CT425 PID Temperature Controller

Technical User Guide

CT425 PID Temperature Controller

Contents

Document Overview

This document provides an overview of how to use the CT425 PID Temperature Controller.

For More Information

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

Introduction

The CT425 is a universal temperature controllers that support two platinum RTD inputs and three outputs. A 32 bit processor allows up to two PID loops to operate simultaneously at individually configurable loop rates up to 25Hz. An autotune feature generates PID coefficients, and all configurations are performed through a Windows application over a USB connection.

Each of the CT425's three outputs (SSR, LVO, and Relay) has its own set of parameters that may be set independently of each other, including the use of either RTD input and On/Off, PID, or Alarm function. (PID available on SSR and LVO only)

AC powered models perform zero-cross detection to reduce switching noise on the SSR and LVO outputs.

Conventions

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

A word or phrase with first letter capitalization (such as Relay Output) refers to a feature on the CT425 such as a terminal block connection or a function feature such as Alarm.

All other typestyles intend to reflect general terms.

Because of the Reverse Acting output feature, specific terms are used to indicate whether an output is in the closed or "on" state, or if that output is in the active state regardless of the Reverse Acting Relay settings. If referring to whether an output is closed or providing voltage, "energize" will be used. If referring to if an output is in the active state, which ignores the Reverse Acting setting and only takes into account the intent of the algorithm, i.e. to turn a heater on when the temperature falls too low, "engage" will be used.

In other words, "energize" refers to the state of the output at the terminal block, and "engage" refers to what the control algorithm would normally do when controlling a heater under the given conditions.

Installation

All configurations are performed through the Windows application. The CT425 may be powered through USB if desired. This allows the user to configure the unit, or simply become familiar without having to connect separate power. Note: the zero-crossing feature is enabled only if AC power is detected when power is applied.

Mounting
The CT425 may be mounted via case flanges if desired, and may be operated in any position.

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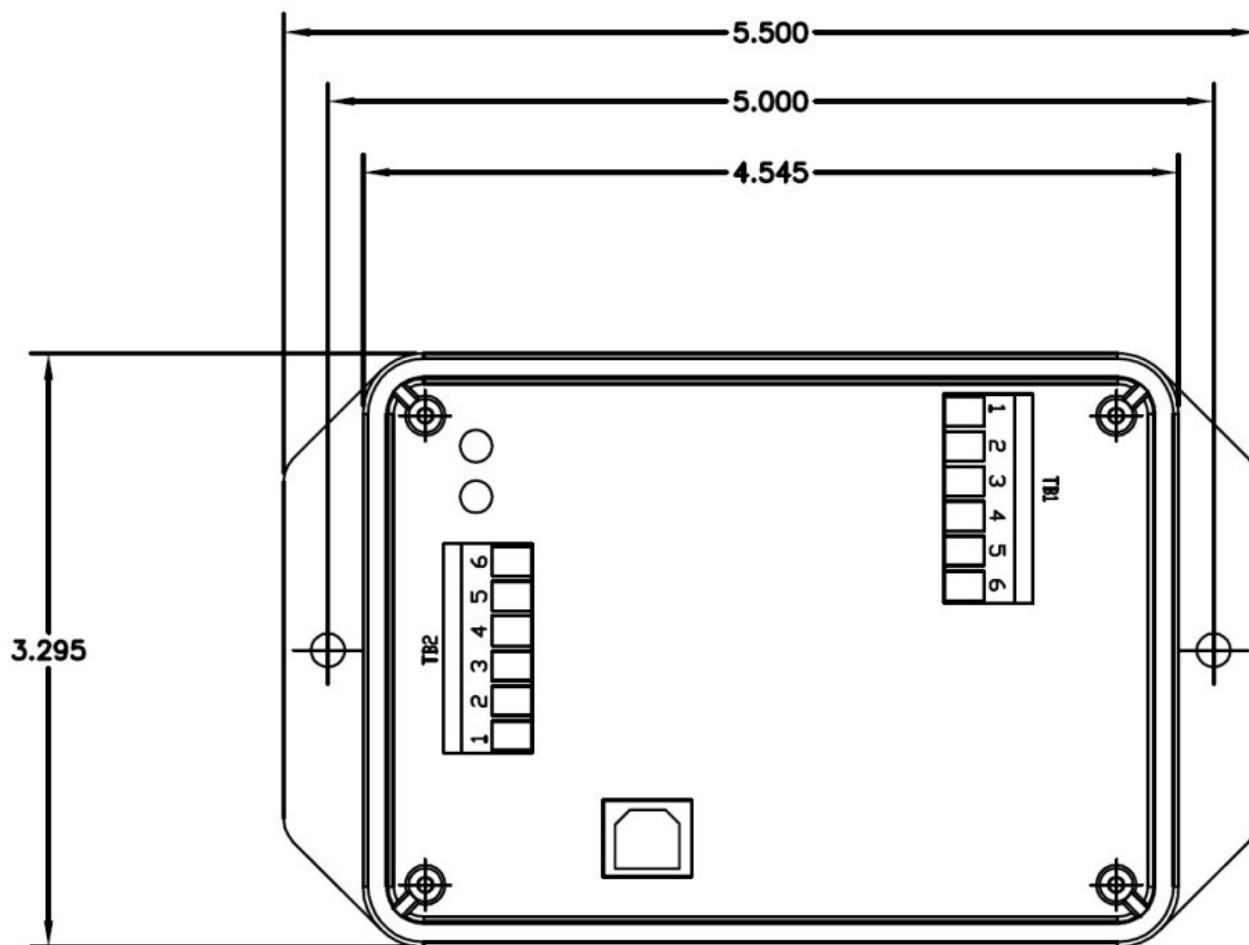
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Figure 1

TB1:1 – POWER (L/+)

TB1:2 – POWER (N/-)

TB1:3 – RELAY CONTACT (N.O.)

TB1:4 – RELAY CONTACT (N.O.)

TB1:5 – SOLID STATE RELAY (-) (AC VERSIONS NON-POLARIZED)

TB1:6 – SOLID STATE RELAY (+) (AC VERSIONS NON-POLARIZED)

TB2:1 – RTD INPUT 1 (+)

TB2:2 – RTD INPUT 1 (-)

TB2:3 – RTD INPUT 2 (+)

TB2:4 – RTD INPUT 2 (-)

TB2:5 – LOGIC VOLTAGE OUTPUT (+)

TB2:6 – LOGIC VOLTAGE OUTPUT (-)

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Power

The CT425 is available in AC and DC models. While the external connections appear identical, care must be taken to properly connect the appropriate power supply.

The power input for the AC model is electrically isolated from the rest of the model's circuitry. The DC model's power supply is NOT electrically isolated from the rest of the model's circuitry.

> **AC Model**
> On AC models, the line and neutral must be connected to the L/+ and N/- terminals, respectively.
>
> **DC Model**
> On DC models, the positive and negative must be connected to the L/+ and N/- terminals, respectively. The power input has reverse-polarity protection.

Inputs

The CT425 can use any combination of supported sensors which are listed in the table on page 17.

The sensor inputs are not electrically isolated from the rest of the circuitry; therefore care must be taken to not create a situation where an unintended short circuit is created.

Each sensor channel has two terminals. The RTD is simply connected to these two terminals. If the RTD has extra wires for lead compensation, these wires could be left disconnected or grouped together on the same terminal. Lead compensation may be performed by specifying an offset in the device configuration.

If a shield is provided on a sensor lead, it should be grounded at only one end for best performance. Which end to ground is usually determined through trial and error since otherwise it is extremely difficult to determine. No terminal is provided for grounding since the CT425 does not require grounding. Ground at either the sensor end, or add a separate ground wire at the CT425 end.

Outputs

> ### SSR Output
>
> One SSR output is provided of varying voltage and current ratings depending upon the model. See the table on page 17 for ratings of each model.
>
> The SSR Output is electrically isolated from all other electronics, and will support PID, On/Off, and Alarm functions.
>
> The SSR output on AC models will switch AC or DC current, while the DC model will switch current in one direction only.
>
> Note that current will always flow in the reverse direction on the DC model SSR output. This may damage the CT425 when carrying higher current levels due to excessive heat dissipation. Ensure the polarity of the SSR load is correct.
>
> ### Logic Voltage Output
>
> One Logic Voltage Output (LVO) is provided on the devices. The LVO is *not* electrically isolated from the rest of the device circuitry; it is intended to drive an external SSR, but could be used for other purposes. The LVO is a current-limited output and therefore it is not possible to overload this output. However, applying a very low resistance load during power-up will cause the CT425 to enter a special manufacturing mode which is characterized by alternating yellow status indicators. If this happens, simply remove the load and re-apply power. See page 16 for specifications.
>
> The LVO will support PID, On/Off, and Alarm functions.
>
> ### Relay Output
>
> An SPST relay is provided on the CT425. The Relay Output is electrically isolated from the rest of the device's circuitry. See the table on page 17 for ratings.

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The Relay Output will support On/Off and Alarm functions only. PID is not supported on the Relay Output due to the possibility of the relay being subjected to frequent switching.

USB

All configurations are performed through the USB interface. The included Windows software communicates with the CT425 and allows the user to configure the unit on the fly, or configure, disconnect, and install the device into the intended application. All settings may be stored to non-volatile memory so removal of power does not cause loss of configuration.

The USB interface is not electrically isolated.

