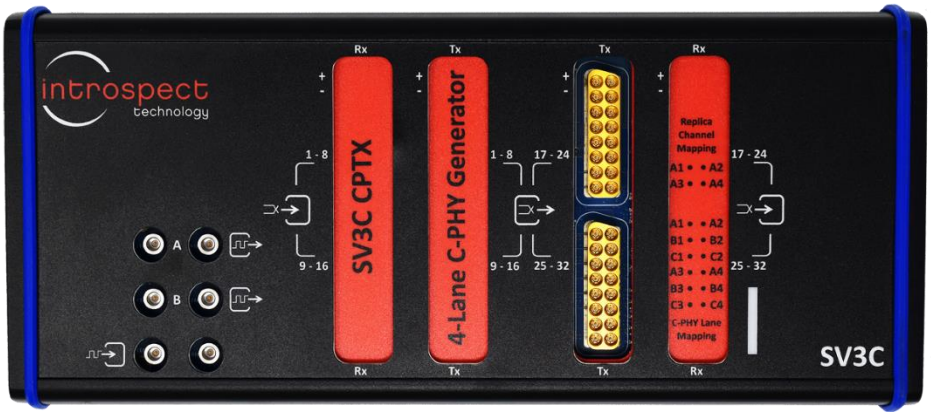
introspect technology

QUICK START GUIDE

SV3C-CPTX

MIPI C-PHY Generator

C SERIES



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Introduction

OVERVIEW

The SV3C-CPTX MIPI C-PHY Generator is an ultra-portable, high-performance instrument that enables exercising and validating MIPI C-PHY receiver ports. Capable of generating any traffic and being completely data-rate agile, the C-PHY generator includes analog parameter controls that enable gaining deep insights into receiver sensitivity performance, as well as skew and jitter tolerance.

The SV3C-CPTX MIPI C-PHY Generator operates using the highly versatile Pinetree software environment. This environment allows for automating receiver tests such as voltage sensitivity or wire-skew tolerance. The environment also includes MIPI pattern tools that enable the generation of complete DSI-2 or CSI-2 packets such as those produced by image sensors or radar devices.

QUICK START DOCUMENTATION

This Quick Start Manual will provide the information required for a user to get up and running with the SV3C-CPTX MIPI C-PHY Generator system. Basic hardware and software installation instructions are included followed by a step-by-step procedure to start generating and manipulating MIPI C-PHY signals using the Pinetree software.

Quick Start Hardware Description

REQUIREMENTS

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

- 1 x SV3C-CPTX MIPI C-PHY Generator
- 1 x 12V 5A AC / DC power supply (Mfg: CUI, Part #: ETSA120500U)
- 1 x Personal Computer connected to the SV3C-CPTX via USB2.0 mini B and USB3.0 micro B
- Optional: 1 x 4GHz oscilloscope or higher for signal visualization

HARDWARE DESCRIPTION

Figure 1 shows a diagram of the physical ports of the SV3C-CPTX.

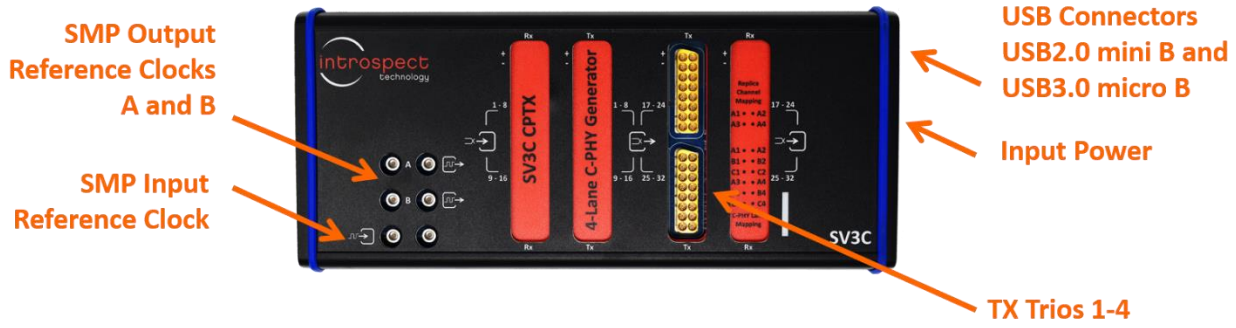
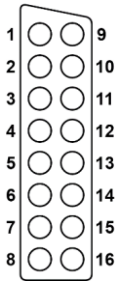


Figure 1: Illustration of the SV3C-CPTX MIPI C-PHY Generator system

The SV3C-CPTX instrument has two MXP connectors. The lower MXP connector, as shown in Figure 1, provides four C-PHY trios. The pin mapping for this connector in provided in Table 1 below.

TABLE 1: LOWER MXP CONNECTOR PINOUT

CONNECTOR	PIN	LANE
	1, 2, 3	Trio 1 (A, B, C)
	9, 10, 11	Trio 2 (A, B, C)
	4, 5, 6	Trio 3 (A, B, C)
	12, 13, 14	Trio 4 (A, B C)

The other pins are NC and should not be used.

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

INSTALLATION PREPARATION

a) Quit any Pinetree 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.

