

# SenseFuture Temperature SoftWare

## PRODUCT INTRODUCTION MANUAL

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Striving for the Bright Future of Precision Optoelectronic Measurement.

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## 0. Software Overview

SenseFuture Temperature Software is customized and developed by SenseFuture (Shenzhen) Technology Co., Ltd. for the TEC series thermostats. This software is developed using Labview based on the ASCII - code communication protocol of the TEC thermostat. It is applicable to the Windows 10 and above operating system environment with a serial port, providing users with an efficient and precise temperature control solution. It has rich functions such as dual - channel temperature control, parameter setting, segmented temperature control, automatic PID self - adaptation drawing, data saving, log output, etc., which can meet the temperature control requirements in a variety of complex scenarios.

## 1. Operating Environment

### 1.1. Hardware Requirements

The computer needs to be equipped with an available TTL serial port. If the computer itself does not have a TTL serial port, it can be connected through a USB - to - TTL serial port converter, but make sure that the converter driver is correctly installed. In addition, it is recommended that the computer has a dual - core or higher processor and 4GB or more of memory to ensure the smooth operation of the software.

### 1.2. Software Requirements

The operating system should be Windows 10 or above. Ensure that the latest system updates and security patches are installed to avoid abnormal software operation caused by system vulnerabilities.

## 2. Installation Guide

### 2.1. Obtaining the Installation File

Download the installation package of SenseFuture Temperature Software corresponding to the TEC series thermostats from the designated download page on the official website of SenseFuture (Shenzhen) Technology Co., Ltd.

### 2.2. Installation Steps

Locate the downloaded installation compressed package. After decompression, the.exe file in the sub - directory is the software installation program. Double - click to run this file, and the installation program target location selection interface will pop up, as shown in Figure1. Select the installation path.

