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USB-IF 2.0 Compliance
Test Report
for Embedded Host

Company Name: <u>NXP Semiconductors</u>

VID (Dec): <u>8137</u> The VID for the company who apply the USB-IF logo.

Model Name: <u>LPC55S16</u>

Product Type: <u>Embedded Host</u>

Report Date: <u>06/30/2020</u>

Test Result: **<u>PASS</u>**

Tester: <u>**Sofiya Mayevskiy**</u>   **Authorized Signature:** <u>**Kayla Seliner**</u>
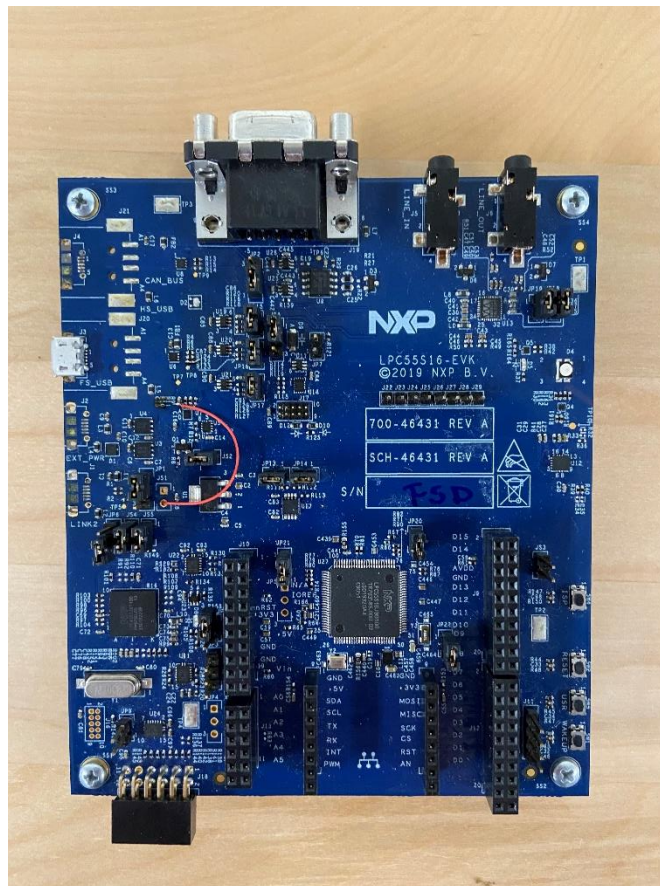
Company Information:

Company

Company Name: NXP Semiconductors
Company Address: 411 E Plumeria Dr. San Jose, CA 95134

Technical Contact

Name: Dezheng Tang (Tom)
Phone Number: N/A
E-Mail: dezheng.tang@nxp.com
FAX Number: N/A

Product Picture:

Overall Test Result Summary

Test Category	Result
Electrical	
Full Speed	Pass
Low Speed	Pass
BC 1.2	
Downstream Port	N/A
IOP	
FS Automated EH Tests	Pass
FS Interoperability Tests	Pass

Product Information:

Information Obtained From Checklist or Vendor			
Input	**Type**	**Purpose**	**Checklist Ref**
Uses Micro-AB	☒	**Check this box for an EH which uses a Micro-AB receptacle instead of a Standard-A receptacle. It will be automatically selected for OTG devices.**	**P15a**
Supports Sessions	☐	**Check this box if the OTG A-UUT or EH with Micro-AB receptacle does not keep V BUS enabled all the time that the ID pin is held low. Check this box for an EH with Standard-A receptacle which does not keep V BUS high all the time it is powered up. In either case it is assumed that SRP or ADP is available to detect the presence of a device.**	**PI10**
SRP as A-device	☐	**Check this box if the UUT, as an A-device, supports detecting, and acting on, an SRP pulse generated by a connected device.**	**PI13**
HNP as A-device	☐	**Check this box if the UUT, as an A-device, supports HNP to enable the connected B-device to become host if it so requires.**	**PI13**
HNP Polling as A-device	☐	**Check this box if the UUT, as an A-device, supports HNP polling. If it does it is allowed to remain as host, for as long as the other device does not set its Host Request Flag.**	**PI13**
ADP as A-device	☐	**Check this box if the UUT, as an A-device, supports ADP probing to detect the presence or otherwise of a connected device.**	**PI13**

