Testing of Analog Video Component Signals Application Note

Products:

- I R&S[®]VTC
- R&S[®]VTE
- I R&S[®]VTS
- ∎ R&S[®]BTC

Despite the now standard digital distribution of video signals, analog video signals are still an integral part of AV terminals in the home.

This application note covers the fundamentals of analog component signals and shows how the signal quality can be measured with the measuring equipment from Rohde & Schwarz.

Note:

Please find the most up-to-date document on our homepage http://www.rohde-schwarz.com/appnote/7MH107.





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GBR and YPbPr Color Systems

1 Introduction

Before digital video interfaces such as HDMI and MHL were introduced into homes, analog component signals were the only way to exchange video signals with high quality and in a wide range of resolutions. For this reason, analog interfaces are well established in home consumer devices and are often still included in new video equipment to maintain compatibility. As a result, the need for suitable T&M equipment remains undiminished.

This application note provides an overview of the video component technology and describes in detail the tests and measurements needed for this technology. It includes a discussion of suitable test signals and the signal supply as well as descriptions of a wide variety of automated measurements.

Finally, step-by-step instructions are provided for recording and ensuring the quality of component signals using Rohde & Schwarz video test equipment.

2 Basics

2.1 GBR and YPbPr Color Systems

Video component signals are defined in two primary color systems - GBR and YPbPr.

GBR signals represent the natural colors of a picture in the form of its basic green, blue and red components. This color system is at the beginning and end of the transmission chain for color images. Every camera supplies GBR signals for all pixels of the image. And every display uses these signals to regenerate the original colors. In homes, GBR signals are primarily encountered in PCs (VGA). In the case of set-top boxes, analog GBR signals are usually only encountered at the SCART output.

YPbPr signals split the color into a brightness information Y and two color difference signals, Pb and Pr. Pb is calculated from the difference between blue and luminance, and Pr from the difference between red and luminance. The use of color difference signals can be traced back to the introduction of color television. They make it possible to transmit a signal that is compatible with black-and-white televisions. In addition, color difference signals have an advantage over GBR because they can be used to reduce the resolution of the color information as compared with the luminance information. In the case of analog component signals, this is done by cutting the transmission bandwidth for the color difference signals in half. Because the human eye is less sensitive to color information, this saves valuable transmission bandwidth without impairing the picture quality. YPbPr interfaces are found in every home consumer device that supports video components.

GBR and YPbPr signals can be converted using simple mathematics. An example of this is provided in Equation 2.1 and Equation 2.2 for converting GBR to YPbPr for the color spaces used in SD and HD television.

Y	=	0.299*R	+ 0.587*G	+ 0.144*B
Pb	=	- 0.169*R	- 0.331*G	+ 0.500*B
Pr	=	0.500*R	- 0.419*G	- 0.081*B

Equation 2 1: GBR to YPbPr conversion for SDTV (720 x 480; 720 x 576).

Y	=	0.213*R'	+ 0.715*G	+ 0.072*B
Pb	=	- 0.115*R'	- 0.385*Gʻ	+ 0.500*B
Pr	=	0.500*R'	- 0.454*G	- 0.046*B

Equation 2 2: GBR to YPbPr conversion for HDTV (1280 x 720 and 1920 x 1080).

When using test signals, it must be noted that not all level combinations that are possible in the YPbPr color format can be mapped to the GBR color format. However, as long as the YPbPr color format is not exited, these level combinations, also called illegal colors, are not harmful for testing YPbPr signals. However, conversion to the GBR color format would lead to level deviations and visible color errors. Frequently, video equipment converts YPbPr to GBR during the internal video processing, even when it finally provides YPbPr at the output. In this case, YPbPr signals would show

level deviation at the output. This must be taken into consideration when generating proprietary test signals. The test signals provided by Rohde & Schwarz for measurements of component signals [3] are designed in such a way that these effects cannot occur.

A few notes regarding notations:

The notations Y'PbPr as well as G'B'R' are frequently seen. The prime indicates that the signals underwent a gamma correction to compensate the nonlinearity of camera systems. The notations YCbCr and Y'CbCr describe color differential signals in the digital domain. Where there is no distinction for the primary color system, GBR and G'B'R' are used for analog and digital domain.

2.2 Level

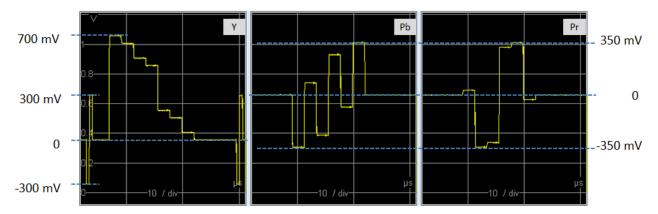
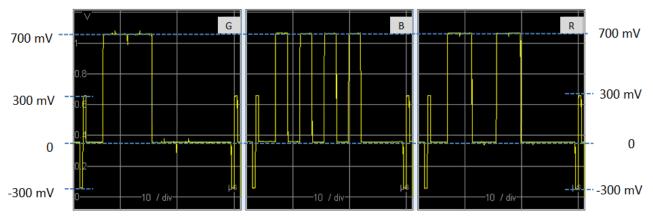


Fig. 2-1 and Fig. 2-2 show the levels for YPbPr and GBR signals.

Fig. 2-1: YPbPr signal levels in line with CEA-770.2/3, ITU-T BT.709-5 and SMPTE-274M.





Due to historical reasons, sometimes component formats with 525 lines come with a signal level of 714 mV and a sync level of 286 mV (40IRE). For North America, the black level is, in addition, boosted to 54 mV. In this case, the peak level is reduced to 660 mV (see Fig. 2-3).

Synchronization

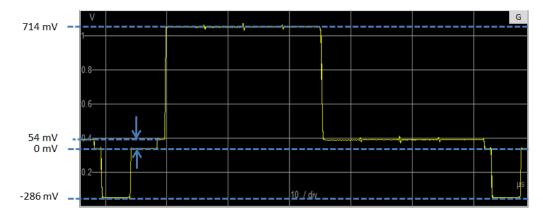


Fig. 2-3: Green component of a 525-line GBR signal with 714 mV peak level and boosted black.

In all examples shown here, the actual position of the black level is significantly shifted against the nominal reference level of 0 V. CEA770.2/3 permits this. Accordingly, the DC level may deviate by as much as +/-1 V from the reference value of 0 V. Component outputs on set-top boxes commonly output the signal with an offset. Thanks to its DC coupling, the scope on the R&S®VT video analyzer allows you to check whether the level still lies within the specifications.

2.3 Synchronization

YPbPr signals normally contain sync pulses only in the Y channel (see CEA-770.3). However, some specifications allow the sync pulses to be inserted into all components (see SMPTE296M). The GBR signal is similar. Its sync pulse can also be transmitted in either one or all channels. In contrast, VGA interfaces split the sync pulses into H and V and transmit the signals over two separate lines (see VESA and Industry Standards and Guidelines for Computer Display Monitor Timing (DMT) Version 1.0, Revision 11 – May 1, 2007).

In the case of SDTV, the sync pulse is implemented as a bi-level pulse. The start of the video line is indicated by the falling slope. In contrast, HDTV uses a tri-level sync (see Fig. 2-4). This is significantly less sensitive to noise and DC offsets, and is therefore suited to the more stringent requirements of the higher-frequency HDTV signal. In this case, the start of the video line is indicated by the rising slope.

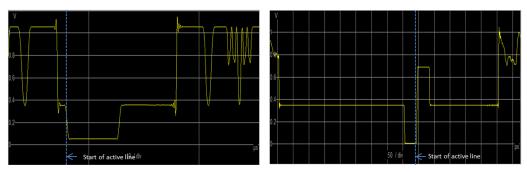


Fig. 2-4: Bi-level and tri-level sync pulses.

3 Test Signals

Automated measurements require special test lines. The Rohde & Schwarz combined test pattern contains all of these test lines in one test pattern for measurements of both YPbPr and GBR signals.

Color Bars GBR	
Color Bars Y,Cb,Cr	
Horizontal Sweep RGB	
Horizontal Sweep Y.Cb,Cr	
Multiburst RGB	
Multiburst Y.Cb,Cr mixed	
Multiburst Y.Cb,Cr half	
Sin(x)/x RGB	
Sin(x)/x Y,Cb,Cr	
2T Pulse and Bar RGB	
2T Pulse and Bar Y,Cb,Cr	
Ramp RGB	
Valid Ramp Y,Cb,Cr(RGB)	
Stairs RGB	
Valid Stairs Y,Cb,Cr(RGB)	
Quiet Line	

Fig. 3-1: Rohde & Schwarz combined test pattern.

Appendix B describes which measurements are performed on which test lines.

All test scenarios in digitally based video equipment require the test patterns in compressed format. However, the associated DCT block building makes test lines around signal changes unusable for measurements (see Fig. 3-2).

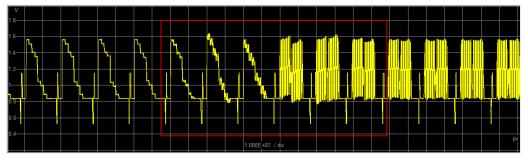


Fig. 3-2: Errors resulting from compression in test lines within the transition range from multiburst to sweep.

All test lines are therefore inserted in multiples in blocks. Lines in the middle of these blocks are not impaired by coding artifacts and can be used for the measurements. By default, the R&S®VTC/VTE/VTS/BTC video analyzer is preconfigured appropriately for the Rohde & Schwarz combined test patterns. Automatic resolution detection makes it unnecessary to configure or adjust the line positions. If the default setting is changed, it can be restored at any time by pressing the Reset button (see section 6.3).

Test patterns are available for all standard resolutions. For details, refer to Appendix A. There you will also find a description of the exact position of the test lines in the various resolutions.

The test patterns are available as a transport stream and as a JPG file. This covers all test scenarios described in section 5.

4 Relevant Standards

ITU-R BT.470-6	Conventional Television Systems
ITU-R BT.601-5	Studio Encoding Parameters of Digital Television for Standard 4:3 and Widescreen 16:9 Aspect Ratios
ITU-R BT.709-5	Parameter Values for the HDTV Standards for Production and International Programme Exchange (Note: Part 1 of this document describes the old European HDTV system and is no longer in use)
ITU-R BT.1700	Characteristics of Composite Video Signals for Conventional Analogue Television Systems
ITU-R BT.1439-1	Measurement Methods Applicable in the Analogue Television Studio and the Overall Analogue Television System
SMPTE ST 125-2013	SDTV Component Video Signal Coding 4:4:4 and 4:2:2 for 13.5 MHz and 18 MHz Systems
SMPTE 170M-2014	Composite Analog Video Signal NTSC for Studio Applications
SMPTE 253M-1998	Three-Channel RGB Analog Video Interface
SMPTE 274M-2008	1920 x 1080 Image Sample Structure, Digital Representation and Digital Timing Reference Sequences for Multiple Picture Rates
SMPTE 296M-1997	1280 x 720 Scanning, Analog and Digital Representation and Analog Interface
CEA-770.2-D	Standard Definition TV Analog Component Video Interface
CEA-770.3-E	High Definition TV Analog Component Video Interface
CEA-861-D	A DTV Profile for Uncompressed High Speed Digital Interfaces
Vsisv1r2	Video Signal Standard (VSIS)
DMTv1r11	VESA and Industry Standards and Guidelines for Computer Display Monitor Timing (DMT) Version 1.0, Revision 11 – May 1, 2007

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5 Test Scenarios

The connections for performing measurements with an R&S®VTC/VTE/VTS/BTC video analyzer are easily made. To prevent false results, however, a few basic principles must be followed.

The 75 ohm BNC cables that feed the component signal to the analyzer must be equal in length to prevent measurement errors during measurements of delay.

RCA connectors are typically used for the component outputs on the UEs. However, the stability of these connections is often a critical factor. Therefore, only high-quality RCA connectors should be used. Cables that include a direct RCA to BNC adaptation are preferred. Alternatively, an RCA to BNC adapter can be used on the DUT. RCA cables with an RCA to BNC adapter on the analyzer side should be avoided. The quality of these cables is typically not suited for precision measurements.

During the tests, it must be consistently ensured that the test pattern resolution matches the resolution of the video interface on the DUT. Although DUTs can convert formats, the conversion typically ignores the Nyquist criteria. This results in aliasing effects, in particular for frequency response measurements.

The test signal feed is dependent on the DUT. The sections below describe a few typical scenarios.

5.1 Set-Top Box with RF Signal Feed

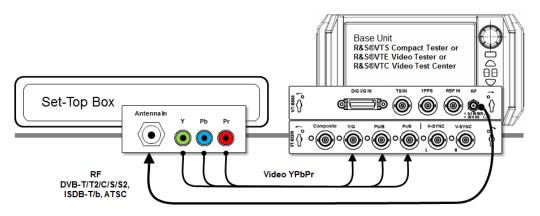


Fig. 5-1: Testing a set-top box with RF signal feed.

In this example, the test signal is applied as a transport stream via a modulator. As shown in Fig. 5-2, this can take place via the optional R&S®VT-B600 broadcast modulator with integrated transport stream generator. The type of modulation is dependent on the DUT frontend. Many receivers expect the signaling in the transport stream to match the transmission standard. For these situations, a SW tool is available for adapting the streams.

The same transport streams can be used for IPTV receivers. The signals are then applied via a server or IP streamer. An appropriate tool is available here: http://www.rohde-schwarz.com/en/product/tsstream-productstartpage_63493-51392.html.

5.2 Set-Top Box with USB Signal Feed

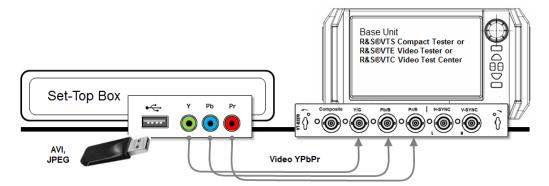


Fig. 5-2: Testing a set-top box with USB signal feed.

Receivers frequently allow video signals to be played back from a USB storage device. The necessary test patterns are also available in JPEG format.

5.3 DVD Player with Signal Feed via DVD or BD

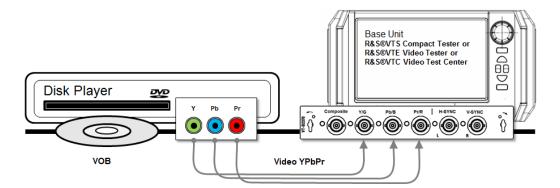


Fig. 5-3: Testing a DVD player with signal feed via DVD.

For DVD or Blu-ray players, the JPEG test signals can be burned to DVD or Blu-ray disc by using the appropriate tools. Alternatively, disk players frequently allow files to be played back from USB storage devices, as described in the previous scenario.

5.4 Laptop with VGA Interface

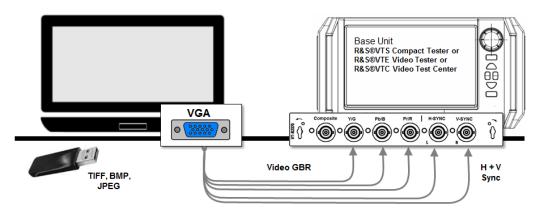


Fig. 5-4: Testing a VGA interface with USB signal feed.

In the case of VGA signals, the H and V sync pulse feeds are in separate lines. Therefore, VGA adapter cables have five BNC outputs. The sync lines are connected to the jacks labeled "H-Sync" and "V-Sync". These are enabled via the "External Sync" configuration in the input view on the video analyzer (see Fig. 6-2).

For measuring, the test signal must be displayed in full-screen mode on the VGA interface. The required tools are available in every operating system as accessories. However, the interface resolution must exactly match that of the test signal. As described at the beginning of section 5, scaling changes the characteristics of the test signal and makes it unusable for precision measurements.

Otherwise the video measurements on VGA interfaces run exactly the same as on RGB outputs on TVs. Even though measurements on the external sync signals are not supported, they can be displayed in the scope view.

Preparatory Steps

6 Operation of the R&S®VTC/VTE/VTS/BTC Video Analyzers

6.1 Preparatory Steps

Enable and open the "Video Analyzer" application

Ensure that the Video Analyzer application is enabled. If it is not, enable it as follows:

- In the right pane on the "Applications" tab, touch and hold the icon of an application
- until the color of the icon changes. Slide it into the left pane of the home screen and release it.

To open the application, click the Video Analyzer icon.

