SOUND AND TV BROADCASTING DIVISION

Signals produced by

CCVS + Component Generator
SAF

and

CCVS Generator
SFF

Standard BG/PAL and N/PAL

Signals which have a valid component structure but do not comply with composite format in BG/PAL and N/PAL are not generated by the SFF. These signals are marked with a " * ".

(by Sigmar Grunwald) 1BTP / gr - 03.93
Subject to change

Contents

1. Signal Group ITS (Insertion Test Signal, test lines)

1.1 List of Signals

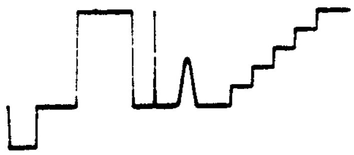
ITS	
1 CCIR 17	16 RAMP MOD. 100 mV
2 CCIOR 18/1	17 15 KHz
3 CCIR 18/2	18 250 KHz
4 CCIR 330/4	19 20T 2T BAR
5 CCIR 330/5	20 COLOUR BARS 100/0/75/0
6 CCIR 331/1	21 RED FIELD
7 CCIR 331/2	22 BLACK
8 H SWEEP 1	23 WHITE
9 H SWEEP 2	24 UK ITS 1
10 H SWEEP 3	25 UK ITS 2
11 H SWEEP 4	26 IBA TESTLINE
12 2T PULSE	27 BT COMP WAVEFORM
13 SIN X/X	28 BBC TESTLINE
14 MULTIPULSE	29 TELETEXT TESTLINE 1
15 RAMP	30 TELETEXT TESTLINE 2

1.2 Signal Description

ITS 1
CCIR 17


CCVS

Description:
The luminance bar is followed by a 2T pulse (HAD 250 ns) **CCVS**and a modulated 20T pulse (HAD 2.00 µs) all with amplitudes of 700 mV. The 5 steps reach an amplitude of 700 mV .

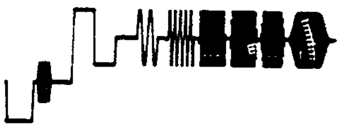

Y

Applications:
This signal structure complies with CCIR Rec. 473-4. It is mainly used as test line for automatic measurement and monitoring of TV signals eg at transmitter sites. The luminance bar also serves as amplitude reference for automatic level control.
The following distortions can be measured using the CCIR 17 signal:
Luminance bar:
    level errors, line time waveform distortion, overshoot and rounding
2T pulse:
    amplitude errors, group delay indicator and reflection
20T pulse:
    amplitude, intermodulation and delay differences between luminance and chrominance
Staircase:
    line time nonlinearity

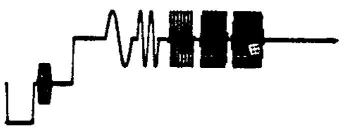

Cb


Cr

ITS 2 (SWEEP + BURST 3)
CCIR 18/1
ITS 3 (SWEEP + BURST 4)
CCIR 18/2


CCVS

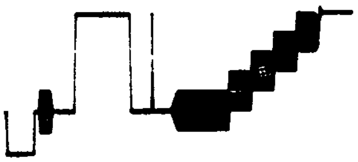
Description:
There are two variants of the CCIR 18 multiburst signal
ITS 2
Meets the CCIR Rec. 473-4, has a squarewave reference and 6 sine bursts with the frequencies 0.5, **CCVS**1.5, 3 and 4.433 MHz (V_{PP} = 420 mV on 50% grey level).


CCVS

ITS 3
Meets the CCIR Rec. 473-4 and the Deutsche Telecom specifications, has a 200 kHz reference and 4 sine bursts with the frequencies 0.5, 1, 2, 4, 4.8 and 5.8 MHz (V_{PP} = 420 mV on 50% grey level).

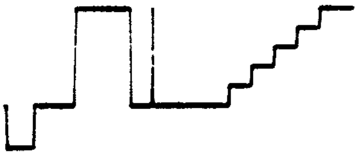
Applications:
Irregularities of the amplitude vs frequency response in the time domain can be determined with the aid of the multiburst.The signal is also used for this purpose as an ITS for automatic measurements and monitoring on television transmitters

ITS 4
CCIR 330/4
ITS 5
CCIR 330/5



CCVS

Description:
These signal have a similar structure to the CCIR 17 signal. The luminance bar and the 2T pulse are followed by a 5 step staircase on which a colour subcarrier (V_{PP} = 280 mV) is superposed. In the case of the first variant (CCIR 330/4), the first four steps have a superposed colour subcarrier and all 5 steps of the second variant (CCIR 330/5) have a superposed colour subcarrier.

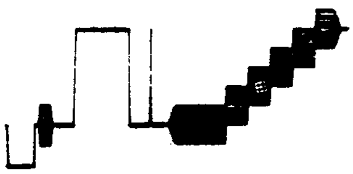


Y

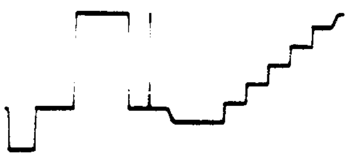
Applications:
5 step staircase with superimposed subcarrier: determination of the differential phase and gain of **Cb** the subcarrier
By using the two signal variants alternately, one can determine what contribution the topmost step makes to **Cb** distortion. From this, it can be deduced which part of the DUT characteristics is being used. The CCIR 330/5 signal meets the CCIR Rec. 473-4 and is used as an ITS **Cr**for automatic measurements and monitoring on television transmitters.

Cr

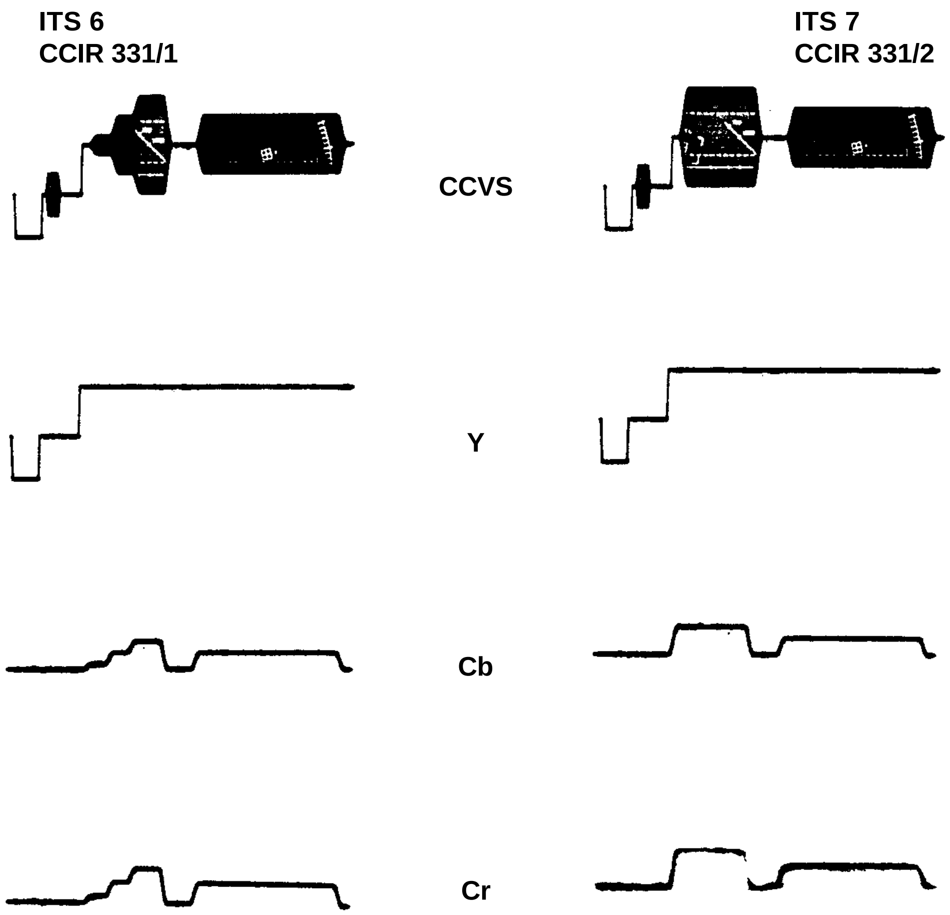
CCIR 330/5



It is obvious that this standard ITS is not a valid PAL signal because there is a colour component on the black level(phase reference of the colour subcarrier for **CCVS** measuring diffential phase and amplitude). This gives a negative green signal which cannot be displayed.



G channel



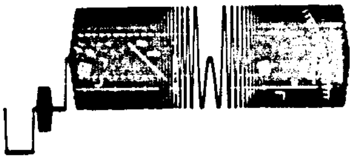
Description:
This signal, which meets CCIR Rec. 473-4, is available intwo versions.

ITS/6
The first version has two colour sbcarrier bursts superposed on a 50% grey level. The first burst has steps at 20%, 60% and 100% of the colour subcarrier amplitude, the second burst has a constant colour subcarrier amplitude of 60 %.

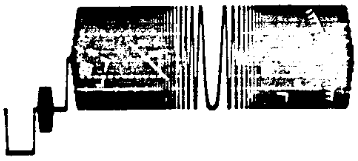
ITS/7
The second version has also two colour sbcarrier bursts superposed on a 50% grey level. Neither burst has steps. The first has a 100% colour subcarrier amplitude, the second burst has a constant colour subcarrier amplitude of 60 %.

Applications:
These signals can be used to detect colour subcarrier transmission errors. Apart from simple amplitude errors, the stepped burst of the first version can be used to determine nonlinear gain and phase errors as a function of the subcarrier's amplitude. The signal is also used to measure luminance/chrominance intermodulation. In the case of standard BG/PAL, intermodulation between the colour subcarrier and the sound carrier (1.07 MHz patterning) can also be measured. The signal is used as an ITS for automatic measurements and monitoring on television transmission systems.

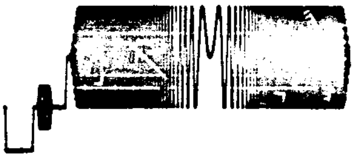
ITS 8, 9, 10, 11 (SWEEP + BURST 1, ZONE PLATE 1)
H SWEEP 1, H SWEEP 2, H SWEEP 3, H SWEEP 4



CCVS



CCVS



CCVS

CCVS

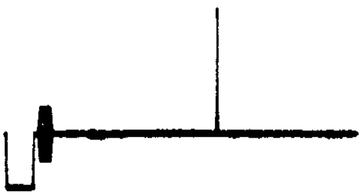
Description:
The H SWEEP covers the whole frequency range over a **CCVS**line, starting at 5.5 MHz at the beginning of the line going down to 0 Hz in the middle of the line and rising again to 5.5 MHz at the end of the line.The signal has 100% amplitude and a flat frequency response at a high energy density over the whole frequency range. It is superimposed on a 50% grey level.
It is generated with the phases:
180° (H SWEEP 1), 270° (H SWEEP 2),
0° (H SWEEP 3) and 90° (H SWEEP 4).

Applications:
If the signal is analyzed in the time domain, both amplitude and group delay vs frequency response can clearly be seen. In case of pure amplitude vs frequency distortion the sweep envelope is distorted symmetrically with respect to the middle of the line, in case of pure group delay distortion the sweep envelope has ripple which is unsymmetrical with respect to the middle of the line. If both amplitude and group delay distortion are present, the unsymmetrical ripple and the envelope which is symmetrical with respect to the middle of the line are superposed.

As the H SWEEP is generated with the phases 0°/90° and 180°/270° the amplitude response and the group delay response can be displayed in the frequency domain by means of the Complex Fourier Transform without the discontinuities which occur using only one H SWEEP.

To limit effects of nonlinear distortions the H SWEEPs 1 and 2 should be inverted and added to the H SWEEPs 3 and 4. This ensures reliable analysis.

ITS 12
2T PULSE

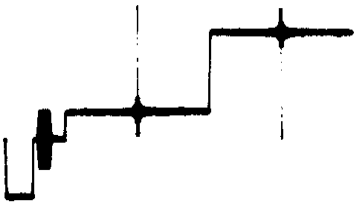


CCVS

Description:
A $\cos^2$ pulse with a half amplitude duration (HAD) of 200 ns is positioned in the middle of the active line.

Applications:
amplitude errors, group delay indicator and reflections to ± 26µs.

ITS 13 (SPECIAL 4, PULSE + BAR 7)
SIN X/X

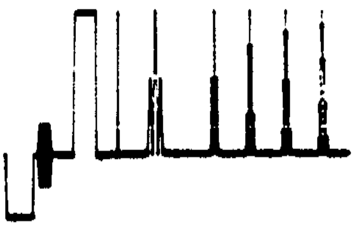


CCVS

Description:
In the analogue world the SIN X/X pulse is generated by applying a Dirac pulse, which should be as ideal as possible, to a group delay compensated low pass filter.
The special feature of of the pulse produced in this way is that its energy is distributed uniformly over the the whole spectrum. Therefore the amplitude and group delay responses are flat within the flat frequency range of the used lowpass filter.
The SIN X/X signal from the SAF and SFF contains two of these the pulses within a video bandwidth of 6 MHz with theoretical flat amplitude and group delay response. The first is a positive going pulse with an amplitude of 575 mV superposed on a 125 mV grey level, the second is a negativ going pulse with an amplitude of 575 mV superimposed on a 575 mV grey level.

Applications:
To find the frequency response of a DUT the SIN X/X signal can be analyzed directly with a spectrum analyzer.
In order to limit the effects of non linear distortion, a positive going and a negative going SIN X/X is generated. Inverting one of them and adding it to the other suppresses in optimal manner the influence of this distortion.
The signal is a very sensitive indicator of group delay distortion. When distortion is present, the preshoot and postshoot are displayed with different amplitudes on the oscilloscope. Using an FFT analyzer the amplitude and group delay vs frequency response of this signal can be analyzed precisely. Because of its low energy content this signal must not be noisy; in this case a H SWEEP is the better alternative.

ITS 14
MULTIPULSE (SWEEP + BURST 5; PULSE + BAR 7)



Description:
A sequence of modulated $\cos^2$ pulses with 100% amplitude follow a luminance bar (width 4µs) and a 2T **CCVS**pulse (HAD 200ns) with 100% amplitude.
The first pulse is modulated with 1 MHz and has a HAD of 2µs.
All others have a HAD of 1µs and are modulated with 2, 3, 4 and 5 MHz.

Applications:
The amplitudes of the modulated $\cos^2$ pulses are referred to the luminance bar at the start of the line to determine the amplitude vs frequency response. In this way, the at each frequency. To determine the group delay vs frequency response, the baseline distortion of the sine waves oscillations, which are generated symmetrically with respect to the center of each pulse, are analyzed.

ITS 15 (LINEARITY 8)
RAMP

CCVS

Description:
The ramp signal is a sawtooth which rises over the whole active line and has an amplitude of 100%.

Applications:
The ramp signal, like various staircase signals, is used to check line time nonlinearity. It can also be used to measure S/N ratio (signal to noise) over the whole level range or to measure quantization noise in A/D and D/A converter systems.

ITS 16 (LINEARITY 11)
RAMP MOD. 100 mV

CCVS

Y

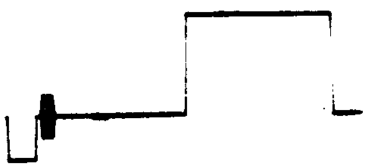
Cb

Cr

Description:
A subcarrier with V_{pp} = 100 mV is superposed on saw-tooth which rises over the whole active line and has an amplitude of 100%.

Applications:
The signal is used to measure nonlinear distortions, like differential gain and phase, on the subcarrier.

ITS 17 (PULSE + BAR 8)
15 KHz

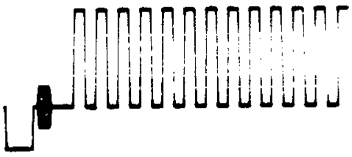


CCVS

Description:
A line time squarewave with 100% amplitude and a rise time of 200 ns is generated.

Applications:
The 15 KHz squarewave can be used to measure the gain and the pulse response at medium frequencies with respect to the video bandwidth. This is shown by line time tilt.

ITS 18 (PULSE + BAR 9)
250 KHz



Description:
This signal is composed of squarewave pulses with a frequency of 250 kHz and a rise time of 200 ns.

CCVS

Applications:
The squarewave signal is used to measure the pulse response at medium frequencies with respect to the video bandwidth, e.g. overshoots and rounding.

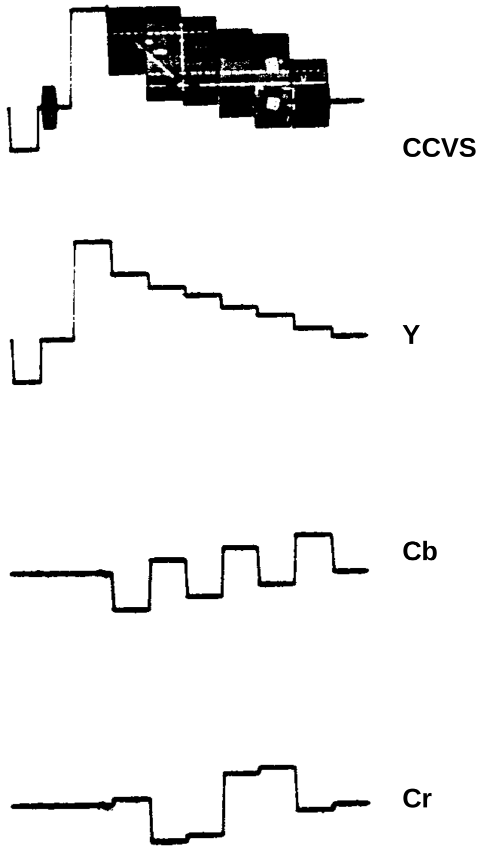
ITS 19 (PULSE + BAR 1)
20T 2T BAR

Description:
The 20T pulse (HAD 2.00 µs) is followed by a 2T pulse (HAD 200 ns) and the luminance bar all with amplitudes of 700 mV (100%).
The subcarrier of the 20 T pulse has
V_{PP} = 700 mV at φ = 0°.

CCVS

Applications:
20 T pulse:
precise assessment of the amplitude and group delay response in the region of the subcarrier referred to the lower frequency range of the luminance signal.
2T pulse:
testing amplitude, echoing and group delay response of the transmission link
700 mV luminance bar:
measurement of pulse distortions at low frequencies by evaluating the pulse top and is used as the white level reference

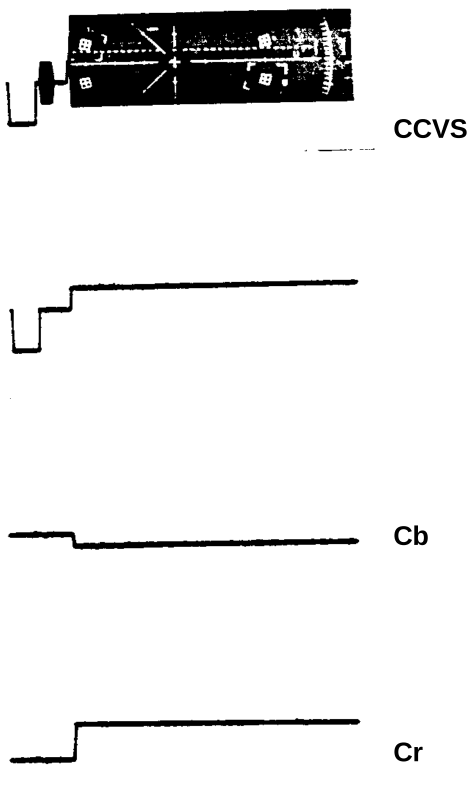
ITS 20 (MONITOR ADJ 38)
COLOUR BARS 100/0/75/0



Description:
In accordance with CCIR and EBU the colour bars are produced with 100% luminance amplitude and 75% colour saturation.

