ELECTRICAL WIRE PROCESSING TECHNOLOGY EXPO 2025
CONFERENCE: MAY 6-8 | EXHIBITION: MAY 7-8
BAIRD CENTER ▪ MILWAUKEE, WI
HARNESS CONNECTIONS

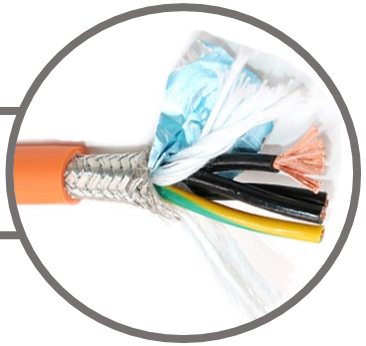
Understanding Cable/Harness Shield Testing Requirements and Solutions

Presenter:

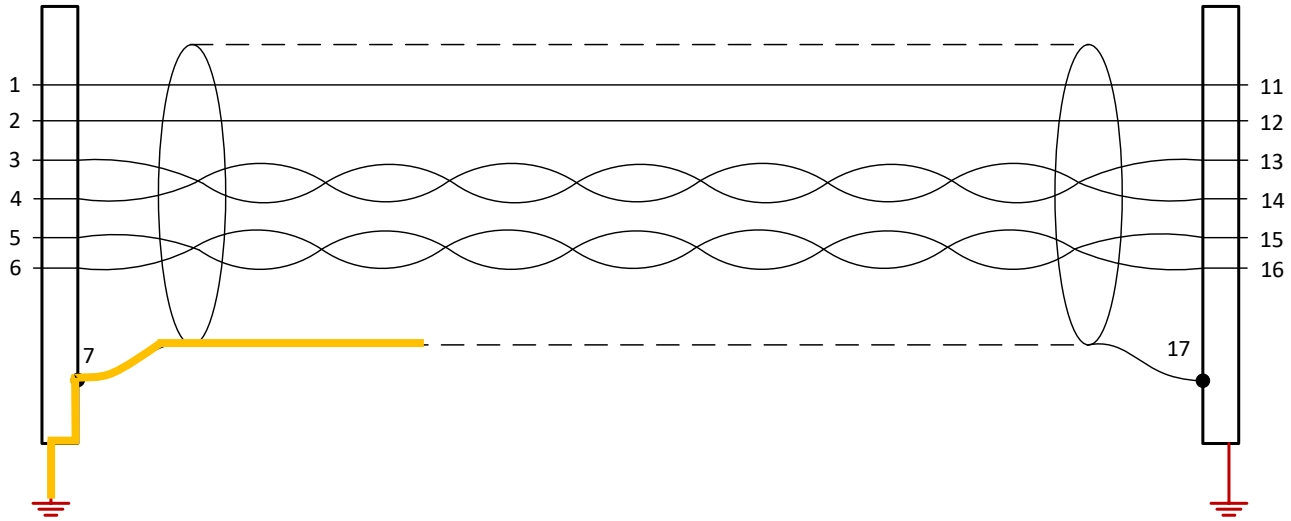
David Shier
President
DIT-MCO International, LLC

HARNESS CONNECTIONS

Use of Shielded Cable

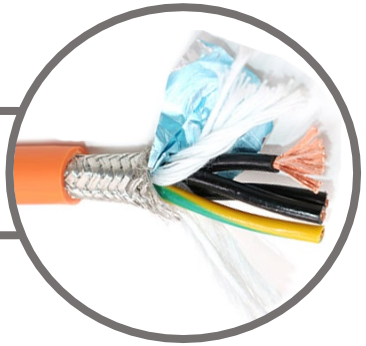


- Shields are used to provide the internal conductors isolation from external noise.
- The shield acts as a Faraday Cage which reduces capacitive coupling that would impact the signals carried by the cable.
- The shield must be grounded to provide the needed isolation.

