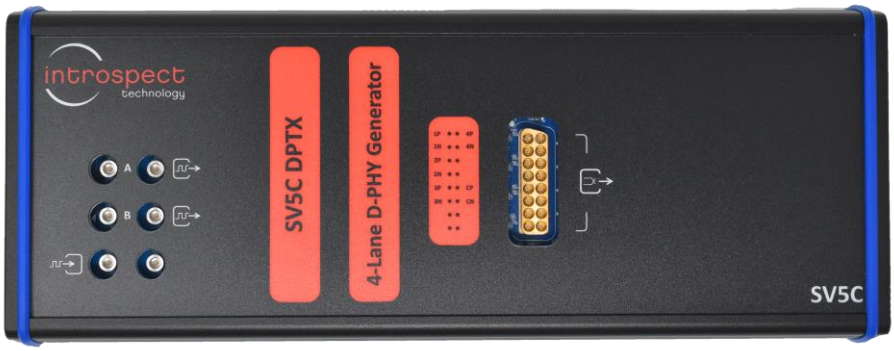
QUICK START GUIDE

SV5C-DPTX

MIPI D-PHY Generator

C SERIES



Published in Canada on August 9, 2023
EN-G067E-E-23221

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Table of Contents

Introduction 3
Overview 3
Quick Start Documentation 3
Quick Start Hardware Description 4
Requirements 4
Hardware Description 4
Pinetree Installation 5
System Requirements 5
How to Install Pinetree 6
USB Driver Installation 11
SV5C-DPTX Demonstration 14
Step-by-step Guide: Generating Video Frames 14
Appendix 26
FTDI Driver Manual Installation 26

Introduction

OVERVIEW

The SV5C-DPTX MIPI D-PHY Generator is an ultra-portable, high-performance instrument that enables exercising and validating MIPI D-PHY receiver ports. Capable of generating any traffic and being completely data-rate agile, the D-PHY generator includes analog parameter controls that enable gaining deep insights into receiver sensitivity performance, as well as skew and jitter tolerance.

The SV5C-DPTX MIPI D-PHY Generator operates using Introspect's highly versatile software environment, Pinetree. This environment allows for automating receiver tests such as voltage sensitivity or clock-to-data setup and hold times. 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 Guide will provide the information required for a user to get up and running with the SV5C-DPTX Generator system. Basic hardware and software installation instructions are included followed by a step-by-step procedure to start generating and manipulating MIPI D-PHY signals using Introspect's software, Pinetree.

Quick Start Hardware Description

REQUIREMENTS

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

- 1 x SV5C-DPTX MIPI D-PHY Generator
- 1 x 12V 15A AC / DC power supply
- 1 x Personal Computer connected to the SV5C-DPTX via a USB2.0 mini B and a USB3.0 micro B cable
- 1 x MXP to SMA Cable Assembly
- Optional: 1 x 4GHz oscilloscope or higher for signal visualization

HARDWARE DESCRIPTION

Figure 1 shows a diagram of the physical ports of the SV5C-DPTX.

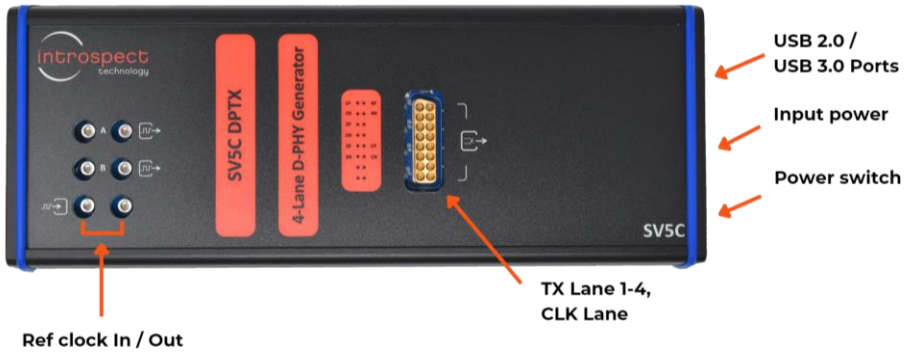
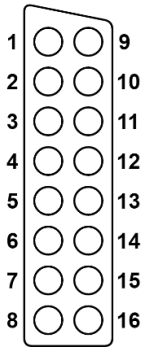


Figure 1: Illustration of the SV5C-DPTX MIPI D-PHY Generator system

The SV5C-DPTX module has one MXP connector, as shown in Figure 1. It provides the differential TX D-PHY Lanes 1-4 and the differential D-PHY Clock output signal. The exact pin mapping for this connector is provided in Table 1 below.

TABLE 1: LOWER MXP CONNECTOR PINOUT

CONNECTOR	PIN	LANE
	1, 2	TX Lane 1 (P, N)
	3, 4	TX Lane 2 (P, N)
	5, 6	TX Lane 3 (P, N)
	9, 10	TX Lane 4 (P, N)
	13, 14	Clock Lane (P, N)

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 10
- The Pinetree software 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.

INTROSPECT'S PINETREE INSTALLATION

1. INSTALLATION PREPARATION

a) Quit any Pinetree 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 the Pinetree 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, 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 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 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 form factor as "SV5C_4L8G_MIPI_DPHY_GENERATOR" and Press "Next" to continue.

