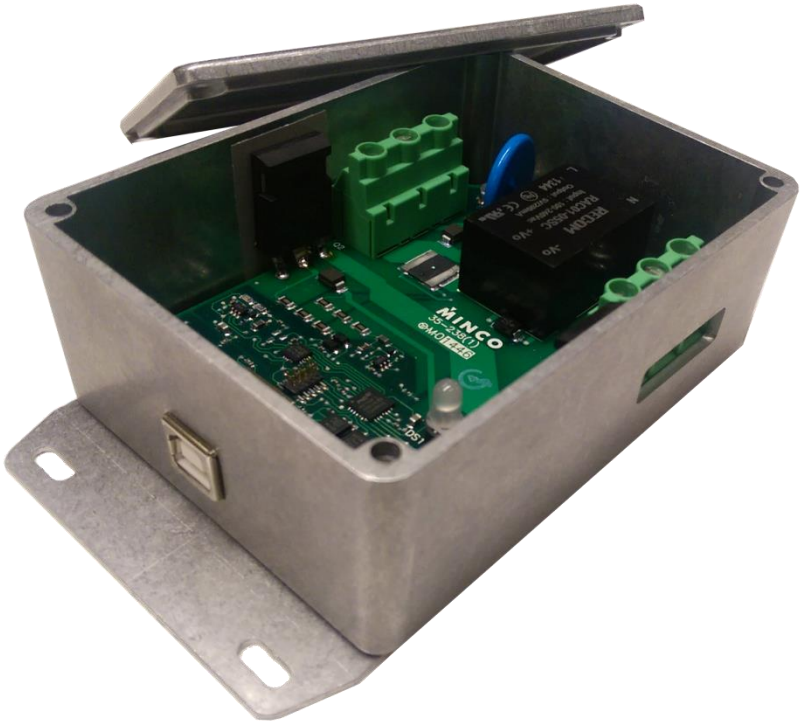

CT298 HeaterStat™ Temperature Controller

Technical User Guide

MINCO

CT298 HeaterStat Controller

Contents

Document Overview

This document provides an overview of how to use the CT298 AC HeaterStat.

For More Information

For more information on the contents of this document, please contact your local Minco representative.

Introduction

The CT298 is a sensorless temperature controller designed to operate on standard AC line power. When a high TCR heater is used with the CT298, the heater element serves as the temperature sensor. This completely eliminates the need for a temperature sensor during operation. A USB interface allows for easy configuration on a computer; the included Windows program provides multiple methods of characterizing a heater and configuring the setpoint to any desired value.

The CT298 utilizes on/off control by applying power to the heater element when the measured resistance, or temperature, is below the Setpoint. Internally, no hysteresis is implemented. When power is applied to the heater, the resistance of the heater is being constantly measured. When the measured element resistance/temperature is above the Setpoint, power is not applied to the heater except for the Measurement Pulse. The Measurement Pulse is a single cycle duration Pulse (16.7ms for 60Hz power) during which power is applied to the heater for the purpose of measuring the heater element resistance. See the Output Settings and FAQ sections for more information on the Measurement Pulse and Pulse Heating.

Depending on the characteristics of the thermal system, the difference between the heater element temperature and the temperature of the heater surface, heat sink, or other object being controlled may vary significantly. Since the CT298 directly measures the heater element and applies the control output accordingly, care should be taken to ensure that the overall system is controlled to the desired operation using external validation.

The CT298 is ideal in situations where additional wires for a sensor are undesirable.

The CT298 performs zero-cross detection to reduce switching noise on the output.

Conventions

Different typestyles are used throughout this manual to make it easier to convey whether the text refers to a physical feature of the CT298, or if it refers to a general term.

A word or phrase with first letter capitalization (such as Heater Output) refers to a feature on the CT298 such as a terminal block connection or a feature such as Device Name.

Installation

All configurations are performed through the USB connection via the Windows application. Because the USB port is optically isolated from the CT298's control circuitry, the device cannot be USB powered even for simple pre-installation configuration. Windows will detect the USB port but no communication will be possible unless AC power is applied to the Power Input.

Mounting

The CT298 may be mounted via case flanges if desired, and may be operated in any position. A minimum of one inch (2.5 cm) airspace must be maintained around the sides and top of the CT298. Be aware that the CT298's enclosure is connected to both Ground terminal block positions.

