# Tektronix®

# Picture Quality Analysis Software
## PQASW Datasjeet



The PQASW is the picture quality analysis software based on the concepts of the human vision system which provides a suite of repeatable, objective quality measurements that closely correspond with subjective human visual assessment.

## Key performance specifications

- Picture quality measurements can be made on a variety of HD video formats (1080p, 1080i, 720p) and SD video formats (525i or 625i)
- Region of interest (ROI) on measurement execution and review
- Automatic temporal and spatial alignment
- Embedded reference decoder

## Key features

- Fast, accurate, repeatable, and objective picture quality measurement
- Predicts DMOS (Differential mean opinion score) based on human vision system model
- User-configurable viewing condition and display models for reference and comparison (Option ADV)
- Attention/Artifact weighted measurement (Option ADV)
- Easy regression testing and automation using XML scripting (Option ADV) with "Export/Import" file from GUI
- Multiple results view options
- IP interface with simultaneous Generation/Capture and 2-Ch capture (Option IP)
- Embedded sample reference and test sequences
- Available for customer installation on the customer's own PC

## Applications

- CODEC design, optimization, and verification
- Conformance testing, transmission equipment, and system evaluation
- Digital video mastering
- Video compression services
- Digital consumer product development and manufacturing

## Picture quality analysis software

The PQASW (PQA) is the Picture Quality Analysis Software based on the concepts of the human vision system which provides a suite of repeatable, objective quality measurements that closely correspond with subjective human visual assessment. These measurements provide valuable information to engineers working to optimize video compression and recovery, and maintaining a level of common carrier and distribution transmission service to clients and viewers.

## Compressed video requires new test methods

The true measure of any television system is viewer satisfaction. While the quality of analog and full-bandwidth digital video can be characterized indirectly by measuring the distortions of static test signals, compressed television systems pose a far more difficult challenge. Picture quality in a compressed system can change dynamically based on a combination of data rate, picture complexity, and the encoding algorithm employed. The static nature of test signals does not provide true characterization of picture quality.

Human viewer testing has been traditionally conducted as described in ITU-R Rec. BT.500-11. A test scene with natural content and motion is displayed in a tightly controlled environment, with human viewers expressing their opinion of picture quality to create a Differential Mean Opinion Score, or DMOS. Extensive testing using this method can be refined to yield a consistent subjective rating. However, this method of evaluating the capabilities of a compressed video system can be inefficient, taking several weeks to months to perform the experiments. This test methodology can be extremely expensive to complete, and often the results are not repeatable. Thus, subjective DMOS testing with human viewers is impractical for the CODEC design phase, and inefficient for ongoing operational quality evaluation. The PQA provides a fast, practical, repeatable, and objective measurement alternative to subjective DMOS evaluation of picture quality.

## System evaluation

The PQA can be used for installation, verification, and troubleshooting of each block of the video system because it is video technology agnostic: any visible differences between video input and output from processing components in the system chain can be quantified and assessed for video quality degradation. Not only can CODEC technologies be assessed in a system, but any process that has potential for visible differences can also be assessed. For example, digital transmission errors, format conversion (i.e. 1080i to 480p in set-top box conversions), analog transmission degradation, data errors, slow display response times, frame rate reduction (for mobile transmission and videophone teleconferencing), and more can all be evaluated.
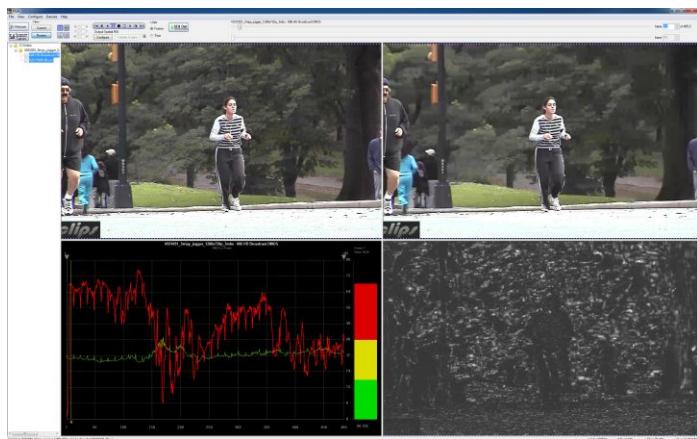


User Interface of PQA. Showing reference, test sequences, with difference map and statistical graph.

## How it works

The PQA takes two video files as inputs: a reference video sequence and a compressed, impaired, or processed version of the reference. First, the PQA performs a spatial and temporal alignment between the two sequences, without the need for a calibration stripe embedded within the video sequence. Then the PQA analyzes the quality of the test video, using measurements based on the human vision system and attention models, and then outputs quality measurements that are highly correlated with subjective assessments. The results include overall quality summary metrics, frame-by-frame measurement metrics, and an impairment map for each frame. The PQA also provides traditional picture quality measures such as PSNR (Peak Signal-to-Noise Ratio) as an industry benchmark impairment diagnosis tool for measuring typical video impairments and detecting artifacts.

Each reference video sequence and test clip can have different resolutions and frame rates. This capability supports a variety of repurposing applications such as format conversion, DVD authoring, IP broadcasting, and semiconductor design. The PQA can also support measurement clips with long sequence duration, allowing a video clip to be quantified for picture quality through various conversion processes.

