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SAFETY AND PERFORMANCE CONSIDERATIONS IN THE DESIGN OF DYNAMIC BRAKING SYSTEMS

UL-recognized resistors (DBRs) allow motor drive manufacturers to more easily offer a complete UL Solution

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Dynamic Braking Options

The Dynamic Braking Resistor (DBR) is called upon to absorb large amounts of energy when AC variable frequency drives produce motor torque during overload conditions. Drive manufacturers have several viable options relating to dynamic braking solutions: an "in-house" design can be developed which is typically a combination of purchased wire-wound elements mounted in an enclosure.

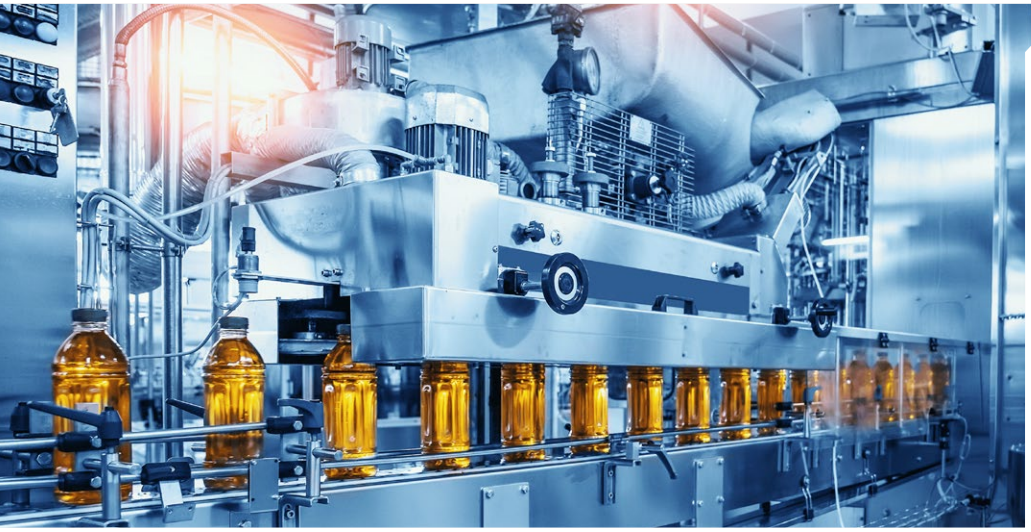
The second option is to leave the sizing, manufacture or locating of a DBR to the AC drive end user. This may not be a welcome task for these customers, given the complex calculations of motor speed, torque, inertia, gear ratio, etc. required to design an effective solution.

The third option is for the manufacturer of the drive to recommend a supplier and model of DBR which is specifically wired (and readily available) for their various drive products. Sometimes a cross reference/parts-matching list is generated between manufacturer and supplier to enable customers to easily match their drive to the appropriate braking package. Typical recommendations are wire-wound, edge-wound and grid resistors as well as strip and flexible heaters. Most of these technologies can be effective, but there are additional considerations for specific applications: Cost, usability (ease of mounting, load connections, etc.), custom marking, electrical isolation and temperature protection all find their way onto the "wish lists" of AC drive designers. A UL-recognized component with one or all of these features becomes an attractive option.

Safety Factors

When investigating a braking solution for an AC drive, peak power capability, safety and ease of use must be considered. The DC bus across which the dynamic braking resistor is typically connected can be as high as 800V. While the ability of the braking resistor to function without failure (open circuit condition or ground short) is the main priority, safety of the drive system and the people in contact with it are also vitally important.

Electrical isolation, temperature rise and dielectric strength of the component are crucial design factors. Because UL is synonymous with safety, a recognized component helps to diminish the concern for potential injury and failure liability.



Understanding the UL Terminology

When searching for industrial components, consideration must be given to the agency approvals or accreditation that a component may carry. Certainly, the first agency that comes to mind is Underwriters Laboratories Inc. (UL). They have been responsible for testing the safety of products for over a century. The UL terminology must be understood prior to quantifying the impact the decision to choose (or not choose) UL components may have on the final design. A component that is UL "recognized" is intended for a specific use or on a wide range of applications. A component that is UL "listed" is intended for a product with very specific hazards, conditions and properties. The standard used to investigate the dynamic braking resistor is UL 508, "Industrial Control Equipment."

Temperature Control

Component temperature continues to be one of the focal points of design engineers whether it's a 1500 Watt dynamic braking resistor or a 5W current sensing resistor. As manufacturers continue to downsize equipment and as designers seek smaller and smaller modules, the need to manage and displace heat has become a significant challenge. Many drive manufacturers now offer dynamic breaking kits that include some style of over-temperature protection. This is not only crucial to the life of the drive but also to the safety of its operators. Thermal fuses and thermostats are both viable options. A thermal fuse "cut off" or TCO is compact, inexpensive and can be utilized with smaller package designs. The trip point of the TCO is based on the chemical makeup of an organic pellet which opens a small set of contacts when sufficiently melted. There are two disadvantages to this solution: first, it is possible to "tease" the fuse with enough heat to shrink the pellet thus opening the contacts at a lower than desired temperature. Secondly, a thermal cutoff is considered a "one-shot." If sealed within the resistor package, the entire resistor assembly would require replacing.

The thermostat has become the choice for most dynamic braking kit manufacturers. It is simple to mount, can be reset, is offered in countless configurations and can be calibrated to operate as high as 340 degrees Celsius (surface temperatures during overload are known to approach this.) The contacts of the switch will only open when a bimetal disc sees the calibrated temperature. A thermostat can also be offered with "normally open" contacts in which a fan bank or alarm can be activated upon overheating.

Some package styles allow for incorporating the thermostat within the resistor, while others require external mounting period since the amount of energy, or heat generated (measured in Joules), varies due to horsepower of the motor, duty cycle, ventilation, etc. The challenge is to find the correct calibration temperature for the application. The calibration set point must be low enough to prevent the surface of the resistor from becoming too hot. It also must be high enough to avoid "nuisance trips" which may prematurely shut down the system.

Additional Safety Concerns: Dielectric Breakdown and Isolation

While preventing overheating of the drive and monitoring braking resistor temperatures are important criteria to the design of the system (enough to warrant warning labels), dielectric breakdown and exposed electrical junctions must also be considered. It is commonplace for a drive manufacturer to mount braking resistors in enclosures because of electrical concerns. However, there are DBR package styles available that can simplify (or eliminate the need for) this task significantly. Edge-wound and grid resistors can be sourced within framed assemblies, while metal clad resistors and various heating elements can be supplied in extruded aluminum to fully enclose the DBR circuit. Also, the use of mica, Kapton and other insulating barriers has allowed various resistor designs to be offered with breakdown voltages exceeding 5000V.

Conclusion

There are many design considerations when specifying a dynamic braking solution for an AC drive. Acquiring UL approval on these systems is becoming more of a requirement than a marketing advantage. Therefore, the importance of using a UL-recognized braking package cannot be overlooked. When a manufacturer of an AC drive has a UL-recognized DBR at its disposal, it means the complete UL drive package can be offered to its customers. The use of UL-recognized components reduces the complexity of obtaining UL approval of the entire system and can save enormous amounts of time and money.

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