Picture Quality Analysis System

PQA500 Data Sheet

Features & Benefits

- Fast, Accurate, Repeatable, and Objective Picture Quality Measurement
- Predicts DMOS (Differential Mean Opinion Score) Measurement based on Human Vision System Model
- Picture Quality Measurements can be made on a Variety of HD Video Formats (1080i, 720p) and SD Video Formats (525 or 625)
- Makes Picture Quality Comparison across Different Resolutions from HD to SD, or HD/SD to CIF
- User-configurable Viewing Condition and Display Models for Reference and Comparison
- Attention/Artifact Weighted Measurement
- Automatic Temporal and Spatial Alignment
- Easy Regression Testing and Automation using XML Scripting with "Export/Import" File
- Multiple Results View Options
- Optional SD/HD SDI Interface with Simultaneous Generation/Capture, 2-channel Capture and 2-channel Generation with Swap-channel Capability
- Preinstalled Sample Reference and Test Sequences

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 System

The PQA500 is the latest-generation Picture Quality Analyzer built on Tektronix' Emmy Award winning PQA200/300. Based on the concepts of the human vision system, the PQA500 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 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 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. A test scene with natural content and motion can be used, with human viewers reporting the results, but this method of evaluating the capabilities of compressed video system is inefficient and not very objective. Subjective testing with human viewers is impractical for CODEC design and operational quality evaluation. The PQA500 provides a fast, practical, repeatable, and objective measurement alternative to subjective evaluation 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 PQA500 provides a fast, practical, repeatable, and objective measurement alternative to subjective DMOS evaluation of picture quality.

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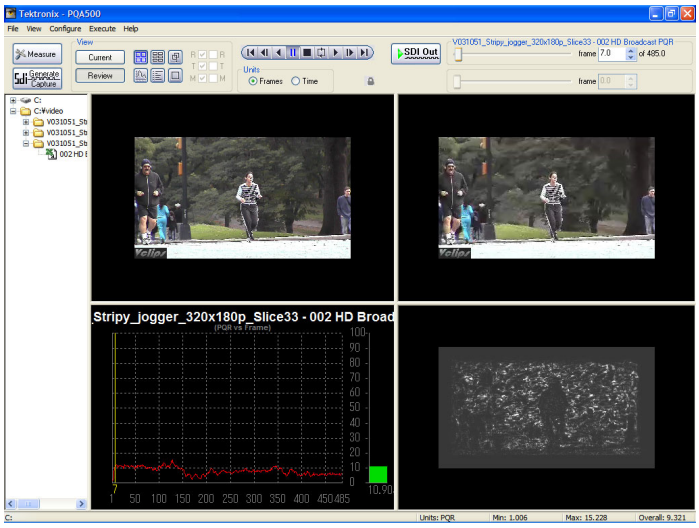


User Interface of PQA500. Showing reference, test sequences, with difference map and statistical graph.

System Evaluation

The PQA500 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), 3-2 pull-down, analog transmission degradation, data errors, slow display response times, frame rate reduction (for mobile transmission and videophone teleconferencing), and more can all be evaluated, separately or in any combination.

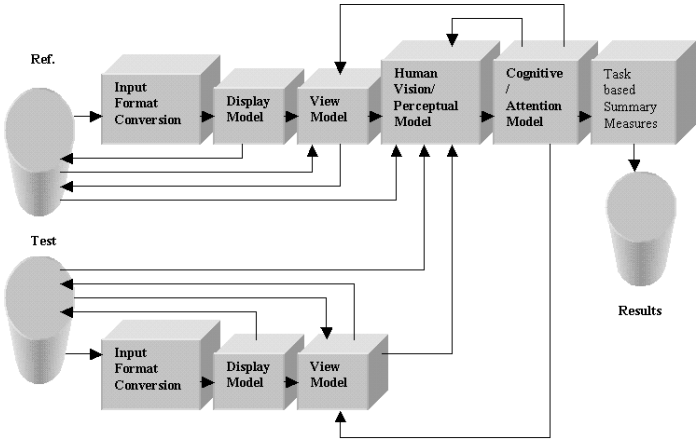
How It Works

The PQA500 takes two video files as inputs: a reference video sequence and a compressed, impaired, or processed version of the reference. First, the PQA500 performs a spatial and temporal alignment between the two sequences, without the need for a calibration stripe embedded within the video sequence. Then the PQA500 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 PQA500 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. The PQA500 can provide picture quality measurement between HD vs SD, SD vs CIF, or any combination. This capability supports a variety of repurposing applications such as format conversion, DVD authoring, IP broadcasting, and semiconductor design. The PQA500 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

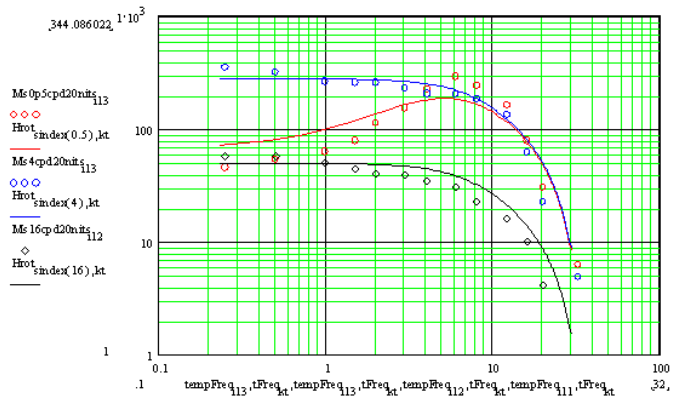
PQA500 measurements are developed from the human vision system model and additional algorithms have been added to improve upon the model used in the PQA200/300. This new extended technology allows legacy PQR measurements for SD while enabling predictions of subjective quality rating of video for a variety 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).



