

# CONTROLLED ENVIRONMENT CHAMBER

## Model 5518



## Operating Manual

3/07



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## 1.0 Model 5518 CONTROLLED ENVIRONMENT CHAMBER

Many applications require a controlled environment for testing, fabricating and/or storage. The Model 5518 Microprocessor Controlled Environmental Chamber is a completely integrated system, fabricated from 0.375" clear and white acrylic that provides the user with excellent visibility inside the controlled environment section. It includes glove ports, equipment and sample access doors, circulating fans, lighting and accessory power outlets. The standard Chamber is capable of precisely controlling temperatures from <32-135°F (<0-55°C) and humidity from 5-98% RH. (**NOTE:** The entire humidity range cannot be obtained at all temperatures due primarily to dew point considerations as shown in Figure 1.0-1.)

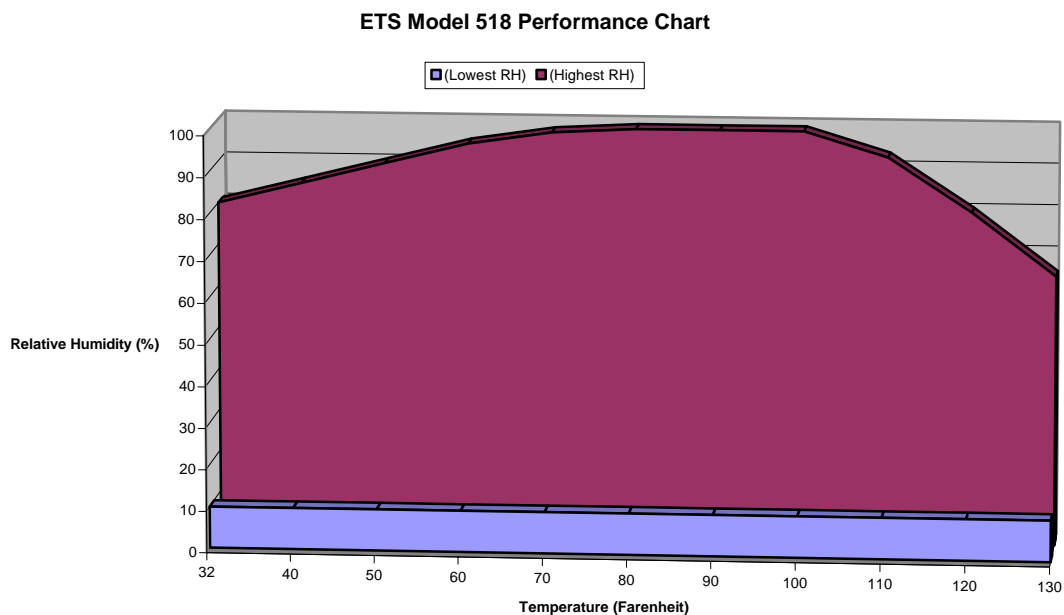


Figure 1.0-1: Model 5518 Dew point performance chart

The overall dimensions of the Model 5518 are 54"Wx25.5"Dx22"H (137x65x56cm). The usable interior working space measures 39"Wx20"Dx21"H (99x51x54cm).

### 1.1 Chambers Controllers & Operating Systems

The controllers and dehumidifier pump are housed in a separate compartment on the right side of the Chamber as shown in Figure 1.0-2.



Figure 1.0-2: Model 5518 Controlled Environment Chamber

The systems are accessible via the removable white, acrylic panel on the right side of the Chamber. Controllers and Operating Systems that are available with the Model 5518 are as follows:

1. Microprocessor Temperature Controller with single ramp/soak, constant temperature; momentary set point display – (Std)
2. Model 554 Temperature compensated RH and RTD Temperature Sensor
3. Integrated 500 Watt Heater (Std.)
4. Choice of Cooling Systems:
  - a. Model 5463 Liquid to Gas CO<sub>2</sub> Cooling System (Std)
  - b. Model 5473-(150W-400W) 510-1360 BTU Thermoelectric Cooling System
  - c. Model 5566 Liquid Nitrogen Cooling System
5. Microprocessor Humidity Controller (single ramp/soak, constant temperature; momentary set point display - Std)
6. Model 5462 Ultrasonic Humidification System (Std)
7. Choice of Dehumidification Systems:
  - a. Model 5461 Desiccant/Pump Dehumidification System – 1.0 lbs (0.45kg) of Desiccant (Std.)
  - b. Model 5478 Self-Regenerating Dehumidification System (requires external air compressor or house air at 50-100 psi)

- c. Model 5465 Dry Gas Dehumidification System
- 8. CALCOMMS Computer Software/Interface Package. (Optional) 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 5518 Chamber is shown in Figure 1.0-3.



Figure 1.0-3: Model 5518 Chamber Front Panel

#### 1.1.1.1 Microprocessor Controllers

The Model 5518 utilizes CAL 3300 microprocessor control modules to control the humidity and temperature in the chamber. The controllers may be operated as stand-alone units or as part of a computer-controlled system using the optional CALCOMMS software package that can control, monitor and log up to 32 control modules (16 Chambers) simultaneously.

The 3300 module displays the measured parameter continuously and the set point at the touch of a button. It can perform a single ramp/soak cycle. Point source LEDs in both modules display the operating status of the control function. Front panel ON/OFF switches enable the respective operating systems to be placed in standby without disturbing controller settings.

Controllers can be programmed as either ON/OFF, or as proportional control (PID) where the process is constantly monitored and power to the

operating system pulsed at a rate that maintains the parameter measured at the sensor, to within  $\pm 0.2$  of the set point.

Refer to Sections 3.0 and 5.0 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 ON/OFF Knob is located to the right of the Power Switch. This switch controls the circulation fans inside the cabinet workspace.
3. **'TEMP'** – Allows the user to manually disable the Temperature Control System. Pushing this switch to the 'Off' ('0') position manually disconnects the low voltage control signal from either of the Temperature Control Relays independently. The Microprocessor will still show the Temperature in the display, the set point may still be adjusted, the internal LEDs will still illuminate and the AC Power will still be sent to the solid state Control Relays. The Relay 'Output' will 'open' because the low voltage control signal will no longer be connected to the Relay, therefore, the corresponding Temperature system will not receive AC Power and will not operate.
4. **'RH'** – Allows the user to manually disable the Humidity Control System. Pushing this switch to the 'Off' ('0') position manually disconnects the low voltage control signal from either of the Humidity Control Relays, independently. The Microprocessor will still show the Relative Humidity in the display, the set point may still be adjusted, the internal LEDs will still illuminate and the AC Power will still be sent to the solid state Control Relays. The Relay 'Output' will 'open' because the low voltage control signal 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 POWER Switches, left of the FAN Speed Knob. This switch controls the overhead light installed in the Chamber workspace.

#### 1.1.1.3 Sensors & PC Boards

The Sensor Input and Control Relays are contained on a PC Board, located at the rear of the Front Panel.

1. **Switches** - The switches are mounted to the front panel, (refer to Figure 1.0-3).
2. **Relays** - The solid-state relays are removable and mounted in sockets secured with plastic cable ties on the PC Board.
3. **Sensor Input** - The Sensor Input is the 5-pin DIN jack located in the lower right corner of the PC Board. The ETS Model 554 RH Sensor consists of a Temperature Compensated Relative Humidity Sensor and a RTD Temperature Sensor and is plugged into this jack. The Sensor Head (Sensing Elements) must be in the Model 5518 Chamber environment. The sensor is held in place on the divider wall with a 3/4" NPT plastic compression 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, corresponding 0-100% RH and 0-100 °C (32-212°F), respectively.