Input	Type	Purpose	Checklist Ref
SRP as B-device	☐	Check this box if the UUT, as a B-device, supports generating an SRP pulse in order to start a session (cause the connected A-device to turn on V BUS).	PI20
HNP as B-device	☐	Check this box if the UUT, as a B-device, supports HNP to allow it to become host if it so requires.	PI20
ADP as B-device	☐	Check this box if the UUT, as a B-device, supports ADP sensing and probing to detect the presence or otherwise of a connected device.	PI20
FS Not Available	☐	Check this box if UUT does not fully support full-speed operation. This is not permitted for an OTG device, but may be for an Embedded Host.	PI11, PI18
IA_VBUS_RATED	100 mA	The rated output current of an A-device in mA units.	PI8
bMaxPower	500 mA	bMaxPower (sic) is the highest current, in mA, declared in any of the device's Configuration Descriptors. This value ignores current drawn under the Battery Charging provisions.	PI17
TPWRUP_RDY	30 S	Maximum time, in seconds, specified by vendor from powering on the UUT until it is ready to perform USB functionality. By default this is set to 30 seconds, but a vendor is permitted to specify a longer time.	PI24

Input	Type	Purpose	Checklist Ref
TA_WAIT_BCON max	30 S	The maximum time, in seconds, that V BUS is left on for by an A-device, in the absence of a B-device connecting. The default value is thirty seconds. A vendor is permitted to specify a longer time, but should be aware that this will have an impact on the time taken for, and therefore possibly the cost of, compliance testing.	PI10
Unknown Dev (No HNP)	VID: 0x1A0A PID: 0x0201	The test will use the VID/PID combination specified during tests for error messages, when an unknown B-device, not capable of HNP, is connected. A default value (1A0A/0201) is used, but any other device not on the UUT's TPL may be defined here.	-
Unknown Dev (HNP)	VID: 0x1A0A PID: 0x0202	The test will use the VID/PID combination specified during tests for error messages, when an unknown B-device, capable of HNP, is connected. A default value (1A0A/0202) is used, but any other device not on the UUT's TPL may be defined here.	-

Test Cable Information:

Information Obtained From MQP USB-PET Test Cables			
Input	**Type**	**Purpose**	**Checklist Ref**
Cable A	<u>175</u> mΩ	Test Cable A loop resistance in mΩ.	Cable A
Cable B	<u>587</u> mΩ	Test Cable B loop resistance in mΩ.	Cable B

USB 2.0 Electrical Compliance Tests

Full Speed Signal Quality Test Result   ☒ **Pass**   ☐ **Fail**

Full Speed Downstream Signal Quality: ☒ **Pass**   ☐ **Fail**

Port 1
Pass

Low Speed Downstream Signal Quality: ☒ **Pass**   ☐ **Fail**   ☐ **N/A**

Port 1
Pass

Drop/Droop Test Result   ☒ **Pass**   ☐ **Fail**

Load: 100mA

Port	1
$V_{non-load}$ (>=4.75V and <=5.5V)	**4.961V**
V_{load} (>=4.75V and <=5.5V)	**4.788V**
V_{drop} (<=500mV)	**173mV**
V_{droop} (<=330mV)	**N/A**

BC 1.2 Implemented Check: ☐ **Supported** ☒ **Not Supported**

If any one of exposed ports has BC 1.2 capability, all items of BC 1.2 specific category(s) should be tested under this port(s) for USB-IF certification.

