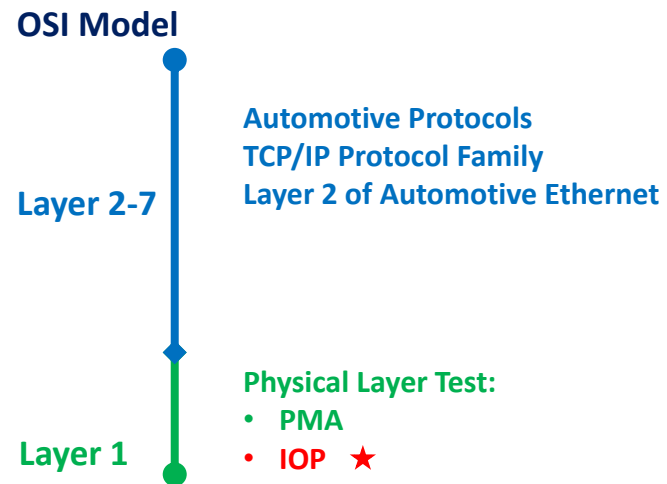


Open Alliance TC8 IOP Testing Training

思佳科技 Sigent Technology

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- Interoperability Tests is part of Test Scope Layer 1 of Automotive Ethernet defined by TC8 Test Specification
互操作性测试是Open Alliance定义的TC8测试规范中的一部分，属于物理层测试。



100BASE-T1 Interoperability Tests includes following 3 aspects:
100BASE-T1互操作性测试包含下面三方面内容

- Link-up Time 连接时间
- Signal Quality 信号质量
- Cable Diagnose 线束诊断

Test Case ID	Test Case Name
Link-up time	
OABR_LINKUP_01	Link-up time - Trigger: Power on Link Partner
OABR_LINKUP_02	Link-up time - Trigger: Power on DUT
OABR_LINKUP_03	Link-up time - Trigger: Wake up DUT
Signal Quality	
OABR_SIGNAL_01	Indicated signal quality for channel with decreasing quality
OABR_SIGNAL_02	Indicated signal quality for channel with increasing quality
Cable diagnostics	
OABR_CABLE_02	Cable diagnostics for near and far end open
OABR_CABLE_02	Cable diagnostics for near and far end short

Technica提供完整的解决方案以完美实现车载以太网TC8中的IOP测试，
配置方案由三部分组成

- Golden Device
- ANDi Software
- ANDi-IOPT Add-on



注：
被测对象需要处于可测试状态，其软件层面的修改由其供应商负责。
培训不在上述配置中。

Synopsis
概要

Shall ensure that the link is established within a given time without a high time variation.
应确保在给定时间内建立Link，且时间变化不大。