WARNING: The CT298 enclosure may become hot to the touch especially when driving a high current heater. This is normal; this must be accounted for when installing the unit.

Wiring

The CT298's cover must be removed in order to gain access to terminal block screws. Simply remove the four Phillips screws at the corners and remove the cover.

WARNING: Do not touch anything inside the CT298 except the terminal block screws. The circuitry contains very small components that are easily damaged by a screwdriver, finger, or electrostatic discharge.

Strip each wire to 9/32 inch (7mm), fully insert into the terminal block though the cutout, and tighten the terminal block screw. Ensure there is no danger of a bare wire touching the CT298's enclosure.

The Power Input terminal block **requires** all three connections; the Ground must be properly connected to earth ground. The Heater Output Ground terminal is optional and available to the installer if required.

After wire connections are made, replace the cover and screws.

The terminal block connections are shown in Figure 1. Each terminal block is outlined in detail in the following sections.

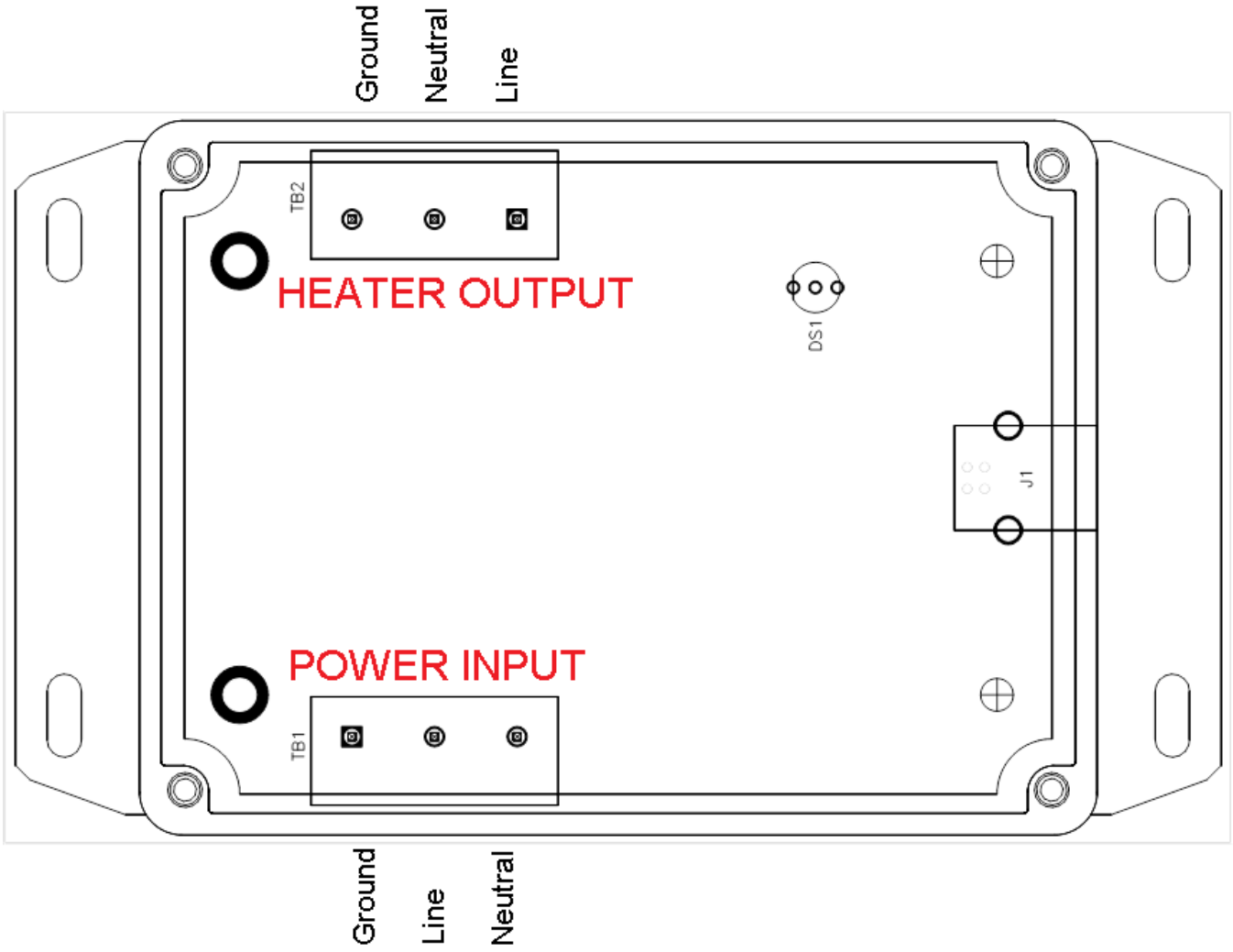

Figure 1

Power Input

The CT298 is exclusively AC powered and must be connected to the appropriate power supply. In addition, the Ground **must** be properly connected for both the CT298's proper operation and the user's safety. An earth ground must be connected to the Ground terminal block connection, the metal enclosure, or both.

