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NI Picture Quality Analysis

NI Picture Quality Analysis
Getting Started Guide

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1

NI Picture Quality Analysis Overview

National Instruments Picture Quality Analysis (NI PQA) software provides customizable analysis of streaming video and audio. You can configure and run NI PQA manual tests using NI PQA Executive or automated tests using NI TestStand or LabVIEW.

When configuring NI PQA tests using TestStand or LabVIEW, you can use the NI PQA Configuration panel within the application development environment to configure your test. The NI PQA Configuration panel functions similarly to NI PQA Executive, but you use each for different purposes.

- Use the NI PQA Configuration panel within TestStand or LabVIEW to configure tests and check and test your configurations. Then run the tests in TestStand or LabVIEW.
- Use NI PQA Executive to complete the entire process, from configuration to running tests to reporting and analysis, within NI PQA Executive.

You can configure the following analysis components using NI PQA:

- A provider, also known as the test stream source.
- A media reference stream or data reference stream to compare against your test stream.
- A trigger to synchronize the test stream and reference stream.
- One or more processors to calculate metrics, such as blockiness or total harmonic distortion (THD), or perform functions on the test stream, such as channeling a test stream to an `.avi` file or the output channels of an NI-DAQ™mx-compatible device.
- Output of one or more metrics that the selected processors calculate.

Refer to the *NI Picture Quality Analysis Help* for more information about the features available in NI PQA.

Conventions

This manual uses the following conventions:

Data reference stream	This NI PQA component is a prerecorded set of calculations you can use to perform calculations relative to a test stream without using the bandwidth for streaming the reference media or duplicating calculations on the reference stream for each test.

Media reference stream	This NI PQA component is a prerecorded media stream to which you can compare your test stream.
Metric	This NI PQA component is a measurement, calculated by a processor, that you can use to evaluate your test stream.
Multipoint metric	This NI PQA component is a measurement that contains multiple data points per video frame.
NI PQA Configuration panel	Similar in appearance and functionality to NI PQA Executive, this is a configuration panel used within TestStand or LabVIEW to create and test new NI PQA configurations for use in test sequences and applications.
NI PQA Executive	This is a standalone application for acquiring and analyzing video and audio test streams.
Processor	This NI PQA component processes the acquired test stream during an NI PQA analysis session. The processor either calculates metrics or performs a task.
Provider	This NI PQA component provides the test stream for an NI PQA analysis session.
Reference stream	This NI PQA component is a stream, either a media reference stream or a data reference stream, to which NI PQA can compare the test stream for analysis.
Session	This NI PQA component is a grouping of information related to an NI PQA test, including any files generated by that test.
Single-point metric	This NI PQA component is a measurement that contains one averaged data point per video frame.
Trigger	This NI PQA component is a condition you specify that NI PQA must match in the test stream before processing and/or streaming to disk starts.

2

Getting Started with
NI Picture Quality Analysis

1. Verifying System Requirements

Verify that your system meets the minimum or recommended system requirements to use
NI PQA. Also verify that you have a valid serial number to activate NI PQA. For more
information about NI PQA requirements, refer to the *NI Picture Quality Analysis Readme* on the
NI PQA media.

2. Verifying the Kit Contents

Verify that the kit contains the following items:

☐ NI Picture Quality Analysis software media, which includes the following documents:

  – *NI Picture Quality Analysis Help*—Contains instructions for using NI PQA software.
    This help file also contains information about programming and fundamentals. Select
    **Start»All Programs»National Instruments»NI Picture Quality Analysis»
    Documentation»NI Picture Quality Analysis Help** to view this document after
    installing NI PQA.

  – *NI Picture Quality Analysis Readme*—Contains system and hardware requirements,
    filenames and locations, and information about new features, known issues, and bug
    fixes. Select **Start»All Programs»National Instruments»NI Picture Quality
    Analysis»Documentation»NI PQA Readme** to view this document after installing
    NI PQA. You also can view the readme prior to installation by selecting **View
    Readme** from the NI PQA installation splash screen.

☐ *NI Picture Quality Analysis Getting Started Guide* (this document)—In addition to the
  printed copy shipped with NI PQA, you also can view a PDF on your computer. Select
  **Start»All Programs»National Instruments»NI Picture Quality Analysis»
  Documentation» NI Picture Quality Analysis Getting Started Guide** to view this
  document after installing NI PQA.

Other Required Items

In addition to the items contained in the kit, you need any hardware, drivers, and cables required for the provider you plan to use. You also need software media for any application development environments you plan to use to automate NI PQA tests. Refer to the *NI Picture Quality Analysis Readme* for supported application development environments and hardware, driver, and cable requirements.

3. Installing the Software

Complete the following steps to install NI PQA:

1. Install any application development environments in which you will use NI PQA. You can use NI PQA in LabVIEW or TestStand.

2. Insert the NI PQA media. The NI PQA installer should open automatically. If not, select **Start»Run**, and enter x:\setup.exe, where x is the letter of the media drive.

3. Follow the instructions in the installation prompts.

    (Windows 7/Vista) You might see access and security messages during installation. Accept the prompts to complete the installation.

4. Activating the Software

If you have not already activated NI PQA from the installer, complete the following steps to activate NI PQA:

1. Launch the NI License Manager at **Start»All Programs»National Instruments» NI License Manager**.

2. Navigate in the product tree to NI PQA, which is at **Local Licenses»Picture Quality Analysis *X.X*»NI PQA**.

3. Right-click **NI PQA** and select **Activate** to launch the NI Activation Wizard.

4. Follow the instructions in the NI Activation Wizard to activate NI PQA.

Refer to the *NI Picture Quality Analysis Help* for additional information about software activation.

5. Installing and Configuring the Hardware

Figure 2-1 shows two methods for setting up the controller for your NI PQA test system. You can control your system using an embedded controller or a computer, and you can connect a redundant array of independent disks (RAID) to either controller method for additional high-performance storage.

Figure 2-1. NI PQA Hardware Setup Options Using Two Different Controller Configurations
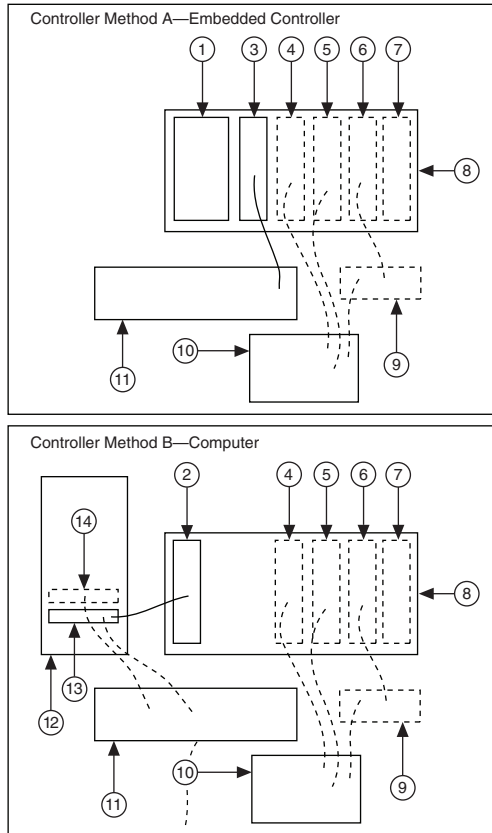
1	Embedded NI PXI Express Controller	9	(Optional) NI CB-2180/2181 Digital Audio Accessory
2	NI x4, x8, or x16 PXI Express MXI Express Controller	10	Device Under Test
3	NI x4 or x8 PXI Express Expansion Module	11	(Optional) Redundant Array of Independent Disks (RAID)
4	(Optional) NI PXIe-1491 Module	12	Computer
5	(Optional) NI-DAQmx Device	13	NI x4, x8, or x16 PCI Express MXI Express Interface
6	(Optional) NI PXI-7813R Device	14	(Optional) NI x4, x8, or x16 PCI Express MXI Express Interface
7	(Optional) NI PXI Express Legacy Digital Video Analyzer		
8	NI PXI Express Chassis		

