



Products: R&S®DVSG Digital Video Signal Generator

Reproducible Quality Analysis of Deinterlacing and Motion Portrayal for Digital TV Displays

Application Note

The specialized R&S®*MULTI-MOTION* test sequences offered by the R&S®DVSG Digital Video Signal Generator permit a reproducible quality analysis of deinterlacing and motion portrayal for digital television (TV) displays. This makes it possible to study all potential degradations resulting from the progressive conversion separately. It also allows the various motion artefacts resulting from liquid crystal (LCD), plasma (PDP), and digital micromirror (DMD) technologies to be quantified. This Application Note explains how to draw specific conclusions from the sequence output on the test display.



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1 Overview

The specialized R&S® *MULTI-MOTION* test sequences offered by the R&S® DVSG Digital Video Signal Generator permit a reproducible quality analysis of deinterlacing and motion portrayal for digital television (TV) displays. This makes it possible to study all potential degradations resulting from the progressive conversion separately. It also allows the various motion artefacts resulting from the liquid crystal (LCD), plasma (PDP), and digital micromirror (DMD) technologies to be quantified. This Application Note explains how to draw specific conclusions from the sequence output on the test display.

2 Introduction

History

Ever since the first television was made available, static test patterns have been used to test for the desired picture quality. Now with the migration from cathode ray tubes to their digital successors, motion must also be taken into account. This is because liquid crystal (LCD), plasma (PDP), and digital micromirror (DMD) technologies are faced with two additional challenges that occur only with dynamic picture contents:

Motivation

The display of only full fields on consumer equipment requires a preliminary conversion of interlaced content. While this leads to a perfect full-field reconstruction in static areas simply by combining two consecutive fields, there exist for regions with motion a number of strategies with various advantages and disadvantages.

And motion portrayal itself has proven difficult: Compared to cathode ray tubes, where the picture is flashed briefly and then the screen returns back to dark very quickly, digital equipment shows the content of every full field significantly longer. However, the presentation time is directly proportionate to the motion blur caused in dynamic areas. Added to this are technology-specific motion artefacts such as "phosphor lag" (PDP), "false contouring" (PDP/DMD), or "colour break up" (DMD).

Conventional approach

Upgrading a static test pattern generator for use with dynamic test sequences would increase the memory requirements because of the additional images needed. For this reason, "pixel shifting" has emerged as a popular approach: Instead of storing entire sequences in memory, only the position of a single image on the screen is varied in the refresh rate. The disadvantage of this approach is the low level of complexity of motion that can be displayed.

The R&S solution

The innovative "AV Signal Player" hardware option for the R&S® DVSG Digital Video Signal Generator supports unlimited motion sequences. This is because H.264 compression is used to make the contents of the R&S® *MULTI-MOTION* test sequences of any length available in a space-saving format. Because the extremely high data rate makes the associated compression artefacts negligible, informative sequences could be developed for evaluating the deinterlacing and motion portrayal. Particular emphasis was placed on making the individual interpretation results both reproducible and distinguishable. As a result, an extensive offering of new tests is available for the areas of development and quality assurance:




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Deinterlacing	Motion portrayal
<ul style="list-style-type: none"> • Evaluation of the reconstruction quality for static/moving areas with film/video contents • Analysis of the frequency response and the edge adaptivity of the vertical interpolation filter 	<ul style="list-style-type: none"> • Quantification of the motion blur and the “phosphor lag” (PDP) • Analysis of overdrive (LCD), “false contouring” (PDP/DMD) & “colour break up” (DMD)

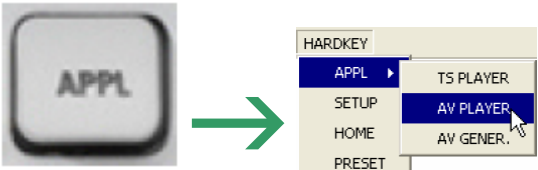
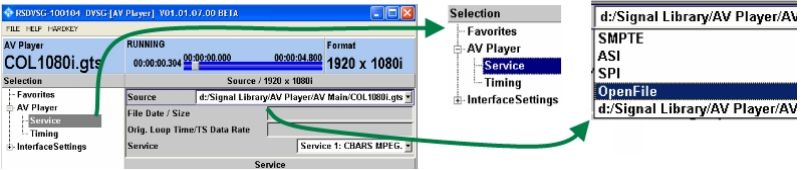
How this Application Note is organized

This Application Note explains the use of these new analysis options. The next chapter describes the general test setup. This includes important prerequisites that will ensure that the expressiveness of the display is not unnecessarily reduced by systematical errors. The test setup chapter is followed by a detailed presentation of the individual R&S® *MULTI-MOTION* test sequences, including their interpretation.

3 Test Setup

Generator		Connection		Display under test	
					
Base device	R&S® DVSG: Digital Video Signal Generator	Digital HD connection (recommended)	HDMI or HD-SDI	Noise reduction	If possible: Deactivate
Additional options	R&S® DVSG-B30: AV Signal Player (required), R&S® DVSG-K30: (required only for HD-SDI output)	Analogue HD Connection (not recommended)	D4 or component	Scaling / overscan	If possible: Select pixel-native display

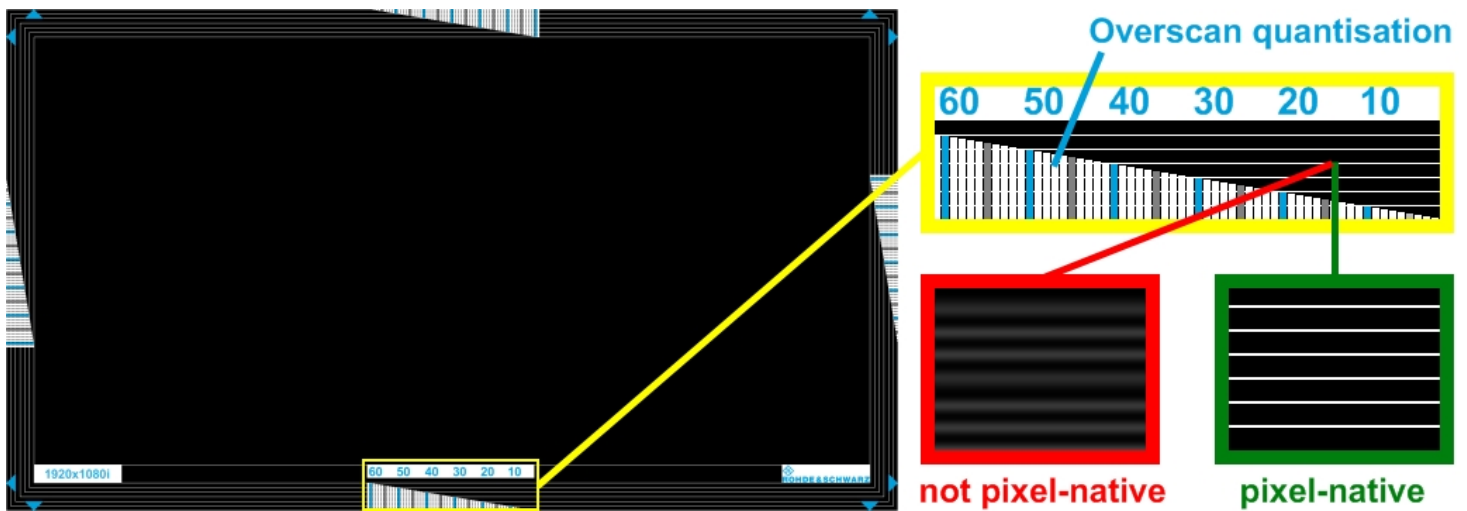
The cornerstone of the test setup is the R&S® DVSG Digital Video Signal Generator. The required hardware option R&S® DVSG-B30 “AV Signal Player” provides the audio/video (AV) interfaces and the R&S® *MULTI-MOTION* test sequences. The instrument is configured in two steps:

1. Launch the AV Signal Player application...	2. Select the desired R&S® <i>MULTI-MOTION</i> test sequence...
	
<p>...by pressing the "Application" key and then selecting "AV PLAYER".</p>	<p>...by selecting "Service" in the left tree structure and then using the middle pull-down menu to select "Open File". The individual file locations are listed in the chapter describing each sequence.</p>

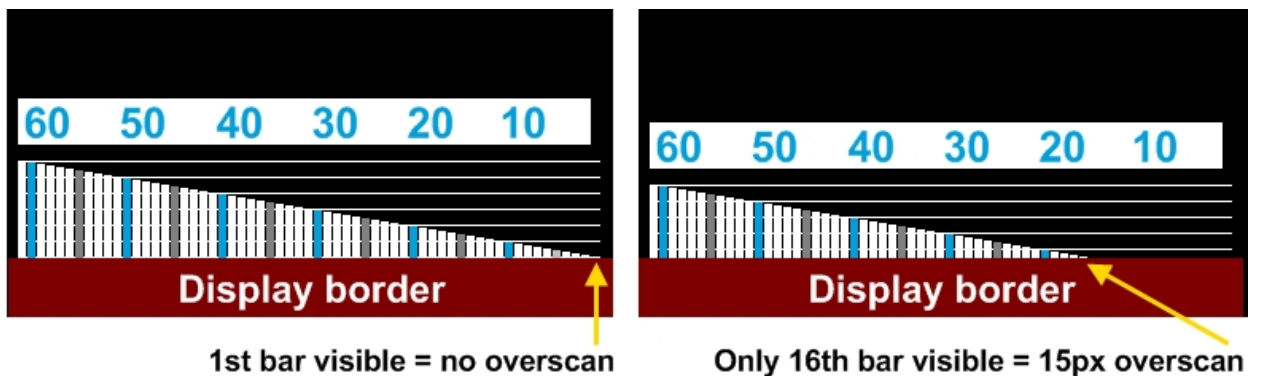
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Because all R&S® *MULTI-MOTION* test sequences are in high definition (HD), the display being studied should be connected only via HDMI or HD-SDI cable. Although the D4 or component interface can also carry HD video signals, their analogue functioning results in additional artefacts such as noise. These artefacts reduce the interpretation options of the R&S® *MULTI-MOTION* test sequences unnecessarily.