Typical Wiring Diagrams

Below are typical wiring diagrams for DC and AC versions of the CT425. Since the SSR and Relay output are isolated, they may use the same power supply that powers the device if desired, or a different power supply.
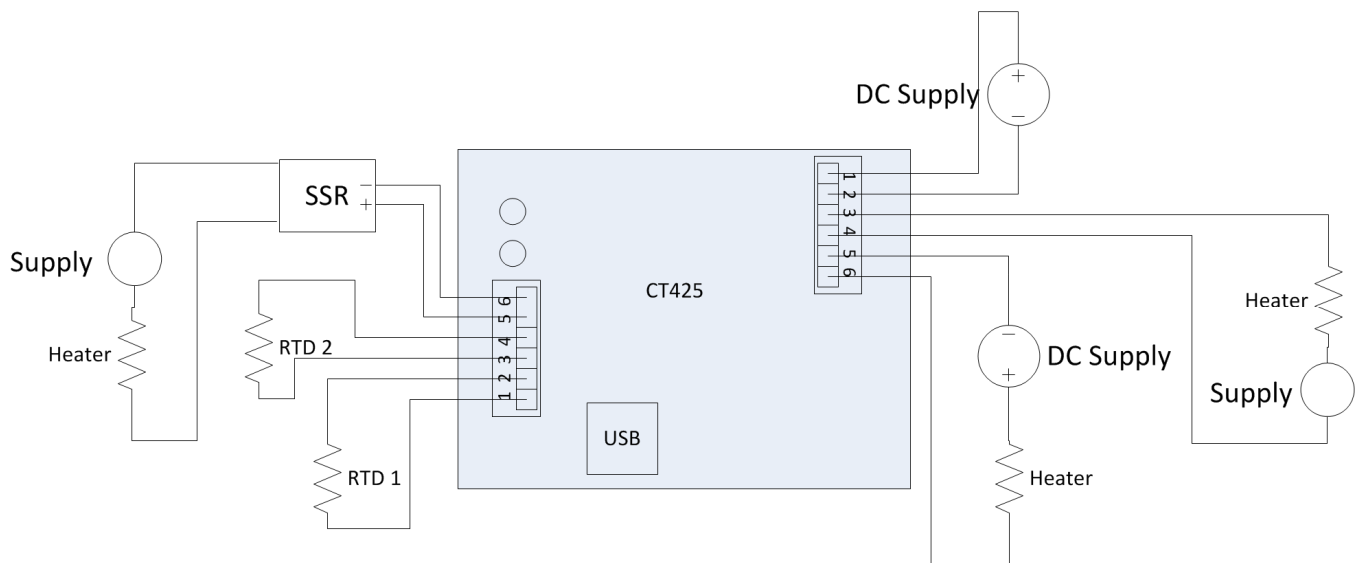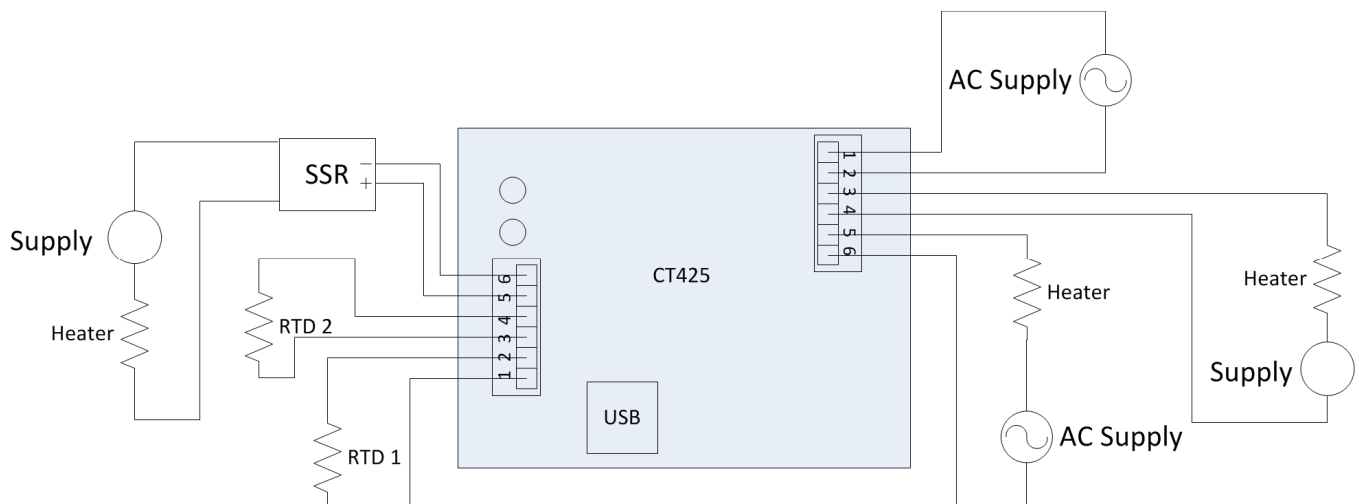

Figure 2

Figure 3

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Configuration

Once the CT425 is attached to a computer and the configuration software is started, press "Connect to Device". If this is successful, the configuration stored on the CT425 is retrieved and displayed, along with the measured sensor temperature and output status. The settings are grouped into tabs.

Status

The Status group displays each sensor's current temperature and each output's state.

If the read temperature is outside the range of the device, either "Error Lo" or "Error Hi" is displayed if the sensor resistance is below or above the input range, respectively.

The output status does not take the Reverse Acting setting into account. For example, if the SSR output is at 75% duty cycle, the output will be energized 75% of the time if Reverse Acting is disabled. If Reverse Acting is enabled, the output will be energized 25% of the time yet the displayed duty cycle will still be 75%.
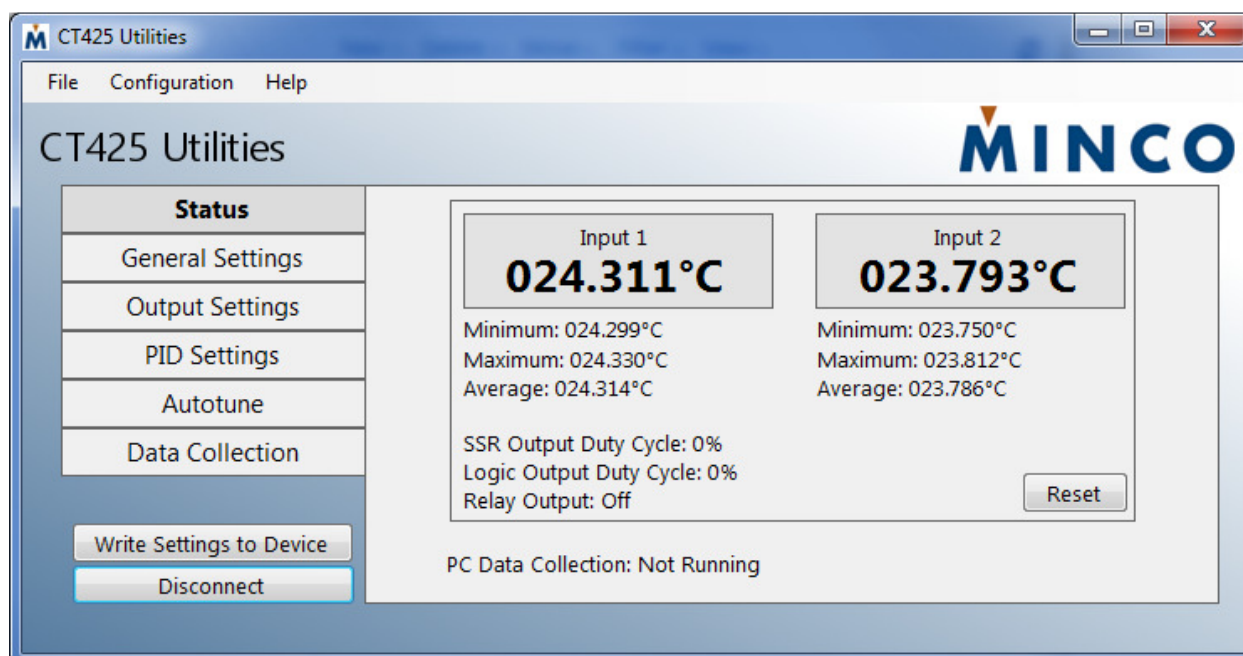

Figure 4

General Settings

The General Settings group contains the configuration for the RTD inputs, the temperature scale, and device name.

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.

Temperature Scale: Determines if the CT425 will interact with the user in the Celsius or Fahrenheit scale.

Type: Set to either Pt100, Pt1000, or Disabled for platinum 100 ohm, platinum 1000 ohm, or no sensor connected, respectively.

Offset: Applies an offset to the respective sensor input. This could be used for wire lead compensation.

