



quantumdata

980 HDMI Video Generator Module Video Pattern Testing of HDMI HDTVs & Displays

980 HDMI Video Generator Module



980 HDMI Video Generator Module Overview

980 HDMI Video Generator Module - Features & Benefits

- Supports speeds up to 300 MHz for testing 4K UHD displays:
 - Supports 4K x 2K Ultra HD at frame rates up to 30Hz.
 - Supports 4K x 2K Ultra HD at 50/60Hz with HDMI 2.0 4:2:0 pixel encoding.
 - Supports 1080p at 120Hz.
 - Supports HDMI 2.0 21:9 formats.
- Supports deep color up to pixel clock rate of 165MHz; TMDS clock rates of 2.25Gb/s.
 - 1080p at 60Hz frame rate at 36-bit color.
- Video analyzer for basic functional testing of HDMI source devices.

980 HDMI Video Generator Module Configurations

980 HDMI Video Generator Module – Slot 2 of 980

- 980 HDMI Video Generator module placed in the second slot of the 980 chassis.
- 980 HDMI Protocol Analyzer module always equipped in first slot.



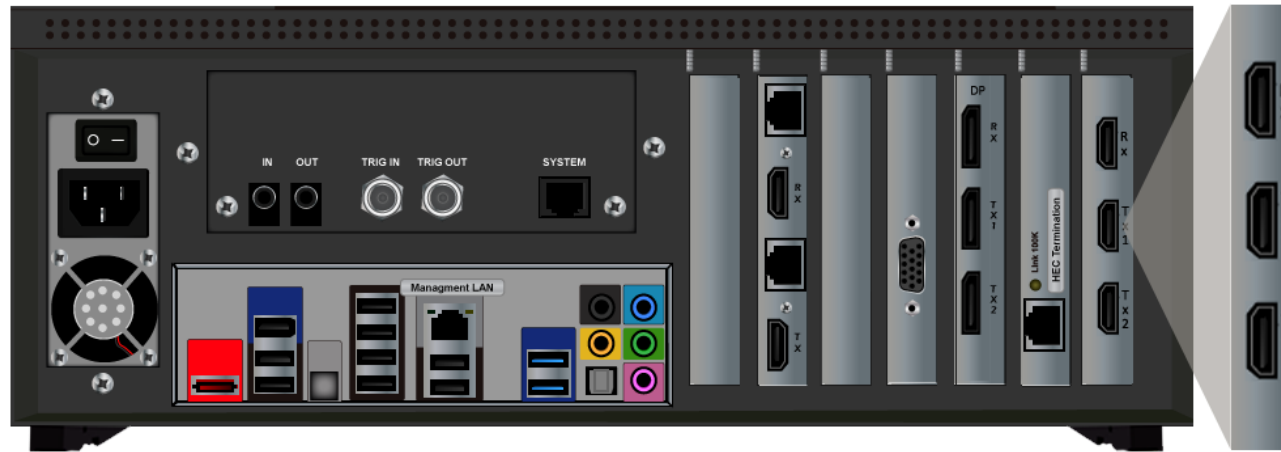
980 HDMI Video Generator Module – Slot Config in 980B

- 980 HDMI Video Generator module placed in slots 1,3,5,6, or 7 of the 980B chassis.



980 HDMI Video Generator Module – Slot Config in 980R

- 980 HDMI Video Generator module placed in slots 1,3,4,5,6, or 7 of the 980R chassis.



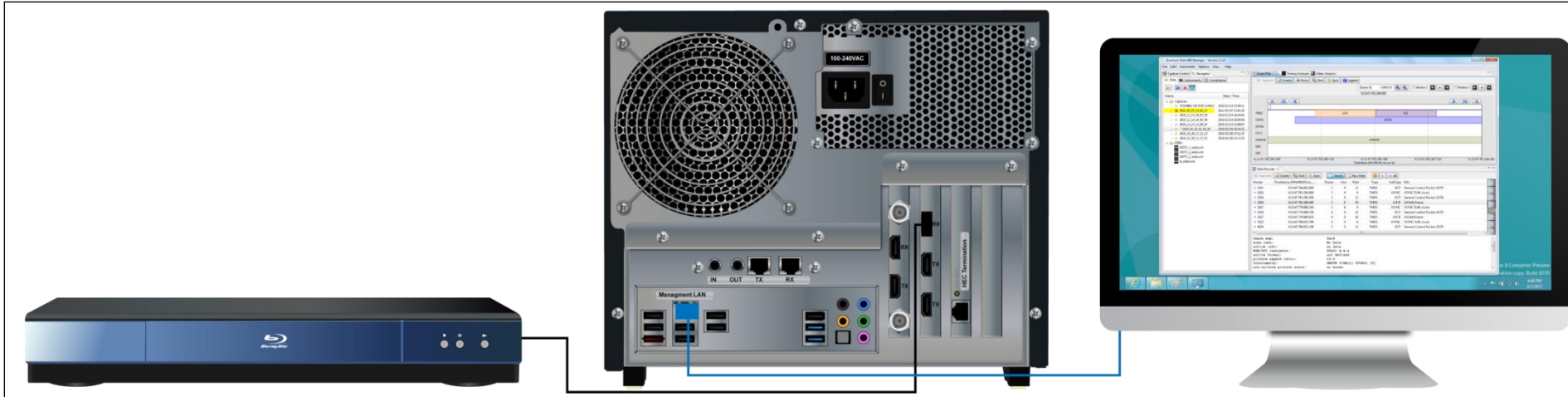
980 HDMI Video Generator Module - Configuration

- 980 HDMI Video Generator testing sink – front and rear view



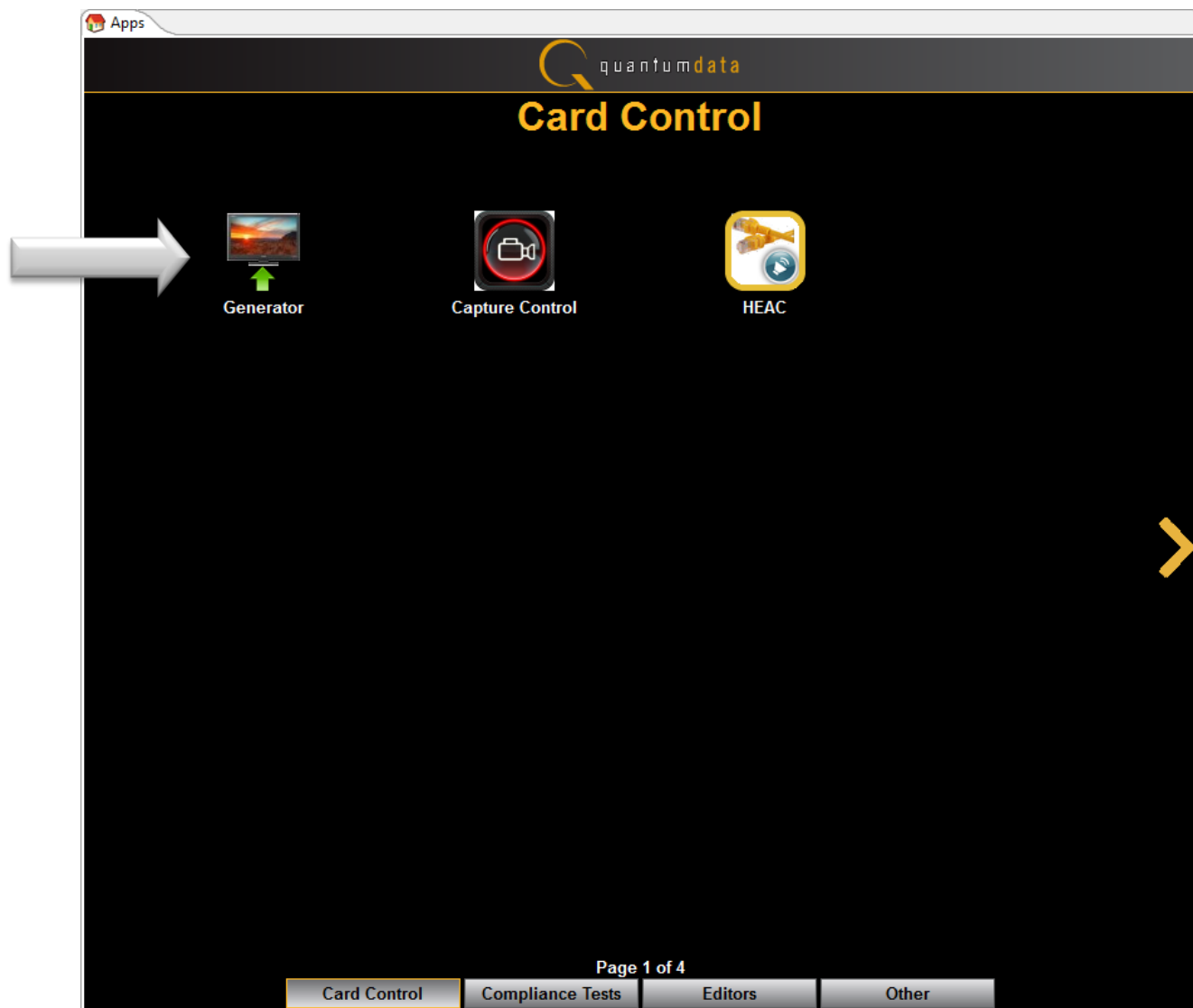
980 HDMI Video Generator Module – Video Analyzer

- (980 HDMI Video Generator now with an analyzer for confidence testing of HDMI source devices.



980 HDMI Video Generator Module Operation – Video Pattern Testing

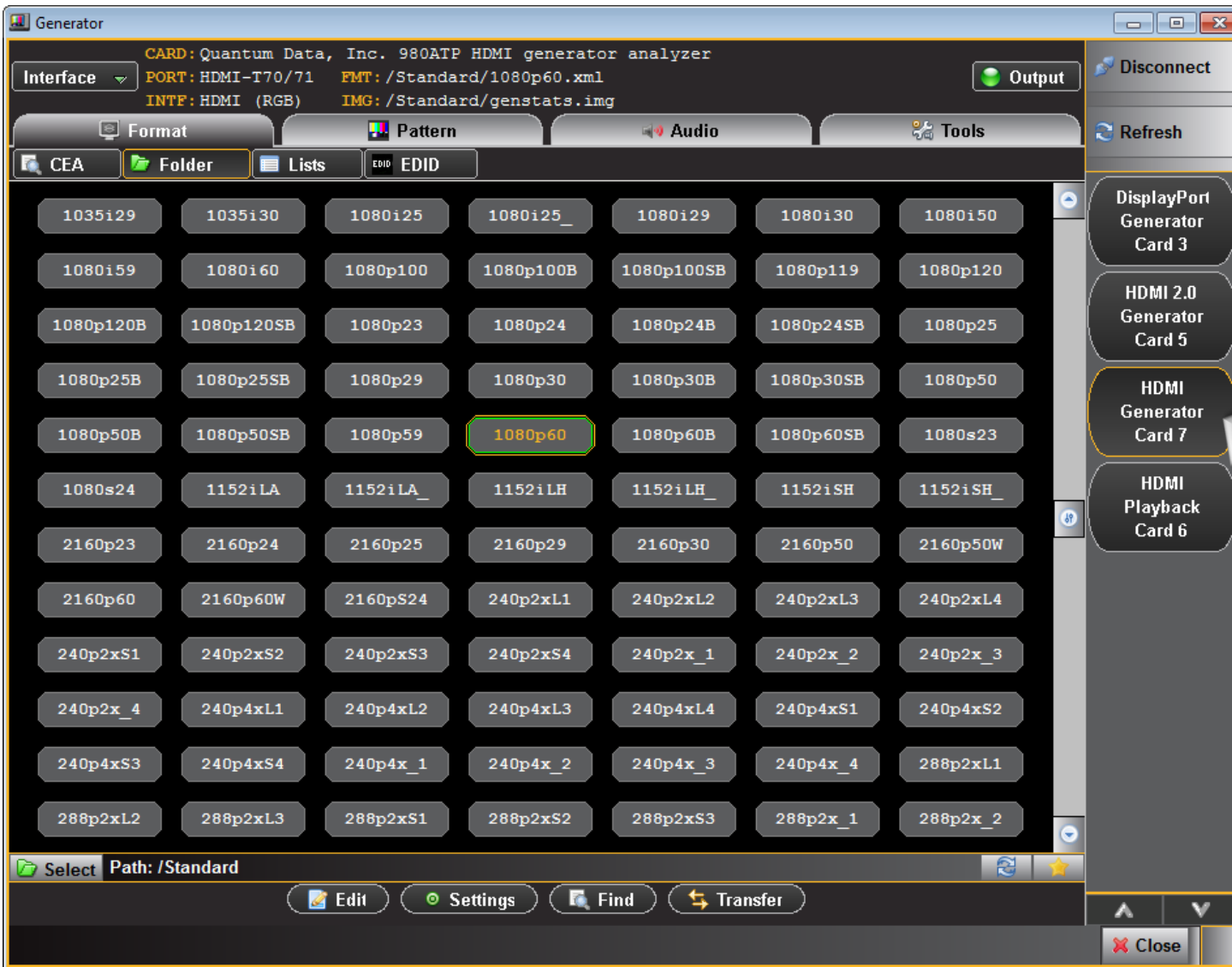
980 HDMI Video Generator Module – HDMI Transmitter



Select video mode:

- Select HDMI Video Generator module.

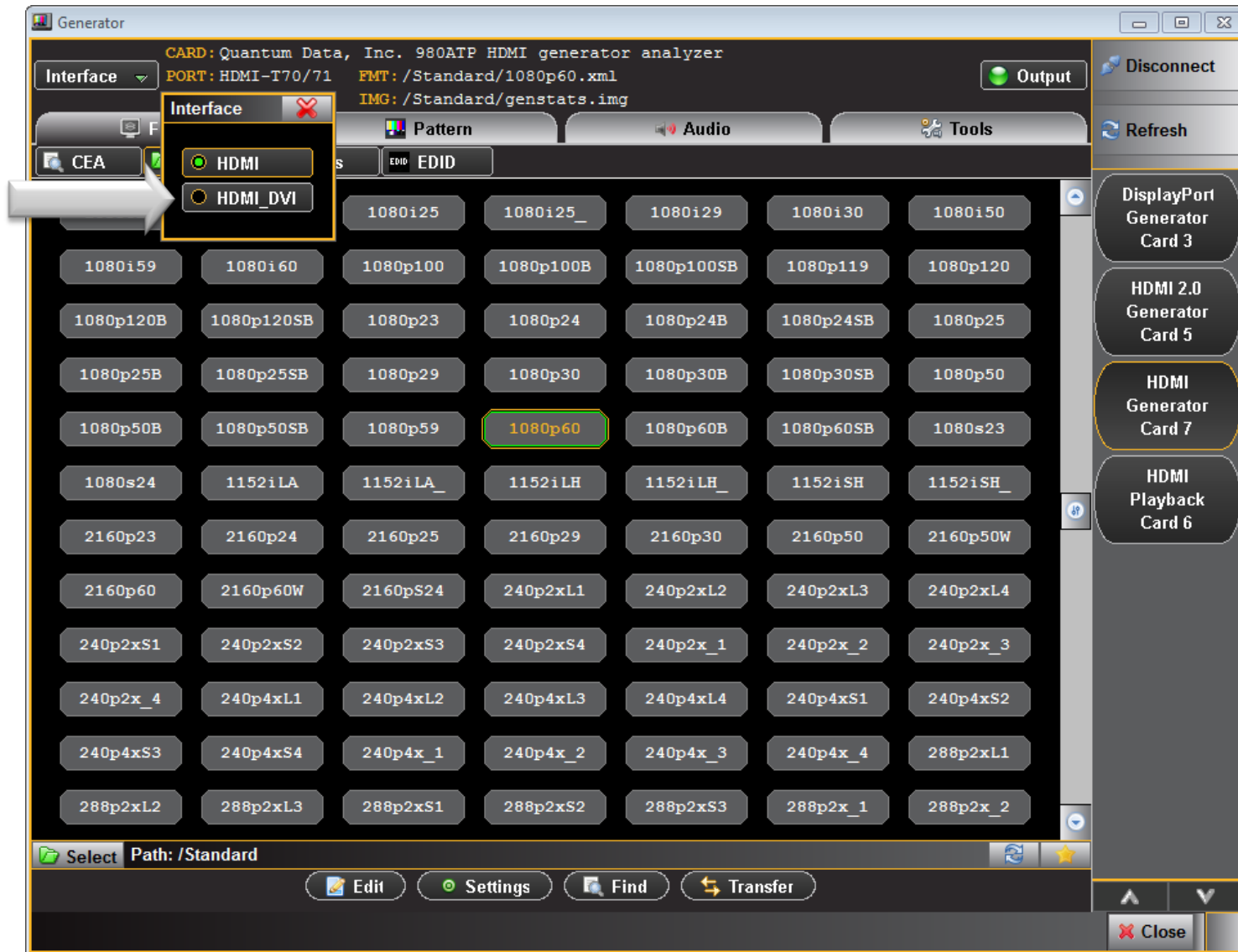
980 HDMI Video Generator Module – HDMI Transmitter



Select video mode:

- Select HDMI Video Generator Tx interface.

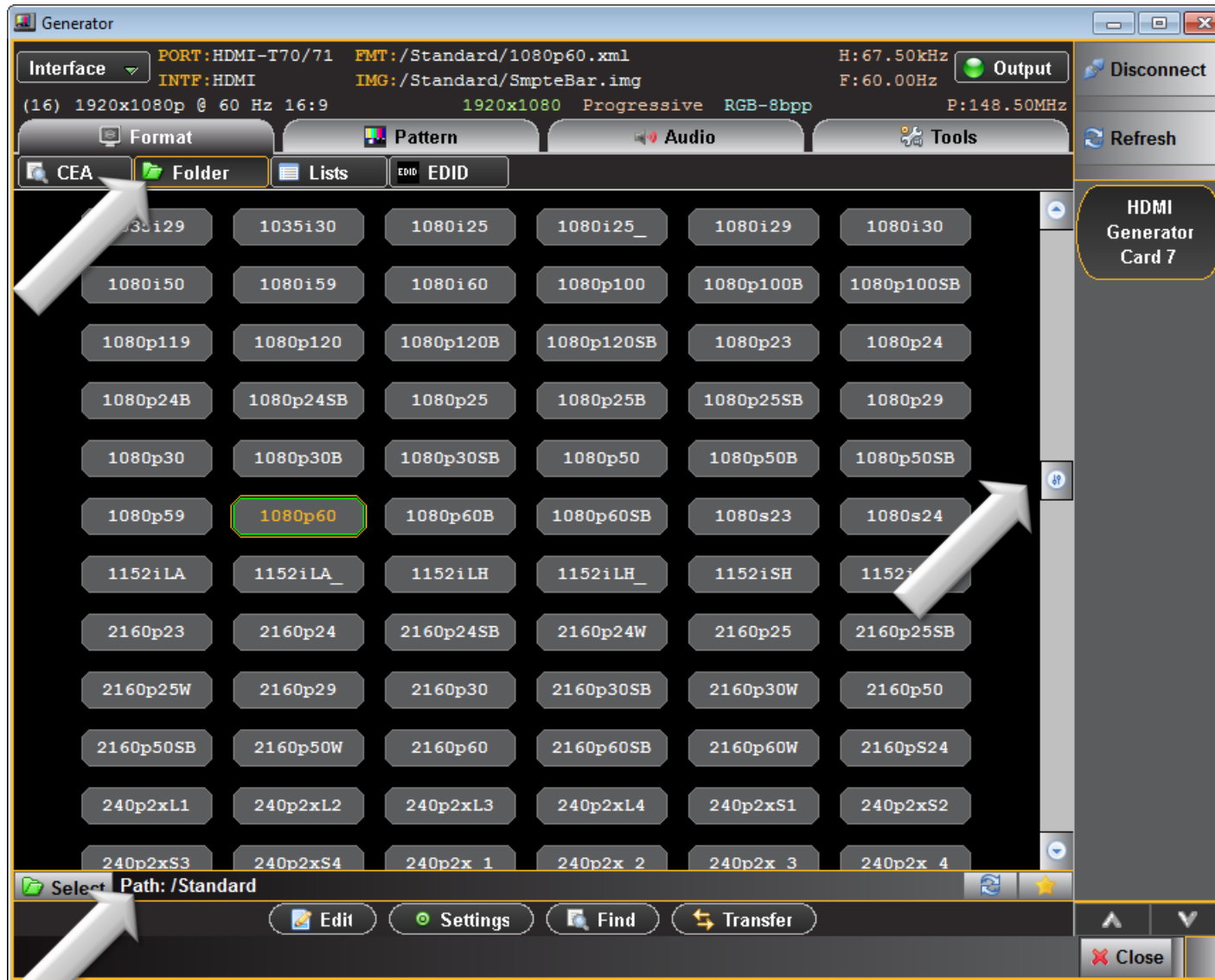
980 HDMI Video Generator Module – HDMI Transmitter



Select video mode:

- Select between HDMI and DVI.