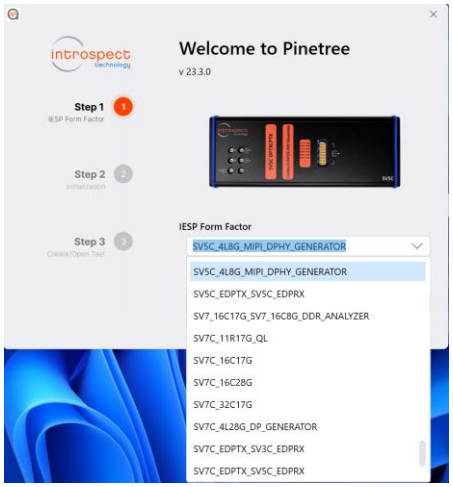


Figure 2: The welcome window of Pinetree

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

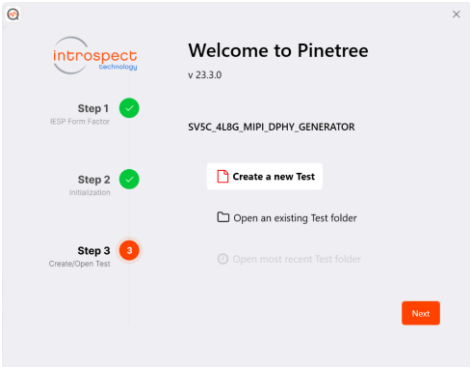


Figure 3: "Create a new Test" option of the welcome menu

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

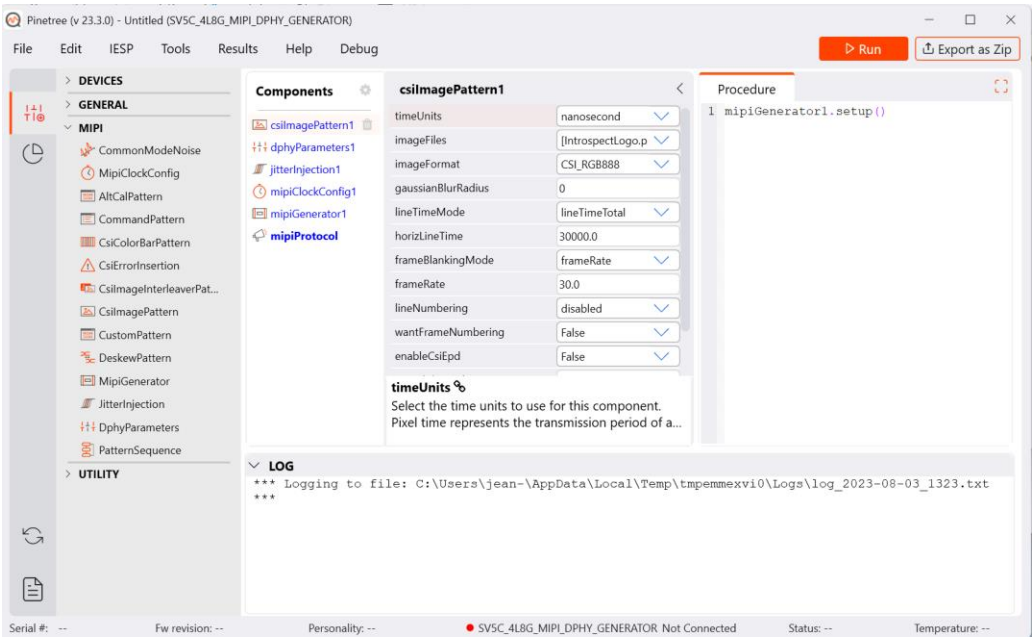


Figure 4: Window indicating that Pinetree has been successfully installed

5. FURTHER DOCUMENTATION

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

- "User Manual" is the user manual for 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-DPTX to the PC using both a USB2.0 mini B and a USB3.0 micro B cable, as shown in Figure 5 below, and power on the module. To allow for driver installation, the PC should be connected to the internet as well.

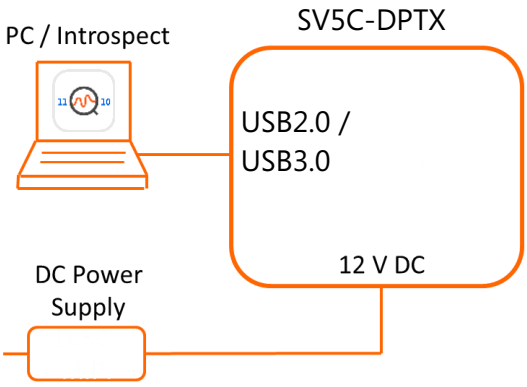


Figure 5: Connection for the automated FTDI driver installation

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 still open, launch Pinetree and select the "SV5C_4L8G_MIPI_DPHY_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. If this fails, an error message will pop-up.