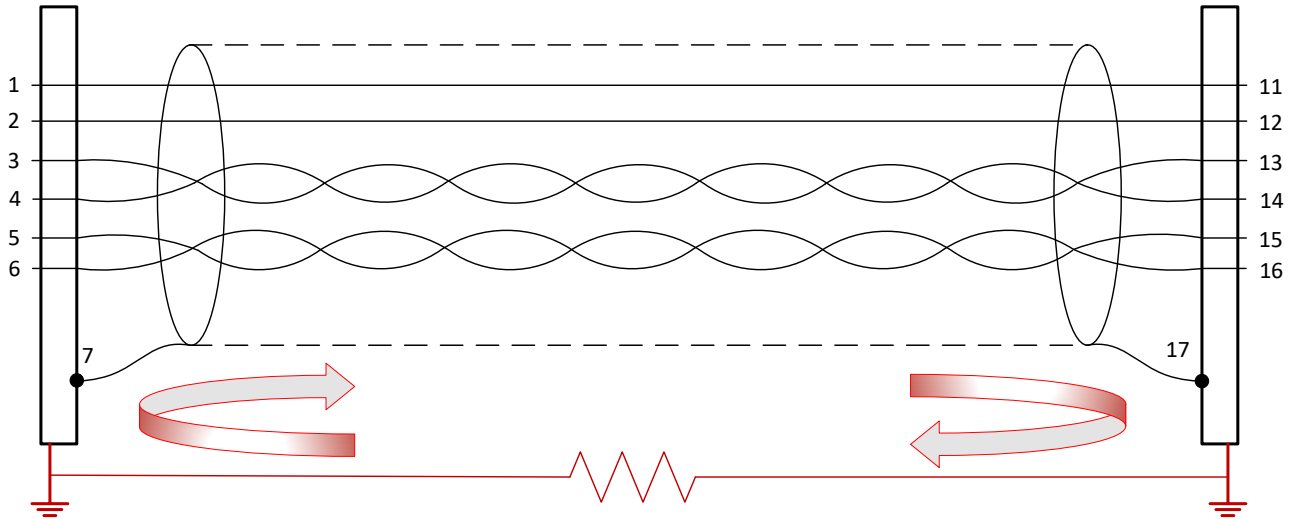


HARNESS CONNECTIONS

Shield Connections



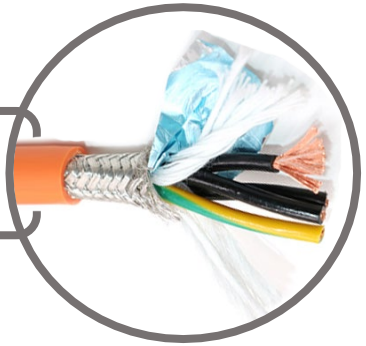
- While some cables connect the shield at both ends of the cable, in cases where the ground potential at each end is not precisely the same, this can induce a current flow in the shield, and is known as a “ground loop”.
- Ground loops can cause noise, and interference in the signals transmitted through the cables.



