VQDM-100

AV Test Pattern Generator

AV Delay & Sync Analyzer

Version 1.1.6

User Manual

VideoQ

VQDM-100

AV Test Pattern Generator and AV Delay & Sync Analyzer

by VideoQ Inc

Compact Tool to evaluate and measure the quality and timing of processed and displayed video.

Advanced test patterns instantly revealing your video procesor and/or display device performance.

Built-in multi-channel audio & video delays analyzer measures absolute and relative AV delay parameters.

VQDM-100 User Manual

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*Michael Shinsky, Maria Rozen and Mikhail Budchenko,
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Revision History

Revision	Date	Description
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1.1.1	2010, November	Release
1.1.2	2011, January	Release
1.1.3	2011, September	Release
1.1.4	2011, November	Release
1.1.5	2012, February	Release
1.1.6	2012, May	Release

Table of Contents

1   Introduction and Overview

VQDM is a multi-functional tool for video systems installers, development labs, software developers and high volume manufacturers – to test cameras, displays, codecs, transcoders, players and complex video systems, e.g. teleconference systems.

It consists of **Test Generator Module**, **Data Acquisition Module** and **Delay Analyzer Software.**

In combination, they provide for accurate measurement of **Video Latency**, **Audio Latency, AV Sync Errors** and **Frames Continuity Testing.**

Data Acquisition Module has **4 video inputs** and **4 audio inputs**. All relevant Test Points of the System Under Test should be connected to the appropriate VQDM inputs*:*

any video input can be connected to the special Light Sensor;

any audio inputs can be connected to standard audio line signal.

Optional **VQHD420** adapter unit converts HDMI/DVI signal to **Sync Pulse** sequence suitable for VQDM video inputs, thus replacing Light Sensor pulse sequence.

Easy-to-use **GUI** reveals multi-channel delay profiles, delay statistics, and AV sync errors in real time; analysis results are updated every 10 seconds.

Test Pattern Generator module provides for *calibration* and *pre-qualification* of System Under Test using built-in subset of **VQL** - VideoQ Test Patterns Library, which allows triple usage: visual-aural, instrumental and fully automated.

All necessary test pattern files in a variety of resolutions and formats are permanently stored in the TPG internal memory together with brief tutorials in slide-show format.

Analysis of video/audio quality is performed by visual-aural evaluation, by running 3rd party tools or by running VideoQ Analyzers, such as **VQMA**.

VQL test patterns, including special VQDM test patterns, are available in **2D** and **3D** versions and in several source options:

- HDMI signal from TPG module - to test displays and cameras

- Uncompressed YUV Files - to test codecs

- Compressed Transport Stream Files - to test transcoders and decoders

VQDM delay measurement methodology is based on specially designed sophisticated dynamic **VQDM Test Patterns.**

Test patterns components are designed to be compatible with a majority of video cameras, software or hardware codecs and media players. VQDM test patterns contain only relatively large components, so they remain suitable for accurate measurements even after low bitrate coding and severe position and/or scaling errors, e.g. zoom-out down to 25% or overscan up to 110%.

VQDM tests are available in a variety of frame rates (as labeled on the test pattern); flashes duration and general layout may vary.

VQDM Analyzer can work with either one of two test patterns: **VQDM1** (also called VQDM) and **VQDM2-1**.

VQDM1 test pattern shown below allows automatic measurement of AV delays and visual estimation of frame continuity errors.

It is suitable for automatic glass-to-glass testing of camera-link-display systems, e.g. video conference systems.

Two large **Light Sensor Areas** on the Test Pattern are flashing white *every second* for the duration of *two video frames*.

These flashes are read for analysis purposes by VQDM **Light Sensors** fitted attached to the display screen by vacuum caps.

This allows testing cameras and displays of any resolution and frame rate; perfect (i.e. time-consuming) setting of zoom/position/focus is not required. Average picture level of the VQDM1 test is approximately mid-gray, thus allowing normal camera operation in auto-iris mode.

Orbiting White Dot serves as Motion Continuity (Frames Continuity) test; any non-uniformity in the appearance of its motion means frame drop/freeze. Highly visible Time Stamps (frame numbers) in the central area are especially useful for off-line frame-by-frame analysis of recorded video data.

Such self-contained glass-to-glass solution allows measurement in normal work conditions without any interference into the System Under Test.

Audio delays are measured similarly - by connecting relevant test points to the corresponding VQDM outputs and inputs. There is no need for special audio sensors, VQDM TPG Module produces and VQDM Data Acquisition Module read standard audio line signals.

VQDM2-1 test pattern shown below also allows measurement of AV delays and frame continuity errors.

It is suitable for manual and automatic testing of signal-to-signal systems, such as video contribution links, and signal-link-display systems, e.g. IPTV systems.

Yellow Flashes: Frame # 0 A & B; All Even Frames: C1, All Odd Frames: C2.
Blue Stripe Width: All Even Frames: single width, All Odd Frames: double width
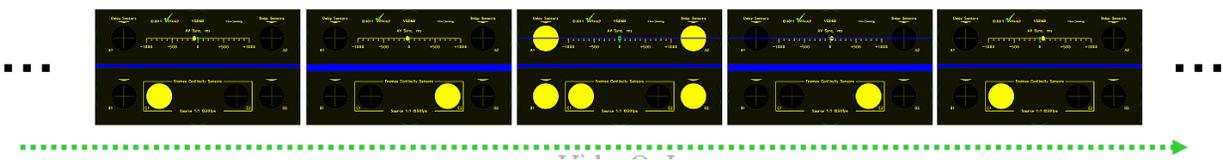
Important feature of VQDM2-1 dark yellow background with yellow texts and markers is that it produces 0% signal in Blue channel.

Four large **Light Sensor Areas** on the Test Pattern are flashing white *every second*. These flashes are read for analysis purposes by VQDM Light Sensors attached to the display screen.

Sensor Areas Sets A1/A2 and B1/B2 serve for measurement of glass-to-glass system latency, and AV sync errors; with reference to A1/A2 the set B1/B2 allows measurement of display latency vertical profile.

Narrow BluSync stripe flashing 100% Blue synchronously with Areas A1/A2 serves to measure display latency using optional HDMI-to-Sync adapter

Note that VQHD420 adapter operation relies on the blue flashes within VQDM2 test pattern; *VQHD420 is not compatible with VQDM1 test.*

Frames Continuity Sensor Areas C1 and C2 are flashing Black-Yellow: 2 video frames each area, sequence period = 4 frames. Any change of this cadence can be easily seen:

- on the System Under Test display screen

- observing the VQDM front panel green LED flashes cadence

- on the VQDM software scope displaying captured sequence of C1, C2 Light Sensor pulses

VQDM main unit, housed in the compact light metal enclosure, contains two modules:

- **TPG -** Test Pattern Generator
  TPG module setup, work modes and content file selection are performed via *on-screen menus* and compact *remote control unit*.

- **DAM -** Data Acquisition Module powered from TPG module and communicating with *host PC* via *USB cable*
  DAM module has 4 video inputs and 4 audio inputs.
  Valid audio and video inputs are indicated by two corresponding groups of green LEDs flashing every second, *independent* of Host PC or software analyzer status.

TPG and DAM modules work independent of each other, so they can be used together or separately - as described in the following sections.

Supplied light-weight carry case contains main VQDM unit with all necessary accessories, such as light sensors, cables, adapters, etc.

Delay Analyzer Software (**VQDM.EXE**) runs under Windows OS.

The program process in real-time 100 kBps data stream, acquired by VQDM main unit and transferred to host PC via USB cable.

VQDM.EXE can be run in two modes:

- **Windows GUI Mode** suitable for design labs and general setup
- **Command Line Mode** suitable for automated applications (background process)

In Windows GUI Mode two types of **Reports** are simultaneously available:

- Machine-readable Test Report file for test automation QA/QC applications
- Detailed Test Summary Table and corresponding PDF document for engineers

In Command Line Mode only machine-readable Test Report file is created.

Picture below shows setup example for Teleconference System video latency measurement:
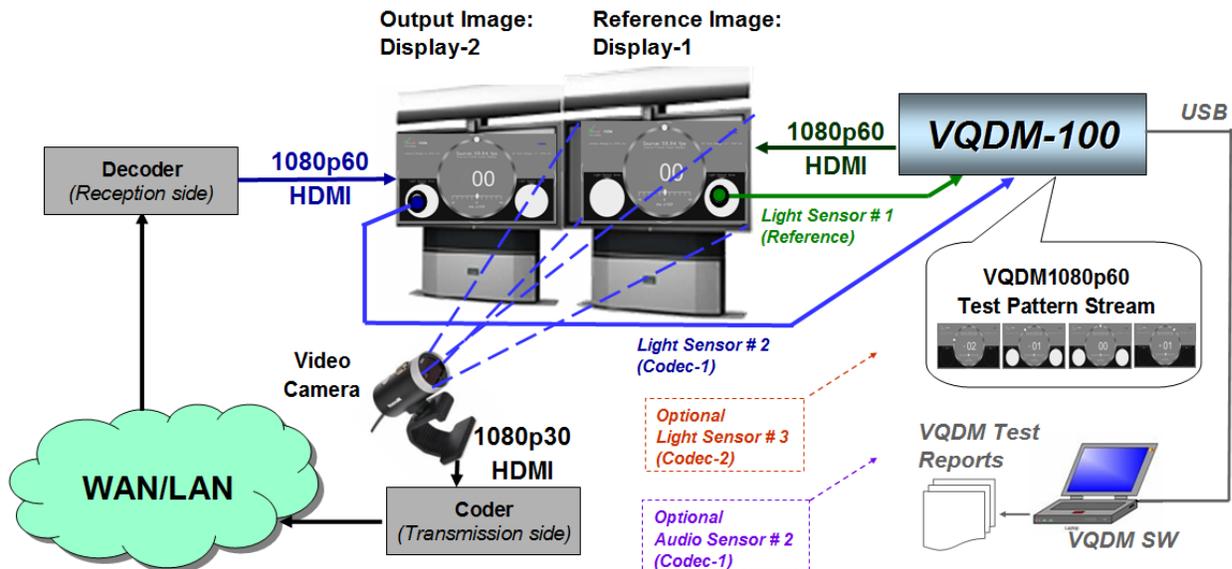
In this example glass-to-glass latency measurement covers complete system:
Camera + Coder + Network + Decoder + Display-2.

VQDM Carry Case Content:

- Main Unit
- PSU
- Remote Control
- Light Sensors in plastic containers, x4
- 2 m (9') stereo mini jack cables with numbered labels, x4
- AV cables of two types:
    YPrPb component
     CVBS plus LR audio
- USB cable, A-B type

2   Front Panel & Rear Panel

Front Panel Status Indicators

- MEM indicator (dimmed blue) shows status of both internal and external memories.
  It is always lit during normal operation; flashes few seconds on power-up and connection to external memory device.

- PWR indicator (dimmed blue) is always lit during normal operation.
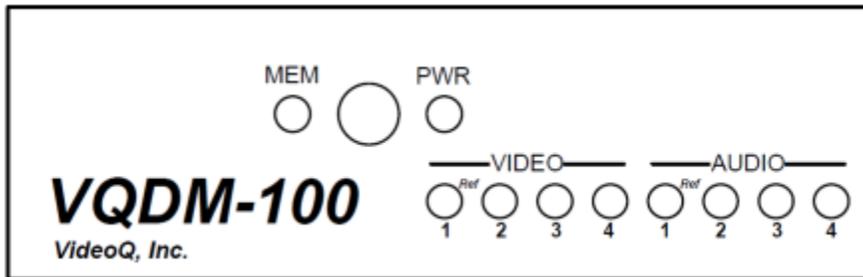
- Eight green LEDs at the bottom are flashing green showing active video/audio channels

Rear Panel Connectors
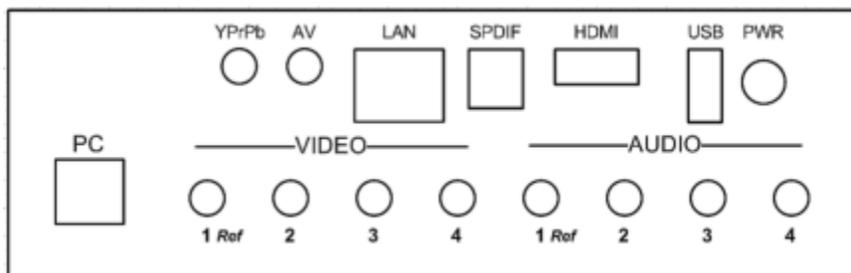
    Top row connectors - TPG Module:

- YPrPb - analog video output, *mini-jack to 3xRCA cable included*

- AV - Y/C (S-video) and CVBS (NTSC/PAL) outputs, *mini-jack to 3xRCA cable included*

- LAN - RJ45, 10/100 Ethernet network

- SPDIF - digital audio (optical) output

- HDMI - main TPG video/audio output, recommended for VQDM Test Pattern play-out

- USB - type A, play-out of additional content from external storage device

- PWR - external power supply adapter input, 12 V, 1.5 A, center = positive

    Bottom row connectors - DAM Module:

- PC - USB type B, connection with Host PC, *mini-jack cable included*

- Video 1-4 - mini-jacks, connection with Light Sensors, *labeled mini-jack cables included*

- Audio 1-4 - mini-jacks, connection with Audio Test Points, *cables and adapters not included*