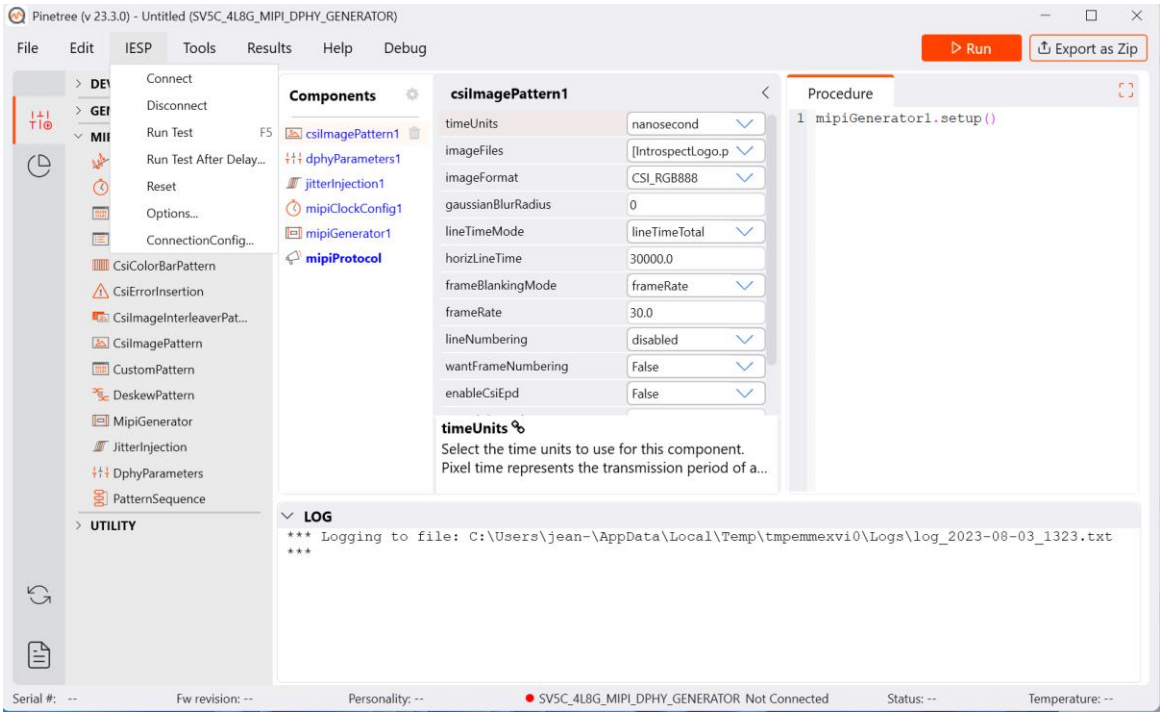


Figure 6: Screen capture of the "Connect" sub-menu item

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.

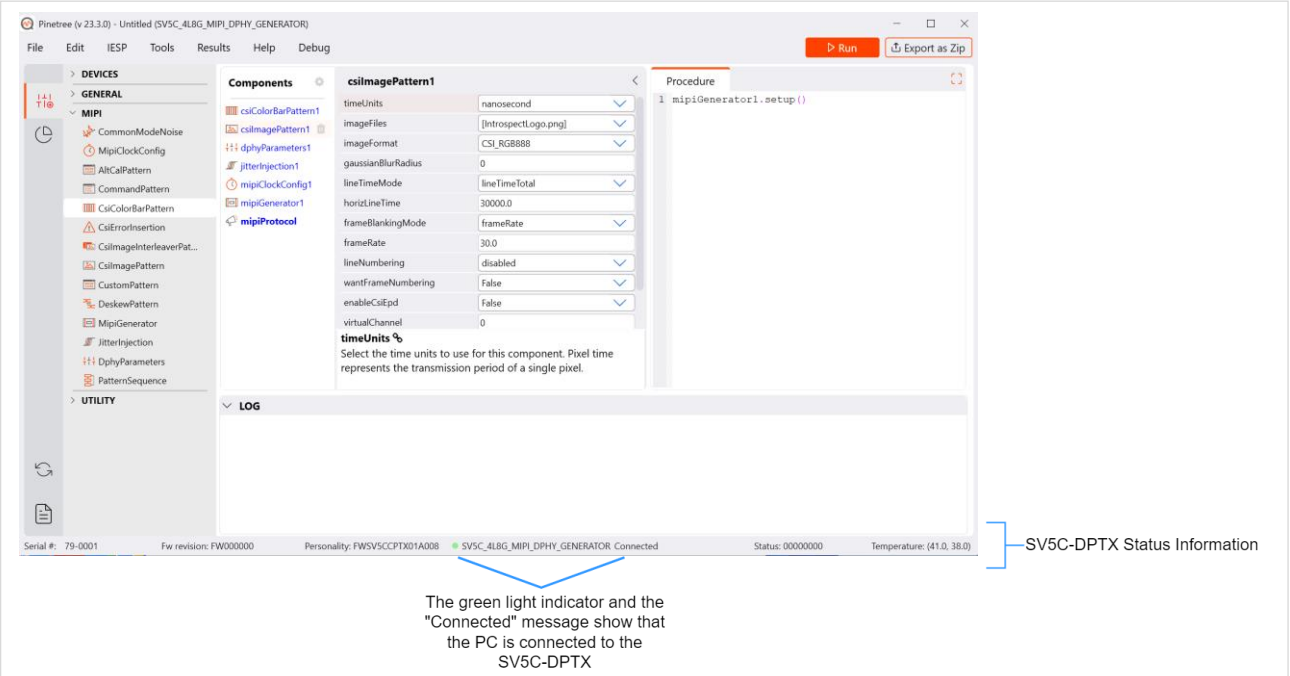


Figure 7: Screen capture of the GUI with the indicator showing that the SV5C-DPTX is connected to the PC

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-DPTX Demonstration

STEP-BY-STEP GUIDE: GENERATING VIDEO FRAMES

The following step-by-step guide will allow the user to set up the SV5C-DPTX Generator module to send video frames over a MIPI D-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

To visualize the generated MIPI D-PHY signal, please connect TX Lane 1 P and N to the first two channels of the oscilloscope and the Clock P and N signals to the second two channels of the oscilloscope. Note that the pinout for all lanes of the SV5C generator module is depicted 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 Pinetree, select the "SV5C_4L8G_MIPI_DPHY_GENERATOR" form factor and create a new test procedure. Connect the SV5C-DPTX 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 cable is used to accelerate data transfers between the SV5C-DPTX 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) By default, when started in the "SV5C_4L8G_MIPI_DPHY_GENERATOR" form factor, the GUI contains a single command in the "Test Procedure" pane and six pre-populated components in the Components section. When executed, the mipiGenerator1.setup() generates patterns that are compliant with the properties associated with the mipiGenerator1 component as shown below.