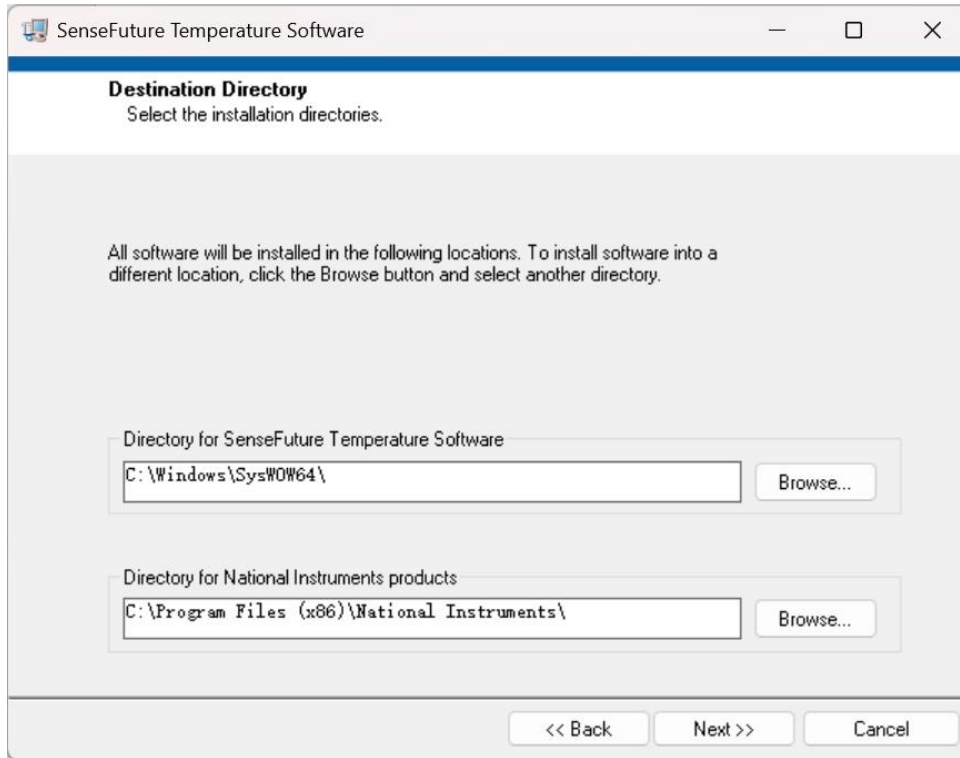


Figure1 Installation Program Target Location Selection Interface

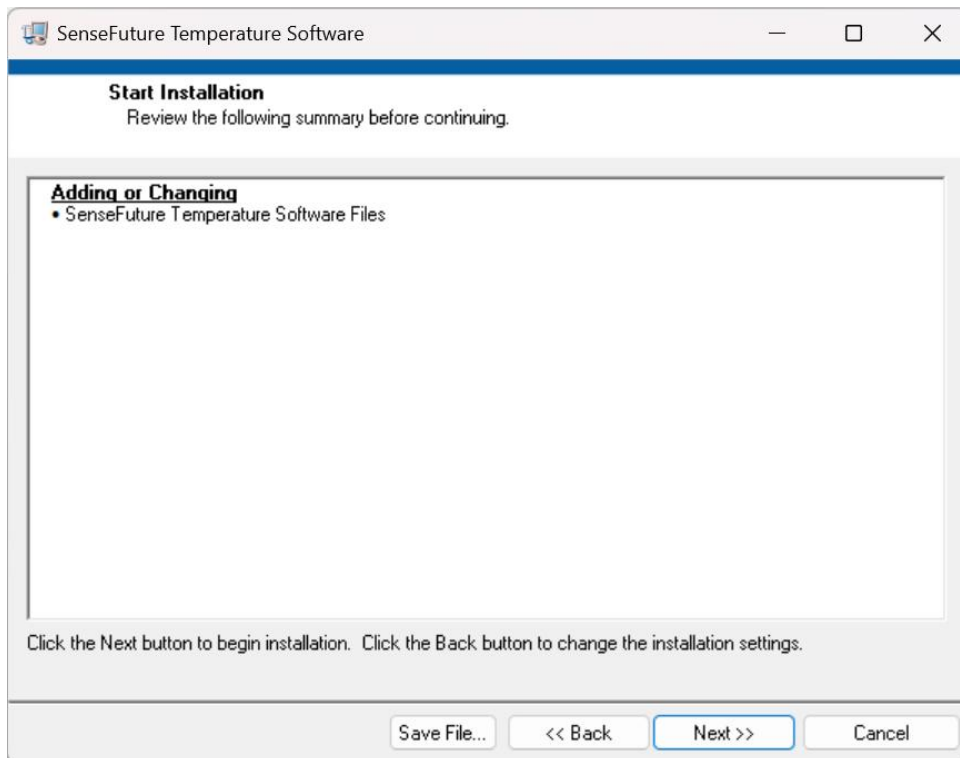


Figure2 Installation Program Confirmation Selection Interface

Click the "Next" button, and the installation program confirmation selection interface shown in Figure2 will pop up. Continue to click the "Next" button to enter the installation process interface, as shown in Figure3.

