RECOMMENDATION ITU-R TF.583-4*

TIME CODES

(Question ITU-R 110/7)

(1982-1990-1994-1995-1997)

The ITU Radiocommunication Assembly,

considering

a) that in many branches of science and technology there is a need for the dating of events which requires knowledge of the date (year, month, day) and clock time;

b) that this information can be transmitted in coded form at relatively low bit rates;

c) that such coded transmissions require relatively small bandwidths resulting in economic spectrum use and enhanced reliability in the received information;

d) that such codes are in increasingly widespread use and can be disseminated by both AM and FM broadcast services in appropriate data channels without impairing the prime service;

e) that it is important that such sources of time reference should conform with the standard for time signal emissions (see Recommendation ITU-R TF.460);

f) that commercial production now exists of low-cost radio-controlled clocks, operating from services in band 5, for both public and private use,

recommends

1 that this form of time dissemination should be encouraged;

2 the introduction of new services in areas not adequately served and also the employment of existing transmitters for time code dissemination;

3 that when a time code is operational its time-keeping should conform to the standard laid down in Recommendation ITU-R TF.460, i.e. the disseminated time should not differ from Universal Coordinated Time (UTC) by more than 1 ms;

4 that where a new service of time code dissemination is introduced its format (coding and modulation) should conform when practicable with an existing service (see Annex 1).

ANNEX 1

Information on coded timing

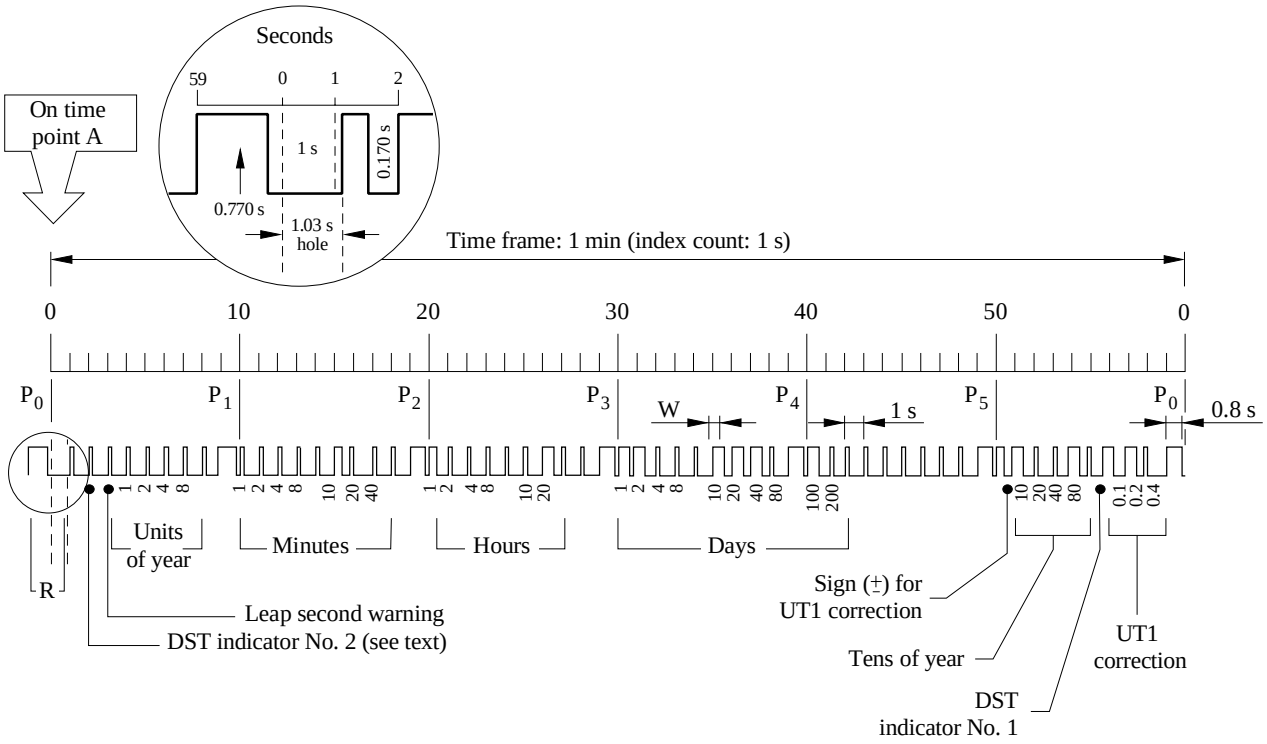
Coded timing information is conveyed in a variety of formats and transmission media. In many cases such information is disseminated in a broadcast mode either on dedicated time and frequency services or as a part of other types of broadcasts primarily intended for other purposes. Time code broadcasts are currently available using amplitude modulation, frequency modulation and phase modulation techniques. Other forms of time codes have been developed and are in wide use for transmitting time information directly from one piece of equipment to another via hardwired or other types of connection.

* This Recommendation should be brought to the attention of Radiocommunication Study Group 10.

In the remainder of this Annex some specific examples are provided both for the broadcast and the instrumentation time code types. While these codes are all currently available and widely used in at least some parts of the world, they are only representative of the total variety of codes that are in use. Examples of broadcast codes include those transmitted by the time services of WWV/WWVH, WWVB, MSF, OMA, JG2AS, JJY, DCF 77, ATA, VNG, CHU, RBU and IAM, the code generated by IEN and disseminated on the AM and FM networks by the Italian broadcasting company RAI, and by the United States GOES satellite system (see Figs. 1 to 15). To illustrate the instrumentation type of codes, several of the specific formats recommended by the United States of America Inter-Range Instrumentation Group (IRIG) are shown in Fig. 14.

FIGURE 1

WWV/WWVH time code format



Modified IRIG H format is composed of the following:
1 ppm frame reference marker R = (P_0 and 1.03 s "hole")
Binary coded decimal year and time-of-year code word
6 ppm position identifiers (P_0 through P_5)
1 pps index markers

P_0 - P_5: position identifiers (0.770 s duration)
W: weighted code digit (0.470 s duration)
Duration of index markers, unweighted code, and unweighted control elements: 0.170 s

Note 1 - *Beginning* of pulse is represented by positive-going edge.
UTC at point A: 1990, 173 days, 21 h, 10 min
UT1 at point A: 1990, 173 days, 21 h, 10 min, 0.3 s

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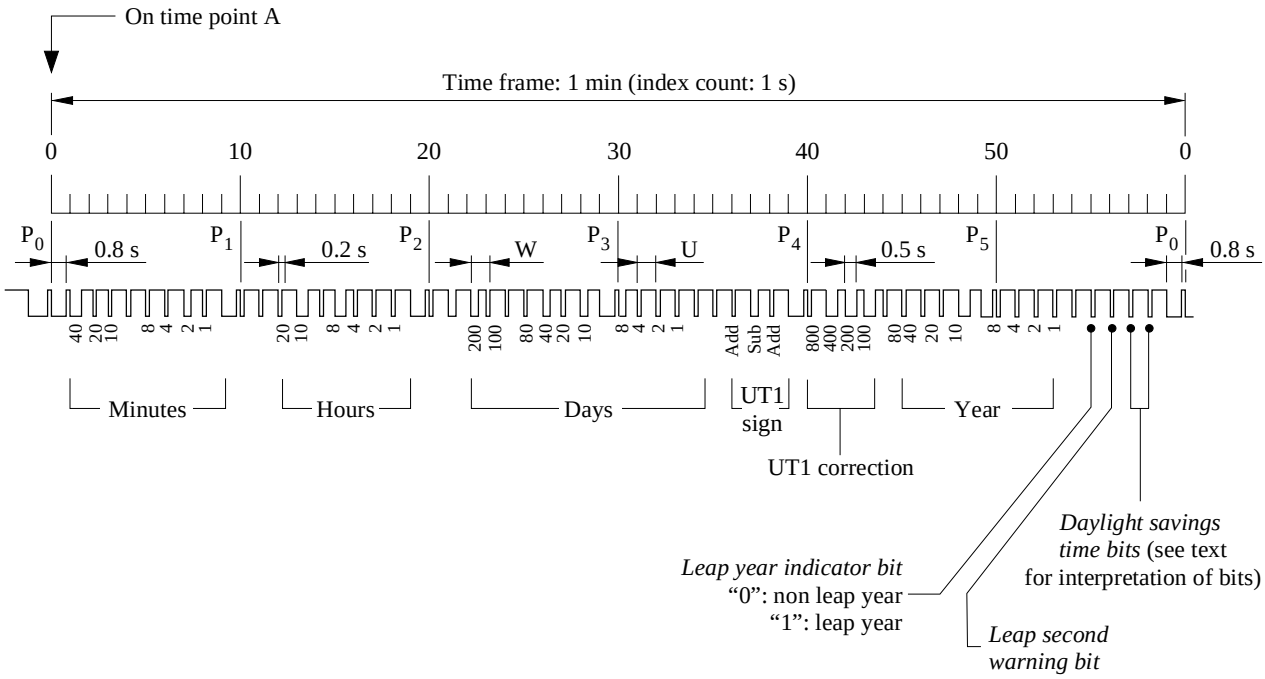
FIGURE 2

