



## **Instrument Lockup Due to Improper Inductive Load Suppression**

**Purpose:** *This Service Bulletin is to provide an overview of a particular common cause of instrument lockup - - improper suppression of inductive loads connected to the instrument's outputs. Below will be a guide for diagnosing the problem and the corrective action necessary to get the instrument back into reliable service.*

### ***Symptoms***

The instrument is considered locked-up when the control panel buttons are non-responsive, timers stop counting, and the test appears to have halted unexpectedly.

### ***Conditions***

The most common scenario in which the Sentinel instrument experiences a system failure (or lockup) involve the following conditions:

1. The lockup occurs during an output transition state.
2. One or more outputs have been configured with inductive loads (such as relays or solenoid valves).

### ***Diagnosis***

The cause of the above mentioned lockup is most likely insufficient, or lack of, suppression of inductive loads. This causes the instrument to experience voltage flyback, which is the sudden voltage spike seen across an inductive load when its current is suddenly removed.

**Note:** *Output signals are meant to be used for low power control circuits and not used for high power output (like driving a device).*

This diagnosis can be confirmed by disabling (disconnecting) the I/O cable and performing a test cycle (assuming the I/O operation is not critical to the pneumatic operation).

### Corrective Action

Install or upgrade inductive load suppression as appropriate. This can usually be accomplished by including a Suppression Diode into the I/O circuit. Suppression diodes are sometimes referred to as snubber diodes, flyback diodes, clamp diodes, or catch diodes.

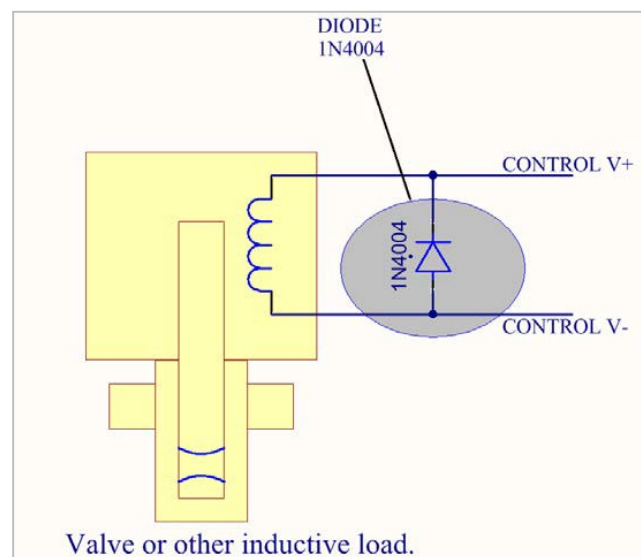
**Note:** For complete explanation of the working principles behind Suppression Diodes see: [http://en.wikipedia.org/wiki/Flyback\\_diode](http://en.wikipedia.org/wiki/Flyback_diode).

The best approach that CTS recommends is to utilize valves that have integrated suppression circuits. Various manufacturers offer these circuits within the valve coil or attached connector. Refer to the manufacturer's datasheets for this configuration.

If integrated suppression is not available, an alternative approach would be to add a snubber diode which has very large peak forward current capacity (to handle voltage transients without burning out the diode), low forward voltage drop, and a reverse breakdown voltage suited to the inductor's power supply. Depending on the application and equipment involved, some voltage surges can be upwards of 10 times the voltage of the power source, so it is critical to not underestimate the energy contained within an energized inductor.

It is recommended to apply the snubber at the location of the inductive load. Installing the snubber within the instrument allows the noise to enter the instrument enclosure.

The following diagram shows a simplified circuit that utilizes a suppression diode for load suppression.



When used with a DC coil relay, a suppression diode can cause delayed drop-out of the contacts when power is removed, due to the continued circulation of current in the relay coil and diode. When rapid opening of the contacts is important, a low-value resistor can be placed in series with the diode to help dissipate the coil energy faster, at the expense of higher voltage at the switch.

When the suppression diode is used to simply dissipate the inductive energy, as with a solenoid or motor, inexpensive 1N4001 and 1N5400 series diodes are used instead.

### **Conclusion**

The most common cause of Sentinel instrument lockup is improper suppression of inductive loads connected to the instrument's outputs. Usually in this case, the installation of a suppression diode solves the issue.

**Note:** *Because this is a precision instrument, it is preferable to locate this instrument at least 15 feet away from high electromagnetic energy devices (induction heat treat equipment and welders) whenever possible. In addition, plants having poor quality electrical power or ground systems should consider using isolation transformers on the power drops.*

For further assistance contact Cincinnati Test Systems service department at 513-202-5108. If necessary, CTS service can assist you in generating a debug log and creating a copy of your program configuration. Analyzing at this information, CTS service representatives should be able to determine whether the lockup problem is hardware, software, or wiring related.