DDR Post Process Compliance Tool

User's Guide

KEYSIGHT TECHNOLOGIES

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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 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.

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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.

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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 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)
	Standby (mains supply). The instrument is not completely disconnected from the mains supply when the power switch is in the standby 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.
	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.

DDR Post Process Compliance—At a Glance

The DDR Post Process Compliance tool evaluates the captured DDR/LPDDR data against a set of user-defined limits to help you validate that a memory system is operating properly. The bus types supported by this tool are:

With B4622A license

- DDR1/2/3

- LPDDR1/2

With B4622B upgrade license

- DDR1/2/3/4

- LPDDR1/2/3

The automated test application guides you through the process of selecting and configuring tests, running tests, and evaluating the test results.

The application assumes that the Keysight logic analysis system has already been set up to properly capture DDR data.

To use the automated test application, see:

Contents

1
About the Tool

Overview of the tests

There are two types of tests:

- Tests which check for timing violations
- Tests which check for illegal DDR state transitions

The test limits can be (and must be) configured by the user.

The provided timing violation tests include:

Table 3 Timing violation tests

Parameter	Description	Test
$tRAS_{max}$	Row Active time ACTIVATE to PRECHARGE/Auto-PRECHARGE	must be < tRASmax
$tRAS_{min}$	Row Active time ACTIVATE to PRECHARGE/Auto-PRECHARGE	must be > tRASmin
tRP	PRECHARGE to any other command (same bank)	must be > tRP
tCCD	Time between any read or write command	must be > tCCD
tRRD	ACTIVATE to ACTIVATE (any bank)	must be >= tRRD
tFAW	Time for four ACTIVATEs (any bank)	must be >= tFAW
tRFC	REFRESH to REFRESH or ACTIVATE	must be > tRFC
tDARW	ACTIVATE to external READ/WRITE	must be > tDARW
tDRP	Read to Precharge/AutoPrecharge	must be > tDRP
tDRW	Read to Write	must be > tDRW
tDWP	Write to Precharge/AutoPrecharge	must be > tDWP
tDWR	Write to Read	must be > tDWR

Table 4 State machine violation tests

Description
READ or WRITE to an inactive row
REFRESH to an active bank
ACTIVATE to an active bank

Compatibility

The DDR Post Process Compliance tool works for most DDR, DDR2, DDR3, DDR4, LPDDR, LPDDR2, and LPDDR3 systems.

The tool is not able to fully model systems which use the following optional DDR features:

- Partial Array Self-Refresh (PASR)
- Auto Self-Refresh (ASR)
- On-the-fly Burst Length switching

About the software

The DDR Post Process Compliance tool is part of the Keysight B4622B Protocol Compliance and Analysis Toolset package.

The application uses the same software framework which is used by Keysight Infiniium oscilloscopes.

2
What's New

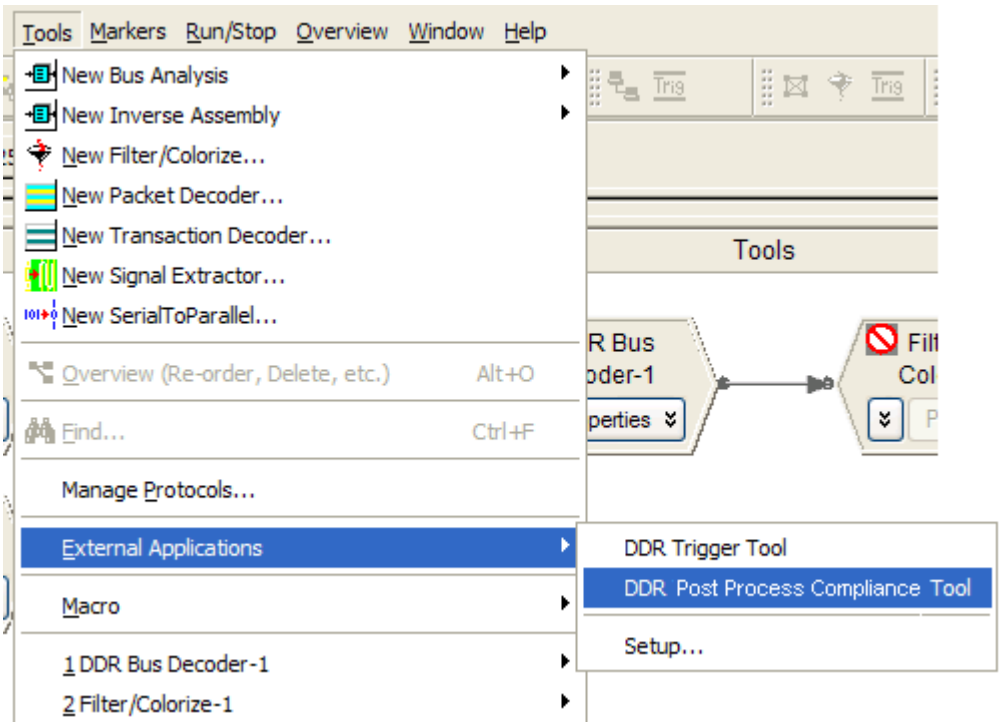
With this release, the tool supports DDR, DDR2, DDR3, DDR4, LPDDR, LPDDR2, and LPDDR3. Several new tests have been added for DDR3/4 and LPDDR2/3.

The DDR4 and LPDDR3 support is available only with the upgrade license - B4622B of the tool.

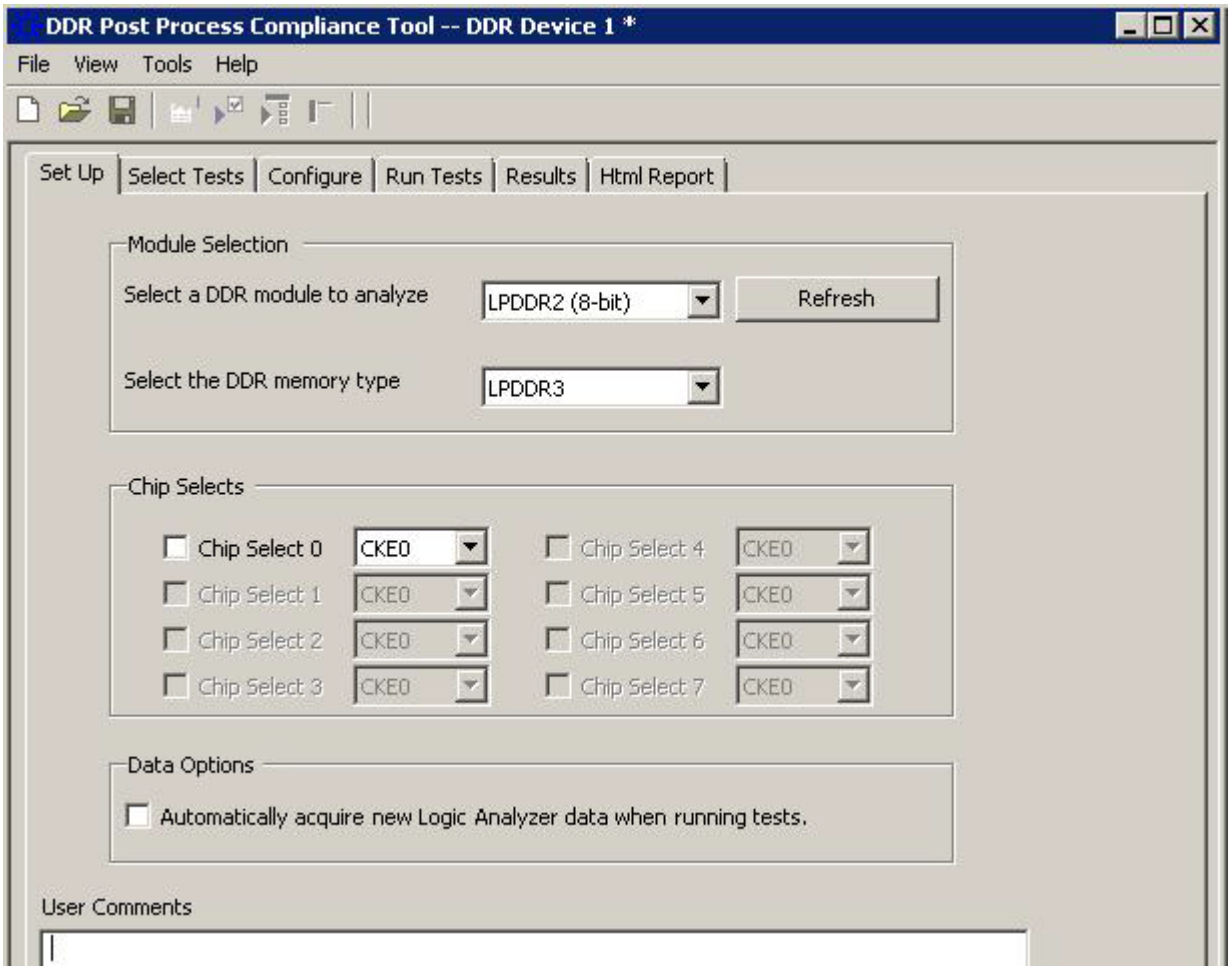
2 What's New

3
Starting the DDR Post Process Compliance Tool

1 From the logic analysis system's main menu, choose **Tools>External Applications>DDR Post Process Compliance Tool**.



The DDR Post Process Compliance tool window appears.



See Also · "To view/hide the toolbar" on page 17

Next · "Creating or Opening a Test Project" on page 53

To view/hide the toolbar

- To toggle between a hidden and visible toolbar, choose **View>Toolbar** from the menu.

