

User's Guide - LPDDR2 Compliance App

Rev. 1, August 2012

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1 Introduction

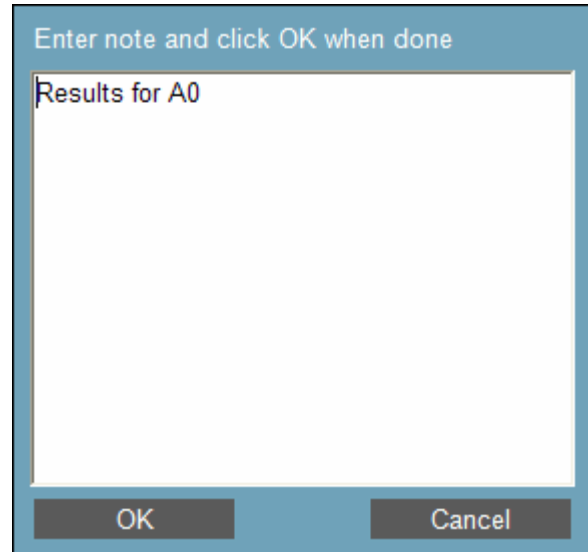
The DDR2 Compliance App uses the *JEDEC JESD 209-2E LPDDR2 Specification* as a reference. There are ten data rates for DDR2: 200 Mbps, 266 Mbps, 333 Mbps, 400 Mbps, 466 Mbps, 533

Mbps, 667 Mbps, 800 Mbps, 933 Mbps, and 1066 Mbps. The operator will have an opportunity to choose either all parts of the specification, or selected parts, to test.¹

Some dialogs, such as the **Individual Results Dialog**, occur commonly in the course of testing. Descriptions of such dialogs are provided in **Appendix A**, and are referred to in the course of the test descriptions. To find out what test will perform the measurement for a particular parameter, consult **Appendix B**.

The title of the test will indicate which signal or signals are being tested. At the end of each test the **Individual Test Results Dialog** will appear. The operator may use the **Add Note** button to bring up the dialog on the right. The operator may enter a note indicating any observations or special conditions for the test; this note will be included in the final report for ease of identifying any signals that fail the testing.

All tests start with two dialogs that tell what version of the JEDEC specification is being used, and the version of M1 WT that is needed to successfully run the Compliance App. At the end of the test, the results of all testing may be saved to a file for documentation.

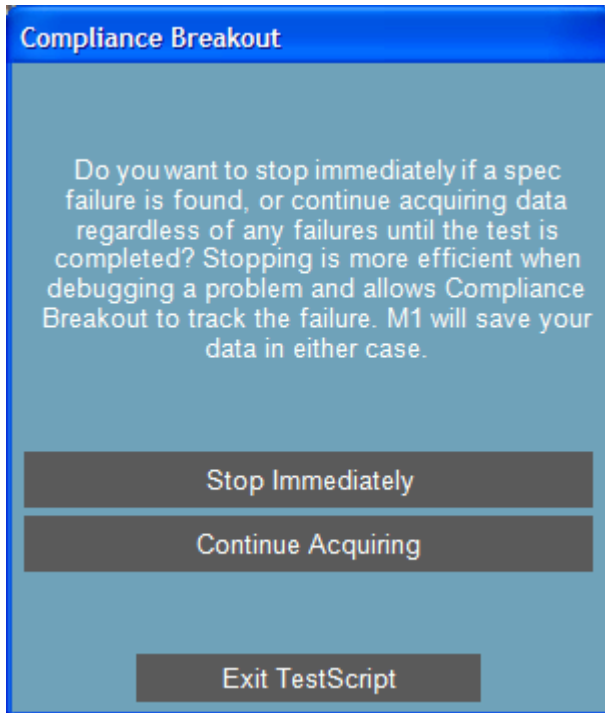


1.1 Probes Needed

The operator will need four single-ended probes and two differential probes.

¹ Anything that gets written down is subject to interpretation, and interpretation is subject to ambiguities in what was written. The world of compliance specifications is, unfortunately, rich with instances of ambiguity. Every compliance test provider has to interpret these specifications but only ASA goes the extra step of providing information on how we interpreted these details and our reasoning behind those decisions. When available, this information is included in the Compliance App's Data Sheet, available for download from the M1 Apps Store.

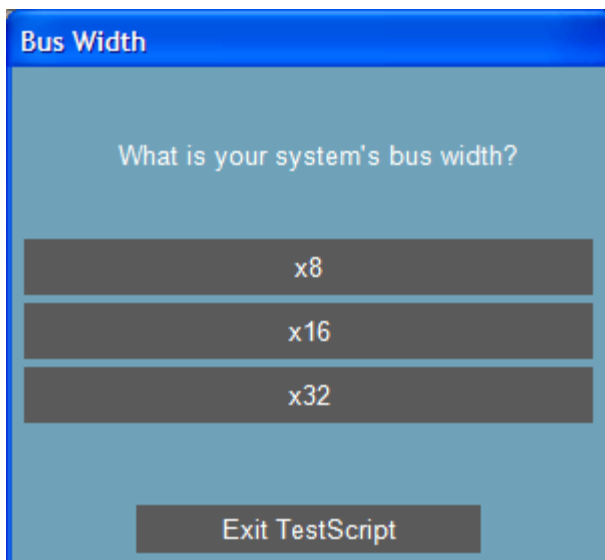
The operator will then see this dialog:



This dialog gives the option of either stopping acquisition when the first out-of-spec measurement is found, or continuing the test until the proper number for events has been acquired. Selecting **Continue Acquiring** will make it more likely that all possible error conditions are found, since it is possible that not all out-of-spec conditions will happen at the same time. However, selecting **Stop Immediately** will ensure that the Compliance Breakout feature of M1 will be available to analyze the problematic waveform properly. The operator should make the selection based upon which scenario is appropriate. The mode selected will be applied to all tests that are conducted during this execution of the Compliance Test..

1.2 Bus Width Selection

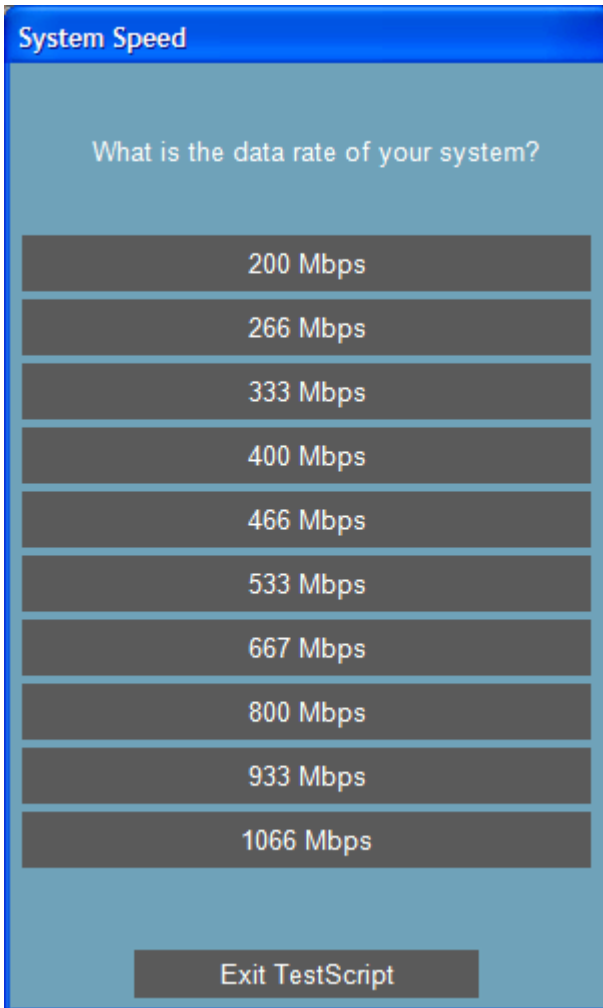
After the dialogs described above have appeared, the operator will see the **Bus Width** dialog:



Operator Action: Click on the button that indicates the bus width of your DUT.

