780/780A Handheld Test Instrument for HDMI
User Guide

Rev: C2

Table of Contents

1   Overview of the 780/780AH Handheld Test Instrument

This section provides an overview of the 780/780AH Handheld Test Instrument. There are two models available:

- 780 Provides HDMI Tx port and HDMI Rx port operating up to 165MHz pixel rate and 225MHz TMDS rate for 12 bit deep color at 1080p.
- 780AH provides HDMI Tx port and an HDMI Rx port operating up to 300MHz pixel and TMDS rates for testing devices which support 4K resolutions.

All models have analog outputs as well.

The 780AH supports HDCP 2.2 authentication and encryption testing of HDMI 2.0 sources and sinks that support HDCP 2.2.

1.1   Scope of this User Guide

This User Guide documents the complete operation of the 780 Handheld Test Instrument for HDMI.

Note: Please be sure to check the quantumdata website for updates to this User Guide.

1.2   Changes to this User Guide

This User Guide has been updated to include information on the Report File Creation feature.

> **Note**: Not all screen examples have been updated to include the Reports Menu selection item on the top menu bar.

DID NOT DO ANYTHING OTHER THAN THIS NEED TO GET SCREENS

1.3   Introducing the 780/780AH Handheld Test Instrument

The 780/780AH Handheld Test Instrument is a battery-powered, portable multimedia pattern generator that enables you to conduct quick, on-site verification testing of your HDMI system and analog video displays. The 780/780AH is equipped with both a reference source and a reference sink HDMI interface allowing you to test audio, video and protocols—HDCP, EDID, CEC & inframes—of any type of HDMI device: sources, repeaters and sinks. Its portability makes it ideal for your bench and for use in the field. Because the 780/780AH has both an HDMI output and an HDMI input, you can test your HDMI cables and systems with splitters, extenders and switches as well with the optional pixel error test feature.

A color touch display makes the 780/780AH easy and convenient to use. When testing an HDMI source device you can toggle between operating the unit through the touch screen and viewing the incoming video from the HDMI source.

Note: 780/780AH Image above is shown with optional hardware board for passive HDMI monitoring between an HDMI source and sink device.

Note: 780AH Image above shows the front edge with the headphone jack and RS-232 connector for command line control.

1.4   Overview of 780/780AH features

The 780/780AH Handheld Test Instrument for HDMI provides a rich set of features. The following is a list of available options and the key features and benefits of each:

1.4.1   Standard features

The following features are standard with the 780/780AH:

- Pattern testing for HDTVs - Enables you to conduct pattern testing for an HDTV through the HDMI and analog component outputs. Provides dozens of patterns with variation options on most.

- Custom bitmaps and pattern scrolling – The 780/780AH enables you to import bitmaps for use in pattern testing. You can initiate a scroll of these bitmaps with user control over the rate and extent of horizontal movement.

- Create custom formats using the standalone Format Editor.

- 3D bitmap pattern testing – The 780/780AH enables you to import 3D bitmaps for use in pattern testing. You can create your own bitmaps from any stereoscopic images you have using the Quantum Data Bitmap Conversion Tool available from the Quantum Data website: http://www.quantumdata.com/apps/3D/BMP_conv.asp. There are some sample 3D bitmaps on this webpage as well.

- Video confidence test of an HDMI source device – The 780/780AH enables you to view the incoming video on the 780/780AH's LCD screen. 780AH enables the incoming image to be routed out the HDMI output connector if unused. 780AH also enables scrolling to view an entire unscaled 4K image received on the HDMI input port.

- Audio confidence test of an HDMI source device – The 780AH enables you to listen to the incoming LPCM audio through the 780AH's headphone jack on the front edge or through an embedded speaker. There will be no sound when compressed audio is received on the incoming HDMI stream.

- Audio Return Channel confidence test of an HDMI 1.4 A/V receiver – The 780AH can emulate an ARC Tx device on its HDMI IN port. Note: The 780AH does not support enabling ARC on the AV receiver, therefore you will have to enable ARC through some other means.

- Audio testing for AVRs and HDTVs – The 780/780AH provides multi-channel digital audio test patterns through the HDMI, SPDIF and optical outputs. A variety of audio patterns and formats are provided at sampling rates from 32kHz up to 192kHz and bit depths of 16, 20 and 24. Format supported are Dolby Digital and DTS compressed formats and lossless compressed or high bit rate HDMI formats.

- Installer Utility – Provides simplified diagnostics of HDMI interoperability problems in an HDMI installation. The Installer utility enables installers to connect the 780/780AH into an HDMI network and quickly conduct diagnostics without required detailed knowledge of HDMI protocols.

- Command line interface for automated testing.

1.4.2   Network Analyzer features

The following features are available with the Network Analyzer option:

- HDCP test of an HDMI sink or input to a repeater device – The 780/780AH enables you to run an HDCP functional test on an HDMI sink device directly or through a repeater device.

- EDID test of an HDMI HDTV or input to a repeater device – The 780/780AH enables you to run an EDID functional test on an HDMI sink device directly or through a repeater device. You can view the entire EDID in human readable text. You can also run a portion of EDID compliance test.

- Video test of an HDMI source device – The 780/780AH provides an HDMI input for testing HDMI source devices. You can run a verification test of a video source which includes timing and format information and an indication of whether the video is HDCP content protected.

- Data Island test of an HDMI source device – The 780/780AH provides an HDMI input for testing HDMI source devices. You can view the infoframes and other data islands.

- Audio test of an HDMI source device – The 780/780AH provides an HDMI input for testing HDMI source devices. You can run a verification test of an audio source which includes decoding of the audio IEC headers, audio infoframes and audio sample packet headers including parsing out of the channel status bits.

- EDID test of an HDMI source device – The 780/780AH's HDMI input can be provisioned with any EDID you have access to. You can verify that a source device responds properly to the provisioned EDID. The EDID could be a known-good EDID or an EDID that you have created specifically for testing.

- HDCP test of an HDMI source device – The 780/780AH enables you to run a test to determine how many HDCP devices an HDMI source can support during HDCP authentication.

- CEC ping test of any HDMI device – The 780/780AH enables you to run a CEC ping test on an HDMI device.

1.4.3   HDMI Cable and Repeater test features

The following features are available with the Cable and Repeater test option:

- HDMI Cable & Repeater test – Because the 780/780AH has both an HDMI input and an HDMI output, you can loop a cable or entire HDMI distribution networks comprised of splitters, extenders, repeaters, switches, etc. from the 780/780AH's output to input and run a pseudo-random noise pattern test to determine pixel errors on the TMDS lines. The feature also runs a continuity test on the DDC test pair, CEC bus, the +5V line and the hot plug lead. The Repeater test also shows you the hot plug delay between the downstream side and the upstream side and the pulse width. The Cable & Repeater Test enable you to test a cable, repeater or distribution network if the source and sink ends are collocated. If the source and sink ends are not collocated then you need to use the Frame Compare test described below.
- HDMI Frame Compare test – Because the 780/780AH has an HDMI input, you can emulate a sink and test a distribution network at the sink end. The feature works by capturing a frame of video from the source and then comparing that frame, pixel-by-pixel, to subsequent frames. Errors are shown along with the number of frames tested which 10 frames.

1.4.4   Auxiliary Channel Analyzer for DDC monitoring features

The following features are available with the Auxiliary Channel Analyzer test options:

- DDC monitoring with Auxiliary Channel Analyzer (ACA) – The 780/780AH ACA enables you to monitor CEC DDC transactions such as HDCP and EDID as well as hot plug related events while emulating an HDMI source and/or an HDMI sink device(s) in an HDMI system.
- DDC passive monitoring with Auxiliary Channel Analyzer (ACA) – The 780/780AH ACA enables you to monitor CEC and DDC transactions throughout an HDMI systems comprised of a source, repeater and sink. You can monitor +5V, hot plug events as well as the HDCP and EDID transactions.

1.4.5   What is in the 780/780AH shipping box

The 780/780AH instrument shipping container includes the items listed in Table 1-1 below:

Table 1-1: 780/780AH Shipping Box Contents	
Item Description	Part No.
780/780AH Handheld Test Instrument for HDMI.	00-00226
12V DC (1.5 amp) Power Supply / Adapter / Charger.	25-00094
Line cord for 12V Power Supply.	30A00400A03
HDMI-to-HDMI Type A cable.	30-00146
Three (3) foot VGA to (3) RCA adaptor cable.	99-00503
Six (6) foot USB cable.	30-00163
Quick Start Guide.	68-00217

2   Physical Interfaces of the 780/780AH Handheld Test Instrument for HDMI

This section describes the administration, video and audio interfaces on the 780/780AH test instrument:

2.1   Video Interfaces

Table 2-1 below describes the video interfaces on the 780/780AH test instrument, these interfaces are used to render test patterns for testing consumer electronic HDTVs and computer displays.

Table 2-1: 780/780AH Video Interfaces	
Video Interface	**Description**
HDMI (1) Output Type A	Single link HDMI output connector. Supports HDMI 1.3: ▪ Bit Depth: 24/30/36 bit. ▪ Colorimetry: RGB, YCbCr. ▪ Sampling: 4:4:4 and 4:2:2 (4:2:0 780AH for 4K at 60Hz formats). ▪ Pixel rate: Timings up to 1080p60. 780AH Timings up to 4K x 2K. ▪ DVI support through HDMI to DVI adapter cable (RGB, 4:4:4, 24 bit). ▪ Audio: LPCM, Dolby Digital and DTS (more details below).
Analog Output – Component and VGA (HD15F)	▪ Bit Depth: 24 bit color depth. ▪ Colorimetry: RGB, YPbPr. ▪ Pixel rate: 80MHz. ▪ Sync types: separate and composite.
HDMI (1) Input Type A	Single link HDMI input connector. Supports HDMI 1.3: ▪ Colorimetry: RGB, YCbCr. ▪ Sampling: 4:4:4 and 4:2:2 (4:2:0 780AH for 4K at 60Hz formats).. ▪ Pixel rate: 780 - Timings up to 1080p60. 780AH Timings up to 4K x 2K

2.2   Audio interfaces

Table 2-2 below describes the audio interfaces supported on the 780/780AH test instrument.

Table 2-2: 780/780AH Audio Interfaces	
Interface	**Description**
HDMI (1) Output Type A	Single link HDMI output connector. Supports HDMI 1.3: ▪ Channels: 8. ▪ Bits per sample: 16, 20, 24. ▪ Sampling rates (kHz): 32.0, 44.1, 48.0, 88.2, 96.0, 176.4, 192.0. ▪ Formats: LPCM, Dolby Digital (clips), DTS (clips)
SPDIF - RCA	SPDIF RCA audio connector: ▪ Channels: 8 (clips) ▪ Bits per sample: 16, 20, 24. ▪ Sampling rates (kHz): 32.0, 44.1, 48.0, 96.0 ▪ Formats: LPCM, Dolby Digital (clips), DTS (clips)
Optical – JIS FOS	Optical audio connector: ▪ Channels: 8 (clips) ▪ Bits per sample: 16, 20, 24. ▪ Sampling rates (kHz): 32.0, 44.1, 48.0 ▪ Formats: LPCM, Dolby Digital (clips), DTS (clips)

2.3   Administrative Interface

The 780/780AH test instrument is equipped with a USB interface. This interface is used to download custom bitmaps and to upgrade firmware and issue commands. The USB interface is a peripheral device. There are two modes:

- COM - Command Mode. Used for sending basic commands to set the interface, select formats and patterns.

- Disk - Mass Storage Mode. Used for downloading bitmaps, audio clips and upgrading firmware or gateware.

3   General Operation

This section describes power up, power usage and general operation.

3.1   Power Considerations

The 780/780AH has a rocker style power switch on the back panel. Refer to the photo below.

The 780/780AH is a portable battery powered test instrument. It is equipped with nickel metal hydride batteries. It requires an overnight charge. Quantum Data recommends that you set the screen brightness to the minimum level required. Turn the unit off if you are not going to be using it for extended periods.

The 780/780AH is supplied with the Part No 25-00094 12V DC power supply and charger as well as a part number 30A00400A03 line cord. ***We recommend that you use the 780/780AH with the charger and only use the batteries when fully charged for a short period of time—an hour or two—when power is not available.***

Important Notes about power usage and status:

- Monitor the battery meter on the lower right.
- The screen will automatically dim after 2 minutes of inactivity to save on battery life.
- The 780/780AH will begin to chirp when it requires recharge. Turn the unit off or plug it in to the wall charger when you hear the chirp.
- A green indication or partial green indication shows the battery is being charged.
- A gold color indicates that the device is being powered through the wall charger.
- Fully charge the 780/780AH overnight.
- You must touch an active portion of the LCD to update the battery indicator to show its power status.
- Do not continue using the 780/780AH from battery power when the battery meter indicates that the batteries are exhausted. When you see a thin green line at the right most portion of the battery icon, turn the power off and switch to line power using the AC Charger adapter; then reapply power.

3.2   Tilt Bail

The 780/780AH has support bail for convenience in viewing. This is depicted in the illustration below.

3.3   Navigating through the 780/780AH User Interface

The 780/780AH user interface is a color touch screen display 480 by 272. A single touch will activate an item on the screen or take you down to a lower level menu. A **+** indicates that you have to double touch to navigate down to a lower level menu.

Note: The top level menu will appear differently depending on what options have been purchased.

Table 3-1 below shows functions available in the top level menu.

Table 3-1: Top Level Menu			
Item	**Submenu - Pattern**	**Third Level Menu**	**Value**
Top Menu Bar	**Home** / **Back** navigation	See Below	Enables you to navigate back to the previous screen unless you are at the Home screen.
	Preferences Page 1	Audible Touch	▪ Off ▪ On
		Screen Brightness	▪ Min ▪ 25% ▪ 50% ▪ 75% ▪ Max
		USB Mode	▪ COM for commands ▪ Disk for downloading files and upgrades
		Startup Mode	▪ Set the 780's menu configuration to the default menu (shown throughout this User Guide). ▪ Custom Menu – Utilize a configuration that you have created.
		Custom Menu	▪ Enter to navigate to custom menu screen.
	Preferences Page 2	Hot Plug Formats	▪ On – 780 automatically select the formats in the EDID of the connected HDTV. ▪ Off – 780 will not automatically select the formats in the EDID of the connected HDTV.
		AVMute on Format Change	▪ On – AVMute will occur when the resolution is changed on the 780/780AH HDMI output. ▪ Off – AVMute will occur when the resolution is changed on the 780/780AH HDMI output.
		RS-232 Baud Rate	▪ Configure the baud rate of the RS-232 interface on the 780AH (N/A to 780).

		RS-232 Keypad Mode	- Off – Keypad connected to RS-232 is disabled. - On – Keypad connected to RS-232 is enabled.
	Help	Upgrades	- USB Storage Flash - Application Flash - FPGA Flash
		Touchscreen	Calibrate the touch screen display
Function Buttons	Video Pattern	See below: Rendering Test Patterns on an HDTV	
	Audio Test Tone	See below: Testing Digital Audio of an HDMI Sink Device	
	Test Sink (Display/TV) (with Network Analyzer option)	See below: Using the 780/780AH Test Instrument to Test HDMI Sink Devices	
	Test Source (DVD/STB) (with Network Analyzer option)	See below: Using the 780/780AH Test Instrument to Test HDMI Source Devices	
	3D Output	See below: Rendering 3D Test Patterns on an HDTV	
	Auxiliary Channel Analyzer	See below: Procedures for Monitoring Auxiliary Channel events and transactions	
	Cable/Repeater Test	See below: Using the 780/780AH Test Instrument to Test HDMI Cable or Repeaters	
	Installer Tests	See below: Procedures for Installer Utility	
Bottom Status Buttons	Signal Type	See below: Using the 780/780AH Test Instrument Installer Utility	
	HRes Vres, FrameRate	See below: Selecting a Signal Type and Resolution	
	Video Pattern	See below: Rendering Test Patterns on an HDTV	
	Battery Icon	See: Power Considerations	

3.4   Back Navigation

When you navigate away from the Home screen a white arrow will appear in the upper left next to the name of the of the screen you are on. You can navigate to the previous screen by touch selecting this arrow. In the example below, touch selecting the upper left area on or near the white, left facing arrow next to **Signal Type** will take you to the previous screen.

3.5   Calibrating the LCD

You can calibrate the touch screen of your 780 if necessary.

Important Note: Please follow the procedures below carefully. Improper calibration can lock the unit up. It is preferable that you contact Quantum Data Support unless you have learned how calibrated the screen properly.

Use the following procedures to perform the calibration.

1. From the **Home** menu, navigate to the Help menu by pressing the **Help** activation button on the upper status bar. The **Home** menu is shown below.

The **Help** menu appears as shown below:

2. Touch select the **Calibrate** activation button. A screen appears instructing you to press each of four red squares.

   When you finish touch selecting the fourth box, the calibration is completed and you will return to the Home menu.

3. If the calibration fails and you cannot access the menus, establish a command line session and enter the calibration command:

   `TCAL`

   This will cause the screen to display the calibration screen again.

4   Using the 780/780AH Test Instrument to Video and Audio Pattern Tests on Sink Devices

This chapter provides procedures for running audio and video pattern tests on high definition sink devices such as HDTVs and projectors. The features and functions described in this chapter are provided with the standard 780/780AH; no options are required. The following signal types are supported.

- HDMI (via the HDMI physical connector)
- DVI (via the HDMI physical connector)
- YPbPr Component analog (via the HD VGA connector)
- RGB Analog (via the HD VGA connector).

4.1   Making Physical Connections

The first step in testing a sink device is to make the physical connections between the 780/780AH and the device(s) under test.

4.1.1   Connecting the 780/780AH to the Display Device

Use the following procedures to make the physical connections from the 780/780AH to the display device under test.

1. Make the cable connection between the appropriate the 780/780AH video output connector (e.g. **HDMI OUT** or **ANALOG**) connector and the input connector of the HDTV using the cables supplied.

2. Alternatively you may connect from the 780/780AH video output connector to an HDTV through an HDMI repeater device such as an A/V receiver. In this case make the HDMI connection between the **HDMI OUT** connector on the 780/780AH and the HDMI input of the HDMI repeater device using an HDMI-to-HDMI cable. Then connect the HDTV to an active output on the repeater. The following illustrations depict the typical test configurations.
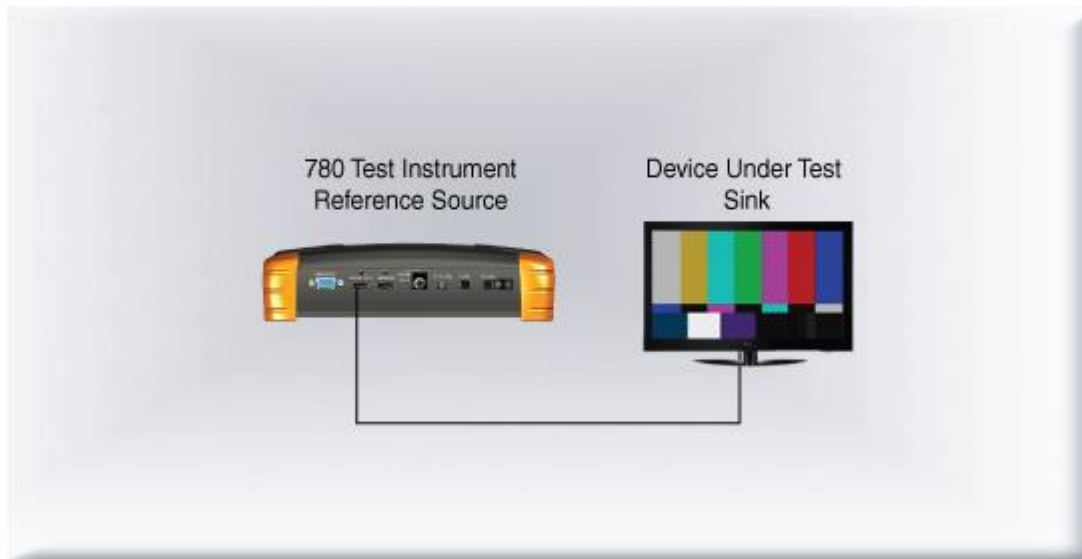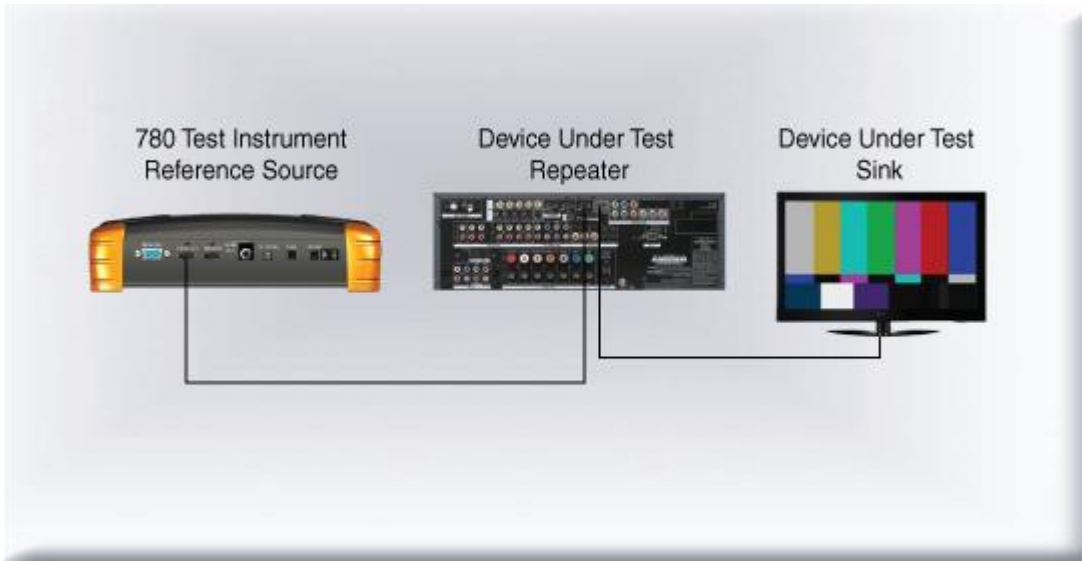
4.2   Selecting a Signal Type and Resolution

After making the physical connections between the 780/780AH and the display device under test you will need to select the signal type, Resolution and Frame Rate for the sink device under test.

4.2.1   Procedures for Selecting a Signal Type

The procedures below describe how to select the active signal type.

1. Power up the 780/780AH using the rocker switch on the back panel. Review the guidelines for battery usage at: Power Considerations.

2. Touch select the **Signal Type** activation button on the panel on the left (see screen example below).

3. Touch select the desired signal type using the associated activation button.

4. Touch select the options for the Signal Type. Use the information in Table 4-1 below as a guide:

Table 4-1: Signal Type			
Signal Type Name	**Physical Connector**	**Option**	**Option Values**
HDMI	HDMI OUT via HDMI to HDMI cable (provided)	Color Space	▪ YCbCr ▪ YCbCr 4:2:2 ▪ RGB
		Bit Depth	▪ 8 ▪ 10 ▪ 12
		Format Type	▪ TV – Uses limited color range ▪ PC – Uses full color range ▪ User
DVI	HDMI OUT via HDMI to DVI cable (not provided)	Format Type	▪ TV – Uses limited color range ▪ PC – Uses full color range ▪ User
YPbPr Analog	ANALOG HD-15 (VGA) via HD to 3-RCA cable (provided)	Sync Type	▪ Sep[arate] Sync ▪ Sync on Green
RGB Analog	ANALOG HD-15 (VGA) via VGA cable (not provided)	Format Type	▪ TV – Uses limited color range ▪ PC – Uses full color range ▪ User
		Sync Type	▪ Sep[arate] Sync ▪ Sync on Green

5.   Use the information in Tables 4-2 and 4-3 below to select the proper video signal.

Table 4-2: HDTV (Consumer) Formats – Applies to HDMI, DVI (TV) and Analog YPbPr				
Resolution	**Frame Rates**	**Color Space**	**Sample Mode**	**Bit Depth**
1080p (1920x1080) 1080i (1920x1080) 720p (1280x720) 576p (720x576) 576i (720x576) 480p (720x480) 480i (720x480)	24Hz 25Hz 29.97Hz 30Hz 50Hz 59.94Hz 60Hz 100Hz 119.88Hz 120Hz	YCbCr (HDMI) YPbPr (Analog only) RGB	4:4:4 (HDMI, DVI, YCbCr only) 4:2:2 (HDMI only)	8 10 (HDMI only) 12 (HDMI only)

Table 4-3: Partial List of Computer Formats – Applies to DVI Computer and Analog RGB Video Signal Types				
Resolutions	**Name**	**Color Space**	**Sample Mode**	**Bit Depth**
• 640x480 • 800x600 • 1024x768 • 1280x768 • 1280x1024 • 1600x1024 • 1920x1200	VGA SVGA XGA WXGA SXGA WSXGA WUXGA	RGB	4:4:4 (DVI)	8

4.2.2   Procedures for Selecting an HDMI Resolution and Frame Rate

The procedures below describe how to select the resolution in HDMI.

Note: You can create your own custom formats using the Quantum Data Format Editor. These procedures are described in Creating and Using Custom Formats, EDIDs and Bitmaps.

When you make a physical connection to an HDMI HDTV, a hot plug event will occur. There are two modes the 780/780AH can be set in when testing HDMI sink devices that determine how the 780/780AH responds to this hot plug event: 1) Hot plug formats On; 2) Hot plug formats Off.

When hot plug formats are On and a hot plug event occurs, the 780/780AH will read the EDID of the display device connected to its output port. It will then automatically configure the list available signal types (resolutions and frame rates) to only those supported by the HDMI sink device. The 780/780AH will also be configured to output the signal indicated in the EDID as the "preferred" timing. The preferred timing is highlighted in green following a hot plug event.

When hot plug formats are Off, the 780/780AH will display all viable HDMI formats for the HDMI interface whether they are supported by the display or not.

1. Select the **Preferences** from the 780/780AH top level menu. Navigate to the second page by touch selecting the **More**… key.

2. Select the Hot Plug Formats mode to On or Off as desired. Refer to the screen above.

3. Touch select the interface button (left button on the bottom panel). Refer to the figure below.

For the HDMI interface, you will set the Color Space, sampling mode, Bit Depth and Format Type.

4. Touch select the resolution and frame rate (middle button on the bottom panel). Refer to the figures below (note that the second figure below shows the 780AH screen which includes the 4K formats).
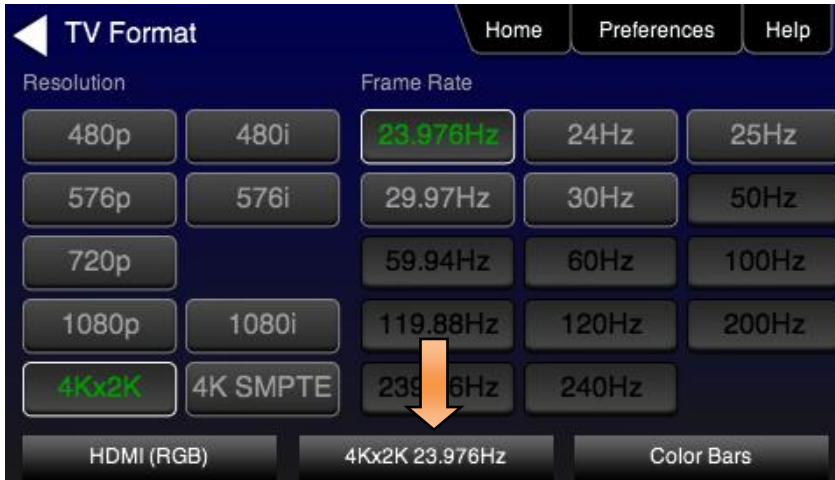
For the HDMI formats, there are color codes that are applied to the Resolution and Frame Rate selections. The following is a summary of their meaning:

- A Resolution or Frame Rate with **white** lettering but with **no outline** – a Resolution or Frame Rate that appears in the EDID and has a short video descriptor associated with it.
- A Frame Rate with **green** lettering and with **white outline** – The Frame Rate that is currently selected.
- A Frame Rate with **red** lettering but with **no outline** – The Frame Rate is not supported by the EDID for that Resolution.
- A Frame Rate(s) with **green** lettering and with **white outline** – The Frame Rate along with the currently selected Resolution that is the "preferred" timing.
- A Frame Rate with **black** lettering but with **no outline** – The Frame Rate is not supported by the standard for the selected resolution.

    Note: When you make a physical connection to an HDMI HDTV, a hot plug event will occur. If **Hot Plug Formats** is enabled on the **Preference** menu, when the hot plug event occurs, the 780/780AH will read the EDID of the display device connected to its output port. The output is automatically set to the preferred timing which is highlighted in green following a hot plug.

4.2.3   Procedures for Enabling AVMute

The procedures below describe how to enable AVMute. AVMute is an optional feature in HDMI that enables a source to signal a sink to extinguish its audio and video. The source, in this case the 780/780AH emulating a source sets the AVMute Set flag in the general control packet. The purpose of AVMute is to avoid audio artifacts when switching resolutions.

1. Select the **Preferences** from the 780/780AH top level menu. Navigate to the second page by touch selecting the **More**… key.

2. Touch select the On activation button next to AVMute on the screen below.

4.3   Rendering Test Patterns on an HDTV

This subsection describes how to render test patterns on an HDTV. You will first have to complete the previous procedures:

- Making the physical connections
- Selecting the Signal Type and Resolution

4.3.1   Procedures for Rendering Test Patterns on an HDTV

The procedures below cover cases where there is a direct connection between the 780/780AH and the HDTV and also where the 780/780AH is connected to an HDTV through a repeater device.

1. From the **Home** screen on the 780/780AH display, touch select **Video Pattern** as shown below.
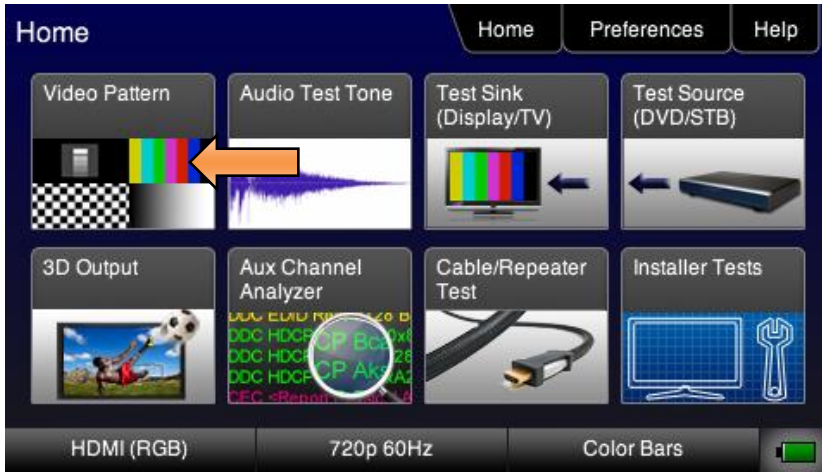
2. Touch select the desired test pattern from the menu shown below. You can select patterns that are standard with the 780/780AH or bitmaps that you have imported.

    Note: A "**+**" on the lower right portion of the pattern indicates that there are options related to the specific pattern. In these cases you double touch select to access the lower level menu.

3. (If applicable) Specify the test pattern options. Use the information in Table 4-3 below as a guide.

    Note: There may be additional patterns not shown in the table.

Table 4-3: Test Patterns			
Pattern Name	**Variant**	**Options**	**Range of Values**
ColorBar patterns Applications: SMPTEBars - To adjust color and hue. Colorbars - To test a display's	SMPTE	Orientation - Vertical	Direction: ▪ Left to Right ▪ Right to Left
		Orientation - Horizontal	Direction: ▪ Top / Bottom ▪ Bottom / Top

Table 4-3: Test Patterns

Pattern Name	Variant	Options	Range of Values
ability to product fully saturated primary and secondary color.		Pixel values in RGB, 8bit with TV (limited range) mode. **Note 1:** Deep color values for 10-bit or 12-bit are different from those shown. **Note 2:** When using PC Format type the range will go from 0 to 255 for 8-bit color mode.	From left to right; top to bottom: Top bars: R=180 G=180 B=180 R=180 G=180 B=16 R=16 G=180 B=180 R=16 G=180 B=16 R=180 G=16 B=180 R=180 G=16 B=16 R=16 G=16 B=180 Middle short bars: R=16 G=16 B=180 R=16 G=16 B=16 R=180 G=16 B=180 R=16 G=16 B=16 R=16 G=180 B=180 R=16 G=16 B=16 R=180 G=180 B=180 Lower bars: R=18 G=70 B=107 R=235 G=235 B=235 R=86 G=31 B=134 R=16 G=16 B=16 R=9 G=9 B=9 R=16 G=16 B=16 R=23 G=23 B=23
	Full 	Orientation - Vertical	Direction: ▪ Left to Right ▪ Right to Left
		Orientation - Horizontal	Direction: ▪ Top / Bottom ▪ Bottom / Top
	Split 	Orientation - Vertical	Direction: ▪ Left to Right ▪ Right to Left
		Orientation - Horizontal	Direction: ▪ Top / Bottom ▪ Bottom / Top
Ramp/Stair Patterns Applications: Stair - To visually check grayscale tracking performance of a rear projection display.	Stair - Full	Orientation - Vertical	Direction: ▪ Left to Right ▪ Right to Left
		Orientation - Horizontal	Direction: ▪ Top / Bottom ▪ Bottom / Top
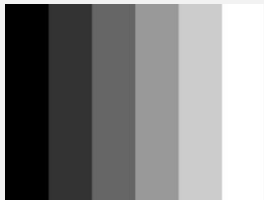
Table 4-3: Test Patterns

Pattern Name	Variant	Options	Range of Values
Ramp – To check the digitizing linearity of video signal processors.		Bars	▪ 5 ▪ 11 ▪ 21
		Color	▪ R ▪ G ▪ B ▪ C ▪ M ▪ Y ▪ W
	Stair – Split	Orientation - Vertical	Direction: ▪ Left to Right ▪ Right to Left
		Orientation - Horizontal	Direction: ▪ Top / Bottom ▪ Bottom / Top
		Bars	▪ 5 ▪ 11 ▪ 21
		Color	▪ R ▪ G ▪ B ▪ C ▪ M ▪ Y ▪ W
	Ramp	Color	▪ R ▪ G ▪ B ▪ C ▪ M ▪ Y ▪ W
		Pixel values in RGB, 8bit with TV (limited range) mode. **Note 1:** When using PC Format type the range will go from 0 to 255 for 8-bit color mode.	In 8-bit color mode (24) the ramp displays all 256 shades of gray. In 10-bit color mode (30) the ramp displays 256 shades of gray throughout a range of 64 – 940 skipping interim shades at each increment. In 12-bit color mode (36) the ramp displays 256 shades of gray throughout a range of 256 – 3760 skipping interim shades at each increment.
3D Box Pattern	No variants	Box 1 Offset	-64 to +64
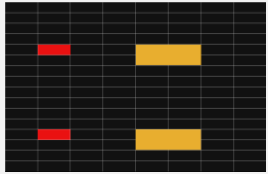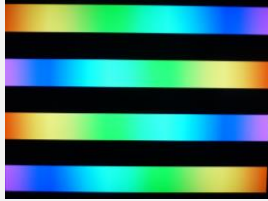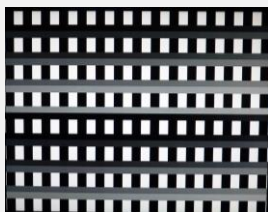
Table 4-3: Test Patterns

Pattern Name	Variant	Options	Range of Values
Application: This is a 3D pattern used to test 3D displays. The pattern enables you to set the offset between the left and right image components.		Box 2 Offset	-64 to +64
		Background Brightness	0 to 63
3D Color Ramp Application: This is a 3D pattern used to test 3D color uniformity and crosstalk or extinction ratio.	No variants	Description: There are 4 pairs of horizontal color bars. Each bar depicts a color gradation from red to purple; two from left to right and one from right to left. Method – Color uniformity: 1. Close left eye to view image from right eye. 2. Assess the color gradation on each bar. 3. Close right eye to view image from left eye. 4. Subjectively compare the images to assess color uniformity. Method – Crosstalk (extinction ratio): 1. Close left eye to view image from right eye. 2. Verify that the bottom bar is extinguished. The extent to which the bar is not extinguished represents the amount of crosstalk. 3. Repeat for a test of the left eye	
3D Cross Talk Application: This is a 3D pattern used to measure the crosstalk (extinction ratio) for frame packing, top and bottom and side by side 3D format structures.	No variants	Description: This image is divided in two sections with four rows of 16 white boxes each. The top section is for testing with the left eye open. The bottom section is for testing with the right eye open. The background area surrounding the boxes is a series of grayscale ramps. The ramps begin at 100 IRE and transitions to 50 IRE at the left end of the fourth row of each series. Method – Calculating percent crosstalk: 1. Close right eye to test the left eye using the top section. 2. Check the visibility of the boxes. Any deviation from black indicates crosstalk. 3. Assess where the box and its background blend such that they are not distinguishable. 4. Calculate the degree of crosstalk as a percent by counting the number of boxes (from the beginning of the series to the box identified in step 3) and divide that by 127. Example if the 20th box blends with its background, the crosstalk would be 20/127 * 100 = 15.7% 5. Repeat with the left eye closed to test the right eye.	
PGCWRGB Pattern Application: This is a scrolling pattern used to test for noise	No variants	Show Text	On / Off
		Show Center Cross	On / Off
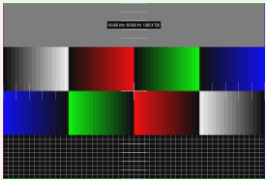
Pattern Name	Variant	Options	Range of Values
Table 4-3: Test Patterns			
on analog displays and motion artifacts.		Show Video	On / Off
		Show Overscan	On / Off
		Grid Type	• 10x50 • 5% H/V
Geometry/Resolution Patterns Applications: Grid – To check and adjust convergence of red, green and blue pictures. Linearity – for testing deflection linearity testing and alignment. Overscan – To check and adjust for the proper geometry of display including picture centering, size, pincushion and linearity.	Grid	Color Mode	▪ White on Black ▪ Black on White
	Linearity	Color Mode	▪ White on Black ▪ Black on White
	Overscan	N/A	
EMI/Grill Applications: EMI – Show grid of "H" characters to check for EMI effects on image. Each "H" character should be clear and distinct.	EMI	H Type	▪ 5 X 9 – each "H" character is 5 pixels wide by 9 pixels high. ▪ 6 X 10 - each "H" character is 6 pixels wide by 10 pixels high.
		Grill On/Off	Not applicable to EMI pattern
		Scroll – Scrolls the "H" characters vertically.	
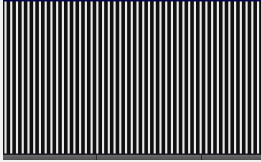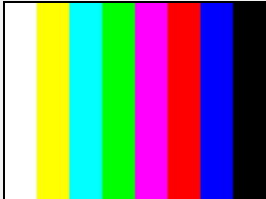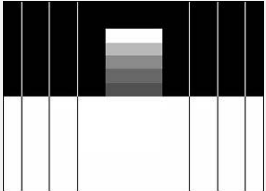
Table 4-3: Test Patterns

Pattern Name	Variant	Options	Range of Values
Grill – for verifying monitor resolution.	EMI - Grill	Grill On/Off	• 1,1 – Grill white lines are 1 pixel in thickness with one pixel in between or 1 line in thickness and 1 line between if the grill is horizontal. • 1,5 – Grill white lines are 1 pixel in thickness with 5 pixels in between or 1 line in thickness and 5 lines between if the grill is horizontal. • 2,2 – Grill white lines are 2 pixels in thickness with 2 pixels in between or 2 lines in thickness and 2 lines between if the grill is horizontal. • 3,3 – Grill white lines are 3 pixels in thickness with 3 pixels in between or 3 lines in thickness and 3 lines between if the grill is horizontal. • 4,4 – Grill white lines are 3 pixels in thickness with 4 pixels in between or 4 lines in thickness and 4 lines between if the grill is horizontal.
		Grill Mode	• Horizontal – Grill lines run horizontal. • Vertical – Grill lines run vertical.
Color Bars – To test a display's ability to produce fully saturated primary and secondary color.	EMI - ColorBars	Scroll – color bars scroll horizontally.	
Needles Pattern Application: To detect whether scan velocity modulation is enabled on display.	No variants		
Window/Raster Pattern Applications:	Window	IRE Level range from 108 to 0	• -5 • -1 • +1 • +5
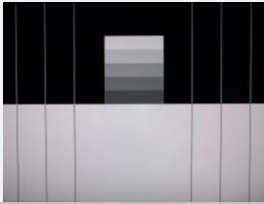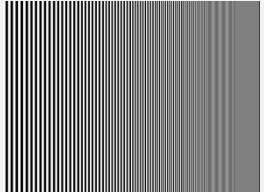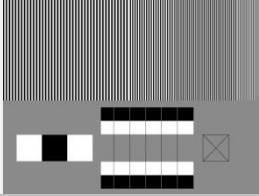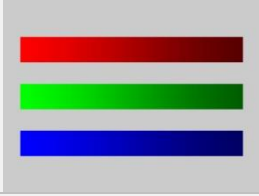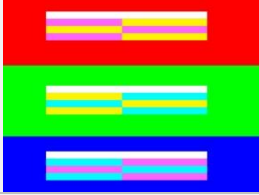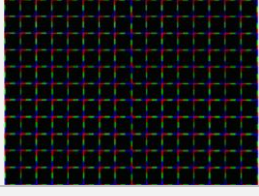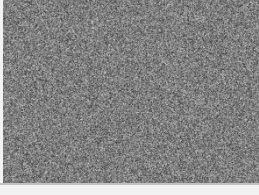
Table 4-3: Test Patterns

