

USB4 Electrical Test Tool Documentation

This version of the tool doesn't support TGL and MH2 modes –for testing these products use tool version 1.1.2.

1. Tool Installation

There are 2 versions of USB4ETT tools.

- **USB4ElectricalTestTool.exe** uses a GUI interface.
- **USB4ElectricalTestToolCLI.exe** uses a command-line interface.

No installation required - just create new directory to contain USB4ETT and copy both files there.

2. Controllers Requirements and Installation

USB4ETT tools are designed to work with the following controllers:

2.1. Wilder Controller

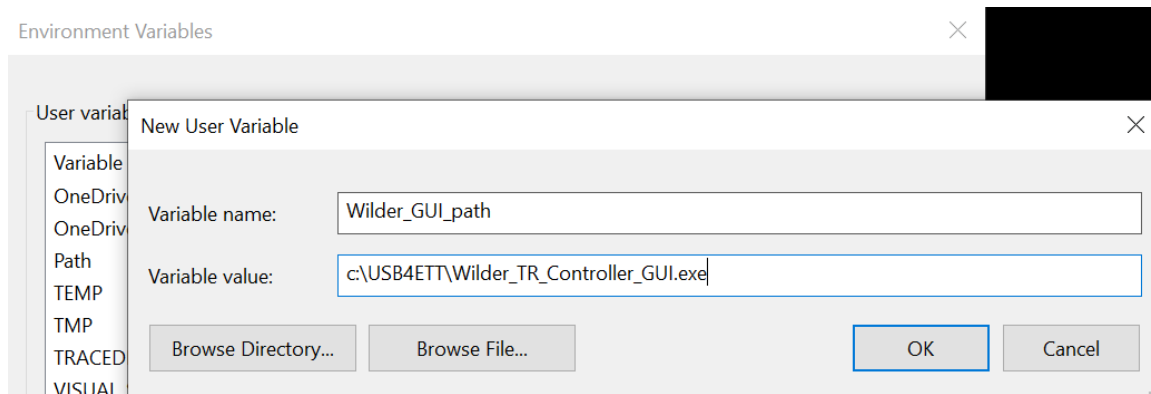
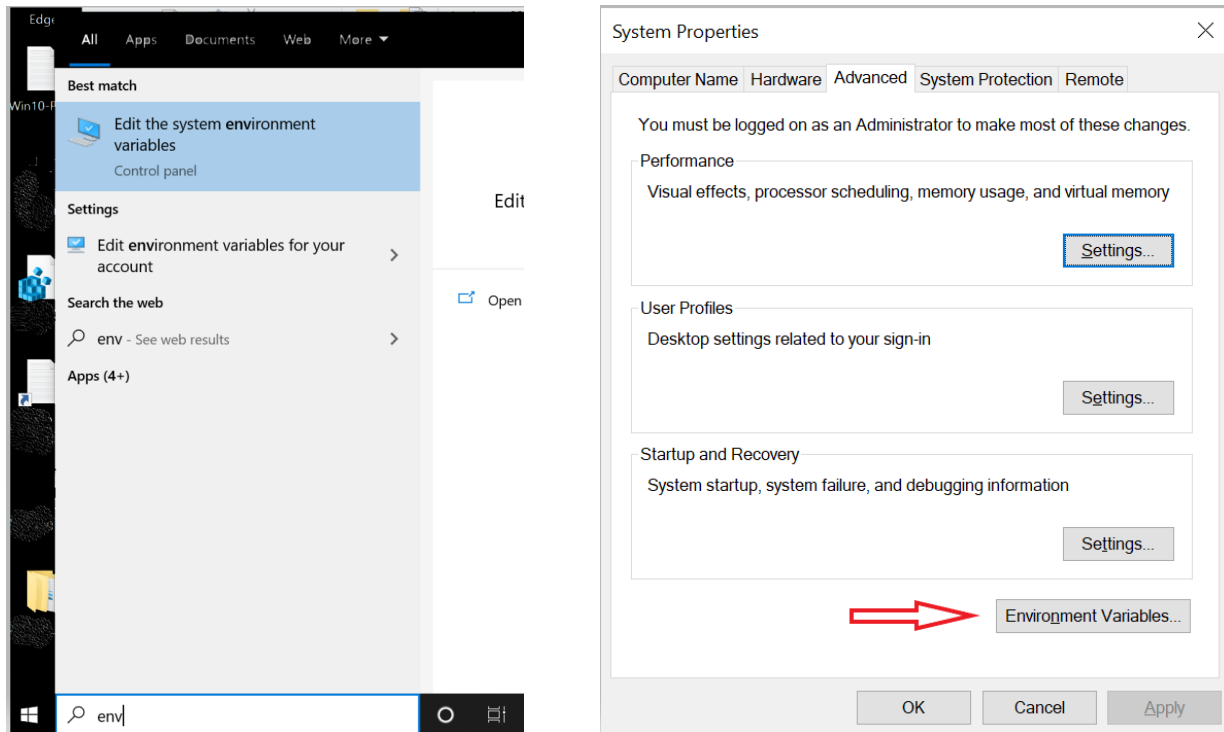
Wilder Controller supports all Gen2/Gen3 tests and Side Band tests (SBRX/SBTX/SBX_CALIBRATION)