Applications:
The colour bars are the standard signal for checking and setting the phase and level of a CCVS and for a quick check of colour monitors. The colour coding in particular can be rapidly and simply checked with a vectorscope.

ITS 21 (MONITOR ADJ 33)
RED FIELD



Description:
The amplitude phase and rise time are the same as those of the red bar in the 100/0/75/0 colour bars (ITS 20).

Applications:
The red area signal is particularly suitable for assessing and measuring unwanted amplitude and phase modulation of the subcarrier such as it occurs with VTRs. The unwanted modulation is called "colour noise", or AM **Y**noise and PM noise. The signal is also used to measure intermodulation products caused by the colour subcarrier and the sound 1 carrier (in B/G system 1.07 MHz patterning)

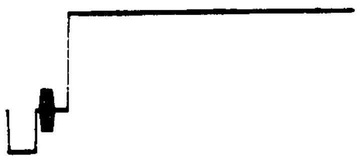
ITS 22
BLACK

CCVS

Description:
The BLACKBURST furnishes all sync pulses and bursts. The active line is at blanking level. Apart from the sync frame, which meets all relevant standards, the burst has also the correct PAL switching phase and stable SC/H phase which also meets all relevant standards.

Applications:
This signal is used as genlock signal for external equipment. When used in studios and for programm editing, a luminance bar can be inserted into line 7 of the first field of the PAL 8-field sequence for identification purposes (this can be done with all other signals)

ITS 23
WHITE



CCVS

Description:
This signal is a white bar with 100% amplitude, which covers the whole active picture area.

Applications:
- testing clamping circuits at 100% APL
- measuring noise voltage as a function of modulation
- testing the maximum beam current of CRTs
- testing the maximum frequency deviation in FM systems

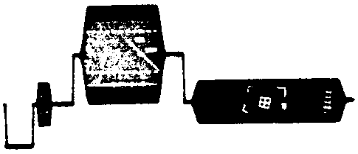
ITS 24
UK ITS 1

CCVS

Description:
This signal comprises a luminance bar, a 2T pulse, a modulated 10T pulse and a 5-step staicase with superposed colour subcarrier. The signal meets the UK national standards.

Applications:
The signal can be used to measure the same types of distortion as are measured with ITS CCIR 17 and CCIR 330.

ITS 25
UK ITS 2



CCVS

G-channel

Description:
This insertion test signal has the structure as the single pedestal CCIR 331 version. The first colour subcarrier burst with 100% amplitude is superposed on a 50% grey level, the second burst with 43% amplitude
(Vpp = 300 mV) is superposed on the black level.

Application:
The signal is used as an insertion test signal for automatic measurements and monitoring of television equipment.
It complies with UK standard. It is used to analyze the same parameters as the CCIR 331 signal.

This signal is not a valid PAL signal because there is a negative component in the green channel.

ITS 26
IBA TEST-LINE

CCVS

Description:
This signal contains some of the signal components from CCIR 17 (luminance bar, 2T, 10T), CCIR 331 (700 mV colour burst) and CCIR330 (staircase with 140 mV colour subcarrier). It meets the national recommendations of Great Britain.

Applications:
This signal is ideal for automatic measurements and monitoring on television equipment and transmission facilities using the parameters which are provided by the inserted signal components.

Measurement examples: level errors, reflections, gain and delay differences between luminance and chrominance, colour subcarrier level, chrominance/luminance intermodulation, differential phase and gain and line time nonlinearity.

ITS 27
BT COMP: WAVEFORM

CCVS

Description:
A 10T pulse and a luminance bar follow the colour sub-carrier burst with Vpp = 700 mV on 350 mV luminance. The test signal meets the national recommendations of Great Britain.

Applications:
Measuring chrominance/luminance intermodulation, colour subcarrier level, white level, tilt and rounding.

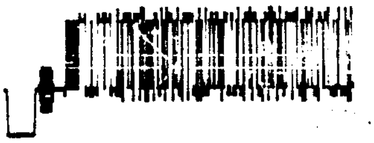
ITS 28
BBC TESTLINE

CCVS

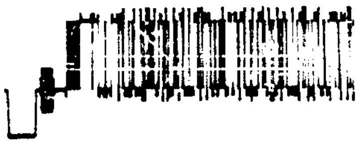
Description:
The structure is the same as that of the IBA testline but without the colour subcarrier superposed on the staircase. Instead, data pulses can be inserted.

Applications:
See ITS 26 without differential phase, differential gain and line time nonlinearity.

ITS 29, 30
TELETEXT TESTLINE 1, 2



CCVS



CCVS

Description:
The teletext testlines, which meet the UK teletext specifications, consist of two fixed data signals of 6.9375 Mbit/s. After the 16 bit run in (sequence of ones and zeros) follows the framing code FFhex and 42 bytes defined for measuring purpose. The bytes toggle from TESTLINE 1 to TESTLINE 2 which are inserted frame by frame. This is assumed to be an optimal sumulation of program teletext.
The basic amplitude is 462 mV.

Applications:
Measuring

- number of run in bits
- decoding margin
- timing margin
- basic and peak to peak amplitude
- timing within the line

2. Signal Group APL (Average Picture Level)

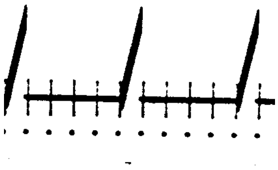
2.1 List of Signals

APL	
1 APL 10 %	5 APL 10/90 %
2 APL 12.5 %	6 APL 12.5/87.5 %
3 APL 90 %	7 BOUNCE
4 APL 87 %	

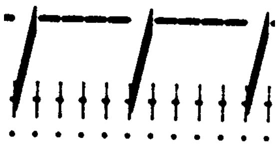
2.2 Signal Description

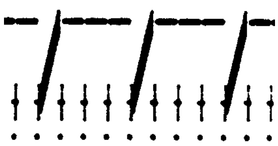
APL 1, 2, 3, 4
APL 10%, 12.5%, 90%, 87.5%

Description:


10%


12.5%


90%


87.5%

Name	Period in lines	Lines black	Lines white	Signal(selectable, see table)
APL 10 %	5	4	0	Ramp mod. 200 mV
APL 12.5%	4	3	0	Ramp mod. 200 mV
APL 90 %	5	0	4	Ramp mod. 200 mV
APL 87.5%	4	0	3	Ramp mod. 200 mV

Selectable Signals:

BLACK	CCIR 17	CCIR 18/1
CCIR 18/2	CCIR 330/4	CCIR 330/5
CCIR 331/1	CCIR 331/2	H SWEEP 1
H SWEEP 2	H SWEEP 3	H SWEEP 4
2T PULSE	SIN X/X	MULTIPULSE
GREY 10%	GREY 50%	GREY 90%
WHITE	UK ITS 1	UK ITS 2
IBA TEST LINE	BT COMP. WAVEFORM	BBC TEST LINE
20T 2T BAR	12.5T 2T BAR	10T 2T BAR
15 kHz	15 kHz 100ns	250 kHz
250 kHz 100ns	SNF SIGNAL	CORING
5 STEPS	5 STEPS MOD. 140mV	5 STEPS MOD. 280mV
5 STEPS B.T.B.	5 STEPS B.T.B. MOD. 200mV	10 STEPS MOD. 280mV
10 STEPS	CHROMA 10 STEPS	RAMP MOD. 1MHz 100mV
RAMP	RAMP MOD. 1MHz 200mV	RAMP MOD. 100mV
RAMP MOD. 200mV	RAMP MOD. 100mV SHORT.	RAMP B.T.B. MOD. 200mV
RAMP B.T.B.	COLOUR BARS 100/0/100/0	COLOUR BARS 100/0/75/0
RED FIELD	TELETEXT TEST LINE 1	TELETEXT TEST LINE 2

Applications:
- measuring signal parameters according to the selected signal line at constant average picture level, for example RAMP MOD. 200mV: differential gain and phase

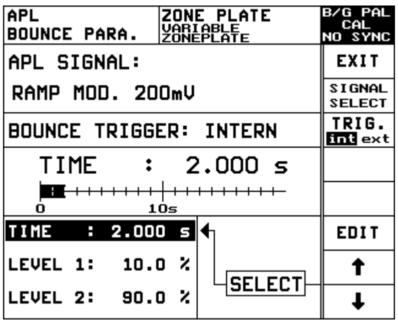
APL 5, 6
APL 10/90%, 12.5/87.5%

Description:
The signal alternates between APL 10% or 12.5% and 90% or 87.5%. The time interval is adjustable.

Applications:
- measuring signal parameters according to the selected signal line when the average picture level is changing in jumps
- testing clamping circuits and sync seperators

APL 7
BOUNCE

Description:
During the selected time interval the grey level jumps between the selected levels.



Setting facilities provided by the APL menu:
The softkey of the last menu line named "MODIFY APL + BOUNCE PARAMETER" opens the menu
page as shown at the left side:
- to select the signal (SELECT SIGNAL)
- to switch over from the internally selected time interval to the external trigger facility TRIG INT/EXT (connector X 64 at the rear of the instrument)
- selecting the time interval (TIME)
- setting the levels between the APL jumps (LEVEL 1, LEVEL 2)

The TIME interval is valid for all alternating APL signals, LEVEL 1 and LEVEL 2 only for the BOUNCE signal (APL 7).

Applications:
- testing clamping circuits and sync seperators
- amplitude vs frequency response for white, black and adjustable levels as required for transmitter measurements

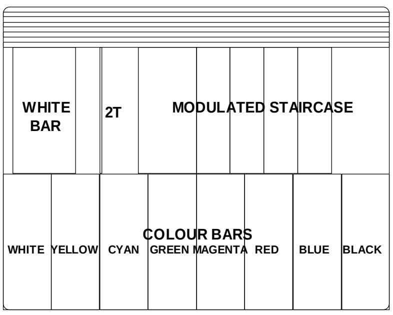
3. Signal Group Special

3.1 List of Signals

SPECIAL

1	VTR SIGNAL	
2	SPLIT LEVEL	
3	CORING	
4	SIN X/X	
5	15 KHz 100 ns	
6	250 KHz 100ns	
7	SNF SIGNAL	
8	VECTORSCOPE TEST	
9	GREY 10%	
10	GREY 50%	
11	GREY 90%	
12	BOWTIE	*
13	DELAY TEST 1 MHz	*
14	H SWEEP 5.8 MHz Y,Cb,Cr	*
15	C.BARS 150 ns 100/0/75/0	
16	C.BARS 150 ns 100/0/100/0	
17	C.BARS 200 ns 100/0/75/0	
18	C.BARS 200 ns 100/0/100/0	
19	RAMP + Y, Cb, Cr	*
20	RAMP - Y, Cb, Cr	*
21	STAIRCASE + Y, Cb, Cr	*
22	STAIRCASE - Y, Cb, Cr	*
23	TRIANGLE 1 Y, Cb, Cr	*
24	TRIANGLE 2 Y, Cb, Cr	*
25	NONLINEARITY TEST	
26	COLOUR CUBE	
27	CUSTOMER'S PHOTO PALplus PATTERN (OPTION)	

3.2 Signal Description

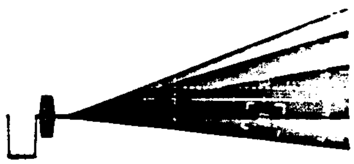


SPECIAL 1
VTR SIGNAL

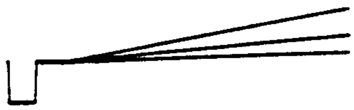
Description:
At the start of the picture area the ITS area is repeated three times, in each case separated by 16 lines. The upper half of the remaining picture area is occupied by the CCIR 330/4 signal the lower half by the EBU COLOUR BARS 100/0/75/0

Applications:
The signal is used as a reference leader for manual or automatic VTR alignment. The additional triple repetition of insertion line area means that each video head with four head machines can be investigated separately with a video analyzer.

SPECIAL 2
SPLIT LEVEL

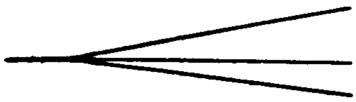


CCVS



Y

Cb



Cr

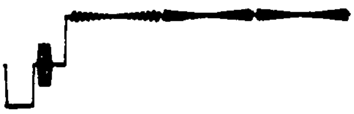
Description:
The active picture on the monitor is split into three areas:

top	red wedge
center	green wedge
bottom	blue wedge

The components Y, Cb and Cr of this signal are selected so that ramps with 100 % amplitude are produced in the three primary colours in the RGB format.

Applications:
- testing the RGB matrix formation
- checking A/D converters in the RGB channels for missing codes
- measuring the line time nonlinearity in the RGB channels

SPECIAL 3
CORING

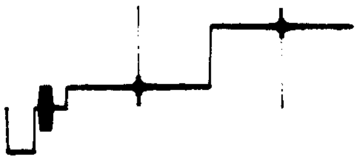


CCVS

Description:
The CORING signal comprises three triangular butterfly pulses modulated with the frequencies 1, 2 and 3 MHz. Each butterfly is 16 µs wide with an amplitude of Vpp = 70 mV. They are superposed on a 50% grey level .

Applications:
Coring circuits are used in cameras and video recorders to improve the signal - to - noise ratio. The coring circuit removes low amplitude noise at higher frequencies by selective suppression. However the resolution of fine picture details may be affected. The coring signal is an important aid for setting and checking the turn off levels of coring circuits.
The length of the area in the middle of each butterfly where the sine wave is suppressed shows up to which level the circuitry is active.

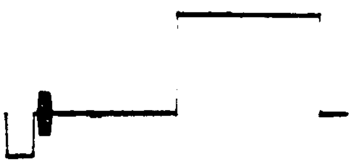
SPECIAL 4 (ITS 13)
SIN X/X



Description:
In the analogue world the SIN X/X pulse is generated by applying a Dirac pulse, which should be as ideal as **CCVS** possible, to a group delay compensated low pass filter. The special feature of of the pulse produced in this way is that its energy is distributed uniformly over the the whole frequency spectrum. Therefore the amplitude and group delay responses are flat within the flat frequency range of the used lowpass filter.
The SIN X/X signal from the SAF and SFF contains two of these pulses, which in this case are generated digitally by calculating the pulses within a video bandwidth of 6 MHz with theoretical flat amplitude and group delay response. The first is a positive going pulse with an amplitude of 575 mV superposed on a 125 mV grey level, the second is a negativ going pulse with an amplitude of 575 mV superimposed on a 575 mV grey level.

Applications:
To find the frequency response of a DUT the SIN X/X signal can be analyzed directly with a spectrum analyzer. In order to limit the effects of non linear distortion, a positive going and a negative going SIN X/X is genera-ted. Inverting one of them and adding it to the other suppresses in optimal manner the influence of this distortion. The signal is a very sensitive indicator of group delay distortion. When distortion is present, the preshoot and postshoot are displayed with different amplitudes on the oscilloscope. Using an FFT analyzer the amplitude and group delay vs frequency response of this signal can be analyzed precisely. Because of its low energy content this signal must not be noisy; in this case a H SWEEP is the better alternative.

SPECIAL 5 (ITS 17)
15 kHz 100 ns

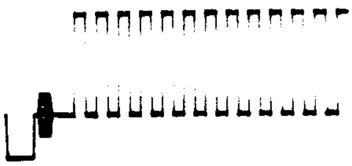


CCVS

Description:
A line time squarewave with 100% amplitude and a rise time of 100 ns is generated.

Applications:
- the 15 kHz squarewave can be used to measure the gain and the pulse response at medium frequencies with respect to the video bandwidth. This is shown by line time tilt
- aligning of the group delay using preshoots and postshoots on the 100ns edge and the 15 kHz /100 ns mask used for TV transmitter measurements

SPECIAL 6 (ITS 18)
250 kHz 100ns



CCVS

Description:
A 250 kHz squarewave with 100ns amplitude and a rise time of 100 ns is generated.

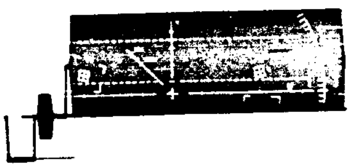
Applications:
- the squarewave signal is used to measure the pulse response at medium frequencies with respect to the video bandwidth, e.g. overshoots and rounding.
- aligning of the group delay using preshoots and postshoots on the 100 ns edge and the 250 kHz /100 ns mask used for TV transmitters.

SPECIAL 7
SNF SIGNAL

Description:
A colour subcarrier with Vpp = 700 mV on a 350 mV grey level follows a white reference. The colour subcarrier is not locked.

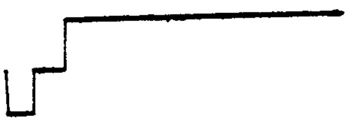
Applications:
Checking colour subcarrier gain, tilt and level of the white bar.

SPECIAL 8
VECTORSCOPE TEST



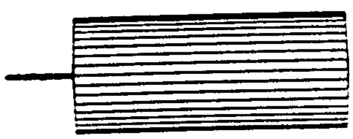
CCVS

Description:
Colour subcarrier bursts with V_{pp} = 700 mV are superposed on a 50 % grey level. Over the frame there are 36 areas each 16 lines long, where the subcarrier phase is incremented in steps of 10 °.

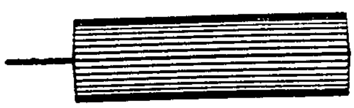


Y

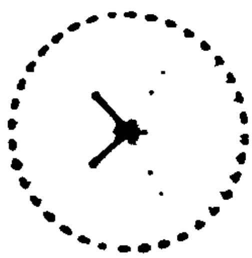
Applications:
If the vectorscope is aligned correctly, this signal is displayed as a circle of 36 dots on the screen.



Cb



Cr



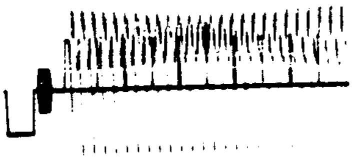
Vectorscope

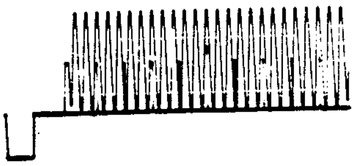
SPECIAL 9, 10, 11
GREY 10%, 50%, 90%

Description:
Grey signals with luminance levels of 10, 50 and 90% that is 70, 350 and 630 mV.

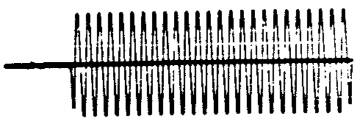
Applications:
(similar to APL signals)
- checking the S/N ratio at different grey levels
- measuring the amplitude vs frequency response via externally loaded sweep signal depending on the luminance level
- Checking CRT beam currents at various grey levels

SPECIAL 12
BOWTIE *

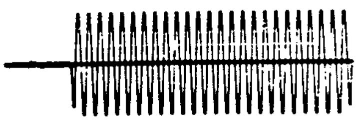




Y



Cb

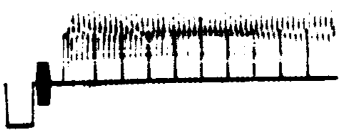


Cr

Description:
The Y component alternately contains measurement **CCVS** markers (interval 20ns) or a 500 kHz sine wave signal with V_{pp} = 100%.
The Cb and Cr components each contain a 502 kHz sine wave
with V_{pp} = 100%. The signal in CCVS is not legal.