1.3 System Speed

The next dialog lets the operator specify the data rate of the DUT:



System Speed

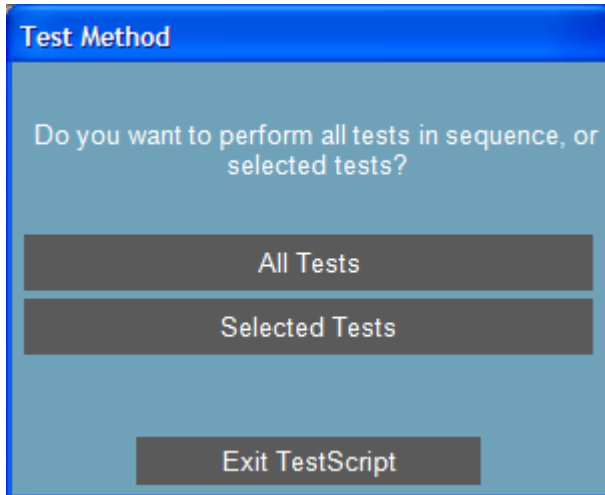
What is the data rate of your system?

- 200 Mbps
- 266 Mbps
- 333 Mbps
- 400 Mbps
- 466 Mbps
- 533 Mbps
- 667 Mbps
- 800 Mbps
- 933 Mbps
- 1066 Mbps

Exit TestScript

Operator Action: Click on the button that indicates the bus width of your DUT.

1.4 Test Method Selection

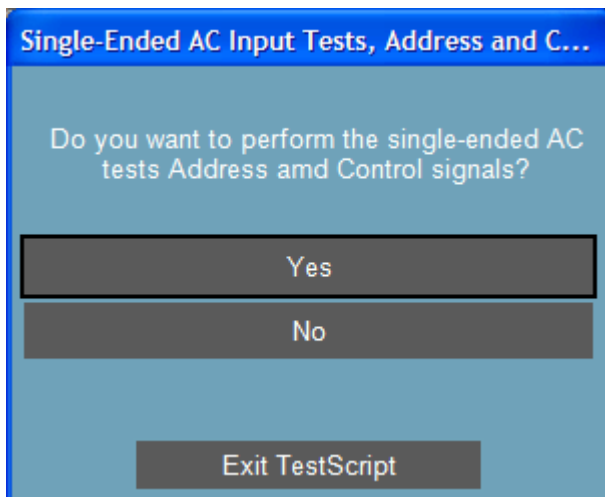


The user must now decide what test method is to be used. Selecting **All Tests** will give the operator the option of testing parts of the specification, while selecting **Selected Tests** will let the user select which part of the specification will be tested.

2 All Tests

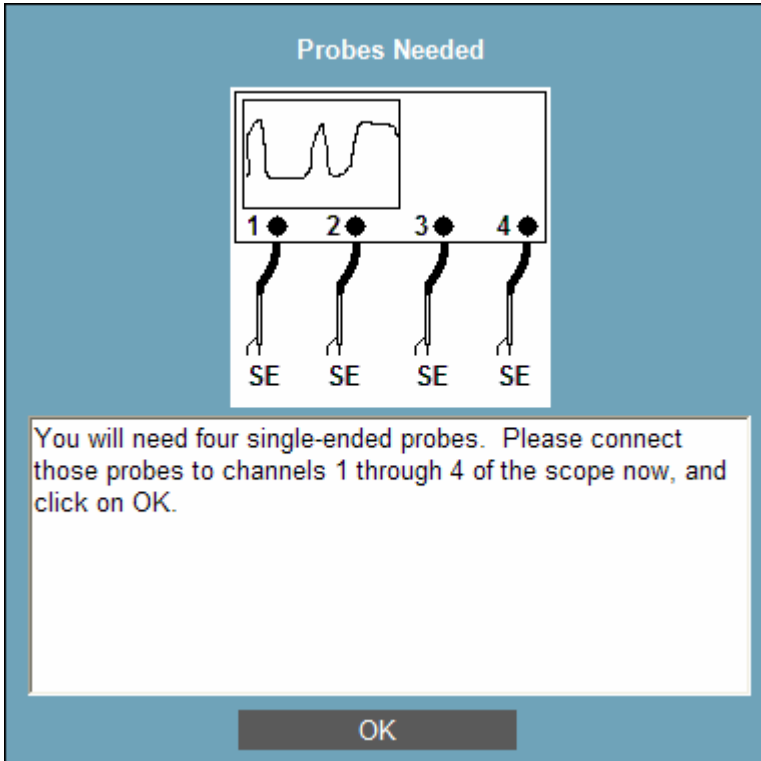
2.1 Single-Ended AC Input Tests, Address and Control

The operator will see this dialog:



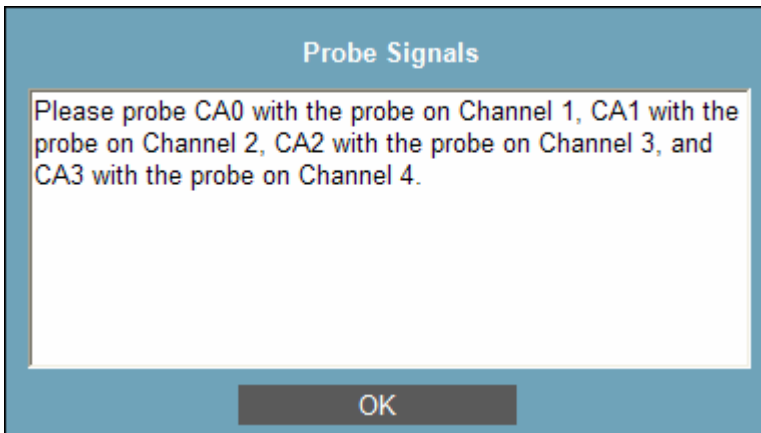
Operator Action: Click **Yes** to perform the tests, or **No** to skip the tests. This document will assume that the operator clicks **Yes**. Otherwise, skip to the Section 2.2, **Single-Ended AC Tests, Data, Strobe, and Mask**.

This dialog will appear:



Operator Action: Attach single-ended probes to Channels 1 through 4.

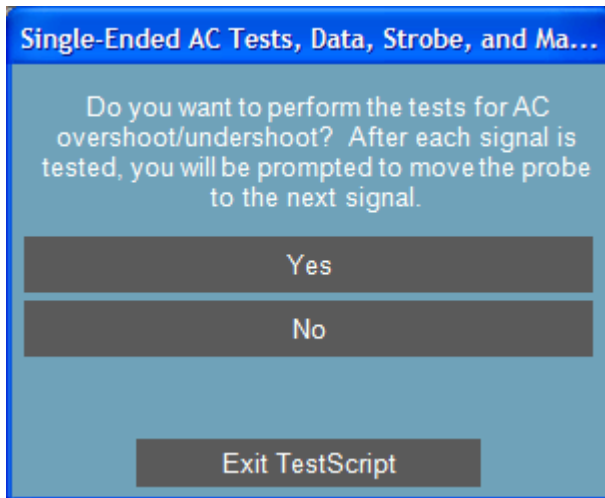
This dialog will appear:



Operator Action: Probe CA0, CA1, CA2, and CA3 with the indicated probes. As the test proceeds, the operator will be prompted to move the probes to CA4, CA5, CA6, CA7, CA8, CA9, CS0, and CS1.