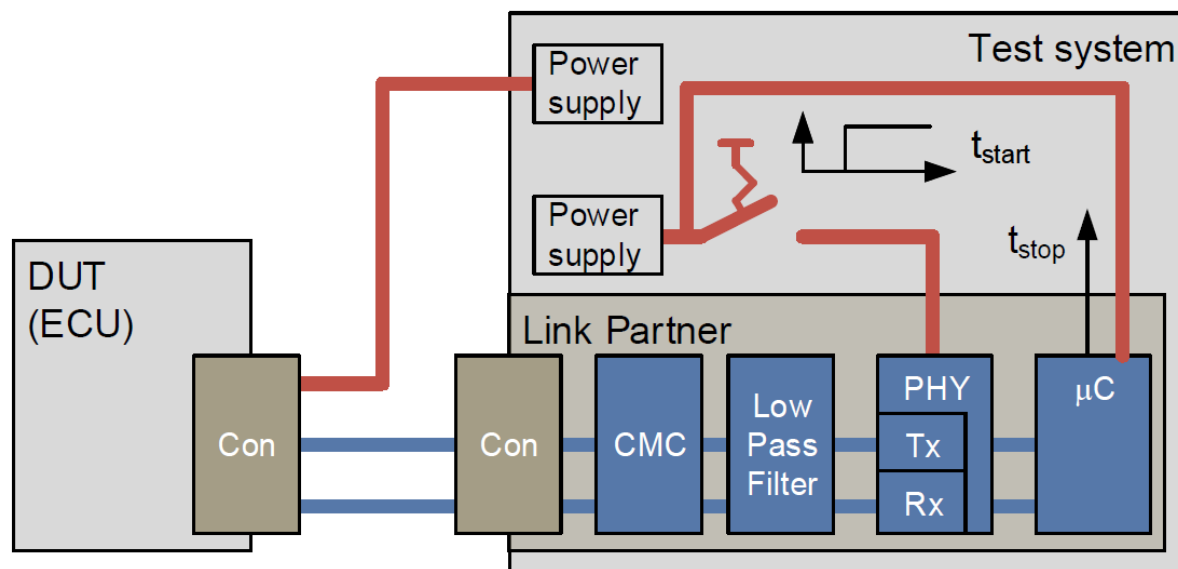
Prerequisites
先决条件

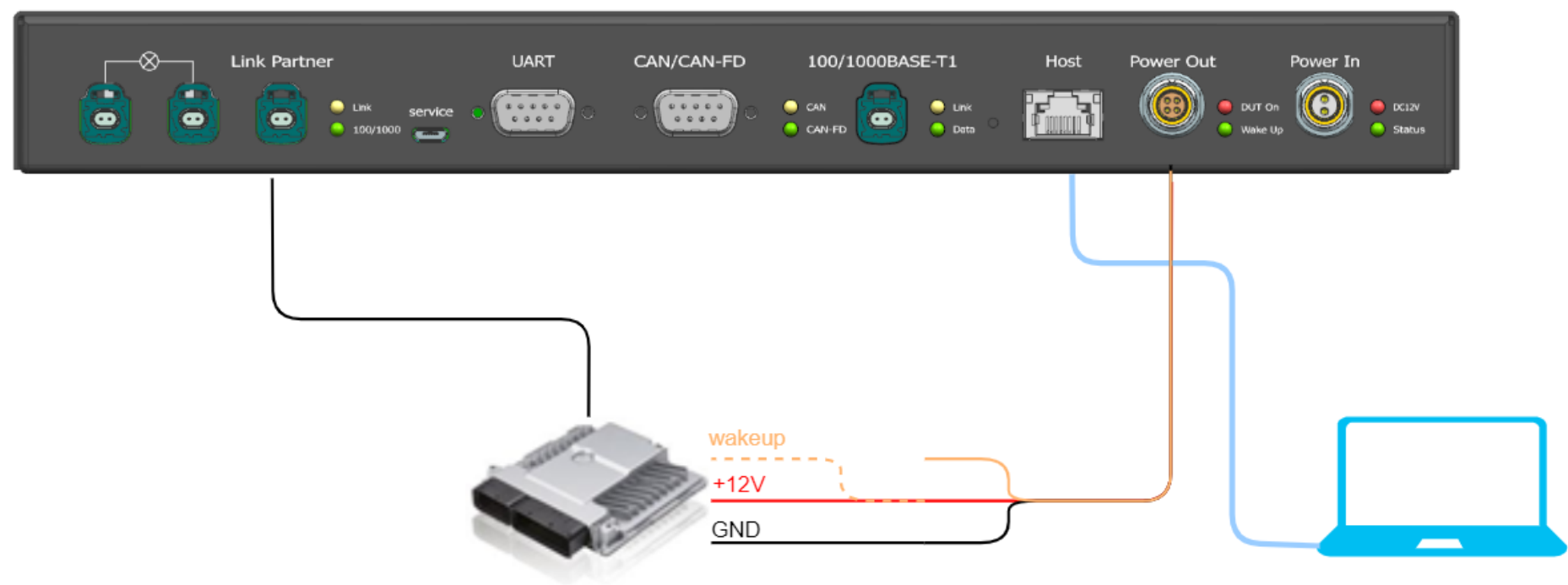
- 1. The DUT is connected to a stable power supply.
DUT连接到稳定的电源。
- 2. The DUT must be operated in normal mode.
DUT必须在正常模式下运行。
- 3. The Test System provides special awake conditions for the DUT such as a wakeup line or network management CAN messages if necessary.
测试系统为DUT提供特殊的唤醒条件，例如唤醒线或网络管理CAN消息（如有必要）。
- 4. If the DUT contains a switch all links have to be tested separately.
如果DUT包含一个switch，则必须分别测试所有链路。
- 5. The mean start up time of the Link Partner is available: t_{ready}
Link Partner的平均启动时间可用： t_{ready}

Test setup
测试搭建

The DUT must be connected to the Link Partner with opposite master/slave configuration. The polarity of the communication channel must be correct. The power supplies are controlled by the test system.

DUT必须以相反的主/从配置连接到Link Partner。通信通道的极性必须正确。电源由测试系统控制。





Test Procedure 测试流程	1. DUT shall be active and ready to build up link. DUT必须处于活动状态并准备建立链接。 Repeat Step 2 to Step 5 n=100 times: 重复步骤2至步骤5， n = 100次： 2. Power on Link Partner. $t_{start}=t_{PowerOnLinkPartner}$ Link Partner 上电 $t_{start}=t_{PowerOnLinkPartner}$ 3. Polling of Link Partner status register. If link_control= active link: $t_{stop}=t_{ActiveLink}$ 轮询Link Partner状态寄存器。 如果link_control= active link: $t_{stop}=t_{ActiveLink}$ 4. Calculate the time t_{up} between power on and link up: $t_{up}= t_{stop} - t_{start}$ 计算power on和Link up之间的时间t_{up}: $t_{up}= t_{stop}-t_{start}$ 5. Power off Link Partner. 关闭Link Partner。 End of Repeat 重复结束 2. Calculate as follows计算如下：	$\bar{t} = \frac{1}{n} \sum_{i=1}^n t_{up}(i)$ $\sigma t = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (t_{up}(i) - \bar{t})^2}$ $t_{min} = \min(t_{up}(i))$ $t_{max} = \max(t_{up}(i))$
Pass criteria 通过标准	$\sigma_t \leq 50 \text{ ms}$ $t_{min} > 10 \text{ ms} + t_{ready}$ $t_{max} < 100 \text{ ms} + t_{ready}$	
Notes 备注	This test has to be performed for each port of the DUT, if it has a switch inside.如果DUT含有switch， 则switch的每个port口都需要进行测试。 In dependency of the design of the link partner, the Test system may switch also the power supply of the μC together with the power supply of the PHY. 取决于link partner的设计， 测试系统也可以同时切换μC的电源和PHY的电源。	

Synopsis
概要

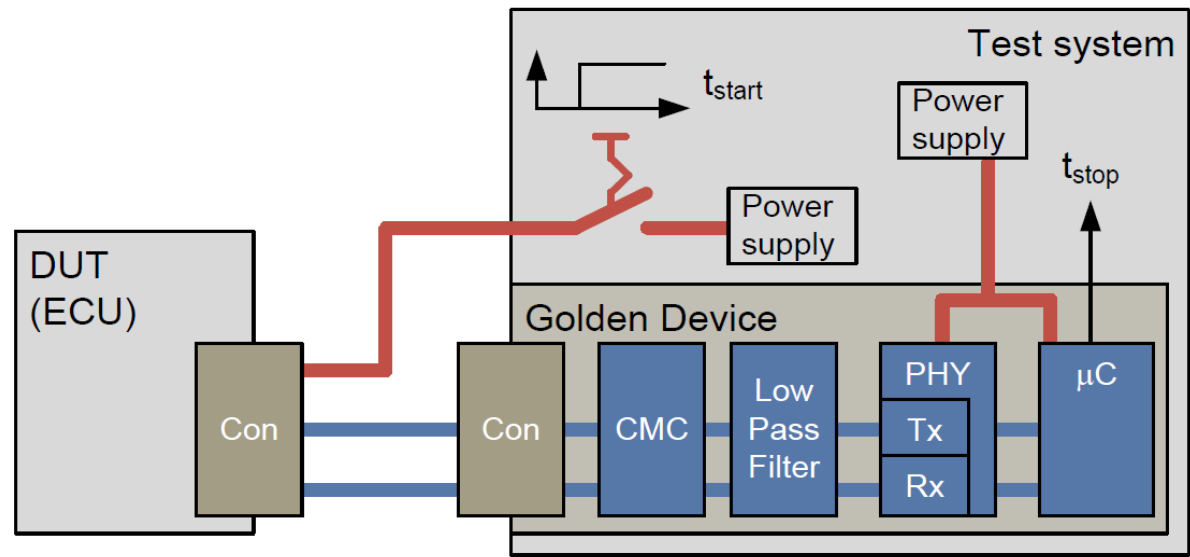
Shall ensure that the link is established within a given time without a high time variation.
应确保在给定时间内建立link，且时间变化不大。

