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Notices

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In This Book

This book is your guide to programming the Keysight Technologies N6463B Thunderbolt Electrical Compliance Test Application.

- Chapter 1, “Introduction to Programming,” starting on page 7, describes compliance application programming basics.
- Chapter 2, “Configuration Variables and Values,” starting on page 11, Chapter 3, “Test Names and IDs,” starting on page 21, and Chapter 4, “Instruments,” starting on page 41, provide information specific to programming the N6463B Thunderbolt Electrical Compliance Test Application.

How to Use This Book

Programmers who are new to compliance application programming should read all of the chapters in order. Programmers who are already familiar with this may review chapters 2, 3, and 4 for changes.

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1 Introduction to Programming

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This chapter introduces the basics for remote programming a compliance application. The programming commands provide the means of remote control. Basic operations that you can do remotely with a computer and a compliance app running on an oscilloscope include:

- Launching and closing the application.
- Configuring the options.
- Running tests.
- Getting results.
- Controlling when and were dialogs get displayed
- Saving and loading projects.

You can accomplish other tasks by combining these functions.

Remote Programming Toolkit

The majority of remote interface features are common across all the Keysight Technologies, Inc. family of compliance applications. Information on those features is provided in the N5452A Compliance Application Remote Programming Toolkit available for download from Keysight here: "www.keysight.com/find/scope-apps-sw". The N6463B Thunderbolt Electrical Compliance Test Application uses Remote Interface Revision 3.40. The help files provided with the toolkit indicate which features are supported in this version.

In the toolkit, various documents refer to "application-specific configuration variables, test information, and instrument information". These are provided in Chapters 2, 3, and 4 of this document, and are also available directly from the application's user interface when the remote interface is enabled (View>Preferences::Remote tab::Show remote interface hints). See the toolkit for more information.

Licensing

To enable programming of compliance applications on your oscilloscope, please visit "www.keysight.com/find/scope-apps" to purchase an N5452A remote programming option license.

2 Configuration Variables and Values

The following table contains a description of each of the N6463B Thunderbolt Electrical Compliance Test Application options that you may query or set remotely using the appropriate remote interface method. The columns contain this information:

- GUI Location – Describes which graphical user interface tab contains the control used to change the value.
- Label – Describes which graphical user interface control is used to change the value.
- Variable – The name to use with the SetConfig method.
- Values – The values to use with the SetConfig method.
- Description – The purpose or function of the variable.

For example, if the graphical user interface contains this control on the **Set Up** tab:

- Enable Advanced Features

then you would expect to see something like this in the table below:

Table 1 Example Configuration Variables and Values

GUI Location	Label	Variable	Values	Description
Set Up	Enable Advanced Features	EnableAdvanced	True, False	Enables a set of optional features.

and you would set the variable remotely using:

```
ARSL syntax
-----------
arsl -a ipaddress -c "SetConfig 'EnableAdvanced' 'True'"
```

```
C# syntax
---------
remoteAte.SetConfig("EnableAdvanced", "True");
```

Here are the actual configuration variables and values used by this application:

NOTE Some of the values presented in the table below may not be available in certain configurations. Always perform a "test run" of your remote script using the application's graphical user interface to ensure the combinations of values in your program are valid.

NOTE The file, ""ConfigInfo.txt"", which may be found in the same directory as this help file, contains all of the information found in the table below in a format suitable for parsing.

