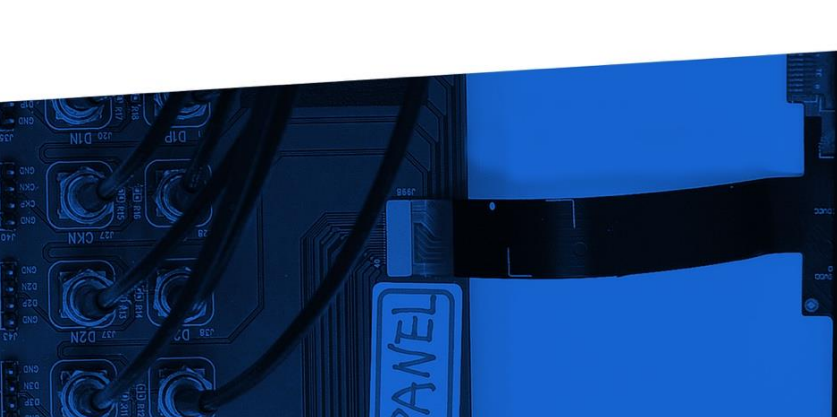
QUICK START GUIDE

SV4E-DPRX

Receive Device Emulator for MIPI D-PHY

E SERIES



Published in Canada on November 24, 2023
EN-G036E-E-23328

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Introduction

OVERVIEW

The SV4E-DPRX Receive Device Emulator for MIPI D-PHY is a highly integrated system-level tester that facilitates the rapid screening, calibration, and optimization of MIPI enabled devices, including display panels or driver ICs, advanced image signal processors, and microcontrollers. Capable of receiving signals up to 2.5 Gbps on four separate D-PHY lanes, the SV4E-DPRX Receive Device Emulator fully supports the MIPI DSI, DSI-2, and CSI-2 protocols, allowing users to easily capture and analyze images coming from graphics chips and cameras alike.

The SV4E-DPRX operates using the award-winning Pinetree software environment. This environment uses the highly flexible Python language and allows for automating transmitter tests such as header and payload CRC error detection.

QUICK START DOCUMENTATION

This Quick Start Guide will provide the information required for a user to get up and running with the SV4E-DPRX system. Basic hardware and software installation are included, followed by a step-by-step procedure to start receiving and analyzing MIPI D-PHY signals using Pinetree.

Quick Start Hardware Description

REQUIREMENTS

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

- 1 x SV4E-DPRX Receive Device Emulator for MIPI D-PHY
- 1 x 12V 5A AC / DC power supply (Mfg: CUI, Part #: ETSA120500U)
- 1 x Personal Computer connected to the SV4E-DPRX via a USB2.0 mini B and a USB3.0 micro B cable
- 1 x D-PHY Device Under Test (DUT) transmitter for signal generation
- Optional: 1 x Rx Adapter for SV4E-DPRX
- Optional: 10 x SMA Cables

HARDWARE DESCRIPTION

Figure 1 shows a diagram of the physical ports of the SV4E-DPRX.

Figure 1: Illustration of the SV4E-DPRX connectors

The Rx Adapter for SV4E-DPRX breakout board (illustrated in Figure 2) is used to connect the SV4E-DPRX to DUTs, such as cameras and graphics chips, using SMA connectors. There are five rows on the breakout board, one for each of the four data lanes, and a fifth one for the clock.

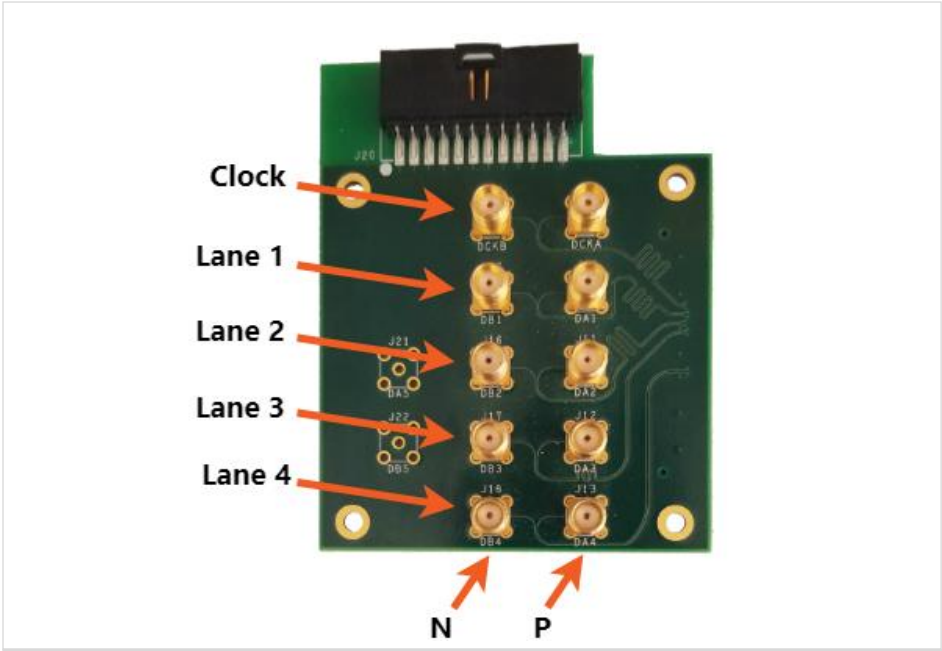


Figure 2: Image of the SV4E-DPRX connectors

Pinetree Software 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 XP, Vista, or Windows 7, 8, or 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.

