification signal:	The callsign is transmitted twice in Morse code in minutes 19, 39 and 59, seconds 20 to 32, in AM; the amplitude is switched between 85% and 100% with a 250 Hz rectangular waveform. This signal will probably be omitted in the future.
Time code:	See Table 7 on page 12
Further information:	Physikalisch-Technische Bundesanstalt. http://www.ptb.de

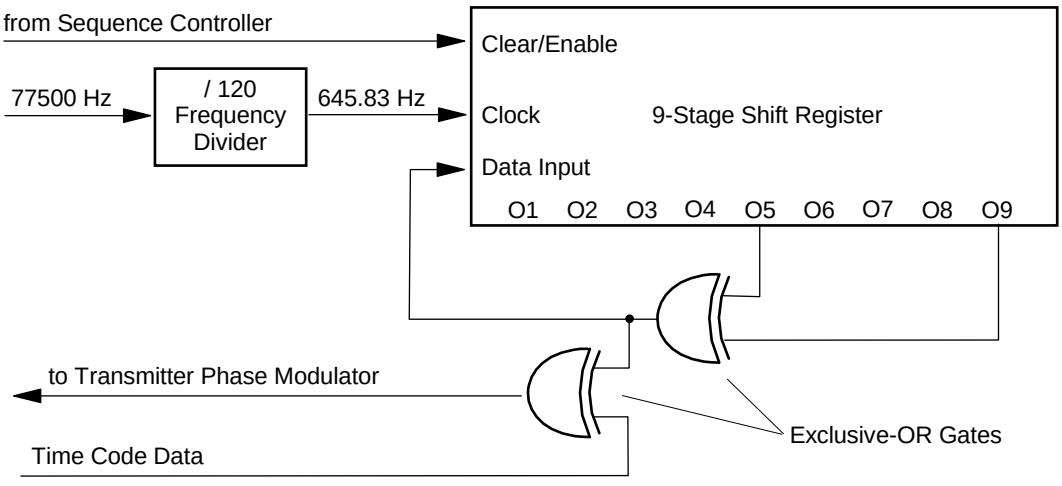

Figure 1a. A pseudo random sequence of 512 steps is generated by means of a feedback shift register. Not shown is a mechanism to force the shift register out of the "all zero state" at the beginning of the sequence. Sequence inversion keying is used: The phase shift is inverted if a logical "1" is transmitted.

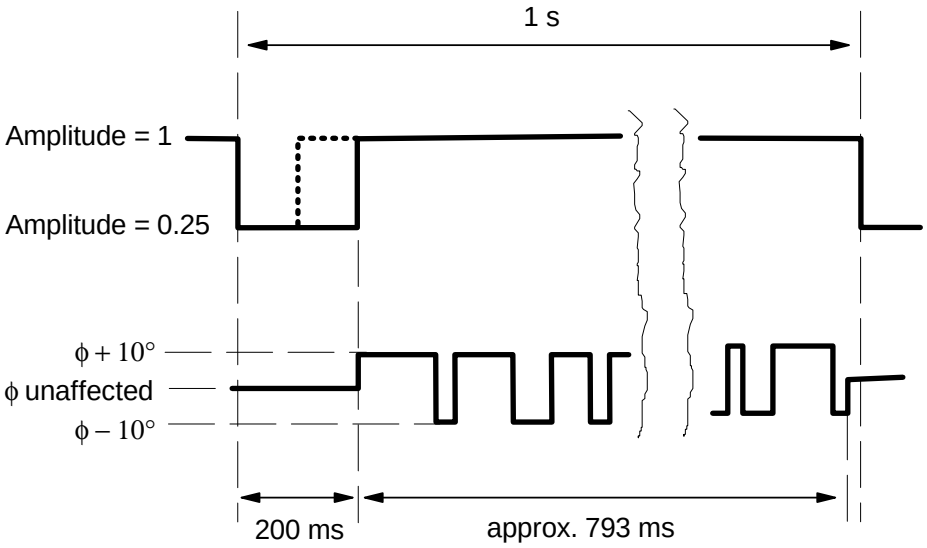

Figure 1b. The 512 step pseudorandom sequence starts 200 ms after the full second, defined by the falling edge of the amplitude, and ends about 7 ms before the next second. This ensures that the falling edge is not disturbed. The transmitter phase is shifted by ±10 degrees. Note: Timing in this sketch is not to scale.

France Inter, Allouis, France

Frequency:	162 kHz
Carrier accuracy:	$\Delta f / f < 1 \times 10^{-12}$ (1 d average)
Call sign:	None. Broadcast station with "inaudible" time subcode
Location:	Allouis, NW Bourges, 47° 10' n, 02° 12' e
Operating hours:	Continuous
Power:	2000 kW (1000 kW at night 00 - 06h)
Modulation:	AM broadcast with additional phase-shift keying of ±1 Rad (57 degrees) for time code, see figure 2
Identification signal:	None
Time code:	Similar to DCF77. See Table 7 on page 11
Further information:	http://www.emetteurs.fr.fm (private site)