4. **Sensor Interface PC Board** – The Sensor Interface PC Board, shown in Figure 1.0-3, is a dual channel device used to convert the 0-1VDC outputs from the Temperature and RH sensors into 0-50mVDC signals for input to the respective microprocessor controllers. Each channel includes a ZERO adjustment potentiometer and a SPAN adjustment potentiometer. This PC Board should be calibrated every time the Model 554 Sensor is recalibrated. Refer to Section 7.0 for calibration procedure.

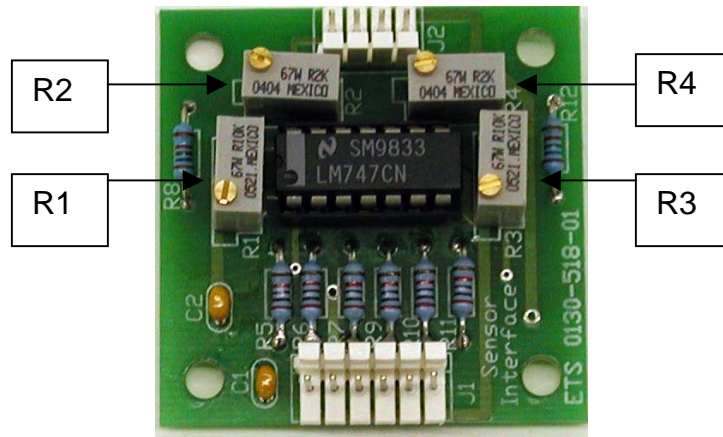


Figure 1.0-3: Interface board adjustments

### 1.1.2 Side Interface Panel Description

All user connections to the Chamber, except the humidifier input and the high-pressure liquid CO<sub>2</sub>, connection are made through the Side Interface Panel shown in Figure 1.0-4. Power connections, Operating Systems connections and the Computer interface are all located on this panel. The



Side Interface Panel is a modular layout that is modified to meet the specifications of the Operating Systems ordered with the Model 5518 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 5518 Configuration. For other configurations, specific installation instructions will be included.

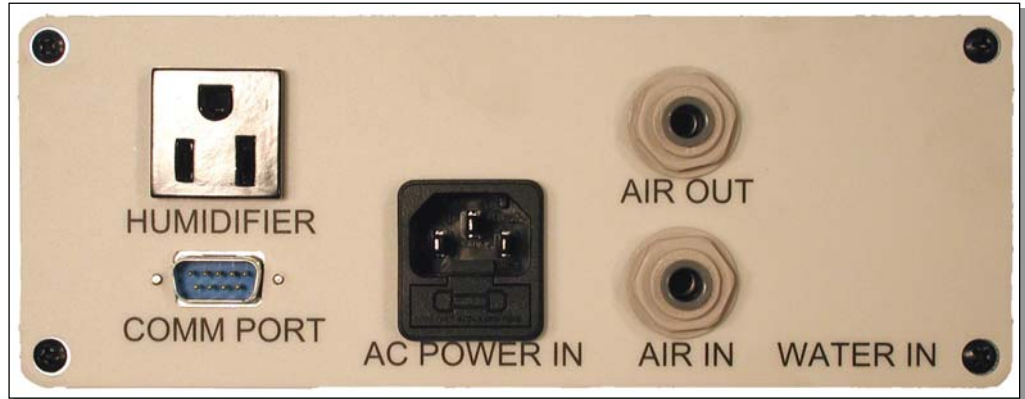


Figure 1.0-4 Model 5518 Side Interface Panel

#### 1.1.2.1 AC Power (Mains)

Labeled **POWER**, this Universal IEC power connector is located on the bottom, left corner of the panel. **The Voltage supplied (Mains) must match the 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. This connector is used for both the analog sensor output signals and the optional RS-485 communications output from both the Temperature and Humidity Microprocessor Controllers. Comms access to either, or both, units is gained through this jack. **(Refer to Section 6.0, CALCOMMS Computer Interface.)**

#### 1. RS-485 Computer Interface

The RS-485 portion of the Comm Port is active with controllers 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.

#### RS-485 Wiring Connections

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

Ground = Pin 4

If using the CALCOMM computer program, refer to Section 6.0 "CALCOMMS-Computer Interface" for set-up instructions.

## 2. Analog Voltage Output

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

This connector 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. Input impedance lower than 20K ohms will affect sensor accuracy of the entire system.

### Analog Voltage Output Wiring Connections

Temperature Positive (+)	Pin 9
RH Positive (+)	Pin 1
Common (Gnd) (-)	Pin 4

#### 1.1.2.3 DEHUMIDIFY IN/OUT

The 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 (AIR IN & AIR OUT) connect the Column into the Dehumidify loop. **(Refer to Section 2.2.1 Dehumidification System)**

#### 1.1.2.4 CO<sub>2</sub> Input Connection

When using the standard Liquid CO<sub>2</sub> Cooling System, a brass quick disconnect fitting is located in the top, right corner of the acrylic Side Panel. This fitting protrudes through the acrylic panel as shown in Figure 1.0-5a for connection to the **user supplied** liquid CO<sub>2</sub> gas tank. **(Refer to Section 4.2.1 Cooling System.)**

### 1.1.3 Operating Systems Compartment

The Operating Systems compartment, shown in Figures 1.0-5a, b & c, contains the control electronics, dehumidifier pump, fluorescent light ballast plus access to the sensor.



Figure 1.0-5a: Operating Systems compartment

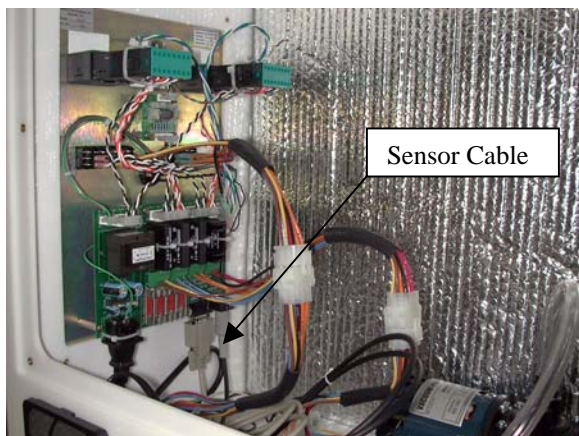


Figure 1.0-5b: Inside left side

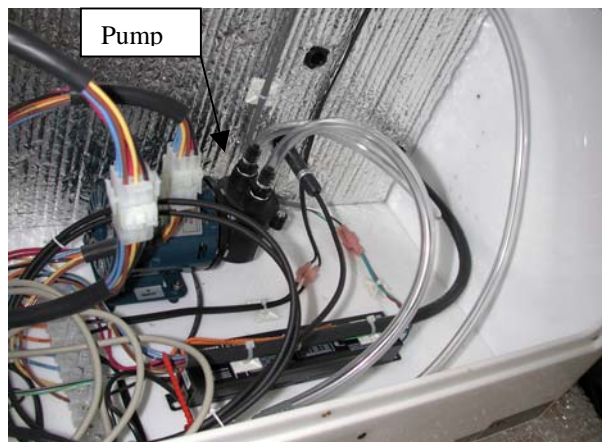


Figure 1.0-5c: Inside right side

## 1.2 Controlled Environment Description

The controlled environment section of the Chamber is 13 ft<sup>3</sup>. (0.32 m<sup>3</sup>) with a useable internal working space of 39"Wx20"Dx21"H (99x51x54 cm). Located on the rear wall is an aluminum panel that protrudes 4" inside and contains the heater, thermal safety switch and 110 cfm fans that are controlled by an ON/OFF knob located on the front panel. Also included is an accessory North American GFI power outlet. Mounted to the top of the unit is a weather-tight 18-Watt fluorescent light (controlled by an ON/OFF switch located on the front panel).

