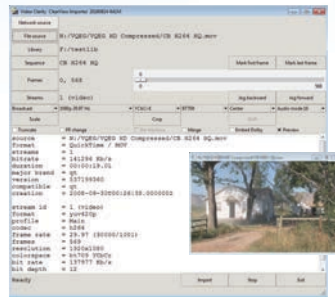


# ClearView<sup>®</sup>

## Video Quality Analysis Software

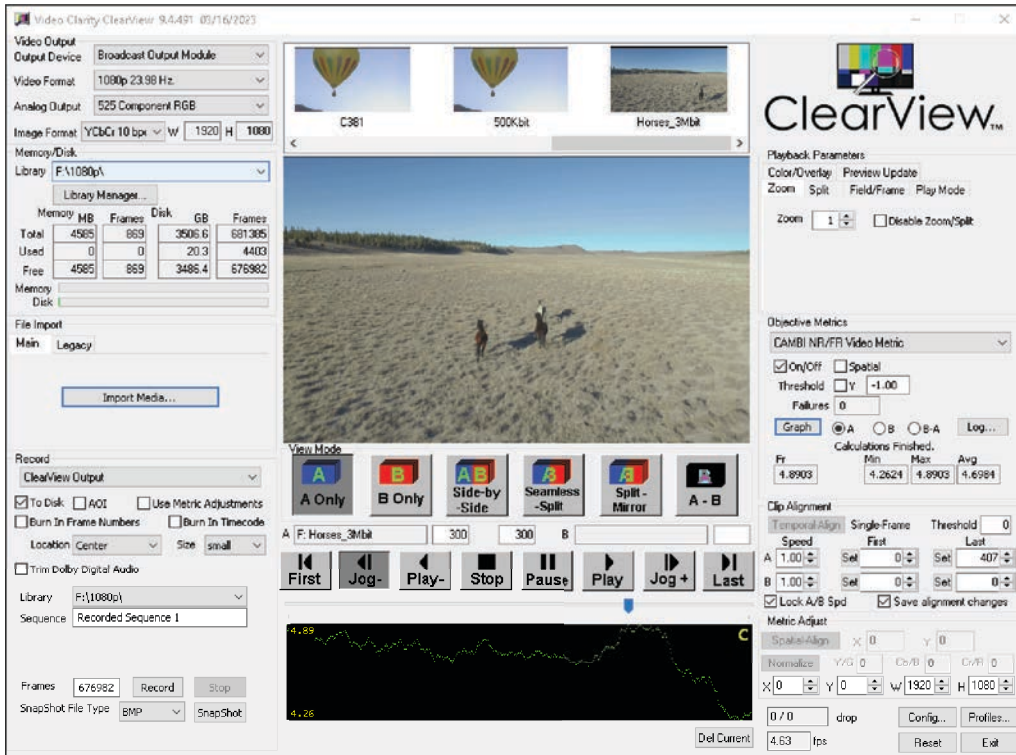


Video **Clarity**



Tools for Video Analysis

**ClearView Software** is highly advanced test & measurement analyzer for audio and video quality, as well as comparatively viewing two uncompressed video sequences up to the graphics capacity of a users computing platform. The solution, along with its comprehensive file importing application, provides a wide choice of measurements that effectively quantify the human subjective experience.



## Full-Reference Objective Quality Metrics

- VMAF: Video Multimethod Assessment Fusion is tailored for quality assessments of streaming video services
- MS-SSIM: Provided on a linear DMOS scale and the native MS-SSIM scale
- HDRMAX: Selection for HDR quality assessment extension to VMAF or MS-SSIM
- Sarnoff JND: Picture Quality Rating (PQR) providing the JND vision model (optional)

## Full-Reference Performance Metrics

- PSNR: Peak Signal to Noise differences in video
- AFREQ: Audio Frequency conformance measurement to find gross errors in audio performance versus a reference, provides lip-sync measurement in milliseconds

## No-Reference Metrics

- CAMBI: Video banding detection and visibility metric on its native scale
- NIQE: A highly performing video quality metric requiring no prior image training
- APEAK: Audio loudness measurement per program according to ITU-R BS.1770-4
- Spatial: Calculates the activity power of a frame within each frame
- Temporal: Calculates the changes between successive frames

## Subjective Viewing Modes On PC Desktop

- Play sequences to a separate window on the desktop
- Apply multiple subjective viewing modes to assess quality at full resolution
- Use all interactive play modes including zoom, pan, and pixel value tools

