Point of Use
Temperature Control System

Model 3500-P – PSC2

September 2015 *User Manual*

A message to our customers:

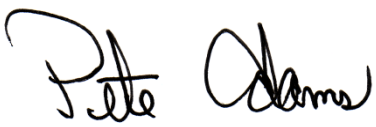
Originally founded in 1985, Noah Precision has grown into a recognized leader in providing temperature control systems to the global semiconductor industry.

Today, Lauda-Noah, LP is guided in our belief that prosperity in this competitive industry stems from providing customers with highly engineered new products and world class customer service.

We know that great products are often the result of great customer feedback and the application of innovative technology. We strive to create value for our customers through a process that lets the customer influence our goals, objectives, product developments and business practices.

We embrace personal accountability and accept responsibility for prudent risk taking. We encourage personal values, which guide us to consistently meet the commitments we make and we endeavor to treat those with whom we interact with respect as we wish to be treated ourselves.

Sincerely,



Peter Adams, CEO
LAUDA-Noah, LP.

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PRODUCT USAGE STATEMENT

DANGER:

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or maintaining this equipment. Practice all plant and product safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. All personnel who work with or who are exposed to this equipment must take precautions to protect themselves against serious or possibly fatal bodily injury.

Lauda-Noah, LP provides information on its products and associated hazards, but it assumes no responsibility for the after-sale operation of the equipment or the safety practices of the owner or user. This equipment produces or uses potentially lethal high-voltage, high-current, electrical power. NEVER DEFEAT INTERLOCKS OR GROUNDS.

TRADEMARKS

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CUSTOMER FEEDBACK

Noah's technical writing staff has carefully developed this manual using research-based document design principles. However, improvement is ongoing, and the writing staff welcomes and appreciates customer feedback.

To order a manual, please contact LAUDA-Noah (see "Returning Units for Repair" on page 6-8 for contact information).

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Chapter 1

Chapter 1 - Introduction

READ THIS SECTION

To ensure safe operation, read and understand this manual before attempting to install or operate this unit. At a minimum, read the safety instructions and follow the safety practices under the heading "Safety" on page 1-3.

INTERPRETING THE MANUAL

The following sections explain the type conventions, icons, and symbols that appear in this manual.

Type Conventions

To identify certain words and phrases in type that differ from the rest of the text quickly, please note the following type conventions:

- Pin and signal names appear in capitalized italics (***DUTY CYCLE.A***).
- Technical terms appear in italicized text when first introduced.
- Unit labels (switches, indicators, etc.) generally appear in boldface letters as they are labeled on the unit (**MODIFY**).
- Commands (**162**) and command names (**setpoint**) appear in boldface lowercase letters.

Icons (Symbols)

This symbol represents important notes concerning potential harm to, this unit, or associated equipment.

LAUDA-Noah® includes this symbol in Danger, Warning, and Caution boxes to identify specific levels of hazard seriousness.

DANGER:
This box identifies hazards or unsafe practices that could result in severe personal injury or death.

WARNING:
This box identifies hazards or unsafe practices that could result in personal injury.

CAUTION:
This box identifies hazards or unsafe practices that could result in product or property damage.

The following symbols may appear on labels on the unit.

High voltage

CE label

NRTL (Nationally Recognized Testing Laboratory)

SAFETY

Do not attempt to install or operate this equipment without proper training.

- Ensure that this unit is properly grounded.
- Ensure that all cables are properly connected.
- Verify that input line voltage and current capacity are within specifications before turning on the power supplies.
- Use proper electrostatic discharge (ESD) precautions.
- BE CAREFUL AROUND THIS EQUIPMENT.

PRODUCT SAFETY/COMPLIANCE

Certain options of this product will be tested for and comply with Electromagnetic Compatibility (EMC) standards. Certification is pending.

Certification

Certain options of this product are pending certification by:

- Canadian Standards Association (CSA) (NRTL/C)
- CE certification
- EMC measurements
- SEMI S2

For more information, refer to the letter of conformance (US) or declaration of conformity (EU) accompanying the product.

Installation Requirements

Install this unit according to the following requirements.

DANGER:
Operating and maintenance personnel must receive proper training before installing, troubleshooting, or maintaining high-energy electrical equipment. Potentially lethal voltages could cause death, serious personal injury, or damage to the equipment. Ensure that all appropriate safety precautions are taken.

DANGER:
RISK OF DEATH OR BODILY INJURY. Disconnect all sources of input power before working on this unit or anything connected to it.

Conditions of Use

To be in compliance with the stated directives and standards, the following conditions of use must be met.

- Operate the Model 3500 only with the type of power connector (190-250 VAC, 30 A, 50/60 Hz, 4-wire connection)
- Install and operate this device in an over voltage category II installation only.
- Install and operate this device only in a pollution degree 2 or better environment, which means an indoor location such as a computer room, office, or factory floor where only non-conductive pollution occurs during operation. Occasionally, a temporary conductivity caused by condensation occurs when the device is not operating.
- To prevent toppling, bolt the rack-mounted power supply/controllers into the rack and bolt the rack to a floor or wall. The 3500 module must also be securely mounted by a bracket or in a subfloor tile mount to prevent toppling.
- Install the Power Distribution Box so that the input power connection is inaccessible to the user behind the electrical panel.
- Use only shielded cables for RS-485 communications.

Chapter 2

Chapter 2 - Theory

DESCRIPTION

The Model 3500 is a Point of Use™ (POU) temperature control system specifically developed for semiconductor wafer processing equipment. The 3500 module incorporates solid-state thermoelectric technology, which completely eliminates the use of *ozone depleting chemicals (ODCs)* or toxic Freon substitutes.

The Model 3500 consists of the 3500 module and a power supply/controller, which is normally housed in an separate, optional, 19" rack-mount unit. The following power supply/controller models are available for a Model 3500 temperature control system:

- PSC2 power supply/controller with 6.6 kW power

Note: The model number is written on the front of the power supply/controller.

Figure 2-1 illustrates the major components, the POU 3500 and PSC2.

Figure 2-1. *Major components of the Point of Use™ Model 3500 system*

THEORY OF OPERATION

The Model 3500 operates on thermoelectric cooling principles based on the Peltier Effect. *Thermoelectric (TE)* devices are small, solid-state heat pumps. The advantages of TE devices are their small size and high reliability. A single-stage thermoelectric cooling

unit is a matrix of thermoelectric couples, connected in series electrically and in parallel thermally. The number of couples depends on the cooling requirement.

