Application Note

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MicroBridge Connector Position Assurance (CPA)

The MicroBridge connector system does have a feature that allows to ensure that plug and receptacle are always safely mated in applications. This feature is called Connector Position Assurance (CPA). The CPA feature is comprised of a dedicated short pin in the center of the connector and its pin field. Please refer to the datasheet for further details.

Herein we refer to cable interconnects made up of at least one MicroBridge PCB connector (plug, male) with its respective mating MicroBridge cable connector (receptacle, female) on one side. On the second side of the interconnect there can either be another connector pair – preferably again MicroBridge – or a directly attached board assembly just to mention another possibility.

How can an application deploy the CPA feature?

In general, the mating state of the CPA pin needs to be sensed. There are two thinkable approaches to an effective utilisation of the CPA feature:

- Static current flow in a loop made up of two wires connected to the receptacle with state sensing
- Local short circuit wire jumper from pin to pin directly and permanently attached to the receptacle on Side A. This option may pose a risk to the quality of the jumper connection.
- Not recommended but theoretically thinkable was to contact the receptacle's contact system where the IDC blades are visible through the small windows in the housing with a dedicated adapter. Difficult adaption and handling appears prohibitive.
- Reflectometric sensing: After mating a connector pair (DUT) an impedance test system probe can be connected to a test port (appropriate contact pad pattern on the PCB) and the test signal be triggered. This test is based on propagation time measurement between an exciting signal pulse and its reflection from the signal path.
  Advantage: no closed signal loop needed.
  Disadvantage: Rather expensive test equipment; complicated to apply
  Evaluation:
  FAIL: immediate reflection from an open end - CPA contact pin pair open / not mated
  GOOD: certain longer time to a reflected signal occurring at the test port.
- Following we give a description of the static method.

What is necessary? What can be expected from this method?

In order for this method to be effective, auxiliary energy has to be applied or the board assembly with the MicroBridge connector has functionally to be tested. Both cases employ a dedicated, external circuit or test equipment to stimulate the connector pair with current and subsequently to evaluate the status of the mated pair for OK or for FAILED in the case of an incompletely mated connector pair. This evaluation happens through a dedicated shorter connector pin placed in the center of the plug connector housing.

Please note, there can be no test or check of the mating state of a MicroBridge connector pair in conjunction with ERNI's electrical CPA without energy be fed to that connector pair.

In general, a wire loop needs to be established for the static method we solely consider here, and at a first glance, it appears there might be a loss of two contacts just for the electrical CPA. However, one wire of the loop can be accomplished through the GND connection and – of course – there cannot be any circuit without such a GND connection. The second wire, the very "test signal", is limited in its utilisation to the Connector Position Assurance feature, as the spring contact only minimally overlaps with its corresponding mating pin while both housings go solid with each other and the second level interlocking latches. ERNI does not recommend to use the CPA pins for anything else. Due to its skinny shape the CPA pin is limited in its current carrying capability. In order to utilise the CPA feature a wire needs to be assembled in the CPA pin position and also be connected on the second side to form the closed loop.

Operating modes of a circuit with electrical CPA

Mode 1: regular operation mode

Mode 2: test mode

As the CPA pin and its corresponding spring contact, including the wire assembled in it, are solely dedicated to sensing the fully-mated state of the connector pair there is no interdependence between the regular operation mode and the test mode and their respective circuits.

