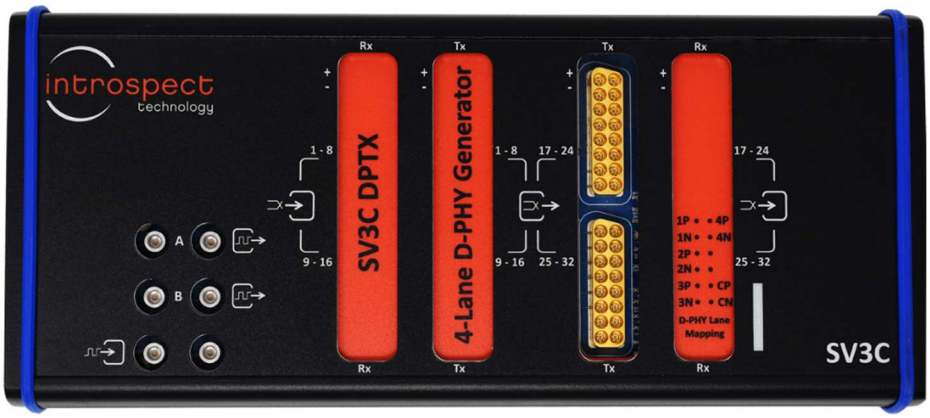
introspect technology

QUICK START GUIDE

SV3C-DPTX

MIPI D-PHY Generator

C SERIES



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Introduction

OVERVIEW

The SV3C-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 SV3C-DPTX MIPI D-PHY Generator operates using the highly versatile Introspect ESP Software environment. 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 Manual will provide the information required for a user to get up and running with the SV3C-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 the Introspect ESP Software.

Quick Start Hardware Description

REQUIREMENTS

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

- 1 x SV3C-DPTX MIPI D-PHY Generator
- 1 x 12V 5A AC / DC power supply (Mfg: CUI, Part #: ETSA120500U)
- 1 x Personal Computer connected to the SV3C-DPTX 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-DPTX.

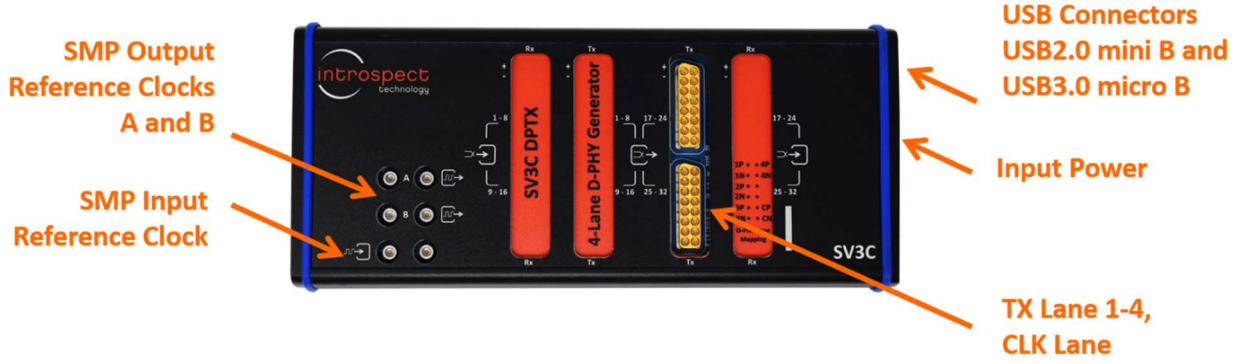
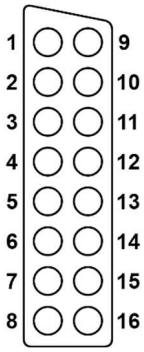


Figure 1: Illustration of the SV3C-DPTX MIPI D-PHY Generator system

The SV3C-DPTX module has two MXP connectors. The lower MXP connector, as shown in Figure 1, provides the differential TX Lanes 1-4 and the differential Clock output signal. The exact pin mapping for this connector in 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.

Introspect ESP Software Installation

SYSTEM REQUIREMENTS

The Introspect ESP Software 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 Introspect ESP install executable
- USB device drivers (refer to the driver installation instructions later in this document)

NOTE

A fully functional command line version of the Introspect ESP software is also available for MacOS and Linux. However, this Quick Start guide will focus on the windows version of the software.

INTROSPECT ESP SOFTWARE INSTALLATION

1. INSTALLATION PREPARATION

a) Quit any Introspect ESP Software instances before starting the installation.
b) If this is your first installation of the Introspect ESP Software, 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 the Introspect ESP 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 Introspect ESP 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 Introspect ESP software and vice versa.