Applications:
By substraction Y - Cb or Y - Cr , a 2 kHz beat frequency is produced. If the delays of both components are the same,
the zero crossing lies exactly in the middle of the active line
(exactly on the zero measurement marker).
The delay difference between the components can be read off at the amplitude minimum.

SPECIAL 13
DELAY TEST 1 MHz *



CCVS

Description:
Like BOWTIE only Y has a 1 MHz and Cb and Cr both have a 1.002 MHz sine wave. The distance of the measurement markers has 10 ns.

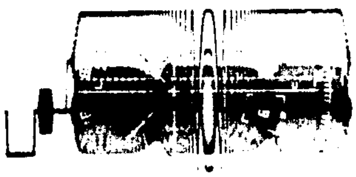
Applications:
Same as for BOWTIE but with twice the measurement accuracy.

Y

Cb

Cr

SPECIAL 14
H SWEEP 5.8 MHz Y, Cb, Cr *



CCVS

Description:
The monitor is devided in three areas:

top	H SWEEP in Y
center	H SWEEP in Cr and
bottom	H SWEEP in Cb

Applications:
The amplitude and group delay vs frequency response can be analyzed for each component separately on an oscilloscope.
In case of pure amplitude vs frequency distortion the sweep envelope is distorted symmetrically with respect to the middle of the line, in case of pure group delay distortion the sweep envelope has ripple which is unsymmetrical with respect to the middle of the line. If both amplitude and group delay distortion are present, the unsymmetrical ripple and the envelope which is symmetrical with respect to the middle of the line are superposed.

The amplitude response and the group delay response can also be displayed in the frequency domain by means of the Fourier Transform. The H SWEEP´s very high spectral density over the whole frequency range ensures in this case very accurate results even in noisy signals.

Y

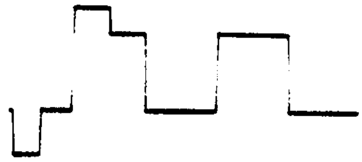
Cb

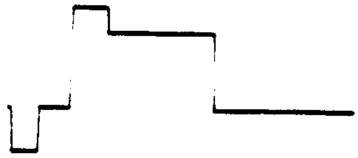
Cr

SPECIAL 15, 16,17,18
C. BARS 150 ns, 100/0/75/0
100/0/100/0
C. BARS 200 ns, 100/0/75/0
100/0/100/0

Description:
Colour bars to CCIR and EBU specifications. Only the rise and fall times of the bar transitions are equal in all components Y, Cb, Cr and R, G, B with 150 ns or 200 ns. A RGB analogue matrix therefore should not produce peaks and troughs when it is supplied by Y, Cb and Cr.

Applications:
- transient response in case of signals with high bandwidth
  (150 ns corresponds to 6.67 MHz).
- colour purity
- see also ITS 20


R


G

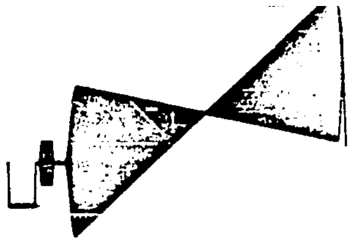

B

SPECIAL 19
RAMP + Y, Cb, *

Description:
The components contain:
Y a ramp 0 to 700 mV
Cb, Cr a ramp -350 to +350 mV

This signal is not valid with composite format.

Applications:
- line time nonlinearity in analogue component systems
- A/D converter tests in the Y, Cb, Cr branches with digital signal processing, testing for linearity and missing codes with rising ramp signals over full level in the active line.


CCVS


Y


Cb

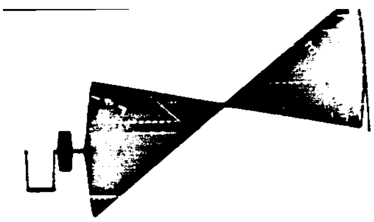

Cr

SPECIAL 20
RAMP - Y, Cb, Cr *

Description:
The components contain:
Y a ramp 0 to 700 mV
Cb, Cra ramp +350 to -350 mV

This signal is not valid with composite format.

Applications:
- line time nonlinearity in analogue component systems
- A/D converter tests in the Y, Cb, Cr branches with digital signal processing, testing for linearity and missing codes with rising ramp (Y) and falling ramp (Cb, Cr) signals over full level in the active line.



CCVS

Y

Cb

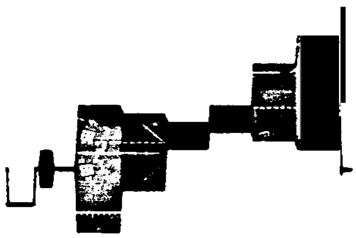
Cr

SPECIAL 21
STAIRCASE + Y, Cb, Cr *

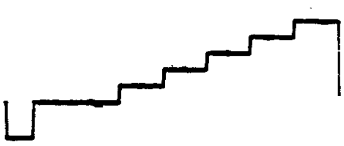
Description:
The components contain:
Y a 5 step staircase 0 to 700 mV
Cb, Cr a 5 step staircase -350 to +350 mV

This signal is not valid with composite format.

Applications:
Line time nonlinearity measurement for all three components with spike filters on rising staircases.



CCVS



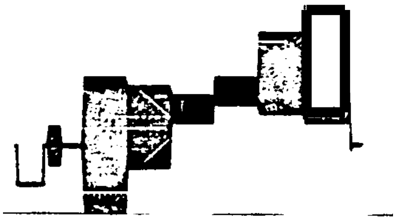
Y

Cb

Cr

SPECIAL 22
STAIRCASE - Y, Cb, Cr *

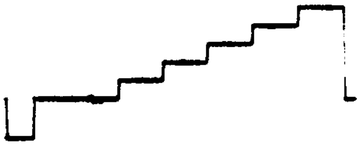
Description:
The components contain:
Y a 5 step staircase 0 to 700 mV
Cb, Cr a 5 step staircase +350 to -350 mV



CCVS

This signal is not valid with composite format.

Applications:
Line time nonlinearity measurement for all three components
with spike filters on rising (Y) and falling (Cb, Cr) staircases.



Y

Cb

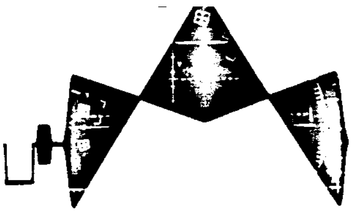
Cr

SPECIAL 23
TRIANGLE 1 Y, Cb, Cr *

Description:
The components contain:

Y a triangular voltage in the active lines going from 0 mV at the beginning to 700 mV in the middle of the line to 0 mV at the end of the line.

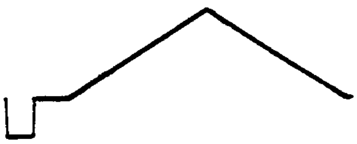
Cb, Cr a triangular voltage in the active lines going from- 350 mV at the beginning of the line to + 350 mV in the center of the line to - 350 mV at the end of the line.



CCVS

This signal is not valid with composite format.

Applications:
- line time nonlinearity with both signal polarities in one line
- rapid test on A/D converters for linearity deviations and missing codes with rising and falling ramps in all three components.



Y

Cb

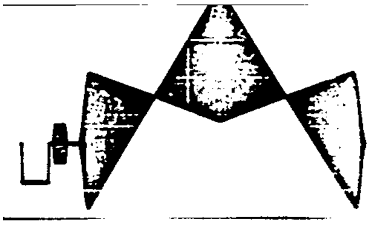
Cr

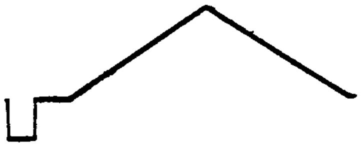
SPECIAL 24
TRIANGLE 2 Y, Cb, Cr *

Description:
Like SPECIAL 21, but the polarity of Cb and Cr is inverted.

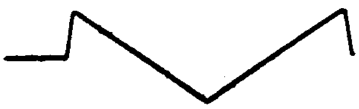
This signal is not valid with composite format.

Applications:
See SPECIAL 23


CCVS


Y


Cb


Cr

SPECIAL 25
NONLINEARITY TEST

Description:
Ramp signals in Y, Cb and Cr which in RGB mode give ramps with maximum level (0 to 700 mV) and different gradients. The NONLINEARIY TEST is generated to the IBA Code of Practice, 1987. This is a valid composite signal.

Applications:
Testing nonlinearities in Y,Cb, Cr and for the most part with RGB using suitable spike filters (Code of Practice, Section 7, Ref. 7.50).

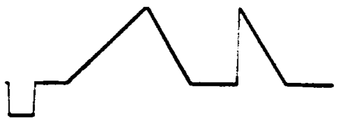

CCVS

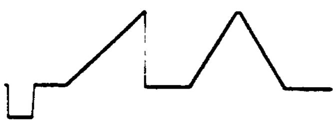

Y


Cb


Cr

R

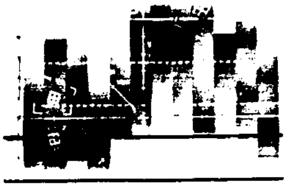

G


B


SPECIAL 26
COLOUR CUBE

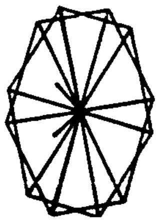
Description:
Ramp signals in Y, Cb, Cr which, with composite (CCVS) coding, describe the limits of the valid signals (see vectorscope). This is particularly clear in RGB mode.

Applications:
Detecting gamut errors

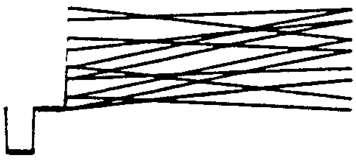


CCVS field

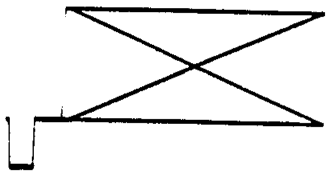
CCVS line



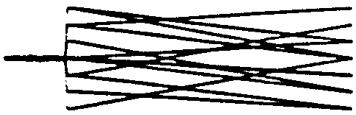
Vectorscope



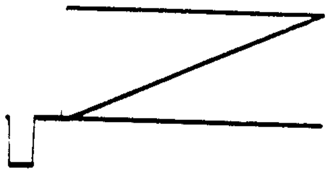
Y



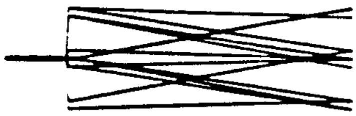
R



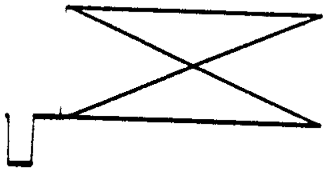
Cb



G



Cr



B

SPECIAL 27, 28 (OPTIONS)
CUSTOMER’S PHOTO,
PALplus TEST PATTERN

Description:
A true image data set (photo) can be generated as an option using a Betacam tape on which a 100/0/75/0 colour bars signal as a leader and then the customer specific photo, taken with a camera, have been recorded. The signal then is stored in the SAF or SFF signal memory.

Application:
Transmitter identification slide

Description:
PALplus TEST PATTERN similar to MAC TEST PATTERN
See Application Note 7BM11-13-0195-e „Signals of the PALplus test pattern generated by Videogenerators SAF and SFF“

4. Signal Group SWEEP + BURST

4.1 List of Signals

SWEEP + BURST			
1	H SWEEP	7	RGB SWEEP 3.25 MHz
2	V SWEEP	8	RGB SWEEP 4.2 MHz
3	CCIR 18/1	9	H SWEEP 5.8 Mhz *
4	CCIR 18/2	10	BURST WITH VAR.FREQUENCY
5	MULTIPULSE	11	V SWEEP WITH VAR.MARKER
6	CORING		

4.2 Signal Description

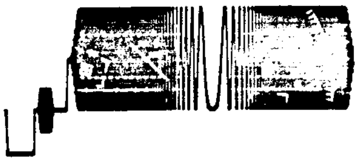
SWEEP + BURST 1
H SWEEP

CCVS

Description:
The H SWEEP signals ITS 8, 9, 10, 11 which cover the frequency range 5.5 - 0 - 5.5 MHz, each take up a quarter of the monitor screen:

1st quarter	H SWEEP 3	0°
2nd quarter	H SWEEP 4	90°
3rd quarter	H SWEEP 1	180°
4th quarter	H SWEEP 2	270°

Applications:
Measurements as described under ITS 8, 9, 10, and 11, but full field measurements.

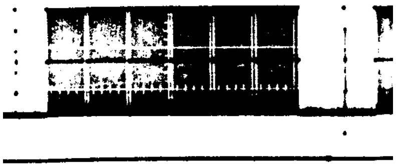


CCVS

CCVS

CCVS

SWEEP + BURST 2
V SWEEP



CCVS field

Description:
SWEEP signal with field frequency:

initial frequency	50 kHz
final frequency	6 MHz

frequency marker at multiples of 1 MHz
frequency deviation per line 25 kHz

Applications:
Determination of amplitude vs frequency response with high frequency resolution

SWEEP + BURST 3,4
CCIR 18/1, CCIR 18/2
See ITS 2,3

SWEEP + BURST 5
MULTIPULSE
See ITS 14

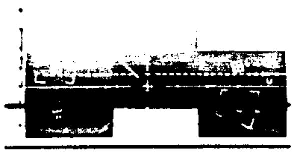
SWEEP + BURST 6
CORING
See SPECIAL 3

SWEEP + BURST 7,8
RGB SWEEP 3.25 MHz, 5.8 MHz

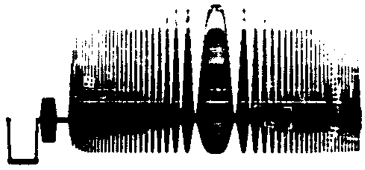
Description:
H SWEEP signals with the 3.25 - 0 - 3.25 MHz format using Y, Cb, Cr coding which in RGB format gives H SWEEPs in the pure primary colours with the maxi mum legal level range of 0 to 700 mV. The sweeps are **line** displayed sequentially on the monitor:

top	red
center	green
bottom	blue

Applications:
- frequency response of amplitude and group delay in the RGB channels
- timing errors when the component signals are compressed to obtain MAC signals as a function of frequency



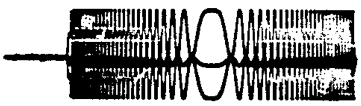
CCVS field



CCVS

Y

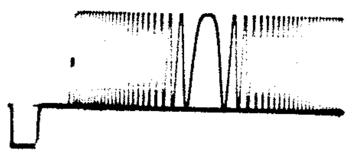
Cb



Cr

R

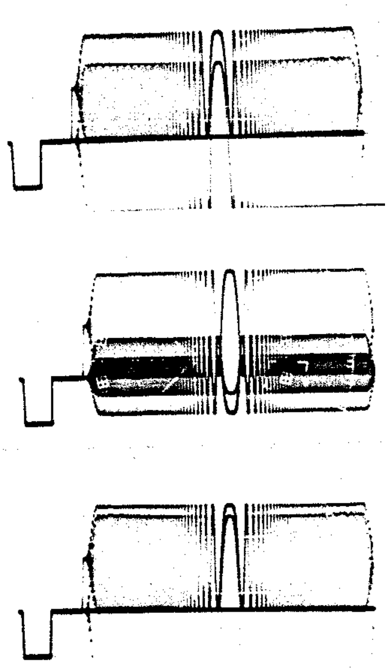
G



B

ROHDE&SCHWARZ
BROADCASTING DIVISION

SWEEP + BURST 9 *
H SWEEP 5.8 MHz



R

G

B

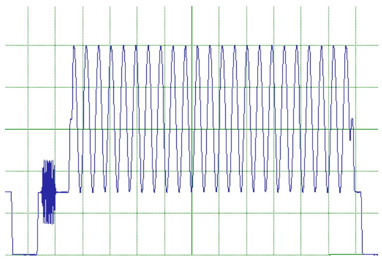
Description:
H SWEEP signals with the 5.8 - 0 - 5.8 MHz format using Y, Cb, Cr coding
The sweeps are **line** displayed sequentially on the monitor:

top	white (Y level range of 0 to 700 mV)
center	blue (Cb level range of Vpp = 700 mV)
bottom	red (Cr level range of Vpp = 700 mV)

This signal is not valid with composite or RGB format.

Applications:
- frequency response of amplitude and group delay in the Y, Cb, Cr components
- timing errors when the component signals are compressed to obtain MAC signals as a function of frequency

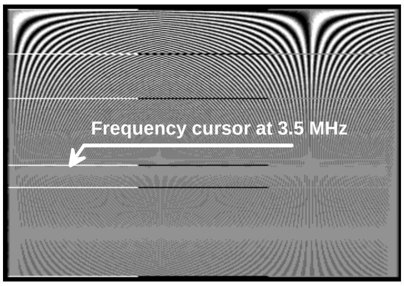
SWEEP + BURST 8
BURST WITH VAR. FREQUENCY



Description:
A sine wave signal with selectable frequency in the range 0 to 6 MHz in steps of 1 kHz and V_{pp} = 700 mV is superimposed to a 50 % grey level.

Applications:
Base band:
- accurate measurements at critical frequencies, such as subcarrier

Transmitter measurement:
- precise determination of Nyquist slope in vestigial side band operation
- intermodulations measurement or checking the adjacent channel emission



SWEEP + BURST 9
V SWEEP WITH VARIABLE MARKER

Description:
V SWEEP like SWEEP + BURST 2 without the markers for 3 and 5 MHz, but with a variable frequency marker which is settable line per line over vertical sweep and the corresponding frequency is indicated on the display.

Applications:
Determination of amplitude vs frequency response with high frequency resolution. The marker shows the exact frequency where for instance critical distortions occur.

5. Signal Group PULSE + BAR

5.1 List of Signals

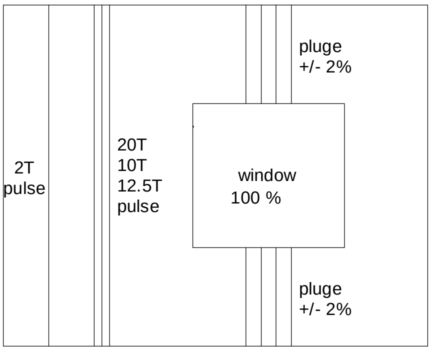
PULSE + BAR			
1	20T 2T BAR	11	50 Hz 2
2	10T 2T BAR	12	50 Hz 3
3	12.5T 2T BAR	13	SNF SIGNAL
4	WINDOW PLUGE	14	CCIR 17
5	MULTIPULSE	15	CCIR 330/4
6	2T PULSE	16	CCIR 330/5
7	SIN X/X	17	UK ITS 1
8	15 kHz	18	BT COMP. WAVEFORM
9	250 kHz	19	BBC TESTLINE
10	50 Hz 1		

5.2 Signal Description

PULSE + BAR 1,2,3
20T 2T BAR
10T 2T BAR
12.5 T 2T BAR

Description:
Like ITS 19, but with different half amplitude duration for the sin^2 pulse modulated by the colour subcarrier

PULSE + BAR 4
WINDOW PLUGE

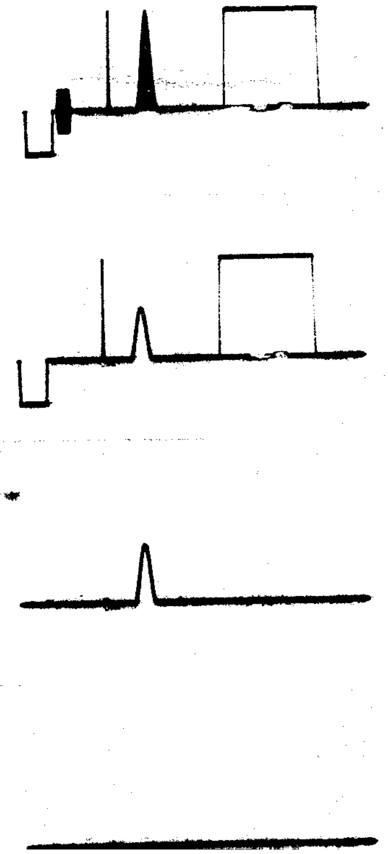


MONITOR

Description:
The WINDOW + PLUGE signal comprises the following signal elements:
The first vertical half of the full field signal includes
a 2T pulse and
a modulated 20T or 10T or 12.5T pulse
with SC at φ = 0°
The second vertical half of the full field signal includes in the upper and the lower part
a PLUGE signal of ± 2% and in the centre a white window.
The signal elements are arranged on a black (0%) background.

