

# Keysight Real Time Compliance Tool

User's Guide

# Notices

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## 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.

## Safety Summary

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings or operating instructions in the product manuals violates safety standards of design, manufacture, and intended use of the instrument. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements. Product manuals are provided with your instrument on CD-ROM and/or in printed form. Printed manuals are an option for many products. Manuals may also be available on the Web. Go to [www.keysight.com](http://www.keysight.com) and type in your product number in the Search field at the top of the page.

General	Do not use this product in any manner not specified by the manufacturer. The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.
Before Applying Power	Verify that all safety precautions are taken. Make all connections to the unit before applying power. Note the instrument's external markings described in "Safety Symbols".
Ground the Instrument	If your product is provided with a grounding type power plug, the instrument chassis and cover must be connected to an electrical ground to minimize shock hazard. The ground pin must be firmly connected to an electrical ground (safety ground) terminal at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.
Fuses	See the user's guide or operator's manual for information about line-fuse replacement. Some instruments contain an internal fuse, which is not user accessible.
Do Not Operate in an Explosive Atmosphere	Do not operate the instrument in the presence of flammable gases or fumes.
Do Not Remove the Instrument Cover	Only qualified, service-trained personnel who are aware of the hazards involved should remove instrument covers. Always disconnect the power cable and any external circuits before removing the instrument cover.
Cleaning	Clean the outside of the instrument with a soft, lint-free, slightly dampened cloth. Do not use detergent or chemical solvents.
Do Not Modify the Instrument	Do not install substitute parts or perform any unauthorized modification to the product. Return the product to an Keysight Sales and Service Office for service and repair to ensure that safety features are maintained.
In Case of Damage	Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

### CAUTION

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



### WARNING

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## Safety Symbols



Table 1 Safety Symbol

Symbol	Description
	Direct current
	Alternating current
	Both direct and alternating current
	Three phase alternating current
	Three phase alternating current
	Earth ground terminal
	Protective earth ground terminal
	Frame or chassis ground terminal
	Terminal is at earth potential
	Equipotentiality
N	Neutral conductor on permanently installed equipment
L	Line conductor on permanently installed equipment
	On (mains supply)
	Off (mains supply)
	Stand by (mains supply). The instrument is not completely disconnected from the mains supply when the power switch is in the stand by position
	In position of a bi-stable push switch

Symbol	Description
	Out position of a bi-stable push switch
	Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION
	Caution, refer to accompanying documentation
	Caution, risk of electric shock
	Do not apply around or remove from HAZARDOUS LIVE conductors
	Application around and removal from HAZARDOUS LIVE conductors is permitted
	Caution, hot surface
	Ionizing radiation
CAT I	IEC Measurement Category I
CAT II	Measurement Category II
CAT III	Measurement Category III
CAT IV	Measurement Category IV

## Compliance and Environmental Information

**Table 2** Compliance and Environmental Information

Safety Symbol	Description
	CSA is the Canadian certification mark to demonstrate compliance with the Safety requirements.
 N10149	The C-tick mark is a registered trademark of the Spectrum Management Agency of Australia. This signifies compliance with the Australia EMC Framework regulations under the terms of the Radio Communication Act of 1992.
	CE compliance marking to the EU Safety and EMC Directives. ISM GRP-1A classification according to the international EMC standard. ICES/NMB-001 compliance marking to the Canadian EMC standard.

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# 1 Introduction

How the Real-Time Compliance Tool Works / 10

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The Real-Time Compliance tool evaluates DDR/LPDDR data in real-time to detect and report violations to compliance limits specified in DDR/LPDDR specifications. Unlike the DDR Post Process Compliance tool that evaluates the data captured in a trace for violations, this tool evaluates real-time data captured by an Keysight logic analyzer module.

The Real-Time Compliance tool can evaluate DDR, DDR2, DDR3, DDR4, LPDDR, LPDDR2, and LPDDR3 target systems for compliance violations.

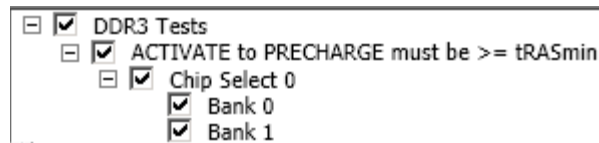
Besides providing predefined compliance tests for DDR/LPDDR, the tool also allows you to create and run user-defined tests for DDR/LPDDR or any other general-purpose tests.

## How the Real-Time Compliance Tool Works

The tool allows you to load, configure, and run a set of compliance tests on the real-time data being captured from a DDR/LPDDR target system.

You can either run compliance tests from the set of predefined tests available with the tool or create and run your own compliance tests to suit your specific requirements.

Each predefined compliance test has an associated specification parameter based on which one or more trigger condition(s) are defined. For example, the test displayed in the screen below has a trigger condition based on the tRASmin specification parameter.



When the test is run, the tool checks the real-time data for compliance limit violations as per the trigger condition(s). On encountering a violation, the trigger condition is met and Logic Analyzer is triggered to report it as a violation. Besides reporting the violation, the tool also performs any additional actions (such as saving the violation trace) that you have configured it to perform in the event of a violation.

In case the tool does not detect any violations within the time that you specified for the execution of the test, the tool stops the current test and starts running the next test in the sequence. If all tests have already been run, then the tool stops.

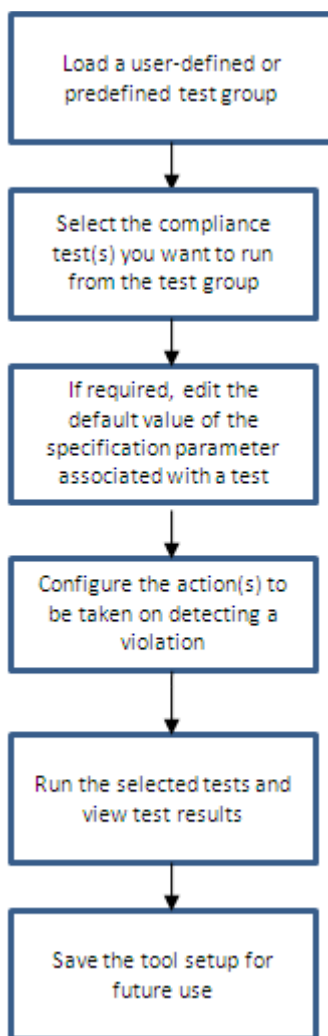
The tool uses the trigger specifications specified for the Logic Analyzer module to run tests on valid captured data. The trigger specifications are already defined for the predefined tests that ship with the tool. For user-defined tests, you need to define the trigger specifications.

### NOTE

There are some tests that cannot be run real-time. For such tests, you need to use the *DDR Post Process Compliance* tool.

## Flow of Steps

The following screen displays a general sequential flow of steps for using the Real-Time Compliance tool.



These steps are described in detail in the topics that follow.



## 2 Before You Start

Before you start using the tool, ensure that you have:

- 1 Installed the *Keysight Logic and Protocol Analyzer software* version 5.50 or higher. The Real-Time Compliance tool works with this software.
- 2 Installed the Real-Time Compliance tool's software and enabled its license. The Real-Time Compliance tool is a part of the B4622B DDR Protocol Compliance and Analysis toolset. Therefore, the tool is available only after you install the *Keysight B4622B DDR2/3 Protocol Compliance and Analysis Tool* package.

### NOTE

You can install the *Keysight Logic and Protocol Analyzer application* and *Keysight B4622B DDR2/3 Protocol Compliance and Analysis Tool* package from the Keysight web site at: [www.keysight.com/find/la-sw-download](http://www.keysight.com/find/la-sw-download).

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After installation, you must enable the software license by following the instructions on your Entitlement Certificate.

### NOTE

The following two licensed options of the B4622 software are currently available.

B4622A license

B4622B license

B4622B is an upgrade license. You get the Real-Time Compliance tool only with the B4622B license. With the B4622A license, you cannot launch and use the tool. Doing so, results in the display of an error message.

Contact Keysight Technologies to purchase the upgrade license.

- 
- 3 Accurately set up the hardware and software of the Keysight logic analyzer to capture the required data of the DDR-type bus being monitored. Doing so ensures that you have valid data on which to run compliance tests to detect violations.

Refer to the *Keysight Logic and Protocol Analyzer Online Help* to know how to set up the Keysight logic analyzer to capture the required data.

