R&S[®]RTO-K92 eMMC Compliance Test Test Procedures







Test & Measurement

Test Procedures

This manual describes the eMMC compliance test procedures with the following options:

• R&S®RTO-K92 (1329.6958.02)/(1333.0444.02) -eMMC

The tests require the R&S ScopeSuite software.

The software contained in this product makes use of several valuable open source software packages. For information, see the "Open Source Acknowledgement" document, which is available for download from the R&S RTO product page at http://www.rohde-schwarz.com/product/rto.html > "Software".

Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

© 2016 Rohde & Schwarz GmbH & Co. KG Mühldorfstr. 15, 81671 München, Germany Phone: +49 89 41 29 - 0 Fax: +49 89 41 29 12 164 Email: info@rohde-schwarz.com Internet: www.rohde-schwarz.com Subject to change – Data without tolerance limits is not binding. R&S[®] is a registered trademark of Rohde & Schwarz GmbH & Co. KG.

Trade names are trademarks of the owners.

The following abbreviations are used throughout this manual: R&S[®]RTO is abbreviated as R&S RTO, and R&S[®]ScopeSuite is abbreviated as R&S ScopeSuite.

Contents

1	R&S ScopeSuite Overview7
2	Preparing the Measurements9
2.1	Test Equipment9
2.2	Installing Software and License9
2.3	Setting Up the Network10
2.4	Starting the R&S ScopeSuite10
2.5	Connecting the R&S RTO11
2.6	Report Configuration12
3	Performing Tests14
3.1	Starting a Test Session14
3.2	Configuring the Test15
3.2.1	General Test Settings 15
3.2.2	eMMC Test Configuration17
3.3	Getting Test Results18
4	HS200 Tests20
4.1	Starting HS200 Tests
4.2	Connecting Probes to the DUT20
4.3	HS200 CLK test
4.3.1	Test Equipment
4.3.2	Performing the Tests21
4.3.3	Purpose
4.3.4	Test Setup22
4.3.5	Measurements
4.4	HS200 CMD Push Pull test
4.4.1	Test Equipment
4.4.2	Performing the Tests
4.4.3	Purpose
4.4.4	Test Setup
4.4.5	Measurements
4.5	HS200 CMD Open Drain test

4.5.1	Test Equipment	36
4.5.2	Performing the Tests	36
4.5.3	Purpose	37
4.5.4	Test Setup	38
4.5.5	Measurements	39
4.6	HS200 Data Write test	41
4.6.1	Test Equipment	41
4.6.2	Performing the Tests	41
4.6.3	Purpose	42
4.6.4	Test Setup	42
4.6.5	Measurements	43
4.7	HS200 Data Read test	47
4.7.1	Test Equipment	47
4.7.2	Performing the Tests	47
4.7.3	Purpose	48
4.7.4	Test Setup	48
4.7.5	Measurements	49
5	HS400 Tests	51
5 5.1	HS400 Tests Starting HS400 Tests	
-		51
5.1	Starting HS400 Tests	51 51
5.1 5.2	Starting HS400 Tests Connecting Probes to the DUT	51 51 52
5.1 5.2 5.3	Starting HS400 Tests Connecting Probes to the DUT HS400 CLK test	51 51 52 52
5.1 5.2 5.3 5.3.1	Starting HS400 Tests Connecting Probes to the DUT HS400 CLK test Test Equipment.	51 51 52 52
5.1 5.2 5.3 5.3.1 5.3.2	Starting HS400 Tests Connecting Probes to the DUT HS400 CLK test Test Equipment Performing the Tests	51 51 52 52 52 53
5.1 5.2 5.3 5.3.1 5.3.2 5.3.3	Starting HS400 Tests. Connecting Probes to the DUT. HS400 CLK test. Test Equipment. Performing the Tests. Purpose.	51 51 52 52 52 53 53
5.1 5.2 5.3 5.3.1 5.3.2 5.3.3 5.3.4	Starting HS400 Tests. Connecting Probes to the DUT. HS400 CLK test. Test Equipment. Performing the Tests. Purpose. Test Setup.	51 52 52 52 53 53 54
5.1 5.2 5.3 5.3.1 5.3.2 5.3.3 5.3.4 5.3.5	Starting HS400 Tests. Connecting Probes to the DUT. HS400 CLK test. Test Equipment. Performing the Tests. Purpose. Test Setup. Measurements.	51 51 52 52 52 53 53 54 59
 5.1 5.2 5.3 5.3.2 5.3.3 5.3.4 5.3.5 5.4 	Starting HS400 Tests Connecting Probes to the DUT HS400 CLK test Test Equipment Performing the Tests Purpose Test Setup Measurements HS400 CMD Push Pull test	51 52 52 52 52 53 53 54 59 59
 5.1 5.2 5.3 5.3.2 5.3.3 5.3.4 5.3.5 5.4 	Starting HS400 Tests. Connecting Probes to the DUT. HS400 CLK test. Test Equipment. Performing the Tests. Purpose. Test Setup. Measurements. HS400 CMD Push Pull test. Test Equipment.	51 51 52 52 52 53 53 54 59 59 59
 5.1 5.2 5.3 5.3.2 5.3.3 5.3.4 5.3.5 5.4 5.4.2 	Starting HS400 Tests Connecting Probes to the DUT HS400 CLK test Test Equipment Performing the Tests Purpose Test Setup Measurements. HS400 CMD Push Pull test Test Equipment Performing the Tests.	51 52 52 52 53 53 54 59 59 59 59
 5.1 5.2 5.3 5.3.3 5.3.4 5.3.5 5.4 5.4.1 5.4.2 5.4.3 	Starting HS400 Tests. Connecting Probes to the DUT. HS400 CLK test. Test Equipment. Performing the Tests. Purpose. Test Setup. Measurements. HS400 CMD Push Pull test. Test Equipment. Performing the Tests. Purpose. Puspose. Puspose. Puspose. Puspose. Puspose. Puspose. Performing the Tests. Performing the Tests. Purpose.	51 52 52 52 53 53 54 59 59 59 60 61

5.5.1	Test Equipment	67
5.5.2	Performing the Tests	67
5.5.3	Purpose	68
5.5.4	Test Setup	69
5.5.5	Measurements	70
5.6	HS400 Data Write test	72
5.6.1	Test Equipment	72
5.6.2	Performing the Tests	72
5.6.3	Purpose	73
5.6.4	Test Setup	73
5.6.5	Measurements	74
5.7	HS400 Data Read test	79
5.7.1	Test Equipment	79
5.7.2	Performing the Tests	79
5.7.3	Purpose	80
5.7.4	Test Setup	80
5.7.5	Measurements	81
5.8	HS400 Data Strobe Test	85
5.8.1	Test Equipment	85
5.8.2	Performing the Tests	86
5.8.3	Purpose	86
5.8.4	Test Setup	87
5.8.5	Measurements	88

1 R&S ScopeSuite Overview

The R&S ScopeSuite software is used with R&S RTO oscilloscopes. It can be installed on a test computer or directly on the R&S RTO if the instrument has the Windows 7 operating system.

RSScopeSuite					_ 🗆 🗙
			Tile View	() About	🕐 Help
Settings	Compliance Tes	sts	📌 BroadR-Re	each	
			📌 Demo		
	***		📌 D-PHY		
			📌 eMMC		
Oscilloscope	BroadR-Reach	D-PHY	📌 Ethernet		
			📌 Ethernet 1	0G	
Ö.		***	📌 USB 2.0		
	_	1 G	📌 Unpin All		
Instruments	eMMC	Ethernet			
		e → H			
Report	Ethernet 10G	USB			
	Demo				
Welcome to complian	ice tests selection scr	een.			

The R&S ScopeSuite main panel has several areas:

- "Settings": connection settings to oscilloscope and other instruments as well as default report settings
- "Compliance Tests": selection of the compliance test
- "Demo": accesses demo test cases that can be used for trying out the software without having a connection to an oscilloscope
- "Help": opens the help file, conatining information about the R&S ScopeSuite configuration
- "About": gives information about the R&S ScopeSuite software
- "Tile View": allows a personalization of the compliance test selection You can configure which tests are visible in the compliance test section and which are hidden, so that only the ones you use are displayed.
- ► To hide a test from the "Compliance Tests" view do one of the following:

Right-click on the compliance test you want to hide.
 The icon of the test changes, see Figure 1-1. Now with a left click you can hide the test



Figure 1-1: Unpin icon

b) Click on "Title View" to show a list of the available test cases. By clicking on a test case in the show list you can pin/unpin it from the main panel.

2 Preparing the Measurements

2.1 Test Equipment

For eMMC compliance tests, the following test equipment is needed:

- R&S RTO oscilloscope with at least 1 GHz bandwidth
- A probe with at least 1 GHz bandwidth
- R&S RTO-K92 eMMC compliance test option (required option, installed on the R&S RTO)

2.2 Installing Software and License

The preparation steps have to be performed only once for each computer and instrument that are used for testing.

NOTICE

Uninstall older versions of the R&S ScopeSuite

If an older version of the R&S ScopeSuite is installed, make sure to uninstall the old version before you install the new one. You can find the version number of the current installation in "Help" menu > "About". To uninstall the R&S ScopeSuite, use the Windows Control Panel > "Programs".

To install the R&S ScopeSuite

- Download the R&S ScopeSuite software from the "Software" section on the Rohde & Schwarz R&S RTO website: www.rohde-schwarz.com/product/rto.html.
- 2. Install the R&S ScopeSuite software:
 - Either on the computer that is used for testing,
 - or on the R&S RTO if the instrument has a Windows 7 operating system.

To install the license key on the R&S RTO

When you got the license key of the compliance test option, enable it on the R&S RTO using SETUP > "SW Options". For a detailed description, refer to the R&S RTO User Manual, chapter "Installing Options", or to the online help on the instrument.

2.3 Setting Up the Network

If the R&S ScopeSuite software runs on a test computer, the computer and the testing R&S RTO require a LAN connection.

There are two ways of connection:

- LAN (local area network): It is recommended that you connect to a LAN with DHCP server. This server uses the Dynamic Host Configuration Protocol (DHCP) to assign all address information automatically.
 If no DHCP server is available, or if the Tabor WX2182B is used for automatic testing, assign fixed IP adresses to all devices.
- Direct connection of the instruments and the computer or connection to a switch using LAN cables: Assign fixed IP addresses to the computer and the instruments and reboot all devices.

To set up and test the LAN connection

- 1. Connect the computer and the instruments to the same LAN.
- 2. Start all devices.
- 3. If no DHCP server is available, assign fixed IP addresses to all devices.
- 4. Ping the instruments to make sure that the connection has been established.
- 5. If VISA is installed, check if VISA can access the instruments.
 - a) Start VISA on the test computer.
 - b) Validate the VISA address string of each device.

See also:

Chapter 2.5, "Connecting the R&S RTO", on page 11

2.4 Starting the R&S ScopeSuite

To start the R&S ScopeSuite on the test computer or on the oscilloscope:

Double-click the R&S ScopeSuite program icon.

To start the R&S ScopeSuite on the instrument, in the R&S RTO firmware:

On the "Analysis" menu, tap "Start Compliance Test".

2.5 Connecting the R&S RTO

If the R&S ScopeSuite is installed directly on the instrument, the software detects the R&S RTO firmware automatically, and the "Oscilloscope" button is not available in the R&S ScopeSuite.

If the R&S ScopeSuite software runs on a test computer, the computer and the testing R&S RTO require a LAN connection, see Chapter 2.3, "Setting Up the Network", on page 10. The R&S ScopeSuite software needs the IP address of the R&S RTO to establish connection.

- 1. Start the R&S RTO.
- 2. Start the R&S ScopeSuite software.
- 3. Click "Settings" > "Osilloscope".

RSScopeSuite							- 🗆 ×
				Ti 🐻	le View	About	Help
Settings	Compliance Te	sts			roadR-Re Demo	ach	
	- -)-PHY		
Oscilloscope	BroadR-Reach	D-PHY		📌 E	thernet		
				📌 E	thernet 10)G	
Ö.				📌 U	JSB 2.0		
Instruments	eMMC	1g Ethernet		∳ U	Inpin All		
Report	Ethernet 10G	USB					
	Demo						
Welcome to complia	nce tests selection scr	een.					

- Enter the IP address of the R&S RTO.
 To obtain the IP address: Press the SETUP key on the instrument and tap the "System" tab.
- 5. Click "Get Instrument Information".

The computer connects with the instrument and gets the instrument data.

Report Configuration

RSScopeSuite	_ 🗆 ×
G Back Oscilloscope Settings	ut 🕐 Help
Oscilloscope	
Get Instrument Information	
Device: RTO	
Serial Number: 400132	
Firmware Version: 2.60.2.7	
Restore Settings On Exit: 💿 Never 🔿 Ask 🔿 Always	
Connect software to your RTO.	