WWVB time code format



1 ppm frame reference markers
Binary coded decimal year and time-of-year code word (31 bits)
6 ppm position identifier markers (P_0 through P_5)
(reduced carrier 0.8 s duration + 0.2 s duration pulse)
W: weighted code digit (carrier restored in 0.5 s, binary one)
U: unweighted code digit (carrier restored in 0.2 s, binary zero)

UTC at point A: 1990, 258 days, 18 h, 42 min
UT1 at point A: 1990, 258 days, 18 h, 41 min, 59.3 s

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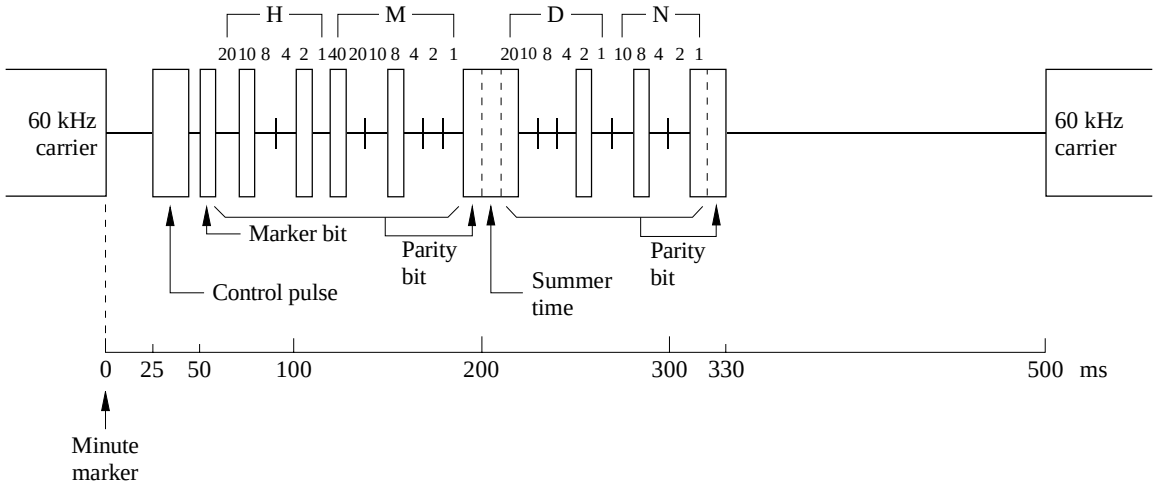
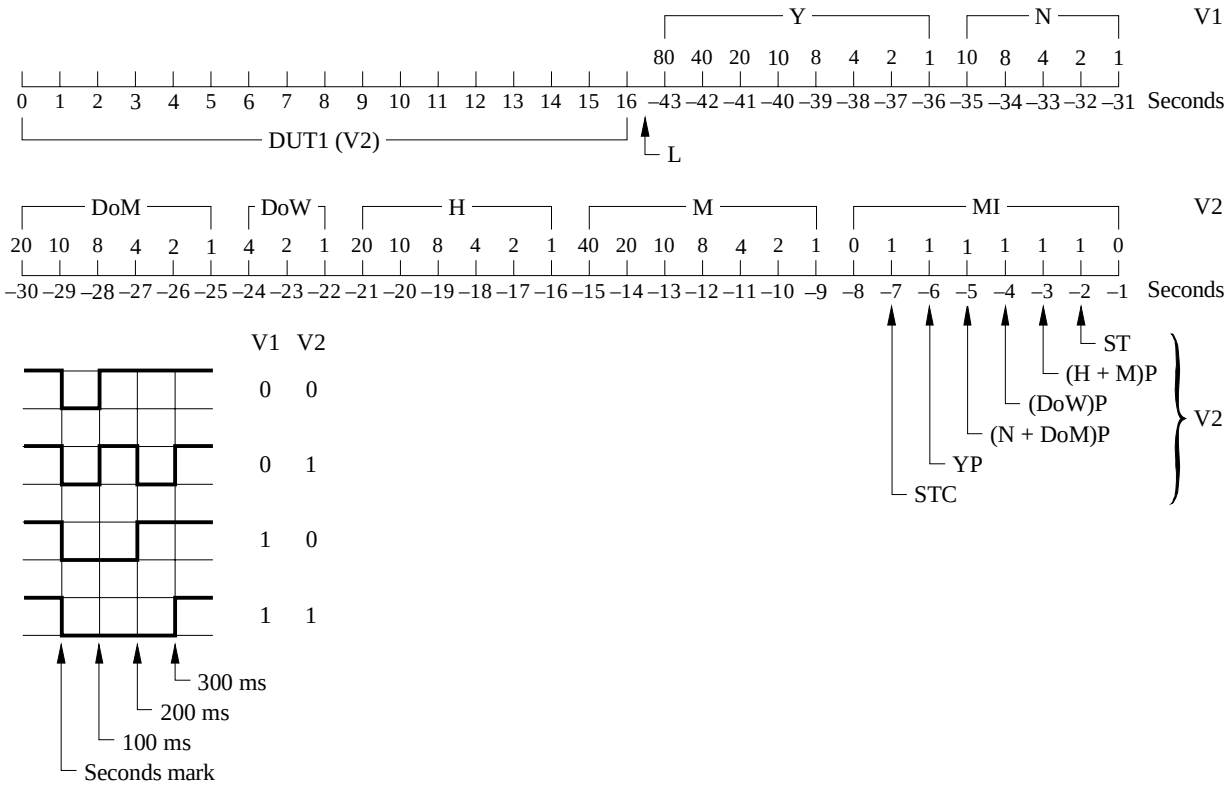
FIGURE 3

MSF time code format



Example above: 29 September, 1248 UTC, during summer time

a) MSF fast code format (60 kHz)



H: hour
M: minute
D: day
N: month

Y: year
V: level
L: leap second insertion
P: parity check bits

ST: summer time
STC: summer time change
MI: minute identifier
SR: seconds mark

DoM: day-of-month
DoW: day-of-week
0 = Sunday to
6 = Saturday

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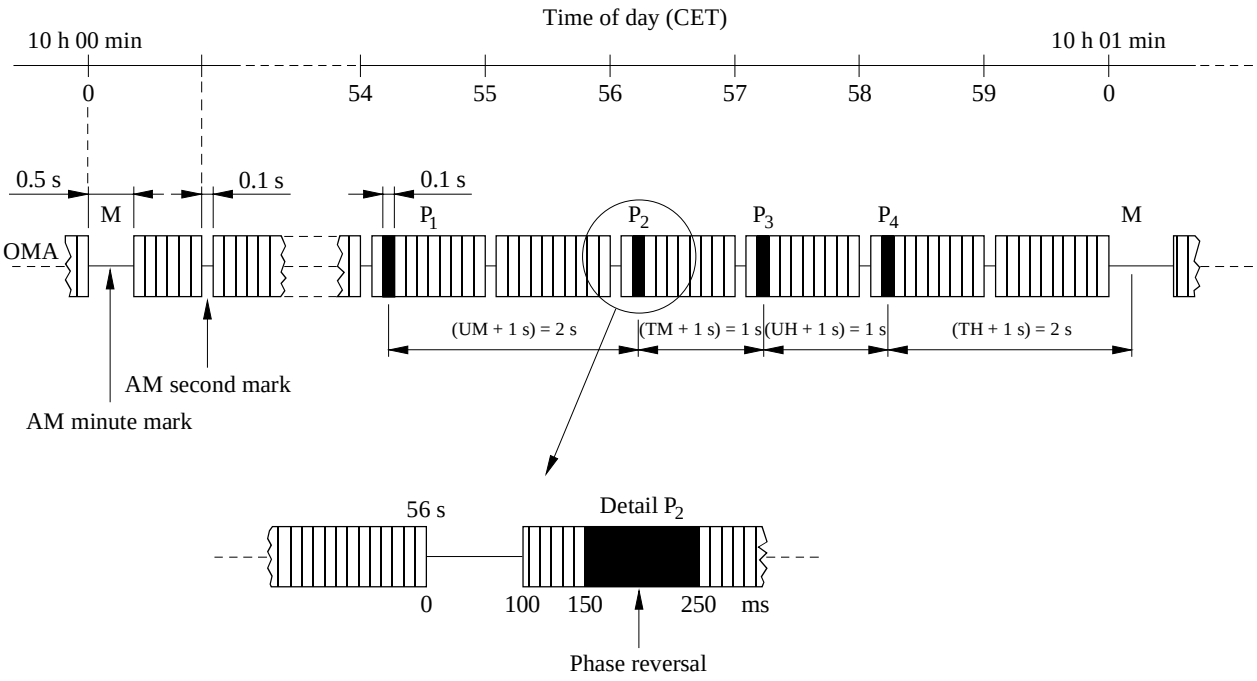
b) MSF slow code format (60 kHz)