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 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:

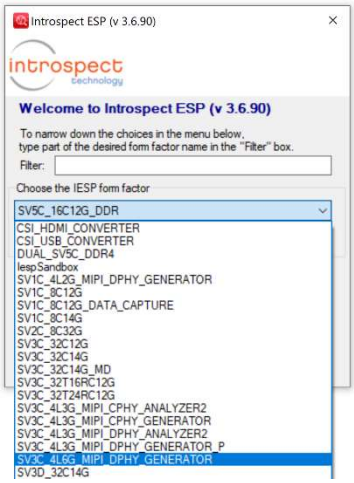
```
C:\[Your Introspect Installation Folder]\Licenses
```

NOTE

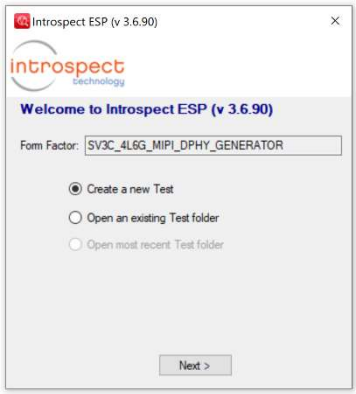
The installer creates a folder called "Introspect" under the "My Documents" folder of your Windows account. This folder is where Test Procedures are saved by default.

4. RUNING THE INTROSPECT ESP SOFTWARE

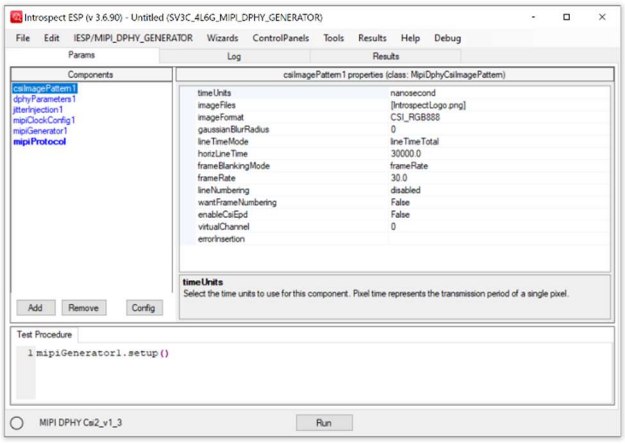
a) Double-click on the "IntrospectESP" shortcut on your Desktop and you should see the first "welcome" window of the GUI. Specify the hardware as “SV3C_4L6G_MIPI_DPHY_GENERATOR” and Press “Next” to continue.



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 the Introspect software 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 Introspect ESP 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_DPHY_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 Introspect ESP 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-DPTX 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.

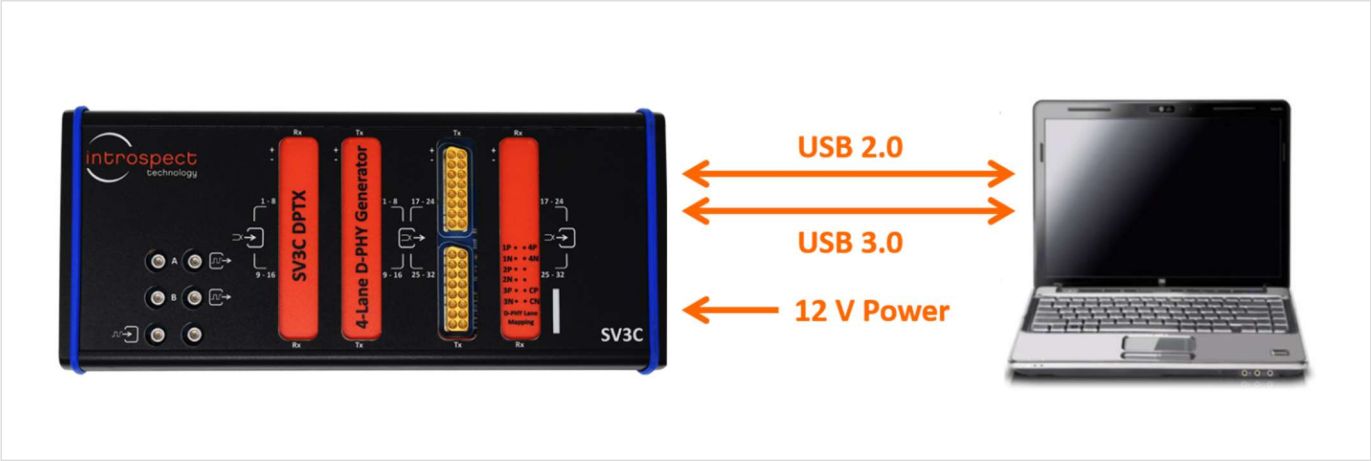


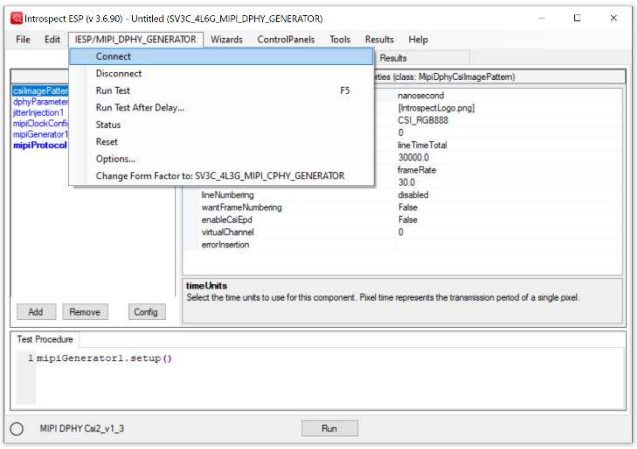
Figure 2: Connection for the automated FTDI driver installation