## Prediction of human vision perception

PQA measurements are developed from the human vision system model and additional algorithms have been added to improve upon the model used in the PQA200/300. This new extended technology allows legacy PQR measurements for SD while enabling predictions of subjective quality rating of video for a variety of video formats (HD, SD, CIF, etc.). It takes into consideration different display types used to view the video (for example, interlaced or progressive and CRT or LCD) and different viewing conditions (for example, room lighting and viewing distance).
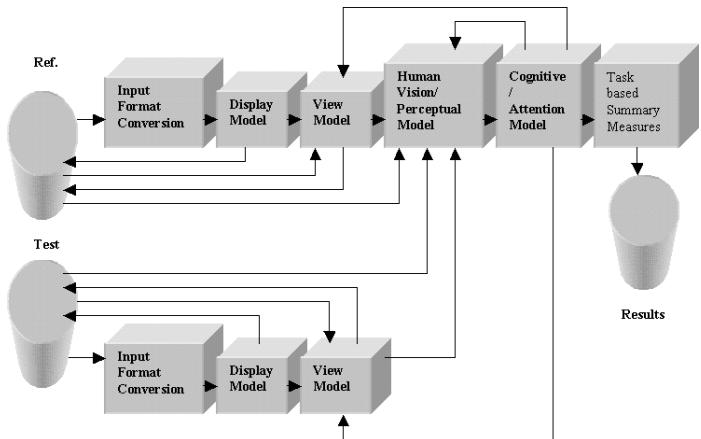


Picture quality analysis system

A model of the human vision system has been developed to predict the response to light stimulus with respect to the following parameters:

- Contrast including supra-threshold
- Mean luminance
- Spatial frequency
- Temporal frequency
- Angular extent
- Temporal extent
- Surround
- Eccentricity
- Orientation
- Adaptation effects
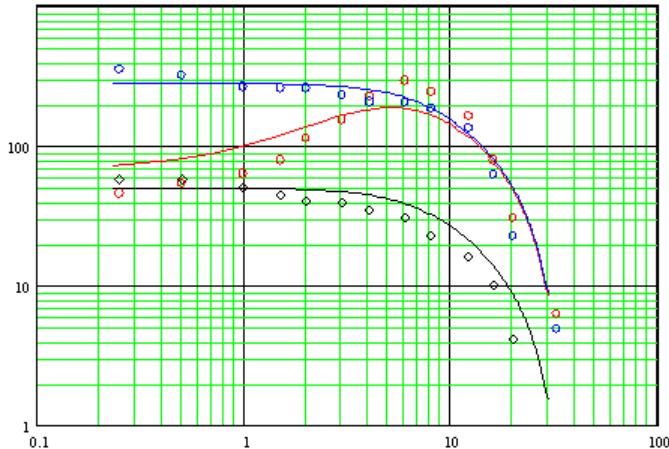
A: Modulation sensitivity vs. temporal frequency
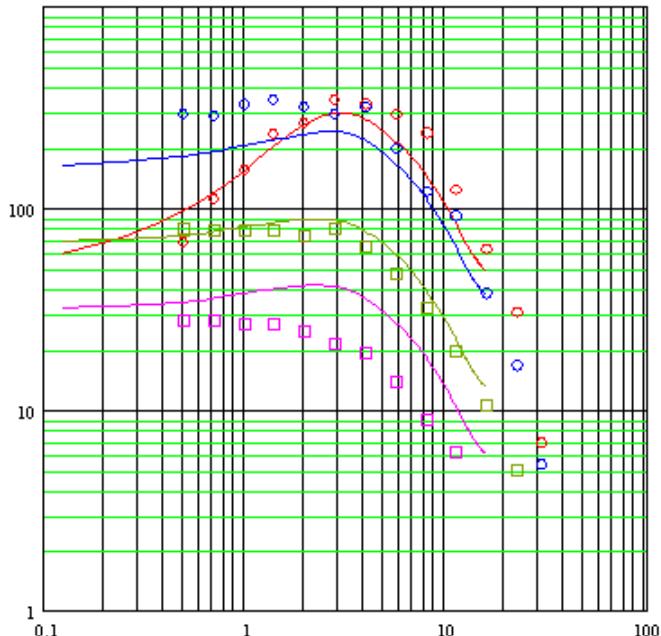


B: Modulation sensitivity vs. spatial frequency

This model has been calibrated, over the appropriate combinations of ranges for these parameters, with reference stimulus-response data from vision science research. As a result of this calibration, the model provides a highly accurate prediction.

The graphs above are examples of scientific data regarding human vision characteristics used to calibrate the human vision system model in the PQA. Graph (A) shows modulation sensitivity vs. temporal frequency, and graph (B) shows modulation sensitivity vs. spatial frequency. The use of over 1400 calibration points supports high-accuracy measurement results.



C: Reference picture



D: Perceptual contrast map

Picture (C) is a single frame from the reference sequence of a moving sequence, and picture (D) is the perceptual contrast map calculated by the PQA. The perceptual contrast map shows how the viewer perceives the reference sequence. The blurring on the background is caused by temporal masking due to camera panning and the black area around the jogger shows the masking effect due to the high contrast between the background and the jogger. The PQA creates the perceptual map for both reference and test sequences, then creates a perceptual difference map for use in making perceptually based, full-reference picture quality measurements.

## Comparison of predicted DMOS with PSNR

In the examples, Reference (E) is a scene from one of the VClips library files. The image Test (F), has been passed through a compression system which has degraded the resultant image. In this case the background of the jogger in Test (F) is blurred compared to the Reference image (E). A PSNR measurement is made on the PQA of the difference between the Reference and Test clip and the highlighted white areas of PSNR Map (G) shows the areas of greatest difference between the original and degraded image. Another measurement is then made by the PQA, this time using the Predicted DMOS algorithm and the resultant Perceptual Difference Map for DMOS (H) image is shown. Whiter regions in this Perceptual Contrast Difference map indicate greater perceptual contrast differences between the reference and test images. In creating the Perceptual Contrast Difference map, the PQA uses a human vision system model to determine the differences a viewer would perceive when watching the video.



E: Reference



F: Test



G: PSNR map
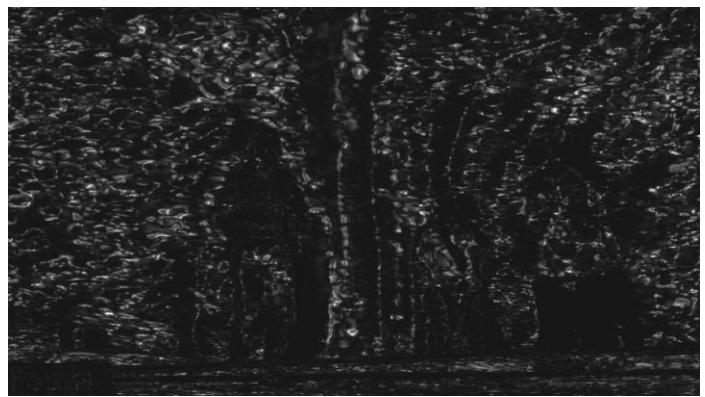


H: Perceptual difference map for DMOS

The Predicted DMOS measurement uses the Perceptual Contrast Difference Map (H) to measure picture quality. This DMOS measurement would correctly recognize the viewers perceive the jogger as less degraded than the trees in the background. The PSNR measurement uses the difference map (G) and would incorrectly include differences that viewers do not see.

