PQA
Picture Quality Analyzer
User Manual

This document supports software versions 4.1.11

www.telestream.net

D00010028A

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For product information, sales, service, and technical support:

Worldwide, visit www.telestream.net/telestream-support/video/support.htm to find contacts in your area.

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Important compliance and safety information

United States of America Compliance Notices

Class A Interference Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15, Subpart B of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a commercial installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Caution

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) This device must accept any interference received, including interference that may cause undesired operation.

Safety

UL 61010-1: 2012 R4.16: Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements.

Environmental

Perchlorate Materials: this product contains one or more type CR lithium batteries. According to the state of California, CR lithium batteries are classified as perchlorate materials and require special handling.

See dtsc.ca.gov/perchlorate/ for additional information.

Canada Compliance Notices

Department of Communications Radio Interference Regulations

This digital apparatus does not exceed the Class A limits for radio-noise emissions from a digital apparatus as set out in the Radio Interference Regulations of the Canadian Department of Communications. This Class A digital apparatus complies with Canadian ICES-003.

Reglement sur le brouillage radioelectrique du Quadstere des Communications

Cet appareil numerique respecte les limites de bruits radioelectriques visant les appareils numeriques de classe A prescrites dans le Reglement sur le brouillage radioelectrique du Quadstere des Communications du Canada. Cet appareil numerique de la Classe A est conforme a la norme NMB-003 du Canada.

Safety

CAN/CSA-22.2 NO. 61010-1-12 + Gil + GI2:: Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements.

Sécurité

CAN / CSA-22.2 NO. 61010-1-12 + Gil + GI2 :: Exigences de sécurité pour l'électricité Matériel de mesure, de contrôle et d'utilisation en laboratoire - Partie 1: Généralités Exigences.

European Union and European Free Trade Association (EFTA) Compliance Notices

This equipment may be operated in the countries that comprise the member countries of the European Union and the European Free Trade Association. These countries, listed in the following paragraph, are referred to as The European Community throughout this document:
AUSTRIA, BELGIUM, BULGARIA, CYPRUS, CZECH REPUBLIC, DENMARK, ESTONIA, FINLAND, FRANCE, GERMANY, GREECE, HUNGARY, IRELAND, ITALY, LATVIA, LITHUANIA, LUXEMBOURG, MALTA, NETHERLANDS, POLAND, PORTUGAL, ROMANIA, SLOVAKIA, SLOVENIA, SPAIN, SWEDEN, UNITED KINGDOM, ICELAND, LICHTENSTEIN, NORWAY, SWITZERLAND

Declaration of Conformity

Marking by the “CE” symbol indicates compliance with the Essential Requirements of the EMC Directive of the European Union 2014/30/EU

This equipment meets the following conformance standards:

Safety

EN 61010-1: Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements
Low Voltage Directive 2014/35/EU

Emissions

EN 55032: 2012 + AC: 2013, CISPR 32: 2015, EN 61000-3-2: 2014,
EN 61000-3-3: 2013

Immunity

EN 55103-2: 2009, EN 61000-4-2: 2009,
EN 61000-4-3: 2006 + Al: 2008 + A2: 2010, EN 61000-4-4: 2004 + Al: 2010,
EN 61000-4-5: 2006, EN 61000-4-6: 2009, EN 61000-4-11: 2004
Environments: E2

Warnings

Warning! This is a Class A product. In a domestic environment, this product may cause radio interference, in which case, the user may be required to take appropriate measures.

Achtung! Dieses ist ein Gerat der Funkstorgrenzwertklasse A. In Wohnbereichen konnen bei Betrieb dieses Gerates Rundfunkstorungen auftreten, in welchen Fallen der Benutzer fur entsprechende Gegenmal3nahmen verantwortlich ist.

Attention! Ceci est un produit de Classe A. Dans un environnement domestique, ce produit risque de creer des interferences radioelectriques, ii appartiendra alors a l?utilisateur de prendre les mesures specifiques appropriees.

Notes:

1. For Compliance with the EMC standards listed here, high quality shielded interface cables should be used.
2. Emissions which exceed the levels required by this standard may occur when this equipment is connected to a test object.

Environmental Compliance

This section provides information about the environmental impact of the product.

Product end-of-life handling
Observe the following guidelines when recycling an instrument or component:

Equipment recycling
Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. To avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.

This symbol on the product or its packaging indicates that this product complies with the applicable European Union requirements according to Directives 2012/19/EU and 2006/66/EC on waste electrical and electronic - equipment (WEEE) and batteries.

It also indicates that this product must not be disposed of with your other household waste. Instead, it is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste for recycling, please contact your local authority, or where you purchased your product.

Battery Recycling
This product may contain a rechargeable battery, which must be recycled or disposed of properly. Please properly dispose of or recycle the battery according to local government regulations.

Transporting Batteries or products with Batteries in them
The capacity of the lithium ion secondary battery shipped with this product is under 100 Wh. The lithium content of the installed primary battery is under 1 g. Each battery meets the applicable requirements of UN Manual of Tests and Criteria Part III Section 38.3. Battery quantity is under the limit for shipment according to Section II of the relevant Packing Instructions from the IATA Dangerous Goods Regulations. Consult your air carrier for applicability and determination of any special lithium battery transportation requirements.

Restriction of Hazardous Substances
This product is classified as an industrial monitoring and control instrument, and is not required to comply with the substance restrictions of the RoHS 3 Directives 2011 /65/EU and EU 2015/863 until July 22, 2021. This product does, however, comply with the RoHS 2 Directive 2011/65/EU.

Korea Compliance Statement

사 용 자 안 내 문
이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

Taiwan Compliance Statement

警告使用者：
這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

This is a Class A product based on the standard of the Bureau of Standards, Metrology and Inspection (BSMI) CNS 13438, Class A. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Japan Compliance Statement

この装置は、クラスＡ情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。 VCCI－A

This is a Class A product based on the standard of the VCCI Council (VCCI 32: 2016). If this equipment is used in a domestic environment, radio interference may occur, in which case, the user may be required to take corrective actions.

Important Safety Information

This manual contains information and warnings that must be followed by the user for safe operation and to keep the product in a safe condition.
To safely perform service on this product, see the Service safety summary that follows the General safety summary.

General Safety Summary

Use the product only as specified. Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. Carefully read all instructions. Retain these instructions for future reference.

Comply with local and national safety codes.

For correct and safe operation of the product, it is essential that you follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

The product is designed to be used by trained personnel only.

Only qualified personnel who are aware of the hazards involved should remove the cover for repair, maintenance, or adjustment.

Before use, always check the product with a known source to be sure it is operating correctly.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

When incorporating this equipment into a system, the safety of that system is the responsibility of the assembler of the system.

To Avoid Fire or Personal Injury

Use proper power cord: Use only the power cord specified for this product and certified for the country of use. Do not use the provided power cord for other products.

Ground the product: This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded. Do not disable the power cord grounding connection.

Power disconnect: The power cord disconnects the product from the power source. See instructions for the location. Do not position the equipment so that it is difficult to operate the power cord; it must remain accessible to the user at all times to allow for quick disconnection if needed.

Observe all terminal ratings: To avoid fire or shock hazard, observe all rating and markings on the product. Consult the product manual for further ratings information before making connections to the product. Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Do not operate without covers: Do not operate this product with covers or panels removed, or with the case open. Hazardous voltage exposure is possible.

Avoid exposed circuitry: Do not touch exposed connections and components when power is present.

Do not operate with suspected failures: If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Disable the product if it is damaged. Do not use the product if it is damaged or operates incorrectly. If in doubt about safety of the product, turn it off and disconnect the power cord. Clearly mark the product to prevent its further operation.

Before use, inspect voltage probes, test leads, and accessories for mechanical damage and replace when damaged. Do not use probes or test leads if they are damaged, if there is exposed metal, or if a wear indicator shows.

Examine the exterior of the product before you use it. Look for cracks or missing pieces.

Use only specified replacement parts.
Do not operate in wet/damp conditions: Be aware that condensation may occur if a unit is moved from a cold to a warm environment.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry: Remove the input signals before you clean the product.

Provide proper ventilation: Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Slots and openings are provided for ventilation and should never be covered or otherwise obstructed. Do not push objects into any of the openings.
Provide a safe working environment: Always place the product in a location convenient for viewing the display and indicators.

Be sure your work area meets applicable ergonomic standards. Consult with an ergonomics professional to avoid stress injuries.

Use only the Telestream rackmount hardware specified for this product.

Service Safety Summary

The Service safety summary section contains additional information required to safely perform service on the product. Only qualified personnel should perform service procedures. Read this Service safety summary and the General safety summary before performing any service procedures.

To avoid electric shock: Do not touch exposed connections.

Do not service alone: Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect power: To avoid electric shock, switch off the product power and disconnect the power cord from the mains power before removing any covers or panels, or opening the case for servicing.

Use care when servicing with power on: Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

Verify safety after repair: Always recheck ground continuity and mains dielectric strength after performing a repair.

Terms in the Manual

These terms may appear in this manual:

WARNING. Warning statements identify conditions or practices that could result in injury or loss of life.

CAUTION. Caution statements identify conditions or practices that could result in damage to this product or other property.

Terms on the Product

These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

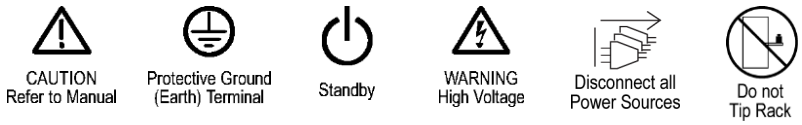
WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols on the Product

When this symbol is marked on the product, be sure to consult the manual to find out the nature of the potential hazards and any actions which have to be taken to avoid them. (This symbol may also be used to refer the user to ratings in the manual.)

The following symbol(s) may appear on the product:



General Safety Product Specific Statements

Use the product only as specified. Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. Carefully read all instructions. Retain these instructions for future reference.

Comply with local and national safety codes.

For correct and safe operation of the product, it is essential that you follow generally accepted safety procedures in addition to the safety precautions specified in this manual. The product is designed to be used by trained personnel only.

Only qualified personnel who are aware of the hazards involved should remove the cover for repair, maintenance, or adjustment.

Before use, always check the product with a known source to be sure it is operating correctly.

This product is not intended for detection of hazardous voltages.

Use personal protective equipment to prevent shock and arc blast injury where hazardous live conductors are exposed.

When incorporating this equipment into a system, the safety of that system is the responsibility of the assembler of the system.

WARNING. *In the instrument, only the line conductor is fused for over-current protection. The fuse is internal and not user replaceable. Do not attempt to replace the fuse. If you suspect the fuse has blown, return the unit to an authorized service center for repair.*

CAUTION. *To minimize the risk of damage to the instrument, we strongly recommend you connect the power cord to the instrument before the power cord is connected to the AC power source.*

CAUTION. *To prevent instrument damage from overheating, maintain at least two inches (5.1 cm) of clearance at the rear and sides of the instrument cabinet when locating the instrument on a bench. When the instrument is mounted in an equipment rack, maintain at least 3 inches (7.6 cm) of clearance from the back wall of the rack.*

CAUTION. *To reduce the risk of fire and shock, ensure that the mains supply voltage fluctuations do not exceed 10% of the operating voltage range.*

Preface

About this manual

This manual describes the installation and basic operation of the PQA Picture Quality Analysis Software.

Product description

PQA is the latest-generation Picture Quality Analysis product built on the Emmy Award winning PQA200/300 Picture Quality Analyzers. Based on concepts of the human vision system, the PQA provides a suite of repeatable, objective quality measurements that closely correspond with subjective human visual assessment.

PQA key features

- Fast, accurate, repeatable, and objective picture quality measurement
- Predicts DMOS (Differential Mean Opinion Score) based on the Human Vision System model
- Picture quality measurements can be made on a variety of HD video formats (1080p, 1080i, 720p) and SD Video Formats (525i or 625i)
- User-configurable viewing condition and display models for reference and comparison Attention/Artifact weighted measurement
- Region Of Interest (ROI) on measurement execution and review Automatic temporal and spatial alignment
- Embedded reference decoder
- Easy regression testing and automation using XML scripting with "Export/Import" file from GUI Multiple results view options
- IP interface with simultaneous generation/capture and 2-Ch capture
- Embedded sample reference and test sequences
- Available for customer installation on the customer's own PC

Product documentation

All of the following documents can be found on the Telestream Web site: www.telestream.net/video/resources.htm

To read about	Use this document (part number)
Installation and safety information including in-depth operating information	*PQA User Manual* This PDF manual contains information about product safety and compliance and describes how to install the instrument. Also included are basic instructions on how to start using the PQA analyzer and detailed information about operating the PQA, including how measurements are calculated and displayed.
Preconfigured measurements	*PQA600C and PQA Measurements Reference* This printed manual contains information about using the preconfigured measurements provided with the product.
Known issues with the product	*PQA Release Notes* This PDF manual contains information about new features and known issues with the PQA software.

Software upgrades

Periodic software upgrades might become available.

To check for upgrades:

Verify the latest version of software at the Telestream website:

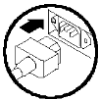
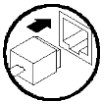
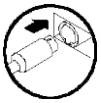
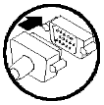
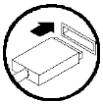
a. In the web browser on a PC, go to the Telestream website: www.telestream.net/video/resources.htm#Software

b. Look under MPEG Analyzer and find the software package for your product.

c. Note the latest version number of the software package(s).

Conventions used in this manual

The following icons may appear throughout this manual.

Sequence step or index number	Front panel power	Connect power	Network	PS2	SVGA	USB
						

PQA installation

This section contains information on installing the PQA software. You can also use this procedure if you purchased the MTSA product with Option PQ.

PQA system requirements

The PC required to run the PQA software must meet the following minimum requirements:

- Windows 7, Windows 8.1, or Windows 10, 64-bit operating system.
- Intel i7 CPU or better
- 1024 x 768 or higher resolution monitor 2 GB RAM or greater
- 1 GB free space on the hard drive for application storage; 50 GB or more free space recommended for data storage

How to install the PQA software

How you proceed with the installation depends on the product you purchased.

Table 6: Installation instructions for the PQA products

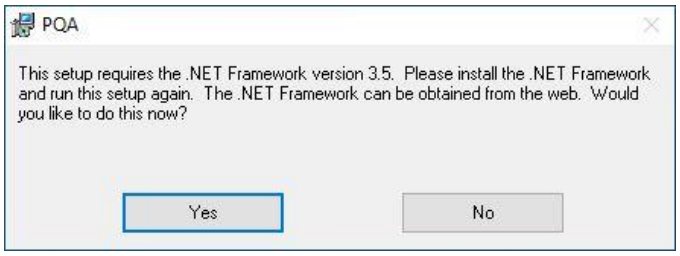
Product	Instructions
MTSA-HW option PQ	The software is already installed on the MTSA-HW instrument and is ready to use. Proceed to the “Operating Basics” section
MTSA-UP option PQ upgrade	The software is already installed on the MTSA-HW instrument, but you must first install the license before you can use the product. Proceed to the “How to install the PQA license” section.
MTSA-PC option PQ	Perform the following installation instructions if you purchased this standalone software products, or if you need to reinstall the PQA software.

To install the PQA software, perform the following procedure:

1. If you already have an existing version of the PQA software installed, first uninstall the existing version of the PQA software using the Microsoft Windows Control Panel. Otherwise, go to step 2.
2. Locate the PQA installation package on www.telestream.net/video/resources.htm#Software under **MPEG Analyzers**.
   a. Download the software on the PC you will use to run the PQA software.
   b. Unzip the installation package to your hard drive and go to the top-level folder of the installation package.
3. Double-click **setup.exe** to begin the installation process.

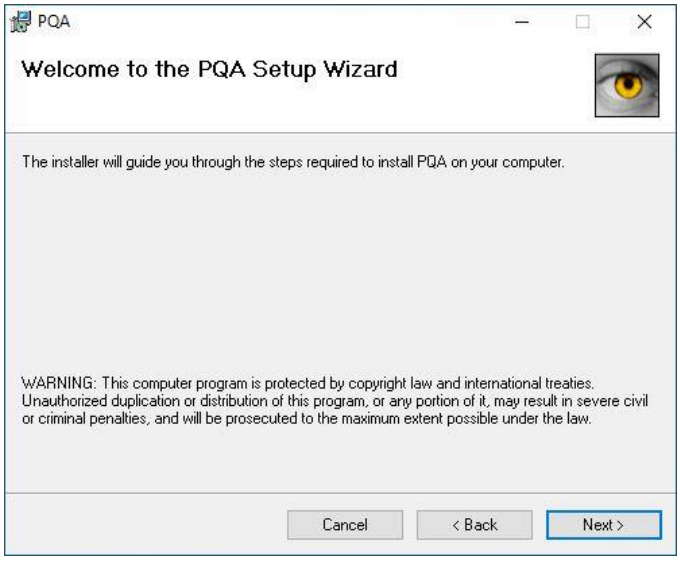
4. The PQ software requires the Microsoft .NET Framework version 3.5 to be installed. If the v3.5 Framework is not installed, this dialog will appear.

   Click **Yes** to go to the Microsoft .NET web site where you can download and install the v3.5 Framework. When you are done installing the v3.5 Framework, re-run the PQA installation starting with step 3.



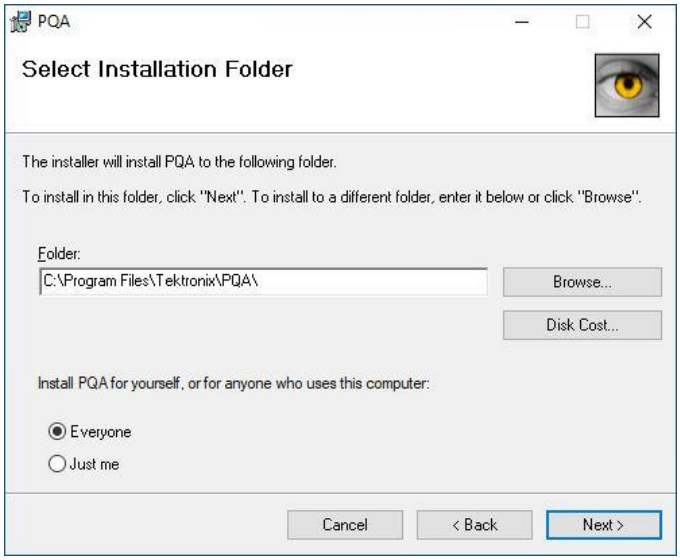
5. When the PQA installer splash screen appears, click **Next** to continue.

6. When the Setup Wizard welcome screen appears, click **Next** to continue.



7. When the **Select Installation Folder** screen appears, click **Next** to continue using the default settings. You can also change the settings as follows:

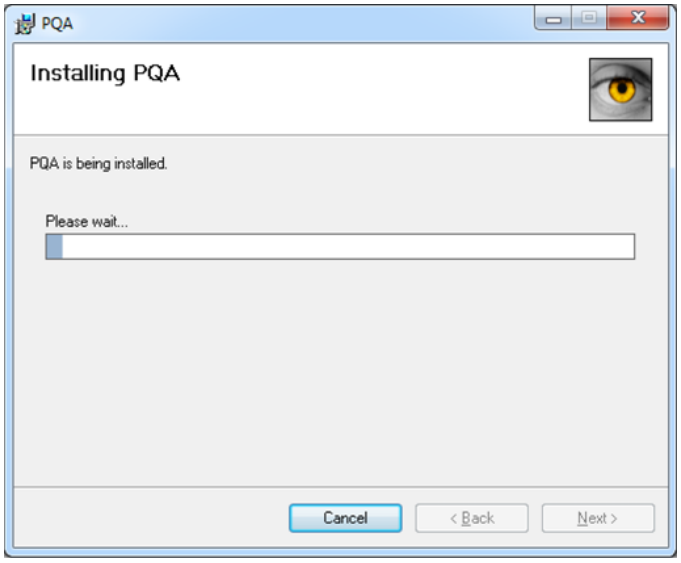
   - Use the **Folder** entry box or the **Browse** button to select a different installation location. Click the **Disk Cost** button to verify there is enough disk space available.
   - Select **Just me** if you want the PQA software available to only you (the currently logged in user) instead of all users of the instrument



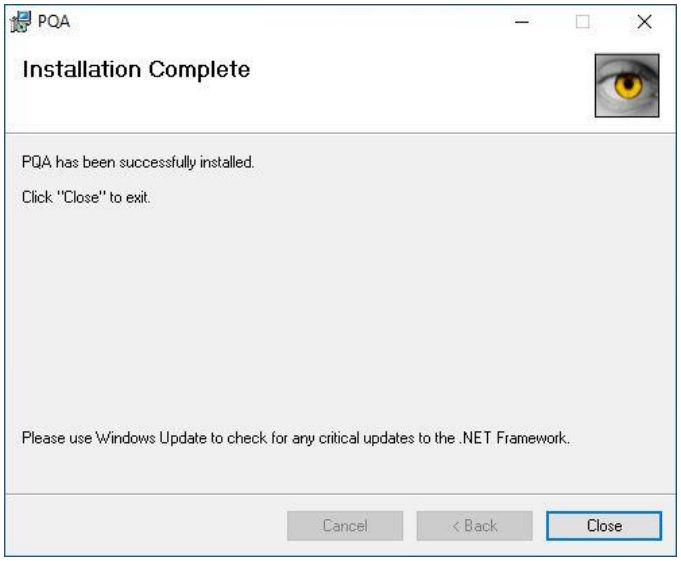
8. The **License Agreement** screen appears. After you read the license agreement, select **I Agree**, and then click **Next** to continue

***NOTE**. If you cannot agree to the software license, click **Cancel** to exit the installation process, and then contact Telestream for more information.*

9. When the **Confirm Installation** screen appears, click **Next** to continue. You will see an **Installing PQA** screen with a progress bar



10. When the PQA product software installation is complete, the **Installation Complete** screen appears. Click **Close** to exit the **Setup Wizard**.



11. The following icons should now be on the desktop:

Icon	Description
	Double-click to launch the PQA software application.
	Double-click to run the PQA software using the standard user login (with no administrator privileges) without being prompted to enter the Administrator's password each time the PQA software is run from a standard user account. ***NOTE.*** *To use the* ***Run As Administrator*** *icon from any user account, you must log into the Administrator account one time by double-clicking the icon and entering the password. After this initial Administrator login, this icon can be used to run the PQA software from any user account without being prompted to enter the Administrator password.*

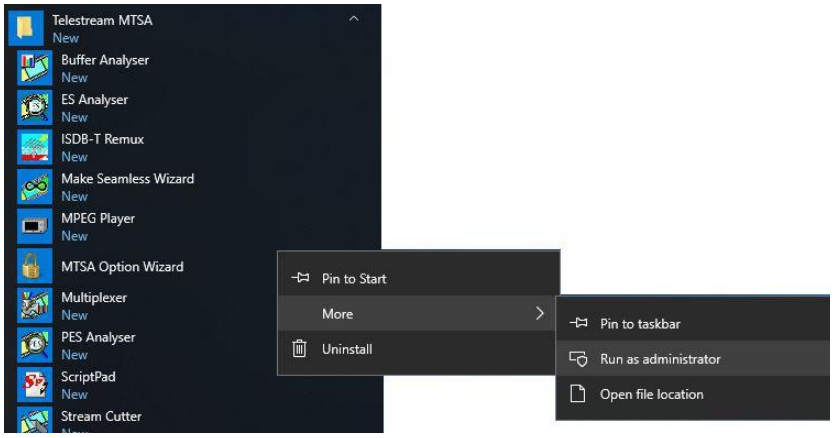
12. Proceed to the instructions on how to activate your software license.

Activate the MTSA software license

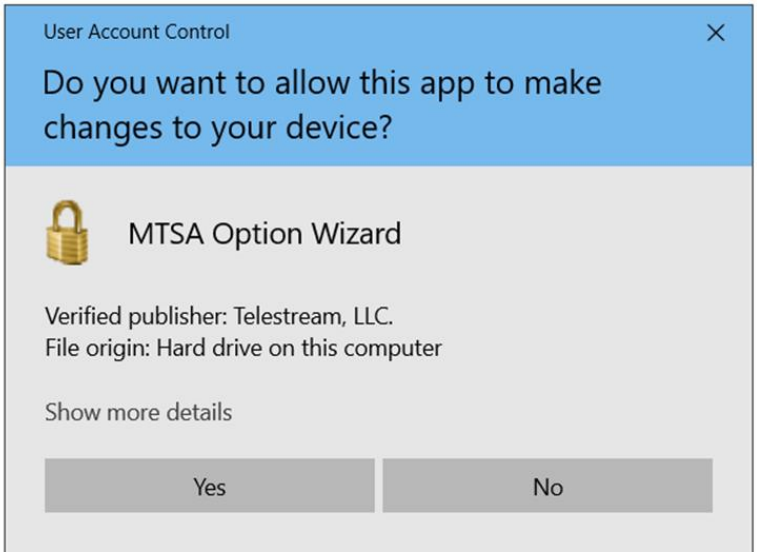
You should have received an email that includes information about your order as well as the Software Serial Number (SSN) required to activate your product. Contact your Sales Representative or Technical Support if you don't have this information.

License activation is performed using the MTSA Option Wizard. Perform the following steps to activate your license.

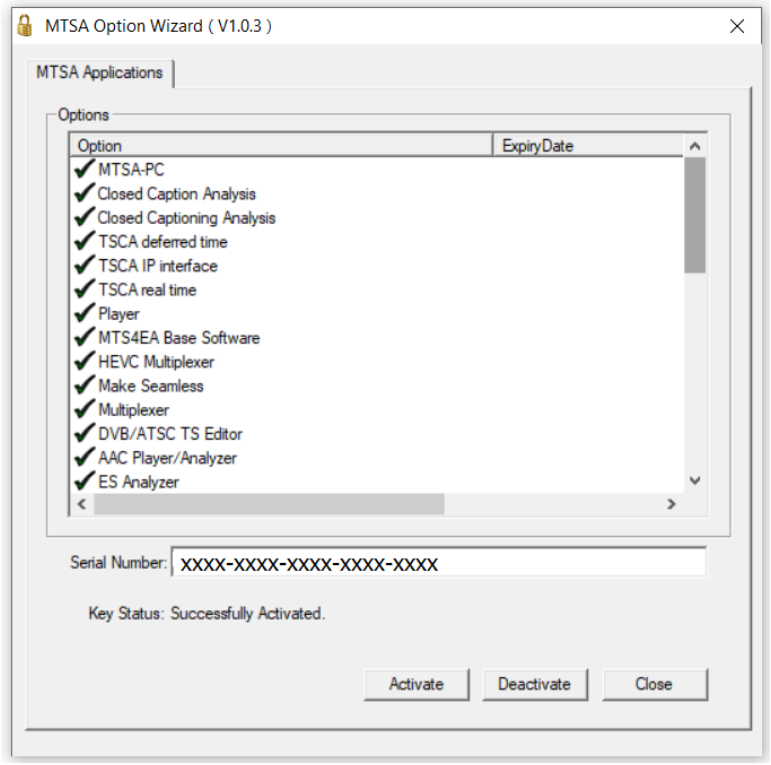
1. It is required to open the MTSA Option Wizard application in Administrator Mode.
   a. From the Start Menu, go to Telestream MTSA applications
   b. Right click on the **MTSA Option Wizard** application and select **More > Run as administrator**



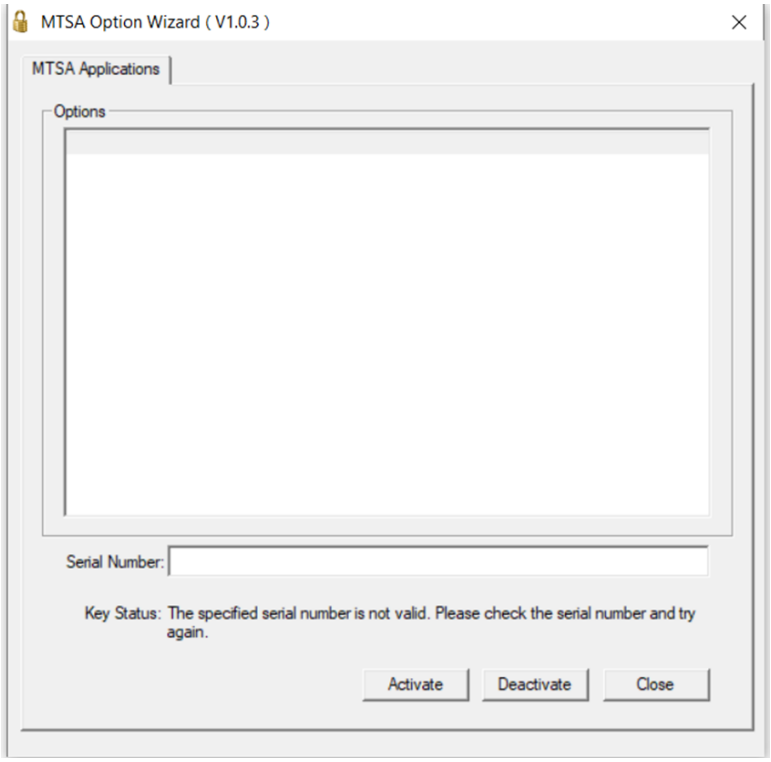
2. Select **Yes** when the application launches.



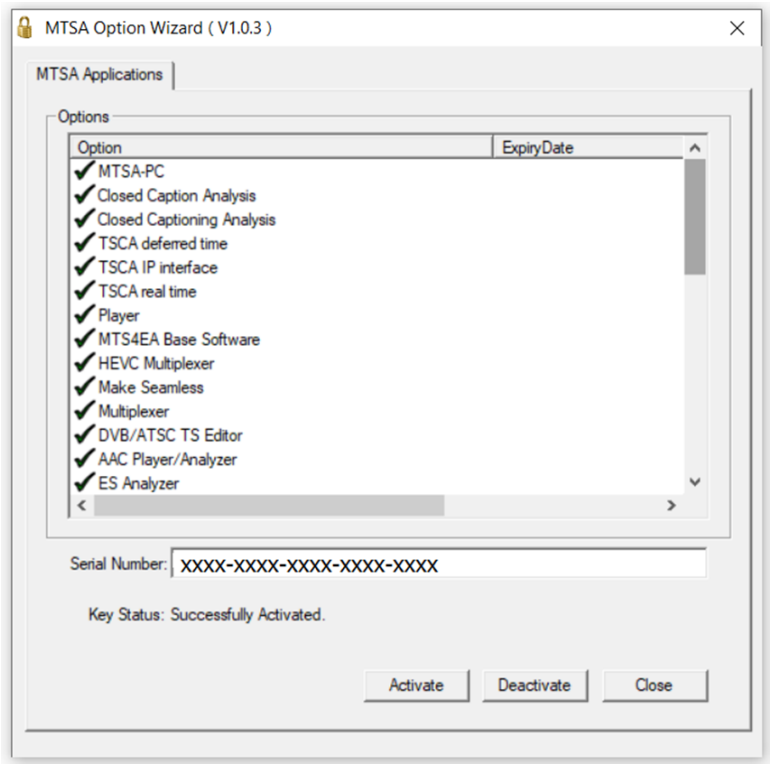
3. If there is an already activated license then the MTSA Option Wizard will show the existing options and the active Serial Number.



4. If license activation is being done for the first time, the MTSA Option Wizard will show no options or serial number.



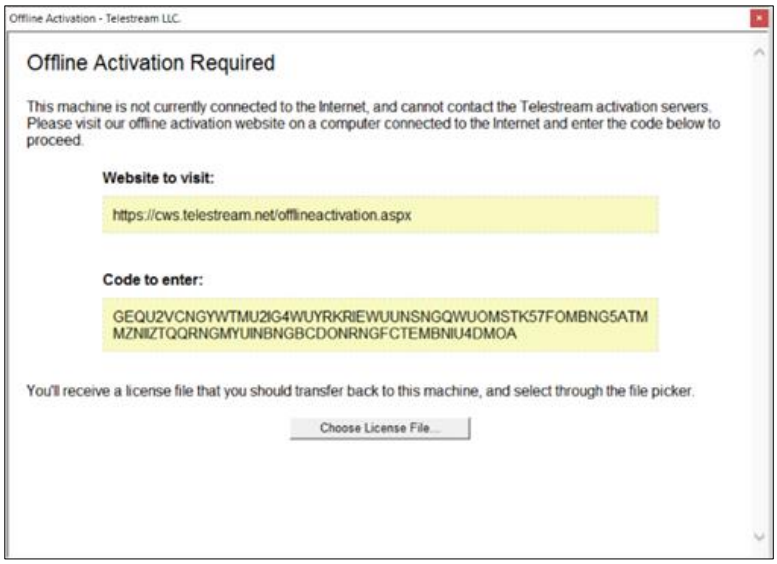
5. Enter the Software Serial Number you received in the Serial Number box and click **Activate**.
   Online activation: If the computer is connected to the internet, the license will be activated in Online Mode. If the specified serial number is activated successfully, the application will list all the enabled options and the key status will be updated to **Successfully Activated** as shown here. Once this process is complete, you can close the MTSA Option Wizard and begin to use your product.



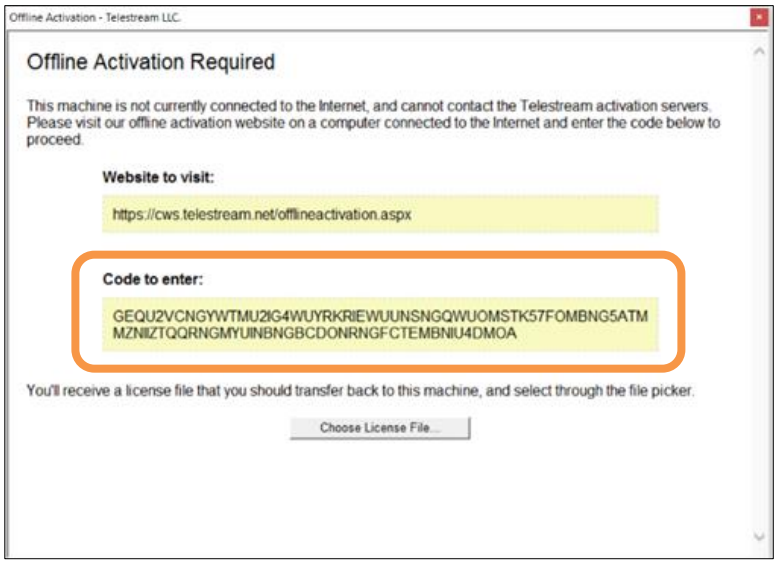
6. If the computer is NOT connected to the internet or if the computer is being blocked by a firewall, causing failure to connect to the Telestream license activation server, the application will prompt for offline activation.

NOTE. *If you are a behind a firewall, please give access to CWS.Telestream.net and ports 80 and 443. That could resolve the online mode activation issue.*

   If you want to proceed with offline activation, do not close this dialog, and perform the following steps.



7. In offline mode, you need to manually activate the software using another computer that has internet access.
   Open a text editor such as Notepad and copy the **Code to enter** code highlighted in the **Offline Activation Required** dialog. Save the text file and move the saved file onto a USB drive.



NOTE. *The code highlighted in the **Offline Activation Required** dialog is linked to this computer. If you move the license to a new computer, you will need to generate a new Offline Activation code on that computer.*

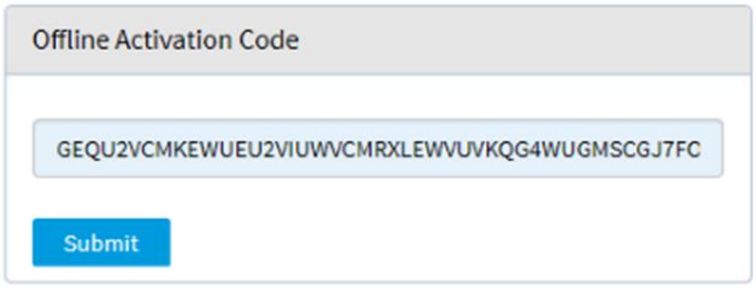
8. Using another computer with internet access:

   a. Copy the code from the USB drive and enter the offline activation code at:

   http://cws.telestream.net/offlineactivation.aspx

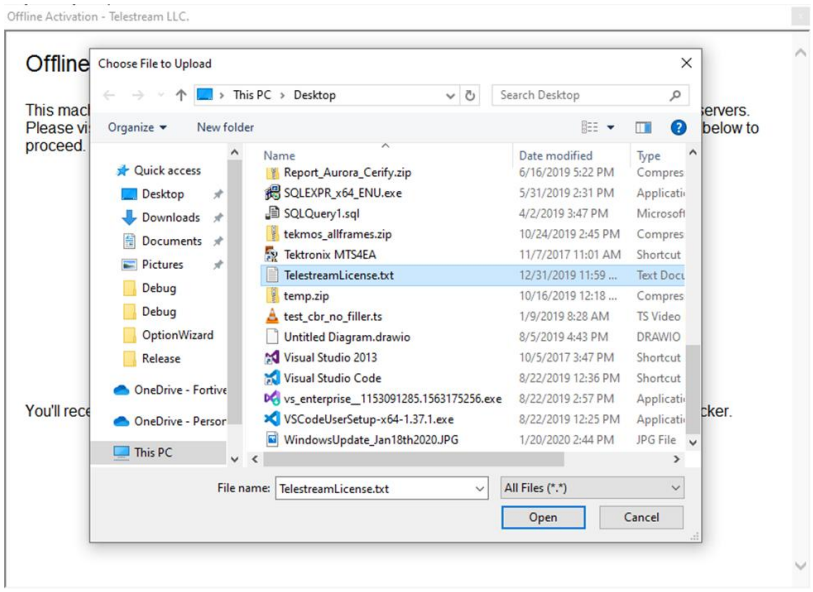
   b. After entering the code, select the **Submit** button to receive the license file.

   c. Once the license file is downloaded, place the file on a USB drive.



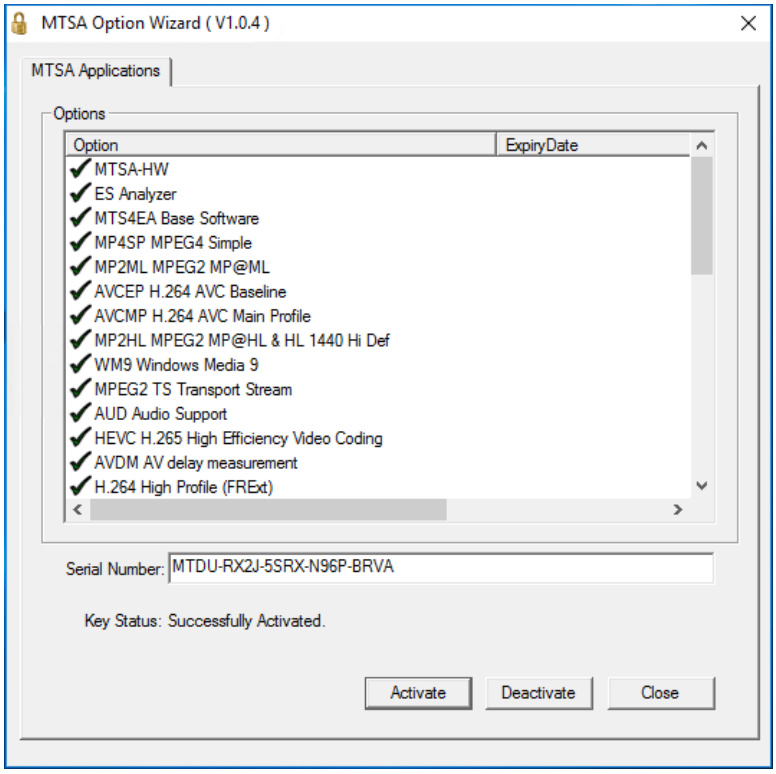
9. Go back to the **Offline Activation Required** dialog on the computer where the MTSA software is installed.

   Select **Choose License File...** button and select the License file from the USB drive.



10. If the offline activation is successful, the list of options and the key status will be updated in the dialog as shown.

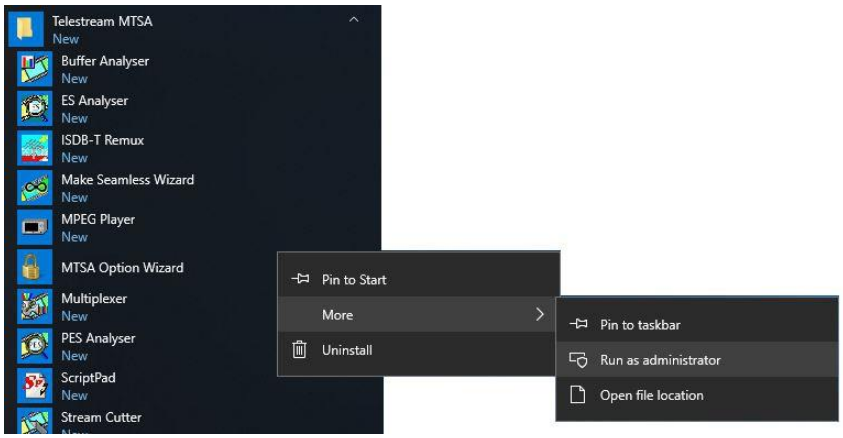
    After activating the license, the enabled MTSA software applications can be used.



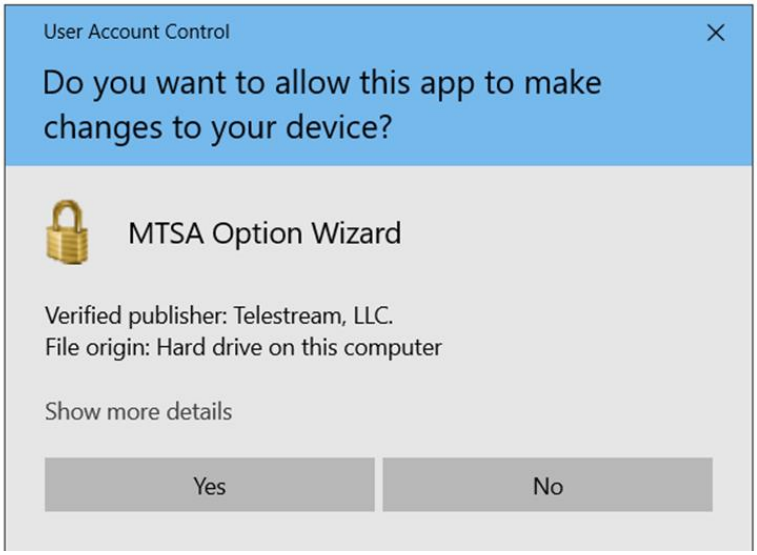
Deactivate the MTSA software license

If you need to move your software to a different computer, you must first deactivate your existing license.
License deactivation is performed using the MTSA Option Wizard. Perform the following steps to deactivate your license.

1. It is required to open the MTSA Option Wizard application in Administrator Mode.
   a. From the Start Menu, go to Telestream MTSA applications
   b. Right click on the **MTSA Option Wizard** application and select **More > Run as administrator**



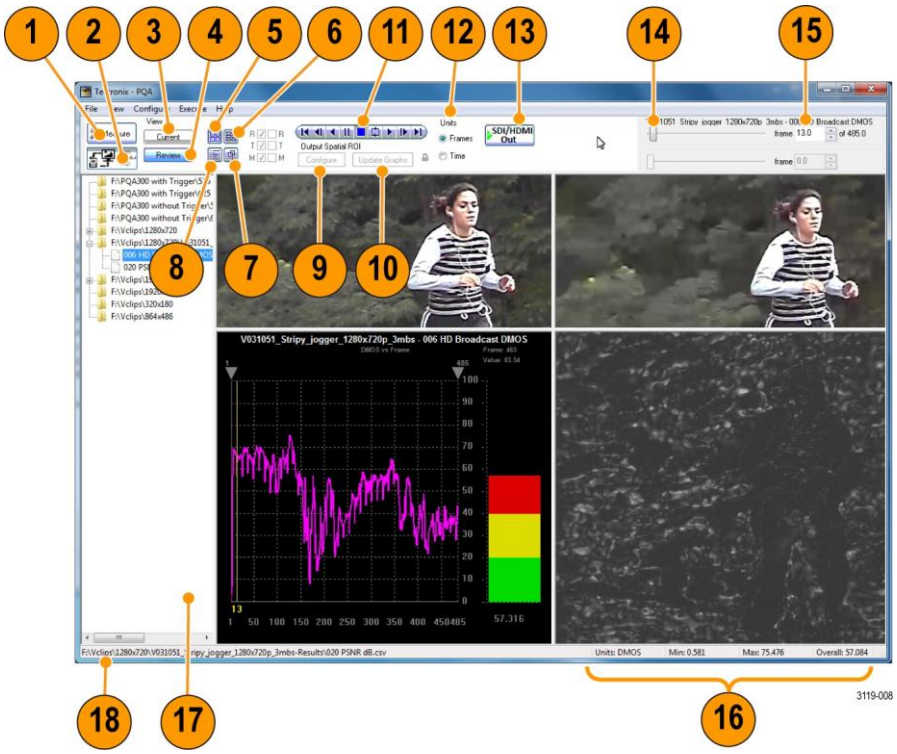
2. Select **Yes** when the application launches.



Operating basics

Display elements and menus

PQA home page display elements



Ref number	Item	Description
1	Measure button	The Measure button performs multiple functions. Use it to display the Configure Measure window (which allows you to select or configure measurements), to initiate measurements, and to stop currently running measurements.
2	Gen / Cap button	Use the Gen / Cap button to generate/capture an SDI/HDMI video signal (PQA600C only) or an IP video stream
3	Current button	Use the Current button to change the view to Current. In the Current view, you can configure and run measurements. You can also click this button to switch between reviewing results and checking the progress of a running measurement.
4	Review button	Use the Review button to change the view to Review. In the Review view, you can select video clips for review and analysis. You can use this button while a measurement is running to review results, though you cannot view running measurement results until they are complete.
5	Summary View button	Select to display the Summary View screen. The Summary View screen shows the reference video, test video, map, and the graph display.
6	Tile View button	Select to display the Tile View screen. The Tile View screen shows three screens in a horizontal arrangement: the reference video at the top, the test video in the middle, and the map at the bottom.

Ref number	Item	Description
7	Overlay View button	Select to display the Overlay View screen. The Overlay View screen mixes two sources for display. Using a slide bar, you can specify which source makes up most of the display.
8	Event Log	Select to display the Event Log screen. The Event Log displays measurements which exceed the settings for warnings and errors.
9	Configure button	Use the Configure button to control the Output Spatial ROI settings.
10	Update Graphs button	Use the Update Graphs button to recalculate measurements after you specify the Output Spatial ROI boundary.
11	Control bar	Controls the playback of video. Functions like the playback controls on a videotape or DVD player.
12	Units selector	Sets the selector bar to select video frames by frame number or elapsed time.
13	SDI/HDMI Out	PQA600C only: Select to output the Reference file to the Channel 1 output connector and to output the Test file to the Channel 2 output connector while reviewing the measurement results (or in review mode). Use the Simultaneous Generate and Capture window to configure which video interface is assigned to each channel (SDI, HDMI).
14	Frame selector	Use this slider bar to select which frame of the video clip to display.
15	Frame/Time readout	The readout indicates the display frame-by-frame number or time. You can also enter a frame number or time to display into this readout.
16	Measurement readout	The readout displays the minimum, maximum, and overall values for the selected measurement.
17	Navigation pane	The Navigation Pane is used to select measurement results for review.
18	Results path	The Results Path readout shows the path to the directory containing the selected measurement results file.

Simultaneous Generate and Capture page display elements

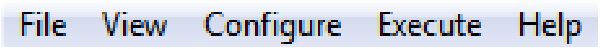
Ref number	Item	Description
1	Channel 1 Mode selection	Use the drop-down list to select from the following modes for Channel 1: Capture or generate video using the SDI interface, capture or generate video using the HDMI interface, capture or generate video using the IP interface.
2	Convert to Format controls	Click the Convert to Format check box to enable/disable the format conversion function. When enabled, use the “From” and “To” drop-down lists to convert the format of the video input or output to a desired format. The available conversion formats depend on the format of the video source. The “From” format must match the format of the source video. Use the Convert Modes button to configure the conversion mode.
3	Channel 1 Preview pane	Displays a preview of the video for the selected Channel 1 video mode. The preview is not displayed until the Channel 1 Format setting matches the video source. In addition, HDCP mode must be enabled in order to view video with HDCP content. ***NOTE.*** *When the PQA software is running, if the HDCP compliant monitor is disconnected and reconnected, then the monitor will no longer be recognized being HDCP compliant and the preview pane will no longer show HDCP content. In this case, you need to close and reopen the PQA application.*

Ref number	Item	Description
4	HDCP Content message	The HDCP Content message is displayed when the selected video source contains HDCP content.
5	Rec / Stop controls	Use the Rec / Stop buttons to manually start or stop a video capture.
6	Start Capture and Stop Capture controls	Use the Start Capture and Stop Capture controls to configure how the video capture will be controlled. You can control the capture manually or by referencing the capture start and stop times to the output generation of the other channel. When you use the output generation of one channel to control the capture on the other channel, you can enter a time delay to compensate for video system delays between the PQA output and input.
7	Available RAM Space, Disk Space, and Time Elapsed readouts	Use the Available RAM and Disk Space readouts to determine the available space for a video capture. The amount of space available is listed in frames and seconds and depends on the format of the video source. If the video source has HDCP content, the video can only be captured to RAM. The Time Elapsed readout shows the size of the video capture.
8	Capture To entry box	Use this entry box to manually enter the location and file name of the capture video file. If the file is to be stored in RAM, enter the following directory path: `MEM:\<file name>` (MEM must be capitalized).
9	Browse Disk and Browse Memory buttons	Use the Browse Disk button to browse the hard drive for the video capture location and to enter a file name. Use the Browse Memory button to browse the RAM memory for the video capture location and to enter a file name. Video with HDCP content can be captured only to RAM memory and cannot be played out.
10	Clock Selection	Use the Clock Selection drop-down list to select the reference clock used to capture or generate video.
11	Format selection	Use the Format drop-down list to manually select the format of the video source(s). Use the AutoSet button to have the PQA software automatically detect and set the format of the video source(s). ***NOTE.*** *When Channel 1 and Channel 2 are both in use at the same time (simultaneous generation/capture), the formats of the video signals for both channels must match.*
12	Enable HDCP button	The HDCP button appears when one of the channels is set to capture from the HDMI interface. In this case, you must click this button to enable the PQA software to view any HDCP content in the video.
13	Channel 2 Mode	Use the drop-down list to select from the following modes for Channel 2: Capture or generate video using the SDI interface, capture or generate video using the HDMI interface, capture video using the IP interface. You cannot generate IP video from Channel 2.
14	Convert to Format controls	Click the Convert to Format check box to enable/disable the format conversion function. When enabled, use the “From” and “To” drop-down lists to convert the format of the video input or output to a desired format. The available conversion formats depend on the format of the video source. The “From” format must match the format of the source video. Use the Convert Modes button to configure the conversion mode.

Ref number	Item	Description
15	Channel 2 Preview pane	Displays a preview of the video for the selected Channel 2 video mode. The preview is not displayed until the Channel 2 Format setting matches the video source. In addition, HDCP mode must be enabled in order to view video with HDCP content. ***NOTE.*** *When the PQA software is running, if the HDCP compliant monitor is disconnected and reconnected, then the monitor will no longer be recognized being HDCP compliant and the preview pane will no longer show HDCP content. In this case, you need to close and reopen the PQA application.*
16	Video replay control bar	Use these buttons to control the replay of video clips.
17	Current frame controls	Use the slider controls or the From and To boxes to set the start and stop points within the video clip for the portion of the clip you want to output. Use the Current Frame box to specify the exact frame where you want the video to start.
18	Browse Disk and Browse Memory buttons	Use the Browse Disk button to browse the hard drive for the location of the video clip you want to generate. Use the Browse Memory button to browse RAM memory for the video clip you want to generate. Video with HDCP content cannot be generated.
19	Configure Measure, Close, and Help buttons	Use the Configure Measure button to configure a measurement. Use the Close button to close the Simultaneous Generate and Capture window.
20	Generate From entry box	Use this entry box to manually enter the location and file name of the video file you want to generate. If the file is stored in RAM, enter the following directory path: `MEM:\<file name>` (MEM must be capitalized).

Menu commands

The commands available from the Menu bar are described in the following table.



Menu	Command	Description
File	Working Directories	Use to add directories to the Navigation Pane.
	Update Sequence List	Use to update contents of directories in the Navigation Pane.
	Import Measures	Use to import user configured measures that have been saved in another location or PQA.
	Print	Sends a screen capture of the PQA application window to the printer.
	Exit	Quits the PQA application.

Menu	Command	Description
View	Current Measure	Sets the View to Current.
	Review	Sets the View to Review.
	Summary View	Sets the display area to Summary View.
	Tile	Sets the display area to Tile View.
	Overlay	Sets the display area to Overlay View.
	Event Log	Sets the display area to the Event Log.
	Result 1	Selects which sources are displayed in the Overlay view as Result 1.
	Result 2	Selects which sources are displayed in the Overlay view as Result 2 (two results files must be selected to display two results).
	Loop	Sets playback to loop mode.
Configure	Measures	Displays the Configure Measures window to enable you to create and configure measurements.
	Generation/Capture	Displays the Capture window to enable you to configure Capture settings.
	Display Settings	Displays the Display Settings window. From the Display settings window, you can set the brightness and contrast for result maps, specify the colors used in the Summary View Graph, and set videos to fit the window.
	Decoder Settings ***NOTE.*** *This menu selection appears on 64-bit systems only. 32-bit systems always use the Standard Decoder.*	Displays the Decoder Settings window. From the Decoder Settings window, you can select the Standard Decoder or the Fast Decoder. The Standard Decoder uses the MTS4EA reference decoder and is the same decoder used in earlier versions of the PQA software. The Fast Decoder uses the Cerify optimized decoder, which covers a wider range of compressed file formats and performs the decoding faster. However, compatibility between the two decoders is not guaranteed.
Execute	Measures	Initiates a measurement.
	Script	Initiates an XML script.
Help	Telestream Home Page	Displays theTelestream Web site in a browser window.
	License Manager	Displays the License management window to enable you to enter a new license key (Option Key) to enable software options, and to seewhich options are currently available.
	About the PQA	Displays version information about the PQA Picture Quality Analyzer.

How the PQA analyzer works

Based on the concepts of the human vision system, the PQA provides a suite of repeatable, objective quality measurements that closely correspond with subjective human visual assessment. To provide picture quality measurements, 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. The automatic spatial and temporal alignment allows picture quality measurements to be made among different resolutions and frame rates (the alignment can also be performed manually). After spatial and temporal alignment, the PQA analyzes the quality of the test video, using measurements based on the human vision system and attention models, and then reports 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).

A reference video sequence and test sequence can have different resolutions. The PQA can provide picture quality measurements using any combination of formats, such as HD and SD, or SD and CIF. The PQA can also support measurement clips with unlimited sequence duration, allowing a full-length movie to be quantified for picture quality through various conversion processes.

With Option IP installed, the PQA can generate and analyze IP video streams.