2. WAIT FOR NEW HARDWARE DETECTION

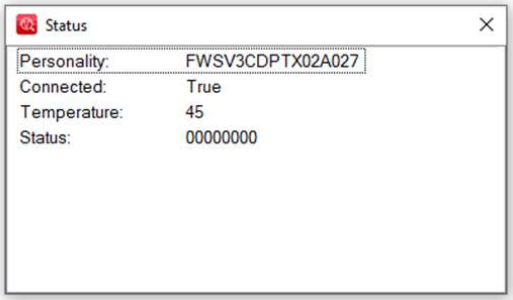
The PC should display the message “New drivers successfully installed” once the installation process is complete. If this does not occur, see the troubleshooting notes at the end of this section.

3. VERIFY DRIVER INSTALLATION

a) If it is not still open, launch the Introspect ESP Software and select the "SV3C_4L6G_MIPI_DPHY_GENERATOR" form factor. From the main GUI window, click the "IESP/MIPI_DPHY_GENERATOR" drop down menu and click "Connect", as shown here. Establishing the connection should take a couple of seconds.



b) To verify the connection, click the "IESP/MIPI_DPHY_GENERATOR" drop down menu and select "Status". A dialog window should confirm that the SV3C-DPTX module is connected, as shown here. Also, the status indicator in the bottom left corner of the main GUI window should be solid green, indicating that the SV3C-DPTX unit is connected and ready. Note that the firmware version may differ from what is shown here.



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-DPTX Demonstration

STEP-BY-STEP GUIDE: GENERATING VIDEO FRAMES

The following step-by-step guide will allow the user to set up the SV3C-DPTX Generator module in order 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 Introspect ESP Software GUI and highlight several of its key features.

1. CONNECT THE HARDWARE COMPONENTS

In order 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 SV3C generator module is depicted in Table 1.

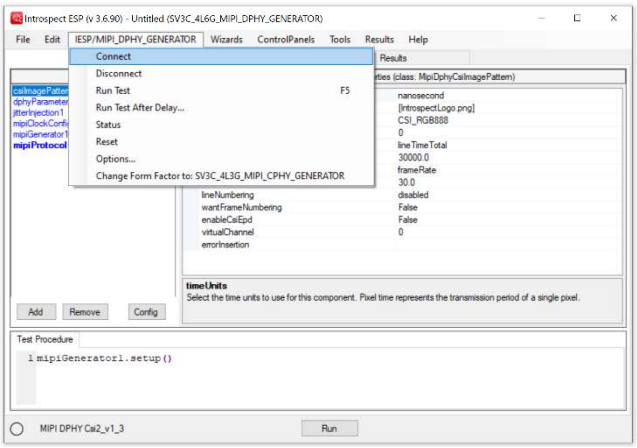
2. GETTING TO KNOW THE INTROSPECT ESP SOFTWARE GUI

a) If you have not done so previously during the USB driver installation procedure, launch the Introspect ESP Software, select the "SV3C_4L6G_MIPI_DPHY_GENERATOR" form factor and create a new test procedure. Connect the SV3C-DPTX 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.

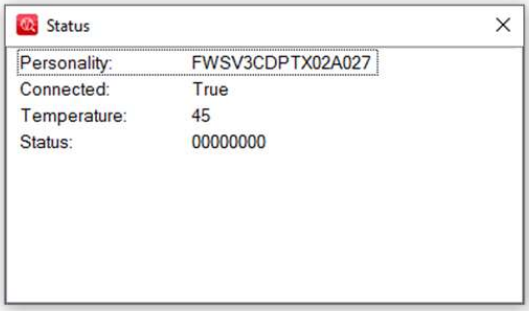
NOTE

The USB3.0 cable is used to accelerate data transfers between the SV3C-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.