Refer to the *DDR Setup Assistant Online Help* to know how to set up your logic analyzer properly for DDR/LPDDR data capture and analysis.

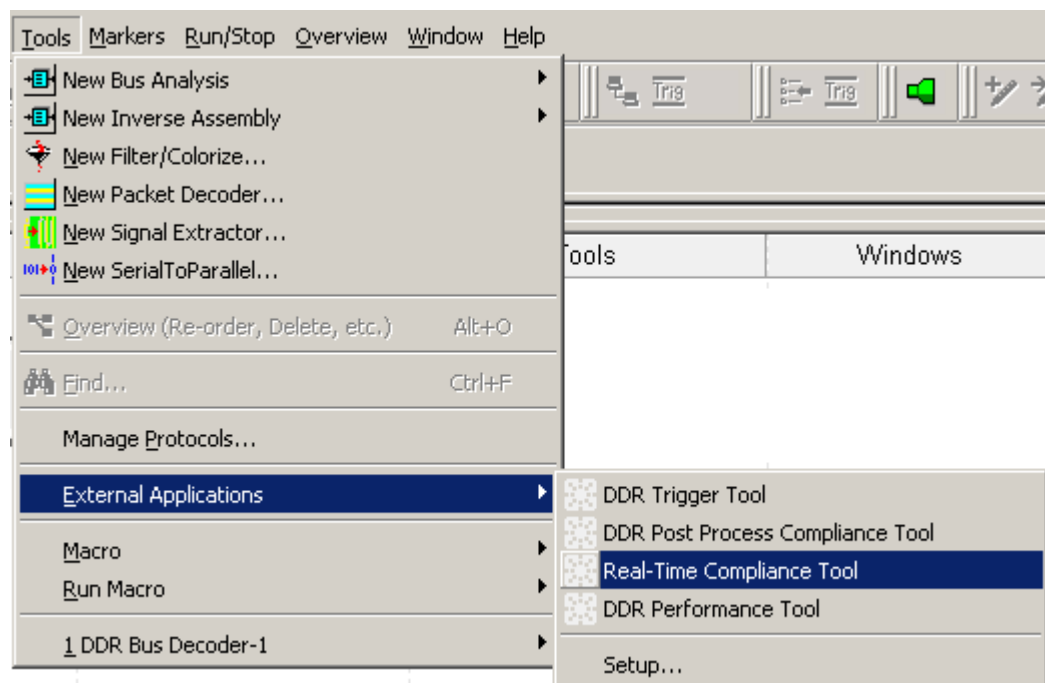


# 3 Starting the Real-Time Compliance Tool

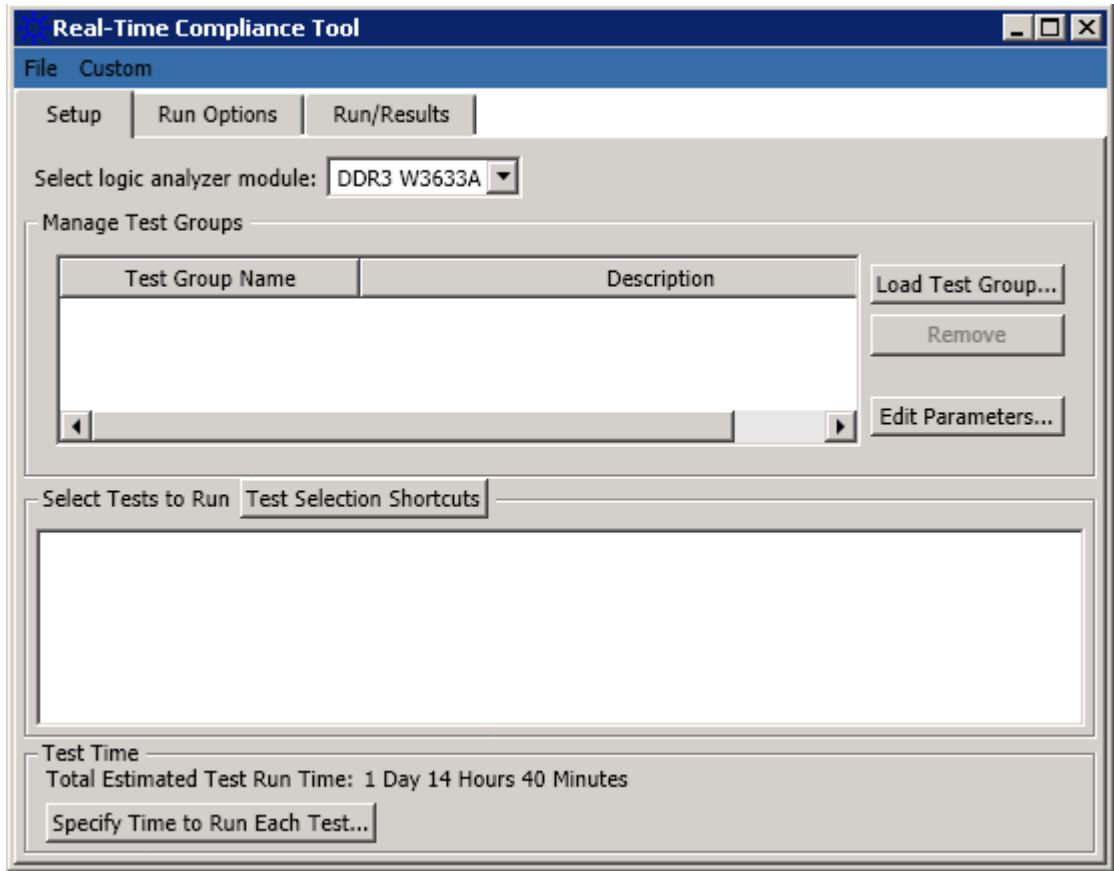
The Real-Time Compliance tool is accessible from the Keysight Logic and Protocol Analyzer GUI.

## To start the Real-Time Compliance tool

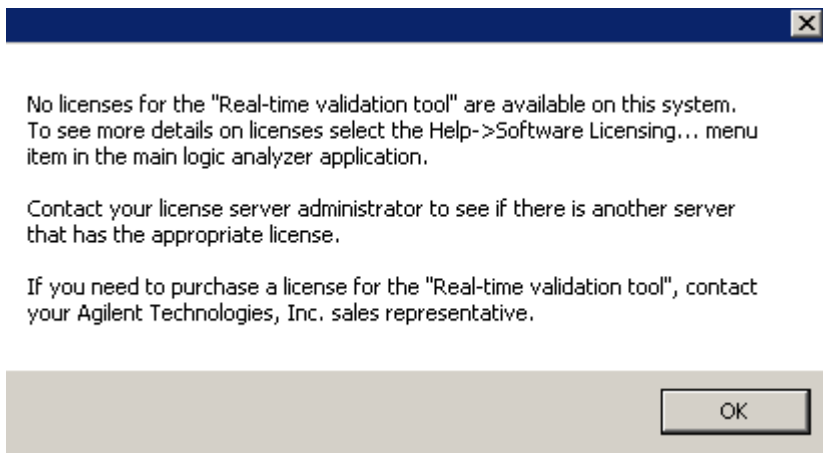
- 1 Select **Tools** > **External Applications** > **Real-Time Compliance Tool** from the Keysight Logic and Protocol Analyzer GUI menubar.



The Real-Time Compliance Tool is displayed.



At times, you may get the following error message when trying to launch the Real-Time Compliance tool.



This error message indicates that the B4622B upgrade license needed for this tool is not currently available on the system. To access the tool, you need to purchase and install the B4622B upgrade license.