A similar situation exists with certain settings in the test display menu. Because the extent of picture detail degradation is a basic criterion for evaluating deinterlacing or motion portrayal, every further degradation resulting from the display's additional signal processing components diminishes the informative value of the R&S® *MULTI-MOTION* test sequences. This is why it is particularly important to avoid spatial filter processes used for noise reduction or image scaling. While the former can ideally be switched off, if possible a pixel-native presentation mode should be chosen during format selection so that every pixel in the video signal is mapped directly to one on the screen. Whether the latter is the case can be checked using a special frame design that is common to all R&S® *MULTI-MOTION* test sequences:



A pixel-native display is characterized by a perfect reconstruction of all six white 1-pixel-wide borderlines. If this is not the case, an activated overscan could be the cause. This can be quantified for all four picture borders using the wedge-shaped bars, whose scale makes it possible to determine the picture trim in pixels:

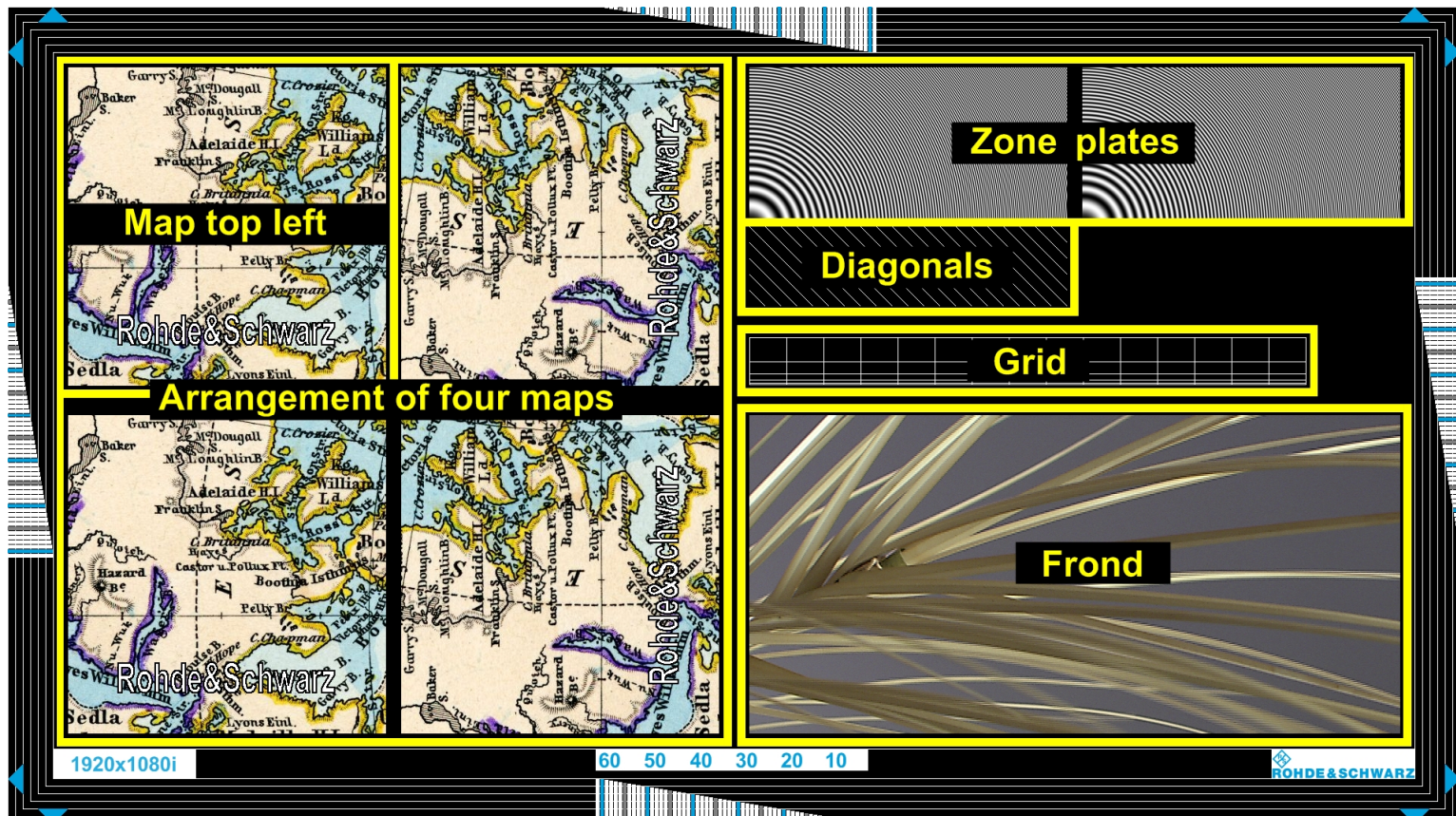


4 Quality Analysis of Deinterlacing

The ideal result of a progressive conversion is the perfect reconstruction of the missing lines. In static areas, this is as simple as copying the contents of the preceding field. However, in regions with motion, this basic temporal combination causes bothersome feathering artefacts because the consecutive fields are recorded at different times. This is why purely spatial methods are available that interpolate the missing lines from the existing lines without accessing additional fields. Although this does prevent feathering artefacts, it also cuts the vertical detail depth in half, because interpolation does not generate any new information. Moreover, the progressive conversion for consecutive fields can have different results that are observed as flickering in the refresh rate. To capitalize on the advantages, adaptive methods first use a preliminary motion detection, followed by temporal combination for static regions and a spatial process for dynamic areas. In the final analysis, motion-compensated temporal combination is the costliest: It attempts to achieve perfect results without feathering artefacts even for regions with motion.

This is why the quality analysis needs to know which strategy is used on static areas and which on moving areas. The implementation quality also has to be studied: For spatial methods, this includes an analysis of the interpolation filter's frequency response and a screening of its edge adaptivity. In the case of motion-adaptive approaches, the precision of the motion detection has to be determined. Motion-compensated methods, on the other hand, are evaluated based on their estimated motion accuracy. The following R&S® *MULTI-MOTION* test sequence meets all requirements:

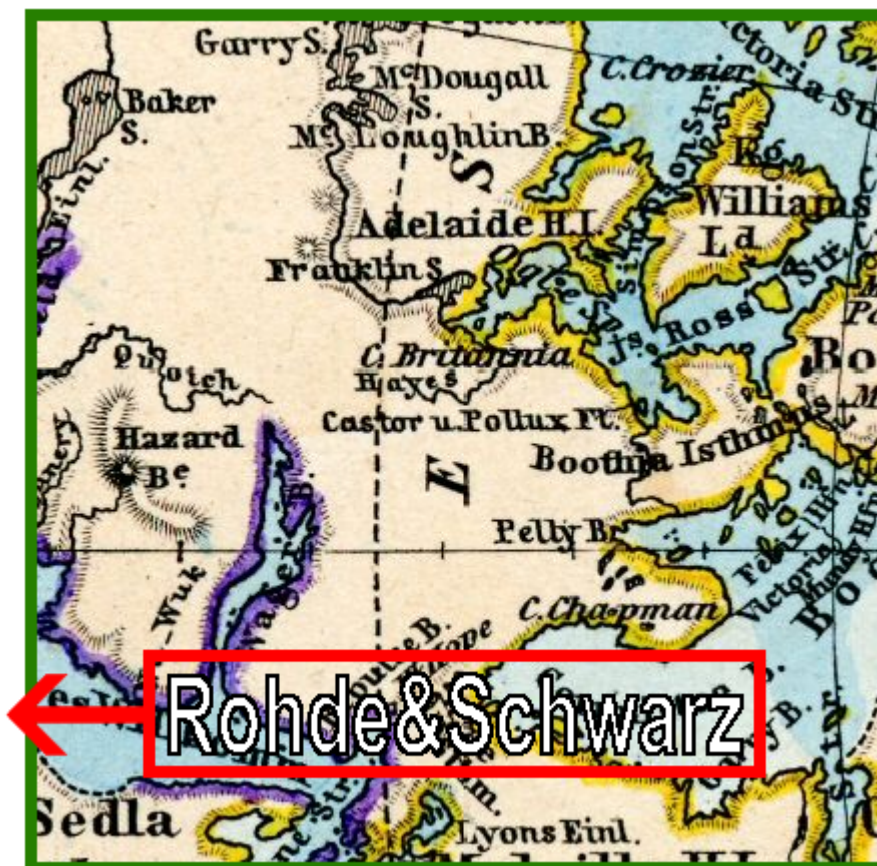
4.1 The R&S® *MULTI-MOTION* Test Sequence



Format	Full field refresh rate	Fields (duration)	File name	File size
1920x1080i	25 Hz	520 (10.4 s)	D:\Lib AV Player\AV Main\Pattern\1080i_25\DeInterlacerTest_1.avp	32.6 MB
1920x1080i	29 Hz	520 (9 s)	D:\Lib AV Player\AV Main\Pattern\1080i_29\DeInterlacerTest_1.avp	32.6 MB

The individual elements are described below. Their interpretation is the subject of Section 4.2.