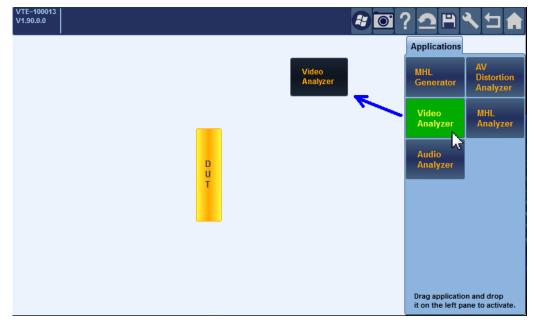


Fig. 6-1: R&S®VTS/VTE/VTC home screen.

Select and configure the signal input

In the analyzer view, go to the **Input** tab and define the settings as follows:

Preparatory Steps

Video Analyzer				1				
Signal	Average		Freeze	_	Resolution		Input	
Sync OK	0	→ Off -)ff ▼	1280x720	p 50.00Hz	Compone	ent [L1] -
Signal			Sync OK	Inpu	it -		Compone	nt [L1] -
Resolution		1280x72	0p 50.00Hz	Exte	ernal Sync		0	Off -
Averaging Level			0					
Freeze	8		Off -					a a la
Average	9		Off -					annen.
Color	6		YPbPr -					-
Picture Aspect Ratio	b0		16:9 -					
Input Scope Vec	tor Auto							

Fig. 6-2: Video analyzer input view.

- 1. Select Component as the signal input.
- 2. Set the external synchronization to Off in the case of video signals with embedded synchronization pulses.
- 3. Set freeze to Off. This option can be used later to freeze measurement results.
- 4. Set the desired averaging to improve the stability of the measured value output in the case of noisy signals.
- 5. Set the color format of the signal YPbPr or GBR. This setting defines which analysis will be performed and therefore must be set correctly. You can verify that the color format is set correctly by checking that the color replication in the preview picture is correct. Fig. 6-2 shows a correctly configured color format. If the color format is set incorrectly, the preview picture will look like the following:

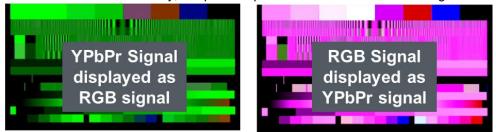


Fig. 6-3: Rohde & Schwarz combined test pattern display with incorrectly set color format.

 Select the picture aspect ratio for the signal. This setting serves only to display the correct picture aspect ratio in the preview picture. It will not affect the analysis itself.

Once all settings have been made and a valid signal is present, the favorites bar will display "Sync OK" under **Signal** and the signal resolution under **Resolution**. If this is not the case, check the cabling and use the scope view to determine whether the expected signal is actually present.

Configuring the Analyzer

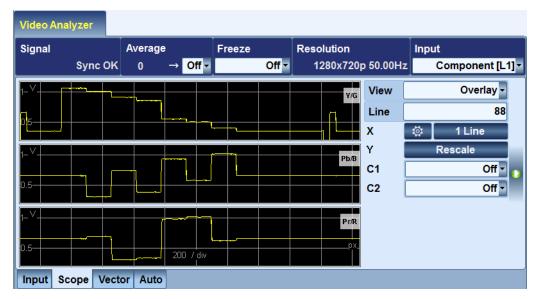


Fig. 6-4: Display of the YPbPr standard color bar in the scope view.

6.2 Configuring the Analyzer

To configure the analyzer, open the **Auto** view and click the **Settings** button to open the "Auto and Measurement Settings" dialog box (Fig. 6-5).

c	Auto and Measurement Settings						
-	Component RGB Compon	ent YPbP	r Extras				mponent [L
_		Enable	Lower Limit	Upper Limit	Unit	Test Signal	inponent [L
	[+] Amplitude and Delay						Clea
	[+] Linear Distortions						
-	[+] Nonlinear Distortions						
] [[-] Frequency Response						
11	Sin x/x Amplitude pos Y	~	-10.00	10.00	dB	🔅 Sin x/x [408 FF]	
	Sin x/x Amplitude pos Pb	~	-10.00	10.00	dB	🔅 Sin x/x [408 FF]	
]	Sin x/x Amplitude pos Pr	~	-10.00	10.00	dB	🔅 Sin x/x [408 FF]	
-	Sin x/x Amplitude neg Y	~	-10.00	10.00	dB	🔅 Sin x/x [408 FF]	
]	Sin x/x Amplitude neg Pb	~	-10.00	10.00	dB	🔅 Sin x/x [408 FF]	
	Absolute Amplitude Unit		mV -			_	
	Enable All Disable Al		Save	Load		OK Cano	Save

Fig. 6-5: Opening the "Auto and Measurement Settings" dialog box in the "Auto" view.

You can set the following in the "Auto and Measurement Settings" dialog box:

- Measurements to be performed
- Limit values for indicating violations
- Via a further dialog box for each measurement
- Location of the test lines

Configuring the Analyzer

- Type of test signal
- Test locations within a test line
- Options to save and load configurations
- Option to define a separator character when saving test logs

Follow these steps to perform a complete configuration:

Component RGE omponent YPbPr Extras											
	Er 2 ^{le}	Lower Limit	Upper Limit	Unit	Test Signal	î					
[+] Amplitude and Delay											
[+] Linear Distortions											
[+] Nonlinear Distortions											
-] Frequency Response											
Sin x/x Amplitude pos Y	~	-10.00	10.00	4 ^B	🔅 Sin x/x [408 FF]						
Sin x/x Amplitude pos Pb	~	-10.00	10.00	dB	🔅 Sin x/x [408 FF]						
Sin x/x Amplitude pos Pr	~	-10.00	10.00	dB	🔅 Sin x/x [408 FF]						
Sin x/x Amplitude neg Y	~	-10.00	10.00	dB	🔅 Sin x/x [408 FF]						
Sin x/x Amplitude neg Pb	~	-10.00	10.00	dB	Sin x/x [408 FF]	3					
Absolute Amplitude Unit		mV -			_						

Fig. 6-6: "Auto and Measurement Settings" dialog box.

- 7. In the upper area of the Component RGB or Component YBbPr tab, select the color space being configured. The color space selected on the Input tab (see Fig. 6-2: Video analyzer input view.) is automatically set as the default. The tabs available in this view are used to configure the defined signal input. If other tabs are present e.g. "PAL" with "NTSC" or "Component RGB" with "Composite YCbCr" close the dialog box and set the signal input to "Component".
- 8. The signal inputs "Component" for analog video components and "HDMI" or "MHL" – for digital video components – use the same configuration. This means that a configuration defined for analog interfaces can immediately be used on digital signals as well. This is especially useful for set-top boxes because the same signal content is often output over both analog and digital interfaces.
- 9. In the Enable column, select the measurements to be performed. Use the Enable All or Disable All button to enable all measurements or disable all measurements. Please note that the number of enabled measurements will affect the time required for the measurement. Therefore, you should enable only those measurements that are actually needed.
- 10. In the Lower Limit and Upper Limit columns, configure the desired limit values. In the Absolute Amplitude Unit field, select whether the limit values for the absolute measurements will be entered in mV or as a % in relation to the nominal amplitude. The setting in this field may make it easier to provide the right limit value. It does not change how the measured value is displayed. The results of absolute measurements are always output in mV.

- 11. If necessary, the dialog box for configuring the individual measurements can be opened. Here, you can set the test signal to be used, adjust the line position setting, and adjust the test locations for the partial measurements. This dialog box also shows the video signal in the selected test line. This makes it possible to check whether the configuration actually matches the current signal. For details, see section 6.3.
- 12. If appropriate, click the **Save** button to save the configuration. Only the settings for the currently selected color format are saved. This makes it possible to save individual measurement configurations for video analysis and to reload them independently of other instrument settings. Alternatively, you can also save and reload the entire instrument configuration. To do this, click the Save icon in the toolbar.

To adjust to country-specific conditions, go to the **Extras** tab to define the character to be used for the decimal point when saving measurement logs. You can choose between a comma and a period. These settings apply to all video standards and signal inputs.

Once all configurations are complete, click the OK button to close the dialog box.

6.3 Configuring the Test Parameters

Video analysis is preconfigured for all standards based on the Rohde & Schwarz combined test pattern. For details on the test signals, refer to Appendix A. If the configuration is in an undefined state, you can restore the default settings by clicking the Reset button in the toolbar.

This section describes how to adjust the configuration to analyze other test signals or patterns with different test line positions. This task is especially easy with the R&S®VTC/VTE/VTS/BTC video analyzer because it sets the video signal format automatically and adjusts the configuration accordingly.

However, you must take the following into consideration for configuring the test line position and the position of the test points within the test lines:

- The configuration is always based on the format of the current video signal.
- If no video signal is present, the last valid format is used.
- If no signal has been present since the instrument was powered on, the configuration will be based on the 720 x 576 p video format.
- If the format changes after the configuration, the test line position and the position of the test points are automatically adjusted to the new format. Because rounding errors can occur, it is useful to use test patterns that have identical test lines over several lines.
- The position of the white pulse's rising slope has a dual significance. It also serves as time reference for the position of the test locations of all other measurements (see section 7.6.5.1).

Configuring the Test Parameters

As described in section 6.2, to configure the measurement, click the appropriate buttons to the left, next to the specification of the test signal and the test line position.

Auto and Measurement Settings										
Component RGB Component YPbPr Extras										
+] All Enable Lower Limit Upper Limit Unit Test Signal										
[-] Amplitude and Delay										
Lum Bar Amplitude Y (abs)	~	630.0	770.0	mV	🔅 2T Pulse & Bar [498 FF]					
Lum Bar Amplitude Pb (abs)	~	315.0	385.0	mV	2T Pulse & Bar [498 FF]					
Lum Bar Amplitude Pr (abs)	~	315.0	385.0	mV	🔅 2T Pulse & Bar [498 FF]					
Lum Bar Amplitude Y (nom)	~	-5.0	5.0	%	🔅 2T Pulse & Bar [498 FF]					

Fig. 6-7: Opening the dialog box for setting the test signal, test line position and test point positions.

The basic layout of the dialog box is the same for all measurements. The only difference is the number and type of measurement windows. The following section describes the user controls based on an example configuration for the 2T pulse amplitude.



Fig. 6-8: Dialog box for configuring the 2T pulse amplitude.

- Test Signal Select the test signal to be used to capture the measured value.
 Appendix B shows the mapping of test signals to the different measurements.
- Test Line Select the line in the video signal that contains the selected test signal. The available line range is based on the current video signal. If it is not known which video line is transmitting the required test signal, the easiest way to find it is to use the vector view. As shown in Fig. 6-9, the video content is displayed along with the waveform of the video line marked with the cursor line. The value of the cursor line corresponds to the full-field line counter.

Configuring the Test Parameters

Signal		Averag	e	Free	ze	R	Resolution	Input	Input		
	Sync OK	0	→ <mark>Off</mark> -		Off	-	1280x720p	50.00Hz	C	omponent [L1]
				2		Curso	or Line	Pos			
				Vector			136		260.0) px	-
						Gain		Phase			
							1.00		0.0) deg	
				Waveform	Position		Lum. Ampl [mV]	Chr. / [mV]	Ampl	Chr. Phase [deg]	
					Cursor		1.	5	0.6	311	1.3
					White			-			
Constanting of the		A AAAA MARKANA	hellowers at the second		Yellow			-			
it a sum of		Willia I	and a start start of		Cyan			-			
					Green			-			

Fig. 6-9: Vector view for finding test lines.

- Line Counter Set how the video lines are counted. This setting is used only for entering the line number. In the measurement log, the line numbers always are referenced to the full field. The following settings are available:
- Full Field Lines including the blanking interval
- Active Field Only active video lines
 In the case of interlaced signals, 1 indicates the first active line in the first field and the largest number indicates the last active line in the second field
- %VAct Like for Active Field, but defined as a % (0 % corresponds to the first line and 100 % to the final line in full field). This is also valid for interlaced signals
- Location Unit Unit used to specify the temporal positions of the test locations and the widths of the measurement windows. The following settings are available:
- µs Input in µs referenced to the start of the video line. 0 µs indicates the first slope of the horizontal sync pulse in this line
- px Input in pixels referenced to the start of the active range in the video line
- Location Center and Width Position of the individual partial measurements and the width of the measurement window. The definition of the measurement window depends on the type of measurement. Available options are:
- Level measurement (see window 1 in Fig. 6-10) The measurement window shows the range within which all level values are averaged. The longer the measurement window, the less sensitive the measurement is to noise. The signal level should remain on a constant level within the measurement window
- Pulse measurement (see window 2 in Fig. 6-10) The measurement window describes the range in which the analysis searches for the pulse to be analyzed. The measurement window must not include any other signal elements than this pulse

Configuring the Test Parameters

Slope measurement (see windows 1 and 2 in Fig. 6-11)

The measurement window describes the position of the slope to be analyzed. The start and the end of the measurement window determine where the analysis captures the 0 % and the 100 % level for determining the 50 % value of the level transition. The measurement window must not include any other signal elements than this slope

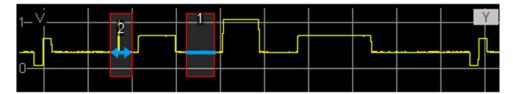


Fig. 6-10: Example of "2T Pulse Amplitude": Measurement window 1 defines the range used to capture the black value reference level and measurement window 2 defines the position of the 2T pulse.

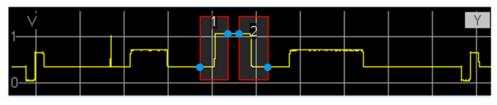


Fig. 6-11: Example of "Lum Bar Duration": Measurement windows 1 and 2 define the position of the rising and falling slopes of the white pulse.

The Default button restores the default settings as optimized for the Rohde & Schwarz combined test pattern measurement.

Several measurements use the same test signal (see Appendix B). The assigned line number for this test signal then also applies to all these measurements. The same goes for test points within the test signal that are used more than once. An example of this is shown in Fig. 6-12, based on the settings for the luminance bar amplitude and 2T amplitude measurements.

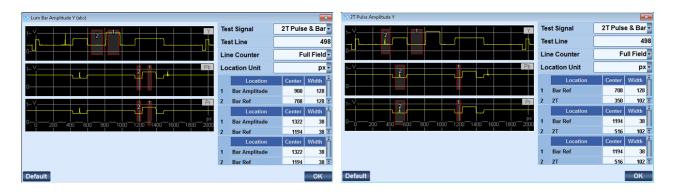


Fig. 6-12: Dialog boxes for configuring the luminance bar amplitude and 2T pulse amplitude measurements on the 2T Pulse & Bar test signal.

The settings shown in Fig. 6-12 are used to measure the "luminance bar amplitude" and the "2T amplitude" on the 2T Pulse & Bar test signal. Both measurements use the same settings for Test Line and Bar Ref. This means that a change in the settings for one measurement will automatically be used for the other measurement. On the other hand, the test position settings for Bar Amplitude and 2T are assigned to the specific individual measurements and are used only there.

6.4 Performing the Measurement

The video analyzer measurement starts automatically. For an improved overview, the measurement results are grouped into categories. The group labels include the overall status of all included measurement results. For example, a red "Fail" for a group indicates that at least one measurement in this group violates its limit value. This permits a quick overview of the quality of the current video signal.

Signal	ignal Average			Freeze	Resolu	Resolution			Input		
Sync OK	10	\rightarrow	16 -	0	<mark>ff -</mark> 128	0x720p {	50.00Hz	Con	۱po	nent [L1] -	
		Value	Unit	Lower Limit	Upper Limit	Status	Test	Signal	ĥ	Clear	
[+] Amplitude and Delay				ОК	ОК						
[+] Linear Distortions				ОК	ОК						
[+] NonLinear Distortions				ОК	ОК						
[+] Frequency Response				Fail	ОК	Status!					
[–] Noise Measurements				Fail	ОК	Status!					
Signal to Noise unw Y		65.2	dB	70.0	1000.0	LL	Quiet Lin	e [723 FF]			
Signal to Noise unw Pb		69.3	dB	40.0	1000.0		Quiet Lin	e [723 FF]	Ш		
Signal to Noise unw Pr		69.3	dB	40.0	1000.0		Quiet Lin	e [723 FF]			
Signal to Noise lumw Y		69.9	dB	40.0	1000.0		Quiet Lin	e [723 FF]		Save	
Signal to Noise lumw Pb		76.1	dB	40.0	1000.0		Quiet Lin	e [723 FF]	T	Settings	

Fig. 6-13: Display of measured values in the video analyzer.