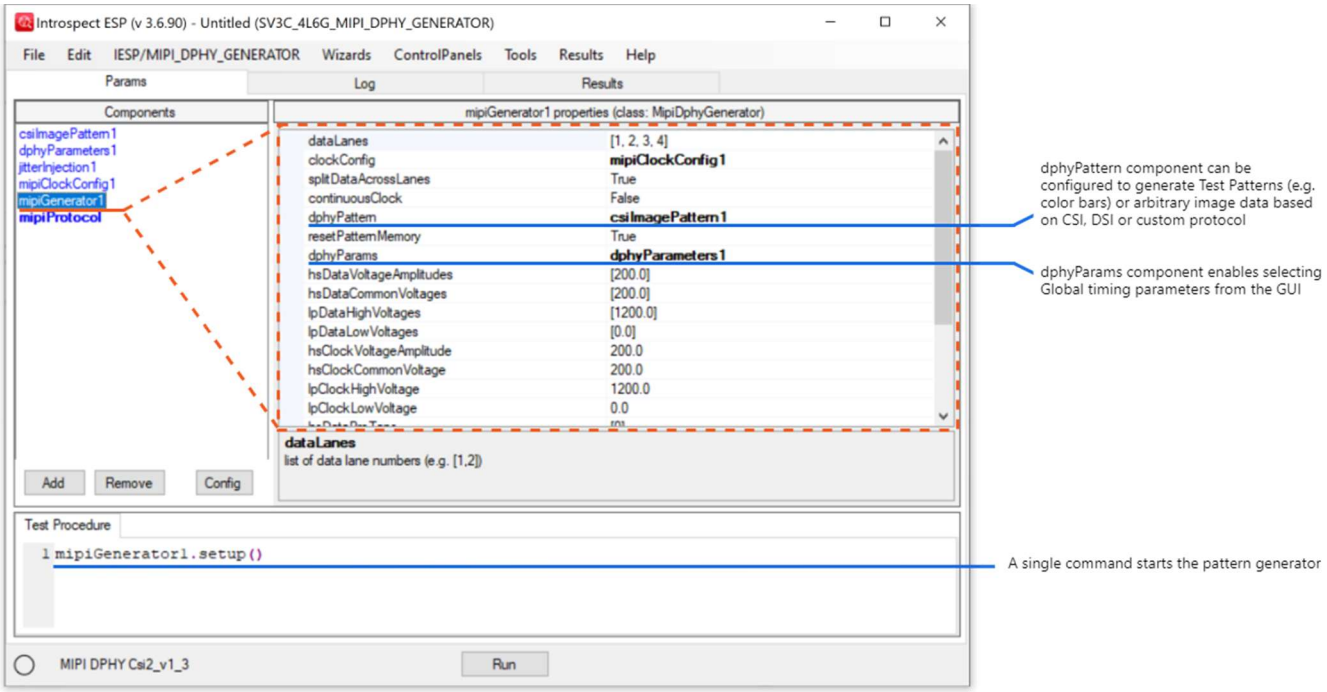
b) In the top left corner of the main GUI window, select the "IESP/MIPI_DPHY_GENERATOR" drop down menu and click the "Connect" option. Establishing connection should take a couple of seconds.



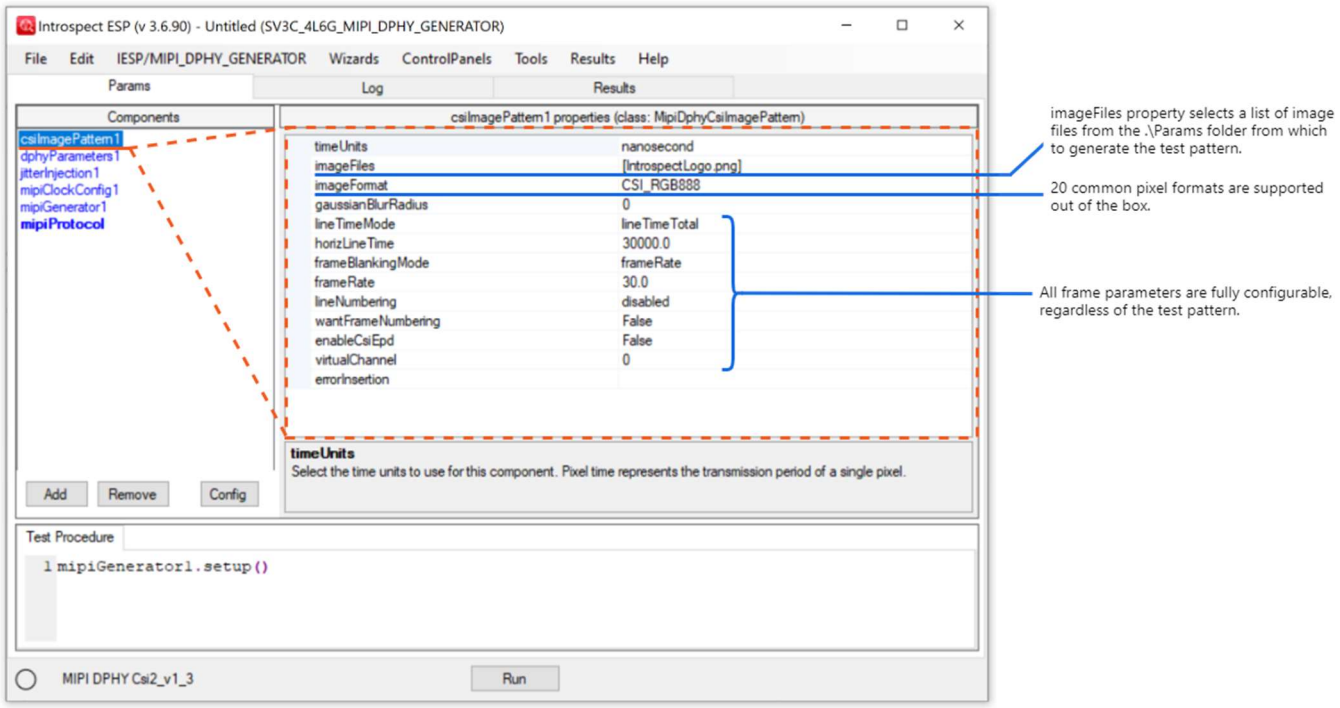
c) To verify the connection between the PC and the SV3C-DPTX module, select the "IESP/MIPI_DPHY_GENERATOR" drop down menu and click the "Status" option. A dialog window should confirm that the SV3C-DPTX module is connected, as shown here. Note that the firmware version may differ from what is shown here.



