

### SLOVENSKI STANDARD SIST ETS 300 731 E1:2003

01-december-2003

#### HY`Yj]n]′g\_]ˈg]ghYa]ˈËˈ≠nVc`′ýUbUˈhY`Yj]n]′UˈgʻZUhbcʻgdfYa]b′U′c cʻgYʻj fgh]WcʻfD5 @cʻg \*&) j fgh]WUa] Ë:D5 @d`i g

Television systems; Enhanced 625-line Phased Alternate Line (PAL) television; PALplus

### iTeh STANDARD PREVIEW (standards.iteh.ai)

Ta slovenski standard je istoveten z: ETS 300 731 Edition 1

https://standards.iteh.ai/catalog/standards/sist/f5f93992-04ba-4a69-8515-

3042237bb320/sist-ets-300-731-e1-2003

ICS:

33.160.25 Televizijski sprejemniki Television receivers 33.170 Televizijska in radijska Television and radio

difuzija broadcasting

SIST ETS 300 731 E1:2003 en

### iTeh STANDARD PREVIEW (standards.iteh.ai)

SIST ETS 300 731 E1:2003 https://standards.iteh.ai/catalog/standards/sist/f5f93992-04ba-4a69-8515-3042237bb320/sist-ets-300-731-e1-2003



# EUROPEAN TELECOMMUNICATION STANDARD

ETS 300 731

March 1997

Source: EBU/CENELEC/ETSI JTC Reference: DE/JTC-PALplus

ICS: 33.020

Key words: Broadcasting, analogue, TV, wide screen

Television Systems; https://standards.iteh.ai/catalog/standards/sist/f5/93992-04ha-4a

Enhanced 625-line Phased Alternate Line (PAL) television; PALplus

#### **ETSI**

European Telecommunications Standards Institute

#### **ETSI Secretariat**

Postal address: F-06921 Sophia Antipolis CEDEX - FRANCE

Office address: 650 Route des Lucioles - Sophia Antipolis - Valbonne - FRANCE

X.400: c=fr, a=atlas, p=etsi, s=secretariat - Internet: secretariat@etsi.fr

Tel.: +33 4 92 94 42 00 - Fax: +33 4 93 65 47 16

**Copyright Notification:** No part may be reproduced except as authorized by written permission. The copyright and the foregoing restriction extend to reproduction in all media.

© European Broadcasting Union 1997.

<sup>©</sup> European Telecommunications Standards Institute 1997.

Page 2

ETS 300 731: March 1997

### iTeh STANDARD PREVIEW (standards.iteh.ai)

SIST ETS 300 731 E1:2003 https://standards.iteh.ai/catalog/standards/sist/f5f93992-04ba-4a69-8515-3042237bb320/sist-ets-300-731-e1-2003

Whilst every care has been taken in the preparation and publication of this document, errors in content, typographical or otherwise, may occur. If you have comments concerning its accuracy, please write to "ETSI Editing and Committee Support Dept." at the address shown on the title page.

#### **Contents**

Fore	word		7		
1	Scope		9		
2	Norma	ative references	9		
3	Abbrev	viations	9		
4	Basic PALplus system description				
	4.1	Introduction			
	4.2 Normative features of a PALplus transmission				
5	The P	ALplus signal	12		
	5.1	Input picture signal to the PALplus encoder			
	5.2	The encoded composite PALplus signal			
6	The P	ALplus encoding processes	15		
_	6.1	Vertical conversion			
		6.1.1 Encoder vertical conversion of luminance			
		6.1.2 Encoder vertical conversion of chrominance	16		
	6.2	6.1.3 430-line letterbox	20		
		6.2.1 Helper amplitude	20		
		6.2.3 Description of helper processing			
		6.2.4 Baseband helper 731 E1:2003	25		
	6.3	Motion Adaptive Colour Plus	25		
		Motion Adaptive Colour Plus 6.3.1 Pre-processing in the encoder 6.3.2 Motion detector operation	26		
		6.3.2 Motion detector operation	29		
	6.4	6.3.3 Non-PALplus use of Motion Adaptive Colour Plus			
	0.4	6.4.1 Luminance			
		6.4.2 Chrominance			
	6.5	Reference signals			
	0.5	6.5.1 Helper reference signals with baseband helper			
	6.6	Signalling			
Anne	ex A (nor	rmative): Filter and look-up table coefficients	37		
A.1	Genera	al rules for filter descriptions	37		
	A.1.1	General rules for horizontal filters			
	A.1.2	General rules for vertical filters			
A.2	Vertica	al conversion	37		
,	A.2.1 ENC_Y_QMF (camera mode)				
	A.2.2				
	A.2.3	ENC_UV_C_VSRC			
	A.2.4	ENC_UV_F_VSRC			
A.3	Helper	r encoding	49		
	A.3.1	ENC_BB_US			
	A.3.2	ENC_BB_PRE_MOD_LPF_SS			
	A.3.3	ENC_BB_POST_MOD_NYQ	50		
	A.3.4 LUT_BB_ENC (film mode)				
	A.3.5	LUT_BB_ENC (camera mode)	51		

