Section A

Chambers

1.0 Model 532 CONTROLLED ENVIRONMENT CHAMBER

Many applications require a controlled environment for testing, fabricating and/or storage. The Model 532 Microprocessor Controlled Environmental Chamber is a completely integrated system, fabricated from 0.375" clear and white acrylic that provides the user with undistorted visibility of the inside of the controlled environment section. It includes glove ports, equipment and sample access doors, circulating fan(s), lighting and accessory power outlets. The Chamber is capable of precisely controlling temperatures from 32-122°F (0-55°C) and humidity from 5-98% RH. (**NOTE:** The entire humidity range cannot be obtained at all temperatures).

The complete Model 532 measures 54"Wx22.5"Dx22"H (137x57x56 cm). The addition of any of the optional cooling systems requires up to 18" (46 cm) more in overall depth.

1.1 Chambers Controllers & Operating Systems

The controllers and some of the operating systems are housed in a separate compartment on the right side of the Chamber as shown in Figure 1.0-1.

Figure 1.0-1 Model 532 Controlled Environment Chamber

The systems are totally accessible via the removable white, acrylic panel on the right side of the Chamber. Controllers and operating systems that are available with the Model 532 are as follows:

1. Microprocessor Temperature Controller - includes Model 554 RTD Temperature Sensor (Std.)

2. Integrated 500 Watt Heater (Std.)

3. Choice of Cooling Systems:

    a. Model 563 Liquid CO_2 Cooling System (Std)
    b. Model 573 800 BTU Thermoelectric Cooling System
    c. Model 575 Variable Load Refrigerated Cooling System
    d. Model 577 1500 BTU Thermoelectric Cooling System

4. Microprocessor Humidity Controller - includes Model 554 Temperature Compensated RH Sensor (Std)

5. Model 572 Ultrasonic Humidification System (Std)

6. Choice of Dehumidification Systems:

    a. Model 571 Desiccant/Pump Dehumidification System - 2.5 lbs. of Desiccant (Std.)
    b. Model 578 Self-Regenerating Dehumidification System (requires external air compressor or house air at 50-100 psi)
    c. Model 565 Dry Gas Dehumidification System

7. CALCOMMS Computer Software/Interface Package. Allows remote monitoring, charting and reprogramming of the Microprocessor Controllers from a PC.

1.1.1 Front Panel Description

The front panel of the Model 532 Chamber is shown in Figure 1.0-3.

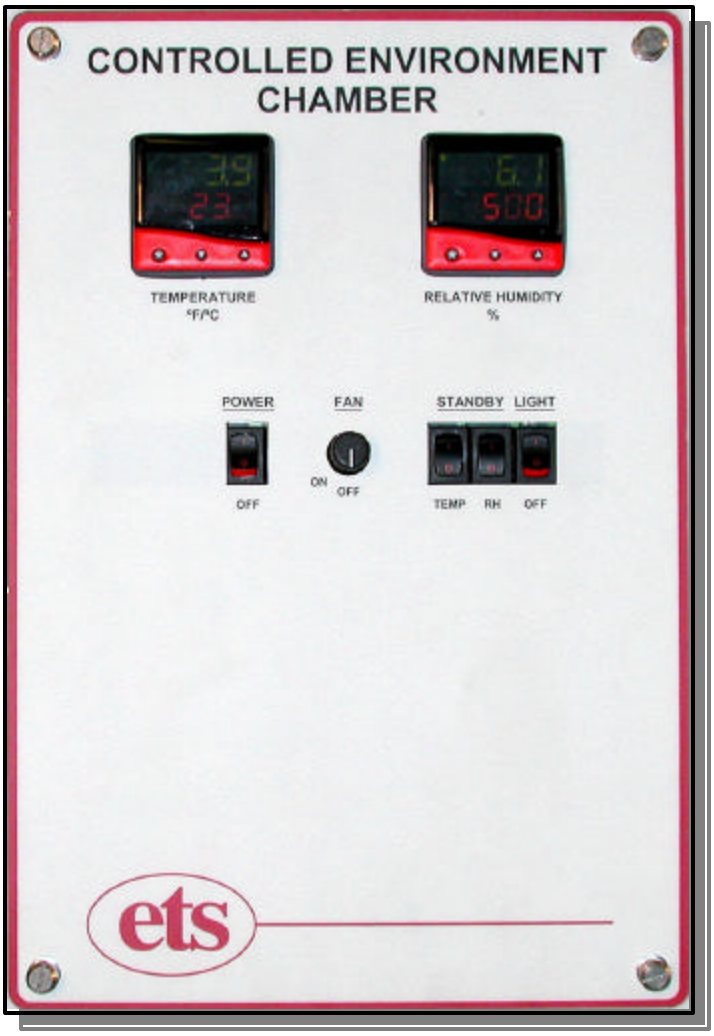

Figure 1.0-3 Model 532 Chamber Front Panel

1.1.1.1 Microprocessor Controllers

The Model 523 Microprocessor Temperature Controller is the top unit. The Model 524 Microprocessor Humidity Controller is the lower unit See Sections 5.0 and 3.0 respectively for a full explanation of all functions and features.

1.1.1.2 Front Panel Switches

1. **'POWER' -** The Main Power Switch is the black rocker switch located directly below the Temperature Controller, to the left of the Fan Power Knob. This switch disconnects all power going to the Chamber Systems. "I" is "ON", "O" is "OFF"

2. **'FAN' -** The Fan Speed Control Knob is located to the right of the Power Switch. In the ETS Model 532 Environmental Control Chamber, this switch controls the speed of the circulation fans inside the cabinet workspace.

'STANDBY' SWITCHES

3. **'TEMP STANDBY' –** Allows the user to manually disable the Temperature Control System. Pushing this switch into the 'Off' ('0') position manually disconnects the AC Power from all of the Temperature Control Relays. The Microprocessor will still show the Temperature in the display, the set point may still be adjusted, the internal LED's will still illuminate and the low voltage control signal will still be sent to the solid state Control Relays. The Relay 'Output' will 'close' but AC Power will no longer be connected to the Relay, therefore, the Temperature systems will not receive AC Power and will not operate.

4. **'RH STANDBY' –** Allows the user to manually disable the Humidity Control System. Pushing this switch into the 'Off' ('0') position manually disconnects the AC Power from all of the Humidity Control Relays. The Microprocessor will still show the Relative Humidity in the display, the set point may still be adjusted, the internal LED's will still illuminate and the low voltage control signal will still be sent to the solid state Control Relays. The Relay 'Output' will 'close' but AC Power will no longer be connected to the Relay, therefore, the Humidity systems will not receive AC Power and will not operate.

5. **'LIGHT' -** The Light Switch is located to the right of the Standby Switches. In the ETS Model 532 Environmental Control Chamber, this switch controls the overhead light installed in the Chamber workspace.

1.1.1.2 Sensors & PC Boards

The Sensor Input, Control Relays and Switches are contained on a pair of PC Boards located on the rear of the Front Panel. The PC Boards are mounted on standoffs and stacked on top of one another.

1. **Switches -** The switches are permanently mounted to the 'front' PC Board, referred to as the **'Switch PC Board'**.

2. **Relays -** The relays are removable and mounted in sockets (and secured with plastic cable ties) on the 'rear' PC Board, referred to as the **'Relay PC Board'**.

3. **Sensor Input -** The Sensor Input is the 5-pin DIN jack located in the lower left corner of the **'Switch PC Board'**. The ETS Model 554 Sensor is equipped with an RTD Temperature Sensor and a temperature compensated Relative Humidity Sensor. Both input signals interface with the system through this jack.

   The ETS Model 554 RH Sensor is plugged into this jack. The Model 554 Sensor Head (Sensing Elements) should be in the 532 Chamber Environment. The sensor is held in place on the divider wall with a ¾" NPT plastic liquid-tight fitting.

   The input is configured at the factory to accept the signal from the ETS Model 554 Humidity/Temperature Sensor. The Model 554 signals are both 0-1VDC, equaling 0-100% RH and 0-100 °C (32-212°F), respectively.

1.1.2 Side Interface Panel Description

All user connections to the Chamber are made through the Side Interface Panel shown in Figure 1.0-2. Power connections, Operating Systems connections and the Computer interface are all on this panel. The Side Interface Panel is a modular layout that will be modified to meet the specifications of the Operating Systems ordered with the Model 532 Chamber. Tube fittings may be added/removed and power outlets may be added/removed. The following sections will describe the main features of the Side Interface Panel in the Standard Model 532 Configuration. For other configurations, specific installation instructions will be included.

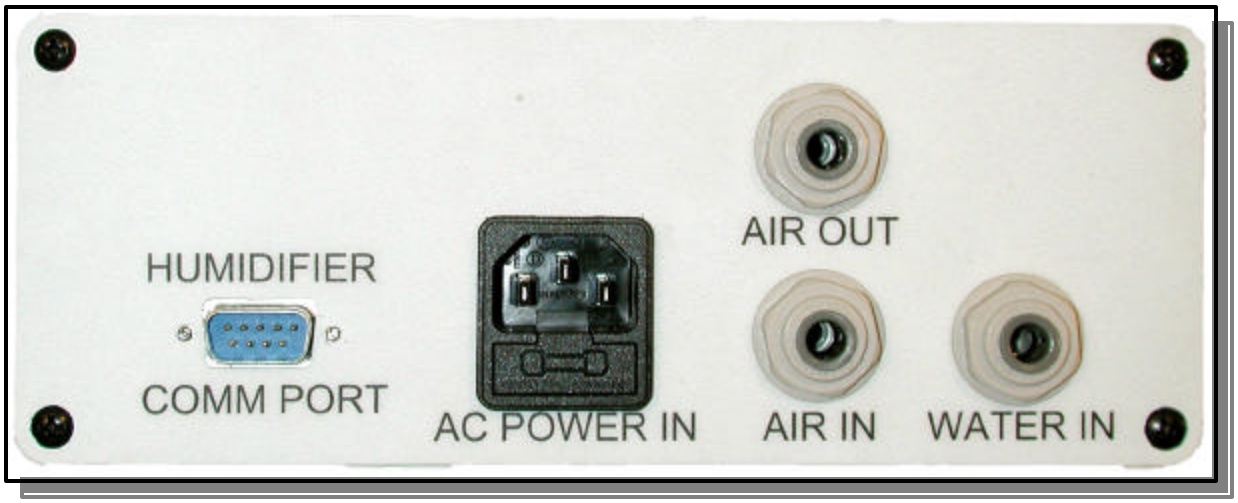

Figure 1.0-2 Model 532 Side Interface Panel

1.1.2.1 AC Power Cord Input

Labeled **POWER**, this Universal IEC power connector is located on the bottom, left corner of the panel. Power supplied must match Chamber Voltage. All Chambers are 115 VAC / 60 Hz, unless otherwise specified.

1.1.2.2 COMM PORT (RS 485 & Analog Voltage Outputs)

The Comm Port is the 9-pin subminiature-D jack (sub-D) located directly above the AC Power Cord Input. The Comm Port is common to both the Temperature and Humidity Microprocessor Controllers. Comms access to either, or both, units is gained through this jack.
This Jack is used for the Analog Chart Recorder Output and the RS 485 Computer Interface. **(See Sections 3.4 & 5.4 CALCOMMS Computer Interface)**

1. **RS 485 Computer Interface**

   The RS 485 portion of the Comm Port will only be active if the Controller is fitted with the COMMS option (see section 1.2.1 LEVL C). The COMMS option allows the microprocessor to communicate with a PC running the CALCOMMS software. The COMMS option must be specified at the time of purchase.