PINETREE INSTALLATION

1. INSTALLATION PREPARATION

a) Quit any Pinetree programs before starting the installation process.

b) If this is your first installation of Pinetree, open the "README_Install.txt" file located in the installation files and install any prerequisite components 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 Program Files > Introspect. The software will be installed into a sub-folder specifying the version number.

NOTE

The selected installation directory must be a new location – it cannot be the same as a previous installation.

c) By the simple press 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 the software.

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 the "Use Activation Key" option 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, select the "Use Existing License" option and the installer will help you copy it 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 in order to obtain one. Copy and paste that information to request a license via: license_support@introspect.ca.
e) Upon receipt of the valid license files, place them into the following directory:

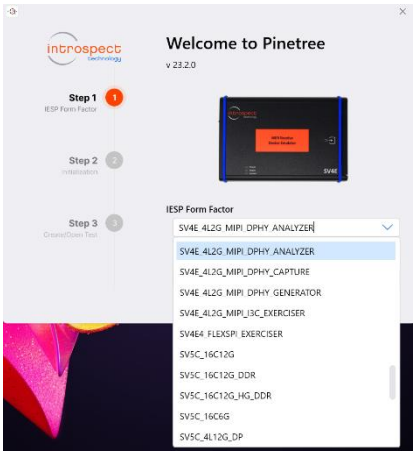
```
C:\[Your Introspect Installation Folder]\Licenses
```

NOTE

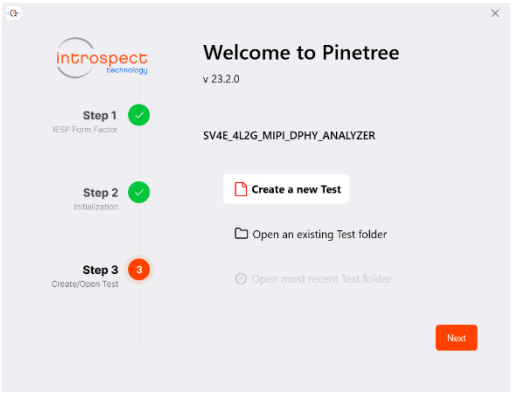
The installer creates a folder called "Introspect" under the "My Documents" folder of your account. This folder is where Test Procedures are usually saved.

4. RUNNING PINETREE

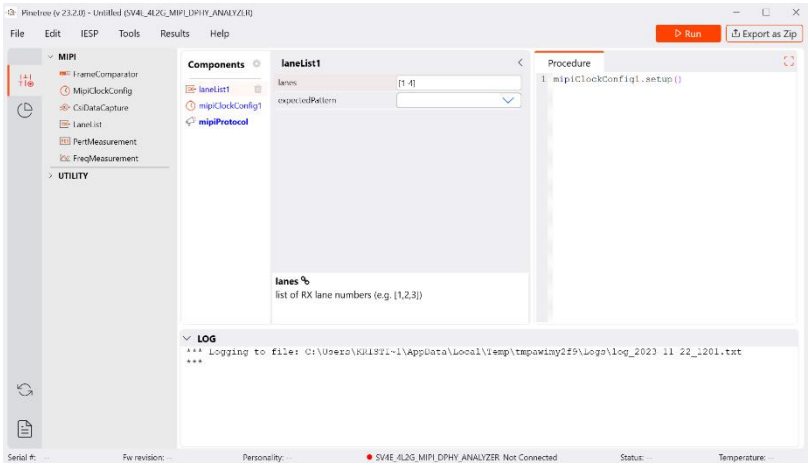
a) Double-click on the "Pinetree" shortcut on your Desktop and you should see the first "welcome" window of the GUI. Specify the hardware as “SV4E_4L2G_MIPI_DPHY_ANALYZER” and Press “Next” to continue.



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



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



5. FURTHER DOCUMENTATION

The "[IntrospectESP_install_dir]\Doc" folder contains the following information on the software:

- "IntrospectESP_UserManual.pdf" is the user manual for the Pinetree software and is recommended reading for all users.
- "svt.html" and "iesp.html" provide documentation on the Python component classes and lower-level functions specific to the selected form factor. Both files can be found in "C:\[IntrospectESP_install_dir]\Doc\FormFactors\SV4E_4L2G_MIPI_DPHY_ANALYZER". These are intended for intermediate and advanced users.

