Keysight N5416A/N5416B USB Compliance Application

Programmer's Reference

Notices

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In This Book

This book is your guide to programming the Agilent Technologies N5416A/N5416B USB Compliance Application.

- Chapter 1, “Introduction to Programming,” starting on page 7, describes compliance application programming basics.
- Chapter 2, “Configuration Variables and Values,” starting on page 9, Chapter 3, “Test Names and IDs,” starting on page 19, and Chapter 4, “Instruments,” starting on page 37 provide information specific to programming the N5416A/N5416B USB Compliance 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.

Contents

1 Introduction to Programming

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/rpi. The N5416A/N5416B USB Compliance Application uses Remote Interface Revision 4.56. 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.

2 Configuration Variables and Values

The following table contains a description of each of the N5416A/N5416B USB Compliance 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
Configure	113xA Channel	DiffChan	CHANNEL1, CHANNEL2, CHANNEL3, CHANNEL4	Select the channel number for the 113xA Differential Probe.
Configure	2nd 113xA Channel	DiffChan2	CHANNEL1, CHANNEL2, CHANNEL3, CHANNEL4	Select the channel number for the second 113xA differential probe.
Configure	Adjacent Device Channel	TrigChan	CHANNEL1, CHANNEL2, CHANNEL3, CHANNEL4, NONE	Select the channel number for adjacent device(D+ or D-).
Configure	Bandwidth	bandwidth	1.5E+09, 2.0E+09, 3.0E+09, 4.0E+09, 5.0E+09, 6.0E+09, 7.0E+09, 8.0E+09, 9.0E+09,10.0E+09, 11.0E+09, 12.0E+09, 13.0E+09	Choose the bandwidth(just valid for the test which support Noise Reduction Option).
Configure	CHIRP Time Range	CHIRPTime	300.0E-03, 200.0E-03, 150.0E-03, 100.0E-03, 70.0E-03, 50.0E-03, 30.0E-03, 20.0E-03, 10.0E-03	Choose the time range to capture the CHIRP signal.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Configure	CHIRP Time Range	HostCHIRPTime	300.0E-03, 200.0E-03, 150.0E-03, 100.0E-03, 70.0E-03, 50.0E-03, 30.0E-03, 20.0E-03, 10.0E-03	Choose the time range to capture the CHIRP signal.
Configure	Current Probe Channel	CP	CHANNEL1, CHANNEL2, CHANNEL3, CHANNEL4	Select the channel number for the N277A/1147A Current Probe.
Configure	D+ Channel (Passive Probe)	DP	CHANNEL1, CHANNEL2, CHANNEL3, CHANNEL4	If using single-ended probe connection (E2697A with 10073C passive probe or 1156A active probe), select the channel number for data-line D+.
Configure	D+ OTG Channel	DPOTG	CHANNEL1, CHANNEL2, CHANNEL3, CHANNEL4	If using single-ended probe connection (E2697A with 10073C passive probe or 1156A active probe), select the channel number for data-line D+.
Configure	D- Channel (Passive Probe)	DN	CHANNEL1, CHANNEL2, CHANNEL3, CHANNEL4	If using single-ended probe connection(E2697A with 10073C passive probe or 1156A active probe), select the channel number for data-line D-.
Configure	DUT Case	dutCase	1, 2	Choose the type of the DUT. A DUT will be defined as special if it is off permanently when "IN" packet is lower than certainly level. Affect receiver sensitivity test only.
Configure	Droop Drop Test Load	DroopDropLoad	500mA, 100mA, 150mA, 900mA	Choose Test Load for Droop Drop Test.
Configure	Droop Drop Test Method	DroopDropType	AUTO, MANUAL	Choose AUTO for automatic Droop Drop Testing. Choose MANUAL for manual Droop Drop Testing.
Configure	Droop Drop Test Type	DroopDropTestType	sys, sphub	Identifies type of droop/drop test.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Configure	Droop Test Averaging	DroopAvrg	1, 2, 4, 8, 16, 32, 64	Choose the number of averaging for droop test.
Configure	Droop test trigger threshold	DroopTrig	(Accepts user-defined text), 1, 2	Choose the trigger threshold for droop test
Configure	Drop Test Instrument	DropTestInst	Probe, Voltmeter	Choose the test instrument used in drop test.
Configure	EL_22 Embedded Host test trigger method	EL22Trig	ScanTrig, ProTrig, Normal	User can use Infiniiscan or protocol to trigger EL22 embedded host packet parameter (InfiniiScan license is required)
Configure	HSPacketParameter	HSPacketParameter	DifferentialPP, SingleEndedPP	Packet Parameter Connection
Configure	HSSignalQuality	HSSignalQuality	SMA, DifferentialSQ	High Speed Signal Quality Connection
Configure	Histogram Packet	HistogramPacket	FullPacketHistogram, EndPacketHistogram	Please choose the option for Histogram Packet
Configure	Inrush Current Test Spec	inrushSpec	1, 2	Choose the Inrush Current Test Specification measurement method.
Configure	Inrush Current Time Range	InrushTime	300.0E-03, 200.0E-03, 150.0E-03, 100.0E-03, 50.0E-03, 20.0E-03, 10.0E-03	Choose the time range to capture the inrush current.
Configure	Inrush Current Trigger Level	InrushTrig	(Accepts user-defined text), 1.0, 500.0E-03, 160.0E-03, 120.0E-03, 100.0E-03, 70.0E-03, 50.0E-03	Choose or enter the trigger level for Inrush Current Test in amperes.
Configure	Inrush Current Vertical Range	InrushRange	(Accepts user-defined text), 0.1, 0.2, 0.5, 1.0, 2.0, 3.0, 5.0, 6.0, 7.0, 8.0, 9.0	Choose or enter the vertical range to capture the inrush current in amperes. Unit : A.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Configure	Manual Eye Test Number of Waveform	mnlWaveform	(Accepts user-defined text), 1, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192	Choose the number of waveform for high speed manual eye mask test.
Configure	Marker Placement	Marker	AUTO, MANUAL	Choose AUTO for automatic marker placement. Choose MANUAL for manual marker placement.
Configure	Mask Template Used in Manual Mode	Template	1, 2, 3, 4, 5, 6	Choose template number to use. Refer to USB 2.0 Specification, Section 7.1.2.2. for Template details.
Configure	Non-Monotonic Hysteresis	Hyteresis	10.0E-03, 20.0E-03, 30.0E-03, 40.0E-03, 50.0E-03, 60.0E-03	Choose the hysteresis for non-Monotonic Edge Test.
Configure	Non-Monotonic Search Window Threshold	MonotonicWindow	300.0E-03, 290.0E-03, 270.0E-03, 250.0E-03, 230.0E-03, 210.0E-03, 180.0E-03, 150.0E-03	Choose the search window threshold for non-Monotonic Edge Test. The test will only look for non-monotonic edges within the threshold values.
Configure	Number of Missing NAKs	MissNAK	1, 2, 3, 4, 5, 6, 7	Specify number of missing NAKs allowed in Receiver Sensitivity, EL_17, test.
Configure	Number of embedded hubs	NoOfHub	0, 1, 2, 3, 4, 5	Choose the number of hubs present in the embedded host .
Configure	Number of embedded hubs	NoOfHub2	1, 2, 3, 4, 5	Choose the number of hubs present in the embedded host .
Configure	OTG Eletrical Test Board Control	OTGCtrl	AUTO, MANUAL	Choose AUTO for automate control of Agilent's N5417A OTG eletrical test board. Choose MANUAL if using other OTG electrical test boards.
Configure	Packet Length	PacketLength	(Accepts user-defined text), 200.0E-09, 1.0E-06, 10.0E-06	Choose or enter the packet length to perform eye test. Do not include idle states.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Configure	Packet Parameter Test Trigger level	PacketThreshold	70.0E-03, 100.0E-03, 150.0E-03, 170.0E-03, 200.0E-03, 250.0E-03, 300.0E-03, 350.0E-03, 400.0E-03	Choose the trigger level for Packet Parameter Test. This value is also used as a level to measure EOP width, SYNC field length and inter-packet gap.
Configure	Pattern Trigger Lower Time Range	PacketLowerTime	90.0E-09, 95.0E-09, 100.0E-09, 105.0E-09, 110.0E-09	Choose the lower time value for the pattern trigger for Packet Parameter Test.
Configure	Pattern Trigger Time Range	DownstreamTimeTrig	10.0e-09, 50.0e-09, 70.0e-09, 100.0e-09, 130.0e-09, 150.0e-09	Choose the time value for the pattern trigger for Downstream Full Speed Signal Quality Test.
Configure	Pattern Trigger Time Range	UpstreamTimeTrig	10.0e-09, 50.0e-09, 70.0e-09, 100.0e-09, 130.0e-09, 150.0e-09	Choose the time value for the pattern trigger for Upstream Full Speed Signal Quality Test.
Configure	Pattern Trigger Upper Time Range	PacketUpperTime	450.0E-09, 500.0E-09, 550.0E-09, 600.0E-09, 650.0E-09	Choose the upper time value for the pattern trigger for Packet Parameter Test.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Configure	Receiver Sensitivity Squelch Detecting Trigger Level	RStrigger	150.0E-03, 160.0E-03, 170.0E-03, 180.0E-03, 190.0E-03, 200.0E-03, 210.0E-03, 225.0E-03, 230.0E-03, 240.0E-03, 250.0E-03, 260.0E-03, 270.0E-03, 280.0E-03, 290.0E-03, 300.0E-03	Choose the trigger level when Receiver Sensitivity Test is detecting squelch .
Configure	Receiver Sensitivity Trigger Level	OvrRStrigger	0, 10.0E-03, 25.0E-03, 50.0E-03, 60.0E-03, 70.0E-03, 80.0E-03, 90.0E-03, 100.0E-03, 150.0E-03, 200.0E-03, 250.0E-03, 300.0E-03, 350.0E-03	Choose the main trigger level for Receiver Sensitivity Test.
Configure	SMA Combination	SMACombo	SMACombo1, SMACombo2	Select the combination for SMA.
Configure	Sampling Points	ACQPoints	262144, 500000, 1000000, 2000000, 3000000, 4000000	Choose the required sampling point
Configure	Set IP address for 81160A	txtIPAddrPFA	192.168.0.2	Set IP address for 81160A
Configure	Set SICL address for 81160A	txtSICLAddrPFA	(Accepts user-defined text), gpib3, 13	Set SICL address for 81160A
Configure	Setup 81160A using IP address or Sicl address	PFAIPorSICL	IP Address, SICL Address	Setup 81160A using IP address or Sicl address

