Keysight N6472A IEEE802.3 bs/cd Compliance Application

KEYSIGHT TECHNOLOGIES

Programmer's Reference

Notices

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CAUTION

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In This Book

This book is your guide to programming the Keysight Technologies N6472A IEEE802.3 bs/cd Compliance Application.

- Chapter 1, “Introduction to Programming,” starting on page 7, describes test application programming basics.
- Chapter 2, “Configuration Variables and Values,” starting on page 9, Chapter 3, “Test Names and IDs,” starting on page 15, and Chapter 4, “Instruments,” starting on page 23, provide information specific to programming the N6472A IEEE802.3 bs/cd Compliance Application.

How to Use This Book

Programmers who are new to test 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

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This chapter introduces the basics for remote programming a test application. The programming commands provide the means of remote control. Basic operations that you can do remotely with a computer and a test 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/test 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 N6472A IEEE802.3 bs/cd Compliance Application uses Remote Interface Revision 5.70. 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 N6472A IEEE802.3 bs/cd 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	Bandwidth	BW	(Accepts user-defined text), 50e9	Enter the scope bandwidth.
Configure	Clock Recovery Method	CRMethod	FOPLL, SOPLL	Select the Cock Recovery Method to be used.
Configure	Damping Factor	DFactor	(Accepts user-defined text), 1	Enter the Damping Factor to use for clock recovery. This values is only used for Second Order PLL. You may enter any value.
Configure	Dp	DpVal	(Accepts user-defined text), 2	Set the Dp value used for steady state, linear fit pulse peak, and error calculations.
Configure	Eye Height/Width Probability	NumUI	(Accepts user-defined text), 1e-5, 1e-6, 1e-15	Select the eye probability to test to for Eye Height and Width tests.
Configure	ISI Filter Lag	ISILag	(Accepts user-defined text), 5	When using Arbitrary mode for the Jitter Pattern Length, set the Lagging ISI filter coefficient. Go to www.agilent.com for application note 5989-4974EN to help select the correct ISI filter.
Configure	ISI Filter Lead	ISILead	(Accepts user-defined text), -2	When using Arbitrary mode for the Jitter Pattern Length, set the Leading ISI filter coefficient. Go to www.agilent.com for application note 5989-4974EN to help select the correct ISI filter.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Configure	Jitter Pattern Length	PatLength	Periodic, Arbitrary	Choose Periodic or Arbitrary. Periodic is used for data patterns that are period and repeat through the scope memory. Arbitrary is used for random data patterns that does not repeat. Set ISI filter options below as well when selecting Arbitrary.
Configure	Loop Bandwidth	LoopBandwidth	(Accepts user-defined text), 4e6, 10e6, 10.3035e6	Enter the loop bandwidth to use for clock recovery. Value with automatically scale with signaling rate change. Manually set to desired value if different from autoset.
Configure	Nb	NbVal	(Accepts user-defined text), 10, 12, 13, 14, 16	Set the Nb value used for steady state, linear fit pulse peak, and error calculations.
Configure	Np	NpVal	(Accepts user-defined text), 8, 12, 13, 14, 16, 200	Set the Np value used for steady state, linear fit pulse peak, and error calculations.
Configure	Pattern for Averaging	AvgPat	(Accepts user-defined text), AUTo, 127, 128, 511, 512, 8191	Auto - will automatically find the pattern when the eye is open. When the eye is closed, pattern averaging needs to know what the pattern length is to best identify the bits to average. Enter the pattern length (i.e. 8191)
Configure	Rj Bandwidth	RjBandwidth	NARRow, WIDE	Choose the Rj Filter used in the jitter measurements.
Configure	Sample Rate	SR	(Accepts user-defined text), 80e9	Enter the scope sample rate.
Configure	Save Tested Waveforms	SaveWFM	No, Yes	Select Yes to save the waveform files of the tested signals. Files will be saved to directory set in Select waveform directory.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Configure	Scope Response	ScopeResp	BESSEL4, WALL	Select the Scope Response. A selection of 4th order Bessel will better represent a reference reciever. A flat response will give a direct look at the exact signal at the test point.
Configure	Scope Response 3dB frequency	ScopeFreq	33e9, 40e9, 43e9, 75, 50e9, 63e9	Select the Scope Response 3dB frequency. Note: a selection of 75% of Baud Rate will automatically calculate the valued based on the Baud Rate.
Configure	Select Waveform Directory	DirWFM	(Accepts user-defined text), C:\Temp\KRwfm	Type in a directory path to save your measured waveforms.
Configure	Signaling Rate	SignalingRate	(Accepts user-defined text), 10.3125e9, 25.78125e9, 26.5625e9, 50e9	Set the Signaling Rate to be tested. Enter value in the format 10.3125e9.
Configure	Start value for CTLE utility for Eye Opening	StartCTLE	1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, 8, 8.5, 9	Select the starting CTLE setting to use for the "Find optimal CTLE Eye Opening" test. The test will test the range of settings from this start value, to the stop value set in the next config.
Configure	Stop value for CTLE utility for Eye Opening	StopCTLE	1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, 8, 8.5, 9	Select the last CTLE setting to use for the "Find optimal CTLE Eye Opening" test. The test will test the range of settings from start value selected in the previous config, to the stop value set here.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Configure	Use Optimized CTLE for Eye Opening.	UseCTLE	Off, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, 8, 8.5, 9	Select the optimized setting to use. Default is off. Run "Find Optimal CTLE Eye Opening" Test under "Utilities" to find the optimal setting. When the utility is run, it will automatically set the optimal setting. This value will only be automatically set if utility is run any time after app load or if project is loaded with setting. All other instances, the setting will be the default of off and will need to be manually selected.
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 <= 99	Specify N using the 'Minimum required margin %' control.