Refer to Figure 2-1 and complete the following steps to set up a recommended system:

1. Power off and unplug all hardware, including the chassis, computer, PXI Express controller, and/or RAIDs.

2. Set up the chassis controller and/or RAID using one of the following methods:

    •   **Controller Method A**—To use an embedded controller, install the PXI Express controller in Slot 1 of the PXI Express chassis.

        (Optional) To use an embedded controller with an NI HDD-8265 or similar external RAID, complete the following steps to set up the controller and RAID:

        a. Install the PXI Express controller in Slot 1 of the PXI Express chassis.

        b. Install the NI PXI Express x4, x8, or x16 MXI Express expansion card in an express slot in the chassis.

        c. Use the copper cable connected to the RAID to connect it to the NI MXI Express expansion card.

    •   **Controller Method B**—To use a computer, install the x4, x8, or x16 PCI Express and PXI Express MXI Express controller modules in any express slot in the computer and in Slot 1 of the PXI Express chassis, respectively.

        (Optional) To use a computer with an NI HDD-8265 or similar external RAID, complete the following steps to set up the controller and RAID:

        a. Install the x4, x8, or x16 PCI Express interface in any express slot in the computer.

        b. Use the copper cable connected to the RAID to connect it to the MXI Express controller in the computer.

3. (Optional) If you are testing HDMI video or audio, install the NI PXIe-1491 in any PXI Express x4 or greater slot in the chassis, then connect the HDMI IN connector on the NI PXIe-1491 to the HDMI output connector on the device under test (DUT) using an HDMI cable.

    •   (Optional) NI PQA also supports the legacy NI Digital Video Analyzer. National Instruments recommends the NI PXIe-1491 for all new applications. To use the legacy analyzer, install it in any PXI Express x4 or greater slot.

4. (Optional) If you are testing S/PDIF audio, install the NI PXI-7813R in any PXI slot in the chassis, then connect the NI PXI-7813R to your DUT using the following method:

    •   To connect one or more DUTs to the CB-2180 or CB-2181, complete the following steps:

        a. Connect any DIO connector on the NI PXI-7813R to the NI CB-2180 or NI CB-2181 using an SHS68-C68-S cable.

        b. Connect the NI CB-2180/2181 to the DUT(s) using the appropriate cable(s) for your DUT(s). You can connect up to four NI CB-2180/2181 accessories to one NI PXI-7813R.

5. (Optional) If you are testing analog audio, install the NI-DAQmx device in any compatible slot in the chassis, then connect the NI-DAQmx device to the DUT using the appropriate cable for your NI-DAQmx device.

6. Power on the chassis.

7. Power on the computer.

8. Configure all hardware according to the hardware documentation.

Navigating NI Picture Quality Analysis

NI Picture Quality Analysis includes a graphical user interface (GUI) that is the primary method for configuring analysis of video and audio test streams, and optionally running them. You can open the GUI as NI PQA Executive from **Start»All Programs»National Instruments» NI Picture Quality Analysis»NI PQA** or from LabVIEW or TestStand. Press <Ctrl-H> or select **Help»Context Help** to launch the context help for specific information on different elements of the GUI. Refer to the *NI Picture Quality Analysis Help* for more information about all other features covered in this chapter.

This chapter teaches you the GUI's basic layout and flow.

Resource Controls

Use the top of the NI PQA GUI to specify parameters for your acquisition and monitor the memory buffer usage.

Figure 3-1. Resource Controls
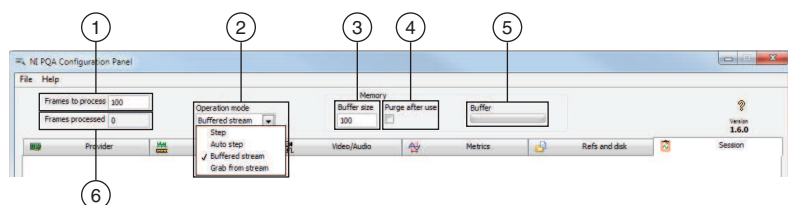
1	Frames to Process	4	Purge After Use
2	Operation Mode	5	Buffer
3	Buffer Size	6	Frames Processed

Frames to process—How many total frames to grab from the incoming stream.

Operation mode—Select how to acquire and advance through the acquisition of frames. Stepped frames are requested and sent one at a time from the provider, while streamed frames are continuously sent with no request necessary. Note that not all providers support stepping, as the test stream sources they specify may not be compatible with stepping. For example, file sources and stream servers typically support stepping, but sources such as cameras, frame-grabbers, and set-top boxes (STBs) do not inherently support stepping.

- **Step**—The user manually steps through the frames. Frames are not lost in this step mode.
- **Auto step**—NI PQA requests one frame at a time and performs an analysis between each acquisition. Frames are not lost in this step mode.
- **Grab from stream**—Automatically acquires one frame at a time, on demand (software timed), from the provider regardless of its history. Optimal for tests that do not require all frames to be acquired in a sequence.
- **Buffered stream**—Acquisition and processing are run as independent tasks by placing the frames into a memory buffer on acquisition and pulling frames out of the buffer for processing. Optimal for tests that are performed online and require all frames to be acquired in a sequence.

Buffer size—Specifies the size, in number of frames, of memory buffer to use. The amount of available memory limits the buffer size.

Purge after use—Releases memory buffer data at the end of the acquisition.

Buffer—Indicates the PC memory buffer's current status.

Frames processed—How many frames have been acquired in the current acquisition.

Graph and Operation Controls

Use the bottom of the NI PQA GUI to view analyzed data and control the acquisition.

Figure 3-2. Graph and Operation Controls
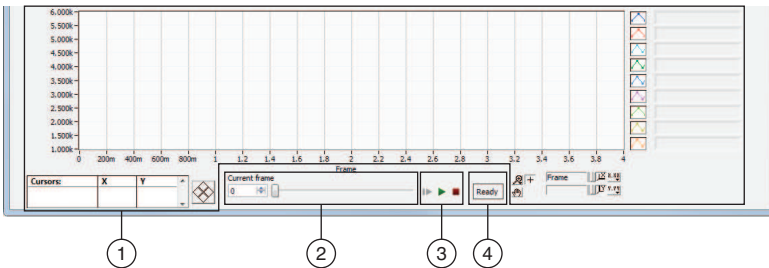
| 1 | Graph and Graph Controls | 3 | Acquisition Controls |
| 2 | Frame Selection | 4 | Status |

Graph and graph controls—Use these controls to view analyzed data and control the graph.