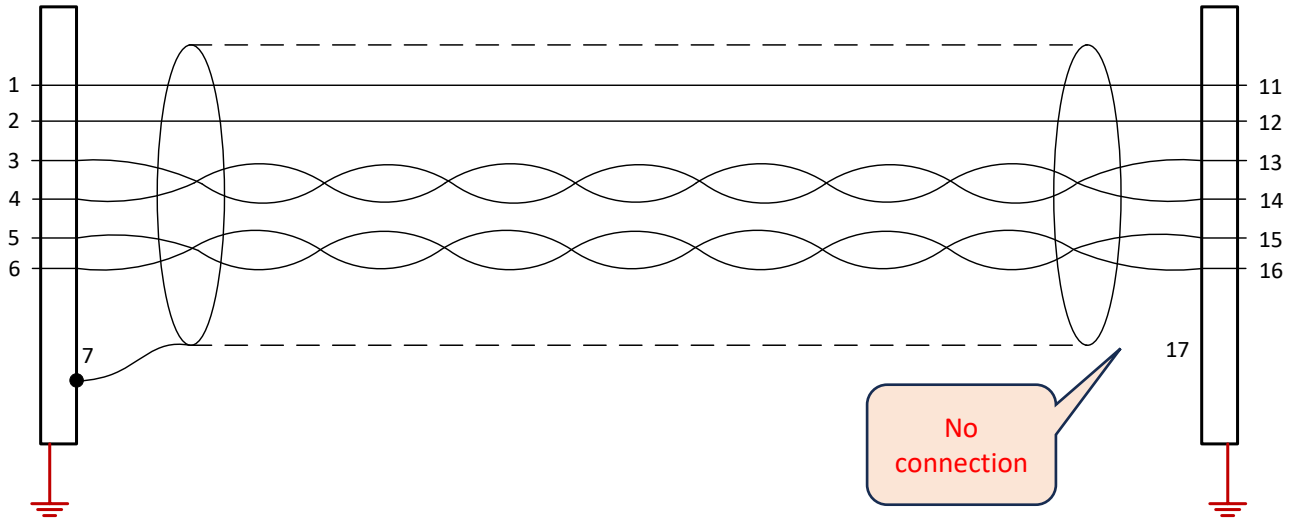
HARNESS

CONNECTIONS

Shield Connections

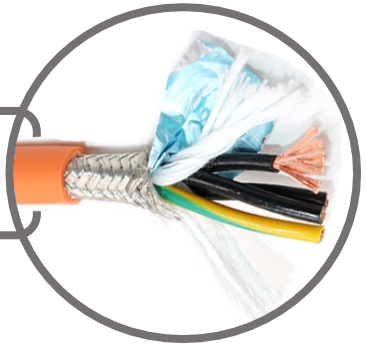


- Isolating the shield from the shell of the connector at the far end of a cable provides a single grounding point for the shield and eliminates the ground loop.
- When the shield is connected at one end only, there will be no continuity between the connector backshells.
- Conventional continuity testing cannot be used to determine proper wiring.
- Visual inspection may not be practical if the connectors are sealed.

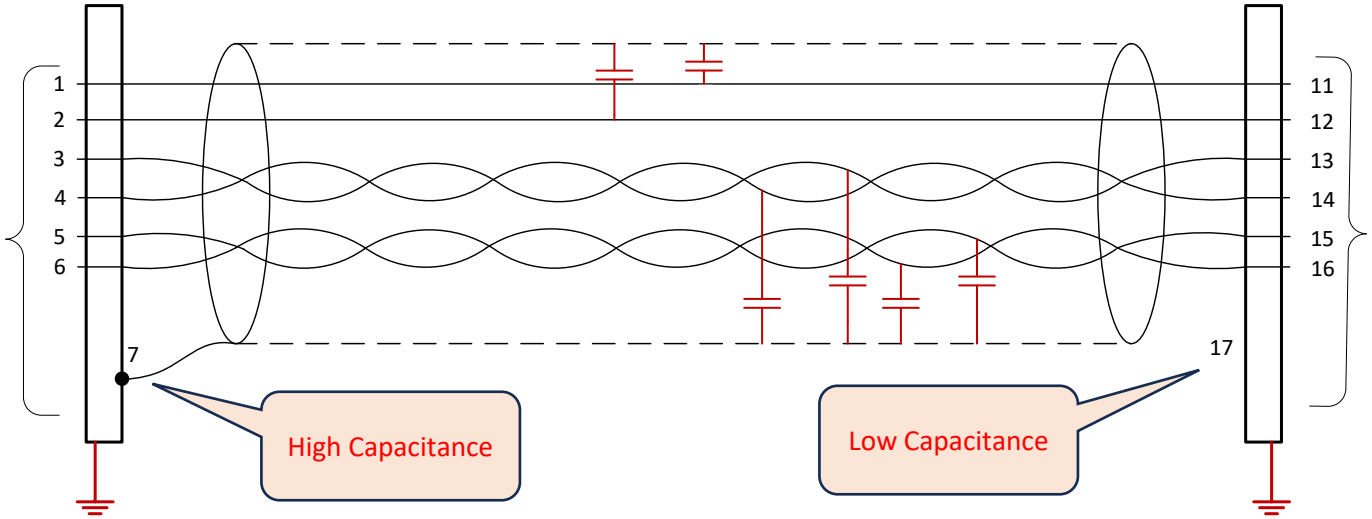


HARNESS CONNECTIONS

Testing via Capacitance

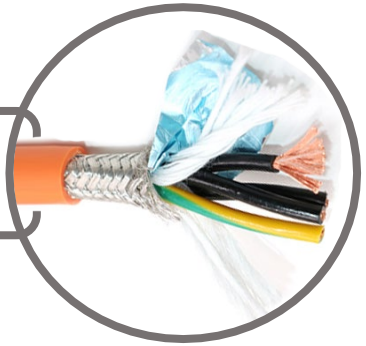


- The shield is capacitively coupled to the conductors of the cable.
- Measuring capacitance between signal pins and the connector shell can be used to detect if the shield is connected or not.
- Unfortunately, the capacitance is a relatively low value, on the order of a few hundred picofarads.