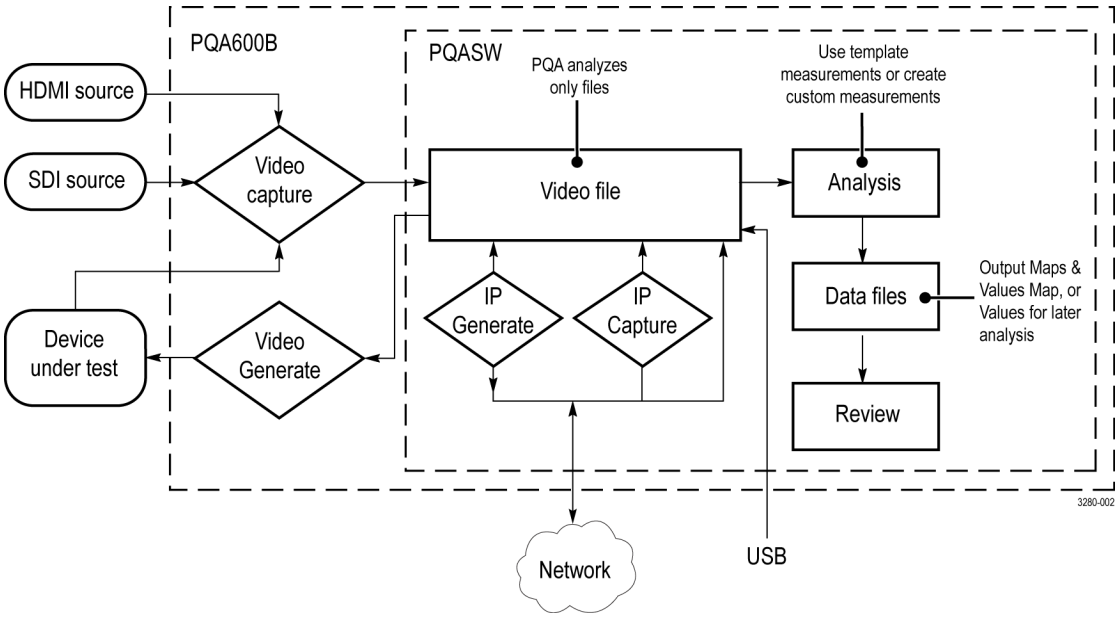


Figure 3: How the PQA analyzer works

Making measurements

The analysis process

Analyzing picture quality with the PQA analyzer is, broadly speaking, a two step process. First, you take a measurement and second, you review the analysis results. Once the measurement is complete, you can choose several ways to review the results.

In taking a measurement, you select a measurement (either a template measurement or a user-created measurement) from the Configure Measure dialog box. After selecting the measurement, you specify the video file(s) on which the measurement will be taken. Some measurements apply to a single file, though most compare a test file to a reference file. Once you have specified the video files on which to take the measurement, you initiate the measurement.

In the second step, you review the analysis results after the measurement is completed. You can view the results in several ways.

How to select a measurement

To select a measurement:

1. Click **Measure** to display the **Configure Measure** dialog box.
2. Select a measurement from the list of **Measures**.

Table 7: Measurements and their processing nodes

Measurement Name	Display Model	View Model	PSNR	Perceptual Difference	Artifact Detection	Attention Model	Summary Node
000 View Video	✓	✓	—	—	—	—	—
001 SD Broadcast PQR	✓	✓	—	✓	—	—	✓
002 HD Broadcast PQR	✓	✓	—	✓	—	—	✓
003 CIF and QVGA PQR	✓	✓	—	✓	—	—	✓
004 D-CINEMA PQR	✓	✓	—	✓	—	—	✓
005 SD Broadcast DMOS	✓	✓	—	✓	—	—	✓
006 HD Broadcast DMOS			—	✓	—	—	✓
007 CIF and QVGA DMOS	✓	✓	—	✓	—	—	✓
008 D-CINEMA DMOS	✓	✓	—	✓	—	—	✓
009 SD Broadcast ADMOS	✓	✓	—	✓	—	✓	✓
010 HD Broadcast ADMOS	✓	✓	—	✓	—	✓	✓

Table 7: Measurements and their processing nodes (cont.)

Measurement Name	Display Model	View Model	PSNR	Perceptual Difference	Artifact Detection	Attention Model	Summary Node
11 CIF and QVGA ADMOS	✓	✓	—	✓	—	✓	✓
12 SD Sports Broadcast ADMOS	✓	✓	—	✓	—	✓	✓
13 HD Sports Broadcast ADMOS	✓	✓	—	✓	—	✓	✓
14 Talking Head Broadcast ADMOS	✓	✓	—	✓	—	✓	✓
15 SD DVD from D-Cinema DMOS	✓	✓	—	✓	—	—	✓
16 CIF from SD Broadcast DMOS	✓	✓	—	✓	—	—	✓
17 SD from HD Broadcast DMOS	✓	✓	—	✓	—	—	✓
017-A Reference: SD, Test: HD Broadcast DMOS	✓	✓	—	✓	—	—	✓
18 QCIF from CIF and QVGA DMOS	✓	✓	—	✓	—	—	✓
19 Stand-alone Attention Model	—	—	—	—	—	✓	✓
20 PSNR dB	—	—	✓	—	—	—	✓
21 Removed Edges Percent	—	✓	—	—	✓	—	✓
22 Added Edges Percent	—	✓	—	—	✓	—	✓
23 Rotated Edges Percent	—	✓	—	—	✓	—	✓
24 DC Blocking Percent	—	✓	—	—	✓	—	✓
25 Removed Edges Weighted PSNR dB	—	✓	✓	—	✓	—	✓
26 Added Edges Weighted PSNR dB	—	✓	✓	—	✓	—	✓
27 Rotated Edges Weighted PSNR dB	—	✓	✓	—	✓	—	✓
28 DC Blocking Weighted PSNR dB	—	✓	✓	—	✓	—	✓
29 Artifact Annoyance Weighted PSNR dB	—	✓	✓	—	✓	—	✓

Table 7: Measurements and their processing nodes (cont.)

Measurement Name	Display Model	View Model	PSNR	Perceptual Difference	Artifact Detection	Attention Model	Summary Node
030 SD DVD from D-Cinema Artifact Weighted PSNR dB	—	✓	✓	—	✓	—	✓
031 CIF from SD Broadcast Artifact Weighted PSNR dB	—	✓	✓	—	✓	—	✓
032 SD from HD Broadcast Artifact Weighted PSNR dB	—	✓	✓	—	✓	—	✓
033 QCIF from CIF and QVGA Artifact Weighted PSNR dB	—	✓	✓	—	✓	—	✓
034 Attention Weighted PSNR dB	—	—	✓	—	—	✓	✓
035 No Reference DC Blockiness Percent	—	—	—	—	✓	—	✓
036 HD ADMOS ITU-BT500 with Interlaced CRT	✓	✓	—	✓	—	✓	✓
037 HD PQR ITU-BT500 with Interlaced CRT	✓	✓	—	✓	—	—	✓
038 HD DMOS ITU-BT500 with Interlaced CRT	✓	✓	—	✓	—	—	✓

Template measurements

The PQA application software is configured with 38 template measurements. These measurements are optimized for a variety of uses. Although you cannot change the parameters of the template measurements, you can create new measurements based on a template measurement and save the new measurement under a different name. Measurements are defined through a series of configuration nodes. You change measurement parameters by selecting a configuration node and adjusting its settings to suit your requirements.

NOTE. *To accurately simulate the procedure called out in the ITU BT.500 standard, all DMOS predictions require a worst case training. To provide this training, take the selected DMOS measurement once with an example of the worst case video expected for the application according to ITU BT.500 worst case training recommendations. After you have taken the measurement, use the Import function in the Summary Node for the measurement to import the Minkowski value from the measurement results csv file. This sets the training bias for your application as if you were conducting a subjective rating study according to ITU BT.500. Save this new summary setting as your custom measurement for this application with your custom training.*

Table 8: Template measurements

Measurement Class		Measurement Name
		000 View Video
Subjective Prediction: Full Reference		
	Noticeable Differences	
	SD Display and Viewing	001 SD Broadcast PQR
	HD Display and Viewing	002 HD Broadcast PQR
	CIF Display and Viewing	003 CIF and QVGA PQR
	D-Cinema Projector and Viewing	004 D-CINEMA PQR
	Subjective Rating Predictions	
	SD Display and Viewing (with preliminary BT.500 training)	005 SD Broadcast DMOS
	HD Display and Viewing (with preliminary BT.500 training)	006 HD Broadcast DMOS
	CIF Display and Viewing (with preliminary BT.500 training)	007 CIF and QVGA DMOS
	D-Cinema Projector and Viewing (with preliminary BT.500 training)	008 D-CINEMA DMOS
	Attention Biased Subjective Rating Predictions	
	SD Display and Viewing (with preliminary BT.500 training)	009 SD Broadcast ADMOS
	HD Display and Viewing (with preliminary BT.500 training)	010 HD Broadcast ADMOS
	CIF Display and Viewing (with preliminary BT.500 training)	011 CIF and QVGA ADMOS
	SD Sports (with preliminary BT.500 training)	012 SD Sports Broadcast ADMOS
	HD Sports (with preliminary BT.500 training)	013 HD Sports Broadcast ADMOS
	SD Talking Head (with preliminary BT.500 training)	014 SD Talking Head Broadcast ADMOS
	Repurposing: Reference and test are independent: Use any combination display model and viewing conditions with each measurement above	
	Format Conversion: Cinema to SD DVD (with preliminary BT.500 training)	015 SD DVD from D-Cinema DMOS
	Format Conversion: SD to CIF (with preliminary BT.500 training)	016 CIF from SD Broadcast DMOS
	Format Conversion: HD to SD (with preliminary BT.500 training)	017 SD from HD Broadcast DMOS
	Format Conversion: SD to HD (with preliminary BT.500 training)	017-A HD from SD Broadcast DMOS
	Format Conversion: CIF to QCIF (with preliminary BT.500 training)	018 QCIF from CIF and QVGA DMOS
	Attention	
		019 Stand-alone Attention Model

Table 8: Template measurements [1] (cont.)

Measurement Class	Measurement Name
Objective Measurements: Full Reference	
General Difference	
	020 PSNR dB
Artifact Measurement	
Removed Edges	021 Removed Edges Percent
Added Edges	022 Added Edges Percent
Rotated Edges	023 Rotated Edges Percent
% of original deviation from block DC	024 DC Blocking Percent
Artifact Classified (Filtered) PSNR	
Removed Edges	025 Removed Edges Weighted PSNR dB
Added Edges	026 Added Edges Weighted PSNR dB
Rotated Edges	027 Rotated Edges Weighted PSNR dB
% of original deviation from block DC	028 DC Blocking Weighted PSNR dB
Artifact Annoyance Weighted (Filtered) PSNR	
PSNR with default artifact annoyance weights	029 Artifact Annoyance Weighted PSNR dB
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
Format Conversion: SD to CIF	031 CIF from SD Broadcast Artifact Weighted PSNR dB
Format Conversion: HD to SD	032 SD from HD Broadcast Artifact Weighted PSNR dB
Format Conversion: CIF to QCIF	033 QCIF from CIF and QVGA Artifact Weighted PSNR dB
Attention Weighted Objective Measurements	
General Difference	
PSNR	034 Attention Weighted PSNR dB
Objective Measurements: No Reference	
Artifact	
DC Blockiness	035 No Reference DC Blockiness Percent
Measurements with Performance Report [1]	
ADMOS	036 HD ADMOS ITU-BT500 with Interlaced CRT
PQR	037 HD PQR ITU-BT500 with Interlaced CRT
DMOS	038 HD DMOS ITU-BT500 with Interlaced CRT

[1] Please refer to the application note *Objective Measurements and Subjective Assessment* (literature number 28W-24876-0) on the Telestream Web site: www.telestream.net.

Overview of the measurement process

This section provides an overview of the following steps that are required to use the PQA to measure picture quality.

Step 1 – Prepare the Reference and Test files

The full reference measurements (e.g. PSNR, DMPS, PQR) offered by the PQA require a Reference file to measure against the picture quality of the Test file.

Step 2 – Perform the PSNR measurement (020 PSNR dB)

It is suggested that you run the PSNR measurement prior to the DMOS/PQR measurements to make sure that the temporal / spatial alignments are precisely done. If the PSNR shows higher score than expected, then you may need to check the temporal / spatial alignment setting again. (See page 84, *Performing temporal synchronization and spatial alignment of sequences*.)

Step 3 – Perform the PQR/DMOS measurements (002 HD Broadcast PQR, 006 HD Broadcast DMOS)

It is suggested that you run the PQR/DMOS measurement after you run the PSNR measurement since it takes a longer time to run. The PQR measurement will offer an accurate score when the test content has small impairments that may not be visible. If the test content has obvious visible impairments, then the DMOS measurement will offer a more accurate score that matches a person's perception with the appropriate worst case training sequence set. For more information, refer to PQR/DMOS measurement and the way to setup the worst case sequence in the application note (28W-24876-0).

Step 4 – Perform the attention weighted measurements (034 Attention weighted PSNR)

The "034 Attention weighted PSNR" measurement provides a PSNR score in the region of the interest where the PQA application predicts that viewers will pay more attention in order to provide a more accurate picture quality rating. The "019 stand-alone attention model" measurement can be used to confirm how the PQA application predicts the region where the viewers will pay more attention on the given content. You can use the pre-configured attention weighted PQR/DMOS measurements (009- 014, 036), or you can create an attention weighted PQR/DMOS measurement by modifying a pre-configured measurement.

Step 5 – Diagnose the impairments using the artifact weighted test (025 – 028 Artifact classified PSNRs)

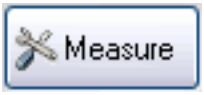
The 025-028 measurements offer the PSNR score with each artifact weighting. A set of these measurement results will indicate the dominant artifact impairment in the test content. You can create artifact weighted PQR / DMOS measurement by modifying the pre-configured measurements.

Creating new measurements

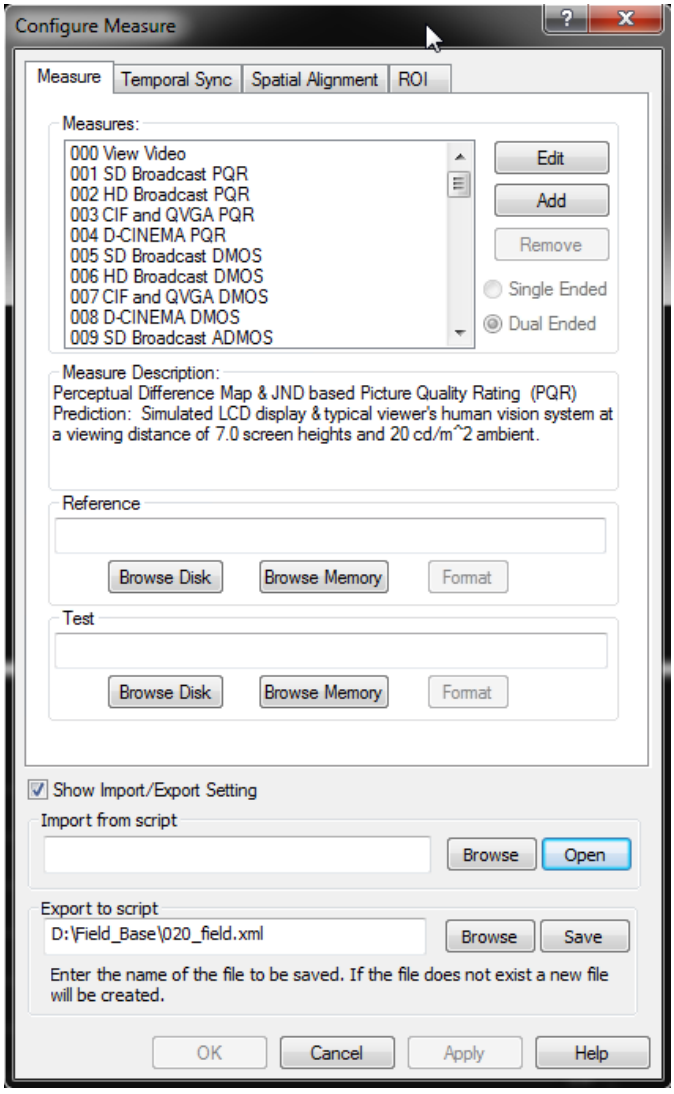
You can create measurements by modifying an existing template measurement or by adding a measurement and then adjusting the necessary parameters in the processing nodes.

To create a new measurement:

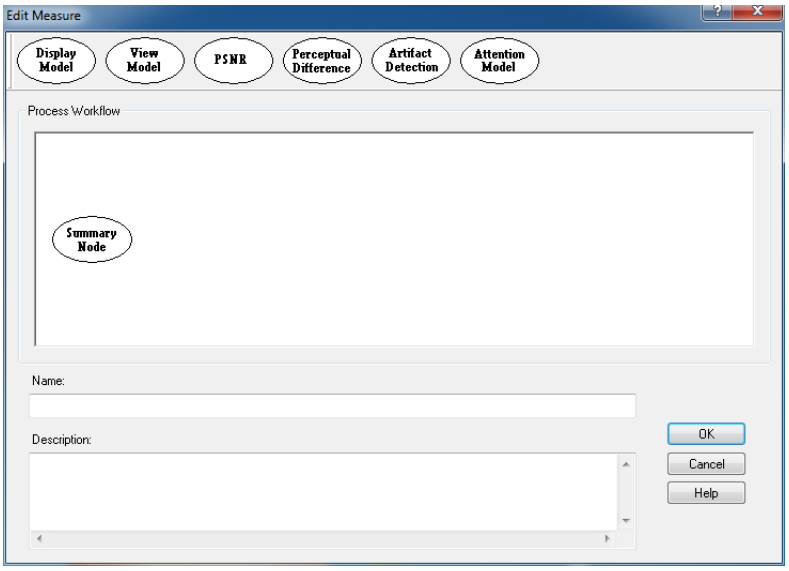
1. Click the Measure button.



2. To create a new measurement based on a template measurement, select a numbered template measurement from the Measures list and click **Edit**.
3. To add a new measurement, click **Add**.



If you click Add to create a new measurement, the PQA analyzer displays the **Edit Measure** window with only one processing node. The measurement has no name or description.

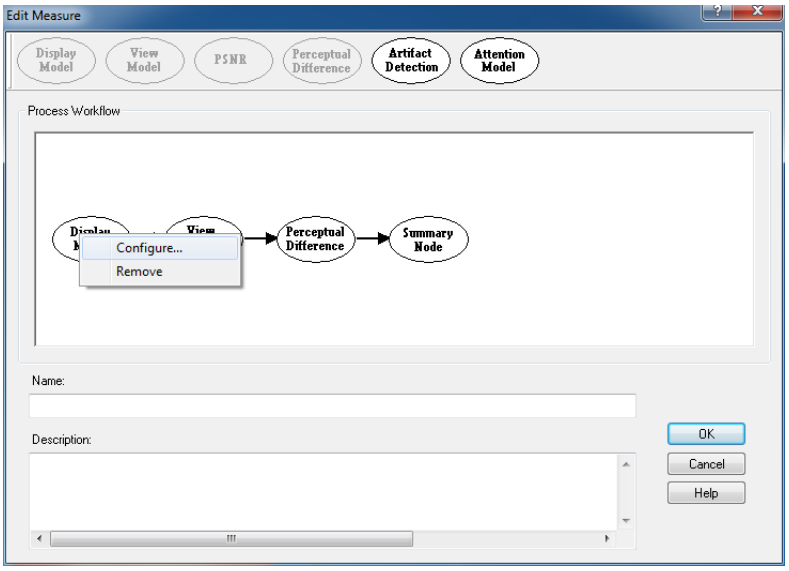


4. To change the parameters of your measurement, right-click on a processing node and select **Configure**. Change the parameters to suit your requirements.

   - To add a processing node to your measurement, select the desired node at the top of the window and drag it into the Process Workflow area.

NOTE. *The PSNR and Perceptual Difference processing nodes are mutually exclusive. A measurement cannot contain both nodes.*

   - To remove a processing node from your measurement, right-click on the processing node and select **Remove**.

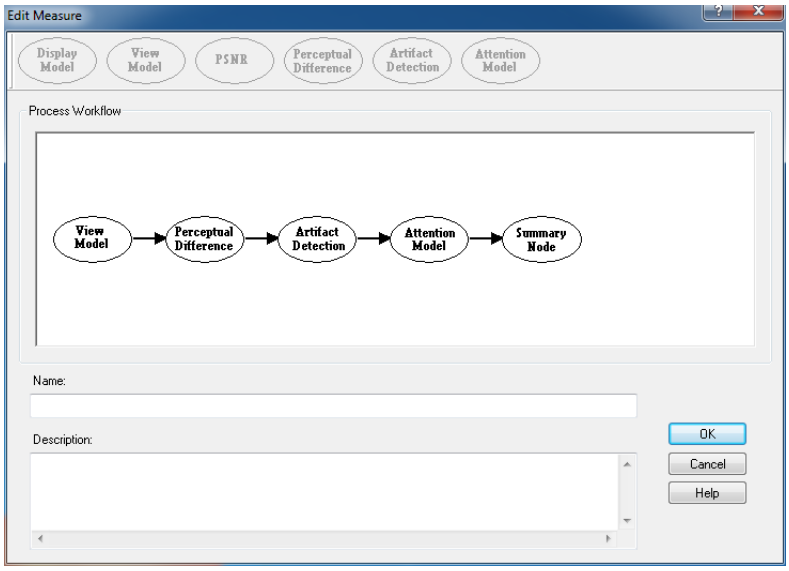


5. When you are finished setting the parameters for your new measurement, type a name for the measurement in the **Name** field.

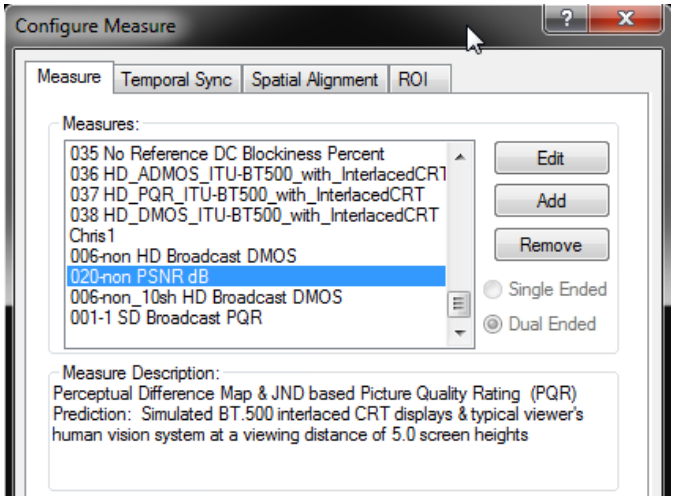
   - If you based your measurement on a template measurement, the Name field already has a name in it based on the template measurement (*Copy of* <template name>). The PQA analyzer will not allow you to replace a template measurement.

6. If you wish, enter a description for your measurement in the Description field.

7. Click **OK** to save your new measurement.

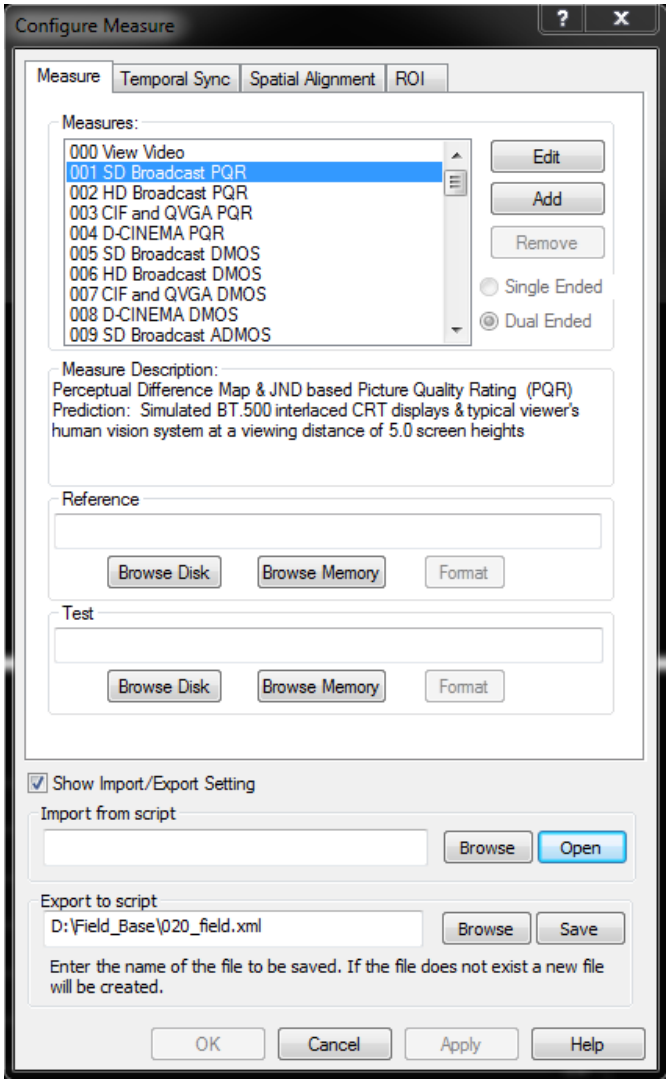


Your new measurement will now appear at the bottom of the list of measurements in the Configure Measure window.

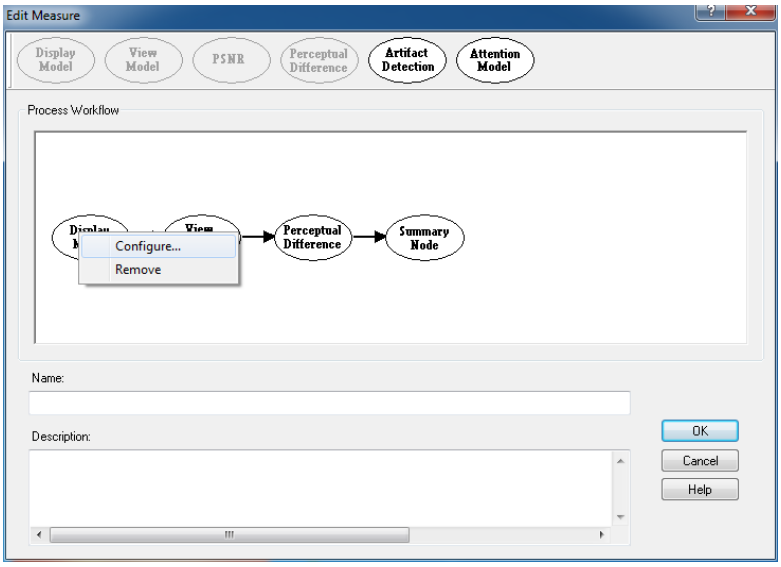


Configuration nodes

The parameters that control how a measurement is taken are defined by Configuration Nodes. Measurement parameters are grouped into several configuration nodes. Each configuration node groups related parameters together. You customize a measurement by adding or removing configuration nodes to the measurement and by changing the parameters within the configuration nodes. To access the configuration nodes of a measurement, select the measurement and then click **Edit** from the Configure Measure window.



You change the parameters within a configuration node by right-clicking on the configuration node and selecting **Configure** from the pop-up menu.



The following paragraphs list the configuration nodes and the parameters they control. Some of these nodes are not included in every measurement. Two of the nodes (PSNR and Perceptual Difference) are mutually exclusive.

Display Model

Parameters controlled by this node. Display technology: CRT, LCD, or DMD. Each technology has user-configurable parameters (Interlace/Progressive, Gamma, Response time, and more). Parameters for the Reference Display and the Test Display can be set independently.

Usage. Displays can have a profound effect on perceived video quality. For example, a slow LCD can mask and emphasize different types of distortion. Also, LCDs can add their unique distortion artifacts. Use this setting to make sure that the viewer response is properly modeled by ensuring the conversion from input video to light is properly modeled.

View Model

Parameters controlled by this node. Viewing distance, Ambient Luminance for Reference and Test (can be set 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, and speed versus accuracy of the scale and shift correction filters.

Usage. The View Model accounts for important aspects of the light that actually reaches the eye, accounting for the environment between the display and the eye. Although ITU BT.500 provides detailed viewing conditions, the actual viewing conditions of your application might not match the BT.500 recommended conditions. This node enables you to adapt the measurement configuration to your viewing conditions, including the addition of ambient light as required by ITU BT.500.

PSNR

Parameters controlled by this node. There are no parameters for PSNR. You can only choose whether the PSNR result is included as part of the measurement.

Usage. Though not nearly as accurate for predicting video quality as measurements that use the human vision model, PSNR is a simple, fast, and objective measurement that can be used for:

- Determining if there is 0 objective difference (bit to bit accuracy) or, if there is a difference.
- A rough guide, in cases where low predicted quality measurement accuracy is OK.

The smaller the display is within the viewer's field of vision, the more accurate PSNR can be. So, for example, for CIF video on a handheld display that is 10 screen heights away, studies show that PSNR can be useful as a quality metric under the right viewing conditions and video content. At the opposite extreme, PSNR generally does a poor job of predicting video quality ratings when compared with the Human Vision Model used by the PQA when evaluating an HD, 2K, 4K line video clip viewed at 2 screen heights, especially if the encoder is doing a good job.

Perceptual Difference

Parameters controlled by this node. Viewer characteristics (acuity, sensitivity to changes in average brightness, response speed to the moving object, sensitivity to photosensitive epilepsy triggers, and more).

Usage. Use the Perceptual Difference node to account for target audience differences in perception. You can use the Perceptual Difference node to model teens watching video on cell phones or football fans watching an HD game on a 58-inch LCD TV. You can also use this node to model for discriminating “expert” users that have different types of higher sensitivities. For example, some expert users may be have better acuity or some may be more able to see flashes of (short temporal) distortions. As an example of an expert application, suppose you want to achieve no perceived differences between your test and reference video, but you know the encoder being used can have very short (1 frame) distortions. You could be more conservative than the PQA Expert setting by adjusting the temporal sensitivity higher.

Two included user types are typical and expert. The typical viewer included is most appropriate for general population simulation as would be included in a DMOS experiment.

Attention Model

Parameters controlled by this node. Overall attention weighting for measures and for each class of attention attractor:

- Temporal (motion).
- Spatial (center, people (skin), foreground, contrast, color, shape, size).
- Distractions (differences between test and reference video, such as artifacts).

Usage. Adding the attention model to a measurement improves predicted DMOS accuracy slightly (the amount depends on many things, but, as with PSNR, the degrees of field of view taken by the display is the most important). Unlike PSNR, the larger the display is in the field of view, the more the attention model improves in accuracy. Keep in mind that video quality ratings are statistical and that a video clip with the best mean quality score might not have the best score among the top-most critical portion of the audience. When the attention model is not included in a measurement, the video quality rating is predicted for viewing the video at all portions of the screen evenly (the equivalent of many eyes watching different portions very carefully to see if any part of the video is different from a reference). However, this is not generally how people watch video. Instead, people tend to look at mostly the same kinds of things, such as people, action and the motion of objects, usually ignoring the background. People are much more sensitive to seeing artifacts if they are looking directly at them than if they are not. The attention model predicts a probability map that indicates where people are most likely to look. For DMOS measurements, this is used to weight the perceptual sensitivities accordingly, thereby improving the DMOS prediction.

The attention model can also be used with PSNR and artifact detection: it weights the respective measurement maps with the attention probability to give the portion of distortion that is within the most viewed areas.

The parameters would normally be adjusted to fit the task of a viewer. For examples, for sports, usually people and motion are most important. For a nature show, motion and color might be more important. For a talk show, people and foreground might be most important.

Artifact Detect

Parameters controlled by this node. Added Edges (Ringing/Mosquito Noise), Removed Edges (Blurring), Rotated Edges (Jaggies, Edge Blockiness) and DC Blockiness (Removed detail within a block).

Usage. This node is used to detect artifacts of different fundamental classes that might be related to particular causes such as encoder filters and excess quantization and analog distortions such as reduced bandwidth of baseband video. For example, DC Blockiness shows up in MPEG-2 video when excess quantization takes place. Including this node in a measurement is especially useful because these types of artifacts are often cited by viewers as features they find especially objective. Because some people find one type of artifact less objectionable than another, measuring these artifacts can help engineers make design or configuration trade-offs in a way that optimizes conflicting trade-offs.

Edge measurements are made by comparing the test and reference luminance gradient at each reference pixel. In this way, jaggies are detected as reference diagonal gradients rotated to the vertical or horizontal directions.

Summary Node

Parameters controlled by this node. Statistical Units (PSNR, Perceptual Difference, Blockiness). Measure Map settings: Gain, Offset, display as signed data. Worst Case Training for ITU-R BT.500 Training (Default or User application tuned, determined by Worst Case example).

Usage. In general, the summary node is used to specify how results are reported. The summary node takes measurement maps and reduces each to a scaler (a single number) of a particular measurement unit. It also takes a sequence of these summary measurement scalers produced over time (one per measurement map per field or frame) and produces a single sequence summary measurement scaler. For example, a predicted DMOS measurement has a perceptual difference map produced per time sample (at the highest rate of field or frame rate) and reduces this map to a DMOS score per time and an overall sequence DMOS score at the end of the measurement. The same processing occurs for measurements such as PSNR, PQR, and Artifact Detection. To reduce the maps to scalars, there are certain choices of units, training and other requirements that are specified in the configuration of the summary node.

Changing configuration node settings

Display Model

The Display Model parameters are used to specify the display technology used by the viewer and the parameters of the display. There are three choices for the type of display used: CRT (cathode ray tube), LCD (liquid crystal display), and DMD (digital micromirror device).

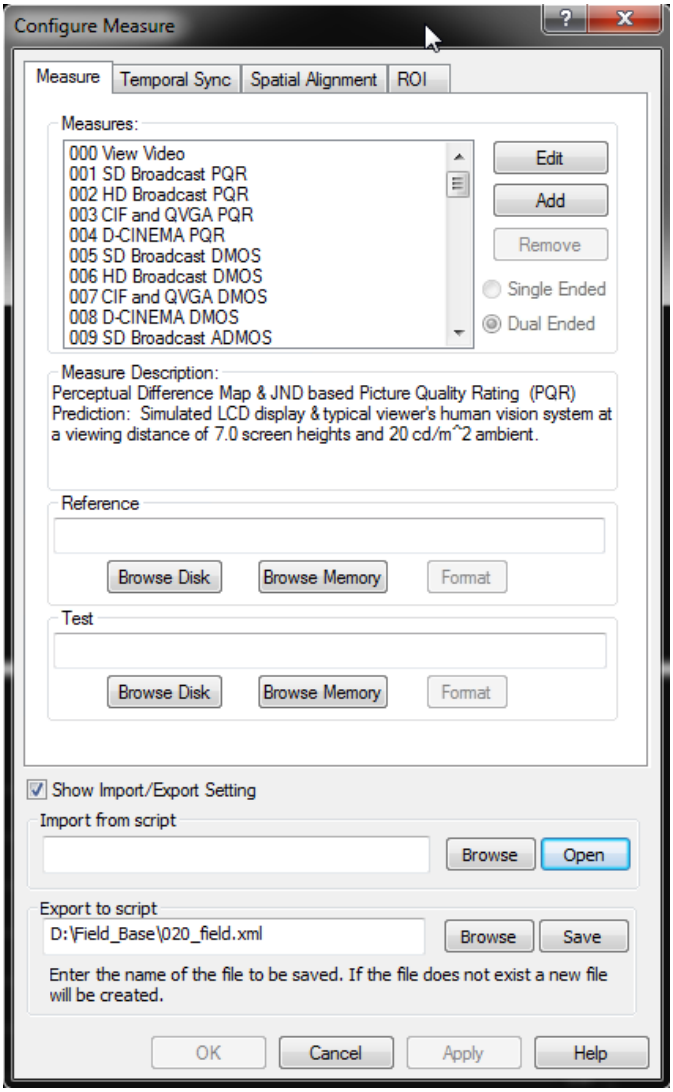
To change the display model parameters:

1. Right-click the Measure button.

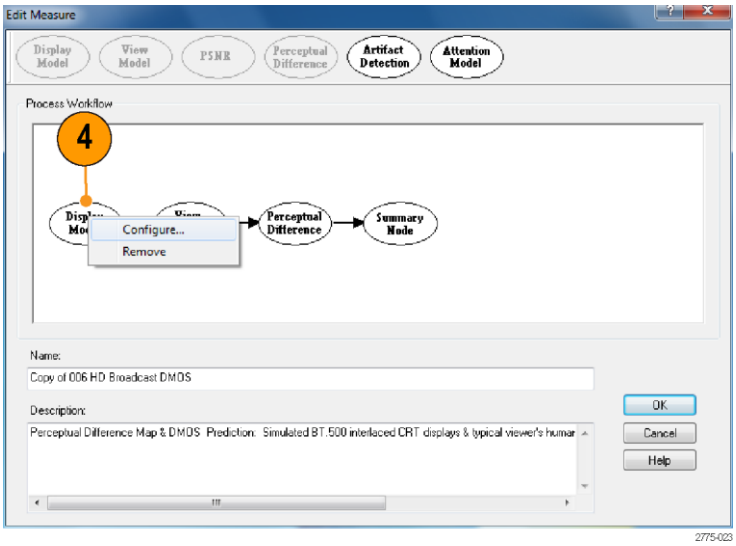
2. Select the desired measurement from the Configure Measure window.

NOTE. *If you choose a template measurement, you will have to save the changed measurement under a new name.*

3. Click **Edit**.

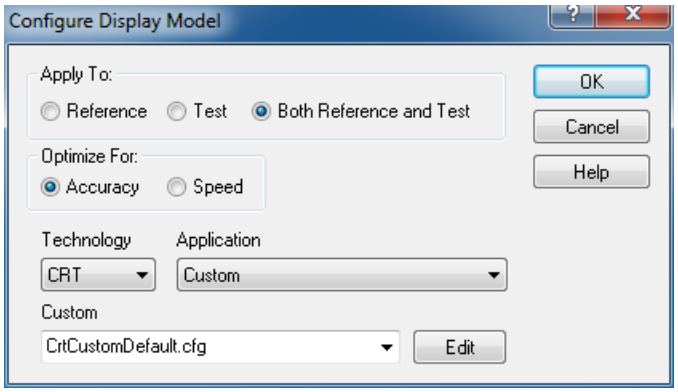


4. Right-click **Display Model** and select **Configure**.



5. Select the display technology from the **Technology** drop-down list.
6. Select **Custom** from the **Application** drop-down list.

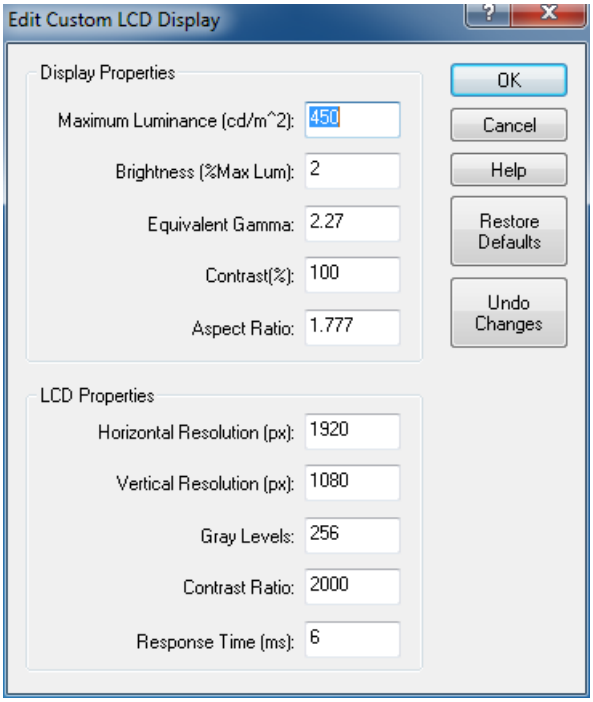
   After you select Custom, the Custom drop-down list is enabled.



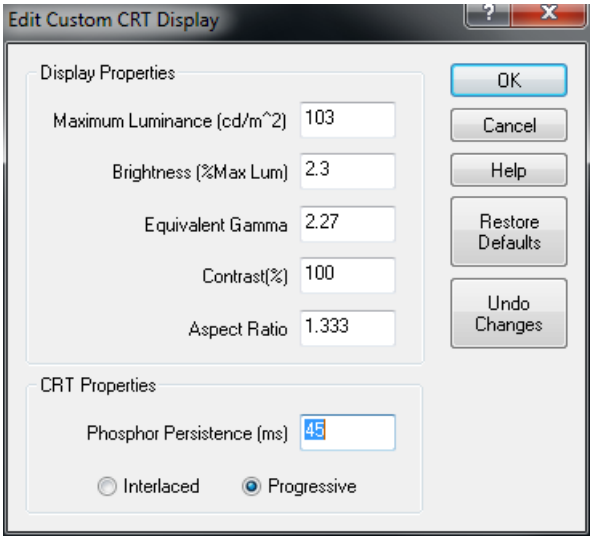
The Edit Custom window contains two groups of settings: Display Properties and CRT/DMD/LCD-specific properties. The parameters in the Display Properties group are the same for every display technology, though the values differ. The parameters in the CRT/DMD/LCD Properties group change depending on the technology. The illustrations to the right show the difference in the properties for an LCD display and a CRT display.

7. Edit the settings as necessary to suit your requirements.
   - Click **Restore Defaults** to return all settings to the initial factory values.
   - Click **Undo Changes** to return all settings to the previously saved values.
8. Click **OK** to save your changes.

NOTE. *The interlaced CRT setting requires "Top field First" interlaced video content. If "Bottom field First" content is supplied, the display simulation might be inaccurate.*



LCD display properties



CRT display properties

The following table lists the parameters that can be set in the Display Model configuration node.

Table 9: Display model parameters

Parameter	Setting	Usage
Apply To:	Reference	Select when specifying the settings for the Reference video.
	Test	Select when specifying the settings for the Test video.
	Both Reference and Test	Select when specifying the settings to use for both Reference and Test video.
Optimize for	Accuracy	Reserved for future use.
	Speed	Reserved for future use.
Technology	CRT / DMD / LCD	Select the appropriate display.
CRT	Broadcast Monitor, Consumer TV, Computer Monitor	Select for the display application.
LCD	LCD TV, Computer LCD Monitor, Mobile Device	Select for the display application.
DMD	Digital Cinema, Business Boardroom, Home Entertainment	Select for the display application.

The following tables list the default values for the Display Model parameters. If the display you want to test for has different parameters than the default values shown in these tables, you must create a custom configuration file that sets the display parameters as required.

Table 10: Predefined CRT display parameters

Display Properties	Broadcast Monitor	Consumer TV	Computer Monitor	Custom Default	HD Default
Maximum Luminance	103	450	103	103	103
Brightness	2.27	2.27	2.27	2.27	2.27
Equivalent Gamma	2.3	2.3	2.3	2.3	2.3
Contrast	100	100	100	100	100
Aspect ratio	1.33	1.33	1.33	1.33	1.77
CRT Properties					
Phosphor Persistence (ms)	10.0	10.0	10.0	45	10
Interlaced	1	1	0	1	0
Progressive	0	0	1	0	1

Table 11: Predefined LCD parameters

Display Properties	LCD TV	Computer Monitor	Mobile Device	Custom Default
Maximum Luminance	450	250	450	450
Brightness	2.27	2.27	2.27	2.27
Equivalent Gamma	2.0	2.0	2.0	2.0
Contrast	100	100	100	100
Aspect ratio	1.77	1.33	1.33	1.33
LCD Properties				
Horizontal Resolution	1920	1600	320	1920
Vertical Resolution	1080	1200	240	1080
Gray Levels	256	256	64	256
Contrast Ratio	2000	500	100	2000
Response Time (ms)	6	20	80	6

Table 12: Predefined DMD parameters

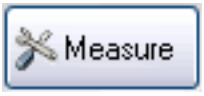
Display Properties	Digital Cinema	Business Boardroom	Home Entertainment	Custom Default
Maximum Luminance	50	30	30	100
Brightness	2.6	2.27	2.27	2.2
Equivalent Gamma	2.3	2.3	2.3	2.3
Contrast	100	100	100	100
Aspect ratio	1.77	1.33	1.77	1.33
DMD Properties				
Horizontal Resolution	2048	1280	1280	1280
Vertical Resolution	1080	720	720	720
Gray Levels	4096	255	255	1024

View Model

The View Model specifies the conditions under which the display is viewed and, optionally, performs spatial alignment, cropping, gain, and DC offset adjustment to match the test video to the reference video. You can set values such as the viewing distance and ambient luminance level.

To change the view model parameters:

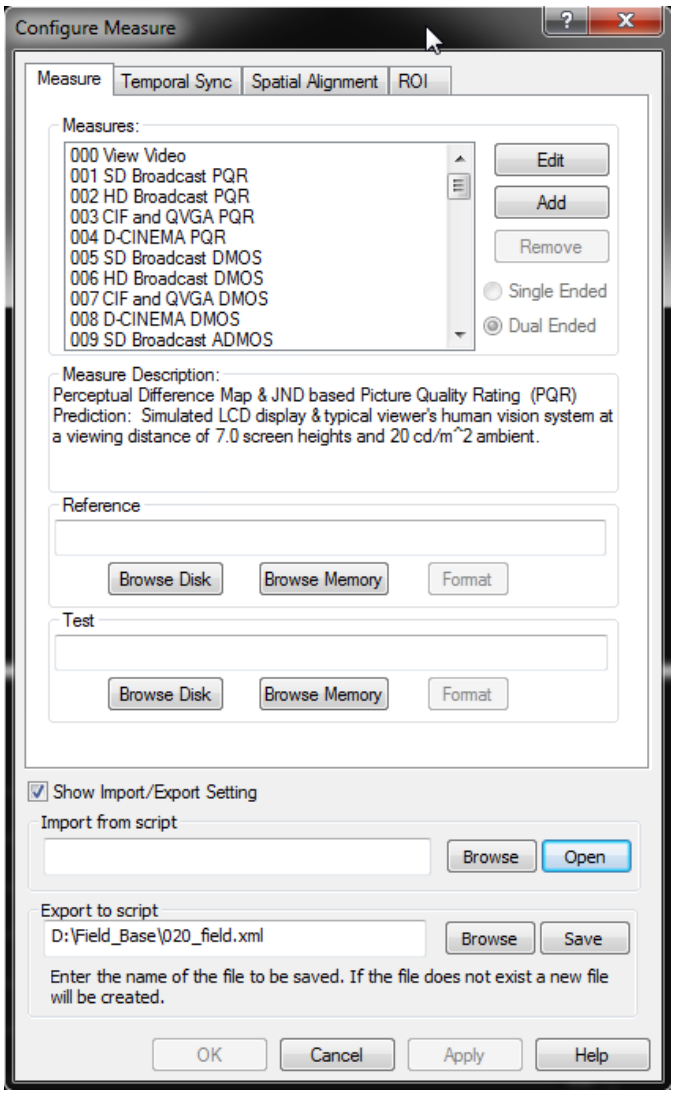
1. Right-click the **Measure** button.



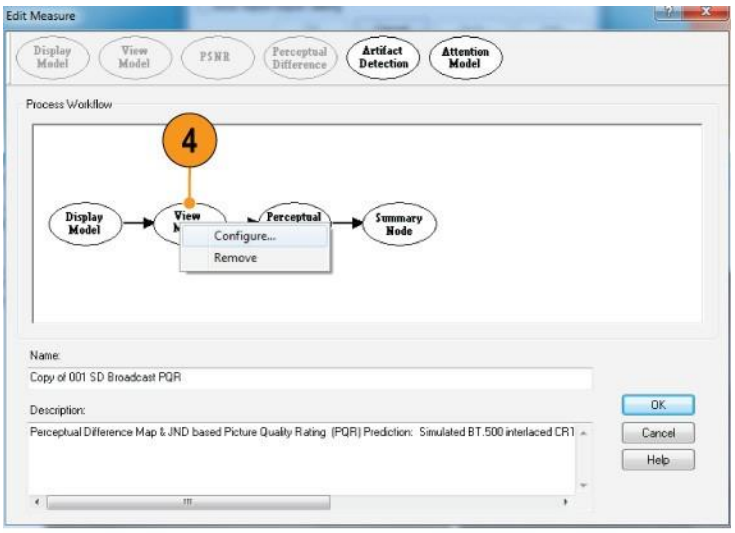
2. Select the desired measurement from the Configure Measure window.

NOTE. *If you choose a template measurement, you will have to save the changed measurement under a new name.*

3. Click **Edit**.



4. Right-click **View Model** and select **Configure**.



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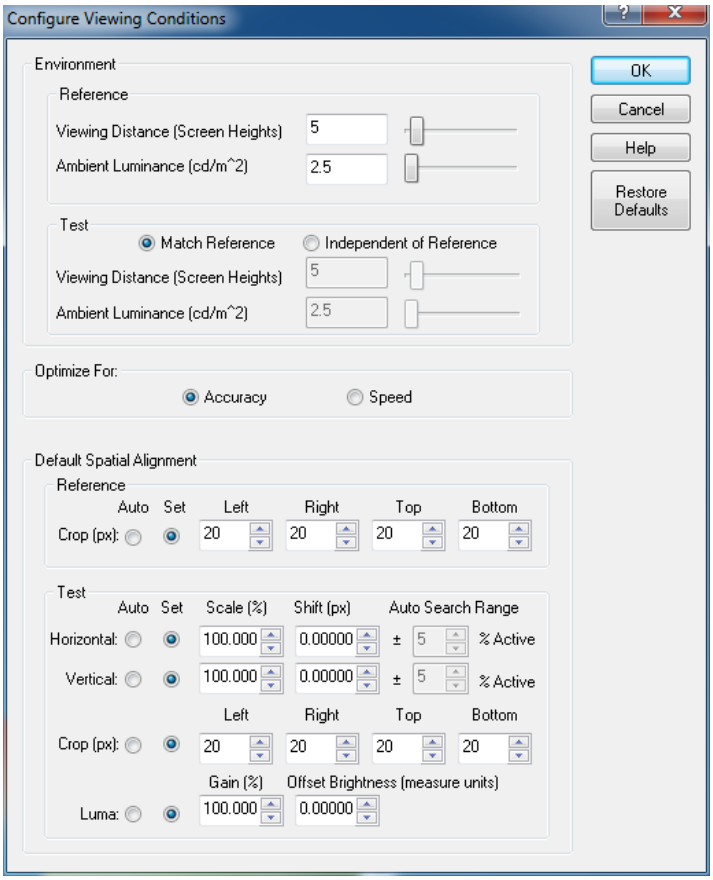
5. Edit the settings as necessary to suit your requirements. All cropping and shift values of the test are in reference pixel units (use post scale values). Offset brightness is in the units used for the view model. For example, if the output of a display model is input, the units are nits (candelas per square meter). But, if video is directly input, the units are LSBs.

   Click **Restore Defaults** to return all settings to the initial factory values.

6. Click **OK** to save your changes.



The following table lists the parameters that can be set in the View Model configuration node.

Table 13: View model parameters

Parameter	Setting	Usage
Environment		
Reference	Viewing Distance (Screen Heights)	Specify the distance between the display and the viewer in screen heights. For compliance with BT.500 recommendations, use 5 screen heights for SD source material. For compliance with BT.710-4, use 3 screen heights. The PQA supports values up to 100.
	Ambient Luminance (cd/m^2)	Specify the light level in the viewing area. Use 0 for a dark room, use 1–3 for moderate lighting, and use a setting >100 for sunny conditions.
Test	Match Reference	Select to set the viewing distance and ambient luminance values to the values used by the reference environment.
	Independent of Reference	Select to set the test environment to different values than those used for the reference environment.
	Viewing Distance (Screen Heights)	Specify the distance between the display and the viewer in screen heights. For compliance with BT.500 recommendations, use 5 screen heights for SD source material. For compliance with BT.710-4, use 3 screen heights. The PQA supports values up to 100.
	Ambient Luminance (cd/m^2)	Specify the light level in the viewing area. Use 0 for a dark room, use 1–3 for moderate lighting, and use a setting >100 for sunny conditions.
Optimize For:		
Accuracy		Select to use a significantly better reconstruction filter that keeps reconstruction artifacts below 11 bits. Selecting this setting effectively doubles the required time for video alignment (if it is used).
Speed		Select to use a simpler reconstruction filter that almost doubles alignment speed. Selecting this setting results in worst case resample artifacts that are about 60% accurate relative to the values achieved by the Accuracy setting (approximately 10-bit accuracy).

Table 13: View model parameters (cont.)

Parameter	Setting	Usage
Default Spatial Alignment		
Reference	Crop (pixels and lines)	Use to ignore border pixels, VITS, or other edge components not of interest for measurement, or pixels and lines not included in the test video clip.
Test	Horizontal Scale and Shift	Use to manually or automatically set the test video horizontal spatial registration to match the reference video. [1]
	Vertical Scale and Shift	Use to manually or automatically set the test video vertical spatial registration to match the reference video. [1]
	Crop (pixels)	Use to ignore border pixels, VITS, or other edge components not of interest for measurement, or pixels and lines not included in the reference video clip.
	Luma Gain and Offset	Select Auto to discount the differences in brightness and contrast between video and displays in quality measurements.

[1] Speed of alignment measurement: The time required to perform an automatic spatial alignment is an exponential function of the Auto Search Range. For video sequences that are already spatially aligned, but need luminance gain and/or DC Offset correction, set the Auto Search Range to 1% (the minimum allowable range) for both dimensions. For small offsets relative to each respective non-active edge, small values can be used for the auto search range that will result in substantial improvements in the time required to perform automatic spatial alignments.

Changing the spatial alignment. You might need to change the spatial alignment between your test and reference video files to accommodate changes in the test file due to processing. Video files must be spatially aligned to get meaningful results.

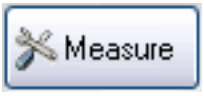
To save time in successive measurements, auto-correction may be run once and then the measured values (cropping, horizontal and vertical scale, horizontal and vertical shift, luma gain, and offset brightness) can be saved as manual settings. This allows the measurement of alignment correction values to be skipped with subsequent measurements, saving substantial processing time.

Perceptual Difference

The Perceptual Difference node includes the human vision model for quantifying perceptual sensitivities to the tested video, including differences (such as artifacts from codecs, noise or any visible difference of any kind) optionally relative to a reference, changes in perception due to changes in displays, viewing distances, and more. The output of this node is a Perceptual Difference Map in units of percent perceptual contrast. The Perceptual Difference node allows you to adjust parameters for viewer characteristics (such as acuity, sensitivity to changes in average brightness, response speed to changing over time, scene changes, sensitivity to photosensitive epilepsy triggers, and more).

To change the Perceptual Difference parameters:

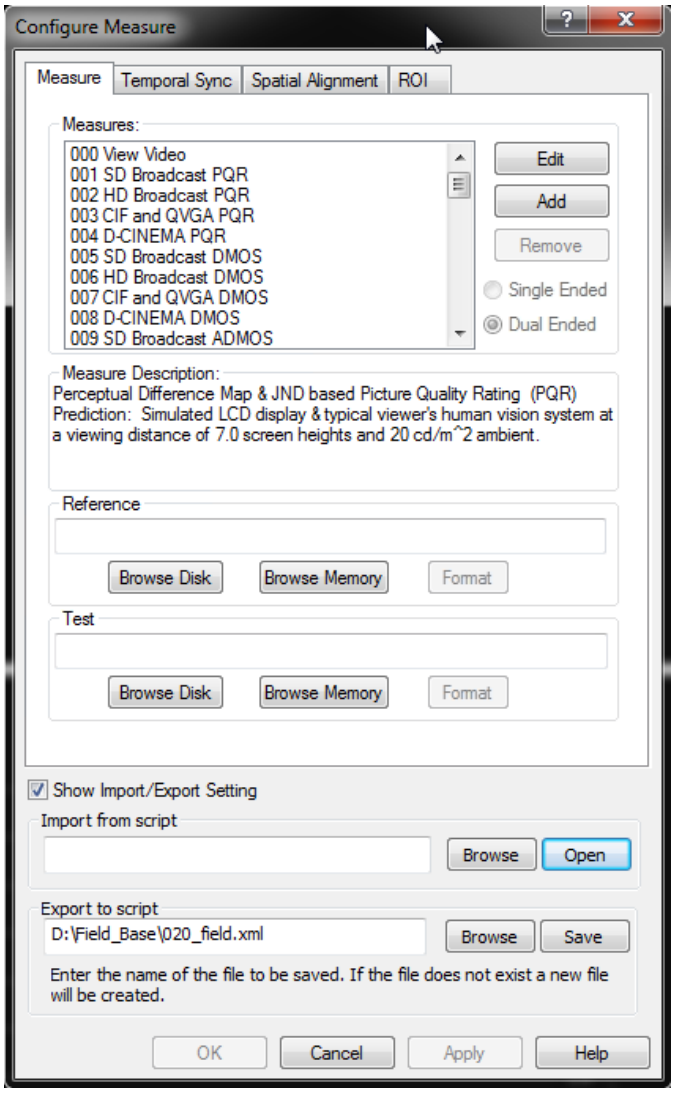
1. Right-click the Measure button.