RS 485 Wiring Connections

Tx/Rx+ = Pin 7
Tx/Rx- = Pin 2
Ground = Pin 4

If using the CALCOMM computer program, see the "CALCOMM" section of this manual for set-up instructions.

2. **Analog Voltage Output**

The Analog Voltage Output will always be active. Temperatures of 0-100°C (32-212°F) correspond to an output of 0-1VDC. Relative Humidity of 0-100% RH corresponds to an output of 0-1VDC. The analog output is a direct voltage reading from the sensors.

This jack is configured as an Analog Voltage (0-1VDC) Output for monitoring the temperature and/or humidity performance using a chart recorder or any other analog input device. The minimum acceptable input impedance for the analog recording device is 20K ohms. An input impedance lower than 20K ohms will affect sensor accuracy for the entire system.

Analog Voltage Output Wiring Connections

Temperature Positive (+) = Pin 9
RH Positive (+) = Pin 1
Common (Temp & RH)
Ground (-) = Pin 4

1.1.2.3 DEHUMIDIFY IN/OUT

The Model 571 Desiccant/Pump Dehumidification System uses a pair of Quick Disconnect fittings. The Pump is inside the Chamber Control Cavity and the Desiccant Column is outside the Chamber. These two fittings connect the Column into the Dehumidify loop. **(See Section 2.2.1 Model 571 Dehumidification System)**

1.1.2.4 COOL INPUT

When using the standard Model 563 Liquid CO_2 Cooling System, a Brass Quick Disconnect Fitting is located in the top, right corner of the acrylic Side Panel. The Brass, Male Quick Disconnect Fitting protrudes out through the acrylic panel for connection to the Cooling Gas Tank. **(See Section 4.2.1 Model 563 Cooling System)**

1.2 Controlled Environment Description

The controlled environment section of the Chamber is 13 ft^3. (0.32 m^3) and measures 39”Wx22.5”Dx22”H (99x57x56 cm). Located against the rear wall is an aluminum “screen” that protrudes 4” from the rear wall and contains the heater, thermal safety switch, variable speed 110 cfm fan(s) (controlled by a speed control knob located on the front panel to the left of the ‘Standby’ switches), and accessory power outlet. Mounted to the top of the unit is a weather-tight 18-Watt florescent light (controlled by an ON/OFF switch located on the front panel to the right of the ‘Standby’ switches).

The thermoelectric and refrigerated cooling systems are mounted to the rear wall behind the “screen” when the chamber is equipped with these optional cooling systems.

The wall separating the controlled environment from the electronics compartment is 0.25” acrylic and contains the humidity and temperature sensor, dry air in/out ports plus the gas cooling fitting, if so equipped. Located on the upper middle portion of the wall is the humidifier input.

The front of the compartment contains 8” (20 cm) glove ports that accepts either gloves or iris ports. The standard Model 532 is equipped with neoprene gloves with removable size 10 hands (other sizes are available). Silicon rubber iris ports or no glove ports at all are optional.

The left hand side of the Chamber consists of a 12"W x 4"H opening with a hinged access door. Towards the rear of the Chamber is a 1.25" ID access hole for feeding cables and tubing to instrumentation placed inside. This hole should be sealed using a soft putty compound.

The front of the Chamber consists of a large door containing a pair of accordion neoprene gloves. The access opening is 32"W x 14"H which enables large objects to be placed inside. To the right of the front door is the humidity and temperature control module. This module is easily removed for servicing by loosening the four (4) captive mounting screws.

Section B:

Humidity

2.0 HUMIDITY OPERATING SYSTEMS

2.1 Humidification System

The Model 532 Chamber includes an ETS Model 572 Ultrasonic Humidification System. The Humidifier is installed inside the Chamber Control Cavity. To access the Humidifier, remove the large white acrylic panel on the right hand side of the Model 532 Chamber. The panel is held in place with eight (8) Phillips head, #6-32 Truss Head Stainless Steel screws.

Refer to the Model 572 Set-up instructions before using the Humidifier!!

The Model 572 Ultrasonic Humidifier produces a fine water mist through ultrasonic action. The mist is forced from the humidifier into the chamber by a small, quiet air pump. The integral air pump draws in ambient air. This is not a closed-loop system.

2.1.1 Ultrasonic Humidifier Accessories

1. 5 Gallon Water Tank

   A. Tank includes plastic faucet. The Faucet is attached to the lid, on the inside of the tank, upon arrival to the user.

   B. A ¼" OD Tubing Quick Connect Fitting is attached to the Faucet.

2. Water Deionizer Column

   A. #10 Clear Sump with black Lid and ¼" OD Tubing Connectors.

   B. The Column is filled with a mixed bed deionizing resin for water.

   C. The Column has Filter Pads on the input and output. The Filter Pads are held firmly in place by a cadmium plated steel spring.

2.1.2 Set-Up

The Model 572 Humidifier may be operated using a water tank or directly from a faucet without a tank. **Use Distilled or Deionized water ONLY!!**

A water de-ionizing column is included, suitable for up to 100 psig. (NOTE: The life of the deionizing column will be greatly increased by using a carbon block water filter in line with the deionizer.)

When the deionizing resin is depleted, it will change from dark to light in color. When it is ¾ light, it must be replaced.

2.1.2.1 Using the Water Tank

1. Attach the water de-ionizing column to a faucet. The faucet should go to the side marked "IN". *The user must provide an appropriate faucet adapter fitting.*

2. Run the outlet tube to the 5-gallon water tank.

3. Turn on the water.

   The water flow rate through the purifier should not exceed *8oz. every 25-30 seconds*. Water will pass at up to 10 gallons per hour.

   NOTE
   Do not increase the flow rate! The amount of purification that can be performed on the water is in direct proportion to how long it takes the water to flow through the column.

   Slow flow rate = highly purified water.
   Fast flow rate = poorly purified water.

4. Fill the tank with the amount of water that can be used in 1-2 weeks of normal operation at the required operating conditions.

   Different conditions will consume different amounts of water. Leaving water in the tank longer than 1-2 weeks is not recommended. Always refresh your water supply to prevent the growth of bacteria and other things that will degrade the water quality. **NEVER** add anti-bacterial growth treatment to this water, it will damage the humidifier.

5. Attach the provided plastic faucet to the water tank.

   a. Remove the tank lid and unscrew the faucet from the inside of the lid.

b. Remove the small white cap from the outside of the lid.

c. Screw the faucet onto the outside of the lid where the white cap had been previously.

The faucet has a ¼" OD. tubing quick-connect fitting attached to the outlet.

6. Make sure the faucet is closed, then push the ¼" OD. tubing into the quick connect fitting.

7. Attach the other end of the tubing to the fitting on the Model 532 Chamber side panel labeled 'WATER IN'.

8. Place the water tank output at least 12" above the humidifier water input. Placing the water tank on top of the chamber is acceptable.

   This is a gravity-feed system that requires the source tank to be above the humidifier. Also, air must be allowed to enter the 5-gallon tank or water will not flow. Simply loosen the cap on top of the tank to allow air to enter.

9. Turn on the 'HUMIDITY STANDBY' switch.

   The Humidifier basin will begin to fill with water as soon as this switch is turned 'ON'.

2.1.2.2 Using the Tap Water System

1. Attach the water de-ionizing column to a faucet. The faucet should go to the fitting on the column lid labeled "IN". *The user must provide an appropriate faucet adapter fitting.*

2. Turn on the water. Establish the proper water flow rate before attaching to the humidifier.

   The water flow rate through the purifier should not exceed 8 oz. every 25-30 seconds. Water will pass at up to 10 gallons per hour.

NOTE

Do not increase the flow rate! The amount of purification that can be performed on the water is in direct proportion to how long it takes the water to flow through the column.

Slow flow rate = highly purified water.
Fast flow rate = poorly purified water.

a. Attach the open end of the tubing to the ‘WATER IN’ fitting on the side of the ETS Model 532 Chamber.

4. Turn on the water.

   Set the flow rate to the pre-determined amount. **DO NOT OPERATE THE HUMIDIFIER WITH THE FAUCET 100% OPEN.** High flow rates will cause the humidifier to overfill and possibly damage the unit. The humidifier consumes very little water; a low flow rate will be sufficient to keep the unit full.

5. Turn on the ‘HUMIDITY STANDBY’ switch.

   The Humidifier basin will begin to fill with water as soon as this switch is turned ‘ON’.

2.1.3 Operation

After setting up the system properly, the user does not have to do anything else to operate the system. Total operation will be under the control of the Model 532 Microprocessor Humidity Controller. Refer to **Section 3.2 Microprocessor Humidity Controller Operation.**

Continue only after reading the Model 572 section of this manual and completing the preliminary set-up.

1. Remove the green Caplug covering the Chamber Vent.

   The vent, inside the chamber, is the 1” orifice on the right wall (the green plug will be found here). The vent passes through to the outside right wall, the 1” barb on the outside should remain open.

2. Set the Model 532 Humidity Controller set-point to a value above the ambient humidity (Refer to **Section 3.2.1 Microprocessor Humidity Controller Operation**).

3. Turn on the “HUMIDITY STANDBY” switch on the front of the Model 532 Controller.

   This will not automatically turn on the Humidifier. Turning on the “HUM STANDBY” switch only makes the humidifier *available* to the Microprocessor Controller.

   When the microprocessor tells the Humidifier to activate, the small green LED in the upper, left corner of the microprocessor will light. The Humidifier

will begin producing a mist and forcing it into the chamber through the Humidity Input Barb.

4. The microprocessor will determine the amount of humidification needed to maintain the desired set point.

   If less than the full capacity of the Humidifier is needed, the controller will provide pulses of power to the unit to limit the output. The Humidifier will be turned on and off cyclically to obtain an average humidity output lower than the full capacity of the Humidifier.

NOTE

To obtain a smooth, even humidity output the Model 532 Cycle Time (CYC.t) should be set to 1.0 second. Longer cycle times will create longer "gaps" between humidification pulses. **DO NOT SET THE CYCLE TIME LESS THAN 1.0 SECOND.** Shorter pulses may damage the Model 572.

2.1.3.1 Operating Precautions

The Model 572 should operate reliably if the following precautions are observed:

1. **Always run the humidifier directly to the chamber.**

   Never attempt to combine the humidifier output with another air or gas source.

2. **Always provide a vent on the chamber being humidified.**

3. **Clean the ultrasonic transducer frequently and thoroughly.**

   Any dirt or particle build-up on the transducer will cause stress to the electronics. Once the electronics overheat and stop working, the humidifier must be replaced. With frequent cleaning, the electronics should operate reliably for many years.

4. **Use distilled or deionized water only.**

2.1.3.2 Maintenance & Cleaning

1. Always unplug the Model 532 Chamber before cleaning Humidifier.

2. Empty the unit of all water. Siphon water out or soak up with a sponge.

3. Disconnect (or remove) water tank or tap water source.

4. **Clean the surface of the transducer using distilled vinegar** and a soft, clean cloth.

This is very important. If the transducer is not kept clean, it will fail. Using distilled or deionized water keeps the build-up to a minimum, but cleaning with distilled vinegar cannot be ignored.

NOTE

Do not use any tools with metal parts or sharp edges to clean the transducer. Scratching the transducer may cause fatal damage to the unit.

5. To clean thick or heavy deposits, pour a small amount of vinegar into the humidifier until the transducer surface is completely covered. Let stand for 30-60 minutes. Wipe clean with a soft cloth. If further cleaning is needed, a soft, plastic bristle brush may be used to gently clean the transducer surface.