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
AC Common Mode Output Voltage Test	5103	Test the AC common mode voltage. This test can only be tested in dual single ended connection
AC Common Mode Output Voltage Test	206103	Test the AC common mode voltage. This test can only be tested in dual single ended connection. Must be DC coupled.
AC Common Mode Output Voltage Test	306103	Test the AC common mode voltage. This test can only be tested in dual single ended connection. Must be DC coupled.
BUJ	55202	Bounded Uncorrelated Jitter BUJ measurement
Baud Rate	55200	Baud rate of the signal
Common Mode Noise, RMS	55103	Test the common mode RMS Noise. This test can only be tested in dual single ended connection
Common Mode Noise, RMS	256103	Test the common mode rms noise. This test can only be tested in dual single ended connection
Common Mode Noise, RMS	356103	Test the common mode rms noise. This test can only be tested in dual single ended connection. Must be DC coupled.
Common Mode Voltage - Vcm	256101	Test the DC common mode voltage. This test can only be tested in dual single ended connection
Common Mode Voltage - Vcm	356101	Test the common mode voltage. This test can only be tested in dual single ended connection. Must be DC coupled.
Common-mode Output Return Loss	10001	Common-mode Output Return Loss measurement
Common-mode Output Return Loss	15001	Common-mode Output Return Loss measurement
Common-mode to Differential Output Return Loss	210003	Common-mode to Differential Output Return Loss measurement
Common-mode to Differential Output Return Loss	310003	Common-mode to Differential Output Return Loss measurement
Common-mode to Differential Output Return Loss	310004	Common-mode to Differential Output Return Loss measurement
Common-mode to Differential Output Return Loss	310005	Common-mode to Differential Output Return Loss measurement

Table 4 Test IDs and Names (continued)