The individual columns of the measured value display include the following information:

- Value Measured value.
 Measured values in red indicate that this measurement violated one of the limit values.
- Unit Unit for the measured value
- Lower limit and upper limit
- Status Additional information if no measured value is displayed or if a limit value was violated. Available options are:
- Signal? No video signal is available or the current signal cannot be synchronized.

Performing the Measurement

- Wait Measurement not yet complete
- Test Signal? The test signal in the test line does not match the measurement.
- LL The lower limit value was violated
- UL The upper limit value was violated
- Test Signal Test signal and line to be measured.
 The line number is always specified in reference to the full field video signal.

To control the measurement, the following user controls are available:

Average is used to define the number of averaged measured values. This permits stable and reproducible measurement results even for noisy signals. The **Clear** button is used to clear all previous measurements. The **Save** button is used to open a dialog box for saving the measured results in csv (comma-separated values) format.

The **Settings** button opens a dialog box to configure the video analysis (see section 6.2).

An example of a typical measurement log is provided in Appendix C.

7 Automated Measurements

Automated measurements for video component signals can be categorized as follows:

- Amplitude and delay
- Linear distortions
- Nonlinear distortions
- Frequency response
- Noise
- Timing
- Jitter

This section describes the individual measurements. It includes a definition of the measurements, the effects of any deviations and a description of the required test signals.

For each measurement, the test signal is shown – at the top as it is seen on a monitor and, below that, as a time signal as displayed on an oscilloscope.

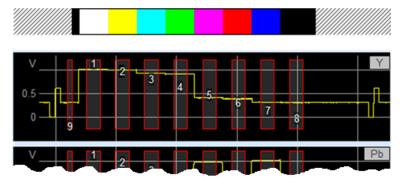


Fig. 7-1: Display of the test signal and the test locations using the color bar as an example.

Markings in the time signal show which elements of the test signal are used for the evaluation. The position of the markings can be adjusted at any time if necessary (see section 6.3).

Unless specified otherwise, all definitions apply to all three video components.

7.1 Amplitude and Delay

This category of measurements captures deviations in the signal level and the relative delay for the three component signals. Level errors can affect the results of other measurements. For that reason alone, a measurement of the level values should be part of every test protocol.

7.1.1 Luminance Bar Amplitude

7.1.1.1 Definition

The Luminance Bar Amplitude specifies the largest signal amplitude in the visible picture. If it is too small, the picture will be too dark and the dynamic range will not be fully utilized. If it is too large, the danger of overdrive exists.

The measured value is calculated from the delta between the level in the white range and the level in the black range. The result is expressed as a % referenced to a nominal value of 700 mV or as an absolute value in mV.

The test signal is a test line with a white pulse as contained in the "T2 Pulse & Bar" test line.

7.1.1.2 Test Locations

Test locations		
1	Bar Amplitude	Level in white range
2	Bar Ref	Level in black range

 Table 7-1: Test locations for the luminance bar amplitude measurement.

7.1.1.3 YPbPr Test Signal

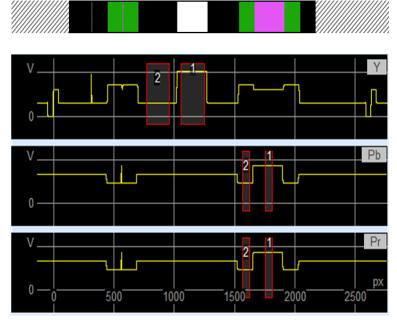


Fig. 7-2: Measuring the luminance bar amplitude on YPbPr "2T Pulse & Bar" test signal.

For the YPbPr signal, the test locations in the three video component signals can be set independently of one another.

7.1.1.4 GBR Test Signal

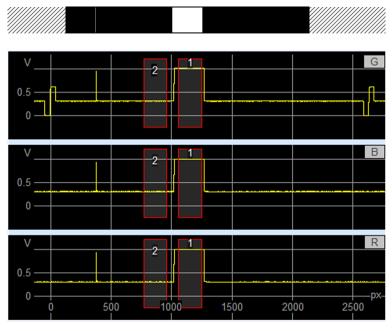


Fig. 7-3: Measuring the luminance bar amplitude on YPbPr "2T Pulse & Bar" test signal. For the GBR signal, the test location is the same for all three components.

7.1.2 Sync Pulse Amplitude

7.1.2.1 Definition

The **Sync Amplitude** measurement records the amplitudes of the sync pulses contained in the Y channel or the G channel.

If the sync pulses are too small, receivers cannot synchronize reliably. If the sync pulses are too large, the dynamic range of the signal will be reduced.

Depending on the video resolution, the sync pulse will be either bi-level or tri-level (see Appendix A.3). The R&S®VTC/VTE/VTS/BTC video analyzer takes this into consideration automatically. In the case of a tri-level sync, the measured value is calculated from the difference between the tri-level high and low levels. For a bi-level sync, the difference between the black value and the base sync is measured.

The result is expressed as a % referenced to the nominal value or as an absolute voltage value in mV.

The measurement can use any video lines in the active picture area or in the vertical blanking interval (VBI).

7.1.2.2 Test Locations

Test	Test locations			
Tri-lev	Tri-level sync			
1	Sync Tri-Level Low	Level at the negative peak for the sync pulse		
2	Sync Tri-Level High	Level at the positive peak for the sync pulse		
Bi-leve	Bi-level sync			
1	Sync Ampl	Level at the sync pulse base		
2	Sync Ref	Level in the black range		

Table 7-2: Test locations for the sync pulse amplitude measurement.

7.1.2.3 YPbPr Test Signal

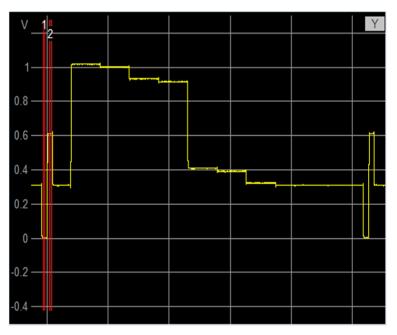


Fig. 7-4: Measuring the sync pulse amplitude on a YPbPr video line with tri-level sync pulse.

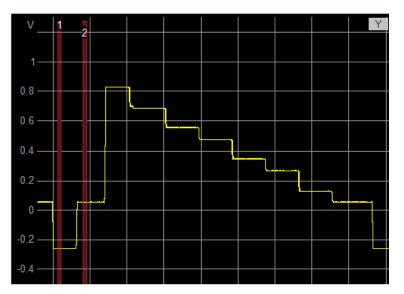


Fig. 7-5: Measuring the sync pulse amplitude on a YPbPr video line with bi-level sync pulse.

7.1.2.4 GBR Test Signal

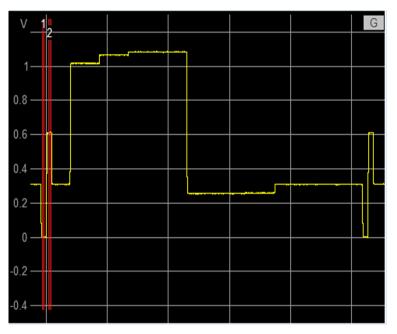


Fig. 7-6: Measuring the sync pulse amplitude on a GBR video line with tri-level sync pulse.

, Ý1 - 2		 			G
0.5					

Fig. 7-7: Measuring the sync pulse amplitude on a GBR video line with bi-level sync pulse.

7.1.3 Color Bar Amplitude

7.1.3.1 Definition

The **Color Bar Amplitude** measurements capture all level values for the individual colors of the normal color bar.

Deviations from the reference value are visible as color deviations in the picture.

This measurement is comparable to an analysis using a vectorscope, except that on a vectorscope, the level values of the individual video component signals are converted into color amplitude and phase angle. The resulting picture shows the immediate effect of level deviations on the color reproduction.

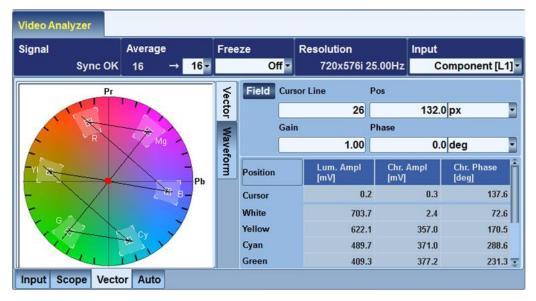


Fig. 7-8: Measuring the color bar using a vectorscope.

In contrast, the auto measurement assesses the level values directly, without any conversions. This makes it easier to attribute deviations to the individual color components. The black value in each line serves as the reference for all values in that line. The result is expressed as an absolute voltage value in mV.

The test signal is a color bar with 100 % modulation.

7.1.3.2 Test Locations

Test locations		
1	White Bar	Amplitude white bar
2	Yellow Bar	Amplitude yellow bar
3	Cyan Bar	Amplitude cyan bar
4	Green Bar	Amplitude green bar
5	Magenta Bar	Amplitude magenta bar
6	Red Bar	Amplitude red bar
7	Blue Bar	Amplitude blue bar
8	Black Bar	Amplitude black bar
9	Black Reference	Black reference for all amplitude measurements

Table 7-3: Test locations for the color bar amplitude measurement.

7.1.3.3 YPbPr Test Signal

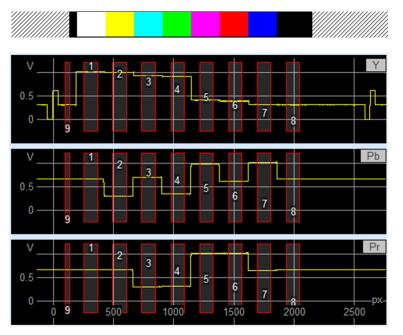


Fig. 7-9: Measuring the color bar amplitudes on the YPbPr "Color Bars" test signal.

$\begin{array}{c} & & & & & & & \\ & & & & & & & \\ & & & & & \\ & & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & &$

7.1.3.4 GBR Test Signal

Fig. 7-10: Measuring the color bar amplitudes on the GBR "Color Bars" test signal.

7.1.4 Inter Channel Amplitude

7.1.4.1 Definition

The **Inter Channel Amplitude** measurement captures the level differences among the individual components. Deviations from the reference values result in color deviations in the picture.

The following table shows which color components are compared.

Inter channel amplitude measurements			
Color system YPbPr			
Inter Channel Ampl. (Y – Pb)	Amplitude of the Y component referenced to color difference component Pb		
Inter Channel Ampl. (Y – Pr)	Amplitude of the Y component referenced to color difference component Pr		
Inter Channel Ampl. Pb – Pr)	Amplitude of color difference component Pb referenced to color difference component Pr		
Color system GBR			
Inter Channel Ampl. (G – B)	Amplitude of the green component referenced to the blue component		
Inter Channel Ampl. (G – R)	Amplitude of the green component referenced to the red component		
Inter Channel Ampl. (B – R)	Amplitude of the blue component referenced to the red component		

Table 7-4: Inter channel amplitude measurements.

The result is expressed in % as a relative deviation. As an example: The test result "Inter Channel Ampl. (Y - Pb) = -10%" means, that the level of the Y component is 10 % smaller than the level of the Pb component.

The measurement is taken on the color bar signal. The transition from green to magenta is used for the comparison of the level differences. This transition represents the greatest difference over all components and is therefore the least sensitive to noise.

7.1.4.2 Test Locations

Test	Test location				
1	Green – Magenta	Transition from green to magenta			
Table 7	Table 7-5: Test location for the inter channel amplitude measurement.				

7.1.4.3 YPbPr Test Signal

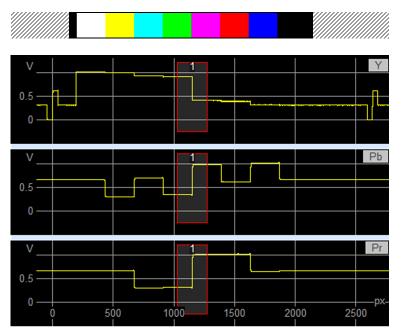
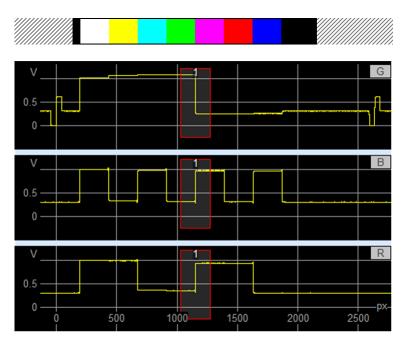


Fig. 7-11: Measuring the inter channel amplitude on the YPbPr "Color Bar" test signal.



7.1.4.4 GBR Test Signal



7.1.5 Inter Channel Delay

7.1.5.1 Definition

Inter Channel Delay measures the differences in delay for the individual components. Deviations from the reference values result in blurring and color deviations during transitions in brightness.

The following table shows which color components are compared.

Inter channel delay measurements			
Color system YPbPr			
Inter Channel Delay (Y – Pb)	Delays in the Y component as compared with color difference component Pb		
Inter Channel Delay (Y – Pr)	Delays in the Y component as compared with color difference component Pr		
Inter Channel Delay Pb - Pr)	Delays in color difference component Pb as compared with color difference component Pr		
Color system GBR			
Inter Channel Delay (G – B)	Delays in the green component as compared with the blue component		
Inter Channel Delay (G – R)	Delays in the green component as compared with the red component		
Inter Channel Delay (B – R)	Delays in the blue component as compared with the red component		

Table 7-6: Inter channel delay measurements.

The delay to each reference component is specified in ns. As an example: The test result "Inter Channel Delay (Y - Pb) = -100 ns" shows that the Y component is 100 ns ahead of the Pb component.

The measurement is taken on the color bar signal at the level transitions from green to magenta. They represent the greatest difference over all components and are therefore the least sensitive to noise.

7.1.5.2 Test Locations

Tes	Test location				
1	Green – Magenta	Transition from green to magenta			
Table	able 7-7: Test location for the inter channel delay measurement.				

7.1.5.3 YPbPr Test Signal

The test signal and settings are identical to that for the inter channel amplitude measurement. See: Fig. 7-11.

7.1.5.4 GBR Test Signal

The test signal and settings are identical to that for the inter channel amplitude measurement. See: Fig. 7-12

7.2 Linear Distortions

Linear distortions result from deviations in the amplitude and/or phase frequency response.

In contrast to the direct measurement of the frequency response using a multiburst or SINX/X, the following measurements indicate how linear distortions affect the individual signal elements, and thus their visibility.

7.2.1 2T Pulse Measurements

7.2.1.1 Definition

The 2T pulse is formed so that it optimally utilizes the transition range of the video signal. As a result, linear distortions directly affect the signal waveform.

All 2T measurements are taken on a 2T pulse as defined in the "T2 Pulse & Bar" test line.

The **2T Pulse Amplitude** measurement captures the percentage of deviation of the 2T amplitude peak as compared with the level of the white pulse. Negative deviations indicate a reduced visibility of fine picture details.

The **2T K Factor** checks the 2T pulse for preshoot and postshoot. These can be caused by group delay distortions, for example. The analysis is performed using a predefined mask. Originally, this mask was defined in the analog video T&M technology for standard definition composite signals.

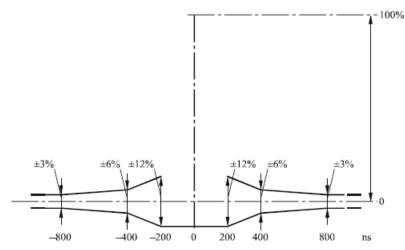


Fig. 7-13: 3 % 2TK mask for a standard definition video signal with 5 MHz bandwidth and a 2T pulse width of 200 ns.

However, because the mask references the width of the 2T pulse – and therefore the bandwidth of the video signal – it is possible to convert it for use with other video formats.

The measured value is specified as a %. 0 % indicates that no overshoot is present.

The **2T Pulse HAD** (half amplitude duration) measurement captures the width of the 2T pulse at 50 % of the 2T amplitude. Because the bandwidth of the video signal determines the reference width of the 2T pulse, this measured value must always be considered in conjunction with the resolution of the current video signal (see Appendix A.3).

7.2.1.2 Test Locations

Test	locations	
1	Bar Ref	Reference level. The value is also used as a reference for the measurement of the white pulse amplitude
2	2T	2T pulses

Table 7-8: Test locations for the 2T pulse measurements.