640-0962-000	USB4-TPA-UC, Microcontroller Only
640-0946-000	CG3-TPA-TR (Microcontroller Gen-3)

2.1.1. Installation

- Install Wilder Controller Driver, see Wilder for documentation specific instructions.
- Copy Wilder Controller GUI application (**Wilder_TR_Controller_GUI.exe**) to the PC.
- Create new Environment Variable with Name: **Wilder_GUI_path** and Value: full path (including the filename) to Wilder Controller GUI application.

Example:



2.2. USB4V2 EV Controller

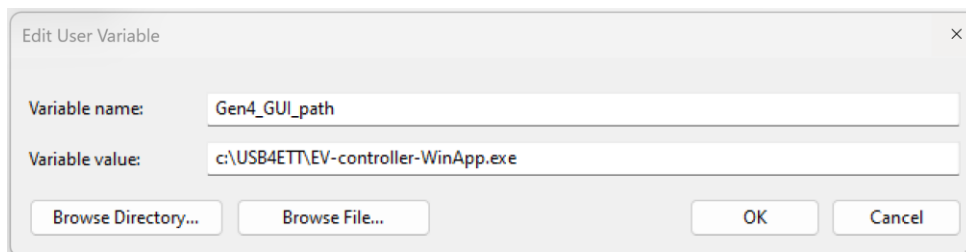
USB4V2 EV Controller supports all Gen2/Gen3/Gen4 tests

TBD	USB4V2 EV Controller

2.2.1. Installation

- Copy USB4V2 EV Controller application to the PC.
- Create new Environment Variable with Name: **Gen4_GUI_path** and Value: full path (including the filename) to the USB4V2 EV Controller application.

Example:



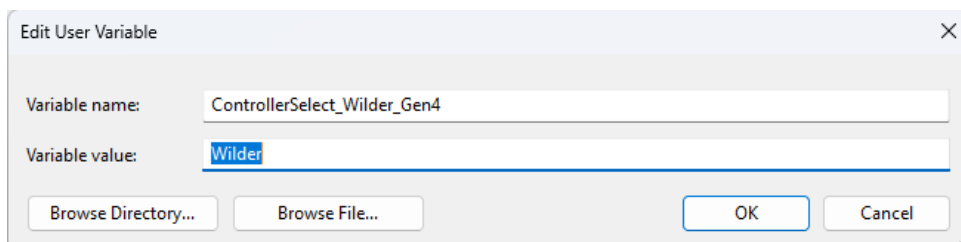
2.3. Usage of both Wilder and USB4V2 EV Controllers

If both controllers installed on one PC, in order to select the controller, need to create new Environment Variable with Name: **ControllerSelect_Wilder_Gen4**.

For operation with Wilder Controller: set it Variable to **Wilder**.

For operation with USB4V2 EV Controller: set it Variable to **Gen4**.

Example:



3. USB4ETT – GUI Mode (USB4ElectricalTestTool.exe)

Open the USB4ElectricalTestTool.exe

Set all GUI fields according to required test.

Set **Tools Usage Mode** to **Tests**. Use **Operations** mode for debugs only.

Click **Run Command** button for Test Execution.

Click **Init Controller** button to return the Controller to default condition.

Click **Clear** button to return the GUI to default setting.

3.1. Transmitter Tests

Set all GUI fields according to test requirements, no specific requirements required.