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Configure	Setup N4903B using IP address or Sicl address	JBERTIPorSICL	IP Address, SICL Address	Setup N4903B using IP address or Sicl address
Configure	Setup Pulse Generator using IP address or Sicl address	PGIPorSICL	IP Address, SICL Address	Setup Pulse Generator using IP address or Sicl address
Configure	Test Type	HSSigIntegrityTestType	hsfe, hsne	Identifies type of signal integrity test. If the device under test incorporates a captive cable, the signal quality measurement is made at the far end. Else if the device has a normal series B or mini-B receptacle, measurement is made at near end.
Configure	Test Type	LSSigIntegrityTestType	lsfe, lsne, fsfe, fshub, lshub	Identifies type of signal integrity test. If the device under test incorporates a captive cable, the signal quality measurement is made at the far end. Else if the device has a normal series B or mini-B receptacle, measurement is made at near end.
Configure	USB Port Under Test	USBPort	Port1, Port2, Port3, Port4, Port5, Port6, Port7, Port8, Port9, Port10, Port11, Port12, Port13, Port14	Select the USB port under test. This is for reporting purposes and does not affect the test.
Configure	User Test Mode	UserMode	NORMAL, SUPER	Choose NORMAL mode if full test instructions are required. Choose SUPER mode for minimal test instructions. The test assumes that the user is already familiar with the test procedure and that all equipment setup and electrical connections have been made.
Configure	VBUS Channel	VB	CHANNEL1, CHANNEL2, CHANNEL3, CHANNEL4	Select the channel number that connect to load port. (Connect to Test Port if using Keysight fixture)