Linear Distortions

7.2.1.3 YPbPr Test Signal

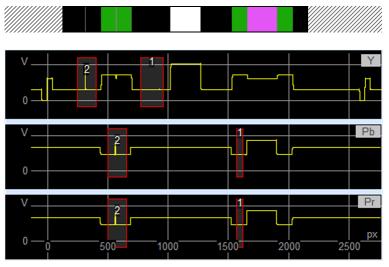


Fig. 7-14: 2T measurements on the YPbPr "2T Pulse & Bar" test signal.

For the YPbPr signal, the test locations in the three video component signals can be set independently of one another.

7.2.1.4 GBR Test Signal

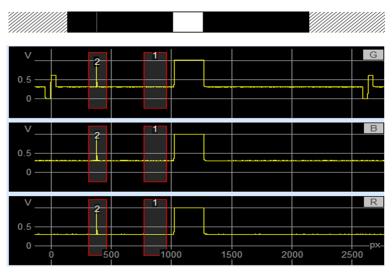


Fig. 7-15: 2T measurements on the GBR "2T Pulse & Bar" test signal.

For the GBR signal, the test location is the same for all three video component signals.

7.2.2 Short Time Distortion

7.2.2.1 Definition

The short time distortion measurement analyzes black-white and white-black transitions. Like for the 2T pulse, the transitions are adapted exactly to the transmission bandwidth of the video signal, and any linear distortions cause deviations in the prescribed signal path. Depending on the type of interference, the picture might be overdrawn or blurred at the level transitions. Color deviations can also occur.

The measurement is taken at the rising and falling slopes of the white pulse as described in the "T2 Pulse & Bar" test line.

The ST Distortion Rise Time and ST Distortion Fall Time measurements assess the rise and fall times for a white pulse. The nominal value is determined from the signal bandwidth (see Appendix A.3). If the rise times are too short, this indicates an increase in the level frequency response, and rise times that are too long indicate a reduction in the level frequency response. The time is measured in ns.

The ST Dist Rise Preshoot and ST Dist Fall Preshoot measurements capture the preshoots at the start of the level transitions.

The ST Dist Rise Overshoot and ST Dist Fall Overshoot measurements capture the overshoots at the end of the level transitions.

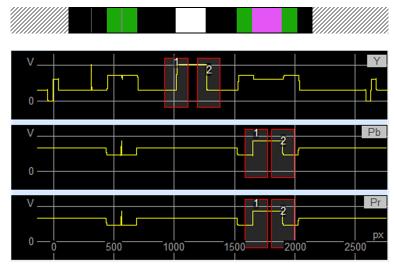
The measured values are expressed as a % referenced to the value of the white pulse.

7.2.2.2 Test Locations

Test locations			
1	Rising Slope	Location of the transition from black to white	
2	Falling Slope	Location of the transition from white to black	

Table 7-9: Locations for the short time distortion measurements.

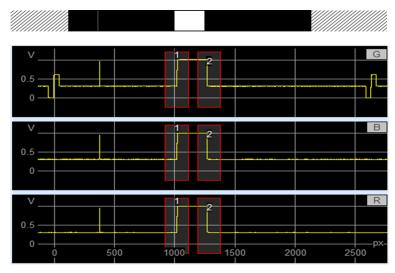
Linear Distortions



7.2.2.3 YPbPr Test Signal

Fig. 7-16: Short time distortion measurements on the YPbPr "2T Pulse & Bar" test signal.

For the YPbPr signal, the test locations in the three video component signals can be set independently of one another.



7.2.2.4 GBR Test Signal

Fig. 7-17: Short time distortion measurements on the GBR "2T Pulse & Bar" test signal.

For the GBR signal, the test location is the same for all three video component signals.

Nonlinear Distortions

7.3 Nonlinear Distortions

Curves in the transmission characteristics cause nonlinear distortions and can lead to color deviations.

7.3.1 Nonlinearity, Nonlinearity Step 1 to Step 5

7.3.1.1 Definition

This measurement assesses the linearity based on a continuous level increase. The level measurements are taken at regular intervals. For an exactly linear transmission characteristic, the level differences are the same at all adjacent test points. If nonlinear distortions are present, the amplitude values will differ from one another.

The measurement is taken on a step signal or a ramp. It must be ensured that the measurement times are set at regular intervals. If they are not, undistorted signals can cause deviations from the reference value.

The **Nonlinearity** measured value is defined as the difference between the largest and the smallest level difference in relation to the largest level difference. This measured value therefore describes the order of magnitude of the nonlinear distortion.

The values of the individual level differences – **Nonlinearity Step 1** to **Nonlinearity Step 5** – show the progression of the nonlinearity. The measured values are defined as the value of the individual level differences 1 to 5 in relation to the largest level difference.

The measured values are expressed as a %. By definition, the measured value is always positive.

7.3.1.2 Test Locations

Test	locations	
1	Reference	Reference level for the first power level
2	Step 1	Level of the first step
3	Step 2	Level of the second step
4	Step 3	Level of the third step
5	Step 4	Level of the fourth step
6	Step 5	Level of the fifth step

 Table 7-10:
 Test locations for the nonlinearity measurements.

Nonlinear Distortions

7.3.1.3 YPbPr Test Signal

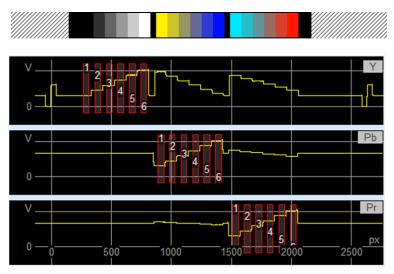


Fig. 7-18: Nonlinearity measurement on the YPbPr "Staircase" test signal.

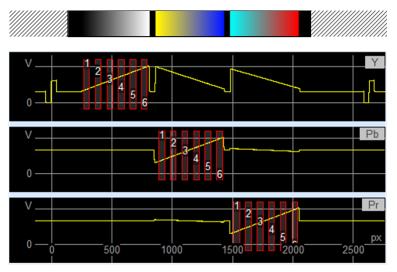


Fig. 7-19: Nonlinearity measurement on the YPbPr "Ramp" test signal.

For the YPbPr signal, the test locations in the three video component signals can be set independently of one another.

Nonlinear Distortions

7.3.1.4 GBR Test Signal

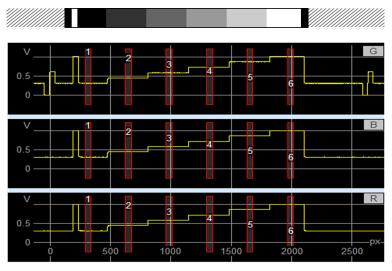


Fig. 7-20: Nonlinearity measurement on the GBR "Staircase" test signal.

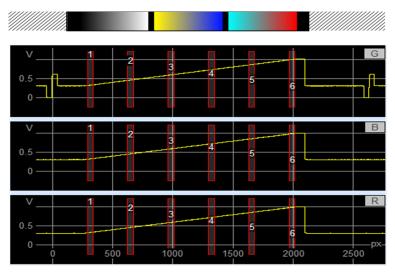


Fig. 7-21: Nonlinearity measurement on the GBR "Ramp" test signal.

7.4 Frequency Response

Errors in the frequency domain are also linear distortions. However, in contrast to the linear distortion measurements, these measurements show the frequency response directly.

7.4.1 SIN X/X Amplitude, SIN X/X Delay

7.4.1.1 Definition

The spectral composition of the SIN X/X signal covers the entire frequency domain, extending without gaps to the band limit. This makes it possible to analyze the amplitude frequency response as well as the signal delay versus the frequency.

However, the test signal feed must be taken into consideration. In the case of a set-top box, this is typically done via a transport stream, so the test signal must be coded with MPEG-2 or H.264. The associated quantization to 8 bit and the unavoidable code artifacts impair the quality of the test signal. As a result of the lower energy of the SIN X/X test signal, this can lead to strongly varying measurement results.

The measurement is performed via an FFT analysis using a Hanning window. It is almost impossible to analyze the test signal in the time domain using an oscilloscope.

SIN X/X Amplitude captures the amplitude frequency response of the signal and SIN X/X Delay captures the delay.

The measured values are defined as the largest positive and the largest negative deviation in the frequency range as given in Table 7-11.

	Frequency range for Y, G, B, R	Frequency range for Pb, Pr	Reference frequency
SDTV 480i/576i 50/60 Hz	0.3 MHz to 5 MHz	0.3 MHz to 2.5 MHz	0.3 MHz
SDTV 480p/576p 50/60 Hz	0.3 MHz to 10 MHz	0.3 MHz to 5 MHz	0.3 MHz
HDTV 720p/1080i 50/60 Hz	0.5 MHz to 24 MHz	0.3 MHz to 12 MHz	0.5 MHz
HDTV 1080p 50/60 Hz	0.5 MHz to 48 MHz	0.3 MHz to 24 MHz	0.5 MHz

Table 7-11: Frequency range and reference frequency for SIN X/X measurement.

7.4.1.2 Test Locations

Test	locations(
1	Positive	Location of the positive SIN X/X pulse
2	Negative	Location of the negative SIN X/X pulse

Table 7-12: Test locations for the SIN X/X measurements.

7.4.1.3 YPbPr Test Signal

Fig. 7-22: Measurement of the SIN X/X amplitude and delay on the YPbPr "SIN X/X" test signal.

7.4.1.4 GBR Test Signal

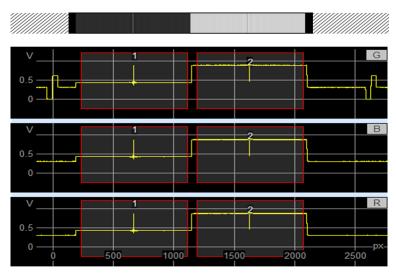


Fig. 7-23: Measurement of the SIN X/X amplitude and delay on the GBR "SIN X/X" test signal.

7.4.2 Multiburst

7.4.2.1 Definition

The multiburst signal contains six sine packets with different frequencies. A multiburst flag pulse serves as the reference.

The high signal level ensures that the signal is significantly less sensitive to disturbances due to quantization, coding and noise superpositions than the SIN X/X signal, for example. It also permits an estimation of the frequency response in the time domain using an oscilloscope.

The disadvantage is that the analysis is performed only on the frequencies that are present in the signal. As a result, any passband ripple might not be captured completely.

The Multiburst Flag Ampl (Abs) and Multiburst Flag Ampl (Nom) measurements capture the size of the reference pulse. This makes it possible to check whether the level of the test signal is correct. The amplitude of the multiburst flag is output as an absolute value in mV and in %, relative to the nominal value.

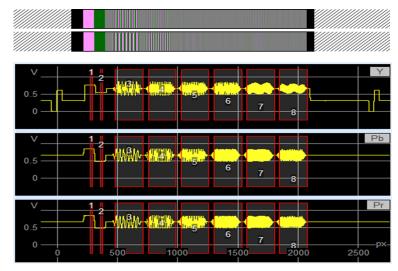
The **Multiburst 1 Ampl** through **Multiburst 6 Ampl** measurements describe the level deviations compared with the reference pulse at the frequency of packets 1 through 6. The deviation is defined linearly as a % and logarithmically in dB.

The **Multiburst 1 Frequ** through **Multiburst 6 Frequ** measurements capture the actual frequencies of the individual burst packets in MHz. The nominal value of the frequencies is dependent on the video format and the test signal (see Appendix A.3).

7.4.2.2 Test Locations

Test	locations	
1	Flag High	Level of luminance flag high
2	Flag Low	Level of luminance flag low
3	Packet 1	Location of the first frequency packet
4	Packet 2	Location of the second frequency packet
5	Packet 3	Location of the third frequency packet
6	Packet 4	Location of the fourth frequency packet
7	Packet 5	Location of the fifth frequency packet
8	Packet 6	Location of the sixth frequency packet

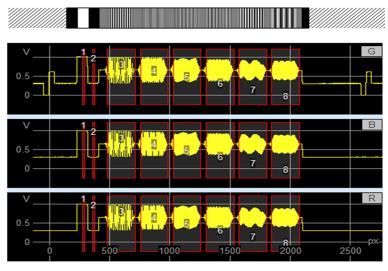
Table 7-13: Test locations for the multiburst measurements.



7.4.2.3 YPbPr Test Signal

Fig. 7-24: Measurement of the multiburst amplitude on the YPbPr "Multiburst" test signal. The top display of the multiburst reproduction on a screen shows the mixed multiburst, the bottom display shows the half multiburst.

In the case of the YPbPr signal, the test locations in the Y channel can be set independently of the test locations in the PbPr video component signals. The test locations for the frequency packets are the same in all three components.



7.4.2.4 GBR Test Signal

Fig. 7-25: Measurement of the multiburst amplitude on the GBR "Multiburst" test signal.

7.4.3 Sweep Amplitude

7.4.3.1 Definition

Like the SIN X/X signal, the sweep signal covers the entire frequency range to the band limit. This means that a FFT can be used to automatically determine the frequency response. By using an oscilloscope, it is also possible to estimate the amplitude frequency response in the time domain.

The measured value **Sweep Amplitude** captures the amplitude frequency response of the signal.

The measured values are defined as the largest positive and the largest negative deviation in the frequency range as given in Table 7-11.

7.4.3.2 Test Locations

Test	location	
1	Sweep	Location and duration of the sweep signal
Fig. 7-2	26: Measurement of the	ne multiburst amplitude on the GBR "Multiburst" test signal.

7.4.3.3 YPbPr Test Signal

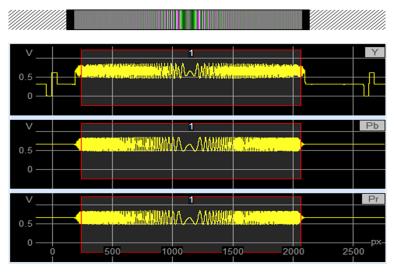


Fig. 7-27: Measurement of the sweep amplitude on the YPbPr "Sweep" test signal.

7.4.3.4 GBR Test Signal

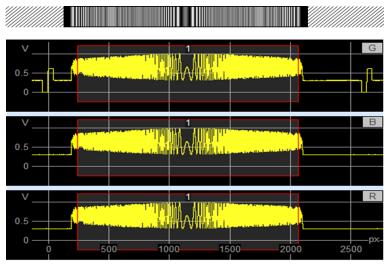


Fig. 7-28: Measurement of the sweep amplitude on the GBR "Sweep" test signal.

7.5 Noise Measurements

7.5.1 Signal to Noise Unweighted, Signal to Noise Luminance Weighted

7.5.1.1 Definition

The superposition of interference signals on the video signal can have different causes. Some examples are provided below:

- Wideband noise from signal amplifiers in the transmission chain
- Overtalk from other signals
- Interference in the power supply
- Quantization errors on A/D and D/A converters

Besides the size of the interference, its spectral distribution is decisive in determining whether the interference will be perceived visually. This is because the human eye is less sensitive to high-frequency interference. It is possible to compensate for this situation by using weighting filters. The transmission format of the weighting filter was originally defined for analog standard TV signals.

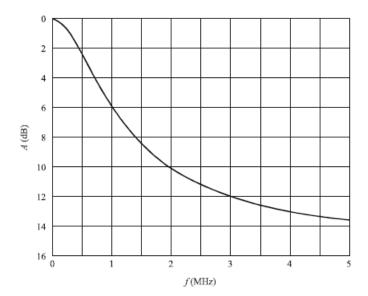


Fig. 7-29: Frequency response of a weighting filter for analog video signals with a bandwidth of 5 MHz.

There is no corresponding definition for HDTV signals. Therefore, the characteristic of the weighting filter shown above is calculated up to the bandwidth for the signal of interest.

The **Signal to Noise Unw** measurement defines the ratio of unweighted noise voltage to the nominal signal level of 700 mV.

The **Signal to Noise Lumw** measurement defines the ratio of weighted noise voltage to the nominal signal level of 700 mV.

The spectral distribution of the noise voltage can be ascertained from the difference between the two measured values. If the noise signals are evenly distributed over the bandwidth (white noise), the signal-to-noise ratio of the unweighted measurement is 7.4 dB worse than the weighted measurement. If the difference is greater, then this interference has a larger component in the upper frequency domain. The same applies in reverse to smaller differences.

Otherwise, the noise voltage is captured up to the band limit of the signal. However, the analyzer includes filter settings for limiting the measurement bandwidth to 4.2 MHz, 5 MHz and 20 MHz. These filters serve only to ensure that the test instrument remains compatible with old T&M equipment, which often cannot cover the entire frequency bandwidth of a modern HDTV signal.