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 the Pinetree software. The default location is “C:\Program Files\Introspect”. The software will be installed into a sub-folder specifying the version number.

NOTE

It is desirable to choose a common installation path like we have shown here. This way, future installations can be placed in sub-folders of this main Introspect software path.

c) By the simple click of a button, the Pinetree software 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 Pinetree software and vice versa.

INSTALLING 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 continue with the installation. You will be asked to enter the Activation Key code later when you start the GUI for the first time.
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 customer support. 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 creates a folder called "Introspect" under the "My Documents" folder of your Windows account. This folder is where Test Procedures are saved by default.

RUNNING THE PINETREE SOFTWARE

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 "SV3C_4L3G_MIPI_CPHY_GENERATOR" and Press "Next" to continue.

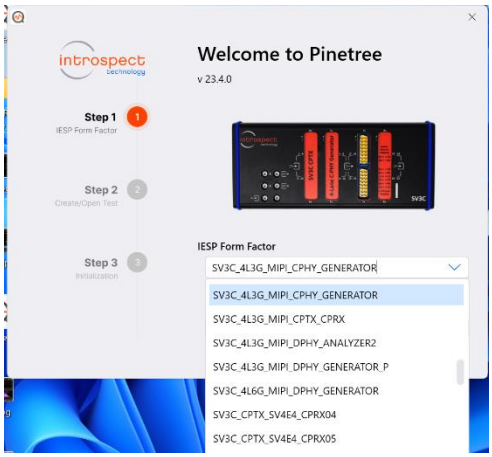


Figure 2: Welcome screen of the to the Pinetree software

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

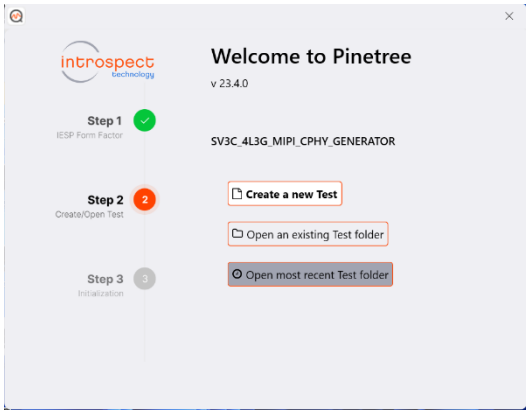


Figure 3: Create a new test window

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

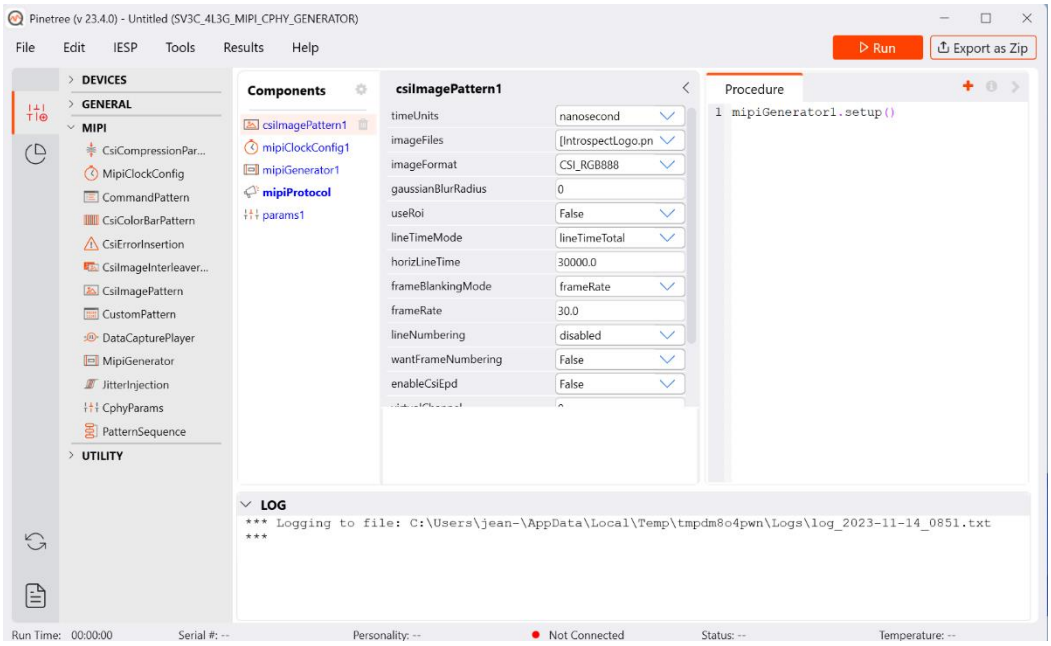


Figure 4: Default window indicating Pinetree is successfully installed

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\ SV3C_4L6G_MIPI_CPHY_GENERATOR". 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" drop down menu located on the top right corner of the main Pinetree software window.

"Application Notes" can also be found in the "[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 SV3C-CPTX to the 12V DC power supply, as well as to the PC using both a USB2.0 mini B and a USB3.0 micro B cable, as shown in Figure 2 below, and power on the module. To allow for driver installation, the PC should be connected to the internet as well.