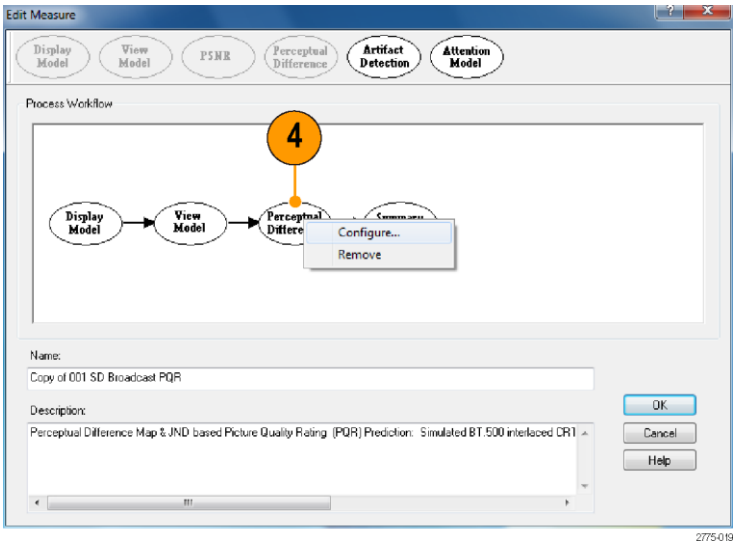
2. Select the desired measurement from the **Configure Measure** window.

NOTE. *If you choose a template measurement, you will have to save the changed measurement under a new name.*

3. Click **Edit**.

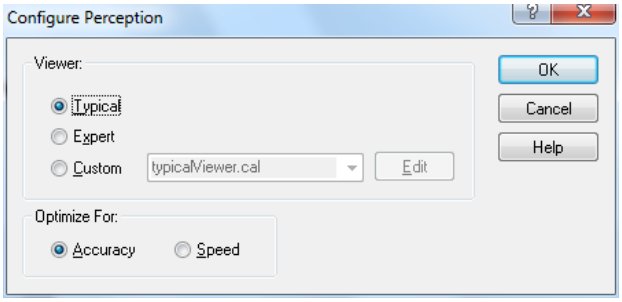


4. Right-click **Perceptual Difference** and select **Configure**.

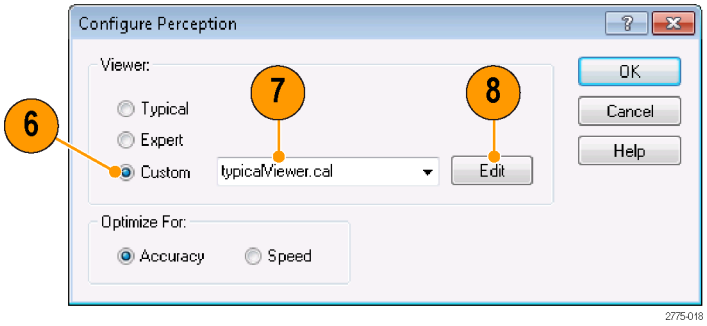


5. Edit the settings as necessary to suit your requirements.

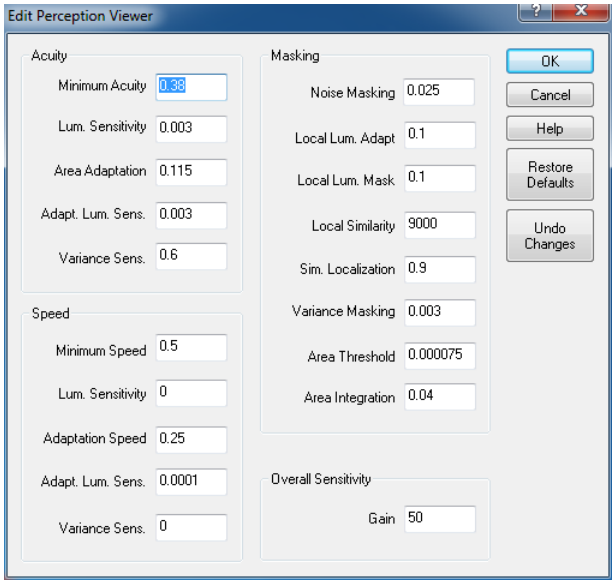
   If the Typical or Expert viewer does not meet your needs, you can specify the parameters for a custom viewer.



6. Click **Custom**.
7. Type a name for the custom viewer parameters in the Custom field or select a previously created configuration file from the drop-down list.
8. Click **Edit** to display the **Edit Perception Viewer** window.



9. Edit the settings as necessary to suit your requirements.
   - Click **Restore Defaults** to return all settings to the initial factory values.
   - Click **Undo Changes** to return all settings to the previously saved values.
10. When you have completed making your changes, click **OK** to save your changes.



The following table describes the parameters that can be set in the Perceptual Difference configuration node.

NOTE. *These are all expert user controls. To ensure accurate results, you should not change these settings unless you are familiar with human vision science and have read the white paper "An Adaptable Human Vision Model for Subjective Video Quality Rating Prediction Among CIF, SD, HD, and E-Cinema" (located on the Documentation CD), which explains these parameters as controls for various portions of the model.*

Table 14: Perceptual difference parameters

Parameter	Setting	Usage
Acuity	Minimum Acuity: 0 (legally blind) to 1 (perfect, super-human acuity). This parameter controls the acuity (center spatial frequency response) in the darkest areas of the image.	The default value is 0.38, which is appropriate for "average" viewers. Use 0.45 for expert viewers. This parameter controls theTelestream Human Vision Model. Start with the default value and move toward the extreme values to suit your requirements.
	Lum. Sensitivity: 0 (no adaptation) to 1.0 (hyper-sensitive). This parameter controls how the local acuity increases with increases in local average luminance.	The default value is 0.003. Start with the default value and move toward the extreme values to suit your requirements.
	Area Adaptation: 0 (the entire visible area) to 1.0 (smallest resolved area). This parameter controls (surround spatial frequency) how large an area is integrated to determine the local luminance used for the local luminance sensitivity adaptation. Larger values make adaptation to luminance more localized.	The default value is 0.115, which is for "average" viewers. Use 0.2 for expert viewers. Start with the default value and move toward the extreme values to suit your requirements.
	Adapt. Lum. Sens.: 0 (no adaptation) to 1.0 (hyper-sensitive). This parameter controls the (surround spatial frequency) luminance sensitivity to the area integration adaptation. Large values accelerate the localization of the acuity adaptation to luminance.	The default value is 0.003. Start with the default value and move toward the extreme values to suit your requirements.
	Variance Sens.: 0 (no adaptation) to 1.0 (hyper-sensitive). This parameter controls how the acuity changes from a stimulus of threshold contrast to supra-threshold contrast. Higher values correspond to bigger differences in acuity for low contrast versus high contrast stimuli.	The default value is 0.6. Start with the default value and move toward the extreme values to suit your requirements.

Table 14: Perceptual difference parameters (cont.)

Parameter	Setting	Usage
Speed	Minimum Speed: 0 (extremely slow) to 1.0 (instant response / zero response time). This parameter controls the speed of visual response in darkness.	The default value is 0.5. Start with the default value and move toward the extreme values to suit your requirements.
	Lum. Sensitivity: 0 (always as slow as in darkness) to 1.0 (fast even for slightly lighter than darkness). This parameter controls how much response time decreases with increase in average local luminance.	The default value is 0. Start with the default value and move toward the extreme value to suit your requirements.
	Adaptation Speed: 0 (virtually no speed adaptation to local luminance) to 1.0 (instantaneous speed adaptation to local luminance). This parameter controls how quickly response time changes to local luminance.	The default value is 0.25. Start with the default value and move toward the extreme values to suit your requirements.
	Adapt. Lum. Sens.: This parameter controls temporal integration used for determining the local luminance value to which speed adapts. Use 0 for static and 1.0 for extreme photosensitive epilepsy.	The default value is 0.0001. Start with the default value and move toward the extreme values to suit your requirements.
	Variance Sens.: 0 (no adaptation) to 1.0 (hyper-sensitive). This parameter controls how the response speed changes from a stimulus of threshold contrast to supra-threshold contrast. Higher values correspond to bigger differences in response speed for low contrast versus high contrast stimuli.	The default value is 0. Start with the default value and move toward the extreme value to suit your requirements.

Table 14: Perceptual difference parameters (cont.)

Parameter	Setting	Usage
Masking	Noise Masking: This parameter sets the baseline threshold of perception (1 JND) for the highest sensitivities.	The default value is 0.025, which is appropriate for “average” viewers. Use 0.0126 for expert viewers. Start with the default value and move toward the extreme values to suit your requirements.
	Local Lum. Sensitivity: This parameter sets sensitivity to changes in luminance (for example, between reference and test).	The default value is 0.1. Start with the default value and move toward the extreme values to suit your requirements.
	Local Lum. Mask: This parameter controls how much luminance masks (or simple Weber's Law) compared to other masking.	The default value is 0.1. Start with the default value and move toward the extreme values to suit your requirements.
	Local Similarity: This parameter controls how much masking is due to local image pattern similarities.	The default value is 9000. Start with the default value and move toward the extreme values to suit your requirements.
	Sim Localization: This parameter specifies the localization of similarity masking. For example, 0 is used for no localization and 1 is used for 100% localization of masking due to local similarity.	The default value is 0.9. Start with the default value and move toward the extreme values to suit your requirements.
	Variance Masking: This is a local complexity masking control.	The default value is 0.003. Start with the default value and move toward the extreme values to suit your requirements.
	Area Threshold: This parameter controls the support region area for variance masking by clipping regions below a threshold.	The default value is 0.000075. Start with the default value and move toward the extreme values to suit your requirements.
	Area Integration: This parameter controls the localization of variance masking: use 0 for no localization and use 1 for 100% localization.	The default value is 0.04. Start with the default value and move toward the extreme values to suit your requirements.
Overall Sensitivity	Gain: This parameter sets the overall sensitivity.	The default value is 50. Start with the default value and move toward the extreme values to suit your requirements.

PSNR

The PSNR configuration node does not contain any parameters. The node is present so that the PSNR result can be added to a measurement. A measurement can include either PSNR or Perceptual Difference, but not both.

PSNR is calculated on a frame-by-frame basis using the following equation from the ATIS Technical Report T1.TR.74–2001.

$$PSNR\left(t_n\right) = 20\,log_{10}\left[\frac{Y_{peak}}{\sqrt{\frac{1}{N_h N_v}\sum_{j=O_h}^{O_h+N_h-1}\sum_{j=O_v}^{O_v+N_v-1}\left[Y_{ref}\left(i,j,t_n-d\right)-\hat{Y}_{\,proc}\left(i,j,t_n\right)\right]^2}}\right]$$

PSNR is calculated on a sequence basis using the following equation from the ATIS Technical Report T1.TR.74–2001.

$$PSNR = 20\,log_{10}\left[\frac{Y_{peak}}{\sqrt{\frac{1}{M N_h N_v}\sum_{n=0}^{M-1}\sum_{j=O_v}^{O_h+N_h-1}\sum_{i=O_v}^{O_v+N_v-1}\left[Y_{ref}\left(i,j,t_n-d\right)-\hat{Y}_{\,proc}\left(i,j,t_n\right)\right]^2}}\right]$$

Artifact Detection

The Artifact Detection configuration node allows you to specify parameters that control the measurement of spatial artifacts. There are two mutually exclusive artifact detection measurements that can be performed at any one time:

- Spatial Gradient Artifacts
- DC Blockiness Artifacts

The chosen measurement can be used to weight any upstream measurement result by using a cross-fade between the input result map and a 100% artifact weighted result using the "Overall Artifact Weighting" control. A setting of 0 is equivalent to eliminating artifact detection (as if the node did not exist in the processing chain), and a setting of 100% gives full artifact weighting. Full artifact weighting filters the previous map, for example PSNR or perceptual contrast such that areas with no artifact are 0 and areas with 100% artifact are passed unchanged.

Spatial gradient artifacts. The three classes of spatial gradient-related artifacts measured are:

- Reduction in gradient magnitude at each point (% Lost Edges, usually associated with blurring).
- Increase in gradient magnitude at each point (% added edges, usually associated with ringing, mosquito noise, and similar artifacts).
- Rotated gradient orientations (% rotated edges, usually associated with blocking).

Gradients are measured by applying vertical, horizontal, and diagonal 3 x 3 edge filters and classifying outputs according to the largest magnitude and corresponding sign. Thus, edges are classified into one of eight possible gradient directions: up, down, right, left, 45°, 135°, –45°, and –135°. If the direction changes from diagonal to vertical or horizontal, a rotated edge artifact associated with jaggies is detected.

The weighting for Lost, Added Edges and Rotated Edges is relative: the total is internally normalized to 100%. Note however, that measurement values for added and lost edges are complimentary; if 100% lost edges are measured, zero added measures will measured.

The Produce complimentary data setting produces a one's compliment of the normalized-to-one result map before being applied to the input result map, if any. Use this setting to measure, for example, DMOS due to artifacts other than those selected. If this setting is chosen, areas without the enabled artifacts are bright in the results map and a perfect (no detected artifact) result is 100% when no upstream node is present, or there is no change for PNSR. For DMOS, artifact weighting is treated as an annoyance weighting. For example, rotated edges of jaggies can be treated as more annoying than blurring by giving the corresponding weights to each.

DC blockiness artifacts. This measurement attempts to find a blocking grid structure and then, for full reference (dual ended) measurements, measures the difference between each pixel and the mean value within the block in which the pixel resides, normalized by the corresponding difference in the reference video. If all pixel values are equal to the block mean in the test, but corresponding pixels in the reference are not equal to the block mean, the measurement result is 100% DC Blockiness.

The denominator can be zero, in which case, the contributing pixel term is zero. Thus, images formed of only DC blocks might have less than 100% results. For example, flat (no detail) areas of the reference and test image that occupy a block will all be zero. However, for detailed areas of the reference video, DC blocked test video will measure very close to 100% DC Blockiness.

In addition to these measurements, when used with other measurements such as DMOS, selecting all edge artifacts and “produce complimentary data” gives weight to perceptible differences not due to edge differences. This includes perceptible differences due to noise and other types of artifacts that are not included in these three edge difference classes.

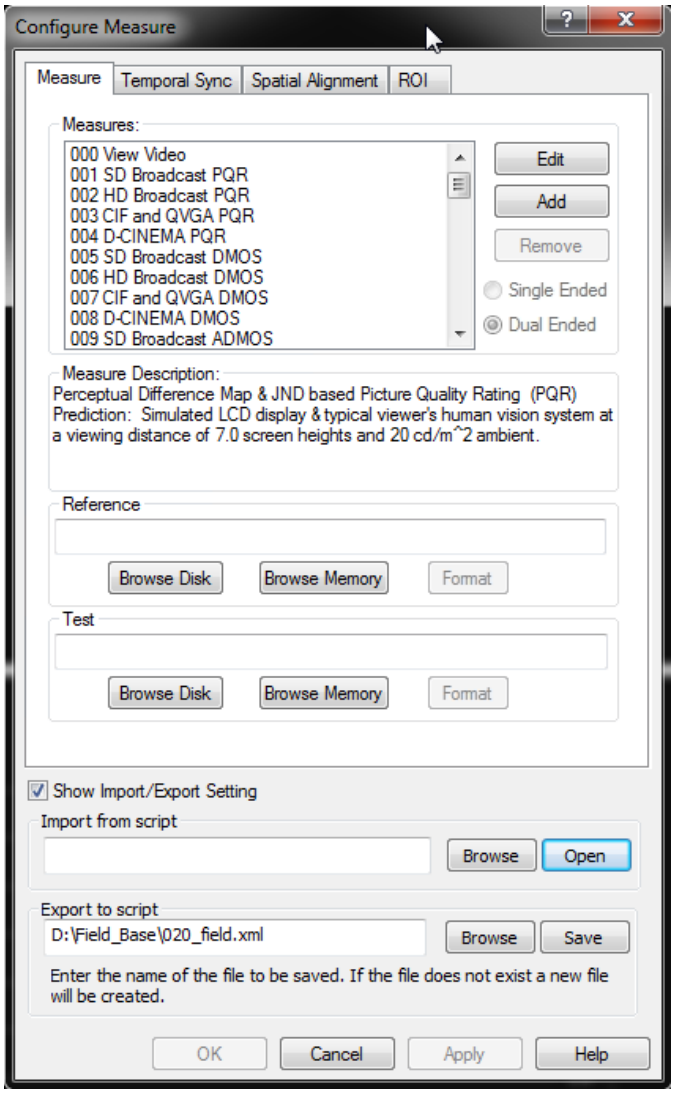
To configure the Artifact Detection parameters:

1. Right-click the Measure button.

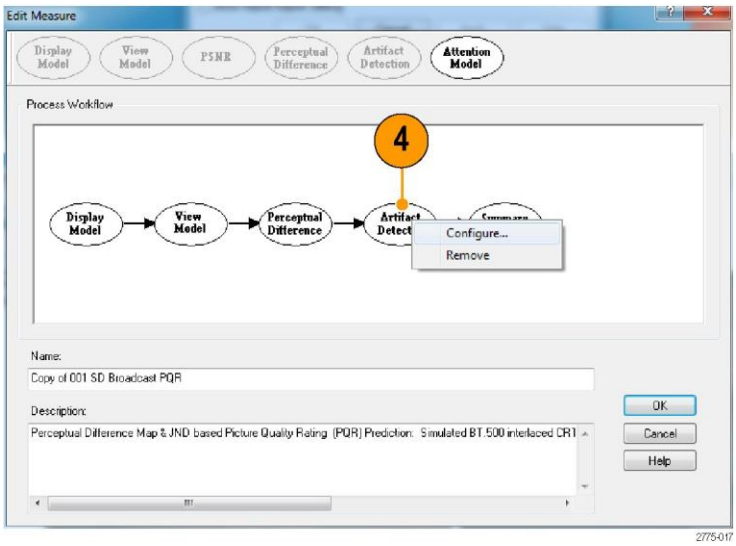
2. Select the desired measurement from the **Configure Measure** window.

NOTE. *If you choose a template measurement, you will have to save the changed measurement under a new name.*

3. Click **Edit**.



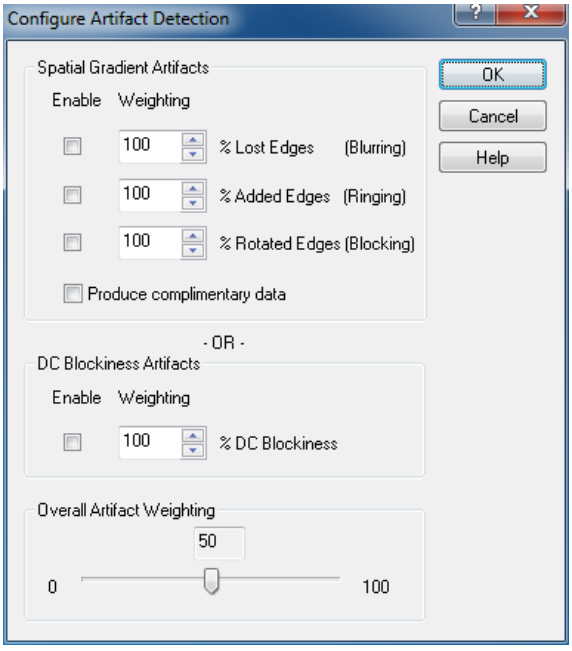
4. Right-click **Artifact Detection** in the Process Workflow area and select **Configure**.



5. Edit the settings as necessary to suit your requirements.

   - Select or deselect the **Enable** check box to determine whether the associated artifact is detected in the measurement.
   - Adjust the value next to each artifact type to specify how much importance is given to the associated artifact.

6. Click **OK** to save your changes.



The following table lists the parameters that can be set in the Attention Model configuration node.

Table 15: Artifact detection parameters

Parameter	Setting	Usage
Spatial Gradient Artifacts	% Lost Edges (Blurring)	Lost Edges refers to a transition (an edge) that occurs over a greater distance (or disappears). Lost Edges occur when the brightness difference from pixel to pixel is less than expected from the reference. Enable this setting to weight the importance of Lost Edges in your measurement.
	% Added Edges (Ringing)	Added Edges refers to a transition (an edge) that appears where there was not an edge before. Added Edges appear when the brightness difference from pixel to pixel is greater than expected from the reference. Enable this setting to weight the importance of Added Edges in your measurement.
	% Rotated Edges (Blocking)	An example of a rotated edge is a diagonal edge in a reference image that becomes a "jaggy" staircase of horizontal and vertical edges in the test image. In this case, the diagonal edges have been rotated to horizontal and vertical edges. In more complex images, the net effect is that the image has rectangular or block-like artifacts. Enable this setting to weight the importance of Rotated Edges in your measurement.
	Produce complimentary data	In a sense, this setting inverts the results of artifact weighting. For example, to know how much of the difference between the test and reference is not attributed to edge changes (noise is an example), select all three edge artifacts and then select this setting.

Table 15: Artifact detection parameters (cont.)

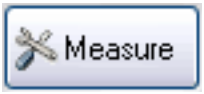
Parameter	Setting	Usage
DC Blockiness Artifacts	% DC Blockiness	This measurement scans for loss of variance (detail of all kinds, not just edges) within each image block. 100% DC blockiness means that the image only has the “DC” or average value and has lost all other information. 0% means it has lost nothing. This measurement is useful for MPEG-2 codec testing where lowering bit rates eventually results in 100% DC blockiness.
Overall Artifact Weighting	Range: 0–100	This setting is used with other measurements as a cross-fade weighting. In other words, if 100% is used here, it serves as a hard filter to mask the measurement map upstream (perceptual difference or PSNR objective difference) where there are no artifacts detected (unless complimentary data is selected, in which case it does the opposite). Thus, the resulting measurement represents the portion of the relative PQR, DMOS or PSNR that is due to the selected artifacts. However, if 50% is used, it allows 50% of the non-artifact weighted map to go through. This is useful when annoyance weighting is desired in a measurement.

Attention Model

The Attention Model configuration node allows you to specify how attention (attraction) is measured and specify the weighting for selected characteristics.

To configure the Attention parameters:

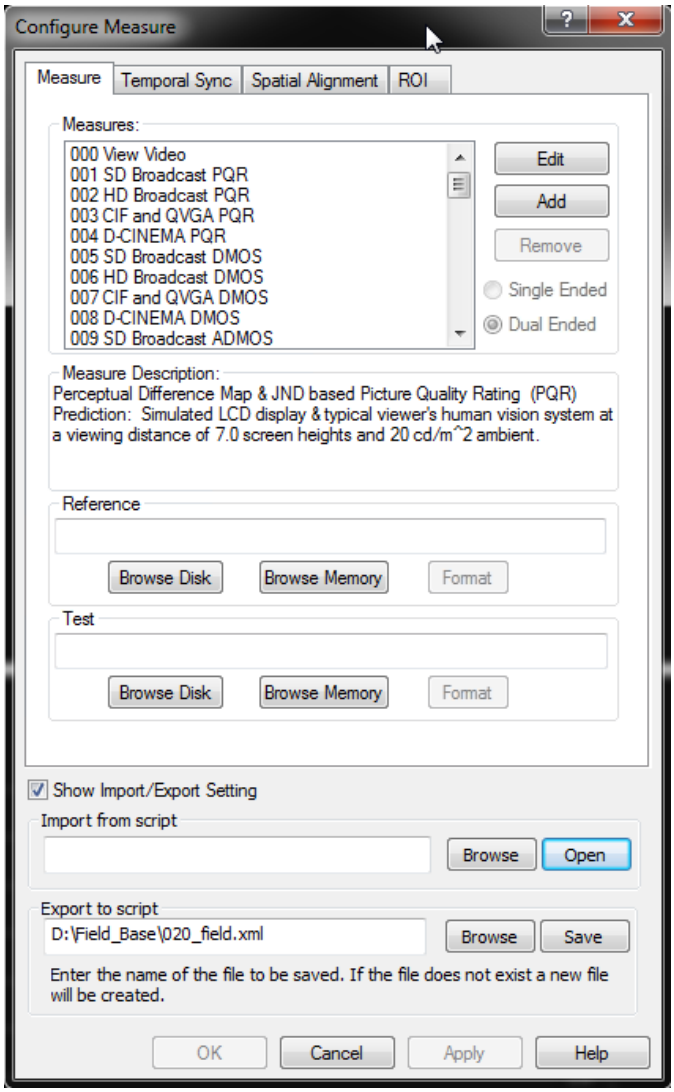
1. Right-click the Measure button.



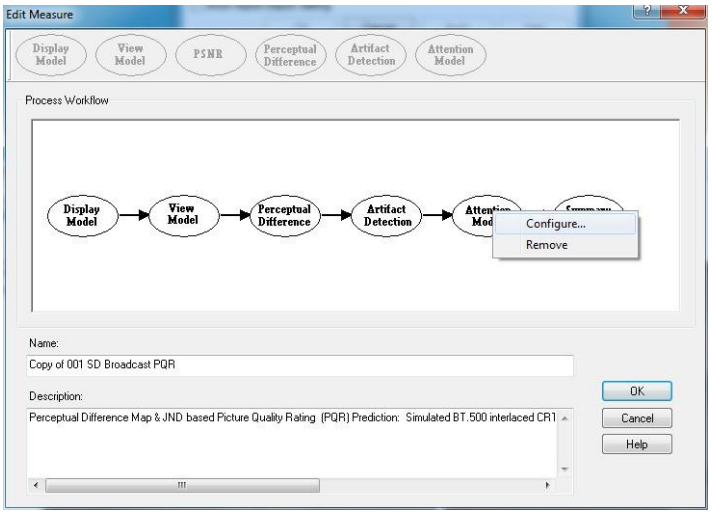
2. Select the desired measurement from the **Configure Measure** window.

NOTE. *If you choose a template measurement, you will have to save the changed measurement under a new name.*

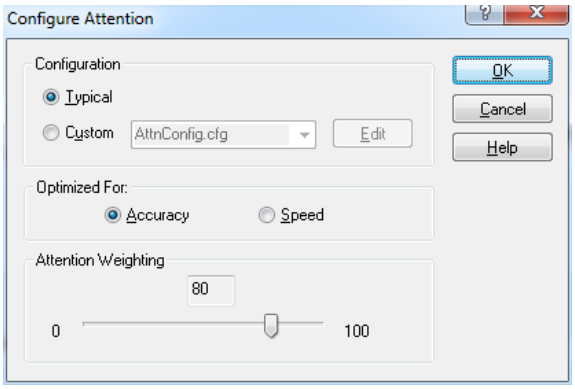
3. Click **Edit**.



4. Right-click **Attention Model** and select **Configure**.

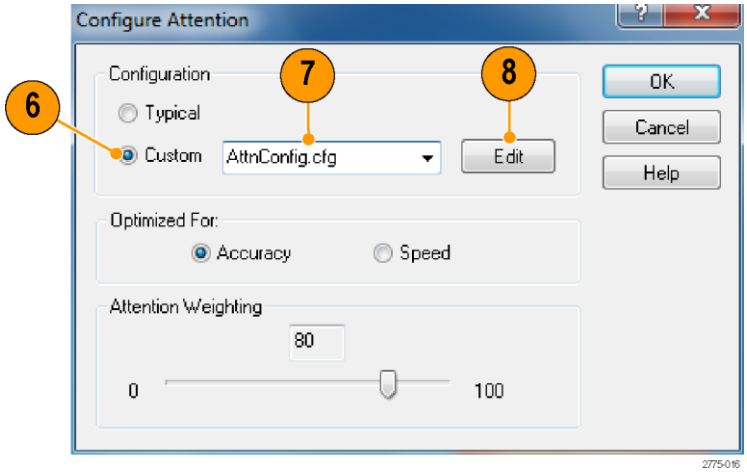


5. Edit the settings as necessary to suit your requirements.

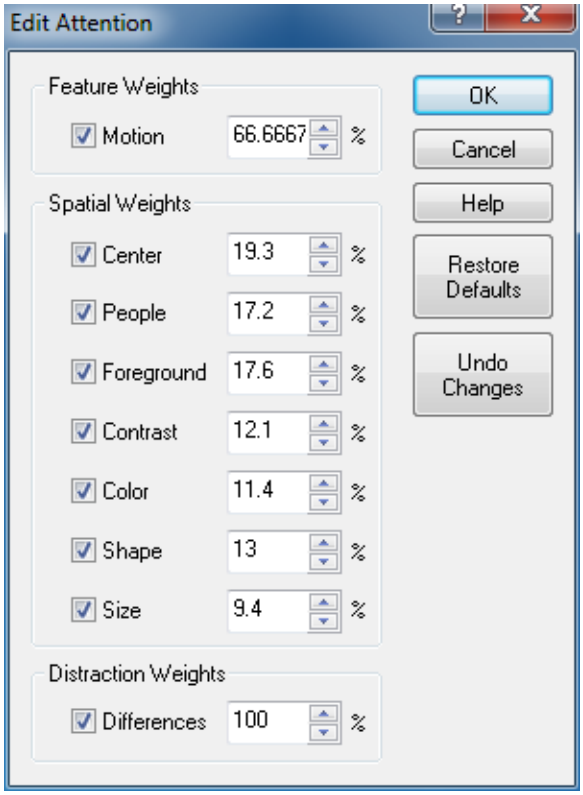


If the Typical configuration does not meet your needs, you can specify the parameters to create a custom attention model.

6. Click **Custom**.
7. Type a name for the custom attention model parameters in the Custom field or select a previously created configuration file from the drop-down list.
8. Click **Edit** to display the **Edit Attention** window.



9. Edit the settings as necessary to suit your requirements.
   - Select or deselect the check box next to a setting to determine whether not the setting is included in the measurement.
   - Click **Restore Defaults** to return all settings to the initial factory values.
   - Click **Undo Changes** to return all settings to the previously saved values.
10. Click **OK** to save your changes.



How Attention Weighting is used

Attention Weighting controls the cross fade between the attention probability weighted upstream map and the unweighted upstream map. Measurements that include the perceptual difference node, such as Predicted DMOS, apply attention weighting differently than objective measurements such as PSNR or Artifact Detection. For Artifact Detection and PSNR, the attention probability density map is used directly to attenuate the resulting upstream map. For DMOS, the attention map is normalized such that the perceptual difference map may be both increased and attenuated according to attention probability.

For objective measurements, attention weighting produces the portion of objective measurement where people are most likely to look. For DMOS, the attention weighting effectively excludes areas where people do not look from the measurement, giving a measurement of predicted DMOS primarily using the areas of interest. This means that ADMOS with 100% Attention Weighting will have lower results than those set at 0%, if the areas of highest attention are less distorted than areas where people do not look and vice versa; ADMOS with 100% attention weighting will have higher results than those set at 0% if areas of highest attention are more distorted than areas where people do not look.

The following table lists the parameters that can be set in the Attention Model configuration node.

Table 16: Attention model parameters

Parameter	Setting	Usage
Feature Weights	Motion	This parameter accounts for the viewer's interest in motion. Higher values correlate with a greater interest in moving objects. If this parameter is not enabled, object motion is ignored.
Spatial Weights	Center	This setting specifies the importance of the center of the screen.
	People	This parameter signifies the importance of people in the video. People are detected through skin and object shape detection.
	Foreground	In theTelestream Attention Model, objects are associated with the center and with the edges. The objects that are not associated with the center are considered background.
	Contrast	This setting specifies how important contrast is. If a heavily airbrushed, faded image is placed next to a high-contrast image, people tend to look at the high-contrast image. This setting controls how much this is expected to happen in a particular application.
	Color	This setting sets the importance of color in the image. A higher value for this setting represents greater attention to highly saturated colors over the generally more dull grays.
	Shape	When this setting is emphasized, simple, long and thin shapes are tracked more than complex blobs.
	Size	This setting considers the presence of large objects in the image, because large objects tend to draw more attention in an image.
Distraction Weights	Differences: Weights distractions outside the probable focus of attention. Distractions include artifacts, large differences between reference and test, or other things that might make someone look at an area normally not of interest in program material.	The focus of attention is the point in an image where viewers place their center of vision. Distraction weighting allows the upstream measurement maps (such as perceptual difference, PSNR, and artifact detection) to be used to define additional attention sources. The settings for the parameters in the upstream measurement maps are controlled in the configuration nodes of the associated measurement maps.

The default values for the Attention Model parameters are shown in the following table.

Table 17: Attention model default parameters

Parameter	Setting	Default value
Feature Weights	Motion	66.66
Spatial Weights	Center	19.3
	People	17.2
	Foreground	17.6
	Contrast	12.1
	Color	11.4
	Shape	11.4
	Size	9.4
Distraction Weights	Differences	100

Summary Node

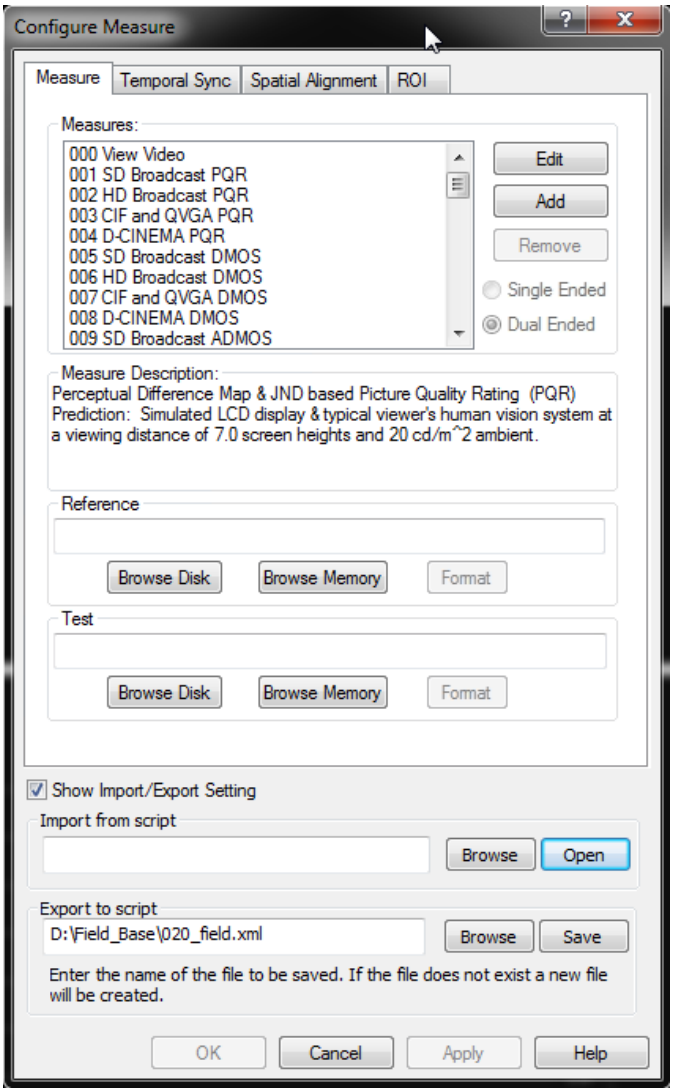
The Summary Node specifies how results are reported. You can specify statistical units for measurements, whether results are saved and how they are saved, display characteristics of the map, and levels for warnings and errors.

1. Right-click the Measure button.

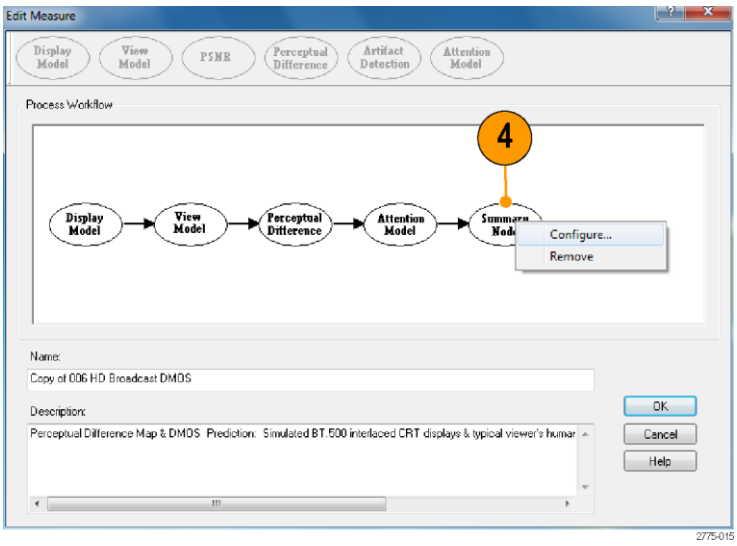
2. Select the desired measurement from the **Configure Measure** window.

NOTE. *If you choose a template measurement, you will have to save the changed measurement under a new name.*

3. Click **Edit**.



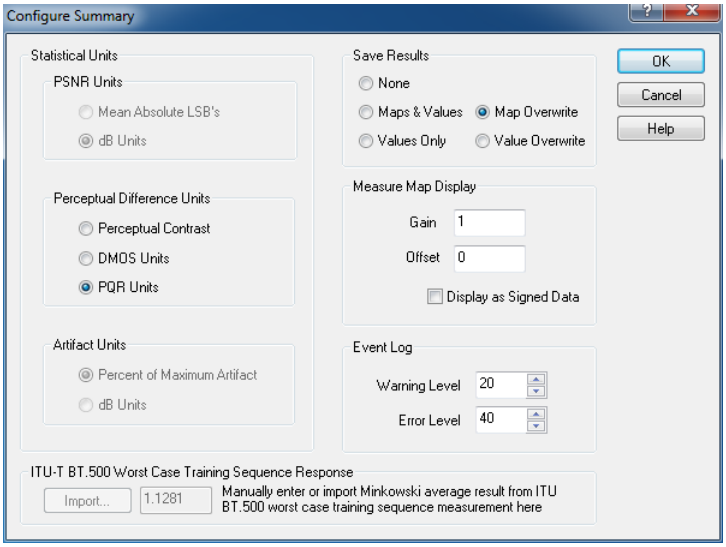
4. Right-click **Summary Node** and select **Configure**.



5. Edit the settings as necessary to suit your requirements.

   The **PSNR** and **Perceptual Difference** settings are mutually exclusive. Only one setting will be accessible at a time, as determined by the core measurement node.

6. Click **OK** to save your changes.



The following table describes the parameters that can be set in the Summary Node configuration node.

Table 18: Summary node parameters

Parameter	Setting	Description	Usage
Statistical Units			
PSNR Units	Mean Absolute LSBs	Sets PSNR results units to map units. Only selectable when measuring PSNR. This is a non-standard PSNR measurement, but is useful for some diagnostics. For example, map units would useful where small differences between large results are of interest.	Selecting this setting might be of interest to some encoder designers and evaluators or other engineers interested in detailed mechanics of distortions.
	dB Units	Sets PSNR results units to dB. Only selectable when measuring PSNR. This is the standard unit of measurement for PSNR and is equivalent to the RMS difference of reference-test pixels in LSB units. Measured in dB referenced to peak white (also in LSB units).	This is the standard unit for PSNR.

Table 18: Summary node parameters (cont.)

Parameter	Setting	Description	Usage
Perceptual Difference	% Perceptual Contrast	Sets the units used in the graph display to % Perceptual Contrast when the Perceptual Difference node is part of the measurement. Percent perceptual contrast is the unit of the perceptual difference map. Percent perceptual contrast of 100% is the maximum possible (except under transient conditions) and 0.1% corresponds to nominal threshold.	Perceptual contrast units can be useful in: ■ Making reduced reference measurements to compare total perceptual contrast of a reference (one number) to the test (which is measured in single-ended mode, remotely). ■ Determining legibility against viewing distance.
	DMOS Units	Sets the units used in the graph display to DMOS Units when the Perceptual Difference node is part of the measurement. Predicted DMOS quantifies video differences above one JND (Just Noticeable Difference) consistent with human ratings (see ITU-T BT.500 Worst Case Training Sequence Response later in this table).	DMOS units would be an appropriate choice for units when a low to relatively high quality range is expected and you are interested in average quality ratings because the test video is expected to be noticeably different than the reference.
	PQR Units	Sets the units used in the graph display to PQR Units when the Perceptual Difference node is part of the measurement. PQR stands for Picture Quality Rating. One PQR unit corresponds to one JND (Just Noticeable Difference).	PQR units would be an appropriate choice for units when: ■ An excellent quality level is expected and you are interested in determining if any difference can be seen between the test and reference. Values above 1 are not as valid as DMOS for quantifying this difference. ■ You want to compare results with legacy Telestream measurements.

Table 18: Summary node parameters (cont.)

Parameter	Setting	Description	Usage
Artifact Units	Percent Maximum Artifact	Sets the units used in the graph display to Percent Max Artifact when Artifact Detection is the measurement. For example, if the artifact detection selected is DC Blockiness, an output of 100% corresponds to the entire image block being a constant ("DC") value, whereas 0% corresponds to no change from the reference.	Percent Maximum Artifact is often more useful if distortion is larger, for example, more than 5%.
	dB Units	Sets the units used in the graph display to dB Units when the Artifact Detection node is part of the measurement.	dB is usually useful under conditions of moderate distortion (less than 5%).

Table 18: Summary node parameters (cont.)

Parameter	Setting	Description	Usage
Save Results			
	None	When selected, no measure map or measurement values are saved to disk when the measurement is completed.	Use this setting to conserve disk space and time managing results. If you saved results of previous tests for comparison, selecting this setting enables you to quickly run tests and make comparisons without filling the disk with temporary results that will have to be manually deleted at some point.
	Maps & Values	When selected, both the measure map and measurement values are saved to disk when the measurement is completed. The map and results filenames are incremented by one (file1, file2, file3), for each subsequent run of the measurement.	Select this setting to maintain a full history of tests.
	Map Overwrite	When selected, both the measure map and measurement values are saved to disk when the measurement is completed. The map and results files are overwritten for all subsequent runs of the measurement.	Use this setting to conserve disk space and time managing results. Also, when you are using scripts, you can run a set of tests, check results, adjust the video or measurement settings and rerun the same test with the intent of throwing out the first results. This saves time in managing file storage.
	Values Only	When selected, only measurement values are saved to disk when the measurement is completed. The results file name is incremented by one (file1, file2, file3), for each subsequent run of the measurement.	Use this setting to load measurement results into your own spreadsheet for analysis or into the Graph View for later analysis. Results maps are not saved, thereby significantly reducing use of disk space.
	Value Overwrite	When selected, only measurement values are saved to disk when the measurement is completed. The results file is overwritten for all subsequent runs of the measurement.	This setting is useful when you are using scripts; you can run a set of tests, check results, adjust the video or measurement settings, and rerun the same test with the intent of throwing out the first results. This saves time in managing file storage.

Table 18: Summary node parameters (cont.)

Parameter	Setting	Description	Usage
Measure Map Display [1]			
	Gain	Change to adjust the brightness level of the results map. This is useful when optimum contrast for the test and reference video is different from that of the results map.	Use this setting to adjust the contrast in the results map. This does not affect measurement results (such as graphs and summary numbers), only the results map display.
	Offset	Change to shift the baseline of the results map. This parameter can be used in combination with Gain to enhance relatively minor differences in the measure map. This is useful when the optimum reference and test video brightness setting on the display are different from the optimum brightness setting for the results map.	Use this setting to control the brightness in the results map. This setting does not affect measurement results (such as graphs and summary numbers), only the results map display.
	Display as Signed Data	When this option is not selected, results map pixels have intensity proportional to the absolute value of the measurement being made. So for example, for PSNR, brighter pixels correspond to larger differences, both positive and negative differences, between the test and reference. However, when this option is selected, the sign is retained at each pixel so that when a positive offset (see Measure Map Display Offset above) is added, no difference is gray, with positive differences being brighter and negative differences being darker.	In normal use, the results map displays the magnitude of difference between the reference and test. Use this setting to make the measure map show the difference between positive and negative values.

Table 18: Summary node parameters (cont.)

Parameter	Setting	Description	Usage
Event Log			
	Warning Level	Sets the green-to-yellow transition point on the indicator bar in the Graph portion of the display.	Adjust this value to shift the warning transition point.
	Error Level	Sets the yellow-to-red transition point on the indicator bar in the Graph portion of the display.	Adjust this value to shift the warning transition point.
ITU-T BT.500 Worst Case Training Sequence Response			
	Import	Used to import the % Perceptual Contrast Difference Minkowski result from a previously run test. This corresponds to the ITU BT.500 worst case training procedure.	This button is selected to calibrate a given DMOS measurement. First, the DMOS measurement is run using a worst case video sequence. Then the measurement is edited, this "Import" button is pressed, and the DMOS results are selected, thereby importing the Minkowski metric of the perceptual contrast difference (which represents the training result).

[1] **These settings are saved with the test results, and are used during the measurement and during the review of saved results. (See page 209, *How to adjust the Measure Map display*.)**

Importing measures

You can add measures that were created on another PQA into your PQA by using the Import Measures function. The Import Measures function works by reading a configuration (.cfg) file, which is the file that contains all measure definitions. PQA measure definitions are saved in a file named Measures.cfg. This file is a binary file and cannot be edited.

NOTE. *Importing measures from another PQA will not remove the factory defined measures, numbered 001 through 038. Importing measures only adds user-defined measures.*

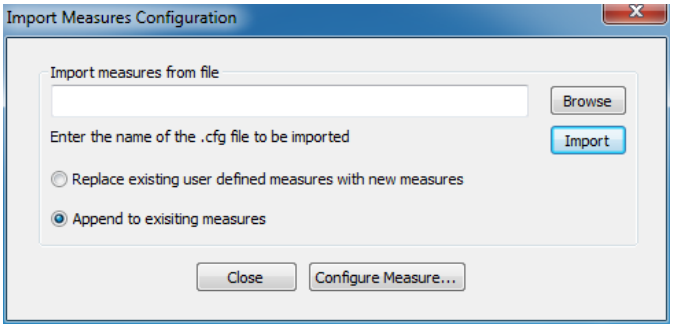
To import a measure from another PQA:

1. Make a copy of the Measures.cfg file in the C:\Program Files (x86)\Tektronix\PQA (Windows 7) or C:\Program Files\Tektronix\PQA (Windows XP) directory of the source PQA (the instrument you are importing from).

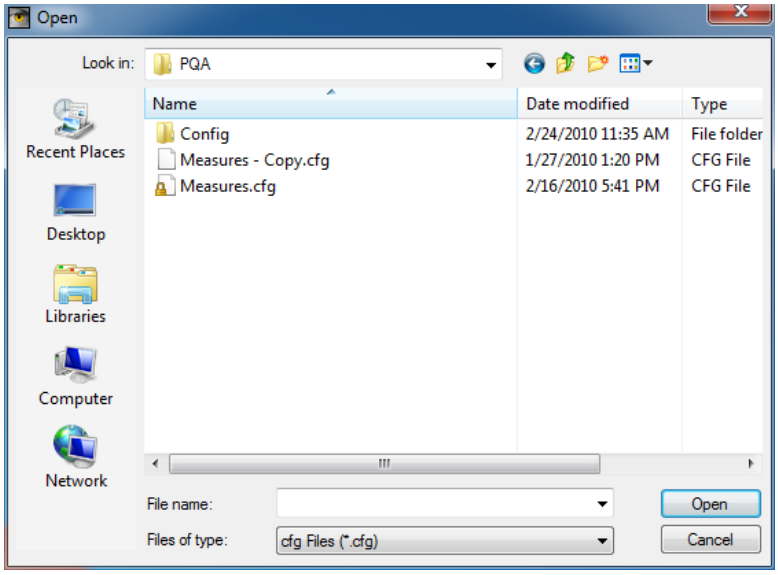
NOTE. *If the source PQA can be accessed across a network, you can skip ahead to step 3.*

2. Copy the copied Measures.cfg file into a directory on the PQA on which you want to add the measure (the destination instrument).

3. Select **File** > **Import Measures**. This displays the Import Measures Configuration dialog box.

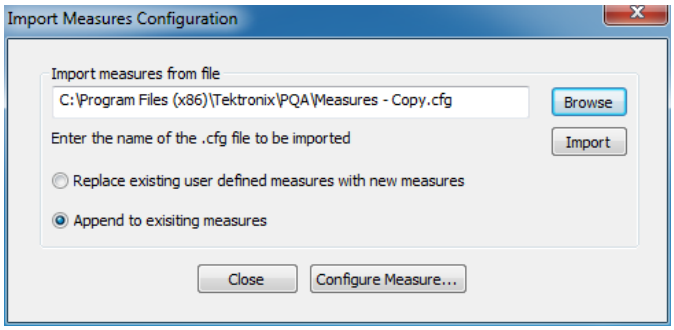


4. Click **Browse**. This opens a dialog you can use to select the .cfg file you want to import.
5. Select the .cfg file that contains the measure you want to import and click **Open**.



6. Select how you want the user defined measures to be imported.

- Select **Append to existing measures** to add measures to your machine without replacing measures you have already created,
- Select **Replace existing user defined measures with new measures** to replace all the user-defined measures in your instrument with the user-defined measures in the imported .cfg file.



7. Click **Import** to load the new measures.
8. Click **Close** to remove the Import Measure dialog or click **Configure Measure** to display the Configure Measure window.

Video file formats supported for measurements

The PQA600C and PQA recognize the following file formats for taking measurements. All formats are 8-bits resolution except .v210 and .vcap10 files. Measurements on the .v210 and .vcap10 file formats are made only on the 8 most significant bits.

Supported uncompressed video file formats

File format	File extension	Frame structure options
CbYCrY (601-4:2:2), UYVY	.yuv	Non-Interlaced, Field 1 First, Field 2 First, Planar
YCbYCr (4:2:2), YUY2	.yuv	Non-Interlaced, Field 1 First, Field 2 First, Planar
YCbCr 4:2:0	.yuv	Planar only
YCbCr 4:2:0 (10-bit, LSB first) [1]	.yuv	Planar only
YCbCr 4:2:0 (10-bit, MSB first) [1]	.yuv	Planar only
CbYCrY 4:2:2 (601-4:2:2), UYVY (10-bit)	v210	Non-Interlaced
YUV 4:4:4	.yuv	Non-Interlaced, Field 1 First, Field 2 First, Planar
BGR	.rgb	Non-Interlaced, Field 1 First, Field 2 First, Planar
ARIB YUV	.yyy	Not applicable
AVI (Uncompressed UYVY, YUY2, RGB, v210)	.avi	Not applicable
Vcap 8-bit (Captured by optional SDI card.)	.vcap	Not applicable
Vcap 10-bit (Captured by optional SDI card.)	.vcap10	Not applicable

[1] The YCbCr 4:2:0 10-bit format is supported only for .yuv files created by MTS4EA which are encoded with one of the “two byte LSB/MSB first” options.

Table 19: Supported elementary stream video file formats

File Format	Description
H.264/AVC/MPEG-4 Part 10	Baseline, Extended, Main, High 10, High 4:2:2, and High 4:4:4 profiles all levels 1 to 5:1
MPEG-2	Main Profile at Main, High, and High 1440 levels, 4:2:2 Profile at Main and High Levels
VC-1	All profiles, all levels
MPEG-4 Part 2, Profile at Level 0–5	Simple Profile at Levels 0-5 and Advanced Simple
H.263 Baseline	

Table 20: Supported system layer video file formats

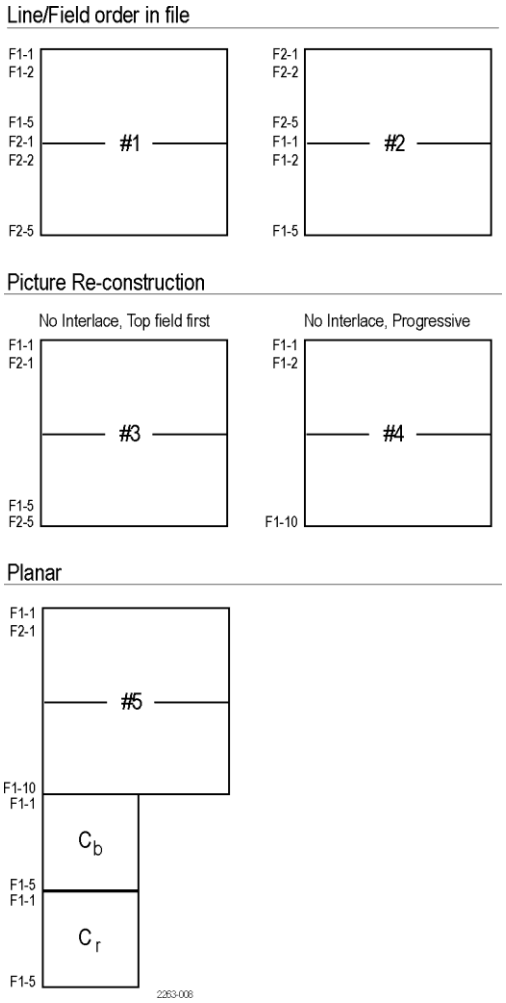
File Format	File extension	Description
MPEG-2 Transport/Program Stream	.ts, .mpg, .mpeg, .ps	MPEG-2 multimedia container format
MP4 Parts 1, 12, and 15	.mp4	MPEG-4 multimedia container format
ASF	.asf, .wmv	Microsoft proprietary video container format
3GPP	.3gp	Multimedia container format defined by Third Generation Partnership Project (#GPP)
DVD VOB	.vob	DVD video object file
QuickTime	.mov	Apple QuickTime

When you select a file format that is headerless (yuv or rgb), the PQA will prompt you to specify the file format (width, height, frame rate, frame structure, and format).

Use the following guidelines for specifying the file format:

- If the selected file is in interlaced format and the line construction matches #1 in the following figure, select “Field 1 First” for Frame Structure.
- If the selected file is in interlaced format and the line construction matches #2, select “Field 2 First” for Frame Structure.
- If the selected file is interlaced scanning and it has a de-interlaced format like #3, select “No_Interlace”.
- If the selected file has the progressive scanning like #4, select “No_Interlace”.
- If the selected file has the 4:2:0 planar format like #5, select “No_Interlace” and “YCbCr 4:2:0 (Planar Only)” at Sample format selection.

The interlaced video content is supposed to be “Top field first”.



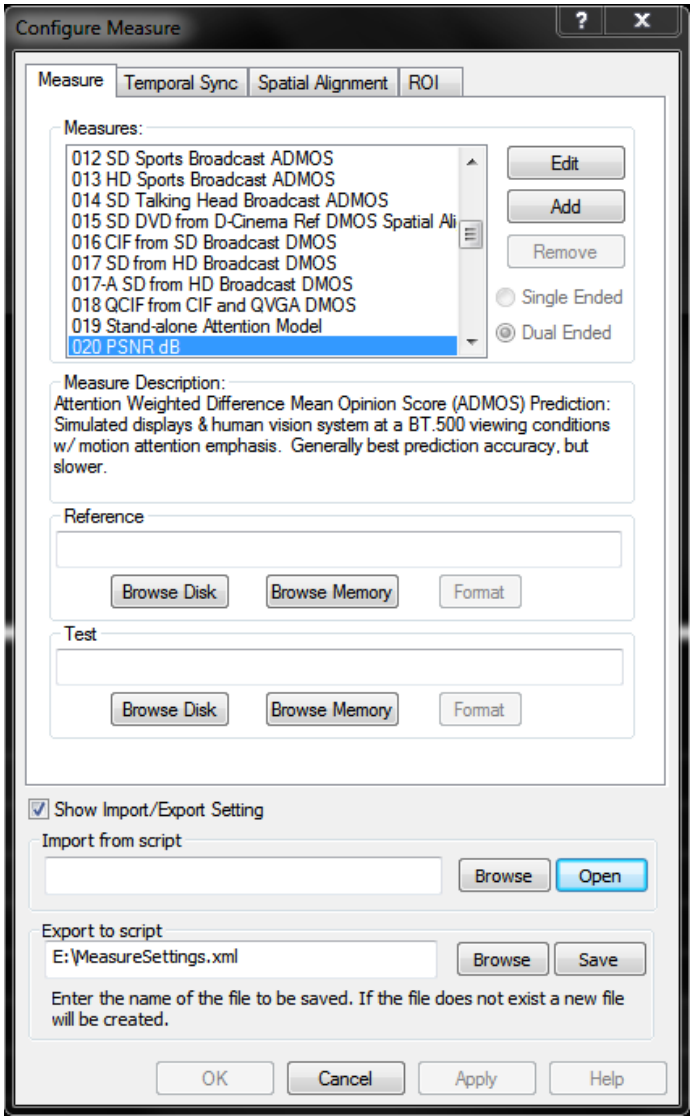
How to take a measurement

Keep the following points in mind when taking a measurement:

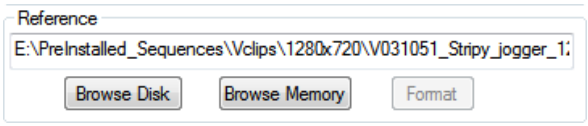
- When .rgb or AVI_RGB format files are used for the reference or test video sequence, the PQA converts to files to the YUV format internally (with a CCIR 601 color matrix) before starting the measurement.
- When the measurement has the Display Model node set to Interlaced CRT, the PQA expects the file video format is "Top Field First".
- The results of measurements performed on files stored in RAM are stored only in RAM at the following location: C:/ProgramData/Tektronix/PQA/RAM_Results. This directory is automatically mapped to the navigation pane in 64-bit systems.