The optional thermoelectric cooling system is mounted to the rear wall behind the aluminum panel when the chamber is so equipped.

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 orifice fitting. The humidifier output is located on the upper middle portion of the wall.

The left hand side of the Chamber consists of a 12"W x 4"H (30.5x10cm) opening with a hinged access door secured by 3, ½-turn latches. Towards the rear is a 1.25" (32mm) ID access hole for feeding cables and tubing to instrumentation placed inside. This hole should be sealed using the soft putty compound provided.

The front of the Chamber consists of a large door containing a pair of 8" (20cm) dia. ports to accept gloves or optional iris ports. The standard Model 5518 is equipped with accordion sleeves with removable #10 size latex rubber gloves (other sizes and types of gloves tgbh6bare available). Silicon rubber iris ports or a solid door are also available as options. A hinged door secured by 10, ½-turn latches with an access opening of 32"W x 14"H (81x36cm) 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.

### 1.3 General Specifications

**Chamber:****Material:**

3/8" (6mm) clear & white acrylic

**Construction:**

PS30 polished welded seams

**Doors:** 3/8" (9mm) clear acrylic, ½-turn latches

**Seal:**

¼" (6mm) Poron, non-setting gasket

**Gloves:** (when configured)

.018" (0.5mm) replaceable hands, natural rubber, accordion sleeves, 8" (20.3cm) ports

**Operating Range:**

Humidity: <10 to >98%

Temp: (Std) <32-135°F (0-55°C)

**Controllers:**

**Type:** 2x CAL 3300, single ramp/soak cycle

1x CAL 3300, (opt.) 3<sup>rd</sup> parameter, linear input

**Resolution:** 0.1%/0.1°

**Set Pt. Tracking:** ±0.1

**Rec. Out:** 0-1Vdc, 0-20ma, 4-20ma

**Computer IF:** MODBUS proto. Via RS485-PC with W98 or higher, NT

**Sensor:**

Type: Temp compensated RH/Temp

RH: Capacitive film, 0 to 100%, non-condensing

Temp: RTD, -40 to +140°F (-40 to 60°C)

Accuracy: ±1.5% RH @ 72°F (22°C)

±0.5°F (±0.3°C)

**Fans:** 2x110 cfm (6230 l/min), ON/OFF

**Access Ports:** (right side)

2x¼" (6mm) Quick disconnects

1x1" (25.4mm) Hose barb

1x1½" (31.4mm) cable pass through

(located on left side)

**Lighting:** 18W sealed fluorescent, ON/OFF Sw

**Dimensions:**

Overall: 54"Wx25.5"Dx22"H (137x65x56cm)

Working space (useable): 39"Wx20"Dx21"H  
(99x51x54 cm)

**Weight:** 120 lbs (55 kg)

**Operating Systems:**

**Dehumidify:** Desiccant/Pump

1.0 lb (0.45kg) CaSO<sub>4</sub>/0.6cfm

**Humidify:** Ultrasonic

Capacity: Distilled Water, 0.5 gal (1.9 l) tank

Flow rate – <0.1 cfm (max)

**Heat:** Electric, 500W

**Cool:** CO<sub>2</sub> Liquid to gas conversion

**Power:**

Voltage: 115/230VAC, 50/60Hz (Specify)

Current: 8-10 Amps

## 1.4 Unpacking Chamber

The standard Model 5518 Controlled Environment Chamber is shipped in 2 separate cartons. The chamber is double boxed in double-wall custom cartons and the accessories, shown in Figure 1.0-6, are packed in a second double-walled carton.

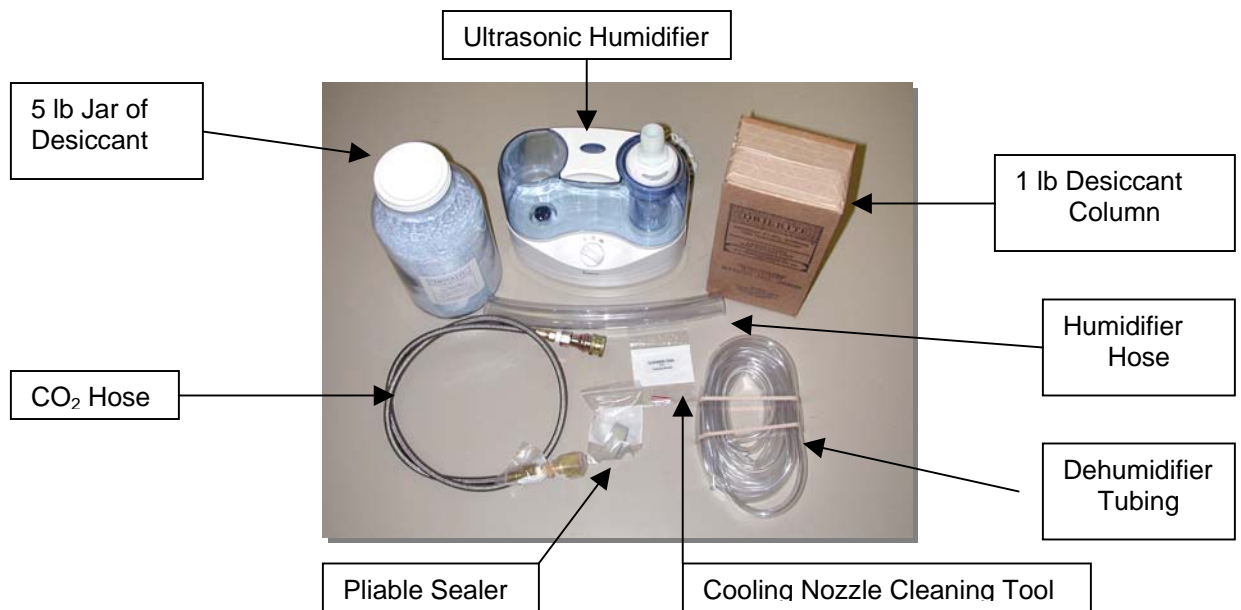


Figure 1.0-6 Model 5518 Accessory box contents

Upon receipt immediately inspect the cartons for any visible damage. If any shipping damage is noticed, unpack the chamber and inspect it for damage. Take pictures of any abnormalities observed. Save all cartons until it is certain that they will no longer be needed. If the Chamber has to be returned to ETS for any reason the original packaging must be used.

### **NOTE:**

**Report any damage immediately to the common carrier delivering the System and to ETS. All damage claims must originate from the recipient. Failure to report damage in a timely manner may result in the claim not being paid. ETS will not be responsible for damaged or lost components if not reported to ETS within 30 days of shipment.**

**Save all cartons and packing material until the Model 5518 System is installed and operating.**

## 2.0 HUMIDITY OPERATING SYSTEMS

### 2.1 Humidification System

The Model 5518 Chamber includes an ETS Model 5462 Ultrasonic Humidification System. The humidifier is a separate unit that sits adjacent to the right side of the Chamber. The humidifier is connected to the chamber by attaching the 1" I.D. clear tubing provided, to the input barb located on the upper right corner of the Side Access Panel (left of the cooling valve input).

