

R&S®Time Code Inserter: Time Code-Based A/V Distortion Analysis Application Note

Products:

- | R&S®Time Code Inserter
- | R&S®VTC
- | R&S®VTE

The Rohde & Schwarz R&S®VTC and R&S®VTE video testers assess audio/video signals from the user's perspective (application testing). They are used to evaluate signal quality and to identify faults reliably.

The tests are based on a difference analysis between the audio/video signal being tested and a reference signal. The required synchronization can be achieved by using a unique identifier, called a time code. This time code is inserted using the R&S®Time Code Inserter software described in this application note.

This application note describes how time codes work and how to add a time code to any A/V file.

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1 Overview

A/V ports are typically found on TV monitors, set-top boxes, A/V receivers, Blu-ray™ players, video game consoles and PCs. In recent years, these ports have also found their way into cameras and video recorders, as well as smartphones and tablet PCs. Customers demand the highest level of quality and reliability from these ports.

Advances in A/V consumer electronics in the area of improved picture and sound quality (e.g. through increased resolutions) have significantly raised the expectations of consumers in recent years. Therefore, manufacturers are continuously developing both new A/V formats and new ports, such as MHL™. Testing during development must evaluate not only the picture quality (e.g. by using picture failure point (PFP) and visible error analysis) but also the long-term stability. A final Go/NoGo test in manufacturing ensures that a device being delivered to the customer functions flawlessly.

The audio/video distortion analysis function provided on the R&S®VTC or R&S®VTE video testers can evaluate audio/video performance very precisely.

A video is first played back from a reference (golden) device (see Fig. 1). The test video is then output by the device under test (DUT) and compared against the previously recorded reference video (see Fig. 2). This method is referred to as a double-ended audio/video analysis.



Fig. 1: Recording a reference video.



Fig. 2: Audio/video distortion analysis for a DUT, e.g. set-top box or smartphone.

The reference video and the test video must be synchronized before they can be compared. The R&S®VTC and R&S®VTE offer three options for synchronizing video sequences:

- Loop APL: Synchronization based on the video contents. This method calculates and compares the average picture level (APL). Multiple frames are needed for synchronizing test and reference videos. The precise number depends on the video (rate of change, duration).

- Loop APL section: This method is the same as the loop APL method, except that the user can specify a segment to be used to calculate the APL. This makes sense in videos that have a change in only one segment of the video.
- Loop time code: In this method, a unique identifier is added to the video. This identifier can be used to associate each frame of the test video with the corresponding frame in the reference video. Synchronization is therefore possible with just one frame. As a result, synchronization is very rapid – an important factor in time-critical applications. Resynchronization after a loss of synchronization is also possible.

The method to be used depends on the type of video decoder and on the rate of change within the video.

The APL can be used for synchronization only if all frames are certain to be output by the DUT. This is assured when hardware coders are used in the DUT. When software coders are used, however, frame drops are a frequent problem. This makes it impossible to associate the test frame with the reference frame, and therefore evaluation of the video quality is not possible. To allow synchronization in spite of these problems, a video with a time code is used. It is then a simple matter to determine which frame is missing and to evaluate the quality of the frames that are present.

The use of an APL is also possible with analog ports (such as component video and composite video), because the noise is averaged over a frame.

A time code must be used whenever there is very little change in a video.

It is always possible to use a time code for synchronization (see Table 1). The only disadvantage to using time codes is the one-time effort of adding the time code to a video.

Application	Synchronization options	
	Loop APL / Loop APL section	Loop time code
Hardware decoder	X	X
Software decoder		X
Digital port	X	X
Analog port	X	X

Table 1: An overview of the various options for synchronizing test videos and reference videos.

This application note explains how a time code can be added to a video using the R&S® Time Code Inserter software. This software is supplied as part of this application note and can be downloaded free of charge.

2 Concepts

Container format

The container format defines the structure in which different data formats such as a video format (e.g. MPEG-2, H.264) and an audio format (e.g. mp3, wma) are stored together. The container format thus determines the file format, and not how the A/V data is coded in the file.

Examples of known container formats are DivX media format (.divx), MPEG-2 transport stream (.ts or .tsp), audio video interleave (.avi) and QuickTime (.mov).

Audio/video format

The audio/video format defines which audio/video coding is used. This coding takes place using codecs.

Codec

The term **codec** is an acronym made up from **coder-decoder**. It defines the procedure used to compress/code or to decompress/decode digital data.

Time code

The term time code identifies a unique, binary identifier for every frame. Rohde & Schwarz uses an implementation in which a unique symmetrical pattern is inserted into each frame (see Fig. 3). This permits a clear allocation between a test video and a reference video.