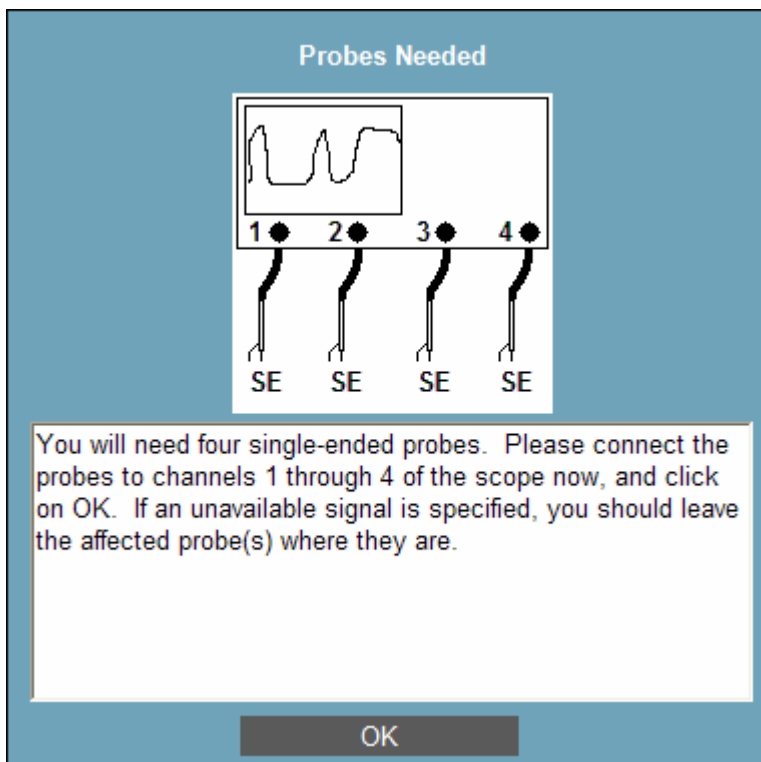
2.2 Single-Ended AC Tests, Data, Strobe, and Mask

The operator will see this dialog:



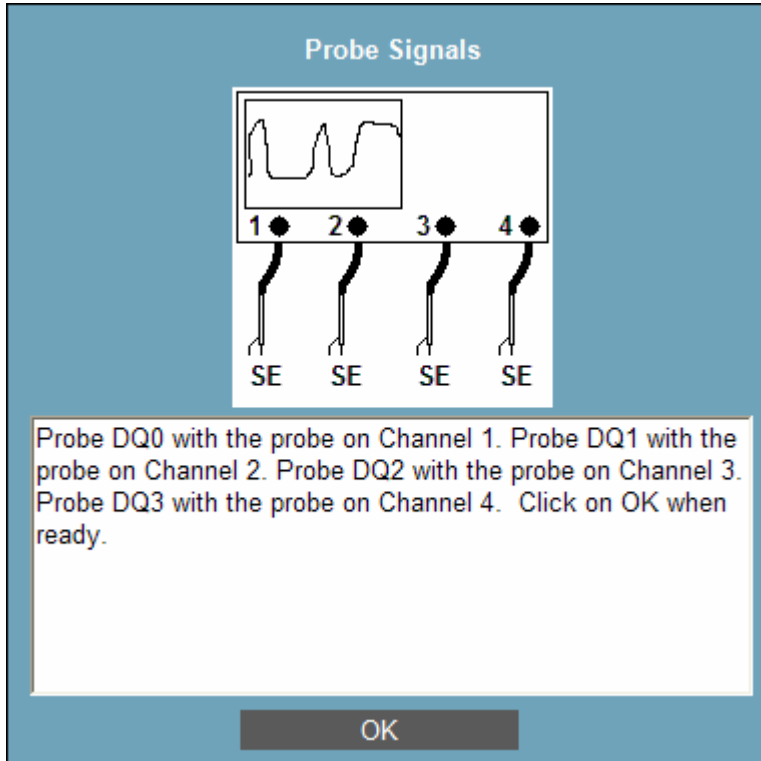
Operator Action: Click on **Yes** to conduct the tests. If the operator clicks on **No** to skip the tests, skip to the Section 2.3, **Differential Input Tests**.

The operator will see this dialog:



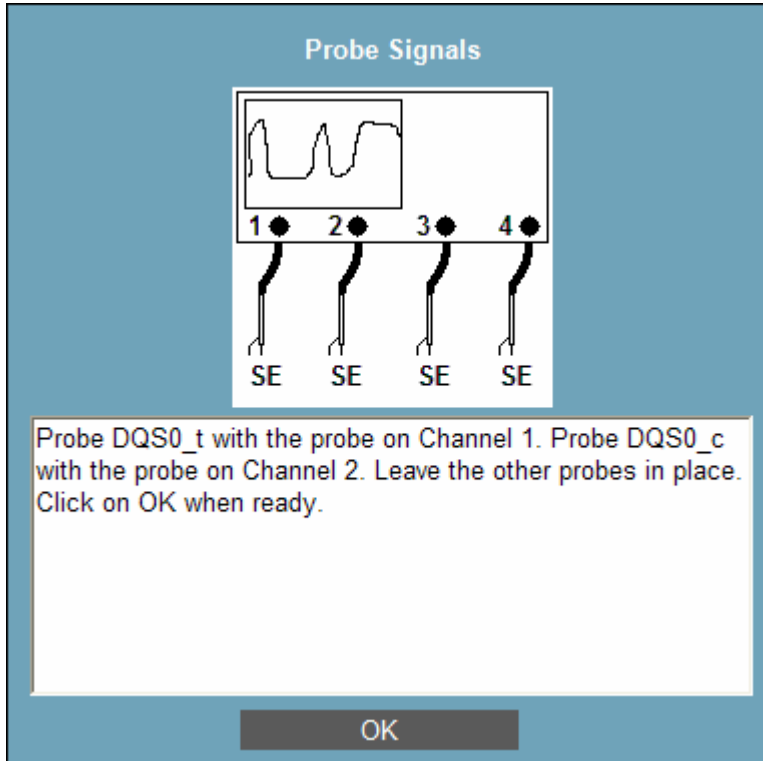
Operator Action: Connect **single-ended probes** to Channels 1 through 4.

The operator will see this dialog:



Operator Action: Probe data lines DQ0 through DQ3 with the single-ended probes, and click **OK**. The operator will be prompted to probe the other data lines as needed for subsequent tests.

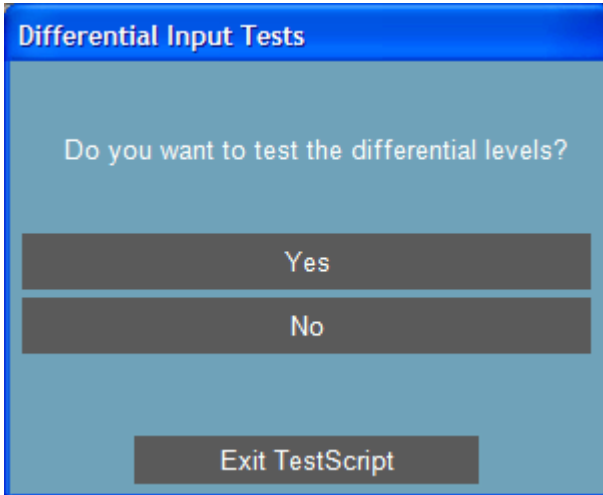
The operator will see this dialog:



Operator Action: Probe data strobe lines **DQS0_t** and **DQS0_c** as directed. If your data bus width is 16 or 32, the operator may be prompted to probe additional DQS lines.

2.3 Differential Input Tests

The Compliance Test will now ask whether the operator wants to test the differential input levels.



Differential Input Tests

Do you want to test the differential levels?