Applications:
Thanks to the integral window, field time tilts and line time tilts can be displayed. Reflections and echos are
seen at the evaluation of the 2T pulse. The group delay and the amplitude response at the subcarrier is measured using either the 20T or 10T or 12.5 T pulse.
The black alignment of monitors is done with the PLUGE signal.

(PLUGE = Picture line up generator)



CCVS

Y

Cb

Cr

PULSE + BAR 5
MULTIPULSE

Description:
See ITS 14

PULSE + BAR 6
2T PULSE

Description:
See ITS 12

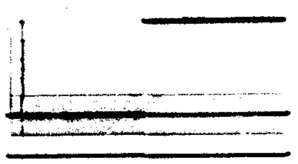
PULSE + BAR 7
SIN X/X

Description:
See ITS 13

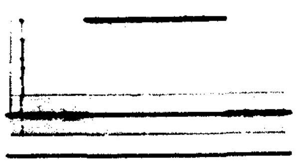
PULSE + BAR 8,9
15 kHz, 250 kHz

Description:
See ITS 17, 18

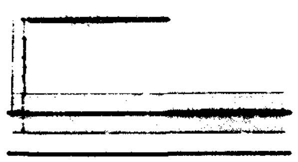
PULSE + BAR 10, 11, 12
50 Hz 1, 50 Hz 2, 50 Hz 3 SQUAREWAVE



field
50 Hz 1



50 Hz 2



50 Hz 3

Description:
This signal is a field repetitive squarewave with 100% **CCVS** amplitude, whose white section lies in the

bottom	50 Hz 1
center	50 Hz 2 and
top	50 Hz 3 of the screen.

Applications:
- using this signal, errors in the lowest frequency range of the video signal can be detected, for example effects caused by defective clamping circuits.

  Faults of this kind are displayed as field time tilt or black level discontinuities.
- when AC coupling is used for this signal, the effects of too low time constants are immediately visible on the oscilloscope.
- test of the high voltage stabilization on monitors

PULSE + BAR 13
SNF SIGNAL

Description:
See SPECIAL 8

PULSE + BAR 14
CCIR 17

Description:
See ITS 1

PULSE + BAR 15, 16
CCIR 330/4
CCIR 330/5

Description:
See ITS 4, 5

PULSE + BAR 17
UK ITS 1

Description:
See ITS 24

PULSE + BAR 18
BT COMP. WAVEFORM

Description:
See ITS 27

PULSE + BAR 19
BBC TESTLINE

Description:
See ITS 28

6. Signal Group LINEARITY

6.1 List of Signals

LINEARITY						
1	5 STEPS		17	CCIR 330/4		
2	5 STEPS	MOD. 140 mV	18	CCIR 330/5		
3	5 STEPS	MOD. 280 mV	19	V STAIRCASE +		
4	5 STEPS	B.T.B.	20	V STAIRCASE -		
5	5 STEPS	B.T.B. MOD. 200 mV	21	SHALLOW RAMP Y		
6	10 STEPS		22	CHROMA 10 STEPS		
7	10 STEPS	MOD. 280 mV	23	RAMP CR		
8	RAMP		24	RAMP CB		
9	RAMP	MOD. 1 MHz 100 mV	25	SHALLOW RAMP Y, Cb, Cr		*
10	RAMP	MOD. 1 MHz 200 mV	26	RAMP +	Y, Cb, Cr	*
11	RAMP	MOD. 100 mV	27	RAMP -	Y, Cb, Cr	*
12	RAMP	MOD. 200 mV	28	STAIRCASE+	Y, Cb, Cr	*
13	RAMP	B.T.B.	29	STAIRCASE -	Y, Cb, Cr	*
14	RAMP	B.T.B. MOD. 200 mV	30	TRIANGLE 1	Y, Cb, Cr	*
15	RAMP MOD. 200 mV SHORTENED		31	TRIANGLE 2	Y, Cb, CR	*
16	CCIR 17		32	NONLINEARITY TEST		

6.2 Signal Description

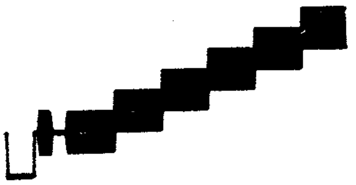
CCVS

LINEARITY 1
5 STEPS

Description:
The active line (52 µs) is devided up into 6 equal sections(8.67 µs).On each section the luminance level increases by 140 mV. No colour is superposed.

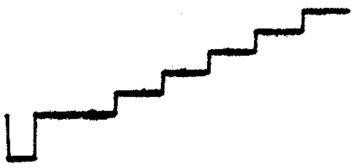
Applications:
Measuring the line time nonlinearity with spike filters or direct measurement of the step amplitudes

LINEARITY 2, 3
5 STEP MOD. 140 mV
5 STEP MOD. 280 mV



CCVS

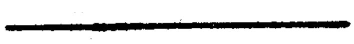
Description:
Like LINEARITY 1,
but a subcarrier with V_{PP} = 140 mV or V_{PP} = 280 mV and $\varphi = 0°$ is superposed. As colour is also superposed on black and white, gamut errors are produced in the red and the green channel



Y

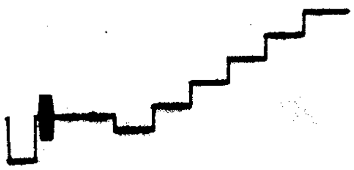
Applications:
Measuring differential distortion (differential gain and phase).

Cb



Cr

LINEARITY 4
5 STEPS B.T.B. (blacker than black)



CCVS

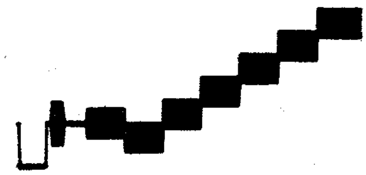
Description:
The active line (52 µs) is devided up into 6 equal sections (8.67 µs).The first section starts with a luminance level of - 100 mV (blacker than black). On each new section the luminance level increases by 160 mV.
No colour is superposed.

Applications:
Measuring the line time nonlinearity with spike filters or direct measurement of the step amplitudes even in the blacker than black region.

function tests on sync seperators with standard sync levels or with PALplus signals

function tests on ABC transmitters

LINEARITY 5
5 STEPS B.T.B. (*b*lacker *t*han *b*lack)
MOD 200 mV

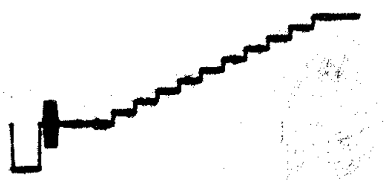


CCVS

Description:
The active line (52 µs) is devided up into 6 equal sections (8.67 µs).The first section starts with a luminance level of - 100 mV (*b*lacker *t*han *b*lack). On each new section the luminance level increases by 160 mV.
A colour subcarrier with 0° phase and Vpp = 200 mV is superposed.

Applications:
Measuring differential distortion (diferential gain and - phase) even in the *b*lacker *t*han *b*lack region in order to check TV transmitter characteristics in this range.

LINEARITY 6
10 STEPS

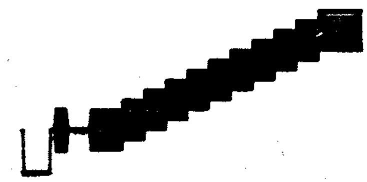


CCVS

Description:
The first staircase edge is at 18 µs. The following 9 steps each have a length of 4 µs each and a height of 70 mV. The tenth step is 8 µs long.
No colour subcarrier is superposed.

Applications:
Measuring line time nonlinearity with spike filters or automatic measurements with ODF(A) or VSA.

LINEARITY 7
10 STEPS MOD. 280 mV



CCVS

Description:
Like LINEARITY 6, but a subcarrier with V_{PP} = 280 mV and $\varphi = 0°$ is superposed.
As colour is also superposed on black and white, gamut errors are produced in the blue and the green channel

Applications:
Measuring differential distortion (differential gain and phase) at 10 discrete luminance levels which allow analyzers to settle completely.

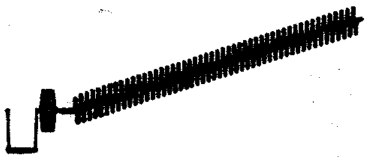
LINEARITY 8
RAMP

CCVS

Description:
The ramp signal is a sawtooth which starts at 0 mV, 11 µs and increases to 700 mV at 52.5 µs.
No colour subcarrier is superposed.

Applications:
The ramp signal, like various staircase signals, is used to check line time nonlinearity. It can also be used to measure S/N ratio (signal to noise) over the whole level range, to measure quantization noise in A/D and D/A converter systems and setting the IF modulator balance for maximum carrier suppression with 0% residual carrier adjusted.

LINEARITY 9, 10
RAMP MOD.100 mV 1 MHz
RAMP MOD.200 mV 1 MHz

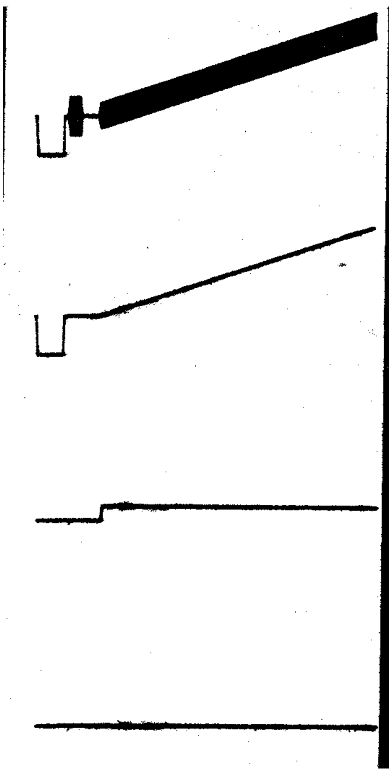


CCVS

Description:
Like LINEARITY 8, but with a 1 MHz sine wave with V_{pp} = 100 mV or V_{pp} = 200 mV superposed.

Applications:
Measuring line time nonlinearity at 1 MHz

LINEARITY 11,12
RAMP MOD.100 mV
RAMP MOD.200 mV



CCVS

Y

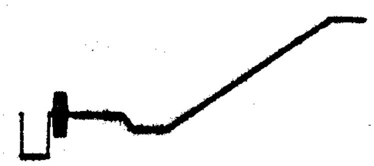
Cb

Cr

Description:
Like LINEARITY 8, but with a colour subcarrier with V_{pp} = 100 mV or Vpp = 200 mV and 0° phase superposed.

Applications:
The signal is used to measure nonlinear distortions, like differential gain and phase on the subcarrier.

LINEARITY 13
RAMP B.T.B. (blacker than black)

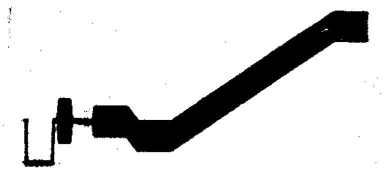


CCVS

Description:
A sawtooth with negative slope starts at 18µs after 0H and dedecreases over 2 µs to give a luminance of - 100 mV which remains constant at - 100 mV until 26 µs after 0H. From here, the ramp rises until 56 µs where the value is 700 mV. The pedestal remains at 700 mV until 62 µs after 0H.

Applications:
- Measuring line time nonlinearity
- function check on sync seperators with standard sync or PALplus signals
- function tests on ABC transmitter

LINEARITY 14
RAMP B.T.B. MOD 200 mV (blacker than black)



CCVS

Description:
A sawtooth with negative slope starts at 18µs after 0H and dedecreases over 2 µs to give a luminance of - 100 mV which remains constant at - 100 mV until 26 µs after 0H. From here, the ramp rises until 56 µs where the value is 700 mV. The pedestal remains at 700 mV until 62 µs after 0H. A colour subcarrier with 0° phase and Vpp = 200 mV is superposed.

Applications:
Measuring differential distortion (diferential gain and - phase) even in the blacker than black region in order to check TV transmitter characteristics in this range.

LINEARITY 15
RAMP. MOD 100 mV SHORTENED

CCVS

Description:
Like LINEARITY 11, but colour subcarrier superposition is selected so that the colour does not go below black or over white.

Applications:
Measuring differential distortions in systems that should not be overdriven.

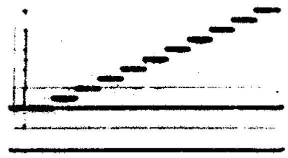
LINEARITY 16
CCIR 17

Description:
See ITS 1

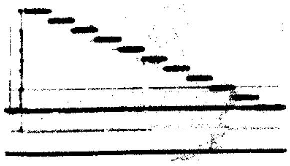
LINEARITY 17, 18
CCIR 330/4
CCIR 330/5

Description:
See ITS 4,5

LINEARITY 19, 20
V STAIRCASE +, V STAIRCASE -



CCVS field +(pos.)

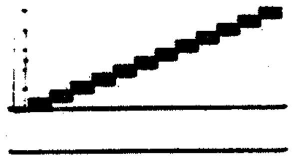


- (neg.)

Description:
With this signal the screen is split into eleven areas, each with full screen width and a duration of 26 lines per field so that there is a grey staircase with constant step height in the vertical direction. The amplitude of each step is 10%, therefore the white step has 100%.
The staircase has two polarities:
on the screen from top to bottom from black to white and from white to black

Applications:
- checking linearity over the frequency deviation range in FM systems (for example VTRs)
- testing linearity errors in vertical direction in DSP (Digital Signal Processing) caused by rounding or vertical filtering

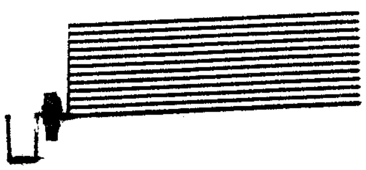
LINEARITY 21
SHALLOW RAMP Y



CCVS field

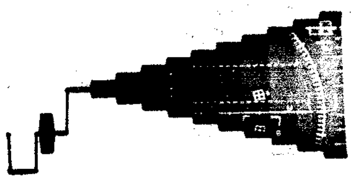
Description:
10 ramps with an amplitude of 70 mV luminance, each on a 70 mV higher setup. This means that each level **field** range is covered with a flat ramp.

Applications:
Detecting digitizing errors which are particularly noticable with a shallow ramp. For fine setting use SETUP and Y or CVS in the AMPLITUDE menu.



CCVS line

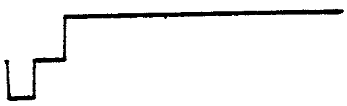
LINEARITY 22
CHROMA 10 STEPS



CCVS

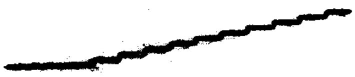
Description:
A 10 step colour subcarrier staircase with a phase of 54.5° is superposed on a 350 mV grey level. The first colour staircase step has an amplitude of Vpp = 120 mV, on each new step the amplitude is increased by Vpp = 120 mV. Consequently, the last step is at Vpp = 1.2 V.

Applications:
Monitoring
COLOUR NONLINEAR GAIN and
COLOUR NONLINEAR PHASE.
If there are nonlinear phase errors, the vectorscope does not display the staircase points on a straight line; in the case of nonlinear amplitude errors, the points are not equi-distant.



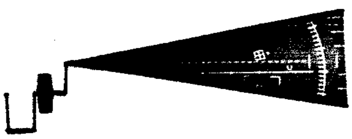
Y

Cb



Cr

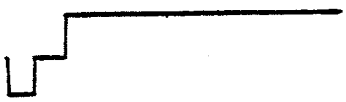
LINEARITY 23
RAMP Cr



CCVS

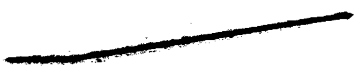
Description:
A colour ramp with only the Cr component (Cb =0) is superposed on a 240 mV grey level. The final value of the Cr ramp is + 330 mV which corresponds to a colour subcarrier amplitude of Vpp = 810 mV.
The phase is 90°.

Applications:
Monitoring
COLOUR NONLINEAR GAIN and
COLOUR NONLINEAR PHASE,
but only the Cr component is measured.



Y

Cb



Cr

LINEARITY 24
RAMP Cb

Description:
A colour ramp with only the Cb component (Cr =0) is superposed on a 240 mV grey level. The final value of the Cb ramp is + 330 mV which corresponds to a colour subcarrier amplitude of Vpp = 580 mV.
The phase is 0°.

Applications:
Monitoring
COLOUR NONLINEAR GAIN and
COLOUR NONLINEAR PHASE,
but only the Cb component is measured.

CCVS

Y

Cb

Cr

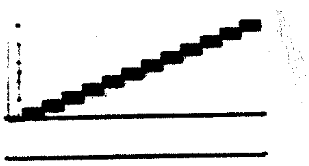
LINEARITY 25
SHALLOW RAMP Y, Cb, Cr *

Description:
Like LINEARITY 21, but the Cb and Cr components have shallow ramps with the same timing and gradation as the Y component.

Initial amplitude for Cb and Cr	- 350 mV
final amplitude for Cb and Cr	+ 350 mV

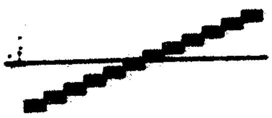
Applications:
Like LINEARITY 21, but with additional assessment possible in Cb and Cr.

