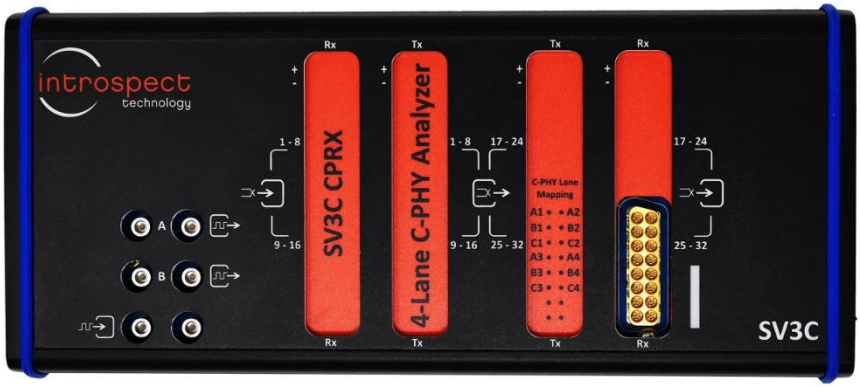
introspect technology

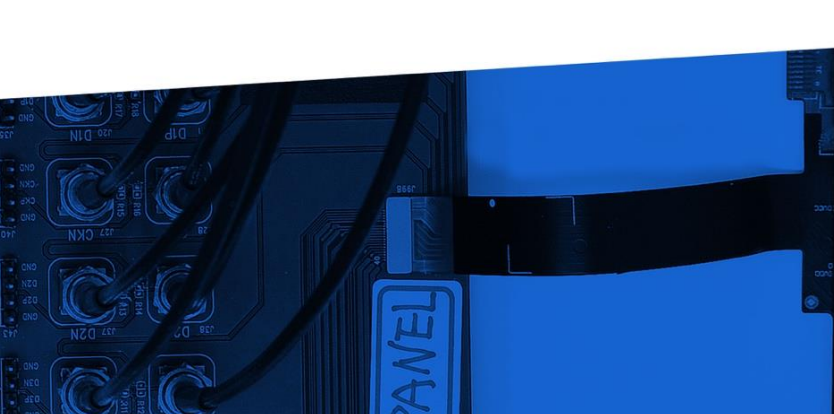
QUICK START GUIDE

SV3C-CPRX

MIPI C-PHY Analyzer

C SERIES





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Introduction

OVERVIEW

The SV3C-CPRX MIPI C-PHY Analyzer is an ultra-portable, high-performance instrument that provides the most comprehensive capabilities on the market for exercising and validating MIPI C-PHY transmitter ports. Receiving traffic over a continuous range of data rates, the C-PHY Analyzer includes complete hardware demapping and decoding, a three-wire C-PHY CDR, and offers sophisticated capture and compare modes.

The C-PHY Analyzer operates using the award-winning Introspect ESP software environment, allowing for automated transmitter tests such as BER, protocol timing, and MIPI CTS. The software also includes a full suite of tools for DSI and CSI-2 video frame extraction for packet analysis and system level test.

QUICK START DOCUMENTATION

This Quick Start Guide will provide the information required for a user to get up and running with the SV3C-CPRX system. Basic hardware and software installation instructions are included, followed by a step-by-step procedure to start receiving and analyzing MIPI C-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-CPRX MIPI C-PHY Analyzer
- 1 x 12V 5A AC / DC power supply (Mfg: CUI, Part #: ETSA120500U)
- 1 x Personal Computer connected to the SV3C-CPRX via a USB2.0 mini B and a USB3.0 micro B cable
- 1 x MXP to SMA Cable Assembly (included with analyzer)

HARDWARE DESCRIPTION

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

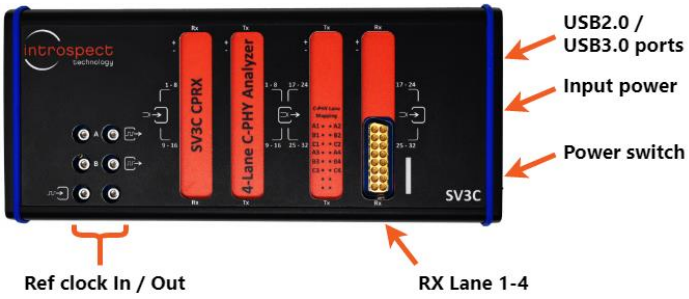
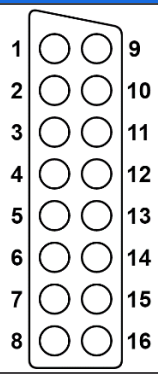


Figure 1: Illustration of the SV3C-CPRX MIPI C-PHY Analyzer system

The SV3C-CPRX MIPI C-PHY Analyzer uses a single MXP connector to receive signals on its data lanes. A detailed pinout of the connector is provided in Table 1 below.

TABLE 1: MXP CONNECTOR PINOUT

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

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, or Windows 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 sessions 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 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 the Introspect ESP Software. 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, 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.