**Refer to the Set-up instructions below before using the Humidifier!!**

The Model 5462 Ultrasonic Humidifier shown in Figure 2.0-1 produces a fine water mist through ultrasonic action. The mist is forced from the humidifier into the chamber by a small, quiet fan. The fan draws in ambient air. **This is not a closed-loop system.**



Figure 2.0-1: Model 5462 Ultrasonic Humidification System

#### 2.1.1 Set-up

The Model 5518 comes with green Caplugs covering the “mist output” and the ‘chamber vent’. These Caplugs must be removed before set-up and operation.

The Humidifier must be used with **distilled or de-ionized water ONLY!!**

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

1. Fill the water tank. **USE Distilled or Deionized water ONLY!!**

Remove the water tank from the humidifier unit and inspect it for small cracks or any other damage that may have occurred during shipping (a small crack will allow air to enter the tank, which can cause the water to overflow the basin and possibly damage the unit). After inspection, fill the tank  $\frac{3}{4}$  full with distilled or deionized water ONLY (user provided).

**NOTE:**

**Using tap water will destroy the ultrasonic transducer and the associated electronics. Tap water will also cause a white dust to form on all surfaces (including the humidity sensor, which will also be destroyed).**

2. Replace the tank on the humidifier unit.

The water will automatically drain from the tank into the basin and stop when the basin is full. If the tank is not installed properly, or the humidifier is not on a level surface, water may continue to flow after the basin is full. If this occurs, remove the top immediately, check for problems and try again. If the problem persists, contact ETS.

3. Turn on the humidifier POWER switch.

The power indicator light will turn on immediately and the internal blower will begin to operate when powered by the controller. When the basin is full, the automatic water level switch will activate and provide power to the ultrasonic transducer. When this happens, the unit will start producing a fine mist.

4. Rotate the MIST INTENSITY control.

This control determines how fast the water is converted from a liquid to a mist. For most applications, set the control at (II) position. Rotating the knob clockwise (II) will produce a denser mist, rotating the knob counter-clockwise (I) will produce a finer mist. When operating at high temperatures or in large enclosures, set the knob at maximum (II) for best results.

### **2.1.2 Operation**

Once the System has been properly set up, the user does not have to do anything else to operate the system. Operation will be under the control of the Model 5518 Microprocessor Humidity Controller. Refer to **Section 3.2 Microprocessor Humidity Controller Operation.**

1. Remove the green Caplug covering the Chamber Vent.

The vent, inside the chamber, is the 1" (25mm) orifice on the right wall (the green plug is located here). The vent passes through to the outside right wall. The 1" (25mm) barb on the outside should remain open.

2. Set the Humidity Controller set point to a value above ambient humidity (Refer to **Section 3.2.1 Microprocessor Humidity Controller Operation**).
3. Turn on the “RH INCREASE” switch on the Model 5518 front control panel.

This will not automatically turn on the Humidifier. Turning on the “RH INCREASE” 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 the pump will force 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 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 5472.**

#### 2.1.3.1 Operating Precautions

The humidifier 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 stress 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.

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



#### 4. Use Distilled or Deionized water only.

## 2.2 Dehumidification System

The Model 5518 Chamber includes an ETS Model 5461 Desiccant-Pump Dehumidification System as standard. As an option, the Model 5478 Self-Regenerating Dehumidification System and the Model 5465 Dry Gas Dehumidification System are available. Operation of each system is described below.

### 2.2.1 Desiccant/Pump Dehumidification System

The Model 5461 Dehumidification System shown in Figure 2.0-2 is a closed loop system, designed to reduce the relative humidity in the Model 5518 Chamber to less than 10% RH. The pump is installed in the control section of the chamber. When paired with the Microprocessor Humidity Controller, the humidity inside the chamber can be controlled, without disturbance, to within  $\pm 0.2\%$  RH of the set point at the sensor.



Figure 2.0-2 Desiccant Pump Dehumidification System  
(Fittings shown are not included with the Model 5518)

#### 2.2.1.1 Description

The Dehumidification System includes a small air pump (located inside the Chamber control cavity), 1.0 lb. of indicating calcium sulfate ( $\text{CaSO}_4$ ) in a clear plastic column (located outside the chamber), and 5/16" I.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 internally connected to the humidity controller. All the user needs to do is connect the desiccant column into the system using the provided 5/16" ID Tubing.

The desiccant removes moisture from the air. This dried air is then forced back into the chamber working space. 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.

A 2.5 lb. desiccant column is available as an option or multiple 1 lb columns can be connected in series. This will extend the time between desiccant changes, but will reduce the air-flow, thereby increasing the drying time.

#### 2.2.1.2 Unit Specifications

1. Average air-flow rate: 0.67 cfm (19 lpm).
2. Air-dried to a dewpoint of -100°F.
3. Capacity for water vapor: 100 grams max.
4. Power – 115 VAC/60 Hz, 1.1 Amps  
230 VAC/50 Hz, 0.6 Amps
5. Desiccant Column working pressure; 90 psig max.
6. Contents: 1 lb. of #8 mesh CaSO<sub>4</sub> Indicating Desiccant.
7. All connections are made using 5/16" ID tubing. ¼" ID x 5/16" OD hose barb adapters are included to adapt from the ¼" OD fittings on the 'Side Interface Panel' to the desiccant column.
8. Plastic cap is fitted with "O-Ring" gasket.
9. Desiccator coil spring: 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 5518 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 5/16" ID tubing long enough to connect the desiccant column to the 'Side Interface Panel' of the Chamber.

3. Connect one piece of the tubing from the fitting labeled “DEHUMIDIFY OUT” on the ‘Side Interface Panel’ to the lower fitting on the desiccant column.

**To connect the hose barb adapters to the ¼” OD tubing fittings:** Push the barb adapter into the fitting as far as possible. The tube will lock into place automatically. To release the adapter, push in on the collar of the fitting and gently pull out the adapter.

4. Connect the second piece of tubing between the upper fitting on the desiccant column and the fitting labeled “DEHUMIDIFY IN” on the ‘Side Interface Panel’ of the Chamber.
5. The chamber vent, inside of the Chamber, is the 1” (25mm) opening on the right wall (the green plug should be placed in the opening). The vent passes through to the outside right wall, the 1”(25mm) barb on the outside should remain open.
6. Set the Humidity Controller set point to a value below the ambient humidity (Refer to Model 5518 Microprocessor Humidity Controller Operation).
7. Turn on the “RH DECREASE” switch on the front panel.

This will not automatically turn on the dehumidification system. Turning on the “RH DECREASE” switch only makes the dehumidification system *available* to the microprocessor controller.

When the controller tells Dehumidification System to activate, the small red LED on the lower right side of the microprocessor display will light. The internal air pump will begin moving. The pump will draw moist air from the Chamber working space and force it through the desiccant column. The dried air will then be returned to the chamber.

8. The microprocessor controller 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 2.0 seconds. 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 5461 pump.

#### 2.2.1.4 Renewing desiccant

**The desiccant can be renewed approximately ten (10) times before having to be replaced. The granules must be removed from the drying column. Disconnect the IN/OUT tubing. Unscrew the plastic cap on top of the unit and remove the felt pad. Spread the desiccant evenly, 1-2 granules deep on a metal or glass tray.**

**Heat the desiccant for approximately one (1) hour at about 400°F (200°C). It should be allowed to cool in an airtight container before refilling the acrylic drying column. The felt filters should also be pre-dried at 200° F (100° C) for about 30 minutes before assembly.**

### 2.2.2 Self-Regenerating Dehumidification System (Optional)

The Model 5478 Self-Regenerating Dehumidification System is capable of drying the Model 5518 Chamber from 50% RH to 12% RH in less than 3 hours, at room temperature.

