



QUICK START GUIDE

SV5C-eDP Analyzer

Embedded DisplayPort Analyzer

C SERIES





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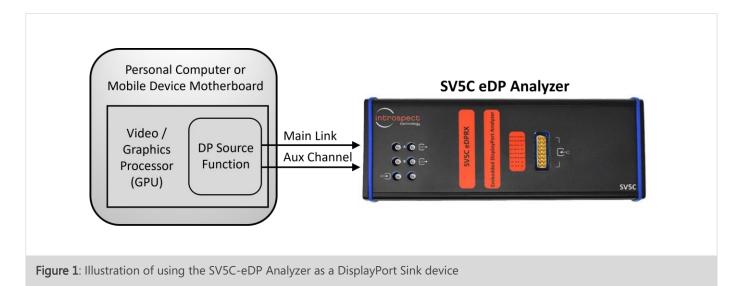


Introduction

OVERVIEW

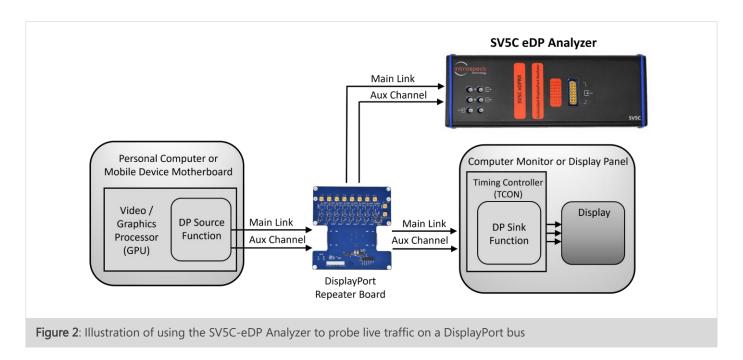
The SV5C-eDP Embedded DisplayPort Analyzer is an ultra-portable, high-performance instrument capable of analyzing traffic for Embedded DisplayPort and DisplayPort applications. The SV5C-eDP Analyzer may be used as either a DisplayPort sink device (for source testing) or as a probing solution for capturing protocol traffic on an Embedded DisplayPort bus. The Analyzer can capture live traffic, decode symbols, detect display parameters, and extract full video frames. All these features are integrated into Pinetree, Introspect's award-winning software environment.

An example of using the SV5C-eDP Analyzer directly as a DisplayPort Sink device is shown in the high-level diagram in Figure 1. This Quick Start Guide will provide the information required for a user to get up and running with the setup as shown in the figure. Basic hardware and software installation instructions are included followed by a step-by-step procedure to start analyzing DisplayPort traffic.





An example of using the SV5C-eDP in a probing application is shown in a high-level diagram in Figure 2. This Quick Start Guide will also provide the information required for a user to get up and running with the setup as shown in this figure. In this case, a personal computer (PC) can be used as the DisplayPort Source, and a computer monitor can be used as the DisplayPort Sink. An Introspect DisplayPort Repeater board is connected between the DisplayPort Source and Sink, which connects to the SV5C-eDP Analyzer as shown.



In the sections of the document which follows, the direct DisplayPort connection as shown in Figure 1 will simply be referred to as "Setup # 1", and the probing connection as shown in Figure 2 will be referred to as "Setup # 2". A full listing of the hardware requirements for both setups is provided. The required connections will be provided for both cases.



Quick Start Hardware Description

HARDWARE REQUIREMENTS

The full list of hardware required for this Quick Start Guide is provided below:

- (QTY = 1) SV5C-eDP Analyzer
- (QTY = 1) 12V 15A AC / DC power supply, part # XP Power, AHE220PS12
- (QTY = 1) USB-A 2.0 to USB Mini-B cable
- (QTY = 1) USB-A 3.0 to USB-C cable
- (QTY = 1) DisplayPort Source (for example, a Personal Computer with a DisplayPort output)
- (QTY = 1) Personal Computer for running Pinetree (which may be the same as the DisplayPort Source mentioned above)

When using Setup # 1, the following cabling is required:

- (QTY = 1) DisplayPort breakout cable, for connection to the PC DisplayPort receptacle:
 - For standard DP receptacles, part # Wilder Technologies DP-TPA-P, 640-0001-000
 - For USB Type-C receptacles, part # Wilder Technologies DP-TPC-P, 640-0800-000
- (QTY = 2) DC blocks, for AUX channel connections, required part # Mini-Circuits BLK-89-S+
- (QTY = 1) MXP to SMA male cable assembly, 12 inch, part number Huber & Suhner MF53/2x8A_21MXP/11SK/305

