introspect technology

QUICK START GUIDE

SV7C

Personalized SerDes Tester

C SERIES

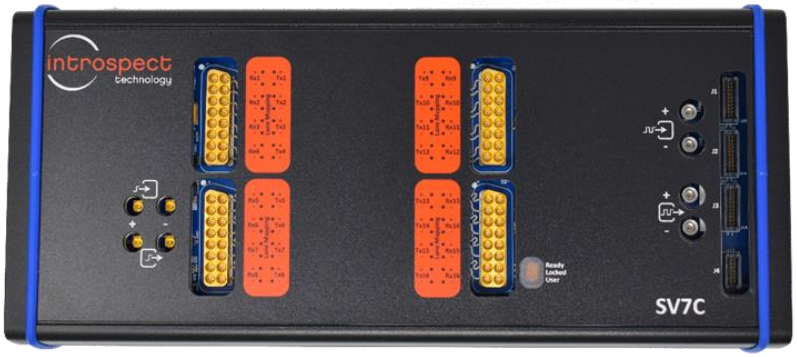

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Table of Contents

Introduction

OVERVIEW

The SV7C is a parallel high-speed tester that meets the emerging test and validation requirements of increasingly complex electronic component and board designs. Operating at up to 28 Gbps and featuring 16 independent pattern generators and 16 independent signal/data analyzers, the SV7C is an all-in-one, phase-aligned bit error rate tester (BERT) and protocol exerciser and analyzer, providing self-contained functional and physical layer test and measurement capabilities for interfaces such as PCIe, Ethernet, USB, and JESD204C.

QUICK START DOCUMENTATION

This Quick Start Guide will provide the information required for a user to get up and running with the SV7C. Basic hardware and software installation instructions are included followed by a step-by-step procedure to start generating and measuring high speed signals in Pinetree, previously known as 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 SV7C Personalized SerDes Tester
- 1 x 12V 25A AC / DC power supply (part # TDK-Lambda, DTM300PW120D1)
- 1 x MXP to 2.4mm Cable Assembly (part # Huber+Suhner 85023135, MF53/2x8A_21MXP/21PC24_erg/152) or similar, if SMA cable assemblies are preferred
- 2 x 2.4mm RF coaxial male-male adapters (example part # Carlisle TMA-4MS-4MS-00) or similar, if SMA cable assemblies are preferred
- 1 x USB-A 2.0 to USB Mini-B cable
- 1 x USB-A 3.0 to USB-C cable
- 1 x Personal Computer for running Pinetree

HARDWARE DESCRIPTION

Figure 1 shows a diagram of the physical ports of the SV7C, and the full pin mapping for the MXP connectors is provided in Table 1 below.

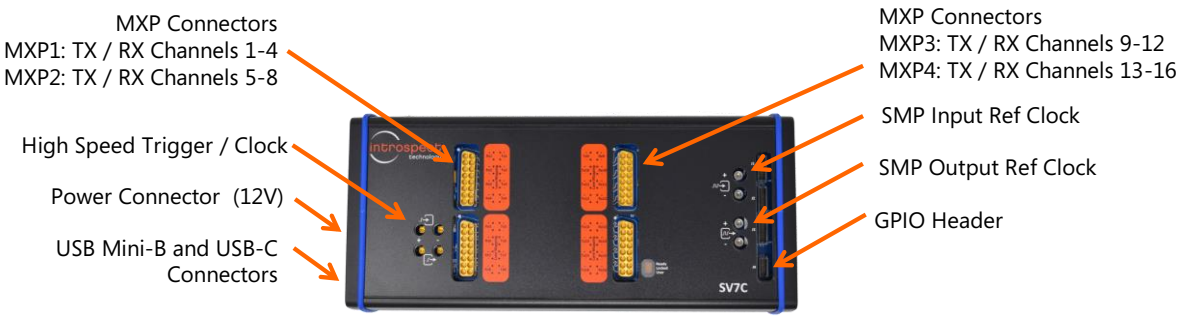


Figure 1: Illustration of the physical ports of the SV7C

TABLE 1: LOWER MXP CONNECTOR PINOUT

	MXP1 PIN	MXP1 SIGNAL	MXP2 PIN	MXP2 SIGNAL	MXP3 PIN	MXP3 SIGNAL	MXP4 PIN	MXP 4 SIGNAL
MXP Top View 1 16 2 15 3 14 4 13 5 12 6 11 7 10 8 9	1	RX1P	1	RX5P	1	RX9P	1	RX13P
	2	RX1N	2	RX5N	2	RX9N	2	RX13N
	3	RX2P	3	RX6P	3	RX10P	3	RX14P
	4	RX2N	4	RX6N	4	RX10N	4	RX14N
	5	RX3P	5	RX7P	5	RX11P	5	RX15P
	6	RX3N	6	RX7N	6	RX11N	6	RX15N
	7	RX4P	7	RX8P	7	RX12P	7	RX16P
	8	RX4N	8	RX8N	8	RX12N	8	RX16N
	9	TX4N	9	TX8N	9	TX12N	9	TX16N
	10	TX4P	10	TX8P	10	TX12P	10	TX16P
	11	TX3N	11	TX7N	11	TX11N	11	TX15N
	12	TX3P	12	TX7P	12	TX11P	12	TX15P
	13	TX2N	13	TX6N	13	TX10N	13	TX14N
	14	TX2P	14	TX6P	14	TX10P	14	TX14P
	15	TX1N	15	TX5N	15	TX9N	15	TX13N
	16	TX1P	16	TX5P	16	TX9P	16	TX13P

Pinetree 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 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.

PINETREE INSTALLATION

1. INSTALLATION PREPARATION

a) Quit any Pinetree (or older Introspect ESP 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.

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 Pinetree.

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 "Use Activation Key" 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 PINETREE

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 "SV7C_16C17G" and Press "Next" to continue.