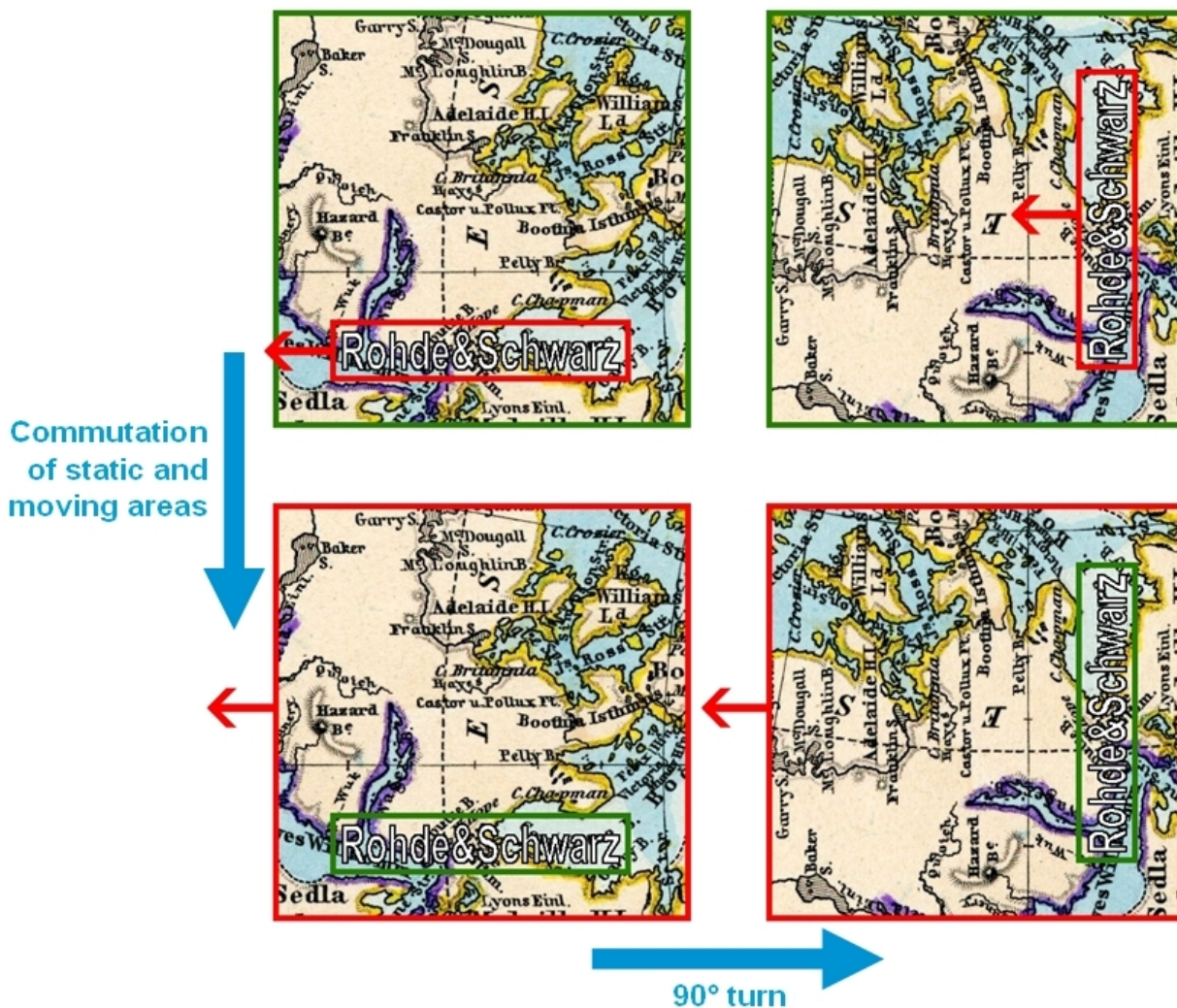
4.1.1 Map Top Left



This 420x420-pixel element consists of a static background (shown in green) with many spatial details and the "Rohde & Schwarz" lettering (marked in red). The lettering scrolls to the left at a speed of two pixels per field. Because segments that are shifted out of the background area are added back on the right, the starting position is reached again after 210 fields. After another sweep, the lettering remains stationary for the final 100 fields of the R&S® *MULTI-MOTION* test sequence.

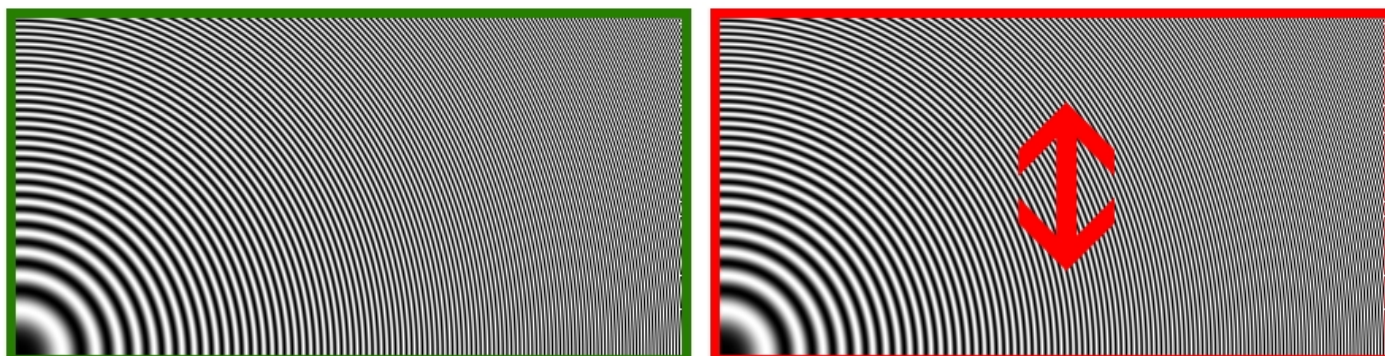
4.1.2 Arrangement of Four Maps

The static and moving areas of the maps on the lower row are swapped as compared to the upper left map: In these maps, the lettering is stationary and the background scrolls. The maps in the right column are additionally turned 90 degrees to the left:



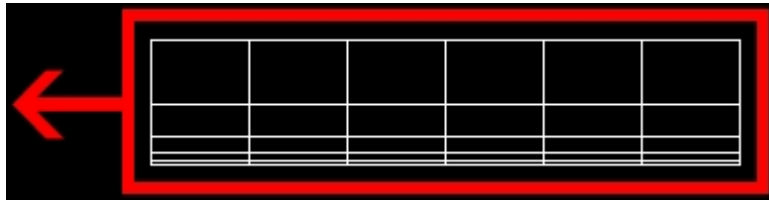
The moving area (marked in red) behaves the same for all four maps: Like with the top left example above, the image shifts two pixels per field, resulting in a total duration of 210 fields. There is no motion during the final 100 fields of the R&S®MULTI-MOTION test sequence.

4.1.3 Zone Plates



The dimensions of the left element marked in green are 420x210 pixels. The contents consist of a linear, radial spatial frequency sweep that achieves the full Nyquist frequency horizontally and the half Nyquist frequency vertically. The right element has the same characteristics and also moves down one pixel per field during the first 210 fields, to subsequently return to the starting position upwards at the same speed. This element also remains stationary during the final 100 fields.

4.1.4 Grid



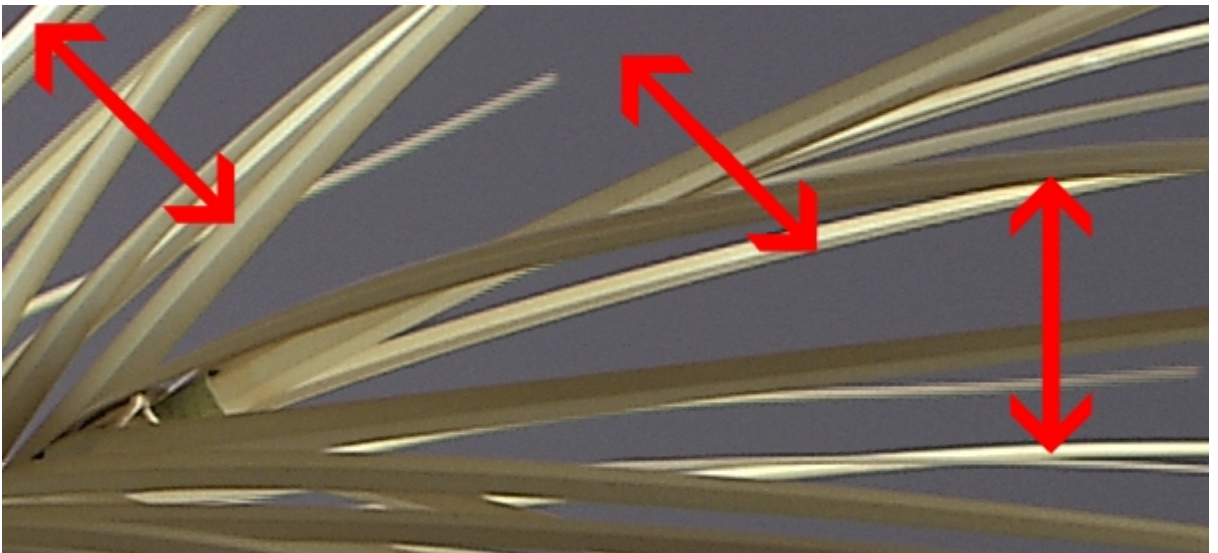
All white lines in this 840x65-pixel element have a width of one pixel. The column width is a constant 48 pixels, and the line spacing from top to bottom is 31, 15, 7, 3, and 1 pixel. This grid scrolls to the left at a rate of two pixels per field during the first 420 fields. Segments that are shifted out of the element are reinserted on the right. Here, too, the element remains stationary in the start position during the final 100 fields.