## Attention model

The PQASW also incorporates an attention model that predicts focus of attention. this model considers:

- Motion of objects
- Skin coloration (to identify people)
- Location
- Contrast
- Shape
- Size
- Viewer distraction due to noticeable quality artifacts
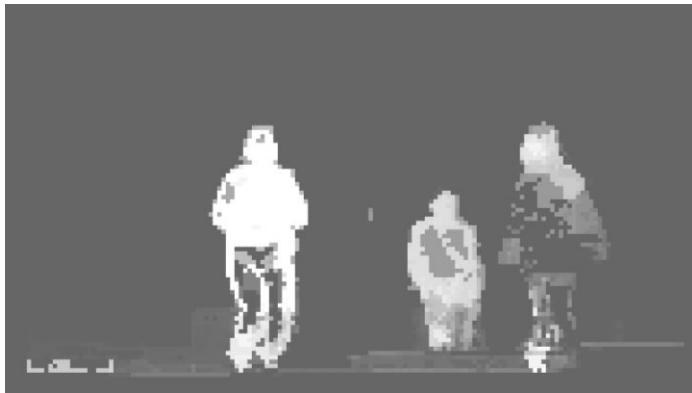
Attention map example: the jogger is highlighted

These attention parameters can be customized to give greater or less importance to each characteristic. This allows each measurement using an attention model to be user-configurable. The model is especially useful to evaluate the video process tuned to the specific application. For example, if the content is sports programming, the viewer is expected to have higher attention in limited regional areas of the scene. Highlighted areas within the attention image map will show the areas of the image drawing the eye's attention.

## Artifact detection

Artifact detection reports a variety of different changes to the edges of the image:

- Loss of edges or blurring

- Addition of edges or Ringing/Mosquito noise

- Rotation of edges to vertical and horizontal or edge blockiness

- Loss of edges within an image block or DC blockiness
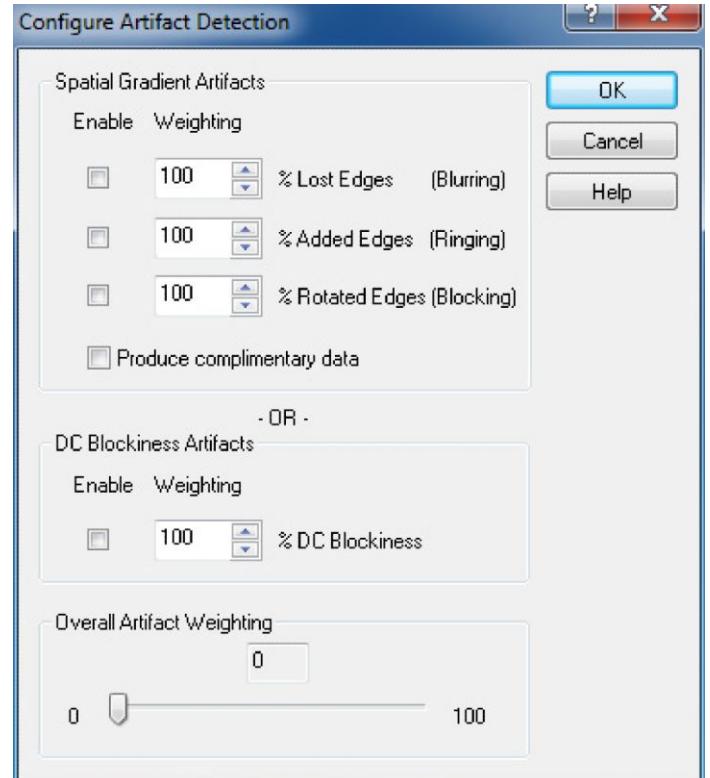

Artifact detection settings

They work as weighting parameters for subjective and objective measurements with any combination. The results of these different measurement combinations can help to improve picture quality through the system.

For example, artifact detection can help answer questions such as: "Will the DMOS be improved with more de-blocking filtering?" or, "Should less prefiltering be used?"

If edge-blocking weighted DMOS is much greater than blurring-weighted DMOS, the edge-blocking is the dominant artifact, and perhaps more de-blocking filtering should be considered.

In some applications, it may be known that added edges, such as ringing and mosquito noise, are more objectionable than the other artifacts. These weightings can be customized by the user and configured for the application to reflect this viewer preference, thus improving DMOS prediction.

Likewise, PSNR can be measured with these artifact weightings to determine how much of the error contributing to the PSNR measurement comes from each artifact.

The Attention Model and Artifact Detection can also be used in conjunction with any combination of picture quality measurements. This allows, for example, evaluation of how much of a particular noticeable artifact will be seen where a viewer is most likely to look.

## Comprehensive picture quality analysis

The PQA provides Full Reference (FR) picture quality measurements that compare the luminance signal of reference and test videos. It also offers some No Reference (NR) measurements on the luminance signal of the test video only. Reduced Reference (RR) measurements can be made manually from differences in No Reference measurements. The suite of measurements includes:

- Critical viewing (Human vision system model-based, Full reference) picture quality

- Casual viewing (Attention weighted, Full reference, or No reference) picture quality

- Peak Signal-to-Noise ratio (PSNR, Full reference)

- Focus of attention (Applied to both Full reference and No reference measurements)

- Artifact detection (Full reference, except for DC blockiness)