FIGURE 4

OMA time code format (50 kHz)



UM: units of minutes
TM: tens of minutes
UH: units of hours
TH: tens of hours

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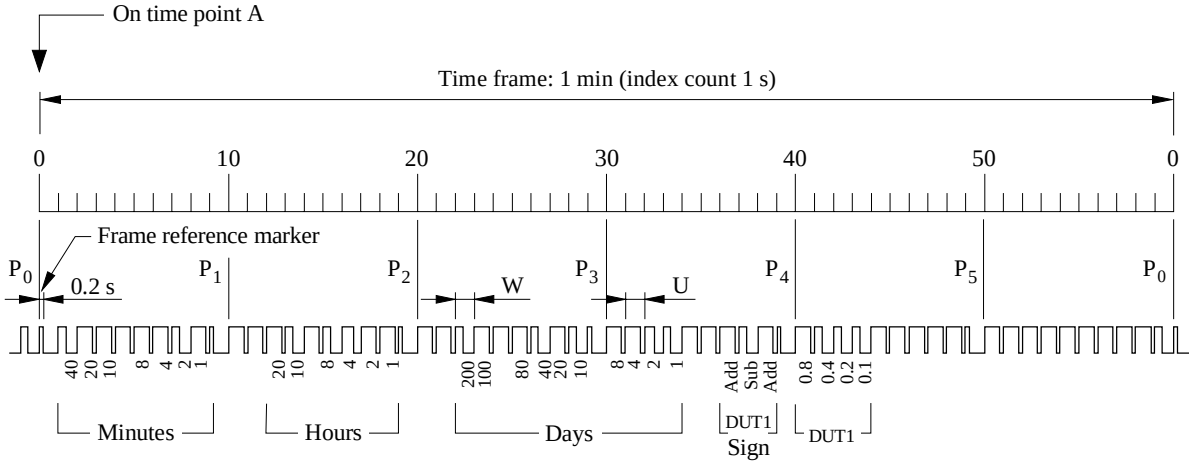
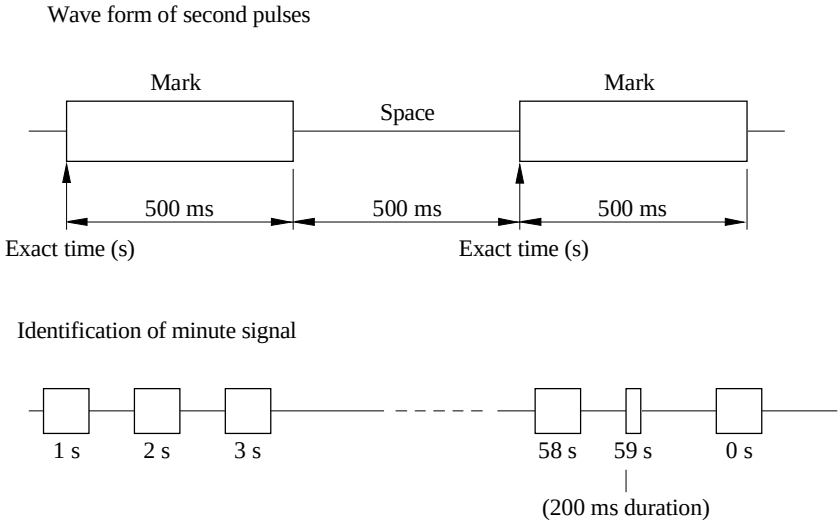
FIGURE 5

JG2AS time code format



a) Format A

Binary coded decimal time-of-year code word (23 bits)
6 ppm position identifier markers (P_0 through P_5) (carrier of 0.2 s duration)
W: weighted code digit (carrier of 0.5 s duration - binary one)
U: unweighted code digit (carrier of 0.8 s duration - binary zero)
JST at point A - 253 days, 18 h, 42 min, - 0.7 s DUT1 correction



b) Format B

Note 1 - The time code format A is transmitted except in the 15th and 45th minutes when the time code of format B and the call sign of JG2AS is transmitted.

Note 2 - JG2AS is an experimental situation.

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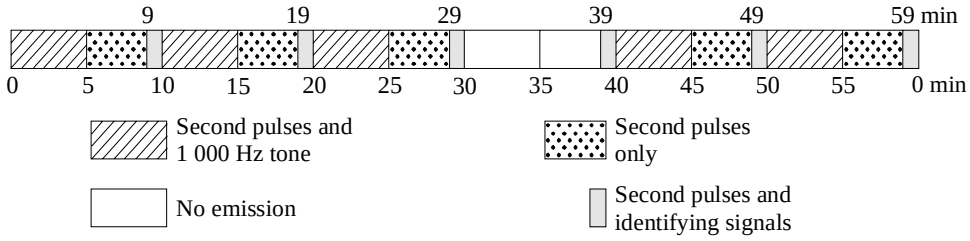
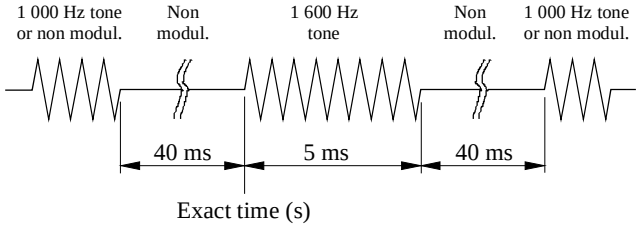
FIGURE 6

JJY time code format

a) Hourly modulation schedule

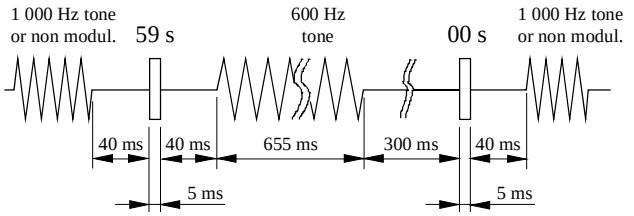


b) Wave form of second pulses



JJY emission schedule

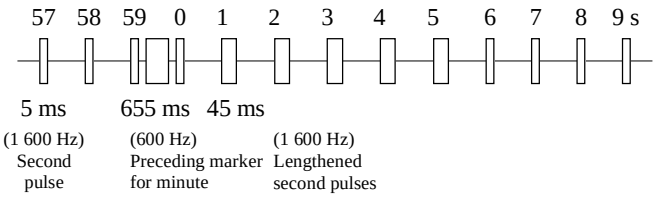
c) Identification of minute signal by preceding marker



d) Identifying signals

Call sign:	2 by the Morse code
Time in JST:	1 by the Morse code
Call sign:	2 in voice
Time in JST:	1 in voice
Radio propagation warning by the Morse code:	(N: normal, U: unstable, W: disturbed)