3 Starting the DDR Post Process Compliance Tool

4
Configuring Tests

You must configure a set of limits before you can run any tests.

These limits describe the memory part you are using and certain characteristics of the memory bus.

You can load, edit, and save limits from the **Tools>Compliance limits** menu.

See Also

- "To set the test limits" on page 20 (for information on how to calculate the limits)
- "To create/edit limit sets" on page 25 (for information on how to enter and save the limits)
- "To activate/refresh limit sets" on page 29 (for information on how to load a limit set which you have saved)

To set the test limits

All timing violation tests are based on compliance limits that are specified by the user. Specify these limits based on the specific DDR memory parts you are using. Limits will vary depending on:

- Memory technology (DDR2, DDR3)
- Speed grade
- Clock speed
- Part density
- User selected options such as Additive Latency and burst length

Units

Some times must be entered in seconds (s). If the data sheet expresses these limits in terms of clock cycles, you will need to convert those limits to seconds.

Each logic analyzer sample has a timestamp. Results will be calculated by subtracting the time stamp of the first event from the timestamp of the second event. Note that the time stamps are only as good as the time stamp resolution of the logic analyzer card being used (this resolution may be as coarse as 2ns; see the Specifications and Characteristics in the logic analyzer's online help for details). The elapsed time includes time during which the DDR clock is inactive.

Other times must be entered as a number of clock cycles (CK). Results will be calculated by counting the number of logic analyzer samples between the two events.

Additive latency (AL) is normally expressed as a number of clocks (CK). For some calculations, you will need to convert AL to seconds (s) by dividing by the clock rate.

Burst length (BL) is simply an integer (4 or 8).

Definitions of the limits

You will need to look up some of the limits from the part data sheet. You will then calculate values for the derived limits.

Keysight suggests using the formulas here to compute the derived limits. However, it is entirely the responsibility of the user to choose limits that are appropriate for the intended application.

Here are the limits you need to specify:

Table 5 Limits used by the tests

Parameter	Description	Unit	Suggested Definition	Reference
tRAS$_{max}$	Row Active time ACTIVE to PRECHARGE	s	Part dependent (9 * tREFI)	Data Sheet (tREFI). See DDR3 (see page 25) page 147.
tRAS$_{min}$	Row Active time ACTIVE to PRECHARGE	s	Part dependent	Data Sheet
tDARW	Min ACT to external READ/WRITE	s	tRCD-AL	DDR2 (see page 24) 3.5 / DDR3 (see page 25) 12.3
tRP	Row Precharge time min PRECHARGE to any other command (same bank)	s	Part dependent	Data Sheet
tDRP	Min Read to Precharge	CK	DDR2: AL + BL/2 + max (tRTP, 2CK) -2CK DDR3: AL + tRTP	DDR2 (see page 24) 3.7.1 / DDR3 (see page 25) 4.13.3
tDRW	Min Read to Write	CK	DDR2: BL/2 + 2CK DDR3: BL4: RL + CCD/2 + 2CK – WL DDR3: BL8: RL + CCD + 2CK - WL	DDR2 (see page 24) figure 35 / DDR3 (see page 25) figure 35, 36
tRFC	REFRESH command time. min time REFRESH to REFRESH or ACTIVATE	s	Part dependent	Data Sheet
tDWP	Min Write to Precharge	CK	WL + BL/2 + tWR	DDR2 (see page 24) 3.7.2 / DDR3 (see page 25) Figure 49, 50
tDWR	Min Write to Read	CK	DDR2: CL -1 + BL/2 + tWTR DDR3: WL + BL/2 + tWTR	DDR2 (see page 24) Figure 41 / DDR3 (see page 25) Figure 53, 56
tCCD	CAS to CAS delay min time between any read or write command	CK	Part dependent	Data Sheet

Table 5 Limits used by the tests (continued)

Parameter	Description	Unit	Suggested Definition	Reference
tRRD	Min time between two ACTIVATE commans (different banks)	s	Part dependent	Data Sheet
tFAW	Min time for four ACTIVATE commands (different banks)	s	Part dependent	Data Sheet

Values used to calculate the limits

To calculate the limits, you will need to look up or calculate the following values:

Table 6 Values used to calculate the limits

Parameter	Description	Unit	Suggested Definition	Reference
AL	Additive Latency	CK, s	User selection	System Design
BL	Burst Length		User selection	System Design
CL	CAS (Read) Latency	CK	Part dependent	Data Sheet
CWL	CAS Write Latency	CK	Part dependent	Data Sheet
RL	Read Latency	CK	AL + CL	DDR3 (see page 25) 3.4.3.4
WL	Write latency	CK	AL + CWL	DDR3 (see page 25) 3.4.3.4
tRCD	RAS to CAS Delay (ACT to internal R/W)	s	Part dependent	Data Sheet
tREFI	Refresh Interval; average time between Refresh commands	s	Part dependent	Data Sheet
tRTP	Internal Read to Precharge	s	Part dependent (max 4CK or 7.5ns)	Data Sheet

Table 6 Values used to calculate the limits (continued)

Parameter	Description	Unit	Suggested Definition	Reference
tWR	Internal Write Recovery	s	Part dependent	Data Sheet
tWTR	Internal Write to internal Read	s	Part dependent (max 4CK or 7.5ns)	Data Sheet

External Read/Write + AL = Internal Read/Write

Naming conventions

Limits which are normally expressed as maximum or minimum times have names beginning with 't'.

The names of derived timing limits begin with 'tD'. Derived limits are not usually specified directly in the part data sheet. In general, you will compute these from the standard timing parameters.

Limits which are normally expressed as a number of clock cycles have no prefix. In some cases, you may need to convert these to seconds for use by the tool.

Customizing the limits

The definitions are suggestions based on the DDR2/3 standards. There is no requirement that the user must set the limits to those specified in the data sheet or in the JEDEC standard. You can set the limits however you like, depending on the goals of your testing.

Example limits

An example limit set is supplied with the validation tool. The example is based on a DDR800 part with 6-6-6 timing.

To load and view the example limits, select **Tools>Compliance Limits>Create/Edit Limit Set**, then select **Load Limit Set...**, select **Official limit sets**, then select **DDR Example**.

Example part:

- Data sheet: MICRON DDR3 MT41J256-32 Me x 4 x 8 Banks PDF: 09005aef82f1e6e2 Rev. M 9/08 EN
- Speed Grade 25 (6-6-6)
- Clock 400 MHz (2.5ns)
- Data Rate 800 MT/s
- Temperature 0-85C

Table 7 Standard parameters used for example limit set

Parameter	Value	Reference
tREFI	7.8 us (low temp)	Data Sheet, page 71
$tRAS_{max}$	70.2us	Data Sheet (tREFI), page 63
$tRAS_{min}$	37.5ns	Data Sheet, page 30
tRP	15ns	Data Sheet, page 30
tCCD	4CK (10ns)	Data Sheet, page 70
tRRD	10ns	Data Sheet, page 30
tFAW	50ns	Data Sheet, page 30
tRFC	110ns	Data Sheet, page 30
tRCD	15ns	Data Sheet, page 30
tRTP	10ns	Data Sheet, page 70
tWR	15ns	Data Sheet, page 70
tWTR	10ns	Data Sheet, page 70
AL	0ns (0CK)	User selected (MR1, 0 means no additive latency)
BL	10ns (8 bursts)	User selected (MR0)
CL	6CK (15ns)	Data Sheet, page 30 (MR0)
CWL	5CK (12.5ns)	Data Sheet, page 116 (MR2)

Table 8 Derived values used for example limit set

Parameter	Value
RL	6CK (15ns)
WL	5CK (12.5ns)
tDARW	15ns
tDRP	10ns
tDRW	17.5ns
tDWP	32.5ns
tDWR	27.5ns

References

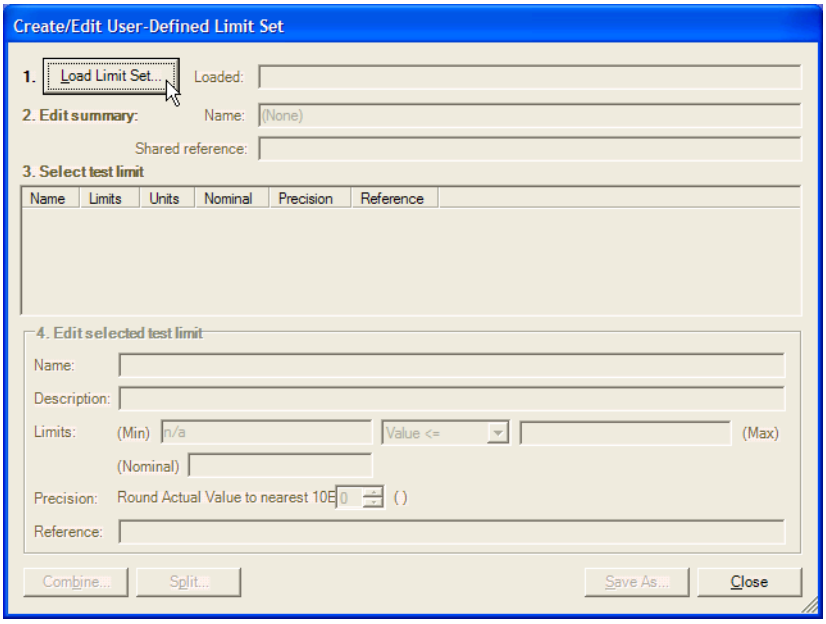
- DDR2 JEDEC Standard 79-2E, April 2008
- DDR3 JEDEC Standard 79-3C, November 2008

To create/edit limit sets

You can create new limit sets by modifying existing limit sets and saving them to new files.