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 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 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:

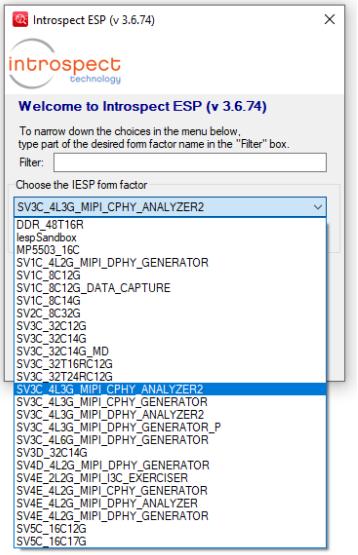
```
C:\[Your Introspect Installation Folder]\Licenses
```

NOTE

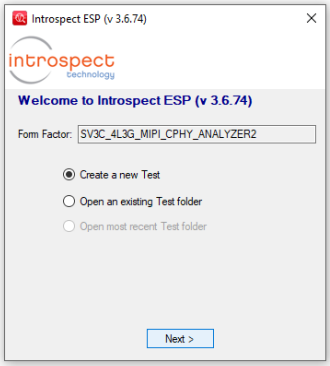
The installer creates a folder called "Introspect" under the "My Documents" folder of your account. This folder is where Test Procedures are usually saved.

4. RUNING THE INTROSPECT ESP SOFTWARE

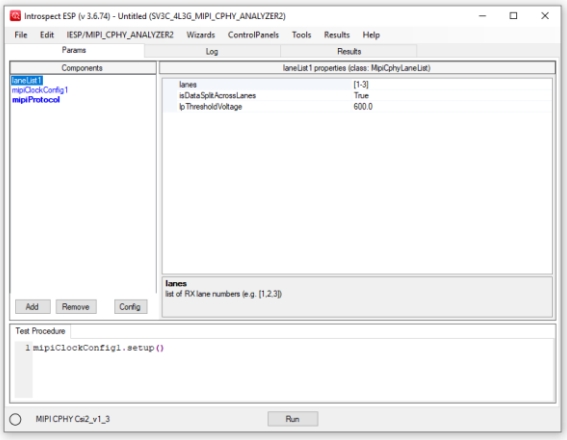
a) Double-click on the "IntrospectESP" shortcut on your Desktop and you should see the first "welcome" window of the GUI. Please specify the hardware as “SV3C_4L3G_MIPI_CPHY_ANALYZER2” and Press “Next” to continue.



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_4L3G_MIPI_CPHY_ANALYZER2". 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 Introspect ESP window.

"Application Notes" can also 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 SV3C-CPRX 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.

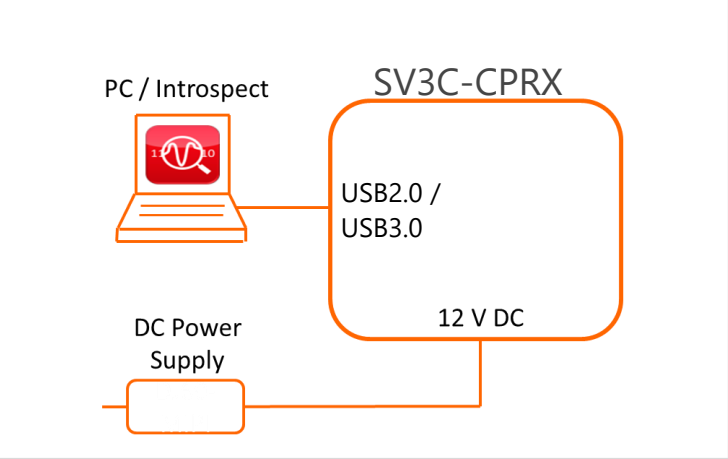


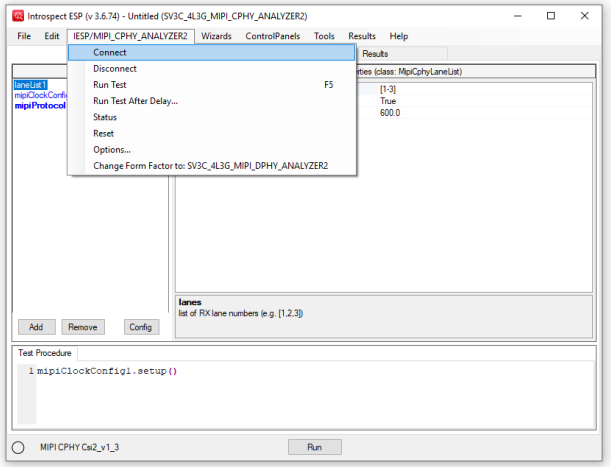
Figure 2: Connection for the automated FTDI driver installation

2. WAIT FOR NEW HARDWARE DETECTION

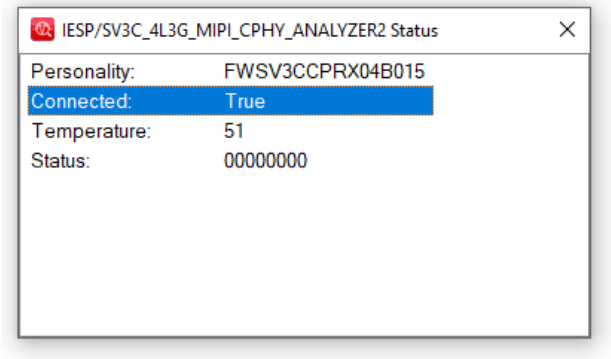
The PC should display the message "New drivers successfully installed" once the installation process is complete. If this does not occur, see the troubleshooting notes at the end of this section.

