Testing USB-C Interface in a Tablet or Smartphone

With Unigraf's TSI SDK

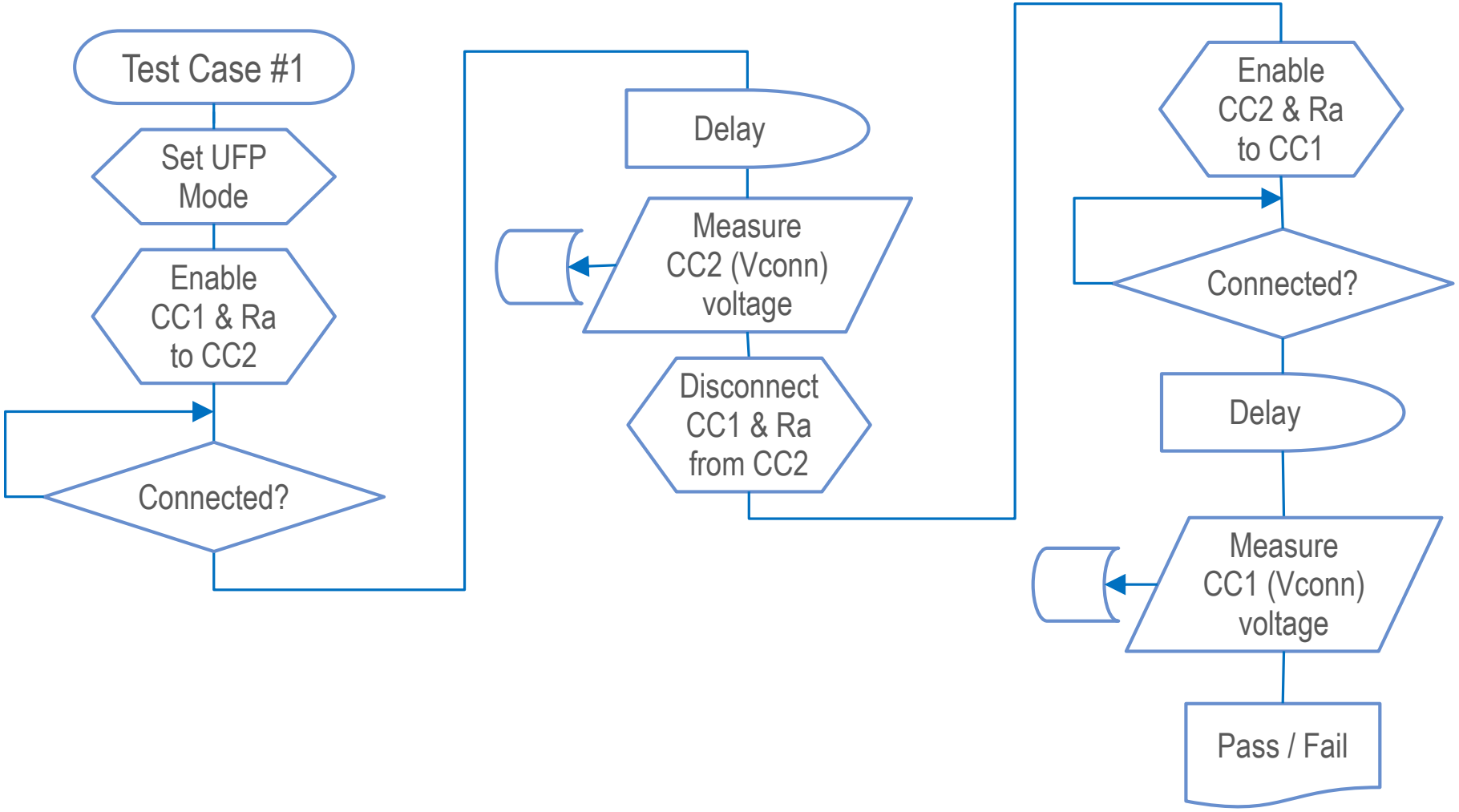
Agenda

- Testing a USB-C connected tablet or smartphone
  - ✓ Continuity of input lines
  - ✓ Bus voltages
  - ✓ Functionality of DP Alt Mode
- Unigraf test solutions for USB-C
- Unigraf TSI SW API for test automation