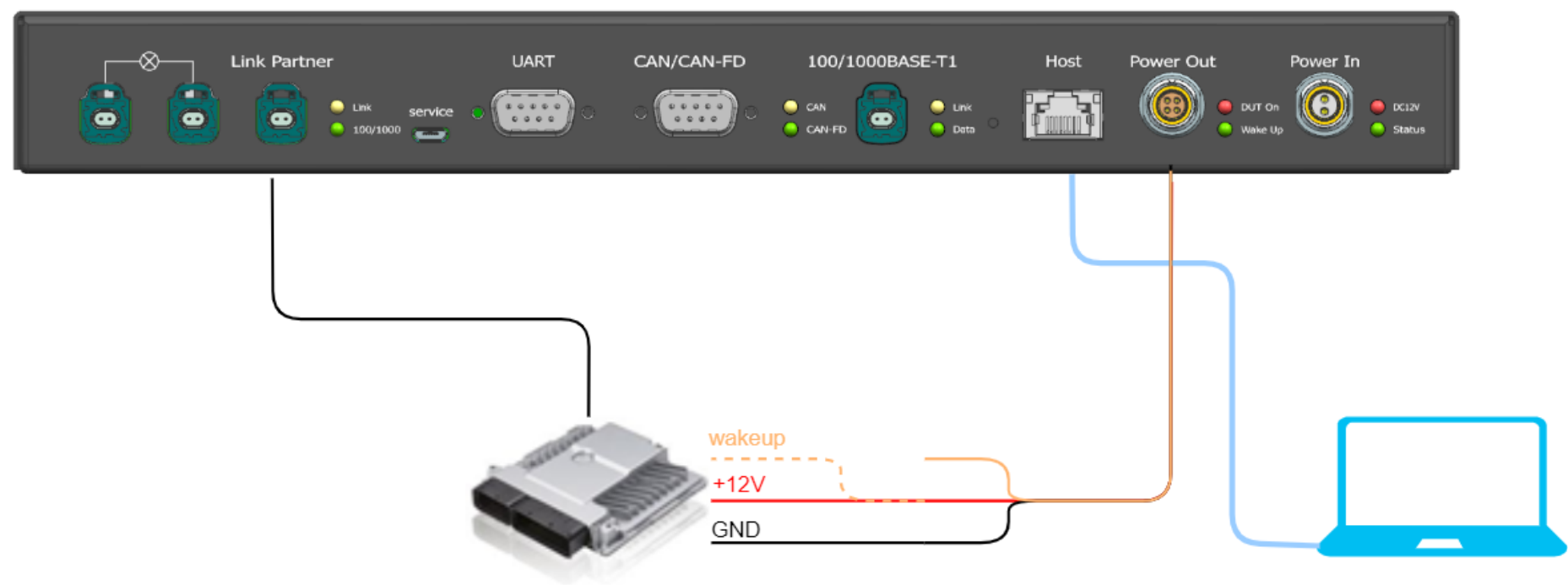
- Prerequisites**
先决条件
- 1. The Link Partner is connected to a stable power supply.链接伙伴已连接到稳定的电源。
 - 2. The Test System provides special awake conditions for the DUT such as a wakeup line or network management CAN messages if necessary.
测试系统为DUT提供特殊的唤醒条件，例如唤醒线路或网络管理CAN消息（如有必要）
 - 3. The manufacturer has to provide the mean start up time of the DUT: t_{ready1}
制造商必须提供DUT的平均启动时间： t_{ready1}

Test setup
测试搭建

The DUT must be connected to the Link Partner with opposite master/slave configuration. The polarity of the communication channel must be correct. The power supplies are controlled by the test system.

DUT必须以相反的主/从配置连接到Link Partner。通信通道的极性必须正确。电源由测试系统控制。





Test procedure
测试流程

1. Link Partner shall be active and ready to build up link. Link Partner必须处于活动状态并准备建立链接。

Repeat Step 2 to Step 5 n=100 times:

重复步骤2至步骤5， n = 100次：

2. Power on Link Partner. $t_{start}=t_{PowerOnDUT}$

Link Partner 上电 $t_{start}=t_{PowerOnDUT}$

3. Polling of Link Partner status register. If link_control= active link: $t_{stop}=t_{ActiveLink}$

轮询Link Partner状态寄存器。 如果link_control= active link: $t_{stop}=t_{ActiveLink}$

4. Calculate the time t_{up} between power on and link up: $t_{up}=t_{stop}-t_{start}$

计算power on和Link up之间的时间 t_{up} : $t_{up}=t_{stop}-t_{start}$

5. Power off DUT.

关闭DUT。

End of Repeat 重复结束

2. Calculate as follows计算如下：

$$\bar{t} = \frac{1}{n} \sum_{i=1}^n t_{up}(i)$$

$$\sigma t = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (t_{up}(i) - \bar{t})^2}$$

$$t_{min} = \min(t_{up}(i))$$

$$t_{max} = \max(t_{up}(i))$$

Pass criteria
通过标准

$$\sigma_t \leq 50 \text{ ms}$$

$$t_{min} > 10 \text{ ms} + t_{ready}$$

$$t_{max} < 100 \text{ ms} + t_{ready}$$

Notes

This test has to be performed for each port of the DUT, if it has a switch inside.如果DUT含有switch， 则switch的每个port口都需要进行测试。

In dependency of the design of the link partner, the Test system may switch also the power supply of the μC together with the power supply of the PHY.