The bandwidth is selected via a menu in the "Signal to Noise" settings dialog box.



Fig. 7-30: Selecting the measurement bandwidth for the signal-to-noise measurement.

The following settings are available:

- "Default" measurement to the signal band limit
- 4.2 MHz (NTC7)" band limit at 4.7 MHz in line with NTC 7
- "5 MHz (NTC7)" band limit at 4.7 MHz in line with NTC 7
- "Unified 20 MHz" band limit at 20 MHz

The noise voltage is measured in a video line without picture content (quiet line). This can be a black or a gray line. If quantization interference from A/D and D/A converters is also to be captured, the noise voltage must be measured on a ramp.

7.5.1.2 Test Locations

	Test I	location	
	1	Signal to Noise	Measurement window for noise measurements in GBR components
٦	Table 7	-14: Test location fo	r the signal-to-noise measurement.

7.5.1.3 YPbPr Test Signal

Fig. 7-31: Signal-to-noise measurement on a YPbPr black line.

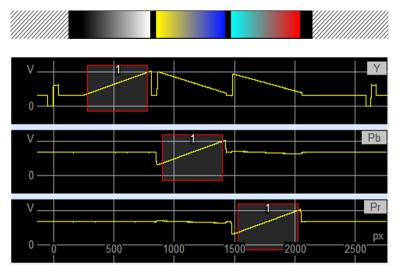


Fig. 7-32: Signal-to-noise measurement on the YPbPr "Ramp" test signal.

For the YPbPr signal, the test locations in the three video component signals can be set independently of one another.

7.5.1.4 GBR Test Signal

Fig. 7-33: Signal-to-noise measurement on a GBR black line.

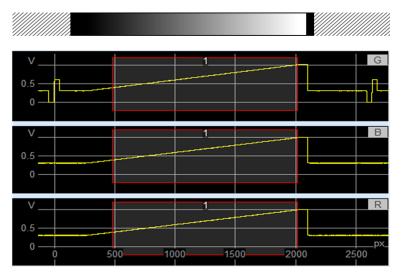


Fig. 7-34: Signal-to-noise measurement on the GBR "Ramp" test signal.

7.6 Timing

Time measurements check the temporal integrity of the video signal. This makes it possible to identify errors during the clock generation in the DUT.

7.6.1 Field Period

The **Field Period** measurement captures the period of the full field video. The measurement is taken on the sync pulses in the blanking intervals. It is therefore not necessary to make a specific test signal available for selection. The measured value is specified in µs.

7.6.2 Field Frequency

The **Field Frequency** measurement captures the repetition rate of the full field video. The measurement is taken on the sync pulses in the blanking interval. It is therefore not necessary to make a specific test signal available for selection. The measured value is specified in Hz.

7.6.3 Line Period

The Line Period measurement captures the duration of the video lines. The measurement is taken on the sync pulses in the blanking interval. It is therefore not necessary to make a specific test signal available for selection. The measured value is specified in μ s.

7.6.4 Line Frequency

The **Line Frequency** measurement captures the repetition rate of the video lines. The measurement is taken on the sync pulses in the video content. It is therefore not necessary to make a specific test signal available for selection. The measured value is specified in Hz.

7.6.5 Lum Bar Duration

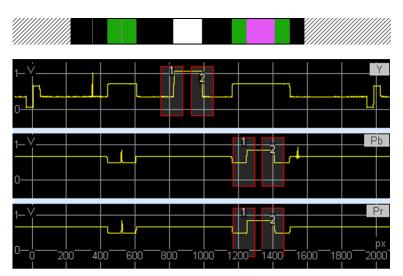
The Lum Bar Duration measurement captures the width of the white pulse and thus the timing in the active picture range. The test signal is a test line with a white pulse as contained in the "T2 Pulse & Bar" test line. The measured value is specified in μ s.

7.6.5.1 Test Locations

Test	t locations	
1	Rising Slope	Position of the rising slope for the white pulse
2	Falling Slope	Position of the falling slope for the white pulse

Table 7-15: Test locations for the luminance bar duration measurement.

The position of the rising slope of the luminance bar also serves as time reference point for all other measurements. This automatically compensates for any shifts of the picture content relative to the synchronous frame. If the luminance bar is not present, the nominal value is used as reference.



7.6.5.2 YPbPr Test Signal



For the YPbPr signal, the test locations in the three video component signals can be set independently of one another.

7.6.5.3 GBR Test Signal

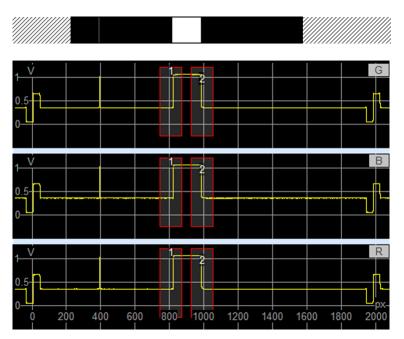


Fig. 7-36: Measuring the luminance bar duration on GBR "2T Pulse & Bar" test signal.

7.7 Jitter

Jitter measurements assess the temporal stability of the video signal. With digital processing of the video signal in UEs, signal jitter is typically no longer visible in the picture. However, the jitter measurement still makes sense because it can be used to identify problems during clock regeneration in the DUT.

The measurement is taken on the sync pulses in the active video content. It is therefore not necessary to make a specific test signal available for selection.

7.7.1 Line Jitter Pos Peak, Line Jitter Neg Peak, Line Jitter pp

The Line Jitter Pos Peak and Line Jitter Neg Peak measurements capture the longest or the shortest video line in full field. The difference to the average length of all video lines in full field is output. The Line Jitter pp measurement specifies the sum of the Line Jitter Pos Peak and Line Jitter Neg Peak measurements. The measured value is specified in ns.

7.7.2 Line Jitter Std. Deviation

Line Jitter Std. Dev specifies the standard deviation of the line duration of all lines of a full field. No unit is assigned to the measured value.

8 Ordering Information

Designation	Туре	Order No.
Video Test Center (base unit, 4 HU)	R&S®VTC	2115.7400.02
Video Tester (base unit, 3 HU)	R&S®VTE	2115.7300.02
Compact Video Tester (base unit, 1 HU)	R&S®VTS	2115.7100.02
Broadcast Test Center (base unit, 4 HU)	R&S®BTC	2114.3000.02
Analog A/V RX (input module)	R&S®VT-B2370	2115.7600.06
Broadcast TX Modulator (+ coder options, not for R&S®BTC)	R&S®VT-B600	2115.7522.06
Video Analysis (software)	R&S®VT-K2100	2115.8029.02
Video Measurements (software)	R&S®VT-K2101	2115.8264.02
Component Support (software)	R&S®VT-K2371	2115.8258.02

Appendix

A Rohde & Schwarz Combined Test Pattern

A.1 Test Signal Mapping of Interlaced Formats

Simul	720 x 480i - Field 1	Active Field Line			Full Flield Line		
Signal	720 X 4801 - Field 1	First	Middle	Last	First	Middle	Last
Color Bars GBR		1	15	29	22	29	36
Color Bars Y,Cb,Cr		32	46	59	37	44	51
Horizontal Sweep GBR		63	76	89	52	59	66
Horizontal Sweep Y.Cb,Cr		94	107	119	67	74	81
Multiburst RGB		125	137	149	82	89	96
Multiburst Y.Cb,Cr mixed		156	168	179	97	104	111
Multiburst Y.Cb,Cr half		187	198	209	112	119	126
Sin(x)/x RGB		218	229	239	127	134	141
Sin(x)/x Y,Cb,Cr		249	259	269	142	149	156
2T Pulse and Bar GBR		280	290	299	157	164	171
2T Pulse and Bar Y,Cb,Cr		311	320	329	172	179	186
Ramp RGB		342	351	359	187	194	201
Valid Ramp Y,Cb,Cr(GBR)		373	381	389	202	209	216
Stairs RGB		404	412	419	217	224	231
Valid Stairs Y,Cb,Cr(GBR)		435	442	449	232	239	246
Quiet Line		466	473	479	247	254	261
Signal	720 x 480i - Field 2	Active Fiel		ive Field Line		Full Flield Line	
Signal	720 X 4801 - Field 2	First	Middle	Last	First	Middle	Last
Color Bars GBR		2	16	30	285	292	299
Color Bars Y,Cb,Cr		33	47	60	300	307	314
Horizontal Sweep GBR		64	77	90	315	322	329
Horizontal Sweep Y.Cb,Cr		95	108	120	330	337	344
Multiburst RGB		126	138	150	345	352	359
Multiburst Y.Cb,Cr mixed		157	169	180	360	367	374
Multiburst Y.Cb,Cr half		188	199	210	375	382	389
Sin(x)/x RGB		219	230	240	390	397	404
Sin(x)/x Y,Cb,Cr		250	260	270	405	412	419
2T Pulse and Bar GBR		281	291	300	420	427	434
2T Pulse and Bar Y,Cb,Cr		312	321	330	435	442	449
Ramp RGB		343	352	360	450	457	464
Valid Ramp Y,Cb,Cr(GBR)		374	382	390	465	472	479
Stairs RGB		405	413	420	480	487	494
Valid Stairs Y,Cb,Cr(GBR)		436	443	450	495	502	509
Quiet Line		467	474	480	510	517	524

