RECOMMENDATION ITU-R TF.583-5*

Time codes

(Question ITU-R 110/7)

(1982-1990-1994-1995-1997-2001)

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 Universal Coordinated Time (UTC) related date and time information in digital form are available via modem in a number of countries on telephone networks;

f) 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);

g) 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 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).

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* This Recommendation should be brought to the attention of Radiocommunication Study Group 6.

ANNEX 1

Information on coded timing

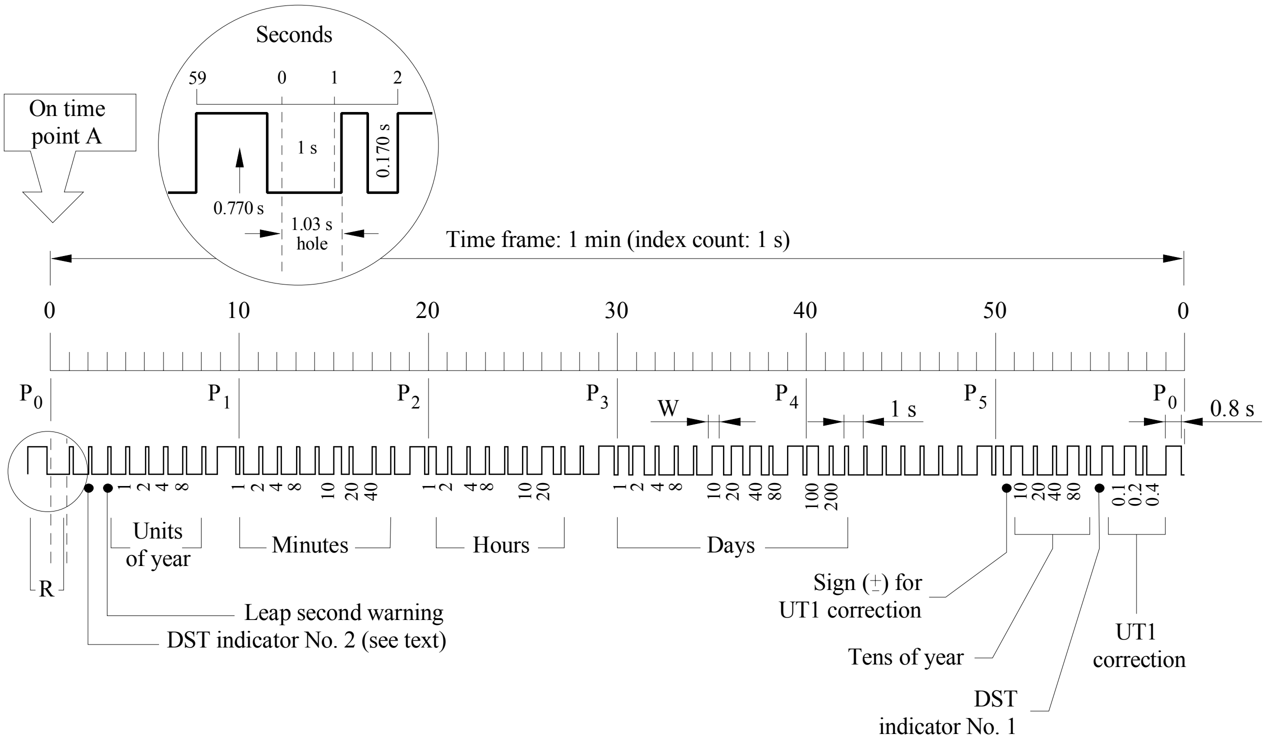
Coded timing information is conveyed in a variety of formats and transmission media. In many cases such information is disseminated in a broadcast mode either on dedicated time and frequency services or as a part of other types of broadcasts primarily intended for other purposes. Time code broadcasts 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.

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.

An example of telephone time codes which shows the format of the code used in several European countries is given in Fig. 16. This code is now available from the primary timing centres of the following countries: Austria, Belgium, Germany, Italy, the Netherlands, Poland, Portugal, Romania, Spain, Sweden, Switzerland, Turkey and the United Kingdom. The time code used in the Swiss transmitter HBG is given in Fig. 17.

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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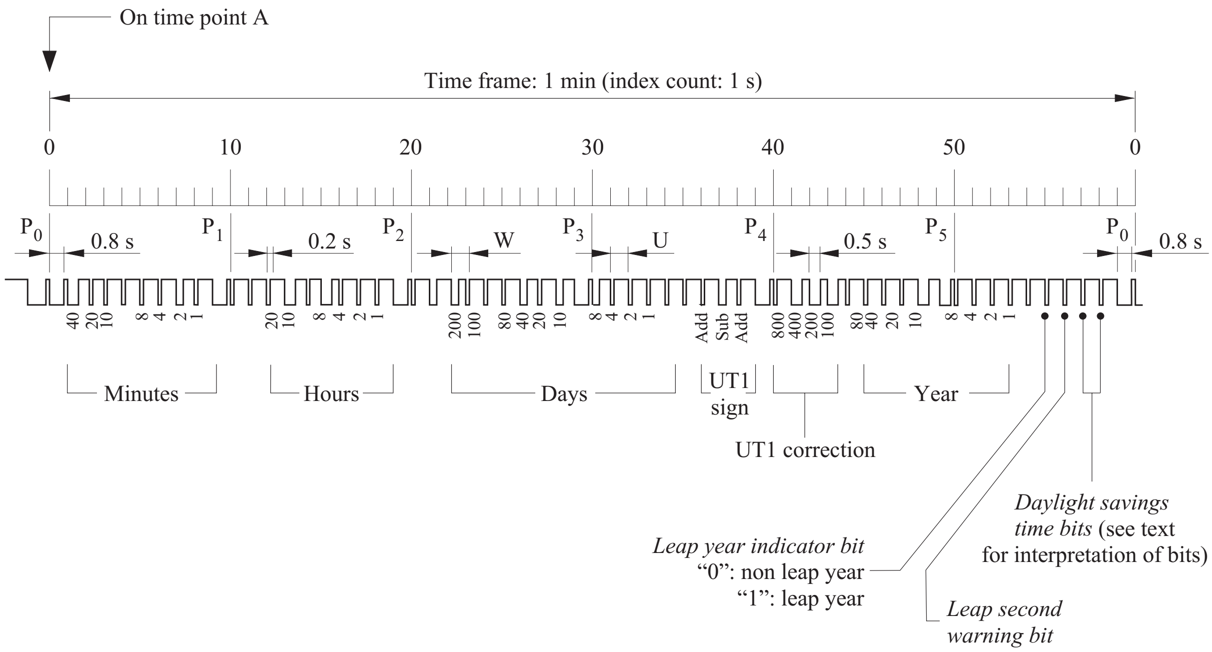
FIGURE 2