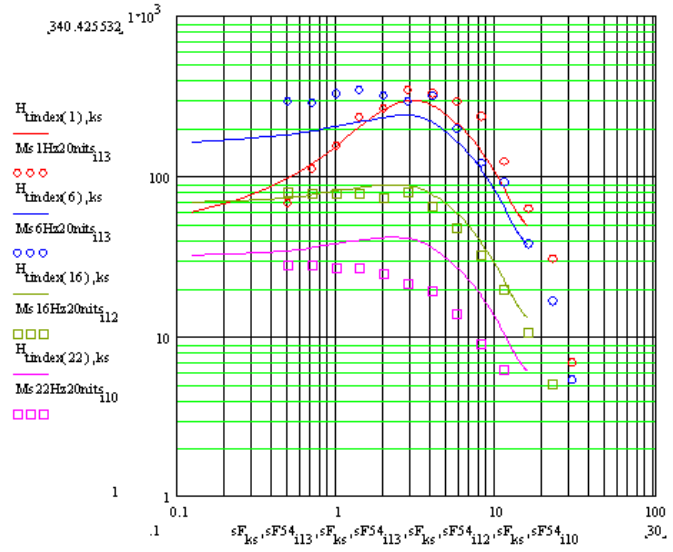
Picture Quality Analysis System.

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 PQA500. 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.

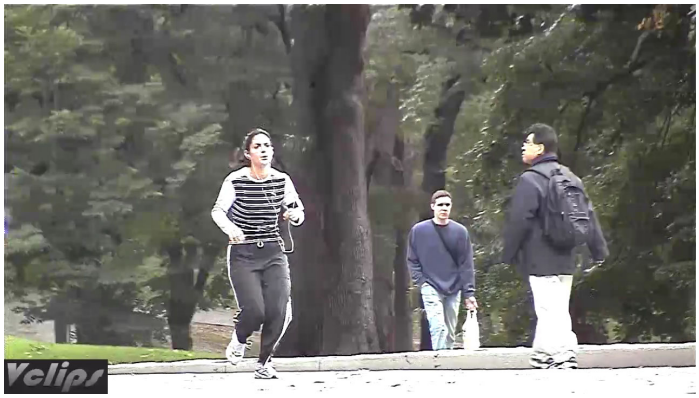
C: Reference Picture.

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 PQA500. 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 PQA500 creates the perceptual map for both reference and test sequences, then creates a perceptual difference map for use in making perceptual-base, full-reference picture quality measurements.

E: Reference.

G: PSNR Map.



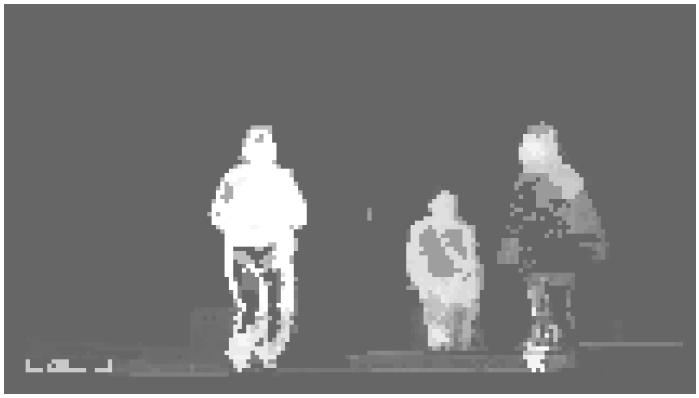
F: Test.

H: Perceptual Difference Map for DMOS.

Comparison of Predicted DMOS with PSNR

In the example above, 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 PQA500 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 PQA500, 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 PQA500 uses a human vision system model to determine the differences a viewer would perceive when watching the video.

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 Map Example: The jogger is highlighted.

Attention Model

The PQA500 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

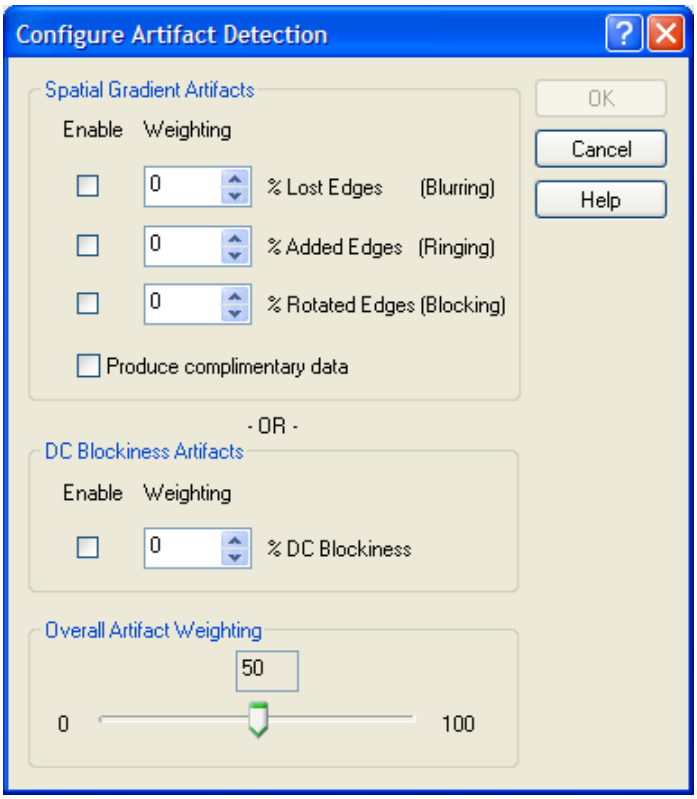
These attention parameters can be customized to give greater or less importance to each characteristic. This allows each measurement using an attention model to be user-configurable. The model is especially useful to evaluate the video process tuned to the specific application. For example, if the content 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