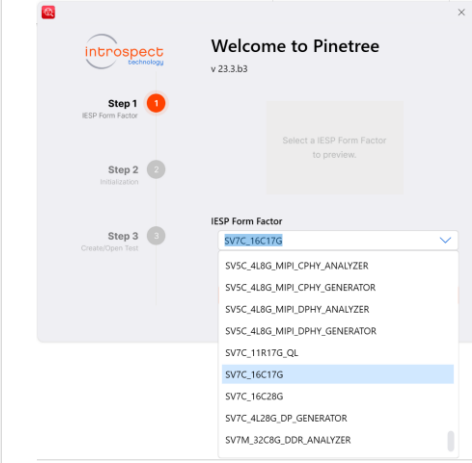


Figure 2: The welcome window for Pinetree

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

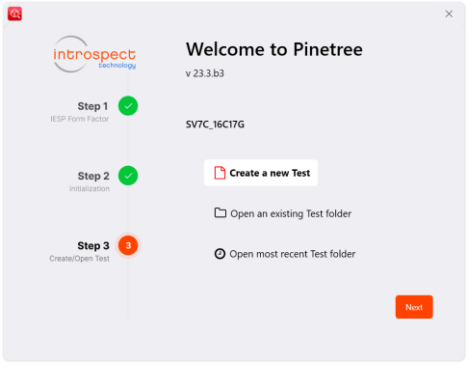


Figure 3: "Create a new Test" option of the welcome menu

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

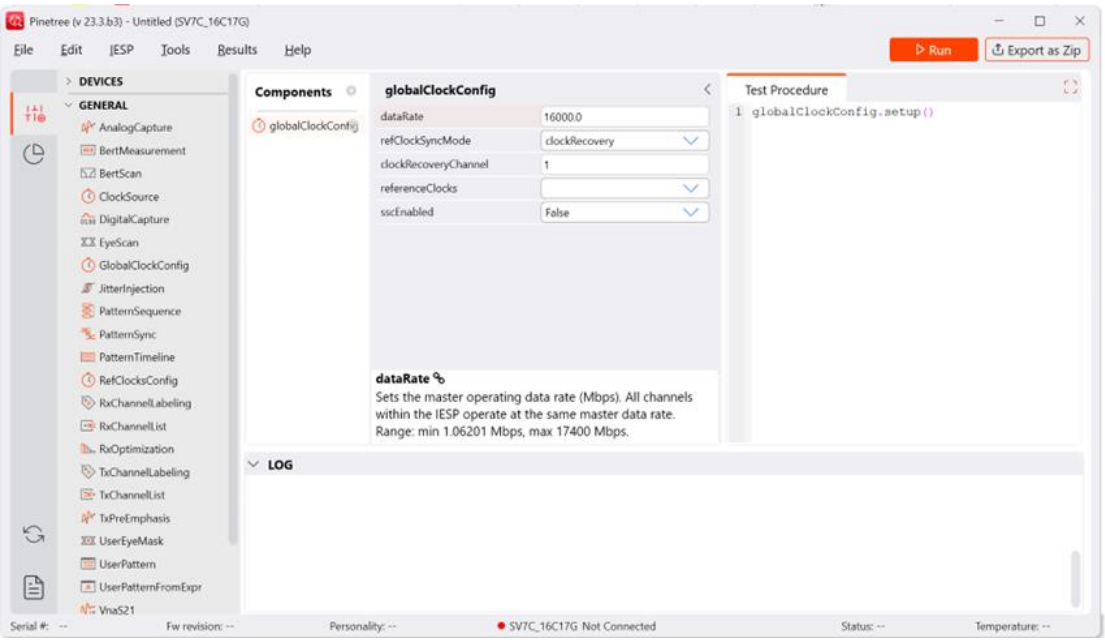


Figure 4: Window indicating the Pinetree has been successfully installed

5. FURTHER DOCUMENTATION

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

- "User Manual" is the user manual for the 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 SV7C to the PC using both a USB-A 2.0 to USB Mini-B and a USB-A 3.0 to USB-C cable, each 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.

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.

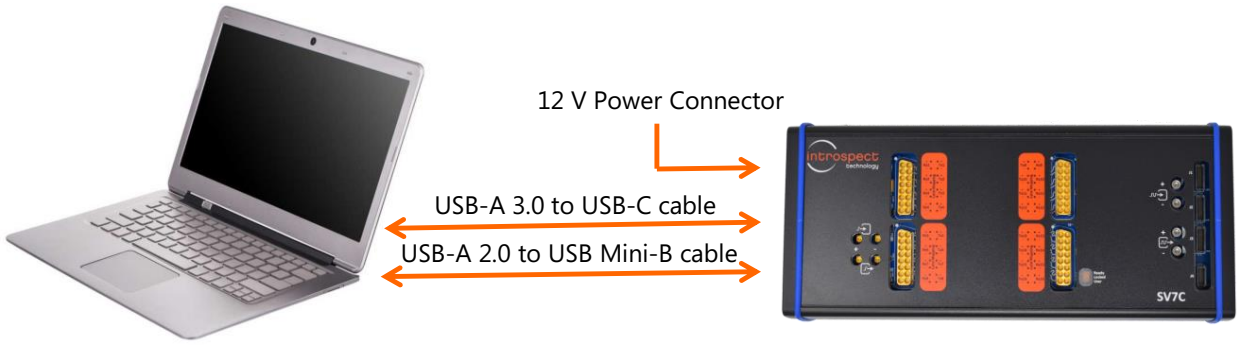


Figure 5: Connection for the automated FTDI driver installation

3. VERIFY DRIVER INSTALLATION

a) Launch Pinetree and select the "SV7C_16C17G" 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.