6. Never leave water in the humidifier or water tank when the humidifier is not in service.

   Always empty all water and thoroughly dry all parts of the humidifier when it is to be stored or taken out of service for any period longer than one week. Do not seal the water tank in storage. Leave the top off to allow the air to completely dry the tank. Any residual moisture will encourage bacterial growth.

   Never clean any parts of the humidifier with water above 120°F.

2.2 Dehumidification System

The Model 532 Chamber includes *an ETS Model 571 Desiccant-Pump Dehumidification* System as the standard dehumidification system. As an option, the *ETS Model 578 Self-Regenerating Dehumidification System* is available. Operation of each system will be described below.

2.2.1 Desiccant/Pump Dehumidification System

The Model 571 Dehumidification System is a closed loop system, designed to reduce the relative humidity in the Model 532 Chamber to less than 10%. When paired with the Model 532 Microprocessor Humidity Controller, the humidity inside the chamber can be controlled to within +/- 0.2% RH of the set-point at the sensor.

2.2.1.1 Description

The Model 571 Dehumidification System includes a small air pump (located inside the Chamber Control Cavity), 2.5 lbs. of indicating calcium sulfate ($CASO_4$) in a clear plastic column (sits outside the chamber), and ¼" O.D. tubing to interface the drying column with the pump. The tubing connects to the chamber through the quick-connect fittings on the right side of the Chamber. The desiccant column may be placed on top of, or next to, the Chamber.

The air pump is already wired into the Model 532 Microprocessor Humidity Controller. All the user needs to do is connect the Desiccant Column into the system using the provided ¼" OD Tubing.

The desiccant removes any moisture that is in the air. This dried air is then forced back into the chamber. The desiccant contains an indicator that turns the normally blue colored desiccant pink as it absorbs moisture. When the cylinder is mostly pink, the desiccant should be renewed or replaced.

2.2.1.2 Unit Specifications

1. The average flow rate from the unit is 1.2 cfm (34 lpm).

2. The air is dried to a dewpoint of -100°F.

3. Capacity for water vapor up to 100 grams.

4. Power – 115 VAC/60 Hz, 0.35 Amps
   230 VAC/50 Hz, 0.18 Amps

5. Desiccant Column is safe for working pressures up to 100 psig.

6. Contents: 2½ lbs. of #8 mesh $CASO_4$ Indicating Desiccant.

7. All connections are made using ¼" OD tubing. Hose barb adapters may be provided for using ¼" ID tubing as an alternative.

8. Plastic cap is fitted with "O-Ring" gasket.

9. Desiccant coil spring is made of cadmium plated steel.

The system delivers air dried to a dew point of -100°F. At room temperature, the system will lower the humidity in the Model 532 Chamber from 50% RH to 12% RH in about 2 hours.

2.2.1.3 Desiccant Dehumidification System Set-Up

1. Place the desiccant column somewhere near the chamber. Next to or on top of the chamber are good locations.

2. Cut 2 pieces of the ¼" OD tubing long enough to connect the desiccant column to the 'Side Interface Panel' of the Chamber.

3. Connect one piece of the tubing between the fitting labeled "DEHUMIDIFY OUT", on the 'Side Interface Panel' of the chamber, and the fitting labeled "IN" on the desiccant column.

   To connect the tubing: Push the tube into the fitting orifice as far as possible. The tube will lock into place automatically. To release the tube, push in on the collar of the fitting and gently pull out the tube.

4. Connect the second piece of tubing between the fitting labeled "OUT" on the desiccant column and the fitting labeled "DEHUMIDIFY IN" on the 'Side Interface Panel' of the chamber.

5. Cover the chamber vent with the supplied 1" green Caplug.

6. The chamber vent, inside of the chamber, is the 1" orifice on the right wall (the green plug should be placed in the orifice). The vent passes through to the outside right wall, the 1" barb on the outside should remain open.

7. Set the Model 532 Humidity Controller set-point to a value below the ambient humidity (refer to Model 532 Microprocessor Humidity Controller Operation).

8. Turn on the "HUMIDITY STANDBY" switch on the model 532 Front Panel.

   This will not automatically turn on the Dehumidification System. Turning on the "HUMIDITY STANDBY" switch only makes the Dehumidification System *available* to the Microprocessor Controller.

   When the microprocessor tells Dehumidification System to activate, the large red LED on the lower left side of the microprocessor will light. The internal air pump will begin moving. The pump will draw moist air out of the Chamber and force it through the desiccant column. The dried air will then be returned to the chamber.

9. The microprocessor will determine the amount of drying needed to maintain the desired set-point.

If less than the full drying capacity of the Desiccant Dehumidification System is needed, the controller will provide pulses of power to the unit to limit the quantity of dried air coming into the chamber. The pump will be turned on and off cyclically to obtain an average input of dried air less than the full capacity of the Dehumidification System.

To achieve a smooth, even dehumidification process the Humidity Microprocessor Cycle Time 2 (CYC.2) should be set to 1.0 second. Longer cycle times will create longer "gaps" between dried air pulses. **DO NOT SET THE CYCLE TIME LESS THAN 1.0 SECOND.** Shorter pulses may damage the Model 571 and the Model 524.

2.2.2 Self-Regenerating Dehumidification System

The Model 578 Self-Regenerating Dehumidification System is capable of drying the Model 532 Chamber from 50% RH to 12% RH in less than 3 hours, at room temperature.

2.2.2.1 Description

The Model 578 Self-Regenerating Dehumidification System requires 50-100 psi of air pressure at 2.6 cfm to operate. For normal, short term usage an internal 50 psi pump may be supplied. Since air must be provided continuously either a separate air compressor or house air should be used for long-term dehumidification applications to ensure long-term air delivery reliability.

The basic Self-Regenerating Dehumidification System consists of a high-pressure air pump (50 psi., minimum), a dual column self-regenerating desiccant dryer utilizing molecular sieve desiccant, and a 3-way control valve. The high-pressure pump and dual column dryer operate continuously to assure a constant supply of dried air on demand. The 3-way control valve controls the flow of dried air into the chamber workspace.

The air pump, dryer and valve are mounted inside the control section of the chamber. The air intake to the pump is muffled and is very quiet.

The pump draws in ambient air and compresses it to 50 psi. The compressed air is passed on to the dual column dryer where it is forced through one of the desiccant columns. The desiccant removes the moisture and dries the air down to a dew point of -40 °F, minimum.

The dried air is then split in two directions: Most of the dried air is sent to the output. A small portion of the dried air is diverted from the main flow and directed into the second column to regenerate the desiccant in the second column. The flow into the second column is in the opposite direction from

the flow in the first column. The dried air, under high pressure, forces out any moisture in the second column through the dryer vent (located internally).

Every 30 seconds, the process reverses and the second column will perform the air drying while the first column is regenerating. The flip-flop process continues as long as the system is in use.

The dried air not used for regeneration is sent to the dryer output. The output of the dryer is attached to the 3-way control valve. When dry air is needed in the chamber, the valve is energized and opens to allow dry air to flow into the workspace. When the valve is not energized, the dry air is vented.

2.2.2.2 Unit Specifications

1. The average flow rate from the unit is 0.26 cfm (7.3 lpm).

2. The air will be dried to a minimum dew point of -40°F with a saturated input at 90°F.

3. Power – 115 VAC/60 Hz, 4.30Amps
   230 VAC/50 Hz, 2.15Amps

4. Working Pressure is 50-60 psig. Dryer unit may be used with compressed air systems up to 120 psig.

5. Dual column dryer uses a molecular sieve desiccant.

2.2.2.3 Self-Regenerating Dehumidification System Set-Up

The standard self-regenerating dehumidification system is contained entirely within the chamber control section.

If house air is used, a quick disconnect air fitting will be installed on the Chamber rear panel.

2.2.2.4 Operation

To operate the self-regenerating system proceed as follows:

1. Open the Chamber Vent by removing the supplied 1” green Caplug.

2. The Chamber Vent, inside of the chamber, is the 1” orifice on the right wall (the green plug should be removed from the orifice). The vent

passes through to the outside right wall, the 1” barb on the outside should also remain open.

The Model 578 is a positive pressure system. Without adequate ventilation, the system will pressurize the chamber. Pressurizing the chamber is not recommended and may cause damage.

3. Set the Microprocessor Humidity Controller set-point to a value below the ambient humidity.

4. Turn on the “HUMIDITY STANDBY” switch on the front of the Model 532.

This will do two things:

a. It will activate the high-pressure pump and the dual column dryer. They will begin producing dry air as soon as the “HUMIDITY STANDBY” switch is turned on. However, no dry air will be allowed into the chamber workspace until the 3-way control valve is energized.

b. Turning on the “HUMIDITY STANDBY” switch makes the 3-way control valve *available* to the Microprocessor Controller.

When the microprocessor tells the control valve to energize, the large red LED in the lower left corner of the Humidity Microprocessor will light. The valve will open and dried air will flow into the chamber workspace.

5. The microprocessor will determine the amount of drying needed to maintain the desired set point.

If less than the full drying capacity of the Self-Regenerating Dehumidification System is needed, the controller will provide pulses of power to the Control Valve to limit the quantity of dried air coming into the chamber. The controller will open and close the Control Valve cyclically to obtain an average input of dried air less than the full capacity of the system.

To achieve a smooth, even dehumidification process, the Humidity Microprocessor Cycle Time 2 (CYC.2) should be set to a low value. However, a short cycle time will prematurely wear out the control valve. As a compromise, CYC.2 should be set to 5.0 seconds. Shorter cycle times will afford better low humidity control at the desired set-point, but at the risk of accelerating valve wear.

3.0 MICROPROCESSOR HUMIDITY CONTROLLER

3.1 System Description

The Model 532 Microprocessor Humidity Controller, with the Model 554 temperature compensated RH Sensor is capable of controlling the relative humidity in the Model 532 Chamber by supplying a proportionally controlled power output to the Humidification System and/or Dehumidification System.

The Controller provides low voltage (6 VDC) control signals to the HEAT and COOL solid-state relays, located on the 'RELAY PC Board'. When the low voltage signal is applied to the relay 'Input', the 'Output' of the relay 'closes' and allows AC Power to flow to the connected device.

When the 'RH STANDBY' switch on the Front Panel is in the 'OFF' ('0') position, AC power is manually disconnected from the control relays and no humidification or dehumidification may take place until the switch is placed in the 'ON' ('I') position.

All devices in the Model 532 are connected through screw terminals on the 'Relay PC Board'. All relays and screw terminals are labeled.

3.2 Microprocessor Humidity Controller Operation

3.2.1 Set-Point Adjust

1. Press and hold the "∗" button. The letters "rh" will appear, followed by the current set-point value. The set point value is displayed on the lower half of the microprocessor display.

2. To adjust the set point higher, press the "▲" button. To adjust the set point lower, press the "▼" button.

3. Release the "∗" button.

3.2.2 Humidification System

The Humidifier is built into the Model 532 Chamber, located inside the Chamber Control Cavity. To access the Humidifier, remove the 'Side Access Panel'.

To operate the Model 532 Humidification System:

1. Attach the ¼" OD Water Tube to the fitting labeled 'WATER IN' on the 'Side Interface Panel'. The water source may be a water tank or a pressurized water line (up to 100p.s.i.).

2. Adjust the RH set point to a value above the ambient RH conditions.

3. Turn on the "RH STANDBY" switch on the Model 532 Front Panel.

   This will not automatically apply power to the Humidifier. Turning on the "RH STANDBY" switch only makes the Humidifier *available* to the Microprocessor Controller.

