Keysight N8828A 40GBASE-CR4 and 100GBASE-CR10 Compliance Test Application

KEYSIGHT TECHNOLOGIES

Programmer's Reference

Notices

Manual Part Number

Version 02.00.0000

Edition

Fegruary 19, 2015

Available in electronic format only

Published by:
Keysight Technologies, Inc.
1900 Garden of the Gods Road
Colorado Springs, CO 80907 USA

Warranty

The material contained in this document is provided "as is," and is subject to being changed, without notice, in future editions. Further, to the maximum extent permitted by applicable law, Keysight disclaims all warranties, either express or implied, with regard to this manual and any information contained herein, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Keysight shall not be liable for errors or for incidental or consequential damages in connection with the furnishing, use, or performance of this document or of any information contained herein. Should Keysight and the user have a separate written agreement with warranty terms covering the material in this document that conflict with these terms, the warranty terms in the separate agreement shall control.

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

Restricted Rights Legend

If software is for use in the performance of a U.S. Government prime contract or subcontract, Software is delivered and licensed as "Commercial computer software" as defined in DFAR 252.227-7014 (June 1995), or as a "commercial item" as defined in FAR 2.101(a) or as "Restricted computer software" as defined in FAR 52.227-19 (June 1987) or any equivalent agency regulation or contract clause. Use, duplication or disclosure of Software is subject to Keysight Technologies' standard commercial license terms, and non-DOD Departments and Agencies of the U.S. Government will receive no greater than Restricted Rights as defined in FAR 52.227-19(c)(1-2) (June 1987). U.S. Government users will receive no greater than Limited Rights as defined in FAR 52.227-14 (June 1987) or DFAR 252.227-7015 (b)(2) (November 1995), as applicable in any technical data.

Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

In This Book

This book is your guide to programming the Keysight Technologies N8828A 40GBASE-CR4 and 100GBASE-CR10 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 17, and Chapter 4, “Instruments,” starting on page 21, provide information specific to programming the N8828A 40GBASE-CR4 and 100GBASE-CR10 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.

Contents

In This Book / 3

1 Introduction to Programming

Remote Programming Toolkit / 8

Licensing / 9

2 Configuration Variables and Values

3 Test Names and IDs

4 Instruments

Index

1 Introduction to Programming

Remote Programming Toolkit / 8
Licensing / 9

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 N8828A 40GBASE-CR4 and 100GBASE-CR10 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 N8828A 40GBASE-CR4 and 100GBASE-CR10 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	Bandwidth	BW	(Accepts user-defined text), 50e9	Enter the scope bandwidth.
Confgure	Disable Pattern Check	DisablePattern	Enable, Disable	Select "Disable" to disable the pattern verification for square 8 pattern tests and suppress pattern error pop-ups. Select "Enable" to ensure that the correct pattern is being tested as per specification.
Confgure	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.keysight.com for application note 5989-4974EN to help select the correct ISI filter.
Confgure	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.keysight.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
Confgure	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.
Confgure	Number of UI	NumUI	(Accepts user-defined text), 1e6	Enter in the number or UI to test. Memory depth will be set accordingly.
Confgure	Rj Bandwidth	RjBandwidth	NARRow, WIDE	Choose the Rj Filter used in the jitter measurements.
Confgure	Sample Rate	SR	(Accepts user-defined text), 80e9	Enter the scope sample rate.
Confgure	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.
Confgure	Select Waveform Directory	DirWFM	(Accepts user-defined text), C:\Temp\KRwfm	Type in a directory path to save your measured waveforms.
Confgure	Signal Channels	CHANPAIR	1, 2, CHANnel1, CHANnel2, CHANnel3, CHANnel4, 3, 4, WMEMory1, WMEMory2, WMEMory3, WMEMory4, FUNCtion1, FUNCtion2, FUNCtion3, FUNCtion4	Select the oscilloscope input channel pair if connected dual single-ended. Or select the channel used for differential connection. All single channel, waveform memories, or functions that contain the word "differential", must be a single probe or signal that is differential. The channel or waveform memories with two channels are for dual single-ended connections. Note: All functions must be differential.
Confgure	Switch Matrix Scope Channels	CHANPAIR2	3, 4	This configuration variable is automatically set. This is for information purposes, to show the user which channels were selected in the setup tab.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Confgure	TX Off Voltage Scale	TXOFFSCALE	(Accepts user-defined text), Auto, 10e-3	Auto will automatically set the voltage scale for tests with the transmitter off. To manually set the scale, enter in the scale per division number (i.e. 10e-3)
Confgure	TX On Voltage Scale	TXONSCALE	(Accepts user-defined text), Auto, 200e-3	Auto will automatically set the voltage scale for tests with the transmitter on. To manually set the scale, enter in a scale per division number (i.e. 200e-3).
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	ChanPair	ChanPairOpt	Channels 1 and 3, Channels 2 and 4	This option allow user to select the scope channel pair.
Set Up	Device ID	pcboOverallDeviceID	(Accepts user-defined text)	This option allow user to key in related test details.
Set Up	External Address	txtExternalInstrumentAddress	(Accepts user-defined text)	This option allows user to connect an ENA or PNA. Please select ENA or PNA in the pull down menu and press the Connect PNA/ENA button.
Set Up	LaneNumOption10Lane	LaneNumOption10Lane	Lane0, Lane1, Lane2, Lane3, Lane4, Lane5, Lane6, Lane7, Lane8, Lane9	This option allows user to select which lane is testing when testing Single Lane.
Set Up	LaneNumOption4Lane	LaneNumOption4Lane	Lane0, Lane1, Lane2, Lane3	This option allows user to select which lane is testing when testing Single Lane.
Set Up	PNAENA	PNAENA	PNA, ENA	This option allows user to select which device is being used to measure return loss. PNA or ENA.
Set Up	Speed Grade	DeviceType	40GBASE-CR4, 100GBASE-CR10	This option allow user to select specific speed grade.
Set Up	Switch Option	SwitchOptionVar	Switch Matrix, Four Diff Probe Pairs, Single Lane	This option allow user to select specific speed grade.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Set Up	User Comment	txtOverallUserComment	(Accepts user-defined text)	This option allow user to key in related test detail.
Set Up	User Description	pcboOverallDeviceDescription	(Accepts user-defined text)	This option allow user to key in test detail.