NOTE

Both the user manual and the above html files are also conveniently available from the "Help" pull down menu located on the top right of the main Pinetree window.

"Application Notes" can be found in the "C:\[IntrospectESP_install_dir]\Doc\" sub-folder and have more 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 SV4E-DPRX to the PC using both a USB2.0 mini B and a USB3.0 micro B cable, as shown in Figure 3 below, and power on the module. To allow for driver installation, the PC should be connected to the internet as well.

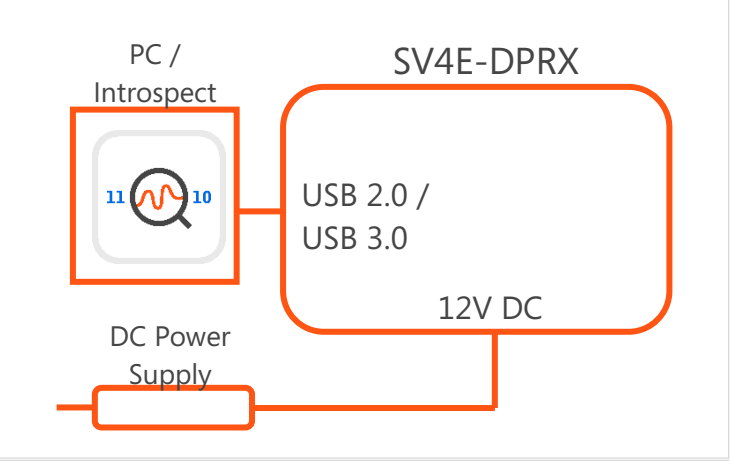


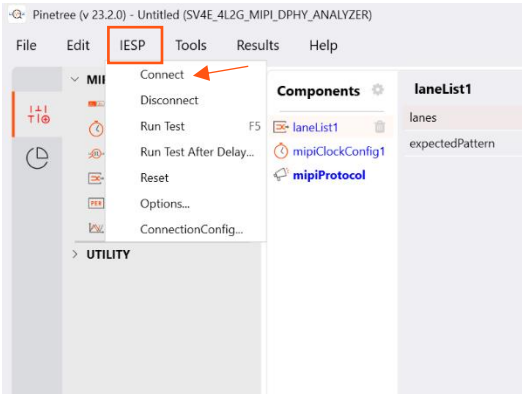
Figure 3: Connection for the automated FTDI driver installation

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.

3. VERIFY DRIVER INSTALLATION

a) If it is not still open, launch Pinetree and select the "SV4E_4L2G_MIPI_DPHY_ANALYZER" form factor. From the main GUI window, click the "IESP" drop down menu and click "Connect", as shown here. Establishing the connection should take a couple of seconds.



b) At the bottom of the main window, a status indicator will indicate whether the SV4E-DPRX module is connected or not. If connected, the status indicator will be solid green. If it isn't connected, the status indicator will be solid red.

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.

SV4E-DPRX Demonstration

STEP-BY-STEP GUIDE: RECEIVING A D-PHY CSI-2 IMAGE FRAME

The following step-by-step guide will allow the user to setup the SV4E-DPRX module in order to receive a CSI-2 image frame being transmitted over a single D-PHY lane. It will also demonstrate how to capture and visualize the received packets using the mipiDphyCsiDataCapture component of the software. The following procedure is intended to provide an overview of how to use the Pinetree GUI and highlight several of the GUI's key features.

1. CONNECT THE HARDWARE COMPONENTS

For this procedure, attach the Rx Adapter for SV4E-DPRX breakout board to the SV4E-DPRX module. In order to analyze a D-PHY signal, you will need a DUT capable of producing CSI-2 image frames, such as a camera. Connect your DUT's differential clock and data signals to the Rx Adapter breakout board according to Figure 2.

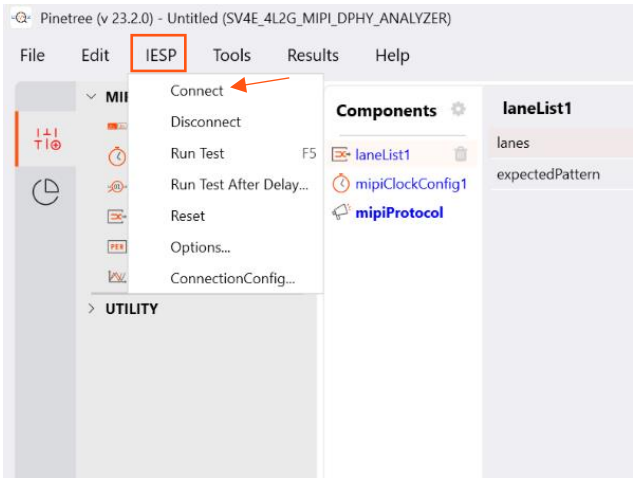
2. GETTING TO KNOW THE PINETREE GUI

a) If you have not done so previously during the USB driver installation procedure, launch Pinetree, and select the "SV4E_4L2G_MIPI_DPHY_ANALYZER" form factor and create a new Test Procedure. Connect the SV4E-DPRX to your PC using both a USB2.0 mini B cable and a USB3.0 micro B cable and power up the module.