Each couple consists of *p-type* and *n-type* semiconductor pillars positioned between two ceramic plates. These plates provide a rigid mounting structure and electrical insulation between the heat sink and the process being cooled. Cooling capacity is proportional to the supply current and the number of couples.

Peltier discovered that heat is released or absorbed when two dissimilar materials that conduct electrical current are joined. A positive voltage applied to the *n-type* material drives electrons from the *p-type* to the *n-type* material and back to the voltage supply. The temperature on the cold side decreases as heat is absorbed. The heat is then conducted through the couple to the hot side to dissipate through a heat sink. The heat dissipated is the sum of the heat removed from the cold side and the heat generated by the thermoelectric input power. Reversing the voltage polarity changes the hot side of the couple to the cold side. Figure 2-2 illustrates this principle.

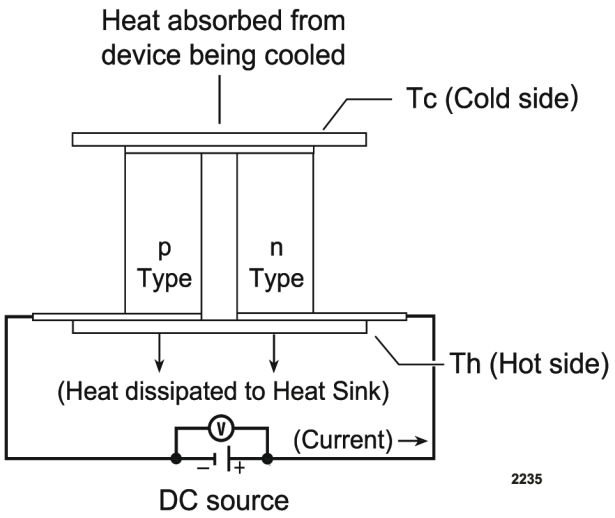


Figure 2-2. *Thermoelectric cooling principle*

Once activated, the Model 3500 system maintains the temperature of the process fluid at a defined setpoint as it returns from the chamber. A resistance temperature detector (RTD) located in the POU module's return fitting provides the feedback signal to the controller, which in turn processes this signal with a PID control algorithm to power the thermoelectric heat pump as needed to maintain the setpoint temperature. The advantages of the thermoelectric heat pump enable the Model 3500 system to control the returning process fluid's temperature with greater resolution and accuracy, faster ramp rates, and higher reliability.

See Figure 2-3 for the circulation flow of the process fluid.

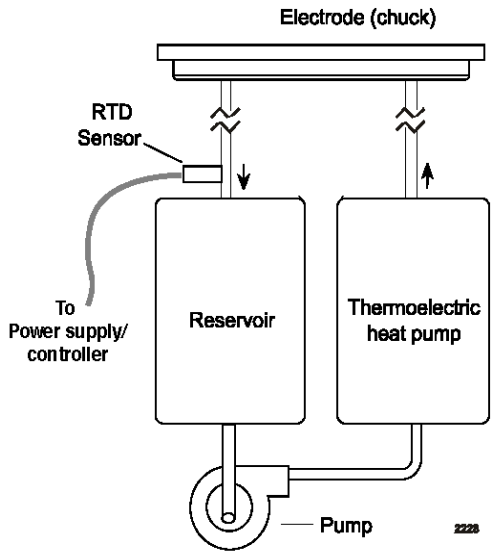


Figure 2-3. *Circulation of process fluid*

Noah's Point of Use™ temperature control systems provide **dynamic temperature control** as opposed to **traditional static control**.

Traditional **static control units** are designed to maintain the setpoint temperature within their reservoir and supply that constant-temperature fluid to the chamber. This is therefore, an **open-loop control** scheme. For stability, the reservoir volume is intentionally made very large to act as a temperature anchor. The drawbacks of this design are decreased efficiency and greater heating and cooling capacity requirements compared to a dynamic control scheme.

Additionally, the fluid's temperature as it reaches the chamber is subject to varying losses based upon installation factors such as the type of hose, hose length and routing, which creates chamber-matching issues. Time-consuming calibration procedures must be performed to attempt to compensate for these installation non-uniformities.

Dynamic temperature control is a **closed-loop control** scheme achieved when Noah's Point of Use™ temperature control systems meet design and installation specifications. These requirements include the short distance between the POU module and chamber, small reservoir volume, return-fluid temperature sensing, adequate fluid flow rate, and responsive heating and cooling elements.

With **dynamic temperature control**, the temperature of the fluid *supplied* to the chamber *changes* in real-time to compensate for varying chamber process conditions, such as RF power application, thereby maintaining chamber temperature for improved wafer-to-wafer and through-the-lot temperature uniformity.

MAJOR COMPONENTS

The Point of Use™ Model 3500 Temperature Control System includes the following features:

- Microprocessor controller with an analog bi-directional power supply
- Digital communication, one RS-485 serial port standard
- Solid-state thermoelectric heating/cooling modules
- Magnetically-coupled, process fluid pump

In addition, the system has the following options. Refer to the "Optional Equipment" section for more information.

- Remote Communication Module (RCM)
- Subfloor tile mount
- Power supply/controller rack with Power Distribution Box

3500 Module

The 3500 module provides dynamic temperature control with minimal space requirements. Designed and tested for reliable, efficient, and quiet operation, the 3500 module requires minimal service to provide continuous dynamic temperature control.

LEDs on the top of the module indicate two status conditions, Liquid Level 1 alarm (LLI, red LED) and system activity (idle/active, green LED).

The fill procedure incorporates a valve system that saves customer downtime. After the initial fill, customers can add process fluid as needed while the system is operating.

Power Supply/Controller

A microprocessor-based controller monitors temperature with 100 Ω, platinum-tip, *resistance temperature detector (RTD)* sensors. The control loop is a three-mode *proportional integral derivative (PID)* control algorithm (see "Tuning the PID Controller" on page 5-8 for more information).

A real-time clock tracks time elapsed in both Idle and Active modes. The clock also measures power usage in both modes and short term power interruptions of up to six seconds, and logs this information.

A two-line, 16-character *LCD* display shows status, alarm, and diagnostic functions. The display also shows setup parameters. An eight-key, tactile keypad under the display is used to input setup data and make parameter adjustments.