4.1.5 Diagonals



On an area of 420x105 pixels, white, one-pixel-wide 45° diagonals scroll upwards at a spacing of 20 pixels and a speed of one pixel per field. Pixels that leave the area are reinserted at the bottom. After 420 fields, the start position is reached for the fourth time, and this position is maintained for the final 100 fields.

4.1.6 Frond



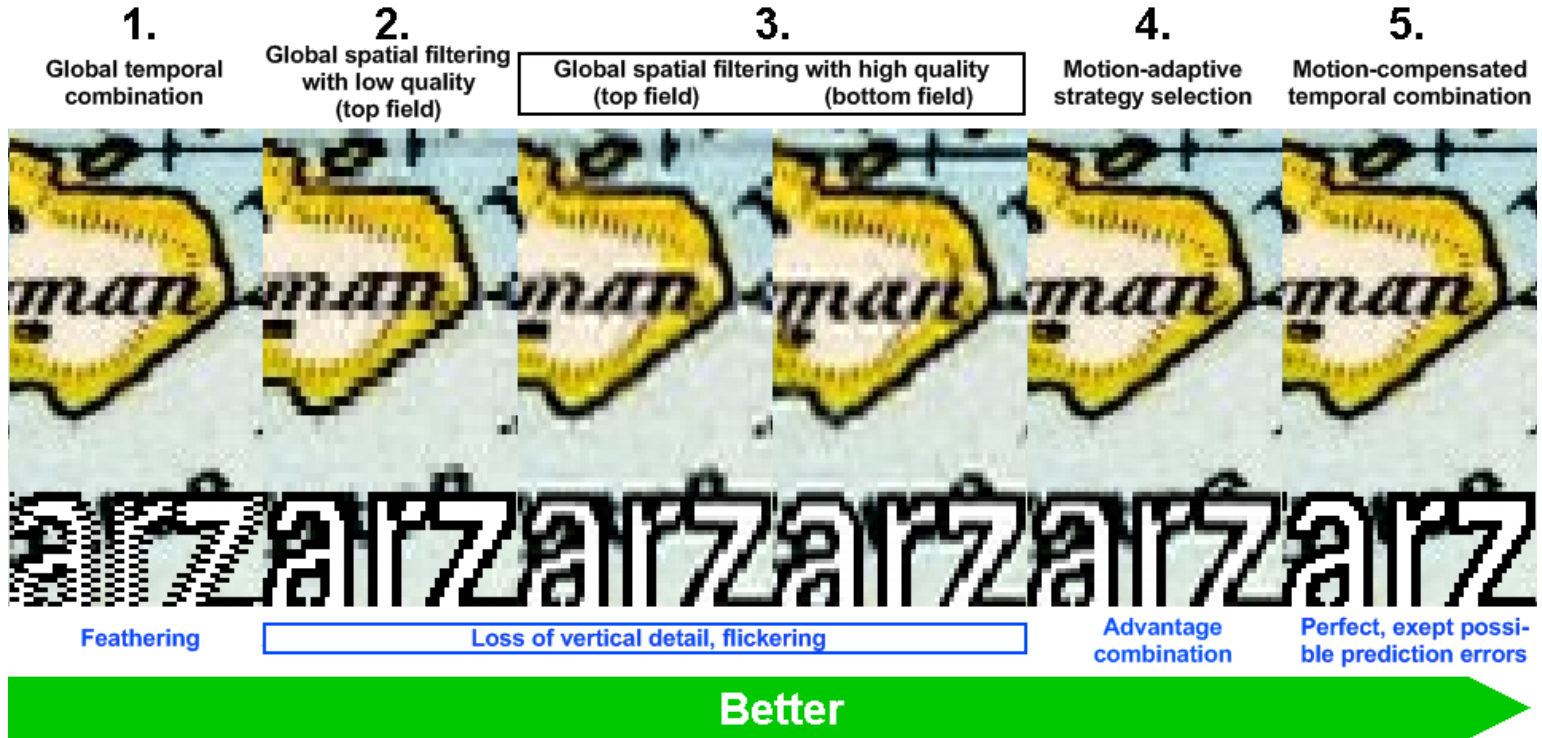
The final element of the sequence measures 860x420 pixels and consists of a very fine plant frond on a grey background whose diagonal and vertical blade movements were filmed using an HD camera. During the final 100 fields, the movement stops here as well.

4.2 Interpretation of the R&S[®] MULTI-MOTION Elements

This section describes how to use the individual elements of the R&S[®] MULTI-MOTION test sequence introduced in the previous section:

4.2.1 Determining the Deinterlacing Strategy

The deinterlacing strategy being used (black) can be determined in the top left map based on the artefacts being formed (blue):



1. Global temporal combination

⊖⊖

The simplest strategy achieves a perfect reconstruction of the static background, but this causes very disturbing feathering artefacts in the area of the moving "Rohde & Schwarz" lettering.

2. Global spatial filtering with low quality

⊖

Every spatial procedure is recognized by the associated degradation in vertical detail, which in this example significantly reduces the legibility of the "man" lettering. An initial impression of the performance of the interpolation filter being used is provided by the black border around the island, which in this case shows significant staircasing artefacts, particularly in the diagonal direction. A detailed analysis is provided in Sections 4.2.2 and 4.2.4.

3. Global spatial filtering with high quality

○

An high-quality interpolator is recognized in particular in the black border around the island as well as in the legibility of the "man" lettering. A deeper analysis of its performance is again provided in Sections 4.2.2 and 4.2.4.

Another artefact that can be used to reliably identify all spatial deinterlacing methods is seen by contrasting the top field and bottom field results: The fine black horizontal line along the top of the segment appears only in the bottom field and cannot be reconstructed in the top field through interpolation. Because the two consecutive fields have dif-

ferent results, flickering of high vertical details is seen in the field refresh rate.¹

4. Motion-adaptive strategy selection \oplus

If the static background is perfectly reconstructed through combination and if instead of feathering artefacts the moving lettering exhibit a vertical loss of resolution as a result of a spatial process, then this indicates that an adaptive process is being used. Again, a more detailed analysis of the interpolation filter quality is described in Sections 4.2.2 and 4.2.4. Section 4.2.3 addresses the analysis of motion detector precision. The lower left map also makes it possible to check whether static and dynamic areas are being handled differently: Because the roles are swapped in those maps, differing map displays indicate an adaptive process. The completely static contents during the final 100 fields of the R&S[®] *MULTI-MOTION* test sequence also offer a further comparison.

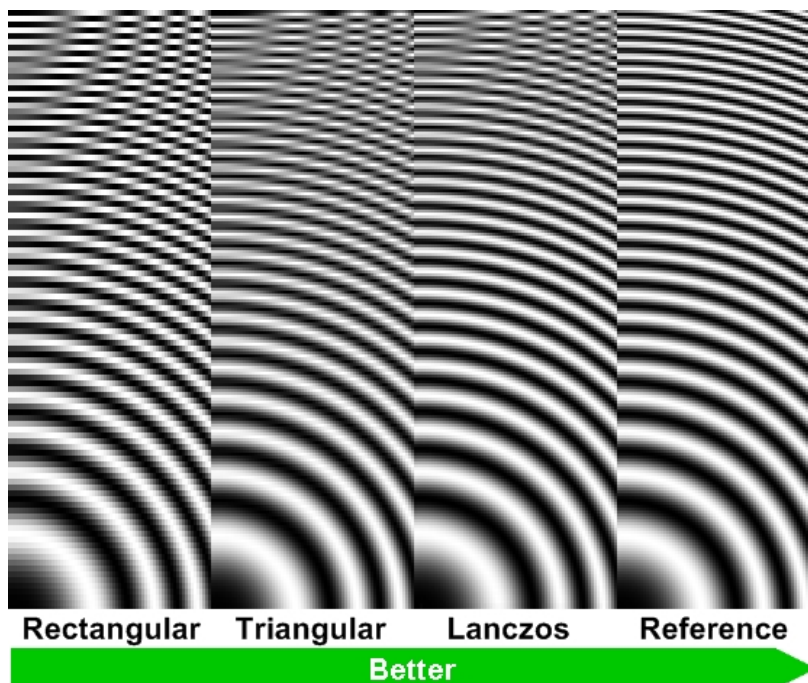
5. Motion-compensated temporal combination $\oplus\oplus$

If both the static background and the moving lettering are perfectly reconstructed, this is the result of a motion-compensated temporal combination. The precision of the motion estimator being used can be identified in the area of the "Rohde & Schwarz" lettering based on the number and severity of the pixel errors. The static final 100 fields serve as a reference.

The maps that are additionally rotated by 90° transpose the degradations in picture detail resulting from spatial interpolation (vertical) and motion blur (horizontal) so that these influences can be compared and thus differentiated.

4.2.2 Frequency Response of the Vertical Interpolation Filter

This is displayed directly on the moving right zone plate:



¹ **Global spatial filtering with field rejection** $\ominus\ominus$

To prevent flickering, some displays ignore one of the two field types and show the result of the other field twice instead: If the upper (lower) white lines of the overscan frame are missing (see Chapter 2), this indicates that the upper (lower) field was rejected.