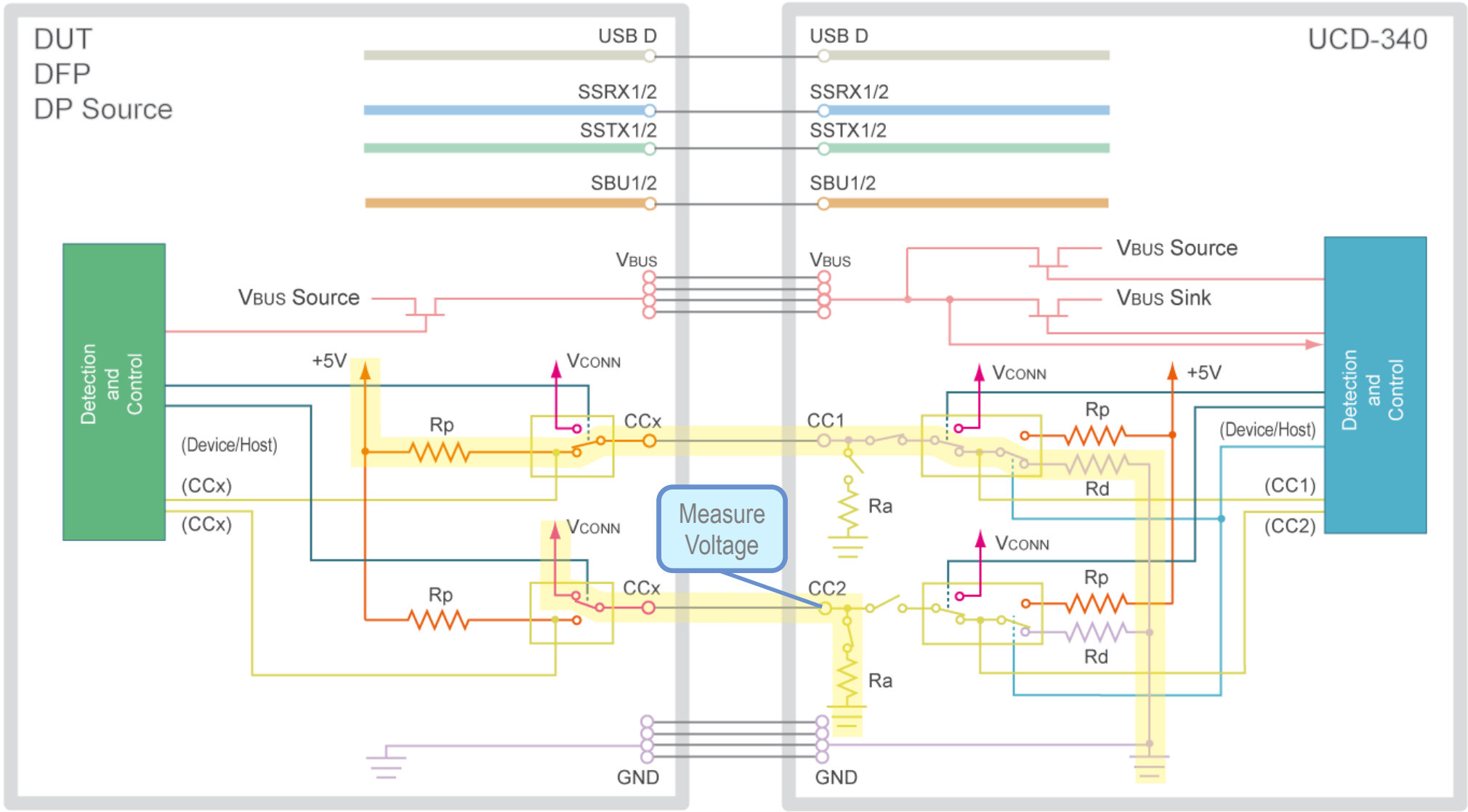
Test case #1: VCONN Signals

- UCD-340 in UFP mode
  - Rd pull-down in CC1, Ra pull-down in CC2
- UUT (DFP mode) detects the UFP's pull-down on CC1
  - DFP turns on Vbus and Vconn to CC-line connected to CC2
- After a delay UCD-340 measures the voltage in CC2 (Vconn)
- UCD-340 reconnects
- UCD-340 in UFP mode
  - Rd pull-down in CC2, Ra pull-down in CC1
- UUT (DFP mode) detects the UFP's pull-down on CC2
  - DFP turns on Vbus and Vconn to CC-line connected to CC1
- After a delay UCD-340 measures the voltage in CC1 (Vconn)
- End of test

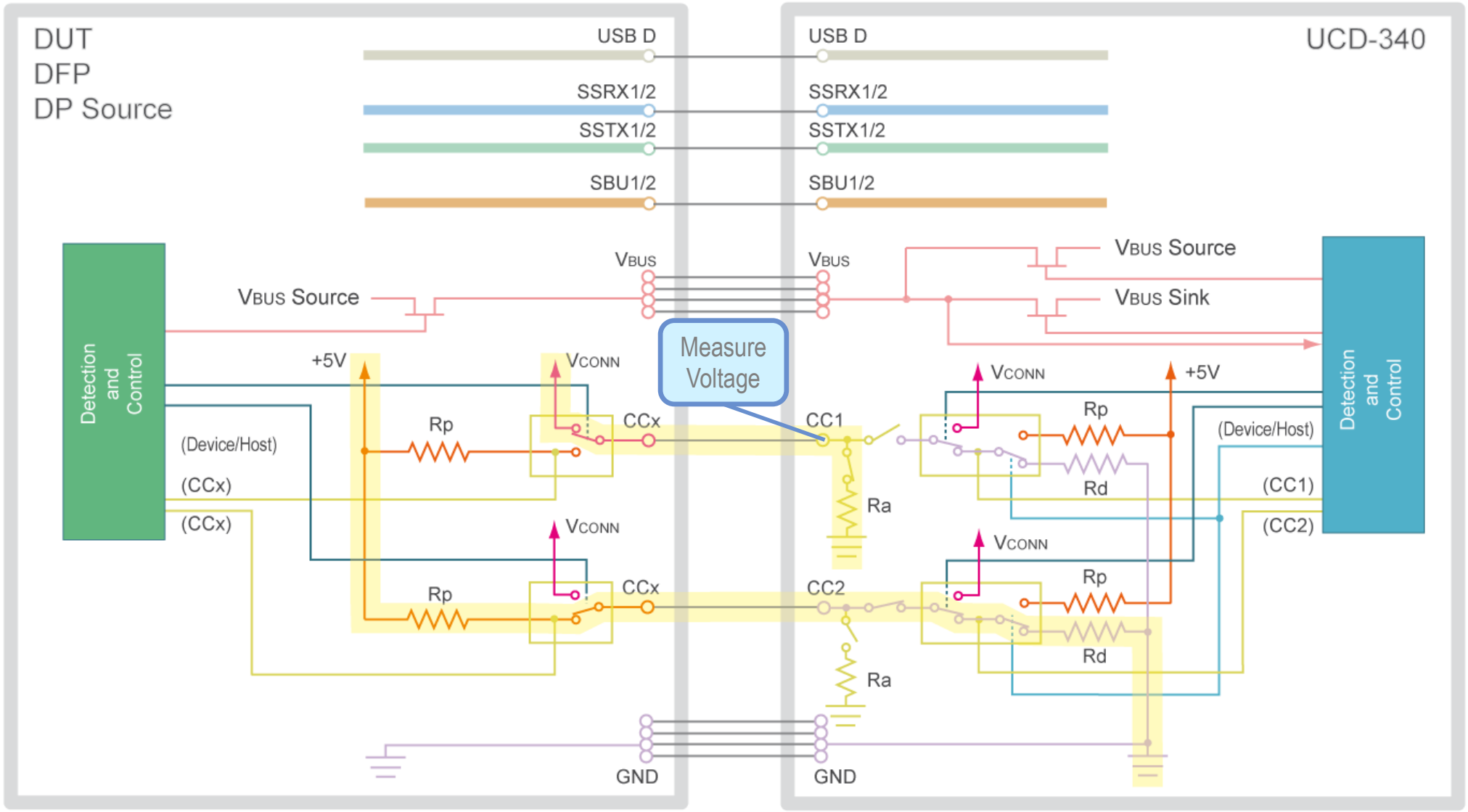
Test case #1
VCONN Signals



Step #1 (CC1)