When using Setup # 2, the following components and cabling are required:

- (QTY = 1) Introspect Repeater Board, Introspect part # 6313
- (QTY = 10) Up to 10 SMA male to SMP female cables, 6 or 12 inch, example part # Amphenol RF 095-902-459. For cables with precise phase matching requirements, contact Introspect Technology.
- (QTY = 1) MXP to SMA female cable assembly, 6 inch, part # Huber & Suhner MF53/2x8A 21MXP/21SMA/152



SV5C-EDP PHYSICAL CONNECTIONS

The physical connections of the SV5C-eDP Analyzer are shown in Figure 3. The required pinout for the MXP connector of the SV5C-eDP Analyzer is shown in Table 1 below.



TABLE 1: MXP CONNECTOR PINOUT

CONNECTOR	PIN	LANE
	1	Auxiliary Channel P
	2	Auxiliary Channel N
1 16 2 15	3	ML Lane 1P
3 14	4	ML Lane 1N
4 13	5	ML Lane 2P
5 12 6 11	6	ML Lane 2N
7 10	16	ML Lane 3P
8 9	15	ML Lane 3N
	12	ML Lane 4P
	11	ML Lane 4N



CONNECTION DIAGRAMS: SETUP #1

A high-level block diagram for a test configuration using the SV5C-eDP Analyzer as a DisplayPort Sink device was shown in Figure 1. A detailed connection diagram is provided in Figure 4 below, with connections provided in Table 2. The complete parts list is given on page 5.

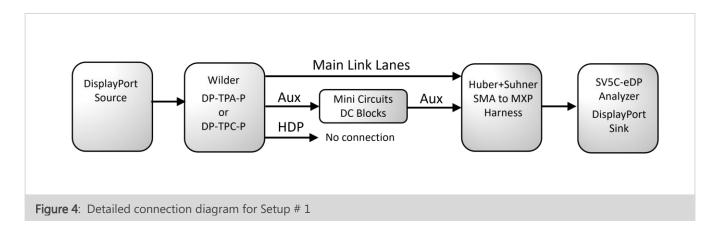


TABLE 2: CONNECTIONS FOR SETUP #1

SIGNAL NAME	WILDER SIGNAL CONNECTION	DC BLOCK REQURIED	SV5C-EDP MXP PIN NUMBER (SEE TABLE 1)
ML Lane 1P	T0_P / R3_N	No	3
ML Lane 1N	T0_N / R3_P		4
ML Lane 2P	T1_P / R2_N	No	5
ML Lane 2N	T1_N / R2_P		6
ML Lane 3P	T2_P / R1_N	No	16
ML Lane 3N	T2_N / R1_P		15
ML Lane 4P	T3_P / R0_N	No	12
ML Lane 4N	T3_N / R0_P		11
Auxiliary Channel P	AUX P	Yes	1
Auxiliary Channel N	AUX N		2



CONNECTION DIAGRAMS: SETUP # 2

A high-level block diagram for a test configuration using the SV5C-eDP Analyzer as a probing solution was shown in Figure 2. A detailed connection diagram is provided in Figure 5 below, with connections provided in Table 3. The complete parts list is given on page 5.

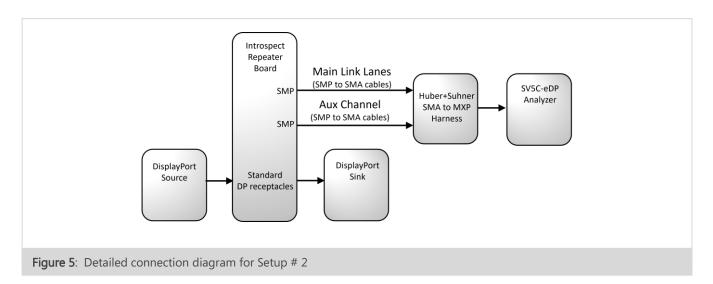


TABLE 3: CONNECTIONS FOR SETUP # 2

SIGNAL NAME	DISPLAYPORT REPEATER SMP CONNECTION	SV5C-EDP MXP PIN NUMBER (SEE TABLE 1)
ML Lane 1P	1P	3
ML Lane 1N	1N	4
ML Lane 2P	2P	5
ML Lane 2N	2N	6
ML Lane 3P	3P	16
ML Lane 3N	3N	15
ML Lane 4P	4P	12
ML Lane 4N	4N	11
Auxiliary Channel P	AUXP	1
Auxiliary Channel N	AUXN	2



NOTE

For Setup # 1: The hot-plug detect (HDP) from the Wilder should not be connected to the SV5C-eDP Analyzer. However, if the HPD is required for the user's DisplayPort Source to detect the connection, the user should connect the Wilder's pin for HPD to a constant voltage (2.3 V to 3.6 V) to allow the DisplayPort Source's HPD circuit to detect the connection.