Pattern Name	Variant	Options	Range of Values
Window1 - To calibrate display drive chromaticity. Window2 - To calibrate display cutoff chromaticity. Raster – To check color purity and display chrominance uniformity.		IRE Label	▪ Off ▪ On
		Color	▪ R ▪ G ▪ B ▪ C ▪ M ▪ Y ▪ W
	Raster 	IRE Level – ranges from 108 to 0	▪ -5 ▪ -1 ▪ +1 ▪ +5
		IRE Label	▪ Off ▪ On
		Color	▪ R ▪ G ▪ B ▪ C ▪ M ▪ Y ▪ W
Needles Pattern Application: To detect whether scan velocity modulation is enabled on display.	N/A 		
Focus Pattern Application: To detect whether scan velocity modulation is enabled on display.	N/A 		
Multiburst Pattern Application: To check a display's ability to produce sharply defined stripes at equal brightness up to full resolution.	N/A 		

Table 4-3: Test Patterns			
Pattern Name	**Variant**	**Options**	**Range of Values**
Sharpness Application: To align display sharpness, picture, aperature and scan velocity modulation adjustments.	No Variants		
Decoder Check Application: To check the color decoder performance to determine if the decoder over-emphasizes red or green colors.	No Variants		
Decoder Adjust Pattern Application: To adjust a display's color decoder/matrix circuit for most accurate color reproduction.	No Variants		
Converge Pattern Application: To color converge a display throughout the entire picture area.	No Variants		
Pseudo Random Pattern Application: To test for pixel errors on an HDMI cable.	No Variants		
LG Color Pattern	No Variants	Horizontal	

Table 4-3: Test Patterns
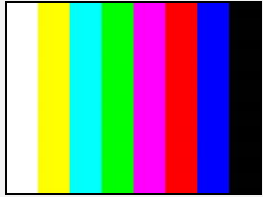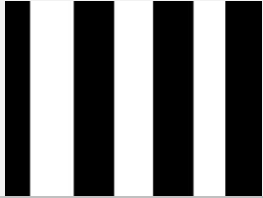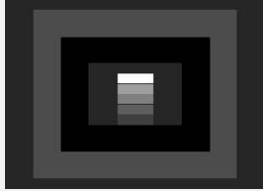
Pattern Name	Variant	Options	Range of Values
Application: To test a display's ability to product fully saturated primary and secondary color. White is 100 IRE Yellow is 100 IRE Cyan is 100 IRE Gray is 35 IRE Red is 100 IRE Blue is 100 IRE Black is 0 IRE		Vertical	
UL 3 Bar Pattern	No Variants		
Black Pluge Pattern Application: To set the picture black level and check the DC restoration performance of a display. Note: Outer boxes blink once per second.	No Variants	Pixel values in RGB, 8bit with limited range (TV) mode.	Outer background: R=16 G=16 B=16 Outer blinking box: R=20/16 G=20/16 B=20/16 Inner blinking box: R=9/16 G=9/16 B=9/16 Top most stair value: R=235 G=235 B=235 Second stair value: R=180 G=180 B=180 Third stair value: R=140 G=140 B=140 Fourth stair value: R=112 G=112 B=112 Bottom stair value: R=90 G=90 B=90
		Pixel values in RGB, 10bit with limited range (TV) mode.	Outer background: R=64 G=64 B=64 Outer blinking box: R=80/64 G=80/64 B=80/64 Inner blinking box: R=36/64 G=36/64 B=36/64 Top most stair value: R=940 G=940 B=940 Second stair value: R=720 G=720 B=720 Third stair value: R=560 G=560 B=560 Fourth stair value: R=448 G=448 B=448 Bottom stair value: R=360 G=360 B=360
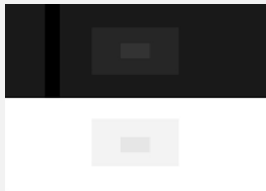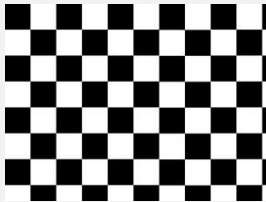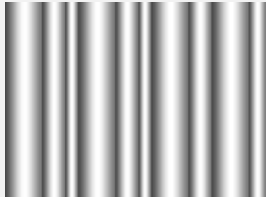
Table 4-3: Test Patterns			
Pattern Name	**Variant**	**Options**	**Range of Values**
		Pixel values in RGB, 12bit with limited range (TV) mode.	Outer background: R=256 G=256 B=256 Outer blinking box: R=320/256 G=320/256 B=320/256 Inner blinking box: R=144/256 G=144/256 B=144/256 Top most stair value: R=3760 G=3760 B=3760 Second stair value: R=2880 G=2880 B=2880 Third stair value: R=2240 G=2240 B=2240 Fourth stair value: R=1792 G=1792 B=1792 Bottom stair value: R=1440 G=1440 B=1440
White Pluge Pattern Application: To set the contrast and brightness controls on fixed pixel displays.	No Variants 	Pixel values in RGB, 8bit with limited range (TV) mode.	Top background: R=16 G=16 B=16 Top dark vertical line: R=8 G=8 B=8 Top larger (outer) box: R=18 G=18 B=18 Top smaller (inner) box: R=20 G=20 B=20 Bottom background: R=235 G=235 B=235 Bottom larger (outer) box: R=232 G=232 B=232 Bottom smaller (inner) box: R=230 G=230 B=230
		Pixel values in RGB, 10bit with limited range (TV) mode.	Top background: R=64 G=64 B=64 Top dark vertical line: R=32 G=32 B=32 Top larger (outer) box: R=72 G=72 B=72 Top smaller (inner) box: R=80 G=80 B=80 Bottom background: R=940 G=940 B=940 Bottom larger (outer) box: R=928 G=928 B=928 Bottom smaller (inner) box: R=920 G=920 B=920

Table 4-3: Test Patterns			
Pattern Name	**Variant**	**Options**	**Range of Values**
		Pixel values in RGB, 12bit with limited range (TV) mode.	Top background: R=256 G=256 B=256 Top dark vertical line: R=128 G=128 B=128 Top larger (outer) box: R=288 G=288 B=288 Top smaller (inner) box: R=320 G=320 B=320 Bottom background: R=3760 G=3760 B=3760 Bottom larger (outer) box: R=3712 G=3712 B=3712 Bottom smaller (inner) box: R=3680 G=3680 B=3680
Checkboard Pattern Application: To check the regulation of CRT video drive power supply circuits.	No Variants 	Rows	2 3 4 5 6
		Columns	2 3 4 5 6
Zone Plate Pattern This is a bitmap that can be scrolled to test motion artifacts. You can replace particular bitmap with any other bitmap image to allow scrolling. You just need to ensure that you assign it the same name.	Vertical 	Vertical Movement	- Stop - Slow - Medium - Fast
		Horizontal Movement	- Stop - Slow - Medium - Fast

4.4   Using Custom Test Image Packs

The 780/780AH provides licensed image packs for certain sets of test images. You need to have a license key to use these custom test image packs. You can arrange to get access to them by contacting Quantum Data customer support at: http://www.quantumdata.com/support.

When you purchase an image pack it appears as an icon at the end of the list of Test Patterns. A sample screen is shown below (Philips1, ChinaRes, Master). You simply select one of the test patterns (e.g. ChinaRes in the screen example below). They will take a few seconds to load. They will load at the resolution of the format that you have selected.

Refer to the tables below for a description and depiction of the Image Packs currently offered.

Table 4-4: Custom Test Image Packs – ChinaRes Pattern

ChinaRes Pattern Pack

This is a bitmap that is available through the Image Packs option. The ChinaRes test pattern is specified by the National Testing and Inspection Center for Radio and TV Products of China.

The image pack includes both a standard definition aspect ratio (shown right) and a high definition aspect ratio. This test pattern is supported at: 1920x1080, 1280x720, 720x576 and 720x480 resolutions.

The following is a description of the elements in this test image

1. Overscan gauges to determine percentage of overscan.
2. Centered cross, centered circles, and centered grid to test centering and concentricity.
3. White grid to test convergence.
4. Central resolution wedge gauges for vertical, horizontal, and diagonal resolutions.
5. Corner resolution wedge gauges for vertical and horizontal resolutions.
6. 4-quadrant horizontal and vertical test areas to judge resolution and display artifacts.
7. Color bar for testing color purity and chroma delay.
8. 10-step grayscale to test brightness, contrast, and luminance.
9. Split (left and right) grayscales for testing dark-field and bright-field gray levels.

•   Average picture level is approximately 50%.
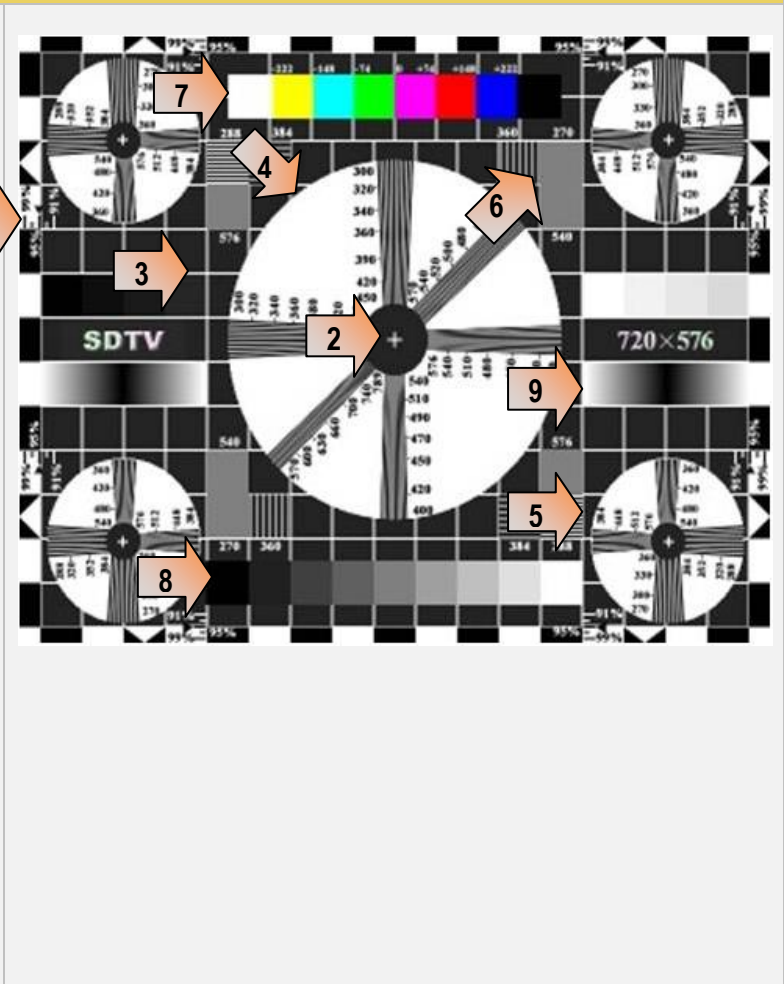
Table 4-5: Custom Test Image Packs – THX Test Patterns

Table 4-5: Custom Test Image Packs – THX Test Patterns

THX Test Patterns

The THX Pattern Pack offers a variety of test patterns for calibrating the luminance and chrominance of high end 3D-capable HDTVs. The following is a list of test patterns provided in this optional test pattern package.

3D Convergence - test patterns to align pixels for proper convergence.

3D Crosstalk – test patterns to determine level of 3D crosstalk.

Color Gamut – 2D/3D primary and secondary color patterns to fine-tune colors and gamma.
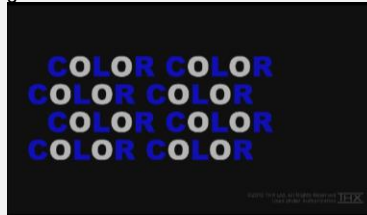
Picture performance – pattern within THX Optimizer to verify accuracy of skin tones.
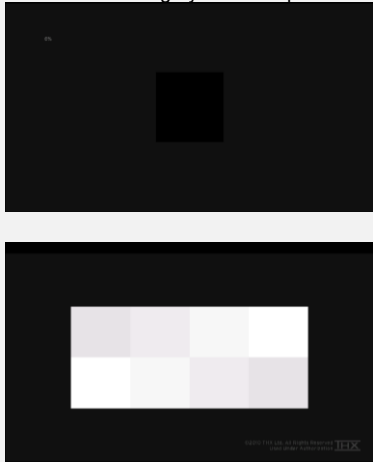
THX Optimizer - test patterns to easily adjust brightness, contrast, color, tint, etc.
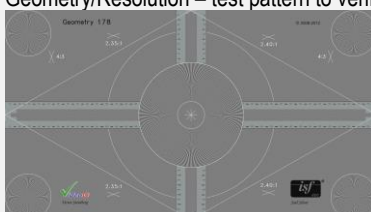
1. Uniformity - 2D/3D circle patterns to determine luminance and chrominance screen uniformity.

Table 4-5: Custom Test Image Packs – THX Test Patterns

	THX box - 2D/3D grayscale test patterns to accurately adjust white point and gamma.

Table 4-6: Custom Test Image Packs – ISF® Test Patterns	
ISF Test Patterns The ISF Pattern Pack offers patterns for verifying white and black levels as well as geometry and resolution for calibrating high end HDTVs	Black Pluge - for calibrating black level for dynamic range. White Pluge - for calibrating white level for dynamic range. Geometry/Resolution – test pattern to verify geometry and resolution. Red-Blue Color Multiburst – test pattern for verifying chroma resolution for red and blue transitions.

4.5 Rendering 3D Test Patterns on an HDTV

This subsection describes how to render 3D test patterns on an HDTV. The 780/780AH supports Side-by-Side, Top-and-Bottom and Frame Packing (for both interlaced and progressive timings) 3D format structures.

4.5.1   Configurations for Rendering 3D Bitmaps on an HDMI Sink Device

Typically you will render 3D bitmap images with the 780/780AH directly connected to an HDTV. This configuration is shown below:
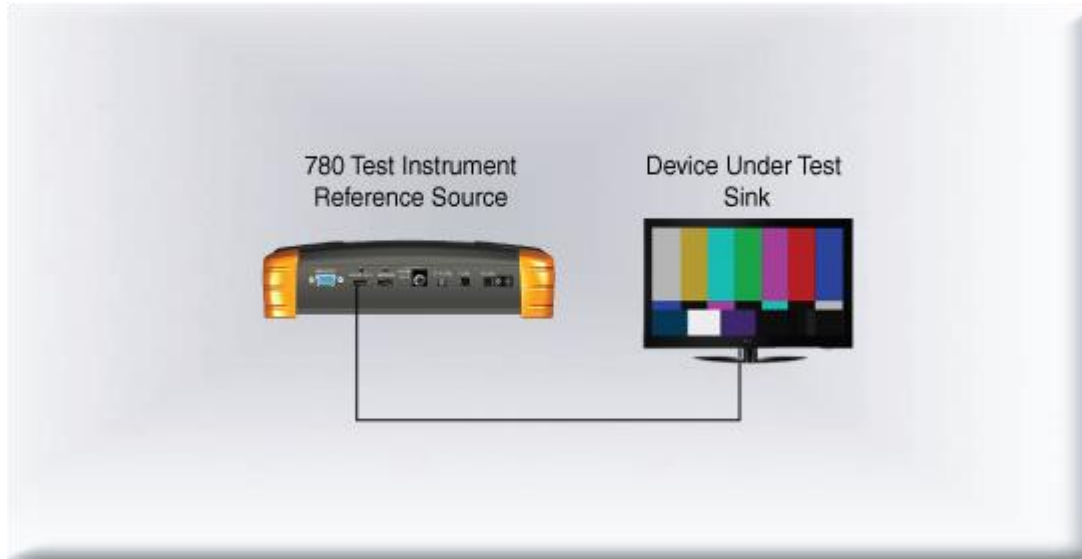
4.5.2   Procedures Obtaining 3D Bitmaps on HDMI Sink Device

Use the procedures below to render 3D bitmap images on an HDMI sink.

1. Follow the procedures provided above to enable the HDMI output as the Signal Type.

2. Obtain 3D bitmaps. You can obtain 3D bitmaps in three ways:

    ▪   Develop your own 3D bitmaps.
    ▪   Sample 3D bitmaps from the Quantum Data website (www.quantumdata.com/downloads).
    ▪   Generate 3D bitmaps from your own stereoscopic image pairs using the Quantum Data 3D Bitmap Conversion Tool available from the Quantum Data website (www.quantumdata.com/downloads).

3. Transfer your 3D bitmaps over to the 780/780AH using the procedures described in Importing Custom Bitmaps.

4.5.3   Procedures for Rendering 3D Bitmaps or 3D Test Patterns on HDMI Sink Device

1. Select a format that is suitable for rendering 3D images such as 720p60 and 1080. Use the procedures above Procedures for Selecting an HDMI Resolution and Frame Rate.

    If you have used the Quantum Data 3D Bitmap Conversion Tool, there is a naming convention for the 3D bitmaps which also provides the required format for each specific bitmap.

2. Touch select **3D Output** option from the top level menu shown below.

The following screen will appear:

3. Select the 3D mode (Side-by-Side, Top-and-Bottom or Frame Packing) and then select the subtype and Left/Right options (if applicable).

4. Select the 3D bitmap image from the Test Pattern list.

   Note: You will have to make sure that the 3D bitmap you use matches your selection of 3D formats and timing (resolution). In the example above, a 3D Frame Packing bitmap is selected for 1280 x 720. Therefore you have to make sure that you select that specific timing (i.e. 1280 x 720) and that specific 3D format structure (Frame Packing).

4.6   How to Scroll a Bitmap Pattern

This subsection describes how to scroll bitmaps on your 780/780AH

4.6.1   Guidelines for Scrolling Bitmaps

There are two ways you can animate (move) a bitmap image: 1) image shifting (scrolling); 2) panning. You can shift or scroll a bitmap image that you have imported into the 780/780AH by modifying the X and Y parameters or by dragging and panning. When you use the X and Y parameters, you are limited to linear scrolling. With panning you can move the image in non-linear motions.

You can only scroll bitmaps whose overall pixel resolution is smaller than the resolution of the active format and you can only scroll them within the bounds of the resolution of the active format. You cannot scroll the standard test patterns in the 780/780AH.

In order to scroll a bitmap the name of the **bitmap has to be "zp.bmp."** But you can scroll any bitmap. You just have to make sure that you have named it "zp.bmp" (without the quotes). The zone plate bitmap is the only bitmap that comes standard with the 780/780AH.

4.6.2   Procedures for Scrolling Bitmaps

Use the following procedure to scroll your bitmaps.

1.   Touch select the desired bitmap image, e.g. Zone Plate image from the list of video patterns.

2.   Double touch select on the Zone Plate bitmap to access its options.

The **Zone Plate Options** menu appears:

3.   Specify the **Horizontal Movement** by touch selecting the appropriate setting **Slow**, **Medium**, **Fast**.

4.   Specify the **Vertical Movement** by touch selecting the appropriate setting **Slow**, **Medium**, **Fast**.

The pattern will begin to move around the raster of the display in accordance with the horizontal and vertical settings. To halt the motion, touch **Stop** for either or both of the **Horizontal Movement** and **Vertical Movement**.

4.7   How to Pan a Bitmap Image

This subsection describes how to pan bitmap test patterns on your 780/780AH

4.7.1   Guidelines for Panning Bitmaps

There are two ways you can animate a bitmap image: 1) image shifting (scrolling) 2) panning. Here are the rules and capabilities:

- You can pan bitmaps whose overall pixel resolution is greater than the resolution of the active format only to the extent of the difference between the resolution of the bitmap and the resolution of the format you currently have selected.
- You can pan bitmaps whose resolution is lower than the active format but only within the range of the excess space in the raster. You cannot pan the standard test patterns in the 780/780AH.

4.7.2   Procedures for Panning Bitmaps

Use the following procedure to pan your custom bitmaps.

1. Select by double touching, the desired bitmap image, e.g. Master 1920x1080 image from the list of video patterns (shown below).

A message will appear informing you how to scroll the bitmap.

2. Drag and pan the test pattern.

4.7.3   Procedures for Viewing the Video from an HDMI Source Device

Use the following procedures to view the incoming video from an HDMI source device.

1. Connect the HDMI source device under test to the 780/780AH **HDMI IN** connector.

2. Touch select **Test Source (DVD/STB)** from the top level menu shown below.

3. Touch select **Video Display** from the **Source Tests** menu shown below.

Note: Video Passthrough feature is not currently implemented.

4. Touch select the **Start Fullscreen** activation button on the **Video Display** menu to view the incoming video without viewing the metadata from the source device under test.

    Note: The 780AH has an additional option for viewing a captures incoming video screen and scrolling throughout the entire video resolution. This is shown on the second screen shot below as **View Full Frame**.

The video from the source is shown on the 780/780AH LCD as depicted below.

Note that you can also view 3D video bitmaps as well. The following screen is a sample of what a 3D bitmap would look like. The example below is a Top-and-Bottom format.

5. Touch select the screen to return to **Video Display** menu.

6. Touch select the **Start Fullscreen** activation button on the **Video Display** menu to view the incoming video along with the metadata from the source device under test. In this example a test pattern is shown.

    Note also that the HDCP encryption status and AVmute status is shown. In addition to the AVI inframe values.
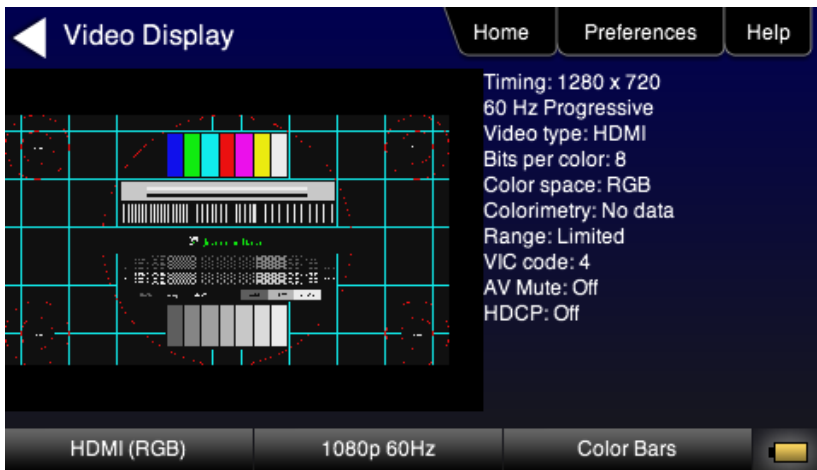
7. Return to the **Source Test** menu by touching the LCD. The **Source Test** menu reappears.

8. For the 780AH you have the additional option of capturing and viewing a captured bitmap of the entire resolution of the incoming video **View Full Frame**.

Use the arrows to move about the video frame.

4.8   Testing Digital Audio on an HDTV or A/V Receiver

This section provides procedures for testing digital audio on an HDTV or A/V Receiver.

Note: It is recommended not to select bitmap images when outputting compressed audio clips.

Table 4-5 below summarizes the 780/780AH support for digital audio.

Table 4-5: Summary of Audio Signal Types		
Audio Signal Type	**Interfaces**	**Description**
Dolby 5.1	▪ HDMI ▪ Optical ▪ SPDIF ▪ HDMI ARC (780AH only)	Provides a set of Dolby Digital 5.1 noise patterns: ▪ 500-2kHz Pink ▪ 20-20kHz Pink ▪ Sine Wave ▪ Impulse ▪ Polarity ▪ Auto Time Delay
Dolby Digital Plus 7.1	▪ HDMI	Provides a set of Dolby Digital Plus 7.1 sine wave clips: ▪ 2.0 192kHz – 2 channel @ 192kHz sampling rate ▪ 5.1 192kHz – 6 channel @ 192kHz sampling rate ▪ 7.1 192kHz – 8 channel @ 192kHz sampling rate
DTS-ES 6.1	▪ HDMI ▪ Optical ▪ SPDIF ▪ HDMI ARC (780AH only)	Provides a set of DTS ES 6.1 noise pattern clips: ▪ 500-2kHz Pink ▪ 20-20kHz Pink ▪ Sine Wave ▪ Impulse ▪ Polarity ▪ Auto Time Delay
Dolby TrueHD	▪ HDMI	Provides a set of Dolby TrueHD Hi Bit Rate sine wave clips: ▪ 192kHz 7.1 1kHz TrueHD – 8 channel @ 192kHz sampling rate ▪ 192kHz 7.1 2kHz TrueHD – 2 channel @ 192kHz sampling rate
DTS HD Master Audio	▪ HDMI	Provides a set of DTS-HD Hi Bit Rate sine wave clips: ▪ 192kHz 7.1 HDMA – 8 channel @ 192kHz sampling rate ▪ 192kHz 5.1 HDMA – 6 channel @ 192kHz sampling rate
PCM Sine Wave (programmable)	▪ HDMI ▪ Optical ▪ SPDIF ▪ HDMI ARC	Provides programmable sine waves: ▪ Bits per sample – 16, 20, 24 ▪ Sampling rate (kHz) – 32, 44.2, 48, 88.2, 96, 176.4, 192 ▪ Channels – 2.0, 2.1, 5.1, 6.1, 7.1 ▪ Level – 0dB to -99dB in 1dB or 3dB increments (per channel) ▪ Frequency – 0.01kHz to 20kHz in 1Hz, 10Hz, 100Hz or 1000Hz increments (per channel) ▪ Mute – On/Off (per channel)

4.8.1   Connecting the 780/780AH to the Audio Rendering Device

Use the following procedures to make the physical connections from the 780/780AH to the audio rendering device under test.

1. Make the cable connection between the appropriate the 780/780AH video output connector (e.g. HDMI OUT, SPDIF or OPTICAL) and the input connector of the audio rendering device using the cables supplied.

Alternatively you may connect from the 780/780AH video output connector to an HDTV through an HDMI repeater device such as an A/V receiver. In this case make the HDMI connection between the HDMI OUT connector on the 780/780AH and the HDMI input of the HDMI repeater device using an HDMI-to-HDMI cable. Then connect the HDTV to an active output on the repeater. The following illustrations depict the typical test configurations.

The following illustrations depict the test setups for the HDMI audio, SPDIF audio and optical. Note also that you can test directly into an HDTV without going through an A/V receiver.
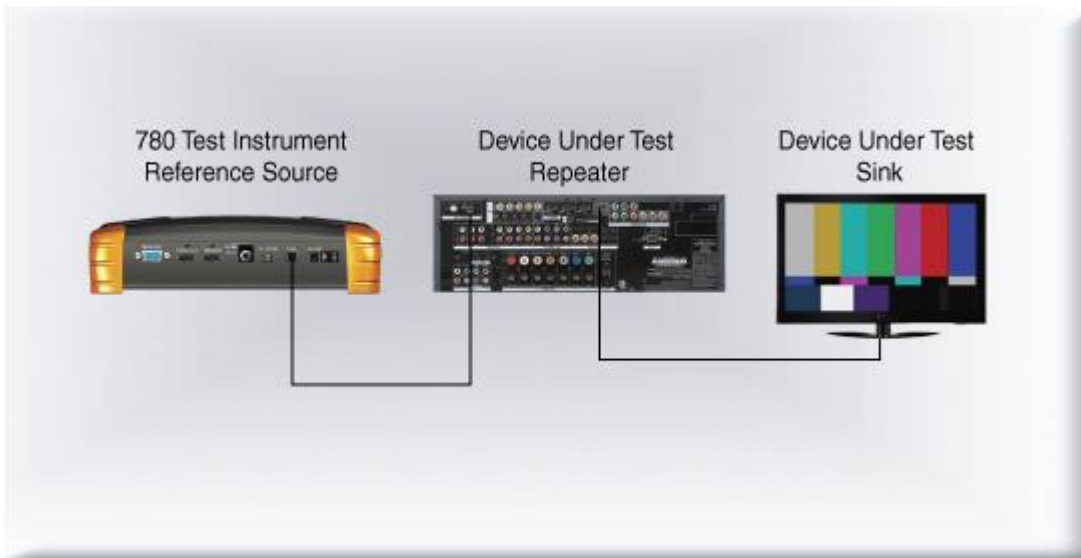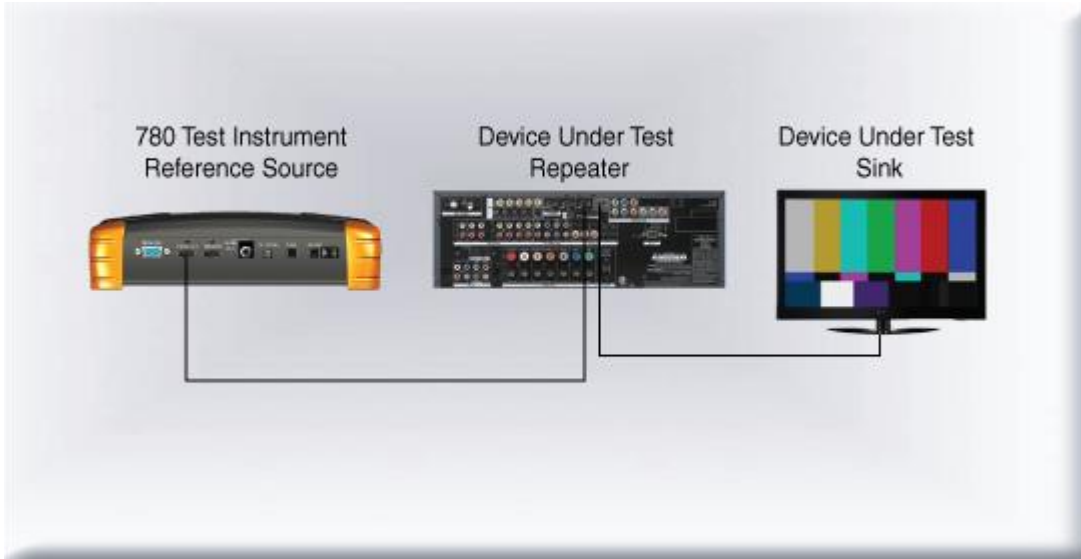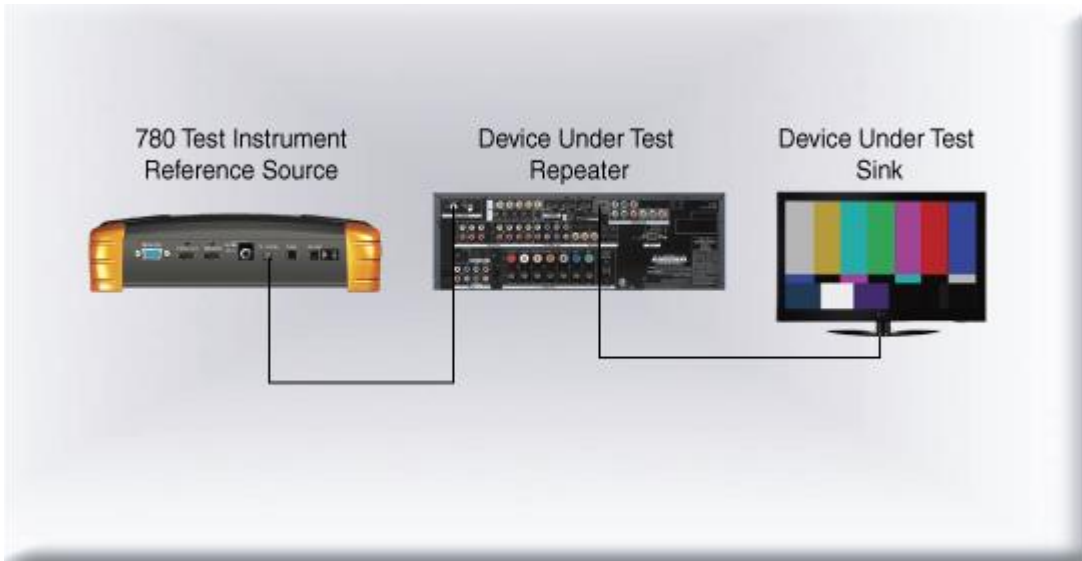
4.8.2   Procedures for Testing a Display with Dolby Digital or DTS Audio Test Patterns

Use the following procedures to run audio tests using Dolby Digital and or DTS audio test patterns. These test patterns are useful for calibrating the room acoustics in a home theatre system.

1. Make the physical connections between the 780/780AH and the audio rendering device as described in the procedures above.

2. From the top level menu (shown in the figure below), select **Audio Test Tone**.

The **Audio Pattern (Test Tone)** menu appears as shown below:

3. Touch select the desired **Interface** from the **Audio Pattern** menu (refer to the screen shot above which shows HDMI). The options are Optical, SPDIF or HDMI.

4. Double touch select the **Dolby Digital 5.1** or **DTS-ES 6.1** item on the **Audio Pattern** menu (refer to the screen shot above).

   The following screen appears (DTS-ES shown):

5. Touch select the desired audio test pattern. (**500-2kHz Pink** is shown selected in the sample screen shot above and **Sine Wave** shown in the screen shot below.) Use the information in Table 4-6 below to understand the application of each audio test pattern.

Note: When selecting Sine Wave at 1kHz or 4kHz the 780 will output 5.0 audio. This is because the subwoofer frequency response is 20Hz to 200Hz.

Table 4-6: Audio Pattern Tests			
Pattern	**Format**	**Interfaces**	**Range of Values**
Pink Noise Patterns: ▪ 500-2kHz Pink noise ▪ 20-20kHz Pink noise Application: ▪ Tests sound pressure level ▪ Main speaker frequency response	Dolby Digital 5.1	HDMI SPDIF Optical HDMI ARC (780AH only)	▪ Individually selectable channels ▪ **Cycle** – cycling through each channel; 8 seconds per channel
	DTS-ES 6.1	HDMI SPDIF Optical HDMI ARC (780AH only)	
Sine Wave Pattern: ▪ 63Hz ▪ 125Hz ▪ 1kHz (5.0 only - no subwoofer) ▪ 4kHz (5.0 only - no subwoofer) Application: ▪ Speaker distortion	Dolby Digital 5.1	HDMI SPDIF Optical HDMI ARC (780AH only)	Channel selection: ▪ Select **All** channels or… ▪ **Cycle** – cycling through each channel; 8 seconds per channel
	DTS-ES 6.1	HDMI SPDIF Optical HDMI ARC (780AH only)	
Impulse Pattern Application: ▪ Early reflections	Dolby Digital 5.1	HDMI SPDIF Optical HDMI ARC (780AH only)	▪ Individually selectable channels ▪ **Cycle** – cycling through each channel; 8 seconds per channel

Table 4-6: Audio Pattern Tests			
Pattern	**Format**	**Interfaces**	**Range of Values**
	DTS-ES 6.1	HDMI SPDIF Optical HDMI ARC (780AH only)	
Polarity Pattern Application: Polarity of the speaker wires	Dolby Digital 5.1	HDMI SPDIF Optical HDMI ARC (780AH only)	- Individually selectable channels **Cycle** – cycling through each channel; 8 seconds per channel
	DTS-ES 6.1	HDMI SPDIF Optical HDMI ARC (780AH only)	
Auto Time Delay Application: Fine tunes sound convergence using the distance setting in an AVR	Dolby Digital 5.1	HDMI SPDIF Optical HDMI ARC (780AH only)	- Individually selectable channels **Cycle** – cycling through each channel; 8 seconds per channel
	DTS-ES 6.1	HDMI SPDIF Optical HDMI ARC (780AH only)	

4.8.3 Procedures for Testing a Display with Dolby Digital or DTS Sine Wave Clips

Table 4-7 below summarizes the 780/780AH support for digital audio.

Table 4-7: Summary of Audio Sine Wave Clips		
Sine Wave Audio Clips	**Interfaces**	**Description**
Dolby Digital Plus 7.1	HDMI	Provides a set of Dolby Digital Plus 7.1 sine wave clips: 2.0 192kHz – 2 channel @ 192kHz sampling rate 5.1 192kHz – 6 channel @ 192kHz sampling rate 7.1 192kHz – 8 channel @ 192kHz sampling rate
Dolby TrueHD	HDMI	Provides a set of Dolby TrueHD Hi Bit Rate sine wave clips: 192kHz 7.1 1kHz TrueHD – 8 channel @ 192kHz sampling rate 192kHz 7.1 2kHz TrueHD – 2 channel @ 192kHz sampling rate
DTS HD HRA	HDMI	Provides a set of DTS-HD Hi Bit Rate sine wave clips: 192kHz 7.1 5376kb HDHRA – 8 channel @ 192kHz sampling rate 192kHz 5.1 3840kb HDHRA – 6 channel @ 192kHz sampling rate 192kHz 7.1 5760kb HDHRA – 8 channel @ 192kHz sampling rate

Table 4-7: Summary of Audio Sine Wave Clips		
Sine Wave Audio Clips	Interfaces	Description
DTS HD Master Audio	▪ HDMI	Provides a set of DTS-HD Hi Bit Rate sine wave clips: ▪ 192kHz 7.1 HDMA – 8 channel @ 192kHz sampling rate ▪ 192kHz 5.1 HDMA – 6 channel @ 192kHz sampling rate

Use the procedures below for testing multi-channel Dolby or DTS sine wave using clips.

1. Make the cable connection between the appropriate the 780/780AH video output connector (e.g. HDMI OUT, SPDIF or OPTICAL) and the input connector of the audio rendering device using the cables supplied.

2. From the top level menu (shown in the figure below), select **Audio Test Tone**.

The **Audio Pattern (Test Tone)** menu appears as shown below:

3. Touch select the desired **Interface** from the **Audio Pattern (Test Tone)** menu (refer to the screen shot above which shows HDMI). The options are Optical, SPDIF or HDMI.

4. Double touch select the **Dolby Digital Plus 7.1/TrueHD** or **DTS-HD** item on the **Audio Pattern (Test Tone)** menu (refer to the screen shot above).

   One of the following screens will appear:

5.   Touch select the desired clip.

4.8.4   Procedures for Testing with Programmable Sine Waves

Use the procedures below for testing with programmable sine waves. Table 4-8 below describes the audio sine wave parameters that can be configured.

Table 4-8: Sine Wave Audio Pattern		
Pattern	**Interface**	**Description**
PCM Sine Wave (programmable)	▪ HDMI ▪ Optical ▪ SPDIF ▪ HDMI ARC (780AH only)	Provides programmable sine waves: ▪ Bits per sample – 16, 20, 24 ▪ Sampling rate (kHz) – 32, 44.2, 48, 88.2, 96, 176.4, 192 ▪ Channels – 2.0, 2.1, 5.1, 6.1, 7.1 ▪ Level – 0dB to -99dB in 1dB and 3dB increments (per channel) ▪ Frequency – 0.01kHz to 20kHz (per channel) in 1Hz, 10Hz, 100Hz and 1000Hz increments ▪ Mute – On/Off (per channel)

1.   Make the cable connection between the appropriate the 780/780AH video output connector (e.g. **HDMI OUT**, **SPDIF** or **OPTICAL**) and the input connector of the audio rendering device using the cables supplied.

2. From the top level menu (shown in the figure below), select **Audio Test Tone**.

The **Audio Pattern** menu appears as shown below:

3. Touch select the desired **Interface** (shown in the screen above) to select the active digital audio output. (Optical selected in the example screen shot above.)

4. Double touch select the **PCM Sine Wave** item (shown in the screen above).

    The **PCM Sine Wave Options** menu appears as shown below:

5. Touch select the values for the **Bits per Sample** using the three buttons provided. (24 bits is selected in the example above.)

6. Touch select the **Sampling Rate** by incrementing the associated arrows adjacent to the current value. (Refer to the screen shot above which shows 96 kHz selected.)

7. Touch select the **Channels** by incrementing the associated arrows adjacent to the current value. (Refer to the screen shot above which shows 7.1 selected.)

8. Specify the **Level** by touch selecting the associated increment or decrement buttons showing +1dB and -1dB. (Refer to the screen shot above which shows the level at 0dB.) Repeat for each channel. You can specify the level for each channel individually.

9. Specify the **Frequency** of the sine wave by touch selecting the associated increment or decrement buttons. There are four buttons on the left of the current value. (1.00 kHz is shown selected in the screen shot above) The four buttons provide a variety of increment and decrement values for convenience. Repeat for each channel. You can specify the frequency for each channel individually in 1 Hz increments.

   Note: Always touch select the **Align** button to ensure that the sine waves for all channels are aligned.

10. Specify which channels you want to mute by touch selecting a channel and then touch selecting the Mute activation button. You can only select one channel at a time. Note that only the active channels (the ones specified in **Channels** will be selectable. (Refer to the screen shot above.)

4.8.5   Testing HDMI Audio Return Channel (ARC) 780AH only

You can test the HDMI 1.4 Audio Return Channel using the 780AH. The selected audio is output from the 780AH's HDMI IN connector in this case. The HDMI IN connector emulates an ARC Tx device to test the ARC Rx function on an A/V Receiver that supports the Audio Return Channel.

Note: The 780AH does not support the CEC commands necessary to activate the ARC Rx function in the connected A/V receiver. Therefore you will have to have some other method of activating this ARC function in the A/V receiver under test.

1. Make the cable connection between the 780AH HDMI IN connector and the A/V receiver's HDMI 1.4 capable output connector.