Frame selection—Use this control to scroll through or select frames from the stream. On the **Video/Audio** tab, the current frame appears on the left video preview tab. Use the slider or increment control to select a frame in the buffer.

Acquisition control

- **Step**—In a step operation mode, acquires another frame on demand.

- **Play**—Starts an acquisition and grabs all frames to process. Runs until completion, an error occurs, or you click the stop button.

- **Stop**—Aborts an acquisition.

Status—Displays the acquisition status: white **Ready** when idle or yellow **Active** when running.

Provider Tab

A provider in PQA is the source for your acquisition, whether from a file or hardware. Use this tab to select and configure a provider for the test stream. To run an acquisition, you must specify a provider.

NI PQA has the following three classes of providers, based on the type of data they stream.

- Video providers stream video data.

- Audio providers stream audio data.

- Combined audio/video providers stream both video and audio data.

Within each provider class are multiple providers that stream audio and/or video in different formats. Refer to the *NI Picture Quality Analysis Help* for more information about specific NI PQA providers.

Figure 3-3. Provider Tab
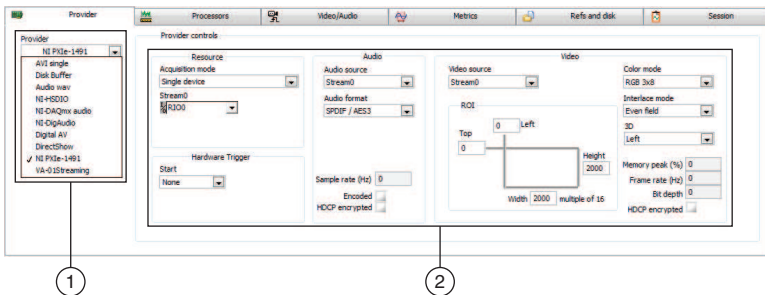
| 1 | Provider | 2 | Provider Controls |

Provider—Specifies which installed provider to use.

Provider controls—Use these controls to choose various parameters and settings specific to the selected provider.

Processors Tab

A processor in PQA is the analysis you can perform on a test stream. Use this tab to select which processors and analysis to perform on your stream. You do not need to select any processors if you do not need them (for example, if acquiring a reference stream).

Select and configure a processor to analyze the acquired test stream. PQA has the following three classes of processors based on the function they perform.

- Video metric processors calculate video metrics on a video test stream.
- Audio metric processors calculate audio metrics on an audio test stream.
- Nonmetric processors perform a task on the test stream rather than calculating metrics.

Within each processor class are multiple processors that calculate different metrics or perform different tasks. You also can write your own processor algorithm to create a custom processor using the User processor. Refer to the *NI Picture Quality Analysis Help* for more information about NI PQA processors and defining a custom processor.

Figure 3-4. Processors Tab
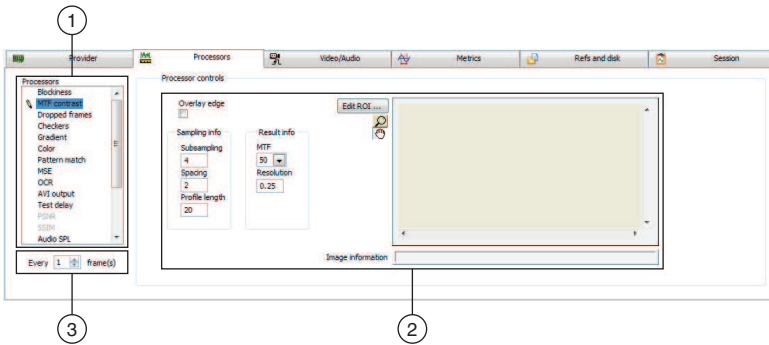
| 1 | Processors | 2 | Processor Controls | 3 | Every *n* Frame(s) |

Any processors highlighted in blue are currently active. To select multiple processors, use either <Ctrl>-click or <Shift>-click. Selecting them here does not necessarily mean you will see the results returned. To view the results on the graph at the bottom, select the metrics of interest in on the **Metrics** tab.

Processors—Specifies one or more processors to use. Use this control to choose the processors on which to change the settings.

Processor controls—Choose various parameters and settings specific to the selected processor.

Every *n* frame(s)—Specifies whether to process data from every frame or at a less frequent interval. Reduced frame rate skips acquiring incoming frames, but results in a faster analysis because some frames are not processed.

Video/Audio Tab

Use this tab to view live video and/or audio during acquisition or when scrolling through a completed acquisition if the buffer contains frames available for viewing.

You also can use this tab to define a video trigger. You can use a video trigger when comparing an acquired test stream to a reference stream to automatically synchronize the two to ensure an accurate comparison. You also can use a trigger with a looping video stream to ensure processing always begins at the same point in the stream.

Figure 3-5. Video/Audio Tab
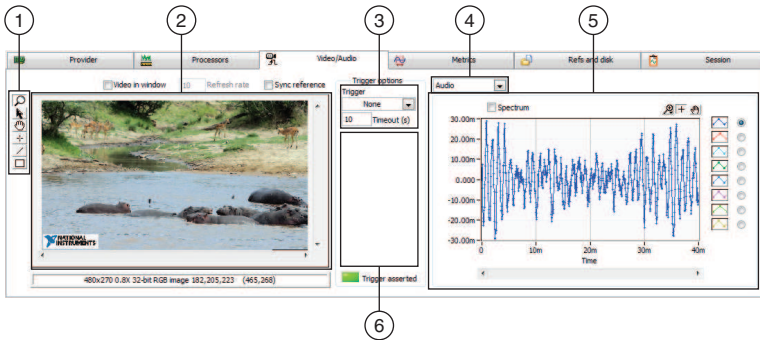
1	Tools	4	Comparison Mode Selector
2	Test Stream Displays	5	Comparison Mode-Specific Controls
3	Trigger	6	Trigger-Specific Controls

Tools—Use these controls to zoom, pan, and set ROIs for the triggers.

Test stream displays—Displays the video stream of the current acquisition, whether currently acquiring or being reviewed from the buffer.

Trigger—Use this control to choose the video trigger type. In the **None** mode, there is no trigger and the acquisition begins immediately. In PQA, all trigger processing takes place in software, rather than on hardware.

Comparison mode selector—Use this control to choose between the audio from the incoming stream or video from the reference stream for the window to the right.

Comparison mode-specific controls—Use these controls to view and modify the comparison window.

Trigger-specific controls—Use these controls to modify the trigger settings.

Metrics Tab

A metric in PQA is a returned analyzed result. Use the **Metrics** tab to specify which analyses to display and optionally what pass/fail test limits to apply to each analysis. All possible metrics are calculated for the selected processors in any acquisition, but you can specify which metrics to view.

Processors can return a single-point or multipoint metric, or both. A single-point metric contains a single value representing the averaged result for the entire frame and is displayed for every frame at once. A multipoint metric contains multiple measurements within each frame and is displayed frame by frame.

💡 **Tip** In PQA metrics, an error refers to a metric that has failed its testing limit, not an error with acquisition or processing. Instead of popping up, frame error information displays in the **Metrics** tab.