Normal Process Value Range: Defines a temperature range that will cause the sensor input's Status Indicator to be green, rather than yellow. This provides a quick visual check as to whether the process is within the user's desired temperature range. See the General Usage on page 13 for more Status Indicator information.
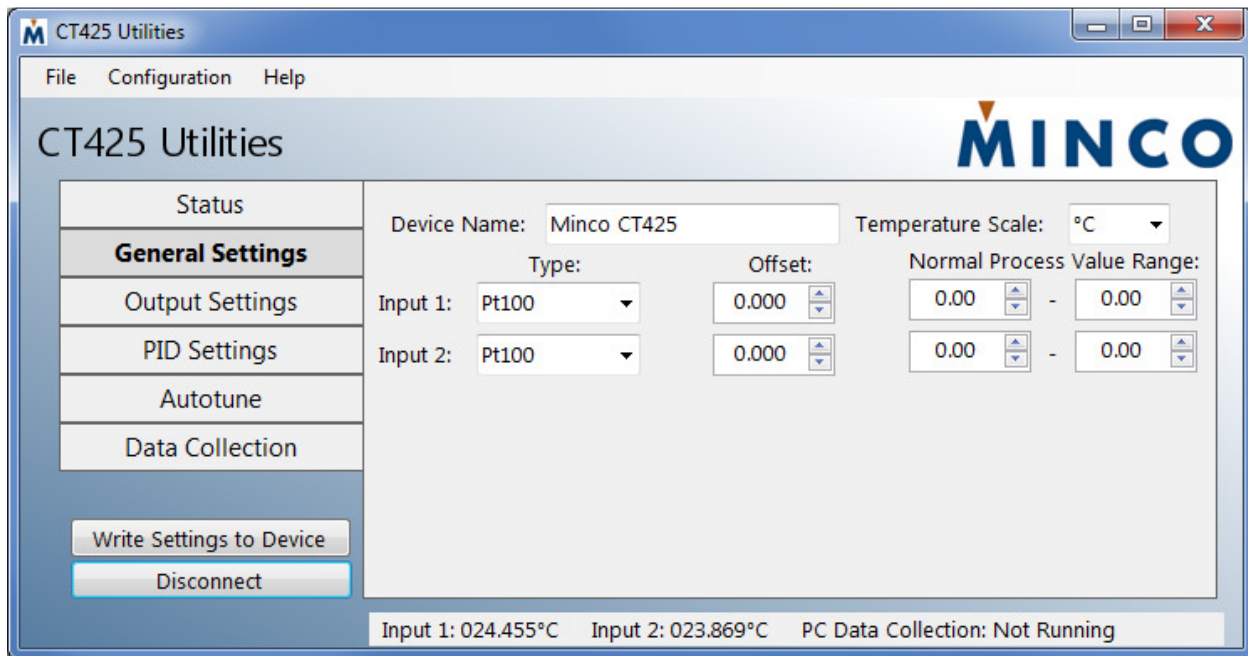
Figure 5

Output Settings

The Output Settings group contains the output configuration. Each output has its own tab within Output Settings. Some options will be unavailable (greyed out) depending upon what function is chosen.

Source: Determines which sensor input the respective output will use. Multiple outputs may share the same sensor input.

Function: Disabled, PID, On/Off, or Alarm.

On/Off and Alarm work similarly with the only difference being how Hysteresis is used. Please see the Hysteresis description for further information.

When set to Disabled, the output is de-energized regardless of the Reverse Acting setting.

Reverse Acting: Setting this to True causes the respective output to behave in the opposite manner, i.e. normally closed instead of normally open. This may be useful for cooling applications.

Note that when the output is Disabled, the respective output is de-energized regardless of this setting. Also note that despite setting Reverse Acting to True, the output will not remain "closed" when the CT425 is unpowered.

Over/Under: Determines whether the output engages when the sensor temperature is over or under the Setpoint. This applies to the Alarm Function only.

Setpoint: Determines the temperature that the selected sensor input is maintained to for PID and On/Off Functions. In the case of the Alarm Function, when the sensor is above or below this temperature the output will activate depending upon if Over or Under is selected, respectively.

Hysteresis: Determines the band around the Setpoint where the output engages and disengages.

When using the On/Off function, the Hysteresis value is evenly divided around the Setpoint. For example, if the Setpoint is 55.0C and Hysteresis is 0.1C, the output will engage at 49.95C, and disengage at 55.05C.

When using the Alarm function, the Hysteresis is placed on the side of the Setpoint that does not engage the output. For example, if the Setpoint is 55C, Over/Under is Over, and Hysteresis is 0.1C, the output will engage when the sensor exceeds 55.0C, but will disengage when the sensor is less than 54.9C.

The hysteresis value is meaningless to the PID Function and therefore is greyed out if that Function is used.

NOTE: To avoid frequent cycling, set the Hysteresis high enough when using the Relay Output.

Minimum Duty Cycle: Determines the minimum duty cycle, in percent, that the output will reach. This is the duty cycle at the output terminals with respect to the Reverse Acting setting. Normally this value is set to zero, however there may be some applications that require a minimum of more than zero. When the Function is set to Disabled, this setting is irrelevant.

Maximum Duty Cycle: Determines the maximum duty cycle, in percent, that the output will reach. This is the duty cycle at the output terminals with respect to the Reverse Acting setting. Normally this value is set to 100; however there may be some applications that require a maximum of less than 100. When the Function is set to Disabled, this setting is irrelevant.
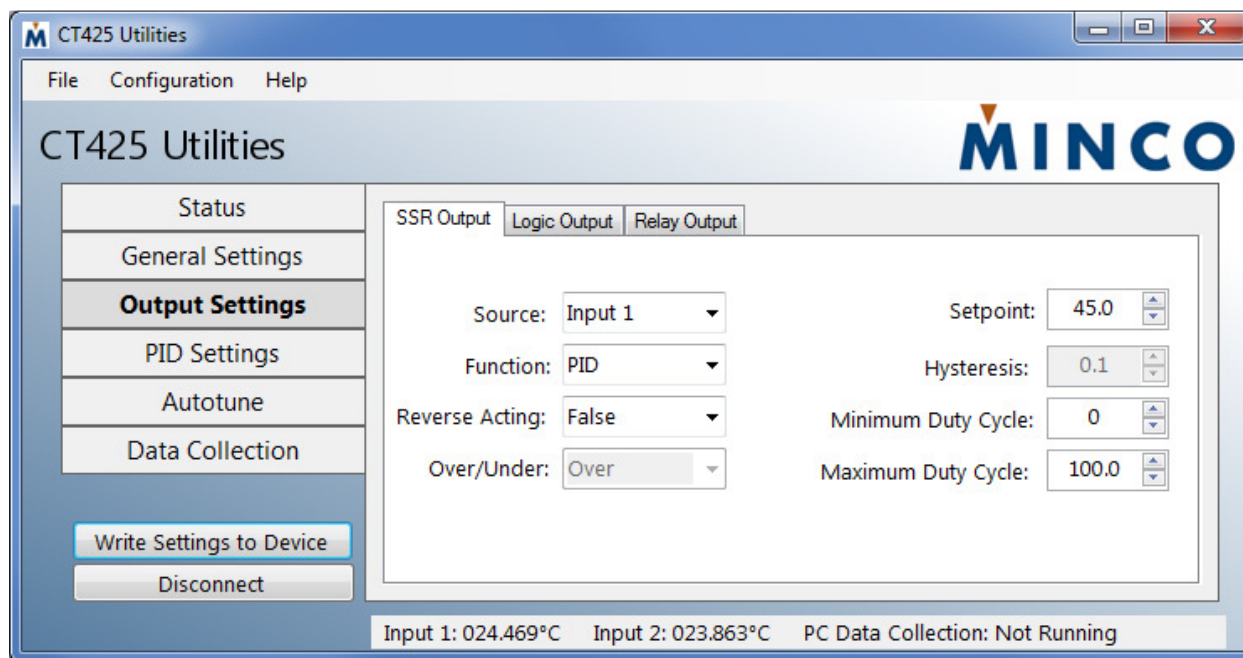

Figure 6

PID Settings

The PID Settings group contains settings specific to the PID Function. These settings will be unavailable unless the respective output is set to the PID Function.

Method: Determines if the PID coefficients (Kp, Ki, Kd) will be entered manually by the user, or if they will be automatically generated from Autotune data by one of several algorithms.

The information gained from an Autotune procedure is saved so the Method may be changed later by the user. As with all other settings, this is preserved through a power cycle only if written to nonvolatile memory.

It should be noted that the various options listed in Method are the common names given to the various algorithms. For example, Minimal Overshoot may or may not result in the least overshoot among the other available methods due to variability in application, and accuracy of the Autotune performed. It's recommended to try different Methods to find the best performer, and if desired, manually tweak from there.

An easy, though generic option is to simply set Kp, Ki, and Kd to 100, 2, and 0, respectively. These are the default values the CT425 are shipped with, and work reasonably well in many applications. Kd could instead be set to 1000 for full PID. Again, these values are generic and are by no means intended to work in every application.

Kp: The Proportional coefficient.

Ki: The Integral coefficient.

Kd: The Derivative coefficient.

Loop Time: The loop time for the PID Function, in milliseconds. This is the amount of time between each PID Function calculation, i.e. how often output duty cycle is recalculated based on current conditions. A lower number will theoretically result in faster response time. However, a Loop Time that is too low may result in an unstable system. In general, slow moving processes should have a higher Loop Time.
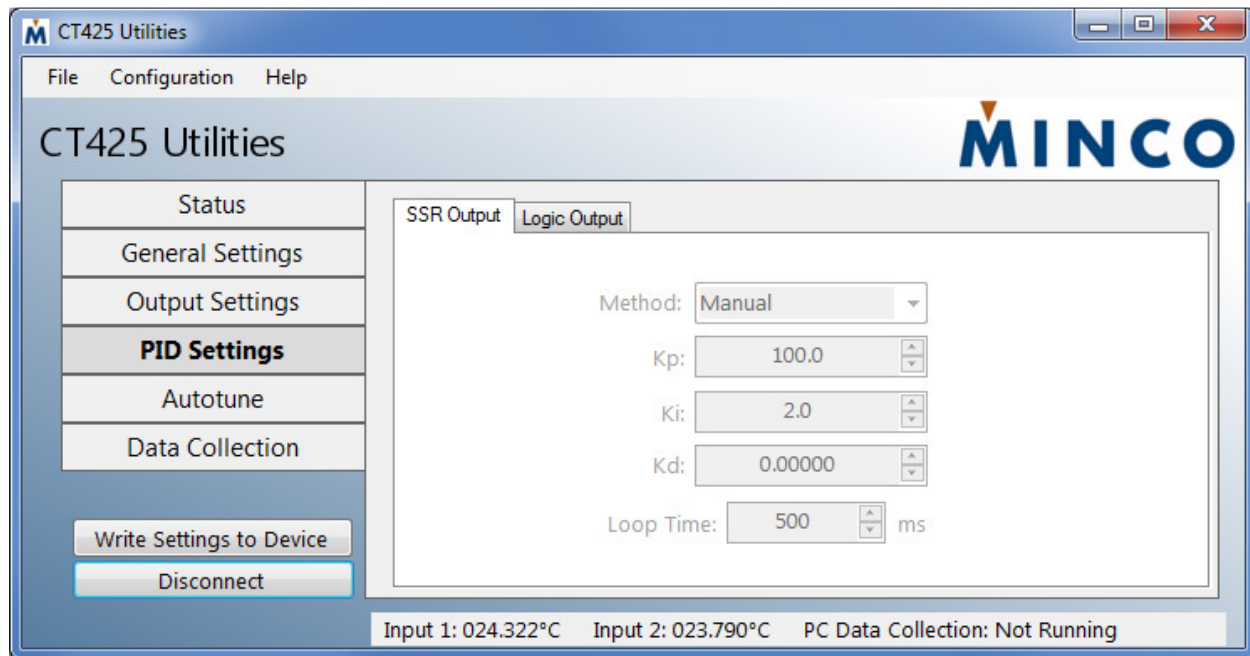

Figure 7

Autotune

The Autotune group contains settings for the Autotune feature.