   The following illustration depicts the test setups for the HDMI audio return channel.
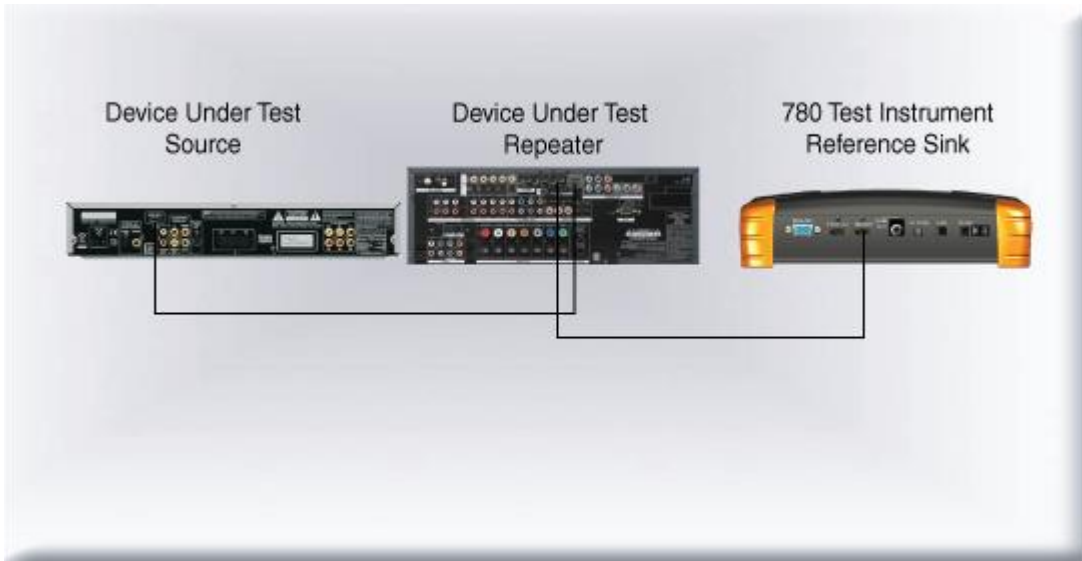
2. From the top level menu (shown in the screen sample below), select **Audio Test Tone**.

The **Audio Test Tone** menu appears as shown below:

3. Select **ARC**.

4. Select the desired audio **Signal Type**.

Table 4-9 below describes the audio format available for testing the HDMI Audio Return Channel.

Table 4-9: HDMI Audio Return Channel (ARC) Testing	
Audio Interface	**Audio Formats**
HDMI ARC (780AH only)	▪ Dolby 5.1 ▪ DTS-ES 6.1 ▪ PCM Sine Wave

5   Using the 780/780AH Test Instrument to Test HDMI Protocols on Sink Devices

This section provides procedures for testing HDMI sink devices such as HDTVs, projectors and inputs on repeater devices. ***The features and functions described in this section are included only if you have purchased the Network Analyzer option.***

5.1   Testing HDCP on an HDMI HDTV or HDMI Repeater Device

This section provides procedures for testing HDCP on an HDMI equipped HDTVs. The HDCP authentication test initiates and HDCP authentication with the sink device (with or without a repeater) and displays the AKSV and BKSV values, the An value, the Ro values and the Ri values. A pass/fail indication is provided as well.

The 780B, 780A supports testing for HDCP 1.4 sources and sinks. The 780AH supports testing both HDCP 1.4 and HDCP 2.2 repeaters and sinks.

5.1.1   Configurations for Testing HDCP on an HDMI Sink Device

You can run this test in two configurations.

- 780/780AH HDMI OUT port connected directly to an HDTV input
- 780/780AH HDMI OUT port connected to a repeater device which is then connected to a downstream HDTV.

These configurations are shown below:
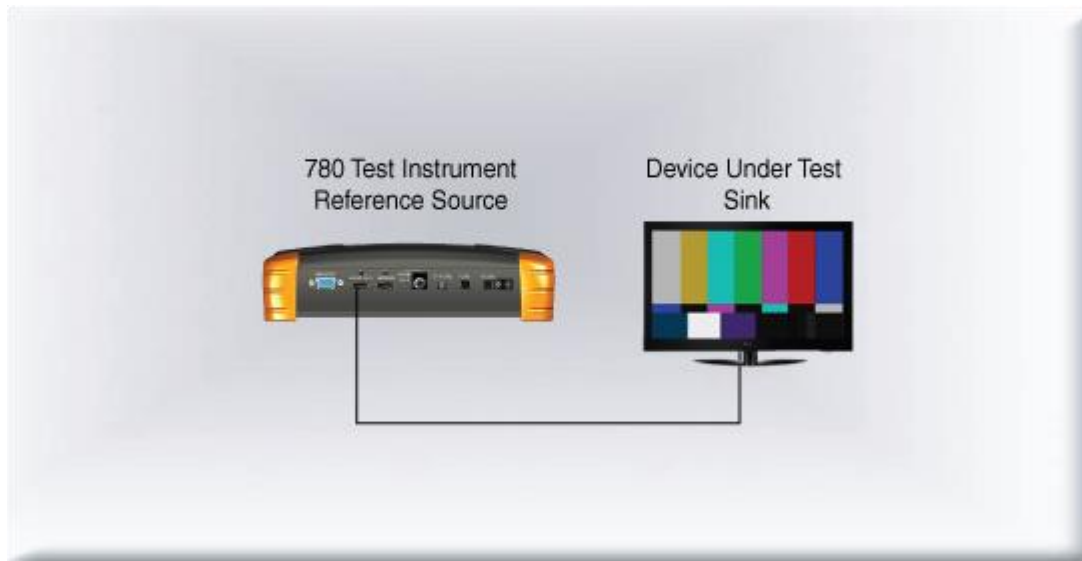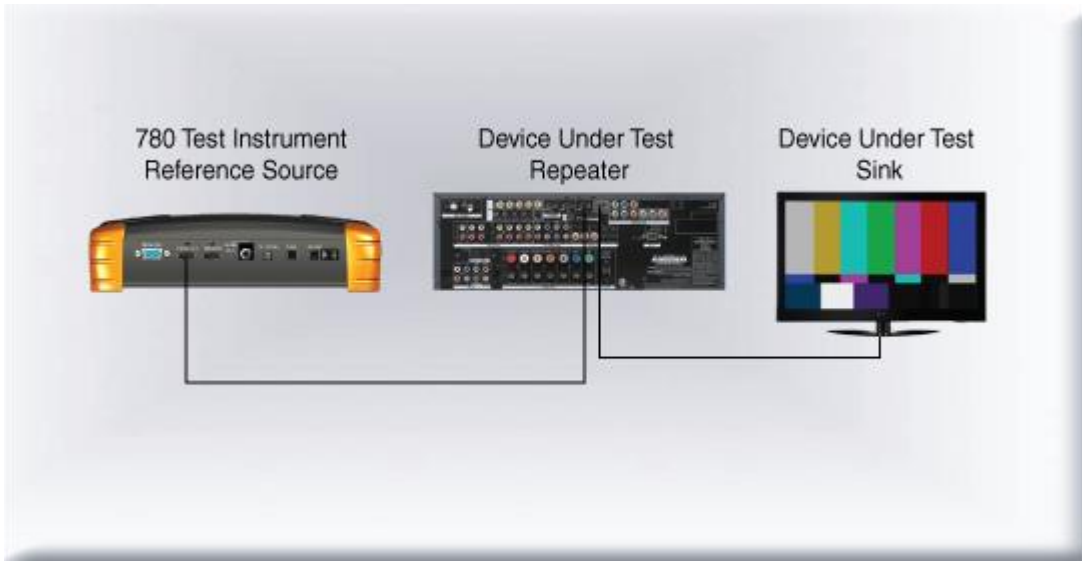
5.1.2   Procedures for Testing HDCP on an HDMI Sink Device

Use the procedures below to run an HDCP test on an HDMI sink.

1.   Make the physical connections between the 780/780AH HDMI OUT connector and the display device under test.

2.   Enable the HDMI output using the procedures at Selecting a Signal Type and Resolution.

3.   Touch select **Test Sink (Display/TV)** from the top level menu shown below.

4.   Select **HDCP Test** from the **Sink Tests** menu shown below.

5. Touch select **Enable** from the **HDCP Output Tests** menu shown below.

The Pass/Fail results and the key values exchanged during the authentication are presented on the display as shown below (780 example):

The Pass/Fail results and the key values exchanged during the authentication are presented on the display as shown below (780AH example):
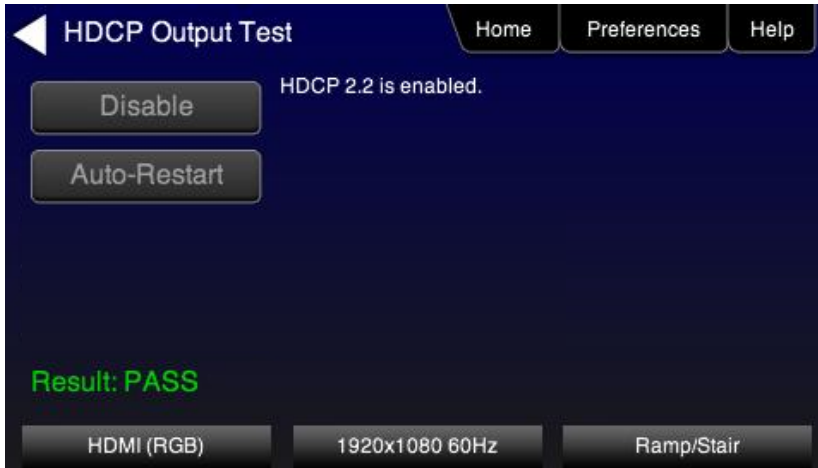
6. Touch select **Auto-Restart** to restart HDCP authentication.

   Alternatively you can run this test from the command line as follows:

   ```
   HDCP?
   0     // indicates pass (1 indicates a failure)
   ```

5.2   Verifying the EDID on an HDMI HDTV or HDMI Repeater Device

This section provides procedures for verifying and viewing the EDID of an HDMI HDTV or an HDMI repeater device such as an A/V receiver. You can also compare two EDIDs.

5.2.1   Configurations for Verifying and Viewing the EDID on an HDMI Sink Device

The following illustrations depict the typical test setups. You can either connect directly to an HDTV or to a repeater device connected to an HDTV.
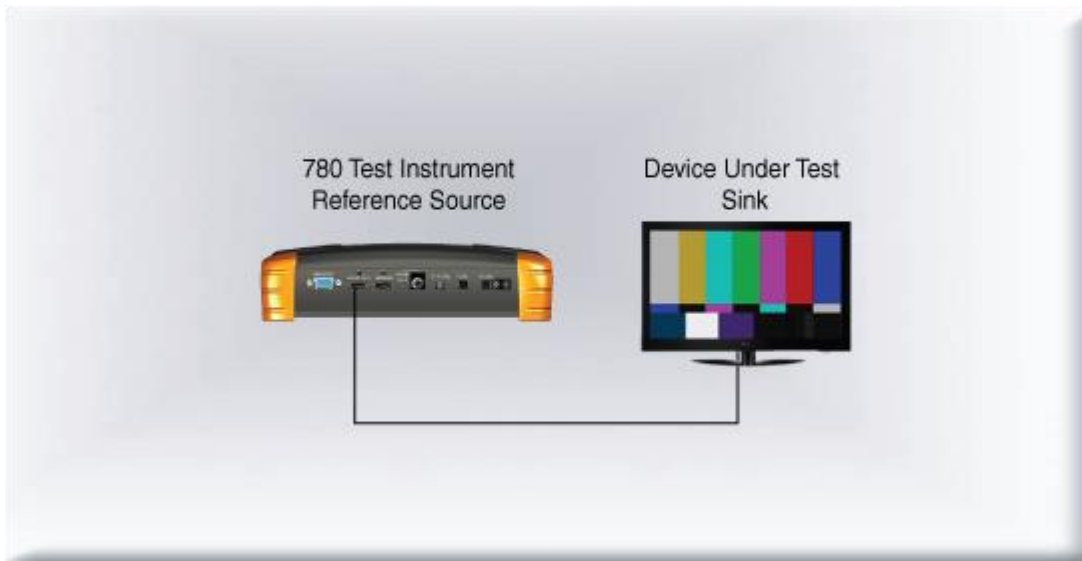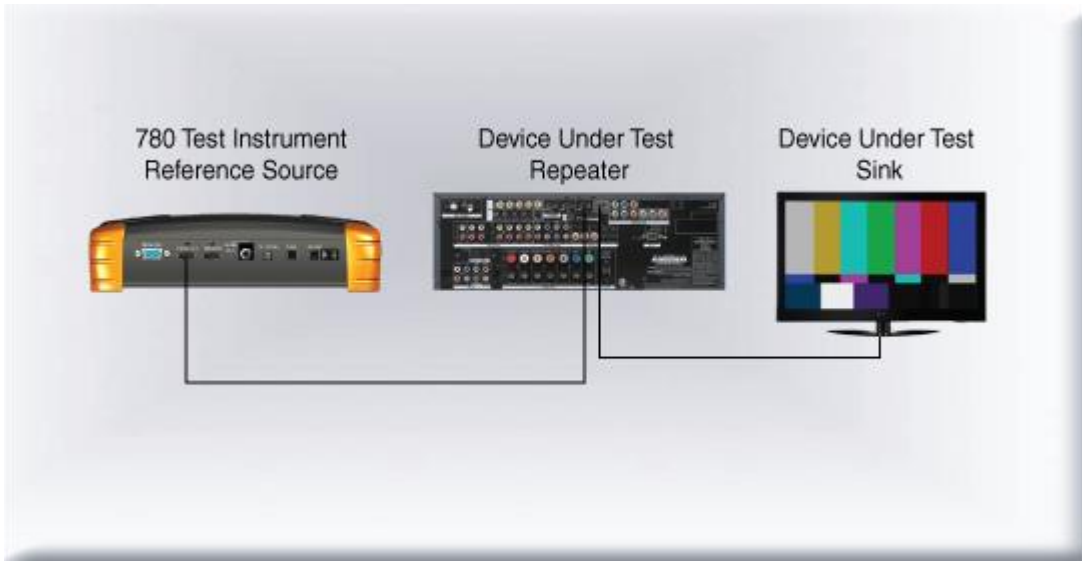
5.2.2   Procedures for Testing and Viewing the EDID on an HDMI Sink Device

Use the procedures below to run an EDID test on an HDMI sink.

1.   Make the physical connections between the 780/780AH **HDMI OUT** connector and the display device under test.

2.   Enable the HDMI output using the procedures at Selecting a Signal Type and Resolution.

3.   Touch select **Test Sink (Display/TV)** from the top level menu shown below.

4.   Touch select EDID Test from the Sink Tests menu shown below.

5. Touch select the Read activation button from the EDID Test menu shown below.

   The EDID information is presented on multiple pages on the display. An example of a few of the pages of an EDID listing is shown below. You scroll through all the pages using the scroll bar at the right side of the listing. In addition, the EDID test runs a check on the EDID header and checksum to determine if the EDID is valid and runs a portion of the EDID compliance test of the HDMI Compliance Test Specification.

The EDID sink test will also run certain sections of the EDID compliance test. The sections that are run are those sections that do not require Capabilities Declaration Form (CDF) information to be entered for example Test ID 8-2 shown in the following screen example below.

5.2.3   Workflow for Comparing EDIDs

Use the following procedures to compare two EDIDs. The following is the workflow for comparing two EDIDs.

- Load a reference EDID either from an EDID file stored on the 780/780AH or an EDID you have obtained from an HDTV and subsequently stored.
- Load the reference EDID.
- Connect the 780/780AH **HDMI OUT** port to the HDMI sink device whose EDID you wish to compare with your reference EDID.
- Compare the two EDIDs.

Note: To load an EDID use the procedures described in <u>Adding Reference EDIDs for Use in Testing HDMI Devices</u>.

5.2.4   Procedures for Comparing EDIDs

Use the following procedures to compare two EDIDs.

1. Follow the procedures above for Selecting a Signal Type and Resolution to enable the HDMI output.

2. Touch select **Test Sink (Display/TV)** from the top level menu shown below.

3. Touch select **EDID Test** from the **Sink Tests** menu shown below.

4. Touch select **Load** from the **EDID Tests** menu. The following screen results.
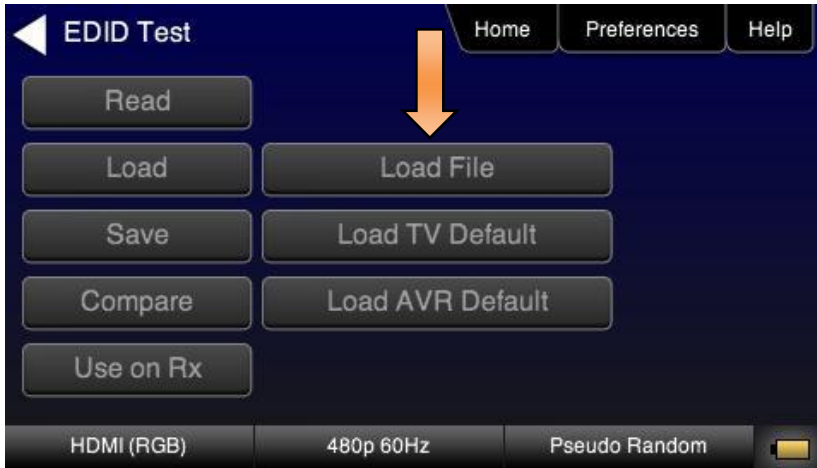
5. Touch select the **Load** option from the **EDID Test** menu shown above that you want to use as a reference EDID. The options:

▪ Load File – Loads from an EDID file stored on the 780/780AH file system
▪ Load TV Default – Loads the standard reference EDID for a TV from the 780/780AH file system
▪ Load AVR Default - Loads the standard reference EDID for a AVR from the 780/780AH file system

6. If you have selected the **Load File** option, the following screen results. Select the file that you wish to use as the reference EDID. In the example below there is only one file.

The EDID is loaded and displayed on the screen.

7. Connect the 780/780AH **HDMI OUT** port to an HDMI sink device (e.g. HDTV or A/V receiver) and touch select **Compare**. The results will show PASS or FAIL with an explanation as in the following two screen examples.

When a failure occurs the following message is displayed.

5.3   Viewing the CEC devices on an HDMI network

This section describes how to view the CEC devices on an HDMI network.

5.3.1   Configurations for Testing CEC on an HDMI Sink Device

You can run this test in two configurations.

- 780/780AH HDMI OUT port connected directly to an HDTV input
- 780/780AH HDMI OUT port connected to a repeater device which is then connected to a downstream HDTV.

These configurations are shown below:
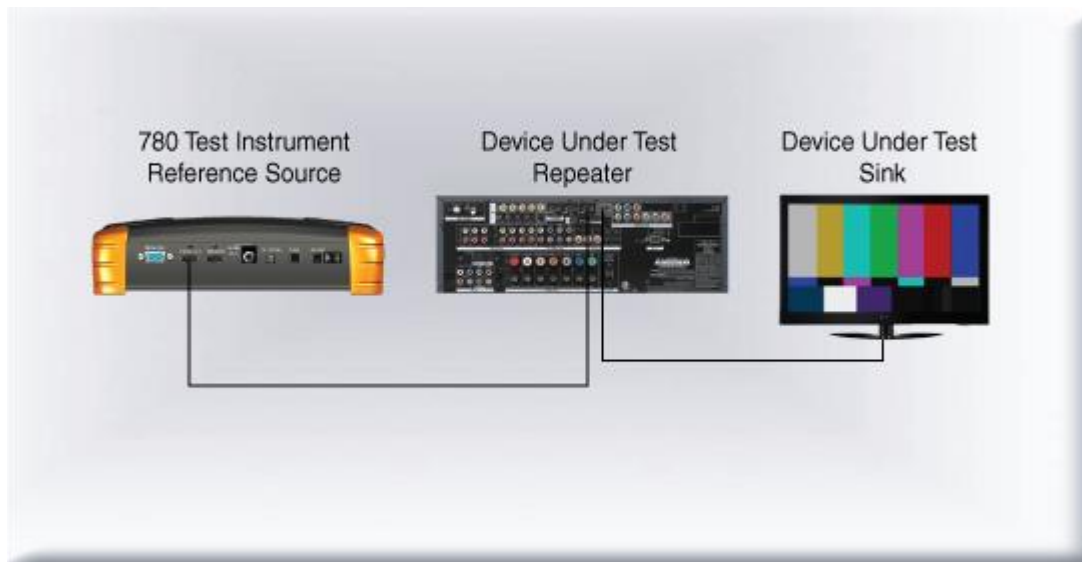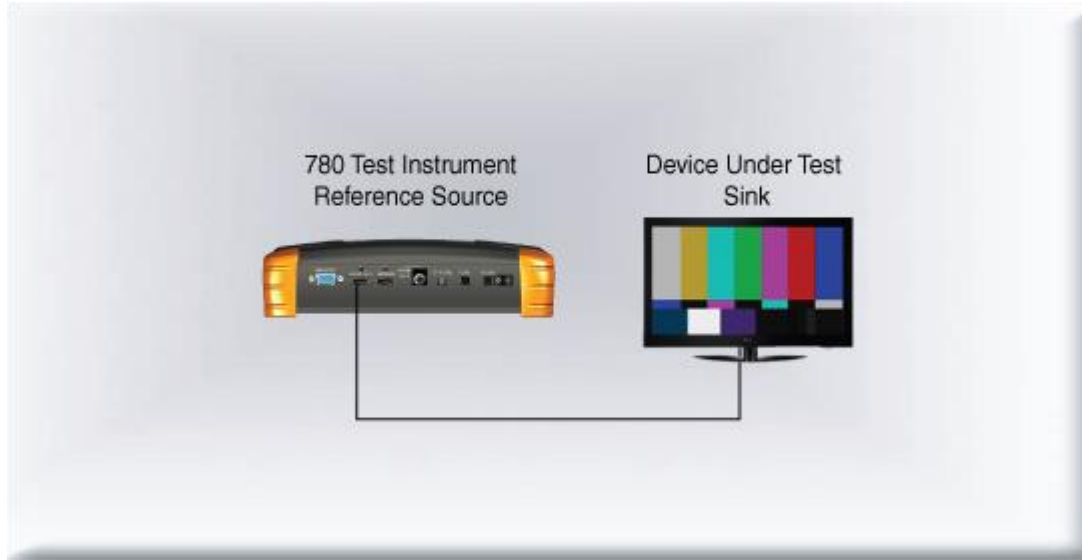
5.3.2   Procedures for Testing CEC on an HDMI Sink Device

Use the following procedures to test CEC on an HDMI sink device.

1. Connect the 780/780AH **HDMI OUT** port to an HDMI sink device (e.g. HDTV or A/V receiver) using the configuration guidelines provided above.

2. Follow the procedures above for Selecting a Signal Type and Resolution to enable the HDMI output.

3. Touch select **Test Sink (Display/TV)** from the top level menu shown below.

4. Touch select the **CEC Test** activation button from the **Sink Tests** menu shown below.

The CEC devices on the HDMI network are presented on the display as shown below:

5.4   Multi-protocol (HDCP, EDID and CEC) testing on an HDMI HDTV

This section provides procedures for testing HDCP, EDID and CEC using the Aux Combo Test image. The Aux Combo Test image runs tests similar to the individual HDCP, EDID and CEC tests except that the results are displayed on the HDTV that the 780/780AH HDMI output is connected to.

5.4.1   Configurations for running multi-protocol tests on an HDMI Sink Device

You run this test with the 780/780AH HDMI OUT port connected directly to an HDTV input

This configuration is shown below:
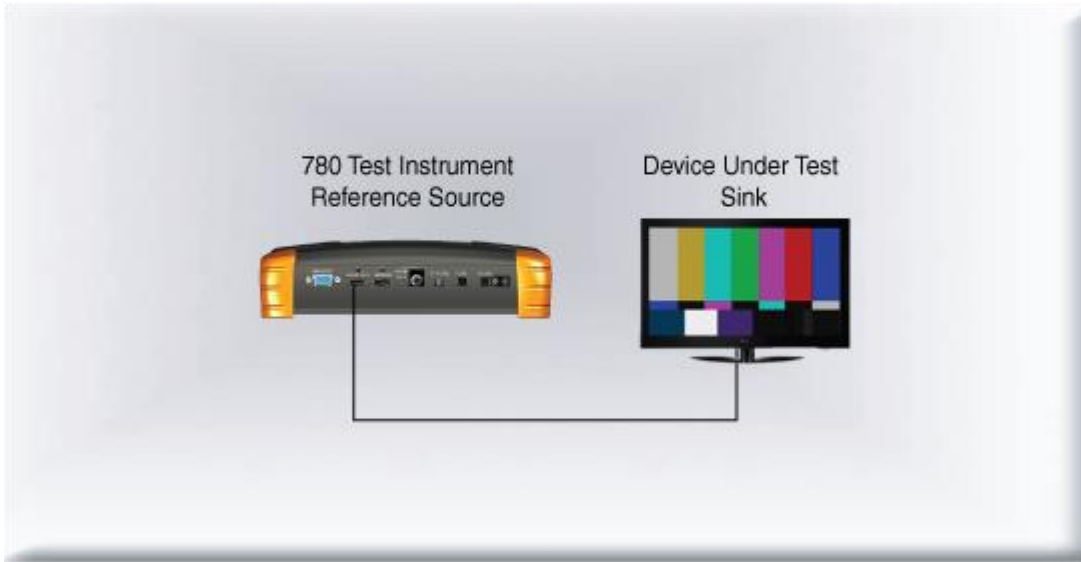
5.4.2   Procedures for running multi-protocol tests on an HDMI Sink Device

Use the procedures below to run a multi-protocol test on an HDMI sink.

1. Make the physical connections between the 780/780AH HDMI OUT connector and the display device under test.

2. Enable the HDMI output using the procedures at Selecting a Signal Type and Resolution.

3. Touch select video pattern status and activation button on the lower right of the LCD interface.

4.   Touch select the Aux Combo Test pattern from the second page of the Video Pattern menu shown below.
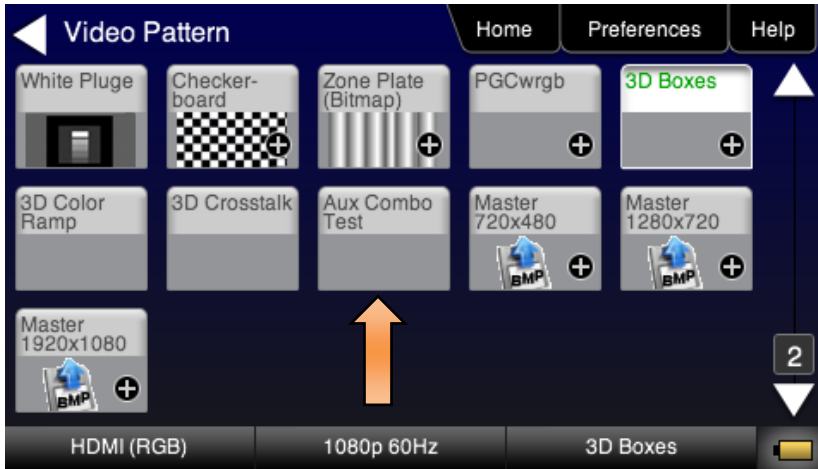
The results will appear on the connected display. An example of the results is shown below:
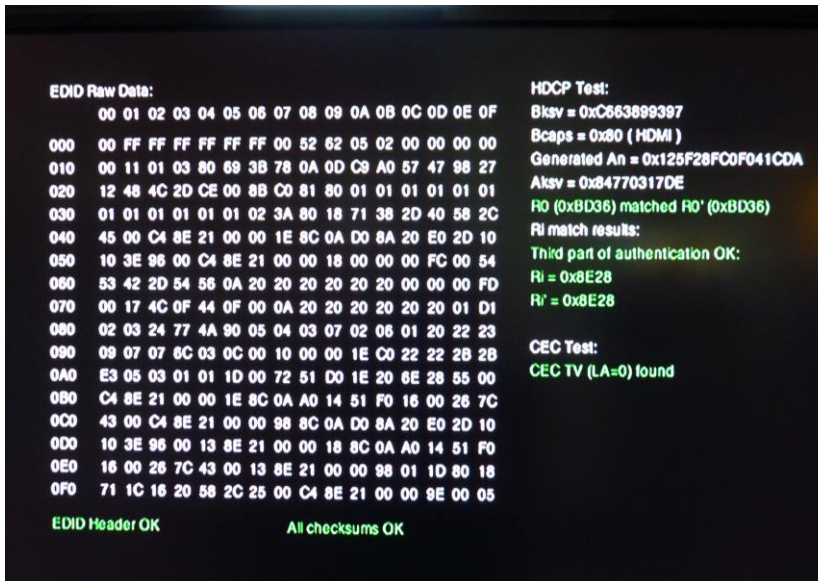
4.   Alternatively you can run the AuxComboTest from the command line as follows:

```
IMGL AuxTest
IMGU
```

6   Using the 780/780AH Test Instrument to Test HDMI Source Devices

This section provides procedures for testing HDMI source devices such as DVD players, set top boxes and outputs on repeater devices. ***The features and functions described in this section are included only if you have purchased the Network Analyzer option.***

6.1   Testing Video from an HDMI Source Device

This subsection describes how to test the video on HDMI source devices.

6.1.1   Connection Configurations for Testing HDMI Source Devices

The 780/780AH's HDMI input port acts as a "reference" HDMI sink device. Therefore it enables you to emulate a known good HDMI sink device to conduct a basic confidence test of an HDMI source device. This test ensures that you are receiving a valid HDMI video signal by displaying the timing of the incoming signal and informing you whether it is HDCP encrypted or not. You can run this test in three configurations:

- Source device connected directly to the 780/780AH **HDMI IN** connector.
- Source device connected to the 780/780AH **HDMI IN** connector through a repeater device.
- 780/780AH **HDMI OUT** and **HDMI IN** ports acting as both as a known good source and a known good sink connect to both the input and output of the repeater device.

In all cases the 780/780AH is emulating a sink to test an upstream source. In the third configuration, the 780/780AH is emulating both an HDMI source and sink. These test configurations are shown below.
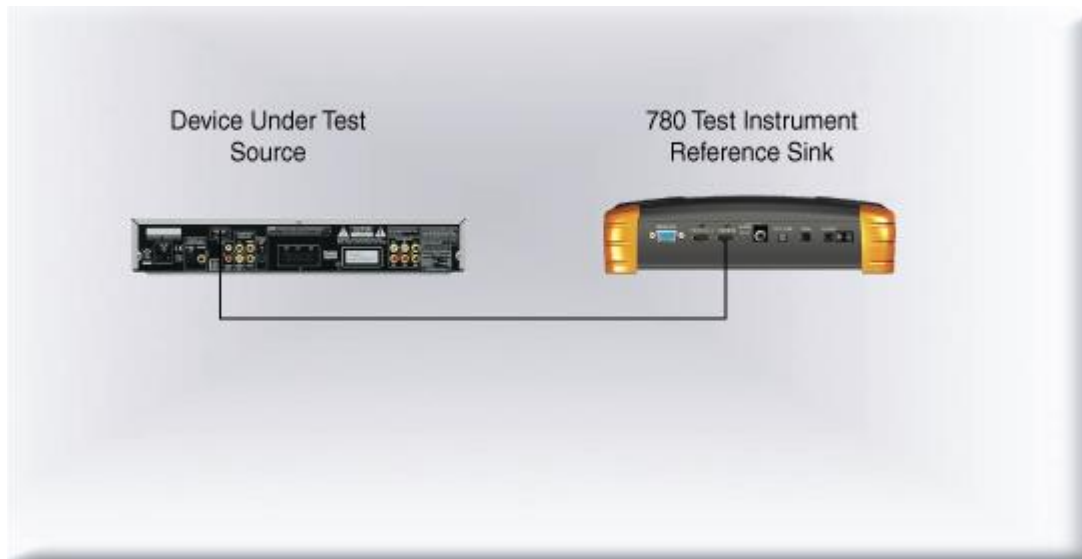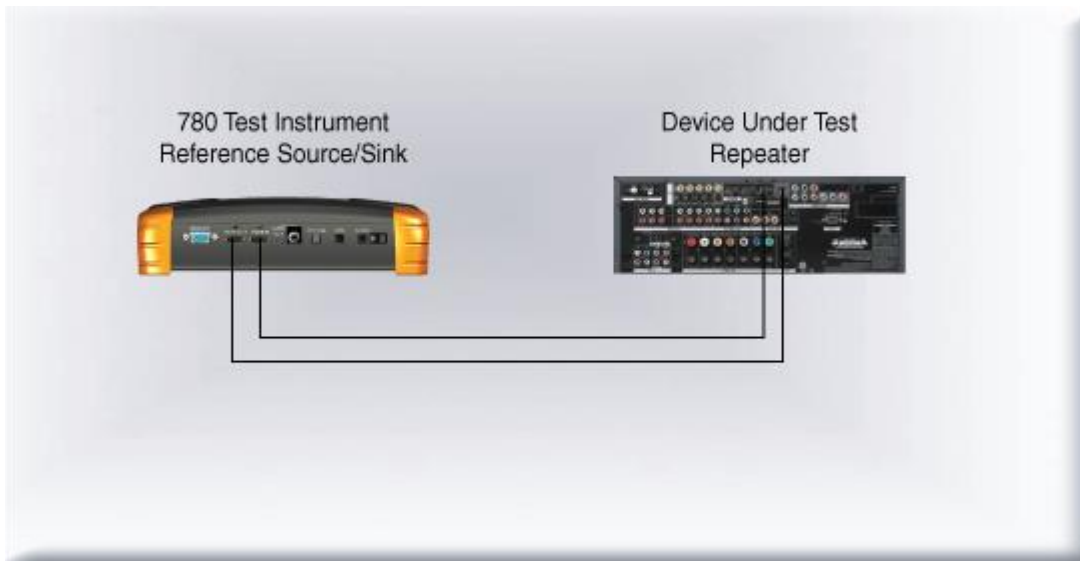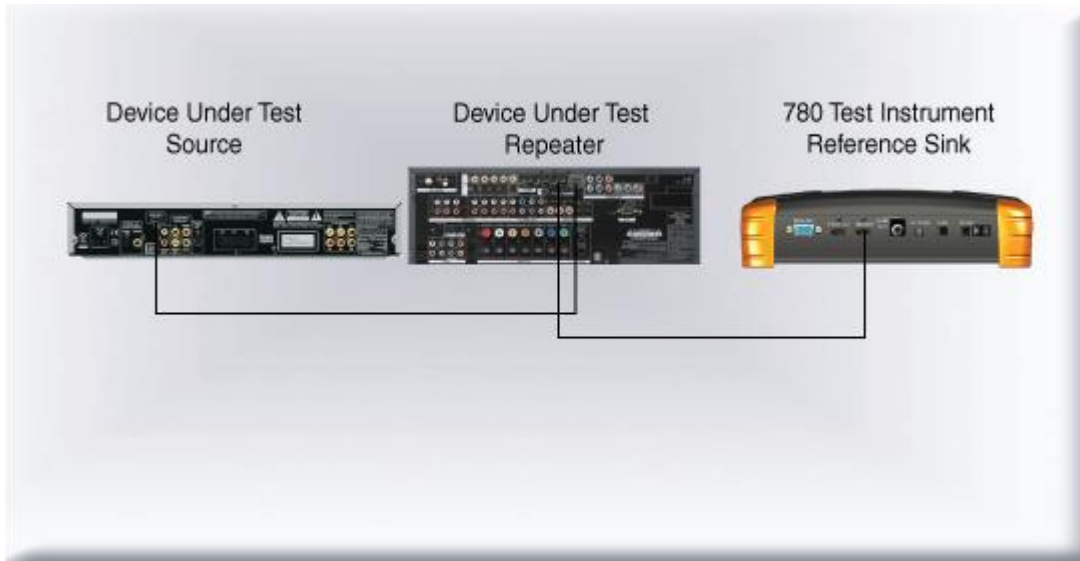
6.1.2   Procedures for Testing Video on an HDMI Source Device

Use the following procedures to test the video from an HDMI source device. You can view the incoming video and check the video and timing parameters of the incoming video.

1. Make the physical connection between the 780/780AH HDMI IN port and the source device under test using the configuration instructions above.

2. Touch select **Test Source (DVD/STB)** from the top level menu shown below.

3. Touch select **Video Display** from the **Source Tests** menu shown below.

4. Touch select the **Start Fullscreen** activation button on the **Video Display** menu to view only the incoming video (no metadata) from the source device under test.

The video from the source is shown on the 780/780AH LCD as depicted below.

5. Return to the Source Test menu by touching the LCD. The **Source Test** menu reappears as shown below.

    Note that you can also view 3D video bitmaps as well. The following screen is a sample of what a 3D bitmap would look like. The example below is a Top-and-Bottom format.

6. Touch select the screen to return to **Video Display** menu.

7. Touch select the **Start Detailed** activation button on the **Video Display** menu to view the incoming video along with the metadata from the source device under test. In this example a test pattern is shown.

    Note that the HDCP encryption status and AVmute status are also shown.
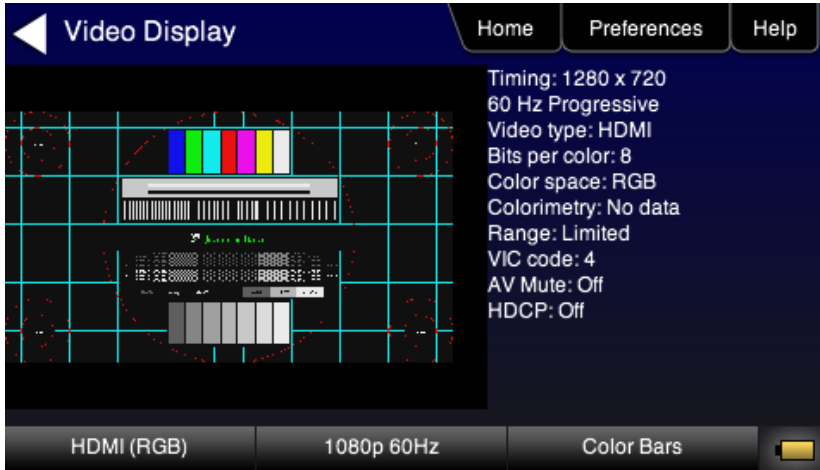
9. For the 780AH you have the additional option of capturing and viewing a captured bitmap of the entire resolution of the incoming video **View Full Frame**.

    Use the arrows to move about the video frame.

8. Return to the **Source Test** menu by touching the LCD. The **Source Test** menu reappears.

9. Touch select **Format Analyzer** from the **Source Tests** menu shown below.

10. Touch select the **Read** activation button (shown on the screen below) to initiate the test. The results are shown in the screen shots below. The first screen shows a typical pass results, the second screen shows a failure condition and the third screen shows a case where the incoming format was unknown.

If one of the timing parameters does not match the value of the parameters in the associated standard timing in the 780/780AH format library, an indication of the error is shown as can be seen below.

If the timing does not match a standard timing in the 780/780AH format library, a message is shown: "Unknown format" as can be seen below.

Table 6-1 below describes each field in the Format Analyzer on-screen report. The basic timing information is shown on the left of the resulting screen and the AVI inframes received are displayed on the right. Also displayed on the right side is an indication of the status of HDCP encryption.

Table 6-1: Format Analyzer	
Timing Parameters (left side)	**Description**
Video Type	Indicates whether the source is HDMI or DVI.
Total	Total horizontal and vertical resolution including blanking.
Active	Total active horizontal and vertical resolution excluding blanking.
Frames/sec	The frame rate of the HDMI/DVI input source.
Scan Type	Indicates whether the HDMI/DVI input source is progressive or interlaced.

Table 6-1: Format Analyzer	
HSYNC delay	The horizontal sync pulse delay in pixels.
HSYNC width	The horizontal sync pulse width in pixels.
VSYNC delay	The vertical sync pulse delay in lines.
VSYNC delay	The vertical sync pulse width in lines.
HSYNC polarity	The polarity of the horizontal sync pulse; either positive (+) or negative (-).
VSYNC polarity	The polarity of the vertical sync pulse; either positive (+) or negative (-).
AVI Infoframe Parameters (right side)	**Description**
Bits per comp	The number of bits per component color. Can be 6, 8, 10, 12, 16.
Color space	Color space and sampling Color space: ▪ YCbCr ▪ RGB ▪ xvColor Sampling: ▪ 4:4:4 ▪ 4:2:2
Basic colorimetry	The ITU colorimetry standard.
Pixels repeated	Indicates whether pixel repetition is active.
Video ID code (VIC)	The CEA video identification code number.
Resolution	Shows the horizontal and vertical resolution as well as the frame rate and the aspect ratio.
AVmute status	The current setting of the AVmute parameter in the General Control Packet.
HDCP	Indicates the HDCP encryption status either: 1) Encrypted or 2) Unencrypted.

6.2 Viewing Source Data Island Packet

This subsection describes how to view the HDMI data island packets from an HDMI source device.

6.2.1 Configurations for Viewing the Data Island Packets from a Source Device

The 780/780AH's HDMI input port acts as a "reference" HDMI sink device. Therefore it enables you to emulate a known good HDMI sink device to conduct a test on a source device. You can view the data island packets with the source device connected directly to the 780/780AH. This test configuration is shown below.
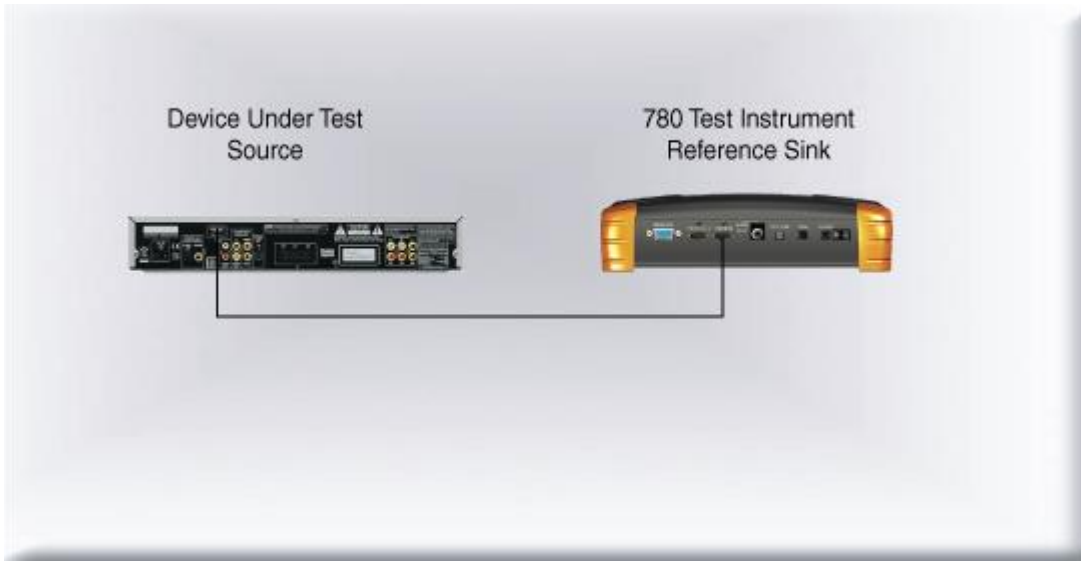
6.2.2   Procedures for Viewing the Data Island Packets from a Source Device

Use the following procedures to view the data islands packets from an HDMI source device.