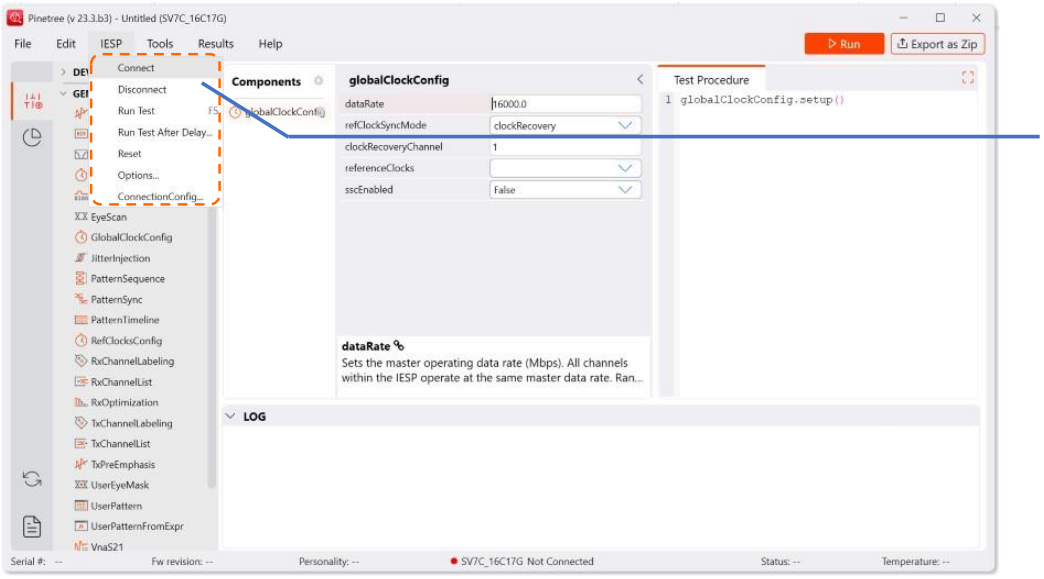
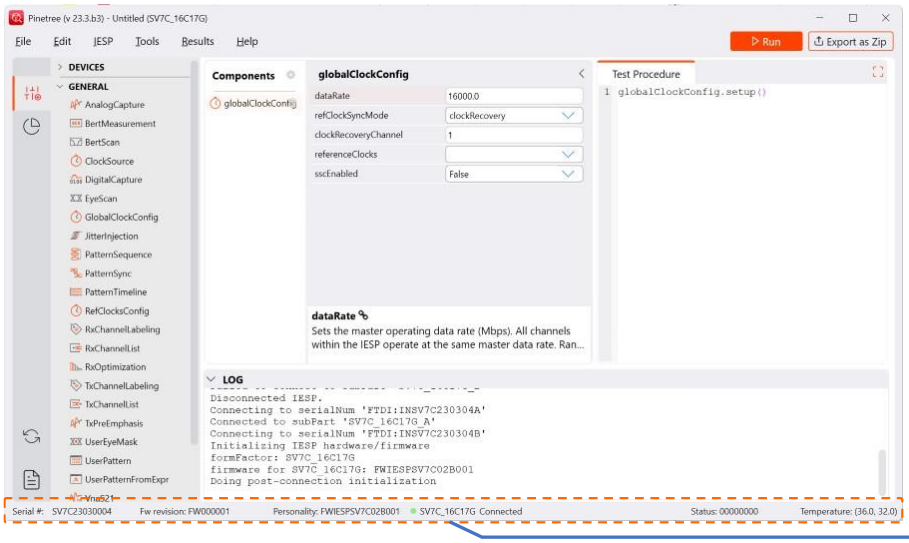


Figure 6: Main Pinetree interface and the "Connect" sub-menu item

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.



Module connection status information. The "Connected" message appears as a solid green status indicator.

Figure 7: Main Pinetree interface with the indicator showing that the SV7C 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.

SV7C Demonstration

STEP-BY-STEP GUIDE: BER AND SIGNAL INTEGRITY MEASUREMENTS

The following step-by-step guide will allow the user to set up the SV7C module in external loopback and perform basic BER measurements, followed by performing signal integrity measurements including a bertScan (bathtub curve) and an eye diagram. The following procedure is intended to provide an overview of how to use the Pinetree interface and highlight several of its key features.

1. CONNECT THE HARDWARE COMPONENTS

To connect the SV7C module in external loopback, please refer to Figure 8 below. In this diagram, TX Channel 1 is externally looped back to RX Channel 1. To make this connection, the MXP to 2.4mm Cable Assembly needs to be connected to MXP 1 as shown, and two 2.4mm RF coaxial adapters need to be used to connect the TX and RX paths in the cable assembly. Connections and part numbers are as shown in the figure.

Please refer to Table 1 for the full pinout for the SV7C MXP connections. The USB cable connections and 12 V power connections are also required, as shown in the figure.

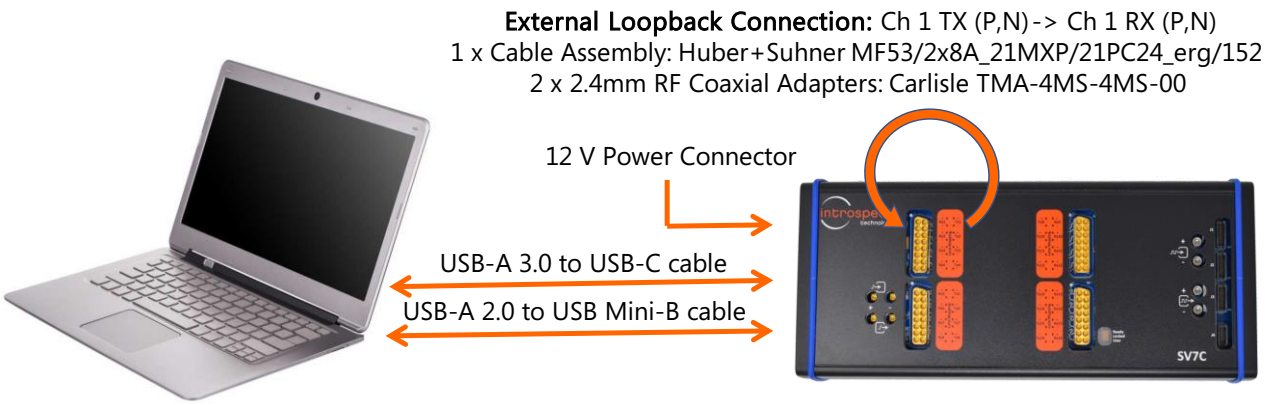


Figure 8: Connection for the SV7C BER test and signal integrity measurement demonstration

2. GETTING TO KNOW THE PINETREE INTERFACE

a) If you have not done so previously during the USB driver installation procedure, launch Pinetree, select the "SV7C_16C17G" form factor and create a new test procedure.

NOTE

The USB-C cable is used to accelerate data transfers between the SV7C and the host PC. This USB-C connection is not mandatory for operating the module, but it is recommended.

b) When started from the "SV7C_16C17G" form factor, Pinetree opens the window as shown in Figure 9. There are five numbered panels highlighted in orange in the figure. Each of the five panels are described on the following page.