Four LEDs below the display indicate heating, cooling, pump outputs and active/idle system status. Additionally, an alarm buzzer sounds if an alarm message appears.

The power supply/controller can be installed up to 24 m (80 feet) away from the Point of Use™ module. Cable length options for the Model 3500 are 3.7 m (12 feet), 13.7 m (45 feet), and 24 m (80 feet).

There are five connectors on the back of the power supply/controller. See Figure 2-4.

- Control signal to the 3500 module (25-pin, D-subminiature connector)
- DC power to the 3500 module (7-pin round connector)
- EMO OUT and EMO IN, connecting various components depending on the EMO configuration (9-pin D-subminiature connectors)
- RS-485 communications to and from the Remote Communication Module or host equipment (9-pin, D-subminiature connector)

The facility power cable enters in the lower right corner, as viewed from behind.

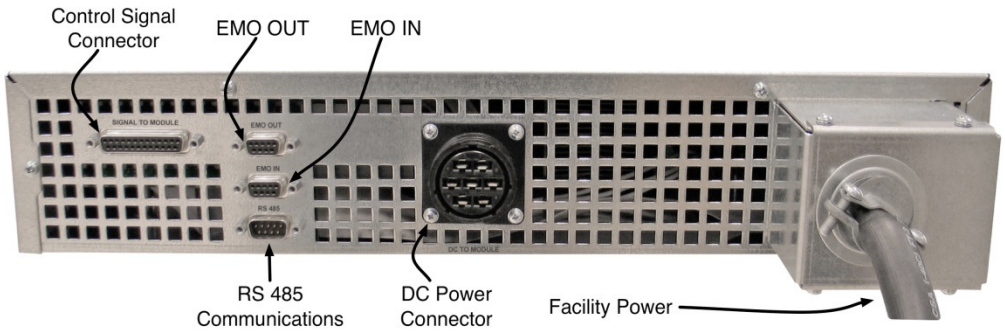


Figure 2-4. *Back view of the power supply/controller*

REMOTE COMMUNICATION MODULE

The Remote Communication Modules (RCM) are interfacing components installed close to the host equipment. The manufacturer and platform-type of the host equipment determines whether an RCM is required for communications. The controller communicates with the RCM through RS-485 digital protocol. The RCM then converts communication data into the protocol of the host equipment. Figure 2-5 shows an RCM.

Figure 2-5. *Remote Communication Module*

DISPLAYS

The window on the front of the controller displays programming parameters and informational messages. There are four types of display messages: informational, status, setup, and alarm messages. Each message contains two lines.

When the controller is initially powered on, the factory display identifies the controller's model number and EPROM version for two seconds while the system initializes. See Figure 2-6.

Figure 2-6. *Initial factory display*

When the system has finished initializing, a system status screen appears indicating the system's operational status, Active or Idle mode and actual temperature. The second line indicates whether the power supply/controller or host tool is assigning the temperature setpoint, Local or Remote control respectively, and the setpoint value. See Figure 2-7.

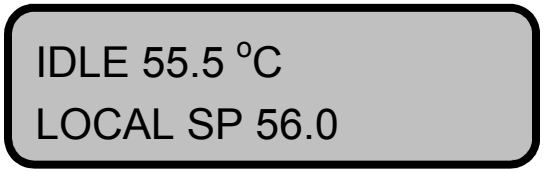


Figure 2-7. *Example IDLE mode display*

Press the **Start key** to enter Active mode. The first line displays mode status and the actual temperature of the process fluid. The second line indicates L (local) or R (remote) control, the setpoint and the power demand percentage. The Active mode display remains until an alarm condition occurs or another function is activated. See Figure 2-8.

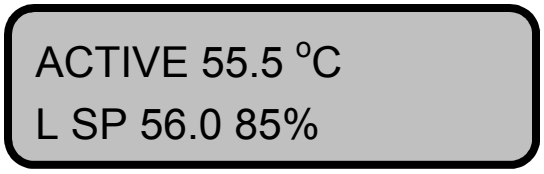


Figure 2-8. *Example ACTIVE mode display*

Entering a three-key sequence allows access to the setup menus. Current EPROM information appears followed by a password request. There are four types of setup menus: global parameters, loop input parameters, loop control parameters, and loop alarms. Press the **Yes** and **No** keys to cycle through the setup menus. Figure 2-9 is an example of a global parameter, the startup alarm delay parameter.

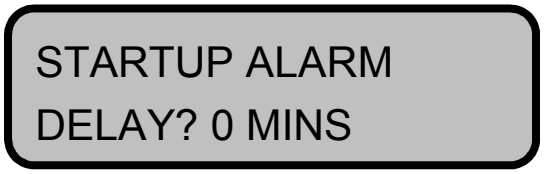


Figure 2-9. *Example startup alarm delay parameter display*

In case of an alarm, the display indicates the type of alarm. The red LED on top of the Point of Use™ 3500 module illuminates if there is an LL1 alarm. Figure 2-10 is an example of a pump power supply alarm.

Figure 2-10. *Pump power supply alarm display. When a warning alarm condition is cleared, the alarm display disappears and the system status screen reappears. When a fault alarm condition is cleared, the alarm has to be acknowledged before the status screen will reappear.*

Chapter 3

Chapter 3 - Specifications

PHYSICAL SPECIFICATIONS

This section has a dimensional drawing for the 3500 module followed by a table of its specifications, a dimensional drawing for the power supply/controller followed by a table of its specifications, and dimensional drawings for the Remote Communication Modules, (both the analog and digital versions).

3500 Module

Figure 3-1 illustrates the physical and mounting dimensions of the 3500 module.
Table 3-1 lists the physical specifications of the 3500 module.

