

Helical-scan digital video cassette recording system using 6,35 mm magnetic tape for consumer use (525-60, 625-50, 1125-60 and 1250-50 systems) —

Part 3: HD format for 1125-60 and 1250-50 systems

The European Standard EN 61834-3:2000 has the status of a
British Standard

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National foreword

This British Standard is the official English language version of EN 61834-3:2000. It is identical with IEC 61834-3:1999.

The UK participation in its preparation was entrusted by Technical Committee EPL/100, Audio, video and multimedia systems, to Subcommittee EPL/100/2, Recording, which has the responsibility to:

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Summary of pages

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**Recording - Helical-scan digital video cassette recording system
using 6,35 mm magnetic tape for consumer use
(525-60, 625-50, 1125-60 and 1250-50 systems)
Part 3: HD format for 1125-60 and 1250-50 systems
(IEC 61834-3:1999)**

Enregistrement - Systèmes de
magnétoscopes numériques à cassette à
balayage hélicoïdal sur bande
magnétique de 6,35 mm pour usage
grand public (systèmes 525-60,
625-50, 1125-60 et 1250-50)
Partie 3: Format HD pour les systèmes
1125-60 et 1250-50
(CEI 61834-3:1999)

Aufzeichnung - Videokassettensystem
mit digitaler Schrägspuraufzeichnung
auf Magnetband 6,35 mm für den
Heimgebrauch (Systeme 525-60,
625-50, 1125-60 und 1250-50)
Teil 3: HD-Format für die Systeme
1125-60 und 1250-50
(IEC 61834-3:1999)

This European Standard was approved by CENELEC on 2000-01-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 100B/233/FDIS, future edition 1 of IEC 61834-3, prepared by SC 100B "Audio, video and multimedia information storage systems" of IEC TC 100 "Audio, video and multimedia systems and equipment", was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61834-3 on 2000-01-01.

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Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annexes A and ZA are normative and annex B is informative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61834-3:1999 was approved by CENELEC as a European Standard without any modification.

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**RECORDING – HELICAL-SCAN DIGITAL VIDEO CASSETTE RECORDING
SYSTEM USING 6,35 mm MAGNETIC TAPE FOR CONSUMER USE
(525-60, 625-50, 1125-60 and 1250-50 systems) –**

Part 3: HD format for 1125-60 and 1250-50 systems

1 General

1.1 Scope

The main object of this part of IEC 61834 is to establish basic principles applicable to the next generation of digital video cassette recording systems for consumer use for the interest of both users and manufacturers.

This part of IEC 61834 specifies the content, format and recording method of the data blocks forming the helical records on the tape containing audio, video, and system data. It describes the specifications for the 1125-line system with a frame frequency of 30,00 Hz (hereinafter referred to as the "1125-60 system") and the 1250-line system with a frame frequency of 25,00 Hz (hereinafter referred to as the "1250-50 system") which are not included in parts 1 and 2. One video channel and four independent audio channels are recorded in the digital format. Each of these channels is designed to be capable of independent editing. The video channel records and reproduces a component television signal in the 1125-60 and 1250-50 systems.

In part 3, the data structure of a track is defined by APT = 000b which consists of four areas as described in 4.3.2 in part 1 and AP1 = AP2 = AP3 = 000b. The data structure of MIC is the same as clause 10 in IEC 61834-2.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61834. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 61834 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 61834-2:1998, *Recording – Helical-scan digital video cassette recording system using 6,35 mm magnetic tape for consumer use (525-60, 625-50, 1125-60 and 1250-50 systems) – Part 2: SD format for 525-60 and 625-50 systems*

ITU-R Recommendation BT.709-3:1998, *Parameter values for the HDTV standards for production and international programme exchange*

ITU-R Recommendation BS.775-1:1993, *Multi-channel stereophonic sound systems with and without accompanying picture*

1.3 Definitions, symbols and abbreviations

None

1.4 Environment and test conditions

Tests and measurements made on the system to check the requirements of this standard shall be carried out under the following conditions.

- Temperature: 20 °C ± 1 °C;
- Relative humidity: (50 ± 2) %;
- Barometric pressure: from 86 kPa to 106 kPa;
- Tape conditioning: not less than 24 h.

1.5 Reference tape

Blank tape to be used for calibration recordings may be purchased from the manufacturers given in annex B.