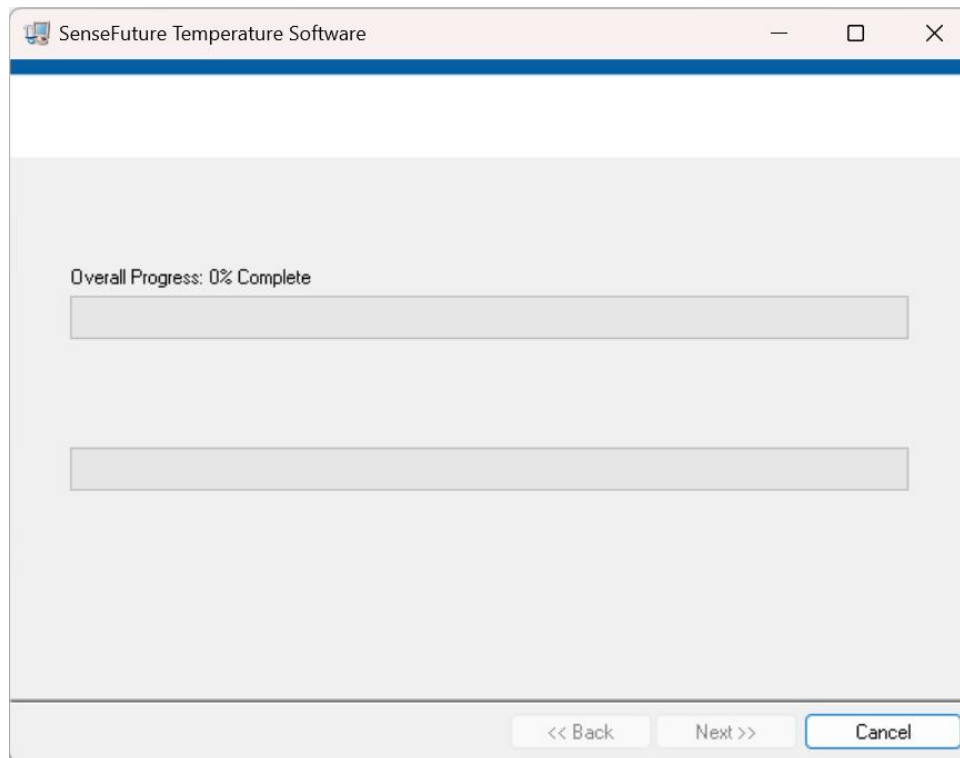


Figure3 Installation Process Interface

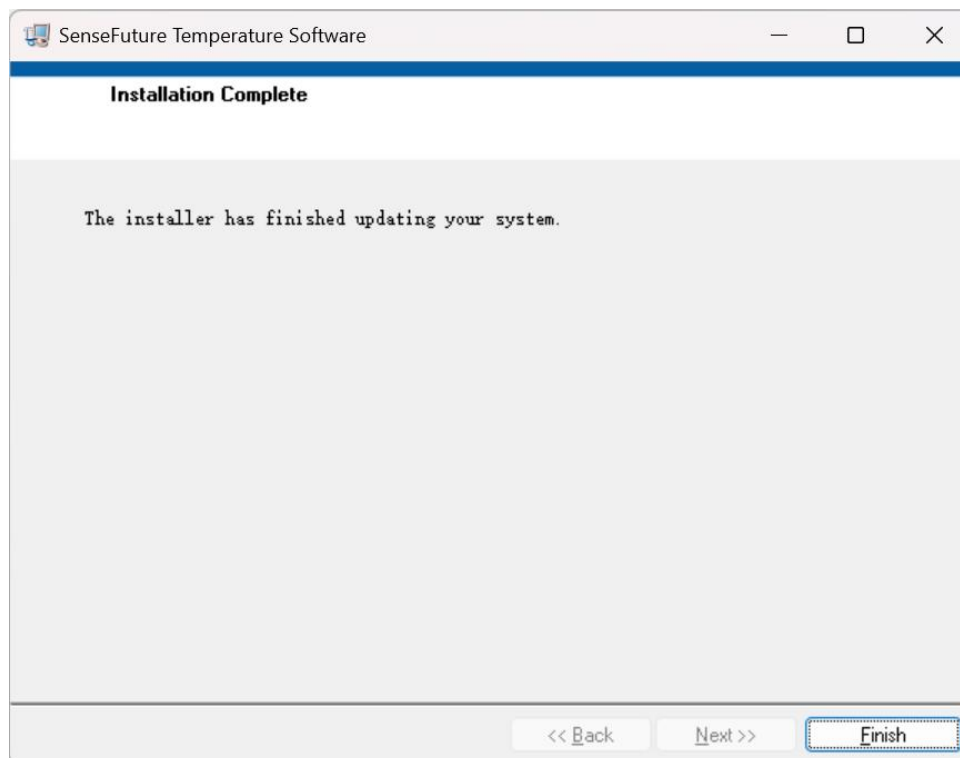


Figure4 Installation Completion Interface

In the installation process interface shown in Figure3, if this is the first time to install the software on your computer, some dependent libraries need to be installed. Please be patient. The whole process takes about 3 minutes to complete. After the installation is completed, the installation completion

interface shown in Figure4 will pop up. The installation of this installation program is completed, and the software can be used normally after restarting.

### **3. Software Usage Instructions and Precautions**

#### **3.1. Description of TTL Interface and ASCII - based Communication Protocol**

The TTL interface is a physical interface standard widely used in serial communication. The TEC thermostat series produced by our company can use the ASCII - code - based communication protocol through the TTL interface to realize data transmission between devices. This protocol is simple and easy to implement, supports multiple data formats and control commands, and is suitable for short - distance communication. For the specific communication protocol details, please refer to Communication Parameters and Instruction Format downloaded from our company's official website.

#### **3.2. Description of File Saving Format**

The file format used by this program is Microsoft Excel 97 - 2003 Worksheet (.xls). This format of file has the characteristics of strong universality and good compatibility, which is convenient for users to perform data processing and analysis. Users can easily open and view the data using spreadsheet software such as Microsoft Excel, and use its powerful data processing functions to perform operations such as sorting, filtering, and chart generation.

#### **3.3. Actuator and Detection Mechanism of the Thermostat**

The actuator of the thermostat is a key component for realizing temperature adjustment. According to the control instructions of the thermostat, it performs heating or cooling operations on the controlled object to reach the set temperature target. Common actuators include TEC semiconductor refrigeration sheets, heating films, electric heating tubes, compressors, fans, water - cooling equipment, etc.

The detection mechanism of the thermostat is a sensor used to measure the temperature of the controlled object. It converts the temperature signal into an electrical signal for processing and judgment by the control circuit of the thermostat, so as to achieve accurate temperature detection. Common detection mechanisms include PT platinum resistors, NTC thermistors, thermocouples, etc.

#### **3.4. Description of Thermostat - related Parameters**

##### **3.4.1. Actual Temperature**

The real - time temperature of the current monitoring point, with the unit of degree Celsius (°C).

##### **3.4.2. Target Temperature**

The set temperature that the thermostat needs to control, with the unit of degree Celsius (°C).

#### **3.4.3.Output Enable**

The enable status of whether the thermostat performs temperature control operations, including two states: "on" and "off".

#### **3.4.4.Output Mode**

The output mode of the thermostat, including three states: "cooling and heating", "heating only", and "cooling only".

#### **3.4.5.Sensor Type**

The sensor solution model of the thermostat, including the NTC thermistor temperature solution model and the PT platinum resistor temperature solution model.

#### **3.4.6.Voltage Output Ratio**

The ratio of the voltage of the specific temperature control actuator of the thermostat to the input voltage.

#### **3.4.7.Maximum Output Ratio**

The maximum ratio of the voltage of the specific temperature control actuator of the thermostat to the input voltage. Since some actuators may be damaged when the voltage is too high, it is necessary to limit the voltage output ratio.

#### **3.4.8.PID Control Parameter Group**

This parameter group includes three parameters for negative feedback adjustment during the temperature control process: proportional parameter P, integral control I, and derivative control D. By adjusting these three parameters to appropriate values, more rapid and stable temperature control can be achieved.

#### **3.4.9.High - temperature Alarm Value**

The activation value of the high - temperature alarm during the temperature control process, with the unit of degree Celsius (°C). When the temperature is higher than this value, the alarm light of the thermostat will flash rapidly, and when the over - temperature protection mode is stop output, the voltage output to the actuator will stop.