Figure 3-6. Metrics Tab
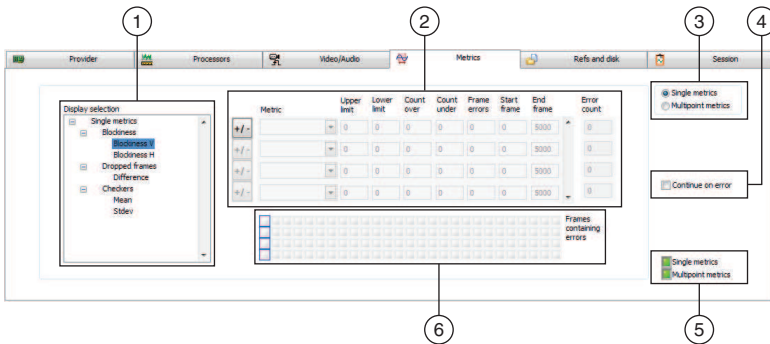
1	Display Selection	4	Continue on Error
2	Limit Test Definition	5	Display Mode Errors
3	Display Mode	6	Frames Containing Errors

Display selection—Controls which metrics are shown in the GUI. Metrics highlighted in blue are active. Press <Ctrl>-click or <Shift>-click to choose multiple metrics.

Limit test definition—Specifies error criteria to test for the available metrics. Each row in the control defines a set of criteria for the metric you select in the **Metric** setting.

Display mode—Controls whether metrics are displayed as a single or multipoint metric.

Continue on error—If disabled, stops the acquisition if a frame error occurs.

Display mode errors—Displays whether an error has occurred in the single or multipoint metrics. Note that one could fail, and not the other.

Frames containing errors—Indicates errors that correspond to the rows in the limit test definition. Red squares indicate the frames that fail the limit test criteria after a test. As you change frames, the **Frames containing errors** control outlines the boxes that correspond to the selected frame in blue.

Refs and Disk Tab

Use this tab to specify whether to record media and data streams for later use, and to configure comparisons of media and data reference streams with test streams.

Figure 3-7. Refs and Disk Tab
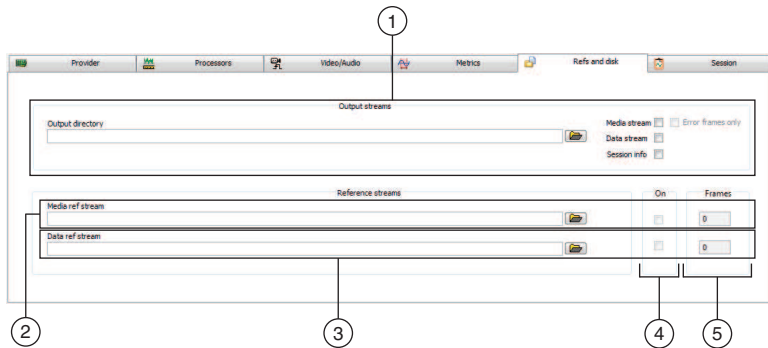
| 1 | Output Directory | 3 | Data Ref Stream | 5 | Frames |
| 2 | Media Ref Stream | 4 | On | | |

Output directory—Specifies the file path of the directory to which you would like to save output streams.

- **Media stream**—Specifies whether to output the audio/video raw data stream.
- **Data stream**—Specifies whether to record a data stream.
- **Session info**—Specifies whether to associate the recorded media stream and data stream with the current session and include a session identifier at the beginning of associated filenames.
- **Error frames only**—Specifies whether to record only frames containing metric errors in the media stream.

Media ref stream—Specifies the file path of the media reference stream to compare with the incoming test stream.

Data ref stream—Specifies the file path of the data reference stream to compare with the test stream.

On—Enables comparison of the test stream to a reference stream during processing.

Frames—Indicates the number of frames found in the reference stream file.

Session Tab

Use this tab to select a previously saved session from which to view results or to modify the files associated with a session. You also can save configuration information to disk and load it later, and load the last accepted configuration from a previous session.

Figure 3-8. Session Tab
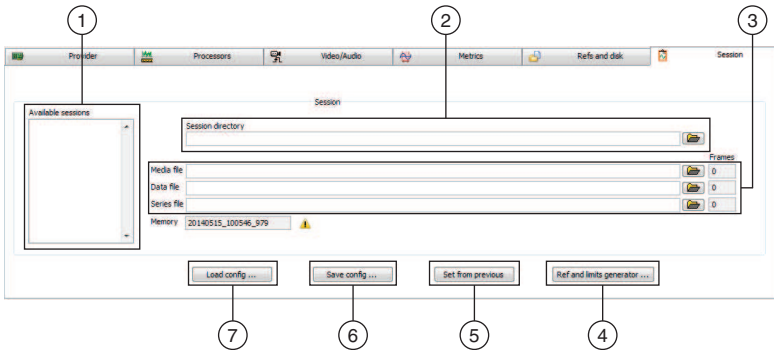
1	Available Sessions	4	Ref and Limits Generator	7	Load Config
2	Session Directory	5	Set from Previous		
3	Media/Data/Series File	6	Save Config		

Available sessions—Lists all saved sessions in the directory specified in the **Session directory** control. You can select the session you want to view from this list.

Session directory—Specifies the file path to the directory containing saved sessions to populate in the **Available sessions** list.

Media/data/series file—Indicates files associated with a previous NI PQA session.

Ref and limits generator—Assists in generating a data reference stream and limits based off stored session data.

Set from previous—Reverts all settings to the configuration previously loaded from the session tab.

Save config—Saves all current control settings in the configuration panel to disk.

Load config—Loads a saved configuration from disk.

Host Control Tab

Use this tab to control sessions at runtime from TestStand or LabVIEW. This controls what data is returned and when to return data to the host environment.

✍ **Note** This tab is not visible in NI PQA Executive.

Figure 3-9. Host Control Tab
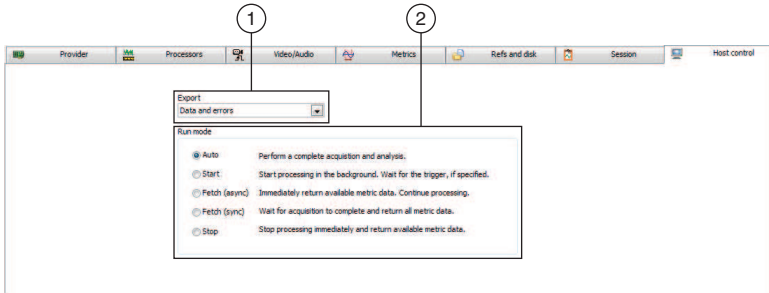
1	Export		2	Run Mode

Export— Controls what metrics and errors are returned to the host environment.

Run mode—Specifies the behavior of PQA when running from a host environment.

4

Creating a Configuration

In this chapter, you will build on knowledge of the basic GUI layout and flow to create and save a configuration. This PQA configuration method applies whether using the GUI as NI PQA Executive or from LabVIEW or TestStand. This chapter covers creating a generic configuration while demonstrating some of the NI PQA feature set. Refer to the *NI Picture Quality Analysis Help* for more information about choosing different and more advanced configurations.