1.6 Calibration tape

Manufacturers of video tape recorders designed for this format specification may sell calibration tapes meeting the following requirements.

1.6.1 Record locations and dimensions

Tolerances shown in tables 1 and 2 should be reduced by 50 %.

1.6.2 Calibration signals

Test signals should be recorded on the calibration tapes:

- Video: 100 % colour bars;
- Audio: 1 kHz tone at –20 dB below full level.

1.6.3 Purchase

The calibration tape may be purchased from the manufacturers given in annex B.

2 Helical recordings

2.1 Tape speed

The tape speed is 37,594 mm/s for both 1125-60 and 1250-50 systems.

The tape speed tolerance is ±0,5 %.

2.2 Record location and dimensions

Record location and dimensions for continuous recording shall be as specified in figure 1 of IEC 61834-2. Each value is described in table 1. For recording, helical tracks shall be contained within the tolerance specified in table 1.

Each sector location from the start of the SSA shall be as specified in figure 2 and table 2 of IEC 61834-2. The physical tape pattern shall be specified by the centre line of each track.

The effective area upper edge, record and playback guarantee, overwrite margin (OM) and switching margin for recording amplifiers are the same as in IEC 61834-2.

2.2.1 Scanner example

Scanner dimensions in table 3 are one possible configuration. Other mechanical configurations are permitted, if the same footprint of recorded information is produced on tape.

3 Programme track data arrangement

3.1 Introduction

Each television frame is recorded on 20 tracks for the 1125-60 system and 24 tracks for the 1250-50 system.

The helical tracks are recorded with video, audio and system data the same as the SD format in IEC 61834-2. Figure 1 shows the arrangement of a track for both systems.

Each track is numbered from the beginning track of the television frame in order. A track which has track number i ($i = 0$ to 19 for 1125-60 system or $i = 0$ to 23 for 1250-50 system) is referred to as track i .

Placement of F0, F1 and F2 tracks is shown in figure 2 for the 1125-60 system and figure 3 for the 1250-50 system. In both systems, pilot frame 0 repeats.

3.2 Labelling convention

The most significant bit is written on the left and is the first recorded on the tape. The lowest numbered byte is shown on the top left and is the first encountered in the input data stream. Byte values are expressed in binary coded decimal notation unless otherwise noted.

An "h" subscript indicates hexadecimal value. A "b" subscript indicates binary value.

3.3 Audio sector

Same as IEC 61834-2 except for sequence number (see table 4) and track pair number (see tables 5 and 6).

3.4 Video sector

Same as IEC 61834-2 except for sequence number (see table 4) and track pair number (see tables 5 and 6).

3.5 Subcode sector

Same as IEC 61834-2 except for subcode postamble which begins with run-up of modulated 1 200 bits for the 1125-60 and 1250-50 systems.

4 Audio interface

Same as IEC 61834-2.

5 Video interface

Same as IEC 61834-2.

6 Audio signal processing

6.1 Introduction

The audio signal is recorded on four audio blocks. Each audio block is processed independently and identically. The audio block is composed of five audio sectors in five consecutive tracks for the 1125-60 system and six audio sectors in six consecutive tracks for the 1250-50 system. Audio signal processing in each audio block is the same as in IEC 61834-2.

Option:

In this standard, 20 bits audio for professional use is prepared. Details are described in annex A.

6.2 Error correction code

Same as IEC 61834-2.

6.3 Randomization pattern

Same as IEC 61834-2.

6.4 Audio encoding

Same as IEC 61834-2.

6.5 Audio channel allocation

6.5.1 Audio block

The audio block is the physical recording channel for audio signal on tape. In this standard, four audio blocks named CH1, CH2, CH3 and CH4 are provided. The construction of these audio blocks is shown in table 7. In each audio block, one of four encoding modes prescribed in table 13 in IEC 61834-2 is applied. Audio signals with the same encoding mode shall be recorded in CH1 and CH2, and in CH3 and CH4. CH1 and CH3 may be recorded with a different encoding mode from each other, but the quantization in CH1 to CH4 shall be the same except for HD-6ch audio described later.

6.5.2 Audio channel mode

For the assignment of encoding mode in four audio blocks, three types of audio channel modes are prepared, that is HD-4ch audio, HD-8ch audio and HD-6ch audio.