1. Connect the HDMI system devices to the 780/780AH as shown in the diagram above. The HDMI source device output is connected the 780/780AH **HDMI IN** connector.

2. Touch select **Test Source (DVD/STB)** from the top level menu shown below.

The following screen appears:

3. Touch select **Packet Viewer** from the **Source Tests** menu shown above.

4. Touch select the **Refresh** activation button on the **Packet Viewer** menu (shown below) to view the data island packet information (AVI Infoframe shown).
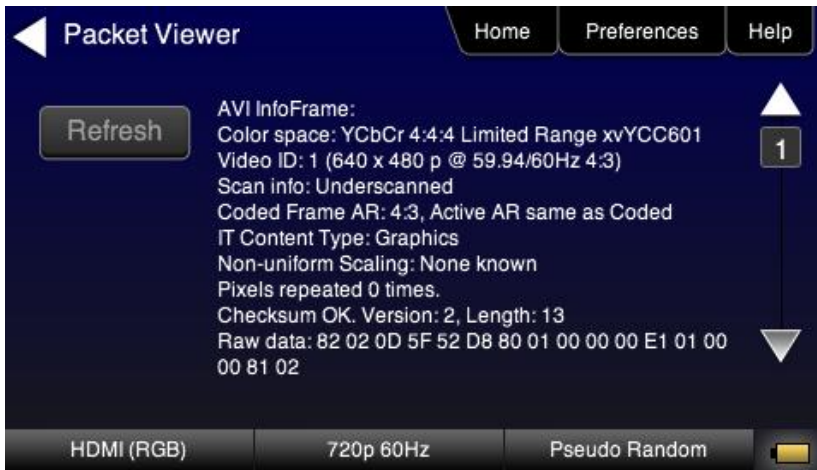
5. Touch select the **Save** activation button on the **Packet Viewer** menu to save the data to a file.

    A keyboard appears enabling you to select a name.

6.3   Testing HDCP Max Devices on an HDMI Source Device

This subsection describes how to run a test of the number of HDCP devices an HDMI source device supports. The Max HDCP devices test runs a test on the source device (such as a DVD or STB) to determine how many downstream devices are supported during an HDCP authentication with a repeater device.

6.3.1   Configurations for Testing Max Devices a Source Device Supports

The 780/780AH's HDMI input port acts as a "reference" HDMI sink device. Therefore it enables you to emulate a known good HDMI sink device to conduct a test on a source device. You can run this source device connected directly to the 780/780AH. This test configuration is shown below.
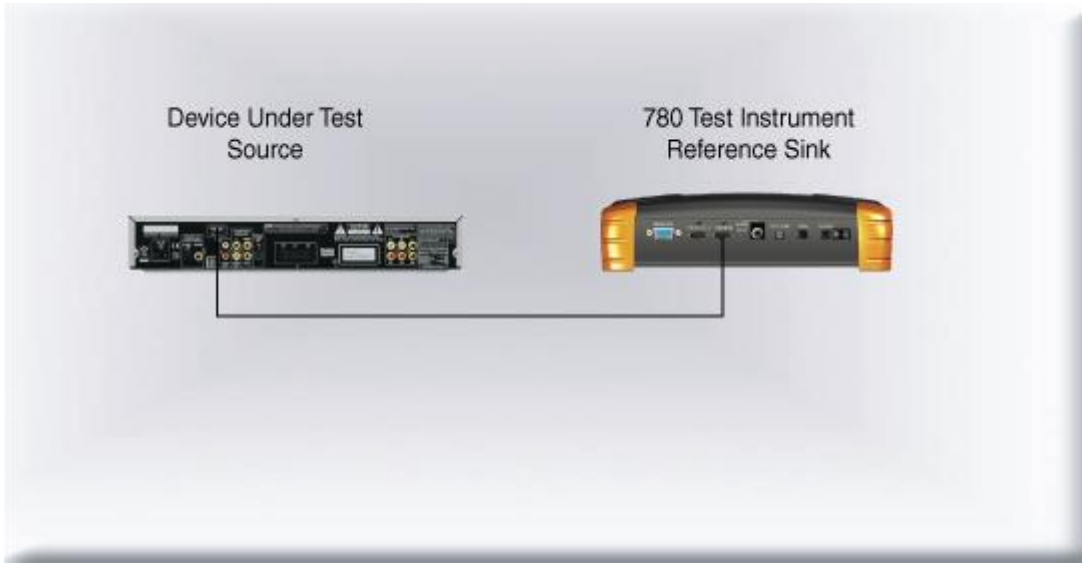
6.3.2   Procedures for Testing Max Devices a Source Device Supports

Use the following procedures to test the maximum number of HDCP devices a source device supports. The 780 will test up to 16 keys. If the there are more than 16 keys reported the 780 will indicate that at least 16 are supported.

1. Connect the HDMI system devices to the 780/780AH as shown in the diagram above. The HDMI source device output is connected the 780/780AH **HDMI IN** connector.

2. Touch select **Test Source (DVD/STB)** from the top level menu shown below.

The following screen appears:
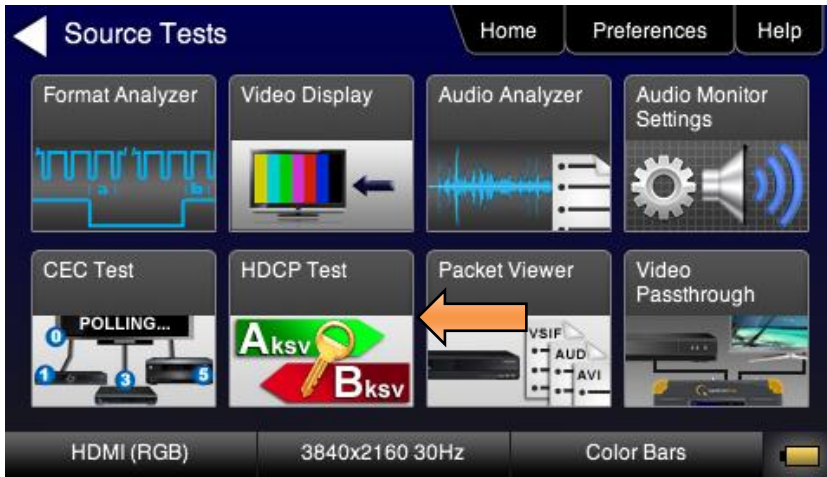
3. Touch select **HDCP Test** from the **Source Tests** menu shown above.

4. Touch select the **Find Max Devs** activation button on the **HDCP Input Tests** menu (shown below) to test the number of HDCP device the source device supports.

    Note: You can also disable HDCP on the HDMI Rx port using the Allow Rx HDCP toggle button.

The results of the test are shown on the screen.
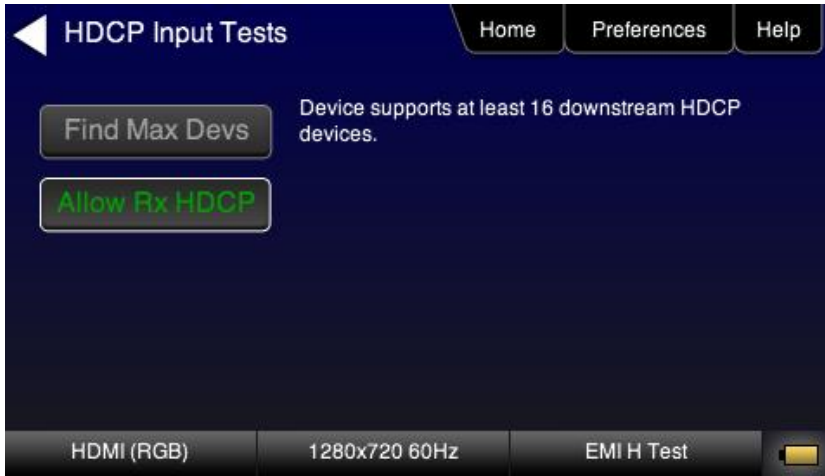
6.3.3   Procedures for disabling HDCP on the 780/780AH Rx port - GUI

You can disable the HDCP registers of the 780/780AH's Rx port to test how your source device responds to HDCP being disabled. You can disable the HDCP port either through the GUI or through the command line.

1. Touch select the **Allow Rx HDCP** activation button to enable / disable HDCP. When the button is green HDCP is enabled.

   Note: You can also disable HDCP on the HDMI Rx port using the Allow Rx HDCP toggle button. See procedures below.

6.3.4   Procedures for disabling HDCP on the 780/780AH Rx port – Command Line

For instructions on establishing a command line session with the 780/780AH from your PC refer to the section: Command Interface. Use the commands in the following procedures enable and disable HDCP on the HDMI Rx port.

1. To disable HDCP on the HDMI Rx port enter the following command:

   ```
   CPAG 0
   ALLU
   ```

2. To re-enable HDCP on the HDMI Rx port enter the following command:

```
CPAG 1
ALLU
```

6.4   Testing Audio of an HDMI Source Device

This subsection describes how to test the audio from an HDMI source device. You can view the audio analyzer report from the GUI or via the command line. Procedures for both are provided below.

6.4.1   Configurations for Testing Audio on an HDMI Source Device

With the 780/780AH you can run a test on the HDMI audio from a source device. This test shows you the decoded audio IEC header information, the audio inframes and the audio sample packet header information transmitted from the connected source device which could be a DVD, set top box or the output of an A/V Receiver. You can run this test in three configurations:

- Source device connected directly to the 780/780AH.
- Source device connected to the 780/780AH through a repeater device.
- 780/780AH **HDMI OUT** and **HDMI IN** ports acting as both as a known good source and a known good sink connect to both the input and output of the repeater device.

In all cases the 780/780AH is emulating a sink to test an upstream source. In the third configuration, the 780/780AH is emulating both an HDMI source and sink. These test configurations are shown below.
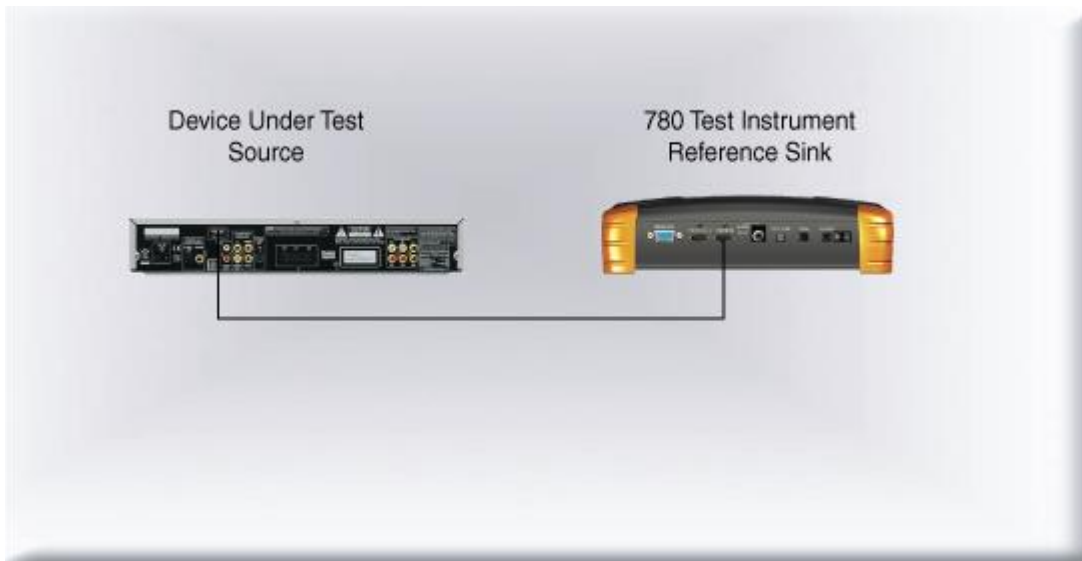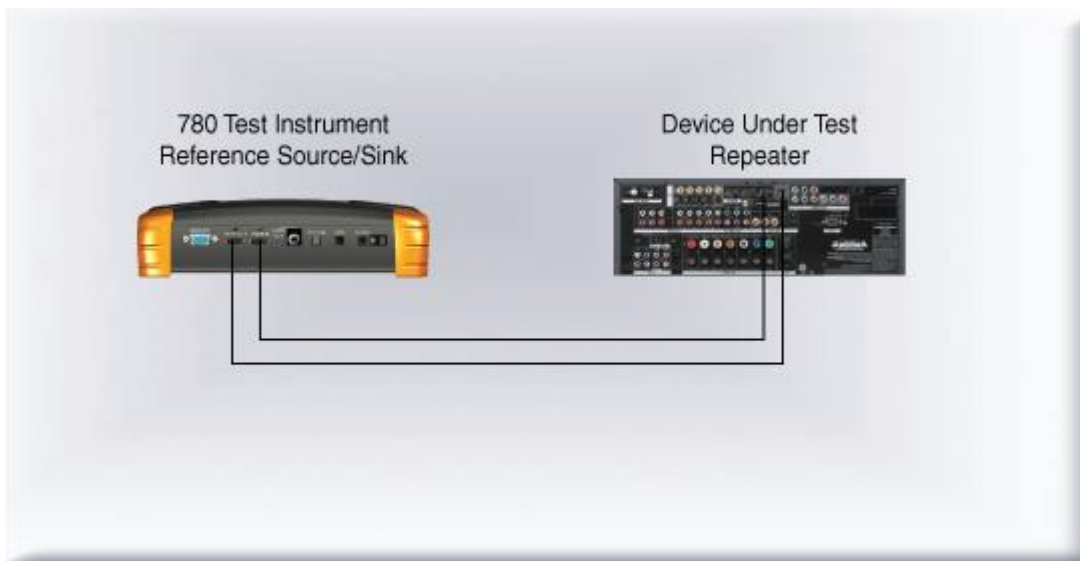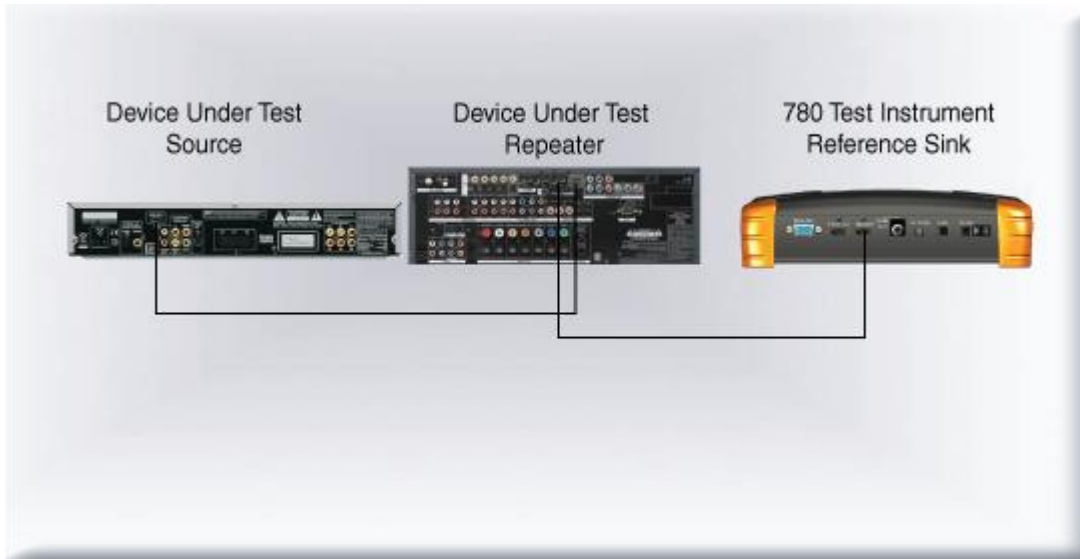
6.4.2   Procedures for Testing Audio on an HDMI Source Device

Use the following procedures to test the audio from an HDMI source device.

1. Make the physical connection between the 780/780AH **HDMI IN** port and the source device under test using the configuration instructions above.

2. Select **Test Source (DVD/STB)** from the top level menu shown below.

3. Touch select **Audio Analyzer** from the **Sources Test** menu shown below.
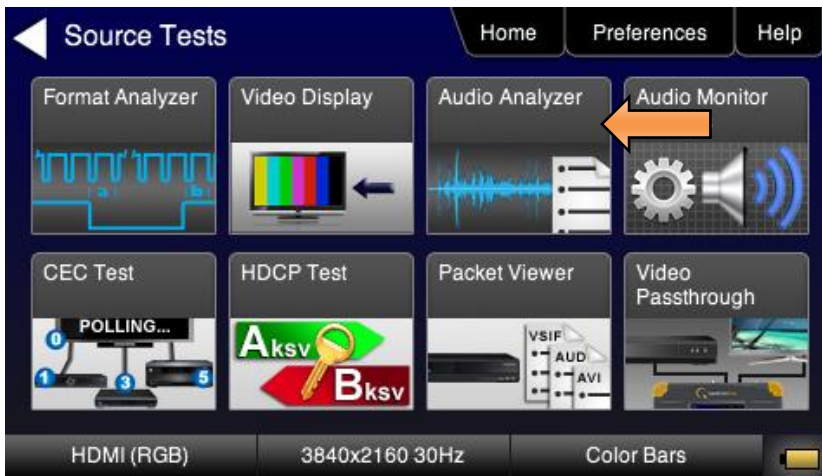
4. Touch select the **Read** activation button to initiate the test.
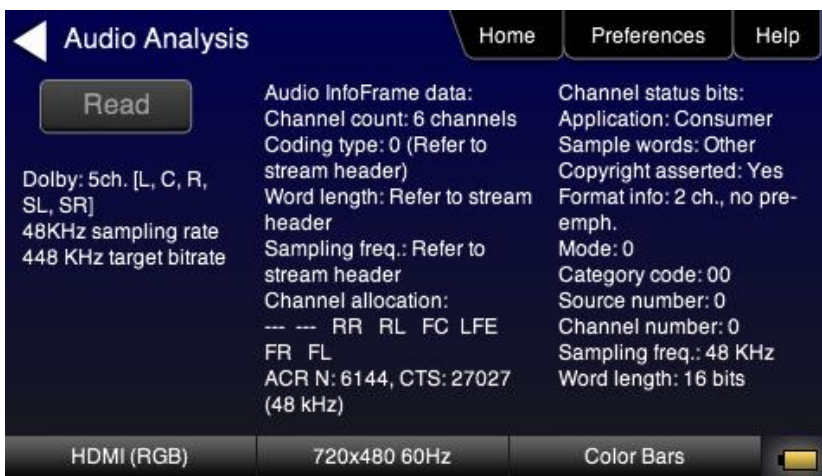
Alternatively you can run this test from the command line as follows:

```
AUDA:RPTP?
```

An example of the results are shown below:

```
Audio InfoFrame data:
Channel count: 2 channels
Coding type: 0 (Refer to stream header)
Word length: Refer to stream header
Sampling freq.: Refer to stream header
Channel allocation:
---   ---   ---   ---   ---   ---    FR    FL
Channel status bits:
Application: Consumer
Sample words: LPCM
Copyright asserted: Yes
Format info: Default
Mode: 0
Category code: 00
Source number: 0
Channel number: 0
Sampling freq.: 48 KHz
Word length: 24 bits)
```

Table 6-2 below describes each field in the Audio Analyzer on-screen report. The audio infoframe information is shown on the left of the resulting screen and the channel status data from the audio sample packets received are displayed on the right.

Table 6-2: Audio Analyzer	
Audio IEC Header decoded data (left side)	**Description**
Audio Format	Indicates the audio format type. Typically one of: ▪ LPCM ▪ Dolby ▪ DTS
Sampling rate	The sampling frequency. One of: ▪ Refer to Stream Header ▪ 32kHz ▪ 44.1kHz ▪ 48kHz ▪ 88.2kHz ▪ 96kHz ▪ 176.4kHz ▪ 192kHz
Target bitrate	
Audio Infoframe/Metadata Data (middle)	**Description**

Table 6-2: Audio Analyzer	
Audio IEC Header decoded data (left side)	**Description**
Channel count	Indicates the number of active channels. One of: ▪ Refer to Stream Header ▪ 2ch ▪ 3ch ▪ 4ch ▪ 5ch ▪ 6ch ▪ 7ch ▪ 8ch
Coding type	Indicates the audio format. One of: ▪ Refer to stream header ▪ LPCM (IEC 60958) ▪ AC-3 ▪ MPEG1 ▪ MPEG2 ▪ AAC ▪ DTS ▪ ATRAC ▪ One Bit Audio ▪ Dolby Digital Plus ▪ DTS-HD ▪ MAT ▪ DST ▪ WMA Pro
Word Length	The sample size or bit depth. One of: ▪ Refer to Stream Header ▪ 16 bit ▪ 20 bit ▪ 24 bit
Sampling Frequency	The sampling frequency. One of: ▪ Refer to Stream Header ▪ 32kHz ▪ 44.1kHz ▪ 48kHz ▪ 88.2kHz ▪ 96kHz ▪ 176.4kHz ▪ 192kHz
Channel Allocation	The speaker mapping and allocation. One or more of the following: ▪ FL ▪ FC ▪ FR ▪ RLC ▪ FRC ▪ RL ▪ RC ▪ RR ▪ RLC ▪ RRC ▪ LFE

Table 6-2: Audio Analyzer	
Audio IEC Header decoded data (left side)	**Description**
Audio Clock Regeneration N/ CTS values	▪ N ▪ CTS
Channel Status Bit Data (right side)	**Description**
Application	Application format. One of: Consumer or Professional.
Sample words	Sample word encoding. One of: LPCM or Encoded (non linear compressed).
Copyright asserted	Copyright assertion. One of: Yes or No.
Format info	Format. Typically Default.
Mode	Channel mode. Typically 0 for Mode 0.
Category code	Category code. Typically 00 for general.
Source number	Source number. Typically 0 for Unspecified.
Channel number	Channel number. Typically 0 for Unspecified
Sampling freq	Sampling rate. One of: ▪ 32kHz ▪ 44.1kHz ▪ 48kHz ▪ 88.2kHz ▪ 96kHz ▪ 176.4kHz ▪ 192kHz
Word length	Audio word length. One of: ▪ 16 bit ▪ 20 bit ▪ 24 bit

6.4.3 Procedures for Monitoring LPCM Audio from a Source Device (780AH only)

You can monitor the incoming stereo LPCM audio on the HDMI IN port at the headphone jack on the front edge of the 780AH. You can also monitor a single channel of LPCM audio through the embedded speaker. You can select what channels of a multi-channel LPCM to monitor on the stereo headphone jack or which single channel on the speaker using the screens provided. Use the following procedures to configure the audio monitoring of the incoming LPCM audio through the headphone jack and embedded speaker.

1. Connect the HDMI system devices to the 780AH as shown in the diagram above. The HDMI source device output is connected the 780AH **HDMI IN** connector.

2. Touch select **Test Source (DVD/STB)** from the top level menu shown below.

The following screen appears:
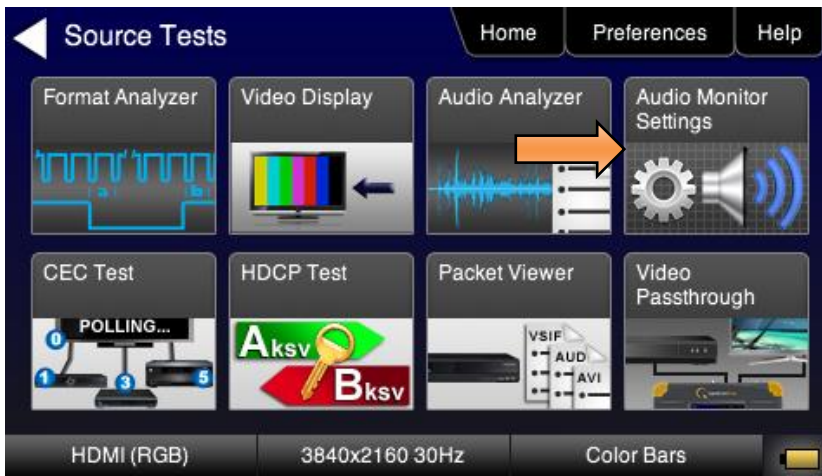
3.   Touch select **Audio Monitor Settings** from the **Source Tests** menu shown above.

The following screen appears.

4. Select the pair of channels to monitor through the headphone jack using the **Headphone Channels** set of selection buttons.

5. Specify the Headphone amplitude in increments of +/-3dB or =/-1dB using the buttons under **Headphone Level.** Select **Mute** to extinguish the audio.

6. Select the single channel to monitor through the embedded speaker using the **Speaker Channel** set of selection buttons.

7. Specify the speaker amplitude in increments of +/-3dB or =/-1dB using the buttons under **Speaker Level**. Select **Mute** to extinguish the audio.

6.5   Testing an HDMI Source's Response to an EDID

The 780/780AH HDMI IN port emulates an HDMI sink device. Part of that emulation function is presenting an EDID to a source when a sink device is powered and hot plug is asserted. The 780/780AH is provisioned with a default EDID from the factory. There are two standard EDIDs available with the 780/780AH as provided: 1) Standard HDTV EDID, 2) Standard A/V Receiver EDID.

However you can reprovision the EDID by connecting it to a sink device whose EDID you would like to use for testing. The 780/780AH can store multiple EDIDs. These EDIDs can be obtained either by extracting them from an HDMI sink device (e.g. HDTV or AVR) or by importing EDID .xml files created using Quantum Data EDID Editor tools. For procedures on importing EDIDs refer to Adding Reference EDIDs for Use in Testing HDMI Devices.

The EDID test of an HDMI source device enables you to see how a source device responds to a specific EDID or a series of EDIDs. The EDID could be a known good EDID or an EDID you have chosen specifically for testing purposes.

6.5.1   Configurations for Testing an HDMI Source Devices Response to an EDID

You can run this test in two configurations: 1) with your source device connected directly to the 780/780AH, 2) with your source device connected to the 780/780AH through a repeater device. In both cases the 780/780AH is emulating an HDMI sink to test an upstream source. These configurations are shown below.
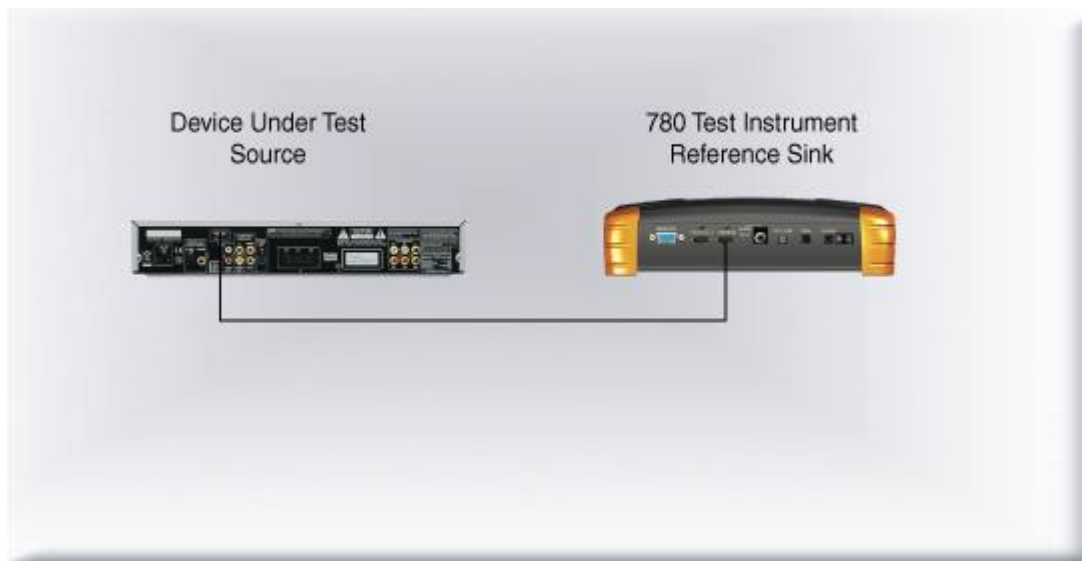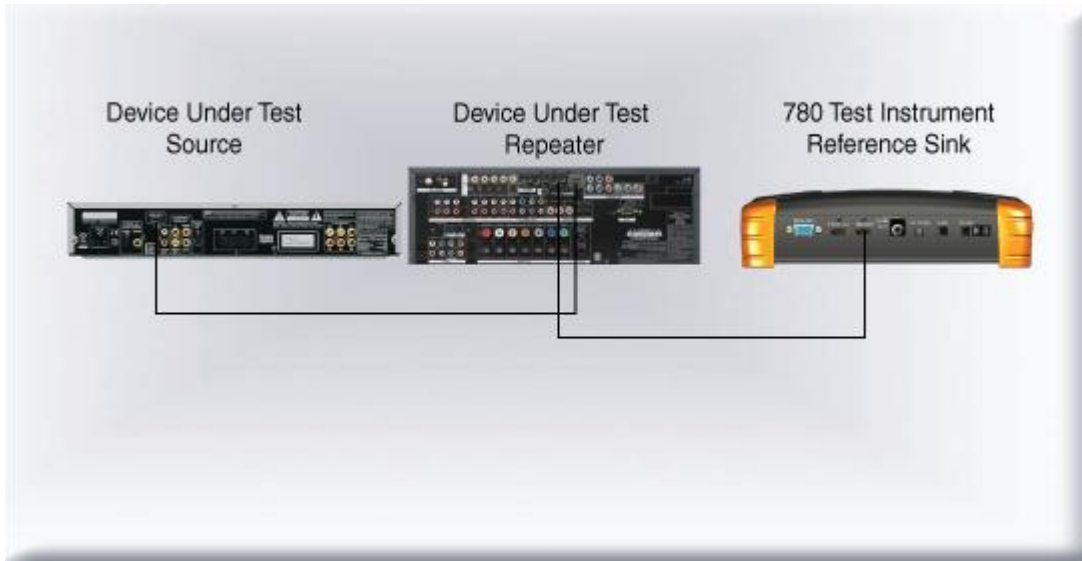
6.5.2   Procedures for Testing an HDMI Source Devices Response to an EDID

Use the following procedures to test the EDID response from an HDMI source device.

1.   Touch select **Test Sink (Display/TV)** to access the EDID test from the top level menu (shown below).

2.   Touch select **EDID Test** from the **Sink Tests** menu shown below.

The following menu appears.

3.   Touch select **Load** from the **EDID Tests** menu. The following screen results.
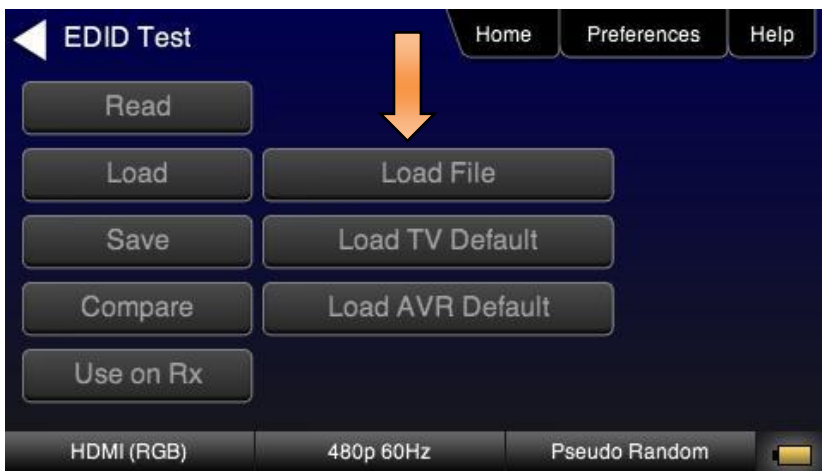
The options:

▪   Load File – Loads from an EDID file stored on the 780/780AH file system
▪   Load TV Default – Loads the standard reference EDID for a TV from the 780/780AH file system

▪ Load AVR Default - Loads the standard reference EDID for a AVR from the 780/780AH file system

4. If you have selected the **Load File** option, the following screen results. Select the file that you wish to use as the reference EDID. In the example below there is only one file.
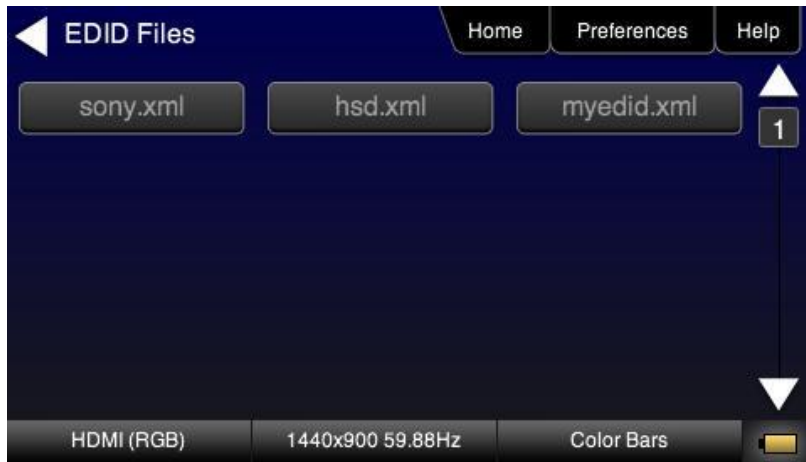
The EDID is loaded and displayed on the screen.

5. If you wish to obtain an EDID from an HDMI sink device that you have on hand, connect the 780/780AH **HDMI OUT** port to the HDMI input of that sink device. This configuration is depicted below.

Skip to Step 8 if you do not want to use an EDID from an HDMI sink device you have on hand.
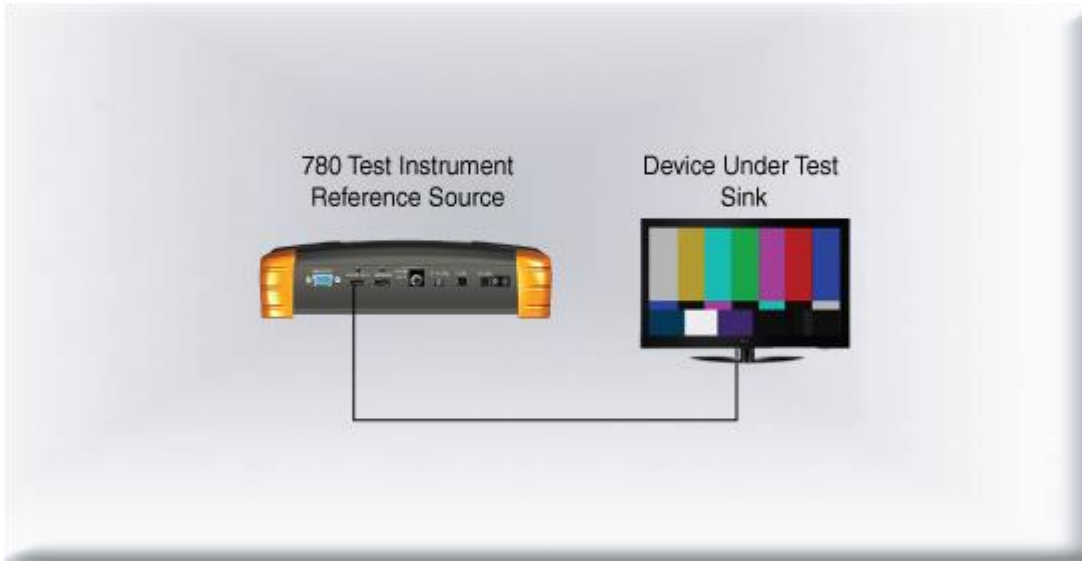
6. Navigate to the **EDID Test** from the **Sink Tests** menu shown below.

7. Touch select the **Read** activation button from the **EDID Test** menu shown above.

    The EDID is listed as shown below.

8. Touch select the **Use on Rx** activation button to apply the EDID, you have either loaded from a file or read from an HDMI sink device, to the 780/780AH HDMI IN port.

9. Connect the 780/780AH **HDMI IN** port to the HDMI output of a source device you wish to test as shown in the illustration below.

   This will cause a hot plug event and the source device under test should read the EDID of the 780/780AH **HDMI IN** port. Run the Format Analyzer test and other diagnostic tests on the source to determine how it responded to the EDID.
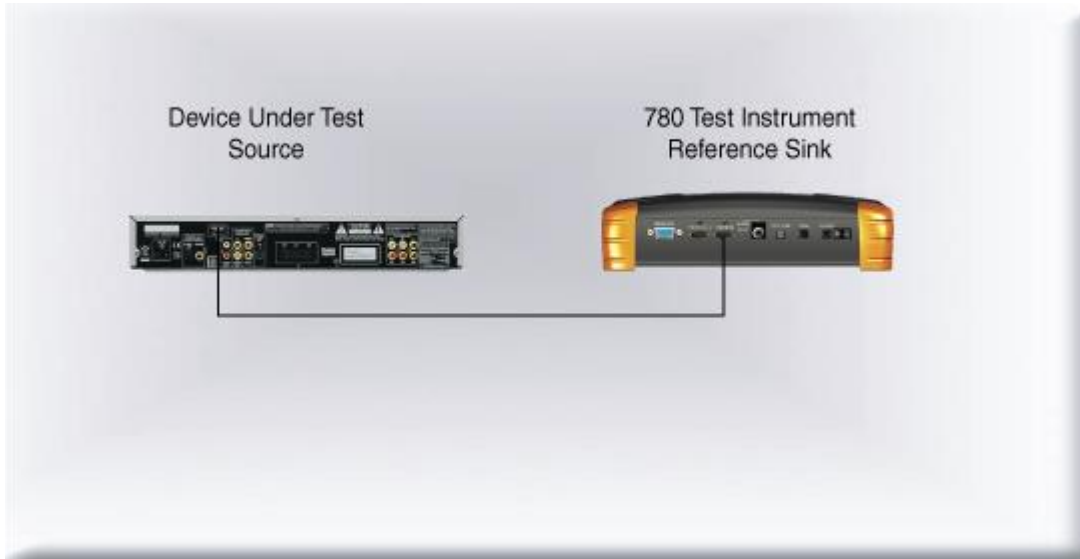
7   Using the 780/780AH Test Instrument Installer Test Utility

This section provides procedures for diagnosing HDMI networks using the automated Installer Test. ***The features and functions described in this section are included as a standard feature.*** The Installer Test enables you to quickly and simply identify common interoperability problems. The Installer Test enables you to conduct step by step diagnostics toward the source—upstream (**Source Test)**, toward the sink—downstream (**Sink Test)**, or in a looped configuration around a repeater device (**Repeater Test**). You can also conduct both and upstream and a downstream diagnostic test at the same time using the **Link Test.**

Table 7-1 below describes what items are tested with each test in the Installer Test.

Table 7-1: Installer Test	
Sink Test	**Description**
	- Verifies hot plug detect is high - Verifies EDID (bad header, bad checksum, pass/fail on compliance) - Runs an HDCP test - Runs a video test at EDID preferred timing, with HDCP enabled - Test EDID video at 1080p(24/50/60), 1080i(25/30), 720p(50/60) - YCbCr 4:2:2 and 4:4:4 video tests - Tests deep color parameters - Test port switch on HDTV with HDCP re-authentication
Source Test	**Description**
	- Tests the maximum number of HDCP keys supported by the source device during HDCP authentication. - Verifies the incoming video at various timings - Verifies video timing parameters.

Repeater Test	Description
	▪ Verifies hot plug detect is asserted.
	▪ Verifies EDID (bad header, bad checksum, pass/fail on compliance)
	▪ Indicates if the EDID was modified.
	▪ Verifies timing pass-through.
	▪ Checks if video was passed through unchanged or not.
	▪ If timing is passed through, test will also verify if the video is passed through without color manipulation.
	▪ Verifies HDCP authentication and if repeater acts as an HDCP repeater or not and verifies that it acts properly as an HDCP repeater.
	▪ Test port switch on HDTV with HDCP re-authentication

Link Test	Description
	▪ Tests the maximum number of HDCP keys (max dev count) supported by the source device during HDCP authentication.
	▪ Verifies hot plug detect is asserted.
	▪ Verifies EDID (bad header, bad checksum, pass/fail on compliance).
	▪ Runs an HDCP authentication test on both source and sink.
	▪ Runs a video test at EDID preferred timing, with HDCP enabled.
	▪ Test port switch on HDTV with HDCP re-authentication
	▪ Verifies the incoming video at various timings
	▪ Verifies video timing parameters.

7.1   Diagnosing HDMI Interoperability Problems toward the Source - Upstream

This subsection describes how to diagnose HDMI interoperability problems on HDMI source devices—upstream (Source Test).