   When the microprocessor activates the Humidifer, the small green LED in the upper left corner of the RH Microprocessor display will illuminate. The Humidifier misting unit and air pump will activate and begin pushing a fine water mist into the chamber.

4. The Microprocessor will determine the amount of humidification needed to maintain the desired set point in the Chamber.

   If less than the full output capacity of the Humidifier is needed, the Controller will provide pulses of power to the unit to limit the output. The Humidifier will be turned on and off cyclically to obtain an average humidity output lower than the full capacity of the Humidifier, appropriate to maintain the desired set point in the enclosure.

   For best results, the Cycle Time (CyC.t) should be set as short as possible. See the Humidifier Manufacturer's Instructions for minimum cycle time recommendations.

   The minimum cycle time for the Humidification System is 1.0 second.

3.2.3 Dehumidification System

The Dehumidification System air pump is located inside the Chamber Control Cavity. The Desiccant column is attached externally through the fittings labeled 'AIR IN' and 'AIR OUT' on the 'SIDE INTERFACE PANEL'.

To operate the Model 532 Dehumidification System:

1. Read the operating instructions for the Dehumidification System being used.

2. Adjust the set-point to a value below the ambient RH conditions.

3. Turn on the “RH STANDBY” switch on the front of the Model 532 Control Panel.

   This will not automatically apply power to the dehumidification system. Turning on the “RH STANDBY” switch only makes the dehumidification system *available* to the Microprocessor Controller.

   When the microprocessor activates the outlet, the large red LED in the lower left corner of the RH Microprocessor display will illuminate.

4. The Microprocessor will determine the amount of dehumidification needed to maintain the desired set-point in the enclosure.

   If less than the full output capacity of the Dehumidification System is needed, the Controller will provide pulses of power to the unit to limit the output. The Dehumidification System will be turned on and off cyclically to obtain an average output lower than the full capacity of the Dehumidification System, appropriate to maintain the desired set-point in the Chamber.

   For best results, the Cycle Time 2 (CyC.2) should be set as short as possible. See the Dehumidification System instructions for cycle time recommendations.

   Desiccant/Pump Dehumidification System minimum cycle time is 1.0 second.

   Self Regenerating Dehumidification System minimum cycle time is 5.0 seconds.

3.3 Programming the Microprocessor Controller

3.3.1 Accessing the Programming Menu

1. To access the Controller Program Menu, press the “▲” and “▼” buttons simultaneously for three (3) seconds. The controller will enter the Menu on Level 1 in the “tunE” function. (If using the CalComm Computer Program, see the “CALCOMM” section of the Manual).

2. To scroll to different parameters within a Level, press the “▲” button to scroll right and the “▼” button to scroll left.

3. To change a parameter or change Levels, press and hold the “∗” button. Press the “▲” or “▼” buttons to change the parameter.

4. All factory-programmed values listed here are optimized for use with the Dehumidification and Ultrasonic Humidification Systems. Other systems may require different settings.
   If the Model 532 Chamber has different systems, the information programmed into the Controller will be different. Information on the specific program should be provided separately, if not, contact ETS.

5. To exit the menu press and hold "▲ ▼" for three seconds.

3.3.2 LEVL C (Level C)

Level C is only visible when the unit is fitted with the COMMS option (RS 485 computer interface card). Level C is responsible for the communication protocol for the unit when interfacing with a PC. The values in Level C must match the values on the computer screen to establish communication.

Addr – (2) Instrument Communication Address. This address may be changed to any number suitable to the user.

bAud – (9600) The baud rate should be set as high as possible.

dAtA – (18n1) *Do Not Change.* The data format should not change.

DbuG – (off) *Do Not Change.* Debugging is an advanced feature that will not be covered in this manual.

3.3.3 LEVL 1 (Level 1)

Level 1 is the programming level. The Proportional, Integral, and Derivative controls are adjusted here. The combination of PID values is virtually limitless. This allows the controller to be used in a wide variety of applications. However, this flexibility can also lead to confusion when programming the controller in the Model 532's limited mode of operation.

To avoid confusion, this section will discuss which parameters may be adjusted, which parameters should not be adjusted.

All Parameters are programmed at the ETS Factory to match the Operating Systems shipped with the Chamber. The programmed values will control the Chamber within specifications. For better control, the user may adjust the values. The values listed here are for standard chambers only. Non-standard units may have different values than those listed here.

The following settings are approximations that will allow any user to achieve good RH control at any set point (approximately ±2.0 %, depending on the specific conditions). However, as the user becomes familiar with each parameter

and it's effect on RH control, the user will be able to program the unit to control within ever tightening tolerances. Control of ±0.2% RH, or better, is achievable with this system.

tunE – (oFF) The Autotune function may be used to help determine the optimum operating conditions for a given set of operating systems and chamber volume. The Autotune operates using the Humidifier only. The Dehumidification System will be disabled during an auto tune. The 'Tune At Setpoint' (**At.SP)** option is recommended with the Model 532 Chamber.

Occasionally, the message 'Tune Fail' will appear in the microprocessor display after the unit attempts an autotune. The user will need to clear the 'Tune Fail' message and attempt another autotune. To clear the message, turn the Model 532 Main Power Switch 'Off' and then 'On' again. When power is re-applied, the message will no longer be displayed.

A 'Tune Fail' may be caused by many variables. However, performing multiple 'Tune' attempts will generally result in a successful 'Tune'.

bAnd – (10.0) Proportional Band for Humidifier.

int.t – (0.5) Integral Time in minutes.

The integral time is responsible for calculating how much output should be coming from the Heating and Cooling Systems to maintain the desired conditions.

der.t – (2.0) Derivative Time in seconds.

The derivative time, in combination with the **dAC**, is responsible for keeping the environment moving toward the set-point, following a pre-determined curve (set by the **dAC** in combination with the **bAnd**). The curve is followed to help avoid set-point overshoots.

Shortening the derivative time will cause the controller to recover slowly from disturbances. Lengthening the derivative time may cause oscillations.

dAC – (1.0) *Recommended.* The **D**erivative **A**pproach **C**ontrol determines how quickly the unit will reach the set- point, without overshooting. The **dAC** creates a gently sloping, exponential curve that the system must follow when approaching the set-point. The smaller the number, the quicker the unit will allow the set-point to be reached. The **dAC** multiplied by the band determines where the beginning of the approach curve will be located. A larger **dAC** setting will cause the beginning of the **dAC** curve to be further away from the set point. The larger setting will control overshoots better, but will cause responses to disturbances to be slower.

CYC.t – (1.0) *Recommended.* Cycle time means how often the unit can potentially be turned on and then off in succession. The Humidifier may be safely turned on and off once a second. **DO NOT DECREASE CYCLE TIME BELOW 1.0 SECOND when operating this system.**

The shorter the cycle time, the greater the degree of precision that may be achieved with the Controller.

If using any other humidification system, determine the minimum cycle time at which the unit can safely operate (consult the manufacturer's instructions for the unit).

oFSt – (0.0) *Do Not Change.* The Offset / Manual Reset control is only usable when the integral time (**int.t**) is turned off. Since the integral time is being used, the offset control may be ignored.

SP.LK – (oFF) Locks the set-point preventing unauthorized adjustment.

SP2 OPERATING PARAMETERS

The SP2 parameters can be configured in a variety of ways. In the Model 532 Humidity Controller, the SP2 parameters are used to tailor the Dehumidification System output for best RH control.

SET.2 – (0.0) Setpoint 2 allows the user to create a setpoint offset for the Dehumidification System. It is generally not used for the Desiccant Dehumidification System.

bnd.2 – (10.0) *Recommended.* Band 2 should generally be equal to **bAnd**. The heating and cooling system will work within the same proportional band, helping to prevent overlap in the system's operation. (i.e., the dehumidification system will have a tendency to stay 'off' when only humidification is needed and vice versa).

CyC.2 – (1.0) *Recommended.* Cycle time means how often the unit can potentially be turned on and then off in succession. The Dehumidifier may be safely turned on and off once a second. **DO NOT DECREASE THE CYCLE TIME BELOW 1.0 SECOND when operating this system.**

ETS Model 578 Self-Regenerating Dehumidification System solenoid valve **CyC.2** may be set as low as 0.5 second, but short times will accelerate valve wear. The recommended Cycle Time is 5.0 seconds. To extend the life of the internal solenoid valve, the cycle time may be increased but control may suffer.

If using any other dehumidification system, determine the minimum cycle time at which the unit can safely operate (consult the manufacturer's instructions for the unit).

NOTE: All functions in Level 2, 3, & 4 are "locked" and may not be altered unless "unlocked". See section 2.4.5 (Level 4).

3.3.4 LEVL 2 (Level 2)

Level 2 is the controller configuration level. The controller is capable of being configured in an unlimited number of ways. However, the parameters needed to control the Temperature Operating Systems, with the ETS Model 554 Humidity Sensor, are programmed and locked.

MANUAL CONTROL MODES

SP1.P – Read **SP1** output percentage power. (Read only).

hAnd – (off) SP1 Manual percentage power control.

For manual control, should a sensor fail, record typical **SP1.P** values beforehand.

PL.1 – (100) Set **SP1** power limit percentage, 100 to 0% of the duty cycle.

Limits maximum SP1 (humidifier) output power during warm-up and in proportional band.

PL.2 – (100) Set SP2 power limit percentage, 100 to 0% of the duty cycle.

Limits maximum SP2 (dehumidifier) output power during warm-up and in proportional band.

SP2 OPERATING MODES

SP2.A – (Cool) Main SP2 operating mode.

Must remain in "Cool" mode to properly operate the Dehumidification System.

SP2.b – (nonE) Subsidary SP2 mode: latch/sequence. Non-linear dehumidify proportional band.

INPUT SELECTION AND RANGING

The following settings are used to calibrate the input of the unit for use with the ETS Model 554 RH Sensor.

diSP – (0.1) Select display resolution. With 'Linear Input' selected (**Lin)**, **deCP** in Level A supercedes this setting.

hi.SC – (100.0) Adjusts the maximum allowed value for the setpoint.
Lo.SC – (0.0) Adjusts the minimum allowed value for the setpoint.

inPt – (Lin) Selects Linear Input Voltage setting for the ETS Model 554 Humidity Sensor. (0-5 VDC max.)

unit – (rh) Selects process units. The process units can be changed independent of the calibration settings. In other words, changing the setting from rh to any other units will not affect the calibration settings, it will only change the units displayed.

3.3.5 LEVL 3 (Level 3)

Level 3 is the output configuration level. There are also features for calibration adjustment and performance data reading.

OUTPUT CONFIGURATION

SP1.d – (SSd1) *Do not change.* Assigns humidification control to the appropriate output.

SP2.d – (SSd2) *Do not change.* Assigns dehumidification control to the appropriate output.

SAFETY SETTINGS

Burn – (uP.SC) *Do Not Change.* Sensor burnout/break protection. This safety setting is not applicable for RH control, it is meant as a high temperature / low temperature cutoff for heating applications to protect the surroundings from damage due to sensor failure.

rEv.d – (1r.2d) *Do Not Change.* Select output modes: Direct/Reverse. Select Reverse for Humidification and Direct for Dehumidification.

rEv.l – (1n.2n) *Do Not Change.* Selects Microprocessor LED display model. Normal mode is selected for each LED. In normal mode, the lower left (red) LED will light when the microprocessor calls for the Dehumidification System and the upper left (green) LED will light when the microprocessor calls for the Humidification System.