In 48k mode, 44,1k mode and 32k mode, a signal of one audio channel is recorded in an audio block. Since four audio channels are available, these modes are called HD-4ch audio.

In 32k-2ch mode, signals of two audio channels are recorded in an audio block. Since eight audio channels are available, this mode is called HD-8ch audio.

In the combination of 48k mode and 32k-2ch mode, signals of two audio channels are recorded in CH1 and CH2, and signals of four audio channels are recorded in CH3 and CH4. Since six audio channels are available, this mode is called HD-6ch audio. HD-6ch audio is available only for lumped audio described in 6.5.3.

6.5.3 Channel allocation rule

A channel allocation is classified into two kinds of rules by the attribute of source contents, that is, multi-stereo audio and lumped audio.

6.5.3.1 Multi-stereo audio

Multi-stereo audio is defined as multiple sets of stereo audio. Each stereo audio signal may be recorded independently. Multi-stereo audio contains HD-4ch audio and HD-8ch audio.

Basic channel allocation rule for HD-4ch audio is described in table 8. Encoded data in CH1 to CH4 correspond to encoded data X in figure 17 in IEC 61834-2. The audio signals which are recorded simultaneously with the video signal shall be recorded in CH1 and CH2.

Basic channel allocation rule for HD-8ch audio is described in table 8. Each audio channel in HD-8ch audio is named as CHa, CHb, CHc, CHd, CHe, CHf, CHg and CHh. CHa and CHb shall be recorded in CH1, CHc and CHd shall be recorded in CH2, CHe and CHf shall be recorded in CH3, and CHg and CHh shall be recorded in CH4. Encoded data in CHa, CHc, CHe and CHg correspond to encoded data Y, and encoded data in CHb, CHd, CHf and CHh correspond to encoded data Z in figure 18 in IEC 61834-2. For the channel described as "No information" in CHb, CHd, CHf or CHh, all zero data or the same data as CHa, CHc, CHe or CHg may be recorded. The audio signals which are recorded simultaneously with the video signal shall be recorded in CH1.

6.5.3.2 Lumped audio

Lumped audio is defined so that all channels of audio blocks shall be recorded simultaneously. Lumped audio contains HD-4ch audio, HD-6ch audio and HD-8ch audio which are called lumped-4ch audio, lumped-6ch audio and lumped-8ch audio respectively. The channel allocation rule of lumped audio is shown in table 9. Lumped-6ch audio and lumped-8ch audio are prepared for pre-recorded tapes. If the woofer channel is not used, all zero data as audio data shall be recorded into the channel. Other channel allocations are reserved.

For lumped audio, SM of AAUX SOURCE pack shall be set to "1". For playback, each SM of AAUX SOURCE pack in all audio blocks should be checked.

Mixing levels of Lmix, Rmix, T, Q1 and Q2 in table 9 are referred to in ITU-R Recommendation 775.

6.6 Frame structure

6.6.1 Relative audio-video timing

Audio signals are recorded separately by the video frame period, and the duration of one audio frame is defined as one video frame. An audio frame begins with the audio sample acquired within the duration of minus 50 samples to zero sample from the beginning of the first line in the first field of the input video signal.

6.6.2 Audio frame processing

This standard provides the same audio frame processing modes as IEC 61834-2.

6.6.2.1 Unlocked mode

Unlocked mode is applied to 48k, 44,1k, 32k and 32k-2ch modes when sampling frequency of the audio signal is not synchronous with the video frame frequency. The number of audio samples per frame is variable within the range between the maximum and the minimum, as shown in table 10. The number of audio samples per frame is rounded to integer. The recording capacity of audio data for each audio block corresponds with the maximum in 48k mode. For the lack of samples for filling the audio block, undefined values, "1" or "0", which mean "don't-care data", shall be recorded.

6.6.2.2 Locked mode

Locked mode is applied to 48k, 32k and 32k-2ch modes when sampling frequency of the audio signal is synchronous with the video frequency. The audio sampling frequency (f_s) is related to the line frequency (f_h) by the following equations.