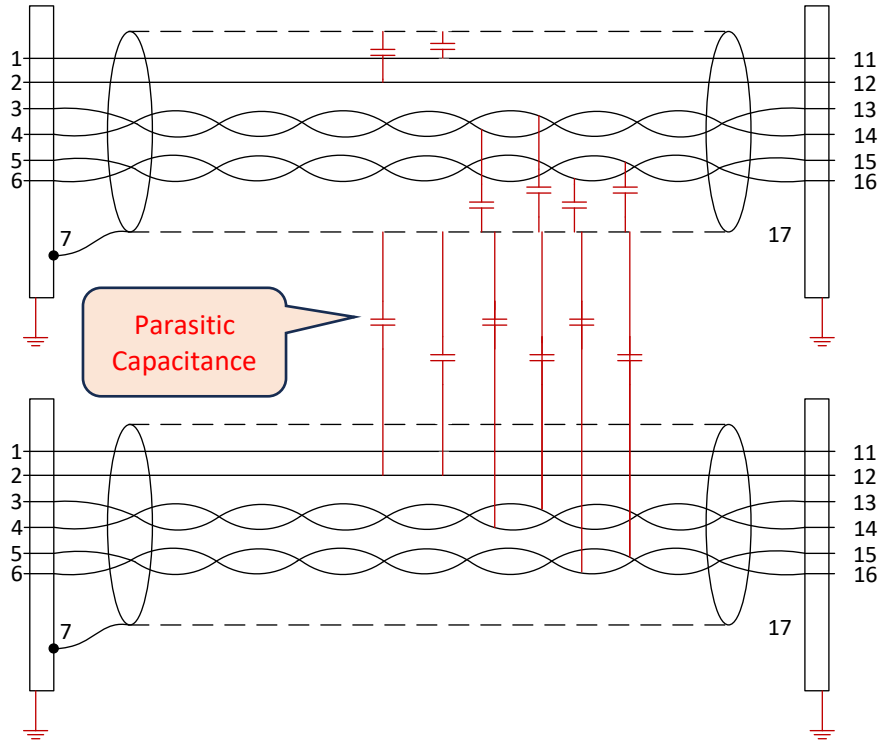


HARNESS CONNECTIONS

The Parasitic Capacitance Issue

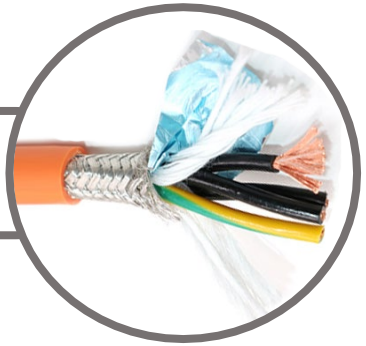


- Since the shields are tied together in a harness, there is unwanted capacitance between all the wires in the UUT and the shield to be tested.
- This parasitic capacitance overwhelms the measurement of the capacitance we are trying to measure.
- The test system and test adapters also contribute to this parasitic capacitance.
- While “tare” measurements can be used to subtract out this extraneous capacitance, the total value can be more than two orders of magnitude greater than the value we are trying to measure. Thus, this is rarely a practical solution.