取决于link partner的设计， 测试系统也可以同时切换 μC 的电源和PHY的电源。

Synopsis
概要

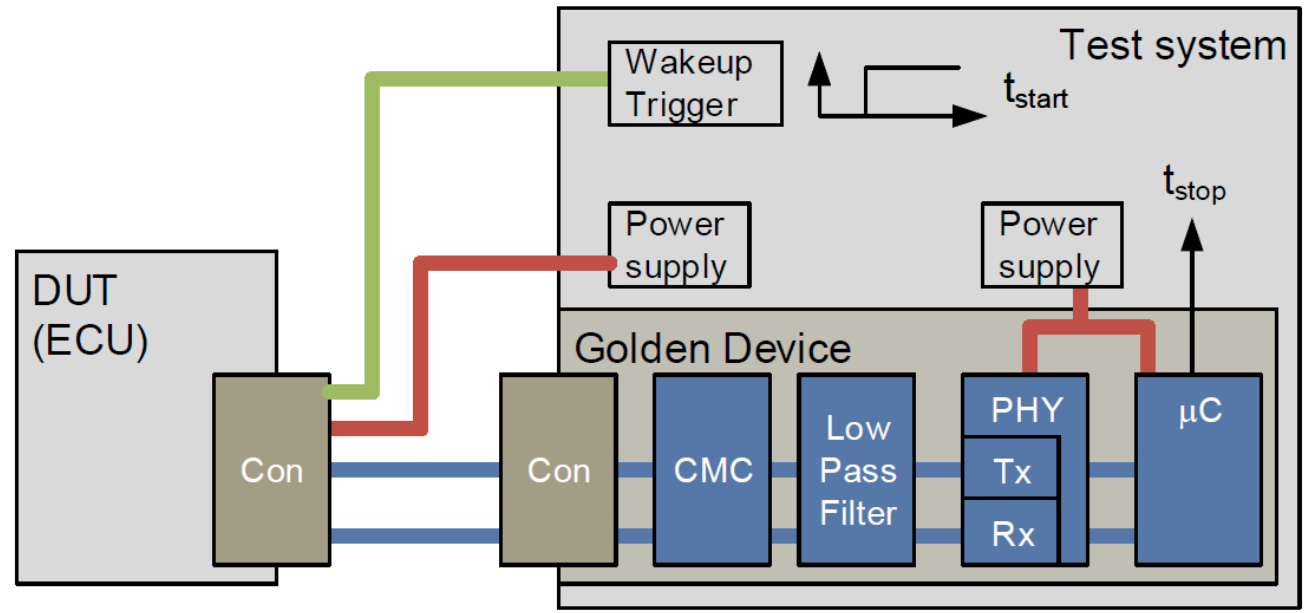
Shall ensure that the link is established within a given time without a high time variation.
应确保在给定时间内建立Link，且时间变化不大。

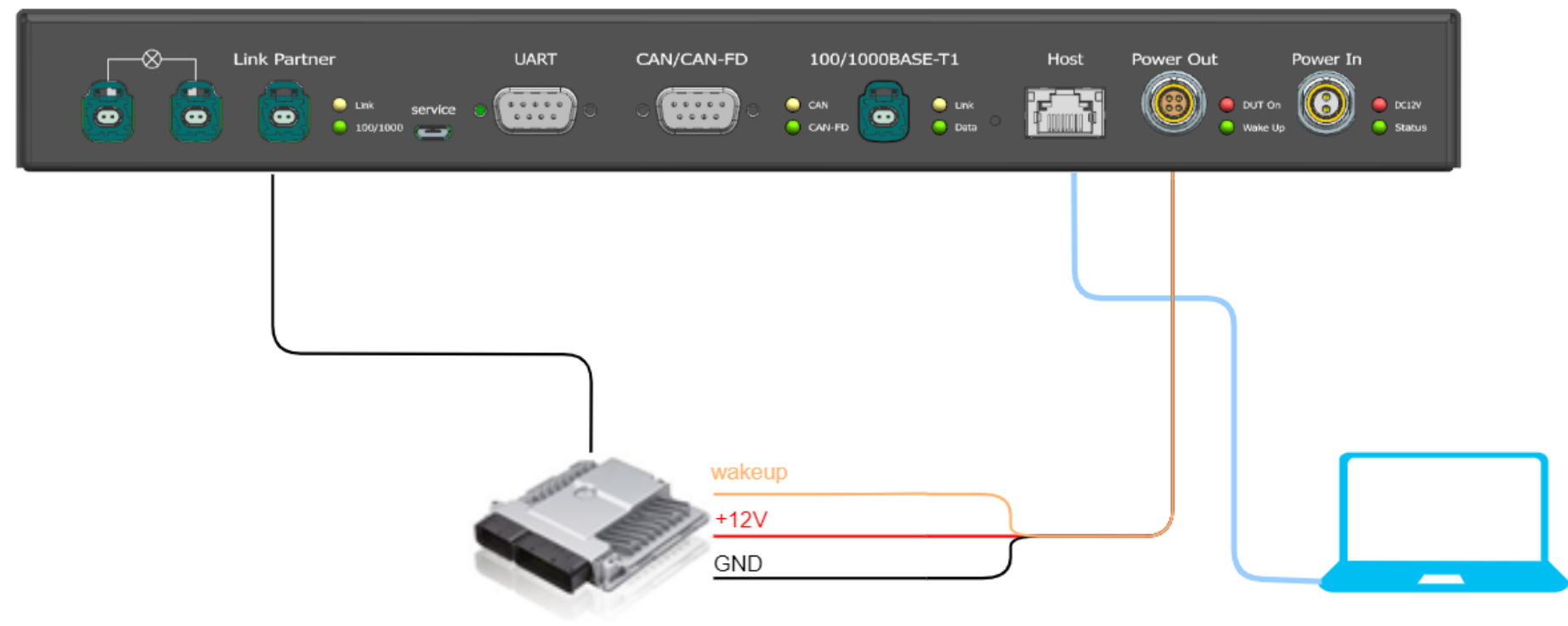
- Prerequisites**
先决条件
1. The DUT and the Link Partner are connected to a stable power supply.
DUT和Link Partner已连接到稳定的电源
 2. The DUT must be operated in normal mode.
DUT必须在正常模式下运行
 3. Wake up message is necessary. The Test System provides special awake conditions for the DUT such as a wakeup line or network management CAN messages.
唤醒消息是必要的。测试系统为DUT提供了特殊的唤醒条件，例如wakeup line或网络管理CAN消息。
 4. The manufacturer has to provide the value Isleep.
制造商必须提供Isleep值
 5. The manufacturer has to provide the mean wake up time of the DUT: t_{ready2}
制造商必须提供DUT的平均唤醒时间： t_{ready2}