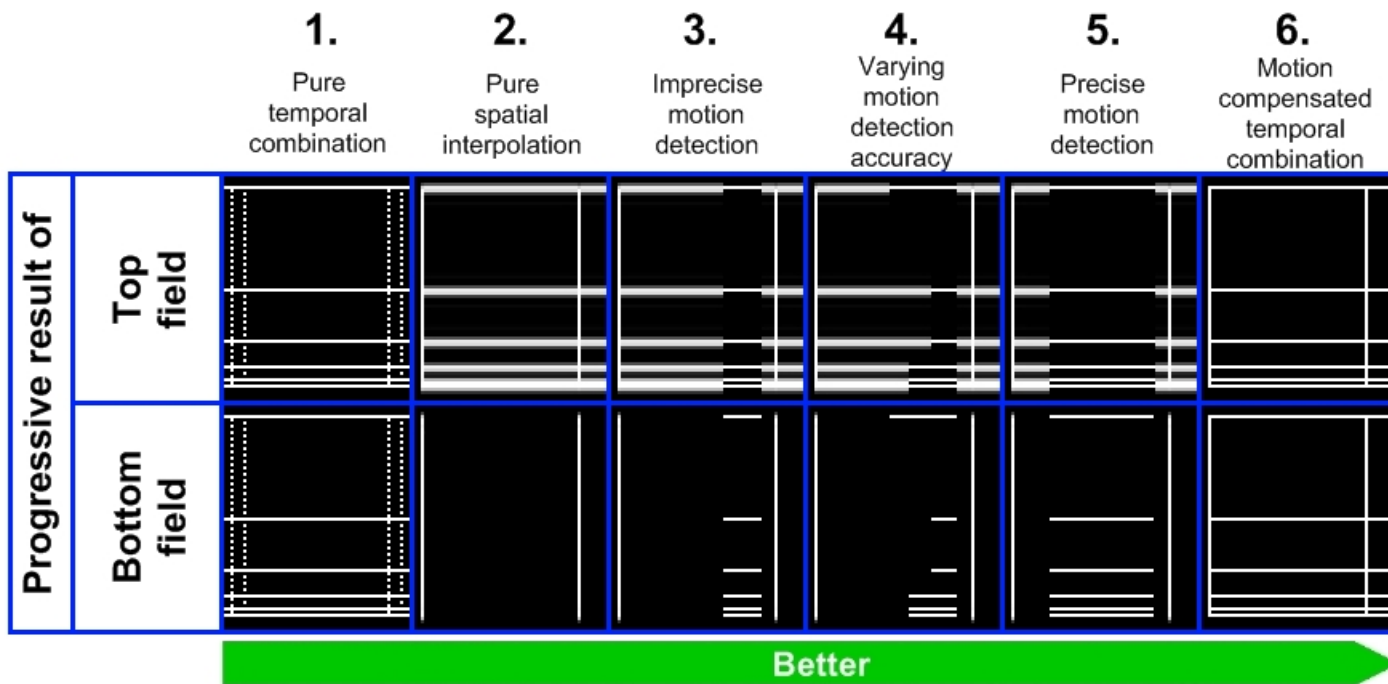
The interferences in the area of the higher vertical frequencies result through insufficient suppression of the first recurring spectrum. More basic filters are especially predisposed to this, like rectangular or triangular filters that only use two or three taps.

On the other hand, if the upper area displays a homogenous grey instead of the vertical high-frequency structure, this means that the cut-off frequency of the filter is set too low.

In an adaptive approach, the static zone plate to the left will be perfectly reconstructed and can therefore act as a reference for a direct comparison.

4.2.3 Precision of the Motion Detector

The precision of the motion detector used for adaptive deinterlacing strategies can be determined based on the differing results of spatial interpolation and temporal combination using the moving grid element. In the former, the horizontal lines become too wide when converting the upper field and are completely lost in the lower field¹. The temporal combination in static areas, on the other hand, results in a perfect reconstruction apart from the feathering artefacts:



1. Purely temporal combination ⊖⊖
Perfect horizontal lines and simultaneous feathering artefacts around the vertical lines are the result of a non-motion adaptive strategy that makes exclusive use of temporal combination.

2. Purely spatial interpolation ⊖⊖
If the horizontal lines are not reconstructed perfectly anywhere, this is not a motion-adaptive method, but rather a purely spatial deinterlacing method.

¹ Showing the results of both fields results in a highly visible flickering of the horizontal lines on the screen.

3. Imprecise motion detection

⊖

If small areas of the horizontal lines are displayed perfectly and the remaining segments have degradation in the vertical detail, this indicates a motion-adaptive method using an imprecise detector. This is because, aside from the grid borders, only the vertical lines are moving, while the pixels of the horizontal lines remain constantly white.

4. Motion detection with varying accuracy

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If the length of the perfectly reconstructed horizontal lines vary, then the accuracy of the motion detection will depend on the picture contents.

5. Precise motion detection

⊕

If the horizontal lines are displayed perfectly over large regions, then the motion detection is working accurately.

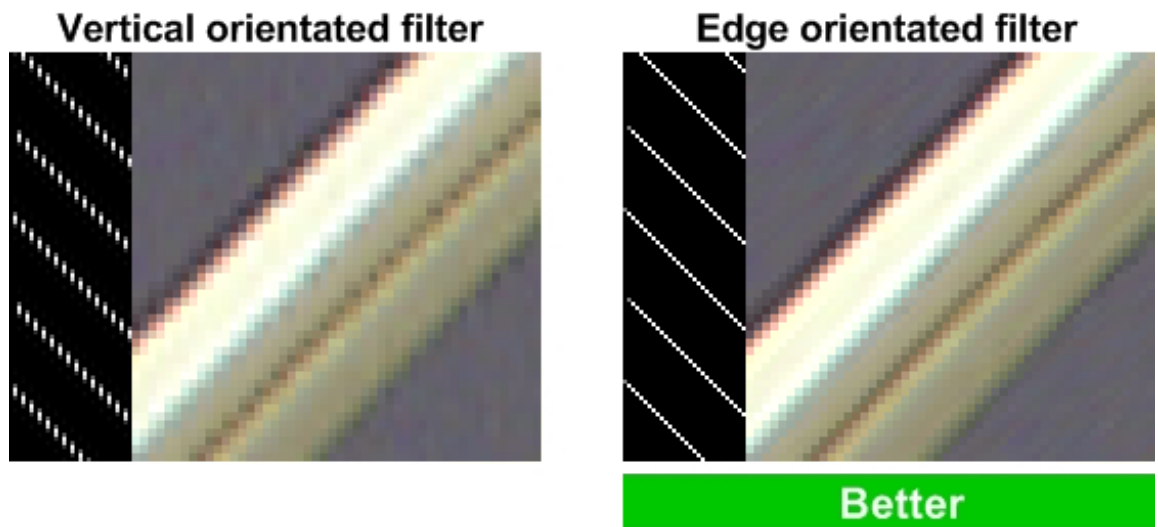
6. Motion compensation

⊕⊕

A completely perfect reconstruction is the work of a motion-compensated temporal combination.

4.2.4 Edge Adaptation of the Vertical Interpolation Filter

The quality of a spatial interpolation is not defined exclusively by the number of filter taps. If the latter is not oriented vertically as is normal, but rather in the direction of the locally dominant edge, then the reduced staircasing artefacts will help to achieve a more precise reconstruction. The movement of diagonals and the frond will indicate whether the display is using edge-adaptive filtering:



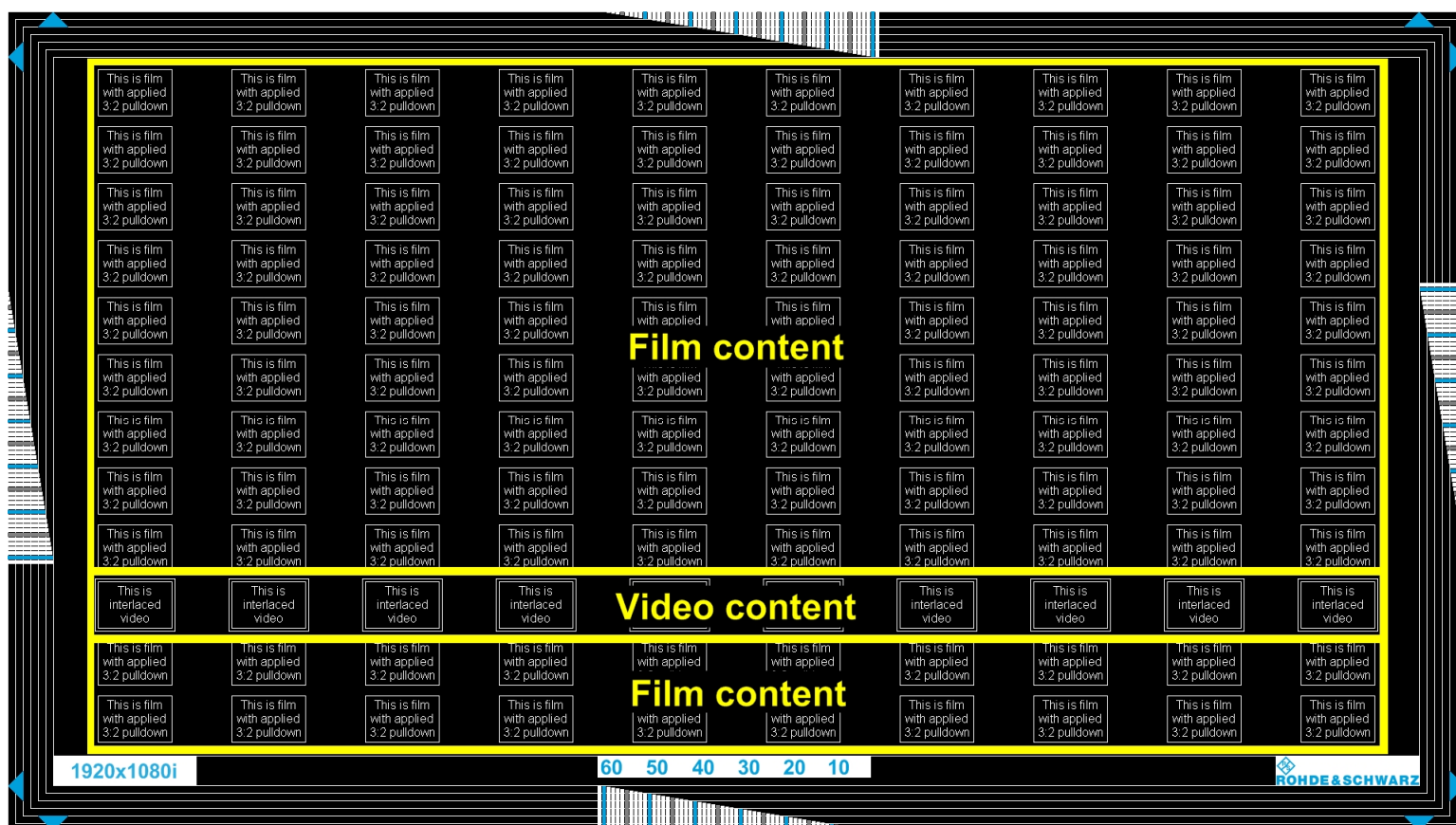
Vertically aligned filter coefficients are recognizable because the diagonals widen and are periodically interrupted. The edges of the frond blades also display poorly. On the other hand, if the filter is aligned exactly along the edge, the diagonals will be reconstructed perfectly. A similar improvement can be observed in the area of the frond.