Pinetree Installation

SYSTEM REQUIREMENTS

Pinetree provides an easy-to-use environment for device characterization and test-plan development. To run the software, the following components are required:

- A PC installed with Windows 10
- The Pinetree install executable
- USB device drivers (refer to the driver installation instructions later in this document)

NOTE

A fully functional command line version of Pinetree is also available for MacOS and Linux. However, this Quick Start Guide will focus on the Windows version of the software.

PINETREE INSTALLATION

- 1. INSTALLATION PREPARATION
 - a) Quit any Pinetree (or older Introspect ESP Software) instances before starting the installation.
 - b) If this is your first installation of Pinetree, open the "README_Install.txt" file located in the installation files and install any pre-requisite software by consulting the "Windows Software Requirements" section.



2. SOFTWARE INSTALLATION

- a) From the directory containing the installation files, double-click the "IntrospectESP Installer.exe" executable and follow the on-screen instructions.
- b) When prompted, specify the location where you want to install Pinetree. The default location is C:\Introspect. The software will be installed into a sub-folder specifying the version number.

NOTE

It is recommended to install the software under C:\Introspect to keep all versions in one place.

c) By the simple click of a button, Pinetree will install its own embedded version of Python, along with its required 3rd-party modules. This means that any previous Python installations on the host computer will not be affected by Pinetree.

3. INSTALL THE LICENSE FILE

- a) Towards the end of the installation, you will be asked to provide either an activation key or a license file for the software.
- b) If you have a valid activation key, simply select "Use Activation Key", and enter your activation key. The installer will then automatically generate the required license files.
- c) If you were provided with a license file instead, or if you have valid license files from a previous installation, select the "Use Existing License" option, and the installer will help you copy the license file into the new installation folder.
- d) If you do not have any of the above, select the "Get a New License" option, and the installer will provide you with information that needs to be sent to Introspect Technology. Before continuing, you will need to send this information to license_support@introspect.ca to request a license. Then, upon receipt of the valid license files, place them into the following directory:

C:\[Your Introspect Installation Folder]\Licenses



NOTE

The installer automatically creates a folder called "Introspect" under the "My Documents" folder of your Windows account. This folder is where Test Procedures are saved by default.

4. RUNNING PINETREE

a) Double-click on the "Pinetree" shortcut on your Desktop and you should see the first "welcome" window of the GUI. Specify the form factor as "SV5C_4L8G_EDP_ANALYZER" and Press "Next" to continue.

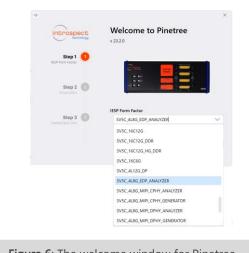


Figure 6: The welcome window for Pinetree

b) Select the option "Create a new Test" and click the "Next" button.

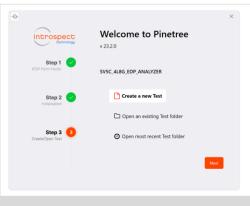


Figure 7: "Create a new Test" option of the welcome menu



c) With a valid license in the "Licenses" directory, the following GUI screen should come up, which indicates that Pinetree has been successfully installed.

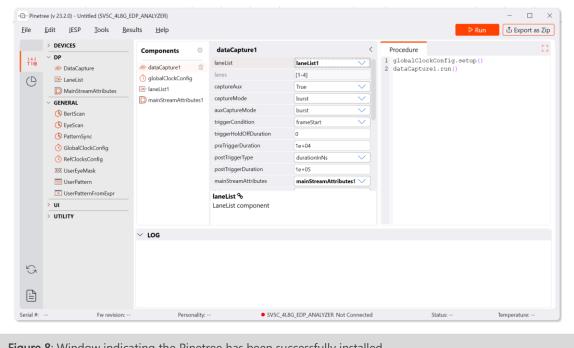


Figure 8: Window indicating the Pinetree has been successfully installed

5. FURTHER DOCUMENTATION

The Help menu contains the following items, giving some information on the software:

- "User Manual" is the user manual for the Pinetree and is recommended reading for all users. Clicking on this menu item will open the document in your default PDF viewer.
- "Test Procedure Functions", "Component Classes", "Utility Functions" and "Low-level IESP Functions" provide documentation on the Python component classes and lower-level functions specific to the selected form factor. Clicking on one of those menu items will open the corresponding document in your default HTML browser. These documents are intended for intermediate and advanced users.
- "Application Notes" describes advanced features, often in the form of tutorials.