Autotune Band: Determines the number of degrees above and below the Intended Setpoint the output is toggled during Autotuning, respectively. Generally this should be set as high as tolerable to improve Autotune results, although 0.5°C is frequently sufficient. See the How Autotune Works section on page 10 for more information.

Autotune Output Step: Determines the output duty cycle while the output is engaged. The Autotune algorithm will cycle the output between fully de-energized ("off") and the Output Step. The purpose of the Autotune Output Step is to limit heater power in applications where 100% duty cycle would cause very rapid heating, making autotuning difficult.

In general, set this value as low as possible while allowing the heater to receive enough power to reach the intended temperatures. See the How Autotune Works section on page 10 for more information.

Intended Setpoint: Determines the temperature around which the Autotune algorithm will operate. The purpose of this value is to first bring the heater to the approximate temperature at which it would normally be operated before Autotuning, which may improve Autotune results.

Be aware that simple on/off control is used while autotuning, and it's possible that significant overshoot will occur during this Autotune step if the Autotune Output Step is set too high.
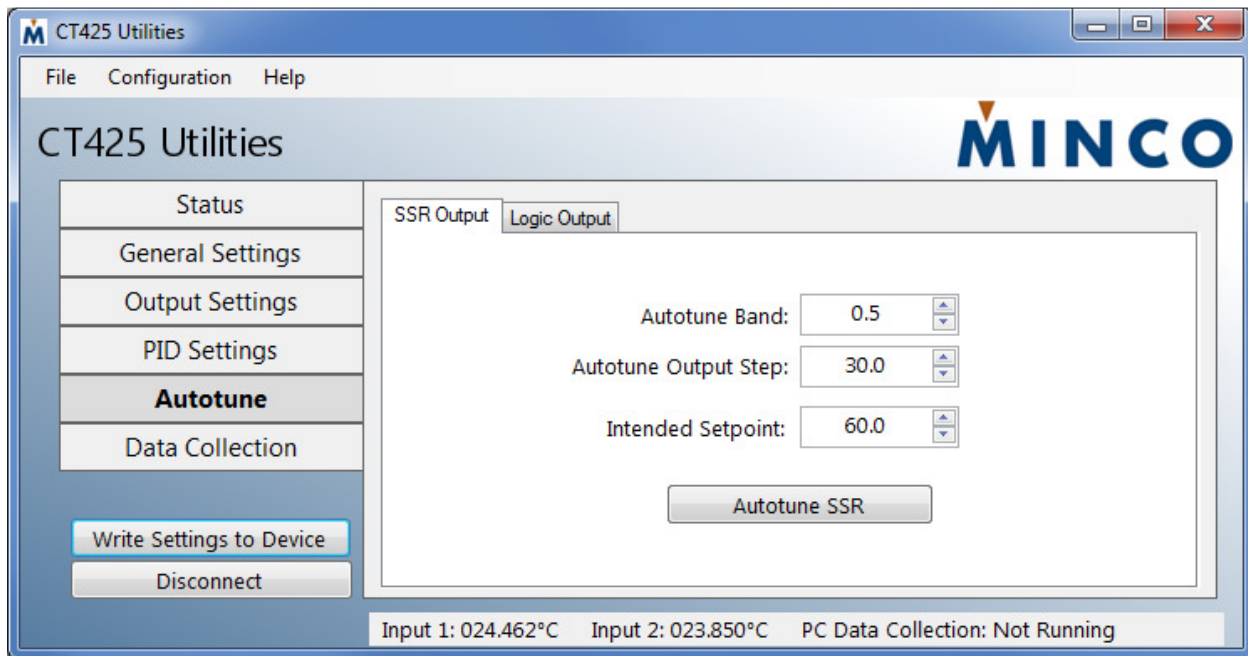
Figure 8

How Autotune Works

The Autotune feature automatically generates PID coefficients based on measurements performed using the actual sensor and load. Sometimes the values generated by Auto Tune are sufficient as the final operating values, but for better control, these may have to be manually tweaked.

The CT425 Autotune functions use the Ziegler-Nichols method. Autotune operates by first engaging the output to the duty cycle defined by Autotune Output Step until the temperature reaches the Intended Setpoint. This step is indicated by displaying "Pre-Heating". The output is left in the engaged state until the temperature exceeds the sum of Intended Setpoint and Autotune Band. The output is disengaged, and the temperature will begin to fall and the output is engaged again once the temperature is less than the difference between Intended Setpoint and Autotune Band. During this step, "Determining Cycle Rate" is displayed; the CT425 is measuring the approximate time required for a full temperature swing.

The output then continues to cycle in the same manner while displaying "Cycle x", where "x" is the cycle number. This gives the user an idea of how far along the Autotune process is.

Essentially, the output is toggled to cause the temperature to vary above and below the Intended Setpoint by approximately the Autotune Band. This process is repeated several times until the results are consistent.

The time between temperature peaks, the difference between temperature peaks and valleys, and the output drive duty cycle are used to determine PID coefficients.

Regardless of what Method is used to automatically generate the PID parameters, the above process is the same. The only difference is how the measured behavior is used to calculate the coefficients.

Once Autotuning is complete, control is immediately returned to the Function selected for that output.

Data Logging

The CT425 includes two methods of data logging: On-Board, and PC. The intended purpose of these two data loggers is different.

The On-Board logger runs continuously and transparently in a loop, storing a number of the most recent samples. Should something unexpected happen, a computer may be connected to the device and the contents downloaded for analysis.

The PC logger is part of the Windows utility program and simply polls the CT425 on a continual basis, then directly saves the temperature readings to a CSV file.

See below sections for more information.

On-board Data Logger

The On-board logger is active as long as the CT425 is powered. It does not affect any other function and therefore, is completely transparent to the user. The On-board logger uses the circular buffer concept which means that once the entire available memory is filled with samples, the oldest data is overwritten with new data. This will store a number of the most recent samples, with the older samples overwritten with newer data. The On-board logger utilizes only two settings:

Data Sources: Determines what data is logged. Channel 1, Channel 2, and Outputs each require one position in the On-board logger memory, and are written simultaneously. Enable only those data sources required in order to maximize the number of useful data stored. For example, if all three data sources are enabled, the On-board logger will begin overwriting old data in one-third the time compared to enabling only one data source.

If this setting is changed, all samples stored in the On-board logger will be erased; this is done to ensure the nature of the recorded data is homogenous.

The utility program will calculate the number of sample groups that can be stored before overwriting older ones, and will also display the amount of time before this happens based on the displayed settings. A sample group consists of samples selected in Data Sources.

Period: Determines the time between each group of samples. For example, if both channels are enabled in Data Sources and this value is set to 40ms, both sensor inputs will be sampled simultaneously every 40ms. Because two items are enabled in Data sources, two data logger memory locations will be used every 40ms. If one item in Data Sources is selected, only one memory location would be used every 40ms.

If this setting is changed, all samples stored in the On-board logger will be erased; this is done to ensure the nature of the recorded data is homogenous.

To download the On-board Data Logger's data from the device, simply connect the utility program and click Download Data from within the On-board Data Collection tab in the Data Collection group. The Download Data button is not visible if any On-board logger settings are modified and not written. See Figure 9. Data logging will be momentarily halted while the entire data logger buffer is downloaded to a file. The **data logger buffer will also be cleared** to maintain time continuity in the stored samples.

