



DPA-400 DisplayPort™ AUX Channel Monitor



USER MANUAL



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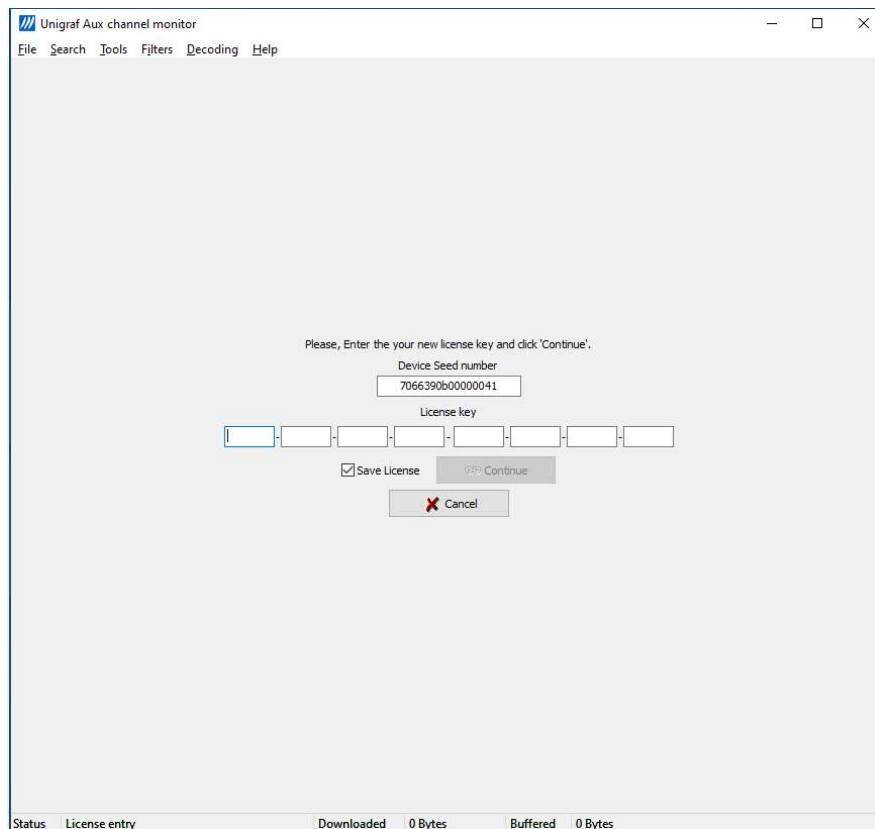
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Quick Start Guide

If you feel confident with installing new hardware and software in your PC you can attempt this simplified version of Unigraf DP AUX channel monitor (DPA-400) setup procedure

Serial Communication and License Key Setup

- ▶ Run the **DPA-400 Setup** installer
- ▶ Plug the USB connector of the DPA-400 to one of the USB ports in your PC.
- ▶ Launch the DPA-400 GUI (**DP_AuxMon.exe**)
- ▶ Indicate the DPA-400 unit in the combo-box and click **Try Connection**.
- ▶ Insert the 32 character long *License Key* in the field provided and click **Continue**.



1. ABOUT THIS MANUAL

This manual introduces you to the installation and use of the Unigraf DP AUX Channel Monitor DPA-400. The purpose of this document is to:

- Provide instructions on how to install the provided software.
- Give an overview of the DPA-400 and of its features.
- Guide to the DPA-400 typical usage.

Product Versions

Functionality and operation described in this manual is related to software release 2.1. Please contact Unigraf for details about other versions or refer to the version specific release notes.

Notes

On certain sections of this manual, when important information is given, text is formatted as follows. Please read these notes carefully.

Note	This text is an important note
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2. GENERAL

Introducing the DPA-400

The Unigraf DP AUX Channel monitor is a compact, pocket-sized device that provides a full DisplayPort™ AUX channel traffic analysis. DPA-400 and its Windows GUI tool enable the user to monitor, capture, parse and document all messages sent by DisplayPort™ source, sink or branch devices.

Each message is shown as time stamped raw data and in its decoded form, expressed with the same terminology used by the DisplayPort™ standard specification. Also, the activity of the Hot Plug Detect (HPD) signal and optionally other external signals is tracked and documented by a time stamp marking each of its changes of state.

Easy to Use

The DPA-400 is a USB-powered device and measures only 10.5 x 13 x 3.5 centimetres, making it an ideal tool for a laboratory desktop and a snappy companion for a laptop computer.

DPA-400 preserves signal integrity by bypassing the Main Stream data lanes with the provided special cable. DPA-400 can be inserted between a sink and a source without needing any custom adapters or expensive pods.

Benefits

- Device independent
- Data documented with time stamps
- Pocket Size
- USB controlled and powered

Applications

- Tool in solving interoperability issues
- Essential partner with Link compliance testing
- Software debug and validation
- Documentation of functionality and protocol implementation
- Monitoring and time measurement of events

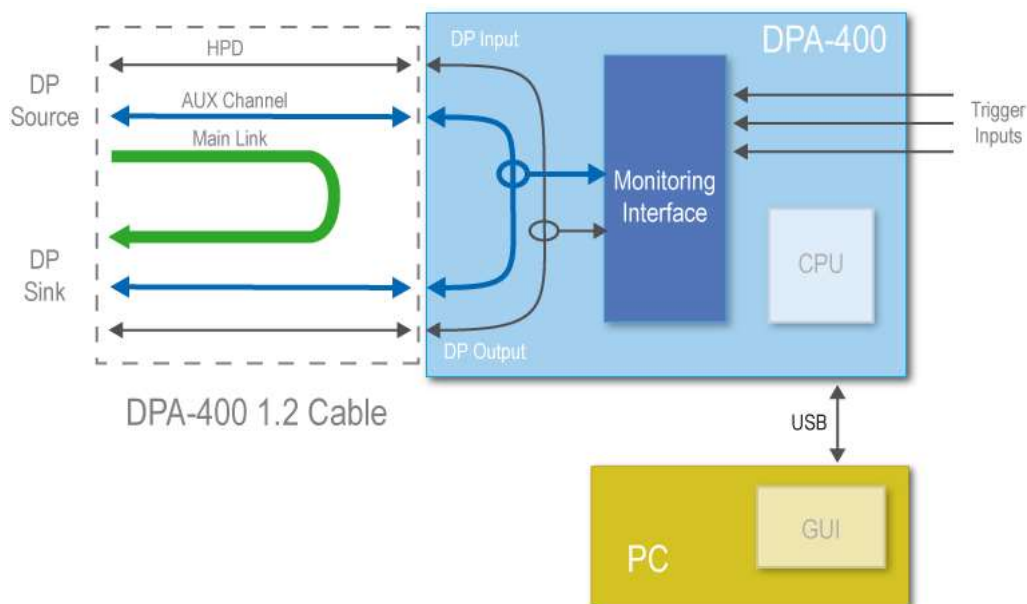
Functionality in a Nutshell

The DPA-400 is meant to be connected between a DisplayPort™ source and a DisplayPort™ sink device or two USB-C ports with DisplayPort Alternate Mode capability in order to detect and record the AUX channel communication between them. The DPA-400 does not take part to the communication but transparently monitors the AUX channel traffic, the HPD (Hot Plug Detect) line and three external digital inputs.

The user can select to start the acquisition manually or on a specific transition (rising edge or falling edge) of one or more of the external inputs or of HPD. The user can also terminate the acquisition manually or on a different transition of the same input signals.

When the acquisition is enabled, each AUX channel transaction detected is stored in the DPA-400 internal memory and marked by a timestamp, starting from the time instant the acquisition begun.

The user can also select one or more of the external input signals or the HPD for being monitored. Every logical state change of the monitored signals is recorded together with the timestamp of when it happened. This is very useful, for instance, to know when HPD gets asserted and how long time each HPD pulse issued has taken.



The GUI application is used to control the acquisition start and stop, to select the monitored signals and to browse through the acquired data in a user-friendly fashion. The DPA-400 features a large internal memory that can quickly collect a huge amount of data. The user can download the data stored in the DPA-400 memory to the GUI as soon as it gets acquired or can pause the download to first inspect the already visible data. The download can be paused and restarted any number of times or aborted if the acquired data is not of interest.