Test setup
测试搭建

The DUT must be connected to the Link Partner with opposite master/slave configuration. The polarity of the communication channel must be correct. The power supplies are controlled by the test system.

DUT必须通过相反的主/从连接到Link Partner组态。通信通道的极性必须正确。供电由测试系统控制。





Test Procedure

测试流程

1. DUT shall be in sleep mode and Link Partner shall be active and ready to build up link.
- DUT应处于睡眠模式，并且Link Partner应处于活动状态并准备建立Link。

Repeat Step 2 to Step 6 n=100times:

2. Turn on Wake up signal for DUT.
- 打开DUT的唤醒信号。
3. $t_{WakeUpDUT}$ if $I_{DUT} > I_{sleep}$, $t_{start} = t_{WakeUpDUT}$
4. Polling of Link Partner status register. If link_control= active link: $t_{stop} = t_{ActiveLink}$
- 轮询链接伙伴状态寄存器。如果link_control =活动链接： $t_{stop} = t_{ActiveLink}$
5. Calculate the time t_{up} between wake up and link up: $t_{up} = t_{stop} - t_{start}$
- 计算唤醒和链接之间的时间 t_{up} : $t_{up} = t_{stop} - t_{start}$

6. Switch DUT to sleep mode.
- 将DUT切换到睡眠模式。

$$\bar{t} = \frac{1}{n} \sum_{i=1}^n t_{up}(i)$$

End of Repeat

7. Calculate as follows计算如下:

$$\sigma t = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (t_{up}(i) - \bar{t})^2}$$

$$t_{min} = \min(t_{up}(i))$$

$$t_{max} = \max(t_{up}(i))$$

Pass criteria

通过标准

$$\sigma_t \leq 50 \text{ ms}$$
$$t_{min} > 10 \text{ ms} + t_{ready}$$
$$t_{max} < 100 \text{ ms} + t_{ready}$$

Notes

This test has to be performed for each port of the DUT, if it has a switch inside.如果DUT含有switch，则switch的每个port口都需要进行测试。

Indicated signal quality for channel with increasing/decreasing quality

Synopsis
概要

Shall ensure that the DUT's indicated signal quality **increase** for a channel with **increasing** channel quality and that there is coherence between the SQI indicated values on the DUT and the respective artificial noise injection.

Prerequisites
先决条件

应确保随着信道质量的**增加/降低**，信道的DUT指示信号质量会**增加/降低**，并且DUT上的SQI指示值与相应的人工噪声注入之间应保持一致。

- 1. 1. The DUT and the Link Partner are connected to a stable power supply.
DUT和链接伙伴已连接到稳定的电源。
- 2. 2. The DUT must be operated in normal mode.
DUT必须在正常模式下运行
- 3. 3. The Test system allows varying and determining the quality of the communication channel that connects the DUT and Link Partner.
测试系统允许改变和确定连接DUT和链接伙伴的通信通道的质量
- 4. 4. DUT must be able to monitor the signal quality indicated by the PHY. The information of the signal quality can be provided by an applicative message. To be able to obtain the DUT information of the signal quality with the respective applied channel degradation step, an additional communication channel like CAN should be available.
DUT必须能够监视PHY指示的信号质量。信号质量的信息可以通过适当的消息来提供。为了能够通过相应的应用信道降级步骤获得信号质量的DUT信息，应该可以使用诸如CAN这样的附加通信信道。

Test setup
测试搭建

See chapter 7.3 Artificial degradation of channel quality of [1].

Indicated signal quality for channel with decreasing quality

Test Procedure 测试流程	1. DUT shall soft reset and reconfigure its PHY. DUT应软重置和重新配置phy 2. Remove any artificial channel degradation, to ensure that the highest possible signal quality is reached on both the DUT and LP. 移除任何人工通道降级，保证DUT和LP通道上为最高的信号质量 3. Measure the PHY's SQI value for at least 100 times. Determine and store the minimum and maximum SQI read values. Store all PHY Health (SNR) indicated in OAM read in parallel with the SQI values. 测量PHY的SQI值至少100次，决定并保存最小和最大的SQI值 4. Increase artificial noise level by one step, i.e. by 100mV Gaussian noise generator amplitude. 按步长，比如每100mV的噪音幅度, 提高人工噪音 5. Repeat steps 3 and 4 for ten additional noise levels after the PHY can no longer establish a link. 在没有link之后，重复10次步骤3和4
Pass criteria 通过标准	Each test iteration shall be classified as passed, if all of the following condition(s) are fulfilled. 满足如下条件的测试可以被归类为通过 1. SQI value: Steadily and monotonic decreased by one step each稳定和单调的SQI值 SQI values are only valid if link-up condition is present只有存在linkup时才有有效的SQI值 2. Link status Link-up status remains for SQI values higher than 0如果SQI指大于0， 状态保持为Link-up No link instabilities with intermittently link drops should be observed between SQI values higher than 0. 当SQI大于零时， link不会中间掉线
Notes	To guarantee comparability of the results, a graphic disclosing SQI value (y-axis) vs. associated noise level on the network [Vpp] (x axis) shall be given in the test report for each test iteration. The noise level seen by the DUT is relevant; this means the noise source level divided by the coupling factor of the differential directional coupler. 绘图以方便比较。