5 Quality Analysis of Pulldown Recognition

It is very difficult to achieve a perfect reconstruction using deinterlacing because the fields are recorded at different times. One exception is film content, which is always shot at 24 full fields per second¹. If the film is to be aired in interlaced mode, then the pull-down method¹ is used to split the full fields into fields. As a result, the upper and lower field are recorded at the same time. This means that even moving objects can be reconstructed without artefacts during progressive conversion of the display by using temporal combination. This is called the inverse pull-down method.

The first step is to determine whether the display recognizes film content based on the fact that the upper and lower fields are recorded at the same time and restores them without any degradation. An additional check determines whether the source decision between film and video is made for the entire image (globally) or independently for the individual subareas (locally). This is relevant for example if a film broadcast is overlaid with a running ticker in real interlacing. The following R&S[®] *MULTI-MOTION* sequence features both tests:

5.1 The R&S[®] *MULTI-MOTION* Test Sequence

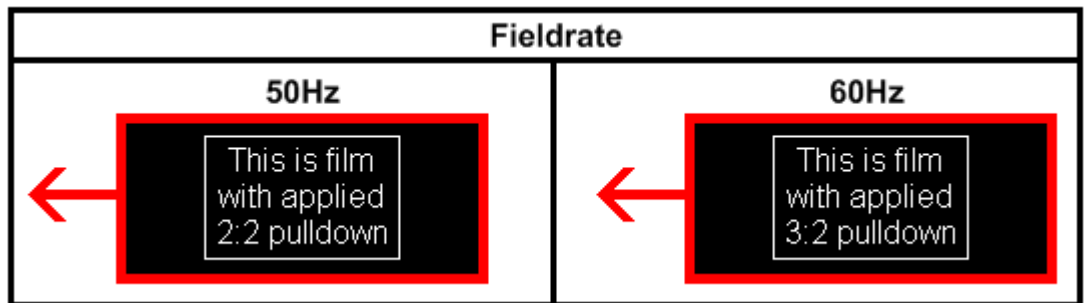


Format	Full field refresh rate	Fields (duration)	File name	File size
1920x1080i	25 Hz	880 (17.6 s)	D:\Lib AV Player\AV Main\Pattern\1080i_25\22Pulldown.avp	32.3 MB
1920x1080i	29 Hz	880 (15.2 s)	D:\Lib AV Player\AV Main\Pattern\1080i_29\32Pulldown.avp	32.5 MB

¹ The 2:2 pulldown is used to generate 50 Hz of interlaced content, while the 3:2 pulldown results in 60 Hz.

The individual contents are described below. Their interpretation is part of Section 5.2.

5.1.1 Film Content



Depending on which R&S® *MULTI-MOTION* test sequence is selected, the film content will consist of one 10x12 tiled arrangement of either the left or right 176x75-pixel element, whereby the tenth line remains black. With an original speed of four pixels per full field, this arrangement scrolls continuously to the left using the corresponding pulldown method over the entire 880 fields. Areas that shift off the image are reinserted on the right side.

5.1.2 Video Content



During the first 175 fields, the element scrolling to the left at four pixels per field using real interlacing (video) is inserted in the free tenth line of the film area (5.1.1).

5.2 Interpretation of the R&S® *MULTI-MOTION* Elements

The performance of the deinterlacing strategy for film content can be analyzed based on the following artefacts:

		1. No film detection (Pure spatial interpolation)	2. Global film detection (Pure temporal combination)	3. Local film detection (Adaptive strategy use)
Progressive result of top field	Film area	This is film with applied	This is film with applied	This is film with applied
	Video area	This is interlaced	This is interlaced	This is interlaced

1. No film detection

⊖⊖

If both the film and the video elements are displayed with degradation of vertical details, then, instead of a special film content handling, the normal deinterlacing strategy is being used. Film content is thus displayed with worse quality than possible.

2. Global film detection

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If the film area is reconstructed perfectly, but the video range suffers from feathering artefacts, then the film content is detected, but handled globally. Thus a running interlaced ticker overlaid on the film considerably forfeits readability.

3. Local film detection

⊕⊕

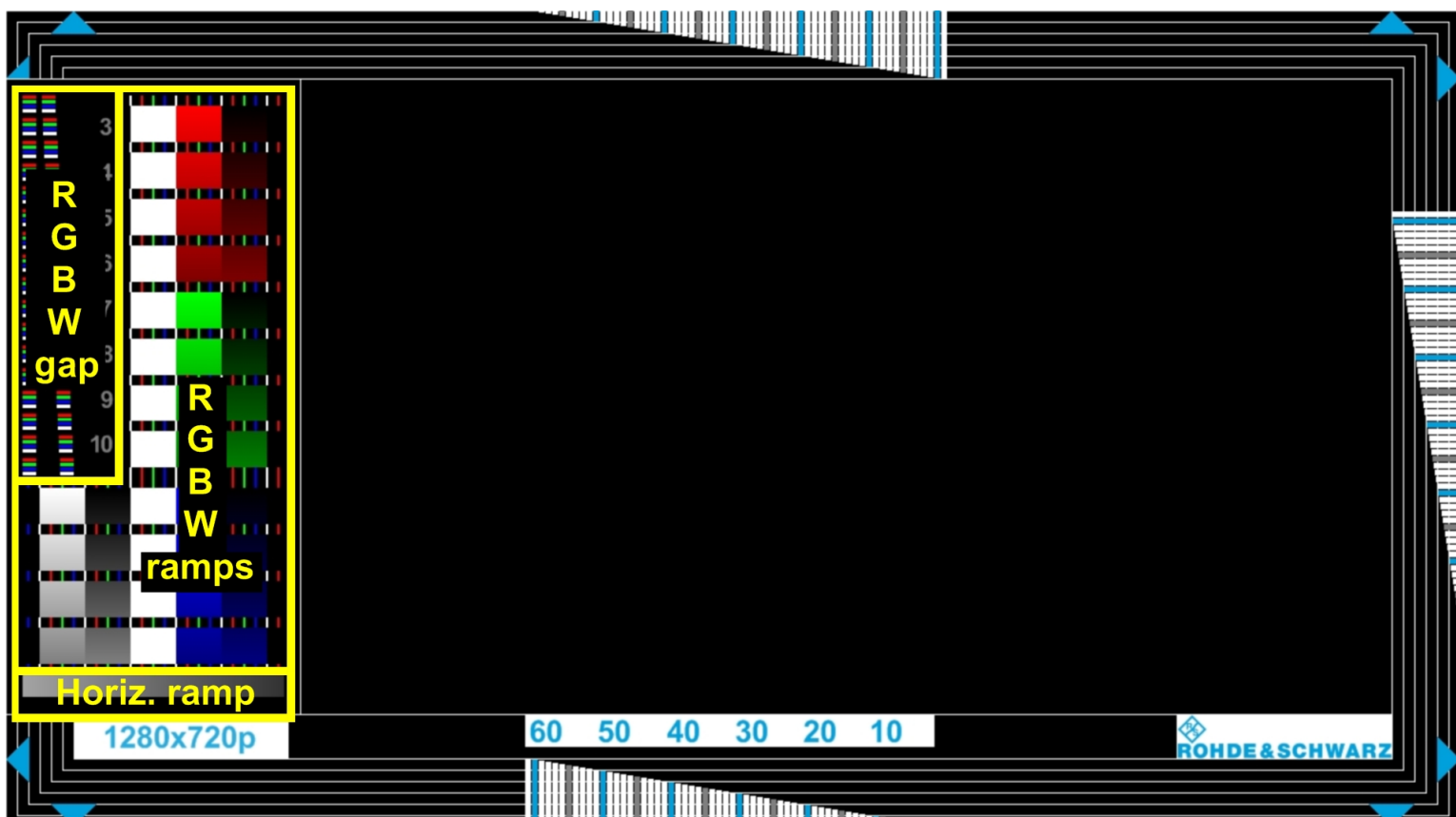
If the film elements are displayed perfectly and no feathering artefacts show up in the area of the video line, then the display is capable of selecting the appropriate strategy locally for film and video contents.