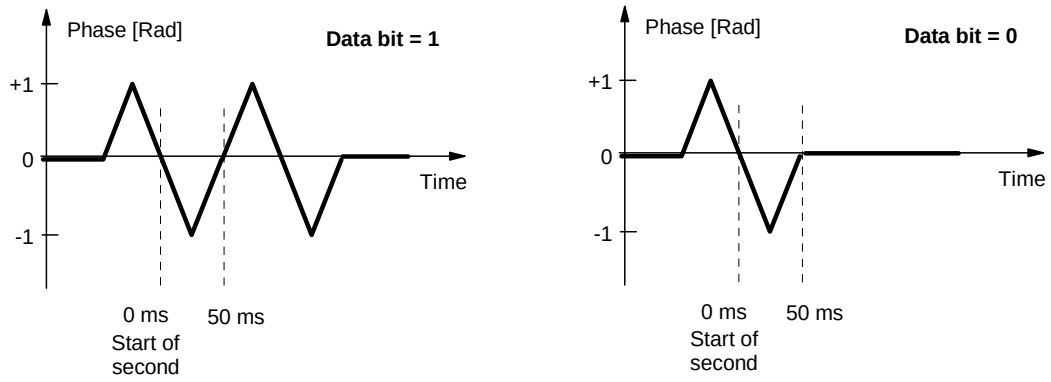

Figure 2. Phase shift keying of France Inter on 162 kHz. The rise and fall time of 1 Rad / 25 ms corresponds to a frequency shift of ± 6 Hz, which is inaudible in the audio broadcast signal. There are either one or two cycles of 100 ms at the begin of each second (except second 59), depending on whether a logical "0" or a "1" is transmitted.

HBG, Prangins, Switzerland

Frequency:	75 kHz
Carrier accuracy:	$\Delta f / f < 2 \times 10^{-12}$
Call sign:	HBG
Location:	Prangins, 46° 24' n, 06° 15' e
Operating hours:	Continuous
Power:	20 kW
Modulation:	Amplitude keying: Amplitude reduced for 100 ms or 200 ms, starting with the full second, except in second 59. A carrier reduction of 200 ms corresponds to a logical 1. Second 00 is marked by a double pulse, i.e. two 100 ms carrier reductions, spaced by a 100 ms full carrier interval. There are three pulses at the full hour and four pulses every 12 hours.
Identification signal:	None
Time code:	Similar to DCF77. See Table 7
Further information:	Bundesamt für Metrologie und Akkreditierung Schweiz (METAS) http://www.official-time.ch, http://www.metas.ch

Second	Value	Meaning
0	M	Minute marker; M = 0, double pulse for HBG
1		Currently used on DCF77 and HBG for weather forcasts. The service is provided by Meteo Time GmbH, Switzerland (www.meteotime.ch) and uses an encrypted proprietary code. Note: The DCF77 pseudo random PSK is inverted (= data set to logical “1”) in seconds 0 to 9. This serves as the minute identifier in the PRPSK signal.
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15	R	R = 1 if backup antenna is used (DCF77 only)
16	A1	A1 = 1 during the hour preceding Z1/Z2 change (HBG: 12 hours)
17	Z1	Z1/Z2 = 01 during MEZ (Winter); Z1/Z2 = 10 during MESZ (Summer)
18	Z2	
19	A2	A2 = 1 during hour preceding leap second (HBG: 12 hours)
20	S	Start of time code; always 1
21	1	BCD Minute
22	2	
23	4	
24	8	
25	10	
26	20	
27	40	
28	P1	Parity: Sum of bit 21…27
29	1	BCD Hour
30	2	
31	4	
32	8	
33	10	
34	20	
35	P2	Parity: Sum of bit 29…34
36	1	BCD Day-of-Month
37	2	
38	4	
39	8	
40	10	
41	20	
42	1	BCD Day-of-Week
43	2	
44	4	
45	1	BCD Month
46	2	
47	4	
48	8	
49	10	
50	1	BCD Year (00…99)
51	2	
52	4	
53	8	
54	10	
55	20	
56	40	
57	80	
58	P3	Parity: Sum of bit 36…57
59	–	No modulation

Table 7. DCF77, France Inter and HBG time code

HD2IOA, Guayaquil, Ecuador

Frequencies:	1510, 3810, 5000, 7600 kHz Note: No observations on other frequencies than 3810 kHz reported recently
Call sign:	HD 2 IOA
Location:	Guayaquil, 02°16’ s, 79° 54’ w
Operating hours:	1510 kHz: Continuous 3810 kHz: 0000 - 1200 5000 kHz: 1200 - 1300 7600 kHz: 1300 - 2400
Power:	1 kW on 3810, 5000 and 7600 kHz
Modulation:	AM, LSB only on 3810, 5000 and 7600 kHz. 1000 Hz tone pulses and voice. See Table 8
Identification signal:	On 3810 and 7600 kHz, the call sign is transmitted in 59m15s through 59m50s of every hour
Further information:	Instituto Oceanográfico de la Armada del Ecuador. http://www.inocar.mil.ec/instit/d_ayuda/elect.php

00s	Minute pulse, 300 ms duration
01s - 28s	Second pulses, 100 ms duration
29s	Silence
30s - 50s	Second pulses, 100 ms duration
51s	Silence
52s - 58s	Voice announcement of time
59s	Silence

Table 8. Minute schedule

JJY, Japan

Frequencies: 40 kHz and 60 kHz

Carrier accuracy: $\Delta f / f < 10^{-12}$

Call sign: JJY

Location 40 kHz: Ohtakadoyayama, Fukushima prefecture, 37° 22' n, 140° 51' e

Location 60 kHz: Haganeyama, Saga prefecture, Kyushu Isl., 33° 28' n, 130° 11' e

Operating hours: Continuous

Power: 50 kW (radiated power > 10 kW)

Antenna: Top-loaded umbrella type antenna. 40 kHz: 250 m high, 60 kHz: 200 m high

Modulation: Amplitude keying: Positive pulses of 0.8 s duration (time code binary zero), 0.5 s (binary one) and 0.2 s (various markers). Amplitude in-between pulses is 10% of pulse level.