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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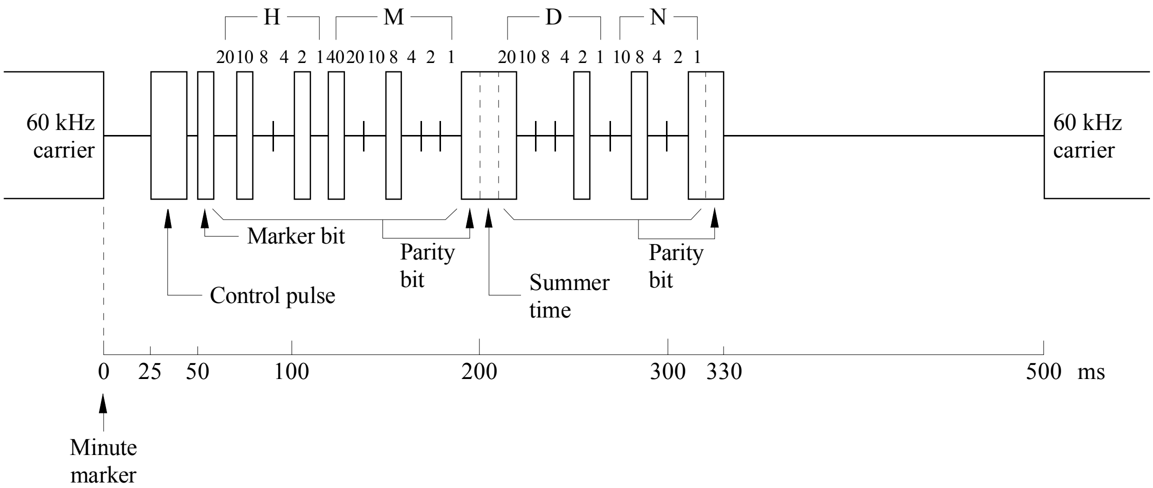
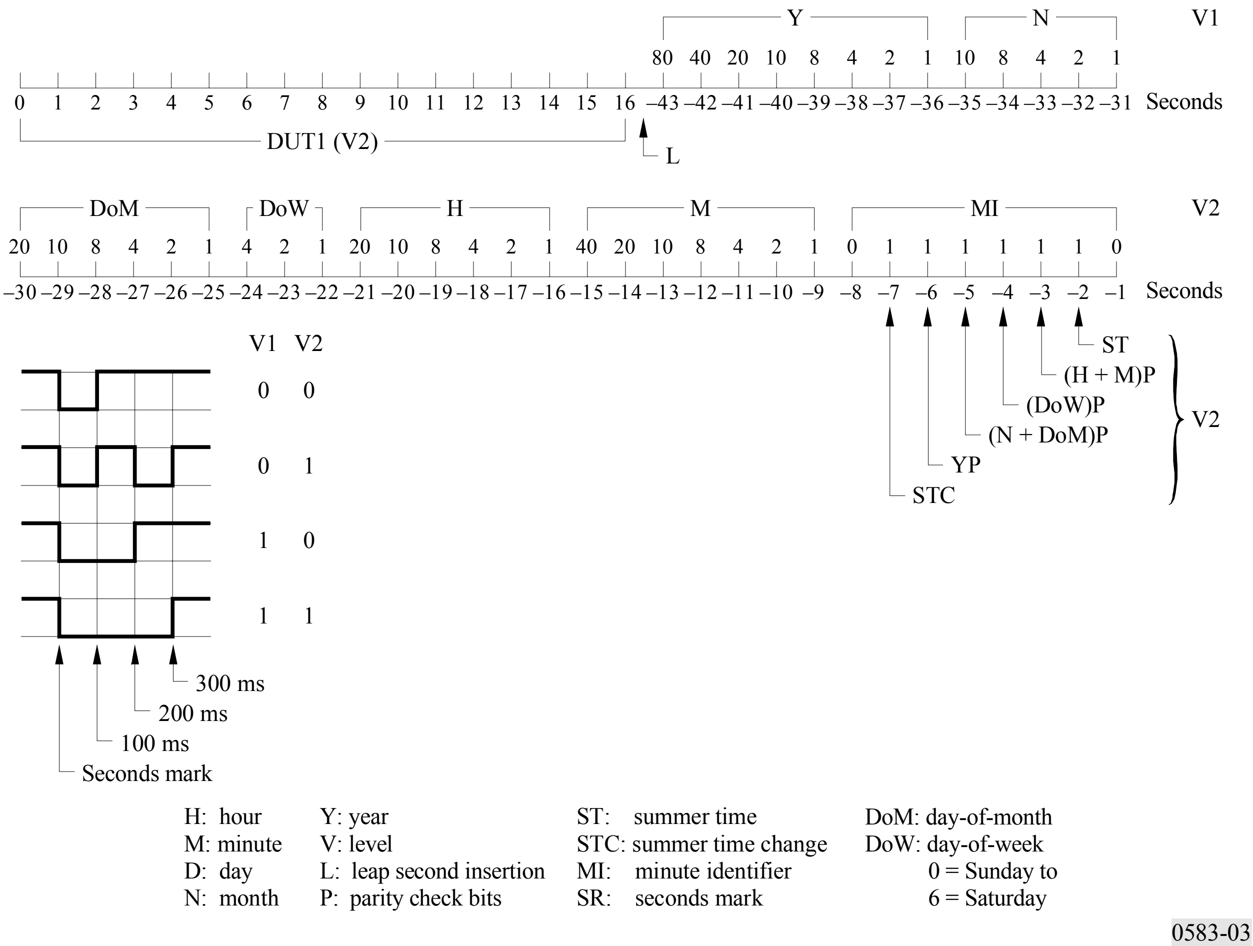
FIGURE 3

MSF time code format



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

a) MSF fast code format (60 kHz)



b) MSF slow code format (60 kHz)

FIGURE 4

OMA time code format (50 kHz)

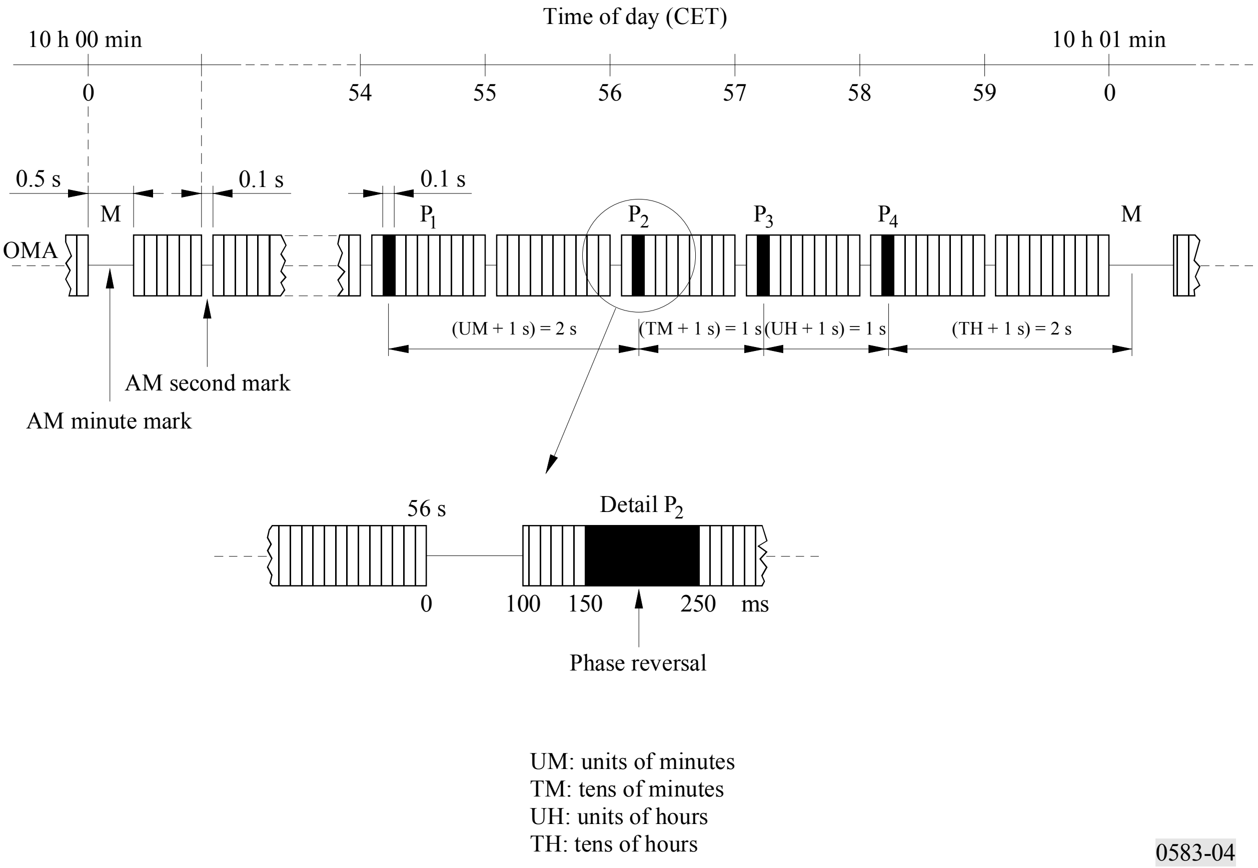
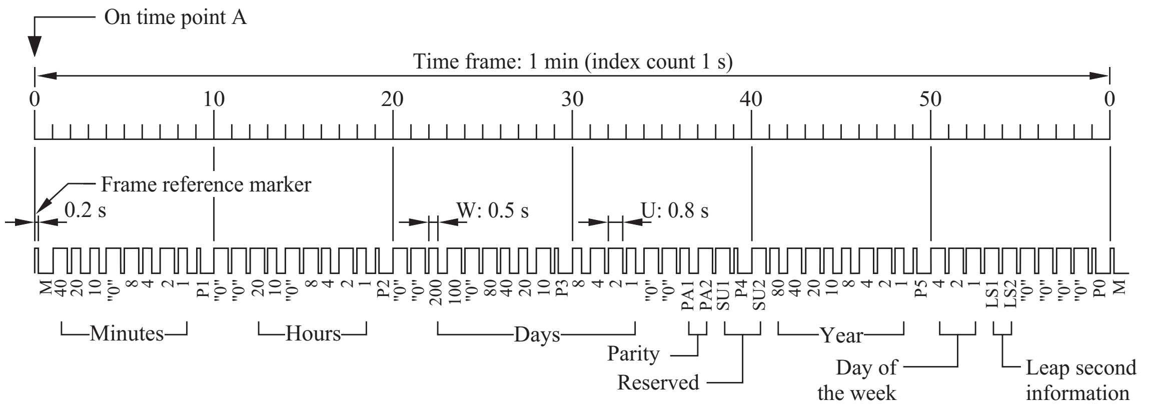