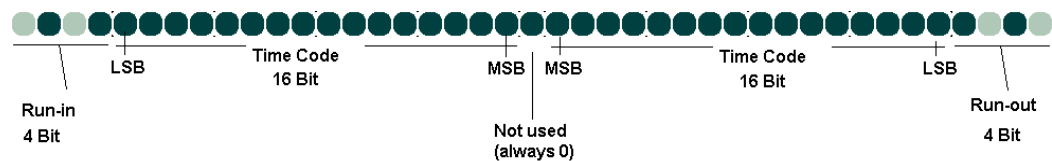


Fig. 3: Rohde & Schwarz time code.

3 Methodology

A time code can be inserted using the R&S[®]Time Code Inserter. There are two possible scenarios, depending on the container format and video format used for the test video. The video's audio format does not affect the R&S[®]Time Code Inserter; this format is retained.

Scenario 1:

In cases where the A/V file is in container format AVI and the container uses video format IYUV (uncompressed data), the R&S[®]Time Code Inserter can be used to insert a time code directly (see Fig. 4).

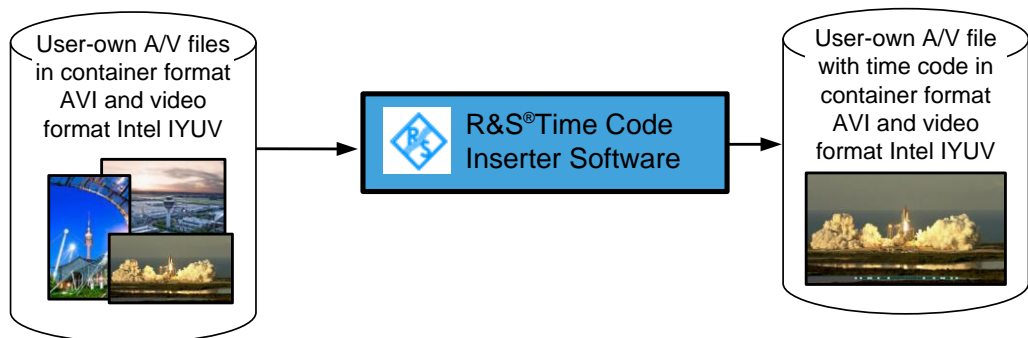


Fig. 4: Steps to insert a time code in uncompressed A/V files (= container format AVI, video format Intel IYUV).

Scenario 2:

In cases where the test video is not in container format AVI using video format Intel IYUV, the video must first be converted. The conversion can be carried out using Prism Video Converter Plus from NCH[®] Software, or similar applications. After the time code has been inserted, this software can be used to convert a generated video into any format. This application note describes the conversion process using Prism Video Converter Plus from NCH[®]. Of course, other applications can also be used to convert the A/V file. However, the application must support the Intel IYUV video format.

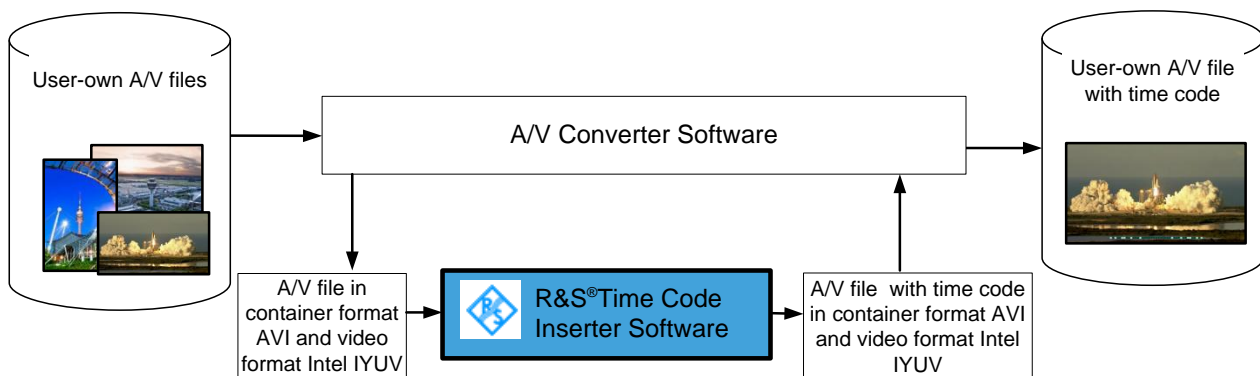


Fig. 5: Steps to insert a time code in compressed A/V files.