48k mode:	$f_s = f_h \times 64 / 45$	for 1125-60 system
	$f_s = f_h \times 192 / 125$	for 1250-50 system
32k mode and 32k-2ch mode:	$f_s = f_h \times 128 / 135$	for 1125-60 system
	$f_s = f_h \times 128 / 125$	for 1250-50 system

The number of audio samples per frame keeps a regular sequence or fixed value as shown in table 12.

6.7 Shuffling method

Audio samples and undefined values are shuffled over tracks and data-sync blocks within a frame. Firstly audio data are shuffled then undefined values are set. Data D_n that is sampled at n -th order ($n = 0, 1, 2, \dots$) within a frame is located at the position derived from the following equations.

Audio shuffling patterns are the same as figure 19 and figure 21 in IEC 61834-2 for 1125-60 system, and figure 20 and figure 22 in IEC 61834-2 for 1250-50 system. The following description of track number is added in each figure.

a) 1125-60 system

- "Track 10 or Track 15" is added to "Track 0 or Track 5".
- "Track 11 or Track 16" is added to "Track 1 or Track 6".
- "Track 12 or Track 17" is added to "Track 2 or Track 7".
- "Track 13 or Track 18" is added to "Track 3 or Track 8".
- "Track 14 or Track 19" is added to "Track 4 or Track 9".

b) 1250-50 system

"Track 12 or Track 18" is added to "Track 0 or Track 6".
 "Track 13 or Track 19" is added to "Track 1 or Track 7".
 "Track 14 or Track 20" is added to "Track 2 or Track 8".
 "Track 15 or Track 21" is added to "Track 3 or Track 9".
 "Track 16 or Track 22" is added to "Track 4 or Track 10".
 "Track 17 or Track 23" is added to "Track 5 or Track 11".

6.7.1 48k, 44,1k, 32k modes

a) 1125-60 system

Track number:	$(\text{INT}(n / 3) + 2 \times (n \bmod 3)) \bmod 5$	for CH1
	$(\text{INT}(n / 3) + 2 \times (n \bmod 3)) \bmod 5 + 5$	for CH2
	$(\text{INT}(n / 3) + 2 \times (n \bmod 3)) \bmod 5 + 10$	for CH3
	$(\text{INT}(n / 3) + 2 \times (n \bmod 3)) \bmod 5 + 15$	for CH4

Sync block number: $2 + 3 \times (n \bmod 3) + \text{INT}((n \bmod 45) / 15)$

Byte position number:	$10 + 2 \times \text{INT}(n / 45)$	for the most significant byte
	$11 + 2 \times \text{INT}(n / 45)$	for the least significant byte

where

$n = 0$ to 1 619 for 48k mode;
 $n = 0$ to 1 488 for 44,1k mode;
 $n = 0$ to 1 079 for 32k mode.

b) 1250-50 system

Track number:	$(\text{INT}(n / 3) + 2 \times (n \bmod 3)) \bmod 6$	for CH1
	$(\text{INT}(n / 3) + 2 \times (n \bmod 3)) \bmod 6 + 6$	for CH2
	$(\text{INT}(n / 3) + 2 \times (n \bmod 3)) \bmod 6 + 12$	for CH3
	$(\text{INT}(n / 3) + 2 \times (n \bmod 3)) \bmod 6 + 18$	for CH4

Sync block number: $2 + 3 \times (n \bmod 3) + \text{INT}((n \bmod 54) / 18)$

Byte position number:	$10 + 2 \times \text{INT}(n / 54)$	for the most significant byte
	$11 + 2 \times \text{INT}(n / 54)$	for the least significant byte

where

$n = 0$ to 1 943 for 48k mode;
 $n = 0$ to 1 785 for 44,1k mode;
 $n = 0$ to 1 295 for 32k mode.

6.7.2 32k-2ch modes

a) 1125-60 system

Track number:	$(\text{INT}(n / 3) + 2 \times (n \bmod 3)) \bmod 5$	for CH1
	$(\text{INT}(n / 3) + 2 \times (n \bmod 3)) \bmod 5 + 5$	for CH2
	$(\text{INT}(n / 3) + 2 \times (n \bmod 3)) \bmod 5 + 10$	for CH3
	$(\text{INT}(n / 3) + 2 \times (n \bmod 3)) \bmod 5 + 15$	for CH4
Sync block number:	$2 + 3 \times (n \bmod 3) + \text{INT}((n \bmod 45) / 15)$	
Byte position number:	$10 + 3 \times \text{INT}(n / 45)$	for the most significant byte Y
	$11 + 3 \times \text{INT}(n / 45)$	for the most significant byte Z
	$12 + 3 \times \text{INT}(n / 45)$	for the least significant byte

where $n = 0$ to 1 079.