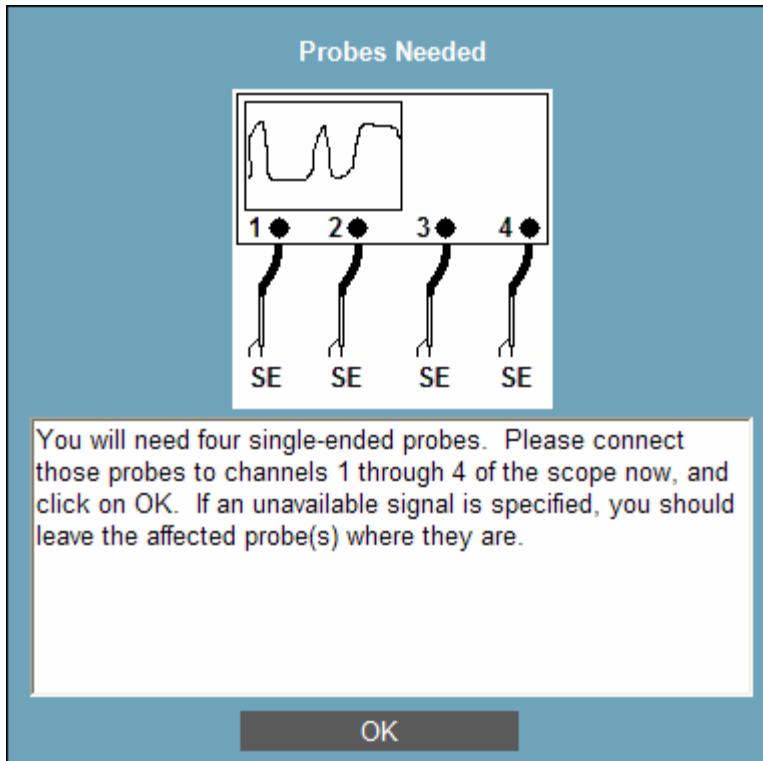
Yes

No

Exit TestScript

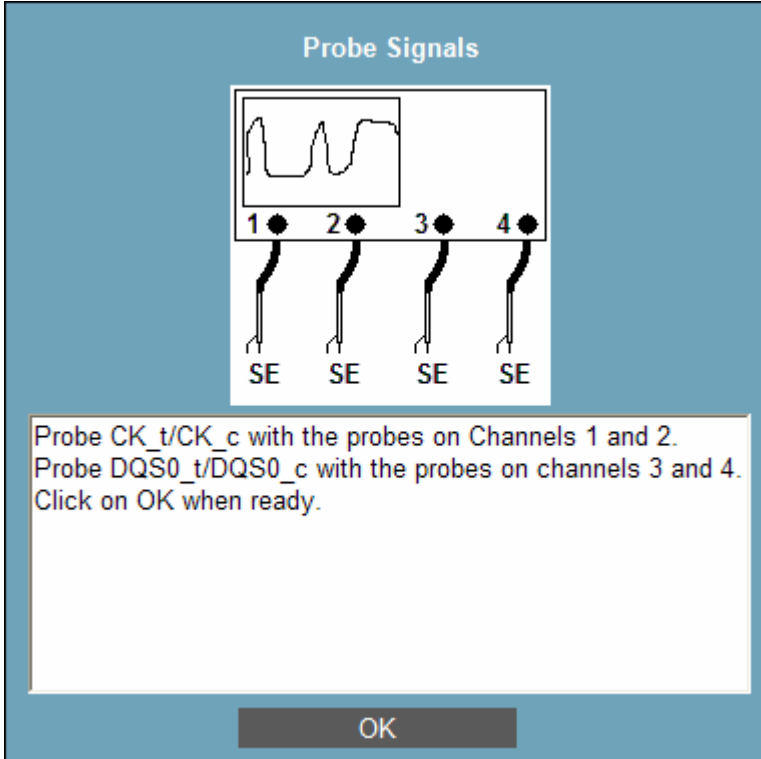
Operator Action: Click on **Yes** to conduct the tests. If the operator clicks on **No** to skip the tests, skip to Section 2.4, **Data Strobe**.

The operator will see this dialog:



Operator Action: Connect four **single-ended** probes to Channels 1 through 4 of the scope, and click on OK.

The operator will see this dialog:

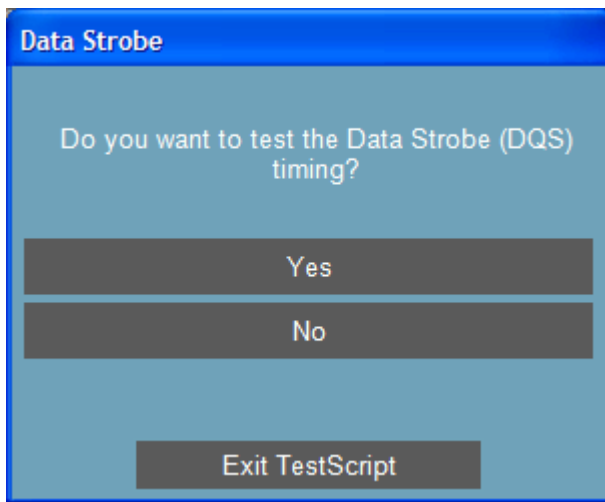


Operator Action: Probe CK_t/CK_c and DQS0_t/DQS0_c as directed, and click on **OK**. After this test completes, the operator may be prompted to probe other DQS lines depending on the data bus width. The probes on CK_t/CK_c will remain in place for these tests.

Two different sets of tests will be run for each probe placement.

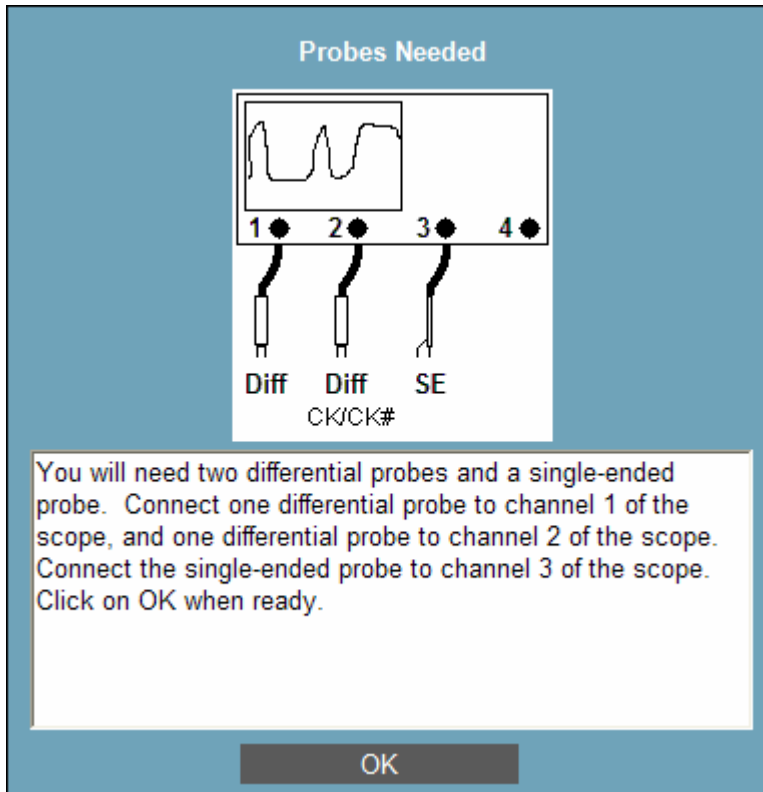
2.4 Data Strobe

After the **Differential Input** tests are complete, the operator will see:



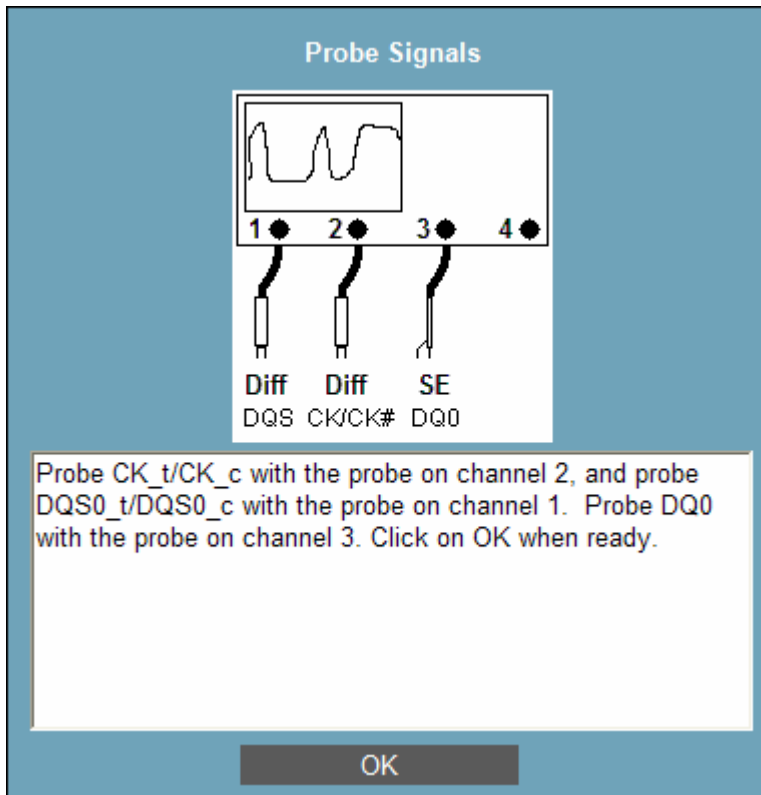
Operator Action: Click on **Yes** to conduct the tests. If the operator clicks on **No** to skip the tests, skip to the Section 2.5, **Data Timing**.