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.



Artifact Detection Settings.

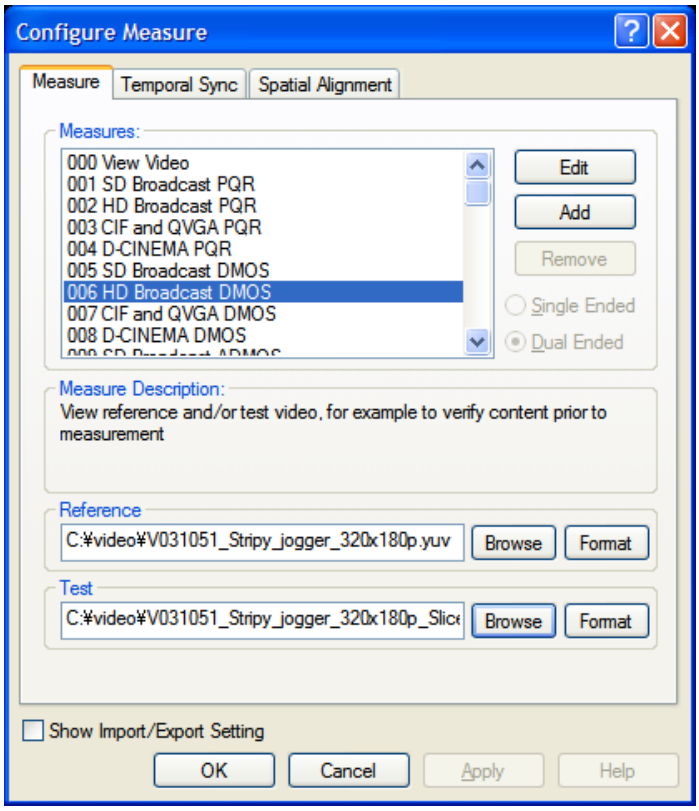
For example, artifact detection can help answer questions such as: “Will the DMOS be improved with more de-blocking filtering?” or, “Should less prefiltering be used?”

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.

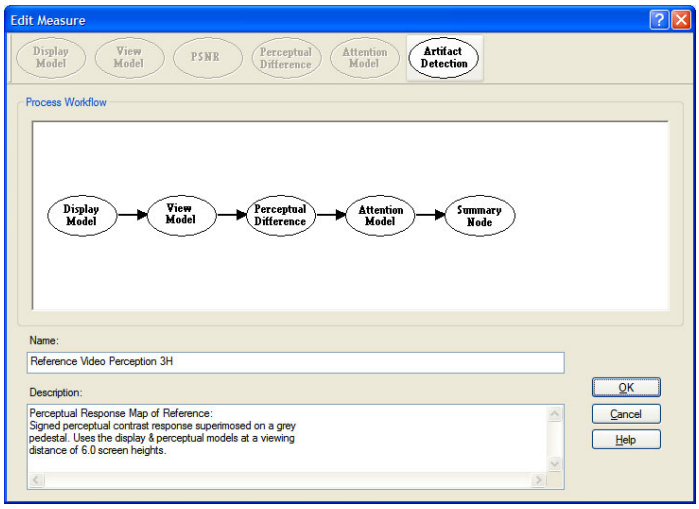


Configure Measure Dialog.

Comprehensive Picture Quality Analysis

The PQA500 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)

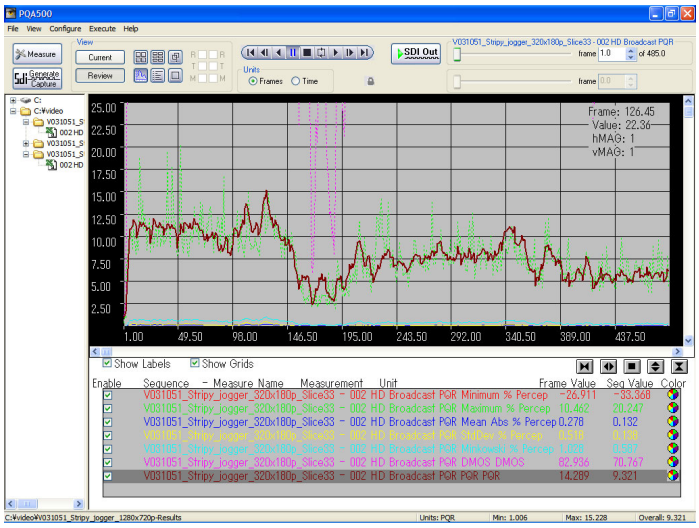


Edit Measure Dialog.