#### 2.2.2.1 Description

The Model 5478 Self-Regenerating Dehumidification System requires 50-100 psi of air pressure at 2.6 cfm to operate. Since air must be provided continuously either a separate air compressor or house air should be used for long-term dehumidification applications to ensure reliable, long-term air.

The basic Self-Regenerating Dehumidification System consists of a dual column self-regenerating desiccant dryer utilizing molecular sieve desiccant, and a 3-way control valve. The dual column dryer operates 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 dryer and valve are mounted inside the control section of the Chamber.

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 dry the air 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. Air 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. 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 Side Interface 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" (25mm) green Caplug.
2. The Chamber Vent, inside of the chamber, is the 1" (25mm) opening on the right wall (the green plug should be removed). The vent passes through to the outside right wall. the 1" (25mm) barb on the outside should also remain open.

The Model 5478 is a positive pressure system. Without adequate ventilation, the System will pressurize the working space. Pressurizing the Chamber is not recommended and may cause damage.

3. Set the microprocessor humidity controller set point to a value below ambient humidity.
4. Turn on the “RH DECREASE” switch on the front panel.

This will do two things:

- a. It will activate the dual column dryer. It will begin producing dry air as soon as the “RH DECREASE” 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 “RH DECREASE” 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 right 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.

### **2.2.3 Model 5465 Dry Gas Dehumidification System (Optional)**

This system consists of a solenoid valve installed inside the operating systems compartment to control the flow of gas from the user supplied, regulated nitrogen tank or other dry air source. The ¼” quick-disconnect fitting supplied is connected to the regulated air output. The supplied ¼” tubing connects the dry air source to the “AIR IN” chamber fitting on the side panel.

#### **NOTE:**

**Make all connections prior to turning on the dry air. The pressure from the dry gas source must be limited to 50psi. If using a tank secure it properly so that it cannot tip over and cause property damage or bodily injury.**

This is a one-way system where gas is injected into the chamber to purge out the wet air. The hose barb fitting on the chamber must be left open or be used to vent the gas to prevent pressure build-up.

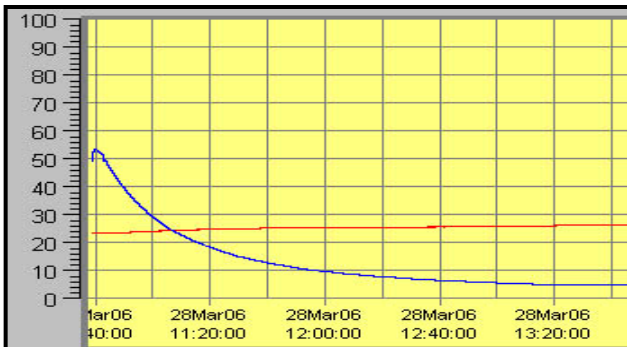
Operation is similar to the desiccant pump system where the controller pulses the valve to regulate the amount of dry gas entering the chamber.

Dry nitrogen is capable of reducing the humidity in the chamber to less than 1% RH, but due to mechanical considerations the lower limit of the chamber is specified at <5%.

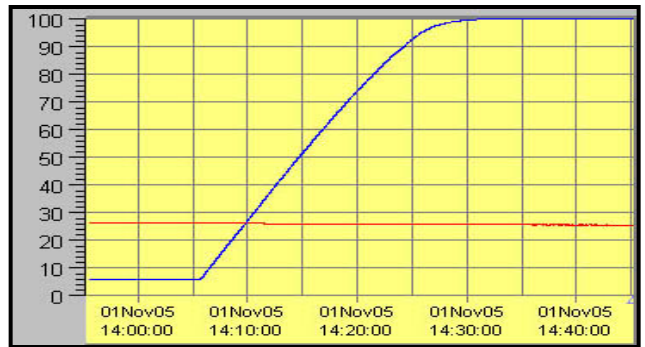
### 2.3 System Performance

Chamber performance pertains to the ability of the chamber to reach and then hold a given humidity level along with humidity gradients. It is not only a function of the chamber, but of the temperature, operating systems and controllers used. Figure 2.0-2 are charts showing the time typically required to decrease and increase humidity (Blue = RH, Red = T °C) plus humidity gradients using the optional CALCOMMS software package for the standard Model 5518 configuration. Other operating systems will exhibit different performance characteristics.

#### HUMIDITY

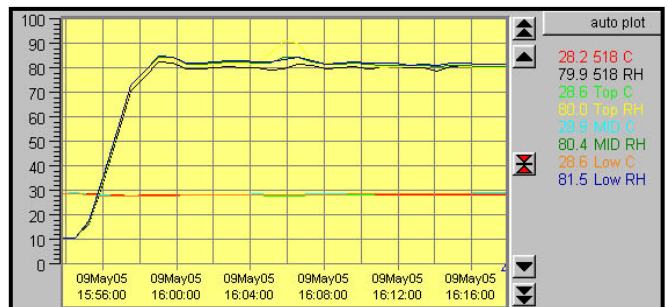
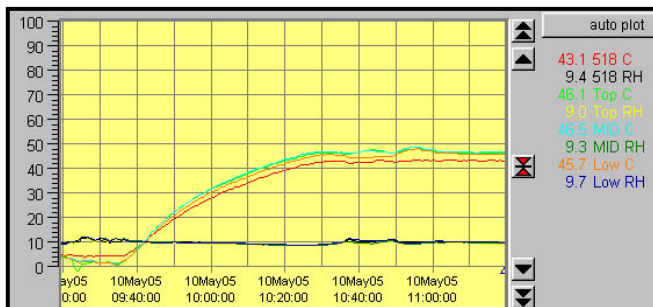


Rate of decrease



Rate of increase

#### HUMIDITY GRADIENTS



Increase temperature, constant low RH                      Increase RH, constant temperature  
 Figure 2.0-2: Typical Humidity/Temperature performance charts

### 3.0 MICROPROCESSOR HUMIDITY CONTROLLER

#### 3.1 Description

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

The controller provides low voltage (5 VDC, 15mA) control signals to the INCREASE and DECREASE solid-state relays, located on the '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" FUNCTION" switches on the front panel are in the 'OFF' ('0') position, AC power is manually disconnected from the control relays and no humidification or dehumidification can take place until the switch is placed in the 'ON' ('1') position.

All devices in the Model 5518 are connected using terminals on the 'PC Board'.