# 4 Loading, Configuring, and Selecting Compliance Tests

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## Test Groups, Tests, and Specification Parameters

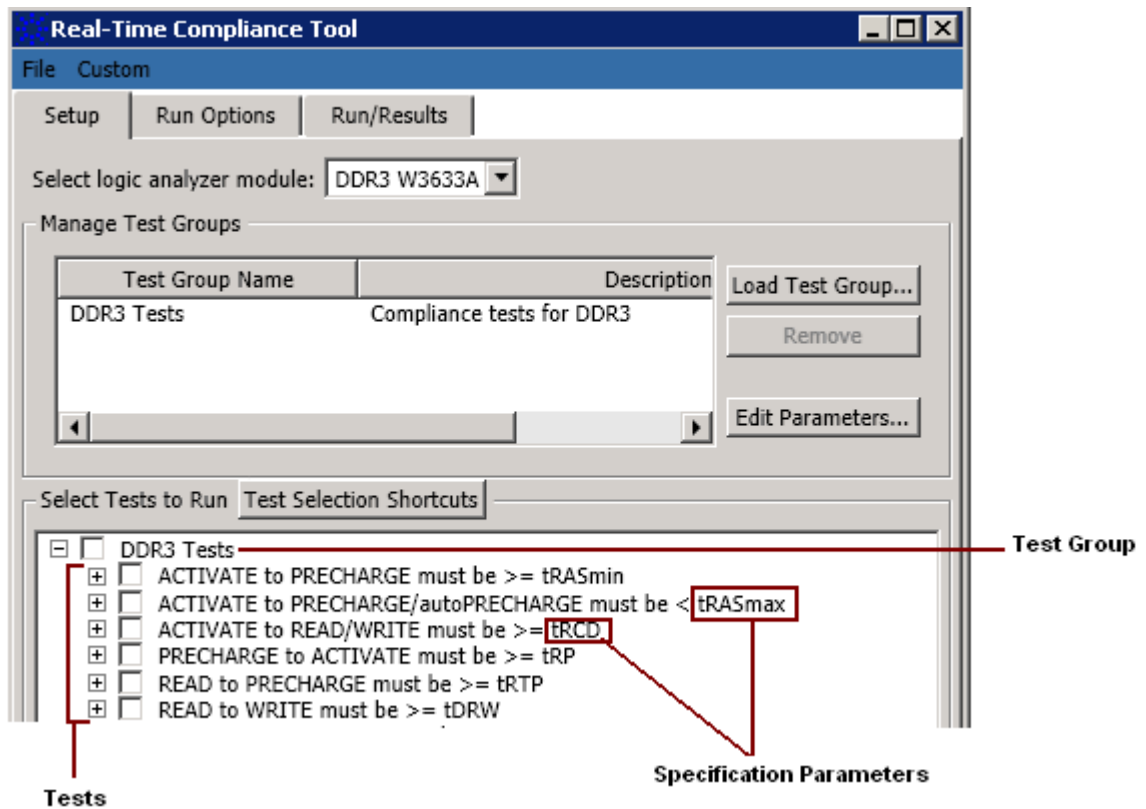
Compliance tests are grouped as test groups and stored in XML files. For instance, the DDR3 tests are grouped and stored in the *DDR3Tests.xml* file.

When you install the Real-Time Compliance tool, a set of predefined test groups (XML files) are installed at the following location.

C:\Program Files (x86)\Keysight Technologies\Logic Analyzer\ExternalApps\  
RealTimeComplianceTool\Test Group Files

You first need to load a required test group XML file, then select the tests that you want to run from that test group, and if required edit the specification parameters of tests.

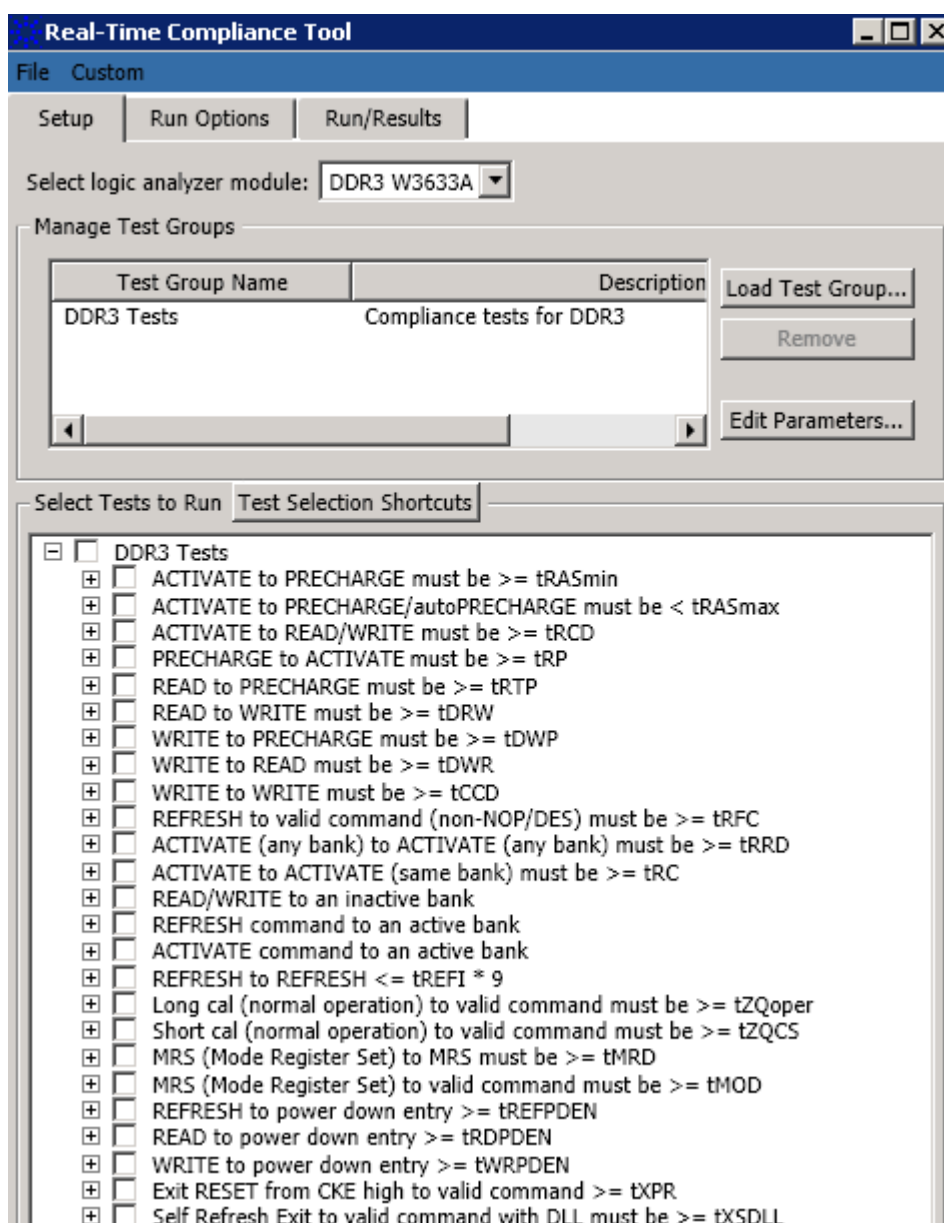
The following screen displays a loaded test group XML file and the tests that it contains along with the associated specification parameter for each test.



To load a test group

- 1 Click the **Setup** tab in the Real-Time Compliance tool.
- 2 From the Select **logic analyzer module** listbox, select the logic analyzer module that you are using for capturing DDR data. If more than one module exists in the setup, you need to select which one to use for running the compliance tests. If only one module exists, it will be selected automatically.
- 3 Click the **Load Test Group...** button.
- 4 Browse and select a predefined or a user-defined test group XML file and click **Open**.

On loading the test group XML file, all the tests included in the group are displayed in the Real-Time Compliance tool.