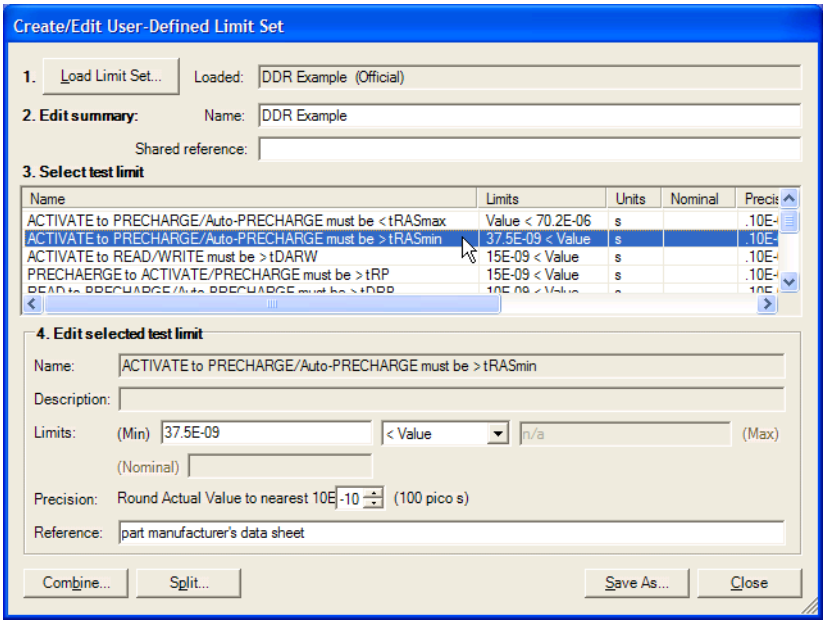
1 From the DDR Post Process Compliance tool's menu, choose **Tools>Compliance limits>Create/Edit limit set...**.

2 In the Create/Edit User-Defined Limit Set dialog, click **Load Limit Set...** to pre-load the dialog with the supplied example limit set (or a user-defined limit set).



3 Give the new limit set a unique name. If all of the tests come from the same reference, you can enter a base description (for example, document name) in the **Shared Reference** field and then add test-specific references (for example, page number) down below.

4 Select a limit to modify.



5 Modify the limit as desired. See also:

- "To split a combined limit" on page 26
- "To combine limits" on page 27

6 Repeat the last two steps until all limits requiring change are modified.

7 Click **Save As...** to save your custom limit set to a file. Enter the file name in the Save File As dialog.

- Now, you can activate your newly-created limit set for use in the next run. See "To activate/refresh limit sets" on page 29.

When Loading Projects

When you load a project, the application will attempt to restore the limit set that was in use at the time the project was saved.

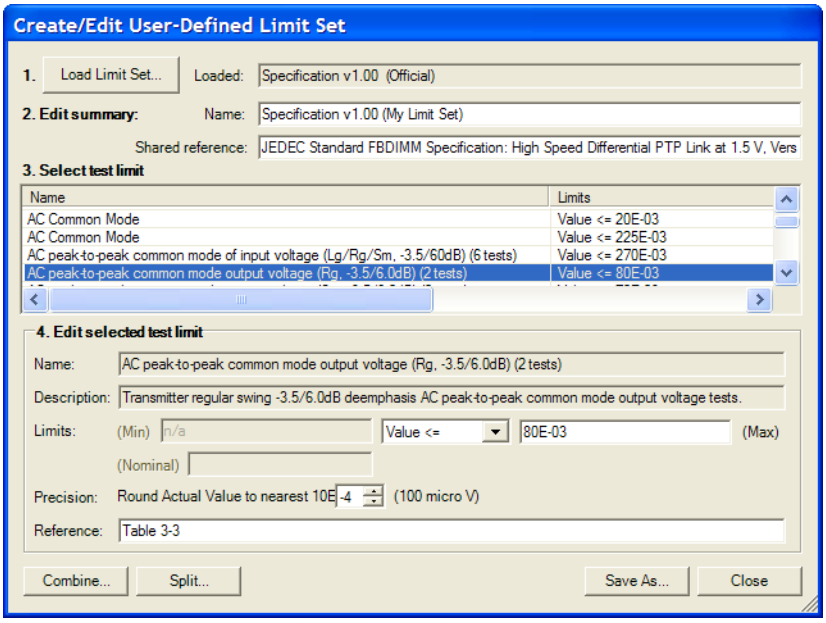
See Also

- "To set the test limits" on page 20 (for information on how to calculate the limits)

To split a combined limit

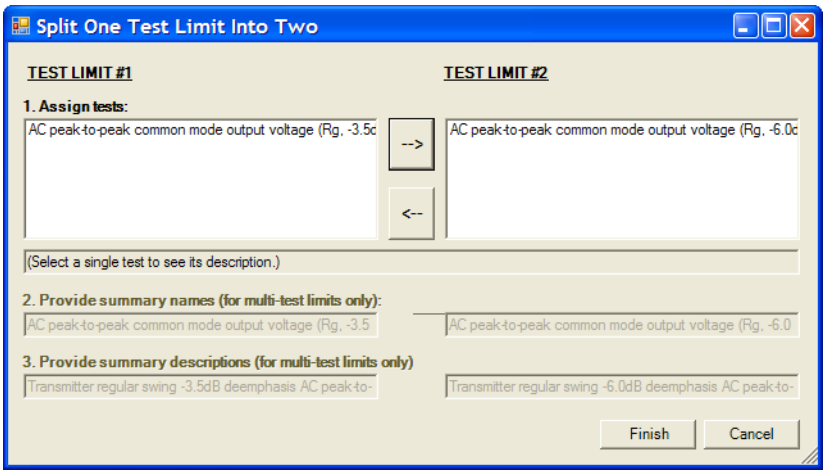
If a limit covers more than one test ID, you can split it into two limits.

- In the Create/Edit User-Defined Limit Set dialog (see "To create/edit limit sets" on page 25), select the limit that covers multiple tests, and click **Split...**.



In this case, we are splitting a 2-test limit into two single-test limits.

8 In the Split Test Limit dialog, assign one of the tests to the new limit by selecting it and clicking the --> button.



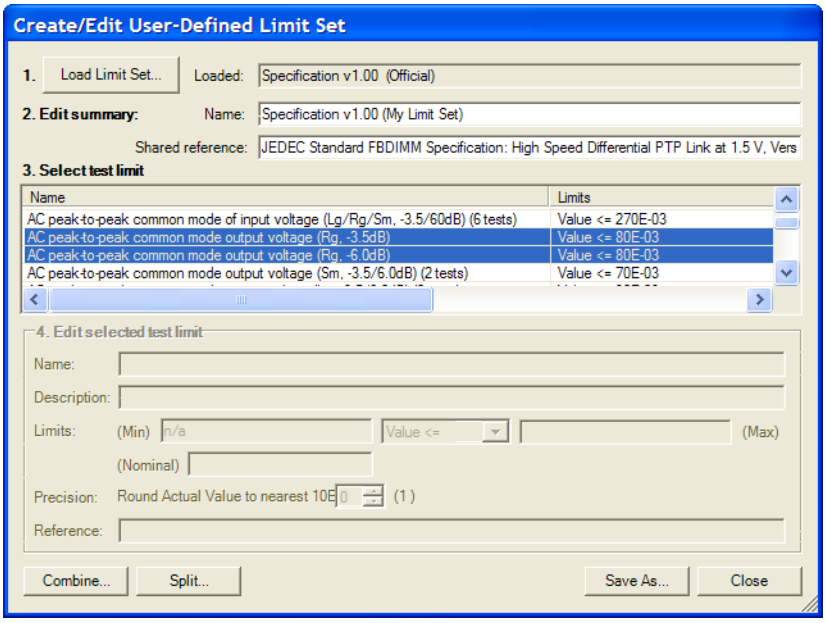
9 Click **Finish**.

See Also

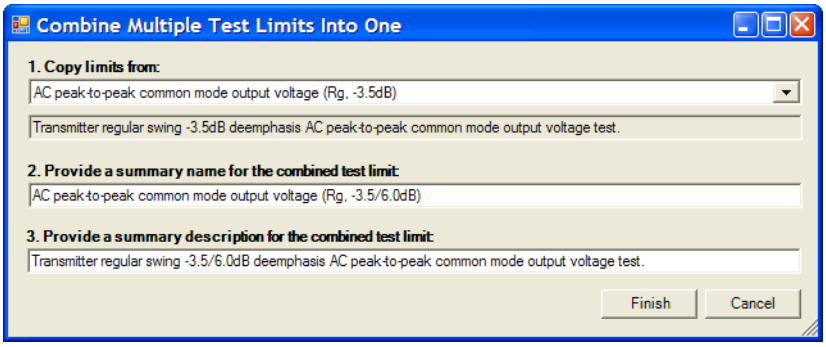
- "To combine limits" on page 27

To combine limits

- In the Create/Edit User-Defined Limit Set dialog (see "To create/edit limit sets" on page 25), select the limits you want to combine, and click **Combine...**.



10 In the Combine Multiple Test Limits dialog, select which limit to copy values from and provide summary names and descriptions.



