VESA 2026 Shenzhen Workshop
VESA 2026深圳研讨会

October 14, 2026/2026年10月14日

Agenda/议程

Time	Topic	Speaker
9:00am CT	Registration Opens	N/A
9:30am – 10:00am CT	Snacks & Refreshments	N/A
10:00am – 10:30am CT	VESA Overview and Standards Updates, Including DisplayPort v 2.1b	Jim Choate, Compliance Manager, VESA
10:30am – 11:00am CT	DisplayPort Link Layer CTS v 2.1 MST Updates and Automotive Extension Services Updates	Neal Kendall, Senior Staff Product Marketing Manager, Teledyne LeCroy
11:00am – 11:30am CT	DP v 2.1 PHY CTS Overview and Updates	Mike Engbretson, Product Manager, Teledyne LeCroy
11:30am – 12:00pm CT	VESA Display Panel Metrics Standards Overview	Cyan Chen, Global Business Lead, Display Technologies, Granite River Labs
12:00pm – 1:00pm CT	Lunch	N/A
1:00pm – 1:30pm CT	LRD/Active Cable Testing and DP 2.1 Enhanced Connector Certification Challenges	Lexus Lee, Technical Program Manager, Allion Labs
1:30pm – 2:30pm CT	Design Considerations for USB-C Products	Abel Astley, Head of USB Technology, Unigraf Oy
2:30pm – 2:45pm CT	Break	N/A
2:45pm – 3:15pm CT	VESA Compliance Program	Jim Choate, Compliance Manager, VESA
3:15pm – 3:35pm CT	Summary, Questions & Answers	Jim Choate, Compliance Manager, VESA
3:35pm – 4:35pm CT	Demo Stations Overview	Rich Minter, VESA

VESA Overview and Standards Updates
VESA概述与标准更新

Jim Choate

VESA Compliance Program Manager/VESA合规项目经理

Agenda/议程

- VESA Overview/VESA概述
- DisplayPort Overview/DisplayPort概述
- VESA Technology Development Areas/VESA技术开发领域
- Summary/总结

VESA OVERVIEW
VESA概述

VESA Vision/VESA愿景

- VESA's vision is continual growth in technical standards development and evolution as an international trade association, with a worldwide membership driving standards initiatives, product implementations, and market implementation.

  作为一家国际行业协会，VESA 的愿景是推动技术标准的开发与演进不断向前发展，通过全球成员推动标准倡议、产品落地和市场运作。

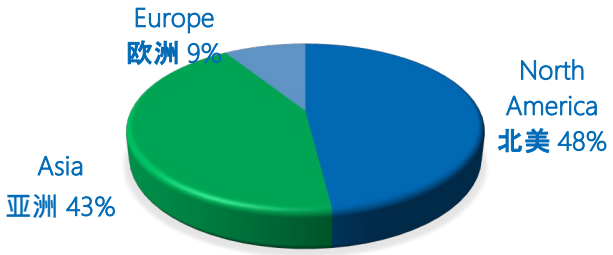
About VESA/关于VESA

- A growing global industry alliance with 369 members. Continuous growth in membership./一个拥有369家成员、规模持续扩大的全球行业联盟。成员数量不断增长。
- Mission to develop, promote and support ecosystem of vendors and ***certified*** interoperable products for the electronics industry./致力于为电子行业开发、推广并支持由供应商及经认证的互操作产品所构成的生态系统
- *Develops OPEN standards, contribution is open to all companies at all stages of development/制定开放标准，欢迎处于各发展阶段的公司参与贡献*

VESA Membership Growth by %/VESA成员增长百分比

MEMBERSHIP BY REGION 2013

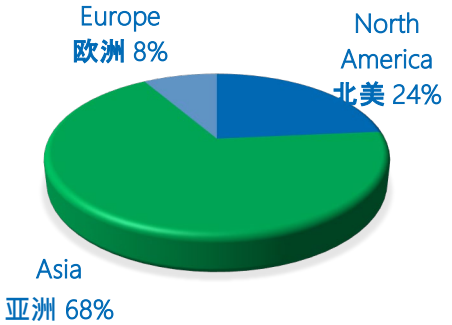
2013年按地区划分的成员增长情况



- Total Ecosystem: 200 total corporate members worldwide./整个生态系统：全球共200家企业成员。
- Western Core: North American companies hold the largest single regional share./西方核心区域：北美企业占据了单一区域中的最大份额。
- Balanced Footprint: Early-stage adoption driven primarily by foundational US chipmakers and device OEMs./均衡布局：早期应用主要由美国基础芯片制造商和设备原始制造商（OEM）驱动。

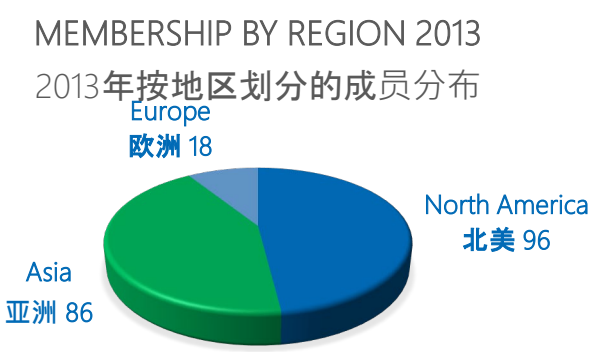
MEMBERSHIP BY REGION 2026

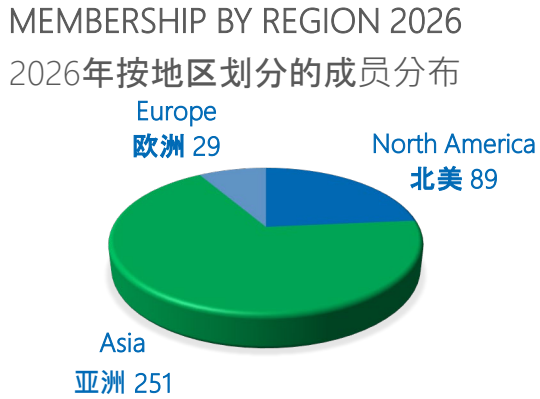
2026年按地区划分的成员增长情况



- Total Ecosystem: Expanded to 369 total corporate members./整个生态系统：扩展至369家企业成员。
- Epicenter Shift: Asian tech hubs now represent over two-thirds of the standards body./重心转移：亚洲科技中心目前在该标准组织中占比超过三分之二。
- Global Standard: Widespread international integration driven by the ubiquity of DisplayPort, DPAM, eDP, Display Panel Metrics (DPM)) and automotive display profiles./全球标准：得益于DisplayPort、DPAM、eDP、Display Panel Metrics (DPM)和车载显示配置文件的广泛普及，实现了深度的国际融合。

VESA Membership Growth by Total Companies/VESA成员增长情况（按公司总数计）





- The Illusion of Decline: A percentage-only view falsely suggests North American membership shrank by half (48% down to 24%)./成员数下降的错觉：仅看百分比会错误地认为北美成员减半（从48%降至24%）。
- The Reality of Stability: In absolute numbers, North American membership stayed completely robust and stable (89 vs 96 companies). Europe membership has grown 61% in this interval./成员稳定的实情：从绝对数量来看，北美成员规模保持强劲且稳定（89家 vs 96家）。同期欧洲成员增长了61%。
- The Growth Engine: The structural shift is entirely additive—fueled by 165 new Asian companies joining the ecosystem to support massive display infrastructure expansion./增长引擎：结构性转变完全是增量式的 — 由165家新加入生态系统的亚洲公司推动，以支持大规模显示基础设施的扩张。

VESA Standards Enable Many Market Segments…/VESA标准助力多个细分市场…



Monitors, PCs and laptops



Gaming consoles and headsets



Smartphones and tablets



Automotive

NEW: VESA DP AE specification and DP AE CTS



Multi-Stream Transport (MST)/Multi-Stream Transport (MST)

VESA Local Asian Support Capability/VESA在亚洲的本地化支持能力

- VESA continues to provide local support to Asia to address growing regional membership needs/VESA持续为亚洲提供本地化支持，以满足该地区不断增长成员需求
- **Kellen** is VESA's Representative in Asia/科伦是VESA在亚洲的代表
- This partnership provide members with a communication option in their native language. Kellen handles membership related activities including, new membership requests, renewals, event support and translation of VESA member messaging, etc./这一合作关系为成员提供了使用母语沟通的渠道。科伦负责成员相关的各项事务，包括新成员申请、续费、活动支持以及VESA成员讯息的翻译等。
- 亚洲联系方式：AsiaVESA@kellencompany.com 或电话 +86 10 6580 0670

DisplayPort ™ Overview
DisplayPort™概述

DisplayPort Market Penetration/DisplayPort市场渗透率

- DisplayPort adoption continues to grow in 2026/DisplayPort的采用范围在2026年持续增长
- DisplayPort and DisplayPort Alternate Mode over USB-C/DisplayPort和USB-C上的DisplayPort 替代模式
  - The common monitor interface for personal computers/个人电脑通用的显示器接口
  - Supported on the USB-C interfaces/在USB-C接口上提供支持
    - Mandated for USB4 and Thunderbolt/USB4和Thunderbolt强制要求
  - Automotive integration with DP AE specification/基于DP AE规范的车载集成
  - Mobile phones with USB-C/支持USB-C的手机
  - ***New:*** *AR/VR standard and CTS/**新增**：AR/VR标准和CTS*
- Embedded DisplayPort (eDP)/嵌入式DisplayPort (eDP)
  - >95% to near 100% penetration in notebook PCs, used in many high-end tablets and automotive/在笔记本电脑中渗透率从95%提升至接近100%，并广泛应用于高端平板电脑和车载领域

DisplayPort 2.1b Summary/DisplayPort 2.1b总结

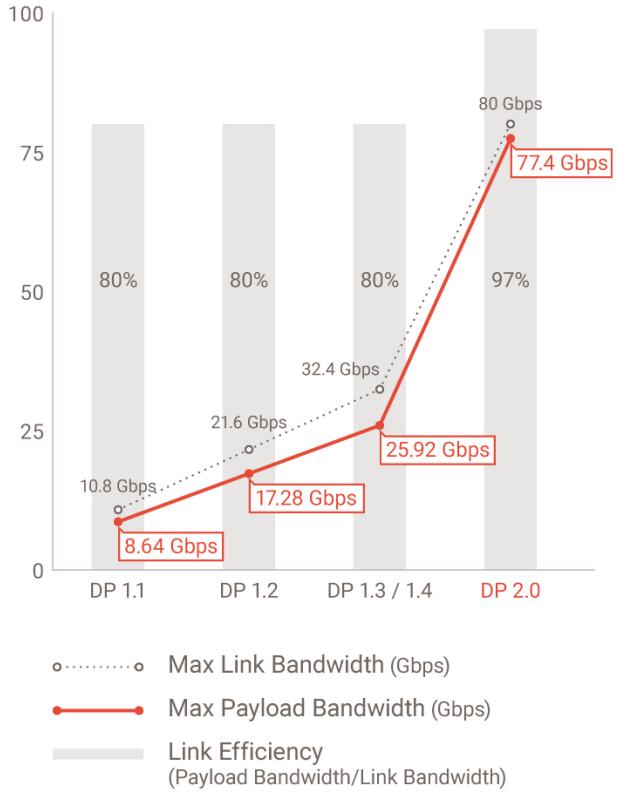
- DisplayPort v2.1b was released in December 2025/DisplayPort v2.1b于2025年12月发布
- Major features added in v2.0/v2.1/v2.1a/v2.1b:/v2.0/v2.1/v2.1a/v2.1b中新增的主要功能：
  - Added 128b/132b DP channel coding (UHBR rates)/新增128b/132b DP信道编码（UHBR速率）
  - Increase in data bandwidth performance (almost 3X) with new link rates up to 20 Gbps/lane/数据带宽性能提升（近3倍），新增链路速率最高可达20 Gbps/通道
  - Panel Replay, similar to PSR (Panel Self Refresh) used for eDP/面板回放，类似于用于eDP的PSR（面板自刷新）
  - DSC support mandated/强制要求DSC支持
  - Enhanced DP connectors and cables (DP40, DP54 and DP80)/增强型DP连接器和线缆（DP40、DP54和DP80）
  - DP PHY specification alignment with USB4 PHY specification/DP PHY规范与USB4 PHY规范保持一致
  - Updated DP to HDMI v2.1 or higher protocol converter (PCON)/更新了DP转HDMI v2.1以上版本的协议转换器（PCON）
  - Corrects errata/更正勘误
  - Replaces DP40 cables with DP54 to expand higher rate cable length/用DP54替代DP40线缆，以延长更高速率下的线缆长度
  - Expanded Tunneling capability/扩展隧道传输能力
  - Updates for DP AE Services specification/DP AE 服务规范的更新
  - DP80LL cable spec section (active cables for longer reach with lower loss)/DP80LL线缆规范部分（有源线缆：传输更远、损耗更低）
  - LRD Active Cable Electrical Mandate section/LRD有源线缆电气要求部分

VESA

- DisplayPort 2.1b enables up to 3X increase in video bandwidth performance vs DP 1.4/DisplayPort 2.1b 相比DP 1.4实现最高可提升至3倍的视频带宽性能
- UHBR10, UHBR13.5 and UHBR20 provides up to 80Gbps link bandwidth for 4 lanes at 20Gbps./UHBR10、UHBR13.5和UHBR20在4通道20Gbps下可提供高达80Gbps的链路带宽。
- First standard to support 8K resolution (7680 x 4320) at 60 Hz refresh rate with full-color 4:4:4 resolution, including with 30 bits per pixel (bpp) for HDR-10 support/首个支持8K分辨率（7680 x 4320）60Hz刷新率、4:4:4全彩色样，包括支持 HDR-10 所需的每像素30位（bpp）的标准
- Beyond 8K resolutions achieved with maximum link rate to up to 20 Gbps/lane and more efficient 128b/132b channel coding/通过高达20 Gbps/通道的最大链路速率和更高效的128b/132b信道编码实现超越8K的分辨率

DisplayPort™

EVOLUTION OF DISPLAYPORT DATA BANDWIDTH



DisplayPort 2.1 Link Layer CTS Summary/DisplayPort 2.1链路层CTS概要

- DP 2.1 LL CTS v1.1 released 12/2025/DP 2.1 LL CTS v1.1于2025年12月发布
- Major updates:/主要更新：
  - Updates to align with other published VESA standards and terminology/本次更新旨在与其他已发布的VESA标准和术语保持一致
  - Incorporated many approved and published SCRs/纳入了许多已批准和已发布的SCR
    - For example: FEC, Audio, DisplayID, min Hblank/Vblank, etc/例如：FEC、音频、DisplayID、最小水平消隐/垂直消隐等
  - Addition of new Source, Sink and Branch device MST tests (covered separately)/新增源端、接收端和分支设备的MST测试（另行单独说明）
  - LTTPR emulation testing/LTTPR仿真测试

VESA Technology Development Areas
VESA技术开发领域

VESA technology development/VESA技术开发

VESA members are collaborating on several key technology areas/VESA成员正在多个关键技术领域开展合作

- Embedded DisplayPort - v2.0 (published Sept 2024)/嵌入式DisplayPort - v2.0（2024年9月发布）
- DP Tunneling over USB4 – compliance testing has begun/基于USB4的DP隧道传输——合规测试已启动
- AR/VR Task Group/AR/VR任务组
  - Focused on creating solutions roadmap to meet performance, power and implementation requirements for future AR/VR needs. Specification is released. Work on CTS underway/专注于制定解决方案路线图，以满足未来AR/VR需求在性能、功耗和实现方面的要求。规范已发布。CTS的相关工作正在推进中
- DP Automotive Extension Task Group/DP 车载扩展任务组
  - Working with automotive industry to address needs for high-resolution performance in this market segment/与汽车行业合作，满足该细分市场对高分辨率性能的需求
  - Working on DP AE CTS and testing/正在开展的DP AE CTS和测试工作
- MST Compliance Test Updates/MST合规测试更新
  - DP 2.1 LL CTS v1.1 released and new tests became normative 7/7/2029/DP 2.1 LL CTS v1.1已发布，新测试于2029年7月7日成为规范性要求
- Display Performance Metrics Task Group/Display Performance Metrics任务组
  - DisplayHDR, ClearMR, AdaptiveSync updates and proposals for future capabilities/DisplayHDR、ClearMR、AdaptiveSync更新及针对未来功能的提案

VESA Logos and Marketing Guidelines
VESA标识和营销指南

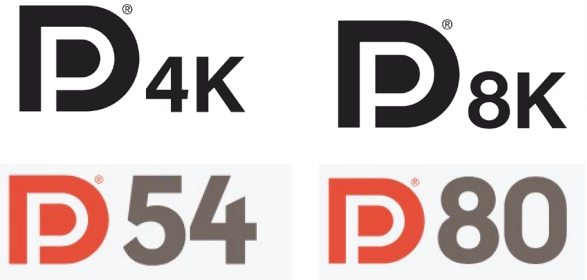
VESA Membership Allows Use of VESA Logos/VESA成员可使用VESA标识

- When your product passes certification company can use VESA logo to show customers proof of quality/产品通过认证后，公司即可使用VESA标识，向客户展示或证明产品品质

Cable Logos include:
/线缆标识包括：

DP Product Logos include:
/DP产品标识包括：

Display Logos include:
/攜示器曞詥包括：



VESA DisplayPort MST CTS 改进

Alok Soni/Neal Kendall

Teledyne LeCroy

2026年10月14日 – Shenzhen, China

MST Source CTS Updates Since CTS Rev 1.1

- **Agenda**
  - Overview of CTS updates since Rev 1.1
  - MST Source CTS updates
  - MST Branch CTS updates
  - Composite Sink CTS updates
  - New Sink and Source tests
  - Summary
  - Q/A and feedback

自 CTS 1.1 版以来的MST 源端 CTS 更新

- **议程.**
  - 自 Rev 1.1 以来的 CTS 更新概览
  - MST 源端 CTS 更新
  - MST 分支设备 CTS 更新
  - 复合接收端 CTS 更新
  - 新增接收端与源端测试
  - 总结
  - 问答与回馈

MST Source CTS updates since CTS Rev 1.1/自 CTS Rev 1.1 以来的 MST 源端 CTS 更新

MST CTS Coverage Summary/MST CTS 覆盖范围摘要

Area	Rev 1.1 Tests/Rev 1.1 测试	New Tests/新测试	Updated Tests/更新测试
Source/源端	21	0	4
Branch/分支设备	54	2	15
Composite Sink/复合接收端	48	1	14

CTS Updates - MST Source Device

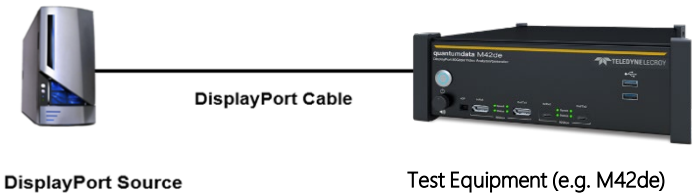
- MST Source Tests in Rev 1.1 CTS (21 Tests):
  - 4.10.1.1 to 4.10.1.21.
- MST Source Tests updates since Rev 1.1 CTS via approved SCRs.
  - 4.10.1.4
  - 4.10.1.8
  - 4.10.1.12
  - 4.10.1.21

CTS 更新 - MST 源端设备

- Rev1.1 CTS中的MST 源端测试（共 21 项）：
  - 4.10.1.1 to 4.10.1.21.
- 自 Rev1.1 CTS以来，MST 源端测试已根据获批的 SCR 进行更新.
  - 4.10.1.4
  - 4.10.1.8
  - 4.10.1.12
  - 4.10.1.21

CTS Updates - MST Source Device

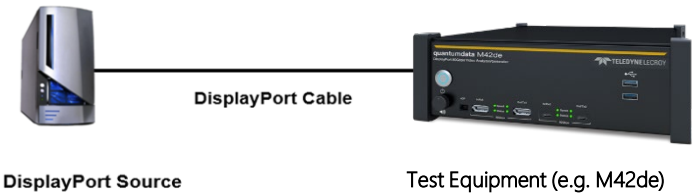
- How to run MST Source CTS:
  - Connect TE to Source DUT.



  - From Test Equipment software fill out CDF entry.
    - **Note**: Test Equipment automatically retrieves CDF entries from the VESA CDF JSON file.
  - Select MST Source Tests and then run them.
  - Follow graphical user interface prompt for setup/validation.
  - After test execution completes, generate the HTML report.

CTS更新 - MST源端设备

- 如何运行 MST 源端 CTS:
  - 将TE 连接至被测源端设备.



  - 从测试设备软件填写 CDF 条目.
    - **注意:测试设备会自动从 VESA CDF JSON 文件中读取 CDF 条目.**
  - 选择 MST 远端测试并运行。
  - 依照图形用户界面的提示进行设置/验证。
  - 测试执行完成后，生成 HTML 报告.

CTS 更新 - MST 来源装置

MST 来源 CTS CDF 输入细节

S.No	能力	CDF注册	预设值
1	**支持**MST传输吗？ 选项：是，否	MST_TRANS_SUPPORTED	Yes
2	**最多支持的同**时流数是多少？ 选项：1、2、3、4	MST_MAX_STREAM_COUNT	4
3	Source DUT**会**处理Up请求吗？ 选项：是，否	MST_UP_REQUEST_SUPPORTED	Yes
4	Source DUT**会**处理RSN Up请求吗？ 选项：是，否	MST_RSN_REQUEST_SUPPORTED	No
5	**支持的最大菊花**链接收端数量？ 选项：1、2、3、4	MST_MAX_DAISY_CHAIN_SINK_SUPPORTED	4
6	Source DUT**能**处理电源启动和关闭物理请求吗？ 选项：是，否	MST_POWER_UP_DOWN_PHY_SUPPORTED	Yes

CTS Updates - MST Branch Device

- MST Branch Device Tests in Rev 1.1 CTS (54 tests)
  - Branch Setup 1: 6.10.1.1 to 6.10.1.12 (12 tests)
  - Branch Setup 2: 6.10.2.1 to 6.10.2.10 (10 tests)
  - Branch Setup 3: 6.10.3.1 to 6.10.3.14 (14 tests)
  - Branch Setup4: 6.10.4.1 to 6.10.4.14 (14 tests)
  - Branch Setup 5: 6.10.5.1 to 6.10.5.4 （ 4 tests)
- MST Branch Device Tests updates since Rev 1.1 CTS via approved SCRs.
  - Branch Setup 1: 6.10.1.[1,5,6,7,8,9,10,11,12] (9 tests)
  - Branch Setup 2: 6.10.2.[3,6,7] (3 tests)
  - Branch Setup 3: 6.10.3.[3] (1 test)
  - Branch Setup 4: 6.10.4.[2,3] (2 tests)
- MST Branch Device Tests addition since Rev 1.1 CTS via approved SCRs
  - Branch Setup 2: 6.10.2.11: Verify the DFP port allocate payload allocation and de-allocation sequence
  - Branch Setup 3: 6.10.3.15: Verify the DFP port allocate payload allocation and de-allocation sequence.

CTS 更新 - MST 分支设备

- Rev 1.1 CTS 中的 MST 分支设备测试（54 项）
  - 分支设备设置 1：6.10.1.1 至 6.10.1.12（12 项测试）
  - 分支设备设置2：6.10.2.1 到 6.10.2.10（10 项测试）
  - 分支设备设置3：6.10.3.1 至 6.10.3.14（14项测试）
  - 分支设备设置4：6.10.4.1 到 6.10.4.14（14项测试）
  - 分支设备设置5：6.10.5.1 到 6.10.5.4（4项测试）.
- 自 Rev1.1 CTS以来，MST 源端测试已根据获批的 SCR 进行更新
  - 分支设备设置1：6.10.1。[1,5,6,7,8,9,10,11,12]（9项测试）
  - 分支设备设置 2：6.10.2。[3,6,7]（3 项测试）
  - 分支设备设置 3：6.10.3。[3]（1 项测试）
  - 分支设备设置 4：6.10.4。[2,3]（2 项测试）.
- 自 Rev.1.1 CTS起，依据已批准的 SCR 新增的 MST 分支设备测试
  - 分支设备设置 2：6.10.2.11：验证 DFP 端口的有效载荷分配与解除分配序列
  - 分支设备设置 3：6.10.3.15：验证 DFP 端口的有效载荷分配与解除分配序列.

CTS Updates - MST Branch Device

- How to run MST Branch CTS
  - Connect Test Equipment to Branch DUT in Setup 1.
  - From Test Equipment software fill out CDF entry.
  - Select MST Branch Setup 1 and then run.
  - Follow graphical user interface prompt for setup/validation.
  - After test execution completes, generate the HTML report.

测试设备



CTS 更新 - MST 分支设备

- 如何运行 MST 分支 设备CTS.
  - 在设置 1 中将测试设备连接至分支设备被测端 (Branch DUT)。
  - 在测试设备软件填写 CDF 条目。
  - 选择 MST 分支设备 1 然后运行。
  - 依照图形用户界面的提示进行设置/验证。
  - 测试执行完成后，生成 HTML 报告。

CTS Updates - MST Device

CTS更新 - MST分支设备

- How to run MST Branch CTS
  - Connect Test Equipment to Branch DUT in Setup 2.
  - From Test Equipment software fill out CDF entry.
  - Select MST Branch Setup 2 and then run.
  - Follow graphical user interface prompt for setup/validation.
  - After test execution completes, generate the HTML report.

- 如何运行 MST 分支 CTS.
  - 在设置2中将测试设备连接至分支设备被测端 (Branch DUT) 。
  - 从测试设备软件填写 CDF 条目。
  - 选择 MST 分支设备设置 2，然后执行。
  - 依照图形用户界面的提示进行设置/验证。
  - 测试执行完成后，生成 HTML 报告.



CTS Updates - MST Branch Device

- How to run MST Branch CTS
  - Connect Test Equipment to Branch DUT in Setup 3.
  - From Test Equipment software fill out CDF entry.
  - Select MST Branch Setup 3 and then run.
  - Follow graphical user interface prompt for setup/validation.
  - After test execution completes, generate the HTML report.

CTS 更新 - MST 分支设备

- 如何运行 MST 分支 设备CTS.
  - 在设置 3 中将测试设备连接至分支设备被测端(Branch DUT）。
  - 在测试设备软件填写 CDF 条目。
  - 选择 MST 分支设备设置 3 然后运行。
  - 依照图形用户界面的提示进行设置/验证。
  - 测试执行完成后，生成 HTML 报告。



CTS Updates - MST Branch Device

- How to run MST Branch CTS
  - Connect Test Equipment to Branch DUT in Setup 4.
  - From Test Equipment software fill out CDF entry.
  - Select MST Branch Setup 2 and then run.
  - Follow graphical user interface prompt for setup/validation.
  - After test execution completes, generate the HTML report.

CTS 更新 - MST 分支设备

- 如何运行 MST 分支设备 CTS.
  - 在设置4中将测试设备连接至分支设备被测端（Branch DUT）。
  - 在测试设备软件填写 CDF 条目。
  - 选择 MST 分支设备设置 2，然后执行。
  - 依照图形用户界面的提示进行设置/验证。
  - 测试执行完成后，生成 HTML 报告。



CTS Updates - MST Branch Device

- How to run MST Branch CTS
  - Connect Test Equipment to Branch DUT in Setup 5.
  - From Test Equipment software fill out CDF entry.
  - Select MST Branch Setup 5 and then run.
  - Follow graphical user interface prompt for setup/validation.
  - After test execution completes, generate the HTML report.

CTS 更新 - MST 分支设备

- 如何運行 MST 分支 设备CTS.
  - 在设置 5 中将测试设备连接至分支设备被测端(Branch DUT）。
  - 在测试设备软件填写 CDF 条目。
  - 选择 MST 分支设备设置 5 然后运行。
  - 依照图形用户界面的提示进行设置/验证。
  - 测试执行完成后，生成 HTML 报告.

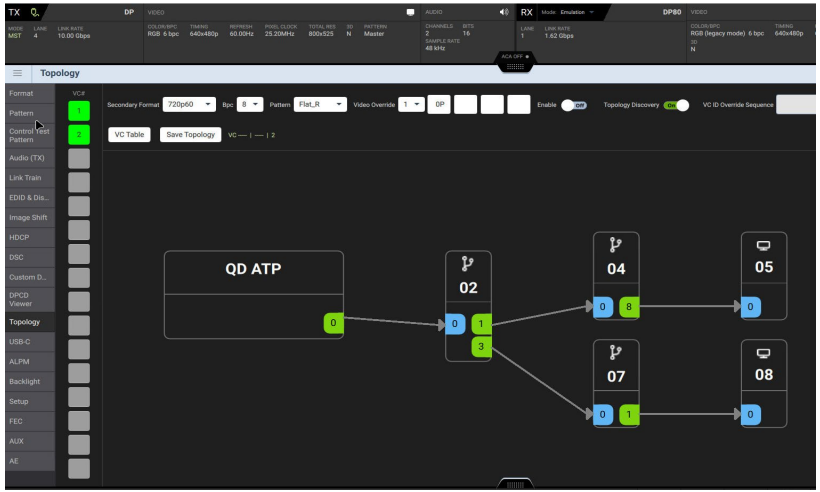


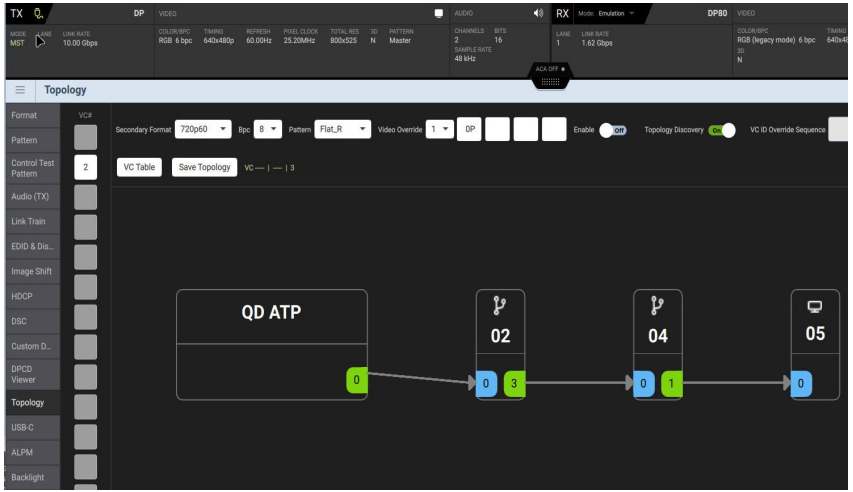
CTS Updates - MST Branch Device

- How to get port number value for CDF.
  - Connect Test Equipment to Branch DUT in Setup 2.
  - See Test Equipment Generator topology for ports (below left).
  - Disconnect one DFP port and see Test Equipment generator topology (below right).
  - The disconnected DFP port number is 1.

CTS 更新 - MST 分支设备

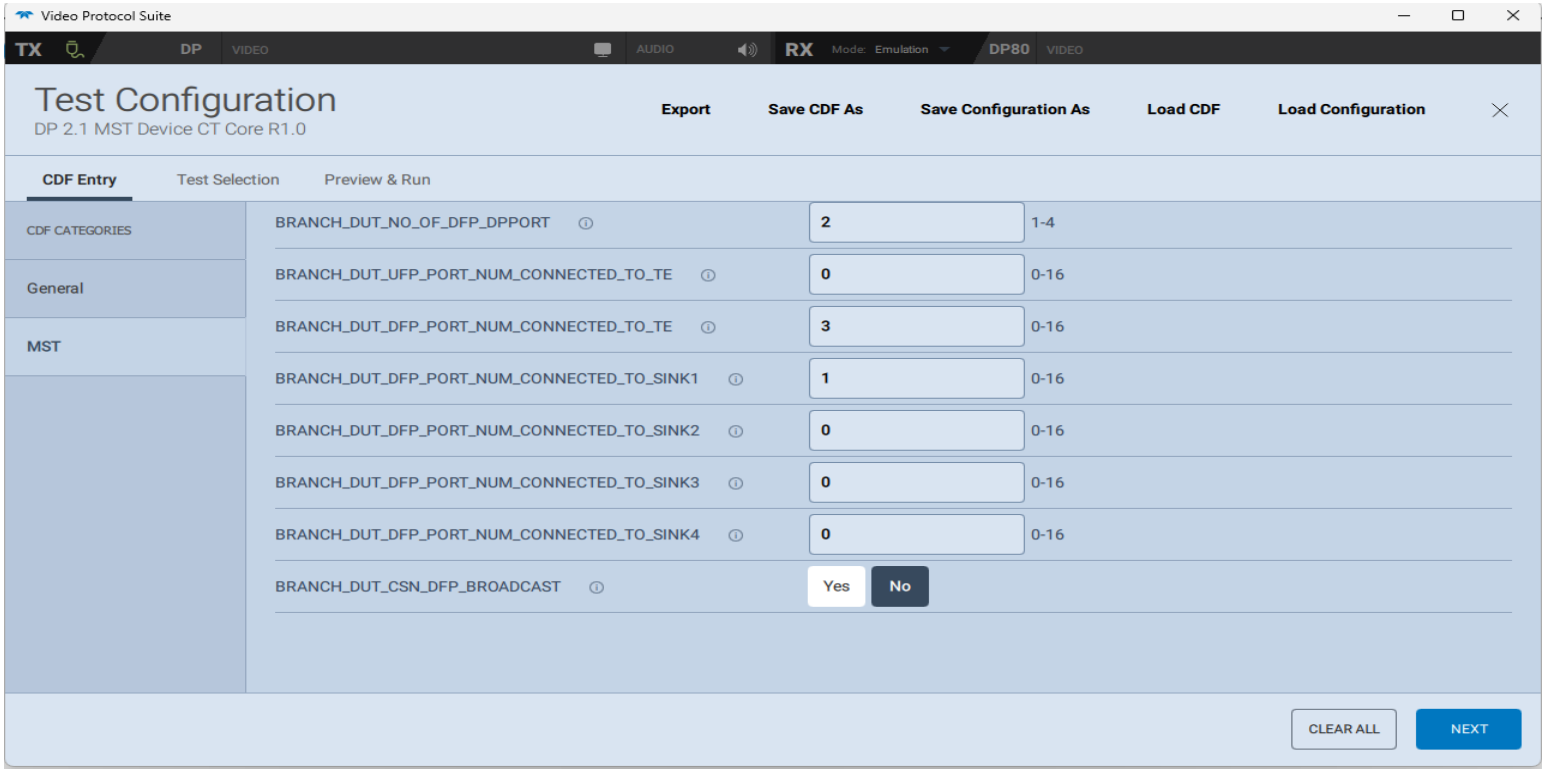
- 如何获取 CDF 的端口编号值
  - 在设置2中将测试设备连接至分支设备被测端（Branch DUT）。
  - 请参阅测试设备生成器的端口拓扑结构（见左下图）。
  - 断开一个 DFP 端口，再查看测试设备生成器的拓扑结构（见右下图）。
  - 所断开的DFP端口编号即为1。





CTS Updates - MST Branch Device/CTS 更新 - MST 分支设备

MST Branch CTS CDF Sample for Setup 2:/MST 分支 设备CTS CDF 設置 2 范例:



CTS Updates – Composite Sink Device

- MST Composite Sink Device Tests in Rev 1.1 CTS (48 tests)
  - CS Setup 1: 6.10.6.1 to 6.10.6.21 (21 tests)
  - CS Setup 2: 6.10.7.1 to 6.10.7.19 (19 tests)
  - CS Setup 3: 6.10.8.1 to 6.10.8.5 (5 tests)
  - CS Setup 4: 6.10.9.1 to 6.10.9.3 (3 tests)
- MST Composite Sink Device Test updates since Rev 1.1 CTS via approved SCRs.
  - CS Setup 1: 6.10.6.[2,4,6,7,8,11,12] (7 tests)
  - CS Setup 2: 6.10.7.[1,3,5,6,7,10] (6 tests)
  - CS Setup 3: 6.10.8.[1] (1 test)
- MST Composite Sink Device Test additions since Rev 1.1 CTS via approved SCRs
  - CS Setup 1: 6.10.6.22: Verify the DFP port allocate payload allocation and de-allocation sequence

CTS 更新 – 复合接收端设备

- Rev.1.1 CTS 中的MST 复合接收端设备测试（48 项）.
  - CS Setup 1: 6.10.6.1 to 6.10.6.21 (21 tests)
  - CS Setup 2: 6.10.7.1 to 6.10.7.19 (19 tests)
  - CS Setup 3: 6.10.8.1 to 6.10.8.5 (5 tests)
  - CS Setup 4: 6.10.9.1 to 6.10.9.3 (3 tests)
- 自 Rev 1.1 CTS 起，依据已批准的 SCR 对 MST 复合接收端设备测试进行了更新
  - CS Setup 1: 6.10.6.[2,4,6,7,8,11,12] (7 tests)
  - CS Setup 2: 6.10.7.[1,3,5,6,7,10] (6 tests)
  - CS Setup 3: 6.10.8.[1] (1 test)
- 自 Rev 1.1 CTS 起，依据已批准的 SCR 新增的 MST 复合接收端设备测试
  - CS 设置 1： 6.10.6.22： 验证 DFP 端口配置有效载荷分配与解除分配序列

CTS Updates - Composite Sink Device

- How to run MST Composite Sink Device CTS Setup 1
  - Connect Test Equipment to Composite Sink DUT in Setup 1.
  - From Test Equipment software fill out CDF entry.
  - Select MST Composite Sink Setup 1 Tests and then run them.
  - Follow graphical user interface prompt for setup/validation.
  - After test execution completes, generate the HTML report.

CTS 更新 – 复合接收端设备

- 如何运行MST 复合接收端设备 CTS 设置 1.
  - 在设置1中将测试设备连接至复合接收端被测设备（Composite Sink DUT）。
  - 在测试设备软件填写 CDF 条目。
  - 选择 MST 复合接收端设置 1 测试，然后运行。
  - 依照图形用户界面的提示进行设置/验证。
  - 测试执行完成后，生成 HTML 报告。



CTS Updates - Composite Sink Device

- How to run MST Composite Sink Device CTS Setup 2
  - Connect Test Equipment to Composite Sink DUT in Setup 2.
  - From Test Equipment software fill out CDF entry.
  - Select MST Composite Sink Setup 2 Tests and then run them.
  - Follow graphical user interface prompt for setup/validation.
  - After test execution completes, generate the HTML report.

CTS 更新 - 复合接收端设备

- 如何运行MST 复合接收端设备 CTS 设置 2.
  - 在设置2中将测试设备连接至复合接收端被测设备（Composite Sink DUT）。
  - 在测试设备软件填写 CDF 条目。
  - 选择 MST 复合接收端设置 2 测试，然后运行。
  - 依照图形用户界面的提示进行设置/验证。
  - 测试执行完成后，生成 HTML 报告。



CTS Updates - Composite Sink Device

- How to run MST Composite Sink Device CTS Setup 3
  - Connect Test Equipment to Composite Sink DUT in Setup 3.
  - From Test Equipment software fill out CDF entry.
  - Select MST Composite Sink Setup 3 Tests and then run them.
  - Follow graphical user interface prompt for setup/validation.
  - After test execution completes, generate the HTML report.

CTS 更新 – 复合接收端设备

- 如何运行MST 复合接收端设备 CTS 设置 3.
  - 在设置3中将测试设备连接至复合接收端被测设备（Composite Sink DUT）。
  - 在测试设备软件填写 CDF 条目。
  - 选择 MST 复合接收端 设置3 测试，然后运行。
  - 依照图形用户界面的提示进行设置/验证。
  - 测试执行完成后，生成 HTML 报告.