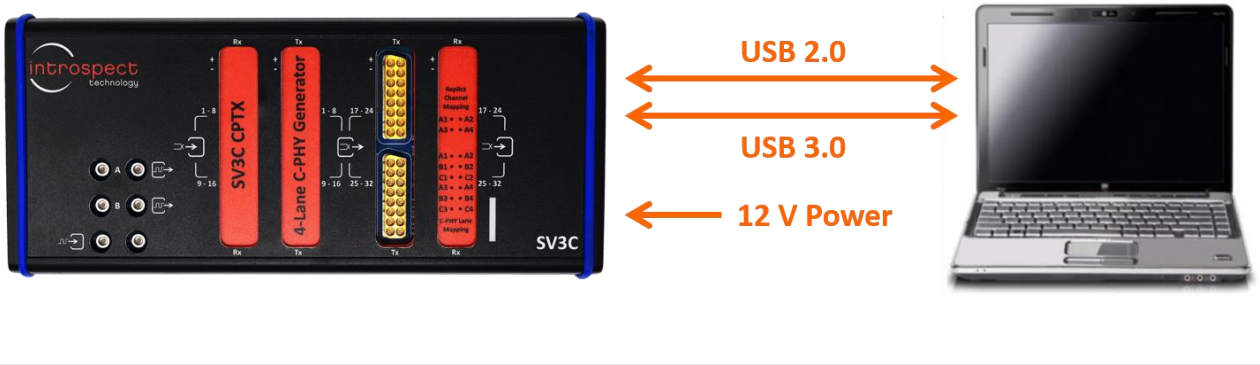


Figure 5: Connection for the automated FTDI driver installation

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 open yet, launch Pinetree and select the "SV3C_4L6G_MIPI_CPHY_GENERATOR" 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.

Figure 6: Connection for the automated FTDI driver

b) To verify the connection, the bottom of the GUI indicates whether the module is connected or not. A red dot indicates that it is not connected, whereas a green dot indicates it is connected and ready.

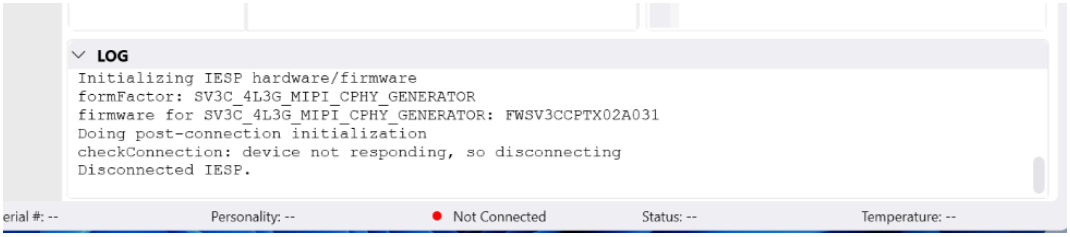


Figure 7: Status bar at the bottom of Pinetree

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 at the end of this document to install the required drivers.

SV3C-CPTX Demonstration

STEP-BY-STEP GUIDE: GENERATING VIDEO FRAMES

The following step-by-step guide will allow the user to set up the SV3C-CPTX Generator module to send video frames over a MIPI C-PHY interface, as well as demonstrate how to visualize the generated frames using an oscilloscope. A receiver DUT can also be used in lieu of the oscilloscope. The following procedure is intended to provide an overview of how to use the Pinetree GUI and highlight several of its key features.

1. CONNECT THE HARDWARE COMPONENTS

In order to visualize the generated MIPI C-PHY signal, please connect Trio 1 A, B, and C to three channels of the oscilloscope. The pinout for the trios of the SV3C CPTX Generator has been provided in Table 1.

2. GETTING TO KNOW THE PINETREE GUI

a) If you have not done so previously during the USB driver installation procedure, launch the Pinetree software, select the "SV3C_4L6G_MIPI_CPHY_GENERATOR" form factor and create a new test procedure. Connect the SV3C-CPTX to the 12V DC power supply, as well as to the 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 cable is used to accelerate data transfers between the SV3C-CPTX and the host PC. A USB3.0 connection is not mandatory for operating the module, but it is highly recommended, especially when generating large video 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.

Figure 8: Connecting the SV3C-CPTX to Pinetree

c) A dialog window should confirm that the SV3C-CPTX module is connected and will list the detected personality / firmware version. Note that the firmware version may differ from what is shown here.