#### **3.4.10.Low - temperature Alarm Value**

The activation value of the low - temperature alarm during the temperature control process, with the unit of degree Celsius (°C). When the temperature is lower than this value, the alarm light of the

thermostat will flash rapidly, and when the over - temperature protection mode is stop output, the voltage output to the actuator will stop.

#### **3.4.11.Over - temperature Protection Mode**

When the temperature is higher than the high - temperature alarm value or lower than the low - temperature alarm value, it determines whether to turn off the output to avoid unpredictable problems.

#### **3.4.12.Temperature Slope**

The speed of temperature change, with the unit of degree Celsius per second (°C/s).

#### **3.4.13.Output Delay at Startup**

The delay time for turning on the output after the thermostat is powered on, with the unit of second (s). Reasonably setting this parameter can avoid damage to the actuator caused by excessive current at startup.

#### **3.4.14.Resistance of the Sensor**

The resistance value of the detection mechanism of the thermostat, with the unit of ohm (Ω).

#### **3.4.15.NTC Sensor Parameter Group**

This parameter group is applicable when the NTC thermistor is used as the detection mechanism, including two parameters: reference resistance NTC R0 (default value: 10000), with the unit of ohm (Ω); NTC B (default value: 3950).

#### **3.4.16.PT Sensor Parameter Group**

This parameter group is applicable when the PT platinum resistor is used as the detection mechanism, including four parameters: reference resistance PT R0 (default value: 1000), with the unit of ohm (Ω); PT A (default value: 3.9083), PT B (default value: - 5.775), and PT C (default value: - 4.183).

#### **3.4.17.Polynomial Solution Model Parameter Group**

This parameter group is the parameter group involved in the general polynomial solution model, including A0, A1, A2, A3, A4, A5, A6, A7.

### **3.5.Precautions**

#### **3.5.1.Maximum Output Voltage Percentage**

Formula for calculating the maximum output voltage percentage:

$$P_{Max} = U_{Max}/U_{Vin}$$

Where, PMax represents the maximum output voltage percentage, UMax represents the maximum operating voltage of the actuator, and UVin represents the input voltage of the thermostat.

Please note that there may be a maximum operating voltage limit for the actuator in the temperature control system. Before enabling the output, the user must refer to the relevant instructions of the actuator in their own system to ensure that the operating voltage is within the specified range. The user needs to set the maximum output voltage percentage in the software to adapt to their own system before enabling the output.

According to the formula, if the maximum output voltage of the user's actuator is 12V and the input voltage is 24V, the calculated maximum output voltage percentage is 50%, and the user needs to set it as 50%.

### 3.5.2. Baud Rate Address for Software Connection

The default baud rate of the serial port for the software is 38400. If the baud rate of your device's TTL interface has been changed, please use a serial port debugging assistant or other methods to change it back to 38400 and then connect to the device again.

## 4. Software Operation and Function Introduction

### 4.1. Starting the Software

After the installation is completed, you can double - click to start the software by finding the icon of SenseFuture Temperature Software on the desktop shortcut or in the Start menu. Then you will enter the main interface of the software, as shown in Figure5.