Example: DUT1 = - 0.5 s



Method of indicating DUT1 on JJY

Example: DUT1 = - 0.2 s

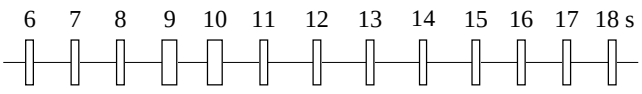


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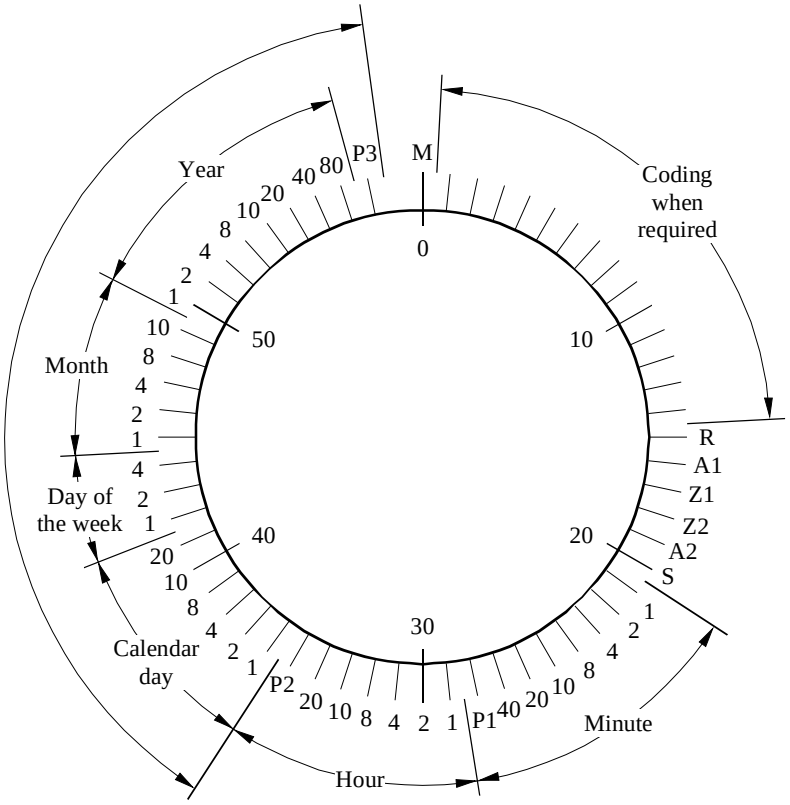
FIGURE 7

DCF-77 time code frame



Coding scheme

M: minute marker (0.1 s)
R: second marker No. 15 has a duration of 0.2 s when the standby antenna is used
A1: announcement of a forthcoming change from CET to CEST or *vice versa*
Z1, Z2: zone time bits
A2: announcement of a leap second
S: starting bit of the coded time information (0.2 s)
P1, P2, P3: parity check bits

The second markers Nos. 17 and 18 indicate the time system to which the transmitted time information is related. In the case of CET, the second marker No. 18 has a duration of 0.2 s and the second marker No. 17 a duration of 0.1 s. When CEST is emitted this order is reversed.

Furthermore, a forthcoming change from CET to CEST or from CEST to CET is indicated by second marker No. 16. During one hour before the change, second marker No. 16 is emitted as a prolonged marker. When time is changed from CET to CEST (from CEST to CET), the prolonged second marker No. 16 is emitted for the first time at 0100.16 h CET (0200.16 h CEST) and for the last time at 0159.16 h CET (0259.16 h CEST).

The second marker No. 19 serves to announce that a leap second is intercalated and it is also emitted as a prolonged marker for one hour prior to the intercalation of the leap second.

When a leap second is inserted, the associated minute has a duration of 61 s and the 59th second marker preceding the marker 01.00.00 h CET or 02.00.00 h CEST is emitted with a duration of 0.1 s. The marker associated with the intercalated 60th second is transmitted without carrier reduction.

The three parity check bits P1, P2 and P3 complete the preceding information words (7 bits for the minute, 6 bits for the hour and 22 bits for the date, including the number of the day of the week) to form an even number of binary ones (duration 0.2 s).

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FIGURE 8

ATA time code format

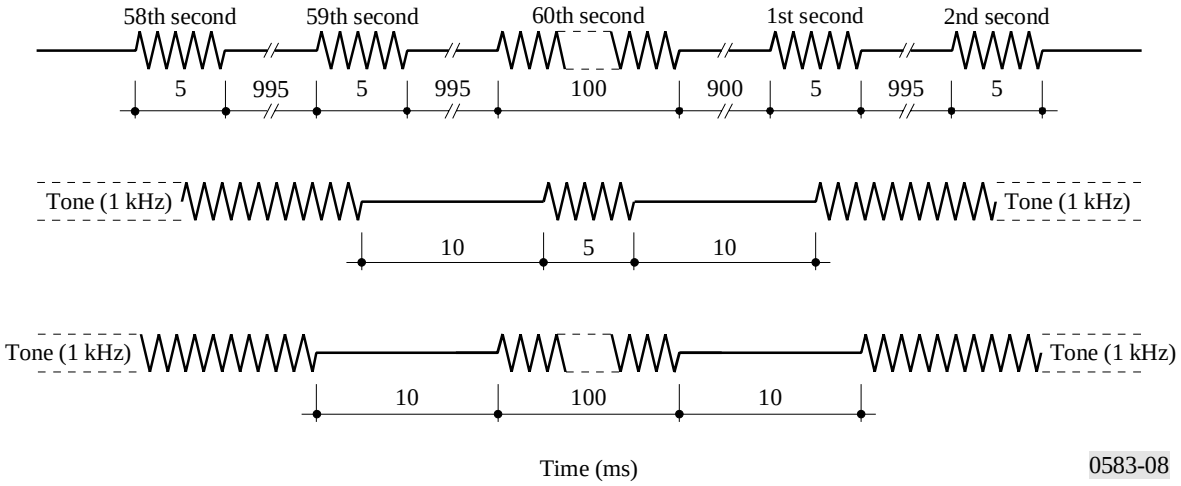


FIGURE 9

VNG time code format

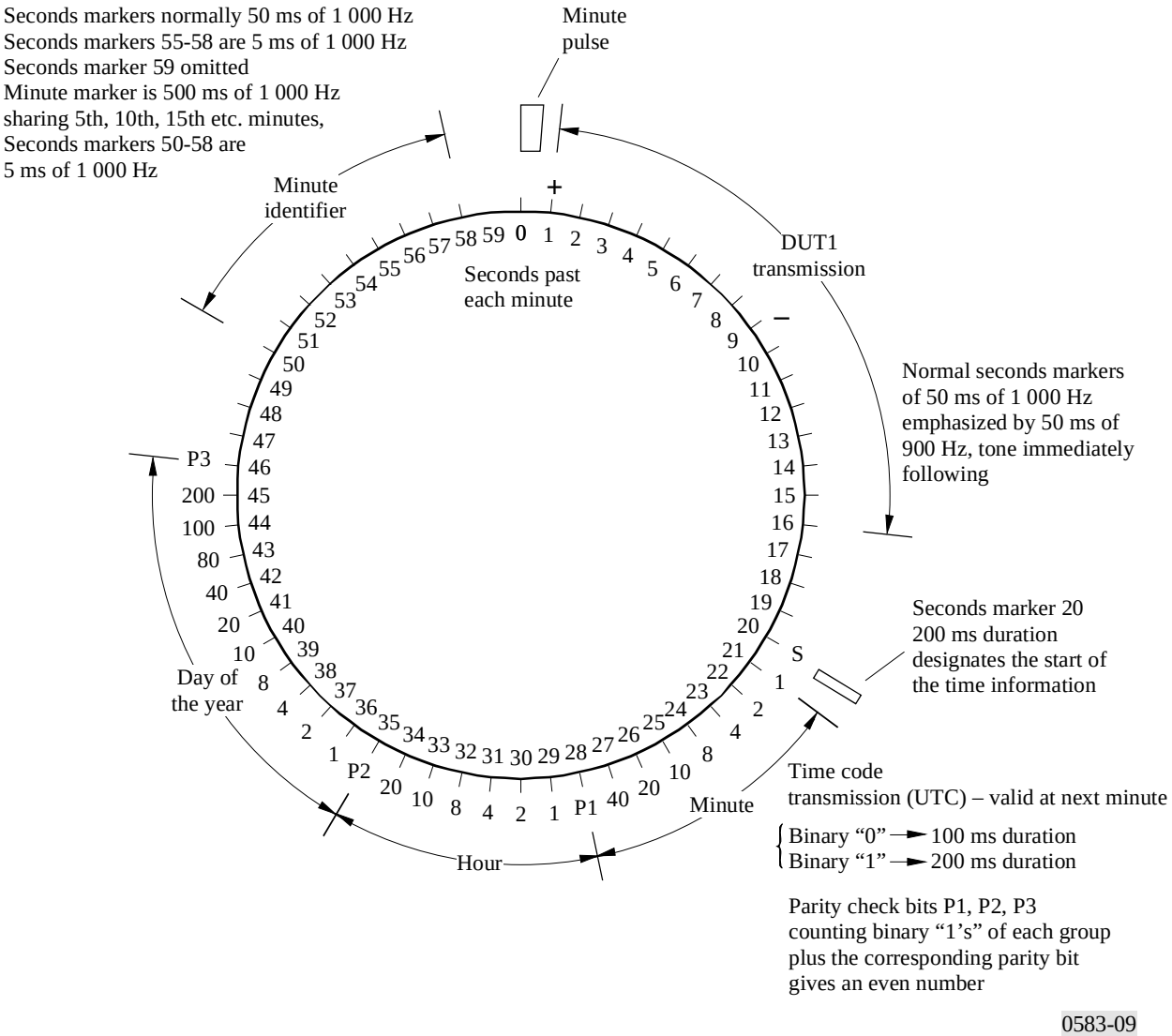


FIGURE 10

CHU time code format

CHU broadcast codes: example for the period 13:58:46 to 14:00:13 UTC on 12 January, 1993 (day 012 of the year):
(DUT1 = + 0.1 s, TAI-UTC = 27 s, no leap second this quarter, Canadian Daylight Time first Sunday of April to last Sunday of October.)