After the acquisition is stopped, the downloaded data can be saved in binary format or as a portable HTML report. In its binary form, the saved data can only be opened by the DPA-400 GUI while in HTML format it can be opened with any available HTML browser.

DPA-400 Versions

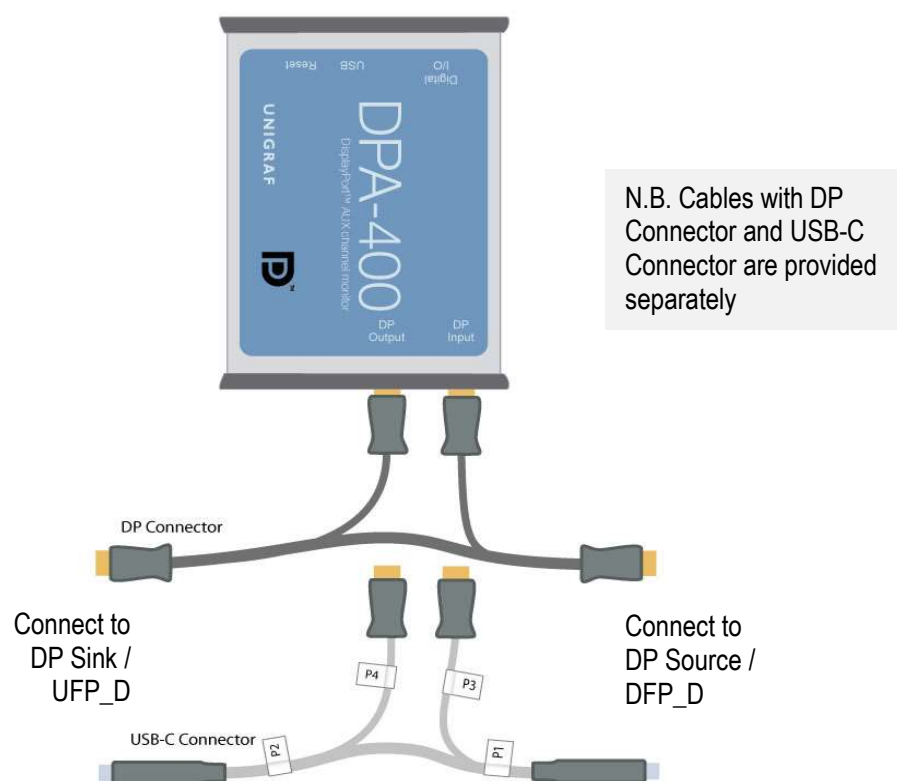
There are multiple versions of DPA-400. All versions share the same test equipment hardware, but more recent versions of the DPA-400 GUI support later versions of DisplayPort DPCD register structure and other more advanced features. Please see the table below.

Version	Added features
DPA-400	DPCD 1.X, HDCP 1.X decoding
DPA-400 1.2	DPCD 1.2 decoding, Sideband CH messages
DPA-400 1.4	DPCD 1.4, HDCP 2.2 decoding
DPA-400 2.0	DP 2.0 support for DPCD 1.4 decoding, including DSC, FEC and LTTTPR specific DPCD registers
DPA-400 2.1	Added eDP 1.5 support.

DPA product delivery contains a custom Y-shaped cables for use with DP 1.2 and later versions. The custom cables bypass the main links outside DPA-400 as shown in the illustration on the previous page.

Note: Please use the custom cable supplied with DPA-400 when monitoring DisplayPort version 1.2 and higher. DPA-400 hardware is not compatible with the HBR2 and higher main link bit rate. The custom cable bypasses main links outside DPA-400.

Note: DPA-400 detects the sink and source role by default from the way how they are connected to DP Input (Source) and DP Output (Sink). When *Connection independent sink / source detection* in *Decoding* pull-down menu, role is detected from the transaction messages.



3. SETUP INSTRUCTIONS

Contents of the Delivery

The DPA-400 installation SW package includes the following items:

- DPA-400 Setup installer (DPA-400 Setup.exe)
- Firmware updater utility (UUFUpd.exe)
- Latest DPA-400 firmware (*.uuf)
- Release notes (DPA-400_release_notes.txt)
- This manual

DPA-400 delivery also includes custom cables for monitoring DisplayPort versions 1.2 and above and DisplayPort Alt mode over USB-C interface.

- DP to DP Y-cable (P/N 546126)
- USB-C to USB-C Y-cable (P/N 546127) (ordered separately).

Product Setup

The DPA-400 unit features an USB to serial conversion controller. Therefore, its Windows driver will be installed as a virtual serial port named as a *DPA-400 USB Serial Port*. Please, use the USB Serial Port driver installed by DPA-400 installer.

Note: System administrator's privileges are required for performing the installation.

Installing the DPA-400

In order to install the DPA-400 software and driver please follow these steps:

- ▶ Power up your PC
- ▶ Open the folder containing DPA-400 installation package
- ▶ Run **DPA-400 Setup.exe** found in the installation package
- ▶ In the **Choose Components** dialog please indicate if you need the device drivers to be installed at this time.
- ▶ In the following dialogs, indicate the folder where the files will be installed and the Start Menu folder for the program shortcuts.

DPA-400 software and firmware will now be installed to your PC.

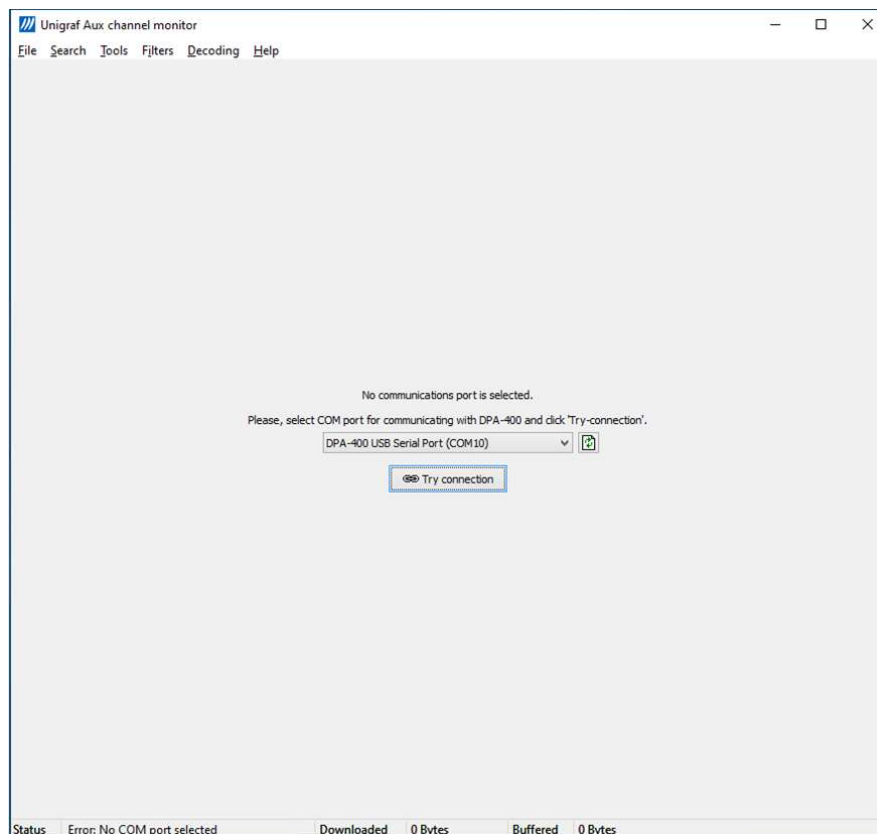
- ▶ Plug in the DPA-400 unit in a vacant USB port of your PC
- ▶ Run **DP-Aux Channel Monitor** application

GUI Setup

In order to enable the DPA-400 graphical user interface (GUI) application to communicate with the firmware in the DPA-400 unit, you have to set up the COM port used and provide the license code delivered with the unit.

Selecting the COM Port Used

- From the GUI pull down menu in the center of the GUI and select the serial port used for communicating with the DPA-400. It will in most cases be named as *DPA-400 USB Serial Port*



Adding the License Key

You will need a hardware specific license key for using Unigraf DPA-400 GUI. Each license is valid for one specific device only. By using the GUI, you can read the *Seed Number* of your DPA-400 unit. For a given Seed Number, Unigraf will provide you a *License Key* that will enable you to use the GUI from any PC to control your DPA-400 GUI, the user can select the interpreted DPCD registers based on the DP version.