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Configure	VBUS Load Channel	VLOAD	CHANNEL1, CHANNEL2, CHANNEL3, CHANNEL4	Select the channel number for Droop port. (Connect to Droop pulse if using Keysight fixture)
Configure	pchkPort0	pchkPort0	1.0, 0.0	Droop drop port 0
Configure	pchkPort1	pchkPort1	1.0, 0.0	Droop drop port 1
Configure	pchkPort2	pchkPort2	1.0, 0.0	Droop drop port 2
Configure	pchkPort3	pchkPort3	1.0, 0.0	Droop drop port 3
Configure	pchkPort4	pchkPort4	1.0, 0.0	Droop drop port 4
Configure	pchkPort5	pchkPort5	1.0, 0.0	Droop drop port 5
Configure	pchkPort6	pchkPort6	1.0, 0.0	Droop drop port 6
Configure	pchkPort7	pchkPort7	1.0, 0.0	Droop drop port 7
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	AutoSave	AutoSaveOpt	0.0, 1.0	AutoSave
Set Up	DeviceType	DeviceType	Device, Hub, Host, On-The-Go	Device Test Point
Set Up	DroopDropComplete	DroopDropComplete	0.0, 1.0	DroopDropComplete
Set Up	Enable TypeC test	TypeCEnable	0.0, 1.0	Enable TypeC test
Set Up	Fixture selection	HSSQFixture	Keysight Fixture, USBIF, Other	Fixture Selection
Set Up	InstrumentSetupComplete	InstrumentSetupComplete	0.0, 1.0	InstrumentSetupComplete
Set Up	Offline	OfflineOpt	0.0, 1.0	Offline
Set Up	pcbDebug	pcbDebug	0.0, 1.0	Debug and Information Only
Set Up	pcbEmbedded	pcbEmbedded	0.0, 1.0	Embedded Host
Set Up	pcboOverallDevice Description	pcboOverallDeviceDescription	(Accepts user-defined text), (Select or Type)	User Description

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Set Up	pcboOverallDeviceID	pcboOverallDeviceID	(Accepts user-defined text), (Select or Type), (Select or Type), (Select or Type), (Select or Type)	Device ID
Set Up	pcboTestMethod	pcboTestMethod	(Accepts user-defined text), USBET, Both	Test Method
Set Up	pckbDroopDrop	pckbDroopDrop	0.0, 1.0	New Droop Drop Enable
Set Up	txtIPAddrPFA	txtIPAddrPFA	(Accepts user-defined text), 141.183.183.101	IP address for 81160A
Set Up	txtIPAddrPG	txtIPAddrPG	(Accepts user-defined text), 141.183.183.101	IP address
Set Up	txtOverallUserComment	txtOverallUserComment	(Accepts user-defined text)	Comments
Set Up	txtSICLAddrDMM	txtSICLAddrDMM	(Accepts user-defined text), gpib3, 13	DMM Gpib address
Set Up	txtSICLAddrPFA	txtSICLAddrPFA	(Accepts user-defined text), gpib3, 13	Gpib address
Set Up	txtSICLAddrPG	txtSICLAddrPG	(Accepts user-defined text), gpib3, 13	Pulse Gen Gpib address
Set Up	txtSICLAddrPS	txtSICLAddrPS	(Accepts user-defined text), gpib3, 13	Power Supply Gpib address
Set Up	withpulsegen	withpulsegen	Yes, No	Enable external devices