Test Procedure 测试流程

1. Start with the highest artificial noise channel degradation The DUT's PHY can no longer establish a link
以最高的人工噪音开始，这时DUT不能建立link
2. DUT shall soft reset and reconfigure its PHY.
DUT应软重置和重新配置phy
3. Decrease artificial noise level until link can be established.
降低人工噪音水平知道能建立link
4. Measure the PHY's SQI value for at least 100 times. Determine and store the minimum and maximum SQI read values. Store all PHY Health (SNR) indicated in OAM read in parallel with the SQI values.
测量PHY的SQI值至少100次，决定并保存最小和最大的SQI值
5. decrease artificial noise level by one step, i.e. by 100mV Gaussian noise generator amplitude.
按步长，比如每100mV的噪音幅度, 降低人工噪音
6. Repeat steps 4 and 5 until no artificial noise is applied.
重复10次步骤3和4，直到没有噪音可以施加

Synopsis
概要

Shall ensure that the DUT's cable diagnostic reliably detects an **open** of one or both of the bus lines. The test shall be performed for both a near end **open** at the connector of the DUT, and for a far end **open** at the connector of the Link Partner.。

Prerequisites
先决条件

应确保DUT的电缆诊断程序可靠地检测到一条或两条总线的**开路**。测试应在DUT的连接器的近端**开路**和Link Partner的连接器的远端**开路**处进行。

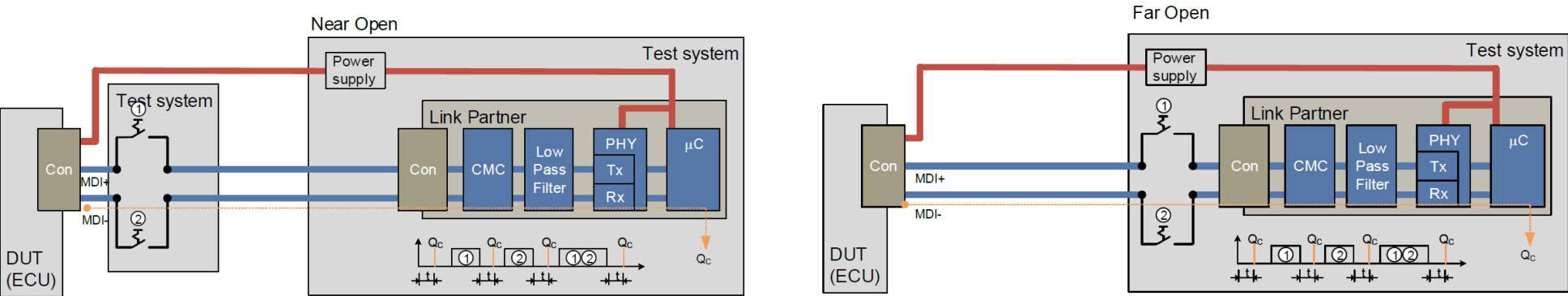
1. The channel should be terminated properly通道应正确终止
2. The DUT must be capable to start cable diagnostic of its PHY
DUT必须能够启动其PHY的cable诊断
3. The DUT must be able to detect any cable errors. This means the DUT has to provide the possibility to trigger the cable diagnostic feature. The result of the DUT's cable diagnostic can be provided by an applicative Ethernet message, an UDS communication or another communication channel like CAN.
DUT必须能够检测到任何cable错误。这意味着DUT必须能够触发cable诊断功能。DUT cable诊断的结果可以通过适用的以太网消息，UDS通信或其他通信通道（如CAN）来提供。

OABR_CABLE_01

Cable diagnostics for near and far end open

Test setup
测试搭建

See chapter 7.3 Artificial degradation of channel quality of [1].



Test procedure 测试流程	1. The following steps shall be applied to test near and far end open cable diagnostics以下步骤应用于测试近端和远端开路电缆诊断程序 2. 1. The DUT cable diagnostic feature is triggered. The DUT cable diagnostics has to be executed within terror.触发DUT cable诊断功能。 DUT cable诊断必须在错误范围内执行 3. 2. The test system creates acable error for a defined time terror. 测试系统会在规定的时间误差内产生有效误差 4. 3. After the wait time t the test system reads out all identified cable errors QC from the DUT在等待时间t之后， 测试系统从DUT读出所有已识别的cable错误QC 5. Repeat step 1 to 3 for all error combinations (alternately MDI+ and/or MDI- are open).对所有错误组合重复步骤1至3（或者打开MDI +和/或MDI-） 6. For additional information regarding the test instances, please refer to test Instances Table of 100BASET1_IOP_32 of [1]. 有关测试实例的更多信息， 请参考[1]的100BASET1_IOP_32的测试实例表。 Each test iteration shall be classified as passed, if the DUT reports all expected cable errors. 对所有错误组合重复步骤1至3（或者打开MDI +和/或MDI-）
Pass criteria 通过标准	Each test iteration shall be classified as passed, if the DUT reports all expected cable errors. 如果DUT报告所有预期的电缆错误， 则每个测试迭代应归类为通过。
Test iterations 测试迭代	5 times.
Notes	For additional information regarding the near and far end open, please refer to Notes of 100BASET1_ IOP_32 of [1]. The results shall be reported for each 100BASE-T1 port available in the DUT.

