

1 INTRODUCTION

1.1 Introduction

WTC-3000 is a programmable control system for automatic control of Omega wind tunnels. The controller is connected to a PC through a USB cable for communication between the software and the controller. The system is capable of controlling the air flow speed in the wind tunnel using a servo loop, measuring the instantaneous temperature and velocity of the air flow.

1.2 General Applications

Heat sink manufacturers, IC houses, board designers and other electronic manufacturers are increasingly becoming interested in evaluating the thermal performance of their product under different airflow conditions. The reduction of electronic component sizes and increase in their power dissipation has forced the electronic community to be more aware of the thermal performance of their products. The hotter the devices, the shorter their life span and the greater the likelihood of a malfunction. The general procedure for testing is to put these components in the wind tunnel and evaluate their temperature at different flow velocities and temperatures. The operator has to wait for an average of a half-hour for the component to reach the thermal equilibrium at each velocity. Typical characterization requires 5 data points with an average wait time of 3 hours. The WTC-3000 automates the air flow delivery process, thereby freeing the operator's time.

2 HARDWARE DESCRIPTION

2.1 WTC-3000 Controller

The controller is the electronic box which accepts commands from the software through the USB communication port and reports the data back to the system. It includes the circuitry for reading air temperatures and velocity using a SSVP temperature sensor and a SSVP velocity sensor. Figure 1, shows the front view of the WTC-3000 controller. The power switch on the top right hand side turns the system on and off.

Note: Please read the manual before operating the system.



Figure 1 Front View of the WTC-3000 Controller

Figure 2 shows the rear view of the controller.

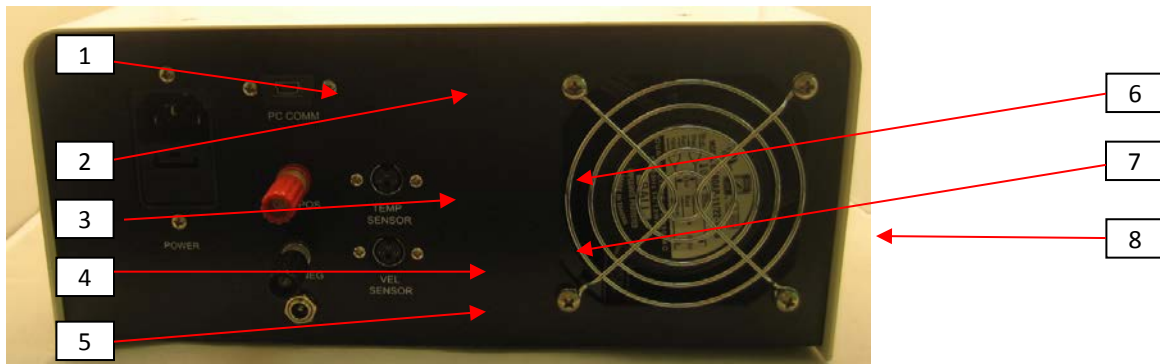


Figure 2 Rear View of the WTC-3000 Controller

The function and description of ports and connectors on the front panel are as follows:

1. POWER - Main AC power input (115V 60 Hz) to the system for powering the system.

2. PC COMM - This is the USB communication port. A special cable (provided with the system and called COMMUNICATION CABLE is used to connect the WTC-3000 system to a PC. All communication between the WTC-3000 and software is through this port.
3. FAN POS - This is the positive voltage output (+24V) from the WTC-3000 which goes to the Fans.
4. FAN NEG - This is the negative voltage output from the WTC-3000 which goes to the fans.
5. PWM Output Port - This is PWM signal output from the WTC-3000 to the fans.
6. TEMP SENSOR - Temperature sensor is connected to the WTC-3000 control box through this port. It reads the air temperature, which is used by the velocity sensor to find the air velocity in the wind tunnel.
7. VEL SENSOR - Velocity sensor is connected to the WTC-3000 control box through this port. It reads the air flow velocity in the wind tunnel.
8. System Cooling Fan - To keep the electronic components in the box at relatively low temperature.

Note: If the air temperature sensor is not connected, the system will report erroneous data for velocity.