Table 2 Configuration Variables and Values

GUI Location	Label	Variable	Values	Description
Confgure	ACCM Acquisition Number	ACCMAcqNum	(Accepts user-defined text), 1, 5, 10, 15	Select the number of signal acquisition for live signal analysis (Signal Acquisition Method = [Live]) of AC Common Mode tests.
Confgure	Acquisition Bandwidth	RiseFallTimeAcqBW	AUTO, AcquisitionSetup	Select the acquisition bandwidth for the rise/fall time measurement. For [Auto], the acquisition bandwidth will be set to maximum (Automatic). For [Acquisition Setup], the acquisition bandwidth will be set to the value based on the settings in Tools->Acquisition Setup.
Confgure	Automation Timeout	AutomationTimeout	(Accepts user-defined text), 200	Select the controller automation timeout. Unit : second.
Confgure	Average Number	EquAvgNum	Max, 2, 4, 16, 64, 256, 1024, 4096, 16384, 65534	Select the averaging number of signal acquisition for live signal analysis (Signal Acquisition Method = [Live]) of equalization test. Select [Max] for maximum averaging number of the oscilloscope.
Confgure	Equalization Coefficient Automation	EnableEquCoefficientAutomation	Enable, Disable	Select to enable or disable the equalization coefficient (C0 and C1) increament and decreament automation.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Confgure	Equalization Coefficient Step	EquCoefficientStep	(Accepts user-defined text), 1	Select the equalization coefficient (C0 and C1) increament and decreament step.
Confgure	Eye Mask Acquisition Number	MaskAcqNum	(Accepts user-defined text), 1, 5, 10, 15	Select the number of signal acquisition for live signal analysis (Signal Acquisition Method = [Live]) of mask test.
Confgure	Eye Mask Horizontal Shift Step Number	MaskHorShiftStepNum	(Accepts user-defined text), 2, 5, 9, 10, 20	Select the number of step the mask shifted horizontally through one entire unit interval when mask fail.
Confgure	ISI Filter Lagging Bit	ISILagBit	0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0, 15.0	Select the number of trailing bits used to calculate the ISI filter. This config only applicable when the Jitter Pattern Length is set to Arbitrary. The trailing bits is greater than or equal to 0.
Confgure	ISI Filter Leading Bit	ISILeadBit	0.0, -1.0, -2.0, -3.0, -4.0, -5.0, -6.0, -7.0, -8.0, -9.0, -10.0	Select the number of leading bits used to calculate the ISI filter. This config only applicable when the Jitter Pattern Length is set to Arbitrary. The leading bits is less than or equal to 0.
Confgure	Interpolation Point	InterpolationPoint	OFF, ON, INT1, INT2, INT4, INT8, INT16	Select the Sin(x)/x interpolation point for acquiring the waveform for all Thunderbolt tests.
Confgure	Jitter Pattern Length	JitterPLength	Default, ARBitrary, AUTO	Select the type of pattern length used for RjDj measurement. For [Default] Jitter Pattern Length, Periodic algorithm will be used for patten length less than 4096; Arbitrary algorithm will be used for others.
Confgure	Lane 0 Connection	L0Connection	5	Select the input channel for the Lane 0.
Confgure	Lane 1 Connection	L1Connection	6	Select the input channel for the Lane 1.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Confgure	Pattern Check	EnableSignalCheck	1.0, 0.0	When pattern check is enabled, the input signal is pre-tested and verified to be within a reasonable range of timing and voltage limits. This can be useful for detecting problems like cabling errors before a test is run.
Confgure	RJ Bandwidth	RJBandwidth	NARRow, WIDE	Select the type of filter bandwidth used to separate the DDJ from the RJ and PJ.
Confgure	RJ Method	RJMethod	BOTH, SPECtral	Select the type of method used to separate the RJ component.
Confgure	SSC Filter Window Size	SSC_LPF_WindowSize	(Accepts user-defined text), 0, 900, 1000, 2000, 3000, 4000, 5000	Select the Moving Average Filter's window size used to separate the SSC profile for Unit Interval and SSC measurement.
Confgure	SSC Phase Acquisition Number	SSCPhaseAcqNum	(Accepts user-defined text), 1, 5, 10, 15	Select the number of signal acquisition for live signal analysis (Signal Acquisition Method = [Live]) of SSC Phase tests.
Confgure	SSC Phase LPF Bandwidth	SSCPhaseLPFBandwidth	1.0E+6, 2.0E+6, 3.0E+6, 4.0E+6, 5.0E+6, 6.0E+6, 7.0E+6, 8.0E+6	Select the bandwidth for the 2nd order LPF used to filter on the signal phase jitter. Unit : MHz.
Confgure	SSC Phase LPF Damping Factor	SSCPhaseLPFDampFactor	(Accepts user-defined text), 0.570, 0.580, 0.707, 1.250, 1.750	Select the damping factor for the 2nd order LPF used to filter on the signal phase jitter.
Confgure	Sample Size - All Pattern (Live)	SampSize_MemPts_Live	(Accepts user-defined text), 8.0, 10.0, 20.0, 40.0	Select the memory points used for acquiring signal for live signal analysis (Signal Acquisition Method = [Live]), except Unit Interval and SSC tests. Unit : Mpts.
Confgure	Sample Size - SSC Phase (Live)	SampSize_MemPts_SSCPhase_Live	(Accepts user-defined text), 8.0, 10.0, 20.0, 40.0	Select the memory points used for acquiring signal for live signal analysis (Signal Acquisition Method = [Live]) of SSC Phase tests. Unit : Mpts.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Confgure	Sample Size - Unit Interval and SSC Modulation (Live)	SampSize_MemPts_UI_SSC_Live	(Accepts user-defined text), 8.0, 10.0, 20.0, 23.0, 40.0	Select the memory points used for acquiring signal for live signal analysis (Signal Acquisition Method = [Live]) of Unit Interval and SSC Modulation tests. Unit : Mpts.
Confgure	Sampling Rate	SampRate	80.0E9, 40.0E9	Select the sampling rate use for acquiring the waveform for all Thunderbolt tests. Unit: Sa/s.
Confgure	Screenshot Image Size	ScreenShotImageSize	GRAT, SCR	Select the screenshot image size for the report items.
Confgure	Signal Acquisition Method	SigAcqMethod	Live, Save_Waveform	Select the signal acquisition method. Select [Live] for live signal analysis without saving the signal waveform. Select [Save Waveform] for memory signal analysis (Live signal is saved prior analysis).
Confgure	Signal Trigger Level	TriggerThreshold	(Accepts user-defined text), 0.0, 50.0E-03, 100.0E-03, 150.0E-03, 200.0E-03, 250.0E-03, 300.0E-03, 350.0E-03, 400.0E-03, 450.0E-03, 500.0E-03, 550.0E-03, 600.0E-03	Choose the trigger level for all the signal in Thunderbolt tests. Unit: volt.
Confgure	Skew Time Tolerance	SkewTimeTolerance	(Accepts user-defined text), 3.00, 20.0, 40.0, 48.485, 50.0, 96.970	Select the time difference allowed for skew time measurement. Time difference greater than tolerance will be ignored. Default value is set to half of the UI. Unit: ps.
Confgure	Tx TBT_CDR1 Bandwidth	TxCDR1Bandwidth	1.0E+6, 2.0E+6, 3.0E+6, 4.0E+6, 5.0E+6, 6.0E+6, 7.0E+6, 8.0E+6	Select the bandwidth for the Thunderbolt CDR1 (2nd order PLL) used in clock to data recovery for transmitter test. Unit : MHz.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Confgure	Tx TBT_CDR1 Damping Factor	TxCDR1DampFactor	(Accepts user-defined text), 0.570, 0.580, 0.707, 1.250, 1.750	Select the damping factor for the Thunderbolt CDR1 (2nd order PLL) used in clock to data recovery for transmitter test.
Confgure	Tx TBT_CDR2 Bandwidth	TxCDR2Bandwidth	1.0E+6, 2.0E+6, 3.0E+6, 4.0E+6, 5.0E+6, 6.0E+6, 7.0E+6, 8.0E+6	Select the bandwidth for the Thunderbolt CDR2 (2nd order PLL) used in clock to data recovery for transmitter test. Unit : MHz.
Confgure	Tx TBT_CDR2 Damping Factor	TxCDR2DampFactor	(Accepts user-defined text), 0.570, 0.580, 0.707, 1.250, 1.750	Select the damping factor for the Thunderbolt CDR2 (2nd order PLL) used in clock to data recovery for transmitter test.
Confgure	Unit Interval Mean Filter Window Size	UI_LPF_WindowSize	(Accepts user-defined text), 0, 900, 1000, 2000, 3000, 4000, 5000	Select the Moving Average Filter's window size used for Unit Interval mean measurement.
Confgure	Unit Interval Mean Window Count	UI_WindowCount	Max, 10, 20, 50, 100	Select the number of window used for Unit Interval mean measurement.
Run Tests	Event	RunEvent	(None), Fail, Margin < N, Pass	Names of events that can be used with the StoreMode=Event or RunUntil RunEventAction options
Run Tests	RunEvent=Margin < N: Minimum required margin %	RunEvent_Margin < N_MinPercent	Any integer in range: 0 <= value <= 100	Specify N using the 'Minimum required margin %' control.
Set Up	Controller Directory	ControllerDirectory	(Accepts user-defined text)	Directory of the TenLira software in the scope. Example : C:\ Program Files\Intel Corporation\ TenLira. Directory of the TenLira software in the scope. Example : C:\Program Files\Intel Corporation\TenLira.
Set Up	Crosstalk Generator	CrosstalkGenerator	Manual, JBERT N4903B	Select the crosstalk generator use for Rx input to provide crosstalk between Tx and Rx during transmitter tests. Select the crosstalk generator use for Rx input to provide crosstalk between Tx and Rx during transmitter tests.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Set Up	Crosstalk Instrument	CrosstalkInstrument	None, JBERTB_IP, JBERTB_SICL, JBERTA_IP, JBERTA_SICL	Setup the external instrument used for crosstalk during remote interface. Setup the external instrument used for crosstalk during remote interface.
Set Up	DUT Type	DUTType	Device, Host	Set the DUT type to either Device or Host. Set the DUT type to either Device or Host.
Set Up	Device Identifier	DeviceIdentifier	(Accepts user-defined text), (Select or Type)	Identifier of the DUT in testing. Identifier of the DUT in testing.
Set Up	Enable Controller	ControllerEnable	0.0, 1.0	Enable or disable the use of Thunderbolt Micro-Controller. Enable or disable the use of Thunderbolt Micro-Controller.
Set Up	Enable Saved Waveform	SavedWaveformEnable	0.0, 1.0	Enable or disable the use of saved waveform in the tests. Enable or disable the use of saved waveform in the tests.
Set Up	Hide Informative Tests	HideInfoTests	0.0, 1.0	Check to hide all the informative tests. Check to hide all the informative tests.
Set Up	IP Address	IPAddress	(Accepts user-defined text)	IP address of the external instrument used for crosstalk during remote interface. IP address of the external instrument used for crosstalk during remote interface.
Set Up	PRBS11_NegSignal Directory	PRBS11_Neg_wfm	(Accepts user-defined text)	This variable use to store the directory of PRBS11 negative signal waveform. This variable use to store the directory of PRBS11 negative signal waveform.
Set Up	PRBS11_PosSignal Directory	PRBS11_Pos_wfm	(Accepts user-defined text)	This variable use to store the directory of PRBS11 positive signal waveform. This variable use to store the directory of PRBS11 positive signal waveform.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Set Up	PRBS31_NegSignal Directory	PRBS31_Neg_wfm	(Accepts user-defined text)	This variable use to store the directory of PRBS31 negative signal waveform. This variable use to store the directory of PRBS31 negative signal waveform.
Set Up	PRBS31_PosSignal Directory	PRBS31_Pos_wfm	(Accepts user-defined text)	This variable use to store the directory of PRBS31 positive signal waveform. This variable use to store the directory of PRBS31 positive signal waveform.
Set Up	PRBS9_NegSignalD irectory	PRBS9_Neg_wfm	(Accepts user-defined text)	This variable use to store the directory of PRBS9 negative signal waveform. This variable use to store the directory of PRBS9 negative signal waveform.
Set Up	PRBS9_PosSignalD irectory	PRBS9_Pos_wfm	(Accepts user-defined text)	This variable use to store the directory of PRBS9 positive signal waveform. This variable use to store the directory of PRBS9 positive signal waveform.
Set Up	Port Number	PortNumber	1 Port, 2 Ports	Set the number of port for the DUT. Set the number of port for the DUT.
Set Up	Port1 Name	Port1Name	(Accepts user-defined text), Port 1, (Select or Type)	Set the port name of the first port. This field will be show in report. Set the port name of the first port. This field will be show in report.
Set Up	Port2 Name	Port2Name	(Accepts user-defined text), Port 2, (Select or Type)	Set the port name of the second port. This field will be show in report. Set the port name of the second port. This field will be show in report.
Set Up	SQ2_NegSignalDire ctory	SQ2_Neg_wfm	(Accepts user-defined text)	This variable use to store the directory of SQ2 negative signal waveform. This variable use to store the directory of SQ2 negative signal waveform.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Set Up	SQ2_PosSignalDirectory	SQ2_Pos_wfm	(Accepts user-defined text)	This variable use to store the directory of SQ2 positive signal waveform. This variable use to store the directory of SQ2 positive signal waveform.
Set Up	SQ_NegSignalDirectory	SQ_Neg_wfm	(Accepts user-defined text)	This variable use to store the directory of SQ16/SQ32 negative signal waveform. This variable use to store the directory of SQ16/SQ32 negative signal waveform.
Set Up	SQ_PosSignalDirectory	SQ_Pos_wfm	(Accepts user-defined text)	This variable use to store the directory of SQ16/SQ32 positive signal waveform. This variable use to store the directory of SQ16/SQ32 positive signal waveform.
Set Up	Sicl Address	SiclAddress	(Accepts user-defined text)	Sicl address of the external instrument used for crosstalk during remote interface. Sicl address of the external instrument used for crosstalk during remote interface.
Set Up	Specification Version	SpecVersion	TBT Specification Rev 1.0	Select the specification version for the compliance tests. Select the specification version for the compliance tests.
Set Up	Test Lane Port 1	TestLanePort1	Both lanes, Lane 0 only, Lane 1 only	Select the test lane of Port 1 for testing. Select the test lane of Port 1 for testing.
Set Up	Test Lane Port 2	TestLanePort2	Both lanes, Lane 0 only, Lane 1 only	Select the test lane of Port 2 for testing. Select the test lane of Port 2 for testing.
Set Up	Thunderbolt Controller Type	TBTControllerType	TBT-TPA-UH, TBT-TPA-UHG2	Select the type of Thunderbolt Micro-Controller for the automation. Select the type of Thunderbolt Micro-Controller for the automation.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Set Up	User Comments	UserComments	(Accepts user-defined text)	Additional comments for the DUT. Additional comments for the DUT.
Set Up	User Description	UserDescription	(Accepts user-defined text), (Select or Type)	Short description of the DUT. Short description of the DUT.