- DC blockiness (Full reference and No reference)
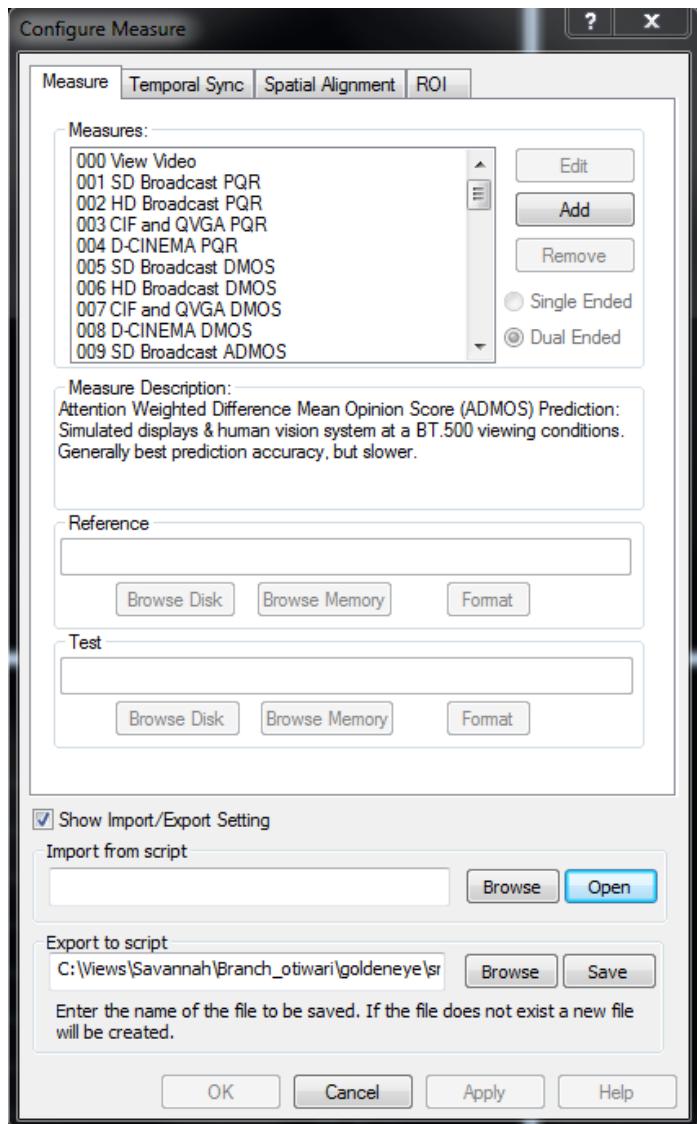
Configure measure dialog
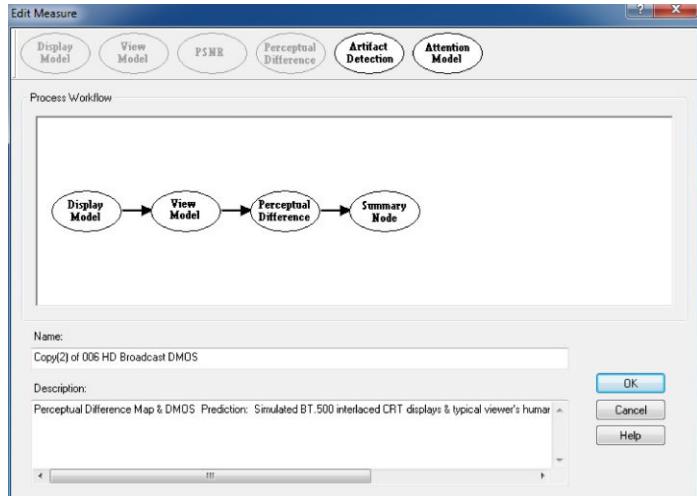
Edit measure dialog

The PQA supports these measurements through preset and user-defined combinations of display type, viewing conditions, human vision response (demographic), focus of attention, and artifact detection, in addition to the default ITU BT-500 conditions. The ability to configure measurement conditions helps CODEC designers evaluate design trade-offs as they optimize for different applications, and helps any user investigate how different viewing conditions affect picture quality measurement results. A user-defined measurement is created by modifying a preconfigured measurement or creating a new one, then saving and recalling the user-defined measurement from the Configure Measure dialog menu.

## Easy-to-use interface

The PQA has two modes: Measurement and Review. The Measurement mode is used to execute the measurement selected in the Configure Dialog. During measurement execution, the summary data and map results are displayed on-screen and saved to the system hard disk. The Review mode is used to view previously saved summary results and maps created either with the measurement mode or XML script execution. The user can choose multiple results in this mode and compare each result side by side using the synchronous display in Tile mode. Comparing multiple results maps made with the different CODEC parameters and/or different measurement configurations enables easy investigation of the root cause of any difference.

## Multiple result display

Resultant maps can be displayed synchronously with the reference and test video in a summary, six-tiled, or overlaid display.
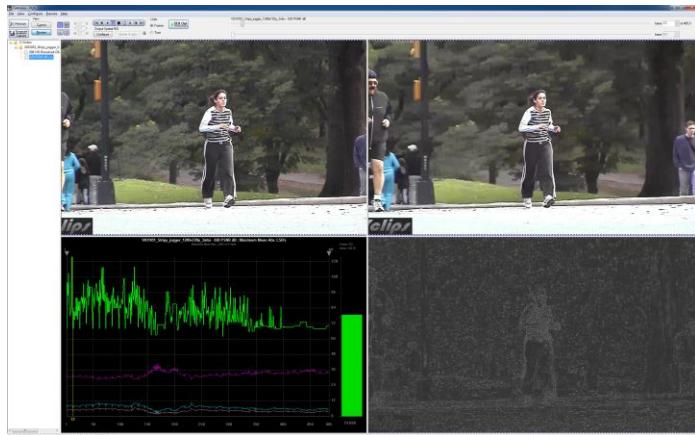