3   VQDM Test Patterns Description

Picture below shows VQDM1 Test Pattern composition:
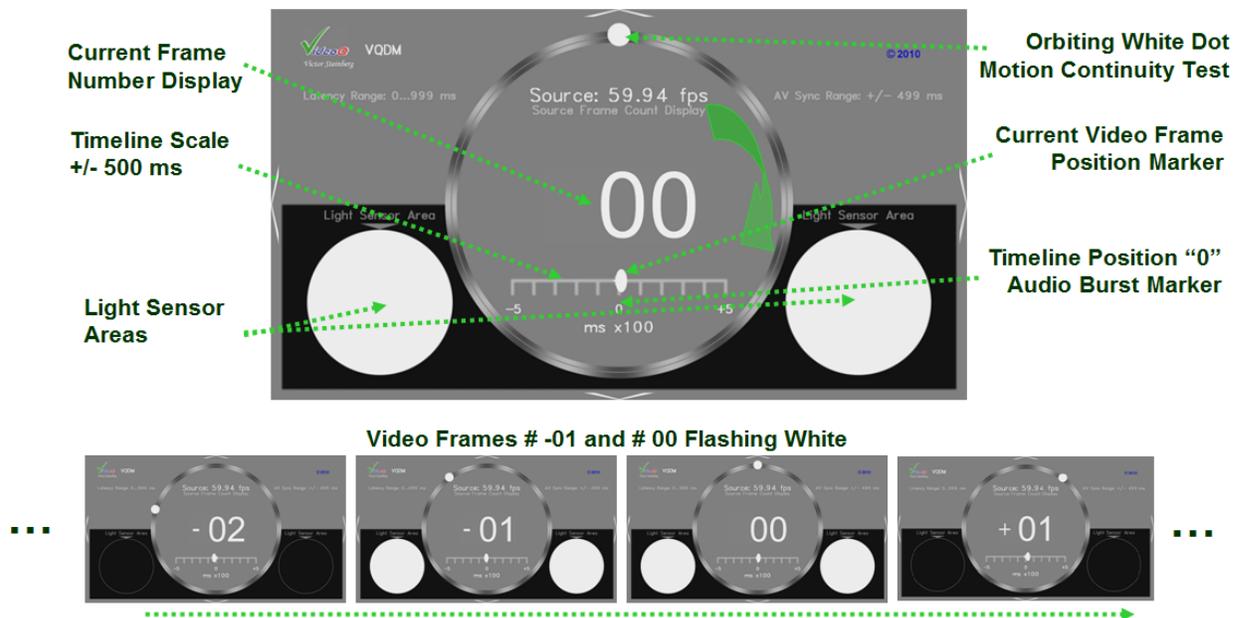
The dynamic test pattern consists of:

- Highly visible time stamps (frame numbers) in the central area

- Synchronously rotating white dot (clock dial)

- Normally black circular Light Sensor Areas flashing 100% White
  on Video Frames #-01 and # 00

- Sliding white ellipse marker indicating current frame position within the +/- 500 ms timeline scale; position "0" marks the center of Audio Burst

VQDM test pattern is available in a variety of frame rates. **Source Frame Rate** labeled on the test pattern itself may differ from **Display Frame Rate**.

Displayed frame number range and dial layout may also vary depending on the video signal format.

3D version differs from 2D version only in the configuration of Light Sensor Areas:

- 2D version – each frame contains two symmetrically positioned Light Sensor Areas

- 3D version – each of Left and Right images contains only one Light Sensor Area, allowing:
  - automatic Left/Right Channel Identification
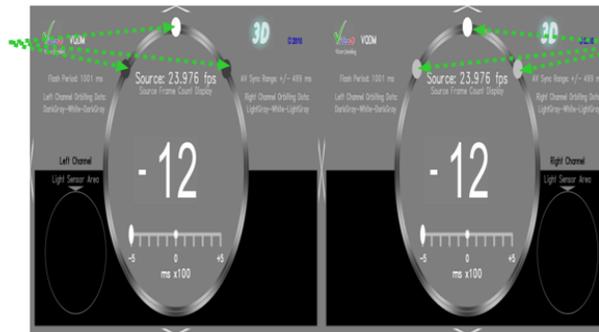 - automatic LR Sync Error Measurements

VQDM 3D test pattern files are available in 2 variants:

- L & R separate channels, full size

- LR channels combined side-by-side, full height

Picture below shows 3D Test Pattern composition:

Orbiting 3 Dots Group L Channel : Dark Gray-White-Dark Gray

Motion Continuity Test and Visual LR Sync Test

Orbiting 3 Dots Group R Channel : Light Gray-White-Light Gray

Motion Continuity Test and Visual LR Sync Test

Video Frames # -01 and # 00 flash white in two separate L & R Sensor Areas, thus allowing detection and measurement of LR Sync Errors as well as other (2D) delay parameters

Picture below shows details of VQDM1 Test Pattern audio component:

Audio Burst Period: 1000 ms (1001 ms for 29.97 and 23.976 fps)

H Zoom x10

Burst Center Position: Start of Video Frame # 00

Audio Burst Parameters

Frequency:	1 kHz
Peak Level:	0 dBfs
Half-amplitude Duration:	25 ms
Central Gap Duration:	1 ms

Video Frames Timeline
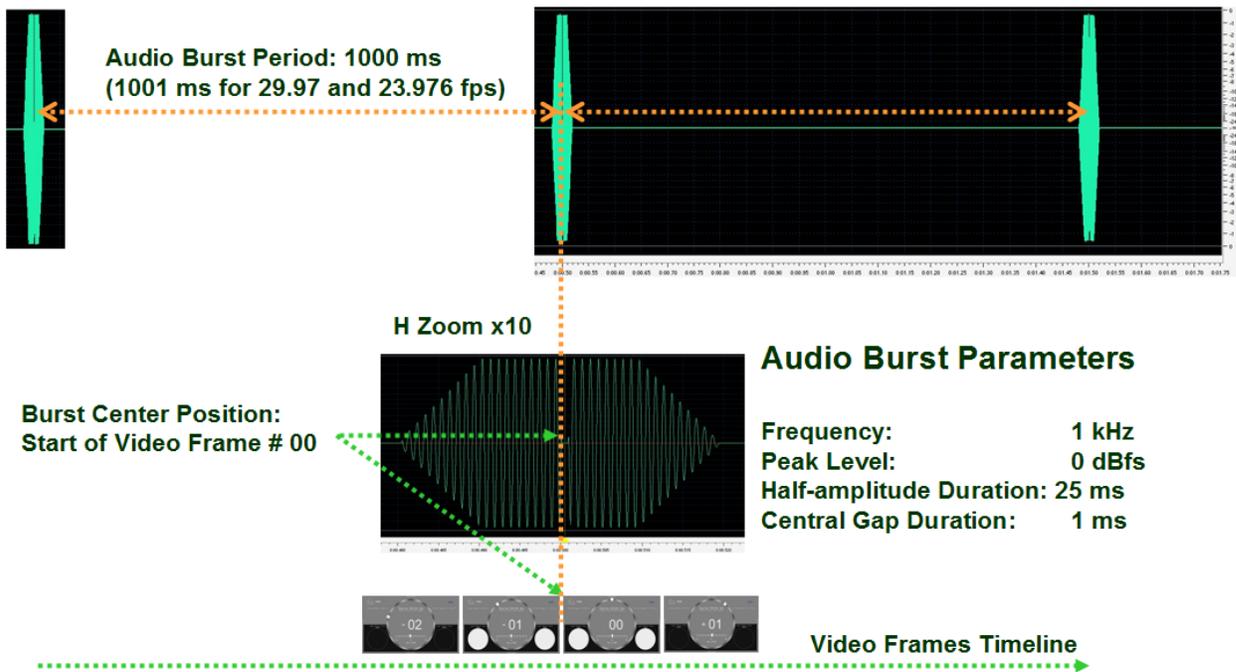
The audio burst central gap can be used as a precise time stamp for very accurate audio timing measurements whilst using waveform monitor or AV editing software.

This 1 ms long central gap is *ignored* by VQDM Delay Analyzer Software, which relies only on audio burst "center of gravity" position.

Such approach allows VQDM to provide reliable audio delay measurement even on severely distorted signals.

Picture below shows VQDM2-1 Test Pattern composition:

Yellow Flashes: Frame # 0 A & B; All Even Frames: C1, All Odd Frames: C2.
Blue Stripe Width: All Even Frames: single width, All Odd Frames: double width
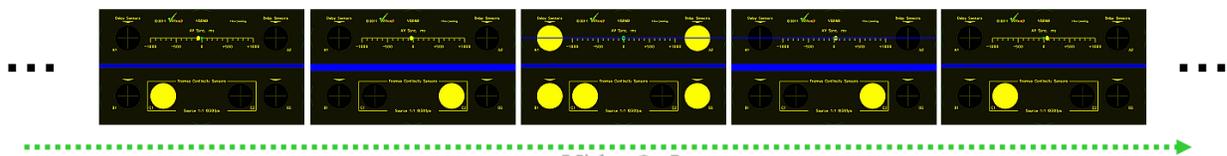
The dynamic test pattern consists of:

- Dark yellow background producing 0% signal in Blue channel

- Normally black circular Light Sensor Areas A1/A2 and B1/B2 flashing 100% White every second
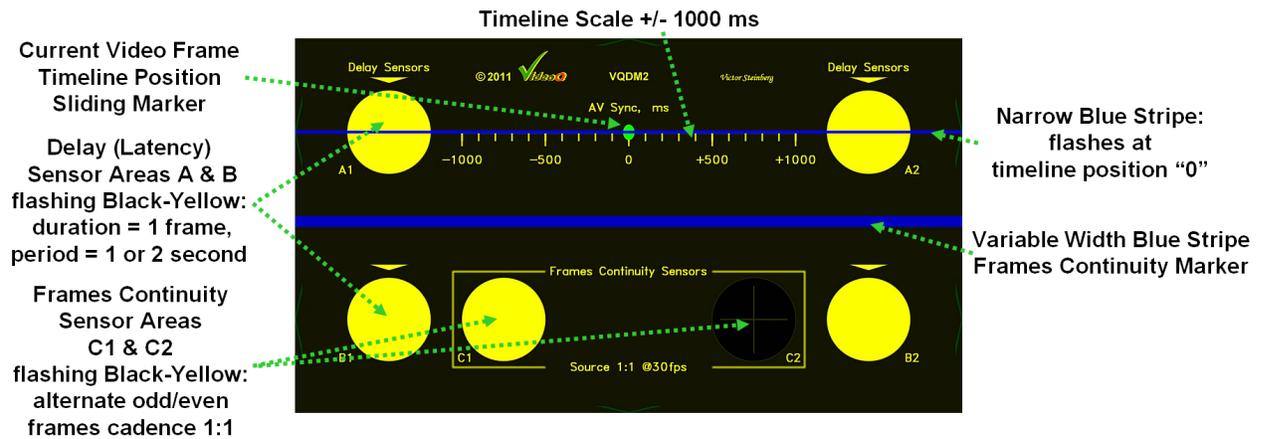
- Narrow BluSync stripe flashing 100% Blue synchronously with Areas A1/A2

- Variable width Frames Continuity Stripes flashing 75% and 100% Blue synchronously with Areas C1/C2

- Sliding yellow ellipse marker indicating current frame position within the +/- 500 ms timeline scale; position "0" marks the center of Audio Burst

- Frames Continuity Sensor Areas C1 and C2 flashing Black-Yellow with 2:2 cadence

Audio component of VQDM2-1 test pattern is the same as VQDM1.

4 Software Installation

1. Install Saleae Logic software and driver - follow on-screen instructions.
Do not connect USB cable until the end of this stage!

2. Connect Host PC with VQDM main unit - plug-in the USB cable.
It is possible, though it is not required, to test connectivity by launching Saleae Logic executable. If Logic Analyzer Title Bar shows "Connected" message, then USB cable and the driver work correctly. Important: shut down Logic executable after this test.

3. Install VQDM software as follows:
Create a folder on the PC hard drive, for example "c:\VQDM", and copy there the following files:

a) VQDM.EXE - Main executable

b) SaleaeDeviceSdk.dll - Driver library for DAM hardware

Removing VQDM software is quite simple.

1. Uninstall Saleae Logic software thru Windows Start Menu or Windows Control Panel

2. VQDM.EXE does not make records in Windows system registry, except the location of the last opened files. Therefore, to remove VQDM from the system it is enough to delete the executable files VQDM.EXE and SaleaeDeviceSdk.dll.

5   Test Pattern Generator Module

TPG module consists of a media player platform loaded with sophisticated video and audio content - set of static and dynamic test patterns in a variety of formats - up to 1080p60.

The TPG module is based on Western Digital "WD TV Live" media player platform.

It is supplied complete with pre-installed audio-video content.

No additional software installation is required for normal system operation.

VQDM system relies on VQL - the unique VideoQ Test Pattern Library.

The sub-set of VQL patterns loaded into VQDM TPG is described in a separate document.

Additional test patterns or any video/audio/static image content files of compatible formats can be played-out thru rear panel USB or RJ45 (network) connectors.