b) 1250-50 system

Track number:	$(\text{INT}(n / 3) + 2 \times (n \bmod 3)) \bmod 6$	for CH1
	$(\text{INT}(n / 3) + 2 \times (n \bmod 3)) \bmod 6 + 6$	for CH2
	$(\text{INT}(n / 3) + 2 \times (n \bmod 3)) \bmod 6 + 12$	for CH3
	$(\text{INT}(n / 3) + 2 \times (n \bmod 3)) \bmod 6 + 18$	for CH4
Sync block number:	$2 + 3 \times (n \bmod 3) + \text{INT}((n \bmod 54) / 18)$	
Byte position number:	$10 + 3 \times \text{INT}(n / 54)$	for the most significant byte Y
	$11 + 3 \times \text{INT}(n / 54)$	for the most significant byte Z
	$12 + 3 \times \text{INT}(n / 54)$	for the least significant byte

where $n = 0$ to 1 295.

6.8 Audio auxiliary data (AAUX)

The same data as in IEC 61834-2 are defined for CH1 to CH4.

6.9 Invalid recording

For recording invalid values as audio data, REC MODE in AAUX1 shall be set to 111b. The values of the invalid data are not taken into account.

7 Video signal processing

7.1 Introduction

Video signals are sampled by 40,5 MHz for luminance and 13,5 MHz for colour differences. Video signal processing for bit rate reduction is almost the same as in IEC 61834-2. A macro block of HD format consists of eight DCT blocks, while that of SD format consists of six DCT blocks.

7.2 Error correction code

Same as IEC 61834-2.

7.3 Randomization pattern

Same as IEC 61834-2.

7.4 Video structure

7.4.1 Sampling structure

The sampling structure is defined as 12:4:4 component television signals based on ITU-R Recommendation 709. Sampling structures of luminance (Y) and two colour difference signals (CR, CB) are shown in table 13.

7.4.1.1 Pixel and line structures in one frame

The sampling starting point of Y signal shall be $124T$ for 1125-60 system or $144T$ for 1250-50 system from the horizontal sync timing reference

where

$$T = \frac{1}{40,5 \times 10^6} \text{ s}$$

The sampling starting point in the active period of CR and CB signals shall be the same as the sampling starting point in the active period of Y signal.

Each pixel has a value from -127 to 126 which is obtained by a subtraction of 128 from the input video signal level.

a) 1125-60 system

For Y signals, 1 008 pixels per line shall be transmitted. Each colour difference signal shall be decimated line sequentially in every two lines and 336 pixels per line shall be transmitted as shown in figure 4.

The active lines shall be from line 44 to line 555 and from line 606 to line 1 117 as shown in table 13. From each field, 512 lines for Y signals and 256 lines for CR and CB signals shall be transmitted.

b) 1250-50 system

For Y signals, 1 080 pixels per line shall be transmitted. Each colour difference signal shall be decimated line sequentially in every two lines and 360 pixels per line shall be transmitted as shown in figure 5.

The active lines shall be from line 45 to line 620 and from line 670 to line 1 245 as shown in table 13. From each field, 576 lines for Y signals and 288 lines for CR and CB signals shall be transmitted.

7.4.1.2 Filter characteristic

Filter characteristics are recommended as follows for 1125-60 and 1250-50 systems:

- less than or equal to -12 dB at $20,25$ MHz for luminance signal;
- less than or equal to -6 dB at $6,75$ MHz for chrominance signal.

7.4.2 DCT block

The Y, CR and CB pixels in one frame shall be divided into DCT blocks as shown in figure 6. All DCT blocks are structured with a rectangular area of eight vertical lines and eight horizontal pixels in a frame. The value of x shows the horizontal coordinate from the left and the value of y shows the vertical coordinate from the top. For 1125-60 system, odd lines of y = 1, 3, 5, 7 are the horizontal lines of field one, and even lines of y = 0, 2, 4, 6 are those of field two. For 1250-50 system, even lines of y = 0, 2, 4, 6 are the horizontal lines of field one, and odd lines of y = 1, 3, 5, 7 are those of field two.