The operator will see this dialog:



Operator Action: Connect two **differential** probes to Channels 1 and 2 of the scope, and connect a **single-ended** probe to channel 3 of the scope. Click on **OK**.

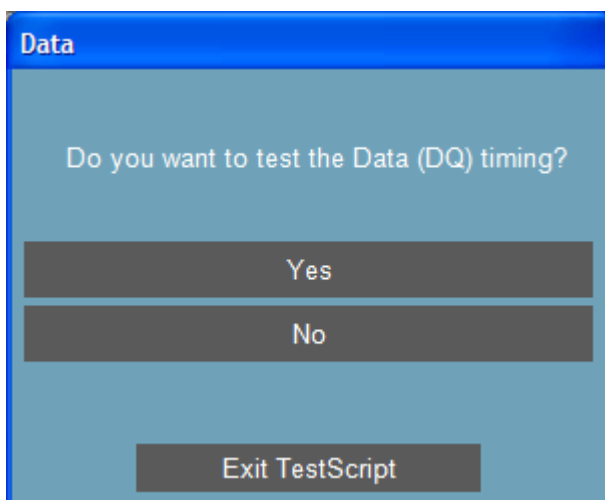
The operator will see this dialog:



Operator Action: Connect a second **differential** probe to channel 1, and probe **DQS0_t/DQS0_c** with it. Probe **DQ0** as directed. with the probe on channel 3. Click on **OK**.

If the bus width is greater than 8, the user will be prompted to move the differential probe on channel 1 to the appropriate DQS lines, and to move the single-ended probe to appropriate DQ lines.

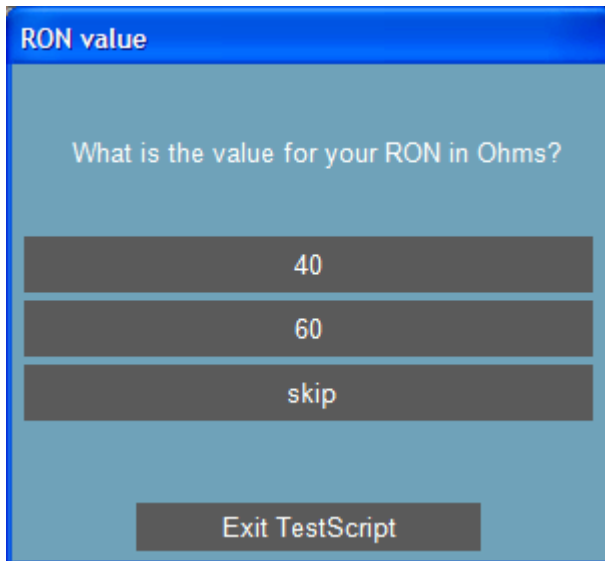
2.5 Data Timing



The operator will see this dialog:

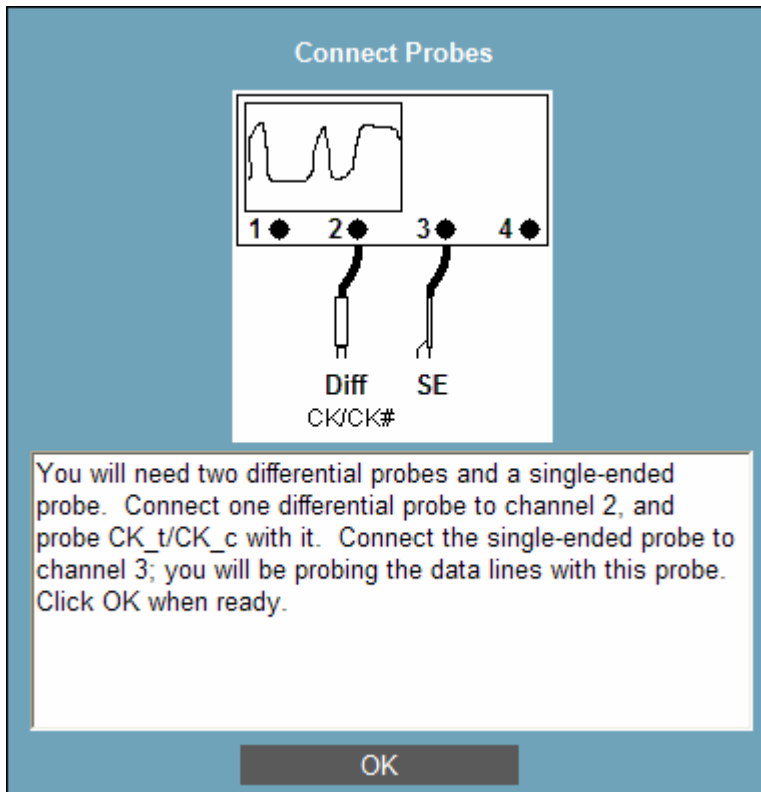
Operator Action: Click on **Yes** to conduct the tests. If the operator clicks on **No** to skip the tests, skip to the Section 2.6, **Clock Timing**.

The operator will see this dialog:



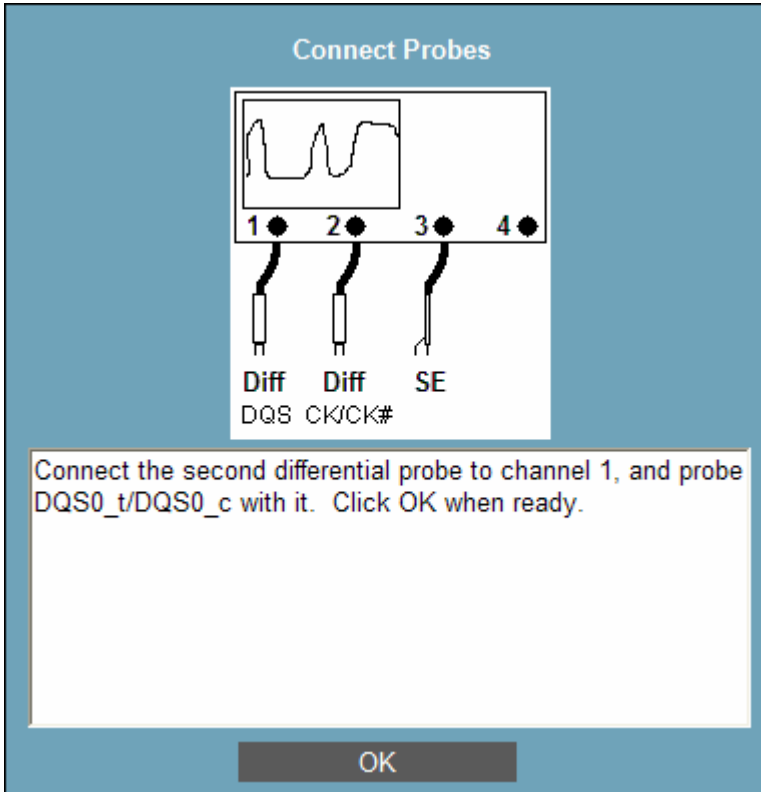
Operator Action: Click on the button that corresponds with the value of RON in the design of the DUT. If you are unsure of the value, clicking on skip will skip the tests that require knowledge of the value of RON.