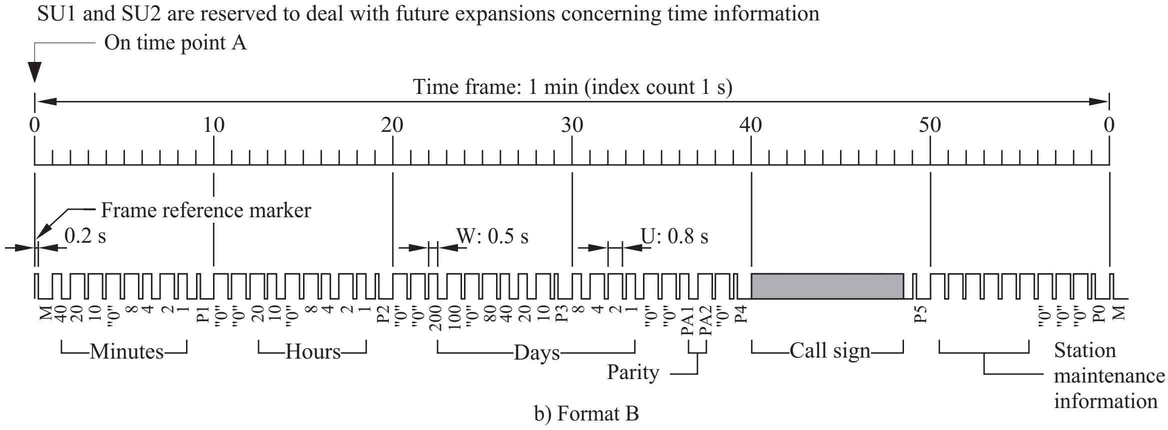
FIGURE 5

JJY (40 kHz) time code format



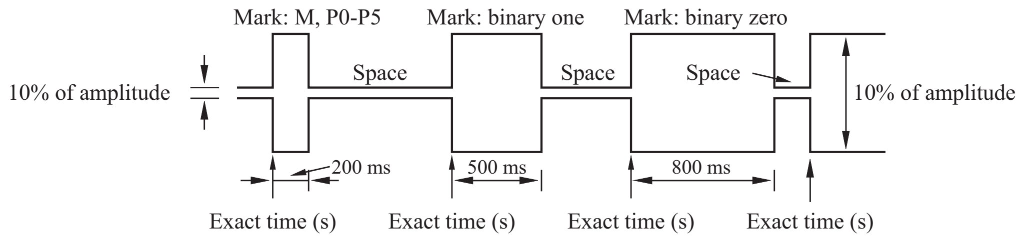
a) Format A

M, P0-P5: position markers (carrier of 0.2 s duration)
W: weighted code digit (carrier of 0.5 s duration)
U: unweighted code digit (carrier of 0.8 s duration)
PA1: even parity for hours
PA2: even parity for minutes
"0": always binary zero
JST at point A: 269 day of 1999, 15 h 35 min, Sunday, no leap second is planned within one month
SU1 and SU2 are reserved to deal with future expansions concerning time information



b) Format B

JST at point A: 269 day of 1999, 15th, 15 h 45 min, Sunday



c) Wave form

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

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FIGURE 6

JJY time code format

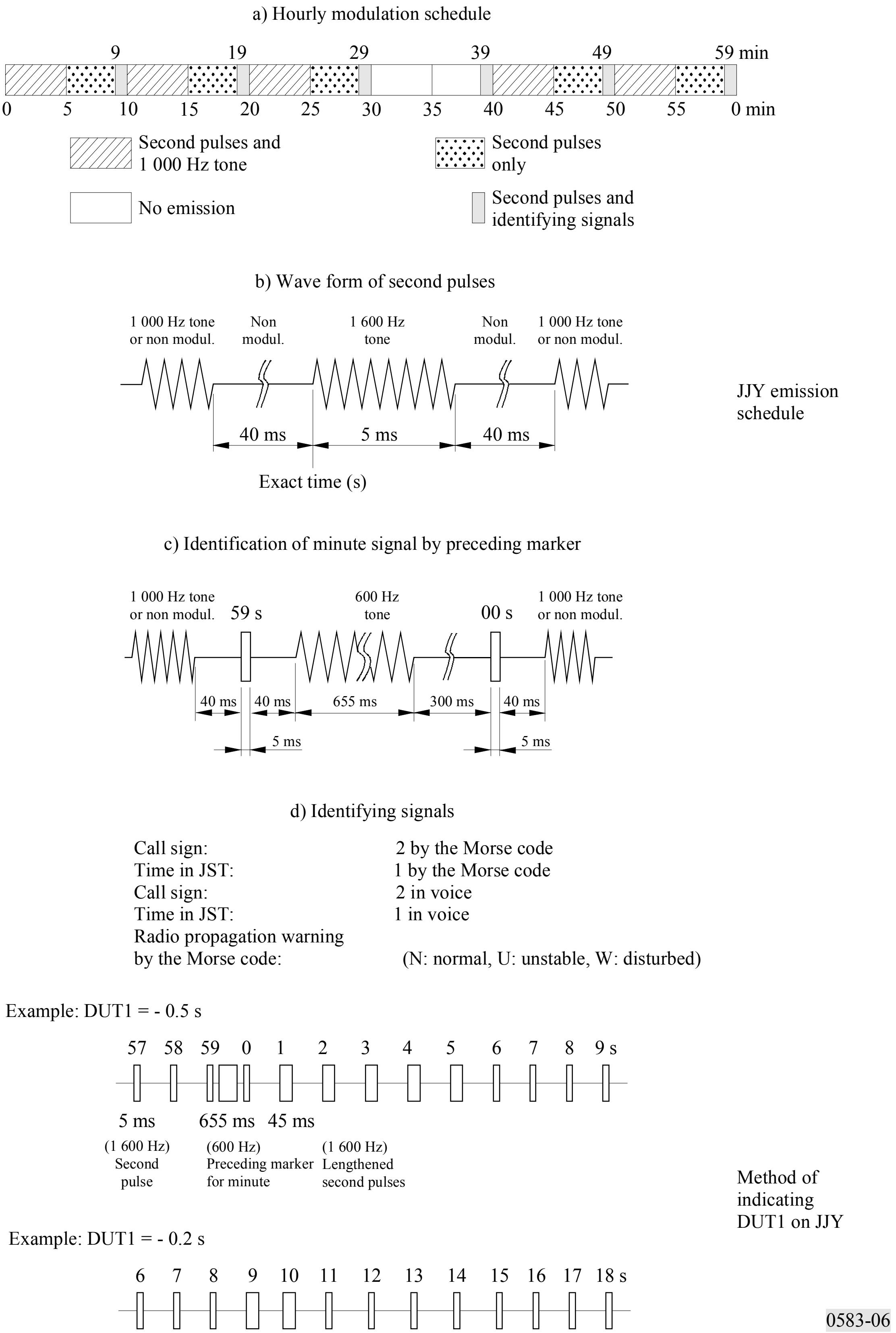
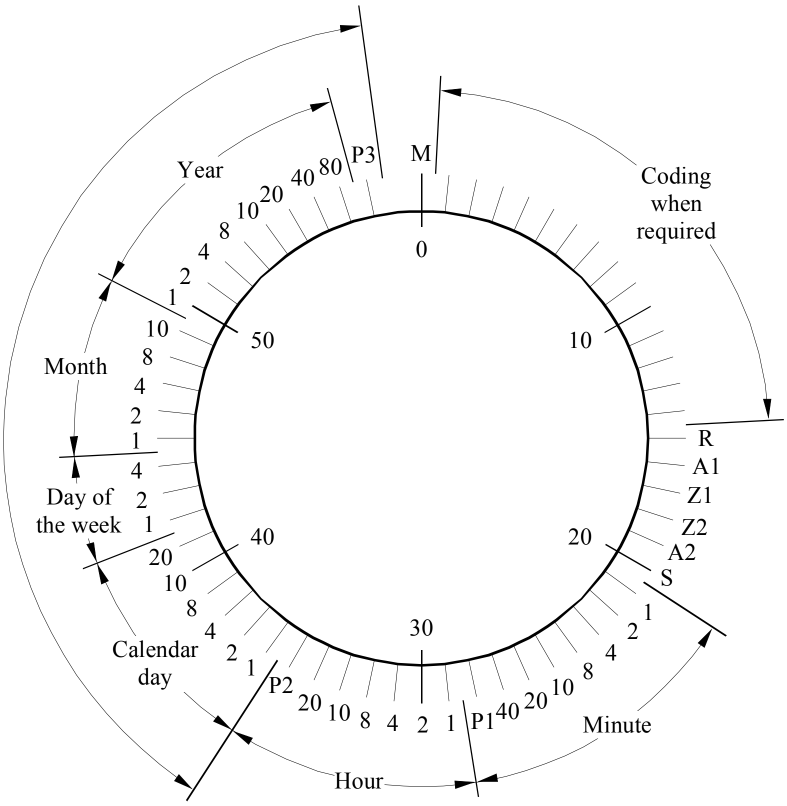