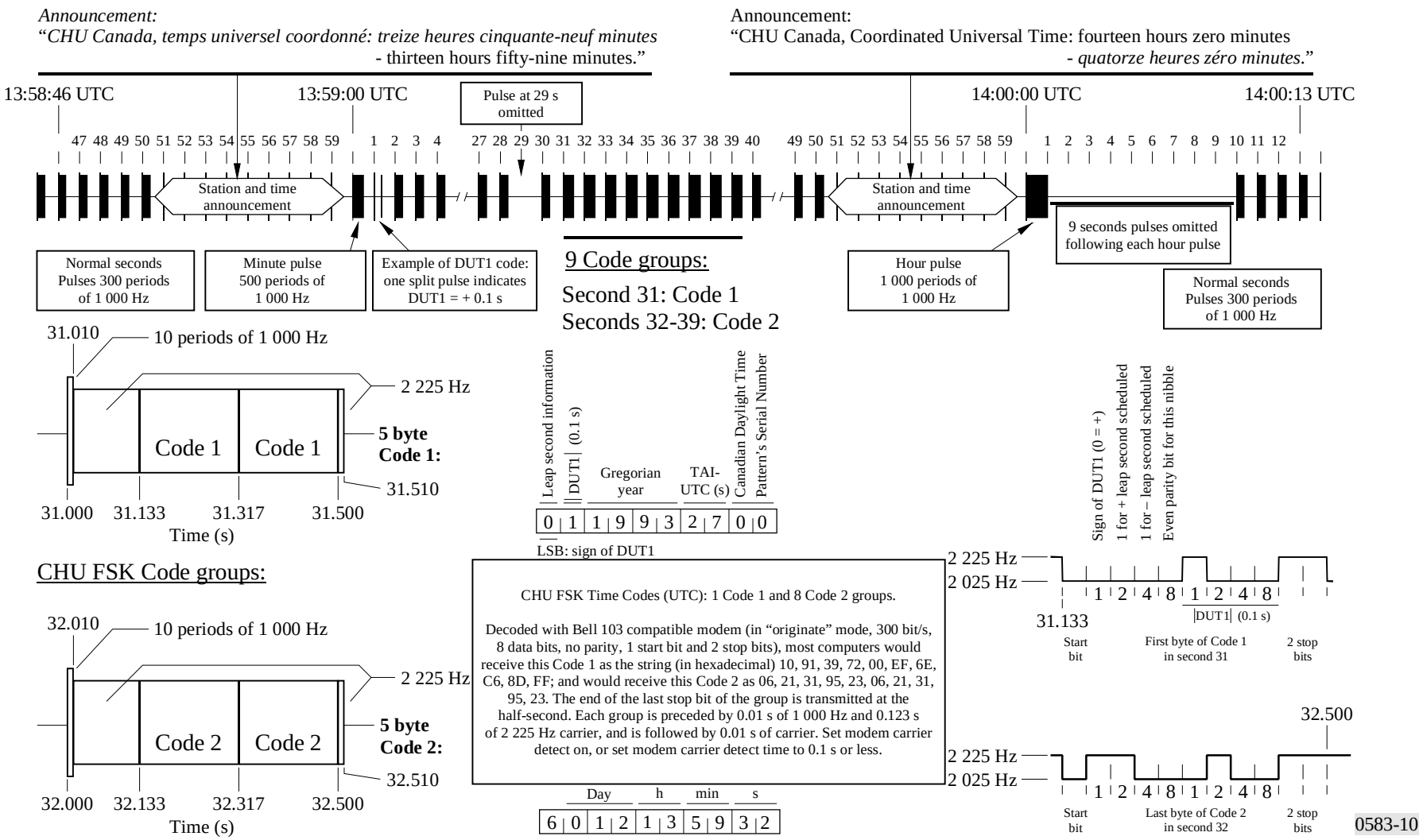
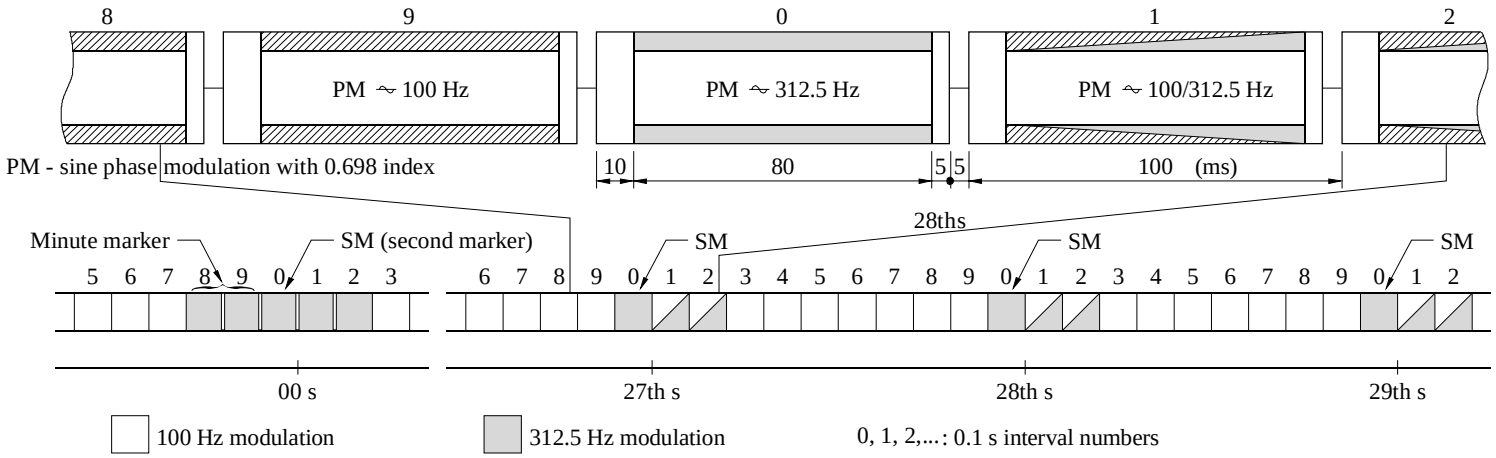
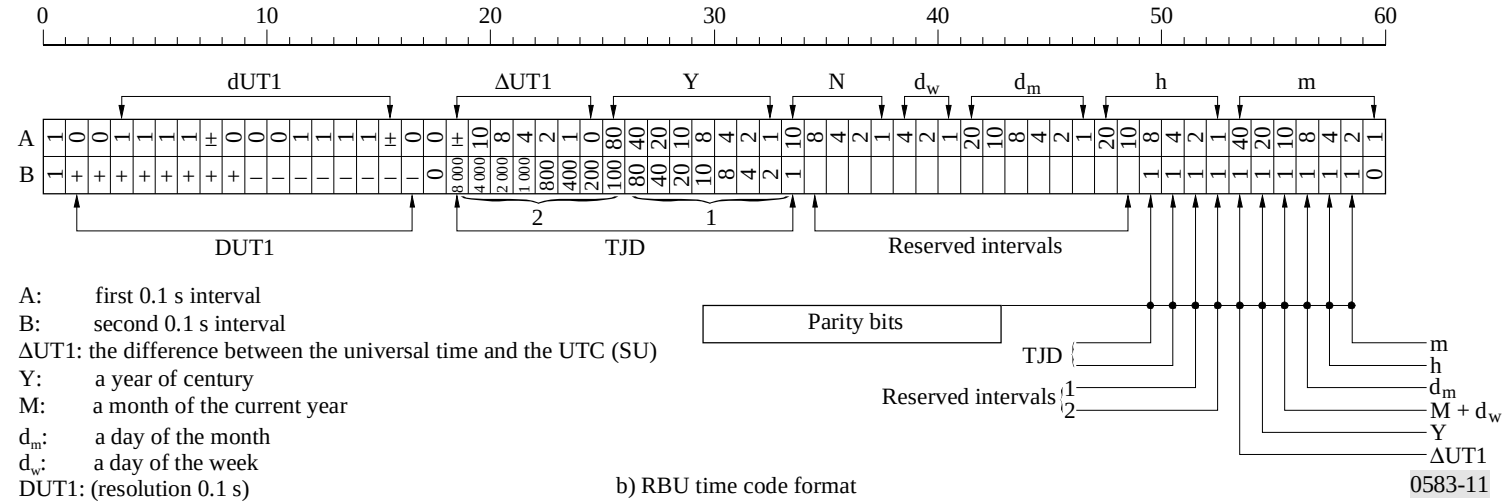