7.4.2.1 DCT block arrangement in one frame for 1125-60 system

The arrangement of horizontal DCT blocks in one frame is shown in figure 7. The same horizontal arrangement is repeated to 128 DCT blocks for Y and 64 DCT blocks for CR and CB in a vertical direction. Pixels in one frame are divided into 21 504 DCT blocks.

- Y: Vertical 128 DCT blocks × horizontal 126 DCT blocks = 16 128 DCT blocks
- CR: Vertical 64 DCT blocks × horizontal 42 DCT blocks = 2 688 DCT blocks
- CB: Vertical 64 DCT blocks × horizontal 42 DCT blocks = 2 688 DCT blocks

7.4.2.2 DCT block arrangement in one frame for 1250-50 system

The arrangement of horizontal DCT blocks in one frame is shown in figure 7. The same horizontal arrangement is repeated on 144 DCT blocks for Y and 72 DCT blocks for CR and CB in vertical direction. Pixels in one frame are divided into 25 920 DCT blocks.

- Y: Vertical 144 DCT blocks × horizontal 135 DCT blocks = 19 440 DCT blocks
- CR: Vertical 72 DCT blocks × horizontal 45 DCT blocks = 3 240 DCT blocks
- CB: Vertical 72 DCT blocks × horizontal 45 DCT blocks = 3 240 DCT blocks

7.4.3 Macro block

7.4.3.1 Macro block and DCT blocks

Each macro block consists of eight DCT blocks. Figure 8 shows the relationship between macro blocks and DCT blocks.

7.4.3.2 Macro block arrangement in one frame for 1125-60 system

Macro block arrangement in one frame has two steps.

a) Step 1: Arranging macro blocks

The pixels in one frame are divided into 2 688 macro blocks as shown in figure 9.

Vertical 64 macro blocks × horizontal 42 macro blocks = 2 688 macro blocks

b) Step 2: Rearranging macro blocks

Nine macro blocks in A0 to A7 and A10 to A17 are arranged into three macro blocks × three macro blocks in B0 to B7 and B10 to B17 respectively as shown in figure 9.

Six macro blocks in A8, A9, A18 and A19 plus three dummy macro blocks are arranged into three macro blocks × three macro blocks in B8, B9, B18 and B19 respectively as shown in figure 9. Each pixel in dummy macro blocks should have the same value such as the centre level of the video signal.

Vertical 60 macro blocks × horizontal 45 macro blocks = 2 700 macro blocks.

As a result, the arrangement of macro blocks in one frame becomes the form as shown in figure 10. The small rectangle shows a macro block.

7.4.3.3 Macro block arrangement in one frame for 1250-50 system

Pixels in one frame are divided into 3 240 macro blocks.

Vertical 72 macro blocks $\times$ horizontal 45 macro blocks = 3 240 macro blocks

The arrangement of macro blocks in one frame is shown in figure 11. The small rectangle shows a macro block.

7.4.4 Super block

Each super block consists of 27 macro blocks.

7.4.4.1 Super block arrangement in one frame for 1125-60 system

The arrangement of super blocks in one frame is shown in figure 10. Each super block is structured with 27 adjacent macro blocks enclosed by a thick line. The pixels in a frame are divided into 100 super blocks.

Vertical 20 super blocks $\times$ horizontal 5 super blocks = 100 super blocks

7.4.4.2 Super block arrangement in one frame for 1250-50 system

The arrangement of super blocks in one frame is shown in figure 11. Each super block is structured with 27 adjacent macro blocks enclosed by a thick line. The pixels in a frame are divided into 120 super blocks.

Vertical 24 super blocks $\times$ horizontal 5 super blocks = 120 super blocks

7.4.5 Definition of super block number, macro block number and value of the pixel

7.4.5.1 Super block number

The super block number in a frame is expressed as $S_{i,j}$ as shown in figures 10 and 11.

$$S_{i,j}$$

where

i is the vertical order of the super block

$i = 0, \dots, 19$ for the 1125-60 system;

$i = 0, \dots, 23$ for the 1250-50 system;

j is the horizontal order of the super block

$j = 0, \dots, 4$.