DUT
DFP
DP Source
UCD-340
USB D
SSRX1/2
SSTX1/2
SBU1/2
VBUS
VBUS Source
VBUS Sink
Detection and Control
+5V
VCONN
Rp
Rd
Ra
CCx
CC1
CC2
(Device/Host)
(CCx)
(CC1)
(CC2)
Measure Voltage
GND

Step #2 (CC2)


DUT
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UCD-340
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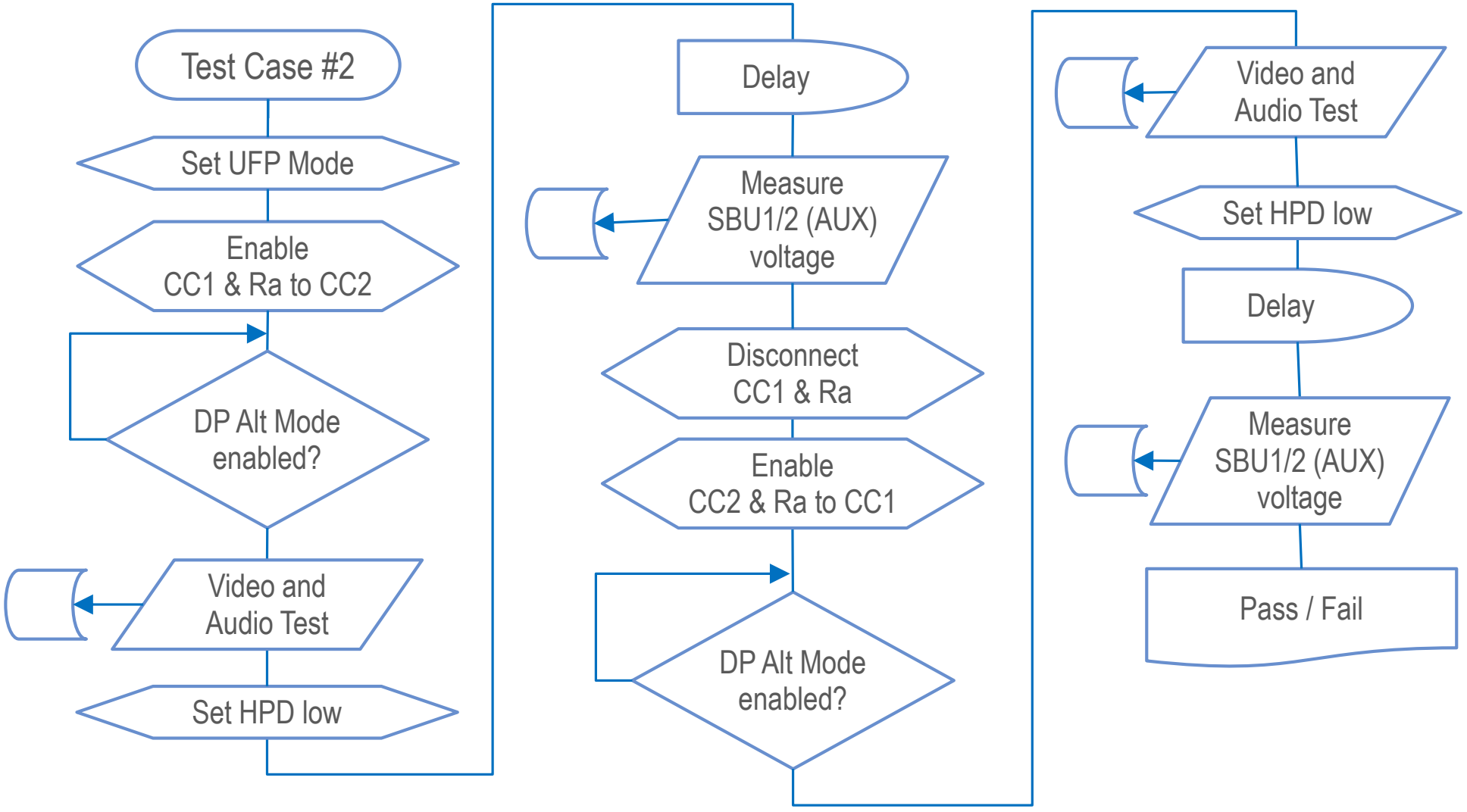
VBUS Source
VBUS Sink
Detection and Control
+5V
VCONN
Rp
Rd
Ra
CCx
CC1
CC2
Measure Voltage
(Device/Host)
(CCx)
(CC1)
(CC2)
GND