3. VERIFY DRIVER INSTALLATION

a) If it is not still open, launch the Introspect ESP Software and select the "SV3C_4L3G_MIPI_CPHY_ANALYZER2" form factor. From the main GUI window, click the "IESP/MIPI_CPHY_ANALYZER2" drop down menu and click "Connect", as shown here. Establishing the connection should take a couple of seconds.



b) To verify the connection, select the "IESP/ MIPI_CPHY_ANALYZER2" drop down menu and click "Status". A dialog window should confirm that the SV3C-CPRX 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 unit is connected and ready.



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.

SV3C-CPRX Demonstration

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

The following step-by-step guide will allow the user to set up the SV3C-CPRX module in order to receive a CSI-2 image frame being transmitted over a single C-PHY lane. It will also demonstrate how to capture, visualize, and analyze the received packets using the mipiCphyCsiDataCapture component of the Introspect ESP Software. 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 analyze a C-PHY signal, you will need a DUT capable of producing CSI-2 image frames, such as a camera. Connect your DUT's C-PHY data lane to the MXP Rx port of the SV3C-CPRX module according to the pinout shown previously in Table 1 of this document.

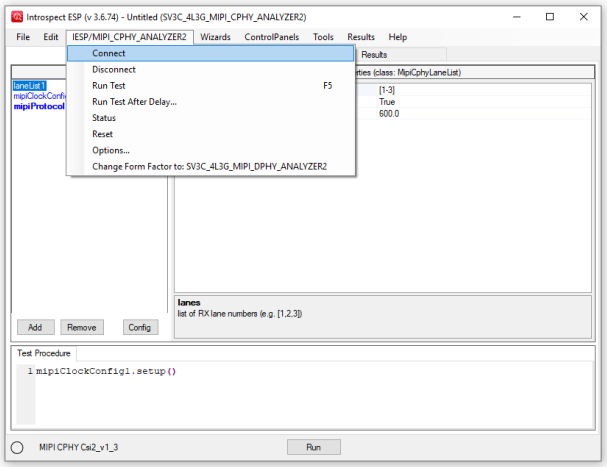
2. GETTING TO KNOW THE INTROSPECT ESP SOFTWARE GUI

a) If you have not done so previously during the USB driver installation procedure, launch the Introspect ESP Software, select the "SV3C_4L3G_MIPI_CPHY_ANALYZER2" form factor and create a new test procedure. Connect the SV3C-CPRX to your PC using both a USB2.0 mini B cable and a USB3.0 micro B cable and power up the module.

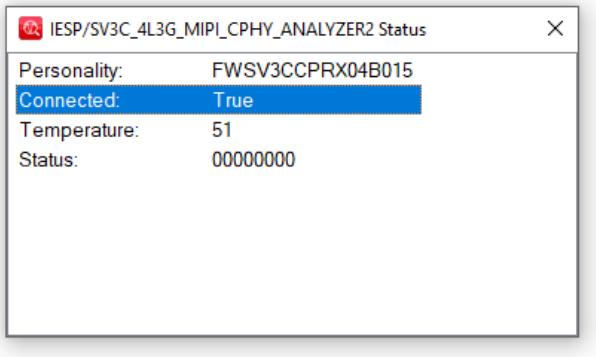
NOTE

The USB3.0 port 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/ MIPI_CPHY_ANALYZER2" drop down menu and click the "Connect" option. Establishing connection should take a couple of seconds.