HARNESS CONNECTIONS

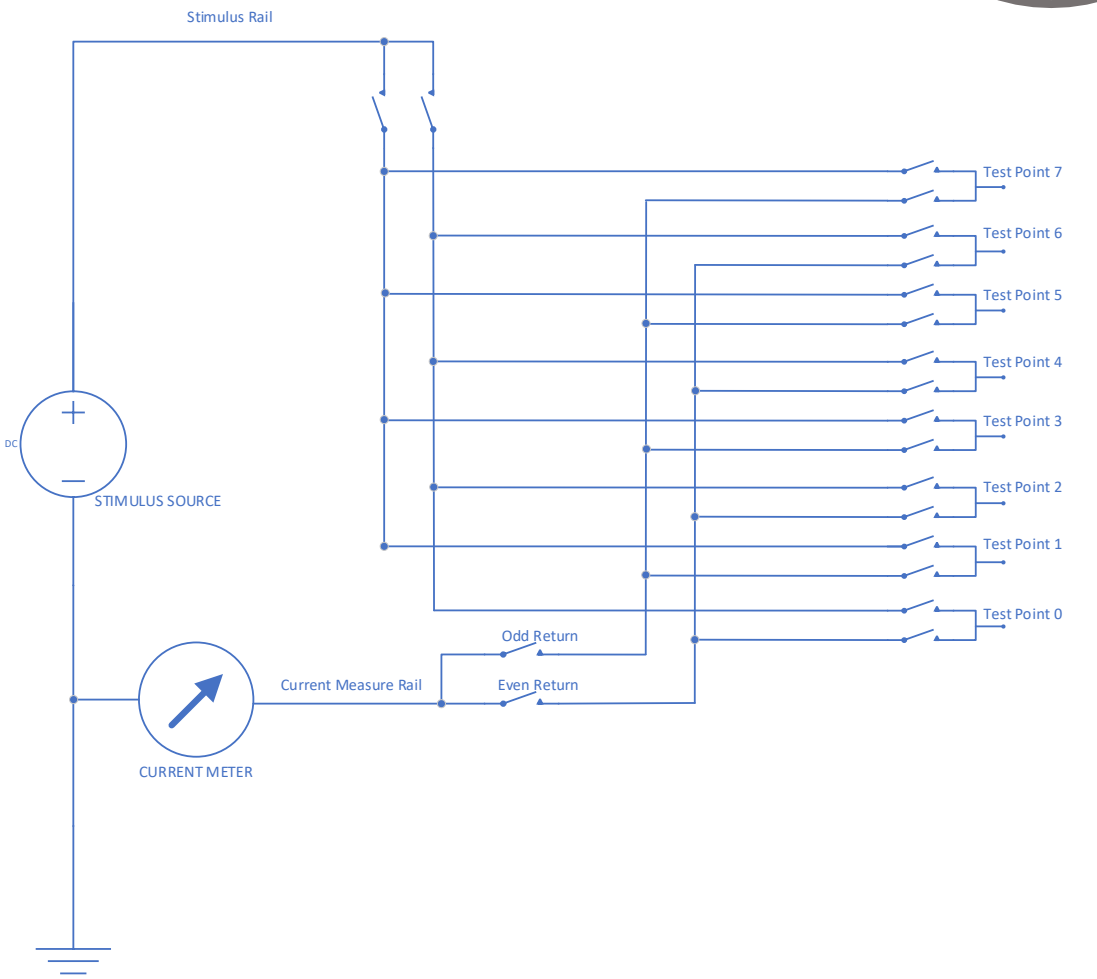
Harness Test Systems



- A typical harness test system determines the capacitance by measuring the current and dividing that the change in voltage over a portion of the charge time:

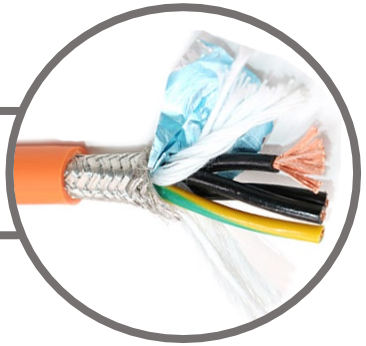
$$C = \frac{I}{\frac{dv}{dt}}$$

- The problem is that nasty parasitic capacitance!