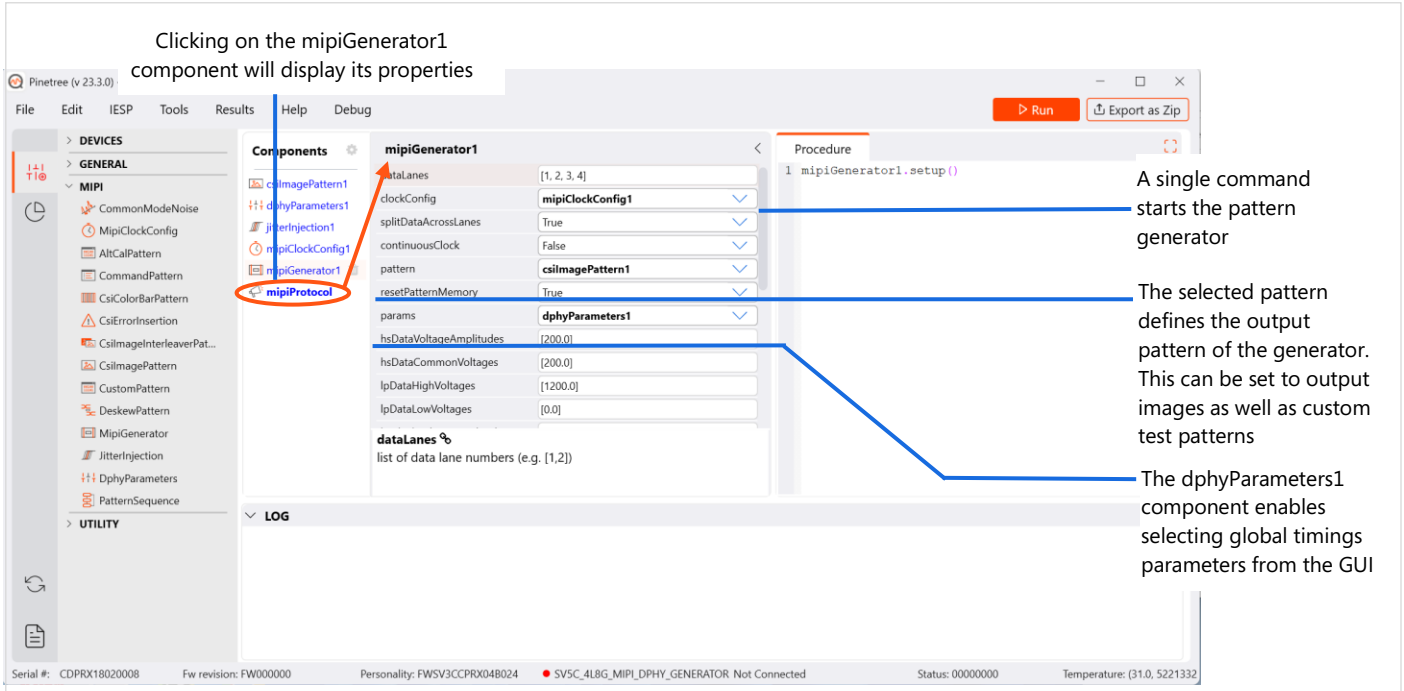


Figure 8: Screen capture showing the mipiGenerator1 component and its properties

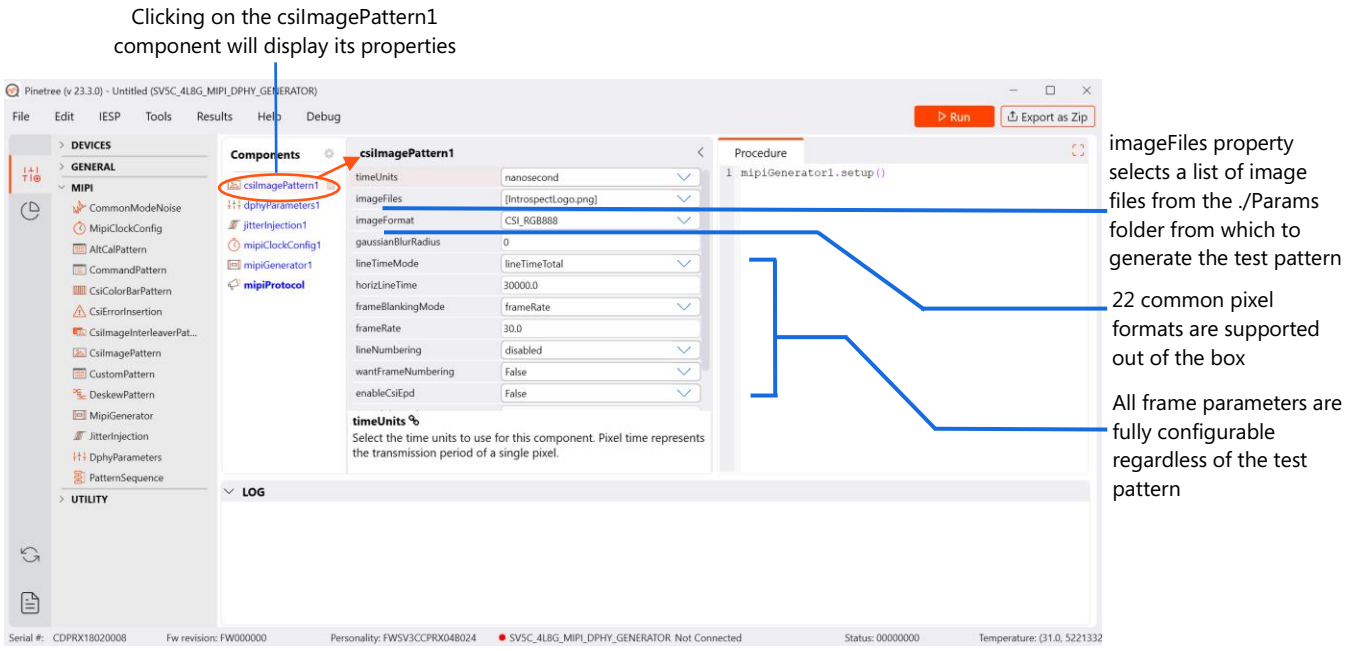


Figure 9: Screen capture showing the csiImagePattern1 component and its properties

c) One of the properties of the mipiDphyGenerator1 component shown above is the pattern property. It is used to define the kind of payload that is generated by the SV5C-DPTX module. In the previous picture, the csiImagePattern1 component was selected as the desired pattern. By selecting the csiImagePattern1 component from the "Components" view of the main window, the properties of the various custom and standard patterns that will be generated can be modified, as shown below.

NOTE

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

d) Similarly, another property of the mipiDphyGenerator1 component shown in Figure 8 is the params property, which allows defining global timing parameters for the physical MIPI D-

PHY layer. By default, this parameter is pre-filled with the dphyParameters1 component. Selecting the dphyParameters1 component in the "Components" view of the main GUI window reveals the list of properties it provides, as shown below.

