WHITE
PAPER

LifeSafety Power®

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Inductive Loads in Life Safety Applications

Key considerations in effectively
balancing power integration

Contents

Introduction

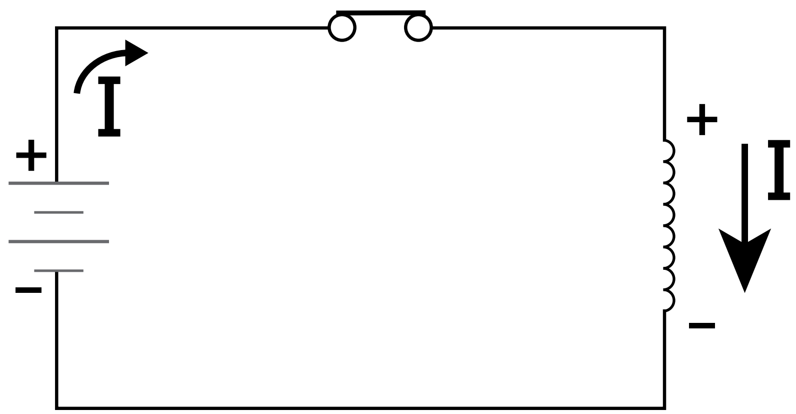
Many loads in the life safety industry are inductive in nature. Inductive loads are devices which use coils of wire to generate a magnetic field - these include magnetic locks, door strikes, solenoids, crash bars, and electric motors as well as other devices. Unlike a simple resistive load, inductive loads can present some challenges when integrating them into a DC power system.

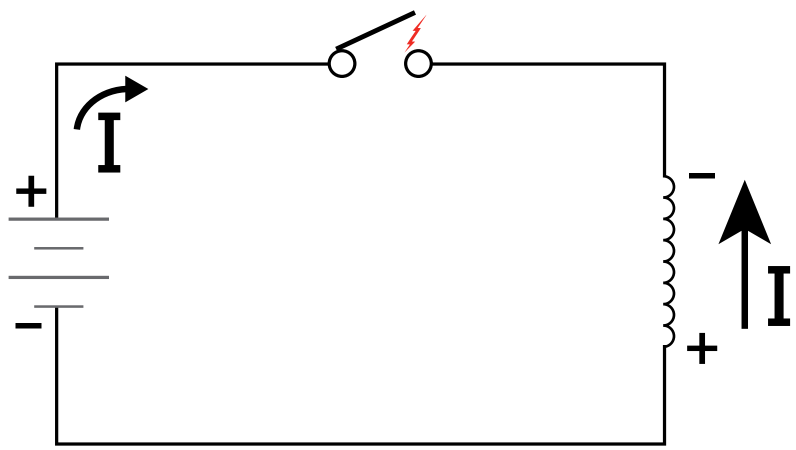
Inductive Loads

To understand the effects of an inductive load, we must first understand the basic operation of an inductive load. Ignoring the function of the load, we will just view it as a simple coil of wire for this discussion.

When an inductive load is powered, a magnetic field is generated in the coil of wire. Faraday's Law states that a change in the magnetic field around a circuit will generate an electromotive force (voltage) in that circuit. This means that the magnetic field generated causes the inductor to resist changes in current through it by generating a voltage to offset the current change (called a back electromotive force, or back-EMF). This voltage is determined by the amount of change in current and the time in which the change occurs - increasing the change in current or shortening the time period in which the change occurs will both result in an increased back-EMF.

In a life safety application, devices such as magnetic locks are typically controlled by a relay contact. When the relay contact in the circuit of a simple magnetic load is opened, the current instantly drops to zero. This large, fast change in current causes the magnetic field to collapse, briefly causing the coil to become a high voltage source and feeding a short duration, negative high voltage spike back into the wiring.



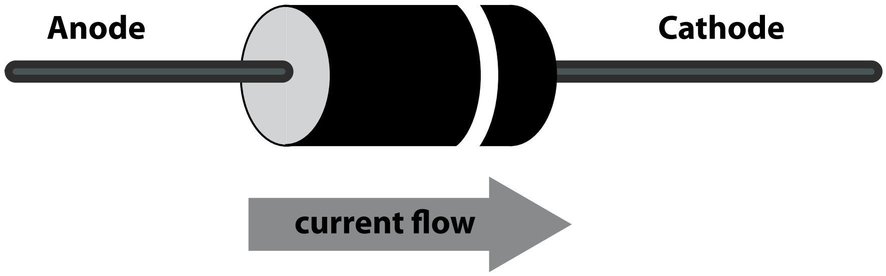


This returned high voltage spike can cause arcing of relay contacts as the high voltage looks for a path to dissipate, greatly shortening relay life. The negative voltage can also travel to other sensitive devices in the system, causing problems such as lockup of microprocessors, false triggering of overcurrent protection, and possibly damaging devices within the system.

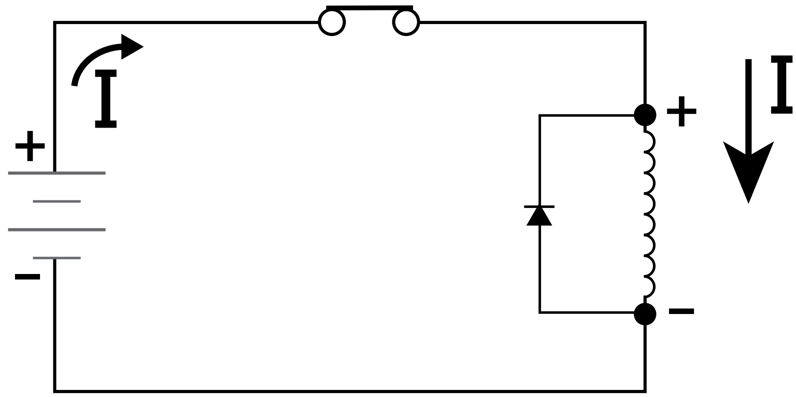
Protecting against Back-EMF

Now that we understand back-EMF and the negative effects it can have on a power system, how do we handle it? Typically, the EMF is returned to a lock or other device by placing a reverse-biased diode across the lock circuit, after the switch (relay).