Perform the following steps to take a measurement:

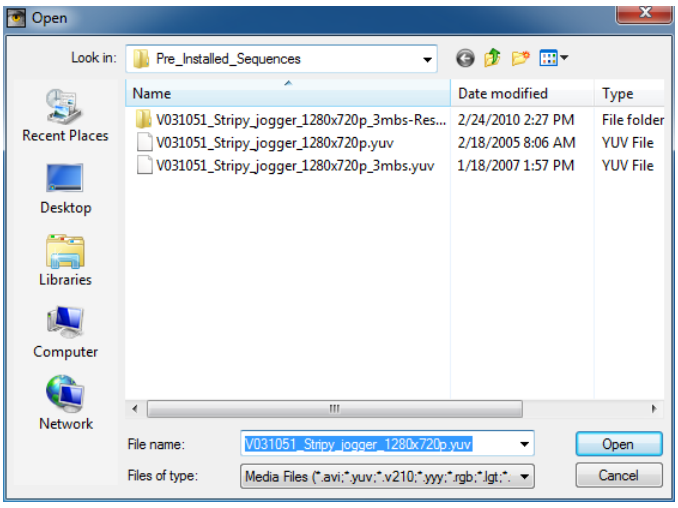
1. Acquire or store two “yuv” format files that you want to time align and compare to each other.
2. From the Menu bar, select **Configure > Measure**. This opens the Configure Measure dialog box.
3. Select a Measure from the Measures list.



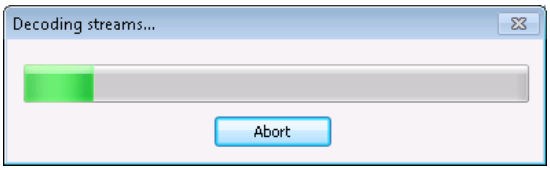
4. In the **Reference** box, click **Browse Disk** or **Browse Memory**.



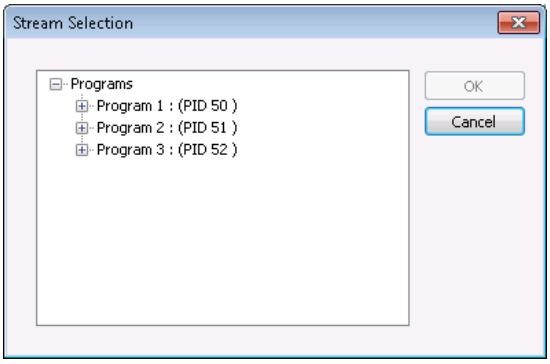
5. Select the reference file to be used for the measurement.



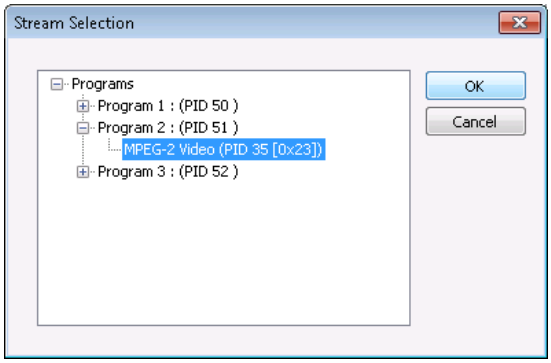
If you select a compressed video file for the reference file, the PQA automatically converts the file to YUV format before the measurement is executed.



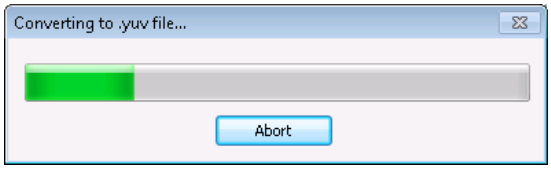
After converting the compressed file to YUV format, the PQA displays the **Stream Selection** window. If a compressed video file contains multiple programs, you must select the program you want to use for the measurement.



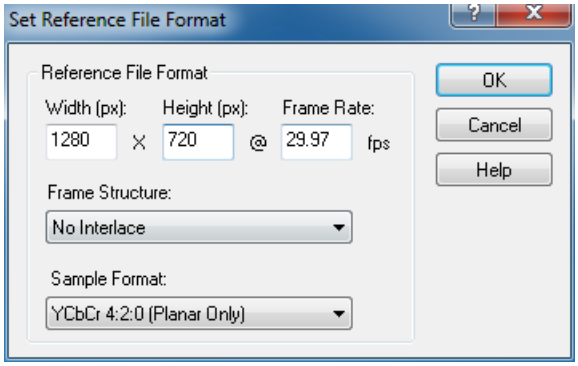
6. Click the **+** symbol next to the program you want to take the measurement on. Select the video within the program and click **OK**.



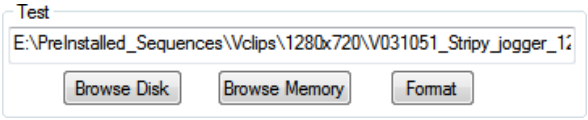
After you select the file, the PQA converts it to YUV format and saves it in the same directory as the selected reference file.



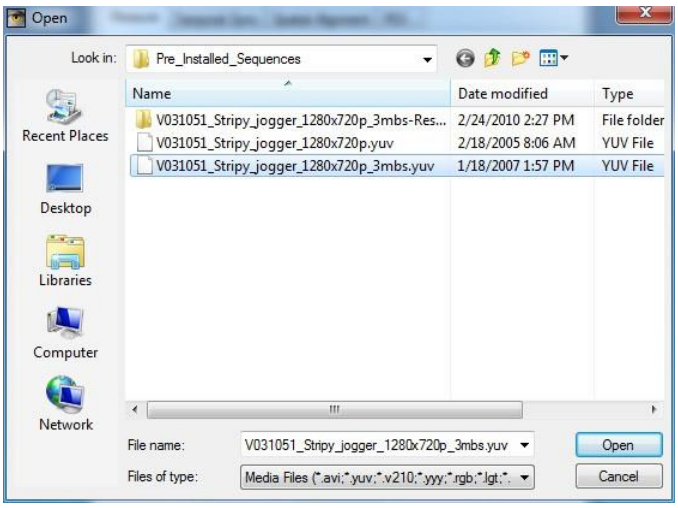
7. If you chose an uncompressed file as the Reference, you will see this dialog. In the **Set Reference File Format** dialog, enter the values appropriate for the file.
8. Click **OK**.



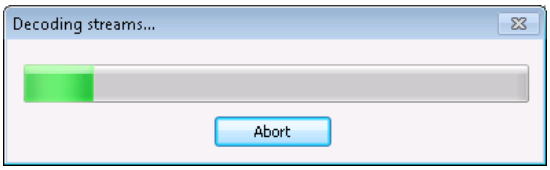
9. In the **Test** box, click **Browse Disk** or **Browse Memory**.



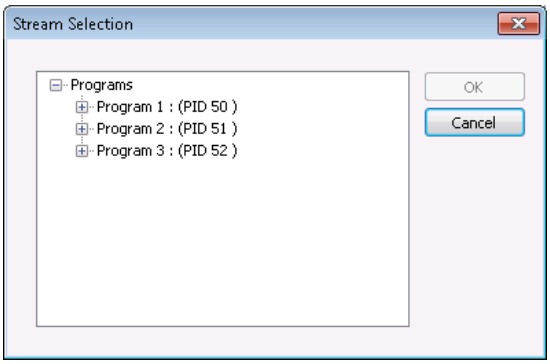
10. Select the test file to be used for the measurement.



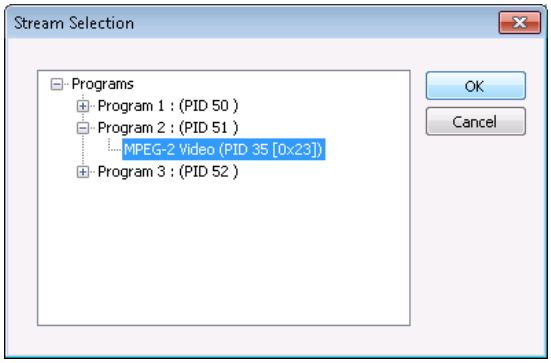
11. If you select a compressed video file for the test file, the PQA converts the file to YUV format before the measurement is executed.



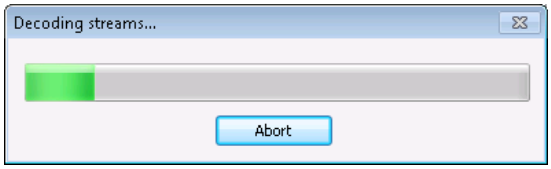
After decoding the compressed file, the PQA displays the **Stream Selection** window. If an uncompressed video file contains multiple programs, you must select the program you want to use for the measurement.



12. Click the **+** symbol next to the program you want to take the measurement on. Select the video within the program and click **OK**.

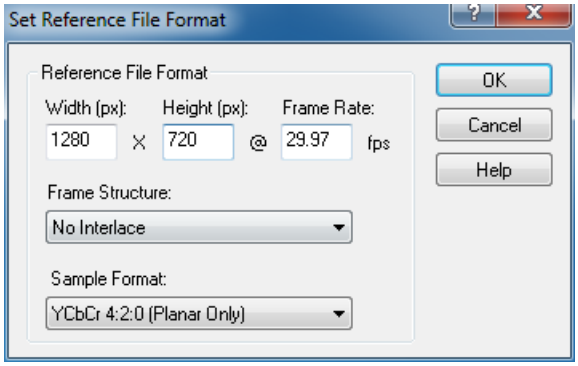


After you select the file, the PQA converts it to YUV format and saves it in the same directory as the selected reference file.



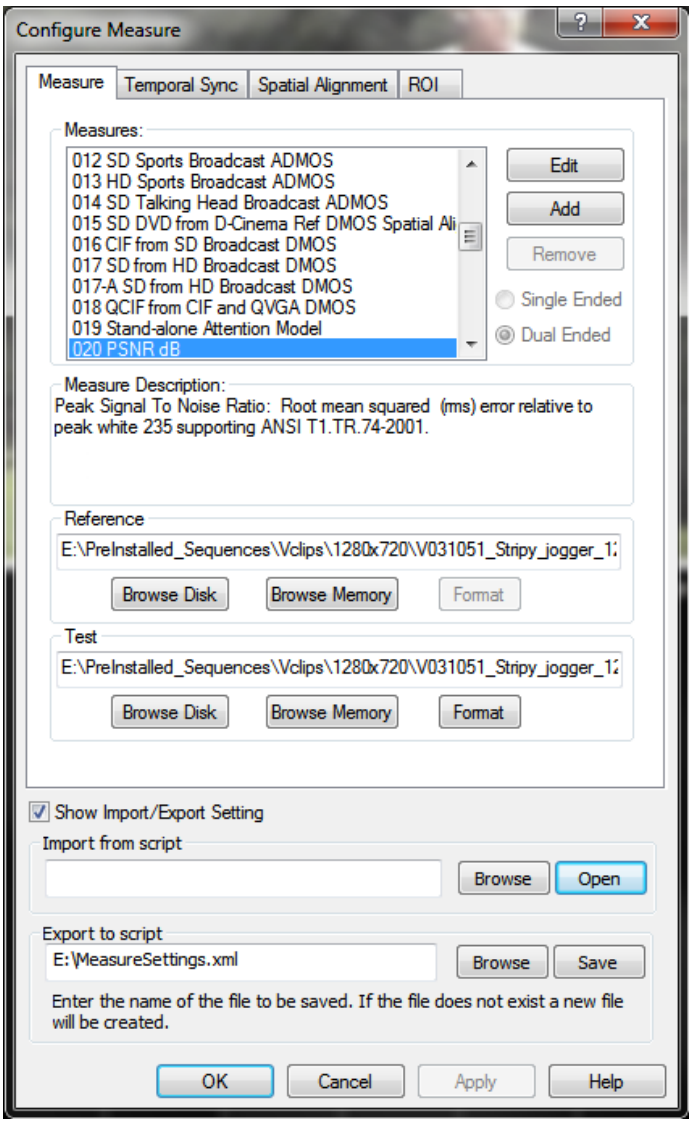
13. If you selected an uncompressed file for the test file, the PQA displays the **Set Test File Format** dialog, enter the values appropriate for the file.

14. Click **OK**.

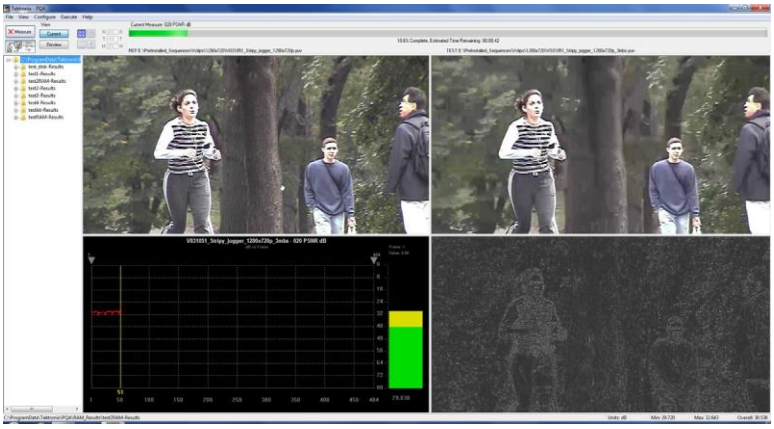


You might need to adjust the temporal and spatial alignments. If you know the reference and test sequences are aligned temporally and spatially, you don't need to perform any alignment procedure before continuing with the measurement. If the spatial alignment parameters of the View Node for the selected measurement are properly configured, you don't need to adjust the spatial alignment settings before proceeding, though you will need to temporally align the files. If you do not know that the test and reference files are aligned, you must align the files temporally and spatially before proceeding with the measurement.

15. Click OK in the Configure Measure window.



16. Click the Measure button to start the measurement. A green progress bar is displayed across the top of the Window.



Performing temporal synchronization and spatial alignment of sequences

For the PQA to take valid measurements, the reference and test video sequences must be temporally synchronized and spatially aligned. There are two tabs on the Configure Measure window that are used to synchronize and align sequences: the **Temporal Sync** tab and the **Spatial Alignment** tab.

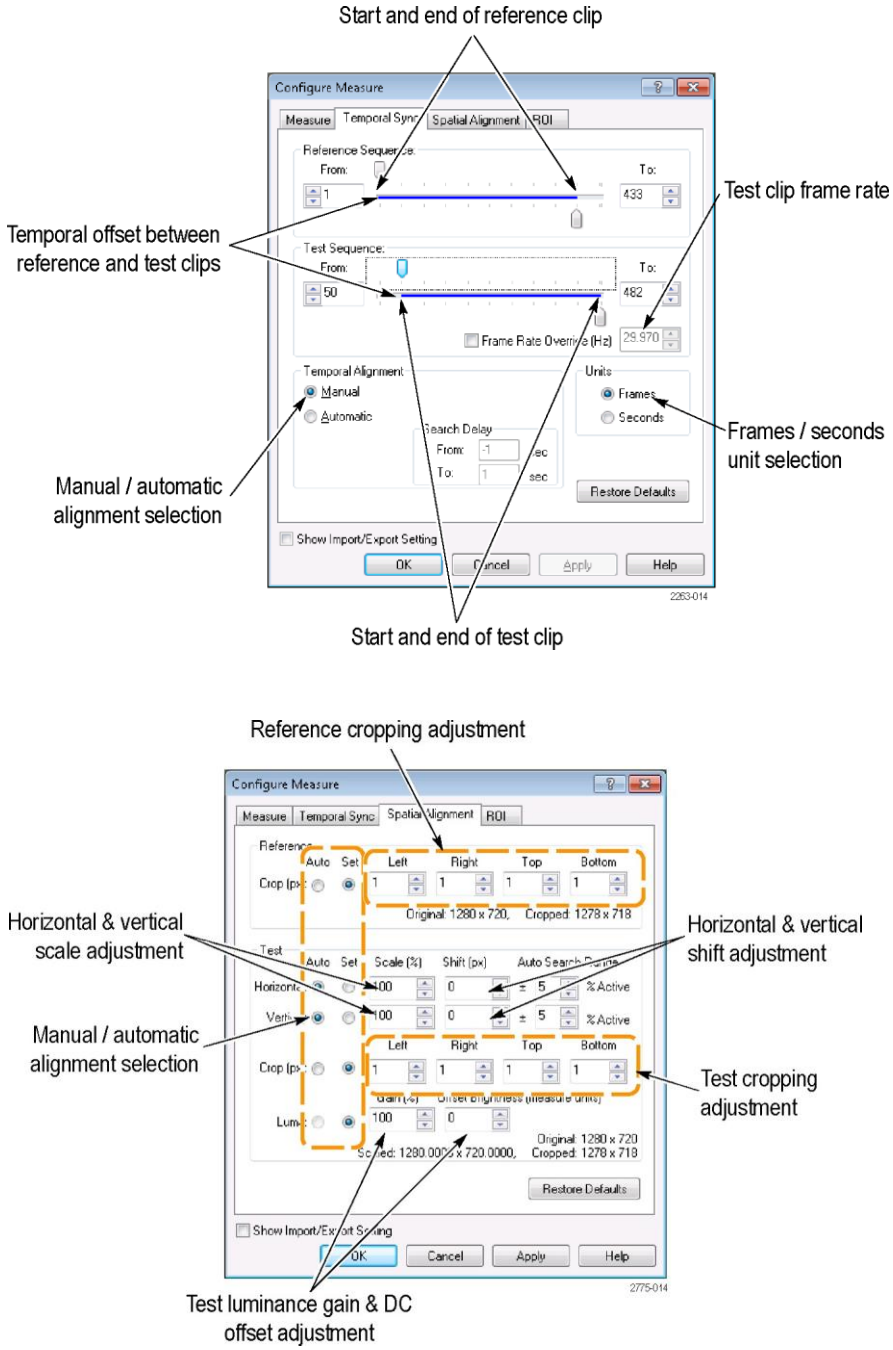


Figure 4: Temporal Sync and Spatial Alignment tabs

Automatic temporal and spatial alignment guidelines

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.

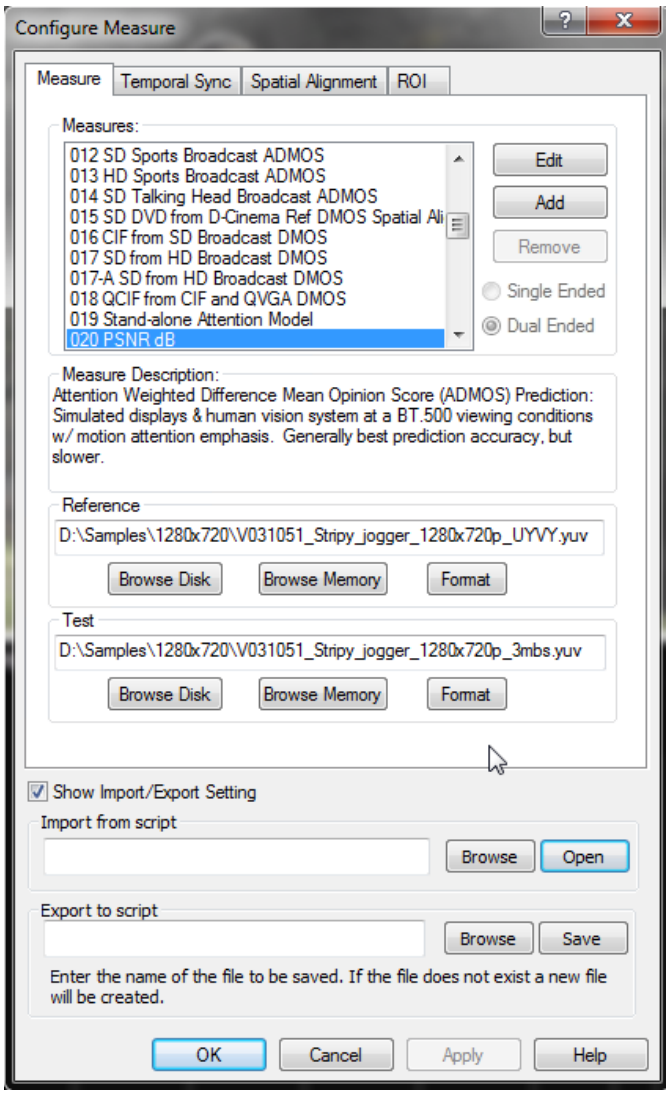
Temporal sync

Use the Temporal Sync tab to match the starting and ending frames of the reference and test video sequences. You can synchronize video sequence either manually or automatically. In manual mode, you specify the start and end frames of the sequences. In automatic mode, the PQA compares a range of frames in the test sequence to the start frame of the reference sequence to synchronize the video sequences.

Manual temporal alignment. In a Manual Temporal Sync, you manually adjust the starting frames of the reference and test sequences until they are aligned, using a PSNR map for guidance. To perform a Manual Temporal Alignment, you will start by specifying the **From** frame for the reference and test sequences. You will then adjust the From frame for the test sequence. Using a PSNR map that indicates differences in the selected frames, you will adjust the test sequence frame until the PSNR map indicates a minimum of differences between the selected frames.

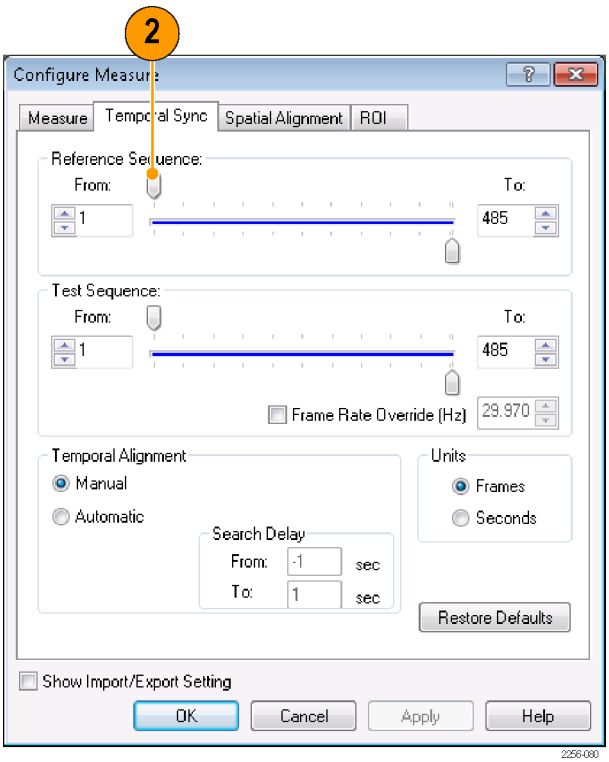
To temporally synchronize the reference and test sequences manually:

1. With the Measures dialog box displayed, click the **Temporal Sync** tab.

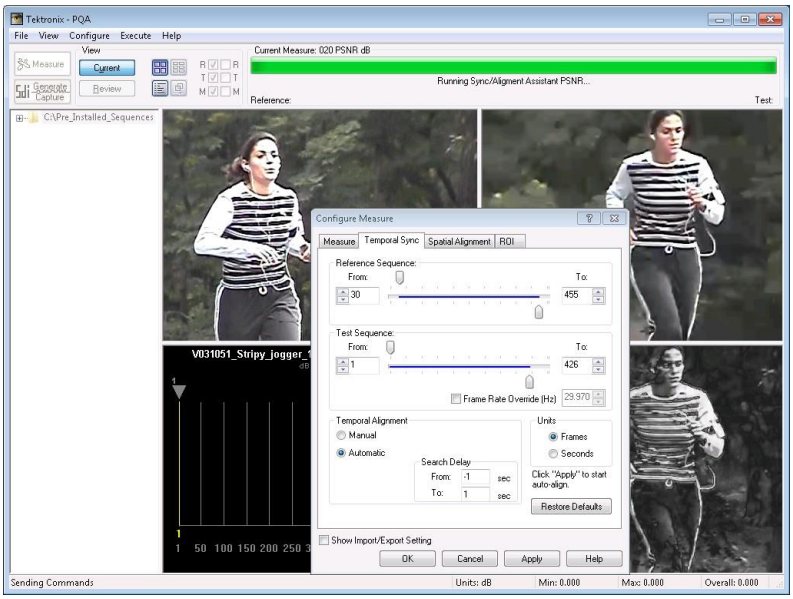


2. To set the starting frame of the reference sequence, adjust the top slider on the **Reference Sequence** bar. If needed, you can use the number entry box to change the starting frame one frame at a time.

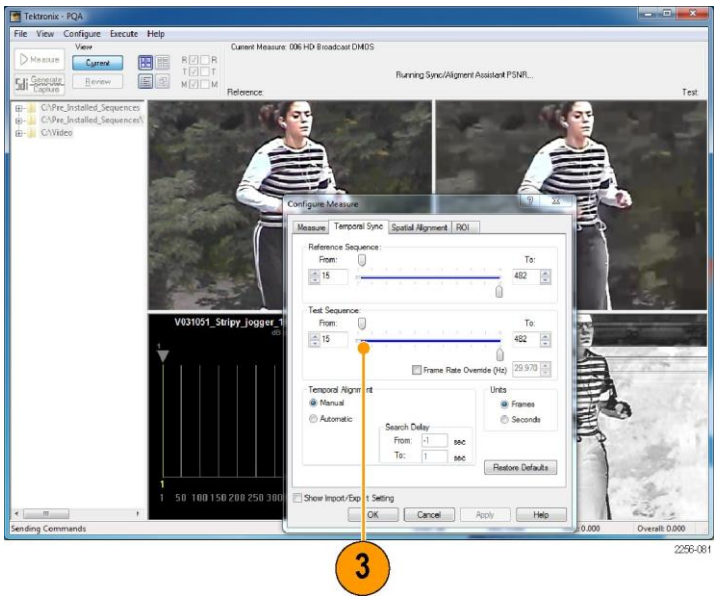
NOTE. *To view the sequence by time rather than by frame, select* ***Seconds*** *in the Units section.*



As you adjust the slider, the image in the Reference window changes to show the selected frame.

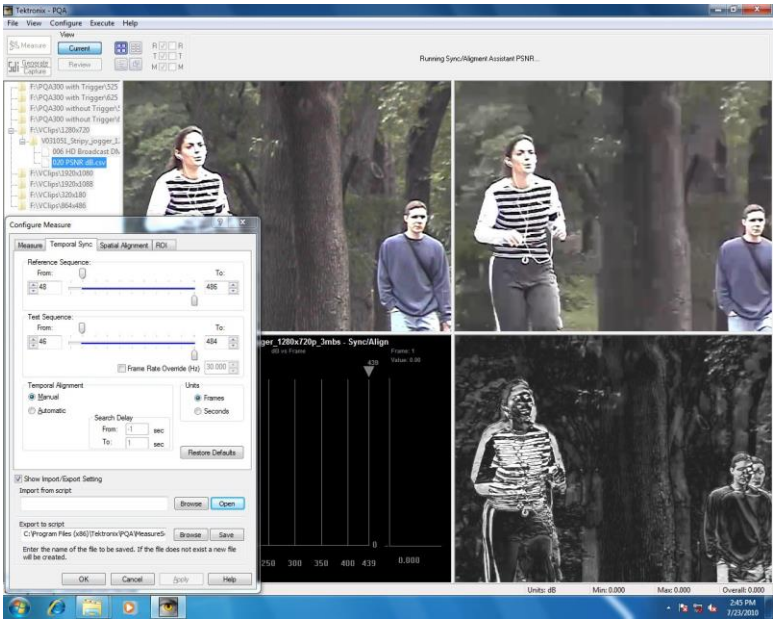


3. To set the starting frame of the test sequence, adjust the top slider on the **Test Sequence** bar. If needed, you can use the number entry box to change the starting frame one frame at a time.

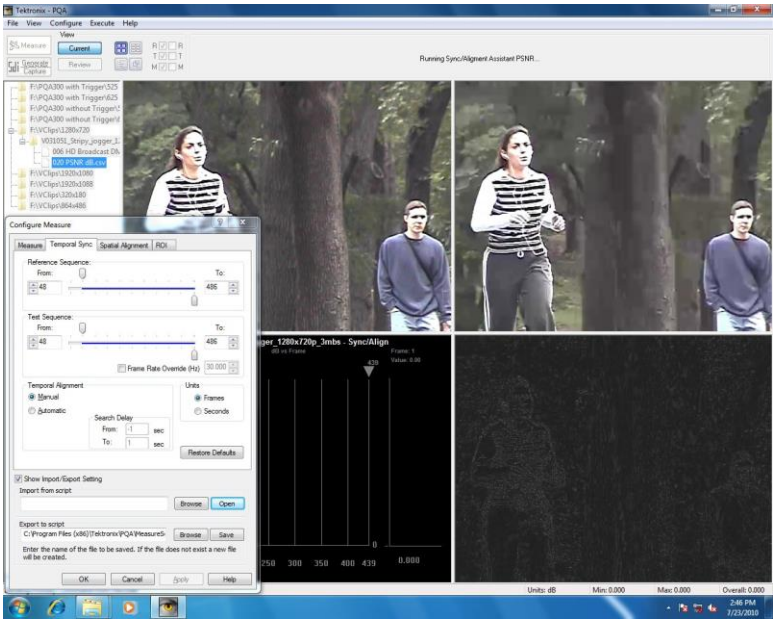


Once video sequences have been specified on the Measure tab, the PQA displays a PSNR map in the Results Map frame. You can use this map to align the two video sequences. Adjust the test sequence to achieve the darkest possible PSNR map (black is best). On the PSNR map, any differences between the reference start frame and the test start frame will be highlighted. The illustration at the top-right shows how a difference of two frames appear in the PSNR map. The illustration below it shows how the PSNR map appears when the two sequences are aligned.

The PSNR map shows both temporal and spatial alignment. Thus, you might also have to use the Horizontal and Vertical Shift settings on the Spatial Alignment tab to properly align the reference and test sequences.



PSNR map with frames temporally unaligned



PSNR map with frames temporally aligned

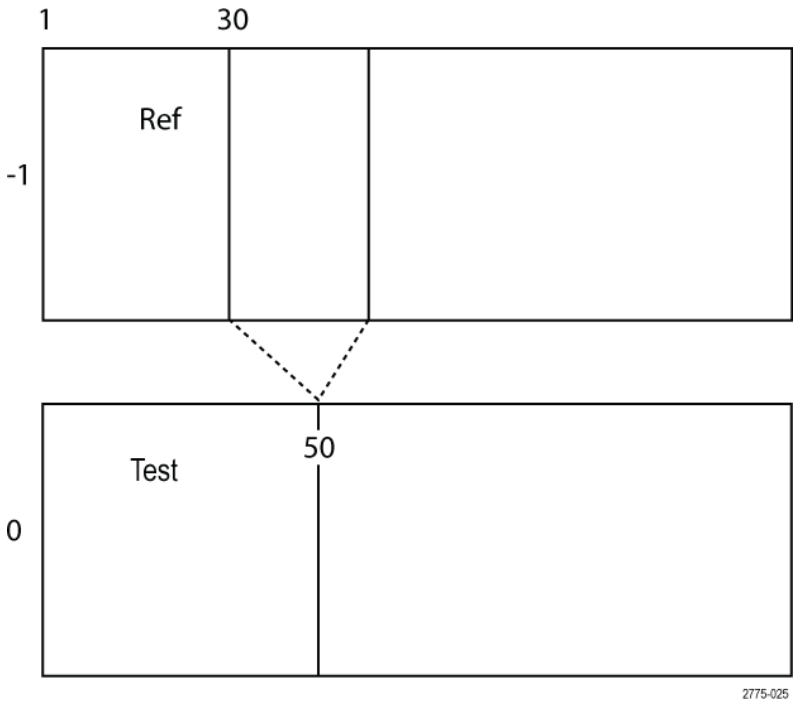
Automatic temporal alignment. In an Automatic Temporal Sync, the PQA compares a range of frames of the reference and test sequences and adjusts the starting frame of the test sequence until alignment is achieved (if possible). As with the manual temporal alignment, you must specify the From frame for both the reference and test sequences. Then you must specify a range of frames to use for comparison.

The range of frames compared is specified by setting values for the Search Delay. The Search Delay is specified in seconds. For example, if the frame rate is 30 frames per second, specifying a search delay of 1 second will result in 30 frames being compared. The Search Delay setting has two elements: From and To.

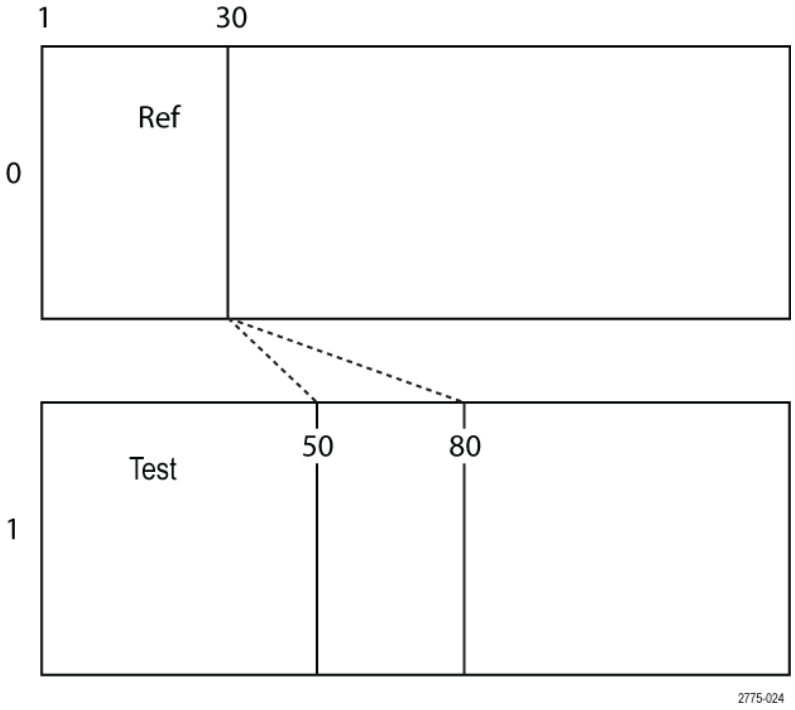
When performing a automatic temporal alignment, the PQA is attempting to determine the offset between frames in the reference and test sequences which are temporally aligned. You control the search range by setting the values for Search Delay From and Search Delay To.

To illustrate how the values for From and To interact, assume the following: the frame rate is 30 Hz, the Reference From frame is 30, and the Test From frame is 50.

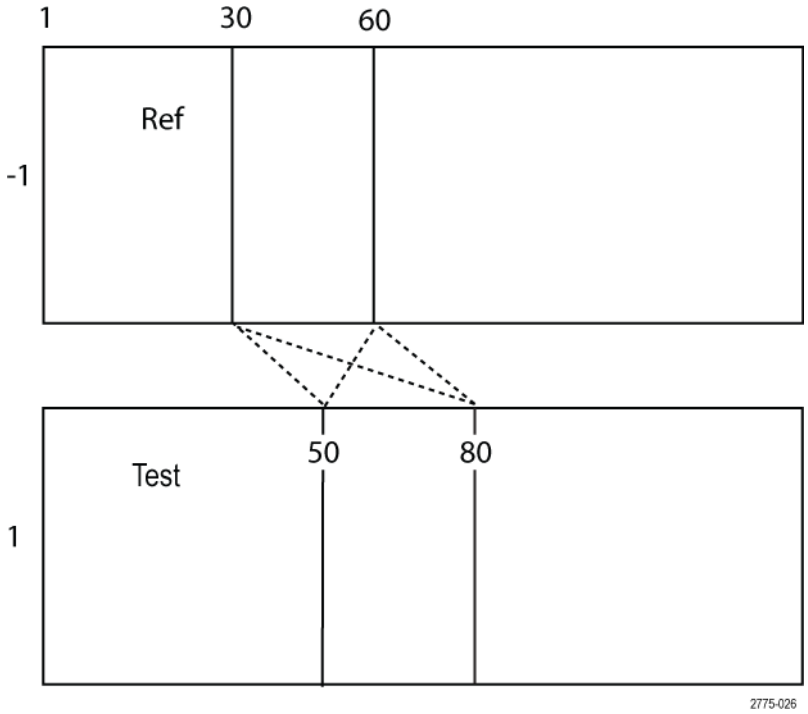
- **Example 1**: When **Search Delay From** is set to -1 and Search Delay To is set to 0, the PQA will compare Reference frames 30–60 against Test frame 50 to achieve temporal synchronization. See the following figure.



- **Example 2**: When **Search Delay From** is set to 0 and Search Delay To is set to 1, the PQA will compare Reference frame 30 against Test frames 50–80 to achieve temporal synchronization. See the following figure.



Example 3: When **Search Delay From** is set to -1 and Search Delay To is set to 1, the PQA will compare Reference frames 30–60 against Test frames 50–80 to achieve temporal synchronization. See the following figure.

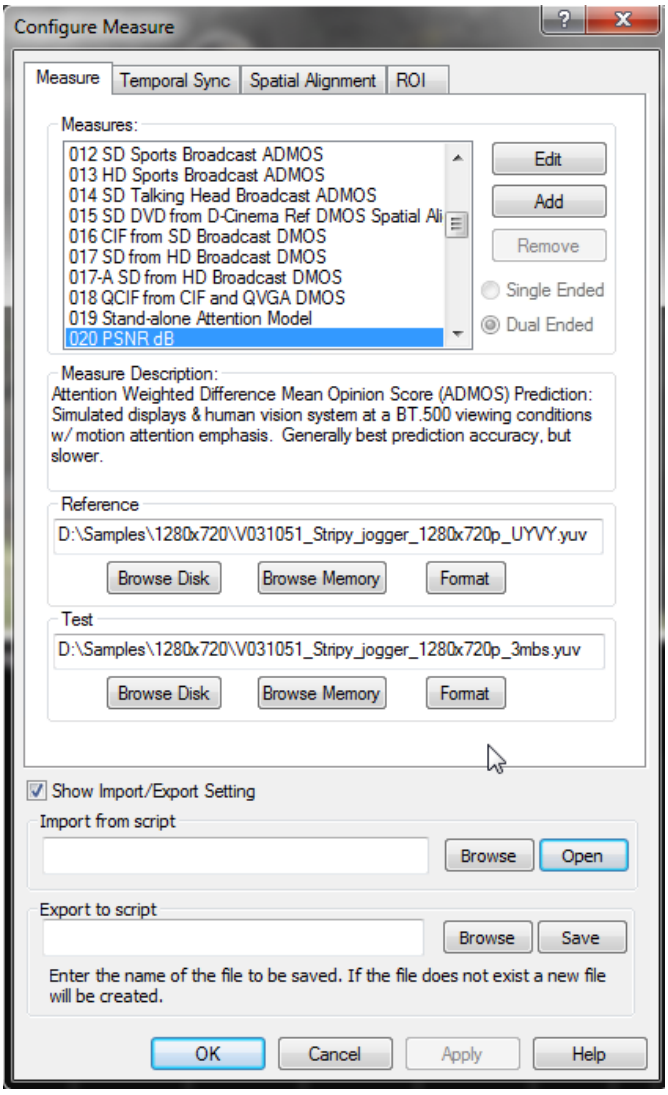


When performing an automatic temporal alignment, keep the following in mind:

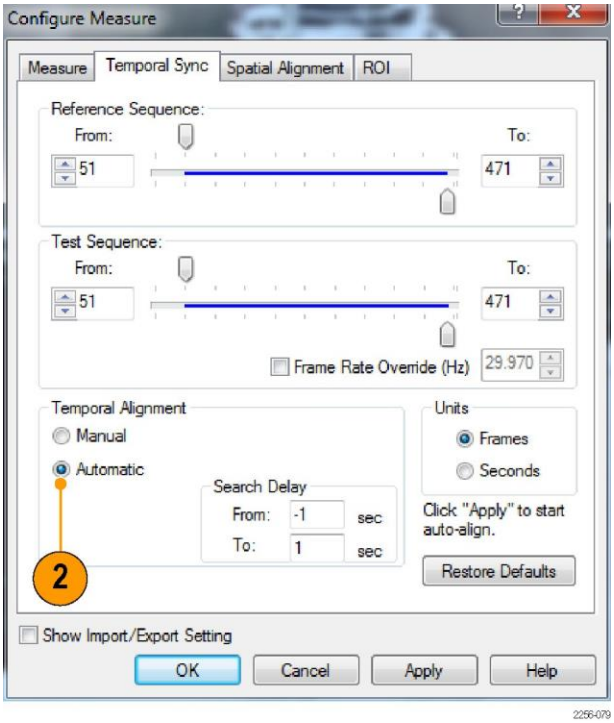
- You can select any start frame for the reference and test sequences. Alignment does not have to begin with the first frame.
- In some cases, when test sequence is badly distorted, you may get a warning the PQA is not able to align perfectly. However, the auto alignment function still provide the best possible match.
- If test sequence has frozen or skipped frames, the PQA might display a warning that the offset (difference between aligned frames) is not constant for the entire sequence. The reference and test frames on the Temporal Sync tab will be set according to measured initial offset.
- The more frames that are compared to determine temporal alignment, the more time will be used. If you have an idea of the location where the sequences will align, you can set the From values in the Reference and Test Sequences and the Search Delay to minimize the time spent searching for aligned frames. For example, if you think that frame 100 in the reference sequence will align with frame 150 in the test sequence, you can set the From values to 90 and 140, respectively, and the Search Delay values to -1 and 1, respectively, to minimize the time spent aligning the sequences rather than setting the From values to 1 and the Search Delay values to -6 and 6 and then waiting for the software locate the aligned frames.

To temporally synchronize the reference and test sequences automatically:

1. With the Measures dialog box displayed, click the **Temporal Sync** tab.



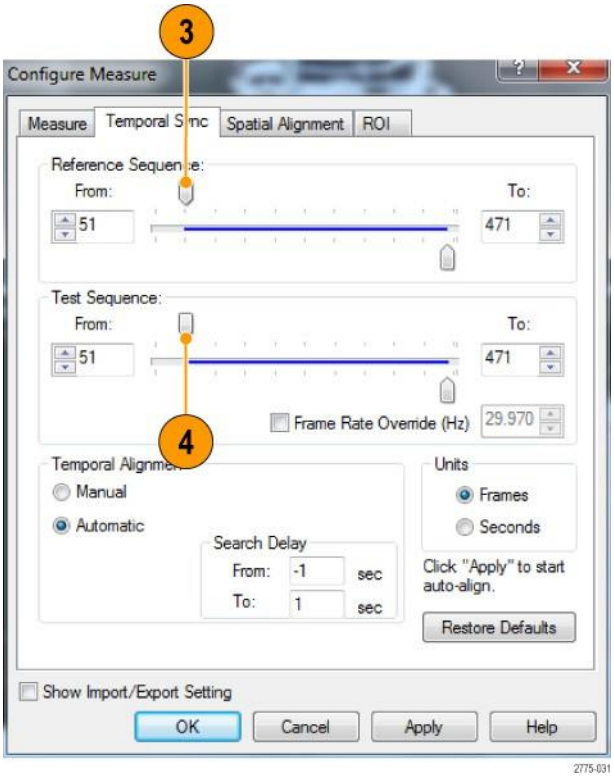
2. Click the **Automatic** option button under **Temporal Alignment**.



3. To set the starting frame of the reference sequence, adjust the top slider on the **Reference Sequence** bar. If needed, you can use the number entry box to change the starting frame one frame at a time.

NOTE. *To view the sequence by time rather than by frame, select* ***Seconds*** *in the Units section.*

4. To set the starting frame of the test sequence, adjust the top slider on the **Test Sequence** bar.

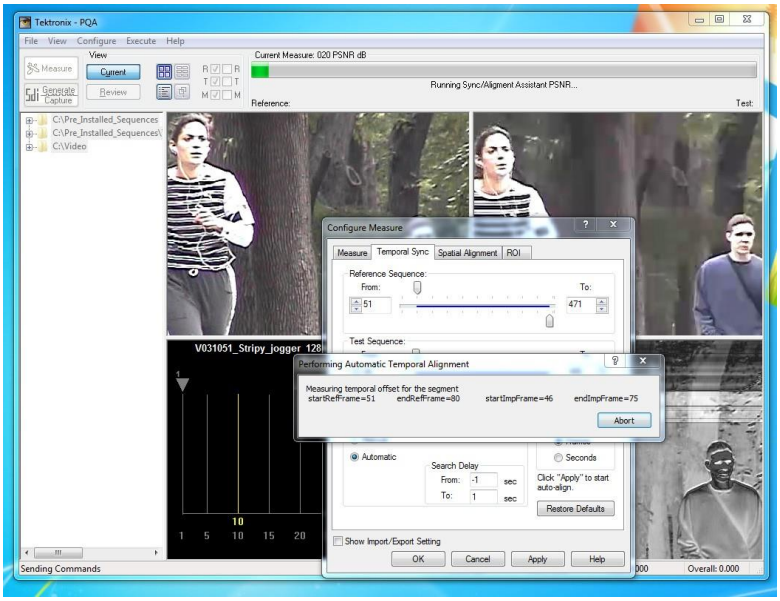


5. To specify the frames of the reference sequence used for comparison, enter a value for the Search Delay **From** parameter.

6. To specify the frames of the test sequence used for comparison, enter a value for the Search Delay **To** parameter.

7. To start the automatic temporal alignment process, click **Apply**.

The figure at the right shows the automatic temporal alignment process running. When the process completes, the From values for reference and test sequences will match (if a matching frame in the test sequence was found within the search range).

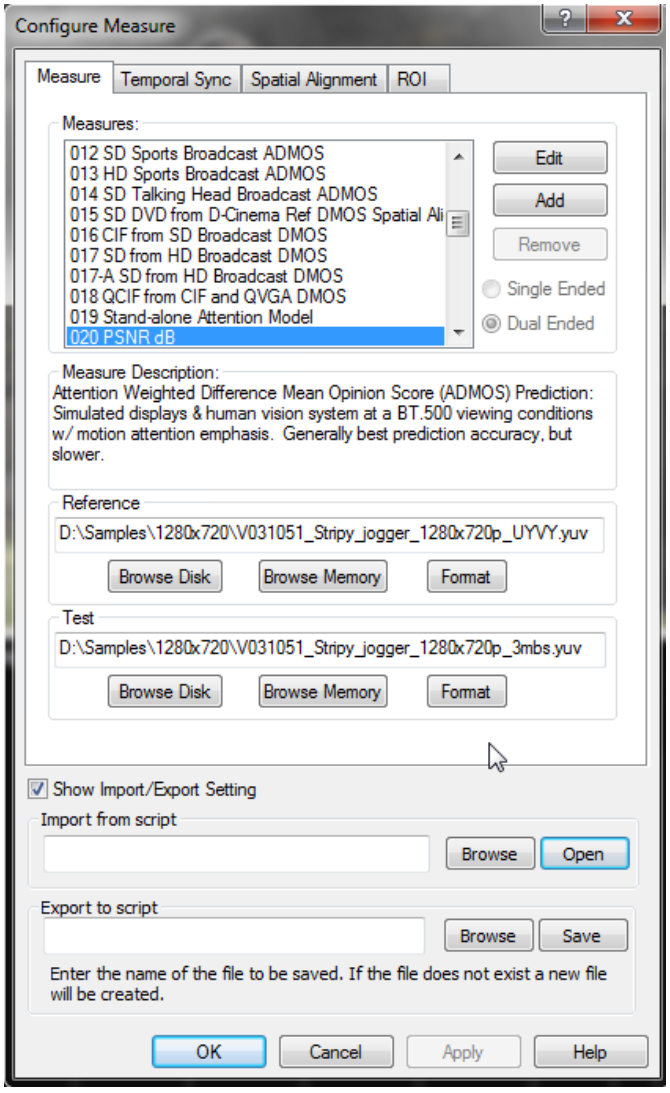


Spatial Alignment

Use the Spatial Alignment tab to match areas of the reference and test sequences that are compared. You can spatially align the reference and test sequences either manually or automatically. The reference and test sequences must be spatially aligned to achieve meaningful measurement results.

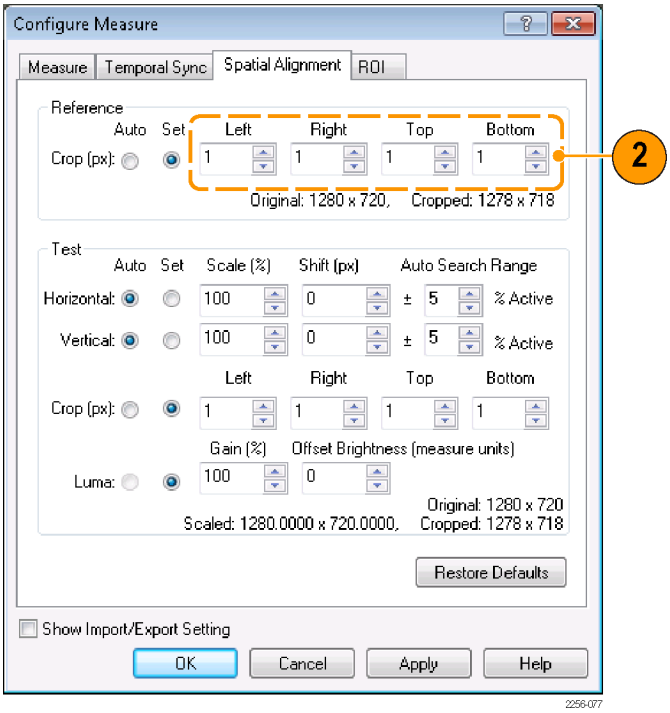
Manual spatial alignment. To spatially align the reference and test sequences manually:

1. Click the **Spatial Alignment** tab.



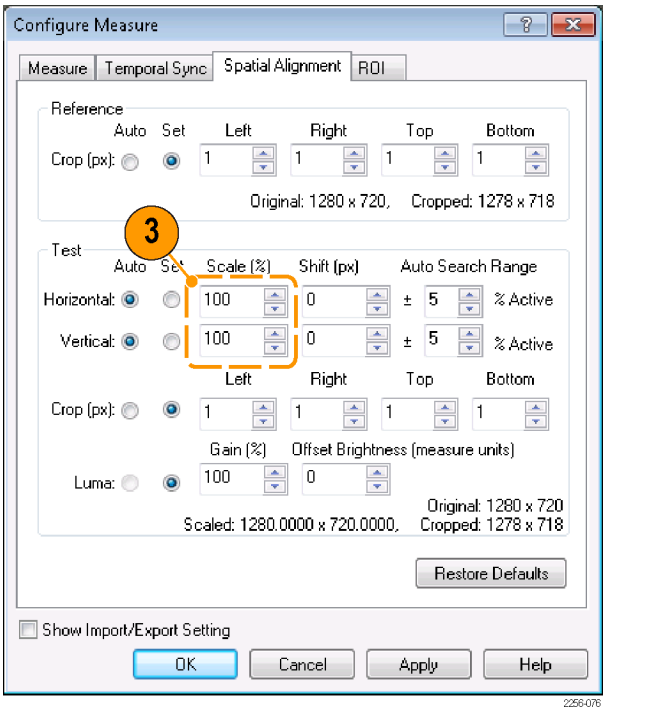
2. To manually crop the reference sequence, enter a number into the **Left**, **Right**, **Top**, and **Bottom** boxes in the Reference section.

*NOTE. As you adjust the values for cropping, the values for **Cropped** will change.*

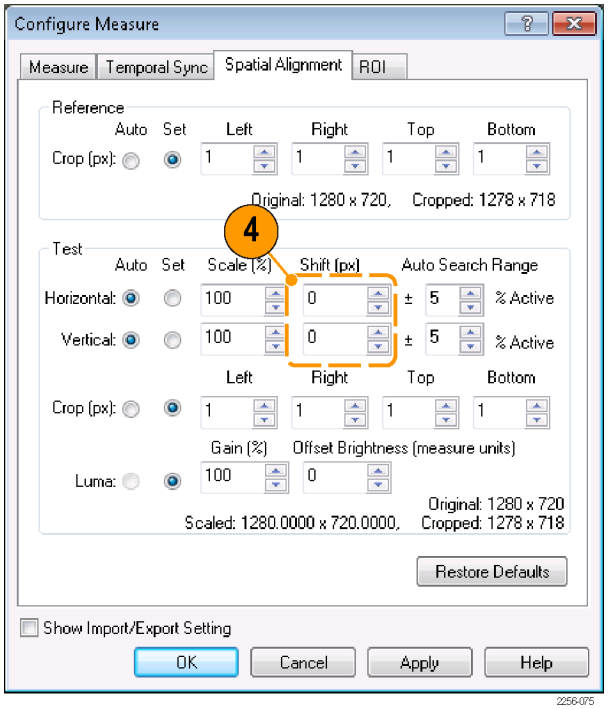


If the resolution of the test sequence does not match the resolution of the reference sequence, you must scale the test sequence. For example, if the reference sequence is 640 x 480 and the test sequence is 1280 x 720, you must scale the test sequence so that the scaled value is equal to 640 x 480.

3. To scale the test sequence, adjust the values in the Scale number entry boxes for both horizontal and vertical values.

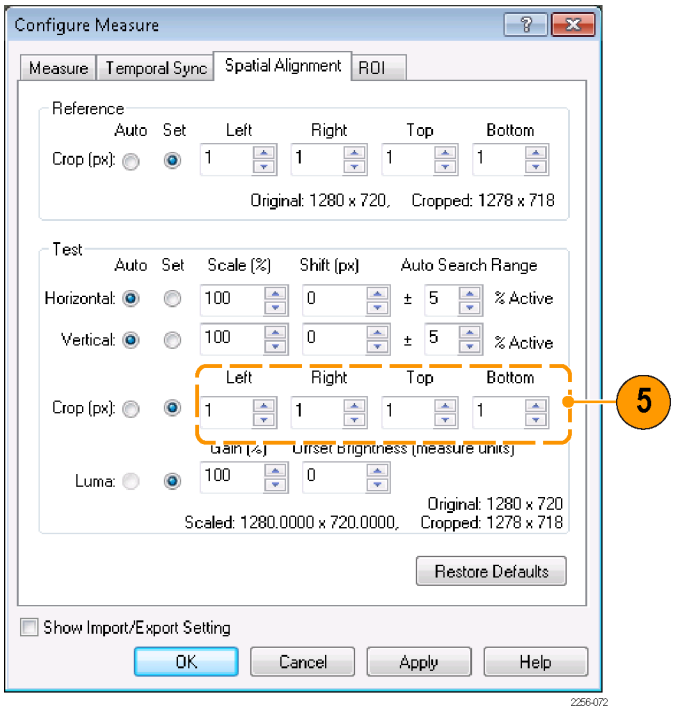


4. If the reference and test sequences do not align vertically, adjust the **Shift(px)** values so that the test sequence matches the reference sequence.