3 Test Names and IDs

The following table shows the mapping between each test's numeric ID and name. The numeric ID is required by various remote interface methods.

- Name – The name of the test as it appears on the user interface **Select Tests** tab.
- Test ID – The number to use with the RunTests method.
- Description – The description of the test as it appears on the user interface **Select Tests** tab.

For example, if the graphical user interface displays this tree in the **Select Tests** tab:

- All Tests
  - Rise Time
  - Fall Time

then you would expect to see something like this in the table below:

Table 3 Example Test Names and IDs

Name	Test ID	Description
Fall Time	110	Measures clock fall time.
Rise Time	100	Measures clock rise time.

and you would run these tests remotely using:

```
ARSL syntax
-----------
arsl -a ipaddress -c "SelectedTests '100,110'"
arsl -a ipaddress -c "Run"

C# syntax
---------
remoteAte.SelectedTests = new int[]{100,110};
remoteAte.Run();
```

Here are the actual Test names and IDs used by this application:

NOTE The file, ""TestInfo.txt"", which may be found in the same directory as this help file, contains all of the information found in the table below in a format suitable for parsing.

Table 4 Test IDs and Names

Name	TestID	Description
1.1.0 Tx Lane Intra-pair Output Skew (Port 1, Lane 0)	2101	The Tx lane intra-pair output skew at TP1 of a Thunderbolt device must be less than maximum limit. The lane intra-pair output skew measurement is the time difference between the single-ended mid-point of the Tx+ signal rising/falling edge, and the single-ended mid-point of the Tx- signal falling/rising edge.
1.1.0 Tx Lane Intra-pair Output Skew (Port 1, Lane 0)	1101	The Tx lane intra-pair output skew at TP1 of a Thunderbolt host must be less than maximum limit. The lane intra-pair output skew measurement is the time difference between the single-ended mid-point of the Tx+ signal rising/falling edge, and the single-ended mid-point of the Tx- signal falling/rising edge.
1.1.0 Tx Lane Intra-pair Output Skew (Port 1, Lane 1)	2201	The Tx lane intra-pair output skew at TP1 of a Thunderbolt device must be less than maximum limit. The lane intra-pair output skew measurement is the time difference between the single-ended mid-point of the Tx+ signal rising/falling edge, and the single-ended mid-point of the Tx- signal falling/rising edge.
1.1.0 Tx Lane Intra-pair Output Skew (Port 1, Lane 1)	1201	The Tx lane intra-pair output skew at TP1 of a Thunderbolt host must be less than maximum limit. The lane intra-pair output skew measurement is the time difference between the single-ended mid-point of the Tx+ signal rising/falling edge, and the single-ended mid-point of the Tx- signal falling/rising edge.
1.1.0 Tx Lane Intra-pair Output Skew (Port 2, Lane 0)	2301	The Tx lane intra-pair output skew at TP1 of a Thunderbolt device must be less than maximum limit. The lane intra-pair output skew measurement is the time difference between the single-ended mid-point of the Tx+ signal rising/falling edge, and the single-ended mid-point of the Tx- signal falling/rising edge.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
1.1.0 Tx Lane Intra-pair Output Skew (Port 2, Lane 0)	1301	The Tx lane intra-pair output skew at TP1 of a Thunderbolt host must be less than maximum limit. The lane intra-pair output skew measurement is the time difference between the single-ended mid-point of the Tx+ signal rising/falling edge, and the single-ended mid-point of the Tx- signal falling/rising edge.
1.1.0 Tx Lane Intra-pair Output Skew (Port 2, Lane 1)	2401	The Tx lane intra-pair output skew at TP1 of a Thunderbolt device must be less than maximum limit. The lane intra-pair output skew measurement is the time difference between the single-ended mid-point of the Tx+ signal rising/falling edge, and the single-ended mid-point of the Tx- signal falling/rising edge.
1.1.0 Tx Lane Intra-pair Output Skew (Port 2, Lane 1)	1401	The Tx lane intra-pair output skew at TP1 of a Thunderbolt host must be less than maximum limit. The lane intra-pair output skew measurement is the time difference between the single-ended mid-point of the Tx+ signal rising/falling edge, and the single-ended mid-point of the Tx- signal falling/rising edge.
1.1.1 Tx AC Common Mode Voltage (Port 1, Lane 0)	2121	The AC common mode peak-to-peak voltage at TP1 of a Thunderbolt device must be less than maximum limit.
1.1.1 Tx AC Common Mode Voltage (Port 1, Lane 0)	1121	The AC common mode peak-to-peak voltage at TP1 of a Thunderbolt host must be less than maximum limit.
1.1.1 Tx AC Common Mode Voltage (Port 1, Lane 1)	2221	The AC common mode peak-to-peak voltage at TP1 of a Thunderbolt device must be less than maximum limit.
1.1.1 Tx AC Common Mode Voltage (Port 1, Lane 1)	1221	The AC common mode peak-to-peak voltage at TP1 of a Thunderbolt host must be less than maximum limit.
1.1.1 Tx AC Common Mode Voltage (Port 2, Lane 0)	2321	The AC common mode peak-to-peak voltage at TP1 of a Thunderbolt device must be less than maximum limit.
1.1.1 Tx AC Common Mode Voltage (Port 2, Lane 0)	1321	The AC common mode peak-to-peak voltage at TP1 of a Thunderbolt host must be less than maximum limit.
1.1.1 Tx AC Common Mode Voltage (Port 2, Lane 1)	2421	The AC common mode peak-to-peak voltage at TP1 of a Thunderbolt device must be less than maximum limit.
1.1.1 Tx AC Common Mode Voltage (Port 2, Lane 1)	1421	The AC common mode peak-to-peak voltage at TP1 of a Thunderbolt host must be less than maximum limit.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
1.1.10a Tx Unit Interval, Min (Port 1, Lane 0)	2151	The minimum unit interval at TP1 of a Thunderbolt device must be within the specification.
1.1.10a Tx Unit Interval, Min (Port 1, Lane 0)	1151	The minimum unit interval at TP1 of a Thunderbolt host must be within the specification.
1.1.10a Tx Unit Interval, Min (Port 1, Lane 1)	2251	The minimum unit interval at TP1 of a Thunderbolt device must be within the specification.
1.1.10a Tx Unit Interval, Min (Port 1, Lane 1)	1251	The minimum unit interval at TP1 of a Thunderbolt host must be within the specification.
1.1.10a Tx Unit Interval, Min (Port 2, Lane 0)	2351	The minimum unit interval at TP1 of a Thunderbolt device must be within the specification.
1.1.10a Tx Unit Interval, Min (Port 2, Lane 0)	1351	The minimum unit interval at TP1 of a Thunderbolt host must be within the specification.
1.1.10a Tx Unit Interval, Min (Port 2, Lane 1)	2451	The minimum unit interval at TP1 of a Thunderbolt device must be within the specification.
1.1.10a Tx Unit Interval, Min (Port 2, Lane 1)	1451	The minimum unit interval at TP1 of a Thunderbolt host must be within the specification.
1.1.10b Tx Unit Interval, Max (Port 1, Lane 0)	2152	The maximum unit interval at TP1 of a Thunderbolt device must be within the specification.
1.1.10b Tx Unit Interval, Max (Port 1, Lane 0)	1152	The maximum unit interval at TP1 of a Thunderbolt host must be within the specification.
1.1.10b Tx Unit Interval, Max (Port 1, Lane 1)	2252	The maximum unit interval at TP1 of a Thunderbolt device must be within the specification.
1.1.10b Tx Unit Interval, Max (Port 1, Lane 1)	1252	The maximum unit interval at TP1 of a Thunderbolt host must be within the specification.
1.1.10b Tx Unit Interval, Max (Port 2, Lane 0)	2352	The maximum unit interval at TP1 of a Thunderbolt device must be within the specification.