d) By default, when started in the MIPI_DPHY_GENERATOR form factor, the GUI contains a single command in the Test Procedure window and six 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 mipiDphyGenerator1 component as shown below.



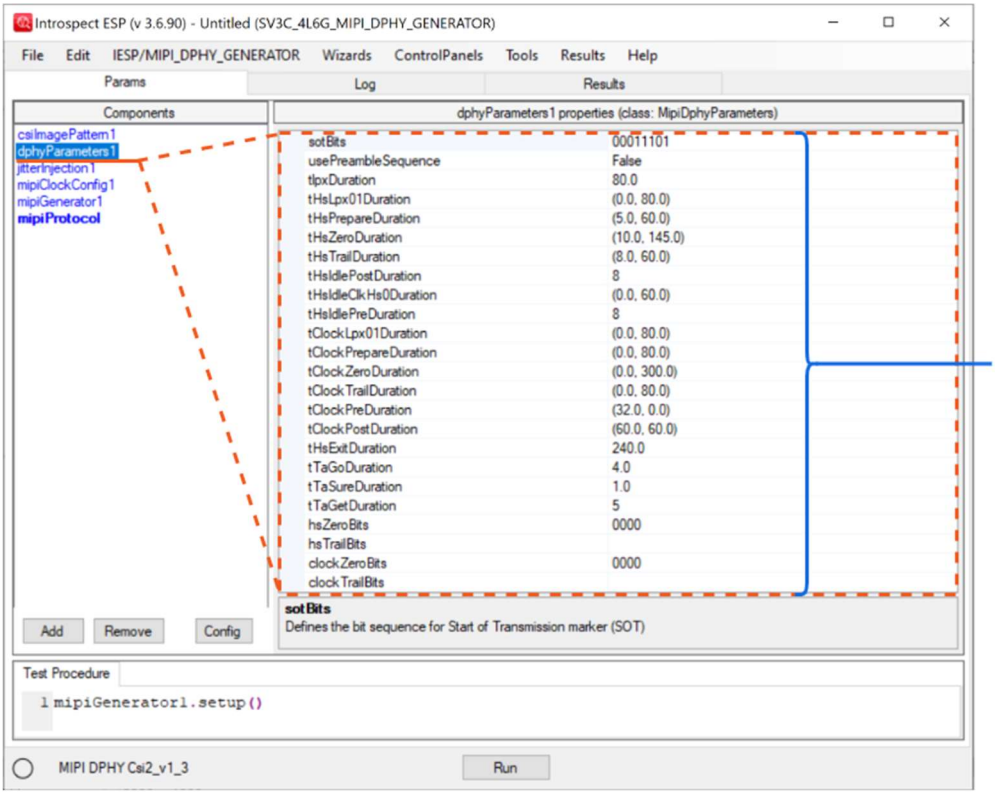
e) One of the properties of the mipiDphyGenerator1 component shown in d) is the dphyPattern and it is used to define the kind of payload that is generated by the SV3C-DPTX module. In the previous picture, the csiImagePattern1 component was selected as the desired dphyPattern. By selecting the csiImagePattern1 component from the "Components" view on the left side 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 setup is a .png image file of the Introspect logo sent as a CSI-2 pattern, but can be changed to any list of image files located in the .\Params folder of your test procedure.