Integrated graph

In Summary display, the user can see the multiple measurement graphs with a barchart along with the reference video, test video, and difference map during video playback. Summary measures of standard parameters and perceptual summation metrics for each frame and overall video sequence are provided.
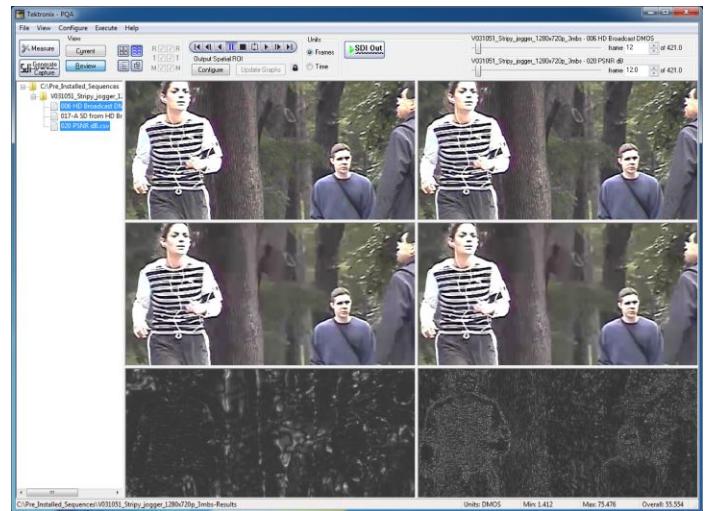


Six-tiled display

In Six-tiled display, the user can display the 2 measurement results side by side. Each consists of a reference video, test video, and difference map to compare to each other.
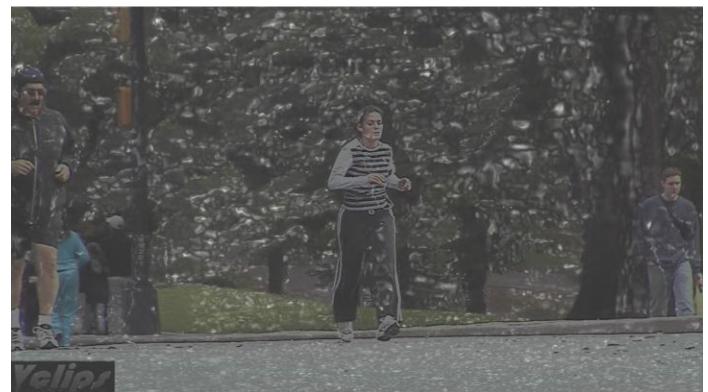


Overlay display, reference and map

In Overlay display, the user can control the mixing ratio with the fader bar, enabling co-location of difference map, reference, and impairments in test videos.

Error logging and alarms are available to help users efficiently track down the cause of video quality problems.

All results, data, and graphs can be recalled to the display for examination.

## Automatic temporal/spatial alignment

The PQA supports automatic temporal and spatial alignment, as well as manual alignment.
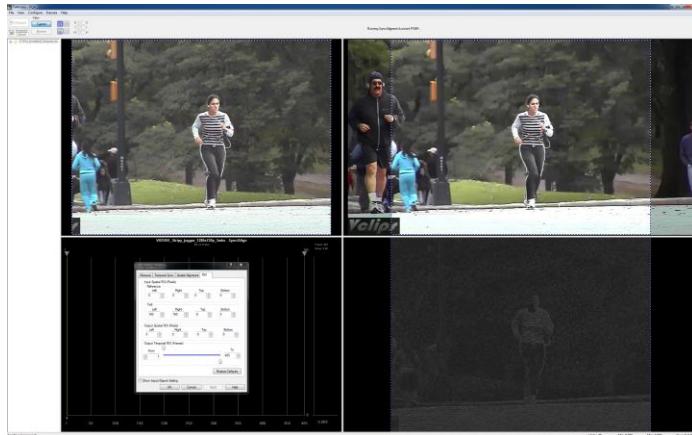


Auto spatial alignment execution with spatial region of interest selected

The automatic spatial alignment function can measure the cropping, scale, and shift in each dimension, even across different resolutions and aspect ratios. If extra blanking is present within the standard active region, it is measured as cropping when the automatic spatial alignment measurement is enabled.

The spatial alignment function can be used when the reference video and test video both have progressive content. In the case where the reference video and test video has content with different scanning (interlace versus progressive or vice versa), the full reference measurement may not be valid. In the case where the reference video and test video both have interlaced content, the measurement is valid when spatial alignment is not needed to be set differently from the default scale and shift.

## Region of interest

There are two types of spatial/temporal Region of Interest (ROI): Input and Output. Input ROIs are used to eliminate spatial or temporal regions from the measurement which are not of interest to the user. For example, Input Spatial ROI is used when running measurements for reference and test videos which have different aspect ratios. Input Temporal ROI, also known as temporal sync, is used to execute measurements just for selected frames and minimize the measurement execution time.
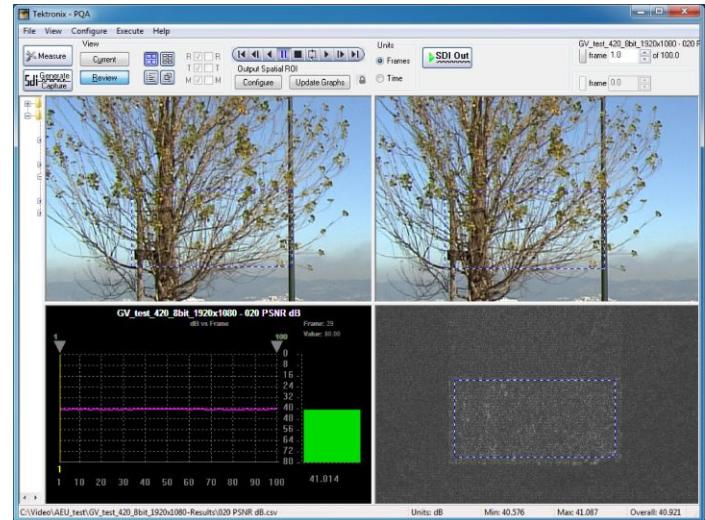


Output spatial ROI on review mode for in-depth investigation

Output ROIs can be used to review precalculated measurement results for only a subregion or temporal duration. Output Spatial ROI is instantly selected by mouse operation and gives a score for just the selected spatial area. It's an effective way to investigate a specific spatial region in the difference map for certain impairments. Output Temporal ROI is set by marker operation on the graph and allows users to get a result for just a particular scene when the video stream has multiple scenes. It also allows users to provide a result without any influence from initial transients in the human vision model. Each parameter can be embedded in a measurement for the recursive operation.