NOTE

The USB3.0 port of the SV4E-DPRX is used to accelerate data transfers between the module and the host PC. A USB3.0 connection is not mandatory for operating the module, but it is highly recommended, especially when capturing large image frames.

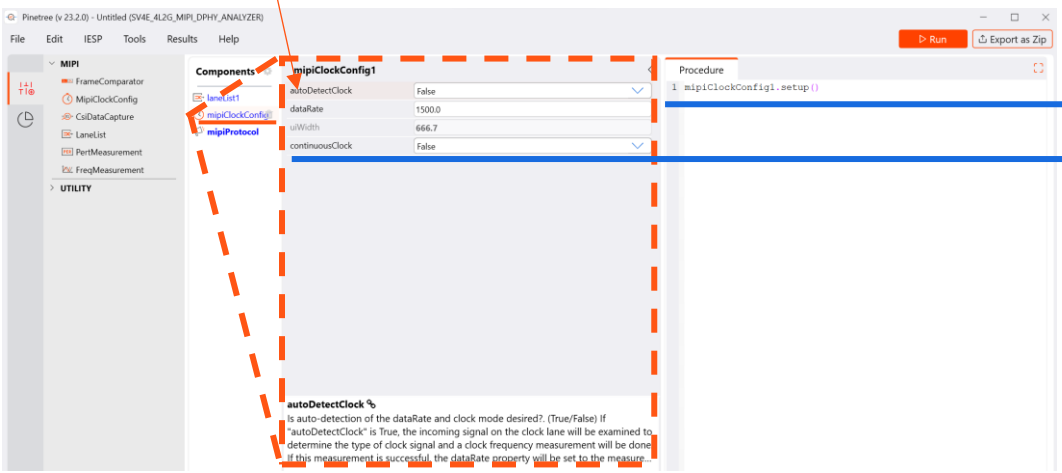
b) In the top left corner of the main GUI window, select the "IESP" drop down menu and click the "Connect" option. Establishing connection should take a couple of seconds.



c) At the bottom of the main window, a status indicator will indicate whether the SV4E-DPRX module is connected or not. If connected, the status indicator will be solid green. If it isn't connected, the status indicator will be solid red.

d) By default, when started in the "SV4E_4L2G_MIPI_DPHY_ANALYZER" form factor, the GUI contains a single line of code in the "Test Procedure" tab and three components in the "Components" section, as shown below. The mipiClockConfig1 component is used to specify the rate at which data is being transmitted to the SV4E-DPRX module. Before continuing, make sure the "dataRate" property matches the data rate of the transmitting DUT, or use the "autoDetectClock" functionality.

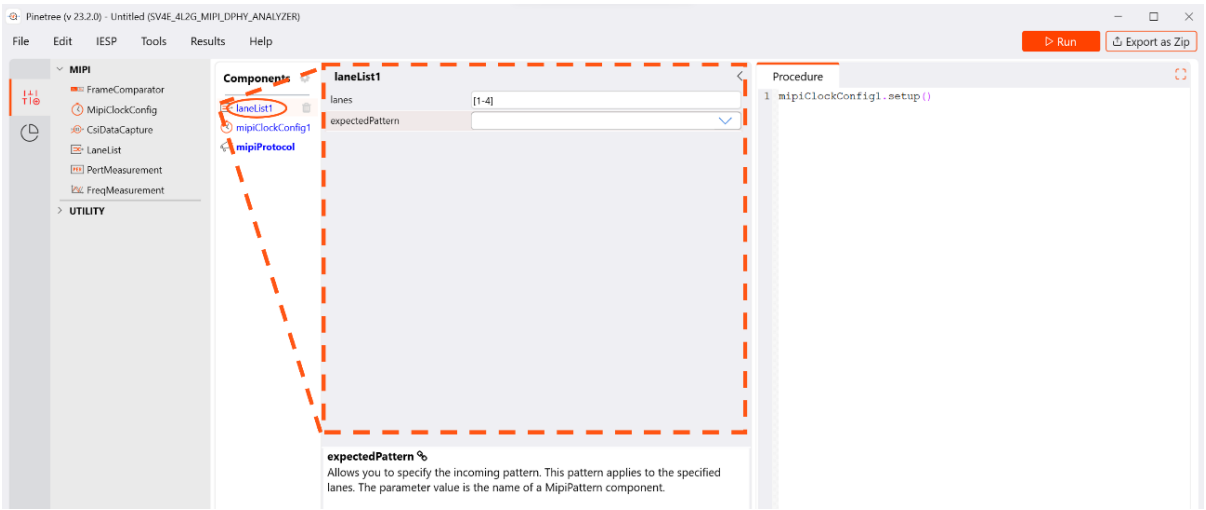
autoDetectClock can be enabled to allow for greater ease of use of the SV4E-DPRX when working with varying data rates