CTS Updates - Composite Sink Device

- How to run MST Composite Sink Device CTS Setup 4
  - Connect Test Equipment to Composite Sink DUT in Setup 4.
  - From Test Equipment software fill out CDF entry.
  - Select MST Composite Sink Setup 4 Tests and then run them.
  - Follow graphical user interface prompt for setup/validation.
  - After test execution completes, generate the HTML report.

CTS 更新 - 复合接收端设备

- 如何运行MST 复合接收端设备 CTS 设置 4.
  - 在设置4中将测试设备连接至复合接收端被测设备（Composite Sink DUT）。
  - 在测试设备软件填写 CDF 条目。
  - 选择 MST 复合接收端设置 4 测试，然后运行。
  - 依照图形用户界面的提示进行设置/验证。
  - 测试执行完成后，生成 HTML 报告.



CTS Updates – Composite Sink Device

- How to get port number value for CDF.
  - Connect Test Equipment to Composite Sink DUT in Setup 2.
  - See Test Equipment Generator topology:
  - The Composite Sink has 2 DFP Ports, 1 internal and 1 external.
  - Test Equip Sink connected by DFP Port 1
  - Sink 1 connected on Test Equip DFP Port 0
  - Sink 2 connected on Sink1 DFP Port 1.



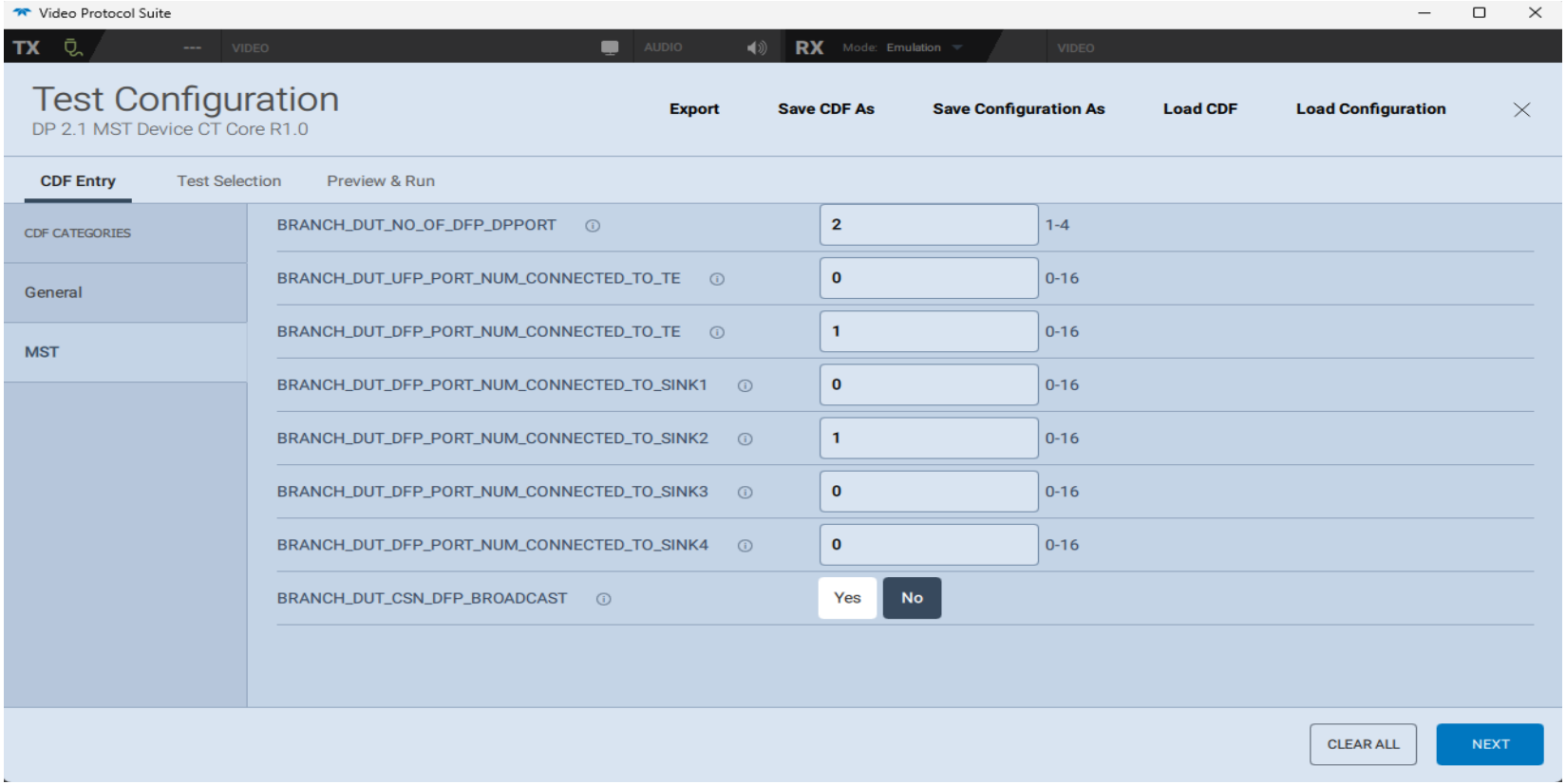
CTS 更新 – 复合接收端设备

- 如何获取 CDF 的端口编号值.
  - 在设置2中将测试设备连接至复合接收端被测设备(Composite Sink DUT)。
  - 查看测试设备生成器拓扑:
  - 复合接收端有两个 DFP 端口，一个内部，一个外部。
  - 测试设备接收端通过 DFP 端口 1 连接
  - 接收端 1(Sink 1)连接在测试设备的 DFP 端口 0 上
  - 接收端 2(Sink 2)连接在 接收端1(Sink1)的 DFP 端口 1 上.



CTS Updates – Composite Sink Device/CTS 更新 – 复合接收端设备

MST Composite Sink CTS CDF | Sample for Setup 2:/MST 复合接收端设备 CTS CDF |设置 2 范例:



Recent New Test Additions

- New Source Tests
  - 4.3.1.25 : Successful link training when Sink is in BIOS mode with random LTTPR .
  - 4.4.1.7 : Verify Source DUT video transmission timing is within MAX_UNCOMPRESSED_PIXEL_RATE capability
  - 4.4.1.8 : Validation for VSC-SDP when transmitting YCbCr4:20 and ITU-R BT.2020 formats

近期新增测试项目

- 新增源端测试
  - 4.3.1.25：当 接收端 进入 BIOS 模式且存在随机 LTTPR 时，链路训练成功。
  - 4.4.1.7 ：验证源端被测设备（Source DUT）的视频传输时序是否处于 MAX_UNCOMPRESSED_PIXEL_RATE 能力范围内。
  - 4.4.1.8 ：验证在传输 YCbCr 4:2:0 和 ITU-R BT.2020 格式时 VSC-SDP 的正确性

Recent New Test Additions

- New Sink Tests
  - 5.7.1.7 EDID – Mandatory Blocks for HDR Displays
  - 5.7.19.7 Native DisplayID – Mandatory Blocks for HDR Displays
  - 5.7.20.4 Native DisplayID – Product Identification Data Block Product Name String ASCII Validation
  - 5.7.20.5 EDID – Product Identification Data Block Revision (Byte 1)
  - 5.7.20.6 EDID – Product Identification Data Block Number of Payload Bytes in Block (Byte 2)
  - 5.7.20.7 EDID – Product Identification Data Block Week of Manufacture/Model Tag and Year of Manufacture/Model Year (Bytes 12 and 13)
  - 5.7.20.8 EDID – Product Identification Data Block Product Name String ASCII Validation
  - 5.7.21.6 Native DisplayID – Display Parameters Data Block Horizontal and Vertical Image Size Verification
  - 5.7.21.7 EDID – Display Parameters Data Block Revision (Byte 1)
  - 5.7.21.8 EDID – Display Parameters Data Block Number of Payload Bytes in Block (Byte 2)
  - 5.7.21.9 EDID – Display Parameters Data Block Feature Support Flags Field (Byte 0Bh)
  - 5.7.21.10 EDID – Display Parameters Data Block Native Luminance-related Fields (Bytes 18h to 1Dh)
  - 5.7.21.11 EDID – Display Parameters Data Block Depth and Display Device Technology Fields (Byte 1Eh).

近期新增测试项目

- 新增接收端测试
  - 5.7.1.7 EDID – HDR 显示器的强制行数据块
  - 5.7.19.7 原生 DisplayID – HDR 显示器的强制行数据块
  - 5.7.20.4 原生 DisplayID – 产品标识数据块 产品名称字符串的 ASCII 验证
  - 5.7.20.5 EDID – 产品标识数据块修订版（字节 1）
  - 5.7.20.6 EDID – 产品标识数据块有效载荷字节数（字节2）
  - 5.7.20.7 EDID – 产品识别数据块 生产周/型号标签与生产年份/型号年份 （字节 12 与 13）
  - 5.7.20.8 EDID – 产品标识数据块 产品名称字串的ASCII 验证
  - 5.7.21.6 原生 DisplayID – 显示参数数据块 水平与垂直图象尺寸验证
  - 5.7.21.7 EDID – 显示参数数据块修订（字节 1）
  - 5.7.21.8 EDID – 显示参数数据块有效载荷字节数（块 2）
  - 5.7.21.9 EDID – 显示参数数据块功能支持标志字段（字节 0Bh）
  - 5.7.21.10 EDID – 显示参数数据块原生亮度相关字段（字节 18h 至 1Dh）
  - 5.7.21.11 EDID – 显示参数数据块色深与显示设备技术字段（字节 1Eh）。

Recent New Test Additions

- New Sink Tests Continued…
  - 5.7.21.12 – EDID – Display Parameters Data Block Horizontal and Vertical Image Size Verification
  - 5.7.22.8 – EDID – Display Interface Features Data Block Revision (Byte 1)
  - 5.7.22.9 – EDID – Display Interface Features Data Block Number of Payload Bytes in Block (Byte 2)
  - 5.7.22.10 – EDID – Display Interface Features Data Block Supported Interface Color Depth-related Fields
  - 5.7.22.11 – EDID – Display Interface Features Data Block Minimum Pixel Rate at Which YCbCr 4:2:0 Encoding Is Supported (Byte 7)
  - 5.7.22.12 – EDID – Display Interface Features Data Block Supported Interface Audio Capability and Feature Flags (Byte 8)
  - 5.7.22.13 – EDID – Display Interface Features Data Block Supported Interface Color Space and EOTF-related Fields
  - 5.7.22.14 – EDID – Display Interface Features Data Block Additional Supported Interface Color Space and EOTF-related Fields (Bytes 0Bh to 12h)
  - 5.4.1.9 : Verify Sink DUT displays the video timing based on MAX_UNCOMPRESSED_PIXEL_RATE capability
  - 5.6.3.8: Verify Sink DUT correctly reconstructs image when HActive % Slice_Count != 0.

近期新增测试项目

- 新增接收端测试（续）
  - 5.7.21.12 – EDID – 显示参数数据块水平与垂直影像尺寸验证
  - 5.7.22.8 – EDID – 显示接口特性数据块修订版(字节 1)
  - 5.7.22.9 – EDID – 显示接口特性数据块中的有效载荷字节数(字节 2)
  - 5.7.22.10 – EDID – 显示接口特性数据块支持的接口色深相关字段
  - 5.7.22.11 – EDID – 显示接口特性数据块支持 YCbCr 4:2:0 编码的最低像素速率(字节 7)
  - 5.7.22.12 – EDID – 显示接口特性数据块支持的接口音频能力与功能标志(字节 8)
  - 5.7.22.13 – EDID – 显示接口特性数据块支持的接口色彩空间及 EOTF 相关字段
  - 5.7.22.14 – EDID –显示接口特性数据块支持的其它接口色彩空间及 EOTF 相关字段(字节0Bh 至 12h)
  - 5.4.1.9 :验证接收端被测设备是否能根据 MAX_UNCOMPRESSED_PIXEL_RATE能力显示视频时序
  - 5.6.3.8:验证当 HActive % Slice_Count ！ = 0 时， 接收端被测设备能否正确重建图像 。

Summary

- **Key Takeaways**
  - CTS coverage significantly expanded since Rev 1.1
  - New Source, Branch, and Composite Sink validations added
  - Test Equipment software supports automated CDF population via VESA JSON file
  - Simplified CTS execution workflow
  - New tests improve EDID, NDID, HDR and MST interoperability coverage

摘要

- **重点摘要.**
  - 自 Rev 1.1 以来，CTS 的覆盖范围显著扩大
  - 新增源端、分支设备及复合接收端的验证
  - 测试设备软件支持通过 VESA JSON 文件自动填充 CDF
  - 简化了 CTS 执行工作流程
  - 新增测试提升了EDID、NDID、HDR及MST互操作性的覆盖范围

问答与反馈

Alok Soni/Neal Kendall – 感谢

Teledyne LeCroy

2026年10月14日 – 中国深圳

VESA DisplayPort汽车扩展（DP AE）测试您的功能安全实现

Neal Kendall and Alok Soni

Teledyne LeCroy

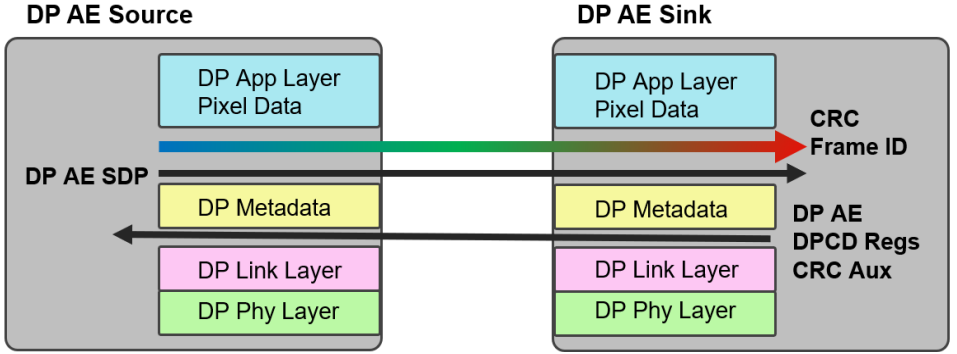
2026年10月14日——中国深圳

DisplayPort 汽车扩展——介绍

VESA DisplayPort 汽车扩展版与 DisplayPort 有什么不同？

- 传统DisplayPort侧重于链路可靠性：
  - 链接训练、链接对齐、时钟恢复。
  - 前向纠错(FEC)。
  - 显示流压缩(DSC)。
  - 传输视频和音频。
  - 多流传输(MST)。
- DisplayPort 不验证以下内容：
  - 整个图像流程都是正确的。
  - 生成了正确的图像。
  - 没有任何帧丢失。
  - 这些照片准时送达。
  - 注意：DisplayPort 汽车扩展拓扑假设为静态；发现、初始化和配置得到简化。

- DisplayPort的汽车扩展插件：
  - AE使用DisplayPort 2.1a和/或eDP 2.0规范。
  - DP AE引入了新的DP AE DPCD 寄存器，用于能力、状态和配置。
  - DP AE对视频和数据使用CRC检查。
  - DP AE检查接收到的DisplayPort流的帧序列和帧时序。
  - DP AE增加了一个次级数据包(DP AE SDP)。



DisplayPort 汽车扩展——配置文件

功能安全与保安配置文件

功能安全要素——配置文件1和2

未压缩像素上的CRC	压缩像素上的CRC
重建后的DSC像素上的CRC	CRC在次级数据包（SDP）上
CRC关注区域	CRC关于主流属性（MSA）
帧丢弃、重复和超时监控	状态报告

- 汽车延伸功能
  - 功能安全（配置文件1和2）——防止意外故障。
  - 安全性（配置文件3和4）——防止恶意入侵和修改。

安全要素——配置文件3和4

MAC映射在未压缩像素/压缩字节和MSA	DP AE二级数据包（SDP）上的MAC
数据平面安全（辅助通道认证）	AE次级数据包（SDP）的全面完整性安全

DisplayPort 汽车扩展——功能安全

将DisplayPort从视频传输接口扩展为汽车显示器的端到端监控系统

为什么选择DP AE功能安全？

汽车显示屏越来越多地呈现安全关键信息.

- 传统DisplayPort验证链路传输，但不验证端到端图像正确性.
- DisplayPort AE增加了监控机制:
  - 形象完整性。
  - 框架连贯性。
  - 时机准确性。
  - 渲染正确性.
- DisplayPort AE实现了快速故障检测和系统级安全响应.
- DisplayPort AE可扩展，从仪表盘到多显示器驾驶舱架构.

DisplayPort汽车扩展功能安全



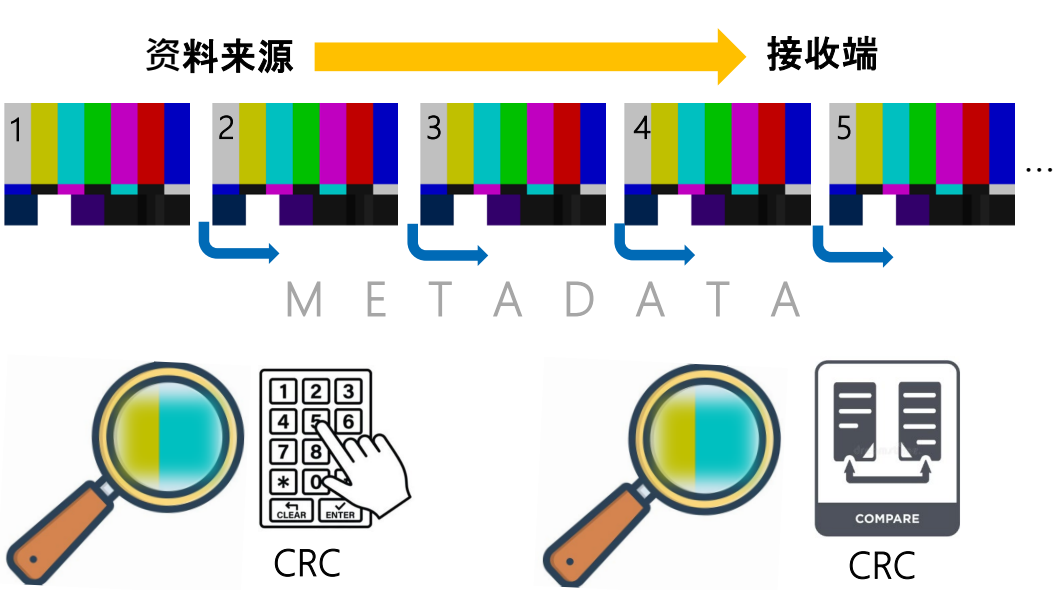
DisplayPort AE – 功能安全 – 图像完整性

图像完整性监测——图像数据是否正确到达？

目标：验证显示的图像是否与源生成的图像一致.

- 机制:
  - CRC PIXELS(未压缩或压缩的“重建像素”).

    注:压缩技术使SerDes成本更低,降低电缆复杂度和重量, 降低功耗.
  - CRC 压缩字节.
  - CRC主流属性(MSA).
  - CRC二级数据包(SDP)).
  - CRC汽车推广SDP.
  - CRC辅助信道消息.
  - CRC兴趣区域(ROI)).
- 探测:
  - 像素损坏(压缩/未压缩)。
  - 链路传输与元数据错误.



DisplayPort AE – 功能安全 - 关注领域

带有关注区域(ROI)的帧视频关键监控

目标：指定显示中哪些区域最为关键.

- 目的:
  - 将功能安全监控重点放在显示中安全关键区域。
  - 能够针对最重要的视觉信息进行有针对性保护.
- 关注区域（ROI）能力:
  - 针对每个投资回报率(ROI)计算的CRC。
  - 每个显示屏最高可获得16的投资回报率。
  - ROI可以动态启用、禁用或重新配置。
  - 投资回报率可能在展示中重叠。
  - 初始化时，ROI 坐标通过辅助通道传输到接收端.



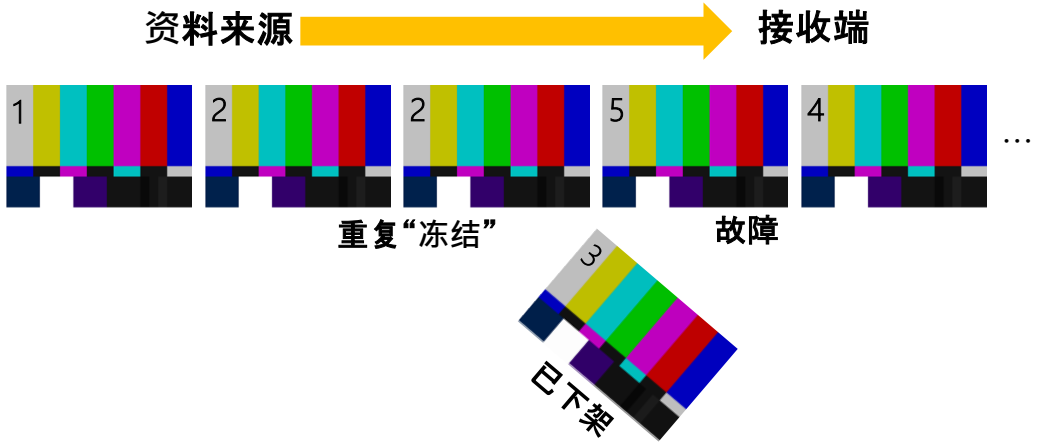


DisplayPort AE – 功能安全 – 帧连续性

帧连续性监测检查，我们收到了每一帧吗？

目标：确认所有视频帧的到达顺序正确.

- 机制:
  - FRAME ID计数器，每帧递增.
- 探测:
  - 帧数缺失(掉落)。
  - 重复帧。
  - 乱序帧.

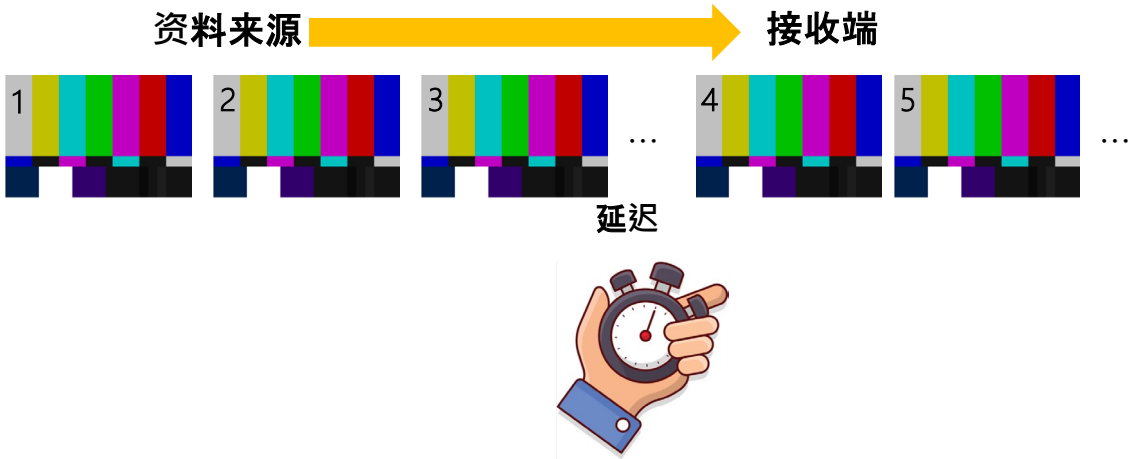


DisplayPort AE – 功能安全 – 时序正确性

时间准确性检查，视频帧和元数据是否按时到达？

目标：确认信息按预期到达.

- 机制:
  - 超时监控。
  - 帧ID进程
  - AE SDP 元数据监控.
- 探测:
  - 延迟帧数。
  - 管道停滞。
  - 过度延迟.



DisplayPort AE – 功能安全 – 故障检测/隔离

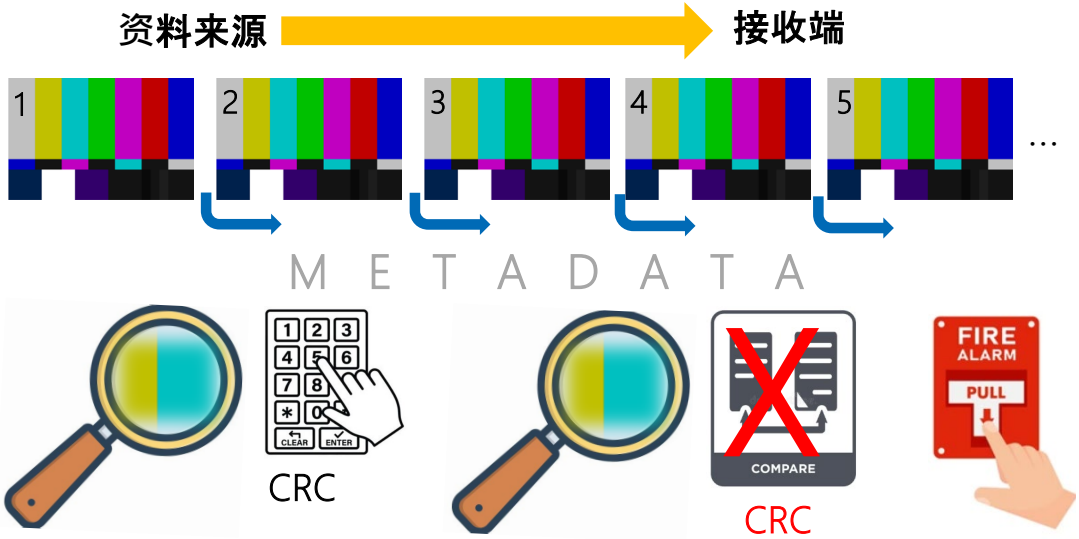
快速故障检测与升级——使车辆能够适当响应

目标：检测到错误时提醒司机和系统.

- 软错误:
  - CRC不匹配。
  - 帧数不匹配。
  - 暂停事件。
- 硬错误:
  - 持续性故障.
  - 错误阈值已超过.

注意:投资回报率(ROI)有自己的CRC.

- 故障检测启用:
  - 司机警报。
  - 故障保护操作。
  - 系统冗余激活与诊断日志.

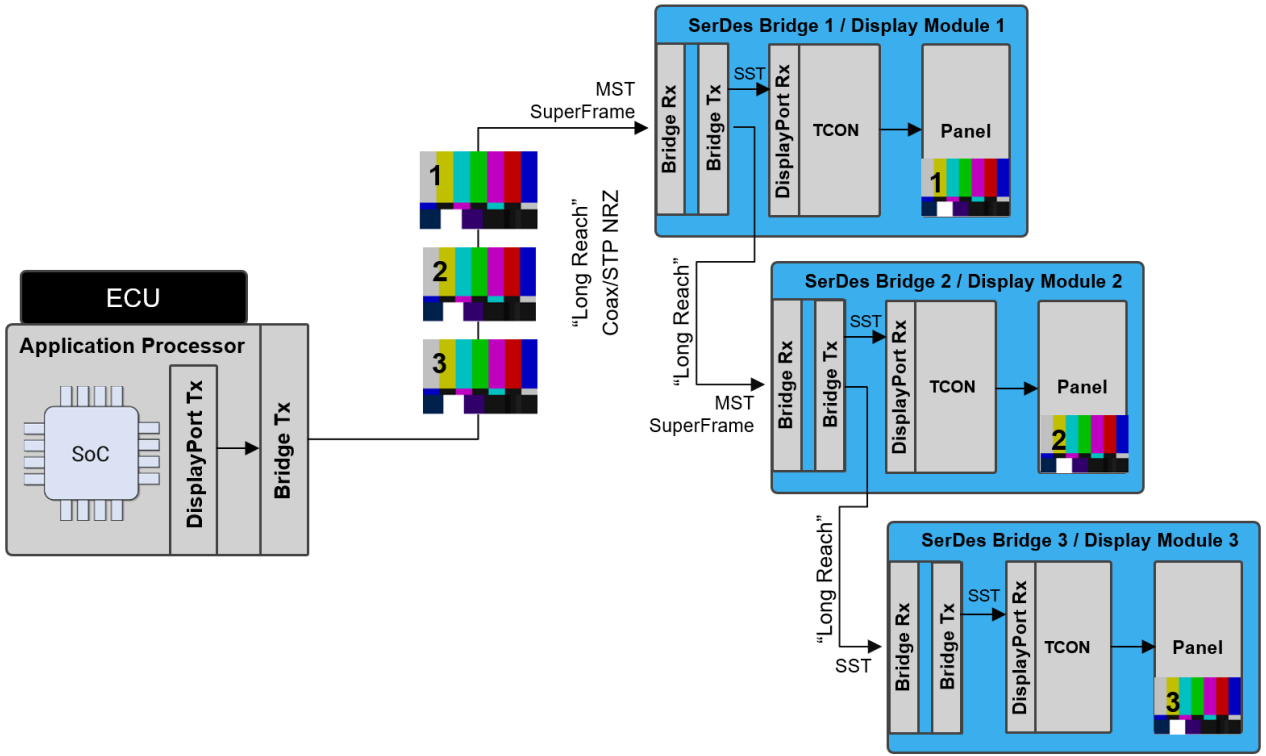


DisplayPort AE – 拓扑与架构

DisplayPort 汽车扩展拓扑

DP AE 测试初始化.

- **多流**传输（MST）——**在**单一物理通道上传输多个**虚**拟通道，用于多个显示。
- MST**运行在**“长距离”传输**介**质上，如OpenGMSL、FPD Link、A-Phy。

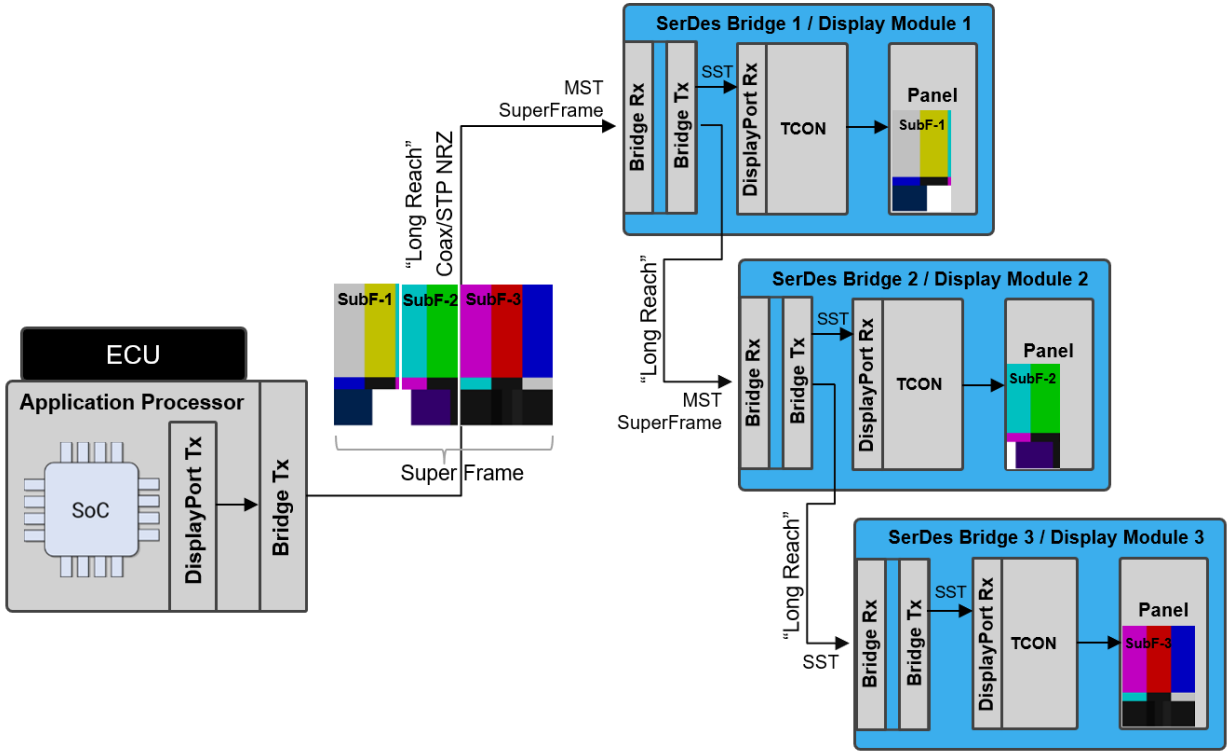


DisplayPort AE – 拓扑与架构

DisplayPort 汽车扩展拓扑

DP AE 测试初始化.

- 超帧和子帧——单帧视频帧扩展至多显示器。
- 超帧运行于"长距离"传输介质，如OpenGMSL、FPD Link、A-Phy。



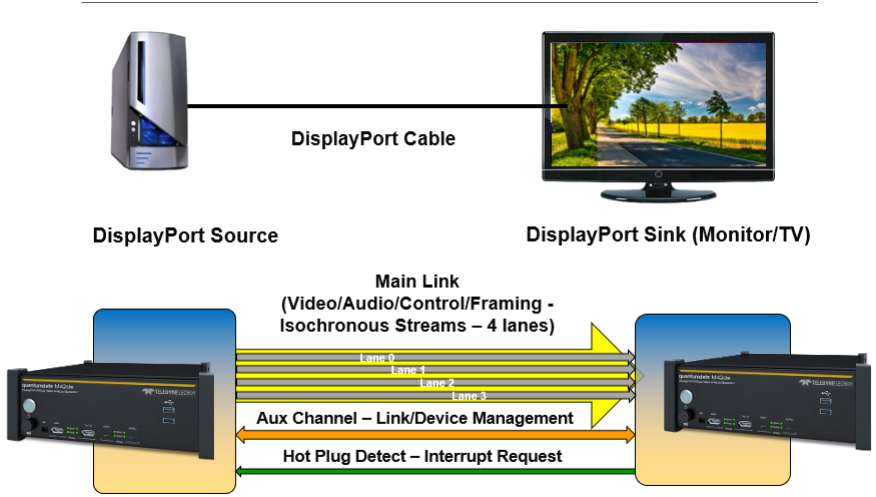
测试您的DisplayPort汽车扩展功能安全实现

DisplayPort AE——功能安全测试

如何测试您的DisplayPort汽车扩展实现

DP AE 源/汇测试.

- 设备仿真:
  - 模拟DP AE源以测试显示和拓扑结构.
  - 模拟DP AE显示器以测试源并展示拓扑结构.
- 视频生成配置:
  - 配置MST或SuperFrame的拓扑.
  - 配置兴趣区域(ROI).
- 视频与协议分析:
  - 实时接收流的视图。
  - 视频和元数据的捕捉、后期分析。
  - 合规测试以支持 VESA DisplayPort 汽车标志项目.





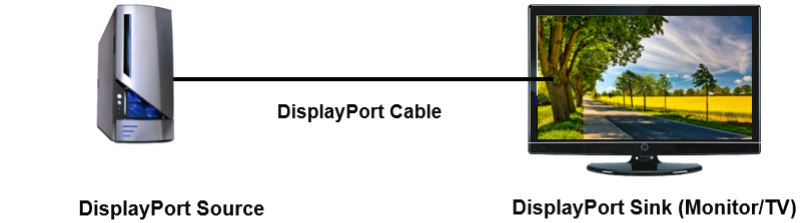
M42DE 80G 视频分析仪/发生器

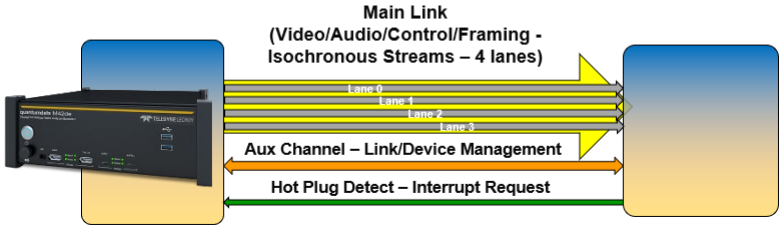
DisplayPort AE——功能安全测试

如何测试您的DisplayPort汽车扩展实现

设置DP AE视频生成器.

- **配置拓扑、流数、配置文件和投资回报率.**
- **次要分支的选择.**
- **配置关注区域.**
- 错误阈值配置.
- 查看汇 DPCD DP AE 寄存器.
- **注入错误.**
- 查看汽车延伸现状.







