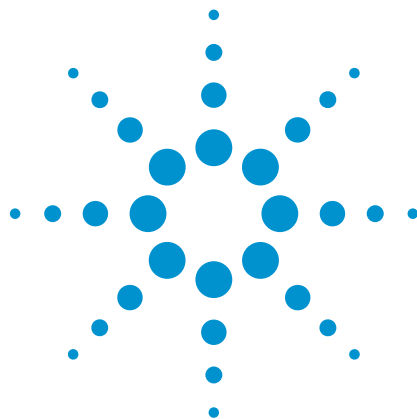


Agilent N5998A HDMI 1.3b Protocol/Audio/Video Analyzer and Generator

Data Sheet
Version 1.1



Features and Benefits:

- HDMI 1.3b compliance measurements
- HDMI protocol analysis
- HDMI data generator
- Deep color support
- EDID writing



Agilent Technologies

N5998A HDMI 1.3b Protocol/Audio/Video Analyzer and Generator

The N5998A is the reference high-speed

- protocol analyzer
- video timing analyzer
- video picture analyzer
- audio timing analyzer
- audio/video protocol generator

for HDMI compliance tests required by the compliance test specification (CTS 1.3b). The global HDMI authorized test centers (ATCs) rely on the N5998A.

The HDMI protocol / audio / video analyzer and generator consists of the following components shown in figure 1:

- Agilent N5998A unit
- Personal computer running Windows XP with a USB 2.0 port available and connected to the Agilent N5998A unit for downloading the captured TMDS sequences (not included in the product)
- Agilent N5998A HDMI analysis software running on the PC
- USB 2.0 cable connected between N5998A unit and PC

HDMI analyzer features:

- User-controlled execution of individual or multiple protocol/audio/video compliance tests
- Clear indication of test PASS/FAIL results. Test outputs to the GUI and can be saved to a text file
- Process captured HDMI data file and shows details of each frame. e.g. the number of packets in the frame and the specific packet types, video data periods, preambles, etc
- Support for deep color 30-bit, 36-bit and 48-bit
- Detailed decode, view the values of the channel data anywhere in the frame

Note: A frequency counter (not included in the product) is needed to measure the TMDS Clock in conjunction with the N5998A for test 7-25 (Video Format Timing).

HDMI generator features:

- Ability to generate protocol and audio pattern, including deep color patterns
- Predefined test patterns are installed with the software installation

Note: For test 8-25 (deep color), both instruments are needed.

EDID writer features

The writer supports 2-block EDIDs

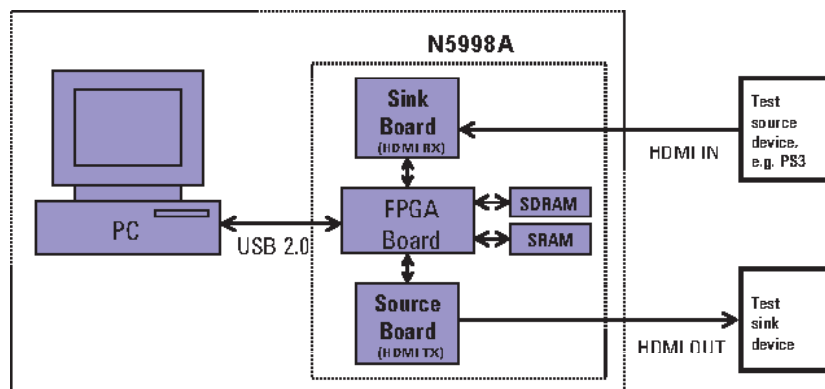


Figure 1: N5998A block diagram

Protocol / audio / video analyzer

The N5998A's protocol / audio / video analyzer supports the HDMI source compliance tests 7-16 through 7-37, with the exception of tests 7-20, 7-21 and 7-22. The protocol analyzer captures up to 4 GB of data as shown in figure 2. The analysis is then conducted in post-processing.

Prior to the processing, a data file has to be created on the controller PC. The CTS source audio tests require the minimum sample time of 2 seconds. The minimum file size to meet this requirement for each primary video format is calculated with the formulas below. Note one pixel is 64 bit (8 Byte) in the target file.