FIGURE 7

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

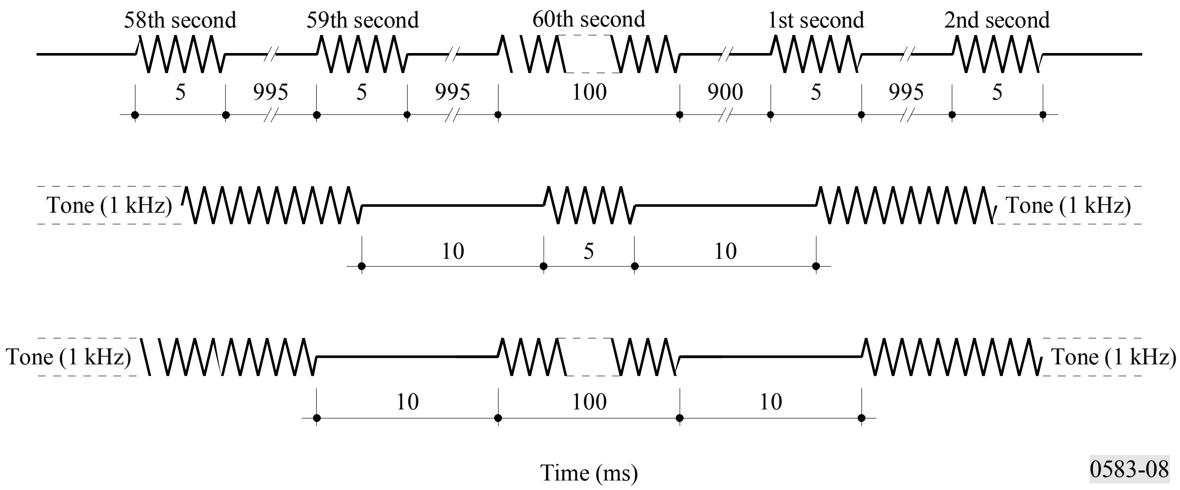

FIGURE 9

VNG time code format

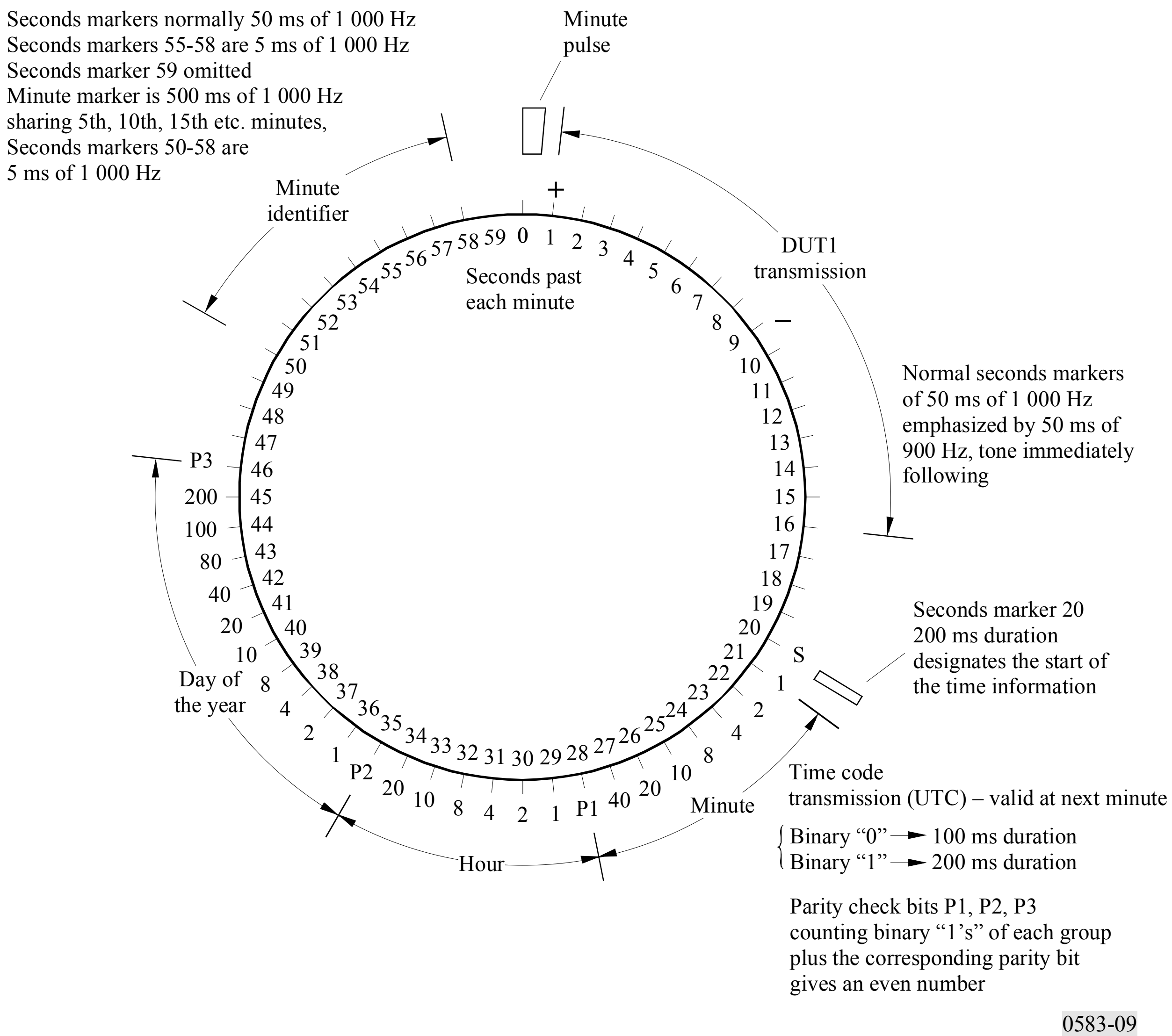

FIGURE 10

CHU time code format

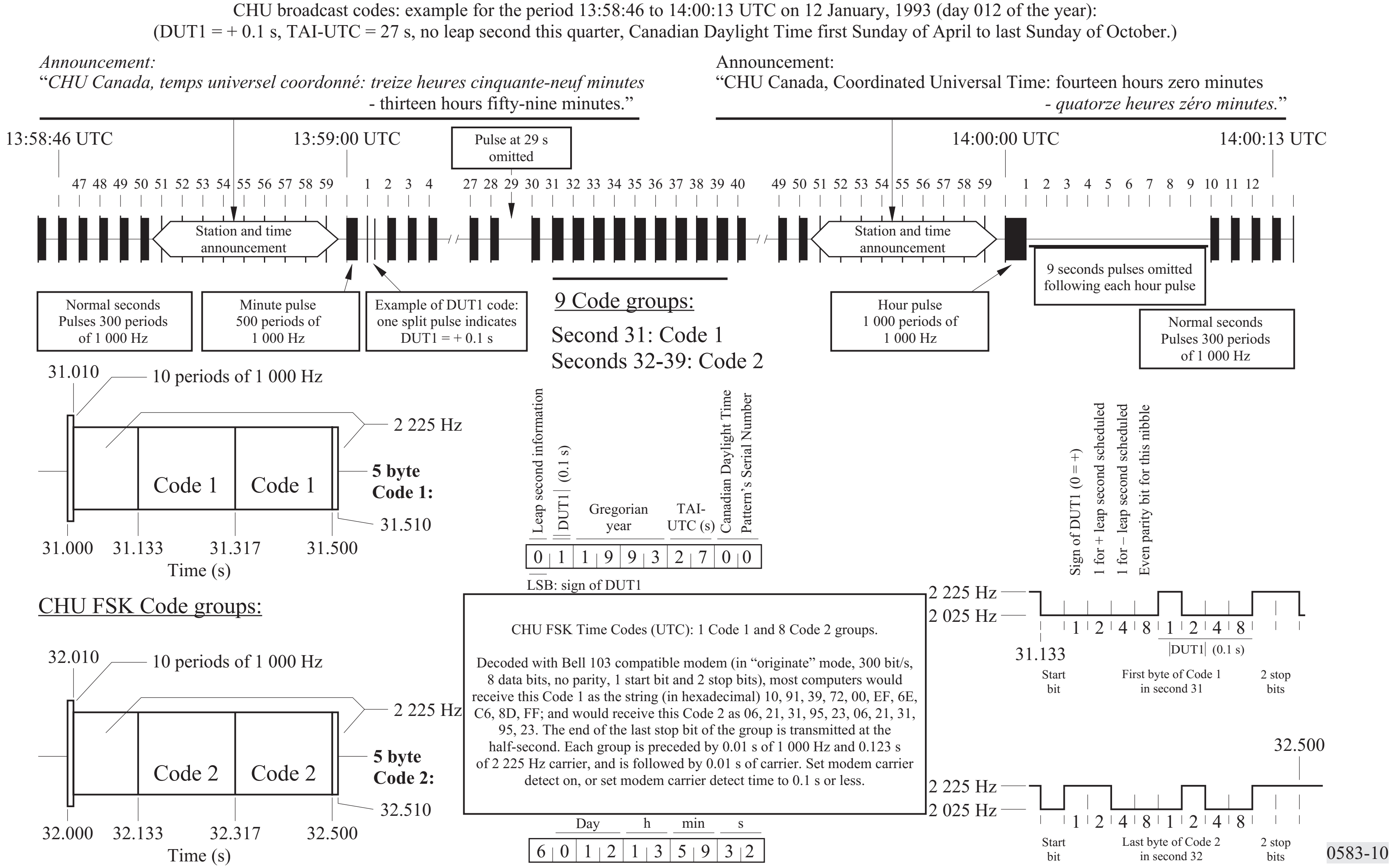