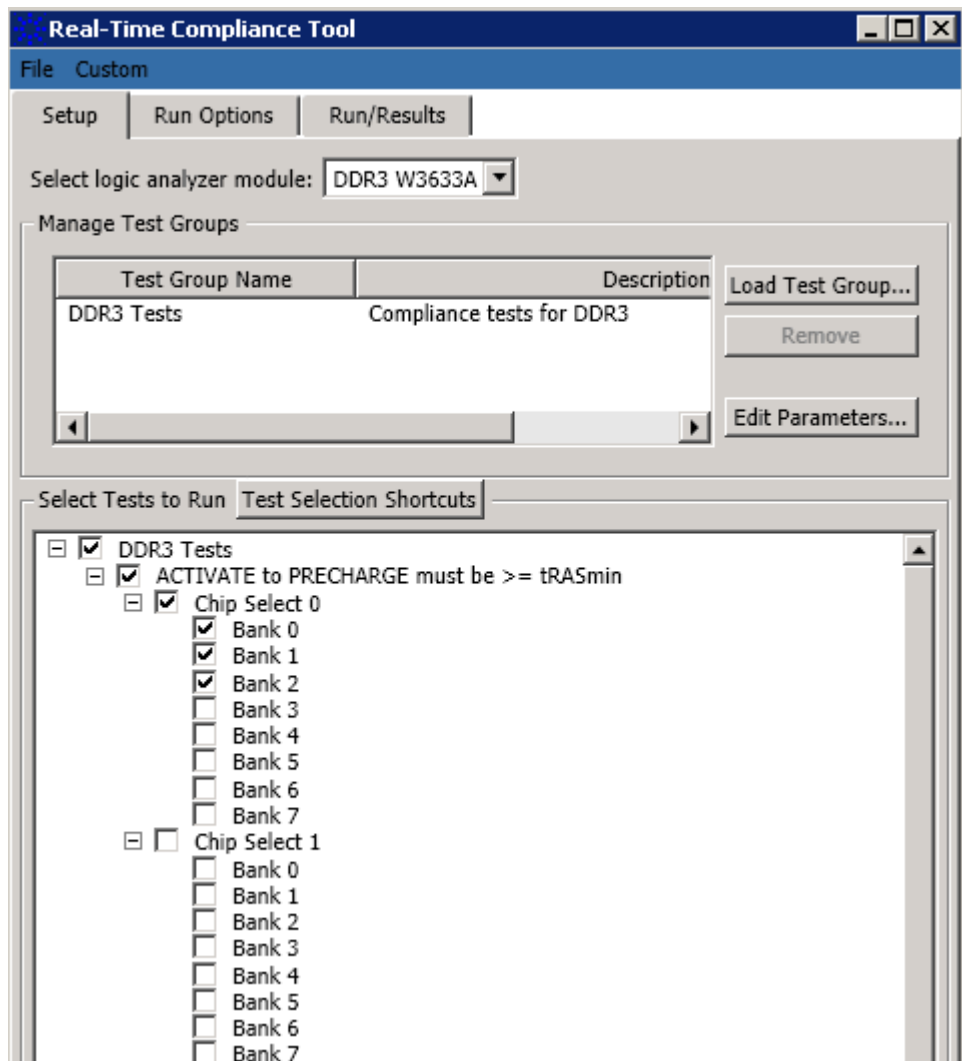


## To select compliance tests

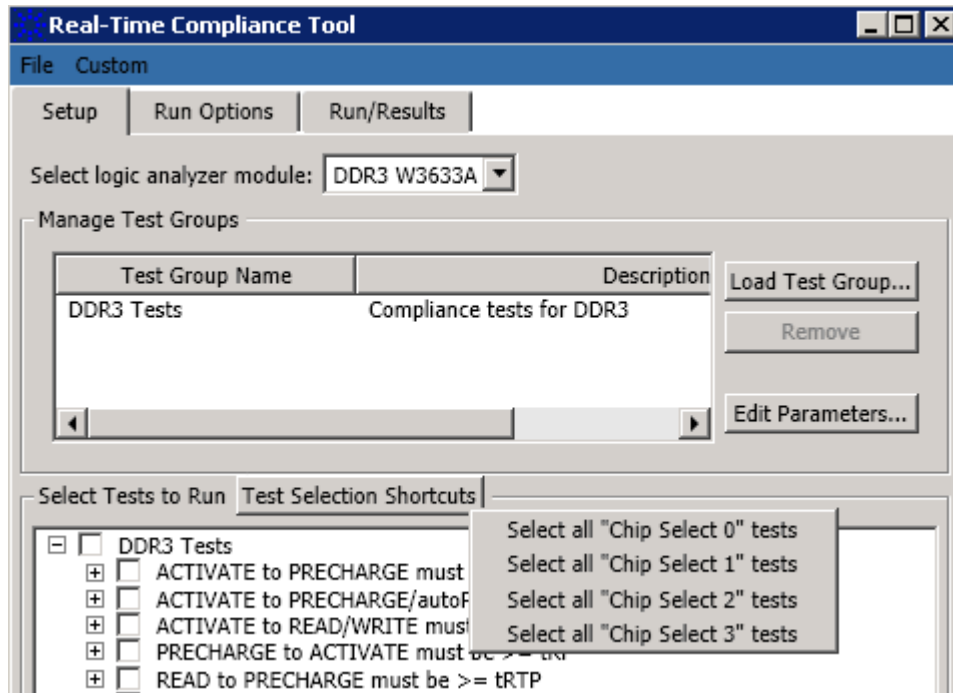
You can choose to run all or some of the tests included in the loaded test group. By default, none of the tests in a group are selected.

By selecting the checkbox displayed with the test group name, all the tests in that group are selected to run. To include specific tests for execution, select the checkbox displayed with each of the individual test you want to run.

Expanding a test allows you to further narrow down the test execution to selective Chip selects and banks. For example, in the screen below, the first test is run only for Bank 0-2 of Chip Select 0.



If you want to run all tests in a test group for a particular chip select, then instead of expanding each test and selecting the specific chip select checkbox, you can use the **Test Selection Shortcuts** option. Clicking this option displays options to select all tests for a particular chip select in a single click.



## To edit specification parameters

Each compliance test has a specification parameter associated with it. The default value of each specification parameter is already set. If required, you can override the default value and provide a desired value suitable for your specific requirements such as bus speed and bus type.

You can override the default value of specification parameters in the following two ways:

- Manually override the default value of a particular specification parameter.
- Apply a Parameter Value XML file to change the value of all the specification parameters in a test group to the values appropriate for a particular bus speed. A number of predefined Parameter Value XML files are installed with the Real-Time Compliance tool for the most common bus speeds for all DDR bus types. These files are installed at:

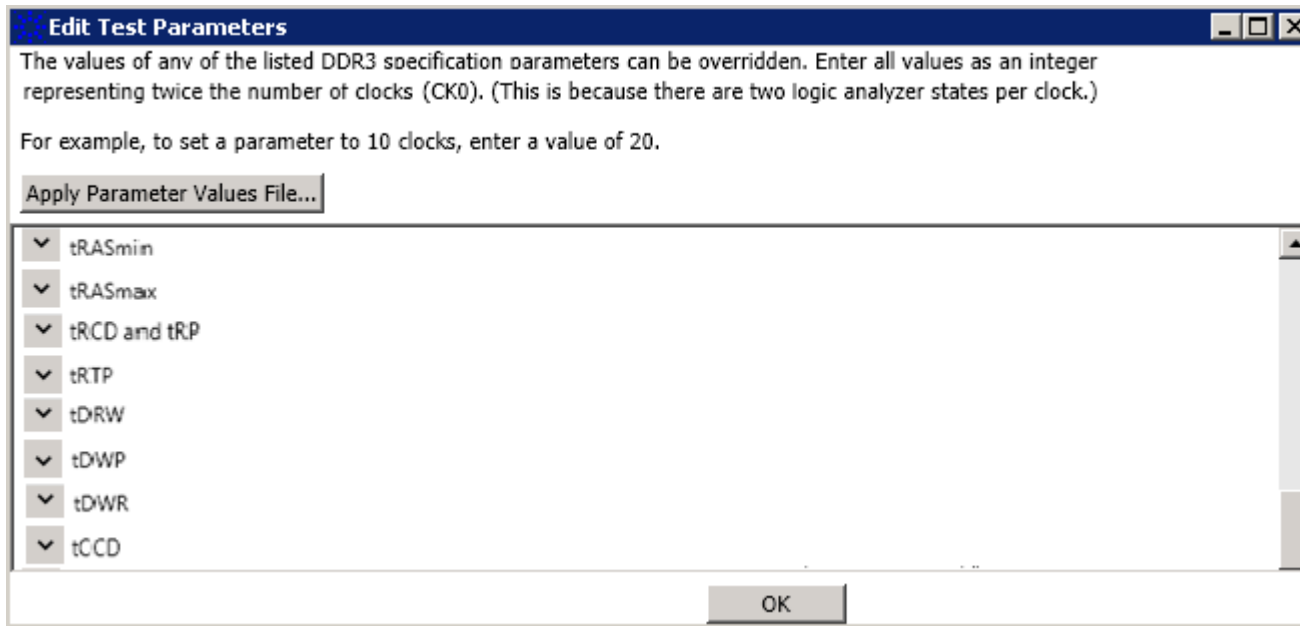
*C:\Program Files (x86)\Keysight Technologies\Logic Analyzer\ExternalApps\  
RealTimeComplianceTool\Parameter Value Files*

Applying a Parameter Value file quickly changes all the parameter values to match the values applicable for a particular bus speed.