Note that the On-board Data Logger retains its stored samples only as long as power is applied. All recorded samples are lost if power to the CT425 is lost.
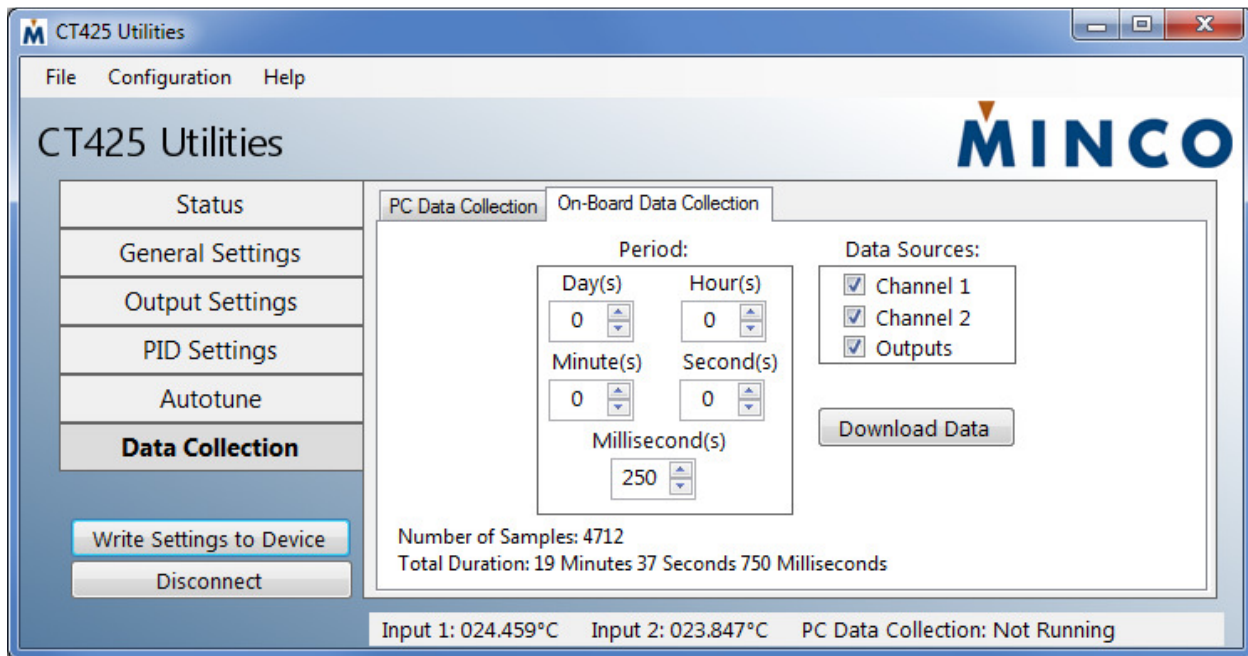
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Figure 9

PC Data Logger

The PC Data Collection tab in the Data Collection group contains settings for the PC logger. The CT425 must be connected to the host computer when using the PC Data Logger since data is immediately stored on the host computer.

The generated file format is CSV. After specifying the collection parameters, press the Start button to begin data collection. The device will continue to perform all other activities while data collection is active. However, Autotune cannot be started while using the PC Data Logger.
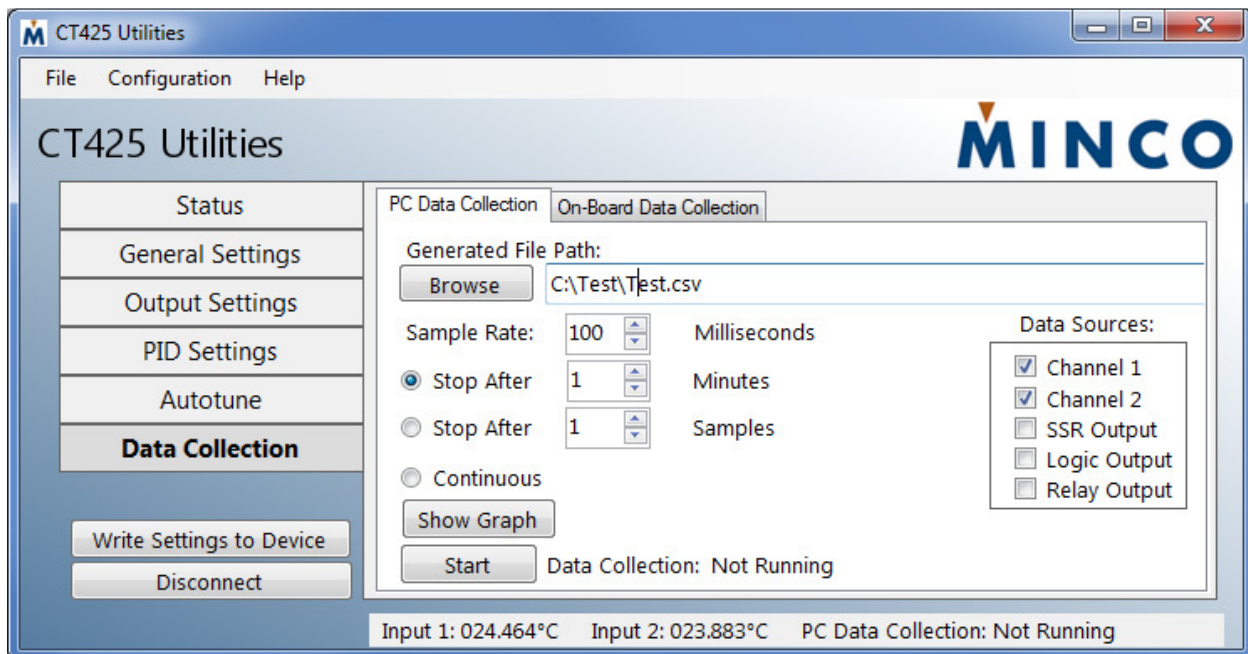

Figure 10

While collecting data, it is possible to view a real-time graph of the data by clicking 'Show Graph' before data collection. The graph displays only the selected channels both on the Graph pane and the Data Sources pane from the PC Data Collection tab. The line color for each line can be changed by clicking the color palette square located leftmost to on the legend. It is important to note that there are two scales – temperature and output percentage. Channel 1 and 2 output temperatures use the leftmost scale and the outputs use the right scale. To fit the data, right click on the chart area and select 'Set Scale to Default'. You can also zoom by left clicking and dragging or pan by middle mouse and drag.
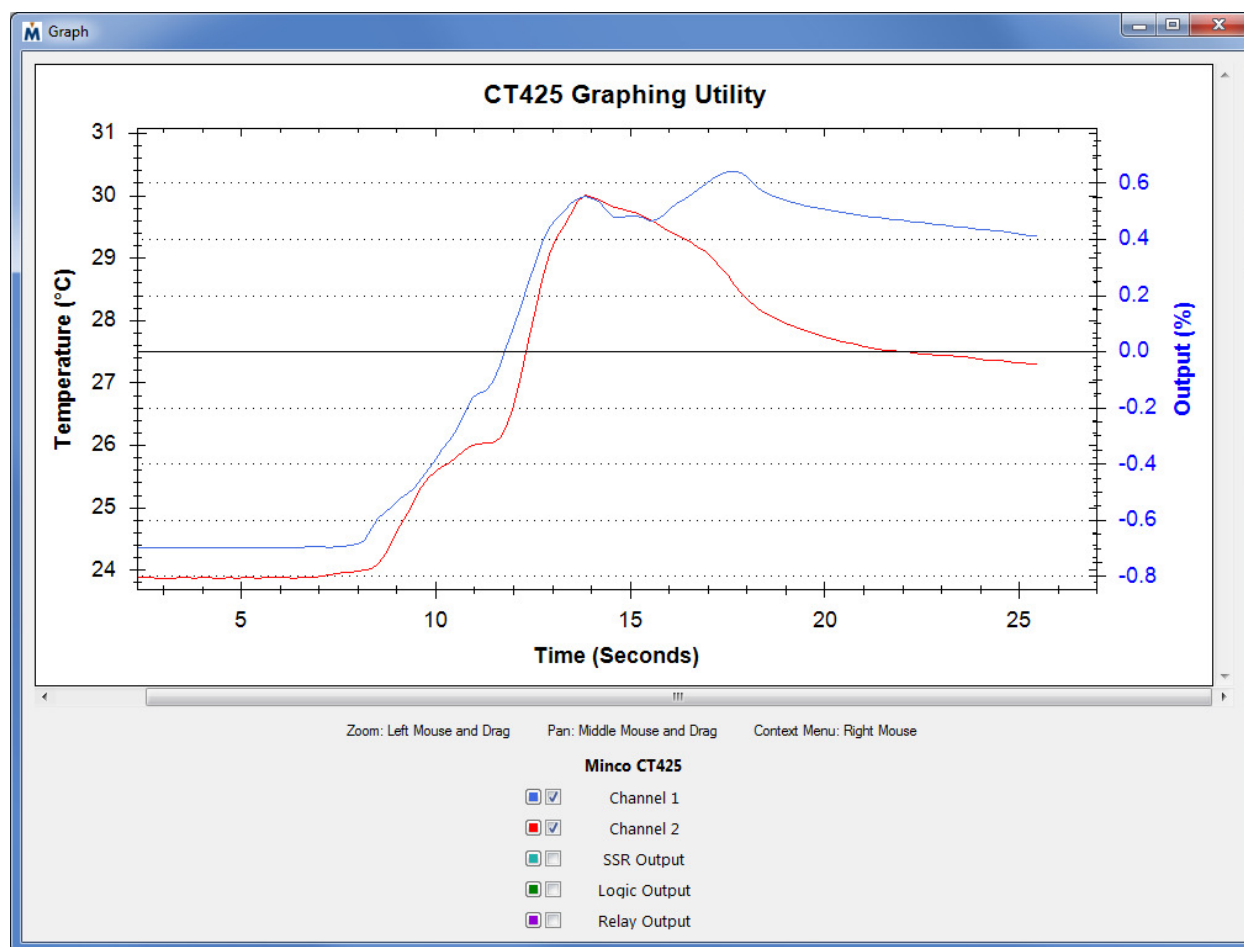

Figure 11

Submitting Settings

The Write Settings to Device button submits all changes that have been made within the utility program to the devices non-volatile memory. The user may make changes to multiple groups and tabs, however the CT425 does not receive these changes until this button is pressed; once it is, all changes in all groups and tabs are submitted to the device.

The text on the Write Settings to Device button will turn red when the device configuration does not match the software's configuration. After selecting, the button will turn black again. This color change to red serves to remind the user that a configuration is not yet active on the CT425.