Heater Output

One SSR output is provided which simply connects to the heater. Power is applied to the heater across the Line and Neutral connections. The Ground connection on the Heater Output is an optional connection the installer may utilize and is simply a pass-through from the Power Input's Ground terminal.

USB

All configurations are performed through the USB interface. The included Windows software communicates with the CT298 and allows the user to either configure the unit while in operation, or to configure, disconnect, and install the CT298 into the intended application. All settings will be stored to non-volatile memory so removal of power does not cause loss of configuration information.

The USB interface is electrically isolated from the Power Input and Heater Output. This is for the user's safety, but this also means the CT298 requires power to be connected to the Power Input for any USB communication to work.

Installing Device Driver

The first time a CT298 is connected to a computer via USB, the driver may not install correctly. Check device manager for something listed as "MCP2200 USB Serial Port Emulator" with a yellow exclamation mark, similar to Figure 2. If this is present, right click on it, choose to update driver, and direct it to load the driver from the CT298 installation media.

There should now be a "USB Serial Port (COM4)" or similar in the "Ports" category.

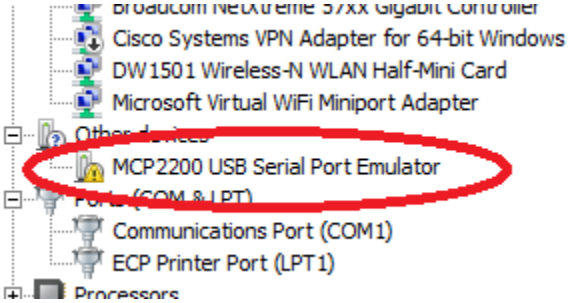

Figure 2

Typical Wiring Diagrams

Below are typical wiring diagrams for the CT298.