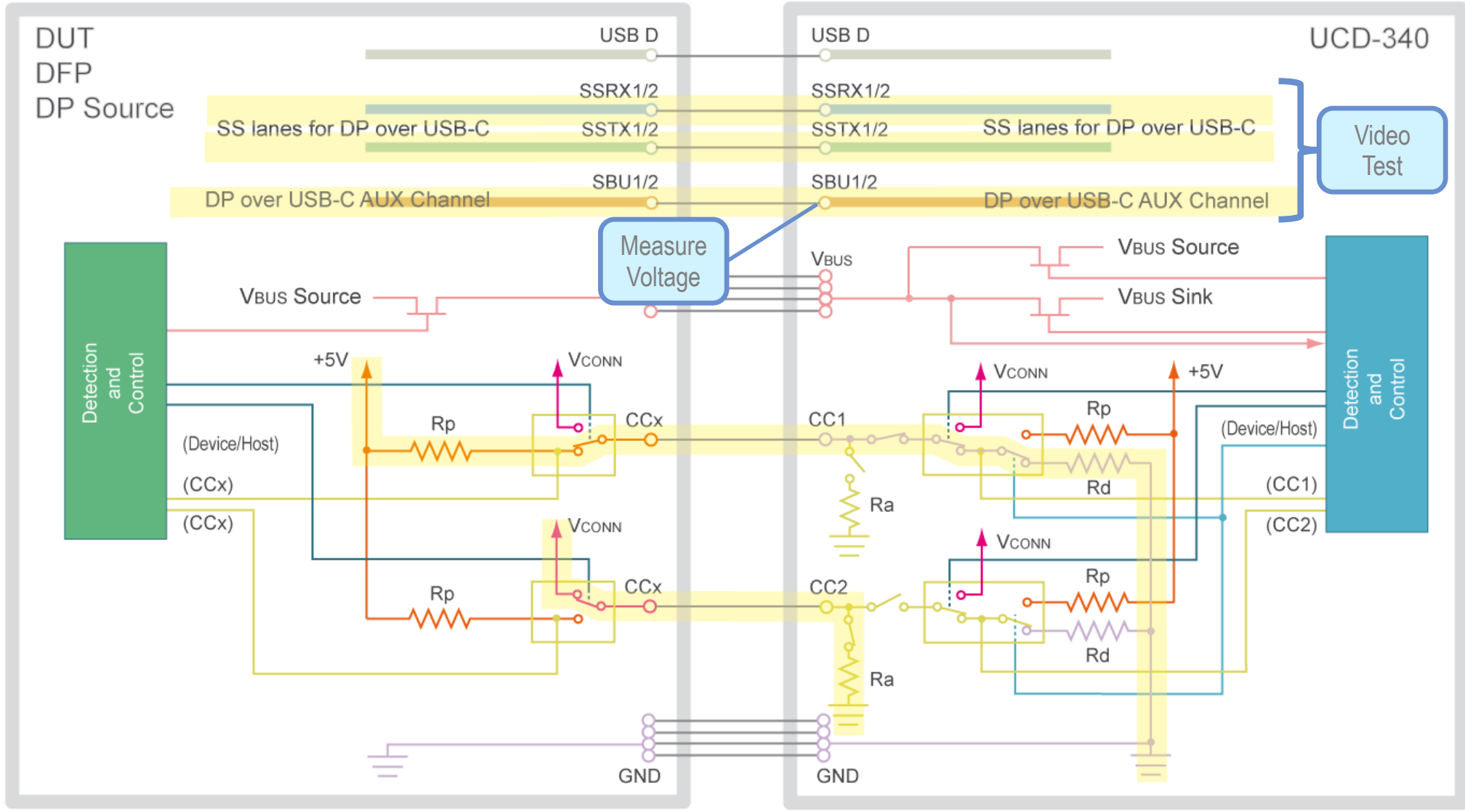
Test case #2: SBU & DP Alt Mode

- UCD-340 in UFP mode and DP Sink
  - Rd pull-down in CC1, Ra pull-down in CC2
  - Enter DisplayPort Alternate Mode
- UCD-340 captures and verifies video and audio
- Measure SBU1/2 (AUX Channel+/-)
  - Dis-assert HPD (low) to stop AUX traffic
- UCD-340 reconnects
  - Rd pull-down in CC2, Ra pull-down in CC1
  - Enter DisplayPort Alternate Mode
- UCD-340 captures and verifies video and audio
- Measure SBU1/2 (AUX Channel+/-)
  - Dis-assert HPD (low) to stop AUX traffic
- End of test