## Automated testing with XML scripting

In the CODEC debugging/optimizing process, the designer may want to repeat several measurement routines as CODEC parameters are revised. Automated regression testing using XML scripting can ease the restrictions of manual operation by allowing the user to write a series of measurement sequences within an XML script. The script file can be exported from or imported to the measurement configuration menu to create and manage the script files easily. Measurement results of the script operation can be viewed by using either the PQA user interface or any spreadsheet application that can read the created .csv file format as a summary. Multiple scripts can be executed simultaneously for faster measurement results.



Script sample

Import/Export script in configure measure dialog



Result file sample

## IP interface

The IP interface enables both generation and capture of compressed video with two modes of simultaneous operation.



Generation/capture

Simultaneous generation and capture lets the user playout the reference video clips directly from an IP port in the PC into the device under test. The test output from the device can then be simultaneously captured by the PC. This saves the user from having to use an external video source to apply any required video input to the device under test. With this generation capability, files created by video editing software can be directly used as reference and test sequences for picture quality measurements.



2-channel capture

Simultaneous 2-channel capture lets the user capture two live signals to use as reference and test videos in evaluating the device under test in operation.

In both modes, the captured compressed stream will be decoded to the uncompressed file by the embedded reference decoder, and the user can run the picture quality measurement without any additional tool or manual processes.
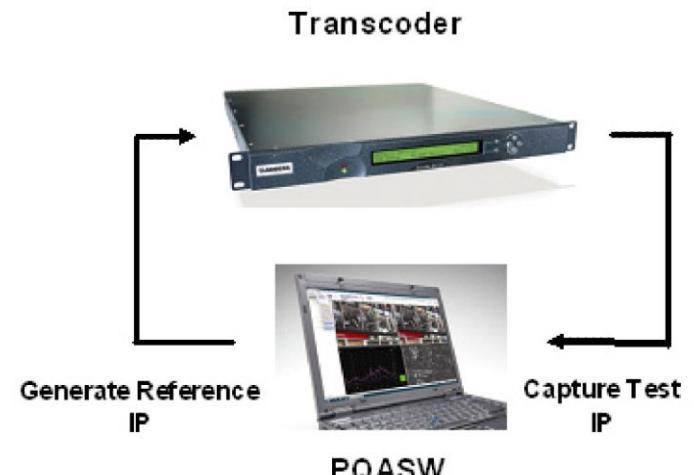


## Supported file format for IP interface

The IP interface option can generate and capture compressed files in compliance with ISO/IEC 13818-1 (TS support over UDP).

## IGMP support

IGMP support in IP capture will make stream selection simple at multicast streaming. The compressed video file captured through IP will be converted to an uncompressed file by an internal embedded decoder.

## Embedded sample video files

The user can run the measurement with the embedded sample video file when the software is invoked without valid option key code or dongle.



Avenue video file



Jogger video file

| Video | Description |
|-------|-------------|
| Jogger | Reference, 320×180, 1 mb/s, 2 mb/s |
| Avenue | Reference, 320×180, 1 mb/s, 2 mb/s |

## Supported file formats for measurement

All formats support 8 bit unless otherwise stated:

- .yuv (UYVY, YUY2, YUV4:4:4, YUV4:2:0_planar)

- .v210 (10 bit, UYVY, 3 components in 32 bits)

- .rgb (BGR24, GBR24)

- .avi (uncompressed, BGR32 (discard alpha channel) / BGR24 / UYVY / YUY2 / v210)

- ARIB ITE format (4:2:0 planar with 3 separate files (.yyy))

- .vcap (created by PQA600A SDI video capture)

- .vcap10 (10 bit, created by PQA600A video capture)

The following compressed files are internally converted to an uncompressed file before measurement execution. The format support listed here is available in software version 4.0 and later.

| Format | ES | ADF | MP4 | 3GPP | Quicktime | MP2 PES | MP2 PS | MP2 TS | MXF | GXF | AVI | LXF |
|--------|----|----|----|------|-----------|---------|--------|--------|-----|-----|-----|-----|
| H263 | X | | X | X | X | | | | | | X | |
| MP2 | X | | | | X | X | X | X | X | X | X | X |
| MP4 | X | | X | X | X | | | | | | X | X |
| H264/AVC | X | | X | X | X | X | X | X | X | | X | X |
| DV | X | | | | X | | | | X | X | X | X |
| VC-1 | X | X | | | | | | | | | X | |
| ProRes | | | | | X | | | | | | | |
| Quicktime | | | X | X | X | | | | | | | |
| JPEG2000 | X | | X | X | X | | | | X | | | |

| Format | ES | ADF | MP4 | 3GPP | Quicktime | MP2 PES | MP2 PS | MP2 TS | MXF | GXF | AVI | LXF |
|--------|----|----|-----|------|-----------|---------|--------|--------|-----|-----|-----|-----|
| VC3/DNxHD | X | | X | X | X | | | | X | | | |
| Raw | X | | | | | | | | | | X | X |

# Preconfigured measurements set

Some measurements are available only with Option ADV.

| **View video with no measurement class** | Requires Option BAS |
|---|---|
| **Measurement name** | "000 View Video" |
| | No applicaable configuration nodes |

## Subjective prediction: Full reference

**Noticeable differences**

**SD display and viewing measurement class**

"001 SD Broadcast PQR" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| SD Broadcast CRT | (ITU-R BT.500) | NA | Typical | NA | Default weightings | PQR Units |

**HD display and viewing measurement class**

"002 HD Broadcast PQR" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| HD Broadcast CRT | (ITU-R BT.500) | NA | Typical | NA | Default weightings | PQR Units |

**CIF display and viewing measurement class**

"003 CIF and QVGA PQR" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| CIF/QVGA LCD | 7 scrn heights, 20 cd/m$^2$ | NA | Typical | NA | Default weightings | PQR Units |

**D-CINEMA Projector and viewing measurement class**

"004 D-CINEMA PQR" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| DMD Projector | 3 scrn heights, .1 cd/m$^2$ | NA | Typical | NA | Default weightings | PQR Units |