If the connection fails, an error message is shown.

2.6 Report Configuration

In the "Report Configuration" menu, you can select the format of the report and the details to be included in the report. You can also select an icon that will be displayed in the upper left corner of the report.

Additionally, you can enter common information on the test that will be written in the "General Information" section of the test report.

Report Configuration

RSScopeSuite _ 🗆								×			
G Back Report Settings								0	About	0	Help
Content	Format		Icon								
Display Summary 💽	/	PDF			£3	Change					
Display Detail 💽	/	O Word Document		×¥							
Display Screenshots	/										
User Input											
Device Under Test (DUT)											
User											
Site											
Temperature											
Comments											
Configure default settings for new s	session										

3 Performing Tests

3.1 Starting a Test Session

R&S ScopeSuite				×
🕒 Back Complian	nce Tests eMMC			1 About 9 Help
Select Type • HS200	○ HS400			
Session Name	Last Accessed	Comment		
HS20020160115_170948	1/15/2016 5:09:48 PM	DUT Nr.300		
HS20020160113_103116	1/15/2016 4:53:09 PM	DUT Nr. 423		
		_		
🕂 Add 🖬 Open	Remove 🖳 Rem	ame 📕 Comment	🖹 Show Report	
Add new or open existing se	ession to run.			

After you open a compliance test the "Session Selection" dialog appears. In this dialog you can create new sessions, open or view existing report.

The following functions are available for handling test sessions:

Function	Description
"Add"	Adds a new session
"Open"	Opens the selected session
"Remove"	Removes the selected session
"Rename"	Changes the "Session Name"
"Comment"	Adds a comment
"Show report"	Generates a report for the selected session

3.2 Configuring the Test

- 1. In the R&S ScopeSuite window, select the compliance test to be performed:
 - "eMMC"
- 2. Open a test session, see Chapter 3.1, "Starting a Test Session", on page 14.
- 3. Adjust the "Properties" settings for the test cases you want to perform.
- 4. Click "Limit Manager" and edit the limit criterias, see Chapter 3.2.1.1, "Limit Manager", on page 16.
- If you want to use special report settings the "Report Config" tab to define the format and contents of the report. Otherwise the settings defined in "RSScopeSuite" > "Settings" > "Report" will be used. See Chapter 2.6, "Report Configuration", on page 12.
- 6. Click "Test Checked"/"Test Single" and proceed as descibed in the relevant test case chapter.

3.2.1 General Test Settings

RSScopeSuite	_ □ ×
G Back Session HS200_20160205_112008	C Show Report About Help
All	Properties Limit Manager Results Report Config
CLK	DUT Setup
CMD	Vccq 1.8 V
Push Pull	
Open Drain	Data Line 0 •
DAT	Measurement Time 1000 Clock Cycles
□ ▼ Data Write	Maximum Wait Time for Data 0.001 s
Data Read	Triggaring CMD
	Triggering CMD
	Push Pull CMD 25: WRITE_MULTIPLE_BLOCK 🔻
	Open Drain CMD 2: ALL_SEND_CID
	DAT Write CMD 25: WRITE_MULTIPLE_BLOCK 🔻
	DAT Read CMD 18: READ_MULTIPLE_BLOCK 💌
Test Checked	
Ready to run.	

Each session dialog is divided into several sections:

 "Properties": shows the settings that can be made for the test case selected on the left side of the dialog. You can differentiate between the "All" and the sub test properties

In the "All" > "Properties" tab you can configure the settings for all test cases in the current session. Once you change and save a setting in this tab the changes will be done for all test in the sessions. At the same time there will be a special marking for the functions that have different settings for different sub tests.

- "Limit Manager": sets the measurement limits that are used for compliance testing, see Chapter 3.2.1.1, "Limit Manager", on page 16.
- "Results": shows an overview of the available test results for this session.
- "Instruments": defines instruments settings for connecting to external devices, that are specific for this t est session.
 When a session is first created the global settings ("RSScopeSuite" > "Settings" > "Instruments") are copied to the session. This "Instruments" tab can be used to change those copied defaults.
- "Report Config": defines the format and contents of the report for this session. When a session is first created the global settings ("RSScopeSuite" > "Settings" > "Report") are copied to the session. This "Report Config" tab can be used to change those copied defaults.
- "Test Checked"/ "Test Single": starts the selected test group.

3.2.1.1 Limit Manager

The "Limit Manager" shows the measurement limits that are used for compliance testing.

Each limit comprises the comparison criterion, the unit, the limit value A, and a second limit value B if the criterion requires two limits.

You can set the values to defaults, change the values in the table, export the table in xml format, or import xml files with limit settings.

Check and adjust the measurement limits.

Configuring the Test

Properties	Limit Manager	Results	Rep	ort Config			
Measureme	nt		Criteria		Unit	А	В
CLK Frequer	ncy: tPERIOD		x>=A	•	s	5E-09	
CLK Rise Tin	ne Percent of Pe	riod: tTLH	x<=A	•	%	20	
CLK Fall Tim	e Percent of Per	iod: tTHL	x<=A	•	%	20	
CLK Duty Cy	/cle		A<=x<	=B ▼	%	30	70
CMD Input	Setup Time: tISU	(CMD)	x>=A	Ψ	s	1.4E-09	
CMD Input	Hold Time: tIH(C	MD)	x>=A	•	s	8E-10	
DAT Input S	etup Time: tISU(DAT)	x>=A	Ψ	s	1.4E-09	
DAT Input H	lold Time: tIH(D/	AT)	x>=A	•	s	8E-10	

3.2.2 eMMC Test Configuration

The test configuration consists of some test-specific configuration settings.

╆ Import

Getting Test Results

RSScopeSuite								□ ×	<
🕒 Back	Session HS200_20160128_155017			🔓 Sho	ow Report	1 Abou	t (Help	l
•	All	Properties	Limit Manager	Results	Report Cor	nfig			
	▼ CLK	DUT Setu	ıp						
	▲ CMD		Vccc	1.8	v				
	▼ Push Pull		Data Line	0 -	1				
	Open Drain DAT		Measurement Time			05			
	▼ Data Write		Wait Time for Data		Clock Cycles				
	▼ Data Read	Waximum	wait time for Data	0.001	s				
		Triggerin	g CMD						
			Push Pul	CMD 25: V	WRITE_MULT	IPLE_BLOCK	•		
		Open Drain CMD 2: ALL_SEND_CID)	•			
		DAT Write CMD 25: WRITE_MULTIPLE_BLOCK				-			
			DAT Read	CMD 18: READ_MULTIPLE_BLOCK V			•		
Test Che	cked								
Ready to run.									

Figure 3-1: Configuration for eMMC compliance tests

 V_{ccq}

Sets the supply voltage for the I/O.

 V_{cc}

Sets the supply voltage for the core.

Data Line

Selects the data line.

Measurement time

Sets the measurement time as the number of entered clock cycles.

Maximum Wait Time for Data

Sets the maximum wait time for data.

Triggering CMD

Select the triggering CMD condition. The settings are dependant on the selected test case.

3.3 Getting Test Results

For each test, the test data - report, diagrams and waveform files - is saved in the following folder: %ProgramData%\Rohde-Schwarz\RSScopeSuite\3.0\Sessions\eMMC\
<Session Name>

If you resume an existing session, new measurements are appended to the report, new diagrams and waveform files are added to the session folder. Existing files are not deleted or replaced. Sessions data remain until you delete them in the "Results" tab of the session.

The report format can be defined in "RSScopeSuite" > "Settings" > "Report" for all compliance tests (see also Chapter 2.6, "Report Configuration", on page 12). If you want to use special report settings for a session, you can define the format and contents of the report in the "Report Config" tab of the session.

All test results are listed in the "Results" tab. Reports can be provided in PDF, MSWord, or HTML format. To view and print PDF reports, you need a PDF viewer, for example, the Acrobat Reader.

The test report file can be created at the end of the test, or later in the "Session Selection" dialog.

To show a test report

- 1. In the R&S ScopeSuite window, select the compliance test to be performed.
- 2. Select the session name in the "Session Selection" dialog and click "Show report".

The report opens in a separate application window, depending on the file format. You can check the test results and print the report.

To delete the results, diagrams and waveform files of a session

- 1. In the "Session Selection" dialog select the session and open it.
- 2. In the "Results" tab, select the result to be deleted.
- 3. Click "Remove".

4 HS200 Tests

4.1 Starting HS200 Tests

- 1. Select "eMMC" in the R&S ScopeSuite start window.
- 2. In the "Session Selection" dialog, set "Select Type" > "HS200".
- Add a new test session and open it, see Chapter 3.1, "Starting a Test Session", on page 14.
- 4. Check the test configuration settings and adjust, if neccessary. See:
 - Chapter 3.2.2, "eMMC Test Configuration", on page 17
 - Chapter 3.2.1.1, "Limit Manager", on page 16
- 5. Select/check the test cases you want to run and click "Test Single"/"Test checked".
- 6. A step-by step guide explains the following individual setup steps. When you have finished all steps of the step-by-step guide, the compliance test runs automatically.

4.2 Connecting Probes to the DUT

In order to get precise test results it is important to consider the experimental setup.

Special care should be taken when connecting the probes to the DUT as the connection may affect the resulting measurement bandwidth. Especially when doing measurements in the HS400 Mode with data rates of up to 400 MBit/s you should make sure that the measurement signal bandwidth of 1 GHz is available. Smaller measurement bandwidth may lead to incorrect results.

There are different solutions you can use for connecting the probes to the DUT such as flexible sockets, special interposers or dedicated measurement points. It is important to consider during the design of your DUT.

4.3 HS200 CLK test

4.3.1 Test Equipment

Item	Description, model	Quantity
Rohde & Schwarz oscilloscope	R&S RTO with minimum 1 GHz bandwidth	1
Probe	Probe with minimum 1 GHz band- width	1
DUT	eMMC device that supports HS200	1

4.3.2 Performing the Tests

- 1. Start the test as described in Chapter 4.1, "Starting HS200 Tests", on page 20.
- 2. Select "CLK".

R&S ScopeS	uite	_ □ >
🕒 Back	Session HS200_20151222_155712	🖹 Show Report 🚺 About 👔 Help
•	All	Properties Limit Manager Results Instruments Report Config
	▲ CLK	DUT Setup
	VIH (10.5.2)	Vccq 1.8 V
	VIL (10.5.2)	
	tPERIOD (10.8.1)	Measurement Time 1000 Clock Cycles
	tTLH - Rise time (10.8.1)	
	tTHL - Fall time (10.8.1)	
	Duty Cycle (10.8.1)	
	▼ CMD	
	▲ DAT	
	▼ Data Write	
	▼ Data Read	
🔄 Test Cl	hecked 🕨 Test Single	
Ready to run		

- 3. Click "Test Single".
- Follow the instructions of the step-by step guide.
 When you have finished all steps, the compliance test runs automatically.

4.3.3 Purpose

The purpose of CLK test case is to verify bus signal levels and timing requirements specific to eMMC device clock signal.

4.3.4 Test Setup



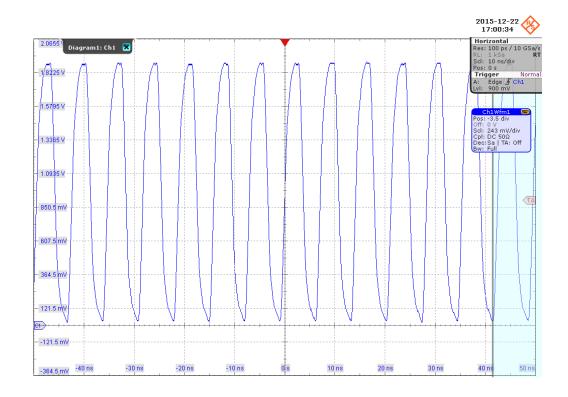
The software will guide you to make proper connections and follow a few steps to conduct the test.

The software is intended to facilitate the execution of a set of measurements on the clock signal.

4.3.4.1 Waveform Requirements

A typical eMMC CLK signal waveform from this test case is shown in the figure below.

HS200 CLK test



The software requires a single capture of CLK signal to perform the test and measurement correctly and successfully.

4.3.5 Measurements

HS200 CLK test case consists of 6 measurements which perform bus signal levels and timing tests on a single capture of the CLK signal.

4.3.5.1 Input High Level Voltage (VIH)

Purpose

The purpose of this test case is to verify the Input High Level Voltage (V_{IH}) of the CLK signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture a certain length of clock signal waveform according to the "Measurement Time" set in the "Configuration" tab.