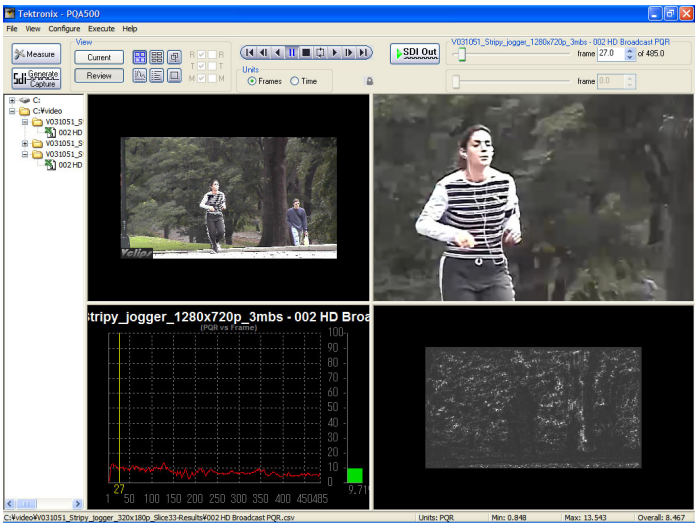
The PQA500 supports these measurements through preset and user-defined combinations of display type, viewing conditions, human vision response (demographic), focus of attention and artifact detection, in addition to the default ITU BT-500 conditions. The ability to configure measurement conditions helps 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 pre-configured 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 PQA500 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.



Statistical Graph.



Auto Spatial and Temporal Alignment Between CIF vs HD Pictures.

Multiple Result Display

Resultant maps can be displayed synchronously with the reference and test video in a tiled or overlaid display. Individual videos can also be viewed at full resolution, one at a time, to accommodate resolutions greater than what the tiled display can accommodate. 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 video sequences.

Summary measures of standard parameters and perceptual summation metrics for each frame and overall video sequence are provided. Summary measure results are displayed as data lists, maps, or graphs with a bar chart during video playback.

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

The logging parameters are:

- Registration information found in automatic temporal and spatial alignment: cropping, scale, shift in horizontal and vertical, Y gain and DC offset
- Alignment confidence (cross-correlation coefficient): (1.0 is perfect match)
- Logs of when measurement values per frame exceed either warning or error levels (configurable by user through the summary node)

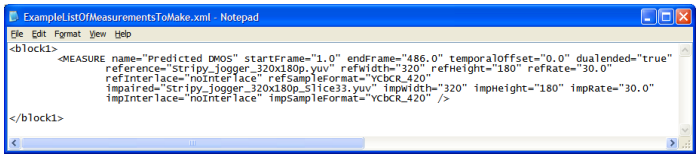
All results, data, and graphs can be recalled to the display for examination.

Automatic Temporal/Spatial Alignment

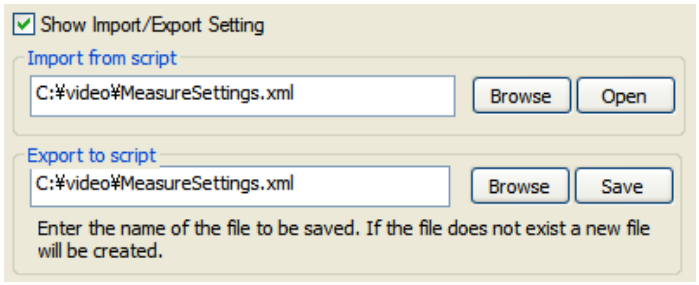
The PQA500 supports automatic temporal and spatial alignment, as well as manual alignment.

The automatic spatial alignment can measure the cropping, scale, and shift in each dimension, even across different resolutions (for example, when aligning SD to HD video). If extra blanking is present within the standard active region, it is measured as cropping when this function is enabled.

The automatic spatial and temporal alignment allows picture quality measurement between reference and test videos of different resolutions and frame rates.



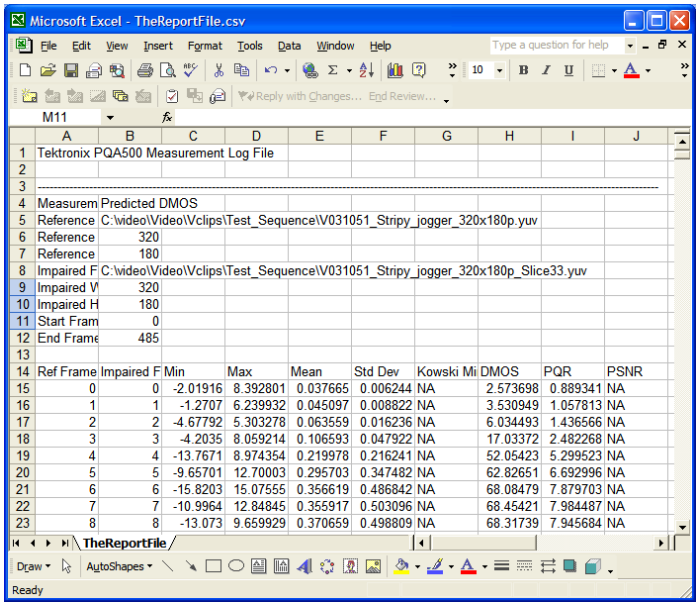
Script Sample.