FIGURE 11

RBU broadcast and time code format



a) RBU broadcast format

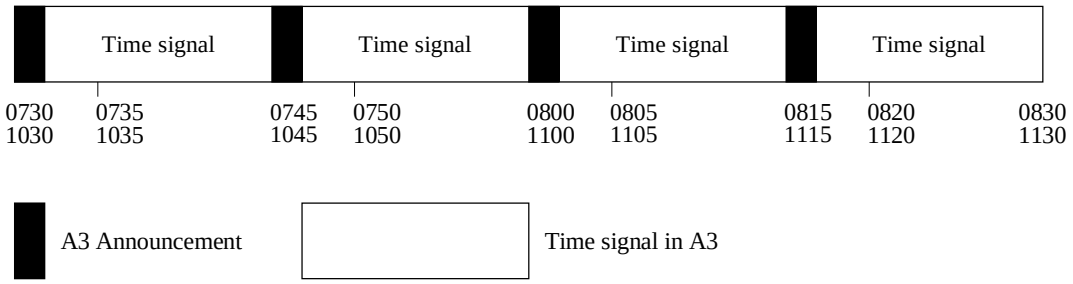


A: first 0.1 s interval
B: second 0.1 s interval
ΔUT1: the difference between the universal time and the UTC (SU)
Y: a year of century
M: a month of the current year
d_m: a day of the month
d_w: a day of the week
DUT1: (resolution 0.1 s)
dUT1: (resolution 0.02 s)

b) RBU time code format

FIGURE 12

IAM time code format

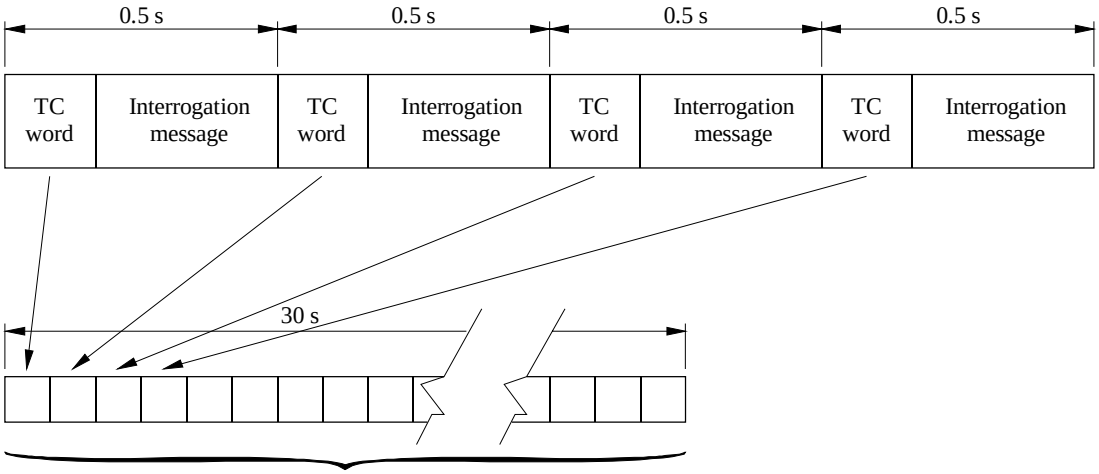


Time is given in slow-speed telegraphy at 0735, 0750, 0805, 0820, 1035, 1050, 1105 and 1120 h UTC.
During summer time, the emissions are advanced by 1 hour.

Transmission schedule of IAM. 0583-12

FIGURE 13

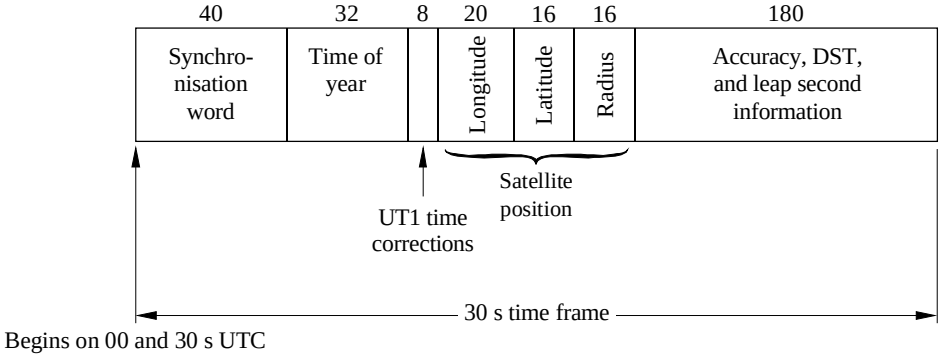
GOES time code format



Time code frame consisting of:

- synchronization word
- days, hours, minutes, seconds
- UT1 time correction; accuracy, DST and leap second indicators
- satellite position