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FIGURE 11

RBU broadcast and time code format

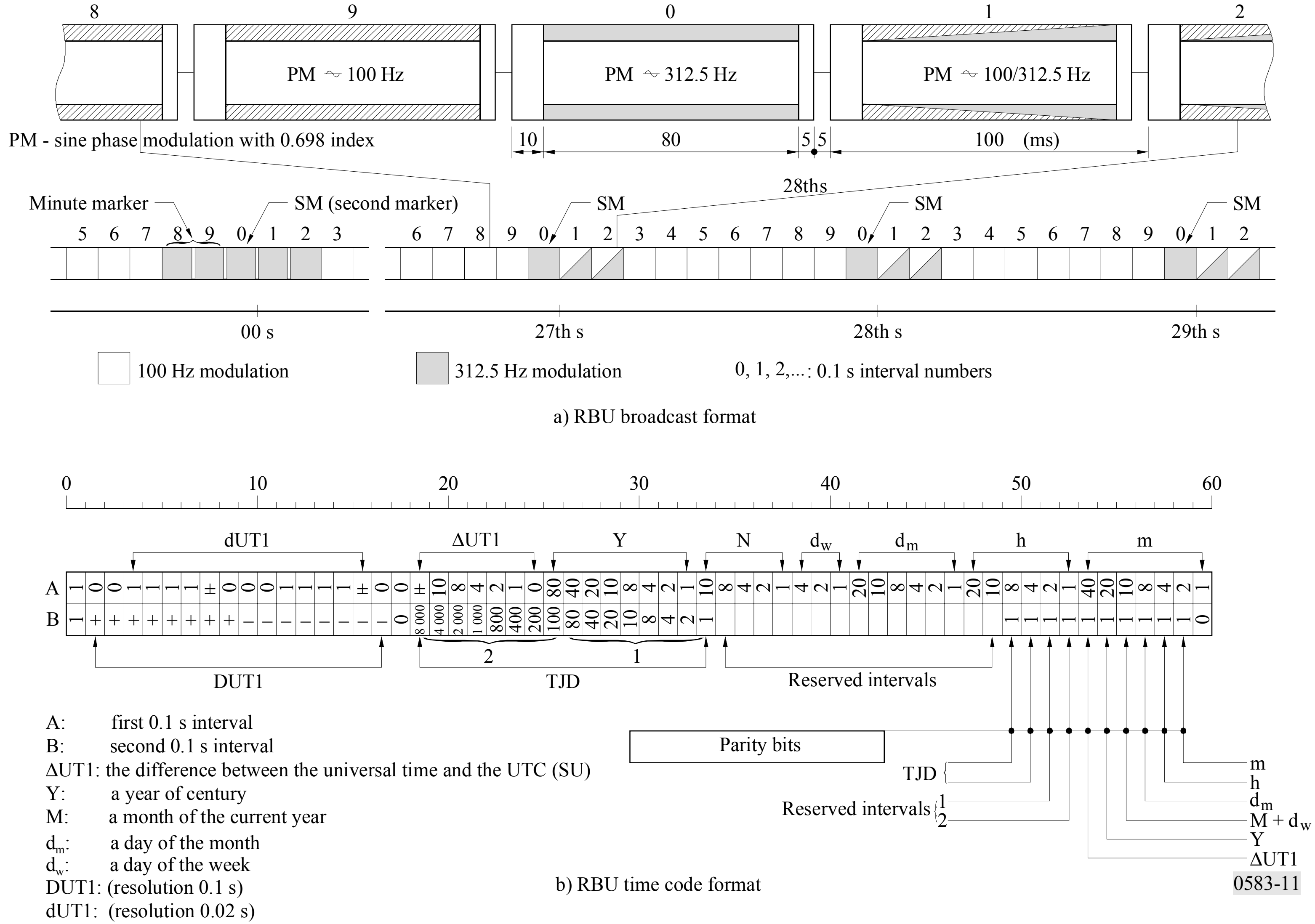
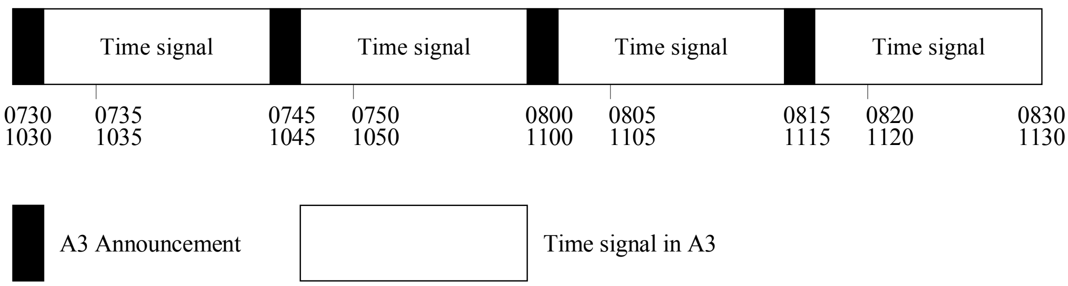


FIGURE 12

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.