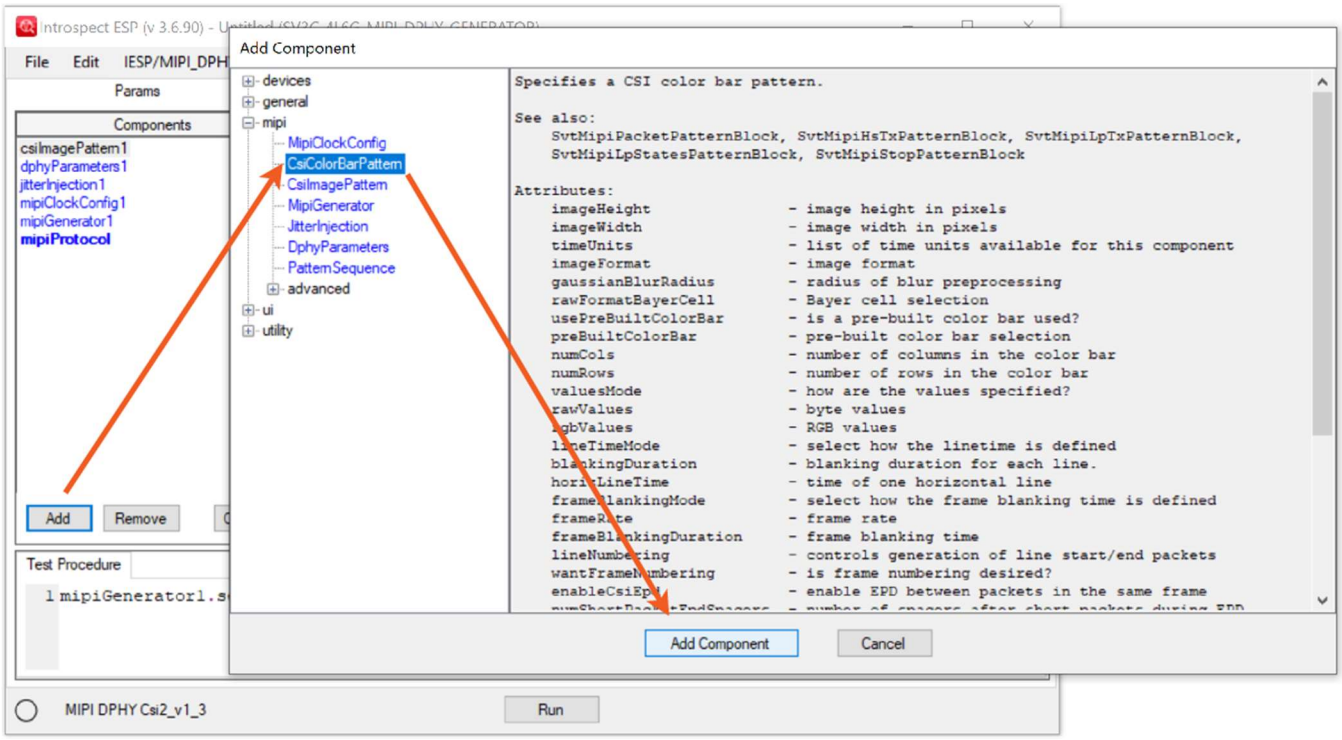
f) Similarly, yet another parameter for the mipiDphyGenerator1 component shown in d) is dphyParams, which allows for defining global timing parameters for the physical MIPI D-PHY layer. By default, this parameter is pre-filled with the dphyParameters1 component. Selecting the dphyParameters1 component in the "Components" view on the left side of the main GUI window reveals the list of properties it provides, as shown below.