 V_{IH} is measured using the R&S RTO "High" measurement against the whole waveform, as shown in Figure 4-1.

The conformance range for V_{IH} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

HS200 CLK test

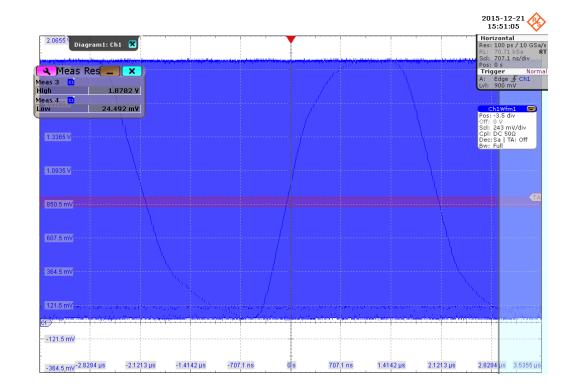


Figure 4-1: HS200 CLK input level voltage

4.3.5.2 Input Low Level Voltage (VIL)

Purpose

The purpose of this test case is to verify the Input Low Level Voltage (V_{IL}) of the CLK signal is within the conformance limits.

Measurements

Measures the clock frequency and then captures a certain length of clock signal waveform according to the "Measurement Time" set in the "Configuration" tab.

 V_{IL} is measured using the R&S RTO "Low" measurement against the whole waveform, as shown in Figure 4-1.

The conformance range for V_{IL} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

4.3.5.3 Period (T_{PERIOD})

Purpose

The purpose of this test case is to verify the period of the CLK signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture a certain length of clock signal waveform according to the "Measurement Time" set in the "Configuration" tab.

 T_{PERIOD} is measured using the R&S RTO "Period " measurement against the whole waveform, as shown in Figure 4-2. "Statistics" is enabled and the "Minimum" value is used as the final result.

The conformance range for T_{PERIOD} is specified in the tables of the JESD84-B50 standard (Section 10.8.1 HS200 Clock Timing).

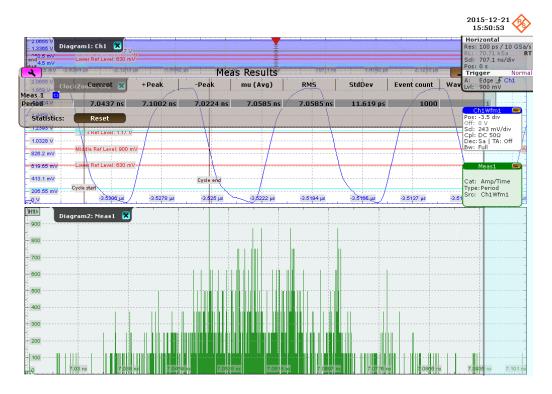


Figure 4-2: Period meausurement

4.3.5.4 Rise Time (T_{TLH})

Purpose

The purpose of this test case is to verify the rise time of the CLK signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture a certain length of clock signal waveform according to the "Measurement Time" set in the "Configuration" tab.

 T_{TLH} is measured using the R&S RTO "Rise Time" measurement against the whole waveform, see Figure 4-3. "Statistics" is enabled and the "Maximum" value is used as the final result.

The conformance range for T_{TLH} is specified in the tables of the JESD84-B50 standard (Section 10.8.1 HS200 Clock Timing).

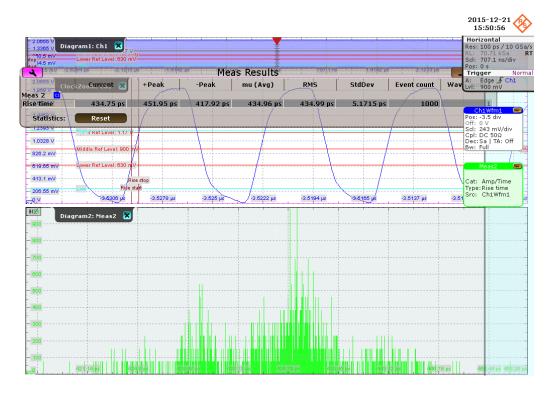


Figure 4-3: HS200 CLK rise time measurement

4.3.5.5 Fall Time (T_{TLL})

Purpose

The purpose of this test case is to verify the fall time of the CLK signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture a certain length of clock signal waveform according to the "Measurement Time" set in the "Configuration" tab.

 T_{TLL} is measured using the R&S RTO "Fall Time" measurement against the whole waveform, as shown in the figure below. "Statistics" is enabled and "Maximum" value is used as the final result.

The conformance range for T_{TLL} is specified in the tables of the JESD84-B50 standard (Section 10.8.1 HS200 Clock Timing).

4.3.5.6 Duty Cycle

Purpose

The purpose of this test case is to verify the duty cycle of the CLK signal is within the conformance limits.

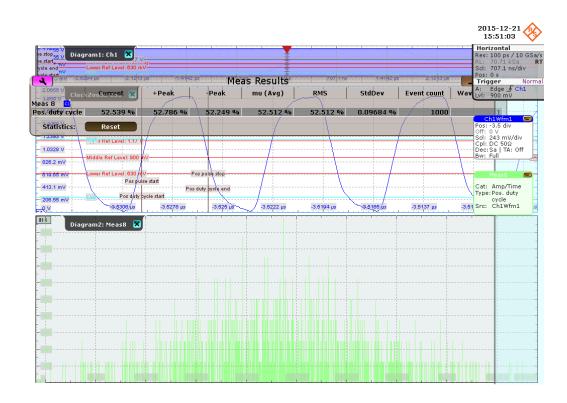
Measurements

Measure the clock frequency and then capture a certain length of clock signal waveform according to the Measurement Time set in the "Configuration" tab.

Duty Cycle is measured using the R&S RTO "Positive Duty Cycle" measurement against the whole waveform, as shown in the figure below. "Statistics" is enabled and "Maximum" and "Minimum" values are reported as the final results.

The conformance range for Duty Cycle is specified in the tables of the JESD84-B50 standard (Section 10.8.1 HS200 Clock Timing).

HS200 CMD Push Pull test



4.4 HS200 CMD Push Pull test

4.4.1 Test Equipment

Item	Description, model	Quantity
Rohde & Schwarz oscilloscope	R&S RTO with minimum 1 GHz bandwidth	1
Probe	Probe with minimum 1 GHz band- width	1
DUT	eMMC device that supports HS200	1

4.4.2 Performing the Tests

- 1. Start the test as described in Chapter 4.1, "Starting HS200 Tests", on page 20.
- 2. Select "CMD" > "Push Pull".

R&S ScopeSuite	,
Back Session HS200_20151222_155712	🖹 Show Report 🕕 About 🕐 Help
All	Properties Limit Manager Results Instruments Report Config
CLK	DUT Setup
CMD	Vccq 1.8 V
Push Pull	Viciq 1.8
VIH (10.5.2)	Triggering CMD
VIL (10.5.2)	CMD Push Pull CMD 25: WRITE_MULTIPLE_BLOCK 🔻
VOH (10.5.2)	
VOL (10.5.2)	
tISU - Setup time (10.8.1)	
tIH - Hold time (10.8.1)	
Open Drain	
▲ DAT	
Data Write Data Read	
Vata Keau	
Test Checked Test Single	
Ready to run.	

- 3. Click "Test Single".
- Follow the instructions of the step-by step guide.
 When you have finished all steps, the compliance test runs automatically.

4.4.3 Purpose

The purpose of CMD Push Pull test case is to verify bus signal levels and timing requirements specific to eMMC device command signal in Push Pull mode.

4.4.4 Test Setup



The software will guide you to make proper connections and follow a few steps to conduct the test.

The software is intended to facilitate the execution of a set of measurements on the clock and command signals under Push Pull mode.

4.4.4.1 Waveform Requirements

A typical eMMC Command with Clock signal waveforms in Push Pull mode from this test case are as shown in the figure below.

HS200 CMD Push Pull test



The software requires a single capture of CMD and CLK signals to perform the test and measurement correctly and successfully.

4.4.5 Measurements

HS200 CMD Push Pull test case consists of 6 test measurements which perform bus signal levels and timing tests on a single capture of the CMD with CLK signals.

4.4.5.1 Input High Level Voltage (VIH)

Purpose

The purpose of this test case is to verify the Input High Level Voltage (V_{IH}) of the CMD signal in Push Pull mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the command with response and clock signal waveforms according to the "CMD Push Pull" set in the "Configuration " tab.

 V_{IH} is measured using the R&S RTO "High" measurement against the portion of the host command, as shown in Figure 4-4.

The conformance range for V_{IH} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

HS200 CMD Push Pull test

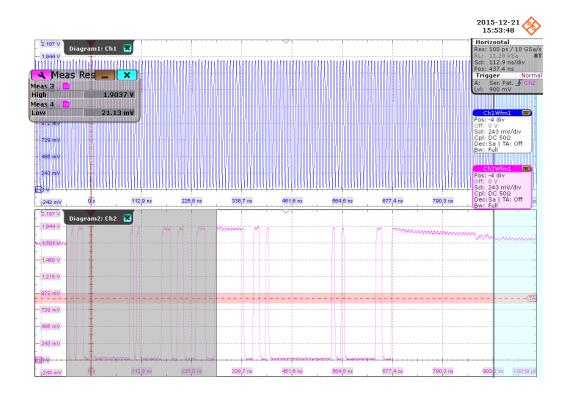


Figure 4-4: HS200 CMD Push Pull input level voltage

4.4.5.2 Input Low Level Voltage (VIL)

Purpose

The purpose of this test case is to verify the Input Low Level Voltage (VIL) of the CMD signal in Push Pull mode is within the conformance limits

Measurements

Measure the clock frequency and then capture the command with response and clock signal waveforms according to the "CMD Push Pull" set in the "Configuration" tab.

 V_{IL} is measured using the R&S RTO "Low" measurement against the portion of the host command, as shown in Figure 4-4.

The conformance range for V_{IL} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

4.4.5.3 Output High Level Voltage (V_{OH})

Purpose

The purpose of this test case is to verify the Output High Level Voltage (V_{OH}) of the CMD signal in Push Pull mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the command with response and clock signal waveforms according to the "CMD Push Pull" set in the "Configuration" tab.

 V_{OH} is measured using the R&S RTO "High" measurement against the portion of the command response, as shown in Figure 4-5.

The conformance range for V_{OH} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

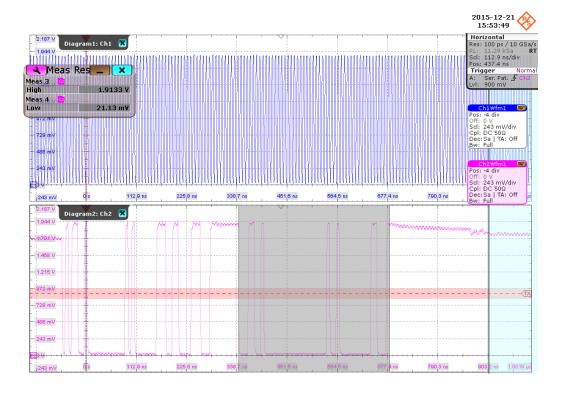


Figure 4-5: HS200 CMD Push Pull output level voltage

4.4.5.4 Output Low Level Voltage (V_{OL})

Purpose

The purpose of this test case is to verify the Output Low Level Voltage (V_{OL}) of the CMD signal in Push Pull mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the command with response and clock signal waveforms according to the "CMD Push Pull" set in the "Configuration" tab.

 V_{OL} is measured using the R&S RTO "Low" measurement against the portion of the command response, as shown in Figure 4-5.

The conformance range for V_{OL} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

4.4.5.5 Setup Time (T_{ISU})

Purpose

The purpose of this test case is to verify the setup time of the CMD signal in Push Pull mode is within the conformance limits.

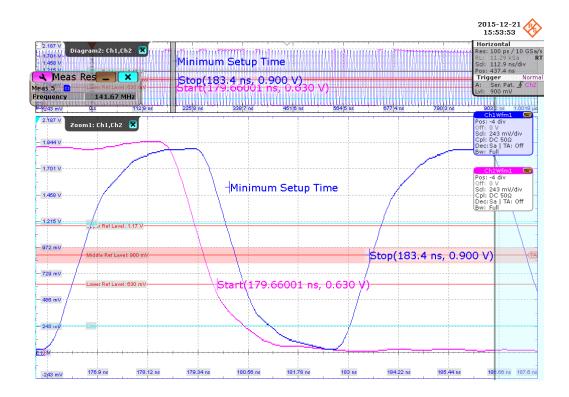
Measurements

Measure the clock frequency and then capture the command with response and clock signal waveforms according to the "CMD Push Pull" set in the "Configuration" tab.