3.2. Receiver Tests

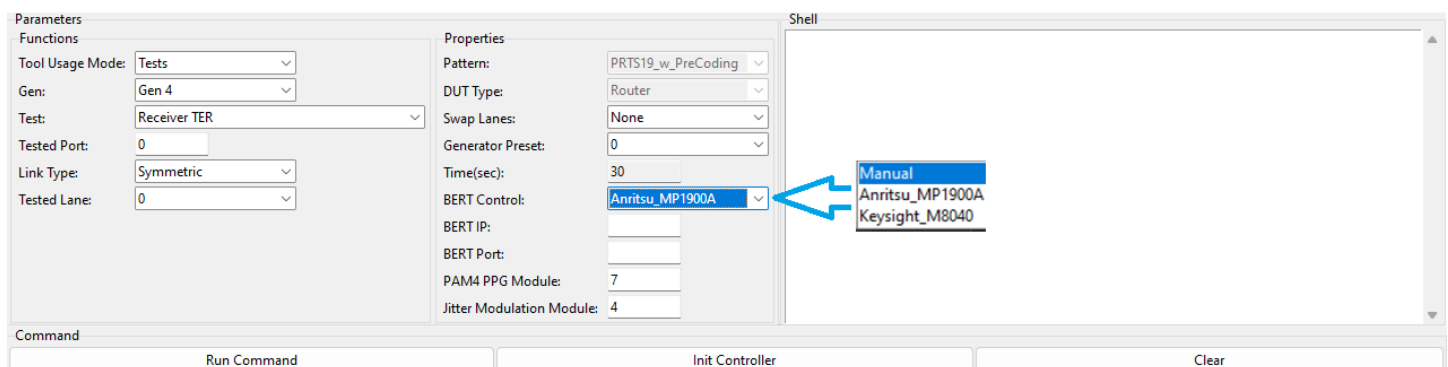
Set all GUI fields according to test requirements.

3.2.1. Pattern Generators (BERT) Control

By default, user should manually (or by semaphore files) change BERT presets or patterns during test execution flow.

ETT supports communication and control of following generators: **Anritsu MP1900A** and **Keysight_M8040**.

In order to enable BERT control, change the **BERT Control** field from **Manual** to type of connected generator and set all generator configuration fields.



3.2.2. TxFFE Swap Detection standalone test

Several vendors may have lanes swap between access by Port Operation to access by SB Registers. This swap may cause to wrong TxFFE negotiation flow and wrong preset as result.

Therefore, products of these vendors require precondition – for each new setup required execution of TxFFE Swap Detection test.

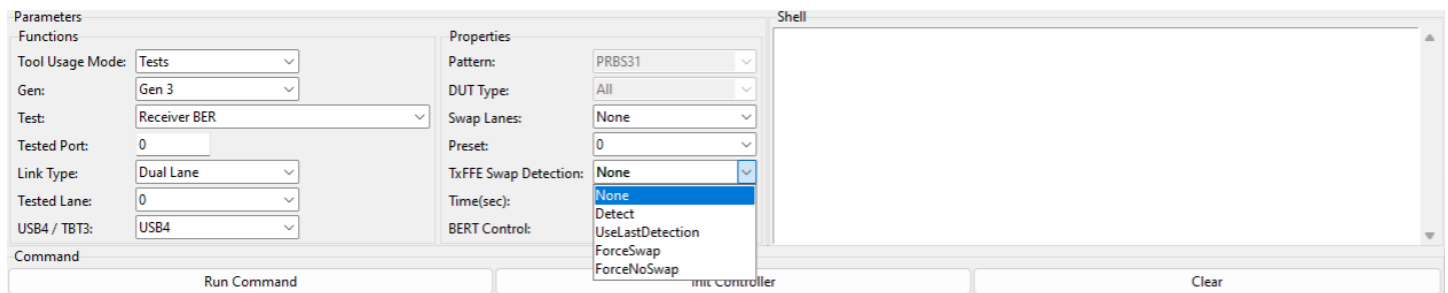
This test detects if swap exists and fixes the swap for future testing of current setup, need to repeat this test when setup changed.

3.2.3. TxFFE Swap Detection during receiver test

Also, there is an option to enable Swap Detection directly, during Receiver Test.