Navigation is easy - thru straight forward folders and files with Remote Control. The most often used pattern, such as VQDM Test Pattern are in the root folder, which is a default location, when VQDM is powered on.
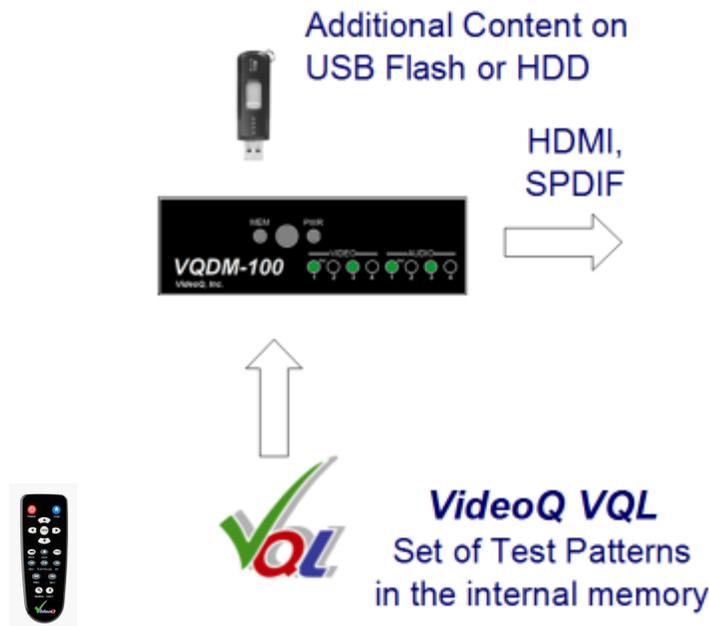
VQDM TPG module is equipped with digital HDMI and SPDIF outputs plus baseband analog YPrPb and NTSC/PAL CVBS video outputs as well as analog L-R audio outputs.

This model does not support 3G or HD-SDI output formats.

However the signals in these formats, can be produced by connecting the VQDM-100 HDMI output to any suitable HDMI-to-SDI converter.

TPG connectors are in the upper row on VQDM rear panel:
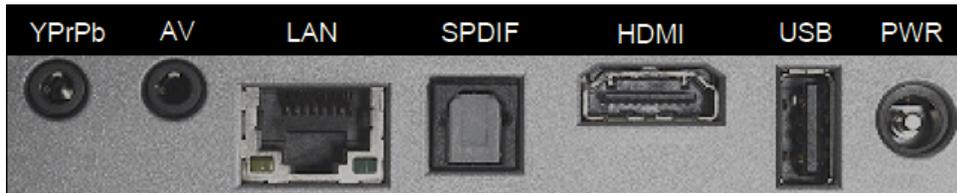
Main TPG Features:

- HDMI 1.3 output, switchable YUV/RGB format:
  - YUV output level scheme is always 16-235
  - RGB level scheme is switchable: 16-235 ("RGB Low") or 0-255 ("RGB High")

- Multi-format SD and HD playback:
  - 480p@59.94, 576p@50, 720p@50, 720p@60
  - 1080i@50, 1080i@59.94, 1080p@24, 1080p50, 1080p@59.94

- Major Video Codecs/Formats: MP2, MP4, H264/AVC, VC1; AVI, MP4, VOB, TS, M2TS

- Major Audio Codecs/Formats: WAV, AAC, AC3, MP3

- SPDIF 5.1 Digital Audio

- Analog Audio (L & R) out (mini-jack)

- Auxiliary analog YPrPb output (mini-jack)

- Auxiliary CVBS output, NTSC/PAL (mini-jack)

- Flexible pixels mapping and scaling:
  - No scaling (dot-by-dot), if file resolution matches native HDMI resolution
  - Up- and down- scaling to match the HDMI resolution, if AutoScaling = On

5.1 Operation

VQDM TPG is supplied fully configured with all settings in the correct positions.

However, it is highly recommended to check the set-up as described in "Configuration and Customization" section.

To select the desired content for play-out use the remote control - browse folders tree and find the content file name.

Different types of content are accessible after choosing the corresponding menu:

- Static or Dynamic VQL test patterns and live clips are accessible via "Video" menu.

- Static photos and slide-shows are accessible via "Photo" menu.

- Audio test patterns are accessible via "Music" menu.

In each of these modes not all folders are visible - only the folders with the content of the selected type.

For example, in "Photo" mode only the folders containing *static pictures* are visible, other folders, e.g. containing only video files or only audio files are hidden.

Picture below shows all folders with all types of the pre-loaded VQL content.

Numbered folders are sorted by *categories*.

This picture serves for information only and it is not displayed on-screen; folders structure may vary depending on release version.
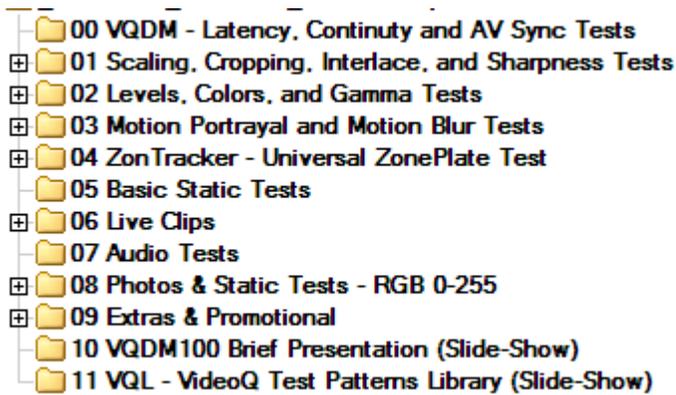
Each of numbered folders contains a tree of sub-folders with relevant test patterns, typically further sorted by **resolutions**.

```
□ 📁 01 Scaling, Cropping, Interlace, and Sharpness Tests
  □ 📁 ST - Static Scaling, Cropping, Sharpness Tests
    ├ 📁 480
    ├ 📁 576
    ├ 📁 720
    └ 📁 1080
  □ 📁 VST - Dynamic Scaling & Interlace Tests
    ├ 📁 480
    ├ 📁 576
    ├ 📁 720
    └ 📁 1080
```

Patterns of particular resolution with *different frame rates* (if available) usually located in the same folder.

There is one *special* folder:

"00 VQDM - Latency, Continuity and AV Sync Tests"

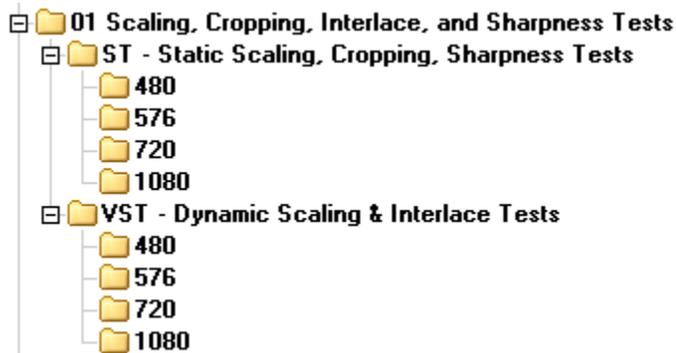It contains two important dynamic test patterns required by VQDM Analyzer software: **VQDM1** and **VQDM2**.

The folder "10 VQDM100 Brief Presentation (Slide-Show)" contains a brief of VQDM-100 User Guide.

The folder "11 VQL - VideoQ Test Patterns Library (Slide-Show)" contains a Short Guide for the most important test patterns and their features.

To access these two folders and to watch the slide-shows the TPG module should be switched into "**Photo**" mode

Important Note:

For truly objective evaluation of the display device performance the internal VQDM-100 scaler should be bypassed, i.e. neither spatial nor temporal internal scaling should be applied.

It means that HDMI resolution, interlace mode and frame rate should be set *exactly* matching the media content file parameters.

For example, the appropriate 1080i60 HDMI mode should be selected via submenu "Settings/Audio-Video/Display Resolution" *before* playing out "VST 1080i 60" test pattern .

Once selected, the HDMI mode is preserved, even when the VQDM-100 is switched on/off by the Remote Control "Power" button.

However, if the external PSU or main supply line is disconnected, the unit may return to HDMI "Auto" (safe) mode, which is the lowest resolution available for this particular display. In such case the submenu "Settings/Audio-Video/Display Resolution" should be re-visited to set or restore the desired HDMI mode.

Below is brief description of Remote Control functions

Remote Control

1. Infrared transmitter
2. HOME
3. POWER
4. Navigation buttons
5. ENTER
6. STOP
7. BACK
8. REV (rewind)
9. PREV (previous track)
10. SEARCH
11. OPTION
12. PAUSE/PLAY
13. FF (fast forward)
14. NEXT (next track)
15. EJECT (safe removal of attached storage)
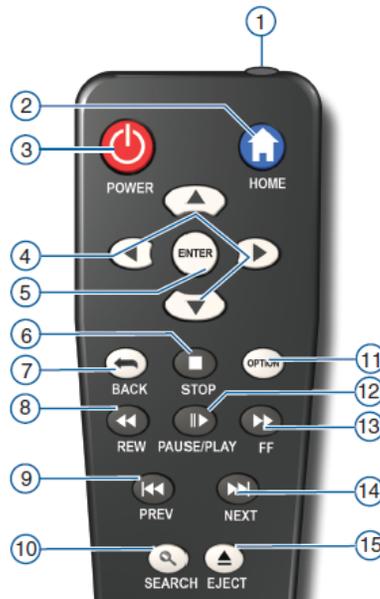
"Option" button is important because it enables OSD messages and menus, in particular - media info, pan & zoom controls, repetition mode (play once, repeat same file, repeat all files in the folder), etc. This button works as on/off toggle switch.

For full description of Remote Control keys and functions, navigation instructions and complete list of on-screen menus see separate document "WD TV Live User Manual.pdf".

5.2 Configuration and Customization

Recommended TPG Settings

From "Home" page select "Settings/Audio/Video" menu
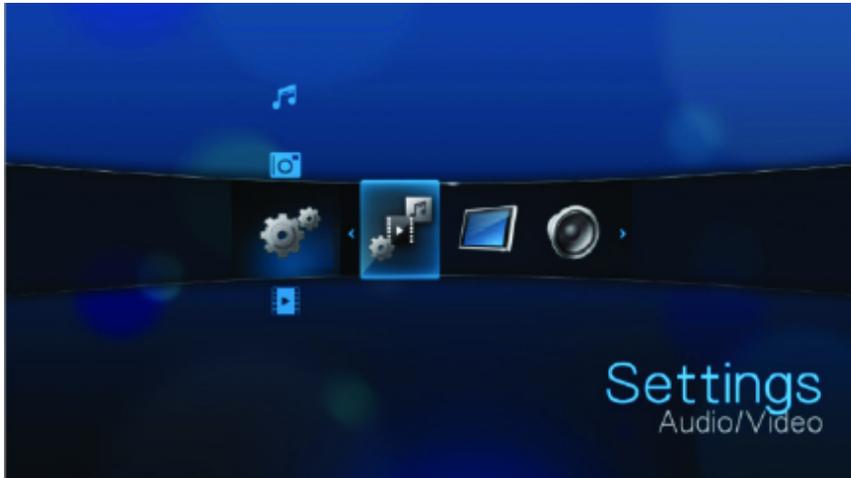
Audio/Video Menu Settings

Use the menus in this category to configure playback for audio and video files. Set the following:

Video Output:

When using an HDMI cable, select HDMI in the Video Output screen. You will be prompted to select the applicable HDMI video resolution for your device. Make your selection and press ENTER.

In the Display Resolution sub-menu below "Auto" means "safe mode", i.e. the *lowest* available resolution, which is seldom needed.

After the unit is powered on first time and "Home" menu appears on screen (in small size), "Audio-Video/Display resolution" should be changed to *native* display resolution, interlace and frame rate, e.g. 1080p60.

Aspect Ratio:

Select "Widescreen" (default, i.e. typical *native* 16:9 display option)

"Normal" here means 4x3 display aspect ratio, which is seldom needed.

Important: In the "Settings/Audio-Video" sub-menu selection of "Composite" instead of "HDMI" *disables* HDMI output and vice versa. This selection should be taken with caution because for few seconds the menus will be visible *only* on the display connected to "CVBS" output. On the other hand, VQDM-100 automatically detects connections to HDMI and CVBS outputs, so once the HDMI output is disconnected the CVBS output is automatically enabled (if connected) - overriding the menu settings. Consequent disconnection of CVBS output automatically restores HDMI output.

Important: In Settings/Audio-Video" menu the selection of "Stereo" as an audio output *disables* digital SPDIF output, but if "Digital" audio output is selected, the analog stereo output may be still present. In the latter case all L+R stereo formats and some types of 5.1 surround sound content (not all formats) can played on both digital and analog output, but on analog output 5.1 content is converted to L+R (down-mix).

Selection of NTSC/PAL in "Settings/Audio-Video" sub-menu affects only the format of auxiliary analog CVBS output, it does not affect HDMI output.
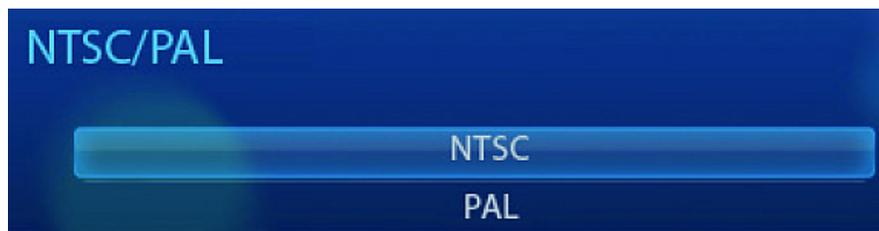
HDMI Deep Color:

Select 8 bit (this is the "safest" option)

Audio Output:

Select "Stereo" (HDMI digital stereo audio will be still available)

Alternatively, select "Digital" - only if you are using an Toslink (optical) connection to output surround sound.