Synopsis
概要 Shall ensure that the DUT’s cable diagnostic reliably detects an **short** of one or both of the bus lines. The test shall be performed for both a near end **short** at the connector of the DUT, and for a far end **short** at the connector of the Link Partner.。

应确保DUT的电缆诊断程序可靠地检测到一条或两条总线的**短路**。测试应在DUT的连接器的近端**短路**和Link Partner的连接器的远端**短路**处进行。

- Prerequisites**
先决条件
1. The channel should be terminated properly通道应正确终止
 2. The DUT must be capable to start cable diagnostic of its PHY
DUT必须能够启动其PHY的cable诊断
 3. The DUT must be able to detect any cable errors. This means the DUT has to provide the possibility to trigger the cable diagnostic feature. The result of the DUT’s cable diagnostic can be provided by an applicative Ethernet message, an UDS communication or another communication channel like CAN.
DUT必须能够检测到任何cable错误。这意味着DUT必须能够触发cable诊断功能。DUTcable诊断的结果可以通过适用的以太网消息，UDS通信或其他通信通道（如CAN）来提供。

DUT is connected to a properly terminated link partner. The bus wires are connected via a $\leq 1\text{ Ohm}$ resistor during following error situations:

DUT已连接到正确终止的link partner。在以下故障情况下，总线通过 ≤ 1 欧姆电阻连接：

Test setup
测试搭建

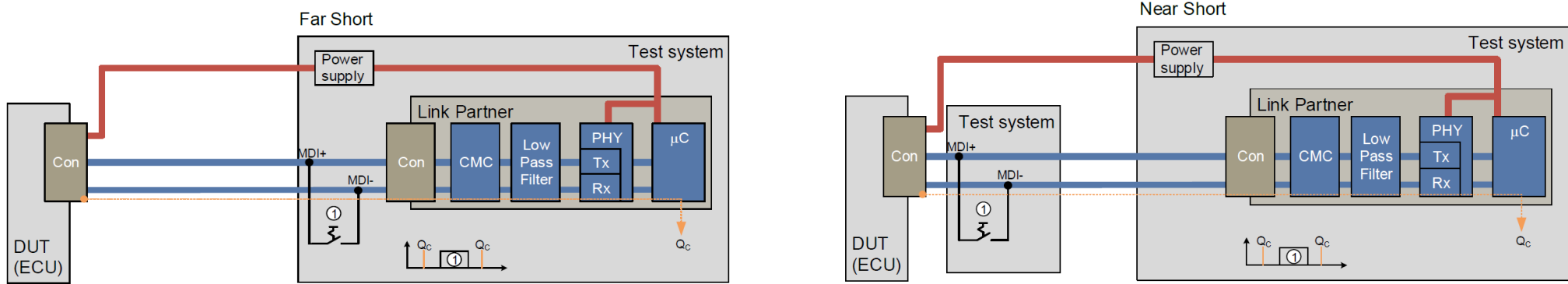
SHORT between both bus wires, far and near end.总线远端和近端内部短路

SHORT of both conductors to ground (GND), far and near end.总线远端和近端对地短路

SHORT of both conductors to supply line (VBAT), far and near end.总线远端和近端对电源短路

Please note that in the figures above there is presented only the 1st error situation (SHORT between both bus wires, far and near end). The 2nd and 3rd error situation, where the two wires MDI+ and MDI- are additionally connected to GND resp. VBAT, are not presented here.

请注意，在上图中，仅显示了第一种错误情况（总线两条线之间，远端和近端之间的短路）。第二和第三错误情况，其中两条线MDI+和MDI-另外连接到GND。VBAT，此处未介绍。

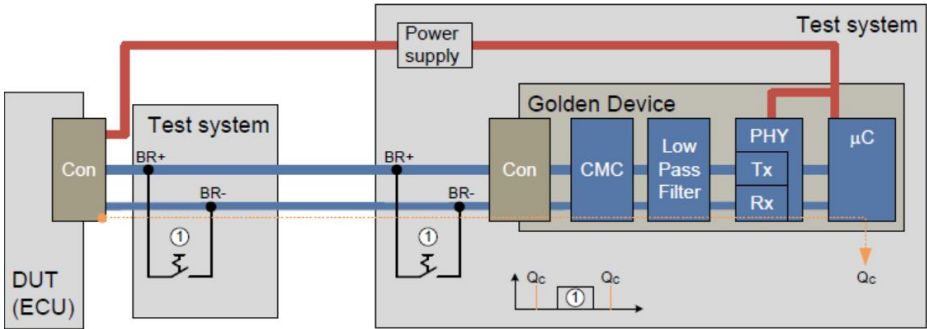


Example:
基于SOME/IP, 可以控制Relay, 实现多种Open和Short设置

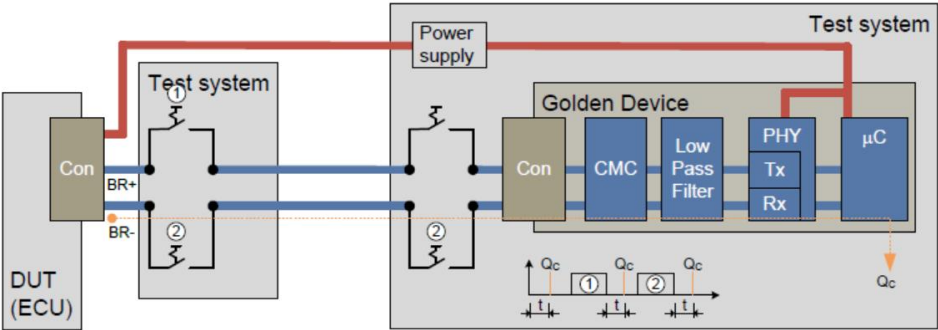
Payload	Byte[0]							
	Bit[7]	Bit[6]	Bit[5]	Bit[4]	Bit[3]	Bit[2]	Bit[1]	Bit[0]
Value	NC*	0/1	0/1	0/1	0/1	0/1	0/1	0/1
Info	NC*	P2P	P2G	N2P	N2G	Pop	Nop	PS

P2P: Short circuit between Positive wire and power (1 active, 0 inactive)
N2P: Short circuit between Negative wire and power (1 active, 0 inactive)

P2G: Short circuit between Positive wire and ground (1 active, 0 inactive)
N2G: Short circuit between Negative wire and ground (1 active, 0 inactive)



PS: Pair short relay, short circuit between Positive and Negative wire
1 short Positive and Negative,
0 Positive and Negative not connected



Pop: Open relay of Positive wire (1 close relay, 0 open relay)
Nop: Open relay of Negative wire (1 close relay, 0 close relay)