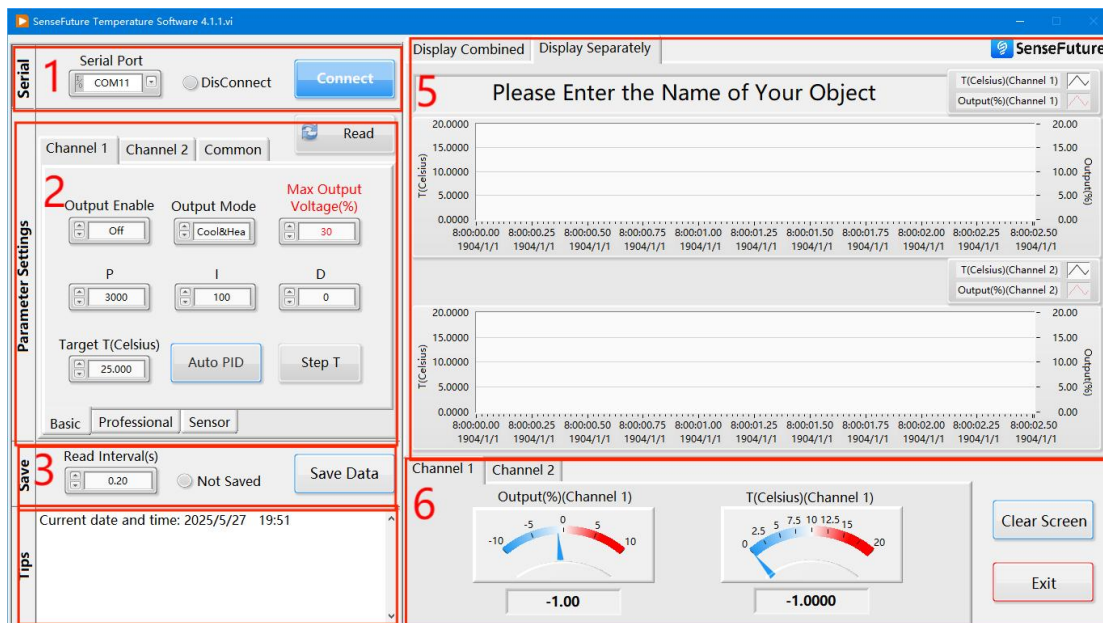


Figure5 Main Interface of SenseFuture Temperature Software

### 4.2. Partition Function

Number	Partition	Function
1	Device Connection Area	Serial port selection and device connection
2	Parameter Setting Area	Basic parameters, professional parameters, general parameters
3	Data Saving Area	Change the reading time, save the curve
4	Log Area	Real - time display of the current software status and user operation records
5	Drawing Area	Real - time drawing of the current temperature curve and output voltage percentage curve
6	Other Areas	Current temperature, current output voltage percentage, clear the screen, and exit the software

### 4.3.Connecting the Device

After opening the software, select the serial port in the connection setting area in the upper - left corner of the main interface of the software as shown in Figure5. The default baud rate of the TTL interface of the program is 38400. If the baud rate of the TTL interface has been changed, please use a serial port debugging assistant or other methods to change it back to 38400 and then connect to the device again.

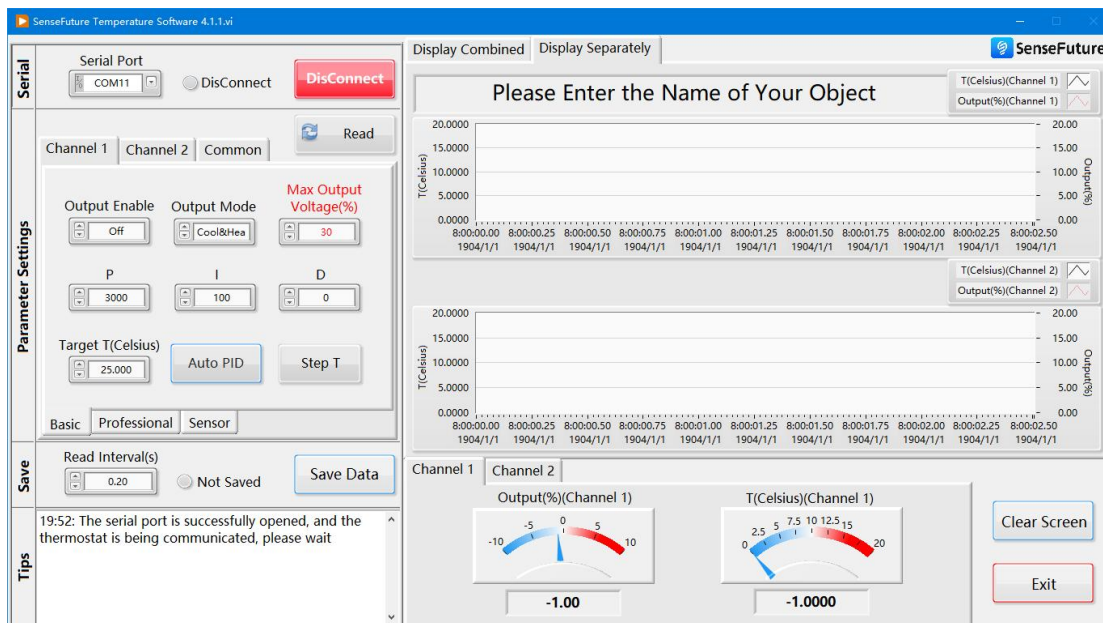


Figure6 Selection and Connection of Serial Port Number

After completing the serial port number setting, click "Open Serial Port", and the program will try to establish a connection with the serial port. After the connection is successful, the "Open Serial Port" button will be displayed as "Close Serial Port", as shown in Figure6. The program will try to communicate with the thermostat. If the connection fails, please check whether the serial port connection is correct, whether the serial port is occupied by other programs, or whether the baud rate of the thermostat's TTL serial port is not 38400.

After the communication is successful, the program will automatically read all the parameters of the thermostat. During this process, it is normal for the program to freeze. Please do not click any buttons of the program. After the reading is completed, the program will update all the parameters again to adapt to the current thermostat.