- ▶ You can usually find your DPA-400 License Key on a sticker glued on its enclosure, in the delivery package or among its related documents. If you cannot locate the License Key, please email to Unigraf the *Seed Number* shown on the dialog in order to receive your License Key.
- ▶ Insert each of the 32 character long License Key in the field provided and click the Continue. The license key is now saved in your PC and you can constantly use the device from this PC. Please Click Close to return to the main window.

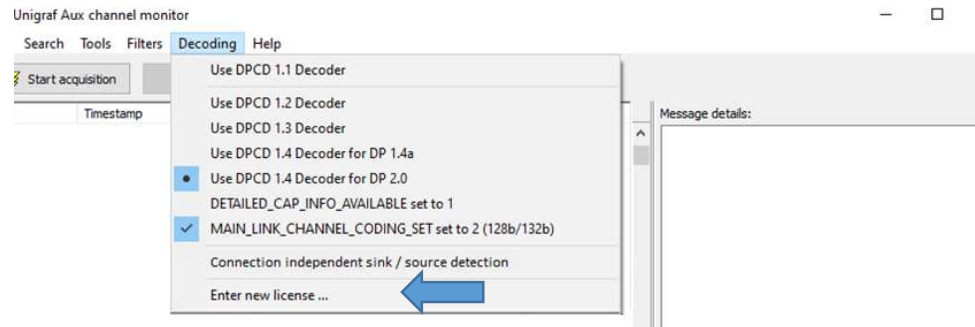
The screenshot shows the 'Unigraf Aux channel monitor' application window. The title bar includes standard window controls (minimize, maximize, close). The menu bar contains 'File', 'Search', 'Tools', 'Filters', 'Decoding', and 'Help'. The main area is a light gray dialog box with the following elements:

- Text: 'Please, Enter the your new license key and click 'Continue'.'
- Text: 'Device Seed number' above a text box containing '7066390b00000041'.
- Text: 'License key' above a row of eight empty text boxes for input.
- Checkboxes: A checked checkbox labeled 'Save License'.
- Buttons: A 'Continue' button and a 'Cancel' button with a red 'X' icon.

The status bar at the bottom shows 'Status', 'License entry', 'Downloaded 0 Bytes', and 'Buffered 0 Bytes'.

Upgrading the License

For upgrading your license, please select **Decoding > Enter new license**. In the license entry dialog, please type in or copy and paste the new license and click **Continue**.



Note	Please note that each Unigraf DPA-400 GUI license is bound to one specific DPA-400 unit. The same license can be used with any number of PCs.
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Note	Please note that various features of DPA-400 are enabled with license keys. For upgrading your DPA-400, please contact Unigraf.
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Note	The License Key never includes characters I, G, B, O because of their similarity with the corresponding numbers. If in doubt, please use numbers. You can use copy and paste to insert the License Key.
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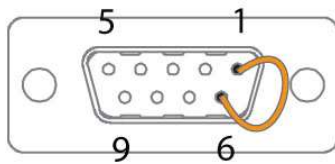
Note	The DPA-400 must be connected to your PC for entering the License Key.
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DPA-400 Firmware Upgrade

When launching the GUI, it will verify that the firmware programmed in the DPA-400 unit is matching the GUI version. If upgrade is needed the GUI will prompt the user to update the firmware.

Please follow these steps in order to upgrade your DPA-400 internal firmware:

- ▶ Unplug the DPA-400 USB cable.
- ▶ With a length of wire, short-circuit pins 1 and 6 of the digital I/O connector. Try to make a good contact by inserting at least ½" of bare conductor in each of the connector pin holes.



- ▶ Plug the DPA-400 USB cable to your PC.
- ▶ Locate the COM port used by your DPA-400 (for instance, COM3).
- ▶ Open Windows command prompt dialog and go to the directory where the installer copied the firmware files. (by default c:\Program Files (x86)\Unigraf\DPA-400\Firmware). In this directory you should find the updater, **UUFUpd.exe**, and the FW file, e.g. **dpa-400.uuf**.
- ▶ In Windows command prompt run:

```
uufupd -c 3 -f dpa-400.uuf
```

(In the entry, please substitute "3" with the number of your COM port and "dpa-400.uuf" with the firmware file included in your package)
- ▶ The UUFUpd utility will upgrade the DPA-400 firmware while printing a series of dots. Please wait for its completion without removing the USB cable.
- ▶ When the message "DONE" is printed, please remove the short-circuit from the I/O connector and unplug the USB cable. Your DPA-400 is now upgraded with its latest firmware.

In case you receive an error message from the UUFUpd utility, please restart the above procedure from its very beginning (USB cable unplugged) and verify that the short-circuit you use makes a good contact and to the right pins.

Note	After a firmware upgrade, the DPA-400 USB cable must be unplugged and plugged once for the device to be again functional.
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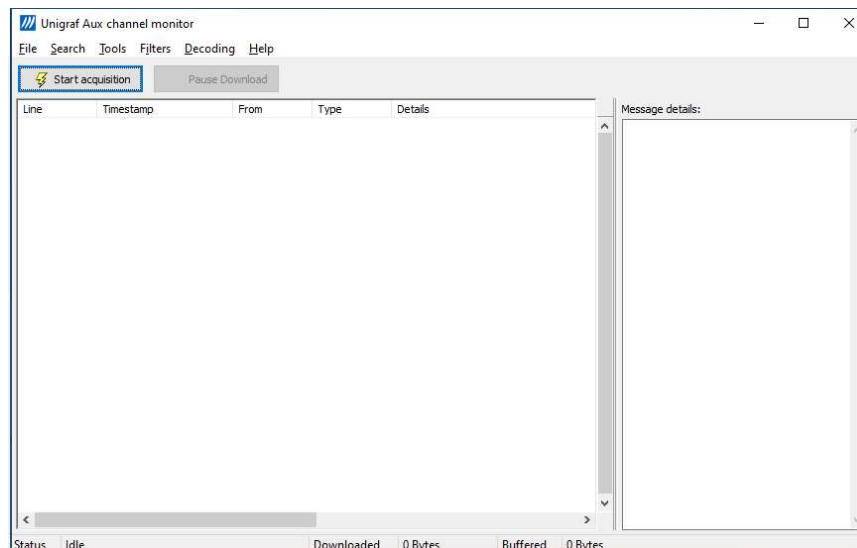
4. DATA ACQUISITION

Unigraf DP AUX Channel Monitor consists of DPA-400 unit for connecting to the DisplayPort™ link and a Graphical User Interface (GUI) application for operating it and creating reports. The serial communication setup and License Key entry are covered in the *Setup Instructions* section of this manual. The following sections describe the process of acquiring AUX channel data. Generating data reports is covered in its own chapter.

Getting Ready

Plug your DPA-400 to your PC and start the GUI application. Verify that the right COM port is selected, a valid License Key is available and the GUI main window opens.

If required, connect your external input signals to the DPA-400 I/O connector using a suitable cable.