5. If you have to shift the test sequence to align it with the reference sequence, you might need to crop the test sequence (remember the PSNR map will highlight any differences between the sequences).

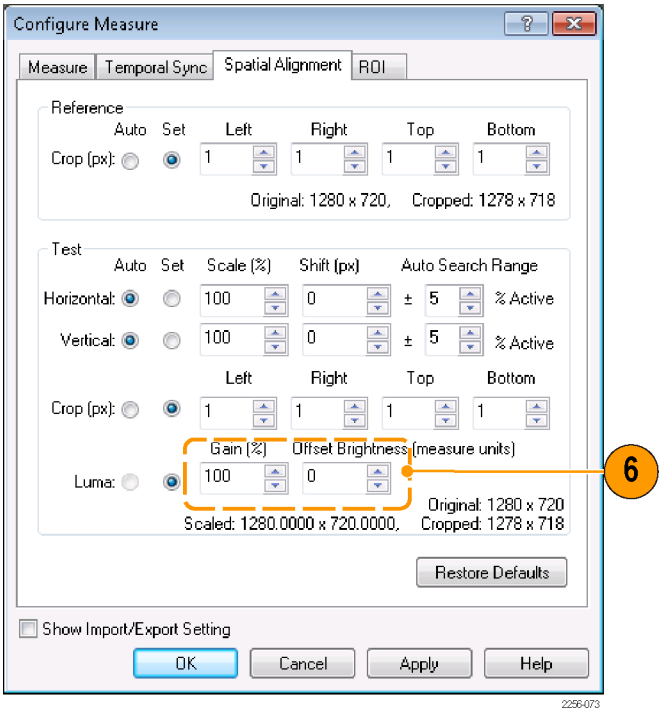
   Crop the test sequence by adjusting the **Left**, **Right**, **Top**, and **Bottom** boxes in the Test section.



6. If you need to adjust the luminance of the test sequence to match the reference sequence, adjust the Luma values **Gain** and **Offset Brightness** in the Test section.

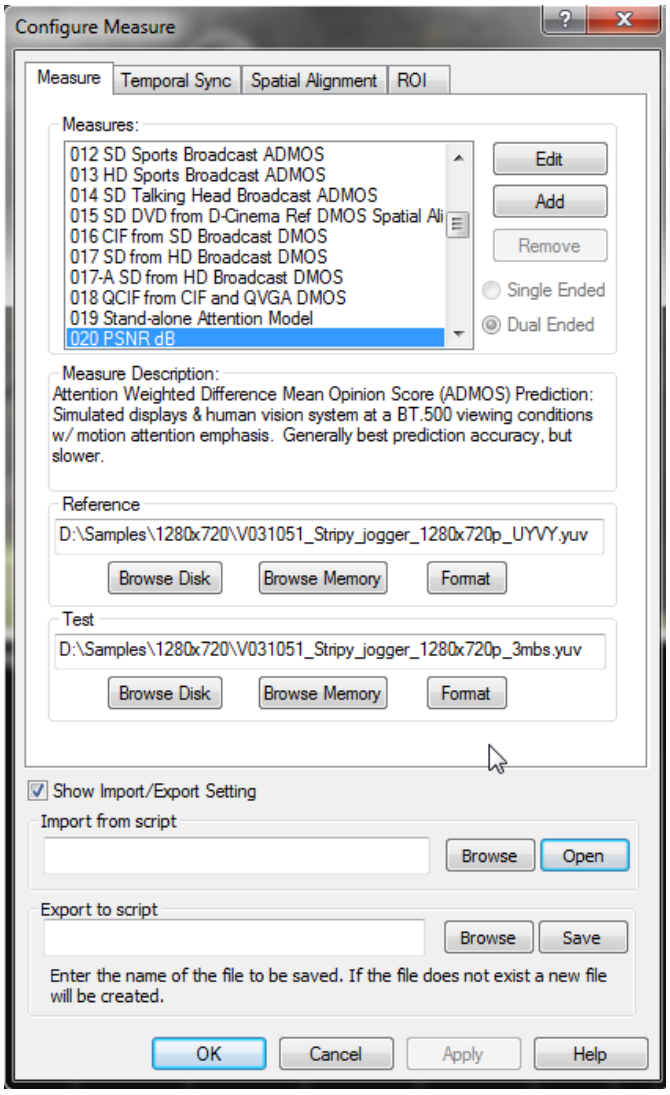
NOTE. If the selected Measure contains a View Model node, this Luma setting is overridden by the values in the View Model node.

7. After you make the spatial alignment adjustments, click **OK**.

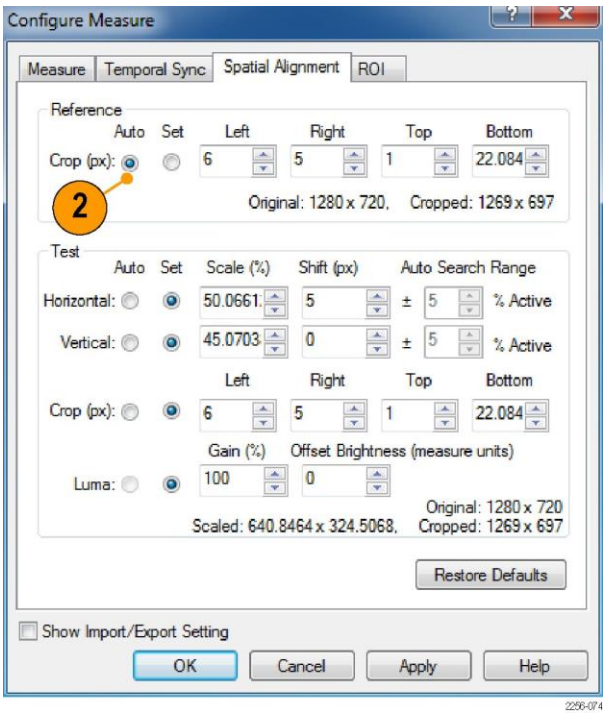


Automatic spatial alignment. You can allow the PQA to spatially align the reference and test sequences. To spatially align the reference and test sequences automatically:

1. Click the **Spatial Alignment** tab.

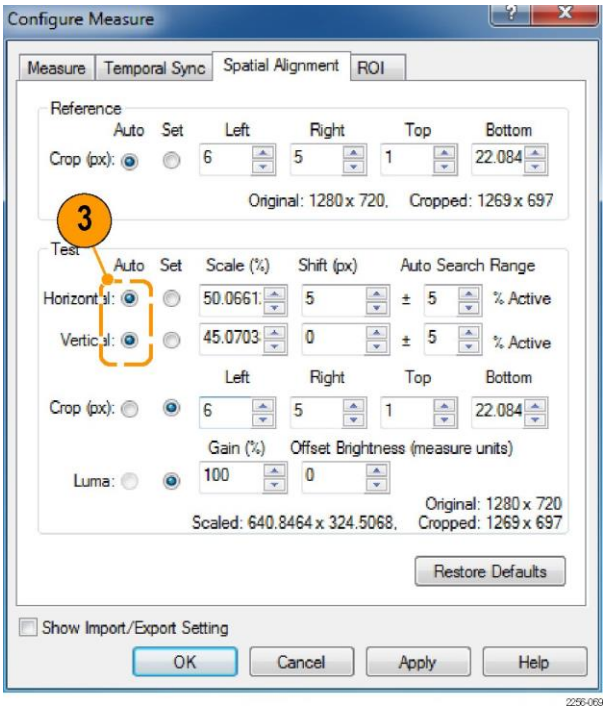


2. To automatically crop the reference sequence, select **Auto** in the Reference section.

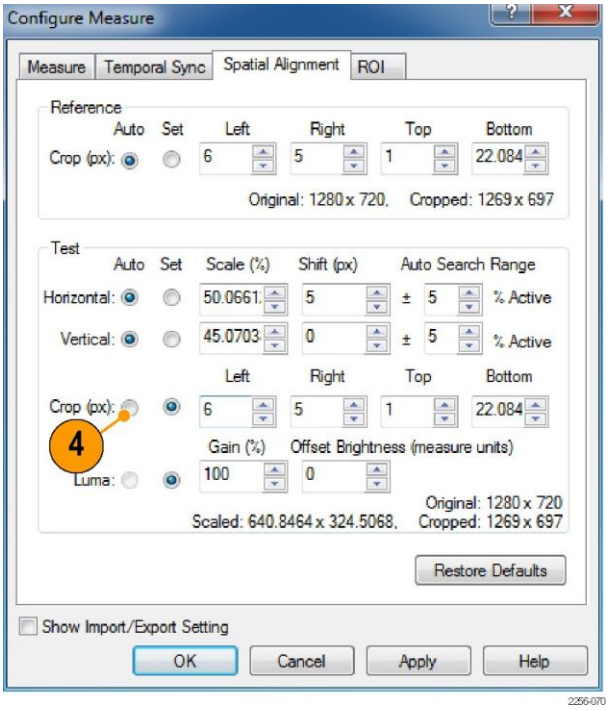


3. To automatically scale the test sequence, select **Auto** for both the Horizontal and Vertical settings.

   The PQA will compare up to ±30% of the test sequence horizontal and vertical pixels to the reference sequence searching for alignment.



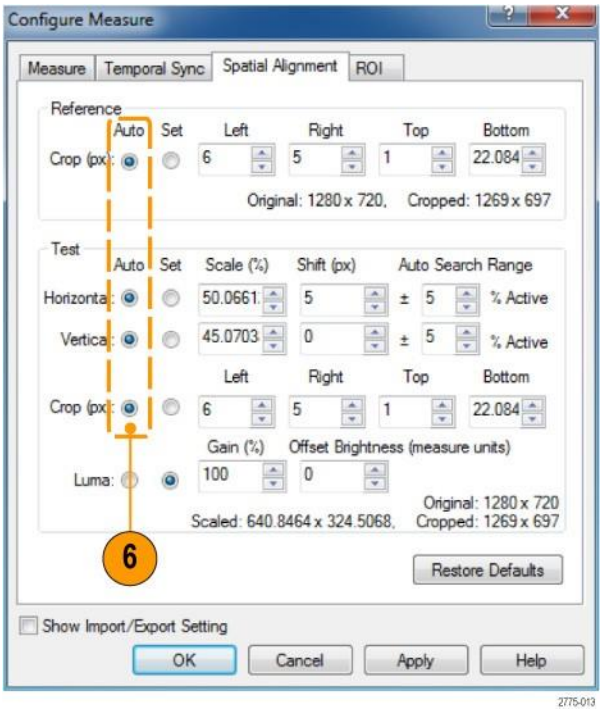
4. To automatically crop the test sequence to match the reference sequence, select **Auto** for the Crop (px) setting.



5. To adjust the Luma of the test sequence, enter values for the Gain and Offset parameters.

NOTE. *If the selected Measure contains a View Model node, this Luma setting is overridden by the values in the View Model node.*

6. After you select Auto for the adjustments you need to make, click **OK** to automatically align the reference and test sequences.



Tips

- If you receive a low correlation warning message after running the automatic temporal or spatial alignment, expand the Auto Search Delay or Auto Search Range and run the alignment again.
- Auto alignment works best when the video sequences contains moving objects. Try to select a portion of the video sequences that contain a moving object if you will be using auto alignment.
- If the video sequence contains scenes that pan and zoom, the automatic temporal / spatial alignment process might have difficulty achieving alignment. You might have to use automatic alignment repeatedly or use manual alignment to properly align the sequences.
- If you are measuring the sequences with different frame rate, ensure that the start frame for the reference and test sequences align on exactly the same start frame. Any phase offset difference between the start frames will result in poor measurements.
- If you are measuring sequences that are part of a 3:2 pull-down process (for example, the reference is 23.98p and the test is 59.94i with the 3:2 pull-down process), the start frames for reference and test must be aligned with the first frame in a 3:2 sequence.
- The Gain and Offset settings on the Spatial Alignments tab are manual only. If you want to use automatic Gain and Offset compensation, you must edit the View node of the measurement and enable the Auto option for Gain and Offset.
- The scaling process in spatial alignment uses a frame base algorithm. If you scale interlaced (field based) content, you may obtain an unreasonable measurement result. It is suggested that you use progressive content if a scaling operation for spatial alignment is required to spatially align the reference and test content.

Using the Region-of-Interest (ROI)

Region-of-Interest basics

Region-of-Interest (ROI) is a feature that limits measurements to a region of a video sequence that is used for measurements. An ROI can be applied before a measurement is taken, which is named an Input ROI; or an ROI can be applied after measurements are taken, which is named an Output ROI. An Input ROI is used to exclude portions of the video sequence from being used in a measurement. The Output ROI is used to limit the calculation of measurement results to a specific region, which can make it easier to determine the source of impairments.

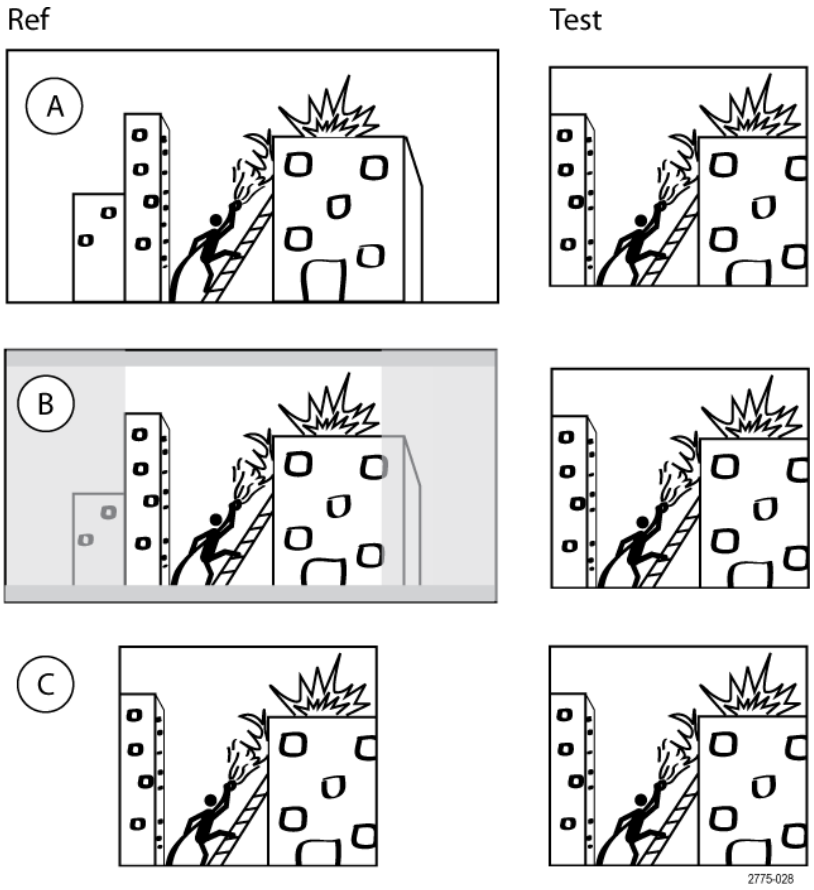
An Input ROI is applied to the reference and test video sequences prior to any other processing and the region outside an Input ROI is excluded from the alignment or measurement. An Output ROI is applied to the measurement result and the overall score can be recalculated for the specified region.

You can specify ROI in spatial terms (an area within a frame), or in temporal terms (which frames to include within a measurement). Spatial ROI defines the region of interest by specifying the pixels contained within the region of interest. A Spatial ROI is the same for all frames within a video clip. A Temporal ROI defines the region of interest by specifying the frames contained within the region of interest. It is these specified frames, in the case of an Output Temporal ROI, that are used to calculate the *Overall* measurement value. For example, if the test sequence is 1000 frames long, you could specify an Output Temporal ROI to limit measurements to frames 200 through 800.

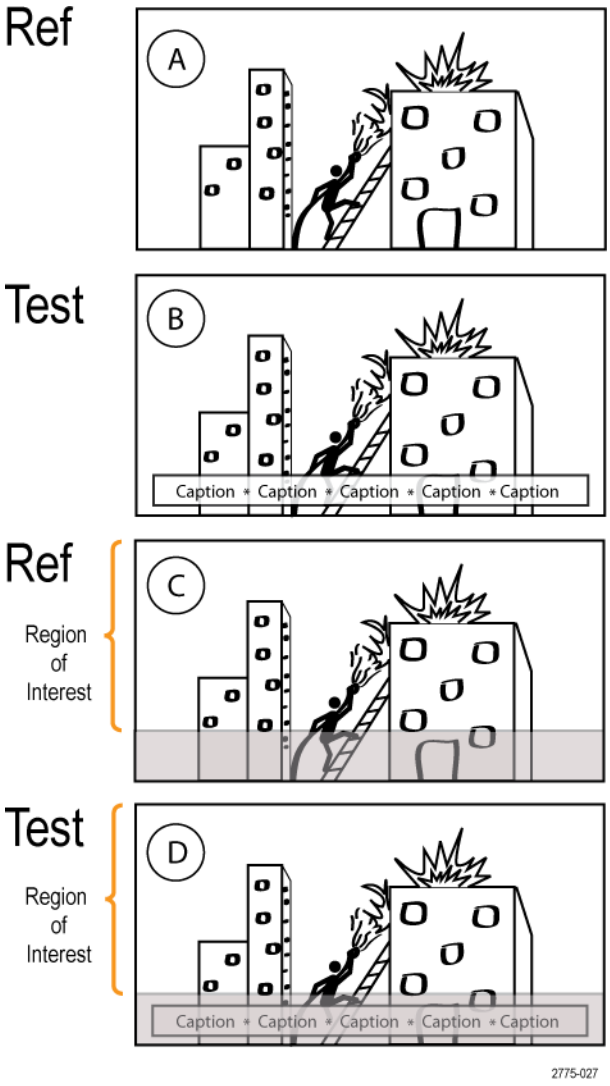
An Output Spatial ROI is a rectangular region within the result map. The overall score can be recalculated for a subregion even after measurement is run.

ROI examples

One use for an Input Spatial ROI is to specify portions of the reference video sequence to ignore when taking a measurement, which would improve the measurement accuracy. If you were using a 16x9 video sequence as the reference sequence, and a 4x3 video sequence as the test test sequence (A in the following figure), you would need to specify the Input Spatial ROI settings to limit the portion of the reference sequence used for measurements to a 4x3 area (B in the following figure), that results in a reference sequence ROI that aligns with the test video sequence (C in the following figure).



Another example of how to use an Input Spatial ROI is to exclude a portions of sequences which do not match from being compared. For example, if the test sequence contains a caption that does not appear in the reference sequence, you can specify an Input Spatial ROI to limit measurements to the regions of the two sequences that match. The following illustration shows how an Input Spatial ROI would be applied in this situation, A represents the reference sequence. B represents the test sequence, which contains a caption that does not appear in the reference sequence. To ensure a valid measurement, you would specify an Input Spatial ROI that limits the region of the reference sequence and the test sequence that is used for measurements. C shows how the ROI applies to the reference sequence. D shows the portion of the test sequence that is not included in the comparison with the reference sequence.



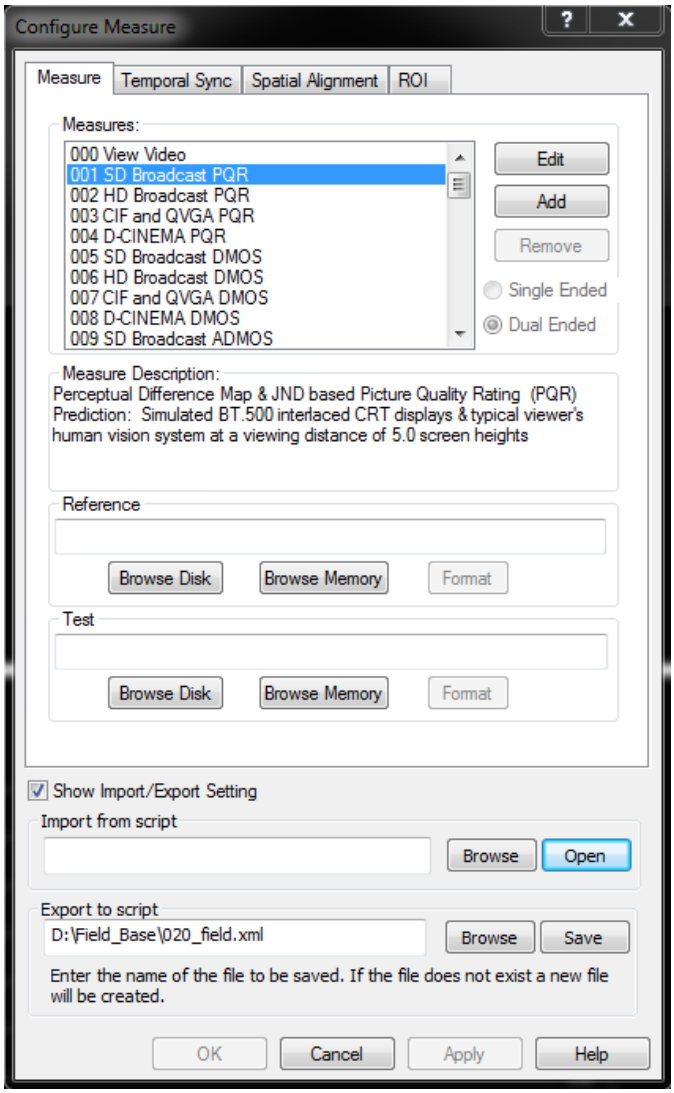
Specifying an ROI

To specify an ROI, you use the ROI tab of the **Configure Measure** window.

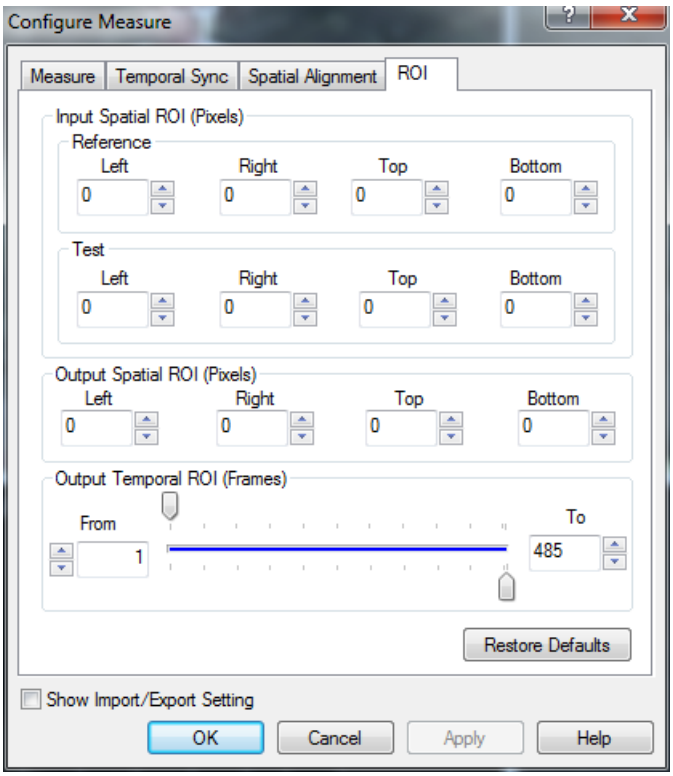
To specify ROIs using the ROI tab in the Configure Measure dialog:

1. Click the **Measure** button.

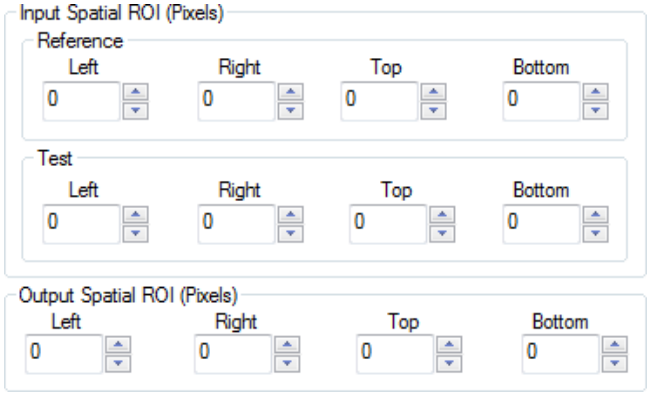
2. Select the measurement you wish to run and specify the Reference and Test files as required.



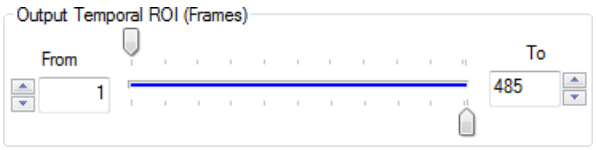
3. Select the **ROI** tab.



4. Enter values for the Input Spatial ROI (both Reference and Test) and the Output Spatial ROI parameters.



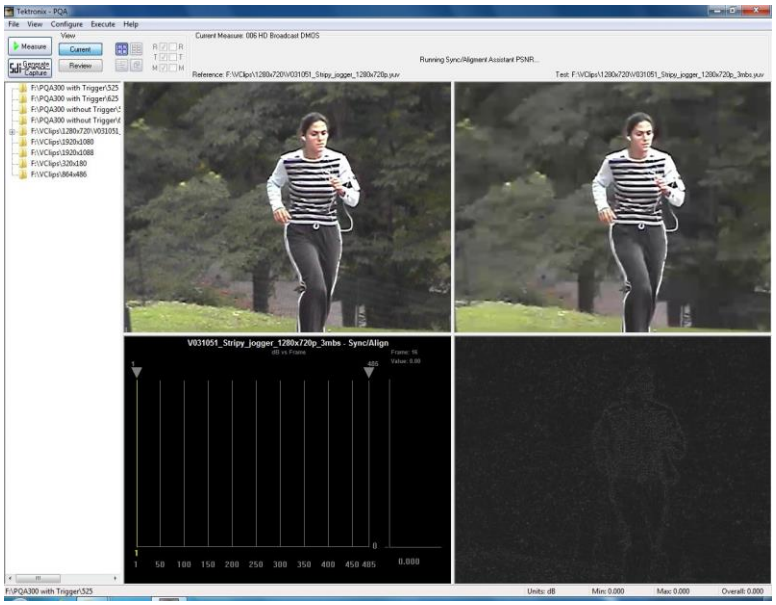
5. To configure the Output Temporal ROI, specify the range of frames to which you wish to limit the *Overall* measurement.



NOTE. *When the measurement is run, the measurement will be calculated for all the frames specified on the Temporal Sync tab. The frames specified on the ROI tab are only the frames used to calculate the Overall measurement value.*

6. Click **OK** to save your measurement selections.

7. Click the **Measure** button to begin the measurement.



How to review measurement results

Once you have taken a measurement, you can view the measurement results in several ways. The PQA analyzer has four display views that allow you to inspect video clips, analyze measurement data, or compare video clips and results.

- The Summary View display allows you to simultaneously review each frame of the reference clip, test clip, and the map with a graph of the selected measurement
- The Tile view allows you to view the reference file, test file, and map simultaneously.
- The Event Log displays points in the test clip where measurements exceed specified levels.
- The Overlay view allows you to display two views (one on top of the other) to compare variations between the two views.

Where measurement results are saved

Measurement results are saved in the folder that contains the test file. The results files are saved in a folder named after the test file with "`-Results`" appended to the file name. For example, the PQA analyzer includes a sample file named V031051_Stripy_jogger_1280x720p_3mbs.yuv. If you run measurements on this file, all measurement results will be saved in a folder named "`V031051_Stripy_jogger_1280x720p_3mbs-Results`", which will be located in the same folder as the V031051_Stripy_jogger_1280x720p_3mbs.yuv file.

NOTE. *Do not move the reference and test files once you have run a measurement. The measurement results file points to the location of the reference and test files and displays those files when you review the measurement results. If you move the reference and test files after running a measurement, the PQA will not be able to find the files in their new location.*
If you must move the reference and test files, you must edit the measurement results file to point to the new location of the reference and test files.

Files stored in RAM. The results of measurements performed on files stored in RAM are stored only in RAM at the following location: `C:/ProgramData/Tektronix/PQA/RAM_Results`.

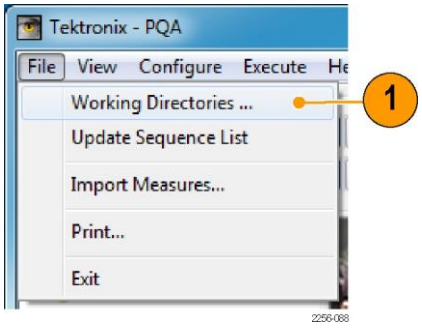
This directory is automatically mapped to the navigation pane in 64-bit systems.

How to select measurement results for display

You select measurement results for display from the Results Navigation pane. To select results from the Navigation pane, you must first add directories to the Navigation pane.

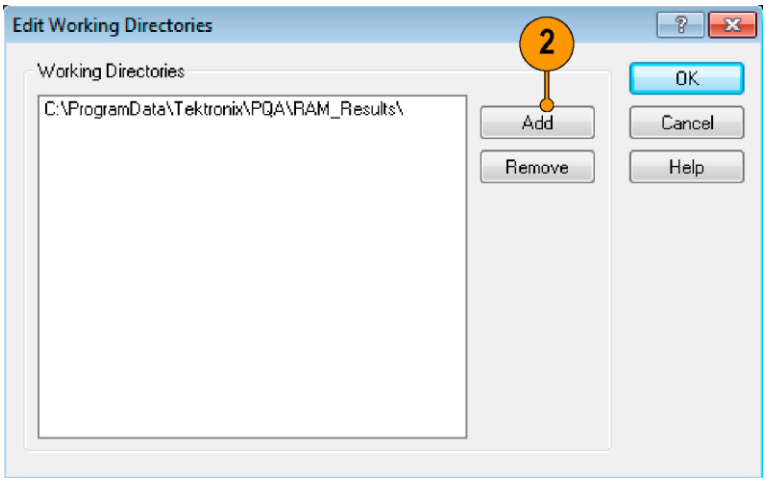
To add directories to the Navigation pane:

1. Select **Working Directories** from the File menu.

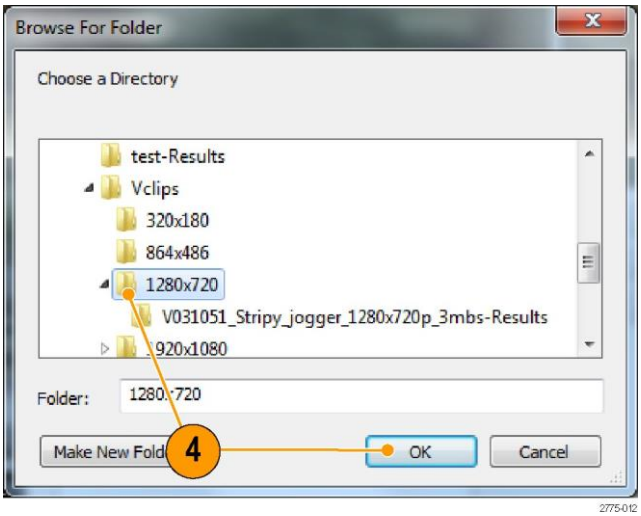


   By default, the RAM memory directory is listed in the Working Directories dialog and cannot be deleted.

2. If your video clips are stored in a directory not listed in the Edit Working Directories dialog, click **Add**.

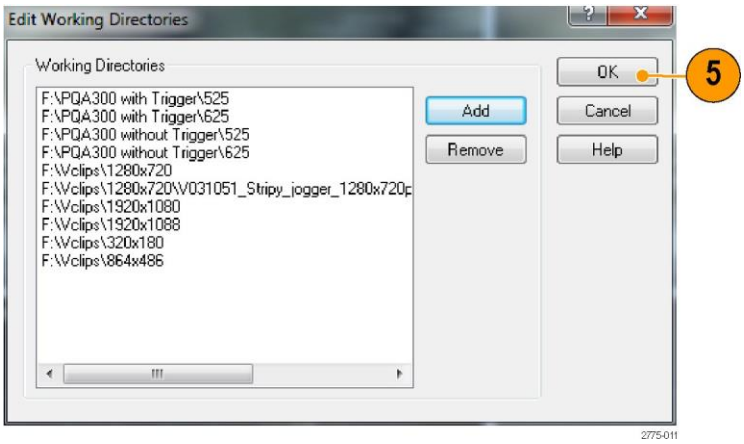


3. From the **Browse For Folder** dialog, navigate to the folder that contains your test video clips.
4. Select the folder that contains the test video clips and click **OK**.



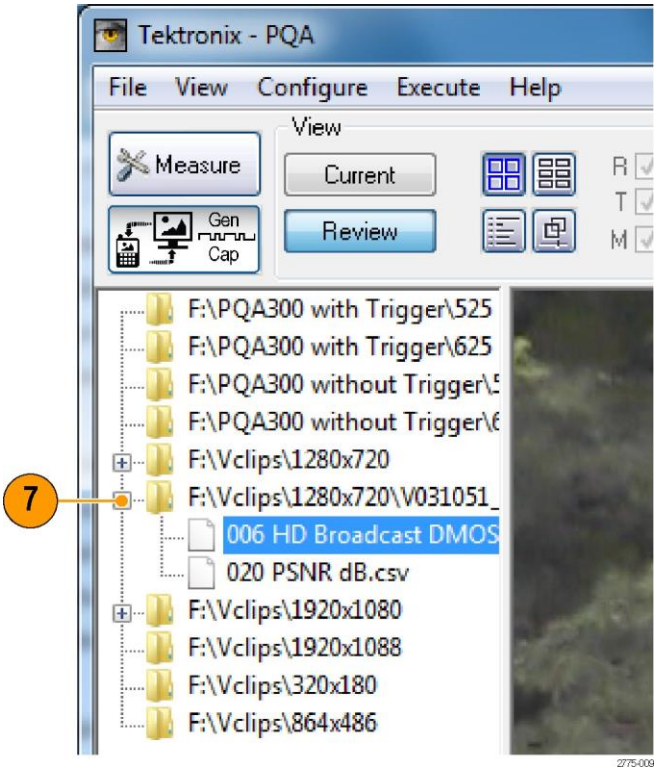
When the Edit Working Directories dialog is displayed, you can see the directory you just added now appears in the list of Working Directories.

5. In the Edit Working Directories dialog box, click **OK**.



6. In the main application window, click the **Review** button.
7. Click the + symbol next to the folder for the directory you just added to the working directory list.

   The results located in the selected directory will appear when you click the + symbol.

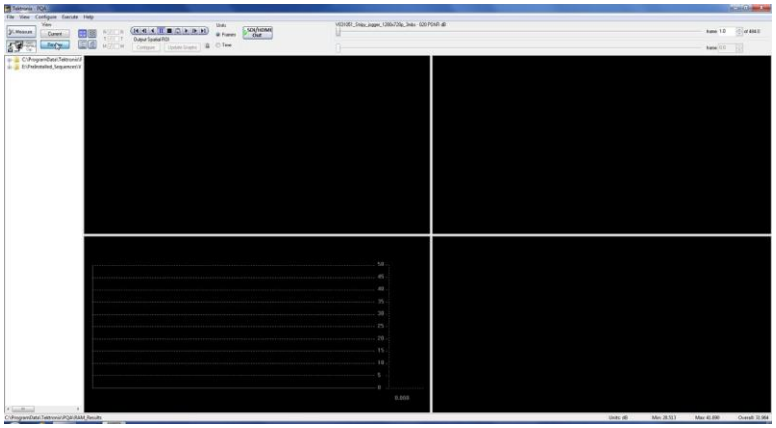


Summary View display

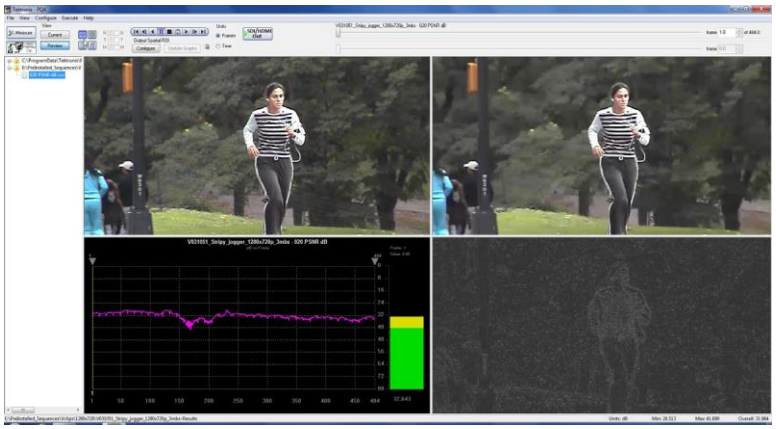
The Summary View display consists of four tiles that show the reference clip, the test clip, the map, and a graph.

1. To show the Summary View Display, click the Summary View button.

This is how the Summary View display appears in Current view with no measurement running.



This is how the Summary View display appears when ready to begin a measurement.



- The Reference video clip appears in the upper-left tile.
- The Test video clip appears in the upper-right tile.
- The graph of the primary measurement appears in the lower-left tile.
- The impairment map appears in the lower-right tile.

This is the Summary View display in Review mode.

- Controls appear above the tiles that you can use to select which frame is displayed.
- A readout appears at the bottom-right corner of the window that shows the Minimum, Maximum, and Average values of the primary measurement (the measurement that is shown in the graph).
- The yellow line in the graph indicates the currently displayed frame.

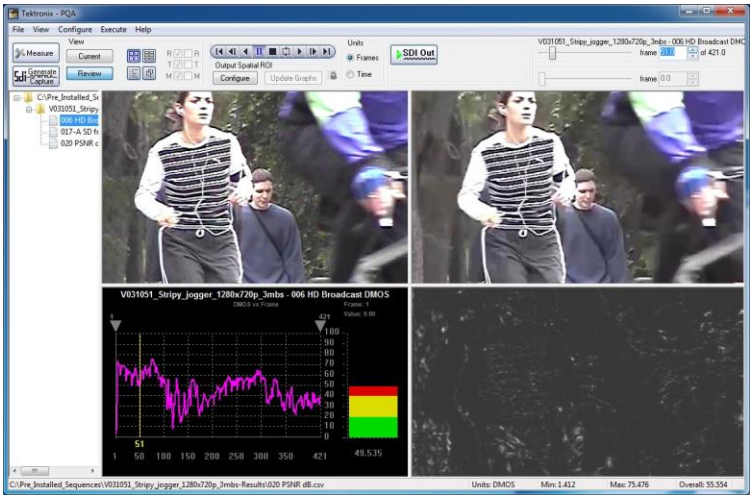
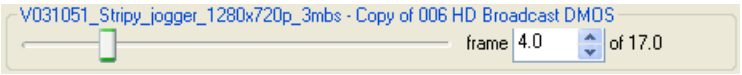
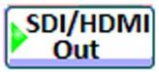


Table 21: Elements of the control bar

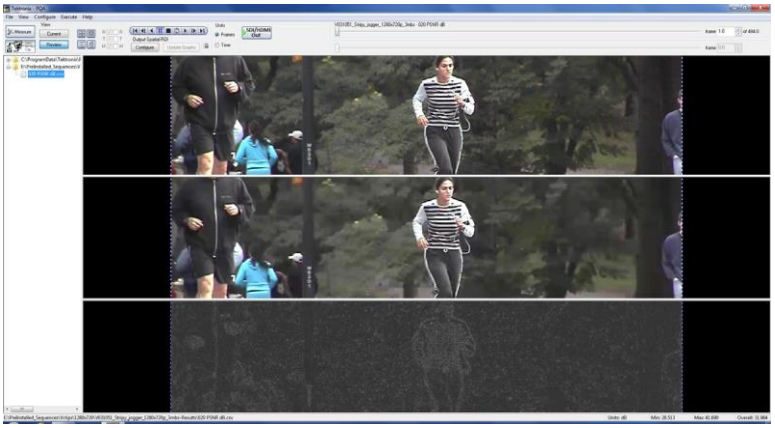
Control	Description
	The control bar controls replay of the video clips.
	The frame selector allows you to choose which frame of the video clip is displayed.
	The Units selector allows you to specify the displayed frame by frame number or time.
 **PQA600C only**	Selecting SDI Out outputs the Test file on the Ch 2 and outputs the Reference file on Ch 1. This enables you to view the Test and Reference files on a standard monitor independent of the PQA display. This function is only available when the format of the Reference and Test files is the same and supported by the SDI card. Click the SDI Capture / Generation button to play the review contents in real time. The application converts avi file to raw file format (yuv, rgb or v210) when it is selected for Reference or Test.

Tile View display

The Tile View enables you to view the reference, test, and map at normal size, in a vertical arrangement. Each tile acts like a window view of the video clip or map. You drag the clip within the window to focus on a particular portion of the clip. You can also resize the tiles by dragging the bars that separate the tiles.

1. To display the Tile View Display, click the Tile View button.

This is the Tile View display in Review mode. The Tile View cannot be displayed in Current mode.

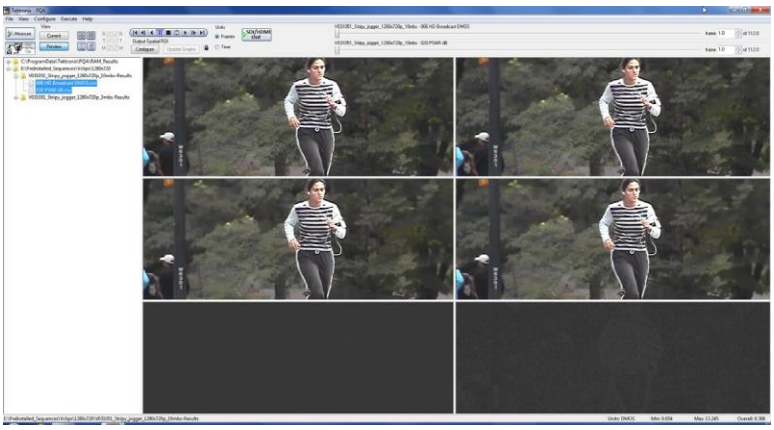


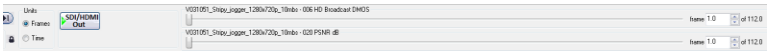
- The Reference clip appears in the top tile. The Test clip appears in the middle tile. The impairment map appears in the bottom tile.
- You can play the video clip in the Tile View using the control bar and frame selector at the top of the window.

2. You can change which portion of the video clip appears in the tile by clicking and dragging the video clip in the tile. The same frame number is used for all three tiles, but you can view different portions of the frame in each tile. You can also enlarge or shrink the tiles by dragging the bars that separate the tiles.

3. You can compare two measurement results in the Tile View. To do this, use the Ctrl key to select two results files in the Navigation pane and then select the Tile View button.

   For example, you could compare an Attention Weighted PSNR measurement to a DMOS measurement.





NOTE. *In the control bar that there is a lock icon. The lock icon indicates whether the two frame selectors are tied together. If the lock is closed, the frame selectors are tied together and changing one selector changes the other. If the lock is open,*  *, then you change either frame selector without changing the other.*

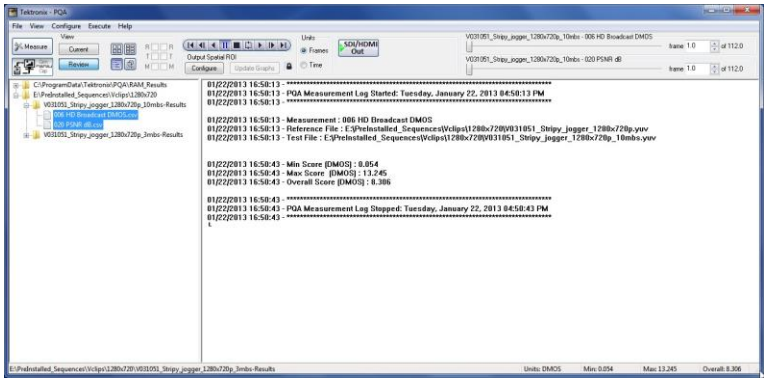
Having the frame selectors locked does not require that they be set to the same frame number. Each frame selector can be set to a different frame number.

Error Log display

The Error Log display contains entries that identify events when the Error and Warning levels have been exceeded. The measurement that is shown in the Error Log depends on the selected measurement. You set the values for Error and Warning levels in the Summary configuration node.

- To display the Error Log Display, click the Tile View button.

The Error Log is a listing of all the events that exceed the Warning and Error levels as specified in the Summary Node for the selected measurement. The Error Log is only a listing, there are no controls associated with the Error Log display.



The following paragraph shows a subset of lines from an error log. Line numbers are added here for the sake of discussion; the line numbers do not appear in an actual error log.

```
1.  05/24/2010 15:50:38 - Measure:  034 Attention Weighted PSNR dB

2. 05/24/2010 15:50:38 - Reference File:  d:Vclips\1280x720p\V031051_Stripy_jog-
ger_1280x720p.yuv

3. 05/24/2010 15:50:38 - Test File:  d:Vclips\1280x720p\V031051_Stripy_jog-
ger_1280x720p_3mbs.yuv

4. 05/24/2010 15:50:42 - Warning:  Begin Limit Warning - Measurement value of
25.937963 at frame 1.0 exceeds warning threshold of 45.00.

5. 05/24/2010 15:50:42 - Error:  Begin Limit Violation - Measurement value of
25.937963 at frame 1.0 exceeds error threshold of 30.00.

6. 05/24/2010 15:57:11 - End Limit Violation - Frame:  165.0 Duration:  164.0.
```

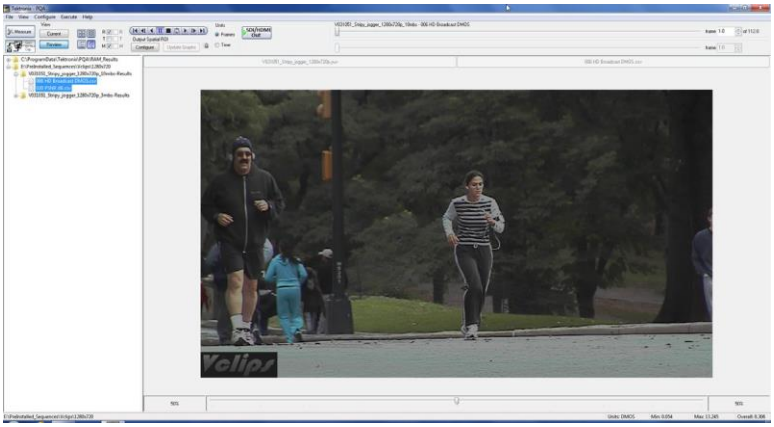
Every line begins with the date and time of the error log entry. Line 1 identifies the measurement selected. Lines 2 and 3 identify the path and name of the reference and test files, respectively. Line 4 identifies an event where the PSNR exceeded the warning level. The line lists the measurement value, the frame number where the event occurred and the level that was violated (the warning threshold of 45.00). Line 5 lists another event, in this case the Error level was violated. Line 6 shows that the limit violations have ended. The violation end point is identified by frame number and the duration of the violation is also listed.

Overlay View display

The Overlay View allows you to compare the reference and test video clips or a video clip (reference or test) and a map by stacking one on top of the other. You can shift the mix of video clip or map from 0% to 100%, with the default mix set at 50% of each. You can use the Overlay View to easily match features in a video clip with features in an map.

- To display the Overlay View Display, click the Overlay View button.

The Overlay View defaults to a 50/50 mix which is indicated by the slider at the bottom of the Overlay View display.



- To select which two sources are compared, use the R/T/M check boxes next to the view buttons.

  - Select **R** to chose the Reference clip. Select **T** to choose the Test clip. Select **M** to choose the map.

  This example view compares the Test video clip with the map. The mix in this view is 50% test clip and 50% map. The ratio of the mix is shown by the numbers at the bottom right and bottom left of the Overlay view.

  At the top of the Overlay view are readouts of the source file name assigned to each side of the slider. In this example, moving the slider to the right will increase the mix in favor of the map (filename.csv) and moving it to the left increases the mix in favor of the test clip (filename.yuv).

Graph display

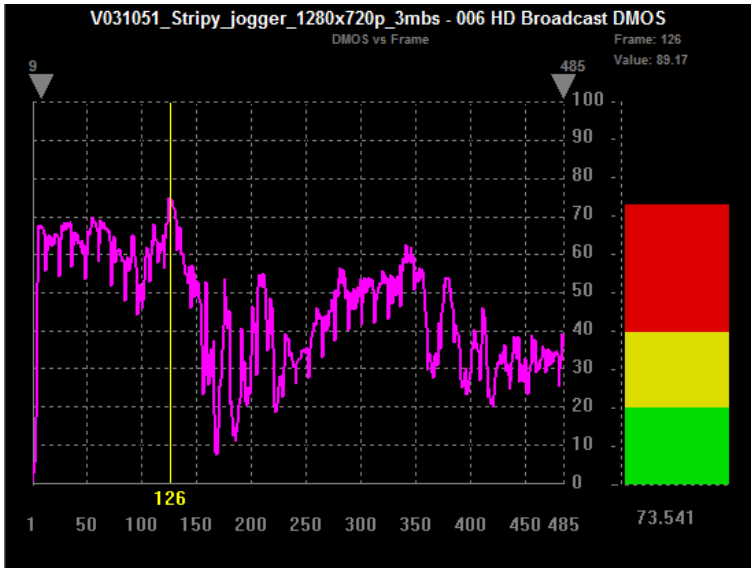
The Graph display plots several measurement values against frame number. The particular measurements shown in the Graph display depend on the selected measurement.

To display the Graph display:

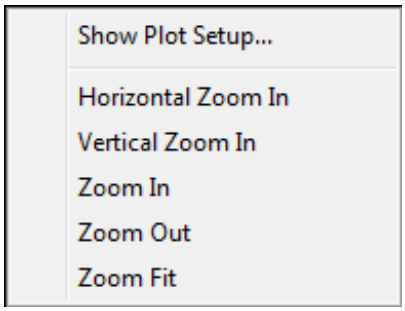
- Select either the Tile View or Summary View.

This is the Graph display in Review mode.

- The graph of measurements (relevant to the selected measurement) are plotted versus frame number shown at the top of the graph.

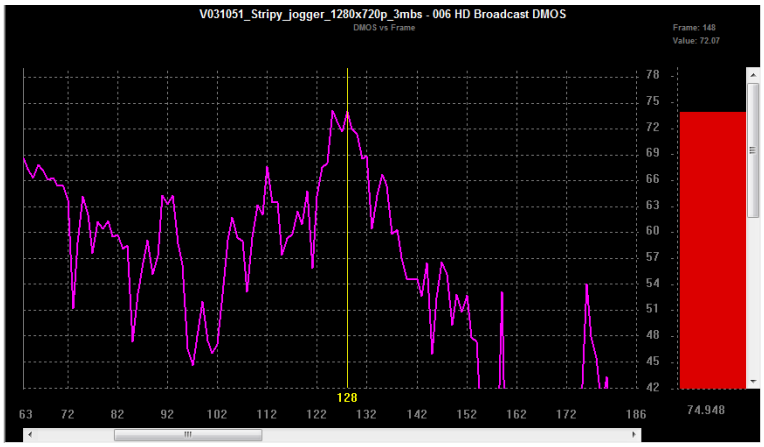


Right-click on the Graph to display the Graph pop-up menu. You can adjust the display of the graph using the commands:

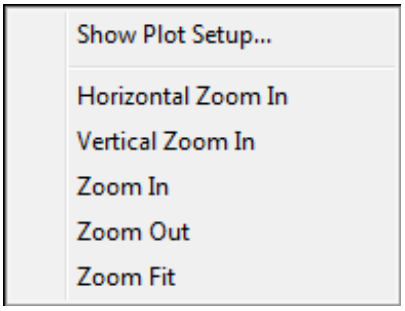


- Expand the horizontal scale of the graph by selecting **Horizontal Zoom In**.
- Expand the vertical scale of the graph by selecting **Vertical Zoom In**.
- Select **Zoom In** or **Zoom Out** to resize the graph as desired.
- To reset the graph to its original scale, select **Zoom Fit**.

This illustration shows the appearance of the graph after selecting **Zoom In**.



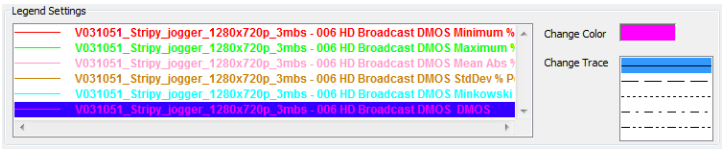
To change the Graph display properties, select **Show Plot Setup**.



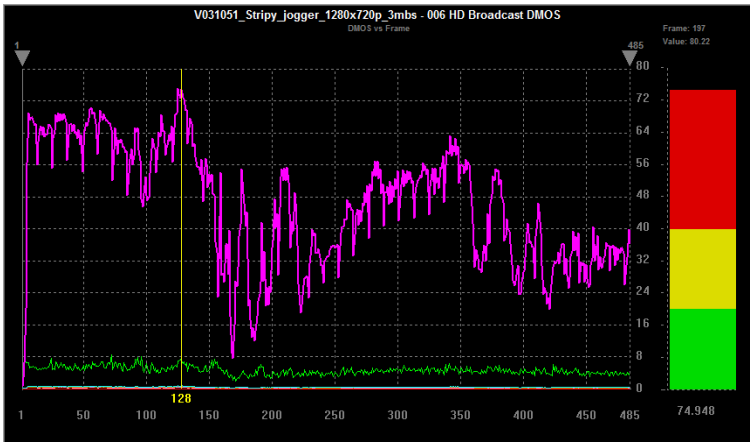
To select additional statistics for the selected measurement, select the statistics you wish to display by checking the box next to the measurement.

To change the appearance of a plot line:

1. Select the measurement.
2. Click on the **Change Color** box and select a color.
3. Select a line from the Change Trace box to use a different line for the measurement.

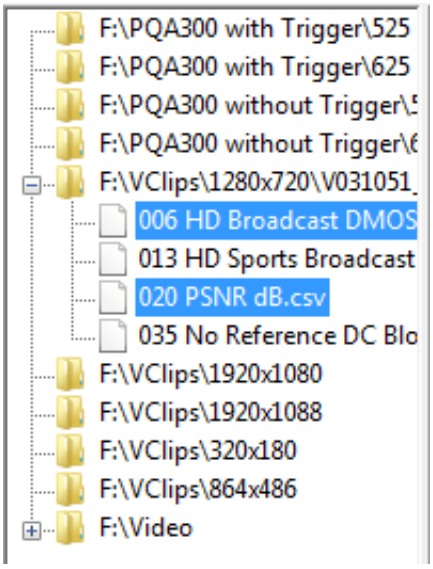


This illustration shows a Graph display with all available measurements displayed.

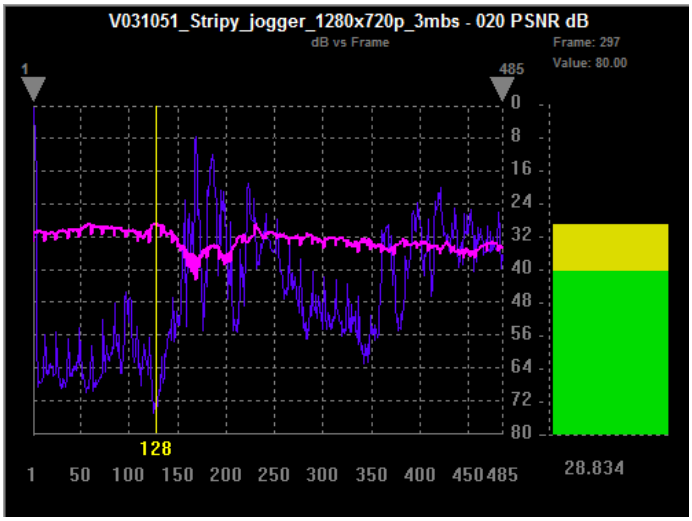


You can easily compare the results of two measurements by plotting both measurements on the Graph display at the same time.

1. To add existing results to the current Graph view, locate the measurement you want to add in the Working directory pane and control-click on the result.



The measurement result you selected will be added to the current graph.