Examples for the utilisation of the CPA feature

"Example 1" – Evaluation circuit on Side A

Refer to below schematic

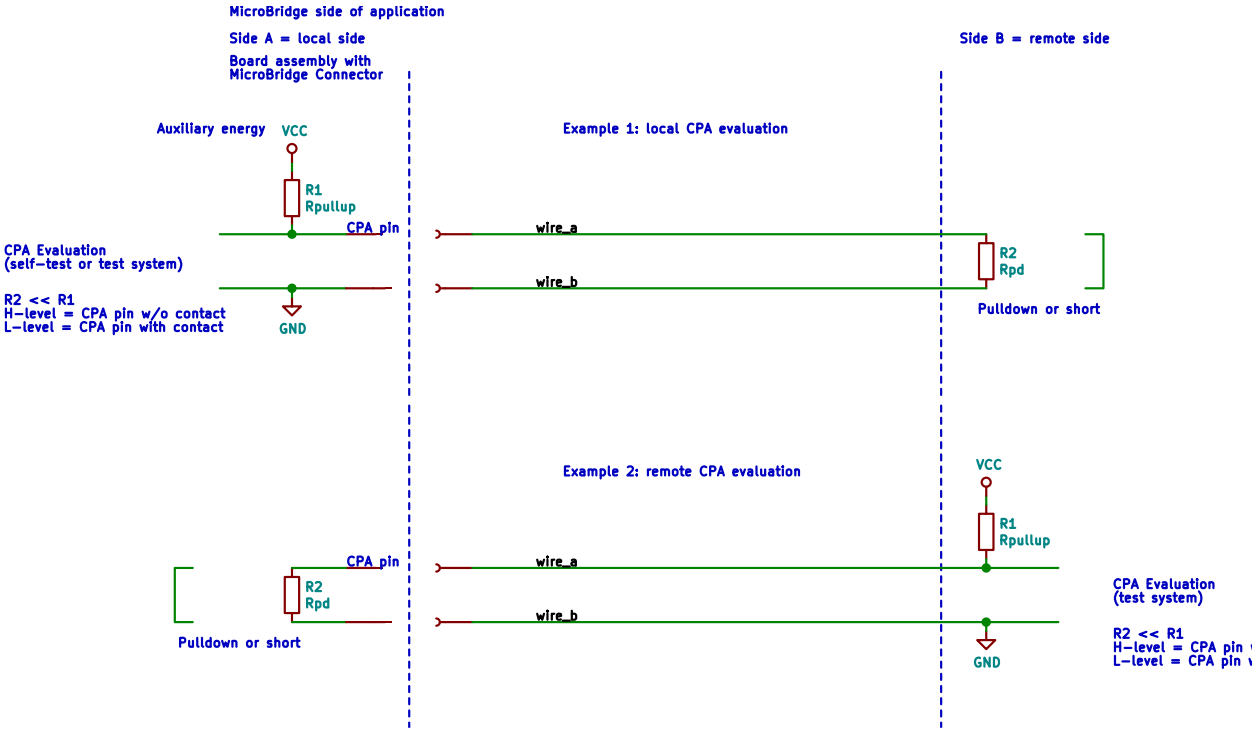
"Example 2" – Evaluation circuit on Side B

Refer to below schematic

Terms used in the below schematic

"Side A"	local side = the side of a cable assembly where the connector pair with CPA resides
"Side B"	remote side = the secondary side that is just considered as it closes the wire loop
"Wire a"	the wire connected to the CPA pin
"Wire b"	the wire that closes the loop (might be GND)

Example Circuits Schematic



Mating states and their evaluation

The three mating states of the MicroBridge connector system's CPA version described below are travelled during mating in exactly this sequence.

"half-mated"

Safely detected as CPA contact pair is guaranteed to be open - in our examples indicated by a high signal level.
Mating state with no interlock employed at all and with some or all pins and contact springs engaged but those can lose contact at any time.

See picture 1.

"safely mated"	The intrinsically safe fall-back state of a failed attempt to reach the deepest mating position. If during mating even only a temporary "safe CPA indication" occurred this state can be assumed to be entered – all working contact pairs are now mated with sufficient wipe length and the MicroBridge connector system was fully qualified in this mating state and all datasheet figures are guaranteed! Mating state with the first-level interlock pair engaged and working contacts safely mated without any restrictions; the CPA contact pair may or may not display electrical continuation. **See picture 2 and 3.**
"safe CPA indication"	**"fully mated"** If after disturbances like pull-forces, applied to the harness or the receptacle housing, "safe CPA indication" permanently occurs at the CPA contact pair it is safe to assume the ultimate mating state with minimum mechanical play has been reached (this is indicated by a low signal level in our example circuits). Mating state with the second-level interlock pair additionally engaged and the CPA contact pair – beyond working contacts – is assured to indicate electrical continuation. **See picture 4.**