 T_{ISU} is calculated based on the R&S RTO "Edge detection" against the portion of the host command, as shown in the figure below. Minimum setup time is reported as the final result.

The conformance range for T_{ISU} is specified in the tables of the JESD84-B50 standard (Section 10.8.2 HS200 Device Input Timing).

HS200 CMD Push Pull test



4.4.5.6 Hold Time (T_{IH})

Purpose

The purpose of this test case is to verify the hold time of the CMD signal in Push Pull mode is within the conformance limits.

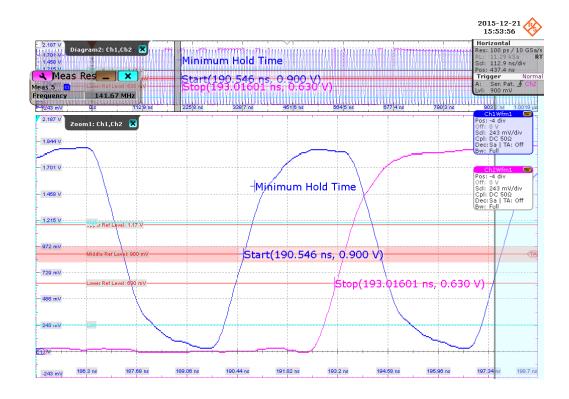
Measurements

Measure the clock frequency and then capture the command with response and clock signal waveforms according to the "CMD Push Pull" set in the "Configuration" tab.

 T_{IH} is calculated based on the R&S RTO "Edge detection" against the portion of the host command, as shown in the figure below. Minimum hold time is reported as the final result.

The conformance range for T_{IH} is specified in the tables of the JESD84-B50 standard (Section 10.8.2 HS200 Device Input Timing).

HS200 CMD Open Drain test



4.5 HS200 CMD Open Drain test

4.5.1 Test Equipment

Item	Description, model	Quantity
Rohde & Schwarz oscilloscope	R&S RTO with minimum 1 GHz bandwidth	1
Probe	Probe with minimum 1 GHz band- width	1
DUT	eMMC device that supports HS200	1

4.5.2 Performing the Tests

- 1. Start the test as described in Chapter 4.1, "Starting HS200 Tests", on page 20.
- 2. Select "CMD" > "Open Drain".

HS200 CMD Open Drain test

R&S ScopeS	uite						_
🕒 Back	Session HS200_20151222_155712			👌 Sh	iow Report	About	P Help
•	All	Properties	Limit Manager	Results	Instruments	Report Conf	īg
	▼ CLK	DUT Setu	р				
	▲ CMD		Vcc	q 1.8	V		
	▼ Push Pull		VCO	4 1.0	v		
	▲ Open Drain	Triggerin	g CMD				
	VOH (10.5.1)		CMD Open Drai	n CMD 2: A	LL_SEND_CID	~	
	VOL (10.5.1)						
	▲ DAT						
	▼ Data Write						
	▼ Data Read						
🔄 Test Cl	hecked Fast Single						
Ready to run							

- 3. Click "Test Single".
- Follow the instructions of the step-by step guide.
 When you have finished all steps, the compliance test runs automatically.

4.5.3 Purpose

The purpose of CMD Open Drain test case is to verify bus signal levels requirements specific to eMMC device command signal in Open Drain mode.

4.5.4 Test Setup



The software will guide you to make proper connections and follow a few steps to conduct the test.

The software is intended to facilitate the execution of a set of measurements on the clock and command signals under Open Drain mode.

4.5.4.1 Waveform Requirements

A typical eMMC Command with Clock signal waveforms in Open Drain mode from this test case are as shown in the figure below:

HS200 CMD Open Drain test



The software requires a single capture of CMD and CLK signals to perform the test and measurement correctly and successfully.

4.5.5 Measurements

HS200 CMD Open Drain test case consists of 2 measurements which perform bus signal levels tests on a single capture of the CMD with CLK signals.

4.5.5.1 Output High Level Voltage (V_{OH})

Purpose

The purpose of this test case is to verify the Output High Level Voltage (V_{OH}) of the CMD signal in Open Drain mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the command with response and clock signal waveforms according to the "CMD Open Drain" set in the "Configuration" tab.

 V_{OH} is measured using the R&S RTO "High" measurement against the portion of the command response, as shown in the figure below.

The conformance range for V_{OH} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

HS200 CMD Open Drain test



Figure 4-6: HS200 CMD open drain measurement results

4.5.5.2 Output Low Level Voltage (V_{OL})

Purpose

The purpose of this test case is to verify the Output Low Level Voltage (V_{OL}) of the CMD signal in Open Drain mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the command with response and clock signal waveforms according to the "CMD Open Drain" set in the "Configuration" tab.

 V_{OL} is measured using the R&S RTO "Low" measurement against the portion of the command response, as shown in Figure 4-6.

The conformance range for V_{OL} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

4.6 HS200 Data Write test

4.6.1 Test Equipment

Item	Description, model	Quantity
Rohde & Schwarz oscilloscope	R&S RTO with minimum 1 GHz bandwidth	1
Probe	Probe with minimum 1 GHz band- width	1
DUT	eMMC device that supports HS200	1

4.6.2 Performing the Tests

- 1. Start the test as described in Chapter 4.1, "Starting HS200 Tests", on page 20.
- 2. Select "DAT" > "Data Write".

R&S ScopeSuite	×
Back Session HS200_20151222_155712	La Show Report 1 About 1 Help
All	Properties Limit Manager Results Instruments Report Config
☐ ▼ CLK	DUT Setup
CMD	Vccq 1.8 V
DAT	
Data Write	Data Line 0 💌
VIH (10.5.2)	Measurement Time 1000 Clock Cycles
VIL (10.5.2)	Maximum Wait Time for Data 0.001 s
tISU - Setup time (10.8.1)	
tlH - Hold time (10.8.1)	Triggering CMD
□ ▼ Data Read	Data Write CMD 25: WRITE_MULTIPLE_BLOCK 🔻
Test Checked Test Single	
Ready to run.	

- 3. Click "Test Single".
- Follow the instructions of the step-by step guide.
 When you have finished all steps, the compliance test runs automatically.

4.6.3 Purpose

The purpose of Data Write test case is to verify bus signal levels and timing requirements specific to eMMC device data write signal.

4.6.4 Test Setup



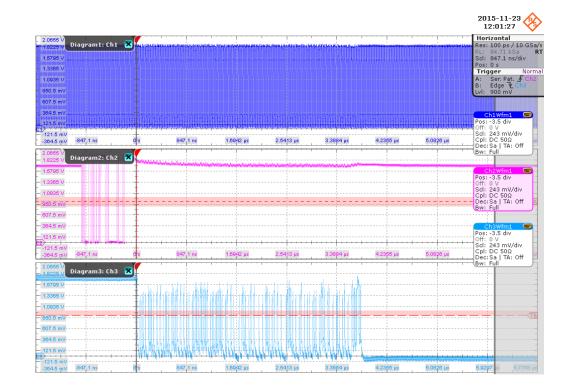
The software will guide you to make proper connections and follow a few steps to conduct the test.

The software is intended to facilitate the execution of a set of measurements on the clock, command and data signals.

4.6.4.1 Waveform Requirements

A typical eMMC Data Write with Command and Clock signal waveforms from this test case are as shown in the figure below.

HS200 Data Write test



The software requires a single capture of DAT and CMD with CLK signals to perform the test and measurement correctly and successfully.

4.6.5 Measurements

HS200 Data Write test case consists of 4 test measurements which perform bus signal levels and timing tests on a single capture of the DAT and CMD with CLK signals.

4.6.5.1 Input High Level Voltage (VIH)

Purpose

The purpose of this test case is to verify the Input High Level Voltage (V_{IH}) of the DAT Write signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms according to the "CMD DAT Write and Measurement Time" set in the "Configuration" tab.

 V_{IH} is measured using the R&S RTO "High" measurement against the portion of data write, as shown in Figure 4-7.

The conformance range for V_{IH} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

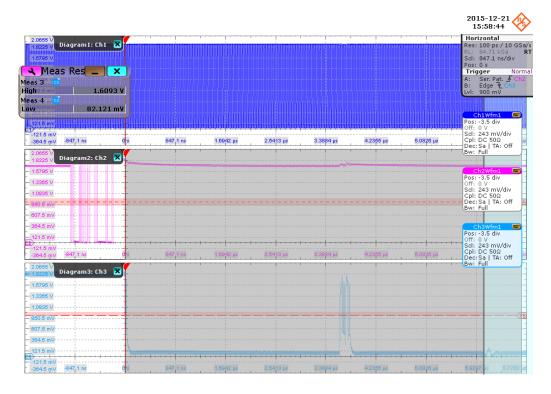


Figure 4-7: HS200 Data Write input level voltage

4.6.5.2 Input Low Level Voltage (VIL)

Purpose

The purpose of this test case is to verify the Input Low Level Voltage (V"IL") of the DAT Write signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms according to the "CMD DAT Write and Measurement Time" set in the "Configuration" tab.

 V_{IL} is measured using the R&S RTO "Low" measurement against the portion of data write, as shown in Figure 4-7.

The conformance range for V_{IL} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

4.6.5.3 1.5.3 Setup Time (T_{ISU})

Purpose

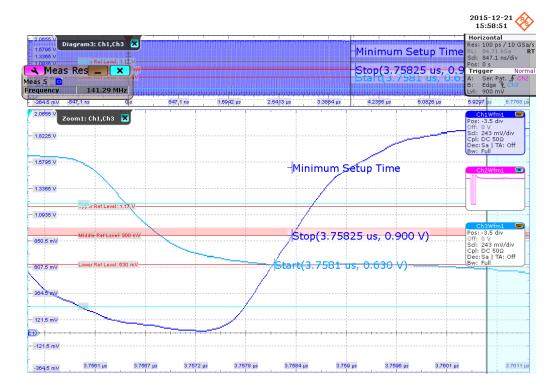
The purpose of this test case is to verify the setup time of the DAT Write signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms according to the "CMD DAT Write and Measurement Time" set in the "Configuration" tab.

 T_{ISU} is calculated based on the R&S RTO "Edge detection" against the portion of data write, as shown in the figure below. Minimum setup time is reported as the final result.

The conformance range for T_{ISU} is specified in the tables of the JESD84-B50 standard (Section 10.8.2 HS200 Device Input Timing).



4.6.5.4 1.5.4 Hold Time (T_{IH})

Purpose

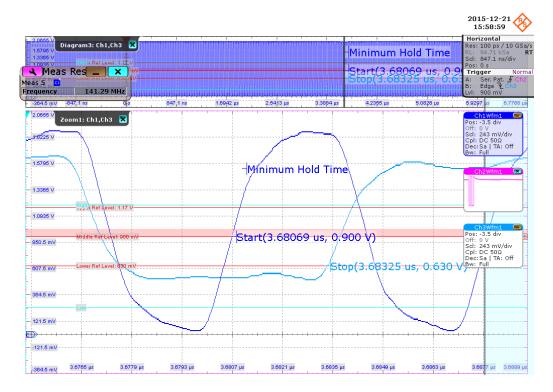
The purpose of this test case is to verify the hold time of the DAT Write signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms according to the "CMD DAT Write and Measurement Time" set in the "Configuration" tab.

 T_{IH} is calculated based on the R&S RTO "Edge detection" against the portion of data write, as shown in the figure below. Minimum hold time is reported as the final result.

The conformance range for T_{IH} is specified in the tables of the JESD84-B50 standard (Section 10.8.2 HS200 Device Input Timing).



4.7 HS200 Data Read test

4.7.1 Test Equipment

Item	Description, model	Quantity
Rohde & Schwarz oscilloscope	R&S RTO with minimum 1 GHz bandwidth	1
Probe	Probe with minimum 1 GHz band- width	1
DUT	eMMC device that supports HS200	1

4.7.2 Performing the Tests

- 1. Start the test as described in Chapter 4.1, "Starting HS200 Tests", on page 20.
- 2. Select "DAT" > "Data Read".

R&S ScopeSuite	_
Back Session HS200_20151222_155712	🔥 Show Report 🚺 About 👔 Help
All	Properties Limit Manager Results Instruments Report Config
	DUT Setup
CMD	Vccq 1.8 V
DAT	
Data Write	Data Line 0 🔻
Data Read	Measurement Time 1000 Clock Cycles
VOH (10.5.2)	Maximum Wait Time for Data 0.001 s
VOL (10.5.2)	
	Triggering CMD
	Data Read CMD 18: READ_MULTIPLE_BLOCK 🔻
Test Checked Test Single	
Ready to run.	