#### 4.4. Image Display

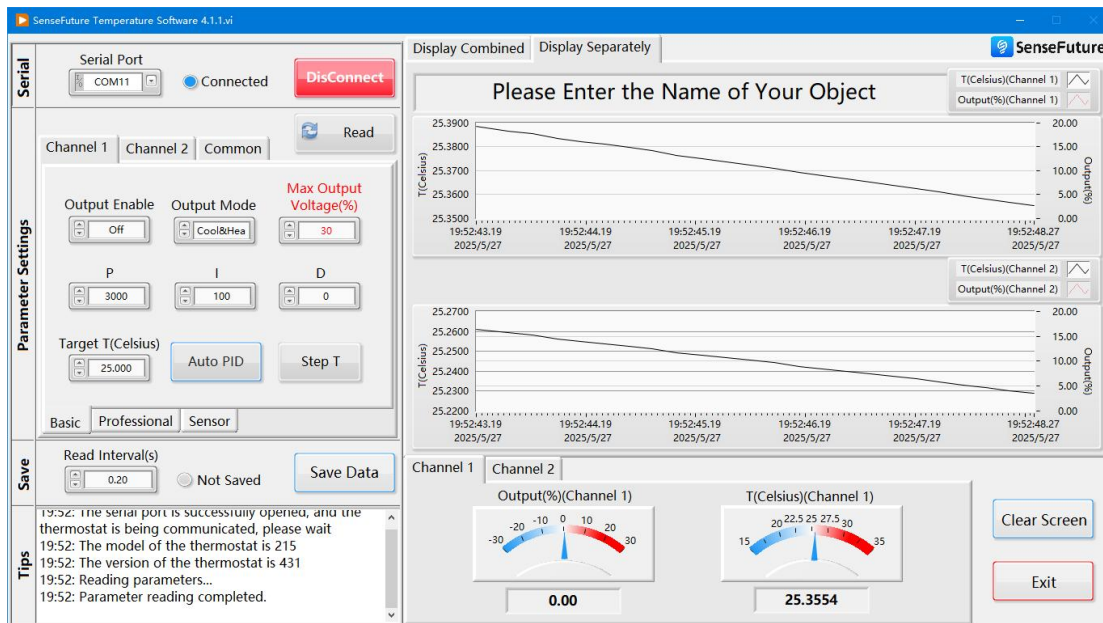


Figure7 Temperature Record Curve

After successfully connecting the device, the temperature record curve will be automatically drawn in the parameter setting area of the main interface of the software, as shown in Figure7. When the user's temperature control object is the TEC2XX series thermostat, the program will draw two temperature record curves, which will accurately display the real - time temperature changes of the two channels respectively. The user can click the "Combined Display" tab in the drawing area to integrate the two temperature curves in the same coordinate system for intuitive comparison, or click the "Separate Display" tab to display the two curves independently, as shown in Figure8.

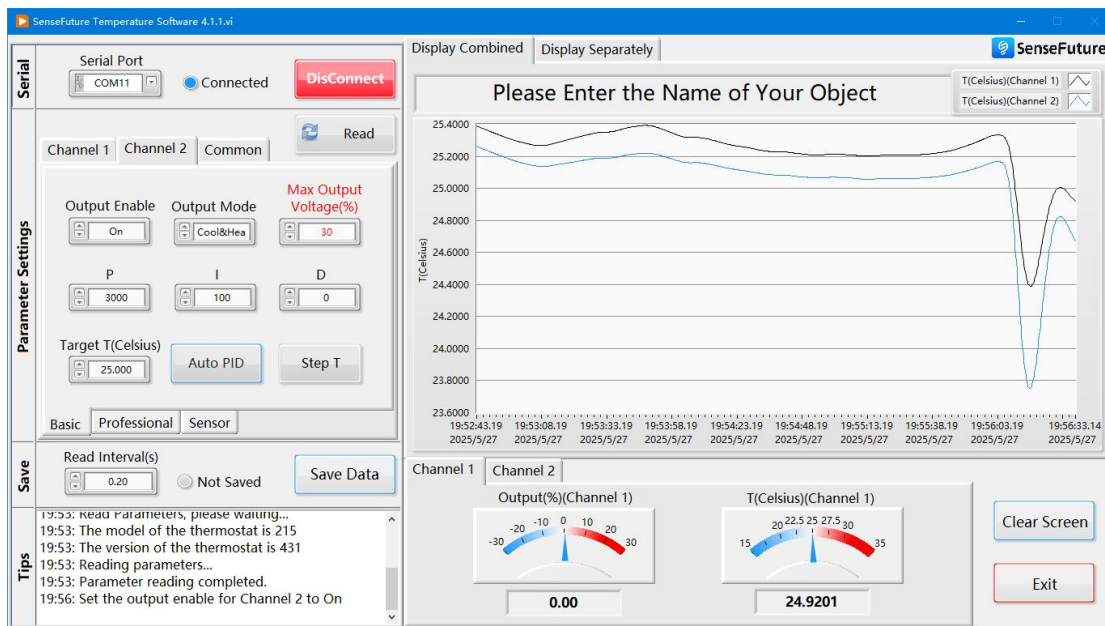


Figure8 Switch between Separate Display/Combined Display

## 4.5. Parameter Setting

After connecting the device, the user can set various parameters in the parameter setting area. For the meaning and setting methods of each parameter, please refer to Section 3.4. After entering the parameter input box, press the Enter key to set the corresponding parameter.

## 4.6. Segmented Temperature Control

The segmented temperature control function of the program provides users with a flexible solution for controlling the temperature in different time periods. The user can click the "Segmented Temperature Control" button in the common parameter interface of a certain channel in the parameter setting area to set the segmented temperature control.

After the user clicks the "Segmented Temperature Control" button, the segmented temperature control dialog box as shown in Figure9 will pop up. In the table of the dialog box, the first column is the temperature control serial number, the second column is the target temperature of temperature control, with the unit of degree Celsius ( $^{\circ}\text{C}$ ), the third column is the temperature control speed, with the unit of degree Celsius per second ( $^{\circ}\text{C}/\text{s}$ ), the fourth column is the temperature control duration, with the unit of minute (min), the fifth, sixth, and seventh columns are the PID parameter settings for temperature control, and the eighth column indicates which row of parameters the next temperature control behavior will follow after the temperature control of the current row is stable and the temperature control duration has passed.