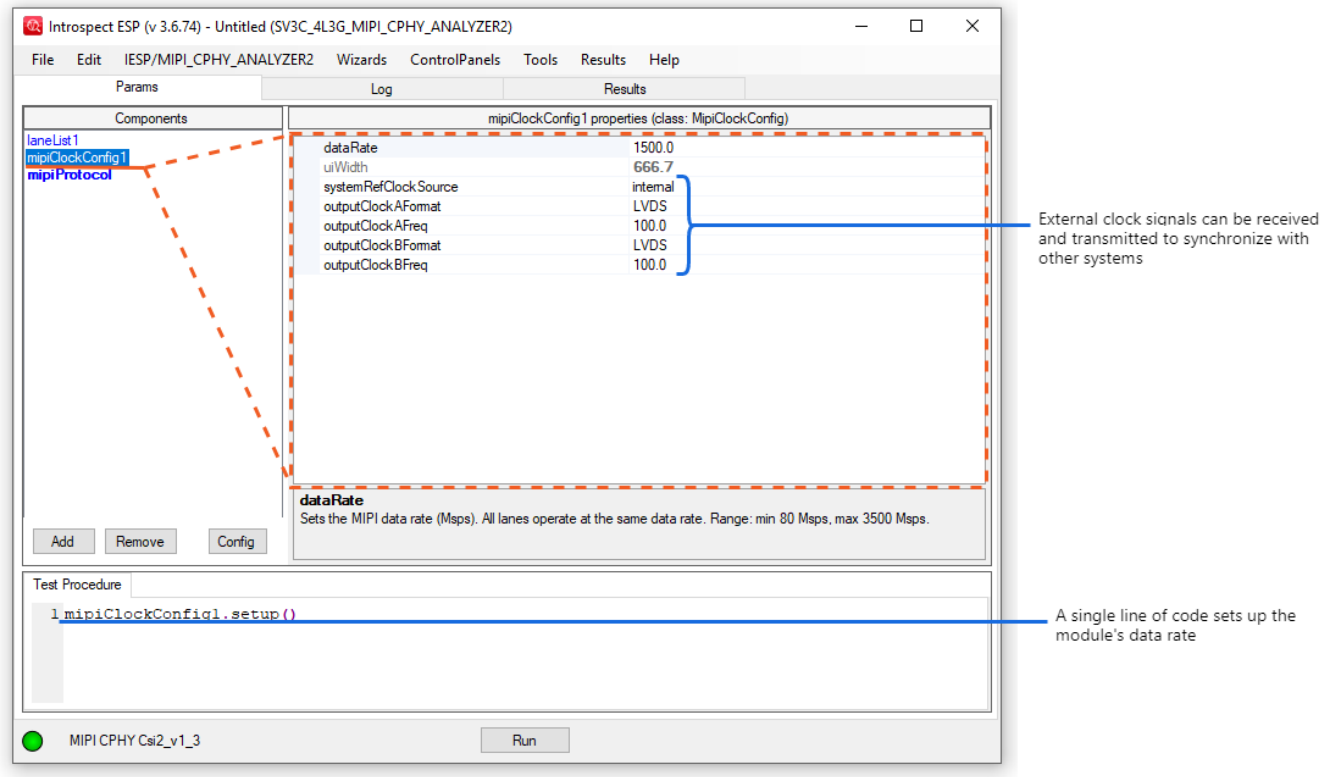


c) To verify the connection between the PC and the SV3C-CPRX module, select the "IESP/ MIPI_CPHY_ANALYZER2" drop down menu and click the "Status" option. A dialog window should confirm that the SV3C-CPRX module is connected, as shown here, and will list the detected personality / firmware version.



d) By default, when started in the "SV3C_4L3G_MIPI_CPHY_ANALYZER2" 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.

e) The mipiClockConfig1 component is used to specify the rate at which data is being transmitted to the SV3C-CPRX module. The mipiClockConfig1 component can also be used to configure external clock signals to synchronize the SV3C-CPRX module to other systems.

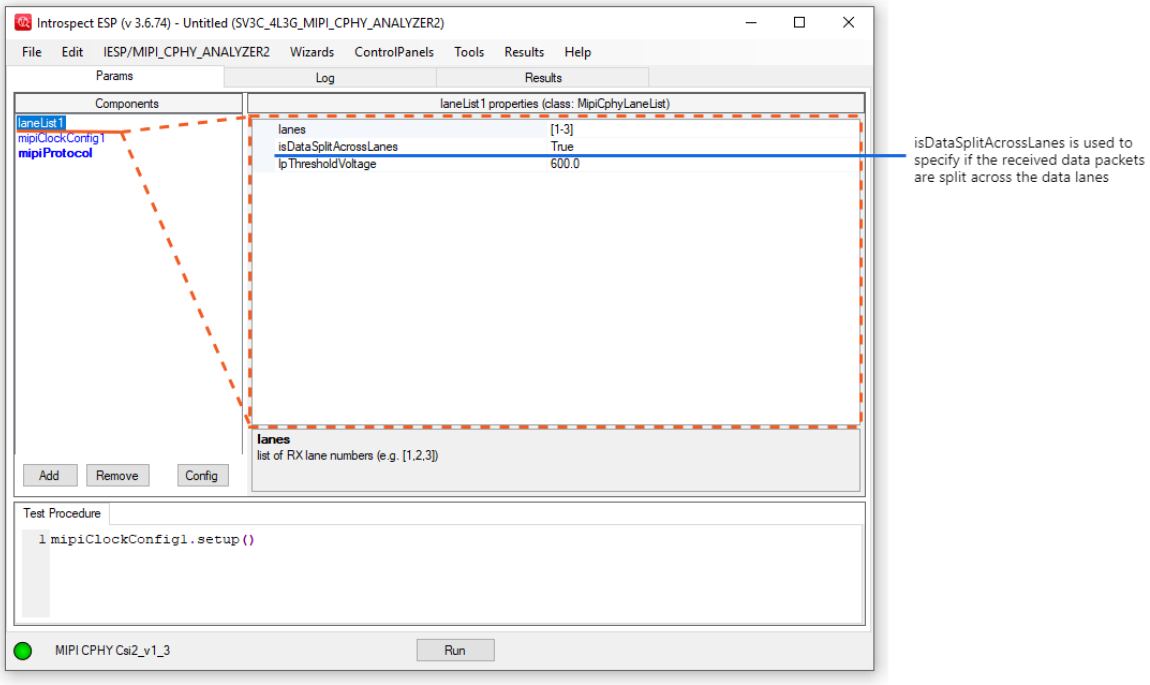


f) Before continuing, make sure the "dataRate" property matches the data rate of the transmitting DUT.