Photo Menu Settings

In the "Settings/Photo" sub-menu "Keep as original" option is recommended because it prevents unwanted scaling (distortion) of photo images.
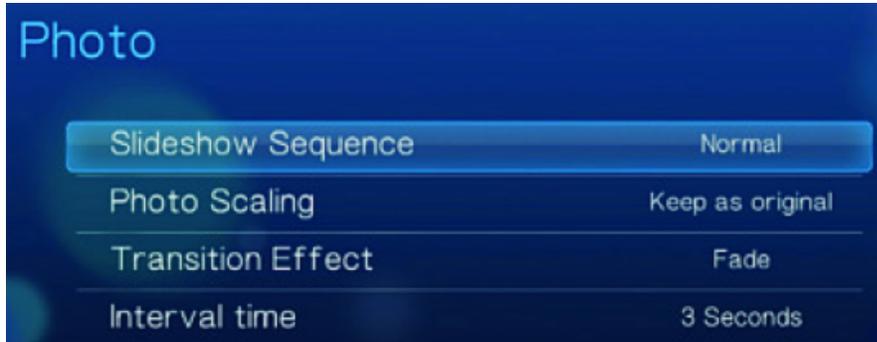
System Settings/Browser Display Menu Settings

In the "System Settings/Browser Display" menu select "List mode", because it allows navigation via folders and long file names.

Selection of "Thumbnails mode" *is not recommended* because the current version of VQDM-100 system does not support navigation by thumbnails.

6   VQHD420 Adapter

Optional VQHD420 adapter module is based on Atlona AT-HD420 HDMI to VGA/YPrPb and Stereo Audio Format Converter.

VQHD420 converts HDMI to a VGA or component output.

VQHD420 unit is fitted with Blue channel video level comparator outputting BluSync Pulse signal compatible in voltage and impedance with the VQDM Light Sensor signal.

This pulse is available on a mini-jack socket next to VGA output connector. BluSync Pulse Activity is indicated by flashing green LED located on the right.

Output video format is selected by VGA/COMPONENT switch. VQHD4200 VGA output can be used for preview/monitoring purposes or left idle (not connected). For YPrPb output special VGA to 3 RCA adaptor cable (supplied) could be used, but BluSync output will be disabled.

Warning: **BluSync Pulse** output is available only if the **VQDM2** Test Pattern is running and VQHD420 format switch is in the **VGA** position.

> HDMI formats supported by VQHD420 in BluSync mode are:
>   720: p50, p59.94, p60
>   1080: i25, i29.97, p50, p59.94, p60.

VQHD420 converter is always de-embedding audio from the HDMI source and converts it to an analog stereo 1/8-inch interface. This will allow the user to connect it to any audio input of main VQDM unit, a set of speakers or any other audio device.

Typically, VQHD420 BluSync output should be connected with VQDM100 **Video Reference** input and VQHD420 Audio output should go to VQDM100 **Audio Reference** input.

Test setup with VQHD420 adapter and vacuum cap sensor attached to the display screen allows display latency measurement.

Test setup with *two or more* VQHD420 adapters allows latency measurement *without any vacuum cap sensors.* Setup without any vacuum cap sensors is preferable for very long test sessions or for fully automated codec/network latency tests; in such case first adapter BluSync output is connected to VQDM V1 (Video Reference) input, second adapter BluSync output is connected to VQDM V2 input, and so on.

Embedded EDID simplifies the installation procedure. The VQHD420 sync up with the source and let the source know to start outputting RGB or YPrPb format depending on the output selection and also switch audio to stereo or PCM.

VQHD420 is HDMI 1.2 and DVI (HDMI to DVI adapter required) compliant, i.e. it can convert HDMI or DVI to VGA or component video.

Note 1. VQHD420 is a format converter only; the converter is not capable to scale the image and therefore it is very important to select the proper HDMI source resolution.

Note 2. VQHD420 does not support HDCP decryption; if an HDMI source includes HDCP (High-bandwidth Digital Content Protection) there will be no output image displayed.

7   Test Environment and Setup

Test setup consists of connecting all relevant Test Points to the appropriate VQDM inputs located on the rear panel :
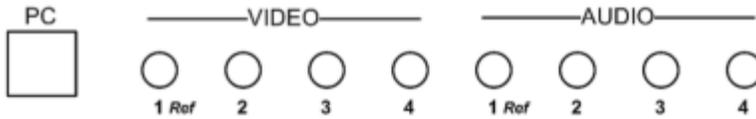
Step 1: Connect USB port with Host PC.
Important: DAM module is powered from external PSU (not from USB port), so all following steps require VQDM100 power adapter to be switched ON.

Step 2: Displays, Camera and Light Sensors Setup

Picture below shows setup example for Teleconference System video latency measurement using VQDM1 test pattern:
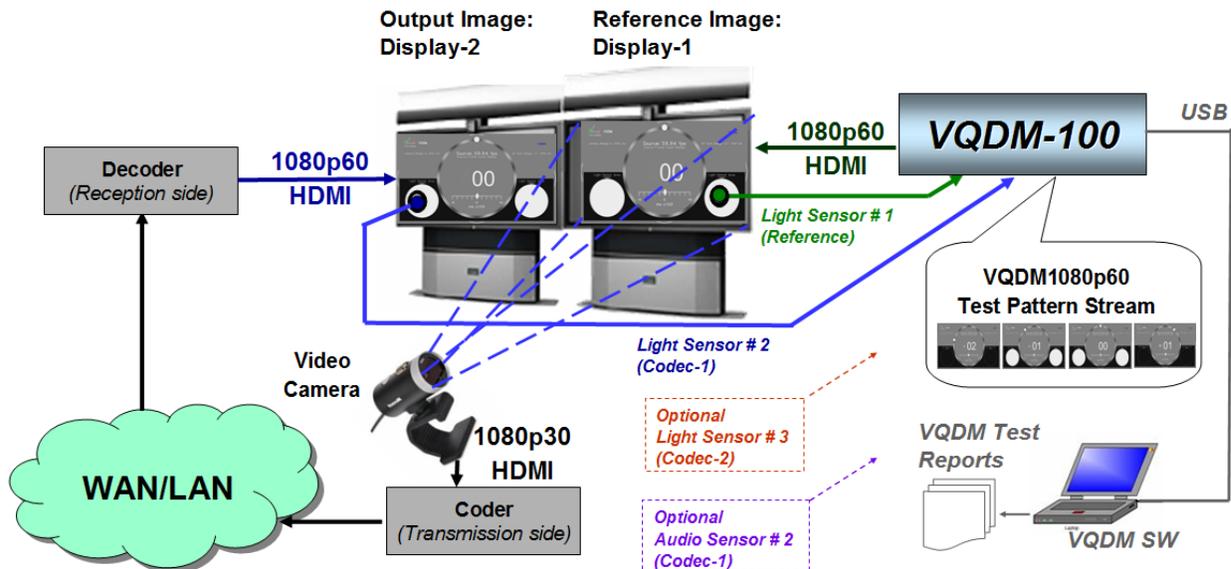
In this example glass-to-glass latency measurement covers complete system:
Camera + Coder + Network + Decoder + Display-2.

Connect *reference display* to the *VQDM test pattern source*, typically to the HDMI output of the TPG module.

Point the ***camera*** to this display and adjust camera's pan, tilt and zoom controls to get best possible fit of the display screen.

Vertical position errors are critical, so proper centering is important.

Horizontal and vertical size errors up to 10% are acceptable.

Attach ***video sensors*** to display screens - as many as required by the test plan.

For example, if the ***reference screen sensor*** is attached within the ***right*** flashing circle, then ***all other sensors*** (attached to other displays, i.e. to other Test Points) should be installed in the not obscured (i.e ***left)*** flashing circle.

It is highly recommended to clean ***sensor vacuum cap*** and the ***screen target area*** with wet LCD cleaning wipe - ***immediately before*** each sensor installation.

A bit of moisture left on the edges of vacuum cap provides for much longer vacuum preservation, especially on mat screen having not so smooth surface.

This is particularly important for tests of large duration - more than 10 minutes.

Warning: Large amount of cool liquid put on hot screen surface may damage screen or kill screen pixels, so necessary precautions should be taken.

Vertical position of the sensor in the flashing circle directly affects the measurement accuracy.

Vertical sensor shift from flashing circle center to the circle edge may offset measured delay value up to 3-4 ms.

Horizontal position is of smaller importance, but proper centering is still desirable because it means better sensitivity.

Screen brightness should be set high enough to drive sensors properly.

Because many LCD displays use pulse-width modulation technique to control back-light intensity it is highly recommended to use **maximal** display brightness, thus minimizing the detrimental effect of back-light modulation.

On the other hand, VQDM automatically adjusts slicing level - separately for each light sensor, so it can work within very wide range of screen luminosities.

Black level is of smaller importance, but better keep it dark enough. Black areas brightness values between 0% and 20% are acceptable.

Compression coding artefacts (blockiness) may deteriorate sensor function, but only if the artefact contrast is very high - more than 25%.

Step 3: Connect video inputs.

Connect by mini-jack cables ***at least two video inputs*** to the Light Sensors attached to displays showing VQDM Test Pattern.

It is highly recommended to connect VQDM Video Reference (V1) input to the Light Sensor attached to display getting "clean" video directly from VQDM main unit HDMI output.

Other video channels can be connected in arbitrary order, e.g. V2 and V4 are activated, but Input V3 is idle (not connected).

Warning: VQDM DAM module requires about 20-30 seconds to reach steady state condition after *any* video cable ***connection*** or ***re-connection*** (light sensor <=> VQDM video input).

Thus, some waiting time is necessary to get accurate reading of front panel indicators and analysis results. Note that re-location of light sensors between different screen areas requires much shorter waiting time - typically few seconds.

Step 4 (optional): Connect audio inputs.

This connection is mandatory only if Audio Delays and/or AV Sync Errors should be measured.

Rules for audio inputs are similar to those for video inputs. ***At least two audio inputs***, including Audio Reference, must be connected.

It is highly recommended to connect Audio Reference input directly to one of two (L & R) audio outputs of VQDM main unit.

Other schemes are also possible, e.g. VQDM Audio Reference input can be connected to the headphone output of TV set, receiving both video and audio from VQDM HDMI output.

If Audio Reference or other audio channel input is not valid, then only VQDM Audio Results (including AV Sync) are invalidated, but video delay measurements are still valid.

To measure AV Sync parameters it is recommended to use Video Reference (V1) and Audio Reference (A1) inputs, however it is possible to use other pairs of inputs.

There is only one parameter, which ***requires*** both **A1** and **V1** inputs to be connected and valid. It is current ***time offset between A and V References***, displayed on a Summary Page. It provides for fast estimation of A-V Reference Inputs relative delay. This parameter is for guidance only and it does not affect any other measurements results.

Step 5: Launch VQDM.EXE application and follow 'VQDM Analyzer Software' section instructions.

Validity of video/audio inputs is confirmed by VQDM front panel LEDs and also by VQDM.EXE main window indicators.

Picture below shows example of typical Timing Diagram of VQDM outputs and inputs:
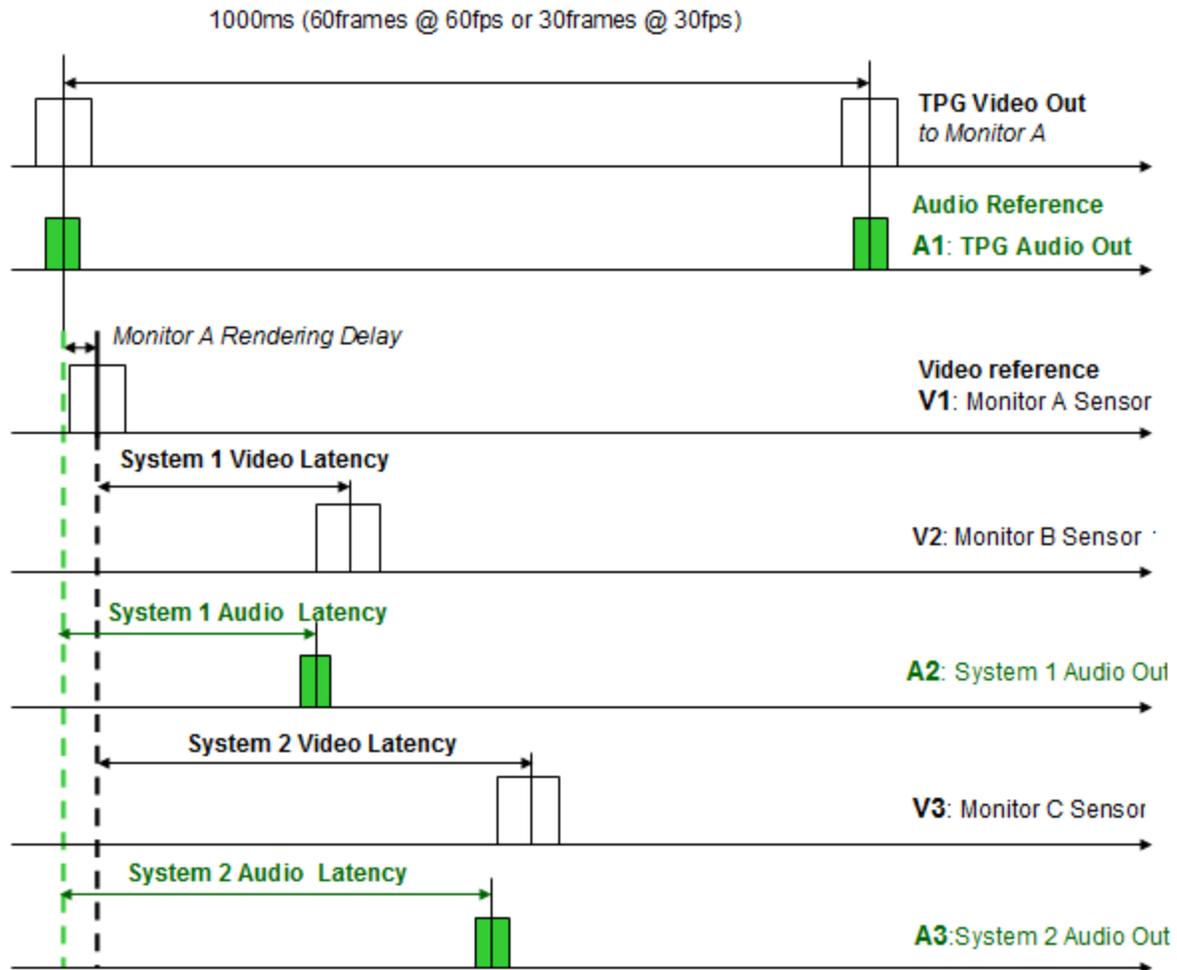
On this diagram two *Systems* are tested in one VQDM *Test Session*.