### Manually Overriding the Default Value of a Parameter

- 1 In the Real-Time Compliance tool, load the required test group.
- 2 Click the **Edit Parameters...** button displayed in the Setup tab.

The **Edit Test Parameters** dialog box is displayed with the list of all the specification parameters applicable for the test group.



- 3 Click the down-arrow button displayed with a specification parameter to view its current value, get more information about it, and view options to modify its value.  
In the screen below, the details and default value of the tRTP parameter is displayed.

### Edit Test Parameters

The values of any of the listed DDR3 specification parameters can be overridden. Enter all values as an integer representing twice the (CK0). (This is because there are two logic analyzer states per clock.)

For example, to set a parameter to 10 clocks, enter a value of 20.

Apply Parameter Values File...

▼ tRCD and tRP

▲ tRTP

READ to PRECHARGE must be  $\geq$  tRTP. According to the DDR3 specification, it is the max of 4 clocks. Thus, it is dependent on target speed. Use the table below to find the correct value for tRTP:

Target speed	Max (4 clocks, 7.5 ns)	Clocks	LA states
800MHz	4 clocks	4	8
1066MHz	same	4	8
1333MHz	7.5ns	5	10
1600MHz	7.5ns	6	12
1866MHz	7.5ns	7	14
2133MHz	7.5ns	8	16

To override this setting, either apply the appropriate test group parameter values file, or manually enter the value below.

Default value: 10

Manually override value of tRTP

Enter value for tRTP (in LA states):

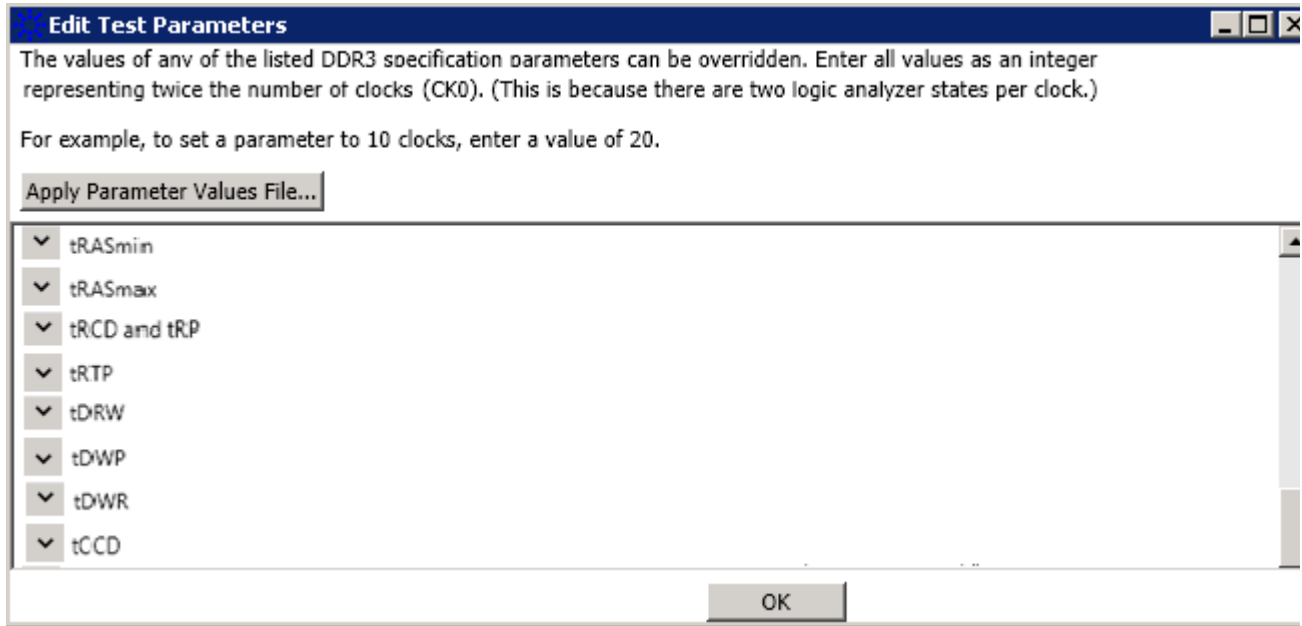
▼ tDRW

OK

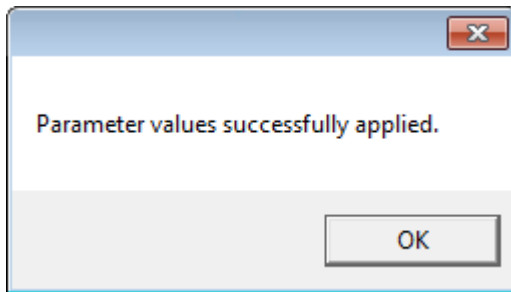
- 4 Select the **Manually override value of <parameter>** checkbox.
- 5 Specify a desired value of the parameter in the Enter value for **<parameter> (in LA states)** field.
- 6 Click **OK**.

#### Applying a Parameter Value XML File

- 1 In the Real-Time Compliance tool, load the required test group.
  - 2 Click the **Edit Parameters...** button displayed in the Setup tab.
- The **Edit Test Parameters** dialog box is displayed with the list of all the specification parameters applicable for the test group.

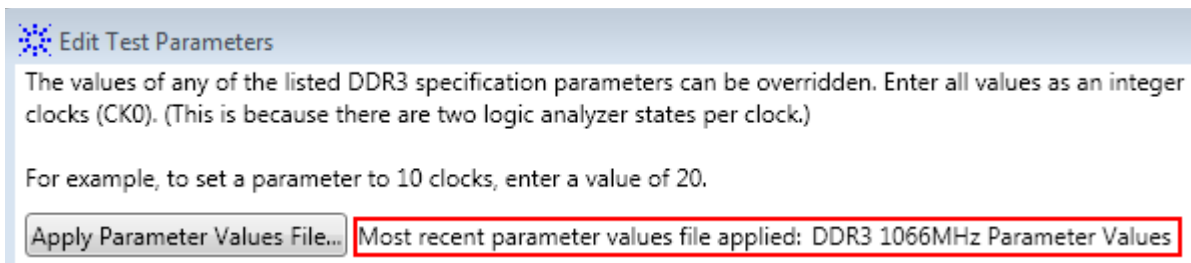


- 3 Click the **Apply Parameter Values File...** button.  
A list of predefined Parameter Value XML files provided with the tool is displayed.
- 4 Select a Parameter Value XML file that matches your bus speed type and click **Open**.
- 5 Click **OK** to acknowledge the success message.



All the parameter values are automatically changed to match the bus speed for which the Parameter Value file is selected.

You can view the most recent parameter file that you applied to the loaded test group in the Edit Test Parameters dialog box.