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
Bus-Powered Hubs Droop Test	25	When a device is hot plugged into another port, a maximum droop of 330mV in the Vbus supplied to a USB port is allowed.
Bus-Powered Hubs Droop Test (New Fixture)	65	When a device is hot plugged into another port, a maximum droop of 330mV in the Vbus supplied to a USB port is allowed.
Bus-Powered Hubs Drop Test	22	Bus-powered hubs must maintain VBus at 4.40V or greater. (On 100mA load)
Bus-Powered Hubs Drop Test (New Fixture)	62	Bus-powered hubs must maintain VBus at 4.40V or greater.
D+ After Enumerate	46	No device shall supply current on VBUS at its upstream facing port at any time. From VBUS on its upstream facing port, a device may only draw current. They may not provide power to the pull-up resistor on D+ and D- unless VBUS is present.
D+ Before Enumerate	36	No device shall supply current on VBUS at its upstream facing port at any time. From VBUS on its upstream facing port, a device may only draw current. They may not provide power to the pull-up resistor on D+ and D- unless VBUS is present.
D- After Enumerate	47	No device shall supply current on VBUS at its upstream facing port at any time. From VBUS on its upstream facing port, a device may only draw current. They may not provide power to the pull-up resistor on D+ and D- unless VBUS is present.
D- Before Enumerate	37	No device shall supply current on VBUS at its upstream facing port at any time. From VBUS on its upstream facing port, a device may only draw current. They may not provide power to the pull-up resistor on D+ and D- unless VBUS is present.
Downstream Full Speed Fall Time Test (manual)	11004	A USB Full Speed driver must have a single-ended rise and fall times between 4ns and 20ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Downstream Full Speed Fall Time Test(information only)	1008	A USB Full Speed driver must have a single-ended rise and fall times between 4ns and 20ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
Downstream Full Speed Rise Time Test (manual)	11003	A USB Full Speed driver must have a single-ended rise and fall times between 4ns and 20ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Downstream Full Speed Rise Time Test(information only)	1007	A USB Full Speed driver must have a single-ended rise and fall times between 4ns and 20ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Downstream Full Speed Signal Quality Test (manual)	20004	The full-speed data rate is nominally 12.000Mb/s. For both full-speed and low-speed signaling, the crossover voltage must be between 1.3V and 2.0V.
Downstream Low Speed Fall Time Test (manual)	11008	A USB Low Speed driver must have a single-ended rise and fall times between 75ns and 300ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Downstream Low Speed Fall Time Test(information only)	1004	A USB Low Speed driver must have a single-ended rise and fall times between 75ns and 300ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Downstream Low Speed Rise Time Test (manual)	11007	A USB Low Speed driver must have a single-ended rise and fall times between 75ns and 300ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Downstream Low Speed Rise Time Test(information only)	1003	A USB Low Speed driver must have a single-ended rise and fall times between 75ns and 300ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
Downstream Low Speed Signal Quality Test (manual)	20005	The low-speed data rate is nominally 1.50Mb/s. For both full-speed and low-speed signaling, the crossover voltage must be between 1.3V and 2.0V.
E1 E2 A-Device VBUS Valid (VMean)	305	E1: If an A-Device is not capable of providing at least 100mA of current, then the A-Device must indicate a low voltage condition. If the A-Device under test can support a load greater than 100mA, no message is required, but VBus(mean) voltage must be from 4.75V to 5.25V to pass.
E1 E2 A-Device VBUS Valid (VMin)	304	E1: If an A-Device is not capable of providing at least 100mA of current, then the A-Device must indicate a low voltage condition. If the A-Device under test can support a load greater than 100mA, no message is required, but VBus(min) voltage must be greater than 4.4V to pass.
E1 E8 A-Device Output Voltage	300	E1, E8: An A-Device must be able to source a minimum of 8mA from VBus while maintaining the VBus voltage from 4.4 to 5.25 volts.
E19 A-Device Session Valid	306	E19: If an A-Device responds to VBus SRP pulsing, its session valid detection threshold voltage must be in the range from 0.8V to 2.0V.
E20 B-Device VBUS Valid	307	E20: A B-Device must not assert either the D+ or D- data-line when VBus voltage is less than the session valid threshold. In addition, the B-Device must assert either the D+ or D- data-line within 1 second after VBus B-Device session valid threshold is exceeded if the B-Device did not initiate the session with SRP.
E22 Data-Line Pulsing Test	308	E22: A B-Device SRP D+ or D- data-line pulse must be 5 milliseconds to 10 milliseconds in duration. Pulse high voltage must be from 2.7 to 3.6 volts.
E3 VBUS Rise Time	301	E3: When attached as an A-Device, the VBus rise time from 0V to 4.4V must be less than or equal to 100 milliseconds when driving an external load capacitance of 10uF.
E5 B-Device (SRP capable) to OTG Device Output Voltage	302	E5: During VBus SRP pulsing to an OTG device, the VBus peak voltage must be at least 2.1V but not exceed 5.25V.
E6 B-Device (SRP capable) to Host Output Voltage	303	E6: During VBus SRP pulsing to a standard host, the VBus peak voltage must not exceed 2.0V.
EL_16 Hub Receiver sensitivity Test @ Squelch	165	EL_16: A hi-speed capable device must implement a transmission envelope detector that indicates squelch (i.e. never receives packets) when a receiver's input falls below 100mV differential amplitude.
EL_16 Receiver sensitivity Test @ Squelch	219	EL_16: A hi-speed capable device must implement a transmission envelope detector that indicates squelch (i.e. never receives packets) when a receiver's input falls below 100mV differential amplitude.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
EL_16 Receiver sensitivity Test @ Squelch (For Samsung Only	2190	EL_16: A hi-speed capable device must implement a transmission envelope detector that indicates squelch (i.e. never receives packets) when a receiver's input falls below 100mV differential amplitude.
EL_17 Hub Receiver sensitivity Test	164	EL_17: A hi-speed capable device must implement a transmission envelope detector that does not indicate squelch (i.e. reliably receives packets) when a receiver exceeds 150mV differential amplitude.
EL_17 Receiver sensitivity Test	218	EL_17: A hi-speed capable device must implement a transmission envelope detector that does not indicate squelch (i.e. reliably receives packets) when a receiver exceeds 150mV differential amplitude.