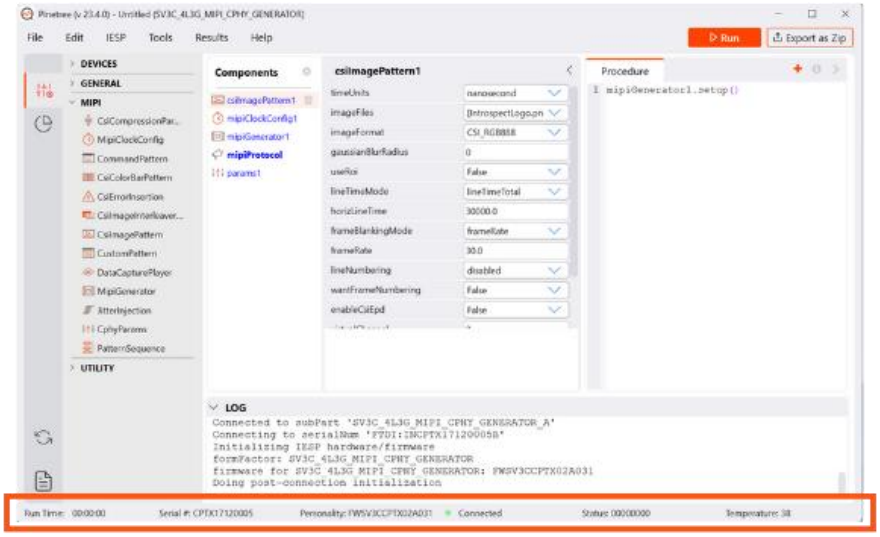


Figure 9: Connection for the automated FTDI driver installation

d) By default, when started in the MIPI_CPHY_GENERATOR form factor, the GUI contains a single command in the Test Procedure window and five pre-populated components in the Components section of the Params tab, as shown in the image below. When executed, the mipiGenerator1.setup() generates patterns that are compliant with the properties associated with the mipiCphyGenerator1 component as shown below.

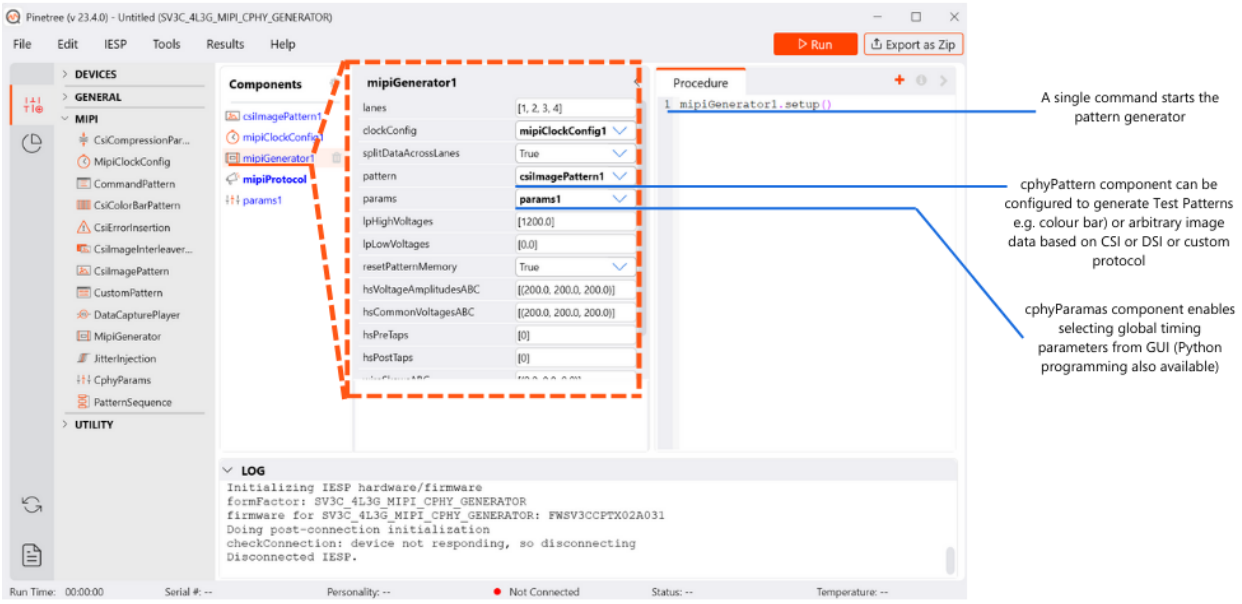


Figure 10: Connection for the automated FTDI driver installation

e) One of the properties of the mipiCphyGenerator1 component shown in d) is the cphyPattern and it is used to define the kind of payload that is generated by the SV3C-CPTX module. In the previous picture, the csiImagePattern1 component was selected as the desired cphyPattern. By selecting the csiImagePattern1 component from the list in the "Components" view on the left side of the main window, the properties of the various custom and standard patterns will be generated can be viewed and modified, as shown below.