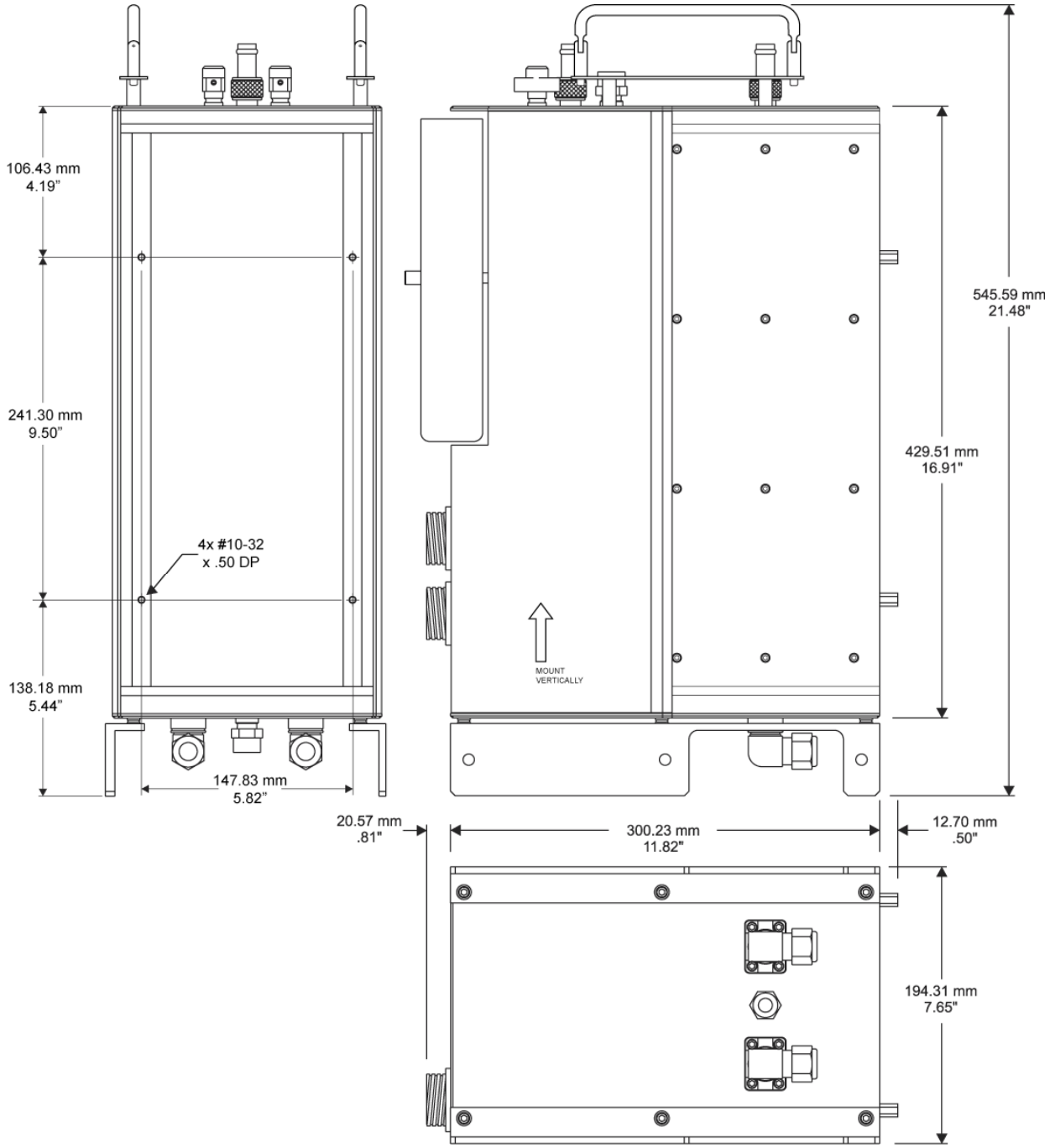


Figure 3-1. *Dimensions of the 3500 module*

Table 3-1. *Physical specifications for 3500 module*

Specification	Description
Size	54.54 cm (H) x 19.4 cm [W] x 30.0 cm (D) (21.48" [H] x 7.65" [W] x 13.13" [D])
Weight	38 kg (84 lb)
Materials	Aluminum and copper; aluminum alodine enclosure
Tank capacity	2.5 liters (0.66 gallons)
Process fluid wetted materials	Aluminum, stainless steel, Viton, PPS, Teflon®, Iglidur, Silicon Carbide
Facility water wetted materials	Anodized aluminum (Xylan®-coated), copper, stainless steel
Temperature range	-20 ºC to +90 ºC (-4 ºF to 194 ºF)
Cooling power	Cooling capacity: 2400 watts at 20 °C
Control	Proportional integral derivative (PID)
Process fluid	Fluorinert™ FC-8270 or Fluorinert™ FC3283 from 3M or Galden® HT-135 or Galden® HT-200 from Solvay Plastics
Process flow rate	4.0 gpm at 30 psi
Pump	2 magnetically coupled pumps
Inlet/outlet tube fittings (process and facility)	½" Swagelok® compression fittings and ½" hose barbs
Power supply/controller	PSC2
CDA inlet ports	¼ inch OD tubing
Protection	• Overtemp switch that monitors facility water temperature • RTD that measures process temperature • Power supply ground fault interrupt • Overtemp and undertemp snap discs in heat exchanger

Introduction of Purged Point of Use Modules

This announcement from the LAUDA-Noah Continuous Improvement Program (CIP) team introduces the Clean Dry Air (CDA) purge module. This is a significant design development intended to address customer feedback and improve reliability. Noah designed the CDA purge model to prevent water vapor from entering the Point of Use (POU) system as well as eliminate water vapor from inside that could condense at temperatures below the dew point and cause premature failure of the module.

The long tenure of the POU system design proves its efficiency, but some consider its resin coating (Dipped) out of place in the fab environment. Additionally, the ideal module mounting location below floor tiles could result in coating damage, which could in turn lead to internal condensation at lower process setpoints, a known factor in reduced thermoelectric lifetime.

The purge approach for preventing condensation is well-accepted and not susceptible to installation/handling damage, but does add new facility requirements which are detailed later in this announcement.

Given that the POU 3500 modules are utilized in the majority of lower temperature setpoint applications, the POU 3500 will be the first model to be upgraded to CDA Purge, effective immediately, with the POU 3300 scheduled to follow.