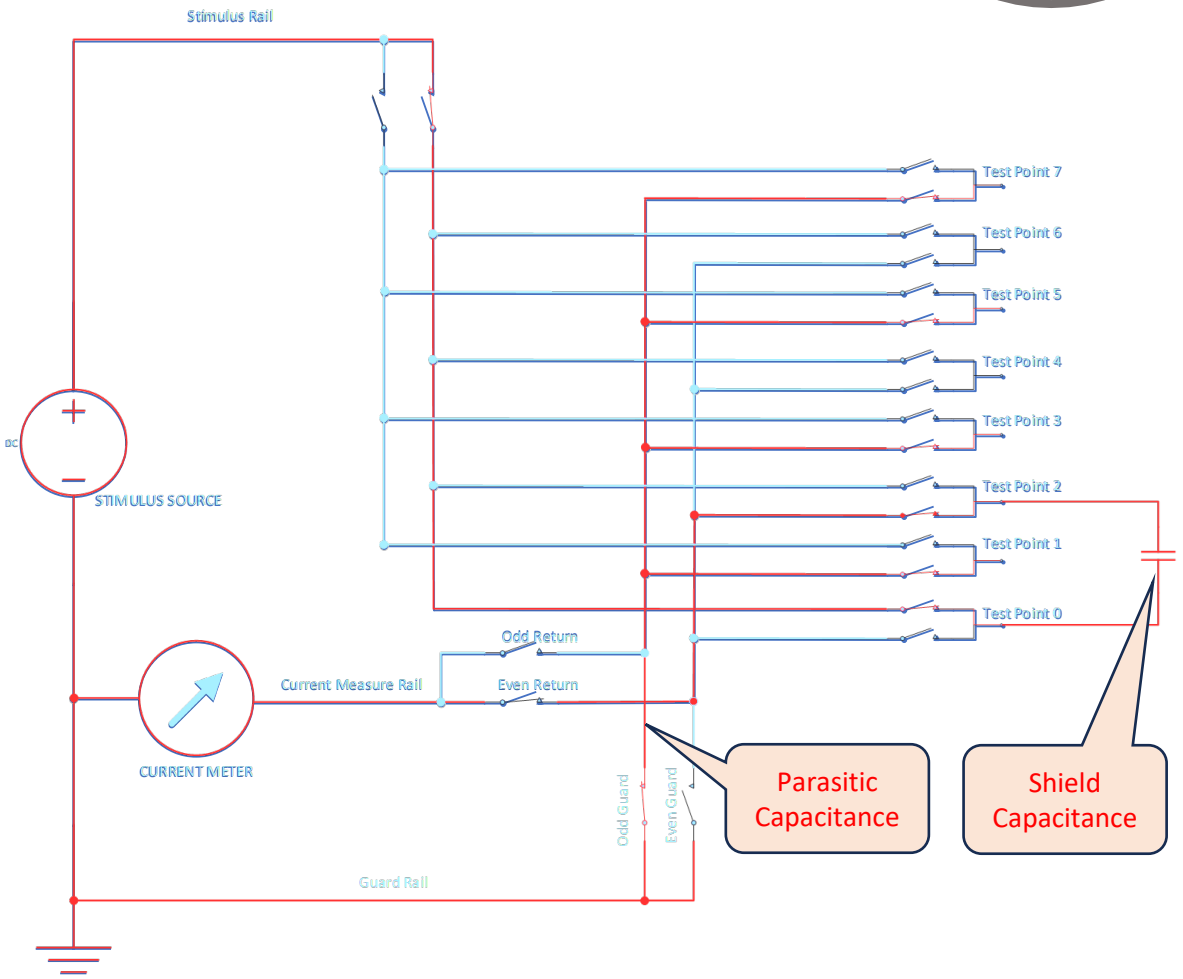


HARNESS CONNECTIONS

Guarded Matrix

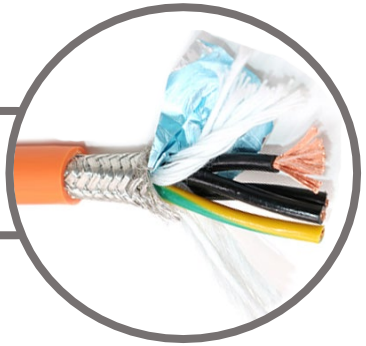


- The addition of a “guard” bus that bypasses the current meter, makes it possible to ignore the impact of the parasitic capacitance when performing the measurement.
- This technique is not new but requires 50% more relays in the switching system making it cost prohibitive for most applications.
- By using our (patent pending) solution, we guard >80% of the points without the need for an extra relay per test point.