USB Driver Installation

The following procedure will allow for automated FTDI driver installation.

1. HARDWARE SETUP

For this procedure, connect the SV5C-eDP to the PC using both a USB 2.0 and USB 3.0 cable as shown in Figure 9 below, and turn on the power to the module. To allow for driver installation, the PC should be connected to the internet as well.

2. WAIT FOR NEW HARDWARE DETECTION

The PC should display the message "New drivers successfully installed" once the installation process is complete. If this does not occur, see the troubleshooting notes at the end of this section.



Figure 9: Connection for the automated FTDI driver installation



3. VERIFY DRIVER INSTALLATION

a) Launch Pinetree and select the "SV5C_4L8G_EDP_ANALYZER" form factor. From the main GUI window, click the "IESP" drop down menu and click "Connect", as shown in Figure 10. Establishing the connection should take a couple of seconds. If this fails, an error message will pop-up.

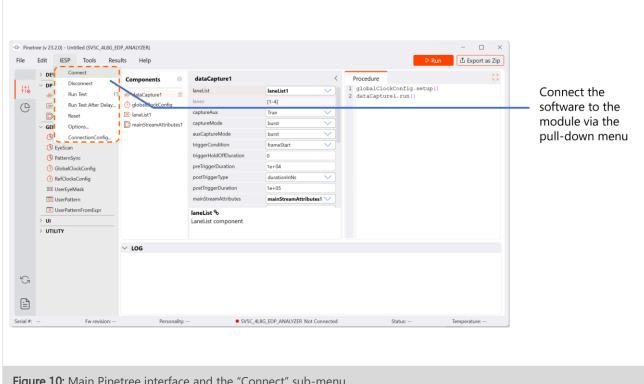
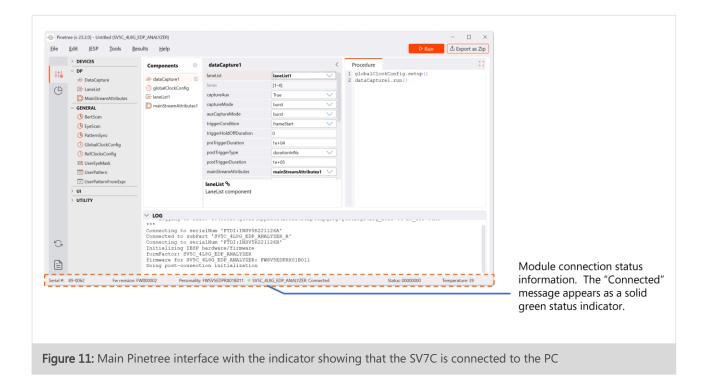


Figure 10: Main Pinetree interface and the "Connect" sub-menu

b) When connected to the unit, the software will display useful information at the bottom of the GUI window: Serial number, Firmware Revision and Personality, the form factor in use, a Status number and the unit's Temperature. The "Connected" message also appears as well as a solid green status indicator. This is as shown in Figure 11.





4. TROUBLESHOOTING

If the connection cannot be established, or if the drivers cannot be found or automatically installed, please refer to the "FTDI Driver Manual Installation" Appendix to install the required drivers.



SV5C-eDP Demonstration

STEP-BY-STEP GUIDE: ANALYZING TRAFFIC ON A DISPLAYPORT BUS

The following step-by-step guide will allow the user to set up the SV5C-eDP module to analyze traffic on the DisplayPort bus. The following procedure is intended to provide an overview of how to use the Pinetree interface and highlight several of its key features.

CONNECT THE HARDWARE COMPONENTS

For Setup # 1, a direct DisplayPort connection, please refer to the high-level diagram as shown in Figure 1, as well as the detailed pinouts and diagrams as shown in Figure 4 and Table 2. Please also ensure that the provided 12 V power supply to the SV5C-eDP module and USB 2.0 and 3.0 cables to the PC are in place.

For Setup # 2, a DisplayPort probing application, please refer to the high-level diagram in Figure 2, as well as the detailed pinouts and diagrams as shown in Figure 5 and Table 3. Please also ensure that the provided 12 V power supply to the SV5C-eDP module and USB 2.0 and 3.0 cables to the PC are in place.

NOTE

The USB 3.0 cable is used to accelerate data transfers between the SV5C-eDP and the host PC. This USB 3.0 connection is not mandatory for operating the module, but it is highly recommended.