Name	TestID	Description
Common-mode to Differential Output Return Loss	215003	Common-mode to Differential Output Return Loss measurement
Common-mode to Differential Output Return Loss	315003	Common-mode to Differential Output Return Loss measurement
DC Common Mode Output Voltage Test	5101	Test the DC common mode voltage. This test can only be tested in dual single ended connection
DC Common Mode Output Voltage Test	206101	Test the DC common mode voltage. This test can only be tested in dual single ended connection. Must be DC coupled.
DC Common Mode Voltage	55101	Test the DC common mode voltage. This test can only be tested in dual single ended connection
DC Common Mode Voltage Test	306101	Test the DC common mode voltage. This test can only be tested in dual single ended connection. Must be DC coupled.
Differential Output Return Loss	10000	Differential Output Return Loss measurement
Differential Output Return Loss	210000	Differential Output Return Loss measurement
Differential Output Return Loss	310000	Differential Output Return Loss measurement
Differential Output Return Loss	15000	Differential Output Return Loss measurement
Differential Output Return Loss	215000	Differential Output Return Loss measurement
Differential Output Return Loss	315000	Differential Output Return Loss measurement
Differential Output Voltage Test	306102	Test the maximum voltage with the TX enabled
Differential Peak to Peak Output Voltage Test	5102	Test the maximum voltage with the TX enabled
Differential Peak to Peak Output Voltage Test	206102	Test the maximum voltage with the TX enabled
Differential Peak to Peak Output Voltage Test with TX disabled	5100	Test the maximum voltage with the TX disabled
Differential Peak to Peak Output Voltage Test with TX disabled	206100	Test the maximum voltage with the TX disabled
Differential Voltage pk-pk	256102	Test the maximum voltage with the TX enabled
Differential Voltage, pk-pk	55102	Test the maximum voltage with the TX enabled
Differential Voltage, pk-pk	356102	Test the maximum voltage with the TX enabled

Table 4 Test IDs and Names (continued)

Name	TestID	Description
ESMW	206603	Measures the Eye symmetry mask width at Host recommended CTLE, 1dB higher, and 1dB lower of optimal CTLE
Effective bounded uncorrelated jitter	65205	Effective bounded uncorrelated Jitter measurement
Effective total uncorrelated jitter	65206	Effective total uncorrelated Jitter measurement
Even-Odd Jitter	5201	Even-Odd Jitter measurement
Even-Odd Jitter	55201	Even-Odd Jitter measurement
Even-Odd Jitter	65204	Even-Odd Jitter measurement
Eye Height - EH6	256600	Measures the height of each the eye at user selected CTLE at 10-6 probability.
Eye Height A	206600	Measures the height of each the eye at user selected CTLE
Eye Width	206601	Measures the width of the eye at user CTLE
Eye Width - EW6	256601	Measures the width of the eye at user CTLE at 10-6 probability.
Eye linearity	256603	Measures the Eye linearity
Eye linearity	356603	Measures the eye linearity of each the eye at user selected CTLE
Far-end ESMW	306613	Measures the Far-end ESMW of each the eye at user selected CTLE
Far-end Eye Height	306610	Measures the Far-end height of each the eye at user selected CTLE
Far-end Eye Height - EH6	356610	Measures the Far-end eye height of each the eye at user selected CTLE at 10-6 probability.
Far-end Eye Width	306611	Measures the Far-end width of the eye at user CTLE
Far-end Eye Width - EW6	356611	Measures the Far-end eye width of the eye at user CTLE at 10-6 probability
Find Optimal CTLE Eye Opening	6602	Measures the eye width and height with each CTLE setting and reports the optimal setting to use in Eye Width and Eye Height measurements. The optimal value is automatically set in the configure tab after this test has run.
J4u	5202	J4u Jitter measurement
JRMS	5203	JRMS Jitter measurement

Table 4 Test IDs and Names (continued)