Port 1
N/A

Battery Charging 1.2 Compliance Tests

Dedicated Charging Port (DCP) ☐ **Pass**   ☐ **Fail**   ☒ **N/A**

Test Items \ Port	1
DCP Overshoot and Undershoot Voltage Test	N/A
DCP Handshaking Test	N/A
DCP Resistance and Capacitance Test	N/A
DCP Voltage and Current	N/A

Charging Downstream Port (CDP) ☐ **Pass**   ☐ **Fail**   ☒ **N/A**

Test Items \ Port	1
CDP Overshoot and Undershoot Voltage Test	N/A
CDP Voltage and Current Test	N/A
CDP Handshaking Test	N/A
CDP Ground Offset Test – Full Speed	N/A
CDP Ground Offset Test – High Speed	N/A

Standard Downstream Port (SDP)   ☐ **Pass**   ☐ **Fail**   ☒ **N/A**

Test Items Port	1
SDP Handshaking Test	N/A

Multiple Role Port (MRP)   ☐ **Pass**   ☐ **Fail**   ☒ **N/A**

Test Items Port	1
MRP Functional Test	N/A

Full Speed Interoperability Tests

Full Speed Automated Tests (Ch 6)   ☒ **Pass**   ☐ **Fail**

MQP USB-PET

Only applicable when the Embedded Host has an A-Port.

Test Item	Port 1
6.7.2 A-UUT Initial Power-up Test	Pass
6.7.4 A-UUT V$_{BUS}$ Voltage and Current Measurements	Pass
6.7.5 A-UUT Bypass Capacitance	N/A
6.7.6 A-UUT SRP	N/A
6.7.8 A-UUT ADP	N/A
6.7.9 A-UUT Leakage	N/A
6.7.14 EH, Capable of ADP and SRP, State Transition Test (Standard-A)	N/A
6.7.15 EH, Capable of ADP but not SRP, State Transition Test (Standard-A)	N/A
6.7.16 EH, Capable of SRP but not ADP, State Transition Test (Standard-A)	N/A
6.7.17 EH with no Session Support State Transition Test (Standard-A)	N/A
6.7.18 EH, Capable of ADP and SRP, (Micro-AB) or OTG-A, Capable of ADP and SRP but not HNP, State Transition Test	N/A
6.7.19 EH, Capable of ADP but not SRP, (Micro-AB) or OTG-A, Capable of ADP but not SRP or HNP, State Transition Test	N/A
6.7.20 EH, Capable of SRP but not ADP, (Micro-AB) or OTG-A, Capable of SRP but not ADP or HNP, State Transition Test	N/A
6.7.21 EH with no Session Support State Transition Test (Micro-AB), or OTG-A with no Session or HNP Support	Pass
6.7.22 A-UUT "Device No Response" for connection timeout	Pass
6.7.23 A-UUT "Unsupported Device" Message	Pass
6.7.24 A-UUT "Device No Response" for HNP enable	N/A
6.7.25 EH using Micro-AB "Incorrect Connection"	Pass

Only applicable when the Embedded Host has a B-Port.

Test Item	Port 1
6.8.1 B-UUT Initial Power-up Test	N/A
6.8.2 B-UUT V_{BUS} Voltage and Current Measurements	N/A
6.8.3 B-UUT Bypass Capacitance	N/A
6.8.4 B-UUT SRP	N/A
6.8.6 B-UUT ADP	N/A
6.8.7 B-UUT Leakage	N/A
6.8.13 ADP-Capable Peripheral Only B-device State Transition Test	N/A
6.8.14 SRP Only Capable Peripheral Only B-device State Transition Test	N/A
6.8.15 Peripheral Only B-device, Capable of No Protocols, State Transition Test	N/A
6.8.16 B-UUT "Device no response" for SRP	N/A

**Full Speed Manual Tests (Ch 7)**　　　　　⊠ **Pass**　　☐ **Fail**

This section will perform DUT interoperability with peripherals that are on the vendor's Target Peripheral List.