EL_17 Receiver sensitivity Test (For Samsung only)	2180	EL_17: A hi-speed capable device must implement a transmission envelope detector that does not indicate squelch (i.e. reliably receives packets) when a receiver exceeds 150mV differential amplitude.
EL_18 Hub Receiver sensitivity Test @ Min SYNC Field	163	EL_18: A hi-speed capable device's Transmission Envelope Detector must be fast enough to allow the HS receiver to detect data transmission, achieve DLL lock, and detect the end of the SYNC field within 12 bit times.
EL_18 Receiver sensitivity Test - Minimum SYNC Field	217	EL_18: A hi-speed capable device's Transmission Envelope Detector must be fast enough to allow the HS receiver to detect data transmission, achieve DLL lock, and detect the end of the SYNC field within 12 bit times.
EL_18 Receiver sensitivity Test - Minimum SYNC Field (For Samsung only)	2170	EL_18: A hi-speed capable device's Transmission Envelope Detector must be fast enough to allow the HS receiver to detect data transmission, achieve DLL lock, and detect the end of the SYNC field within 12 bit times.
EL_2 EL_3 Data Eye and Mask Test	155	EL_2: A USB 2.0 hi-speed transmitter data rate must be 480MB/s +/- 0.05%. EL_3: A USB2.0 downstream facing port must meet Template 1 transform waveform requirements measured at TP2 (each hub downstream port).
EL_2 EL_4 EL_5 Data Eye and Mask Test	222	EL_2: A USB 2.0 hi-Speed transmitter data rate must be 480Mb/s +/- 0.05%. EL_4: A USB 2.0 upstream facing port on a device without a captive cable must meet Template 1 transform waveform requirements measured at TP3. EL_5: A USB 2.0 upstream facing port on a device with a captive cable must meet Template 2 transform waveform requirements measured at TP2.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
EL_2 EL_4 EL_5 Data Eye and Mask Test (manual)	20003	EL_2: A USB 2.0 hi-Speed transmitter data rate must be 480Mb/s +/- 0.05%. EL_4: A USB 2.0 upstream facing port on a device without a captive cable must meet Template 1 transform waveform requirements measured at TP3. EL_5: A USB 2.0 upstream facing port on a device with a captive cable must meet Template 2 transform waveform requirements measured at TP2.
EL_2 EL_46 Data Eye and Mask Test	152	EL_2: A USB 2.0 hi-speed transmitter data rate must be 480MB/s +/- 0.05%. EL_46: A hub upstream repeater must meet Template 1 transform waveform requirements measured at TP3.
EL_21 Device Sync Field Length Test	203	EL_21: The SYNC field for all transmitted packets (not repeated packets) must begin with a 32 bits SYNC field. However since the first K bit is allowed to be distorted, the test will measure the SYNC field from the first J bit onwards (31 bits).
EL_21 Hub Sync Field Length Test	159	EL_21: The SYNC field for all transmitted packets (not repeated packets) must begin with a 32 bits SYNC field. However since the first K bit is allowed to be distorted, the test will measure the SYNC field from the first J bit onwards (31 bits).
EL_21 Hub Sync Field Length Test	1590	EL_21: The SYNC field for all transmitted packets (not repeated packets) must begin with a 32 bits SYNC field. However since the first K bit is allowed to be distorted, the test will measure the SYNC field from the first J bit onwards (31 bits).
EL_21 Sync Field Length Test	610	EL_21: The SYNC field for all transmitted packets (not repeated packets) must begin with a 32 bit SYNC field.
EL_22 Hub Measure Interpacket Gap Between First and Second Packets	162	EL_22: When transmitting after receiving a packet, hosts and devices must provide an inter-packet gap of at least 8 bits times and not more than 192 bit times.
EL_22 Hub Measure Interpacket Gap Between Second and Third Packets	161	EL_22: When transmitting after receiving a packet, hosts and devices must provide an inter-packet gap of at least 8 bits times and not more than 192 bit times.
EL_22 Inter-packet Gap Between Host And Device Packet Test	620	EL_22: When trasmitting after receiving a packet, hosts and devices must provide an inter-packet gap of at least 8 bit times and not more than 192 bit times.
EL_22 Inter-packet Gap Between Host And Device Packet Test	621	EL_22: When trasmitting after receiving a packet, hosts and devices must provide an inter-packet gap of at least 8 bit times and not more than 192 bit times.
EL_22 Measure Interpacket Gap Between First and Second Packets	206	EL_22: When transmitting after receiving a packet, hosts and devices must provide an inter-packet gap of at least 8 bits times and not more than 192 bit times.
EL_22 Measure Interpacket Gap Between Second and Third Packets	205	EL_22: When transmitting after receiving a packet, hosts and devices must provide an inter-packet gap of at least 8 bits times and not more than 192 bit times.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
EL_23 Inter-packet Gap Between First 2 Packets Test	625	EL_23: Hosts transmitting two packets in a row must have an inter-packet gap of at least 88 bit times and not more than 192 bit times.
EL_25 Device EOP Length Test	204	EL_25: The EOP for all transmitted packets (except SOFs) must be an 8-bit NRZ byte of 01111111 without bit stuffing.
EL_25 EOP Length Test	615	EL_25: The EOP for all transmitted packets (except SOFs) must be an 8-bit NRZ byte of 01111111 without bit stuffing.(Note, that a longer EOP is waiverable)
EL_25 Hub EOP Length Test	160	EL_25: The EOP for all transmitted packets (except SOFs) must be an 8-bit NRZ byte of 01111111 without bit stuffing. (Note, that a longer EOP is waiverable)
EL_25 Hub EOP Length Test	1600	EL_25: The EOP for all transmitted packets (except SOFs) must be an 8-bit NRZ byte of 01111111 without bit stuffing. (Note, that a longer EOP is waiverable)
EL_27 Device CHIRP Response to Reset from Hi-Speed Operation	212	EL_27: Devices must transmit a CHIRP handshake no sooner than 3.1ms and no later than 6ms when being reset from a non-suspended hi-speed mode. The timing is measured from the beginning of the last SOF transmitted before the reset begins.
EL_27 Hub CHIRP Response to Reset from Hi-Speed Operation	176	EL_27: Devices must transmit a CHIRP hanshake no sooner than 3.1ms and no later than 6ms when being reset from a non-suspended hi-speed mode. The timing is measured from the beginning of the last SOF transmitted before the reset begins.
EL_28 Device CHIRP Response to Reset from Suspend	213	EL_28: Devices must transmit a chirp handshake no sooner than 2.5us and no later than 6ms when being reset from a suspend state. Devices must transmit a chirp handshake no sooner than 2.5us and no later than 3ms when being reset from a full-speed state.
EL_28 Hub CHIRP Response to Reset from Suspend	177	EL_28: Devices must transmit a chirp handshake no sooner than 2.5us and no later than 6ms when being reset from a suspend state. Devices must transmit a chirp handshake no sooner than 2.5us and no later than 3ms when being reset from a full-speed state.