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
Amplitude Peak-to-Peak Test	2102	Test the maximum peak to peak voltage with the TX enabled
Common Mode AC Output Voltage Test	2103	Test the AC common mode voltage. This test can only be tested in dual single ended connection
Common Mode AC Output Voltage Test	3103	Test the AC common mode voltage. This test can only be tested in dual single ended connection
Common Mode Voltage Limits Test	2101	Test the common mode voltage limits. This test can only be tested in dual single ended connection
Common Mode Voltage Limits Test	3101	Test the common mode voltage limits. This test can only be tested in dual single ended connection
Common-mode Output Return Loss	10001	Common-mode Output Return Loss measurement
DME Differential Peak to Peak Output Voltage Test	2700	Test the maximum voltage of the signal during DME
DME Differential Peak to Peak Output Voltage Test	3700	Test the maximum voltage of the signal during DME
DME T1-Transition Position Spacing (period) Test	2701	Test transition position spacing when in mode DME
DME T1-Transition Position Spacing (period) Test	3701	Test transition position spacing when in mode DME
DME T2-Clock Transition to Clock Transition Test	2702	Test Clock Transition to Clock Transition in mode DME
DME T2-Clock Transition to Clock Transition Test	3702	Test Clock Transition to Clock Transition in mode DME
DME T3-Clock Transition to Data Transition Test	2703	Test transition time between clock transition to data transition in mode DME
DME T3-Clock Transition to Data Transition Test	3703	Test transition time between clock transition to data transition in mode DME
Differential Output Return Loss	10000	Differential Output Return Loss measurement
Differential Peak to Peak Output Voltage Test	3102	Test the maximum voltage with the TX enabled
Differential Peak to Peak Output Voltage Test with TX disabled	3100	Test the maximum voltage with the TX disabled

Table 4 Test IDs and Names (continued)