## Control

- ClearView GUI
- Play list commands
- Load list commands
- Batch file commands
- Full Command Line Interface

## Operation

- Input From IP Network
- Both a source and test stream
- Real-time demux/decode
- Importing Files
- Demultiplex MPTS files
- Scale/Crop
- Decode all media file types
- Visual Analysis Modes
- Side-by-side
- Over-under
- Split mirror
- A-B with Addback & Threshold
- Field-only play
- Zoom & pan
- Find pixel values via mouse
- Perceptual Metrics
- VMAF
- MS-SSIM with DMOS scale
- HDRMAX
- NIQE and  $\Delta$ EITP
- Additional Measurements
- APEAK true-peak amplitude
- LKFS loudness test
- AFREQ audio impairment test
- Lip-sync +/- measurement
- PSNR
- CAMBI
- Spatial (Activity)
- Temporal (Change)

## Test Score Analysis

- Log files contain the quality scores and information about each test's setup
- Metric Log Grapher creates multiple test comparisons
- Drag & drop log files back to ClearView to recall previous tests and comparison views

**The best way to subjectively analyze** and compare two different sequences is to look at them on the same video display. Using two different displays, even of the same type, requires vigilant calibration. Therefore, ClearView has many viewing modes that show the two sequences in a separate playback window on the applied PC system desktop.

- In side-by-side and split-mirror modes the sequences can be panned as only half of the image is showing.
- In seamless split mode part of the image is from the reference and the rest of the image is from a processed version of the video content.
- ClearView allows the split point to be moved interactively.

## Side-By-Side Viewing



## Split Mirror Viewing



## Seamless Split Viewing



Video sequences can be further analyzed as follows:

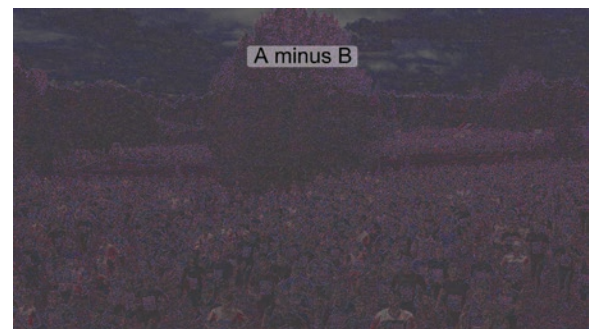
- Zooming into any picture area up to 16x
- Panning within the picture during zoom or split screen
- Identifying pixel values via mouse click
- Playing individual fields

Using the included command line interface play lists can be created to allow any view mode to be executed in a series.

ClearView A-B: An easy way to view pixel intensity differences between two images.

- Below a straight subtraction shows one pixel level intensity which may not be possible with some displays.
- Therefore, ClearView systems include A minus B with a Threshold and Addback command allowing users to see differences that are greater or less than a specific pixel intensity threshold as a selectable color.
- This also allows edge differences to stand out.

A minus B with Threshold = 20 View Mode



Colors green A>B; yellow B>A



These views are all simultaneously fed to the ClearView graphical user interface and to a separate desktop window.

**Important note: Playback functionality for real-time desktop display using ClearView Software is dependent on the applied platform's internal throughput to its disk subsystem. A multiple disk SSD array or NVMe storage is recommended for full frame rate comparison view modes shown in the above examples.**

**VMAF:** This full-reference metric is also designed by Netflix and implemented on its native scale in ClearView according to the latest published VMAF version. VMAF closely approximates human perception of video quality and is consistent across content types whether for natural videos or animated content. VMAF is particularly tuned to assess quality of video streaming by taking various source content characteristics into account and by focusing on compression and picture scaling artifacts as the dominant degradation components in delivered versions of streamed content.

**MS-SSIM, SSIM, and DMOS:** In Multi-Scale Structural Similarity Image Metric (MS-SSIM), the picture is evaluated at various resolutions and the result is an average of these calibrated steps. MS-SSIM out-performs simple SSIM even when the SSIM is correctly calibrated to the environment and data set. ClearView includes MS-SSIM and SSIM, developed by the University of Texas, and provides both on their native scales with MS-SSIM also mapped to a linear DMOS (Differential Mean Opinion Score). The measurements may be performed on luma and a combined score is provided for color channels.