A single line of code sets up the module's data rate

continuousClock allows the use of clock signals with or without LP to HS transitions

e) The "laneList1" component is used to specify what data lanes will be used to receive data using the SV4E-DPRX module. The SV4E-DPRX module supports any combination of data lanes, allowing for greater flexibility when testing multiple types of DUTs.



f) In this first example, only a single D-PHY lane will be used to transmit data from the DUT to the SV4E-DPRX module. To use only lane 1 of the SV4E-DPRX, select the "laneList1" component in the left view, then select the "lanes" parameter in the right view and edit it to: [1].

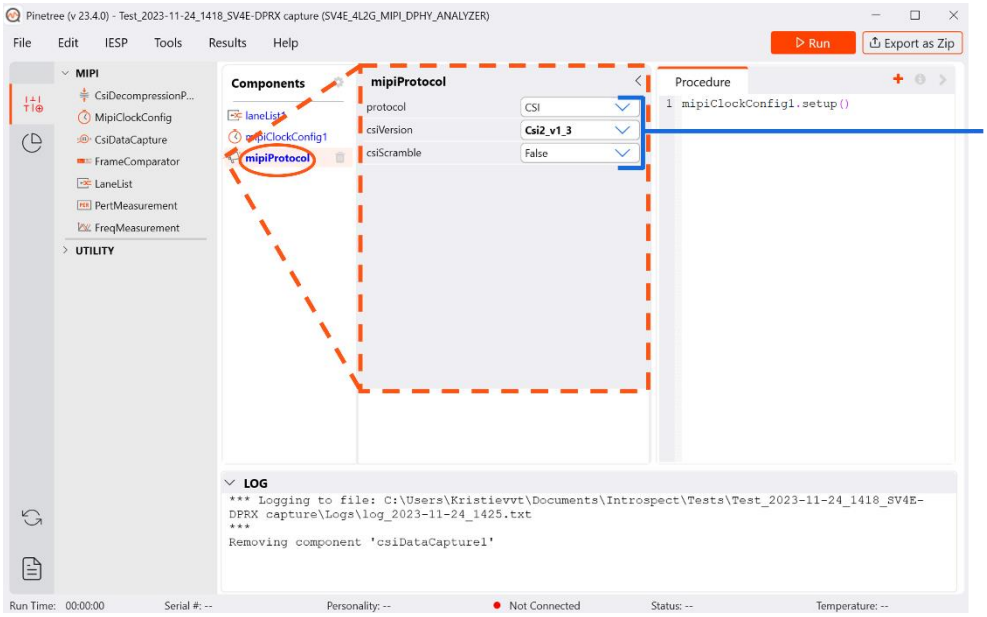
NOTE

To modify a component property, a user can either manually edit the corresponding field in the "Properties" view, or programmatically via the "Test Procedure" editor tab. For example, if a user only wants to use Lane 1, they can add the following line to the "Test Procedure" tab:

```
laneList1.lanes = [1]
```

This allows for on-the-fly change of the attributes during a test run for greater flexibility.

g) The "mipiProtocol" component is used to specify the encoding specifications of the received data packets, as shown below. The SV4E-DPRX module fully supports the DSI, DSI-2 and CSI-2, as well as the reception of bits streams without any type of encoding. In this example, the transmitted data packets are encoded using the CSI-2 v1.3 protocol, so the default settings will do.