CCVS field

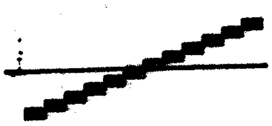


Y field

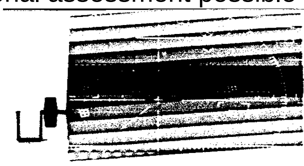
I



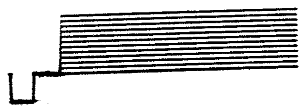
Cb field



Cr field

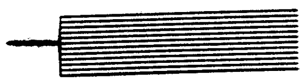


CCVS line



Y line

Cb line



Cr line

LINEARITY 26, 27
RAMP + Y, Cb, Cr *
RAMP - Y,Cb, Cr *

Description:
See SPECIAL 19, 20

LINEARITY 28, 29
STAIRCASE + Y, Cb, Cr *
STAIRCASE - Y, Cb, Cr *

Description:
See SPECIAL 21, 22

LINEARITY 30, 31
TRIANGLE 1 Y, Cb, Cr *
TRIANGLE 2 Y, Cb, Cr *

Description:
See SPECIAL 23, 24

LINEARITY 32
NONLINEARITY TEST

Description:
See SPECIAL 25

7. Signal Group MONITOR ADJUSTMENT

7.1 List of Signals

MONITOR ADJUSTMENT	
1 TEST PATTERN UNIVERSAL	25 CROSS HATCH WINDOW 1 16:9
2 TEST PATTERN FUBK	26 CROSS HATCH WINDOW 2 16:9
3 TEST PATTERN MAC	27 CROSS HATCH WINDOW 3 16:9
4 CROSSHATCH (FUBK)	28 CROSS HATCH WINDOW 4 16:9
5 CROSSHATCH (FUBK) CIRCLE	29 YELLOW FIELD
6 CROSSHATCH (FUBK) DOTS	30 CYAN FIELD
7 WINDOW PLUGE	31 GREEN FIELD
8 TEST PATTERN UNIVERSAL 16:9	32 MAGENTA FIELD
9 TEST PATTERN DUAL RATIO	33 RED FIELD
10 TEST PATTERN MAC 16:9	34 BLUE FIELD
11 CROSSHATCH (FUBK) 16:9	35 GREY 50%
12 CROSSHATCH (FUBK) CIRCLE16:9	36 BLACK
13 CROSS HATCH (FUBK) DOTS 16:9	37 WHITE
14 WINDOW PLUGE 16:9	38 COLOUR BARS 100/0/75/0
15 CROSS HATCH	39 COLOUR BARS 100/0/100/0
16 CROSS HATCH CIRCLE	40 SPLIT FIELD
17 CROSS HATCH DOTS	41 ICE HOCKEY
18 CROSS HATCH WINDOW 1	42 YELLOW RED YELLOW
19 CROSS HATCH WINDOW 2	43 WHITE CROSS ON RED
20 CROSS HATCH WINDOW 3	44 MOVING CROSS HATCH 1
21 CROSS HATCH WINDOW 4	45 MOVING CROSS HATCH 2
22 CROSSHATCH 16:9	46 SPOT
23 CROSSHATCH CIRCLE 16:9	47 SMILY
24 CROSS HATCH DOTS 16:9	

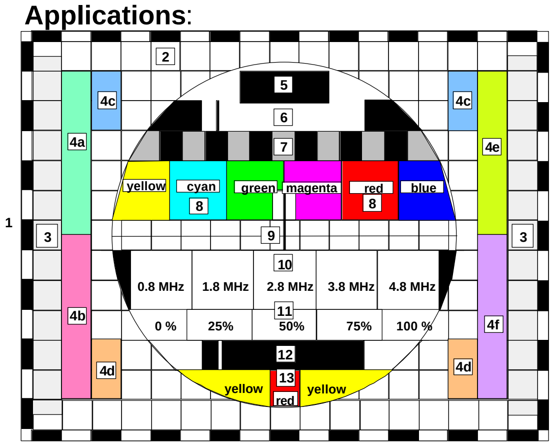
7.2 Signal Description

MONITOR ADJUSTMENT 1,8
TEST PATTERN UNIVERSAL 4 : 3
TEST PATTERN UNIVERSAL 16 : 9

Description:

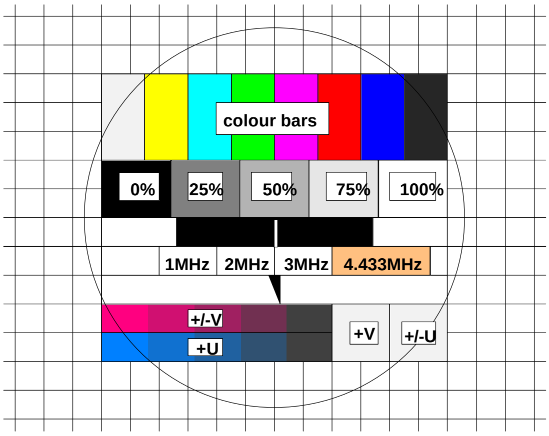
No.	Designation	Aspect checked
1	border castellation	picture size, deflection, effect of blanking, synchronization
2	cross hatch, circle	convergence, linearity, beam deflection, focussing,
3	anti-PAL +V, ±U	delay errors in PAL decoder,
4	R-Y, G-Y and B-Y	no delay errors = fields not coloured
4a	B-Y = 0, φ_{sc} = 270°	colour decoding
4b	B-Y = 0, φ_{sc} = 90°	
4c	G-Y = 0, φ_{sc} = 326°	
4d	G-Y = 0, φ_{sc} = 146°	
4e	R-Y = 0, φ_{sc} = 180°	
4f	R-Y = 0, φ_{sc} = 0°	
5	black window + pluge (if no text is inserted)	streaking, rounding, brightness adjustment of monitors text field 1
6	white window with negtive going 2T pulse	reflection
7	250 kHz squarewave	overshoot
8	colour bars	colour characteristics
9	centre marker	picture centring
10	multiburst	resolution
11	5 step grey scale	linearity, brightness and contrast
12	black window with positive going 2T pulse (if no text is inserted)	reflection text field 2
13	yellow red yellow	chrominance / luminance delay differences

Applications:



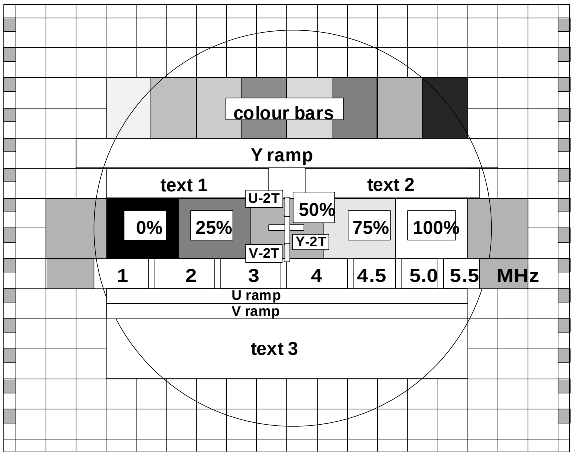
This test pattern is internationally used for testing TV receivers. It comprises a number of signal elements which permit virtually all distortions (e.g. of a receiver) to be seen at a glance.
User specific texts can be entered into 3 predetermined text fields from the front panel and via IEEE 488 bus.
As with all non moveable generator signals, a text line (up to 127 characters) whose position, background and content can be selected by the user, is programmable.

TEST PATTERN FUBK



Description:
The FuBK test pattern, which is standard in Germany and some other European countries like Switzerland, and is also used to some extent in Austria and Italy, is a common signal for checking TV receivers (text insertion like MONITOR ADJ. 1- TEST PATTERN UNIVERSAL). It contains:

Designation	Application
cross hatch+circle	convergence, linearity, beam deflection, focussing and geometrical distortions
colour bars 100/0/75/0	checking colour coding
grey staircase	linearity, brightness, contrast
2T convergence cross	reflections, group delay, picture centering
multiburst	frequency response, resolution (1, 2, 3, 4.433 MHz)
black section	reflections, transient response, group delay
±V/ +U ramp	linearity of PAL decoder
+V/ ±U anti PAL	setting the 64 µs delay line in the PAL decoder (fields uncoloured = precisely 64 µs)

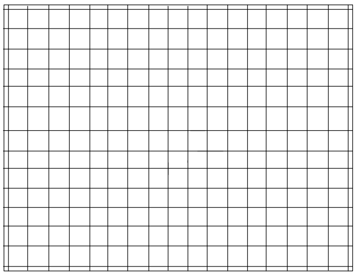


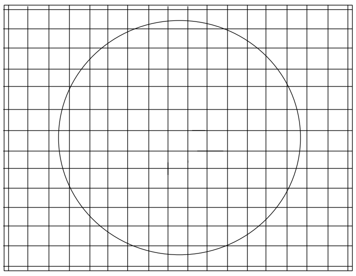
MONITOR ADJUSTMENT 3,10
TEST PATTERN MAC 4 : 3
TEST PATTERN MAC 16 : 9

Description:

Designation	Application
start of lines	± 75% Cb, Cr The clamp period comes before the start of Cb and Cr. If the clamping pulse is not exactly in the right position and does not have the correct width, it samples either the burst pulses or the edge of ± 75% Cb, Cr components of the signal which causes a very critical video signal clamping error.
crosshatch and circle	geometrical alignment of monitors,short duration echoes
colour bars	colour purity, component swapovers (R,G,B; Y,Cb,Cr)
Y ramp	D/A, A/D converter test for missing codes
text field 1 + 2	source identification
grey staircase	line time nonlinearity, white/grey contrast setting
convergence cross in luminance and blue and red pulses	aligning monitor center point and delay differences between Y, Cb and Cr ⇒ blue-, Y and red pulses must form a vertical line (N.B: in line CRT's incorrectly position red and blue by the width of a „triplet“).
multiburst (1,2,3,4,4.5,5.0,5.5 MHz)	frequency response, horizontal resolution
Cb, Cr ramps	D/A, A/D converter test for missing codes
text field 3	Description of transmitted sound configuration or other descriptions

MONITOR ADJUSTMENT 4,5,6,11,12,13,15,16,17,22,23,24,
CROSSHATCH (4:3, 16:9, with/without circle, with/without dots)





Description:

cross hatch like	lines		back-ground	circle/cross-hatch (vertical,horizontal) intersection points
	horizontal	vertical		
test pattern universal 4:3	14	18	50% grey	2/7,12 5/3,14 10/3,14 13/7,12
16:9	14	24	50% grey	2/10,15 5/7,18 10/7,18 13/10,15
test pattern FuBK 4:3	15	19	25% grey	2/7,13 5/4,16 11/4,16 14/7,13
16:9	15	25	25% grey	2/10,16 5/7,19 11/7,19 14/10,16

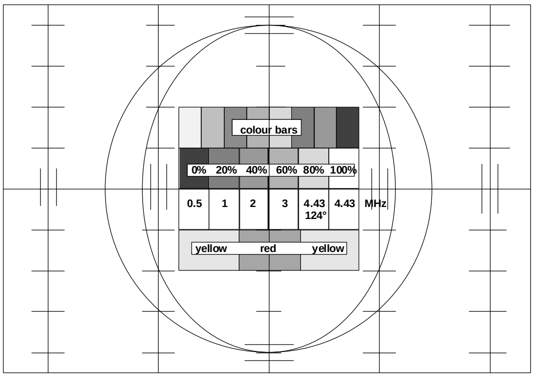
The vertical lines are produced from 2T pulses with 100% amplitude, the horizontal lines are from one line/field white with 100% amplitude and the dots from a 2T pulse per dot and per field with 100% amplitude.

Applications:
With this signal, convergence deviations and geometrical distortions on TV receivers and monitors can be detected. In the case of convergence errors, the lines are no longer white but run into the three primary colours RGB. If there is geometrical distortion, the cross hatch squares are not in the same size at different points on the sreen and are distorted.

MONITOR ADJUSTMENT 7,14
WINDOW PLUGE 4:3
WINDOW PLUGE 16:9

Description:
See PULSE + BAR 4

MONITOR ADJUSTMENT 9
TEST PATTERN DUAL RATIO



Description:
The horizontal line at the center of the screen has calibration markers for measuring the linearity of the horizontal deflection. Additional measurement markers at the beginning and end of the line or to the left and to the right of the „measurement signal box“ indicate ± 2% of the line duration.
The vertical lines have calibration markers for measuring the linearity of the vertical deflection. Additional measurement markers at the top and bottom of the monitor display indicate ± 2% of the display height.

When a 4:3 aspect ratio is used, the outer circle is aligned (inside circle becomes ellipse with major axis vertical). With an aspect ratio of 16:9, the inner circle is aligned (outer circle becomes ellipse with major axis horizontal).

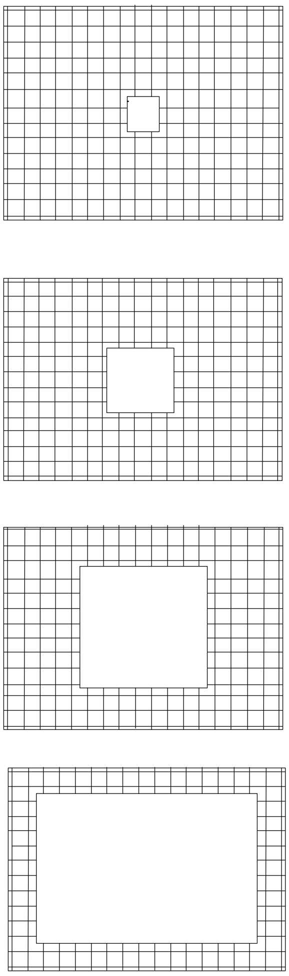
The following signals are inside the „measurement signal box“:

colour bars 100/0/75/0
5 step staircase
multiburst 0.5, 1, 2, 3, 4.433 MHz @ 124°, 4.43 MHz
yellow red yellow field

Applications:
Aligning 4:3 and 16:9 monitors using single signal

MONITOR ADJUSTMENT **18, 19, 20, 21**
25, 26, 27, 28

CROSS HATCH WINDOW 4:3



Description:
In the centre of the screen there are white windows of various sizes surrounded by the cross hatch pattern.

Applications:
- beam current limiting for monitors
- linearity of the monitor deflection units at abrupt brightnes transitions
- convergence settings

MONITOR ADJUSTMENT **29, 30, 31, 32, 33, 34, 36, 37**

YELLOW FIELD
CYAN
GREEN
MAGENTA
BLUE
RED
BLACK
WHITE

Description:
The colours of the 100/0/75/0 colour bars are generated individually as full field signals.

Applications:
Checking colour monitors for colour purity when a particular colour covers the whole screen.

MONITOR ADJUSTMENT 35
GREY 50%

Description:
Grey signal with medium brightness,
luminance level of 50%.

Applications:
- measuring the amplitude vs frequency response via externally loaded sweep signal
- noise measurement at grey level 50% grey for superposing external signals via EXT2

MONITOR ADJUSTMENT 38
COLOUR BARS 100/0/75/0

Description:
See ITS 20

MONITOR ADJUSTMENT 39
COLOUR BARS 100/0/100/0

Description:
See ITS 20 but with 100% colour saturation

Applications:
Suitability test for signals whose colour component rises to 133% CVS
measuring spurious intercarrier effects when the carrier is suppressed by colour

MONITOR ADJUSTMENT 40
SPLIT FIELD

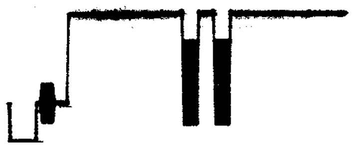
Description:
The upper 2/3 of the screen shows the COLOUR BARS 100/0/75/0 the lower 1/3 is filled with the colour of the red bar.

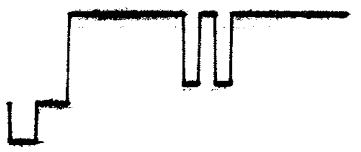
Applications:
This signal is used as tape leader on VTR recording and also as substitution signal when the program signal fails.

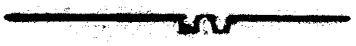
MONITOR ADJUSTMENT 41
ICE HOCKEY

Description:
On a 100% white screen there are two vertical red bars(same red as 100/0/75/0 colour bars) which are symmetrical about the centre.

Applications:
Measuring the group delay between luminance and chrominance on the screen.


CCVS


Y

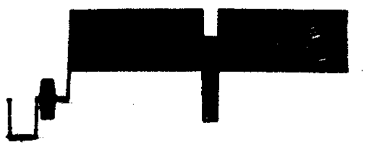

Cb

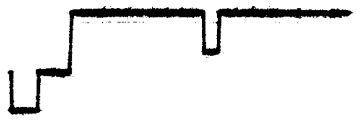

Cr

MONITOR ADJUSTMENT 42
YELLOW RED YELLOW

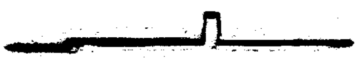
Description:
In the middle of a yellow screen (same yellow as 100/0/75/0 colour bars) there is a vertical red bar (same red as 100/0/75/0 colour bars).

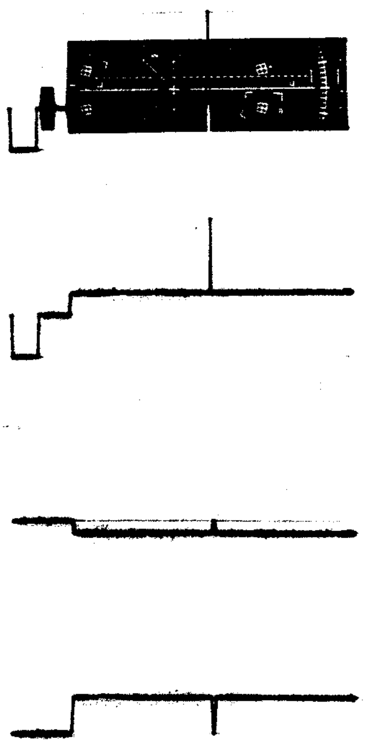
Applications:
Measuring the group delay between yellow (high Cb component), red (high Cr component) and the Y component.


CCVS


Y


Cb


Cr



MONITOR ADJUSTMENT 43
WHITE CROSS ON RED

Description:
On a red area there is a white cross (same red as 100/0/75/0 colour bars). The intersection point is in the middle of the active picture area.

Applications:
- centering the monitor display
- measuring group delay between chrominance and luminance on the monitor

MONITOR ADJUSTMENT 44, 45
MOVING CROSS HATCH 1, 2

Description:
The CROSS HATCH (MONITOR ADJ. 4) moves
from bottom to top and
from right to left

Applications:
Determining the motion vectors for digital signal processing with data reduction.

MONITOR ADJUSTMENT 46
SPOT

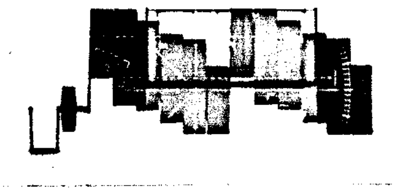
Description:
In the centre of the active picture there is a 100% white spot with a duration of 3 µs and a height of 22 lines per field.

Applications:
Measurement of the beam current of a CRT.

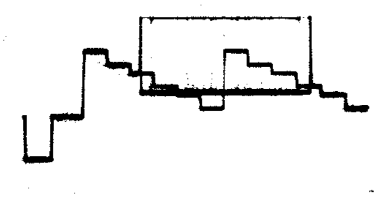
MONITOR ADJUSTMENT 47
SMILY

Description:
In two 100/0/75/0 colour bars signals there is a grey field containing a smily with rolling eyes

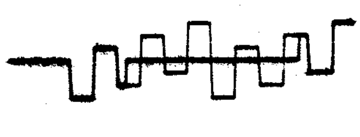
Applications:
Colour alignment on monitors and determining motion vectors for digital signal processing with data reduction



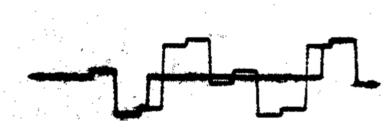
CCVS line



Y line



Cb line



Cr line

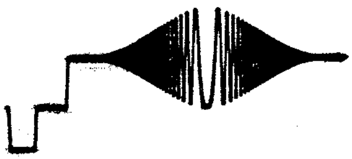
8. Signal Group ZONE PLATE

8.1 List of Signals

ZONE PLATE	
1 H LINEAR	4 HYPERBOLIC DIAGONAL
2 V LINEAR	5 HYPERBOLIC VERTICAL
3 CIRCULAR	6 VARIABLE ZONE PLATE

8.2 Signal Description

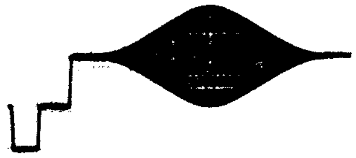
ZONE PLATE 1
H LINEAR



H LINEAR through LP

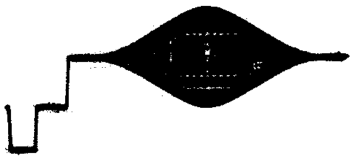
Description:
Signal like H SWEEP 5.5 MHz - 0 - 5.5 MHZ (ITS 8, 9, 10, 11) generated using the equation:
$A(x,y,t) = const. + \sin (k_0 + k_x x + k_{x^2} x^2 + k_t t + k_{t^2} t^2)$

Applications:
See Annex 3 ZONE PLATE SIGNALS.