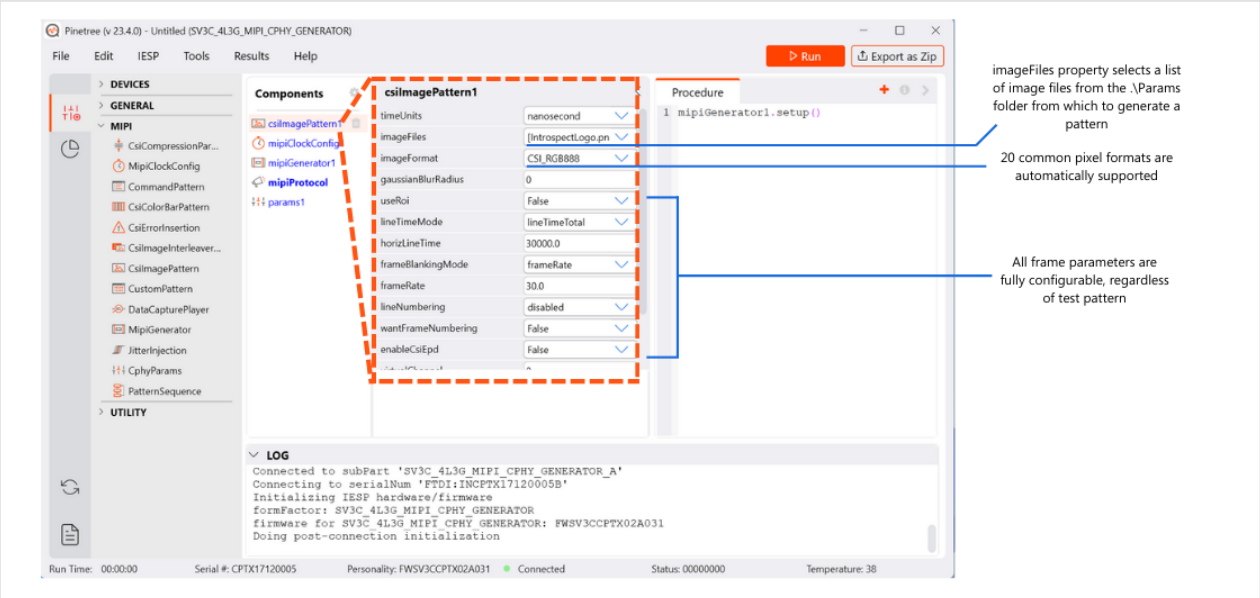


Figure 11: csiImagePattern1 as an option within the properties of the mipiCphyGenerator1

NOTE

The default setup is a .png image file of the Introspect logo sent as a CSI-2 video stream, but it can be changed to any list of image files located in the .\Params folder of your test procedure.

f) Similarly, yet another parameter for the mipiCphyGenerator1 component shown in d) is cphyParams, which allows for defining global timing parameters for the physical MIPI C-PHY layer. By default, this parameter is pre-filled with the cphyParameters1 component. Selecting the cphyParameters1 component in the "Components" view on the left side of the main GUI window reveals the list of properties it provides, as shown below.

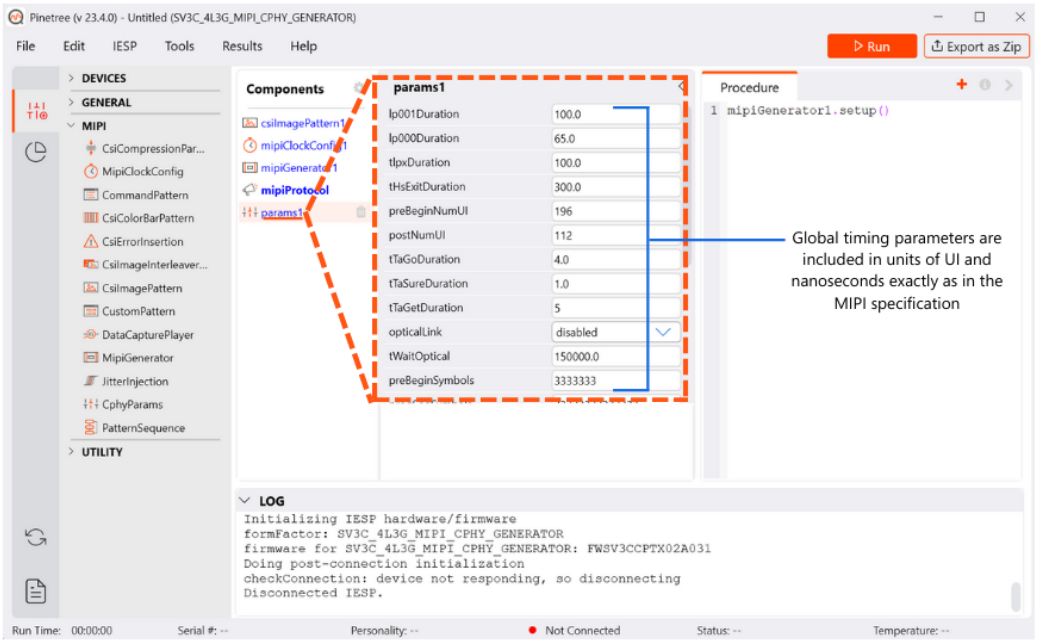


Figure 12: List of properties provided by the Params1 component.

3. ADDING TEST COMPONENTS

For simplicity, this Quick Start guide will be using color bars instead of an image frame for generating its cphyPattern. To do so, add a new component to the test by double-clicking on CsiColorBarPattern (1) from the MIPI options. This will now appear in the Components menu (2). Next, click on mipiGenerator1 in the Components menu, and select csiColorBarPattern1 from the drop down menu as shown below (3).