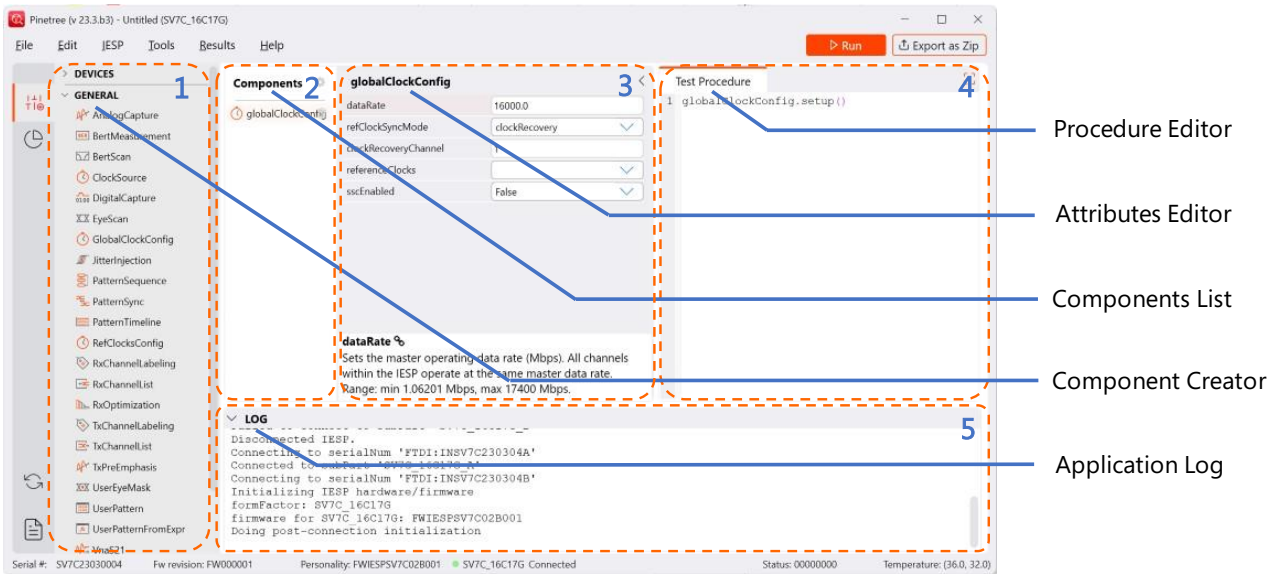


Figure 9: The five main panels of the Pinetree interface

1. The **Component Creator** is the panel on the left side of the interface as shown in Figure 9. A component is a Python class provided by Pinetree for controlling the SV7C. The Component Creator contains all the components which can be instantiated in software.
2. The **Component List** is the panel adjacent to the Component Creator, and it contains the list of components instantiated within the present Python procedure. A user can double click (or drag) components from the Component Creator panel into the Component List to instantiate them.
3. The **Attributes Editor** is the panel on the right of the Component List. When a component is selected in the Component List, the Attributes Editor displays the key attributes of the selected component. All attributes of all components may be modified directly in Python code. The attributes shown in the Attributes Editor are presented for convenience, since these are the commonly used settings. The attributes shown can be edited by clicking on their entries directly.
4. The **Procedure Editor** is on the right side of the interface. This panel contains the Python code that executes when the test is run. Most components (Python classes, described above) have either a "run" method or a "setup" method, and those commands are entered here.
5. The **Application Log** is the panel along the bottom of the interface. It shows the detailed activity log generated by an execution of the main Python procedure. It also contains messages related to the connection between the SV7C module and the Pinetree software.

NOTE

Both the "Application Log" and the "Attributes List" described above may be collapsed to provide more room for the other panels of the interface.

c) When Pinetree is initialized, by default there is only one component in the “Componets List” for the procedure, which is “globalClockConfig”. This component sets the key clocking modes and the data rate of the SV7C. The globalClockConfig component, its attributes and its test procedure are highlighted in Figure 10. For example, within the “Attributes Editor”, the shown data rate is set to 16.000 Gbps (by default). Note that there is always context help availble at the bottom of the “Attritubes Editor” panel to describe the current selected attribute. If applicable, the range of settings for the attribute are also listed.