4 Step-By-Step

4.1 Step 1: Convert to an Uncompressed AVI Format

If the A/V files are already in an uncompressed AVI format, this step can be skipped. The conversion is described here using Prism Video File Converter Plus from NCH[®] software as an example.

The first steps is to launch Prism Video Converter Plus, then click Add File(s) and select a compressed A/V file (e.g. in container format mpg). Select .avi as the output format and then click Encoder Options ... to define the settings for the encoder.

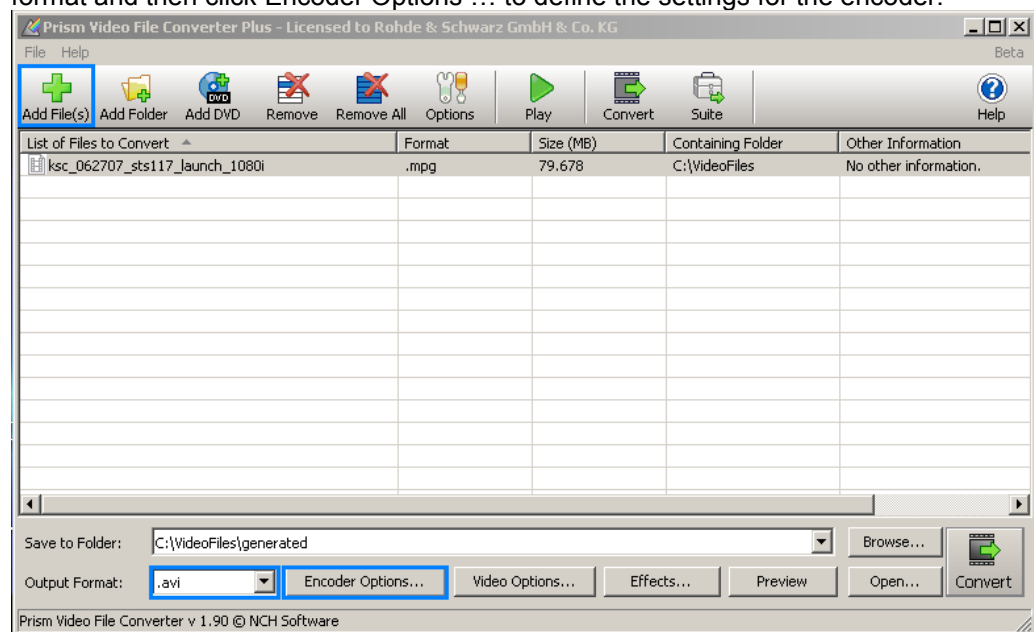


Fig. 6: NCH[®] Prism Video File Converter Plus: Adding a video file for conversion.

In the AVI Encoder Settings dialog box, select Intel IYUV Codec (iyuv) as the video compressor (see Fig. 7) and click ok.

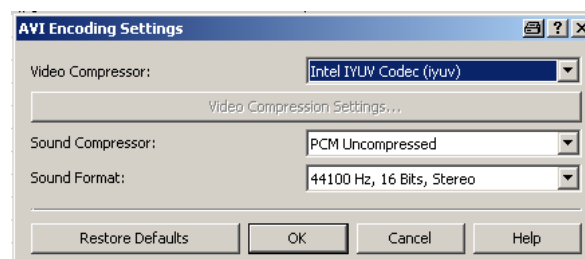


Fig. 7: NCA[®] Prism Video File Converter Plus, Encoder Options: Selecting Intel IYUV as the video format.

Finally, click Convert to start the conversion. Depending on the size of the video, this can take a few minutes.

4.2 Step 2: Insert a Time Code

As soon as the test video is available in an uncompressed AVI format (video format Intel IYUV), you can use the R&S® Time Code Inserter to add a time code. To do this, launch the software, then click Open ... from the Rohde & Schwarz menu and select the test video (see Fig. 8).

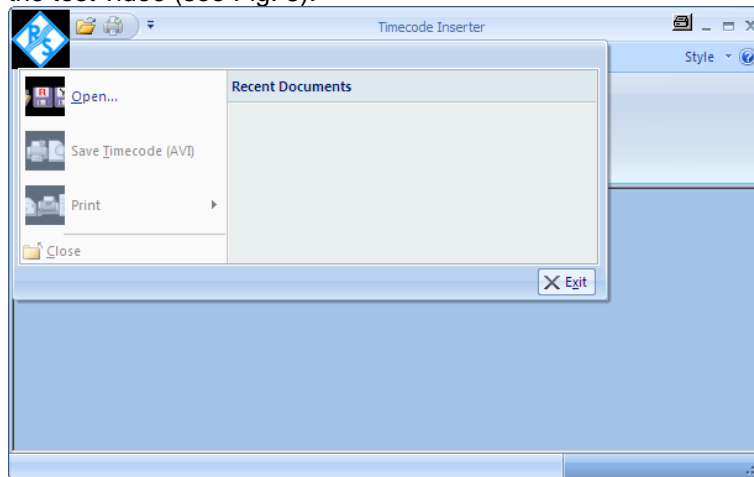


Fig. 8: R&S® Time Code Inserter software: Opening an AVI file.