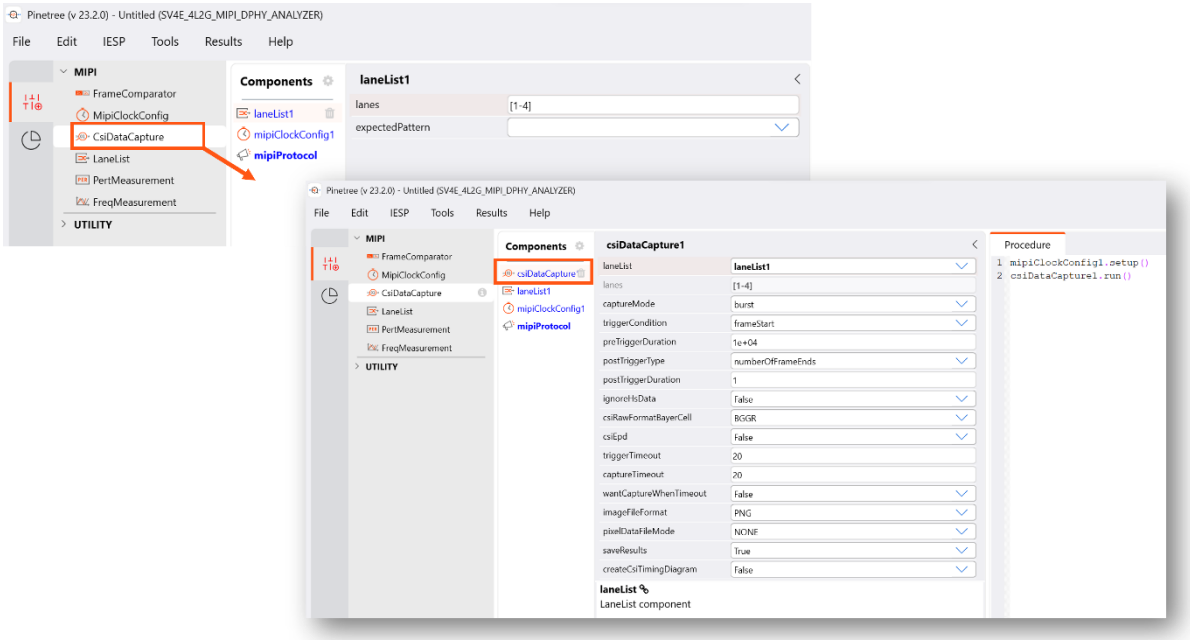
NOTE

If your DUT uses another version of the CSI-2 protocol, make sure to edit the "mipiProtocol" component as described previously to match your device's settings.

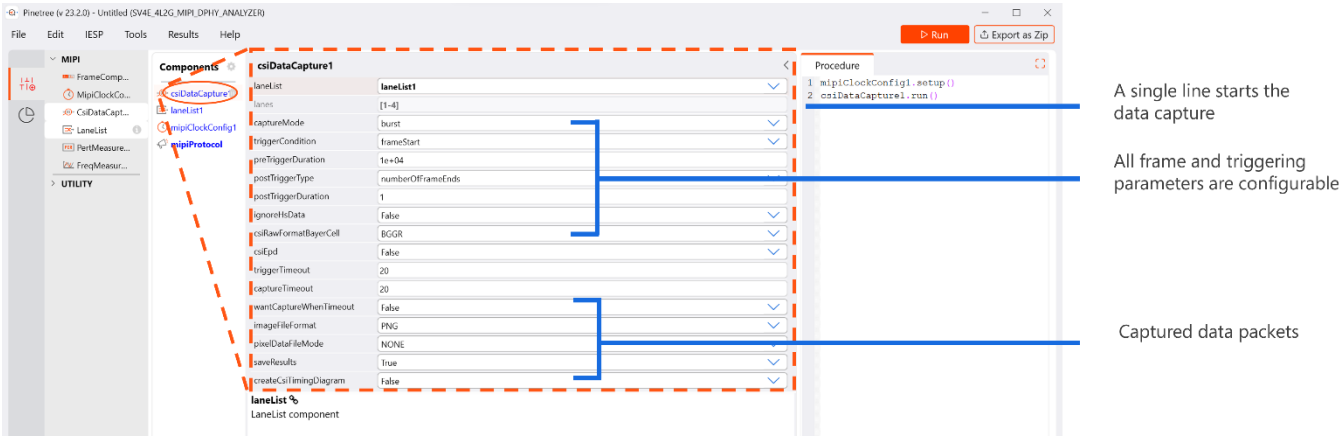
3. ADDING TEST COMPONENTS

a) The objective of this step-by-step guide is to capture a CSI-2 encoded image frame over a single D-PHY lane. In order to capture an image frame, the CsiDataCapture component must be added to the test procedure. This component is responsible for capturing, analyzing, and saving data packets received by the SV4E-DPRX module.

To add a component to the test procedure, double-click or drag the component such as the CsiDataCapture, into the Components column.