After the user clicks the "Segmented Temperature Control" button, the segmented temperature control dialog box will pop up, and its interface layout is as shown in Figure9. In the table of this dialog

box, the first column is the temperature control serial number, which is used to identify different temperature control stages; the second column is the target temperature of temperature control, with the unit of degree Celsius ( $^{\circ}\text{C}$ ), where the user can set the precise temperature expected to be reached in each stage; the third column is the temperature control speed, with the unit of degree Celsius per second ( $^{\circ}\text{C}/\text{s}$ ), which is used to set the rate of temperature change; the fourth column is the temperature control duration, with the unit of minute (min), which is used to set the duration of each stage; the fifth, sixth, and seventh columns are the PID parameter settings for temperature control, and the user can finely adjust these parameters according to actual needs to achieve the best temperature control effect; the eighth column indicates the running serial number that the next temperature control behavior will follow after the temperature control of the current row is stable and the temperature control duration has passed.

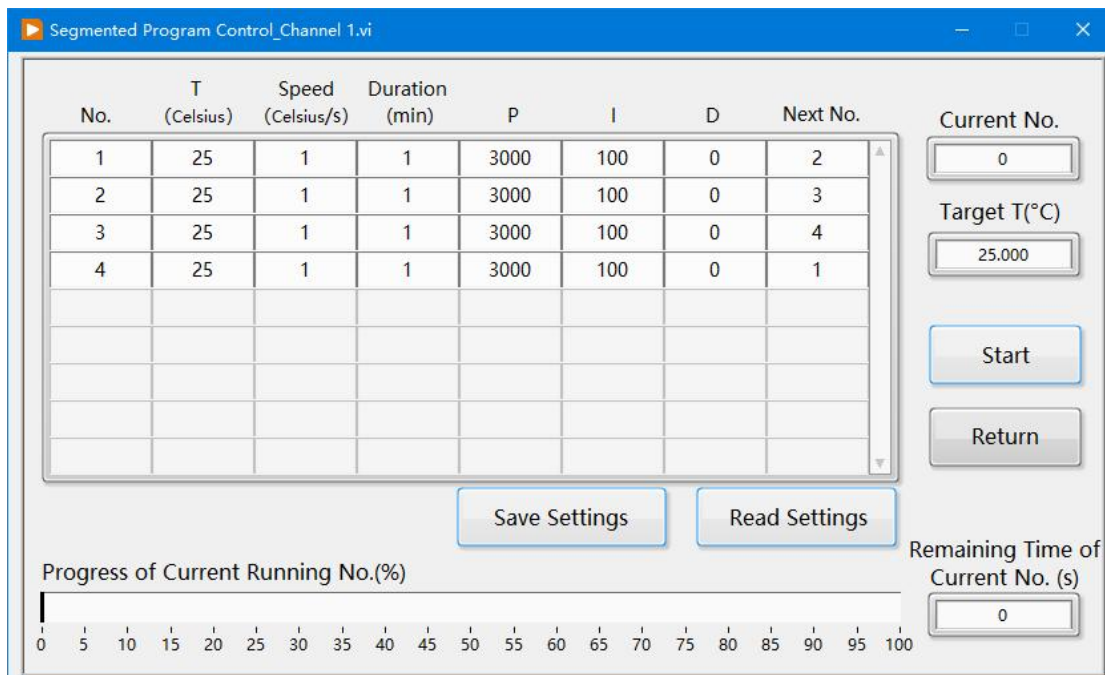


Figure9 Sub - dialog Box of Segmented Temperature Control

After editing the parameters of the control process, click the "Start Running" button to start the segmented temperature control. After the temperature control of the current serial number is stable, the program will start timing according to the specified running duration of the serial number. After the timing is completed, the program will continue the next stage of temperature control according to the set next serial number, as shown in Figure10.