11 Click **Finish**.

See Also

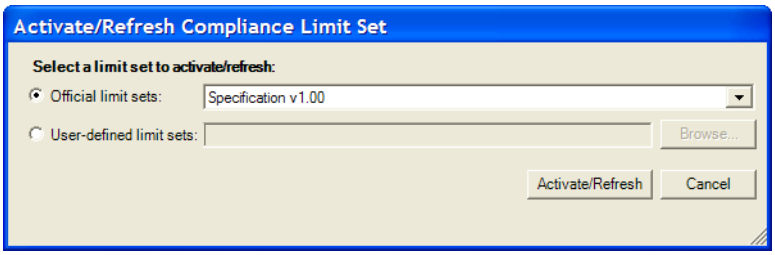
- "To split a combined limit" on page 26

To activate/refresh limit sets

To load a previously defined limit set:

1 From the DDR Post Process Compliance tool's menu, choose **Tools>Compliance limits>Activate/Refresh limit set...**.

2 In the Activate/Refresh Compliance Limit Set dialog, select one of the official limit sets or a user-defined limit set.



3 Click **Activate/Refresh**.

NOTE If you have existing test results when you activate a different limit set, the application examines your results to see if any of them would experience a limit change when the different limit set is loaded. If any results would be affected in this way, the application tells you which ones they are and warns that they must be deleted.

See Also

- "To combine limits" on page 27

4 Configuring Tests

5
Setting Up the Test Environment

1 Click the **Set Up** tab.

2 If more than one DDR bus decoder exists in the logic analysis system setup, select which one to use for the compliance tests from the **Select a DDR module to analyze** listbox.

If only one decoder exists, it will be selected automatically.

If needed, click **Refresh** to update the list. You may need to refresh the list and select a new decoder if you load a new logic analyzer configuration file, or whenever you add or remove a decoder.

3 Select the DDR memory type. The DDR Post Process Compliance tool can work with any of the following memory bus standards (depending on which license of the B4622 software is installed).

With B4622A license -

- DDR1/2/3

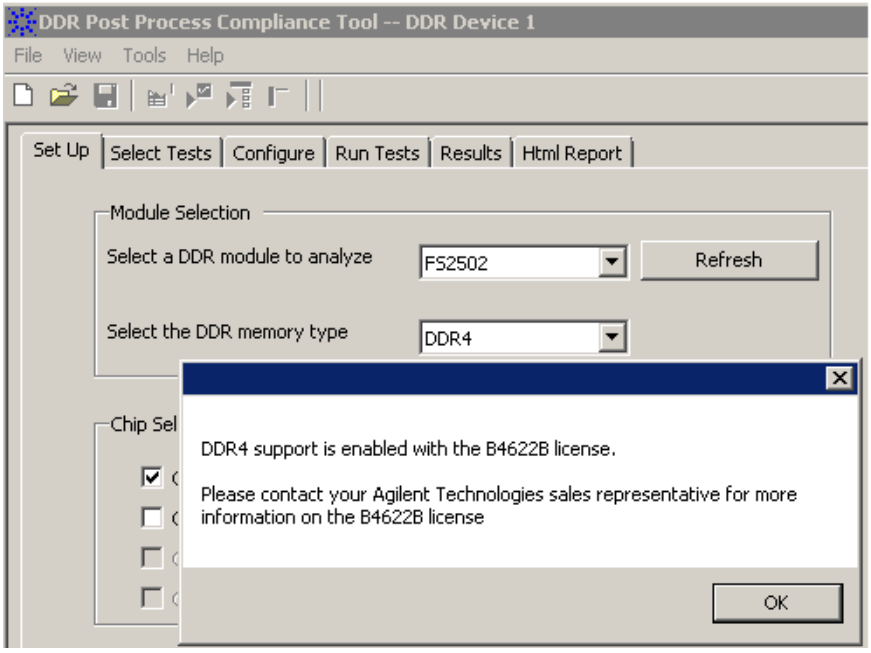
- LPDDR1/2

With B4622B upgrade license -

- DDR1/2/3/4

- LPDDR1/2/3

License Error - If you have only the B4622A license and you try to select DDR4 or LPDDR3 as the DDR memory type in the DDR Post Process Compliance tool, the following error messages are displayed.

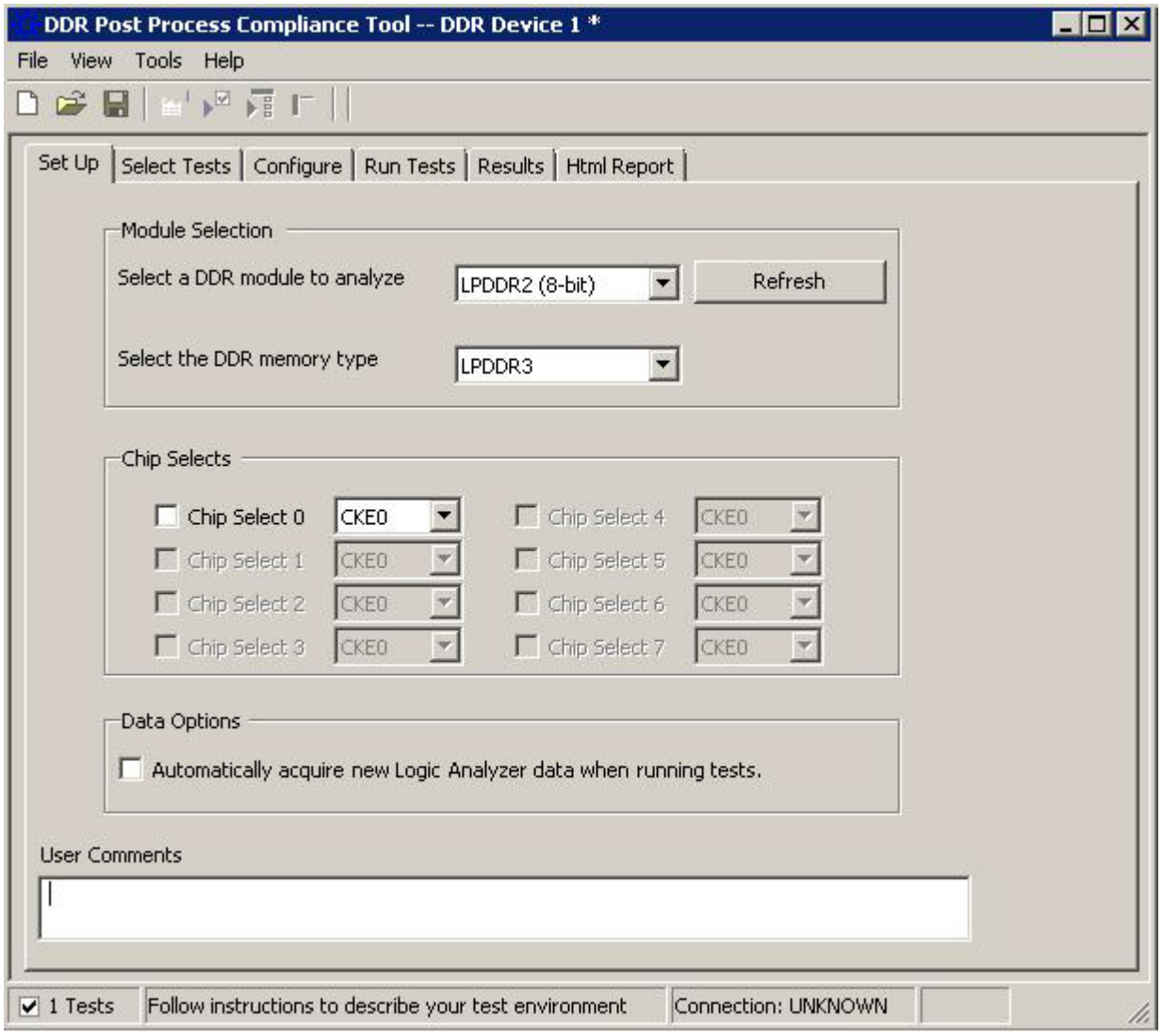


To get DDR4 and LPDDR3 support, you must purchase the B4622B license.

4 From the **Data Options** section, select whether or not you want the tool to automatically acquire new data when compliance tests are run. Whether you plan to run tests once or multiple times, the selection of this checkbox instructs the tool to first run the logic analyzer for data acquisition. When the data acquisition run is complete, the tool starts post processing the newly acquired data by running the selected tests. If you plan to run the tests multiple times or forever, then you must select this checkbox to ensure that the tool runs the logic analyzer repetitively for data acquisition and then acquires the new data automatically for post processing.

   Deselecting this checkbox instructs the tool to use the already acquired data for post processing. The tool does not run the logic analyzer for data acquisition in this case. Therefore, when you deselect this checkbox, you can run the tests only once on existing data.

