

AN-014: Contact Welding

GIGAVAC has performed extensive testing to determine the make current capability of their contactors. In applications where contact welding occurs almost every case can be attributed to either the coil drive circuit or underestimating the make load current. Higher make load currents are usually from load capacitance.

Coil Drive Circuit

- Do **not** add coil flyback EMF suppression, including:
 - Diodes (rectifying, free-wheeling, schottky, Zener, TVS, rectifying bridges, etc.)
 - Capacitors
 - Transistors that pull the coil voltage to ground when off (instead of just opening the connection)
 - <http://www.gigavac.com/sites/default/files/AN-003-GX-Coil-Suppression.pdf>
- Switch coil voltage on quickly ($\leq 1\text{ms}$). Ramping can cause a weak/incomplete make.
 - <http://www.gigavac.com/sites/default/files/AN-002-Two-Coil-Economizer-Principles-Operation.pdf>
- When using one of GIGAVAC's external PWM models where you supply PWM control, please contact the factory for application assistance if needed.

Make Load Current

- If there is any capacitance in the system, it needs to be pre-charged so that the make current is within specification. Please see below for comments on measuring the current. Sometimes there is capacitance in an inverter (for example) that the user is not aware of.
 - Recommendations for pre-charge circuits can be found here:
<http://www.gigavac.com/application-notes/power-products/pre-charge-circuits-and-capacitors>

Measurements that are needed to debug welding:

- Scope trace of current at the mains, especially during make.
 - It is important to measure this with $\leq 50\mu\text{s}$ / division on the scope because the current spikes can be very fast.
 - GIGAVAC uses a current probe, but a resistor in the system can be used if it is also there when the welding occurs.
- Scope trace of the coil voltage during make and break with 2 ms to 5 ms / division.
- A scope trace of the coil's inrush current is useful if the above measurements don't expose a problem.
- If possible, these measurements would be taken when the part actually welds, but that is often hard to do.

Light welding (tac weld)

- One way to quickly diagnose a tac weld (contacts stuck in closed position) is to cycle the coil 10 to 20 times. A typical tac weld will break as a result of this coil actuation.