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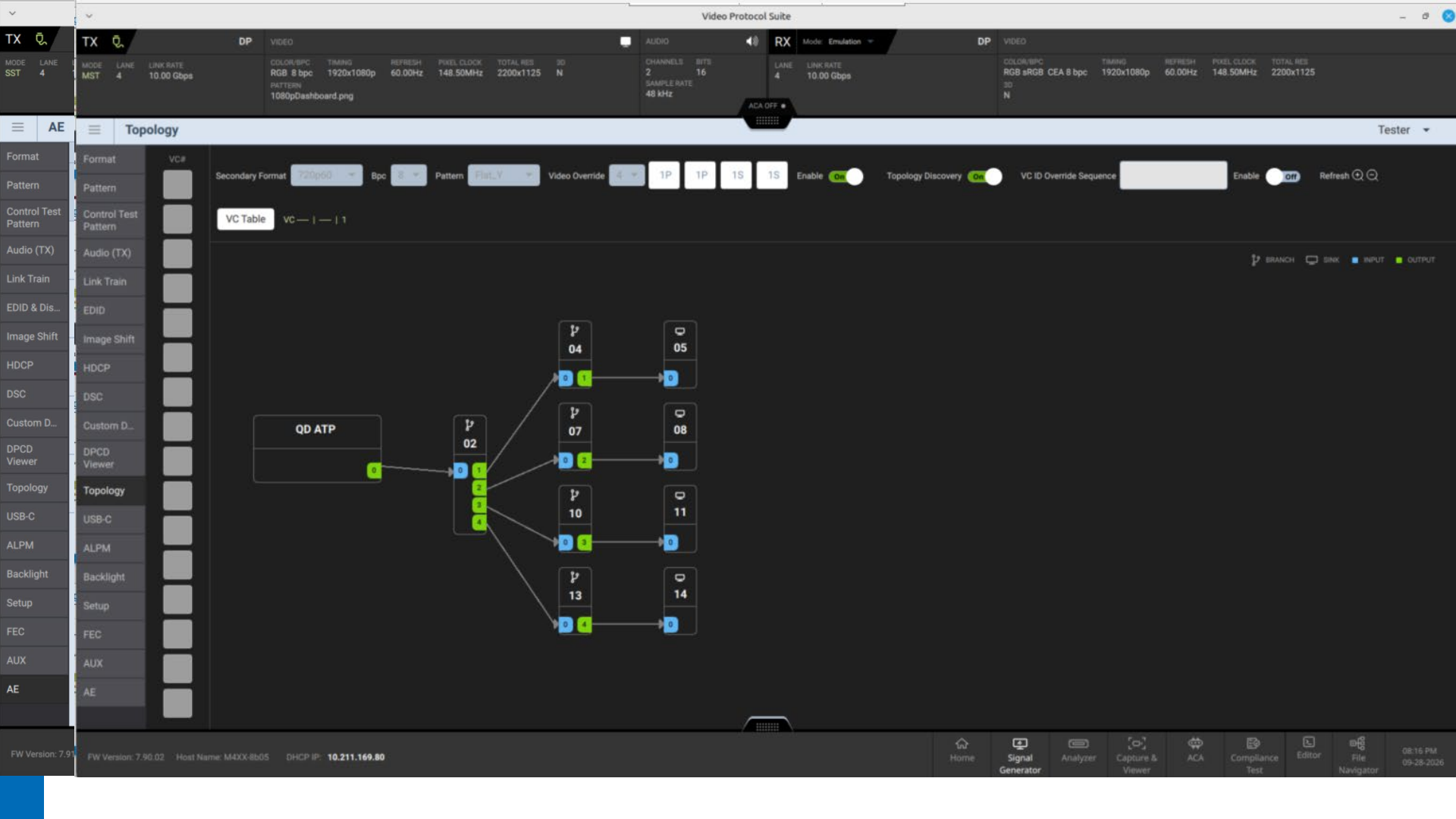
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TX
DP
VIDEO
AUDIO
RX
Mode: Emulation
DP
VIDEO
MODE SST
LANE 4
MODE MST
LANE 4
LINK RATE 10.00 Gbps
COLOR/BPC RGB 8 bpc
TIMING 1920x1080p
REFRESH 60.00Hz
PIXEL CLOCK 148.50MHz
TOTAL RES 2200x1125
3D N
PATTERN 1080pDashboard.png
CHANNELS 2
BITS 16
SAMPLE RATE 48 kHz
LANE 4
LINK RATE 10.00 Gbps
COLOR/BPC RGB sRGB CEA 8 bpc
TIMING 1920x1080p
REFRESH 60.00Hz
PIXEL CLOCK 148.50MHz
TOTAL RES 2200x1125
3D N
ACA OFF
AE
Topology
Tester
Format
Pattern
Control Test Pattern
Audio (TX)
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EDID
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DPCD Viewer
Topology
USB-C
ALPM
Backlight
Setup
FEC
AUX
AE
VC#
Secondary Format
720p60
Bpc
8
Pattern
Flat_Y
Video Override
4
1P
1P
1S
1S
Enable
On
Topology Discovery
On
VC ID Override Sequence
Enable
Off
Refresh
VC Table
VC — | — | 1
BRANCH
SINK
INPUT
OUTPUT
QD ATP
02
04
05
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08
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14
FW Version: 7.90.02
Host Name: M4XX-8b05
DHCP IP: 10.211.169.80
Home
Signal Generator
Analyzer
Capture & Viewer
ACA
Compliance Test
Editor
File Navigator
08:16 PM
09-28-2026

DisplayPort AE——功能安全测试

如何测试您的DisplayPort汽车扩展实现

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- 选择次要课程。
- **配置感**兴趣区域。
- **配置**错误阈值。
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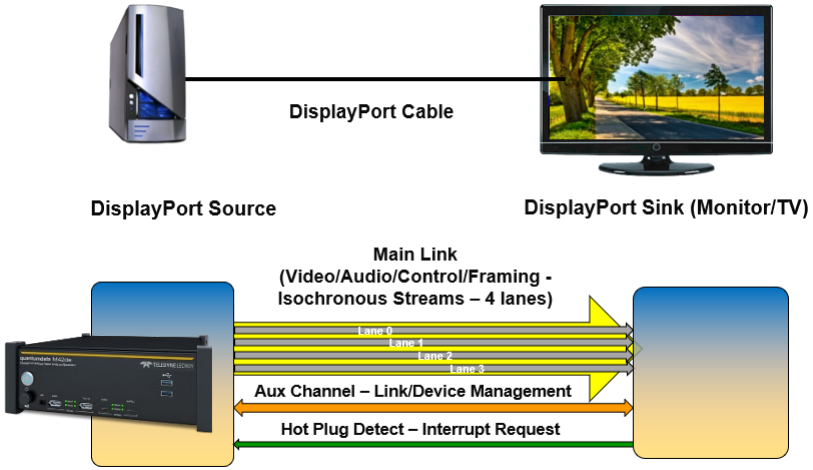
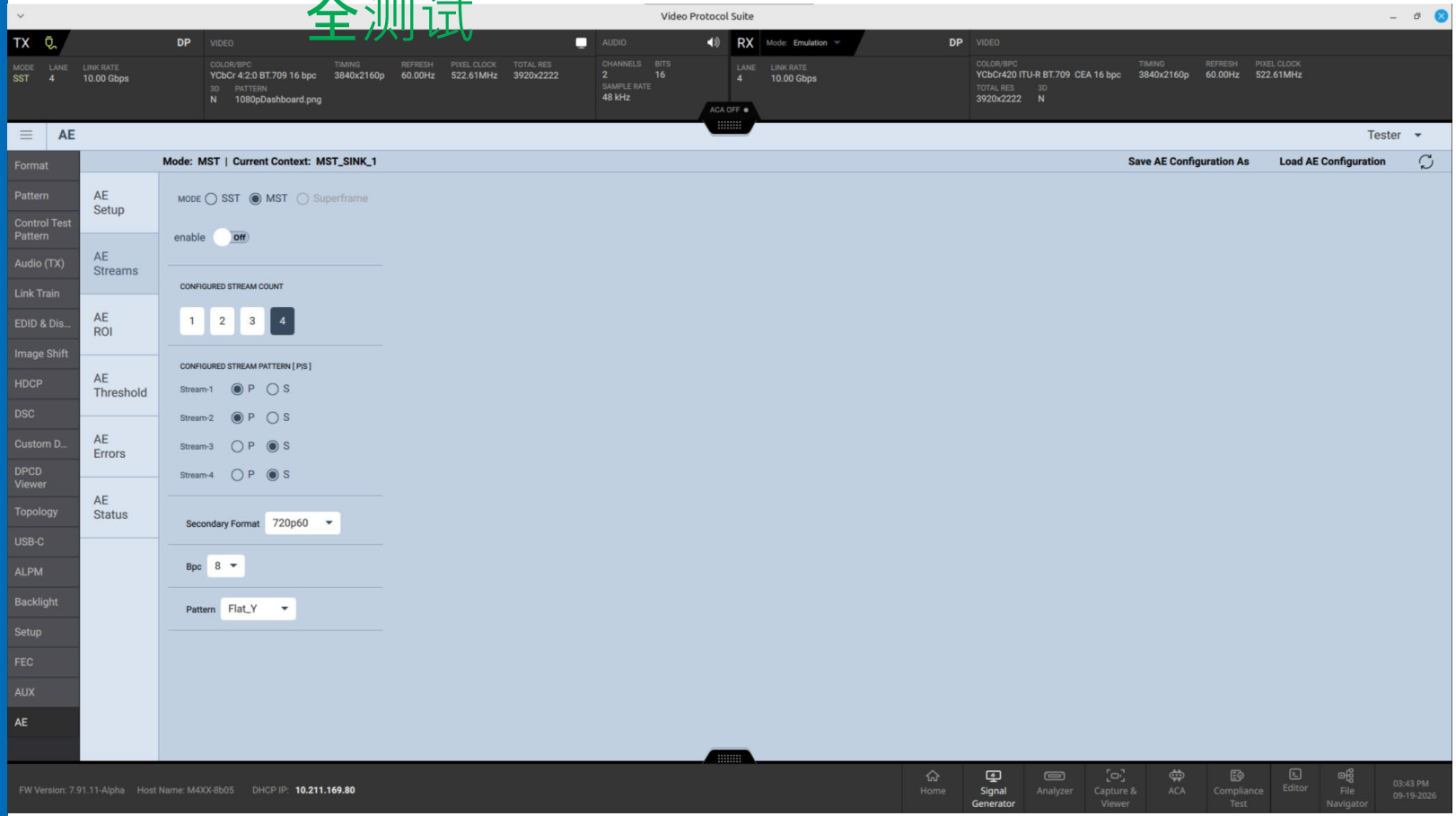


DisplayPort AE – Testing Functional Safety /功能安全测试



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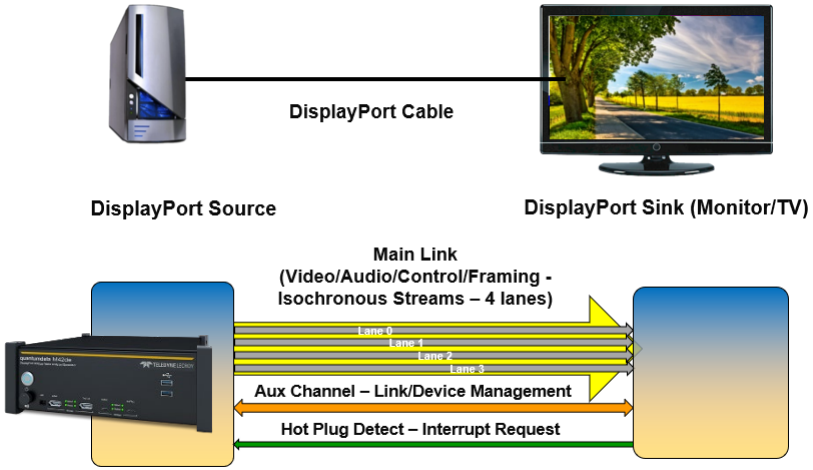

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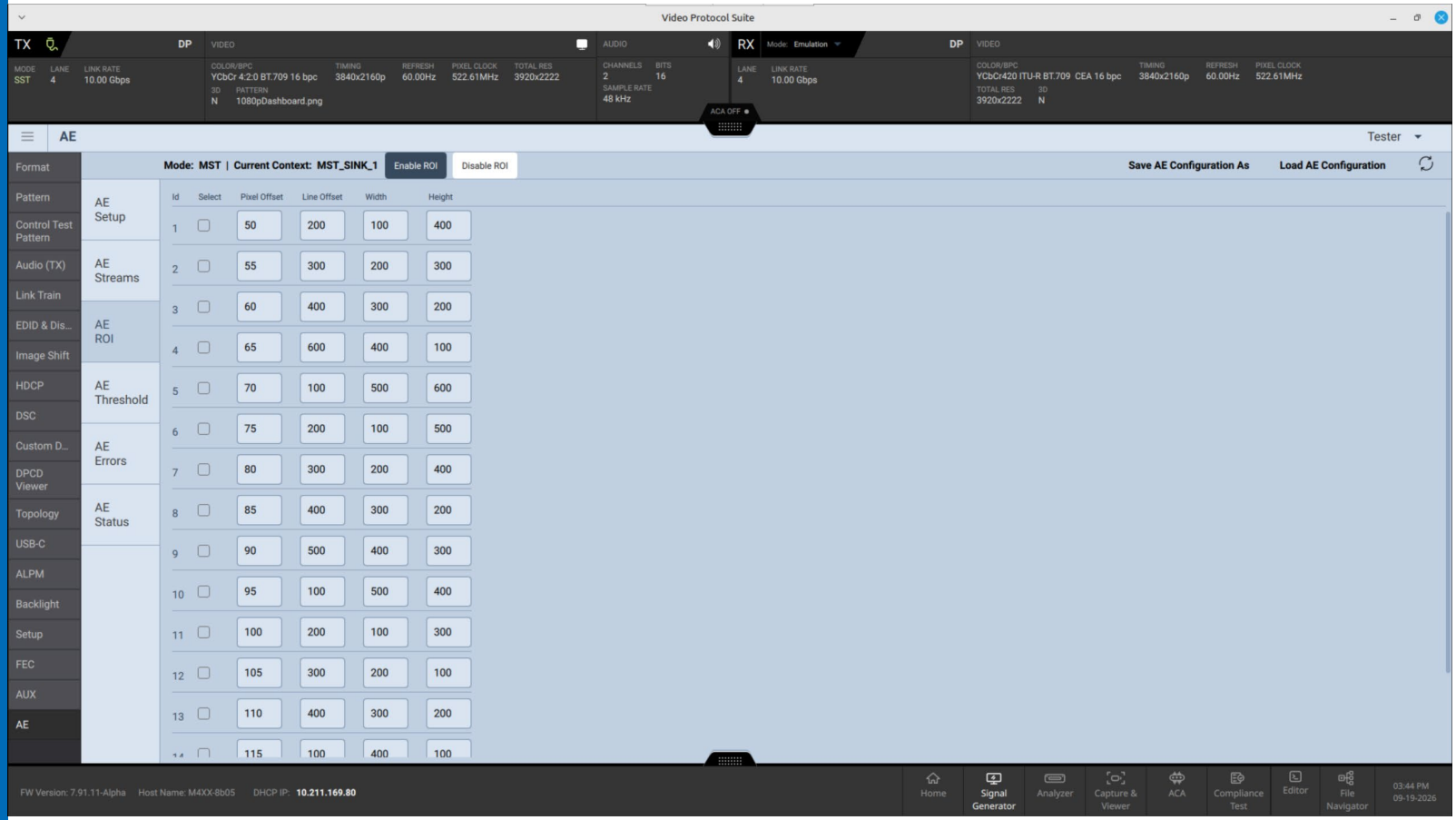

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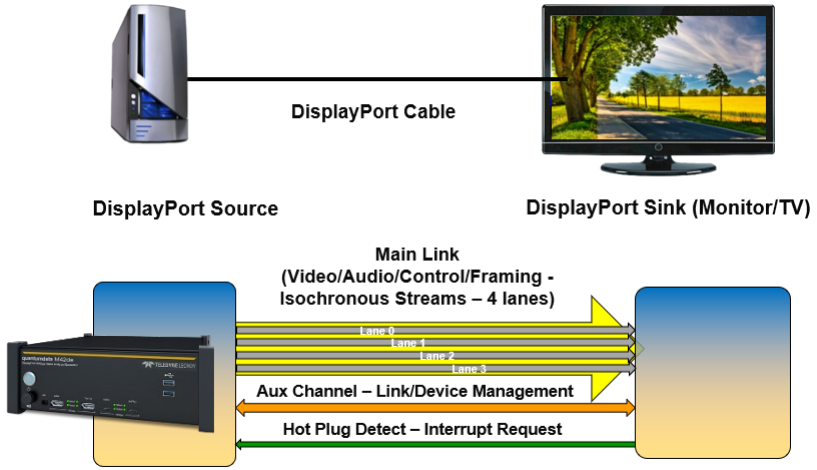
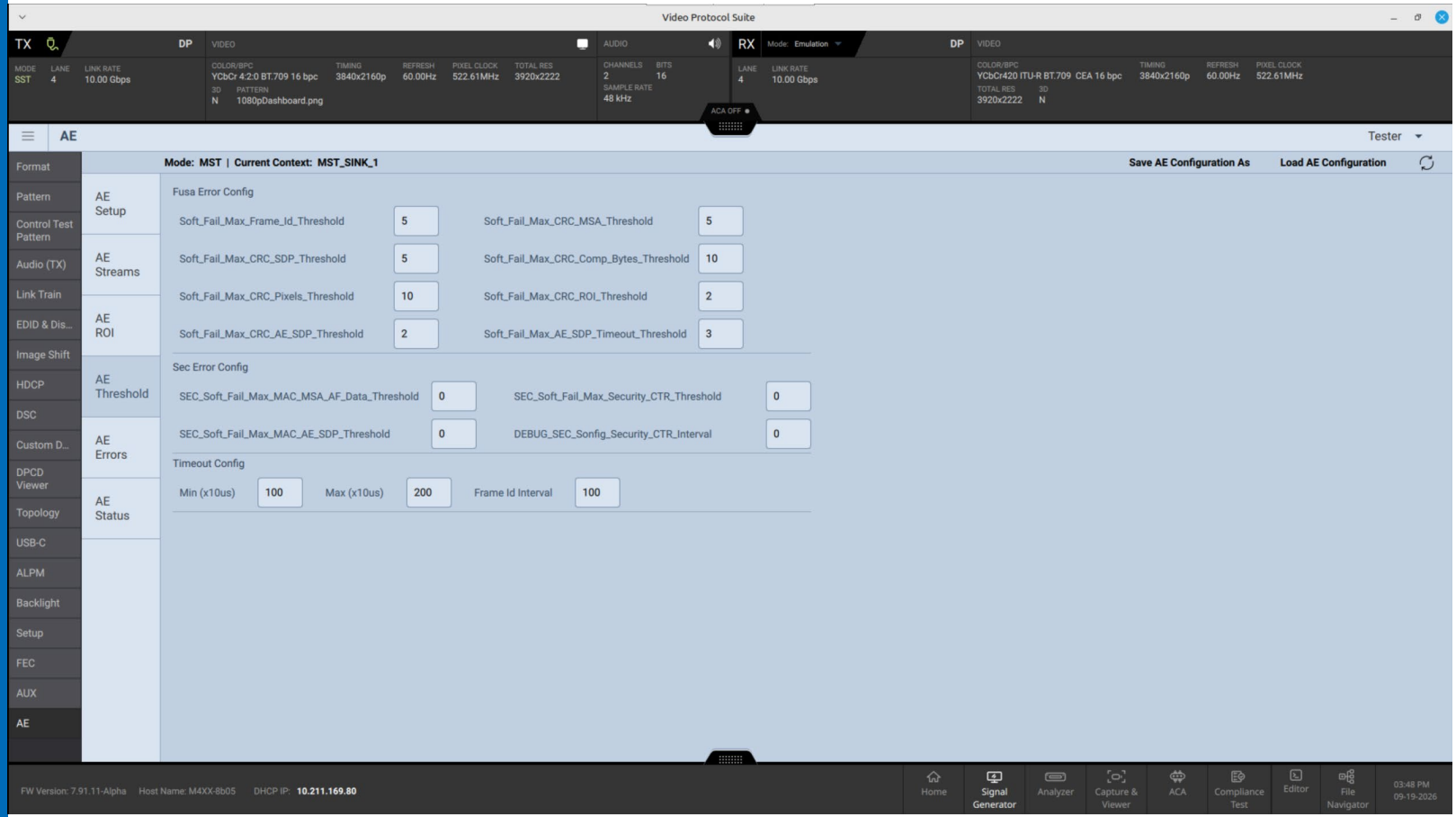


DisplayPort AE – Testing Functional Safety/安全功能测试



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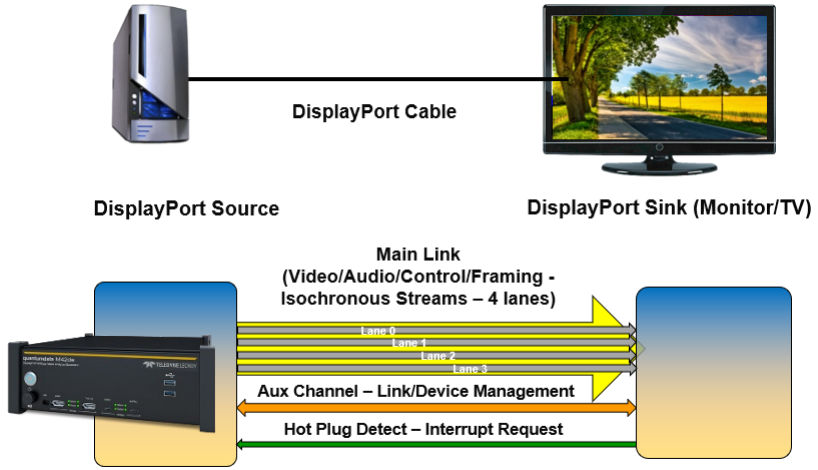

DisplayPort AE – Testing Functional Safety/安全功能测试



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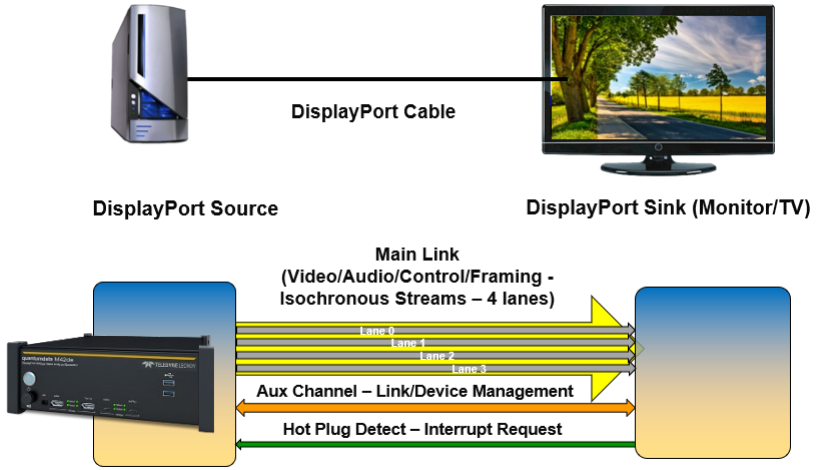
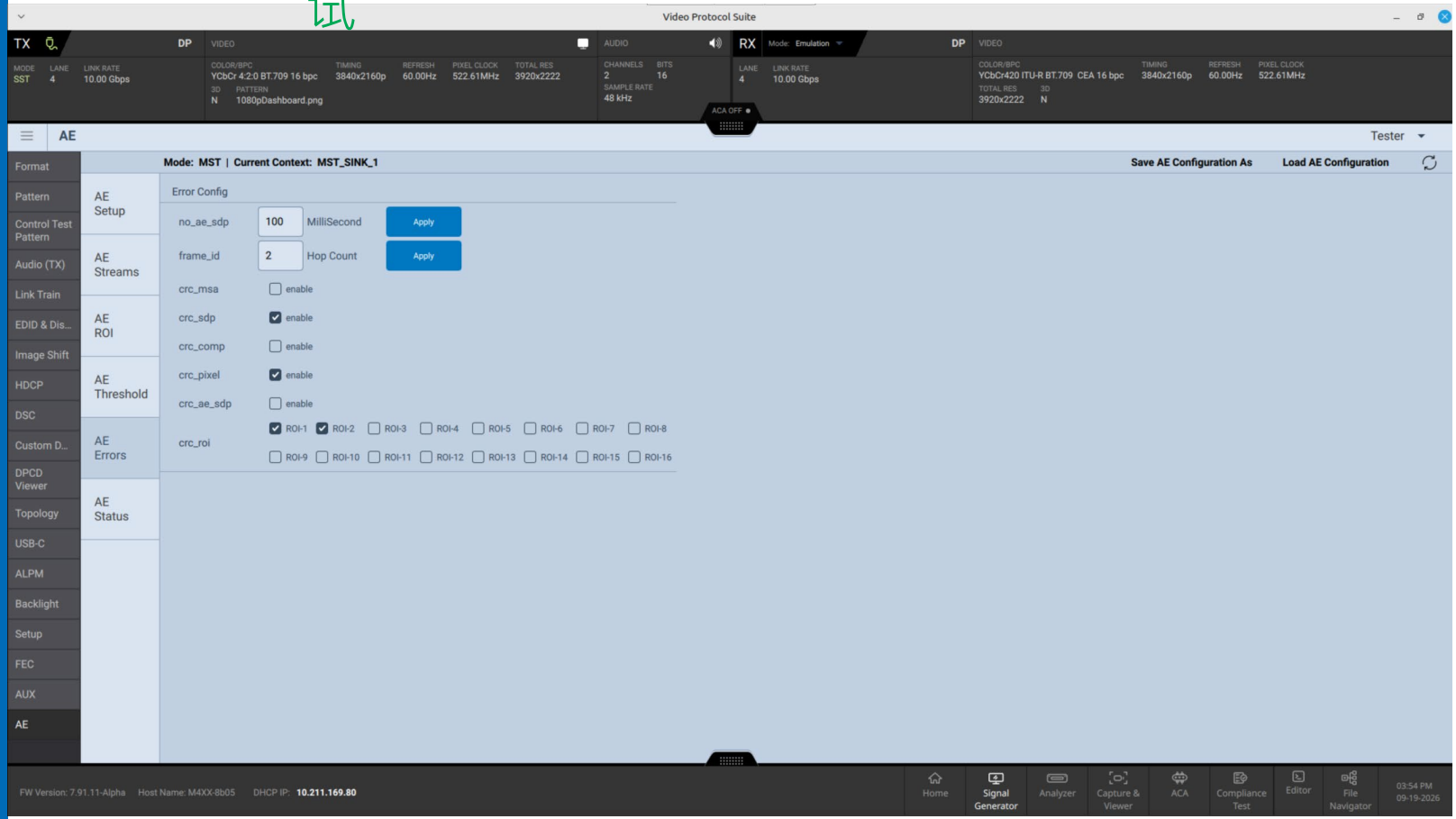


DisplayPort AE – Testing Functional Safety/功能安全测试



DisplayPort AE——功能安全测试

如何测试您的DisplayPort汽车扩展实现

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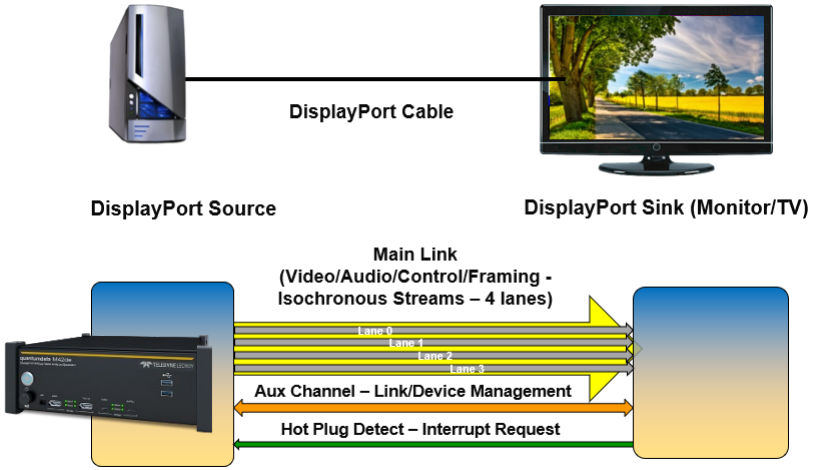
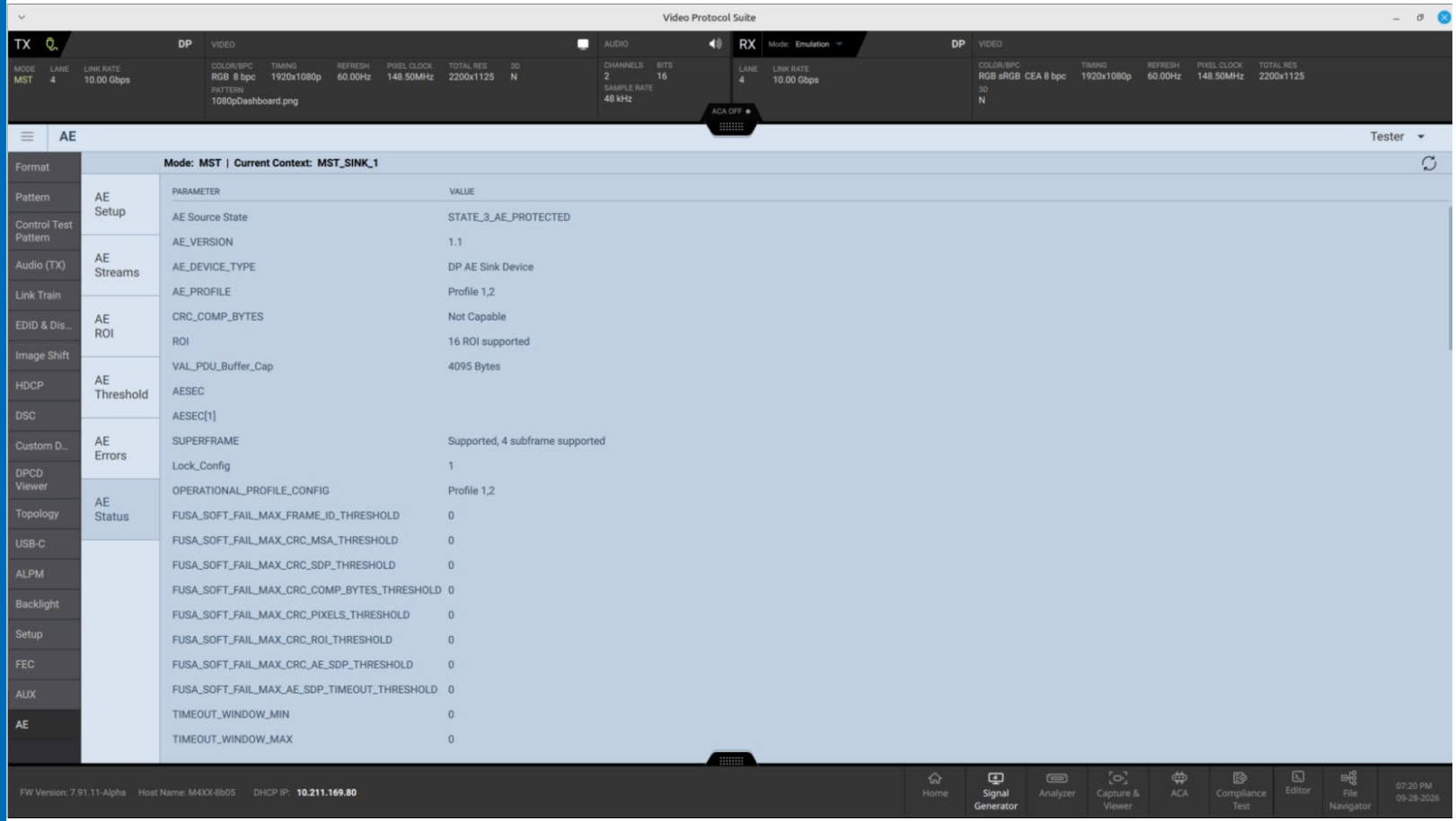


DisplayPort AE – Testing Functional Safety/安全功能测试



DisplayPort AE——功能安全测试

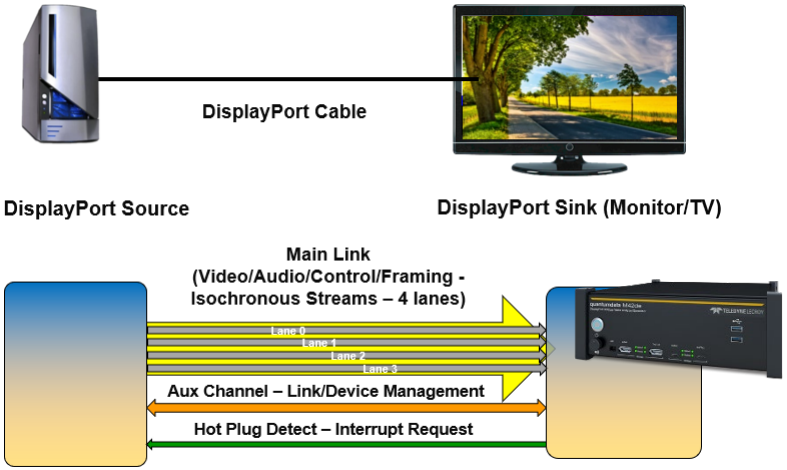
如何测试您的DisplayPort汽车扩展实现

设置DP AE视频/协议分析仪.

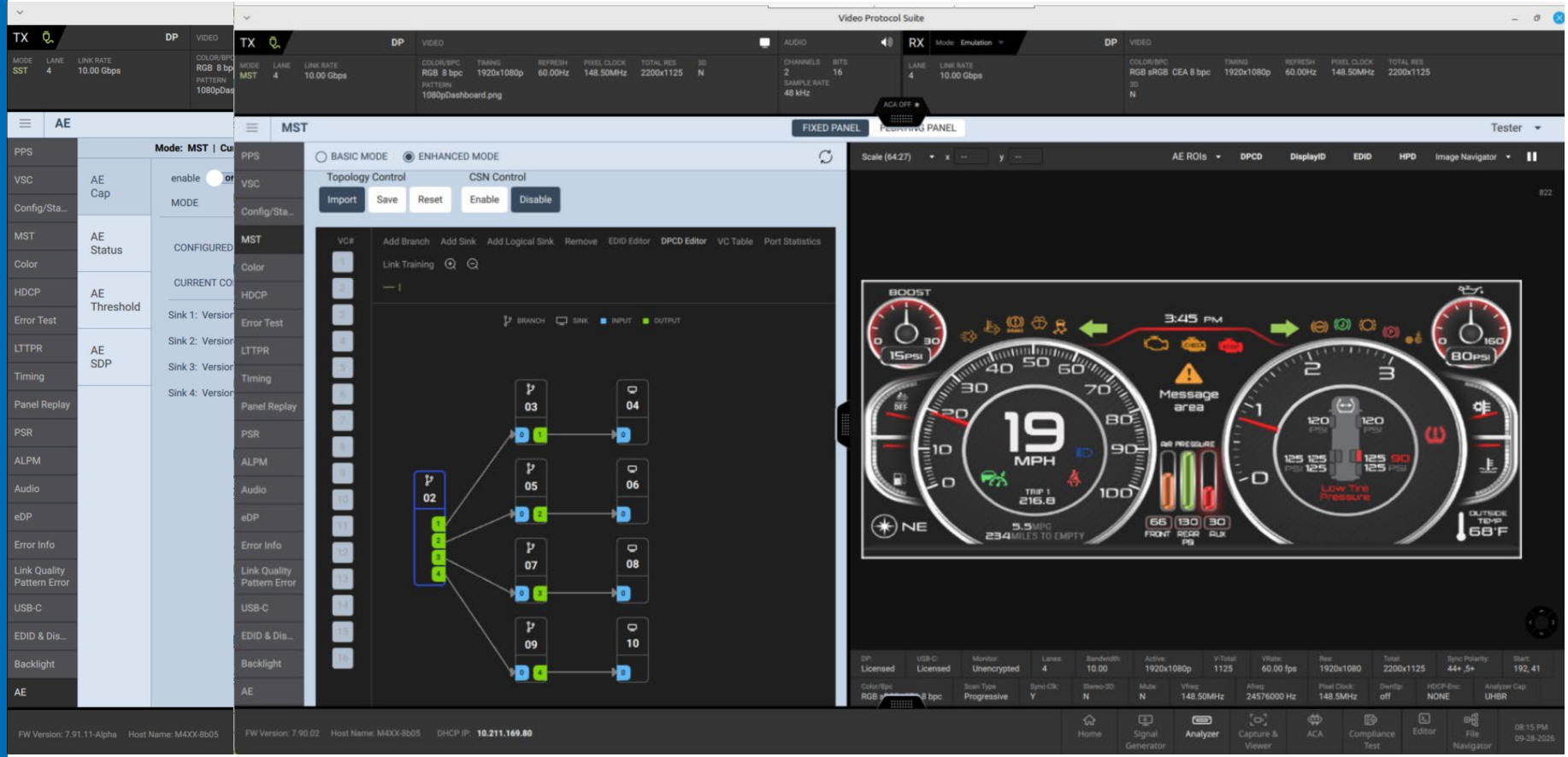
- **配置拓扑、配置文件、流数和版本数.**

分析输入的DP AE流.

- 观看状态。
- 查看辅助通道和边带交易。
- 实时查看DP AE次级数据包（SDP）。
- 捕获和分析接收的DP AE流.