EL_28 Measure Device CHIRP-K Latency	207	EL_28: Devices must transmit a chirp handshake no sooner than 2.5us and no later than 6ms when being reset from a suspend state. Devices must transmit a chirp handshake no sooner than 2.5us and no later than 3ms when being reset from a full-speed state.
EL_28 Measure Hub CHIRP-K Latency	171	EL_28: Devices must transmit a chirp handshake no sooner than 2.5us and no later than 6ms when being reset from a suspend state. Devices must transmit a chirp handshake no sooner than 2.5us and no later than 3ms when being reset from a full-speed state.
EL_29 Measure Device CHIRP-K Duration	208	EL_29: The CHIRP handshake generated by a device must be at least 1ms and not more than 7ms in duration.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
EL_29 Measure Hub CHIRP-K Duration	172	EL_29: The CHIRP handshake generated by a device must be at least 1ms and not more than 7ms in duration.
EL_3 Data Eye and Mask Test	102	EL_3: A USB 2.0 downstream facing port must meet Template 1 transform waveform requirements measured at TP2 (each hub downstream).
EL_3 Data Eye and Mask Test	600	EL_3: A USB 2.0 downstream facing port must meet Template 1 transform waveform requirements measured at TP2 (each hub downstream).
EL_31 Device Hi-Speed Terminations Enable and D+ Disconnect Time	209	EL_31: During device speed detection, when a device detects a valid CHIRP K-J-K-J-K-J sequence, the device must disconnect its 1.5K pull-up resistor and enable its hi-speed terminations within 500us.
EL_31 Hub Hi-Speed Terminations Enable and D+ Disconnect Time	173	EL_31: During device speed detection, when a device detects a valid CHIRP K-J-K-J-K-J sequence, the device must disconnect its 1.5K pull-up resistor and enable its hi-speed terminations within 500us.
EL_33 CHIRP Timing Response	110	EL_33: Downstream ports start sending and alternating sequence of CHIRP K's and CHIRP J's within 100us after device CHIRP K stops.
EL_33 CHIRP Timing Response	630	EL_33: Downstream ports start sending and alternating sequence of CHIRP K's and CHIRP J's within 100us after device CHIRP K stops.
EL_34 CHIRP J Width	112	EL_34: Downstream port CHIRP K and CHIRP J durations must be between 40us and 60us duration.
EL_34 CHIRP J Width	636	EL_34: Downstream port CHIRP K and CHIRP J durations must be between 40us and 60us duration.
EL_34 CHIRP K Width	111	EL_34: Downstream port CHIRP K and CHIRP J durations must be between 40us and 60us duration.
EL_34 CHIRP K Width	633	EL_34: Downstream port CHIRP K and CHIRP J durations must be between 40us and 60us duration.
EL_35 SOF Timing Response	113	EL_35: Downstream ports begin sending SOFs within 500us and not sooner than 100us from transmission of the last CHIRP(J or K).
EL_35 SOF Timing Response	639	EL_35: Downstream ports begin sending SOFs within 500us and not sooner than 100us from transmission of the last CHIRP(J or K).
EL_36 Host Disconnect Detect Test At 625mV Threshold (information only)	109	EL_36: A USB 2.0 downstream facing port must detect the hi-speed disconnect state when the amplitude of the differential signal at the downstream facing driver's connector is >=625mV.
EL_36 Hub Disconnect Detect Test At 625mV Threshold(information only)	158	EL_36: A USB 2.0 downstream facing port must detect the hi-speed disconnect state when the amplitude of the differential signal at the downstream facing driver's connector is >= 625mV.
EL_37 Host Disconnect Detect Test At 525mV Threshold (information only)	108	EL_37: A USB 2.0 downstream facing port must not detect the hi-speed disconnect state when the amplitude of the differential signal at the port is <= 525mV.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
EL_37 Hub Disconnect Detect Test At 525mV Threshold(information only)	157	EL_37: A USB 2.0 downstream facing port must not detect the hi-speed disconnect state when the amplitude of the differential signal at the downstream facing driver's connector is <= 525mV.
EL_38 EL_39 Device Suspend Timing Response	210	EL_38: A device must revert to full-speed termination no later than 125us after there is a 3ms idle period on the bus. EL_39: A device must support the Suspend state.
EL_38 EL_39 Hub Suspend Timing Response	174	EL_38: A device must revert to full-speed termination no later than 125us after there is a 3ms idle period on the bus. EL_39: A device must support the Suspend state.
EL_39 Suspend Timing Response	114	EL_39: Device must support a suspend state.
EL_39 Suspend Timing Response	640	EL_39: Device must support a suspend state.
EL_40 Device Resume Timing Response	211	EL_40: If a device is in the suspend state, and was operating in hi-speed before being suspended, then device must transition back to hi-speed operation within 2 bit times from the end of resume signaling. Note: It is not feasible to measure the device transition back to hi-speed operation within 2 bit times from the end of the resume signaling. The presence of SOF at nominal 400mV amplitude following the resume signaling is sufficient for this test.
EL_40 Hub Resume Timing Response	175	EL_40: If a device is in the suspend state, and was operating in hi-speed before being suspended, then device must transition back to hi-speed operation within 2 bit times from the end of resume signaling. Note: It is not feasible to measure the hub transition back to hi-speed operation within 2 bit times from the end of the resume signaling. The presence of SOF at nominal 400mV amplitude following the resume signaling is sufficient for this test.
EL_41 Resume Timing Response	115	EL_41: After resuming a port, the host must begin sending SOFs within 3ms of the start of the idle state.
EL_41 Resume Timing Response	645	EL_41: After resuming a port, the host must begin sending SOFs within 3ms of the start of the idle state.
EL_42 EL_43 Downstream Measure Truncated Bits from Repeated SYNC Field	167	EL_42: Hub repeaters must not truncate more than 4 bits from a repeated SYNC pattern. EL_43: Hubs must not corrupt any repeated bits of the SYNC field.
EL_42 EL_43 Upstream Measure Truncated Bits from Repeated SYNC Field	169	EL_42: Hub repeaters must not truncate more than 4 bits from a repeated SYNC pattern. EL_43: Hubs must not corrupt any repeated bits of the SYNC field.
EL_44 EL_45 Downstream Measure Repeated EOP Width	168	EL_44: A hub may add at most 4 random bits to the end of the EOP field when repeating a packet. EL_45: A bug must not corrupt any of the valid EOP bits when repeating a packet.
EL_44 EL_45 Upstream Measure Repeated EOP Width	170	EL_44: A hub may add at most 4 random bits to the end of the EOP field when repeating a packet. EL_45: A bug must not corrupt any of the valid EOP bits when repeating a packet.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
EL_47 Data Eye and Mask Test	156	EL_47: A hub downstream facing repeater must meet Template 1 transform waveform requirements measured at TP2(each hub downstream port).