Identification signal: Call sign in morse in minute 15 and 45 in second 40 through 48

Time code: Japan Standard Time in binary coded decimal (BCD), see Table 9

Further information: National Institute of Information and Communications Technology NICT, Japan Standard Time Group. http://jjy.nict.go.jp/

Second	Value	Meaning	Second	Value	Meaning
0	M	Minute marker (0.2 s)	30	8	BCD Day; 1 = January 1
1	40	BCD Minute	31	4	
2	20		32	2	
3	10		33	1	
4	"0"		34	"0"	(always 0.8 s)
5	8		35	"0"	
6	4		36	PA1	Parity bits. PA1= (20h + 10h + 8h + 4h + 1h) mod 2, PA2 = (40m + 20m + 10m + 8m + 4m + 2m + 1m) mod 2
7	2		37	PA2	
8	1		38	SU1	Spare bit or summer time information, see Table 9c
9	P1	Position marker (0.2 s)	39	P4	Position marker (0.2 s)
10	"0"	(always 0.8 s)	40	SU2	Spare bit or summer time information, see Table 9c
11	"0"		41	80	BCD Year
12	20	BCD Hour	42	40	
13	10		43	20	
14	"0"		44	10	
15	8		45	8	
16	4		46	4	
17	2		47	2	
18	1		48	1	
19	P2	Position marker (0.2 s)	49	P5	Position marker (0.2 s)
20	"0"	(always 0.8 s)	50	4	Day of week; 0 = Sunday
21	"0"		51	2	
22	200	BCD Day; 1 = January 1	52	1	
23	100		53	LS1	LS1, LS2 = 00 = no leap second within one month, 11 = positive, 10 = negative leap second within one month
24	"0"		54	LS2	
25	80		55	"0"	(always 0.8 s)
26	40		56	"0"	
27	20		57	"0"	
28	10		58	"0"	
29	P3	Position marker (0.2 s)	59	P0	Position marker (0.2 s)

Table 9a. JJY time code (except in minute 15 and 45, see Table 9b)

Second	Value	Meaning	Second	Value	Meaning
0	M	Minute marker (0.2 s)	30	8	BCD Day; 1 = January 1
1	40	BCD Minute	31	4	
2	20		32	2	
3	10		33	1	
4	“0”		34	“0”	(always 0.8 s)
5	8		35	“0”	
6	4		36	PA1	Parity bits. PA1= (20h + 10h + 8h + 4h + 1h) mod 2, PA2 = (40m + 20m + 10m + 8m + 4m + 2m + 1m) mod 2
7	2		37	PA2	
8	1		38	"0"	
9	P1	Position marker (0.2 s)	39	P4	Position marker (0.2 s)
10	“0”	(always 0.8 s)	40		Call sign
11	“0”		41		
12	20	BCD Hour	42		
13	10		43		
14	“0”		44		
15	8		45		
16	4		46		
17	2		47		
18	1		48		
19	P2	Position marker (0.2 s)	49	P5	Position marker (0.2 s)
20	"0"	(always 0.8 s)	50	ST1	Station maintenance information, see Table 9d
21	“0”		51	ST2	
22	200	BCD Day; 1 = January 1	52	ST3	
23	100		53	ST4	
24	“0”		54	ST5	
25	80		55	ST6	
26	40		56	“0”	(always 0.8 s)
27	20		57	“0”	
28	10		58	“0”	
29	P3	Position marker (0.2 s)	59	P0	Position marker (0.2 s)

Table 9b. JJY time code in minute 15 and 45. Shaded areas: Differences to Table 9a

SU1	SU2	Meaning
0	0	No change to summer time within 6 days
1	0	Change to summer time within the next 6 days
0	1	During summer time: No change to regular time within 6 days
1	1	During summer time: Summer time will end within 6 days

Table 9c. Summertime information bits SU1 and SU2

	ST1	ST2	ST3	Meaning
Starting notice	0	0	0	No information available
	0	0	1	Transmission break within 7 days
	0	1	0	Transmission break within 3 to 6 days
	0	1	1	Transmission break within 2 days
	1	0	0	Transmission break within 24 hours
	1	0	1	Transmission break within 12 hours
	1	1	0	Transmission break within 2 hours

	ST4	Meaning
Status information	1	Daytime only
	0	All day, or no information available

	ST5	ST6	Meaning
Period information	0	0	No information available
	0	1	More than 7 days or unknown period
	1	0	2 to 6 days
	0	1	Less than 2 days

Table 9d. Station maintenance information bits ST1…ST6

LOL, Buenos Aires, Argentina

Frequencies:	5000, 10000, 15000 kHz (5000 and 10000 announced temporary inactive in 2002 and 2003)
Carrier accuracy:	$\Delta f / f < 2 \times 10^{-10}$
Call sign:	LOL
Location:	Buenos Aires, 34°37's, 58° 21'w
Operating hours:	1100-1200, 1400-1500, 1700-1800, 2000-2100, 2300-2400
Power:	2 kW
Modulation:	AM; 440 Hz and 1000 Hz tones and voice
	The begin of each second is marked with a 5 ms long tick (5 periods of 1000 Hz), except second 59.
Identification signal:	Call sign in morse and announcement, see Table 10
Programme:	See Table 9
Time code:	None
Further information:	Observatorio Naval Buenos Aires. http://www.hidro.gov.ar

Minutes after the full hour						**Transmission content**
00 - 03	10 - 13	20 - 23	30 - 33	40 - 43	50 - 53	1000 Hz tone
03 - 05	13 - 15	23 - 25	33 - 35	43 - 45	53 - 55	Call sign "LOL" in Morse, announcement "Observatoria Naval – Argentina" and time announcement
05 - 08	15 - 18	25 - 28	35 - 38	45 - 48		440 Hz tone. From 55m to 58m silence except second tics
08 - 10	18 - 20	28 - 30	38 - 40	48 - 50	58 - 60	Call sign "LOL" in Morse, announcement "Observatoria Naval – Argentina" and time announcement