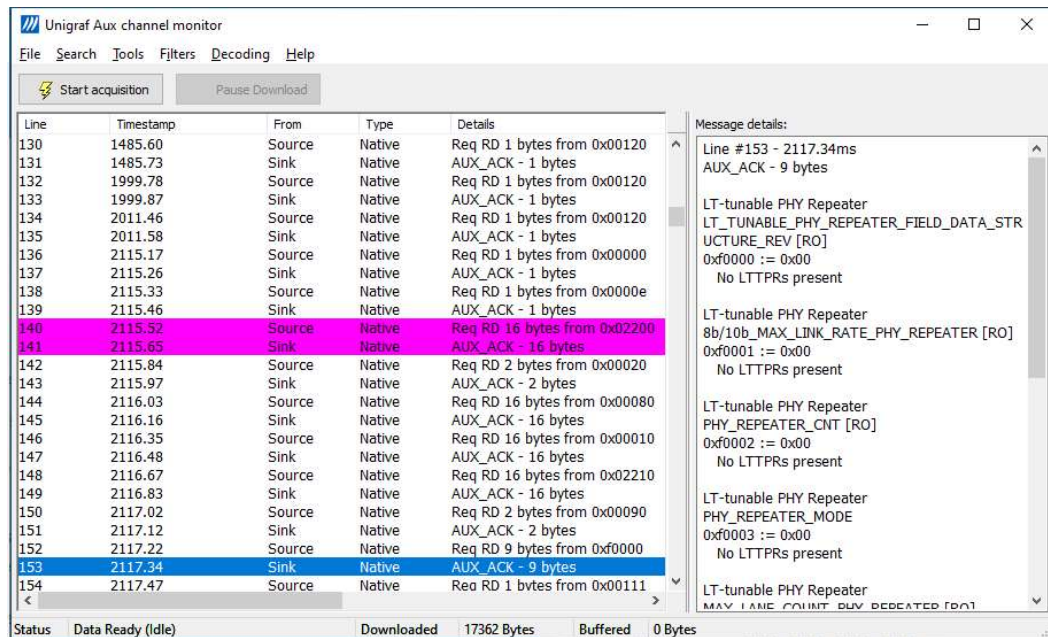


Note	In order to ensure the signal integrity of high main data lane speeds (HBR2 and higher) you will need to use the custom Y-shaped pass-by cable supplied with the delivery of DPA-400 or the Upgrade package. DPA-400 hardware is not compatible with HBR2 and higher data transfer speed.
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Note:	DPA-400 detects the sink and source role by default from the way how they are connected to DP Input (Source) and DP Output (Sink). When <i>Connection independent sink / source detection</i> in <i>Decoding</i> pull-down menu, role is detected from the transaction messages.
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The Main Window

The GUI main window is divided into two sections. The **Transaction list** in the left displays the acquired AUX channel transactions and events. The **Message details** panel on the right side of the window shows the interpretation of the currently selected AUX channel transaction line. The **Start acquisition** button controls the start and stop of the data acquisition. The **Status line** at the bottom of the window shows the current GUI state, the amount of data already downloaded to it and the amount of data still stored in the DPA-400 internal memory (buffered) and waiting for downloading.



Note Please note that the **Filters** function found in the Main Window in some previous versions of the GUI can now be found as a pull down menu. Its function is described later in this document.

Controlling the Acquisition

The start and stop conditions of the data acquisition and monitoring of optional signals can be defined in the corresponding dialogs. Please consult Appendix B to find out how these external signals can be connected to your DPA-400.

Starting and Stopping Data Acquisition

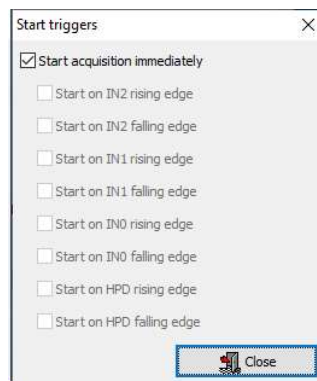
By default, the data acquisition is started immediately after the **Start acquisition** pushbutton in the *Main window* is pressed. Additional conditions can be set in the *Start triggers* dialog.

► Select Tools -> Start triggers...

By default the **Start acquisition immediately** option is selected. By deselecting it you can select one or the more of the advanced options:

- Start on the rising or falling edge of HPD signal
- Start on the rising or falling edge of IN0 signal
- Start on the rising or falling edge of IN1 signal
- Start on the rising or falling edge of IN2 signal

The acquisition will start after the Start acquisition pushbutton is pressed and when any of the selected conditions is verified.



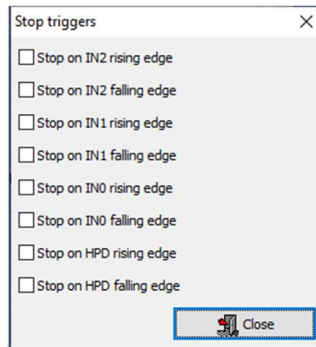
Data acquisition can be manually stopped at any time by pressing the **Stop acquisition** pushbutton in the *Main window*. Optionally, the acquisition can be stopped automatically when one of the enabled stop conditions is verified.

► Select Tools -> Stop triggers...

You can select one or the more of the advanced options:

- Stop on the rising or falling edge of HPD signal
- Stop on the rising or falling edge of IN0 signal
- Stop on the rising or falling edge of IN1 signal
- Stop on the rising or falling edge of IN2 signal

The acquisition will stop automatically when any of the selected conditions is verified.

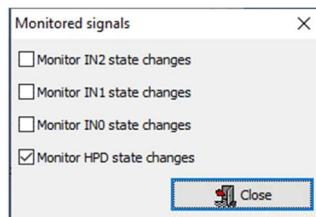


Monitored Signals

In addition to the AUX channel traffic, you can also monitor the status of four digital signals. By default, only the HPD signal is monitored. In the *Monitored signals* dialog, you can include also one or more of the external digital signals IN0, IN1 and IN2.

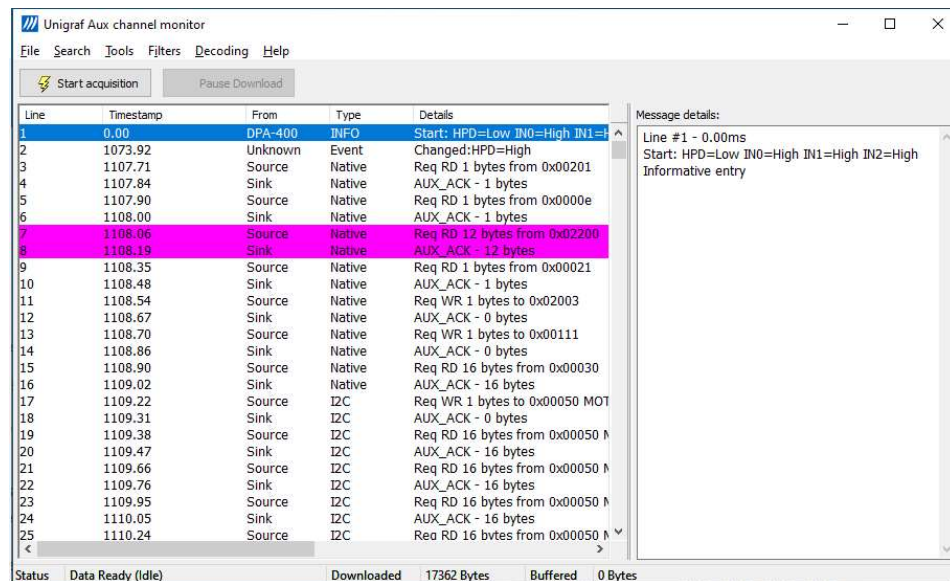
- Select Tools > Monitored signals...

The dialog allows you to select the monitored signals.



Acquiring Data

- Plug your source and sink devices to the DPA-400 as described in section Getting Ready of this chapter.
- Select the signals to be monitored or check that the HPD is selected.
- Check the start and stop triggers.
- Finally press the **Start Acquisition** button.



The GUI automatically enables data download and data is displayed in the *Transaction List* as soon as it is acquired and reaches the GUI. From the Status line at the bottom of the Main window you can monitor the amount of downloaded data and how much data is still waiting to be downloaded.

Usually, the buffered data amount always read as zero, meaning that all the acquired data has been downloaded to the GUI. When a quick and long sequence of transactions is acquired or when a rapidly toggling external input is monitored, the DPA-400 internal buffer can fill-up much more rapidly than what the GUI can download.

- If the DPA-400 buffer gets filled with a large amount of data, you can pause the download by pressing the Pause Download pushbutton.
- After inspecting the downloaded data, you can decide to resume the download to gather more data by pressing the Download pushbutton.
- If the acquisition is not stopped automatically by one of the selected stop triggers, you can force its termination by pressing the Stop Acquisition pushbutton.

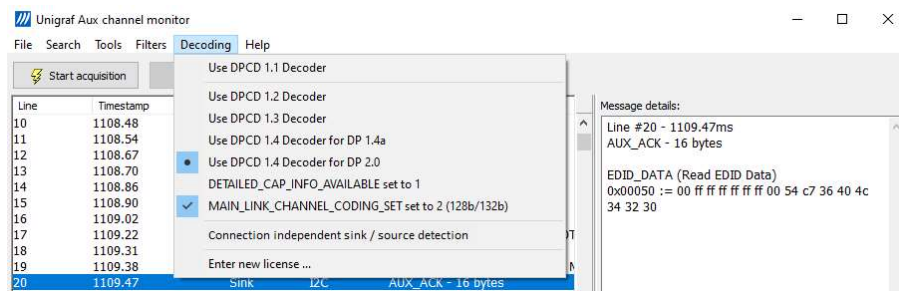
Note	Restarting the data acquisition clears the DPA-400 internal buffer and the GUI downloaded data!
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Decoding the Data

There are multiple versions of DPA-400. All versions share the same test equipment hardware, but more recent versions of the DPA-400 GUI support later versions of DisplayPort DPCD register structure and other more advanced features. Please see the table below.