Progressive formats:

$$2 \text{ sec frame size} = (\text{H total} \times \text{V total} \times 8) \times \text{V Freq} \times 2$$

Interlace formats:

$$2 \text{ sec frame size} = (\text{H total} \times \text{V total} \times 8) \times \text{V Freq}$$

- The H total, V total and V Freq values are listed in the Video Format Timings 2 of the CEA-861-C CEA Standard
- For 36 bit deep color, multiply by 1.5

Example 720x480p 60 Hz:

$$\text{file size} = 858 \times 525 \times 8 \times 60 \times 2 = 432,432,000 \text{ Byte}$$

A 10 % margin is recommended because the data file does typically not start exactly at the beginning of a frame. Hence a 480 MB file size is required for testing 2 seconds of 720x480p 60 Hz audio data.

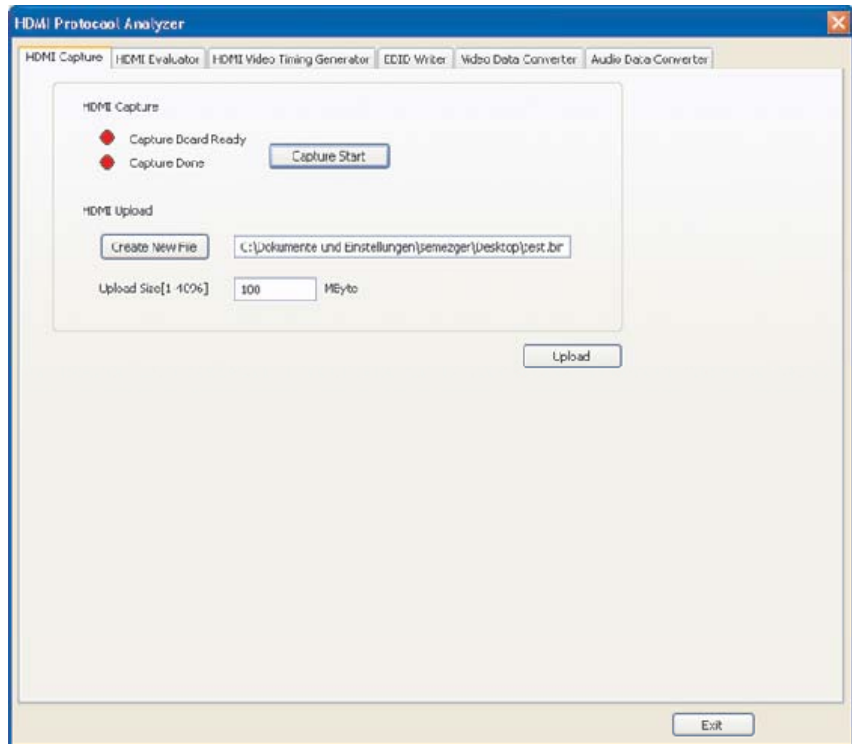


Figure 2: Data capture setup screen

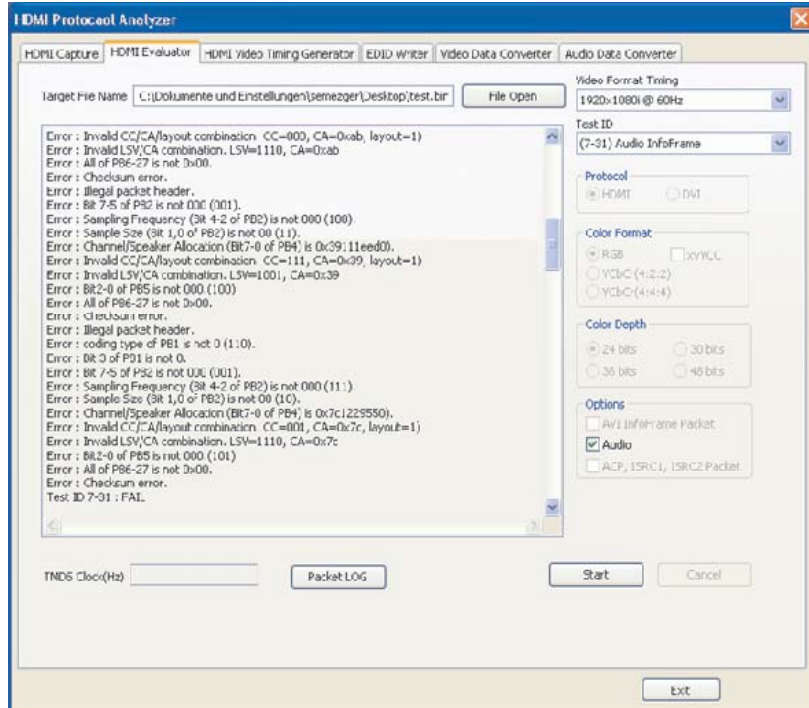
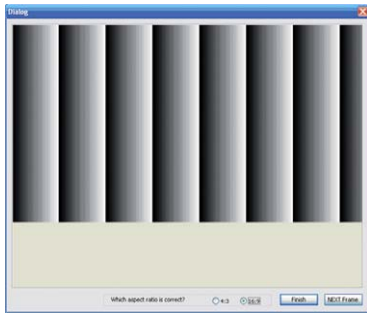


Figure 3: HDMI protocol analysis, failed test 7-31



Some analyzer tests display the captured video frame during data processing (see figure 4).

Figure 4: Display of captured video frame

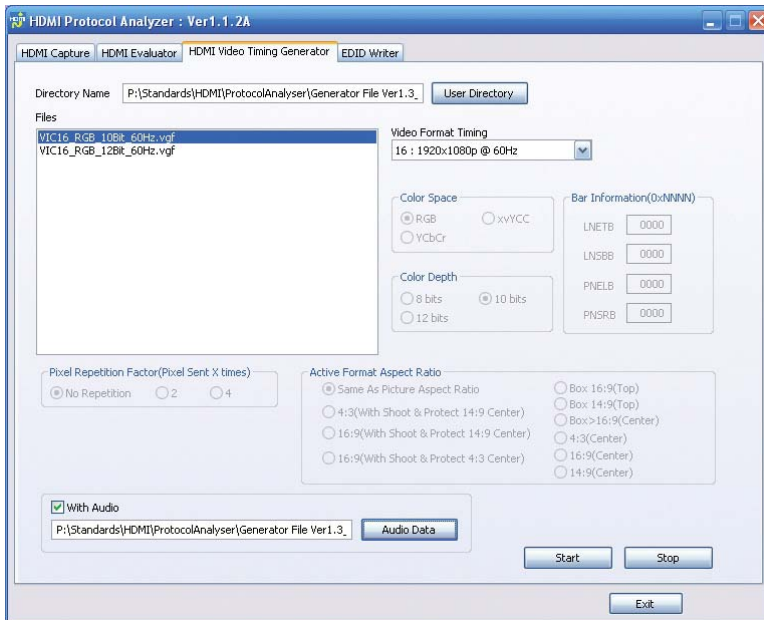


Figure 5: Protocol generator user interface

Protocol generator

The N5998A HDMI Protocol Generator subsystem provides the pattern required for the sink tests 8-16, 8-21, 8-23 and, in conjunction with the Agilent TMD5 Signal Generator E4887A, 8-25. An example is shown in figure 5.