To complete the following sections, NI PQA 1.5 or later must be installed on your system. Hardware is optional, and you can substitute it instead of using the provided video files.

1. Choosing a Provider and Performing an Acquisition

In this section, you will choose a provider and perform a simple acquisition. You will continue to build on these concepts in the following sections.

Open and Explore PQA

Complete the following steps to open and explore PQA:

1. Open NI PQA Executive from **Start»Programs»National Instruments»NI Picture Quality Analysis»NI PQA**.

2. Familiarize yourself with the PQA environment discussed in the previous chapter.

    a. Notice the top of the GUI, which you can use to set parameters for your acquisition and monitor it.
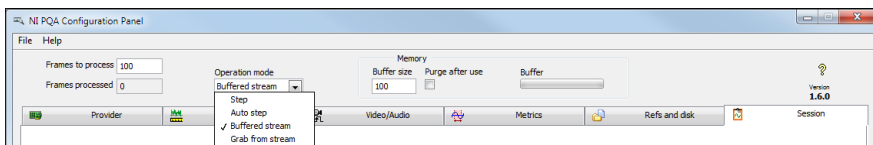
b.   Notice the bottom of the GUI, which displays information as a graph and allows you
to control the acquisition.
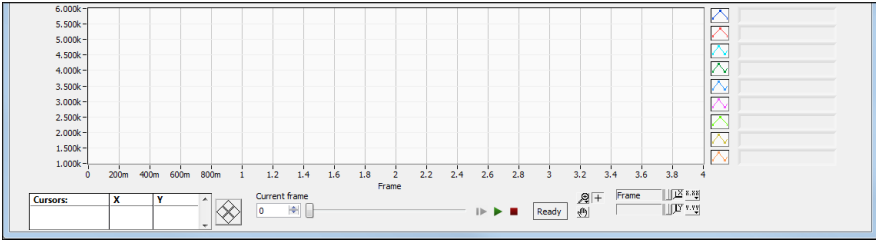
Choosing a Provider

In this case you are using a Disk Buffer provider to load a previously acquired file from PQA.
You can choose any other provider to acquire from hardware or file. For more information about
the various providers and their settings, refer to the *NI Picture Quality Analysis Help*.

Complete the following steps to choose a provider:

1.   Select the **Provider** tab.

2.   Select the **Disk Buffer** provider from the **Provider** drop-down menu. You can use the Disk
Buffer to load previous PQA acquisitions. In this case, you will be loading a short video
that ships with NI PQA.

3.   Use the **Path** control to point to the `Hippo 480x270 100f AV.bin` file at `<Users>\`
`Public\Documents\National Instruments\NI PQA\Media\`. The **Total**
frames indicator should indicate 100 frames available.
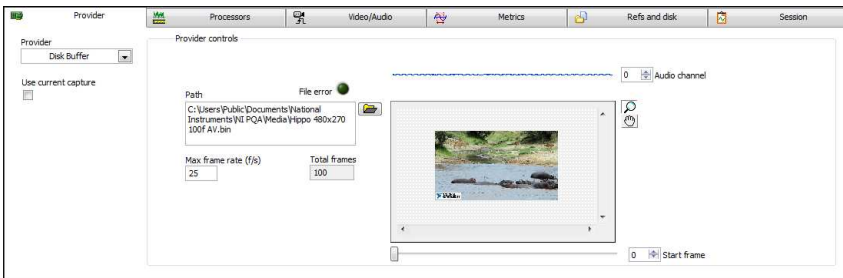
Performing an Acquisition

You can perform an acquisition in PQA as long as you have specified a provider.

Complete the following steps to begin an acquisition, view it while it streams, and review the acquired data:

1. Switch to the **Video/Audio** tab.

> **Note** You can acquire in any tab, but in this tab you can preview your data on the fly as it streams and is acquired, whether from hardware or a video file. You also can return to this tab after an acquisition to review your acquired data.

2. Click the play button ▶ in the controls area at the bottom of the GUI to begin the acquisition. After you click the play button, the white **Ready** indicator turns yellow and displays **Active** until the acquisition has ended. You should see your acquisition live in the left preview pane.

> **Tip** If your video stream appears small in the window, use the magnifying glass control 🔍 (at the left of the left video pane) to zoom in on it. Press <Shift>-click to zoom out.

3. When the acquisition completes and the status returns to **Ready**, you can then review your data using either the **Current frame** control or the slider next to it. Use each control to scroll through the frames you acquired.

2. Adding Processing and Reviewing Metrics

In this section, you perform a basic analysis of your video stream and view the resulting data.

Setting Up a Processor

Complete the following steps to set up a processor:

1. You still should be in the configuration from the previous section. If not, set it up by following the steps in section 1.

2. Select the **Processors** tab. This tab contains all analyses you can perform on the test streams.

3. From the **Processors** list, choose the **Blockiness** processor and ensure it is highlighted in blue. Any processors highlighted in blue run with each acquisition. You can select multiple processors by pressing <Ctrl>-click or <Shift>-click. A processor with a pencil icon next to it indicates its settings are currently selected to be edited.

This processor detects compression artifacts and returns an averaged blockiness value across a video frame. Some compression formats are based on breaking up the frame into smaller blocks, called macroblocks, commonly 16 × 16 pixels. The cause of compression artifacts are differences between pairs of pixels that cross the borders of macroblocks, which can be difficult to encode. The Blockiness processor identifies such cross-block artifacts. You can learn more about the Blockiness processor and other processors in the *NI Picture Quality Analysis Help*.
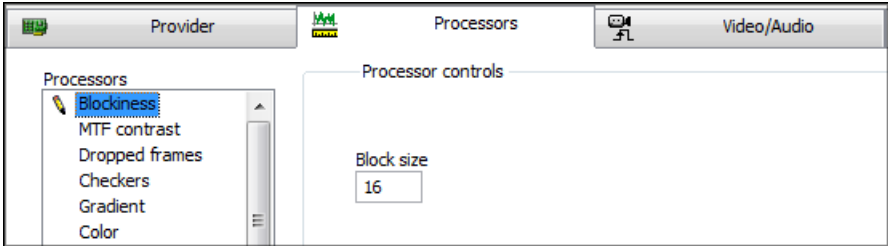
4.   Leave the **Block size** setting at 16.

Acquiring and Reviewing Results

Complete the following steps to acquire and review results:

1.   Return to the **Video/Audio** tab.

📝   **Note**   You are not required to be on the **Video/Audio** tab when acquiring, but in this tab you can watch the video as it is analyzed.

2.   Press the play button at the bottom of the GUI to acquire the video stream.

3.   A per-frame result score should appear at the bottom of the GUI in the graph. This score is the result of the Blockiness processor.

4.   Select the **Metrics** tab. Use this area of the GUI to control the display of analyzed results, set pass/fail limits, and more. In this exercise, you will change only the analyzed results being displayed.

5.   Under the **Display selection** list, click the **Blockiness H** metric. Another line of data appears on your graph. Notice that the Blockiness V metric became unselected. You can press <Ctrl>-click or <Shift>-click to select multiple metrics at once. All metrics are processed at the time of the acquisition, regardless of whether they were selected in the **Metrics** tab when the acquisition occurred.