Video inputs V1, V2 and V3 are connected to corresponding Light Sensors.

Audio input A1 is connected to TPG audio output, inputs A2 and A3 are connected to audio Test Points.

Note that Audio Reference time moment is taken directly from TPG output, but Video Reference on this diagram is not the TPG output, but Monitor A Sensor Signal.

A/V Sync Errors of two systems are calculated as two differences:
**A/V Sync Error 1 = Audio Latency 1 – Video Latency 2**
A/V Sync Error 2 = Audio Latency 2 – Video Latency 2

Note that in each system video and audio latencies are measured separately and independently.

Picture below shows setup example for Display Latency measurement using VQDM2-1 test pattern and VQHD420 adapter:
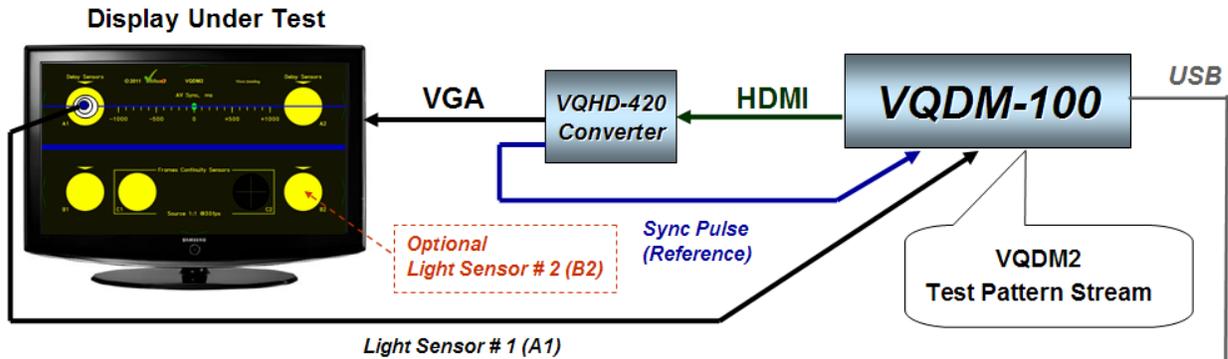
VQDM methodology also allows measurement of display latency spatial (horizontal and vertical) profile by comparison of:
display latency at screen top (Areas A1 and/or A2)
vs.
display latency at screen bottom (Areas B1 and/or B2)
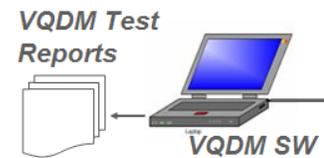
Display Latency = Sensor Pulse Timeline Position – Reference Sync Pulse Position

Picture below shows example of typical Timing Diagram of VQDM outputs and inputs for Display Latency test:
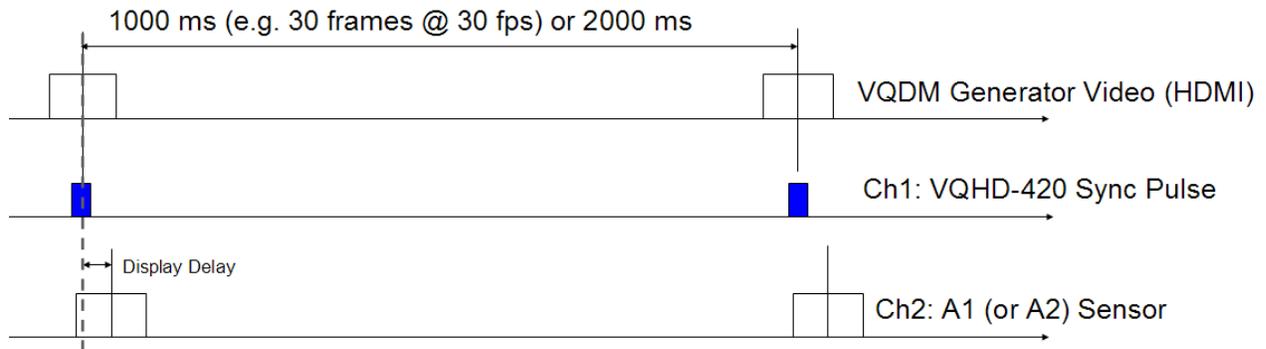
Display Latency = Light Sensor Pulse Time Position – Reference Sync Pulse Position

8   VQDM Analyzer Software

Click on the VQDM executable icon, or launch VQDM.EXE with no parameters specified in the command line.

This opens two-windows GUI, including:
- Control Panel Window
- Main VQDM Window

All VQDM setup and run-time controls, mainly dialog boxes and press-buttons, are located on the VQDM Control Panel.

The most important part of Main VQDM Window is Test Results Table, which is auto-updated every 10 seconds for the duration of Test Session.

Test progress and channel status indicators are shared, so in normal operation mode both VQDM Windows displays the same status.

VQDM Analyzer calculates delay of an input (Test Point) with reference to some other input (Referent Test Point).

For example: "Codec #1 video input vs. Video Reference input".

The same applies to Audio Delays and AV Sync Errors calculations.

Test Session Name and Names, associated with particular inputs, are editable via Control Panel.

VQDM has 4 video inputs and 4 audio inputs, thus the number of possible input *combinations* (pairs) is quite large. VQDM *does not* calculate the relative delays for *all* possible pairs, instead it allows the user to select small number of *relevant pairs*.

Summary Page Results Table allows simultaneous calculation of:

- up to 3 different video delays (3 different pairs of video inputs)

- up to 3 different audio delays (3 different pairs of audio inputs)

- 1 or 2 AV Sync Errors (audio vs. video delays).

Each input can participate in one, two or three pairs.

For example, if video inputs 2, 3 and 4 are referred to input 1, then input 1 is the Referent Point for all 3 pairs. This example relates to very simple test measuring delays of three (usually consecutive) Test Points from the signal origination Test Point. Default Names are "Video Sensor 1", "Video Sensor 2" and "Video Sensor 3".

8.1 Main Window

It contains "Summary Page", including Test Results Table, Channel Status and Test Progress Indicators. It also contains three standard drop-down Windows menus: "File", "View" and "Help".

All delay parameters calculated by VQDM are shown in five columns on the right side of the page. Rows of the results represent **pairs** of Test Points selected by the user.

There are two *averaged* delay values: **global average** for the total elapsed time and **last 10 seconds average -** the latter value represents noise-reduced current delay.

Next columns displays global **maximum** and **minimum** of the delays and **standard deviation**.

The rightmost column displays **delay trend** in ms/s calculated by linear regression method for the total elapsed time. For example 0.1 ms/s trend means delay incrementing by 1 ms every 10 s.

Calculated Standard Deviation is "trend adjusted", i.e. if the delay is stable, or steadily increments or decrements, then the standard deviation should be quite low. Large values of standard deviation (comparable with average delay) indicate unstable system behavior or low video/audio quality.

Any input can be *activated* by the user - corresponding check boxes are located on the Control Panel.
However, this input may be *not valid* - input is not connected or signal type/level/quality is inadequate.
On the other hand, input can be present and valid, but the user may decide to exclude this particular channel from the current Test Session.

The Test Results Table shows only measured values for **activated** and **valid** channels, otherwise the corresponding cells are empty.

For any Input the color of its Status Indicator can be:

☐	White	- Input channel is Not Activated and Not Valid
🟨	Yellow	- Input channel is Activated, but its status is Undefined
🟩	Green	- Input channel is Activated and Valid
🟦	Blue	- Input channel is Activated and Valid BluSync
🟥	Red	- Input channel is Activated, but Not Valid
🟩	Teal	- Input channel is Not Activated, but Valid

Note that Input Status can be determined only **after** the end of **previous** Test Cycle - i.e. **after at least 10 seconds long data acquisition**.

Thus, before the start of the very first Test Session all Status Indicators are in White, then Yellow.

Pressing PREVIEW button allows faster testing of all inputs for presence and validity of A and V signals; updated every 2.5 seconds.

In presence of valid BluSync on *Video Reference Input* additional message in light blue font is displayed, stating the frame/field rate detected:

Input	Test Point Name	Referent Point
🟦 V1	Video Reference	BluSync 59.94 fps

Presence of BluSync signal on *any other input* is also indicated by the color of the corresponding box on the left, but reference frame/field rate is measured only on V1 (Video Reference) input.

Valid Samples count in the upper left corner shows the share of *valid combinations* of *all activated inputs* in percents.

For example, if any one input was invalid for first 5 seconds, it will show 50% after 10 s, 75% after 20 s, and so on.

If some activated input is *permanently invalid*, this indicator will show *0%*. Note that in this case *partial* results for other inputs may be still valid.

For inputs V2 ... V4 and A2 ... A4 user may select the default Referent Point, i.e Video Reference (Input V1) or Audio Reference (Input A1). In this case the delay (latency vs. Reference Input) will be measured within the range -49ms to 949 ms.

However, *relative* delay between inputs V2 ... V4 or A2 ... A4 (i.e. if Reference Inputs V1 and A1 are not involved) is measured and displayed within the more appropriate range of +/-499 ms.

The AV Sync error range is effectively the sum of the ranges of audio and video inputs involved; however the resulting AV Sync error is always mapped to +/-499 ms range.

For example, if AV Sync configuration is A3-A2 vs. V2-V1, V2-V1 = 870 ms, and A3 -A2 = -120 ms, then displayed AV Sync error will be not - 990 (-120 - 870) ms, but +10 ms, which is much better representation of actual AV timing.

8.2 Menus

There are three standard drop-down Windows menus: "File", "View" and "Help".

8.2.1 Menu - File

This menu may be used immediately after launch of VQDM.EXE, e.g. to load configuration file prior to any test session. However, this is not mandatory - user can start new Test Session from VQDM Control Panel.

Thru "File" menu user can also perform standard Windows functions, - Open, Print, Save and Exit.

Sub-menus **"Load Configuration"** and **"Save Configuration"** allow to browse, open and save VQDM Configuration files (.cfg).

Sub-menu **"Print Setup"** is always available; it allows setting-up of printer defaults, e.g. pre-selection of page orientation to "Landscape".

Sub-menus **"Save Short Report", "Print Preview"** and **"Print Report"** are available only *after the end* of Test Session.

It is advisable to use PDF writer, e.g. "PDF Factory" to create electronic reports of VQDM test results; paper copies can also be printed if necessary.

Sub-menu **"Save Short Report"** allows user to browse folders and save short text report in .TXT or .CSV format identical to DOS mode output, described in the correspondent section of this manual.

Sub-menu **"Open Data File (.bin)"** invokes standard "File/Open" Windows dialog box. User can browse folders to find and open binary data file exported by 'Logic' software from the pre-captured test session file. The mandatory file extension is .BIN.
This function is for advanced users only, and it is seldom required.

8.2.2 Menu - View Page

This menu allows selection of Test Summary page or Timeline Plots page as described in the following sub-sections.

Default page selection is "Test Summary".

Note that in some VQDM versions Timeline Plots page is not available and the corresponding menu item is grayed-out.