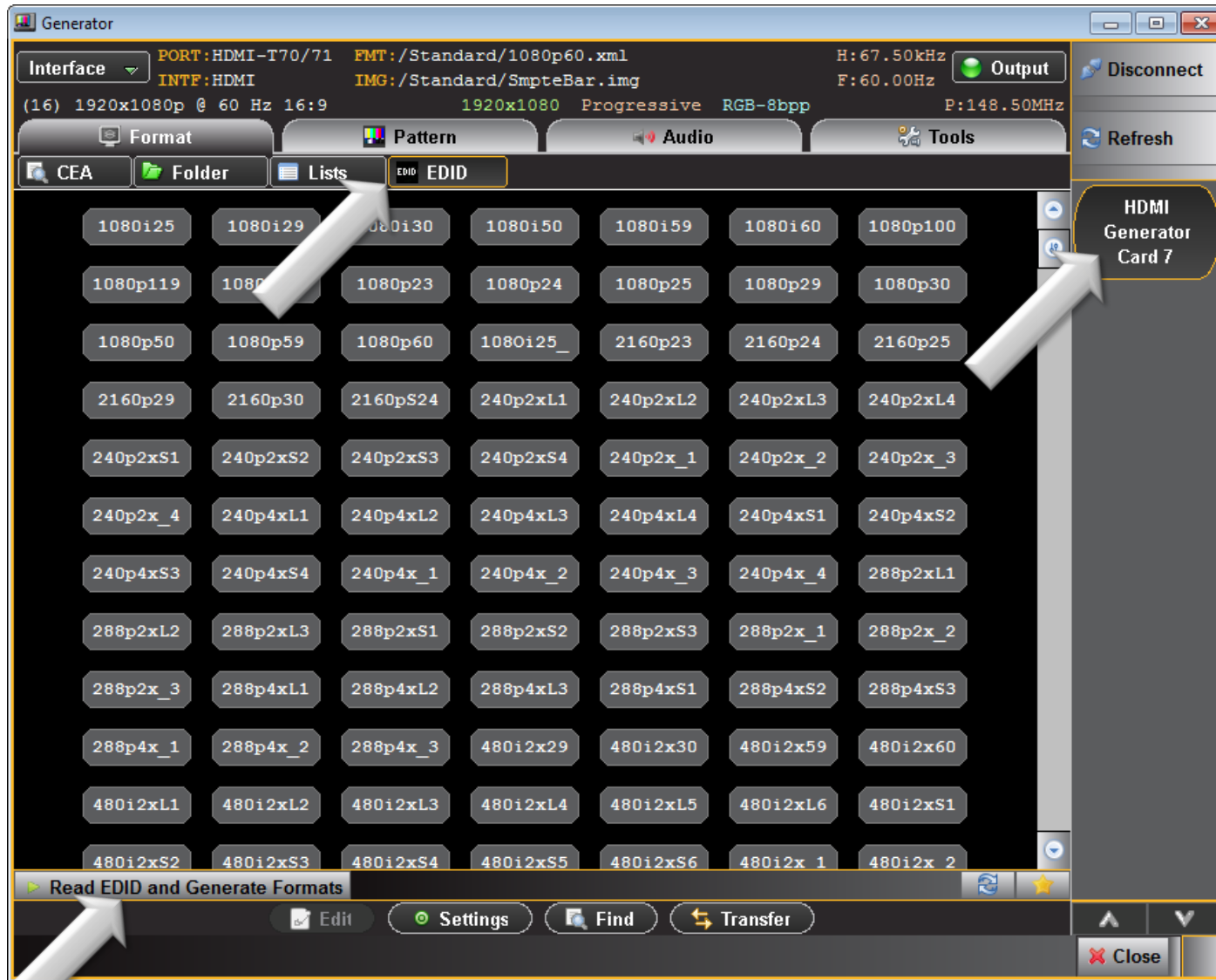
980 HDMI Video Generator Module – Format Selection



Select Format (Timing) by browsing:

- Select timing format from Format Library.
- Over 600 formats to select from.
- Use Format Editor to create additional custom formats.
- Scroll through list of test patterns.

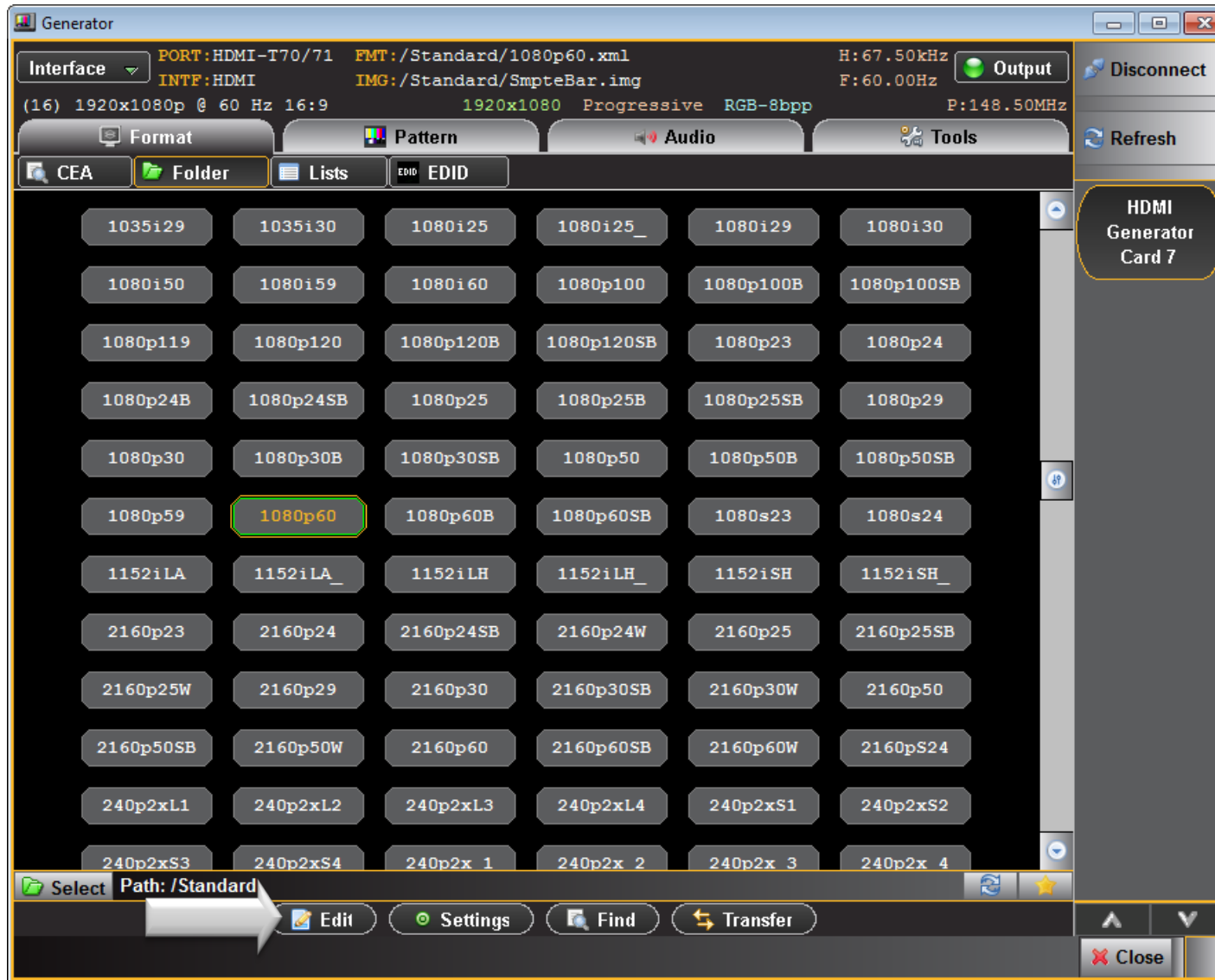
980 HDMI Video Generator Module – Format Selection



Select Format (Timing) by browsing:

- Configure list of formats based on EDID of connected display.
- EDID format list active shown on lower status panel.

980 HDMI Video Generator Module – Format Selection



Viewing detailed video parameters:

- Select Edit to view parameters in Format Editor (next page).

980 HDMI Video Generator Module – Format Selection

The screenshot shows the 'Format Editor' window with the 'Timing' tab selected. The interface is divided into several sections:

- Calculated:** Pixel Rate 74.250000 MHz, 13.468013 ns.
- Rate:** Horizontal 33.750000 KHz, Vertical 30.000000 Hz.
- Active:** Horizontal 1920 Pixels (25.858586 us), Vertical 1080 Lines (32.000000 ms).
- Blank:** Horizontal 280 Pixels (3.771044 us), Vertical 45 Lines (1.333333 ms).
- Total:** Horizontal 2200 Pixels (29.629630 us), Vertical 1125 Lines (33.333333 ms).
- Pulse Delay:** Horizontal 88 Pixels (1.185185 us), Vertical 4 Lines (0.118519 ms).
- Pulse Width:** Horizontal 44 Pixels (0.592593 us), Vertical 5 Lines (0.148148 ms).
- Other parameters:** Serration width Adjustment 0 Pixels, H to V Pulse Delay 0 Pixels, Horizontal Broad Pulse Delay 0 Pixels, Eq. Before 0 Lines, Eq. After 0 Lines.
- Scan Type:** Progressive (selected), Interlace.
- Other options:** Back Porch, Clock Pulse, PreEmphasis, DC Balance, Flat Front Porch, TriLevel (checked), Repeat Field.

At the bottom, there are buttons for 'Use', 'New', 'Open', 'Save', and 'Close'.

Viewing detailed video parameters:

- View detailed video and audio parameters on Format Editor.

980 HDMI Video Generator Module – HDMI Transmitter



Intelligent selection of CEA format timings:

- Use CEA button for filtered intelligent selection.
- Work from left to right.
- Format VIC list presented on right as you progress.

980 HDMI Video Generator Module – Format Selection



Configure Format video settings:

- Select timing format from Format Library.
- Configure format parameters such as Color Space, Sampling, Range and Bits per Component.

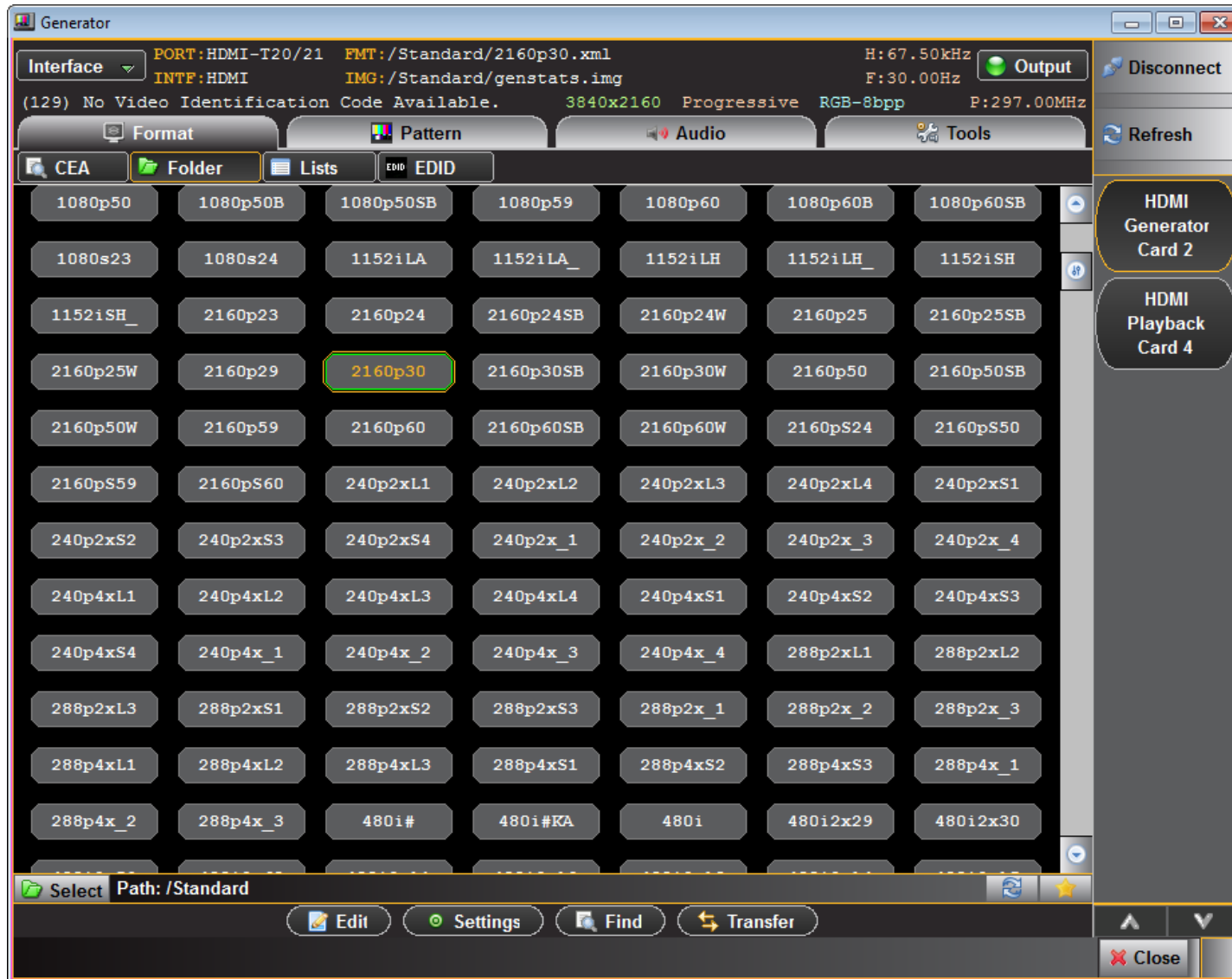
980 HDMI Video Generator Module – Settings Deep Color



Configure Format video settings:

- Select Deep Color at 10, 12 or 16 bits per component.

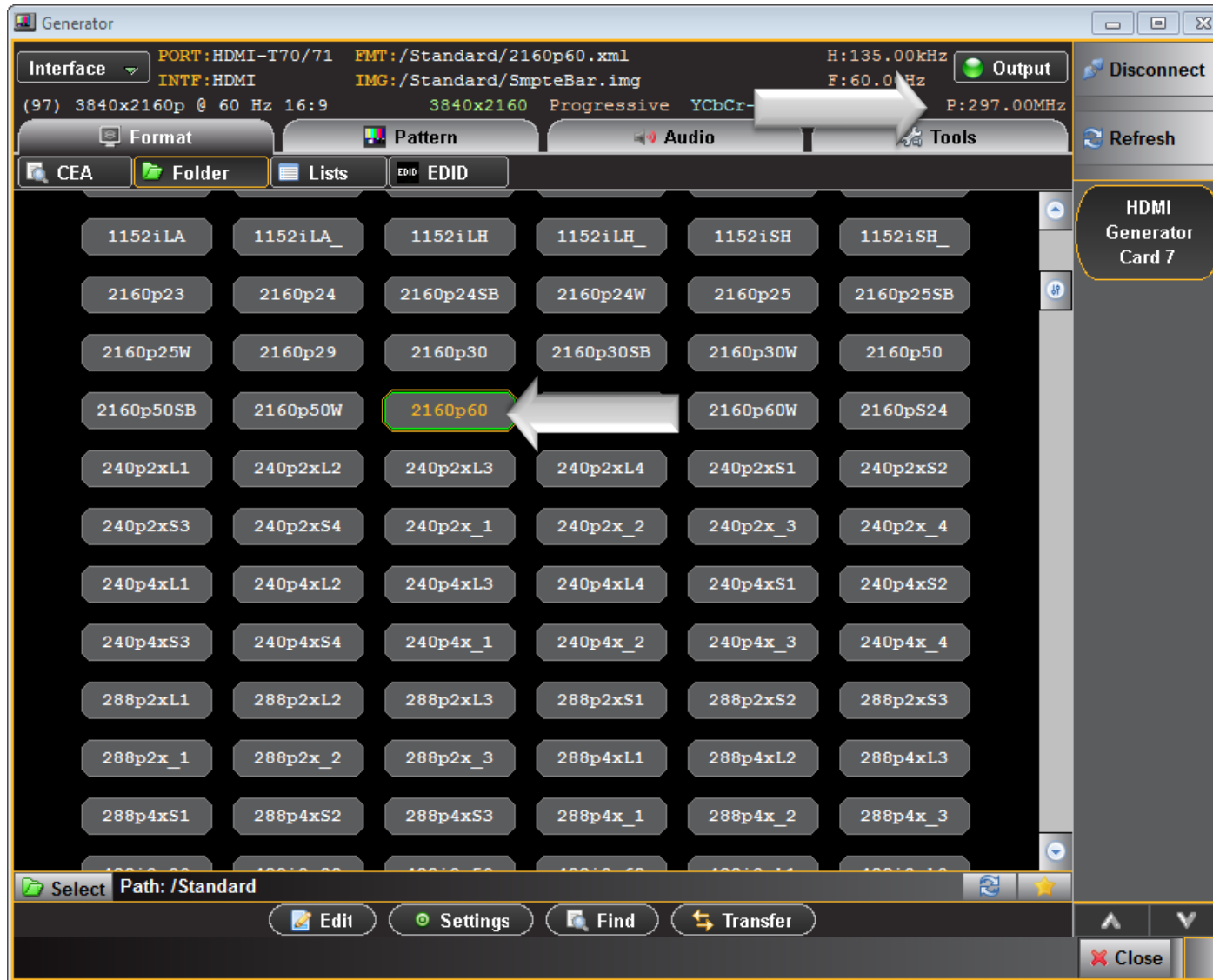
980 HDMI Video Generator Module – Format Selection 4K



Select Formats:

- Select HDMI 4K x 2K format at 30Hz.
- Note pixel clock at 297MHz.

980 HDMI Video Generator Module – Format Selection 4K



Select Formats:

- Select HDMI 4K x 2K format at 50/60Hz which automatically selects HDMI 2.0 4:2:0 pixel encoding (next slide).

980 HDMI Video Generator Module – Format Selection 4K



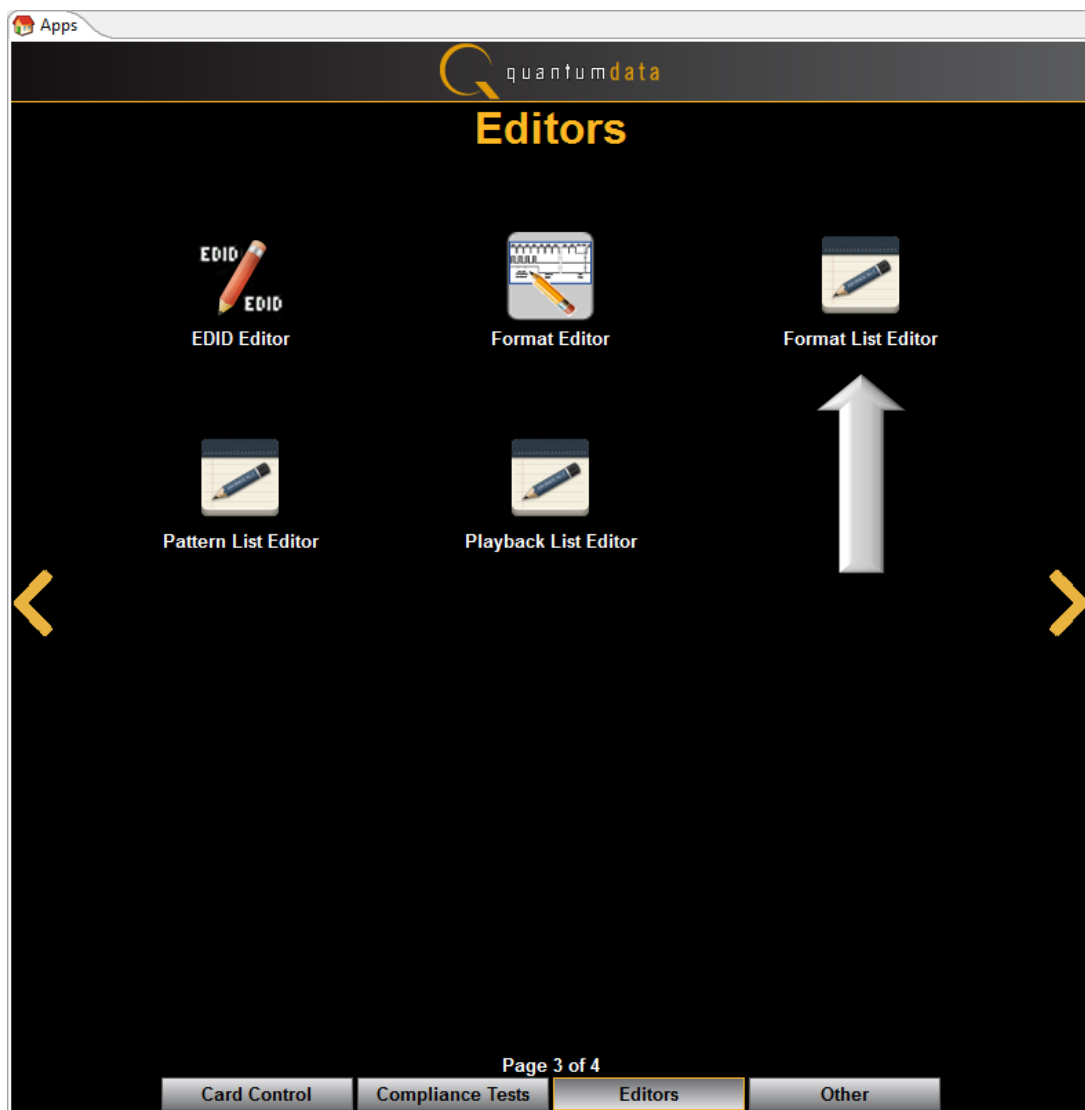
Select Formats:

- Select HDMI 4K x 2K format at 50/60Hz which automatically selects HDMI 2.0 4:2:0 pixel encoding.
- Note pixel clock at 297MHz.