| Test Item	Port 1
7.3.1 A-UUT Functionality B-device	**Pass**
7.3.2 A-UUT Category Functionality B-device	**Pass**
7.3.3 A-UUT Boot test	**Pass**
7.3.4 A-UUT Legacy Speed test	**N/A**
7.3.5 A-UUT Concurrent and Independently test	**N/A**
7.3.6 A-UUT Unsupported device Message test	**Pass**
7.3.7 A-UUT Hub Error message test	**Pass**
7.3.8 A-UUT Hub Functionality test	**N/A**
7.3.9 A-UUT Hub maximum tier test	**N/A**
7.3.10 A-UUT Hub Concurrent and Independent test	**N/A**
7.3.11 A-UUT Bus powered hub power exceeded test	**N/A**
7.3.12 A-UUT Maximum concurrently device exceed message test	**N/A**
7.3.13 A-UUT Standby test	**N/A**
7.3.14 A-UUT Standby Disconnect test	**N/A**
7.3.15 A-UUT Standby Attach test	**N/A**
7.3.16 A-UUT Standby Topology Change test	**N/A**
7.3.17 A-UUT Standby Remote Wakeup test	**N/A**

More Detailed Test Results:

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1. Full Speed Downstream Signal Quality: Pass

- Overall result: pass!
- Sync result:
  sync passes
- Signal eye:
  eye passes
- EOP width: 166.95 ns
  EOP width passes
- Measured signaling rate: 12.0139 MHz
  signal rate passes
- Edge Monotonicity: 49 mV
  Monotonic Edge passes
- Crossover voltage range: 1.64 V to 1.71 V, mean crossover 1.67 V
  (first crossover at 1.67 V, 16 other differential crossovers checked)
  crossover voltages pass
- Consecutive jitter range: -413.204 ps to 344.023 ps, RMS jitter 226.389 ps
- Paired JK jitter range: -27.042 ps to 400.170 ps, RMS jitter 180.804 ps
- Paired KJ jitter range: -261.094 ps to 240.848 ps, RMS jitter 161.758 ps
  jitter passes

Additional Information

- Rising Edge Rate: 211.22 V/us (Equivalent risetime = 12.50 ns)
- Falling Edge Rate: 210.29 V/us (Equivalent falltime = 12.55 ns)
- Edge Rate Match: 0.44% (limit +/-10%)
- Margin Above eye: 0.5780 V
- Margin Below eye: 0.4045 V
- Maximum Voltage: 3.9236 V
- Margin Below Top: 0.4764 V
- Minimum Voltage: -0.5622 V
- Margin Above Bottom: 0.3378 V