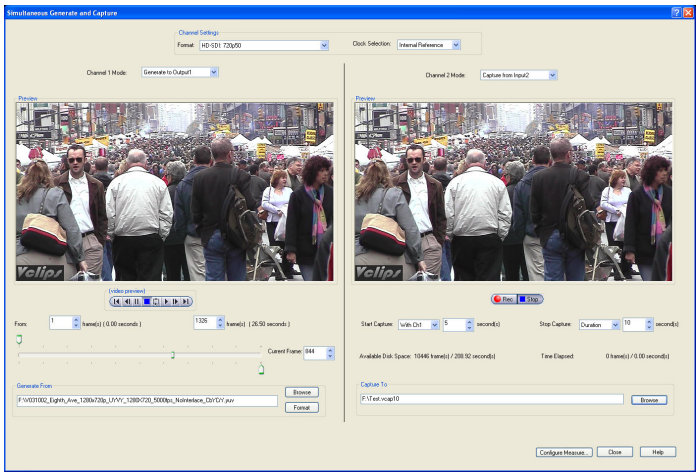
Import/Export script in Configure Measure Dialog.

Automation Test with XML Scripting

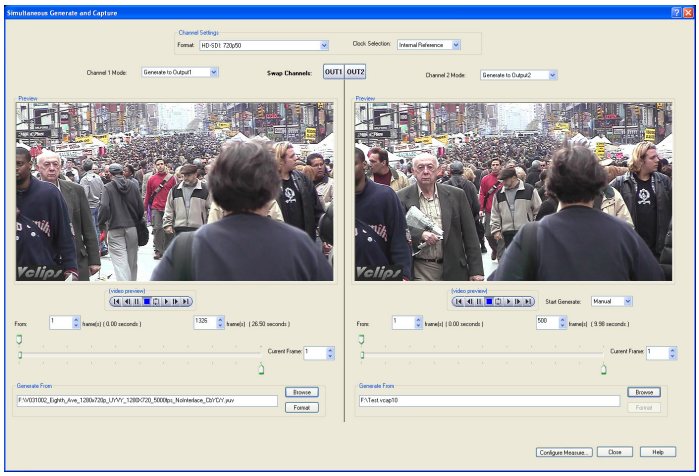
In the CODEC debugging/optimizing process, the designer can repeat several measurement routines as CODEC parameters are revised. Automated regression testing with XML scripting can ease the restrictions of manual operation by allowing the user to write a series of measurement sequences within an XML 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 PQA500 user interface or any spreadsheet application that can read the created .csv file format as a summary. Up to four scripts can be executed simultaneously for faster measurement results.



Result File Sample.



Generation/Capture.



2-channel Generation.

Optional SD/HD SDI Interface

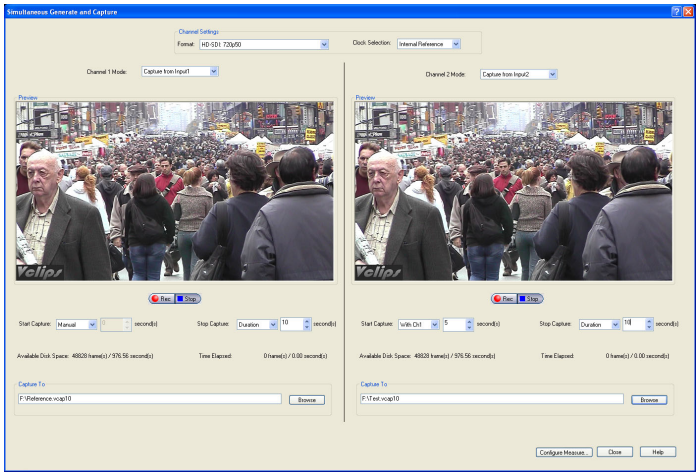
An optional SD/HD SDI interface enables both generation and capture of SDI video with 3 modes of simultaneous operations.

Simultaneous generation and capture lets the user playout the reference video clips directly from the PQA500 into the device under test. The test output from the device can then be simultaneously captured by the PQA500. 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.

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.

To accommodate equipment processing delay that may be present in the system the user can use the Delay Start function when capturing video. Using Delayed Start will minimize the number of unused overhead frames in the test file and enable faster execution of the auto temporal alignment in the measurement.

Simultaneous 2-channel generation capability supports the 2 types of subjective testing. With 2 displays, the user can check the reference and test video content on side-by-side monitors.



2-channel Capture.

With 1 display and swap-channel capability, the user can check the reference and test video content without moving the eye's focus point.

Supported File Formats for SD/HD SDI Interface

The SD/HD SDI video option can generate SDI video from files in the following formats (8-bit unless otherwise stated):

- .yuv (UYVY, YUY2)
- .v210 (10 bit, UYVY, 3 components in 32 bits)
- .rgb (BGR24)
- .avi (uncompressed, BGR32 (discard alpha channel) / BGR24 / UYVY / YUY2 / v210)
- .vcap (created by PQA500 video capture)
- .vcap10 (10 bit, created by PQA500 video capture)

Option	Supported Frame Geometry	Formats Supported by SD/HD SDI Interface
SD-SDI	720×486, 720×576	525i/59.94, 625i/50
HD-SDI	1280×720, 1920×1080	720p/50, 720p/59.94, 720p/60
		1080i/50, 1080i/59.94, 1080i/60
		1080p/23.98, 1080p/23.98SF, 1080p/24, 1080p/24SF, 1080p/25, 1080p/29.97, 1080p/30