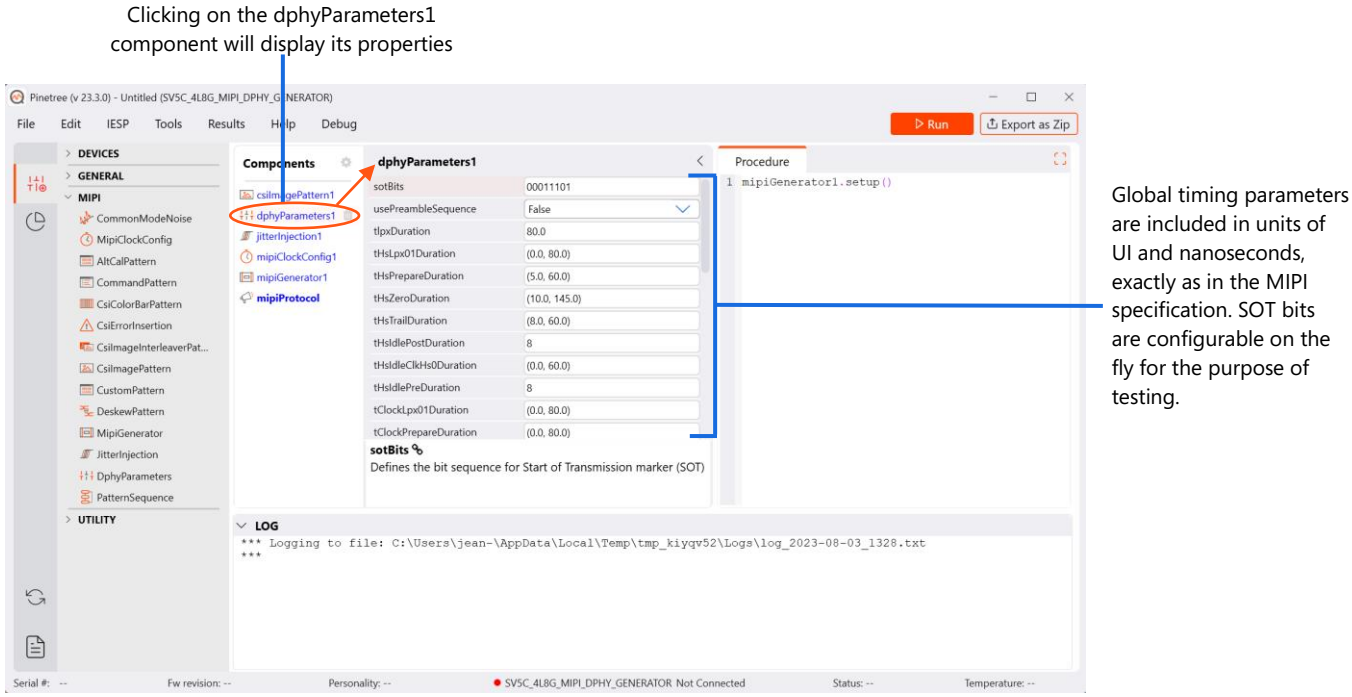


Figure 10: Screen capture showing the dphyParameters1 component and its properties

3. ADDING TEST COMPONENTS

To illustrate how to add new components, this guide will be using a built-in color bar pattern instead of the default csiImagePattern1 component. To add a "CsiColorBarPattern", users can double-click this component on the list of available components on the left of the GUI window. This will instantiate a "csiColorBarPattern1" component in the Components list. Another way of doing this is to drag-and-drop the "CsiColorBarPattern" component from the list of available components into the Components Pane.

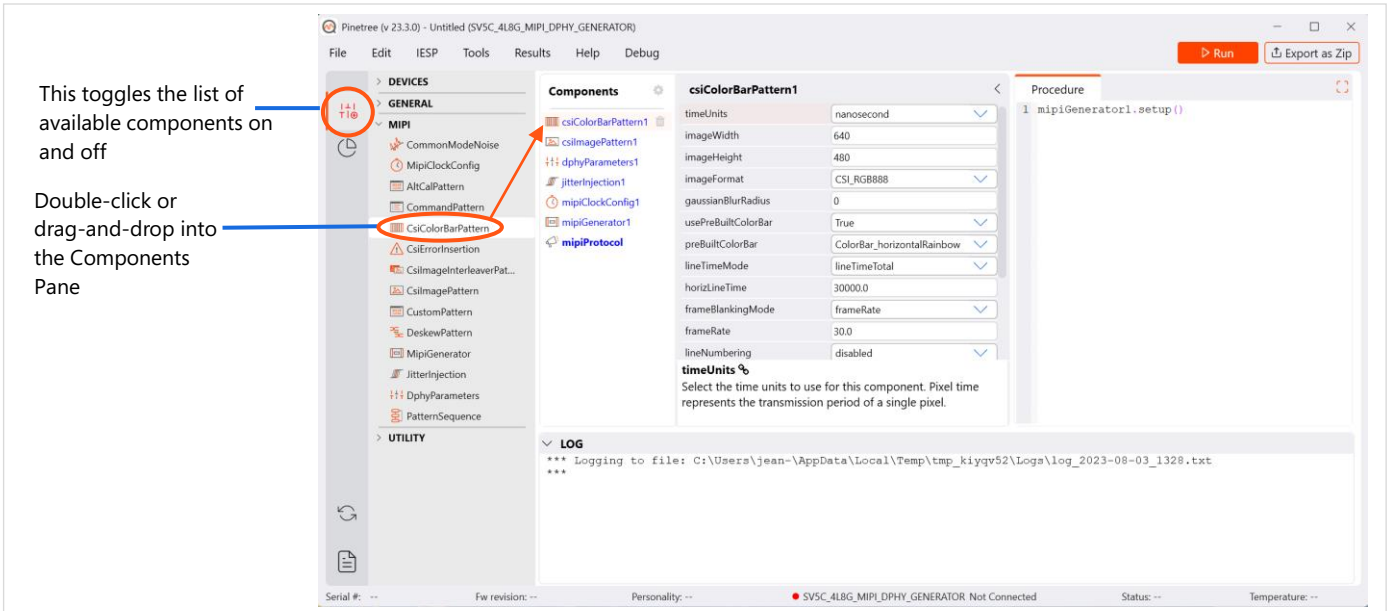


Figure 11: Adding the CsiColorBarPattern component

By selecting the newly created csiColorBarPattern1 component from the Components list, its parameters can be viewed and edited, as shown below.