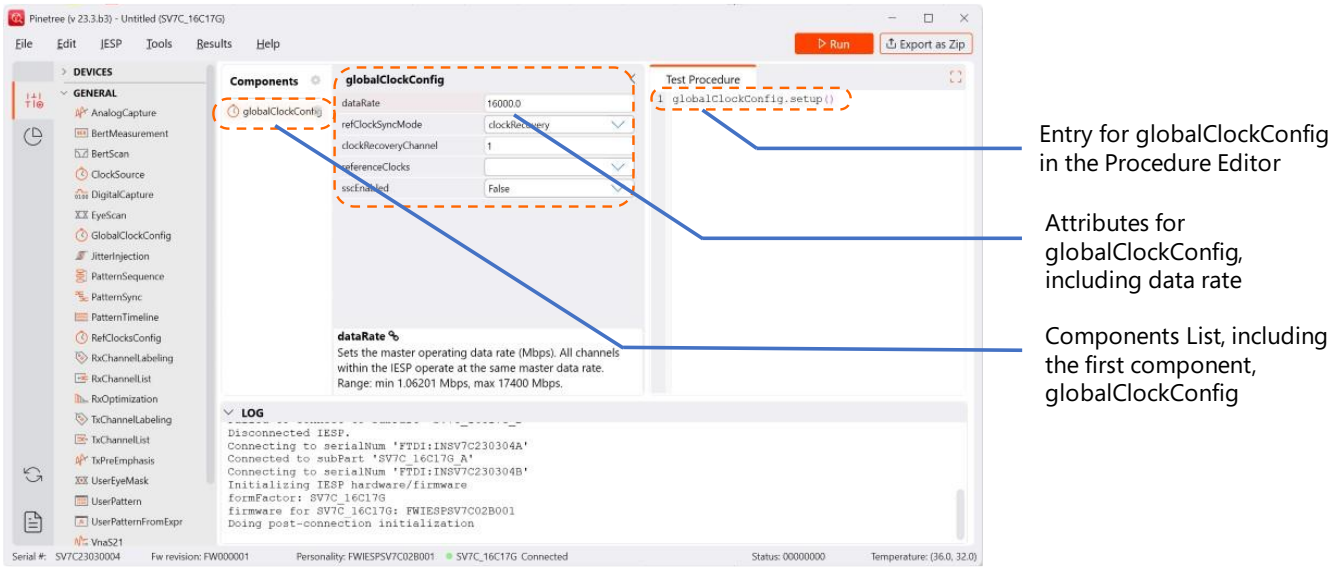


Figure 10: Implementation of the globalClockConfig component and its attributes

3. ADDING TEST COMPONENTS

a) **TX Channel List**: This guide will illustrate how to add new components, starting with a txChannelList. This component sets the attributes associated with the transmitter of the SV7C, and the process of setting these attributes is highlighted in Figure 11 below. To add a "txChannelList", double-click on this component in the "Component Creator" on the left side of the interface. This will instantiate a "txChannelList1" in the "Components List" window. Another way of doing this is to drag-and-drop the "txChannelList1" component from the "Component Creator" directly into the "Component List". Either action results in a new line of code being automatically added to the "Procedure Editor".

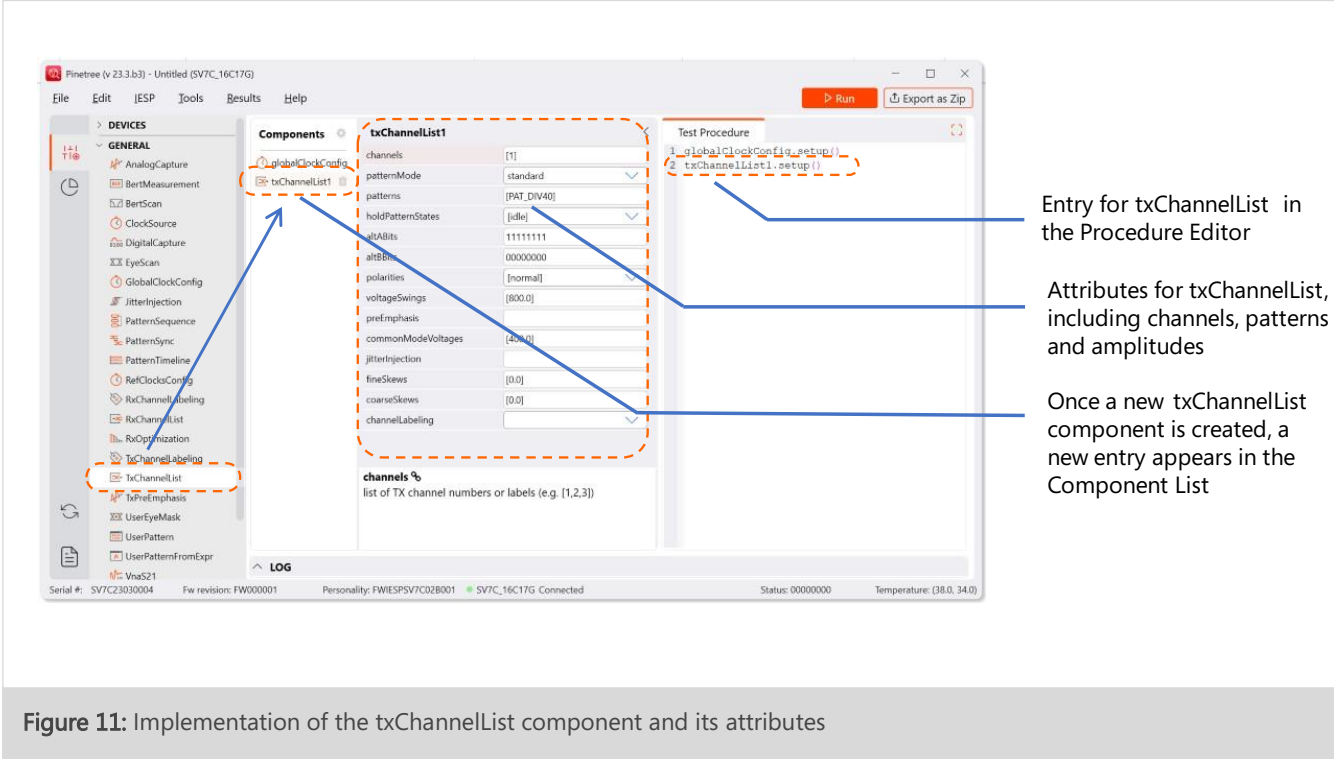


Figure 11: Implementation of the txChannelList component and its attributes

b) The txChannelList component may be modified as shown in Figure 12 below. Double-click on a "patterns" attribute in the "Attributes Editor", and this will bring up a pop-up window which allows the data patterns to be modified on a per-channel basis. Since only TX channel 1 is of interest in this Quick Start Guide, modify the Channel 1 pattern to "PAT_PRBS_7" as shown in the figure and press "OK".

c) Similarly, modify the signal amplitude via the "voltageSwings" attribute to "600 mV" as shown in the figure.