Supported File Formats for Measurement

All formats support 8-bit unless otherwise stated, and measurements use 8MSBs:

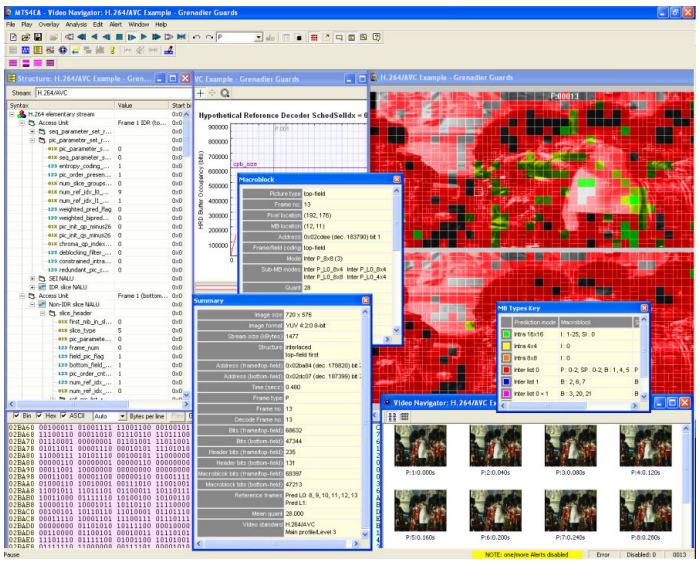
- .yuv (UYVY, YUY2, YUV4:4:4, YUV4:2:0_planar)
- .v210 (10 bit, UYVY, 3 components in 32 bits)
- .rgb (BGR24, GBR24)
- .avi (uncompressed, BGR32 (discard alpha channel) / BGR24 / UYVY / YUY2 / v210)
- ARIB ITE format (4:2:0 planar with 3 separate files (.yyy, .bbb, .rrr))
- .vcap (created by PQA500 video capture)
- .vcap10 (10 bit, created by PQA500 video capture)

Preinstalled Video Sequences

Sequence	Resolution	Formats	Clips
Vclips	1920×1088	YUV4:2:0 planar	V031202_Eigth_Ave, V031255_TimeSquare, V031251_Stripy_jogger
	1920×1080	UYVY	V031251_Stripy_jogger
	1280×720	UYVY, YUV4:2:0 planar	V031002_Eigth_Ave, V031055_TimeSquare, V031051_Stripy_jogger with 3/10/26 Mb/s
	864×486	YUV4:2:0 planar	Converted V031051_Stripy_jogger with 2/4/7 Mb/s
	320×180	YUV4:2:0 planar	Converted V031051_Stripy_jogger with 1000/1780/2850 Kb/s
PQA300 without Trigger	720×486	UYVY	Ferris, Flower, Tennis, Cheer with 2 Mb/s_25 fps
	720×576	UYVY	Auto, BBC, Ski, Soccer
PQA300 with Trigger	720×486	UYVY	Mobile with 3/6/9 Mb/s
	720×576	UYVY	Mobile with 3/6/9 Mb/s

Related Products

Recent updates and more details are available in each data sheet.



Video Stream Analysis.

MTS4EA Elementary Stream Analysis Software for VC-1, H.264/AVC, MPEG-2, MPEG-4, H.263 and 3GPP Standards

Features & Benefits

- Next Generation (VC-1, H.264/AVC, MPEG-4, and 3GPP) and Legacy (MPEG-2 and H.263) CODEC Support
- Frame-by-Frame and Block-by-Block Analysis to Allow Easy CODEC Comparison
- Easy-to-Interpret Detailed Graphical Displays (Requires User-installed Microsoft® Excel)
- Comprehensive Semantic Trace File Output to Determine Block-by-Block Encoder Decision Making
- AV Delay Measurement (option)
- Audio Decode and Analysis (option)
- Synchronized Audio and Video Analysis
- Real-Time and Non-Real-Time Decoding and Analysis of Compressed Video Streams (Dependant on PC Performance)
- Bit Stream Editing
- Batch Mode to Allow Automated Testing
- YUV Decoded Video Output for Baseband Video Analysis and Picture Quality Analysis
- Extraction of Elementary Stream from Transport Stream
- Available as Single-user Local License for PC and Tektronix Instruments or Server-based Floating License.

Picture Quality Testing.

Vclips - For Video Testing and Evaluation

Features & Benefits

Vclips are a diverse set of short video clips designed to test video encoders and decoders to the limits of their abilities.