The Write Settings to Device button commands the CT425 to commit the changes directly into non-volatile memory. This means that if the CT425 loses power, it will power up with this configuration. Performing this function while running a high

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speed PID loop could possibly disrupt it; the function halts all operations for a maximum of 30ms. Although this is unlikely to cause any issue, the user could disconnect the loads first to be safe.

As an example, assume the user has a CT425 they wish to use in a heating application. It will be connected to a sensor, heater, and source of power, but won't be connected to a computer. First the user connects the CT425 to their computer in order to configure the sensor types, outputs, set point, etc.; everything is configured as desired for this heating application. The Write Settings to Device button is pressed so this configuration is automatically loaded and used the next time power is applied to the device.

General Usage

Status Indicators

Upon application of power, the two status indicators RTD1 STATUS and RTD2 STATUS display a pattern of red then green. This assures the user that the status indicators and device circuitry are functioning.

Each status indicator corresponds to the RTD1 Input and RTD2 Input in general. There are two situations in which the action of the status indicators does not indicate the status of its respective RTD Input, but rather a general CT425 error or situation. The legend for the status indicators is shown Table 1.

Indicator	Color	Pattern	Meaning
RTD1 or RTD2	Green	Solid	This sensor input is enabled, and temperature is within user configured Normal Process Value Range.
RTD1 or RTD2	Yellow	Solid	This sensor input is enabled and reading a valid value, but the temperature is not within user configured Normal Process Value Range.
RTD1 or RTD2	Red	Solid	This sensor input is enabled; however sensor is out of range. Check sensor connections and configuration.
RTD1 and RTD2	Red	Blink	A hardware failure has occurred. All outputs de-energized. Both status indicators blink in unison. See the errors section on page 15 for more information.
RTD1 and RTD2	Yellow	Blink	CT425 is in manufacturing mode. Status indicators alternately blink yellow. Ensure LVO isn't shorted through low resistance.
RTD1 or RTD2	Off	N/A	No outputs configured to use this sensor input.

Table 1

Output Behavior

The SSR and LVO behave differently depending if they are in AC mode or DC mode; the Relay Output is unaffected. The CT425 DC models are always in DC mode, but an AC model may be in either mode.

The output mode is determined each time power is applied to the device. When power is applied, a frequency measurement is taken on the power input terminals. If the minimum frequency threshold is detected, the CT425 will start in AC mode; otherwise it will be in DC mode. When powered only from USB, DC mode will always be detected due to the lack of an AC waveform. If initially powered from USB, the CT425 will remain in DC mode even if an AC power supply is later connected to the power input terminals. The AC/DC mode determination is made each time the device is powered up.

NOTE: Do not initially power a device with AC power then switch to exclusively DC power while driving a load on the SSR or LVO. The CT425 will not switch to DC mode and therefore, the SSR and LVO outputs will cease to function, potentially causing damage to the attached load.

DC Mode

In DC mode the SSR and LVO are driven by a fixed-frequency PWM signal. The duty cycle will vary based on the output drive requested by the selected function. The frequency and duty cycle specifications are listed on page 17 under PWM Output Characteristics.

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AC Mode

In an effort to reduce switching noise, the CT425 will switch the SSR and LVO at the zero crossings (ZC) when in AC mode. This behavior applies to any function (PID, On/Off, Alarm). The Relay Output does not perform ZC switching due to the impracticality of doing so with mechanical contacts.

ZC switching is generally the preferred method to switch AC loads since the transitions are performed when the AC voltage is near zero volts.

A disadvantage of ZC switching is the PWM duty cycle resolution is decreased. For example, with 60Hz power there are only 120 opportunities per second to switch the output. While this results in a duty cycle resolution of 0.833%, in DC mode the duty cycle resolution is much higher. However, achieving better resolution in AC mode would mean disabling zero-cross switching and would result in an inconsistent and unpredictable amount of energy during the output "on" time; something that is important for good PID control.

For further explanation of how ZC detection works, see **Error! Reference source not found.**. The red "Requested Control" trace represents the SSR or LVO in DC mode; this is what the control algorithm is actually requesting. The green "Zero-Cross Aligned Control" is the adjusted output where transitions occur at the zero cross points. The resulting AC output is shown on the last waveform; switching occurs only when the voltage is near zero.

It's important to use the rated AC voltage with the SSR for accurate ZC switching. Using a substantially different voltage may result in switching that doesn't occur at the zero crossings. This should not damage the CT425 provided maximum voltage ratings are observed, but does somewhat negate the advantage of ZC switching.
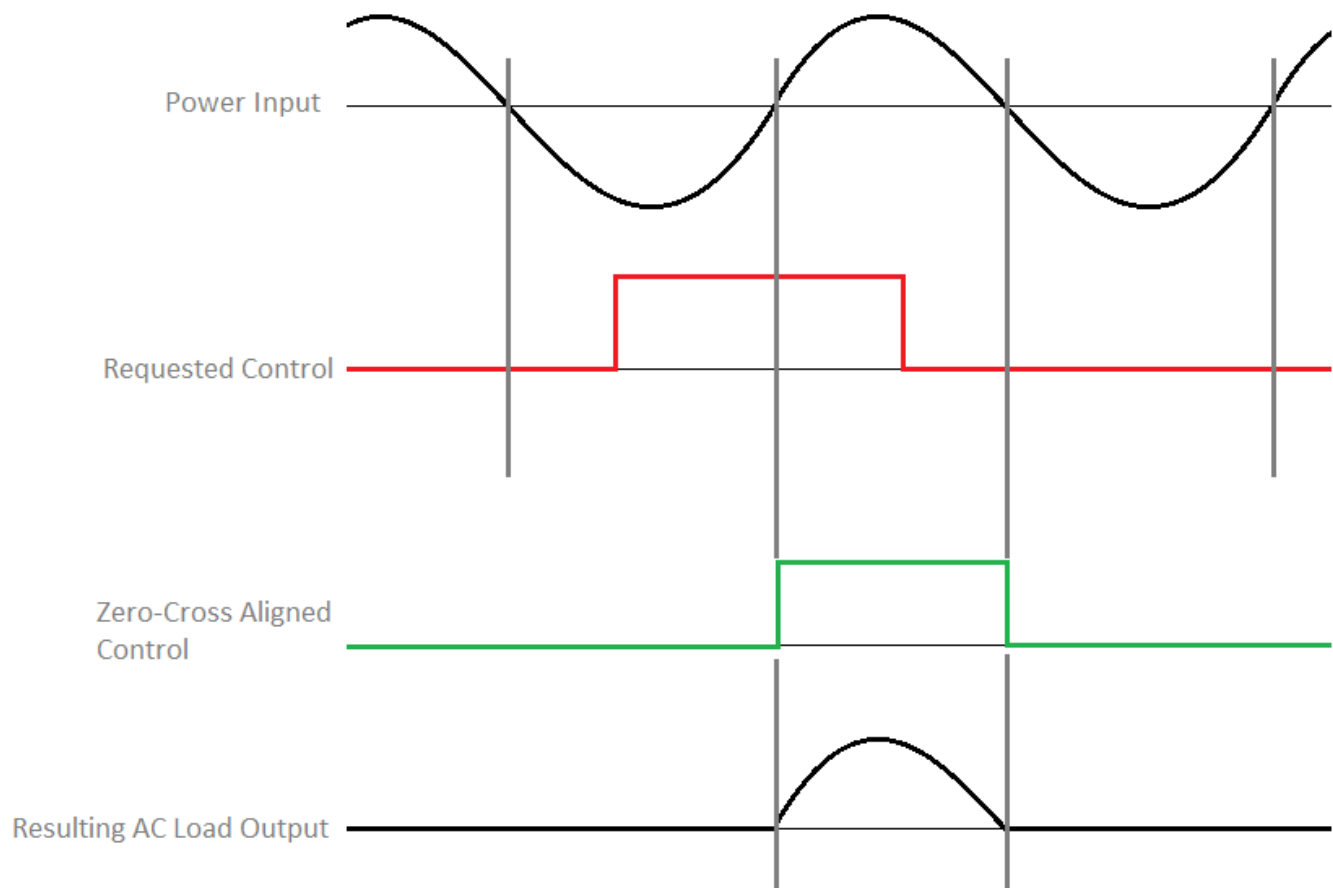

Figure 12

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Errors

Status LEDs

The Status LEDs normally indicate sensor status, but analog-to-digital converter failure is indicated by both LEDs blinking red in unison. When this occurs, all outputs are set to the de-energized state and the device 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 CT425 is receiving proper supply voltage and try cycling the power.

Another possible situation the Status LEDs can indicate is if the CT425 is in manufacturing mode. This is characterized by rapidly alternating yellow Status LEDs, and occurs if a very low resistance is present across the LVO during application of power. This is not a fault or error, but rather a mode invoked during manufacturing for the purpose of programming the unit. Ensure the load across the LVO is greater than the specification in 0, then cycle power.