3. Adding a Video Trigger

Use video triggers to analyze, in software, an incoming video stream to look for a condition to begin acquisition and analysis. You can trigger from criteria such as optically recognized text or a certain pattern or object in a particular frame. Use video triggers for tasks such as always

starting analysis at the same point on a repeated stream or to ensure that an incoming stream lines up frame-to-frame with a reference stream. For more information about triggers and their settings, refer to the *NI Picture Quality Analysis Help*.

Embedding a Frame Counter in a Video

In this exercise you will be working with one of the video triggers, Optical Character Recognition (OCR). This video trigger works by processing a selected Region of Interest (ROI) for each frame, converting the region's content into text characters, and then comparing them against a specified string to trigger on.

The OCR video trigger typically is used with a frame counter embedded in the video, but it also can work to recognize any text in the frame. You can embed a frame counter into your video manually with video editing software, or you can use a PQA processor to output an AVI file with it added.

Complete the following steps to embed a frame counter in a video:

1. Select the **Processors** tab.

2. From the **Processors** list, choose the AVI Output processor. Rather than calculating a metric, this processor takes content that is not copy protected and outputs an AVI file with the video content. It also can embed a frame counter into a resulting file.

> **Note** There is also an OCR processor, which reads characters embedded in a video.

3. Use **Path** to select a destination for your AVI Output file. Using the same directory as the reference files makes it easier for future steps. Use `<Users>\Public\Documents\ National Instruments\NI PQA\Media\Hippo with Counter.avi` for these exercises.

4. Click **Add Counter** to overlay a frame counter into the output file.

5. For this exercise, leave all other options as is.
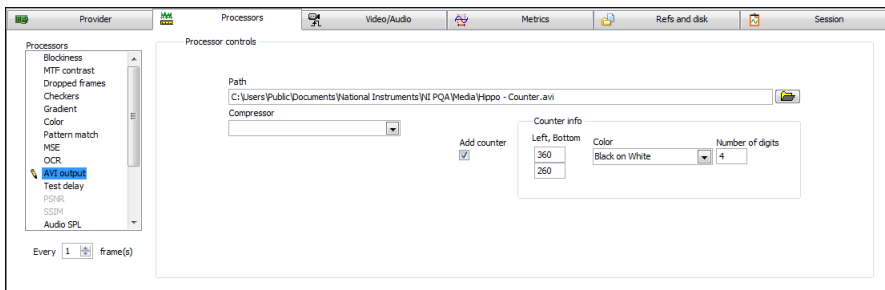
6. Press the play button at the bottom of the GUI to acquire the video stream. This time, it also creates the AVI file you specified above.

7. Once the acquisition has completed, press <Ctrl>-click on **AVI Output** to deselect it so it is no longer highlighted in blue. This is important so that you don't attempt to create an AVI file when completing future steps.

Setting up a Video Trigger

You now will change providers to read from the AVI file you created in the previous section, and then set up your video trigger to work with the embedded frame counter.

Complete the following steps to set up a video trigger:

1. Select the **Provider** tab and make sure the **AVI Single** provider is selected.

2. From the AVI file path, choose the path you specified in the previous section, which should be *<Users>*\Public\Documents\National Instruments\NI PQA\Media\ Hippo with Counter.avi.

3. Select the **Video/Audio** tab.

4. For now, specify the **Trigger** as **None**. Click the play button to acquire your video.

5. In the video preview pane, use the Zoom 🔍 and Pan 🖐 tools to find the embedded frame counter in the bottom right corner of the video frame, and zoom into it.

6. Use the ROI tool ▭ to select an area around the characters inside the frame counter. This specifies the area the video trigger searches for characters.

7. Use the drop-down to choose **OCR** for the **Trigger**. This specifies that future acquisitions are not logged until the conditions of this trigger have been met.

8. Set the **Trigger string** to **0010**. This corresponds to the 10th frame in your video. When this text is found, the trigger asserts.

9. Click the **Char set file** control and choose *<Users>*\Public\Documents\National Instruments\NI PQA\Configurations\Courier New 22 Bold 0-9.abc. The character set file is the reference for the OCR Trigger to use when searching for characters. A special file is needed for each character set. You chose an example character set file trained to the characters used by the AVI Output processor. You also can create other character set files using the NI Vision OCR Training Interface, which is part of the NI Vision Development Module, a separate NI software package.

10. Currently, the **Read string** indicator should indicate the counter from the current slide. Use the frame control at the bottom of the GUI to advance to frame 10. The **Trigger asserted** indicator should change to green, indicating a match has been found, and the video trigger would be asserted successfully on this frame.
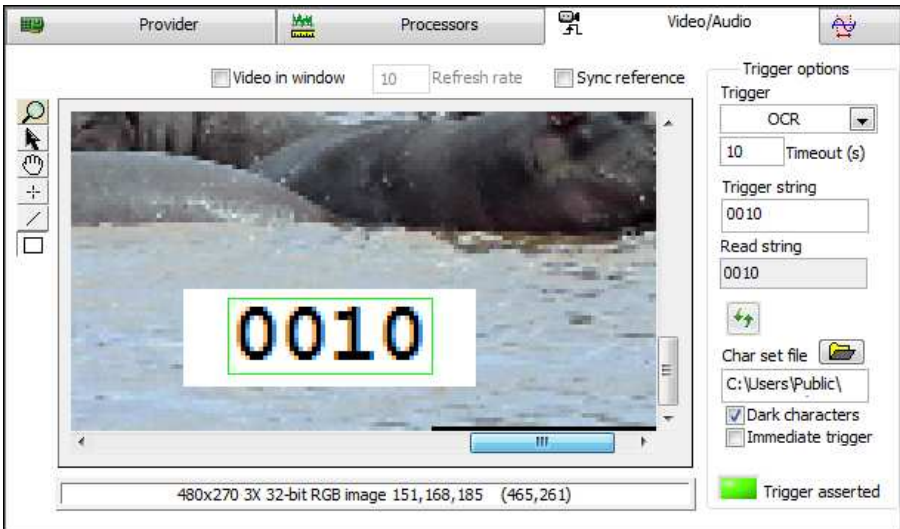
11. In the top left corner of the GUI, change **Frames to process** to 50 frames. The video file contains 100 frames. However, you are now starting on the 10th frame via the trigger.

12. Press the play button at the bottom of the GUI to acquire the video stream.

13. Review the acquired frames using the frame controls at the bottom of the GUI. Observe that the first frame acquired is the 10th frame, marked as 0010 in the frame counter. Also notice that the **Trigger asserted** indicator has turned green for this frame. You have successfully set up a video trigger.

4. Performing a Referenced Measurement

NI PQA can perform both nonreferenced and referenced measurements on a stream. You can perform a nonreferenced measurement on a single incoming stream without comparing to another stream. For some measurements, you will want to compare a known good stream, sometimes called a golden stream, to your incoming stream to test for similarities. This is known as a referenced measurement. In PQA, some processors support only nonreferenced or referenced, and some support both.

In this section, you first will create a disk buffer output from your incoming stream, then reference that and the original stream version to your AVI stream and compare them.

Creating a Golden Reference

With NI PQA, you can capture a known good stream to use as your golden reference for future measurements. In these exercises you are working with files as a demonstration, but this process is more applicable when working with hardware captures from DUTs.