NOTE

An external clock reference must be used to capture HS-only data signals.

g) The "laneList1" component is used to configure the data lanes that will be used to capture C-PHY signals using the SV3C-CPRX module. The SV3C-CPRX module supports any combination of data lanes, allowing for greater flexibility when testing multiple types of DUTs.



h) In this first example, only a single C-PHY lane will be used to transmit data from the DUT to the SV3C-CPRX module. To use only lane 1 of the SV3C-CPRX, select the "laneList1" component in the left view, then select the "lanes" parameter in the right view and edit it to: [1].

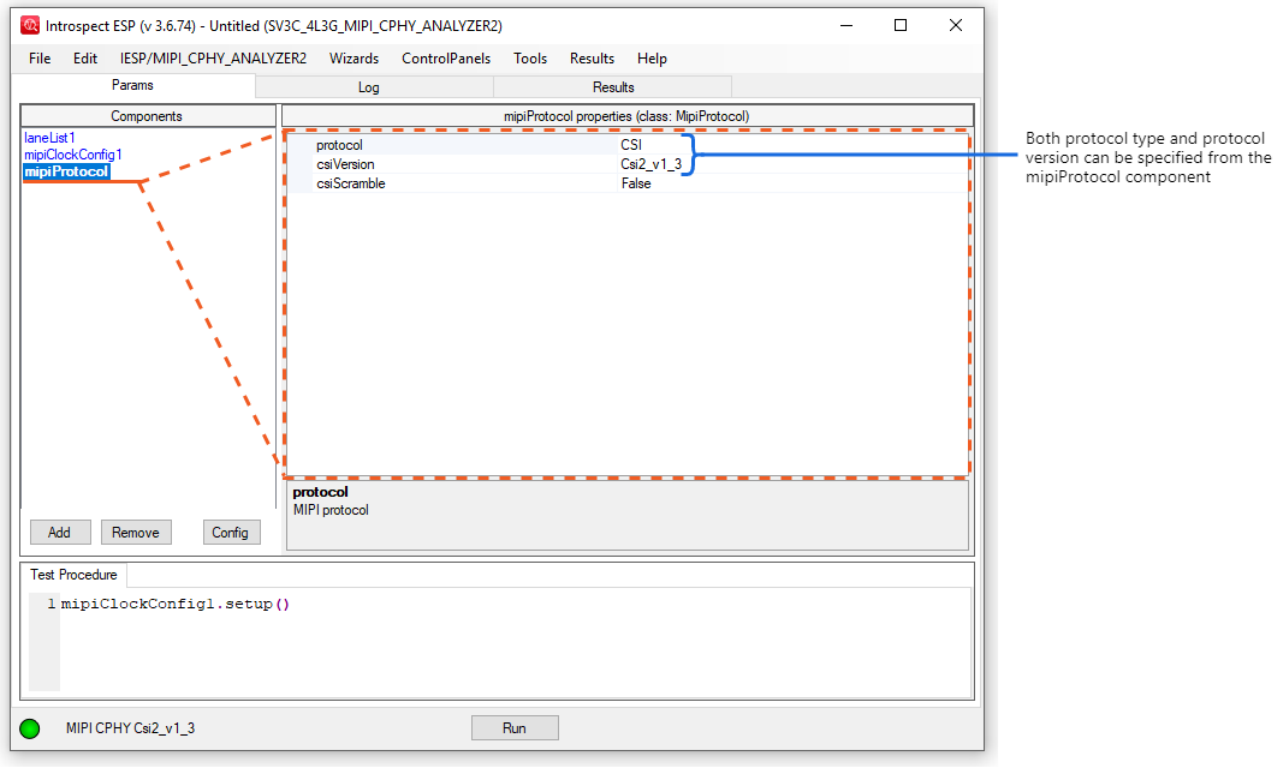
NOTE

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.

i) The "mipiProtocol" component is used to specify the encoding specifications of the received data packets, as shown below. The SV3C-CPRX module fully supports the DSI, DSI-2 and CSI-2, as well as the reception of bitstreams without any type of encoding.



j) In this example, the transmitted data packets are encoded using the CSI-2 v1.3 protocol, so the default settings will do.