Multiple Units

The CT425 Utilities software checks if multiple units are connected to the same computer when a user selects 'Connect to Device'. From this dialog, the user can either configure a single unit or data log from multiple units (up to 5).
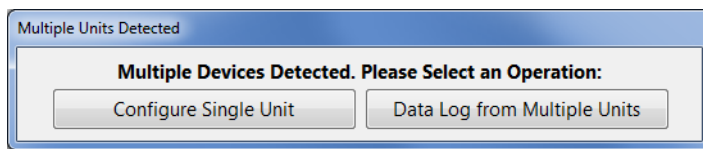
Figure 13

When data logging with multiple units, a new form opens up which displays all of the data collections settings similar to the PC data logger. Note that the minimum sample rate is increased to 100mS * number of devices. During data collection this form also shows real-time readings of all devices and can graph the data.
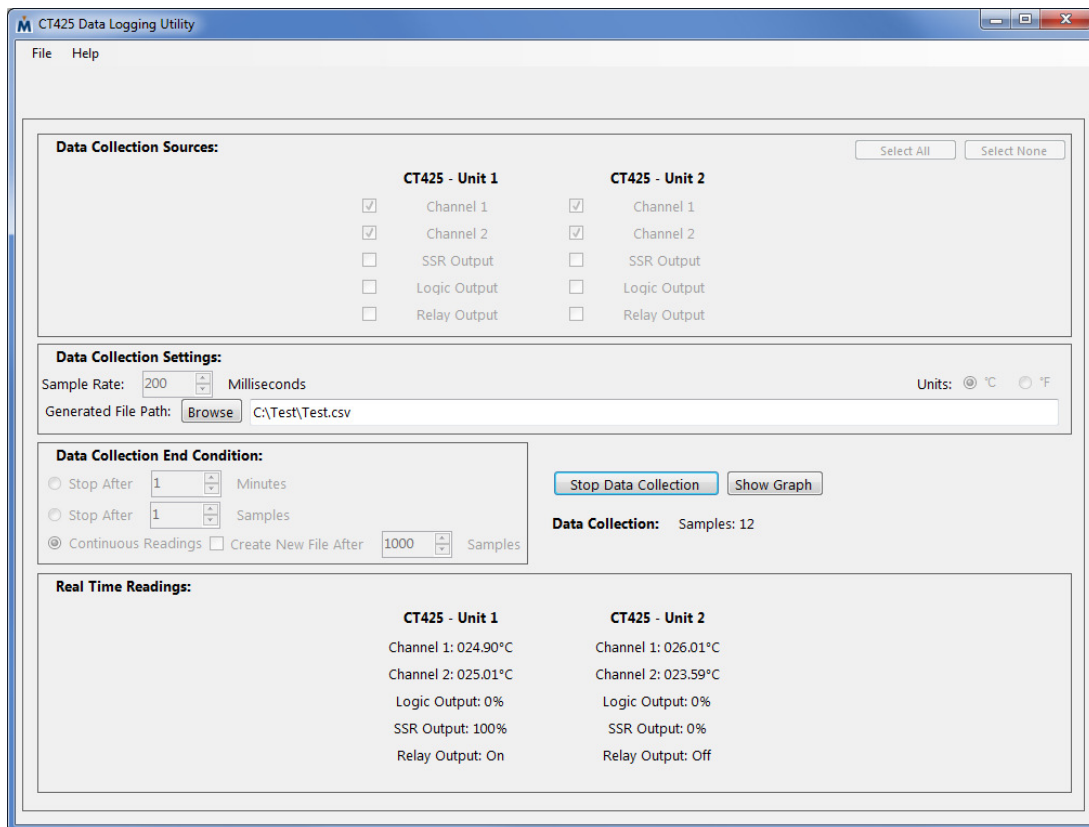
Figure 14

Bluetooth Low Energy (-BT Option Only)

Overview

A Bluetooth Low Energy (BLE) modem has been included on the CT425 to allow wirelessly viewing of temperatures and changing of set points using an Android or Apple smartphone. The primary purpose of this is to monitor real-time operation of the CT425 without using a PC because the CT425 does not have a display. It is important to note that the PC software is required to initially configure the CT425 with sensor types, output types, etc. as this cannot be competed from the smartphone applications.

The CT425 uses a Class 2 Bluetooth Low Energy radio. Our testing indicates that a 10-meter range is typical with direct line-of-sight, independent of the orientation. In an installed application, the actual range may vary depending on the location, phone, objects located around the device, and other external factors.

Android Application

An Android smartphone with BLE support (Android version 4.3 and higher) can be used to connect to the CT425. First, install CT425 Utilities from the Google Play Store. With Bluetooth powered on, open up the application and scan for devices by selecting Scan on the top right (Figure 15). Bluetooth Low Energy (BLE) devices in range will be populated in a table which can be accessed by three vertical dots that appear next to the scan button (if the three dots do not appear, no devices have been found). Tap the name of the CT425 device (Figure 16) to connect to it.
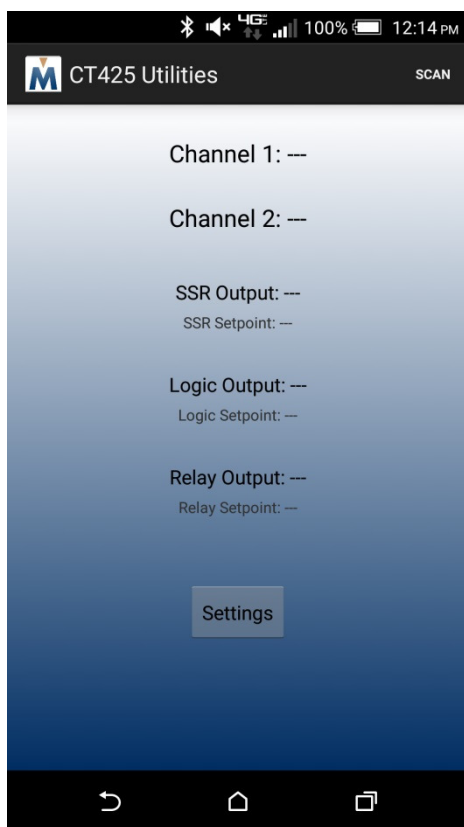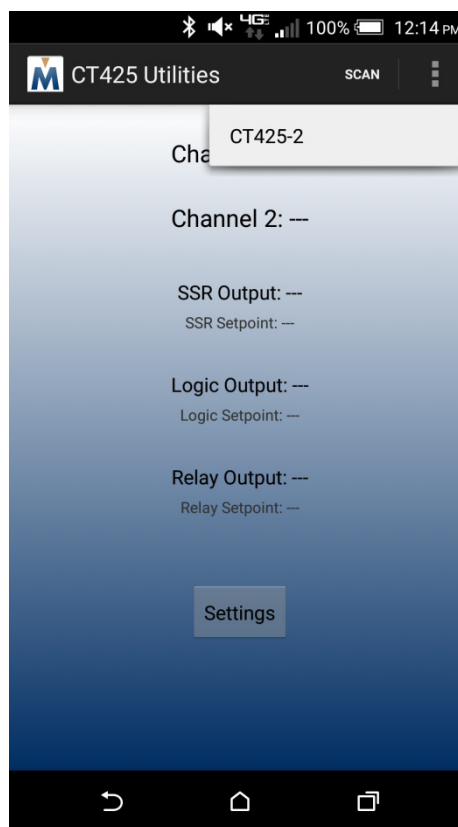

Figure 15

Figure 16

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Wait for several seconds as the phone attempts to connect to the CT425. When a device is properly connected, "Scan" will change to "Disconnect" and temperatures will appear (Figure 17). To change units and setpoints, select the Settings button and change the appropriate settings. The CT425 is updated when the Save button is selected (Figure 18). Then use the back key to return to the previous screen.
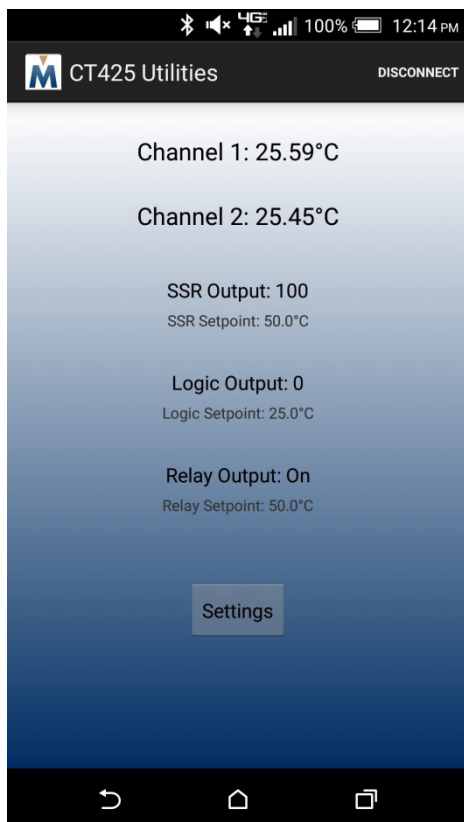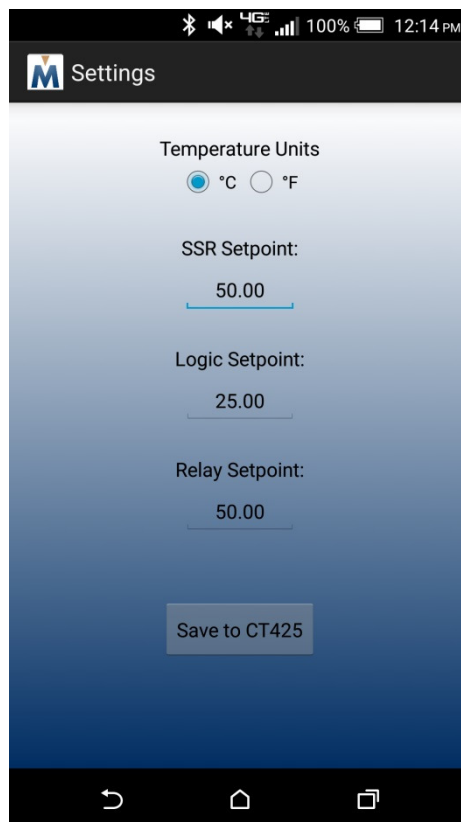

Figure 17

Figure 18

When finished, disconnect the CT425 by selecting Disconnect and then closing the application.