Receiver tests have **TxFFE Swap Detection** field with following options:

- **None** (default condition): skip Swap Detection flow, run regular Receiver test
- **Detect**: run Swap Detection procedure and fixes the swap for future testing before Receiver Test execution (equal to execution of TxFFE Swap Detection Test (above) with following Receiver test with **UseLastDetection** selected)
- **UseLastDetection**: skip detection procedure, but fix lanes swap according to last detection procedure before Receiver Test execution
- **ForceSwap**: skip detection procedure, but fix lanes swap before Receiver Test execution
- **ForceNoSwap**: skip detection procedure, don't fix lanes swap before Receiver Test execution



3.2.4. Bathtub Test

This test detects supported by DUT Margining Modes, measures all supported modes and generates Excel report with plot.

Set all GUI fields according to test requirements. If one of fields has unsupported by DUT data, error message will point to wrong field.

3.3. LRD Test

TBD

3.4. Side Band Tests

TBD

3.4.1. SBTX Test

TBD

3.4.2. SBRX Test

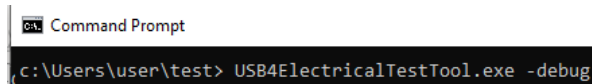
TBD

3.4.3. SBX_CALIBRATION Test

TBD

4. USB4ETT – GUI Debug Mode (USB4ElectricalTestTool.exe)

Open the USB4ElectricalTestTool.exe with **-debug** argument



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Command Prompt
c:\Users\user\test> USB4ElectricalTestTool.exe -debug
```

The debug mode opens few additional options:

- ✓ CLI Command generator: Automatically generates the CLI command.
- ✓ File Semaphore: select this check box when need to generate CLI Command with File Semaphore. Also, there is an option to change the semaphore path.
- ✓ SB Debug Mode – this debug option prints SB Traffic (TxRx Transaction Commands, Bytes or both). By default – disabled.
- ✓ Debug Print – prints test flow details.
- ✓ Option to define specific FTDI device – in case of more than one FTDI devices in the system.

5. USB4ETT – CLI Mode (USB4ElectricalTestToolCLI.exe)

USB4ElectricalTestToolCLI utilizes a command line interface, which allows integration with other tools.

5.1. CLI Commands:

Table 1.0 describes all possible arguments and values.

All arguments are optional (i.e. all arguments have default values).

For Help run the tool with **-h** argument (see examples below).

All messages/requests during the test execution will appear on the screen – user interaction required.

For automated tests use Semaphore files by adding the **-S** argument.

By default – file semaphore path is *c:\temp\semaphore.txt*

User may change the path by adding **-Sp** argument with new path.

- When the Tool wants to send the message to user it creates the Semaphore File with the message. The tool pending the deleting of the file (as acknowledge that user got the message and addressed it).
- When the user requested to supply some information to the tool, user creates the Semaphore file with the message. The tool pending the creation of the Semaphore File, then reads it and deletes it (as acknowledge to user that the tool got the message and addressed it).

Argument		Value	Description
Short	Long		
-h	--help		show this help message and exit