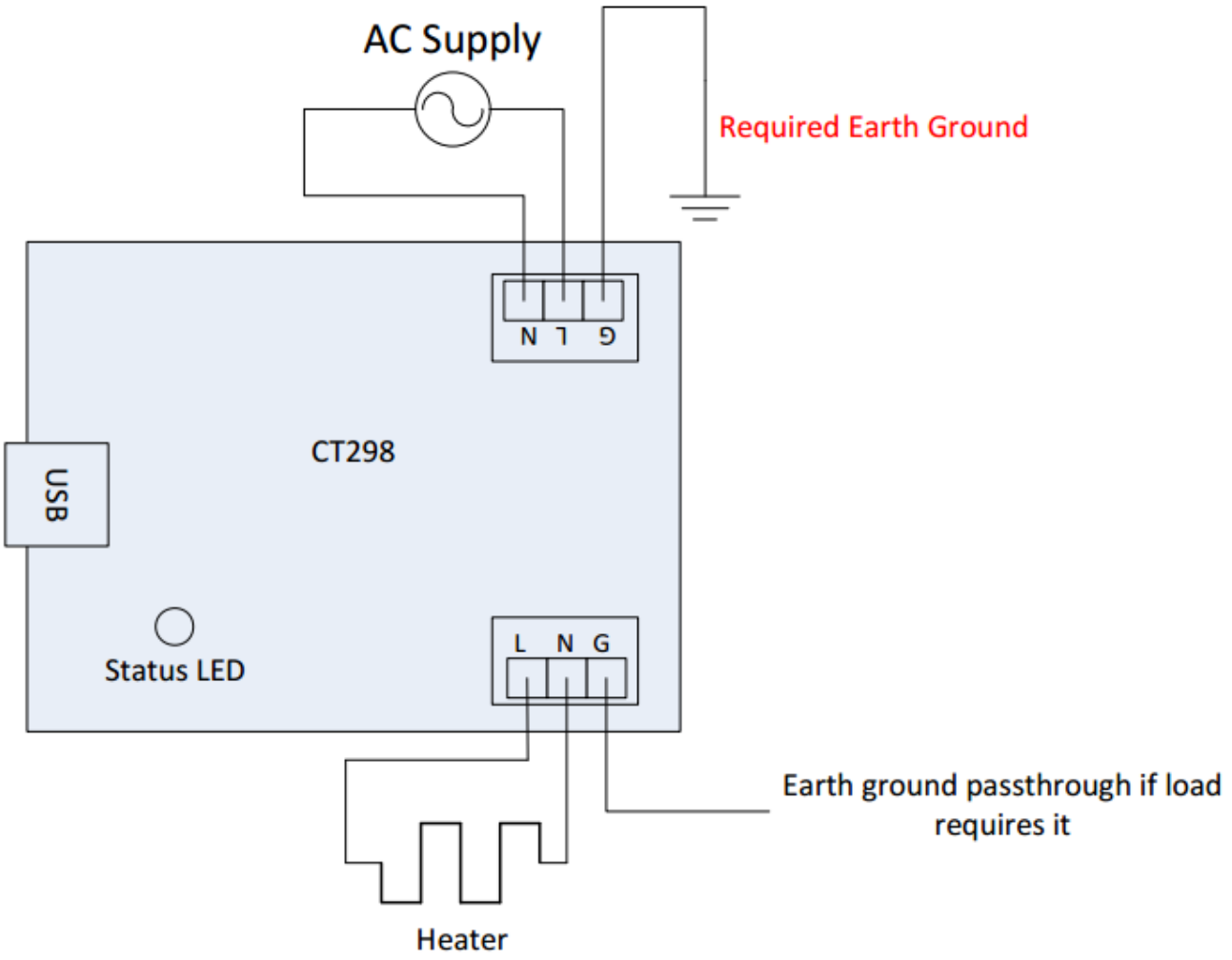

Figure 3

Configuration

Once the CT298 is attached to a computer and the configuration software is started, press “Connect to Device”. If this is successful, the configuration stored on the CT298 is retrieved and displayed, along with the calculated temperature and output status. The settings are grouped into tabs.

Status

The Status group displays the heater’s measured resistance and output status. Temperature is calculated from the heater resistance, provided the heater characteristics have been configured. The Heater Output status will indicate if the Heater Output is energized while attempting to increase its temperature, but not while the CT298 is pulsing the output to test the heater temperature. The true output status, including pulsing, can be seen on the Status LED.

A heater within the allowed resistance range must be connected for correct operation. Leaving the Heater Output open will not cause damage, but will result in erratic operation.