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FIGURE 13

GOES time code format

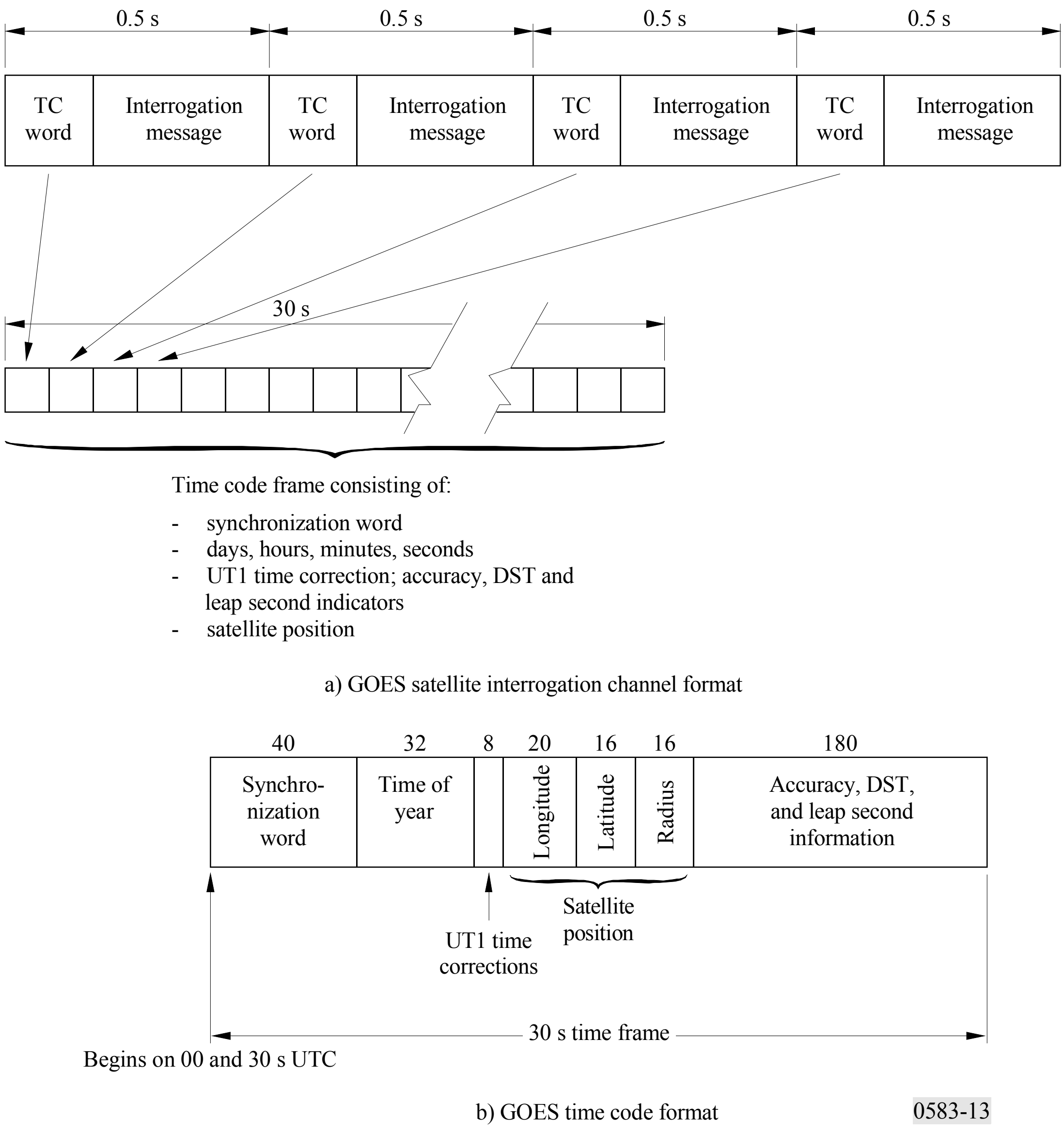


FIGURE 14

IRIG specific formats

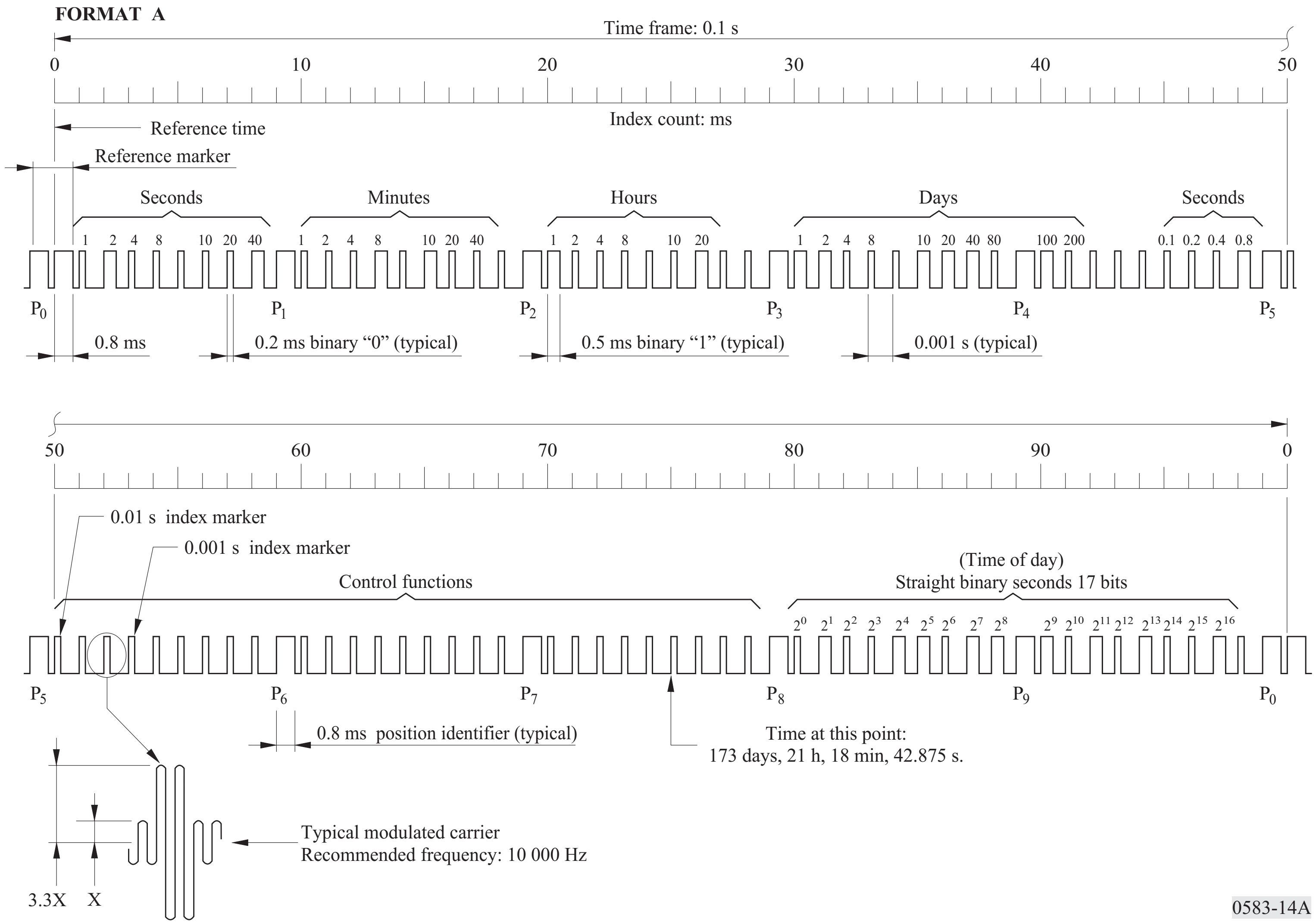


FIGURE 14 (*continued*)

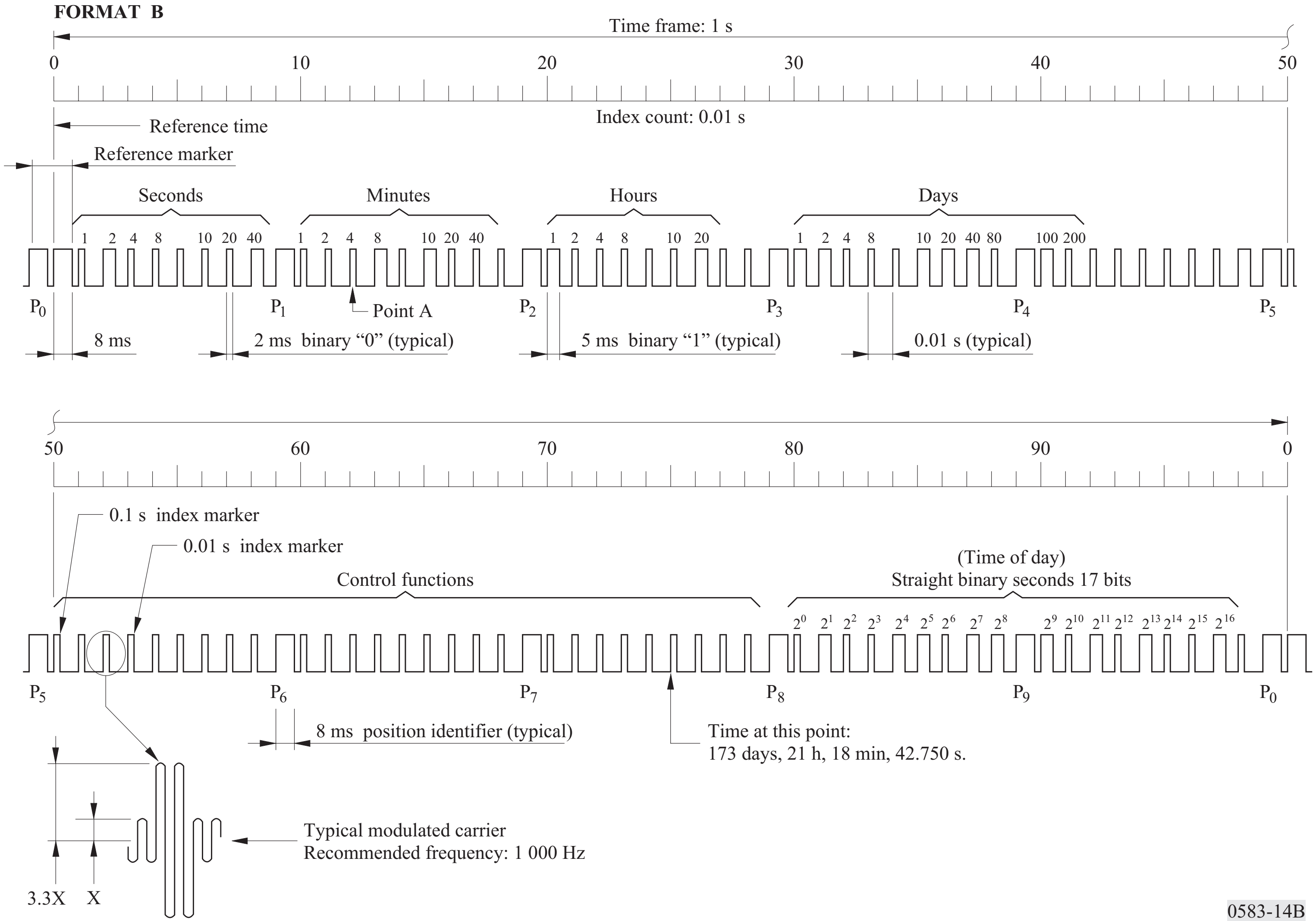


FIGURE 14 (*continued*)