Page 4 ETS 300 731: March 1997

A.4	Motion A	daptive Colour Plus	52			
	A.4.1	Y_BSPLIT	52			
	A.4.2	ENC_Y_IFA				
	A.4.3	ENC_UV_LPF				
	A.4.4 A.4.5	VERT_IFA ENC MD UV LPF				
	A.4.5 A.4.6	ENC_MD_US				
	A.4.7	LUT_IFD_U_CLIP				
	A.4.8	LUT_IFD_V_CLIP				
	A.4.9	LUT_MD_M				
	A.4.10	LUT_ENC_MD_YL				
	A.4.11	LUT_ENC_MD_CS	59			
A.5	PAL encoding					
	A.5.1	ENČ_UV_US	59			
Annex	κ Β (inform	native): Encoder filter plots	60			
Annex	C (inforn	native): The PALplus decoder	65			
C.1	Conoral		G.E.			
U. I	General.	Composite PALplus input signal				
	C.1.1	Decoder output signal	65			
	0.1.2	Docodor output digital	00			
C.2	Overview	of the PALplus decoding process	66			
	C.2.1	PAL decoding	66			
	C.2.2	MACP post-processing				
	• • •	C.2.2.1 Motion detector operation	70			
	C.2.3	Helper processing	73			
	C.2.4 C.2.5	Vertical conversion of luminance vertical conversion of chrominance vertical conversion of chrominance vertical conversion of chrominance vertical conversion of chrominance vertical conversion of luminance vertical conversion of chrominance vertical conversion vertical conversion of chrominance vertical conversion verti	74 74			
	C.2.5 C.2.6	Use of the Line 23/623 reference signals to assist vertical conversion	74 77			
	0.2.0	SIST ETS 300 731 E1:2003	''			
Annex	CD (inforn		78			
D.1	General i	rules for filter descriptions				
	D.1.1	General rules for horizontal filters				
	D.1.2	General rules for vertical filters	78			
D.2	Vertical o	conversion	78			
	D.2.1	DEC_Y_QMF (camera mode)	78			
	D.2.2	DEC_Y_QMF (film mode)				
	D.2.3	DEC_UV_VSRC				
	D.2.4	DEC_UV_VSRC_NDL	85			
D.3	Helper decoding					
	D.3.1	DEC_BB_PRE_MOD				
D.2 V	D.3.2	DEC_BB_POST_MOD_LPF_ISS				
	D.3.3	LUT_BB_DEC (film mode)				
	D.3.4	LUT_BB_DEC (camera mode)	90			
D.4	Motion Adaptive Colour Plus, decoder					
	D.4.1	Y BSPLIT				
	D.4.2	DEC_Y_VAA	91			
	D.4.3	DEC_UV_LPF				
	D.4.4	VERT_IFA				
	D.4.5	DEC_MD_UV_LPF				
	D.4.6 D.4.7	DEC_M_USLUT_IFD_U_CLIP				
	D.4.7 D.4.8	LUT_IFD_V_CLIP				
	D.4.8 D.4.9	LUT_MD_M				
	D.4.10	LUT_DEC_MD_YL				
		LUT DEC MD CS				

