Discussion of Rosemount 470 Transient Protection vs the ZeroDT 24-1

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Rosemount 470 Protection Options vs the ZeroDT 24-1

The following discussion of Rosemount protection options was extracted from an email between a major pipeline customer that was experiencing issues with the Rosemount 470 Transient Protector and a member of the ZeroDT technical support staff.

Hello Xxxxxxxx,

Here are the Rosemount part numbers:

Table 1. Rosemount 470 Transient Protector Ordering Information

★ The Standard offering represents the most common options. The starred options (★) should be selected for best delivery. The Expanded offering is subject to additional delivery lead time.

Model	Product description
470D	Transient Protector; 4-20MA, 3½-in. Nipple length
470C	Transient Protector; 4-20MA; with Ground Wire 3½-in. Nipple length
470L	Transient Protector; Max. Supply Voltage 45, 5-in. Nipple length
470J	Transient Protector; Low Power; with Ground Wire 5-in. Nipple length
Code	**Loop resistance**
1	20 Ohms Max
1	1 Ohm Per Lead; Max
Code	**Options**
NA	No Approval Required
E6	CSA Explosion-Proof Approval(1)
I6	CSA Intrinsic Safety Approval
Typical model number:	**470D 1 NA**

(1) Unavailable with 470D and 470L.

I have also attached the Product Data Sheet for the Rosemount 470 Transient Protectors. (*these were originally attached to the email but have not been included within this document – they are available on the web or by request*)

One of the big things that we are finding with almost every customer is the situation where the unit with the Rosemount protector installed on it will get "Ghosts" and need to be re-calibrated as they start getting funky readings/communications. This seems to remedy the situation for a bit, but then it starts acting strange again, and people start pulling out their hair trying to figure out what is going on.

Below is some additional information that I wrote up previously on the Rosemont units.

> The Rosemount 470 Transient protector consists of a circuit that utilizes a Gas Discharge Tube (GDT), an inductor, and a bi-polar zener diode. The primary protection is provided by the GDT. The GDT will conduct large currents, but has a few trade-offs or drawbacks:
>
> 1. slow reaction time
> 2. degradation with usage
> 3. 'glo-mode' with DC currents

1.) To overcome this first deficiency, Rosemont uses the inductor and bipolar zener diode (from the *Rosemont 470 Transient Protector Product Data Sheet*)

> A high-voltage transient appearing on any field signal wire is conducted to the case through the gas-filled spark gap. This device conducts large currents, but has a slow reaction time. The fast-rising portion of the transient is conducted to the case through the zener diode, which has a fast reaction time. The inductor limits the diode current during the time required for the spark gap to conduct.

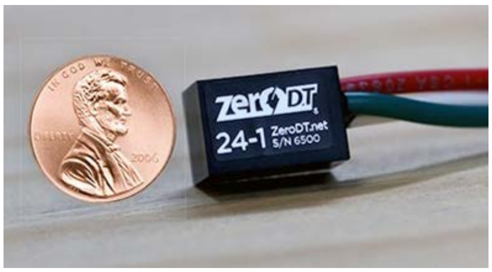
Because Gas Discharge Tubes (GDTs) are slow to react compared to the rise times of lightning induced surge currents, and they have attempted to use a Zener Diode to try to conduct the fast-rising edge until the GDT can start conducting. Although the Zener diode is fast, it cannot handle large surge currents, so they place an inductor in series to try to limit the current thru the zener diode (attempt to protect the diode) but this also limits its ability to handle the fast-rising edge of the lightning induced surge current. In addition, the voltage across the inductor (from the fast-changing surge current) and the zener diode is in parallel with the measurement device / transmitter, so that voltage is being applied to the measurement device during the transient event (and the surge current not going thru the Zener is going thru the measurement device/ zener diode). Many times, these initial surge currents will exceed the capabilities of the zener diode and cause it to fail, however there will not be any indication to the outside that the protector has been compromised and is now just a GDT based protector.

2.) The electrodes or spark gaps in GDTs degrade every time that they activate and carry current (the amount of degradation to the electrodes is dependent on the magnitude and the durations of the surge currents thru the electrodes). Typically, the degradation will show up as the turn-on voltage for the GDT starts moving higher in voltage (this is due to the deterioration of the electrodes – think of an arc when welding). If the zener diode has not already failed, this degradation will mean that the zener diode will have to conduct current for longer time periods and carry higher currents because the GDT is not turning on as soon during the transient event. The zener diode is not designed for these levels of current or the durations of conduction and because of this it fails. Once the Zener diode fails, now the Rosemont protector is just a GDT based unit with a degraded GDT until the turn-on level gets high enough that the protected device is destroyed. Again, there is no indication from the outside that the protector (with the failed zener diode) is any different than before, but now the rising edge of the transient energy is being applied directly to the measurement device each time until the GDT can start conducting. Eventually, this degraded GDT will cause the measurement device/transmitter to fail.

3.) Additionally, GDTs has another drawback when used in implementations where DC currents are involved such as with the Rosemont 470 Transient Protector. Once the arc inside of the GDT has been lit from the transient over-voltage event, the impedance of the device (GDT) drops and the voltage needed to maintain the arc drops well below the 'spark-over voltage" for the device, and the arc will continue to conduct DC current even at much lower voltages. Because of this 'glo-mode' of the GDT, Rosemont has specified that unless the instrument power supply will limit the current to <0.5 Amps, a 47 ohm quenching resistor should be added to the installation.

> Once the spark gap has begun to conduct, it will continue to do so unless the instrument power supply limits current to 0.5 amps or less. A 47-ohm quenching resistor can be added to prevent conduction after the transient has discharged.

The ZeroDT family of measurement surge protection devices do not rely on GDT, MOVs, or even Zener diodes. **They ONLY utilize Silicon Avalanche Suppression Diode (SASD) technology**. SASDs are designed to be able to handle the large surge currents that can be induced by lightning, while being as fast, or faster, than the zener diodes.



Being a true semi-conductor material, they have a very low impedance to current flow once their turn on voltage is reached (this means lower voltage and better protection for the measurement devices) and as long as the surge currents do not exceed the diode's capacity, the SASD returns to its original state with **no degradation** in the device or its protection capabilities. If the surge current exceeds the unit's capabilities, the SASDs are designed to fail shorted to ground in a final attempt to protect the measurement device / transmitter. While it is true that SASDs may cost more than the other devices (GDTs, MOVs, Zener Diodes, …) the total cost of ownership can be much lower as they will continue to provide protection when other units may have been replaced (along with the "protected" measurement devices) multiple times.

I hope this gives you some additional insight into how to the ZeroDT is very different from the Rosemont/Emerson/Edco units. Yes, they (the ZeroDT) may cost more initially, but that cost difference is very small when compared to the costs that are incurred if a device fails and there is down-time and loss of production! ! The downtime costs will be much, much higher than even the cost of a replacement measurement device, a new protector for it, and the cost of labor to reinstall the measurement device.

By the way the ZeroDT units are UL Listed Isolated Loop Circuit Protectors (E499683) as well as UL Listed Isolated Loop Circuit Protector for Use in Hazardous Locations (E502612). If they are being applied into an intrinsically safe system, they meet the requirements of being a Simple Apparatus under NEC 504.2 and as such can be installed in hazardous locations under NEC 504.10.

I hope this helps and I would be happy to discuss any of this further at your convenience.

Regards,

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