Complete the following steps to create a golden reference:

1. Select the **Refs and disk** tab. Use this area of the GUI to store an incoming stream on hard disk or recall a stored stream to use as a reference against other incoming streams.

2. In the **Output directory** control in the **Output streams** section, choose `<Users>\Public\Documents\National Instruments\NI PQA\Media\`.

3. Click the **Media Stream** box to check it. When this is selected, PQA stores your incoming stream to disk.
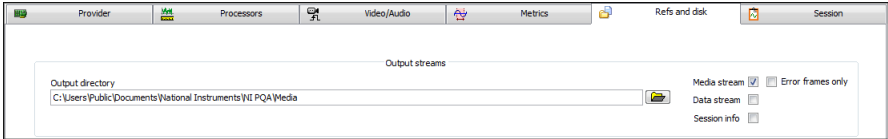
4. Press the play button at the bottom of the GUI. This time, you not only perform the acquisition you previously performed, but because you have checked the **Media stream** box, the acquisition is stored to the hard disk as `media.bin`.

> 📝 **Note**   If you leave **Media stream** checked, it continues to overwrite `media.bin` on each acquisition. To create unique filenames each time, select the **Session info** box.

5. After the acquisition completes, check `<Users>\Public\Documents\National Instruments\NI PQA\Media\` to ensure the `media.bin` file has been created.

6. Click the **Media stream** box to uncheck it. For this exercise, you do not need to continue storing reference streams.

Setting Up the Reference Stream and SSIM Processor

Complete the following steps to set up the reference stream and Structural Similarity Index Metric (SSIM) processor:

1. Select the **Refs and disk** tab if you are not already there.

2. Use the **Media ref stream** control to specify the file created in the previous section at `<Users>\Public\Documents\National Instruments\NI PQA\Media\media.bin`.

3. Check the **On** box to the left of the **Media ref stream** control. This enables use of the reference.
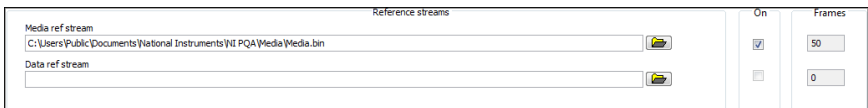
4. Select the **Processors** tab. Select **SSIM** from the list and ensure it is highlighted blue, which indicates it is active. SSIM compares entire frames from incoming streams and references to give a total overall score of the similarities between the two. SSIM scores are weighted toward human perception of images and can catch many types of defects, including blurriness, compression artifacts, and more.

5. Select the **Video/Audio** tab.

6. Above the right video pane, choose **Media reference** from the dropdown. This pane has two views, **Audio** and **Media reference**, and you want to view the media reference stream.

7. It also is helpful to choose the **Sync reference** option above the left pane, which syncs the zoom and view from the incoming stream to the reference stream.

8. Click the play button for the acquisition and watch the acquisition and scoring happen. You should get 1, or a perfect score, because the reference media is an exact copy of the original. Use the frame slider to review the two streams.

9. Notice that you got a perfect score because you started on frame 10 of your incoming stream automatically via the video trigger, from which the reference stream also was created. If you change the **Trigger** to **None**, your incoming stream starts on frame 0 instead of frame 10. This means the videos are not aligned. If you now click the play button, you see a lower, varying SSIM score indicating the two streams were different. Use the frame slider to review and compare two streams.

5

Automated Testing

1. Deciding Whether to Automate NI PQA Tests

If you plan to monitor your NI PQA tests closely from configuration until the final results analysis, iterating on your configuration to adjust it to your testing needs, you can configure and run NI PQA tests manually using NI PQA Executive.

If you plan to run several NI PQA tests, and especially if you plan to run existing configurations that require less interaction, you can save time and reduce repetition by automating tests using TestStand or LabVIEW. When automating tests, you can define new configurations using VIs in LabVIEW, load existing configurations within TestStand or LabVIEW, or create new configurations using the NI PQA Configuration panel within TestStand or LabVIEW.

2. Launching NI PQA Executive

After installing NI PQA and any necessary hardware and software, you can use NI PQA Executive to configure analysis of video and audio test streams. Launch NI PQA Executive at **Start»All Programs»National Instruments»NI Picture Quality Analysis»NI PQA Executive**.

3. Running or Automating NI PQA Tests

Depending on whether you chose to automate NI PQA tests in section *1. Deciding Whether to Automate NI PQA Tests*, run or automate and run your NI PQA test(s) using the environment you selected.

Note Memory availability for running NI PQA tests differs depending on your OS and application development environment. Refer to the *NI Picture Quality Analysis Readme* for information about memory availability in NI PQA systems.

Running Tests in NI PQA Executive

To run the test you configured in NI PQA Executive, click ▶.

Tip Click **Video** on the **Video/Audio** tab before you run a test to view incoming video and/or audio test streams in a separate window during the test.

Automating and Running Tests Using the NI PQA Configuration Panel or a Saved Configuration in TestStand

You can automate NI PQA tests in NI TestStand by combining a series of tests into a test sequence, running the test sequence, then reporting the results. You can configure the tests to automate by launching the NI PQA Configuration panel within TestStand, loading previously saved tests, or using the last configuration accepted in the NI PQA Configuration panel.

Complete the following steps to configure a test sequence in TestStand to automate your NI PQA tests:

1. Select **Start»All Programs»National Instruments»TestStand»Sequence Editor** to launch TestStand.

2. Add an NI PQA step, located in the Insertion palette at **Step Types»NI PQA»NI PQA**.

3. Click **Configure NI PQA** in the **NI PQA** tab of the **Step Settings** pane to launch the NI PQA Configuration panel.

> **Note**   The NI PQA Configuration panel has the same appearance and functionality as NI PQA Executive. However, while you use NI PQA Executive to perform all test-related tasks from configuration to running and analysis, you use the NI PQA Configuration panel to configure and check tests you will ultimately run and analyze in TestStand.

4. Configure your NI PQA test using one of the following methods:

   • To configure your NI PQA test using the NI PQA Configuration panel, complete the NI PQA Executive steps, which also apply to using the NI PQA Configuration panel, in sections *1. Choosing a Provider and Performing an Acquisition* and *2. Adding Processing and Reviewing Metrics* in Chapter 4, *Creating a Configuration*.

   • To use the last accepted configuration in the NI PQA Configuration panel, click **Set from previous** in the **Refs and disk** tab in the NI PQA Configuration panel.

> **Tip**   To accept a configuration, click **OK** in the NI PQA Configuration panel. This closes the configuration panel and retains the configuration settings for temporary use within TestStand, overwriting the previously accepted configuration. To close the NI PQA Configuration panel without accepting the configuration, click **Cancel**.

   • To use a configuration saved in a previous NI PQA test session, complete the following steps:

      a. Click **Load config** in the **Refs and disk** tab in the NI PQA Configuration panel.

      b. Select the configuration file to load.

      c. Click **OK**.

5. Click **OK** in the NI PQA Configuration panel to accept the configuration and close the configuration panel.

6. Repeat steps 2 through 5 for every NI PQA test you want to run in the test sequence. All steps are independent of each other by default. After configuring each step, you can execute the sequence in TestStand to test it.