D.5	PAL dec	oding		98	
	D.5.1	DEČ_U	V_DS_LPF	98	
	D.5.2	DEC_C	HROM_BPF	98	
Anne	x E (infor	mative):	Decoder filter plots	99	
Anne	x F (infor	mative):	Receivers for the PALplus system	103	
F.1	General			103	
F.2	Receive	r IF chara	acteristics	103	
F.3	Features	s included	d in a PALplus receiver	103	
F.4	Receive	r switchin	ng time in response to changes signalled by the WSS	104	
F.5	Use of V	Vide Scre	en Signalling (WSS)	104	
	F.5.1	PALplus	S	104	
	F.5.2		Lplus Motion Adaptive Colour Plus		
	F.5.3		tional PAL		
	F.5.4 F.5.5		tional PAL with helperissions transcoded into SECAM		
Anne	x G (infor	mative):	Application of ghost cancellation	106	
Anne	x H (infor	mative):	Studio production requirements	107	
H.1	General	····iT	Ceh STANDARD PREVIEW	107	
H.2	Limitatio	ns of the	composite PALplus signalsi.t.e.ha.i.	107	
H.3	Camera	mode an	nd film mode <u>SIST EIS 300 731 EI 2003</u>	108	
H.4	Program	nme junct	tandards iteh ai/catalog/standards/sist/5703992-04ha 4a69-8515- ions between transmissions in PALplus and PAL 3042237bb320/sist-ets-300-731-e1-2003	108	
H.5			nd logos		
H.6	Non-PALplus use of Motion Adaptive Colour Plus10				
Histo	ry			110	

Page 6

ETS 300 731: March 1997

Blank page

# iTeh STANDARD PREVIEW (standards.iteh.ai)

SIST ETS 300 731 E1:2003

https://standards.iteh.ai/catalog/standards/sist/f5f93992-04ba-4a69-8515-3042237bb320/sist-ets-300-731-e1-2003

Page 7 ETS 300 731: March 1997

#### **Foreword**

This European Telecommunication Standard (ETS) has been produced by the Joint Technical Committee (JTC) of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECtrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI).

NOTE:

The EBU/ETSI JTC was established in 1990 to co-ordinate the drafting of ETSs in the specific field of broadcasting and related fields. Since 1995 the JTC became a tripartite body by including in the Memorandum of Understanding also CENELEC, which is responsible for the standardization of radio and television receivers. The EBU is a professional association of broadcasting organizations whose work includes the co-ordination of its Members' activities in the technical, legal, programme-making and programme-exchange domains. The EBU has Active Members in about 60 countries in the European Broadcasting Area; its headquarters is in Geneva \*.

European Broadcasting Union
Case Postale 67
CH-1218 GRAND SACONNEX (Geneva)
Switzerland

Tel: +41 22 717 21 11 Fax: +41 22 717 24 81

#### **Transposition dates**

Date of adoption: 28 February 1997

Date of latest announcement of this ETS (doa): RD PREVIE 31 May 1997

Date of latest publication of new National Standard iteh.ai)

or endorsement of this ETS (dop/e):

30 November 1997

SIST ETS 300 731 E1:2003

Date of withdrawal of any conflicting National Standard (dow): 04ba-4a6930 November 1997

3047237bb320/sist-ets-300-731-e1-2003

Page 8

ETS 300 731: March 1997

Blank page

# iTeh STANDARD PREVIEW (standards.iteh.ai)

SIST ETS 300 731 E1:2003

https://standards.iteh.ai/catalog/standards/sist/f5f93992-04ba-4a69-8515-3042237bb320/sist-ets-300-731-e1-2003

Page 9 ETS 300 731: March 1997

#### 1 Scope

This European Telecommunication Standard (ETS) is applicable to 625-line PAL systems B, G, H, I, D and K

It specifies an enhanced transmission system which allows PAL broadcasters to offer wide-screen pictures in the 16:9 aspect ratio format, maintaining compatibility with existing PAL receivers.

This ETS specifies the transmitted signal. It specifies the method of coding for accommodating wide aspect ratio signals, and the method of coding for reducing conventional PAL cross-effects and for making optimal use of the video signal spectrum. The method for reduction of PAL artefacts may also be used for studio contribution or distribution purposes. Annex C provides details of a reference PALplus decoder that makes full use of the picture enhancements offered by PALplus. Annex F gives rules of operation for the minimum requirements for a PALplus receiver.

#### 2 Normative references

This ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] ITU-R Recommendation BT.601-5: "Studio Encoding Parameters of Digital Television for Standard 4:3 and Wide-screen 16:9 Aspect Ratio".

[2] ITU-R Recommendation BT.470-4: "Television Systems".

