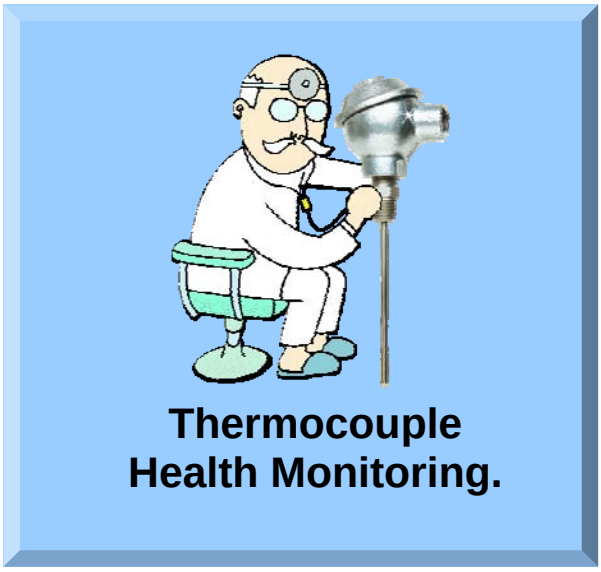
Application Note 2:

X-Series Recorder Thermocouple Health-Monitoring

Using the Thermocouple Health Monitoring function of the QX and SX Recorders

The **QX** and **SX** recorders provide the user with the ability to monitor the health of their thermocouples and use this to help predict their replacement before they fail. This function makes it easier to monitor and predict when servicing may be required to avoid costly process problems caused by a failing thermocouple. The Diagnostics Credit feature of the recorder along with the standard message system of the recorder is used to alert the user of the health of the thermocouples and if the thermocouple is starting to fail. This feature is another way Honeywell helps to provide process knowledge to the customer so they can avoid costly process shutdowns, rework and producing defective product.

The Thermocouple Health Monitoring Function



The T/C Health Monitoring function is like having a doctor resident inside the recorder constantly monitoring the health of the connected T/C's and alerting the user to a potential problem before it happens.

The recorder can be set up to monitor the resistance of the thermocouple circuit and if a thermocouple loop increases in resistance, messages will be sent to the System Messages list identifying the suspect input channel and the measured condition of the T/C to indicate its current status which are:

1. Normal (no message sent)
2. Active burnout failing on channel X
3. Active burnout almost failed on channel X
4. Upscale/Downscale burnout on channel X (Upscale or Downscale as defined in the setup menu)

Using the Thermocouple Health Monitoring Function

The T/C Health Monitoring is a standard feature of the recorder, but to use the T/C Health Monitoring function requires a slightly different wiring set up on the input plus the proper configure of the Burnout Type on each input of the recorder. This allows the recorder to actively monitor the health of the connected T/C's. For the T/C Health function, select 'Active' under 'Burnout Type' in the Analog Input Setup menu. *(Main Menu > Configure > Setup > Edit > Field IO > Analogue In).* The T/C connections must then be made between ***** (asterisk which is the positive T/C terminal) and **-** (negative T/C terminal), instead of between **+** (plus) and **–** (negative) terminals for passive burnout. (see **Figure 1** for wiring details).

Active burnout will actually pass a current pulse through the T/C to check the health of the T/C while Passive burnout takes a reading without using a current pulse. Passive burnout should be used when T/C's from another device are paralleled together or the burnout should be turned off in the other device.

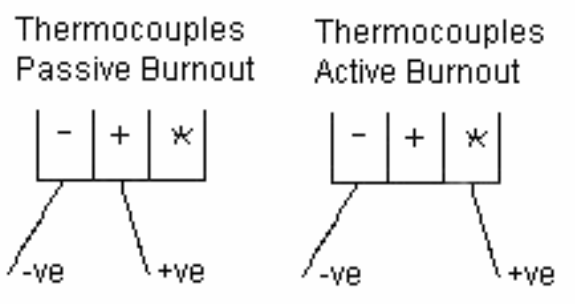


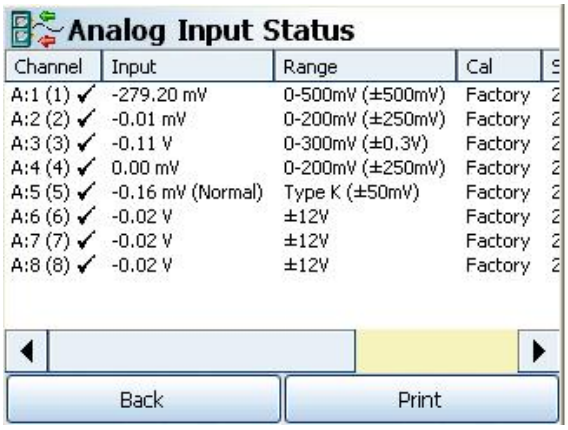
Figure.1
Input Wiring connections for QX and SX Recorders

When the burnout is set to Active Burnout, the recorder will measure and save the initial loop resistance of the thermocouple, and then periodically monitor the resistance of the loop, using the change in loop resistance to determine the state of the thermocouple.