Working steps of MicroBridge connector mating including CPA testing

Procedure:

1) Apply test system probes or energize self-test circuit to the local side (Example 1) or the remote side (Example 2)
2) Firmly mate the receptacle connector housing with the plug connector housing
3) One or two audible clicks occur
4) Evaluate the CPA contact's state by employing a) a circuit test system or b) by operating a self-test circuit that indicate GOOD or FAIL
5) In case of FAIL MORE firmly and carefully press the receptacle housing again towards the plug housing
6) Repeat 4 until the evaluation yields GOOD

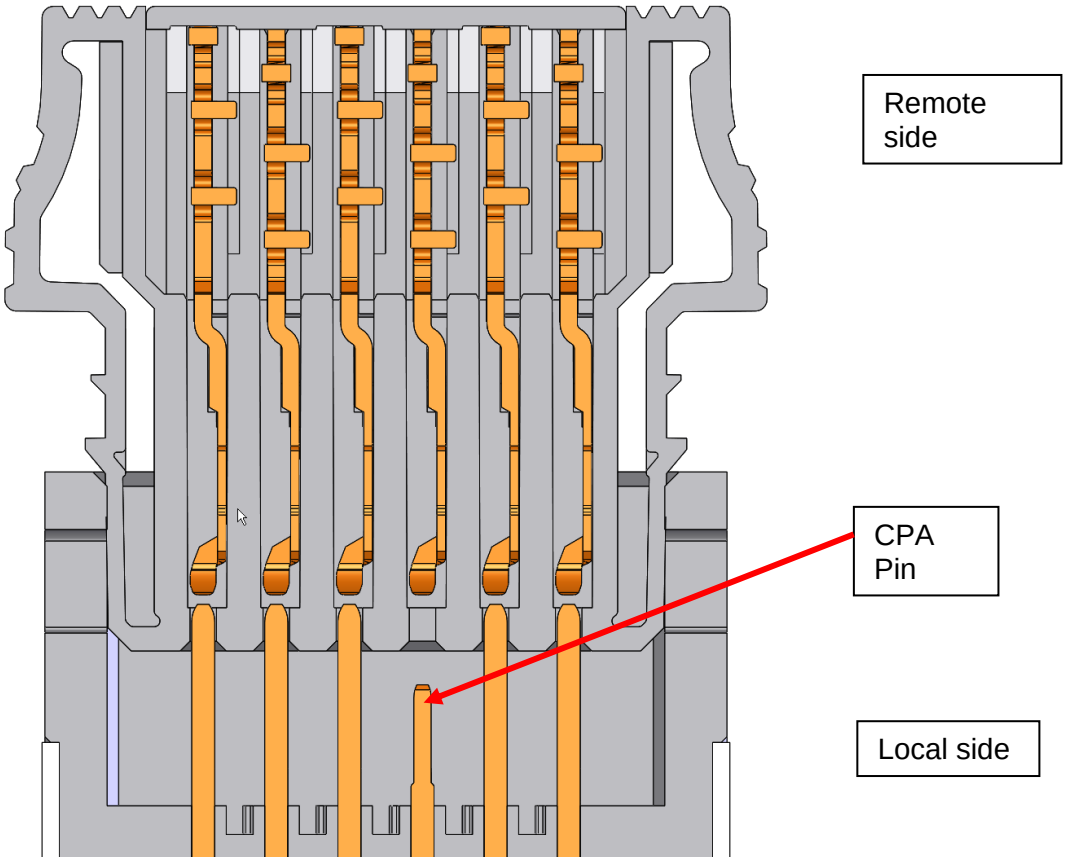
7) If GOOD does not occur apply an appropriate failure handling procedure.