7. Add steps to your test sequence to fit your automated test needs, including setting up any custom analysis of NI PQA test results. Refer to Appendix A, *NI PQA Programming Examples*, the *Using TestStand* manual, and the *NI TestStand Help* for information about setting up your NI PQA test sequence in TestStand.

8. Configure a report for your test sequence. Refer to the *NI Picture Quality Analysis Help* for information about configuring reports for NI PQA in TestStand.

9. Click ▶ to run the test sequence.

Automating and Running Tests Using the NI PQA Configuration Panel, the niPQA Configurations VI, or a Saved Configuration in LabVIEW

You can automate NI PQA tests in LabVIEW by incorporating your NI PQA tests into a test application, running the application, then returning results. You can configure the tests to automate by launching the NI PQA Configuration panel within LabVIEW, by loading a previously saved configuration, or by configuring the tests programmatically.

📝 **Note** Use the niPQA Configurations VI to modify certain settings, rather than completely define the configuration. The GUI is the recommended method of generating configurations.

Complete the following steps to configure a VI in LabVIEW to automate your NI PQA tests:

1. Select **Start»All Programs»National Instruments»LabVIEW** to launch LabVIEW.

2. Open a blank VI.

3. Configure your NI PQA tests using one of the following methods:

   • To configure your NI PQA tests using the NI PQA Configuration panel within LabVIEW, complete the following steps:

      a. Navigate to the niPQA GUI VI, on the Functions palette at **Functions» Multimedia Test»NI PQA»GUI**, then select and place the VI on the block diagram.

      b. Click **Run** to launch the NI PQA Configuration panel within LabVIEW.

📝 **Note** The NI PQA Configuration panel has the same appearance and functionality as NI PQA Executive. However, while you use NI PQA Executive with the purpose of performing all tasks related to the tests from configuration to running and analysis, you use the NI PQA Configuration panel with the purpose of configuring and checking tests you will ultimately run and analyze in LabVIEW.

    c.   Complete the NI PQA Executive steps, which also apply to using the NI PQA Configuration panel, in sections *1. Choosing a Provider and Performing an Acquisition* and *2. Adding Processing and Reviewing Metrics* in Chapter 4, *Creating a Configuration*, to configure your test using the NI PQA Configuration panel.

    d.   Click **OK** to accept the configuration and close the NI PQA Configuration panel.

- To configure your NI PQA tests using the niPQA Configurations VI, complete the following steps:

    a.   Navigate to the niPQA Configurations VI, on the Functions palette at **Functions»Multimedia Test»NI PQA»Configurations**, then select and place the VI on the block diagram.

    b.   Use the Polymorphic VI Selector on the VI to select the NI PQA component to configure.

    c.   Use the VI parameters to configure the selected NI PQA component.

    d.   Repeat steps a through c and wire the VIs together to configure other components of your NI PQA test.

- To use a configuration saved in a previous NI PQA test session, use the Read from Binary File VI, in the Functions palette at **Functions»Programming»File I/O»Read from Binary File**, to load a configuration into the configuration panel. Refer to Appendix A, *NI PQA Programming Examples*, and the *LabVIEW Help* for additional information about loading an existing NI PQA configuration in LabVIEW.

4.   Configure your VI to fit your automated test needs, including setting up any custom analysis of NI PQA test results and customizing the display of NI PQA results in the VI front panel. Refer to the *NI Picture Quality Analysis Help*, Appendix A, *NI PQA Programming Examples*, and the *LabVIEW Help* for information about configuring your NI PQA test and programming in LabVIEW.

5.   (Optional) If you used the niPQA GUI VI to configure your NI PQA tests in step 3 and you want to save your configuration when running tests, use the Write to Binary File VI, in the Functions palette at **Functions»Programming»File I/O»Write to Binary File**, to program your VI to save your NI PQA configuration. Refer to Appendix A, *NI PQA Programming Examples*, and the *LabVIEW Help* for additional information about programming your VI to save your NI PQA configuration.

6.   Click to run the VI.

4. Viewing Results

After running your NI PQA test(s), you can view test results in the environment in which you ran the test(s).

Viewing Results in NI PQA Executive

Complete the following steps to view test results in NI PQA Executive:

1. Select the **Metrics** tab.
2. Select one or more metrics to view in the **Display selection** control. You can select multiple metrics by holding down <Ctrl> as you select the metrics.
3. Select the display mode by selecting either **Single metrics** or **Multipoint metrics**.
4. Use the graph controls below the graph to manipulate the graph for analysis including moving the X and Y cursors, highlighting a frame, and zooming in or out on the graph. Refer to the *NI Picture Quality Analysis Help* for information about each graph control.
5. (Optional) If you specified error criteria to test for any of the metrics in the **Limit test array** control, use the slider control beneath the graph to highlight frames that contain errors in the **Frames containing errors** control.
6. If the test did not complete, notice whether the Single metrics or Multipoint metrics indicators are red, indicating that a stop condition occurred in that display mode.

> **Note** A stop condition in the Single metrics or Multipoint metrics display mode indicates that the DUT does not meet the specifications of your limit test. If a stop condition occurs, use the metrics from the test session to analyze where the problem occurred and why.

Viewing Results in NI TestStand

Viewing NI PQA test results in TestStand varies depending on how you configure your report in step 8 of the *Automating and Running Tests Using the NI PQA Configuration Panel or a Saved Configuration in TestStand* section.

Viewing Results in LabVIEW

Viewing NI PQA test results in LabVIEW varies depending on how you configure your VI to automate the display of results in step 4 of the *Automating and Running Tests Using the NI PQA Configuration Panel, the niPQA Configurations VI, or a Saved Configuration in LabVIEW* section.

5. (Optional) Saving the Configuration, Test Sequence, or VI

Save the configuration, test sequence, or VI if you plan to reuse it.

Saving in NI PQA Executive

You can save the settings that you have specified in NI PQA Executive for later use.

Complete the following steps to save the NI PQA Executive settings:

1. Click **Save config** in the **Session** tab to save the settings you have specified in NI PQA Executive.
2. In the **Choose or enter path of file** dialog box, navigate to the directory in which you would like to save the configuration file and specify a filename in the **File Name** field.
3. Click **OK**.

You can later reuse this configuration file by clicking **Load config** in the **Session** tab.

Saving in TestStand

Refer to the *Using TestStand* manual for instructions for saving the sequence file that you have created to automate NI PQA tests in TestStand. Saving the sequence file in TestStand saves any NI PQA configurations used in the test sequence.

Saving in LabVIEW

Refer to the *LabVIEW Help* for additional information about saving the VI you created to automate NI PQA tests. If you used the niPQA GUI VI to create your NI PQA configuration and you want to save your NI PQA configuration when running the VI, verify that you have programmed your VI to save the configuration in step 5 of the *Automating and Running Tests Using the NI PQA Configuration Panel, the niPQA Configurations VI, or a Saved Configuration in LabVIEW* section, as saving the VI does not save the NI PQA configuration.

A

NI PQA Programming Examples

NI PQA programming examples are instructional tools that demonstrate picture quality analysis functionality. NI PQA programming examples are available for both LabVIEW and TestStand. For example locations and supported application development environment versions, refer to the *NI Picture Quality Analysis Readme*.

B

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