Name	TestID	Description
Differential Peak-to-Peak Output Voltage Test with TX disabled	2100	Test the maximum voltage with the TX disabled
Duty Cycle Distortion	2203	Duty Cycle Distortion measurement
Duty Cycle Distortion	3203	Duty Cycle Distortion measurement
EEE Common Mode Voltage Deviation Test	2802	Test the common mode voltage Deviation in EEE. This test can only be tested in dual single ended connection
EEE Common Mode Voltage Deviation Test	3802	Test the common mode voltage Deviation in EEE. This test can only be tested in dual single ended connection
EEE Differential Peak to Peak Output Voltage Test	2801	Test the maximum voltage with the TX enabled in EEE
EEE Differential Peak to Peak Output Voltage Test	3801	Test the maximum voltage with the TX enabled in EEE
EEE Differential Peak to Peak Output Voltage Test with TX disabled	2800	Test the maximum voltage with the TX disabled in EEE
EEE Differential Peak to Peak Output Voltage Test with TX disabled	3800	Test the maximum voltage with the TX disabled in EEE
Initialize State Rpst	2901	Rpst measurement for Initialize Rpst
Initialize State Rpst	3901	Rpst measurement for Initialize Rpst
Intialize State Rpre	2900	Rpre measurement when in Initialize State.
Intialize State Rpre	3900	Rpre measurement when in Initialize State.
Linear Fit Pulse	2301	Linear Fit Pulse
Linear Fit Pulse Peak	3301	Linear Fit Pulse Peak
Minimum Post-cursor Full-scale Ratio	2501	Minimum Post-cursor Full-scale measurement for Coefficient c(1)zero c(0)minimum c(-1)minimum
Minimum Post-cursor Full-scale Ratio	3501	Minimum Post-cursor Full-scale measurement for Coefficient c(1)zero c(0)minimum c(-1)minimum
Minimum Pre-cursor Full-scale Ratio	2500	Minimum Pre-cursor Full-scale measurement for Coefficient c(1)minimum c(0)minimum c(-1)zero
Minimum Pre-cursor Full-scale Ratio	3500	Minimum Pre-cursor Full-scale measurement for Coefficient c(1)minimum c(0)minimum c(-1)zero
Random Jitter	2201	Random Jitter measurement

Table 4 Test IDs and Names (continued)

Name	TestID	Description
Random Jitter	3201	Random Jitter measurement
Signaling Rate	2200	Signaling rate of the signal
Signaling Rate	3200	Signaling rate of the signal
Total Jitter	2204	Total Jitter measurement
Total Jitter	3204	Total Jitter measurement
Transmitter DC Amplitude	3300	Transmitter DC Amplitude masurement
Transmitter DC Amplitude	2300	Transmitter DC Amplitude measurement
abs Coefficient Step Size c(1)dec c(0)hold c(-1)hold	2401	abs Coefficient Step Size measurement for Coefficient update c1-dec c0-hold c-1-hold
abs Coefficient Step Size c(1)dec c(0)hold c(-1)hold	3401	abs Coefficient Step Size measurement for Coefficient update c1-dec c0-hold c-1-hold
abs Coefficient Step Size c(1)hold c(0)dec c(-1)hold	2403	abs Coefficient Step Size measurement for Coefficient update c1-hold c0-dec c-1-hold
abs Coefficient Step Size c(1)hold c(0)dec c(-1)hold	3403	abs Coefficient Step Size measurement for Coefficient update c1-hold c0-dec c-1-hold
abs Coefficient Step Size c(1)hold c(0)hold c(-1)dec	2405	abs Coefficient Step Size measurement for Coefficient update c1-hold c0-hold c-1-dec
abs Coefficient Step Size c(1)hold c(0)hold c(-1)dec	3405	abs Coefficient Step Size measurement for Coefficient update c1-hold c0-hold c-1-dec
abs Coefficient Step Size c(1)hold c(0)hold c(-1)inc	2404	abs Coefficient Step Size measurement for Coefficient update c1-hold c0-hold c-1-inc
abs Coefficient Step Size c(1)hold c(0)hold c(-1)inc	3404	abs Coefficient Step Size measurement for Coefficient update c1-hold c0-hold c-1-inc
abs Coefficient Step Size c(1)hold c(0)inc c(-1)hold	2402	abs Coefficient Step Size measurement for Coefficient update c1-hold c0-inc c-1-hold
abs Coefficient Step Size c(1)hold c(0)inc c(-1)hold	3402	abs Coefficient Step Size measurement for Coefficient update c1-hold c0-inc c-1-hold
abs Coefficient Step Size c(1)inc c(0)hold c(-1)hold	2400	abs Coefficient Step Size measurement for Coefficient update c1-inc c0-hold c-1-hold
abs Coefficient Step Size c(1)inc c(0)hold c(-1)hold	3400	abs Coefficient Step Size measurement for Coefficient update c1-inc c0-hold c-1-hold

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
scope	The primary oscilloscope

Index

C

configuration variables and values, 11

I

IDs and names of tests, 17
instrument names, 21

L

licensing, 9

N

names and IDs of tests, 17
names of instruments, 21
notices, 3

P

programming, introduction to, 7

R

Remote Programming Toolkit, 8

T

test names and IDs, 17

V

variables and values, configuration, 11