7.1.1   Connection Configurations for Testing HDMI Source Devices

The 780/780AH's HDMI input port acts as a "reference" HDMI sink device. Therefore it enables you to emulate a known good HDMI sink device to conduct diagnostics upstream toward the source device. The following illustrations show the typical configurations.
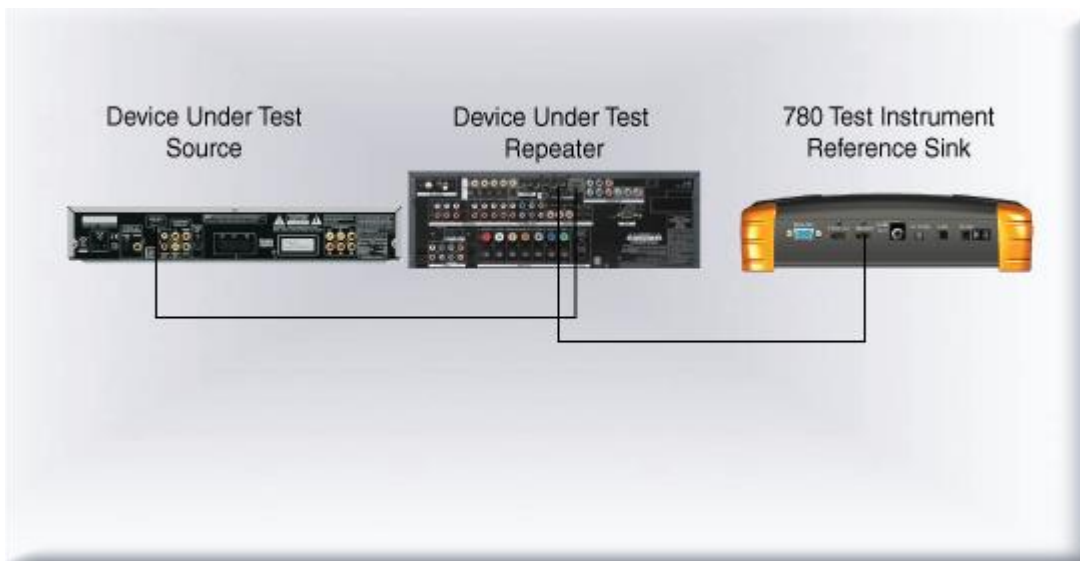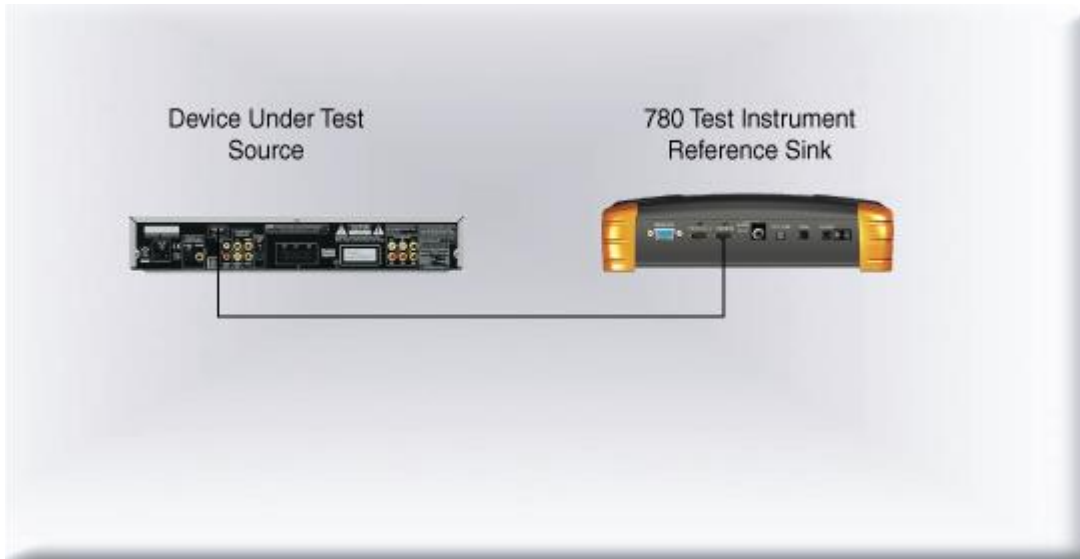
7.1.2   Procedures for Testing Upstream (Source Test) with the Installer Utility

Use the following procedures to test the video from an HDMI source device. You can view the incoming video and check the video and timing parameters of the incoming video.

1.   Make the physical connection between the 780/780AH HDMI IN port and the source device under test using the configuration instructions above or by following the instructions on the screen.

2.   Touch select **Installer Test** from the top level menu shown below.

3. Touch select **Source Test** from the **Test Selection** menu shown below.
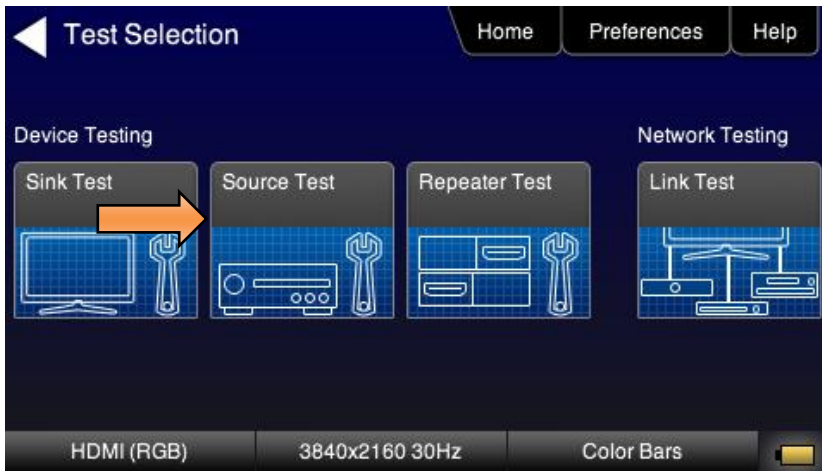
4. Touch select the **OK** activation button to initiate the test.

The test will run for up to about a minute. A status screen is provided as shown below.
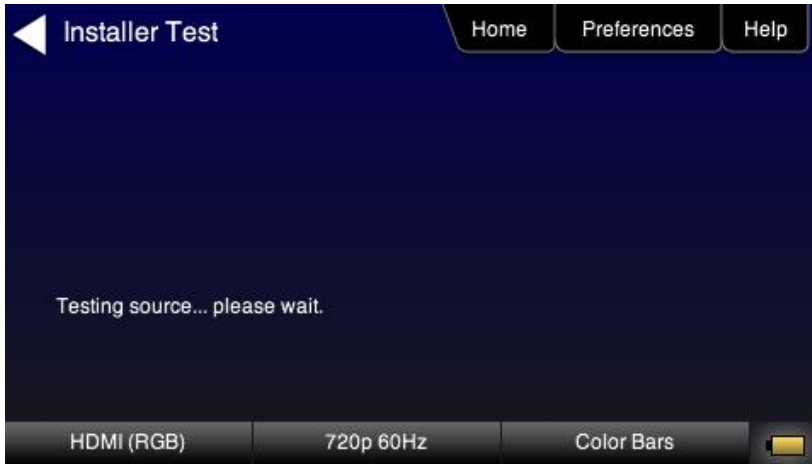
You will be asked to verify the video and video parameters presented on the 780/780AH display. Touch select the appropriate activation button **Yes** or **No**.
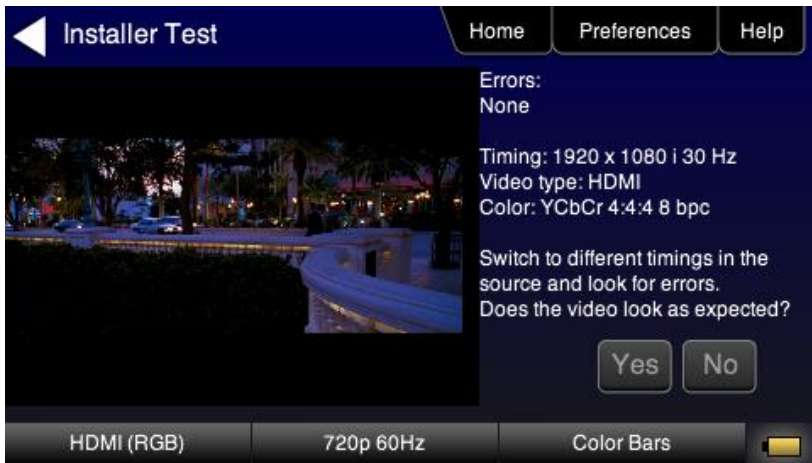
A sample of a results screen is shown below.

Note: The test results show the field rate not the frame rate for interlaced formats.
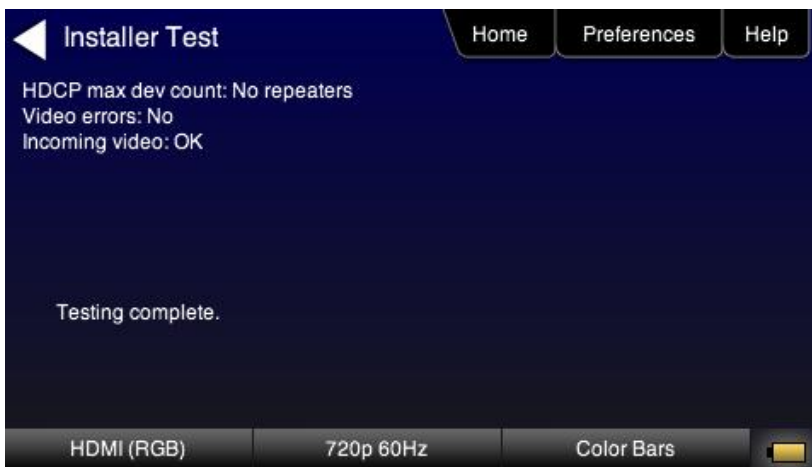
7.2   Diagnosing HDMI Interoperability Problems at the Sink - Downstream

This subsection describes how to diagnose HDMI interoperability problems on HDMI source devices—downstream (**Sink Test**).

7.2.1   Connection Configurations for Testing HDMI Sink Devices

The 780/780AH's HDMI input port acts as a "reference" HDMI source device. Therefore it enables you to emulate a known good HDMI source device to conduct diagnostics downstream toward the sink device. The following illustrations show the typical configurations.
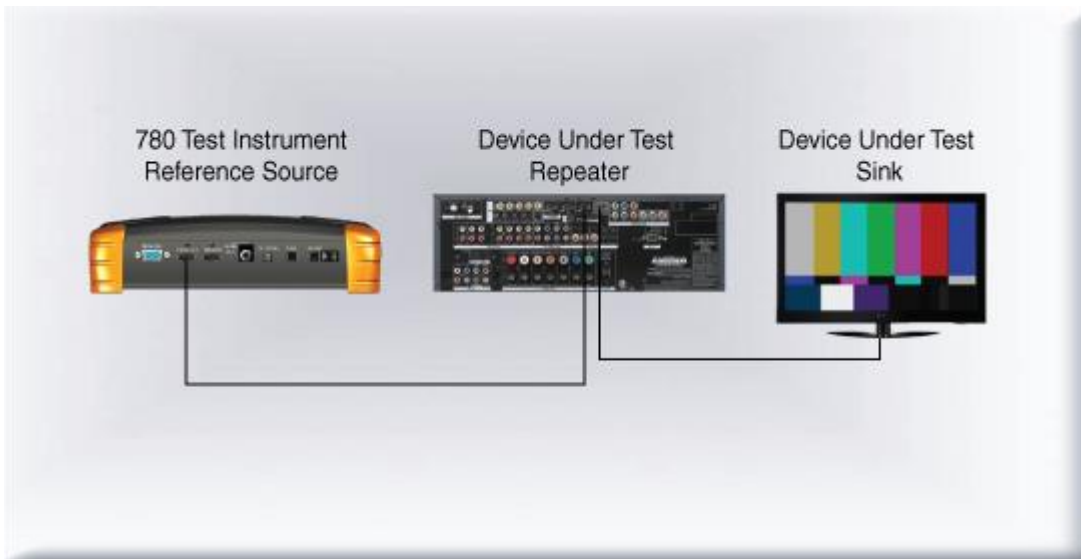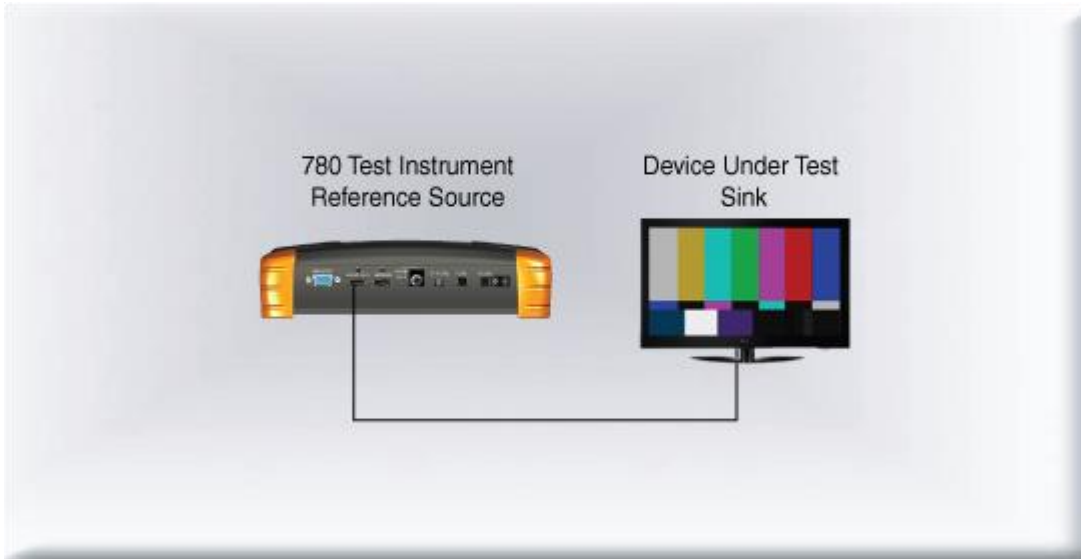
7.2.2   Procedures for Testing Downstream (Sink Test) with the Installer Utility

Use the following procedures to test the video from an HDMI sink device.

1. Make the physical connection between the 780/780AH HDMI OUT port and the sink device under test using the configuration instructions above or by following the instructions on the screen.

2. Touch select **Installer Test** from the top level menu shown below.

3. Touch select **Sink Test** from the **Test Selection** menu shown below.
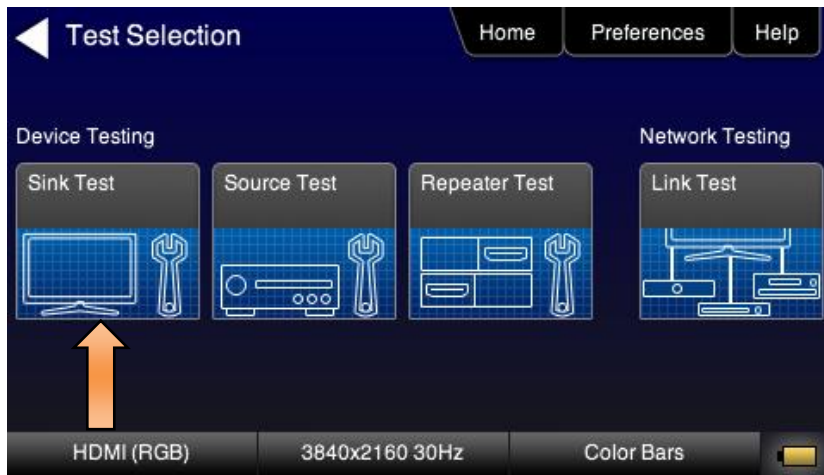
4. Touch select the **OK** activation button to initiate the test.
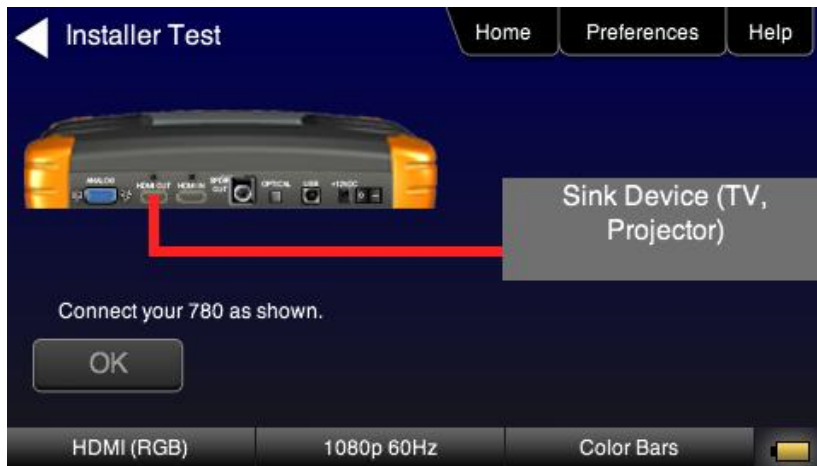
The test will run for up to about a minute. You will be asked to verify the video and video parameters presented on the display device under test. Touch select the appropriate activation button **Yes** or **No**.
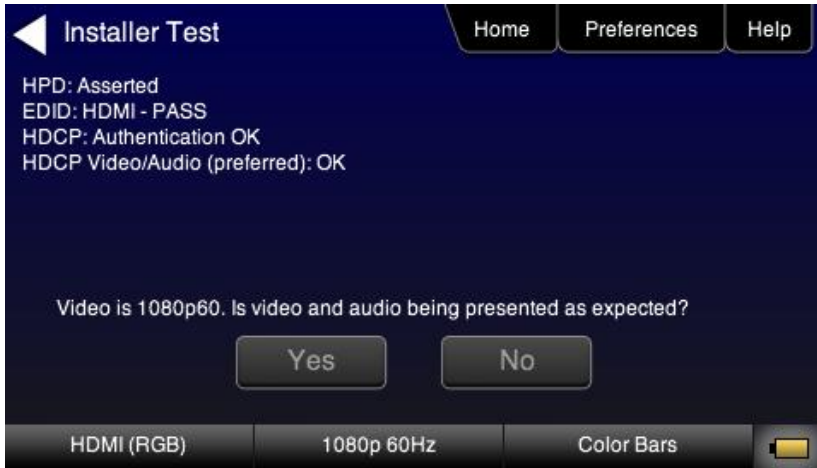
The results are presented for each timing (video resolution) tested. The following two screens are samples of these results screens.
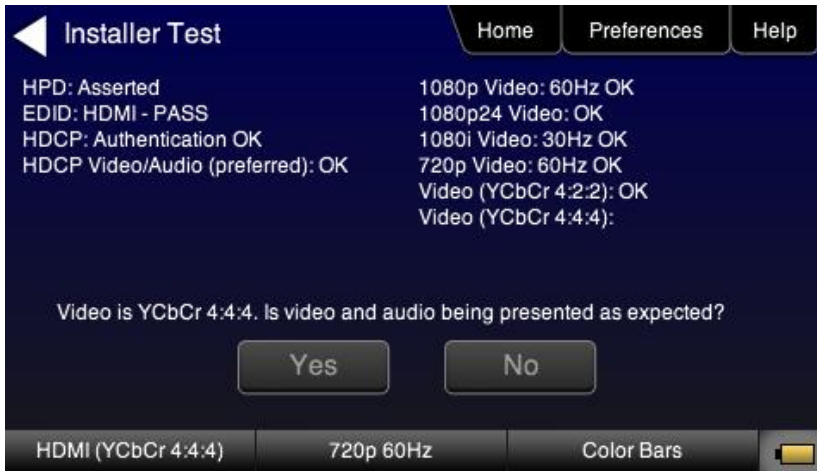
7.3   Diagnosing HDMI Interoperability Problems with a Repeater

This subsection describes how to diagnose HDMI interoperability problems related to an HDMI repeater device (**Repeater Test**).

7.3.1   Connection Configurations for Testing HDMI Repeater Devices

The 780/780AH's HDMI input port acts as a "reference" HDMI source and sink device simultaneously. Therefore it enables you to emulate both a known good HDMI source and sink device to conduct diagnostics on a repeater device. The following illustration shows the typical configuration.
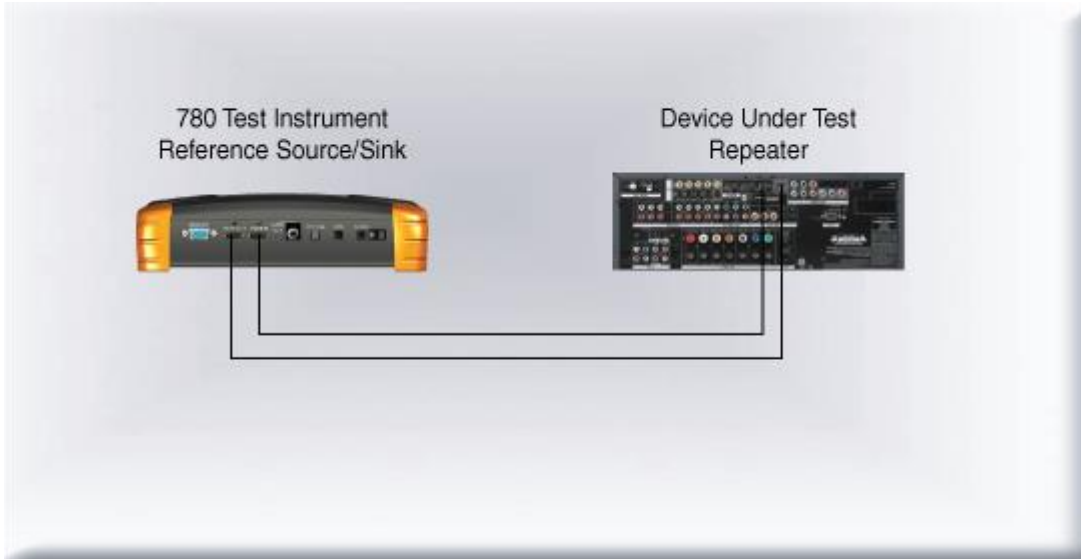
7.3.2   Procedures for Testing Repeaters (Repeater Test) with the Installer Utility

Use the following procedures to test the video from an HDMI repeater device with the Installer Utility.

1. Make the physical connections between the 780/780AH HDMI IN and OUT ports and the sink device under test using the configuration instructions above or by following the instructions on the screen.

2. Touch select **Installer Test** from the top level menu shown below.

3. Touch select **Repeater Test** from the **Test Selection** menu shown below.
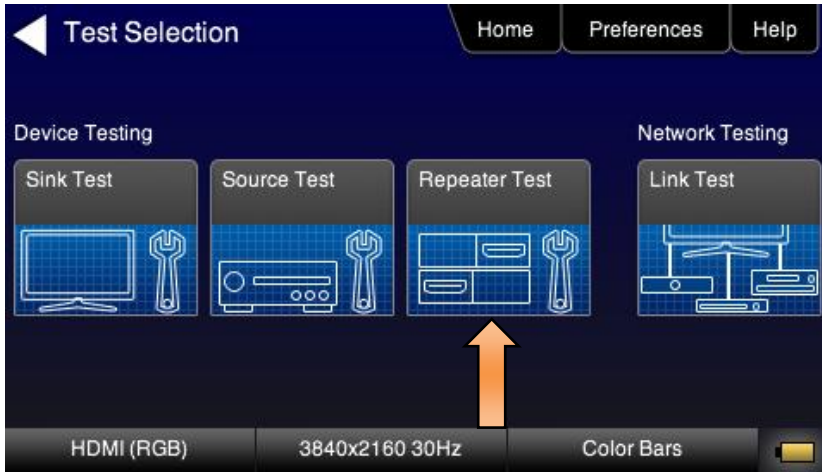
The Repeater Test screen will appear as shown below.
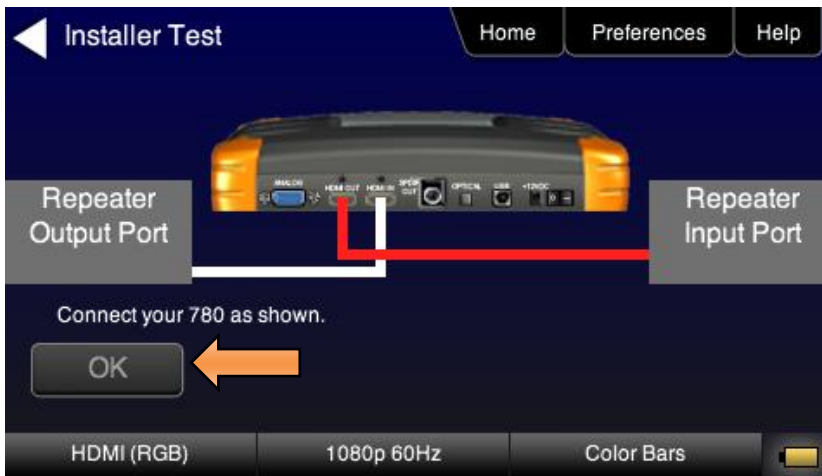
4. Touch select the **OK** activation button to initiate the test.

The test will run for up to about a minute. A status screen is provided as shown below.

You will be instructed to switch to different timings and verify that the video displayed on the 780/780AH screen looks correct. Touch select the appropriate the activation button **YES or NO**.
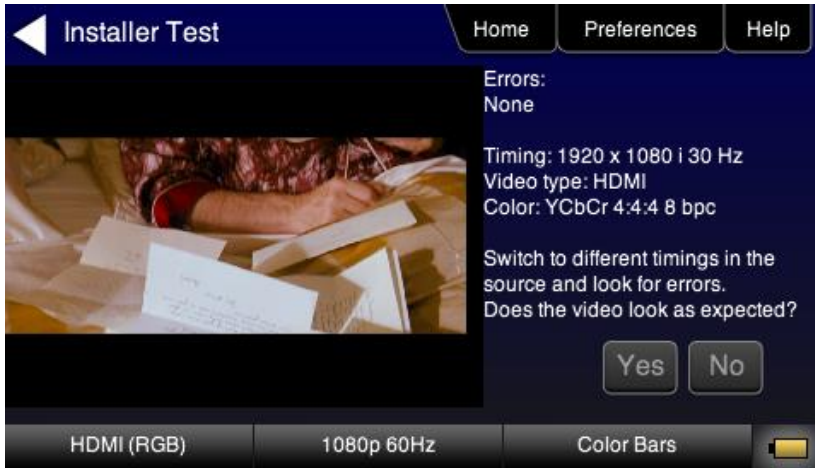
The results are presented for each timing (video resolution) tested. The following screen is a sample of these results.
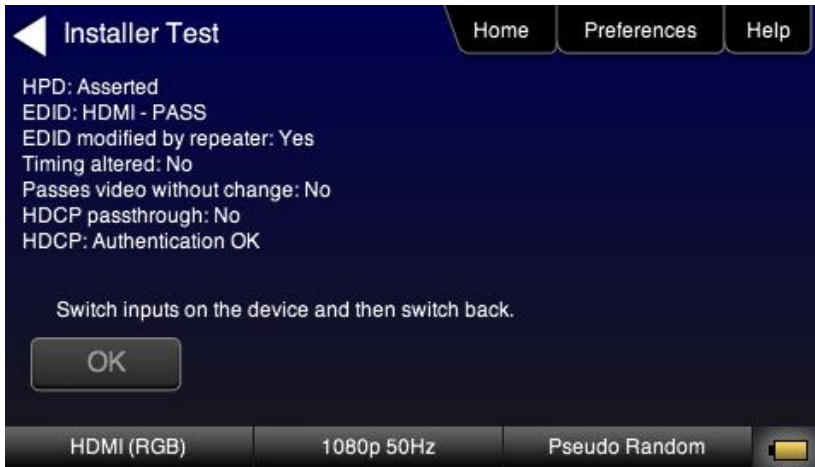
7.4   Diagnosing HDMI Interoperability Problems in an HDMI Network

This subsection describes how to diagnose HDMI interoperability problems in an HDMI network (**Link Test**).

7.4.1   Connection Configurations for Testing HDMI Links

The 780/780AH's HDMI input port acts as a "reference" HDMI source and sink device simultaneously. Therefore it enables you to emulate both a known good HDMI source and sink device to conduct diagnostics on a source devices upstream and sink devices downstream simultaneously. The following illustration shows the typical configuration.
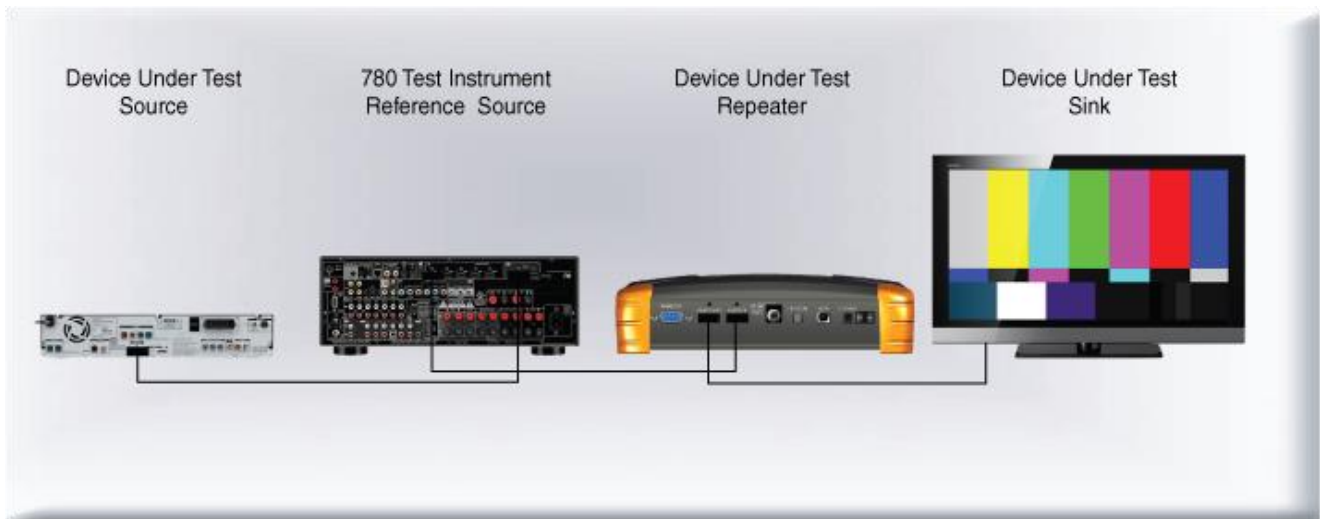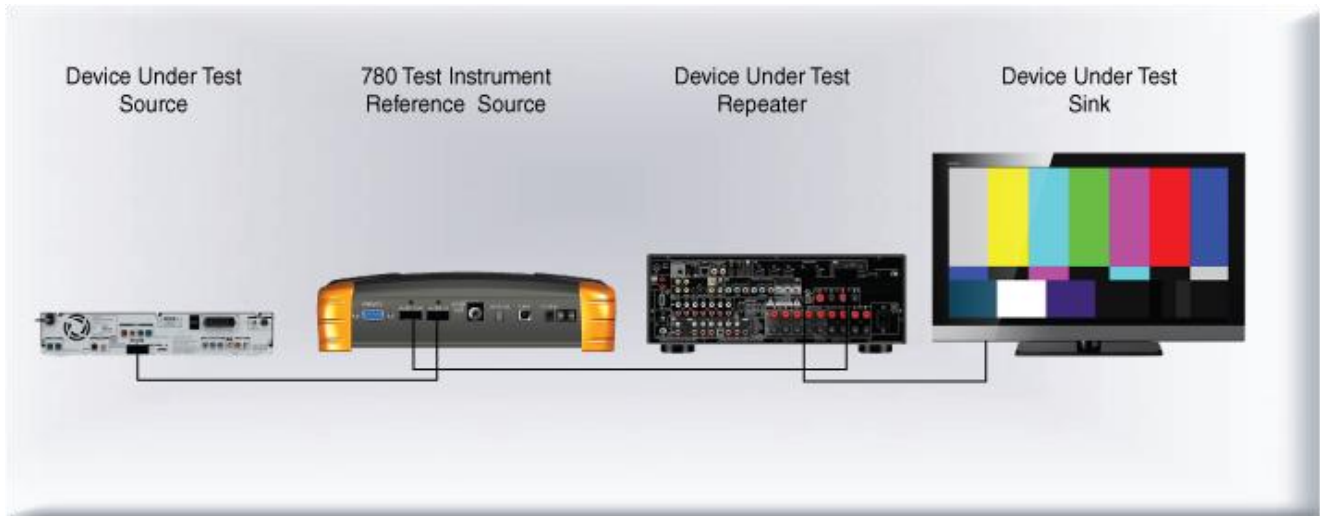
7.4.2   Procedures for Testing HDMI Networks (Links) with the Installer Utility

Use the following procedures to test the video on an HDMI link with the Installer Utility.

1. Make the physical connection between the 780/780AH HDMI IN and OUT ports and the HDMI source and sink devices under test using the configuration instructions above or by following the instructions on the screen.

2. Touch select **Installer Test** from the top level menu shown below.

3. Touch select **Link Test** from the **Test Selection** menu shown below.
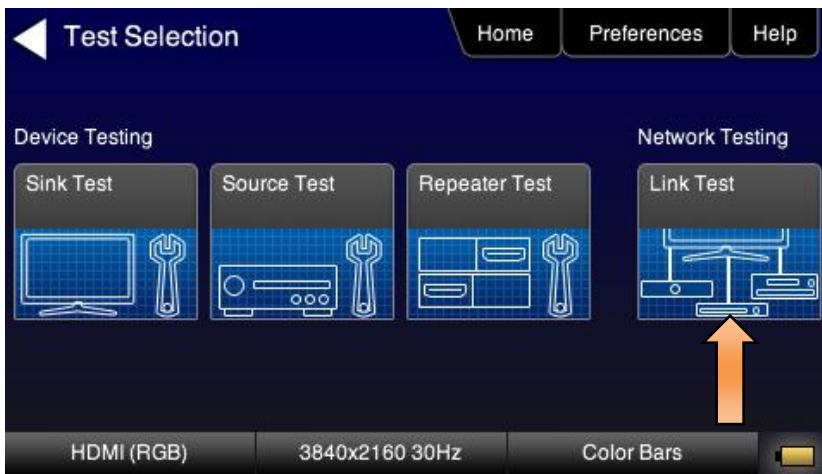
A diagram will appear on the 780/780AH display depicting the proper setup for the Link Test.

4. Touch select the **OK** activation button to initiate the test.
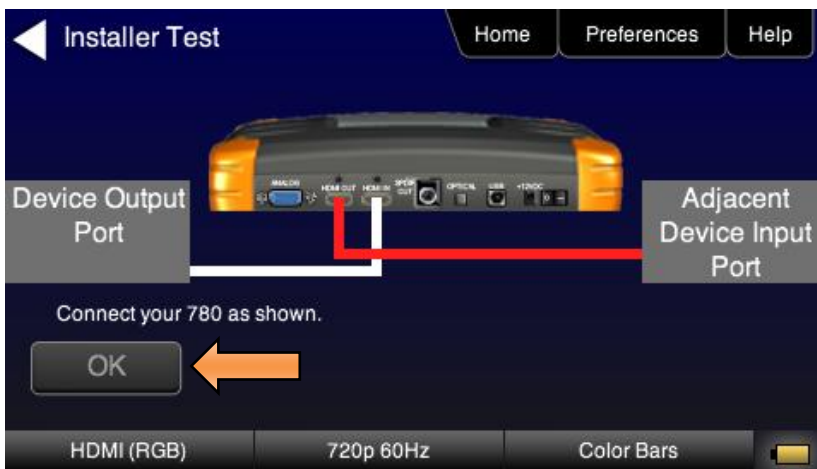
The test will run for up to about a minute. A status screen is provided as shown below.
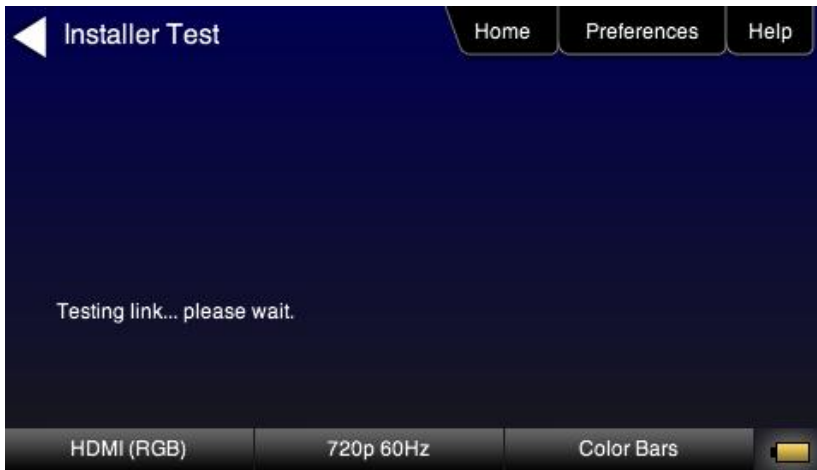
You will be instructed to switch interfaces on the HDTV during the test. Touch select the appropriate the **OK** activation button.
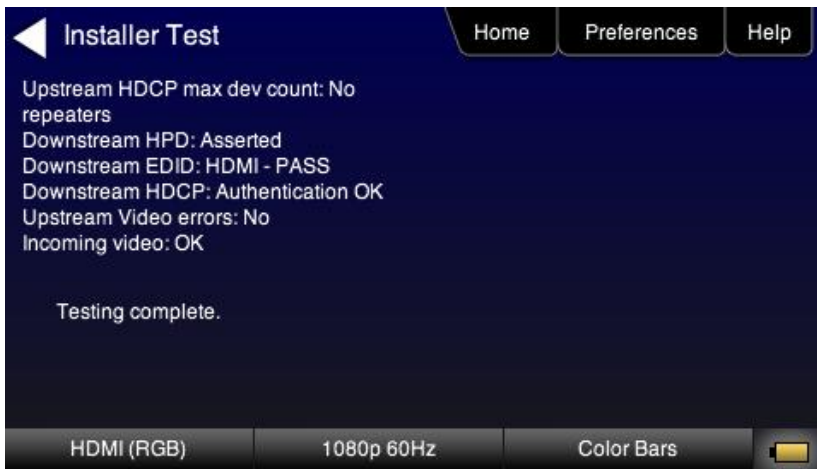
8   Using the 780/780AH Test Instrument to Monitor the HDMI CEC and DDC channel

This section provides procedures for using the optional Auxiliary Channel Analyzer (ACA) feature options. There are two options available:

- DDC and CEC monitoring with Auxiliary Channel Analyzer (ACA) – The 780/780AH ACA enables you to monitor CEC and DDC transactions such as HDCP and EDID as well as hot plug related events while emulating an HDMI source and/or an HDMI sink device(s) in an HDMI system.
- DDC and CEC passive monitoring with Auxiliary Channel Analyzer (ACA) – The 780/780AH ACA enables you to monitor CEC and DDC transactions throughout an HDMI systems comprised of a source, repeater and sink. You can monitor +5V, hot plug events as well as the HDCP and EDID transactions.

 These ACA features require a license key and can be enabled remotely. ***The features and functions described in this section are included only if you have purchased either one of the Auxiliary Channel Analyzer options.***

8.1   Auxiliary Channel Analyzer – Emulation Monitoring

The Aux Channel Analyzer test monitors the DDC channel transactions and hot plug events while emulating HDMI devices. ***The features and functions described in this section are included only if you have purchased the Auxiliary Channel Analyzer – Emulation option.***

You can view the details of each transaction and save the traces for viewing on the external ACA application available from the Quantum Data website.

8.1.1   Configurations for Monitoring CEC and/or DDC Transactions with ACA on HDMI Sink Devices

This subsection provides configuration diagrams that depict ACA monitoring of HDMI sink devices, with or without a repeater while the 780/780AH is emulating an HDMI source device.
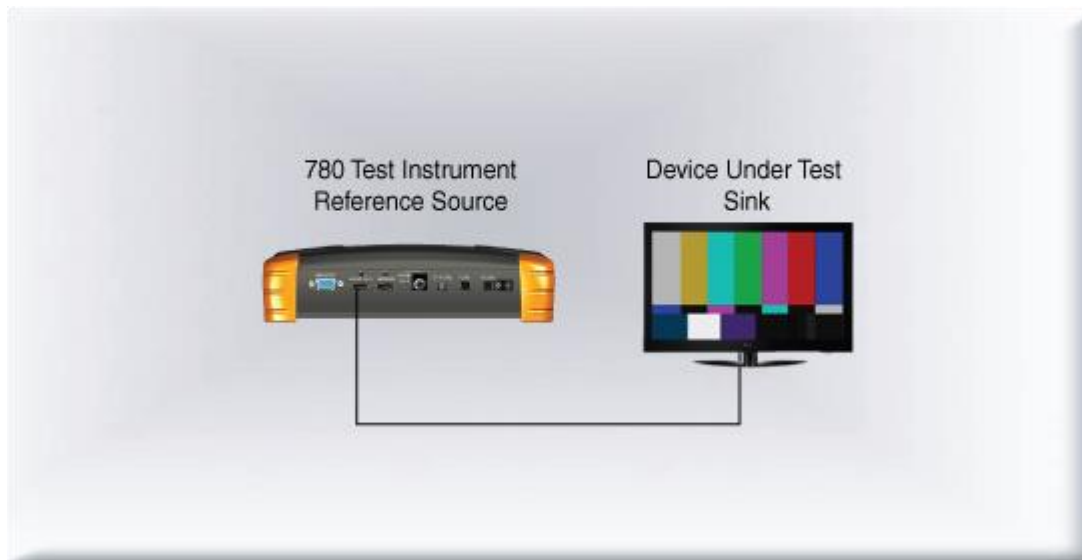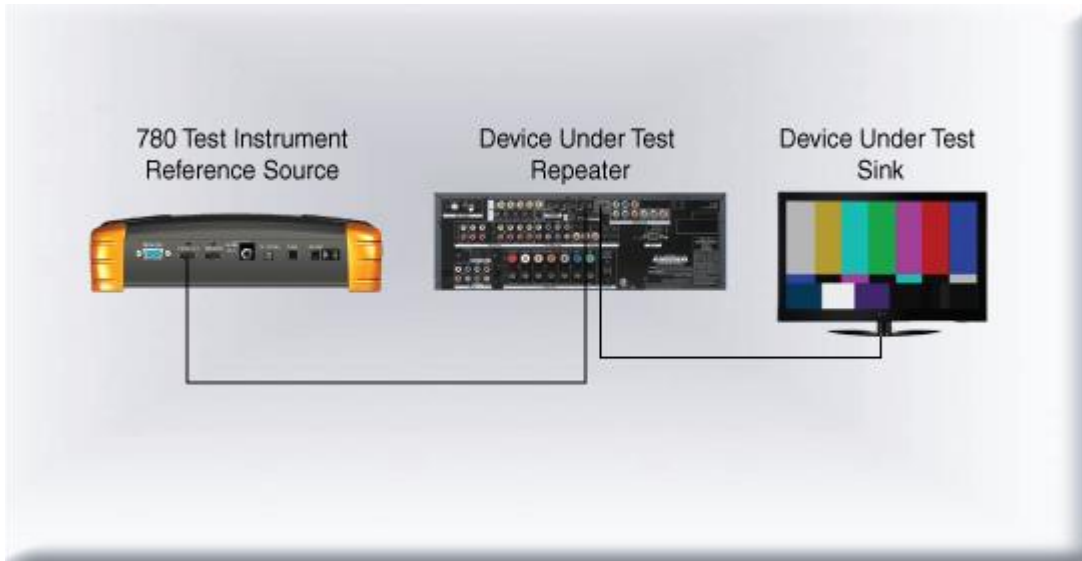
8.1.2   Procedures for monitoring the DDC with the Auxiliary Channel Analyzer on HDMI Sink Devices

This subsection provides procedures for ACA monitoring of HDMI sink devices, with or without a repeater while the 780/780AH is emulating an HDMI source device.