6 Quality Analysis of Motion Portrayal

The display quality of dynamic picture areas is defined by the extent of individual motion artefacts: In addition to technology-specific artefacts, such as “colour break up” (DMD), “phosphor lag” (PDP), and “false contouring” (PDP/DMD), this also includes the general blurring that increases proportionately with the presentation time of a frame. It therefore also makes sense to study how transition-dependent response times (LCD) are compensated for by overdrive.

The following R&S® *MULTI-MOTION* test sequence allows analysis of all items and also makes it possible to quantify the general motion blurring as well as the “phosphor lag”:

6.1 The R&S® *MULTI-MOTION* Test Sequence



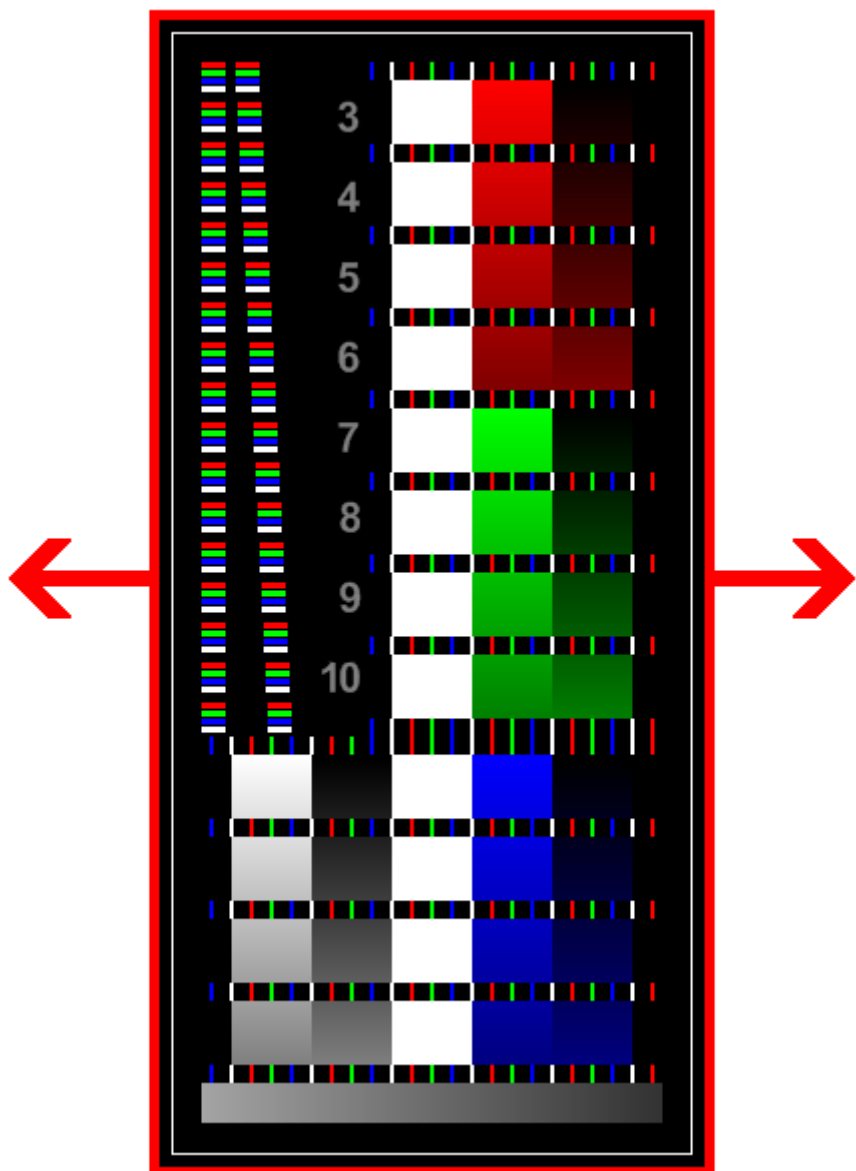
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Format	Full field refresh rate	Full fields (duration)	File name	File size
1280x720p	50 Hz	360 (7.2 s)	D:\Lib AV Player\AV Main\Pattern\720p_50\MotionArtefacts_1.avp	2.81 MB
1280x720p	59 Hz	360 (6.1 s)	D:\Lib AV Player\AV Main\Pattern\720p_59\MotionArtefacts_1.avp	2.8 MB

Format	Full field refresh rate	Fields (duration)	File name	File size
1920x1080i	25 Hz	440 (8.8 s)	D:\Lib AV Player\AV Main\Pattern\1080i_25\MotionArtefacts_1.avp	27.2 MB
1920x1080i	29 Hz	440 (7.6 s)	D:\Lib AV Player\AV Main\Pattern\1080i_29\MotionArtefacts_1.avp	27.2 MB

The progressive formats are to be preferred because their display is not degraded through additional deinterlacing artefacts.

The following shows the 260x561-pixel pattern arrangement as well as its movement during the R&S[®] MULTI-MOTION test sequence. The interpretation is explained in Section 6.2.



Number of		Animation
full field (720p)	field (1080i)	
0-14	0-14	Constant acceleration in the direction of the right screen edge
15-67	15-109	Linear continuation of the motion with the previously achieved speed of 15 pixels per image
68-82	110-124	Deceleration analogous to the initial acceleration
83-179	125-219	Pause on the right edge of the screen
180-194	220-234	Acceleration in the direction of the left screen edge
195-247	235-329	Linear continuation of the movement at 15 pixels per image
248-262	330-344	Deceleration
263-359	345-439	Pause on the left edge of the screen

6.1.1 RGBW Gap

This element consists of 17 stacked horizontal bars in red, green, blue, and white. In the centre these are interrupted by vertical black gap, which gets one pixel wider in bottom direction for every set of bars. The white scale to the right equals one half of the achieved width in pixels. The dimensions of the remaining bar segments on both sides are 12x3 pixels for each colour.

6.1.2 RGBW Ramps

In the middle of the black background, an area of 100% white stretches from top to bottom. In its proximity there is a 40x128-pixel vertical, 8bit gradient of 0-50% as well as an additional one from 50-100% for each colour (red, green, blue, and white), and the two are arranged antipodally in horizontal direction. They are interrupted in multiple locations by red, green, blue, and white 2x9-pixel markers that are spaced eight pixels apart.

6.1.3 Horizontal Grey Ramp

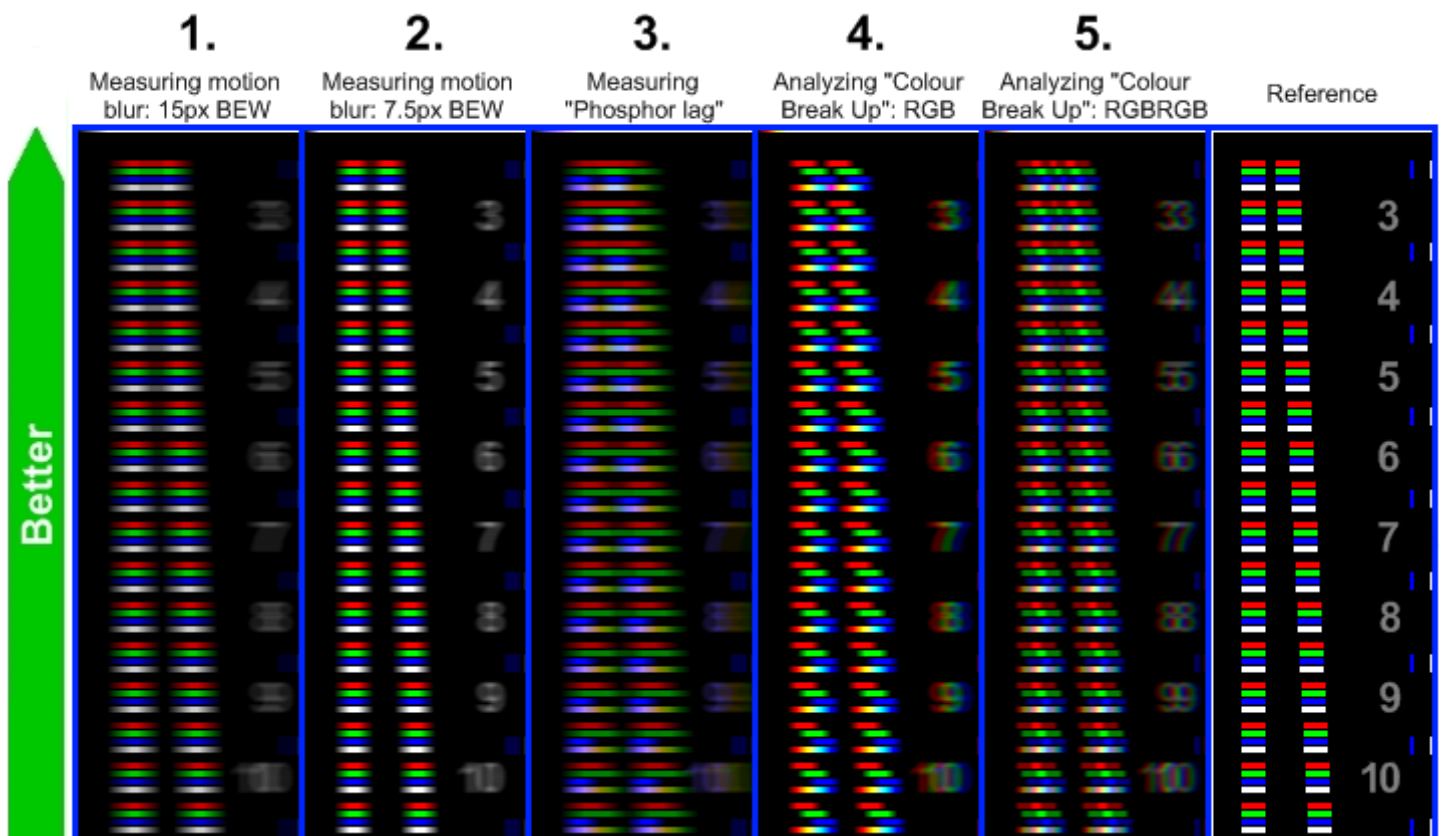
This 230x20-pixel linear, horizontal grey gradient contains values of 19.5-64% white.