SPAn – (0.0) *SPAn* adjusts the range error over the 0-100% RH scale.

An increase of 1.0 will adjust a 99% RH reading to 100% RH without affecting lower RH readings.

ZEro – (0.0) *ZEro* Increases or decreases the Process Display reading linearly over the entire 0-100% RH scale.

An increase of 1.0 will raise all RH values 1.0%.

The SPAn and ZEro settings can be used to recalibrate the entire system in the field without recalibrating the Model 554 Humidity Sensor separately. Reference points of 12.0% (ZEro) and 75.5% (SPAn) RH are recommended when calibrating the System. Humidity Sensor calibration should be performed at 23.0°C (73.3°F) only.

PERFORMANCE DATA

ChEK – (oFF) Select control accuracy monitor.

rEAD – (Var) Read control accuracy monitor.

TECH – (Ct A) Read Autotune cycle data. Using the Autotune function is not recommended with the ETS Model 524 RH Controller.

VEr – software version

rSEt – (none) *Do Not Change.* If the unit is reset, all programmed information will be lost. Each parameter must be re-entered manually.

3.3.6 LEVL 4 (Level 4)

Level 4 is a "hidden" level. This allows "locked" functions to be inaccessible to any unauthorized user. Access to Level 4 is gained through "VEr" in Level 3. Press and hold "▲" and "▼" for ten seconds.

Enter Level 4 at "LoCK", release "▲" and "▼" together.

LoCK – (LEV.2) Select from three lock options.

LEV.3 – Locks Level 3 and 4 only – Technical Functions.

LEV.2 – Locks Levels 2, 3 and 4 only – Configuration and Technical Functions.

ALL – Locks all functions (unrestricted LEVL, VEr, dAtA, SP.LK)
Note: Locked functions and options may be read.

ProG – (Auto) Program mode auto-exit switch. Auto-exit returns display to normal if 60 seconds of key inactivity, select **StAy** to disable.

no.AL – (oFF) Disable SP2 alarm annunciator -AL-. Select **on** to disable -AL-.

diS.S – (dir) *Do Not Change.* Display sensitivity.
DEr.S – (0.1) *Do Not Change.* Derivative sensitivity.

3.3.7 LEVL A (Level A)

Level A contains the Linear Input Scaling Settings and the SP3 Settings. The SP3 operating mode is not used in the ETS Model 585.

LINEAR SCALING AND INPUT SETTINGS

An.hi – (100.0) Sets process display high scale value corresponding to the **hi.in** setting.

An.Lo – (0.0) Sets the process display low scale value corresponding to the **Lo.in** setting.

hi.in – (10.0) *Sensor Input Maximum (mV)*. The 9500P Controller uses a resistive divider of 100 to adjust the input voltage across the desired mV range. A 1VDC Maximum Sensor Output = 10.0mV **hi.in** setting.

Lo.in – (0.0) *Sensor Input Minimum (mV)*.

dECP – (000.0) Sets the resolution for the Linear Input Settings. When the 'Linear Input' option has been selected, this setting over-rides the scale resolution setting in **di.SP** in level 2.

SP3 SETTINGS

The Standard ETS Model 532 does not use the SP3 Operating Mode.

SP3 MODES

SP3.A – (nonE) Main SP3 operating Mode.

SP3.b – (nonE) Subsidiary SP3 operating Mode.

SP3 ADJUSTMENTS

SEt.3 – (0) SP3 setpoint adjustment.
HYS.3 – (20) Set SP3 hysteresis (0.1 to 100% of **hi.SC**).

SP3 SAFETY SETTINGS

brn.3 – (uPSC) Sensor burn-out/break protection. Select Upscale or Downscale.
rEV.3 – (3d) Reverse SP3 output mode. Select direct or reverse operation.

3.4 CALCOMMS - Computer Interface

CALCOMMS is a graphic Windows™ based software package designed for PC supervision of CAL 3300 Controllers. It offers the capability of remote adjustment, instrument configuration, cloning, saving and retrieving instrument settings to files together with logging and charting in real time. Communications uses the MODBUS® protocol via a fully isolated RS485 link.

To gain full benefit of CALCOMMS software, it is recommended that the PC be fitted with a Pentium processor (although a 486 will work) and is running WINDOWS 95 or Windows NT programs. A minimum of 16 MB RAM is recommended to run the program (slightly less is OK), together with enough free hard disc space to meet logging requirements.

Because the controllers are "stand alone" they do not need PC supervision for their normal function, and will continue to control the process unaffected by failure of any part of the communications loop.

When used with the Model 532 Chamber, the Temperature & Humidity Microprocessor COMM PORTS are wired together, in parallel. One RS-485 COMM PORT, common to both Controllers, is located on the 'Side Interface Panel' of the Model 532 Chamber.

3.4.1 Set-up and Installation

(See Pp. 2 & 3 in the CALCOMMS Manual)

3.4.1.1 RS 485 COMM PORT

RS-485 is a half duplex serial communications link and is the standard most commonly used for industrial applications due to it's high noise immunity and multi-drop capability. It enables a PC to communicate with up to 32 instruments over distances of over 1200 meters, and requires the addition of an RS-485 interface card, or a separate RS-232/485 converter.

The RS-485 COMM PORT is a 9-pin subminiature-D female connector located on the 'Side Interface Panel'..

3.4.1.2 RS-232/485 Converter

The RS-232/485 Converter will not be needed if the computer is outfitted with an RS-485 interface card.

The converter is a 9-pin / 9-pin in-line style connector. The converter is gray and bears the label ‘ RS-232 TO RS-485 / Model 485SDD9R’.

3.4.1.3 Connections

1. Connect the supplied 9-pin male/female sub-D cable to the RS-485 COMM PORT on the ‘Side Interface Panel’.

2. Connect the other end of the cable to the ‘RS485’ side of the RS-232/485 converter.

3. Connect the ‘RS232’ side of the converter into the appropriate Comm Port on the PC.

3.4.1.4 Software Installation

Software installation instructions can be found on pp. 9-11 in the CALCOMMS Manual.

The CALCOMMS Manual is separate from the CAL 9500 Users Manual, it is the manual with the color cover.

3.4.2 Operation

After installing the computer program and making the appropriate wiring connections to a PC, turn to P. 11 in the CALCOMMS Manual. This section is titled GETTING STARTED. Follow the directions to begin operating the program.

3.4.2.1 MODBUS Addresses

The MODBUS address is found in Level C. (See Section 2.4.1)

HUMIDITY controller address is set to **2** at the ETS factory.

3.4.2.2 Open Communications

Instructions for opening communication are found on p.13 of the CALCOMMS manual.

3.4.3 Logging and Charting

Instructions for operating the Logging and Charting functions of the CALCOMMS program begin on P. 21 of the CALCOMMS Manual.

Section C

Temperature

4.0 HEATING OPERATING SYSTEMS

4.1 Heating System

The Model 532 Chamber contains two (2) 250 Watt Electric Heaters (500 Watts total). The Heater is an integral part of the chamber, located inside the Chamber workspace. Since the Heater is already installed, there is no additional set-up required.

After turning "ON" the "TEMP STANDBY" switch, the Microprocessor Temperature Controller governs the operation of the Heating System.

1. The Microprocessor will determine the amount of heat needed to maintain the desired set-point. Power will be applied to the heater as a series of time proportioned pulses. **See Section 2.2 – Microprocessor Temperature Controller Operation** for details.

2. The Electric Heating Element and Indicator Light are located on the Fan Panel (the Heater is hidden from view). The Fan Panel is the white metal panel inside the Chamber workspace, on the rear wall.

3. The Heater Indicator Light will illuminate to indicate when power is being applied to the Heater. (The Microprocessor LED's will illuminate at the same time.)

A thermal safety switch (also on the fan panel) is connected in series with the heater. Power to the heater will be cut off if the temperature within the chamber exceeds 135 °F. (The Acrylic Chamber will begin to melt at 150 °F)

4.2 Cooling Systems

The Model 532 Chamber includes the *ETS Model 563 Liquid Carbon Dioxide Cooling System* as a standard feature. Other cooling options include:

ETS Model 573-800 800 BTU/hr Thermoelectric Cooling System
ETS Model 573-1500 1500 BTU/hr Thermoelectric Cooling System
ETS Model 575 Variable Load Refrigerated Cooling System

The implementation and operation of each of these systems is described in detail below.

4.2.1 Model 563 Liquid CO_2 Cooling System

The Liquid CO_2 Cooling System is standard and is already installed onto the Model 532 Chamber. The Solenoid Control Valve is wired into the 'Relay PC Board', which is controlled by the Microprocessor Temperature Controller. All the user needs to do is connect the Transfer Hose to the appropriate liquid CO_2 cylinder with dip tube. (**NOTE: CO_2 gas will not work**)

The ETS Model 563 Gas Cooling System enables the temperature within the Model 532 Chamber to be reduced below ambient.

1. The System utilizes Liquid CO_2* (Carbon Dioxide) as the cooling medium.

   CO_2 is user supplied. 50lb. CO_2 tanks are readily available from local bottled gas companies.

   ***Liquid CO_2* with a *DIP Tube* must be specified. The DIP Tube allows liquid to be siphoned from the bottom of the tank. CO_2 Gas (without DIP Tube) will not provide cooling with this system.**

2. The CO_2 is allowed to evaporate (expand from a liquid to a gas) within the chamber.

3. The phase change of the CO_2 produces a large cooling effect. (The temperature *directly in front of* the nozzle will be near -100 °F.)

4. The Microprocessor Temperature Controller will monitor the chamber temperature and proportionally control the Solenoid Valve to provide the appropriate amount of cooling to maintain the desired set point.

4.2.1.1 Cooling System Accessories

1. Liquid CO_2 Transfer Hose
   a. 4' long with Braided Stainless Steel Safety Shield.
   b. Brass High Pressure Fitting for mating to Liquid CO_2 tank.
   c. Brass Quick Disconnect (female) for mating to Valve Input.

2. Cooling Nozzle Cleaning Tool

4.2.1.2 Liquid CO_2 Tank Connections

1. Secure the CO_2 cylinder to a wall using an approved securing belt or clamp.

2. Failure to secure the cylinder to a wall or other suitable stationary object may result in serious injury to personnel should CO_2 cylinder fall over.

3. The CO_2 cylinder contains liquid carbon dioxide under extremely high pressure (800-1000 psi). Care must be exercised at all times when working with this cylinder. The manual valve on top of the cylinder should be closed (fully clockwise) when the cooling system is not in use.

4. Although CO_2 is non-toxic, it can cause asphyxiation if not used in areas with adequate ventilation. The Model 532 Chamber is equipped with a Chamber Vent (1" White Hose Barb located in the middle of the Black Panel on the right side of the Chamber). The spent CO_2 gas will escape from the Chamber Vent and dissipate into the room atmosphere. To vent the gas outside of the room or building, connect an appropriate length of 1" ID tubing to the Vent Hose Barb. The open end of the tubing should be exhausted outside the working environment.

5. Connect the Transfer Hose to the CO_2 Tank and Valve.

   A. Connect the Female Quick Disconnect fitting to the Male Quick Disconnect fitting. Pull back on the collar of the female fitting and place it onto the male fitting, release the collar. These fittings should mate to form a leak-free seal.

   B. Connect the other end of the transfer hose (Large Brass Fitting) to the CO_2 Cylinder. Tighten the fitting onto the tank using a wrench.

4.2.1.3 Operation

The user does not have to do anything else to operate the system. Total operation will be under the control of the Microprocessor Temperature Controller.