Table 10. LOL hourly transmission scheme

MSF, Anthorn, United Kingdom

Frequency:	60.0 kHz
Carrier accuracy:	$\Delta f / f < 2 \times 10^{-12}$
Call sign:	MSF
Location:	Anthorn, England, 54° 55' n, 03° 15' w (as of 01 April 2007)
	Rugby, England, 52° 22’ n, 01° 11’ w (until 31 March 2007)
Operating hours:	Continuous
Power:	15 kW estimated "equivalent monopole radiated power" (ERMP)
Modulation:	On-off keying (A1B), see Figure 3
Time code:	See Table 11. In minutes lengthened or shortened by a positive or negative leap second, the second numbers 17 through 59 are correspondingly increased or decreased by one (i.e. during these 61- or 59-second minutes, the position of the time and date code is shifted by one second relative to the start of the minute).
Further information:	National Physics Laboratory Time & Frequency Service. http://www.npl.co.uk/time/

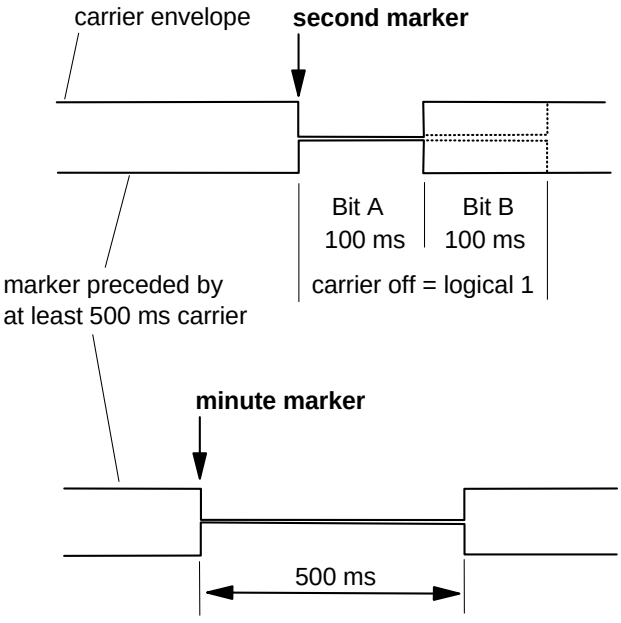

Fig 3. MSF amplitude keying

Data Bit A (100 - 200 ms after full second)			Data Bit B (200 - 300 ms after full second)		
Second	**Value**	**Meaning**	**Second**	**Value**	**Meaning**
0	“1”	Minute marker	0	“1”	Minute marker
1		Reserved. Currently set to “0”	1	+100 ms	DUT1 Difference between astronomical time UT1 and atomic time UTC, rounded to the nearest 100 ms in the range ±800 ms. Example: If DUT1 = +0.3, data bit B of seconds 1…3 are set to 1
2			2	+100 ms	
3			3	+100 ms	
4			4	+100 ms	
5			5	+100 ms	
6			6	+100 ms	
7			7	+100 ms	
8			8	+100 ms	
9			9	-100 ms	
10			10	-100 ms	
11			11	-100 ms	
12			12	-100 ms	
13			12	-100 ms	
14			14	-100 ms	
15			15	-100 ms	
16			16	-100 ms	
17	80	Binary-Coded-Decimal (BCD) Year (00…99)	17		Reserved. Currently set to “0”
18	40		18		
19	20		19		
20	10		20		
21	8		21		
22	4		22		
23	2		23		
24	1		24		
25	10	BCD Month (01…12)	25		
26	8		26		
27	4		27		
28	2		28		
29	1		29		
30	20	BCD Day-of-Month (01…31)	30		
31	10		31		
32	8		32		
33	4		33		
34	2		34		
35	1		35		
36	4	BCD Day-of-Week (0…6; 0 = Sunday)	36		
37	2		37		
38	1		38		
39	20	BCD Hour (00…23)	39		
40	10		40		
41	8		41		
42	4		42		
43	2		43		
44	1		44		
45	40	BCD Minute (00…59)	45		
46	20		46		
47	10		47		
48	8		48		
49	4		49		
50	2		50		
51	1		51		
52	“0”	This sequence 01111110 never appears elsewhere in bit A, so it uniquely identifies the following minute marker.	52		
53	“1”		53	“1” during 61 minutes before Bit 58B changes	
54	“1”		54	Parity: Sum of bit 17A…24A + 1	
55	“1”		55	Parity: Sum of bit 25A…35A + 1	
56	“1”		56	Parity: Sum of bit 36A…38A + 1	
57	“1”		57	Parity: Sum of bit 39A…51A + 1	
58	“1”		58	“1” during Summer time (UK civil time = UTC + 1)	
59	“0”		59	“0”	

Table 11. MSF time code

RBU, Moscow, Russia

Frequency:	66.67 kHz (= 200 kHz divided by 3)
Carrier accuracy:	$\Delta f / f < 2 \times 10^{-12}$
Call sign:	RBU
Location:	Moscow, 55° 48’ n, 38° 18’ e
Operating hours:	Continuous
Power:	10 kW
Modulation:	Carrier keyed off for 5 ms at 100 ms intervals. AM subcarrier 100 Hz and 312.5 Hz (modulation index m = 0.7) for second and minute identification and time code, see Figure 4.
Time code:	See Table 12