-Nf	--ftdiName	FTDNAME	TestEquipment FTDI Name. Example:'Dual RS232-HS A' (None by Default)
-U	--SbDebugMode	Disabled,Commands,Traffic,Full	Side Band Debug Mode (Disabled/Commands/Traffic/Full, by default:Disabled)
-S	--FileSemaphore		Use File Semaphore for FFE Preset Request (by default: Disabled)
-Sp	--FileSemaphorePath	FILESEMAPHOREPATH	Set File Semaphore path.(default is 'c:\temp\semaphore.txt')
-P	--DebugPrint		Debug Print Flag (by default: Disabled)
-Dp	--PortDUT	0,1, 2, ..., 63	DUT Tested Port (0...63, by default:0)
-L0	--Lane0		DUT Lane0 Enabled (by default: Disabled)
-L1	--Lane1		DUT Lane1 Enabled (by default: Disabled)
-L2	--Lane2		DUT Lane2 Enabled (for Gen4 only ; by default: Disabled)
-Lr	--LaneReversal		DUT Lane Reversal (by default: DUT Lane Straight)
-L	--TestedLane	0,1,2,All	DUT Tested Lane (0/1/2/All, by default:All)
-T	--TBT3		DUT TBT3 Support Enabled (by default: Disabled)
-G3	--Gen3		DUT Gen3 Support Enabled (by default: Disabled)
-G4	--Gen4		DUT Gen4 Support Enabled (by default: Disabled)
-Sw	--SwapLanes	None,Router,Retimer#2,Router+Retimer#2	Swap Lanes in Router side (by default: 'None')
-E	--EarlyOperation		Early Operation Mode Enabled (by default: Disabled)
-Ex	--StopExitOnError		Don't Drop the Link / Disconnect in case of ERROR (by default: Disconnect in case of ERROR)
-O	--Operation	SET_TX_COMPLIANCE,SET_RX_COMPLIANCE, START_BER_TEST,END_BER_TEST,END_BURST_TEST, READ_BURST_TEST,ENTER_EI_TEST, READ_LANE_MARGIN_CAP,RUN_HW_LANE_MARGINING, RUN_SW_LANE_MARGINING,READ_SW_MARGIN_ERR, CONTROLLER_INIT	Operation Name (SET_TX_COMPLIANCE, SET_RX_COMPLIANCE, START_BER_TEST,END_BER_TEST, END_BURST_TEST, READ_BURST_TEST,ENTER_EI_TEST,READ_LANE_MARGIN_CAP, RUN_HW_LANE_MARGINING,RUN_SW_LANE_MARGINING, READ_SW_MARGIN_ERR,CONTROLLER_INIT, by default:None)
-Tt	--Test	TX,RXBER,RXBURST,RXRL,RXFREQVAR,TXFREQVARTRAIN, ENTER_EI_TEST,LFPS,SBTX,SBRX,SBX_CALIBRATION,LRD, BATHTUB_CURVE,TXFFE_SWAP_DETECTION	Test Name (TX,RXBER,RXBURST,RXRL,RXFREQVAR,TXFREQVARTRAIN, ENTER_EI_TEST,LFPS,SBTX,SBRX,SBX_CALIBRATION,LRD, BATHTUB_CURVE,TXFFE_SWAP_DETECTION, by default:None)
-D	--DutType	Router,All,Receptacle,TxFrequencyVariation	DUT Type (Router, Receptacle, All, by default:Router)
-X	--xTalk		Cross Talk Enable (by default:Disabled)
-Pa	--Pattern	PRBS31,PRBS15,PRBS11,PRBS9,PRBS7,PRTS19,PRTS7, PRTS19_w_PreCoding,PRTS19_wo_PreCoding,SQ224, SQ128,SQ32,SQ4,SQ2,STAIRS112,TS2_clksw,SLOS1	Pattern (PRBS31/PRBS15/PRBS11/PRBS9/PRBS7/PRTS19/PRTS7/ PRTS19_w_PreCoding/PRTS19_wo_PreCoding/SQ224/SQ128/ SQ32/SQ4/SQ2/ STAIRS112/TS2_clksw/SLOS1, by default:PRBS15)
-Pr	--Preset	0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21, 22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39, 40,41	FFE Preset (0...41 for Gen4 and 0...15 for Gen2/Gen3, by default:0)
-M	--TxModificationEnable		Enables non-default values for Preset and for Tx Modifications (by default: Disabled)
-De	--DeEmphasisEnable		Enables de-emphasis Tx Modifications (by default: Disabled)
-Ps	--PreShootEnable		Enables pre-shoot Tx Modifications (by default: Disabled)
-Wt	--WaitTime	TIME	Test Time[Sec] (by default:3 Sec)
-Wm	--WaitManual		Set Manual Test Time(by default: Disabled)
-Mt	--MarginingTest	T,V	Lane Margining Voltage/Time Test (V/T, by default:T)