- 3. Click "Test Single".
- Follow the instructions of the step-by step guide.
 When you have finished all steps, the compliance test runs automatically.

4.7.3 Purpose

The purpose of Data Read test case is to verify bus signal levels requirements specific to eMMC device data read signal.

4.7.4 Test Setup



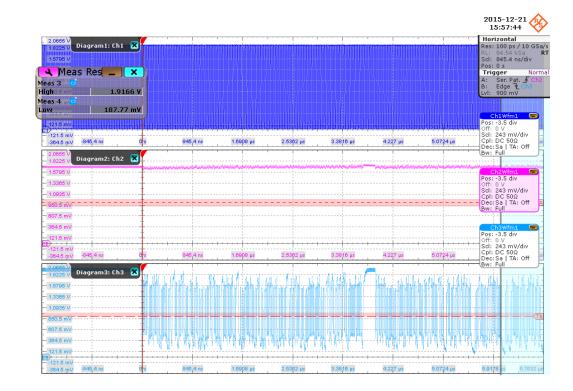
The software will guide you to make proper connections and follow a few steps to conduct the test.

The software is intended to facilitate the execution of a set of measurements on the clock, command and data signals

4.7.4.1 Waveform Requirements

A typical eMMC Data Read with Command and Clock signal waveforms from this test case are as shown in the figure below.

HS200 Data Read test



The software requires a single capture of DAT and CMD with CLK signals to perform the test and measurement correctly and successfully.

4.7.5 Measurements

HS200 Data Read test case consists of 2 test measurements which perform bus signal levels tests on a single capture of the DAT and CMD with CLK signals.

4.7.5.1 Output High Level Voltage (V_{OH})

Purpose

The purpose of this test case is to verify the Output High Level Voltage (V_{OH}) of the DAT Read signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms according to the "CMD DAT Read and Measurement Time" set in the "Configuration" tab.

 V_{OH} is measured using RTO "High" measurement against the portion of data read, as shown in Figure 4-8.

HS200 Data Read test

22.0055 U Diagram 1: Ch1 2 1.0225 U Diagram 1: Ch1 2 Meas Res _ 2 light a mv 1.7245 leas 4 mc 2 0W _ 283.82 m	<pre>v</pre>						Horizontal Res: 100 ps / 100 Rt: 84 k54 Sd: 845.4 ns/di Pos: 0.5 Trigger A: Ser. Pat. ▲ B: Edge ¥ Lvl: 900 mV Ch1Wfm1 Pos: -3.5 div
30 121.5 mV -364.5	0rs 845,4 ns	1.6908 µs	2.5362 µs	3.3816 µs	4.227 µs	5.0724 µs	 Off: 0 V Scl: 243 mV/div Cpl: DC 50Ω Dec:Sa TA: Off Bw: Full
- 15795 V - 13865 V - 10855 V - 850 5 mV - 807 5 mV		9,44,47,400,169,17,49,47,464,464,464,464,464				9.479.799.4799.499.499.499 	Ch2Wfm1 Pos: -3.5 div Off: 0 V Scl: 243 mV/div Cpl: DC 500 Dec: Sa TA: Off Bw: Full
384.5 mV 121.5 mV 220 121.5 mV 	0-3 B45 4 m	1.8908 µs	2.5302 µs	3.38 <mark>16 µ</mark> з	4.227 µs	5.0724 µs	Ch3Wfm1 Pos: -3.5 div Off: 0 V Scl: 243 mV/div Cpl: DC 50Ω Dec:Sa TA: Off Bw: Full
18225 v Diagram3: Ch3						, (121, 11), (1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1	
850.6 mV 607.5 mV 364.5 mV 121.5 mV		- state to the state of the sta					(which which

Figure 4-8: HS200 Data Read output voltage

The conformance range for V_{OH} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

4.7.5.2 Output High Level Voltage (V_{OL})

Purpose

The purpose of this test case is to verify the Output Low Level Voltage (V_{OL}) of the DAT Read signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms according to the "CMD DAT Read and Measurement Time" set in the "Configuration" tab.

 V_{OL} is measured using the R&S RTO "Low" measurement against the portion of data read, as shown in Figure 4-8.

The conformance range for V_{OL} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

5 HS400 Tests

5.1 Starting HS400 Tests

- 1. Select "eMMC" in the R&S ScopeSuite start window.
- 2. In the "Session Selection" dialog, set "Select Type" > "HS400".
- Add a new test session and open it, see Chapter 3.1, "Starting a Test Session", on page 14.
- 4. Check the test configuration settings and adjust, if neccessary. See:
 - Chapter 3.2.2, "eMMC Test Configuration", on page 17
 - Chapter 3.2.1.1, "Limit Manager", on page 16
- 5. Select/check the test cases you want to run and click "Test Single"/"Test checked".
- 6. A step-by step guide explains the following individual setup steps. When you have finished all steps of the step-by-step guide, the compliance test runs automatically.

5.2 Connecting Probes to the DUT

In order to get precise test results it is important to consider the experimental setup.

Special care should be taken when connecting the probes to the DUT as the connection may affect the resulting measurement bandwidth. Especially when doing measurements in the HS400 Mode with data rates of up to 400 MBit/s you should make sure that the measurement signal bandwidth of 1 GHz is available. Smaller measurement bandwidth may lead to incorrect results.

There are different solutions you can use for connecting the probes to the DUT such as flexible sockets, special interposers or dedicated measurement points. It is important to consider during the design of your DUT.

5.3 HS400 CLK test

5.3.1 Test Equipment

Item	Description, model	Quantity
Rohde & Schwarz oscilloscope	R&S RTO with minimum 1 GHz bandwidth	1
Probe	Active probe with minimum 1 GHz bandwidth	1
DUT	eMMC device that supports HS400	1

5.3.2 Performing the Tests

- 1. Start the test as described in Chapter 5.1, "Starting HS400 Tests", on page 51.
- 2. Select "CLK".

RSScopeSui	te						_ 🗆 ×
G Back	Session HS400_20160205_160005			I à	Show Report	About	🕐 Help
	All	Properties	Limit Manager	Results	Report Config		
	▲ CLK	DUT Setu	р				
	VIH (10.5.2)		Vcc	q 1.8	v		
	VIL (10.5.2)		VCC	d T:0	v		
	tPERIOD - Cycle Time in Data Transfer Mode(10.10.1)						
	SR - Slew Rate (10.10.1)						
	tCKDCD - Duty Cycle Distortion (10.10.1)						
	tCKMPW - Minimum Pulse Width (10.10.1)						
	▲ CMD						
	▼ Push Pull						
	▼ Open Drain						
	▲ DAT						
	▼ Data Write						
	▼ Data Read						
	▲ DS						
	▼ Data Strobe for Data Read						
Test C	hecked 🕨 Test Single						
Ready to rur	L						

- 3. Click "Test Single".
- Follow the instructions of the step-by step guide.
 When you have finished all steps, the compliance test runs automatically.

5.3.3 Purpose

The purpose of CLK test case is to verify bus signal levels and timing requirements specific to eMMC device clock signal.

5.3.4 Test Setup



The software will guide you to make proper connections and follow a few steps to conduct the test.

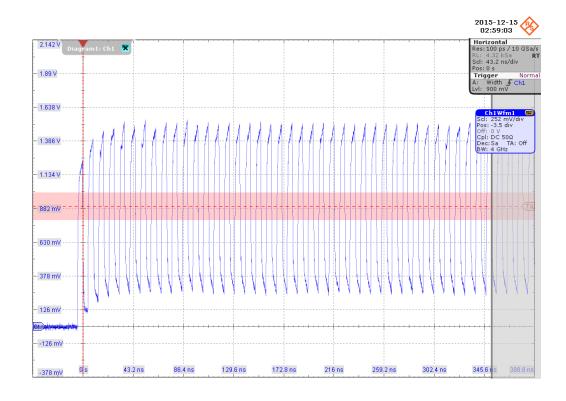
The software is intended to facilitate the execution of a set of measurements on the clock signal.

5.3.4.1 Waveform Requirements

A typical eMMC CLK signal waveform from this test case is shown in the figure below.

HS400 Tests

HS400 CLK test



The software requires a single capture of CLK signal to perform the test and measurement correctly and successfully.

5.3.5 Measurements

HS400 CLK test case consists of 6 measurements which perform bus signal levels and timing tests on a single capture of the CLK signal.

5.3.5.1 Input High Level Voltage (VIH)

Purpose

The purpose of this test case is to verify the Input High Level Voltage (V_{IH}) of the CLK signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture 48 cycles length of clock signal waveform in data transfer mode..

 V_{IH} is measured using the R&S RTO "High" measurement against the whole waveform, as shown in Figure 5-1.

The conformance range for V_{IH} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

HS400 Tests

HS400 CLK test

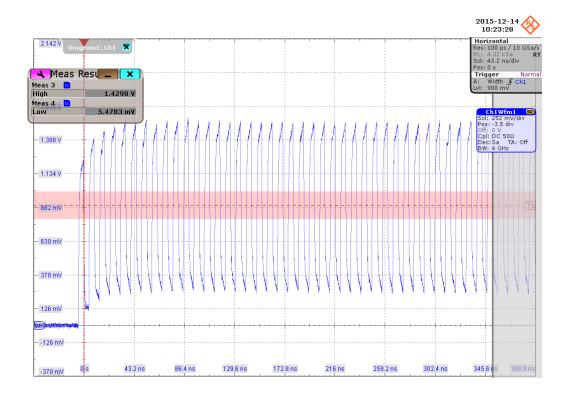


Figure 5-1: HS400 CLK input level voltage

5.3.5.2 Input Low Level Voltage (VIL)

Purpose

The purpose of this test case is to verify the Input Low Level Voltage (V_{IL}) of the CLK signal is within the conformance limits.

Measurements

Measures the clock frequency and then captures a certain length of clock signal waveform according to the "Measurement Time" set in the "Configuration" tab.

 V_{IL} is measured using the R&S RTO "Low" measurement against the whole waveform, as shown in Figure 5-1.

The conformance range for V_{IL} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

5.3.5.3 Cycle Time Data Transfer Mode (T_{PERIOD})

Purpose

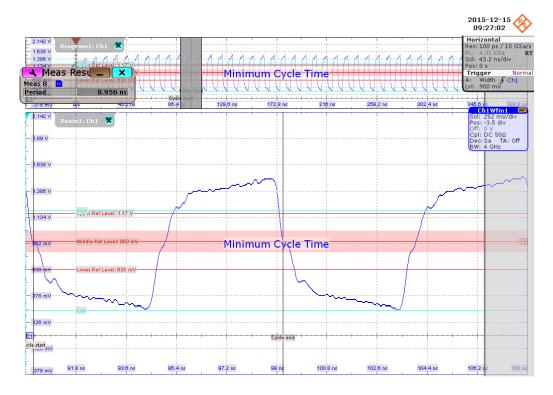
The purpose of this test case is to verify the period of the CLK signal is within the conformance limits.

Measurements

Measure the clock frequency and capture 48 cycles length of clock signal waveform in data transfer mode.

 T_{PERIOD} is measured using the R&S RTO "Period " measurement coupled with a gate by gate measurment against the whole waveform, as shown in the figure below. The "Minimum" value is used as the final result.

The conformance range for T_{PERIOD} is specified in the tables of the JESD84-B50 standard (Section 10.10.2 HS400 Clock Timing).



5.3.5.4 Slew Rate (SR)

Purpose

The purpose of this test case is to verify the slew rate of the CLK signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture 48 cycles length of clock signal waveform in data transfer mode.

SR is calculated based on the R&S RTO "Period", "Rise Time" and "Fall Time" measurements coupled with a gate by gate measurment against the whole waveform, as shown in Figure 5-2. Each "Slew Rate" is calculated based on the results from each gate measurement. The "Minimum Slew Rate" is used as the final result.

The conformance range for SR is specified in the tables of the JESD84-B50 standard (Section Section 10.10.1 HS400 Clock Timing).