2.2 Fan Tray

The range of air velocity is dependent on the fluid dynamic resistance of the components mounted inside the wind tunnel. If the fan tray is attached to the WTC-3000, there is no need for any power supply, since the WTC-3000 controller will power the fans. The fans can be powered by a 24VDC power supply if one decides to use the wind tunnel as a stand-alone device.

NOTE: The input voltage to the fans (ebm-papst 6314/2TDHP) is rated as 16-36 volts. If the fan tray is powered by an external power supply, please short the negative output of the external power supply to the FAN NEG on the rear panel of the WTC-3000.

2.3 Temperature Monitoring

Omega can supply optional temperature sensors for the WTC-3000. The sensors are used for monitoring the air temperature inside the wind tunnel. The calibration coefficients for each sensor are provided for every unit.

2.4 Velocity Monitoring

Omega can supply optional velocity sensors for the WTC-3000. These sensors are especially calibrated for measurement in flows ranging from 0 to 1200 ft/min (6 m/s). The sensors are used for monitoring the air velocity at any location in the wind tunnel for controlling the blower speed and flow using a feedback control servo loop. The calibration coefficients for each sensor are provided for every unit.

3 SOFTWARE DESCRIPTION

3.1 Operating Software

The WTC-3000 software is a graphical user interface that communicates with the controller through a PC USB port. The software enables the user to perform an automatic flow control characterization on a test specimen. The user can automate this process by selecting a few parameters in the software. The temperature and velocity sensors can be attached to any surface inside the wind tunnel to control the flow in the wind tunnel based on that point. The flow sensor uses the temperature reading obtained by temperature sensor to calculate the velocity. In most applications the flow sensor and the thermocouple are installed close to the entrance of the test section.

3.2 Software Installation

1. Install the software by double clicking CD\ Installer\Volume\Setup.exe
2. Select the destination directory for the software, see Figure 3.
3. After the installation, a shortcut will be created in All Program\Omega and another shortcut will be created on the desktop.

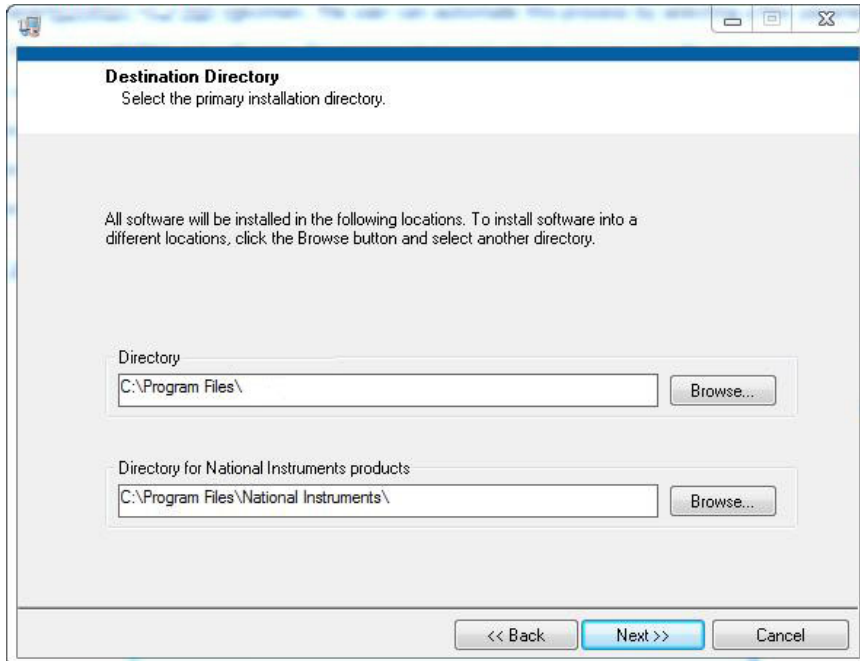


Figure 3 Software Installation

3.3 Software Operation

When you run the software for the first time, a window (see Figure 4) will pop out asking for the Calibration File. This file can be found on the CD sent by Omega. You have to load this file before you can start using the software.