Characteristic	Description
Video Sizes	Test with many different video sizes; Sub-QCIF, QCIF, CIF, D1, HD (720p and 1080i)
Difficult Subjects	Test with fine detail, night time, areas of high contrast, sharp borders, uniform areas, bright and dull colors
Visual Objects	People, buildings, vehicles, trees, landscapes, clouds, water, and synthetic objects
Movement	Fast, slow, uniform, random, multiple moving objects. Also pan, zoom, and rotate
Test Card Sequences	Precisely defined motion, bright colors, dull colors, lines, patterns, and grids. Also strobing and white noise

Characteristics

Preconfigured Measurement Set

Measurement Class	Measurement Name	Configuration Nodes						
		Display Model	View Model	PSNR	Perceptual Difference	Artifact Detection	Attention Model	Summary Node
View Video With No Measurement	"000 View Video"	NA	NA	NA	NA	NA	NA	NA
Subjective Prediction: Full Reference								
Noticeable Differences								
SD Display and Viewing	"001 SD Broadcast PQR"	SD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	NA	PQR Units
HD Display and Viewing	"002 HD Broadcast PQR"	HD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	NA	PQR Units
CIF Display and Viewing	"003 CIF and QVGA PQR"	CIF/QVGA LCD	7 scrn heights, 20 cd/m^2	NA	Typical	NA	NA	PQR Units
D-CINEMA Projector and Viewing	"004 D-CINEMA PQR"	DMD Projector	3 scrn heights, .1 cd/m^2	NA	Typical	NA	NA	PQR Units
Subjective Rating Predictions								
SD Display and Viewing	"005 SD Broadcast DMOS"	SD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	NA	DMOS Units Re: BT.500 Training
HD Display and Viewing	"006 HD Broadcast DMOS"	HD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	NA	DMOS Units Re: BT.500 Training
CIF Display and Viewing	"007 CIF and QVGA DMOS"	CIF/QVGA LCD	7 scrn heights, 20 cd/m^2	NA	Typical	NA	NA	DMOS Units Re: BT.500 Training
D-CINEMA Projector and Viewing	"008 D-CINEMA DMOS"	DMD Projector	3 scrn heights, .1 cd/m^2	NA	Typical	NA	NA	DMOS Units Re: BT.500 Training
Attention Biased Subjective Rating Predictions								
SD Display and Viewing	"009 SD Broadcast ADMOS"	SD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	Default Weightings	DMOS Units Re: BT.500 Training
HD Display and Viewing	"010 HD Broadcast ADMOS"	HD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	Default Weightings	DMOS Units Re: BT.500 Training
CIF Display and Viewing	"011 CIF and QVGA ADMOS"	CIF/QVGA LCD	7 scrn heights, 20 cd/m^2	NA	Typical	NA	Default Weightings	DMOS Units Re: BT.500 Training
SD Sports	"012 SD Sports Broadcast ADMOS"	SD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	Motion and Foreground Dominant	DMOS Units Re: BT.500 Training
HD Sports	"013 HD Sports Broadcast ADMOS"	HD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	Motion and Foreground Dominant	DMOS Units Re: BT.500 Training
SD Talking Head	"014 SD Talking Head Broadcast ADMOS"	SD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	Skin and Foreground Dominant	DMOS Units Re: BT.500 Training

Measurement Class	Measurement Name	Configuration Nodes						
		Display Model	View Model	PSNR	Perceptual Difference	Artifact Detection	Attention Model	Summary Node
Repurposing: Reference and Test are Independent. Use Any Combination Display Model and Viewing Conditions with Each Measurement Above								
Format Conversion: Cinema to SD DVD	"015 SD DVD from D-Cinema DMOS"	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	"016 CIF from SD Broadcast DMOS"	LCD and SD Broadcast CRT	(ITU-R BT.500) and 7 scrn heights, 20 cd/m^2	NA	Expert	NA	NA	DMOS Units Re: BT.500 Training
Format Conversion: HD to SD	"017 SD from HD Broadcast DMOS"	SD and HD Broadcast CRT	(ITU-R BT.500)	NA	Expert	NA	NA	DMOS Units Re: BT.500 Training
Format Conversion: SD to HD	"017-A SD from HD Broadcast DMOS"	SD and HD Progressive CRT	(ITU-R BT.500)	NA	Expert	NA	NA	DMOS Units Re: BT.500 Training
Format Conversion: CIF to QCIF	"018 QCIF from CIF and QVGA DMOS"	QCIF and CIF/QVGA LCD	7 scrn heights, 20 cd/m^2	NA	Expert	NA	NA	DMOS Units Re: BT.500 Training
Attention								
Attention	"019 Stand-alone Attention Model"	NA	NA	NA	NA	NA	Default Weightings	Map units: % Probability of focus of attention
Objective Measurements: Full Reference								
General Difference								
PSNR	"020 PSNR dB"	NA	Auto-align spatial	Selected	NA	NA	NA	dB units
Artifact Measurement								
Removed Edges	"021 Removed Edges Percent"	NA	NA	NA	NA	Blurring	NA	%
Added Edges	"022 Added Edges Percent"	NA	NA	NA	NA	Ringing / Mosquito Noise	NA	%
Rotated Edges	"023 Rotated Edges Percent"	NA	NA	NA	NA	Edge Blockiness	NA	%
% of original deviation from block DC	"024 DC Blocking Percent"	NA	NA	NA	NA	DC Blockiness	NA	%
Artifact Classified (Filtered) PSNR								
Removed Edges	"025 Removed Edges Weighted PSNR dB"	NA	NA	Selected	NA	Blurring	NA	dB units
Added Edges	"026 Added Edges Weighted PSNR dB"	NA	NA	Selected	NA	Ringing / Mosquito Noise	NA	dB units
Rotated Edges	"027 Rotated Edges Weighted PSNR dB"	NA	NA	Selected	NA	Edge Blockiness	NA	dB units
% of original deviation from block DC	"028 DC Blocking Weighted PSNR dB"	NA	NA	Selected	NA	DC Blockiness	NA	dB units
Artifact Annoyance Weighted (Filtered) PSNR								
PSNR w/ default artifact annoyance weights	"029 Artifact Annoyance Weighted PSNR dB"	NA	NA	Selected	NA	All artifacts selected	NA	dB units