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iOS Application

An iPhone 4S or newer iPhone can also be used to connect to the CT425. From the App Store, download the CT425 Utilities App. With Bluetooth powered on, open the CT425 Utilities application and scan for devices by selecting Scan on the top left. Bluetooth Low Energy (BLE) devices in range will be populated on the table (Figure 19). Tap the name of your CT425 to connect to it.
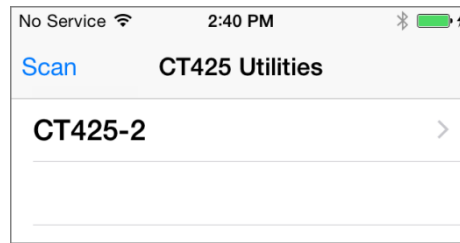
No Service 🛜	2:40 PM	🔋⚡
Scan	**CT425 Utilities**	
CT425-2		›

Figure 19

Wait for several seconds as the phone attempts to connect to the CT425. If after ~4 seconds a successful connection has not been made, press Connect on the top right again. Repeat this process if necessary. You may have to move closer to the CT425 if many attempts are made without achieving a solid, reliable connection. Temperatures and setpoints will appear when connected (Figure 20). Basic settings can be changed by selecting Device Settings (Figure 21).

No Service 🛜	2:40 PM	🔋⚡
‹ Back	**CT425 Utilities**	Disconnect

Sensor 1: 25.29°C

Sensor 2: 25.22°C

SSR Output: 100%
SSR Setpoint: 50.0°C

Logic Output: 0%
Logic Setpoint: 25.0°C

Relay Output: Off
Relay Setpoint: 50.0°C

Device Settings

Figure 20

No Service 🛜	2:40 PM	🔋⚡
‹ Back	**Settings**	Save to CT425

Units
°C | °F

SSR Setpoint:
50.0

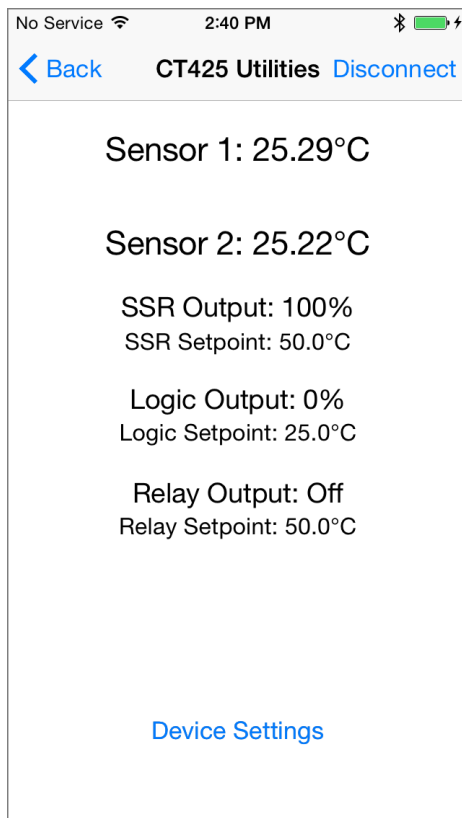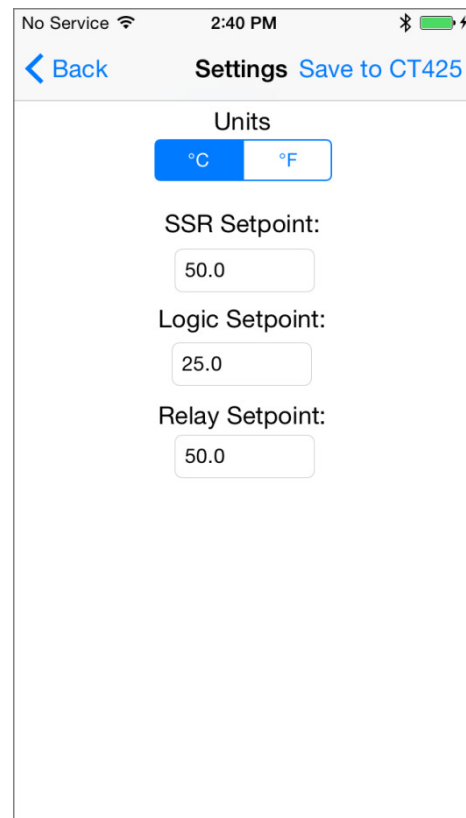Logic Setpoint:
25.0

Relay Setpoint:
50.0

Figure 21

When finished, disconnect the CT425 by selecting Disconnect and then closing the application.

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Frequently Asked Questions (FAQ)

Q: Is a USB connection to a computer required for the CT425 to operate correctly?
A: No. The CT425 itself does not rely on the USB connection for any function.

Q: How long will the CT425 maintain a configuration in non-volatile memory?
A: The specification states the retention is at least 20 years and will withstand almost 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.

Q: Why are the STATUS indicators blinking yellow and nothing works?
A: Check what is connected to the LVO. A low resistance across that output will cause this.

Q: I have a 3 or 4 wire RTD, but the CT425 only provides two connections. Can these RTDs be used?
A: Yes. Either the extra wires can be left disconnected, or they can be grouped together.

Q: Why is autotuning taking so long? Its well beyond Cycle 3 or 4, and it's still not done.
A: Try reducing the Autotune Output Step and/or increasing the Autotune Band.

Q: Why is the SSR output conducting current even though it's off?
A: If this is a DC unit, it's likely the SSR wiring polarity is reversed.

Q: Can an external SSR be connected directly to the LVO?
A: In most cases, yes. Many external SSRs, including the ones sold by Minco, will operate correctly this way.

Q: Will data logging, downloading data, or disconnecting the USB cable disrupt output functions?
A: As long as the device continues to receive power, none of these functions are affected.

Specifications

Inputs

Power

Option A: 120 VAC 50/60Hz, 3.25W maximum

Option B: 10.5 to 60 VDC, 1.75W maximum

Option C: 240 VAC 50/60Hz 3.75W maximum

Any model may be powered through USB, 200mA maximum.

The power input is electrically isolated on AC powered models only, up to 3KV AC. The power input on DC models and the USB connection are not isolated.

Sensors

1 or 2 RTDs in any combination, -70C° to 650C° (-70F° to 1202F°)

PD/PE (100Ω @ 0°C, 0.00385Ω/Ω/C°)
PF (1000Ω @0°C, 0.00385Ω/Ω/C°)

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Outputs

SSR

Electrically isolated to 2500V RMS.

Ambient	25℃			55℃		
Model	CT425A	CT425B	CT425C	CT425A	CT425B	CT425C
Current Rating	6 amps	15 amps	3 amps	5 amps	11 amps	2.5 amp
Voltage Rating	120VAC	60VDC	240VAC	120VAC	60VDC	240VAC
Relay Rating	10 amps, resistive					

Logic Voltage Output

"On" open circuit voltage: 4.4VDC +/- 0.1V

Internally limited to 26mA, +/- 3mA

Minimum load resistance allowed without entering manufacturing mode: 12 Ω

Internally, LVO is connected through approximately 29Ω resistance along with a current limit circuit.

Relays

240VAC or 30VDC, 10A resistive

PWM Output Characteristics

These characteristics apply to SSR and LVO only.

PWM output frequency (DC mode only): 25Hz

PWM duty cycle range (DC mode only): 0.0% to 100.0% (1000 steps)

In AC mode, the PWM output frequency follows the power source, and duty cycle range is 0.0% to 100.0% over a number of steps equal to twice the frequency.

Minimum power supply frequency to start in AC mode: 47Hz

Communication

USB 2.0, Type B

Bluetooth Low Energy, Class 2

Data Logger

Internal Data Logger

Capacity: 14,136 total samples

Resolution: 0.1℃ / 0.18℉

Sample rate: 40ms to 49.7 days in one millisecond increments

Type: Circular buffer (oldest sample overwritten with new sample)

Utility Program Data Logger

Capacity: Limited only by host computer disk space

Resolution: 0.01℃ / 0.018℉

Period range: 100ms to 60 minutes in one milliseconds increments

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Type: Read and store to host PC disk

General

Resolution

Temperature displayed to 0.01 degree (℃ or ℉)

Accuracy

At 25℃ (77℉) ambient temperature:

+/- 0.25℃ (0.45℉) or +/- 0.25% over entire input range

Over entire rated ambient temperature:

+/- 1.5℃ (2.7℉) or +/- 1% over entire input range

Dimensions

5.46"L x 3.34"W x 1.22"D (13.87cm L x 8.48cm W x 3.10cm D)

Weight

Approximately 0.35Kg (12.3 ounces)

Environmental

Operating temperature: -25 to 55℃ (-13 to 131℉) @ 90% relative humidity, non-condensing
Storage temperature: -40 to 85℃ (-40 to 185℉) @ 90% relative humidity, non-condensing

Construction

Potted plastic enclosure with plastic mounting flanges and terminal blocks.

Glossary

CSV	Comma Separated Values: A method of storing data in a file where each value is separated by commas. Most spreadsheets will directly read this format into spreadsheet columns.
LED	Light Emitting Diode: A solid state device that converts electricity directly into light.
LVO	Logic Voltage Output: A digital output that is typically used to control another device such as an external SSR.
PID	Proportional Integral Derivative: A control algorithm that uses present error, cumulative error, and error rate of change to control the process.
RTD	Resistance Temperature Detector: A variable resistor that changes resistance based on temperature.
SPST	Single Pole Single Throw: The simplest switch configuration, having two connections and providing simple on/off functionality.
SSR	Solid State Relay: A type of relay without mechanical contacts constructed from solid state components.
USB	Universal Serial Bus: A common computer interface on computers for interfacing to various peripherals.

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