980 HDMI Video Generator Module

Creating Custom Format Lists

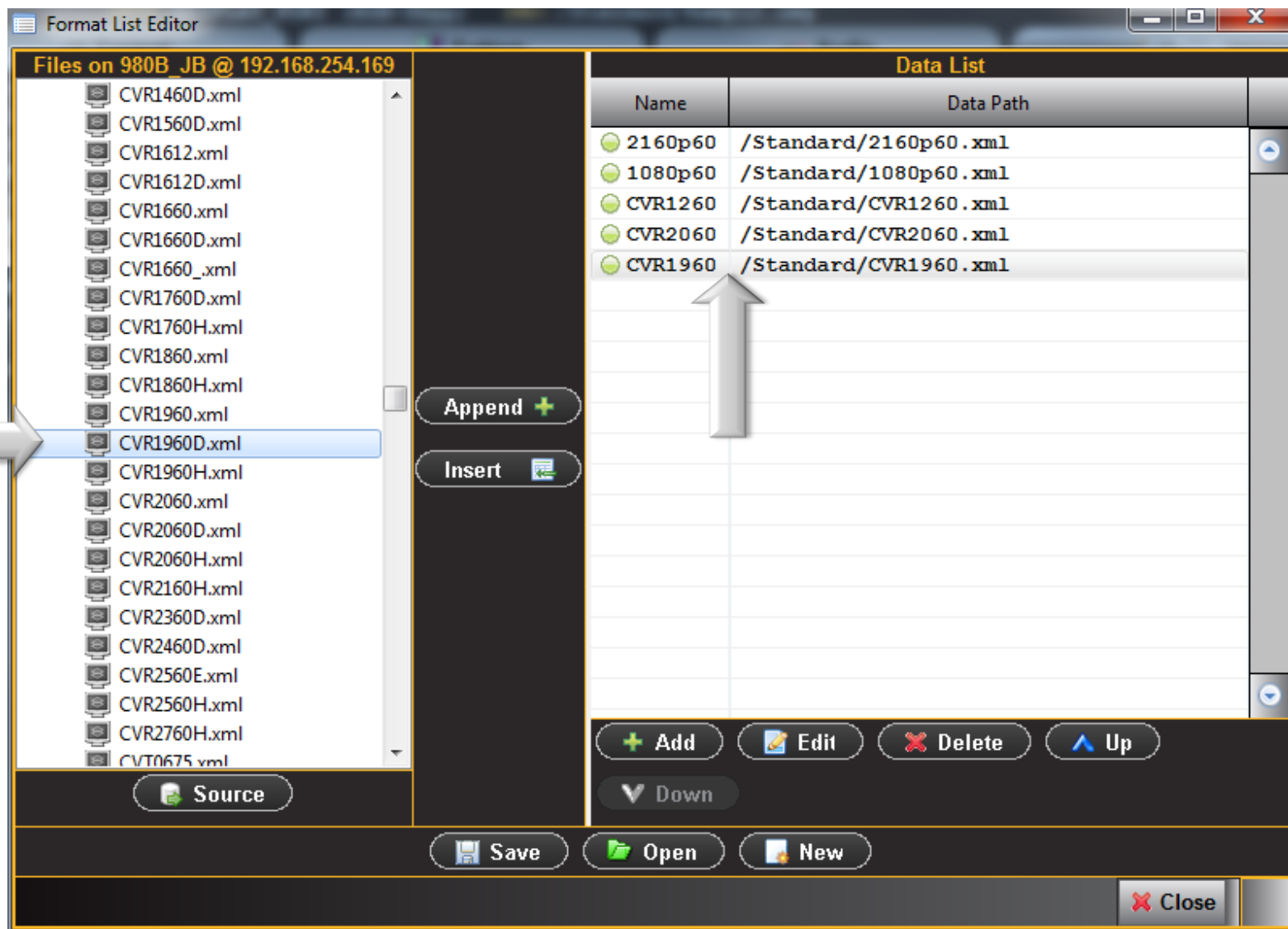
980 HDMI Video Generator Module – Format List Creation



Create custom lists of format timings:

- Access Format List Editor from Apps Editors page.

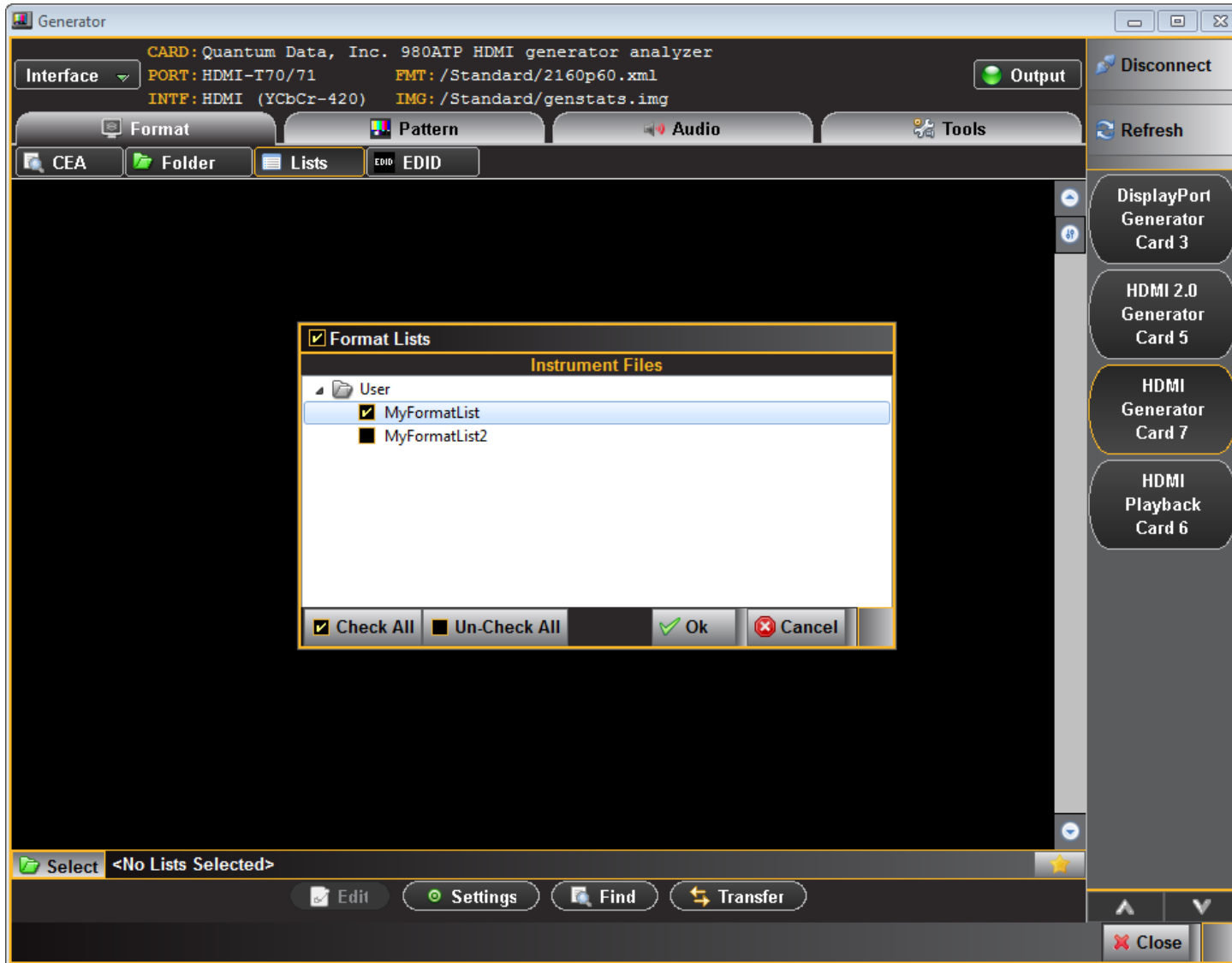
980 HDMI Video Generator Module – Format List Creation



Create custom lists of formats:

- Configure a specific test of formats for viewing and selecting.
- Save for later reuse.

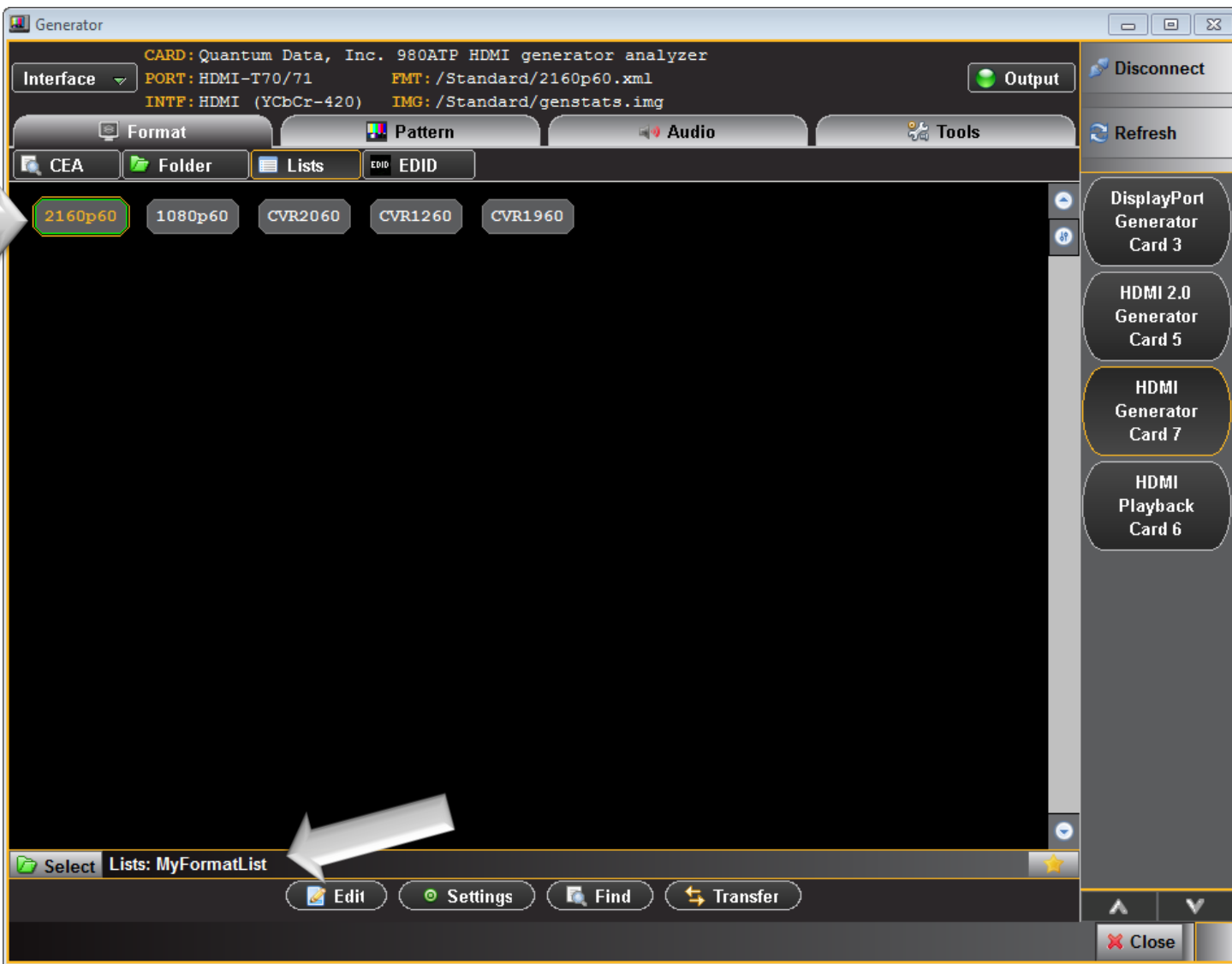
980 HDMI Video Generator Module – Format List Creation



Use custom lists of format timings:

- Select custom format lists from User directory.

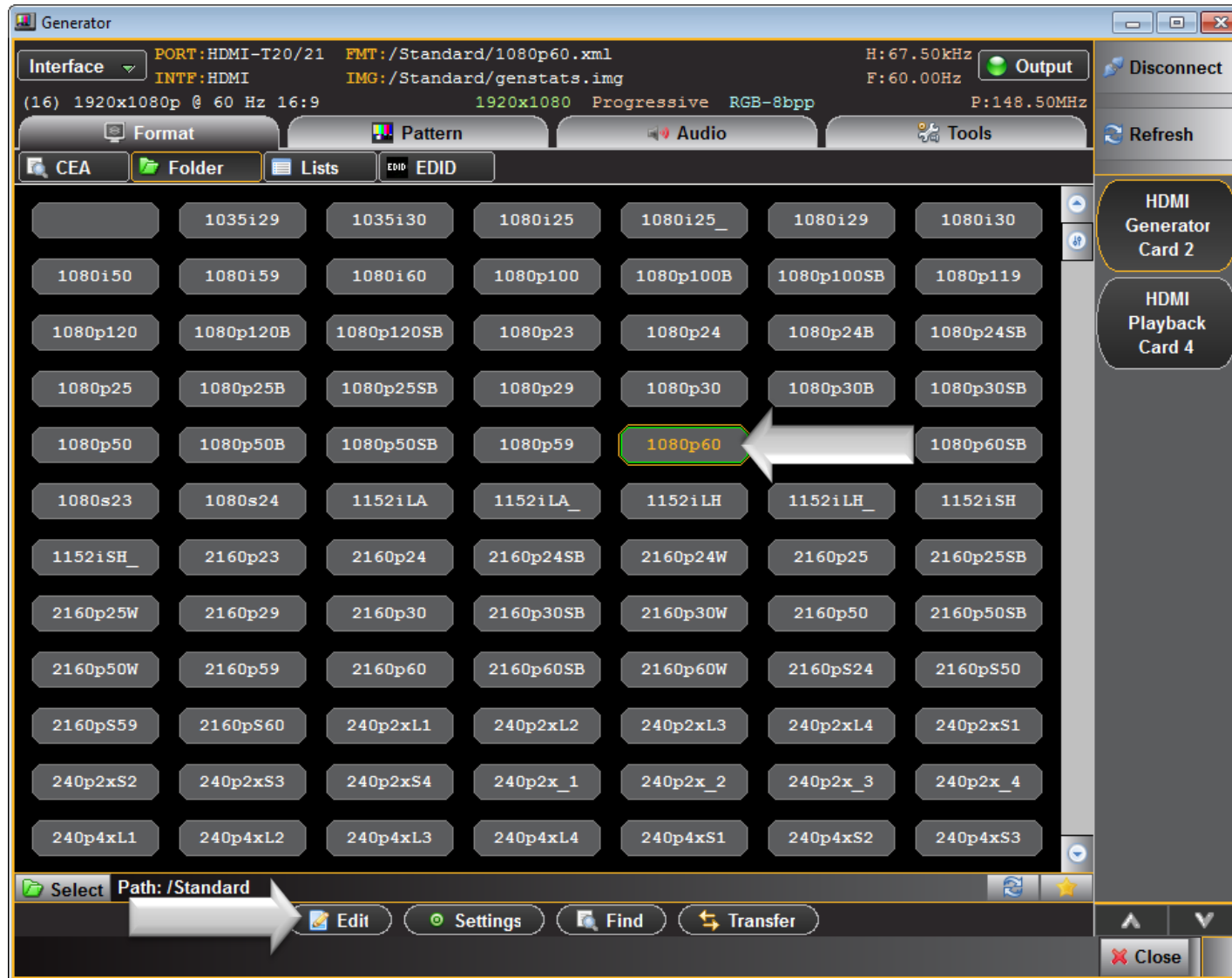
980 HDMI Video Generator Module – Format List Selection



View custom list of formats:

- Select from specific set of formats.
- Active list is shown on lower status bar.

980 HDMI Video Generator Module – Format Editor



Create custom formats:

- Select format to edit using the Format Editor (next page).

980 HDMI Video Generator Module – Format Editor

Format Editor: /Standard/1080p60.xml

Timing | General | Digital Video | Digital Audio | AFD

Calculated Pixel Rate 148.500000 MHz 6.734007 ns

Entry Units
 Machine
 Time

Scan Type
 Progressive
 Interlace

Back Porch
 Clock Pulse
 PreEmphasis
 DC Balance
 Flat Front Porch
 TriLevel
 Repeat Field

Horizontal
Rate 67.500000 KHz
Tune 1.000000 Base 67.500000 KHz
Active 1920 Pixels 12.929293 us
Blank 280 Pixels 1.885522 us
Total 2200 Pixels 14.814815 us
Pulse Delay 88 Pixels 0.592593 us
Pulse Width 44 Pixels 0.296296 us

Vertical
Rate 60.000000 Hz
Active 1080 Lines 16.000000 ms
Blank 45 Lines 0.666667 ms
Total 1125 Lines 16.666667 ms
Pulse Delay 4 Lines 0.059259 ms
Pulse Width 5 Lines 0.074074 ms

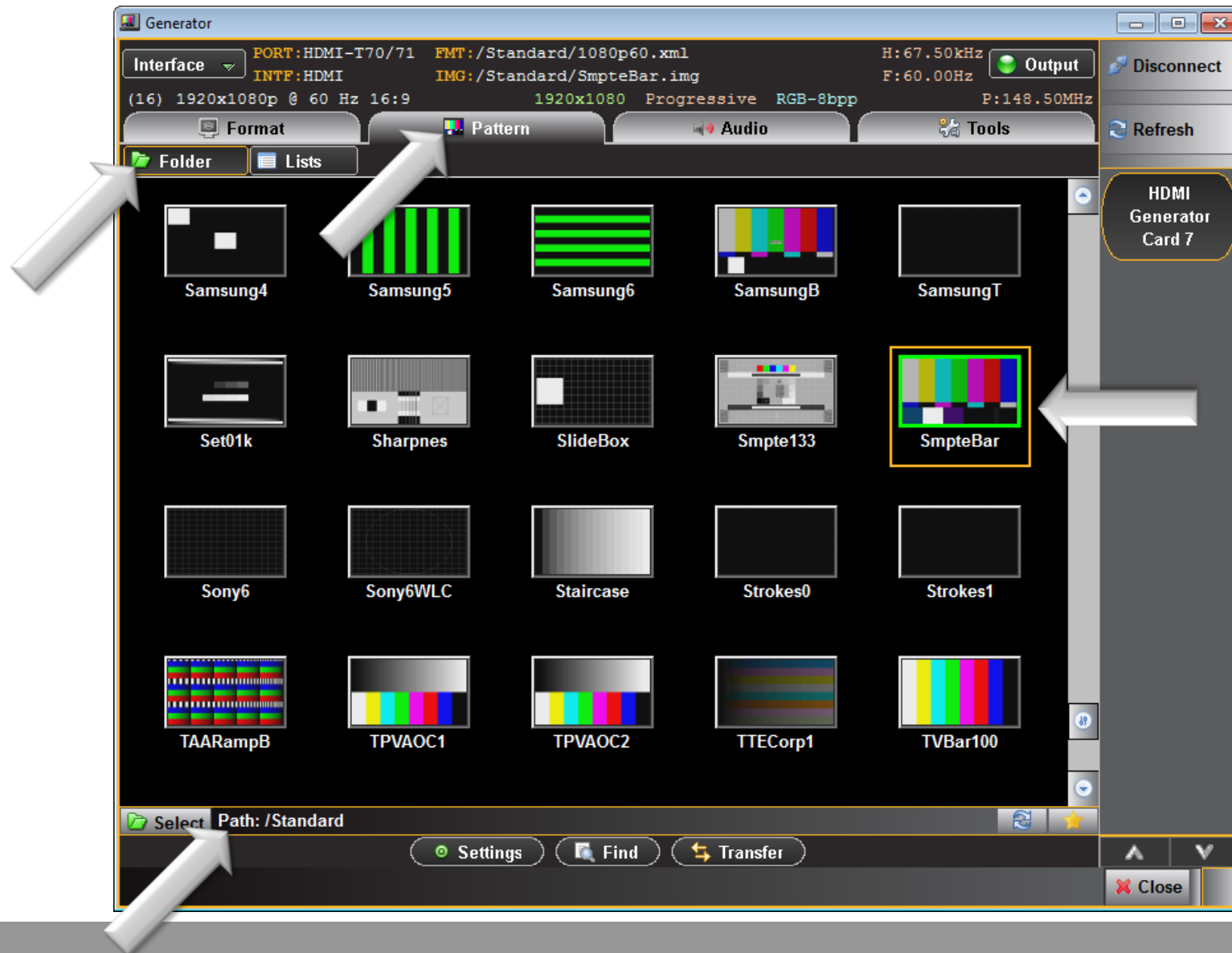
Serration width Adjustment 0 Pixels
H to V Pulse Delay 0 Pixels
Horizontal Broad Pulse Delay 0 Pixels
Eq. Before 0 Lines
Eq. After 1 Lines

Use New Open Save Close

Create custom formats:

- Use Format Editor to create additional custom formats.
- Apply immediately for testing or save custom formats for later reuse.