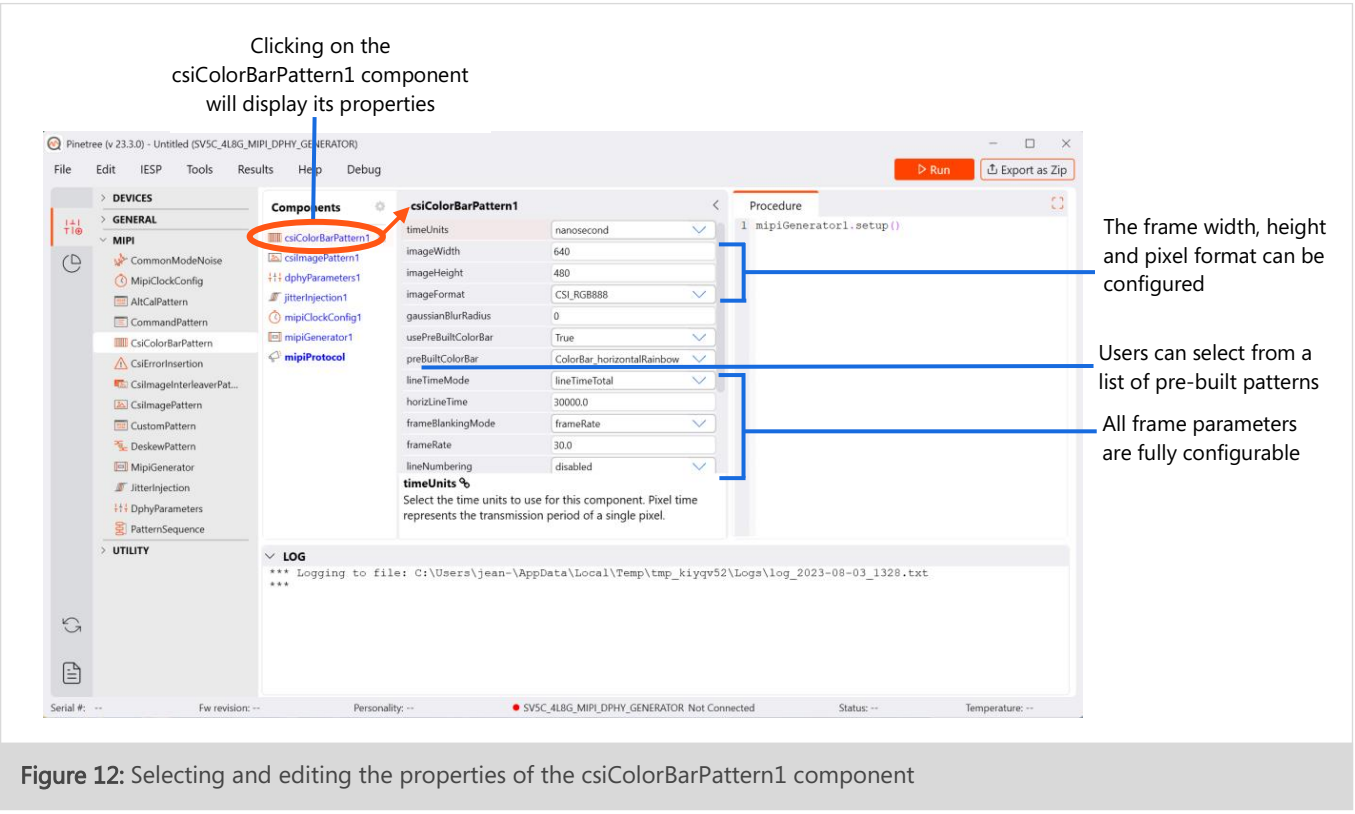


Figure 12: Selecting and editing the properties of the csiColorBarPattern1 component

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” list, select the pattern property and click on "csiColorBarPattern1" from the pull-down menu, as shown below.

