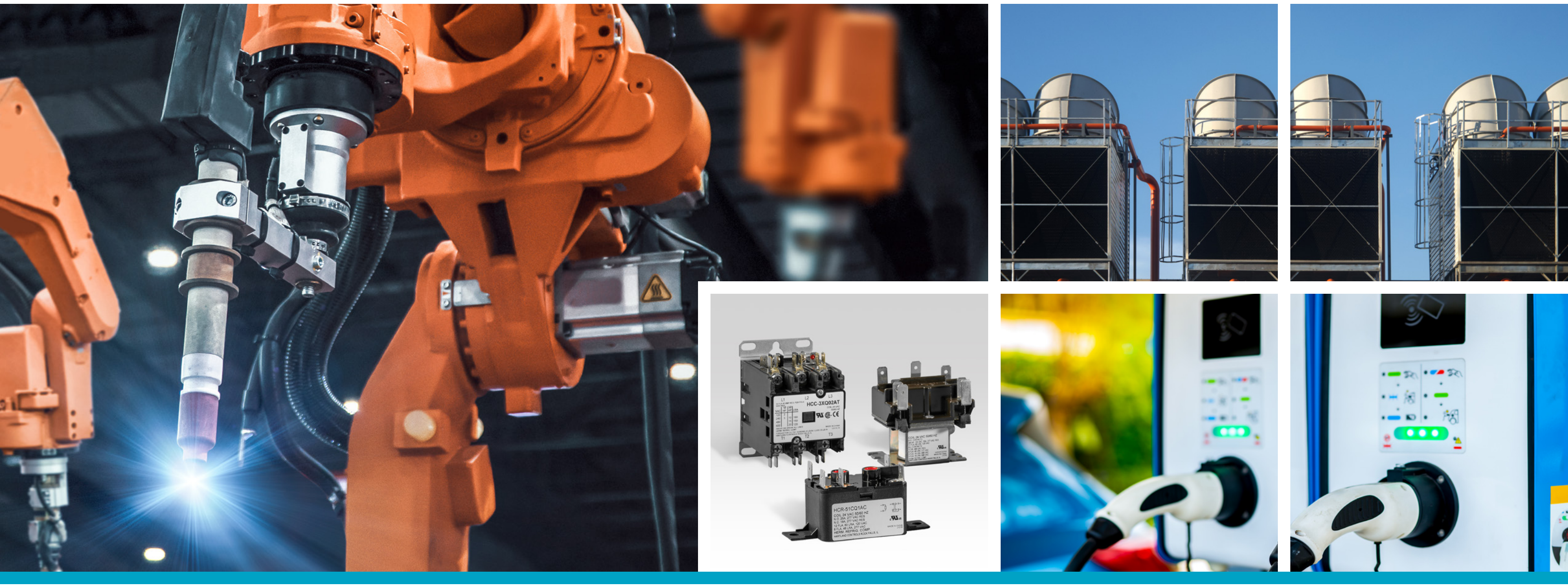
APPLICATION NOTE



UNDERSTANDING THE DIFFERENCE BETWEEN CONTACT CHATTER AND CONTACT BOUNCE

If you're working with equipment that uses contactors and relays, you've probably heard of contact chatter and contact bounce. In fact, while "contact bounce" and "contact chatter" are often used interchangeably, they are actually two different phenomena. Contact bounce is the uncontrolled opening and closing of the contacts due to forces within the relay (internal forces), whereas contact chatter is the uncontrolled opening and closing of contacts due to external forces. This application note describes both conditions to help both manufacturers and contractors better understand the causes of chatter and bounce.

The Mechanics Behind Contactors

Relays are electrically controlled devices that open or close electrical contacts to affect the operation of other devices in the same or different circuits. A relay's most basic components are its coil, armature, and contacts.

When the relay is put into a given circuit, the current from that circuit induces a magnetic field in the relay coil. The magnetic field then affects the armature in such a fashion that it causes the contacts to make or break the part of the circuit that is attached to the relay output.