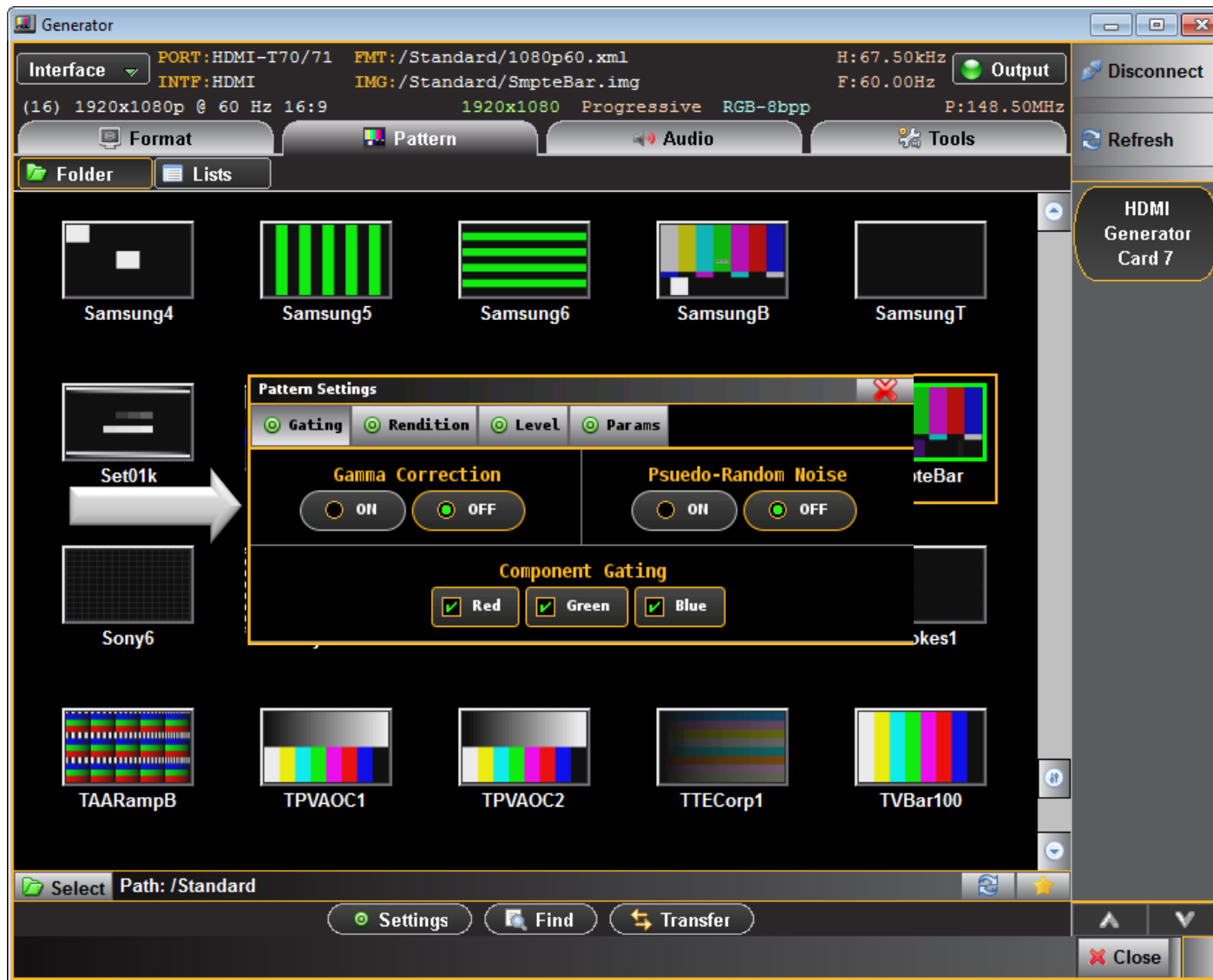
980 HDMI Video Generator Module – Pattern Testing



Select Test Patterns:

- Select test pattern from Pattern Library.
- Over 300 test patterns to select from.
- Scroll through list of test patterns.
- Select from standard library folder or Lists (next page).

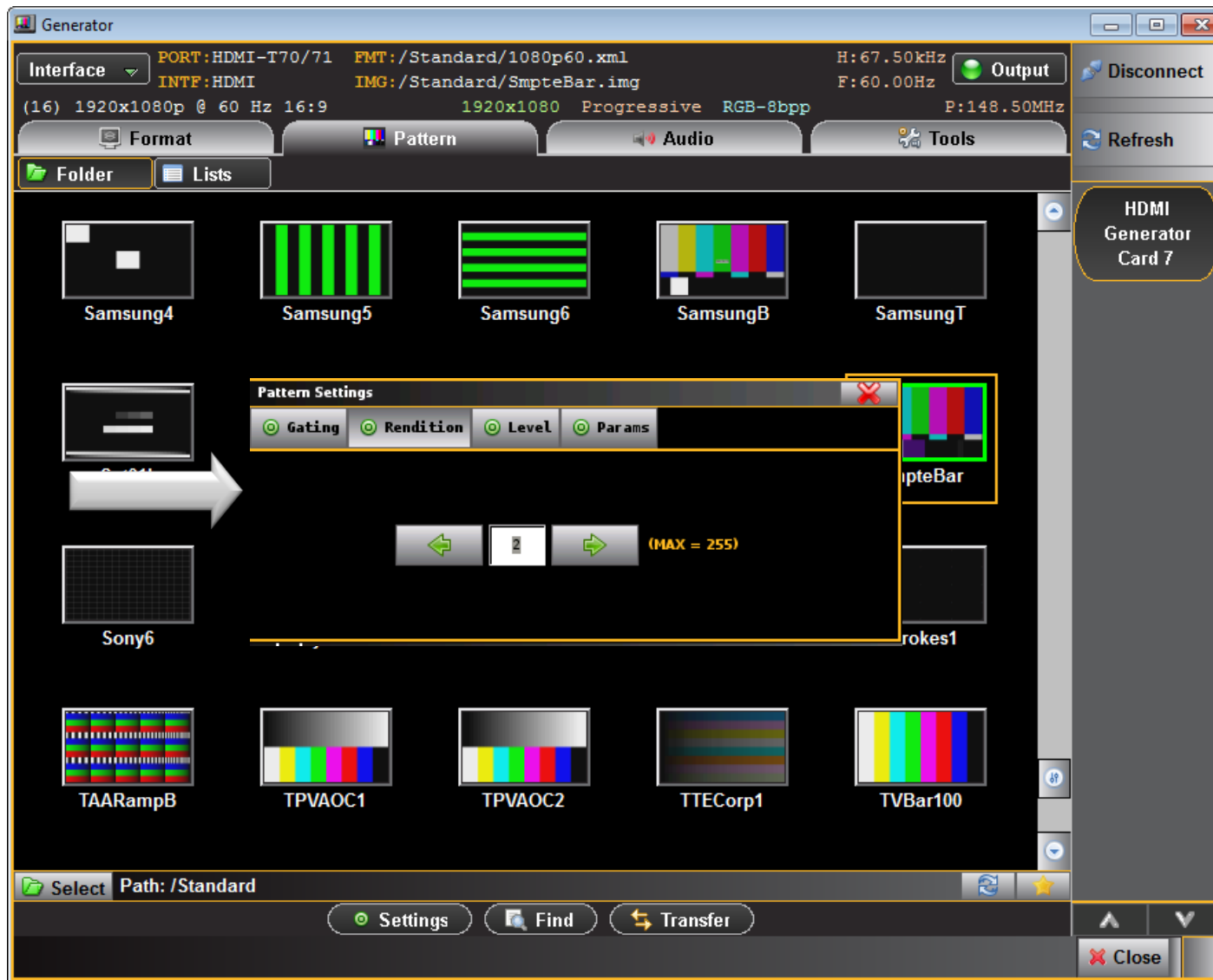
980 HDMI Video Generator Module – Pattern Testing



Configure pattern parameters:

- Set test pattern parameters such as gating colors on/off, noise pattern and gamma.

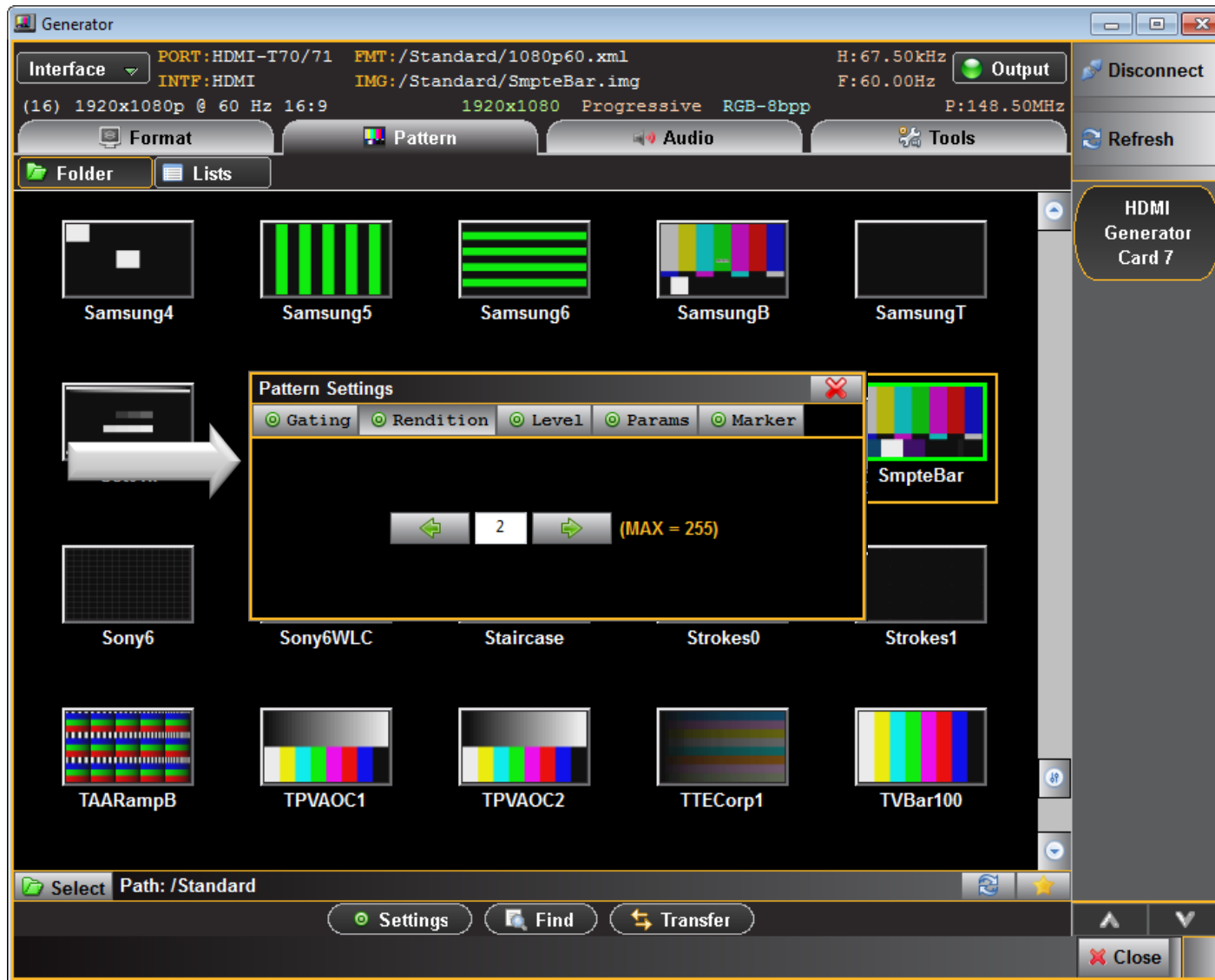
980 HDMI Video Generator Module – Pattern Testing



Select video level for test pattern:

- Set level in 1 IRE increments.

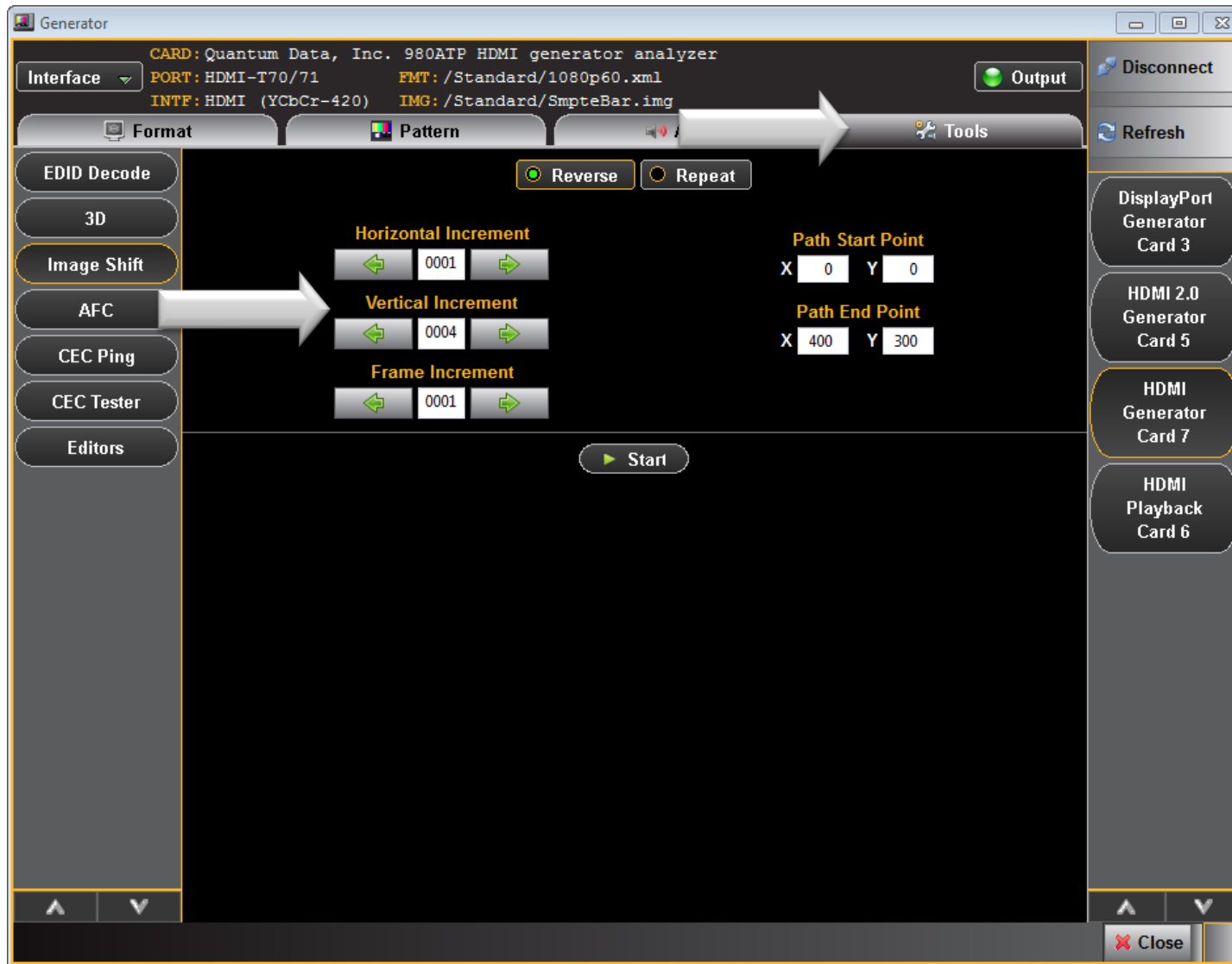
980 HDMI Video Generator Module – Pattern Testing



Select subimage (Image Version) of Test Pattern where available:

- Select using arrows provided.

980 HDMI Video Generator Module – Pattern Testing

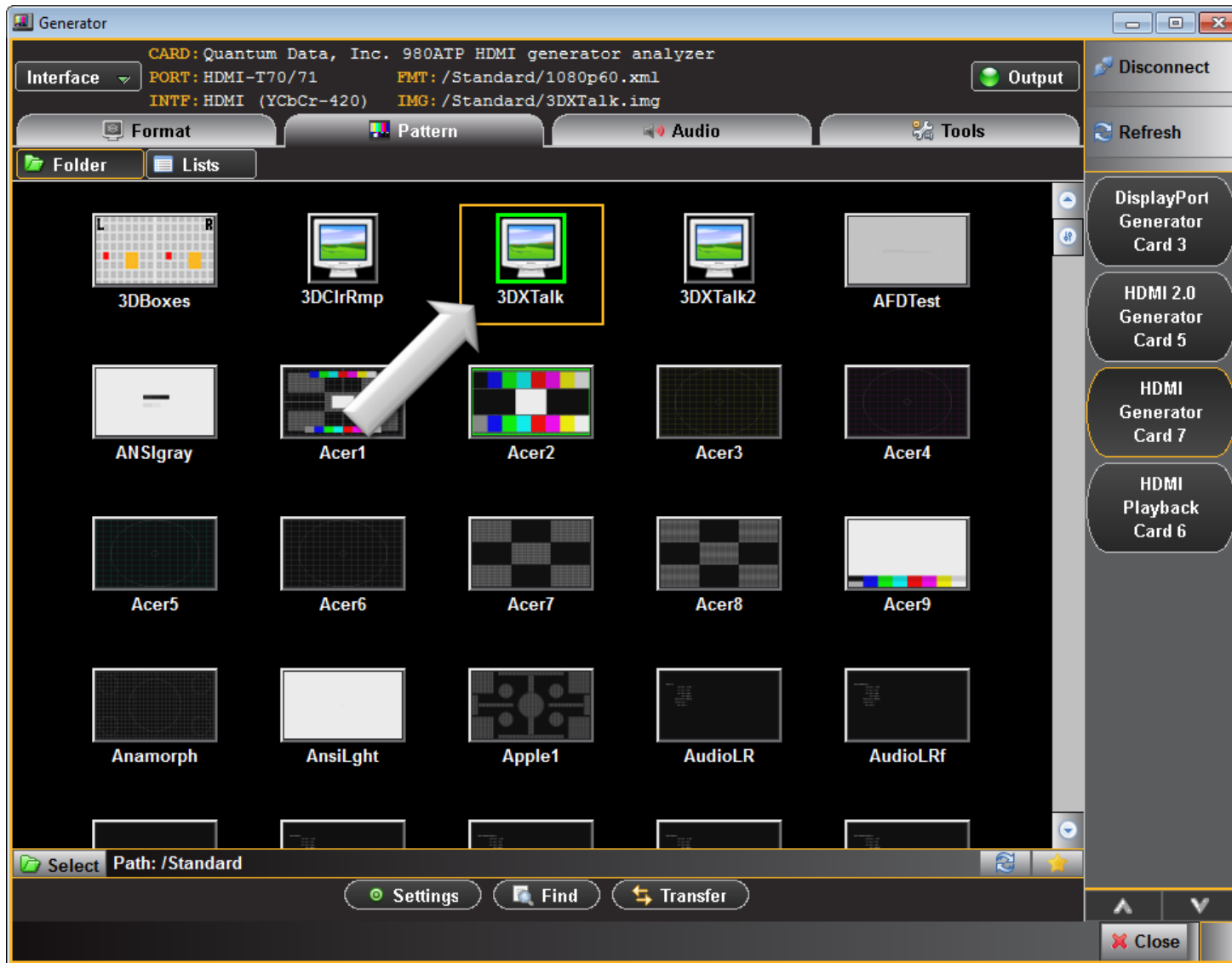


Scroll a selected Test Pattern from Tools menu:

- Select scroll speed in horizontal and vertical axes.
- Select extent of travel with End Points.
- Select reverse or repeat scrolling.

980 HDMI Video Generator Module Testing 3D Formats

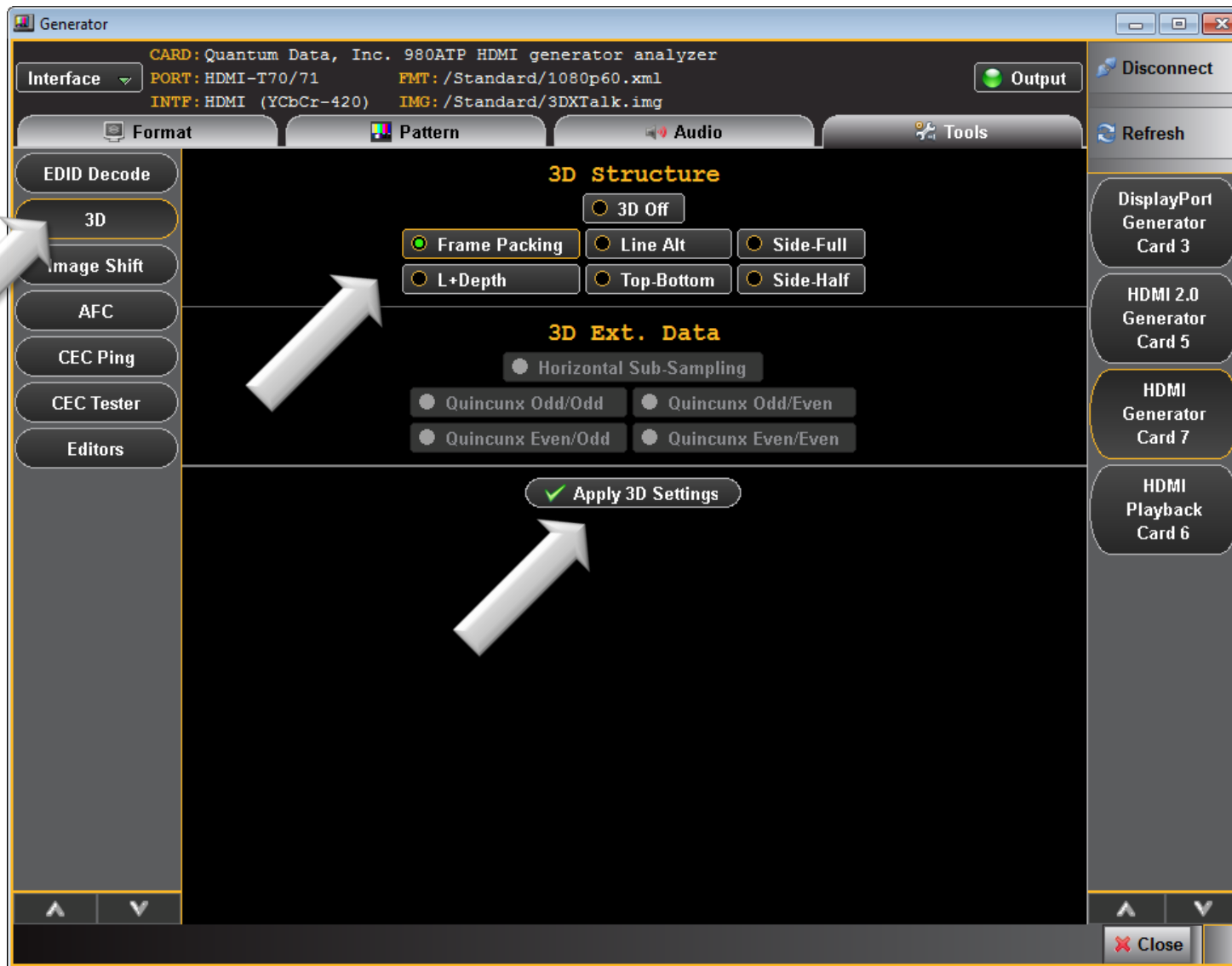
980 HDMI Video Generator Module – 3D Testing



Test 3D displays:

- Select 3D Test Pattern.