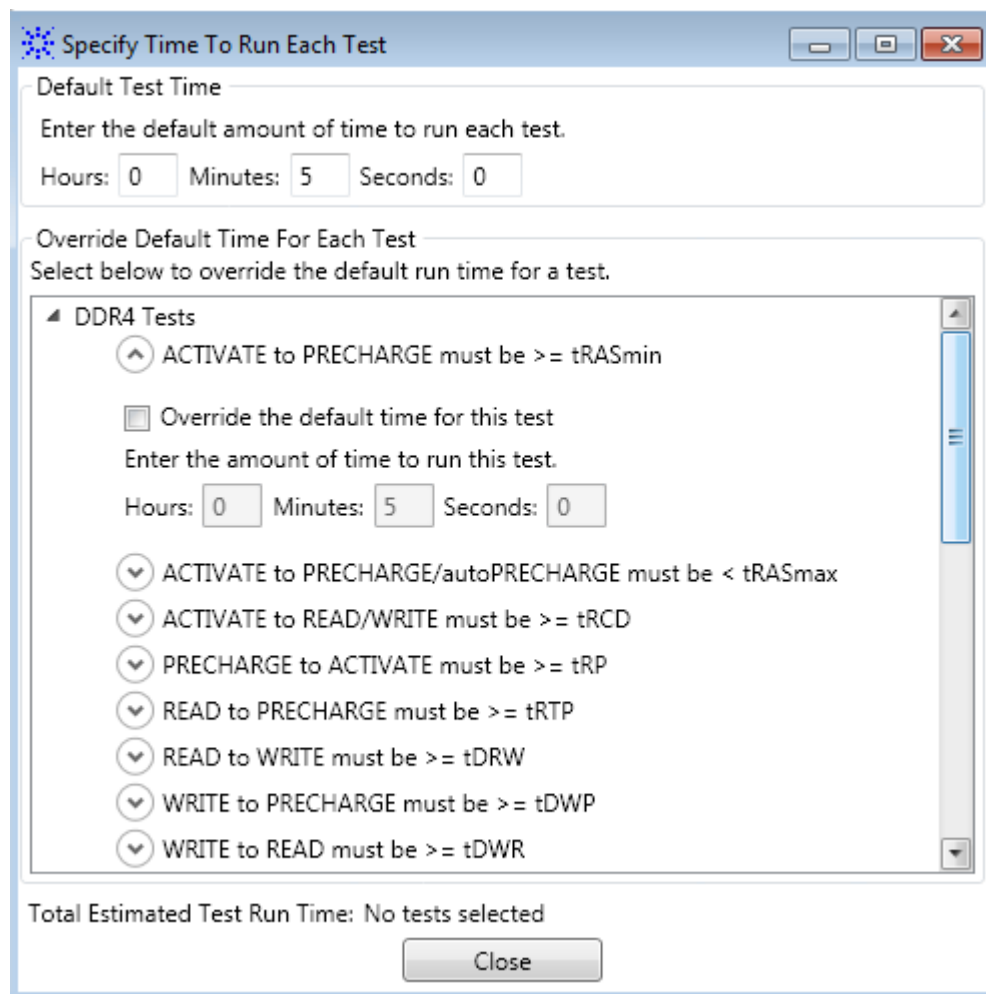


## Specifying Test Execution Time

You can specify the time for which you want the tool to execute a test. The tool then automatically stops the test execution after the expiry of the specified time and continues running the next test in the sequence.

### To specify test execution time

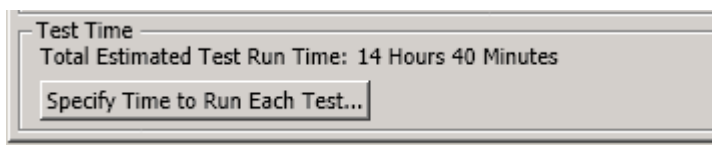
- 1 Click the **Setup** tab in the tool.
- 2 Load the test group for which you want to specify the execution time.
- 3 Click the **Specify Time to Run Each Test...** button.  
The **Specify Time to Run Each Test** dialog box is displayed.



- 4 In the **Default Test Time** section, specify the execution time in hours, minutes, and seconds for which you want a test to be executed. This time is applicable for each test in the loaded test group.

- 5 To run different tests for different length of time, you can override the default execution time for tests. To override the default execution time for a test:
  - a Click the down-arrow button displayed with the test in the Override Default Time for Each Test section.
  - b Select the **Override the default time for this test** checkbox.
  - c Specify the execution time for the test.
- 6 Click **Close**.

Based on the time that you specify, the tool automatically calculates estimated total time for the execution of all the tests that you selected in the Setup tab.

**NOTE**

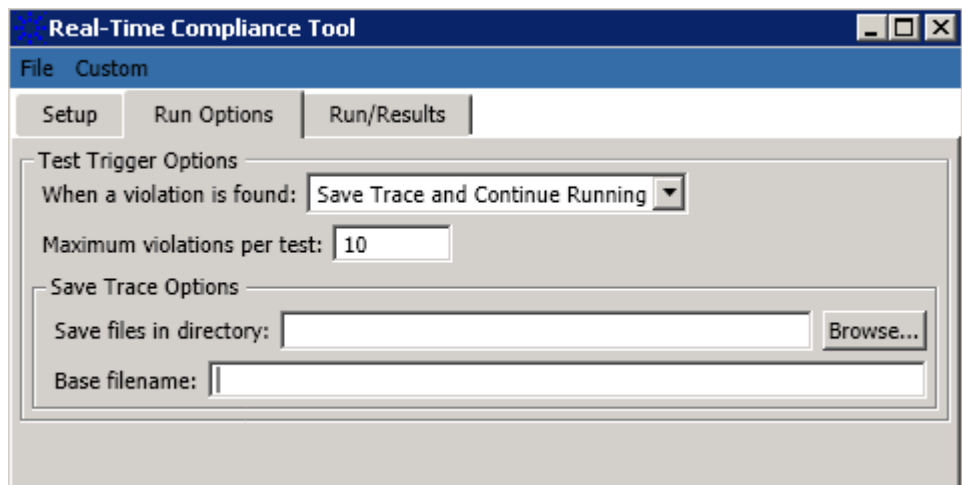
The actual execution time for tests can be less or more than the estimated total time calculated by the tool based on factors such as:

Saving a violation trace during a test run can increase the execution time for the test if the violation is found very close to the end of a test's run time.

If the maximum number of violations are detected for a test, the tool stops running that test even if there is time remaining for the test execution. The test then runs for a shorter amount of time than the specified time.

## Configuring the Tool's Run Options

After loading and configuring the compliance tests that you want to run, you can configure the Real-Time Compliance tool's run options for the actions to be performed on detecting a compliance violation. You use the Run Options tab of the tool to configure these options.



### To configure run options for the tool

- 1 Click the **Run Options** tab in the tool.
- 2 From the **When a violation is found** listbox, select the action to be performed on detecting a violation. Besides reporting a compliance violation in the Run/Results tab, the Real-Time Compliance tool can perform one of the following actions on detecting a compliance violation:
  - Stop running the current as well as remaining tests.
  - Save the violation trace in a Logic Analyzer configuration (.ala) file with a user-specified name and location and continue running tests. Each time a violation is detected, the tool saves the violation trace in a new file with the same base file name that you specified and appends `<n>` to the base file name to avoid overwriting the previously saved trace files. `<n>` represents the violation number. For instance, if you specified the base file name as `DDR3ComplianceViolation`, then the tool saves the first violation trace as `DDR3ComplianceViolation_0.ala` and the next violation trace as `DDR3ComplianceViolation_1.ala`.
  - Continue running tests without saving the captured data in a trace.
- 3 Specify the maximum number of violations that the tool can report for a test. The default value is 10. When the number of violations reported for a test reaches the maximum number allowed per test, the tool stops the execution of that test and continues with running the next test in the sequence. This allows you to control and limit the number of violation traces to be saved when a violation is found repeatedly.
 

After reporting the maximum number of violations for a test, the test execution stops even if there is time remaining for the execution of the test.
- 4 In the **Save files in directory** field, specify the complete path where you want the tool to save violation traces. This field is enabled only when you select the **Save trace and continue running** option from the **When a violation is found** listbox.
- 5 In the **Base filename** field, specify the base file name with which you want the tool to save violation traces as logic analyzer configuration (.ala) files. For a violation trace, the tool appends a violation number (starting with 0) to this base file name to save traces with unique file names.

This field is enabled only when you select the **Save trace and continue running** option from the **When a violation is found** listbox.