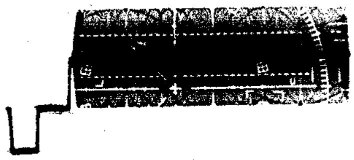
CIRCULAR through LP

The figures show the zone plates:
H LINEAR
CIRCULAR and
HYPERBOLIC DIAGONAL through a 231 ns Thomson low pass filter. It is easy to see that all three signals provide the same information about the amplitude vs frequency response within one line.



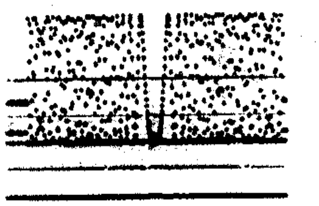
HYPERBOLIC DIAGONAL through LP

The HYPERBOLIC VERTICAL zone plate however appears to be inaccessable to analysis in H frequent display on the oscilloscope. The HYPERBOLIC VERTICAL zone plate is similar to the V SWEEP and therefore to be measured in a V frequent display.



HYPERBOLIC VERTICAL through LP

ZONE PLATE 2
V LINEAR



V LINEAR
field

Description:
Field repetitive signal which starts with a high vertical frequency at the top of the screen goes through a vertical frequency minimum at the centre of the screen and at the bottom of the screen again rises to a high vertical frequency.

This signal obeys the following equation:

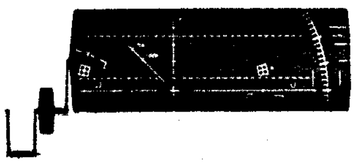
$A(x,y,t) = const. + \sin (k_0 + k_y y + k_{y^2} y^2 + k_t t + k_{t^2} t^2)$

Applications:
See Annex 3 ZONE PLATE SIGNALS.

ZONE PLATE 3, 4, 5, 6
CIRCULAR
HYPERBOLIC (DIAGONAL/VERTICAL)
VARIABLE

Description / **Applications**:
See Annex 3 ZONE PLATE SIGNALS.

HYPERBOLIC



CIRCULAR

9. Signal Group "CCIR 601" (Option)

9.1 List of Signals

CCIR 601	
1 GREY LEVEL	21 PATHOL.SIGNAL Y=088h C=100h
2 ALTERNATING BLACK/WHITE	22 PATHOL.SIGNAL Y=044h C=080h
3 EOL PULSE	23 PATHOL.SIGNAL Y=022h C=040h
4 BLACK/WHITE	24 PATHOL.SIGNAL Y=011h C=020h
5 RAMP YELLOW/GREY	25 PATHOL.SIGNAL Y=008h C=210h
6 RAMP GREY BLUE	26 PATHOL.SIGNAL Y=198h C=108h
7 RAMP CYAN GREY	27 PATHOL.SIGNAL Y=004h C=300h
8 RAMP GREY RED	28 PATHOL.SIGNAL Y=0CCh C=180h
9 RAMP CB Y CR Y	29 PATHOL.SIGNAL Y=066h C=0C0h
10 EOL BAR WHITE	30 PATHOL.SIGNAL Y=033h C=060h
11 EOL BAR BLUE	31 PATHOL.SIGNAL Y=019h C=230h
12 EOL BAR RED	32 PATHOL.SIGNAL Y=00Ch C=318h
13 EOL BAR YELLOW	33 PATHOL.SIGNAL Y=006h C=18Ch
14 EOL BAR CYAN	34 DIG.COL.BARS 100/0/100/0
15 SEQUENCE 1010	35 DIG.COL.BARS 100/0/75/0
16 SEQUENCE 11001100	36 RAMP Y
17 SEQUENCE 111000111000	37 RAMP Y CB CR
18 SDI CHECK FIELD	38 RAMP CB
19 PATHOL.SIGNAL Y=198h C=300h	39 RAMP CR
20 PATHOL.SIGNAL Y=110h C=200h	

When the CCIR 601 option is used **all** generator signals are output via the parallel and the serial (270 MHz/s) data interface. These signals include all modifications which can be set from the "signal variation " panel on the instrument and which influence the Y, Cb and Cr components.
Test sequences according to CCIR Rep. 1212, pathalogical signals for cable equalizers and PLLs used in the serial interface and special ramp signals listed above are also output in the analogue CCVS, Y Cb Cr and RGB formats.

9.2 Signal Description

See Annex 1: CCIR Rep. 1212 Section 3. Examples of 4:2:2 test signals and
Annex 2: Pathological Signals

ANNEX 1

ITU-R BT. 801

RECOMMENDATION ITU-R BT.801-1

TEST SIGNALS FOR DIGITALLY ENCODED COLOUR TELEVISION SIGNALS CONFORMING WITH RECOMMENDATIONS ITU-R BT.601 (PART A) AND ITU-R BT.656

(Question ITU-R 25/11)

(1992-1995)

The ITU Radiocommunication Assembly,

considering

a) that digital television systems operate in very different ways from analogue systems with the consequence that a quite different set of picture impairments may be introduced;

b) that impairments may occur both from the conversions to and from the digital domain (which include filtering, sampling and quantization), and by degradations of the digital signal itself (such as individual digit errors, timing jitter or loss of frame synchronization);

c) that for measurements of such impairments it is necessary to provide the test signals,

recommends

1 that for measurements of quantization errors and timing errors between analogue and digital active lines in conversion process from and to the digital signals conforming with Recommendation ITU-R BT.601 (Part A), using 8-bit quantization, and for verifying the conformity of the multiplex format with Recommendation ITU-R BT.656, and checking for the correct operation of the associated interfaces, test signals used should be selected from the list given in Table 1, rows No. 1 to 15;

2 that for the verification of cable equalizers and phase-locked loop (PLL) circuits the test signal of Table 1, row 16 should be used.

The test signals are listed in Table 1 and its brief description and precise sample values are annexed in Annexes 1 and 2, respectively.

TABLE 1

List of test signals

No.	Title
1	Grey
2	Alternating white/black at 0.1 Hz
3	End-of-line pulses
4	Black/white ramp
5	Yellow/grey ramp
6	Grey/blue ramp
7	Cyan/grey ramp
8	Grey/red ramp
9	C_B, Y, C_R, Y ramp
10	White, end-of-line porches
11	Blue, end-of-line porches
12	Red, end-of-line porches
13	Yellow, end-of-line porches
14	Cyan, end-of-line porches
15	Digital colour-bar
16	Check field signal

ANNEX 1

Brief description of test signals

The formulae corresponding to the test signals are defined in § 1, and the waveforms are illustrated in § 2.

1 Formulae (see Note 1)

In cases where sample values are derived by computation, an addition of 0.5 is included in the formula to ensure that the appropriate level is obtained by rounding the result.

NOTE 1 – Y, C_R, C_B sample numbering is in accordance with Recommendation ITU-R BT.656.

These digital waveforms are made up of pulses in uniform ranges, ramps between two uniform ranges, and transitions between two uniform ranges, shaped by a filter whose impulse response $R(t)$ is defined as a function of time t as follows:

– for $-3T < t < 3T$, $R(t) = 0.42 + 0.50 \cos(\pi\, t / 3T) + 0.08 \cos(2\pi\, t / 3T)$

– otherwise $R(t) = 0$

($R(t)$: Blackman window).

The value of T is 74 ns for digital waveforms $A1$, $A2$, $A3$ and $A4$ and 148 ns for $A5$ and $A6$.

1.1 Test signal No. 1: grey

The active video lines of this signal are defined by:

$Y(i) = A1(i)$, $C_R = C_B = 128$.

This signal is critical for transmission via a parallel interface, since each of the 8 interface data binary signals then contains a succession of bits 0, 1, 0, 1, 0, 1 ... and attains maximum power concentration at high frequencies (multiples of 13.5 MHz) which often prove difficult to preserve in practical transmission links.

1.2 Test signal No. 2: alternating white/black at 0.1 Hz

This signal produces alternately:

– for 5 s, pictures containing “white” digital active video lines defined by:

$Y(i) = A2(i)$, $C_R = C_B = 128$;

– for 5 s, pictures containing “black” digital active video lines defined by:

$Y = 16$, $C_R = C_B = 128$.

This signal produces a variation of the black level in the corresponding analogue video signals, owing to the suppression of continuous components and very low frequencies by the analogue transmission links. It provides a means of checking the compensation for this variation, as well as black stability and accuracy in digital coding.

1.3 Test signal No. 3: end-of-line pulses

The signal’s digital active video lines are defined by:

$Y(i) = A3(i)$, $C_R = C_B = 128$.

This four-pulse signal can be used to check the position of the digital active line in relation to the analogue reference, as well as the activity of samples situated at the end of the digital active line. The outside edges of the two internal pulses coincide with the ends of the line, in the 625/50 system.

1.4 Test signal No. 4: black/white ramp

The digital active video lines of this signal are defined by:

$Y(i) = \text{int}(A4(i))$, $C_R = C_B = 128$.

This signal may be used to test the existence and position of quantization levels 1 to 254 of the luminance signal.

1.5 Test signal No. 5: yellow/grey ramp

The digital active lines of this signal are defined by:

$C_B(i) = \text{int}(A5(i))$

$C_R(i) = \text{int}(128.5 - (0.114 / 0.701)(A5(i) - 128))$

$Y(i) = \text{int}(126 - (169 / 224)(A5(i) - 128))$

This signal can be used to test the existence and position of quantization levels 1 to 128 of the colour difference signal C_B.

1.6 Test signal No. 6: grey/blue ramp

The digital active video lines of this signal are defined by the same formulae as in § 1.5, replacing $A5$ by $A6$.

This signal can be used to test the existence and position of quantization levels 128 to 254 of the colour difference signal C_B.

1.7 Test signal No. 7: cyan/grey ramp

The digital active video lines of this signal are defined by:

$C_B(i) = \text{int}(128.5 - (0.299 / 0.886)(A5(i) - 128))$

$C_R(i) = \text{int}(A5(i))$

$Y(i) = \text{int}(126 - (88 / 224)(A5(\text{i}) - 128))$

This signal may be used to test the existence and position of quantization levels 1 to 128 of the colour difference signal C_R.

1.8 Test signal No. 8: grey/red ramp

The digital active video lines of this signal are defined by the same formulae as in § 1.7, replacing $A5$ by $A6$.

This signal may be used to test the existence and position of quantization levels 128 to 254 of the colour difference signal C_R.

1.9 Test signal No. 9: C_B, Y, C_R, Y ramp

The active video lines of this signal are defined by $A7(i)$ in Table 2 for 1 440 samples of the digital active line multiplex.

This signal is useful for testing the conformity of the digital video signal format at the output of the digital processing equipment carrying out demultiplexing and remultiplexing operations on the components of the digital video signal.

NOTE 1 – This signal produces spurious colours in the *R*, *G*, *B* field.

1.10 Test signal No. 10: white, end-of-line porches

The active video lines of this signal are defined by:

$Y(i) = A8(\mathrm{i})$, $C_B = C_R = 128$.

This signal has no shaping of the transitions on Y at the ends of the digital active line and is useful for observing the analogue shaping of the line blankings by the 4:2:2 decoders.

Two integral transitions of the Blackman pulse with a rise time of 300 ns are placed 3 µs from the leading and trailing edges of analogue line blankings for 625-line systems, permitting comparative observation of the transitions and verification of the conformity of the digital-analogue time correspondence on Y.

1.11 Test signal No. 11: blue, end-of-line porches

The active video lines of this signal are defined by:

$Y = 41$, $C_B(i) = A9(i)$, $C_R = 110$.

This signal can be used to make the observations described in § 1.10 for high transitions on C_B.

1.12 Test signal No. 12: red, end-of-line porches

The active video lines of this signal are defined by:

$Y = 81$, $C_B = 90$, $C_R = A9(i)$.

This signal can be used to make the observations described in § 1.10 for high transitions on C_R.

1.13 Test signal No. 13: yellow, end-of-line porches

The active video lines of this signal are defined by:

$Y = 210$, $C_B(i) = A_{10}(i)$, $C_R = 146$.

This signal can be used to make the observations described in § 1.10 for low transitions on C_B.

1.14 Test signal No. 14: cyan, end-of-line porches

The active video lines of this signal are defined by:

$Y = 170$, $C_B = 166$, $C_R(i) = A10(i)$.

This signal can be used to make the observations described in § 1.10 for low transitions on C_R.

1.15 Digital colour bar signals

The frequent use of colour bar signals in analogue television suggests the need to define such encoded signals for digital, in order to monitor levels and phasing between components after 4:2:2 decoding.

Tables 3a) and 3b) give a description of 100/0/100/0 and 100/0/75/0 colour bars calculated by means of mathematical equations with the following characteristics:

– shaping of transitions by integral of the Blackman impulse;

– rise time 10% to 90% for $Y = 150$ ns;

– rise time 10% to 90% for C_B and $C_R = 300$ ns.

1.16 Check field test signal

The following description specifies digital test sequences suitable for evaluating the low-frequency response of equipment handling serial digital video signals. Although a range of sequences will produce the desired low-frequency effects, two specific sequences are defined to test cable equalization and phase-locked loop (PLL) circuits.

1.16.1 Equalizer testing

Equalizer testing is accomplished by producing a serial digital sequence with maximum DC content. Applying the sequence C0.0h, 66.0h continuously during the active line portion of at least one-half of a field and forcing the last sample in the first active line of the first field to the value 20.0h accomplishes the desired result. If other data is added to the test signal, an odd number of 1s should be provided in a majority of frames to ensure that both polarities of the test sequence are produced.

1.16.2 Phased-locked loop testing

Phased-locked loop testing is accomplished by producing a serial digital sequence with maximum low-frequency content and minimum number of zero crossings. Applying the sequence 80.0h, 44.0h continuously during the active line portion of at least one-half of a field accomplishes the desired result.

Figure 1 gives a brief description of "check field signal".

FIGURE 1

Brief description of "check field test signal"

Vertical blanking interval
First half of active field C0.0h, 66.0h (Note 1) as described by: $Y = A12$ and $C_B/C_R = A14$ For cable equalization testing
Second half active field (Notes 2 and 3) 80.0h, 44.0h as described by: $Y = A13$ and $C_B/C_R = A15$ For phase locked loop testing

<---------------------------- Horizontal active line (only) ---------------------------->

Note 1 – The last sample in the first active line of the first field is 20.0h, or $Y = A11$.

Note 2 – The first half active field is defined as line 20 to (*X* –€1) where $140 \leq X \leq 148$ and 283 to (*X* –€1) where $400 \leq X \leq 408$ for 525 system and *X* is integer.

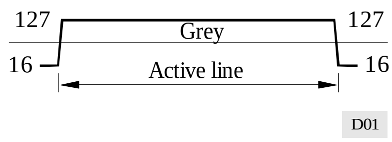
Note 3 – The first half active field is defined as line 23 to (*X* –€1) where $160 \leq X \leq 168$ and 336 to (*X* –€1) where $470 \leq X \leq 478$ for 625 system and *X* is integer.

*A*11, *A*12, *A*13, *A*14 and *A*15 in Table 2 describe the exact numerical definitions of "check field signals".

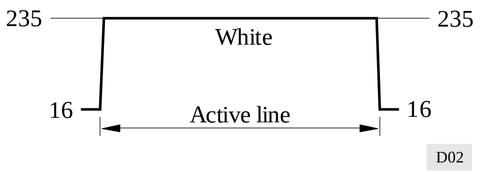
2 Waveforms of test signals

Figures as follows indicate sample levels.

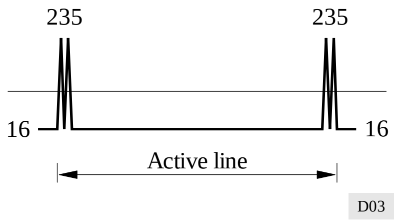
2.1 Grey: *A*1



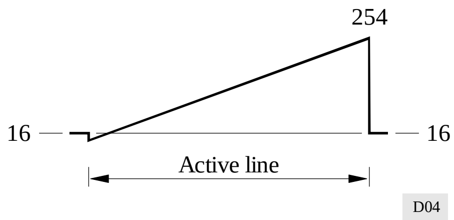
2.2 White: *A*2



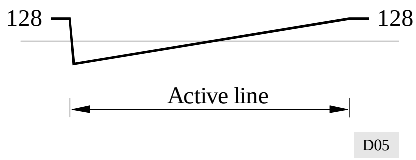
2.3 End-of-line pulses: *A*3



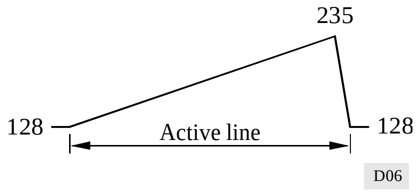
2.4 Black/white ramp: *A*4



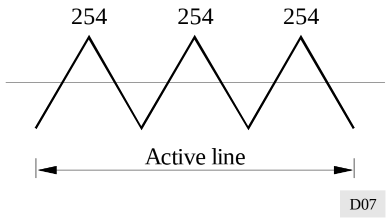
2.5 Yellow/grey and cyan/grey ramp: *A*5



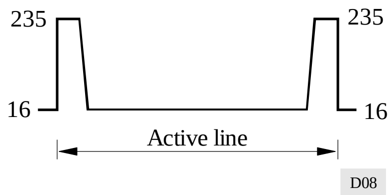
2.6 Grey/blue and grey/red ramp: *A*6



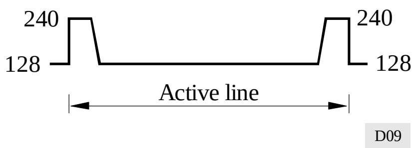
2.7 C_B, Y, C_R, Y ramp: *A*7



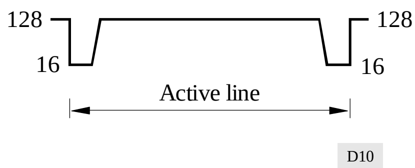
2.8 White, end-of-line porches: *A*8



2.9 Blue and red, end-of-line porches: *A*9



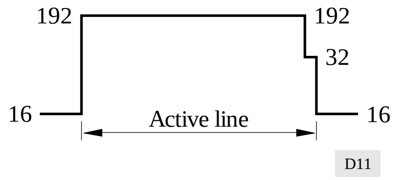
2.10 Yellow and cyan, end-of-line porches: *A*10



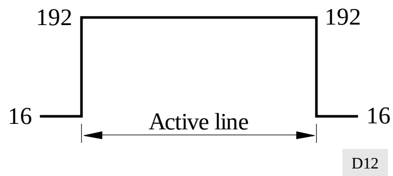
2.11 Check field test signals

2.11.1 *Y* for the first active line of the first field: *A*11

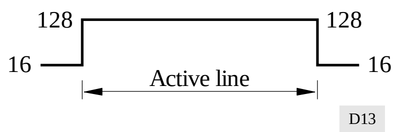
This waveform is used as the line 20 for 525 system and the line 23 for 625 system.