# Datasheet

**Subjective rating predictions**

**SD display and viewing measurement class**

"005 SD Broadcast DMOS" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| SD Broadcast CRT | (ITU-R BT.500) | NA | Typical | NA | Default weightings | DMOS Units Re: BT.500 Training |

**HD display and viewing measurement class**

"006 HD Broadcast DMOS" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| HD Broadcast CRT | (ITU-R BT.500) | NA | Typical | NA | Default weightings | DMOS Units Re: BT.500 Training |

**CIF display and viewing measurement class**

"007 CIF and QVGA DMOS" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| CIF/QVGA LCD | 7 scrn heights, 20 cd/m$^{2}$ | NA | Typical | NA | Default weightings | DMOS Units Re: BT.500 Training |

**D-CINEMA Projector and viewing measurement class**

"008 D-CINEMA DMOS" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| DMD Projector | 3 scrn heights, .1 cd/m$^{2}$ | NA | Typical | NA | Default weightings | DMOS Units Re: BT.500 Training |

**Attention biased subjective rating predictions**

Requires Option ADV

**SD display and viewing measurement class**

"009 SD broadcast ADMOS" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| SD Broadcast CRT | (ITU-R BT.500) | NA | Typical | NA | Default weightings | DMOS Units Re: BT.500 Training |

**HD display and viewing measurement class**

"010 HD Broadcast ADMOS" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| HD Broadcast CRT | (ITU-R BT.500) | NA | Typical | NA | Default weightings | DMOS Units Re: BT.500 Training |

**CIF display and viewing measurement class**

"011 CIF and QVGA ADMOS" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| CIF/QVGA LCD | 7 scrn heights, 20 cd/m$^{2}$ | NA | Typical | NA | Default weightings | DMOS Units Re: BT.500 Training |

**SD sports measurement class**

"012 SD Sports Broadcast ADMOS" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| SD Broadcast CRT | (ITU-R BT.500) | NA | Typical | NA | Motion and Foreground Dominant | DMOS Units Re: BT.500 Training |

**HD sports measurement class**    "013 HD Sports Broadcast ADMOS" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| HD Broadcast CRT | (ITU-R BT.500) | NA | Typical | NA | Motion and Foreground Dominant | DMOS Units Re: BT.500 Training |

**SD talking head measurement class**    "014 SD Talking Head Broadcast ADMOS" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| SD Broadcast CRT | (ITU-R BT.500) | NA | Typical | NA | Motion and Foreground Dominant | DMOS Units Re: BT.500 Training |

**Repurposing: reference and test are independent**    Use any combination display model and viewing conditions with each measurement.

**Format conversion: cinema to SD DVD measurement class**    "015 SD DVD from D-Cinema DMOS" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| DMD projector and SD CRT | 7 scrn heights, 20 cd/m^2 and (ITU-R BT.500) | NA | Expert | NA | NA | DMOS Units Re: BT.500 Training |

**Format conversion: SD to CIF measurement class**    "016 CIF from SD Broadcast DMOS" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| LCD and SD Broadcast CRT | 7 scrn heights, 20 cd/m^2 and (ITU-R BT.500) | NA | Expert | NA | NA | DMOS Units Re: BT.500 Training |

**Format conversion: HD to SD measurement class**    "017 SD from HD Broadcast DMOS" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| SD and HD Broadcast CRT | (ITU-R BT.500) | NA | Expert | NA | NA | DMOS Units Re: BT.500 Training |

**Format conversion: SD to HD measurement class**    "017-A SD from HD Broadcast DMOS" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| SD and HD Progressive CRT | (ITU-R BT.500) | NA | Expert | NA | NA | DMOS Units Re: BT.500 Training |

**Format conversion: CIF to QCIF measurement class**    "018 QCIF from CIF and QVGA DMOS" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| QCIF and CIF/ QVGA LCD | 7 scrn heights, 20 cd/m^2 | NA | Expert | NA | NA | DMOS Units Re: BT.500 Training |

**Attention**

**Attention measurement class**  "019 Stand-alone Attention Model" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| NA | NA | NA | NA | NA | Default weightings | Map units: % Probability of focus of attention |

# Objective measurements: Full reference

**General difference**

**PSNR measurement class**  "020 PSNR dB" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| NA | Auto-align spatial | Selected | NA | NA | NA | dB units |

**Artifact measurement**  Requires Option ADV

**Removed edges measurement class**  "021 Removed Edges Percent" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| NA | Auto-align spatial | NA | NA | Blurring | NA | % |

**Added edges measurement class**  "022 Added Edges Percent" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| NA | Auto-align spatial | NA | NA | Ringing / Mosquito Noise | NA | % |

**Rotated edges measurement class**  "023 Rotated Edges Percent" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| NA | Auto-align spatial | NA | NA | Edge Blockiness | NA | % |

**% of original deviation from block DC measurement class**  "024 DC Blocking Percent" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| NA | Auto-align spatial | NA | NA | DC Blockiness | NA | % |

**Artifact classified (filtered) PSNR**  Requires Option ADV

**Removed edges measurement class**  "025 Removed Edges Weighted PSNR dB" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| NA | Auto-align spatial | Selected | NA | Blurring | NA | dB units |

**Added edges measurement class**  "026 Added Edges Weighted PSNR dB" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| NA | Auto-align spatial | Selected | NA | Ringing / Mosquito Noise | NA | dB units |

**Rotated edges measurement class**  "027 Rotated Edges Weighted PSNR dB" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| NA | Auto-align spatial | Selected | NA | Edge Blockiness | NA | dB units |

**% of original deviation from block DC measurement class**  "028 DC Blocking Weighted PSNR dB" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| NA | Auto-align spatial | Selected | NA | DC Blockiness | NA | dB units |

**Artifact annoyance weighted (filtered) PSNR**  Requires Option ADV

**PSNR w/ default artifact annoyance weights measurement class**  "029 Artifact Annoyance Weighted PSNR dB" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| NA | Auto-align spatial | Selected | NA | All artifacts selected | NA | dB units |

**Repurposing:**  Use View model to resample, shift, and crop test to map to measurement

Requires Option ADV

**Format conversion: Cinema to SD DVD measurement class**  "030 SD DVD from D-Cinema Artifact weighted PSNR dB" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| NA | Auto-align spatial | Selected | NA | All artifacts selected | NA | dB units |