Supported CTS Tests

Table 1: Supported HDMI CTS 1.3b sink and source tests

Test	Name	N5998A PAG	E4887A TMDS Signal Generator	Quantum Data 882CA
Source Protocol				
7-16	Legal Codes	X		
7-17	Basic Protocol	X		
7-18	Extended Control Period	X		
7-19	Packet Types	X		
Source Video				
7-23	Pixel Encoding – RGB to RGB Sink	X		
7-24	Pixel Encoding – YCbCr to YCbCr Sink	X		
7-25	Video Format Timing	X		
7-26	Pixel Repetition	X		
7-27	AVI InfoFrame	X		
Source Audio				
7-28	IEC 60958/IEC 61937	X		
7-29	ACR	X		
7-30	Audio Sample Packet Jitter	X		
7-31	Audio InfoFrame	X		
7-32	Audio Sample Packet Layout	X		
Source Interoperability with DVI				
7-33	Interoperability with DVI	X		
Source Advanced Features				
7-34	Interoperability with DVI	X		
7-35	Gamut Metadata Transmission	X		
7-36	High Bitrate Audio	X		
7-37	One Bit Audio	X		
Sink Electrical				
8-5	TMDS - Min/Max Diff. Swing Tol.		X	
8-6	TMDS - Intra-Pair Skew		X	
8-7	TMDS - Jitter Tolerance		X	
Sink Protocol				
8-15	Char. Synchronization		X	
8-16	Accep. of All Valid Packet Types	X		
Sink Video				
8-17	Basic Format Support Req.			X
8-18	HDMI Format Support Req.			X
8-19	Pixel Encoding Requirements		X	X
8-20	Video Format Timing		X	
Sink Audio				
8-21	Audio Clock Regeneration	X		
8-22	Audio Sample Packet Jitter		X	
8-23	Audio Formats	X		
Sink Interoperability with DVI				
8-24	Interoperability with DVI		X	
Sink Advanced Features				
8-25	Deep Color	X	X	

Note: For tests 8-19 and 8-25, all instruments indicated are needed

Supported Video Formats

Table 2

CEA Video ID Code	Format	Field Rate	Picture Aspect Ratio	Analyzer				Generator			
				24 bit	30 bit	36 bit	48 bit	24 bit	30 bit	36 bit	48 bit
1	640x480p	59.94 Hz / 60 Hz	4:3	X	X			X	X	X	T
2	720x480p	59.94 Hz / 60 Hz	4:3	X	X			X	X	X	T
3	720x480p	59.94 Hz / 60 Hz	16:9	X	X			X	X	X	T
4	1280x720p	59.94 Hz / 60 Hz	16:9	X	X			X	X	X	T
5	1920x1080i	59.94 Hz / 60 Hz	16:9	X	X			X	X	X	T
6	720(1440)x480i	59.94 Hz / 60 Hz	4:3	X	X			X	X	X	T
7	720(1440)x480i	59.94 Hz / 60 Hz	16:9	X	X			X	X	X	T
8	720(1440)x240p	59.94 Hz / 60 Hz	4:3					T	T	T	T
9	720(1440)x240p	59.94 Hz / 60 Hz	16:9					T	T	T	T
10	2880x480i	59.94 Hz / 60 Hz	4:3					T		T	T
11	2880x480i	59.94 Hz / 60 Hz	16:9					T		T	T
12	2880x240p	59.94 Hz / 60 Hz	4:3					T	T	T	T
13	2880x240p	59.94 Hz / 60 Hz	16:9					T	T	T	T
14	1440x480p	59.94 Hz / 60 Hz	4:3	X	X			X	X	X	T
15	1440x480p	59.94 Hz / 60 Hz	16:9	X	X			X	X	X	T
16	1920x1080p	59.94 Hz / 60 Hz	16:9	X	X			X	X	X	T
17	720x576p	50 Hz	4:3	X	X			X	X	X	T
18	720x576p	50 Hz	16:9	X	X			X	X	X	T
19	1280x720p	50 Hz	16:9	X	X			X	X	X	T
20	1920x1080i	50 Hz	16:9	X	X			X	X	X	T
21	720(1440)x576i	50 Hz	4:3	X	X			X	X	X	T
22	720(1440)x576i	50 Hz	16:9	X	X			X	X	X	T
23	720(1440)x288p	50 Hz	4:3					T	T	T	T
24	720(1440)x288p	50 Hz	16:9					T	T	T	T
25	2880x576i	50 Hz	4:3					T	T	T	T
26	2880x576i	50 Hz	16:9					T	T	T	T
27	2880x288p	50 Hz	4:3					T	T	T	T
28	2880x288p	50 Hz	16:9					T	T	T	T
29	1440x576p	50 Hz	4:3	X	X			X	X	X	T
30	1440x576p	50 Hz	16:9	X	X			X	X	X	T
31	1920x1080p	50 Hz	16:9	X	X			X	X	X	T
32	1920x1080p	23.97 Hz / 24 Hz	16:9	X	X			X	X	X	T
33	1920x1080p	25 Hz	16:9					T	T	T	T
34	1920x1080p	29.97 Hz / 30 Hz	16:9					T	T	T	T
35	2880x480p	59.94 Hz / 60 Hz	4:3	X	X			X	X	X	T
36	2880x480p	59.94 Hz / 60 Hz	16:9	X	X			X	X	X	T
37	2880x576p	50 Hz	4:3	X	X			X	X	X	T
38	2880x576p	50 Hz	16:9	X	X			X	X	X	T
39	1920x1080i	50 Hz	16:9					T	T	T	T
40	1920x1080i	100 Hz	16:9					T	T	T	T
41	1280x720p	100 Hz	16:9					T		T	T