2. GETTING TO KNOW THE PINETREE INTERFACE

- a) If you have not done so previously during the USB driver installation procedure, launch Pinetree, select the "SV5C_4L8G_EDP_ANALYZER" form factor and create a new test procedure.
- b) When starting from the "SV5C_4L8G_EDP_ANALYZER" form factor, Pinetree opens the window as shown in Figure 12. There are five numbered panels highlighted in orange in the figure. Each of the five panels are described on the following page.

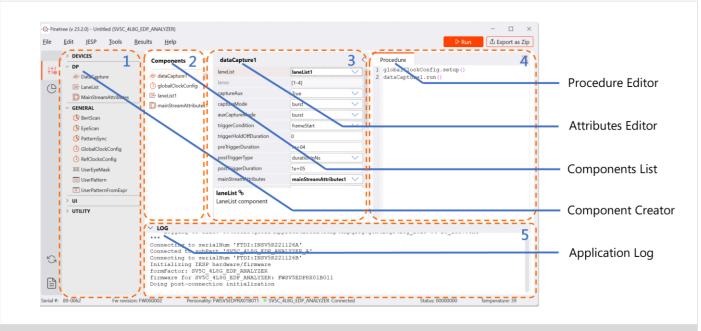


Figure 12: The five main panels of the Pinetree interface



- The Component Creator is the panel on the left side of the interface as shown in
 Figure 12. A component is a Python class provided by Pinetree for controlling the
 SV5C-eDP Analyzer. The Component Creator contains all the components which can
 be instantiated in software.
- 2. The **Component List** is the panel adjacent to the Component Creator, and it contains the list of components instantiated within the present Python procedure. A user can double click (or drag) components from the Component Creator panel into the Component List to instantiate them.
- 3. The **Attributes Editor** is the panel on the right of the Component List. When a component is selected in the Component List, the Attributes Editor displays the key attributes of the selected component. All attributes of all components may be modified directly in Python code. The attributes shown in the Attributes Editor are presented for convenience, since these are the commonly used settings. The attributes shown can be edited by clicking on their entries directly.
- 4. The **Procedure Editor** is on the right side of the interface. This panel contains the Python code that executes when the test is run. Most components (Python classes, described above) have either a "run" method or a "setup" method, and those commands are entered here.
- 5. The **Application Log** is the panel along the bottom of the interface. It shows the detailed activity log generated by an execution of the main Python procedure. It also contains messages related to the connection between the SV5C-eDP module and the Pinetree software.

NOTE

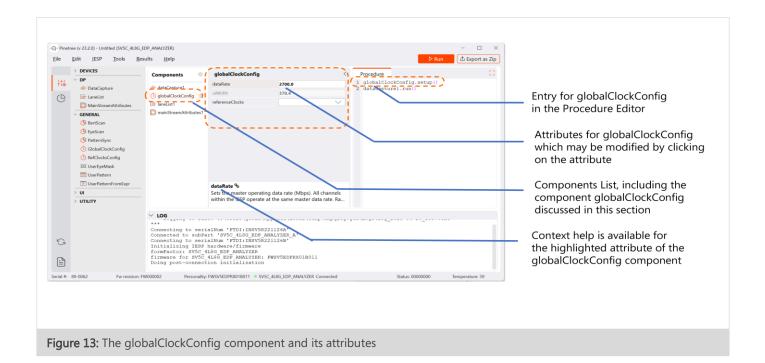
Both the "Application Log" and the "Attributes List" described above may be collapsed to provide more room for the other panels of the interface.



3. VIEWING TEST COMPONENTS

- a) When Pinetree is initialized in the "SV5C_4L8G_EDP_ANALYZER" form factor, by default there are four pre-populated components in the "Componets List", and each of these components will be presented in the section below.
- b) Global Clock Configuration: To begin, click on the "globalClockConfig" component as shown in Figure 13 below. By default the "Attributes Editor" sets the data rate is set to 8100.0 Mbps. This entry may be modified by clicking on data rate attribute as shown by the second callout in the figure below, where the data rate has been modified to 2700.0 Mbps as shown. Note that there is always context help available at the bottom of the "Attritubes Editor" panel to describe the currently selected attribute. If applicable, the range of settings for the attribute are also listed.

Please set the data rate attribute as required by the DisplayPort Source that you will be using as the device under test.





c) Lane List: Click on the "laneList" component as shown in Figure 14 below. This component sets the active Main Link lanes of the SV5C-eDP Analyzer, as well as properties such as receiver's threshold voltages and lane equalizations. These entries may be modified by clicking on the attributes as shown within the "Attributes Editor" in the first callout in the figure below.