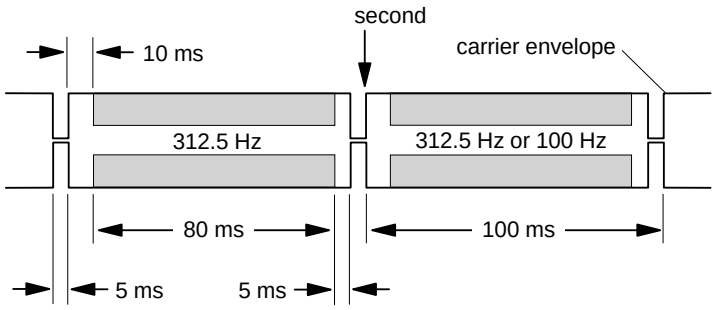

Figure 4a. Signal detail

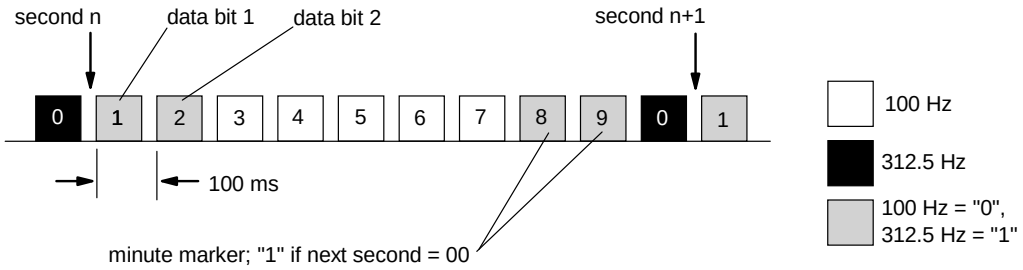

Figure 4b. Relationship between subcarrier frequencies and data

Data Bit 1			Data Bit 2		
Second	**Value**	**Meaning**	**Second**	**Value**	**Meaning**
0	“1”		0	“1”	
1	“0”		1	+100 ms	DUT1 Difference between astronomical time UT1 and atomic time UTC, rounded to the nearest 100 ms in the range ±800 ms. Example: If DUT1 = +0.3, data bit 2 of seconds 1…3 are set to 1
2	“0”		2	+100 ms	
3	*	dUT1 additional 20 ms steps for increased accuracy of DUT1	3	+100 ms	
4	*		4	+100 ms	
5	*		5	+100 ms	
6	*		6	+100 ms	
7	± (1 = negative)		7	+100 ms	
8	“0”		8	+100 ms	
9	“0”		9	-100 ms	
10	“0”		10	-100 ms	
11	*		11	-100 ms	
12	*		12	-100 ms	
13	*		12	-100 ms	
14	*		14	-100 ms	
15	± (1 = negative)		15	-100 ms	
16	“0”		16	-100 ms	
17	“0”		17	“0”	
18	± (1 = negative)	ΔUT Difference between transmitted time and UTC, in hours (+3 in winter, +4 in summer)	18	8 000	TJD The 4 least significant digits of the Julian day number. Example: For 3 December 2000 at 0 UTC, JD is 2451881.5, TJD is 1881. Note: TJD does not change at 12 UTC, although the Julian day begins at noon.
19	10		19	4 000	
20	8		20	2 000	
21	4		21	1 000	
22	2		22	800	
23	1		23	400	
24	0		24	200	
25	80	Y year	25	100	
26	40		26	80	
27	20		27	40	
28	10		28	20	
29	8		29	10	
30	4		30	8	
31	2		31	4	
32	1		32	2	
33	10	M month	33	1	
34	8		34		reserved
35	4		35		
36	2		36		
37	1		37		
38	4	d_w day of week (1 = monday)	38		
39	2		39		
40	1		40		
41	20	d_M day of month	41		
42	10		42		
43	8		43		
44	4		44		
45	2		45		
46	1		46		
47	20	h hour	47		
48	10		48		
49	8		49	TJD sec. 18-25	parity bits (even parity)
50	4		50	TJD sec. 26-33	
51	2		51	reserved	
52	1		52		
53	40	m minute	53	ΔUT	
54	20		54	Y	
55	10		55	M + dW	
56	8		56	dM	
57	4		57	h	
58	2		58	m	
59	1		59	0	

Table 12: RBU time code transmitted in data bits 1 and 2, valid for the following minute

RWM, Moscow, Russia

Frequencies:	4996, 9996, 14996 kHz
Carrier accuracy:	$\Delta f / f < 1 \times 10^{-11}$
Call sign:	RWM
Location:	Moscow, 55° 48’ n, 38° 18’ e
Operating hours:	Continuous
Power:	5 kW on 4996 and 9996 kHz, 8 kW on 14996 kHz
Modulation:	On-off keying (A1B)
Identification signal:	Call sign in Morse in minutes 09 and 39
Programme:	Schedule repeats every 30 minutes, see Table 13
Time code:	None

00m00s - 07m55s	30m00s - 37m55s	Unmodulated carrier
08m00s - 09m00s	38m00s - 39m00s	No transmission
09m00s - 09m55s	39m00s - 40m55s	"rwm rwm rwm …" in Morse code (before 2004: “vvv cq cq cq de rwm rwm rwm”)
10m00s - 19m55s	40m00s - 49m55s	1 Hz pulses with UT1-UTC code, see Figure 5. Pulse duration = 100 ms, minute pulse = 500 ms
20m00s - 29m55s	50m00s - 59m55s	10 Hz pulses. Duration = 20 ms, second pulse = 40 ms, minute pulse = 500 ms