Table 8-1 below describes each field in the Auxiliary Channel Analyzer on-screen transactions.

Table 8-1: Auxiliary Channel Analyzer record description		
Data type	Description	Color coding
Hot Plug indication	An indication from the HDMI sink to the HDMI source that there is a device connected. The Hot Plug voltage is a steady. In the case of a repeater, it is a 100ms pulse.	Blue
+5V	A voltage from an HDMI source to the HDMI sink to power the hot plug voltage. The +5V is a steady voltage nominally 5 volts.	Cyan
EDID Exchange	A data set in the HDMI sink that describes its capabilities to a connected source device. This data is transmitted over the DDC channel.	Yellow
HDCP Transactions	Content protection authentication and encryption transactions. The source initiates HDCP for protected content. Various values and registers are exchanged over the DDC.	Green
CEC messages	CEC messages are transmitted over a one wire CEC bus. These messages are monitored through the ACA	Magenta
Errors	The DDC channel uses the I2C protocol. Errors in the I2C protocol are shown in the ACA transactions.	Red

Note: You will have to obtain a license key for the ACA option to use the feature.

1. Connect the HDMI system devices to the 780/780AH in either of the ways shown in the diagrams above and described as follows:

   a. The HDMI sink device input is connected the 780/780AH HDMI OUT connector.

OR

   a.   The HDMI repeater device input is connected to the 780/780AH HDMI OUT connector.

   b.   The HDMI sink device input is connected to the HDMI repeater device output.

2.   From the main screen (shown below) touch select the **Aux Channel Analyzer** activation button.

The **ACA Setup Options** screen appears:

5.   Select the data types that you wish to monitor. In this application you would select data types from the **Tx Port side**.

6.   Determine what data types you wish to monitor. Typically you will want to monitor the DDC and hot plug (+5V only available with passive monitoring option).

Note: By default the two activation buttons labeled **780/780AH Tx Port** and **780/780AH Rx port** are enabled. You cannot disable them. Transactions will be shown based on which ports (HDMI OUT and/or HDMI IN) are connected to HDMI devices and which set of transactions you have enabled (i.e. DDC, HPD on Tx or Rx side).

7. Enable HDCP on the 780/780AH **HDMI OUT** port. Use the procedures in the section entitled: Testing HDCP on an HDMI HDTV or HDMI Repeater Device.

8. Take whatever action necessary to initiate a new HDCP authentication. Typically this would be a hot plug event at the sink device you are testing. Alternatively you can simply disable and re-enable HDCP on the 780/780AH.

9. Touch select the **Capture Data Table** activation button to initiate the capturing of the data. A screen similar to the one shown below will appear.

10. Touch select the **Details** activation button (top center) to view the details of any specific transaction that you have selected. The following screen is an example of the details screen for the BCAPS register.

11. Touch select **Stop** activation button (top left) to halt the collection of messages.

12. Touch select **Clear** activation button (top center) to clear the collected of messages.

8.1.3   Configurations for Monitoring DDC Transactions with ACA on HDMI Source Devices

This subsection provides configuration diagrams that depict ACA monitoring of HDMI source devices, with or without a repeater, while the 780/780AH is emulating an HDMI sink device.

Device Under Test Source   Device Under Test Repeater   780 Test Instrument Reference Sink
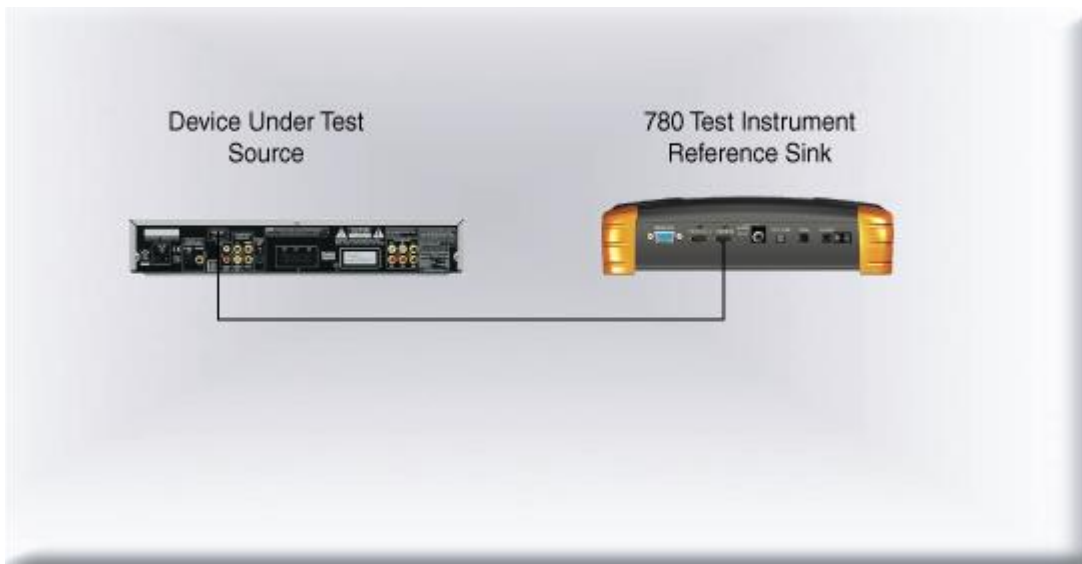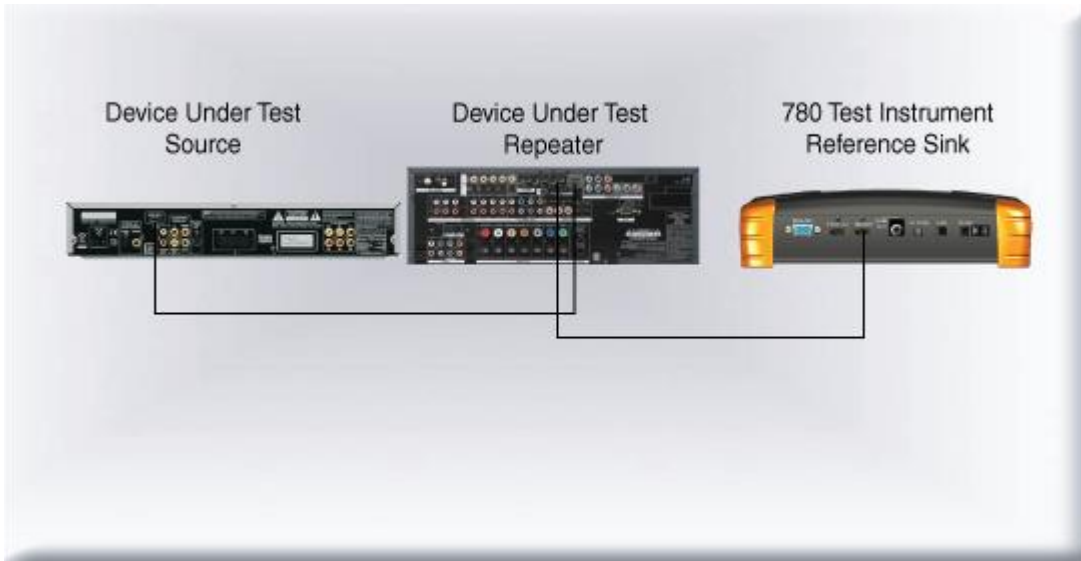
8.1.4   Procedures for Monitoring the DDC Transactions using the Auxiliary Channel Analyzer on HDMI Source Devices

This subsection provides procedures for ACA monitoring of HDMI source devices, with or without a repeater while the 780/780AH is emulating an HDMI sink device.

Note: You will have to obtain a license key for the ACA option to use the feature.

1. Connect the HDMI system devices to the 780/780AH in either of the ways shown in the diagrams above and described as follows:

    a.   The HDMI source device output is connected the 780/780AH HDMI IN connector.

    OR

    b.   The HDMI repeater device output is connected to the 780/780AH HDMI IN connector.

    c.   The HDMI source device output is connected to the HDMI repeater device input.

    From the main screen (shown below) touch select the **Aux Channel Analyzer** activation button.

    The **ACA Setup Options** screen appears:

2. Select the data types that you wish to monitor on the **Rx Port** side.

3. Determine what data types you wish to monitor. Typically you will want to monitor the DDC, hot plug (shown in the example above).

    Note: By default the two activation buttons labeled **780/780AH Tx Port** and **780/780AH Rx port** are enabled. You cannot disable them. Transactions will be shown based on which ports (HDMI OUT and/or HDMI IN) are connected to HDMI devices and which set of transactions you have enabled (i.e. DDC, HPD on Tx or Rx side).

4. Take whatever action necessary to initiate a new HDCP authentication. Typically this would be a hot plug event, for example a disconnection and reconnection on the 780/780AH **HDMI IN** port.

5. Touch select the **Capture Data Table** activation button to access the Auxiliary Channel Analyzer screen. Then touch select **Start** to initiate the capturing of the data. A screen similar to the one shown below will appear.

6. Touch select the **Details** activation button (top center) to view the details of any specific transaction that you have selected. The following screen is an example of the details screen. The screen below shows a detailed view of the BCAPS register.

7. Touch select **Stop** activation button (top left) to halt the collection of messages.

8. Touch select **Clear** activation button (top center) to clear the collected of messages.

8.1.5 Procedures for Monitoring the CEC with the Auxiliary Channel Analyzer on HDMI Sink and Source Devices

This subsection provides procedures for monitoring the CEC transactions using the ACA of HDMI sink devices.

Note: You will have to obtain a license key for the ACA option to use the feature.

1. Connect the HDMI system devices to the 780/780AH in either of the ways shown in the diagrams above and described as follows:

    a. The HDMI sink device input is connected the 780/780AH HDMI OUT connector, or

    b. The HDMI source device input is connected to the 780/780AH HDMI IN connector.

    From the main screen (shown below) touch select the **Aux Channel Analyzer** activation button.

The **ACA Setup Options** screen appears:

2. Select the data types that you wish to monitor. In this application you would select CEC from the **Tx Port side** (if testing with a sink DUT) or you would select CEC from the **Rx Port side** (if testing with a source DUT).

3. Determine what data types you wish to monitor. In this case select CEC.

    Note: By default the two activation buttons labeled **780/780AH Tx Port** and **780/780AH Rx port** are enabled.

4. Take whatever action necessary to initiate a new CEC messages.

5. Touch select the **Capture Data Table** activation button to initiate the capturing of the data. A screen similar to the one shown below will appear.
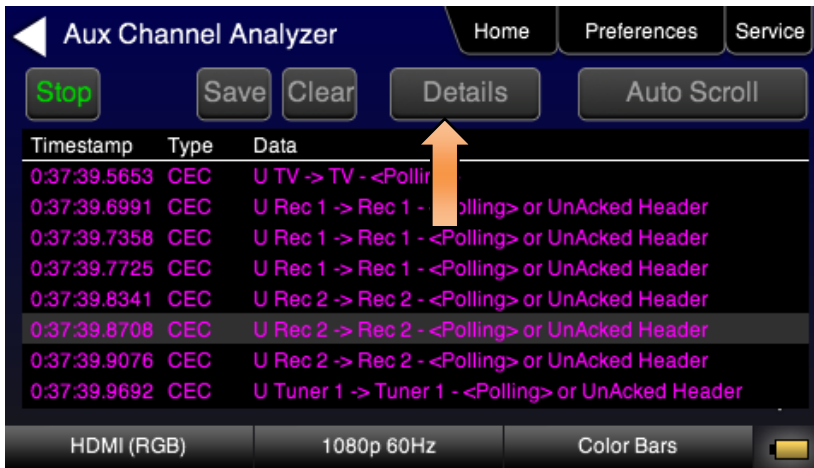
6. Touch select the **Details** activation button (top center) to view the details of any specific transaction that you have selected. The following screen is an example of a polling transaction. The details show the number of bytes transmitted, the device type and the bit timings.

7. Touch select **Stop** activation button (top left) to halt the collection of messages.

8. Touch select **Clear** activation button (top center) to clear the collected of messages.

8.1.6   Configuration for Monitoring DDC Transactions with the ACA on a Repeater

This subsection provide a configuration diagram that depicts ACA monitoring of HDMI repeater devices while emulating both an HDMI source device and an HDMI sink device.
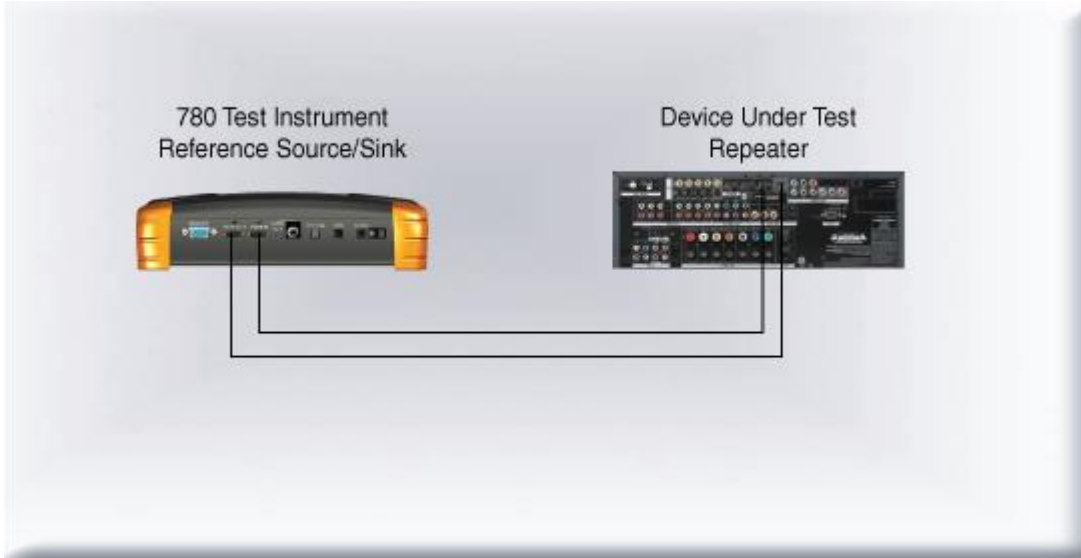
8.1.7   Procedures for Running an Auxiliary Channel Analyzer Test on HDMI Repeater Devices

This subsection provides procedures for ACA monitoring of HDMI repeater devices while the 780/780AH is emulating both an HDMI sink device and an HDMI source device.

1. Connect the HDMI system devices to the 780/780AH as shown in the diagram above and described as follows:

    a. The HDMI repeater device input is connected the 780/780AH **HDMI OUT** connector.

    b. The HDMI repeater device output is connected to the 780/780AH **HDMI IN** connector.

    From the main screen (shown below) touch select the **Aux Channel Analyzer** activation button.

The **ACA Setup Options** screen appears:

2. Determine what data types you wish to monitor. Typically you will want to monitor the DDC and hot plug (+5V is only available for monitoring with the passive monitoring option). Select the data types that you wish to monitor.

    Note: By default the two activation buttons labeled 780/780AH **Tx Port** and 780/780AH **Rx Port** are enabled. You cannot disable them. Transactions will be shown based on which ports (HDMI OUT and/or HDMI IN) are connected to HDMI devices and which transaction types (i.e. DDC and HPD) you have enabled.

3. Enable HDCP on the 780/780AH **HDMI OUT** port. Use the procedures in the section entitled: Configurations for Testing HDCP on an HDMI Sink Device.

4. Take whatever action necessary to initiate a new HDCP authentication. Typically this would be a hot plug event at the sink device you are testing. Alternatively you can simply disable and re-enable HDCP on the 780/780AH.

5. Touch select the **Capture Data Table** activation button to initiate the capturing of the data. A screen similar to the one shown below will appear.

6. Touch select the **Details** activation button (top center) to view the details of any specific transaction that you have touch selected. The following screen is an example of the details screen. A detailed view of the BCAPS register is shown.

7. Touch select **Stop** activation button (top left) to halt the collection of messages.

8. Touch select **Clear** activation button (top center) to clear the collected of messages.

8.2   Auxiliary Channel Analyzer – Passive Monitoring

The Aux Channel Analyzer test monitors the CEC and DDC channel transactions and hot plug events. You can monitor the events while emulating either an HDMI source or sink device or you can passively monitor the transactions. This subsection provides procedures on passive monitoring. ***The features and functions described in this section are included only if you have purchased the Auxiliary Channel Analyzer – Passive Monitoring option which requires a new hardware module with 4 additional HDMI ports.***

You can view the details of each transaction and save the traces for viewing on the external ACA application available from the Quantum Data website.

8.2.1   Configurations for Passively Monitoring CEC and or DDC Transactions with ACA on an HDMI System

This subsection provides configuration diagrams that depict ACA passive monitoring of an HDMI system.
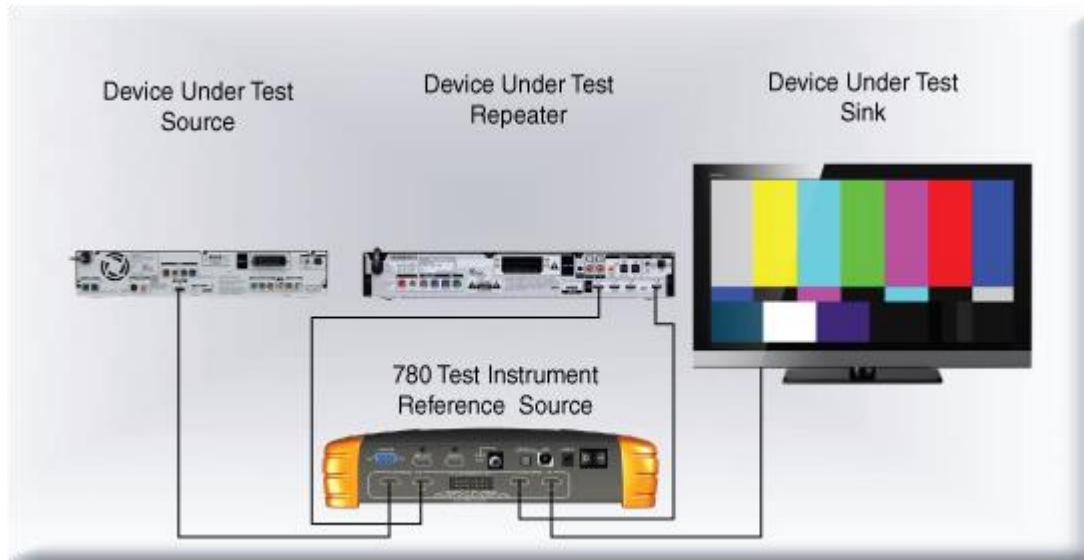
8.2.2   Procedures for Passive Monitoring DDC transactions and hot plug events with the Auxiliary Channel Analyzer on HDMI Devices

This subsection provides procedures for ACA passive monitoring of HDMI devices.

Note: You will have to obtain a license key for the ACA passive monitoring option to use the feature.

1. Connect the HDMI system devices to the 780/780AH as shown in the diagram above and described as follows:

    a. The HDMI source is connected to the 780/780AH **Upstream Link IN** connector.

    b. The HDMI repeater device input is connected the 780/780AH **Upstream Link OUT** connector.

    c. The HDMI repeater device output is connected to the 780/780AH **Downstream Link IN** connector.

    d. The HDMI sink device (e.g. HDTV) is connected to the 780/780AH **Downstream Link OUT** connector.

2. From the main screen (shown below) touch select the **Aux Channel Analyzer** activation button.

The **ACA Setup Options** screen appears:

3. Select the data types that you wish to monitor. In this application you would select **Passive Upstream** and **Passive Downstream**.

4. Determine what data types you wish to monitor. Typically you will want to monitor the DDC and hot plug and +5V.

5. Enable HDCP on the HDMI source device under test. Use the procedures in the section entitled: Testing HDCP on an HDMI HDTV or HDMI Repeater Device.

6. Take whatever action necessary to initiate a new HDCP authentication. Typically this would be a hot plug event at the sink device you are testing.

7. Touch select the **Capture Data Table** activation button to initiate the capturing of the data. A screen similar to the one shown below will appear.

8. Touch select the **Details** activation button (top center) to view the details of any specific transaction that you have selected. The following screen is an example of the details screen. This example shows the BCAPS register details.

9. Touch select **Stop** activation button (top left) to halt the collection of messages.

10. Touch select **Clear** activation button (top center) to clear the collected of messages.

8.2.3   Procedures for Passive Monitoring CEC Messages with the Auxiliary Channel Analyzer on HDMI Devices

This subsection provides procedures for ACA passive monitoring of HDMI devices.

Note: You will have to obtain a license key for the ACA passive monitoring option to use the feature.

1. Connect the HDMI system devices to the 780/780AH as shown in the diagram above and described as follows:

    a.   The HDMI source is connected to the 780/780AH **Upstream Link IN** connector.

    b.   The HDMI repeater device input is connected the 780/780AH **Upstream Link OUT** connector.

    c.   The HDMI repeater device output is connected to the 780/780AH **Downstream Link IN** connector.

    d.   The HDMI sink device (e.g. HDTV) is connected to the 780/780AH **Downstream Link OUT** connector.

2. From the main screen (shown below) touch select the **Aux Channel Analyzer** activation button.

The **ACA Setup Options** screen appears:

3. Select the CEC to monitor. In this application you would select **Passive Upstream**.

4. Enable HDCP on the HDMI source device under test. Use the procedures in the section entitled: Testing HDCP on an HDMI HDTV or HDMI Repeater Device.

5. Take whatever action necessary to initiate CEC messages.

6. Touch select the **Capture Data Table** activation button to initiate the capturing of the data. A screen similar to the one shown below will appear.

7. Touch select the **Details** activation button (top center) to view the details of any specific transaction that you have selected. The following screen is an example of the details screen. These screen examples show polling example.


8. Touch select **Stop** activation button (top left) to halt the collection of messages.

9. Touch select **Clear** activation button (top center) to clear the collected of messages.

8.3 Auxiliary Channel Analyzer – Passive and Emulation Monitoring

The Aux Channel Analyzer test monitors the CEC and DDC channel transactions and hot plug events. You can monitor the events while emulating either an HDMI source or sink device or you can passively monitor the transactions. You can also monitor while emulating an HDMI source or sink device and passively monitoring the other side. For example you can configure the 780/780AH to emulate an HDMI source device and monitor the upstream side and then you can passively monitor on the downstream side (i.e. on the source side of a repeater and the HDMI sink [HDTV]). This subsection describes the procedures for passively monitoring and monitoring while emulating.

The features and functions described in this section are included only if you have purchased the Auxiliary Channel Analyzer – Passive Monitoring option which requires a new hardware module with 4 additional HDMI ports.

You can view the details of each transaction and save the traces for viewing on the external ACA application available from the Quantum Data website.

8.3.1 Configuration for Passive Monitoring the Downstream Devices while Emulating an HDMI Source Device with the Auxiliary Channel Analyzer on HDMI Devices

This subsection provides configuration diagrams that depict ACA passive and emulation monitoring of an HDMI system.
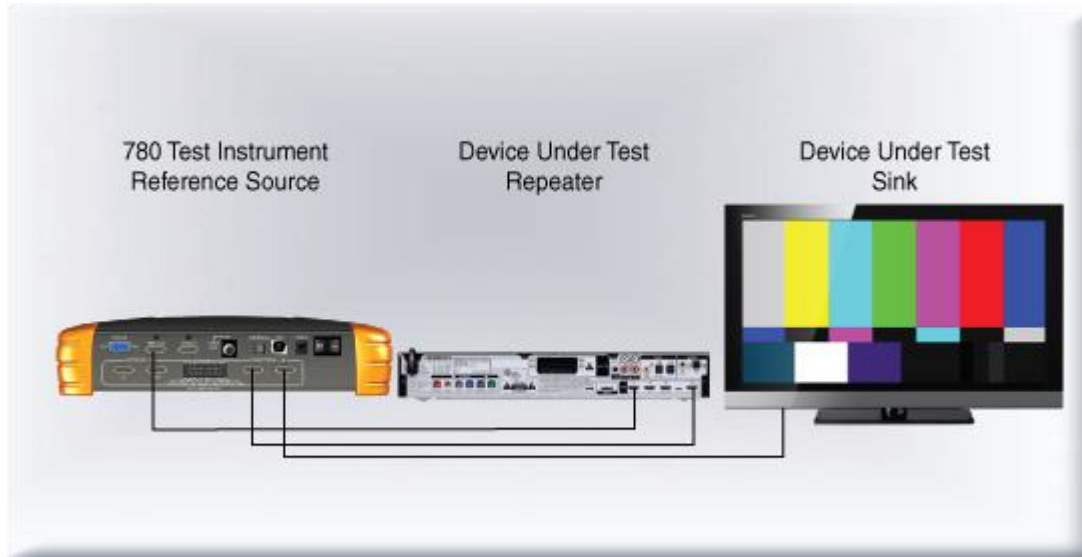
8.3.2 Procedures for Passive Monitoring the Downstream Devices while Emulating an HDMI Source Device with the Auxiliary Channel Analyzer on HDMI Devices

This subsection provides procedures for ACA passive and emulation monitoring of HDMI devices.

Note: You will have to obtain a license key for the ACA passive monitoring option to use the feature.

1. Connect the HDMI system devices to the 780/780AH as shown in the diagram above and described as follows:

    a. The 780/780AH **HDMI OUT** connector is connected to the HDMI repeater device input connector.

    b. The HDMI repeater device output is connected to the 780/780AH **Downstream Link IN** connector.

    c. The HDMI sink device (e.g. HDTV) is connected to the 780/780AH **Downstream Link OUT** connector.

2. From the main screen (shown below) touch select the **Aux Channel Analyzer** activation button.

The **ACA Setup Options** screen appears:

3. Select the data types that you wish to monitor. In this application you would select **780/780AH Tx Port** and **Passive Downstream**.

4. Determine what data types you wish to monitor. Typically you will want to monitor the DDC and hot plug and +5V on the passive downstream side and monitor the DDC and hot plug events on the **HDMI OUT** side.

5. Enable HDCP on the HDMI source device under test. Use the procedures in the section entitled: Testing HDCP on an HDMI HDTV or HDMI Repeater Device.

6. Take whatever action necessary to initiate a new HDCP authentication. Typically this would be a hot plug event at the sink device you are testing.

7. Touch select the **Capture Data Table** activation button to initiate the capturing of the data. A screen similar to the one shown below will appear.

8. Touch select the **Details** activation button (top center) to view the details of any specific transaction that you have selected. The following screen is an example of the details screen. This example shows the BCAPS register details.

9. Touch select Stop activation button (top left) to halt the collection of messages.

10. Touch select Clear activation button (top center) to clear the collected of messages.

8.3.3   Configuration for Passive Monitoring the Upstream Devices while Emulating an HDMI Sink Device with the Auxiliary Channel Analyzer on HDMI Devices

This subsection provides configuration diagrams that depict ACA passive and emulation monitoring of an HDMI system.

8.3.4   Procedures for Passive Monitoring the Upstream Devices while Emulating an HDMI Sink Device with the Auxiliary Channel Analyzer on HDMI Devices

This subsection provides procedures for ACA passive and emulation monitoring of HDMI devices.

Note: You will have to obtain a license key for the ACA passive monitoring option to use the feature.

1. Connect the HDMI system devices to the 780/780AH as shown in the diagram above and described as follows:

    a. The HDMI source is connected to the 780/780AH **Upstream Link IN** connector.

    b. The HDMI repeater device input is connected the 780/780AH **Upstream Link OUT** connector.

| November 17, 2016 | Revision C2 |

      c.   The HDMI repeater device output is connected to the **780/780AH HDMI IN** connector.

2.   From the main screen (shown below) touch select the **Aux Channel Analyzer** activation button.

The **ACA Setup Options** screen appears:

3.   Select the data types that you wish to monitor. In this application you would select **780/780AH Rx Port** and **Passive Upstream**.

4.   Determine what data types you wish to monitor. Typically you will want to monitor the DDC and hot plug and +5V on the passive upstream side and monitor the DDC and hot plug events on the Rx side.

5. Enable HDCP on the HDMI source device under test. Use the procedures in the section entitled: Testing HDCP on an HDMI HDTV or HDMI Repeater Device.

6. Take whatever action necessary to initiate a new HDCP authentication. Typically this would be a hot plug event at the sink device you are testing.

7. Touch select the **Capture Data Table** activation button to initiate the capturing of the data. A screen similar to the one shown below will appear.


8. Touch select the **Details** activation button (top center) to view the details of any specific transaction that you have selected. The following screen is an example of the details screen. This example shows the BCAPS register details.

9. Touch select Stop activation button (top left) to halt the collection of messages.

10. Touch select Clear activation button (top center) to clear the collected of messages.

8.4   Auxiliary Channel Analyzer – Saving Auxiliary Channel Analyzer Traces

The Aux Channel Analyzer test monitors the DDC channel transactions and hot plug events while emulating HDMI devices. You can view the details of each transaction and save the traces for viewing on the external ACA application available from the Quantum Data website.

This subsection provides procedures for saving an ACA trace to a text file for importation and analysis in the Quantum Data Auxiliary Channel Analyzer (ACA) application. The ACA application is available from the Quantum Data website on the downloads page: www.quantumdata.com/downloads. This procedure assumes that you have captured transactions using the 780/780AH's ACA feature.

1. From the **Auxiliary Channel Analyzer** screen showing the captured data (see example screen below), touch select the **Save** activation button.

2. Note you will have to have stopped the capturing of data to save the traces. You stop the traces by touching the **Stop** button.
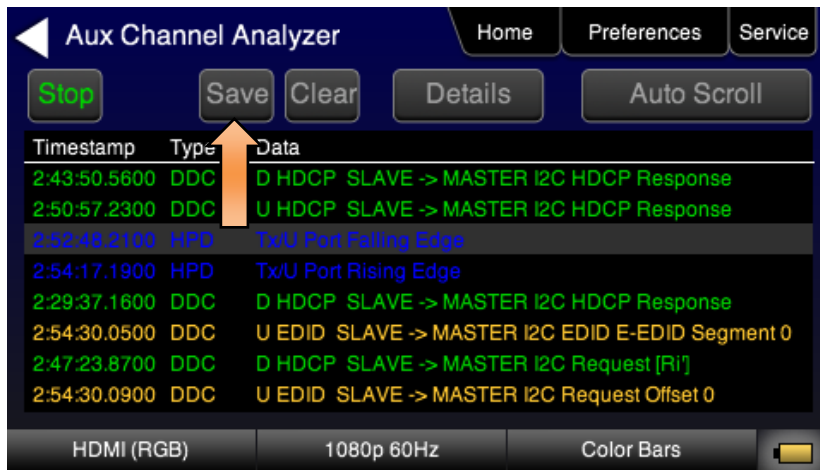
    Note you will have to have stopped the capturing of data to save the traces. You stop the traces by touching the **Stop** button.

3. Touch select the **Save** button to assign a name to your saved trace file. Enter a name using the keyboard. Press the **Enter** key to save the file.

8.4.1   Procedures for Transferring ACA Traces

Use the procedures below to import bitmaps.

1. Connect the 780/780AH to a PC host via the USB cable provided.

2. Select the **Preferences** from the 780/780AH top level menu.

3. Choose **Disk** mode.

    The **Disk** selection for **USB Mode** will be highlighted in green.

4. Power cycle the 780/780AH using the rocker switch on the back panel.

   The 780/780AH will appear as a mass storage device on your PC like any other USB drive.

5. If this is the first time you have used the 780/780AH in the **Disk** mode you will have to reformat the disk. The system will prompt you through the format process.

6. Transfer your saved Trace text file from the 780/780AH to your PC using standard windows procedures for transferring files to a USB drive, i.e. dragging and dropping or copying and pasting.

   Note: ACA traces are saved in the /Reports/ACA directory.

7. Touch select the **Preferences** from the 780/780AH top level menu. Refer to the screen below.

8. You can load these trace text files into the Quantum Data ACA available on the Quantum Data website at: www.quantumdata.com/downloads.

9   Using the 780/780AH Test Instrument to Test HDMI Cable or Repeaters

This section provides procedures for testing HDMI cables, cable extenders, splitters, repeaters, etc. The HDMI/DVI Cable Test runs a pixel error test on the TMDS leads and a continuity check on the 5V & hot plug leads and the DDC leads. The Repeater test runs a pixel error test on the TMDS leads and a continuity check on the 5V & hot plug leads and the DDC leads but additionally tests the hot plug delay and the hot plug width.

The cable test and repeater test can be used when the source and sink ends are collocated, in other words can be connected to the 780/780AH Tx and Rx ports. For a cable or distribution system that is installed and where the source and sink ends cannot be connected to the 780/780AH, you can use the Frame Compare feature. The Frame Compare feature captures a reference frame and then compares a series of captured frames pixel by pixel to the reference frame.

The features and functions described in this section are included only if you have purchased the HDMI Cable and Link Test option.

9.1   HDMI Cable or Repeater Test

The HDMI/DVI Cable Test runs a test on all the leads in the HDMI cable and HDMI links (when extenders, splitters, switchers and repeaters are used) except the power bus as follows:

- Pixel error test using a pseudo-noise pattern on the TMDS lines using three separate timings:

    o   480p60 using 8 bit/component color

    o   720p60 using 8 bit/component color

    o   1080p60 using 8 bit/component color

    o   1080p60 using 12 bit/component (deep color)

- Read/write test on the DDC leads and the CEC bus. It reads an EDID at the output from the input.

- Continuity test on the 5V/Hot plug leads.

- Hot plug delay and hot plug pulse width. The hot plug delay is the time that elapses between the falling edge of the hot plug line on the on the sink side of a repeater and the falling edge of the hot plug line on the source side. The hot plug pulse width is the time that the hot plug pulse goes low as detected on the HDMI Tx side.

9.1.1   Configurations for Running an HDMI Cable or Repeater Test

This subsection provides configurations supported when performing an HDMI cable test or a test of an HDMI network comprised of repeaters, splitters, extenders, switches, etc.

780 Test Instrument

Device Under Test Repeater   Device Under Test Extender   Device Under Test Extender

CAT5

780 Test Instrument
Reference Source/Sink
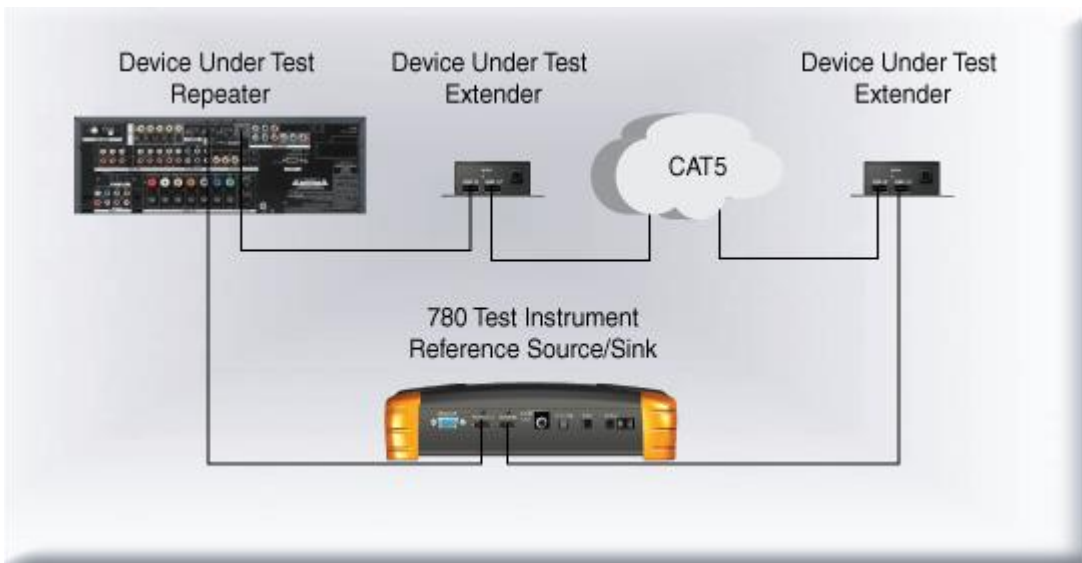
9.1.2   Procedures for Running an HDMI Cable or Network ("Repeater") Test

This subsection provides procedures for performing an HDMI cable test or a test of an HDMI network comprised of repeaters, splitters, extenders, switches, etc.

1. For testing an HDMI cable, connect one end of the HDMI cable to the 780/780AH **HDMI OUT** connect and the other end to the 780/780AH **HDMI IN** connector.

    For testing an HDMI repeater device such as a repeater, video or audio processor, extender, switch, etc, connect the 780/780AH **HDMI OUT** connector to the repeater device input and connect the 780/780AH **HDMI IN** connector to the repeater device output.

2. Touch select **Cable/Repeater Test** from the top level menu shown below.

3. For testing an HDMI cable touch select **Test Wire** to initiate the test.

    The pixel errors are displayed for each timing on the screen as shown below. The +5V, Hot Plug and DDC test results are shown as Pass/Fail.
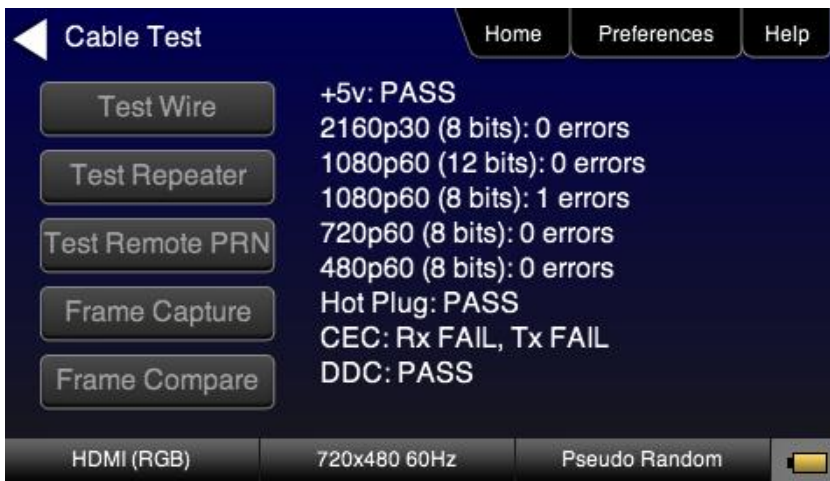
    For testing an HDMI repeater device touch select **Test Repeater** to initiate the test.

When a repeater device is tested using the **Test Repeater** function, the hot plug pulse delay and the hot plug pulse with are shown in addition to the information and results displayed for the Cable Test. In the Test Repeater function, the 780/780AH initiates a hot plug event on its sink (HDMI IN) port. The hot plug delay is the time that elapses between the falling edge of the hot plug line on the on the sink side of a repeater and the falling edge of the hot plug line on the source side. The hot plug pulse width is the time that the hot plug pulse goes low as detected on the HDMI OUT side.
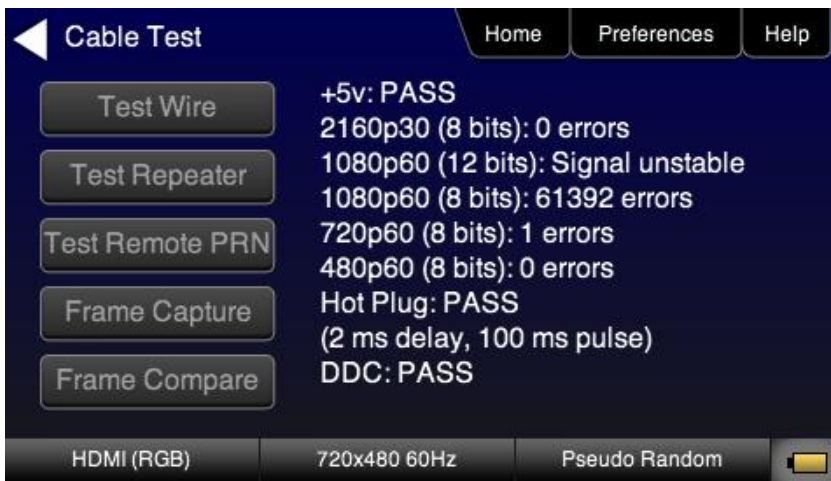
9.2   HDMI Frame Compare Test

The cable test and repeater test can be used when the source and sink ends are collocated, in other words can be connected to the 780/780AH Tx and Rx ports. For a cable or distribution system that is installed and where the source and sink ends cannot be connected to the 780/780AH, you can use the Frame Compare feature. The Frame Compare feature captures a reference frame and then compares a series of captured frames pixel by pixel to the reference frame.