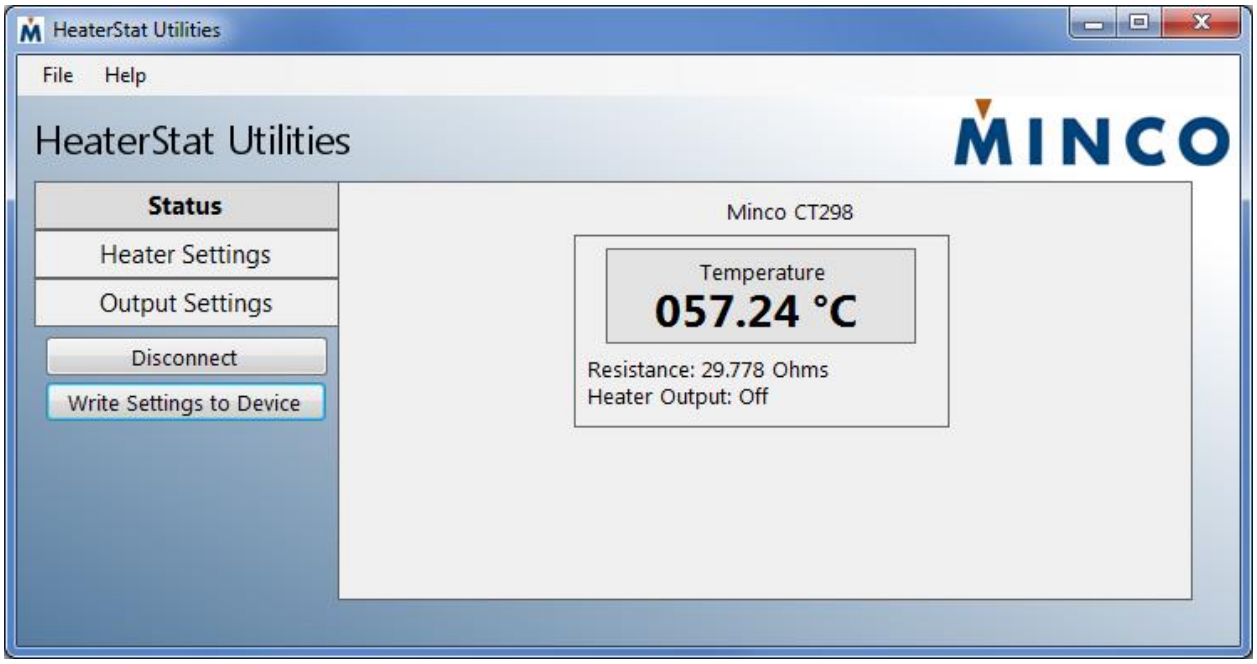

Figure 4

Heater Settings

The Heater Settings group contains different methods CT298 Utilities may use to convert heater resistance to temperature. The different methods are outlined below; only one method is required. Each method is accessed by the tab of the same name.

Heater Code: A string of characters which, if provided with the heater, fully describes the heater's characteristics.

Heater Characteristics: The heater element composition, base resistance, and optional calibration data points are used to characterize the heater.

Temperature / Resistance Data: A set of temperature/resistance points are entered and used to characterize the heater. A minimum of two temperature/resistance pairs are required, although more increases accuracy.

Equation: Polynomial coefficients are entered and used to characterize a heater. The equation relating heater resistance to temperature must be known.

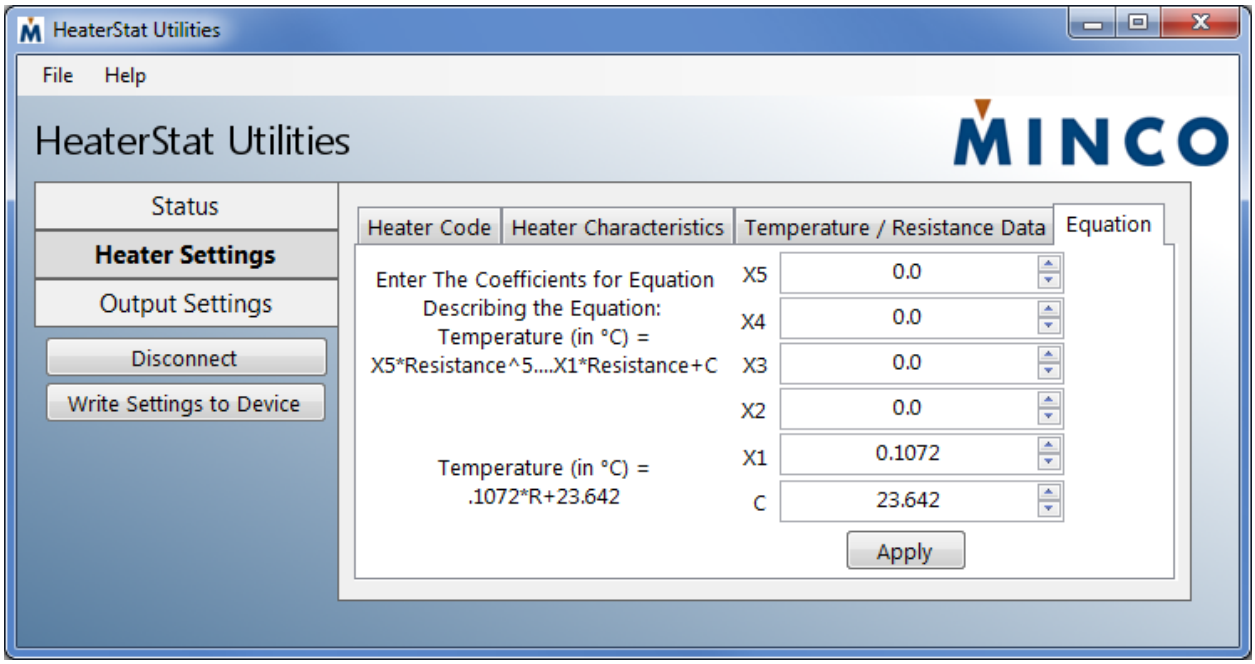

Figure 5

Output Settings

The Output Settings group contains Device Name and parameters which directly control the Heater Output.