The Temperature Controller is a PID Microprocessor with a time proportioned AC voltage output. Refer to **Section 5.2**, **Microprocessor Temperature Controller Operation**, for a full description of operation.

The user should periodically monitor the status of the CO_2 cylinder. The user should also periodically monitor the cooling performance of the system to check for an exhausted CO_2 tank.

4.2.1.4 Changing CO_2 Tank

Before disconnecting any fittings or attempting to change the tank, all of the CO_2 must be vented from the system. Venting the CO_2 will relieve any

pressure in the system. **Failure to bleed the system may result in injury!!** To bleed the pressure from the line:

1. Turn “ON” the Cooling Valve. Turn on the “COOL” switch on the front panel of Temperature Controller and adjust the set-point to the lowest possible setting. Wait for the Cool Valve to turn “ON”.

2. While the Cool Valve is open, turn off the manual valve on top of the CO_2 tank. This will shut off the CO_2 supply to the system.

   The CO_2 will bleed out of the Cooling Nozzle, into the chamber. When all the CO_2 is out of the system, the flow of gas from the Nozzle will stop.

3. Using a wrench, disconnect the Transfer Hose (loosen the large brass fitting) from the CO_2 tank.

4. Replace the empty tank with a fresh Liquid CO_2 tank. Then, using a wrench, reconnect the transfer hose.

5. Turn “OFF” the “COOL” switch on the Temperature Controller. This will close the Cool Valve.

6. After the system is turned “OFF”, open the manual valve on top of the CO_2 cylinder.

   The Transfer Hose and Cool Valve will now be pressurized. If any leaks occur, close the manual valve on top of the CO_2 cylinder. Then, tighten any fittings that are leaking. Open the manual valve and recheck for leaks.

4.2.1.5 Specifications and Performance

1. Cooling Capacity:

   The Model 563 CO_2 Gas Cooling System, when used in the ETS Model 532 Chamber with a full 50 lb. CO_2 tank, will provide cooling to at least 32 °F (0 °C). The total CO_2 consumption rate for the system depends upon the temperature that is being maintained.

   The following chart shows the approximate consumption rate for the system at different temperatures, assuming a full 50lb. CO_2 tank and room ambient temperature of 72 °F (23 °C).

Temperature Set-point (°F)	Time (approx.) to empty CO_2 tank.
62 °F (16.7 °C)	6 hours
52 °F (11.1 °C)	3 hours
42 °F (5.6 °C)	2 hours
32 °F (0 °C)	1 hour

NOTE

These consumption rates are for maintaining the shown temperatures. When lowering the temperature from room ambient to the set-point temperature, the consumption rate will be higher. The consumption rate will be as shown once the set-point temperature is reached.

2. To lower the CO_2 consumption rate and extend the operating time per tank, insulation should be added to the chamber. Adding insulation will reduce heat loss and aid in stabilizing the chamber temperature (especially at very low temperatures).

4.2.1.6 Maintenance and Troubleshooting

The Model 563 Liquid CO_2 Cooling System should provide years of trouble free service. Other than changing CO_2 tanks when depleted, very little servicing should be required.

Before performing any service, the pressurized CO_2 must be bled from the system. See section 4.2.1.4.

1. Clearing a clogged Cooling Nozzle.

   Occasionally, the Cooling Nozzle may become clogged due to impurities in the CO_2, small pieces of dirt or small pieces of Teflon sealing tape breaking free and lodging in the nozzle.

   Item #2, the Cooling Nozzle Cleaning Tool is provided to help clear such blockages. If the Nozzle is extremely clogged, it may be necessary to completely remove the Nozzle, clear the orifice, and reinstall it.

2. If the system is not producing a cooling effect after clearing the Nozzle, make sure the CO_2 tank is full and the manual valve is fully open.

3. If the Valve will not fully close when the system is turned “OFF”, a small piece of dirt, etc. may have lodged in the valve seal. The valve may be taken apart to inspect the seal.

4. Remove AC Power from the unit.

5. Remove the Solenoid from the Valve Stem.

6. Using a wrench, carefully unscrew the valve stem from the upper portion of the valve body.

7. The stem contains a plunger with a round, red seal on the top. Make sure the seal is clean and free of debris. Also check the valve internally for obstructions.

8. After cleaning, carefully replace the Valve Stem and Solenoid.

9. For help with any other problems please contact ETS.

4.2.2 Thermoelectric Cooling Systems (Models 573-800 & -1500)

The Model 573 Series of thermoelectric cooling systems utilize the Peltier effect to reduce the temperature of a large heat sink. One or more 110 cfm fans circulate the air within the workspace through the heat sink to continuously reduce the temperature. Very precise temperatures can be maintained with this system by the microprocessor temperature controller. The standard Model 573-800 is capable of removing up to 800 BTU/hr (240 Watts/hr) from the Chamber.

The Model 573-1500 is capable of removing up to 1500 BTU/hr (450 Watts) from the Chamber.

4.2.2.1 Thermoelectric Cooling Systems Set-Up

1. The Model 573-800 & 1500 Thermoelectric Cooling Systems operate in the same manner. The Model 573-800 uses an external DC Power Supply (mounted in the Chamber Control Cavity). The Model 573-1500 has an internal DC Power Supply. While the type of Power Supply and location of the Supply does not affect operation, it is noted for maintenance purposes.

2. The Thermoelectric System is an integral part of the Chamber, protruding through the rear wall. The cold side of the unit is located behind the fan panel. The Thermoelectric Cooler is shipped separately and must be installed onto the rear wall of the Chamber by the user.

3. The Thermoelectric Cooler is a solid state heat pump. It is virtually maintenance free, with no filters to change. The only moving parts are the fans. As air inside the chamber is drawn through the interior heat sink by the internal thermoelectric fan (this fan is separate and different form the chamber circulation fans), heat is removed from the air and conducted through the thermoelectric modules to the exterior heat sink. The heat is removed from the exterior heat sink and dissipated into the

atmosphere by a pair of external fans. **DO NOT BLOCK AIRFLOW TO THE REAR OF THE UNIT.** The hot air must be allowed to dissipate.

Increased hot side temperature = Decreased cooling effect.

4.2.2.2 Installation

The Model 532 Chamber is shipped with mounting studs already installed. Place the supplied gasket over the studs then fit the cooling to the rear wall. Tighten the supplied nuts sufficiently to provide even compression of the gasket.

However, before installing the unit onto the chamber the power wires must first be connected to the circulation fan(s) and Thermoelectric Modules. The ORANGE (Line or +VDC), WHITE/ORANGE (Neutral or –VDC) and GREEN (Ground) wires are for the Thermoelectric Module power. The Circulation Fan wires are BLUE (Line) and YELLOW/RED (Neutral).

All of the wires are connected by slipping the male/female connectors from the Cooler onto the respective female/male connectors inside the chamber. All of the wires should be tagged and marked to indicate the appropriate connections. After connecting all of the wires, the Cooler may be placed onto the studs and secured to the chamber using the provided nuts and washers.

4.2.2.3 Operation

1. The Thermoelectric cooler operation is divided into two parts:

    7 a. The 115 VAC internal thermoelectric circulation fan.

    b. The Power Supply that provides power to the thermoelectric modules and the external 24 VDC fans.

2 Turn on the “TEMP STANDBY” switch on the front of the Model 523 Controller. This will allow the 24 VDC Power Supply to become *available to* the Temperature Microprocessor Controller (in both the Model 573-888 & Model 573-1500).

3 Adjust the Temperature Microprocessor Controller set point to a value below the ambient temperature (see Controller Operation). When the Microprocessor determines that cooling is needed, the external fans will begin moving, the internal heat sink will begin to cool and the external heat sink will begin to warm.

4 The Microprocessor will allow the Thermoelectric Module should be operated in *on/off mode only.* Therefore, **CYC.2** (*See Section 2.4.2 – SP2 Operating Parameters*) will be set to 'On/Off'. **Bnd.2** (*See Section 2.4.2 – SP2 Operating Parameters*) sets the range in which the TE Module will operate. It will usually be set to a value of 2.0 °C. If the actual temperature differs from the setpoint temperature by more than 2.0°C, then the microprocessor will turn on the TE Module to cool. Once turned on, the TE cooler will run at maximum output. The heaters will receive pulses of power to precisely regulate the temperature of the chamber.

5 The 115 VAC internal thermoelectric circulation fans are operated in tandem with the main circulation fans. The Fan Speed Control, located on the front panel, operates all of the internal circulation fans.

6 **See Section 2.3**, Microprocessor Temperature Controller Programming.

4.2.2.4 Specifications and Performance

All cooling capacity figures are based on a room ambient temperature of 73 ºF (23ºC).

All figures are expressed as a DT. DT expresses the difference in temperature from room ambient (73ºF).

Example: 73ºF - 63ºF = DT of 10ºF

1. The Model 573-800 Thermoelectric Cooler will remove up to 800 BTU/hr (240 Watts/hr) from the Model 532 Chamber.

   In a *non-insulated* Model 532 Chamber (standard chamber): ΔT = 10°F (5.5 °C).

   In a Model 532 Chamber, using appropriate *insulation*, the ΔT may be increased an additional 10-15 °F (5.5-8.3 °C), depending on the thickness and quality of the insulation.

2. The Model 573-1500 Thermoelectric Cooler will remove up to 1500 BTU/hr (450 Watts/hr) from the Model 532 Chamber.

   In a *non-insulated* Model 532 Chamber (standard chamber):
   ΔT = 18°F (10°C)

   In a Model 532 Chamber, using appropriate *insulation*, the ΔT may be increased an additional 10-15 °F (5.5-8.3 °C), depending on the thickness and quality of the insulation.

3. Contact ETS for details about insulating the Model 532 Chamber.

4.2.3 Variable Load Refrigerated Cooling System (Model 575)

The Model 575 utilizes a standard Vapor Compression Cycle to provide up to 1500 BTU/hr (450 Watts/hr) of cooling @ 32 °F (0 °C). The System is operated above freezing at all times to eliminate the defrost cycle, thus enabling a more even temperature to be maintained.

The standard components of the system include a compressor, a condenser, an evaporator plus a TXV expansion valve that measures the temperature of the R-134a refrigerant leaving the evaporator and adjusts the metering of the refrigerant to maintain a more uniform cooling capacity. A Hot Gas Bypass Valve that effectively short circuits the refrigerant path enables the compressor to continue to run even when cooling is not required. This provides both longer compressor life and better temperature stability.

4.3.2.1 Set-Up

The Model 575 is installed onto the Chamber in the same manner as the Model 573-800 Thermoelectric unit. Depending on the application, this system can be configured to not only provide cooling, but also provide dehumidification down to approximately 25% RH.

Refer to the separate instructions that describe custom configurations.

5.0 MICROPROCESSOR TEMPERATURE CONTROLLER

5.1 System Description

The Microprocessor Temperature Controller, with Model 554 RTD Temperature Sensor is capable of controlling the temperature in the Model 532 Chamber by supplying a proportionally controlled power output to the Heating System and/or Cooling System.

The Controller provides low voltage (6 VDC) control signals to the HEAT and COOL solid state relays, located on the ‘RELAY’ PC board. When the low voltage signal is applied to the relay ‘Input’, the ‘Output’ of the relay ‘closes’ and allows AC Power to flow to the connected device.

When the ‘TEMP STANDBY’ switch on the Front Panel is in the ‘OFF’ (‘0’) position, AC power is manually disconnected from the control relays and no heating or cooling may take place until the switch is placed in the ‘ON’ (‘I’) position.