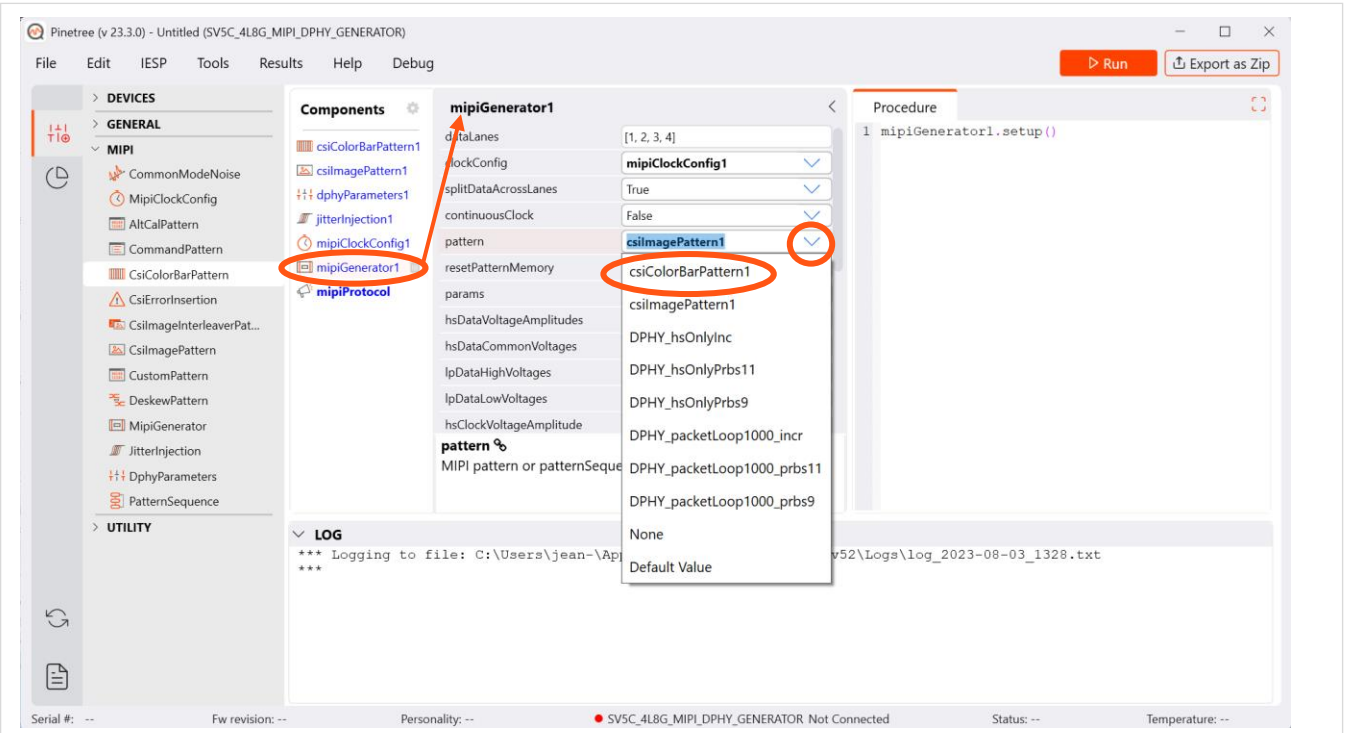


Figure 13: Selecting the csiColorBarPattern1 as the pattern of the mipiGenerator1 component

4. EXECUTING THE TEST PROCEDURE

Up until this point, you have selected a desired pattern and configured the mipiGenerator1 component. However, no pattern is being produced by the generator yet. Users must run the test procedure to start the pattern generation. If the PC has not connected to the SV5C-DPTX already, there is no need to do so manually. The connection will be performed automatically when the Test Procedure is run for the first time.

a) To execute the test procedure, click on the "Run" button at the top right of the main GUI window, as shown here, or use the F5 shortcut key.

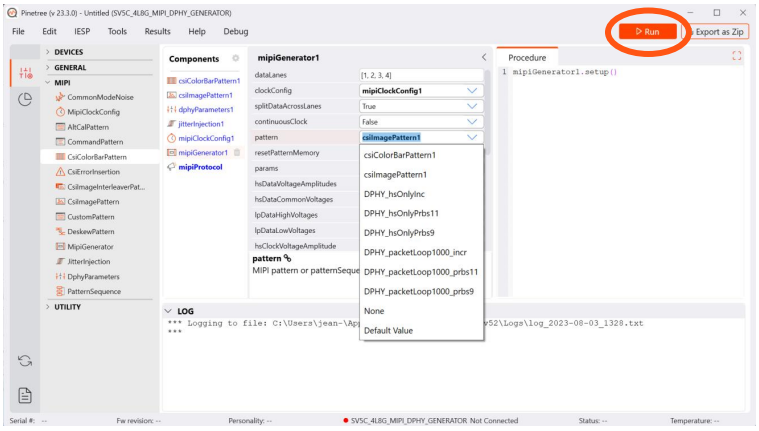


Figure 14: "Run" button placement at the top right of the main GUI

NOTE

Clicking the "Run" button starts executing all the Python code located in the "Test Procedure" pane. 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 packets as shown here.

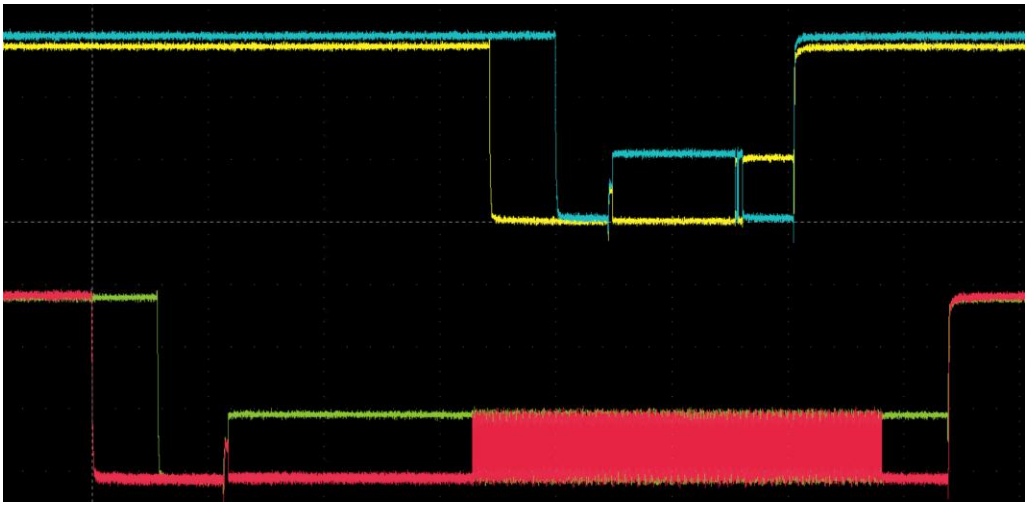


Figure 15: Illustration of the Frame Start Packet

5. MODIFYING TEST PARAMETERS

Now that you have successfully generated your first pattern with the SV5C-DPTX generator, let's experiment with changing some parameters of the generator and observe its effect on the generated signal.