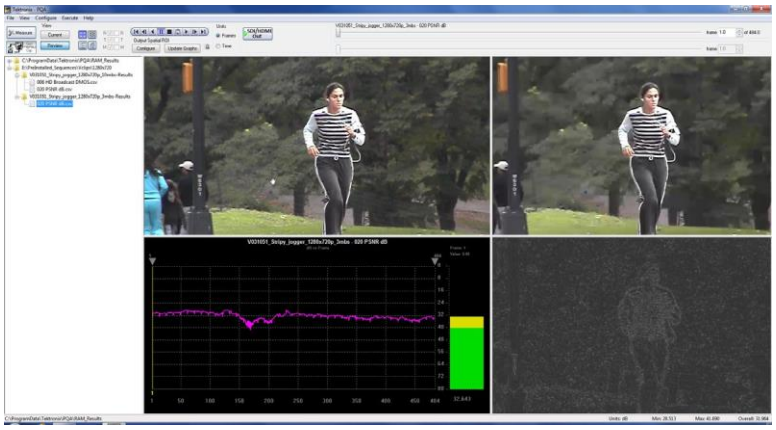


How to use the output Region-of-Interest to review results

Output Spatial ROI. To specify the region of interest, you draw a box over the region in the video in which you are interested and then update the measurements. The measurement result is then recalculated for the region you have selected.

To specify an Output Spatial ROI in Review mode:

1. Set up and run a measurement on the video clip of interest.



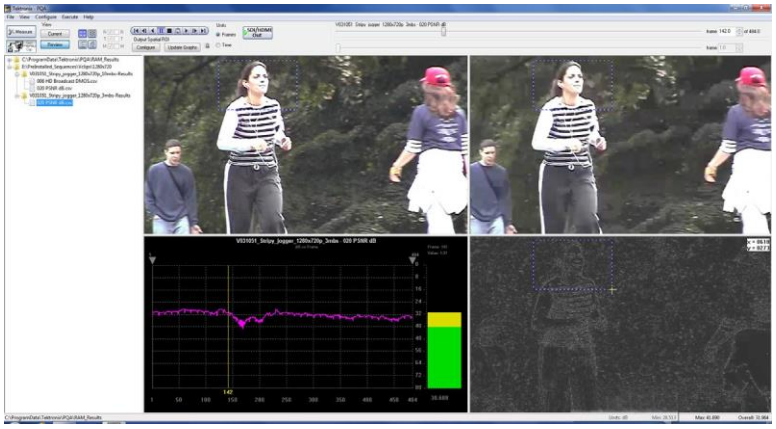
2. Move the slider bar or use the control bar to select a frame which you can use to select the region of interest.

   The region of interest that you specify will be applied to each frame in the test clip.

NOTE. *Note that the Configure button is highlighted and the Update Graphs button is not selectable.*

3. Shift-click and drag over the region of the Results Map that you wish to limit the measure to (if you do not use Shift, you will just drag the video clip within the window).

   As you start to drag the pointer over the region of interest, a box will appear on the Results Map that displays the location of the pointer.

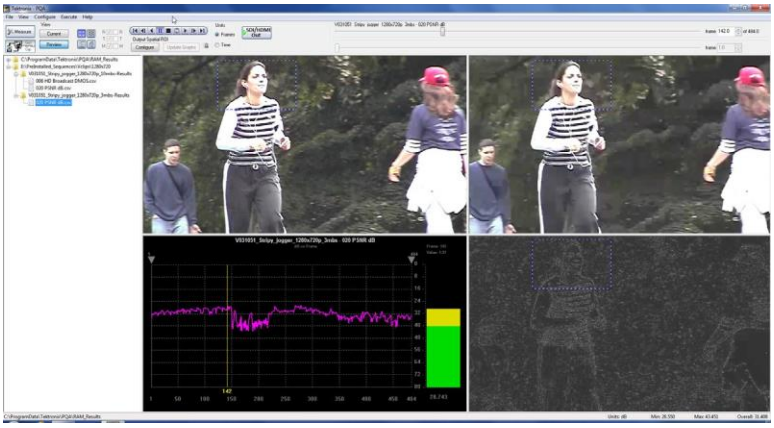


Note that as you click and drag, the selection box is drawn over the Reference video, Test video, and Results Map at the same time.

Once you have specified the region of interest, the **Update Graphs** button is selectable.

4. To evaluate the measurement only for the region of interest, click the **Update Graphs** button.

The measurement result in the graph area is updated to reflect the measurement limited to the region of interest. Both the graph and the bar readout change to reflect the new measurement results.



Output Temporal ROI. To specify an Output Temporal ROI, you select the frames of the video clip you wish to analyze. After you specify the frames to which you want to limit your measurement, the measurement results are updated immediately.

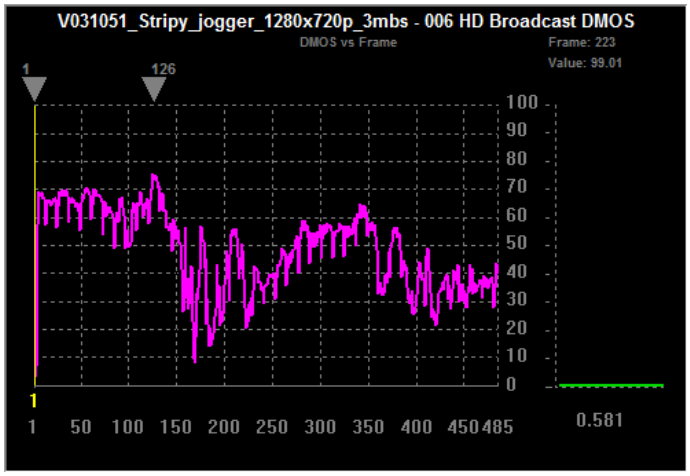
A typical use for Temporal ROI is when you wish to analyze a portion of a concatenated test clip.

To specify an Output Temporal ROI:

1. Set up and run a measurement on the video clip of interest.

NOTE. *After the measurement is complete, look at the measurement results in the lower-right corner of the window. Note the value for Overall.*

2. Adjust the gray triangles above the plot in the Graph display to select the frames to which you wish to limit the measurement.



The measurement results are updated immediately after you specify the frames used in the measurement. You do not have to initiate an update to the results.

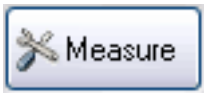
Compare the **Overall** measurement result in the lower-right corner of the window with the value you saw before you limited the frames used in the measurement. In this example, the Overall value for the whole video clip is 57.084. But the Overall value after specifying the Temporal ROI is 65.692.

PSNR measurement

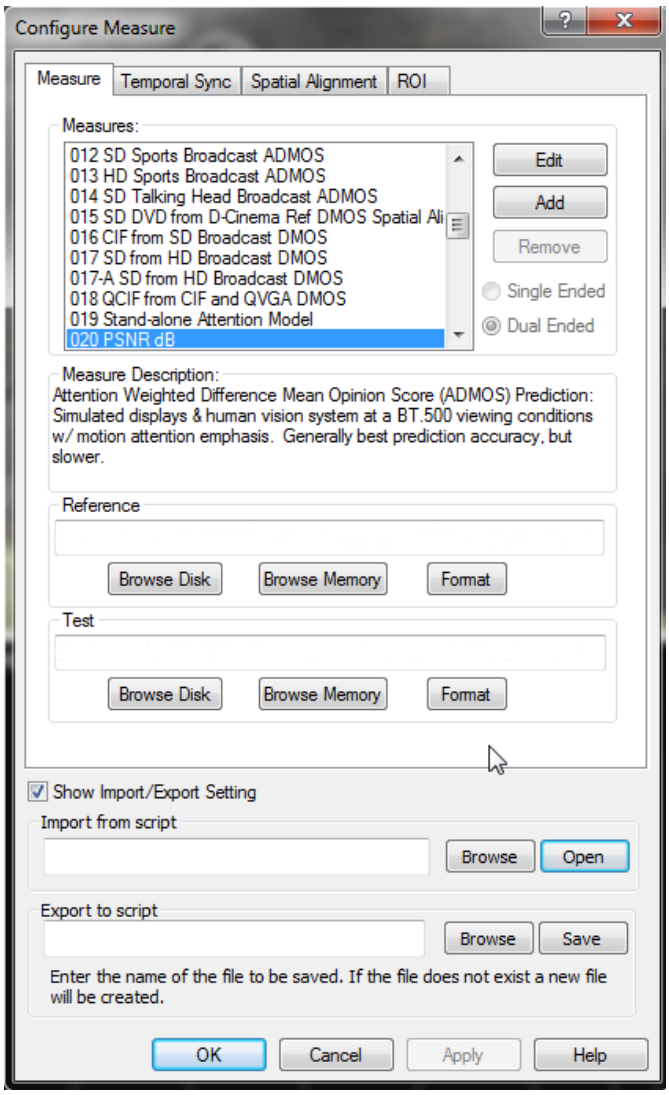
PSNR Measurement shows the difference between the reference sequences and test sequences by subtracting them. It does not take into account the human vision model, so the result shows the absolute difference between the reference and test sequences. PSNR is useful for identifying small errors that the human cannot recognize. The highlighted white areas of a PSNR map show the areas of greatest difference between the original and degraded image. This measurement is useful at the beginning of the CODEC debugging process.

The PQA analyzer provides PSNR results for overall sequence and each frame. It also provides the PSNR map that is used to find the location where there are differences. The brightness and contrast for the PSNR map can be controlled from the Configure > Display Settings dialog. By adjusting the brightness and contrast you can make it easier to find differences on the PSNR map when it appears there is little difference between the reference and test sequences.

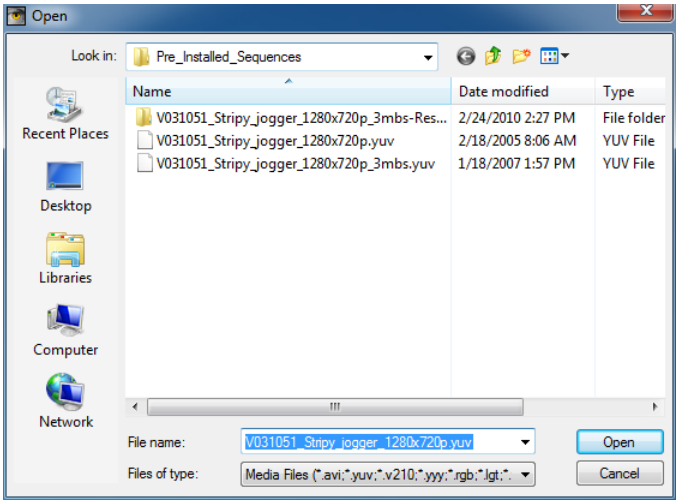
1. Click the **Measure** button.



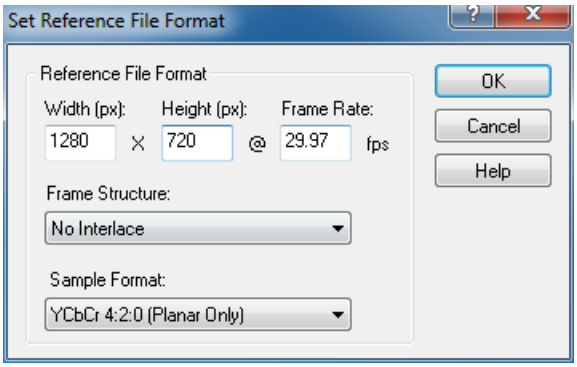
2. Select the **020 PSNRdB** measurement from the **Configure Measure** window.
3. In the **Reference** box, click **Browse Disk**.



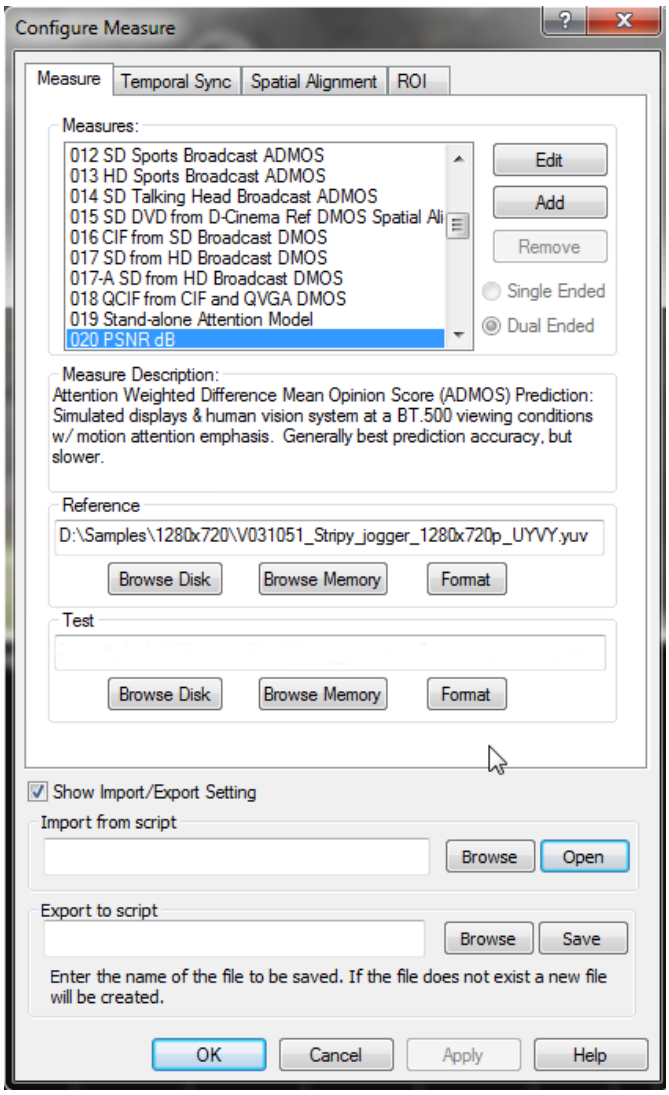
4. In the **Open** dialog box, browse to the directory: **D:\Vclips\1280x720p**.
5. Select the file **V031051_Stripy_jogger_1280x720p.yuv** and click **Open**.



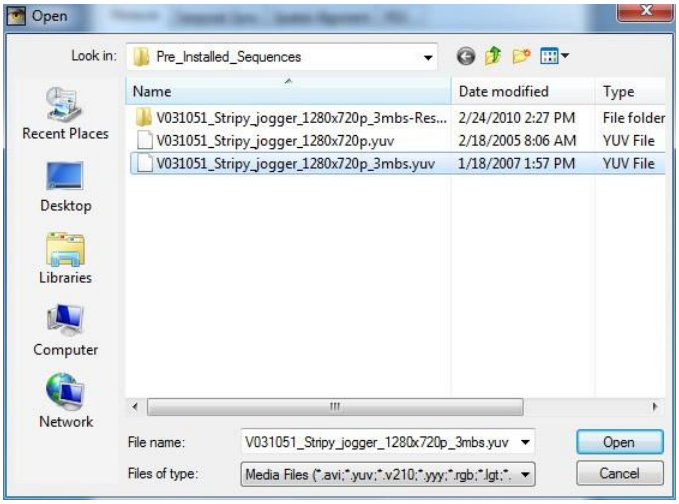
6. In the **Set Reference File Format** dialog, enter the following values:
   - Width: 1280
   - Height: 720
   - Frame Rate: 30
   - Sample Format: YCbCr 4:2:0 (Planar Only)
7. Click **OK**.



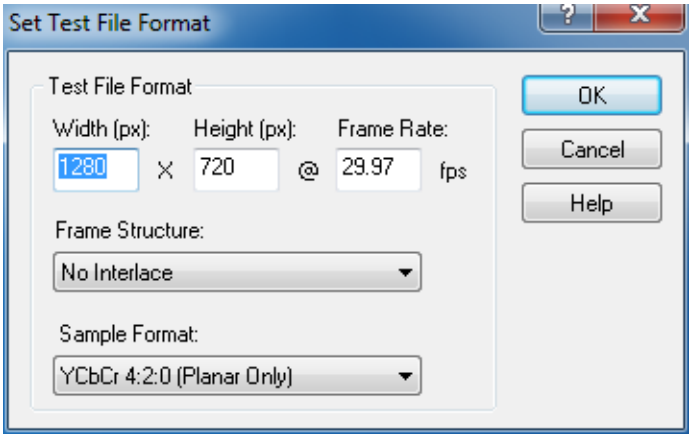
8. In the **Test** box, click **Browse Disk**.



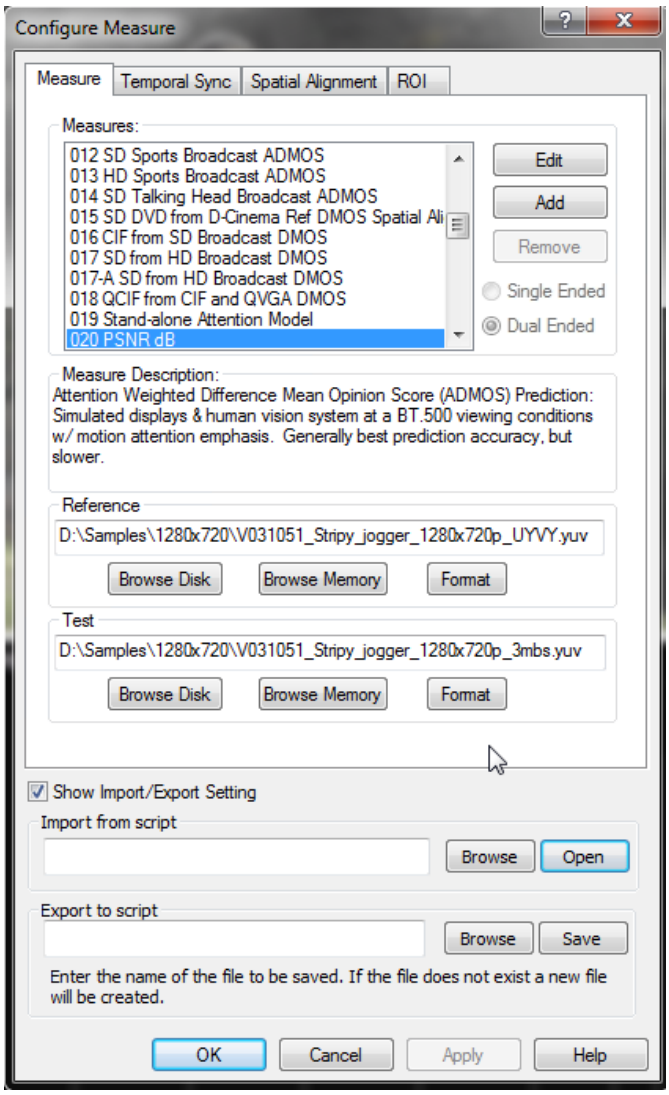
9. Select the file **V031051_Stripy_jogger_1280x720p_3mbs-.yuv** and click **Open**.



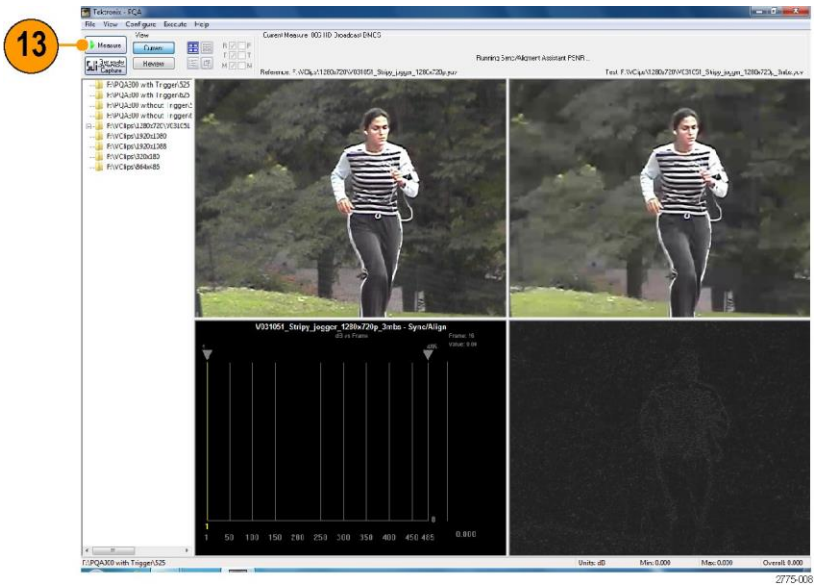
10. In the **Set Test File Format** dialog, enter the following values:
    - Width: 1280
    - Height: 720
    - Frame Rate: 30
    - Sample Format: YCbCr 4:2:0 (Planar Only)
11. Click **OK**.



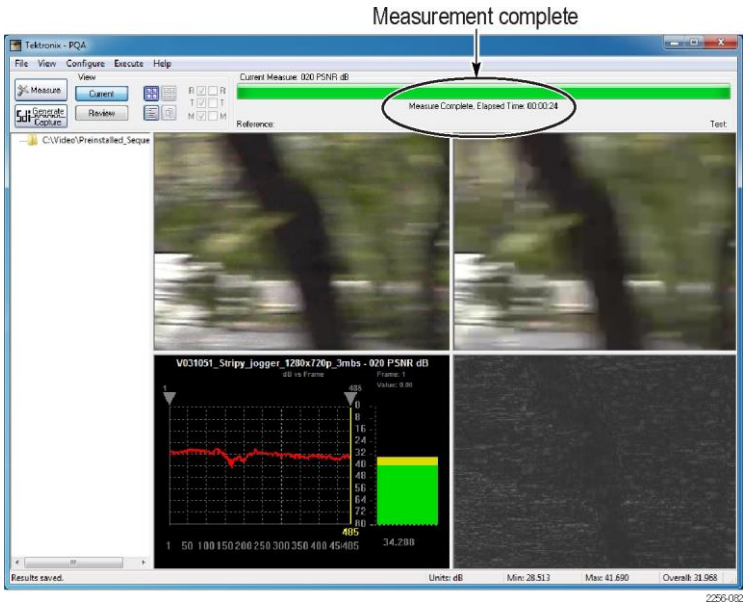
12. Click **OK** in the Configure Measure dialog box.



13. Click the **Measure** button to begin the measurement.

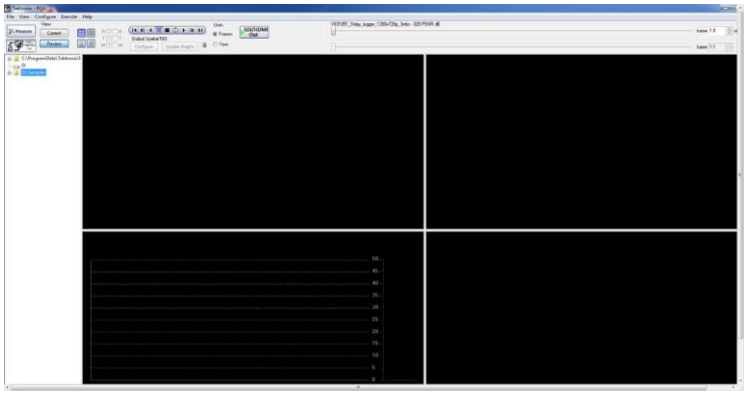


When the measurement is complete, the progress bar will display **Measure Complete** and display the elapsed time the measurement required.

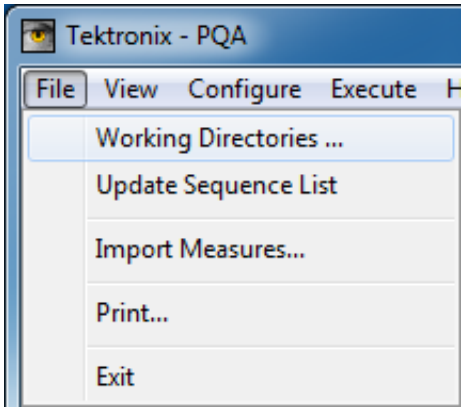


14. To view the results of the measurement, click the **Review** button.

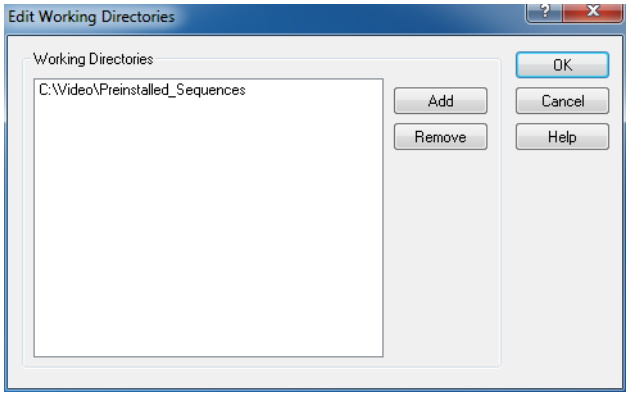
When you select the Review view, the existing display will change to the one shown at the right. To review results, you select them from the Navigation pane. To select a results file for review, the directory that contains the results file must be selectable in the Navigation panel. Since there are no directories currently in the navigation pane, we will add them.



15. To add directory containing measurement results to the navigation pane, select **File > Working Directories**.

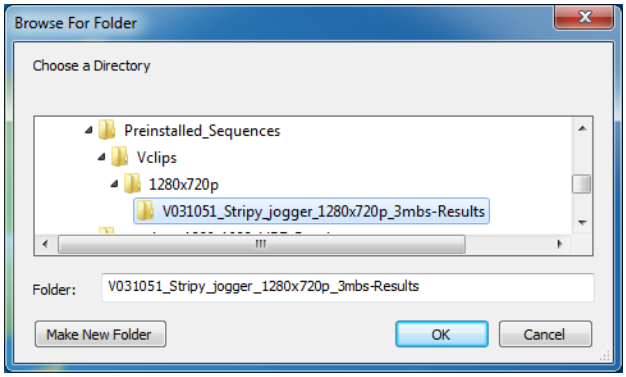


16. From the Edit Working Directories dialog, select **Add**.



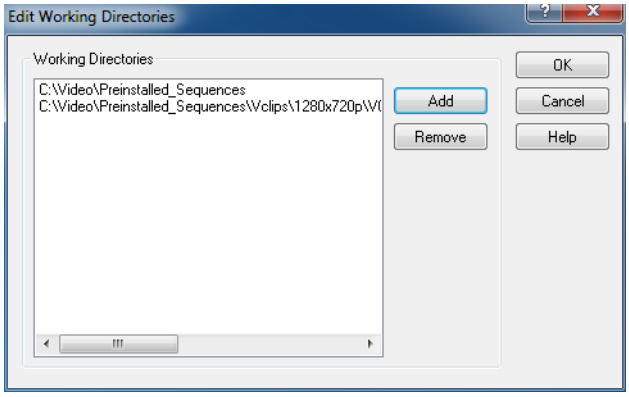
17. From the **Browse For Folder** dialog, navigate to the folder that contains the video clips you tested.

18. Select the folder that contains the video clips and click **OK**.

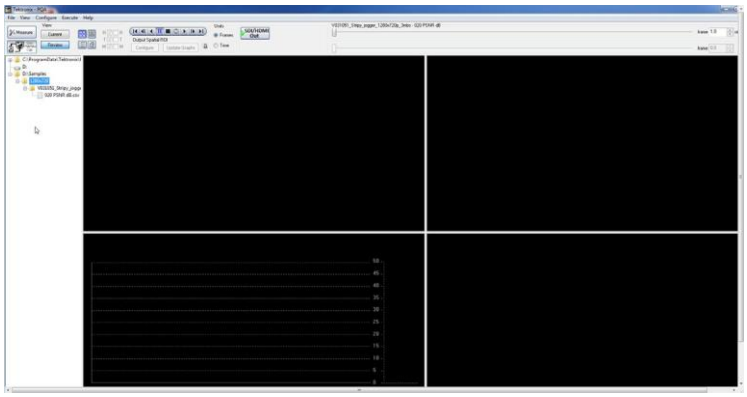


When the Edit Working Directories dialog is displayed, you can see the directory just added now appears in the list of Working Directories.

19. In the **Edit Working Directories** dialog box, click **OK**.



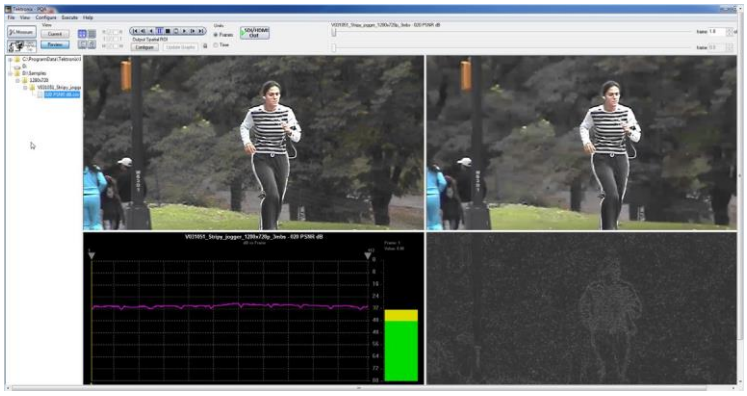
20. Click the **+** symbol next to the folder for the directory you just added to the working directory list.



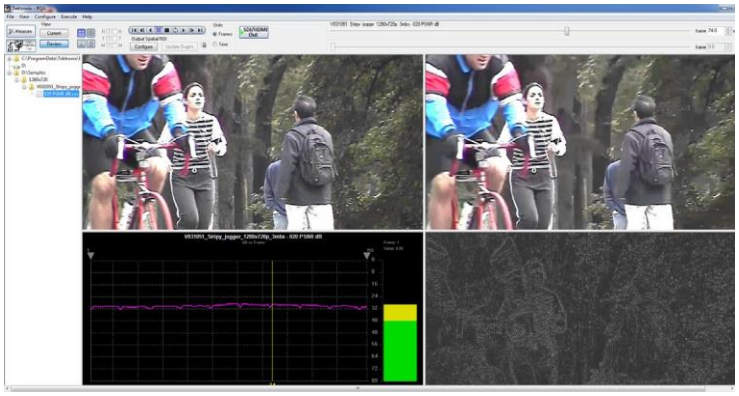
21. Click the **+** symbol next to the folder named after the test file you selected.

    When the folder expands, you will see results files for all the tests you have run using the test video clip.

22. Select the results file labeled **020 PSNR dB.csv**.



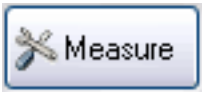
23. To review the results, adjust the slider bar to change the displayed frame. Note which frame has the worst value, and note the highlighted region on the map.



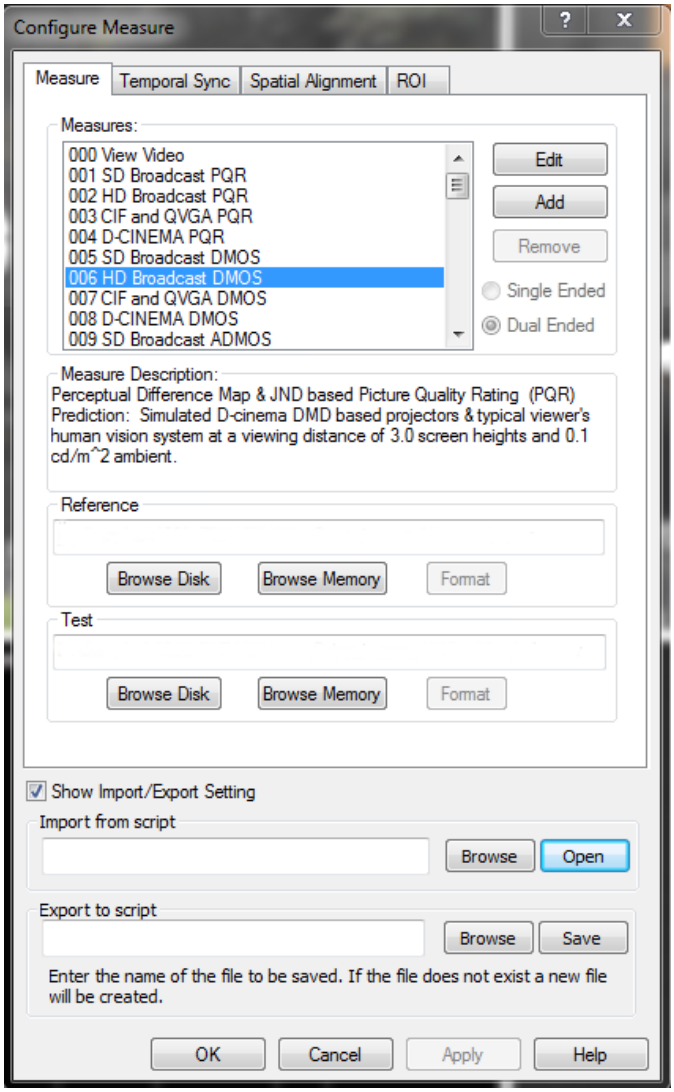
DMOS measurement

The DMOS (Differential Mean Opinion Score) measurement shows the difference between the reference and test sequences taking the human vision model into consideration under ITU-R BT.500 conditions. This measurement predicts the degree to which viewers perceive the difference between reference and test sequences (under the ITU-R BT.500 conditions). This measurement is useful for evaluating the general performance of CODEC algorithms / instruments. The perceptual difference map shows the location in the sequence where there are differences that can be perceived by people. The DMOS measurement is useful for identifying what sequence and CODEC algorithm combination impacts picture quality.

1. Click the **Measure** button.

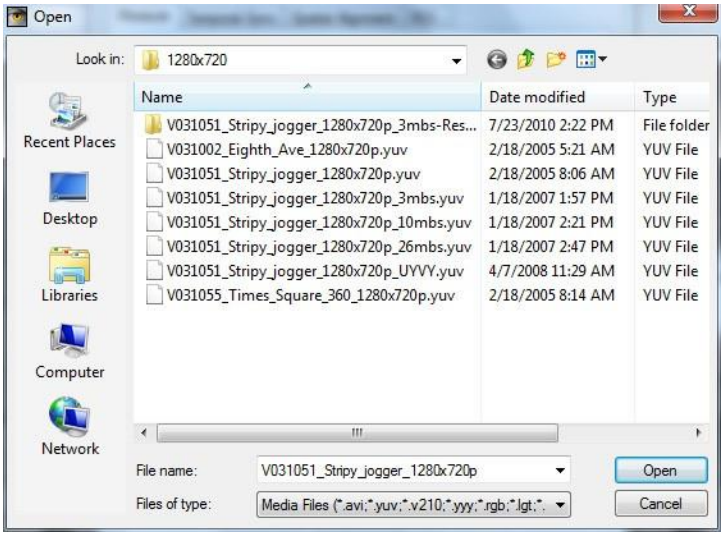


2. Select the **006 HD Broadcast DMOS** measurement from the **Configure Measure** window.
3. In the **Reference** box, click **Browse**.



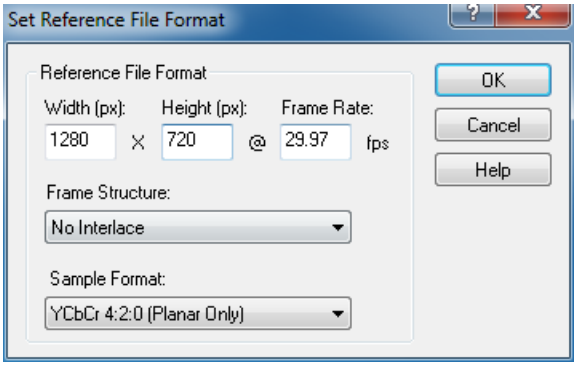
4. In the **Open** dialog box, browse to the directory: **D:\Video\PreInstalled_ Sequence\Vclips\1280x720p**.

5. Select the file **V031051_Stripy_jog-ger_1280x720p.yuv** and click **Open**.

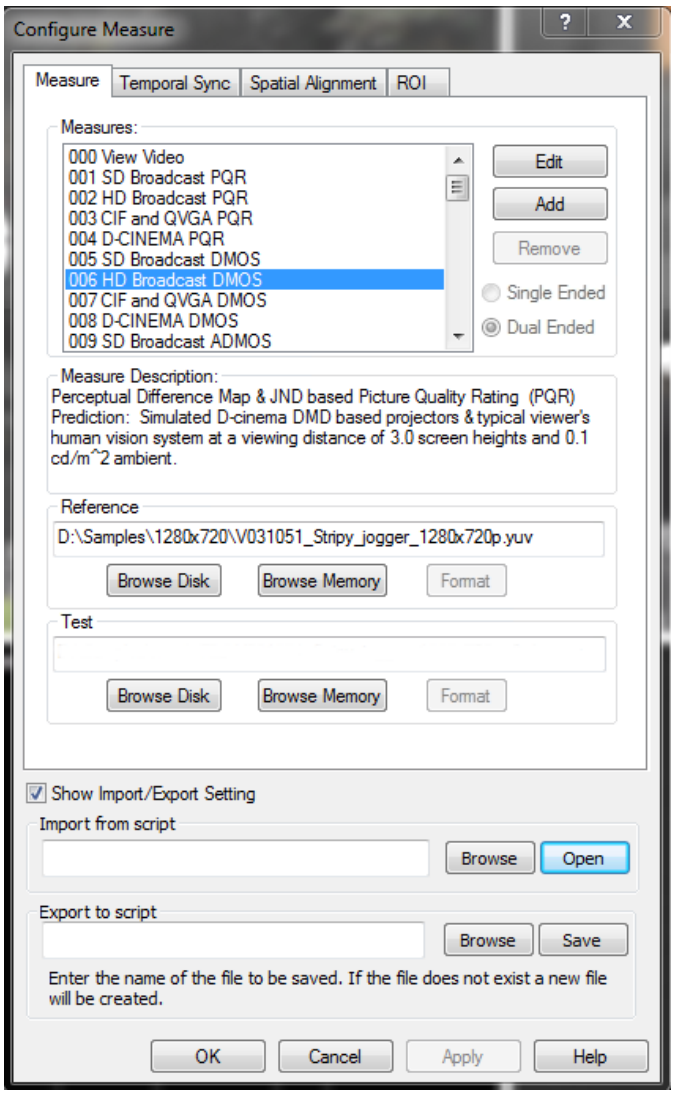


6. In the **Set Reference File Format** dialog, enter the following values:
   - Width: 1280
   - Height: 720
   - Frame Rate: 30
   - Sample Format: YCbCr 4:2:0 (Planar Only)

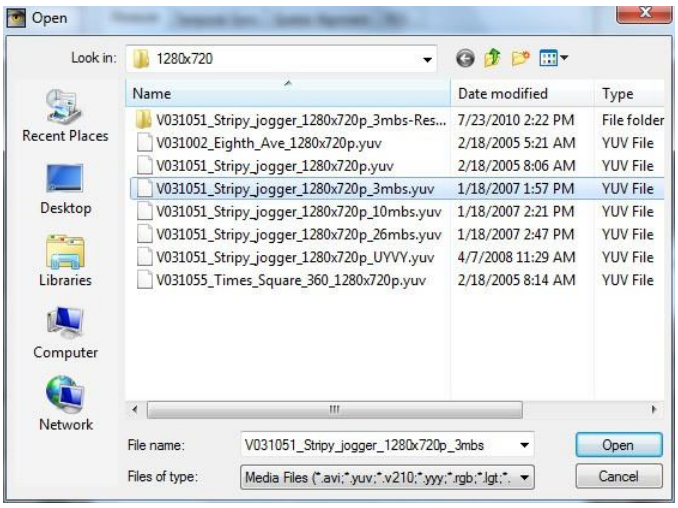
7. Click **OK**.



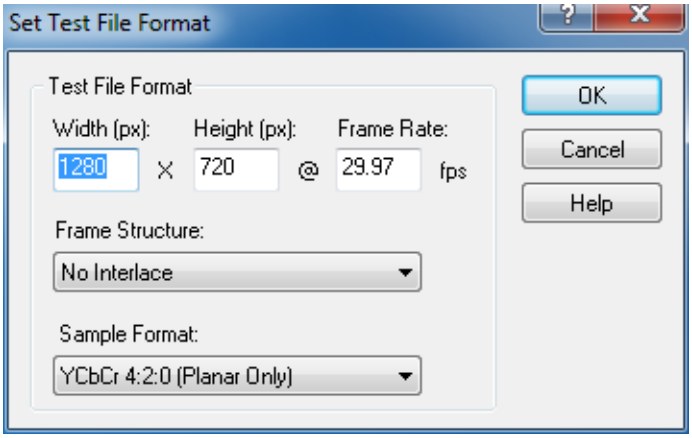
8. In the **Test** box, click **Browse**.



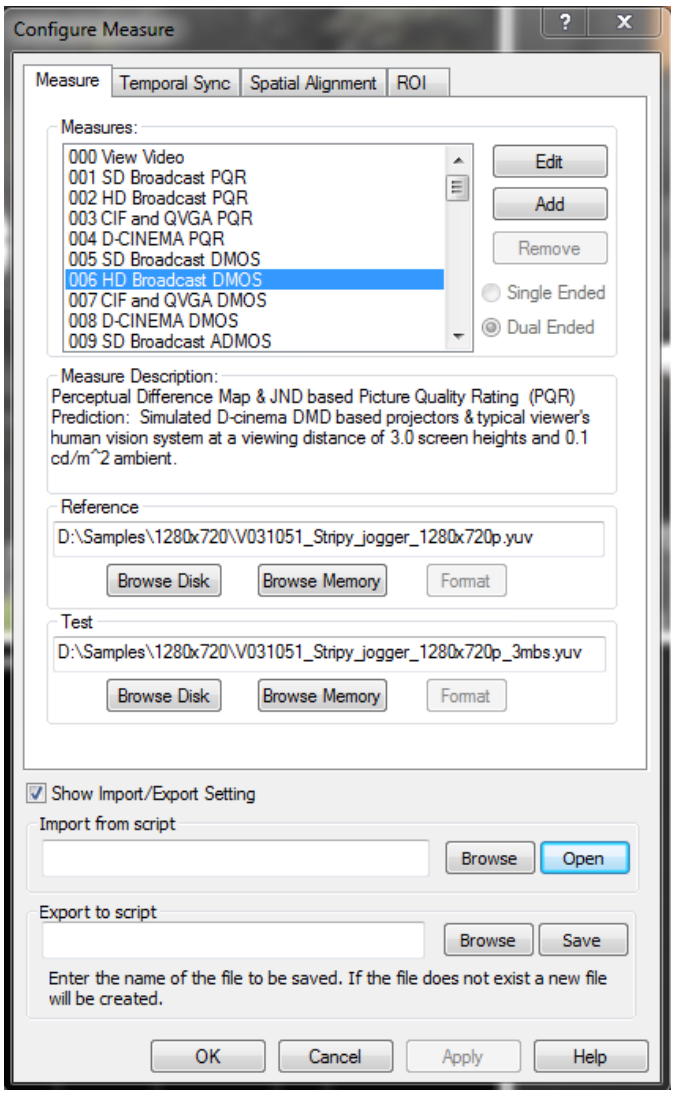
9. Select the file **V031051_Stripy_jogger_1280x720p_3mbs.yuv** and click **Open**.



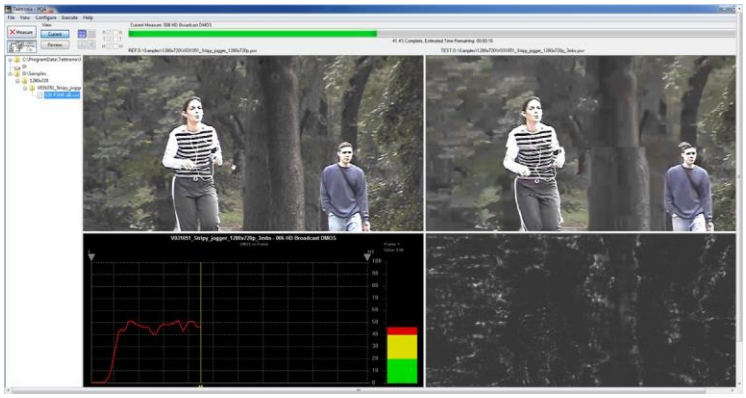
10. In the **Set Test File Format** dialog, enter the following values:
    - Width: 1280
    - Height: 720
    - Frame Rate: 30
    - Sample Format: YCbCr 4:2:0 (Planar Only)
11. Click **OK**.



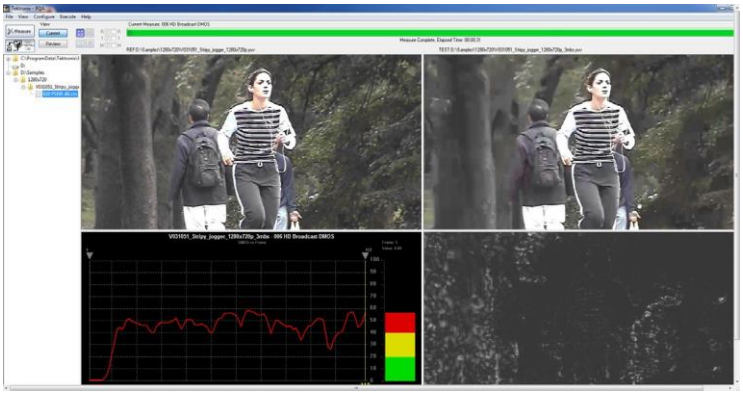
12. Click **OK** in the Configure Measure dialog box.



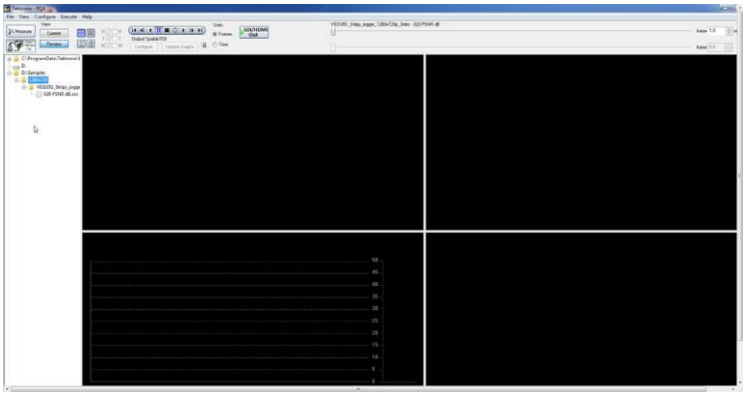
13. Click the **Measure** button to begin the measurement.



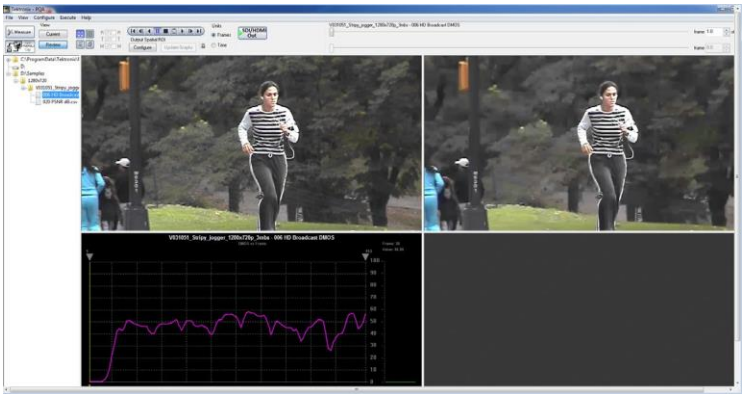
When the measurement is complete, the progress bar will display **Measure Complete** and display the elapsed time the measurement required.



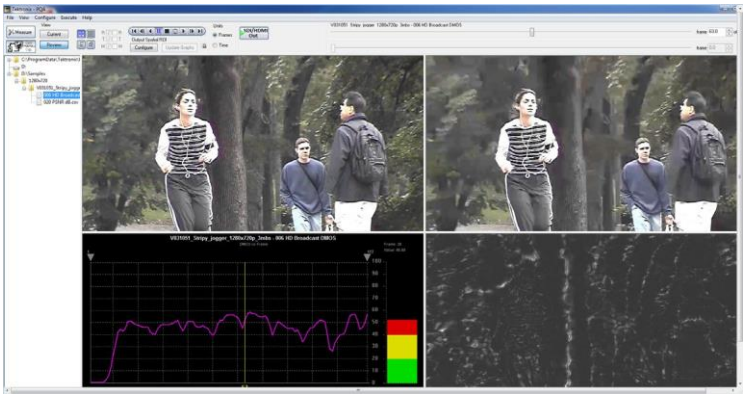
14. To view the results of the measurement, click the **Review** button.



If you performed the previous application, PSNR Measurement, you will see that the results for this measurement now appear above the previous results. (If the results do not appear in the Navigation panel, select **File** > **Update Sequence List**.)



15. To review the measurement results, click the **006 HD Broadcast DMOS.csv** results file.

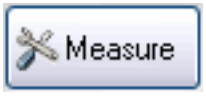


16. To review the results, adjust the slider bar to change the displayed frame. Note the different pattern in the results compared to the PSNR measurement.

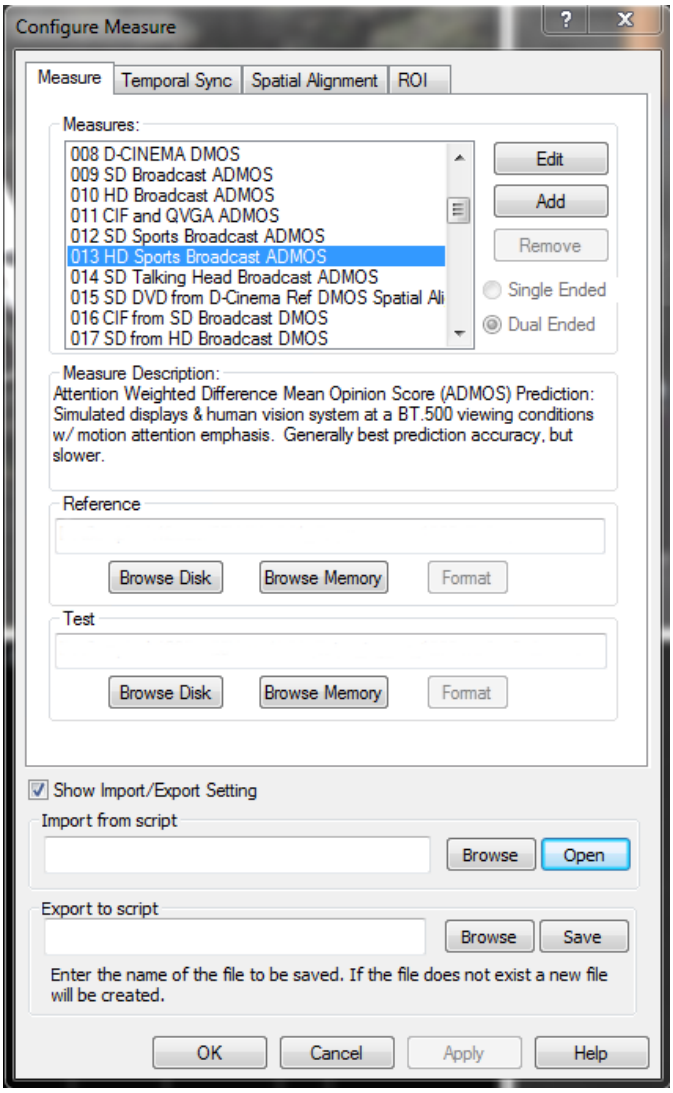
Attention weighted DMOS measurement

The attention weighted DMOS measurement provides a DMOS result with weighting apportioned by probable areas in the sequences on which the human eye is focusing. This measurement provides information that enables a designer to optimize a CODEC for a specific application, such as a Sports program. Knowing which areas of sequences get the most attention from viewers enables the designer allocate to bit resources for the more important objects in the scene.

1. Click the **Measure** button.

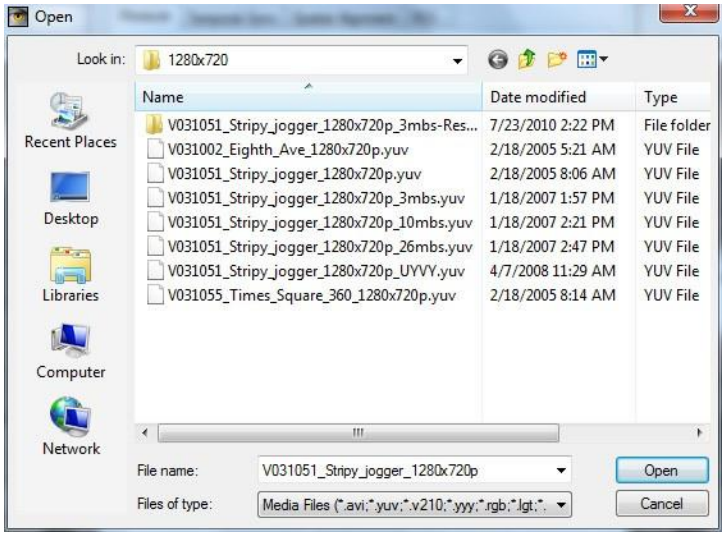


2. Select the **013 HD Sports Broadcast ADMOS** measurement from the **Configure Measure** window.
3. In the **Reference** box, click **Browse**.



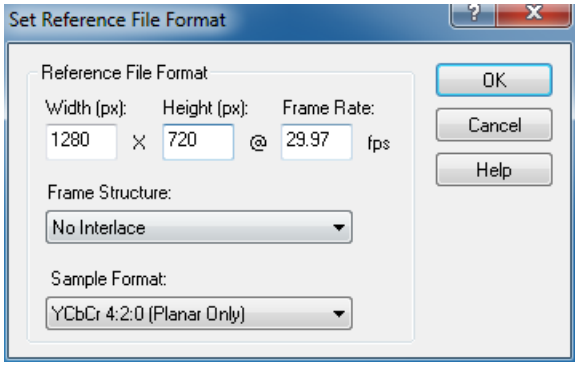
4. In the **Open** dialog box, browse to the directory: **D:\VClips\1280x720p**.

5. Select the file **V031051_Stripy_jogger_1280x720p.yuv** and click **Open**.

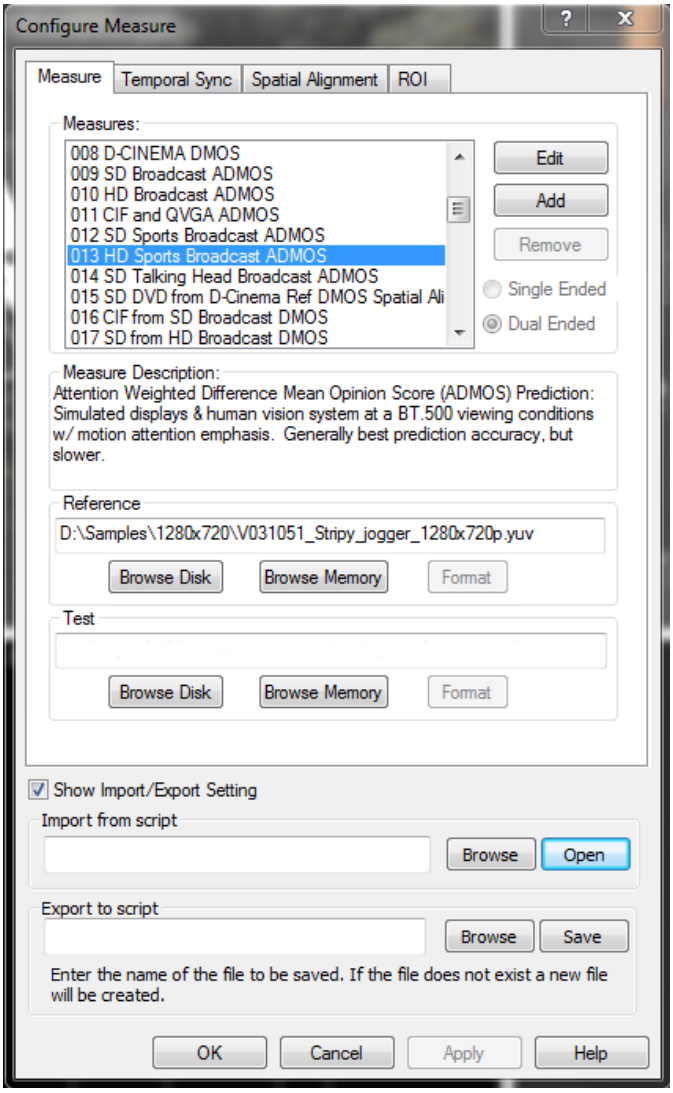


6. In the **Set Reference File Format** dialog, enter the following values:
   - Width: 1280
   - Height: 720
   - Frame Rate: 30
   - Sample Format: YCbCr 4:2:0 (Planar Only)

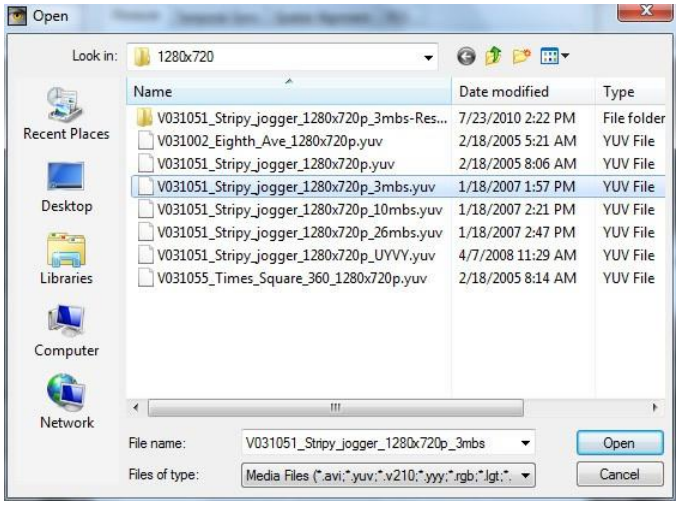
7. Click **OK**.



