IEC 60461

Edition 4.0 2010-03

INTERNATIONAL STANDARD

Time and control code

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE X

ICS 33.160.40; 33.170

ISBN 978-2-88910-197-9

® Registered trademark of the International Electrotechnical Commission

CONTENTS

FOREWORD 6
INTRODUCTION 8
1 Scope 9
2 Normative references 9
3 Terms, definitions and reserved 9
3.1 Terms and definitions 9
3.2 Reserved 11
4 Time representation in 30 frames per second and 60 frames per second systems 11
4.1 Definitions of real time and NTSC time 11
4.1.1 Definition of real time 11
4.1.2 Definition of NTSC time 11
4.2 Time address of a frame 11
4.2.1 Definition of time address of a frame 11
4.2.2 Non-drop frame – Uncompensated mode 12
4.2.3 Drop frame – NTSC time compensated mode 12
4.3 Colour frame identification in NTSC analogue composite television systems 12
5 Time representation in 25 frames per second and 50 frames per second systems 12
5.1 Definition of real time 12
5.2 Time address of a frame 12
5.3 Colour frame identification in PAL analogue composite television systems 13
5.3.1 Colour frame identification 13
5.3.2 Logical relationship 13
5.3.3 Arithmetic relationship 13
6 Time representation in 24-frame systems 13
6.1 Definitions of real time and NTSC time 13
6.1.1 Definition of real time 13
6.1.2 Definition of NTSC time 14
6.2 Time address of a frame 14
7 Structure of the time address and control bits 14
7.1 Numeric code 14
7.2 Time address 14
7.3 Flag bits 14
7.3.1 Definition of flag bits 14
7.3.2 Drop frame flag (NTSC composite television system only) 14
7.3.3 Colour frame flag (NTSC and PAL composite television systems only) 14
7.3.4 Binary group flags 15
7.3.5 Modulation method specific flag 15
7.4 Use of the binary groups 15
7.4.1 Binary group flag assignments 15
7.4.2 Character set not specified and unspecified clock time (BGF2=0, BGF1=0, BGF0=0) 15
7.4.3 Eight-bit character set and unspecified clock time (BGF2=0, BGF1=0, BGF0=1) 15
7.4.4 Date/time zone and unspecified clock time (BGF2=1, BGF1=0, BGF0=0) 16
7.4.5 Page/line multiplex system and unspecified clock time (BGF2=1, BGF1=0, BGF0=1) 16

7.4.6 Clock time specified and unspecified character set (BGF2=0, BGF1=1, BGF0=0) 16
7.4.7 Unassigned binary group usage and unassigned clock time (BGF2=0, BGF1=1, BGF0=1) 16
7.4.8 Date/time zone and clock time (BGF2=1, BGF1=1, BGF0=0) 16
7.4.9 Specified clock time and page/line multiplex system (BGF2=1, BGF1=1, BGF0=1) 16
7.5 Clock time reference – Binary group flag combinations 16
8 Linear time code application 17
8.1 Code word format 17
8.2 Code word data content 17
8.2.1 LTC code word content 17
8.2.2 Time address 17
8.2.3 Flag bits 17
8.2.4 Binary groups 18
8.2.5 Synchronization word 18
8.2.6 Biphase mark polarity correction 19
8.3 Modulation method 19
8.4 Bit rate 20
8.5 Timing of the code word relative to a television signal 20
8.6 Linear time code interface electrical and mechanical characteristics 21
8.6.1 Measurements 21
8.6.2 Rise/fall time 21
8.6.3 Amplitude distortion 21
8.6.4 Timing of the transitions 21
8.6.5 Interface connector 21
8.6.6 Output impedance 21
8.6.7 Output amplitude 21
9 Vertical interval application – Analogue television systems 26
9.1 Code word format 26
9.2 Code word data content 26
9.2.1 VITC code word content 26
9.2.2 Time address 29
9.2.3 Flag bits 29
9.2.4 Binary groups 29
9.2.5 Field mark flag 30
9.2.6 Synchronization bits 30
9.2.7 Cyclic redundance check code 30
9.3 Modulation method 31
9.4 Bit timing 31
9.5 Timing of the code word relative to the television signal 32
9.5.1 525/59,94 television system 32
9.5.2 625/50 television system 32
9.6 Location of the address code signal in the vertical interval 32
9.6.1 Location of the VITC code 32
9.6.2 525/59,94 television system 32
9.6.3 625/50 television system 32
9.6.4 Component television system 32
9.7 Redundancy 32