1.1.10b Tx Unit Interval, Max (Port 2, Lane 0)	1352	The maximum unit interval at TP1 of a Thunderbolt host must be within the specification.
1.1.10b Tx Unit Interval, Max (Port 2, Lane 1)	2452	The maximum unit interval at TP1 of a Thunderbolt device must be within the specification.
1.1.10b Tx Unit Interval, Max (Port 2, Lane 1)	1452	The maximum unit interval at TP1 of a Thunderbolt host must be within the specification.
1.1.11a Tx Unit Interval Mean, Min (Port 1, Lane 0)	2153	The mean unit interval at TP1 of a Thunderbolt device must be within the specification. The average UI should measured over windows at the size of one SSC cycle.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
1.1.11a Tx Unit Interval Mean, Min (Port 1, Lane 0)	1153	The mean unit interval at TP1 of a Thunderbolt host must be within the specification. The average UI should measured over windows at the size of one SSC cycle.
1.1.11a Tx Unit Interval Mean, Min (Port 1, Lane 1)	2253	The mean unit interval at TP1 of a Thunderbolt device must be within the specification. The average UI should measured over windows at the size of one SSC cycle.
1.1.11a Tx Unit Interval Mean, Min (Port 1, Lane 1)	1253	The mean unit interval at TP1 of a Thunderbolt host must be within the specification. The average UI should measured over windows at the size of one SSC cycle.
1.1.11a Tx Unit Interval Mean, Min (Port 2, Lane 0)	2353	The mean unit interval at TP1 of a Thunderbolt device must be within the specification. The average UI should measured over windows at the size of one SSC cycle.
1.1.11a Tx Unit Interval Mean, Min (Port 2, Lane 0)	1353	The mean unit interval at TP1 of a Thunderbolt host must be within the specification. The average UI should measured over windows at the size of one SSC cycle.
1.1.11a Tx Unit Interval Mean, Min (Port 2, Lane 1)	2453	The mean unit interval at TP1 of a Thunderbolt device must be within the specification. The average UI should measured over windows at the size of one SSC cycle.
1.1.11a Tx Unit Interval Mean, Min (Port 2, Lane 1)	1453	The mean unit interval at TP1 of a Thunderbolt host must be within the specification. The average UI should measured over windows at the size of one SSC cycle.
1.1.11b Tx Unit Interval Mean, Max (Port 1, Lane 0)	2154	The mean unit interval at TP1 of a Thunderbolt device must be within the specification. The average UI should measured over windows at the size of one SSC cycle.
1.1.11b Tx Unit Interval Mean, Max (Port 1, Lane 0)	1154	The mean unit interval at TP1 of a Thunderbolt host must be within the specification. The average UI should measured over windows at the size of one SSC cycle.
1.1.11b Tx Unit Interval Mean, Max (Port 1, Lane 1)	2254	The mean unit interval at TP1 of a Thunderbolt device must be within the specification. The average UI should measured over windows at the size of one SSC cycle.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
1.1.11b Tx Unit Interval Mean, Max (Port 1, Lane 1)	1254	The mean unit interval at TP1 of a Thunderbolt host must be within the specification. The average UI should measured over windows at the size of one SSC cycle.
1.1.11b Tx Unit Interval Mean, Max (Port 2, Lane 0)	2354	The mean unit interval at TP1 of a Thunderbolt device must be within the specification. The average UI should measured over windows at the size of one SSC cycle.
1.1.11b Tx Unit Interval Mean, Max (Port 2, Lane 0)	1354	The mean unit interval at TP1 of a Thunderbolt host must be within the specification. The average UI should measured over windows at the size of one SSC cycle.
1.1.11b Tx Unit Interval Mean, Max (Port 2, Lane 1)	2454	The mean unit interval at TP1 of a Thunderbolt device must be within the specification. The average UI should measured over windows at the size of one SSC cycle.
1.1.11b Tx Unit Interval Mean, Max (Port 2, Lane 1)	1454	The mean unit interval at TP1 of a Thunderbolt host must be within the specification. The average UI should measured over windows at the size of one SSC cycle.
1.1.12 Tx SSC Down Spread Deviation (Port 1, Lane 0)	2162	The spread spectrum clocking (SSC) modulation deviation at TP1 of a Thunderbolt device must be within the specification.
1.1.12 Tx SSC Down Spread Deviation (Port 1, Lane 0)	1162	The spread spectrum clocking (SSC) modulation deviation at TP1 of a Thunderbolt host must be within the specification.
1.1.12 Tx SSC Down Spread Deviation (Port 1, Lane 1)	2262	The spread spectrum clocking (SSC) modulation deviation at TP1 of a Thunderbolt device must be within the specification.
1.1.12 Tx SSC Down Spread Deviation (Port 1, Lane 1)	1262	The spread spectrum clocking (SSC) modulation deviation at TP1 of a Thunderbolt host must be within the specification.
1.1.12 Tx SSC Down Spread Deviation (Port 2, Lane 0)	2362	The spread spectrum clocking (SSC) modulation deviation at TP1 of a Thunderbolt device must be within the specification.
1.1.12 Tx SSC Down Spread Deviation (Port 2, Lane 0)	1362	The spread spectrum clocking (SSC) modulation deviation at TP1 of a Thunderbolt host must be within the specification.
1.1.12 Tx SSC Down Spread Deviation (Port 2, Lane 1)	2462	The spread spectrum clocking (SSC) modulation deviation at TP1 of a Thunderbolt device must be within the specification.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
1.1.12 Tx SSC Down Spread Deviation (Port 2, Lane 1)	1462	The spread spectrum clocking (SSC) modulation deviation at TP1 of a Thunderbolt host must be within the specification.
1.1.13 Tx SSC Phase Deviation (Port 1, Lane 0)	2171	The spread spectrum clocking (SSC) phase jitter at TP1 of a Thunderbolt device must be within the specification.
1.1.13 Tx SSC Phase Deviation (Port 1, Lane 0)	1171	The spread spectrum clocking (SSC) phase jitter at TP1 of a Thunderbolt host must be within the specification.
1.1.13 Tx SSC Phase Deviation (Port 1, Lane 1)	2271	The spread spectrum clocking (SSC) phase jitter at TP1 of a Thunderbolt device must be within the specification.
1.1.13 Tx SSC Phase Deviation (Port 1, Lane 1)	1271	The spread spectrum clocking (SSC) phase jitter at TP1 of a Thunderbolt host must be within the specification.
1.1.13 Tx SSC Phase Deviation (Port 2, Lane 0)	2371	The spread spectrum clocking (SSC) phase jitter at TP1 of a Thunderbolt device must be within the specification.
1.1.13 Tx SSC Phase Deviation (Port 2, Lane 0)	1371	The spread spectrum clocking (SSC) phase jitter at TP1 of a Thunderbolt host must be within the specification.
1.1.13 Tx SSC Phase Deviation (Port 2, Lane 1)	2471	The spread spectrum clocking (SSC) phase jitter at TP1 of a Thunderbolt device must be within the specification.
1.1.13 Tx SSC Phase Deviation (Port 2, Lane 1)	1471	The spread spectrum clocking (SSC) phase jitter at TP1 of a Thunderbolt host must be within the specification.
1.1.14 Tx SSC Phase Slew Rate (Port 1, Lane 0)	2172	The spread spectrum clocking (SSC) phase slew rate at TP1 of a Thunderbolt device must be within the specification.
1.1.14 Tx SSC Phase Slew Rate (Port 1, Lane 0)	1172	The spread spectrum clocking (SSC) phase slew rate at TP1 of a Thunderbolt host must be within the specification.
1.1.14 Tx SSC Phase Slew Rate (Port 1, Lane 1)	2272	The spread spectrum clocking (SSC) phase slew rate at TP1 of a Thunderbolt device must be within the specification.
1.1.14 Tx SSC Phase Slew Rate (Port 1, Lane 1)	1272	The spread spectrum clocking (SSC) phase slew rate at TP1 of a Thunderbolt host must be within the specification.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