Version	Added features
DPA-400	DPCD 1.X, HDCP 1.X decoding
DPA-400 1.2	DPCD 1.2 decoding, Sideband CH messages
DPA-400 1.4	DPCD 1.4, HDCP 2.2 decoding
DPA-400 2.0	DP 2.0 support for DPCD 1.4 decoding, including DSC, FEC and LTTTPR specific DPCD registers
DPA-400 2.1	Added eDP 1.5 support.

From the pull-down menu select **Decoding** and select the version.



You can select:

- DPCD 1.1 Decoder
- DPCD 1.2 Decoder
- DPCD 1.3 Decoder
- DPCD 1.4 Decoder for DP 1.4a
- DPCD 1.4 Decoder for DP 2.0
- Define if DETAILED_CAP_INFO_AVAILABLE bit (DPCD 0x00005) is set to indicate that DFP capability field is 4 bytes/port for the detailed capability description
- Define if MAIN_LINK_CHANNEL_CODING_SET (DPCD 0x00108) is set to 2 to indicate 128b/132b Link Layer

Note Please note that various features of DPA-400 are enabled with license keys. For upgrading your DPA-400, please contact Unigraf.

Determining Sink and Source Role

DPA-400 detects the messages sent by sink and source by default from the way in which connectors they are connected. The device connected to 'DP Input' is determined as Source and the device connected 'DP Output' is determined as Sink.

When normal DP cable connection is not used, or when the direction cannot be otherwise determined reliably, user can select **Connection independent sink / source detection** in *Decoding* pull-down menu. In this case message source is detected from the payload of transaction message by identifying payload items belonging to messages sent by a source and sink respectively.

Inspecting the Acquired Data

The data acquired by the DPA-400 and downloaded to the GUI is shown in the *Transaction list*. Please refer to chapter *Customizing the Main Window* below for details on how to modify the content and look of the *Transaction list*.

Lines

The data is organized in lines, each numbered starting from 1 and marked with a timestamp. There are four kinds of lines:

1. **Information lines**
Identified by the text “INFO” in their Type column, they provide some useful information like the time acquisition has started and stopped or the logical state of the inputs, etc.
2. **Transaction lines**
Identified by the text “Native” or “I2C” in their Type column, they report an AUX channel data transfer, either a data Request or a data Reply.
3. **Event lines**
Identified by the text “Event” in their Type column, they signal the state change in one or more of the monitored inputs.
4. **Sideband Channel Messages**
The Isochronous Transport Service uses the sideband communications over sideband channel (AUX CH and HPD) for the management of topology/virtual channel connection/Main Link and performs Main Link symbol mapping.
5. **Error lines**
A line Type reading “Error” marks the detection of an illegal AUX channel data packet. An irregular start condition, an irregular stop condition or transfer of a number of bits which is not a multiple of 8 are all conditions that cause an error line.
6. **Trace lines**
Combines the data from several lines of a HDCP related message to one entry in *Message details* panel for easier readability.

Columns

The data on each line is ordered in columns. Each column provides additional information about the data line, facilitating its viewing and interpretation:

Line

This column displays the line number, starting from 1, and cannot be hidden.

Timestamp

Each line is identified by its timestamp, marking the instant when an event or error was detected, or when a data transaction got started. The timestamp can be displayed as a time delay from the start of the acquisition (absolute) or from the previous line (relative). The timestamp can be displayed in milliseconds or in minutes, seconds and microseconds.

From

This column indicates the originator of the data line:

- “**Source**” and “**Sink**” for an AUX channel transaction, respectively a data Request and a data Reply.
- “**Source Trace**” and “**Sink Trace**” respectively for Sideband Message data Request and Reply.
- “**DPA-400**” for error and information lines.
- “**Unknown**” for signal state change events.
- “**DPA-GUI**”
- “**Src. Trace**”
- “**Sink Trace**”
- “**HDCP 2.3**”
- “**HDCP 1.3**”

Type

This column provides additional information about the type of the line:

- “**Native**” marks Native AUX channel Requests and Replies.
- “**I2C**” marks I2C AUX channel Requests and Replies.
- “**Sideband Request**” and “**Sideband Reply**” to mark the Sideband Channel messages
- “**Event**” is used for signal state change events.
- “**INFO**” is used with information lines.
- “**Error**” is used for illegal conditions detected on the AUX channel.
- “**Data Error**”
- “**???**”
- “**Sb Reg**”
- **Sb Reply**
- “**Trace**”

Details

This column contains an abbreviated description of the line content in textual form.

Data

The binary data exchanged during AUX channel transactions, in hexadecimal notation.

Note

Please make sure that you have connected the DP cables right:
DP Source >> DP Input, DP Output >> DP Sink Device

Message Details

The *Message details* panel is used to provide a detailed explanation of the line currently selected in the *Transaction list*. For AUX channel transaction lines, for each of the DPCD memory locations affected, the panel lists:

- All data bytes read or written.
- All DPCD memory locations affected.
- The name of the locations and of each of their bit fields.
- All bit field's numeric and binary values, together with their decoded value.
- The Replies outcome (AUX_ACK, AUX_NACK, I2C_DEFER, etc.).

Unigraf Aux channel monitor

File Search Tools Filters Decoding Help

Start acquisition Pause Download

Line	Timestamp	From	Type	Details
160	2118.05	Source	Native	Req WR 1 bytes to 0x00600
161	2118.18	Sink	Native	AUX_ACK - 0 bytes
162	2118.24	Source	Native	Req WR 5 bytes to 0x00102
163	2118.43	Sink	Native	AUX_ACK - 0 bytes
164	2118.50	Source	Native	Req WR 1 bytes to 0x00108
165	2118.62	Sink	Native	AUX_ACK - 0 bytes
166	2118.69	Source	Native	Req WR 1 bytes to 0x00600
167	2118.82	Sink	Native	AUX_ACK - 0 bytes
168	2118.85	Source	Native	Req WR 1 bytes to 0x00100
169	2118.98	Sink	Native	AUX_ACK - 0 bytes
170	2119.04	Source	Native	Req WR 1 bytes to 0x00101
171	2119.17	Sink	Native	AUX_ACK - 0 bytes
172	2119.26	Source	Native	Req WR 5 bytes to 0x00102
173	2119.46	Sink	Native	AUX_ACK - 0 bytes
174	2119.62	Source	Native	Req RD 2 bytes from 0x00202
175	2119.74	Sink	Native	AUX_ACK - 2 bytes
176	2119.84	Source	Native	Req RD 1 bytes from 0x00204
177	2119.97	Sink	Native	AUX_ACK - 1 bytes
178	2120.03	Source	Native	Req RD 2 bytes from 0x00206
179	2120.16	Sink	Native	AUX_ACK - 2 bytes
180	2120.22	Source	Native	Req WR 5 bytes to 0x00102
181	2120.45	Sink	Native	AUX_ACK - 0 bytes
182	2136.51	Source	Native	Req RD 2 bytes from 0x00202
183	2136.64	Sink	Native	AUX_ACK - 2 bytes
184	2136.70	Source	Native	Req RD 1 bytes from 0x00204

Message details:

Line #175 - 2119.74ms
AUX_ACK - 2 bytes

Link/Sink Device Status
LANE0_1_STATUS [RO]
0x00202 := 0x11
LANE0_CR_DONE = 1
LANE0_CHANNEL_EQ_DONE = 0
LANE0_SYMBOL_LOCKED = 0
LANE1_CR_DONE = 1
LANE1_CHANNEL_EQ_DONE = 0
LANE1_SYMBOL_LOCKED = 0

Link/Sink Device Status
LANE2_3_STATUS [RO]
0x00203 := 0x11
LANE2_CR_DONE = 1
LANE2_CHANNEL_EQ_DONE = 0
LANE2_SYMBOL_LOCKED = 0
LANE3_CR_DONE = 1
LANE3_CHANNEL_EQ_DONE = 0
LANE3_SYMBOL_LOCKED = 0