The operator will see this dialog:



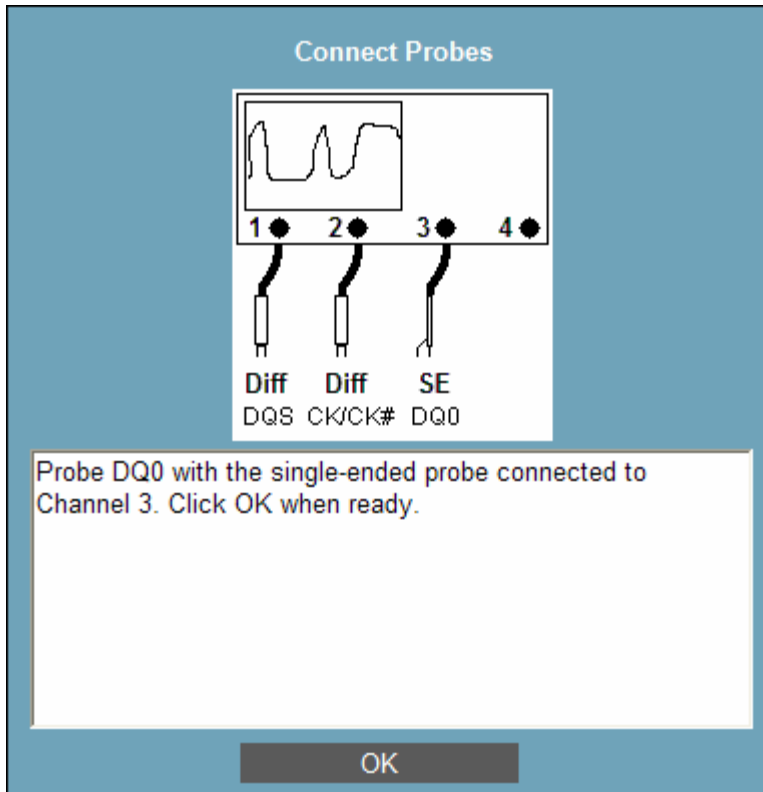
Operator Action: Connect a differential probe to channel 2, and probe CK_t/CK_c with that probe. Connect a single-ended probe to channel 3. Click on OK.

The operator will see this dialog:



Operator Action: Connect a second **differential** probe to channel 1, and probe **DQS0_t/DQS0_c** with that probe. Connect a **single-ended** probe to channel 3. Click on **OK**.

The operator will see this dialog:

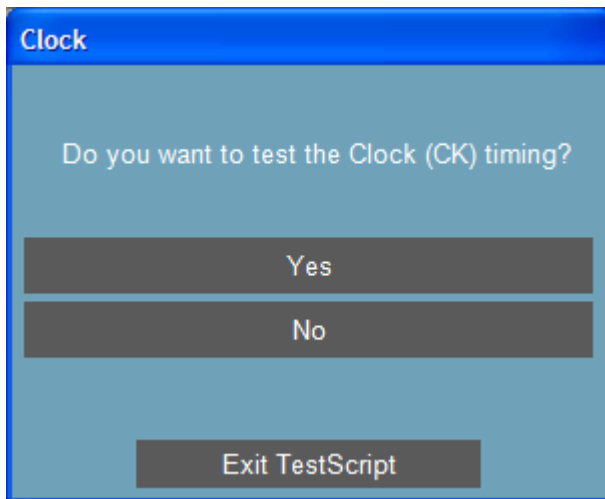


Operator Action: Probe DQ0 with the single-ended probe on channel 3. Click on OK.

Tests will be run for each DQ line, as well as the DM line(s), with a prompt to move the single-ended probe each time. For bus widths greater than 8, the DQS probe will need to be moved at times.

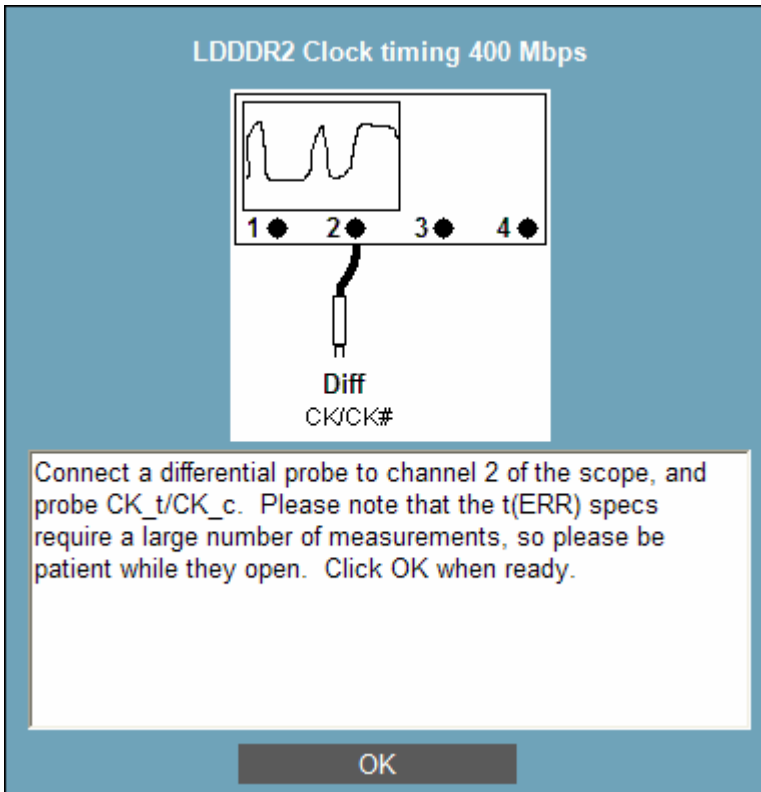
2.6 Clock Timing

The operator will see this dialog:



Click on **Yes** to conduct the tests. If the operator clicks on **No** to skip the tests, skip to the Section 2.7, **Command and Address Timing**.

The operator will see this dialog:

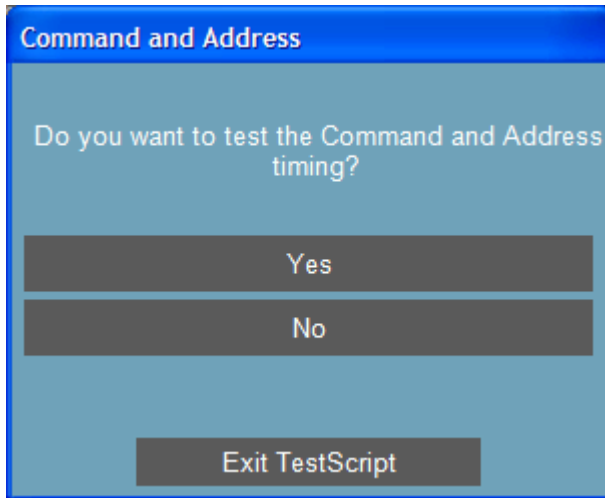


Operator Action: Connect a differential probe to channel 2, and probe CK_t/CK_c with it. Click on OK.

This tests requires many measurements, so it may take a while to complete.

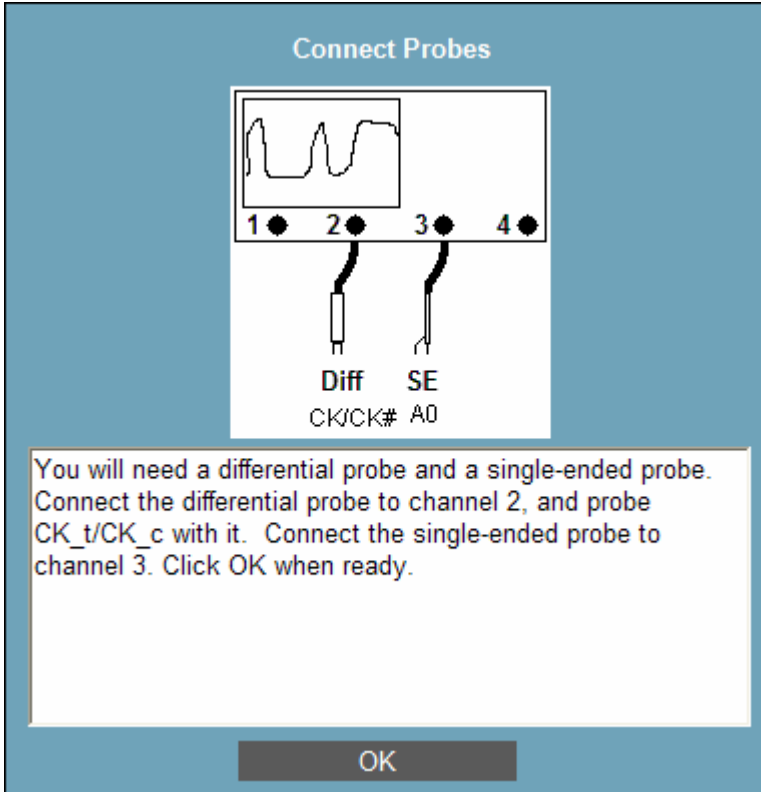
2.7 Command and Address Timing

The operator will see this dialog box:



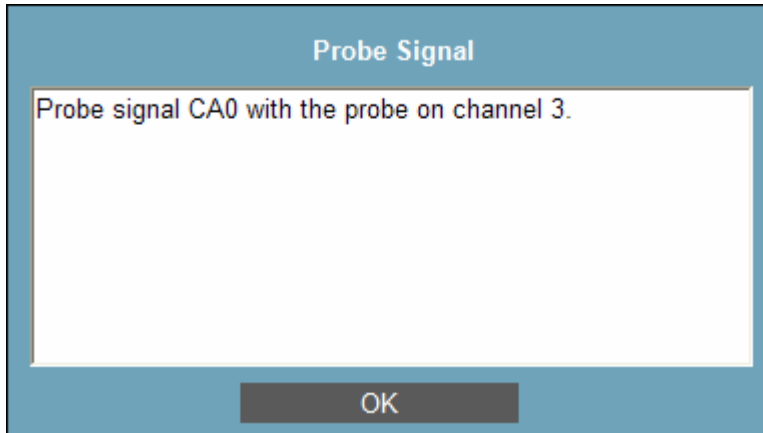
Operator Action: Click **Yes** to perform the test, or **No** to skip the test. This document will assume that the operator clicks **Yes**. Otherwise, testing is complete, and the test results summary will be shown.

The operator will see this dialog:



Operator Action: Connect a **differential** probe to channel 2, and probe CK_t/CK_c with it. Connect a **single-ended** probe to channel 3. Click on **OK**.

The operator will see this dialog:

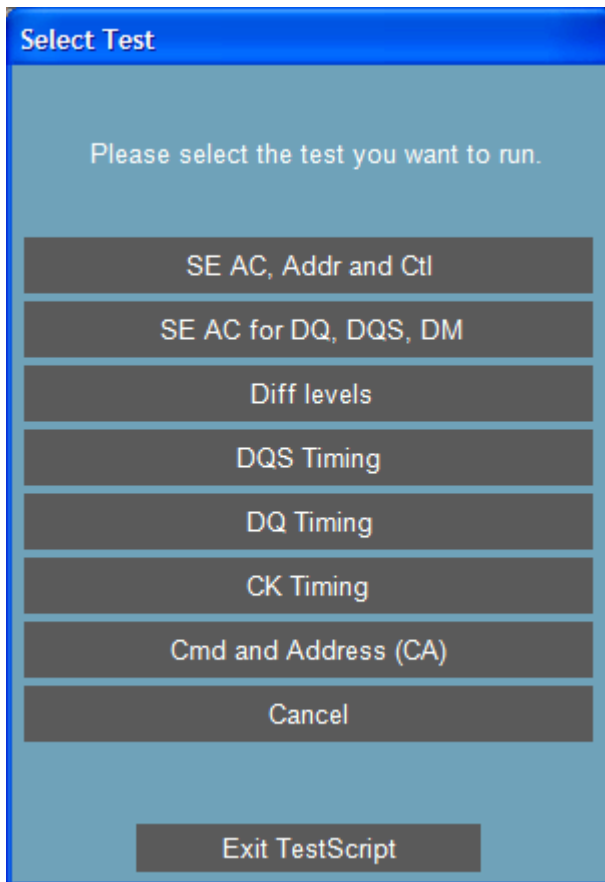


Operator action: Probe CA0 with the **single-ended** probe on channel 3.

As the tests progress, the operator will be prompted to probe the rest of the CA lines, as well as CS0 and CS1.

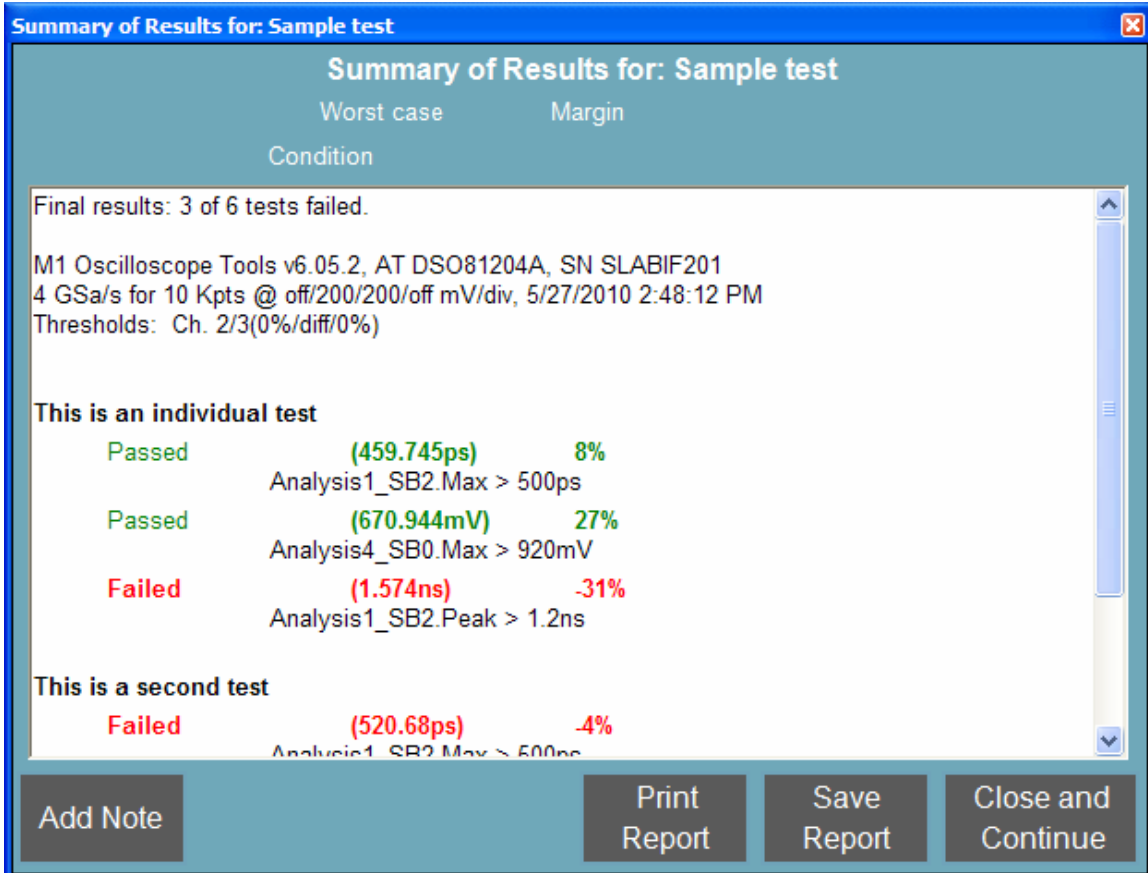
3 Selected Tests

The operator will see this dialog:



Operator Action: Click on the desired test, or on **Cancel**. For information on each test, see the instructions in the appropriate section above. It may help to refer to the **Table of Contents**.