EL_48 Measure Hub Downstream Delay	166	EL_48: A hub repeater may not delay packets for more than 36 bit times plus 4ns.
EL_55 SOF EOP Width Test	628	EL_55: Hosts trasmitting SOF packets must provide a 40-bit EOP without bit stuffing where the first symbol of the EOP is a transition from the last data symbol.
EL_6 Device Fall Time	201	EL_6: A USB 2.0 HS driver must have a differential rise and fall times of greater than 300ps. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
EL_6 Device Rise Time	200	EL_6: A USB 2.0 HS driver must have a differential rise and fall times of greater than 300ps. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
EL_6 Fall Time	606	EL_6: A USB 2.0 HS driver must a differential rise and fall times of greater than 500ps. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
EL_6 Fall Time (manual)	20002	EL_6: A USB 2.0 HS driver must have a differential rise and fall times of greater than 300ps. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
EL_6 Host Fall Time	101	EL_6: A USB 2.0 HS driver must have a differential rise and fall times of greater than 300ps. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
EL_6 Host Rise Time	100	EL_6: A USB 2.0 HS driver must have a differential rise and fall times of greater than 300ps. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
EL_6 Hub Downstream Fall Time	154	EL_6: A USB 2.0 HS driver must have a differential rise and fall times of greater than 300ps. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
EL_6 Hub Downstream Rise Time	153	EL_6: A USB 2.0 HS driver must have a differential rise and fall times of greater than 300ps. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
EL_6 Hub Upstream Fall Time	151	EL_6: A USB 2.0 HS driver must have a differential rise and fall times of greater than 300ps. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
EL_6 Hub Upstream Rise Time	150	EL_6: A USB 2.0 HS driver must have a differential rise and fall times of greater than 300ps. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
EL_6 Rise Time	603	EL_6: A USB 2.0 HS driver must a differential rise and fall times of greater than 500ps. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
EL_6 Rise Time (manual)	20001	EL_6: A USB 2.0 HS driver must have a differential rise and fall times of greater than 300ps. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
EL_7 Device Non-Monotonic Edge Test	2220	EL_7: A USB 2.0 HS driver must have monotonic data transitions over the vertical openings specified in the appropriate eye pattern template.
EL_7 Host Non-Monotonic Edge Test	1020	EL_7: A USB 2.0 HS driver must have monotonic data transitions over the vertical openings specified in the appropriate eye pattern template.
EL_7 Hub Downstream Non-Monotonic Edge Test	1550	EL_7: A USB 2.0 HS driver must have monotonic data transitions over the vertical openings specified in the appropriate eye pattern template.
EL_7 Hub Upstream Non-Monotonic Edge Test	1520	EL_7: A USB 2.0 HS driver must have monotonic data transitions over the vertical openings specified in the appropriate eye pattern template.
EL_8 Device J Test	214	EL_8: When either D+ or D- is not being driven, the output voltage must be 20mV +/- 10% when terminated with precision 45 ohm resistors to ground.
EL_8 Device K Test	215	EL_8: When either D+ or D- is not being driven, the output voltage must be 20mV +/- 10% when terminated with precision 45 ohm resistors to ground.
EL_8 Host J Test	116	EL_8: When either D+ or D- is not being driven, the output voltage must be 20mV +/- 10% when terminated with precision 45 ohm resistors to ground.
EL_8 Host J Test (Informative)	650	EL_8: When either D+ or D- are driven high, the output voltage must be 400mV +/- 10% when terminated with precision 45 ohm resistors to ground. This test is informative only and is no longer required for certification.
EL_8 Host K Test	117	EL_8: When either D+ or D- is not being driven, the output voltage must be 20mV +/- 10% when terminated with precision 45 ohm resistors to ground.
EL_8 Host K Test (Informative)	653	EL_8: When either D+ or D- are driven high, the output voltage must be 400mV +/- 10% when terminated with precision 45 ohm resistors to ground. This test is informative only and is no longer required for certification.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
EL_8 Hub Downstream J Test	181	EL_8: When either D+ or D- are driven high, the output voltage must be 400mV +/- 10% when terminated with precision 45 ohm resistors to ground. This test is informative only and is no longer required for certification.
EL_8 Hub Downstream K Test	182	EL_8: When either D+ or D- are driven high, the output voltage must be 400mV +/- 10% when terminated with precision 45 ohm resistors to ground. This test is informative only and is no longer required for certification.
EL_8 Hub Upstream J Test	178	EL_8: When either D+ or D- are driven high, the output voltage must be 400mV +/- 10% when terminated with precision 45 ohm resistors to ground. This test is informative only and is no longer required for certification.
EL_8 Hub Upstream K Test	179	EL_8: When either D+ or D- are driven high, the output voltage must be 400mV +/- 10% when terminated with precision 45 ohm resistors to ground. This test is informative only and is no longer required for certification.
EL_9 Device SE0_NAK Test	216	EL_9: When either D+ or D- is not being driven, the output voltage must be 0V +/- 20mV when terminated with precision 45 ohm resistors to ground.
EL_9 Host SE0_NAK Test	118	EL_9: When either D+ or D- is not being driven, the output voltage must be 0mV +/- 20mV when terminated with precision 45 ohm resistors to ground.
EL_9 Host SE0_NAK Test (Informative)	656	EL_9: When either D+ or D- are not driven high, the output voltage must be 0mV +/- 10mV when terminated with precision 45 ohm resistors to ground. This test is informative only and is no longer required for certification.
EL_9 Hub Downstream SE0_NAK Test	183	EL_9: When either D+ or D- are not being driven, the output voltage must be 0V +/- 20mV when terminated with precision 45 ohm resistors to ground. This test is informative only and is no longer required for certification.
EL_9 Hub Upstream SE0_NAK Test	180	EL_9: When either D+ or D- are not being driven, the output voltage must be 0V +/- 20mV when terminated with precision 45 ohm resistors to ground. This test is informative only and is no longer required for certification.
Host Full Speed Fall Time Test (information only)	1010	A USB Full Speed driver must have a single-ended rise and fall times between 4ns and 20ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