Table 13. RWM hourly transmission schedule

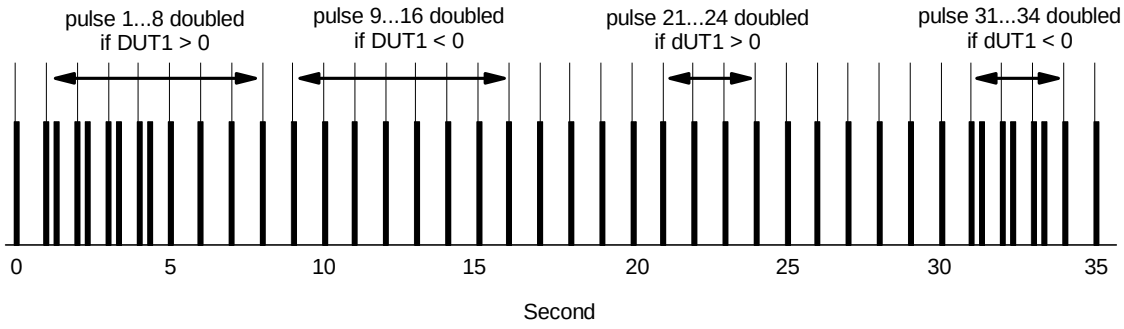

Figure 5. Coding of the deviation between astronomical time UT1 and atomic time UTC. The difference in seconds is given by 0.1 x DUT1 + 0.02 x dUT1. In this example, DUT1 is +4 and dUT1 is -3, hence UT1 - UTC = +0.34 seconds.

RTZ, Irkutsk, Russia

Frequency: 50.0 kHz

Carrier accuracy: $\Delta f / f < 5 \times 10^{-12}$

Call sign: RTZ

Location: Irkutsk, Russia, 52° 26' n, 103° 41' e

Operating hours: Winter 22 - 21, summer 21 - 20 UTC (01 - 24 Moscow time). Note: The transmission is often resumed before the end of the scheduled one-hour break.

Power: 10 kW

Modulation: On-off keying (A1B)

Identification signal: Call sign in Morse in minute 05

Programme: Repeats every 60 minutes, see Table 14

Time code: None

00m00s - 04m55s	1 Hz pulses with UT1-UTC code similar to RWM Moscow, see Figure 5
05m00s - 06m00s	Call sign RTZ in Morse code
06m00s - 58m55s	Unmodulated carrier
59m00s - 59m55s	10 Hz pulses

Table 14. RTZ transmission schedule

RAB99, RJH63, RJH66, RJH69, RJH77, RJH99

Frequency: 25.0 kHz. Additional transmissions on 20.5, 23.0, 25.1 and 25.5 kHz, see Table 15

Carrier accuracy: $\Delta f / f < 5 \times 10^{-12}$

Call signs: Russian Navy related call signs; See Table 14

Locations: Various Russian Navy sites; See Table 14

Operating hours: See Table 14

Power: 300 kW

Modulation: On-off keying (A1B)

Identification signal: Call sign in Morse in minute 06

Programme: See Table 16

Time code: None

Further information: Trond Jabobsen: *The Russian VLF Time-Signal Stations "Beta",* December 2000. Available at http://www.vlf.it.

Call sign	Location	Operating hours winter	Operating hours summer	No transmission (day of month, see Note 1)
RAB99	Khabarovsk, Russia 48° 30'n, 134° 50'e	0206 - 0240 0606 - 0640	0106 - 0140 ? 0506 - 0540 ?	10., 20., 30.
RJH63	Krasnodar, Russia 44° 46'n, 39° 34'e	1106 - 1140	1006 - 1040	3., 13., 23.
RJH66	Bishkek, Kirgizia 43° 03'n, 73° 37'e	0406 - 0447 1006 - 1047	0306 - 0347 0906 - 0947	6., 16., 26.
RJH69	Molodecno, Belorussia 54° 28'n, 26° 47'e	0706 - 0747	0606 - 0647	2., 12., 22.
RJH77	Arkhangelsk, Russia 64° 22'n, 41° 35'e	0906 - 0947	0806 - 0847	4., 14., 24.
RJH99	Nizhniy Novgorod, Russia 56° 11'n, 43° 57'e	0506 - 0547	0406 - 0447	8., 18., 28.
Note 1: Definetely no transmission on these dates, but emissions are often missing at other times as well. About once per year, each station has been noted off air for a period of weeks to months.				

Table 15. Call signs, locations and transmission times (UTC)

Transmitting time RJH66/69/77/99	Transmitting time RJH63, RAB99	Transmitted pattern
06m00s - 07m00s	06m00s - 07m00s	Call sign in morse code
07m00s - 10m00s	07m00s - 09m00s	Unmodulated carrier
10m00s - 13m00s	09m00s - 11m00s	40 Hz pulses
13m00s - 22m00s	11m00s - 20m00s	10 Hz, 1 Hz, 1/10 Hz, 1/60 Hz pulses
22m00s - 25m00s	not available	40 Hz pulses
25m00s - 27m00s	20m00s - 21m00s	Reserved fo tuning break
27m00s - 30m00s	21m00s - 23m00s	Unmodulated carrier on 25.1 kHz
30m00s - 32m00s	23m00s - 24m00s	Reserved for tuning break
32m00s - 35m00s	24m00s - 26m00s	Unmodulated carrier on 25.5 kHz
35m00s - 38m00s	26m00s - 29m00s	Reserved for tuning break
38m00s - 41m00s	29m00s - 31m00s	Unmodulated carrier on 23.0 kHz
41m00s - 44m00s	31m00s - 34m00s	Reserved for tuning break
44m00s - 47m00s	34m00s - 36m00s	Unmodulated carrier on 20.5 kHz
not available	36m00s - 40m00s	50 Baud 100 Hz shift FSK on 20.5 kHz. Unknown system; word length 10 bits, block length 100 bits. Observations on RJH63 in March 2003: All blocks contained the same data; one data word was transmitted 10 times either normal or bit-inverted, according to some toggling scheme.