**HDR Video Quality Assessment Extensions to VMAF and MS-SSIM:** The HDRMAX human perceptual vision model is specifically designed to give existing metrics an extended function for assessing both high dynamic range and standard dynamic range video. By applying a new and original non-linearity operation, which generally expands the brightness ranges at the ends of the local dynamic luma scale while suppressing the middle ranges, HDRMAX implements an extended feature set. In addition, the Visual Information Fidelity features and Detail Loss Metric features are extracted from these processed luma values to work in conjunction with features already embedded in the existing metric's functions to bring ClearView a significant new video quality measurement. An HDRMAX video quality calculation may now be applied to 10-bit video in the VMAF and MS-SSIM/DMOS metrics within the ClearView video quality analyzer.

**PSNR:** One of the most widely used metrics is PSNR (Peak Signal-to-Noise Ratio). It measures the mean error between input and output expressed as a ratio of the peak signal in dB. PSNR, while not performing a human perceptual video quality prediction, does serve an important role as one of the objective metrics included in all ClearView systems. PSNR is important for device performance or network path testing when a PASS/FAIL indicator is needed and as complement or alternative to perceptual metrics when picture processing performance is near or above the limit of human perception.

**NIQE:** Natural Image Quality Evaluator is a completely blind, distortion free, no reference, image quality assessment index. This quality evaluator by University of Texas LIVE is of a natural scene statistic (NSS) based modeling framework for an opinion unaware (OU) and distortion unaware (DU) no-reference (NR) image quality assessment (IQA). The result is no-reference IQA model not requiring previous distorted image exposure nor any training on human opinion scores.

**CAMBI:** Contrast-aware Multiscale Banding Index operates as a no-reference banding detector.

**$\Delta E_{ITP}$ :** Following ITU Recommendation BT.2124,  $\Delta E_{ITP}$  is useful to assess the potential visibility of color differences in HDR television images and signals. The metric returns a just noticeable difference (JND) score.

**Sarnoff JND:** A ClearView option, the Sarnoff JND Vision Model is a highly accurate predictor of perceptual quality in video. It includes the Picture Quality Ratio (PQR) algorithm and is quantified in units of JND (Just Noticeable Difference).

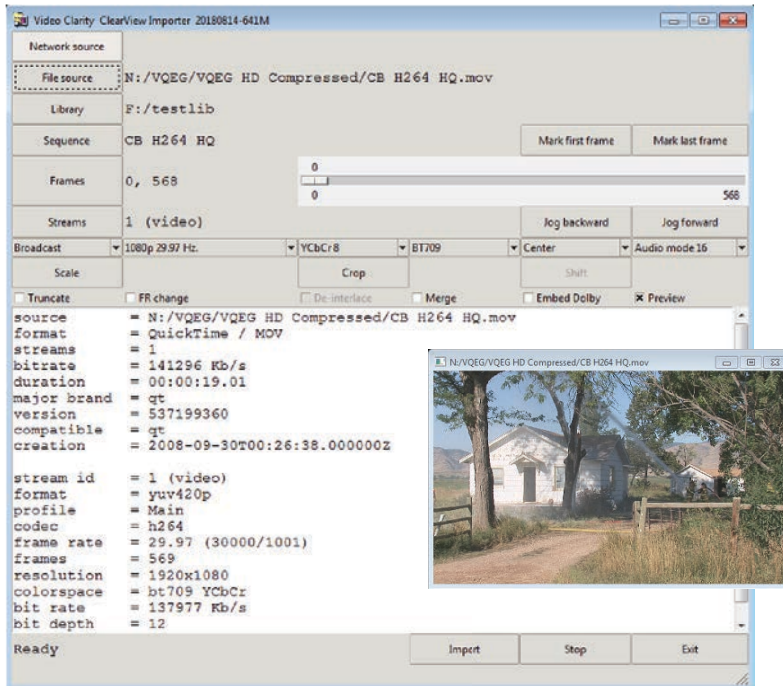
## Audio Performance Measurements - Included In All ClearView Models

**aFREQ** - Audio Frequency Metric - Gives a comparison of audio versus a reference to find gross audio errors and provide a general performance comparison of source audio channels to processed audio channels.  
- The audio/video offset (lip-sync) is also calculated to the millisecond as part of the aFREQ metric.

**aPEAK** - Audio Peak Metric and Loudness Measurement - Measures the true-peak amplitude, providing a value for each frame and a separate value for each channel. Within the aPEAK measurement there is a selection for **LKFS**, Loudness, K-weighted, relative to Full Scale. LKFS provides a measurement that defines peak loudness over a one second period over all audio channels in a given program and responds with one value over that period. The values returned are based on a logarithmic scale with 0 being the maximum value and -60 being close to silence. The LKFS measurement follows recommendation ITU-R BS.1770-4.