#### 3.1.1 Controller Specifications

<p><b>Controller:</b>          Sensor input (std linear): 0-1.0V          Accuracy: ±0.1%          Resolution: ±0.1 of digital readout          Calibration accuracy: ±0.25% (max input)          Sampling frequency: Input - 10 Hz, CJC - 2 sec          Display: High Brightness LED            Reading: 0.4" (10mm) Green            Set Point: Same as Reading            SP1: Flashing square Green            SP2: Flashing round Red            SP3 (Alarm): None          Controls:            Control module: Function, Up/Down buttons            Front Panel: INCR - ON/OFF, DECR - ON/OFF          Power (Input): 90-240VAC, 50/60 Hz          AC output control current: 1,000 VA max            Std configuration: 4A            Heater Control: 8A            Solenoids: 2A (extra low turnoff leakage current)          Ramp/Soak: 1 cycle          Communications (Optional): MODBUS® protocol,            Windows 95/98/2000/NT/XP, 200MHz/16MB RAM min (CALCOMMS only)            Multiple unit link: RS-485          Software:            Standard: CALCOMMS Applications Software            Optional : CALgrafix Process Monitoring &amp; Configuration Software                    CALopc Server Software (for use with user software)</p>	<p><b>Sensor:</b>          Temperature compensated          Humidity: Capacitive film          Range: 0-100% (10mV/%RH)          Range:0-100% (10mV/%RH)          Accuracy: ±2% RH @ 73°F (23°C)          Temperature: RTD          Range: -40 to +185°F (-40 to +85°C) (10mV/°C)            Accuracy: ±0.9°F ( 0.5°C)          Size: 0.625" dia.x 6.5" L (15mm x 165m)          Cable length: 6.5' (2m)          Housing: Polycarbonate, Black (Ral 7016)          Compliance: EN50081-2, EN50082-2</p>
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## 3.2 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. While holding the “\*” button, the current set point value and ‘rh’ will alternately appear in 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

To operate the Model 5518 Humidification System:

1. Read the Humidifier operating instructions.
2. Plug the Humidifier into the ‘HUMIDIFY’ outlet on the ‘Side Interface Panel’.
3. Adjust the RH set point to a value above the ambient RH conditions.
4. Turn on the “RH INCREASE” switch on the Model 5518 Front Panel.

This will not automatically apply power to the Humidifier. Turning on the “RH INCREASE” switch only makes the ‘HUMIDIFY’ outlet *available* to the microprocessor controller.

When the controller activates the outlet, the small green LED in the upper left corner of the RH display will illuminate. The humidifier will activate and begin pushing a fine water mist into the chamber.

5. The controller 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. Refer to the Humidification System instructions for

minimum cycle time recommendations. The minimum cycle time for the ETS Model 5462 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 5518 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 DECREASE" switch on the front of the Model 5518 control panel.

This will not automatically apply power to the dehumidification system. Turning on the "RH DECREASE" switch only makes the dehumidification system *available* to the microprocessor controller.

When the controller activates the outlet, the small red LED in the lower right corner of the RH 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.

ETS Model 5461 minimum cycle time is 2.0 seconds.

ETS Model 5478 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, refer to Section 6.0.)
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 5461 Desiccant Dehumidification System and ETS Model 5462 Ultrasonic Humidification System. Other systems may require different settings.

If the Model 5518 Chamber has different systems, the information programmed into the controller will be different. Information on the specific program will be provided separately in the Appendix.

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 5518's limited mode of operation.*

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

*All Parameters are programmed at ETS 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  $\pm 2.0$  %, 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  $\pm 0.2\%$  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 Set Point' (**At.SP**) option is recommended with the Model 5518.

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 5518 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 humidifying and dehumidifying 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 – (2.0) Recommended.** Cycle time means how often the unit can potentially be turned on and then off in succession. The ETS Model 5462 and Model 5472 Humidifiers may each be safely turned on and off once a second. **DO NOT DECREASE CYCLE TIME BELOW 1.0 SECOND when operating these systems.**

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 5518 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 – (20.0) Recommended.** Bnd.2 should generally be equal to **bAnd**. The increase and decrease 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). Doubling **bnd.2** helps prevent flip-flopping around the set point.

**CyC.2 – (1.0) Recommended.** Cycle time means how often the unit can potentially be turned on and then off in succession. The ETS Model 5461 Dehumidifier may be safely turned on and off once a second but the pump will be excessively noisy. **DO NOT DECREASE THE CYCLE TIME BELOW 1.0 SECOND when operating this system.**

ETS Model 5478 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 Humidity 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)** Subsidiary 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.

**hi.SC – (100.0)** Sets Sensor full scale. The sensor full scale is also the upper limit for the setpoint.

**Lo.SC – (0.0)** Sets Sensor minimum. The sensor minimum is also the lower limit for the sensor set point.

**inPt – (Lin 1)** Selects a Linear Input Voltage setting (0-50mV) for use with the ETS Model 554 Humidity Sensor & Sensor Interface PC Board (0-1VDC Input, 0-50mVDC Output).

**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 mode. Normal mode is selected for each LED. In normal mode, the lower left (red) LED will light when the microprocessor calls for dehumidification and the upper left (green) LED will light when the microprocessor calls for humidification.

**SPAN – (-60)** Do Not Change. Changing the SPAN will affect unit calibration.

#### **NOTE:**

The calibration settings (SPAN & ZERo) should not be altered. All calibration should be performed on the Model 554 Sensor (Temp. & RH) directly, or through the calibration potentiometers on the Model 5518 ‘Sensor Interface Board’. The SPAN adjustment pot on the ‘Sensor Interface Board’ is far more accurate than this microprocessor setting.

**ZERo – (0.0)** Do Not Change. Zero sensor error, see SPAN.

**NOTE:**

The Model 5518 'Sensor Interface Board' includes an internal ZERO adjustment pot that is far more accurate than the microprocessor setting.

**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.

**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.



## 4.0 TEMPERATURE OPERATING SYSTEMS

### 4.1 Heating System

The Model 5518 Chamber contains 2, 250 Watt Electric Heaters (500 Watts total). The heater is an integral part of the chamber, located behind the white aluminum panel inside the Chamber workspace. Since the heater is already installed, there is no additional set-up required.

After turning “ON” the “TEMP INCREASE” switch, the microprocessor temperature controller governs the operation of the Heating System.

1. The controller 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. Refer to **Section 4.2 – Microprocessor Temperature Controller Operation** for details.
2. The electric heating element and indicator light are located on white aluminum panel containing the fans located on the inside, rear wall (the heater is hidden from view).
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.)
4. A thermal safety switch (also on the 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. (58 °C) (The acrylic chamber will begin to melt at 150 °F)

### 4.2 Cooling Systems

The Model 5518 Chamber includes the ETS Model 5463 Liquid Carbon Dioxide Cooling System as a standard feature. Other cooling options include:

ETS Model 5473-150	510BTU/hr Thermoelectric cooling System
ETS Model 5466	Liquid Nitrogen Cooling System

#### 4.2.1 Model 5463 Liquid CO<sub>2</sub> Cooling System

The Liquid CO<sub>2</sub> Cooling System is already installed onto the Model 5518 Chamber. The Solenoid Control Valve is wired into the ‘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<sub>2</sub> cylinder with dip tube. **(NOTE: CO<sub>2</sub> gas will not work.)**

The Gas Cooling System enables the temperature within the Model 5518 Chamber to be reduced below freezing, 32°F (0°C).

1. The System utilizes Liquid CO<sub>2</sub>\* (Carbon Dioxide) as the cooling medium.

CO<sub>2</sub> is user supplied. 50lb. CO<sub>2</sub> tanks are readily available from local bottled gas companies.

**NOTE:**

**Liquid CO<sub>2</sub> with a Dip Tube must be specified. The DIP Tube allows liquid to be siphoned from the bottom of the tank. CO<sub>2</sub> Gas (without DIP Tube) will not provide cooling with this system.**

2. The CO<sub>2</sub> is allowed to evaporate (expand from a liquid to a gas) within the chamber.
3. The phase change of the CO<sub>2</sub> 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<sub>2</sub> Transfer Hose consists of
  - a. 4' long with Braided Stainless Steel Safety Shield.
  - b. Brass High Pressure Fitting for mating to Liquid CO<sub>2</sub> tank.
  - c. Brass Quick Disconnect (female) for mating to Valve Input.
2. Cooling Nozzle Cleaning Tool

#### 4.2.1.2 Liquid CO<sub>2</sub> Tank Connections

1. Secure the CO<sub>2</sub> cylinder to a wall using an approved securing belt or clamp.

**Failure to secure the cylinder to a wall or other suitable stationary object may result in serious injury to personnel should CO<sub>2</sub> cylinder fall over.**

2. The CO<sub>2</sub> 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<sub>2</sub> is non-toxic, it can cause asphyxiation if not used in areas with adequate ventilation. The Model 5518 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<sub>2</sub> 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<sub>2</sub> Tank and Valve as shown in Figure 4.0-1.