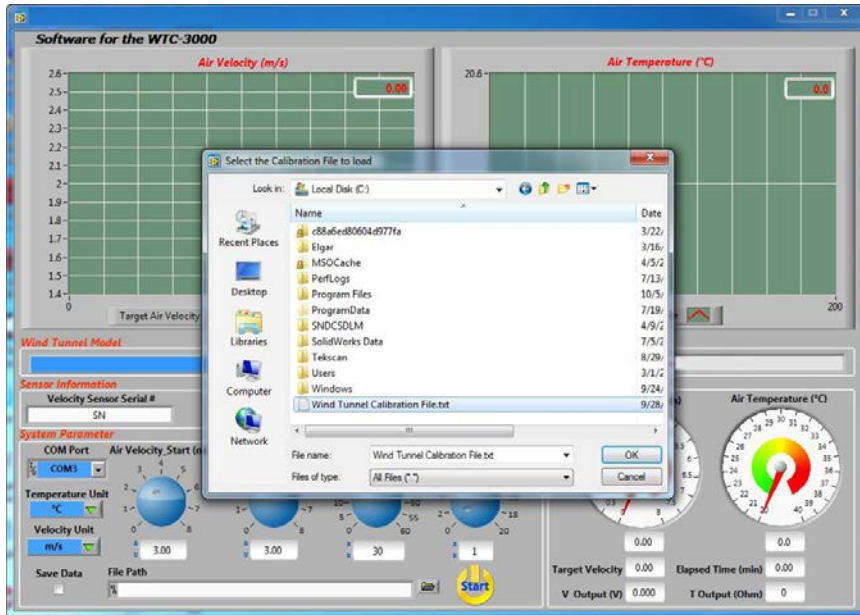


Figure 4 Loading Calibration File

When the software starts, it will automatically look for the WTC-3000 controller. If it cannot find the device, a window displaying a warning will pop out, see Figure 5. Please check the USB connection between the computer and the WTC-3000 controller. You can also check under Device Manager\Ports (COM & LPT) to see if a USB Serial Port is present. Choose Retry or Continue to proceed.

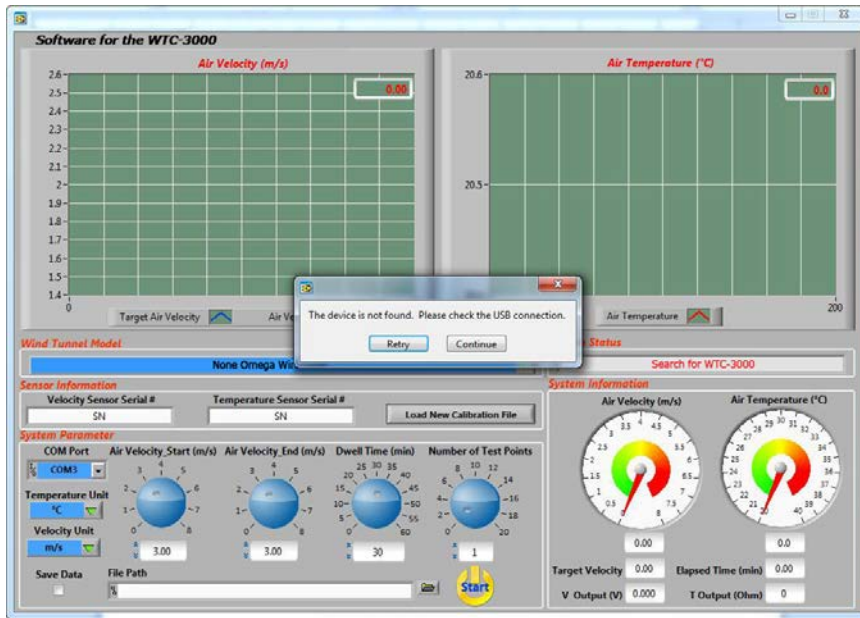


Figure 5 “Device Not Found” Warning

The following procedures should be taken by the operator prior to starting the wind tunnel.

1. Specify the desired air velocity ranges for the experiment to be performed.
2. Select the desired number of data points. This value includes the two data points at the starting and ending velocities. When the software is executed, the wind tunnel will begin at starting velocity and will stay there until the dwell time is reached. The software then increases the air velocity by the amount of velocity interval calculated from the following equation

$$\text{Velocity interval} = (V_{\text{Start}} - V_{\text{End}}) / (\text{Desired number of test points} - 1)$$
3. This process is repeated for subsequent velocities until the data for the end velocity has been obtained.
4. Set the dwell time. This is the amount of time the controller will keep the air flow velocity at the set point.