This improvement upgrade affects the following part numbers and descriptions:

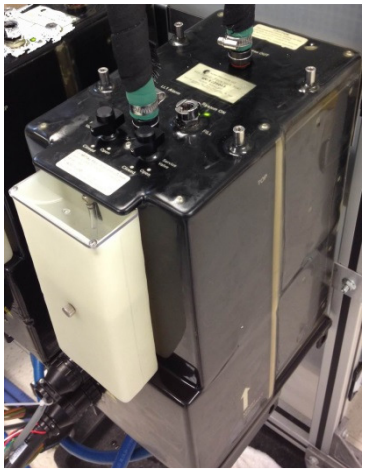
Description	POU TE Chiller		POU TE Chiller w/Purge		POU TE Chiller
Model Type	Old P/N		New P/N Purge		New P/N Dipped
New	900-3500		900-3500-P		900-3500-D
Refurbished / RMA	910-3500		910-3500-P		910-3500-D
Time & Materials / RMA	915-3500		915-3500-P		915-3500-D
New	900-3300		900-3300-P		900-3300-D
Refurbished / RMA	910-3300		910-3300-P		910-3300-D
Time & Materials / RMA	915-3300		915-3300-P		915-3300-D

For customers who may experience delays in facility requirements for CDA, we will accommodate the resin coated model up to May 2016. Please direct further questions to your LAUDA-Noah representative or the Noah factory.

Photos of Resin Coated (Dipped) POU's vs Purged

3300-D **3300-P**

3500-D **3500-P**



Serial number plate examples:

“D”

“P”

Top view for both 3300-P and 3500-P Modules

CDA Labeling

CDA Inlet Ports

3300-P

3500-P

Facility Specification for CDA Supply:

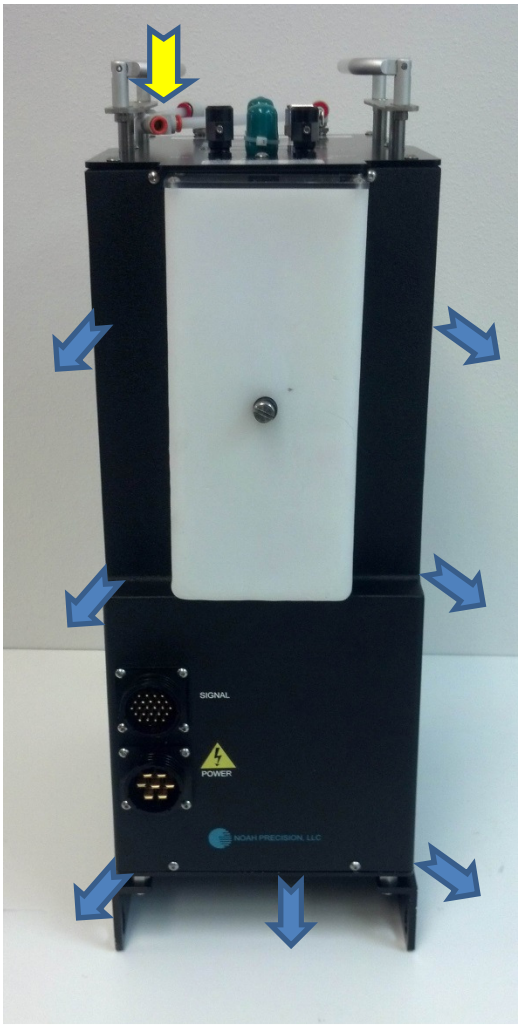
3300-P	**3500-P**
CDA inlet port (¼ inch OD tubing)	CDA inlet port (¼ inch OD tubing)
Pressure: 7-9 psig, (48-62 kPa)	Pressure: 6-11 psig, (41-76 kPa)
Flow rate: 80-120 scfh, (2-3 m^3/h) m^3/h)	Flow rate: 100-160 scfh, (3-5
Dewpoint: -30°C or lower	Dewpoint: -30°C or lower

Application Specification for both 3300-P and 3500-P Modules

CDA required for -20°C to 30°C.
CDA flow diagram for 3500-P Module

Inlet

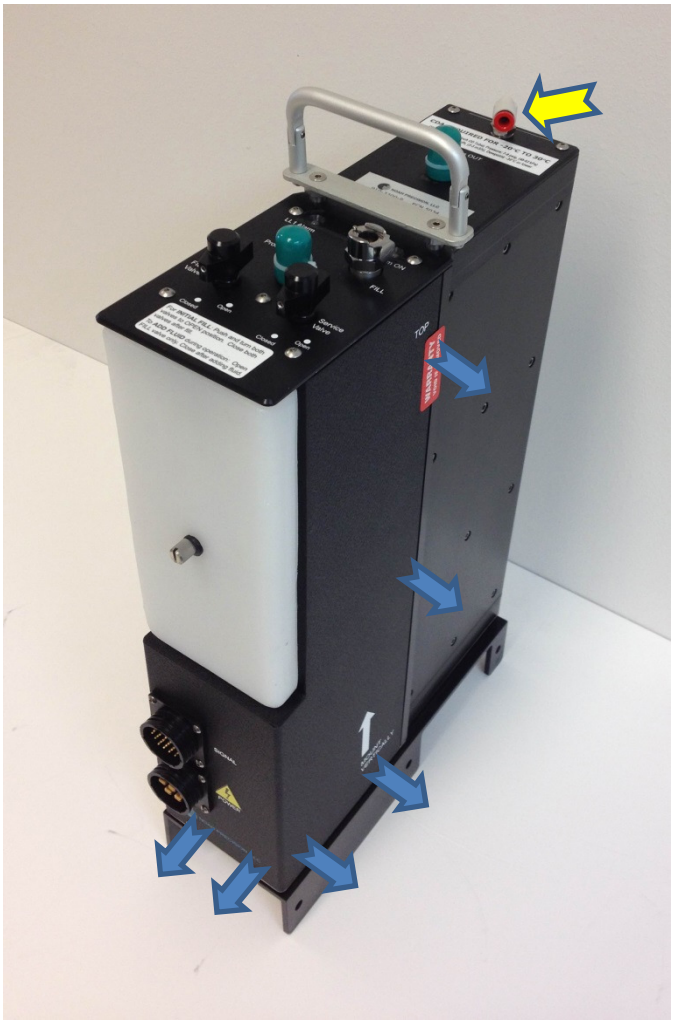
Exhaust



CDA flow diagram for 3300-P Module

Inlet

Exhaust



CDA fittings and tubing

	Manufacturer	Manufacturer P/N	Description	Qty

Noah P/N				
150-4371	SMC	KQ2T07-00A	Fitting, Plastic Tee, ¼”	1
150-4367	SMC	KSL07-35S	Fitting, Rotary, KS, ¼”	2

¼” QD (Quick Disconnect) ¼” NPT

1/4” polypropylene thick-wall type tubing is recommended.