Host Full Speed Fall Time Test (manual)	11012	A USB Full Speed driver must have a single-ended rise and fall times between 4ns and 20ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Host Full Speed Rise Time Test (information only)	1009	A USB Full Speed driver must have a single-ended rise and fall times between 4ns and 20ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Host Full Speed Rise Time Test (manual)	11011	A USB Full Speed driver must have a single-ended rise and fall times between 4ns and 20ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Host Full Speed Signal Quality Test	27	The full-speed data rate is nominally 12.000Mb/s. For both full-speed and low-speed signaling, the crossover voltage must be between 1.3V and 2.0V.
Host Full Speed Signal Quality Test (manual)	20008	The full-speed data rate is nominally 12.000Mb/s. For both full-speed and low-speed signaling, the crossover voltage must be between 1.3V and 2.0V.
Host Low Speed Fall Time Test (information only)	1012	A USB Low Speed driver must have a single-ended rise and fall times between 75ns and 300ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Host Low Speed Fall Time Test (manual)	11010	A USB Low Speed driver must have a single-ended rise and fall times between 75ns and 300ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
Host Low Speed Rise Time Test (information only)	1011	A USB Low Speed driver must have a single-ended rise and fall times between 75ns and 300ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Host Low Speed Rise Time Test (manual)	11009	A USB Low Speed driver must have a single-ended rise and fall times between 75ns and 300ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Host Low Speed Signal Quality Test	30	The low-speed data rate is nominally 1.50Mb/s. For both full-speed and low-speed signaling, the crossover voltage must be between 1.3V and 2.0V.
Host Low Speed Signal Quality Test (manual)	20009	The low-speed data rate is nominally 1.50Mb/s. For both full-speed and low-speed signaling, the crossover voltage must be between 1.3V and 2.0V.
Host and Self-Powered Hubs Droop Test	24	When a device is hot plugged into another port, a maximum droop of 330mV in the Vbus supplied to a USB port is allowed.
Host and Self-Powered Hubs Droop Test (New Fixture)	64	When a device is hot plugged into another port, a maximum droop of 330mV in the Vbus supplied to a USB port is allowed.
Host and Self-Powered Hubs Drop Test (New Fixture)	61	High-powered USB ports must provide a VBus between 4.75V to 5.25V.
Host and Self-Powered Hubs Drop Test(Loaded)	23	High-powered USB ports must provide a VBus between 4.75V to 5.25V.
Host and Self-Powered Hubs Drop Test(No Load)	21	High-powered USB ports must provide a VBus between 4.75V to 5.25V.
Hub Downstream Full Speed Signal Quality Test	28	The full-speed data rate is nominally 12.000Mb/s. For both full-speed and low-speed signaling, the crossover voltage must be between 1.3V and 2.0V.
Hub Downstream Low Speed Signal Quality Test	31	The low-speed data rate is nominally 1.50Mb/s. For both full-speed and low-speed signaling, the crossover voltage must be between 1.3V and 2.0V.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
Inrush Current Test	50	A high-power bus-powered device that is switching from a lower power configuration to a higher power configuration must not cause droop > 330mV on the Vbus at its upstream hub. The device can meet this by ensuring that changes in the capacitive load it presents do not exceed 10uF (this translates to 50.0uC as the maximum inrush current value). Note: A waiver is granted for the inrush current measured up to 150uC.
Upstream Full Speed Fall Time Test (information only)	1006	A USB Full Speed driver must have a single-ended rise and fall times between 4ns and 20ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Upstream Full Speed Fall Time Test (manual)	11002	A USB Full Speed driver must have a single-ended rise and fall times between 4ns and 20ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Upstream Full Speed Rise Time Test (information only)	1005	A USB Full Speed driver must have a single-ended rise and fall times between 4ns and 20ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Upstream Full Speed Rise Time Test (manual)	11001	A USB Full Speed driver must have a single-ended rise and fall times between 4ns and 20ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Upstream Full Speed Signal Quality Test	29	The full-speed data rate is nominally 12.000Mb/s. For both full-speed and low-speed signaling, the crossover voltage must be between 1.3V and 2.0V.
Upstream Full Speed Signal Quality Test (manual)	20007	The full-speed data rate is nominally 12.000Mb/s. For both full-speed and low-speed signaling, the crossover voltage must be between 1.3V and 2.0V.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
Upstream Low Speed Fall Time Test (manual)	11006	A USB Low Speed driver must have a single-ended rise and fall times between 75ns and 300ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Upstream Low Speed Fall Time Test(information only)	1002	A USB Low Speed driver must have a single-ended rise and fall times between 75ns and 300ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Upstream Low Speed Rise Time Test (manual)	11005	A USB Low Speed driver must have a single-ended rise and fall times between 75ns and 300ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Upstream Low Speed Rise Time Test(information only)	1001	A USB Low Speed driver must have a single-ended rise and fall times between 75ns and 300ns. However, slew rate measurement will be made and expressed in terms of (V/us) to ensure waveform with slow corners will not result in a measured rise/fall time that is slower than the actual edge rate. The conversion from rise time to edge rate uses the specified rise time over 80% of the nominal peak to peak signal amplitude.
Upstream Low Speed Signal Quality Test	32	The low-speed data rate is nominally 1.50Mb/s. For both full-speed and low-speed signaling, the crossover voltage must be between 1.3V and 2.0V.
Upstream Low Speed Signal Quality Test (manual)	20006	The low-speed data rate is nominally 1.50Mb/s. For both full-speed and low-speed signaling, the crossover voltage must be between 1.3V and 2.0V.
VBUS After Enumerate	45	No device shall supply current on VBUS at its upstream facing port at any time. From VBUS on its upstream facing port, a device may only draw current. They may not provide power to the pull-up resistor on D+ and D- unless VBUS is present.
VBUS Before Enumerate	35	No device shall supply current on VBUS at its upstream facing port at any time. From VBUS on its upstream facing port, a device may only draw current. They may not provide power to the pull-up resistor on D+ and D- unless VBUS is present.

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
JBert	JBert
MBert	MBert
PFAGenerator	PFAGenerator
dmm	dmm
pulsegen	pulsegen
pwrsupply	pwrsupply
scope	scope

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