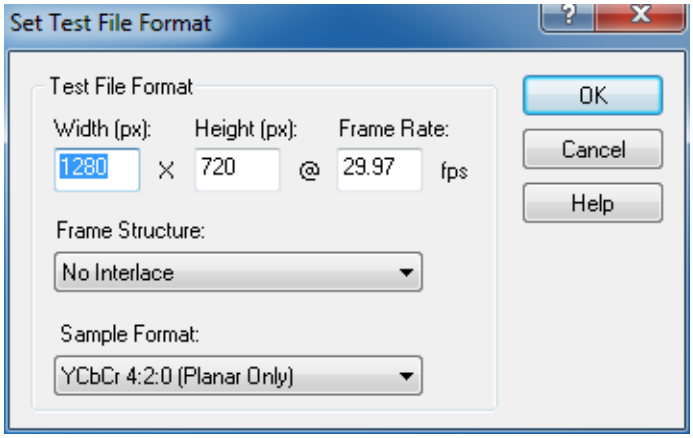
8. In the **Test** box, click **Browse**.



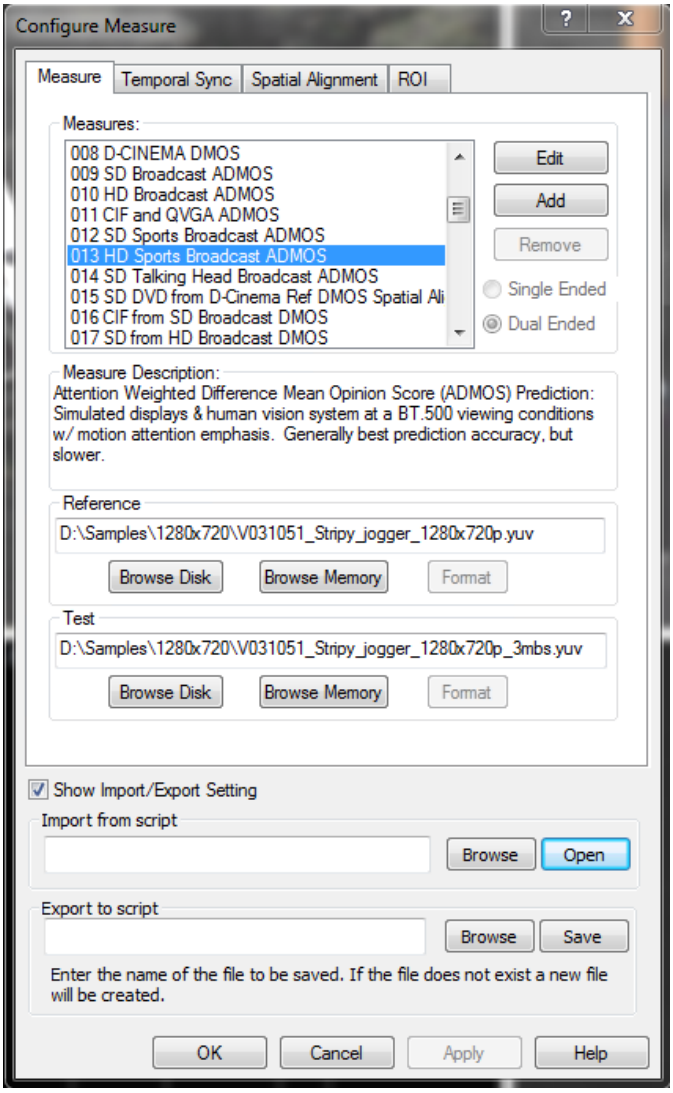
9. Select the file **V031051_Stripy_jogger_1280x720p_3mbs.yuv** and click **Open**.



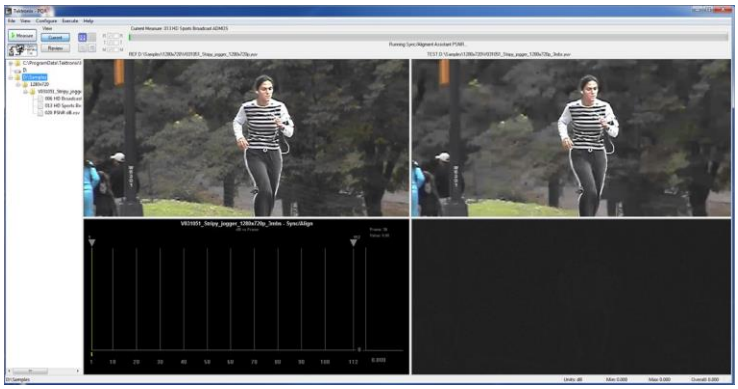
10. In the **Set Test File Format** dialog, enter the following values:
    - Width: 1280
    - Height: 720
    - Frame Rate: 30
    - Sample Format: YCbCr 4:2:0 (Planar Only)
11. Click **OK**.



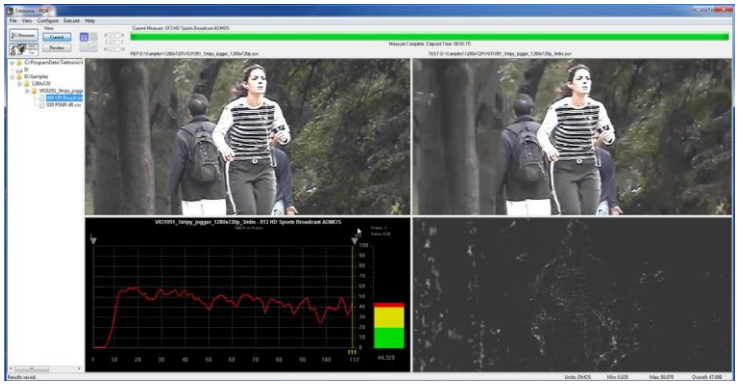
12. Click **OK** in the Configure Measure dialog box.



13. Click the **Measure** button to begin the measurement.



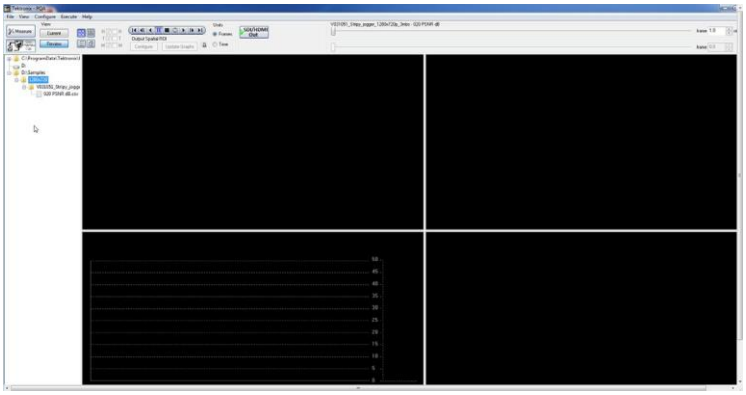
When the measurement is complete, the progress bar will display **Measure Complete** and display the elapsed time the measurement required.



14. In the main application window, click the **Review** button.

    If you performed the one of the previous applications, you will see that the results for this measurement now appears with the previous results. (If the results do not appear in the Navigation panel, select **File** > **Update Sequence List**.)

    If you have not performed any of the previous measurements, you will need to add the directory containing the measurement results to the Navigation pane. (See page 110, *How to select measurement results for display*.)

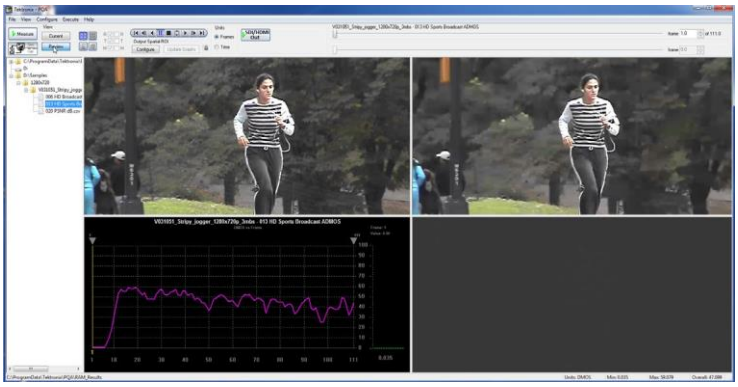


15. Click the **+** symbol next to the folder for the directory you just added to the working directory list.

16. Click the **+** symbol next to the folder named after the test file you selected.

    When the folder expands, you will see results files for all the tests you have run using the test video clip.

17. Select the results file labeled **013 HD Sports Broadcast ADMOS.csv**.



If you see a different trend for the DMOS result, it means the contents contains an area which attracts higher attention from the viewer. You might consider optimizing the algorithm in ways to reduce human eye attention.

Artifacts measurement with no reference

An artifacts measurement with reference provides a more accurate picture quality measurement (with respect to human perception) than an artifact measurement with no reference. The reason for this is that the measurement system cannot determine if the artifacts in the picture are caused intentionally by the creator or by unexpected system behavior. Nonetheless, an artifacts measurement with no reference is still a valuable measurement tool. An artifact measurement with no reference will measure well-known digital compression artifacts in a picture sequence. This measurement is useful for monitoring a broadcast system where there is no expectation of a reference sequence as there would be in a camera evaluation.

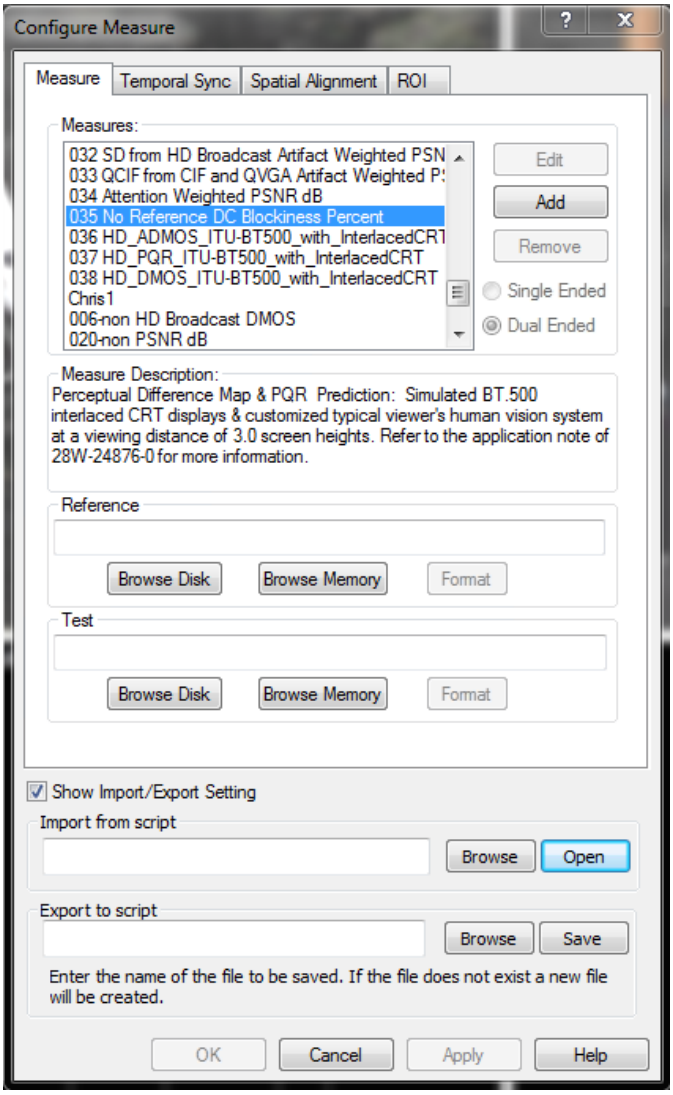
Artifact detection reports a variety of different changes to the edges of an image:

- Lost Edges or Blurring
- Added Edges or Ringing/Mosquito Noise
- Rotated Edges (Vertical and Horizontal) or Edge Blockiness
- Loss of Edges Within an Image Block or DC Blockiness

The No Reference DC Blockiness Percent measurement measures artifacts in a sequence and is used when there is no reference sequence. This measurement is useful for sample monitoring of a broadcast.

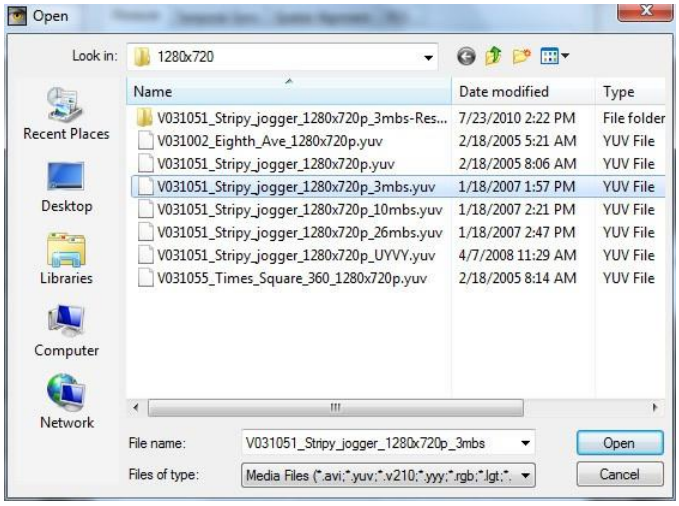
1. Click the **Measure** button.

2. Select the **035 No Reference DC Blockiness Percent** measurement from the **Configure Measure** window.
3. In the **Test** box, click **Browse**.



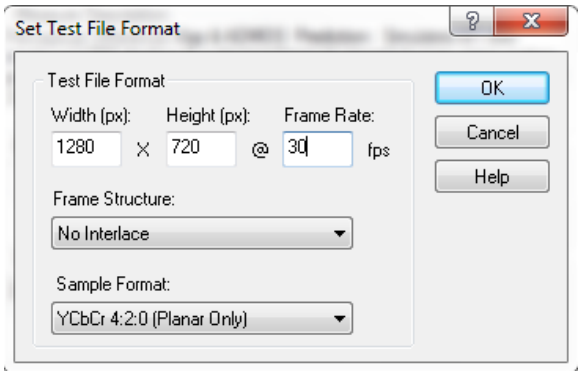
4. In the **Open** dialog box, browse to the directory: **D:\Vclips\1280x720p**.

5. Select the file **V031051_Stripy_jogger_1280x720p_3mbs.yuv** and click **Open**.

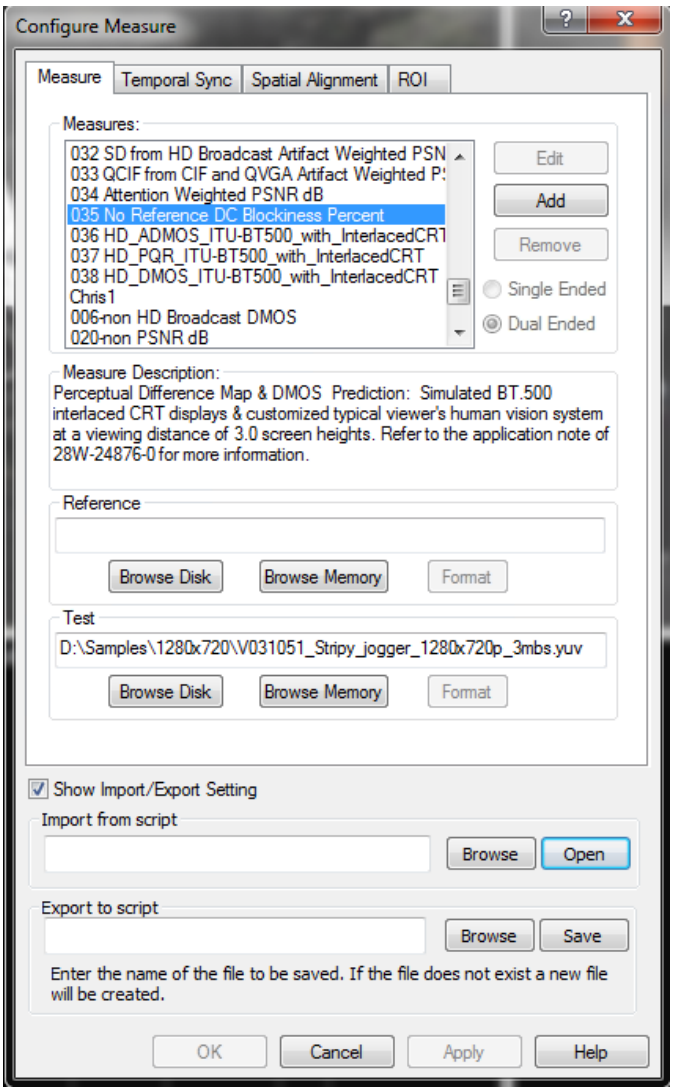


6. In the **Set Test File Format** dialog, enter the following values:
   - Width: 1280
   - Height: 720
   - Frame Rate: 30
   - Sample Format: YCbCr 4:2:0 (Planar Only)

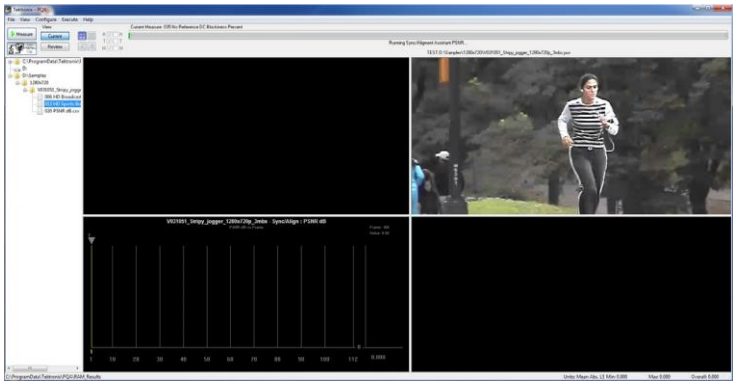
7. Click **OK**.



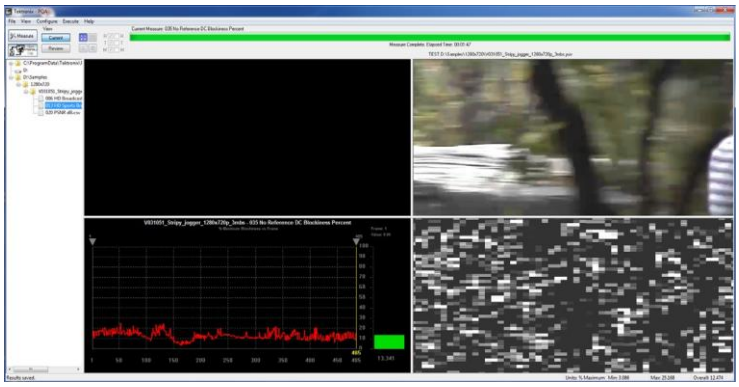
8. Click **OK** in the Configure Measure dialog box.



9. Click the **Measure** button to begin the measurement.



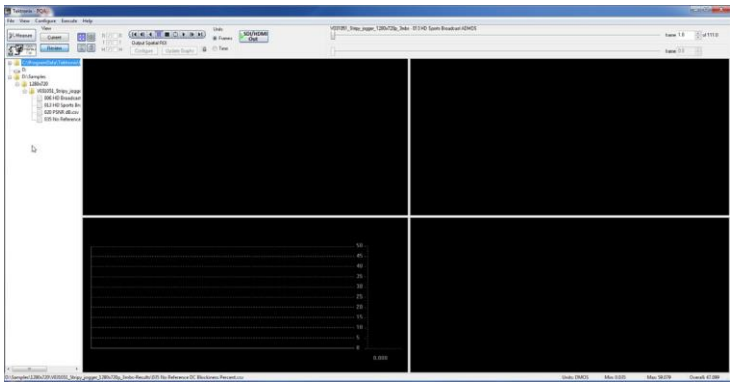
When the measurement is complete, the progress bar will display **Measure Complete** and display the elapsed time the measurement required.



10. In the main application window, click the **Review** button.

    If you performed the one of the previous applications, you will see that the results for this measurement now appears with the previous results. (If the results do not appear in the Navigation panel, select **File** > **Update Sequence List**.)

    If you have not performed any of the previous measurements, you will need to add the directory containing the measurement results to the Navigation pane. (See page 110, *How to select measurement results for display*.)

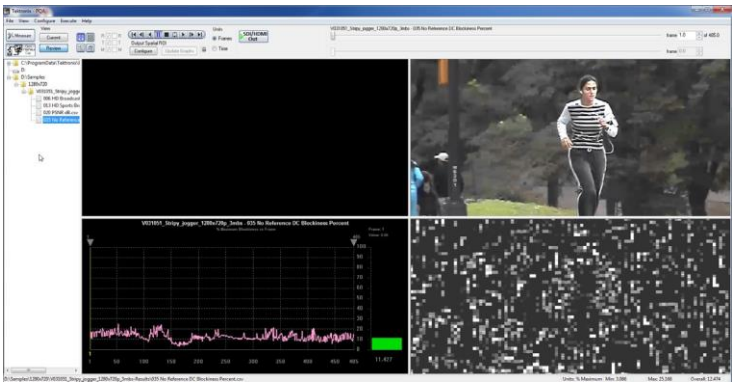


11. Click the **+** symbol next to the **D:\Vclips\1280x720p** folder.

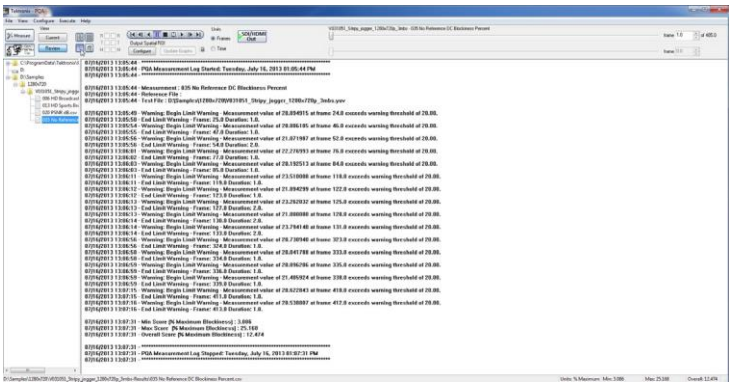
12. Click the **+** symbol next to the **V031051_Stripy_jogger_ 1280x720p_3mmbs-Results**.

    When the folder expands, you will see results files for all the tests you have run using the test video clip.

13. Click on the results file labeled **035 No Reference DC Blockiness Percent.csv**.



14. To view the Event Log for the measurement, click on  (the Event Log button).



Automated measurements using XML scripting

Using the PQA analyzer XML scripting capability, you can also run multiple measurement sequences simultaneously. You do this by running the software from a command line. When run in this way, the normal Windows application interface is not launched, but you will get a status readout in the command prompt while the measurement is running. Using the XML scripting capability maximizes system performance when you need to perform multiple measurements.

There are two ways to create an XML script. The simplest way is to export a measurement to a script from the Configure Measure window. Alternatively, you can edit an XML script file to specify the measurement to be made, the reference and test files, and any other parameters necessary to execute the test.

Exporting an XML script

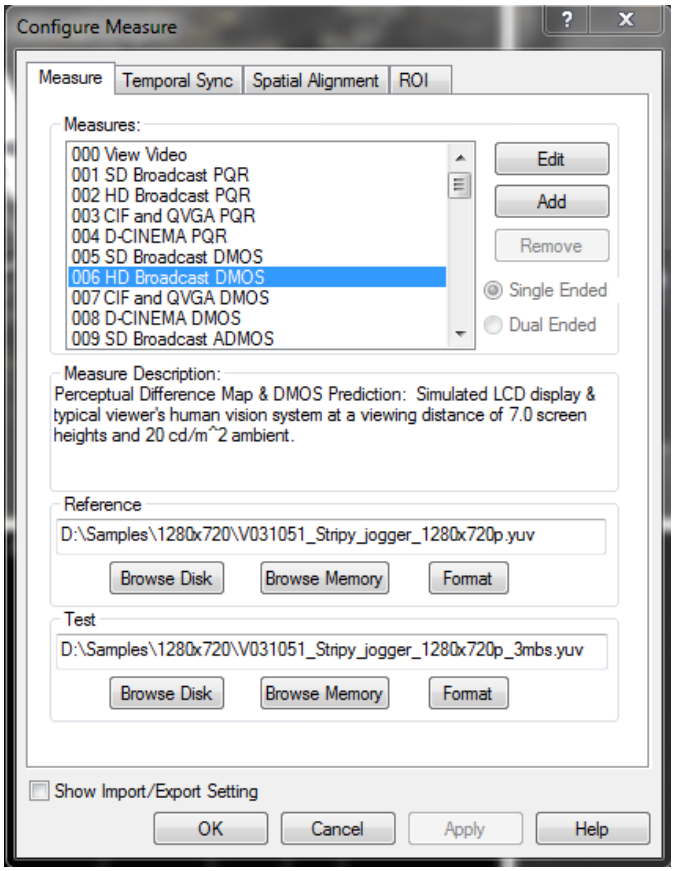
To export an XML script:

NOTE. *You cannot export an XML script that performs measurements on compressed media files.*

1. Click the Measure button.

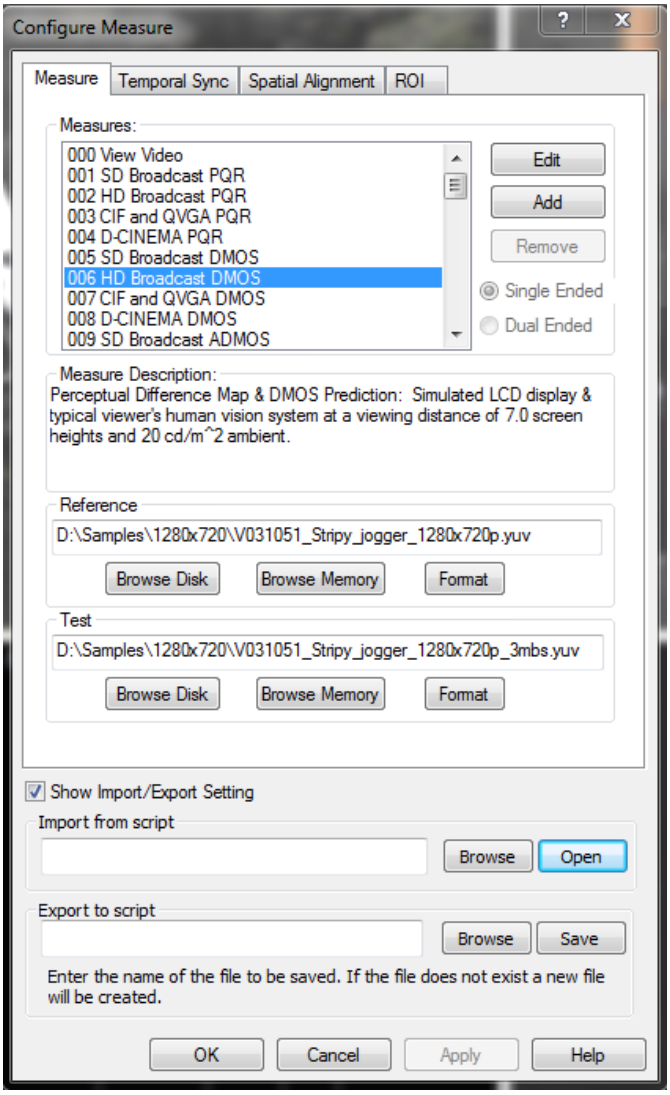
2. Configure a measure as you want to run it.

   Select a measure and specify all measurement characteristics (when you are not using a predefined measure). Specify the Reference and Test files as required.

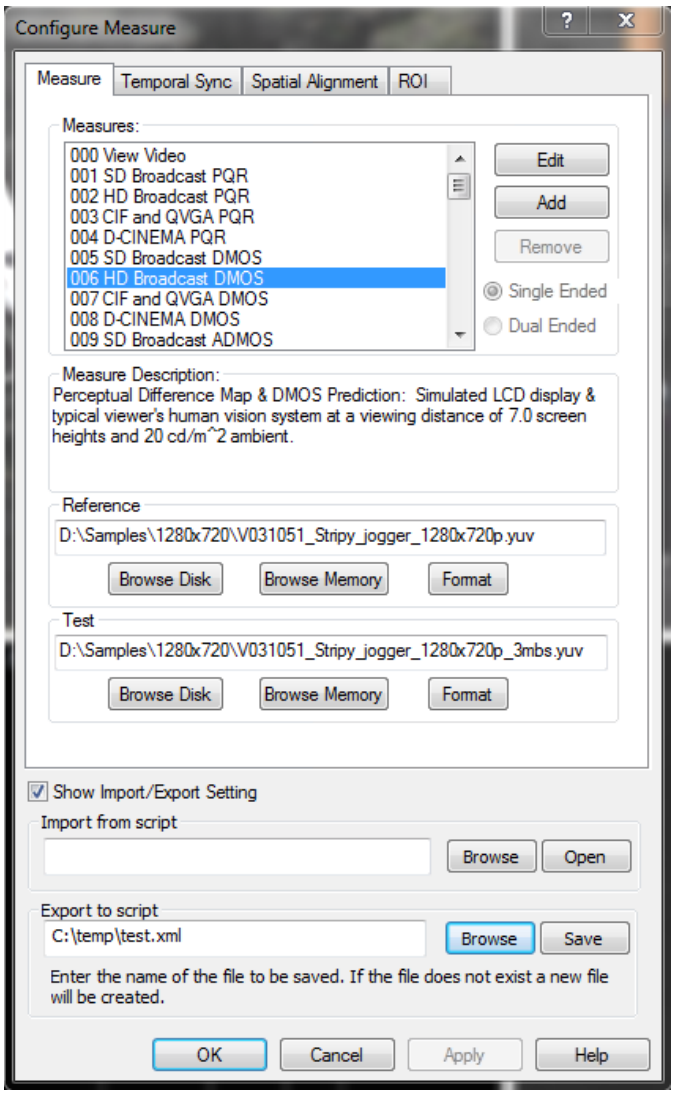


3. Select the **Show Import/Export Setting** check box.

   This displays two additional text entry boxes. One text entry box is used to specify a script to import and the other text entry box is used to specify the file name of an exported script.



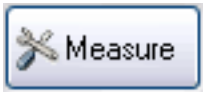
4. Type in a path and file name for your exported script or click the Browse button to specify where to save your script file.
5. Click Save to save the measure to the script file.



Importing an XML script

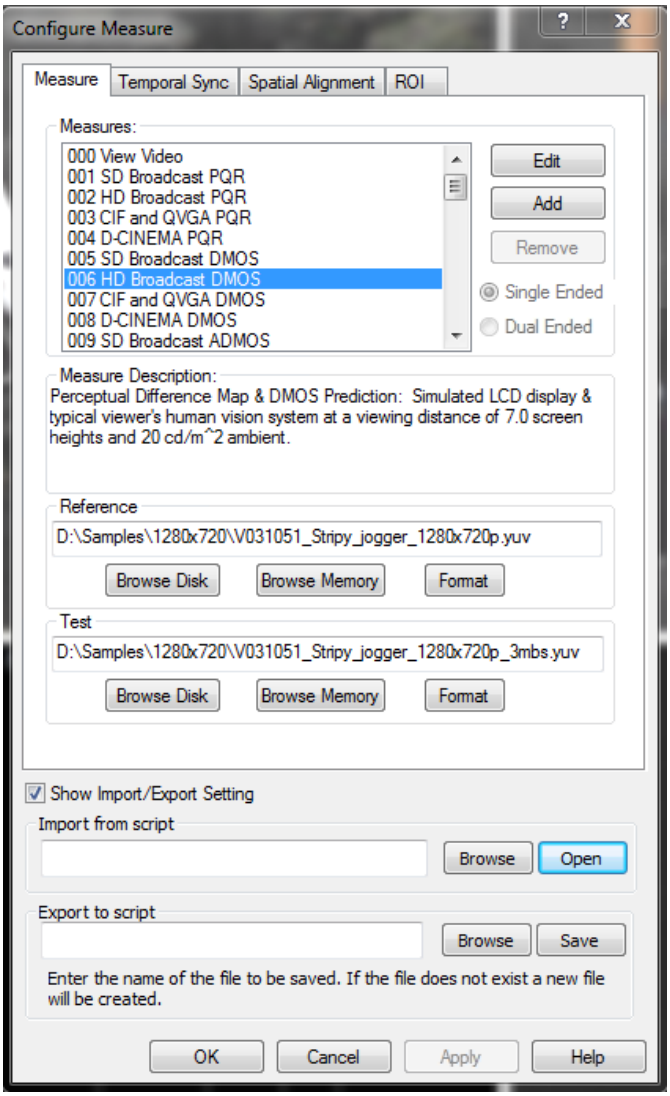
To import an XML script:

1. Click the Measure button.



2. Select the **Show Import/Export Setting** check box.

   This displays two additional text entry boxes. One text entry box is used to specify a script to import and the other text entry box is used to specify the file name of an exported script.

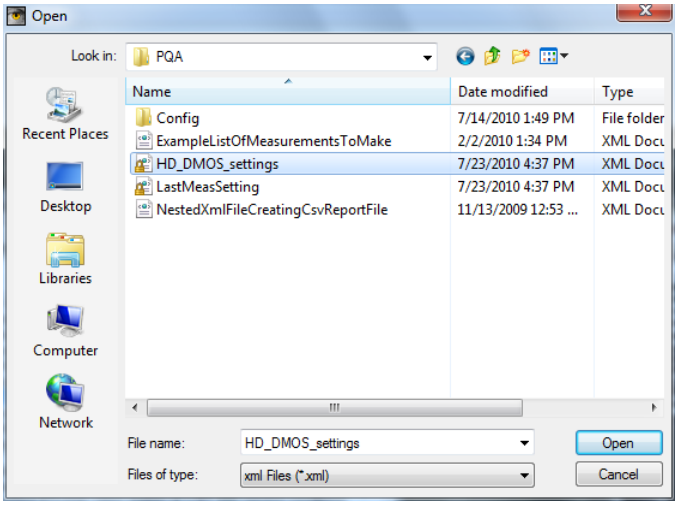


3. Type in a path and file name for your imported script or click the Browse button to use the Open dialog to select the script file to import.

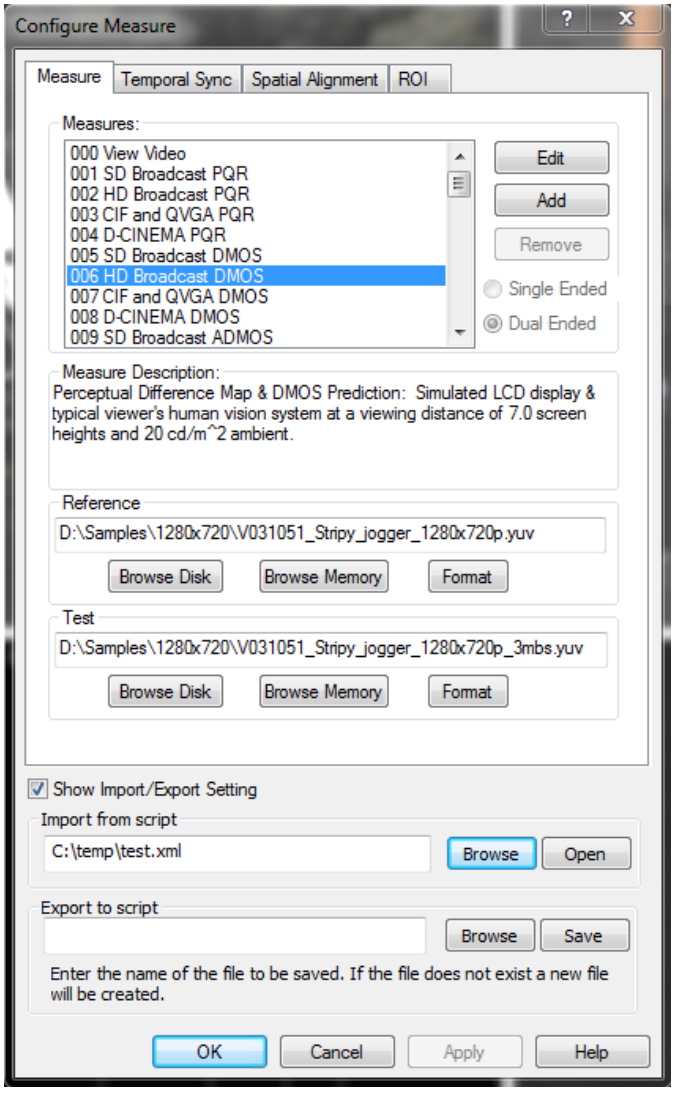
4. If you use the Browse button, click **Open** in the Open dialog box to open the selected script file.

   When you click Open, the PQA imports the script and configures the Measure as defined in the script file. This includes the selected measure, Temporal Sync tab settings, Spatial Alignment tab settings, ROI tab settings, and the reference and the test files.

5. If you typed in a path and file name for the script, click **Open** to import the script file.



6. Once the script is imported, click **OK** to accept the script settings.



Running a script on uncompressed media files

To run a script, open a command prompt window, change directories to the PQA application directory, and type “PQxml filename”. The measurement begins and the results are saved in the same location as they would be if the measurement were run through the regular PQA Windows application.

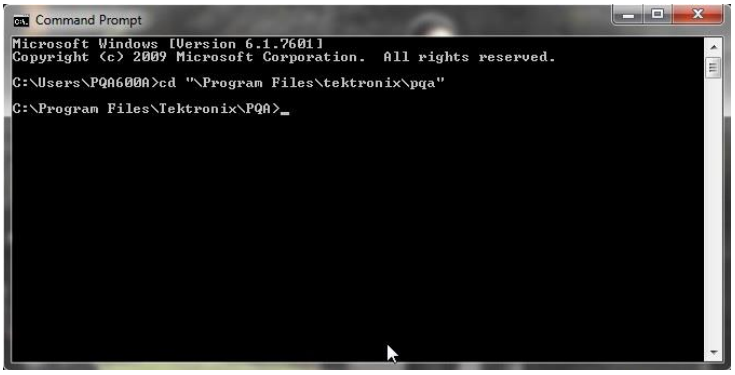
There are two sample XML script files installed with the PQA application (they are located in the PQA application folder). The sample scripts are NestedXmlFileCreatingCsvReportFile.xml and ExampleListOfMeasurementsToMake.xml.

To run an XML script:

1. Open a command prompt window by selecting **Start > All Programs > Accessories > Command Prompt**.

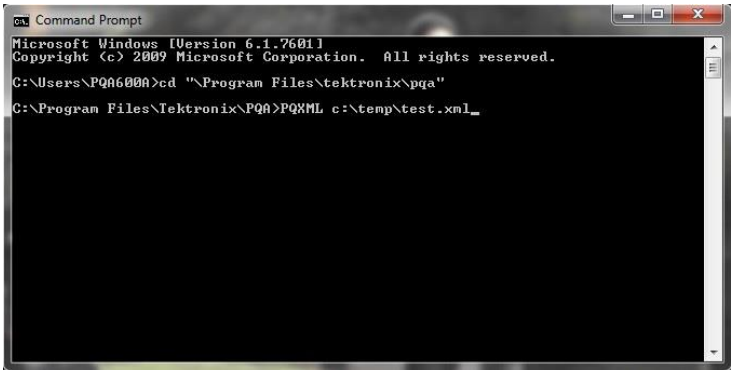
2. Change directories to the PQA application directory.

   For example: `cd "\Program Files\tektronix\pqa"`

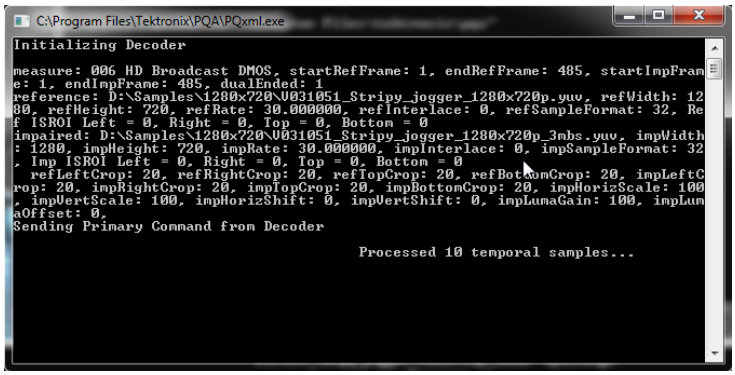


   To execute a script file, you enter the name of the script application (PQXML) followed by the name of the script. Scripts can be located on other drives than the C: drive, as the following example shows.

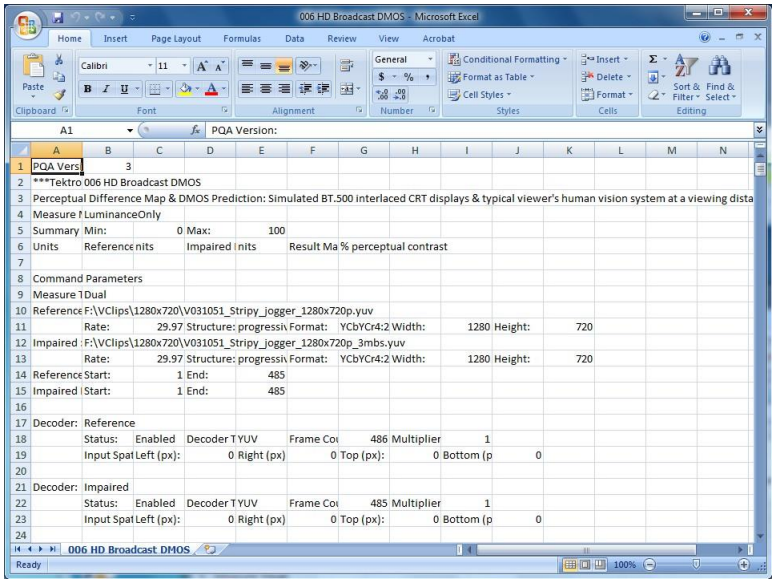
3. Type PQXML followed by the script name. For example:
   `PQXML c:\temp\test.xml`



While the XML script is running, the application will display its progress.



4. When the measurement is complete, you can open the results file with the PQA application or with a spreadsheet.



Running a script on compressed media files

If you will be running a measurement on a compressed media file, you will need to manually edit a template XML script file before you can run a script. The PQA will not export a script for use with compressed media files.

There is a sample XML script file installed with the PQA application (located in the PQA application folder). The sample script is testip.xml. The sample script is shown below:

```
<block1>

<MEASURE name="020 PSNR dB" startRefFrame="1" startImpFrame="1" dualended="true"
reference="E:\PQA\Vclips\reference_.5MbpsH.264.trp" refStreamID="49"
impaired="E:\PQA\Vclips\test.trp" impStreamID="65" autoTemporalAlign="false"
minSearchDelay="-1" maxSearchDelay="1" />

</block1>
```

When you want to create a script to run on a compressed media file, start with the sample script and edit it as needed, keeping the following points in mind:

- For a single program transport stream, no stream ID is required.
- For a multiple program transport stream, if a stream ID parameter is not included in the script, the user will be prompted with a list of available video PIDs and asked to enter the PID of interest before the program is converted to yuv.
- If the reference and test sequences of interest are not temporally aligned, the user can assign autoTemporalAlign="true". The min and max search delay can be set if you have the information. (See page 84, *Performing temporal synchronization and spatial alignment of sequences*.)
- For spatial alignment, a measurement of interest (for example, 006) can be edited to enable Auto for spatial alignment parameters in the View node.
- All other xml fields are valid for the corresponding yuv files. The sample template file provided has been shortened for simplicity. However, if you have the necessary information to specify the reference and test file ROI (Region of Interest), the respective ROI fields can be set in the xml file and they will be used for the converted yuv files. (See page 103, *Using the Region-of-Interest (ROI)*.) .

Capturing and generating video

The PQA600C can generate SDI video signals using a file as a source. The PQA600C can also capture video signals to a file for later review and analysis.

Simultaneous generation and capture

The PQA600C can generate and capture video on two channels simultaneously. Using this capability, you can generate a video signal, route that signal to a device-under-test, and then route the device-under-test output back into the PQA600C for analysis. When used in this way, the video formats must match. Both the generation and capture capabilities can be used independently. The two-channel capture and generate capability can be configured to generate two channels simultaneously, capture two channels simultaneously, or generate one channel and capture one channel simultaneously.

The PQA600C enables you to swap the two output channels so that you can view either output even if you have only a single monitor. The ability to simultaneously generate two outputs can be used to perform subjective picture quality evaluation that complements the PQA600C objective measurements. The ability to simultaneously capture two channels enables you to capture both the reference and test signal simultaneously, which can be useful in broadcast operations.

Supported video source file formats

The PQA600C requires a video file as a source to generate a video signal. The PQA600C supports the following file formats. All formats are 8-bits resolution.

Supported video formats for generation

File format	File extension	Frame structure options
CbYCrY (601-4:2:2), UYVY	.yuv	Non-Interlaced, Field 1 First, Field 2 First, Inverted
YCbYCr (4:2:2), YUY2	.yuv	Non-Interlaced, Field 1 First, Field 2 First, Inverted
BGR	.rgb	Non-Interlaced, Field 1 First, Field 2 First, Inverted
CbYCrY (601-4:2:2), UYVY (10-bit)	.v210	Non-Interlaced
AVI (Uncompressed UYVY, YUY2, RGB, RGB32, v210)	.avi	Not applicable
Vcap (Captured by optional SDI card.)	.vcap	Not applicable
Vcap 10-bit (Captured by optional SDI card.)	vcap10	Not applicable

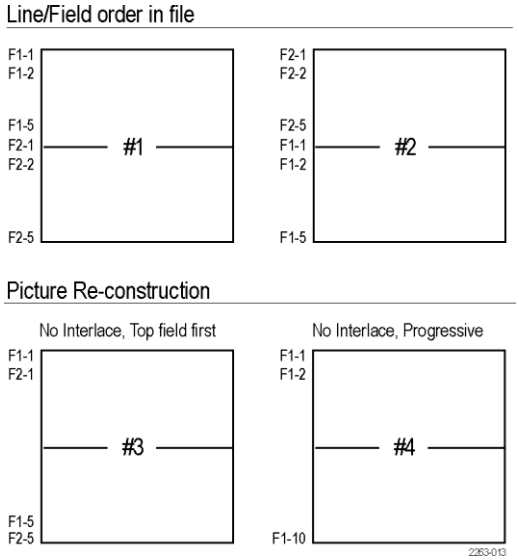
When you select a file format that is headerless (yuv or rgb), the PQA600C will prompt you to specify the file format (Width, Height, frame rate, frame structure, and format). Use the following guidelines for specifying the file format.

- If the selected file is in interlaced format and the line construction matches #1 in the following figure, select "Field 1 First" for Frame Structure.
- If the selected file is in interlaced format and the line construction matches #2, select "Field 2 First" for Frame Structure.
- If the selected file is interlaced and it has a noninterlaced format like #3, select “No_Interlace”.
- If the selected file has progressive scanning like #4, select “No_Interlace”.

NOTE. *If the selected file is in AVI format, the PQA600C converts the file to a raw file format (yuv, vcap10, or rgb) before beginning generation (the filename extension indicates the format). After the conversion is completed, the file format dialog appears and asks you to confirm the file format before starting the generation.*

If the yuv file or the converted data from an rgb file selected for generation contains values of "0" or "255",in the output data these values are replaced by"1" or "254", respectively, due to the SDI standard requirements.

The interlaced video content is supposed to be "Top field first".



The following table lists the resolution and start lines for each output format.

Resolution and start lines for each format

Format	Resolution	Start Lines
525i	720 x 486	F1-21/F2-20 (On generation, the second line in the file is F2-20 and the F1-263 is a copy line of F2-262) (On capture, the topmost line in the captured file is a copy line of F2-20 and the bottommost line in the captured file is F2-262).
625i	720 x 576	F1–23 / F2–23
720p	1280 x 720	F1–26
1080i	1920 x 1080	F1–21 / F2–21
1080p	1920 x 1080	F1–42

Supported SDI video formats

The PQA600C can generate and capture the SD and HD-SDI video formats listed in the following table.

Supported video formats

Format	Frame Rates
SD-SDI	525i/59.94
	625i/50
HD-SDI	720p/50, 720p/59.94, 720p/60
	1080i/50, 1080i/59.94, 1080i/60
	1080psF/23.98, 1080psF/24, 1080p/23.98 1080p/24, 1080p/25, 1080p/29.97, 1080p/30

Preinstalled video sequences

The PQA600C is shipped with sample video sequences preinstalled on the hard drive. The following table lists the details of these sample files.

Table 22: 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

Converting video files

Many programs cannot use the VCAP files generated by the PQA600C. To use VCAP files with other programs, the PQA600C includes a DOS command line program, TekFileConverter.exe, that converts AVI or VCAP files to RGB, YUV, or V210 file format. The format to which the files are converted depends on the format within the source AVI or VCAP file. For example, if the source AVI file contains video data in RGB format, the converter program converts the AVI file to a RGB format file (video data only, no audio data). If the AVI file contains video data in YUV format, the converter program converts the AVI file to a YUV format file (video data only, no audio data). If the source file is in VCAP format (8-bit), the converter program converts the VCAP file to a YUV format file. If the source file is in VCAP10 format (10-bit), the converter program converts the VCAP10 file to a V210 format file.

How output files are named

The output file is named according to the source file name and the video format contained in the file. For example, suppose you capture a video signal with the PQA600C that is saved as `tutorial.vcap`. The format of the file is encoded within the file structure. The file converter program uses that internal data to name the converted file. Thus, the output of the file converter using tutorial.vcap might be `tutorial_1920x1080_2997fps_NoInterlace_CbYCrY.yuv`.

To convert an AVI or VCAP file:

1. Display a **Command Prompt** window (**Start** > **All Programs** > **Accessories** > **Command Prompt**).
2. In the Command Prompt window, change directories to the directory that contains the file you want to convert.
3. Type the following: `TekFileConverter.exe filename` where filename is the name of the file you want to convert. Press the **Enter** key.

After the file converter starts, it displays its progress: `Converted XX of XXXX frames...`.

When the conversion is complete, the converter displays the name of the converted file:

- `The converted file is – tutorial_1920x1080_2997fps_NoInterlace_CbYCrY.yuv`

Converting video formats

The PQA600C allows you to up/down convert video formats when you generate or capture video. In addition, for SD signals you can perform an aspect ratio conversion.

Supported conversion formats

The following formats are supported for up / down conversion:

Table 23: Supported formats for video format conversions

Input format	Output format
525i 29.97	720p 59.94, 1080i 29.97
625i 25	720p 50, 1080i 25
720p 50	625i 25, 1080i 25
720p 59.94	525i 29.97, 1080i 29.97
720p 60	1080i 30
1080psf 23.98	525i 29.97
1080i 25	625i 25, 720p 50
1080i 29.97	525i 29.97, 720p 59.94
1080i 30	720p 60

How to compare converted formats

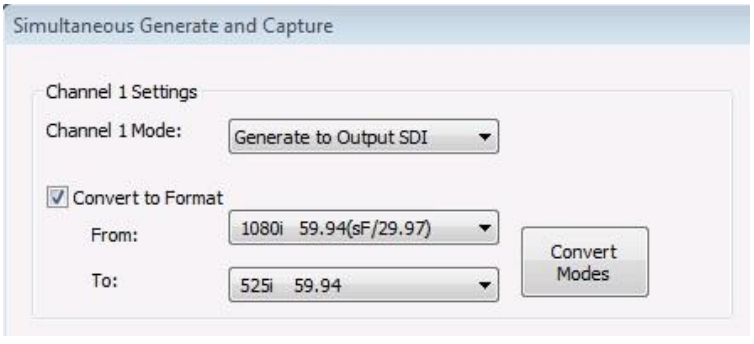
If you need to use the PQA to compare video files that are different formats, you first need to temporally and spatially align the video sources. (See page 84, *Performing temporal synchronization and spatial alignment of sequences*.)

How to configure a video format conversion

To configure a video format conversion, perform the following steps:

NOTE. *The format of the source video must be supported. (See page 175, Supported conversion formats.)*

1. In the Simultaneous Generate and Capture window, click the Convert to Format selection box. This enables the format conversion controls.
2. Use the **From** drop-down box to select the format of the video source you want to convert.
3. Use the **To** drop-down box to select the format to which you want to convert the source video.



4. Click the **Convert Modes** button to open the Format Conversion Modes dialog box.
5. Depending on whether you are up-converting or down-converting the video, use the appropriate controls to select the desired conversion mode. (See Table 24.)
6. Click the **OK** button to close the Format Conversion Modes dialog box.

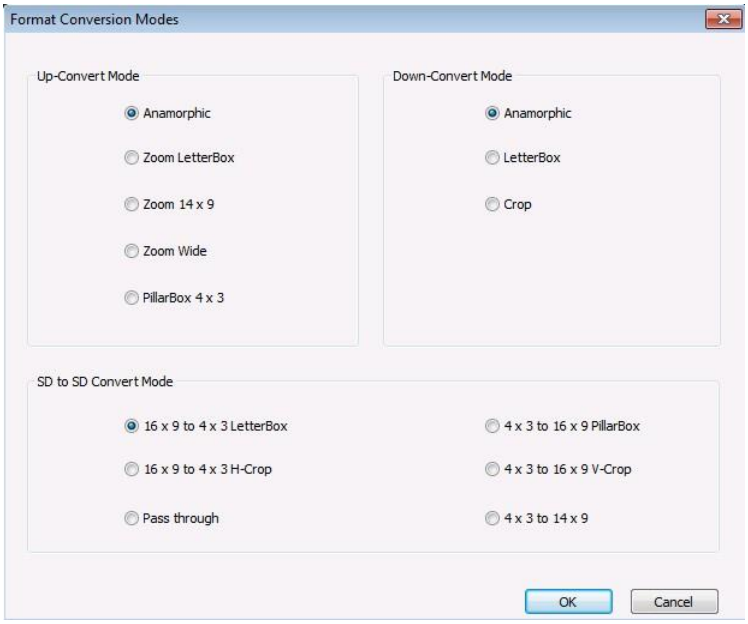


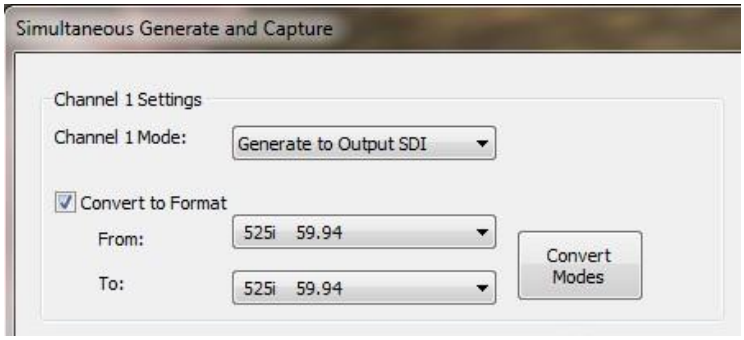
Table 24: Up / down video format conversion modes

Conversion type	Conversion mode	Description
Up	Anamorphic	Full-screen “stretched” image
	Pillar box 4:3	Results in a 4:3 image in center of screen with black sidebars
	Zoom 14:9	Results in a 4:3 image zoomed slightly to fill a 14:9 image with black sidebars
	Zoom Letterbox	Results in image zoomed to fill full screen
	Zoom Wide	Results in a combination of zoom and horizontal stretch to fill a 16:9 screen; this setting can introduce a small aspect ratio change
Down	Anamorphic	Full-screen “stretched” image
	Letterbox	Image is reduced with black top and bottom added to image area with the aspect ratio preserved
	Crop	Image is cropped to fit new screen size

How to configure an SD-to-SD aspect ratio conversion

To configure an SD-to-SD aspect ratio conversion, perform the following steps:

1. In the Simultaneous Generate and Capture window, click the Convert to Format selection box. This enables the format conversion controls.
2. Use the **From** drop-down box to select the SD format of the video source you want to convert.
3. Use the **To** drop-down box to select the same SD format as the video source.