DisplayPort AE – Testing Functional Safety/功能安全测试



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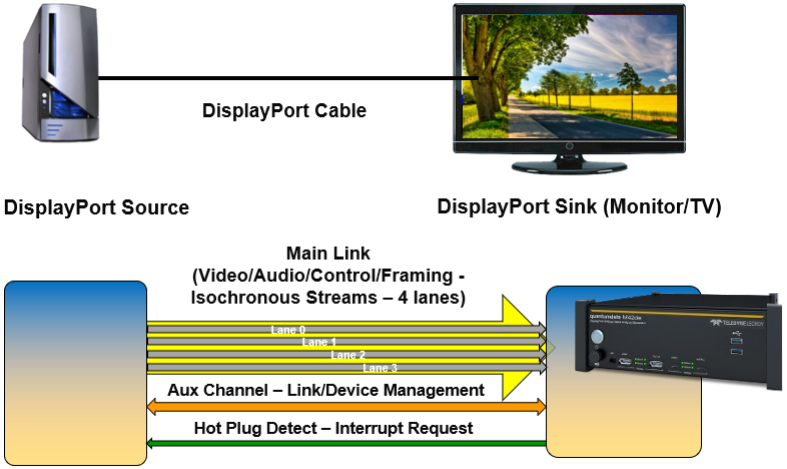
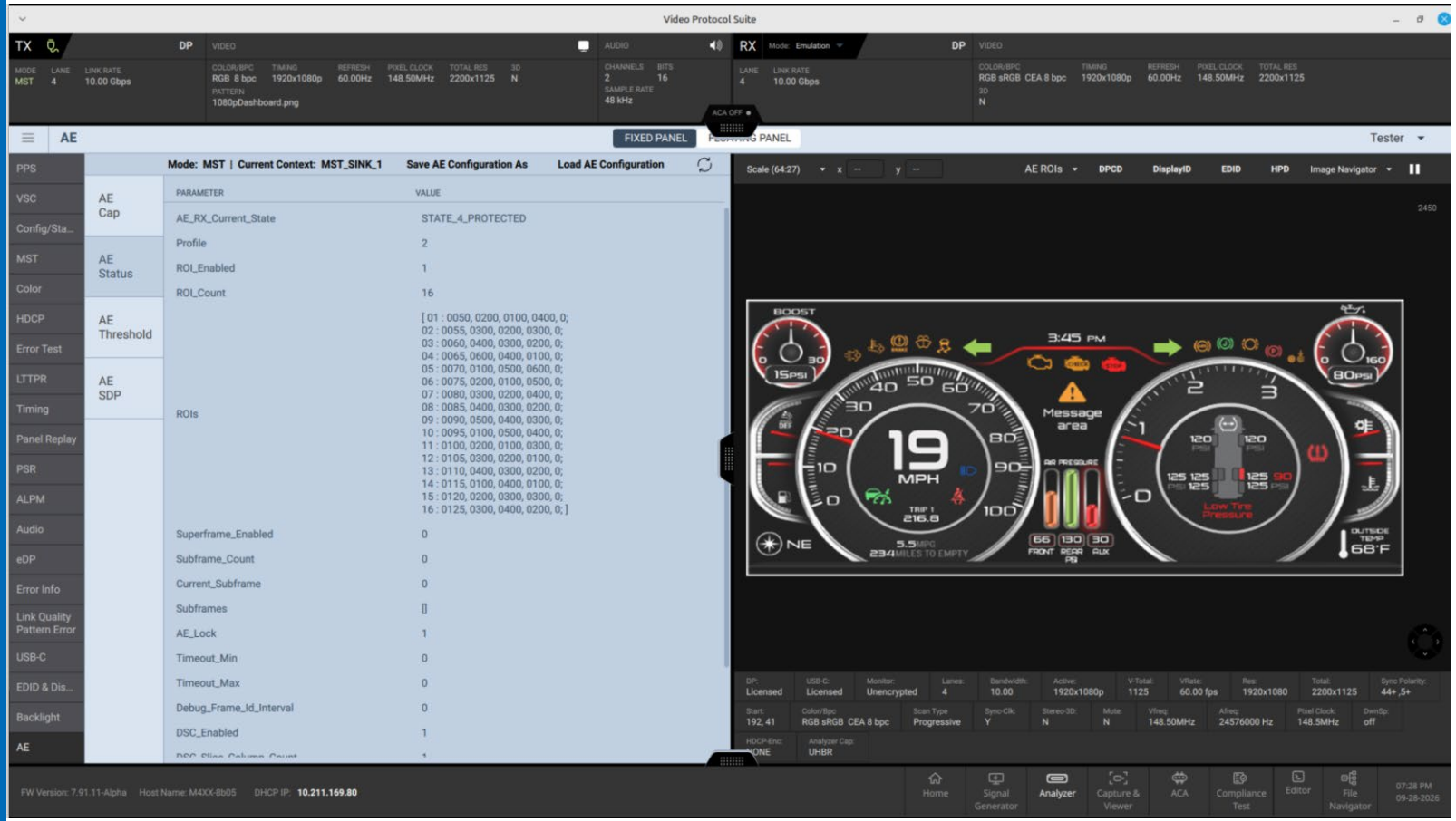


DisplayPort AE – Testing Functional Safety/功能安全测试



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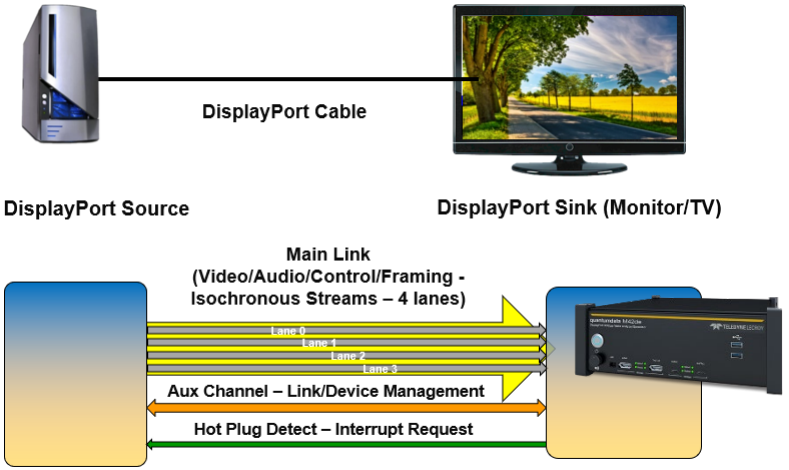

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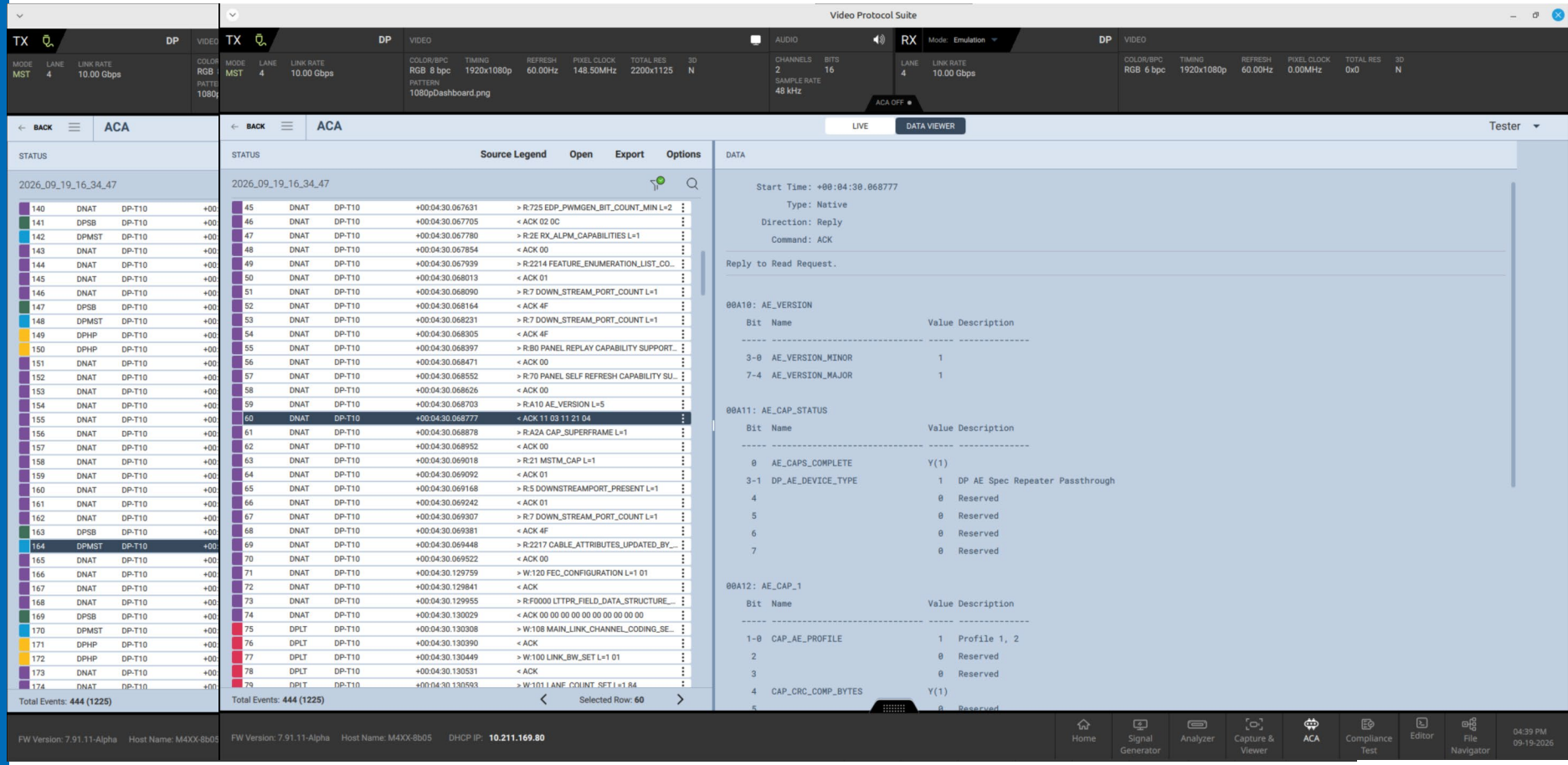

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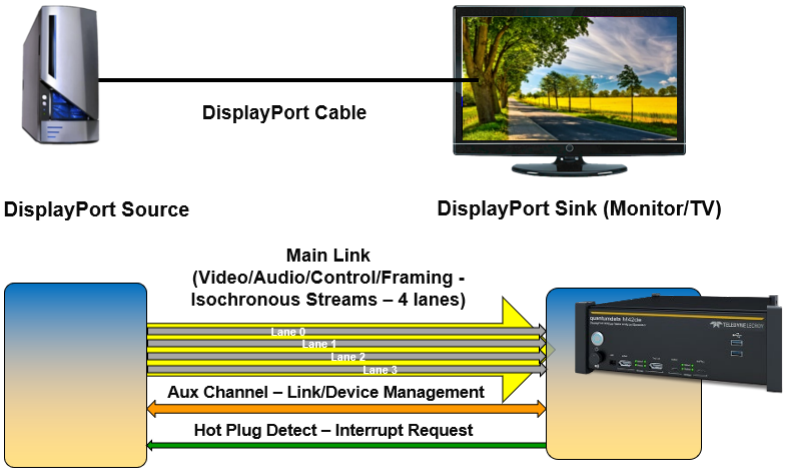
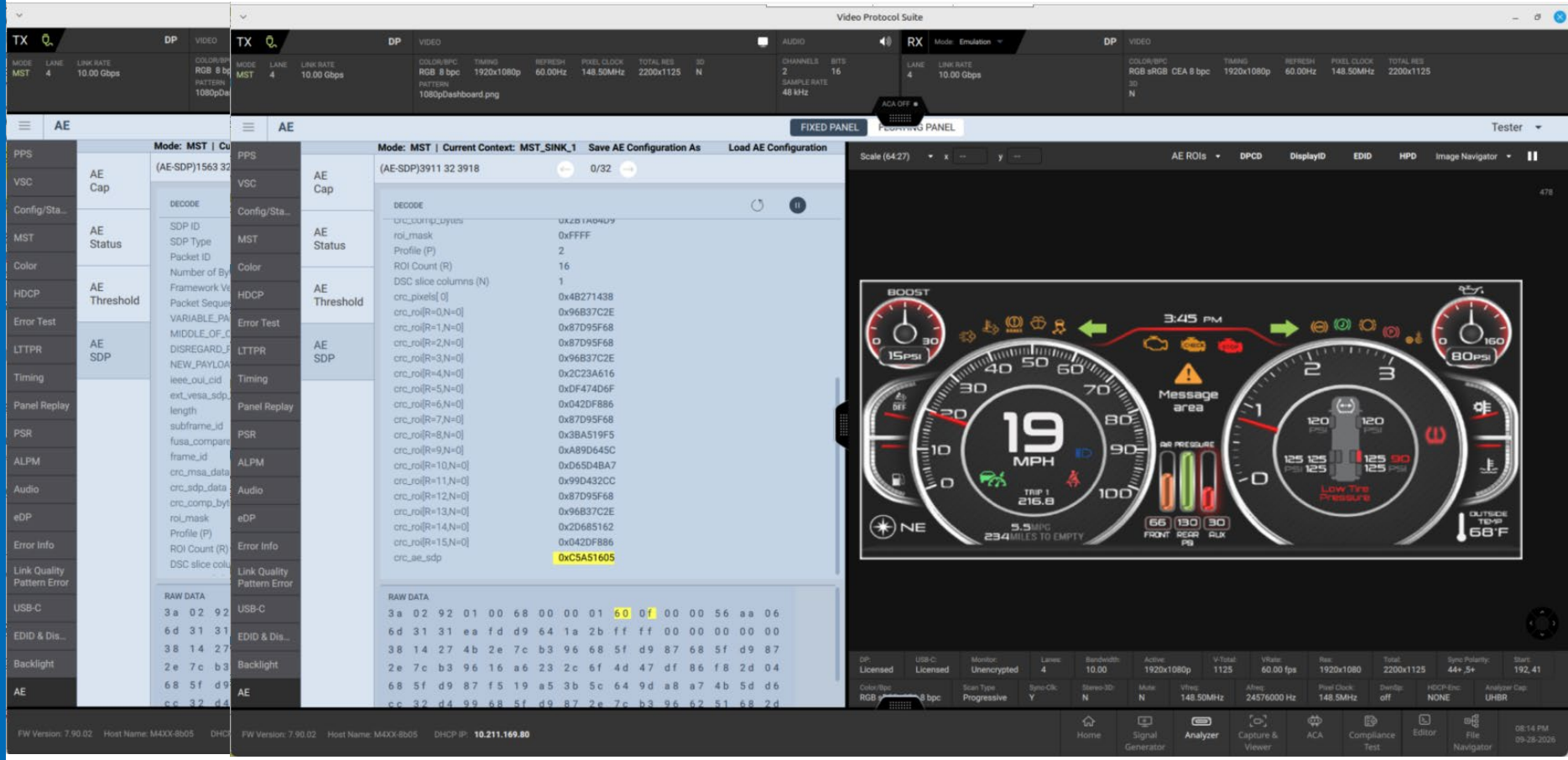


DisplayPort AE – Testing Functional Safety/功能安全测试



DisplayPort AE——功能安全测试

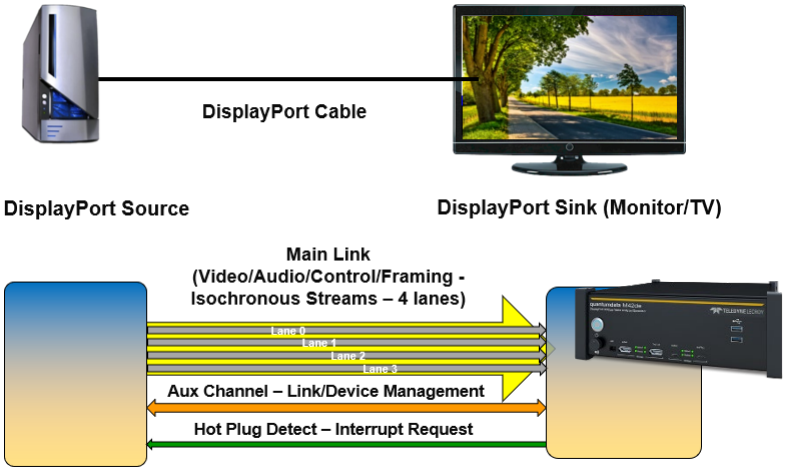
如何测试您的DisplayPort汽车扩展实现

设置DP AE视频/协议分析仪.

- **配置拓扑、配置文件、流数和版本数.**

分析输入的DP AE**流**.

- 观看状态。
- 查看辅助通道和边带交易。
- 实时查看DP AE**次**级数据包（SDP）。
- **捕捉和分析进入的DP客户获取数据流及查看投资回报率.**



DisplayPort AE – Testing Functional Safety /功能安全测试



VESA DisplayPort汽车扩展（DP AE）测试您的功能安全实现

Neal Kendall - 感谢!

Teledyne LeCroy

2026年10月14日——中国深圳

DisplayPort Electrical Testing Overview
DisplayPort电气测试概述

Mike Engbretson

Teledyne LeCroy Product Manager/Teledyne LeCroy产品经理

10/12/2026

Agenda/议程

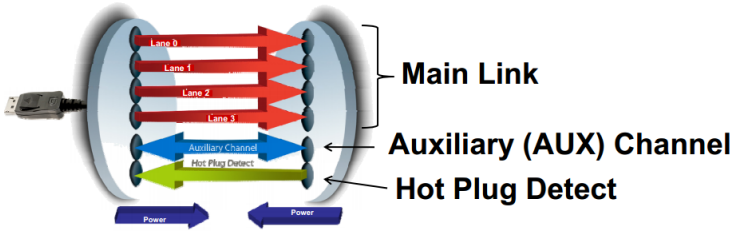
- DP2.1 Electrical Compliance Test Requirements/DP2.1电气合规测试要求
- DP2.1 PHY Updates/DP2.1 PHY更新
- DP2.1 Transmitter Test/DP2.1发送器测试
- DP2.1 Receiver Test/DP2.1接收器测试
- DP2.1 PHY Vendor Methods of Implementation (MOIs)/DP2.1 物理层（PHY）供应商实施方法（MOI）

DP2.1a Electrical Compliance Test Requirement
DP2.1a电气合规测试要求

DisplayPort Interface/DisplayPort接口

Main Link/主链路

- Display data transfer/显示数据传输
- 4 unidirectional high-speed lanes/4条单向高速通道
- Multiple bitrates supported/支持多种比特率



AUX Channel/AUX信道

- Link management/链路管理
- Test mode control/测试模式控制
- 1 bidirectional low-speed lane/1条双向低速通道

Hot Plug Detect/热插拔检测

- Source detects presence of sink/源端检测到接收端的存在
- Sink notifies of status changes via IRQ/接收端通过IRQ通知状态变化

Test Points/测试点

Test Point	Definition
TP1	Source transmitter pins.
TP2	Test interface of a TPA, next to mated connection to a DP source.
TP2’	RX JTOL signal injection point for DUTs with plug.
TP2_CTLE	RX JTOL calibration and test point for DUTs with plug.
TP3	Test interface of a TPA, next to mated connection to a DP sink.
TP3’	Signal injection point to a DP sink.
TP3_EQ	TP3 using a defined DP cable model with equalization applied.’
TP3_CTLE	TP3 using a defined HBR3 cable model with CTLE applied.
TP3_DFE	TP3 using a defined HBR3 cable model with CTLE and DFE applied.
TP4	Sink receiver pins.

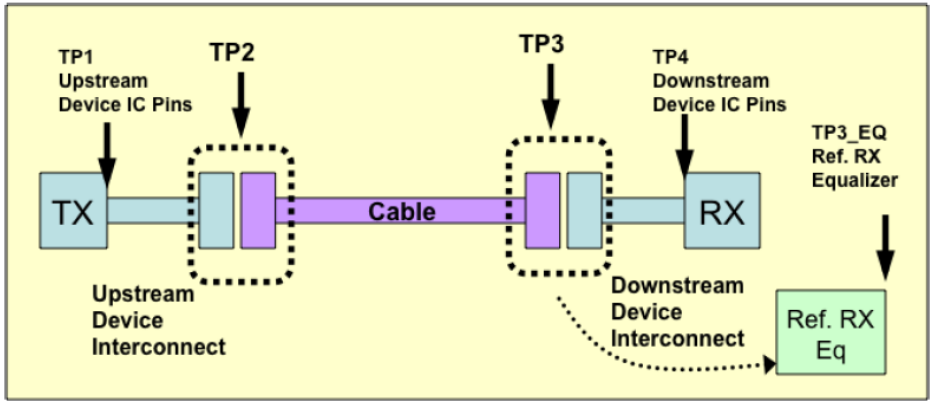


Figure 2-1: Ideal PHY Layer Measurement Points in a DP Interconnect System

Test Point Access Examples/测试点访问示例

DPTX Testing/DPTX测试

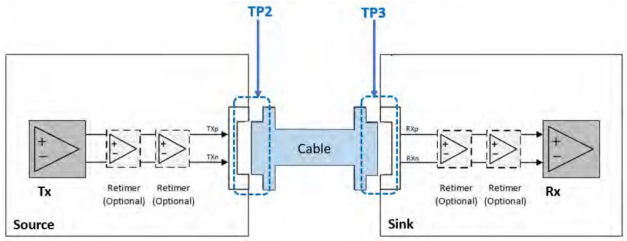
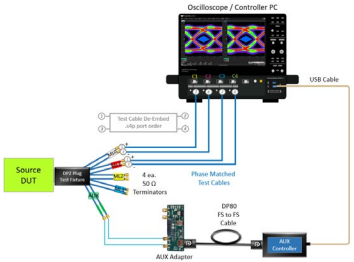
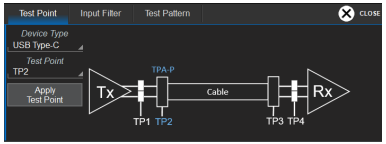
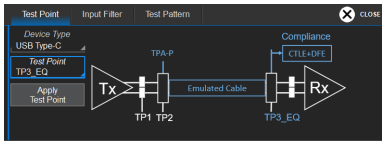


Figure 33. DisplayPort 2.1 Source Test Point definition.







DPRX Testing/DPRX测试

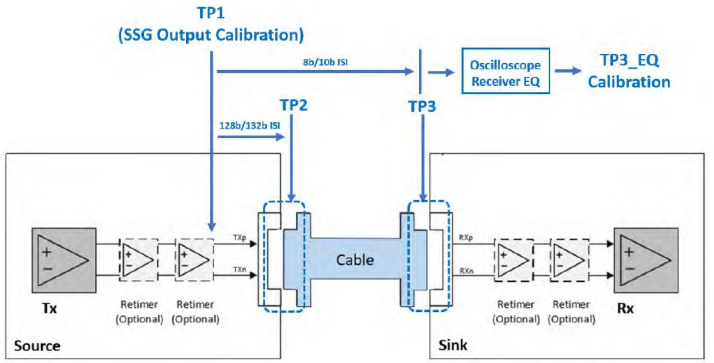


Figure 36. Test Point definition.

How to test the PHY layer?/如何测试物理层？

Source/源端测试

- Configure the source to output test patterns with certain drive settings → **AUX controller/配置源端输出特定驱动设置的测试图样 → AUX控制器**
- Embed worst-case channels, apply equalization on the oscilloscope/**嵌入最差情况信道，在示波器上**应用均衡
- Run measurements/**运行**测量

Sink/接收端测试

- Generate the stress signal with a pattern generator/**用**码型发生器生成加压信号
- Guide the sink through Link Training → **AUX controller/引导接收端完成链路训练 → AUX控制器**
- Read built-in error counter → **AUX controller/读取接收端内置错误计数器 → AUX控制器**

DP2.1 PHY Updates
DP2.1 PHY更新

Electrical Updates from DP2.1 to DP2.1a to DP2.1b/从DP2.1到DP2.1a再到DP2.1b的电气规范更新

- There are minimal changes in 8b/10b electrical compliance testing./8b/10b电气合规测试仅有微小变化。
- A new DP54 cable has been introduced in DP2.1a for UHBR13.5./DP2.1a针对 UHBR13.5引入了新的DP54线缆。
- The UHBR13.5 Source Enhanced FSDP testing will utilize the new DP54 cable model./UHBR13.5源端 增强型FSDP测试将采用新的DP54线缆模型。
- A new DP80LL cable has been introduced in DP2.1b for UHBR20./DP2.1b针对UHBR20 引入了新的DP80LL线缆。
- The UHBR20 Source with 9dB loss budget will utilize the DP80LL cable./具有9dB损耗预算的UHBR20 源端将使用DP80LL线缆。
- Addition of LRD test section/新增LRD测试部分
- Changes in test limits primarily affect Source Testing./测试限值的变化主要影响源端测试。

- UHBR10/UHBR10
  - DPTX TP2
    - Total Jitter =380 mUI
    - Data-Dependent Jitter =160 mUI
    - Eye Width = 600 mUI
    - Eye Height = 242 mV
- UHBR13.5/UHBR13.5
  - DPTX TP2
    - Eye Height = 185 mV
  - DPTX TP3_EQ
    - Total Jitter =450 mUI
    - Data-Dependent Jitter =200 mUI
    - Eye Width = 540 mUI
    - Eye Height = 115 mV
  - DPRX TP3_EQ
    - Total Jitter =485 mUI
    - Data-Dependent Jitter =240 mUI
    - Eye Width = 540 mUI
    - Eye Height = 112 mV
- UHBR20/UHBR20
  - DPTX TP2
    - Total Jitter =435 mUI
    - Data-Dependent Jitter =200 mUI
    - Eye Width = 540 mUI
    - Eye Height = 240 mV
  - DPTX TP3_EQ
    - Total Jitter =455 mUI
    - Data-Dependent Jitter =210 mUI
    - Eye Width = 560 mUI
    - Eye Height = 100 mV
  - DPRX TP3_EQ
    - Data-Dependent Jitter =255 mUI
    - Eye Width = 520 mUI
    - Eye Height = 96 mV



- UHBR10/UHBR10
  - DPTX TP2
    - Total Jitter =440 mUI
    - Data-Dependent Jitter =220 mUI
    - Eye Width = 550 mUI
    - Eye Height = 162 mV
- UHBR13.5/UHBR13.5
  - DPTX TP2
    - Eye Height = 200 mV
  - DPTX TP3_EQ
    - Total Jitter =515 mUI
    - Data-Dependent Jitter =245 mUI
    - Eye Width = 520 mUI
    - Eye Height = 80 mV
  - DPRX TP3_EQ
    - Total Jitter =530 mUI
    - Data-Dependent Jitter =260 mUI
    - Eye Width = 520 mUI
    - Eye Height = 73 mV
- UHBR20/UHBR20
  - DPTX TP2 EnhDP
    - Total Jitter =495 mUI
    - Data-Dependent Jitter =220 mUI
    - Eye Width = 530 mUI
    - Eye Height = 170 mV
  - DPTX TP3_EQ EnhDP
    - Total Jitter =510 mUI
    - Data-Dependent Jitter =242 mUI
    - Eye Width = 550 mUI
    - Eye Height = 84 mV
  - DPRX TP3_EQ EnhDP
    - Data-Dependent Jitter =265 mUI
    - Eye Width = 510 mUI
    - Eye Height = 80 mV

DPTX TP2 USB-C
- Total Jitter =480 mUI

DPTX TP3EQ USB-C
- Total Jitter = 500 mUI

- UHBR20/UHBR20
  - DPTX TP2 EnhDP
    - Total Jitter =495 mUI
    - Data-Dependent Jitter =220 mUI
    - Eye Width = 530 mUI
    - Eye Height = 170 mV
  - DPTX TP3_EQ EnhDP
    - Total Jitter =510 mUI
    - Data-Dependent Jitter =242 mUI
    - Eye Width = 550 mUI
    - Eye Height = 84 mV
  - DPRX TP3_EQ EnhDP
    - Data-Dependent Jitter =265 mUI
    - Eye Width = 510 mUI
    - Eye Height = 80 mV

DPTX TP2 USB-C
- Total Jitter =480 mUI

DPTX TP3EQ USB-C
- Total Jitter = 500 mUI



- UHBR20/UHBR20
  - DPTX TP2 EnhDP DP80
    - Total Jitter = 480 mUI
    - Data-Dependent Jitter = 200 mUI
    - Eye Width =540 mUI
    - Eye Height = 240 mV
  - DPTX TP2 EnhDP DP80LL
    - Total Jitter = 495 mUI
    - Data-Dependent Jitter = 220 mUI
    - Eye Width =530 mUI
    - Eye Height = 170 mV
  - DPTX TP3_EQ for all connector Type/**所有连接器类型的**DPTX TP3_EQ
    - Total Jitter = 500 mUI
    - Data-Dependent Jitter = 210 mUI
    - Eye Width =560 mUI
    - Eye Height = 100 mV
  - DPRX TP3EQ for all connector type/**所有连接器类型的**DPRX TP3EQ
    - Data-Dependent Jitter = 255 mUI
    - Eye Width = 520 mUI
    - Eye Height = 96 mV

DP2.1 PHY CTS Errata/DP2.1 PHY CTS勘误

- Clarification on 8b/10b SSC Modulation Deviation Limit/8b/10b SSC调制偏差限值说明
- Test fixture insertion loss update/测试夹具插入损耗更新
- FFE Preset 15 measurement update/FFE预设15测量要求更新
- LTTPR Frequency Variation test update/LTTPR频率变化测试更新
- Eye Height and Mask requirement update for UHBR Rates/UHBR速率下眼图高度和模板要求更新
- BERT Preset Calibration/BERT预设校准
- UHBR Source Return Loss (Normative)/UHBR源端回波损耗（规范性要求）

DP2.1 Transmitter Test
DP2.1发送器测试

Electrical Source-Tx Tests/源端发送端电气测试

Item	Name	Normative/ Informative
3.1	8b/10b DP Source Device Control and Capability	
3.2	Eye Diagram Test	Normative
3.3	HBR/RBR Non-PE Level Verification Test	Normative
3.4	HBR/RBR PE Level Verification and Maximum Differential Peak-to-Peak Voltage Test	Normative
3.5	HBR3/HBR2 PE Level and Equalization Verification Test	Normative
3.6	HBR3/HBR2 $V_{TX_DIFFp\text{-}p_MAX}$ Test	Normative
3.7	Inter-pair Skew Test	Informative
3.8	Intra-pair Skew Test	Informative
3.9	AC Common Mode Noise Test	Informative
3.10	Non-ISI Jitter Measurement Test	Normative
3.11	HBR3 TX Differential RL Test	Informative
3.12	TJ/RJ/DJ Measurement Tests	Normative
3.13	Main-Link Frequency Compliance Test	Normative
3.14	Spread-spectrum Modulation Frequency Test	Normative
3.15	Spread-spectrum Modulation Deviation Test	Normative
3.16	dF/dT Spread-spectrum Deviation High-frequency Variation Test	Informative
3.17	Embedded Re-timer Frequency Variation Test	Normative

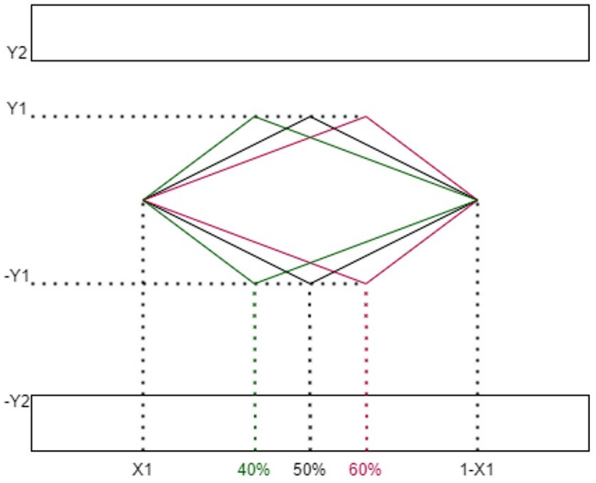
8b/10b

Item	Name	Normative/ Informative
4.1	UHBR Source Test Equipment Requirements	
4.2	Preset and CTLE-DFE Declaration	Normative
4.3	UHBR Source Transmitter Equalization	Normative
4.4	UHBR Bit Rate	Normative
4.4	UHBR Unit Interval	Informative
4.5	UHBR SSC Down Spread Range, Rate, Phase Deviation, and Slew Rate	Normative
4.6	UHBR Embedded Re-timer Frequency Variation	Informative
4.7	UHBR TP2 Eye at 1E-6 BER	Normative
4.8	UHBR TP2 Jitter at 1E-9 BER	Normative
4.9	UHBR AC Common Mode Nosie Test	Informative
4.10	UHBR TP3_EQ Eye at 1E-6	Normative
4.11	UHBR TP3_CTLE Jitter at 1E-9	Informative
4.12	UHBR Transmitter Return Loss	Normative

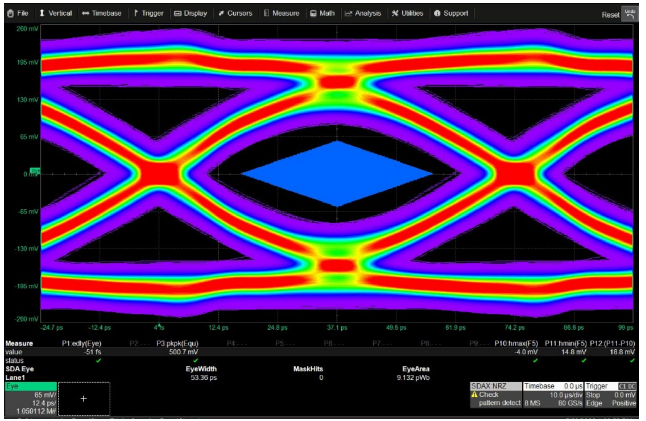
128b/132b

UHBR Eye Mask Update/UHBR眼图模板更新

- If original eye mask fails, then modified mask will be used to re-test./如果原始眼图模板测试未通过，则将使用修改后的模板重新测试。
- Modify mask must comply the Y1 and X1 as per the DP 2.1 PHY CTS/修改后的模板必须符合DP 2.1 PHY CTS中关于Y1和X1的规定



TE Vendor Specific MOI/TE供应商特定MOI



LTTPR Frequency Variation Test/ LTTPR频率变化测试

- LTTPRs are needed as total channel loss increases with the PHY rate/随着PHY速率的提升，总信道损耗增大，需要引入LTTPR
  - Longer channel/更长信道
  - More complex link training/更复杂的链路训练
- LTTPR Re-timer Clock Switch Test Mode/LTTPR 重定时器时钟切换测试模式
  - DPCD 0x0010B – 0x0010Eh [7] =1/DPCD 0x0010B – 0x0010Eh [7] =1
- Initial Test Challenges/初始测试面临的挑战
  - **Entering** Clock Switch test mode/进入时钟切换测试模式
  - **Triggering** on LTTPR local clock event/触发LTTPR本地时钟事件

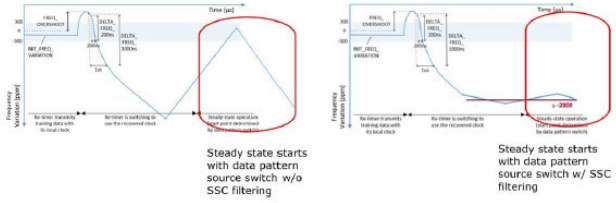
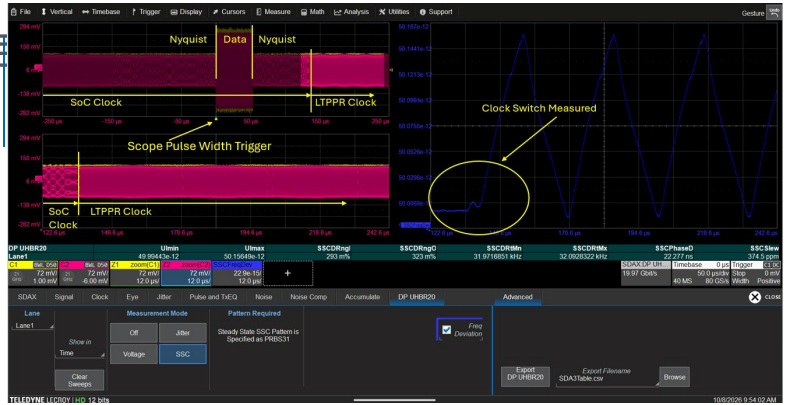


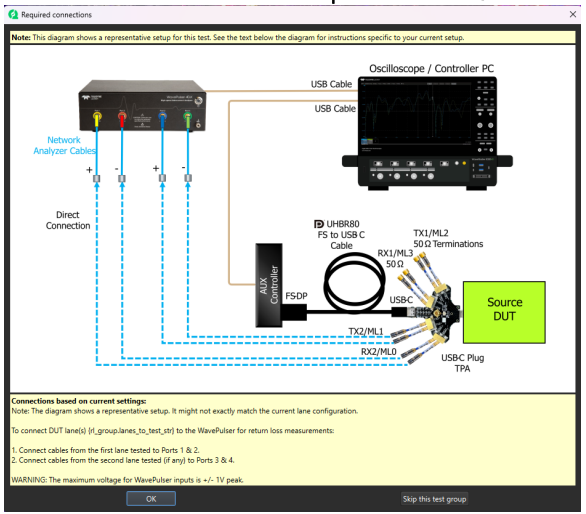
Figure 3-10: LTTPR SSC Filtering Examples

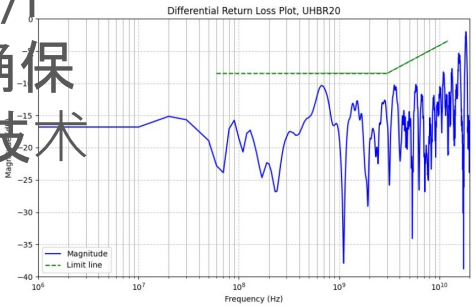
TE Vendor Specific MOI/TE供应商特定MOI

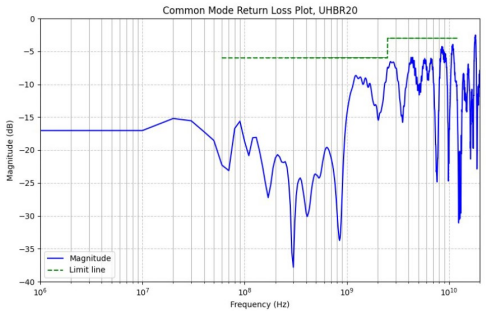


UHBR Tx Return Loss/ UHBR Tx回波损耗

- Normative requirement/规范性要求
- Vendor MOIs provide techniques for consistent P/F results/供应商MOI提供了确保合格/不合格结果一致性的技术手段







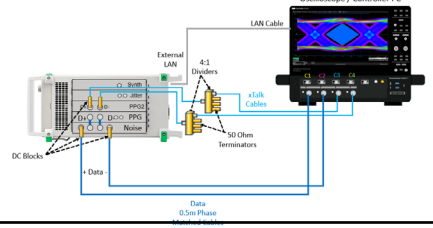
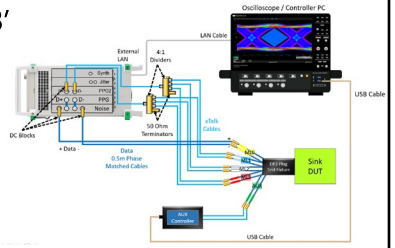
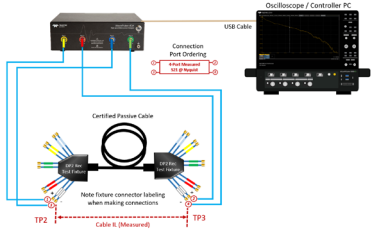
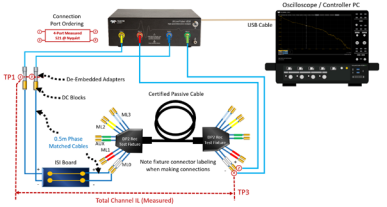
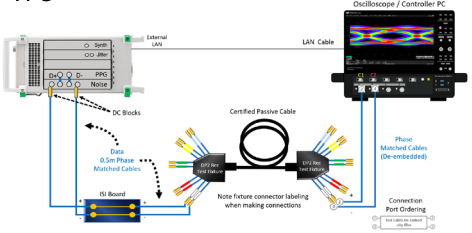
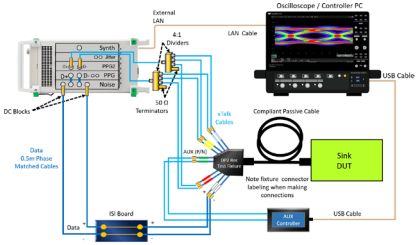
DP Source-TX testing challenges/
DP 源端发送端测试挑战

- The test time for DP TX is significant/DP TX的测试耗时非常显著
- DP Source not supporting PHY Test Automation/DP源端不支持PHY测试自动化
  - DP Source does not transmit the compliance pattern/DP源端未发送合规图样
- VESA is currently discussing DP TX and DP RX reduced PHY test plan for reducing test time/VESA目前正在讨论针对DP TX和DP RX的精简版PHY测试计划，以缩短测试时间

DP2.1 Receiver Test
DP2.1接收器测试

UHBR Sink-Rx Testing/ UHBR接收端测试

- SSG Calibration /SSG校准
  - TP1
  - TP3
- Channel Calibration/信道校准
  - TP2-TP3
  - TP1-TP3
- BER
  - TP3’ (Short Channel)/TP3’（短信道）
  - TP3 (Long Channel)/TP3（长信道）

Calibration	BER Test
TP1 	TP3’ 
TP2-TP3 Certified Cable 	TP1-TP3 Total Channel 
TP3 	

Electrical Receiver Tests/电气接收器测试

Item	Name	Normative/ Informative
5.1	8b/10b DP Sink JTOL Test	Normative

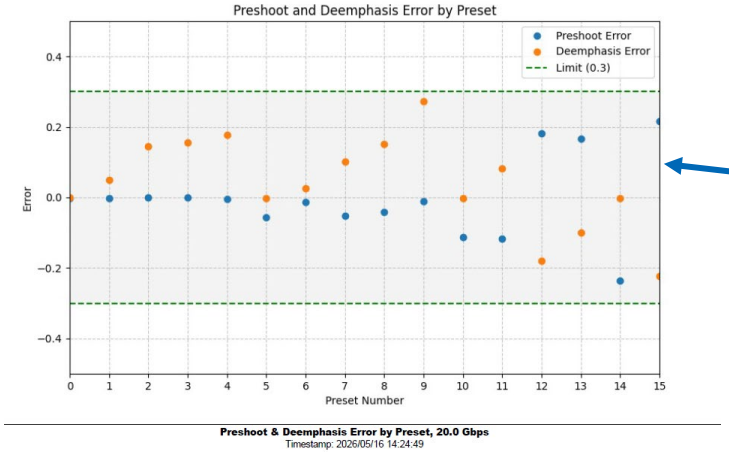
Item	Name	Normative/ Informative
6.1	128b/132b DP UHBR Sink JTOL Test	Normative

Item	Calibration Point	Name
5.1.3.1.1	TP1-TP3	HBR3 Jitter Calibration
5.1.3.1.2	TP1-TP3	HBR2 Jitter Calibration
5.1.3.1.3	TP1-TP3	HBR Jitter Calibration
5.1.3.1.4	TP2/TP3	HBR3 Eye Height and Total Jitter Calibration
5.1.3.1.4	TP3	HBR2 Eye Height and Total Jitter Calibration
5.1.3.1.4	TP3	HBR Eye Height and Total Jitter Calibration
5.1.3.1.5	TP1/TP3	HBR3/HBR2/HBR Crosstalk Calibration
5.1.3.2	TP2/TP3	RBR Jitter Calibration
5.1.3.2	TP3	RBR Eye Height Calibration
5.1.3.2.1	TP3	RBR Crosstalk Calibration

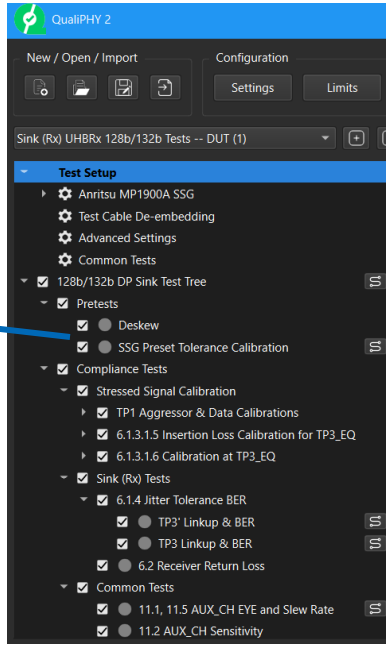
Item	Calibration Point	Name
6.1.3.1.4.1	TP1	AC Common-Mode Interference Calibration
6.1.3.1.4.2	TP1	Random Jitter Calibration
6.1.3.1.4.3	TP1	Periodic Jitter Calibration
6.1.3.1.4.4	TP1	Total Jitter Calibration
6.1.3.1.4.5	TP1	Eye Height Calibration
6.1.3.1.5	TP3	Insertion Loss Calibration
6.1.3.1.6	TP3	Eye Diagram Calibration