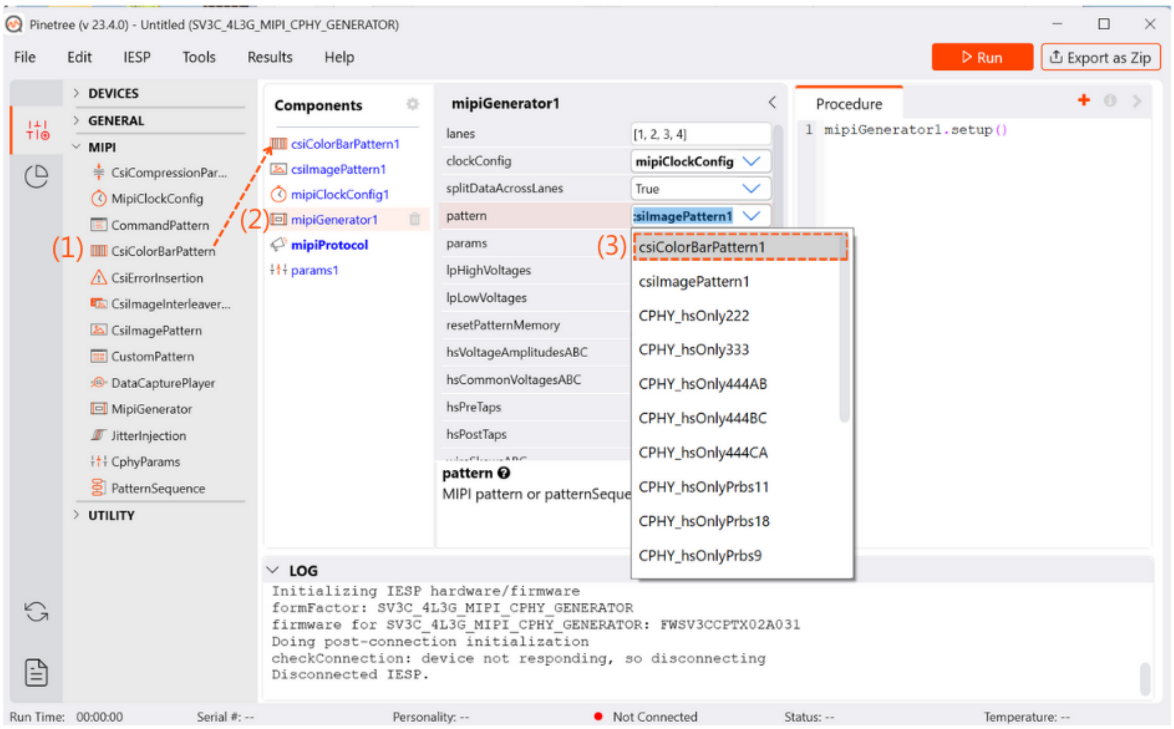


Figure 13: Adding a component to the test procedure

After adding the component, it will appear in the “Components” view on the left side of the main GUI window. By selecting the newly created csiColorBarPattern1 component from the list, its parameters can be viewed and edited, as shown below.

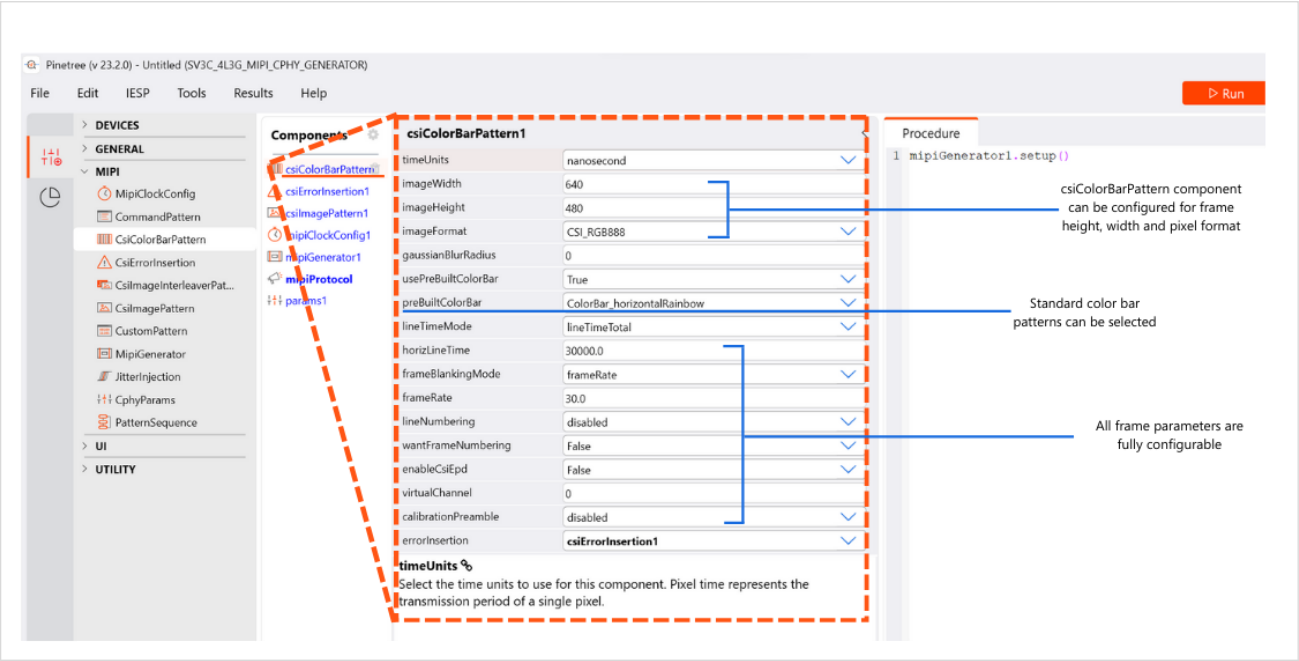


Figure 14: Parameters available with the csiColorBarPattern1 component selected

NOTE

In addition to image files and color bar patterns, simple test patterns and packet loops may also be selected for use with the mipiGenerator component. Any of these patterns may be selected for the test execution in the section which follows.