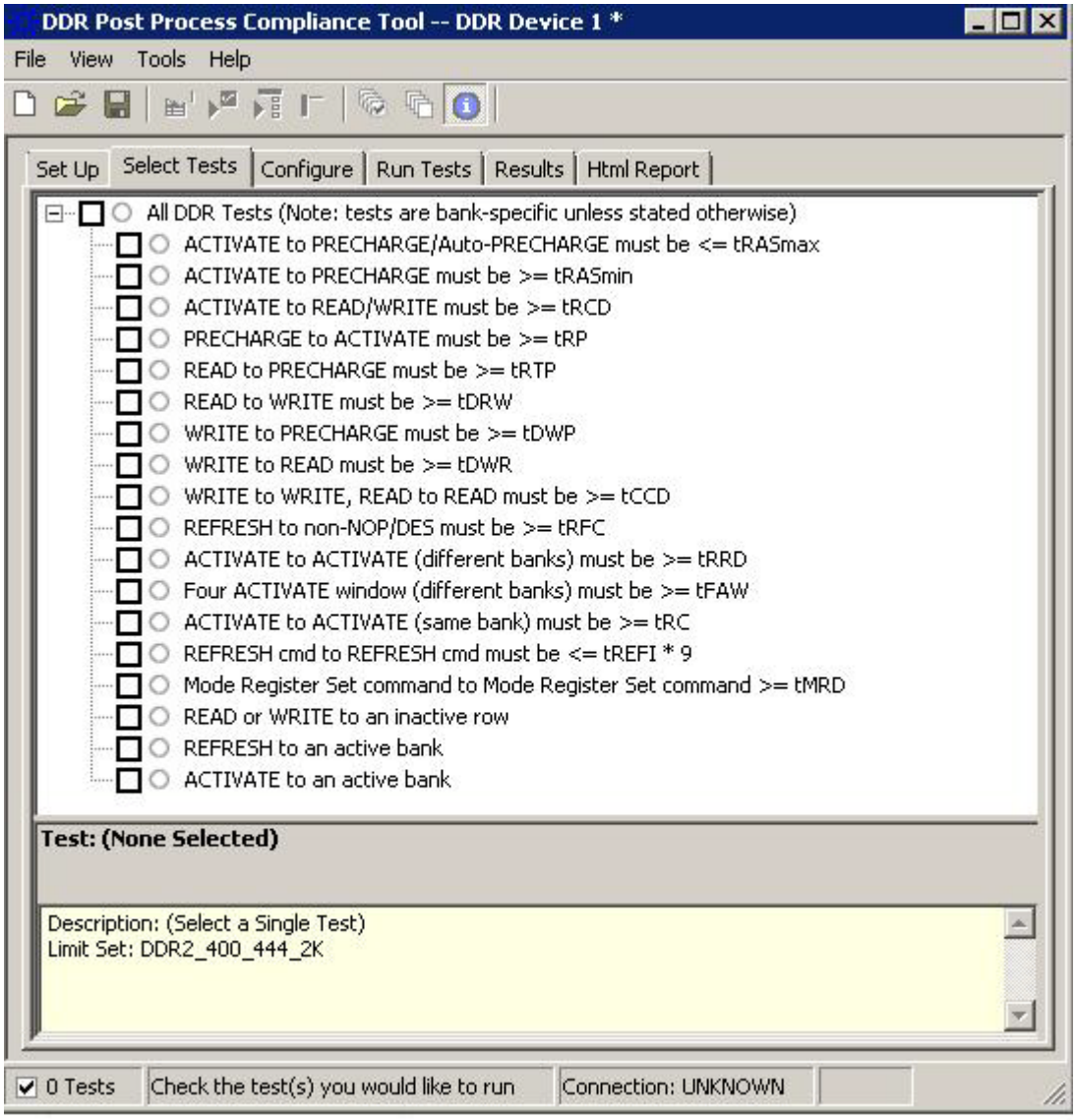
5 (optional) Describe the test for future reference. The specified **User Comments** will appear on the HTML report which is generated for the test.



Next · "Selecting Tests" on page 35

5 Setting Up the Test Environment

6
Selecting Tests



1 Click the **Select Tests** tab and then select the tests you want to run.

The tests displayed in this tab vary depending on the memory bus type that you selected in the Set Up tab and the type of software license installed for the B4622 toolset. (The DDR Post Process Compliance tool is a part of this toolset.)

There are two license versions available for B4622 - B4622A and B4622B. With B4622B, you get additional tests for each memory bus type as well as tests for DDR4 and LPDDR3 (which are not available with B4622A license). The following table lists the tests available for memory bus types with each of these two licenses.

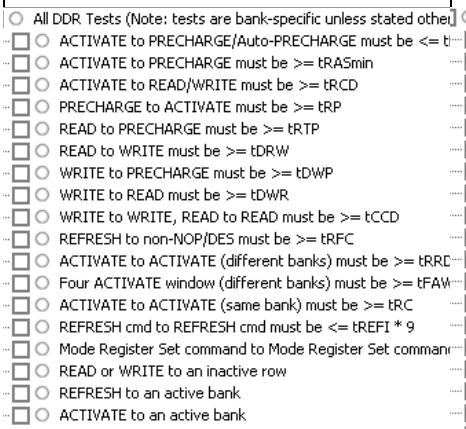
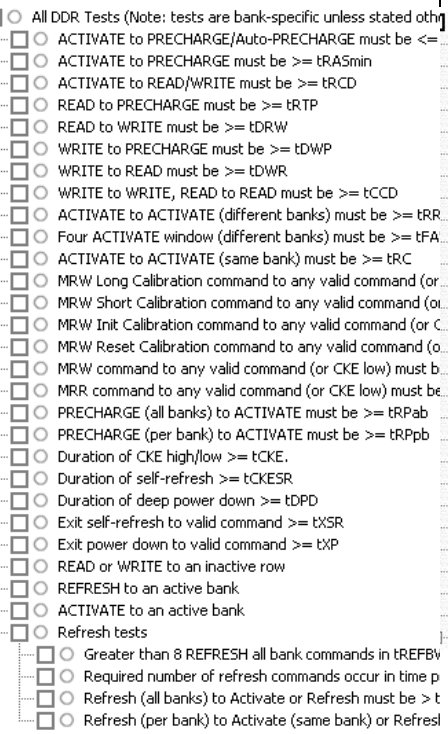
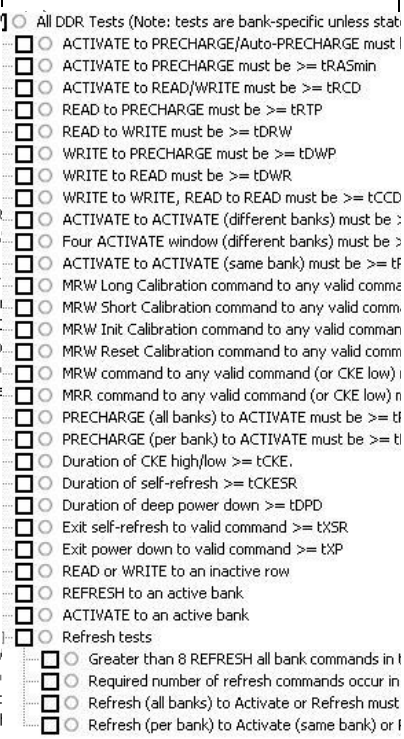
With B4622A license

DDR1, 2, 3 tests	LPDDR, LPDDR2 tests	DDR4 tests	LPDDR3 tests
All DDR Tests (Note: tests are bank-specific unless stated othe ACTIVATE to PRECHARGE/Auto-PRECHARGE must be <= t ACTIVATE to PRECHARGE must be >= tRASmin ACTIVATE to READ/WRITE must be >= tRCD PRECHARGE to ACTIVATE must be >= tRP READ to PRECHARGE must be >= tRTP READ to WRITE must be >= tDRW WRITE to PRECHARGE must be >= tDWP WRITE to READ must be >= tDWR WRITE to WRITE, READ to READ must be >= tCCD REFRESH to non-NOP/DES must be >= tRFC ACTIVATE to ACTIVATE (different banks) must be >= tRRI Four ACTIVATE window (different banks) must be >= tFAW ACTIVATE to ACTIVATE (same bank) must be >= tRC READ or WRITE to an inactive row REFRESH to an active bank ACTIVATE to an active bank	All DDR Tests (Note: tests are bank-specific unless stated otherwise) ACTIVATE to PRECHARGE/Auto-PRECHARGE must be <= tRASma ACTIVATE to PRECHARGE must be >= tRASmin ACTIVATE to READ/WRITE must be >= tRCD READ to PRECHARGE must be >= tRTP READ to WRITE must be >= tDRW WRITE to PRECHARGE must be >= tDWP WRITE to READ must be >= tDWR WRITE to WRITE, READ to READ must be >= tCCD ACTIVATE to ACTIVATE (different banks) must be >= tRRD Four ACTIVATE window (different banks) must be >= tFAW ACTIVATE to ACTIVATE (same bank) must be >= tRC READ or WRITE to an inactive row REFRESH to an active bank ACTIVATE to an active bank	Not available	Not available