SSG Preset Calibration/SSG预设校准

- To verify the SSG FFE as outlined in the DP 2.1 PHY CTS specification/验证符合DP 2.1 PHY CTS规范中概述的SSG FFE
- The Preset calibration check can assist in identifying setup problems. /预设校准检查有助于排查测试环境问题。



TE Vendor Specific MOI/TE供应商特定MOI



SSG – Stressed Signal Generator/SSG—压力信号发生器

DP Sink-Rx testing challenges/DP Sink-Rx测试难点

- Error count registers not enabled in DP Sink/DP接收端中未启用错误计数寄存器
  - Error count register always report 0 errors/错误计数寄存器始终报告0个错误
  - USB-C Lane orientation causing failure in error counter and link training/USB-C通道极性导致错误计数器和链路训练失败
- Calibrations take a significant amount of time/校准过程耗费大量时间
  - Different setup needs for 8b/10b and 128b/132b/针对8b/10b和128b/132b需要不同的测试设置

Vendor MOI Process
供应商MOI流程

Vendor Specific Methods of Implantation (MOIs)/供应商特定的实施方法（MOI）

- Submitted by TE vendors to Test Implementation Working Group/由TE供应商提交给测试实施工作组
- Reviewed by WG members/由工作组成员进行评审
- General Member Review (GMR)/全体成员评审（GMR）
- Approved and posted at https://vesa.org/authorized-test-tools//批准并发布在 https://vesa.org/authorized-test-tools/

VESA

Thank You!
感谢！

VESA
Display Performance Metrics
VESA显示性能指标

Cyan Chen

Granite River Labs

2026 / 10 / 16

Tables/目录

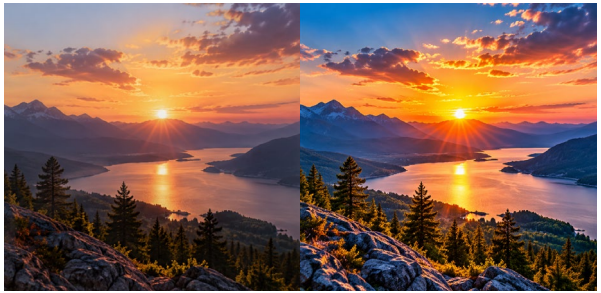
- VESA DPM Introduction/VESA DPM简介
- VESA Certified — DisplayHDR/VESA认证——DisplayHDR
- VESA Certified — AdaptiveSync/VESA认证——AdaptiveSync
- VESA Certified — ClearMR/VESA认证——ClearMR
- Summary/总结

VESA DPM Introduction
VESA DPM简介

VESA Display Performance Metrics (DPM)/VESA显示性能指标

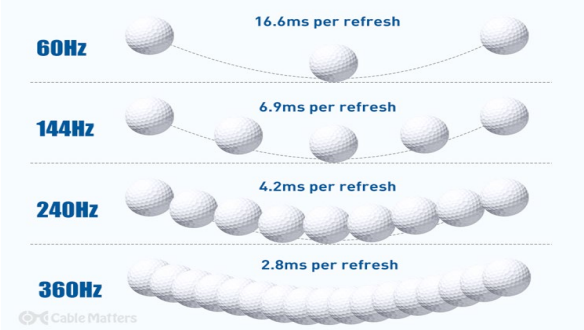
VESA CERTIFIED DisplayHDR™

✔Better brightness & contrast/✓更好的亮度和对比度
✔Accurate color reproduction/✓精准色彩还原



VESA CERTIFIED AdaptiveSync DISPLAY 144

✔Dynamic refresh rate/✓动态刷新率
✔Prevents tearing & stuttering/✓防止画面撕裂和卡顿

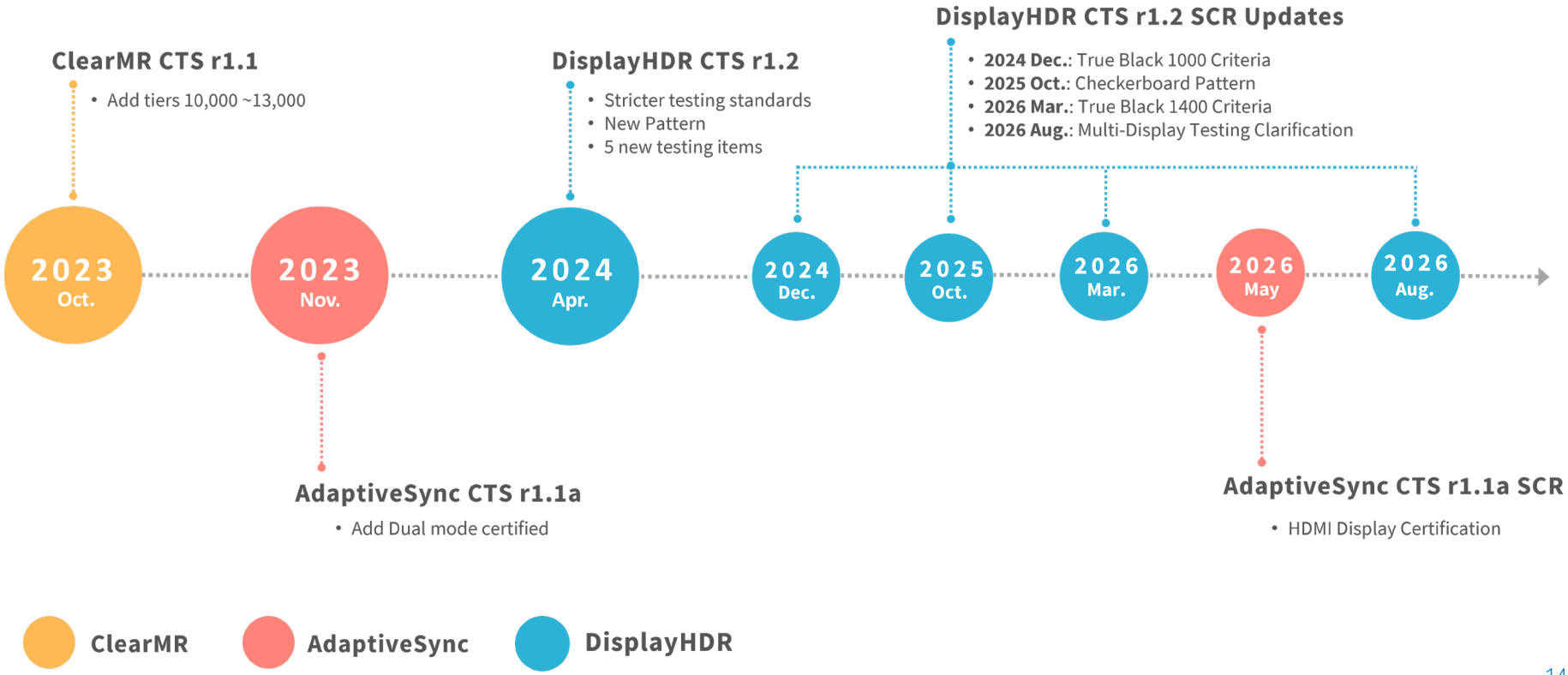


VESA CERTIFIED ClearMR

✔Motion clarity/✓运动清晰度
✔Ratio of clear vs. blurry pixels/✓清晰与模糊像素比率



VESA DPM CTS Timeline/VESA DPM CTS时间线



VESA Certified — DisplayHDR

The Higher Standard for HDR Monitors/
VESA认证—DisplayHDR：HDR显示器的更高标准

DisplayHDR Certification/DisplayHDR认证

VESA performance certification for HDR displays/VESA HDR显示器性能认证

VESA CERTIFIED DisplayHDR™

HDR image quality with higher brightness, color and contrast./具备更高亮度、更丰富色彩和更高对比度的HDR图像质量。

Peak Luminance/峰值亮度

Color & EOTF

Contrast



VESA CERTIFIED DisplayHDR™ TRUE BLACK

HDR performance with exceptional deep black for OLED and emissive displays./专为OLED和自发光显示器打造，呈现卓越纯黑表现得HDR性能。

Deep Black Level/深黑等级

High Contrast/高对比度

OLED/Emissive Displays/OLED/自发光显示器

DisplayHDR Performance Tier/DisplayHDR性能等级

400 | 500 | 600 | 1000 | 1400

DisplayHDR True Black Performance Tier/DisplayHDR True Black性能等级

400 | 500 | 600 | 1000 | 1400

Focus of 2026 update/2026年更新重点

True Black Performance Tier Update/True Black性能等级更新

TB1000 criteria update and TB1400 reintroduction/TB1000标准更新和TB1400重新引入

Apr. 2024
CTS r1.2
Shared criteria with standard DisplayHDR tiers/与标准DisplayHDR等级共享的准则

Dec. 2024
SCR: TB1000
Dedicated TB1000 criteria introduced/引入专用的TB1000标准

May 2026
SCR: TB1400
TB1400 reintroduced with revised criteria/TB1400以修订后的标准重新引入

Key Criteria Update/关键标准更新

Full-screen Luminance (cd/m²)	True Black 1000	True Black 1400
Flash Test	~~1000~~ → **500**	**700**
Long Duration Test	~~600~~ → **500**	**700**
Combined Color Luminance (Lr + Lg + Lb)	~~600~~ → **500**	**700**

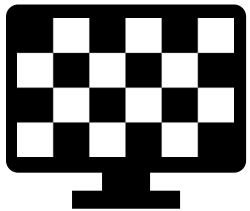
Both TB1000 and TB1400 apply the same 50% approach for full-screen luminance./TB1000和TB1400在全屏亮度上均采用相同的50%方案。

True Black Checkerboard Update/True Black棋盘格更新

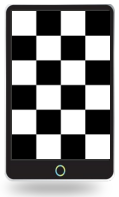
New checkerboard pattern for small-size displays/用于小尺寸显示屏的新棋盘格图案

Small Display Challenge/小尺寸显示屏挑战

Existing checkerboard patterns scale with display size, resulting in measurement areas that become too small on small displays/现有的棋盘格图案随显示屏尺寸缩放，导致在小尺寸显示屏上测量区域过小



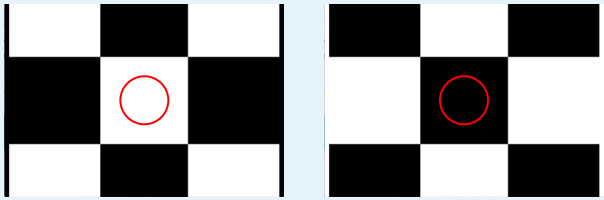
Larger display (6 × 4 pattern)/较大显示屏(6 × 4图案)



Smaller display (patches too small)/较小显示屏(色块过小)

New 3 × 3 Checkerboard/新型3 × 3棋盘格

Introduce a cropped 3 × 3 checkerboard with fixed patch size for small displays/为小尺寸显示屏引入裁剪的3 × 3棋盘格，并采用固定的色块尺寸



80 mm/80毫米

Fixed test square/固定测试方块

50% Loading/50%负载

Auto-maintained/自动维护

Center Measurement/中心测量

Same probe position/相同探针位置

Display Size	Available Checkerboard
Default	6 × 4
< 20"	Optional 4 × 3
7–13" (16:9)	Optional Cropped 3 × 3 ***(New)***

3 × 3 Applicable Display Sizes
7 ~13" diagonal (16:9)
Other aspect ratios: 87–162 mm screen height

Multi-Display Certification Update/多显示屏认证更新

Defines certification requirements for devices with multiple integrated displays/定义具有多个集成显示屏的设备的认证要求。

Secondary Displays/辅助显示屏（副屏）



Examples/示例:

- Status panel/状态面板
- Control bar/控制栏
- Virtual keyboard/虚拟键盘

Primary Display Only/仅主显示屏
No testing for secondary display/不对副屏进行测试

Identical Displays/相同显示屏

(Meet Family Member Definition)/（符合家族成员定义）



Reduced Test Set/精简测试集
for each additional display/针对每个附加显示屏

- 8% / Star Field Luminance/8% / 星场亮度
- Checkerboard Contrast Ratio/棋盘格对比度
- Color Gamut/色域

Different Primary Displays/不同的主显示屏

(Do NOT Meet Family Member Definition)/不满足家族成员定义）



Full Test Suite per Display/每台显示屏的完整测试套件
All test items required/需测试全部项目

Device Certification =
Lowest Tier Achieved/设备认证 = 所达到的最低等级

VESA Certified — AdaptiveSync

Flawless Frames, Every Time

VESA认证—AdaptiveSync

帧帧无暇 始终流畅

AdaptiveSync Certification/AdaptiveSync认证

Variable refresh rate certification for smoother, tear-free display performance/可变刷新率认证，实现更流畅、无撕裂的显示性能

VESA CERTIFIED MediaSync DISPLAY

Optimized for Media Playback/针对媒体播放优化

Max RR ≧ 60Hz;
Min RR ≦ 48Hz

VESA CERTIFIED AdaptiveSync DISPLAY 144

Optimized for Gaming/针对游戏优化

Max RR ≧ 144Hz
Min RR ≦ 60Hz

Smooth & Tear-Free Motion/流畅无撕裂的动态画面

Eliminates screen tearing for better visual experience/消除屏幕撕裂，带来更佳视觉体验

Low Latency & Fast Response/低延迟和快速响应

More responsive and fluid motion performance/更灵敏流畅的动态性能

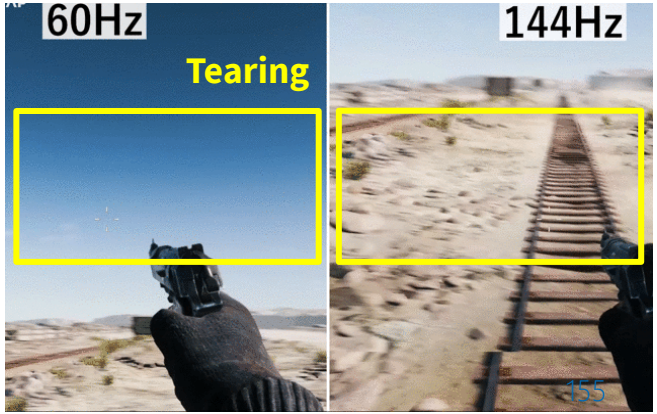
Dual Mode Logo/双模式标志

VESA CERTIFIED AdaptiveSync DISPLAY 240 2160P DISPLAY 480 1080P

Supports certification with two resolution and refreshrate modes/支持两种分辨率和刷新率模式的认证

240
Max RR
@ Max Res.

480
Max RR
@ Alt. Res.



AdaptiveSync Certification Expanded to HDMI/AdaptiveSync认证扩展至HDMI

HDMI displays are now eligible for AdaptiveSync or MediaSync certification/HDMI显示器已符合AdaptiveSync或MediaSync认证资格

DisplayPort

NEW

HDMI
HIGH-DEFINITION MULTIMEDIA INTERFACE



VESA CERTIFIED AdaptiveSync DISPLAY 144

VESA CERTIFIED MediaSync DISPLAY

HDMI Eligible/HDMI符合资格

AdaptiveSync / VRR via HDMI/通过HDMI实现 AdaptiveSync / VRR

Same VRR Behavior/相同VRR行为

Equivalent panel-level operation/等效面板级操作

Same CTS Requirements/相同CTS要求

Existing requirements still apply/现有要求仍然适用

Adaptive-Sync Multi-Mode Certification/Adaptive-Sync多模式认证

Expand from Dual mode to Multi-mode, enabling certification for displays with more than two modes/从双模式扩展到多模式，支持两种以上模式的显示器认证

Dual mode/双模式



2 Certified Modes/2种认证模式

Multi-Mode多模式



3+ Certified Modes/3+认证模式

01

Dual mode Baseline/双模式基线

Native + Max Refresh modes remain required/原生+最高刷新率模式为必需

02

All Modes Certified/全模式认证

All modes must meet AdaptiveSync requirements/所有模式均须满足 AdaptiveSync 要求

03

Flexible Scaling/灵活缩放

Non-integer scaling & different aspect ratios allowed/允许非整数缩放及不同宽高比

04

Testing Impact/测试影响

Warm-up is required for each certified mode/每个已认证模式均需预热

VESA Certified — ClearMR

Clarity in Motion

VESA认证 —ClearMR动态清晰

ClearMR Certification/ClearMR认证

Motion Clarity Performance for Displays/显示屏运动清晰度性能

VESA CERTIFIED ClearMR 13000

Clear Pixels : blurry pixels = 130 : 1/
清晰像素 : 模糊像素 = 130 : 1

Standardized motion quality metric/标准化运动质量指标

Smoother motion, less ghosting/动态更流畅，拖影更少

ClearMR Tiers/ClearMR 等级
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
15000
18000
21000

Lower CMR



More Motion Blur Ghosting/更多运动模糊与拖影

Higher CMR



Clearer Motion with Less Visible Blur/运动画面更清晰，可见模糊更少

Summary
总结

DPM Key Takeaways/DPM核心要点

Key Updates Across DisplayHDR, AdaptiveSync &
ClearMR/DisplayHDR、AdaptiveSync和ClearMR的关键更新

VESA CERTIFIED DisplayHDR™

VESA CERTIFIED AdaptiveSync DISPLAY 144

VESA CERTIFIED ClearMR 13000

VESA CERTIFIED DisplayHDR™ TRUE BLACK

VESA CERTIFIED MediaSync DISPLAY

Expanded Certification Coverage/扩大认证覆盖范围

- TB1000 / TB1400 criteria updates/TB1000 / TB1400标准更新
- Small-display checkerboard support/小尺寸显示屏棋盘格支持
- Multi-display certification/多显示屏认证

More Certification Flexibility/更多认证灵活性

- HDMI now eligible for/HDMI现已符合资格 certification/认证
- Dual-Mode expanded to Multi-Mode/双模式扩展至多模式
- More display modes/更多显示模式 can be certified/可获得认证

Motion Clarity Benchmark/运动清晰度基准

- Standardized clear-to-blurry/标准化的清晰-模糊比 pixel ratio
- ClearMR tiers: 3000 → 21000/ClearMR等级：3000 → 21000
- Higher CMR = better motion/CMR越高 = 运动表现越好

GRL Worldwide Locations/GRL全球分布



Genk Lab
- EMC / EMI
- Performance Testing
- Protocol Testing
- Wireless

Incheon Lab
- Performance Testing
- Wireless

Taipei Lab
- Performance Testing
- Protocol Testing
- Wireless

Karlsruhe Lab
- Safety Certification
- EMC / EMI
- Performance Testing
- Protocol Testing
- Wireless

Bangalore Lab
- Safety Certification
- Protocol Testing
- Wireless
- Cybersecurity

Dongguan Lab
- Safety Certification
- Performance Testing
- Protocol Testing
- Wireless

Shanghai Lab
- Safety Certification
- Performance Testing
- Protocol Testing
- Wireless

Yokohama Lab
- Performance Testing
- Protocol Testing
- Wireless

Santa Clara Lab
- EMC / EMI
- Performance Testing
- Protocol Testing
- Wireless

Lunch Break

Sessions will resume at 1 pm/

午餐休息

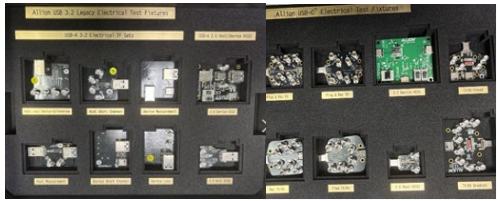
会议将于下午1点继续

Allion Demo Table/Allion展示台

- Test Fixtures/测试夹具



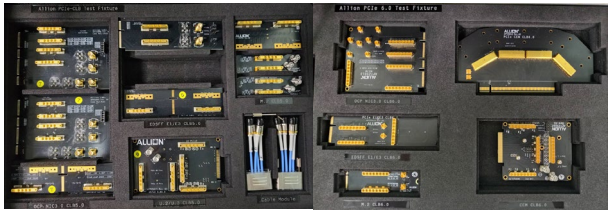
DisplayPort USB-C TO DP Cable/DisplayPort USB-C转DP线缆



USB-C PHY Test/USB-C PHY测试



HDMI 1.x & 2.x PHY Test/HDMI 1.x和2.x PHY测试



PCI-E Gen 5 & 6 PHY Test/PCI-E Gen 5和6 PHY测试

- VESA Certified DP80LL LRD Cables/VESA认证的DP80LL LRD线缆



Luxshare-ICT 3M DP-DP/立讯精密3M DP-DP



Luxshare-ICT 3M USBC-USBC/立讯精密3M USBC-USBC



Luxshare-ICT 3M USBC-DP/立讯精密3M USBC-DP

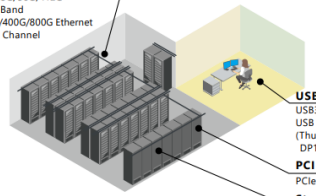
Anritsu MP1900A Signal Quality Analyzer DP1.4/2.1 SINK Compliance Test Structure

Anritsu MP1900A信号质量分析仪DP1.4/2.1 SINK 合规测试结构

Target Applications

General Interfaces

CEI-28G/56G/112G
InfiniBand
100G/400G/800G Ethernet
Fibre Channel



USB
USB3.2, 4
USB Type-C (Thunderbolt3/4, DP1.4/2.0/2.1)

PCI Express
PCIe 1-7

Storage Device
SAS-3/-4

Various Applications

Internal and external interfaces, such as Ethernet, PCIe, SAS, and DDR5, are supported along with USB3.2, 3.4, and Thunderbolt via USB Type-C connectors and cables, and Display Port.

MP1900A supports PCIe 3.0, 4.0, 5.0, 6.0 and 7.0 as well as SAS using the same configuration.



All-in-One Test Support

MP1900A

PCIe 3/4/5/6/7* Receiver Test
Base Specification
- Stressed Eye Test

CEM Specification*
- Transmitter initial Tx Equalization
- Transmitter Link Equalization response
- Receiver Link Equalization
- PLL Bandwidth
- Retimer

USB Type-C Receiver Test (USB4, Thunderbolt3/4, DP1.4/2.0/2.1)
Receiver Test
SJ Margin Test
Amplitude Margin Test

USB 3.2 Gen1/2 Receiver Test
Transmitter Eye Test
Receiver Jitter Tolerance Test
LFPS Test

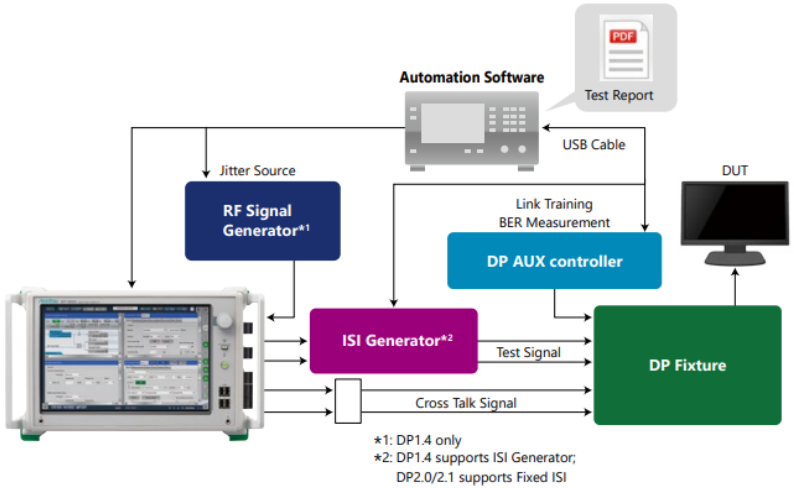
Storage Receiver Test (SAS-3/-4)
Receiver Jitter Tolerance Test

Memory/Memory Controller Receiver Test
- CXL2/3
- DDR5

Jitter Tolerance Test
SJ/RJ/BUJ Injection
Low-rate estimated BER measurement

*: PCIe CEM SPEC supports PCIe 3 to 6.

DisplayPort 1.4/2.0/2.1 Sink Test



Required Functions

- 2.7 Gbit/s to 20 Gbit/s PPG
- Stressed Signal Calibration and Test
- USB Type-C Alternative Mode Operation



DisplayPort Alt Mode Compliance Testing and Analysis solutions

ellisys

DisplayPort 替代模式 合规性测试与分析解决方案

SYMBIOSYS ALLIANCE

Ellisys USB/DPAM Test and Analysis Solutions

Ellisys USB/DPAM 测试与分析解决方案

USB Explorer™ 350



Multi-function USB Type-C®, USB 3.2, and Power Delivery Protocol Test Platform

VESA-Approved Tester for DisplayPort ALT Mode

多功能 USB Type-C®、USB 3.2 及 Power Delivery 协议测试平台
VESA 批准的 DisplayPort ALT 模式测试仪

Type-C Tracker™



Protocol and Electrical Analysis Tool for USB Type-C® Standards

Includes DP AUX and DP ALT Support

针对 USB Type-C® 标准的协议与电气分析工具
包含 DP AUX 和 DP ALT 支持

ellisys
Better Analysis

VESA eDP and DisplayPort Protocol Analysis and Validation/eDP和DisplayPort协议分析与验证

FuturePlus Systems

Advancing Technology Development

Real Time

ANY Source to ANY Sink/实时：从任意信号源到任意接收端



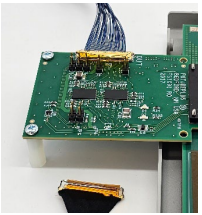


NEW

eDP 2.0 Protocol Analysis/eDP 2.0 协议分析

With

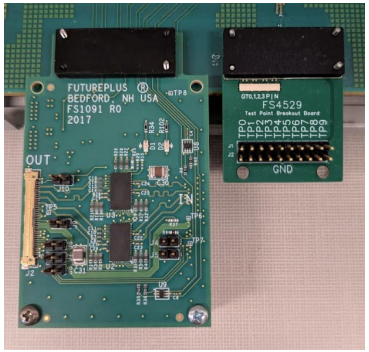
128b/132b Decode!/128b/132b解码！



NEW

eDP Status and Timing/eDP状态和时序

Breakout Board/转接板



Features:

- ***Panel Self Refresh (PSR) and Selective Update Status/面板自刷新(PSR)和选择性更新状态***
- Connect Test Points to oscilloscope, mixed-signal oscilloscope, or timing analyzer/将测试点接入示波器、混合信号示波器或时序分析仪
- ***Test Points can be customized!/测试点可自定义！***

All Supported!

- ***eDP 2.0 with 128b/132b Decode/支持128b/132b解码的eDP 2.0***
- Panel Replay/面板重放
- Aux-Less ALPM/无Aux 的ALPM
- **UHBR13.5**



Something Special?/有何特别之处？

We Like Challenges!/我们喜欢挑战！


GRL
By SGS
GRL VESA
Certification
Testing Services
GRL Taiwan | VESA Workshop 2026
graniteriverlabs.com
GRL VESA
认证测试服务
GRL台湾 | VESA 研讨会 2026

VESA GRL VESA Certification Testing Services/GRL VESA认证测试服务

Supporting Your VESA Certification Journey/助力您的VESA认证之旅



DisplayPort

DP Source & Sink Certification/DP源端与接收端认证

- DP 1.4 & DP 2.1 (UHBR 10 / 13.5 / 20)/DP 1.4和DP 2.1（UHBR 10 / 13.5 / 20）

VESA CERTIFIED DisplayHDR™

HDR Picture Quality Certification/HDR图像质量认证

- Multiple performance tiers (400 ~ 1400 / True Black)/多个性能等级（400 ~ 1400 / True Black）

VESA CERTIFIED AdaptiveSync DISPLAY 144

Variable Refresh Rate Certification/可变刷新率认证

- Variable refresh rate performance validation/可变刷新率性能验证

VESA CERTIFIED ClearMR 13000

Motion Clarity Certification/运动清晰度认证

- Multiple performance tiers (ClearMR 3000 ~ 21000)/多个性能等级（ClearMR 3000 ~ 21000）

GRL Service Scope/GRL服务范围

Pre-Compliance/预合规
Early issue identification/早期问题识别

Compliance Testing/合规测试
VESA compliance testing/VESA合规测试

Debug Support/调试支持
Analysis & troubleshooting/分析与故障排除

Certification Support/认证支持
Certification follow-up/认证后续

Why GRL

- VESA Authorized Test Center with **10+ years** of VESA compliance testing experience/拥有10年以上VESA合规测试经验的VESA授权测试中心
- **3000+ products tested** across DisplayPort, DisplayHDR, AdaptiveSync, and ClearMR/在DisplayPort、DisplayHDR、AdaptiveSync和ClearMR领域测试了3000多款产品
- Global labs, local support in your time zone/全球实验室，匹配您所在时区的本地支持

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VESA



GRL PLATFORM SOLUTIONS
FOUNDATIONAL - INTELLIGENT - PRECISE

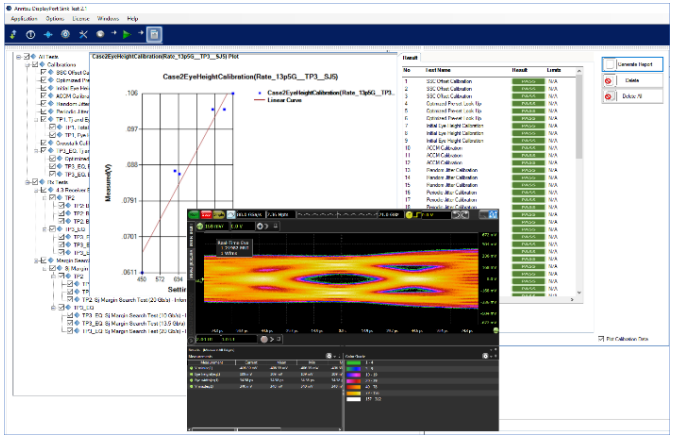
GRLPS DisplayPort

DP2.1 Tx PHY Test Solution
DP2.1 Rx PHY Test Solution
DPAM Test Solution

www.grlps.com

GRL Platform Solutions (www.grlps.com)/GRL平台解决方案

DisplayPort 2.1 Tx/Rx Test Automation Solution/DisplayPort 2.1 Tx/Rx测试自动化解决方案



USB Type-C® Power Delivery Tester & Analyzer - EPR/USB Type-C® Power Delivery测试仪和分析仪-EPR



- USB Power Delivery Specification 3.2/USB Power Delivery Specification 3.2
- Type-C ® Functional Specification
- IEC Functional Safety (IEC 62368-1)/IEC功能安全（IEC 62368-1）
- **DisplayPort™ Alternate Mode Tests**
- Thunderbolt 3/4/5 Alternate Mode Tests/Thunderbolt 3/4/5 Alternate Mode 测试
- Thunderbolt 3/4/5 Power Tests/Thunderbolt 3/4/5电源测试
- Qualcomm® Quick Charge 2™/Qualcomm® Quick Charge 2™
- Qualcomm® Quick Charge 3™ and 3+™/Qualcomm® Quick Charge 3™和3+™
- Qualcomm® Quick Charge 4™ and 4+™/Qualcomm® Quick Charge 4™和4+™
- Qualcomm® Quick Charge 5™/Qualcomm® Quick Charge 5™
- BC 1.2 for QC Sink products/用于QC受电产品的BC 1.2
- IEC 63680-1-2

Anritsu + Tektronix OR KEYSIGHT TECHNOLOGIES



The only instrument you need for validating compliance, inter-operability, and reliability of your designs/验证设计合规性、**互操作性和可靠性的唯一必备仪器**

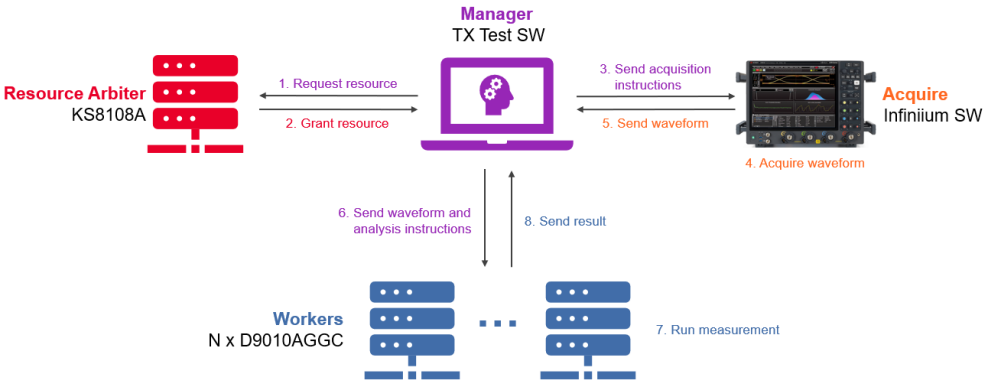
KEYSIGHT

Maximizing Time Efficiency & Prepared for the Future
最大化时间效率 为未来做好准备

- Contact Information/联系方式
  - Abhijeet Shinde/Abhijeet Shinde
  - Abhijeet.Shinde@keysight.com/Abhijeet.Shinde@keysight.com

Keysight Technologies/是德科技

VESA





XR8 + Disaggregation = Time Efficiency/XR8 + 分布式解耦 = 时间效率

What are your costs?/您的成本是多少？

- A comprehensive test plan leads to prolonged testing durations./全面的测试计划会导致测试时间延长。
- A majority, about 75%, of the testing period is consumed by data processing./约75%的测试时间被数据处理占用。

What would be an optimal solution?/最佳解决方案是什么？

- Considerable reduction in test time through Measurement Disaggregation./通过测量解耦，大幅缩短测试时间。
- Maximizes the use of your existing investment./最大化利用您现有的投资。
- $$$ Cost-effective savings./$$$ 高性价比的节省。
- Enhances your current equipment and expertise./增强您现有的设备和专业知识。

M8050A: Prepared for the future/M8050A：面向未来

What are your costs?/您的成本是多少？

- Investment in hardware to meet next-generation requirements/硬件投资以满足下一代需求
- Reduced passing margin/通过余量变小

What would be the optimal solution?/最佳解决方案是什么？

- Reliable support for up to 120GBd and various PAM types/可靠支持高达120GBd的速率和多种PAM调制类型
- Provides the lowest intrinsic noise, enhancing passing margin/具备最低的固有噪声，有效扩大通过裕量
- Facilitates hassle-free stress calibration, saving both time and money/轻松实现应力校准，省时又省钱

KEYSIGHT

DisplayPort Tx Compliance Test Solution/DisplayPort Tx合规测试解决方案

Challenge/挑战

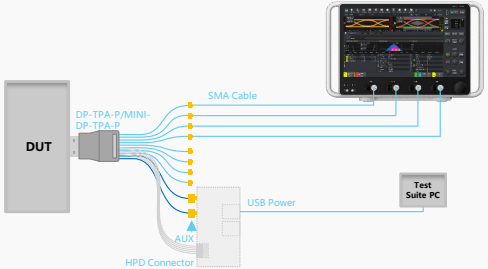
01 Numerous parameters & slower validation

Table 3-2: Allowed Voltage Swing and TX Emphasis Level Combinations

Bit Rate	Voltage Swing Level	TX Emphasis Level			
		0	1	2	3
HBR3/HBR2[a]	0	Shall be supported	Shall be supported	Shall be supported	Shall be supported
	1	Shall be supported	Shall be supported	Shall be supported	Not allowed
	2	Shall be supported	Shall be supported	Not allowed	Not allowed
	3	Shall be supported	Not allowed	Not allowed	Not allowed
HBR/RBR[b]	0	Shall be supported	Shall be supported	Shall be supported	May be supported
	1	Shall be supported	Shall be supported	Shall be supported	Not allowed
	2	Shall be supported	Shall be supported	Not allowed	Not allowed
	3	May be supported	Not allowed	Not allowed	Not allowed

- 4 lanes × 4 bit rates × 4 swing levels × 4 pre-emphasis levels/4通道 × 4种速率 × 4种摆幅 × 4个预加重等级
- Test time: 8h for 4 lanes/测试时间：4通道8小时

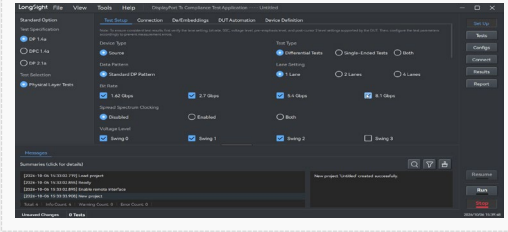
02 4 differential lanes on a 4-channel scope/4 通道示波器支持 4 个差分通道



- One extra manual re-connection during test

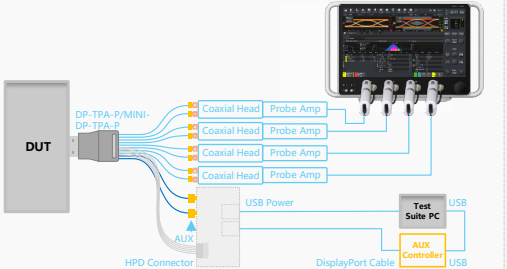
Test Solution/测试解决方案

01 One-touch automatic test & report/一键自动测试和报告



- Flexible configuration, flexible test plans/灵活配置，灵活测试计划

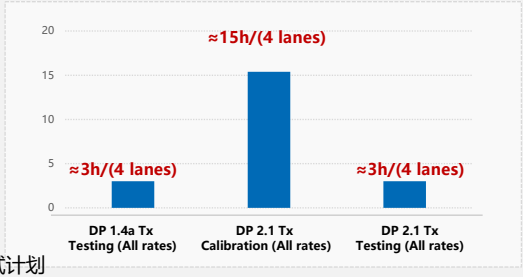
02 Coaxial differential probing solution/同轴差分探头解决方案



- Scope: up to 90 GHz, Coaxial diff probes: up to 25 GHz

Solution Value/方案价值

01 Faster testing



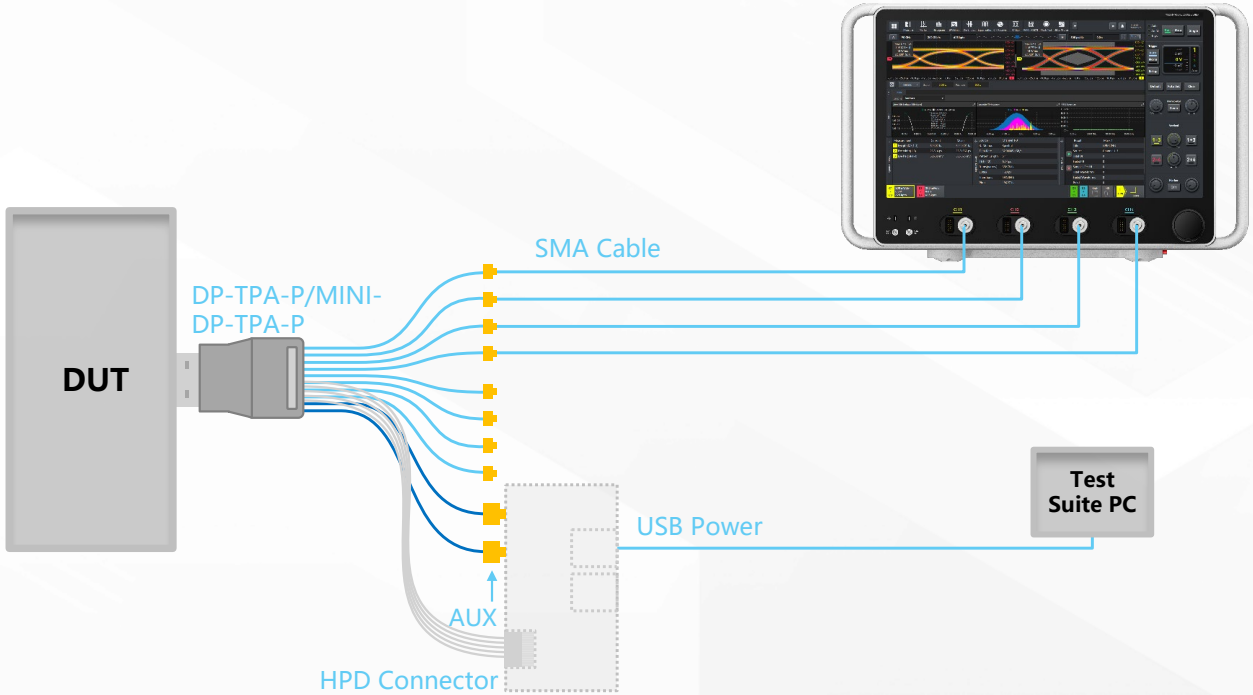
02 All 4 differential lanes tested in single connection/单次连接即可测试全部4条差分通道