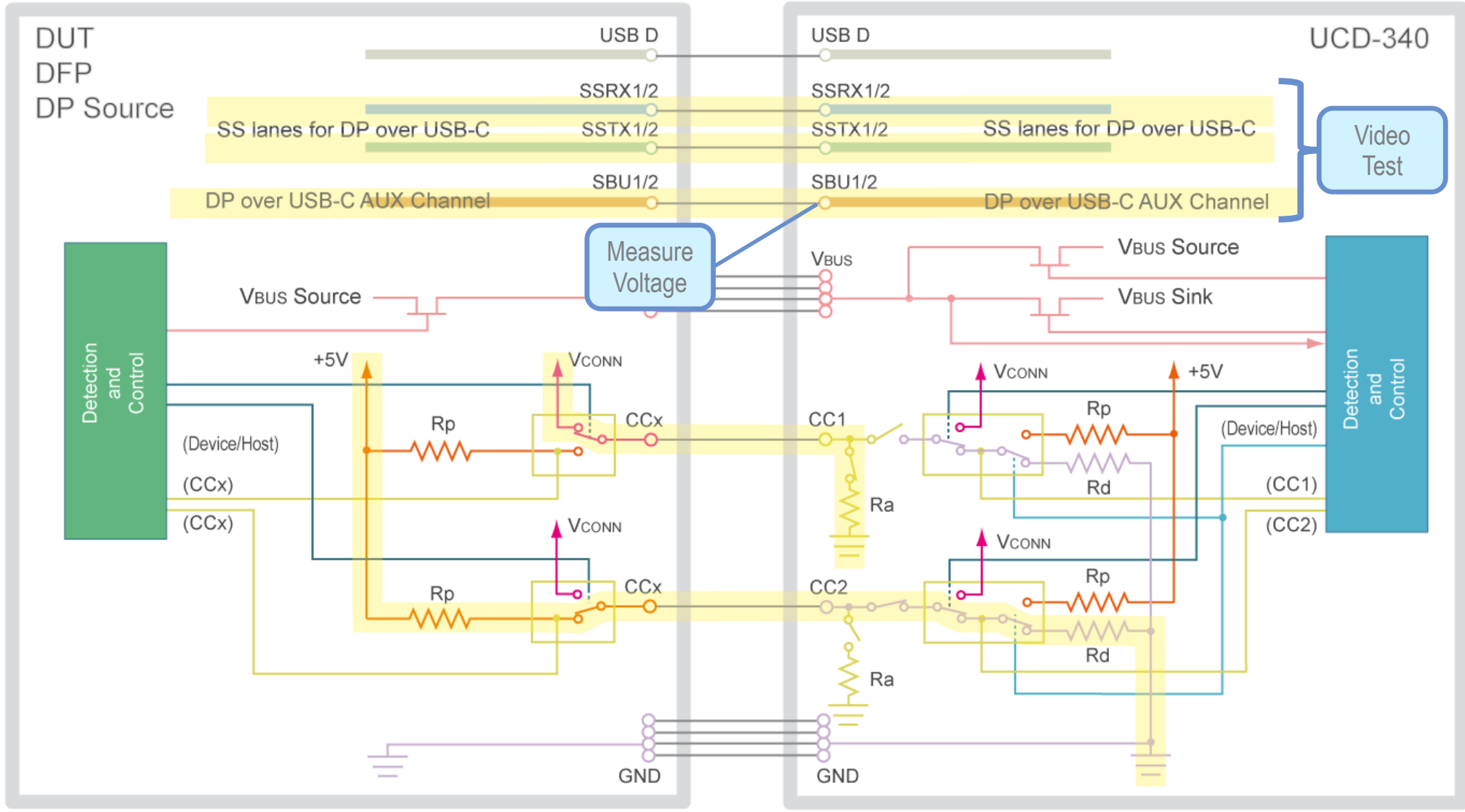
Test Case #2
SBU & DP Alt Mode



Step #3 (CC1)


DUT
DFP
DP Source
USB D
SSRX1/2
SSTX1/2
SS lanes for DP over USB-C
SBU1/2
DP over USB-C AUX Channel
UCD-340
Video Test
Measure Voltage
VBUS
VBUS Source
VBUS Sink
Detection and Control
+5V
VCONN
Rp
Rd
Ra
CCx
CC1
CC2
(Device/Host)
(CCx)
(CC1)
(CC2)
GND

Step #4 (CC2)


DUT
DFP
DP Source
USB D
SSRX1/2
SSTX1/2
SS lanes for DP over USB-C
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Measure Voltage
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VBUS Source
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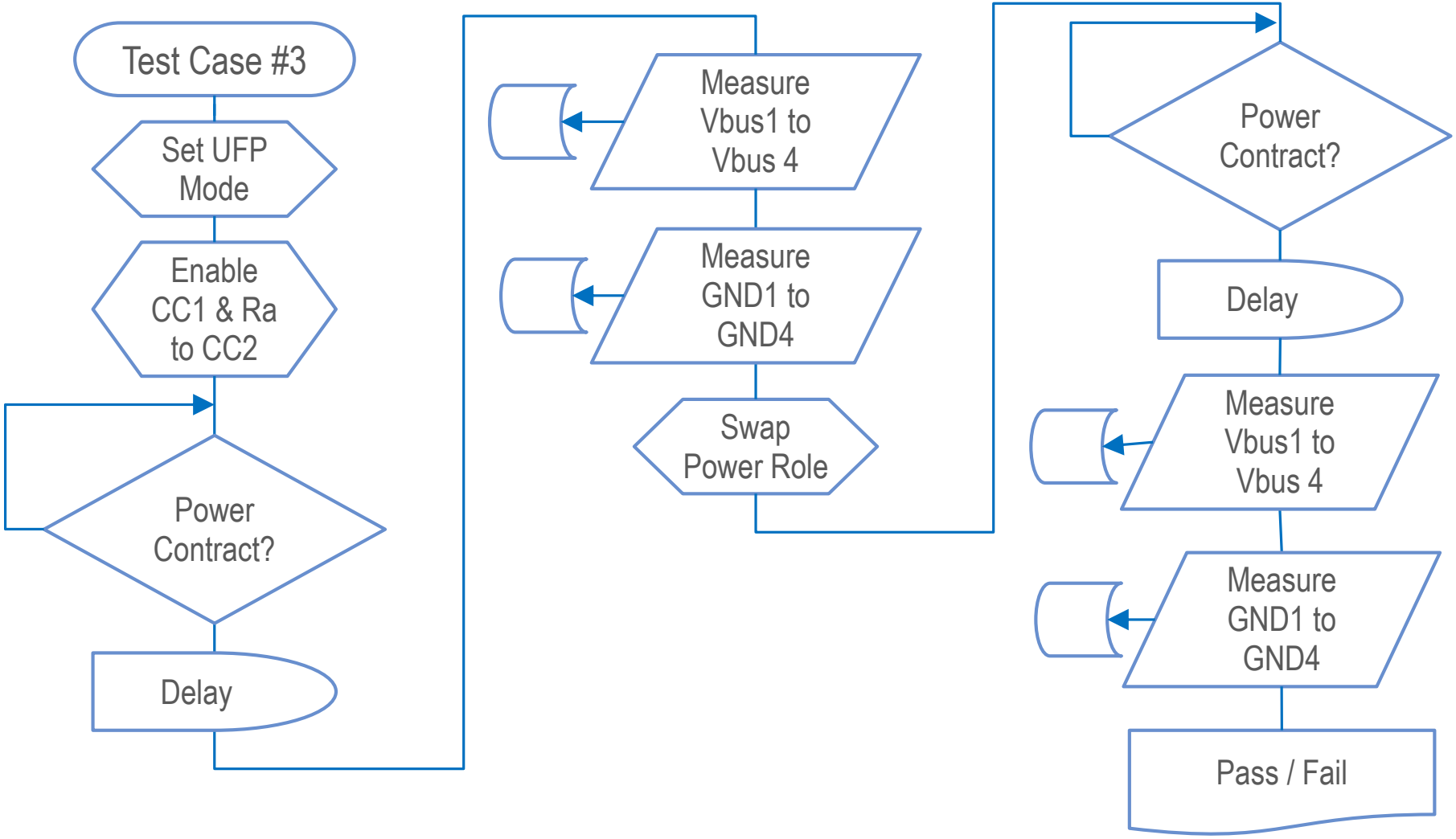
VCONN
+5V
Rp
Rd
(Device/Host)
(CC1)
(CC2)
CC1
CC2
Ra
GND