With B4622B license

DDR1, 2 tests	DDR3 tests	DDR4 tests
All DDR Tests (Note: tests are bank-specific unless stated othe ACTIVATE to PRECHARGE/Auto-PRECHARGE must be <= t ACTIVATE to PRECHARGE must be >= tRASmin ACTIVATE to READ/WRITE must be >= tRCD PRECHARGE to ACTIVATE must be >= tRP READ to PRECHARGE must be >= tRTP READ to WRITE must be >= tDRW WRITE to PRECHARGE must be >= tDWP WRITE to READ must be >= tDWR WRITE to WRITE, READ to READ must be >= tCCD REFRESH to non-NOP/DES must be >= tRFC ACTIVATE to ACTIVATE (different banks) must be >= tRRD Four ACTIVATE window (different banks) must be >= tFAW ACTIVATE to ACTIVATE (same bank) must be >= tRC REFRESH cmd to REFRESH cmd must be <= tREFI * 9 Mode Register Set command to Mode Register Set comman READ or WRITE to an inactive row REFRESH to an active bank ACTIVATE to an active bank	All DDR Tests (Note: tests are bank-specific unless stated othe ACTIVATE to PRECHARGE/Auto-PRECHARGE must be <= t ACTIVATE to PRECHARGE must be >= tRASmin ACTIVATE to READ/WRITE must be >= tRCD PRECHARGE to ACTIVATE must be >= tRP READ to PRECHARGE must be >= tRTP READ to WRITE must be >= tDRW WRITE to PRECHARGE must be >= tDWP WRITE to READ must be >= tDWR WRITE to WRITE, READ to READ must be >= tCCD REFRESH to non-NOP/DES must be >= tRFC ACTIVATE to ACTIVATE (different banks) must be >= tRRD Four ACTIVATE window (different banks) must be >= tFAW ACTIVATE to ACTIVATE (same bank) must be >= tRC REFRESH cmd to REFRESH cmd must be <= tREFI * 9 Long cal (normal operation) to valid command must be >= t Short cal (normal operation) to valid command must be >= Mode Register Set command to Mode Register Set comman Mode Register Set command to valid command >= tMOD REF command to power down entry >= tREFPDEN Read command to power down entry >= tRDPDEN Write command to power down entry >= tWRPDEN Exit reset from CKE high to valid command (ex MRS) >= tXI SelfRefreshExit to Valid command with DLL <tXSDLL Exit Precharge Power Down with DLL to any valid command READ or WRITE to an inactive row REFRESH to an active bank ACTIVATE to an active bank	All DDR Tests (Note: tests are bank-specific unless state ACTIVATE to PRECHARGE/Auto-PRECHARGE must b ACTIVATE to PRECHARGE must be >= tRASmin ACTIVATE to READ/WRITE must be >= tRCD PRECHARGE to ACTIVATE must be >= tRP READ to PRECHARGE must be >= tRTP READ to WRITE must be >= tDRW WRITE to PRECHARGE must be >= tDWP WRITE to READ must be >= tDWR REFRESH to non-NOP/DES must be >= tRFC Four ACTIVATE window (different banks) must be >= ACTIVATE to ACTIVATE (same bank) must be >= tR REFRESH cmd to REFRESH cmd must be <= tREFI * Long cal (normal operation) to valid command must b Short cal (normal operation) to valid command must t Mode Register Set command to Mode Register Set cc Mode Register Set command to valid command >= tM REF command to power down entry >= tREFPDEN Read command to power down entry >= tRDPDEN Write command to power down entry >= tWRPDEN Exit reset from CKE high to valid command (ex MRS) SelfRefreshExit to Valid command with DLL <tXSDLL Exit Precharge Power Down with DLL to any valid cor WRITE to WRITE, READ to READ must be >= tCCD_ ACTIVATE to ACTIVATE (different banks) must be >= READ or WRITE to an inactive row REFRESH to an active bank ACTIVATE to an active bank

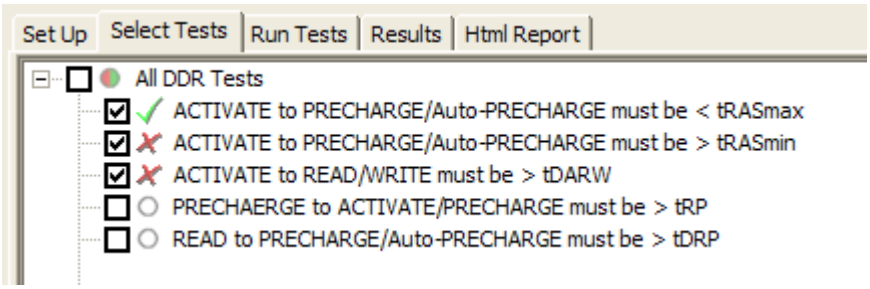
With B4622B license

LPDDR tests	LPDDR2 tests	LPDDR3 tests
		

Some things to consider while selecting tests:

- Some tests might not make sense for your system. Do not select those tests.
- Checking a parent node/group will check all available sub-groups/tests.
- Unchecking a parent node/group will uncheck all sub-groups/tests.
- A parent node is checked if all subgroups are checked.
- A parent node is unchecked if ANY subgroup is unchecked.

When Tests Have Already Been Run



The marks have the following meanings:

	The test passed.
	The test failed.
	The test has not been run, or no tests in the group have been run.
	The test is currently running.
	Some tests in the group have run and passed.
	Some tests in the group have run and failed.
	Some tests in the group have passed and some have failed; not all of the tests have been run.
	Some tests in the group have passed and some have failed; all of the tests have run.
	All tests in the group have run and passed.
	All tests in the group have run and failed.

See Also

- "To set the test limits" on page 20 (for information on how to calculate the limits)
- "About the Tool" on page 11 (for an overview of the tests performed)

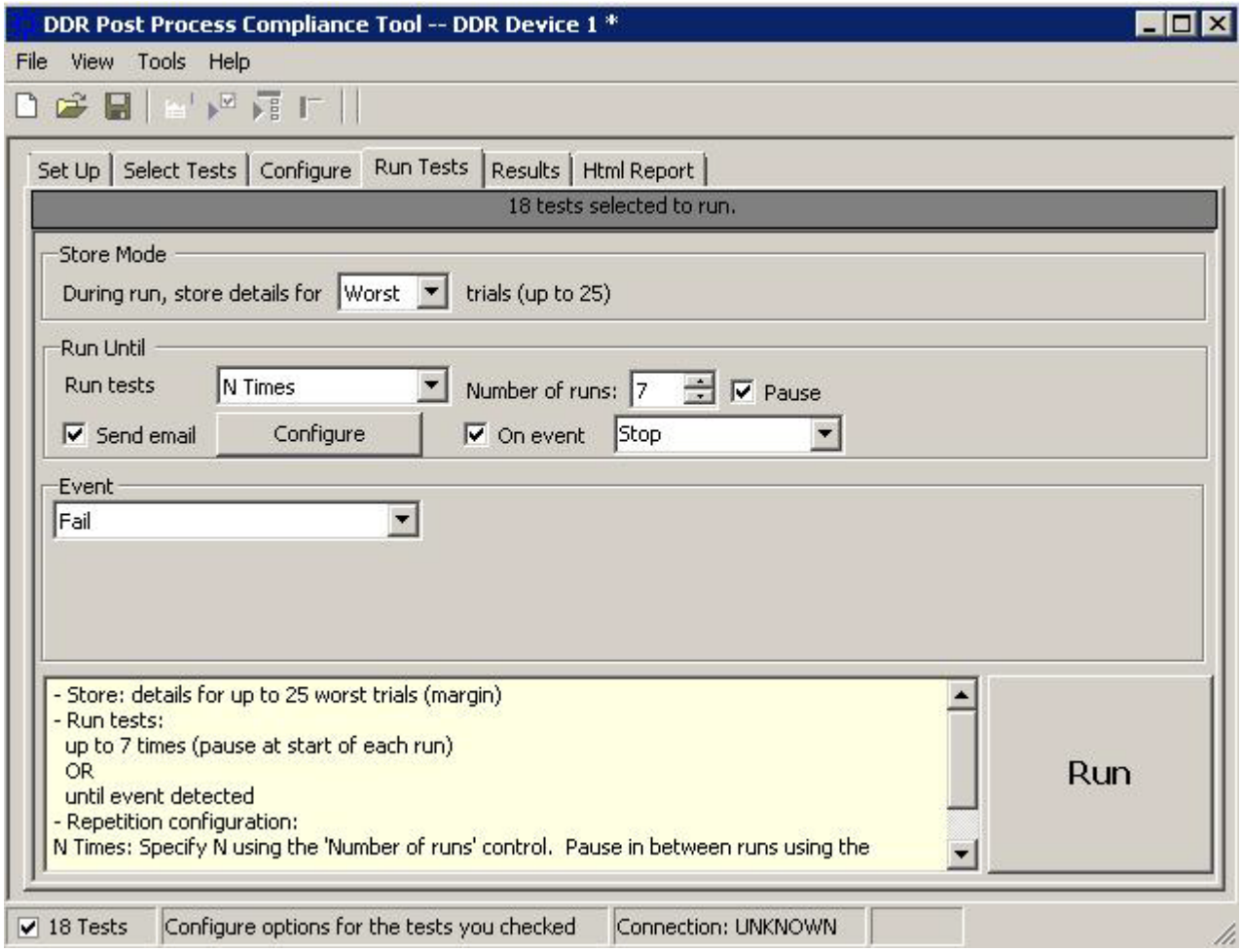
Next

- "Configuring Tests" on page 19

7
Running Tests

You can use the Run Tests tab to specify how the tests should be run and then run the tests as per these settings.

You can run the tests once or repetitively.



To run the selected tests

1 Click the **Run Tests** tab.

2 Configure the settings for running the tests.

a From the **Store Mode** section, select which trial results from the test run(s) you want to store. You can store results for a maximum of 25 trials.

b From the **Run Until** section, select the number of times you want to run the tests. Following options are available:

- **Once** - The tests are run once.
- **N Times-** The tests are run repetitively for the number of times specified in the **Number of Runs** field.
- **Forever**- The tests are run repetitively until you press the Stop button.