Signal Data and Eye
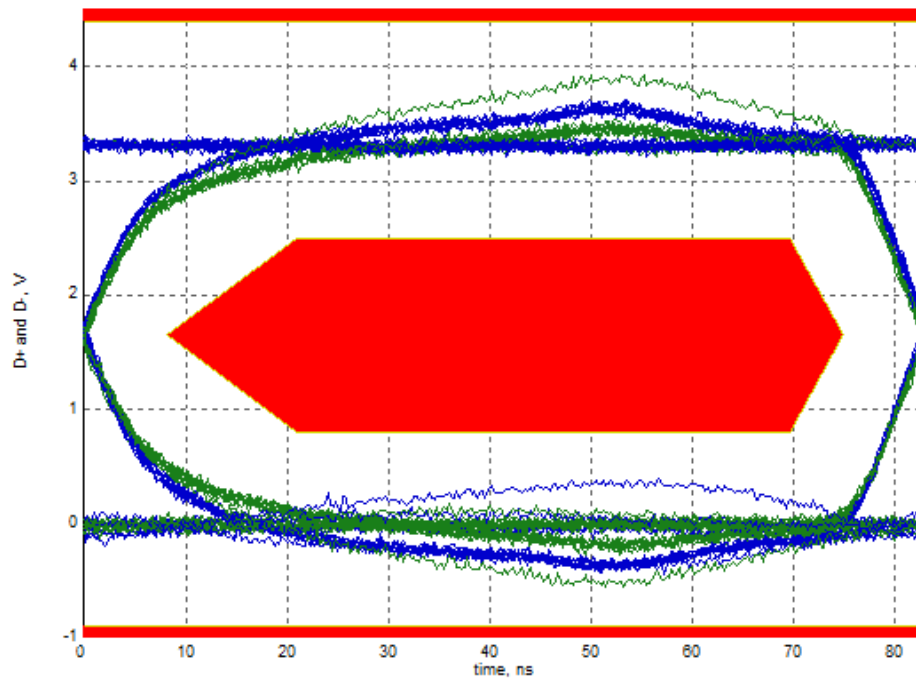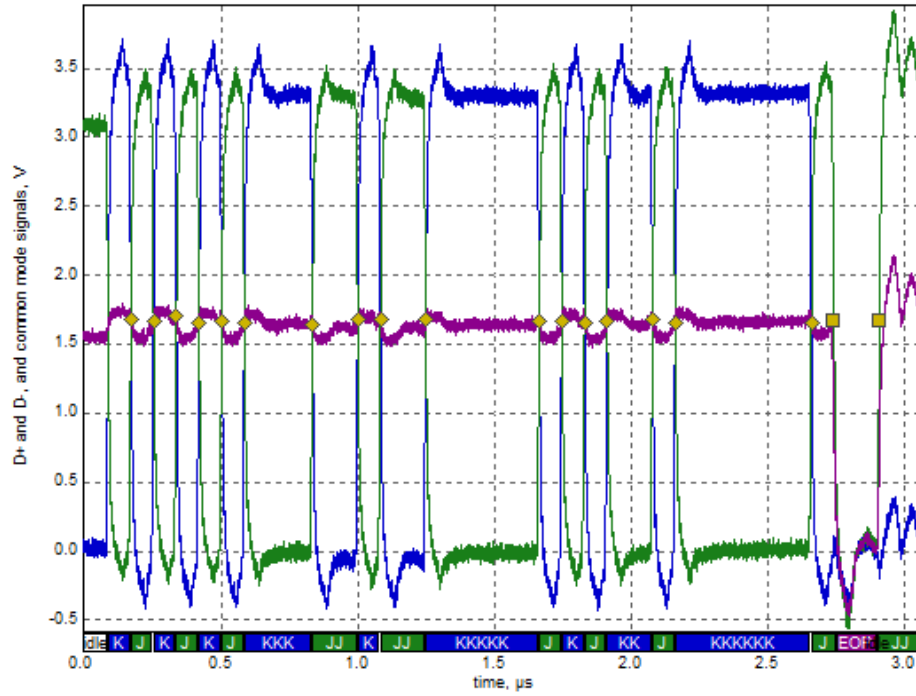
2. Low Speed Downstream Signal Quality: Pass

- Overall result: pass!
- Sync result:
  sync passes
- Signal eye:
  eye passes
- EOP width: 1.33 us
  EOP width passes
- Measured signaling rate: 1.5002 MHz
  signal rate passes
- Edge Monotonicity: 96 mV
  Monotonic Edge passes
- Crossover voltage range: 1.65 V to 1.79 V, mean crossover 1.72 V
  (first crossover at 1.66 V, 19 other differential crossovers checked)
  crossover voltages pass
- Consecutive jitter range: -6.236 ns to 6.862 ns, RMS jitter 3.800 ns
- Paired JK jitter range: -2.338 ns to 2.502 ns, RMS jitter 1.699 ns
- Paired KJ jitter range: -0.110 ns to 3.226 ns, RMS jitter 1.434 ns
  jitter passes

Additional Information

- Rising Edge Rate: 16.20 V/us (Equivalent risetime = 162.96 ns)
- Falling Edge Rate: 16.79 V/us (Equivalent falltime = 157.28 ns)
- Edge Rate Match: 3.55% (limit +/-20%)
- Margin Above eye: 0.4300 V
- Margin Below eye: 0.1584 V
- Maximum Voltage: 3.4404 V
- Margin Below Top: 0.2596 V
- Minimum Voltage: -0.1074 V
- Margin Above Bottom: 0.0926 V

Signal Data and Eye

Test Procedure Reference:

1. Keysight D9010USBC USB 2.0 Compliance Test Application, Version: 4.1
2. Universal Serial Bus Implementers Forum Full and Low Speed Electrical and Interoperability Compliance Test Procedure, Version: 1.3
3. USB Battery Charging 1.2 Compliance Plan, Revision: 1.1
4. USB On-The-Go and Embedded Host Automated Compliance Plan for the On-The-Go & Embedded Host Supplement Revision 2.0, Version 1.2

Notice: Test result is valid only to the original tested device model.