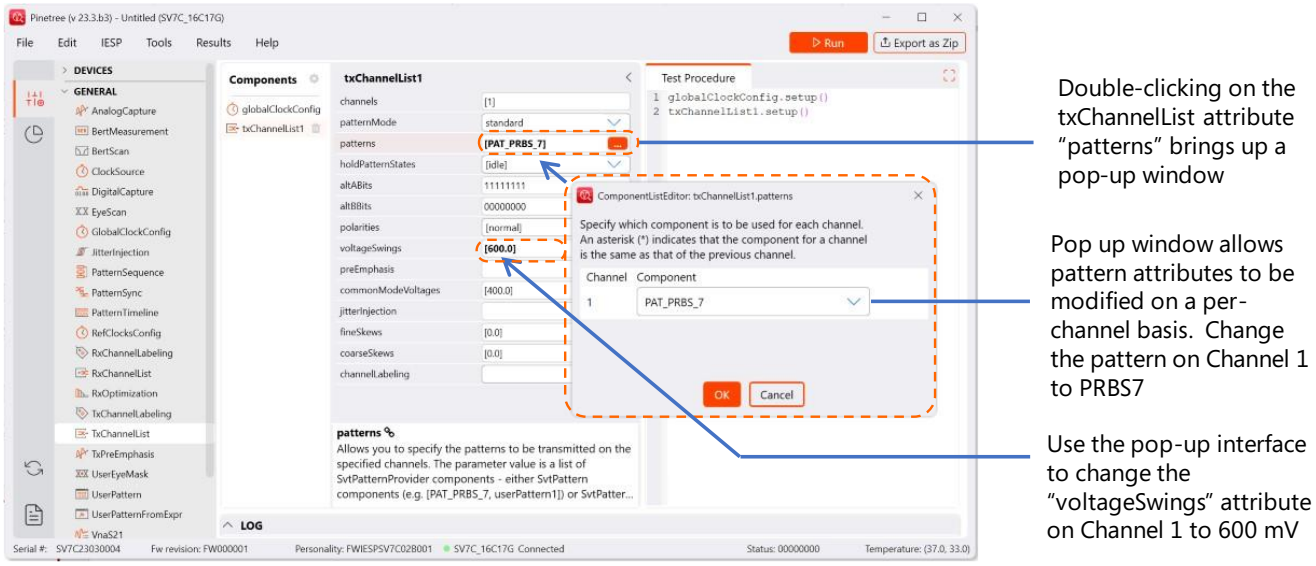


Figure 12: Modifying the attributes of the txChannelList component

d) **RX Channel List**: Next, the rxChannelList component will be added to the test. This component sets the attributes associated with the receiver of the SV7C, and the process of setting these attributes is highlighted in Figure 13 below. Double-click on "rxChannelList" in the "Components List" on the left side of the interface. The "rxChannelList1" component may be modified as in the previous txChannelList case. Modify the RX Channel 1 pattern to "PAT_PRBS_7" as shown in the figure and press "OK".

e) In this case, note there is no new line of code automatically added to the "Procedure Editor" window. This is because the rxChannelList is a component generally called in a hierarchical manner by other components, such as "berMeasurement", to be described next.

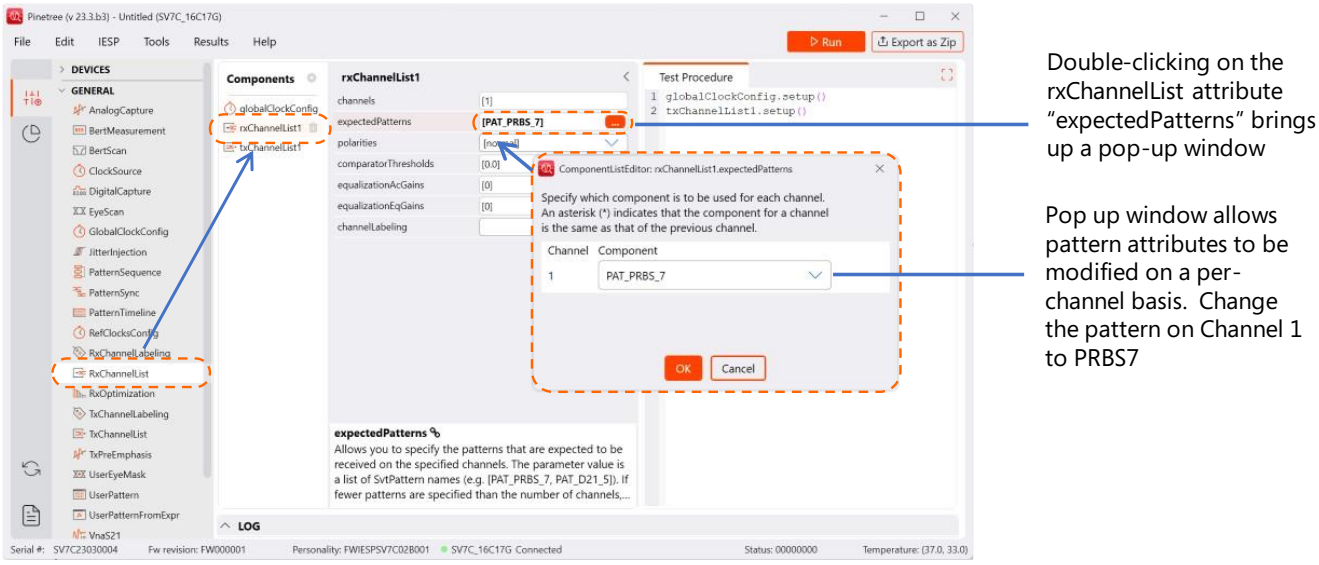


Figure 13: Implementation of the rxChannelList component and its attributes

d) **BERT Measurement**: Add a bertMeasurement component to the test, which sets all attributes associated with a Bit Error Rate Test to be performed. Double-click on "bertMeasurement" in the "Components List" on the left side of the interface, as shown in Figure 14 below. The "bertMeasurment1" component does not require any modification. The measurement "durations" attribute is set by default to 1000 ms, which will be used in this example. Note that the attribute "rxChannelList" in the bert measurement component has automatically been filled with the only available rxChannelList component, which was created in the previous step of this guide. Also note that a new line of code has been automatically added to the "Procedure Editor" panel to start the bert measurement.