a) GOES satellite interrogation channel format



Begins on 00 and 30 s UTC

b) GOES time code format 0583-13

FIGURE 14

IRIG specific formats

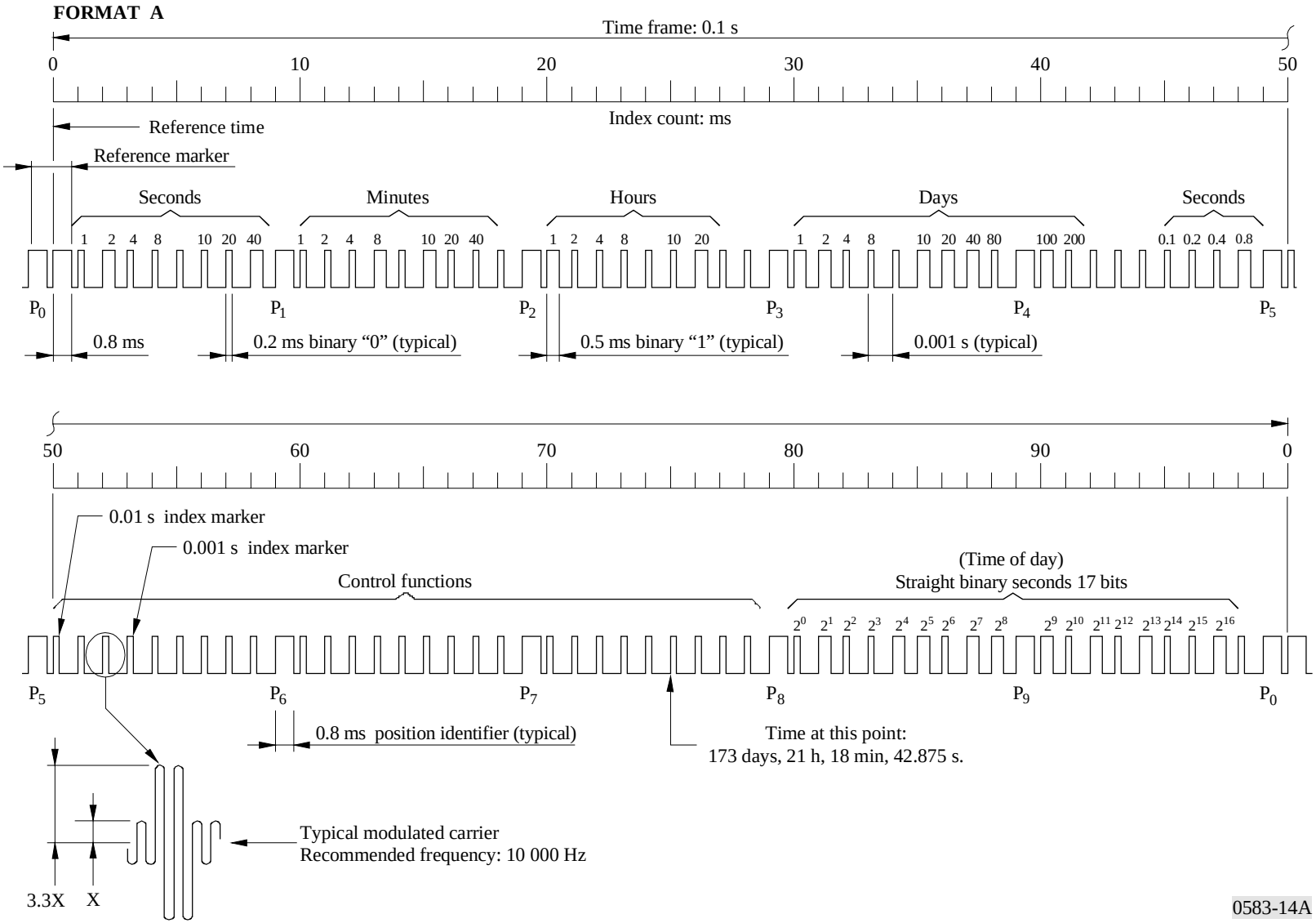


FIGURE 14 *(continued)*

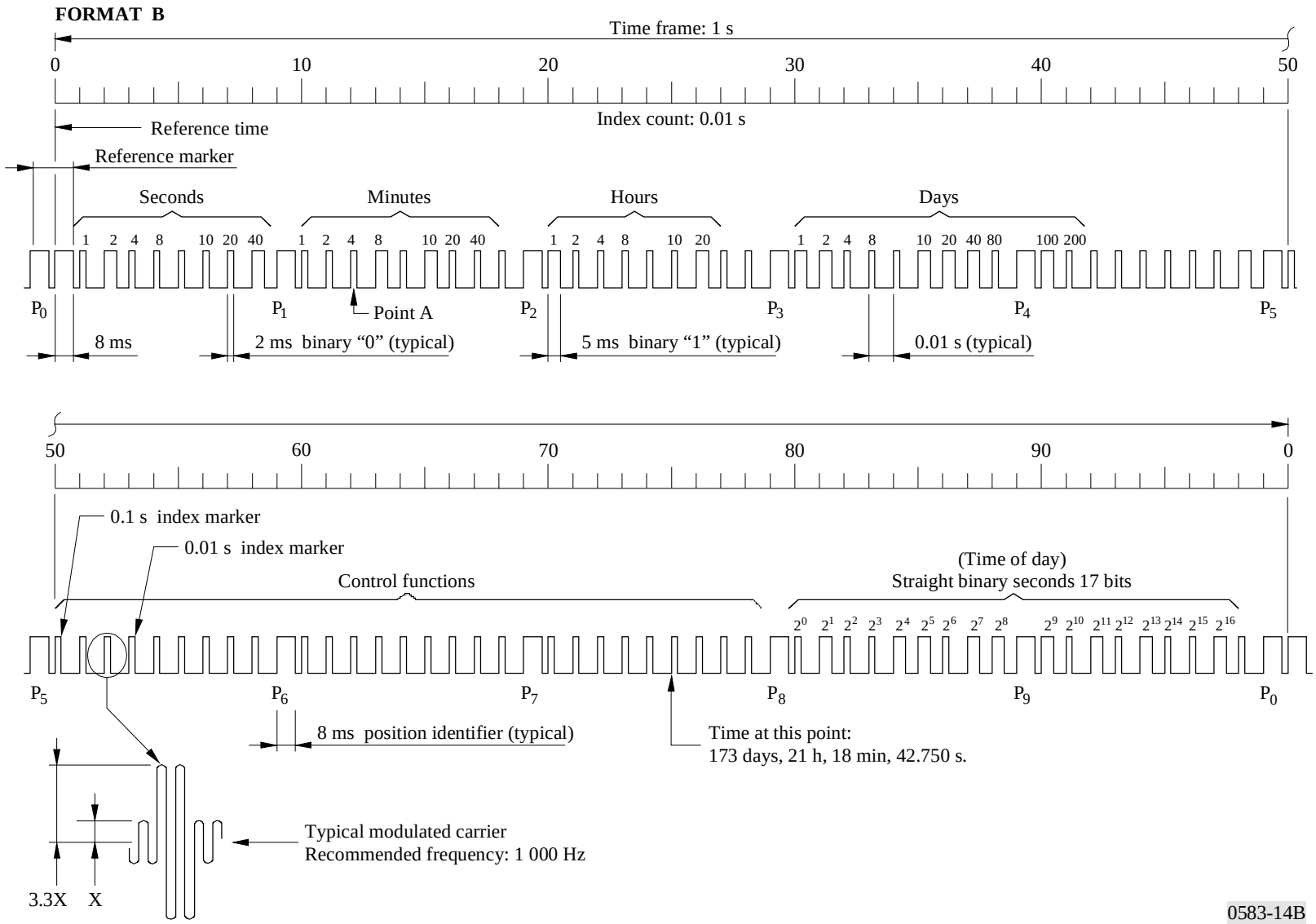


FIGURE 14 *(continued)*

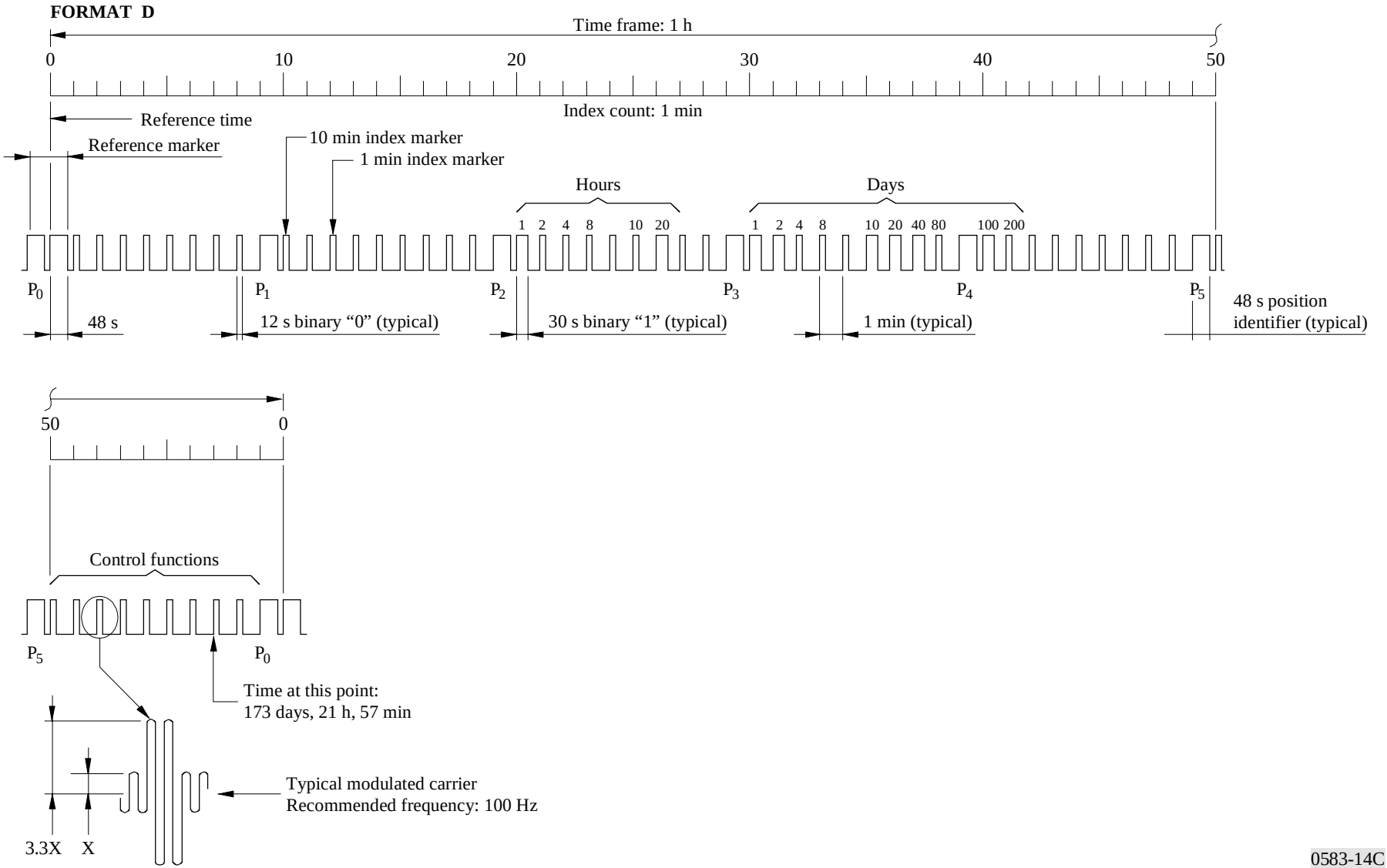


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FIGURE 14 *(continued)*

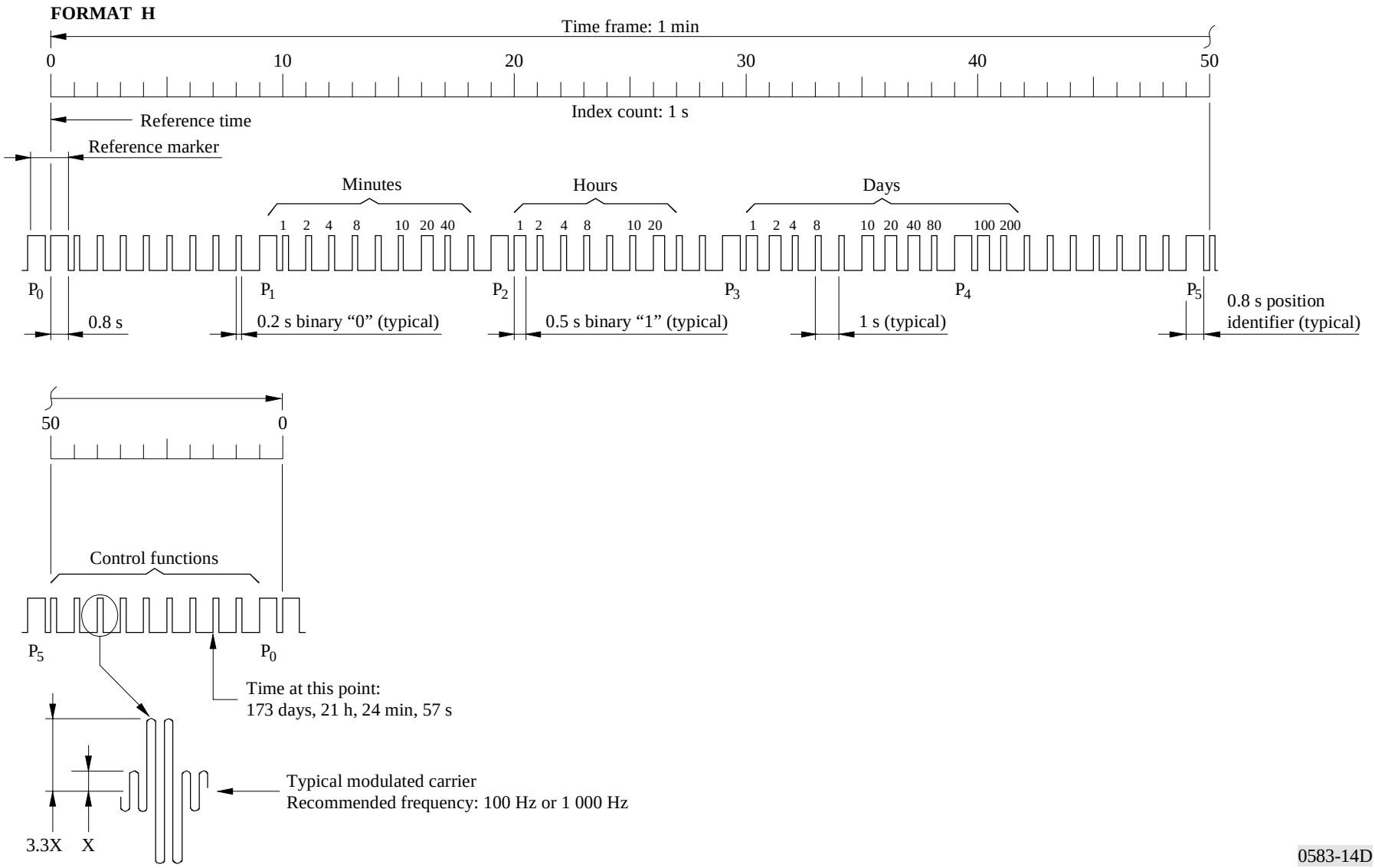

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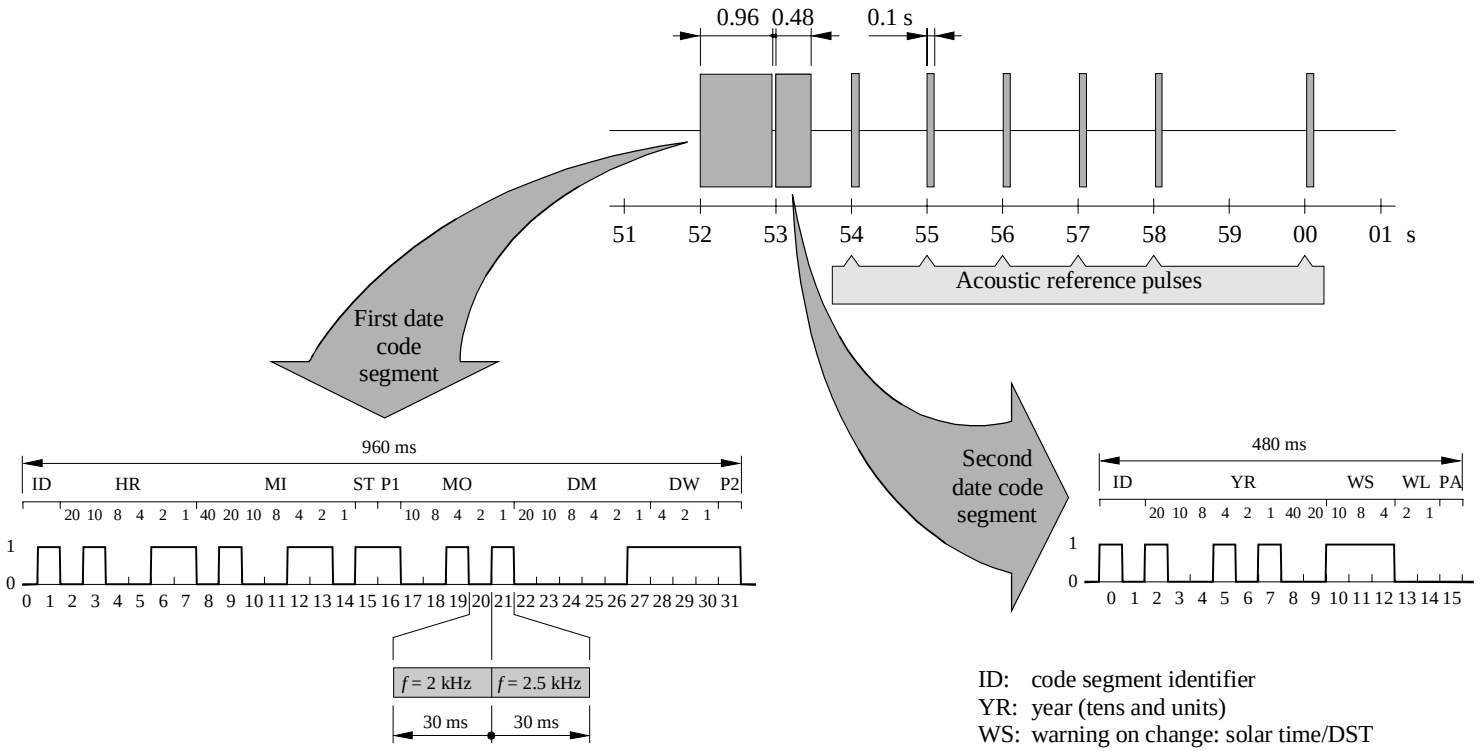
FIGURE 15

IEN/RAI time code format



ID: code segment identifier
HR: hours (tens and units)
MI: minutes (tens and units)
ST: "0" solar time, "1" summer time (DST)
P1: odd parity bit of the first information group (from bit 2 to 15)
MO: month (tens and units)
DM: day of the month (tens and units)
DW: day of the week
P2: odd parity bit of the second information group (from bit 17 to 30)

ID: code segment identifier
YR: year (tens and units)
WS: warning on change: solar time/DST
- 111 no change in the next 7 days
- 110 change foreseen within 6 days
- •
- •
- •
- 001 change foreseen within 1 day
- 000 at 0200 switches to DST or at 0300 to solar time

WL: warning on leap second
- 00 no leap second within the month
- 10 1 s delay at the end of the month
- 11 1 s advance at the end of the month

PA: odd parity bit

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