Device Name: A string of up to 20 characters that the user may change to “name” the device. This may be useful to identify multiple units.

Pulse Rate: The rate at which the CT298 tests the heater resistance when the heater’s temperature is above the Setpoint. This value is in milliseconds (thousandths of a second). When the heater’s temperature is below the Setpoint, the heater is energized and its resistance is checked continuously.

Generally a lower Pulse Rate is better, however the lower the Pulse Rate, the higher the pulse heating (heating due to testing the heater’s resistance). A Pulse Rate of 1000ms is a recommended starting point. The length of each pulse is one full AC waveform – 16.7ms for 60Hz power.

Control Units: Selectable between Resistance and Temperature. This setting controls whether resistance or temperature is used to configure the Setpoint and Heater Shutdown limits. If Temperature is used, the Heater Settings information must be entered. If Resistance is used, no information about the heater is required by the utility program. The Setpoint and Heater Shutdown values on the same screen will be displayed / entered in the selected units.

Setpoint: The desired resistance or temperature of the heater. If this value is higher than the heater’s measured value, the heater is energized until this is no longer true. If this value is lower than the heater resistance, the heater is pulsed until this is no longer true.

Heater Shutdown: The lower and upper limit at which normal operation will continue. If the heater falls outside of these limits, the CT298 goes into Heater Shutdown and power must be cycled to resume operation. It’s recommended to set these to values that would indicate a problem with the heater.

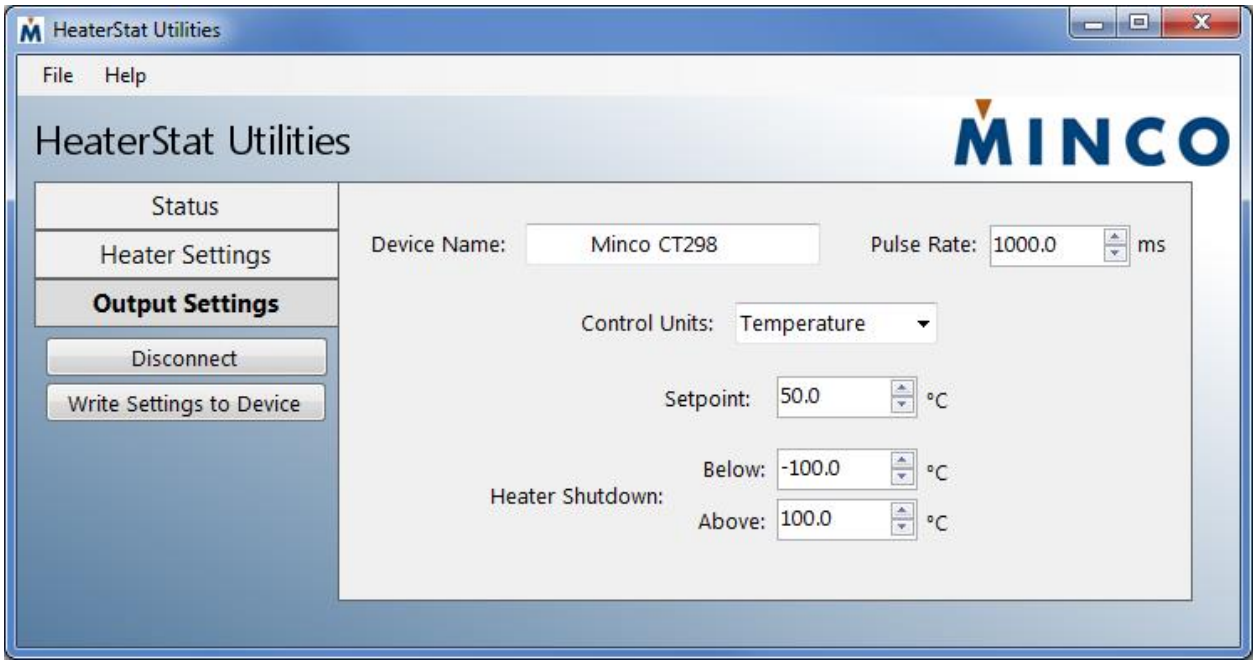

Figure 6

General Usage

Status Indicator

The Status LED is visible through the CT298's perforated cover. The legend for the status indicator is shown Table 1.