7.4.5.2 Macro block number

The macro block number is expressed as $M_{i,j,k}$. The symbol k is the macro block order in the super block as shown in figure 12. The small rectangle in figure 12 shows a macro block, and a number in the small rectangle expresses k .

$$M_{i,j,k}$$

where

i, j are the super block number;

k is the macro block order in the super block

$k = 0, \dots, 26$.

7.4.5.3 Value of the pixel

The value of the pixel is expressed as $P_{i,j,k,l}(x,y)$. The pixel is indicated as the suffix of $i,j,k,l(x,y)$. The symbol l is the DCT block order in a macro block as shown in figure 8. The rectangle in the figure shows a DCT block, and a DCT number in the rectangle expresses l . The symbols x and y are the pixel coordinate in the DCT block as described in 7.4.2.

$$P_{i,j,k,l}(x,y)$$

where

i, j, k are the macro block number;

l is the DCT block order in the macro block;

(x,y) is the pixel coordinate in the DCT block

$$x = 0, \dots, 7.$$

$$y = 0, \dots, 7.$$

7.4.6 Definition of video segment and compressed macro block

Same as IEC 61834-2 except for the macro block numbers which are included in one video segment. The macro block numbers are as shown below.

$$M_{a,2,k} \quad \text{where} \quad a = (i + 4) \bmod n$$

$$M_{b,1,k} \quad \text{where} \quad b = (i + 12) \bmod n$$

$$M_{c,3,k} \quad \text{where} \quad c = (i + 16) \bmod n$$

$$M_{d,0,k} \quad \text{where} \quad d = (i + 0) \bmod n$$

$$M_{e,4,k} \quad \text{where} \quad e = (i + 8) \bmod n$$

where

l is the vertical order of the super block

$$l = 0, \dots, n-1;$$

n is the number of vertical super blocks in a video frame

$$n = 20 \quad \text{for 1125-60 system};$$

$$n = 24 \quad \text{for 1250-50 system};$$

k is the macro block order in the super block

$$k = 0, \dots, 26.$$

7.5 DCT processing

Same as IEC 61834-2.

7.6 Quantization

7.6.1 Introduction

Weighted DCT coefficients are transformed into 9 bits. The 9 bits-transformed data are then divided by the quantization step in order to limit the amount of data in one video segment to five compressed macro blocks.

7.6.2 Bit assignment for quantization

Weighted DCT coefficients are represented as follows:

DC coefficient value (9 bits):	b8 b7 b6 b5 b4 b3 b2 b1 b0 2's complement (−255 to 255)
AC coefficient value (10 bits):	s b8 b7 b6 b5 b4 b3 b2 b1 b0 1 sign bit + 9 bits of absolute value (−511 to 511)

7.6.3 Class number

Each DCT block shall be classified into four classes by the definitions as described in table 21 of IEC 61834-2. For 1125-60 and 1250-50 systems, red-block detection is considered as option. The method of red-block detection is not defined.

- Example of red-block detection method

$P_{i,j,k,6}(x,y)$ is the pixel value of DCT 6 (CR) in macro block $M_{i,j,k}$.

$P_{i,j,k,7}(x,y)$ is the pixel value of DCT 7 (CB) in macro block $M_{i,j,k}$.

```
count = 0;
for (x = 0; x < 8; x++){
    for (y = 0; y < 8; y++){
        if (Pi,j,k,6(x,y) >= 160 && Pi,j,k,7(x,y) < 128 ) {count ++;}
    }
}
if (count > 10) DCT 6 (CR) in macro block Mi,j,k is red-block
else DCT 6 (CR) in macro block Mi,j,k is not red-block;
```

For reference, table 14 shows an example of the classification including red-block detection.

7.6.4 Initial scaling

Initial scaling is an operation for coefficients to transform from 10 bits to 9 bits. Initial scaling shall be carried out as shown below.

For class numbers 0, 1, 2

input data	s b8 b7 b6 b5 b4 b3 b2 b1 b0
output data	s b7 b6 b5 b4 b3 b2 b1 b0

For class number 3

input data	s b8 b7 b6 b5 b4 b3 b2 b1 b0
output data	s b8 b7 b6 b5 b4 b3 b2 b1

7.6.5 Area number

The area number is used for selection of a quantization step. AC coefficients within a DCT block shall be classified into eight areas with an area number as shown in figure 13.