- Automated single-connection testing with coaxial differential probes/采用同轴差分探头，实现自动化单次连接测试
- Auto pattern switching (AUX RefSink / user scripts) for full compliance testing and debugging/自动图案切换（AUX RefSink / 用户脚本），用于全面合规测试

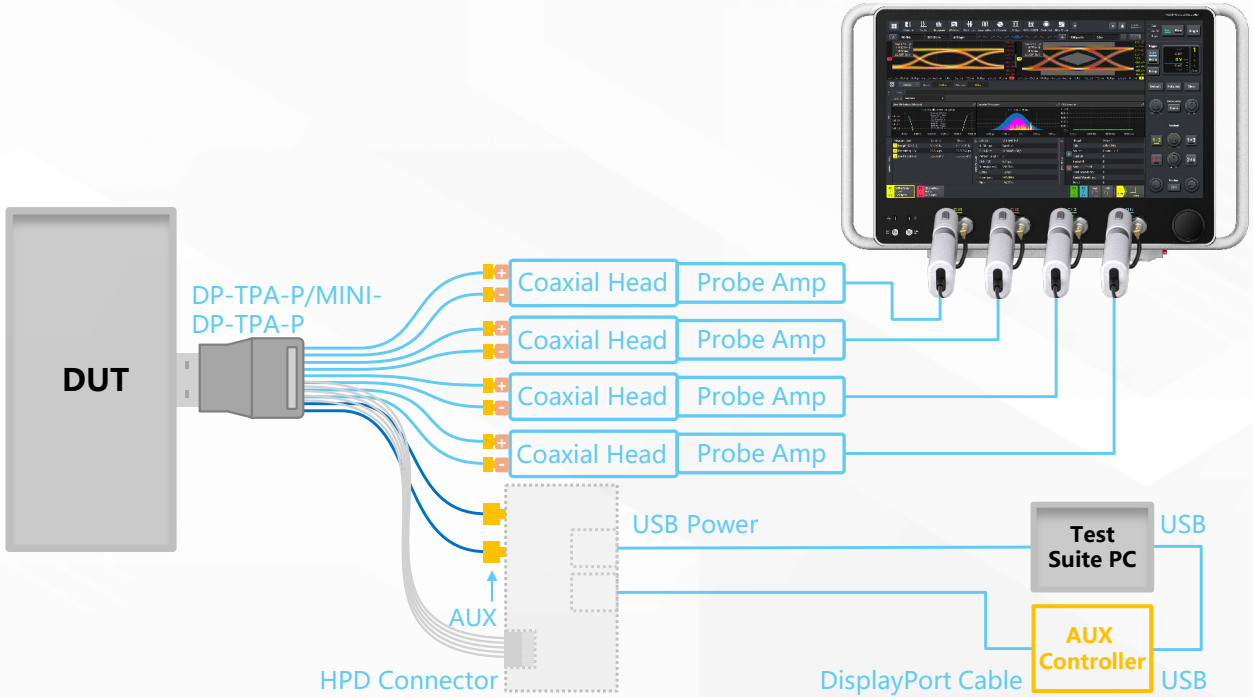
03 Efficient verification across interfaces & link rates

- Supports DP 1.4a/2.1a & eDP 1.4b/1.5a Tx
- Covers RBR through UHBR20/覆盖RBR到UHBR20
- Provides DP / USB-C / Mini DP / eDP compatibility 提供DP / USB-C / Mini DP / eDP兼容性

图片素材

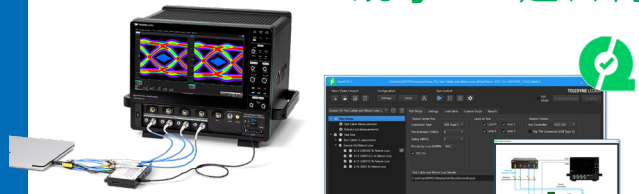

DUT
DP-TPA-P/MINI-
DP-TPA-P
SMA Cable
USB Power
Test
Suite PC
AUX
HPD Connector

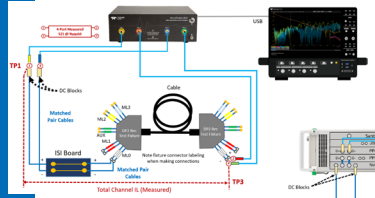
图片素材

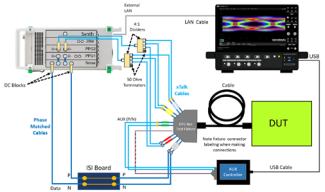

DUT
DP-TPA-P/MINI-
DP-TPA-P
Coaxial Head
Probe Amp
Coaxial Head
Probe Amp
Coaxial Head
Probe Amp
Coaxial Head
Probe Amp
USB Power
Test
Suite PC
USB
AUX
AUX
Controller
HPD Connector
DisplayPort Cable
USB

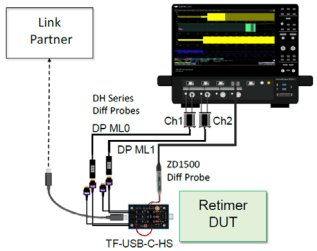


DisplayPort 2.1 PHY Compliance and PHY-Logic Debug/DisplayPort 2.1 PHY合规与PHY逻辑调试









- DisplayPort 2.1 Source (Tx) Compliance/DisplayPort 2.1 Source (Tx)合规
- WaveMaster/SDA 8000HD with QualiPHY® 2 software/ 配备QualiPHY® 2软件的WaveMaster/SDA 8000HD
  - SDAX-DP expert analysis – Find Best CTLE/DFE/SDAX-DP专家分析——寻找最佳CTLE/DFE
  - Reduced test times with QPHY2-PC/使用QPHY2-PC缩短测试时间
  - Automated Return Loss with WavePulser 40iX/使用WavePulser 40iX进行自动化回波损耗测试
- DisplayPort 2.1 Sink (Rx) Compliance/DisplayPort 2.1 Sink (Rx)合规性
- WaveMaster/SDA 8000HD with QualiPHY 2 software/ 配备QualiPHY 2软件的WaveMaster/SDA 8000HD
  - SSG Cal and BER testing using Anritsu MP1900 SQA/使用Anritsu MP1900 SQA进行SSG校准和BER测试
  - Automated Channel Cal with WavePulser 40iX/使用WavePulser 40iX进行自动化信道校准
- PHY-Logic (Interop) Debug/PHY逻辑（互操作性）调试
  - AUX Triggered + Main Link capture/AUX触发+主链路捕获
  - TF-USB-C-HS – probing access/TF-USB-C-HS – 探测点接入
  - DP-AUX, USB-PD TDMP software/DP-AUX、USB-PD TDMP 软件
  - Clock switch testing on live link/活动链路上的时钟切换测试

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Voyager M4120/Voyager M4120

Complete USB4® v2 Solution/完整的USB4® v2 解决方案

Analyzer, Exerciser, & Compliance Tester/分析仪、激励器和合规性测试仪

Asymmetric Link Capture/非对称链路捕获

Capable of capturing and testing 120Gb/s Asymmetric Link Configurations/具备捕获和测试120Gb/s非对称链路配置的能力

Traffic Decoding & Unified Workflow/流量解码与统一工作流

HopIDs Automatically Detected; **Tunneled DisplayPort Decoded/自动检测HopID；隧道化DisplayPort 解码**

Single Click Export Native **DisplayPort Traffic**, view in VPS/一键导出原生DisplayPort流量，并在VPS中查看

All Speeds, One Unit/所有速率，一机搞定

- USB4 v2 120Gb/s (PAM3, Asymmetric)/USB4 v2 120Gb/s（PAM3，非对称）
- USB4 v1 40Gb/s (NRZi)/USB4 v1 40Gb/s (NRZi)
- Thunderbolt™ 5, 4, & 3/Thunderbolt™ 5、4和3
- USB 3.2, USB 2.0/USB 3.2、USB 2.0
- USB-PD, & Type-C/USB-PD和Type-C



TELEDYNE | LECROY

UCD-500 Gen3/UCD-500 Gen3

16K DP 2.1b Generator & Analyzer/16K DP 2.1b发生器和分析仪



- DP 2.1b Sinks and Sources up to 8K@60Hz/DP 2.1b 接收端与 发送端，最高支持 8K@60Hz
- Supports DP and USB-C connectors/支持DP和USB-C连接器
- DP 2.1b and DP 1.4a Link Layer CTS including DSC, LTTPR,/DP 2.1b和DP 1.4a链路层CTS，包括DSC、LTTPR, DisplayID/EDID, MST, Adaptive-Sync and more./DisplayID/EDID、MST、Adaptive-Sync等。

UTC-274

USB Type-C Tester for Test Automation/用于测试自动化的USB Type-C测试仪



- Test DP Alt Mode, Power Delivery and USB speed/测试DP Alt Mode、Power Delivery和USB速度
- 2 upstream USB-C test ports/2个上行USB-C测试端口
- EPR function test up to 240W Source and Sink/ EPR功能测试，最高支持240W Source和Sink

DP LRD Active Cable Testing
DP LRD有源线缆测试

Lexus Lee

Allion Labs,Inc/百佳泰

2026/10/14

Overview/概述

- Why VESA Defines LRD Active Cable Spec/VESA为何制定LRD有源线缆规范
- VESA LRD Active Cable Testing Challenges/VESA LRD有源线缆测试挑战
- VESA LRD Active Cable Testing Experience/VESA LRD有源线缆测试经验
- VESA Connector Certification Introduction/VESA连接器认证介绍
- Cable Next - Active Optical Cable?/Cable Next—有源光缆？

Overview/概述

- Why VESA Defines LRD Active Cable Spec/VESA为何制定LRD有源线缆规范
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- VESA Connector Certification Introduction/VESA连接器认证介绍
- Cable Next - Active Optical Cable?/ Cable Next —有源光缆？

Why VESA Defines LRD Active Cable Spec /VESA为何制定LRD有源线缆规范

- Enable UHBR20 transmission over a 2-meter cable/支持在2米线缆上实现UHBR20传输
  - Only works for 1-meter passive cable, which cannot meet all use-case requirements/仅适用于 1 米无源线缆， 无法满足所有用例需求
- LRD Active Cable Type for VESA Certification/用于VESA认证的LRD有源线缆类型

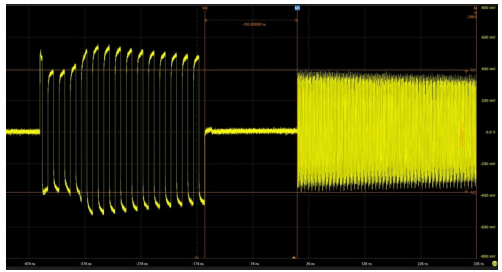


Overview/概述

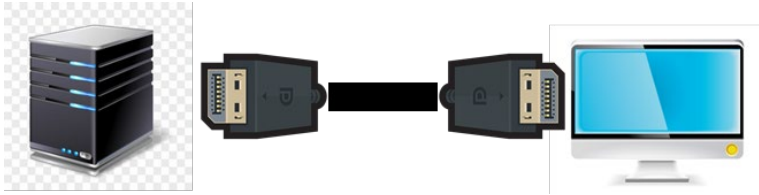
- Why VESA Defines LRD Active Cable Spec/VESA为何制定LRD有源线缆规范
- VESA LRD Active Cable Testing Challenges/VESA LRD有源线缆测试挑战
- VESA LRD Active Cable Testing Experience/VESA LRD有源线缆测试经验
- VESA Connector Certification Introduction/VESA连接器认证介绍
- Cable Next - Active Optical Cable?/ Cable Next —有源光缆？

What Is Inside VESA LRD Cable CTS? /VESA LRD线缆CTS包含哪些内容？

- Time Domain test/时域测试
  - Eye Diagram/眼图
  - Instantaneous Common Mode Voltage/瞬时共模电压
  - CONFIG2 Voltage and No DP_PWR thru Cable
  - AUX-Less ALPM/无AUX 的ALPM
  - LOS Test/LOS测试
  - Inrush Current Test/浪涌电流测试
  - AUX Voltage Clamping/AUX电压钳位
  - Preset Distortion Thru the cable/线缆FTE预设引入的失真



What Is Inside VESA LRD Cable CTS? Cont' / VESA LRD线缆CTS包含哪些内容？（续）



- Functional test/功能测试
  - Successful Link Training/链路训练成功
    - All data rate(from RBR to UHBR20)/所有数据速率（从RBR到UHBR20）
    - All lane count (1-Lane, 2-Lane,4-Lane)/所有通道数（1通道、2通道、4通道）
    - Bidirectional (Swap Sink/Source end)/双向（交换接收端/Source端）
    - Power management (Active Power ,Wake/Sleep, Aux-less ALPM)/电源管理（活动功耗、唤醒/休眠、无Aux 的ALPM）
    - USB-C Orientation (Flip/Normal)/USB-C方向（正插/反插）
  - SOP/SOP' Response Check(SVDM2.0/SVDM2.1)/SOP/SOP' 响应检查（SVDM 2.0/SVDM 2.1）

What Is Inside VESA LRD Cable CTS? Cont'/ VESA LRD线缆CTS包含哪些内容？(续)

- Frequency Domain test/
  频域测试
  - Insertion Loss Fit/插入损耗拟合
  - Receiver Margin Evaluation/接收端裕量评估
  - IRL Integrated Return Loss/IRL集成回波损耗

Table 4-14: DP80LL Nyquist Frequencies and their ILFitAtNq Mandates (Normative)

Nyquist Frequency (GHz)	DP-to-DP and USB-C-to-DP ILFitAtNq Mandate (dB)[a]
15.00	> -10.40
12.50	> -9.50
10.00	> -6.50
6.75	> -5.20
5.00	> -4.55
2.70	> -3.25
0.10	> -1.00

a. Cable values are measured mated pair-to-mated pair.

Table 8-6: LRD Cable IRL Limits

Mode	IRL Limit
DP80	*if (-4 dB ≤ ILfit@Nq): IRL ≤ -13 dB* *if (ILfit@Nq < -4 dB): IRL ≤ ILfit@Nq – 9*
DP54	$IRL \leq 0.046 \cdot ILfitatNq^2 + 1.812 \cdot ILfitatNq - 8.784$

8.3.3 Receiver Margin Evaluation

Channel Operating Margin (COM) ≥ 3 dB

Update About LRD Active Cable in DP 2.1b Spec/关于DP 2.1b规范中LRD有源线缆的更新

- DP80LL (Low Loss)/DP80LL（低损耗）
  - The only difference between the DP80LL and DP80 cable spec is the IL FitAtNq requirement./DP80LL和DP80线缆规范之间的唯一区别是IL FitAtNq要求。

Table 4-14: DP80LL Nyquist Frequencies and their ILFitAtNq Mandates (Normative)

Nyquist Frequency (GHz)	DP-to-DP and USB-C-to-DP ILFitAtNq Mandate (dB)[a]
15.00	> -10.40
12.50	> -9.50
10.00	> -6.50
6.75	> -5.20
5.00	> -4.55
2.70	> -3.25
0.10	> -1.00

a. Cable values are measured mated pair-to-mated pair.

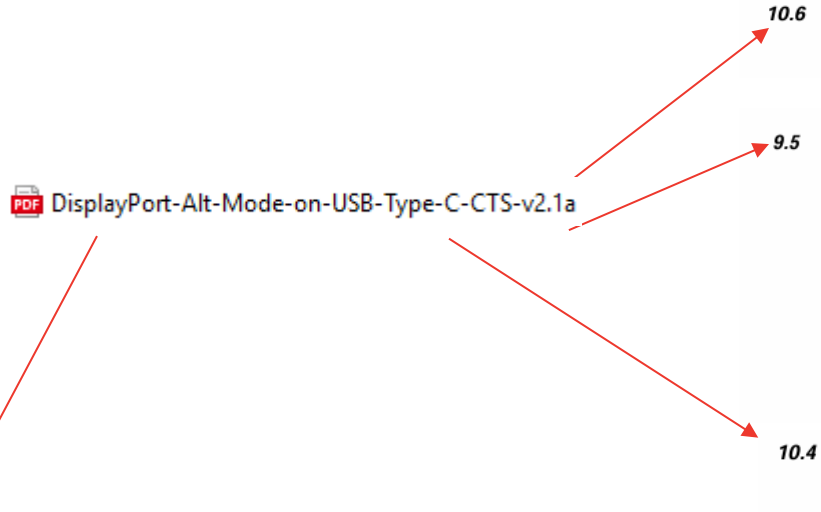
Table 4-12: DP80 Nyquist Frequencies and their ILFitAtNq Mandates (Normative)

Nyquist Frequency (GHz)	ILFitAtNq Mandate (dB)	
	DP-to-DP[a]	USB-C-to-DP[b]
15.00	> -12.0	> -12.25
10.00	> -7.50	> -8.10
6.75	> -6.00	> -6.20
5.00	> -5.25	> -5.30
2.70	> -3.75	> -3.80
0.10	> -0.75	> -1.00

a. Cable values are measured mated pair-to-mated pair.
b. Cable values are measured plug-to-mated pair.

What Is Inside VESA LRD Cable CTS? Cont' / VESA LRD线缆CTS包含哪些内容？(续)

- Additional Tests Added for USB-C to DP LRD Active Cable为USB-C转DP LRD有源线缆新增测试项
  - From DP Alt Mode 2.1 CTSa/摘自DP Alt Mode 2.1 CTSa



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CTS Testing Challenges /CTS测试挑战

- Knowledge to get DP LRD cable to work up/让DP LRD线缆正常工作**所需的知**识
  - AUX and DP_PWR Electrical setting/AUX**和**DP_PWR电气设置
    - Sink devices and Source devices/**接收端**设备和Source设备

1. Aux P: Pull down to GND
2. Aux N: Pull high to 2.89~3.6V.
3. DP_PWR:2.89~3.6V/DP_PWR：2.89~3.6V
4. Aux transaction if needed



1. Aux P: Pull high to 2.25~3.6V
2. Aux N: Pull down to GND.
3. DP_PWR:2.89~3.6V/DP_PWR：2.89~3.6V
4. HPD: Pull high to 2.25~3.6V
5. Aux transaction if needed

CTS Testing Challenges Cont' / CTS测试挑战(续)

- Knowledge to get USB-C to DP LRD cable to work up/让USB-C转DP LRD线缆正常工作**所需的知识**
  - Vconn, AUX, and DP_PWR Electrical setting/Vconn、AUX**和**DP_PWR电气设置
    - Sink devices and Source devices/**接收端**设备和Source设备

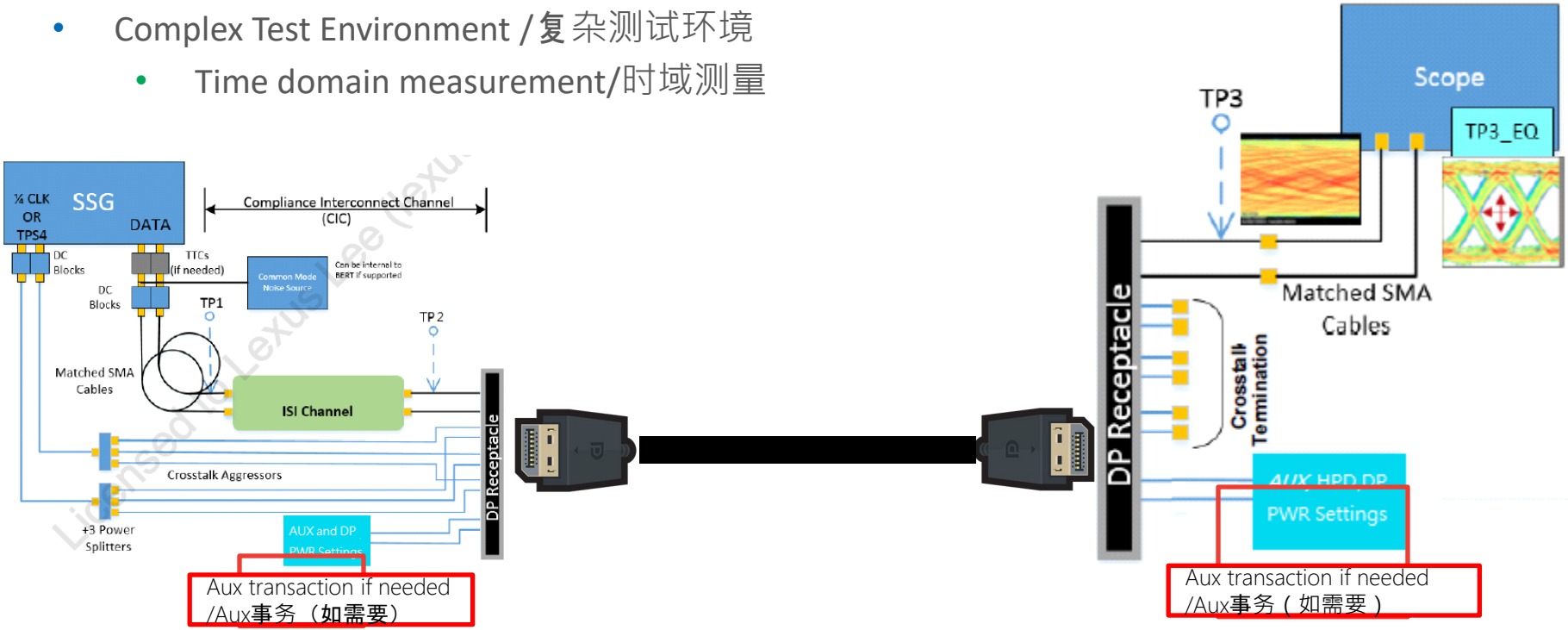
1. Vconn:3.0~5.5V/Vconn：3.0~5.5V
2. DP alt mode exerciser if needed./**如需要则使用**DP Alt Mode**激励器。**
3. Aux circuitry if needed./Aux **电路(如需要)**
4. Aux transaction if needed/Aux**事务(如需要)**



1. Aux P: Pull high to 2.25~3.6V
2. Aux N: Pull down to GND.
3. DP_PWR:2.89~3.6V/DP_PWR：2.89~3.6V
4. HPD: Pull High to 2.25~3.6V
5. Aux transaction if needed

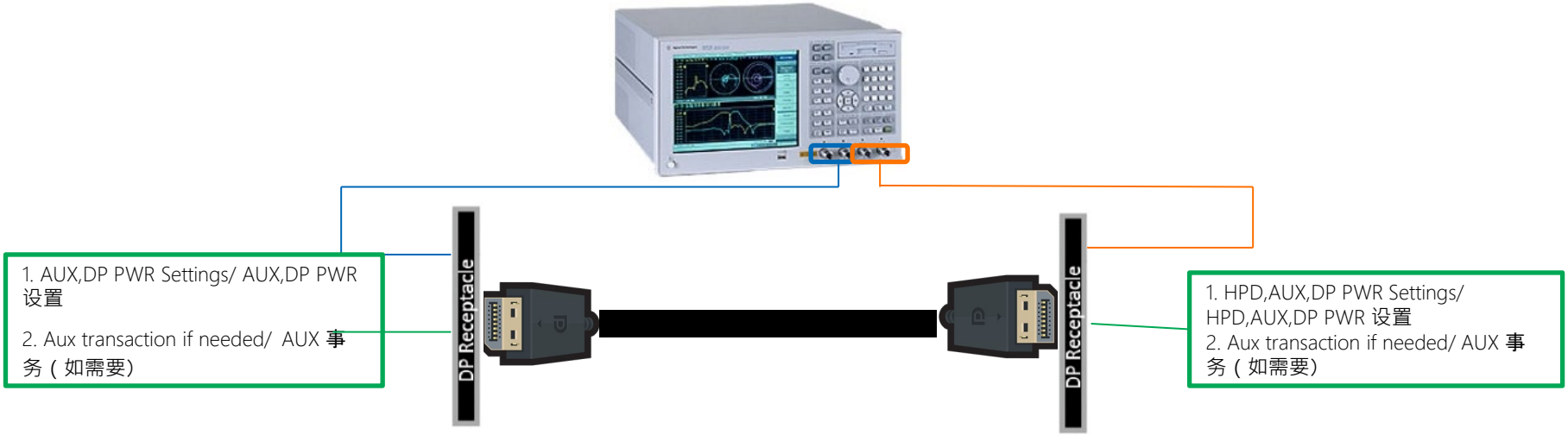
CTS Testing Challenges Cont'/ CTS测试挑战（续）

- Complex Test Environment /复杂测试环境
  - Time domain measurement/时域测量



CTS Testing Challenges Cont'/ CTS测试挑战(续)

- Complex Test Environment /复杂测试环境
  - Frequency domain measurement/频域测量



Overview/概述

- Why VESA Defines LRD Active Cable Spec/VESA为何制定LRD有源线缆规范
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- Cable Next - Active Optical Cable?/ Cable Next —有源光缆？

The Most Frequently Failed Items /最常失败的测试项

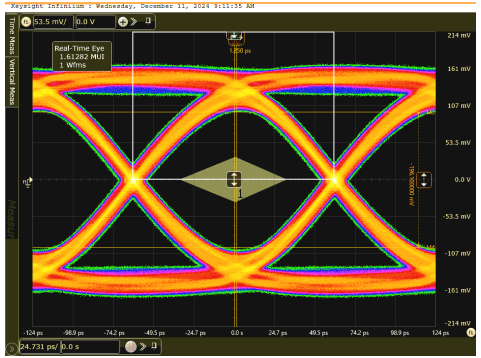
- Eye Diagram/眼图
  - UHBR20 Criteria/UHBR20标准
    - TP3_EQ-Inner Eye Height: 100mV

    /TP3_EQ-内眼高：100mV
    - TP3_EQ-Eye Width: 560mUI

    /TP3_EQ-眼宽: 560mUI
    - Cannot hit the eye mask

      /无法满足眼图模板要求

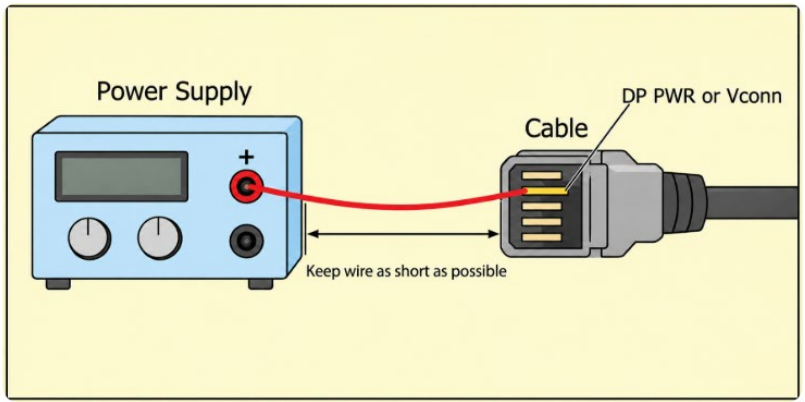
Preset Configuration #	Preshoot (dB)	De-emphasis (dB)
0	0	0
1	0	-1.9
2	0	-3.6
3	0	-5.0
4	0	-8.4
5	0.9	0
6	1.1	-1.9
7	1.4	-3.8
8	1.7	-5.8
9	2.1	-8.0
10	1.7	0
11	2.2	-2.2
12	2.5	-3.6
13	3.4	-6.7
14	3.6	0
15	1.7	-1.7



- Requirement: Need to pass with 3 TxFFE Presets and average of 5 times./要求：要在3个TxFFE Preset下通过，并取5次平均值。
- Caused by Raw cable material quality and cable vendor manufacturing capability/由线材原材料和线缆供应商制造能力导致

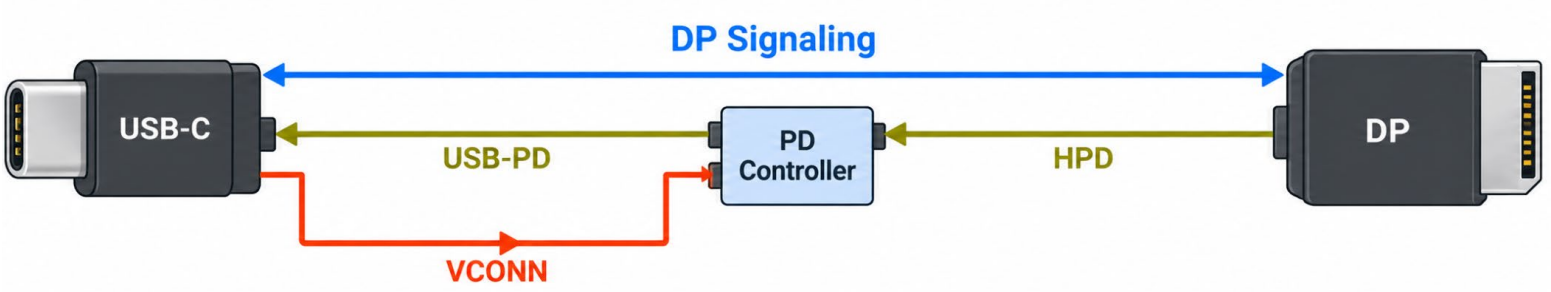
The Most Frequently Failed Items Cont' /最常失败的测试项(续)

- The Minimal Required Voltage/**最低要求**电压
  - DP PWR Range: 2.89-3.6V for DP-DP Cable/DP_PWR 电压范围：2.89–3.6V（**适用于** DP-DP 线缆）
    - Voltage Range/电压范围 : 2.89-3.6V
    - 2.89V → Failure/失败
  - Vconn Range for USB-C to DP Cable/USB-C转DP线缆的Vconn电压**范**围
    - Voltage Range/电压范围: 3.0-5.5V
    - 3.0V → Failure/失败



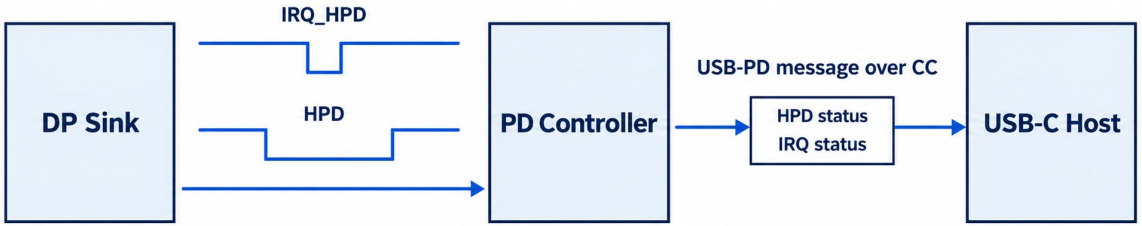
The Most Frequently Failed Items Cont' /最常失败的测试项（续）

- USB-C to DP Cable Structure/USB-C转DP线缆结构



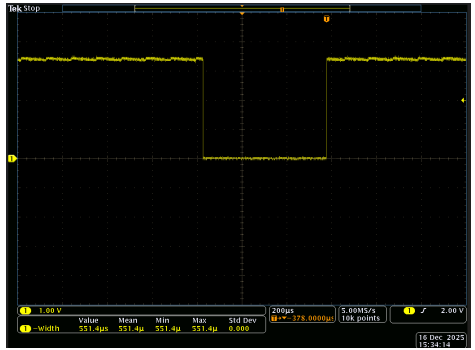
The Most Frequently Failed Items Cont' /最常失败的测试项（续）

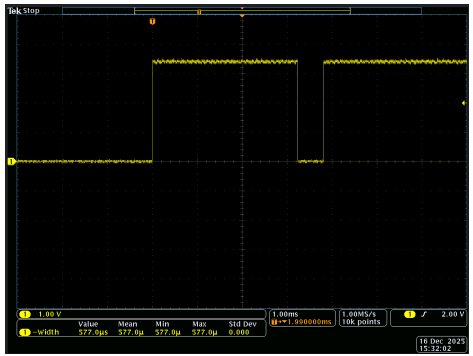
- HPD to PD Conversion/HPD到PD转换
  - Different IRQ_HPD width/不同的IRQ_HPD宽度
    - 2.05 to 2.1msec
    - 1.9 to 1.95msec
    - **2.60 to 270usec**
    - 230 to 240usec
  - Different HPD width/不同的HPD宽度
    - 5ms
    - 150ms

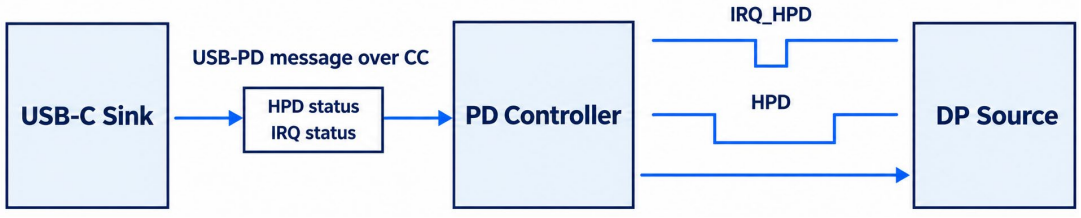


The Most Frequently Failed Items Cont' /最常失败的测试项(续)

- PD to HPD Conversion/PD到HPD转换
  - IRQ_HPD status flag is set/IRQ_HPD状态标志已置位
  - HPD_Low is set/HPD_Low已置位
    - HPD_High is set/HPD_High已置位
  - HPD_Low is set for 100ms/HPD_Low置位持续100ms
  - HPD_High and IRQ_HPD are set/HPD_High和IRQ_HPD已置位
    - In a single message/在单条报文内

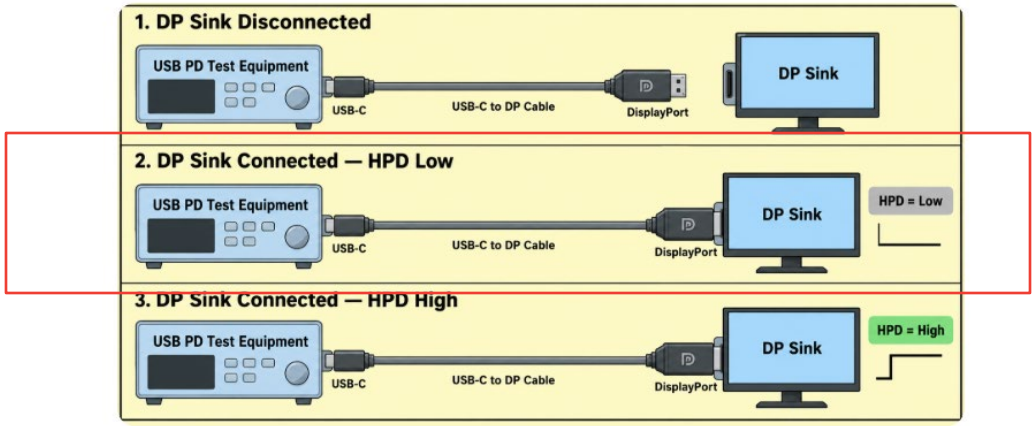






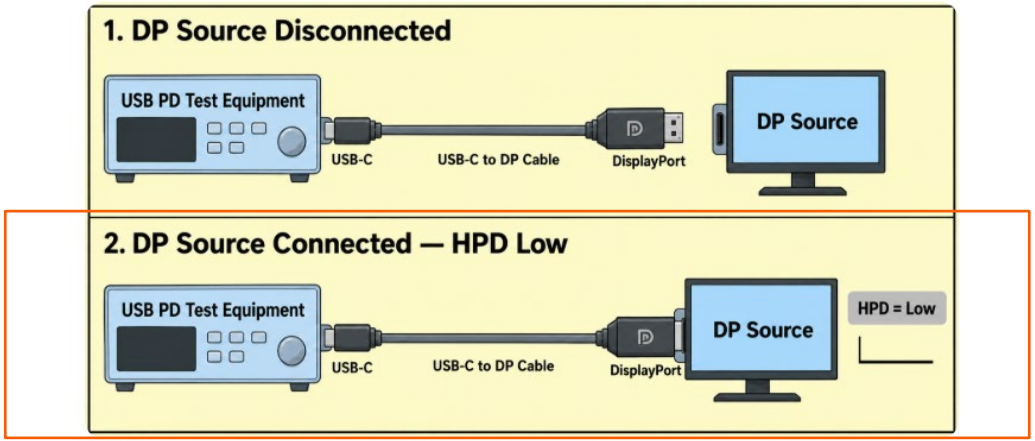
The Most Frequently Failed Items Cont'/最常失败的测试项(续)

- Attach to DP Sink/连接到DP 接收端
  - 3 test cases/3个测试用例
    - Middle one→Failure/中间一项➡失败
      - Assertion of DP Sink Disconnected/DP 接收端 断开



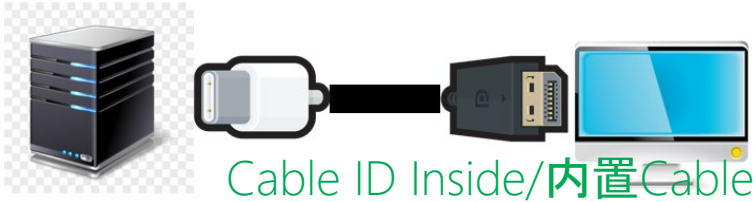
The Most Frequently Failed Items Cont' '/最常失败的测试项(续)

- Attach to DP Source/连接到DP Source
  - 2 test cases/2个测试用例
    - Buttom one→Failure/最后一项➡失败
      - Assertion of "DP Source Disconnected" when HPD is low/当 HPD 为低电平时，断言 "DP Source 已断开"



The Most Frequently Failed Items Cont' '/最常失败的测试项(续)

- Typical Application of Cable ID/Cable ID典型应用



Cable ID Inside/内置Cable ID

Rx: Read Cable ID from Cable/Rx:从线缆读取Cable ID

Tx: Read Cable ID from The Cable at USB-C end/Tx:在USB-C端从线缆读取Cable ID

Tx: Inform Rx of Cable ID at USB-C end/Tx:将USB-C端的Cable ID 告知Rx



Cable ID Inside/内置Cable ID

Rx: Read Cable ID from Cable/Rx:从线缆读取Cable ID

Tx: Read Cable ID from Rx/Tx:从Rx读取Cable ID

The Most Frequently Failed Items Cont' '/最常失败的测试项(续)

- Cable ID at USB-C Connector/ USB-C连接器处的Cable ID
  - Rely of SOP' Discover Modes /依赖SOP Discover Modes
- If UHBR20 Is Set/ 若已设置UHBR20
  - UHBR13.5 shall be set accordingly/ 则相应设置UHBR13.5

Bit(s)	Description	Values
1:0	**RESERVED**	RESERVED (always 00b).
5:2	**Signaling for Transport of DisplayPort Protocol**[b]	XXX1b = Supports all defined *DP* bit rates up to HBR3. XX1Xb = Supports *DP* bit rate UHBR10. X1XXb = Supports *DP* bit rate of UHBR20 (e.g., 0111b supports all *DP* bit rates, including UHBR10 and UHBR20). All other values are RESERVED for higher bit rates.[c]
7:6	**RESERVED**	RESERVED (always 00b).
15:8	**DP Source Device Pin Assignments Supported**	0Ch = Pin Assignments C and D are supported. 10h = *USB-C* and *DP* connector Pin Assignment E is supported. All other values are RESERVED.
23:16	**DP Sink Device Pin Assignments Supported**	0Ch = Pin Assignments C and D are supported (USB-C-to-USB-C cable). 10h = *USB-C* and *DP* connector Pin Assignment E is supported. All other values are RESERVED.
25:24	**RESERVED**	RESERVED (always 00b).
26[d]	**UHBR13.5**	0 = UHBR13.5 is not supported. 1 = UHBR13.5 is supported.[e]
27	**RESERVED**	RESERVED (always 0).
29:28[d]	**Active Component**	00b = Passive. 01b = Active re-timer. 10b = Active re-driver. 11b = Optical.
31:30	**DPAM Version**	00b = Version 2.0 or earlier. 01b = Version 2.1 or higher.

