



## Failed T/C Sensor Functions

### CLS200/MLS300/CPC400

Thermocouple (T/C) sensors may have failures in different modes due to normal operational deterioration as well as to other process conditions such as physical damage due to repeated movement of the sensor.

The type of failure as well as the desired response to the failure can be determined by the controllers CLS200, MLS300, and CPC400. There are factory default parameters that must be changed by the operator of the controller for each application requirements and for desired controller response to process requirements.

There are three main failures of a physical nature that the controllers can protect against as well as providing for different forms of response. Chemical attack and erosion of the sensor due to chemical attack is not covered by the controller sensor failure modes except for possible open T/C sensor conditions.

#### OPEN T/C DETECTION

The first failure as well as the most common is the thermal deterioration of the T/C junction that causes an open condition of the T/C junction. Loose terminal screws as well as a broken lead wire will produce the same type of alarm known as T/C Burnout. This form of failure is always on and available when selecting a T/C as the sensor input in the Input Menu. It is activated for both Heating and Cooling Outputs.

The standard mode of operation is that upon an open circuit with an impedance of 3000 ohms or higher between the positive and negative input terminals, an Open T/C alarm condition will occur.

With an open input condition, the CLS200 and MLS300 display will show a flashing “FS” (Failed Sensor) and the CPC400 display will show a flashing “TO” (T/C Open). All controllers will change the control mode to Manual at 0% output level. Pressing the Acknowledge button will cause the flashing to stop, but the symbol will not disappear until the condition is corrected.

The amount of the controller output level can be changed to provide an output upon a T/C open condition. This may be useful for processes that would want to try to maintain a level of temperature control with no T/C input until the T/C has been replaced. Another type of process such as the metals or glass industry might want to have the heat on at a high level until the T/C has been replaced. The output level can be manually adjusted within the **Output Menu** via the “**Sensor Fail Heat (Cool) Output**” submenu. The default value is at 0% and the adjustable range is 0 to 100%. Use this wisely as this is an area for safety concerns. It is suggested to watch the controller output level while the PV has been at SP for a time and to use this value with a small reduction for this function.

Another way is to allow the PID Auto Mode to supply a running average of the PID control output level that would provide the closest level possible to maintain the temperature level to the SP. This is in the **Output Menu** under the submenu of “**Heat (Cool) T/C Break Output Average**”. The default value is OFF. To activate this function and to use the average of the PID output level, select ON.

#### REVERSE T/C DETECTION

The second failure is known as a Reverse T/C condition. This type of failure is rare and almost always happens in two circumstances. The first one is when the controller is first installed and the T/C is connected. It can be easily reversed on the connections and may not be noticed until too late to avoid a dangerous situation. The second one is when a T/C sensor is being replaced due to an open condition or just routine maintenance replacement. Upon placing the control mode into Auto, the heat output will come on and stay on most often at a 100% output level with no control possible. Reverse wiring terminals are easy to do and once again may not be detected in time to avoid a dangerous situation.



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### CLS200/MLS300/CPC400

The “**Reverse TC Detection**” Submenu is within the **Input Menu**. The CLS200 and MLS300 default value is to have the reverse detection OFF. The CPC400 default value is to have the reverse detection ON. It is suggested having the Reverse T/C Detection function turned ON for protection from conditions of having the input sensor or wiring installed incorrectly. It is activated for both Heating and Cooling Outputs.

Upon an alarm condition due to a detection of a reversed T/C, the display of the CLS200 and MLS300 will be flashing a “RT” and the CPC400 will be flashing a “TR” symbol. The control mode will go into Manual with 0% control output.

There is a possibility when doing calibration checks while in a control mode of Auto or Adaptive that upon a rapid movement of the input signal to a lower value it might trigger the Reversed T/C Detection alarm. It is suggested to place the controller mode into Manual or turning off the reverse T/C detection while doing calibration. Do not forget to turn it back on after calibration.

### SHORTED T/C DETECTION

Another possibility of a T/C sensor failure is a shorted condition that is not at the point of the “hot end” temperature measurement. A shorted T/C can give a wide range of temperature reading over the range of the T/C sensor depending where the short is located within the system. Some will say “a T/C is a shorted sensor” and this is true. It is a matter of where the short is located that makes the difference as that is where the temperature will be measured.

This point of where the short is located is critical and can be any temperature reading from ambient up to the maximum temperature just below the actual SP value. A shorted condition is a very dangerous condition as it is not easily noticed and most will often add excessive heat to the process with the possibility of fire.

A shorted T/C is not only very dangerous, but is difficult to detect without producing erroneous intermittent alarm conditions. There are two major conditions that must be met before the shorted T/C detection can be used. The first is to detect if the load power is turned on for the process. This is done through the selection of a digital input in the Submenu of “**Process Power Dig In**” for the CLS200 and MLS300 or “**TC Short Alarm**” for the CPC400 within the **Global Menu**. Selecting any digital input number will activate the shorted T/C detection function. This digital input must be pulled low for the shorted T/C detection feature. The contact must be dry and no voltage is allowed to be on the contacts. A contact from either the load power switch or contactor is wired across the Dig In terminal to controller common. Another method, if the contact is not available, is to wire a jumper across the Dig In terminal to controller common, but with the knowledge that with no power on, the T/C short detection feature would give a false alarm as to a shorted T/C condition when the control mode is put into Auto.

The second condition to have shorted T/C detection is to have the controller control mode in Auto Mode. Upon a low input on the selected Dig In terminal for the Process Power Dig In and the control mode in Auto Mode, the shorted T/C detection feature is activated and running. It is activated for Heating and Cooling Outputs.

Upon a failure to have an increasing PV delta as well as an offset from the SP over period of time, the shorted TC detected alarm will come on placing the loop in Manual at 0% output level with a flashing ‘ST’.

To test this, place a jumper across the selected Dig In of the Process Power Dig In. Put a loop PID parameters to PB = 50, TI = 10, and TD = 0. Install a jumper across the same loop Input terminals. Place the control loop in Auto mode. Approximately 10 seconds after placing the loop in Auto, the shorted T/C (ST) symbol should be flashing and the control mode should be in Manual at 0% output.

Warning! SP close to ambient with a short at ambient may not be able to use shorted T/C detection feature.