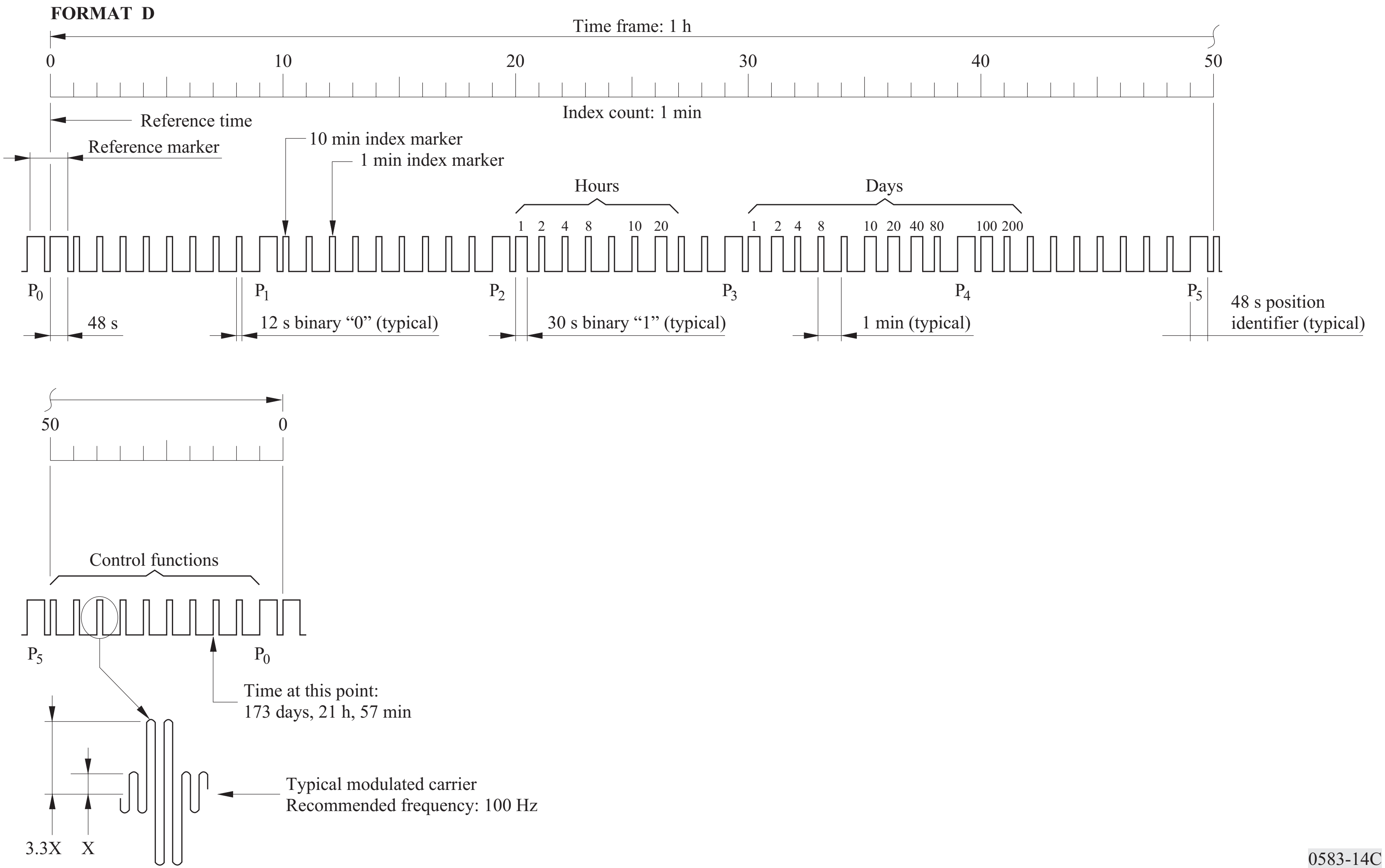


FIGURE 14 (*continued*)

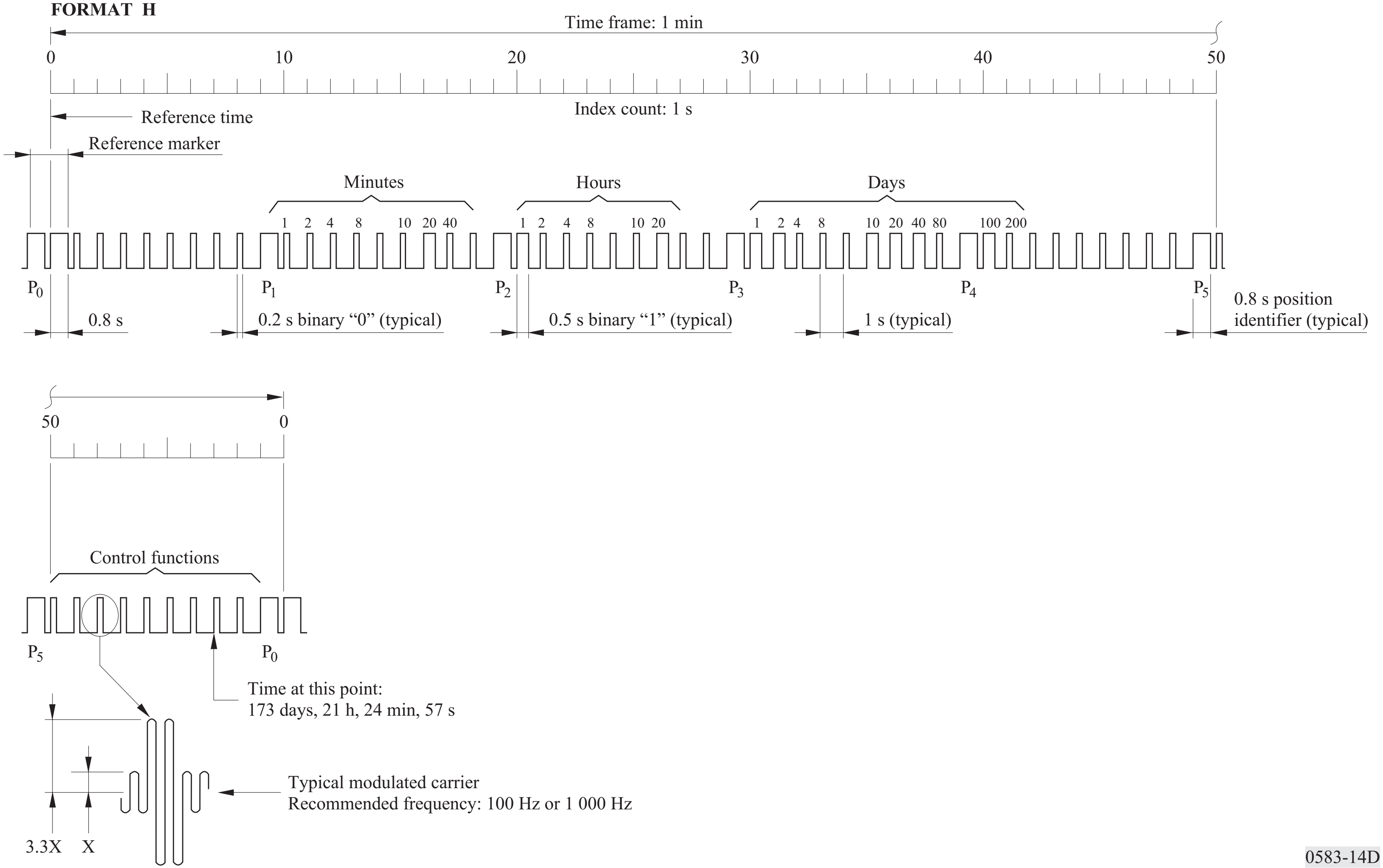
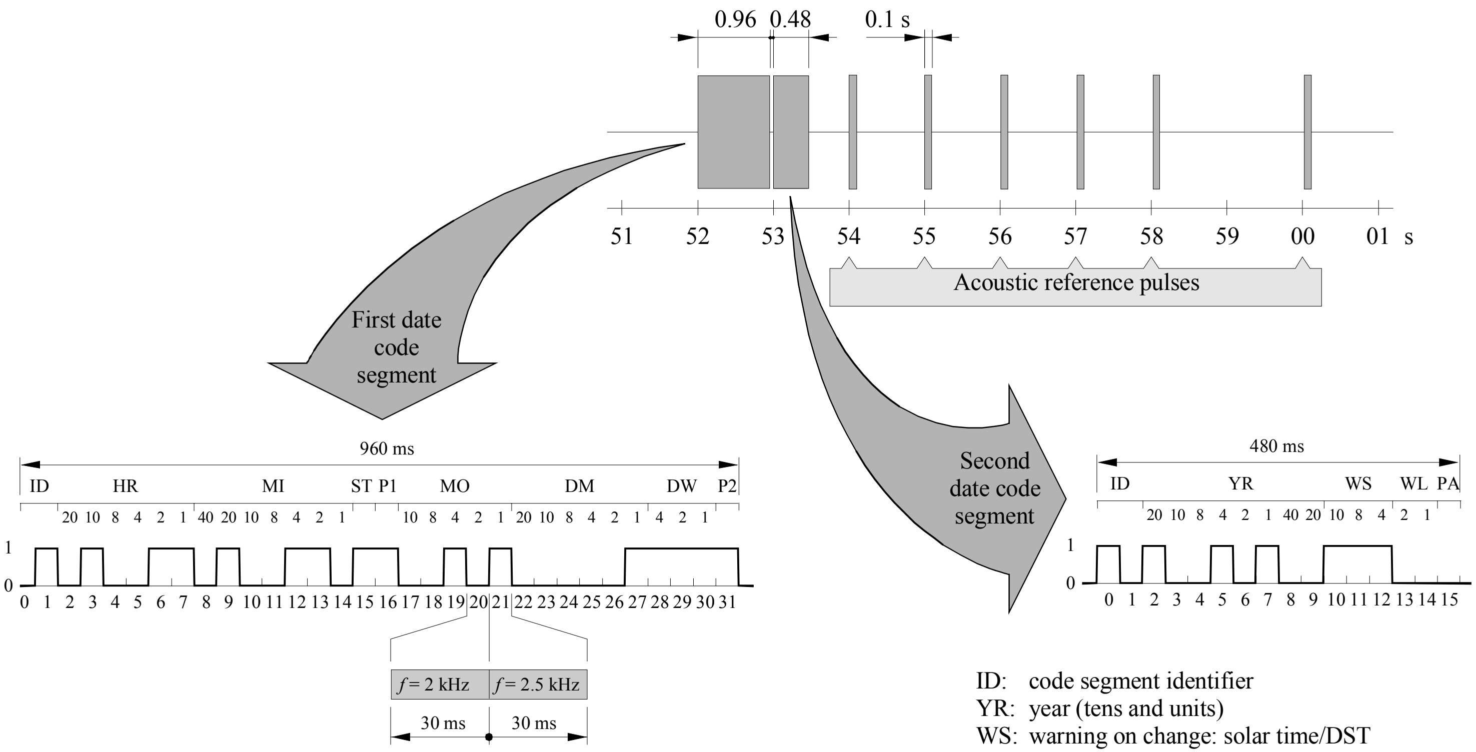