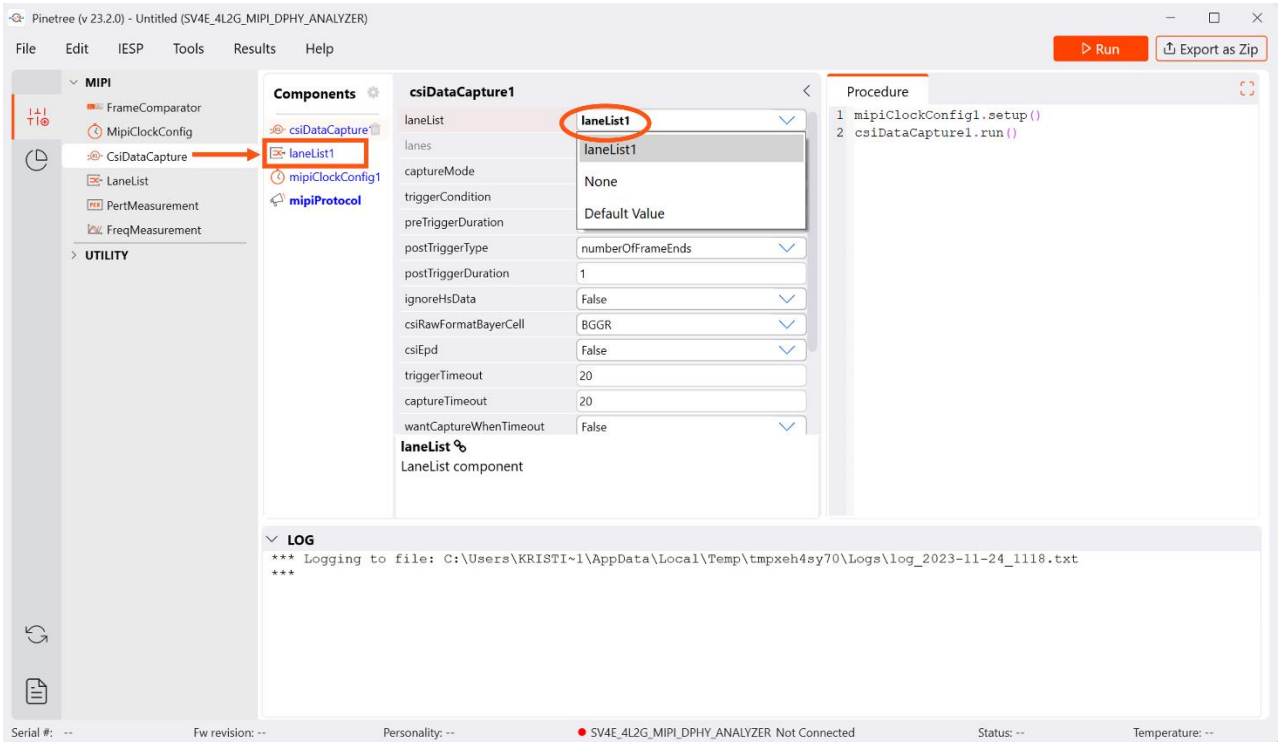


b) A new "csiDataCapture1" component will appear in the "Components" view of the main GUI window. Notice that a new line of code has automatically been added to the end of the "Test Procedure" editor window in order to start the data capture, as shown below.



c) The default configuration of the CsiDataCapture will capture a whole CSI-2 data frame from beginning to end. If you want to capture different types of data, for example a single data packet, you can do so by editing the "triggerCondition", "postTriggerType" and "postTriggerDuration" properties to fit your needs.

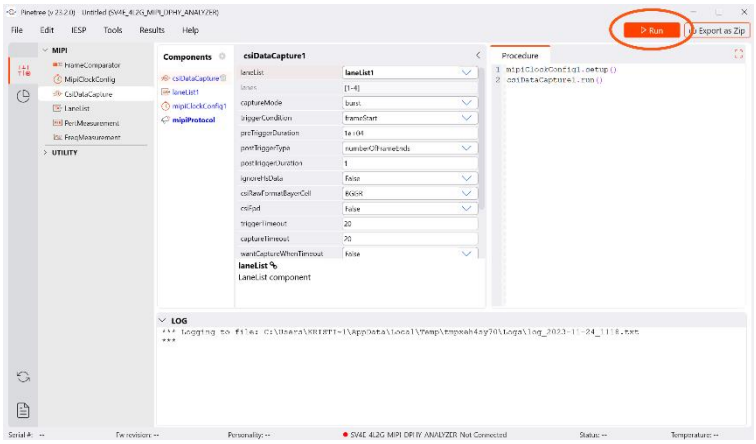
d) The CsiDataCapture component requires a list of lanes to be specified in order to capture data packets. To do so, select the "laneList" property of the csiDataCapture1 component, click the arrow from the drop-down menu on the right-hand side, and choose the desired "laneList" component from the list. Since the current test procedure only contains a single "laneList" component, select "laneList1" as shown below.



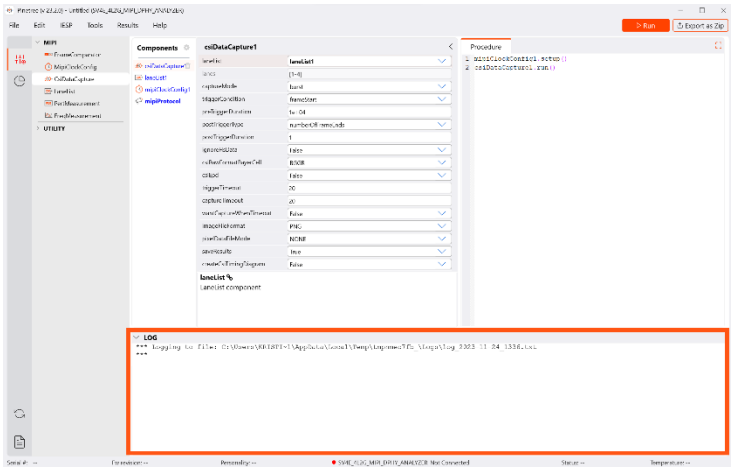
4. EXECUTING THE TEST PROCEDURE

a) Now that the hardware has been connected and the procedure has been configured to fit the DUT settings, the SV4E-DPRX module is ready to receive D-PHY CSI-2 image frames. Before starting the procedure, make sure the DUT is transmitting data on Lane 1. Once data is being sent to the SV4E-DPRX module, the test procedure can be executed from the GUI.