Click Play to play back the video one frame at a time. The progress is displayed in the title bar (see Fig. 9). Click Pause at any time to pause the analysis. If the time code is to be assigned to only a portion of the video, use the First Frame, Previous Frame, Next Frame and Last Frame buttons to navigate among the frames.

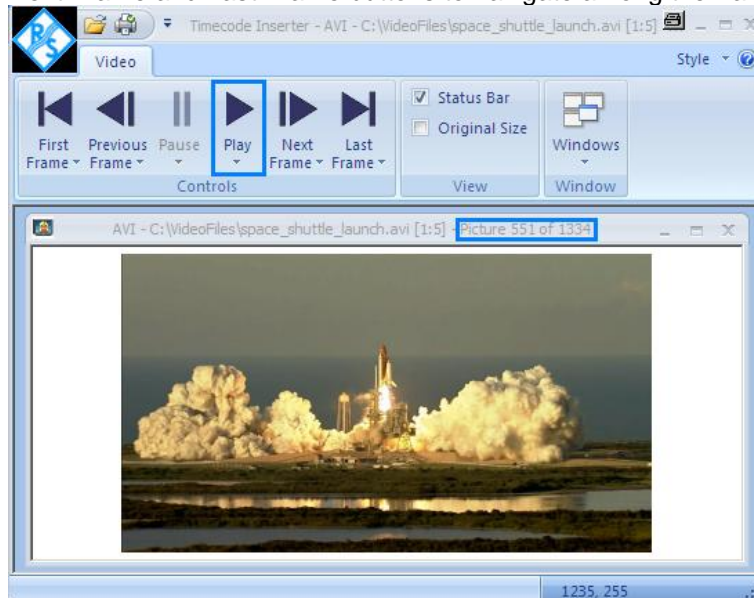


Fig. 9: R&S® Time Code Inserter software: Analyzing the video frames.

To generate the video with the time code, go to the Rohde & Schwarz menu and click Save Time Code (AVI). It is now possible to specify the segment of frames as well as the image position (vertical position) where the time code should be inserted (see Fig. 10).

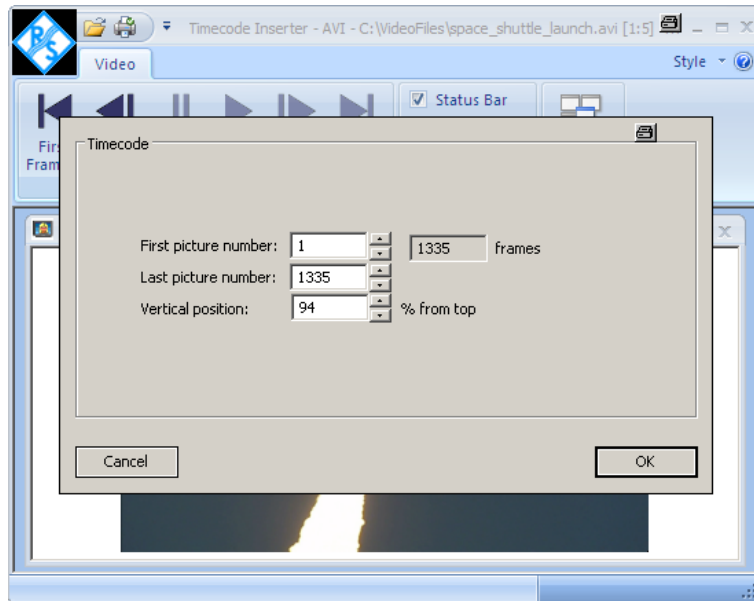


Fig. 10: R&S® Time Code Inserter software: Configuration dialog box for generating a video with time codes.

Click OK to close the configuration dialog box and specify the name and location for saving the video with time codes. The video with time codes is now generated (see Fig. 11). The maximal number of frames which can be provided with a time code is 1500.