Table 16. Schedule

Pulse rate in Hz	40	10	1	1/10	1/60
Pulse width	12.5 ms	25 ms	100 ms	1 s	10 s

Table 17. Nominal pulse durations

WWV, Fort Collins, USA and WWVH, Kekaha, Hawaii

Frequencies:	2500, 5000, 10000, 15000, WWV also on 20000 kHz
Carrier accuracy:	$\Delta f / f < 1 \times 10^{-11}$
Call signs:	WWV and WWVH
Location WWV:	Fort Collins, Colorado, 40° 41' n, 105° 02' w
Location WWVH:	Kekaha (Island of Kauai), 21° 59' n, 159° 46' w
Operating hours:	Continuous
Power:	Radiated power: 2.5 kW on 2.5 MHz (WWVH: 5 kW), 10 kW on 5/10/15 MHz, 2.5 kW on 20 MHZ
Modulation:	AM. Various tones and voice announcements, see Table 18 and 19. Second pulses: 1000 Hz, 5 ms duration. Minute pulses: 1000 Hz, 800 ms. Hour pulses: 1500 Hz, 800 ms. Each seconds pulse is preceded by 10-ms of silence and followed by 25-ms of silence. A time code is transmitted on a 100 Hz subcarrier. Modulation level is 100% for the second, minute and hour pulses, 50% for the steady tones, 50% for the BCD time code and 75% for the voice announcements. DUT1 code is transmitted in seconds 1 through 16 of each minute by doubling ticks. The value of DUT1 (the difference between astronomical time UT1 and UTC) is determined by the number of successive doubled ticks. If the doubled ticks are in the first 8 s, the DUT1 is positive; if they are in seconds 9-16, DUT1 is negative.
Antennas:	Omnidirectional half-wave vertical antennas. WWVH uses two-element half-wave verticals for 5/10/15 MHz, radiating a cardioid pattern with the maximum gain pointed toward the west.
Identification signal:	Announcement in minutes 00 and 30 (WWV), minutes 29 and 59 (WWVH)
Time code:	100 Hz subcarrier, BCD code, one bit per second. The pulses begin 30 ms after the start of a second. A 170 ms pulse represents a "0" bit, a 470 ms pulse represents a "1". During the first second of a minute, no pulse is transmitted. A position identifier lasting 770 ms is transmitted every 10 s. See Table 20.
Further information:	National Institute of Standards and Technology NIST, Time and Frequency Division. http://www.boulder.nist.gov/timefreq/

Minute	Second	WWV	WWVH
Even	00 s - 45 s	Special announcement or 500 Hz tone	600 Hz tone
	45 s - 52.5 s	Silent except tick	UTC female voice announcement
	52.5 s - 60 s	UTC male voice announcement	Silent except tick
Odd	00 s - 45 s	600 Hz tone	Special announcement or 500 Hz tone
	45 s - 52.5 s	Silent except tick	UTC female voice announcement
	52.5 s - 60 s	UTC male voice announcement	Silent except tick

Table 18. WWV and WWVH minute format

Minute	WWV	Minute	WWVH
0	Station ID	0	No audio tone
1		1	440 Hz 1-hour mark
2	440 Hz 1-hour mark	2	
3		3	NIST reserved
4	NIST reserved	4	
5		5	
6		6	
7		7	
8	Storm information	8	No audio tone
9		9	
10		10	
11		11	
12		12	
13		13	
14	GPS reports	14	No audio tone
15		15	
16		16	
17		17	
18	Geo alerts	18	
19		19	
20		20	
21		21	
22		22	
23		23	
24		24	
25		25	
26		26	
27		27	
28		28	
29	No audio tone	29	Station ID
30	Station ID	30	No audio tone
31		31	
32		32	
33		33	
34		34	
35		35	
36		36	
37		37	
38		38	
39		39	
40		40	
41		41	
42		42	
43	No audio tone	43	GPS reports
44		44	
45		45	
46		46	
47		47	
48		48	Storm information
49		49	
50		50	
51		51	
52		52	
53		53	
54		54	
55		55	
56		56	
57		57	
58		58	
59	No audio tone	59	Station ID

Table 19. Hourly broadcast schedules of WWV and WWVH

Second	Value	Meaning
0		
1		
2		DST indicator #2: Changes 24 hours later than bit 55
3		“1” = Leap second will be inserted at the end of the current month
4	1	Year
5	2	
6	4	
7	8	
8		
9		Position identifier P1 (770 ms duration)
10	1	Minutes
11	2	
12	4	
13	8	
14		
15	10	
16	20	
17	40	
18		
19		Position identifier P2 (770 ms duration)
20	1	Hours
21	2	
22	4	
23	8	
24		
25	10	
26	20	
27		
28		
29		Position identifier P3 (770 ms duration)
30	1	Days
31	2	
32	4	
33	8	
34		
35	10	
36	20	
37	40	
38	80	
39		Position identifier P4 (770 ms duration)
40	100	Days
41	200	
42		
43		
44		
45		
46		
47		
48		
49		Position identifier P5 (770 ms duration)
50		DUT1 sign
51	10	Year
52	20	
53	40	
54	80	
55		DST indicator: “0” if standard itme, “1” if daylight saving time
56	0.1 s	DUT1 absolute value $\lvert UT1 - UTC \rvert$
57	0.2 s	
58	0.4 s	
59		Position identifier P0 (770 ms duration)