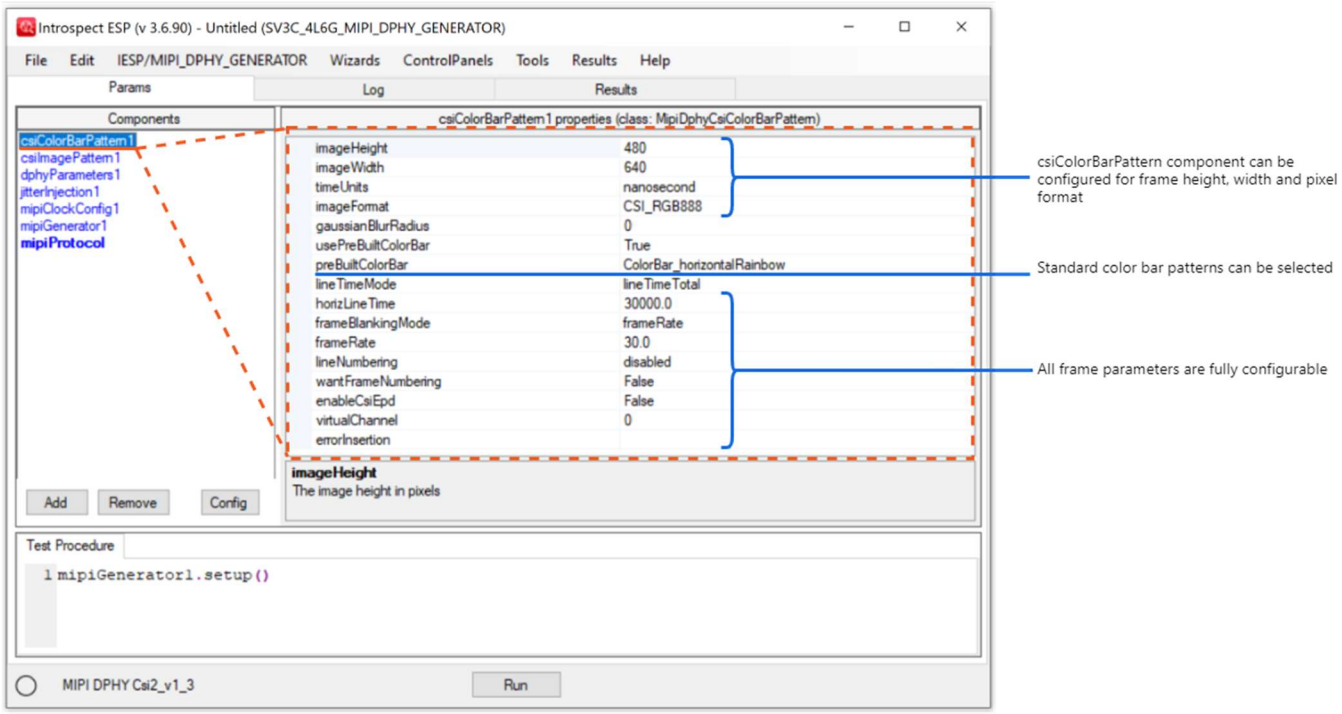
Global timing parameters are included in units of UI and nanoseconds, exactly as in the MIPI specification. SOT bits are configurable on the fly for the purpose of testing

3. ADDING TEST COMPONENTS

For simplicity, this Quick Start guide will be using color bars instead of an image frame for generating its dphyPattern. To do so, add a new component to the test by clicking the "Add" button in the "Components" view and select the "dphyColorBarPattern" component in the pop-up window. Then, click the "Add Component" button to add the selected component to the test, as shown below.



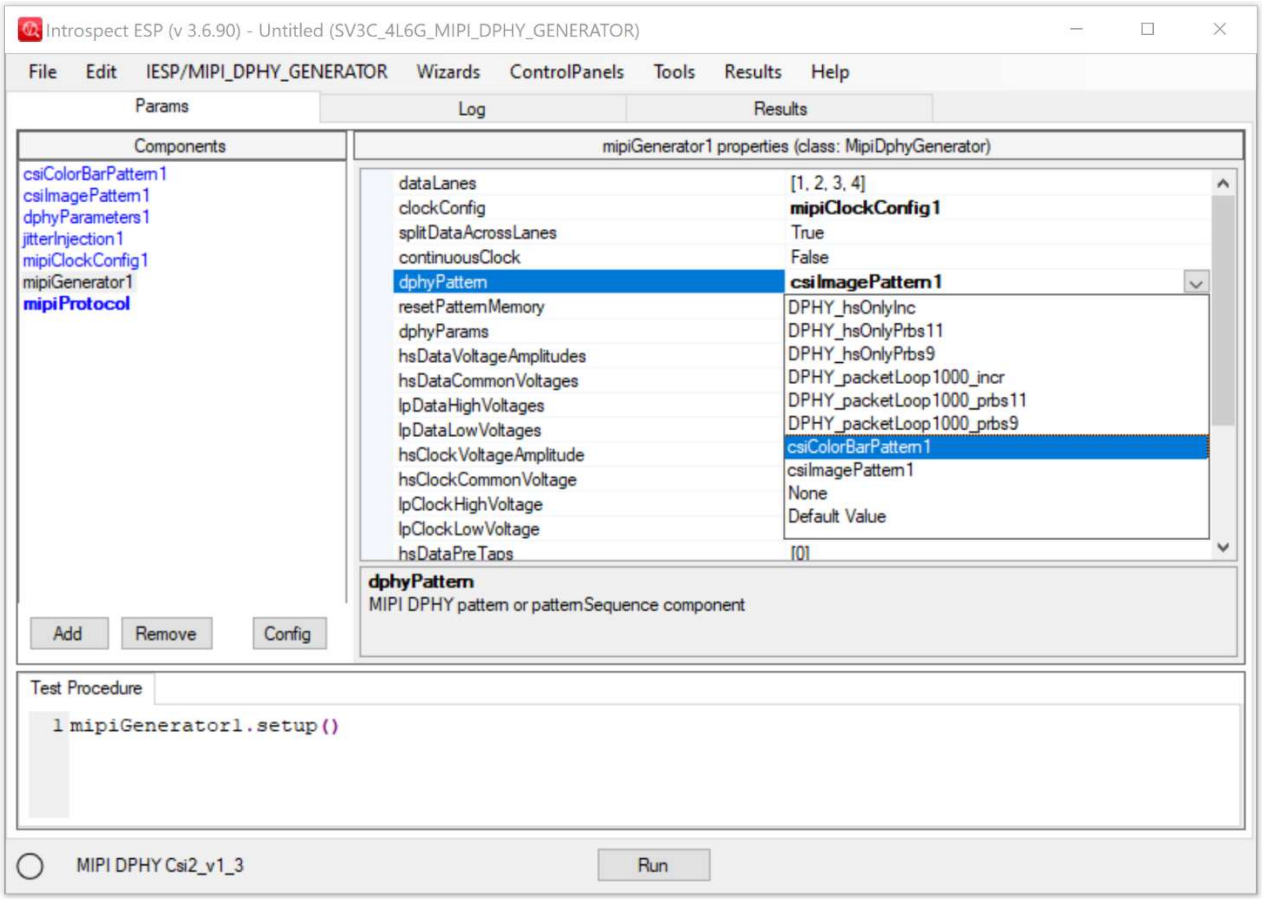
After adding the component, it will appear in the "Components" view on the left side of the main GUI window. By selecting the newly created csiColorBarPattern1 component from the list, its parameters can be viewed and edited, as shown below.