4 Testing Complete



Summary of Results for: Sample test

Worst case	Margin	Condition
Final results: 3 of 6 tests failed.		
M1 Oscilloscope Tools v6.05.2, AT DSO81204A, SN SLABIF201 4 GSa/s for 10 Kpts @ off/200/200/off mV/div, 5/27/2010 2:48:12 PM Thresholds: Ch. 2/3(0%/diff/0%)		
This is an individual test		
Passed	(459.745ps) 8%	Analysis1_SB2.Max > 500ps
Passed	(670.944mV) 27%	Analysis4_SB0.Max > 920mV
Failed	(1.574ns) -31%	Analysis1_SB2.Peak > 1.2ns
This is a second test		
Failed	(520.68ps) -4%	Analysis1_SB2.Max > 500ps

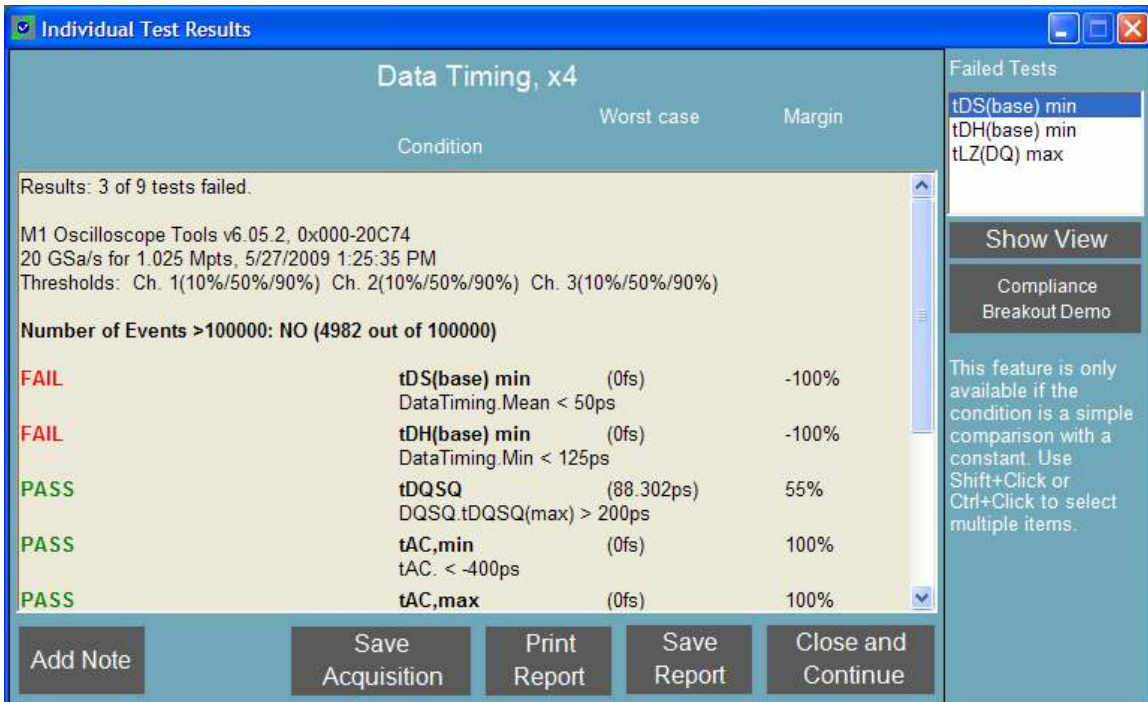
When testing is complete, a summary of all tests run will be presented in a dialog. At this time the operator should use **Add Note** to add any notes regarding any unexpected events during the test, and click on **Save Report** to save the results of the testing in an appropriate place and format.

Appendix A – Individual Test Results Dialog

The **Individual Test Results** dialog appears while acquisitions are being taken to perform a test. Some of the buttons on the bottom will be disabled while testing is being done; when they are all enabled, the test has completed. The operator should not take any action if any of the buttons on the bottom are disabled.

The main text display shows a summary line telling the overall results, as well as information about the scope being used, the acquisition settings of the scope, and the time the acquisitions started. The remainder of the main text display tells the status of each condition being tested (**PASS** or **FAIL**).

The **Add Note** button brings up a dialog that will let the operator enter a note about the test. If none of the tests failed, the right-hand portion of the dialog (“**Failed Tests**”) will not be



Individual Test Results

Data Timing, x4

Condition	Worst case	Margin
Results: 3 of 9 tests failed.		
M1 Oscilloscope Tools v6.05.2, 0x000-20C74 20 GSa/s for 1.025 Mpts, 5/27/2009 1:25:35 PM Thresholds: Ch. 1(10%/50%/90%) Ch. 2(10%/50%/90%) Ch. 3(10%/50%/90%)		
Number of Events >100000: NO (4982 out of 100000)		
FAIL	tDS(base) min (0fs) DataTiming.Mean < 50ps	-100%
FAIL	tDH(base) min (0fs) DataTiming.Min < 125ps	-100%
PASS	tDQSQ (88.302ps) DQSQ.tDQSQ(max) > 200ps	55%
PASS	tAC,min (0fs) tAC. < -400ps	100%
PASS	tAC,max (0fs)	100%

Failed Tests

- tDS(base) min
- tDH(base) min
- tLZ(DQ) max

Show View

Compliance Breakout Demo

This feature is only available if the condition is a simple comparison with a constant. Use Shift+Click or Ctrl+Click to select multiple items.

Add Note Save Acquisition Print Report Save Report Close and Continue

visible.

Appendix B – Parameters Tested

This appendix lists the parameters tested by this Compliance Test, in which section the parameter is tested, and which signal lines are tested. Section numbers refer to section numbers in this document.

Section	Parameter Name	Signals Tested
2.1 Single-Ended AC Input Tests, Address and Control	VIL(ac) min, max	CA0-CA9, CS0, CS1
	VIH(ac) min, max	CA0-CA9, CS0, CS1
	SLEW min (rise time)	CA0-CA9, CS0, CS1
	SLEW min (fall time)	CA0-CA9, CS0, CS1
	Max overshoot area above VDD	CA0-CA9, CS0, CS1
	Max undershoot area below VS	CA0-CA9, CS0, CS1
2.2 Single-Ended AC Tests, Data, Strobe, and Mask	Vmax (overshoot)	DQ0-DQn, DQS0-DQS _m
	Vmin (undershoot)	DQ0-DQn, DQS0-DQS _m
	Overshoot area	DQ0-DQn, DQS0-DQS _m
	Undershoot area	DQ0-DQn, DQS0-DQS _m
2.3 Differential Input Tests	VSEL(ac) min, max	CK, DQS0-DQS _m
	VSEH(ac) min, max	CK, DQS0-DQS _m
	VIX(ac) min, max	CK, DQS0-DQS _m
	Overshoot peak	CK, DQS0-DQS _m
	Undershoot peak	CK, DQS0-DQS _m
	Overshoot area	CK, DQS0-DQS _m
	Undershoot area	CK, DQS0-DQS _m

Section	Parameter Name	Signals Tested
2.4 Data Strobe	tDQSH min	CK, DQS0-DQS _m
	tDQSL min	CK, DQS0-DQS _m
	tDSS min	CK, DQS0-DQS _m
	tDSH min	CK, DQS0-DQS _m
	tWPST min, max	CK, DQS0-DQS _m
	tDQ _{SCK} min, max	CK, DQS0-DQS _m
	tQSH min	CK, DQS0-DQS _m
	tQSL min	CK, DQS0-DQS _m
	tLZ(DQS) min	CK, DQS0-DQS _m
	tHZ(DQS) min	CK, DQS0-DQS _m
	tRPRE min	CK, DQS0-DQS _m
	tRPST min	CK, DQS0-DQS _m
SRQdiff min, max	CK, DQS0-DQS _m	
2.5 Data Timing	tDS min	DQ0-DQ _n
	tDH min	DQ0-DQ _n
	tDIPW min	DQ0-DQ _n
	tDQSQ max	DQ0-DQ _n
	tLZ(DQ) min	DQ0-DQ _n
	tHZ(DQ) min	DQ0-DQ _n
	SRQse min, max	DQ0-DQ _n
	tQHP min	DQ0-DQ _n

Section	Parameter Name	Signals Tested
	tQH min	DQ0-DQn
2.6 Clock Timing	tCK(avg) min, max	CK
	tCK(abs) min	CK
	tCH(avg) min, max	CK
	tCH(abs) min, max	CK
	tCL(avg) min, max	CK
	tCL(abs) min, max	CK
	tJIT(per) min, max	CK
	tJIT(cc) max	CK
	tERR(2per) through tERR(50per) min, max	CK
2.7 Command and Address Timing	tIS(base) min	CA0-CA9, CS0, CS1
	tIH(base) min	CA0-CA9, CS0, CS1
	tIPW min	CA0-CA9, CS0, CS1