Table 20. WWV and WWVH time code

WWVB, Fort Collins, Colorado, USA

Frequency:	60.0 kHz
Carrier accuracy:	$\Delta f / f < 1 \times 10^{-11}$
Call sign:	WWVB
Location:	Ft. Collins, 40° 41'n, 105° 02' w
Operating hours:	Continuous
Power:	50 kW *radiated* power
Modulation:	Amplitude shift keying. The carrier power is reduced 10 dB at the start of each second (this corresponds to an amplitude reduction by factor of about 3). If full power is restored 200 ms later, it represents a "0" bit. If full power is restored 500 ms later, it represents a "1". Certain reference markers and position identifiers are sent by restoring full power after 800 ms. Eventually the modulation depth will be increased from 10 dB to 20 dB. Studies indicate that the change in dropout depth may result in the equivalent of an increase in radiated power from 50 kW to as much as 80 kW. Test transmissions have been conducted May 2005.
Antenna:	Two antennas, spaced 857 m apart. Each antenna is a top loaded dipole consisting of four 122-m towers arranged in a diamond shape.
Identification signal:	WWVB identifies itself by advancing its carrier phase 45° at 10 minutes after the hour and returning to normal phase at 15 minutes after the hour. If the WWVB phase is plotted, this results in a phase step of approximately 2.08 µs.
Time code:	See Table 21
Further information:	National Institute of Standards and Technology NIST, Time and Frequency Division. http://www.boulder.nist.gov/timefreq/

YVTO, Caracas, Venezuela

Frequency:	5000 kHz
Carrier accuracy:	$\Delta f / f < 1 \times 10^{-10}$. Note: Station was observed 35 Hz high in early 2002
Call sign:	YVTO
Location:	Caracas, 10° 30' n, 66° 56' w
Operating hours:	Continuous
Power:	1 kW
Modulation:	AM, tones and voice Each second starts with a 1000 Hz tone of 100 ms duration, except second 30, when the tone is omitted. A 800 Hz tone of 500 ms duration is emitted at the beginning of a minute. Time announcement in Spanish in seconds 52 through 57.
Identification signal:	Announcement in seconds 41…50: "Observatorio Naval Cagigal – Caracas – Venezuela"
Time code:	None
Further information:	Observatorio Naval Cagigal. http://www.dhn.mil.ve/

Second	Value	Meaning
0		Minute marker (800 ms)
1	40	Minutes
2	20	
3	10	
4		
5	8	
6	4	
7	2	
8	1	
9		Position identifier P1 (800 ms)
10		
11		
12	20	Hours
13	10	
14		
15	8	
16	4	
17	2	
18	1	
19		Position identifier P2 (800 ms)
20		
21		
22	200	Days
23	100	
24		
25	80	
26	40	
27	20	
28	10	
29		Position identifier P3 (800 ms)
30	8	Days
31	4	
32	2	
33	1	
34		
35		
36	+	DUT1 sign. Note: Inconsistent in NIST Special Publication 432, not confirmed.
37	-	
38	+	
39		Position identifier P5 (800 ms)
40	0.8 s	DUT1 absolute value: $\lvert UT1 - UTC \rvert$
41	0.4 s	
42	0.2 s	
43	0.1 s	
44		
45	80	Year
46	40	
47	20	
48	10	
49		Position identifier P5 (800 ms)
50	8	Year
51	4	
52	2	
53	1	
54		
55		Leap year indicator
56		Leap second warning
57		DST flag: “1”, if daylight saving time in effect
58		As bit 57, but changes 24 hours later
59		Position identifier P0 (800 ms)

Table 21. WWVB time code

Short glossary of terms

BIPM — *Bureau International des Poids et Mesures*. Maintains the *International Atomic Time* **TAI**. Internet address: http://www.bipm.org.

DUT1 — Predicted difference between **UT1** and **UTC**, rounded to 0.1 s. DUT1 may be regarded as a correction to be added to UTC to obtain a better approximation to UT1. The values of DUT1 are given by the **IERS**, from where also more precise values for UT1 - UTC can be obtained.

A number of time signal stations (still) transmit DUT1 values. Usually DUT1 is coded by emphasized (lengthened, doubled, or split) pulses in seconds 1 through 16 of each minute. The possible range is ±0.8 s. When the emphasis is on seconds 1 through 8, DUT1 is positive; and when DUT1 is negative, seconds 9 through 16 are emphasized.

Russian time signal stations transmit an additional quantity called dUT1 (with lowercase d) in order to increase the resolution of UT1 - UTC to 0.02 s.

GMT — *Greenwich Mean Time*. Obsolete and replaced by **UTC**.

IERS — *International Earth Rotation Service*. One of the objectives of the IERS is to study and monitor earth orientation variations. IERS announces twice yearly whether there will be a **leap second** at the end of the following June or December. The current deviation of **UT1** from **UTC** is also available from IERS (http://www.iers.org).

Leap second — An intentional time step of one second used to adjust **UTC** to ensure approximate agreement with **UT1**. An inserted second is called a positive leap second, an omitted second is called a negative leap second. A positive leap second is presently needed about once per year; normally it is inserted at the end of June.

TAI — *Temps Atomique International* or *International Atomic Time*. TAI is calculated by the **BIPM** from the readings of more than 200 atomic clocks located in metrology institutes around the world. It is estimated that TAI does not lose or gain with respect to an imaginary perfect clock by more than about 0.1 µs per year. TAI is the basis for **UTC**.

UT1 — Mean solar time obtained from direct astronomical observation and corrected for effects of small irregularities of the Earth's rotation.

UTC — *Co-ordinated Universal Time*. UTC corresponds in rate with **TAI** but differs from it by an integral number of seconds. The UTC scale is adjusted by insertion or deletion of seconds (positive or negative leap seconds) to ensure that UTC does not deviate from UT1 by more than ±0.9 s. In 1999 through 2004, the difference TAI - UTC was 32 seconds. Time signal stations broadcast UTC, or a zone time that differs from UTC by an integral number of hours.