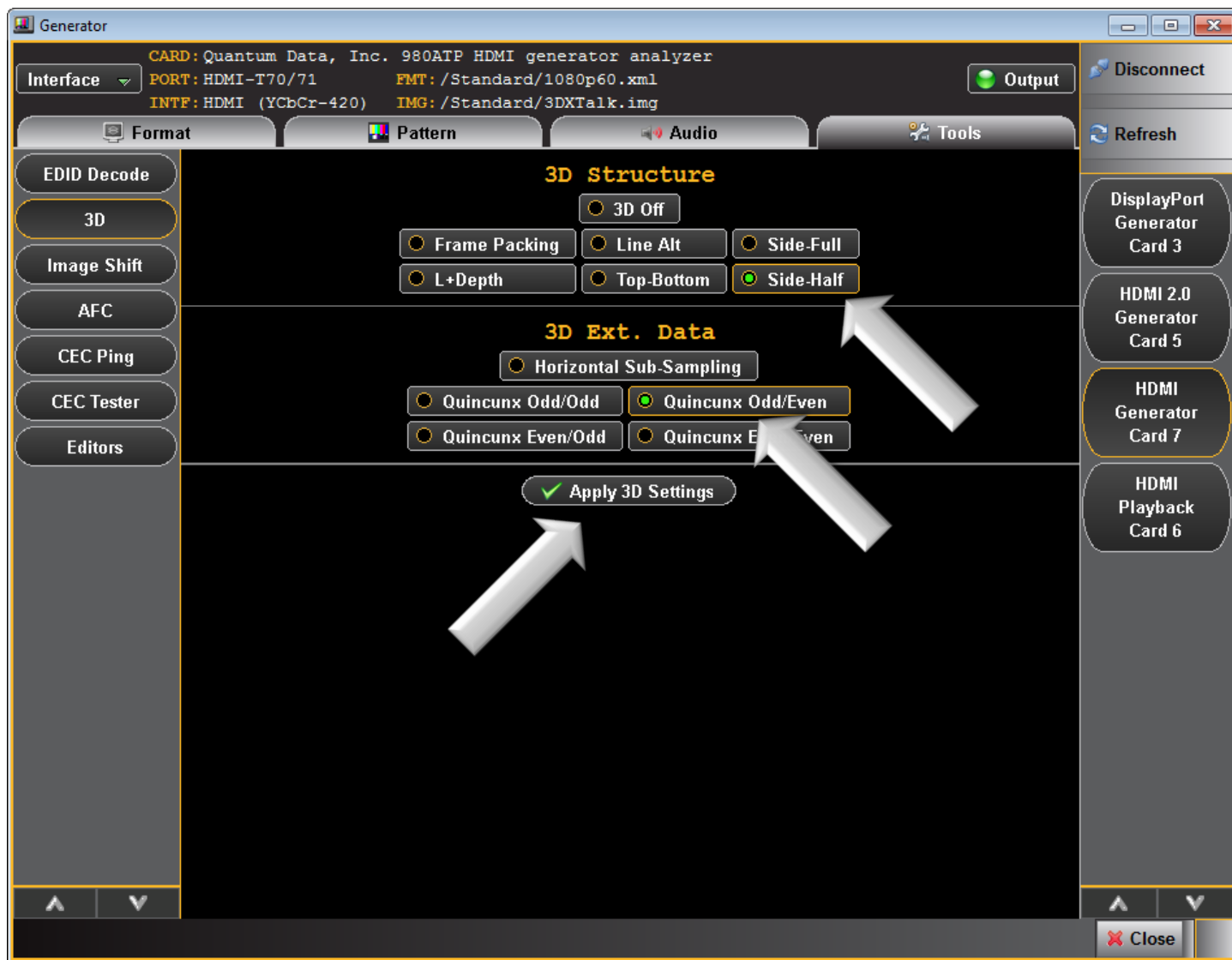
980 HDMI Video Generator Module – 3D Testing



HDMI 3D Video Formats:

- Access from Tools tab.
- Enable 3D mode.
- Select 3D Structure and substructure where applicable.

980 HDMI Video Generator Module – 3D Testing

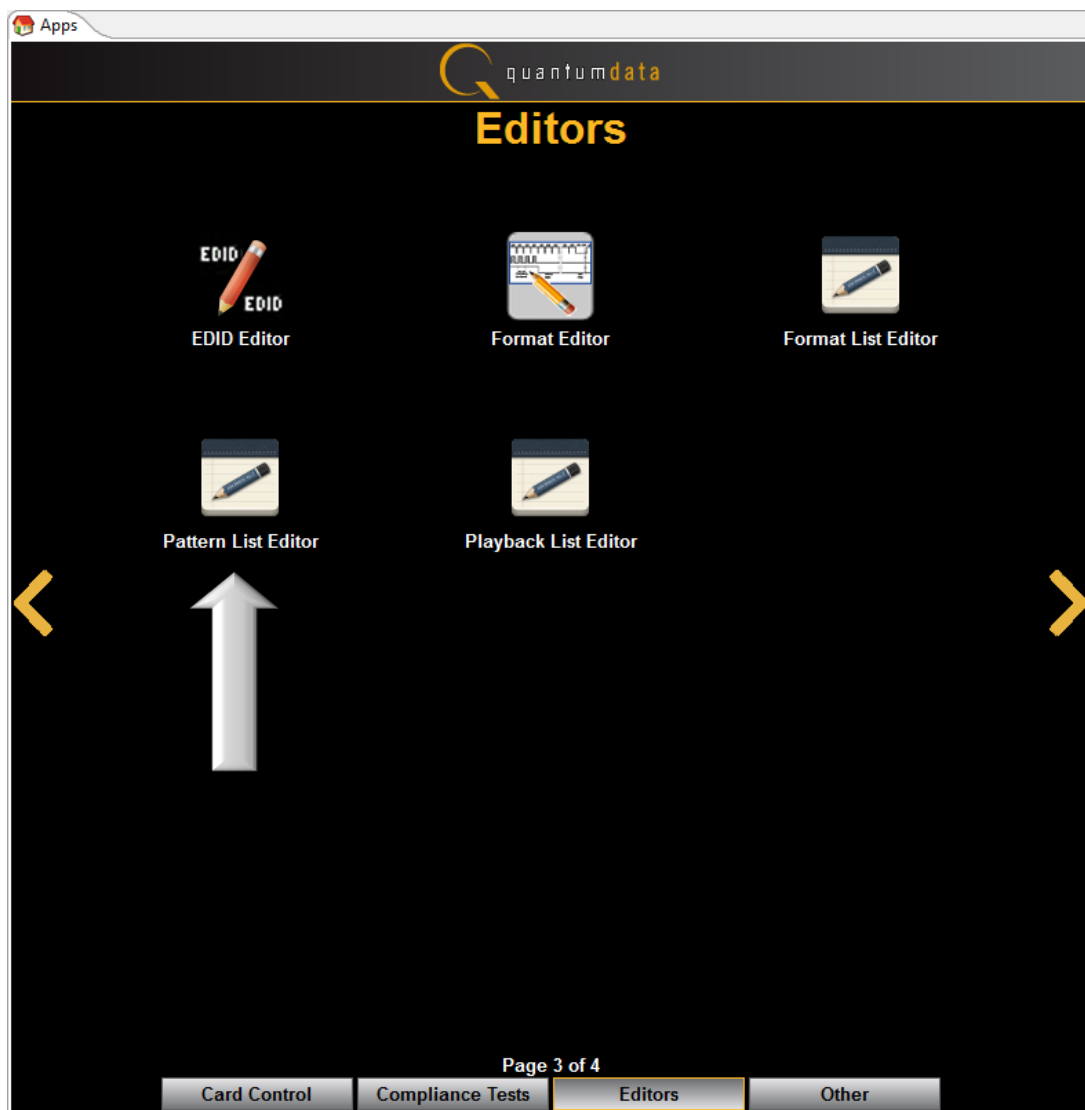


HDMI 3D Video Formats:

- Enable 3D mode.
- Select 3D Structure and substructure (extra data).

980 HDMI Video Generator Module Creating Custom Pattern Lists

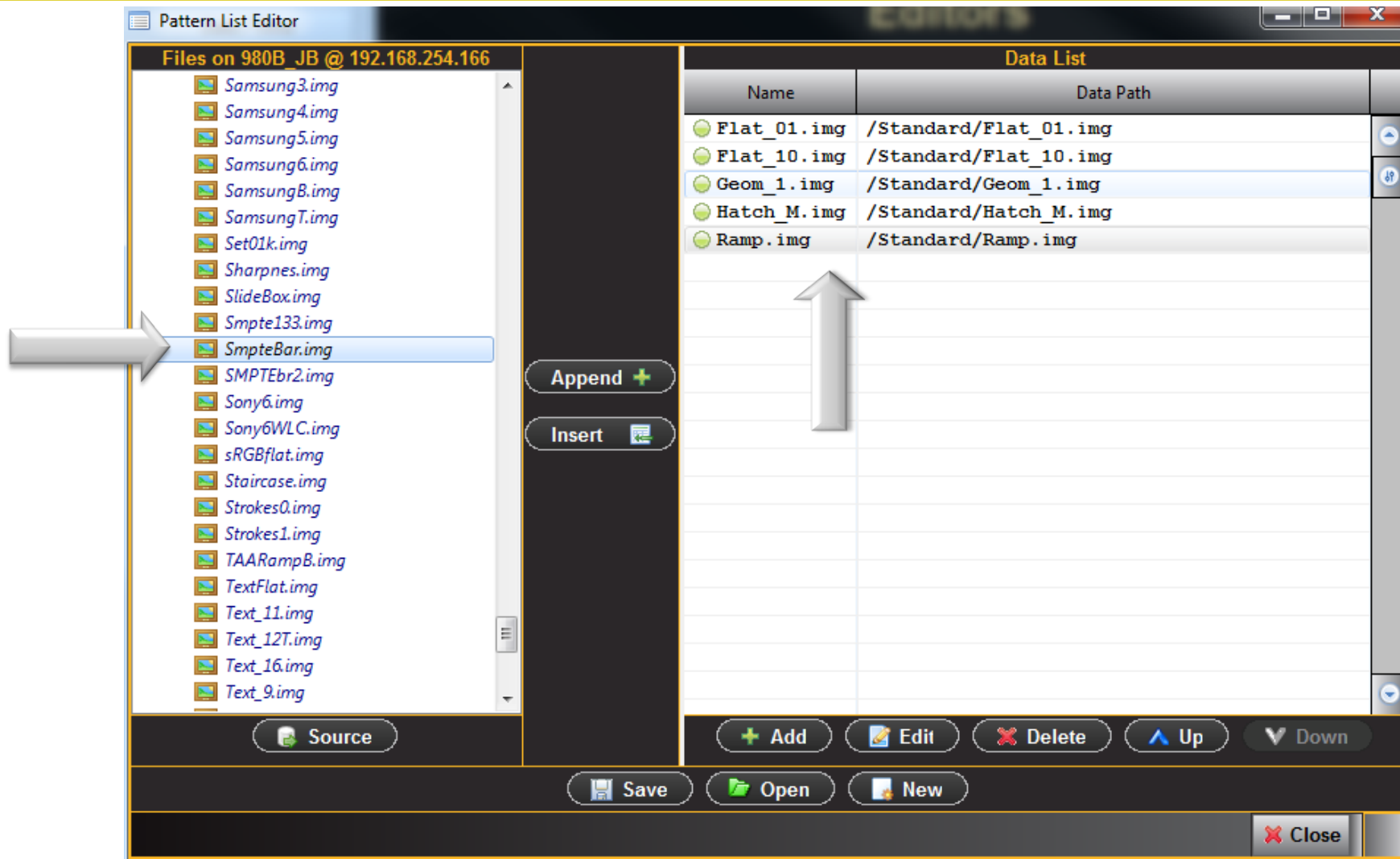
980 HDMI Video Generator Module – Pattern List Creation



Create custom lists of test patterns:

- Access Pattern List Editor from Apps Editors page.

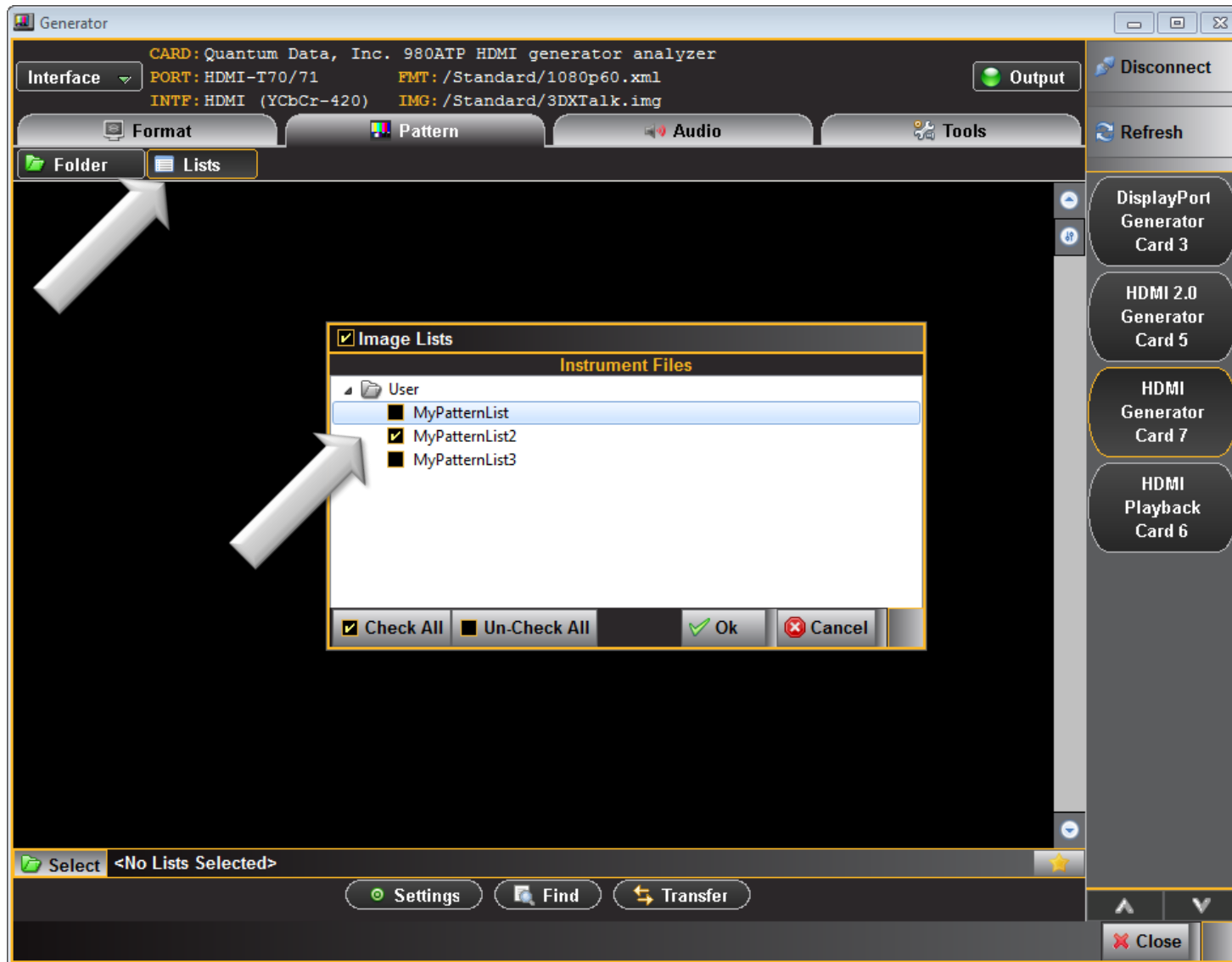
980 HDMI Video Generator Module – Pattern List Creation



Create custom lists of test patterns:

- Configure a specific test of patterns for viewing and selecting.
- Save for later reuse.

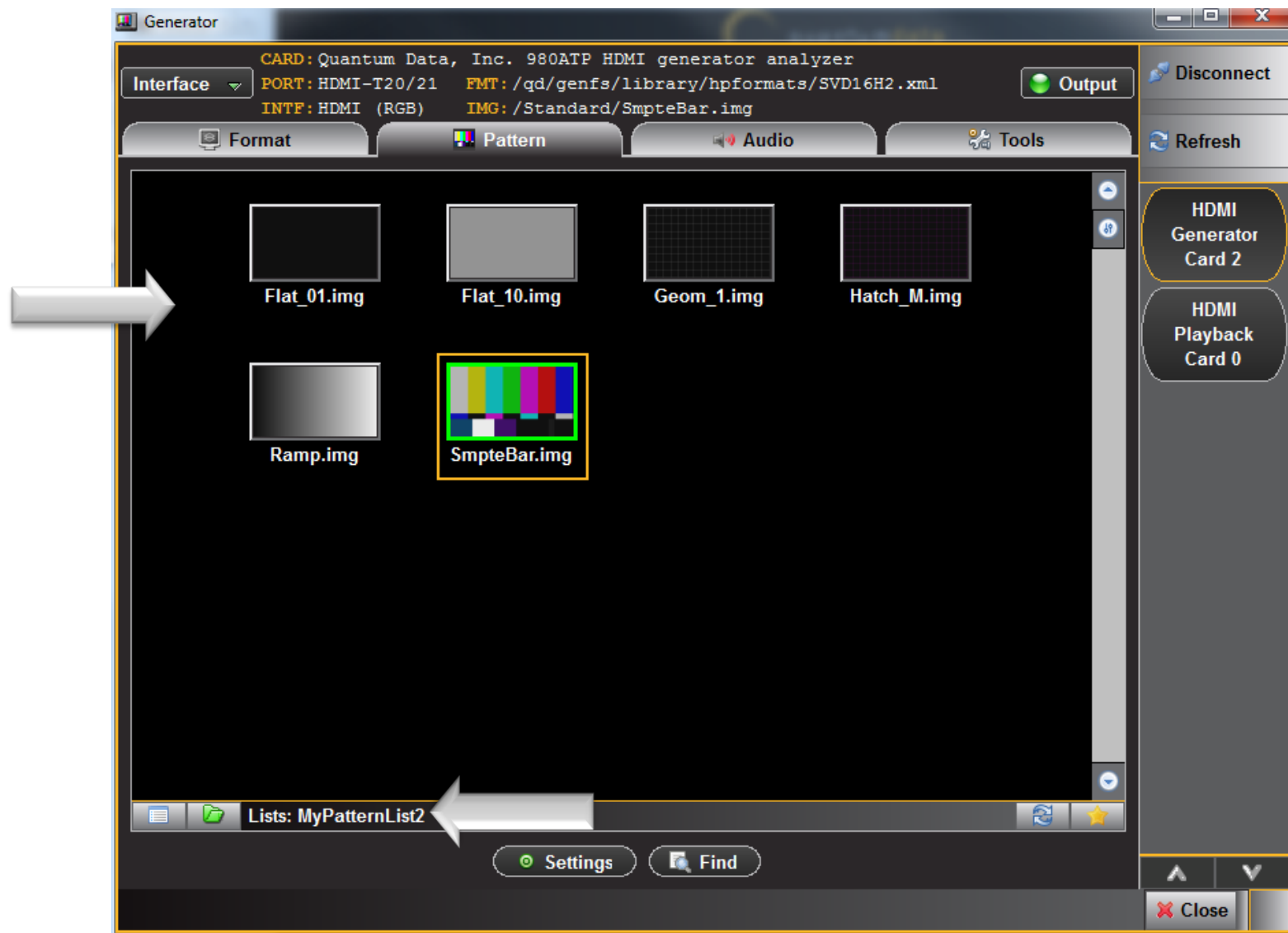
980 HDMI Video Generator Module – Pattern Testing



Select Test Patterns:

- Select test pattern from custom list.

980 HDMI Video Generator Module – Pattern List Selection



Create custom lists of test patterns:

- Configure a specific test of patterns for viewing and selecting.

980 HDMI Video Generator Module

Selecting Audio Formats

980 HDMI Video Generator Module – Audio Testing



Select audio formats:

- Supports testing of LPCM and compressed formats.
- Enables precise control over channels, sampling rate, bits per sample level.
- Set sine wave amplitude and frequency.