# 5 Running the Selected Tests and Viewing Results

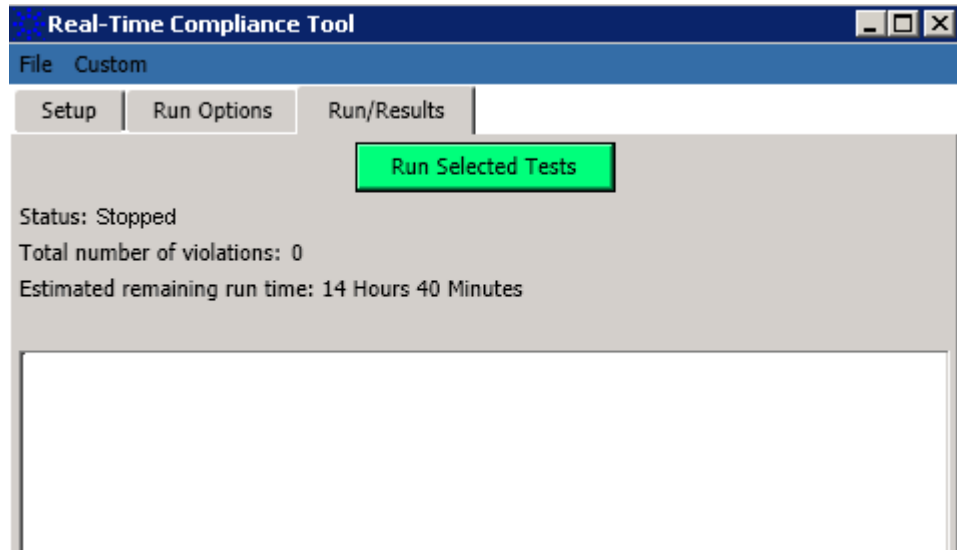
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## Running the Selected Tests

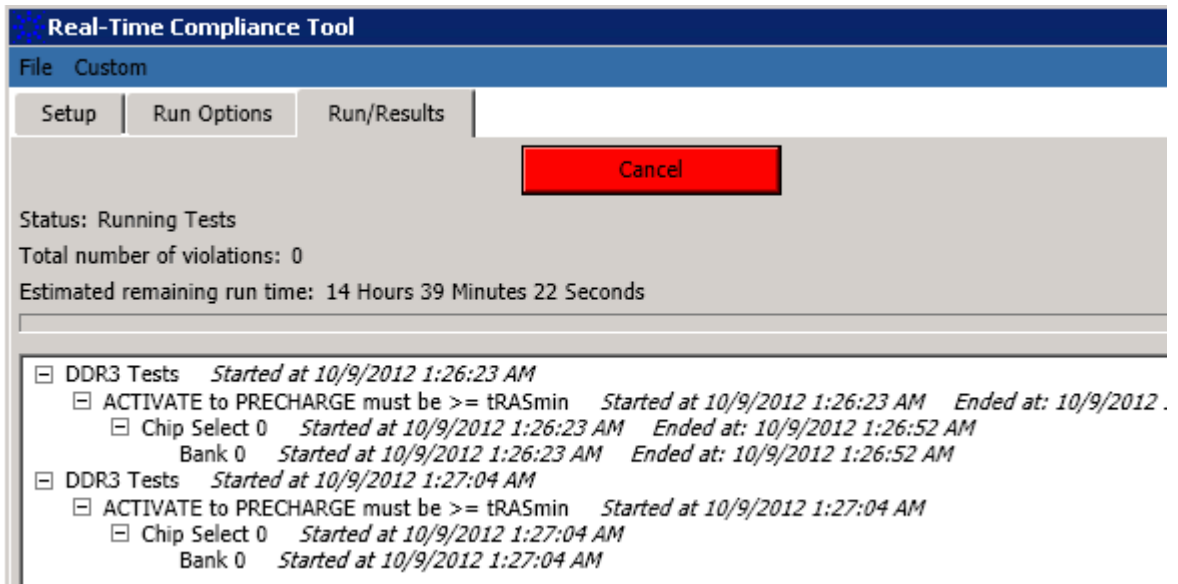
You use the **Run/Results** tab of the Real-Time Compliance tool to run the selected tests as per the options configured in the tool setup.



### To run the selected tests

- 1 Click the **Run/Results** tab of the tool.
- 2 Click the **Run Selected Tests** button.

The tool starts sequential execution of selected tests on the real-time data captured by logic analyzer module.

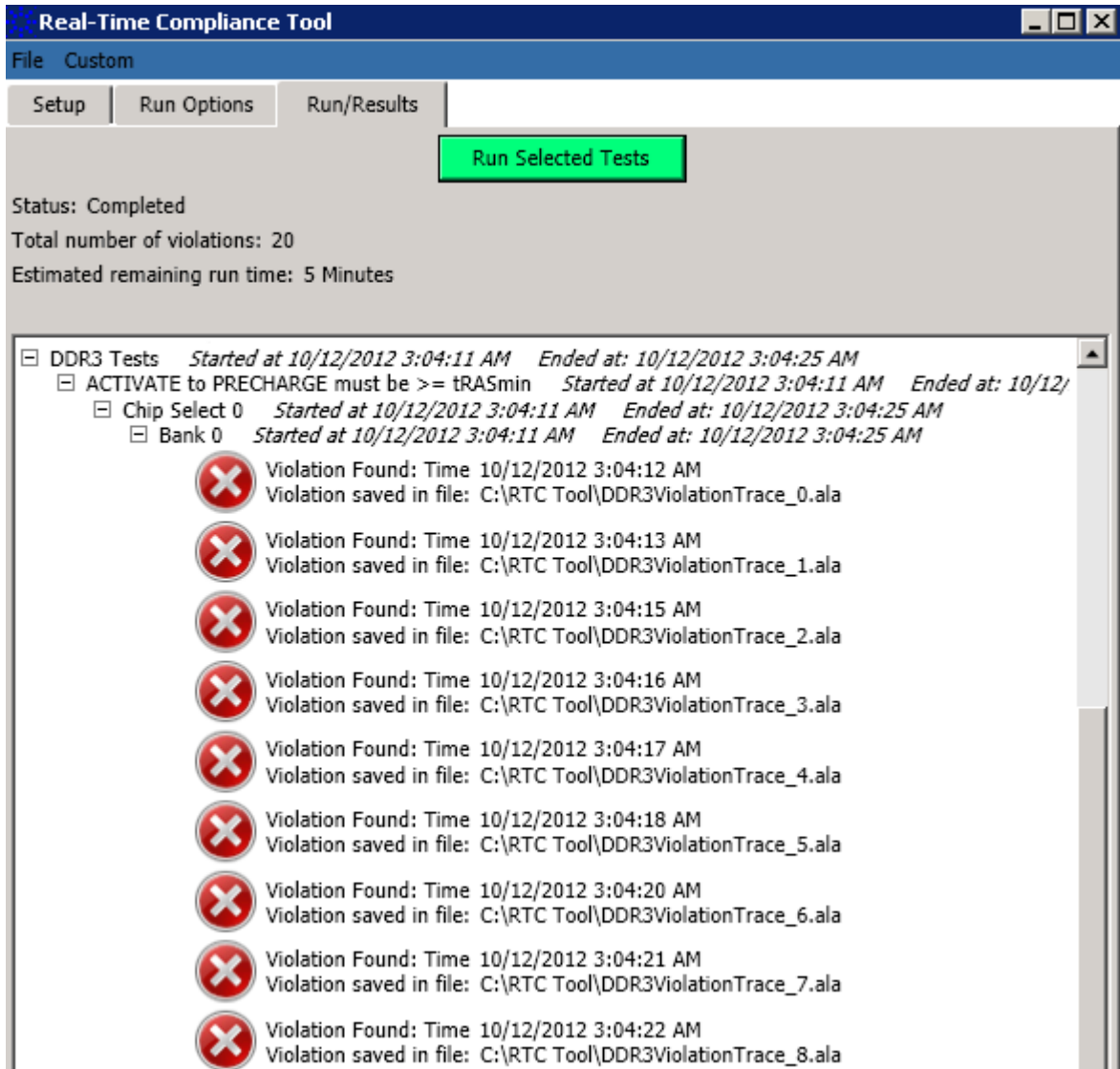


## Stopping the Tool

Once started, the tool executes the selected tests for the time that you specified for test execution and stops automatically after all the tests have been executed for the specified time. To cancel the test run and stop the tool manually, click the **Cancel** button in the Run/Results tab.

## Viewing Results

The tool keeps reporting the test results in the Run/Results tab for each test. In the test results, the test start and end time and the chip select and bank for which it was executed is displayed. On encountering a violation, the tool displays the violation as follows:



### Viewing a Violation Trace

If you have configured the tool to save violation traces, you can open the violation trace .ala file in the Logic and Protocol Analyzer GUI and view the captured data with violation(s) in various viewers.

### Exporting Test Results to a CSV file

You can export the test results displayed in the Run/Results tab to a CSV (Comma Separated Value) file.



**To export test results**

- 1 Click **File > Export Results...** in the Real-Time Compliance tool.
- 2 Browse and specify the path and name for the CSV file in which you want to export results.
- 3 Click **Save**.