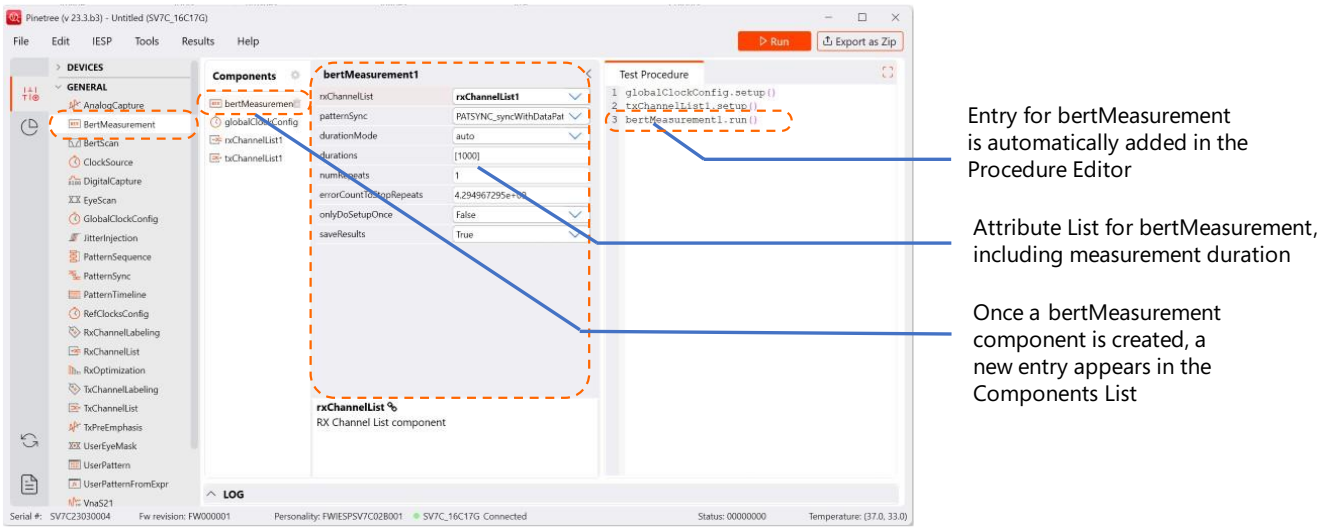


Figure 14: Implementation of the bertMeasurement component and its attributes

4. EXECUTING THE TEST PROCEDURE

To execute the test, click on the "Run" button at the top right of the interface, or use the F5 shortcut key. This is as shown in Figure 15 below. Expand the "Application Log" during the execution, and you should see that no errors were observed during the bert measurement. If the SV7C receiver did not manage to synchronize to the incoming loopback signal, or if bit errors are observed, check the external loopback connections between the transmitter and receiver as shown previously in Figure 8.

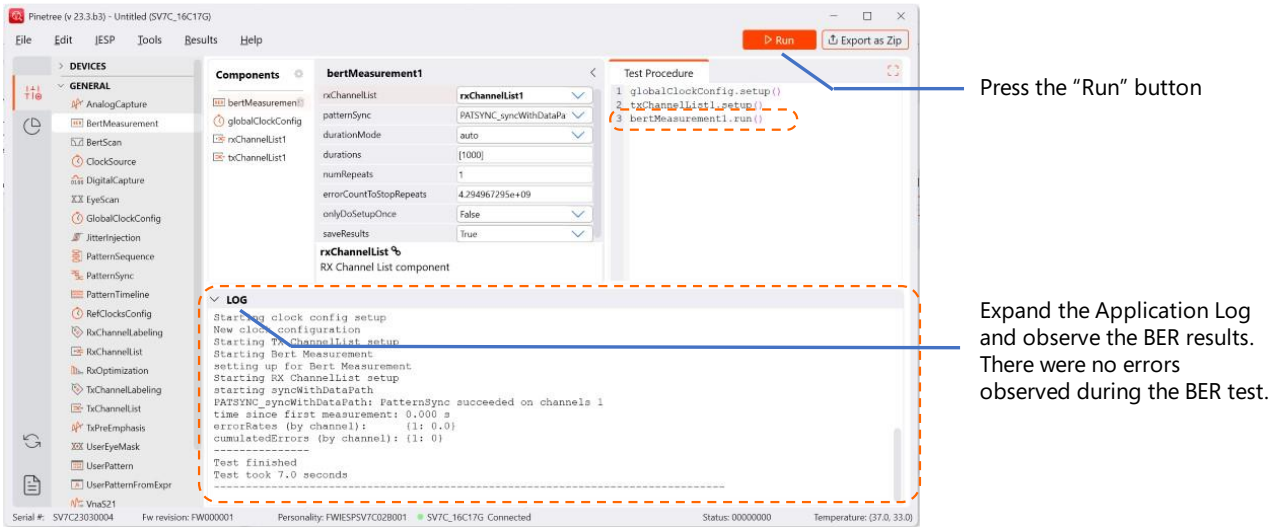


Figure 15: Executing the BER test

5. ADDING SIGNAL INTEGRITY TESTS

a) BertScan and EyeScan: Two additional signal integrity measurements may be added to the existing test. Double-click on each of the "bertScan" and "eyeScan" components in the "Component Creator" on the left side of the interface. The components are as shown in Figure 16. These two components do not require any modification. Note that the attribute "rxChannelList" in each component has automatically been filled with the only available rxChannelList component. Also note that two new lines of code have been automatically added to the "Procedure Editor" window to perform the BertScan and EyeScan measurements.