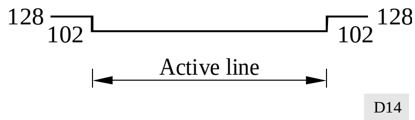
2.11.2 *Y* for equalizer testing: *A*12



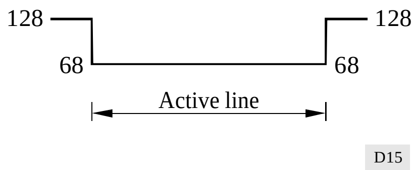
2.11.3 *Y* for phase locked loop testing: *A*13



2.11.4 *C* for equalizer testing: *A*14



2.11.5 *C* for phase locked loop testing: *A*15



ANNEX 2

Sample values corresponding to test signal

TABLE 2

Table of values used for defining digital test signals

A1: Grey

i	0 to 19	20	21	22	23	24	25 to 693	694	695	696	697	698	699 to 719
*A*1(*i*)	16	18	33	72	110	125	127	125	110	72	33	18	16

A2: White

i	0 to 19	20	21	22	23	24	25 to 693	694	695	696	697	698	699 to 719
*A*2(*i*)	16	19	50	126	201	232	235	232	201	126	50	19	16

A3: End-of-line pulses

i	0	1	2	3	4	5	6 to 9	10	11	12	13	14	15	16 to 705	706	707
*A*3(*i*)	16	44	154	235	154	44	16	17	64	185	229	121	31	16	17	64

i	708	709	710	711	712	713	714	715	716	717	718	719
*A*3(*i*)	185	229	121	31	16	16	44	154	235	154	44	16

A4: Black/white ramp

i	0 to 20	21	22	23	24 to 59	60 to 87	88 to 99	100 to 535	536 to 549	550 to 585
*A*4(*i*)	16	14	9	5	1	((*i* – 60) / 2)	16	((*i* – 66) / 2)	235	((*i* – 78) / 2)

i	586 to 599	600	601	602	603	604	605 to 719
*A*4(*i*)	254	250	217	135	53	20	16

i: sample number and takes on values from 0 to 719.

TABLE 2 *(continued)*

A5: Yellow/grey and cyan/grey ramp

i	0 to 19	20	21	22	23	24	25	26	27	28	29 to 39	40 to 95
*A*5(*i*)	128	126	120	108	89	65	40	21	9	3	1	((*i* – 32) / 4)

i	96 to 119	120 to 563	564 to 719
*A*5(*i*)	16	((*i* – 52) / 4)	128

A6: Grey/blue and grey/red ramp

i	0 to 19	20 to 563	564 to 579	580 to 631	632 to 659	660	661	662	663	664
*A*6(*i*)	128	((*i* + 396) / 4)	240	((*i* + 384) / 4)	254	252	246	234	215	191

i	665	666	667	668	669 to 719
*A*6(*i*)	167	148	136	130	128

i	0 to 253	254 to 507	508 to 761	762 to 1 015	1 016 to 1 269	1 270 to 1 439
*A*7(*i*)	*i* + 1	508 – *i*	*i* – 507	1 016 – *i*	*i* – 1 015	1 524 – *i*

i	0 to 46	47	48	49	50	51	52	53	54	55 to 667
*A*8(*i*)	235	232	218	187	139	86	46	24	17	16

i	668	669	670	671	672	673	674	675	676 to 719
*A*8(*i*)	19	33	64	112	165	205	227	234	235

A7: C_B, Y, C_R, Y ramp

A8: White, end-of-line porches

TABLE 2 *(continued)*

A9: Blue and red, end-of-line porches

i	0 to 23	24	25	26	27 to 333	334	335	336	337	338 to 359
*A*9(*i*)	240	232	191	143	128	130	152	204	236	240

A10: Yellow and cyan, end-of-line porches

i	0 to 23	24	25	26	27 to 333	334	335	336	337	338 to 359
*A*10(*i*)	16	24	65	113	128	126	104	52	20	16

A11: Y for the first active line of the first field

i	0 to 718	719
*A*11(*i*)	192(C0.0h)	32(20.0h)

A12: Y for equalizer testing

i	0 to 719
*A*12(*i*)	192(C0.0h)

A13: Y for phase locked loop testing

i	0 to 719
*A*13(*i*)	128(80.0h)

A14: C for equalizer testing

i	0 to 359
*A*14(*i*)	102(66.0h)

A15: C for phase locked loop testing

i	0 to 359
*A*15(*i*)	68(44.0h)

TABLE 3

Description of encoded colour-bar signals according to the 4:2:2 level of Recommendation ITU-R BT.601

a) *Designation: 100/0/100/0 colour bars*

Definition of Y for digital active line with rise time = 150 ns

i	0 to 13	14	15	16	17	18	19 to 99	100	101	102	103	104	105 to 185
Y(*i*)	16	16	39	126	212	235	235	235	232	223	213	210	210

i	186	187	188	189	190	191 to 271	272	273	274	275	276	277 to 357	358
Y(*i*)	210	206	190	174	170	170	169	167	157	147	145	145	144

i	359	360	361	362	363 to 443	444	445	446	447	448	449 to 529	530	531
Y(*i*)	141	126	110	107	106	106	104	94	84	82	81	81	77

i	532	533	534	535 to 615	616	617	618	619	620	621 to 719
Y(*i*)	61	45	41	41	41	38	28	19	16	16

i	0 to 5	6	7	8	9	10	11 to 48	49	50	51	52	53	54 to 91
$C_R(i)$	128	128	128	128	128	128	128	128	130	137	144	146	146

i	92	93	94	95	96	97 to 134	135	136	137	138	139	140 to 177	178
$C_R(i)$	146	133	81	29	16	16	16	16	25	32	34	34	35

i	179	180	181	182	183 to 220	221	222	223	224	225	226 to 263	264	265	266
$C_R(i)$	54	128	202	221	222	222	224	231	238	240	240	240	227	175

i	267	268	269 to 306	307	308	309	310	311	312 to 359
$C_R(i)$	123	110	110	110	112	119	126	128	128

Definition of C_R for digital active line with rise time = 300 ns

i: sample number and takes on values from 0 to 719.

TABLE 3 *(continued)*

Definition of C_B for digital active line with rise time = 300 ns

i	0 to 5	6	7	8	9	10	11 to 48	49	50	51	52	53	54 to 91	92
$C_B(i)$	128	128	128	128	128	128	128	128	116	72	28	16	16	16

i	93	94	95	96	97 to 134	135	136	137	138	139	140 to 177	178	179	180
$C_B(i)$	31	91	150	166	166	166	154	110	65	54	54	54	69	128

i	181	182	183 to 220	221	222	223	224	225	226 to 263	264	265	266	267
$C_B(i)$	187	202	202	202	191	146	102	90	90	90	106	165	225

i	268	269 to 306	307	308	309	310	311	312 to 359
$C_B(i)$	240	240	240	228	184	140	128	128

b) *Designation: 100/0/75/0 colour bars*

Definition of Y for digital active line with rise time = 150 ns

i	0 to 13	14	15	16	17	18	19 to 99	100	101	102	103	104	105 to 185
$Y(i)$	16	16	39	126	212	235	235	235	227	198	169	162	162

i	186	187	188	189	190	191 to 271	272	273	274	275	276	277 to 357	358
$Y(i)$	161	158	146	134	131	131	131	129	122	114	112	112	112

i	359	360	361	362	363 to 443	444	445	446	447	448	449 to 529	530
$Y(i)$	109	98	87	84	84	84	82	74	67	65	65	65

i	531	532	533	534	535 to 615	616	617	618	619	620	621 to 719
$Y(i)$	62	50	38	35	35	35	33	25	18	16	16

TABLEAU 3 *(continued)*

Definition of C_R for digital active line with rise time = 300 ns

i	0 to 5	6	7	8	9	10	11 to 48	49	50	51	52	53	54 to 91
$C_R(i)$	128	128	128	128	128	128	128	128	129	135	140	142	142

i	92	93	94	95	96	97 to 134	135	136	137	138	139	140 to 177	178
$C_R(i)$	141	132	93	54	44	44	44	45	51	56	58	58	58

i	179	180	181	182	183 to 220	221	222	223	224	225	226 to 263	264	265	266
$C_R(i)$	72	128	184	198	198	198	200	205	211	212	212	212	202	163

i	267	268	269 to 306	307	308	309	310	311	312 to 359
$C_R(i)$	124	115	114	114	116	121	127	128	128

i	0 to 5	6	7	8	9	10	11 to 48	49	50	51	52	53	54 to 91
$C_B(i)$	128	128	128	128	128	128	128	128	119	86	53	44	44

i	92	93	94	95	96	97 to 134	135	136	137	138	139	140 to 177	178
$C_B(i)$	44	56	100	143	156	156	156	148	114	81	73	72	73

i	179	180	181	182	183 to 220	221	222	223	224	225	226 to 263	264	265
$C_B(i)$	84	128	172	183	184	183	175	142	108	100	100	100	111

i	266	267	268	269 to 306	307	308	309	310	311	312 to 359
$C_B(i)$	156	200	212	212	212	203	170	137	128	128

Definition of C_B for digital active line with rise time = 300 ns

ANNEX 2

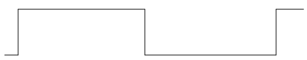
1. Pathological Signals for Cable Equalizers in the Serial Digital Interface

Possible word combinations to generate a stress pattern for cable equalization

.	Hex		Validity	
No.	chroma	luminance	4 : 2 : 2	D1
	1st sample	2nd sample	10 bit	8 bit
1	200 h	331 h	yes	no
2	300 h	198 h	yes	yes
3	180 h	0CC h	yes	yes
4	0C0 h	066 h	yes	no
5	060 h	033 h	yes	no
6	230 h	019 h	yes	no
7	318 h	0CC h	yes	yes
8	18C h	006 h	yes	no

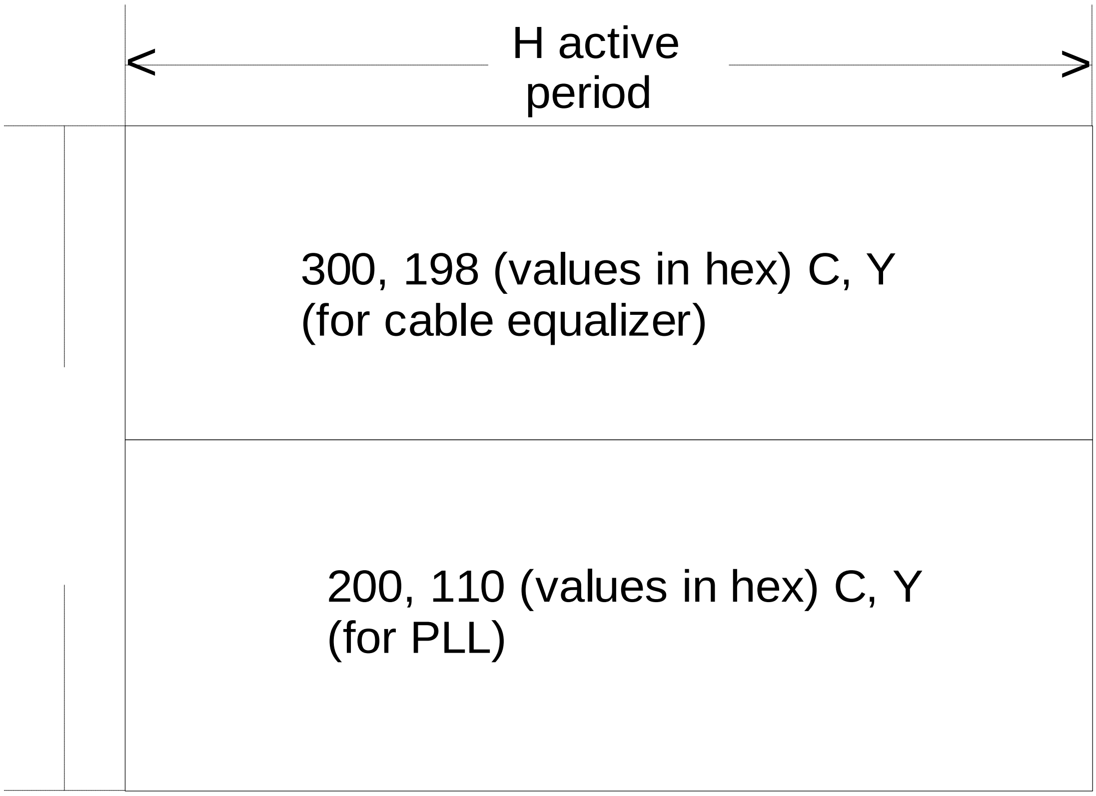
2. Pathological Signals for Genlock of PLL in the Serial Digital Interface

Possible word combinations to generate a stress pattern for genlock of PLL



.	Hex		Validity	
No.	chroma	luminance	4 : 2 : 2	D1
	1st sample	2nd sample	10 bit	8 bit
1	200 h	110 h	yes	yes
2	100 h	088 h	yes	yes
3	080 h	044 h	yes	yes
4	040 h	022 h	yes	no
5	020 h	011 h	yes	no
6	210 h	008 h	yes	yes
7	108 h	004 h	yes	yes

3. SDI Check Pattern (serial digital interface)



ROHDE&SCHWARZ

BROADCASTING DIVISION

Application Note

ZONE PLATE SIGNALS
625 Lines
Standard BG/PAL

Products:

CCVS+COMPONENT GENERATOR	*SAF*
CCVS GENERATOR	*SFF*

7BM24_0E

ROHDE&SCHWARZ
BROADCASTING DIVISION

ZONE PLATE SIGNALS

625 lines PAL

Back in the early days of television measurements in the baseband, the analog insertion test lines commonly known today were invented and standardized worldwide, constituting an indispensable tool for assessing picture quality. Now the development is beginning to depart from the analog TV world and turn towards digital image processing and transmission. This necessitates new test signals. An important group of signals used in this connection are the zone plate signals which of course also provide valuable information on analog systems and components, eg monitors.

1. Structure of Zone Plate Signal

The zone plate signal in its original form is an optical pattern of alternately black and white concentric circles spaced increasingly closer as their diameters increase.

Fig.1

A section through the centre point of the concentric circles will always reveal the same signal structure no matter at what angle the section is made. A section in the horizontal direction (corresponding to the line structure of a television picture) is referred to as H sweep.

Fig.2 H sweep

Looking for a universally applicable formula describing the zone plate signal, the following equation was found:

$$A\,(x, y, t) = \text{const.} + \sin.\,(K_{\phi} + K_x\, x + K_y\, y + K_{x^2}\, x^2 + K_{y^2}\, y^2 + K_{xy}\, x\, y + k_{xt}\, x\, t + K_{yt}\, y\, t + K_t\, t + K_{t^2}\, t^2)$$

where

x = horizontal distance from a defined zero point, eg the centre of the screen

y = vertical distance from the defined zero point

t = time variable at which the signals change

By setting specific coefficients of the above equation to zero, different types of zone plate signals will be generated, eg:

- H sweep (K_y,, K_{y^2}, $K_{xy} = 0$)
- V sweep (K_x,K_{x^2} , $K_{xy} = 0$)
- circular and hyperbolic diagonal zone plate signals depending on the sign of the quadratic coefficient ($K_{xy} = 0$)
- hyperbolic vertical zone plate signal (K_{x^2},K_{y^2} = 0)

If K_t is also set to zero, stationary patterns will be generated.

2 . Example

In the example given below, the coefficients of a circular zone plate pattern moving at a frequency of 1 Hz are to be calculated. The horizontal frequency resolution is assumed to be 5 MHz at the beginning of the line, decreasing to 0 Hz in the centre, and increasing to 5 MHz again at the end of the line. The vertical frequency resolution is assumed to be the same. First, some terms and constants are to be defined:

- Terms:

pw = picture width
ph = picture height

c = cycle (1/13.5 MHz = 74.074 ns to CCIR Rec. 601)
l = line

- Constants for B/G standard:

Complete line:	c / pw = 64 µs / 1 / 13.5 Mhz	= 864
Complete picture height:	l / ph	= 625

Visible part

of line:	c / pw = 864 x 52 µs / 64 µs	= 702
of picture:	l / ph = 625 - (2 x 25)	= 575

To clarify the calculation, the meaning of the coefficients is to be explained:

K_X^2: describes the frequency deviation over one line period, eg 13.5 MHz / 64 µs

K_X: describes the location of a specific frequency on the active line, eg 5.5 MHz at the beginning of the line

K_y^2: describes the frequency deviation over the picture height referred to the 4:3 picture format, eg 10.125 MHz vertical frequency deviation derived from 625 lines: 13.5 MHz / 4 x 3.

K_y: describes the vertical frequency at the beginning of the visible vertical picture range, eg (10.125 MHz x 575) / 625 = 8.505 MHz

The coefficients K_y^2 and K_y are for the time being applied to a progressively built-up frame, ie without 2:1 interlace.

The coefficients of the circular zone plate signal to be calculated can be determined with the aid of the above definitions:

K_{x^2} frequency deviation ⇨ 5 MHz per 26 µs ⇨ 12.31 MHz per 64 µs
= 64 µs x 12.31 MHz [c/pw^2]
K_{x^2} = 787.7 [c / pw^2]

K_x = 787.7 x 52 / 64 / 2 = - 320.0 [c / pw] (negative since located left of centre)

K_{y^2} = 787.7 / 864 x 3 / 4 x (575 x 625 / 625) = 393.2 [l / ph^2]

K_y = 393.2 x (575 / 625) / 2 = - 180.9 [l / ph]

As the picture is to move at a rate of 1 Hz, the "coefficients of motion" are to be set as follows:
K_t = 1 Hz, K_ϕ= 0° and K_{t^2} = 0 [1/sec].

Applying the above formulas, the user can fast and easily program any horizontal and vertical starting and stop frequencies, as well as linear, circular and hyperbolic, moving and phase-swept zone plate patterns within the 625-line standard.

3. Linear Distortion

The circular zone plate pattern is the most commonly known of the family of zone plate signals. All measurements relevant in practice can be performed using this pattern. For this reason, the considerations made in the following are all based on this signal which is governed by the equation:

$$A(x,y,t) = \text{const.} + \sin.\left(K_\phi + K_x x + K_y y + K_{x^2} x^2 + K_{y^2} y^2 + K_t t \right)$$

The coefficients of this signal are predefined to have the following values:

K_x = - 320.0
K_y = - 180.9
K_{x^2} = 787.7
K_{y^2} = 393.2
K_t = 0 (taking a stationary pattern for the sake of simplification)

3.1 Amplitude Frequency Response in Horizontal Direction

When a lowpass filter with a cutoff frequency of approx. 3 MHz is connected between the signal source and the monitor, a pattern of rather unexpected form will appear on the monitor. While the original pattern is circularly symmetric about the centre of the screen, vertical boundary lines will now be seen to the left and right of the centre, and beyond these lines grey level only. The grey level is generated as a result of the sinewave components being suppressed by the lowpass filter. Why vertical lines?