Status Data Ready (Idle) Downloaded 17362 Bytes Buffered 0 Bytes

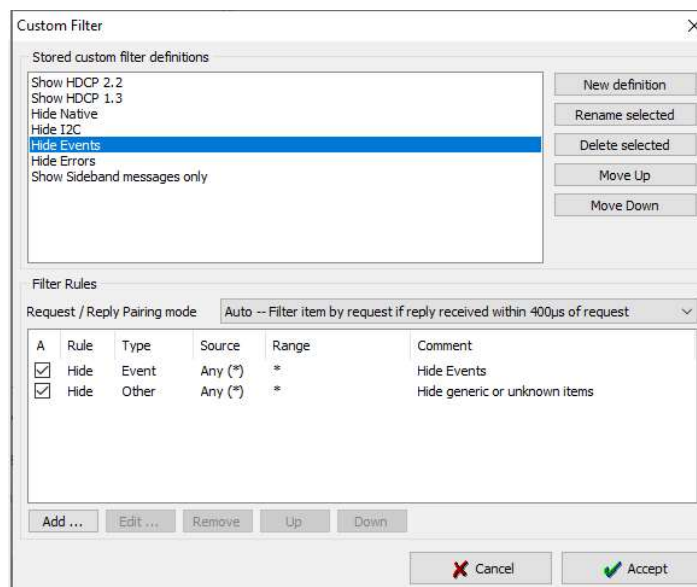
Filtering

In the *Filters* drop down menu you can set up rules describing which data lines are shown in the Transaction List. You can choose the data based on:

- The type of data line
- The origin of the message
- The DPCD address range

In the *Filters* drop down menu you can find by default a set of pre-programmed filters.

The *Custom Filter* dialog provides you a possibility to add and modify new filters. The pre-programmed filters are listed in the dialog. You can copy their structure as bases of your custom filters. It is advisable not to modify the pre-programmed filters directly but make copies of them.

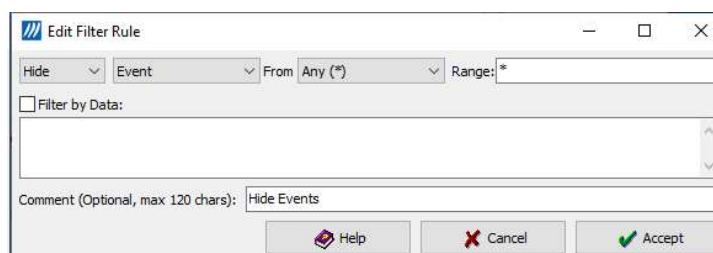


In the *Stored custom filter definitions* panel, you will have the list of currently defined Filters. On the right hand side buttons, you can define new Filters, rename, or delete them. You can also reorder their appearance in the *Filters* pull-down menu.

In the *Filter Rules* panel lower in the dialog, you can review and change the *Rules* in the selected *Filter*. By clicking **Add...** you can create new rules, clicking **Edit...** you can review and edit existing Filters and by clicking **Remove** from the Filter definition.

When you click **Add...** or **Edit...** *Edit Filter Rule* dialog opens. In the dialog you can in detail define the action of the rule, select the event and the event details.

You can get help by clicking **Help**. The “Help” text is attached to Appendix C of this document.



Note	Please note that Filters are a very powerful tool. They can however unintentionally hide valuable data from you. Please be careful when applying custom filters. A good practice is to start from an existing filter and gradually add new rules while testing their performance.
------	--

Note	Filtering and selecting the columns for display do not affect the actual data acquisition. All transactions and their full data are always captured.
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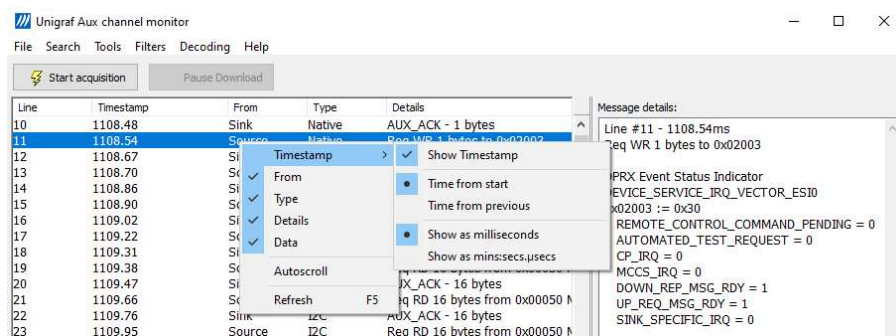
Note	You can recall the default filters by deleting or renaming Filters.ini file stored in configuration file location (default c:\ProgramData\Unigraf\DPA-400). When DPA-400 GUI is restarted, a new Filters.ini file will be created.
------	--

Customizing the Main Window

You can change the format of the data shown in the *Transaction list* and the *Message details* panels in order to highlight the details of your interest.

Selecting Data Columns

You can customize the *Transaction list* by clicking the right button of your mouse over the list. From the pop-up menu, you can choose which columns to display, the style of the timestamp and switch between absolute and relative timestamps.



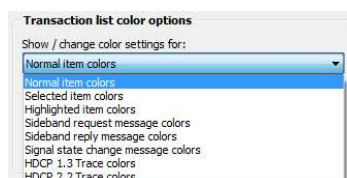
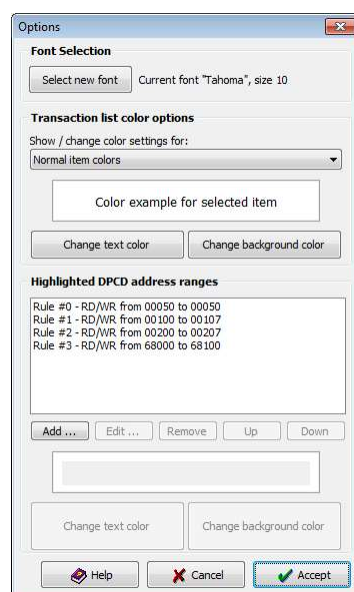
Selecting Font and Colors

You can select the font style and size used for displaying the *Transaction list* and the *Message details*.

Select **Tools -> Options ...**. In the Options dialog press **Select new font** and choose the font that you want to use.

Transaction List Color Options

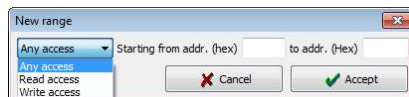
You can select the colors for the font and background of various items.



Highlighted DPCD Address Ranges

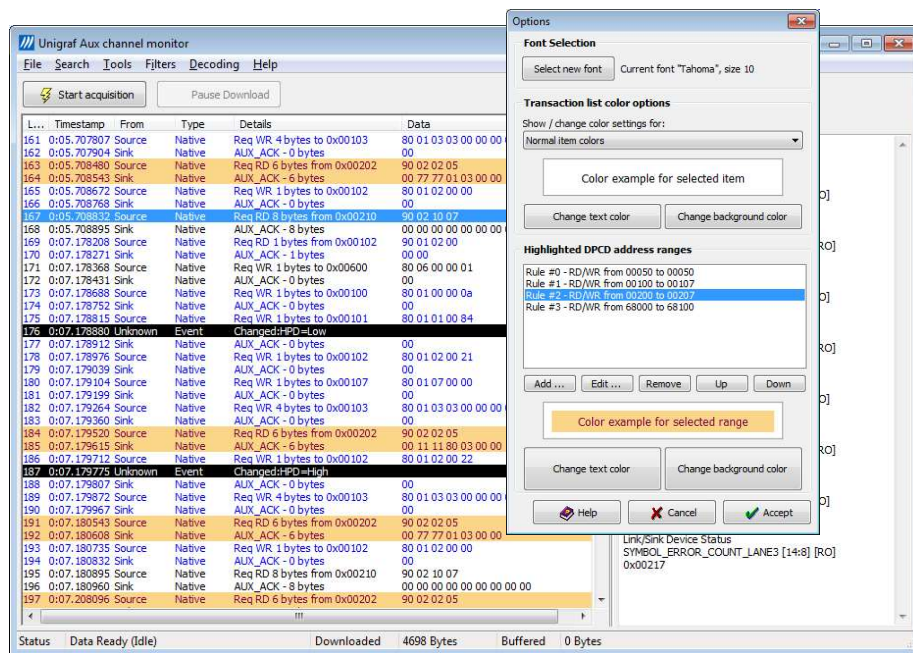
In order to improve the readability of the *Transaction list*, you can mark the AUX channel transactions where a certain DPCD register address or address range is accessed with a color of your choice.