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Signal 1920 x 1080i - Field 2 First Middle Last First Middle Last Color Bars GBR 2 35 67 584 601 617 Color Bars Y,Cb,Cr 33 68 103 618 634 650 Horizontal Sweep Y,Cb,Cr 95 135 175 668 701 717 Multiburst RGB 126 169 211 718 735 751 Multiburst Y,Cb,Cr mixed 157 202 247 752 768 784 Multiburst Y,Cb,Cr nixed 157 202 247 752 768 784 Multiburst Y,Cb,Cr nixed 188 236 283 785 802 818 Sin(x)/x RGB 250 303 355 852 869 885 21Pulse and Bar GBR 281 336 391 886 902 918 21Pulse and Bar Y,Cb,Cr 312 370 427 919 936 952	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y.Cb,Cr Multiburst RGB Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr nixed Multiburst Y.Cb,Cr nixed Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Valid Stairs Y,Cb,Cr(GBR)		1 32 63 94 125 156 187 218 249 280 380 380 342 373 404	34 67 101 134 168 201 235 268 302 335 369 402 436 469 503	66 102 138 174 210 246 282 318 354 354 390 426 462 498 534 570	21 555 888 122 155 189 222 2566 2899 3233 3566 3900 4233 457 490	38 71 105 138 172 205 239 272 306 339 373 373 406 440 440 473 507	54 87 121 154 225 288 322 355 389 422 456 489 523
Color Bars GBR 2 35 67 584 601 617 Color Bars Y,Cb,Cr 33 68 103 618 634 650 Horizontal Sweep GBR 64 102 139 651 668 684 Horizontal Sweep Y.Cb,Cr 95 135 175 685 701 717 Multiburst RGB 157 202 247 752 768 784 Multiburst Y.Cb,Cr mixed 157 202 247 752 768 784 Multiburst Y.Cb,Cr half 188 236 283 785 802 818 Sin(x)/x Y,Cb,Cr 250 303 355 852 869 885 2T Pulse and Bar GBR 281 336 391 886 902 918 2T Pulse and Bar Y,Cb,Cr 334 403 463 953 969 985 Yalid Ramp Y,Cb,Cr(GBR) 343 403 463 953 969 985 Yalid Stairs Y,Cb,	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y.Cb,Cr Multiburst RGB Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr nixed Multiburst Y.Cb,Cr nixed Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Valid Stairs Y,Cb,Cr(GBR)		1 32 63 94 125 156 187 218 249 280 311 342 373 404 4435	34 67 101 134 168 201 235 268 302 335 369 402 436 469 503 536	66 102 138 174 210 246 282 318 354 390 426 462 498 534 570 606	21 555 888 122 155 189 222 2566 289 323 3566 3900 423 457 490 524	38 71 105 138 172 205 239 272 306 339 272 306 339 373 406 440 473 507 540	54 87 121 154 2255 288 322 355 389 422 456 489 523 556
Color Bars Y,Cb,Cr 33 68 103 618 634 650 Horizontal Sweep GBR 64 102 139 651 668 684 Horizontal Sweep Y.Cb,Cr 95 135 175 685 701 717 Multiburst NCb,Cr mixed 126 169 211 718 735 751 Multiburst Y.Cb,Cr half 188 236 283 785 802 818 Sin(x)/x Y,Cb,Cr 250 303 355 852 869 885 2T Pulse and Bar GBR 281 336 391 886 902 918 2T Pulse and Bar Y,Cb,Cr 312 370 427 919 936 952 Ramp RGB 343 403 463 953 969 985 Valid Ramp Y,Cb,Cr(GBR) 314 437 499 986 1003 1019 Valid Stairs Y,Cb,Cr(GBR) 436 504 571 1053 1070 1086	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y,Cb,Cr mixed Multiburst Y.Cb,Cr mixed Multiburst Y,Cb,Cr mixed Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line		1 32 63 94 125 156 187 218 249 280 311 342 373 404 4435	34 67 101 134 168 201 235 268 302 335 369 402 436 469 503 536 ve Field	66 102 138 174 210 246 282 318 354 390 426 462 498 534 570 606	21 555 888 122 155 189 222 2566 289 323 3566 3900 423 457 490 524	38 71 105 138 172 205 239 272 306 339 272 306 339 373 406 440 473 507 540	54 87 121 154 2255 288 322 355 389 422 456 489 523 556
Horizontal Sweep GBR 64 102 139 651 668 684 Horizontal Sweep Y.Cb,Cr 95 135 175 685 701 717 Multiburst RGB 126 169 211 718 735 751 Multiburst Y.Cb,Cr mixed 157 202 247 752 768 784 Multiburst Y.Cb,Cr half 188 236 283 785 802 818 Sin(x)/x RGB 219 269 319 819 835 851 Sin(x)/x Y.Cb,Cr 250 303 355 852 869 885 2T Pulse and Bar GBR 281 336 391 886 902 918 2T Pulse and Bar Y.Cb,Cr 312 370 427 919 936 952 Ramp RGB 343 403 463 953 969 985 Valid Ramp Y.Cb,Cr(GBR) 374 437 499 986 1003 1019 Valid Stairs Y.Cb,Cr(G	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y,Cb,Cr mixed Multiburst Y.Cb,Cr mixed Multiburst Y,Cb,Cr mixed Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line	1920 x 1080i - Field 2	1 32 63 94 125 156 187 218 249 280 311 342 373 3404 435 466 Act	34 67 101 134 168 201 235 268 302 335 369 402 436 469 503 536 ve Field	66 102 138 174 210 282 318 354 390 426 462 498 534 570 606 Line	21 55 88 122 155 222 256 289 323 356 390 423 457 490 524 Fu	38 71 105 138 172 205 239 272 306 339 373 406 440 473 507 540	54 87 121 154 255 288 322 355 389 422 456 489 523 556 ine
Horizontal Sweep GBR 64 102 139 651 668 684 Horizontal Sweep Y.Cb,Cr 95 135 175 685 701 717 Multiburst RGB 126 169 211 718 735 751 Multiburst Y.Cb,Cr mixed 157 202 247 752 768 784 Multiburst Y.Cb,Cr half 188 236 283 785 802 818 Sin(x)/x RGB 219 269 319 819 835 851 Sin(x)/x Y.Cb,Cr 250 303 355 852 869 885 2T Pulse and Bar GBR 281 336 391 886 902 918 2T Pulse and Bar Y.Cb,Cr 312 370 427 919 936 952 Ramp RGB 343 403 463 953 969 985 Valid Ramp Y.Cb,Cr(GBR) 374 437 499 986 1003 1019 Valid Stairs Y.Cb,Cr(G	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Sin(x)/x RGB Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal	1920 x 1080i - Field 2	1 32 63 94 125 156 187 218 249 280 311 342 373 404 435 466 Act First	34 67 101 134 168 201 235 268 302 335 369 402 436 469 503 536 ve Field Middle	66 102 138 174 210 282 318 354 390 426 462 498 534 570 606 Line Last	21 55 88 122 155 289 222 256 289 323 356 390 423 457 490 524 Fu First	38 71 105 205 239 272 306 339 373 406 440 473 507 540 1 Field Li Middle	54 87 121 158 221 255 288 322 355 389 422 456 489 523 556 ine Last
Horizontal Sweep Y.Cb,Cr 95 135 175 685 701 717 Multiburst RGB 126 169 211 718 735 751 Multiburst Y.Cb,Cr mixed 157 202 247 752 768 784 Multiburst Y.Cb,Cr half 188 236 283 785 802 818 Sin(x)/x RGB 219 269 319 819 835 851 Sin(x)/x Y.Cb,Cr 250 303 355 852 869 885 2T Pulse and Bar GBR 281 336 391 886 902 918 2T Pulse and Bar Y,Cb,Cr 312 370 427 919 936 952 Ramp RGB 343 403 463 953 969 985 Valid Ramp Y,Cb,Cr(GBR) 374 437 499 986 1003 1019 Stairs RGB 405 470 535 1020 1036 1052 Valid Stairs Y,Cb,Cr(GBR) 31070 1086 436 504 571 1053 1070	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep GBR Multiburst RGB Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Sin(x)/x RGB Sin(x)/x RGB ZT Pulse and Bar GBR 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR	1920 x 1080i - Field 2	1 32 63 94 125 1566 187 218 249 280 311 342 373 404 404 435 466 Act First 2	34 67 101 134 168 201 235 268 302 335 369 402 436 469 503 536 ve Field Middle	66 102 138 174 210 246 282 318 354 390 426 467 467 534 570 606 Line Last 67	21 55 88 122 155 189 222 256 289 323 356 390 423 457 490 524 First 584	38 71 105 138 172 205 239 272 306 339 373 406 440 473 507 540 I Field L Middle 601	54 87 121 158 221 255 288 322 355 389 422 456 489 523 556 ine Last 617
Multiburst RGB 126 169 211 718 735 751 Multiburst Y.Cb, Cr mixed 157 202 247 752 768 784 Multiburst Y.Cb, Cr mixed 188 236 283 785 802 818 Sin(x)/x RGB 219 269 319 819 835 851 Sin(x)/x Y,Cb,Cr 250 303 355 852 869 885 2T Pulse and Bar GBR 281 336 391 886 902 918 2T Pulse and Bar Y,Cb,Cr 312 370 427 919 936 952 Ramp RGB 343 403 463 953 969 985 Valid Ramp Y,Cb,Cr(GBR) 374 437 499 986 1003 1019 Stairs RGB 405 470 535 1020 1036 1052 Valid Stairs Y,Cb,Cr(GBR) 436 504 571 1053 1070 1086	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr nixed Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars Y,Cb,Cr	1920 x 1080i - Field 2	1 32 63 94 1255 156 187 218 249 280 311 342 373 404 4435 466 Act First 2 333	34 67 101 134 168 201 235 268 302 335 369 402 435 536 536 536 536 ve Field Middle 355 68	66 102 138 174 210 246 282 318 354 390 426 462 498 534 570 606 Line Last 67 103	21 55 88 122 256 289 323 356 390 423 457 490 524 First First 584 618	38 71 105 205 239 272 306 339 373 406 440 473 507 540 I Field Li Middle 601 634	54 87 121 154 188 221 255 288 322 355 389 422 456 489 523 5566 ine Last 617 650
Multiburst Y.Cb,Cr mixed 157 202 247 752 768 784 Multiburst Y.Cb,Cr half 188 236 283 785 802 818 Sin(x)/x RGB 219 269 319 819 835 851 Sin(x)/x Y,Cb,Cr 250 303 355 852 869 885 2T Pulse and Bar GBR 281 336 391 886 902 918 2T Pulse and Bar Y,Cb,Cr 312 370 427 919 936 952 Ramp RGB 343 403 463 953 969 985 Valid Ramp Y,Cb,Cr(GBR) 312 370 427 919 936 1019 Stairs RGB 403 403 463 953 969 985 Valid Stairs Y,Cb,Cr(GBR) 436 504 571 1053 1070 1086	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR	1920 x 1080i - Field 2	1 32 63 94 1255 156 187 218 249 2800 3111 342 373 404 4355 466 Act First 23 33 3	34 67 101 134 168 201 235 268 302 335 369 402 436 469 503 536 ve Field Middle 35 68 8	66 102 138 174 210 246 282 318 354 390 426 462 498 534 534 534 570 606 Line Last 67 103 139	21 55 88 122 155 289 222 256 289 323 356 390 423 457 490 524 Fust 584 618 651	38 71 105 2205 239 272 306 339 373 406 440 473 507 540 I Field L Middle 601 634 668	54 87 121 154 1888 221 255 288 322 355 389 422 456 489 523 556 ine Last 617 650 684
Multiburst Y.Cb,Cr half 188 236 283 785 802 818 Sin(x)/x RGB 219 269 319 819 835 851 Sin(x)/x Y,Cb,Cr 250 303 355 852 869 885 2T Pulse and Bar Y,Cb,Cr 281 336 391 886 902 918 2T Pulse and Bar Y,Cb,Cr 312 370 427 919 936 952 Ramp RGB 343 403 463 953 969 985 Valid Ramp Y,Cb,Cr(GBR) 374 437 499 986 1003 1019 Stairs RGB 405 470 535 1020 1036 1052 Valid Stairs Y,Cb,Cr(GBR) 436 504 571 1053 1070 1086	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Sin(x)/x RGB Sin(x)/x RGB Sin(x)/x RGB ZT Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars GBR Color Bars GBR Horizontal Sweep GBR Horizontal Sweep Y.Cb,Cr	1920 x 1080i - Field 2	1 32 63 94 1255 156 187 218 249 280 311 342 373 404 4355 466 Act First 2 333 644 95	34 67 101 134 168 201 235 268 302 335 369 402 436 469 503 536 ve Field Middle 35 68 102 135	66 102 138 174 210 246 282 318 354 390 426 462 498 534 570 606 Line Last 67 103 139 175	21 55 888 122 1555 289 323 3566 390 423 457 490 524 First 584 651 685	38 71 105 239 272 306 339 373 406 440 473 507 540 I Flield L Middle 601 634 668 701	54 87 121 154 188 221 255 288 322 355 389 422 456 489 523 556 ne Last 617 650 684 717
Sin(x)/x RGB 219 269 319 819 835 851 Sin(x)/x Y,Cb,Cr 250 303 355 852 869 885 2T Pulse and Bar GBR 281 336 391 886 902 918 2T Pulse and Bar Y,Cb,Cr 312 370 427 919 936 952 Ramp RGB Valid Ramp Y,Cb,Cr(GBR) 374 437 499 986 1003 1019 Stairs RGB 405 470 535 1020 1036 1052 Valid Stairs Y,Cb,Cr(GBR) 436 504 571 1053 1070 1086	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Sin(x)/x RGB Sin(x)/x RGB Sin(x)/x RGB T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB	1920 x 1080i - Field 2	1 32 63 94 125 156 187 218 249 280 311 342 373 404 435 466 Act First 2 333 64 95 5	34 67 101 134 168 201 235 268 302 335 369 402 436 469 503 536 402 436 469 503 536 68 402 102 135 568 102 135 5169	66 102 138 174 210 246 282 318 354 390 426 462 498 534 570 606 Line Last 67 103 139 175 211	21 55 888 122 155 289 222 256 289 323 356 390 423 457 490 524 457 490 524 Fu First 584 618 651 685 718	38 71 105 239 272 306 339 373 406 440 473 507 540 I Field L Middle 601 634 668 701 735	54 87 121 158 225 288 322 355 288 322 355 389 422 456 489 523 556 6 ine Last 617 650 680 717 751
Sin(x)/x Y,Cb,Cr 250 303 355 852 869 885 2T Pulse and Bar GBR 281 336 391 886 902 918 2T Pulse and Bar Y,Cb,Cr 312 370 427 919 936 952 Ramp RGB 343 403 463 953 969 985 Valid Ramp Y,Cb,Cr(GBR) 374 437 499 986 1003 1019 Stairs RGB 405 470 535 1020 1036 1052 Valid Stairs Y,Cb,Cr(GBR) 436 504 571 1053 1070 1086	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr mixed Sin(x)/x RGB Sin(x)/x RGB ZT Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y,Cb,Cr mixed	1920 x 1080i - Field 2	1 32 63 94 1255 156 187 218 2499 280 311 342 373 404 435 466 Act First First 2 333 64 95 1266 157	34 67 101 134 168 201 235 268 302 335 369 402 436 469 503 536 503 536 We Field Middle 355 68 102 135 68 102	66 102 138 174 210 246 282 318 354 390 426 498 534 570 606 Line Last 67 103 139 175 211 247	21 55 88 122 155 189 222 256 390 323 356 390 423 457 490 524 Fust 584 618 651 685 718 752	38 71 105 2205 239 272 306 339 373 406 440 473 507 540 Hield L Middle 601 634 668 701 735 768	54 87 121 154 188 221 255 288 322 355 389 422 456 489 523 556 ine Last 617 650 684 717 751 784
2T Pulse and Bar GBR 281 336 391 886 902 918 2T Pulse and Bar Y,Cb,Cr 312 370 427 919 936 952 Ramp RGB 343 403 463 953 969 985 Valid Ramp Y,Cb,Cr(GBR) 374 437 499 986 1003 1019 Stairs RGB 405 470 535 1020 1036 1052 Valid Stairs Y,Cb,Cr(GBR) 436 504 571 1053 1070 1086	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars GBR Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst Y,Cb,Cr mixed Multiburst Y.Cb,Cr mixed	1920 x 1080i - Field 2	1 32 63 94 1255 156 187 218 249 280 311 342 373 404 4355 466 Act First 22 2 333 64 95 126 157 7 188	34 67 101 134 168 201 235 268 302 335 369 402 435 536 9 503 536 9 503 536 9 503 536 9 503 536 9 102 135 68 8 102 135 169 202 2236	66 102 138 174 210 246 282 354 354 354 354 462 462 498 534 534 534 462 462 498 534 570 606 Line Last 677 103 139 175 2111 247 283	21 55 88 122 155 289 222 256 289 323 356 390 423 457 490 524 Fu First 584 651 685 718 651 685 718	38 71 105 2205 239 272 306 339 373 406 440 473 507 540 I Field Li Middle 601 634 668 701 735 768 802	54 87 121 154 188 221 255 288 322 355 389 422 456 489 523 556 ine Last 617 650 684 717 754 818
2T Pulse and Bar Y,Cb,Cr 919 936 952 Ramp RGB 343 403 463 953 969 985 Valid Ramp Y,Cb,Cr(GBR) 374 437 499 986 1003 1019 Stairs RGB 405 470 535 1020 1036 1052 Valid Stairs Y,Cb,Cr(GBR) 436 504 571 1053 1070 1086	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Sin(x)/x RGB Sin(x)/x RGB ZT Pulse and Bar GBR ZT Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Ramp Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep GBR Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr half Sin(x)/x RGB	1920 x 1080i - Field 2	1 32 63 94 1255 156 187 218 249 2800 3111 3422 373 404 4355 4666 Act First 23 33 64 95 126 157 188 219 230 231 249 280 280 280 280 280 280 280 280	34 67 101 134 168 201 235 268 302 3355 369 402 436 469 503 536 We Field Middle 35 68 8 102 135 169 202 236 68	66 102 138 174 210 246 282 318 354 354 390 426 462 498 534 570 606 Line Last 67 103 139 175 211 247 283 319	21 55 88 122 155 289 323 356 390 423 457 490 524 Fu First 584 618 651 685 718 752 7855 819	38 71 105 138 172 205 239 272 306 339 373 406 440 473 507 540 I Field L Middle 601 634 668 701 735 768 802 835	54 87 121 154 188 221 255 288 322 355 389 422 456 489 556 ne Last 617 650 684 717 751 784 818 851
Ramp RGB 343 403 463 953 969 985 Valid Ramp Y,Cb,Cr(GBR) 374 437 499 986 1003 1019 Stairs RGB 405 470 535 1020 1036 1052 Valid Stairs Y,Cb,Cr(GBR) 436 504 571 1053 1070 1086	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Sin(x)/x RGB Sin(x)/x RGB Color Bars GBR Valid Ramp Y,Cb,Cr(GBR) Valid Ramp Y,Cb,Cr(GBR) Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars GBR Color Bars GBR Color Bars GBR Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep GBR Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr half Sin(x)/x RGB Sin(x)/x RGB	1920 x 1080i - Field 2	1 32 63 94 1255 156 187 218 249 280 311 342 373 404 4355 466 Act First 2333 644 955 126 157 188 219 250	34 67 101 134 168 201 235 268 302 335 369 402 436 469 503 536 We Field Middle 35 68 8 08 102 236 269 202 236 269 303	66 102 138 174 210 246 282 318 354 350 426 462 498 534 570 606 Line Last 67 103 139 175 211 247 283 319 355	21 55 888 122 1555 289 323 356 390 423 457 490 524 First 584 651 685 718 752 785 819 852	38 71 105 2205 239 272 306 339 373 406 440 473 507 540 I Field L Middle 601 634 668 701 735 768 802 835 885	54 87 121 154 188 221 255 288 322 355 422 456 489 523 556 617 654 717 751 784 818 851 885
Valid Ramp Y,Cb,Cr(GBR) 374 437 499 986 1003 1019 Stairs RGB 405 470 535 1020 1036 1052 Valid Stairs Y,Cb,Cr(GBR) 436 504 571 1053 1070 1086	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Sin(x)/x RGB Sin(x)/x RGB T Pulse and Bar GBR 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars GBR Color Bars GBR Color Bars GBR Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep GBR Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr nalf Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR	1920 x 1080i - Field 2	1 32 63 94 1255 156 187 218 2499 2800 3111 342 373 404 435 466 Act First 2 333 64 955 1266 157 188 219 2500 281	34 67 101 134 168 201 235 268 302 335 369 402 436 469 503 536 We Field Middle 35 688 102 135 688 102 202 236 269 203 333	66 102 138 174 210 246 282 318 354 390 426 498 534 570 606 Line Last 67 103 139 175 211 247 283 319 355 391	21 55 88 122 155 189 222 256 390 323 356 390 423 356 390 423 457 490 524 First First 584 618 651 685 718 752 785 819 852 886	38 71 105 2205 239 272 306 339 373 406 440 473 507 540 Hield L Middle 601 634 668 701 735 768 802 835 889 902	54 87 121 154 188 221 255 288 322 355 389 422 456 489 523 556 ne Last 617 650 684 717 751 784 818 885 855 918
Stairs RGB 405 470 535 1020 1036 1052 Valid Stairs Y,Cb,Cr(GBR) 436 504 571 1053 1070 1086	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr nixed Sin(x)/x RGB 2T Pulse and Bar GBR 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar GBR	1920 x 1080i - Field 2	1 32 63 94 1255 156 187 218 249 280 3111 342 373 404 4355 466 Act First 2 333 64 95 1266 157 188 219 250 250 281 312 312	34 67 101 134 168 201 235 268 302 335 369 402 435 536 536 536 Middle 355 68 102 135 68 102 236 269 202 236 269 303 336 269	66 102 138 174 210 246 282 318 354 390 426 462 498 534 570 606 Line Last 677 103 139 175 2111 247 283 319 356 391 427	21 55 88 122 155 189 222 256 2899 323 356 390 423 457 490 524 Fu First 584 651 685 718 655 718 852 8819 852 886 919	38 71 105 2205 239 272 306 339 373 406 440 473 507 540 I Field Li Middle 601 634 668 701 634 668 701 735 768 802 835 768	54 87 121 154 188 221 255 288 322 355 389 422 456 489 523 5566 ine Last 617 650 684 717 751 784 818 851 8851 885 918
Valid Stairs Y,Cb,Cr(GBR) 436 504 571 1053 1070 1086	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr nixed Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr nalf Sin(x)/x RGB Sin(x)/x RGB Sin(x)/x RGB Sin(x)/x RGB Sin(x)/x RGB Sin(x)/x RGB Sin(x)/x RGB	1920 x 1080i - Field 2	1 32 63 94 1255 156 187 249 249 280 311 342 373 404 4355 466 Act First 22 333 64 955 126 157 188 219 250 281 312 343 342 343 342 343 342 343 342 343 342 343 342 343 342 343 343	34 67 101 134 168 201 235 268 302 335 369 402 433 536 9 503 536 9 503 536 9 503 536 9 503 536 9 503 536 9 503 536 9 202 2236 8 8 102 135 536 9 202 235 268 335 268 335 268 335 268 35 268 35 268 35 268 35 268 35 268 35 268 35 268 35 268 35 268 35 268 35 268 369 402 402 402 406 503 536 503 536 9 402 402 402 406 503 536 9 402 402 406 503 536 503 536 9 402 402 402 406 8 536 536 9 503 536 9 503 536 9 202 203 536 9 202 203 536 9 202 203 536 9 203 536 9 202 203 536 9 202 203 536 9 203 536 9 202 203 536 9 202 203 536 9 202 203 536 9 202 203 536 9 202 203 536 9 203 536 9 202 203 536 9 203 536 9 203 536 9 203 536 9 203 536 9 203 536 9 203 536 9 203 536 9 203 536 9 203 536 9 203 536 9 202 2355 268 203 536 9 203 536 203 536 202 203 536 203 536 203 536 203 536 203 536 203 536 203 536 203 536 203 536 203 536 203 536 203 536 202 203 536 202 203 536 202 203 536 202 203 536 202 203 536 202 203 536 202 203 536 202 203 536 202 203 536 202 203 536 200 203 536 200 203 50 50 200 200 200 200 200 200 200 200 2	666 102 138 174 210 246 282 318 354 354 390 426 462 498 534 534 534 534 606 Line Last 67 606 Line 247 7 283 319 355 391 3427 2463	21 55 88 122 155 289 222 256 2899 323 356 390 423 457 490 524 Fu First 584 685 718 685 718 685 718 819 852 886 919	38 71 105 2205 239 272 306 339 373 406 440 473 507 540 I Field L Middle 601 634 668 701 735 768 802 835 869 902 936 9969	54 87 121 154 188 225 288 322 355 389 422 456 489 489 523 556 ine Last 617 650 684 717 751 751 751 781 885 918 952 985
	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Sin(x)/x RGB Sin(x)/x RGB ZT Pulse and Bar GBR ZT Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars GBR Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep GBR Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr nalf Sin(x)/x RGB Sin(x)/x Y,Cb,Cr ZT Pulse and Bar GBR ZT Pulse and Bar GBR ZT Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR)	1920 x 1080i - Field 2	1 32 63 94 1255 156 187 218 249 2800 3111 3422 373 404 4355 4666 Act First 22 333 644 955 126 157 188 219 2500 2811 312 3433 374	34 67 101 134 168 201 235 268 302 3355 369 402 436 469 503 536 We Field Middle 355 68 8 102 135 169 202 236 68 303 336 370 403 336 370	66 102 138 174 210 246 282 318 354 350 426 462 498 534 570 606 Line Last 677 103 139 175 211 247 283 319 355 391 427 467 499	21 55 88 122 155 289 323 356 390 423 457 490 524 Fu First 584 618 651 685 718 752 7855 819 852 886 919 953 986	38 71 105 138 172 205 239 272 306 339 373 406 440 473 507 540 I Field L Middle 601 634 668 701 735 768 802 835 768 802 936 992 936	54 87 121 154 188 221 255 288 322 355 389 422 456 489 553 556 617 660 684 717 751 7848 851 885 918 952 985 1019
Quiet Line 467 537 607 1087 1103 1119	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Sin(x)/x RGB Sin(x)/x RGB,CC ZT Pulse and Bar GBR ZT Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars GBR Color Bars GBR Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep Y.Cb,Cr Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr nixed Multiburst Y,Cb,Cr nixed Sin(x)/x RGB Sin(x)/x RGB Sin(x)/x RGB Sin(x)/x Y,Cb,Cr ZT Pulse and Bar GBR ZT Pulse and Bar GBR ZT Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB	1920 x 1080i - Field 2	1 32 63 94 1255 156 187 218 249 2800 311 342 373 404 4355 466 Act First 22 333 64 95 126 157 188 219 2500 2811 312 374 405 280 280 280 280 280 280 280 280	34 67 101 134 168 201 235 268 302 3355 369 402 436 469 503 536 We Field Middle 35 68 8 08 102 236 269 303 336 336 3336 3336 3370 403 336 370 403	66 102 138 174 210 246 282 318 354 390 426 498 534 570 606 Line Last 677 103 139 175 211 247 283 319 355 391 427 463 499 535	21 55 888 122 1555 289 323 356 390 423 356 390 423 457 490 524 First 584 651 685 718 752 785 819 852 886 919 852 886 910	38 71 105 239 272 306 339 373 406 440 473 507 540 I Field L Middle 601 634 668 701 735 768 802 835 768 809 902 936 902 936 902	54 87 121 154 188 221 255 288 322 355 389 422 456 489 556 617 6584 717 751 784 8181 885 918 952 985 9051 1019 1052
	Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr mixed Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep GBR Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr mixed Multiburst Y,Cb,Cr notect Sin(x)/x RGB Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar GBR 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Valid Ramp Y,Cb,Cr(GBR)	1920 x 1080i - Field 2	1 32 63 94 1255 156 187 218 2499 2800 3111 342 373 404 4355 466 Act First First 1266 157 188 219 2500 2811 312 343 374 4055 4365 4375 4475 4475 4575 477	34 67 101 134 168 201 235 268 302 335 369 402 436 469 503 536 We Field Middle 355 68 102 135 68 102 2366 269 202 2366 269 303 336 269 202 236 269 202 236 268 370 202 236 268 370 203 55 268 369 402 402 402 402 402 402 402 402 402 402	66 102 138 174 210 246 282 318 354 390 426 498 534 570 606 Line 67 103 139 175 211 247 283 319 355 391 427 463 499 535 571	21 55 88 122 256 289 323 356 390 423 457 490 524 Fu Fist 584 618 651 685 718 752 785 819 852 886 919 953 986 10200 1053	38 71 105 2205 239 272 306 339 373 406 440 473 507 540 I Field Li Middle 601 634 668 701 634 668 701 7355 768 802 835 768 802 936 9902 936 969 1003	54 87 121 154 188 221 255 288 322 355 389 422 456 489 523 556 617 650 684 717 784 818 851 985 91052 9865 1019 1052 1086