4. Click the **Convert Modes** button to open the Format Conversion Modes dialog box.
5. Use the **SD to SD Convert Mode** controls to select the desired conversion mode. (See Table 25.)
6. Click the **OK** button to close the Format Conversion Modes dialog box.

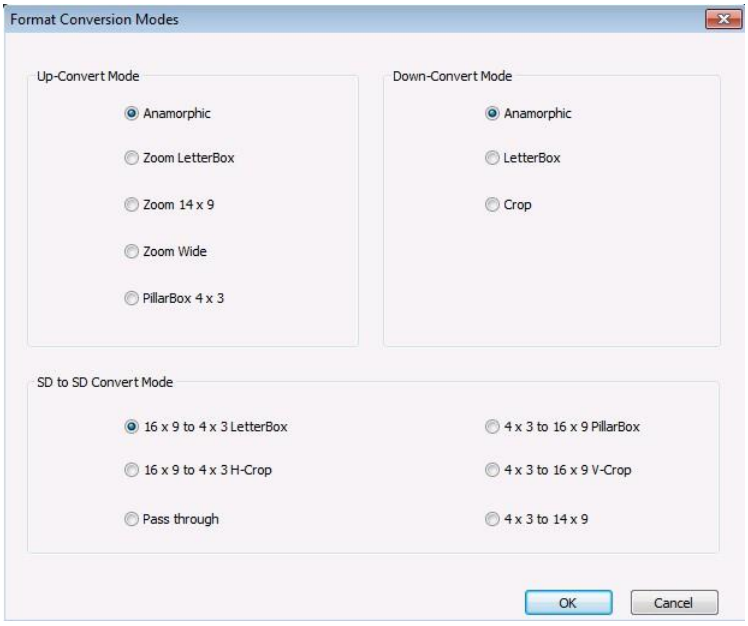


Table 25: SD to SD format conversion modes

Conversion mode	Description
Letterbox	Transforms SD anamorphic material to a letterboxed image
H Crop	Produces a horizontally stretched effect on the image; transforms anamorphic SD to full frame SD
Pillarbox	Produces an image in the center of the screen with black borders on the left and right sides and an anamorphized image in the center
V Crop	Transforms SD letterbox material to an anamorphic image

How to capture IP video

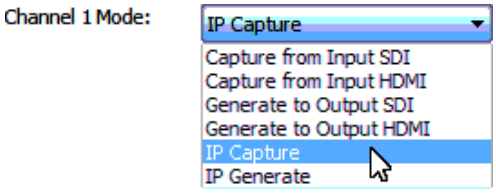
The PQA can generate and capture IP video streams . The PQA uses files as the source for generating IP video streams. It captures IP video streams to files for analysis.

To capture an IP video stream:

1. Connect the IP video source to the instrument. (See Figure 2 on page 5.)

2. Click the **Gen / Cap** button to open the Simultaneous Generate and Capture window. (See page 21.)

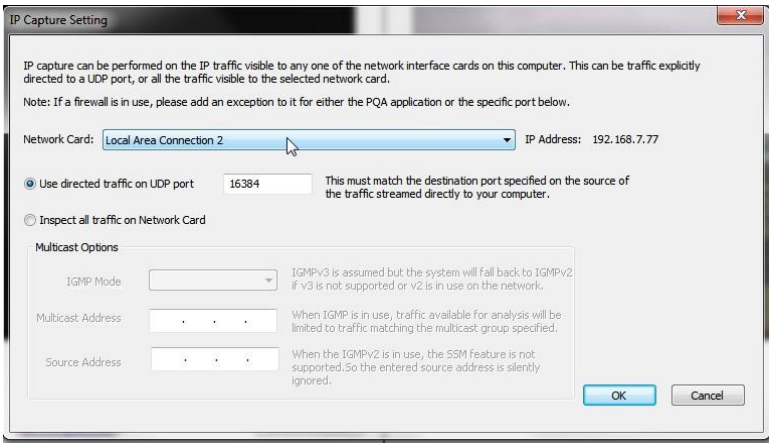
3. Click the **Channel 1 Mode** drop-down box and select **IP Capture**.



4. Click the **Network Setting** button. This opens the IP Capture Setting window. Specify the IP capture settings as follows:

   - Select the network card that supplies the video stream you want to capture. (For the PQA600C, there are two network cards available. For PQA installations, there may only be one network card available.) Look at the displayed IP Address to verify you have selected the right card.

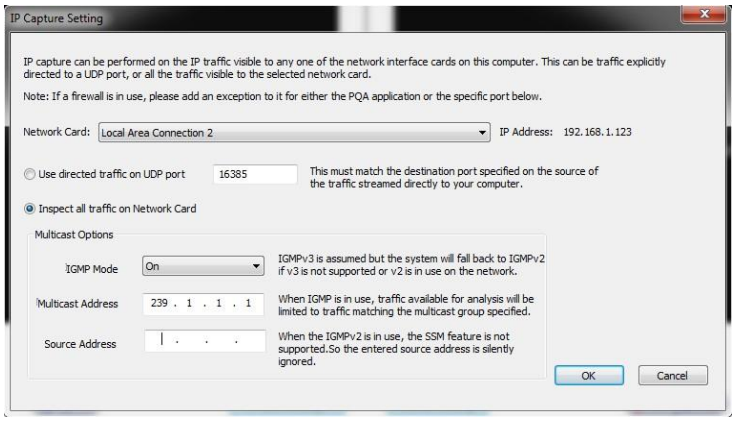
   - If you know the UDP port number that contains the IP stream you want to capture, enter the port number in the text box next to **Use directed traffic on UDP port**.



- If you do not know the UDP port number that contains the IP stream you want to capture, select **Inspect all traffic on Network Card**. This enables the Multicast Options.

  Use the IGMP Mode drop-down list to turn the IGMP mode on or off. When set to on, use the Multicast and Source Address boxes to enter address of the video source.

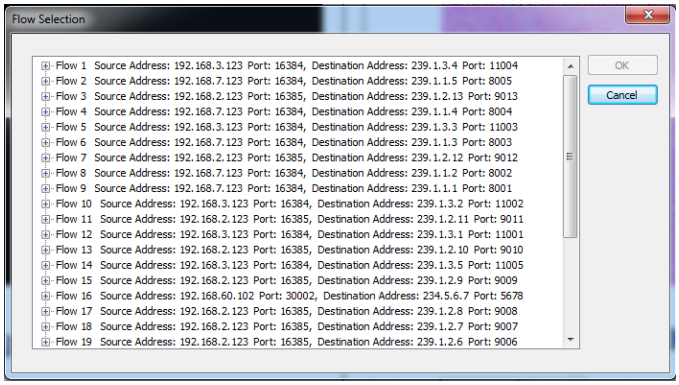
  For IGMPv2, only enter a multicast address. For IGMPv3, also enter the source address.



- Click **OK** when you have completed changing settings.

5. If you did not specify a UDP port when you set the IP Capture Settings, click **Stream Selection** in the Simultaneous Generate and Capture window. This displays the Flow Selection window.

   Select the Flow that contains the IP stream you wish to capture.



NOTE. *The PQA will capture the whole transport stream. You cannot select a specific program from within a stream for capture. However, when you perform a measurement on the captured stream, you will be able to select a specific program from within the stream for analysis.*

   Click **OK** after you select the desired Flow.

6. In the Simultaneous Generate and Capture window, click the Channel 1 **Browse Disk** or **Browse Memory** button to specify where the captured stream will be saved.

NOTE. *When you capture IP video, the Preview pane is disabled.*

7. Click the **Rec** button to begin capturing the IP stream.

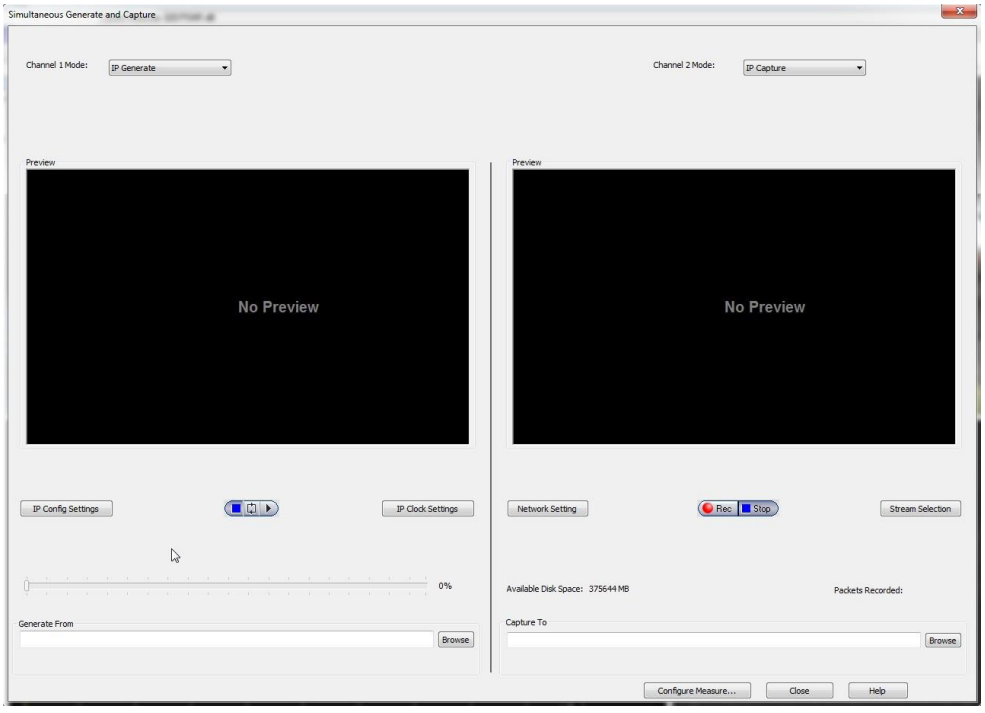
8. Click the **Stop** button to quit capturing the IP stream.

How to generate IP video

The PQA can generate and capture IP video streams (Option IP is required for the PQA). The PQA uses files as the source for generating IP video streams. It captures IP video streams to files for analysis.

To generate an IP video stream:

1. Select the Gen / Cap button to display the Simultaneous Generate and Capture window.



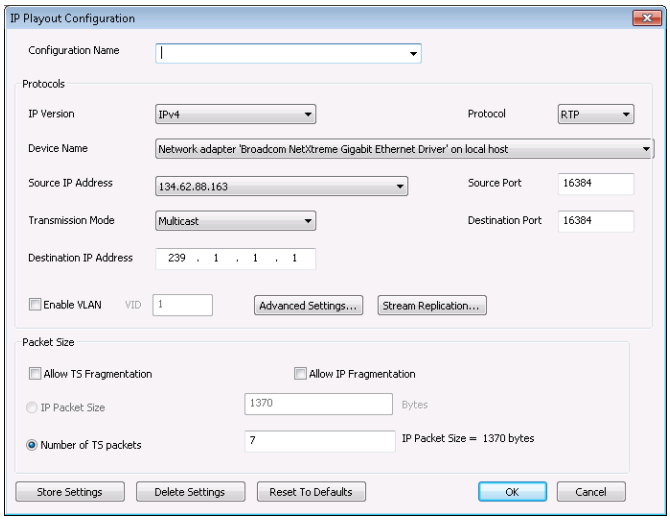
Simultaneous Generate and Capture window

NOTE. *In the PQA, there are no Preview windows.*

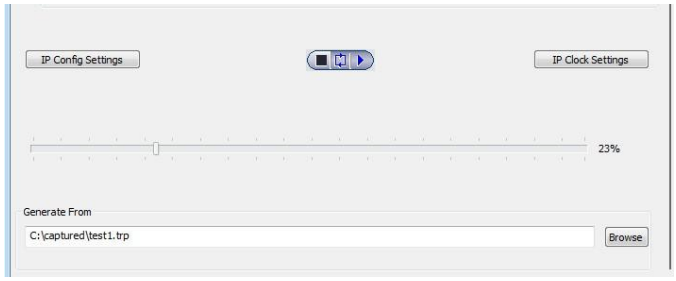
2. For the Channel 1 Mode, select IP Generate.

NOTE. *Only Channel 1 can generate an IP stream. Channel 2 can only capture an IP stream.*

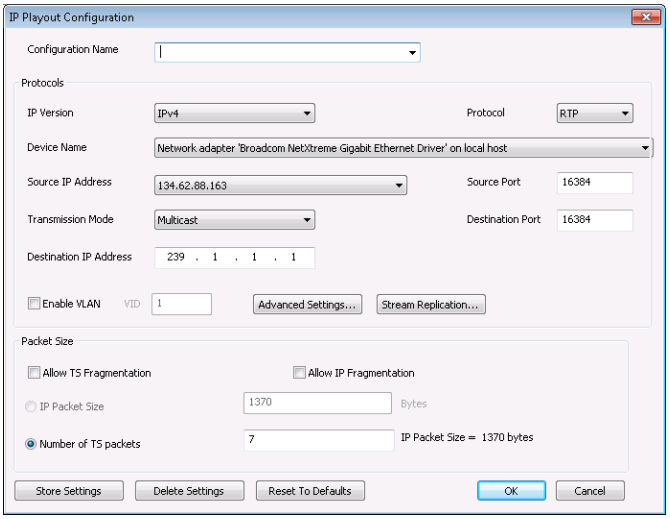
3. Click **IP Config Settings** to display the IP Config Settings dialog box.



4. Set the IP configuration settings as appropriate for your needs.
   a. If you have previously saved settings, select the settings from the Configuration Name text box and click OK.
   b. If you are not using previously saved settings, set the Device Name based on the IP address to which you want to stream the video.
   c. Set the other parameters as required. (See page 202, *Configuring the IP Settings for IP Generate*.).
   d. If you wish to save your settings for future recall, enter a name in the **Configuration Name** text box and click **Store Settings**.
   e. Click **OK** after you have completed making any needed changes.
5. Click the **Browse** button to display the Open dialog box. Use the Open dialog box to locate and select the file to be used for generating an IP video stream. You can select .trp, .ts, .mpg, or .mpeg file types.
6. You can verify the IP clock settings for the selected video file by clicking the **IP Clock Settings** button. The values are automatically calculated.
7. Click the loop button () to enable looping if you want the stream to repeat until you stop it.
8. Click **Play** to generate the IP video stream. While the stream is playing, a progress bar is displayed which indicates the percentage of the source file that has been played out.



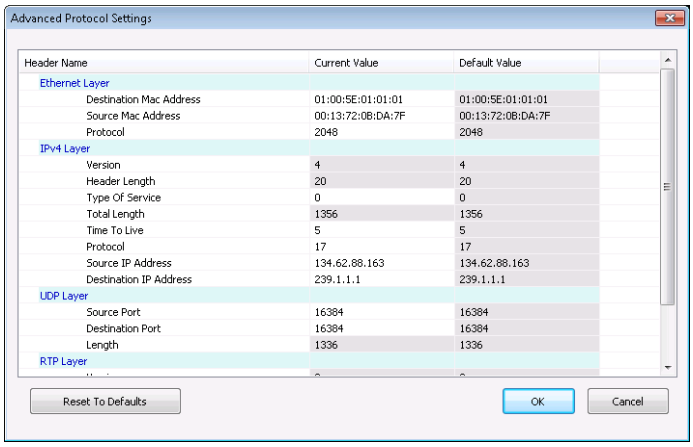
Configuring the IP Settings for IP Generate. If you set the mode to IP Generate, a button enabling you to set the IP Playout Configuration appears. When you click the IP Config Settings button, the IP Playout Configuration dialog box is displayed as shown in the following figure.



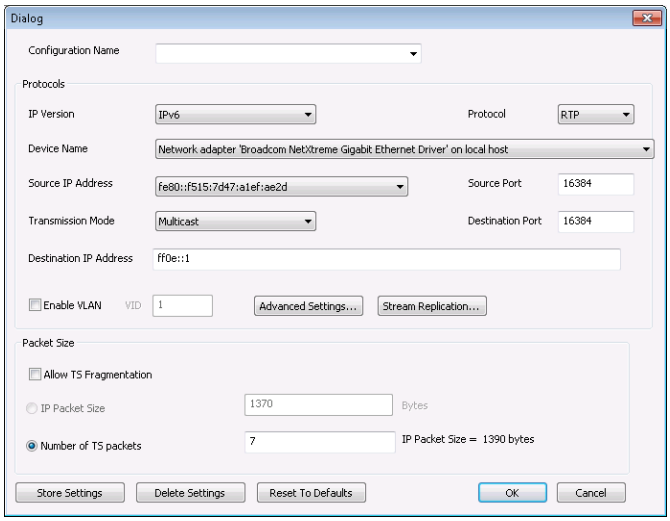
This dialog box allows you to configure the following settings:

- **Configuration name**: Allows you to enter or select a configuration name from the drop-down list. This list can store up to ten configuration names. The default value is blank.
- **IP Version**: Allows you to choose the IP version (IPv4 or IPv6) from the drop-down list. IPv4 is the default value.
- **Protocol**: Sets the protocol (UDP, RTP) for the IP playout. RTP is set as the default value.
- **Device Name**: Allows you to select the device for the IP playout. The Device Name lists all the active Network Interface Cards (NIC) in the system. The first interface that has a valid IP address assigned to it is automatically selected as the default value for both IPv4 and IPv6 versions.
- **Source IP Address**: Sets the source IP address for the IP playout. The first valid IP address of the selected device will be set as the default. The Source IP Address can be modified in the Advanced Protocol Settings dialog. If the Source IP Address is modified in the Advanced Protocol Settings dialog, then this value is changed to "Customized".
- **Source Port**: Sets the source port for the IP playout. The port value ranges from 0 to 65535. The default value for UDP protocol is 0 and for RTP protocol is 16384.
- **Transmission Mode**: Sets the transmission mode of the protocol. Unicast, Multicast, and Broadcast are the three transmission modes available in the drop-down list. Multicast is set as the default value.
- **Destination IP Address**: Sets the destination IP address for the IP playout. 239.1.1.1 is set as the default value for IPv4 and ff0e::1 is set as the default value for IPv6. Depending on the selected transmission mode, the system validates the entry based on the following rules:
  - **Unicast Range**: Any IP address that does not fall into the Multicast or the Broadcast range.
  - **Multicast Range**: 224.0.0.0 to 239.255.255.255 for IPv4 and FFxx:Y:Y:Y (where x is 0 to F and Y is 0000 to FFFF) for IPv6.
  - **Broadcast Range**: The Network or node portion of an IP address will be set to "1"s or "0"s.

- **Destination Port**: Sets the destination port for the IP playout. The port value ranges from 0 to 65535. 16384 is set as the default value.
- **Enable VLAN**: Enables the VLAN layer that is present between the Ethernet layer and IP layer. You will have to enter the VLAN ID to allow the identification of 4096 VLANs that is basically used by the 802.1Q standard.
- **Advanced Settings**: Click Advanced Settings to view or customize the protocol settings of active protocols in the current configuration. All the settings have only header customization for which no validation is done.



Advanced Protocol Settings dialog box for IPv4



Advanced Protocol Settings dialog box for IPv6

The Header Name and Default Value are read only options. The protocol headers displayed will be limited to headers common to all packets. You can customize the Current Value of the headers which can be specified at packet creation. The customized valid values are displayed in lavender and the customized invalid values are displayed in pink.

Click the **Reset to Defaults** button to reset the current values to default values. Whenever any of the attributes is set, an icon is displayed in the status bar during the play.

The parameters displayed in the Advanced Protocol Settings dialog box are as follows:

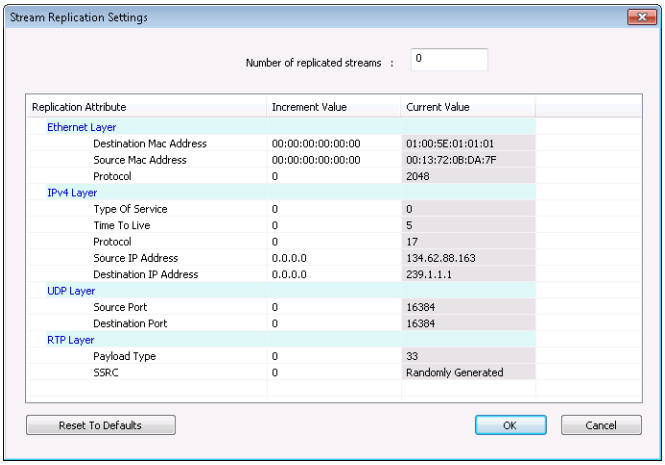
- **Ethernet Layer**: Destination Mac Address, Source Mac Address, Protocol
- **IPv4 Layer**: Version (read only), Header Length (read only), Type Of Service, Total Length (read only), Time To Live, Protocol, Source IP Address, Destination IP Address
- **IPv6 Layer**: Version (read only), Traffic Class, Flow Label, Payload Length (read only), Next Header, Hop Limit, Source IP Address, Destination IP Address
- **UDP Layer**: Source Port, Destination Port, Length (read only)
- **RTP Layer**: Version (read only), Payload Type, Sequence Number, SSRC

NOTE. *If a condition exists where multicast is selected as the transmission mode and a unicast destination address is entered in the Advanced Protocol Settings dialog box then the destination address will not be validated.*

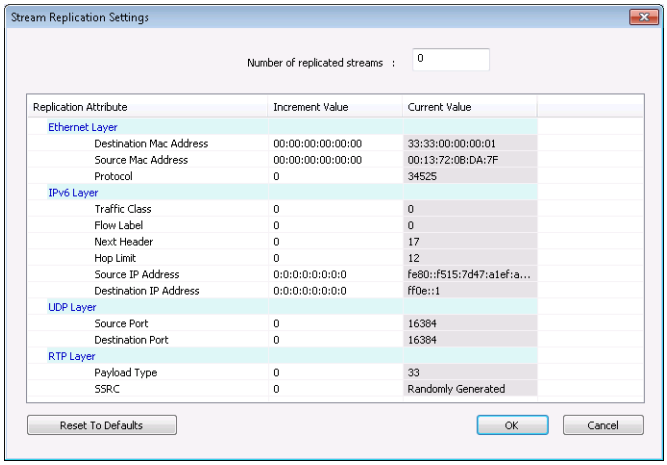
NOTE. *If the destination IP address is changed in the Advanced Protocol Settings dialog box, the application will not check for the accessibility of the address. A change in the source and the destination IP address will not change the source and the destination MAC address of the Advanced Screen Settings.*

- **Stream Replication Settings:** Click Stream Replication Settings to set the number of replicated streams and customize the attributes accordingly. This setting is used to replicate the streams wherein a stream is replicated n times with certain attributes of the stream incremented by a value within the 'n' replicated streams. The customized valid values are displayed in lavender and customized invalid values are displayed in pink.

  You can enter the number of replications in the Number of replicated streams text box. The table lists the attributes which can be incremented by entering a number in the Increment Value column. All attributes except for MACs and IP addresses will accept an integer.



Stream Replication Settings for IPv4



Stream Replication Settings for IPv6

You can click **Reset to Defaults** to reset the increment values to default values. Whenever the stream replication is active, an icon is displayed in the status bar during the play.

- **Allow TS Fragmentation**: Controls the fragmentation of the transport stream packets. If this option is selected, the transport stream packets will be split across the IP packets else all the transport stream packets will be present in the IP packet. By default, this is cleared. The IP Packet size option will be enabled only if Allow TS Fragmentation option is selected. The Number of TS packets option will be enabled irrespective of the Allow TS Fragmentation option being enabled.
- **Allow IP Fragmentation**: Controls the fragmentation of IP packets. This option is applicable to packet sizes which are greater than the MTU size of the interface (typically 1500B). If this option is selected, the IP packets are fragmented, otherwise they will be retained with the same size. By default this option is cleared. The maximum packet size is 16128 when IP fragmentation is selected. This option is available only in IPv4 version.
- **IP Packet Size**: Allows you to set the size of IP packet. This option is enabled only if TS fragmentation is allowed. When IP fragmentation is enabled, the maximum size of IP packet for IPv6 version is 16128 bytes and for IPv4 version is 1500 bytes.

The IP packet size includes the headers. The payload size is calculated at runtime using the following equation:

```
IP Packet Size = Payload Size + Header Size
```

For IPv4 version, the header size is 54 (58 with VLAN enabled) for RTP and 42 (46 with VLAN enabled) for UDP. For IPv6 version, the header size is 74 (78 with VLAN enabled) for RTP and 62 (66 with VLAN enabled) for UDP.

- **Number of TS Packets**: Allows you to type the number (integer) of TS packets that needs to be embedded into an IP packet.

  The maximum IP packet size is 1500 bytes or equivalent to TS packets.

  A read only text field showing the IP packet size is displayed next to this option. The IP packet size will be calculated automatically and displayed in bytes. Based on the number of TS packets, the IP packet size is calculated using the following equation:

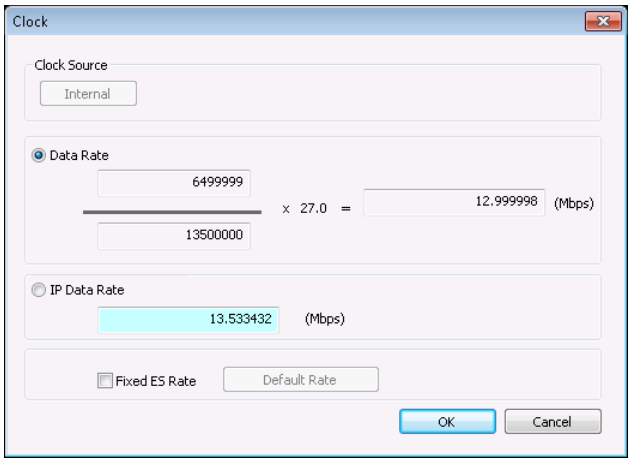
  ```
  IP Packet Size = Payload Size + Header Size
  ```

  where payload size is calculated as follows:

  ```
  Payload Size = Number of TS Packets x TS Packet Size
  ```

- **Store Settings**: Stores or updates the entire configuration settings including the Advanced Protocol Settings. All these settings will be listed out in the Configuration Name drop-down list.
- **Delete Settings**: Deletes the selected configuration setting that is displayed in the Configuration Name drop-down list and selects the next configuration in the list. If there are no more configurations stored in the list, the values in the configuration dialog box will be reset to the default values.
- **Reset to Defaults**: Resets the settings to the factory default values.

Configuring the IP clock settings. Clicking **IP Clock Settings** displays the Clock dialog box.



- Clock Source – This indicates that the internal clock will be used as the reference for the stream output. This value cannot be changed.
- Data Rate – This value is automatically calculated. It indicates the clock rate for the transport stream output.

NOTE. *The IP data rate will be automatically calculated based on the TS data rate available. IP Data Rate is calculated as follows:*

IP Data Rate = (TS Data Rate x IP Packet Size) / Payload Size

- IP Data Rate – Sets the clock rate for the IP packet. In the IP mode, a change in the IP data rate will impact the TS data rate and a change in the TS data rate will impact the IP data rate. The packet length changes according to the selected protocol.

NOTE. *The TS data rate will be automatically calculated based on the IP data rate available and consequently influence the PCR/PTS/DTS update cycles. TS Data Rate is calculated as follows:*

TS Data Rate = (IP Data Rate x Payload Size) / IP Packet Size

- Fixed ES Rate – When the Fixed ES Rate check box is enabled, PCR/PTS/DTS Update Method is set to the default rate.

Reference

What is the Measure Map?

The Measure Map is an image frame that uses differences in brightness to indicate reference video pixel co-located differences between the reference and test sequences or the magnitude of a measure, depending on the selected Measure. The brighter the area on the impairment map, the greater the difference between the reference and test sequence or, for no reference measurements, the magnitude of the result. The measure map file has the same name as the executed measurement except for a “map” file extension (for example, 013 HD Sports Broadcast ADMOS.map). The measure map file is located in the same folder as the measurement results files. Measurement results are saved in the folder that contains the test file. The results files are saved in a folder named after the test file with “-Results” appended to the file name (for example, V031051_Stripy_jogger_1280x720p_3mbs-Results).

The measure map file has no header information and each pixel data is in 32-bit floating point format. For example, the file size for a measure file with 1920x1080 video has 1920x1080*4 = 829,440 Bytes/frame. If the measurement has the Display Model node properties set to interlaced, the measurement creates one measure map for each field.

Measure map units

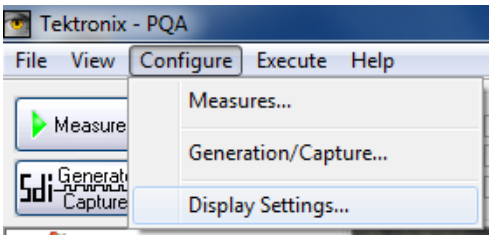
Map type	Units
PSNR	601 8-bit LSBs
Display Model	Nits
Perceptual Difference (including PQR and DMOS measurements)	% Perceptual contrast difference
Perceptual Response (single-ended perceptual response node outputs – perceptual response measurements)	% Perceptual contrast
Artifact Detection	% of maximum possible
Attention Model	Unnormalized probability density

How to adjust the Measure Map display

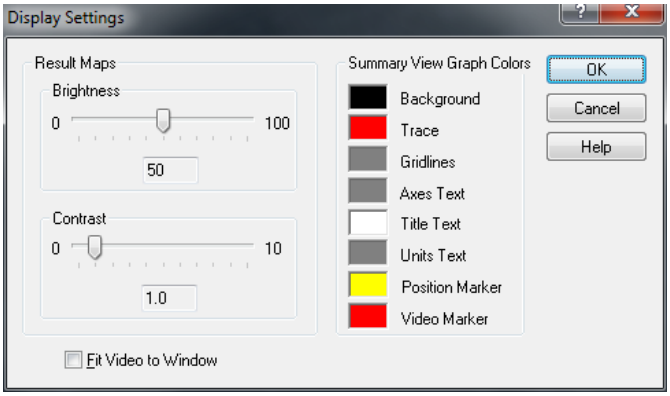
There are times when the difference between a reference and test sequence is not significant and the impairment map will not display a large difference in brightness. You can adjust the impairment map settings to enhance the display of differences. Use the Configure > Display Settings dialog box to adjust the display.

To adjust the display of the Measure map:

1. Select **Configure** > **Display Settings**.



2. Use the sliders for Brightness and Contrast to suit your needs.
3. Click **OK** to save your changes.



XML scripting commands

Using the PQA analyzer XML scripting capability, you can also run multiple measurement sequences simultaneously. You do this by running the software from a command line. When run in this way, the normal Windows application interface is not launched, but you will get a status readout in the command prompt while the measurement is running. Using the XML scripting capability maximizes system performance when you need to perform multiple measurements.

There are two ways to develop an XML script. The most practical way is to export a measurement to a script from the Configure Measure window after configuring a measurement. The other way to develop an XML script is to edit an existing XML script file to specify the measurement to be made, the reference and test files, and any other parameters necessary to execute the test. To run a script, you open a command prompt window, change directories to the PQA application directory, and type “PQxml filename”. The measurement will begin and the results are saved in the same location as they would be if the measurement were run through the regular PQA Windows application. There is an example script file provided with the PQA. The name of the example file is ExampleListOfMeasurementsToMake.xml. It is located in the PQA application folder (within the C:\Program Files (x86)\Tektronix folder).

The following table describes the XML scripting commands.

Table 26: XML scripting commands

Command	Type	Parameter	Description
Log File Commands			
LOG filename	char		Sets the log file name. The log file is saved in the PQA application folder.
		Example: LOG filename= "TheReportFile.csv"	
LOG status	char		Sets the log file status.
		start	Start logging.
		stop	Stop logging.
		close	Close the log file.
		Example: LOG status=”start”	
Nest Commands			
XMLFILE filename	char		XML file to call from this file.
		Example: XMLFILE file= "ExampleListOfMeasurementsToMake.xml"	
Measurement Commands			
MEASURE name	char		Set the measurement that is shown on the Measure config dialog.
		Example: MEASURE name="001 SD Broadcast PQR"	
autoTemporalAlign	char		Initiates auto temporal alignment.
		Example: autoTemporalAlign = "true"	
minTemporalOffset	int		Use to set the minimum offset search range value. Copy the number that is shown on the ROI tab in the Config Measure dialog window.
		Example: maxTemporalAlign = "-1"	

Table 26: XML scripting commands (cont.)

Command	Type	Parameter	Description
maxTemporalOff-set	int		Use to set the maximum offset search range value. Copy the number that is shown on the ROI tab in the Config Measure dialog window.
		Example: maxTemporalAlign = "1"	
RefInputROILeft	int		Specifies the reference Input Spatial Region-of-Interest (ROI) left value. Copy the number that is shown on the ROI tab in the Config Measure dialog window. Resolution is 1.0.
		Example RefInputROILeft=”1200”	
RefInputROIRight	int		Specifies the reference Input Spatial ROI right value. Copy the number that is shown on the ROI tab in the Config Measure dialog window. Resolution is 1.0.
		Example RefInputROIRight=”1500”	
RefInputROITop	int		Specifies the reference Input Spatial ROI top value. Copy the number that is shown on the ROI tab in the Config Measure dialog window. Resolution is 1.0.
		Example RefInputROITop=”800”	
RefInputROIBot-tom	int		Specifies the reference Input Spatial ROI bottom value. Copy the number that is shown on the ROI tab in the Config Measure dialog window. Resolution is 1.0.
		Example RefInputROIBottom=”200”	
ImpInputROILeft	int		Specifies the test Input Spatial Region-of-Interest (ROI) left value. Copy the number that is shown on the ROI tab in the Config Measure dialog window. Resolution is 1.0.
		Example ImpInputROILeft=”1200”	
ImpInputROIRight	int		Specifies the test Input Spatial ROI right value. Copy the number that is shown on the ROI tab in the Config Measure dialog window. Resolution is 1.0.
		Example ImpInputROIRight=”1500”	
ImpInputROITop	int		Specifies the test Input Spatial ROI top value. Copy the number that is shown on the ROI tab in the Config Measure dialog window. Resolution is 1.0.
		Example ImpInputROITop=”800”	

Table 26: XML scripting commands (cont.)

Command	Type	Parameter	Description
ImpInputROIBottom	int		Specifies the test Input Spatial ROI bottom value. Copy the number that is shown on the ROI tab in the Config Measure dialog window. Resolution is 1.0.
		Example ImpInputROIBottom=”200”	
OutputROILeft	int		Specifies the Output Spatial ROI left value. Copy the number that is shown on the ROI tab in the Config Measure dialog window. Resolution is 1.0.
		Example OutputROILeft=”720”	
OutputROIRight	int		Specifies the Output Spatial ROI right value. Copy the number that is shown on the ROI tab in the Config Measure dialog window. Resolution is 1.0.
		Example OutputROIRight=”1020”	
OutputROITop	int		Specifies the Output Spatial ROI top value. Copy the number that is shown on the ROI tab in the Config Measure dialog window. Resolution is 1.0.
		Example OutputROITop=1280	
OutputROIBottom	int		Specifies the Output Spatial ROI bottom value. Copy the number that is shown on the ROI tab in the Config Measure dialog window. Resolution is 1.0.
		Example OutputROIBottom=”680”	
OutputROIStartFrame	int		Start frame for Output Temporal ROI. Copy the number that is shown on the ROI tab in the Config Measure dialog window. Resolution is 1.0.
		Example OutputROIStartFrame=”50”	
OutputROIEndFrame	int		End frame for Output Temporal ROI. Copy the number that is shown on the ROI tab in the Config Measure dialog window. Resolution is 1.0.
		Example OutputROIEndFrame=”550”	
startRefFrame	float		Start frame for reference sequence. Copy the number that is shown on the temporal alignment tab in the Config Measure dialog window. Resolution is 1.0.
		Example: startRefFrame="1.0"	

Table 26: XML scripting commands (cont.)

Command	Type	Parameter	Description
endRefFrame	float		End frame for reference sequence. Copy the number that is shown on the temporal alignment tab in the Config Measure dialog window. Resolution is 1.0.
		Example: endRefFrame="149.0"	
startImpFrame	float		Start frame for test (impaired) sequence. Copy the number that is shown on the temporal alignment tab in the Config Measure dialog window. Resolution is 1.0.
		Example: startImpFrame="1.0"	
endImpFrame	float		End frame for test (impaired) sequence. Copy the number that is shown on the temporal alignment tab in the Config Measure dialog window. Resolution is 1.0.
		Example: endImpFrame="149.0"	
dualended	char		Selects the measurement mode.
		false	Specifies single-ended measurement.
		Example: dualended="true"	
reference	char		Specifies the file name for the reference sequence. When an avi or vcap file type is selected, the system ignores the refWidth, refHeight, refRate, refInterlace and refSampleFormat commands. If a compressed media file containing multiple video streams is selected, refStreamID must also be specified.
		Examples: reference="D:\PreInstalled_Sequences\PQA600 with Trigger\525\ Mobile+.601-525.yuv" reference="E:\PQA\Vclips\sample-1.5MbpsH.264.trp"	
refStreamID	int		Specifies the stream ID in a compressed media file, which contains multiple video streams, to be used for the reference sequence.
		Example: refStreamID="49"	
refWidth	int		Width of the reference sequence.
		Example: refWdith=”720”	
refHeight	int		Height of the reference sequence.
		Example: refHeight=”486”	
refRate	float		Frame rate of the reference sequence.
		Example: refRate=”30.0”	

Table 26: XML scripting commands (cont.)

Command	Type	Parameter	Description
refInterlace	char		File format for reference sequence. Please refer to the *Supported Video Formats* in the Quick Start User Manual
		noInterlace	Progressive video or deinterlaced video.
		planar	Planar format.
		inverted	Top and bottom reversed video.
		fieldOneFirst	A line belonging to field 1 comes first, then a line for field 2, then a line for field 1, and so forth.
		fieldTwoFirst	A line belonging to field 2 comes first, then a line for field 1, then a line for field 2, and so forth.
		Example: refInterlace="noInterlace"	
refSampleFormat	char		Color sample format for reference sequence.
		BGR_8_8_8	BGR 24 bits/pixel.
		GBR_8_8_8	GBR 24 bits/pixel.
		YUV_8_8_8	YUV 24 bits/pixel.
		YCbYCr_8_8	YUY2 16 bits/pixel.
		CbYCrY_8_8	UYVY 16 bits/pixel.
		YCbCr_420	YUV420 planar 12 bits/pixel (also use refInterlace to specify noInterlace when using this format).
		Example: refSampleFormat="CbYCrY_8_8"	
refLeftCrop	int		The pixel where the reference sequence is cropped on the left side.
		Example: refLeftCrop="1" refRightCrop="1" refTopCrop="1" refBottomCrop="1"	
refRightCrop	int		The pixel where the reference sequence is cropped on the right side.
		Example: refRightCrop="1"	
refTopCrop	int		The pixel where the reference sequence is cropped on the top edge.
		Example: refTopCrop="1"	
refBottomCrop	int		The pixel where the reference sequence is cropped on the bottom edge.
		Example: refBottomCrop="1"	
autoRefHorizCrop	char		Enables the automatic horizontal crop function to align the reference sequence with the test sequence.
		Example: autoRefHorizCrop="true"	

Table 26: XML scripting commands (cont.)

Command	Type	Parameter	Description
autoRefVertCrop	char		Enables the automatic vertical crop function to align the reference sequence with the test sequence.
		Example: autoRefVertCrop="true"	
impaired	char		Specifies the file name for the test sequence. When an avi or vcap format file is selected, the system ignores the impWidth, impHeight, impRate, impInterlace and impSampleFormat commands. If a compressed media file containing multiple video streams is selected, impStreamID must also be specified.
		Example: impaired="D:\PreInstalled_Sequences\PQA300 with Trigger\525\ Mobile3mbs+.601-525.yuv"	
impStreamID	int		Specifies the stream ID in a compressed media file, which contains multiple video streams, to be used for the impaired sequence.
		Example: impStreamID="65"	
impWidth	int		Width of the test sequence.
		Example: impWdith=”720”	
impHeight	int		Height of the test sequence.
		Example: impHeight=”486”	
impRate	float		Frame rate of the test sequence.
		Example: impRate=”30.0”	
impInterlace	char		The file format of the test sequence. Please refer to *Supported Video Formats* in the Quick Start User Manual.
		noInterlace	Progressive video or deinterlaced video.
		planar	Planar format.
		inverted	Top bottom reversed video.
		fieldOneFirst	A line belonging to field 1 comes first, then a line for field 2, then a line for field 1, and so forth.
		fieldTwoFirst	A line belonging to field 2 comes first, then a line for field 1, then a line for field 2, and so forth.
		Example: refInterlace="noInterlace"	

Table 26: XML scripting commands (cont.)

Command	Type	Parameter	Description
impSampleFormat	char		Color sample format for the test sequence.
		BGR_8_8_8	BGR 24 bits/pixel.
		GBR_8_8_8	GBR 24 bits/pixel.
		YUV_8_8_8	YUV 24 bits/pixel.
		YCbYCr_8_8	YUY2 16 bits/pixel.
		CbYCrY_8_8	UYVY 16 bits/pixel.
		YCbCr_420	YUV420 planar 12 bits/pixel (also use impInterlace to specify noInterlace when using this format).
		Example: impSampleFormat="CbYCrY_8_8"	
impHorizScale	int		The percentage value that the test sequence is scaled horizontally to match the reference sequence.
		Example: impHorizScale="100"	
impHorizShift	int		The number of pixels that the test sequence is shifted horizontally to align with the reference sequence.
		Example: impHorizShift="0"	
impVertScale	int		The percentage value that the test sequence is scaled vertically to match the reference sequence.
		Example: impVertScale="100"	
impVertShift	int		The number of pixels that the test sequence is shifted vertically to align with the reference sequence.
		Example: impVertShift="0"	
impLeftCrop	int		The horizontal pixel to which the test sequence is cropped on the left side.
		Example: impLeftCrop="1"	
impRightCrop	int		The horizontal pixel to which the test sequence is cropped on the right side.
		Example: impRightCrop="1"	
impTopCrop	int		The vertical pixel to which the test sequence is cropped on the top side.
		Example: impTopCrop="1"	

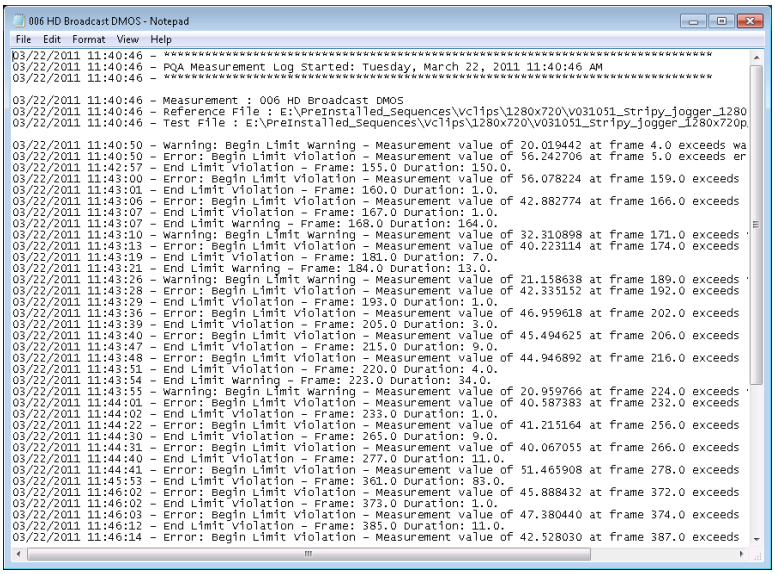
Table 26: XML scripting commands (cont.)

Command	Type	Parameter	Description
impBottomCrop	int		The vertical pixel to which the test sequence is cropped on the bottom side.
		Example: impBottomCrop="1"	
autoImpHorizCrop	char		Enables the automatic horizontal crop function to align the test sequence with the reference sequence.
		Example: autoImpHorizCrop = "true"	
autoImpVertCrop	char		Enables the automatic vertical crop function to align the test sequence with the reference sequence.
		Example: autoImpVertCrop = "true"	
autoImpHorizScale	char		Enables the automatic horizontal scale function to match the resolution of the test sequence with the reference sequence.
		Example: autoImpHorizScale= "true"	
autoImpVertScale	char		Enables the automatic vertical scale function to match the resolution of the test sequence with the reference sequence.
		Example: autoImpVertScale = "true"	
autoImpHorizShift	char		Enables the automatic horizontal shift function to align the test sequence with the reference sequence.
		Example: autoImpHorizShift = "true"	
autoImpVertShift	char		Enables the automatic vertical shift function to align the test sequence with the reference sequence.
		Example: autoImpVertShift = "true"	
autoImpLuma-GainAndOffset			Enables the automatic luma and gain offset function to match the test sequence with the reference sequence.
		Example: autoImpLumaGainAndOffset=”true”	

Log files

You can capture a log of a measurement run to a file using the LOG command. A log file provides detailed information about the measurement settings used, the reference and test files used in the measurement, and a summary of the results. Also, if measurement results cross the warning limit set in the Summary View, the log file will include a warning message with the frame number when the warning limit is crossed.

The following illustration shows an example log file for a DMOS measurement. The log file is saved in text format.



Frequently asked questions

Q- Can the PQA be used to detect watermarking or subliminal images?

A- The PQA does not have any built-in tools to specifically address watermarking or subliminal images. However, a comparison between PSNR and the human vision model can provide some valuable insights when measuring such video sequences. For example, if you compare a PSNR measurement of an video clip with no watermark or subliminal images to the same clip after adding these items to the video clip but having no other visual impairments, the resultant difference map will show the absolute impairment introduced by the marking. The impairment will generally show up as a dark gray region in the PSNR difference map. If you then run a PQR or DMOS comparison between the same two video clips, the resultant difference map shows those portions of the watermark or subliminal image that are visible to the average viewer. This comparison provides an indication of how subtle the marking is and ideally, will be zero or close to zero for completely unobtrusive watermarks. Furthermore, different display technologies can unmask some watermark methods more than others. If you need to keep a watermark below the threshold of perception, you might have to test many different displays and viewing distances to guarantee that the watermark is below the threshold of perception.

Q- Does the PQA run in real-time?

A- No. The PQA is designed to be an offline measurement and analysis tool, not a real-time picture quality monitor. However, a QCIF PSNR measurement run four at a time (using XML scripting) runs faster than real time. Also, up to four XML scripts can be run simultaneously without significant speed reduction in script execution, thereby substantially increasing throughput.

Q- Does the PQA have any single-ended measurements?

A- Yes. The PQA supports single-ended DC blockiness measurements as well as stand-alone simulation of human attention to determine which regions of the video are most likely to draw the eye. These measurements can be run with or without the human perceptual model to estimate either a MOS or objective measures. Also, single-ended % Perceptual Contrast, added edges, and blockiness measurements can be made at the transmission and receiver ends to make reduced reference measurements by comparison of test and reference results.

Q- What measurements does the PQA perform?

A- The PQA can perform PSNR, PQR (same as the PQA300 JND), predicted DMOS (similar to test audience MOS score differences), and artifact and simulated human attention-weighted versions of the above measurements. These measurements can be made between video clips of any resolution and any frame rate and even between different resolution or frame-rate source and impaired content. The artifact and attention measurements can also run separately to give artifact and attention probability measurements, respectively.

Q- How long does it take to run a measurement on the PQA?

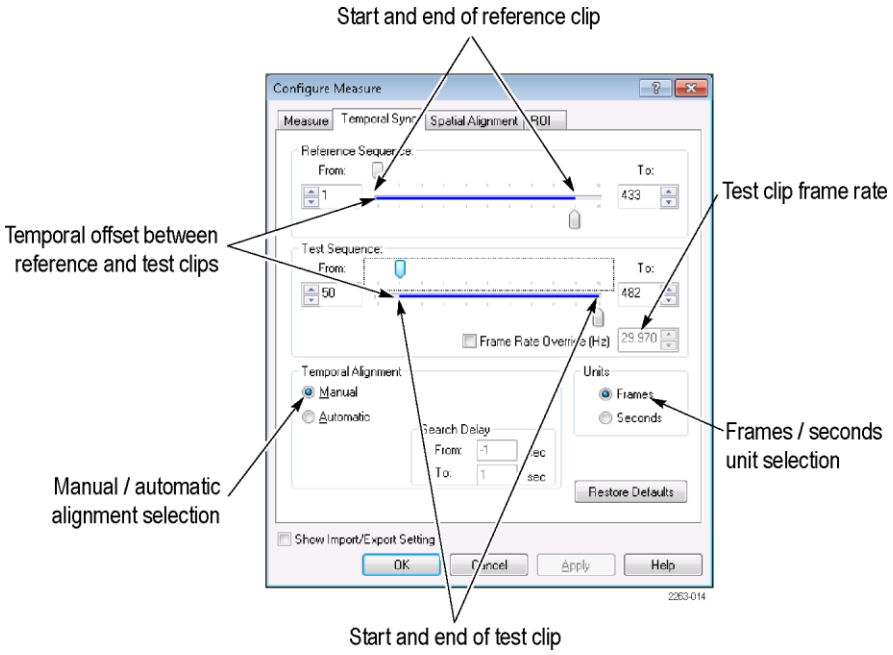
A- The amount of time it takes to take a measurement on the PQA varies a great deal depending on what type of measurement is being run and what type of content the measurement is being run against. For example, PQR on SD formats runs considerably faster than on the PQA300. The best way to estimate how fast the tool will perform a measurement is to benchmark it on a sample of similar video material with the desired test. If multiple measurements are to be made, XML scripts can be run in parallel for more than a 4X improvement in speed. Each script runs a given measurement faster than when run through the graphical user interface, because the graphical user interface updates the screen for each time interval of the input video.

Q- How do you account for temporal and spatial alignment between clips in the PQA?

A- The PQA supports both manual and automatic alignment of reference and test clips by adjusting the following items:

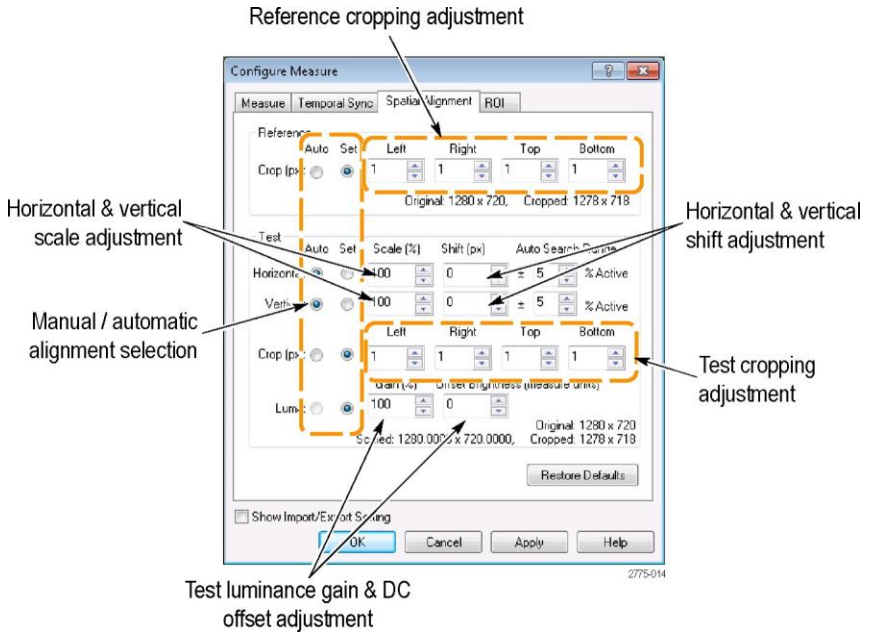
Temporal Sync

- Start and end frame or time for reference clip
- Start and end frame or time for test clip
- Temporal offset (shift) between reference and test clips
- Test clip frame rate



Spatial Alignment

- Horizontal and/or vertical shift between reference and test clips
- Horizontal and/or vertical scaling or stretching between reference and test clips
- Horizontal and/or vertical cropping between reference and test clips (letterboxing, zoom and so forth)
- Overall luminance gain and/or DC offset between reference and test clips



You can manually adjust each of these parameters while you watch a live-running PSNR until you achieve temporal and spatial alignment between the clips or you can run an automatic alignment that scans a portion of the video clips looking for similarities and automatically determines the best temporal and spatial alignment.

For systems with fixed spatial shift, scale and cropping, run the system spatial alignment once and save the measurements in the View model mode for subsequent measurements to save time taking measurements in the future. Also, note that the Auto Search Range can affect alignment measurement time exponentially. If you know that the Shift, Scale, and Crop settings are very close, reduce the Auto Search Range for much faster performance.

Q- Is there any limit to the length of clip that can be analyzed by the PQA?

A- No. The only limiting factors to how long a clip you can analyze are the capacity of the hard-drive and the amount of time required to perform the measurement.

Q- With subjective testing ratings being the benchmark in the market, how does the PQA300/PQA correlate to those results?

A- The PQA300 has the only independently verified objective and repeatable score (PQR) that strongly correlates to subjective testing ratings (up to 90% correlation). As the first to market with a picture quality analysis system with a repeatable objective score, it has been recognized in the market as the de facto standard, which includes winning the Emmy Award for Technical Excellence in 2000.

The predicted DMOS of the PQA goes further to actually predict the DMOS values directly rather than simply correlate to DMOS in another scale. The ITU BT.500 training simulation makes this possible, and significant development of both threshold and suprathreshold perceptual contrast prediction accuracy of the new human vision model.

Q- What is considered a "good" PQR score?

A- A "good" picture quality score depends greatly on the system being tested. Ideally, a PQR score of 0 is perfect, but you would only see a score that low with a very high-quality SDI loop through. Any composite video will likely see a score of 3 to 4 on a high-quality loop through from the NTSC/PAL conversion alone. As a general rule of thumb, a PQR score of 1 is considered to show little or no perceived impairment. A score of 3 would show some impairment, but it would not be very noticeable. For PQR values above 1, DMOS is a more appropriate measurement for quantification of video quality. A PQR score of 10 or more would show clearly observable impairment. For a high-quality MPEG encoder/decoder system, you might see PQR values ranging from 3 to 14, roughly corresponding to bit rates of 12 Mbps to 3 Mbps. For more information on PQR scores, see the Telestream application note *Measuring and Interpreting Picture Quality in MPEG Compressed Video Content* (available for download on www.telestream.net).

Q- What is considered a "good" DMOS score?

A- DMOS is the difference between two MOS (Mean Objective Score) values. The 100 point scale used in the PQA corresponds to the 100 point range usually used in the analysis of DMOS. A MOS generally uses a 5 point scale, with each integer assigned to a subjective quality adjective such as "excellent" for 5 and "poor" for 1. Thus, on a 5-point scale with an excellent reference, a DMOS of ≤1 is considered "good." On the 100-point scale, this corresponds to a DMOS of ≤20. The scale also depends on training. (See Table 18 on page 67.)