Test procedure 测试流程	1. The following steps shall be applied to test near and far end short cable diagnostics以下步骤应用于测试近端和远端短路电缆诊断程序 2. 1. The DUT cable diagnostic feature is triggered. The DUT cable diagnostics has to be executed within terror.触发DUT电缆诊断功能。DUT电缆诊断必须在错误范围内执行 3. 2. The test system creates acable error for a defined time terror. 测试系统会在规定的时间误差内产生有效误差 4. 3. After the wait time t the test system reads out all identified cable errors QC from the DUT在等待时间t之后，测试系统从DUT读出所有已识别的电缆错误QC 5. Repeat step 1 to 3 for all error combinations (alternately MDI+ and/or MDI- are open).对所有错误组合重复步骤1至3（或者打开MDI +和/或MDI-） 6. For additional information regarding the test instances, please refer to test Instances Table of 100BASET1_IOP_32 of [1]. 有关测试实例的更多信息，请参考[1]的100BASET1_IOP_32的测试实例表。
Pass criteria 通过标准	Each test iteration shall be classified as passed, if the DUT reports all expected cable errors. 对所有错误组合重复步骤1至3（或者打开MDI +和/或MDI-） Each test iteration shall be classified as passed, if the DUT reports all expected cable errors. 如果DUT报告所有预期的电缆错误，则每个测试迭代应归类为通过。
Test iterations 测试迭代	5 times.
Notes备注	For additional information regarding the near and far end open, please refer to Notes of 100BASET1_IOP_32 of [1]. The results shall be reported for each 100BASE-T1 port available in the DUT.

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Tester Name

R&S

DUT HW Version

0.0.1

DUT Test Port

1

of

4

Version to execute

Version 2

Golden Device IP address

192.168.0.49

Logs Folder

C:\Users\eparra\Downloads\gd-logs

System Date

08.08.2019

DUT SW Version

0.0.3

Tester Network Interface

Ethernet

192.168.0.99

Stop

Start

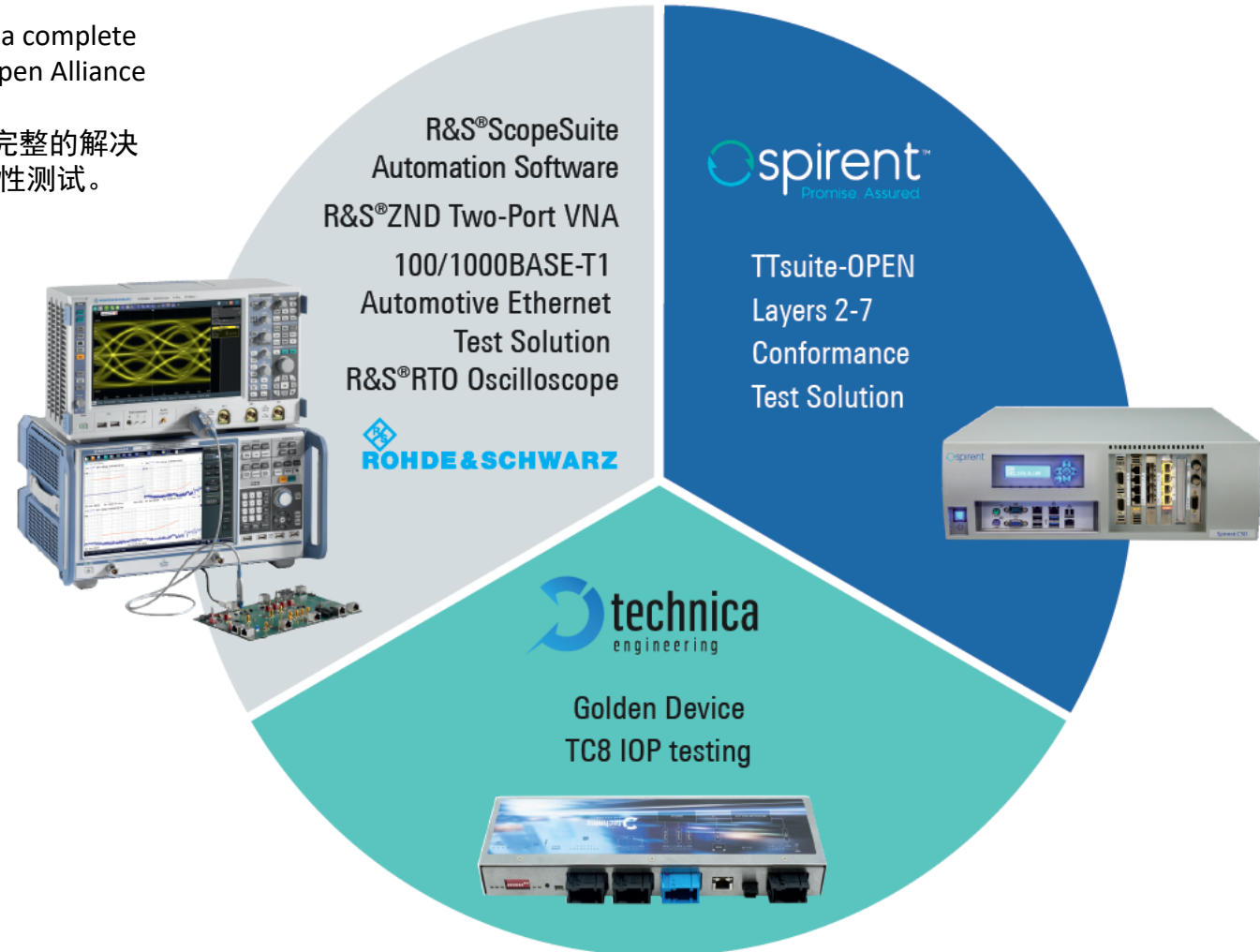
Previous

Next

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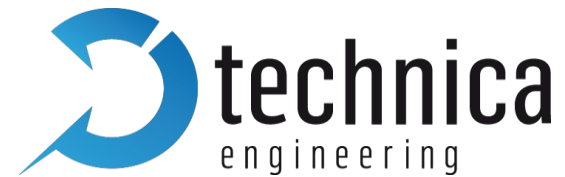
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Let's talk!



Thank you for your attention!

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