8.2.3 Menu - Help

"Help" menu contains three items:

Short Guide - How To Launch VQDM Program

This sub-menu produces pop-up box with short description of modes of operation and supported file formats:
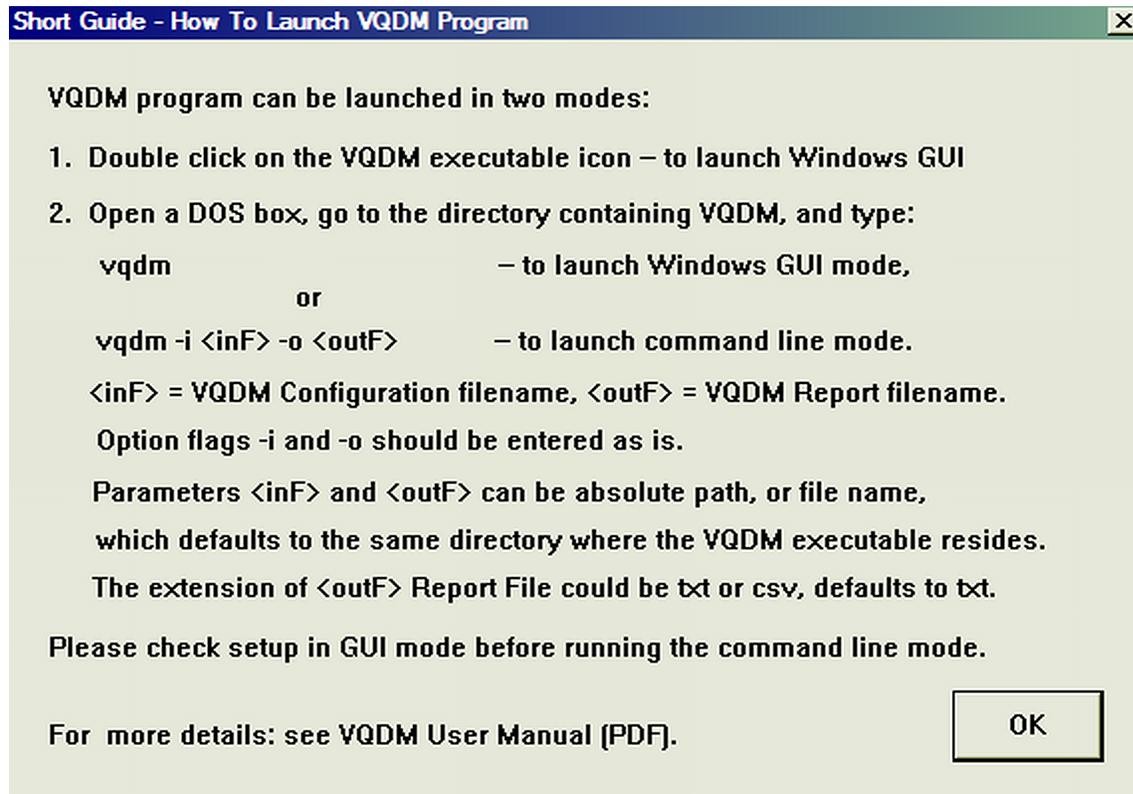
Inputs Activation and Status Indicators

This sub-menu produces pop-up box with short instructions on Inputs Activation and explanation of Color Coded Input Status Indicators:

Inputs Activation and Status Indicators

VQDM measures relative delays for Pairs of Activated and Valid Inputs.

Inputs V2, V3, V4 and A2, A3, A4 can be activated by checking the corresponding boxes of Control Panel.

Input V1 (Video Reference) is always activated - by default.

Input A1 (Audio Reference) is automatically activated whenever any of A2, A3 or A4 inputs is activated.

Color Coded Input Status Indicators:

- White   - Input channel is Not Activated and Not Valid
- Yellow - Input channel is Activated, but its status is Undefined
- Green   - Input channel is Activated and Valid
- Blue   - Input channel is Activated and Valid BluSync
- Red   - Input channel is Activated, but Not Valid
- Teal   - Input channel is Not Activated, but Valid

Input Status Indicators are updated:
    every 2.5 s in Preview Mode
    every 10 s in Test Mode

For more details: see VQDM User Manual (PDF).

OK

About VQDM program

This sub-menu shows program version, copyright and technical support information.

About VQDM

Version 1.1.6, May 2012
VideoQ, Inc. Copyright (c) 2010-2012
Technical Support: support@videoq.com

OK

8.3 Control Panel Window

The Control Panel allows to set up all important parameters of the Test Session. All controls on this panel are divided into two groups:

- Test Session Setup Controls - dialog boxes and drop-down lists
- Test Session Run-time Controls - 3 push buttons at the top

Test Session Setup Controls allow selection of Test Session Duration, typing-in Session Name and Test Points Names, and most importantly - grouping of particular inputs into pairs, which then will be used to calculate relative delays.

User can activate and name any number of input Test Points and select the appropriate Referent Points. Activation of Audio Inputs and AV Sync measurements are optional.

User can form pairs of inputs by selecting the Names from drop-down lists. Available are two default Names (Video Reference & Audio Reference) and the Names user already entered into editable dialog boxes associated with particular inputs.

In any case user can select only *activated* channels of *matching* type - "video to video" and "audio to audio".

Control Panel Elements

Test Session Name dialog box
Default name is "*Date_**VQDM_001**".
Date prefix is inserted automatically in DDMMYYYY format. User can type-in ***any other name***, e.g. simply "Test # 1".
Note that this name also affects the default Session Report file name.

Test Session Duration dialog box
Default for this numerical value is "10 s". User can select any other value from drop-down list - up to 10,000 s.

If the System Under Test operates at mixed 60/59.94 Hz or 30/29.97 frame rates, it is advisable to select durations divisible by 30, e.g. 60 seconds. This allows better suppression of possible delay variations caused by 1001 frames long 60/59.94 beating cycles. Durations longer than 60 seconds typically do not guarantee more accurate results; they rather provide for more representative statistics, in particular - for trend analysis.

Test Progress Indicators
There are two progress bars:

- current 10 s segment progress
- overall progress bar, it may increment relatively slow in case of long test session duration

Editable Test Point (Channel) Names dialog boxes

There are 3 editable names for video inputs and 3 editable names for audio inputs.

Default name is "Sensor V#"; it can be edited once the channel is ***activated***.
By clicking the check box of the VQDM Control Panel user ***activates*** the channel.

Note that **Video Reference** input is activated by default.

"**Video Reference**" and "**Audio Reference**" names are *reserved* and not editable.

Input Labels "V1" - "V4" and "A1" -"A4" are for guidance only, they are fixed, i.e.not editable.

LED style **Input Status Indicators** on the left side shows current status of each Input:

- **White** with Gray border - channel is Not Activated and there is no Valid signal present on its input

- **Yellow** - channel is Activated, but its validity not yet tested

- **Green** - channel is Activated and Valid data acquired

- **Red** - channel is Activated, but there is no Valid signal present on its input

- **Teal** - channel is Not Activated, but there is Valid signal present on its input

Select Test Point (Channel) Name dialog boxes

There are 3 selectable names for *referent* video inputs and 3 selectable names for *referent* audio inputs, i.e. for the second terms of subtraction operations used to calculate relative delays. Note that the default names "**Reference Video**" and "**Reference Audio**" are always present on the corresponding selection lists besides the custom names created by user, such as "Codec #1".

It is possible to select the same Referent Test Point Name for several rows of the Results Table, for example "Codec #1 vs. Reference Video" and "Codec #2 vs. Reference Video".

For AV Sync 1 & 2 (two bottom rows of the table) the selection process is slightly different because in this case *the test point* and corresponding *referent point* can be either *single test points*, e.g. A3 vs. V2, or pre-selected *combinations* (pairs), e.g. A2-A1 vs V3-V2. User can select only the *activated* test points**.** Two terms selected for subtraction operation define the assumed polarity of calculated AV Sync Errors - positive error value indicates that Audio Delay is greater than Video Delay, i.e. Audio coming *later* than Video.

Input Labels "V1"... "V4" and "A1" ... "A4" automatically appear in the corresponding boxes, following the Test Point Name part of the table.

VQDM Analyzer calculate *all delays* as *timeline distances* between the selected Test Point and the Referent Test Point - see "Main VQDM Window" section.

Run-time Controls

These 3 press-buttons are the *only* controls, which are *active* during the Test Session.

All other controls are *disabled* during the Test Session and *re-enabled after the session end*.

By pressing **PREVIEW** button user launches VQDM Analyzer in a special mode, causing endless repetition of very short Test Sessions until either STOP or START button is pressed.

The preview mode is useful for initial setup and debugging. Channel Status Indicators play quite important role in this mode - they show the validity of the connected inputs (switching between Green and Red). Another source of useful information is the Results Table of Main VQDM Window. It shows regularly updated *rough estimates* of video and audio delays.

Note that in this mode it is not possible to save or print VQDM reports and VQDM log file is not appended.

START button initiates the Test Session of pre-selected duration.

STOP button can be pressed at any moment, but the Test Session Results of the *current* 10 s segment will be *annulated*, thus only *previous* 10 s segments will contribute to the final results table. It also means that pressing STOP during *first* 10 s segment user effectively abort the whole Test Session.

8.4 Command Line Mode

VQDM.EXE can be used in DOS window in unattended (robotic) mode.
It is highly recommended to check Test Session setup and save it in the appropriate configuration file, using Windows GUI Mode *prior* to running VQDM in the Command Line Mode.

Two groups of Command Line parameters after "vqdm" allow to setup *single* Test Session:
- Test Session Setup Controls to be loaded from the .CFG file specified after *-i* flag
- Test Session interim and final Results to be saved in the .TXT/.CSV file specified after *-o* flag
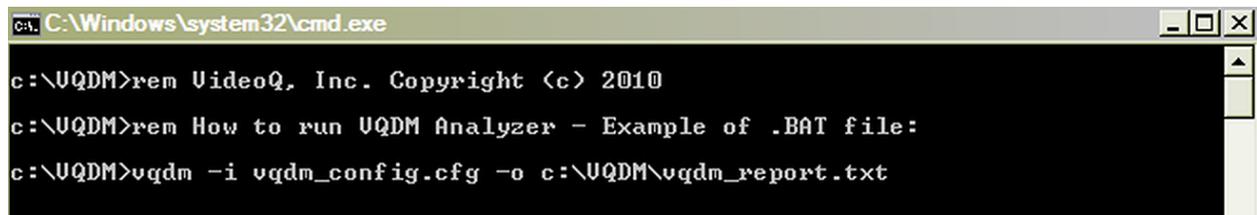
Input and output file names may include full path; if full path is omitted, then the file location defaults to the current folder, e.g. to VQDM executable folder.
File names may include spaces and a mixture of lowercase/uppercase characters, short and long names accepted.
For example: "VQDM_12345config.cfg" and "VQDM Report.txt" are valid file names.
Moreover, even if some characters in the file name have been entered in wrong case, e.g. "VQDM 12345config.cfg" instead of actual "vqdm 12345config.cfg", the "vqdm 12345config.cfg" file will be found and used.

Note that Command Line Mode is suitable only for *online* analysis. Analysis of pre-captured .BIN files is not supported.

Important Note: VQDM.EXE launched from command line represents separate *background* process. Thus, in *can not be stopped or interrupted* until the end of the requested test session duration. However, this process will be *aborted* if specified configuration file is missing or USB cable unplugged.
The corresponding warning messages will pop-up as *Windows GUI messages*, outside of the original DOS window:
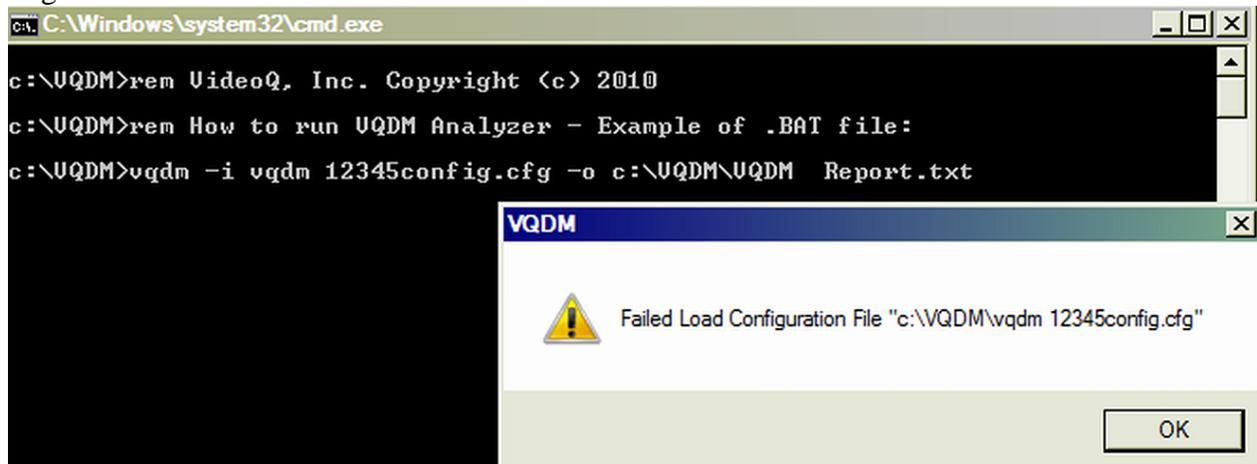
After first 10 seconds of the Test Session Duration the Report File will be created.

Then, this file will be updated (overwritten) every 10 seconds until the end of the Test Session.

Such *interim* Report Files can be opened for viewing or copied/archived for off-line analysis - as needed. This feature is especially useful for large and very large durations.

In normal operation mode the final Report File includes the following lines:
VQDM_MODE, ONLINE
TEST_SESSION_END_MODE, FULL DURATION
;
REQUESTED_TIME_INTERVAL_S, 100
ACTUAL_TIME_INTERVAL_S, 100

Report Files are created in any case, even for interrupted or aborted Test Sessions.

For example, with the USB cable unplugged *before the start of Test Session* the Report File shows actual duration = 0 seconds:

VQDM_MODE, ONLINE
TEST_SESSION_END_MODE, PARTIAL DURATION
;
REQUESTED_TIME_INTERVAL_S, 100
ACTUAL_TIME_INTERVAL_S, 0

With the USB cable unplugged *during the Test Session* the Report File will show actual duration = N*10 seconds, where N is the total number of valid 10 second long segments.