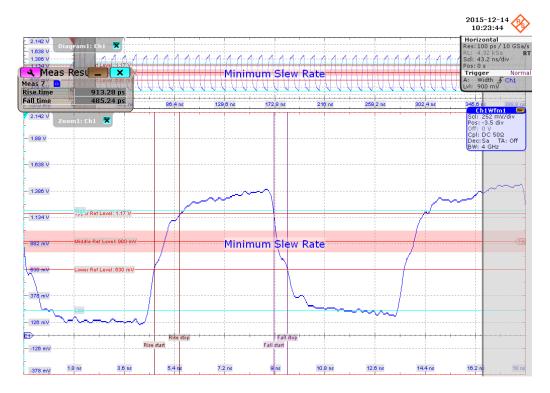


Figure 5-2: HS400 CLK slew rate measurement

5.3.5.5 Duty Cycle Distortion (T_{CKDCD})

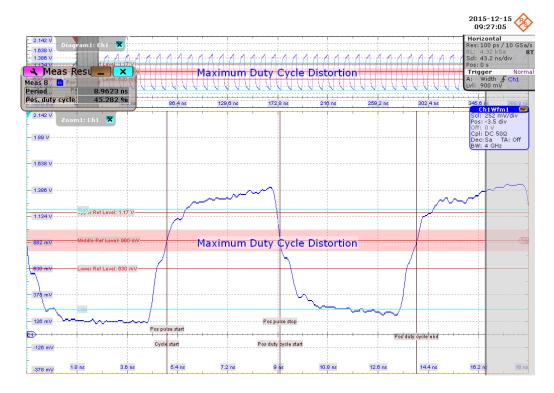
Purpose

The purpose of this test case is to verify the duty cycle distortion of the CLK signal in data transfer mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture 48 cycles length of clock signal waveform in data transfer mode T_{CKDCD} is measured using the R&S RTO "Positive Duty Cycle" measurements coupled with a gate by gate measurment against the whole waveform, as shown in the figure below. Each duty cycle distortion is calculated based on results from each gate measurement. "Maximum" duty cycle distortion is used as the final result

The conformance range for T_{CKDCD} is specified in the tables of the JESD84-B50 standard (Section 10.10.1 HS400 Clock Timing).



5.3.5.6 Minimum Pulse Width (T_{CKMPW})

Purpose

The purpose of this test case is to verify the minimum pulse width of the CLK signal is within the conformance limits.

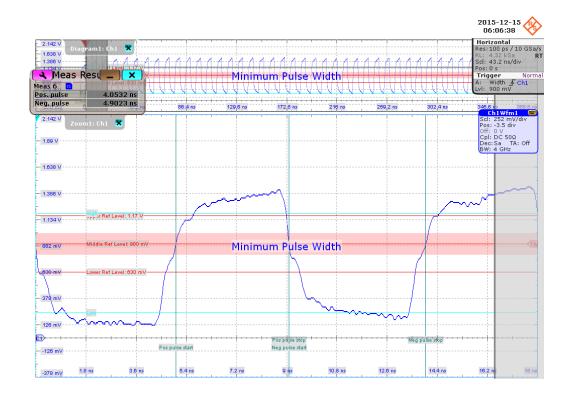
Measurements

Measure the clock frequency and then capture 48 cycles length of clock signal waveform in data transfer mode.

T_{CKMPW} is measured using the R&S RTO "Period", "Positive Pulse" and "Negative Pulse" measurements coupled with a gate by gate measurment against the whole waveform, as shown in the figure below. Each pulse width is calculated based on results from each gate measurement. "Minimum pulse width" is used as the final result.

The conformance range for T_{CKMPW} is specified in the tables of the JESD84-B50 standard (Section 10.10.1 HS400 Clock Timing).

HS400 CMD Push Pull test



5.4 HS400 CMD Push Pull test

5.4.1 Test Equipment

Item	Description, model	Quantity
Rohde & Schwarz oscilloscope	R&S RTO with minimum 1 GHz bandwidth	1
Probe	Active probe with minimum 1 GHz bandwidth	1
DUT	eMMC device that supports HS400	1

5.4.2 Performing the Tests

- 1. Start the test as described in Chapter 5.1, "Starting HS400 Tests", on page 51.
- 2. Select "CMD" > "Push Pull".

HS400 CMD Push Pull test

RSScopeSuite	_ 🗆 ×
G Back Session HS400_20160205_160005	K Show Report 1 About Pelp
All	Properties Limit Manager Results Report Config
☐ ▼ CLK	DUT Setup
CMD	Vccq 1.8 V
Push Pull	VCCq 1.0 V
VIH (10.5.2)	Triggering CMD
VIL (10.5.2)	Push Pull CMD 25: WRITE_MULTIPLE_BLOCK V
VOH (10.5.2)	
VOL (10.5.2)	
tISU - Setup time (10.10.1)	
tIH - Hold time (10.10.1)	
Open Drain	
DAT	
Data Write	
□ ▼ Data Read	
DS	
Data Strobe for Data Read	
Test Checked Test Single	
Ready to run.	

- 3. Click "Test Single".
- Follow the instructions of the step-by step guide.
 When you have finished all steps, the compliance test runs automatically.

5.4.3 Purpose

The purpose of CMD Push Pull test case is to verify bus signal levels and timing requirements specific to eMMC device command signal in Push Pull mode.

5.4.4 Test Setup



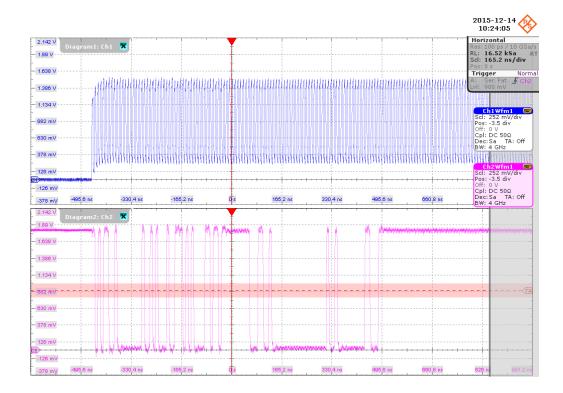
The software will guide you to make proper connections and follow a few steps to conduct the test.

The software is intended to facilitate the execution of a set of measurements on the clock and command signals under Push Pull mode.

5.4.4.1 Waveform Requirements

A typical eMMC Command with Clock signal waveforms in Push Pull mode from this test case are as shown in the figure below.

HS400 CMD Push Pull test



The software requires a single capture of CMD and CLK signals to perform the test and measurement correctly and successfully.

5.4.5 Measurements

HS400 CMD Push Pull test case consists of 6 test measurements which perform bus signal levels and timing tests on a single capture of the CMD with CLK signals.

5.4.5.1 Input High Level Voltage (VIH)

Purpose

The purpose of this test case is to verify the Input High Level Voltage (V_{IH}) of the CMD signal in Push Pull mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the command with response and clock signal waveforms according to the "CMD Push Pull" set in the "Configuration " tab.

 V_{IH} is measured using the R&S RTO "High" measurement against the portion of the host command, as shown in Figure 5-3.

The conformance range for V_{IH} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

HS400 CMD Push Pull test

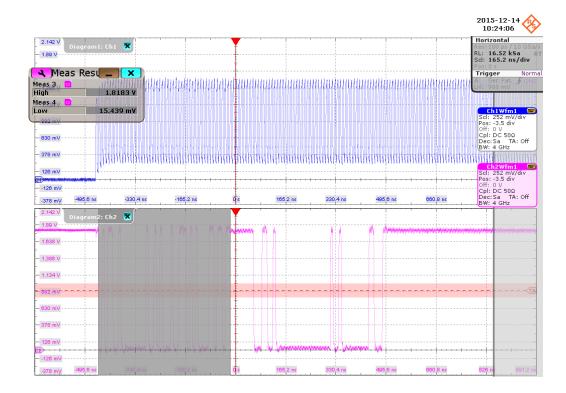


Figure 5-3: HS400 CMD Push Pull input level voltage

5.4.5.2 Input Low Level Voltage (VIL)

Purpose

The purpose of this test case is to verify the Input Low Level Voltage (VIL) of the CMD signal in Push Pull mode is within the conformance limits

Measurements

Measure the clock frequency and then capture the command with response and clock signal waveforms according to the "CMD Push Pull" set in the "Configuration" tab.

 V_{IL} is measured using the R&S RTO "Low" measurement against the portion of the host command, as shown in Figure 5-3.

The conformance range for V_{IL} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

5.4.5.3 Output High Level Voltage (V_{OH})

Purpose

The purpose of this test case is to verify the Output High Level Voltage (V_{OH}) of the CMD signal in Push Pull mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the command with response and clock signal waveforms according to the "CMD Push Pull" set in the "Configuration" tab.

 V_{OH} is measured using the R&S RTO "High" measurement against the portion of the command response, as shown in Figure 5-4.

The conformance range for V_{OH} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

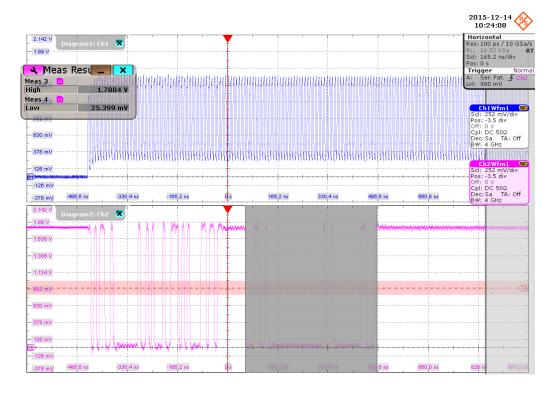


Figure 5-4: HS400 CMD Push Pull output level voltage

5.4.5.4 Output Low Level Voltage (V_{OL})

Purpose

The purpose of this test case is to verify the Output Low Level Voltage (V_{OL}) of the CMD signal in Push Pull mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the command with response and clock signal waveforms according to the "CMD Push Pull" set in the "Configuration" tab.

 V_{OL} is measured using the R&S RTO "Low" measurement against the portion of the command response, as shown in Figure 5-4.

The conformance range for V_{OL} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

5.4.5.5 Setup Time (T_{ISU})

Purpose

The purpose of this test case is to verify the setup time of the CMD signal in Push Pull mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the command with response and clock signal waveforms according to the "CMD Push Pull" set in the "Configuration" tab.

 T_{ISU} is calculated based on the R&S RTO "Edge detection" against the portion of the host command, as shown in the figure below. Minimum setup time is reported as the final result.

The conformance range for T_{ISU} is specified in the tables of the JESD84-B50 standard (Section 10.10.1 H400 Device Input Timing).

HS400 CMD Push Pull test



5.4.5.6 Hold Time (T_{IH})

Purpose

The purpose of this test case is to verify the hold time of the CMD signal in Push Pull mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the command with response and clock signal waveforms according to the "CMD Push Pull" set in the "Configuration" tab.

 T_{IH} is calculated based on the R&S RTO "Edge detection" against the portion of the host command, as shown in the figure below. Minimum hold time is reported as the final result.

The conformance range for T_{IH} is specified in the tables of the JESD84-B50 standard (Section 10.10.1 HS400 Device Input Timing).

HS400 CMD Open Drain test



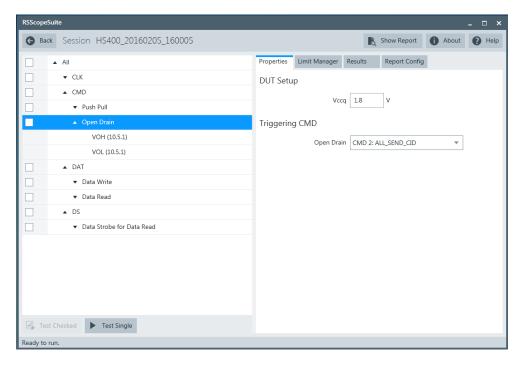
5.5 HS400 CMD Open Drain test

5.5.1 Test Equipment

Item	Description, model	Quantity
Rohde & Schwarz oscilloscope	R&S RTO with minimum 1 GHz bandwidth	1
Probe	Active probe with minimum 1 GHz bandwidth	1
DUT	eMMC device that supports HS400	1

5.5.2 Performing the Tests

- 1. Start the test as described in Chapter 5.1, "Starting HS400 Tests", on page 51.
- 2. Select "CMD" > "Open Drain".



- 3. Click "Test Single".
- Follow the instructions of the step-by step guide.
 When you have finished all steps, the compliance test runs automatically.

5.5.3 Purpose

The purpose of CMD Open Drain test case is to verify bus signal levels requirements specific to eMMC device command signal in Open Drain mode.

5.5.4 Test Setup



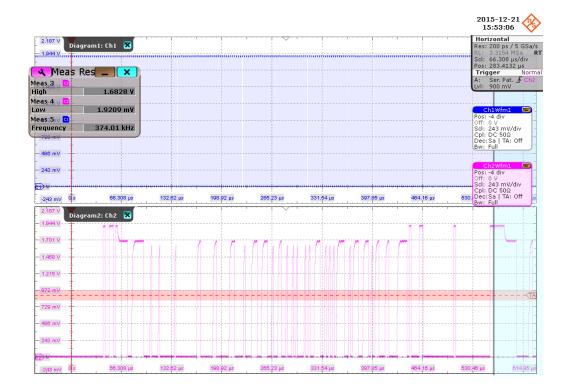
The software will guide you to make proper connections and follow a few steps to conduct the test.