**ClearView Importer is a comprehensive tool for importing many media file types.** The application is provided with ClearView Software allowing identification of source file types and full control of file importing parameters to store uncompressed sequences that are automatically inserted into a ClearView library for use within a ClearView test routine.

## ClearView Importer GUI



## ClearView Importer Highlights

- Wide range of supported video and audio formats
- Fast audio and video decoding speed
- Detailed file import source information with video window
- MPTS import with program stream selector-decoder
- Easy source length import modification
- Detailed per pixel source cropping
- Image quality, size and positioning adjustment
- Up to 16 channels of audio decoding
- Command Line and GUI user interface

## User controllable file adjustments:

- Import HDR video in BT.2020 (PQ) or BT.2100 (HLG)
- Import ICtCp native color format or record it from HDSDI
- Decoded or imported frame size, rate
- First/last frames to import
- 3:2 pull down insertion or removal
- Native bit depth import of 8, 10 or 12 bit video
- Crop source with input values
- Scale video resolution up or down to x, y / w, h
- Variable image and canvas resolution
- Truncate to legal broadcast values (yes/no)
- Import audio and closed caption data

## Imported File Formats (partial list):

Accom YUV CCIR 601 8-bit  
ARI Raw Bayer Pattern  
Avid AVR, DS HD/SD, DV (\*.gen), DNxHD  
Avid Meridian, Y'CbCr, OMFI (\*.omf, \*.omfi)  
AV1, AVC, AVC-HD, AVR, AVS  
Cineon (\*.cin), CineWave  
DPX RGB 8, RGB 10, Y'CbCr 4:2:2  
DV (\*.dv, \*.dif), Digital Negative (\*.dng)  
DVS Direct File Format (\*.dvs)  
DVSD, DV25, DV50, MPEG-I, mJPEG, DigiSuite  
GXF Format/SMPTE-360 (\*.gxf)  
H.261, H.263, H.264, H.265, HDV  
Headerless/Raw (\*.hdr, \*.yuv, \*.rgb, \*.raw)  
HiCon SLB32 RFB format (\*.slb)  
Image (\*.gif, \*.jpg, \*.png), Jaleo (\*.js), JFIF, JPED  
JPEG, JPEG2000, LXF, Meridian, Media 100 MJPEG  
Microsoft AVI (\*.avi), BMP, DIB Files (\*.dps)  
MJPEG, MPEG 1 4:2:0 (\*.mpg, \*.mpeg)  
MPEG-2 Elem. Stream, (4:2:0/4:2:2), MPEG2 (\*.m2v)  
MPEG-2 Program Stream, (4:2:0/4:2:2)  
MPEG-2/4 in Transport Stream, (4:2:0/4:2:2)  
MPEG-2/4 in MPTS (4:2:0, 4:2:2), MPEG-4 (\*.m4v)  
MPEG-4 AVC Elementary Stream 4:2:0/4:2:2, (\*.h264)  
MPEG-H HEVC/H.265 4:2:0 Main Profile (\*.h265)  
MXF Format (DCP, DV, DVCPro50, MPEG, IMX, OP1a)  
Nwtek Video Toaster (\*.rtv)  
Phantom Support (\*.cine), PhotoShop FilmStrip (\*.flm)  
Photo CD PCD, Photoshop PSD, Portable anymap PNM  
Portable Bitmap Format PBM DPS  
Portable graymap PGM  
Portable pixmap PPM  
QuickTime Movies (\*.mov)  
QuickTime formats w/proper codec, ProRes, etc...  
RealVideo (\*.ra, \*.rm, \*.ram), Red Camera Stream (\*.r3d)  
Run-Length encoding (rle)  
Sony XDCam, SGI Movie Format (\*.mv), SGI RGB  
Silicon Image Bayer (\*.siv), Sun Raster (\*.ras)  
Targa TGA, ICB, VDA, VST, Targa 3000, TIFF, TIF  
v210 Y'CbCr 10 Bit, VC-1 Pro, VP8, VP9, Viewstore (\*.vsr)  
vcap, vcap10, Windows Media (\*.asf, \*.wmf, \*.wmv)  
Y'CbCr 8/10, Y'CbCr, RGB, YCrCb 8/RGBA