-Mi	--MarginIndependent	Both,Either,Min	Independent Margin: minimum between the high and low, either high or low or both high or low (Both/Either/Min, by default:Both)
-Mm	--Margin	H,R,L	High/Low Lane Margin for Voltage Tests or Right/Left Lane Margin for Timing Tests, (H/L or R/L, by default:L)

-Mb	--MarginBerLevel	BERLEVEL	Lane Margining BER Level Contour (by default:0)
-Mo	--OptionalVoltageOffsetRangeEnable		Lane Margining Optional Voltage Offset Range Enable (by default: Disabled)
-Mf	--voltageTimeOffset	VOLTAGETIMEOFFSET	Lane Margining Voltage/Time Offset (by default:0)
-Me	--errorCounter	NOP,CLEAR,START,STOP	Error Counter Control (NOP/CLEAR/START/STOP, by default:NOP)
-Lm	--LfpsMode	LFPS,LFPS_IF_DETECTED,LFPS_IF_DETECTED_ELSE_EI, LFPS_EI_PATTERN	LFPS Test Mode (LFPS/LFPS_IF_DETECTED/LFPS_IF_DETECTED_ELSE_EI/ LFPS_EI_PATTERN, by default:LFPS)
-Se	--TxFFEswapDetectionEnabledMode	None,Detect,UseLastDetection,ForceSwap,ForceNoSwap	TxFFE Swap Detection Mode ('None', 'Detect', 'UseLastDetection', 'ForceSwap', 'ForceNoSwap', by default: 'None')
-Bc	--BertControl	Manual,Anritsu_MP1900A,Keysight_M8040	Bert Control (Manual/Anritsu_MP1900A/Keysight_M8040, by default:Manual)
-Bi	--BertIp		Bert IP (for Bert Control) (by default:'127.0.0.1')
-Bp	--BertPort		Bert Port (for Bert Control) (by default: 5001)
-Bm	--BertGeneratorModule	1,2,3,4,5,6,7,8,M1,M2,M3,M4,M5,M6,M7,M8	Bert Generator Module (for Bert Control) (by default: 7)
-Bj	--BertAwgModule	1,2,3,4,5,6,7,8,M1,M2,M3,M4,M5,M6,M7,M8	Bert AWG Module (for Bert Control) (by default: 4)
-V	--Version		Shows tool version in CLI.

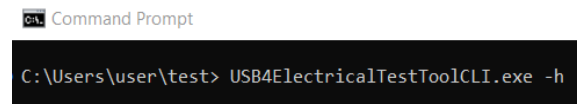
Table 1.0: all possible arguments and values.

5.2. CLI Examples:

1. Help:

use **-h** argument:

USB4ElectricalTestToolCLI.exe -h



2. Operation SET_TX_COMPLIANCE example:

Operation	SET_TX_COMPLIANCE
Port	0
Lane0 Active	True
Lane1 Active	True
Tested Lane	All
GEN	GEN3
USB4/TBT3	USB4
Pattern	SQ128
Modification Enabled	True
Preset	0
Preshoot Enabled	True
De-emphasis Enabled	True

DUT Type	Receptacle
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USB4ElectricalTestToolCLI.exe -Dp 0 -L0 -L1 -L All -G3 -Pa SQ128 -O SET_TX_COMPLIANCE -M -Pr 0 -De -Ps -D Receptacle

Command Prompt

C:\Users\user\test> USB4ElectricalTestToolCLI.exe -Dp 0 -L0 -L1 -L All -G3 -Pa SQ128 -O SET_TX_COMPLIANCE -M -Pr 0 -De -Ps -D Receptacle

3. Test: Receiver BER:

Test	RXBER
Port	1
Lane0 Active	True
Lane1 Active	True
Tested Lane	0
GEN	GEN2
USB4/TBT3	TBT3
Swap Lanes	On Router
Crosstalk Enabled	True
Generator Preset	7
Test Time	10 sec
Pattern	PRBS31
DUT Type	All

USB4ElectricalTestToolCLI.exe -Dp 1 -L0 -L1 -L 0 -Pa PRBS31 -Tt RXBER -D All -Wt 10 -Pr 7 -X -T -Sw Router

Command Prompt

C:\Users\user\test> USB4ElectricalTestToolCLI.exe -Dp 1 -L0 -L1 -L 0 -Pa PRBS31 -Tt RXBER -D All -Wt 10 -Pr 7 -X -T -Sw Router

4. Test: Receiver BER test with Semaphore:

Test	RXBER
Port	0
Lane0 Active	True
Lane1 Active	True
Tested Lane	1
GEN	GEN3
USB4/TBT3	USB4
Swap Lanes	Retimer#2
Crosstalk Enabled	False
Generator Preset	15
Test Time	300 sec
Pattern	PRBS31
DUT Type	All

USB4ElectricalTestToolCLI.exe -Dp 0 -L0 -L1 -L 1 -G3 -Pa PRBS31 -Tt RXBER -D All -Wt 300 -Pr 15 -Sw Retimer#2 -S