b) To do so, click the “Run” button at the top right corner of the main GUI window as shown here, or use the F5 shortcut key.



c) After clicking the “Run” button, the “Log” window will display the results of the current running procedure. Any errors occurring during the test run will be reported here.

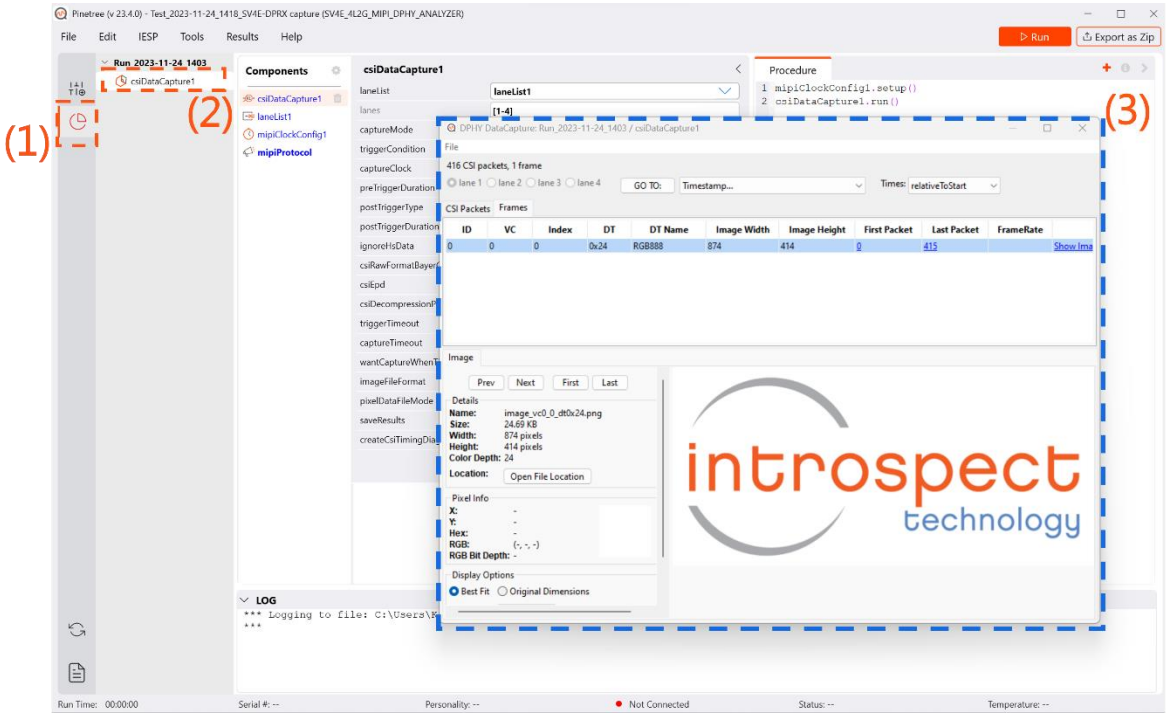


NOTE

The Python print() function will automatically print out messages in the “Log” tab during the test run. This can be used for debugging as well as keeping track of the execution of the test procedure.

d) Refer to the image below for this next step.
After the test procedure has completed, you may click on the results tab **(1)** on the left of the window. Double-click on csiDataCapture1 **(2)** and the results will appear in a new window **(3).** Note that there are two tabs available in this window: CSI packets and Frames.

e) As can be seen below, the SV4E-DPRX module was able to properly capture the Introspect Technology logo encoded using the CSI-2 protocol and transmitted over a single D-PHY lane.



NOTE

More detailed information about the received data packets can be visualized by consulting the result files. To do so, right click the csiDataCapture1 result file and click on "Show Folder".

This concludes the SV4E-DPRX Quick Start demonstration. For further information, please consult the Pinetree user manual from the "Help > User Manual" pull down menu of the main GUI window.

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

Note that the driver version used in our product development is 2.12.

You may wish to use the "usbview" utility program linked to 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.

Revision Number	History	Date
1.0	E.g. Document Release	August 7, 2019
1.1	Updated all software screenshots with Pinetree	November 24, 2023

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Published in Canada on November 24, 2023
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