



Application Note #5524

Thermostat Temperature control using a RIO Pocket PLC

Table of Contents

Description.....	1
Hardware	1
The Program	1
Results	3

Description

Many applications need to hold a specific temperature for long periods of time. With conventional cooling systems a compressor is used to remove heat from the chamber and bring the temperature down. These compressors are AC motors which cannot be pulsed with a conventional PWM signal so a different method of control is needed. The RIO is capable of controlling high precision refrigeration units, such as PID circulation heater chillers, but if a chiller/heater is not available a simple thermostat style loop can control conventional refrigeration units.

Hardware

The RIO-4712x has analog inputs and when used with a SCB-483x6 Thermocouple Interface board a K-type thermocouple can easily be integrated into the controller. The SCB-483x6 offers 6 thermocouple inputs capable of reading multiple measurement zones or controlling different measurement chambers. The SCB Interface board has internal circuitry onboard to take care of the thermocouple conditioning, amplification, and cold junction incorporation.

The Program

In this example the RIO needs to have 2 pieces of information: a target temperature and a tolerance. The tolerance is the number of degrees that the temperature in the chamber is allowed to drift before being corrected. By using a high power output on the controller and an external relay, the RIO can switch the AC power of the compressor. The controller does this by turning on one of its high power outputs which activates the relay and allows the hot AC power to reach the hot AC line of the compressor to turn it on.

The sample DMC code provided on the next page shows how to accomplish this task using DMC code. The program spins in a deterministic loop monitoring the voltage read by the thermocouple. If the temperature rises above the target, plus the tolerance, the output will switch on, turning on the compressor. The controller monitors the temperature, and when the temperature reads a value below the target set-point, the output turns on shutting down the

compressor. The window variable sets the tolerance for the temperature. This example used a window of .5 degrees and a set-point of 5 degrees C. Smaller numbers can be used and will result in tighter control. The limiting factor is how often the compressor turns on and how long it takes between the compressor turning on and the thermocouple registering a temperature change.

```
#AUTO
setpoint = 5;' target in degrees C
window = .5;' tolerance in degrees C
AF*=-1;' Makes sure the analog read
'is not interrupted
AQ 1,3;' configure analog input
voltk= 10.15;'mV/deg C - type K
AT 0;'set initial time reference
#calc
temp= (@AN[1]*1000)/voltk
'Thermocouple conversion
'
IF temp< setpoint
CB 1;' turn off compressor
ENDIF
'
IF temp > (setpoint+window)
SB 1;' turn on compressor
ENDIF
'
MG temp;' message out current temp
AT -100;'wait 100ms from last time ref
ZC (temp*1000);'ZC is an integer
'so scaling it up by 1000 was needed
JP #calc
EN
```

The equation for converting the thermocouple output voltage into a temperature value is in the RIO manual in Appendix A2. Visit <http://www.galilmc.com/products/rio-47xxx.php> to download complete specifications and view an on-line video about the RIO.



Be warned that changing the wiring of any AC signal is dangerous and should not be done without sufficient knowledge on AC circuitry and modification should never be done while still plugged in to a power source. This document in no way provides enough detail to handle AC circuitry without prior knowledge and mishandling AC power can be dangerous.

Results

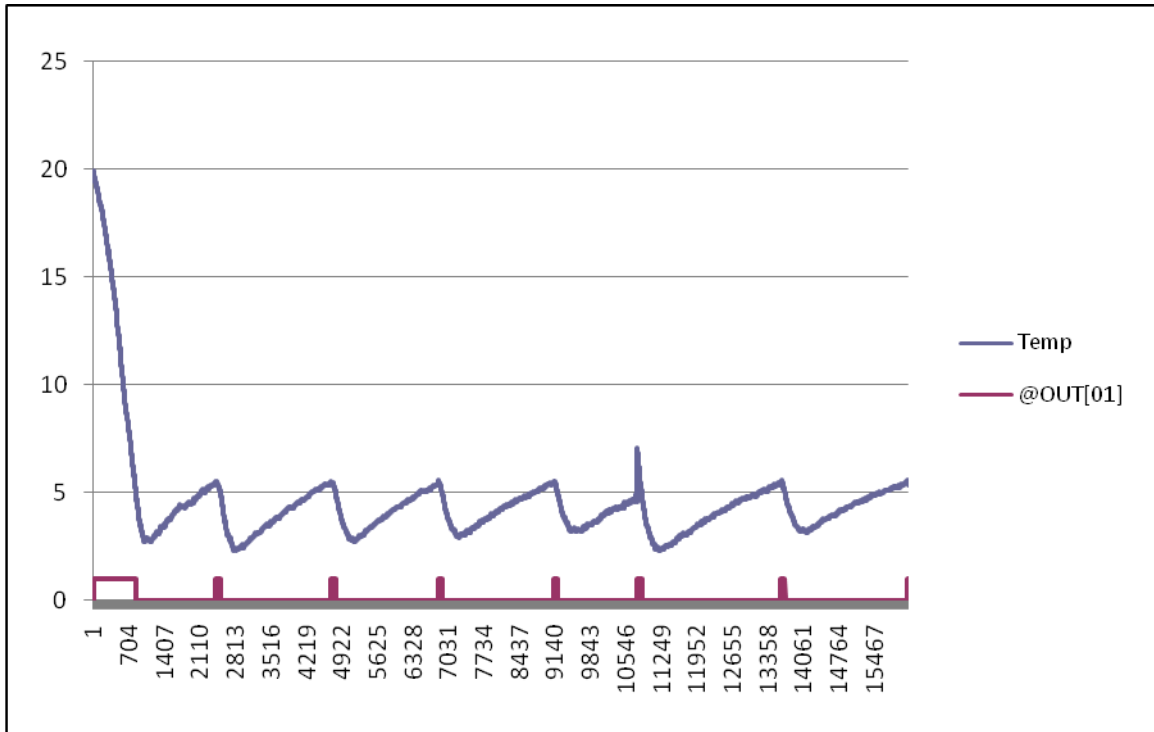


Figure 1 Output from the RIO captured from the data record.

The results in Figure 1 show the temperature in blue and the status of output 1 in red, versus time. The temperature dropped below the target of 5 because of the 'spool up' nature of a compressor cooling system. The non-characteristic rise of temperature around sample 10000 was due to the refrigeration unit being opened, allowing heat to reach the chamber and the thermocouple.