If you select N Times or Forever, make sure you select the **Automatically acquire new logic analyzer data when running tests** checkbox in the Set up tab.

c On selecting the **N Times** option, the **Pause** checkbox is displayed. Select this checkbox to instruct the tool to pause the test run after the completion of each run in the repetitive run.

d Select the **Send email** checkbox to instruct the tool to send a notification email with the information about the test run when the test run completes or pauses. You can specify the email address to which email should be sent by clicking the Configure button displayed when this checkbox is selected.

e Select the **On Event** checkbox to instruct the tool to perform a specified action when the specified event is detected in the test run. On selecting this checkbox, a listbox is displayed with this checkbox. From this listbox, you can select either Pause or Stop to pause or stop the test run when the selected event is detected during a test run.

f When you select **Event** in the **Store Mode** section or select the **On Event** checkbox, the **Event** listbox is displayed to allow you to select the event. When the selected event occurs in the test run, the specified action is performed if the On Event checkbox is selected or the details for the event are stored if the Store Mode is set to Event. You can select from the following events:

- **Pass** - Perform the event action or store the event details when a test passes.
- **Fail** - Perform the event action or store the event details when a test fails.
- **Margin < N** - Perform the event action or store the event details when a test result margin is less than the specified minimum required margin percentage.

At times, you may receive warning messages when the selected event does not logically matches with the selected Store Mode. For instance, if the Store Mode is Best, then you can only use Pass as the event. Similarly, if the store mode is Worst, you cannot use Pass as the event. The tool automatically corrects the event selection in such cases.

While you select the test configurations, the tool automatically keeps documenting the test configurations for your reference in the open listbox in this tab.

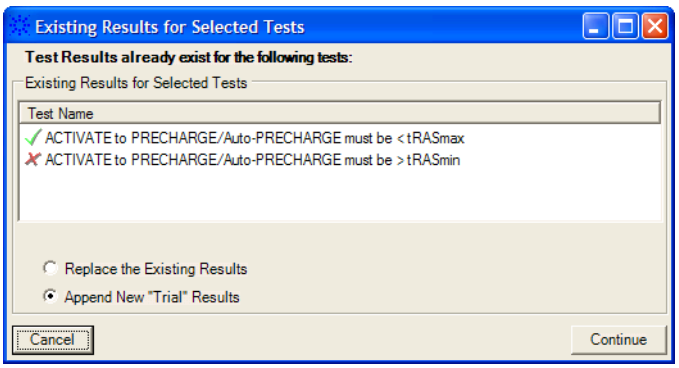
3 Run the tests. There are several ways to run the selected tests:

- Click  in the toolbar. to run all the selected tests.
- Select a branch in the Select Tests tab and then click  in the toolbar to run only the tests of the selected branch.
- Click the big **Run** button in the Run Tests tab.

4 If there are existing test results, you are asked if you would like to keep them or re-test (delete) them.

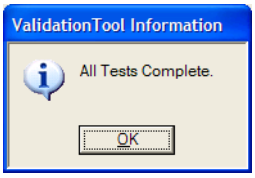
If you would like to keep the existing test results to compare against new results, select **Append New "Trial" Results**.

Select **Replace the Existing Results** if you would like to delete the existing test results.



5 While the tests are running, status dialogs appear to inform you about the test progress.

6 When the tests are complete, click **OK**.



See Also · "To set the display preferences" on page 42

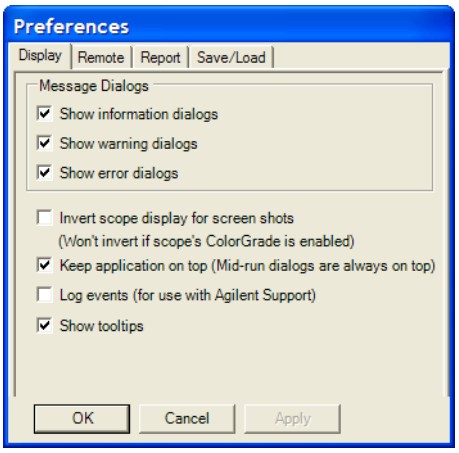
Next · "Viewing Results" on page 43

To set the display preferences

Information, warning, and error conditions can occur while running tests. The display preferences let you choose whether message dialogs are shown. And, there are other display preferences that affect what happens as tests are run.

1 From the DDR Post Process Compliance tool's menu, choose **View>Preferences...**.

2 In the Preferences dialog, select the **Display** tab.



3 In the Display tab, you can choose to show the following types of message dialogs:

- Information dialogs.
- Warning dialogs.
- Error dialogs.

NOTE Messages that require you to make a choice, such as "OK/Cancel" and "Yes/No" are always enabled.

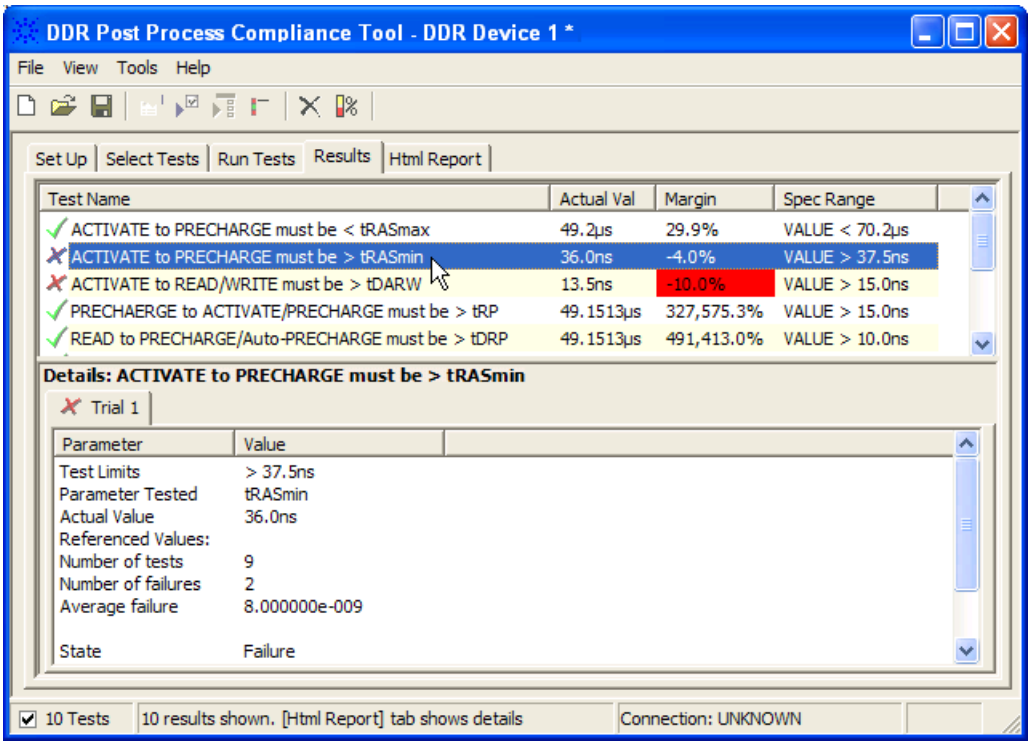
4 Also, you can choose to:

- **Invert scope display** — (Not used) Use a white background when the application captures the screen shots.
- **Keep application on top** — Always keep the application's main dialog on the top of the logic analyzer application. Note that the mid-run dialogs are always displayed on the top.
- **Log events** — Use this option only when directed to by Keysight Support (Note that this option degrades the runtime performance).
- **Show tooltips** — By enabling this option, the tooltips appear as you move the pointer over various controls in the application.

5 Click **Apply** to save the changes and click **OK** to close the Preferences dialog.

8
Viewing Results

1 Click in the toolbar, or click the **Results** tab.



The Results tab contains three resizable panes for test results information. If you select one of the tests in the top pane, details and reference images (if any) are shown in the lower panes.

TIP A quick way to reset all configuration options and delete all test results is to create a new project (see page 53). The new project will have default configuration options.

For each individual test that you selected to run, the tool reports the total number of failures that occurred for that specific test. It can show up to a maximum of *250 failures* in the Details screen for an individual test.

Each limit is measured as the time between two states. Each logic analyzer state has a number and a timestamp. In case of a failure, the numbers of the two states will be reported. Note that the time stamps are only as good as the time stamp resolution of the logic analyzer card being used (this resolution may be as coarse as 2ns; see the Specifications and Characteristics in the logic analyzer's online help for details).

If a test case is not encountered in the logic analyzer trace:

- In the details for the test, the number of tests will be 0.
- For limit tests, the "Actual Value" column will display "N/A."
- For pass/fail tests, the "Actual Value" column will display "Pass."

See Also · "To change margin thresholds" on page 45

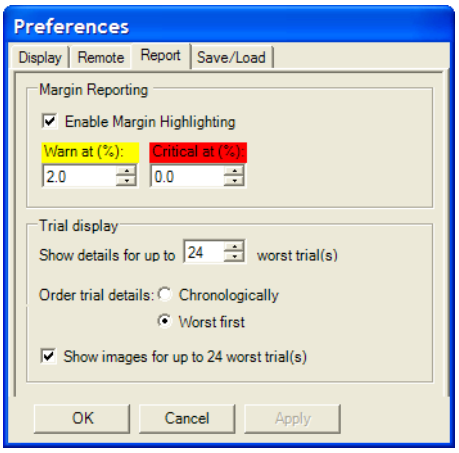
Next · "Viewing/Exporting/Printing the Report" on page 47

To change margin thresholds

1 From the DDR Post Process Compliance tool's menu, choose **View>Preferences...**.

Or, when viewing the Results tab, click  in the toolbar.

2 In the Preferences dialog, select the **Report** tab.



3 In the **Margin Reporting** area, you can:

- Enable or disable margin highlighting.
- You can change the percent of margin at which to give warnings or critical failures.