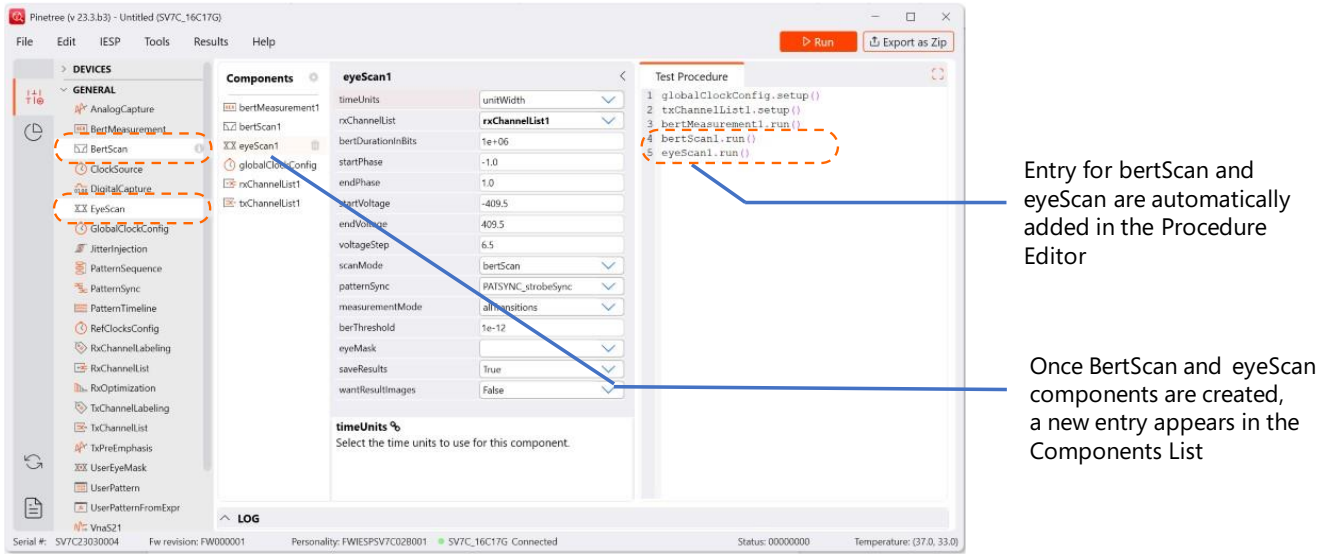


Figure 16: Adding the BertScan and EyeScan components to the test procedure

b) To execute the test, click on the "Run" button at the top right of the interface, or use the F5 shortcut key. The test should take less than 1 minute to execute and the "Application Log" should indicate that the tests completed successfully, as shown in Figure 17 below.

c) By clicking on the "Results" icon on the top left side of the interface (see the blue pointer in Figure 17 below) the user can toggle onto the "Results Quick Access" panel. In the "Results Quick Access" view as shown below, a time-stamped directory of results is visible from each test execution. In this example, there is a test folder with time stamp "Run_2023-04-14 1928" which contains the bertMeasurement1, bertScan1, and eyeScan1 results from the most recent execution.

d) In the most recent versions of Pinetree, you may "Right-Click" on the test results described above and select "Open with Default Viewer". This will bring up plots such as those shown in on the following page in Figure 18, which allow for rapid evaluation of the signal received by the SV7C.

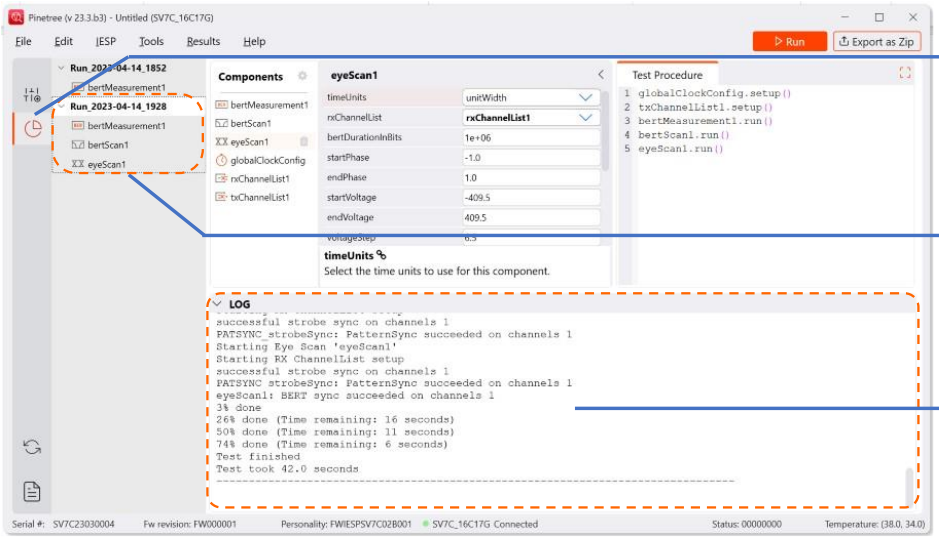


Figure 17: Execution of BertScan and EyeScan tests

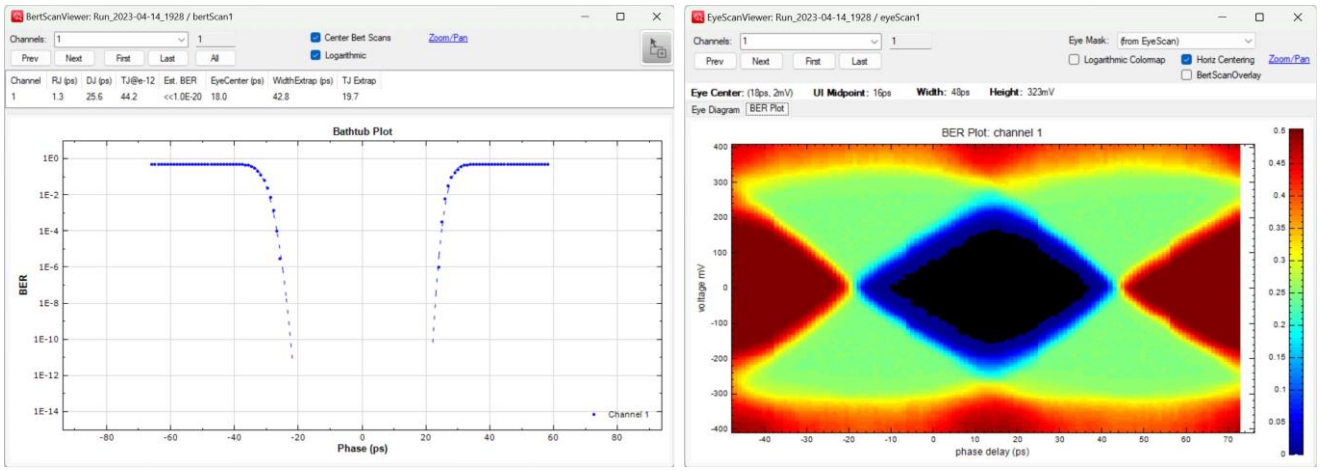


Figure 18: Results of BertScan and EyeScan tests in the Pinetree default viewers

NOTE

To modify a component attribute, a user can either manually edit the corresponding field in the "Attributes Editor" view, or programmatically via the "Procedure Editor" panel. For example, if a user wants to change the amplitude of the TX signal during the test run, they can add the following two lines within the "Procedure Editor" panel:

```
txChannelList1.voltagesSwings = 400
txChannelList1.update()
```

This allows on-the-fly change of the attributes during a test for greater flexibility. Please see help files located in the pull-down menu (Help -> Component Classes…) for additional details.

This concludes the SV7C Quick Start demonstration. For further information, please consult the Pinetree user manual from the "Help > User Manual" pull down menu on the main interface.

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 use the "usbview" utility program linked 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	April 18, 2023

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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