Name	TestID	Description
Level - Linearity pattern	51000	Measures the level for each level in the linearity pattern on UI 7 and 8 of 16
Level - PRBS pattern	2000	Tests the level for each level in the PRBS pattern
Level - PRBS pattern	52000	Tests the level for each level in the PRBS pattern
Level Noise - Linearity pattern	51002	Tests the noise of each level in the linearity pattern
Level Noise - PRBS pattern	2002	Tests the noise of each level in the PRBS pattern
Level Noise - PRBS pattern	52002	Tests the noise of each level in the PRBS pattern
Level RMS - Linearity pattern	51001	Tests the level rms for each level in the linearity pattern on UI 7 and 8 of 16
Level RMS - PRBS pattern	2001	Tests the level rms for each level in the PRBS pattern
Level RMS - PRBS pattern	52001	Tests the level rms for each level in the PRBS pattern
Level Separation Mismatch Ratio - RLM	2003	Tests the level mismatch ratio
Level Separation Mismatch Ratio - RLM	52003	Tests the level mismatch ratio
Level Separation Mismatch Ratio - RLM	51003	Tests the level mismatch ratio on UI 7 and 8 of 16
Linear Fit Pulse Peak	5301	Linear Fit Pulse Peak
Linear Fit Pulse Peak	55301	Linear Fit Pulse Peak
Minimum Output Fall Time (20%-80%)	206401	Fall Time measurement
Minimum Output Fall Time (20%-80%)	306401	Fall Time measurement
Minimum Output Rise Time (20%-80%)	206400	Rise Time measurement
Minimum Output Rise Time (20%-80%)	306400	Rise Time measurement
Near-end ESMW	306603	Measures the Near-end ESMW of each the eye at user selected CTLE
Near-end Eye Height	306600	Measures the Near-end height of each the eye at user selected CTLE
Near-end Eye Height - EH6	356600	Measures the Near-end eye height of each the eye at user selected CTLE at 10-6 probability.
Near-end Eye Width	306601	Measures the Near-end width of the eye at user CTLE

Table 4 Test IDs and Names (continued)

Name	TestID	Description
Near-end Eye Width - EW6	356601	Measures the Near-end eye width of the eye at user CTLE at 10-6 probability
Post-cursor equalization Local_eq_c1(0)	5504	Measures Post-cursor equalization for c(1) weight 0
Post-cursor equalization Local_eq_c1(1)	5505	Measures Post-cursor equalization for c(1) weight 1
Post-cursor equalization Local_eq_c1(2)	5506	Measures Post-cursor equalization for c(1) weight 2
Post-cursor equalization Local_eq_c1(3)	5507	Measures Post-cursor equalization for c(1) weight 3
Post-cursor equalization Local_eq_c1(4)	5508	Measures Post-cursor equalization for c(1) weight 4
Post-cursor equalization Local_eq_c1(5)	5509	Measures Post-cursor equalization for c(1) weight 5
Pre-cursor equalization Local_eq_cm1(0)	5500	Measures Pre-cursor equalization for c(-1) weight 0
Pre-cursor equalization Local_eq_cm1(1)	5501	Measures Pre-cursor equalization for c(-1) weight 1
Pre-cursor equalization Local_eq_cm1(2)	5502	Measures Pre-cursor equalization for c(-1) weight 2
Pre-cursor equalization Local_eq_cm1(3)	5503	Measures Pre-cursor equalization for c(-1) weight 3
Signal-to-noise-and-distortion ratio	5302	Measures the SNDR
Signal-to-noise-and-distortion ratio	55302	Measures the SNDR
Signaling Rate	5200	Signaling rate of the signal
Signaling Rate	206200	Signaling rate of the signal
Signaling Rate	306200	Signaling rate of the signal
Single-Ended Output Voltage Test	206104	Test the minimum and maximum voltages of the single-ended signals
Steady-State Voltage Vf	5300	Steady-State Voltage Vf measurement
Steady-State Voltage Vf	55300	Steady-State Voltage Vf measurement
Transition Time - Rise Time (20%-80%)	55400	Rise Time measurement

Table 4 Test IDs and Names (continued)

Name	TestID	Description
Transition Time - Rise Time (20%-80%)	256400	Rise Time measurement
Transition Time - Fall Time (20%-80%)	55401	Fall Time measurement
Transition Time - Fall Time (20%-80%)	256401	Fall Time measurement
Transition Time - Fall Time (20%-80%)	356401	Fall Time measurement
Transition Time - Rise Time (20%-80%)	356400	Rise Time measurement
Transmitter Output residual ratio SNRISI	5303	Measures the transmitter residual ratio
UUGJ	55203	Uncorrelated Unbounded Gaussian Jitter UUGJ measurement
Vertical Eye Closure	306602	Measures the Vertical Eye Closure at Near-End
Vertical Eye Closure	356602	Measures the Vertical Eye Closure at Near-End

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
Infiniium	The primary oscilloscope
Keysight ENA	Economy Network Analyzer
Keysight PNA	Performance Network Analyzer

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