- ▶ Select **Tools > Options ...**. In the Option dialog press **Add...**.
- ▶ In the New range dialog select the access type, start address and end address of the range that you want to be colored. Press **Accept**.



- ▶ Select the range you just created from the Colored addresses ranges list and click the **Font Color** and **Background Color** buttons to select the colors desired.

You can create multiple simultaneous coloring rules to help you get a better view of the data captured.



Note

The data of *Transaction List Color Options* and *Highlighted DPCD Address Ranges* is stored in Windows registry under `HKEY_CURRENT_USER\Software\Unigraf\DPA_400B\ProgramConfig`. By using the *Regedit* tool you can copy the settings to another PC or under another user.

Searching for Data

You can search and highlight all lines in the *Transaction list* representing an AUX channel access to a selected DPCD location.

- Use **Search -> Find...** or press **Ctrl + F**. In the Search dialog select the access type and the DPCD location address that you want to search.

The first occurrence of the found access is selected and the rest are highlighted.



- After a new acquisition you can use the same search criteria and select **Search -> Find again** or just press **F3**.

5. SAVING YOUR DATA

After the acquisition is stopped, the data displayed in the *Transaction list* can be saved to a file in binary format or in a readable HTML format as a report. In its binary form, the saved data can only be opened by the DPA-400 GUI while in HTML format it can be opened with any available HTML browser.

Saving to a Binary File

From the pull down menu select **File -> Save** or **File -> Save As ...** and specify the name for the file to be saved. You can reload a previously saved file for later inspection using **File -> Load**.

The DPA-400 GUI application includes a report generator that creates a test report of the results displayed in the Results Grid. The report is generated in HTML format and includes a detailed description of the test steps executed, the actions taken and the causes of the pass or failure. You can also include detailed description of the monitored source and sink and the used TE in the report.

Creating a Test Report

The report generated by the GUI application includes all the lines from the *Transaction list* and the content of the *Message details* panel for each of them. For creating a report select from the pull down menu **File -> Save Report**

After selecting the report file name, in the *Report Information* dialog you can add a description of the monitored source and sink devices, and your personal remarks that will be included in the report.

Report Information

Version Information

Unigraf AUX Channel monitor GUI version 2.1 [R0]
DPA-400 Firmware version 1.2.0
DPA-400 FPGA configuration version 1.6.0

Report Options

☒ Start from first line ☐ Start at line:
☒ End to last line ☐ End at line:
CSV Separator: ; ☐ Separate data bytes

Source and Sink information

Source device name:
Source device details:
Sink device name:
Sink device details:

Remarks

Report generated on 06/09/2021 13:35:25

Cancel Accept

Save the report by clicking **Accept** or return to the main window without saving by clicking **Cancel**. After the report is saved, your default internet browser will be opened to display the report file created.

The information entered in the dialog fields will be available also for the following reports until the GUI is closed.

Note You can create reports from previously acquired data that has been saved in binary format. Use first **File -> Load** and then **File > Save Report**

Note Report creation for large amounts of acquired data can generate large HTML files and take several minutes. During this operation the GUI will not respond to user commands. Please, be patient.

Test Report Views

When you save a report file or open a previously saved report, your internet browser will open the report default view.

Note how each time you select a report line the transaction details at the left shows a lot of useful information about the data involved.

The screenshot shows a web browser window with the address bar displaying 'C:/Users/Tester/Desktop/Test%20Report.html'. The main content area is titled 'Unigraf DisplayPort AUX Channel monitor report'. It is divided into two main sections: 'AUX CHANNEL TRANSACTIONS AND EVENTS' on the left and 'REPORT DETAILS' on the right.

AUX CHANNEL TRANSACTIONS AND EVENTS

Click entry to see details

Time	Source	Sink	Event	Details
0.00	DPA-400	INFO	Start: HFD=Low IN0=High IN1=High	
1079.92	Unknown	Event	Changed:HFD=High	
1107.71	Source	Native	Req RD 1 bytes from 0x00201	
1107.84	Sink	Native	AUX_ACK - 1 bytes	
1107.90	Source	Native	Req RD 1 bytes from 0x0000e	
1108.00	Sink	Native	AUX_ACK - 1 bytes	
1108.04	Source	Native	Req RD 16 bytes from 0x00000	
1108.13	Sink	Native	AUX_ACK - 16 bytes	
1108.35	Source	Native	Req RD 1 bytes from 0x00021	
1108.48	Sink	Native	AUX_ACK - 1 bytes	
1108.54	Source	Native	Req WR 1 bytes to 0x02003	
1108.67	Sink	Native	AUX_ACK - 0 bytes	
1108.70	Source	Native	Req WR 1 bytes to 0x00111	
1108.86	Sink	Native	AUX_ACK - 0 bytes	
1108.90	Source	Native	Req RD 16 bytes from 0x00030	
1109.02	Sink	Native	AUX_ACK - 16 bytes	
1109.22	Source	I2C	Req WR 1 bytes to 0x00050 MOT=1	
1109.31	Sink	I2C	AUX_ACK - 0 bytes	
1109.38	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1	
1109.47	Sink	I2C	AUX_ACK - 16 bytes	
1109.66	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1	
1109.76	Sink	I2C	AUX_ACK - 16 bytes	
1109.95	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1	
1110.05	Sink	I2C	AUX_ACK - 16 bytes	
1110.24	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1	
1110.37	Sink	I2C	AUX_ACK - 16 bytes	
1110.56	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1	
1110.66	Sink	I2C	AUX_ACK - 16 bytes	
1110.85	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1	
1110.94	Sink	I2C	AUX_ACK - 16 bytes	
1111.14	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1	
1111.23	Sink	I2C	AUX_ACK - 16 bytes	
1111.42	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1	
1111.52	Sink	I2C	AUX_ACK - 16 bytes	
1111.74	Source	I2C	Req WR 1 bytes to 0x00050 MOT=1	

REPORT DETAILS

Version information

Unigraf AUX Channel monitor GUI version 2.1 [R0]
DPA-400 Firmware version 1.2.0
DPA-400 FPGA configuration version 1.6.0

Other information

Source Device: AAAA
Sink Device: BBBB

Remarks

Report generated on 06/09/2021 13:35:25

Start conditions

Immediate start

Stop conditions

Manual stop

Monitored signals

Monitor signals:
HFD

In order to print the report, scroll down and click the **Show printer friendly format...** pushbutton to get a new view formatted for an easy printing.

The screenshot displays the 'DP AUX Channel report' window. The main area shows a list of transactions with columns for time, source/sink, and data. A blue arrow points to the 'Show printer friendly format ...' button at the bottom. The right panel shows details for a selected transaction (Line #21 - 1109.66ms), including entry type, data, and a hex dump.

