

## Application Notes on Coil Power Economizing using PWM Circuits (Continued)

This fast opening is useful for circuit interruption, and it allows the over travel mechanism of the contact actuator to work effectively in breaking minor contact welds that may occur when closing the contacts.

Allowing the free-wheeling diode to remain across the coil would significantly increase the contact opening time and opening speed, and possibly result in nuisance contact welds and/or reduced capability to interrupt circuit currents.

If additional diodes are required to protect the FET body diodes, select a Transient Voltage Suppressor (TVS) diode with a breakdown rating lower than that of the driver FET body diode. In general, a higher voltage TVS diode will result in faster contact opening and higher clamping voltage, while a lower voltage TVS diode will result in slower contact opening and lower clamping voltage. For more detailed information regarding TVS diode selection, contact TE and request the report titled [DC Relay Magnetic Energy Determination and Transient Voltage suppressor Diode Selection](#).

### 1.1 Recommended Operating Frequency and Duty Cycle

The frequency at which the PWM circuit is operated should be high enough such that the oscillation of the coil current does not lead to audible noise being generated by the magnetic components and coil winding. For most KILOVAC contactors, a coil drive frequency > 15 kHz is usually sufficient to ensure that nuisance audible noise is not generated. The PWM duty cycle required for economizing power while maintaining sufficient holding force can be calculated from the required holding current as follows:

$$\text{Duty Cycle(\%)} = (I_{\text{hold}} * R(T)_{\text{Coil}} / V_{\text{source}}) * 100 \quad (1)$$

Where:

R(T) = Coil Resistance at Temperature

I<sub>hold</sub> = Required Holding Current

V<sub>source</sub> = Source Voltage

Contact TE regarding the minimum required hold current needed for a particular Part Number. In general, divide the specified dropout voltage by the coil resistance at 20°C, and add 25% above that to get an estimate of the value to use in equation (1) for I<sub>hold</sub>.

### 2.0 Summary

This Application Note is meant to address some of the more common questions regarding the use of PWM circuits for coil power economization. In all cases, please refer to the applicable product data sheet for specific information.

TE can also recommend alternative solutions for mechanical dual-coil economizers, as well as “Electronic Cut-Throat” economizers. Product Application Engineers are available to answer questions regarding this subject by calling 800-253-4560 x2055, or 805-220-2055.