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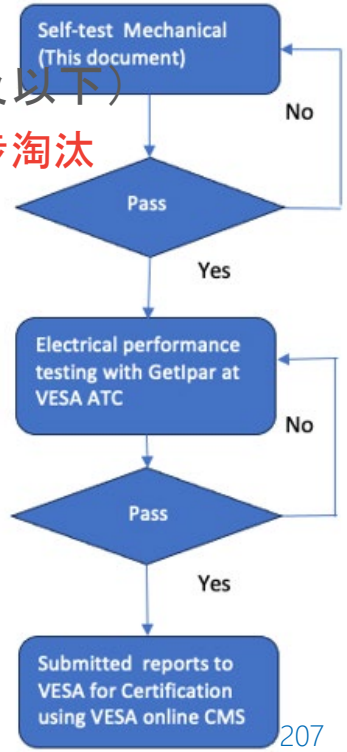
DP Connector Certification Status/DP连接器认证状态

- Connector certification/连接器认证
  - Legacy Connector(HBR2 and below)/传统连接器（HBR2及以下）
    - Has been phased out from end of 2025/自2025年底起已逐步淘汰
  - DP8K & Enhanced Connector/DP8K及增强型连接器
    - Self-test Mechanical/自检机械
    - ATC test Electrical Performance/ATC测试电气性能

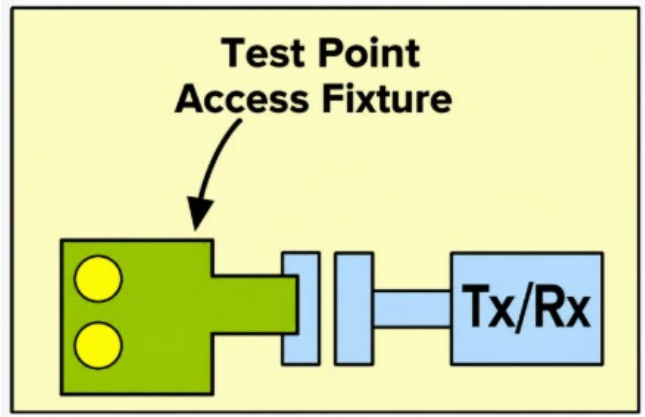


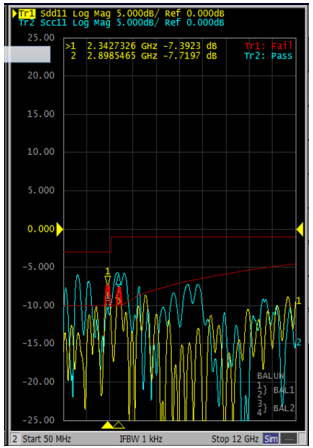
VESA® DisplayPort™ Self-Test Report for Connectors v2.1

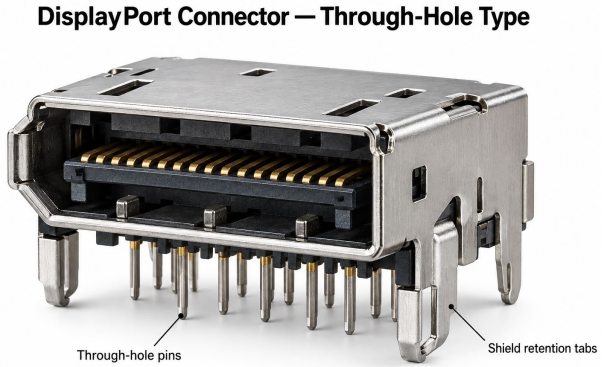
VESA® DisplayPort™ Self-Test Report for DP Connectors Supporting HBR3 Link Rate and DP8K Cables

DP Connector Certification Status Cont'
/DP连接器认证状态（续）

- Enhanced DP Connector (DIP Type)/增强型DP连接器（DIP型）
  - Possibly causing Sink/Source Return Loss test to fail/可能导致接收端/Source回波损耗测试失败
    - Even if it is a certified EnDP connector/ 即使它是已认证的 EnDP 连接器
    - Test method different between Connector and Sink/Source in CTS/CTS中连接器与接收端/Source的测试方法也不同







Overview/概述

- Why VESA Defines LRD Active Cable Standard/VESA为何制定LRD有源线缆标准
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Active Optical Cable/有源光缆

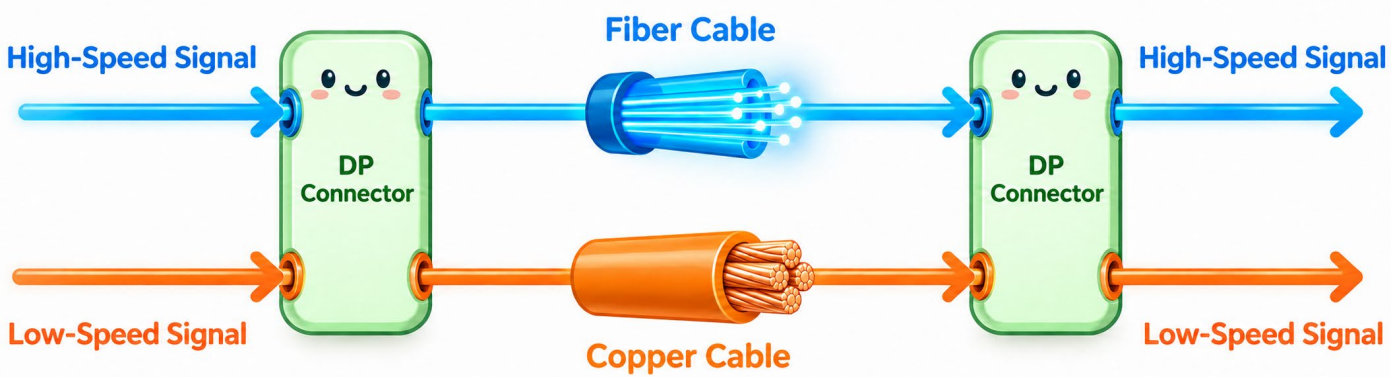
- Definition of DPCD 02217h and 00110h/DPCD 02217h和00110h的定义
  - Will add optical cable type in Bit 5:3 Cable Type field: 100b = Optical cable/将在Cable Type字段的Bit 5:3 中添加光缆类型：100b = 光缆

	5:3	**Cable Type** 000b = Cable type is unknown (default; a DPRX device with a DP receptacle connector shall keep this value). 001b = Passive cable. 010b = LRD cable. 011b = LTTPR re-timer active cable. All other values are RESERVED.

Licensed to

Active Optical Cable Cont’ /有源光缆（续）

- The Optical Cable’s Structure/有源光缆结构
  - Fiber used for Main-Link channels (High-Speed Data)/主链路信道（高速数据）采用光纤
  - Copper used for Non-Main-Link channels/非主链路信道采用铜线



Active Optical Cable Cont' /有源光缆(续)

- Allion has been verifying AOC performance/Allion一直在验证AOC性能
  - Equalization Setting on Each Lane/每条通道的均衡设置
    - USB-C to USB-C Ends/USB-C转USB-C端
      - Could be different due to the loss different definition between DP and USB specs while in Pin Assignment D Mode/在Pin Assignment D Mode下，由于DP和USB规范对损耗的定义不同，结果可能存在差异
    - USB-C to DP/mDP Ends and DP/mDP to DP/mDP Ends/USB-C转DP/mDP端和DP/mDP转DP/mDP端
      - Should be the same or be closer./应相同或更接近。
  - Creating PHY test proposal/制定PHY测试提案
    - Test items Include common items like Jitter/Eye/SSC/Skew/测试项目包括抖动/眼图/SSC/偏斜等常见项目
    - More focus on "Stressed Signal Condition" verification for TP3/TP3_EQ Eye/重点加强 TP3/TP3_EQ 眼图的"加压信号条件"验证

Thank you
感谢！

Design Considerations for USB-C® Products
USB-C®产品设计注意事项

Abel Astley
Unigraf
October 2026/2026年10月

Design Considerations for USB-C/USB-C设计注意事项



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Design Considerations for USB-C Agenda/USB-C设计注意事项议程

- **Back to Basics**: Sources, Sinks, and how they interoperate/**回归基础**：Source、接收端及其互操作方式
- **Common Mistakes** and how to avoid them/**常见错误及规避方法**
- **Factory Testing** Challenges and Solutions/**产线测试挑战与解决方案**
- **Recent Updates** to DP Alt Mode/DP Alt Mode**最新更新**

Back to Basics

Fundamental Concepts of USB-C

回归基础

USB-C基本概念

Back to Basics: Vocabulary/回归基础:术语

- From *USB Type-C® Cable and Connector Specification*, Rev 2.5 (March 2026)/摘自USB Type-C® 线缆与连接器规范, Rev 2.5（2026年3月）

Source	Port asserting ***Rp*** on CC and when attached is providing power over VBUS; most commonly a Host or Hub DFP.

Sink	Port asserting ***Rd*** on CC and when attached is consuming power from VBUS; most commonly a Device.

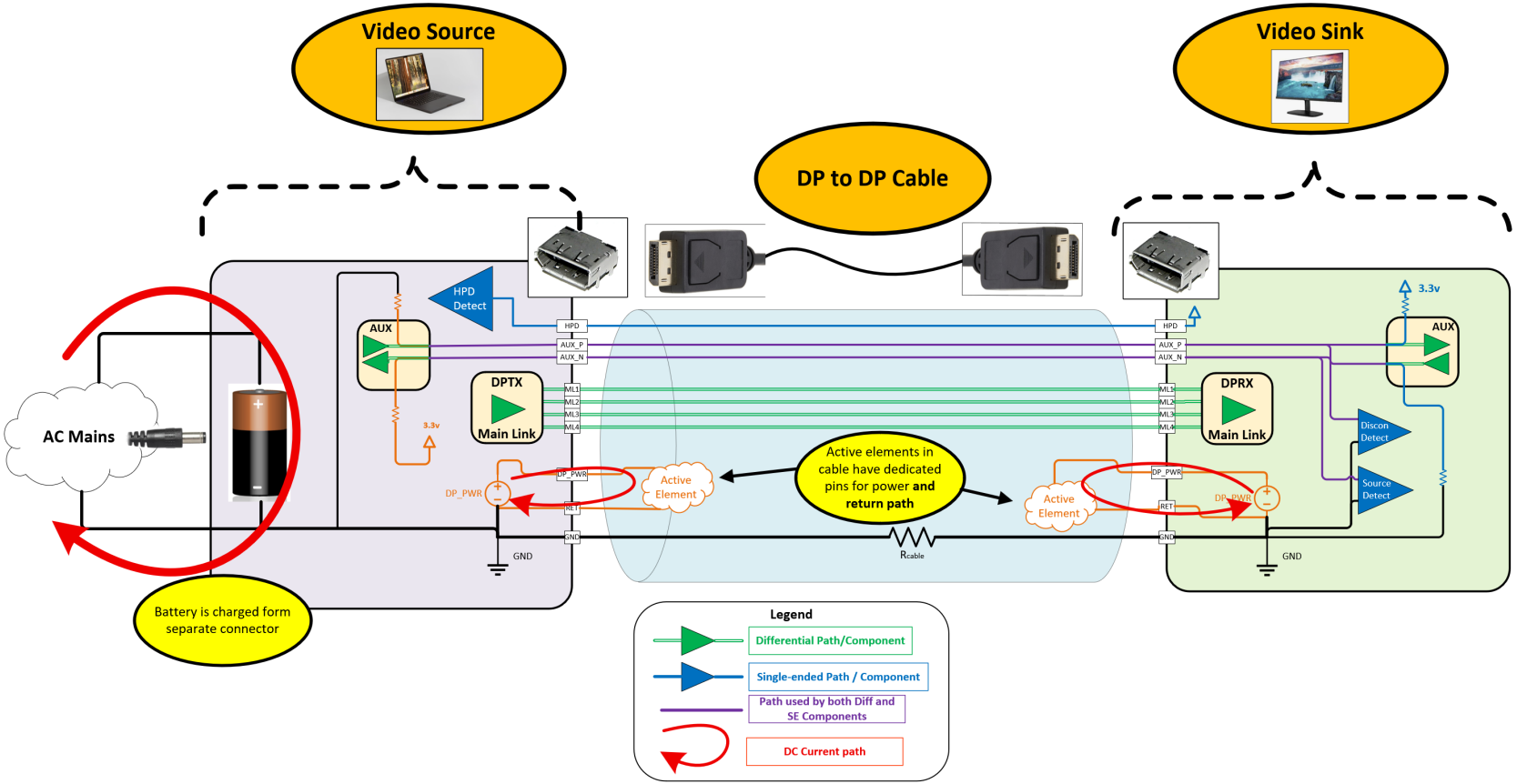
- In USB Speak, ***Source*** and ***Sink*** refer to a device's ***power role***, not its video role/ 在 USB 术语中，***Source*** 和 ***Sink(接收端)*** 指的是设备的***电源角色***，而不是其视频角色
- Where possible, this presentation will explicitly state which role is being referenced/本文稿将尽可能明确说明所指的是哪一种角色

Common Mistakes
The Impact of Ground Current
常见错误
接地电流的影响

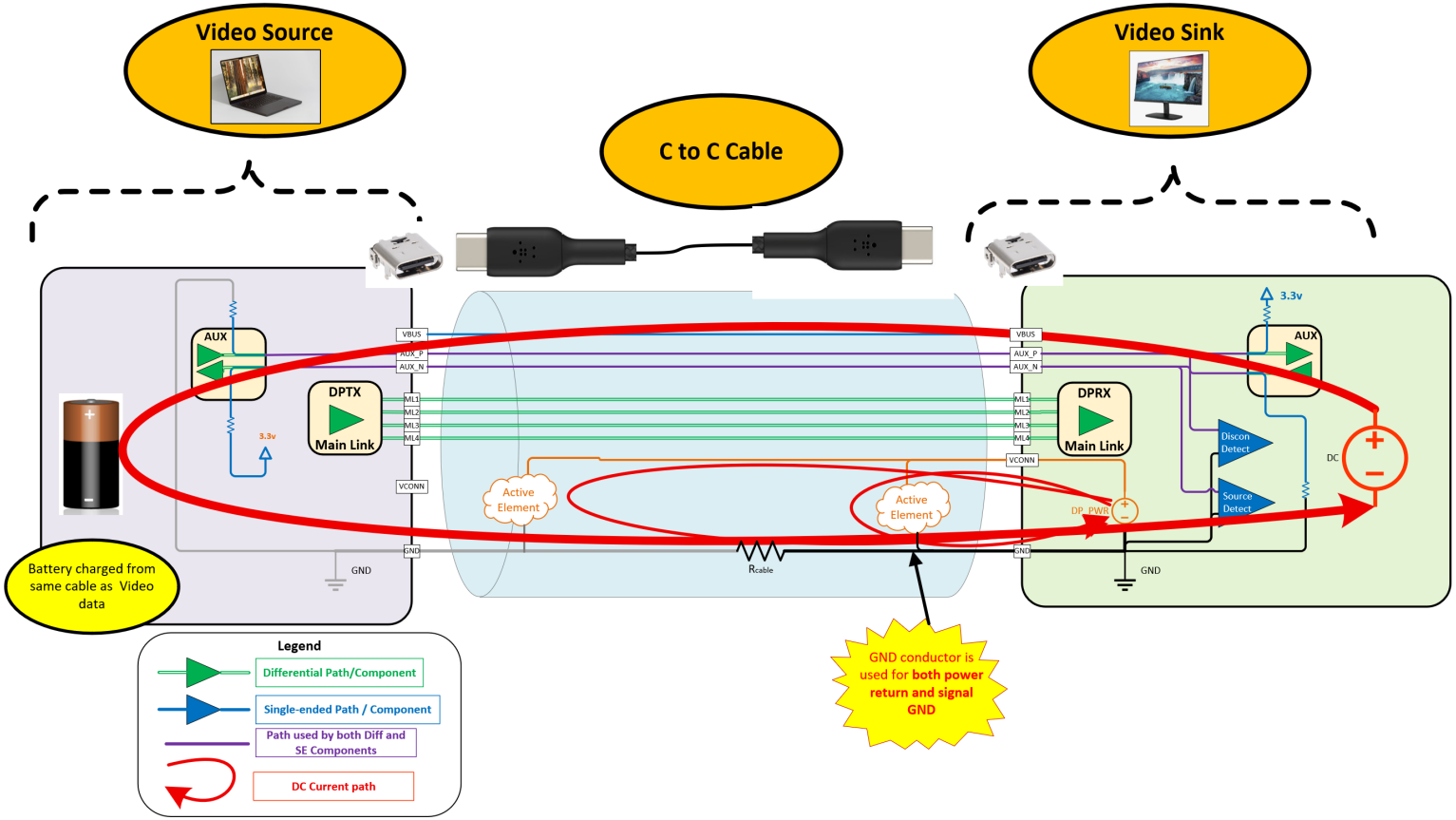
Ground Current/接地电流

- ***Ground current*** refers to current flowing through the cable GND conductors/**接地**电流**是指流**经电缆**接地**导体（GND）**的**电流
- For Native DP, this current should be close to zero/对于原生DP，该电流应接近**于零**
- For USB-C, ***ground current*** can be **5 amps** in either direction, and can **change dynamically**/对于USB-C，**接地**电流在任一方向**上可达到5安培，并且可以动态变化**

Native DP Link/原生DP链路

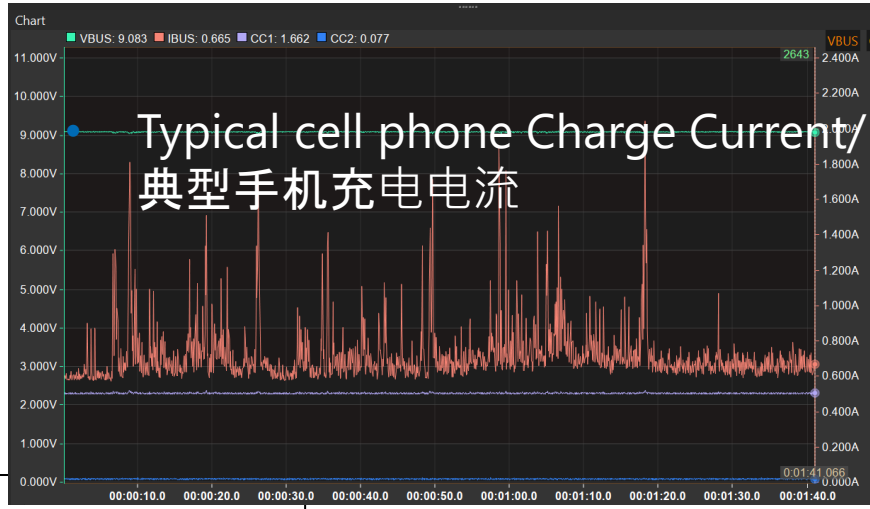


USB-C Link/USB-C链路



Notes on Ground Current/接地电流说明

- Bad/old cable will increase effect/劣质或老化的电缆会加剧这一影响
- Usually can't fix in fw/通常无法在固件（fw）中修复
- From *Universal Serial Bus Power Delivery Specification*, Release 3.2, Version 1.2, May 20, 2026:/摘自Universal Serial Bus Power Delivery Specification, Release 3.2, Version 1.2, 2026年5月20日



Typical cell phone Charge Current/典型手机充电电流

Table 4.7. Sink Electrical Parameters

Parameter Name	Min Value	Nom Value	Max Value	Unit	Description
cSnkBulk			See [USB3]		Sink bulk capacitance on VBUS at Attach and during FRS after the Initial Source stops sourcing and prior to establishing the First Explicit Contract.
cSnkBulkPd			100	µF	Bulk Capacitance that a Sink is allowed to present on VBUS after a successful Negotiation.
iLoadReleaseRate	-150			mA/ µs	Load release di/dt.
iLoadStepRate			150	mA/ µs	Load step di/dt.
iPpsCLLoadStep	-500		500	mA	Maximum Current set-point change while operating in CL Mode.

Common Mistakes

Time from plug-in to display light-up

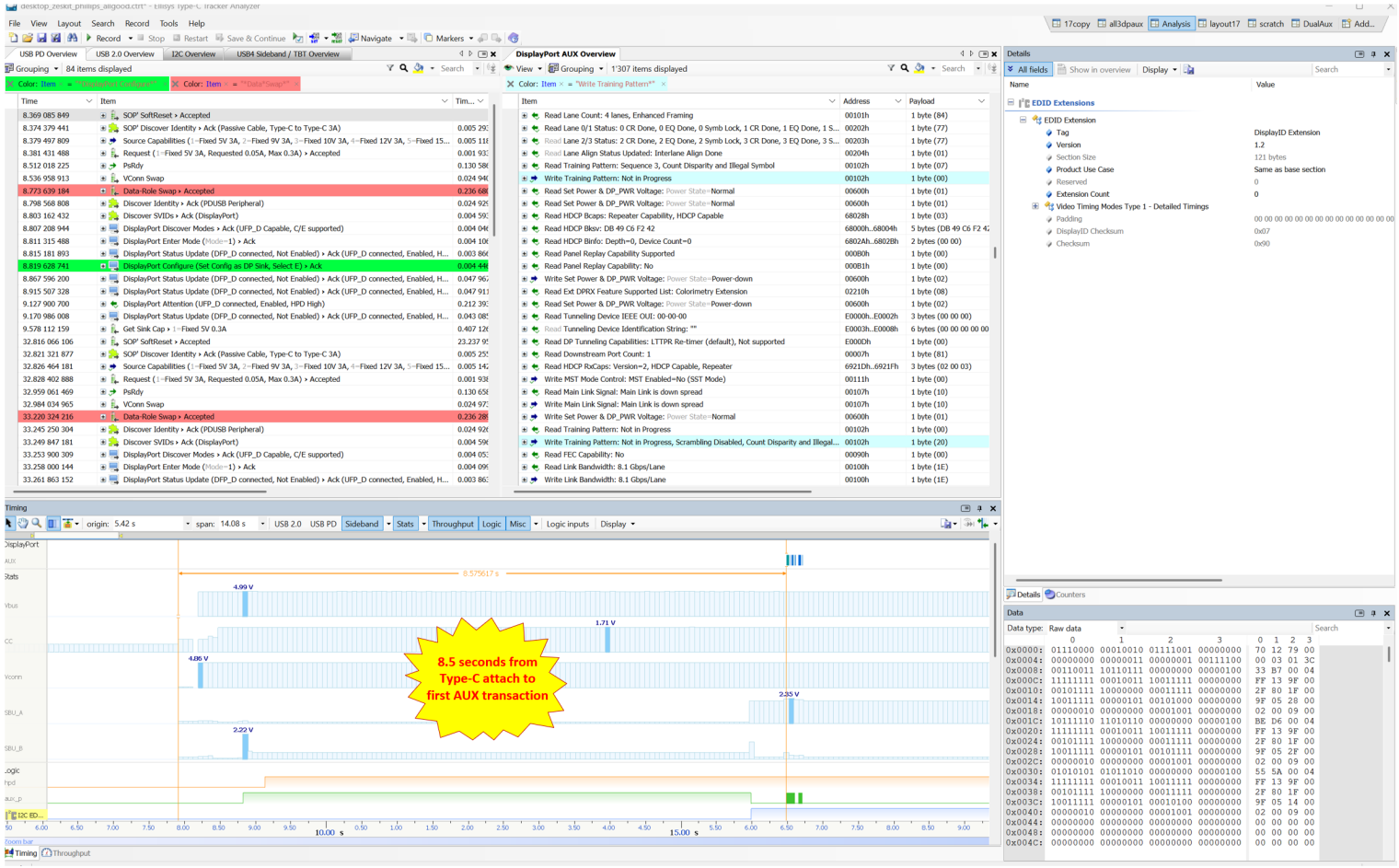
常见错误

从插入到显示屏点亮的时间

Time from plug-in to Display “light-up”/从插入到屏幕点亮的时间

- USB-C and DP Subsystems are typically developed by independent engineering teams/USB-C和DP子系统通常由独立的工程团队开发
- This sometimes leads to sub-optimal interactions between the two/这有时会导致两者之间交互不够理想
- This can be noticed in certain DP Alt Mode scenarios, in which the display takes several seconds to light up after cable plug-in/这可以在某些DP Alt Mode场景中观察到，在这些场景下，插入线缆后显示屏需要数秒才能点亮

Time from plug-in to Display “light-up” /从插入到屏幕点亮的时间



Factory Testing

Considerations for improving accuracy in production line test environments

工厂测试

关于提高生产线测试环境准确性的考量因素

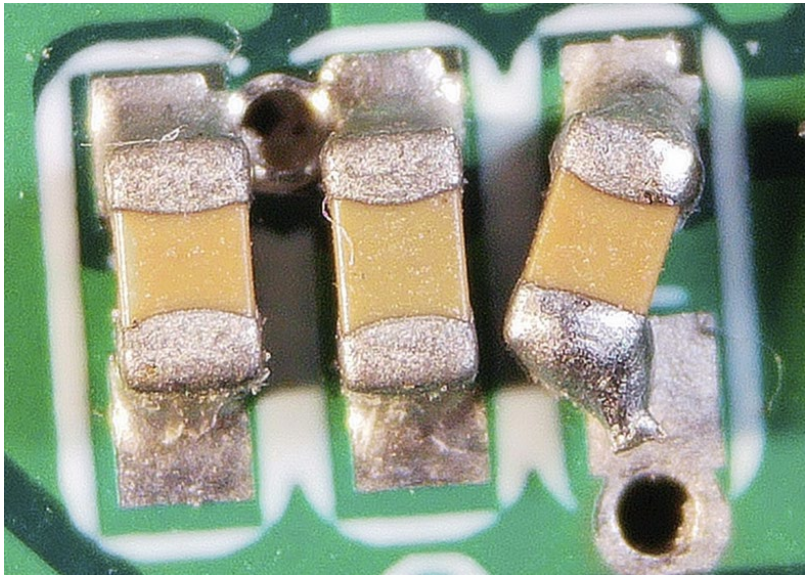
Factory Testing: Definitions/工厂测试：定义

False Pass: when a defective product erroneously passes (even though it should have failed)/误判合格：指有缺陷的产品被错误地判定为通过测试（尽管本应被判为失败）

DPPM: Defective Parts Per Million/DPPM：百万分之不良率

Factory Testing Basics/工厂测试基础

- Purpose: Detect manufacturing defects, such as **cold solder joint** or **misaligned component**/目的：检测制造缺陷， 如**冷焊点**或**元件错位**



Factory Testing: Why it matters/工厂测试：为何重要

2022 RECALL

HYPER

Stackable GaN USB-C Chargers



65W / 100W

OVERHEATING

Product design issue identified
Potential fire hazard
Approx. three confirmed incidents

Design and thermal risks can trigger a market recall.

Ref : https://reurl.cc/k9gGYn

OCT 2024 RECALL

ANKER

Portable Charging Power Banks



≈ 2,100 units

FIRE & BURN HAZARD

Lithium-ion batteries could overheat
28 reported incidents
Two reported burn injuries

Charging products require robust safety validation.

Ref : https://reurl.cc/dOAKjy

NOV 2023 RECALL

BELKIN

BoostCharge Pro Power Bank 10K



≈ 83,500 units

FIRE HAZARD

Lithium-ion battery could overheat
One reported product fire
House fire with property damage

A field failure can affect safety and customer trust.

Ref : https://reurl.cc/dOAKkg

A product recall can cost far more than investing in proper validation.

Factory Testing Basics/工厂测试基础

- For USB-C connector testing, it is critical that **all pins are connected**, and **none of them are shorted/**对于USB-C连接器测试而言，关键是要确保**所有引脚均连接良好，且没有任何引脚发生短路**

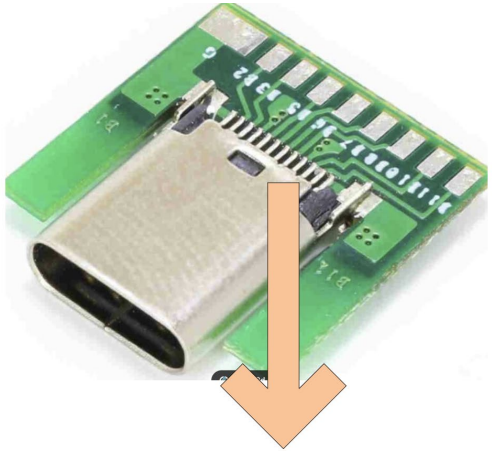
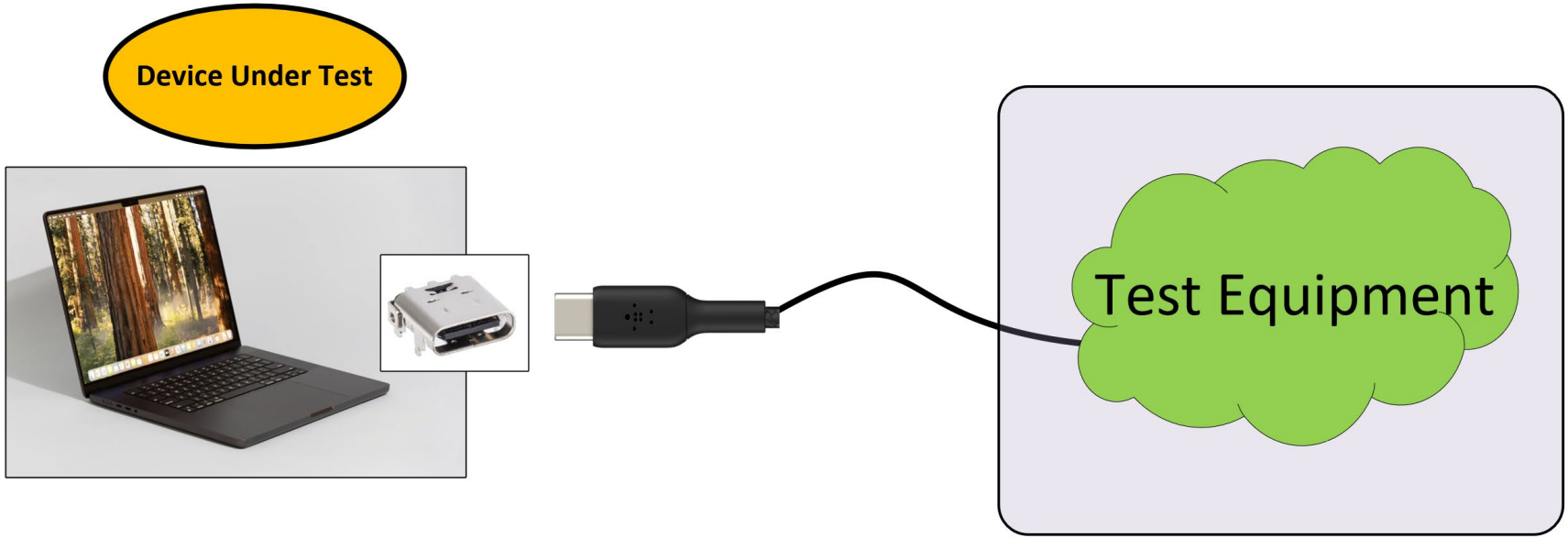


Figure 2-1 USB Type-C Receptacle Interface (Front View)

A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
GND	TX1+	TX1−	VBUS	CC1	D+	D−	SBU1	VBUS	RX2−	RX2+	GND
GND	RX1+	RX1−	VBUS	SBU2	D−	D+	CC2	VBUS	TX2−	TX2+	GND
B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1

Factory Test Setup/工厂测试设置



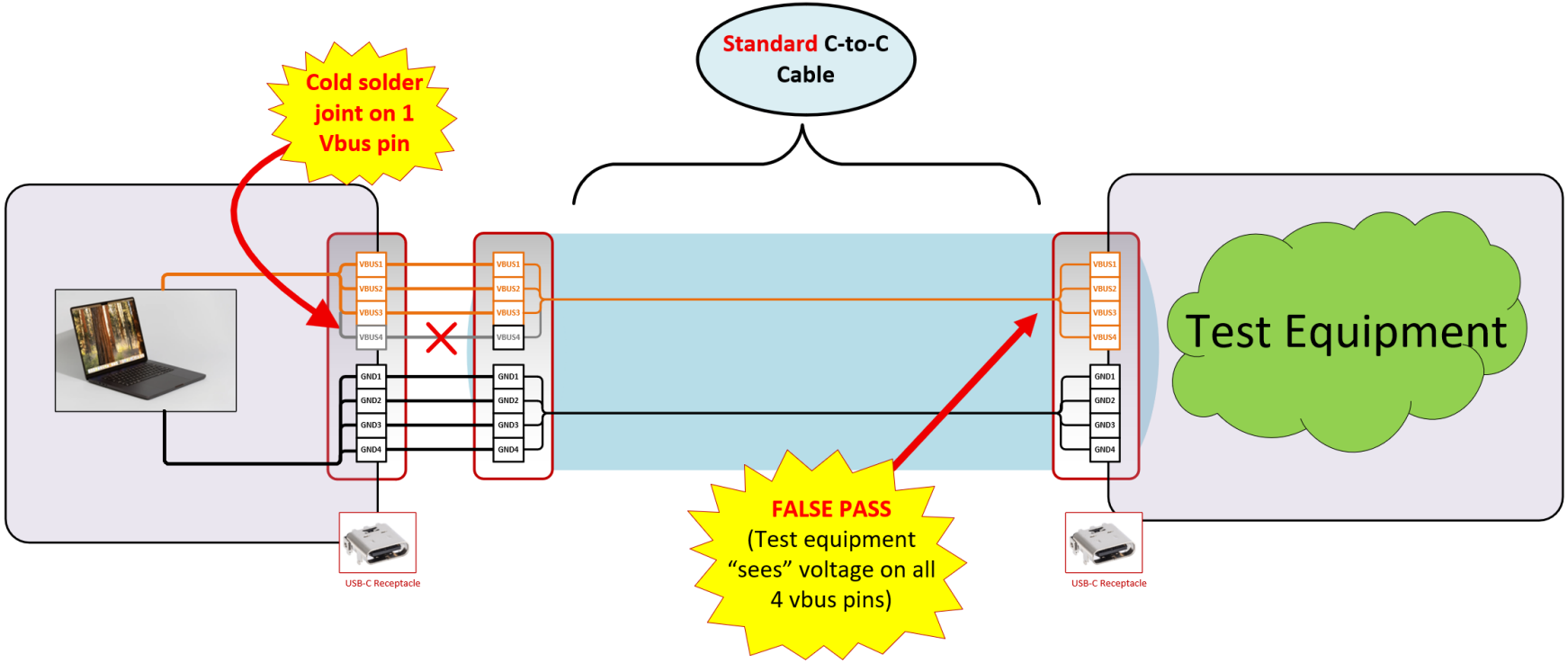
Factory Test Example: Defect on Vbus/工厂测试示例：Vbus上的缺陷

- Question: What happens if one (and only one) of the VBUS pins is not making proper contact?/问题：如果VBUS引脚中有一个（且仅有一个）接触不良会怎样？

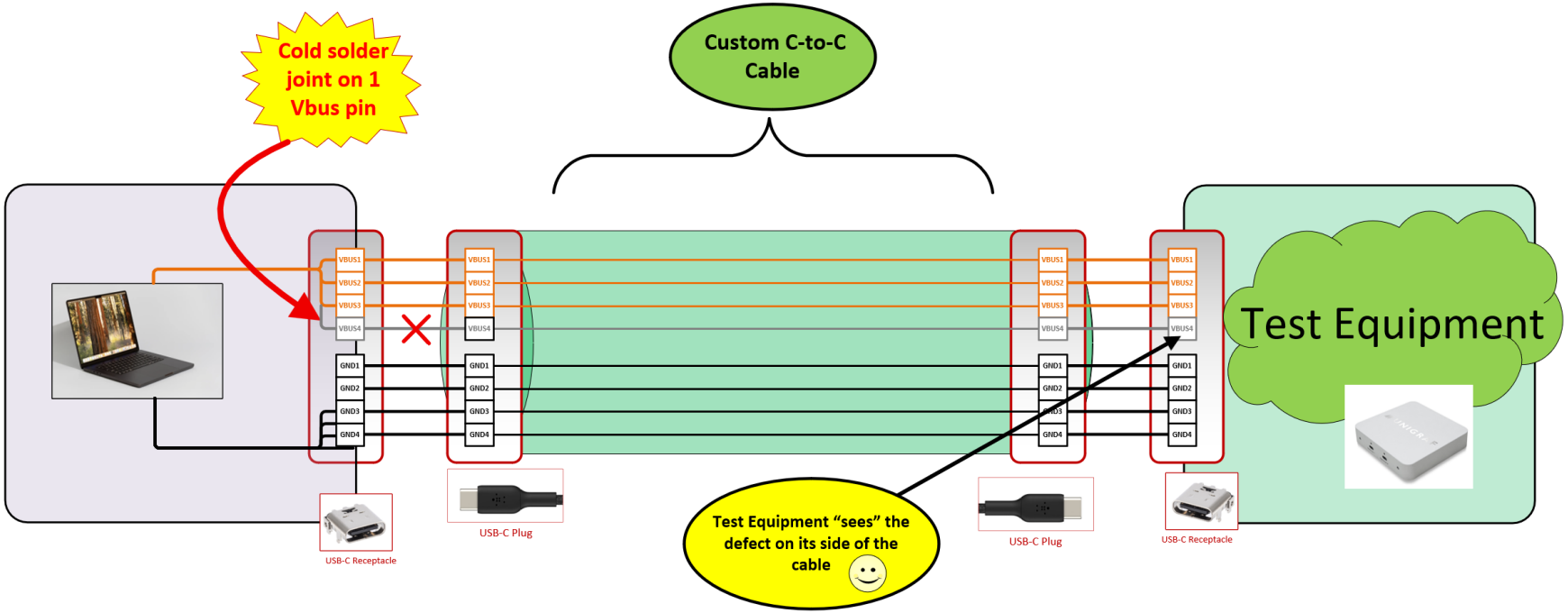
Figure 2-1 USB Type-C Receptacle Interface (Front View)

A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
GND	TX1+	TX1−	VBUS	CC1	D+	D−	SBU1	VBUS	RX2−	RX2+	GND
GND	RX1+	RX1−	VBUS	SBU2	D−	D+	CC2	VBUS	TX2−	TX2+	GND
B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1