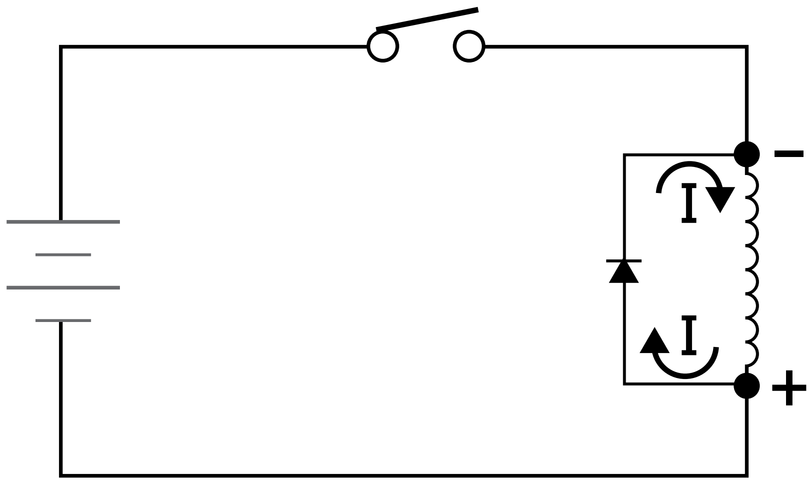
A diode is an electrical "check valve", allowing current to only flow in one direction from the anode to the cathode.



Under normal powered conditions, the diode is reverse biased and not conducting current, allowing the current to flow through the lock normally.



When the switch is opened, the negative voltage will flow back through the diode, returning to the lock to be dissipated by the lock's internal resistance.



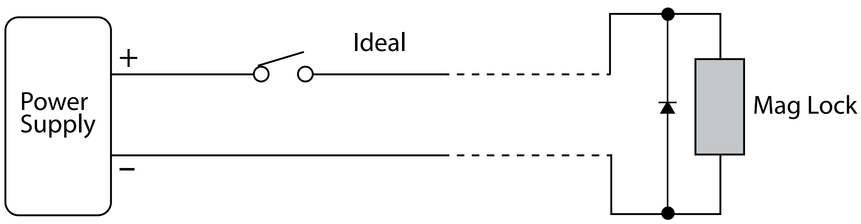
Be aware that this return of voltage to the lock does result in power remaining on the lock for a very brief moment as the voltage continues to circulate. In a fail-secure door strike application, this means a slightly delayed relocking of the strike. In a mag lock or fail-safe door strike application, it means a brief delay in RELEASE of the lock. Typically, this delay is well under 1/4 of a second and poses no problem, but in extreme cases may result in a perceptible delay between card swipe and the ability to open the door.

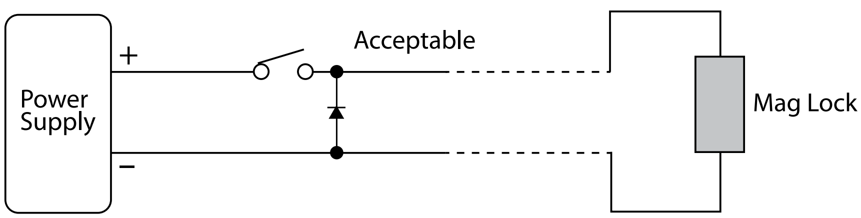
Practical Applications

Many of today's locks handle back-EMF internally, either by reverse diode or other methods. These locks do not require external protection. However the internal back-EMF diodes built into locks often fail over time, causing problems to appear months, or even years down the road. Many new locks do not have any back-EMF protection . Older pre-installed locks also may have no protection, or the protection may have failed years ago. A good practice is to place a reverse diode on all locking circuits as cheap insurance, regardless of the protection that may or may not be present internally to the lock.

LifeSafety Power's C8 lock control boards now have back-EMF diodes across each set of output terminals from the factory, eliminating the need for external diodes.

External diodes for back-EMF protection should be placed as close to the lock, electrically, as possible. Given an ideal situation, this means placing the diode at the lock itself. Obviously this is not always possible, especially in retrofit applications where the locks are already installed. In these cases, it is acceptable to place the diodes at the power supply side of the lock circuit (after the relay).





When using an external diode, most any general purpose power diode will work. Avoid small signal diodes, as they cannot handle the voltage and current levels generated by the back-EMF of most locks. The 1N4000 series is inexpensive and easily obtainable and works well as back-EMF protection.

Conclusion

LifeSafety Power's intelligent power solutions provide comprehensive and proactive built-in measures to address potential challenges integrating inductive load inputs to DC voltage circuits, effectively minimizing voltage spikes and other possible system compromise.

About LifeSafety Power — Power is Knowledge™

LifeSafety Power is the leader in Smart Power Solutions and patented remote monitoring capabilities, providing modular AC, DC, and PoE power systems that meet the growing needs of the life safety and security industries. Realizing that network technology presents new opportunities for active monitoring and management of power supplies connected to access control systems, fire systems, video surveillance and more, the company has built its products from day one with intelligence and functionality in mind. LifeSafety Power's current product offering and planned future innovations in battery test, display and diagnostics represent an important step in providing overall system reliability and uptime.

All of the product features discussed in this white paper are available within LifeSafety Power's product line.

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