To make the csiColorBarPattern1 the active pattern used by the generator, select the mipiGenerator1 component from the “Components” view list, select the Pattern property and click on "csiColorBarPattern1" from the pull-down menu, as shown below.

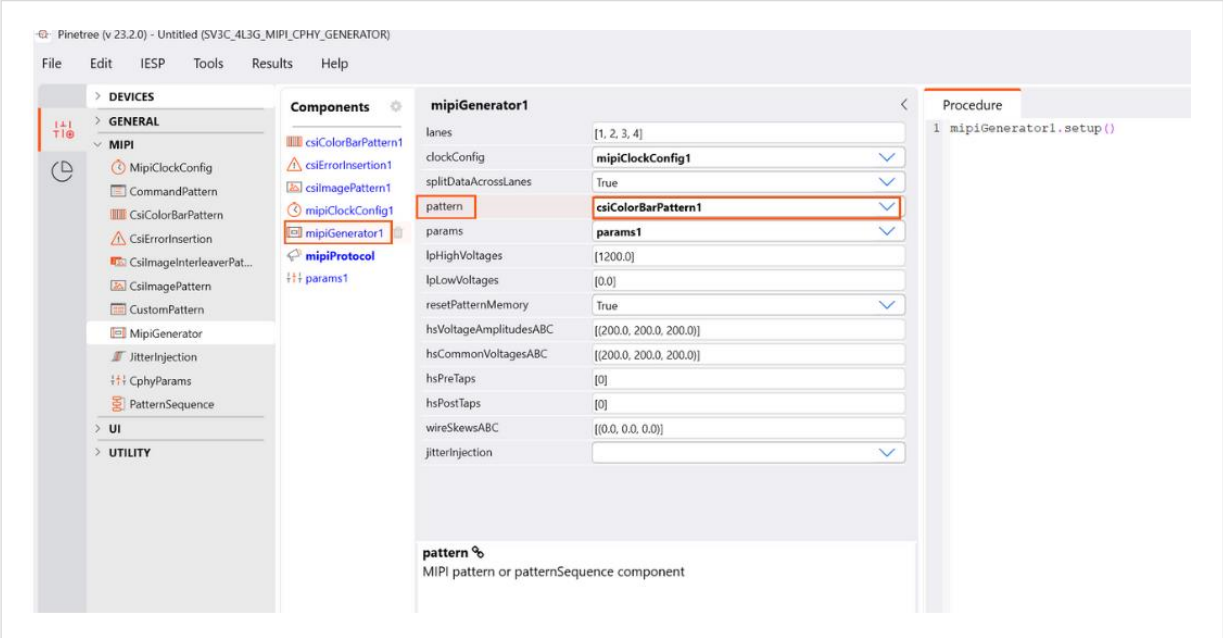


Figure 15: Making the csiColorBarPattern1 the active pattern used by the generator

4. EXECUTING THE TEST PROCEDURE

Up until this point, you have connected the hardware and familiarized yourself with the software interface. However, no pattern is being produced by the generator yet.

a) To start the test procedure and generate the pattern, click the "Run" button at the bottom of the main GUI window, as shown here.

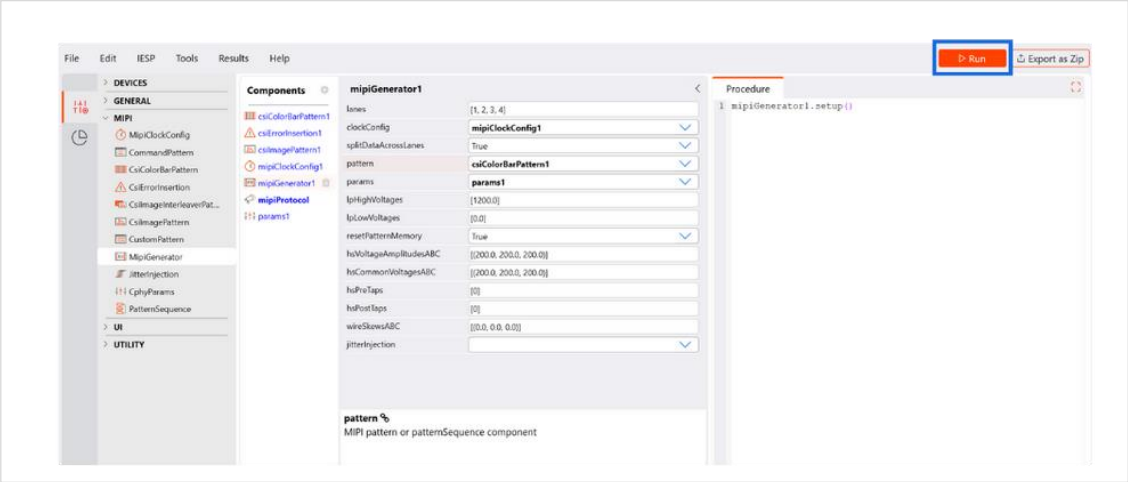


Figure 16: Starting the test procedure

NOTE

Clicking the "Run" button starts executing all the Python code located in the "Test Procedure" tab at the bottom of the main GUI window. Since this example only contains mipiGenerator1.setup(), clicking "Run" will simply start generating the pattern.

b) Set up the oscilloscope trigger level to around 400 mV and confirm transmission of packet. A typical C-PHY packet for a single trio is shown on the right.