9.8 Vertical interval time code waveform characteristics 33
9.8.1 Waveform characteristics 33
9.8.2 Logic level 33
9.8.3 Rise/fall time 33
9.8.4 Amplitude distortion 33
10 Relationship between LTC and VITC 33
10.1 Time address data 33
10.2 Binary group data 33
10.2.1 General 33
10.2.2 Transferring vertical interval binary group data to linear binary group data 34
10.2.3 Transferring linear binary group data to vertical interval binary group data 34
10.3 VITC and LTC code word comparison 34
11 Progressive systems with frame rates greater than 30 frames per second 36
11.1 Time address of a frame pair in 50 and 60 frames per second progressive systems 36
11.2 Implementation guidelines 36
Annex A (informative) Explanatory notes 37
Annex B (informative) Converting time codes when converting video from 24 fps television systems 39
Bibliography 42

Figure 1 – Linear time code source output waveform 20
Figure 2 – 29,97/30 frame linear time code example 22
Figure 3 – 25 frame linear time code example 23
Figure 4 – 24 frame linear time code example 24
Figure 5 – Linear time code relationship to 59,94 frame progressive video example 25
Figure 6 – 525/59,94 vertical interval time code address bit assignment and timing 27
Figure 7 – 625/50 vertical interval time code address bit assignment and timing 28
Figure 8 – Vertical interval time code waveform 31
Figure 9 – Example of frame labeling for 50 and 60 frames per second progressive systems 36
Figure B.1 – Example of conversion of 23,98 fps video to 525/59,94/I 40
Figure B.2 – Example of conversion of 24 fps high definition video to 625/50/I 41

Table 1 – Binary group flag assignments 15
Table 2 – LTC time address bit positions 17
Table 3 – LTC flag bit positions 18
Table 4 – LTC binary group bit positions 18
Table 5 – LTC synchronization word bit positions and values 19
Table 6 – VITC time address bit positions 29
Table 7 – VITC flag bit positions 29
Table 8 – VITC binary group bit positions 30
Table 9 – CRC bit positions 31
Table 10 – VITC logic level ranges 33

Table 11 – Summation of VITC and LTC codeword bit definitions 35

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

TIME AND CONTROL CODE

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60461 has been prepared by technical area 6: Professional electronics storage media, data structures and equipment, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

This fourth edition cancels and replaces the third edition published in 2001, of which it constitutes a technical revision.

It includes the following significant change with regard to the previous edition: The time code for progressive television systems with a frame rate greater than 30 frames per second is added.

The text of this standard is based on the following documents:

CDV	Report on voting
100/1515/CDV	100/1616/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

IEC 60461 was originally developed for analogue television recording systems and thus dealt only with interlaced television systems operating with frame rates up to 30 frames per second. It is, however, flexible enough in design to be used in digital television systems, both standard definition and high definition. The support for progressive video systems with frame rates above 30 frames per second is described in this International Standard.

Clauses 4, 5, and 6 specify the manner in which time is represented in frame-based systems. Clause 7 specifies the structure of the time address and control bits of the code, and sets guidelines for storage of user data in the code. Clause 8 specifies the modulation method and interface characteristics of a linear time code (LTC) source. Clause 9 specifies the modulation method for inserting the code into the vertical interval of a television signal. Clause 10 summarises the relationship between the two forms of time and control code. Clause 11 summarises time code implementations for video formats with frame rates greater than 30 fps.

TIME AND CONTROL CODE

1 Scope

This International Standard specifies a digital time and control code for use in television, film, and accompanying audio systems operating at nominal rate of 60, 59,94, 50, 30, 29,97, 25, 24 and 23,98 frames per second. This International Standard specifies a time address, binary groups, and flag bit structure. In addition, the standard specifies a binary group flag assignment, a linear time code transport, and a vertical interval time code transport.

This International Standard defines primary data transport structures for linear time code (LTC) and vertical interval time code (VITC). This standard specifies the LTC modulation and timing for all video formats. This standard also defines the VITC modulation and location for 525/59,94 and 625/50 analogue composite and component systems only.

NOTE The digital representation of analogue VITC (D-VITC) is specified in SMPTE 266M and is defined for 525/59,94 and 625/50 digital component systems only. High definition formats, such as those documented in SMPTE 274M and SMPTE 296M, should use ancillary time code (ATC) as specified in SMPTE 12M-2 (formerly SMPTE RP 188) for transport of time code in the digital video data stream. For future implementations of time code for digital standard definition formats, the use of ATC rather than D-VITC is encouraged.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 646:1991, *Information processing – ISO 7-bit coded character set for information interchange*

ISO/IEC 2022:1994, *Information technology – Character code structure and extension techniques*

ITU-R BT.1700-1(2005), Annex 2, *Characteristics of composite video signals for conventional analogue television systems*

SMPTE 170M:2004, *Television – Composite Analog Video Signal – NTSC for Studio Applications*

SMPTE 258M:1993, *Television – Transfer of Edit Decision Lists*

SMPTE 262M:1995, *Television, Audio and Film – Binary Groups of Time and Control Codes – Storage and Transmission of Data*

SMPTE 309M:1999, *Television – Transmission of Date and Time Zone Information in Binary Groups of Time and Control Code*