Noah P/N	Description
171-5502	Tubing ¼”, polypropylene

Optional- regulator assembly

Noah P/N	Manufacturer	Manufacturer P/N	Description	Qty
903-1900-KIT	Noah	n/a	Regulator Assembly	1
Or piece parts:				
157-2859	McMaster-Carr	4956K11	Air Regulator, 1/4 Pipe	1
157-2865	McMaster-Carr	4000K745	Multipurpose Gauge, Steel Case	1
150-4373	McMaster-Carr	5779K109	Push-to-Connect Tube Fitting	2

Power Supply/Controller

Figure 3-2 illustrates the physical and mounting dimensions in inches of the power supply/controller. Table 3-2 lists physical specifications.

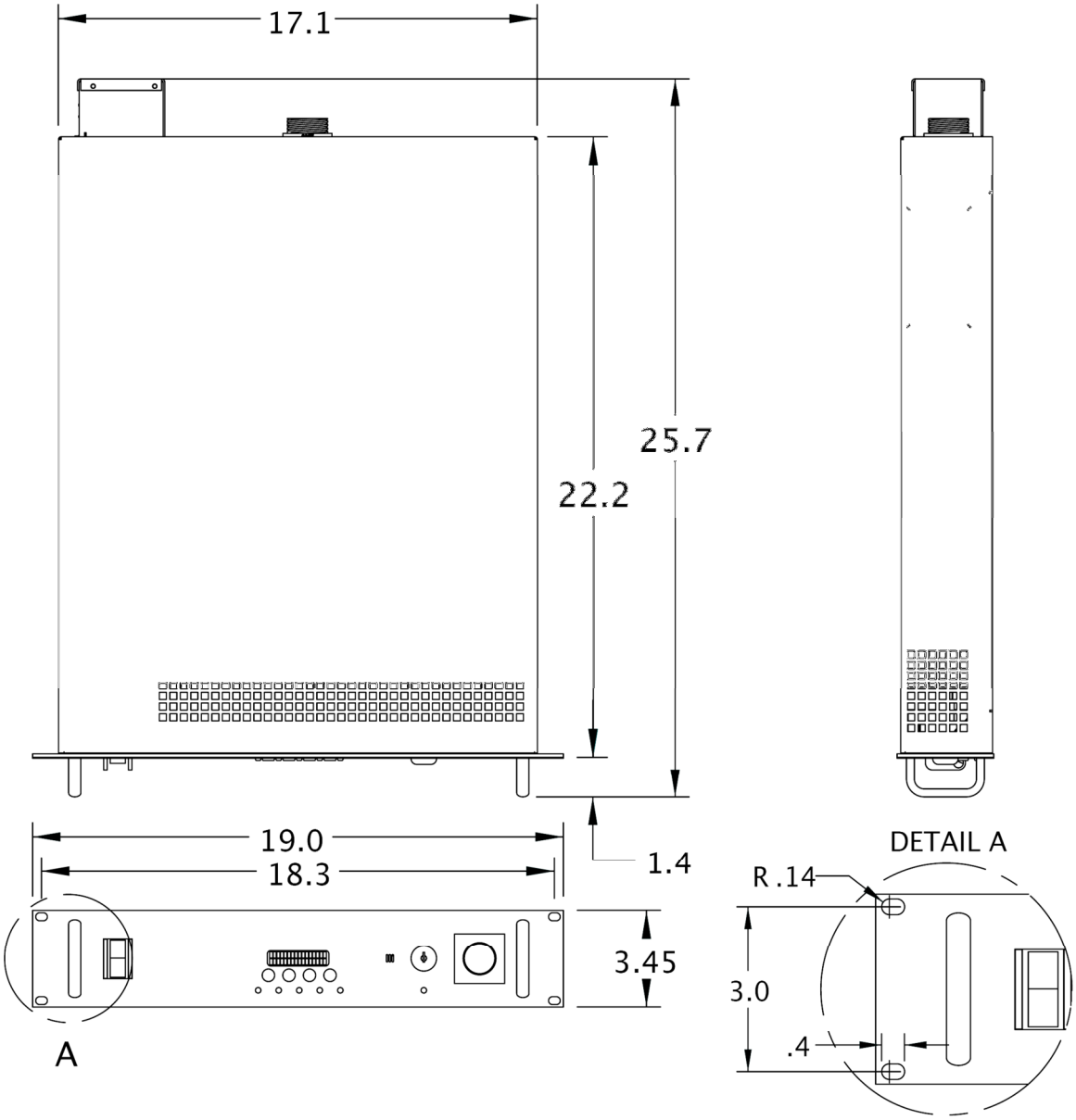


Figure 3-2. *Dimensions of the power supply/controller*

Table 3-2. *Physical specifications for the power supply/controller*

Specification	Description
Size PSC2	 8.76 cm (H) x 48.26 cm (W) x 65.28 cm (D) 3.45" (H) x 19.00" (W) x 25.70" (D) 48.2 cm (19") rack mounted
Weight PSC2	 20 kg (44 lbs)
Materials	Enclosure: Steel Face: Plastic
Operation range	0 ºC to 50 ºC (32 ºF to 122 ºF)
Storage range	-20 ºC to +60 ºC (4 ºF to 140 ºF)
Humidity range	10% to 90% noncondensing
Temperature resolution	0.1 ºC
Display	Alpha numeric display 2 x 16, LCD Backlit 0.51 cm (0.2") characters
Alarm buzzer	Audio tone 90 dB
Setup memory	EPROM, all parameters
Memory retention	10 years without power
Control	Proportional integral derivative (PID)
Adjustment	Heat PB (proportional band): 1.5 ºC to 375 ºC Heat TI (integral): 0 s to 6000 s/r Heat TD (derivative): 0 s to 255 s Heat control filter: 0 to 255 Heat spread: 0 ºC to 25.5 ºC Cool PB (proportional band): 1.5 ºC to 375 ºC Cool TI (integral): 0 s to 6000 s/r Cool TD (derivative): 0 s to 255 s Cool control filter: 0 to 255 Cool spread: 0 ºC to 25.5 ºC
Communication	• CHX protocol (RS-485) • RCM (used with analog communication protocol) • RTU (Modbus, RS-485) • RCMT (RS-232C)
Baud rate	9600

Communication port	RS-485

Table 3-2. *Physical specifications for the power supply/controller (Continued)*

Specification	Description
Communication	• CHX protocol (RS-485) • RCM (used with analog communication protocol) • RTU (factory use only) • RCMT (RS-232C)
Baud rate	9600
Communication port	RS-485

Remote Communication Module

Figure 3-3 shows the dimensions of the Remote Communication Module for 100 mV/ºC analog communication. Figure 3-4 shows the dimensions of the Remote Communication Module with RS-232C serial communication protocol.