Time	Source	Sink	Data
1107.90	Source	Native	Req RD 1 bytes from 0x0000e
1108.00	Sink	Native	AUX_ACK - 1 bytes
1108.04	Source	Native	Req RD 12 bytes from 0x00220
1108.08	Sink	Native	AUX_ACK - 16 bytes
1108.35	Source	Native	Req RD 1 bytes from 0x00021
1108.48	Sink	Native	AUX_ACK - 1 bytes
1108.54	Source	Native	Req WR 1 bytes to 0x02003
1108.67	Sink	Native	AUX_ACK - 0 bytes
1108.70	Source	Native	Req WR 1 bytes to 0x00111
1108.86	Sink	Native	AUX_ACK - 0 bytes
1108.90	Source	Native	Req RD 16 bytes from 0x00030
1109.02	Sink	Native	AUX_ACK - 16 bytes
1109.22	Source	I2C	Req WR 1 bytes to 0x00050 MOT=1
1109.31	Sink	I2C	AUX_ACK - 0 bytes
1109.38	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1
1109.47	Sink	I2C	AUX_ACK - 16 bytes
1109.66	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1
1109.76	Sink	I2C	AUX_ACK - 16 bytes
1109.95	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1
1110.05	Sink	I2C	AUX_ACK - 16 bytes
1110.24	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1
1110.37	Sink	I2C	AUX_ACK - 16 bytes
1110.56	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1
1110.66	Sink	I2C	AUX_ACK - 16 bytes
1110.85	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1
1110.94	Sink	I2C	AUX_ACK - 16 bytes
1111.14	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1
1111.23	Sink	I2C	AUX_ACK - 16 bytes
1111.42	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1
1111.52	Sink	I2C	AUX_ACK - 16 bytes
1111.74	Source	I2C	Req WR 1 bytes to 0x00050 MOT=1
1111.84	Sink	I2C	AUX_ACK - 0 bytes
1111.87	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1
1112.00	Sink	I2C	AUX_ACK - 16 bytes
1112.19	Source	I2C	Req RD 16 bytes from 0x00050 MOT=1

Transaction Details (Line #21 - 1109.66ms):
 Entry type I2C
 Sent from Source
HEX Dump
 50 00 50 0f
Content decoder
 Line #21 - 1109.66ms
 Req RD 16 bytes from 0x00050 MOT=1
 Middle of transaction
 EDID_DATA (Read EDID Data)
 0x00050

Buttons: **Show printer friendly format ...** (highlighted with blue arrow), **Show report information ...**

Created with **Unigraf** AUX Channel Monitor

APPENDIX A: SPECIFICATIONS

General

Functionality	Real-time AUX channel traffic capturing, decoding and display. Data store and reload in binary format. HTML report generation. Internal 14 MByte capture buffer. AUX transactions as fast as 0.5 ms per transaction (Request + Reply). Input state changes monitored up to 8000 changes / s. Timestamps with 32 μ s resolution.
Operating Systems	Windows® 10, 8, 7
Mechanical size	105 x 130 x 35 mm
Weight	260 grams
Power Consumption	5 V, 400 mA

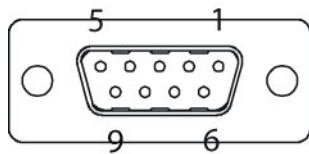
Interfaces

DisplayPort™ Interfaces	One DisplayPort™ receptacle input connector. One DisplayPort™ receptacle output connector. AUX channel and HPD signals pass-through. DPA-400: Main stream lanes buffered with 1:1 amplification (maximum bandwidth 2.7 Gbps). Pin 20 (DP_PWR) pass-through DPA-400 1.2 and later: Main stream lanes by-passed with the provided cable. Pin 20 (DP_PWR) not connected
Custom I/O	Sub-D 9 socket (female). 3 trigger inputs, link HPD signal. 4 expansion outputs. ESD protection on all external signals.
PC Interface	USB interface, USB-powered. Software upgrade capability through USB
Trigger inputs	5V tolerant. 3.3V CMOS input levels. IEC 61000-4-2 (ESD) 8kV (air), 6kV (contact)
DisplayPort™ signals	IEC 61000-4-2 (ESD) 8kV (air), 6kV (contact)

APPENDIX B: I/O CONNECTOR

You can use three external trigger signals to start or stop the data acquisition. The trigger signals are available on the SubD-9 socket connector of the DPA-400. Please refer to the **Start triggers** and **Stop triggers** dialogs to control the triggers functionality.

The HPD_IO signal is also available on this connector to provide you an easy measurement access to the HPD signal driven by your DisplayPort™ sink and connected to your DisplayPort™ source device.



Pin	Signal Name	Direction
1	IN0	Input
2	IN1	Input
3	IN2	Input
4	HPD_IO	Output
5	OUT0	Output
6	OUT1	Output
7	OUT2	Output
8	OUT3	Output
9	GND	-

IN0: external input trigger 0.

IN1: external input trigger 1.

IN2: external input trigger 2.

HPD_IO: HPD signal common to the DisplayPort sink and source devices.

OUT0 – OUT3: for future expansions.

GND: electrical reference ground.

APPENDIX C: ADVANCED FILTERS

The following help text can be seen as well by clicking the Help button of the *Edit Filter Rule* dialog.

Note	Please note that Filters are a very powerful tool. They can however unintentionally hide valuable data from you. Please be careful when applying custom filters. A good practice is to start from an existing filter and gradually add new rules while testing their performance.
------	--

Note	Filtering and selecting the columns for display do not affect the actual data acquisition. All transactions and their full data are always captured.
------	--

Data pattern expressions

A data-pattern expression is a string that describes how to determine if a data-block should be considered as "matched" or "unmatched". The syntax used with data-pattern expressions in DPA-400 Aux Channel Monitor application is described below

The data-block must be covered completely by the data-pattern expression. If the data block is shorter, or longer than the expression, then the data block is determined as "not matched". The '*' wildcard can be used to allow data blocks of any size to match.

Whitespaces and new-lines are ignored, and are allowed anywhere; White spaces and new-lines can be used strategically to make the expression more readable.

For example: "*(10)??(10)" is the same as "* ! (10) ? ? (10)"

Comment blocks:

Comments must be written enclosed in curly-braces '{' and '}'.

Wildcards

Wildcards used are '*' and '?'

? = Match any single data byte only.

* = Match any number of any data bytes. (including the possibility of matching NO data bytes)

For data matching, the byte value must be enclosed in braces '(' and ')'. Use prefixes '\$' to indicate HEX value, '%' to indicate BIN. No prefix indicates DEC.

Examples:

* (\$10) (\$00) : Matches any data pattern that has the bytes \$10, \$00 at end of data.

? (\$10) (\$00) : Matches 3-byte data pattern that has \$10 as second byte and \$00 as third byte.

* (\$10) * (\$00) : Matches any data pattern that has \$10 and ending to a \$00 byte.

* (\$10) * (\$00) * : Matches any data pattern that has \$10 and \$00 after it.

(\$10) ? * (\$20) * : Matches any data pattern that has \$10 as first byte, followed by \$20 with at least one other byte in between. (i.e. will not match \$10, \$20)

Use '!' to invert the match:

!(\$00) = Match any data byte that isn't \$00.

Use '?' within HEX or BIN value to ignore that bit in comparison:

(\$??) = ? = Any data Byte.

(\$?0) = Any data byte with bits 0-3 cleared.

(%1???????) = Any data byte with bit 7 set.

(%0??????1) = Any data byte with bit 7 cleared and bit 0 set.

The '!' inversion can still be used:

!(%??????00) = Matches any data byte ending to %10, %11, %01 but not %00.

To match a single data byte with more than one value, separate the values with comma ',':

(0, 1, 100, 200, 254) : Matches a data byte whose value is 0, 1, 100, 200 or 254.

Invert the value group match with '!'. Value wildcard '?' is also allowed.

Example:

!(1, 2, 3) : Match any data byte other than 1, 2 or 3.

!(\$?f, \$f?) : Don't match data bytes with bits 0-3 set to 1, or data bytes that have bits 7-4 set.

Version History

Rev.	Date	Author	Description
9	30.08.2019	JSa	<ul style="list-style-type: none"> - Added USB-C capability in Functionality in a Nutshell - Freshened the Note about the Y-cable in Data Acquisition > Getting Ready - Renamed and edited chapter DPA-400 Versions - Added DSC, FEC and LTTPR support - In Decoding the Data replaced the first chapter with text and table from DPA-400 Versions - Simplified text in several places by removing mentions of individual DPA-400 versions. - Freshened Contents of the Delivery - Updated Specifications - Added link to www.unigraf-china.cn - Updated Trademarks
10	16.12.2019	JSa	<ul style="list-style-type: none"> - Corrected: USB-C to USB-C Y-cable needs to be ordered separately.
11	06.09.2021	JSa	<ul style="list-style-type: none"> - Updated 2.1 in Product Versions - DPA-400 2.1 is added in DPA-400 Versions - Description of about automatic role detection is added to the note of connection direction in multiple places - Added chapter Determining Sink and Source Role - Added chapter Double Decoding with eDP in Inspecting the Acquired Data - Updated screen captures to reflect version 2.1
12	13.09.2021	JSa	<ul style="list-style-type: none"> - Corrected screenshot in Upgrading the license - Removed chapter describing Double Decoding
13	6.9.2023	Jes	<ul style="list-style-type: none"> - Made additions according to Igor S. comments