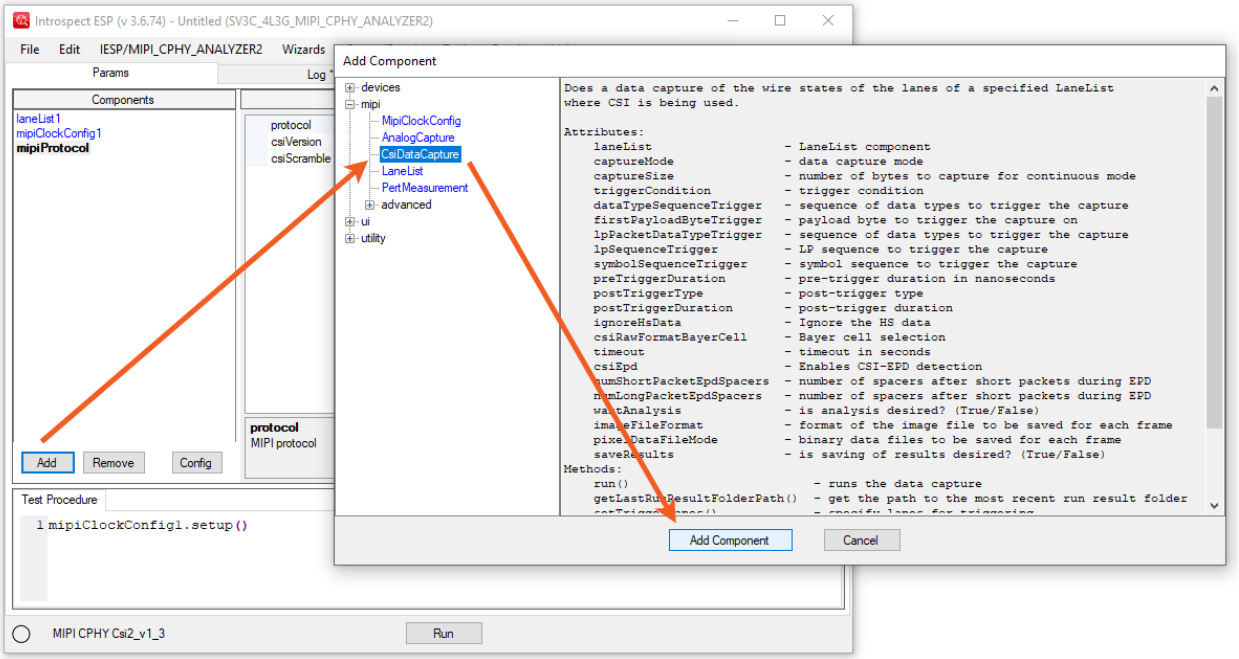
NOTE

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.

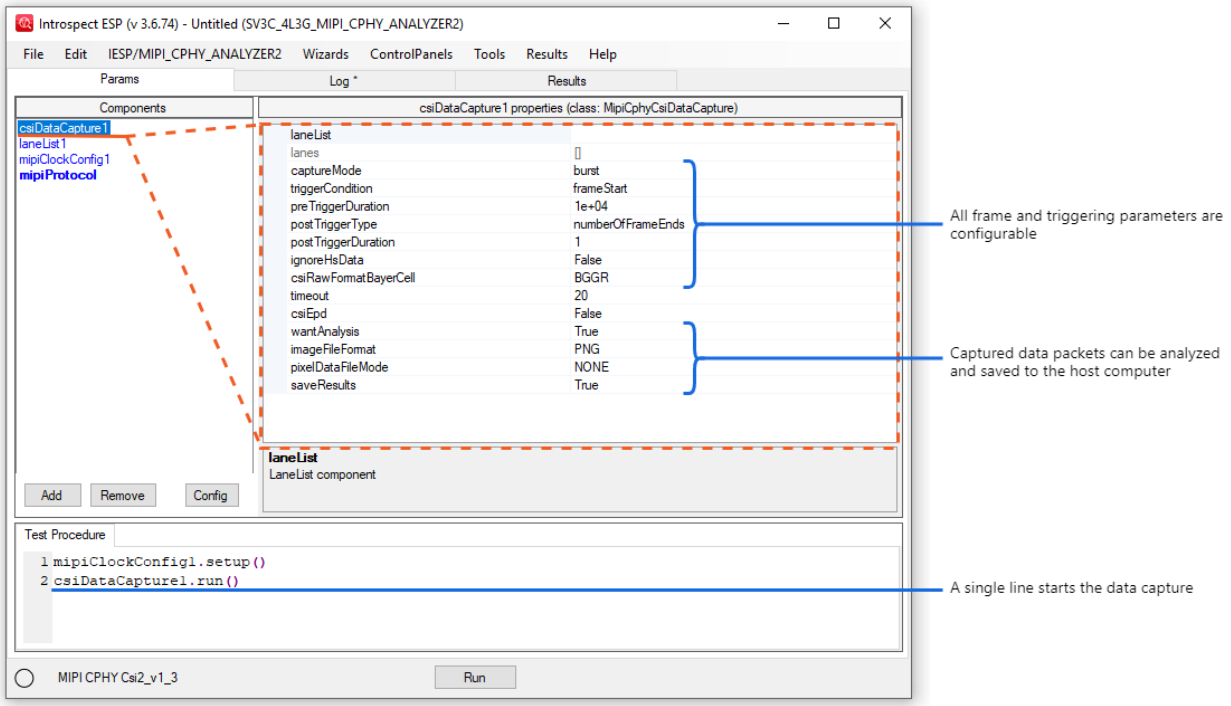
3. ADDING TEST COMPONENTS

a) The objective of this step-by-step guide is to capture a CSI-2 encoded image frame over a single C-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, displaying, and analyzing data packets received by the SV3C-CPRX module.