8.5 **Short Report Samples**

Example of **Command Line Mode Short Report**:

```
; VideoQ Inc. Copyright [c] 2010
; VQDM v1.1 Report
TEST_REPORT_TIME, Thu, 06 January 2011,  22:41:23,  GMT-08:00
;
TEST_START_TIME, Thu, 06 January 2011,  22:39:30,  GMT-08:00
TEST_END_TIME, Thu, 06 January 2011,  22:40:32,  GMT-08:00
;
TEST_SESSION_NAME, VQDM_Online_Mode_ Example
;
CONFIGURATION_FILE,  C:\VQDM\VQDM_Online_Mode_ Example.cfg
;
VQDM_MODE, ONLINE
TEST_SESSION_END_MODE, FULL DURATION
;
REQUESTED_TIME_INTERVAL_S, 60
ACTUAL_TIME_INTERVAL_S, 60
VALID_SAMPLES_PERCENT, 100.0
;
V1_VIDEO_REFERENCE_STATUS1, ACTIVE
V1_VIDEO_REFERENCE_STATUS2, VALID
;
V2_STATUS1, ACTIVE
V2_STATUS2, VALID
V2_TEST_POINT_NAME, Video Reference +4 ms
V2_REFERENT_POINT_NAME, Video Reference
V2_AVERAGE_DELAY_MS,  3.6
V2_MAX_DELAY_MS,  4.3
V2_MIN_DELAY_MS,  3.1
V2_DELAY_STD_DEV_MS,  0.4
V2_DELAY_TREND_MS_PER_S, 0.00
;
V3_STATUS1, NOT_ACTIVE
V3_STATUS2, INVALID
V3_TEST_POINT_NAME, N/A
V3_REFERENT_POINT_NAME, N/A
V3_AVERAGE_DELAY_MS, N/A
V3_MAX_DELAY_MS, N/A
V3_MIN_DELAY_MS, N/A
V3_DELAY_STD_DEV_MS, N/A
V3_DELAY_TREND_MS_PER_S, N/A
;
V4_STATUS1, NOT_ACTIVE
V4_STATUS2, INVALID
V4_TEST_POINT_NAME, N/A
V4_REFERENT_POINT_NAME, N/A
V4_AVERAGE_DELAY_MS, N/A
V4_MAX_DELAY_MS, N/A
V4_MIN_DELAY_MS, N/A
V4_DELAY_STD_DEV_MS, N/A
V4_DELAY_TREND_MS_PER_S, N/A
;
A1_AUDIO_REFERENCE_STATUS1, ACTIVE
A1_AUDIO_REFERENCE_STATUS2, VALID
;
A2_STATUS1, ACTIVE
A2_STATUS2, VALID
A2_TEST_POINT_NAME, Audio Reference +0 ms
A2_REFERENT_POINT_NAME, Audio Reference
```

```
A2_AVERAGE_DELAY_MS,  0.0
A2_MAX_DELAY_MS,  0.1
A2_MIN_DELAY_MS, -0.1
A2_DELAY_STD_DEV_MS,  0.0
A2_DELAY_TREND_MS_PER_S, -0.00
;
A3_STATUS1, NOT_ACTIVE
A3_STATUS2, INVALID
A3_TEST_POINT_NAME, N/A
A3_REFERENT_POINT_NAME, N/A
A3_AVERAGE_DELAY_MS, N/A
A3_MAX_DELAY_MS, N/A
A3_MIN_DELAY_MS, N/A
A3_DELAY_STD_DEV_MS, N/A
A3_DELAY_TREND_MS_PER_S, N/A
;
A4_STATUS1, NOT_ACTIVE
A4_STATUS2, INVALID
A4_TEST_POINT_NAME, N/A
A4_REFERENT_POINT_NAME, N/A
A4_AVERAGE_DELAY_MS, N/A
A4_MAX_DELAY_MS, N/A
A4_MIN_DELAY_MS, N/A
A4_DELAY_STD_DEV_MS, N/A
A4_DELAY_TREND_MS_PER_S, N/A
;
AVSYNC1_STATUS1, ACTIVE
AVSYNC1_STATUS2, VALID
AVSYNC1_AUDIO_TEST_POINT, Audio Reference +0 ms
AVSYNC1_AUDIO_REFERENT_POINT, Audio Reference
AVSYNC1_VIDEO_TEST_POINT, Video Reference +4 ms
AVSYNC1_VIDEO_REFERENT_POINT, Video Reference
AVSYNC1_AVERAGE_DELAY_MS, -3.6
AVSYNC1_MAX_DELAY_MS, -3.0
AVSYNC1_MIN_DELAY_MS, -4.4
AVSYNC1_DELAY_STD_DEV_MS,  0.4
AVSYNC1_DELAY_TREND_MS_PER_S, -0.00
;
AVSYNC2_STATUS1, NOT_ACTIVE
AVSYNC2_STATUS2, UNKNOWN
AVSYNC2_AUDIO_TEST_POINT, N/A
AVSYNC2_AUDIO_REFERENT_POINT, N/A
AVSYNC2_VIDEO_TEST_POINT, N/A
AVSYNC2_VIDEO_REFERENT_POINT, N/A
AVSYNC2_AVERAGE_DELAY_MS, N/A
AVSYNC2_MAX_DELAY_MS, N/A
AVSYNC2_MIN_DELAY_MS, N/A
AVSYNC2_DELAY_STD_DEV_MS, N/A
AVSYNC2_DELAY_TREND_MS_PER_S, N/A
;
;End of VQDM Report
```

Example of **BIN File Mode Short Report** (Off-line Analysis):

; VideoQ Inc. Copyright [c] 2010-2011

; VQDM v1.1.6 Report

TEST_REPORT_TIME, Tue, 29 May 2012, 00:52:24, GMT-08:00

;

TEST_START_TIME, Tue, 29 May 2012, 00:45:48, GMT-08:00

TEST_END_TIME, Tue, 29 May 2012, 00:45:50, GMT-08:00

;

TEST_SESSION_NAME, 29May2012_VQDM_AOC_001

;

CONFIGURATION_FILE, C:\VQDM_\Debug\Demo 29May2012 v1.cfg

;

MODE, BIN_FILE

BIN_FILE_PATH, C:\VQDM_\Debug\VQDM2-1 60fps Vx3 Ax2 20Sep2011 -AOC.bin

;

REQUESTED_TIME_INTERVAL_S, 10

ACTUAL_TIME_INTERVAL_S, 10

VALID_SAMPLES_PERCENT, 100.0

;

V1_VIDEO_REFERENCE_STATUS1, ACTIVE

V1_VIDEO_REFERENCE_STATUS2, VALID

;

V2_STATUS1, ACTIVE

V2_STATUS2, VALID

V2_TEST_POINT_NAME, Sreen Area A1

V2_REFERENT_POINT_NAME, Video Reference

V2_AVERAGE_DELAY_MS, 4.0

V2_MAX_DELAY_MS, 4.1

V2_MIN_DELAY_MS, 4.0

V2_DELAY_STD_DEV_MS, 0.0

V2_DELAY_TREND_MS_PER_S, 0.000

;

V3_STATUS1, ACTIVE

V3_STATUS2, VALID

V3_TEST_POINT_NAME, Sreen Area B1

V3_REFERENT_POINT_NAME, Sreen Area A1

V3_AVERAGE_DELAY_MS, 7.9

V3_MAX_DELAY_MS, 8.0

V3_MIN_DELAY_MS, 7.9

V3_DELAY_STD_DEV_MS, 0.0

V3_DELAY_TREND_MS_PER_S, 0.000

;

V4_STATUS1, NOT_ACTIVE

V4_STATUS2, INVALID

V4_TEST_POINT_NAME, N/A

V4_REFERENT_POINT_NAME, N/A

V4_AVERAGE_DELAY_MS, N/A

V4_MAX_DELAY_MS, N/A

V4_MIN_DELAY_MS, N/A

V4_DELAY_STD_DEV_MS, N/A

V4_DELAY_TREND_MS_PER_S, N/A

;

A1_AUDIO_REFERENCE_STATUS1, ACTIVE

A1_AUDIO_REFERENCE_STATUS2, VALID

;

A2_STATUS1, ACTIVE

A2_STATUS2, VALID

A2_TEST_POINT_NAME, Sensor A2

A2_REFERENT_POINT_NAME, Audio Reference

A2_AVERAGE_DELAY_MS, 0.0

A2_MAX_DELAY_MS, 0.1

A2_MIN_DELAY_MS, 0.0

A2_DELAY_STD_DEV_MS, 0.0

A2_DELAY_TREND_MS_PER_S, 0.000

;

A3_STATUS1, NOT_ACTIVE

A3_STATUS2, INVALID

A3_TEST_POINT_NAME, N/A

A3_REFERENT_POINT_NAME, N/A

A3_AVERAGE_DELAY_MS, N/A

A3_MAX_DELAY_MS, N/A

A3_MIN_DELAY_MS, N/A

A3_DELAY_STD_DEV_MS, N/A

A3_DELAY_TREND_MS_PER_S, N/A

;

A4_STATUS1, NOT_ACTIVE

A4_STATUS2, INVALID

A4_TEST_POINT_NAME, N/A

A4_REFERENT_POINT_NAME, N/A

A4_AVERAGE_DELAY_MS, N/A

A4_MAX_DELAY_MS, N/A

A4_MIN_DELAY_MS, N/A

A4_DELAY_STD_DEV_MS, N/A

A4_DELAY_TREND_MS_PER_S, N/A

;

AVSYNC1_STATUS1, ACTIVE

AVSYNC1_STATUS2, VALID

AVSYNC1_AUDIO_TEST_POINT, Sensor A2

AVSYNC1_AUDIO_REFERENT_POINT, Audio Reference

AVSYNC1_VIDEO_TEST_POINT, Sreen Area A1

AVSYNC1_VIDEO_REFERENT_POINT, Video Reference

AVSYNC1_AVERAGE_DELAY_MS, -4.0

AVSYNC1_MAX_DELAY_MS, -3.9

AVSYNC1_MIN_DELAY_MS, -4.1

AVSYNC1_DELAY_STD_DEV_MS, 0.0

AVSYNC1_DELAY_TREND_MS_PER_S, 0.000

;

AVSYNC2_STATUS1, ACTIVE

AVSYNC2_STATUS2, VALID

AVSYNC2_AUDIO_TEST_POINT, Sensor A2

AVSYNC2_AUDIO_REFERENT_POINT, Sensor A2

AVSYNC2_VIDEO_TEST_POINT, Video Reference

AVSYNC2_VIDEO_REFERENT_POINT, Video Reference

AVSYNC2_AVERAGE_DELAY_MS, 1.9

AVSYNC2_MAX_DELAY_MS, 2.4

AVSYNC2_MIN_DELAY_MS, 1.5

AVSYNC2_DELAY_STD_DEV_MS, 0.3

AVSYNC2_DELAY_TREND_MS_PER_S, -0.050

;

;End of VQDM Report

8.6 Configuration File Sample

This section contains a sample of VQDM Configuration File:

```
; VideoQ Inc. Copyright [c] 2010
; VQDM Configuration File
;
[TEST_SESSION]
TEST_SESSION_NAME=VQDM_Online_Mode_ Example
REQUESTED_TIME_INTERVAL_S=60
;
;
[V1_VIDEO_REFERENCE]
STATUS=ACTIVE
;
[V2]
STATUS=ACTIVE
TEST_POINT_NAME=Video Reference +4 ms
REFERENT_POINT_NUMBER=1
;
[V3]
STATUS=NOT_ACTIVE
TEST_POINT_NAME=Sensor V3
REFERENT_POINT_NUMBER=1
;
[V4]
STATUS=NOT_ACTIVE
TEST_POINT_NAME=Sensor V4
REFERENT_POINT_NUMBER=1
;
;
[A1_AUDIO_REFERENCE]
STATUS=ACTIVE
;
[A2]
STATUS=ACTIVE
TEST_POINT_NAME=Audio Reference +0 ms
REFERENT_POINT_NUMBER=1
;
[A3]
STATUS=NOT_ACTIVE
TEST_POINT_NAME=Sensor A3
REFERENT_POINT_NUMBER=1
;
[A4]
STATUS=NOT_ACTIVE
TEST_POINT_NAME=Sensor A4
REFERENT_POINT_NUMBER=1
;
[AVSYNC1]
STATUS=ACTIVE
AUDIO_TEST_POINT=2
VIDEO_TEST_POINT=2
;
[AVSYNC2]
STATUS=NOT_ACTIVE
AUDIO_TEST_POINT=2
VIDEO_TEST_POINT=2
;
;End of VQDM Config
```

9 Test Session Setup

This section describes recommended VQDM software (GUI) actions, assuming that hardware setup is correct, TPG module outputs VQDM Test Pattern signal of appropriate format and all relevant VQDM inputs receive valid data - see 'TPG Module Operation' and 'Input Connection Setup' sections.

Setting up and running VQDM Test Session includes the following steps:

Step 1:

User *must* set some custom parameters prior to any test session. These parameters can be **entered** directly in the dialog boxes of the VQDM Control Panel, **inherited** from previous session or **loaded** from configuration file:

1.1. Test Point (Input Channel) Activation & Name Edit Dialog Boxes
First of all, user must *activate* all relevant video and audio inputs as required by the Test Plan. To fill at least one row of the Results Table user must check at least one Video Input, e.g. "V2". For any channel the default name is "Sensor #"; it appears first, when the channel is activated. *Typing-in any other name, e.g. "Codec # 1" does not affect the channel activation, but it does affect the list of Referent Points prepared for Step 1.2.*

1.2. Referent Test Point (Referent Input Channel) Selection Dialog Boxes
For each Test Point there are up to 3 *selectable* names for Referent Input Channel, i.e. for the second term of subtraction operation used to calculate relative delay. There are two *special* Referent Test Point Names, which are *always* activated and available: "Video Reference" and "Audio Reference".