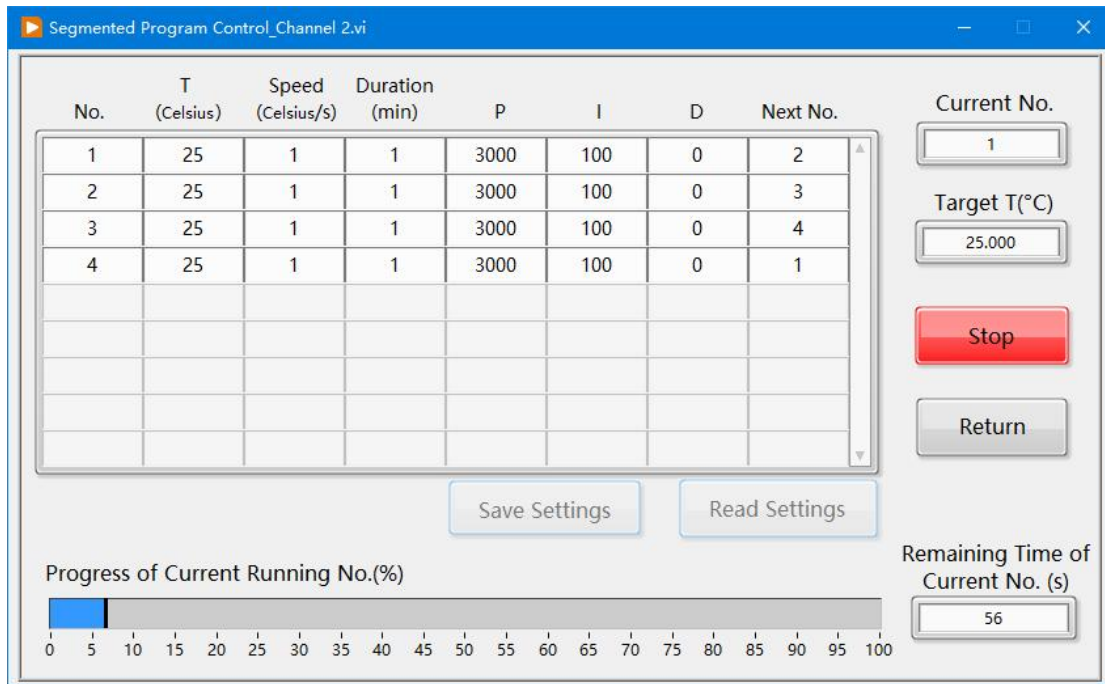


Figure10 Segmented Temperature Control in Progress

#### 4.7.Collection Interval and Data Saving

After the user connects the device, the reading interval time can be modified by changing the reading interval input box in the data saving area. After collecting some data, click the "Save Data" button in the data saving area of the main interface, and select the path according to the prompt to save the data. The file format of the saved data is Microsoft Excel 97 - 2003 Worksheet.

### 5.Common Problems and Solutions

#### 5.1.Software Fails to Start

**Problem Cause:** Errors may have occurred during the software installation process, or there may be other programs in the computer system that conflict with the software.

**Solution:** Try reinstalling the software to ensure that there are no error prompts during the installation. If the software still fails to start after reinstallation, check the task manager of the computer to see if there are any processes related to the software running. If so, end these processes and then try to start the software again. Additionally, try uninstalling other programs installed recently that may conflict with the software, then restart the computer and attempt to start the software once more.

#### 5.2.Device Connection Fails

Problem Cause: Incorrect serial port connection, inconsistent communication parameter settings, the thermostat not being powered on normally, or the device driver not being installed, etc.

Solution: First, check whether the serial port connection cable is firmly connected to the corresponding interfaces of the computer and the thermostat. After confirming that the serial port connection is correct, check whether the communication parameter settings in the software are consistent with the actual settings of the thermostat, including baud rate, data bits, stop bits, parity bits, etc. If the parameter settings are correct, check whether the thermostat is powered on normally. If a USB-to-serial port converter is used for the thermostat, ensure that the converter driver is correctly installed. You can check whether the serial port device is normally recognized through the device manager of the computer. If there are problems with the serial port device displayed in the device manager, try reinstalling the driver program or replacing the converter.

### **5.3. Abnormal Temperature Data Display**

Problem Cause: Malfunction of the temperature sensor, communication interference, software data processing errors, etc.

Solution: If the temperature data of a certain monitoring point is abnormally displayed, first check whether the temperature sensor corresponding to this monitoring point is working normally. Test by replacing the temperature sensor with the same model. If the temperature data returns to normal after replacement, it indicates that the original temperature sensor is damaged and needs to be replaced with a new one. If the temperature data of all monitoring points is abnormally displayed, it may be due to interference during the communication process. Check whether the 485 serial port connection cable is kept away from other high-voltage electrical lines to avoid electromagnetic interference. Try using a serial port connection cable with better shielding performance and ensure that the shielding layer of the connection cable is correctly grounded. If the above methods are ineffective, try closing and restarting the software to see if the normal data display can be restored. If the problem still persists, you can contact the technical support staff of SenseFuture (Shenzhen) Technology Co., Ltd. for further assistance.

## **6. Technical Support and After-sales Service**

During the use of the High-precision Temperature Control System Software, if you encounter any technical problems or need further support, you can contact our professional technical team at any time through the following methods:

Telephone Support: Call our customer service hotline [Tel: 86-755-88658289]. Our customer service staff and technical experts will provide you with immediate telephone support during working hours and respond quickly to your needs.

Email Consultation: You can also send an email to [Email: support@sensefuture.com], describe the problems you encounter in detail, and our technical team will reply to you as soon as possible after receiving the email and provide you with professional solutions.

On-site Service: For some complex on-site problems, after negotiation, we can also arrange technical personnel to provide on-site service for you to ensure that the problems are solved in a timely manner.

SenseFuture (Shenzhen) Technology Co., Ltd. always adheres to the customer-centric concept and is committed to providing you with efficient and high-quality products and perfect after-sales service. Our team will go all out to ensure that you can complete various tasks smoothly and efficiently during the use of this software, eliminating your worries.

## Version Change Log

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Version No.	Modification Details	Change Date	Reviewer
1.0	Latest Initial Version	2025/6/13	ZSJ、WYR

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