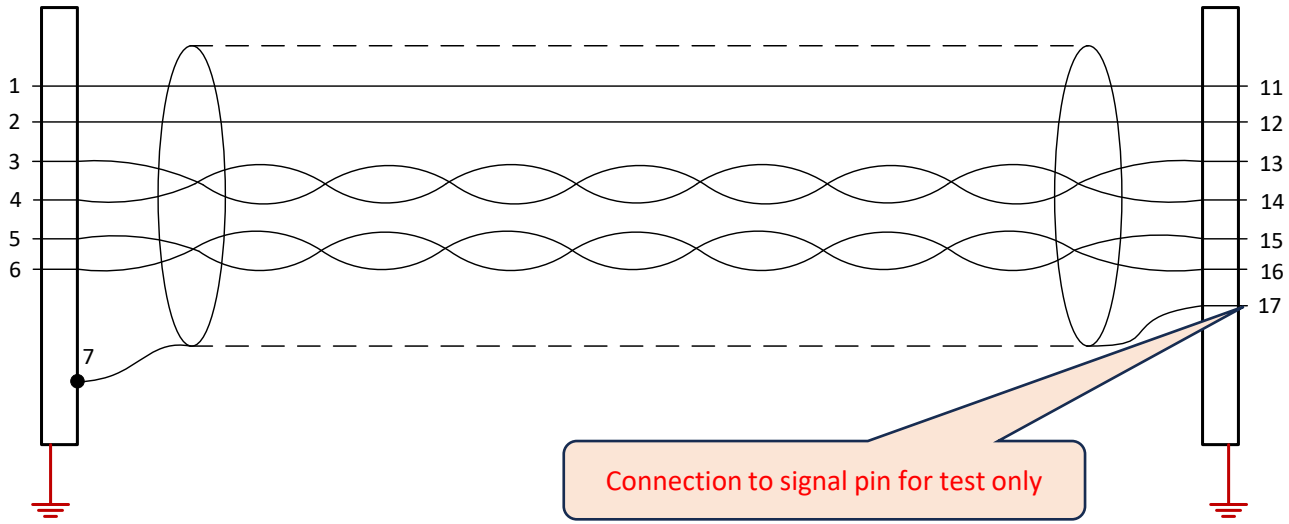


HARNESS CONNECTIONS

Alternative Harness Design



- If you have control of the harness design, then require shields to be connected to a spare signal pin at the end where **it is to be isolated from the backshell.**
- This pin would be an N/C on the mating connector side, so isolation is maintained.
- This allows for the testing of the integrity of the shield connection(s) using conventional continuity and isolation tests.



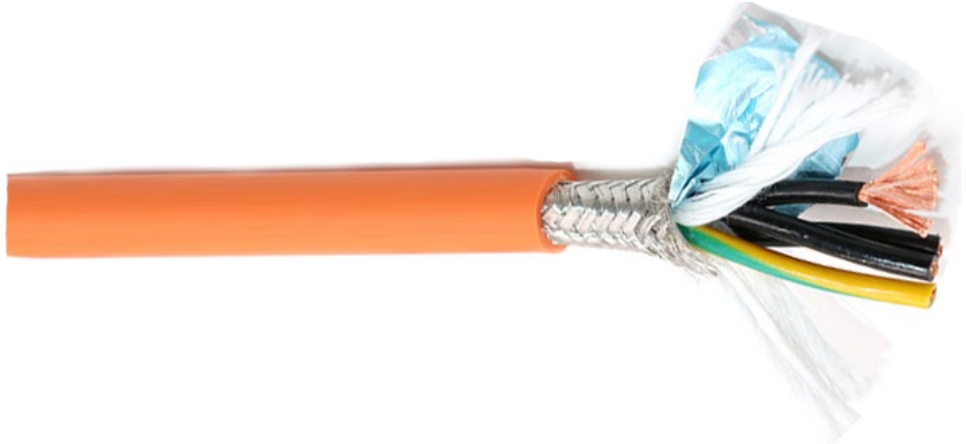
HARNESS CONNECTIONS

Conclusions

- Testing shields terminated at one end of a cable cannot be performed with standard continuity testing.
- If visual inspection is not an option, capacitance testing is required.
- Capacitance testing is generally not practical due to high “parasitic” values overwhelming the test.
- Guarded matrices can help, but are generally expensive.
- The patent pending solution of a “semi-guarded” matrix is a cost effective solution.
- Simple design changes can solve the problem, but “design for testability” is rarely a priority.

HARNESS CONNECTIONS

Questions?



- For more information, contact:
  - Scott Ruland
    Director of Engineering
    DIT-MCO International, LLC
    SRuland@ditmco.com

    or…

  - David Shier
    President
    DIT-MCO International, LLC
    DShier@ditmco.com

DIT-MCO INTERNATIONAL