The software is intended to facilitate the execution of a set of measurements on the clock and command signals under Open Drain mode.

5.5.4.1 Waveform Requirements

A typical eMMC Command with Clock signal waveforms in Open Drain mode from this test case are as shown in the figure below.

HS400 CMD Open Drain test



The software requires a single capture of CMD and CLK signals to perform the test and measurement correctly and successfully.

5.5.5 Measurements

HS400 CMD Open Drain test case consists of 2 measurements which perform bus signal levels tests on a single capture of the CMD with CLK signals.

5.5.5.1 Output High Level Voltage (V_{OH})

Purpose

The purpose of this test case is to verify the Output High Level Voltage (V_{OH}) of the CMD signal in Open Drain mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the command with response and clock signal waveforms according to the "CMD Open Drain" set in the "Configuration" tab.

 V_{OH} is measured using the R&S RTO "High" measurement against the portion of the command response, as shown in Figure 5-5.

The conformance range for V_{OH} is specified in the tables of the JESD84-B50 standard (Section 10.5.1 Bus signal levels).

HS400 CMD Open Drain test



Figure 5-5: HS400 CMD open drain measurement results

5.5.5.2 Output Low Level Voltage (V_{OL})

Purpose

The purpose of this test case is to verify the Output Low Level Voltage (V_{OL}) of the CMD signal in Open Drain mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the command with response and clock signal waveforms according to the "CMD Open Drain" set in the "Configuration" tab.

 V_{OL} is measured using the R&S RTO "Low" measurement against the portion of the command response, as shown in Figure 5-5.

The conformance range for V_{OL} is specified in the tables of the JESD84-B50 standard (Section 10.5.1 Bus signal levels).

5.6 HS400 Data Write test

5.6.1 Test Equipment

Item	Description, model	Quantity
Rohde & Schwarz oscilloscope	R&S RTO with minimum 1 GHz bandwidth	1
Probe	Probe with minimum 1 GHz band- width	1
DUT	eMMC device that supports HS400	1

5.6.2 Performing the Tests

- 1. Start the test as described in Chapter 5.1, "Starting HS400 Tests", on page 51.
- 2. Select "DAT" > "Data Write".

RSScopeSuite	_ □ ×
G Back Session HS400_20160205_160005	🖹 Show Report 🚺 About 😧 Help
All	Properties Limit Manager Results Report Config
CLK	DUT Setup
CMD	Vccq 1.8 V
□ A DAT	
Data Write	Data Line 0 💌
VIH (10.5.2)	Measurement Time 1000 Clock Cycles
VIL (10.5.2)	Maximum Wait Time for Data 0.001 s
tISUddr - Setup time (10.10.1)	
tlHddr - Hold time (10.10.1)	Triggering CMD
SR - Slew Rate (10.10.1)	DAT Write CMD 25: WRITE_MULTIPLE_BLOCK 🔻
Data Read	
DS VICE	
Test Checked Test Single	
Ready to run.	

- 3. Click "Test Single".
- Follow the instructions of the step-by step guide.
 When you have finished all steps, the compliance test runs automatically.

5.6.3 Purpose

The purpose of Data Write test case is to verify bus signal levels and timing requirements specific to eMMC device data write signal.

5.6.4 Test Setup



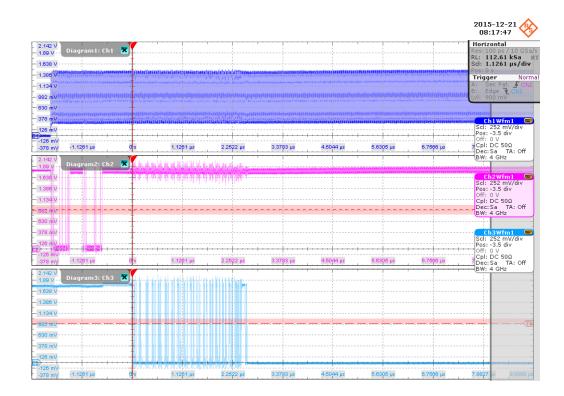
The software will guide you to make proper connections and follow a few steps to conduct the test.

The software is intended to facilitate the execution of a set of measurements on the clock, command and data signals.

5.6.4.1 Waveform Requirements

A typical eMMC Data Write with Command and Clock signal waveforms from this test case are as shown in the figure below.

HS400 Data Write test



The software requires a single capture of DAT and CMD with CLK signals to perform the test and measurement correctly and successfully.

5.6.5 Measurements

HS400 Data Write test case consists of 5 test measurements which perform bus signal levels and timing tests on a single capture of the DAT and CMD with CLK signals.

5.6.5.1 Input High Level Voltage (VIH)

Purpose

The purpose of this test case is to verify the Input High Level Voltage (V_{IH}) of the DAT Write signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms according to the "CMD DAT Write and Measurement Time" set in the "Configuration" tab.

 V_{IH} is measured using the R&S RTO "High" measurement against the portion of data write, as shown in Figure 5-6.

The conformance range for V_{IH} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

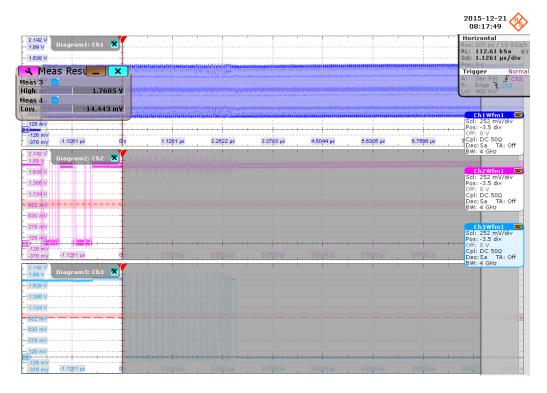


Figure 5-6: HS400 Data Write input level voltage

5.6.5.2 Input Low Level Voltage (VIL)

Purpose

The purpose of this test case is to verify the Input Low Level Voltage (V"IL") of the DAT Write signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms according to the "CMD DAT Write and Measurement Time" set in the "Configuration" tab.

 V_{IL} is measured using the R&S RTO "Low" measurement against the portion of data write, as shown in Figure 5-6.

The conformance range for V_{IL} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

5.6.5.3 Setup Time (T_{ISUddr})

Purpose

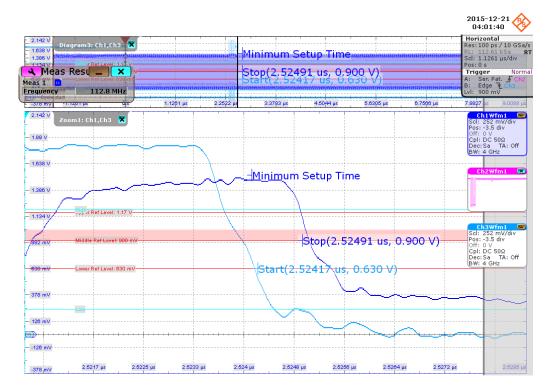
The purpose of this test case is to verify the setup time of the DAT Write signal in data transfer mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms according to the "CMD DAT Write and Measurement Time" set in the "Configuration" tab.

 T_{ISUddr} is calculated based on the R&S RTO "Edge detection" against the portion of data write, as shown in the figure below. Minimum setup time is reported as the final result.

The conformance range for T_{ISUddr} is specified in the tables of the JESD84-B50 standard (Section 10.10.1 HS400 Device Input Timing).



5.6.5.4 Hold Time (T_{IHddr})

Purpose

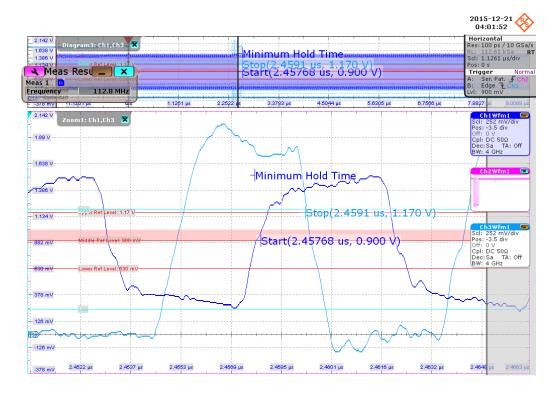
The purpose of this test case is to verify the hold time of the DAT Write signal in data transfer mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms according to the "CMD Data Write " and "Measurement Time" set in the "Configuration" tab.

 T_{IHddr} is calculated based on the R&S RTO "Edge detection" against the portion of data write, as shown in the figure below. Minimum hold time is reported as the final result.

The conformance range for T_{IHddr} is specified in the tables of the JESD84-B50 standard (Section 10.10.1 HS400 Device Input Timing).



5.6.5.5 Slew Rate (SR)

Purpose

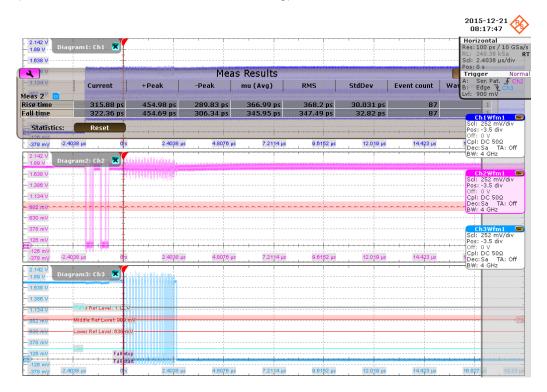
The purpose of this test case is to verify the slew rate of the DAT Write signal in data transfer mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms according to the "CMD Data Write " and "Measurement Time" set in the "Configuration" tab.

SR is calculated based on the R&S RTO "Period", "Rise Time" and "Fall Time" measurements cagainst the portion of data write, as shown in the figure below. The "Minimum Slew Rate" is used as the final result.

The conformance range for SR is specified in the tables of the JESD84-B50 standard (Section Section 10.10.1 HS400 Clock Timing).



5.7 HS400 Data Read test

5.7.1 Test Equipment

Item	Description, model	Quantity
Rohde & Schwarz oscilloscope	R&S RTO with minimum 1 GHz bandwidth	1
Probe	Probe with minimum 1 GHz band- width	1
DUT	eMMC device that supports HS400	1

5.7.2 Performing the Tests

- 1. Start the test as described in Chapter 5.1, "Starting HS400 Tests", on page 51.
- 2. Select "DAT" > "Data Read".

RSScopeSuite	×
G Back Session HS400_20160205_160005	🖹 Show Report 🕕 About 😮 Help
All	Properties Limit Manager Results Report Config
CLK	DUT Setup
CMD	Vccq 1.8 V
▲ DAT	
🗌 🔻 Data Write	Data Line 0 💌
Data Read	Measurement Time 1000 Clock Cycles
VOH (10.5.2)	Maximum Wait Time for Data 0.001 s
VOL (10.5.2)	
tRQ - Output Skew (10.10.2)	Triggering CMD
tRQH - Output Hold Skew (10.10.2)	DAT Read CMD 18: READ_MULTIPLE_BLOCK V
SR - Slew Rate (10.10.2)	
DS V	
□ ↓ Test Single	
Ready to run.	

- 3. Click "Test Single".
- Follow the instructions of the step-by step guide.
 When you have finished all steps, the compliance test runs automatically.

5.7.3 Purpose

The purpose of Data Read test case is to verify bus signal levels requirements specific to eMMC device data read signal.

5.7.4 Test Setup



The software will guide you to make proper connections and follow a few steps to conduct the test.

The software is intended to facilitate the execution of a set of measurements on the clock, command and data signals

5.7.4.1 Waveform Requirements

A typical eMMC Data Read with Command and Clock signal waveforms from this test case are as shown in the figure below.

HS400 Data Read test



The software requires a single capture of DAT and CMD with CLK signals to perform the test and measurement correctly and successfully.

5.7.5 Measurements

HS400 Data Read test case consists of 5 test measurements which perform bus signal levels tests on a single capture of the DAT and CMD with CLK and Data Strobe signals.

5.7.5.1 Output High Level Voltage (V_{OH})

Purpose

The purpose of this test case is to verify the Output High Level Voltage (V_{OH}) of the DAT Read signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms according to the "CMD Data Read " and "Measurement Time" set in the "Configuration" tab.

 V_{OH} is measured using RTO "High" measurement against the portion of data read, as shown in Chapter 5.7.5.1, "Output High Level Voltage (V_{OH})", on page 81.