Figure 4.0-1: CO<sub>2</sub> cylinder hook up

- 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<sub>2</sub> 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 both the status of the CO<sub>2</sub> cylinder and the cooling performance of the system to check for an exhausted CO<sub>2</sub> tank.

#### 4.2.1.4 Changing CO<sub>2</sub> Tank

Before disconnecting any fittings or attempting to change the tank, all of the CO<sub>2</sub> must be vented from the system. Venting the CO<sub>2</sub> 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 “TEMP DECREASE” switch on the front panel and adjust the set point several degrees below the temperature inside the chamber. 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<sub>2</sub> tank. This will shut off the CO<sub>2</sub> supply to the system.

The CO<sub>2</sub> will bleed out of the cooling nozzle, into the chamber. When all the CO<sub>2</sub> 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<sub>2</sub> tank.
4. Replace the empty tank with a fresh Liquid CO<sub>2</sub> tank. Then, using a wrench, reconnect the transfer hose.
5. Turn “OFF” the “TEMP DECREASE” switch on the front panel. This will close the Cool Valve.
6. After the system is turned “OFF”, open the manual valve on top of the CO<sub>2</sub> cylinder.

The Transfer Hose and Cool Valve will now be pressurized. If any leaks occur, close the manual valve on top of the CO<sub>2</sub> cylinder and 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 5463 CO<sub>2</sub> Gas Cooling System, when used in the ETS Model 5518 Chamber with a full 50 lb. CO<sub>2</sub> tank, will provide cooling to below 32 °F (0 °C). The total CO<sub>2</sub> 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<sub>2</sub> tank and room ambient temperature of 72 °F (23 °C).

Temperature Set-point (°F)	Time (approx.) to empty CO <sub>2</sub> 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 above 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<sub>2</sub> 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 low temperatures).

#### 4.2.1.6 Maintenance and Troubleshooting

The Model 5463 Liquid CO<sub>2</sub> Cooling System should provide years of trouble free service. Other than changing CO<sub>2</sub> tanks when depleted, very little servicing is required. Refer to Section 8.2 for cleaning the nozzle orifice

#### **4.2.2 Thermoelectric Cooling System**

The Model 5473 Series of thermoelectric electric cooling systems are available as an option. Refer to the Appendix for operating instructions if this option is installed in the Model 5518 Chamber.

#### **4.2.3 Liquid Nitrogen Cooling System**

The Model 5466 Liquid Nitrogen Cooling System operation is similar to the standard liquid CO<sub>2</sub> System installed. Most liquid nitrogen supply tanks also provide nitrogen gas. If the Dry Gas Dehumidification option is installed, this cooling configuration should be used. The main difference between the two systems is that the Liquid Nitrogen System requires a cryogenic valve and hose assembly. Refer to the Appendix for operating instructions if this option is installed in the Model 5518 Chamber.

## **5.0 MICROPROCESSOR TEMPERATURE CONTROLLER**

### **5.1 System Description**

The Microprocessor Temperature Controller, in conjunction with the Model 554 RTD Temperature Sensor, is capable of controlling the temperature in the Model 5518 Chamber by supplying a proportionally controlled power output to the Heating and/or Cooling Systems.

The Controller provides low voltage (5 VDC, 15mA) control signals to the INCREASE and DECREASE solid-state relays, located on the '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 Function' switches on the front panel are in the 'OFF' ('0') position, power is manually disconnected from the control relays and no heating or cooling can take place until the switch is placed in the 'ON' ('1') position.

All devices in the Model 5518 are connected through terminals on the 'PC Board'.

#### **5.1.1 Controller Specifications**

Refer to Section 3.1.1 Specifications (Humidity Controller)

### **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. While holding the "\*" button, the current set point value and '°C' or '°F' will alternately appear in 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 5518 Heating System:

1. Adjust the Temperature set point to a value above the ambient temperature.
2. Turn on the “TEMP INCREASE” switch on the front of the Control Panel.

This will not automatically apply power to the heaters. Turning on the “TEMP INCREASE” 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 display will illuminate. The red neon light on the ‘Fan Panel’ will also illuminate to indicate that the heaters are receiving power.

3. The controller 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 5518 Chamber is 1.0 second. Shorter times may damage the controller.

### 5.2.3 Cooling System

*The Gas 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 5518 Cooling System:

1. Adjust the set point to a value below the ambient temperature.
2. Turn on the “TEMP DECREASE” switch on the front of the Control Panel.

This will not automatically apply power to the cooling system. Turning on the “TEMP DECREASE” switch only makes the cooling system the *available* to microprocessor controller.

When the controller activates the cooling system, the small red LED in the lower right corner of the temperature controller 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 Gas Cooling System should be set as short as possible.

The minimum cycle time is 1.0 seconds (3.0 recommended).

## 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 5463 Liquid Carbon Dioxide Cooling System and the ETS Model 5474L’s 500-Watt Heating System. Other systems may require different settings.

If the Model 5518 Chamber has different systems, the information programmed into the controllers will be different. Information on the specific program is 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 controllers in the Model 5518's limited mode of operation.*

*To avoid confusion, this section will discuss which parameters may be adjusted and 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  $\pm 1.0^{\circ}\text{C}$ , depending on the specific conditions). However, as the user becomes familiar with each parameter and its effect on temperature control, the user will be able to program the unit to control within ever tightening tolerances. Control of  $\pm 0.2^{\circ}\text{C}$ , 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 Set point' (**At.SP**) option is recommended with the Model 5518 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 – (2.0) Proportional Band** for the heaters.

**int.t – (1.0) 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 – (1) 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 5518 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)** Set point 2 allows the user to create a set point 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 – (5.0) Recommended.** Cycle time means how often the unit can potentially be turned on and then off in succession. 5.0 SECONDS is the recommended cycle time for the ETS Model 5463 Cooling System to achieve good control and extended valve life. The ETS Model 5463 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 5463 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**

**°C to °F conversion** - *A total of 4 settings must be modified to change scales. These include **hi.SC**, **lo.SC**, **unit** and **Zero** (See Level 3). For these settings there will be two sets of values in parenthesis. The first one is the °C setting, the second is the °F setting.*

**diSP – (0.1)** Select display resolution.

**hi.SC – (100), (212.0)** Sets Sensor full scale. The sensor full scale is also the upper limit for the set point.

**Lo.SC – (0.0), (32.0)** Sets Sensor minimum. The sensor minimum is also the lower limit for the sensor set point.

**inPt – (Lin1)** Selects a Linear Input Voltage setting (0-50mV) for use with the ETS Model 554 RTD Temperature Sensor & Sensor Interface PC Board (0-1VDC Input, 0-50mVDC Output).

**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 LEVEL 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 Temperature 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 – (-60) Do Not Change.** Changing the SPAn will affect unit calibration.

