

# FACTS ABOUT TYPE 2 “NO DAMAGE” PROTECTION FOR MOTOR STARTERS

## HOW DO SHORT CIRCUIT CURRENTS DAMAGE MOTOR STARTERS?

Short circuit currents can cause damage to electrical components by a combination of up to three ways:

- Excessive electromagnetic forces,
- Excessive heating, and
- Extreme heat energies due to arcs.

In the case of a contactor, the repulsive force created between contact surfaces during a short circuit can cause the contacts to part and begin to break the fault current. The resultant arcing caused by this phenomena can lead to disintegration of the contacts and without proper precautions could lead to a serious arc flash event. Because this force is proportional to the “square of the current” ( $F = I^2t$ ), the magnitude of the force can build rapidly in the first half cycle. Protection against these forces often requires that the instantaneous peak current be kept to a sufficiently low level by current limiting devices.

The next element to consider is heating. Heating of the contact’s surfaces normally occurs because of the contact resistance. Since this resistance is very low, the heat generated during normal operation can easily be dissipated and operating temperatures kept within specified levels. However, under short circuit conditions the heat can build quickly to high levels due to the thermal energy delivered by the current ( $\text{Heat} = I^2t$ ). Excessive heating can damage contacts and also burn open the current element of the overload relay which can potentially lead to an arc flash event if not properly protected. Protection against this heating often requires that the  $I^2t$  be kept to a sufficiently low level by current limiting devices.

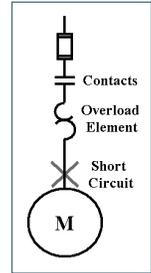


Figure 1. Short Circuit Protection of a Motor Controller

## ACHIEVING TYPE 2 PROTECTION

Type 2 Coordination not only ensures that there is no danger, but that there is “No-Damage” to the controller for downstream faults. The following excerpt is from the UL 508E definition for Type 2 Coordination:

“Under short circuit conditions, the controller shall not result in danger to persons or the installation, and after the short circuit test the controller shall be suitable for further use...”

The only allowable damage under Type 2 Coordination is light contact welding provided that the contacts are easily separable. To qualify for Type 2 Coordination (No-Damage Protection) the motor starter manufacturers must test all combinations of starters, contactors, overload relay and short circuit protective devices (SCPD). The tests include:

- A low-level short circuit test to confirm proper operation of the SCPD.
- A high-level short circuit test to check for No Damage protection of the contactor and overload relay.
- A Dielectric Voltage-Withstand Test to prove the adequacy of the insulation after both short circuit current tests have been performed.
- An Overload Relay Calibration Test to verify that the overload relay conforms to published tripping characteristics.
- A discrimination test to ensure proper coordination between the overload relay and the fuse.

Achieving “No-Damage” short circuit protection of a motor starter requires that the overcurrent protective device limit both the peak current and the  $I^2t$  let-through energy. Type 2 coordination is typically obtained with tests at 100,000A with very current limiting devices.

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## WHICH FUSES ARE BEST?

Tests show that current - limiting fuses are the best choice for the protection of motor controllers if damage - free performance is required. In particular, Mersen AJT (Class J) and A6D (Class RK1) fuses are ideally suited for this application. These current limiting fuses will clear a short circuit within their current - limiting range in less than ½ cycle and prevent the fault current from reaching its first peak.

## FUSES FOR TYPE 2 COORDINATED PROTECTION OF MOTOR STARTERS

The fuses shown are UL Listed for branch circuit protection and have been proven in third party laboratory tests to meet the requirements of IEC 947-4-1 by motor control manufacturers. To properly select these fuses for Type 2 protection of motor starters, refer to the individual selection tables available from Mersen. The data in these tables has been obtained from the manufacturers or their web sites for your convenience. These tables are also available on our website, [ep.mersen.com](http://ep.mersen.com). Also, refer to the Application Section of the Advisor for more information on selecting fuses for motor circuits.



### Amp-Trap 2000<sup>®</sup> AJT Class J Fuse

Starter manufacturer’s testing has proven that the AJT’s lower let-thru energies provide Type 2 protection of NEMA- and IEC- style starters. The ideal choice for new applications of 600 amps and less, the AJT offers excellent current-limiting performance for short circuits and time delay for reliable operation in the presence of temporary overloads. The unique Class J dimensions prevent improper substitutions.



### Amp-Trap 2000<sup>®</sup> A6D Class RK1 Fuse

When it comes to upgrading existing applications of 600 amps and less there is no better alternative than the A6D. Starter manufacturer’s testing has proven that the A6D’s low current-limiting let-thru energies provide Type 2 protection of NEMA - style starters. The time delay feature ensures reliable operation in the presence of temporary overloads. Its dimensions allow for direct replacement of existing Class H, Class K and Class RK5 fuses.



### Amp-Trap 2000<sup>®</sup> ATDR Class CC Fuse

Often a good choice for motor circuit applications with motor full load amps of 15 amps and less, ATDR’s current-limiting performance can provide Type 2 Protection of NEMA- and IEC- style starters. Consult sizing tables as Class CC fuses do not have as much time delay for overloads as the AJT. Advantages of using Class CC include its small footprint fuse block and rejection feature that prevents improper substitutions.