1.1.14 Tx SSC Phase Slew Rate (Port 2, Lane 0)	2372	The spread spectrum clocking (SSC) phase slew rate at TP1 of a Thunderbolt device must be within the specification.
1.1.14 Tx SSC Phase Slew Rate (Port 2, Lane 0)	1372	The spread spectrum clocking (SSC) phase slew rate at TP1 of a Thunderbolt host must be within the specification.
1.1.14 Tx SSC Phase Slew Rate (Port 2, Lane 1)	2472	The spread spectrum clocking (SSC) phase slew rate at TP1 of a Thunderbolt device must be within the specification.
1.1.14 Tx SSC Phase Slew Rate (Port 2, Lane 1)	1472	The spread spectrum clocking (SSC) phase slew rate at TP1 of a Thunderbolt host must be within the specification.
1.1.15 Tx Eye Diagram (Port 1, Lane 0)	2131	The eye diagram at TP1 of a Thunderbolt device must within the template as specified by the specification.
1.1.15 Tx Eye Diagram (Port 1, Lane 0)	1131	The eye diagram at TP1 of a Thunderbolt host must within the template as specified by the specification.
1.1.15 Tx Eye Diagram (Port 1, Lane 1)	2231	The eye diagram at TP1 of a Thunderbolt device must within the template as specified by the specification.
1.1.15 Tx Eye Diagram (Port 1, Lane 1)	1231	The eye diagram at TP1 of a Thunderbolt host must within the template as specified by the specification.
1.1.15 Tx Eye Diagram (Port 2, Lane 0)	2331	The eye diagram at TP1 of a Thunderbolt device must within the template as specified by the specification.
1.1.15 Tx Eye Diagram (Port 2, Lane 0)	1331	The eye diagram at TP1 of a Thunderbolt host must within the template as specified by the specification.
1.1.15 Tx Eye Diagram (Port 2, Lane 1)	2431	The eye diagram at TP1 of a Thunderbolt device must within the template as specified by the specification.
1.1.15 Tx Eye Diagram (Port 2, Lane 1)	1431	The eye diagram at TP1 of a Thunderbolt host must within the template as specified by the specification.
1.1.15.1 Tx Maximum Differential Voltage (Port 1, Lane 0)	2132	The maximum differential voltage at TP1 of a Thunderbolt device must be less than maximum limit.
1.1.15.1 Tx Maximum Differential Voltage (Port 1, Lane 0)	1132	The maximum differential voltage at TP1 of a Thunderbolt host must be less than maximum limit.
1.1.15.1 Tx Maximum Differential Voltage (Port 1, Lane 1)	2232	The maximum differential voltage at TP1 of a Thunderbolt device must be less than maximum limit.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
1.1.15.1 Tx Maximum Differential Voltage (Port 1, Lane 1)	1232	The maximum differential voltage at TP1 of a Thunderbolt host must be less than maximum limit.
1.1.15.1 Tx Maximum Differential Voltage (Port 2, Lane 0)	2332	The maximum differential voltage at TP1 of a Thunderbolt device must be less than maximum limit.
1.1.15.1 Tx Maximum Differential Voltage (Port 2, Lane 0)	1332	The maximum differential voltage at TP1 of a Thunderbolt host must be less than maximum limit.
1.1.15.1 Tx Maximum Differential Voltage (Port 2, Lane 1)	2432	The maximum differential voltage at TP1 of a Thunderbolt device must be less than maximum limit.
1.1.15.1 Tx Maximum Differential Voltage (Port 2, Lane 1)	1432	The maximum differential voltage at TP1 of a Thunderbolt host must be less than maximum limit.
1.1.16 Tx Platform Equalization (Port 1, Lane 0)	2181	The platform equalization level (PLATFORM_EQ) at TP1 of a Thunderbolt device must be within the specification.
1.1.16 Tx Platform Equalization (Port 1, Lane 0)	1181	The platform equalization level (PLATFORM_EQ) at TP1 of a Thunderbolt host must be within the specification.
1.1.16 Tx Platform Equalization (Port 1, Lane 1)	2281	The platform equalization level (PLATFORM_EQ) at TP1 of a Thunderbolt device must be within the specification.
1.1.16 Tx Platform Equalization (Port 1, Lane 1)	1281	The platform equalization level (PLATFORM_EQ) at TP1 of a Thunderbolt host must be within the specification.
1.1.16 Tx Platform Equalization (Port 2, Lane 0)	2381	The platform equalization level (PLATFORM_EQ) at TP1 of a Thunderbolt device must be within the specification.
1.1.16 Tx Platform Equalization (Port 2, Lane 0)	1381	The platform equalization level (PLATFORM_EQ) at TP1 of a Thunderbolt host must be within the specification.
1.1.16 Tx Platform Equalization (Port 2, Lane 1)	2481	The platform equalization level (PLATFORM_EQ) at TP1 of a Thunderbolt device must be within the specification.
1.1.16 Tx Platform Equalization (Port 2, Lane 1)	1481	The platform equalization level (PLATFORM_EQ) at TP1 of a Thunderbolt host must be within the specification.
1.1.2 Tx Rise Time (Port 1, Lane 0)	2111	The Tx output rise time and fall time at TP1 of a Thunderbolt device must be greater than minimum limit. The rise/fall time measurement is based on the 20% to 80% of the Vpp of the signal.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
1.1.2 Tx Rise Time (Port 1, Lane 0)	1111	The Tx output rise time and fall time at TP1 of a Thunderbolt host must be greater than minimum limit. The rise/fall time measurement is based on the 20% to 80% of the Vpp of the signal.
1.1.2 Tx Rise Time (Port 1, Lane 1)	2211	The Tx output rise time and fall time at TP1 of a Thunderbolt device must be greater than minimum limit. The rise/fall time measurement is based on the 20% to 80% of the Vpp of the signal.
1.1.2 Tx Rise Time (Port 1, Lane 1)	1211	The Tx output rise time and fall time at TP1 of a Thunderbolt host must be greater than minimum limit. The rise/fall time measurement is based on the 20% to 80% of the Vpp of the signal.
1.1.2 Tx Rise Time (Port 2, Lane 0)	2311	The Tx output rise time and fall time at TP1 of a Thunderbolt device must be greater than minimum limit. The rise/fall time measurement is based on the 20% to 80% of the Vpp of the signal.
1.1.2 Tx Rise Time (Port 2, Lane 0)	1311	The Tx output rise time and fall time at TP1 of a Thunderbolt host must be greater than minimum limit. The rise/fall time measurement is based on the 20% to 80% of the Vpp of the signal.
1.1.2 Tx Rise Time (Port 2, Lane 1)	2411	The Tx output rise time and fall time at TP1 of a Thunderbolt device must be greater than minimum limit. The rise/fall time measurement is based on the 20% to 80% of the Vpp of the signal.
1.1.2 Tx Rise Time (Port 2, Lane 1)	1411	The Tx output rise time and fall time at TP1 of a Thunderbolt host must be greater than minimum limit. The rise/fall time measurement is based on the 20% to 80% of the Vpp of the signal.
1.1.3 Tx Fall Time (Port 1, Lane 0)	2112	The Tx output rise time and fall time at TP1 of a Thunderbolt device must be greater than minimum limit. The rise/fall time measurement is based on the 20% to 80% of the Vpp of the signal.
1.1.3 Tx Fall Time (Port 1, Lane 0)	1112	The Tx output rise time and fall time at TP1 of a Thunderbolt host must be greater than minimum limit. The rise/fall time measurement is based on the 20% to 80% of the Vpp of the signal.
1.1.3 Tx Fall Time (Port 1, Lane 1)	2212	The Tx output rise time and fall time at TP1 of a Thunderbolt device must be greater than minimum limit. The rise/fall time measurement is based on the 20% to 80% of the Vpp of the signal.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
1.1.3 Tx Fall Time (Port 1, Lane 1)	1212	The Tx output rise time and fall time at TP1 of a Thunderbolt host must be greater than minimum limit. The rise/fall time measurement is based on the 20% to 80% of the Vpp of the signal.