FIGURE 15

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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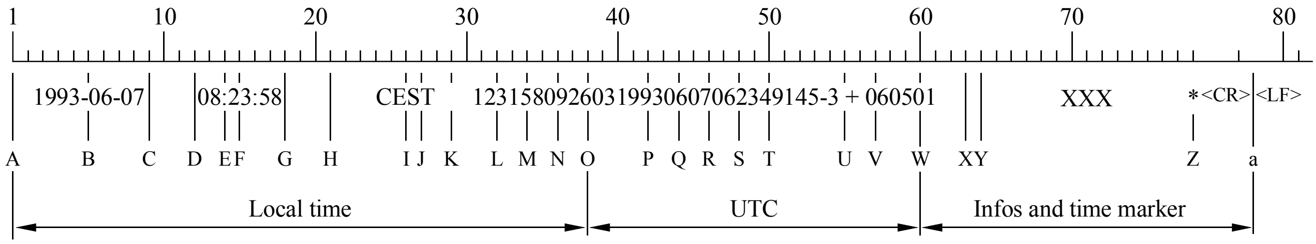
FIGURE 16

European telephone time code format

Each second a string of 80 ASCII characters is sent containing date and time information of the next second. The example below shows the time code (line 3) and marks the character position (lines 1 and 2) as well as the items described later on (lines 4 and 5).



Terms related to local time

A: Year
B: Month
C: Day
D: Hour
E: In some countries there is a liability to mark the hour when switching from daylight saving time (DST) to standard time (ST), therefore the following option exists; the delimiter ":" normally used may change to "A" during the last hour of DST and to "B" during the first hour of ST.
F: Minute
G Second
H: The local time identifier reveals the time zone and which local time (ST or DST) is currently used.
I: Day of week (1 to 7 starting on Monday).
J: Week of the year
K: Day of the year
L: Month/next change of local time from DST to ST or vice versa
M: Day/next change of local time from DST to ST or vice versa
N: Hour/next change of local time from DST to ST or vice versa

Terms related to UTC

O: Year
P: Month
Q: Day
R: Hour
S: Minute
The minute of UTC and local time may differ, because the offset between these two time scales should not be a multiple of hours.
T: Modified Julian date (MJD)
MJD is a continuous counting of days since 17 November 1858.
U: DUT1 in tenths of seconds
DUT1 is the difference between Universal Time and Universal Time Coordinated (UT1 – UTC).
V: Announcement of leap second (sign and mouth)
At the end of the last day of the month the leap second will be introduced according to the positive (+) or negative (–) sign. Three zeroes on these places indicate, that no leap second is announced.

Messages and time reference

W: Delay compensation in milliseconds
Indicates the value the code is advanced with respect to the time scale of the laboratory operating the generator (see Z).
X: Message sequence number (0 to 9). Indicates the line number of the message (see Y).
Y: Message
Up to a maximum of 10 lines, 14 characters each, contains a laboratory dependent message.
Z: Visible time marker
Usually this character is "*", but it changes to "#" if the code is advanced according to a delay measurement made by the generator.
a: Time marker
The time reference is the leading edge of the start bit of <LF>. All time information collected during the second before becomes valid at this moment.

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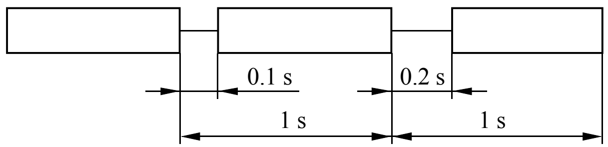
FIGURE 17

Modulation format for HBG

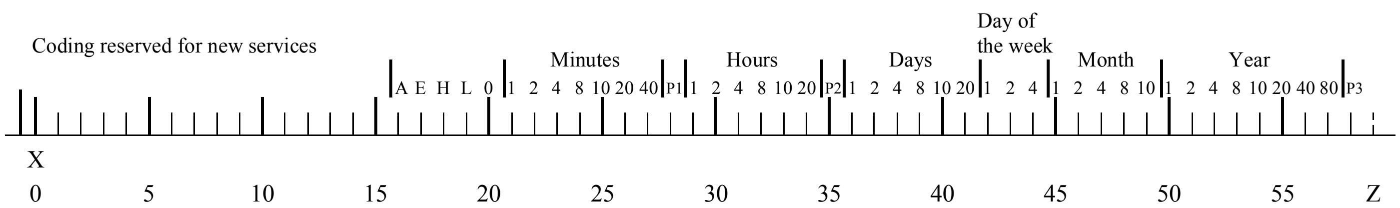
a) *Second and minute marker*
The carrier interruption during either 0.1 or 0.2 s signals the beginning of a second.
A double interruption, second 0.0 to 0.1 and 0.2 to 0.3, signals the beginning of a minute.

b) *Binary coding*
For the binary 0 (bit not set) the carrier is interrupted for a duration of 0.1 s. For the binary 1 (bit set) the duration is 0.2 s.



c) *Time code*
HBG broadcasts a complete time code, containing the indication of the time system used (CET or CEST), minutes, hours, days, days in the week, month and year.
This code is transmitted once every minute at a rate of one bit per second. The bit is set by lengthening the delay of a second interval from 0.1 to 0.2 s.
The bit of second 16 for summer or winter time announcement is set 12 h in advance.
The bit of second 19 serves to announce that a leap second is intercalated. It is set 12 h in advance.
When a leap second is inserted, the associated minute has a duration of 61 s and the 59th second marker preceding then marker 01.00.00 h CET or 02.00.00 CEST is emitted with a duration of 0.1 s. The marker associated with the intercalated 60th second is transmitted without carrier reduction.

HBG time code frame



Explanation:

X: double pulse on second 0
Z: pulse omitted for second 59
A: broadcast of CEST beginning or end
E: <<1>> = CEST, <<0>> = CET
H: <<1>> = CET, <<0>> = CEST
L: leap second announcement
P1: not used
P2: not used
P3: not used

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