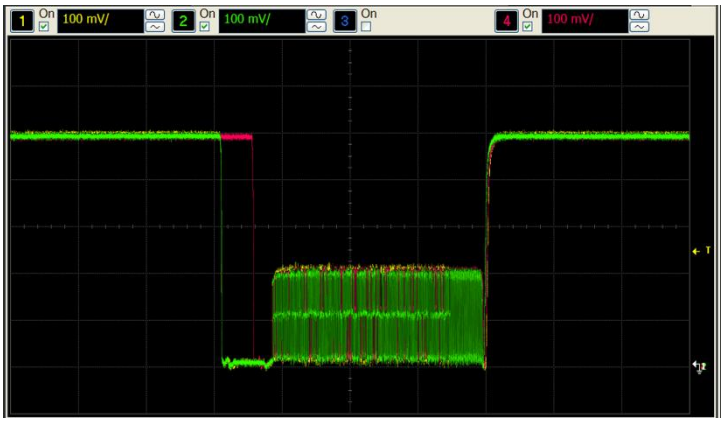


Figure 16: Illustration of a typical C-PHY packet, one trio.

5. MODIFYING TEST PARAMETERS

Now that you have successfully generated your first pattern with the SV3C-CPTX generator, let's experiment with changing some parameters of the generator and observing its effect on the generated signal.

a) Select the mipiGenerator1 component in the Components view of the GUI, as shown here.

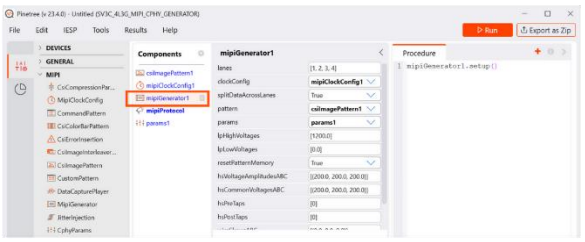


Figure 17: mipiGenerator1 component

b) Select the "hsVoltageAmplitudesABC" and "hsCommonVoltagesABC" parameters as shown on the right. You may modify each of these parameters one at a time. This is done by clicking the text field to the right of the attribute, as show here. Notice that upon pressing enter, the font of the value changes to bold. This is to indicate that the property has been changed from its default value.

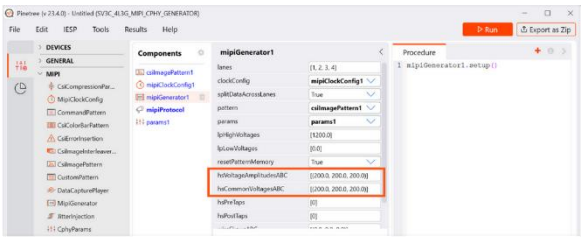


Figure 18: Selecting parameters

c) Execute the test again by clicking "Run". The following picture was captured from the oscilloscope after changing the HS amplitude to its minimum value, and by changing the HS common mode voltage to a range of different values, while leaving the oscilloscope on infinite persistence for illustrative purposes.

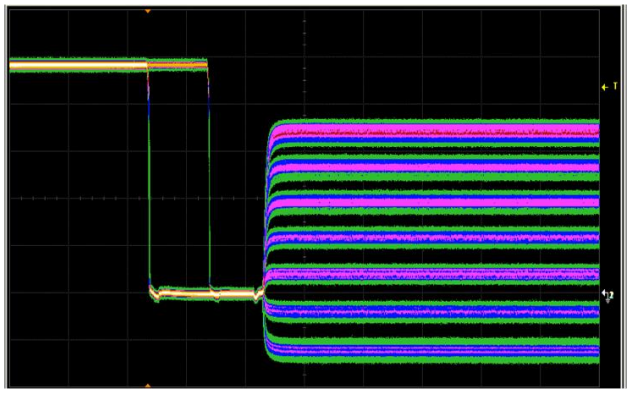


Figure 19: Capture from an oscilloscope

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 wants to change the HS common mode voltage during the test run, they can add the following two lines to the "Test Procedure" tab:

```
mipiGenerator1.hsCommonVoltagesABC = [(500.0, 500.0, 500.0)]
mipiGenerator1.update()
```

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

This concludes the SV3C-CPTX Quick Start demonstration. For further information, please consult the Introspect ESP GUI user manual from the "Help > User Manual" pull down menu of the main GUI window.

Appendix

FTDI DRIVER MANUAL INSTALLATION

The Pinetree Software 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	Document updated into new template format.	April 8, 2020
1.1	Added figure boxes for all images; updated all software screenshots and small typo under “Running the Pinetree Software” section	November 15, 2023

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