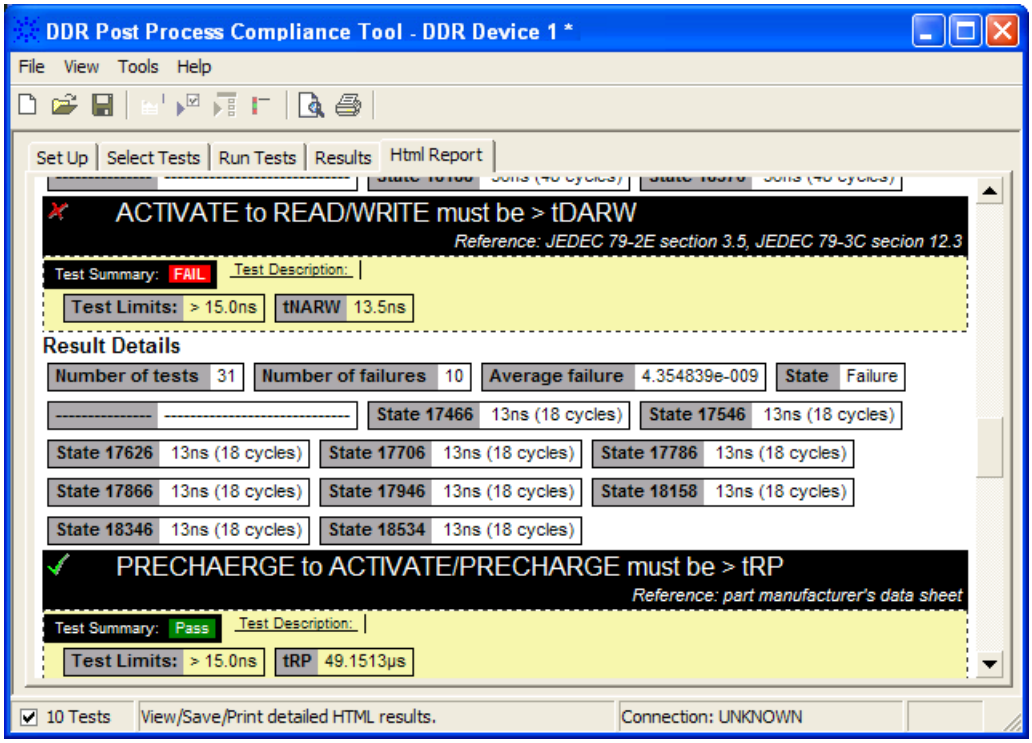
4 Click **OK** to close the Preferences dialog.

NOTE The DDR Post Process Compliance tool runs the tests one time, so the Trial display options do not apply.

8 Viewing Results

9 Viewing/Exporting/Printing the Report

- To view the HTML test report, click the **Html Report** tab.



See Also

- "Viewing/Exporting/Printing the Report" on page 47
- "To export the report" on page 48
- "To print the report" on page 50

Next

- "Saving Test Projects" on page 51

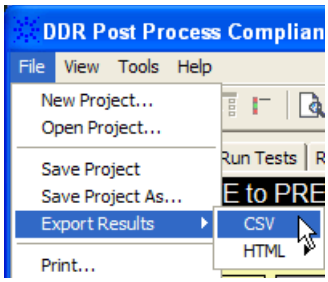
To export the report

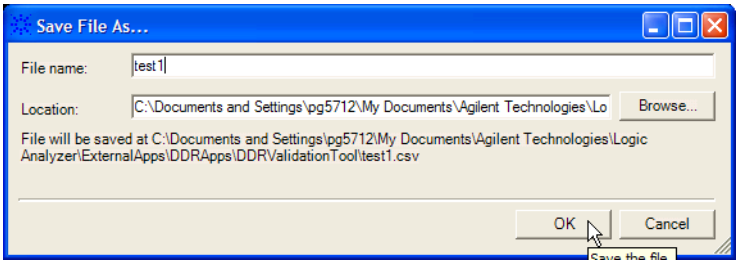
1 From the DDR Post Process Compliance tool's menu, choose **File>Export Results>** from the menu.

There are two options for exporting the HTML test report: CSV or HTML.

To export results in CSV (comma-separated values) format

Select the CSV option to export the results as a comma-separated list of values.

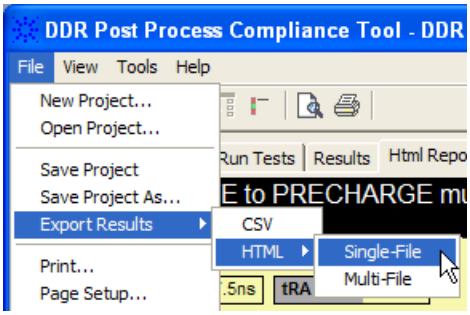




The data format is shown in the first line of the exported *.csv file.

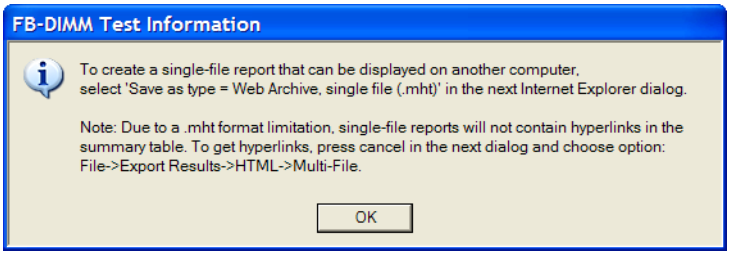
```
Test ID, Test Name, Measured Item, Trial 1 Value
100,"ACTIVATE to PRECHARGE/Auto-PRECHARGE must be < tRASmax",Number of t
ests ,"9"
100,"ACTIVATE to PRECHARGE/Auto-PRECHARGE must be < tRASmax",Number of f
ailures ,"0"
100,"ACTIVATE to PRECHARGE/Auto-PRECHARGE must be < tRASmax",Actual Valu
e,"4.92E-05"
100,"ACTIVATE to PRECHARGE/Auto-PRECHARGE must be < tRASmax",Margin,"29.
9"
```

To export the report in HTML format



There are two options for exporting HTML format test reports:

- **Single-File** — To save a single-file report, use the "save as" type "Web Archive, single file (.mht)".



NOTE Single-file reports will not contain hyperlinks in the summary table (due to a .mht format limitation). If you want these hyperlinks, use the multi-file format.

- **Multi-File** — If your report is large and you would like to use links within the report, select the **HTML>Multi-File** option. Selecting the multi-file option exports the results as a set of separate image and HTML files. It creates a folder with the specified name that may be copied to any computer.

  To view the exported report, open the HTML file stored in the folder.

To print the report

- To preview the HTML test report printout, click  or choose **File>Print Preview...** from the menu.
- To print the HTML test report, click  or choose **File>Print...** from the menu.

10
Saving Test Projects

To save test settings and results to the current project directory:

1 Choose **File>Save Project** from the menu.

To save test settings and results to a new project directory:

1 Choose **File>Save Project As...** from the menu.

2 In the Save Project As... dialog, enter the device name and location.

Project files will be saved in a directory whose name is the device name.

3 Click **OK**.

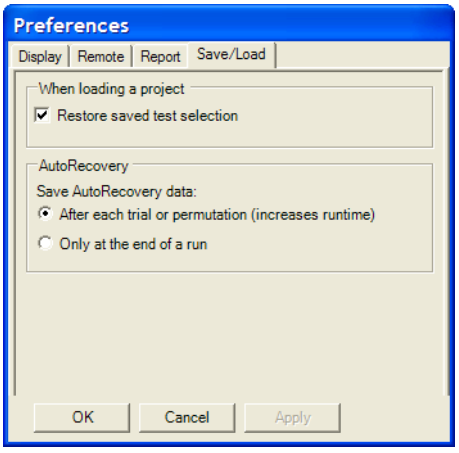
See Also

- "To set AutoRecovery preferences" on page 52

To set AutoRecovery preferences

1 From the DDR Post Process Compliance tool's menu, choose **View>Preferences...**.

2 In the Preferences dialog, select the **Save/Load** tab.



3 In the **AutoRecovery** area, you can choose:

- To auto-save results after each trial or permutation even if the entire multi-trial is not completed. This option enables full recovery.
- To auto-save results only upon the completion of the entire multi-trial.

4 Click **Apply** to save the changes and click **OK** to close the Preferences dialog.

11
Creating or Opening a Test Project

To create a new test project:

1 Choose **File>New Project...** from the menu.

A new, empty project, with all the default settings is created.

To open an existing test project:

1 Choose **File>Open Project...** from the menu.

2 In the Open dialog, browse to a test project directory and select the desired ".proj" file.

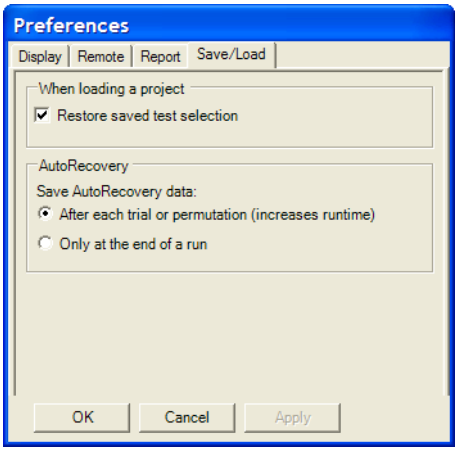
3 Click **Open**.

See Also
- "To set load preferences" on page 54

Next
- "Setting Up the Test Environment" on page 31

To set load preferences

1. From the DDR Post Process Compliance tool's menu, choose **View>Preferences...**.
2. In the Preferences dialog, select the **Save/Load** tab.



3. In the Save/Load tab, you can choose to restore saved test selections when loading a project.
4. Click **Apply** to save the changes and click **OK** to close the Preferences dialog.

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