980 HDMI Video Generator Module – Audio Testing

Generator

CARD: Quantum Data, Inc. 980ATP HDMI generator analyzer

Interface: PORT: HDMI-T00/01 FMT: /Standard/1080p60.xml Output

INTF: HDMI (RGB) IMG: /Standard/SmpteBar.img Disconnect

Format Pattern Audio Tools Refresh

PCM Sine Wave

Compr. Audio

Type	Description
DOLBY (AC3)	Audio core address test
DOLBY (AC3)	Pink Noise 500-2kHz L channel
DOLBY (AC3)	Pink Noise 500-2kHz C channel
DOLBY (AC3)	Pink Noise 500-2kHz R channel
DOLBY (AC3)	Pink Noise 500-2kHz Cycle channels
DOLBY (AC3)	Pink Noise 500-2kHz LFE channel
DOLBY (AC3)	Pink Noise 500-2kHz All channels
DOLBY (AC3)	Pink Noise 500-2kHz Ls channel
DOLBY (AC3)	Pink Noise Rs channel
DOLBY (AC3)	Pink Noise 20-20kHz L channel
DOLBY (AC3)	Pink Noise 20-20kHz C channel
DOLBY (AC3)	Pink Noise 20-20kHz R channel
DOLBY (AC3)	Pink Noise 20-20kHz pulse ???
DOLBY (AC3)	Pink Noise 20-20kHz LFE
DOLBY (AC3)	Pink Noise 20-20kHz Ls channel
DOLBY (AC3)	Pink Noise 20-20kHz Rs channel
DOLBY (AC3)	Sine Wave 63Hz Cycle channels
DOLBY (AC3)	Sine Wave 63Hz All channels
DOLBY (AC3)	Sine Wave 125Hz Cycle channels
DOLBY (AC3)	Sine Wave 125Hz All channels
DOLBY (AC3)	Sine Wave 1kHz Cycle channels
DOLBY (AC3)	Sine Wave 1kHz All channels
DOLBY (AC3)	Sine Wave 4kHz Cycle channels
DOLBY (AC3)	Sine Wave 4kHz All channels

Play Refresh

Close

HDMI Generator Card 0

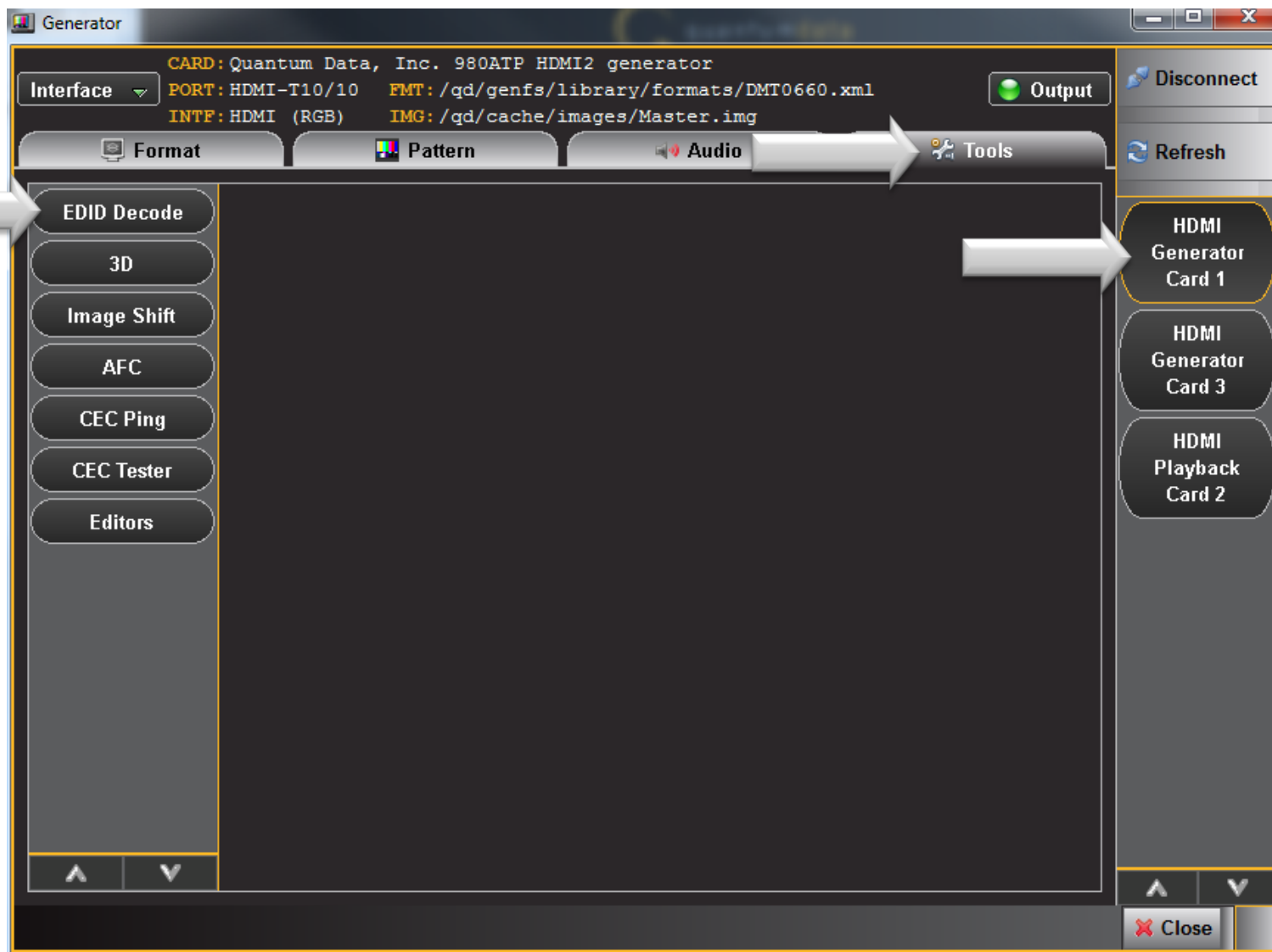
HDMI Playback Card 3

Select audio format:

- Select from variety of compressed audio formats.
- Enables precise control over channels, sampling rate, bits per sample level.

980 HDMI Video Generator Module Viewing EDIDs

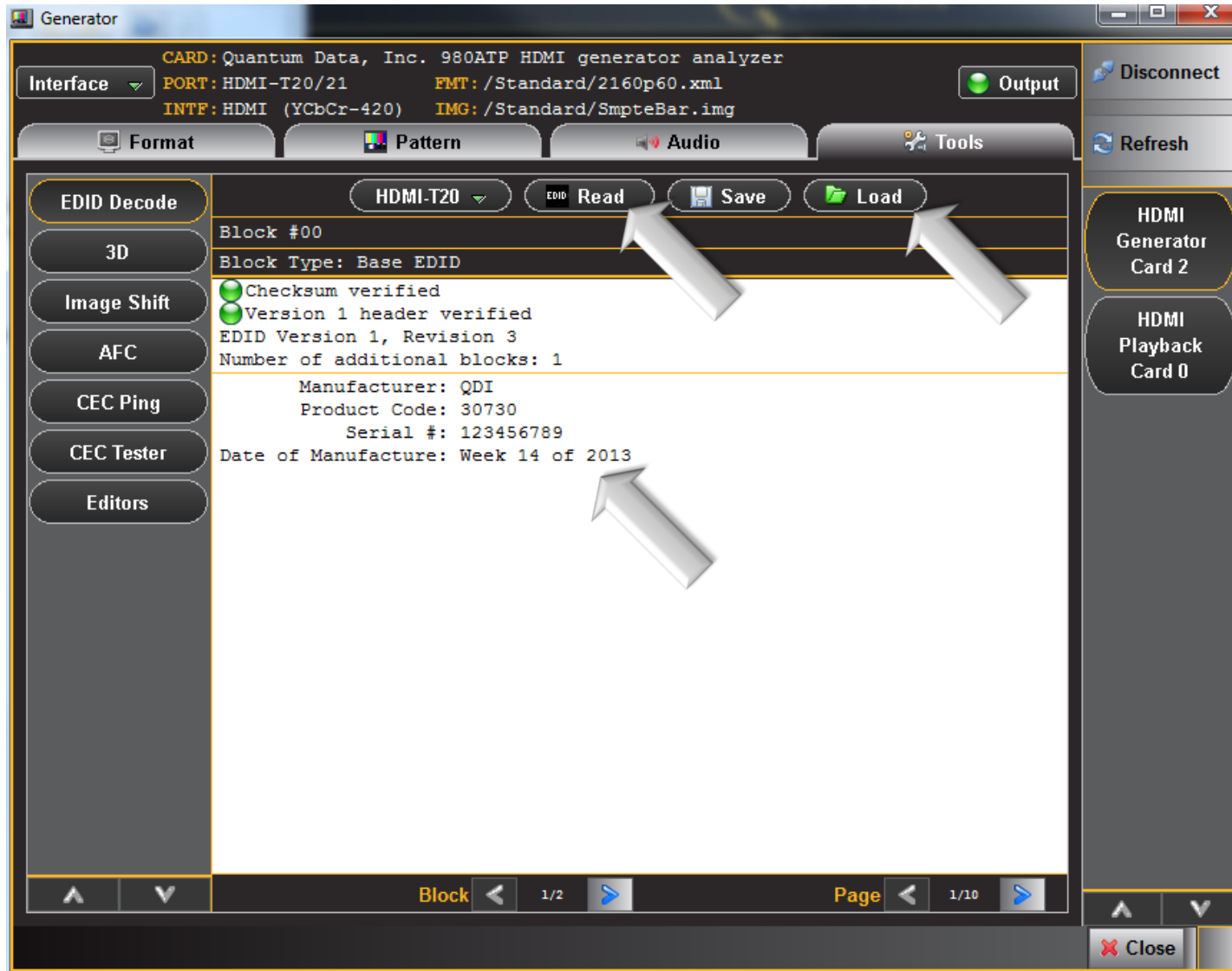
980 HDMI Video Generator Module – EDID Testing



View EDIDs – Select Interface:

- Navigate through the EDID blocks and pages.
- Select which Tx port to view EDID of connected display.

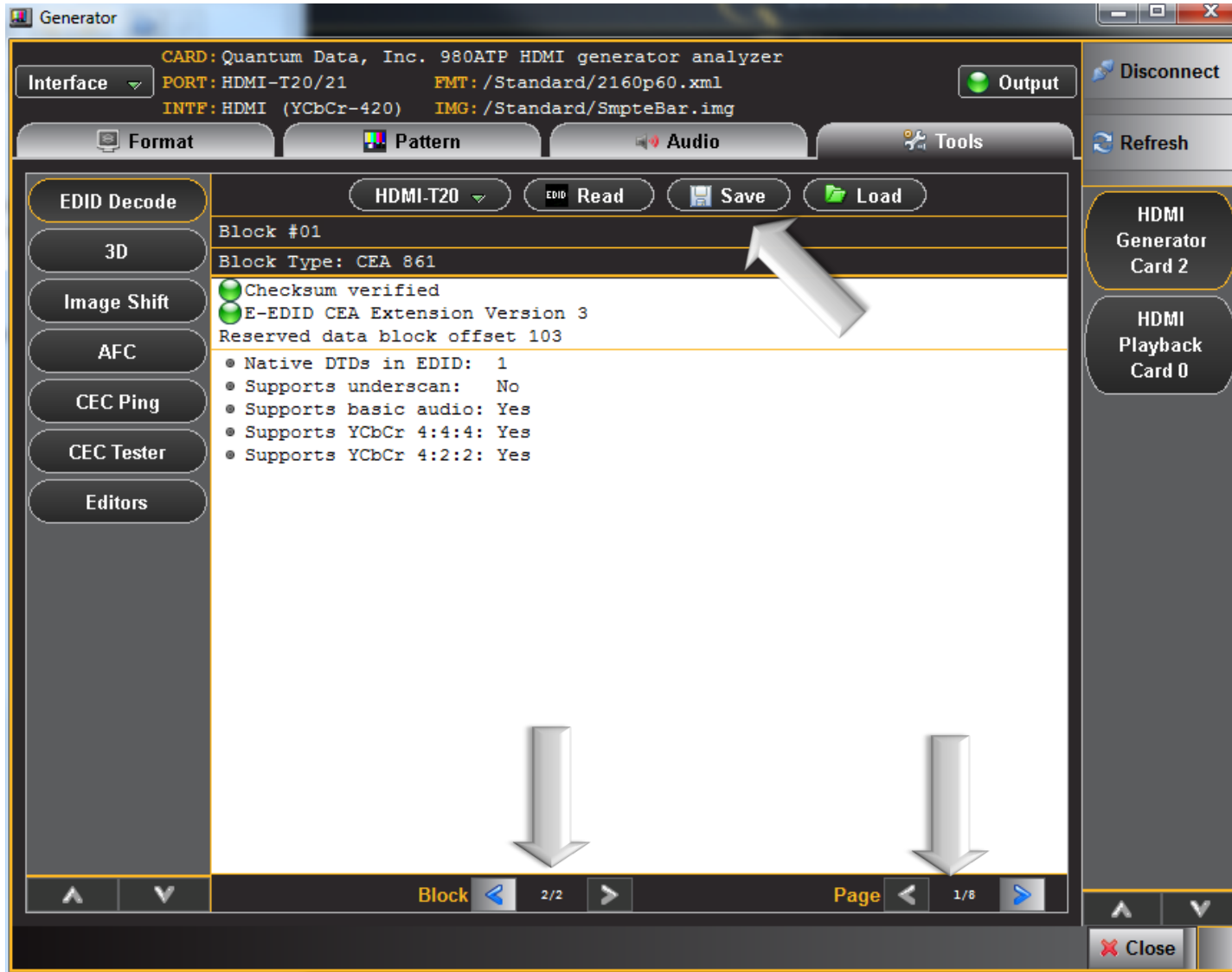
980 HDMI Video Generator Module – EDID Testing



Decode and view EDIDs:

- Read EDID of connected display.
- Load stored EDIDs for viewing.
- View EDIDs of in human readable text.

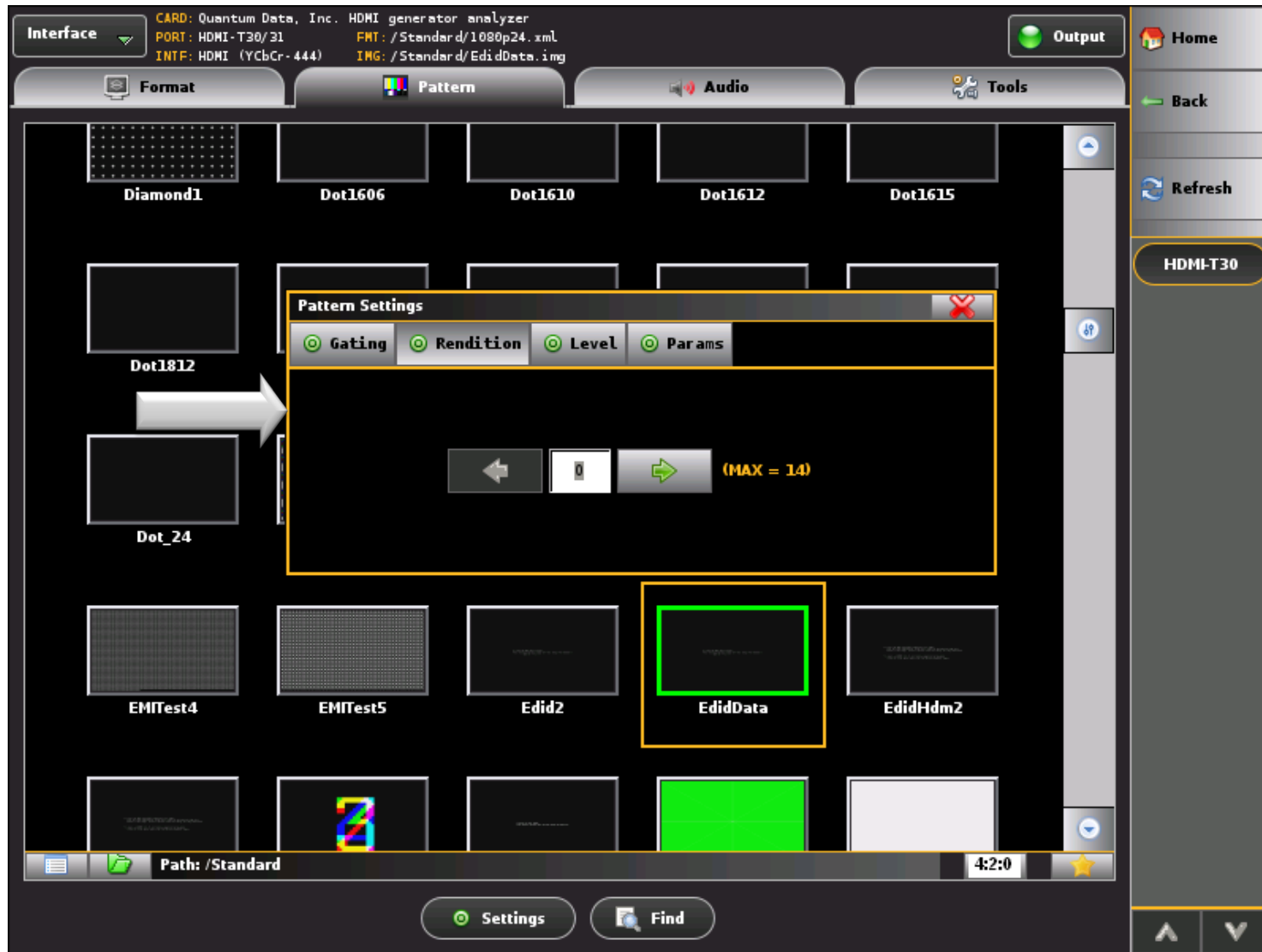
980 HDMI Video Generator Module – EDID Testing



Decode and view EDIDs:

- View both VESA and CEA block.
- Save EDIDs for emulation testing of sources.

980 HDMI Video Generator Module – EDID Testing



Select test images for HDMI protocols:

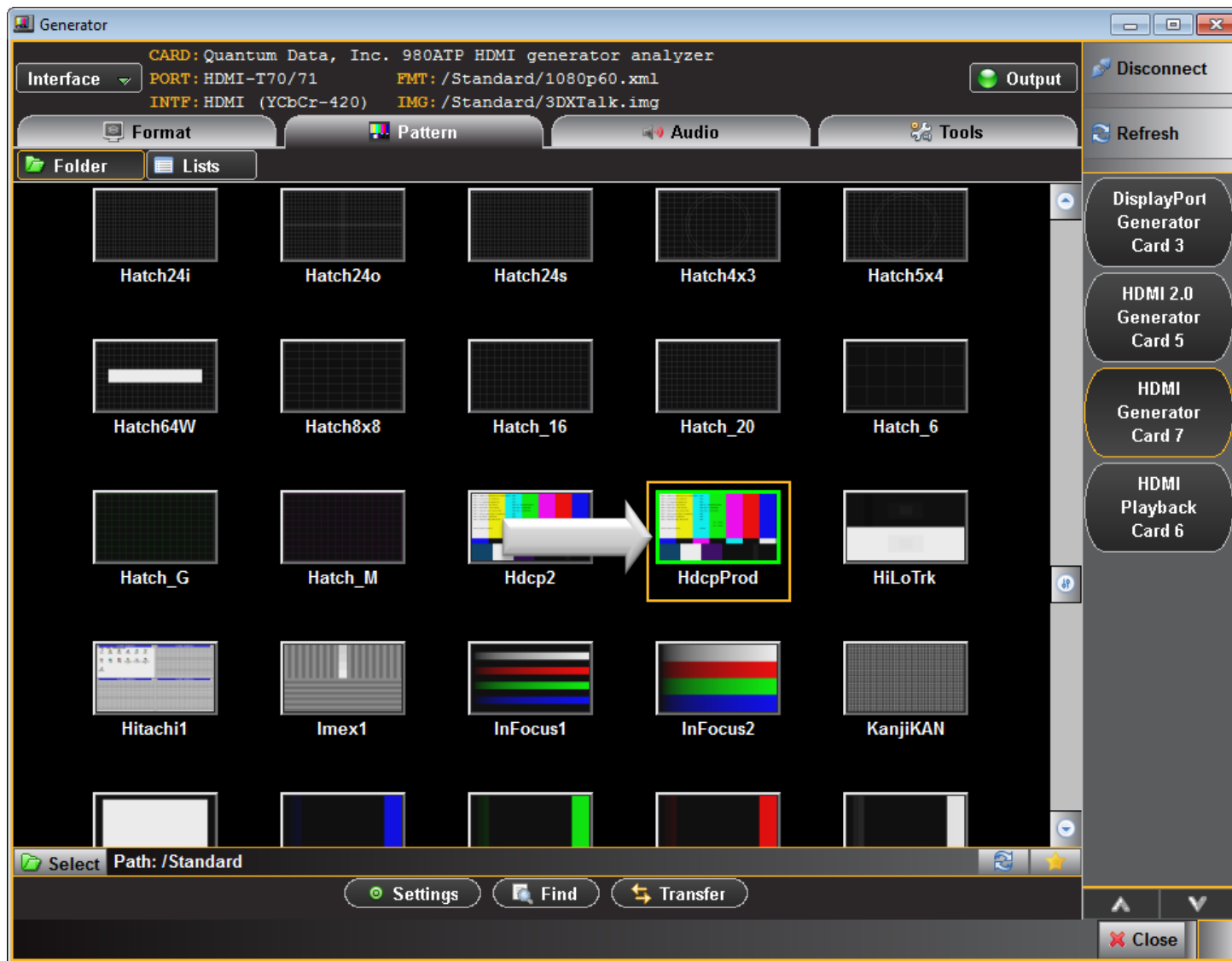
- Select EDID test image (example).
- View pages of EDID on connected display.
- Select page through Rendition parameter.

980 HDMI Video Generator Module Monitoring DDC Transactions

980 HDMI Video Generator - Auxiliary Channel Analyzer

- Monitor DDC transactions (HDCP and EDID) through Auxiliary Channel Analyzer (ACA).
- 980 Video Generator module emulates HDMI source and monitors HDCP and EDID transactions.
- Auxiliary Channel Analyzer (CEC) – save traces for dissemination to subject matter experts and Quantum Data customer support.

980 HDMI Video Generator Module – HDCP Testing



Select test images for HDMI protocols:

- Select HDCP test image.

980 HDMI Video Generator - Auxiliary Channel Analyzer

Generating An = 0xF6A250EA63E388AA - PASS
Aksv = 0x17AB998A33 - PASS
Bksv = 0x5A0B3A4CAF - PASS
Bcaps = 0x80 (HDMI)
Ri and RO' Comparison - PASS
RiTx = 0x26F7
RiRx = 0x26F7
HDCP encryption - TESTING

HDCP test passed as long as you can read this.
RiTx = 0xD9C1
RiRx = 0xD9C1

PASS 38

The image shows a color bar with vertical stripes of yellow, cyan, magenta, red, and blue. Below the text is a black box containing the test results and a green 'PASS' indicator. The background of the interface is a grid of various colored squares.

Monitoring DDC transactions with HDMI sink device:

- View progress of authentication and encryption on connected sink e.g. HDTV (shown).