All devices in the Model 532 are connected through screw terminals on the 'Relay PC Board'. All relays and screw terminals are labeled.

5.2 Controller Operation

5.2.1 Set-Point Adjust

1. Press and hold the "∗" button. The letters "°C" or "°F" (depending on set-up) will appear followed by the current set-point value. The set point value is displayed on the lower half of the microprocessor display.

2. To adjust the set point higher, press the "▲" button. To adjust the set point lower, press the "▼" button.

3. Release the "∗" button.

5.2.2 Heating System

To operate the Model 532 Heating System:

1. Adjust the Temperature set-point to a value above the ambient temperature.

2. Turn on the "TEMP STANDBY" switch on the front of the Control Panel.

   This will not automatically apply power to the heaters. Turning on the "TEMP STANDBY" switch only makes the heaters *available* to the Microprocessor Controller.

   When the microprocessor activates the heaters, the small green LED in the upper left corner of the Temperature Microprocessor display will illuminate. The red neon light on the 'Fan Panel' will also illuminate to indicate that the heaters are receiving power.

3. The Microprocessor will determine the amount of heating needed to maintain the desired set point in the enclosure.

   If less than the full output capacity of the Heater is needed, the Controller will provide pulses of power to the unit to limit the output. The heater will be turned on and off cyclically to obtain an average temperature output lower than the full capacity of the heater, appropriate to maintain the desired set point in the Chamber.

   For best results, the Cycle Time (CyC.t) should be set as short as possible. The minimum cycle time for the 500 Watt Heater in the Model 532 Chamber is 1.0 second. Shorter cycle times may damage the Controller.

5.2.3 Cooling System

*Model 563 Liquid Carbon Dioxide Cooling System may be disabled if it is not needed or if not connected to a gas tank. In **LEVEL 2** of the Programming Menu, adjust **SP1.P** from **'Cool'** to **'nonE'.** This will manually disable only the cooling system and prevent the solenoid valve from 'clicking' on and off unnecessarily. The Heating System will be unaffected.*

To operate the Model 532 Cooling System:

1. Adjust the set point to a value below the ambient temperature.

2. Turn on the "TEMP STANDBY" switch on the front of the Control Panel.

   This will not automatically apply power to the cooling system. Turning on the "TEMP STANDBY" switch only makes the cooling system the *available* to Microprocessor Controller.

   When the microprocessor activates the cooling system, the large red LED in the lower left corner of the Temperature Microprocessor display will illuminate.

3. The Microprocessor will determine the amount of cooling needed to maintain the desired set point in the enclosure.

   If less than the full output capacity of the Cooling System is needed, the Controller will provide pulses of power to the unit to limit the output. The cooling system will be turned on and off cyclically to obtain an average output lower than the full capacity of the cooling system, appropriate to maintain the desired set point in the enclosure.

   For best results, the Cycle Time 2 (CyC.2) for the Model 563 Gas Cooling System should be set as short as possible. The Cycle Time for the Thermoelectric Cooling Systems (Models 573-800 & -1500) and the Refrigerated Cooling System (Model 575) must be set to "ON/OFF". To extend the life of these systems, they must be cycled as little as possible. See the Cooling System instructions for cycle time recommendations.

   ETS Model 563 minimum cycle time is 1.0 seconds.
   ETS Model 573 minimum cycle time is 'On/Off'.
   ETS Model 577 minimum cycle time is 'On/Off'.
   ETS Model 575 minimum cycle time is 'On/Off'.

5.3 Programming the Microprocessor Controller

5.3.1 Accessing the Programming Menu

1. To access the Controller Program Menu, press the "▲" and "▼" buttons simultaneously for three (3) seconds. The controller will enter the Menu on Level 1 in the "tunE" function. (If using the CalComm Computer Program, refer to the "CALCOMM" section of the Manual).

2. To scroll to different parameters within a Level, press the "▲" button to scroll right and the "▼" button to scroll left.

3. To change a parameter or change Levels, press and hold the "∗" button. Press the "▲" or "▼" buttons to change the parameter.

4. All factory-programmed values listed here are optimized for use with the ETS Model 563 Liquid Carbon Dioxide Cooling System and the ETS Model 564 500-Watt Heating System. Other systems may require different settings.

   If the Model 532 Chamber has different systems, the information programmed into the Controller will be different. Information on the specific program should be provided separately, if not, contact ETS.

5. To exit the menu press and hold "▲ ▼" for three seconds.

5.3.2 LEVL C (Level C)

Level C is only visible when the Controller is fitted with the COMMS option (RS 485 computer interface card). Level C is responsible for the communication protocol for the unit when interfacing with a PC. The values in Level C must match the values on the computer screen to establish communication.

Addr – (1) Instrument Communication Address. This address may be changed to any number suitable to the user.

bAud – (9600) The baud rate should be set as high as possible.

dAtA – (18n1) *Do Not Change.* The data format should not change.

DbuG – (off) *Do Not Change.* Debugging is an advanced feature that will not be covered in this manual.

5.3.3 LEVL 1 (Level 1)

Level 1 is the programming level. The Proportional, Integral, and Derivative controls are adjusted here. The combination of PID values is virtually limitless. This allows the controller to be used in a wide variety of applications. However, this flexibility can also lead to confusion when programming the controller in the Model 532's limited mode of operation.

To avoid confusion, this section will discuss which parameters may be adjusted, which parameters should not be adjusted.

All Parameters are programmed at the ETS Factory to match the Operating Systems shipped with the Chamber. The programmed values will control the Chamber within specifications. For tighter control, the user may want to adjust the values. The values listed here are for standard chambers only. Non-standard units may have different values than those listed here.

The following settings are approximations that will allow any user to achieve good temperature control at any set-point (approximately ±1.0°C, depending on the specific conditions). However, as the user becomes familiar with each parameter and it's effect on temperature control, the user will be able to program the unit to control within ever tightening tolerances. Control of ±0.2 °C, or better, is achievable with this system.

tunE – (oFF) The Autotune function may be used to help determine the optimum operating conditions for a given set of operating systems and chamber volume. The Autotune operates using the Heater only. The Cooling System will be disabled during an auto tune. The 'Tune At Setpoint' (**At.SP)** option is recommended with the Model 532 Chamber.

Occasionally, the message 'Tune Fail' will appear in the microprocessor display after the unit attempts an autotune. The user will need to clear the 'Tune Fail' message and attempt another autotune. To clear the message, turn the Model 532 Main Power Switch 'Off' and then 'On' again. When power is re-applied, the message will no longer be displayed.

bAnd – (1.0) Proportional Band for the Heaters.

int.t – (4.1) Integral Time in minutes.

The integral time is responsible for calculating how much output should be coming from the Heating and Cooling Systems to maintain the desired conditions.

der.t – (14.0) Derivative Time in seconds.

The derivative time, in combination with the **dAC**, is responsible for keeping the environment moving toward the set-point, following a pre-determined curve (set by the **dAC** in combination with the **bAnd**). The curve is followed to help avoid set-point overshoots.

Shortening the derivative time will cause the controller to recover slowly from disturbances. Lengthening the derivative time may cause oscillations.

dAC – (1.0) *Recommended.* The **D**erivative **A**pproach **C**ontrol determines how quickly the unit will reach the set- point, without overshooting. The **dAC** creates a gently sloping, exponential curve that the system must follow when approaching the set-point. The smaller the number, the quicker the unit will allow the set-point to be reached. The **dAC** multiplied by the band determines where the beginning of the approach curve will be located. A larger **dAC** setting will cause the beginning of the **dAC** curve to be further away from the set point. The larger setting will control overshoots better, but will cause responses to disturbances to be slower.

CYC.t – (1.0) *Recommended.* Cycle time means how often the unit can potentially be turned on and then off in succession. The ETS 500 Watt heater may be safely turned on and off once a second. **DO NOT DECREASE CYCLE TIME BELOW 1.0 SECOND when operating this system.**

The shorter the cycle time, the greater the degree of precision that may be achieved with the controller.

If using any other heating system, determine the minimum cycle time at which the unit can safely operate (slightly shorter cycle times may be used for smaller heaters).

oFSt – (0.0) *Do Not Change.* The Offset / Manual Reset control is only usable when the integral time (**int.t**) is turned off. Since the integral time is being used, the offset control may be ignored.

SP.LK – (oFF) Locks the set-point preventing unauthorized adjustment.

SP2 OPERATING PARAMETERS

The SP2 parameters can be configured in a variety of ways. In the Model 532 Temperature Controller, the SP2 parameters are used to tailor the Cooling System output for best temperature control.

The SP2 parameters are all shown in °C.

SET.2 – (0.0) Setpoint 2 allows the user to create a setpoint offset for the Cooling System. It is generally not used for the Gas Cooling System. When a

Thermoelectric Cooler or Refrigerated cooling system is used, this setting may be increased or decreased to determine the point at which the Cooling System will activate. (These systems are operated in On/Off mode instead of within a proportional band.)

bnd.2 – (2.0) Band 2 should generally be equal to **bAnd**. The heating and cooling system will work within the same proportional band, helping to prevent overlap in the system's operation. (i.e., the cooling system will have a tendency to stay 'off' when only heating is needed and vice versa).

When a Thermoelectric Cooler or Refrigerated cooling system is used, this setting may be increased or decreased to determine the point at which the Cooling System will activate. (These systems are operated in On/Off mode instead of within a proportional band.)

CyC.2 – (3.0) *Recommended.* Cycle time means how often the unit can potentially be turned on and then off in succession. 3.0 SECONDS is the recommended cycle time for the ETS Model 563 cooling system to achieve good control and extended valve life. The ETS Model 563 solenoid valve **CyC.2** may be set as low as 0.5 second, but short times will accelerate valve wear. **DO NOT DECREASE THE CyC.2 BELOW 0.5 SECOND when operating this system.** The cycle time may be increased above 3.0 seconds to extend valve life but control may suffer. If using any other cooling system determine the minimum cycle time at which the unit can safely operate (consult the manufacturer's instructions for the unit).

NOTE: All functions in Level 2, 3, & 4 may be "locked" so that they may not be altered unless "unlocked". See section 4.4.5 (Level 4).

5.3.4 LEVL 2 (Level 2)

Level 2 is the controller configuration level. The controller is capable of being configured in an unlimited number of ways. However, the parameters needed to control the Temperature Operating Systems, with the ETS Model 554 Temperature Sensor, are programmed and locked.

MANUAL CONTROL MODES

SP1.P – Read **SP1** output percentage power. (Read only).

hAnd – (off) SP1 Manual percentage power control.

For manual control, should a sensor fail, record typical **SP1.P** values beforehand.

PL.1 – (100) Set **SP1** power limit percentage, 100 to 0% of the duty cycle.

Limits maximum **SP1** (heater) output power during warm-up and in proportional band.

PL.2 – (100) Set **SP2** power limit percentage, 100 to 0% of the duty cycle.

Limits maximum **SP2** (cooling) output power during warm-up and in proportional band.

SP2 OPERATING MODES

SP2.A – (Cool) Main **SP2** operating mode.

Must remain in "Cool" mode properly to operate the cooling system.

If use of the Model 563 Liquid Carbon Dioxide System is not needed, it is recommended that **SP2.A** be set as **'nonE'**. The output to the cool valve will be disabled and will not 'click' on and off unnecessarily.

SP2.b – (nonE) Subsidiary **SP2** mode: latch/sequence. Non-linear dehumidify proportional band.