[3] EBU Technical Recommendation R62: "Recommended dominant field for

625-line 50-Hz video processing". 31)

[4] ETS 300 294; "Television Systems; 625-Line television Wide Screen Signalling

https://starWards.lieh.ai/catalog/standards/sist/f5f93992-04ba-4a69-8515-

3042237bb320/sist-ets-300-731-e1-2003

#### 3 Abbreviations

For the purpose of this ETS, the following abbreviations apply in the construction of system coefficient names:

BB Black Bands
BPF Band-Pass Filter
BSPLIT Band-SPLITing filter
C Camera mode

CHROM Modulated PAL CHROMinance

CLIP CLIPping

CS motion detector Chrominance Switching control

CVBS Composite Video, Blanking and Sync

DEC DECoder
DS Down-Sampling
ENC ENCoder
F Film mode

HDTV High-Definition TeleVision
IFA Intra-Frame Averaging
IFD Inter-Frame Difference
ISS Inverse Spectrum Shaping

L motion detector Luminance level control signal

LPF Low-Pass Filter LUT Look-Up Table

M Motion detector chain chrominance motion signal

MAC Multiplexed Analogue Components
MACP Motion Adaptive Colour Plus

MD Motion Detector chain

Page 10

ETS 300 731: March 1997

NDL Not incorporating PAL Delay Line function

NYQ NYQuist

PAL Phased Alternate Line
POST\_MOD POST-(de)MODulation
PRE\_MOD PRE-(de)MODulation
QMF Quadrature Mirror Filter

S motion detector chrominance Switching control signal

 $\begin{array}{ccc} \text{SS} & & \text{Spectrum Shaping} \\ \text{U} & & \text{present in $C_B$ path} \\ \text{US} & & \text{Up-Sampling} \end{array}$ 

UV present in both colour-difference signal (C<sub>B</sub> and C<sub>R</sub>) paths

V present in C<sub>R</sub> path VAA Vertical Anti-Aliasing

VERT VERTical

VSRC Vertical Sample-Rate Conversion

Y luminance signal

YL motion detector luminance Level control

#### 4 Basic PALplus system description

#### 4.1 Introduction

PALplus is an enhanced transmission system which has been designed to allow PAL broadcasters to offer wide-screen pictures with greatly reduced levels of conventional PAL artefacts, whilst retaining a high level of compatibility with the PAL transmission infrastructure and with existing PAL receivers. The system is intended to co-exist with both MAC and digital television services in a complementary fashion, enabling viewers to receive enhanced quality wide-screen pictures originated in component form. The objective of the PALplus project has not been to design an HDTV system. The expected cost of PALplus receivers is therefore lower than that of HDTV receivers.

The format of the primary input and output signals for PALplus shall be 625/50/2:1, with 16:9 aspect ratio. HDTV 1250/50/2:1 sources can be used after down-conversion to 625/50/2:1.

The wide-screen picture shall be transmitted in letterbox format to achieve compatibility with existing 4:3 receivers. Loss of vertical resolution (as compared to the 576 active line source picture) is minimized in the PALplus receiver by making use of a vertical helper signal transmitted in the black bands above and below the letterbox picture.

The PALplus system has two modes of operation. These are called "film mode", which should be used only with film sources, and "camera mode" which should be used with normal 50 Hz video sources. Both the vertical conversion (to the letterbox picture) and the Motion Adaptive Colour Plus (MACP) method of improved chrominance/luminance separation make use of a camera mode and a film mode to give optimum system performance.

Starting from a 625/50/2:1 4:2:2 digital component input signal (in accordance with ITU-R Recommendation BT.601-5 [1], based on 13,5 MHz sampling) with 576 active lines per frame and an aspect ratio of 16:9, a conversion to 430 active picture lines shall be first carried out.

NOTE: All references to ITU-R Recommendation BT.601-5 [1] refer to the 13,5 MHz sampling

rate variant specified in part A thereof.

In "camera mode" (when the source provides 50 Hz motion), this conversion shall be performed intra-field in order to avoid motion artefacts but, in "film mode" (when the source is known to have only 25 Hz motion), then an intra-frame conversion shall be used. The letterbox picture signal used for transmission has only three quarters of the number of active picture lines as the source; in order to minimize loss of vertical resolution in the PALplus display, the black bands shall be used to transmit a vertical helper signal.

An enhanced PAL encoding and decoding technique known as "Motion Adaptive Colour Plus" shall be used to reduce PAL luminance/chrominance cross-talk artefacts and to maximize horizontal resolution. In film mode, the system takes advantage of the known temporal redundancy of the signal and uses an intra-frame PAL encoding technique ("fixed" Colour Plus). In camera mode, the same technique shall be applied to appropriate areas of each picture frame. However, in areas containing moving saturated colour (usually representing only small parts of typical pictures), there is likely to be a significant amount of

Page 11 ETS 300 731: March 1997

movement between the adjacent fields of a source picture frame, which could lead to occasionally visible colour judder if fixed Colour Plus processing were applied. To minimize this problem, in such areas of the picture the system shall revert adaptively to a simpler form of PAL encoding, making use of motion detectors in both the encoder and decoder to identify areas of fast colour motion between adjacent frames.