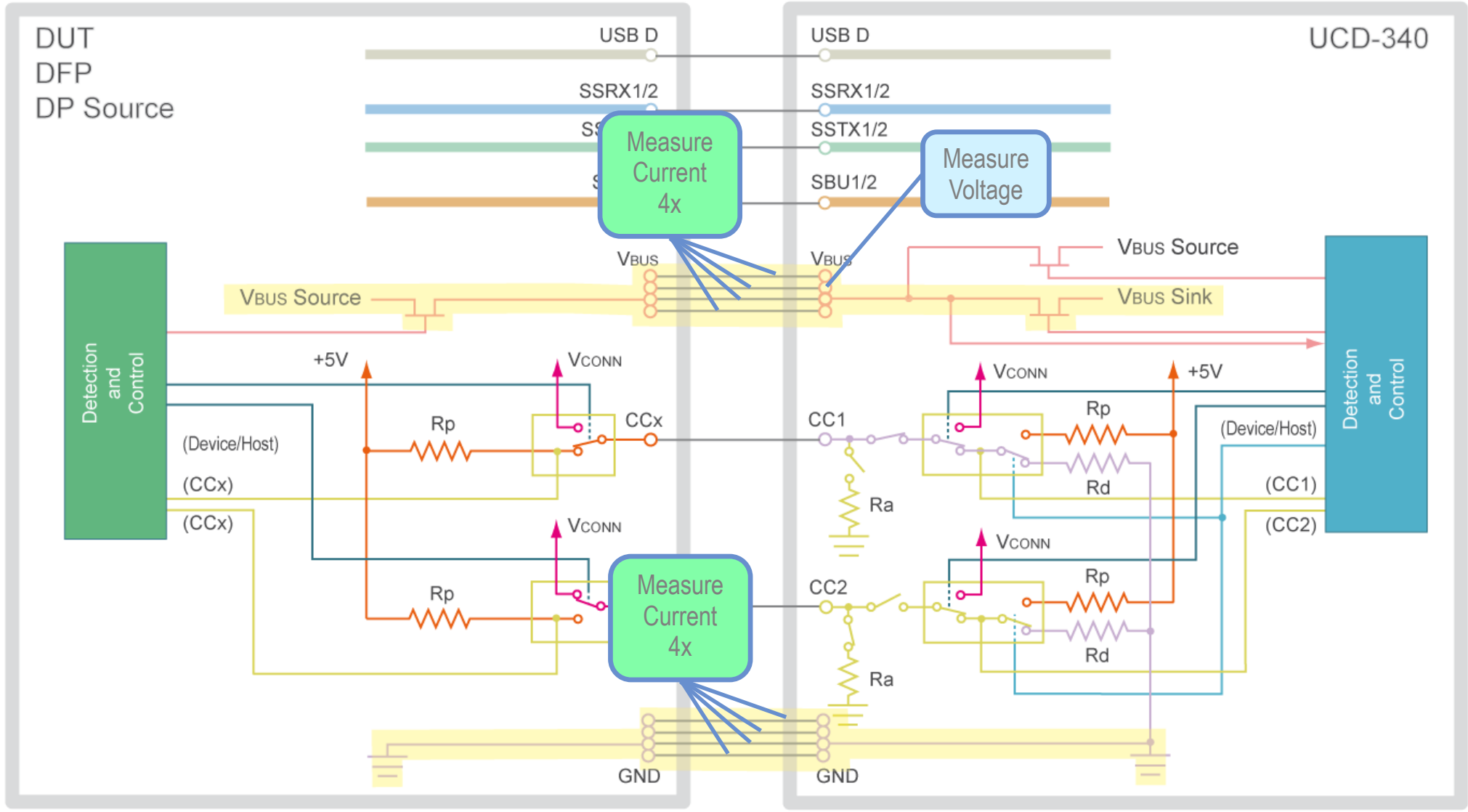
Test case #3
Vbus and GND

- UCD-340 in UFP mode and DP Sink
  - Rd pull-down in CC1, Ra pull-down in CC2
- Wait for completed Power Contract (UUT Vbus source)
- Measure Vbus and GND lines
  - Vbus1 – Vbus4 current, Vbus voltage
  - GND1 – GND4 current
- Power role swap (UUT Vbus sink)
- Measure Vbus and GND lines
  - Vbus1 – Vbus4 current, Vbus voltage
  - GND1 – GND4 current
- End of test

Test case #3
Vbus and GND



Step #5 Vbus & GND (Sink)