Please set the lane list attributes as required by the DisplayPort Source device that you will be using as the device under test.





c) Main Stream Attributes: Click on the "mainStreamAttributes" component as shown in Figure 15 below. Entries in the mainStreamAttributes component may be modified by clicking on the attributes as shown within the "Attributes Editor". For example, both enhanced data framing mode and data descrambling are supported by the analyzer, and the scrambling seed is configurable. Browse through the attributes supported by this component, and see the SV5C-eDP Analyzer datasheet specifications for the complete listing of stream attributes supported.

Please set this component to match the DisplayPort Source device that you will be using as the device under test.

NOTE

The main stream attributes **component** of the analyzer is not to be confused with the Main Stream Attributes (MSA) as sent by a DP source.





- d) Data Capture: Click on the "dataCapture" component as shown in Figure 16 below. Entries in the data capture component may be modified by clicking on the attributes as shown within the "Attributes Editor", as with previous components. The figure below demonstrates an example of this.
- e) The dataCapture attributes can be modified to capture data after a particular trigger event. In this example, set the capture to start after a scrambler reset has been detected by clicking on the attribute "triggerCondition", and then from the resulting pull-down menu, selecting "scramblerReset" as shown in the figure.

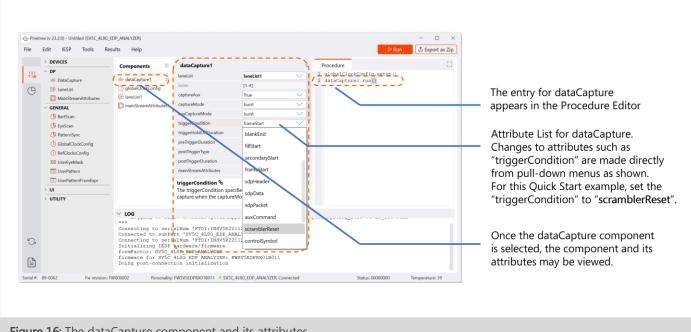
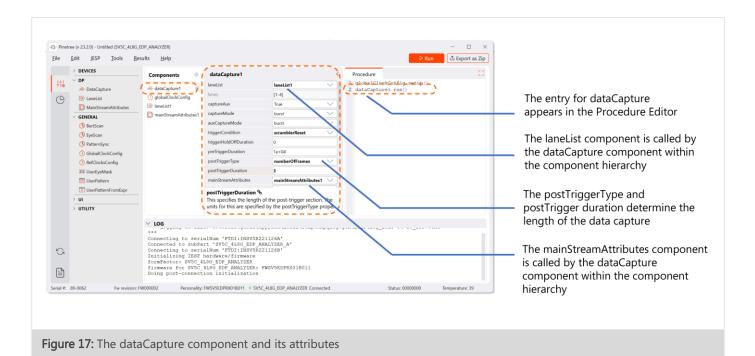


Figure 16: The dataCapture component and its attributes



The length of the data capture is controlled by the attributes "postTriggerType" and "postTriggerDuration". In this example, set the "postTriggerType" to "numberOfFrames" and the "postTriggerDuration" to the number of frames desired in the capture. As shown in Figure 17 below, the number of full frames to capture has been set to "3". Note that the two components modified previously, the "laneList" and the "mainStreamAttributes", are called in a hierarchical manner by the dataCapture component.

f) Finally, the "Procedure Editor" is shown on the right side of the figure below. The test procedure contains two lines of code, which first sets the clock rate, and then performs the desired data capture in this example.



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NOTE

Specific attributes within the dataCapture component need to be modified to operate with the DisplayPort Source device that you will be using as the device under test. Scroll through the entire list of attributes of this component and verify that they are set correctly.

Note that when using the SV5C-eDP as a DisplayPort Sink (as in Setup # 1) the dataCapture attribute "wantAuxHandshake" should be set to "True". When using the SV5C-eDP in a probing application (as in Setup # 2) the dataCapture attribute "wantAuxHandshake" should be set to "False". This component attribute is highlighted in Figure 18 below.