9.2.1   Configuration for Running an HDMI Frame Compare Test

This subsection shows a typical configuration when performing an HDMI Frame Compare test for an HDMI cable or network comprised of repeaters, splitters, extenders, switches, etc.
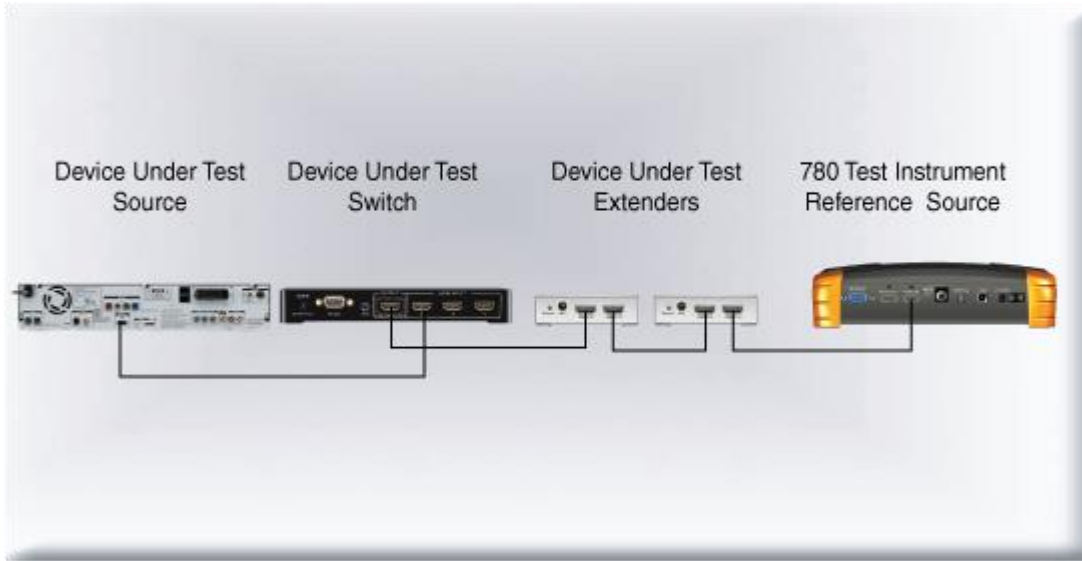
9.2.2 Procedures for Running the Frame Compare Test

This subsection provides procedures for performing an HDMI Frame Compare test on an HDMI network comprised of repeaters, splitters, extenders, switches, etc.

1. Connect the far end of the HDMI cable (at the display or HDTV) to the 780/780AH HDMI IN connect as shown in the diagram above.

2. Touch select **Cable/Repeater Test** from the top level menu shown below.

The following screen appears:

3. Select **Frame Capture** to capture a reference frame.

   The 780/780AH will capture a frame and indicate that the +5V was detected properly or not. The screen below shows these results.
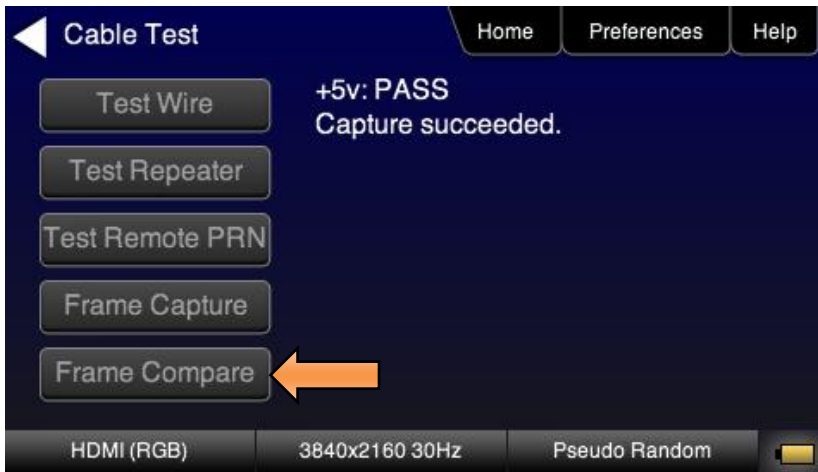
4. Select **Frame Compare** to compare a series of frames to the reference frame.

   The following screen example shows the results of the **Frame Compare** test. Note that the incoming resolution is shown with the number of pixel errors detected.

9.2.3   Procedures for Running the Remote PRN Test

This subsection provides procedures for performing an HDMI Remote PRN test on an HDMI network comprised of repeaters, splitters, extenders, switches, etc. This test differs in that there is a 780 at both ends of the network—source and sink ends.

1. Follow the procedures above for rendering a Test Pattern on an HDMI HDTV Rendering Test Patterns on an HDMI HDTV.

2. Disconnect the source device at the near end of an HDMI distribution network and connect the HDMI cable to the first 780's HDMI output connector.

3. Disconnect the sink device at the far end of an HDMI distribution network and connect the HDMI cable to the second 780's HDMI input connector.

4. Touch select **Cable/Repeater Test** from the top level menu shown below.

The following screen appears:

5. Select **Test Remote PRN** to capture a reference frame.

   The 780/780AH will run the PRN test at the format resolution set for the 780 at the source end. Repeat the test at other resolutions and bit depths.

10 Creating and Using Custom Formats, EDIDs, Bitmaps and Menus

This chapter provides procedures on creating and using custom formats, EDIDs, bitmaps and Menus.

10.1   Creating and Using Custom Formats

You can also create your own formats using the Quantum Data Format Editor available at: www.quantumdata.com/downloads. The Format Editor will create an .xml format file that you can store in the 780/780AH. The instructions for using the Format Editor are included with the 882 User Guide also available on at: www.quantumdata.com/downloads. Once created you can load your custom formats either through the command line or by selecting them through the User buttons on the Signal Type menu.

10.1.1 Workflow for Using Custom Formats

In order to import and use custom formats in the 780/780AH you must take the following high level steps (detailed procedures are provided further below):

- Create custom formats with the Quantum Data Format Editor available from www.quantumdata/com/downloads page. The instructions for using the Format Editor are provided in the 882 User Guide also available from www.quantumdata/com/downloads page.
- Store the .xml format files on your PC.
- Place the 780/780AH's USB interface in the **Disk** mode. This is not the default mode for the USB interface.
- Transfer the .xml format file(s) to the FMT directory of 780/780AH over the USB interface.
- Establish a command line session with the 780/780AH from your PC over the USB port.
- Select the custom format through the User Signal Type menu.
- Apply the custom formats using the FMTL and FMTU commands.

10.1.2 Procedures for Creating and Loading Custom Formats

Use the following procedures to add custom formats to your 780/780AH.

1. Create a new custom format or modify an existing formats with the Quantum Data Format Editor. You can use some of the sample formats available from the Quantum Data website as a starting point for creating a new format. Be sure to save the file. The format files will be saved as .xml files by the Format Editor.

2. Select the **Preferences** from the 780/780AH top level menu.

    The following screen will appear:

3. Choose **Disk** mode.

    The Disk selection for **USB Mode** in the above screen will be highlighted in green.

4. Power cycle the 780/780AH using the rocker switch on the back panel.

    The 780/780AH will appear as a mass storage device on your PC like any other USB drive.

    Note: If this is the first time you have used the 780/780AH in the **Disk** mode you will have to reformat the disk. The system will prompt you through the format process.

5. Connect the 780/780AH to a PC host via the USB cable provided.

    The 780/780AH should appear as a USB storage device.

6. Transfer your custom format .xml files from your PC to the FMT directory of the 780/780AH using standard Windows methods for transferring files to a USB drive, i.e. by dragging and dropping or copying and pasting.

    Note: Your formats are limited to 8 characters with an extension (.xml).

7. Touch select the **Preferences** from the 780/780AH top level menu. Refer to the screen below.

8. Touch select **COM** for the **USB Mode** (refer to the screen above).

9. Power cycle the 780/780AH.

10. Navigate to the Signal Type menu of the desired interface and select User for the Format Type as indicated below.

11. Navigate to the formats menu to view the list of custom User Formats.

The following screen appears which shows the list of custom formats.

12. (Alternatively) Establish a command line session with the 780/780AH from your PC using the procedures described in Procedures for Enabling the Command Line Interface.

13. Load a custom format using the following commands:

```
FMTL <formatName>  // where formatName is the name of the custom format
FMTU
```

10.2   Adding Reference EDIDs for Use in Testing HDMI Devices

You can import EDIDs for use in testing HDMI source and sink devices. You can compare a reference EDID stored in the 780/780AH with the EDID of an HDMI sink device the 780/780AH is connected to. You can also test HDMI source devices to test how they will respond to a variety of EDIDs you have stored in the 780/780AH.

10.2.1 Workflow for Importing EDIDs into the 780/780AH

In order to import and use EDIDs in the 780/780AH you must take the following high level steps (detailed procedures are provided further below):

▪ Place the 780/780AH's USB interface in the **Disk** mode. This is not the default mode for the USB interface.
▪ Create.xml EDID files using Quantum Data EDID Editor utilities available with the 882 or the 980. You can use the EDID Editor utility provided with the 980 Manager application available from the Quantum Data website on the downloads page at: www.quantumdata/com/downloads.
▪ Transfer the .xml EDID file(s) to the EDID directory of 780/780AH over the USB interface.
▪ Navigate to EDID Test screen to view and use the EDIDs

Alternatively you can load an EDID from an HDMI sink device and store its EDID for use as a reference EDID in the EDID compare test. Procedures for this feature are also provided below.

10.2.2 Procedures for Importing EDIDs into the 780/780AH

Use the following procedures to add custom EDIDs to your 780/780AH.

1. Create a new custom EDID or modify an existing EDID with the Quantum Data EDID Editor. Be sure to save the file. These will be saved as .xml files by the EDID Editor.

2. Select the **Preferences** from the 780/780AH top level menu.

    The following screen appears:

3. Choose **Disk** mode.

    The Disk selection for **USB Mode** in the above screen will be highlighted in green.

4. Power cycle the 780/780AH using the rocker switch on the back panel.

    The 780/780AH will appear as a mass storage device on your PC like any other USB drive.

    Note: If this is the first time you have used the 780/780AH in the **Disk** mode you will have to reformat the disk. The system will prompt you through the format process.

5. Connect the 780/780AH to a PC host via the USB cable provided.

    The 780/780AH should appear as a USB storage device.

6. Transfer your custom EDID .xml files from your PC to the **EDID** directory of the 780/780AH using standard Windows methods for transferring files to a USB drive, i.e. by dragging and dropping or copying and pasting.

    Note: Your EDID names are limited to 8 characters with an extension (.xml).

7. Touch select the **Preferences** from the 780/780AH top level menu. Refer to the screen below.

8. Touch select **COM** for the **USB Mode** (refer to the screen above).

9. Power cycle the 780/780AH.

10. Navigate to the **EDID Test** menu.

    You should now see the new EDIDs on the list.

10.2.3 Procedures for Saving an EDID into the 780/780AH

Use the following procedures to add an EDID to your 780/780AH from a connected HDMI sink device.

1. Make the physical connections between the 780/780AH **HDMI OUT** connector and the display device whose EDID you wish to store.

2. Enable the HDMI output using the procedures at Selecting a Signal Type and Resolution.

3. Touch select **Test Sink (Display/TV)** from the top level menu shown below.

4. Touch select **EDID Test** from the **Sink Tests** menu shown below.
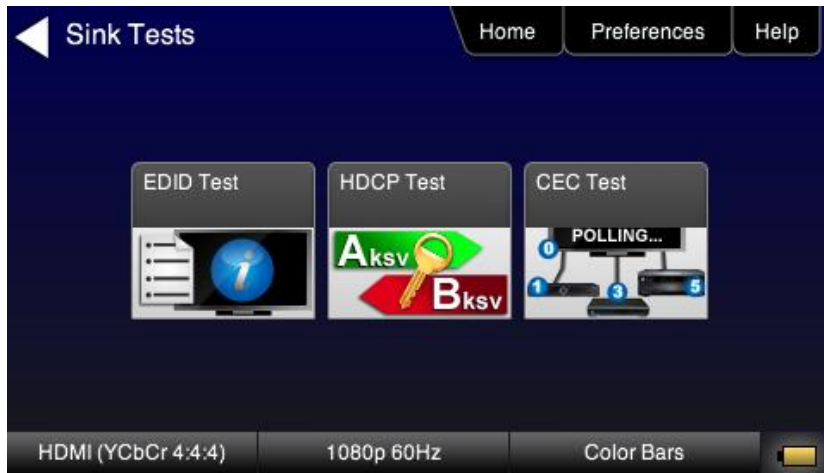
5. Touch select the Read activation button from the **EDID Test** menu shown below.

The EDID information is presented on multiple pages on the display. An example of a page of the EDID listing is shown below. You scroll through all the pages using the scroll bar at the right side of the listing.

6. Touch select the **Save** activation button from the **EDID Test** menu shown below.

    A keypad appears as shown below allowing you to save the EDID to a file.

7. Spell out a name for the EDID (limit 8 characters) by touch selecting the virtual keys (e.g. above "MYEDID". Then touch select the **Enter** key.

8. Power cycle the 780/780AH.

9. Navigate to the EDID Test screen and touch select **Load** from the **EDID Tests** menu. The following screen results.

8.   Touch select the **Load File** option to view your new EDID.

10.3   Using Custom Bitmaps

You can import your own bitmaps into the 780/780AH through the USB interface or load them from an SD card. Note that when bitmaps are imported into the 780/780AH, they are *rendered at their native resolution, i.e. they do not scale* to the resolution of the video format you have selected as the standard test patterns do. Therefore, if you want to test with a specific bitmap pattern for each resolution and you want the bitmap to fill the entire display, you would need to import a separate bitmap of that image for each resolution you wish to test.

The 780/780AH can accommodate up to 40 custom bitmap images in its internal memory and additional bitmaps stored on the SD card.

Important Note: It is highly recommended that you not select bitmap images when outputting compressed audio clips.

10.3.1   Workflow for Importing Bitmaps

In order to import and use bitmaps in the 780/780AH you must take the following high level steps (detailed procedures are provided further below):

- Place the 780/780AH's USB interface in the **Disk** mode. This is not the default mode for the USB interface.

- Create a text file called "UserPats.txt" that lists each bitmap stored for use. The name in the file has to match the name of the bitmap. The procedures below provide an example of this text file.

- Transfer the UserPats.txt file to the 780/780AH over the USB interface.

- Transfer the bitmap(s) over to the 780/780AH flash memory through the USB interface.
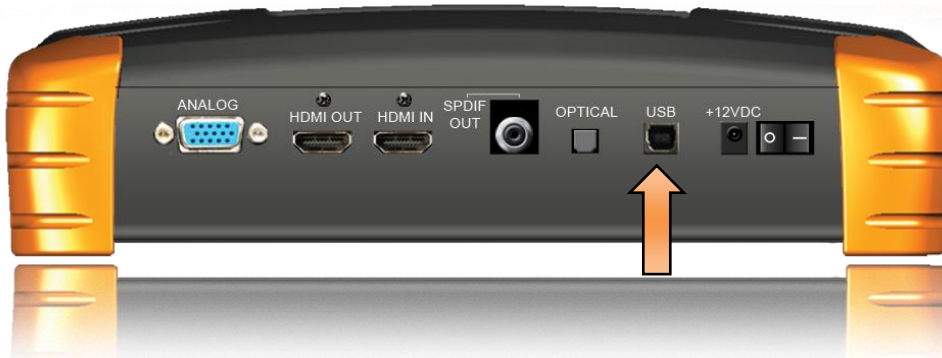
10.3.2   Workflow for loading bitmaps from the SD card

In order to load bitmaps from the 780/780AH's SD card you must take the following high level steps (detailed procedures are provided further below):

- Create a text file called "UserPats.txt" that lists each bitmap stored for use. The name in the file has to match the name of the bitmap. The procedures below provide an example of this text file.

- Transfer the UserPats.txt file to the 780/780AH to an SC card using a card reader.

- Insert the SD card into the 780/780AH SD slot on the front.

Important notes about SD card use and formatting:

1. The SD card (not an SDHC and not an SDXC).

2. The SD card should be a 1GB or less.

3. The SD card should be formatted using an SD format program available from www.sdcard.org.

4. The SD card must be formatted FAT16.

November 17, 2016	Revision C2

10.3.3 Procedures for Importing Bitmaps

Use the procedures below to import bitmaps.

1. Connect the 780/780AH to a PC host via the USB cable provided.

2. Select the **Preferences** from the 780/780AH top level menu.

3. Choose **Disk** mode.

    The Disk selection for **USB Mode** in the above screen will be highlighted in green.

4. Power cycle the 780/780AH using the rocker switch on the back panel.

    The 780/780AH will appear as a mass storage device on your PC like any other USB drive.

5. If this is the first time you have used the 780/780AH in the **Disk** mode you will have to reformat the disk. The system will prompt you through the format process.

6. Create the **userpats.txt** text file listing your bitmaps. Use the information in Table 10-1 below to construct your text file:

Table 10-1: Importing Bitmaps – UserPats.txt file		
Bitmap Name (use 8.3 naming convention)	**Bitmap Resolution**	**UserPats.txt Text File Structure**
Mast480.bmp	720x480	The structure of the UserPats file is:
Mast720.bmp	128x720	<Bitmap Name> space <Description>
Mast1080.bmp	1920x1080	The contents of the UserPats.txt text file would be:
		Mast480.bmp Master 720x480 Mast720.bmp Master 1280x720 Mast1080.bmp Master 1920x1080
		Note 1: The bitmap name has to match the name of the stored bitmap.
		Note 2: The description is limited to 20 characters.

Important Note: It is very important to ensure that the names in the userpats.txt file match the names of the bitmaps.

Example: Given the following bitmap file names:

    Mast720.bmp

Mast1080.bmp

MYPLG07.bmp

MYPLG10.bmp

MYGEO07.bmp

MYGEO10.bmp

MYBRTS07.bmp

MYBRTS 10.bmp

Your userpats.txt file would be something like the following:

Note: Must use 8.3 naming system. Eight (8) characters. The names in the name field (first field) must match the bitmap names.

Mast720.bmp Master 720

Mast1080.bmp Master 1080

MYPLG07.bmp BlkPlug 720

MYPLG10.bmp BlkPlug 1080

MYGEO07.bmp Geom178 720

MYGEO10.bmp Geom178 1080

MYBRTS07.bmp RGMultBurst 720

MYBRTS10.bmp RGMultBurst 1080

7. Transfer your userpats.txt file from your PC to the 780/780AH using standard Windows methods for transferring files to a USB drive, i.e. by dragging and dropping or copying and pasting.

   Note: Your bitmaps are limited to 8 characters with an extension (.bmp).

8. Transfer your bitmap(s) from your PC to the 780/780AH using standard windows procedures for transferring files to a USB drive, i.e. dragging and dropping or copying and pasting.
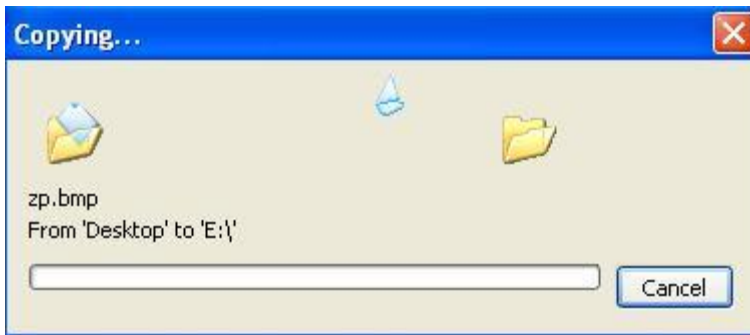
9. Touch select the **Preferences** from the 780/780AH top level menu. Refer to the screen below.
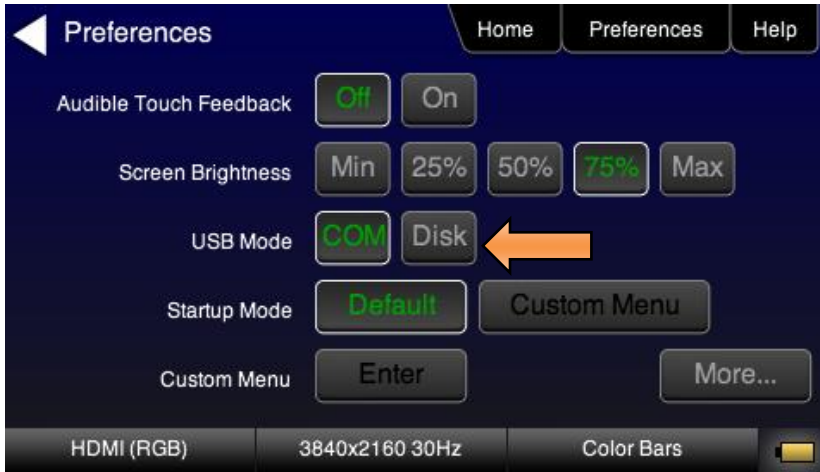
10. Touch select **COM** for the **USB Mode** (refer to the screen above).

11. Power cycle the 780/780AH.

12. Navigate to the **Video Pattern** menu.

    You should now see the new bitmap image(s) on the pattern list (below).

10.3.4   Procedures for Loading Bitmaps from SD Card

Use the procedures below to load bitmaps from an SD card.

1. Load your bitmaps on to the SD card from your PC using a USB SD card reader.

2. Create the **UserPats.txt** text file listing your bitmaps. Use the information in Table 10-2 below to construct your text file:

Table 10-2: Importing Bitmaps – UserPats.txt file		
Bitmap Name (use 8.3 naming convention)	**Bitmap Resolution**	**UserPats.txt Text File Structure**
Mast480.bmp	720x480	The structure of the UserPats file is:
Mast720.bmp	128x720	<Bitmap Name> space <Description>

Table 10-2: Importing Bitmaps – UserPats.txt file		
Bitmap Name (use 8.3 naming convention)	**Bitmap Resolution**	**UserPats.txt Text File Structure**
Mast1080.bmp	1920x1080	The contents of the UserPats.txt text file would be: Mast480.bmp Master 720x480 Mast720.bmp Master 1280x720 Mast1080.bmp Master 1920x1080 **Note 1:** The bitmap name has to match the name of the stored bitmap. **Note 2:** The description is limited to 20 characters.

3. Transfer your UserPats.txt file from your PC to the SD card using standard Windows methods for transferring files to a USB drive, i.e. by dragging and dropping or copying and pasting.

   In this example, you would have created a bitmap called for example 980_640.bmp and stored it on the SD card. In this example the bitmap is 640 x 480 resolution. You would then create a userpats.txt file as follows:

4. 980_640.bmp 980 640x480

   Note: Your bitmaps are limited to 8 characters with an extension (.bmp).

5. Insert the SD card into your 780/780AH.

6. Power cycle the 780/780AH.

7. Navigate to the **Video Pattern** menu.

   You should now see the new bitmap image(s) (980 640x480) on the pattern list (below).
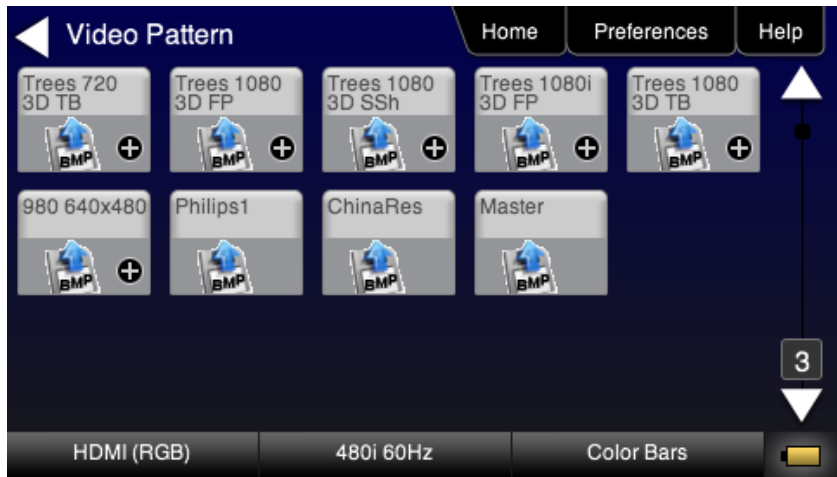
10.4 Creating Custom Menus

This section describes how to configure custom menus on the 780/780AH. Custom menus enable you to display a menu of commonly used functions on the 780/780AH touch display. This allows you to save time by quickly executing a specific set of resolution and image combinations.

The custom menus are setup using two text files that you create on your PC and transfer over to the 780/780AH. The two files are: 1) UserKeys.txt and 2) SeqMap.txt. The UserKeys.txt is a set of commands with menu key codes. Each set of commands is a line in the text file.

10.4.1 To create a custom menu:

Use the following procedure to create a custom menu on your 780/780AH.

1. Create a UserKeys.txt file or edit an existing file. An example of a UserKeys.txt file is shown below.

```
#F0 fmtl 720p60;imgl user01;fmtu
#F1 fmtl 1080p60;imgl pgcwrgb;fmtu
#F2 fmtl 480p60;imgl smptebar;fmtu
#F3 fmtl dmt0660;imgl ramp;fmtu
#F4 fmtl 1080i30;imgl focus;fmtu
#FF fmtl dmt0660;imgl smpte;fmtu
```

Note that the commands are separated by a semicolon. In the example above in the first line there is a custom bitmap image "user01" that is used.

2. Create a SeqMap.txt file or edit an existing file. An example of a SeqMap.txt file is shown below.

The SeqMap.txt then maps the commands listed in the UserKeys.txt file to a name and a location on the custom menu. The following is an example of a SeqMap.txt file.

```
#F0 720p Master
#F1 1080p PGCWrgb
#F2 480p SMPTEbar
#F3 DMT0660 Ramp
#F4 1080i Focus
#FF Go Home
```

The result of these two files would be the following custom menu:

Touch selecting the key labeled "1080p PGCWrgb" would cause the following command sequence to execute:

```
#F1 fmtl 1080p60;imgl pgcwrgb;fmtu  // loads 1080p60 format,
                                       displays pgcwrgb test pattern
```

10.4.2 To access custom menus:

Use the following procedure access the custom menu on your 780/780AH.

1. Navigate to the Preference menu by selecting the Preferences tab from the Home menu.

2. Navigate Touch select **Custom Menu** from the Preference screen as shown below.

The following screen appears.

11 Command Interface

This chapter describes how to use the command line to control the 780/780AH. The command line is useful for automated control applications.

11.1   Guidelines for Using the Command Line

The command line is available through the 780/780AH USB port and additionally through an RS-232 connector on the 780AH. In order to use the command line through the USB port you need to set the 780/780AH USB port in COM mode. You may need to download an .INF file from the Quantum Data website on the downloads page.

11.2   Procedures for Enabling the Command Line Interface through USB Port

Use the following procedures for command line control of the 780/780AH via the USB port.

Please note if you experience a different behavior on your PC, refer to the 780/780AH release notes on the Quantum Data website at: http://www.quantumdata.com/downloads/index.asp.

1. Download the .INF file from the Quantum Data website at: http://www.quantumdata.com/support/780readme.asp#supplemental to your PC and unzip the file. Store it in a convenient location on your PC.

2. Power up the 780/780AH and touch select **Preferences** from the 780/780AH top level menu.

3. Choose **COM** for the **USB Mode** (refer to the screen below).

4. Connect the 780/780AH to your host PC via the USB cable provided.

    The first time you connect 780/780AH to your PC in COM mode, the Found New Hardware Wizard will appear.

5. Follow the instructions provided on the dialog box to browse to the location of the .INF file.

    Once you locate the .INF file the required software will load as shown below.
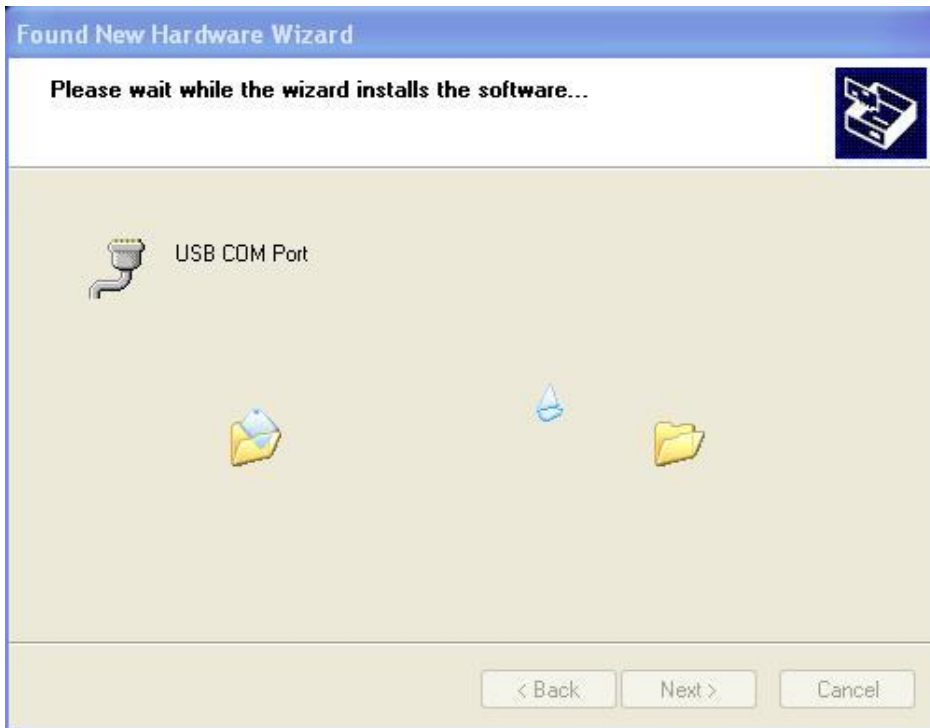
6. Power cycle the 780/780AH.

11.3   Procedures for using the Command Line Interface through RS-232 Port (780AH only)

Use the following procedures for command line control of the 780AH via the RS-232 serial port.

Please note if you experience a different behavior on your PC, refer to the 780/780AH release notes on the Quantum Data website at: http://www.quantumdata.com/downloads/index.asp.

1.   Power up the 780AH and touch select **Preferences** from the 780AH top level menu.

2.   Select **More** to view the second Preferences page.

3.   Choose the baud rate for the RS-232 port.

4.   Connect the 780AH to your host PC via an RS-232 cable.

     You will have to use a standard RS-232 cable.

11.4   Procedures for Entering Commands

Use the following procedure to connect to the 780/780AH through the USB port.

1.   Open up a terminal program such as Hyperterm on your Windows PC. Configure the terminal session with the following settings:

     ▪   Bits per second = 2400, 4800 or 9600

- Data bits = 8
- Parity = none
- Stop bits = 1
- Flow control = Hardware

2. Press the Return key on your PC and you should receive the **R:\>** prompt.

   Now you are ready to enter commands.

3. Use the following tables as a guideline for enter commands.

   Note: Changes you make through the command line will not be reflected on the 780/780AH touch panel. For example if you make a selection through the touch panel for the signal type, format and pattern and then override these changes through the command line, the 780/780AH touch screen will still show the selections you made through the touch screen but the interface, format and pattern selections you made through the command line will be active.

Table 11-1 below provides the list of commands supported or testing HDMI sink devices:

Note: The commands are not case sensitive.

Table 11-1: List of Commands (alphabetical) – For Testing HDMI Sink Devices				
Command	**Description**	**Syntax**	**Parameters**	**Command Example**
TIME	Sets the system time.	TIME YY MM DD HH MM SS	Where *YY* is the last two digits of the year (e.g. 16). Where *MM* is the two digits of the month (e.g. 11). Where *DD* is the two digits of for the day of the month (e.g. 18). Where *HH* is the two digits of the current hour in 24 hour clock (e.g. 23). Where *MM* is the two digits of the current minutes (e.g. 32). Where *MM* is the two digits of the current seconds (e.g. 57).	To set the time to October 11th 2016 at on second after 8:35 PM `TIME 16 10 11 20 35 01`

ACRG	Enables or disables ("Gates" on or off) the ACR packets sent to a sink.	ACRG *0, 1*
		ASSG?
		<0, 1>
			Where *1, 0* are one of:
			0 – disable
			1 - enable
				To disable ACR packets:
				`ACRG 0`
				`ALLU`

ALLU	Activates a change to the video output.	ALLU	Not applicable	To load and invoke a format load command:
				`FMTL 1080i60`
				`ALLU`

Table 11-1: List of Commands (alphabetical) – For Testing HDMI Sink Devices				
Command	**Description**	**Syntax**	**Parameters**	**Command Example**
ASCT	Sets or queries the analog sync composite type. It sets the analog sync type properly for TV vs PC formats for HDMI, DVI, HDBaseT and RGB analog.	ASCT <type> ASCT?	Where *type* is one of: 2 = American ORed. Used for HDMI, DVI, HDBaseT when PC formats are used. Used with RGB Analog when PC formats are used. 4 = American with Serrations and equalization pulses. Used for Component Analog. Used for RGB Analog with TV formats. 10 = American HDTV with Serrations and equalization pulses. Used for HDMI, DVI, HDBaseT with TV formats.	To set the analog sync composite type on the RGB Analog interface for TV formats: `ASCT 4` `ALLU` To set the analog sync composite type on the HDMI format for PC formats: `ASCT 2` `ALLU`
ASSG	Enables or disables adding composite sync to all three analog components.	ASSG *R, G, B* ASSG? <R, G, B>	Where *R, G, B* are one of: 0 – disable 1 - enable	To enable composite sync on green: `ASSG 0, 1, 0` `FMTU`
ASSS	Sets or queries the analog sync signal swing.	ASSS <swing> ASSS?	Where *swing* is between the range of: min = 0.000 volts max = 0.500 volts	To set the analog sync signal swing: `ASSS 0.286` `ALLU`
AVMG	Sets or clears AVmute on the HDMI output.	AVMG <enable> AVMG?	Where *enable* is one of: disable = 0 enable = 1	To set avmute: `AVMG  1` `ALLU`
AVMM	Enables or disables AVmute upon format change on the HDMI output.	AVMM <enable> AVMM?	Where *enable* is one of: disable = 0 enable = 1	To enable avmute on an HDMI format change: `AVMM  1` `ALLU`
AVSS	Sets the maximum peak-to-peak swing for all three analog video channels.	AVSS<level> AVSS?	Where *level* is between the range of: min = 0.000 volts max = 1.000 volts	To set the analog video type: `AVSS  0.9` `ALLU`
AVST	Selects the analog video format type.	AVST <format_type> AVST?	Where *format_type* is one of: 2 – Analog RGB 6 - Analog YPbPr	To set the analog video type: `AVST 2` `ALLU`
BKSV?	Shows value of sink device's BKSV (in hex) when connected to 780/780AH Tx	BKSV?	Not applicable	To read a sink device's BKSV: ` BKSV?` `152BDD2533`

Table 11-1: List of Commands (alphabetical) – For Testing HDMI Sink Devices

Command	Description	Syntax	Parameters	Command Example
BOXG	To enable or disable the moving box on an image.	BOXG <enable>	Where *enable* is: 0 = disable 1 = enable	To enable the moving box: BOXG 1 ALLU

CECx:PING?	Runs a CEC ping test from:
	  the HDMI Tx (x = 1)
	or
	  the HDMI Rx (x = 2) port.
		CECx:PING <LA> <results>	Where *x* = 0 for the HDMI Rx port and *x* = 1 for the HDMI Tx port.
			Where *LA* = the logical address of the device you want to ping.
				To ping an HDTV from the 780/780AH HDMI Tx port:
				CEC1:PING 00
				TV (LA=0) found

CSPG	Enable and disable the digital composite sync outputs when digital composite sync is selected via the SSST command.	CSPG <enable> CSPG?	Where *enable* is: 0 = disable 1 = enable	To enable digital composite sync: SSST 2 CSPG 1 ALLU
CSPP	Sets or queries the polarity of the composite sync pulse.	CSPP <polarity> CSPP?	Where *polarity* is: 0 = active low (negative going) 1 = active high (positive going)	To set the composite sync pulse to a positive going: CSPP 1 FMTU or ALLU
DACG	Specifies which audio channels are activated (gated on) for LPCM audio.	DACG <mask>	Where *mask* is an 8 bit value. Each bit corresponds to a channel with the first bit (bit 0) associated with channel 1, bit 1 for channel 2 and so on to bit 7 corresponding to channel 8. The bit position values are: Bit 0 – Ch 1 = 1 Bit 1 – Ch 2 = 2 Bit 2 – Ch 3 = 4 Bit 3 – Ch 4 = 8 Bit 4 – Ch 5 = 16 Bit 5 – Ch 6 = 32 Bit 6 – Ch 7 = 64 Bit 7 – Ch 8 = 128 You can enable multiple channels.	To enable channel 1 only: DACG 1 ALLU To disable all channels: DACG 0 ALLU To enable all channels: DACG 255 ALLU To enable channel 8 only: DACG 128 ALLU To enable channels 1-6: DACG 127 ALLU

Table 11-1: List of Commands (alphabetical) – For Testing HDMI Sink Devices				
Command	**Description**	**Syntax**	**Parameters**	**Command Example**

DSCT	Sets or queries the digital sync composite type. It sets the digital sync type properly for TV vs PC formats for HDMI, DVI, HDBaseT and RGB analog.	DSCT <type>
		DSCT?
			Where type is one of:
			0 = None
			    Used for HDMI, DVI, HDBaseT when TV formats are used.
			2 = American HDTV w/ Serrations and equalization pulses
			    Used for HDMI, DVI & RGB Analog with PC formats.
			4 = American HDTV w/double serrations
			    Used for Component Analog all formats.
			    Used for RGB Analog when TV formats are selected.
				To set the digital sync composite type for the RGB Analog interface for TV formats:
				`DSCT 4`
				`ALLU`
				
				To set the digital sync composite type for the HDMI interface for PC formats:
				`DSCT 2`
				`ALLU`

DSST	Sets or queries the digital separate sync type. It sets the sync type properly for TV vs PC formats for HDMI, DVI, HDBaseT and RGB Analog.	DSST <type>
		DSST?
			Where type is one of:
			1 = American ORed.
			    Used for HDMI, DVI, HDBaseT when PC formats are used.
			    Used with RGB Analog when PC formats are used.
			4 = American with Serrations and equalization pulses.
			    Used for Component Analog interface.
			    Used for RGB Analog with TV formats.
			10 = American HDTV with Serrations and equalization pulses.
			    Used for HDMI, DVI, HDBaseT with TV formats.
				To set the digital separate sync type on the RGB Analog interface for PC formats:
				`DSST 1`
				`ALLU`
				
				To set the digital separate sync composite type for the HDMI interface for TV formats:
				`DSST 10`
				`ALLU`

DVSM	Sets or queries the digital video sampling mode. Applies only for HDMI.	DVSM <sampling>
		DVSM?
			Where sampling is one of:
			0 – RGB (4:4:4)
			2 – YCbCr (4:2:2)
			4 - YCbCr (4:4:4)
				To set the HDMI sampling mode to RGB (4:4:4):
				`DVST 10`
				`DVSM 0`
				`ALLU`

DVST	Sets or queries the digital video type. Applies only for HDMI.	DVST<type>
		DVST?
			Where type is one of:
			10 – RGB
			14 – YCbCr
				To set the HDMI sampling mode to YCbCr (4:4:4):
				`DVST 14`
				`DVSM 4`
				`ALLU`

Table 11-1: List of Commands (alphabetical) – For Testing HDMI Sink Devices				
Command	**Description**	**Syntax**	**Parameters**	**Command Example**
DVQM	Sets or queries the digital video quantizing range. Applies only for HDMI.	DVQM <mode> DVQM?	Where range is one of: 0 – 0-255 (8 bit) 1 – 1-254 (8 bit) 2 – 16-235 (8 bit RGB 16-240 (8 bit YCbCr)	To set the HDMI quantizing range to 0-255: to RGB: `DVQM 0` `ALLU`
EDID?	Shows the EDID (in hex) of the sink device connected to the 780/780AH Tx port.	EDID?	Not applicable	To read a sink device's EDID: `EDID?` `01FFFFFFF01…`
FMTL	Loads a format.	FMTL <format>	Where format is one of the formats listed in Table 7-2 and Table 7-3	See example below for FMTU
FMTU	Activates a format that has been loaded and queries for the currently active format.	FMTU FMTU?	Not applicable	To load and invoke a format load command: `FMTL 1080i60` `FMTU`
FRAT?	Queries the frame rate of the outgoing HDMI format.	FRAT?	Not Applicable	To read the frame rate of the outgoing HDMI signal: `FRAT?` `+60.000E+00`
HDCP?	Runs an HDCP authentication test on an HDMI sink device	HDCP? <frames>	Number of frames: Where frames is number of frames rounded to the nearest 128 frames. Results: where results are: 0 = pass 1 = fail	To run an HDCP authentication test on an HDMI sink device or repeater device: To run an HDCP test for 128 frames: (pass reported) `HDCP? 255` To run an HDCP test for 256 frames: `HDCP? 257` `0` To run an HDCP test for 512 frames (with a failure reported): `HDCP?` `1`
HPAG?	Query the incoming sink for hot plug pin status.	HPAG? <hotplug>	Where hotplug can be 0 (no hot plug detected) or 1 (hot plug deteted)	To check for hot plug on the HDMI Out port: `HPAG?`
HRAT	Sets the horizontal rate of the video timing.	HRAT <rate> HRAT? <rate>	Where rate can be within the range of: 1000Hz to 130000Hz	To set the horizontal rate to 15000Hz: `HRAT 15000` `ALLU or FMTU`