INPUT SELECTION AND RANGING

ºC to ºF conversion - *A total of 3 settings must be modified to change scales. These include **An.hi**, **An.Lo** (See Level A), and **unit**. For these settings there will be two sets of values in parenthesis. The first one is the ºC setting, the second is the ºF setting.*

diSP – (0.1) Select display resolution. With 'Linear Input' selected (**Lin)**, **deCP** in Level A supercedes this setting.

hi.SC – (212.0) Adjusts the maximum allowed value for the setpoint.

Lo.SC – (0.0) Adjusts the minimum allowed value for the setpoint.

inPt – (Lin) Selects Linear Input Voltage setting for the ETS Model 554 Temperature Sensor. (0-5 VDC max.)

unit – (°C), (°F) Selects process units. The process units can be changed independent of the calibration settings. In other words, changing the setting from °C to °F or any other units will not affect the calibration settings, it will only change the units displayed.

5.3.5 LEVL 3 (Level 3)

Level 3 is the output configuration level. There are also features for calibration adjustment and performance data reading.

OUTPUT CONFIGURATION

SP1.d – (SSd1) *Do not change.* Assigns heating control to the appropriate output.

SP2.d – (SSd2) *Do not change.* Assigns cooling control to the appropriate output.

SAFETY SETTINGS

Burn – (uP.SC) *Do Not Change.* Sensor burnout/break protection. This safety setting will protect a system if the sensor quits working. All systems will be shut down if the temperature rises above the hi.SC setting.

rEv.d – (1r.2d) *Do Not Change.* Select output modes: Direct/Reverse. Select Reverse for Heating and Direct for Cooling.

rEv.l – (1n.2n) *Do Not Change.* Selects Microprocessor LED display mode. Normal mode is selected for each LED. In normal mode, the lower left (red) LED will light when the microprocessor calls for the Cooling System and the upper left (green) LED will light when the microprocessor calls for the Heating System.

SPAn – (0.0)) SPAn adjusts the range error over the 0100°C (32-212°F) temperature scale.

An increase of 1.0 will adjust a 99.0°C (210.2°F) reading to 100°C (212.0°F) without affecting lower temperature readings.

ZEro – (0.0) *ZEro* Increases or decreases the Process Display reading linearly over the entire 0-100°C (32-212°F) scale.

An increase of 1.0°C (1.8°F), will raise all temperature values 1.0°C (1.8°F).

The SPAn and ZEro settings can be used to recalibrate the entire system in the field without recalibrating the Model 554 Temperature Sensor separately. ZEro should be adjusted to a low reference temperature, SPAn should be adjusted to a high reference temperature

PERFORMANCE DATA

ChEK – (oFF) Select control accuracy monitor.

rEAD – (Var) Read control accuracy monitor.

TECH – (Ct A) Read Autotune cycle data. Using the Autotune function is not recommended with the ETS Model 523 Temperature Controller

VEr – software version

rSEt – (none) *Do Not Change.* If the unit is reset, all programmed information will be lost. Each parameter must be re-entered manually.

5.3.6 LEVL 4 (Level 4)

Level 4 is a "hidden" level. This allows "locked" functions to be inaccessible to any unauthorized user. Access to Level 4 is gained through "VEr" in Level 3. Press and hold "▲" and "▼" for ten seconds.

Enter Level 4 at "LoCK", release "▲" and "▼" together.

LoCK – (LEV.2) Select from three lock options.

LEV.3 – Locks Level 3 and 4 only – Technical Functions.

LEV.2 – Locks Levels 2, 3 and 4 only – Configuration and Technical Functions.

ALL – Locks all functions (unrestricted LEVL, VEr, dAtA, SP.LK)

Note: Locked functions and options may be read.

ProG – (Auto) Program mode auto-exit switch. Auto-exit returns display to normal after 60 seconds of key inactivity, select **StAy** to disable.

no.AL – (oFF) Disable SP2 alarm annunciator -AL-. Select **on** to disable -AL-.

diS.S – (dir) *Do Not Change.* Display sensitivity.

DEr.S – (0.1) *Do Not Change.* Derivative sensitivity.

5.3.7 LEVL A (Level A)

Level A contains the Linear Input Scaling Settings and the SP3 Settings. The SP3 operating mode is not used in the ETS Model 585.

LINEAR SCALING AND INPUT SETTINGS

ºC to ºF conversion - *A total of 3 settings must be modified to change scales. These include* ***An.hi****,* ***An.Lo*** *, and* ***unit*** *(See Level 2). For these settings there will be two sets of values in parenthesis. The first one is the ºC setting, the second is the ºF setting.*

An.hi – (100.0°C) (212.0°F) Sets process display high scale value corresponding to the **hi.in** setting.

An.Lo – (0.0°C) (32°F) Sets the process display low scale value corresponding to the **Lo.in** setting.

hi.in – (10.0) *Sensor Input Maximum (mV)*. The 9500P Controller uses a resistive divider of 100 to adjust the input voltage across the desired mV range. A 1VDC Maximum Sensor Output = 10.0mV **hi.in** setting.

Lo.in – (0.0) *Sensor Input Minimum (mV)*.

dECP – (000.0) Sets the resolution for the Linear Input Settings. When the 'Linear Input' option has been selected, this setting over-rides the scale resolution setting in **di.SP** in level 2.

SP3 SETTINGS

The Standard ETS Model 585 does not use the SP3 Operating Mode.

SP3 MODES

SP3.A – (nonE) Main SP3 operating Mode.

SP3.b – (nonE) Subsidiary SP3 operating Mode.

SP3 ADJUSTMENTS

SEt.3 – (0) SP3 setpoint adjustment.

HYS.3 – (20) Set SP3 hysteresis (0.1 to 100% of **hi.SC**).

SP3 SAFETY SETTINGS

brn.3 – (uPSC) Sensor burn-out/break protection. Select Upscale or Downscale.

rEV.3 – (3d) Reverse SP3 output mode. Select direct or reverse operation.

5.4 CALCOMMS - Computer Interface

CALCOMMS is a graphic Windows™ based software package designed for PC supervision of CAL 3300 & 9500 Controllers. It offers the capability of remote adjustment, instrument configuration, cloning, saving and retrieving instrument settings to files together with logging and charting in real time. Communications uses the MODBUS® protocol via a fully isolated RS485 link.

To gain full benefit of CALCOMMS software, it is recommended that the PC is fitted with a Pentium processor and running WINDOWS 95, 98 or NT programs. A minimum of 16 MB RAM is recommended to run the program, (32 MB for Windows NT) together with enough free hard disc space to meet logging requirements.

As an option, the more sophisticated CALgrafix Process Monitoring and Configuration Software is available. It requires a minimum 450 MHz Pentium Processor with 128MB RAM and running Windows 98/ME/NT/2000.

Because the controllers are "stand alone" they do not need PC supervision for their normal function, and will continue to control the process unaffected by failure of any part of the communications loop.

When used with the Model 532 Chamber, the Temperature & Humidity Microprocessor COMM PORTS are wired together, in parallel. One RS-485 COMM PORT, common to both Controllers, is located on the Side Interface Panel of the Model 532 Chamber.

5.4.1 Set-up and Installation

(See Pp. 2 & 3 in the CALCOMMS Manual)

5.4.1.1 RS 485 COMM PORT

RS-485 is a half duplex serial communications link and is the standard most commonly used for industrial applications due to it's high noise immunity and multi-drop capability. It enables a PC to communicate with up to 32 instruments over distances of over 1200 meters, and requires the addition of an RS-485 interface card, or a separate RS-232/485 converter.

The RS-485 COMM PORT is a 9-pin subminiature-D female connector located on the 'Side Interface Panel'..

5.4.1.2 RS-232/485 Converter

The RS-232/485 Converter will not be needed if the computer is outfitted with an RS-485 interface card.

The converter is a 9-pin / 9-pin in-line style connector. The converter is gray and bears the label ‘ RS-232 TO RS-485 / Model 485SDD9R’.

5.4.1.2 Connections

1. Connect the supplied 9-pin male/female subminiature-D cable to the RS-485 COMM PORT on the ‘Side Interface Panel’.

2. Connect the other end of the cable to the ‘RS485’ side of the RS-232/485 converter.

3. Connect the ‘RS232’ side of the converter into the appropriate Comm Port on the PC.

5.4.1.4 Software Installation

Software installation instructions can be found on pp. 9-11 in the CALCOMMS Manual.

The CALCOMMS Manual is separate from the CAL 3300 Users Manual. It is the manual with the color cover.

5.4.2 Operation

After installing the computer program and making the appropriate wiring connections to a PC, turn to p.11 in the CALCOMMS Manual. This section is titled GETTING STARTED, follow the directions to begin operating the program.

5.4.2.1 MODBUS Addresses

The MODBUS address is found in Level C. (See Section 2.4.1)

TEMPERATURE controller address is set to **1** at the ETS factory.

5.4.2.1 Open Communications

Instructions for opening communication are found on p.13 of the CALCOMMS Manual.

5.4.3 Logging and Charting

Instructions for operating the Logging and Charting functions of the CALCOMMS program begin on P. 21 of the CALCOMMS Manual.

2/20/03

6.0 WARRANTY

Electro-Tech Systems, Inc. warrants its equipment, accessories and parts of its manufacture to be and remain free from defects in material and workmanship for a period of one (1) year from date of invoice and will, at the discretion of Seller, either replace or repair without charge, F.O.B. Glenside, similar equipment or a similar part to replace any equipment or part of its manufacture which, within the above stated time, is proved to have been defective at the time it was sold. All equipment claimed defective must be returned properly identified to the Seller (or presented to one of its agents for inspection). This warranty only applies to equipment operated in accordance with Seller's operating instructions.

Seller's warranty with respect to those parts of the equipment which are purchased from other manufacturers shall be subject only to that manufacturer's warranty.

The Seller's liability hereunder is expressly limited to repairing or replacing any parts of the equipment manufactured by the manufacturer and found to have been defective. The Seller shall not be liable for damage resulting or claimed to result from any cause whatsoever.

This warranty becomes null and void should the equipment, or any part thereof, be abused or modified by the customer of if used in any application other than that for which it was intended. This warranty to replace or repair is the only warranty, either expressed or implied or provided by law, and is in lieu of all other warranties and the Seller denies any other promise, guarantee, or warranty with respect to the equipment or accessories and, in particular, as to its or their suitability for the purposes of the buyer or its or their performance, either quantitatively or qualitatively or as to the products which it may produce and the buyer is expected to expressly waive rights to any warranty other than that stated herein.

ETS must be notified before any equipment is returned for repair. ETS will issue an RMA (Return Material Authorization) number for return of equipment.

Equipment should be shipped prepaid and insured in the original packaging. If the original packaging is not available, the equipment must be packed in a sufficiently large box (or boxes if applicable) of double wall construction with substantial packing around all sides. The RMA number, description of the problem along with the contact name and telephone number must be included in formal paperwork and enclosed with the instrument. Round trip freight and related charges are the owner’s responsibility.

WARNING

WOODEN CRATES MUST NOT BE USED. PACKAGING OF DELICATE INSTRUMENTS IN WOODEN CRATES SUBSTANTIALLY INCREASES THE CONTENT’S SUSCEPTIBILITY TO SHOCK DAMAGE. DO NOT PLACE INSTRUMENTS OR ACCESSORIES INSIDE OTHER INSTRUMENTS OR CHAMBERS. ELECTRO-TECH SYSTEMS, INC. WILL NOT ASSUME RESPONSIBILITY FOR ADDITIONAL COST OF REPAIR DUE TO DAMAGE INCURRED DURING SHIPMENT AS A RESULT OF POOR PACKAGING.