3.4 Description of the Software User Interface

The interface of the software is illustrated in Figure 6.

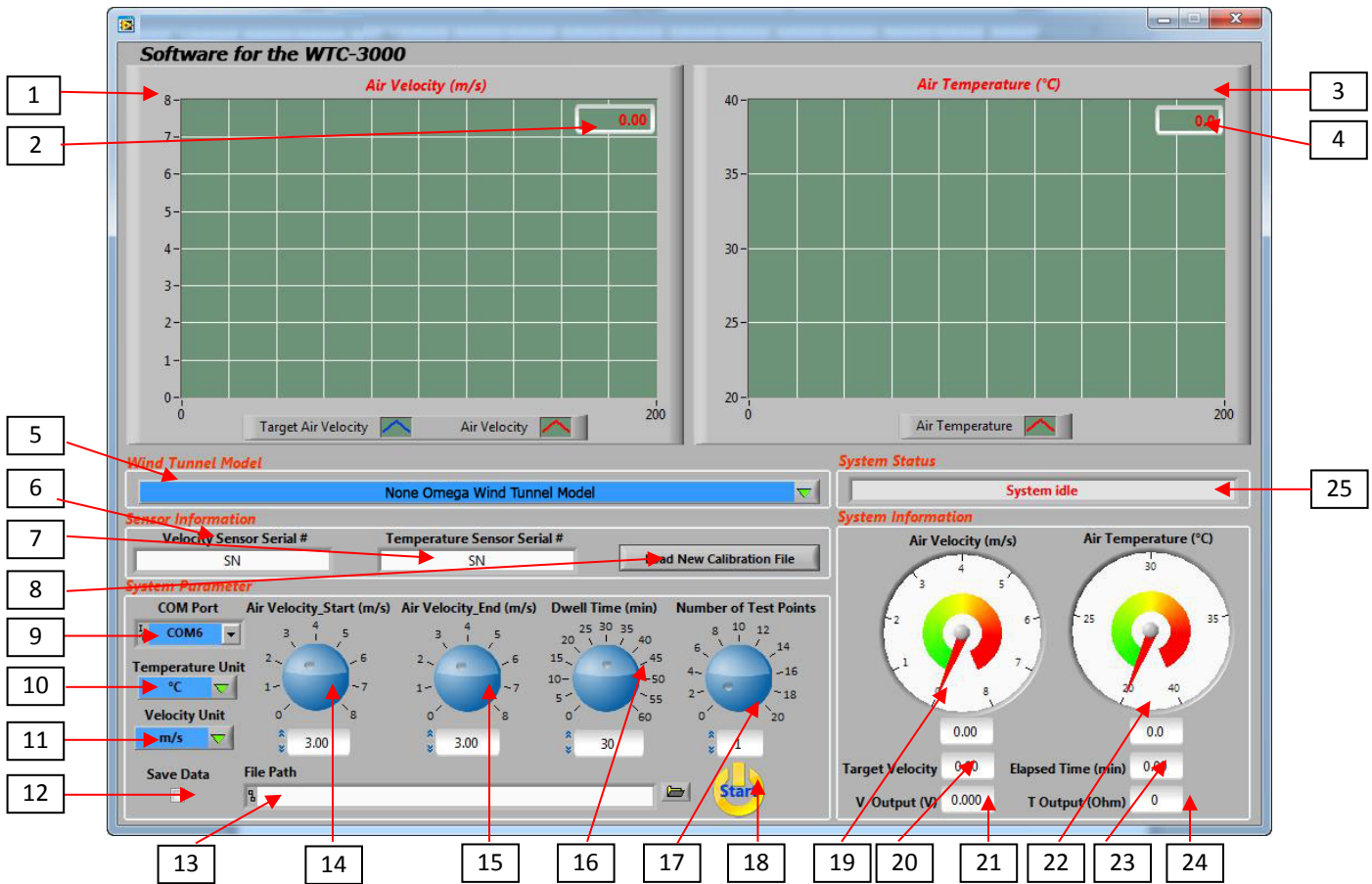


Figure 6 Software User Interface

The user interface elements (number in the boxes) are explained as follows:

1. Air Velocity Chart: This chart shows the transient value and history of the air velocity.
2. Air Velocity Digital Display: This shows the current air velocity value.
3. Air Temperature Chart: This chart shows the transient value and history of the air temperature.
4. Air Temperature Digital Display: This shows the current air temperature value.
5. Wind Tunnel Model: Select the wind tunnel connected to the WTC-3000 controller. The wind tunnel model is specified on the plate of the wind tunnel. Select the correct wind tunnel model before starting the test.
6. Velocity Sensor Serial #: Input the velocity sensor serial #, which can be found on the sensor connector.
7. Temperature Sensor Serial #: Input the temperature sensor serial #, which can be found on the sensor connector.

8. Load New Calibration File: Click to load new calibration file for the temperature and velocity sensors.
9. COM Port: Choose the port for data communication. The value chosen will determine which COM port will be active for serial data communication.
10. Temperature Unit: Select the temperature unit used in the test.
11. Velocity Unit: Select the velocity unit used in the test.
12. Save Data: Check the box to save the temperature and velocity data.
13. File Path: Enter a file path for the test data.
14. Air velocity _Start: Set the starting velocity.
15. Air velocity _End: Set the ending velocity.
16. Dwell time. This is the amount of time, in minutes, spent between each velocity interval.
17. Number of Test Points: Enter the desired number of data points. For example, if you enter 6, the software will perform the experiment for six different velocities, i.e. at the starting and ending velocities and four velocities in between at equal velocity intervals.
18. Start/Stop: When Start is pressed, the software turns on the fans and testing begins. When Stop is pressed, testing ends and the software asks if you would like to turn the fans off.
19. Air Velocity: Air velocity indicator.
20. Target Velocity: This shows the target velocity.
21. V Output (V): This shows the output of the velocity sensor. This value is for debug purposes only.
22. Air Temperature: Air temperature indicator.
23. Elapsed Time: This shows the elapsed time, in minutes, at the current test point.
24. T Output (Ohm): This shows the output of the temperature sensor. This value is for debug purposes only.
25. System Status: This displays the system's operating status.

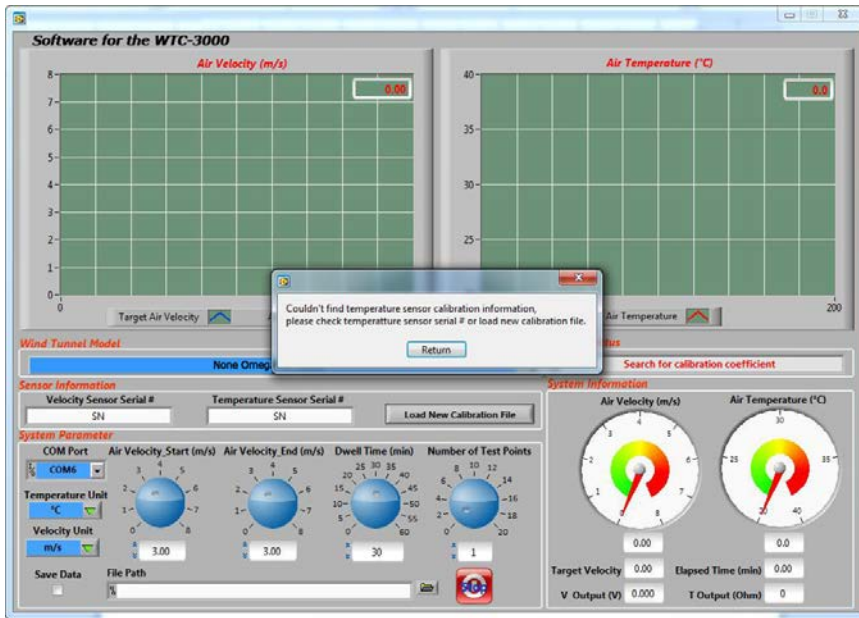


Figure 7 Sensor Serial # Warning

Note: If the Temperature/Velocity Sensor Serial # is incorrect, a warning window will pop out when the test starts, see Figure 7. Please select “Return” and input the correct serial number.