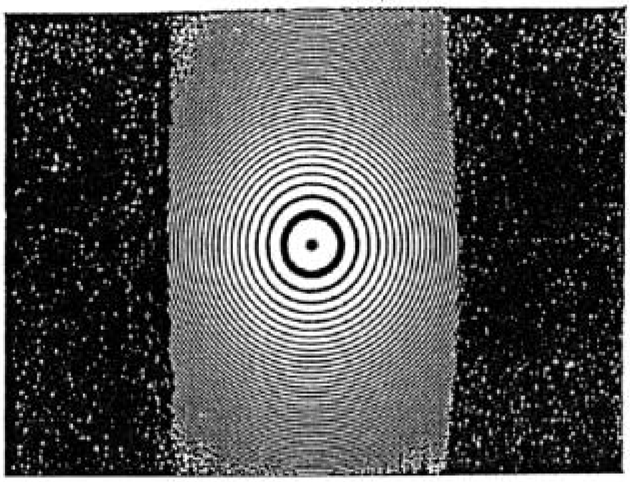


Fig. 3 Circular Zone Plate with horizontal bandlimitting at 3 MHz

This can be best understood by looking at the equation. By differentiating the argument ϕ of the sinewave signal partially with respect to x, the frequency variation in the x direction will be obtained:

$$\delta\phi\,(x,y,t)\,/\,\delta x = \delta\,(K_\phi + K_x x + K_y y + K_x^2 x^2 + K_y^2 y^2 + K_t t)\,/\,\delta x = K_x + 2K_x^2 x$$

This variation of the frequency is a function of the x coefficient exclusively. This means that at the same x locations the same frequencies will occur across the entire picture. Hence the straight vertical boundary lines described above are formed.

3.2 Amplitude Frequency Response in Vertical Direction

Analogously to the frequency response in the horizontal direction, the symmetrical pattern of the circular zone plate signal makes the vertical signal structure appear as a frequency sweep. In accordance with the 4:3 picture format, the starting and end frequencies at the upper and lower margins of the picture are reduced by a factor of 3 / 4 compared with those in the horizontal direction. The fine patterns at the upper and lower margins of the picture can be removed by means of a "vertical filter" having a cutoff frequency corresponding to that of the "horizontal filter" and converted accordingly. Grey bars will then appear at the top and bottom of the picture, corresponding to the grey bars obtained right and left of the centre with horizontal filtering. Such a "vertical filter" is not a filter in a conventional sense (that is, made up of coils, capacitors, etc) but a digital filter with a line or frame memory capable of calculating points of identical x locations and variable y loations by employing suitable algorithms (eg FIR filters).

3.3 Diagonal Filtering

The circular zone plate signal considered here has now undergone horizontal and vertical filtering (see sections 3.1 and 3.2). The result is a square window symmetrical about the centre of the screen, with the concentric circles of the zone plate pattern inside the window. It will be seen at a glance that at the margins of the square the resolution is varying: at the corners of the square the resolution is higher by √2 compared with that encountered in the middle of the square sides. To achieve approximately equal resolution along the margins of the square, diagonal filtering can be used employing the same type of digital filter as used for vertical filtering.

3.4 Temporal Filtering

But that's not all there is to filtering. There is still one dimension to be dealt with : the time.
With 2:1 interlaced scanning used in today's TV transmission, large picture areas are reconstructed with a 25-Hz flicker, and fine-structured areas and edges with a 12.5-Hz flicker. The flicker effects can be eliminated by filtering them out from several consecutive frames. The effects of filtering can again be checked by means of a zone plate pattern, which clearly shows the described flicker effects for the normal interlaced scanning operation.
The calculations in the above example (see section 2) are based on a maximum horizontal frequency of 5 MHz. From this a maximum "vertical frequency"

$$f_V = 12.31 \text{ MHz} \times 3 / 4 = 9.23 \text{ MHz}$$

is obtained that can be represented for the vertical 625-line structure. With 2:1 interlaced scanning, however, only 312.5 lines per field are written on the screen, yielding a maximum frequency of only 9.23 MHz / 2 = 4.62 MHz. As a result, aliasing components will be formed at this "vertical frequency", flickering at a rate of 12.5 Hz since the phase of the aliasing signals is shifted by no more than 180° per frame (also see section 4).
Looking at the 2 x 312.5-line-per-frame scanning method, it becomes evident for the first time that television has always had a "digital" character.

3.5 Data Reduction in Digital TV

Fast movements in a TV system can be transmitted at the frame repetition rate as the maximum rate of change. For practical requirements, however, this rate is far too high in the case of a great many, if not all, of the pictures transmitted, or at least in the case of large parts thereof. Temporal filtering, on the other hand, allows stationary picture areas to be transmitted at a lower repetition rate, ie at a reduced bandwidth.

The various types of filtering discussed so far all serve one main purpose:
to achieve maximum data reduction while maintaining optimum picture quality at the receiver end.

Data reduction is necessary in the "digital TV era" to enable digital serial transmission of the complete TV signal. Zone plate signals are a suitable, easy-to-handle tool for on-the-screen verification of error-free data reduction in all four filter dimensions. There are other data reduction algorithms, eg DCT (Discrete Cosine Transform), which are to be mentioned only briefly in this context. To understand these algorithms, it is necessary to engage in the topic of digital signal processing. As an introduction to this topic we would like to refer the reader to the book "Digitale Filter in der Videotechnik" (Digital Filters in Video Engineering) by H. Schönfelder, published by Drei-R, Berlin.

4. Effects of Nonlinear Distortion

Television has always been a digital system due to its line structure. To sample and reproduce the original signal undistorted within such a system, an antialiasing filter matched to the sampling frequency is required. Since most of the monitors and television receivers do not incorporate such a lowpass filter, aliasing effects occur which are clearly visible on the screen.

In a band-limited system (5 MHz in the BG/PAL standard), nonlinear distortion may occur which means that harmonics of the original frequency are generated far beyond the standard bandwidth. The out-of-band signal components are sampled with the digital system clock which produces aliasing effects clearly visible on the screen (see Fig). Such effects are described in section 3.4, "Temporal Filtering", for the 2 x 312.5 line structure of the BG/PAL signal; in that example, however, the aliasing components remain within the standard band.

A typical example of nonlinearity is the γ - precorrection ensuring linear brightness variation of the CRT phosphor. CCIR Rec. 624 prescribes γ to be 2.8 for the BG/PAL standard, ie the camera output voltage is weighted according to the equation $V_P \sim V_C^{0.357}$ (V_P = precorrected voltage; V_C = camera voltage; 0.357 = 1/2.8). If this equation is applied to a sinewave voltage, the negative halfwave of the resulting waveform will be relatively flat and the positive halfwave very pointed. The peak of the positive halfwave contains a high proportion of harmonics that may produce aliasing patterns in the digital representation.

5. (Circular) Zone Plate Signal in CCVS Format

A zone plate signal without chroma components, ie generated in the Y channel only, will still show colour components on the screen due to cross-luminance effects. These becomes particularly evident from the BG/PAL circular zone plate pattern. The locations and movements of the colour components can be explained on the basis of the definitions for the BG/PAL format, using the calculations given above:

* Horizontal location of cross-luminance components

As explained in section 3.1, the circular zone plate pattern will have identical horizontal frequencies at identical x coordinates. For this reason, 4.433-MHz colour centres are obtained symmetrically about the centre of the pattern at the left and right margins.

* Vertical location of cross-luminance components

There will be identical vertical frequencies at identical y coordinates. The y coordinates are counted in lines per picture height. Where will the "colour subcarrier frequency" in the vertical direction be found?

In BG/PAL, the colour subcarrier is displaced by -90° from line to line. This means that the colour subcarrier will have completed a full cycle in the vertical direction
(4x (-90°) = -360°) after four lines. In other words, the "vertical" colour subcarrier frequency will be found where the four-line sequence repeats itself vertically in each field on the circular zone plate pattern. Applied to the line structure this means:
f_{SCV} = 312.5/4 = 78.1 [l/ph] with maximum vertical deviation (K_y^2 = 625 c/ph ph)

Using the above formula the distribution of the colour centres on the screen can be accurately determined:

In our example, K_y^2 = 392.2 [c/ph ph] corresponding to 226.49 [° / l ph]

The colour centres are located where the "vertical line phase" is shifted by 90° per line:
l_V = 90 x 312.5 / 226.49 = 124.2 lines (interlaced mode) or
l_V = 45 x 625 / 226.49 = 124.2 lines (progressiv mode)

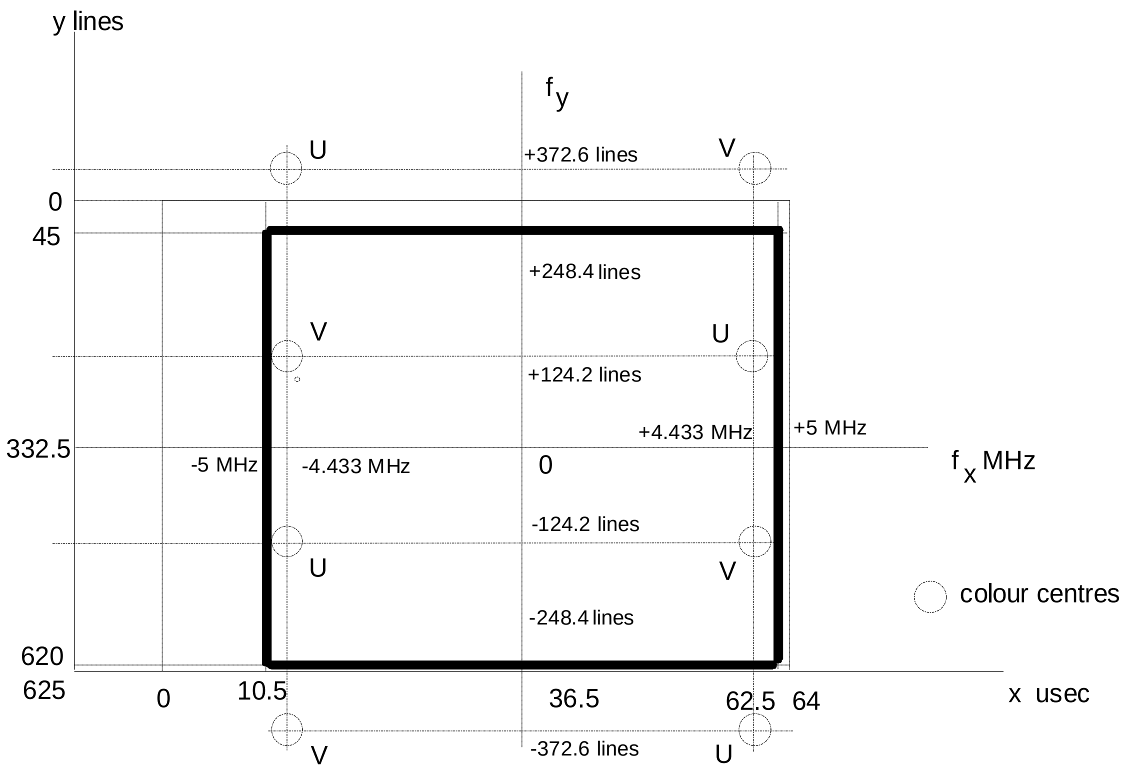


Fig. 4 The two dimensional Zone Plate

In this example, the 25-Hz offset of the colour subcarrier is not taken into account.

With 15625 Hz / 4 = 3906.25 Hz >> 25 Hz, this simplified approach is permissible. However, the 25-Hz offset is to be dealt with separately.

* Effect of 25-Hz colour subcarrier offset (PAL 8-field sequence)

The colour centres, whose locations in the above pattern have been exactly defined, change their phases at the rate of the 25-Hz offset, from which the moving, coloured concentric circles result. The rate of motion can be best seen from the following diagram:

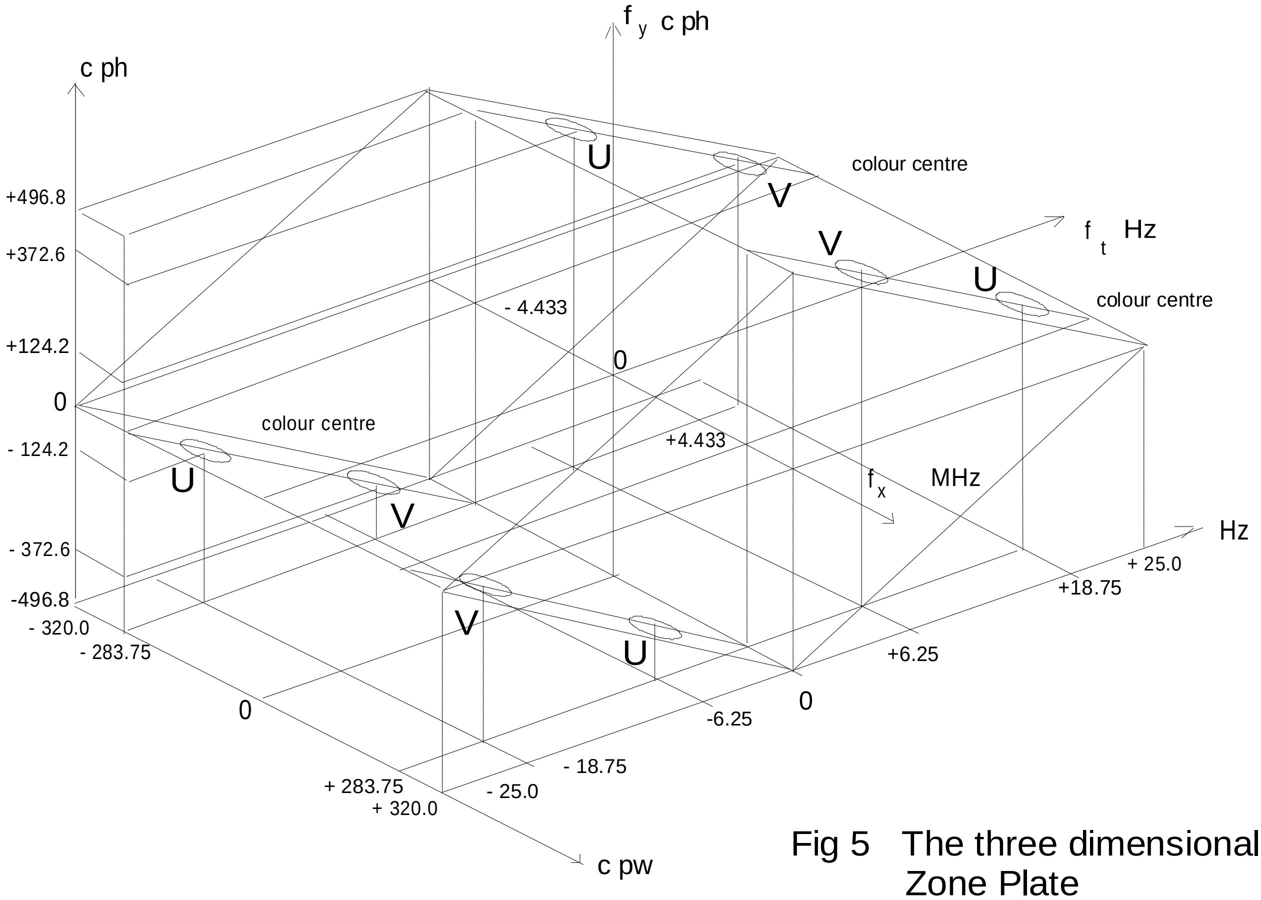


Fig 5 The three dimensional Zone Plate

The diagram shows that the colour centres change at a rate of

$\pm$ 18.75 Hz at $\pm$ 124 lines

about the centre of the picture, while the coloured circles just about visible at the upper and lower margins of the picture change at a rate of

$\pm$ 6.25 Hz.

* Application

In addition to the various possibilities of direct on-the-screen evaluation of linear and nonlinear distortion, circular zone plate signals enable another, very important parameter to be measured: cross-colour effects. Zone plate signals are made up of luminance components only, which may also contain frequencies close to the colour subcarrier due to the 5-MHz bandwidth on which our example is based. These frequencies produce the coloured circles generated about the centres whose locations were determined above.

The cross-colour effects can be suppressed by means of comb filters more or less effectively, taking into account that movements of the colour components are to be eliminated as well. The efficiency of such filters, which should be provided on all colour TV sets in the upper price range, can be made visible directly and immediately on the screen, again by means of zone plate patterns.

Hyperbolic vertical zone plate signal

Definiton of the coefficients in the sine argument

$K_\phi + K_x x + K_y y + K_{x2}\, x^2 + K_{y2}\, y^2 + K_t\, t + K_{t2}\, t^2$)

K_x defines the frequency at field start with a correction factor depending on the frequency deviation per line determined by K_{xy}.

$K_y = 0$

K_{x2} and $K_{y2} = 0$, ie there is no additional frequency deviation in the x or y - direction.

K_{xy} defines the frequency deviation per picture height as a factor of the frequency deviation per line. For example: desired frequency deviation
15kHz up to 5 MHz over a 625-line frame
at a field frequency of 50 Hz.

$$K_{xy} = \frac{5\text{ MHz}}{625 \times 50\text{ Hz}/2} = \frac{5\text{ MHz}}{15\,625\text{ Hz}} = 320\ \frac{c}{pw\ ph}$$

As an example a zone plate signal corresponding to the V SWEEP of the SAF/SFF signal group SWEEP+BURST is calculated:

V Sweep	Beginning	End
frequency	50 kHz	6 MHz
line in 1st field	48	286
duration in lines	239	

The frequency deviation of (6.000 - 0.050) MHz = 5.95 MHz is to occur in the frame during 2 x 239 = 478 lines:

$$K_{xy} = \frac{5.95\text{ MHz}}{625 \times 50\text{ Hz}/2} \times \frac{625}{478} = 497.7\ \frac{c}{pw\ ph}$$

Here 5.95 MHz per 239 lines correspond to a deviation of
5.95 MHz/239 lines = 24.895 kHz/line and the correction factor calculated for K_x is
k = 24.895/15.625 = 1.5933

In line 48, the zone plate signal should have the frequency of 50 kHz. The factor K_x is to be determined accordingly.

The frequency 0 Hz is located in line Z_0:

$Z_0 = 48 - (50\text{ kHz} / 24.895\text{ kHz})$

= 48 - 2.0008 = 45.992
The zone plate signal starts in line 24. Therefore the new reference line is:

Z_0 - 23 = 22.992

The factor K_X is thus obtained from the reference line and the correction factor:

K_X = - 22.992 x 1.5933
K_X = - 36.63 c/pw

K_X is negative as the frequencies of the first 22.992 zone plate lines in the field decrease from 572 kHz in line 24 to 0 Hz in line 45.992.

Due to the zone plate signal pattern with half line offset, the sinewave zero crossing at the upper righthand picture edge is flickering at 25 Hz as opposed to the V SWEEP since for the latter the half line offset is taken into account.i

Nyquist condition in vertical direction

The highest vertical frequency within the 625 line system is:

$k_{y\ max}$ = 625/2 =312.5 c/ph

If furthermore the value of k_φ
k_φ = 0°
the samples are calculated in the first field at 0° and in the second field at 180°. The (vertical) sinewave has in both arguments the same value:
sin (0°) = sin (180°) = 0. A DC voltage is generated.
The highest vertical frequency with greatest amplitude is only generated, if additional the value of k_φ is
k_φ = 90° or 270°.
Here you recognize at once, that digitizing a sinewave signal is not possible up to half the sampling frequency. Real values arrive at appoximately 0.4 times the sampling rate.