1.1.3 Tx Fall Time (Port 2, Lane 0)	2312	The Tx output rise time and fall time at TP1 of a Thunderbolt device must be greater than minimum limit. The rise/fall time measurement is based on the 20% to 80% of the Vpp of the signal.
1.1.3 Tx Fall Time (Port 2, Lane 0)	1312	The Tx output rise time and fall time at TP1 of a Thunderbolt host must be greater than minimum limit. The rise/fall time measurement is based on the 20% to 80% of the Vpp of the signal.
1.1.3 Tx Fall Time (Port 2, Lane 1)	2412	The Tx output rise time and fall time at TP1 of a Thunderbolt device must be greater than minimum limit. The rise/fall time measurement is based on the 20% to 80% of the Vpp of the signal.
1.1.3 Tx Fall Time (Port 2, Lane 1)	1412	The Tx output rise time and fall time at TP1 of a Thunderbolt host must be greater than minimum limit. The rise/fall time measurement is based on the 20% to 80% of the Vpp of the signal.
1.1.4 Tx Total Jitter, CDR1 (Port 1, Lane 0)	2141	The total jitter (TJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58. Total jitter is the sum of all DJ plus 14.7 times the RJ rms.
1.1.4 Tx Total Jitter, CDR1 (Port 1, Lane 0)	1141	The total jitter (TJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58. Total jitter is the sum of all DJ plus 14.7 times the RJ rms.
1.1.4 Tx Total Jitter, CDR1 (Port 1, Lane 1)	2241	The total jitter (TJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58. Total jitter is the sum of all DJ plus 14.7 times the RJ rms.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
1.1.4 Tx Total Jitter, CDR1 (Port 1, Lane 1)	1241	The total jitter (TJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58. Total jitter is the sum of all DJ plus 14.7 times the RJ rms.
1.1.4 Tx Total Jitter, CDR1 (Port 2, Lane 0)	2341	The total jitter (TJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58. Total jitter is the sum of all DJ plus 14.7 times the RJ rms.
1.1.4 Tx Total Jitter, CDR1 (Port 2, Lane 0)	1341	The total jitter (TJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58. Total jitter is the sum of all DJ plus 14.7 times the RJ rms.
1.1.4 Tx Total Jitter, CDR1 (Port 2, Lane 1)	2441	The total jitter (TJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58. Total jitter is the sum of all DJ plus 14.7 times the RJ rms.
1.1.4 Tx Total Jitter, CDR1 (Port 2, Lane 1)	1441	The total jitter (TJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58. Total jitter is the sum of all DJ plus 14.7 times the RJ rms.
1.1.4.1 Tx Random Jitter, CDR1 (Port 1, Lane 0)	2142	The random jitter (RJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.4.1 Tx Random Jitter, CDR1 (Port 1, Lane 0)	1142	The random jitter (RJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.4.1 Tx Random Jitter, CDR1 (Port 1, Lane 1)	2242	The random jitter (RJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
1.1.4.1 Tx Random Jitter, CDR1 (Port 1, Lane 1)	1242	The random jitter (RJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.4.1 Tx Random Jitter, CDR1 (Port 2, Lane 0)	2342	The random jitter (RJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.4.1 Tx Random Jitter, CDR1 (Port 2, Lane 0)	1342	The random jitter (RJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.4.1 Tx Random Jitter, CDR1 (Port 2, Lane 1)	2442	The random jitter (RJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.4.1 Tx Random Jitter, CDR1 (Port 2, Lane 1)	1442	The random jitter (RJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.5 Tx Total Jitter, CDR2 (Port 1, Lane 0)	2143	The total jitter (TJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR2 with closed loop corner frequency 5MHz and damping factor 1.25. Total jitter is the sum of all DJ plus 14.7 times the RJ rms.
1.1.5 Tx Total Jitter, CDR2 (Port 1, Lane 0)	1143	The total jitter (TJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR2 with closed loop corner frequency 5MHz and damping factor 1.25. Total jitter is the sum of all DJ plus 14.7 times the RJ rms.
1.1.5 Tx Total Jitter, CDR2 (Port 1, Lane 1)	2243	The total jitter (TJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR2 with closed loop corner frequency 5MHz and damping factor 1.25. Total jitter is the sum of all DJ plus 14.7 times the RJ rms.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
1.1.5 Tx Total Jitter, CDR2 (Port 1, Lane 1)	1243	The total jitter (TJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR2 with closed loop corner frequency 5MHz and damping factor 1.25. Total jitter is the sum of all DJ plus 14.7 times the RJ rms.
1.1.5 Tx Total Jitter, CDR2 (Port 2, Lane 0)	2343	The total jitter (TJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR2 with closed loop corner frequency 5MHz and damping factor 1.25. Total jitter is the sum of all DJ plus 14.7 times the RJ rms.
1.1.5 Tx Total Jitter, CDR2 (Port 2, Lane 0)	1343	The total jitter (TJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR2 with closed loop corner frequency 5MHz and damping factor 1.25. Total jitter is the sum of all DJ plus 14.7 times the RJ rms.
1.1.5 Tx Total Jitter, CDR2 (Port 2, Lane 1)	2443	The total jitter (TJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR2 with closed loop corner frequency 5MHz and damping factor 1.25. Total jitter is the sum of all DJ plus 14.7 times the RJ rms.
1.1.5 Tx Total Jitter, CDR2 (Port 2, Lane 1)	1443	The total jitter (TJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR2 with closed loop corner frequency 5MHz and damping factor 1.25. Total jitter is the sum of all DJ plus 14.7 times the RJ rms.
1.1.5.1 Tx Random Jitter, CDR2 (Port 1, Lane 0)	2144	The random jitter (RJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR2 with closed loop corner frequency 5MHz and damping factor 1.25.
1.1.5.1 Tx Random Jitter, CDR2 (Port 1, Lane 0)	1144	The random jitter (RJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR2 with closed loop corner frequency 5MHz and damping factor 1.25.
1.1.5.1 Tx Random Jitter, CDR2 (Port 1, Lane 1)	2244	The random jitter (RJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR2 with closed loop corner frequency 5MHz and damping factor 1.25.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
1.1.5.1 Tx Random Jitter, CDR2 (Port 1, Lane 1)	1244	The random jitter (RJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR2 with closed loop corner frequency 5MHz and damping factor 1.25.
1.1.5.1 Tx Random Jitter, CDR2 (Port 2, Lane 0)	2344	The random jitter (RJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR2 with closed loop corner frequency 5MHz and damping factor 1.25.
1.1.5.1 Tx Random Jitter, CDR2 (Port 2, Lane 0)	1344	The random jitter (RJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR2 with closed loop corner frequency 5MHz and damping factor 1.25.
1.1.5.1 Tx Random Jitter, CDR2 (Port 2, Lane 1)	2444	The random jitter (RJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR2 with closed loop corner frequency 5MHz and damping factor 1.25.
1.1.5.1 Tx Random Jitter, CDR2 (Port 2, Lane 1)	1444	The random jitter (RJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR2 with closed loop corner frequency 5MHz and damping factor 1.25.
1.1.6a Tx Low-Frequency Total Jitter (Port 1, Lane 0)	2145	The Low-Frequency Total Jitter (TJ_LF) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured with CDR1 and 1st order LPF with 3dB point 11MHz.
1.1.6a Tx Low-Frequency Total Jitter (Port 1, Lane 0)	1145	The Low-Frequency Total Jitter (TJ_LF) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured with CDR1 and 1st order LPF with 3dB point 11MHz.
