

Application Note



Hot plugging of PoE Modular Jacks

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1 Introduction

Modular jacks (MJ) connectors and cables are broadly used to bring Ethernet signal up to 10 Gb/s depending on the category of the product. It is also possible to deliver power through it. This is called PoE (Power over Ethernet), defined by IEEE 802.3 standard, which is divided in four different types, providing different Power delivery as shown in Table 1.

	PoE Type 1	PoE+ Type 2	4PPoE Type 3	4PPoE Type 4
Standard IEEE	802.3af	802.3at	802.3bt	802.3bt
Power max delivered by source (PSE)	15.4 W	30 W	60 W	90 W
Current max	350 mA	600 mA	2 x 600 mA	2 x 960 mA

Table 1: Summary of the different PoE power classes

Type 1 and 2 PoE specifications are applicable to Würth Elektronik modular jacks. In this Application Note we will study if recommendations can be extended up to Type 4. Moreover most WE MJ connectors are rated up to 1.5 A. That is why they will be tested at this current.

However, like all of the other types of input/output connectors, MJ connectors should not be plugged and unplugged (hot swapped) under load. Disconnectors products (breakers, switch, etc.) have special disconnection areas to be able to break the electric arc without damaging the contacts. This Application Note will show the capabilities of modular jacks in case they are accidentally used as a disconnector product in a PoE application.

2 Hot swap tests

2.1 Electrical sparks

A disconnection under load (voltage and current) must cut the current between mating contacts. The power will ionize the air between the contacts which will let current go through it until the separation distance is too large. This spark or electric arc can damage both sides of the connector. At low power, sparks can degrade the plating and thus drastically decrease contact quality over time.

2.2 Modular jack connection

All Würth Elektronik modular jacks are gold plated with a nickel underlay, ensuring a very stable and optimized electrical contact during its mating life cycle specifications.

We saw that sparks are likely to create plating damages. It has been found that sparking can cause damage to the coating. When a connector is inserted into the jack, the electrical contacts first mate at the front end of

the jack contact spring (attack point). Then the contact point moves towards the rear end of the contact spring (E-Point). The mechanical and electrical contact points are therefore physically separated from each other. Even if the coating on the first contact point is being damaged, the electrical contact remains unharmed.

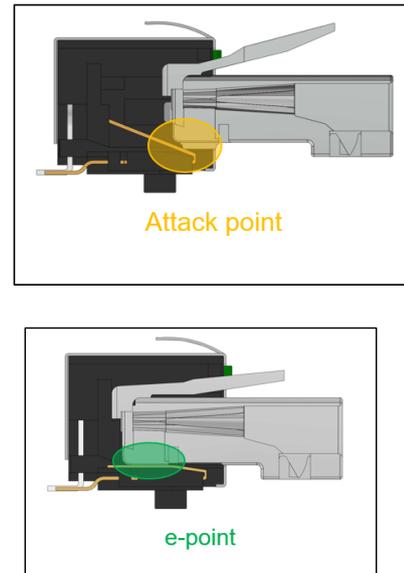


Figure 1: Modular jack contact

2.3 Test plan and results

Contact resistance change is monitored to highlight any contact pin damage. The rated 750 mating cycles are performed as per WE modular jack specifications. The initial measurement is done without current for a reference. Then the worst case simulation is performed at 1,5 A. This covers PoE capabilities up to Type 4 (960 mA). The test is performed on three different modular jack designs and all products are new out of the stock.

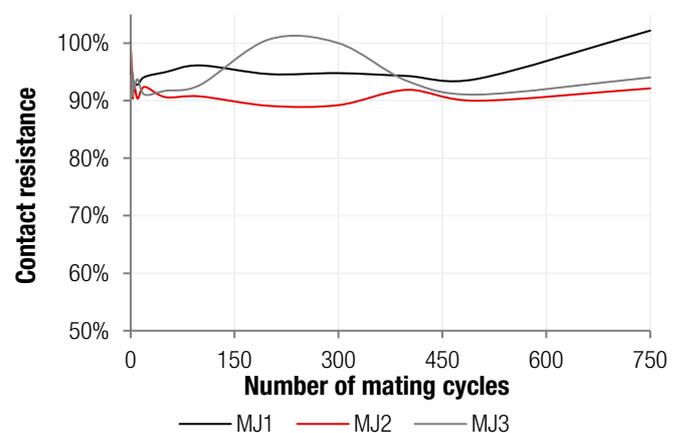


Figure 2: Contact resistance change vs. mating cycle under load at 1.5 A

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Values are presented in percent for a clearer comparison of the change.
The initial measurement at zero current is 100 % for each modular jack.

First observations:

- All the values decrease after the first measurement.
- Contact resistance is very stable for the three samples
- Electrical contact area does not show any traces of degradation after 750 mating cycles under load.
- Visible degradation at the contact point area does not impact the usability of the MJ's

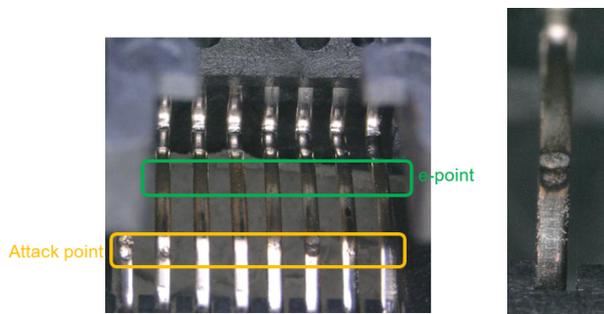


Figure 3: Modular jack pins after 750 mating cycles at 1.5 A

Conclusions:

- Contaminants are removed by the wiping action of the contacts during insertion. Modular jacks from Würth Elektronik are self-cleaning
- Hot swap has no impact on the quality of the electrical contact at the e-point with up to 1.5 A and 750 mating cycles
- Samples were from CAT 3, CAT 5e, and CAT 6 products. The jack's category is independent of hot swap capability

3 Summary

Electrical switches products are designed to open and close circuit under load. Modular jacks are not switches so they are not meant to be plugged and unplugged under load. However, Würth Elektronik modular jacks, thanks to their design are able to withstand accidental mating cycles under load whenever used within the current specifications.

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