980 HDMI Video Generator - Auxiliary Channel Analyzer



Three (3) Aux Channel Analyzer (ACA) Tools:

- Embedded GUI ACA from 980 touch panel.
- ACA Remote Control from external GUI Manager (shown left)
- ACA Data Viewer for viewing saved ACA trace files.

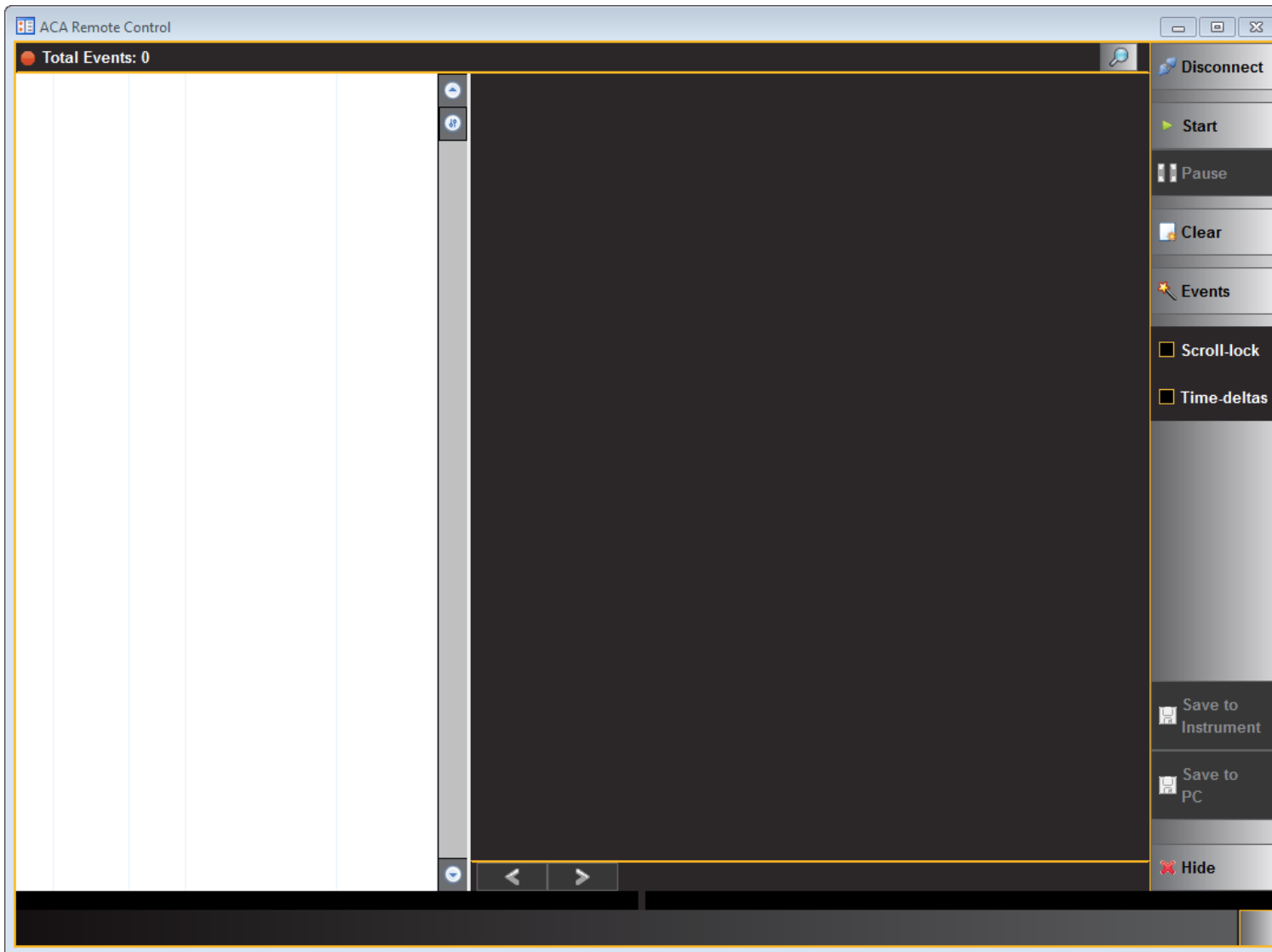
980 HDMI Video Generator - Auxiliary Channel Analyzer



ACA Remote Control:

- View ACA trace transactions in real time from host PC.
- Control the ACA remotely from the External 980 GUI Manager GUI.
- Remains in sync with embedded ACA utility running on 980 test instrument.

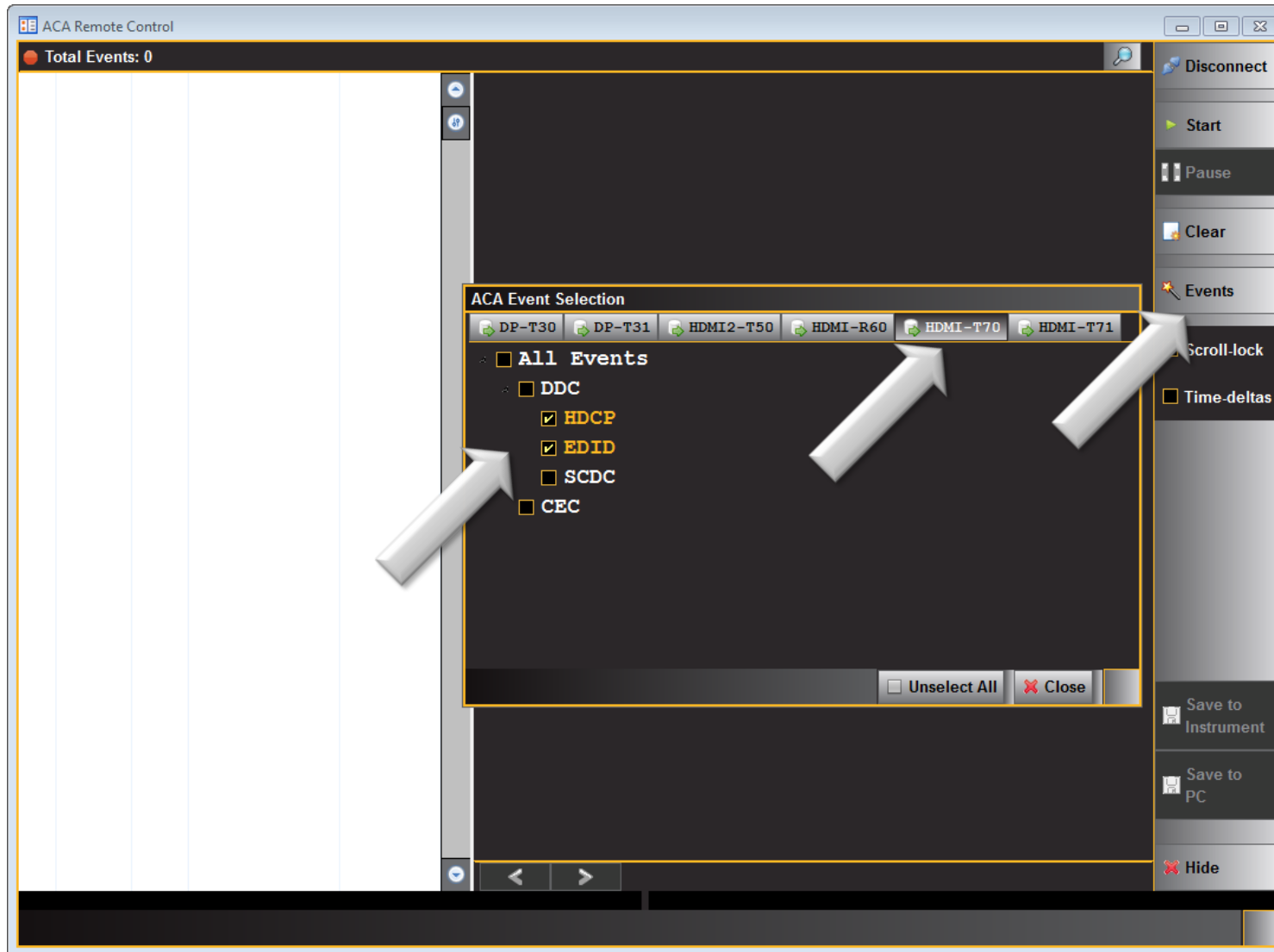
980 HDMI Video Generator - Auxiliary Channel Analyzer



ACA Remote Control:

- Connect to 980 instrument.

980 HDMI Video Generator - Auxiliary Channel Analyzer



ACA Remote Control:

- Select which interface using Events activation button on right.
- Choose which type of transactions (Events) you wish to view (HDCP and EDID shown).

980 HDMI Video Generator - Auxiliary Channel Analyzer

The screenshot displays the ACA Remote Control software interface. On the left, a list of 70 events is shown, with event 54 selected. The main window displays the details for this event, which is a HDCP transaction. The details include the register address (40h), name (Bcaps), and value (83h). A table below shows the bit fields for the Bcaps register, including FAST_REAUTHENTICATION, 1.1_FEATURES, FAST, READY, and REPEATER. A large white arrow points from the selected event in the list to the details view.

Bit	Name	Value	Description
0	FAST_REAUTHENTICATION	Y(1)	
1	1.1_FEATURES	Y(1)	
2		0	Reserved
3		0	Reserved
4	FAST	N(0)	
5	READY	N(0)	KSV FIFO
6	REPEATER	N(0)	
7		1	Reserved

ACA Remote Control:

- View transactions. In real time.
- Select transaction to view its details (BCAPS shown).

980 HDMI Video Generator - Auxiliary Channel Analyzer

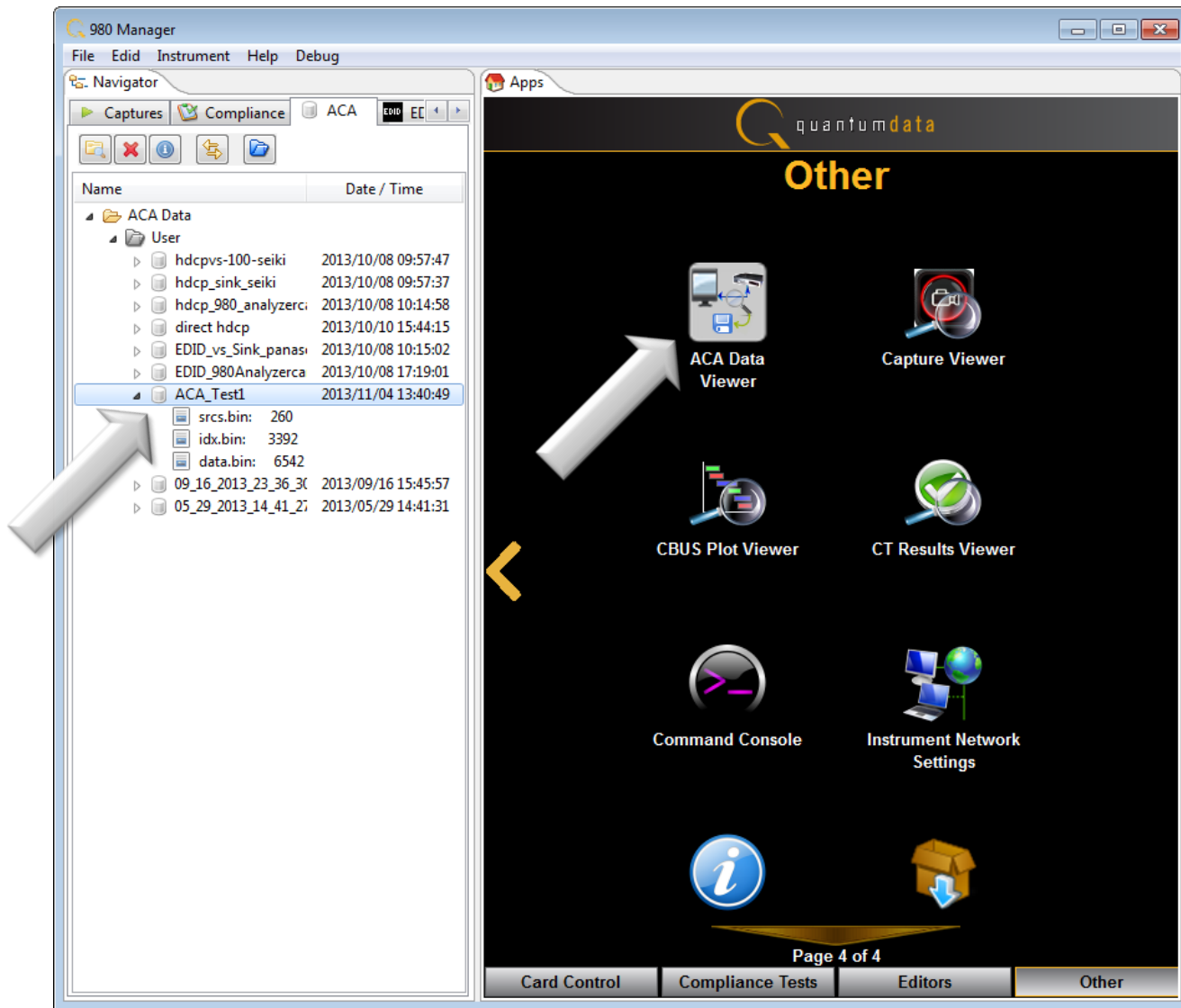
The screenshot displays the ACA Remote Control software interface. On the left, a table lists 70 total events. The selected event (row 54) is an HDCP transaction at 01:30:34.2403, showing a read of 1 byte from register 40h (Boaps) with a value of 83h. The main window shows details for this event, including its type (HDCP), start time, duration, and maximum I2C rate. A 'Save As...' dialog box is open, showing a file list in the 'Local Files' section. The file name 'MyTrace' is entered in the 'Name' field. The 'Path' is set to '/User'. The 'Ok' button is highlighted.

Event #	Type	Count	Time	Source	Value
35	HDCP	70	01:30:30.5405	R Ri'	(72.39 kbps)
36	HDCP	70	01:30:30.5407	< FACB	(72.39 kbps)
37	HDCP	70	01:30:31.5737	R Ri'	(72.39 kbps)
38	HDCP	70	01:30:31.5738	< FACB	(72.39 kbps)
39	HDCP	70	01:30:31.5902	R Ri'	(72.39 kbps)
40	HDCP	70	01:30:31.5906	< C9D9	(72.39 kbps)
41	EDID	70	01:30:33.8461	W Segment 00	(78.39 kbps)
42	EDID	70	01:30:33.8463	R EDID 00	(78.27 kbps)
43	EDID	70	01:30:33.8466	< 128 bytes	(78.39 kbps)
44	HDCP	70	01:30:33.8630	R Bksv	(72.39 kbps)
45	HDCP	70	01:30:33.8633	< 628BABA687	(72.39 kbps)
46	HDCP	70	01:30:33.8641	R Bcaps	(72.39 kbps)
47	HDCP	70	01:30:33.8643	< 83	(72.39 kbps)
48	EDID	70	01:30:33.8679	W Segment 00	(78.27 kbps)
49	EDID	70	01:30:33.8681	R EDID 80	(78.27 kbps)
50	EDID	70	01:30:33.8684	< 128 bytes	(78.39 kbps)
51	HDCP	70	01:30:34.2390	R Bksv	(72.39 kbps)
52	HDCP	70	01:30:34.2393	< 628BABA687	(72.50 kbps)
53	HDCP	70	01:30:34.2400	R Bcaps	(72.50 kbps)
54	HDCP	70	01:30:34.2403	< 83	(72.39 kbps)
55	HDCP	70	01:30:36.0171	R Bksv	(72.50 kbps)
56	HDCP	70	01:30:36.0174	< 628BABA687	(72.50 kbps)
57	HDCP	70	01:30:36.0177	R Bcaps	(72.50 kbps)
58	HDCP	70	01:30:36.0186	< 83	(72.39 kbps)
59	HDCP	70	01:30:36.01572	W An 4D439A467CB147CD (7...	
60	HDCP	70	01:30:36.1585	W Aksv 9DCA9C4BA8 (72.39...	
61	HDCP	70	01:30:36.3843	R Ri'	(72.50 kbps)
62	HDCP	70	01:30:36.3846	< 633C	(72.39 kbps)
63	HDCP	70	01:30:38.5517	R Ri'	(72.39 kbps)
64	HDCP	70	01:30:38.5518	< 633C	(72.39 kbps)
65	HDCP	70	01:30:40.6178	R Ri'	(72.39 kbps)
66	HDCP	70	01:30:40.6182	< 633C	(72.39 kbps)

ACA Remote Control:

- Save transactions as an ACA trace file to disseminate to colleagues.
- View saved trace files later for comparison through ACA Viewer utility.

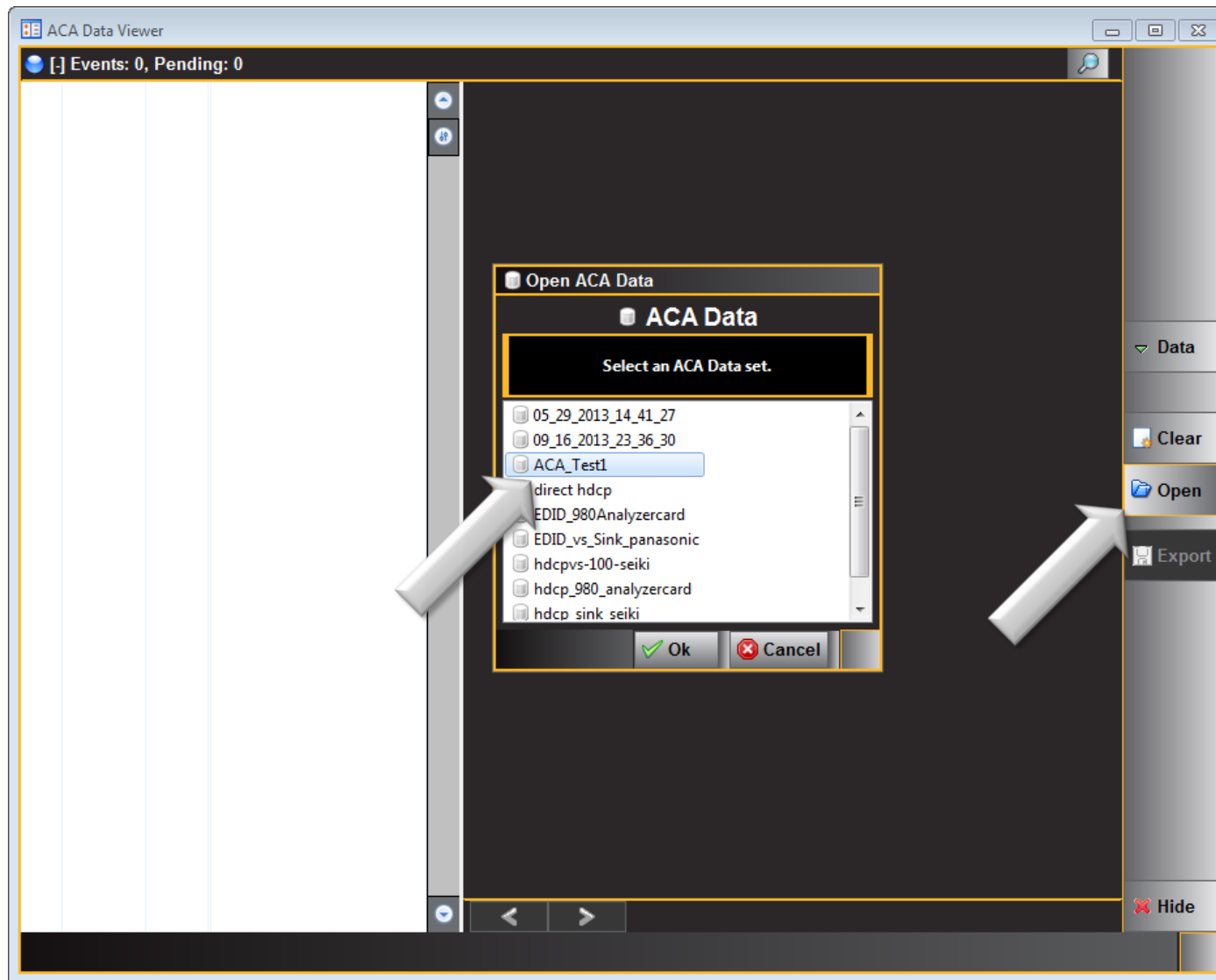
980 HDMI Video Generator - Auxiliary Channel Analyzer



ACA Viewer utility:

- View saved transactions.
- Do not need 980 test instrument.
- Ideal for collaboration with subject matter experts.

980 HDMI Video Generator - Auxiliary Channel Analyzer



ACA Viewer utility:

- Open ACA Viewer.
- Select file from Open.

980 HDMI Video Generator - Auxiliary Channel Analyzer

The screenshot shows the ACA Data Viewer utility. The main window is titled "[ACA_Test1] Events: 130". It displays a list of events in a table format. The selected event is row 114, which is a HDCP event with a value of 80. A large white arrow points to this row. The detailed view on the right shows the following information:

Type: HDCP
Start Time: 00:12:46.8006
Duration: 164 to 328 us
Maximum I2C Rate: 70.52 kbps

Read, 1 byte

Register: 40h
Name: Bcaps (HDCP B Capability Bits)
Value: 80h

Bit	Name	Value	Description
0	FAST_REAUTHENTICATION	N(0)	
1	1.1_FEATURES	N(0)	
2		0	Reserved
3		0	Reserved
4	FAST	N(0)	
5	READY	N(0)	KSV FIFO Ready
6	REPEATER	N(0)	
7		1	Reserved

Below the table, there is a hex dump showing the start and stop of the read operation:

```
* START *  
0000 75 80- | u .  
* STOP *
```

The bottom status bar shows the current event: "114: < 80 (70.52 kbps)".