CEA Video ID Code	Format	Field Rate	Picture Aspect Ratio	Analyzer				Generator			
				24 bit	30 bit	36 bit	48 bit	24 bit	30 bit	36 bit	48 bit
42	720x576p	100 Hz	4:3					T	T	T	T
43	720x576p	100 Hz	16:9					T	T	T	T
44	720(1440)x576i	100 Hz	4:3					T	T	T	T
45	720(1440)x576i	100 Hz	16:9					T	T	T	T
46	1920x1080i	119.88 Hz / 120 Hz	16:9					T		T	T
47	1280x720p	119.88 Hz / 120 Hz	16:9					T			T
48	720x480p	119.88 Hz / 120 Hz	4:3					T			T
49	720x480p	119.88 Hz / 120 Hz	16:9					T			T
50	720(1440)x480i	119.88 Hz / 120 Hz	4:3					T	T	T	T
51	720(1440)x480i	119.88 Hz / 120 Hz	16:9					T	T	T	T
52	720x576p	200 Hz	4:3					T	T	T	T
53	720x576p	200 Hz	16:9					T	T	T	T
54	720(1440)x576i	200 Hz	4:3					T	T	T	T
55	720(1440)x576i	200 Hz	16:9					T	T	T	T
56	720x480p	239.76 Hz / 240 Hz	4:3					T			T
57	720x480p	239.76 Hz / 240 Hz	16:9					T			T
58	720(1440)x480i	239.76 Hz / 240 Hz	4:3					T			T
59	720(1440)x480i	239.76 Hz / 240 Hz	16:9					T			T

T: High Resolution TMDS signal converter E4887A opt. 007

The supported video formats will be enhanced over time.

General system requirements	
PC system requirements	
Hardware	Pentium® processor 1 GHz or equivalent 512 MB available RAM 8 x CD-ROM driver or higher VGA resolution 1024 x 768 5 GB or more free disc space USB 2.0 interface
Operating system	Windows® XP
General characteristics	
Power requirements	100 - 240 V~ 300 VA max. 50/60 Hz
TMDS clock output	3.3 V LVTTTL
Memory analyzer	4 GB
Environment	
Temperature	Operating: 5 °C to + 45 °C Storage: 5 °C to + 45 °C
Humidity	Operating: 15% - 95% @40°C (non-condensing) Storage: 90% @65°C
Safety & EMC standards	IEC 61010-1/EN 61010-1 IEC 61326/EN 61326-1 Installation category II, Pollution degree: 2
Physical characteristics	
2-slot chassis	Width: 43 cm (16.9 in); Depth: 35 cm (13.8 in); Height: 14 cm (5.5 in) Weight: 6 kg (13.2 lbs)
Connectors	
HDMI (input and output)	Type B receptacle
PC controller	USB 2.0
TMDS clock output	BNC

Related Literature

Pub. No.

Agilent E4887A HDMI TMDS
Signal Generator
Data Sheet

5989-5537EN

HDMI Sink and Source
Compliance Test and
Characterization
Application Note

5989-4959EN

Infinium 80000 Series
Oscilloscopes
Data Sheet

5989-4271EN

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