6.2 Interpretation of the R&S[®] *MULTI-MOTION* Elements

Whereas the preceding section described the individual elements of the R&S[®] *MULTI-MOTION* test sequence, this section will now elucidate their use:

6.2.1 Motion Blur, “Phosphor Lag”, and “Colour Break Up”

The display of the moving RGBW gap allows a number of conclusions to be drawn:



1. + 2. Quantification of the motion blur

A measure of motion blur is the "blurred edge width" (BEW). It tells by how many pixels one edge is distended because of motion blur. This value can be read directly from the display: It corresponds to double the scale value of those lines that barely comprise the black gap. The normalised blurred edge (NBE) value can be determined by dividing the obtained BEW by the element's movement per frame, which is 15 pixel per frame. The maximum possible frame presentation time results in exactly 1.0 NBE. If a higher test value is achieved, it is due to insufficient panel cycle times.

3. Quantification of the "phosphor lag"

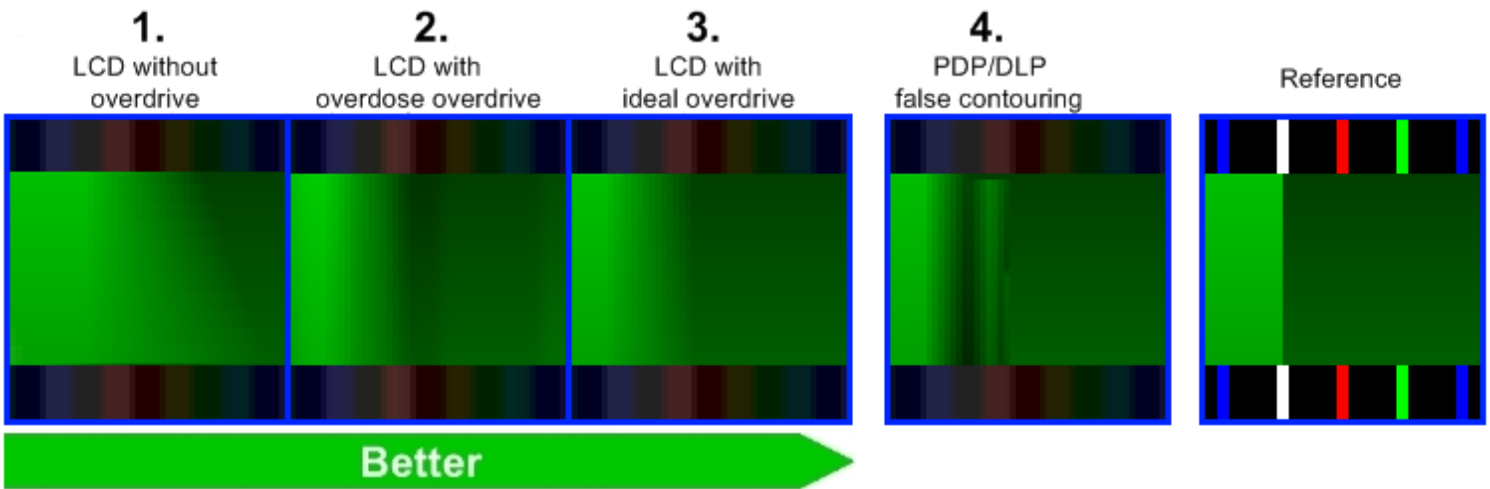
Analogous to the measurement of the motion blur (1.+2.), the BEW / NBE for the three phosphors can be determined using the correspondingly coloured bars. The figure shows a typical distribution with a rapid blue, average red, and slow green phosphor.

4. + 5. "Colour break up" analysis

The split arrangement also permits the "colour break up" of a 1-chip DMD projector to be analyzed because the display of a single colour bar indicates which colour wheel is being used: The number of double image contours plus one corresponds to the number of wheel segments in the corresponding colour. Therefore, Figure 4 uses a 3-segment colour wheel (RGB) while Figure 5 uses a 6-segment colour wheel (RGBRGB).

6.2.2 LCD Overdrive and PDP/DMD "False Contouring"

The analysis of LCD overdrive and PDP/DMD false contouring is explained here based on the moving vertical antipodal green ramps (third part from top):



1. LCD without overdrive



If overdrive is not used in the display, the cycles that are dependent on the value change cause a wedge-shaped transition to form instead of a vertical transition. The colour scale along the top and bottom edge can be used to compare the individual blurs.

2. LCD with overdose overdrive



While overdose overdrive does prevent a wedge-shaped transition, it also causes an overshoot (light green area) and undershoot (dark green area).

3. LCD with ideal overdrive



Ideal overdrive perfectly compensates for the various cycle times.

4. PDP/DMD false contouring

The subfield addressing method used for an individual display determines what pixel value changes cause various degrees of false image contours. Because the antipodal vertical ramps involve a number of different value changes, this method can be used to determine which changes are critical. The final element in the R&S[®] *MULTI-MOTION* test sequence also operates according to this principle. For the conventional approach using eight subfields, this horizontal grey ramp is displayed as follows:



On many displays, instead of looking for false image contours, the increased noise, used here for error concealment, must be observed.

Above considerations are based on the number of different value changes. Therefore, white and black areas situated to the side of the antipodal vertical ramps are used to provide additional value changes. Furthermore, when the elements change direction, this causes the transitions to be inverted.

7 Summary

The specialized R&S[®] *MULTI-MOTION* test sequences offered by the R&S[®] DVSG Digital Video Signal Generator permit a reproducible quality analysis of deinterlacing and motion portrayal for digital TV displays:

Analysis of the progressive conversion makes it possible to identify the strategy used by the display for initial assessment of the achieved full field quality. Additional differentiation can also be gained by determining the Q factor of the vertical interpolation filter in spatial methods, the accuracy of the motion detector in adaptive methods, and the precision of motion-compensating methods. It is also possible to assess whether the display handles both variants of the inverse pulldown for perfect deinterlacing of film content. This assessment is additionally used to determine whether the source detection remains stable even when an interlaced ticker is inserted.

The motion portrayal can be evaluated by quantizing the motion blur and the PDP “phosphor lag” using the BEW / NBE. The functioning of the LCD overdrive can also be checked. Finally, additional tests are provided for revealing and analyzing the technology-specific artefacts of “false contouring” (PDP/DMD) and “colour break up” (DMD).

8 Abbreviations

AV	-	Audio / Video
BEW	-	Blurred Edge Width
DMD	-	Digital Micromirror Device
HD	-	High Definition
LCD	-	Liquid Crystal Display
NBE	-	Normalised Blurred Edge
PDP	-	Plasma Display Panel
TV	-	TeleVision

9 Additional Information

Our Application Notes are regularly revised and updated. Check for any changes at <http://www.rohde-schwarz.com>.

Please send any comments or suggestions about this Application Note to Broadcasting-TM-Applications@rohde-schwarz.com.

10 Ordering Information

Designation	Type	Order No.
Base unit		
Digital Video Signal Generator	R&S@DVSG	2113.0008.02
Options		
TS Player and Recorder	R&S@DVSG-K20	2113.0320.02
AV Signal Player	R&S@DVSG-B30	2113.0237.02
AV Signal Generator	R&S@DVSG-K10	2113.0314.02
SDI/HD-SDI Output	R&S@DVSG-K30	2113.0337.02
Stream libraries		
HDTV Sequences	R&S@DV-HDTV	2085.7650.02
H.264 Stream Library	R&S@DV-H264	2085.9052.02
DVB-H Stream Library	R&S@DV-DVBH	2085.8704.02
Test Card M Sequences	R&S@DV-TCM	2085.7708.02
ISDB-T Stream Library	R&S@DV-ISDBT	2085.9146.02
TS creation tool		
Advanced Stream Combiner (dongle for USB interface)	R&S@DV-ASC	2085.8804.03
Recommended extras		
Printed operating manual (English)		2113.1862.12
Keyboard with USB Interface (US keyboard)	R&S@PSL-Z2	1157.6870.04
Mouse with USB Interface, optical	R&S@PSL-Z10	1157.7060.02
Accessories delivered with the R&S® DVSG		
Quick start guide, operating manual with firmware on CD, power cable		
19" Adapter (R&S®DVSG with second instrument)	R&S@ZZA-T33	1109.4458.00
19" Adapter (R&S®DVSG with spare slot)	R&S@ZZA-T34	1109.4464.00
Service options (Service options can only be ordered in connection with the purchase of an instrument.)		
Repair service		
One-Year Repair Service following the warranty period	R&S@RO2DVSG	please contact your local sales office
Two-Year Repair Service following the warranty period	R&S@RO3DVSG	please contact your local sales office
Four-Year Repair Service following the warranty period	R&S@RO5DVSG	please contact your local sales office
Calibration service		
Two-Year Calibration Service	R&S@CO2DVSG	please contact your local sales office
Three-Year Calibration Service	R&S@CO3DVSG	please contact your local sales office
Five-Year Calibration Service	R&S@CO5DVSG	please contact your local sales office

Option identification: R&S®DVSG-Bxxx = hardware option; R&S®DVSG-Kxxx = software option.



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