Ghost cancellation is an optional enhancement. The parameters of the ghost cancellation reference signal are given in ITU-R Recommendation BT.1 124, annex 1, section 1.3.

#### 4.2 Normative features of a PALplus transmission

A PALplus signal shall be derived according to the processes illustrated in figure 1. These are summarized below and detailed descriptions of each process are given in clause 6. The signal at the output of the encoder shall be described as "PALplus" only when all of the following processes are implemented:

- a) Vertical conversion (QMF process) to 430-line letterbox:
  - this is the conversion of the 16:9 aspect ratio source picture with 576 active lines to a 16:9 aspect ratio letterbox picture with 430 active lines. The QMF (Quadrature Mirror Filter) format conversion process also yields vertical luminance resolution information that shall be encoded and transmitted in the black bands.
- b) Vertical helper encoding;
  - this is the method of processing and modulating the vertical luminance information derived from the QMF format conversion process, resulting in the "vertical helper" signal that shall be transmitted in the black bands above and below the active letterbox picture.
- c) Motion Adaptive Colour Plus (MACP); ARD PREVIEW
  - this is the encoding technique that makes possible improved separation of chrominance and luminance in the PALplus receiver.

SIST ETS 300 731 E1:2003

- d) Wide Screen Signalling (WSS); atalog/standards/sist/f5f93992-04ba-4a69-8515-3042237bb320/sist-ets-300-731-e1-2003
  - this shall be used to convey essential information about the content of the transmitted signal to the decoder. The system used is defined in ETS 300 294 [4].
- e) Reference signals;
  - the transmission shall contain reference signals in lines 23 and 623 that may be used by the PALplus receiver for the accurate setting of the levels of the incoming luminance and vertical helper signals. Details are given in subclause 6.5.

The PALplus signal at the output of the encoder shall consist of the combination of the PAL-encoded MACP pre-processed letterbox picture, the modulated helper signal resulting from the QMF conversion process, the reference signals, and the signalling bits, as shown in figure 1.

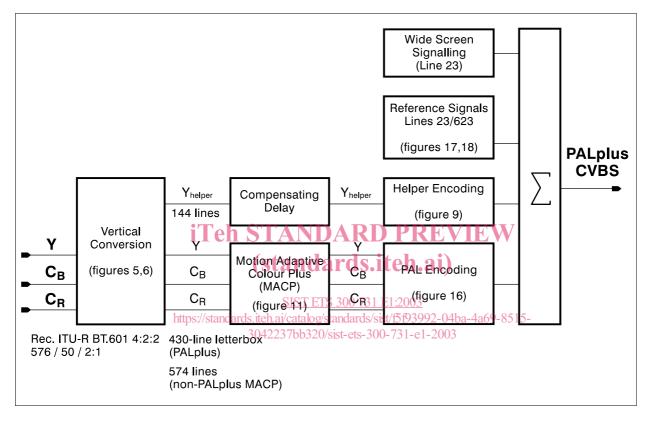
The features of a PALplus transmission are summarized in table 1. Compensating delays should be included in associated audio paths prior to transmission, so as to match the vision processing time in the PALplus encoder.

Page 12

ETS 300 731: March 1997

Table 1: The enhancement features incorporated in a PALplus transmission

Enhancement	Normative for PALplus?
Format conversion (QMF) from ITU-R	YES
Recommendation BT.601-5 [1] source with 16:9	
aspect ratio to central 430-line letterbox	
Vertical helper encoding	YES
Motion Adaptive Colour Plus	YES
Reference signals (lines 23/623)	YES
Wide Screen Signalling (ETS 300 294 [4])	YES
Ghost cancellation reference signal	OPTIONAL



NOTE: Helper not used with non-PALplus MACP.

Figure 1: Outline of PALplus encoding process

#### 5 The PALplus signal

Figure 1 gives a top-level block diagram of the encoding process. All operations are carried out in the digital domain, using line-locked sampling rates of 13,5 MHz, 27 MHz, and 6,75 MHz.