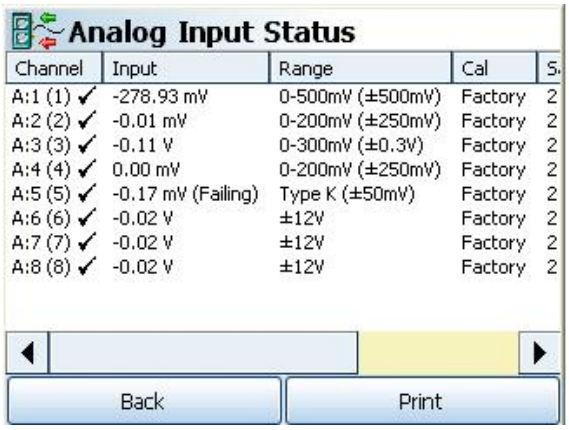
Significant increases in the loop resistance are interpreted as various degrees of thermocouple degradation, which are reported as System Messages in the message list and as messages on the chart.

The Current Status (Normal vs. Failing or Failed) can also be viewed via the *Status->Diagnostics->Analog Input* display using the Health/Maintenance Credit option. The Status conditions of the T/C are shown in brackets after the current input value of the 'Input' column of the *Status->Diagnostics->Analog Input* display. In the absence of any warnings, 'Normal' status is indicated. See **Figure 2**

There are two other conditions which also get displayed in the Status screen, but which are not sent to the message list. These are "Degraded", which gives a very early indication of the T/C health and is an indication that the loop resistance is starting to increase and "Short Circuit", which is displayed when a possible short circuit of the thermocouple wiring is detected; (i.e. the loop resistance has been reduced significantly). A short circuit somewhere along the thermocouple wiring would result in an erroneous temperature reading, so this is a useful warning. Examples of some of the recorder displays showing these various status conditions such as Normal, Failing and Short Circuit are shown below.



Status Screen showing Channel 5 as Normal



Status Screen showing Channel 5 "Failing"

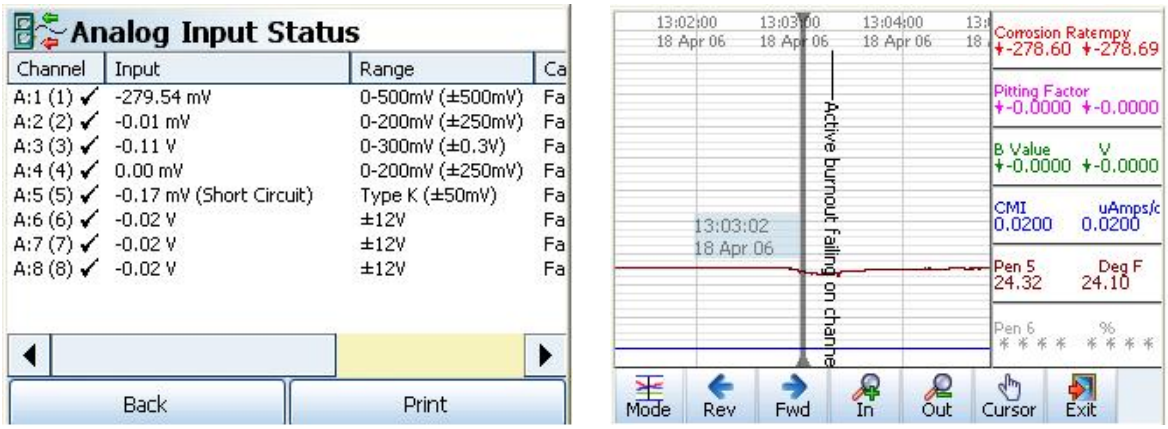


Figure 2

Once there is an indication of the 'Active Burnout Failing' and 'Active Burnout Almost Failed' in the message list. The T/C must return to a normal condition (i.e. corrected or replaced) before the 'Active Burnout Failing' is reported again. The recorder essentially latches the message and the T/C condition must be corrected before the message is repeated. A return to normal condition is flagged with a message 'Out of burnout on channel X'.

The loop resistance is checked at 30 seconds intervals. If the thermocouple wiring breaks completely, the input signal could be undefined or drifting for up to 30 seconds before the status changes to burnout. During this time, the displayed temperature value will typically show an increase in temperature to a maximum reading, but depending on external wiring factors this is not guaranteed. If this would cause a problem in the application, it is possible to connect the + input to the * input with a short wire link at the recorder terminals, which will apply passive burnout as well as active. In this case, a break in the thermocouple wiring will result in the temperature reading rapidly dropping to an invalid value and being indicated as 'four down arrows' in a Digital Panel Meter display, which will then change to the designated burnout (3 up arrows or 3 down arrows) after the next active burnout check.

The initial loop resistance is normally saved when Active burnout is selected and committed. If there is no thermocouple connected at this time, the initial resistance will be saved at the next power-up that has a valid loop resistance present. Until that time, the recorder will use pre-defined levels, without reference to changes from an initial level for determining what burnout message to display.

If the recorder detects there has been a large change in loop resistance while the recorder was powered down, it assumes that a wiring change has been made, and the recorder will use pre-defined levels, without reference to changes from an initial level. When the wiring is changed, the initial loop resistance should be refreshed by changing the burnout type to passive and committing this setup, then changing it back to active burnout and committing the setup again. The full functionality of the T/C Health function will then be applied to the new wiring.

Summary

As you can see the T/C Health Monitoring function is like having a doctor resident inside the recorder constantly monitoring the health of the connected T/C's and alerting the user to a potential problem before it happens. This feature can save production downtime caused by thermocouple failures and problems caused by erroneous readings from thermocouples that are starting to exhibit signs of degradation even before you are aware of them. No special tools or processes are required; it's built into the recorder measurements and diagnostics.