**Format of a CSV File**

The format in which tests results are exported is displayed in the first line of the exported CSV file.

```
Agilent Real-Time Compliance Tool Test Results
Start Time,10/11/2012 2:06:49 AM
End Time,10/11/2012 2:06:58 AM
Total Number of Violations,2
Full Test Name,Start Time,End Time,Number of Violations,Violation Time,Violation
DDR4 Tests\ACTIVATE to PRECHARGE must be >= tRASmin\Chip Select 0/Bank Group 0\B
DDR4 Tests\ACTIVATE to PRECHARGE must be >= tRASmin\Chip Select 0/Bank Group 0\B
DDR4 Tests\ACTIVATE to PRECHARGE must be >= tRASmin\Chip Select 0/Bank Group 0\B
DDR4 Tests\ACTIVATE to PRECHARGE must be >= tRASmin\Chip Select 0/Bank Group 0\B
```



# 6 Saving the Real-Time Compliance Tool Setup

You can save the Real-Time Compliance tool's setup in a XML file. Saving the setup saves the settings that you configured in Setup and Run Options tabs of the tool as well as the test results displayed in the Run/Results tab. Once saved, the test environment is available for future use by loading the saved XML file.

### To save tool's setup

- 1 Click **File > Save Setup...** in the Real-Time Compliance tool.
- 2 Browse to the location where you want to save the setup XML file.
- 3 Specify a name for the XML file and click **Save**.

All the current settings displayed in the tool are saved in the specified XML file.

### To load a previously saved setup

- 1 Click **File > Load Setup...** in the Real-Time Compliance tool.
- 2 Browse to the location of the XML file in which the required setup is saved.
- 3 Select the XML file and click **Open**.

All the settings and any test results saved in the selected XML file are displayed in the tool.



# 7 Creating Your Own Compliance Tests/Test Groups

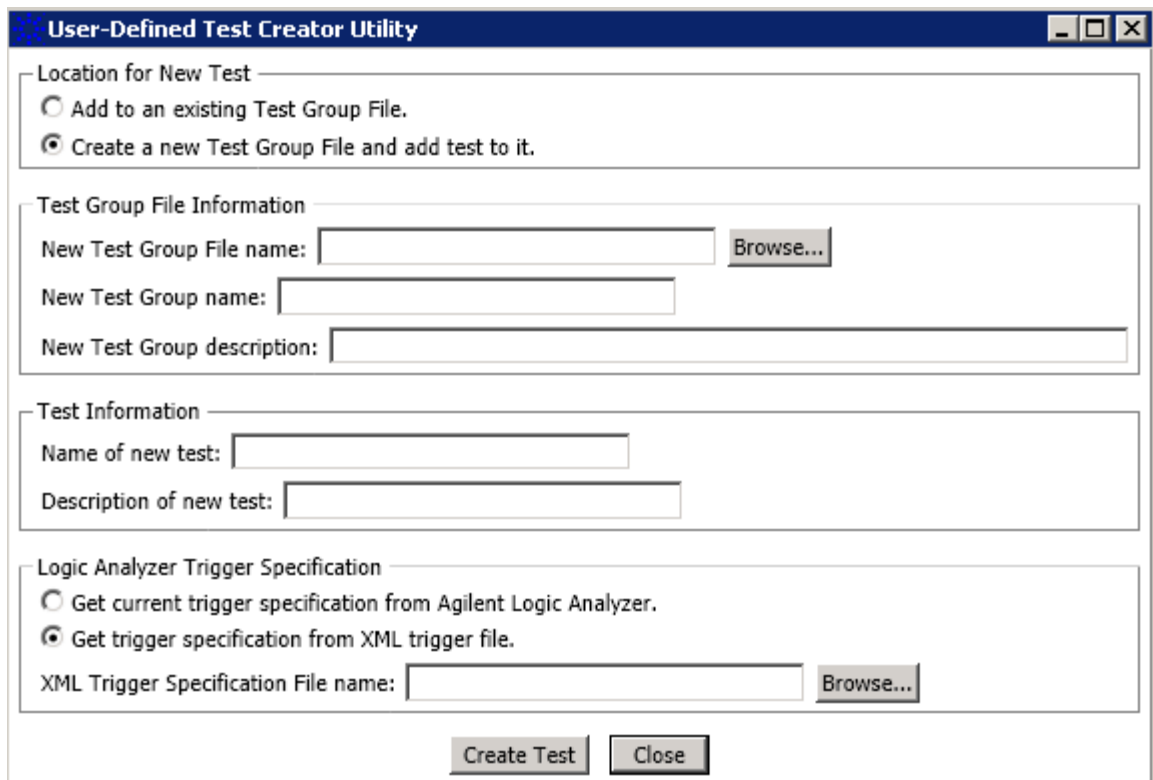
Besides running the compliance tests provided with the tool, you can create your own specific tests and run these tests using the tool.

You can:

- create a new test group XML file and create new test(s) within this test group.
- create new test(s) and add these to an existing test group XML file

### To create user-defined tests and test groups

- 1 Click **Custom > User-Defined Test Utility...** in the Real-Time Compliance tool.  
The **User-Defined Test Creator Utility** is displayed.



The screenshot shows the 'User-Defined Test Creator Utility' dialog box. It is divided into four main sections:

- Location for New Test:** Contains two radio buttons. The first is 'Add to an existing Test Group File.' and the second is 'Create a new Test Group File and add test to it.' The second option is selected.
- Test Group File Information:** Contains three text input fields: 'New Test Group File name:' (with a 'Browse...' button), 'New Test Group name:', and 'New Test Group description:'.
- Test Information:** Contains two text input fields: 'Name of new test:' and 'Description of new test:'.
- Logic Analyzer Trigger Specification:** Contains two radio buttons. The first is 'Get current trigger specification from Agilent Logic Analyzer.' and the second is 'Get trigger specification from XML trigger file.' The second option is selected. Below the radio buttons is a text input field for 'XML Trigger Specification File name:' (with a 'Browse...' button).

At the bottom of the dialog box are two buttons: 'Create Test' and 'Close'.

- 2 In the **Location for New Test** section, select where you want to create the test - in a new or an existing test group XML file.
- 3 If you selected to create the test in a new test group file, specify the details of this new XML file. These test group details will be displayed in the tool when you later load the test group.
- 4 If you selected to create the test in an existing test group file, browse and select the XML file.

- 5 In the **Test Information** section, specify the name and description for the new test. The test will be displayed with this name in the tool when you later load it.
- 6 Select the source from which trigger specifications will be taken for the new test to trigger the Logic Analyzer module.
  - Select **Get current trigger specification from Keysight Logic Analyzer** to use the trigger specifications specified for the logic analyzer module currently used for capturing data on which tests are run.
  - Select **Get trigger specification from XML trigger file** to use the trigger specifications specified in a previously saved Logic Analyzer trigger specification XML file. To know how to save a trigger sequence setup of a logic analyzer module in a XML trigger file, refer to the topic “*To store a trigger*” in the Logic and Protocol Analyzer Online Help.
- 7 Specify the name and location of the XML trigger specification file if you selected the **Get trigger specification from XML trigger file** option.
- 8 Click **Create Test**.
- 9 Click **OK** to acknowledge the test creation.

The tool creates the new test in the specified XML file. If required, you can further customize it by editing the XML file directly.

Once created, you can load and run the new test in the tool in the same way as any other predefined test.

# 8 Troubleshooting Error Messages

## **Problem: Trigger specifications for a test not understood by Logic Analyzer**

### **Description**

While running a compliance test in the Real-Time Compliance tool, the Run/Results tab may display an error message that the trigger specification for the test was not understood by Logic Analyzer.

### **Causes and Solution**

The trigger specifications specified in the test's XML file are used to set the trigger specifications for the Logic Analyzer module based on which the tool runs the test on captured data. At times, the trigger specification from the XML file is not understood by Logic Analyzer because of one of the following reasons:

- For a predefined test shipped with the tool, the trigger specification is predefined. For such a test, the cause of error can be:
  - The test refers to a bus or a signal that does not exist in your current setup. In such a situation, verify that the test is appropriate for your current setup and probing solution. The most common occurrences of this problem is when either the CS# or CKE busses are not wide enough. For instance, you may run a test for chip select 3 when there are only 2 chip select or clock enable signals resulting in an error displayed for chip Select 3.
  - An incorrect value provided while manually overriding the default value of a test parameter in the Edit Test Parameters dialog. For instance, a non-numeric value provided for a parameter that requires a numeric value.
- For a user-defined test, review the trigger specification that you specified for the test in its XML file in addition to checking the above-mentioned possible causes.





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