	Table 11-1: List of Commands (alphabetical) – For Testing HDMI Sink Devices			
Command	**Description**	**Syntax**	**Parameters**	**Command Example**

HRES	Sets the horizontal resolution of the video timing.	HRES <*pixels*>
		HRES?
		< *pixels* >
			Where *pixels* can be within the range of:
			100 to 4000 pixels
				To set the horizontal resolution to 1282 pixels:
				`HRES 1282`
				`ALLU`

HTOT	Sets the horizontal total number of pixels of the video timing.	HTOT <*pixels*>
		HTOT?
		< *pixels* >
			Where *pixels* can be within the range of:
			100 to 4000 pixels
				To set the horizontal total to 1376 pixels:
				`HTOT 1376`
				`ALLU or FMTU`

HSPP	Sets of the polarity of the horizontal sync pulse.	HSPP <*polarity*>
		HSPP?
		<*polarity*>
			Where *polarity* can be within the range of:
			0 = high to low transition
			1 = low to high transition
				To set the horizontal sync pulse polarity to low to high transition:
				`HSPP 1`
				`ALLU or FMTU`

HSPW	Sets the horizontal sync pulse width of the video timing in pixels.	HSPW <*pixels*>
		HSPW?
		< *pixels* >
			Where *pixels* can be within the range of:
			1 to HTOT-HRES-HSPD
				To set the horizontal sync pulse width to 32 pixels:
				`HSPW 32`
				`ALLU or FMTU`

HSPG	Sets enable gate of the horizontal sync pulse.	HSPG <*enable*>
		HSPG?
		< *enable* >
			Where *enable* is:
			0 = disable
			1 = enable
				To enable the horizontal sync pulse:
				`HSPG 1`
				`ALLU or FMTU`

IMGL	Loads an image (pattern).	IMGL <*image*>	Where *image* is one of the images listed in Table 7-4	See example below for IMGU

IMGU	Activates an image that has been loaded and queries for the currently active image.	IMGU
		IMGU?
			Not applicable	To load and invoke a image load command:
				`IMGL SMPTEbar`
				`IMGU`

NBPC	Sets or queries the number of bits per component. Applies only to HDMI	NBPC
		<*bit_depth*>
		NBPC?
			Where *bit_depth* is one of:
			8 – 8 bits per component
			10 – 10 bit per component
			12 – 12 bits per component
				To set the HDMI bit depth to 10:
				`NBPC 10`
				`ALLU or FMTU`

PRAT?	Queries the pixel rate of the outgoing HDMI format.	PRAT?	Not Applicable	To read the pixel rate of the outgoing HDMI signal:
				`PRAT?`
				`+74.2500E+06`

SCAN	Defines whether the active timing is progressive or interlaced or queries the state of the active timing.	SCAN <*scan*>
		SCAN?
		< *scan* >
			Where *scan* is:
			1 = progressive
			2 = interlaced
				To set the scan to interlaced:
				`SCAN 2`
				`ALLU or FMTU`

SIRE	Sets IRE levels for certain images: Window1/2, Raster, Flat_Wht/Grn/ Red/Blu/Cyn/Mag/Blk	SIRE <*range*>	Where *range* is a value from 0 to 100.	To set the IRE range for any of the images listed:
				`SIRE 50`
				`ALLU`

Table 11-1: List of Commands (alphabetical) – For Testing HDMI Sink Devices

Command	Description	Syntax	Parameters	Command Example

SSST	Sets or queries the sync signal type. It sets the sync type properly for the RGB Analog interface and the Component Analog interface.	SSST *<type>*
		SSST?
			Where *type* is one of:
			1 = digital separate horizontal and vertical sync.
			    Used for the HDMI, DVI, HDBaseT interfaces.
			    Used with RGB Analog and Component Analog interface when separate sync is selected.
			3 = digital separate composite sync.
			    Used for Component Analog and RGB Analog interface when sync on Y or sync on green are used.
				To set the sync signal type on the Component Analog interface for separate sync:
				`SSST 1`
				`ALLU`
				
				To set the sync signal type on the RGB Analog interface for sync on green:
				`SSST 3`
				`ALLU`

VRES	Sets or queries the vertical resolution of the active timing. Express in number of lines.	VRES *<lines>*
		VRES?
		< lines >
			Where *lines* can be within the range of:
			Min = 1 (if scan = 1)
			      = 2 (if scan = 2)
			Max = VTOT – 1 (if scan = 1)
			      = VTOT – 3 (if scan = 2)
				To set the horizontal resolution:
				`VRES 480`
				`ALLU`

VRAT?	Queries the vertical rate (field rate for interlaced formats) of the outgoing video format.	VRAT?	Not Applicable	To read the vertical rate of the outgoing HDMI signal of 1080i30:
				`VRAT?`
				`+60.000E+00`

VSPD	Sets or queries the vertical sync pulse delay of the active timing. Express in number of lines.	VSPD *<lines>*
		VSPD?
		< lines >
			Where *lines* can be within the range of:
			Min = 1 (if scan = 1)
			      = 2 (if scan = 2)
			Max = VTOT – 1 (if scan = 1)
			      = VTOT – 3 (if scan = 2)
				To set the horizontal sync pulse delay:
				`VSPD 11`
				`ALLU`

VSPW	Sets or queries the vertical sync pulse width of the active timing. Express in number of lines.	VSPW *<lines>*
		VSPW?
		< lines >
			Where *lines* are the number of lines for the vertical pulse width	To set the horizontal sync pulse width:
				`VSPW 3`
				`ALLU`

VSPP	Sets the polarity of the vertical sync pulse.	VSPP *<polarity>*
		VSPP?
		<polarity>
			Where *polarity* can be one of:
			0 = high to low transition
			1 = low to high transition
				To set the horizontal sync pulse polarity to low to high transition:
				`VSPP 1`
				`ALLU`

VSPG	Enables or disables the vertical sync pulse.	VSPG *<enable>*
		VSPG?
		< enable >
			Where *enable* is:
			0 = disable
			1 = enable
				To enable the vertical sync pulse:
				`VSPG 1`
				`ALLU`

Command	Description	Syntax	Parameters	Command Example
Table 11-1: List of Commands (alphabetical) – For Testing HDMI Sink Devices				
VTOT	Sets the vertical total number of lines of the video timing.	VTOT *<lines>* VTOT? *< lines >*	Where *lines* are the total number of lines.	To set the vertical total to 525 lines: VTOT 525 ALLU
XVSI	Selects the interface.	XVSI *<interface>* XVSI?	Where *interface* is one of: 2 – DVI (Computer) 3 – DVI (TV) 4 - HDMI 9 – Analog YPbPr or RGB)	To set the interface: XVSI 4 ALLU
XVSG	Determines which video components are active when a format is selected.	XVSG *R G B* FMTU or ALLU XVSG? *R G B*	Where *R G* and *B* are: R = 0 (Off) or 1 (On) G = 0 (Off) or 1 (On) B = 0 (Off) or 1 (On)	To set gate on or off red, green or blue components: XVSG 1 0 1 (Red On; Green Off; Blue On) ALLU

Table 11-1: List of Commands (alphabetical) – For Testing HDMI Sink Devices

Command	Description	Syntax	Parameters	Command Example

XAVI	Enables you to send specific parameter values of the AVI infoframes out the HDMI outputs independent of the HDMI video stream parameters.	XAVI:*aviparameter* <*value*>
		Where aviparameter is one of the values identified below and value is an associated value provided in CEA-861-E.
		S – Scan information. Sets the scan information value or retrieves the value transmitted.
		B – Bar information. Sets the bar information value or retrieves the value transmitted.
		A – Active format information. Sets the active format information value or retrieves the value transmitted.
		C – Colorimetry. Sets the colorimetry value or retrieves the value transmitted.
		Y – Video type. Sets the video type value or retrieves the value transmitted.
		Q – RGB Quantization range. Sets the RGB Quantization range or retrieves the value transmitted.
		YQ – YCC quantization range. Sets the YCC quantization range or retrieves the value transmitted.
		R – Active Format Aspect Ratio. Sets active format aspect ratio value or retrieves the value transmitted.
		M – Picture Aspect Ratio. Sets the picture aspect ratio value or retrieves the value transmitted.
		EC – Extended Colorimetry. Sets the extended colorimetry value or retrieves the value transmitted.
		SC – Non-uniform Picture Scaling. Sets the non-uniform picture scaling value or retrieves the value.
		ETB – Line number at start of top bar. Sets the pixel number start top value or retrieves the value transmitted.
		SBB – Line number at start of bottom bar. Sets the pixel number start bottom value or retrieves the value transmitted.
		ELB – Pixel number at start of left bar. Sets the pixel number start left value or retrieves the value transmitted.
		SRB – Pixel number at start of right bar. Sets the pixel number start right value or retrieves the value transmitted.
		VIC – Video Identification Code. Retrieves the value transmitted.
		PR – Pixel repetition. Sets the pixel repetition value or retrieves the value transmitted.
		ITC – IT Content. Sets the IT content value or retrieves the value transmitted.
		CN – Content Type. Sets the content type value or retrieves the value transmitted.
		CSUM – Checksum. Sets the checksum value or retrieves the value transmitted.
				To set the scan parameter to overscanned:
				`XAVI:S 1`
				`IFGU`
				To set the video type to RGB and aspect ratio to 4:3:
				`XAVI:Y 0; M 1`
				`IFGU`
				To return the value of the video parameter type:
				`XAVI:Y?`

Table 11-1: List of Commands (alphabetical) – For Testing HDMI Sink Devices

Command	Description	Syntax	Parameters	Command Example

XAUD	Enables you to send specific parameter values of the AUD infoframes out the HDMI output independent of the HDMI audio stream.	XAUD:*audparameter* <*value*>
		Where *audparameter* is one of the values identified below and *value* is an allowed value associated with the parameter provided in CEA-861-E.
		CA – Channel assignment. Sets the channel assignment value or retrieves the value transmitted.
		CC – Channel count. Sets the channel count value or retrieves the value transmitted.
		CT – Audio coding type. Sets the audio coding type value or retrieves the value transmitted.
		SS – Sample size. Sets the sample size value or retrieves the value transmitted.
		SF – Sampling frequency. Sets the sampling frequency value or retrieves the value transmitted.
		DMI – Down-mix inhibit. Sets the down-mix inhibit value or retrieves the value transmitted.
		LSV – Level shift value. Sets the level shift value or retrieves the value transmitted.
		PBL – LFE playback level. Sets the LFE playback level or retrieves the level transmitted.
		CSUM – Checksum. Sets or gets the checksum value for the corresponding InfoFrame.
				To set the channel count to 3:
				`XAUD:CC 2`
				`IFGU`
				To set the sampling size to 24:
				`XAUD:SS 3`
				`IFGU`
				To return the value of the channel count parameter type:
				`XAUD:CC?`

XHVI	Enables you to send specific parameter values of the Vendor Specific infoframe out the HDMI output independent of the HDMI stream.	XHVI:*hviparameter* <*value*>
		Where *hviparameter* is one of the values identified below and *value* is an allowed value associated with the parameter provided in CEA-861-E.
		HVF – HDMI Video Format field. Values: 0 = no info, i.e. 2D; 1 = 4Kx2K; 2 = 3D.
		HVIC – HDMI Video Identification Code (VIC). Sets VIC for 4Kx2K use.
		H3DS– HDMI 3D structure. Sets the 3D structure indication.
		3DMG – 3D metadata present gate. Indicates whether 3D metadata is present or not present.
		3DED – 3D External data.
		LEN – HDMI VSIF length in bytes.
		CSUM – Checksum. Sets or gets the checksum value for the corresponding InfoFrame.
				To enable 3D:
				`XHVI:HVF 2`
				`IFGU`
				To indicate that 3D metadata is present:
				`XHVI:3DMG 2`
				`IFGU`
				To query if 3D metadata is present:
				`XHVI:3DMG?`

Table 11-1: List of Commands (alphabetical) – For Testing HDMI Sink Devices

Command	Description	Syntax	Parameters	Command Example

XSPD	Enables you to send specific parameter values of the Source Product Descriptor infoframe out the HDMI output independent of the HDMI stream.	XSPD:*spdparameter* <*value*>
		Where *spdparameter* is one of the values identified below and *value* is an allowed value associated with the parameter provided in CEA-861-E.
		XSPD [VNS [PDS [SDI]]
		Where:
		XSPD – Vendor string name.
		PDS – Product description string.
		SDI – Source device information (see EIA/CEA-861-E standard)
				To assign a vendor string name:
				`XSPD QDI HDMI-Analyzer IFGU`
				To query the vendor string name:
				`XSPD?`

Note: The commands are not case sensitive.

Table 11-2 below provides the list of commands supported or testing HDMI sink devices:

Note: The commands are not case sensitive.

Table 11-2: List of Commands (alphabetical) – For Testing HDMI Audio in Sink Devices

Command	Description	Syntax	Parameters	Command Example

ARAT	Sets the audio rate on Optical, SPDIF and HDMI LPCM audio.	ARAT *rate*
		ARAT?
		<*rate*>
			Where *rate* is one of:
			32000, 44100, 48000, 88200, 96000, 176400, 192000.
				To set the audio sampling rate to 48kHz:
				`ARAT 48000`
				`FMTU`

RGBW	Sets RGB values on with Raster and Window test patterns	RGBW <*pattern*> <*R*> <*G*> <*B*>
		RGBW?
		<*pattern*> <*R*> <*G*> <*B*>
			Where pattern is either 4 for Window pattern or 33 for raster pattern
			Where *R G B* are the respective values for the RGB color components
				To set the Window pattern to dark brown:
				`imgl window`
				`imgu`
				`rgbw 4 115 82 68`
				or
				`rgbw 4 115 87 74`

SAMP	Sets the amplitude on either a specific channel or channels.	SAMP <*amp*> <*ch*>
		SAMP?
		<*amp*> <*ch*>
			Where *amp* is between the range of:
			min = -99 dB
			max = 0 dB
			Where *ch* is in one of:
			0 - 7
				To set the amplitude of the audio signal on channel 1 (FR) to -3dB:
				`SAMP -3 1`
				`FMTU`
				To set the amplitude of the audio signal on all channels to -6dB:
				`SAMP -6`
				`FMTU`

Table 11-2: List of Commands (alphabetical) – For Testing HDMI Audio in Sink Devices

Command	Description	Syntax	Parameters	Command Example
SRAT	Sets the sine wave frequency on either a specific channel or all channels.	SRAT <rate> <ch> SRAT? <rate> <ch>	Where rate is between the range of: min = 8Hz max = 20000Hz Where ch is in one of: 0 - 7	To set the sinewave frequency of the audio signal on channel 1 (FL) to 2000 Hz: `SRAT 2000 0` `FMTU` To set the sinewave frequency of the audio signal on all channels to 4000Hz: `SRAT 4000` `FMTU`
NBPA	Sets the number of bits per sample in the SPDIF, Optical and HDMI PCM audio.	NBPA <bits> NBPA? <bits>	Where bits is one of: 16, 20, 24	To set the audio bit depth to 24: `NBPA 24` `FMTU`
NDAC	Sets the number of digital audio channels for an LPCM audio signal.	NDAC <channels> NDAC? <channels>	Where channels is: 2 or 8	To set the number of channels to 8: `NDAC 8` `FMTU`
DASI	Sets the digital audio interface.	DASI <interface> DASI? <interface>	Where interface is one of: 0 = disabled 1 = SPDIF 4 = Optical 6 = HDMI	To set the digital audio interface to HDMI: `DASI 6` `FMTU`

Table 11-3 below provides the list of commands supported or testing HDMI source devices:

Table 11-3: List of Commands – For Testing HDMI Source Devices

Command	Description	Syntax	Command Example
AKSV?	Shows value of source device's AKSV (in hex) when connected to 780/780AH Rx.	AKSV?	To read a source device's AKSV: `AKSV?` `152BDD2533`
AUDA?	Queries the Audio Clock Regeneration (ACR) N and CTS values received from a source.	AUDA:N? AUDA:CTS?	To view the N value from a source: `AUDA:N?` `458779`

Table 11-3: List of Commands – For Testing HDMI Source Devices			
Command	**Description**	**Syntax**	**Command Example**
AUDA:RPTP?	Queries the audio infoframe and channel status bits and issues a text report.	AUDA:RPTP?	To view the audio infoframe and channel status bits: `AUDA:RPTP?` Audio InfoFrame data: Channel count: 2 channels Coding type: 0 (Refer to stream header) Word length: Refer to stream header Sampling freq.: Refer to stream header Channel allocation: --- --- --- --- --- --- FR FL Channel status bits: Application: Consumer Sample words: LPCM Copyright asserted: Yes Format info: Default Mode: 0 Category code: 00 Source number: 0 Channel number: 0 Sampling freq.: 48 KHz Word length: 24 bits

CECx:PING?	Runs a CEC ping test from:
	the HDMI Tx (x = 1)
	or
	the HDMI Rx (x = 2) port.
		CECx:PING <LA>
		<results>
		Where x = 0 for the HDMI Rx port and x = 1 for the HDMI Tx port.
		Where LA = the logical address of the device you want to ping.
			To ping an HDTV from the 780/780AH HDMI Tx port:
			`CEC1:PING 00`
			`TV (LA=0) found`

CPAG	Enables or disables HDCP on the HDMI Rx port.	CPAG <enable>
		CPAG?
		Where enable is:
		0 = disable
		1 = enable
			To disable HDCP on the HDMI Rx port:
			`CPAG 0`
			`ALLU`

DIDL	Loads an EDID file into memory in preparation to apply it to the Rx port with the DIDU command.	DIDL <file.xml>
		Where file.xml is an EDID file stored in the 780/780AH memory.
			To load an EDID file and apply it to the Rx port:
			`DIDL my720p.xml`
			`DIDU`

DIDU	Applies an EDID file loaded with DIDL to the Rx.	DIDU	To load an EDID file and apply it to the Rx port:
			`DIDL my720p.xml`
			`DIDU`

Table 11-3: List of Commands – For Testing HDMI Source Devices			
Command	**Description**	**Syntax**	**Command Example**

HPPW	Sets the hot plug pulse width on the HDMI In port.	HPPW *<pulse>*
		HPPW?
		<pulse>
		Where *pulse* can be within the range of:
		100 to 4000 milliseconds
			To set the hot plug pulse width:
			`HPPW 99`
			`HPPW?`
			`99`

IFAU	Reads inoframes.	IFAU	See IFAD? Below.

IFAD?	Displays the contents of a specific type of inoframe.	IFAU
		IFAD? *<inoframe packet>*
		Where *inoframe packet* is the header number assigned to the inoframe type in the HDMI specification:
		- VSIF = 81
		- AVI = 82
		- SPD = 83
		- AUD = 84
		- MPEG = 85
			To display the contents of the vendor specific inoframe:
			`IFAD? 81`
			`Vendor-Specific`
			`InfoFrame:`
			`Vendor ID: 0x000C03`
			`(HDMI, LLC)`
			`HDMI Video Format:`
			`None`
			`Checksum OK. Version:`
			`1, Length: 4`
			`Raw data: 81 01 04 6B`
			`03 0C 00 00`

TMAU	Invokes timing analyzer.	TMAU	To initiate a timing test: `TMAU` **Note**: Then use one or more of the TMAX commands below.
TMAX:HTOT?	Reads horizontal total pixels.	TMAX:HTOT?	To read horizontal total pixels: `TMAX:HTOT?`
TMAX:HRES?	Reads horizontal active pixels.	TMAX:HRES?	To read horizontal active pixels: `TMAX:HRES?`
TMAX:HSPD?	Reads horizontal sync pulse delay	TMAX:HSPD?	To read horizontal sync pulse delay: `TMAX:HSPD?`
TMAX:HSPW?	Reads horizontal sync pulse width	TMAX:HSPW?	To read horizontal sync pulse width: `TMAX:HSPW?`
TMAX:HSPP?	Reads horizontal sync pulse polarity	TMAX:HSPP? 1 = positive 2 = negative	To read horizontal sync pulse polarity: `TMAX:HSPP?`
TMAX:SCAN?	Reads scan type	TMAX:SCAN? 1 = progressive 2 = interlaced	To read the scan parameter: `TMAX:SCAN?`
TMAX:VRAT?	Reads vertical frame rate	TMAX:VRAT?	To read vertical frame rate: TMAX:VRAT?

Table 11-3: List of Commands – For Testing HDMI Source Devices

Command	Description	Syntax	Command Example
TMAX:VTOT?	Reads vertical total pixels (lines)	TMAX:VTOT?	read vertical total pixels (lines): `TMAX:VTOT?`
TMAX:VRES?	Reads vertical active pixels (lines)	TMAX:VRES?	To read vertical active pixels (lines): `TMAX:VRES?`
TMAX:VSPD?	Reads vertical sync pulse delay	TMAX:VSPD?	To read vertical sync pulse delay: `TMAX:VSPD?`
Note: The commands are not case sensitive.			

Table 11-4 below provides the list of commands supported for testing HDMI source devices:

Table 11-4: List of Commands – For Testing HDMI Cables and Distribution Networks

Command	Description	Syntax	Command Example

CBLT?	Cable Test. Runs pseudo random noise error test on the TMDS R,G,B channels of an HDMI cable.	CBLT?
		<x errors>
		Where *x errors* is the number of errors detected on R, G and B channels.
			To run a pseudo random noise error test on the TMDS R,G,B channels of an HDMI cable:
			`CBLT?`
			`0 errors`

CBL2?	Runs continuity test on +5V, Hot Plug and DDC leads in an HDMI cable.	CBL2?
		<+5v results>
		>Hot Plug results>
		<DDC results>
		Where *+5V results, hot plug results* and *DDC results* indicate Pass or Fail for each lead or lead pair.
			To run a cable test on the +5V, DDC and hot plug leads:
			`CBL2?`
			`+5v: PASS`
			`Hot Plug: PASS`
			`DDC: PASS`

Table 11-5 below provides the list of commands supported for running the Frame Compare test:

Table 11-5: List of Commands – For Testing Distribution Networks with the Frame Compare Test

Command	Description	Syntax	Command Example
PDAX:CAPF	Initiates the capture of a reference frame for the Frame Compare test.	PDAX:CAPF	To capture a reference frame: `PDAX:CAPF`
PDAX:FRMS	Specifies the number of frames to capture during the Frame Compare test.	PDAX:FRMS *<frames>* Where *frames* are the number of frames that you want to capture and compare to the reference frame. Valid values are 0-250. Default value is 10. You can query the current value with: PDAX:FRMS?	To specify that 100 incoming frames will be used to compare with the reference frame: `PDAX:FRMS 100`

Table 11-5: List of Commands – For Testing Distribution Networks with the Frame Compare Test

Command	Description	Syntax	Command Example
PDAX:REFG	Enables or disables auto reference capturing for the Frame Compare test. If this parameter is disabled you have to manually capture a reference frame.	PDAX: REFG <enable> Where *enable* is either 0 to disable or 1 to enable auto reference capturing. Default value is o to disable. You can query the current value with: PDAX: REFG?	To enable auto reference capturing: `PDAX: REFG 1`

PDAU	Initiates the capture of the number of frames specified by the PDAX:FRMS command and compares those frames with the captured reference frame.	PDAU	To capture a reference frame and compare 100 of incoming frames to the reference frame:
			`PDAX:CAPF`
			`PDAX:FRMS 100`
			`PDAU`

PDAX:ERRQ?	Returns the number of pixel errors that occurred during the comparison.	PDAX:ERRQ?	To query for the number of errors following the pixel error comparison (PDAU): `PDAX:ERRQ?`

XVAI	Sets the active digital video interface. Query returns the active digital video interface	XVAI <interface>
		Where *interface* is one of:
		0 – HDMI
		
		XVAI?
		Returns *interface*
			To set the digital video interface to HDMI:
			`XVAI 0`
			`ALLU`
			To query the current value:
			`XVAI?`
			`0`

Table 11-6 below lists the format names, their resolutions and frame rates for television formats. For command line control you would use the format name as the argument for the FMTL command.

Table 11-6: List of HDTV Format Names for Command Line Applies to: HDMI, DVI (TV), Analog YPbPr Video Signal Types			
Syntax for Format Name	Resolution	Frame Rates (Hz)	Command example
480i[frame rate] e.g.: 480i29	H: 720; V: 480	29.97, 30, 59.94, 60, 119.88, 120	`FMTL 480i60` `FMTU`
480p[frameRate] e.g.: 480p59	H: 720; V: 480	59.94, 60, 119.88, 120	`FMTL 480p60` `FMTU`
576i[frame rate] e.g.: 576i25	H: 720; V: 576	25, 50, 100	`FMTL 576i25` `FMTL`
576p[frameRate] e.g.: 576p50	H: 720; V: 576	50, 100	`FMTL 576p50` `FMTU`
720p[frameRate] e.g.: 720p25	H: 1280; V: 720	24, 25, 29.97, 30, 59.94, 60, 100, 119.88, 120	`FMTL 720p60` `FMTU`
1080i[frameRate] e.g.: 1080i25	H: 1920; V: 1080	25, 29.97, 30, 50, 59.94, 60	`FMTL 1080i59` `FMTU`
1080p[frameRate] e.g.: 1080p30	H: 1920; V: 1080	25, 29.97, 30, 50, 59.94, 60	`FMTL 1080p60` `FMTU`

Table 11-7 lists some of the format names for computer formats. For command line control you would use the format name as the argument for the FMTL command as shown in the example

Note: The following table *only shows a sample of some of the more common formats*. The other names can be obtained from the list on the 780/780AH itself.

Table 11-7: Partial List of Computer Format Names for Command Line Applies to: DVI (Computer) Analog RGB Video Signal Types	
Format Name	**Command example**
640x480_72Hz	`FMTL 640x480_72Hz` `FMTU`
800x600_56Hz	`FMTL 800x600_56Hz` `FMTU`
1024x768_60Hz	`FMTL 1024x768_60Hz` `FMTU`
1280x768_60Hz	`FMTL 1280x768_60Hz` `FMTU`
1280x1024_60Hz	`FMTL 1280x1024_60Hz` `FMTU`
1600x1024_60Hz	`FMTL 1600x1024_60Hz` `FMTU`
1920x1440_60Hz	`FMTL 1920x1440_60Hz` `FMTU`

Table 11-8 below lists the image names. For command line control you would use the image name as the argument for the IMGU command.

Table 11-8: List of Image parameter names for command line					
Image Name	**Example**	**Image Name**	**Example**	**Image Name**	**Example**
SMPTEBar	IMGL SMPTEBar IMGU	Regulate	IMGL Regulate IMGU	Flat_Yel	`IMGL Flat_Yel` `IMGU`
H_Stair (Horizontal)	IMGL H_Stair IMGU	Checker (6x6)	IMGL Checker IMGU	Flat_Blk	`IMGL Flat_Blk` `IMGU`

Pluge	IMGL Pluge
	IMGU
		Focus	IMGL Focus
			IMGU
				Crosshtch (Grid)	`IMGL`
					`Crosshtch`
					`IMGU`

Needle	IMGL Needle
	IMGU
		Multibrst	IMGL Multibrst
			IMGU
				Anmorphic	`IMGL`
					`Anmorphic`
					`IMGU`

HiLoTrk (White Pluge)	IMGL HiLoTrk IMGU	SplitGray (11 vertical bars)	IMGL SplitGray IMGU	GrayBar	`IMGL GrayBar` `IMGU`

Overscan	IMGL Overscan
	IMGU
		LG_V_CBAR
		(Vertical bars)
			IMGL LG_V_CBAR
			IMGU
				Staircase	`IMGL`
					`Staircase`
					`IMGU`

Window1 (30 IRE)	IMGL Window1 IMGU	LG_H_CBAR (Horiz bars)	IMGL LG_H_CBAR IMGU	PulseBar	`IMGL PulseBar` `IMGU`

Table 11-8: List of Image parameter names for command line

Image Name	Example	Image Name	Example	Image Name	Example
Window2 (80 IRE)	IMGL Window2 IMGU	V_3BARS (UL 3 bar pattern)	IMGL V_3BARS IMGU	Rev_Grid	`IMGL Rev_Grid IMGU`
Raster	IMGL Raster IMGU	Flat_Wht	IMGL Flat_Wht IMGU	Linearity	`IMGL Linearity IMGU`
DecodAdj (Color Adjust)	IMGL DecodAdj IMGU	Flat_Red	IMGL Flat_Red IMGU	PRN24Bit (pseudo noise)	`IMGL PRN24Bit IMGU`
DecodChk (Color Decode)	IMGL DecodChk IMGU	Flat_Grn	IMGL Flat_Grn IMGU	ZonePlate (Moving zone plate)	`IMGL ZonePlate IMGU`
ColorBar (75 IRE)	IMGL ColorBar IMGU	Flat_Blu	IMGL Flat_Blu IMGU	User00/24 (User bitmaps)	`IMGL User01 IMGU`
Ramp	IMGL Ramp IMGU	Flat_Cyn	IMGL Flat_Cyn IMGU	Aux Combo Test	`IMGL AuxTest IMGU`
Converge	IMGL Converge IMGU	Flat_Mag	IMGL Flat_Mag IMGU		

12 Using the Keypad

This section provides information and procedures for operating the 780AH with a keypad. The 780AH can support keypad operation to enable efficient production test operation. An RS-232 numeric keypad is used for this application. Supported keypad functions include selection of interface, timing, pattern, and test sequences.

12.1   Connecting a Keypad

A serial terminal keypad can be connected to the 780AH front edge RS-232 connector.
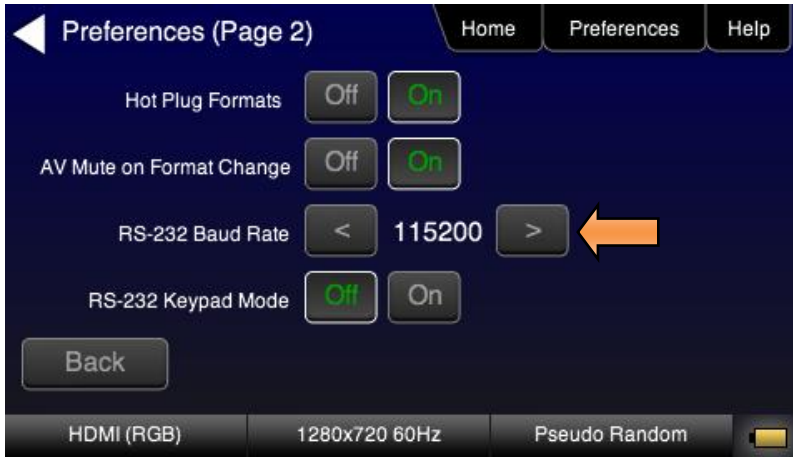

12.2   Enabling and Configuring an RS-232 Keypad

The RS-232 keypad must be enabled and configured from the 780AH **Preferences** menu. Use the following procedures to enable a keypad.

1. From the 780AH **Home** menu, select the **Preferences** tab. The **Preferences** menu will be displayed as shown below.

2. Navigate to the second page using the **More** button.

3. For the **RS-232 Keypad Mode** menu item, select the ON button.

    When selected, the ON button will be highlighted green.

4. Under **RS-232 Baud Rate**, use the arrow keys to select the correct baud rate for the keypad to be used. For the Genovation keypad supplied by Quantum Data, choose 1200 baud. After selecting the correct baud rate, power-cycle the 780AH so that the changes take effect.

12.3   Keypad Functionality

For keypad support, the 780AH uses four configuration files stored in the root directory of the internal flash. Here are the names and functions of the four files:

- **UserKeys.txt**: This file provides mappings of key codes so that the 780AH knows which key has been pressed. This file may be different for each model of keypad that is used. This file should be configured by Quantum Data Engineering, and should not be changed by the customer unless you wish to create a specific test sequence. Procedures for creating a test sequence in the UserKeys.txt file are provided further below. Please contact Quantum Data Applications Engineering if you need this file changed, or if you want to use a different model of keypad.

- **fmtmap.txt:** This file provides mapping of format numbers to specific formats on specific interfaces. Each interface has a range of format numbers associated with it, and these ranges are specified in file intmap.txt. An example of the mapping for this file is depicted in Table 12-2.

- **intmap.txt:** This file specifies the ranges of format numbers assigned to each video interface. An example of the mapping for this file is depicted in Table 12-3.

- **imgmap.txt:** This file provides a mapping of test pattern numbers to the actual test patterns. An example of the mapping for this file is depicted in Table 12-4.

Keypad functions are assigned as shown in Table 12-1 below:

Table 12-1 – Keypad Functions	
Key	**Function**
Num Lock	Timing - Select a format
/	Pattern - Select an image
*	Program – Create a sequence
. or Del	Out or End
-	Go to Previous item
+	Go to Next item

12.4 Selecting a Format (Timing)

A format can be selected by pressing the TIMING key followed by the number that represents the desired timing and interface. The following is an example of how you would select a format using the Format Map file shown in Table 12-2 below. Table 12-3 further below shows a sample mapping between formats (timings) and interfaces.

```
TIMING
352
ENTER
```

This will change the timing format to 1080p60 on the HDMI interface. Then the "Previous" and "Next" keys can be pressed to sequence through the format list. The following table is an example of a map between formats and keypad numbers that you would select.

Table 12-2 – Example Format Map File		
Format Number	**Format Name**	**Interface-Specific**
301	NTSC44	TV
302	NTSC-J	
303	NTSC-M	
304	PAL-BDGH	
305	PAL-N	
306	PAL-NC	
307	PAL-M	
308	PAL-60	
310	480i30	BNC (YPbPr)
311	576i25	
312	480p59	
313	576p50	
314	720p60	
315	720p59	
316	720p50	
317	1035i30	
318	1035i24	
319	1152i25	
320	1080i25	
321	1080i24	
322	1080i29	
323	1080i30	
324	1080p24	
325	1080p24	
326	1080p25	

327	1080p29	
328	1080p30	BNC (YPbPr)
329	1080p50	
330	1080p59	
331	1080p60	
332	480i24	
333	480p60	
334	1080i30	DVI
335	720p60	
336	1080p59	
341	480i24	
342	480i24	
343	576i25	
344	480p60	
345	480p59	
346	576p50	
347	720p60	
348	720p50	
349	1080i30	
350	1080i25	
351	1080p50	
352	1080p60	
353	DMT0659	
354	DMT0860	
355	DMT1060	HDMI
368	1080p59	
370	720p59	
371	1080p50	
372	1080i25	
373	1080i24	
374	576i25	
375	480i30	
396	720p59	
397	DMT0660	
398	480p60	

Table 12-3 – Format Range per Interface Map	
Interface Number	Interface Name
301 - 309	TV
310 - 331	BNC + S-Video + CVBS (ED/HD)
332 - 336	DVI
341 - 398	HDMI
400 - 499	VGA(HD15) Analog RGB
500 - 599	VGA(HD15) Analog YPbPr

12.5   Selecting a Test Pattern (Image)

A test pattern (image) can be selected by pressing the PATTERN key followed by the number that represents the desired pattern. The following is an example of how you would select a test pattern using the Image Map file shown in Table 12-4 below.

```
PATTERN
001
ENTER
```

This will display the SMPTEBar pattern at the current format and on the current interface. Then the "Previous" and "Next" keys can be pressed to sequence through the pattern list.

Table 12-4 – Example Image Map File	
Image Number	Image Name
001	SmpteBar
002	TVBar100
003	TVBar_75
004	H_Stair
005	Pluge
100	Ramp
101	SplitGray
200	LG_V_CBAR
300	EcoFlower
301	Halation
302	Loading
400	Flat
401	Flat93
402	Flat87
403	Flat80
404	Flat73
405	Flat67

406	Flat60
407	Flat53
500	PRN24Bit

12.6   Programming a Test Sequence using the keypad

You can create and run test sequences in one of two ways.

▪ You can program a test sequence through the keypad using the procedures below.
▪ You can create a sequence by adding a set of commands to the UserKeys.txt file using the procedures below.

Keypad functions are assigned as shown in Table 12-5 below:

Table 12-5 – Keypad Functions	
Key	**Function**
Num Lock	**TIMING** - Select a format
/	**PATTERN** - Select an image
*	Program **PROG** – Create a sequence
. or Del	**OUT** or **END**
-	Go to Previous item
+	Go to **NEXT** item

1.   Define a sequence as follows:

Note: Information after "//" are comments to help you understand.

```
OUT          // press the OUT key to start the creation of the sequence
001          // enter the sequence number
PROG         // press the PROG key to begin programming
TIMING
344          // 480p60 HDMI
PATTERN
001          // SmpteBar pattern
NEXT
TIMING
347          // 720p60 HDMI
PATTERN
004          // horizontal stair
NEXT
TIMING
352          // 1080p60 HDMI
PATTERN
100          // ramp
END          // press the END key to halt the of sequence programming
```

2.   Play back a sequence as follows.

```
OUT
001
```

```
NEXT
NEXT
(repeat NEXT or PREVIOUS)
```

12.7   Programming a Test Sequence in the UserKeys file

You can also create a test sequence by including a set of commands in the UserKeys.txt file. The UserKeys.txt file is primarily used internally for mapping the keypad keys to a set of commands for general keypad use. However you can also use the UserKeys.txt file to store programming test sequences similar to macros.

The following is an example of a UserKeys.txt file which shows the keypad mapping and more importantly a test sequence instruction set (#F0, #F1 and #FF). Note that there are two macro test sequences defined #F0 and #F1. The #FF definition is a macro that simply disables manufacturing mode in the 804 test instrument. The #F0 macro also shows a special use case for the kbrd command. In this case the kbrd f0 command will cause the macro to loop back on itself such that the #F0 macro continuously loops.

Note: Do not change any of the keypad mapping commands. These are the commands such as xkpm, xkpkj, xkpu, xkpi. Modifying these commands will affect the general functions of the keypad.

```
S xkpm 2
T xkpm 1
U xkpm 4
V xkpj 1
W xkpj -1
X xkpu
Y xkpi 1
Z xkpi 2
[ xkpi 3
\ xkpi 4
] xkpi 5
^ xkpi 6
_ xkpi 7
` xkpi 8
a xkpi 9
b xkpi 0
c xkpm 3
#F0 xvsi 4;fmtl 720p60;imgl smptebar;fmtu;dlay 5000;fmtl 480p60;imgl
h_stair;fmtu;dlay 5000;fmtl 1080i30;imgl needle;fmtu;dlay 5000;fmtl
1080p60;imgl decodchk;fmtu;dlay 5000;fmtl 480i30;imgl v_3bars;fmtu;dlay 5000
#F1 xvsi 4;fmtl cvt1460d;imgl checkby6;fmtu;dlay 5000;fmtl dmt1170_;fmtu;dlay
5000;fmtl dmt0660;fmtu;dlay 5000
#FF mfgm 0
```

To run a test sequence macro stored in the UserKeys.txt file you use the kbrd command on the command line as follows.

```
 KBRD F0    // This command would run the F0 macro in the UserKeys.txt file
               (case is not important)
```

13 Upgrading the 780/780AH

13.1   Upgrading the Firmware and Gateware on your 780/780AH Handheld Test Instrument for HDMI

You can upgrade the firmware and gateware on your 780/780AH through the USB interface. In order to upgrade the 780/780AH firmware and gateware you have to put the 780/780AH in the "Disk" mode. This is not the default mode.

Important Note: Be sure to check the Release Notes on the Quantum Data website for additional information on upgrading for a particular release. The instructions below may not apply in all upgrade scenarios. If you have any questions or encounter a problem with the upgrade, contact Quantum Data customer support.

Use the following procedure to upgrade the firmware and gateware for your 780/780AH. Note that the files will also come with a bootstrp.bin file.

1. Download the 780/780AH firmware and gateware (if necessary) files from the Quantum Data website http://www.quantumdata.com/downloads/index.asp to your PC and unzip the file.

2. Connect the 780/780AH to a PC host via the USB cable provided.

3. Touch select the **Preferences** from the 780/780AH top menu.

4. Choose **Disk** for the **USB Mode** (refer to the screen below).

5. Power cycle the 780/780AH.

    The 780/780AH appears as a mass storage device like any other USB drive.

6. Transfer the bootstrp.bin from your PC to the 780/780AH using standard Windows drag and drop techniques.

7. Transfer the new firmware (VP500app.bin) from your PC to the 780/780AH using standard Windows drag and drop techniques.

8. (if necessary) Transfer the new gateware file (for 780: Xilinx.bin; for 780AH: 780AHfpga.bin) from your PC to the 780/780AH using standard Windows drag and drop techniques.

9. Use Windows Eject function on the 780/780AH USB device then physically disconnect the 780/780AH from your PC.

10. Reboot the 780/780AH.

11. Navigate to the Help window.

12. Activate the gateware (if you are updating the FPGA Flash) by touching the associated **Update** button.

    A confirmation prompt is displayed. Touch select **Confirm** to initiate the firmware upgrade. (**Note**: The screen on your unit may appear slightly different.)

The screen will show several messsages indicating the progress of the update. Once the gateware update has completed the following screen appears.

13. Reboot the 780/780AH by power cycling.

14. Navigate back to the **Help** menu to access the upgrade screen.

15. Activate the firmware (Application Flash) by touch selecting the associated **Update** button.

    A confirmation prompt is displayed as shown below. Touch select **Confirm** to initiate the firmware upgrade.

The screen will show several messsages indicating the progress of the update. Once the firmware update has completed the following screen appears.

16. Reboot the 780/780AH by power cycling.

17. Touch select the **Preferences** from the 780/780AH top menu.

18. Choose **COM** for the **USB Mode** (refer to the screen below).

19. Power cycle the 780/780AH.

20. Navigate back to the Help menu to verify the upgraded versions.

END OF USER GUIDE