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

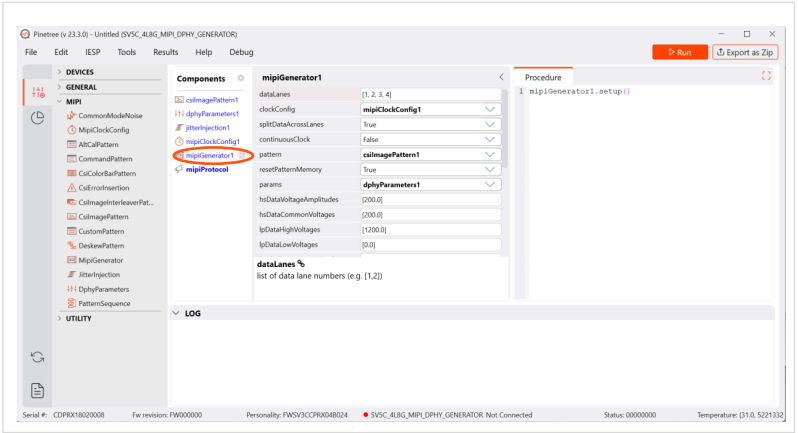


Figure 16: Selecting the mipiGenerator1 component

b) Select the "hsClockCommonVoltage" parameter and change its value from 200mV to 500mV. This is done by clicking the text field to the right of the attribute and editing the value as shown 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.

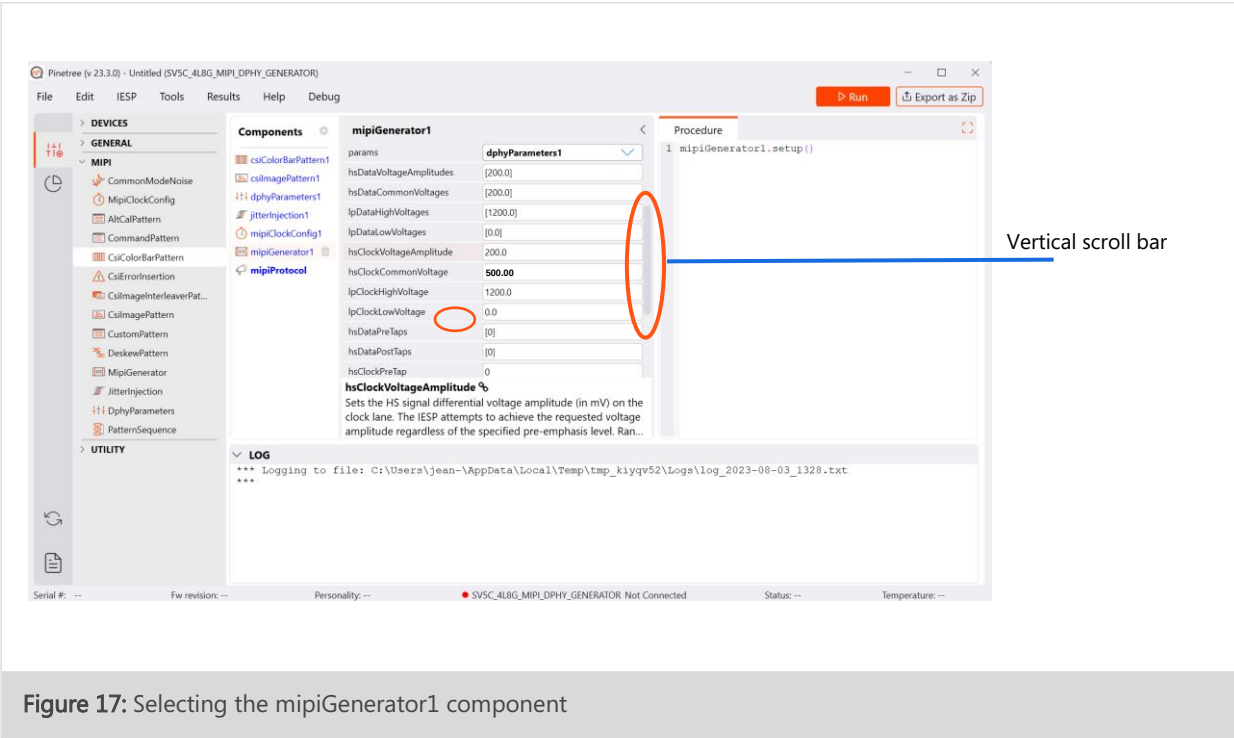


Figure 17: Selecting the mipiGenerator1 component

c) Execute the test again by clicking "Run". The following picture was captured from the scope after changing the previous parameter. Notice that the offset voltage of the clock signal has shifted from 200mV to 500mV, as expected.

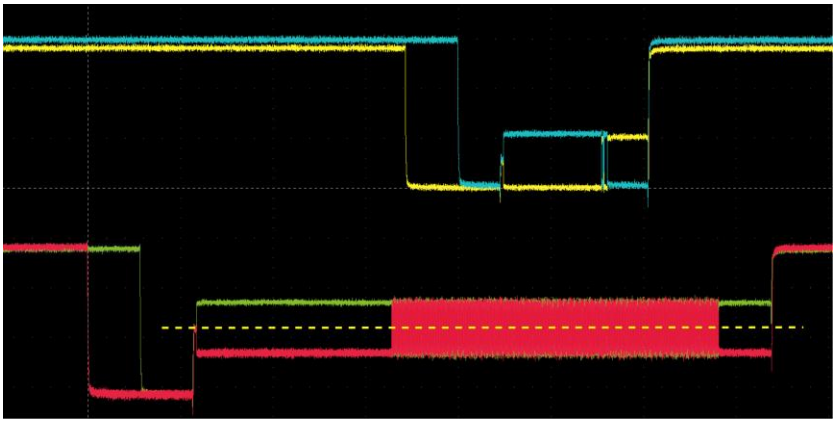


Figure 18: Waveform showing the HS Clock common mode voltage change

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 common mode of the generated clock during the test run, they can add the following two lines to the "Test Procedure" tab:

```
mipiGenerator1.hsClockCommonVoltage = 500
mipiGenerator1.update()
```

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

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 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 Release	January 13, 2023
1.1	Updated all screenshots and software mentions to Pinetree	August 9, 2023

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Published in Canada on August 9, 2023
EN-G067E-E-23221

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