To add a component to the test procedure, click the "Add" button in the left "Components" view of the main GUI window. In the "Add Component" window, select the "CsiDataCapture" component, and click the "Add Component" button, as shown below.

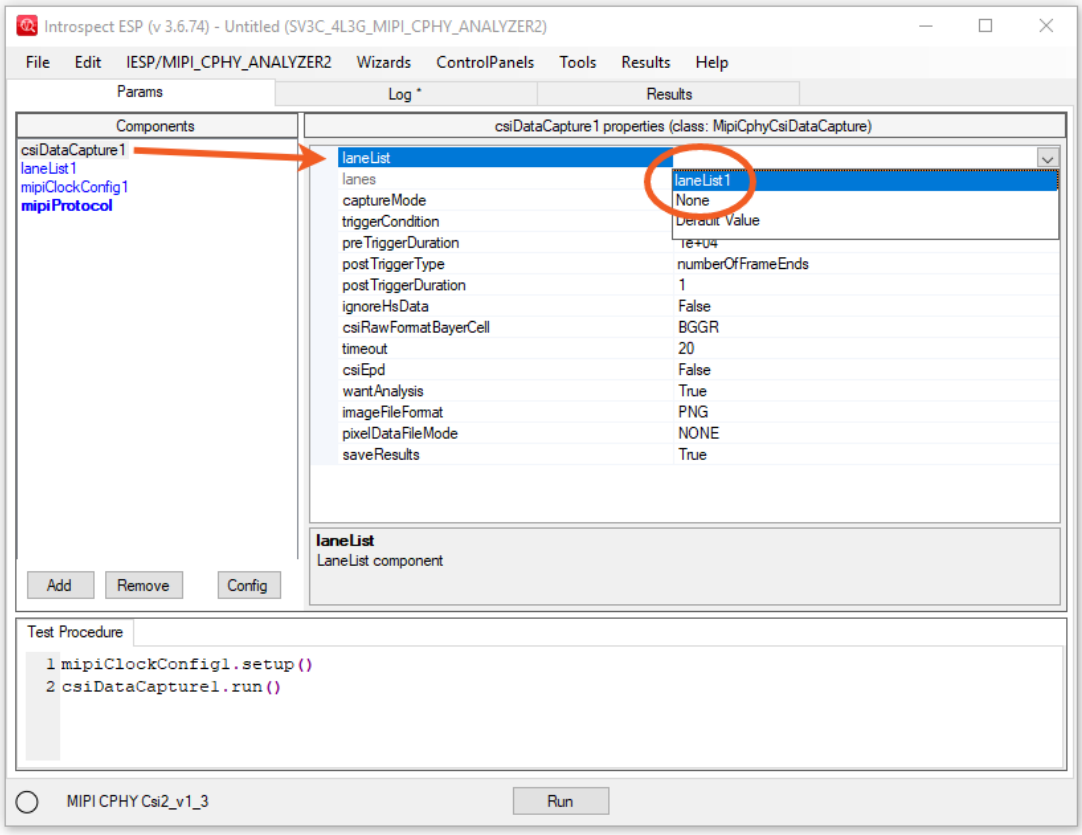


b) A new "csiDataCapture1" component will be added to the left "Components" view of the main GUI window. Notice that a new line of code has automatically been added to the end of the "Test Procedure" editor window in order to start the data capture, as shown below.



c) The default configuration of the “CsiDataCapture” component 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.

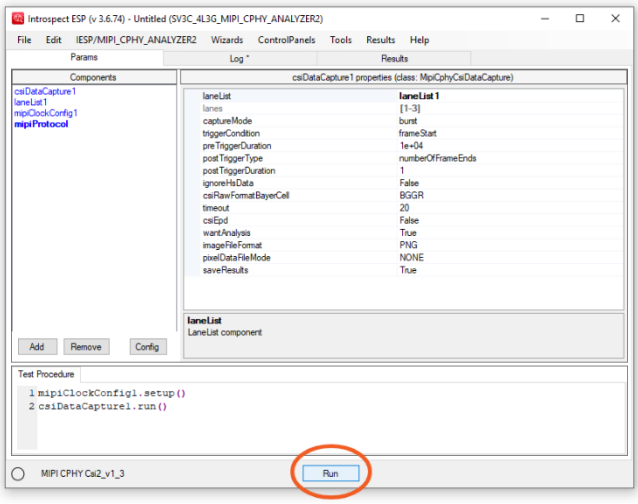
d) The “CsiDataCapture” component requires a list of lanes to be specified in order to capture data packets. To do so, select the “laneList” property of the csiDataCapture1 component, click the arrow from the drop-down menu on the right-hand side, and choose the desired “laneList” component from the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