Color	Pattern	Meaning
Green	Solid	The Heater Output is energized.
Red	Solid	In Heater Shutdown. Heater Output is de-energized, and power must be cycled to clear this condition.
Red	Blink	A hardware failure has occurred. Heater Output is de-energized.
Yellow	Blink	CT298 is in manufacturing mode. This should normally not occur.
Off	N/A	No power applied, or Heater Output is de-energized.

Table 1

Errors

Status LEDs

The Status LED normally indicates if the Heater Output is energized, but other conditions can also be indicated by the LED.

A solid red color indicates that the user-defined heater resistance range has been violated. When this happens, the Heater Output is de-energized, the Status LED turns solid red, and a power cycle is required to clear the error. The occurrence of this condition with an otherwise correctly configured heater resistance range may indicate a faulty heater or faulty connection.

An analog-to-digital converter failure is indicated by a blinking Status LED. When this occurs, the Heater Output is de-energized and the CT298 must be power-cycled to reset it. This situation may indicate permanent hardware failure; however more often it will indicate insufficient supply voltage is present. Ensure the CT298 is receiving proper supply voltage and try cycling the power.

Another possible situation the Status LED can indicate is if the CT298 is in manufacturing mode. This is characterized by a rapidly blinking yellow Status LED and normally should not occur.

Frequently Asked Questions (FAQ)

Q: Is a USB connection to a computer required for the CT298 to operate?
A: No. The CT298 itself does not rely on the USB connection for any function other than configuration.

Q: How long will the CT298 maintain a configuration in non-volatile memory?
A: The specification states the retention is at least 20 years and will withstand at least 1 million writes.

Q: Why am I getting a “Device Not Recognized”, or why is the utility program not connecting?
A: Try unplugging the USB cable, close the utility program, and wait at least 10 seconds before reconnecting the USB cable.

Q: Windows Device Manager sees the USB connection, but the utility program will not connect. What’s wrong?
A: The CT298’s USB connection will not fully power the device. AC power must be applied for the utility program to communicate with the CT298.

Q: Why isn’t the measured temperature of the heater surface the same as what is reported in the utility program?
A: The CT298 uses the resistance of the heater’s element to determine the heater’s temperature. It is not uncommon for this measured value to be higher than the heater’s surface temperature.

Q: Why does the temperature slowly increase despite already exceeding the Setpoint?
A: Try reducing the Pulse Rate. In order to measure the heater’s resistance, power is briefly supplied to the heater and the current and voltage are measured. If the CT298 checks too frequently, this will result in excessive heating.

Specifications

Inputs

Power Input
100 to 240 VAC, 50 to 60Hz

Outputs

Heater Output

Ambient	25°C	35°C	45°C	55°C
Current Rating	10 amps	9 amps	8 amps	7 amps

Heater Setpoint Range
10Ω to 500Ω

Pulse Rate
100ms to 10s

Communication

USB 2.0, Type B.

Electrically isolated from the Power Input up to 3750V.

General

Resistance Setpoint Resolution
1 milliohm

Resistance Measurement Accuracy
+/- 3% over the entire allowed temperature and load range.

Dimensions
5.49"L x 3.24"W x 1.80"D (13.94cm L x 8.23cm W x 4.57cm D) including flange.

Weight
Approximately 12.1 oz (0.34 kg)

Environmental
Operating temperature: -25 to 55°C (-13 to 131°F) @ 90% relative humidity, non-condensing
Storage temperature: -40 to 85°C (-40 to 185°F) @ 90% relative humidity, non-condensing

Construction
Diecast aluminum enclosure with mounting flanges and internal terminal blocks.

Glossary

Term	Definition
LED	Light Emitting Diode: A solid state device that converts electricity directly into light.
Pulse Heating	Heating that occurs not due to the request for heat, but due to the heater being energized momentarily to check its temperature.
SSR	Solid State Relay: A type of relay without mechanical contacts constructed from solid state components.
TCR	Temperature Coefficient of Resistance
USB	Universal Serial Bus: A common computer interface on computers for interfacing to various peripherals.