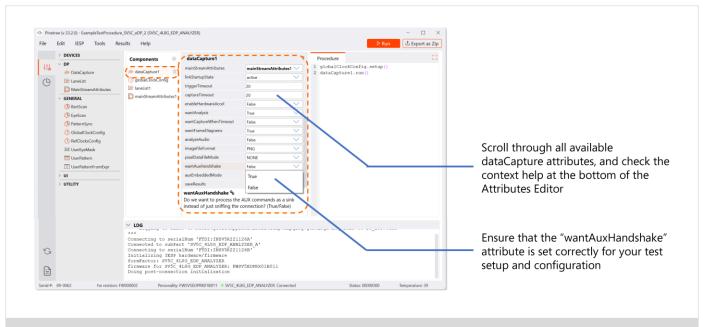
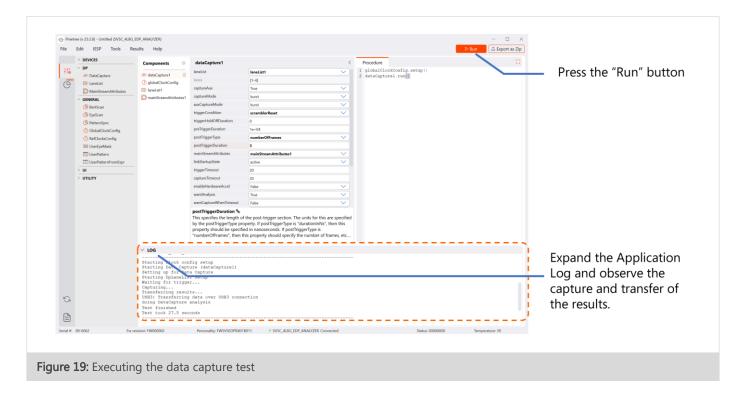


Figure 18: The dataCapture attributes and the "wantAuxHandshake" attribute



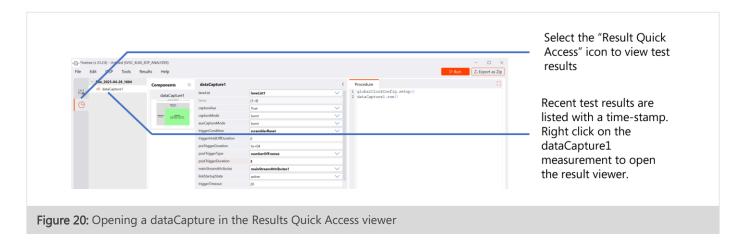
4. EXECUTING THE TEST PROCEDURE

a) To execute the test, click on the "Run" button at the top right of the interface, or use the F5 shortcut key. Expand the "Application Log" during the execution, and you can observe the execution of the data capture in real time. An example log is as shown in Figure 19 below.



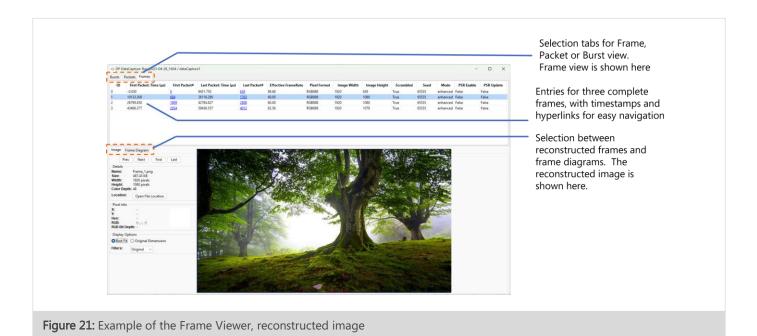
b) By clicking on the "Results" icon on the top left side of the interface (see the blue pointer in Figure 20 on the following page) the user can toggle onto the "Results Quick Access" panel. In the "Results Quick Access" view as shown, a time-stamped directory of results is visible from each test execution. In this example, there is a test folder with time stamp "Run_2023-04-18 1604" which contains the dataCapture1 results from the most recent execution.