Measurement Class	Measurement Name	Configuration Nodes						
		Display Model	View Model	PSNR	Perceptual Difference	Artifact Detection	Attention Model	Summary Node
Repurposing: Use View Model to Resample, Shift, and Crop Test to Map to Reference								
Format Conversion: Cinema to SD DVD	"030 SD DVD from D-Cinema Artifact weighted PSNR dB"	NA	Auto-align spatial	Selected	NA	All artifacts selected	NA	dB units
Format Conversion: SD to CIF	"031 CIF from SD Broadcast Artifact weighted PSNR dB"	NA	Auto-align spatial	Selected	NA	All artifacts selected	NA	dB units
Format Conversion: HD to SD	"032 SD from HD Broadcast Artifact weighted PSNR dB"	NA	Auto-align spatial	Selected	NA	All artifacts selected	NA	dB units
Format Conversion: CIF to QCIF	"033 QCIF from CIF and QVGA Artifact weighted PSNR dB"	NA	Auto-align spatial	Selected	NA	All artifacts selected	NA	dB units
Attention-weighted Objective Measurements								
General Difference								
PSNR	"034 Attention Weighted PSNR dB"	NA	NA	NA	NA	No-reference DC Block	Default Weightings	dB units
Objective Measurements: No Reference								
Artifact								
DC Blockiness	"035 No Reference DC Blockiness Percent"	NA	NA	NA	NA	No-reference DC Block	NA	% DC Blockiness

Nodes

Node Name	Configurable Parameter
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

Computer System and Peripherals

Component	Description
Operating System	Windows XP
CPU	Intel Xeon Dual Core 3 GHz processor
Hard Disk Drive	6x 3.5 in. SATA, Front-panel, removable hard disk drive
CD-R/W Drive	Front-panel CD-R/W drive
DVD Drive	Read only

Input/Output Ports

Port	Description
Power	100 – 240 V, 50/60 Hz
Keyboard Port	PS-2 compatible
Mouse Port	PS-2 compatible
USB 2.0 Port	One front panel, Two rear panel
LAN Port	Two RJ-45 connector, supports 10/100/1000 Base-T
DVI Port	DVI female connector x2 ; Dual-link DVI-I. Up to 2560×1600 60 Hz.
SDI IO Port (Option SDI)	2ch Input, 2ch Output with BNC to mini-BNC SDI cable (174-5466-xx)

Physical Characteristics

Benchtop Configuration

Dimensions	mm	in.
Height	87.3	3.44
Width (Without Rails)	430	16.93
Depth	704.8	27.75
Weight	**kg**	**lb.**
Net	29.5	65

Ordering Information

PQA500
Picture Quality Analysis System

PC Monitor Requirement
Note: PQA500 does not include a PC monitor. A monitor is to be provided by the user.

- Dual-link DVI ports
- Up to 2560 × 1600 resolution

Standard Accessories

Order Number	Description
PQA500 Picture Quality Analysis System Documentation	
071-2256-XX (English)	Quick Start User Manual in English, and Simplified Chinese or Japanese translation if a language option was ordered
071-2259-XX	Release Notes
071-2263-XX	User Technical Reference
071-2260-XX	Measurement Technical Reference
077-2264-XX	Specification and Performance Verification Manual in PDF format on Documentation CD
071-2266-XX	Measurement Declassification and Security Instructions
063-4065-XX	Documentation CD, containing PDF files of the documentation set
Other	
119-7054-00	Microsoft Optical Mouse, black, with scroll wheel, USB, and PS2
119-7083-00	Mini-keyboard, USB with 2-port Hub
020-2902-XX	Application Recovery Disk
020-1901-XX	Video Sequences Recovery Media
016-1995-00	Tool-less Rail Kit

Options
SDI – SD/HD SDI Interface

International Power Plugs
Opt. A0 – North America power.
Opt. A1 – Universal EURO power.
Opt. A2 – United Kingdom power.
Opt. A3 – Australia power.
Opt. A4 – 240 V, North America power.
Opt. A5 – Switzerland power.
Opt. A6 – Japan power.
Opt. A10 – China power.
Opt. A11 – India power.
Opt. A99 – No power cord or AC adapter.

Language Options
Opt. L0 – English Manual.
Opt. L5 – Japanese Manual.
Opt. L7 – Simple Chinese Manual

Service

Option	Description
R3	Repair Service 3 Years (including warranty)
R5	Repair Service 5 Years (including warranty)

Post-sale Upgrade

Option	Description
PQA5UP	Field Upgrade Kit for PQA500
Opt. SDI	SD/HD SDI Interface for Field Installation

Extended service Offerings

Option	Description
-CA1	Single Calibration
-R1PW	Repair Service 1 year (Post-warranty)
-R2PW	Repair Service 2 year (Post-warranty)
-R3PW	Repair Service 3 year (Post-warranty)
-R5PW	Repair Service 5 year (Post-warranty)

Additional Information
Please contact your local Service Manager for information regarding our products and services, or contact us at: www.tektronix.com/serviceandsupportcontactus.

CE

ISO 9001 Product(s) are manufactured in ISO registered facilities.

GPIB IEEE-488 Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

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Updated 25 May 2010

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**

03 Nov 2010 25W-20585-4