Pre-conditions of the above procedure:

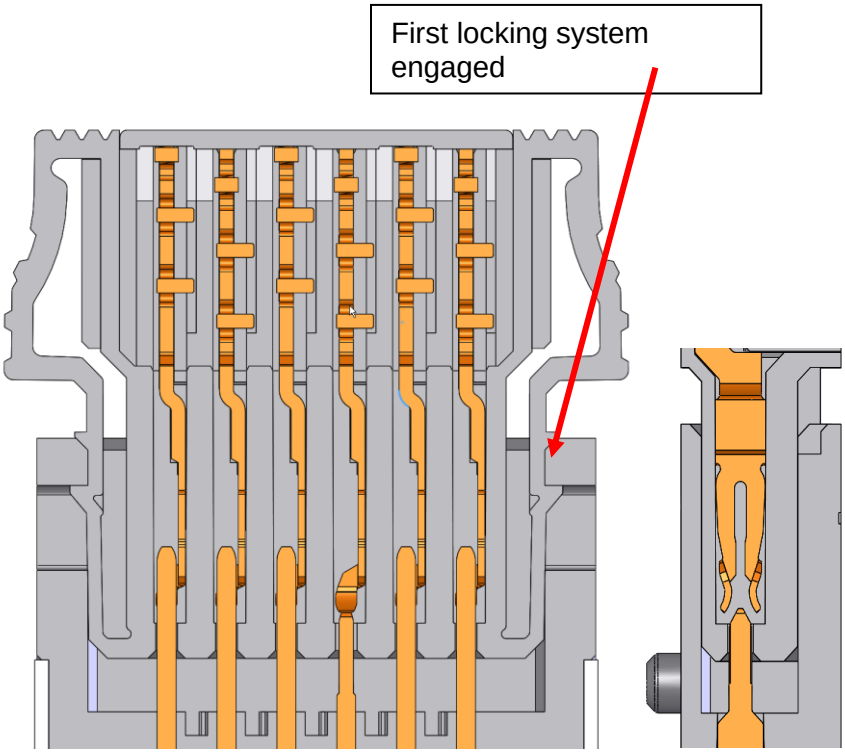
I. Side A and Side B are connected either according to schematic "Example 1" or "Example 2"

II. On Side A there is definitely a MicroBridge CPA receptacle mounted on the board assembly

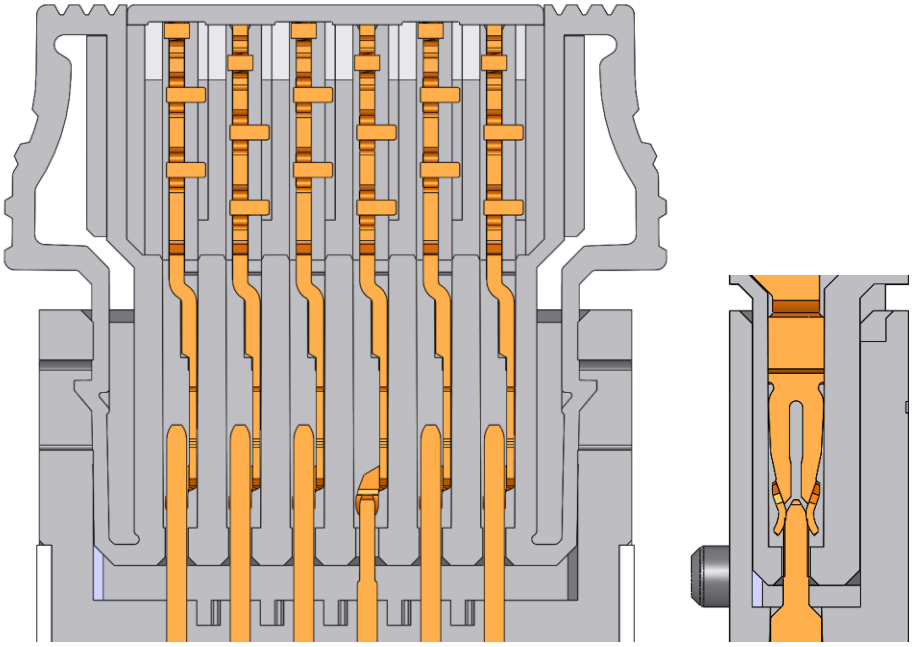
III. The second side of the cable assembly has already been connected – also refer to "Example 1" and "Example 2"



