# Keysight D9010BJBC 100GBASE-KR4 Compliance Test Application

KEYSIGHT

PROGRAMMER'S REFERENCE

# Notices



## Revision

Version 4.20.3.0

## Edition

September 19, 2023

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 License

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.

## U.S. Government Rights

The Software is "commercial computer software," as defined by Federal Acquisition Regulation ("FAR") 2.101. Pursuant to FAR 12.212 and 27.405-3 and Department of Defense FAR Supplement ("DFARS") 227.7202, the U.S. government acquires commercial computer software under the same terms by which the software is customarily provided to the public. Accordingly, Keysight provides the Software to U.S. government customers under its standard commercial license, which is embodied in its End User License Agreement (EULA), a copy of which can be found at www.keysight.com/find/sweula. The license set forth in the EULA represents the exclusive authority by which the U.S. government may use, modify, distribute, or disclose the Software. The EULA and the license set forth therein, does not require or permit, among other things, that Keysight: (1) Furnish technical information related to commercial computer software or commercial computer software documentation that is not customarily provided to the public; or (2) Relinquish to, or otherwise provide, the government rights in excess of these rights customarily provided to the public to use, modify, reproduce, release, perform, display, or disclose commercial computer software or commercial computer software documentation. No additional government requirements beyond those set forth in the EULA shall apply, except to the extent that those terms, rights, or licenses are explicitly required from all providers of commercial computer software pursuant to the FAR and the DFARS and are set forth specifically in writing elsewhere in the EULA. Keysight shall be under no obligation to update, revise or otherwise modify the Software. With respect to any technical data as defined by FAR 2.101, pursuant to FAR 12.211 and 27.404.2 and DFARS 227.7102, the U.S. government acquires no greater than Limited Rights as defined in FAR 27.401 or DFAR 227.7103-5 (c), 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 D9010BJBC 100GBASE-KR4 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 9, Chapter 3, “Test Names and IDs,” starting on page 13, and Chapter 4, “Instruments,” starting on page 19 provide information specific to programming the D9010BJBC 100GBASE-KR4 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

# 1 Introduction to Programming



This chapter introduces the basics for remote programming a compliance/test application. The programming commands provide the means of remote control. Basic operations that you can do remotely with a computer and a compliance/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 D9010BJBC 100GBASE-KR4 Compliance Test Application uses Remote Interface Revision 7.2. 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 D9010BJBC 100GBASE-KR4 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 |
|---|---|---|---|---|
| Configure | Bandwidth | BW | (Accepts user-defined text), 100e9 | Enter the scope bandwidth. |
| 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.keysight.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.keysight.com for application note 5989-4974EN to help select the correct ISI filter. |
| 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 | Number of UI | NumUI | (Accepts user-defined text), 1e6 | Enter in the number or UI to test. Memory depth will be set accordingly. |

**Table 2** Configuration Variables and Values (continued)

| GUI Location | Label | Variable | Values | Description |
|---|---|---|---|---|
| Configure | 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. |
| Configure | Rj Bandwidth | RjBandwidth | NARRow, WIDE | Choose the Rj Filter used in the jitter measurements. |
| Configure | Sample Rate | SR | (Accepts user-defined text), 256e9 | 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. |
| Configure | Select Waveform Directory | DirWFM | (Accepts user-defined text), C:\Temp\KRwfm | Type in a directory path to save your measured waveforms. |
| Configure | 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. |
| Configure | Signaling Rate | SignalingRate | (Accepts user-defined text), 25.78125e9 | Set the Signaling Rate to be tested. Enter value in the format 10.3125e9. |
| Configure | Switch Matrix Scope Channels | CHANPAIR2 | 2, 4, 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 |
|---|---|---|---|---|
| Configure | 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) |
| Configure | 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 <= 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. Listed at the end, you may also find:

- Deprecated IDs and their replacements.
- Macro IDs which may be used to select multiple related tests at the same time.

**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 | 6103 | Test the AC common mode voltage. This test can only be tested in dual single ended connection |
| Bounded Uncorrelated Jitter | 5202 | Bounded Uncorrelated Jitter measurement |
| Bounded Uncorrelated Jitter | 6202 | Bounded Uncorrelated Jitter measurement |
| Common-mode Output Return Loss | 10001 | Common-mode Output Return Loss measurement |
| Common-mode to Common-mode Output Return Loss | 10002 | Common-mode to Common-mode Output Return Loss measurement |
| Common-mode to Differential Output Return Loss | 10003 | 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 | 6101 | Test the DC common mode voltage. This test can only be tested in dual single ended connection |
| DME Differential Peak to Peak Output Voltage Test | 5700 | Test the maximum voltage of the signal during DME |
| DME Differential Peak to Peak Output Voltage Test | 6700 | Test the maximum voltage of the signal during DME |
| DME T1-Transition Position Spacing (period) Test | 5701 | Test transition position spacing when in mode DME |
| DME T1-Transition Position Spacing (period) Test | 6701 | Test transition position spacing when in mode DME |
| DME T2-Clock Transition to Clock Transition Test | 5702 | Test Clock Transition to Clock Transition in mode DME |
| DME T2-Clock Transition to Clock Transition Test | 6702 | Test Clock Transition to Clock Transition in mode DME |