#### 5.1 Input picture signal to the PALplus encoder

The input to the PALplus encoder shall be a component digital 625-line, 50 field/s interlaced 4:2:2  $YC_BC_R$  signal (according to ITU-R Recommendation BT.601-5 [1], minimum 8-bit resolution), with 576 (nominal) active picture lines and an aspect ratio of 16:9. Field 1 shall be the dominant field (see EBU Technical Recommendation R62 [3]) at all times in the case of material to be PALplus encoded in film mode.

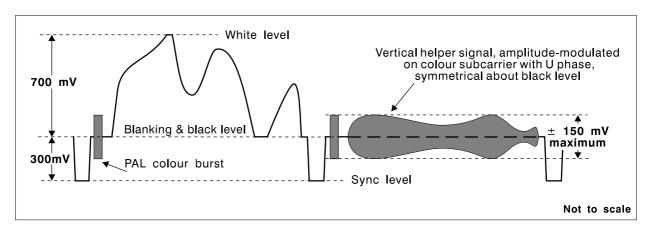
#### 5.2 The encoded composite PALplus signal

The output of the PALplus encoder shall be a standard analogue PAL composite signal containing 430 active picture lines in letterbox format, together with helper information contained in the black bands above and below the visible letterbox picture area (see figures 2 and 3). In addition, signalling bits are contained in the first half of Line 23 (see subclause 6.6), and reference signals for use by the PALplus decoder are inserted

Page 13 ETS 300 731: March 1997

into the second half of Line 23 and the first half of Line 623 (see subclause 6.5 and figures 17 and 18). The structure of the PALplus frame is illustrated in figure 3.

All general characteristics of the encoded PALplus signal shall conform to the parameters listed in ITU-R Recommendation BT.470-4 [2]. These include all aspects of the standard PAL colour burst, which shall be retained on the same lines as for a standard PAL signal.



- NOTE 1: Standard PAL horizontal blanking shall be applied in lines carrying the vertical helper signal.
- NOTE 2: Burst blanking shall be identical to that of a standard PAL signal.

Figure 2: Waveforms showing typical lines of PALplus letterbox and vertical helper signals

All operations in the encoder are performed in digital form. Prior to digital-to-analogue conversion at the output of the encoder, the encoded PALplus signal shall have the following characteristics:

standards.iten.ai

- sampling rate: 13,5 MHz (or multiple thereof), quantizing range:  $0.00_{10}$  to  $25255,755_{10}$  (unsigned), 10-bit resolution. Black level =  $64.00_{10}$ , peak-white level =  $192,00_{10}$ ;
- https://standards.iteh.ai/catalog/standards/sist/15/193992-04ba-4a69-8515the quantizing range is illustrated in figure 4.1 he use of 10-bit resolution within this range reduces the effects of quantizing errors in critical areas of processing;
- permitted signal data levels for this 10-bit signal shall be in the range 1,00<sub>10</sub> to 254,75<sub>10</sub> for compatibility with the signal data levels of ITU-R Recommendation BT.601-5 [1]. (All vision signals lie within this range);
- using the above quantizing scale, the maximum peak-to-peak amplitudes of the modulated chrominance signals shall be:  $U = 112,00_{10}$ ,  $V = 157,50_{10}$ .
  - NOTE 1: Within this ETS, the contents of digital words are expressed in decimal form. To avoid confusion between 8-bit and 10-bit unsigned representations, the eight most significant bits are considered to be an integer part while the two additional bits, if present, are considered to be fractional parts. (For example, the bit pattern 10 010 001 would be expressed as 145<sub>10</sub>, and 1 001 000 101 as 145,25<sub>10</sub>). Where no fractional part is shown, it is to be assumed to have binary value 00.

Each active line of letterbox picture and of helper shall be formed from 702 digital active samples, and the structure of the PALplus frame shall be as shown in figure 3.

NOTE 2: For convenience, the sampling clock period numbers are indicated in this ETS as being in the range 1 to 864, where clock period 1 represents the leading edge of line syncs, half amplitude reference (see figure 3). Sampling clock period 1 therefore corresponds to ITU-R Recommendation BT.601-5 [1] luminance sample number 732. The first active sample of each line shall be in clock period 143, which corresponds to the 11th sample of the digital active luminance line of ITU-R Recommendation BT.601-5 [1] (luminance sample number 10).

The frequency spectrum occupied by the chrominance signal shall be 4,43 MHz ± 1,3 MHz at -3 dB.