

1 Purpose

Documentation for Simple Brewtroller Firmware

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2 Objective

Goals

The program aims to be a “most simple” firmware suitable for beer brewing. It may also be useful for other temperature control applications that need selectable open-loop control as well as closed-loop thermostatic control in the same unit.

3 Microcontroller hardware

The microcontroller used is an ATMEGA328 8-bit AVR© microcontroller. It was selected for its availability. The firmware would run on other AVR microcontrollers with minimal modification. The microcontroller is powered by 5V and runs at 1MHz, which is how it's configured out-of-the-box. No external crystal is needed, just apply 5V on the Vcc pin and pull up RESET.

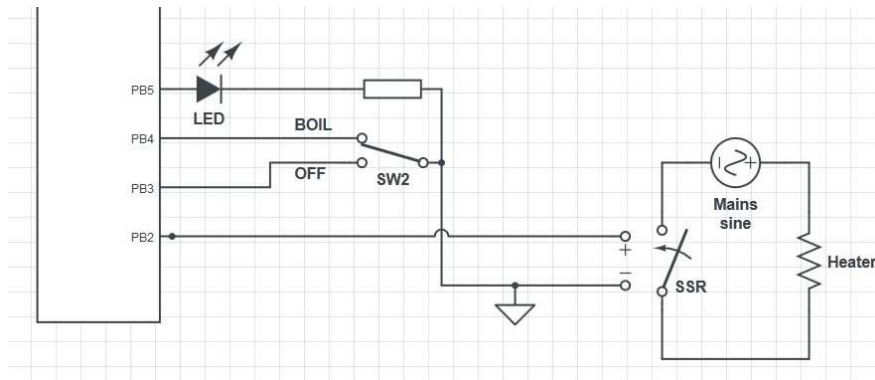


Figure 1: Example Minimal System

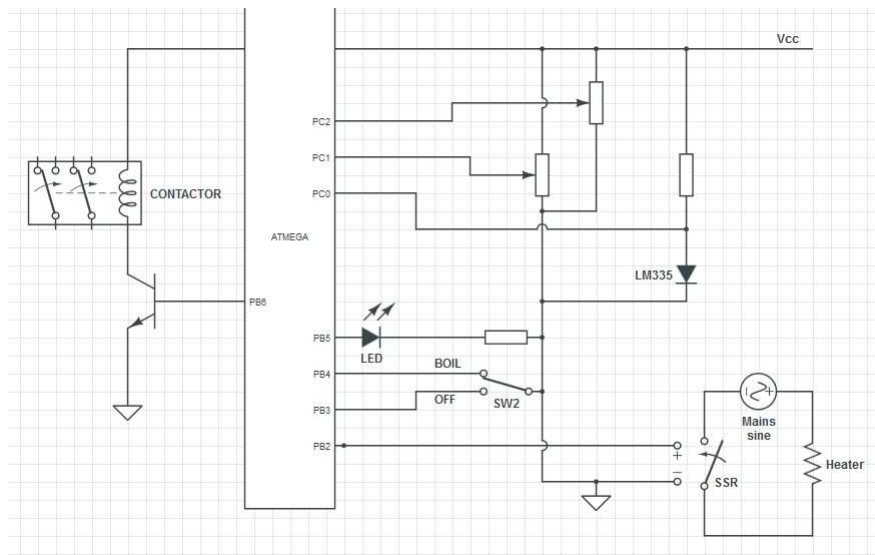


Figure 2: Example Complete System with temp control, contactor and LED

Flashing this firmware to the microcontroller will require an in-system-programmer such as the AVRISPv2 or USBTinyISP. Instructions on programming AVR microcontrollers is outside the scope of this document. All the cool kids are using Arduino nowadays, and you may be able to pretend this is an Arduino program and try to flash it with the Arduino IDE and it may Just Work. You are on your own on the Arduino front.

Input Item	AVR Pin	Voltage details	Function notes
Boil Switch	PB4	GND=ACTIVE	Set boil duty cycle
ON Switch	PB5	GND=OFF	kill SSR and contactor
Temp probe	PC0	0V-5V analog in	LM335
BOIL pot	PC1	0V-5V analog in	Heating element power
TEMP pot	PC2	0V-5V analog in	Temp setpoint

Figure 3: Table Of Inputs

Output Item	AVR Pin	Voltage details	Function notes
Blinkenled	PB2	LED+resistor	Blinks
SSR	PB5	Hook to SSR	5V=heater on
Contactor	PB5	for NO Contactor	5V=Contactor on

Figure 4: Table Of Outputs

4 Perhipheral hardware options

5 Operating Details

As you can see, the system is configurable. With nothing hooked up, the firmware does nothing. You can add functionality by simply hooking up more hardware. For example, an output for a contactor is provided, but if you leave it disconnected, no problem. An input for a temp probe is provided, but if you leave it disconnected, the firmware just ignores thermostat functionality.

The simplest possible hardware is a 2-position (or 3-position “center-off”) switch connected to the “boil” and “off” inputs. With a pull-up resistor on the “BOIL” pot input, this allows 3-way switching between ON, OFF, and BOIL. If you want to control the boil with a knob, hook a pot up to the BOIL input. If you want at thermostat, hook up a temp probe and another pot.

A full-featured system has a contactor, temp probe connection, 2 knobs, a 3-way, “center-off” switch to select “OFF”, “ON”, and “BOIL”. When OFF, the contactor and SSR output are both off. When ON, the contactor is on and the element is controlled thermostatically whenever the temp probe is plugged in. The BOIL potentiometer is used to set the element duty cycle, whether or not a temp probe is connected. Placing the switch on “BOIL” fires the element at the pre-selected duty cycle for consistent boiling.