**NOTE:**

The calibration settings (SPAn & ZERo) should not be altered. All calibration should be performed on the Model 554 Sensor (Temp. & RH) directly, or through the calibration potentiometers on the Model 5518 ‘Sensor Interface Board’. The SPAN adjustment pot on the ‘Sensor Interface Board’ is far more accurate than the microprocessor setting.

**ZERo – (0.0), (32.0)** Zero sensor error, see SPAn.

**NOTE:**

The Model 5518 ‘Sensor Interface Board’ includes an internal ZERO adjustment pot that is far more accurate than the microprocessor setting.

**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.

**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.

## 6.0 CALCOMMS - COMPUTER INTERFACE (Optional)

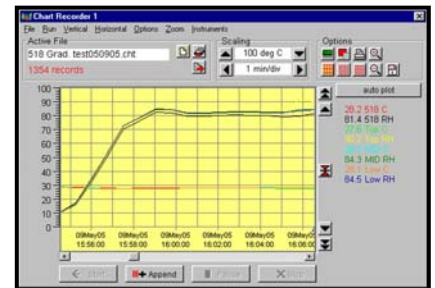
The standard CALCOMMS Applications Software provides enhanced display, charting and alarming. The Optional CALgrafix Process Monitoring & Configuration and CALopc Server (for interfacing with OPC compatible client software) software packages are also available. The software communicates with Windows 95/98/p2000/NT/XP using the MODBUS<sup>®</sup> protocol via a fully isolated RS-485 (multiple units) link for CALCOMMS. The graphic WINDOWS<sup>™</sup> based software provides PC supervision of any combination up to 32 control modules with the capability of remote adjustment, instrument configuration, cloning, saving and retrieving instrument settings to files together with logging and charting. Up to 12 controller readings can be shown live on the screen in real time.



Controller Configuration



Charting



Controller Activity

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, 98, 2000, XP or Windows NT programs. A minimum of 16 MB RAM is recommended to run the program (slightly less is acceptable), together with sufficient 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 5518 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 5518 Chamber.

## 6.1 Set up and Installation

(Refer to pp. 2 & 3 in the CALCOMMS Manual)

### 6.1.1 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 its 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. A RS-485/USB converter is also available.

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

### 6.1.2 RS-232/485 Converter

**The RS-232/485 Converter is not required if the computer is configured 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'. If the computer has only a USB port contact ETS for the correct adapter.

### 6.1.3 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-485/232 converter.
3. Connect the 'RS-232' side of the converter into the appropriate Comm Port on the PC.

### 6.1.4 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.

## 6.2 Operation

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

### 6.2.1 MODBUS Addresses

The **MODBUS** address is found in Level C.

The following addresses are preset at the factory:

- TEMPERATURE** controller address is set to **1**.
- HUMIDITY** controller address is set to **2**.

### 6.2.2 Open Communications

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

### 6.3 Logging and Charting

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

## 7.0 CALIBRATION

The only components of the Model 5518 Controlled Environment System that requires periodic calibration are the Microprocessor Controllers and Temperature/Humidity sensor. It is recommended that this section be returned to ETS for calibration. However, the user can check the overall system calibration as follows:

Place the sensor of a known, calibrated temperature and humidity meter as close as possible to the System sensor. After the temperature and humidity within the chamber has stabilized, compare the readings. They should be within the combined tolerance of the two measuring devices.

To return equipment to ETS for calibration or repair it is first necessary to obtain a RMA number. **Call 215-887-2196.**

To remove the Control Panel and sensor, first gain access to the operating systems compartment by removing the 8 screws holding the right side panel in place. Unplug all connections to the front Control Panel. Loosen the 4 captive screws holding the Control Panel and remove. Remove the sensor by loosening the compression fitting inside the controlled environment section. Return both the Control Panel and sensor to ETS.

### 7.1 Sensor Interface Board

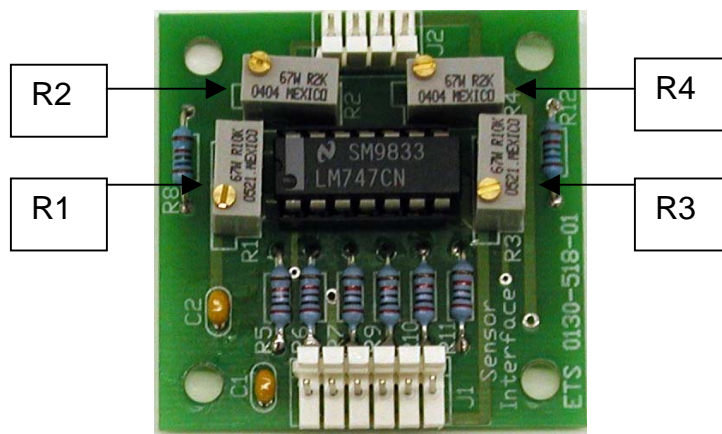




Figure 7.0-1: Interface board adjustments

### 7.1.1 Equipment Required

1. 0-1 VDC signal source.
2. Digital Voltmeter

### 7.1.2 Calibration Procedure

1. Attach the 0-1 VDC signal source to Pins 1&4 of the Sensor Input connector located in the lower right-hand corner of the main PC Board. Pin 1 = Humidity and is the first pin starting from the right side of the connector (About 2:00 o'clock) as shown in Figure 7.0-2. Pin 4 = Temperature and Pin 2 = Ground.

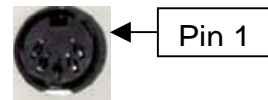


Figure 7.0-2: Sensor input connector

2. Set the signal source to 0.000 VDC (ground).
3. Using the Meter, measure at the sensor inputs on each of the microprocessor controllers, positions 1 (+) and 2(-).
4. Measuring at the RH Microprocessor, adjust R3 for a reading of 0.000mVDC.
5. Measuring at the Temperature Microprocessor, adjust R1 for a reading of 0.000mVDC.
6. Set the signal source to 1.000 VDC.
7. Measuring at the RH Microprocessor, adjust R4 for a reading of 50.000mVDC.
8. Measuring at the Temperature Microprocessor, adjust R2 for a reading of 50.000 mVDC.
9. Check the actual RH Microprocessor display to verify it shows 0-100% RH for and input of 0-1VDC at the sensor jack (pin1). Adjust R3 & R4 if necessary.

10. Check the actual Temperature microprocessor display to verify it shows 0-100°C (32-212°F) for an input of 0-1VDC at the sensor jack (pin4). Adjust R1 & R2 if necessary.

## 8.0 MAINTENANCE

The Model 5518 requires very little additional maintenance from that described in the individual operating systems sections except for the periodic cleaning of the humidifier and the cooling orifice. For specific maintenance requirements contact ETS at 215-887-2196 for assistance or to obtain an RMA.

### 8.1 Cleaning Humidifier Transducer

1. Always unplug the humidifier from the Model 5518 Chamber before cleaning.
2. Empty all the water from the unit. Pour water out or soak it up with a sponge.
3. Disconnect (or remove) the water tank.
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.

### 8.2 Cleaning Cooling System Nozzle Orifice

**Before performing any service, the pressurized CO<sub>2</sub> must be bled from the system. Refer to Section 4.2.1.4.**

1. Clearing a clogged Cooling Nozzle.

Occasionally, the Cooling Nozzle, shown in Figure 8.0-2, may become clogged due to impurities in the CO<sub>2</sub>, small pieces of dirt or small pieces of Teflon sealing tape breaking free and lodging in the nozzle.



Figure 8.0-1: Cooling nozzle orifice

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<sub>2</sub> tank is full and the manual valve is fully open.
3. If the valve does 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.

## 9.0 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, 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 or 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.**