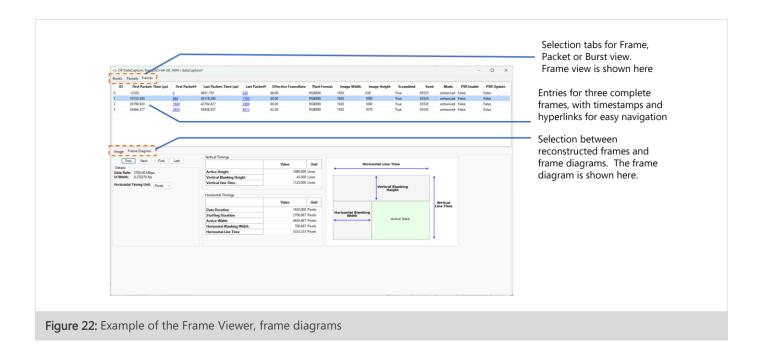




- c) Next, "right-click" on the test results shown in Figure 20 above and select "Open with Default Viewer". This will bring the viewer tool as shown on the following page, which allow for rapid evaluation of the frames received by the SV5C-eDP Analyzer.
- d) At the top of the viewer, there are selection tabs for viewing captured data according to Frame View, Packet View, or Burst View. Pressing on the "Frames" tab will bring up the **Frame Viewer**, as shown in Figure 21. This represents the highest level of the hierarchy in the data capture viewer. In the top window pane, observe that there are three full frames (and one partial frame) captured, as expected when setting the dataCapture attribute "postTriggerDuration" to 3. Timestamps, images sizes, and frame statistics are automatically generated, and hyperlinks are provided for easy navigation between tabs.
- e) At the bottom of the viewer, there is a selection tab to switch between reconstructed frames and frame diagrams. Figure 21 and Figure 22 show examples of these two views.

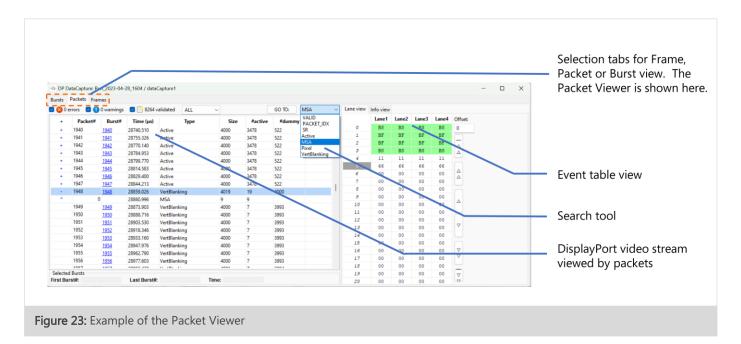






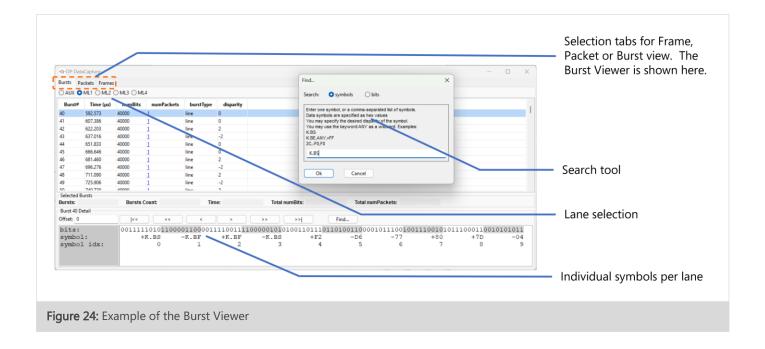


f) Pressing on the "Packets" tab at the top of the viewer will present the **Packet Viewer**, and an example of this is shown in Figure 23 below. This represents the next highest level in the data capture viewer hierarchy. The left side of the figure shows the DisplayPort video stream construction at a packet level, while the right side of the figure shows an event table, where Line Data, Blanking Start and End, Line Footers, Dummy Data, and received symbols are tabulated for easy visual analysis. The search tool as shown allows for easy navigation through the Packet Viewer. Errors present in the received packets may be searched as well.



g) Finally, pressing on the "Bursts" tab at the top of the viewer will present the **Bursts Viewer**, and an example of this is shown in Figure 24 on the following page. This represents the lowest level of the hierarchy in the data capture viewer. This viewer provides a symbol table, which is traceable by index or lane. Once again, the search tool as shown allows for easy navigation through the Burst Viewer.





Please browse through all the information presented in the dataCapture viewer tool.

This concludes the SV5C-eDP Quick Start demonstration. For further information, please consult the Pinetree user manual from the "Help > User Manual" pull down menu on the main interface.



Appendix

FTDI DRIVER MANUAL INSTALLATION

Pinetree communicates with the SPI Controller via an FTDI device (connected via USB). If you don't already have required FTDI drivers installed on your Windows computer, or if the automated driver detection presented earlier in this document was unsuccessful, you will need to download them from the FTDI web site.

To do this, follow the instructions found at http://www.ftdichip.com/Documents/InstallGuides.htm

The latest drivers can be found at http://www.ftdichip.com/Drivers/D2XX.htm http://www.ftdichip.com/Drivers/D3XX.htm

You may use the "usbview" utility program linked on the following FTDI page http://www.ftdichip.com/Resources/Utilities.htm

This program will allow you to check that your computer can "see" the FTDI device over USB.



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1.0	Document Release	August 11, 2023

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