1.3. AV Sync 1 & 2 Dialog Boxes (optional)
Unlike steps 1.1. and 1.2, user can not edit test points names.

User may
 - **select two pairs** of video and audio inputs from the short lists of **combinations** already created at Steps 1.1 and 1.2, e.g. **A2-A1** vs. **V2-V1**
    Relative AV Sync Error: Audio Latency vs. Video Latency, small source point errors are *acceptable;*
or
- **create new combination** of *activated* audio and video inputs, e.g. **A2** vs. **V1**
    Absolute AV Sync Error at the test point: assuming *zero error* at source.

Step 2 (optional):

There are two groups of custom parameters which user may modify prior to any test session:

2.1. Test Session Name
The default Test Session Name is created automatically at every launch of VQDM.EXE.
User can change it and type-in any other name, e.g. "Test_1". *Note that this name also appears as the default VQDM Report name in the File/Save menu dialog.*

2.2. Test Session Duration
Default for this numerical value is "10 s". User can select any other value from drop-down list.

Step 3:

Start Test Session by pressing the **START** button.

During the session the VQDM Summary Table will show current test results, updated every 10 seconds.

These Test Results can be *printed* or *saved* as a short report only when data acquisition process is *terminated*.

Running test can be terminated at any moment by pressing **STOP** button. If this buttons is not pressed, the test session will continue until the end of the pre-selected time interval.

Click on STOP button in the middle of the Test Session will terminate it, thus allowing to print and/or save the *interim* results, but it will be not possible *to resume* current Test Session.

Pressing START again will start *new* test session - *all previous results will be lost*.

Warning: Do not disconnect USB cable during the Test Session - it results in warning message pop-up and then abort of the whole Test Session. However, in case of accidental disconnection there is no need to re-launch VQDM.EXE. After reconnection of the USB cable user can simply press START to initiate new Test Session.

If a video or audio input is lost or frozen for some time, the Test Session will go on, and it is possible to get relevant final results. VQDM software automatically *detects* and *skips* damaged segments of the time-line.

However, the statistics and accuracy of the results will be affected depending on the relative duration of damaged segment(s).

Step 4 (optional):

At the end of Step 1, 2 or 3, all configuration parameters can be saved in the .CFG file.

The configuration can be recalled via VQDM "File" menu, then next Step can be Step 1, 2 or 3.

It is not possible to change configuration *during* the Test Session..

User may want to repeat previous session without any change of VQDM setup, e.g. when System Under Test undergoes some changes.

In this case it is enough to adjust the Session Name (only if necessary), then press START button and wait for new results.

10 Saleae 'Logic' Software Usage

In normal VQDM operation mode Saleae 'Logic' driver does not need any user attention.

However, it is possible to launch Saleae Logic.EXE software *instead* of VQDM.EXE. In the "Logic Analyzer Mode" user can preview "raw" pulses derived from video sensors and audio inputs.

Multiple instances of Logic.EXE can be launched; this may be useful for debugging and diagnostics.

Note that at any time moment only one of two programs (VQDM.EXE or Logic.EXE) may communicate with DAM.

Important: *Shut down* VQDM.EXE *before* launching Logic.EXE and vice versa.

Click on **Logic** executable icon - this will bring up Logic GUI. Select 100 kHz sampling rate and the desired data size, minimum is 1 M Samples, equivalent to VQDM Test Session duration of 10 s. This duration is long enough to see the 9 or 10 pulses, arriving once per second.

Click on 'Acquire Data' button and wait about 10 s. Multi-channel pulses display will show at the end.

Four VQDM *video* inputs 1 ... 4 are mapped to first four Logic channels - Inputs 1 ... 4, thus VQDM Video Reference input is represented by Input 1.

Four VQDM *audio* inputs 1 ... 4 are mapped to Inputs 5 ... 8, thus VQDM Audio Reference input is represented by Input 5.

Pan and Zoom to the wanted segment on the timeline. User can measure every pulse duration, pulse sequence period (and frequency), distance to the next pulse of the same channel or distance between pulses in two different channels.

Leave the Logic Analyzer Mode by *shutting down* Logic.EXE application.

Important: If necessary current Logic.EXE Test Session can be saved as a compressed "Session" file with the extension **.LogicData**.

Moreover, acquired binary data can be immediately exported to .BIN file, or such file can be extracted later from the saved Session file.

Thus Logic Analyzer Mode provides for off-line and/or remote analysis by creating .BIN files.

Use menus: "Options/Save Session", "Options/Open Session", and "Options/Export Data/Export Format/Binary/8 bit bytes".

Such files can be opened *later* by VQDM.EXE running on a remote PC without any VQDM hardware involvement (note that if VQDM.EXE works in real time test mode, the acquired data chunks are not stored on hard drive).

*Note that Logic.EXE is just a capture/save/view utility, it does not **replace** VQDM Delay Analyzer, so it should not be used as AV delay meter.*

Following are two examples of Logic screenshots , the only difference is zoom factor. Both examples show two video channels and two audio channels

Channels 1 & 2 are connected to *two* light sensors attached to the *same* screen, so very small timing difference is caused by unavoidable small mismatch in the *vertical positions* of the sensors.

Note that cable length difference (3m for Channel 1 vs. 2m for Channel 2) actually *does not affect timing error*. Pulse propagation delay in the cable is about 5 ns/m. Such values are negligible in comparison with the results expressed in milliseconds.

Channels 4 and 5 shows two audio channels. In this example reference input (channel 4) is connected to the TV set headphone socket. Channel 5 is taken directly from analog audio output of the TPG. Thus, in this example audio test point signal appears slightly *advanced* vs. audio reference signal.

The most important timing problem revealed here is relatively big AV Sync error: video is coming *later* than audio. Time markers T1 and T2 allow accurate measurement of different video vs. audio positions: T2-T1 = 32.2 ms.

This instant *estimate* on *single* pulse should not be confused with AV Sync Error *measurement* by VQDM software algorithm, which provides statistical *average* of *multiple* pulses.
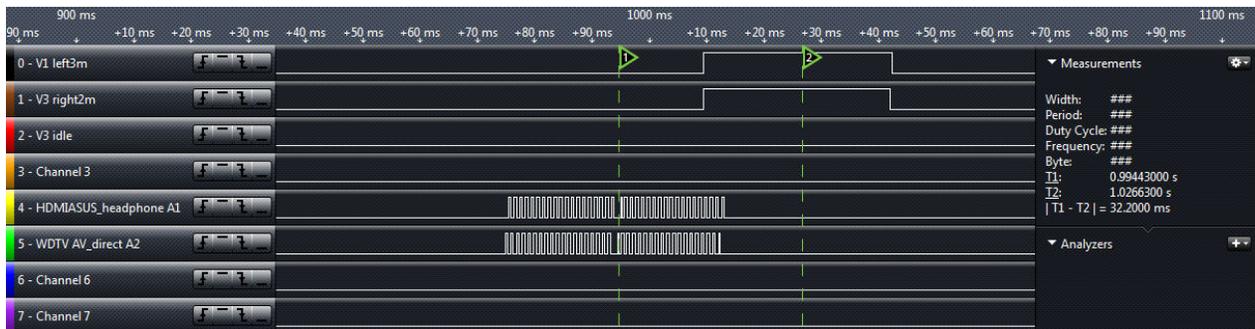
Zooming to the front edge of video pulses makes visible even very small timing differences. In this example T1-T2 = 10 us, i.e. 0.01 ms.
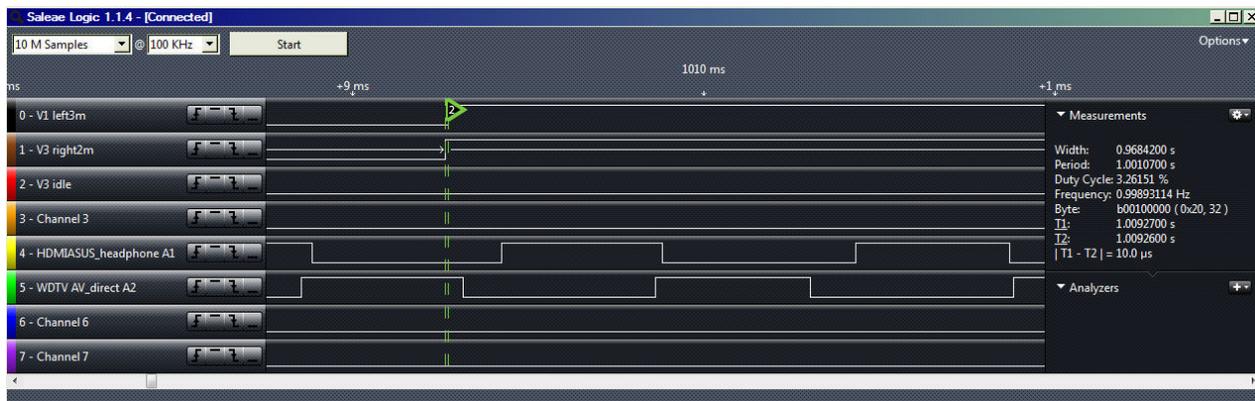
11 Specifications

Carry Case:

- Content:

  - Main Unit with PSU and Remote Control

  - Light Sensors in plastic containers, x4

  - 2 m (9') mini-jack cables with numbered labels, x4

  - AV cables, mini-jack to RCA:

      a) YPrPb component video

      b) CVBS video and LR audio

  - Standard USB cable, A-B type

- Weight, fully loaded: 0.9 kg

- Dimensions (D x W x H): 230 mm x 305 mm x 102 mm (9" x 12" x 4")

Main Unit - General:

- Weight: 0.3 kg

- Dimensions (D x W x H): 95 mm x 155 mm x 50 mm (3.75" x 6" x 2")

- External PSU (required for TPG and DAM modules to be active):

  - Input 100-240 V, 50-60 Hz

  - DC Output 12 V, 1.5 A, center = positive

Main Unit - TPG Module

- LED Indicators (dimmed blue):

  - Power On

  - Memory Status (blinking: scans for media from the USB storage, lit**:** ready)

- Remote Control: IR, wide angle

- Internal memory: 4GB (standard), 8 GB (option)

- USB 2.0 Plug-n-Play port for external storage device: x1

- USB Storage Device File System: NTFS, FAT/FAT32 or HFS+

- Display resolution and display frame rate::
  - 480p@59.94, 576p@50, 720p@50, 720p@60
  - 1080i@50, 1080i@59.94, 1080p@24, 1080p50, 1080p@59.94
- Video content resolution: up to 1080p at 60 fps, built-in scaler/deinterlacer
- Static images: BMP (max 2048x2048), JPG (lossy, max 4096x4096), also GIF, TIFF, PNG
- Video Codecs & : MP1, MP2, MP4, H264/AVC, VC1, WMV9
- Video Container Formats: ASF, MKV, AVI, Xvid, MP4, DVR-MS, VOB, TS, M2TS
- Playlist formats: PLS, WPL, M3U
- Audio Codecs & Containers: WAV (including 5.1 WAV), WMA, FLAC, AAC, AC3, MP3
- Video outputs:
  - HDMI 1.3 x1
  - NTSC/PAL CVBS, 1Vpp on 75 Ohm
- Audio outputs:
  - 5.1 Digital, SPDIF optical x1
  - Analog Stereo (L & R)

Main Unit - DAM Module

- Video Sensor Inputs:
  x4, mini-jack
- Audio Inputs:
  x4, mini-jack, mono or stereo, high impedance
- Audio input level:
  - from 0.5 Vpp to 4 Vpp
- USB port:
  - type B
- LED Indicators (x8, flashing green):
  - Active Video Channel: x4
  - Active Audio Channel: x4

VQDM Software Application

- System Requirements:

  - Windows XP, Windows Vista, Windows 7 - 32 bit or 64 bit versions

- Test Session Duration:

  - min 10 s

  - max 10,000 s

- Analysis Results:

  - Average Delay, ms

  - Minimal Delay, ms

  - Maximal Delay, ms

  - Delay Variance (Standard Deviation), ms

  - Delay Trend, ms/s

  - Average AV Sync Error, ms

- Measurable Ranges:

- Video Delay vs. Video Reference Input:	-49 ms to +949 ms
- Video Delay vs. any other Video Input:	-499 ms to +499 ms
- Audio Delay vs. Audio Reference Input:	-49 ms to +949 ms
- Audio Delay vs. any other Audio Input:	-499 ms to +499 ms
- AV Sync Errors:	-499 ms to +499 ms

Optional VQHD420 Adapter

- HDMI input: HDMI 1.2, HDCP 1.1 and DVI compliant

- BluSync pulse output: mini-jack, VQDM compatible

- HDMI formats supported in BluSync mode:
  720: p50, p59.94, p60; 1080: i25, i29.97, p50, p59.94, p60

- Video output: VGA/YPrPb, up to 1920x1200, format as by HDMI input

- Audio output: mini-jack, analog stereo, VQDM compatible

- Power supply: +5 V via external AC PSU

- Dimensions: (W x D x H) 2.99" x 1.18" x 3.62" / 76 x 30 x 92 mm

- Weight: 0.37LB /172g

VideoQ Inc