**Table 4** Test IDs and Names (continued)

| Name | TestID | Description |
|---|---|---|
| DME T3-Clock Transition to Data Transition Test | 5703 | Test transition time between clock transition to data transition in mode DME |
| DME T3-Clock Transition to Data Transition Test | 6703 | 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 | 5102 | Test the maximum voltage with the TX enabled |
| Differential Peak to Peak Output Voltage Test | 6102 | 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 | 6100 | Test the maximum voltage with the TX disabled |
| EEE Common Mode Voltage Deviation Test | 5802 | 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 | 6802 | 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 | 5801 | Test the maximum voltage with the TX enabled in EEE |
| EEE Differential Peak to Peak Output Voltage Test | 6801 | Test the maximum voltage with the TX enabled in EEE |
| EEE Differential Peak to Peak Output Voltage Test with TX disabled | 5800 | Test the maximum voltage with the TX disabled in EEE |
| EEE Differential Peak to Peak Output Voltage Test with TX disabled | 6800 | Test the maximum voltage with the TX disabled in EEE |
| Even-Odd Jitter | 5201 | Even-Odd Jitter measurement |
| Even-Odd Jitter | 6201 | Even-Odd Jitter measurement |
| Initialize State Rpst | 5901 | Rpst measurement for Initialize Rpst |
| Initialize State Rpst | 6901 | Rpst measurement for Initialize Rpst |
| Intialize State Rpre | 5900 | Rpre measurement when in Initialize State. |
| Intialize State Rpre | 6900 | Rpre measurement when in Initialize State. |
| Linear Fit Pulse Peak | 5301 | Linear Fit Pulse Peak |
| Linear Fit Pulse Peak | 6301 | Linear Fit Pulse Peak |
| Minimum Post-cursor Full-scale Range | 5501 | Minimum Post-cursor Full-scale measurement for Coefficient c(1)minimum c(0)minimum c(-1)zero |

**Table 4** Test IDs and Names (continued)

| Name | TestID | Description |
|---|---|---|
| Minimum Post-cursor Full-scale Ratio | 6501 | Minimum Post-cursor Full-scale measurement for Coefficient c(1)minimum c(0)minimum c(-1)zero |
| Minimum Pre-cursor Full-scale Range | 5500 | Minimum Pre-cursor Full-scale measurement for Coefficient c(1)zero c(0)minimum c(-1)minimum |
| Minimum Pre-cursor Full-scale Ratio | 6500 | Minimum Pre-cursor Full-scale measurement for Coefficient c(1)zero c(0)minimum c(-1)minimum |
| Normalized Coefficient Step Size c(1)dec c(0)hold c(-1)hold | 5401 | Normalized Coefficient Step Size measurement for Coefficient update c1-dec c0-hold c-1-hold |
| Normalized Coefficient Step Size c(1)hold c(0)dec c(-1)hold | 5403 | Normalized Coefficient Step Size measurement for Coefficient update c1-hold c0-dec c-1-hold |
| Normalized Coefficient Step Size c(1)hold c(0)hold c(-1)dec | 5405 | Normalized Coefficient Step Size measurement for Coefficient update c1-hold c0-hold c-1-dec |
| Normalized Coefficient Step Size c(1)hold c(0)hold c(-1)inc | 5404 | Normalized Coefficient Step Size measurement for Coefficient update c1-hold c0-hold c-1-inc |
| Normalized Coefficient Step Size c(1)hold c(0)inc c(-1)hold | 5402 | Normalized Coefficient Step Size measurement for Coefficient update c1-hold c0-inc c-1-hold |
| Normalized Coefficient Step Size c(1)inc c(0)hold c(-1)hold | 5400 | Normalized Coefficient Step Size measurement for Coefficient update c1-inc c0-hold c-1-hold |
| Preset | 1 | Measures the Preset signal for step size and full-scale measurements |
| Signal-to-noise-and-distortion ratio | 5302 | Measures the SNDR |
| Signal-to-noise-and-distortion ratio | 6302 | Measures the SNDR |
| Signaling Rate | 5200 | Signaling rate of the signal |
| Signaling Rate | 6200 | Signaling rate of the signal |
| Steady-State Voltage Vf | 5300 | Steady-State Voltage Vf measurement |
| Steady-State Voltage Vf | 6300 | Steady-State Voltage Vf measurement |
| Total Uncorrelated Jitter | 5203 | Total Uncorrelated Jitter measurement |
| Total Uncorrelated Jitter | 6203 | Total Uncorrelated Jitter measurement |
| abs Coefficient Step Size c(1)dec c(0)hold c(-1)hold | 6401 | 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 | 6403 | 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 | 6405 | 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 | 6404 | abs Coefficient Step Size measurement for Coefficient update c1-hold c0-hold c-1-inc |

**Table 4** Test IDs and Names (continued)

| Name | TestID | Description |
|---|---|---|
| abs Coefficient Step Size c(1)hold c(0)inc c(-1)hold | 6402 | 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 | 6400 | 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 |
|---|---|
| Infiniium | The primary oscilloscope |
| Keysight PNA | Performance Network Analyzer |
| Keysight ENA | Economy Network Analyzer |

# Index