Application Note

Optimizing Short Circuit Performance of AZEV116 / AZEV132 / AZEV140

Introduction

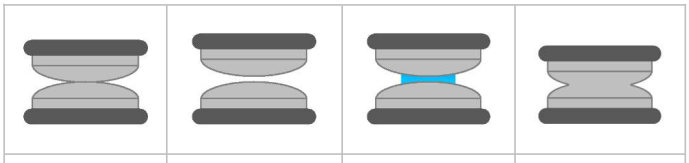
ZETTLER's relay series AZEV116, AZEV132 and AZEV140 are designed specifically for applications needing exceedingly stringent short circuit current capability as it is required by certain application standards like IEC 62752, IEC 61851 and IEC 62955.

The intent of this application note is to provide the necessary background information and to give practical hints and tips to fulfil these requirements.

Issues with short circuit currents at relay contacts

Excessive over currents, as they occur in short circuit conditions, may have the risk of welding the contacts of a relay and thus permanently damage the part and leading to malfunction of the application.

The reason behind this failure mode are excessive repulsing magnetic force at the contact tips which may be higher than the closing force of the contacts in normal operating conditions. This repulsing force - which is proportional to the square of current - may open the contacts temporarily which leads to electrical arcing at the contact tips and thus excessive heating of the contact surfaces leading to softening of the contact materials. As soon as the contact tips meet again, welding will occur.

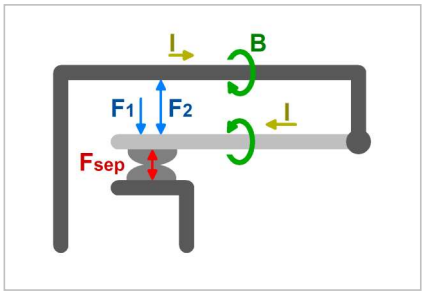


In normal operating conditions current flows through the closed contacts.	At extreme currents the contacts open due to repulsive magnetic forces at the contacts.	Electrical arcing occurs, softening the contact's surfaces at high temperatures.	As soon as the contacts meet again, they will weld or become sticky.

Structure of the AZEV116, AZEV132 and AZEV140 series

The AZEV116, AZEV132 and AZEV140 series feature a special contact structure to generate an additional closing force in case of short circuit conditions.

In normal operating conditions the relay contacts are closed by the relay's coil, generating a closing force F_1. As described earlier, in high short circuit conditions the repulsing separating force F_{sep} may be greater than the closing force F_1, causing the contacts to open. By means of the structural details of the AZEV116, AZEV132 and AZEV140 series, F_{sep} is counteracted by a magnetic force F_2 which is generated by the very same short circuit current. Due to F_{sep} is reduced by F_2, the risk of welding is minimized.



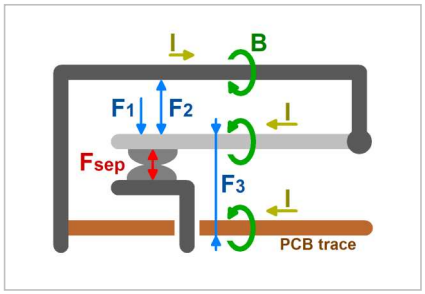
AZEV116 / AZEV132 / AZEV140 series contact structure

Multiple relays on the PCB

In 3-phase charging systems, three or four relays can be placed on one PCB. In these situations, special care must be taken according the placement and the mounting distance of the relays and the routing of copper traces of the PCB. The same guidelines should be applied even when using two relays in 1-phase design.

The reason is again the magnetic forces as they may occur in short circuit conditions which will interfere in between the relays and also the relays and adjacent copper traces of the PCB.

PCB designs can even enhance the relay's capability to withstand short circuits by smartly feeding PCB traces underneath the relays and thus generating an additional closing force F_3, as illustrated. This measure is used for the reference PCB layout shown in this application note.

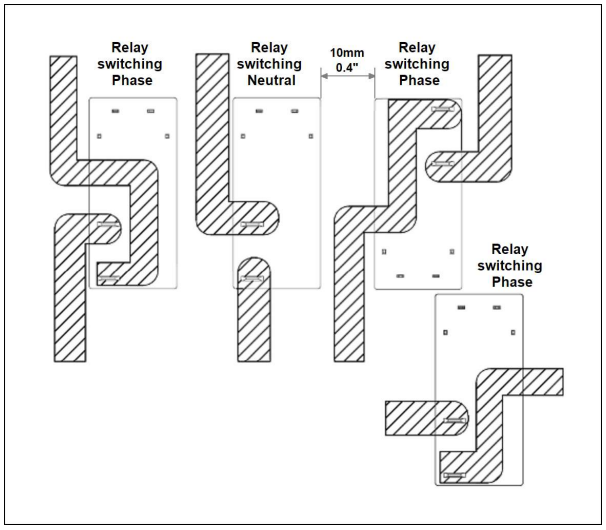


AZEV116 / AZEV132 / AZEV140 series contacts with PCB interference

PCB placement and layout proposal utilizing 4 relays

At ZETTLER, great efforts were made testing the short circuit performance of the AZEV116, AZEV132 and AZEV140 using different PCB layouts. In general, if the relays are placed side by side to each other, a mounting distance of about 50 mm / 2" is necessary in order to minimize magnetic interference and to be capable to withstand short circuits of 1.5 kA_{peak} / 6 kA^2s (AZEV132 series) and 1.85 kA_{peak} / 4.5 kA^2s (AZEV140 series). In practice, this distance is quite space consuming and often impractical. With smart arrangement of the relays, the mounting distance can be successfully reduced down to about 10 mm / 0.4".

A key factor is to have as much distance in between the contacts of the relays that switch the three Phases (L1, L2, L3) as possible. When switching on the relays, it is suggested to switch the relay for Neutral (N) some time in advance (1 sec) to let it stabilize its switching dynamics before the other relays close.



3-phase PCB proposal