0:	700 /00	Acti	ve Field	Line	Fu	ll Flield L	ine
Signal	720 x 480p	First	Middle	Last	First	Middle	Last
Color Bars GBR		1	16	30	43	58	72
Color Bars Y,Cb,Cr		31	46	60	73	88	102
Horizontal Sweep GBR		61	76	90	103	118	132
Horizontal Sweep Y.Cb,Cr		91	106	120	133	148	162
Multiburst RGB		121	136	150	163	178	192
Multiburst Y.Cb,Cr mixed		151	166	180	193	208	222
Multiburst Y.Cb,Cr half		181	196	210	223	238	252
Sin(x)/x RGB		211	226	240	253	268	282
Sin(x)/x Y,Cb,Cr		241	256	270	283	298	312
2T Pulse and Bar GBR		271	286	300	313	328	342
2T Pulse and Bar Y,Cb,Cr		301	316	330	343	358	372
Ramp RGB		331	346	360	373	388	402
Valid Ramp Y,Cb,Cr(GBR)		361	376	390	403	418	432
Stairs RGB		391	406	420	403	-	462
Valid Stairs Y,Cb,Cr(GBR)		421	400	420	463	440	402
Quiet Line		421	430	430	403		522
Quiet Line		451	400	460	493	506	522
					-		
Signal	720 x 576p		ve Field			II Flield L	
-	-	First	Middle	Last	First	Middle	Last
Color Bars GBR		1	19	36	45		80
Color Bars Y,Cb,Cr		37	55	72	81	99	116
Horizontal Sweep GBR		73	91	108	117	135	152
Horizontal Sweep Y.Cb,Cr		109	127	144	153	171	188
Multiburst RGB		145	163	180	189	207	224
Multiburst Y.Cb,Cr mixed		181	199	216	225	243	260
Multiburst Y.Cb,Cr half		217	235	252	261	279	296
Sin(x)/x RGB		253	271	288	297	315	332
Sin(x)/x Y,Cb,Cr		289	307	324	333	351	368
2T Pulse and Bar GBR		325	343	360	369	387	404
2T Pulse and Bar Y,Cb,Cr		361	379	396	405	423	440
Ramp RGB		397	415	432	441	459	476
Valid Ramp Y,Cb,Cr(GBR)		433	451	468	477	495	512
Stairs RGB		469	487	504	513	531	548
Valid Stairs Y,Cb,Cr(GBR)		505	523	540	549	567	584
Quiet Line		541	559	576	585	603	620
4010121110		011	000	010	000	000	020
		Acti	ve Field	Line	Fu	ll Flield L	ine
Signal	1280 x 720p	First	Middle	Last	First	Middle	Last
Color Bars GBR		1	23	45	26	48	70
Color Bars Y,Cb,Cr		46	68	90	71	93	115
Horizontal Sweep GBR		91	113	135	116	138	160
Horizontal Sweep Y.Cb,Cr		136	158	180	161	183	205
Multiburst RGB		181	203	225	206	228	250
Multiburst Y.Cb,Cr mixed		226	248	270	251	273	295
		220		315			340
		271			206	318	
Multiburst Y.Cb,Cr half		271	293		296	318	
Multiburst Y.Cb,Cr half Sin(x)/x RGB		316	338	360	341	363	385
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr		316 361	338 383	360 405	341 386	363 408	385 430
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR		316 361 406	338 383 428	360 405 450	341 386 431	363 408 453	385 430 475
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr		316 361 406 451	338 383 428 473	360 405 450 495	341 386 431 476	363 408 453 498	385 430 475 520
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB		316 361 406 451 496	338 383 428 473 518	360 405 450 495 540	341 386 431 476 521	363 408 453 498 543	385 430 475 520 565
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR)		316 361 406 451 496 541	338 383 428 473 518 563	360 405 450 495 540 585	341 386 431 476 521 566	363 408 453 498 543 588	385 430 475 520 565 610
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB		316 361 406 451 496 541 586	338 383 428 473 518 563 608	360 405 450 540 585 630	341 386 431 476 521 566 611	363 408 453 498 543 588 633	385 430 475 520 565 610 655
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR)		316 361 406 451 496 541 586 631	338 383 428 473 518 563 608 653	360 405 450 540 585 630 675	341 386 431 476 521 566 611 656	363 408 453 498 543 588 633 678	385 430 475 520 565 610 655 700
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB		316 361 406 451 496 541 586	338 383 428 473 518 563 608	360 405 450 540 585 630	341 386 431 476 521 566 611	363 408 453 498 543 588 633 678	385 430 475 520 565 610 655 700
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR)		316 361 406 451 496 541 586 631 676	338 383 428 473 518 563 608 653 698	360 405 450 495 540 585 630 675 720	341 386 431 476 521 566 611 656 701	363 408 453 498 543 588 633 678 723	385 430 475 520 565 610 655 700 745
Multiburst Y.Cb,Cr half Sin(x)/x RGB Zin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line	1920 x 1080p	316 361 406 451 541 586 631 676 Acti	338 383 428 473 518 563 608 653 698 ve Field	360 405 450 540 585 630 675 720	341 386 431 476 521 566 611 656 701 Fu	363 408 453 498 543 588 633 678 723	385 430 475 520 565 610 655 700 745
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR)	1920 x 1080p	316 361 406 451 496 541 586 631 676	338 383 428 473 518 563 608 653 698	360 405 450 495 540 585 630 675 720	341 386 431 476 521 566 611 656 701	363 408 453 498 543 588 633 678 723	385 430 475 520 565 610 655 700 745
Multiburst Y.Cb,Cr half Sin(x)/x RGB Zin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line	1920 x 1080p	316 361 406 451 541 586 631 676 Acti	338 383 428 473 518 563 608 653 698 ve Field	360 405 450 540 585 630 675 720	341 386 431 476 521 566 611 656 701 Fu	363 408 453 498 543 588 633 678 723	385 430 475 520 565 610 655 700 745 745 ine Last
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal	1920 x 1080p	316 361 406 451 586 631 676 Acti First	338 383 428 473 518 563 608 653 698 ve Field Middle	360 405 450 585 630 675 720 Line Last	341 386 431 476 521 566 611 656 701 Fu Fu	363 408 453 498 543 588 633 678 723 I Flield L Middle	385 430 475 520 565 610 655 700 745 745 ine Last 108
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR	1920 x 1080p	316 361 406 451 586 631 676 Acti First 1	338 383 428 473 518 563 608 653 698 ve Field Middle 34	360 405 450 540 585 630 675 720 Line Last 67	341 386 431 476 521 566 611 656 701 Fu Fust 42	363 408 453 498 543 588 633 678 723 Il Flield L Middle 75 142	385 430 475 520 565 610 655 700 745 ine Last 108 175
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars Y,Cb,Cr	1920 x 1080p	316 361 406 451 586 631 676 Acti First 1 68	338 383 428 473 518 563 608 653 698 ve Field Middle 34 101	360 405 450 540 585 630 675 720 Line Last 67 134	341 386 431 476 521 566 611 656 701 Fu Fu First 42 109	363 408 453 498 543 588 633 678 723 Il Flield L Middle 75 142	385 430 475 520 565 610 655 700 745 ine Last 108 175 242
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR	1920 x 1080p	316 361 406 451 541 586 631 631 631 676 First 1 68 135	338 383 428 473 518 563 653 653 658 ve Field Middle 34 101 168	360 405 450 540 585 630 675 720 Line Last 67 134 201	341 386 431 476 521 566 611 656 701 Fu Fu Fu 42 109 176	363 408 453 498 543 588 678 723 I Field L Middle 75 142 209 276	385 430 475 520 565 610 655 700 745 700 745 108 108 175 242 309
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr	1920 x 1080p	316 361 406 451 541 586 631 676 First 1 68 135 202	338 383 428 473 518 563 608 653 698 ve Field Middle 34 101 168 235	360 405 450 585 630 675 720 Line Last 67 134 201 268	341 386 431 476 521 566 611 656 701 Fu Fu Fu Fus 42 109 176 243	363 408 453 498 543 588 678 723 I Field L Middle 75 142 209 276	385 430 475 520 565 700 745 700 745 108 175 242 242 309 376
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x P,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst RGB	1920 x 1080p	316 361 406 451 541 586 631 676 Acti First 1 68 135 202 269	338 383 428 473 518 563 608 653 698 Ve Field Middle 34 101 168 235 302	360 405 450 540 585 630 675 720 Line Last 67 134 201 268 335	341 386 431 476 566 611 656 701 Fu Fu Fu 42 109 176 243 310	363 408 453 498 543 588 633 678 723 Il Field L 75 142 209 276 343 410	385 430 475 520 565 700 745 ine Last 108 175 242 309 376 443
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y,Cb,Cr Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr nixed Multiburst Y.Cb,Cr nalf	1920 x 1080p	316 361 406 541 586 631 676 First 1 68 135 202 269 336 403	338 383 428 473 518 563 608 653 698 We Field Middle 34 101 168 235 302 369 436	360 405 450 5540 585 630 675 720 Last 67 134 201 268 335 402 469	341 386 431 521 556 611 656 611 656 701 Fut Frst 42 109 176 243 310 377 444	363 408 453 543 588 633 678 723 11 Field L Middle 75 142 209 276 343 3410 410	385 430 475 565 610 655 700 745 ine Last 108 175 242 309 376 443 510
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep GBR Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr half Sin(x)/x RGB	1920 x 1080p	316 361 451 586 631 676 First 1 676 First 1 68 8 8 335 202 269 336 403 470	338 383 428 473 518 563 608 653 698 We Field Middle 34 101 168 235 302 369 436 503	360 405 495 540 585 630 675 720 Line Last 67 134 201 268 335 402 469 536	341 386 431 501 501 501 656 701 First 42 109 176 243 310 377 444 511	363 408 453 498 543 588 678 723 Il Flield L Middle 75 142 209 276 343 410 477 544	385 430 475 520 565 610 655 700 745 ine Last 108 175 242 309 376 443 510 577
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x P(Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep GBR Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr naif Sin(x)/x RGB Sin(x)/x Y,Cb,Cr	1920 x 1080p	316 361 496 541 586 631 676 Acti First 1 688 135 2002 269 336 403 470 537	338 383 428 473 518 563 608 653 698 We Field Middle 34 101 168 235 302 369 436 503 570	360 405 495 540 585 630 675 720 Line Last 67 134 201 268 335 402 469 536 603	341 386 431 476 521 566 611 656 701 Fu Frst 42 109 176 243 310 377 444 511 578	363 408 453 498 543 588 633 678 723 Il Flield L Middle 75 142 209 276 343 410 477 544 611	385 430 475 565 610 655 700 745 700 745 700 745 700 745 700 745 700 745 108 175 242 309 376 443 510 577 644
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep GBR Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr nirked Multiburst Y.Cb,Cr nalf Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR	1920 x 1080p	316 361 496 541 586 631 676 Acti First 1 68 135 202 269 336 403 470 537 604	338 383 428 473 518 563 608 653 698 We Field Middle 34 101 168 235 302 369 436 503 570 637	360 405 450 5540 585 630 675 720 Line Last 67 134 201 268 335 402 469 536 603 670	341 386 431 476 521 566 611 656 701 Fu Fust 42 109 176 243 310 377 444 511 578 645	363 408 453 498 543 588 633 678 723 723 1 Field L Middle 75 142 209 276 343 410 477 544 611 678	385 430 475 565 610 655 700 745 700 745 700 745 700 745 700 745 745 108 175 242 3099 376 443 510 577 644 711
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep Y.Cb,Cr Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr naif Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar GBR		316 361 406 541 586 631 676 Acti First 1 68 135 2002 269 336 403 470 537 604 671	338 383 428 473 518 563 608 653 698 ve Field Middle 34 101 168 2355 302 369 436 500 5700 637 704	360 405 450 5540 585 630 675 720 Line Last 67 134 201 268 335 402 469 536 600 670 737	341 386 431 476 521 566 611 656 611 656 701 Fu Frst 42 109 176 243 310 377 444 511 578 645 712	363 408 453 498 543 588 633 678 723 1 li Field L Middle 75 142 209 276 343 410 477 544 611 678 745	385 430 475 565 610 655 700 745 745 745 745 745 745 745 745 242 309 376 443 510 577 644 711
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep GBR Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr cn alf Sin(x)/x RGB Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr		316 361 406 541 586 631 676 First 1 68 135 202 269 336 403 470 537 604 671 738	338 383 473 518 563 608 653 698 Middle 34 101 168 235 302 3699 436 503 570 637 704 771	360 405 495 540 585 630 675 720 Last 134 201 268 335 402 469 536 603 673 737 804	341 386 431 476 521 566 611 656 701 Fu Fust 42 109 176 243 310 377 444 511 578 645 712 779	363 408 453 498 543 588 678 723 Il Flield L 723 142 209 276 343 410 477 544 611 678 745 812	385 430 475 520 565 700 745 700 745 108 175 242 309 376 443 510 577 644 711 778 8845
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep GBR Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr naif Sin(x)/x RGB Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR)		316 361 406 451 586 631 676 First 1 68 135 202 269 336 403 470 537 604 671 738 8805	338 383 428 473 518 563 608 653 698 ve Field Middle 34 101 168 235 302 369 4366 503 570 637 704 771 1838	360 405 495 540 585 630 675 720 Line Last 67 134 201 268 335 402 469 536 603 670 737 804 871	341 386 431 476 521 566 611 656 701 Fu Frst 42 109 176 243 310 377 444 511 578 645 712 779 8846	363 408 453 498 543 588 633 678 723 Il Flield L Middle 75 142 209 276 343 410 477 544 611 678 745 812 879	385 430 475 520 565 610 655 700 745 700 745 108 175 242 309 376 443 510 577 644 711 778 845 5912
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep Y.Cb,Cr Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr chalf Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid RGB Sin(x)/x Y,Cb,Cr Stairs RGB		316 361 496 541 586 631 676 Acti First 1 68 135 202 269 336 403 470 537 604 671 738 8805 872	338 383 428 473 518 563 608 653 698 We Field Middle 34 101 168 235 302 369 436 503 570 637 704 771 838 905	360 405 495 540 585 630 675 720 Line Last 677 134 201 268 335 402 469 536 603 670 737 804 871 938	341 386 431 476 521 566 611 656 701 Fu Fus 42 109 176 243 310 377 444 511 578 645 712 779 846 913	363 408 453 498 543 588 633 678 723 Il Flield L Middle 75 142 209 276 343 410 477 544 611 678 745 812 879 946	385 430 475 520 565 610 655 700 745 700 745 700 745 700 745 242 309 376 443 510 577 644 711 778 845 912 979
Multiburst Y.Cb,Cr half Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR) Stairs RGB Valid Stairs Y,Cb,Cr(GBR) Quiet Line Signal Color Bars GBR Color Bars Y,Cb,Cr Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep GBR Horizontal Sweep GBR Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr mixed Multiburst Y.Cb,Cr naif Sin(x)/x RGB Sin(x)/x RGB Sin(x)/x Y,Cb,Cr 2T Pulse and Bar GBR 2T Pulse and Bar Y,Cb,Cr Ramp RGB Valid Ramp Y,Cb,Cr(GBR)		316 361 406 451 586 631 676 First 1 68 135 202 269 336 403 470 537 604 671 738 8805	338 383 428 473 518 563 608 653 698 ve Field Middle 34 101 168 235 302 369 4366 503 570 637 704 771 1838	360 405 495 540 585 630 675 720 Line Last 67 134 201 268 335 402 469 536 603 670 737 804 871	341 386 431 476 521 566 611 656 701 Fu Frst 42 109 176 243 310 377 444 511 578 645 712 779 8846	363 408 453 498 543 588 633 678 723 Il Flield L Middle 75 142 209 276 343 410 477 544 611 678 745 812 879 946	385 430 475 520 565 610 655 700 745