ACA Viewer utility:

- View details of any record.

980 HDMI Video Generator - Auxiliary Channel Analyzer

The screenshot shows the ACA Data Viewer utility. The main window displays a list of events for [ACA_Test1] with 130 events. The selected event (114) is an HDCP event at 00:12:46.8006, showing a read of 1 byte. The detailed view on the right shows the event type as HDCP, with start time 00:12:46.8006, duration 164 to 328 us, and maximum I2C rate of 70.52 kbps. The register value is 80h, which corresponds to the Bcaps (HDCP B Capability Bits) register. The bit field is shown as follows:

Bit	Name	V
0	FAST_REAUTHENTICATION	N
1	1.1_FEATURES	N
2		
3		
4	FAST	N
5	READY	N
6	REPEATER	N
7		

The bit field is also shown in a hexadecimal representation: * START * 0000 75 80- * STOP * | u .

ACA Viewer utility:

- View details of any record.
- Configure to view timestamps.

980 HDMI Video Generator - Auxiliary Channel Analyzer

The screenshot displays the ACA GUI with two main panels. The left panel, titled 'ACA Events: 148', shows a list of events from 118 to 148. Event 129 is selected and highlighted in blue. The right panel, titled 'ACA Event Details', shows the details for the selected event. A white arrow points from the selected event in the left panel to the details panel. Another white arrow points from the details panel to the text on the right.

ACA Events: 148

Event ID	Type	Value	Rate
118	HDCP	00 Reply 53D8	(44.28 kbps)
119	HDCP	00 Read Ri'	(44.32 kbps)
120	HDCP	00 Reply 16D0	(44.32 kbps)
121	HDCP	00 Read Ri'	(44.32 kbps)
122	HDCP	00 Reply 7076	(44.28 kbps)
123	EDID	00 Segment 0x00	(45.01 kbps)
124	EDID	00 Req at Offset 0x00	(44.28 kbps)
125	EDID	00 Read 128 bytes	(44.32 kbps)
126	EDID	00 Segment 0x00	(44.28 kbps)
127	EDID	00 Req at Offset 0x80	(44.28 kbps)
128	EDID	00 Read 128 bytes	(44.32 kbps)
129	HDCP	00 Read Bcaps	(44.28 kbps)
130	HDCP	00 Reply 80	(44.28 kbps)
131	HDCP	00 Write An 01E1FE9DF210CFEB	(44.28 kbps)
132	HDCP	00 Write Aksv 70092FFE61	(44.28 kbps)
133	HDCP	00 Read Bksv	(44.32 kbps)
134	HDCP	00 Reply 5A0B3A4CAF	(44.32 kbps)
135	HDCP	00 Read Ri'	(44.32 kbps)
136	HDCP	00 Reply 6D4C	(44.32 kbps)
137	HDCP	00 Read Bcaps	(44.32 kbps)
138	HDCP	00 Reply 80	(44.32 kbps)
139	HDCP	00 Write An 8F90C5295D6E7112	(44.32 kbps)
140	HDCP	00 Write Aksv 70092FFE61	(44.32 kbps)
141	HDCP	00 Read Bksv	(44.28 kbps)
142	HDCP	00 Reply 5A0B3A4CAF	(44.32 kbps)
143	HDCP	00 Read Ri'	(44.32 kbps)
144	HDCP	00 Reply E834	(44.32 kbps)
145	HDCP	00 Read Ri'	(44.28 kbps)
146	HDCP	00 Reply 7856	(44.32 kbps)
147	HDCP	00 Read Ri'	(44.28 kbps)
148	HDCP	00 Reply 22AE	(44.32 kbps)

ACA Event Details

Type: HDCP
Start Time: 00:00:00.0301
Duration: < 164 us
Maximum I2C Rate: 75.85 kbps

The master read the following data:
0x80 from Reg 0x40 (Bcaps (HDCP B Capability Bits))
REPEATER: 0
READY: 0
FAST: 0
1.1 FEATURES: 0
FAST_REAUTHENTICATION: 0

* START *
0000 75 80- | u .
* STOP *

1538: Reply 80 (75.85 kbps)

Embedded GUI ACA from 980 touch panel.

- Works same way of ACA Remote Control application for external 980 GUI Manager (example left).

980 HDMI Video Generator Module Testing CEC

980 HDMI Video Generator Module – CEC Tester

- Optional feature for testing CEC-capable HDMI devices.
- Emulate any CEC device and send any message to any CEC device.
- Monitor CEC transactions through CEC Tester and view details.
- Monitor CEC messages using Auxiliary Channel Analyzer (CEC) – save traces for dissemination to subject matter experts and Quantum Data customer support.

980 HDMI Video Generator Module – CEC Tester

- Run “irregular” tests for robustness testing of CEC devices:
 - Send messages with user-specified corrupt bits.
 - Send messages with variations in timing for any bit and any message.
 - Test non-acknowledgement scenarios when CEC devices under test send messages to the 980 Video Generator.
 - Test arbitration scenarios where 980 Video Generator seizes bus at various times to test the behavior of the CEC device under test.

980 HDMI Video Generator Module – CEC Tester

The screenshot displays the software interface for the 980 HDMI Video Generator Module. At the top, the 'Generator' section shows system information: 'CARD: Quantum Data, Inc. HDMI generator analyzer', 'Interface' dropdown, 'PORT: HDMI-T20/21', 'FMT: /Standard/1080p60.xml', 'INTF: HDMI (RGB)', and 'IMG: /Standard/Acer2.img'. Below this are tabs for 'Format', 'Pattern', 'Audio', and 'Tools'. The 'Tools' menu is highlighted with a white arrow pointing to it. On the left side, a vertical menu contains options: 'EDID Decode', '3D', 'Image Shift', 'AFC', 'CEC Ping', 'CEC Tester' (highlighted with a white arrow), and 'Editors'. The main area is divided into 'Command' and 'Control' tabs. Under 'Command', there are fields for 'Port' (HDMI-T20), 'Configuration' (0x04: PLAY1), and 'Physical Address' (0.0.0.1) with an 'Apply' button. Under 'Control', there are fields for 'Initiator' (0x04: PLAY1), 'Follower' (<None>), and 'Opcode' (<None>), along with a 'Parameters' input field and the text 'No parameters.'. At the bottom, there are buttons for 'Clear', 'Reset To', 'Send', 'Get Response', and 'Details'. On the right side, there are buttons for 'Disconnect', 'Refresh', 'HDMI-T20', 'HDMI-T01', and 'Hide'.

Testing CEC devices:

- CEC Tester accessible from Tools menu.

980 HDMI Video Generator Module – CEC Tester



Testing CEC devices:

- Configure 980 CEC Tester to emulate a specific CEC device.
- Example shows emulating a Player.

980 HDMI Video Generator Module – CEC Tester

Generator

Interface **CARD:** Quantum Data, Inc. HDMI generator analyzer
PORT: HDMI-T20/21 **FMT:** /Standard/1080p60.xml **Output**
INTF: HDMI (RGB) **IMG:** /Standard/Acer2.img

Format Pattern Audio Tools

EDID Decode 3D Image Shift AFC CEC Ping CEC Tester Editors

Command Control

Port: HDMI-T20 Configuration: 0x04: PLAY1 Physical Address: 0 0 0 1 Apply

Initiator: 0x04: PLAY1 Follower: 0x00: TV Opcode: 0x8C: Give Vendor ID

Parameters:

- 0x87: Device Vendor ID
- 0x89: Vendor Command
- 0x8A: Vendor Remote Button Down
- 0x8B: Vendor Remote Button Up
- 0x8C: Give Vendor ID
- 0x8D: Menu Request
- 0x8E: Menu Status
- 0x8F: Give Device Power Status
- 0x90: Report Power Status
- 0x91: Get Menu Language

17:02:30.278	HDMI-T20	PLAY1
17:02:57.689	HDMI-T20	TV

Clear Reset To Send

Disconnect Refresh HDMI-T20 HDMI-T01 Hide

Testing CEC devices:

- Select CEC message to send.
- Example shows Give Vendor ID.

980 HDMI Video Generator Module – CEC Tester

Generator

CARD: Quantum Data, Inc. HDMI generator analyzer
Interface: **PORT:** HDMI-T20/21 **FMT:** /Standard/1080p60.xml **Output**
INTF: HDMI (RGB) **IMG:** /Standard/Acer2.img **Disconnect**

Format Pattern Audio Tools **Refresh**

EDID **Response Details**

3D
Image Shift
AFC
CEC Ping
CEC Tester
Editors

TV->*ALL*, Device Vendor ID (0x87)
Bytes: 0F 87 00 07 AA

Size of message: 5 bytes
Message source: TV (0x0)
Message destination: *ALL* (0xF)
Message opcode: Device Vendor ID (0x87)
Device Vendor ID: 0x0007AA

Close

17:02:30.278 HDMI-T20 PLAY1 -> TV: Give Physical Address
17:02:57.689 HDMI-T20 TV->*ALL*, Report Physical Ad...
17:05:12.7 HDMI-T20 PLAY1 -> TV: Give Vendor ID
17:05:15.816 HDMI-T20 TV->*ALL*, Device Vendor ID (...)

Clear Reset To Send Get Response Details Hide

Testing CEC devices:

- Send message and monitor response.
- View details of response.

980 HDMI Video Generator Module – CEC Tester



Testing CEC devices:

- Send message with corrupt bits to test CEC device under test handling.
- Specify any bit of any byte in a message.

980 HDMI Video Generator Module – CEC Tester

The screenshot shows the 'Generator' software interface for testing CEC devices. The top status bar displays: **CARD:** Quantum Data, Inc. HDMI generator analyzer; **Interface:** HDMI-T20/21; **PORT:** HDMI-T20/21; **FMT:** /Standard/1080p60.xml; **INTF:** HDMI (RGB); **IMG:** /Standard/Acer2.img. A green 'Output' button is visible. Below the status bar are tabs for 'Format', 'Pattern', 'Audio', and 'Tools'. The main control area is divided into 'Command' and 'Control' sections. The 'Control' section includes:
- **Test Arbitration:** 'Seize Start Bit', 'Seize Address Bits', and 'Seize Data Bits' are unchecked.
- **Enable ACKs:** 'Directed Header', 'Directed Data', 'Broadcast Header', and 'Broadcast Data' are checked.
- **Timing Control:** A grid of six sliders for timing parameters:
 - Start Bit Low Period (3.5 - 3.9 ms): 3.88 ms
 - Start Bit Total Period (4.3 - 4.7 ms): 4.68 ms
 - 1 Bit Low Period (0.4 - 0.8 ms): 0.78 ms
 - 1 Bit Total Period (2.05 - 2.75 ms): 2.07 ms
 - 0 Bit Low Period (1.3 - 1.7 ms): 1.32 ms
 - 0 Bit Total Period (2.05 - 2.75 ms): 2.07 ms
- **Corrupt Bit:** Set to 'None' for 'Byte 1'.
- A 'Reset all to Defaults' button.
On the right side, there are 'Disconnect' and 'Refresh' buttons, and two selected interface buttons: 'HDMI-T20' and 'HDMI-T01'. A white arrow points from the '1 Bit Low Period' slider to the text on the right.

Testing CEC devices:

- Send messages with variances in timing to test CEC device under test handling.
- Change timing of any type of bit, e.g. start, data, low period or high period.

980 HDMI Video Generator Module – CEC Tester



Testing CEC devices:

- Test CEC device under test handling of non-acknowledgement (nack) scenarios.
- Specify nack for any type of message and message component, e.g. Broadcast Data byte.
- Tests CEC device under test handling of acknowledgement.

980 HDMI Video Generator Module – CEC Tester



Testing CEC devices:

- Test CEC device under test handling for various arbitration scenarios.
- Specify 980 CEC Tester attempts to seize bus under a variety of conditions, e.g. seize bus during transmission of a data bit.
- Tests CEC device under test proper handling of arbitration.

980 HDMI Video Generator Module – CEC Tester

The screenshot displays the CEC Tester interface. On the left, a list of 23 events is shown, with event 20 selected. The main panel shows the details for event 20: a CEC message of type 'Report Physical Address (0x84)' from TV (0x0) to *ALL* (0xF). The message size is 2 bytes (21 bits total). The physical address is <Insufficient Data>. The device type is ERROR: None given. Below this, a bit timing table is provided.

Number	Lo(ms)	Hi(ms)	Inv	Dat	Val
0	3.69	0.81	---	H	S
1	1.50	0.89	---	Y	0
2	1.50	0.90	---	Y	0
3	1.50	0.89	---	Y	0
4	1.50	0.90	---	Y	0
5	0.59	1.80	---	Y	1
6	0.59	1.81	---	Y	1
7	0.59	1.80	---	Y	1
8	0.59	1.81	---	Y	1
9	1.49	0.90	---	Y	0
10	0.60	1.80	---	Y	1
11	0.59	1.80	---	Y	1
12	1.49	0.91	---	Y	0
13	1.49	0.90	---	Y	0
14	1.49	0.91	---	Y	0
15	1.49	0.90	---	Y	0
16	0.59	1.80	---	Y	1
17	1.49	0.90	---	Y	0
18	1.49	0.90	---	Y	0
19	1.49	0.91	---	Y	0
20	1.50	9.16	---	Y	0

Testing CEC devices:

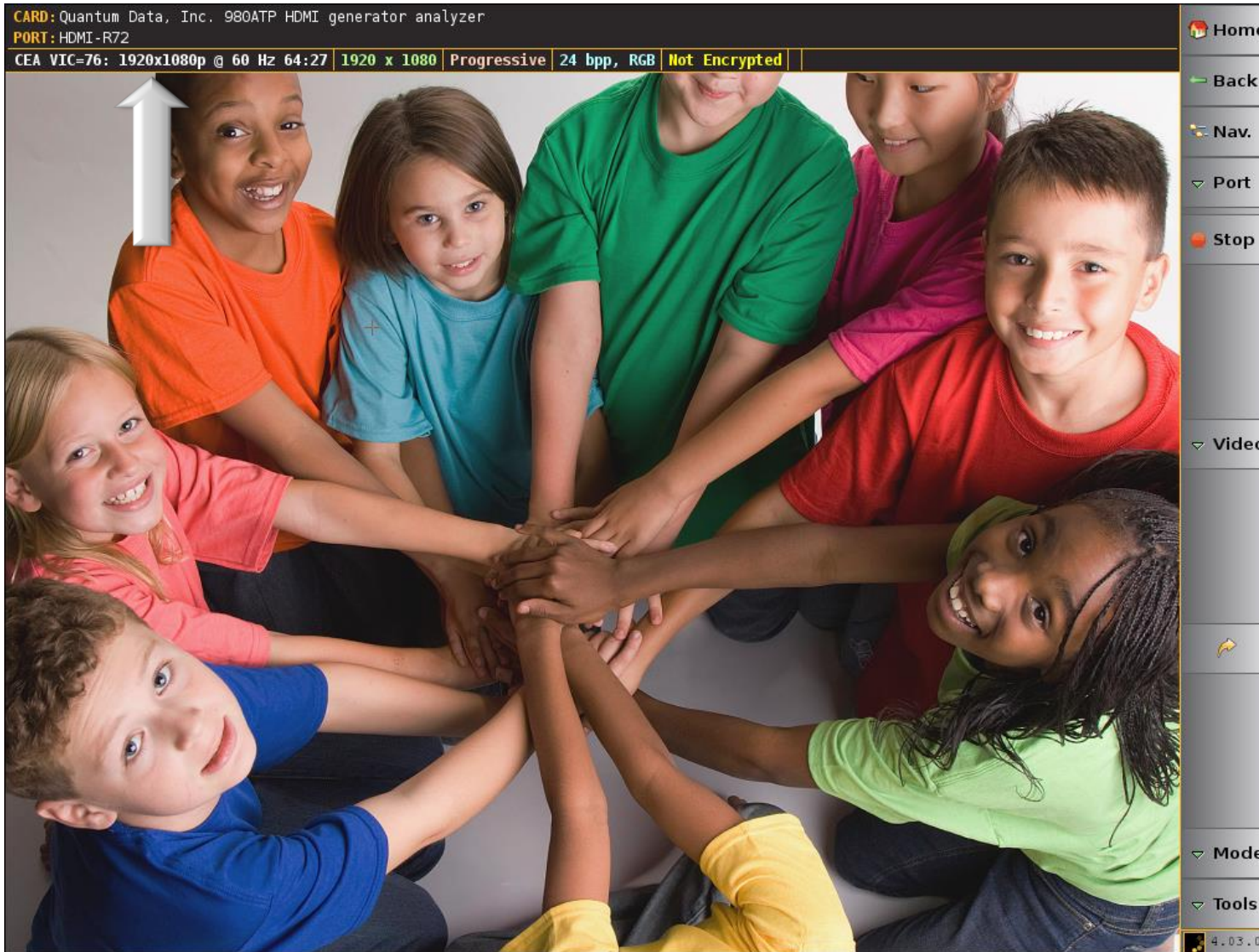
- Monitor CEC messages using the Auxiliary Channel Analyzer (ACA).
- View all messages and details of all messages.
- Save file for dissemination to colleagues and other subject matter experts as well as Quantum Data customer support.

980 HDMI Video Generator Module Basic Analyzer for Source Testing

980 HDMI Video Generator Module – Basic Analysis

- Optional feature for basic verification of HDMI source devices.
- Verify incoming video image.
- Check basic video parameters.
- Select EDIDs for emulation.

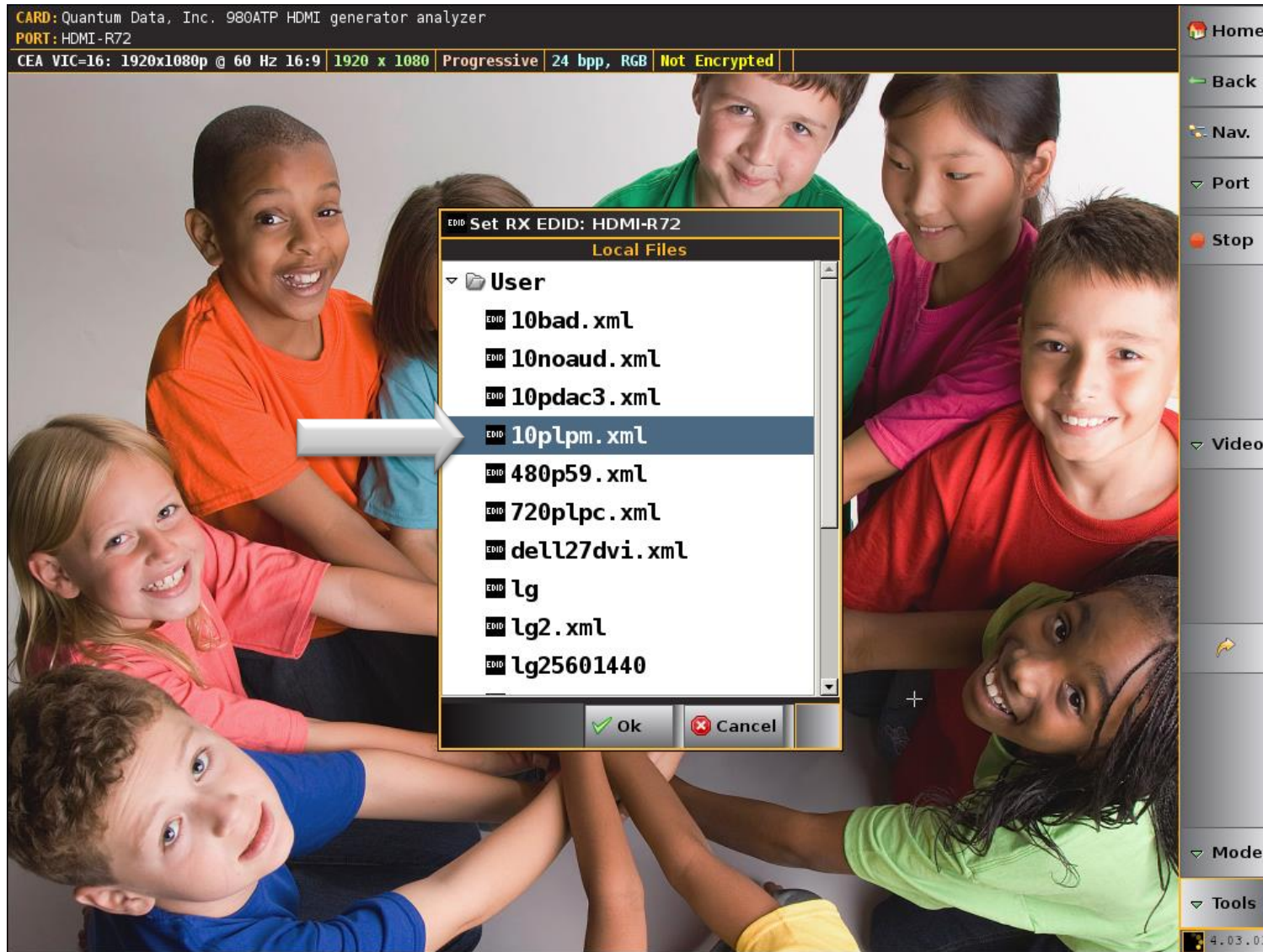
980 HDMI Video Generator Module – Analyzer



Confidence Testing of HDMI source devices:

- Main window shows incoming video.
- Dashboard shows important attributes of incoming HDMI video.

980 HDMI Video Generator Module – Analyzer



- Confidence Testing of HDMI source devices:
- Set EDID on Rx port to emulate any EDID.

980 HDMI Video Generator Module – Analyzer



Confidence Testing of HDMI source devices:

- Example showing Encrypted content.

980 HDMI Video Generator Module – Analyzer



Confidence Testing of HDMI source devices:

- Example showing Encrypted content.

Quantum Data 980 Video Test Generation Module



... 980 now supports video pattern testing of HDMI HDTVs and displays.