## Audio Import Formats (partial list):

Dolby® Digital Plus Professional Input Decoder  
-including AC-3 and Enhanced AC-3  
MPEG Audio Layers 1, 2, 3 (\*.mp1), \*.mp2), (\*.mp3)  
Waveform Audio (\*.wav)  
Adaptive Multi-rate (\*.amr)  
Audio Interchange File Format (\*.aiff)  
Windows Media Audio (\*.wma)  
Advanced Audio Coding (\*.aac)

## Exported File Formats:

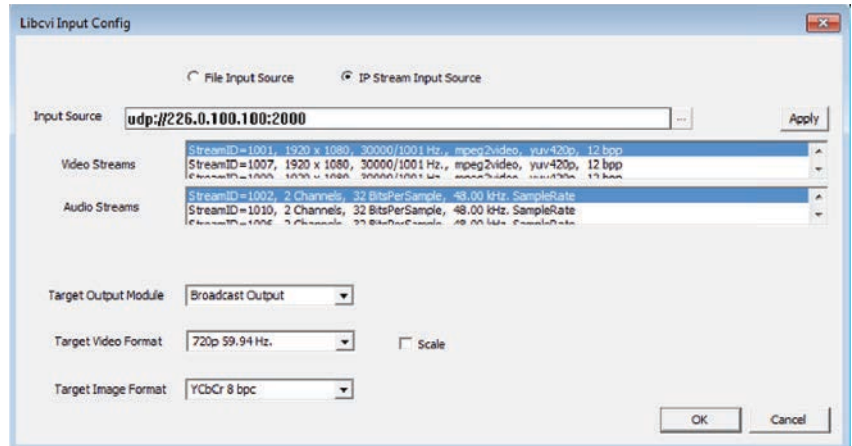
BMP, Headerless/Raw (\*.yuv, \*.rgb, \*.raw)  
Microsoft AVI (\*.avi), MXF (v210),  
QuickTime (.mov) with up to 16 audio channels

**ClearView Software provides several tools for recording via IP networks** as outlined below. The solution also provides the very useful ability to record a side by side comparison from the system's output to a separate sequence for export into standard file format.

## IP Input - For Compressed Stream Decoding and Recording

Compressed IP streams are automatically decoded with single or dual input modes that record a video sequence as sensed at the IP multicast address and port specified within the IP configuration menu. *IP Input may decode up to the capabilities of the multicore processor in the applied system.*

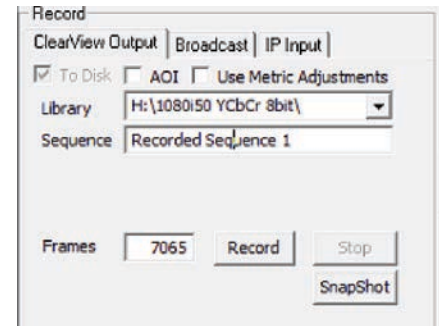
Each input selection is provided with individual menus to set up each IP stream input parameters. Each IP menu contains transformation settings for scale, crop, de-interlace, rate change and position for matching of source content to the IP network delivered sequence format for testing.



## From ClearView

The ClearView Output tab provides the unique ability to record any sequence or combination of two sequences that are set into any View Mode. As an example a side by side view of two synchronized sequences, each with an identifying overlay window, is created as a single file in a ClearView library. This sequence can then be exported in YUV, AVI or QuickTime format for delivery and playback review by most of today's computer desktop graphics outputs. This mode also allows a snapshot recording so that representative stills can be inserted as reference material to presentations.

Note: ClearView system products have functions for HDSDI, ST 2110 IP network, or HDMI source recording and full resolution output playback. ClearView Software only supports the ability to record from IP networks and playback to its desktop output module.



## ClearView Software Models and Specifications

**CV-1L** - Permanent on-premise software  
**CV-Software-1L-12** - One year subscription  
**CV-Software-1L-6** - Six months subscription  
 - Software may be on-premise or cloud-based  
 - On-premise requires USB license key shipment

**All Models Include:** ClearView Software, ClearView Importer, Metric Log Grapher, Command Line Interface, PDF Guides  
**Option: CV-JND** JND metric license for ClearView Software  
**On-Premise Software** - Minimum Required System Specification: Intel I7 or equivalent, 16 GB memory, 3 Gb/s minimum disk throughput

**On AWS** - Minimum Required Specification: T2.xlarge with 16 GB memory  
**On Azure** - Minimum Required Specification: Standard E2s v3 - 2 vCPU(s) with 16 GB memory