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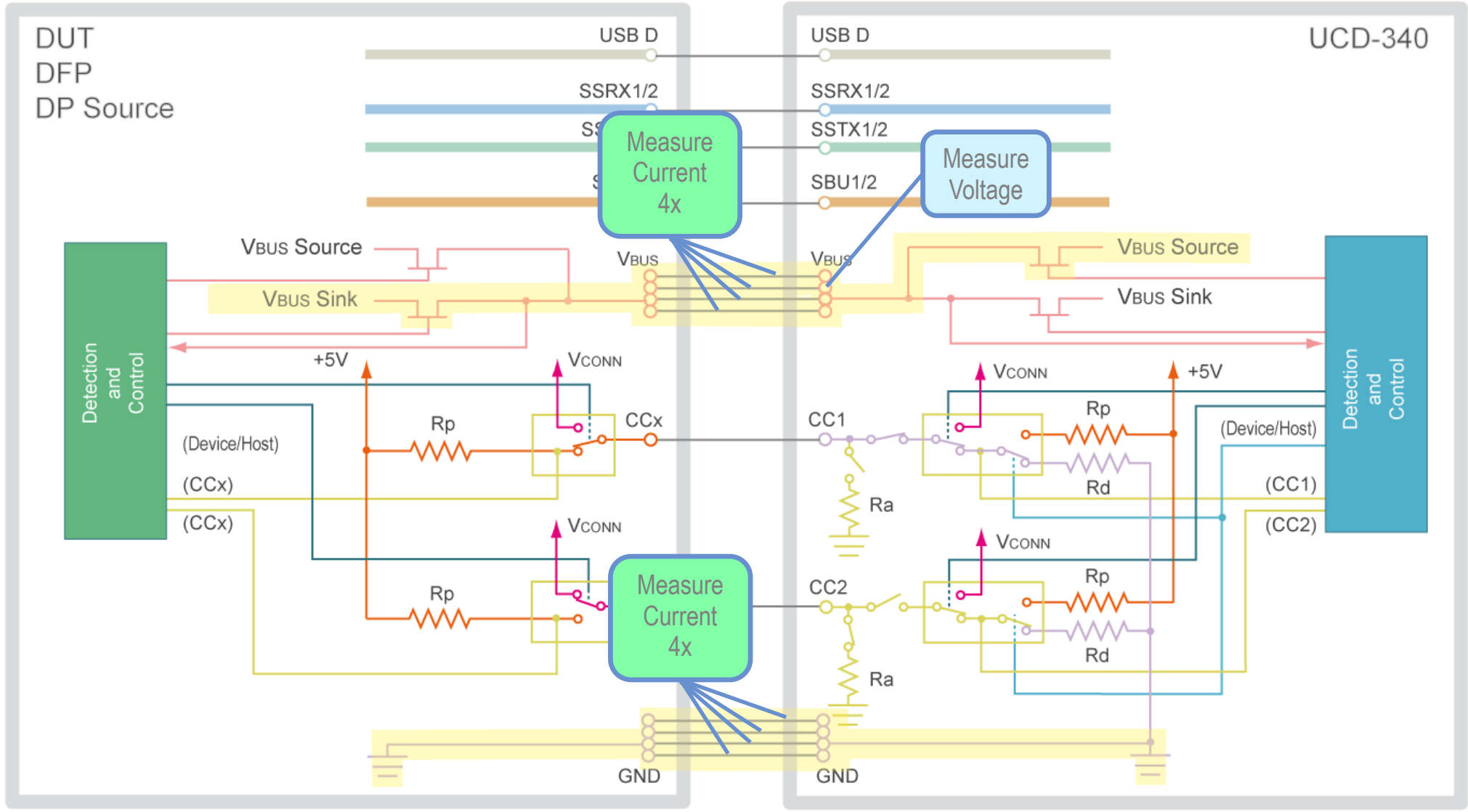
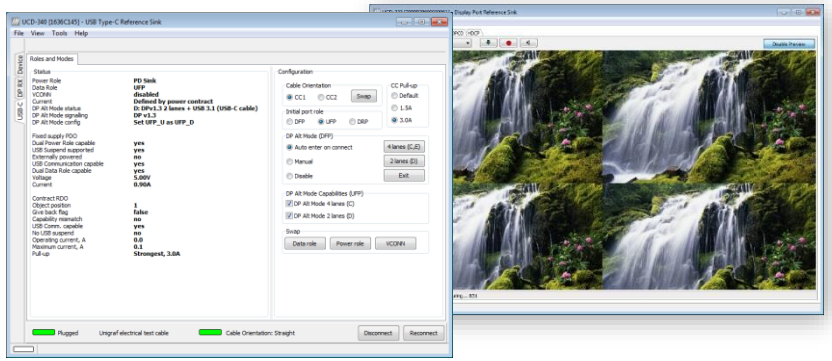
Step #6 Vbus & GND (Source)



Unigraf Test Solution for USB-C

- Includes all SW and HW needed to test a USB-C interface
  - ✓ UCD-340 test equipment hardware
  - ✓ UCD Console GUI for R&D
  - ✓ TSI SDK with ready Test Cases
- Supports various test intents
  - ✓ GUI with full controls for R&D and QA use
  - ✓ Customizable high level API for end-of-design regression testing
  - ✓ Ready to integrate Test Cases for most USB-C product types
- Integrated DP Alt Mode testing
  - ✓ Video and audio capture
  - ✓ Video pattern generator



UCD-340

Test Unit for USB-C DP Alt Mode Sinks and Sources

- Test DP Alt Mode video and audio
- Test USB-C Power Delivery & DP Alt Mode
- Verify interface signal continuity
- HDCP 1.3 and HDCP 2.2 support
- USB signal pass-thru
- GUI for lab use and API for test automation

Unigraf Special Features

- USB-C Electrical Test
  - ✓ Electrical Test Cable includes individual cords for each GND and V_{BUS} input
  - ✓ Measure the continuity of VBUS and Ground inputs
    - Enables verification of each input separately
  - ✓ Measure the voltage levels of CC and SBU connections
    - Full functionality measured in modes where SBU lines are operational
- Cable Flip
  - ✓ Electrically swap the role of CC lines
- Power Delivery Test