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.

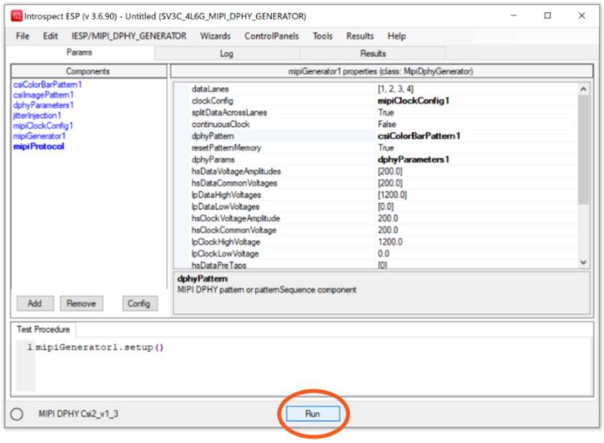
In order to make the dphyColorBarPattern1 the active pattern used by the generator, select the mipiGenerator1 component from the “Components” list, select the dphyPattern property and click on "csiColorBarPattern1" from the pull-down menu, as shown below.



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.



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.

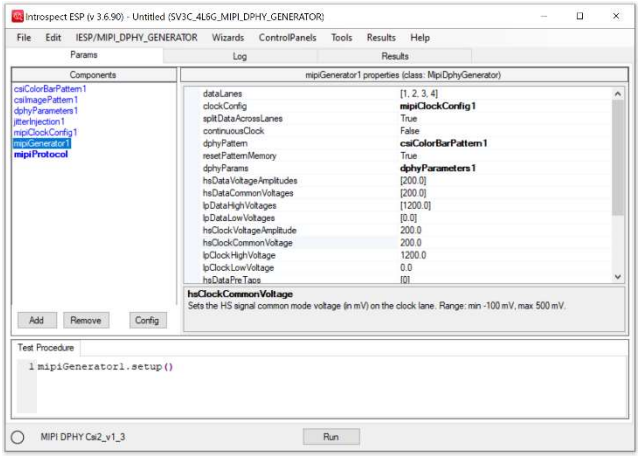
b) Set up the oscilloscope trigger level to around 400 mV and confirm transmission of packets as shown here.

Illustration of the Frame Start Packet

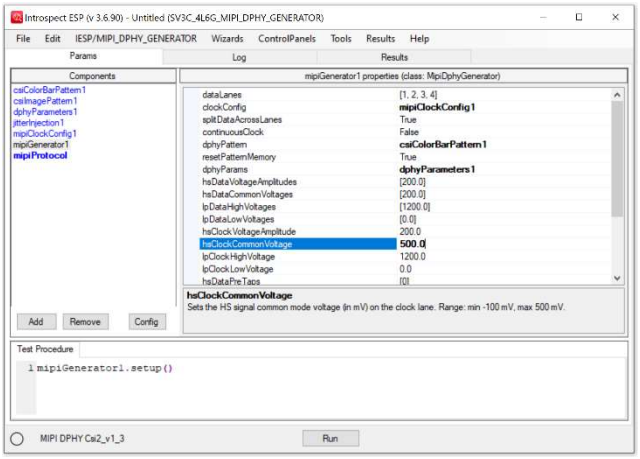
5. MODIFYING TEST PARAMETERS

Now that you have successfully generated your first pattern with the SV3C-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.



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, 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.



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.

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.

This concludes the SV3C-DPTX 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 Introspect ESP 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	Import from original template.	July 22, 2015
1.1	Minor edits. Added Active Perl Link.	July 29, 2015
1.2	New features included, Perl descriptions removed.	May 25, 2018
2.0	Major document revision and update to the new document template.	April 2, 2020

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