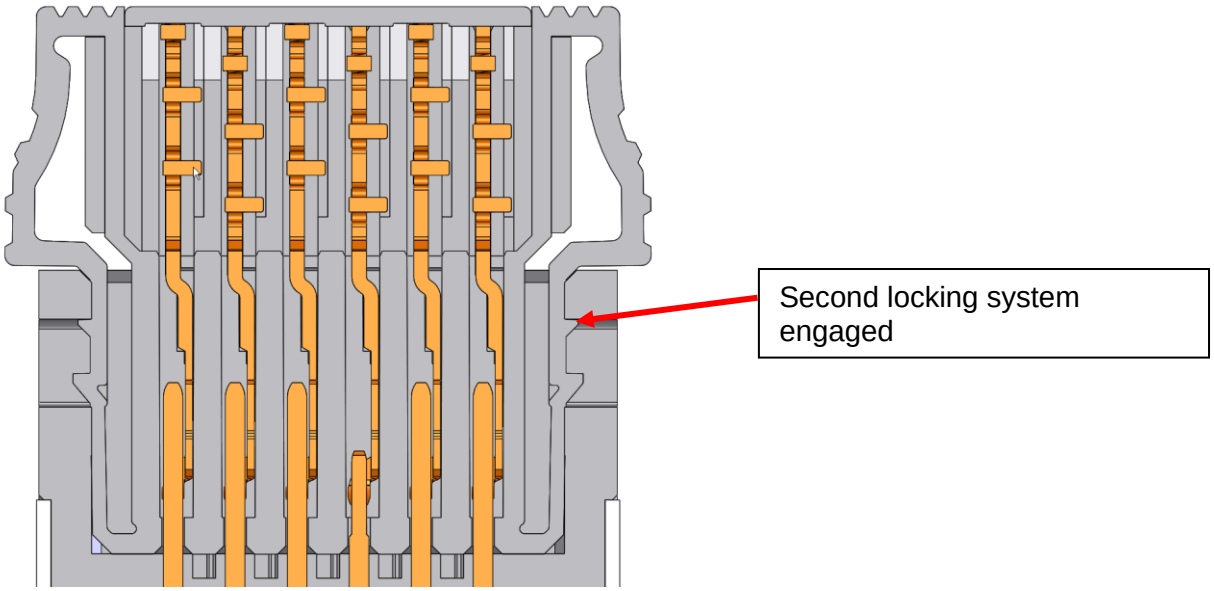
Picture 1: Half mated situation. No contacts mated.



Picture 2: Safely mated, signal contacts mated. CPA signal unmated.



Picture 3: Safely mated, signal contacts mated. CPA signal mated.



Picture 4: Fully mated, signal contacts and CPA signal mated.

Evaluation of several CPA connectors

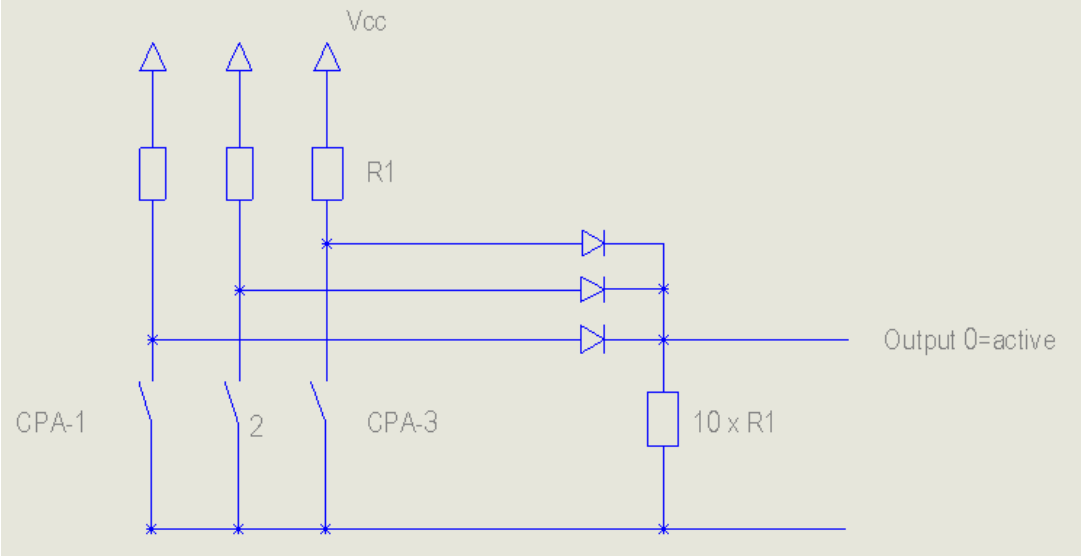
The evaluation of several CPA pins from different connectors can be done in different ways.