```
C:\Users\user\test> USB4ElectricalTestToolCLI.exe -Dp 0 -L0 -L1 -L 1 -G3 -Pa PRBS31 -Tt RXBER -D All -Wt 300 -Pr 15 -Sw Retimer#2 -S
```

5.3. Semaphore for FFE Preset Request

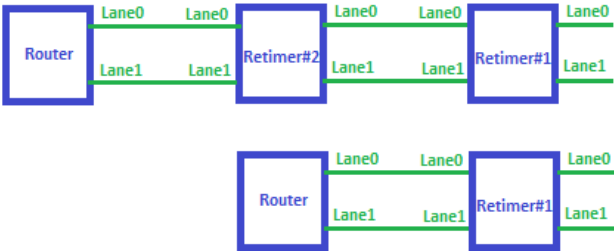
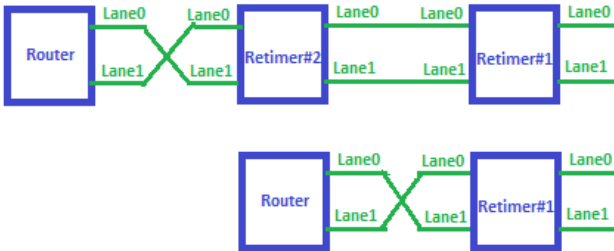
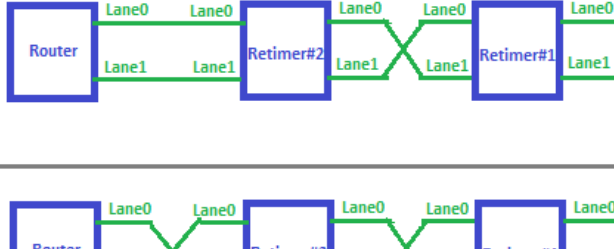

Semaphore created by Test - Condition	Semaphore Value	Description
Receiver Test, the DUT finished the TxFFE Negotiation Flow	"Done"	BERT preset negotiation finished – delete the semaphore and continue to test execution
Receiver Test, the DUT requested new TxFFE Preset from the BERT	<i>Preset Value</i>	Set requested BERT Preset and delete the semaphore when done
Transmitter Test Configuration Done	"Ready"	The transmitter transmits requested configuration, do Scope measurements and delete the semaphore
BER Test Done	<i>Receiver Statistics</i>	When the BER/BURST Test Done, the Receiver returns Measurement Statistics. Read the data and delete the semaphore.
READ_LANE_MARGIN_CAP Statistics	<i>Supported Capabilities</i>	Returns Supported Margin Capabilities. Read the data and delete the semaphore.
The Result of following Operations: RUN_SW_LANE_MARGINING RUN_HW_LANE_MARGINING READ_SW_MARGIN_ERR	<i>Margining Statistics</i>	Returns Margining Test Statistics. Read the data and delete the semaphore.

Semaphore created by User - Condition	Semaphore Value	Description
Transmitter Test with Modification Enabled – set new Transmitter Preset (or exit the test)	<i>Preset Value</i>	To Change the Preset - Create the semaphore with required Preset value (in range 0-15). To Exit the Test - Create the semaphore with any other value. Wait while the semaphore exists. When deleted – Transmitter got the New Preset and configures it (or exits).
Transmitter Frequency Variation test – Scope triggered, Start	N/A	Create the semaphore when the scope is triggered. Wait while the semaphore exists. When deleted – Transmitter got the command and starts the Router transmitter.
Receiver Frequency Variation test – Clock Switch Turned On	N/A	Create the semaphore when the Clock Switch Turned On (on the BERT) . Wait while the semaphore exists. When deleted – test starts.
Receiver BER test with Manual Test Time – Stop the Test (Call END_BER_TEST operation)	N/A	Create the semaphore when need to stop the BER test. Wait while the semaphore exists. When deleted – test ends, wait for Test Result Semaphore.
Receiver BURST test with Manual Test Time – Read statistics without Test Stop	N/A	Create the semaphore when need to Read Statistics and Continue the Test. Wait while the semaphore exists.

		When deleted – wait for Test Result Semaphore.
Receiver BURST test with Manual Test Time – Read statistics and Stop the Test	"END"	Create the semaphore when need to Read Statistics and stop the Test. Wait while the semaphore exists. When deleted – test ends, wait for Test Result Semaphore.

6. Swap Lanes

Different Layouts require following **Swap Lanes** field configuration:

	Swap Lanes: None
	Swap Lanes: Router
	Swap Lanes: Router + Retimer#2
	Swap Lanes: Retimer#2