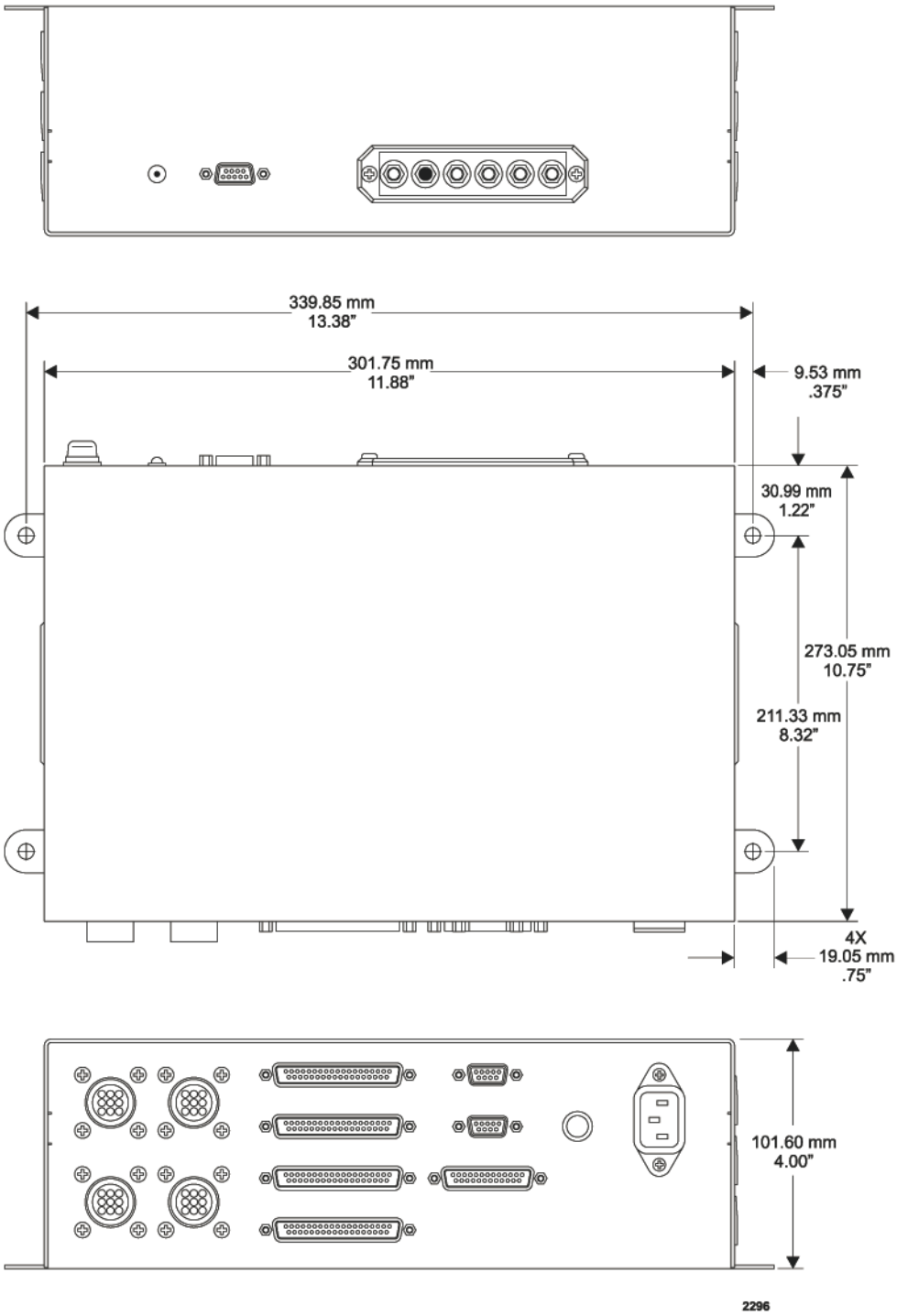


Figure 3-3. *Dimensions of a Remote Communication Module with 100 mV/°C analog communication*