The easiest way is to connect the CPA evaluation signal to a logic AND Gate.

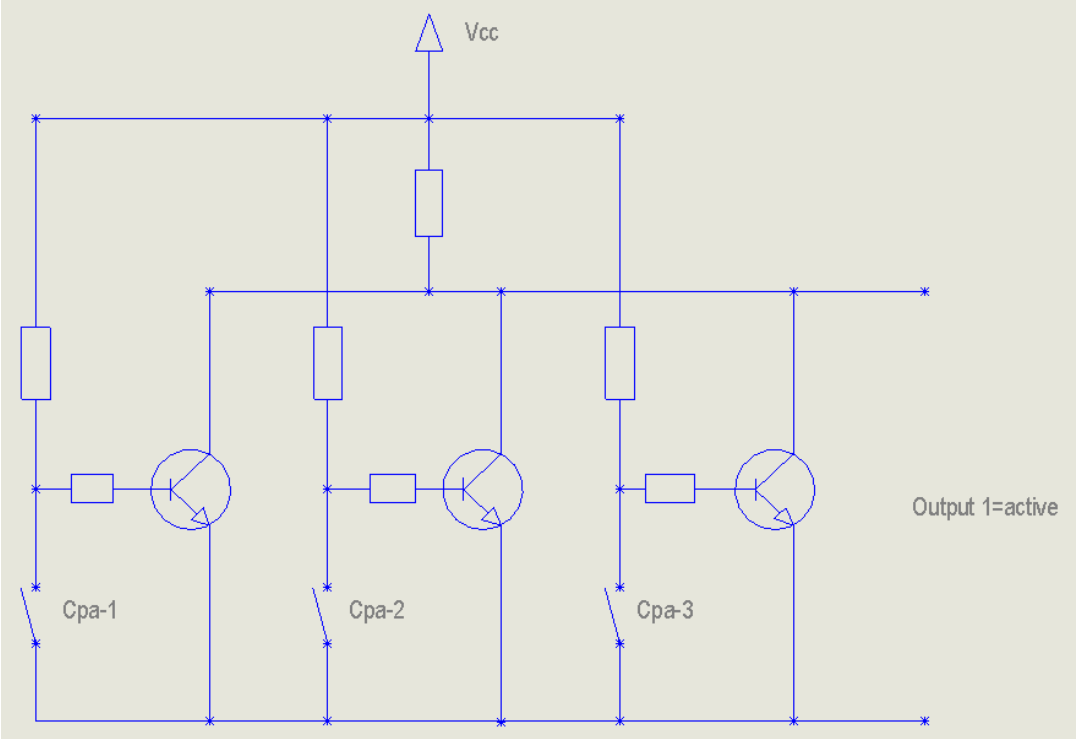
Another opportunity is to realize a Wired AND connection.

For this, we can use a resistor or a diode solution.

Diode solution, Wired AND



Transistor solution, Wired AND



Revision history

Revision	Date	Prepared by	Comments
1.0	16.08.2019	Eifer/Moedinger	First edition
2.0	14.01.2020	Moedinger	Preliminary