1.1.6a Tx Low-Frequency Total Jitter (Port 1, Lane 1)	2245	The Low-Frequency Total Jitter (TJ_LF) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured with CDR1 and 1st order LPF with 3dB point 11MHz.
1.1.6a Tx Low-Frequency Total Jitter (Port 1, Lane 1)	1245	The Low-Frequency Total Jitter (TJ_LF) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured with CDR1 and 1st order LPF with 3dB point 11MHz.
1.1.6a Tx Low-Frequency Total Jitter (Port 2, Lane 0)	2345	The Low-Frequency Total Jitter (TJ_LF) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured with CDR1 and 1st order LPF with 3dB point 11MHz.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
1.1.6a Tx Low-Frequency Total Jitter (Port 2, Lane 0)	1345	The Low-Frequency Total Jitter (TJ_LF) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured with CDR1 and 1st order LPF with 3dB point 11MHz.
1.1.6a Tx Low-Frequency Total Jitter (Port 2, Lane 1)	2445	The Low-Frequency Total Jitter (TJ_LF) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured with CDR1 and 1st order LPF with 3dB point 11MHz.
1.1.6a Tx Low-Frequency Total Jitter (Port 2, Lane 1)	1445	The Low-Frequency Total Jitter (TJ_LF) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured with CDR1 and 1st order LPF with 3dB point 11MHz.
1.1.6b Tx Low-Frequency Deterministic Jitter (Port 1, Lane 0)	2148	The Low-Frequency Deterministic Jitter (DJ_LF) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured with CDR1 and 1st order LPF with 3dB point 11MHz.
1.1.6b Tx Low-Frequency Deterministic Jitter (Port 1, Lane 0)	1148	The Low-Frequency Deterministic Jitter (DJ_LF) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured with CDR1 and 1st order LPF with 3dB point 11MHz.
1.1.6b Tx Low-Frequency Deterministic Jitter (Port 1, Lane 1)	2248	The Low-Frequency Deterministic Jitter (DJ_LF) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured with CDR1 and 1st order LPF with 3dB point 11MHz.
1.1.6b Tx Low-Frequency Deterministic Jitter (Port 1, Lane 1)	1248	The Low-Frequency Deterministic Jitter (DJ_LF) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured with CDR1 and 1st order LPF with 3dB point 11MHz.
1.1.6b Tx Low-Frequency Deterministic Jitter (Port 2, Lane 0)	2348	The Low-Frequency Deterministic Jitter (DJ_LF) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured with CDR1 and 1st order LPF with 3dB point 11MHz.
1.1.6b Tx Low-Frequency Deterministic Jitter (Port 2, Lane 0)	1348	The Low-Frequency Deterministic Jitter (DJ_LF) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured with CDR1 and 1st order LPF with 3dB point 11MHz.
1.1.6b Tx Low-Frequency Deterministic Jitter (Port 2, Lane 1)	2448	The Low-Frequency Deterministic Jitter (DJ_LF) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured with CDR1 and 1st order LPF with 3dB point 11MHz.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
1.1.6b Tx Low-Frequency Deterministic Jitter (Port 2, Lane 1)	1448	The Low-Frequency Deterministic Jitter (DJ_LF) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured with CDR1 and 1st order LPF with 3dB point 11MHz.
1.1.7 Tx Data Dependent Jitter (Port 1, Lane 0)	2146	The data dependant jitter (DDJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.7 Tx Data Dependent Jitter (Port 1, Lane 0)	1146	The data dependant jitter (DDJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.7 Tx Data Dependent Jitter (Port 1, Lane 1)	2246	The data dependant jitter (DDJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.7 Tx Data Dependent Jitter (Port 1, Lane 1)	1246	The data dependant jitter (DDJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.7 Tx Data Dependent Jitter (Port 2, Lane 0)	2346	The data dependant jitter (DDJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.7 Tx Data Dependent Jitter (Port 2, Lane 0)	1346	The data dependant jitter (DDJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.7 Tx Data Dependent Jitter (Port 2, Lane 1)	2446	The data dependant jitter (DDJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
1.1.7 Tx Data Dependent Jitter (Port 2, Lane 1)	1446	The data dependant jitter (DDJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.8 Tx Sum of Uncorrelated Deterministic Jitter and Random Jitter (Port 1, Lane 0)	2147	The sum of uncorrelated deterministic jitter and random jitter (UJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.8 Tx Sum of Uncorrelated Deterministic Jitter and Random Jitter (Port 1, Lane 0)	1147	The sum of uncorrelated deterministic jitter and random jitter (UJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.8 Tx Sum of Uncorrelated Deterministic Jitter and Random Jitter (Port 1, Lane 1)	2247	The sum of uncorrelated deterministic jitter and random jitter (UJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.8 Tx Sum of Uncorrelated Deterministic Jitter and Random Jitter (Port 1, Lane 1)	1247	The sum of uncorrelated deterministic jitter and random jitter (UJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.8 Tx Sum of Uncorrelated Deterministic Jitter and Random Jitter (Port 2, Lane 0)	2347	The sum of uncorrelated deterministic jitter and random jitter (UJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.8 Tx Sum of Uncorrelated Deterministic Jitter and Random Jitter (Port 2, Lane 0)	1347	The sum of uncorrelated deterministic jitter and random jitter (UJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.8 Tx Sum of Uncorrelated Deterministic Jitter and Random Jitter (Port 2, Lane 1)	2447	The sum of uncorrelated deterministic jitter and random jitter (UJ) at TP1 of a Thunderbolt device must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
1.1.8 Tx Sum of Uncorrelated Deterministic Jitter and Random Jitter (Port 2, Lane 1)	1447	The sum of uncorrelated deterministic jitter and random jitter (UJ) at TP1 of a Thunderbolt host must be less than maximum limit. The jitter will be measured using 2nd order CDR1 with closed loop corner frequency 5MHz and damping factor 0.58.
1.1.9 Tx SSC Down Spread Rate (Port 1, Lane 0)	2161	The spread spectrum clocking (SSC) modulation frequency at TP1 of a Thunderbolt device must be within the specification.
1.1.9 Tx SSC Down Spread Rate (Port 1, Lane 0)	1161	The spread spectrum clocking (SSC) modulation frequency at TP1 of a Thunderbolt host must be within the specification.
1.1.9 Tx SSC Down Spread Rate (Port 1, Lane 1)	2261	The spread spectrum clocking (SSC) modulation frequency at TP1 of a Thunderbolt device must be within the specification.
1.1.9 Tx SSC Down Spread Rate (Port 1, Lane 1)	1261	The spread spectrum clocking (SSC) modulation frequency at TP1 of a Thunderbolt host must be within the specification.
1.1.9 Tx SSC Down Spread Rate (Port 2, Lane 0)	2361	The spread spectrum clocking (SSC) modulation frequency at TP1 of a Thunderbolt device must be within the specification.
1.1.9 Tx SSC Down Spread Rate (Port 2, Lane 0)	1361	The spread spectrum clocking (SSC) modulation frequency at TP1 of a Thunderbolt host must be within the specification.
1.1.9 Tx SSC Down Spread Rate (Port 2, Lane 1)	2461	The spread spectrum clocking (SSC) modulation frequency at TP1 of a Thunderbolt device must be within the specification.
1.1.9 Tx SSC Down Spread Rate (Port 2, Lane 1)	1461	The spread spectrum clocking (SSC) modulation frequency at TP1 of a Thunderbolt host must be within the specification.