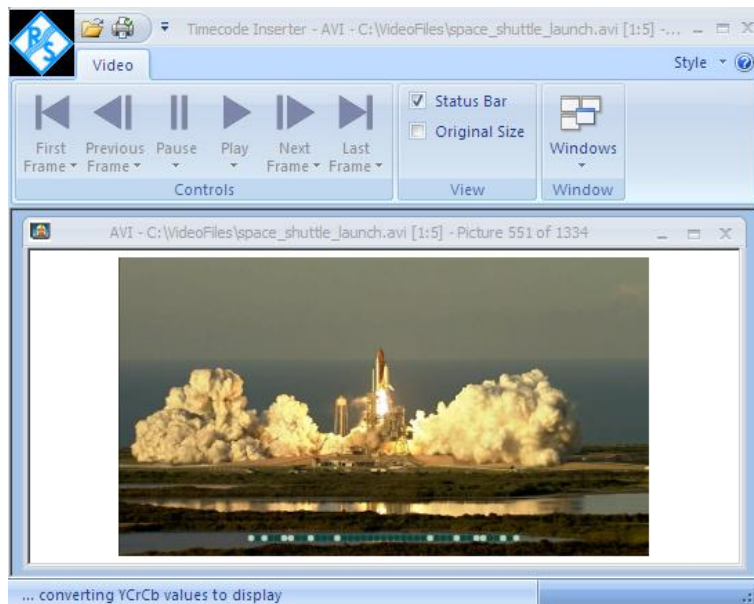


Fig. 11: R&S® Time Code Inserter software: Generating a video with time codes.

4.3 Step 3: Convert an Uncompressed AVI Format to a Different Format

Depending on the DUT, a variety of audio/video codings and container formats might be needed. The NCH®Prism Video File Converter Plus application can be used to convert from uncompressed AVI file into a number of different container and video format combinations (see Fig. 12).

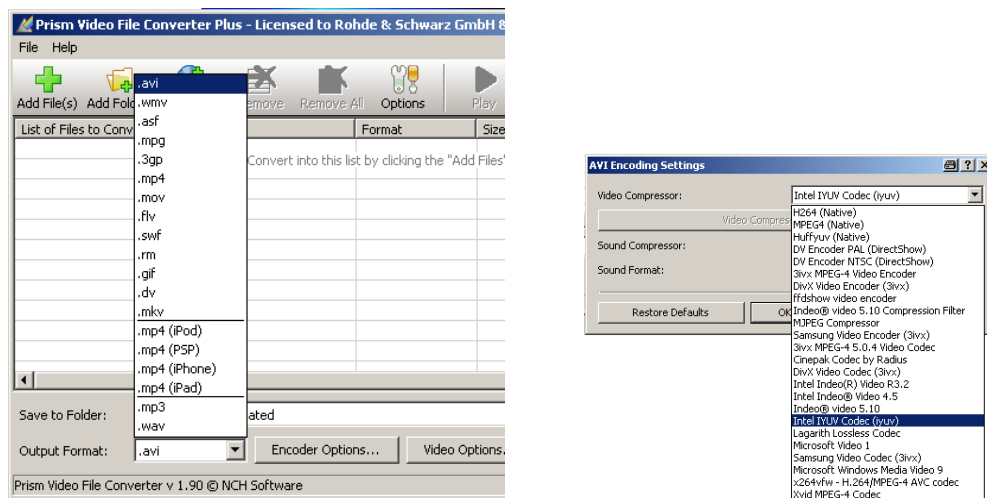


Fig. 12: NCA® Prism Video File Converter Plus: Supports a number of different container and video formats.

5 Abbreviations

APL	Average picture level
A/V	Audio / Video
AVI	Audio video interleave
DUT	Device under test
MPEG	Moving Picture Experts Group
PFP	Picture failure point
TS	Transport stream

6 References

Prism Video File Converter Plus: www.nch.com.au/

7 Ordering Information

Designation	Type	Order No.
Instrument		
One of the following base units:		
R&S [®] VTC Video Test Center Base Unit	R&S [®] VTC	2115.7400.02
R&S [®] VTE Video Tester Base Unit	R&S [®] VTE	2115.7300.02
Required options		
AV Distortion Analysis	R&S [®] VT-K2111	2115.8041.02
AV Inspection	R&S [®] VT-K2110	2115.8035.02
One of the following interface modules:		
R&S [®] VT-B2350 MHL RX/TX	R&S [®] VT-B2350	2115.7622.06
R&S [®] VT-B2360 HDMI RX 225 MHz	R&S [®] VT-B2360	2115.7616.06
R&S [®] VT-B2361 HDMI RX 300 MHz	R&S [®] VT-B2361	2115.7639.06
R&S [®] VT-B2370 Analog AV RX	R&S [®] VT-B2370	2115.7600.06

About Rohde & Schwarz

Rohde & Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 75 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

Environmental commitment

- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system



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