**Format conversion: SD to CIF measurement class**  "031 CIF from SD Broadcast Artifact weighted PSNR dB" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| NA | Auto-align spatial | Selected | NA | All artifacts selected | NA | dB units |

**Format conversion: HD to SD measurement class**

"032 SD from HD Broadcast Artifact weighted PSNR dB" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| NA | Auto-align spatial | Selected | NA | All artifacts selected | NA | dB units |

**Format conversion: CIF to QCIF measurement class**

"033 QCIF from CIF and QVGA Artifact weighted PSNR dB" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| NA | Auto-align spatial | Selected | NA | All artifacts selected | NA | dB units |

## Attention weighted objective measurements

**General differences**

Requires Option ADV

**PSNR measurement class**

"034 Attention Weighted PSNR dB" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| NA | NA | Selected | NA | NA | Default weightings | dB units |

## Objective measurements: No reference

**Artifact**

Requires Option ADV

**Artifact measurement class**

"035 No Reference DC Blockiness Percent" measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| NA | NA | NA | NA | No-reference DC block | NA | % DC blockiness |

**Subjective prediction calibrated by subjective rating**

Conducted in 2009 with 1080i29 Video Contents and H.264 CODEC (Refer to application note, 28W_24876_0.pdf)

036 HD PQR ITU-BT500 with Interlaced CRT measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| Custom HD CRT | 3 scrn heights | NA | Custom | NA | NA | PQR units |

037 HD DMOS ITU-BT500 with Interlaced CRT measurement

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| Custom HD CRT | 3 scrn heights | NA | Custom | NA | NA | DMOS Units Re:BT. 500 Training |

038 HD ADMOS ITU-BT500 with Interlaced CRT measurement [1]

| Display model | View model | PSNR | Perceptual difference | Artifact detection | Attention model | Summary node |
|---|---|---|---|---|---|---|
| Custom HD CRT | 3 scrn heights | NA | Custom | NA | Typical | DMOS Units Re:BT. 500 Training |

# Specifications

All specifications apply to all models unless noted otherwise.

## Nodes (available with Option ADV)

**Display model**
Display technology: CRT/LCD/DMD each with preset and user-configurable parameters (Interlace/Progressive, gamma, response time, etc). reference display and test display can be set independently

**View model**
Viewing distance, ambient luminance for reference and test independently, image cropping and registration: automatic or manual control of image cropping and test image contrast (ac gain), brightness (dc offset), horizontal and vertical scale and shift

**PSNR**
No configurable parameters

**Perceptual difference**
The viewer characteristics (acuity, sensitivity to changes in average brightness, response speed to the moving object, sensitivity to photosensitive epilepsy triggers, etc)

**Attention model**
Overall attention weighting for measures, temporal (Motion), spatial (Center, people (Skin), foreground, contrast, color, shape, size), distractions (Differences)

**Artifact detect**
Added edges (Blurring), removed edges (Ringing/Mosquito noise), rotated edges (Edge blockiness), and DC blockiness (Removed detail within a block)

**Summary node**
Measurement Units (Subjective: Predicted DMOS, PQR or % Perceptual Contrast. Objective: Mean Abs LSB, dB)., Map type: Signed on gray or unsigned on black. Worst-case Training Sequence for ITU-R BT.500 Training (Default or User-application Tuned: Determined by Worst Case Video % Perceptual Contrast), Error Log Threshold, Save Mode

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[1] Requires Option ADV

# Ordering information

## Models

| | |
|---|---|
| **PQASW** | Picture Quality Analysis software |

## PC requirements

| | |
|---|---|
| **Operating system** | Windows 7 64-bit |
| **Processor** | Dual core or more |
| **Display** | 1024×768 or higher resolution |
| **RAM** | 4 GB or greater |
| **Hard disk drive** | |
|     **Application** | 1 GB minimum |
|     **Data** | 50 GB or more recommended |

## Included accessories

### PQASW Picture Quality Analysis Software documentation

| | |
|---|---|
| **071-3208-xx** | User manual |
| **071-3157-xx** | Measurement technical reference |
| **077-0787-xx** | Release notes [2] |
| **077-0812-xx** | User technical reference [2] |

### Other accessories

| | |
|---|---|
| **020-3130-xx** | Application install disk |
| **-** | Software key dongle |

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[2] These PDF-only documents are available on the Tektronix Web site (www.tektronix.com/manuals)

## PC requirements
## Options

### Product options

| | |
|---|---|
| **ADV** | Advanced measurement package (script execution, user-configurable measurement, artifact/attention weighting measurement) |
| **IP** | IP Generation/Capture |
| **USB** | USB dongle |
| **PPD** | Parallel port dongle |
| **LUD** | Add permissions to an existing dongle |

**Post-sale upgrade**

| | |
|---|---|
| **PQASWUP** | Field upgrade kit for PQASW |
| **ADV** | Advanced measurement package (Script execution, user-configurable measurement, artifact/attention weighting measurement) |
| **IP** | IP Generation/Capture |

### Product selection

| Feature | PQASW | PQA600A |
|---|---|---|
| PSNR, PQR, DMOS preconfigured measurements | Yes | Option BAS |
| Multi-resolution/Frame-rate support | Yes | Option BAS |
| Multi-results view options | Yes | Option BAS |
| Embedded reference decoder | Yes | Option BAS |
| Automatic temporal and spatial alignment | Yes | Option BAS |
| IP Generation/Capture | Option IP | Option IP |
| User-configurable measurements | Option ADV | Option ADV |
| Attention/Artifact weighted measurements | Option ADV | Option ADV |
| XML scripting with Export/Import files | Option ADV | Option ADV |
| SD/HD/3G SDI generation and capture | No | Yes |
| HDMI without HDCP generation and capture | No | Yes |
| HDMI with HDCP generation & capture | No | Option BAS |
| Video format conversion | No | Yes |
| Side by side, wipe display at generation | No | Yes |

CE

Datasheet

## PC requirements

**For Further Information.** Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit www.tektronix.com.

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