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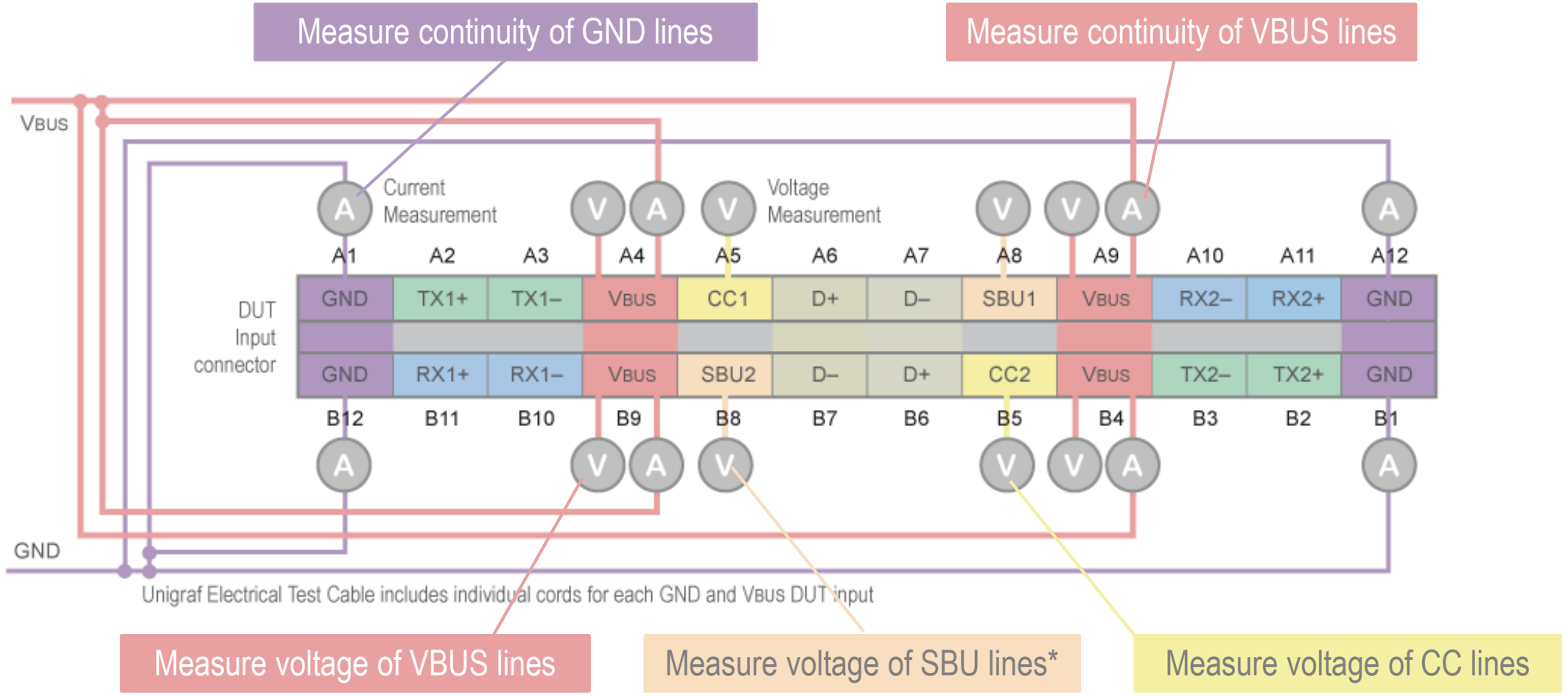
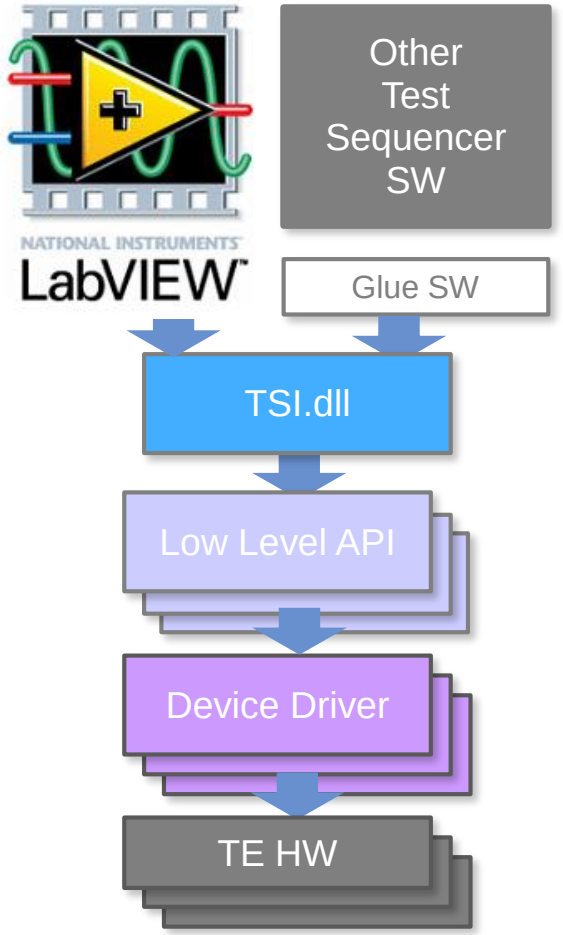
USB-C Electrical Testing



*) Full functionality measured in modes where SBU lines are operational

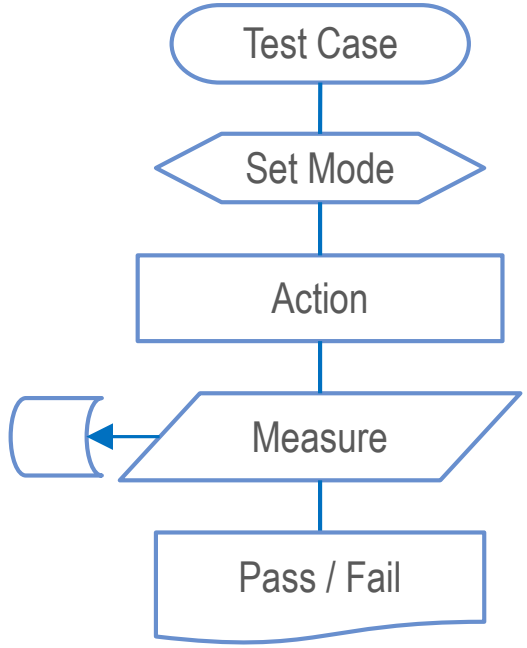
TSI API for Test Automation

- Suitable for Test Automation in R&D and Production Line
- Straightforward to use
  - ✓ High level interface
  - ✓ Pre-programmed Test Cases
  - ✓ No need for low-level TE-specific controls
- Example applications with source code
- NI / LabVIEW support



TSI Test Cases for USB-C

- Dedicated Test Case for each DP Sink and Source role
- Complete
  - ✓ Verify all functions in the product type
  - ✓ Separate Test Case for each combination
- Compact and Fast
  - ✓ Skip roles that are not applicable
- Reliable
  - ✓ Implemented directly from the standard
- Easy to Integrate
  - ✓ High level, parameterized



Thank You!

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