HS400 Data Read test

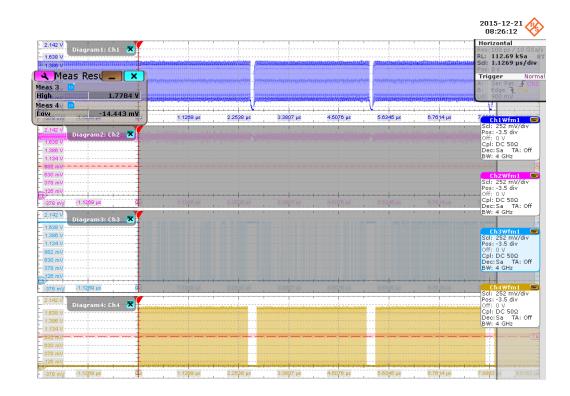


Figure 5-7: HS400 Data Read output voltage

The conformance range for V_{OH} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

5.7.5.2 Output Low Level Voltage (V_{OL})

Purpose

The purpose of this test case is to verify the Output Low Level Voltage (V_{OL}) of the DAT Read signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms according to the "CMD Data Read " and "Measurement Time" set in the "Configuration" tab.

 V_{OL} is measured using the R&S RTO "Low" measurement against the portion of data read, as shown in Chapter 5.7.5.1, "Output High Level Voltage (V_{OH})", on page 81.

The conformance range for V_{OL} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

5.7.5.3 Output Skew (T_{RQ})

Purpose

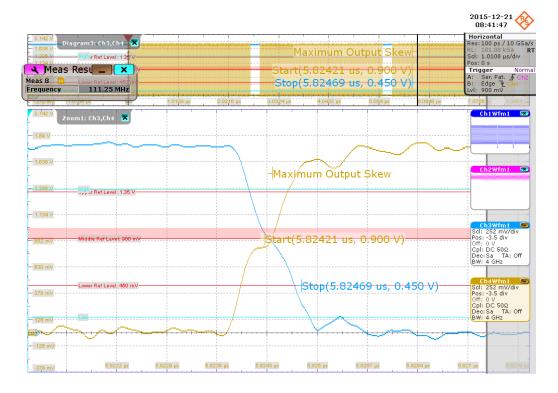
The purpose of this test case is to verify the output skew of the DAT Read signal in data transfer mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms and data strobe waveforms according to the "CMD Data Read " and "Measurement Time" set in the "Configuration" tab.

 T_{RQ} is calculated based on the R&S RTO "Data strobe" and "Data edges detection " against the portion of data read, as shown in the figure below. "Maximum output skew" is reported as the final result.

The conformance range for SR is specified in the tables of the JESD84-B50 standard (Section 10.10.2 HS400 Device Output Timing).



5.7.5.4 Output Hold Skew (T_{RQH})

Purpose

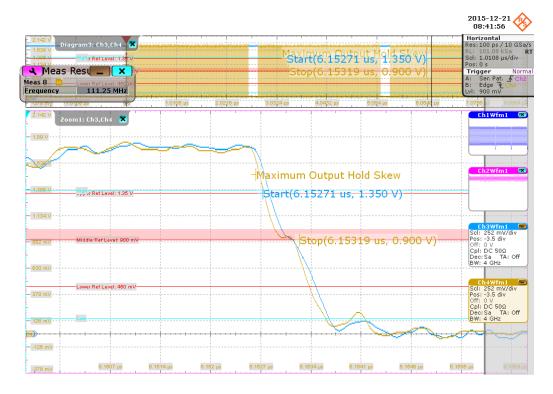
The purpose of this test case is to verify the output skew of the DAT Read signal in data transfer mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms and data strobe waveforms according to the "CMD Data Read " and "Measurement Time" set in the "Configuration" tab.

 T_{RQH} is calculated based on the R&S RTO "Data strobe" and "Data edges detection " against the portion of data read, as shown in the figure below. "Maximum output hold skew" is reported as the final result.

The conformance range for SR is specified in the tables of the JESD84-B50 standard (Section 10.10.2 HS400 Device Output Timing).



5.7.5.5 Slew Rate (SR)

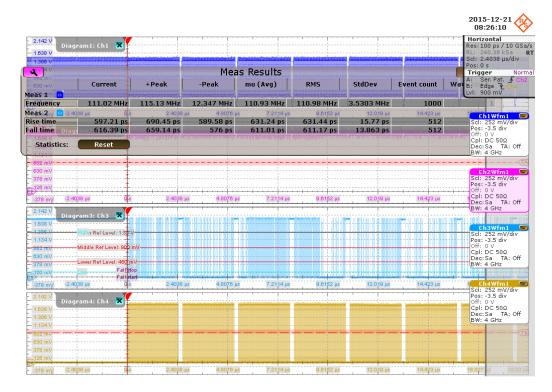
Purpose

The purpose of this test case is to verify the slew rate of the DAT Read signal in data transfer mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms and data strobe waveforms according to the "CMD Data Read " and "Measurement Time" set in the "Configuration" tab. SR is calculated based on the R&S RTO "Period", "Rise Time" and "Fall Time" measurede against the portion of data write, as shown in the figure below. The "Minimum Slew Rate" is used as the final result.

The conformance range for SR is specified in the tables of the JESD84-B50 standard (Section 10.10.2 HS400 Device Output Timing).



5.8 HS400 Data Strobe Test

5.8.1 Test Equipment

Item	Description, model	Quantity
Rohde & Schwarz oscilloscope	R&S RTO with minimum 1 GHz bandwidth	1
Probe	Active probe with minimum 1 GHz bandwidth	1
DUT	eMMC device that supports HS400	1

5.8.2 Performing the Tests

- 1. Start the test as described in Chapter 5.1, "Starting HS400 Tests", on page 51.
- 2. Select "DS" > "Data Strobe".

RSScopeSuite	×	
G Back Session HS400_20160205_160005	🖹 Show Report 🚺 About 🚺 Help	
All	Properties Limit Manager Results Report Config	
☐ CLK	DUT Setup Vccq 1.8 V Triggering CMD	
CMD DAT		
Data Strobe for Data Read	DS for Data Read ANY COMMAND 💌	
Test Checked Test Single Ready to run.		

- 3. Click "Test Single".
- Follow the instructions of the step-by step guide.
 When you have finished all steps, the compliance test runs automatically.

5.8.3 Purpose

The purpose of DS test case is to verify bus signal levels and timing requirements specific to eMMC device data strobe signal.

HS400 Data Strobe Test

5.8.4 Test Setup



The software will guide you to make proper connections and follow a few steps to conduct the test.

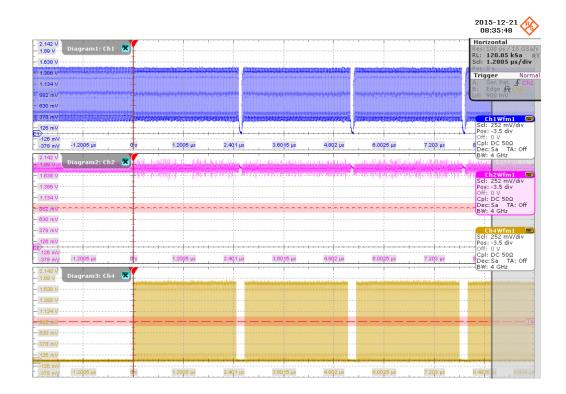
The software is intended to facilitate the execution of a set of measurements on the clock signal.

5.8.4.1 Waveform Requirements

A typical eMMC Data Strobe signal waveform from this test case is as shown in the figure below.

R&S®RTO-K92

HS400 Data Strobe Test



The software requires a single capture of Data Strobe signal to perform the test and measurement correctly and successfully.

5.8.5 Measurements

HS400 Data Strobe test case consists of 6 test measurements which perform bus signal levels and timing tests on a single capture of the Data Strobe signal.

5.8.5.1 Output High Level Voltage (V_{OH})

Purpose

The purpose of this test case is to verify the Output High Level Voltage (V_{OH}) of the Data Strobe signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms according to the "CMD Data Read " and "Measurement Time" set in the "Configuration" tab.

 V_{OH} is measured using RTO "High" measurement against the portion of data read, as shown in Figure 5-8.

HS400 Data Strobe Test

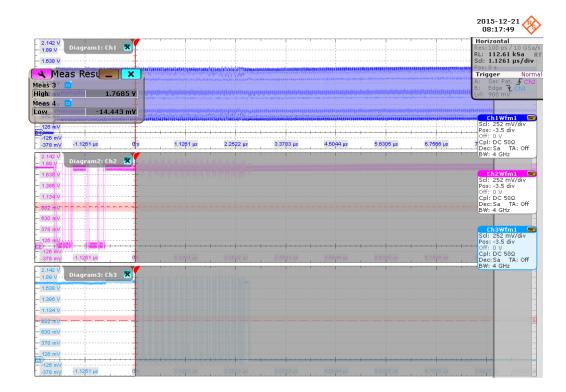


Figure 5-8: HS400 Data Strobe output voltage

The conformance range for V_{OH} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

5.8.5.2 Output Low Level Voltage (V_{OL})

Purpose

The purpose of this test case is to verify the Output Low Level Voltage (V_{OL}) of the DAT Read signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms according to the "CMD Data Read " and "Measurement Time" set in the "Configuration" tab.

 V_{OL} is measured using the R&S RTO "Low" measurement against the portion of data read, as shown in Figure 5-8.

The conformance range for V_{OL} is specified in the tables of the JESD84-B50 standard (Section 10.5.2 Bus signal levels).

5.8.5.3 Cycle Time Data Transfer Mode (T_{PERIOD})

Purpose

The purpose of this test case is to verify the cycle time of the Data Strobe signal in data transfer mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms according to the "CMD Data Read " and "Measurement Time" set in the "Configuration" tab.

 T_{PERIOD} is measured using the R&S RTO "Period " against the whole waveform, as shown in Figure 5-9. The "Minimum" value is used as the final result.

The conformance range for T_{PERIOD} is specified in the tables of the JESD84-B50 standard (Section 10.10.2 HS400 Clock Timing).

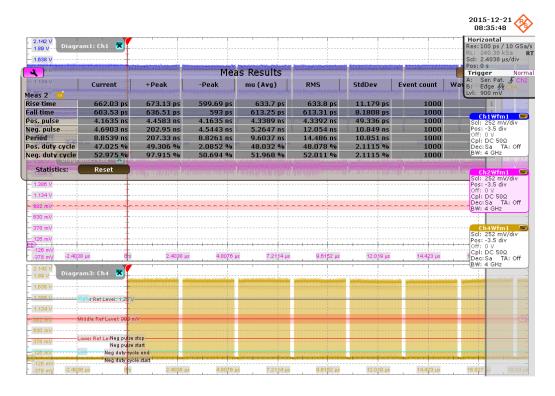


Figure 5-9: HS400 Data Strobe measurement

5.8.5.4 Slew Rate (SR)

Purpose

The purpose of this test case is to verify the slew rate of the Data Strobe signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms and data strobe waveforms according to the "CMD Data Read " and "Measurement Time" set in the "Configuration" tab.

SR is calculated based on the R&S RTO "Period", "Rise Time" and "Fall Time" measurede against the portion of data write, as shown in Figure 5-9. The "Minimum Slew Rate" is used as the final result.

The conformance range for SR is specified in the tables of the JESD84-B50 standard (Section 10.10.2 HS400 Clock Timing).

5.8.5.5 Duty Cycle Distortion (T_{DSDCD})

Purpose

The purpose of this test case is to verify the duty cycle distortion of the Data Strobe signal in data transfer mode is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms and data strobe waveforms according to the "CMD Data Read " and "Measurement Time" set in the "Configuration" tab.

T_{DSDCD} is measured using the R&S RTO "Positive Duty Cycle" and "Negative Duty Cycle" measurements against the whole waveform, as shown in Figure 5-9. Both "Minimum duty cycle distortion" and "Maximum duty cycle distortion" are used as the final results.

The conformance range for T_{DSDCD} is specified in the tables of the JESD84-B50 standard (Section 10.10.2 HS400 Clock Timing).

5.8.5.6 Minimum Pulse Width (T_{DSMPW})

Purpose

The purpose of this test case is to verify the minimum pulse width of the Data Strobe signal is within the conformance limits.

Measurements

Measure the clock frequency and then capture the data and command with clock signal waveforms and data strobe waveforms according to the "CMD Data Read " and "Measurement Time" set in the "Configuration" tab.

 T_{DSMPW} is measured using the R&S RTO "Positive Duty Cycle" and "Negative Duty Cycle" measurements against the whole waveform, as shown in Figure 5-9. "Minimum pulse width" is used as the final result.

The conformance range for T_{DSMPW} is specified in the tables of the JESD84-B50 standard (Section 10.10.2 HS400 Clock Timing).