Contact Bounce

The amount of contact bounce is dependent on, and an inherent part of, the design of the relay. The closing velocity of the contacts, the initial contact force, the mass of the contacts and mechanical resonances in the contact system all have an impact on the amount of contact bounce generated during contact closure. When using load levels and types that do not generate arcing, contact bounce does not shorten the life of the contacts, although it may be undesirable when the associated circuitry would sense these added openings and closings.

However, when an arc is present, contact bounce can lower the life expectancy of the relay or cause contact welding. Contact bounce can also induce oscillations of several kilohertz, contact arcing frequencies of several megahertz and, in the case of reactive loads, amplitudes 10 to 100 times the normal circuit voltages or more.

One way to reduce the impact that contact bounce has is to employ a contact protection circuit, such as a resistor—capacitor (RC) network. The RC combination absorbs the high-energy oscillations caused by the contact bounce. Similarly, the oscillations created by the arcing are averaged and suppressed by the RC combination. This RC network will also help suppress the arc during the contact break operation and increase the overall life of the relay.

Contact Chatter

Contact chatter is extended contact bounce that is not an inherent part of the relay. Contact chatter usually occurs because of either shock or vibration to the relay or an improper relay control signal.

Relay Control Signal

A Class II transformer is used to supply Class II circuits, commonly used on HVAC/R control systems. The maximum Va (volt-ampere) generally offered is 75 (Hartland offers Class II Transformers as high as 100 Va), and the most common secondary voltage is 24 V ac. All Class II transformers are either inherently or non-inherently limited, meaning the maximum output current is limited either by the intrinsic coil impedance or by a fuse or circuit breaker. It’s worth noting that we offer transformers up to 150 Va, and we also have the ability to customize transformers from 3 Va up to 200 Va.

General Purpose Transformer

As their name suggests, general purpose transformers are typically used for general lighting and other low voltage applications. These transformers include any Va rating along with primary and secondary voltage ratings up to 600 V ac. Typically no fusing is required, but internal fusing is an option.

Control Transformer

A type of isolation transformer, control transformers are designed to provide rated output voltage at full Va. As the load decreases, the output voltage will go up. Conversely, if the load increases it will result in lower output voltages. Providing excellent voltage regulation, control transformers are commonly used in industrial applications.

Relay Control Signal

A control voltage is applied to the coil of the relay in order for the relay to operate. The relay has a minimum voltage that provides the necessary current for the relay contacts to actuate. If the control voltage drops below the specified minimum operating voltage, the relay may chatter. This rapid on- and off-cycling of the contacts occurs continuously for several seconds, causing excessive contact heating and results in severe damage to the contacts. This chatter condition occurs due to insufficient magnetic pull at low voltages to overcome the spring forces needed to operate the relay effectively.

One factor that should be considered with regard to contact chatter is the inrush current of the relay coil. The coil current is higher than the rated current when the relay initially operates. This inrush current, although brief, can drop the voltage significantly if an inadequate source of power is supplied to the coil.

The coil temperature rise of the relay may also have an impact on contact chatter. The coil heats up due to resistive heating of the wire, resistive heating in the shading coil, eddy-current losses in the magnetic circuit, hysteresis losses and contact current heating internal relay components. This temperature rise along with the ambient temperature will increase the coil resistance and thus increase the required relay pick-up voltage. This is equivalent to lowering the control voltage.

Other factors that may cause chatter are other control circuit components. These components could either drop the voltage to the relay or cause an intermittent voltage. For example, a pressure switch or proximity switch in the circuit has a trip point that can cause the switch to cycle on and off intermittently. This will turn the relay on and off very rapidly, causing the contacts to chatter.

When dealing with low-voltage chatter, the designer needs to confirm that the specified relay operating characteristics are met. The specified minimum must-operate voltage for the relay must be known. Care should be taken when sizing the control transformer or power supply and specifying the proper control wire size such that the control voltage must not be capable of going below this minimum requirement. The designer also needs to take into consideration the ambient temperature in which the relay will operate, and how this ambient and temperature rise of the relay coil, will impact the pick-up voltage.

Conclusion

Use the guides above to determine the difference between contact chatter and contact bounce. Learning how to troubleshoot the situation can help to extend the contactor life.

For more information on transformers visit HartlandControls.com