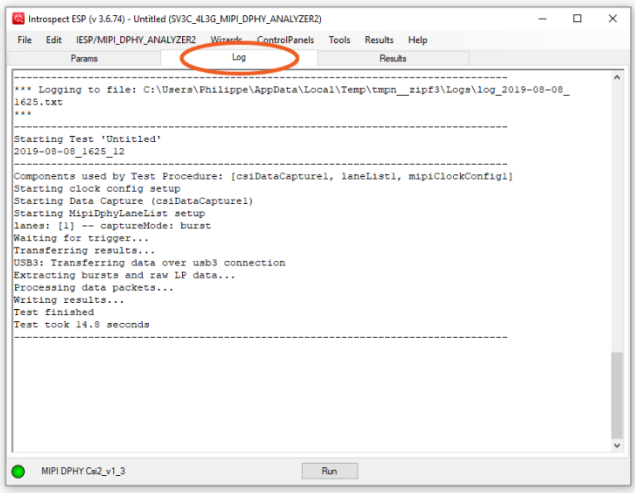
4. EXECUTING THE TEST PROCEDURE

a) Now that the hardware has been connected and the procedure has been configured to fit the DUT's settings, the SV3C-CPRX module is ready to receive C-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 SV3C-CPRX module, the test procedure can be executed from the GUI.

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



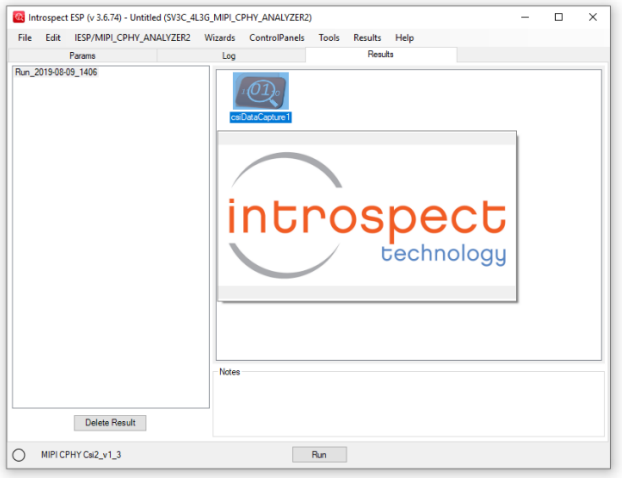
c) After clicking the “Run” button, the GUI will automatically change from the “Params” tab to the “Log” tab where you can find information about the currently running procedure. Any errors occurring during the test run will be reported here.



NOTE

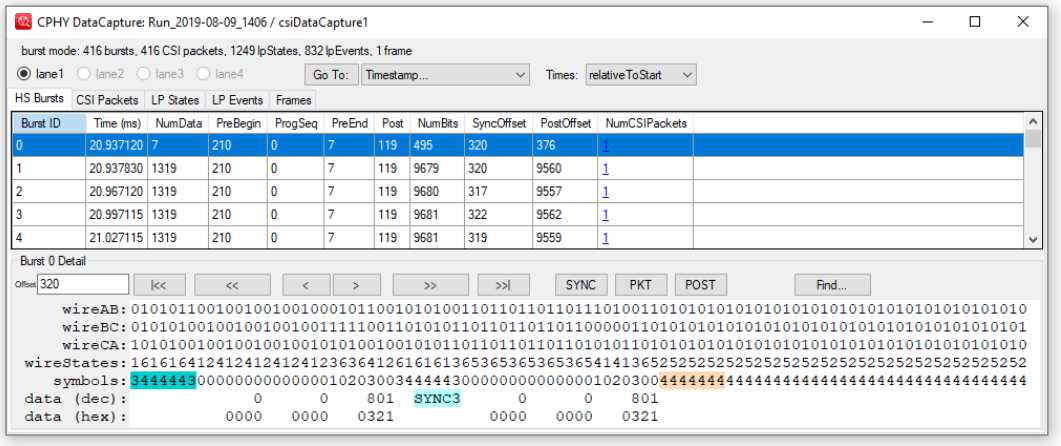
The Python print() function will automatically print out messages in the “Log” tab during the test run. This can be used for debugging as well as keeping track of Test Procedure execution.

d) After the test procedure has completed, the GUI will automatically change to the "Results" tab. The captured image frame can be previewed by selecting the most recent test run result on the left side of the window and hovering above the "csiDataCapture1" icon.



e) As can be seen, the SV3C-CPRX module was able to properly capture the Introspect Technology logo encoded using the CSI-2 protocol and transmitted over a single C-PHY lane.

All packets received during the data capture can be visualized by double clicking the "csiDataCapture1" file under the "Results" tab. The received data can be arranged into "HS Bursts", "CSI Packets" or "Frames" by navigating the "CPHY DataCapture" window. "LP States" and "LP Events" are also accessible to allow easy inspection of LP to HS transitions of the transmitting DUT.



NOTE

The "CPHY DataCapture" result window allows for easy failure analysis by highlighting frames where errors have been detected.

This concludes the SV3C-CPRX 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	Document Release	August 9, 2019

The information in this document is subject to change without notice and should not be construed as a commitment by Introspect Technology. While reasonable precautions have been taken, Introspect Technology assumes no responsibility for any errors that may appear in this document.

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