4 Instruments

The following table shows the instruments used by this application. The name is required by various remote interface methods.

- Instrument Name — The name to use as a parameter in remote interface commands.
- Description — The description of the instrument.

For example, if an application uses an oscilloscope and a pulse generator, then you would expect to see something like this in the table below:

Table 5 Example Instrument Information

Name	Description
scope	The primary oscilloscope.
Pulse	The pulse generator used for Gen 2 tests.

and you would be able to remotely control an instrument using:

```
ARSL syntax (replace [description] with actual parameter)
------------------------------------------------------------------------
arsl -a ipaddress -c "SendScpiCommandCustom 'Command=[scpi
command];Timeout=100;Instrument=pulsegen'"

arsl -a ipaddress -c "SendScpiQueryCustom 'Command=[scpi
query];Timeout=100;Instrument=pulsegen'"


C# syntax (replace [description] with actual parameter)
------------------------------------------------------------------------
SendScpiCommandOptions commandOptions = new SendScpiCommandOptions();
commandOptions.Command = "[scpi command]";
commandOptions.Instrument = "[instrument name]";
commandOptions.Timeout = [timeout];
remoteAte.SendScpiCommand(commandOptions);

SendScpiQueryOptions queryOptions = new SendScpiQueryOptions();
queryOptions.Query = "[scpi query]";
queryOptions.Instrument = "[instrument name]";
```

```
queryOptions.Timeout = [timeout];
remoteAte.SendScpiQuery(queryOptions);
```

Here are the actual instrument names used by this application:

NOTE The file, ""InstrumentInfo.txt"", which may be found in the same directory as this help file, contains all of the information found in the table below in a format suitable for parsing.

Table 6 Instrument Names

Instrument Name	Description
JBERTA	N4903A High Performance Serial BERT
JBERTB	N4903B High Performance Serial BERT
scope	The primary oscilloscope

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