Factory Test Example: Defect on Vbus/工厂测试示例：Vbus上的缺陷



Factory Test Example: Defect on Vbus/工厂测试示例：Vbus上的缺陷



Factory Test Example: Defect on Vbus/工厂测试示例：Vbus上的缺陷

Takeaway/要点:

To detect a **single-pin defect** on ***Vbus*** or ***GND***, the test equipment must have **independent visibility** of all 8 of these pins (4 vbus and 4 gnd)./要检测***Vbus***或***GND***上的**单引脚缺陷**，测试设备必须能够**独立监测**全部8个引脚（4个vbus和4个gnd）。

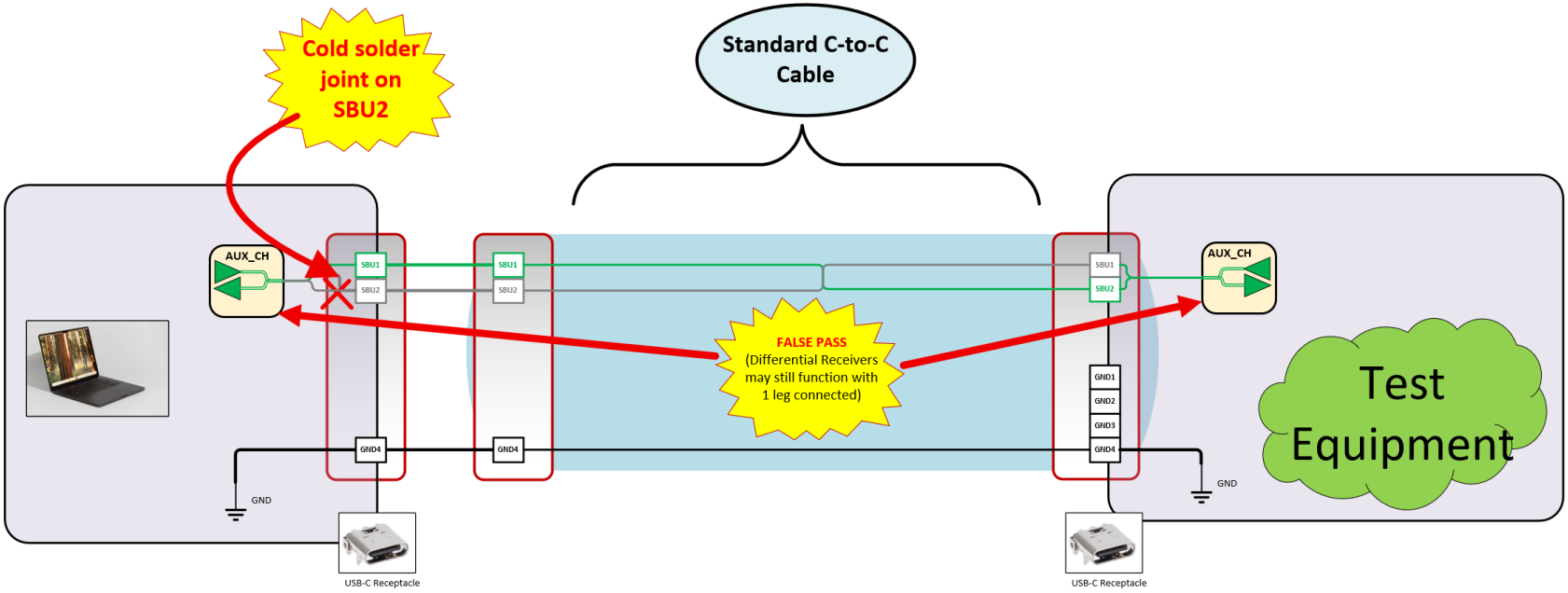
Factory Test Example: Defect on SBU/工厂测试示例：SBU上的缺陷

- Question: What happens if one (and only one) of the **SBU** pins is not making proper contact?/问题：如果SBU引脚中有一个（且仅有一个）接触不良会怎样？

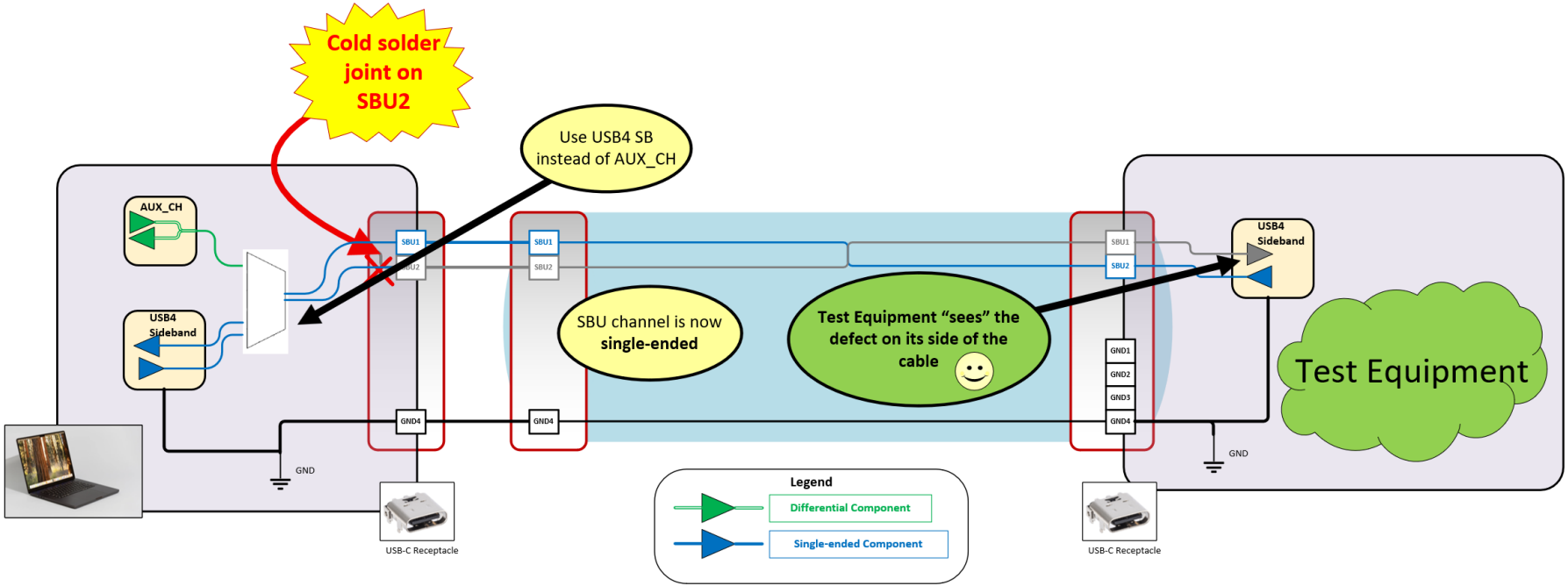
Figure 2-1 USB Type-C Receptacle Interface (Front View)

A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
GND	TX1+	TX1−	VBUS	CC1	D+	D−	SBU1	VBUS	RX2−	RX2+	GND
GND	RX1+	RX1−	VBUS	SBU2	D−	D+	CC2	VBUS	TX2−	TX2+	GND
B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1

Factory Test Example: Defect on SBU/工厂测试示例:SBU上的缺陷



Factory Test Example: Defect on SBU/工厂测试示例:SBU上的缺陷



Factory Test Example: Defect on SBU/工厂测试示例：SBU上的缺陷

Takeaway/要点:

The most reliable way to detect **single-pin defects** on ***SBU*** is to configure these pins for a **single-ended application** (for example, USB4)/检测***SBU*****单引脚缺陷**最可靠的方法是将这些引脚配置为**单端应用模式**（例如USB4）

Factory Test/工厂测试

- Question: What about the other pins??/问题：其他引脚呢？？

Figure 2-1 USB Type-C Receptacle Interface (Front View)

A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
GND	TX1+	TX1−	VBUS	CC1	D+	D−	SBU1	VBUS	RX2−	RX2+	GND
GND	RX1+	RX1−	VBUS	SBU2	D−	D+	CC2	VBUS	TX2−	TX2+	GND
B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1

Factory Testing: Unigraf UTC-274/工厂测试：Unigraf UTC-274

- ✓ **Purpose-built** for production environments/**专为**生产环境打造
- ✓ Reliably detects **single-pin defects** on **all 24** USB-C pins/**可**靠检测**全部24个**USB-C引脚**上的单引脚缺陷**
- ✓ Cost-effective for **large-scale deployments**/对于**大规模部署具有成本效益**
- ✓ Automatable/**可**实现**自**动化



Recent Changes

Noteworthy updates to *USB PD* and *DisplayPort Alternate Mode* Specifications

近期变更

USB PD与DisplayPort Alternate Mode规范要点更新

DPAM Suspend/ DPAM挂起

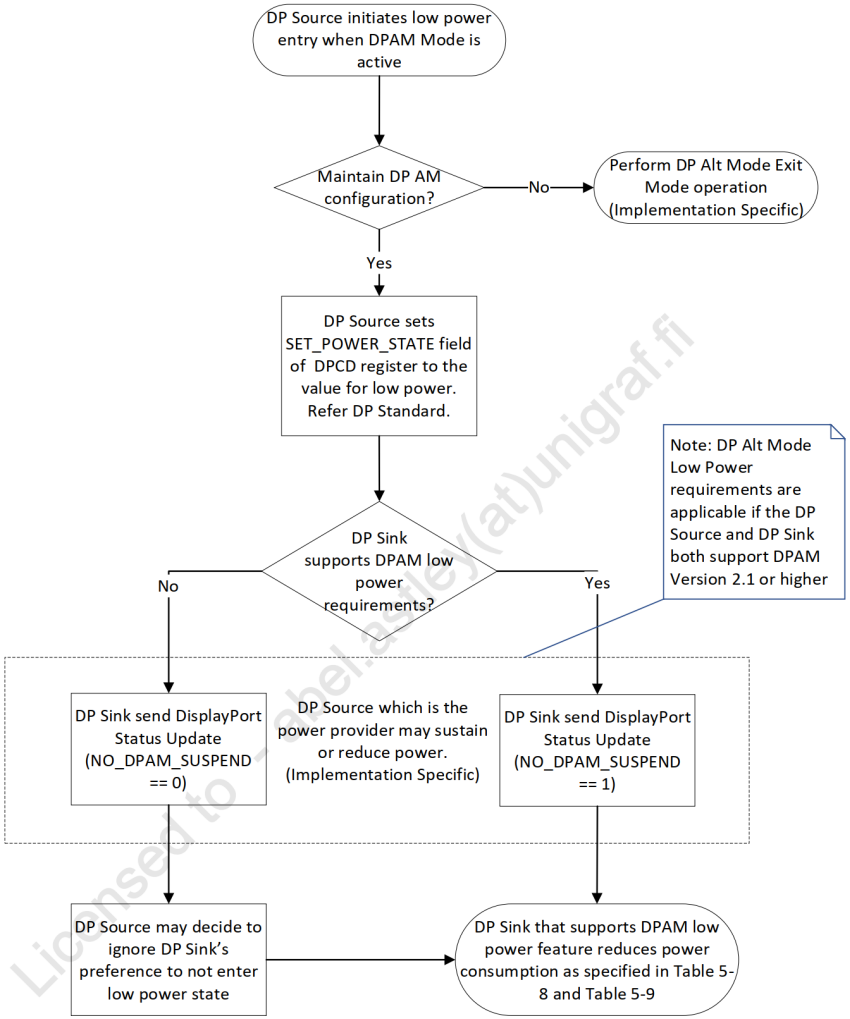


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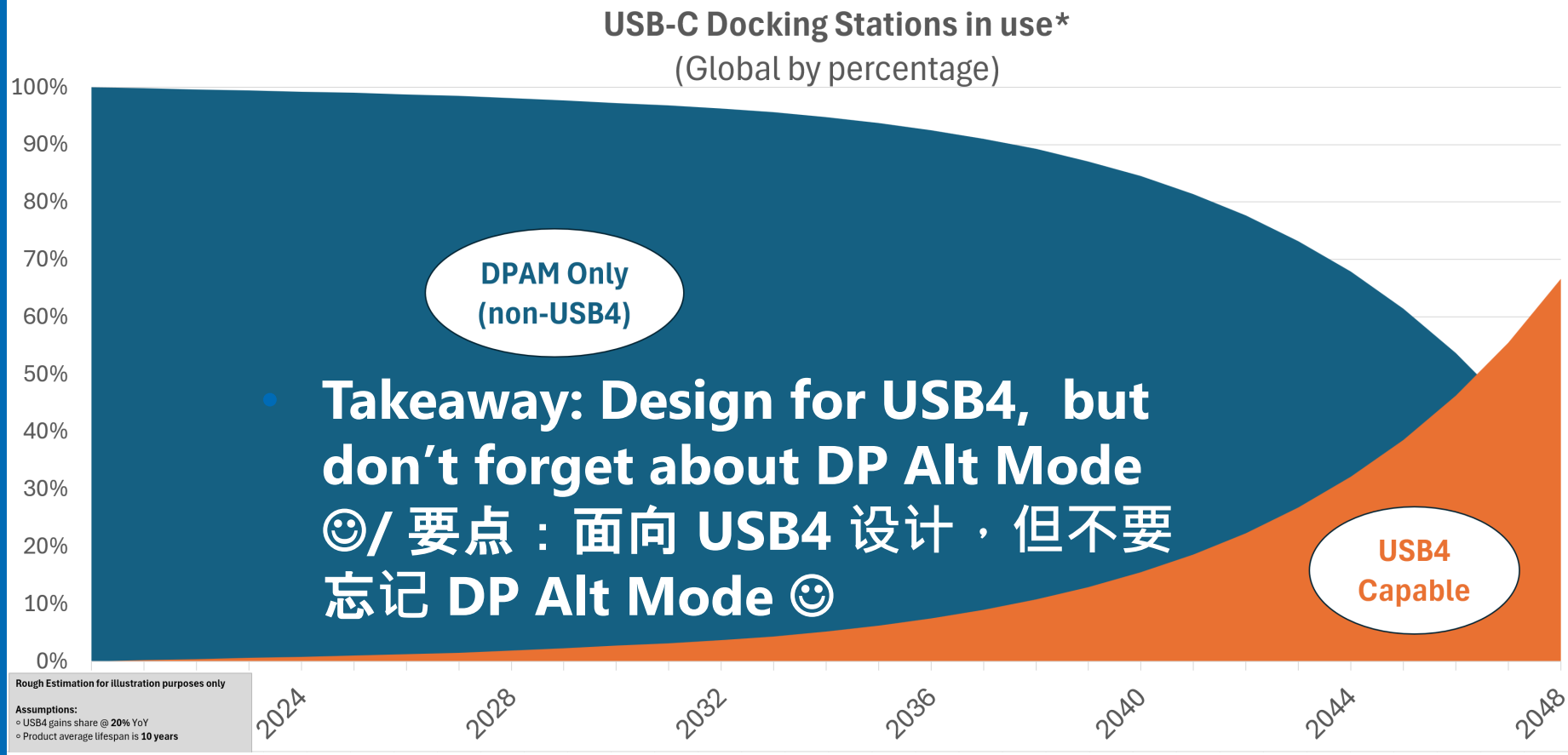
Figure 6-1: High-level example DP Alt Mode low power flow with a bus powered UFP_U/DP Sink

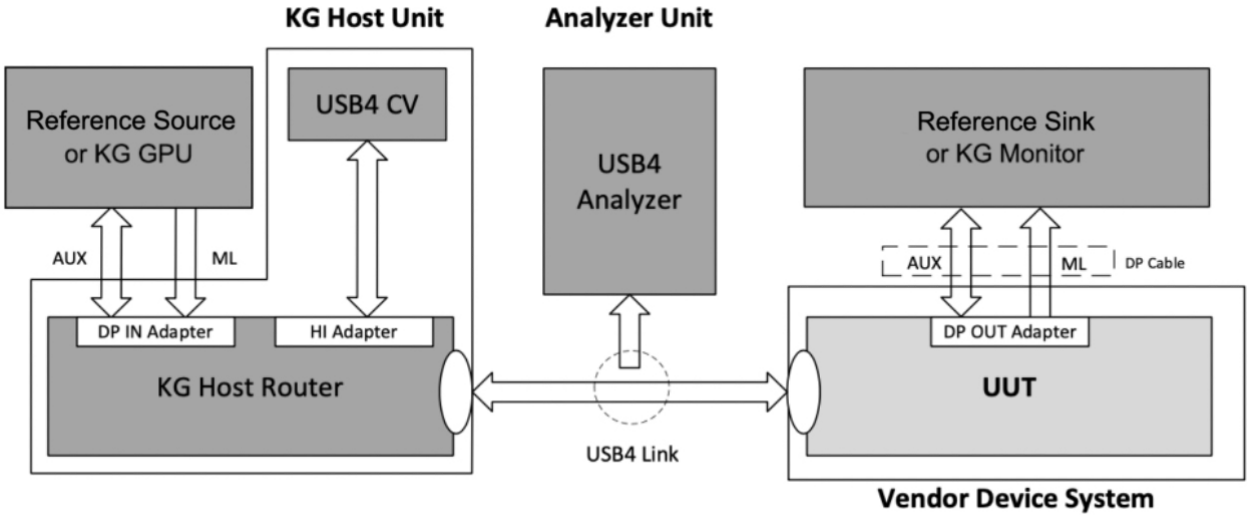
USB4



- **Takeaway: Design for USB4，but don’t forget about DP Alt Mode ☺/ 要点：面向 USB4 设计，但不要忘记 DP Alt Mode ☺**

USB4 Testing/USB4测试

- From *USB4 DP Tunneling CTS Rev 2.6/摘自USB4 DP Tunneling CTS Rev 2.6*



UCD-500 Gen 3

16K DP 2.1b Generator & Analyzer/16K DP 2.1b信号发生器和分析仪

- DP 2.1b Sinks and Sources up to 8K@60Hz/DP 2.1b 接收端（Sink）和发送端（Source）最高支持 8K@60Hz (16K@60Hz with DSC up to UHBR 20 Bit Rate)/在使用 DSC、最高 UHBR 20 比特率时可达 16K@60Hz
- Supports DP and USB-C connectors/支持DP和USB-C连接器
- GPIO interface for external control/用于外部控制的GPIO接口
- New fan cooler and chassis design/新型风扇散热和机箱设计
- Adaptive Sync, DSC, FEC and LTTPR support/支持Adaptive Sync、DSC、FEC和LTTPR
- DP 2.1b and DP 1.4a Link Layer CTS Tool including DSC, LTTPR,/支持DP 2.1b和DP 1.4a链路层CTS测试工具，包括DSC、LTTPR、

  DisplayID/EDID and Adaptive-Sync/DisplayID/EDID和Adaptive-Sync
- MST (up to 4 streams) with MST CTS Source and Branch DUT/MST（最多4路流）， 支持MST CTS Source和 Branch DUT

  (full test set for Branch scheduled release in 4Q 2026)/（Branch完整测试集计划于2026年第四季度发布）
- HDCP 2.3 Compliance Test Device for Transmitters, Receivers and Repeaters/用于发送端、接收端和中继器的HDCP 2.3合规测试设备
- Color depth 6 to 16bpc/色深6至16bpc
- Capture memory 16GB/捕获内存16GB
- Now featuring Link Analyzer (monitor), *Panel Replay and eDP 1.5 test functions (eDP 2.0 scheduled release in 4Q 2026)/现新增链路分析仪（监视器）、*Panel Replay和eDP 1.5测试功能（eDP 2.0计划于2026年第四季度发布）

*Demo video on Youtube/*YouTube演示视频



DP 2.1 LL CTS

HDCP 2.3 CTS











Summary
总结

Summary/总结

- Factory testing mistakes are costly; don't skimp on test engineering development or equipment
  工厂测试中出现的失误代价高昂；切勿在测试工程的开发或设备上节省投入。
- For questions on USB-C product design or testing, don't hesitate to reach out to us at www.unigraf.fi
  如有关于USB-C 产品设计或测试的问题，欢迎随时通过 www.unigraf.fi 联系我们。

QA
问答环节

Compliance Testing
合规测试

VESA PlugTest Events/ VESA PlugTest活动

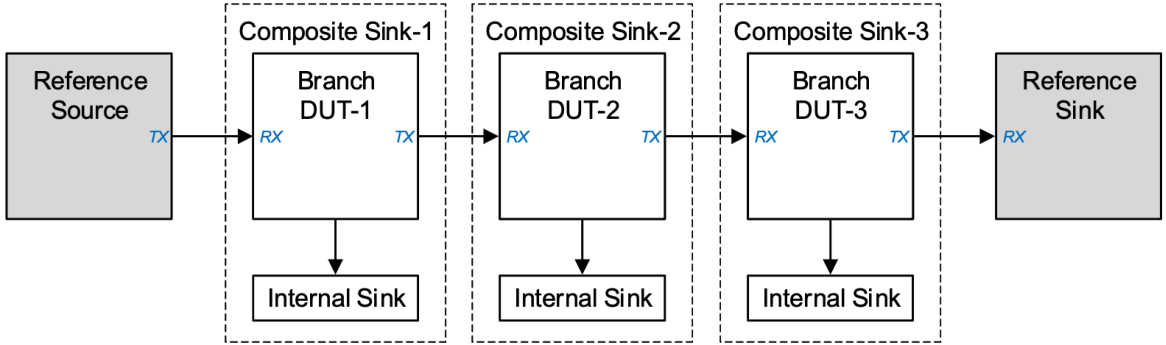
- Provide significant value to VESA compliance program and member companies, particularly as new capabilities and products are deployed./为VESA合规项目和成员公司带来显著价值，尤其是在新功能和新产品部署之际。
- Demonstrate and improve traditional interoperability/展示并提升传统互操作性
- Test Native DP and DP Alt Mode over USB Type-C™ products/测试原生DP以及在USB Type-C™产品上测试DP Alt Mode
  - UHBR rates, DSC, New MST Link Layer Tests, FEC, DisplayHDR and other new capabilities/UHBR速率、DSC、新MST链路层测试、FEC、DisplayHDR及其他新功能
  - Verify Test Equipment Correlation/验证测试设备相关性
- VESA hosted two successful PlugTests in 2025 (Taiwan and US)/VESA于2025年成功举办了两场PlugTest活动（台湾和美国）
- VESA hosts two PlugTests in 2026/VESA于2026年举办两场PlugTest活动
  - Honolulu, Hawaii USA: **May 2026 (completed)/**美国夏威夷檀香山：**2026年5月（已完成）**
  - Taipei, Taiwan: **October 19-23, 2026 (next week)/**台湾台北：**2026年10月19-23日（下周）**

Multi-Stream Transport (MST) Compliance Testing Enhancements/多流传输(MST)合规测试增强

- After over a year of specification and test equipment test development VESA is preparing to release its biggest MST test update since DP 1.2. With the introduction of UHBR20 + DSC, users can now daisy chain multiple 4K/120Hz displays from a single output connector/经过一年多的规范制定和测试设备开发，VESA正准备发布自DP 1.2以来最大规模的MST测试更新。随着UHBR20 + DSC的引入，用户现在可以通过单个输出接口菊花链方式连接多台4K/120Hz显示器

- The unique DP capability of driving multiple daisy chained displays with a single output connection/cable is increasingly the most popular feature of DP for end users/通过单个输出接口/线缆驱动多台菊花链显示器这一DP独特功能，正日益成为终端用户眼中DP最受欢迎的特性

- To further improve end user experience with MST configurations, VESA's latest DP Link Layer Compliance Test Specification adds dozens of new MST source/sink tests to verify products are implemented according to DP specifications/为进一步提升终端用户在MST配置下的使用体验，VESA最新的DP链路层合规性测试规范新增了数十项MST源端/接收端测试，以验证产品是否按照DP规范实现。



DP 2.1a LL CTS Composite Sink (Daisy-chainable Sink) Setup 3
DP 2.1a LL CTS 复合接收端(菊花链接收端)配置 3

DP54, DP80 and DP80LL Cable Specifications and Certification program/DP54、DP80和DP80LL线缆规范及认证项目

- Work on Enhanced DP cable and connector specifications and test requirements started in 2021 to ensure high performance connectors and cables would be available for products supporting UHBR rates/增强型DP线缆和连接器规范及测试要求的工作始于2021年，以确保支持UHBR速率的产品能够获得高性能的连接器和线缆
- DP54 and DP80 Certified cables provide added assurance of proper operation at the highest link rates (UHBR10, UHBR13.5 and UHBR20 Gbps)./DP54和DP80认证线缆为在最高链路速率（UHBR10、UHBR13.5和UHBR20 Gbps）下的正常运行提供了额外保障。
- DP80LL active LRD cable CTS and certification added to provide UHBR20 Gbps rate support for longer cables (can support ~3 meter cables)/新增DP80LL有源LRD线缆的CTS和认证，以为更长线缆提供UHBR20 Gbps速率支持（可支持约3米线缆）
  - Linear Redrivers (LRD) are level boosting amplifiers that boost signal transmission over longer distances/线性重驱动器（LRD）是一种电平增强放大器，可增强信号在更长距离上的传输
- Over 150 Enhanced DP cables and connectors have been certified since launch of the Enhanced DP cable and connector certification programs/自增强型DP线缆和连接器认证项目启动以来，已有超过150款增强型DP线缆和连接器获得认证

Product certifications* 2024/2025/2026/ 产品认证* 2024/2025/2026

Products	2024	2025	2026
DP Sources	93	136	81
DP Sinks	491	428	362
DP Cables	70	57	34
DisplayHDR	556	582	528
ClearMR	53	71	68
AdaptiveSync	75	113	122

*Note: Numbers are base model certs not including family models. Updates to Compliance Management System (CMS) will include feature to count family models in the future./*注：上述数据为基础型号认证数量，不包括系列/同族型号。合规管理系统(CMS)的未来更新将加入统计系列型号功能。

DisplayPort Link Testing
Source CDF Tool

Overview
DisplayPort链路测试Source CDF工具

概述

VESA Workshop/VESA研讨会

Oct 14 2026/2026年10月14日

What is a DisplayPort CDF/DisplayPort CDF是什么

- **CDF** stands for Capability Declaration Form./**CDF代表**Capability Declaration Form（**能力声明表**）。
- A **CDF** is an official document or electronic form that a product manufacturer (OEM or brand) fills out and submits when seeking official DisplayPort Certification./**CDF是**产品制造商（OEM**或品牌**）**在申**请**正式**DisplayPort认证时填写并提交的正式文件或电子表格。
- **Purpose:** It serves as a detailed checklist recording all the exact capabilities, hardware features, and specifications supported by a DisplayPort transmitter (source, like a graphics card) or receiver (sink, like a monitor)./**目的**：**它作**为一份详细清单，记录DisplayPort发送**端**（**源端**，**如**显**卡**）**或接收端**（汇**端**，**如**显示器）所支持的全部确切能力、硬件特性和规格。
- **Authorized Test Centers** (ATCs) use the data entered into the CDF to configure automated testing equipment. The test equipment dynamically builds test parameters to verify that the device actually behaves according to the capabilities claimed in its CDF./**授权测试中心**（ATC）**使用**输入到CDF**中的数据来配置自**动化测试设备。测试设备**会**动态构建测试参数，以验证设备是否**确**实按照其CDF**中声明的能力运行**。

Source CDF Tool/Source CDF工具

The **Source CDF Tool** is an active Excel Spreadsheet but can be used without enabling Macros

Source CDF 工具是一个带活动内容的Excel电子表格，但无需启用宏即可使用

Source CDF Tool /Source CDF工具

The **Source CDF Tool** is available to VESA members on the VESA Causeway Test Implementation Subgroup Page/**Source CDF工具可在**VESA Causeway 测试实施子组**页面上供**VESA成员获取使用

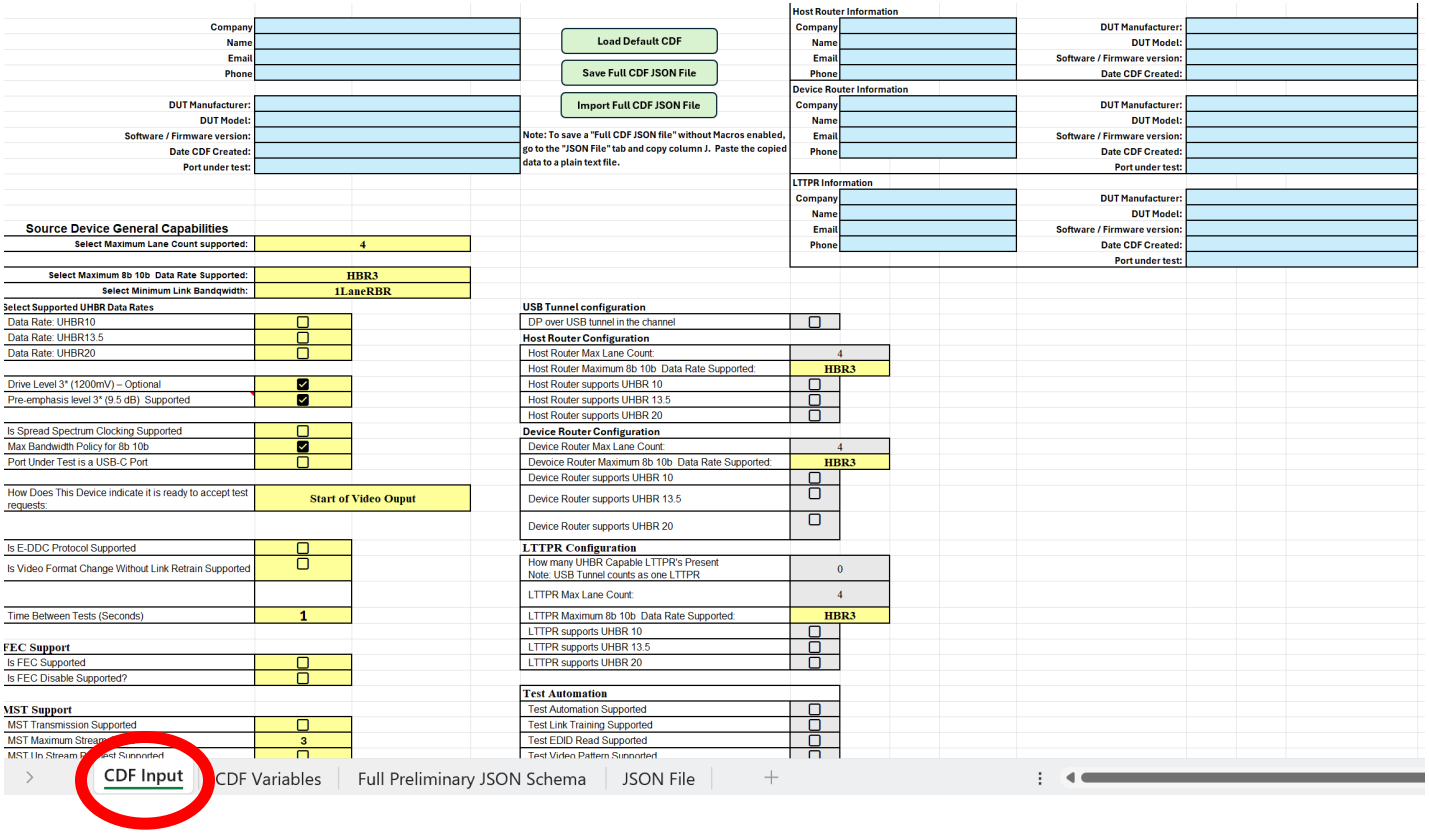
SourceCDFTool_Beta_xxxx_xx_2026.xlsm

Source CDF Tool /Source CDF工具

The **Source CDF Tool** creates a CDF file in json format that can be imported and used with the two approved Link Test Equipment:/
Source CDF工具会生成一个JSON格式的CDF文件，可导入并与两款获批的链路测试设备配合使用：
UCD500 and **M42d / M42de**

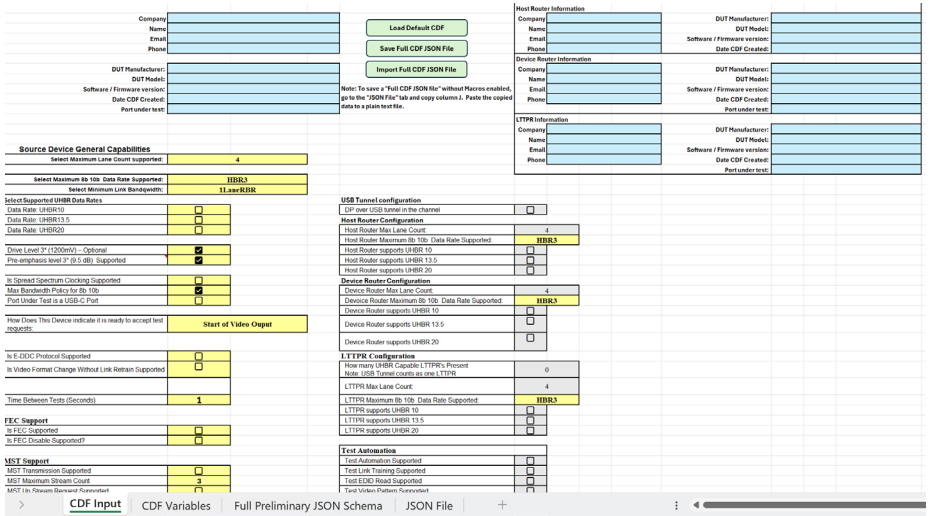
Source CDF Tool /Source CDF工具

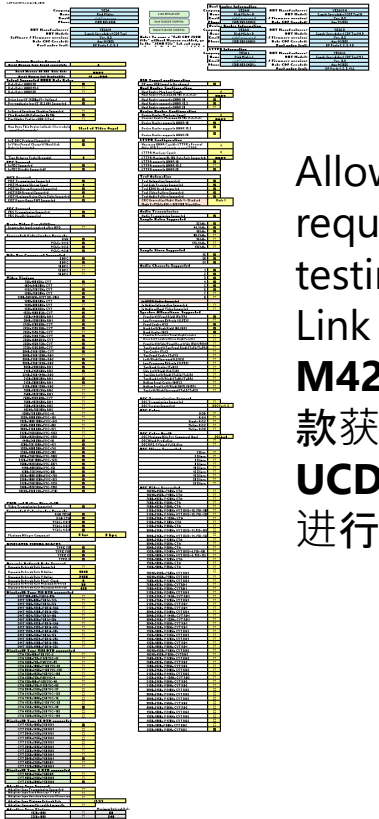
The Source CDF Tool takes user input in the first "CDF Input" tab/Source CDF 工具在第一个"CDF Input"选项卡中接收用户输入



Source CDF Tool /Source CDF工具

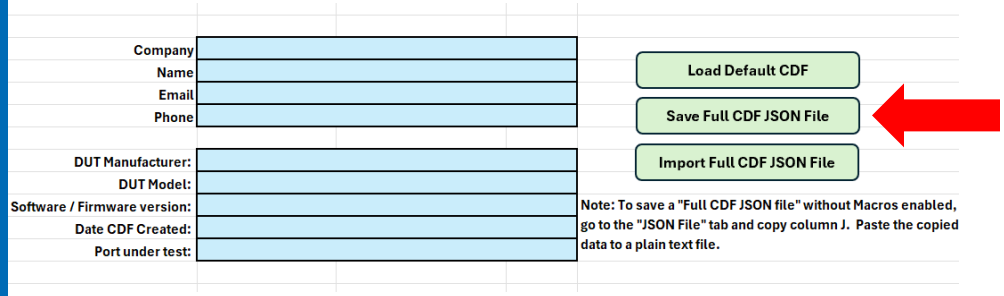
The Source CDF Tool allows full CDF User Input (up to 330+ input fields)/Source CDF 工具支持完整的CDF用户输入（多达330多个输入字段）

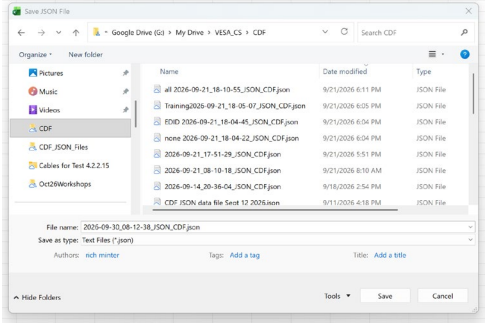




Allows input for every field required for compliance testing with the two approved Link test tools: **UCD500** and **M42d / M42de/支持输入两款获批链路测试工具（UCD500和M42d / M42de）进行合规测试所需的全部字段**

Source CDF Tool /Source CDF工具





After completing the CDF input information, the CDF JSON file can be saved. A file save dialog will open to allow saving the CDF JSON file./完成CDF输入信息后，可保存CDF JSON文件。此时系统将打开文件保存对话框，以便保存该CDF JSON文件。

Note: If Macros are not enabled in your excel application, you may save the JSON file manually/注：如果您的Excel应用程序中未启用宏，您可以手动保存JSON文件

Source CDF Tool /Source CDF工具

A comprehensive Source CDF Tool Tutorial has instructions to load CDF files into the Test Equipment/一份全面的Source CDF工具教程包含将CDF文件加载到测试设备中的操作说明

M42de: Instructions to load a CDF file see: Slide 16 – 22
M42de：加载CDF文件说明请参见：第16-22页

UCD500: Instructions to load a CDF file see: Slide 23 – 27
UCD500：加载CDF文件说明请参见：第23-27页

The Source CDF Tool Tutorial is available on VESA Causeway/ Source CDF工具教程可在VESA Causeway上获取
Test Implementation Subgroup Documents Page:/测试实施子组文档页面:
Source CDF Tool Tutorial.ppsx/Source CDF工具教程.ppsx

END/完

Summary
总结

Summary/总结

- VESA-based product shipments and certifications have transitioned from rapid growth to a steady state of high-volume output./基于VESA的产品出货量和认证已从快速增长过渡到高产量输出的稳定状态。
- DP 2.1 UHBR capable product development and certifications are in mass production and continue to grow/ 支持 DP 2.1 UHBR 的产品开发与认证已进入量产阶段，并持续增长
- VESA Enhanced cable and connector certification programs have been very successful with significant numbers of DP54, DP80 and now DP80LL cables certified/VESA增强型线缆和连接器认证项目非常成功，已有大量DP54、DP80以及现在的DP80LL线缆获得认证
- MST continues to be a popular DP feature and with UHBR20 + DSC it can be used to drive multiple high resolutions displays at high refresh rates through a single connector/MST仍是广受欢迎的DP特性，借助UHBR20 + DSC，它可以通过单个连接器驱动多台高分辨率、高刷新率显示器
- Display Performance Standards adoption and certification have been extremely successful the last several years/过去几年中，Display Performance Standards（显示性能标准）的采用和认证取得了极大成功
- Development and adoption of new technologies continues to drive steady VESA membership growth/新技术的开发和采用持续推动VESA成员数量稳步增长

Questions? 问题？

Thank you to the contributors that made this event possible/鸣谢所有促成本次活动的所有贡献者！

- ***Thank you, speakers.*** For donating your time, energy and expertise/感谢各位演讲嘉宾。感谢你们奉献的时间、精力和专业知识
- ***Thank you, VESA organizing staff.*** The detailed work of arranging these events is tedious and tiring but critical./感谢VESA组织团队。安排这些活动的细致工作繁琐而辛苦，但至关重要。
- ***Thank you, attendees.*** You are why we are here. Let us know how we did in feedback and include any suggestions for additional topics or improvement for next year./感谢各位参会者。你们是我们举办此次活动的原因。请通过反馈告诉我们本次的活动效果，并附上关于明年的活动主题或任何改进的建议。

VESA

THANK YOU / 感谢！

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