A.2 Test Signal Mapping of Progressive Formats

	A.3	Timing	and	Frequ	encies
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Parameter	Unit	720x480i	720x576i	1920x1080i	720x480p	720x576p	1280x720p	1920x1080p
Number of total lines		525	625	1125	525	625	750	1125
Frame rate	Hz	29.97/30	25	50/59.94/60	59.94/60	50	50/59.94/60	50/59.94/60
Sync pulse		Bi-Level	Bi-Level	Tri-Level	Bi-Level	Bi-Level	Tri-Level	Tri-Level
Pixel frequency	MHz	13.5	13.5	74.25	27	27	74.250	148.5
Bandwidth Y/G/B/R	MHz	4	5	30	12	12	30	60
Bandwidth Pb/Pr	MHz	2	2.5	15	6	6	15	30
2T Half amplitude duration Y/G/B/R	ns	250	200	33	83	83	33	17
2T Half amplitude duration PbPr	ns	500	400	67	167	167	67	33
10 to 90 % rise and fall time Y/G/B/R	ns	148	118	19.677	49	49	20	10
10 to 90 % rise and fall time PbPr	ns	295	236	39	98	98	39	20
Multiburst frequency Y/G/B/R packed 1	MHz	1.00	1.00	5.00	2.00	2.00	5.00	10.00
Multiburst frequency Y/G/B/R packed 2	MHz	2.00	2.00	10.00	4.00	4.00	10.00	20.00
Multiburst frequency Y/G/B/R packed 3	MHz	3.00	3.00	15.00	6.00	6.00	15.00	30.00
Multiburst frequency Y/G/B/R packed 4	MHz	4.00	4.00	20.00	8.00	8.00	20.00	40.00
Multiburst frequency Y/G/B/R packed 5	MHz	5.00	5.00	25.00	10.00	10.00	25.00	50.00
Multiburst frequency Y/G/B/R packed 6	MHz	6.00	6.00	30.00	12.00	12.00	30.00	60.00
Multiburst frequency Pb/Pr packed 1	MHz	0.50	0.50	2.50	1.00	1.00	2.50	5.00
Multiburst frequency Pb/Pr packed 2	MHz	1.00	1.00	5.00	2.00	2.00	5.00	10.00
Multiburst frequency Pb/Pr packed 3	MHz	1.50	1.50	7.50	3.00	3.00	7.50	15.00
Multiburst frequency Pb/Pr packed 4	MHz	2.00	2.00	10.00	4.00	4.00	10.00	20.00
Multiburst frequency Pb/Pr packed 5	MHz	2.50	2.50	12.50	5.00	5.00	12.50	25.00
Multiburst frequency Pb/Pr packed 6	MHz	3.00	3.00	15.00	6.00	6.00	15.00	30.00

A.4 Color Bars Signal Level

100% SDTV Color Bars	R mV	G mV	B mV	Y mV	Pb mV	Pr mV	Chr. level mV	Chr. Phase deg
White	700	700	700	700.0	0.0	0.0	0.0	n.a.
Yellow	700	700	0	620.2	-350.0	56.7	354.6	170.8
Cyan	0	700	700	490.7	118.3	-350.0	369.5	288.7
Green	0	700	0	410.9	-231.7	-293.3	373.8	231.7
Magenta	700	0	700	289.1	231.7	293.3	373.8	51.7
Red	700	0	0	209.3	-118.3	350.0	369.5	108.7
Blue	0	0	700	79.8	350.0	-56.7	354.6	350.8
Black	0	0	0	0.0	0.0	0.0	0.0	n.a.

Levels of 100 % color bars for SDTV.

100% HDTV Color Bars	R mV	G mV	B mV	Y mV	Pb mV	Pr mV	Chr. Level mV	Chr. Phase deg
White	700	700	700	700	0	0	0.0	n.a.
Yellow	700	700	0	650	-350	32	351.5	180.0
Cyan	0	700	700	551	81	-350	359.1	360.0
Green	0	700	0	501	-270	-318	416.7	180.0
Magenta	700	0	700	200	270	318	416.7	0.0
Red	700	0	0	149	-81	350	359.1	180.0
Blue	0	0	700	50	350	-32	351.5	360.0
Black	0	0	0	0	0	0	0.0	n.a.

Levels of 100 % color bars for HDTV.

B Mapping of Measurements and Test Signals

Measurement	Test signal(s)
Amplitude and delay	
Luminance Bar Amplitude	2T Pulse & Bar
Sync Amplitude	2T Pulse & Bar, Color Bars, SIN X/X, Sweep, Multiburst, Quiet Line, Ramp
Color Bar Amplitude	Color Bars
Inter Channel Delay and Amplitude	Color Bars
Linear distortions	
2T Pulse Amplitude, k-Factor and HAD	2T Pulse & Bar
ST Distortion Rise/Fall Time, Preshoot and Overshoot	2T Pulse & Bar
Nonlinear distortions	
Nonlinearity, Nonlinearity Step 1 to Step 5	2T Pulse & Bar
Frequency response	
SIN X/X Amplitude and Delay	SIN X/X
Sweep Amplitude	Sweep
Multiburst Flag Amplitude Multiburst 1 to 6 Amplitude Multiburst 1 to 6 Frequency	Multiburst
Noise measurements	
Signal to Noise Unweighted and Weighted	Quiet Line, Ramp
Timing	
Field Period and Frequency	Full Field
Line Period and Frequency	Full Field
Luminance Bar Duration	2T Pulse & Bar
Jitter	
Line Jitter	Full Field

Mapping of measurements to test signals.

C Sample Measurement Log

Measurement	Value	Lower Limit	Upper Limit	Unit	Status	Test Signal
Lum Bar Amplitude Y (nom)	0,400535	-5	5	%		2T Pulse & Bar [498 FF]
Lum Bar Amplitude Pb (nom)	0,808137	-5	5	%		2T Pulse & Bar [498 FF]
Lum Bar Amplitude Pr (nom)	1,067076	-5		%		2T Pulse & Bar [498 FF]
Sync Amplitude Y (nom)	0,109275	-10	10			Sync Line [93 FF]
Inter Channel Delay (Y - Pb)	12,774762	-100	100			Color Bars [93 FF]
Inter Channel Delay (Y - Pr)	-15,114892	-100	100			Color Bars [93 FF]
Inter Channel Delay (Pb - Pr)	-27,889654	-100	100			Color Bars [93 FF]
Inter Channel Ampl. (Y - Pb)	-0,525367	-5		%		Color Bars [93 FF]
Inter Channel Ampl. (Y - Pr)	-0,618638	-5		%		Color Bars [93 FF]
Inter Channel Ampl. (Pb - Pr)	-0,093764	-5		%		Color Bars [93 FF]
2T Pulse Amplitude Y	-0,964321	-10	10			2T Pulse & Bar [498 FF]
2T Pulse Amplitude Pb	0,796354	-10	10			2T Pulse & Bar [498 FF]
2T Pulse Amplitude Pb	0,790334	-10	10			2T Pulse & Bar [498 FF]
2T Pulse k-Factor Y	,	-10		%		
21 Pulse k-Factor Y 2T Pulse k-Factor Pb	0,457808	,		% %		2T Pulse & Bar [498 FF]
	0,42727	-0,1				2T Pulse & Bar [498 FF]
2T Pulse k-Factor Pr	0,459688	-0,1		%		2T Pulse & Bar [498 FF]
ST Dist Rise Time Y	21,767288	0	1000			2T Pulse & Bar [498 FF]
ST Dist Rise Time Pb	42,554386	0	1000			2T Pulse & Bar [498 FF]
ST Dist Rise Time Pr	42,986511	0	1000			2T Pulse & Bar [498 FF]
ST Dist Fall Time Y	21,516178	0	1000			2T Pulse & Bar [498 FF]
ST Dist Fall Time Pb	42,247524	0	1000			2T Pulse & Bar [498 FF]
ST Dist Fall Time Pr	42,455929	0	1000			2T Pulse & Bar [498 FF]
Multiburst 1 Ampl. Y (dB)	-0,087994	-1		dB		Multiburst [273 FF]
Multiburst 1 Ampl. Pb (dB)	0,062524	-1		dB		Multiburst [273 FF]
Multiburst 1 Ampl. Pr (dB)	0,044235	-1		dB		Multiburst [273 FF]
Multiburst 2 Ampl. Y (dB)	-0,173898	-1		dB		Multiburst [273 FF]
Multiburst 2 Ampl. Pb (dB)	-0,072491	-1		dB		Multiburst [273 FF]
Multiburst 2 Ampl. Pr (dB)	-0,126012	-1	1	dB		Multiburst [273 FF]
Multiburst 3 Ampl. Y (dB)	-0,430626	-1	1	dB		Multiburst [273 FF]
Multiburst 3 Ampl. Pb (dB)	0,029908	-1	1	dB		Multiburst [273 FF]
Multiburst 3 Ampl. Pr (dB)	-0,12146	-1	1	dB		Multiburst [273 FF]
Multiburst 4 Ampl. Y (dB)	-0,432895	-1	1	dB		Multiburst [273 FF]
Multiburst 4 Ampl. Pb (dB)	-0,109002	-1	1	dB		Multiburst [273 FF]
Multiburst 4 Ampl. Pr (dB)	-0,282501	-1	1	dB		Multiburst [273 FF]
Multiburst 5 Ampl. Y (dB)	-0,646353	-1	1	dB		Multiburst [273 FF]
Multiburst 5 Ampl. Pb (dB)	-0,270875	-1	1	dB		Multiburst [273 FF]
Multiburst 5 Ampl. Pr (dB)	-0,479595	-1	1	dB		Multiburst [273 FF]
Multiburst 6 Ampl. Y (dB)	-1,94915	-6	1	dB		Multiburst [273 FF]
Multiburst 6 Ampl. Pb (dB)	-3,328525	-6	1	dB		Multiburst [273 FF]
Multiburst 6 Ampl. Pr (dB)	-3,402147	-6	1	dB		Multiburst [273 FF]
Signal to Noise unw Y	64,986	70	1000	dB	LL	Quiet Line [723 FF]
Signal to Noise unw Pb	69,47361	40	1000			Quiet Line [723 FF]
Signal to Noise unw Pr	68,658592	40	1000			Quiet Line [723 FF]
Nonlinearity Y	0,841979	-0,1	10			Staircase [674 FF]
Nonlinearity Pb	0,992864	-0,1	10			Staircase [674 FF]
Nonlinearity Pr	1,161308	-0,1	10			Staircase [674 FF]
Field Period	20000	1000	99999			Full Field
			00000	30		
Line Period	26,666666	5	1000	us		Full Field

Log output for selected measurements on a YPbPr video signal.

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Regional contact

Europe, Africa, Middle East +49 89 4129 12345 customersupport@rohde-schwarz.com

North America 1 888 TEST RSA (1 888 837 87 72) customer.support@rsa.rohde-schwarz.com

Latin America +1 410 910 79 88 customersupport.la@rohde-schwarz.com

Asia Pacific +65 65 13 04 88 customersupport.asia@rohde-schwarz.com

China +86 800 810 82 28 |+86 400 650 58 96 customersupport.china@rohde-schwarz.com

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Rohde & Schwarz GmbH & Co. KG Mühldorfstraße 15 | 81671 Munich, Germany Phone + 49 89 4129 - 0 | Fax + 49 89 4129 - 13777

www.rohde-schwarz.com