

## *Temperature Control with Hysteresis*

### NOTICE

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### Application Description

This example uses the HEC-1020 with a TS4015 (NAPA automotive thermistor) to sense resistance to determine the temperature using slope and intercept calculations. If a different thermistor is used, different variable defaults will need to be loaded for the slope and intercept.

The temperature is monitored and automatically controls either a heater (heat output) or air conditioning (air output). There are two temperature zones (one for A/C and one for Heat). Each zone has an high and low set point. The difference between the high and low set point is the amount of hysteresis.

As a precaution, if heat and air conditioning is called for simultaneously, the system is in error and both the air and heat are disabled.

### Equipment Used

| Harsh Environment 1020 Series |                      |
|-------------------------------|----------------------|
| Controller Part #:            | HEC-1020-E-R         |
| Programming Software:         | EZ LADDER Toolkit    |
| Digital I/O:                  | On -Board            |
| Application Filename:         | AN117-HEC1X.dld      |
| Programming Cable:            | HEC-910 & Null Modem |

Other controllers may be used providing that a suitable temperature device and converter (transmitter, etc) is used to match the controller's analog input requirements.

### Input / Output Description

AN0: Analog Input zero. Input voltage used to sense resistance / calculate the temperature.

GPO0: GPO0 (general purpose output 0) is used to control the heater (contactor, etc.)

GPO1: GPO1 (general purpose output 1) is used to control the A/C (contactor, etc.).

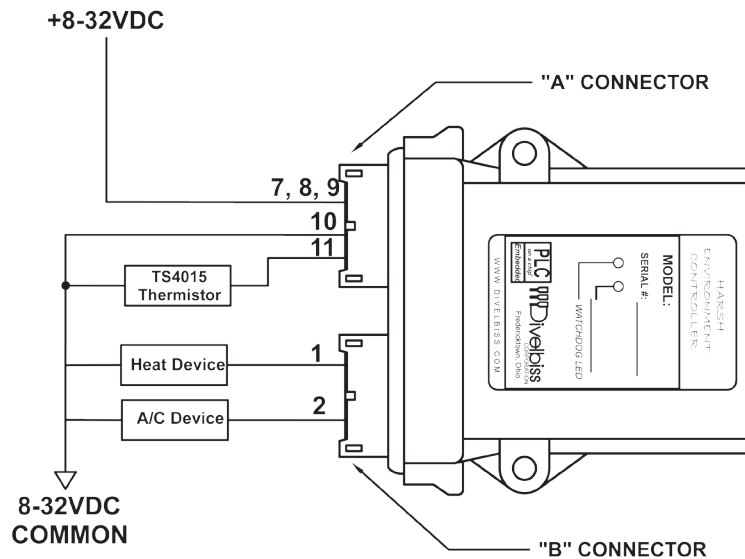
## Program Variables

|              |                                                                                                                                                             |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AN0:         | Analog input zero. Integer representation of the analog input voltage that is used to calculate the temperature.                                            |
| AN0Avg:      | Moving average of Analog Input 0 (AN0) as an integer.                                                                                                       |
| RAN0Avg:     | Real variable representing the integer AN0Avg variable (converted to real).                                                                                 |
| RIntercept:  | Real variable. Variable used to calculate temperature based on specifications of the thermistor.                                                            |
| RSlope:      | Real variable. Variable used to calculate temperature based on specifications of the thermistor.                                                            |
| RTemp1:      | Temporary real variable used during calculations of the temperature.                                                                                        |
| Temperature: | Actual calculated temperature (real variable).                                                                                                              |
| HtTempRise:  | Heat mode, high set point. This is the heat turn off point as the temperature rises.                                                                        |
| HtTempFall:  | Heat mode, low set point. This is the heat turn on point as the temperature falls.                                                                          |
| HtrOn:       | Internal Boolean Control relay requesting heat to be on.                                                                                                    |
| AcTempRise:  | Cool mode, high set point. This is the A/C turn on point as the temperature rises.                                                                          |
| AcTempFall:  | Cool mode, low set point. This is the A.C turn off point as the temperature falls.                                                                          |
| ACon:        | Internal Boolean Control relay requesting A/C to be on.                                                                                                     |
| Error:       | Internal Boolean Control relay indicating an error condition (both heat and A/C are trying to operate simultaneously). This will disable both heat and A/c. |

## Program Description

|              |                                                                                                                                    |
|--------------|------------------------------------------------------------------------------------------------------------------------------------|
| Rungs 7-8:   | The analog input (thermistor input) is averaged and converted to a real variable.                                                  |
| Rungs 12-14: | The actual temperature is calculated using a slope and intercept calculation based on the TS4015 thermistor.                       |
| Rungs 16-19: | The temperature is compared to the heating control set points and a contact (HtrOn) is controlled (turned on if heat is required). |
| Rungs 21-24: | The temperature is compared to the cooling control set points and a contact (ACon) is controlled (turned on if A/C is required).   |
| Rung 26      | The HtrOn and ACon are compared. If both are true, then an error condition is detected.                                            |
| Rungs 27-28: | The actual outputs (GPO0 and GPO1) are controlled using HtrOn and ACon respectively.                                               |

## Connection Diagrams



## Ladder Diagram