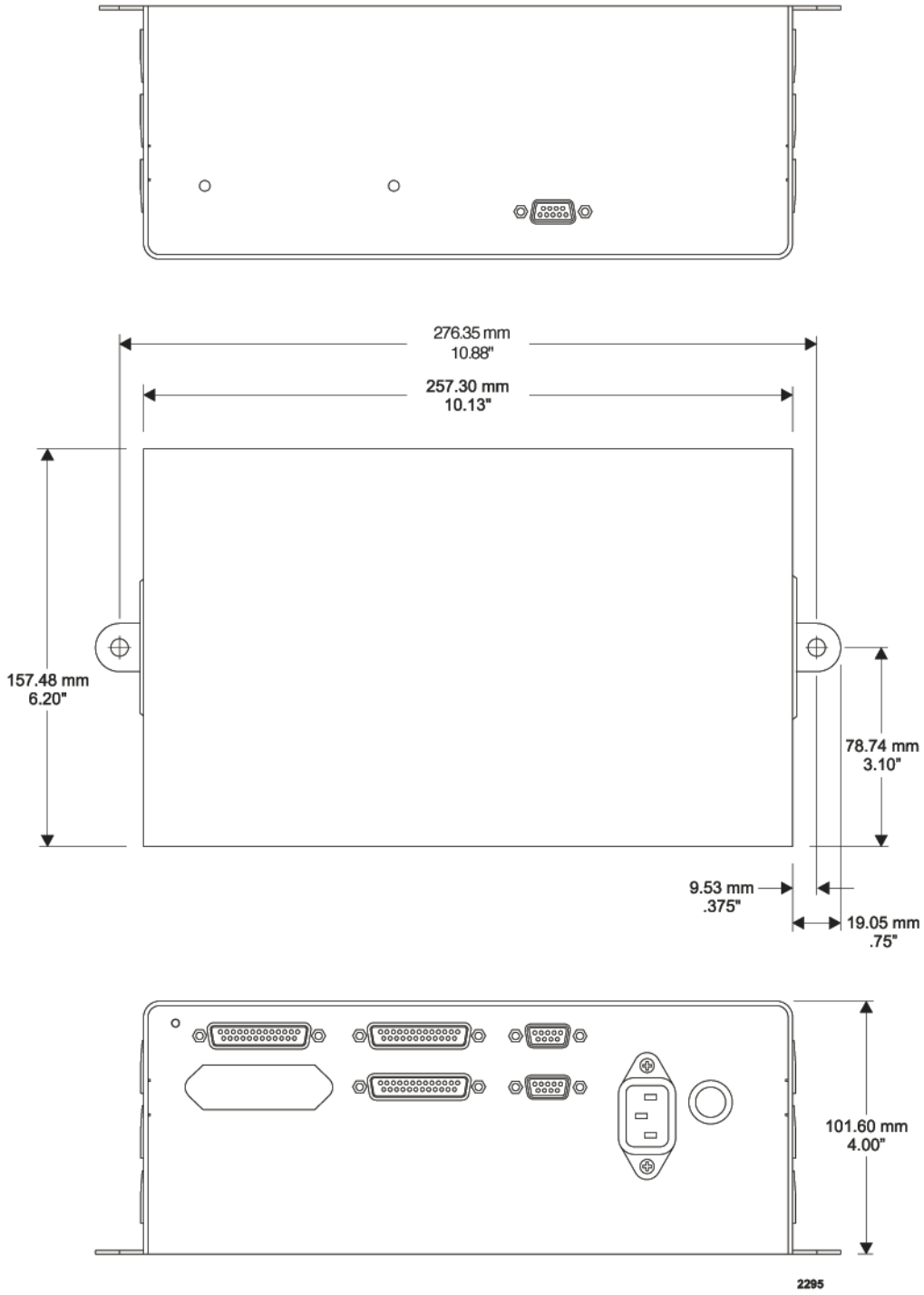


Figure 3-4. *Dimensions of a Remote Communication Module for RS-232C, digital, serial communication*

ELECTRICAL SPECIFICATIONS

Table 3-3 describes the electrical specifications for the Model 3500. Table 3-4 describes the electrical specifications for the power supply/controller.

Table 3-3. *Electrical specifications for the 3500 module*

Description	Specification
Input power from power supply/controller	Thermoelectrics: ±200 VDC, 33 A maximum Pump: 48 VDC, 3-4 A
Connector/cable DC input	7-pin CPC
Signal to module connector from power supply/controller	25-pin, CPC shielded

Table 3-4. *Electrical specifications for the power supply/controller*

Description	Specification
Input power[a]	PSC2 with a 3500 module 190-250 VAC, 30 A, 3-phase, 4-wire, 47-63Hz
Thermoelectric output	±200 VDC, 33 A maximum
Pump output	48 VDC, 3-4 A
TE & Pump o/p connector/cables	7-pin CPC
AC input power connector	3-phase, NEMA L15-30, 3 m (10´) power cord
DC output power to module connector	7-pin CPC
Signal to module connector	25-pin, shielded, D-subminiature
RS-485 communications	9-pin, D-subminiature
EMO In/Out	9-pin, D-subminiature

[a.] In multisystem hookups, each power supply/controller requires 30 amperes.

ENVIRONMENTAL SPECIFICATIONS

Table 3-5 describes climatic specifications.

Table 3-5. *Climatic specifications*

	Temperature	Relative Humidity	Air Pressure
Operating	0°C to +50°C +32°F to +122°F	10% to 90% Note 1 +2 g/m^3 to +25 g/m^3	atmosphere
Storage and Transportation	-20°C to +60°C -4°F to +140°F	10% to 90% Note 1 +2 g/m^3 to +25 g/m^3	atmosphere
Note 1 Noncondensing			

Chapter 4

Chapter 4 - Installation

UNPACKING

Unpack the unit carefully. Verify that all items checked on the packing slip are in the crate. Table 4-1 lists parts.

Note: Shipping containers are reusable, do not destroy.

WARNING:
Heavy Load. The 3500 module weighs 38 kg (84 lb). The power supply/ controller weighs up to 20 kg (44 lb).

Lifting can cause muscle strain or back injury. Use lifting aids and proper lifting techniques when installing, removing or replacing.

CAUTION:
The Point of Use™ module is sealed in a protective plastic coating to prevent condensation. Do *not* puncture or remove. This coating produces a light, non-toxic vanilla smell.

Table 4-1. *Typical list of parts*

Part Number	Part Description	Quantity
900-PSC2	PSC2 power supply/controller	1
900-3500	3500 module	1
901-3620B-KIT	Process FTG 90 1/2"-Sharp	1
275-3587-45	Power/signal cable, 45’	1
171-0679-B25	HOSE PROCESS FLUID BLUE 1/2"X25'	1
900-FILLCAN	Fill/drain canister assembly (optional)	1

Inspect the unit for obvious physical damage. Contact LAUDA-Noah Customer Support and the carrier immediately if there are signs of shipping damage. See “Returning Units for Repair” on page 6-8. Save the shipping container for submitting necessary claims to the carrier.

HOOK-UP

A basic Model 3500 system installation takes about 45 minutes including hook-up and system startup. The only items required are basic plumbing tools and a power source.

Before beginning the installation, verify the facility and process chilled water (PCW).

- Flow rate: 11.4 lpm (3.0 gpm), minimum
- Filtering: 10 micron particle filtering, if deemed necessary
- Temperature: 25 °C (77 °F) or less
- Water pressure: 206.8 to 551.6 kPa (30 to 80 psi)
- Water pressure minimum delta: 206.8 kPa (30 psi)

Facility water must have a minimum flow rate of 11.4 lpm (3.0 gpm) with a maximum temperature of 25 ºC (77 ºF) or less and a minimum pressure delta of 206.8 kPa (30 psi). Supply pressure cannot be lower than 206.8 kPa (30 psi). LAUDA-Noah recommends PCW manifolds with supply and return-side shut-off valves and pressure sensors and return-side flow meters. Inline, 10 micron particle filtering may be necessary for facilities with high impurity concentrations. House water should be chemically treated to prevent the growth of biologicals.

Process fluid fittings (Process IN and Process OUT) for the POU module can be straight barb fittings or optional 90º elbows with barb fittings. Refer to Figure 4-1.

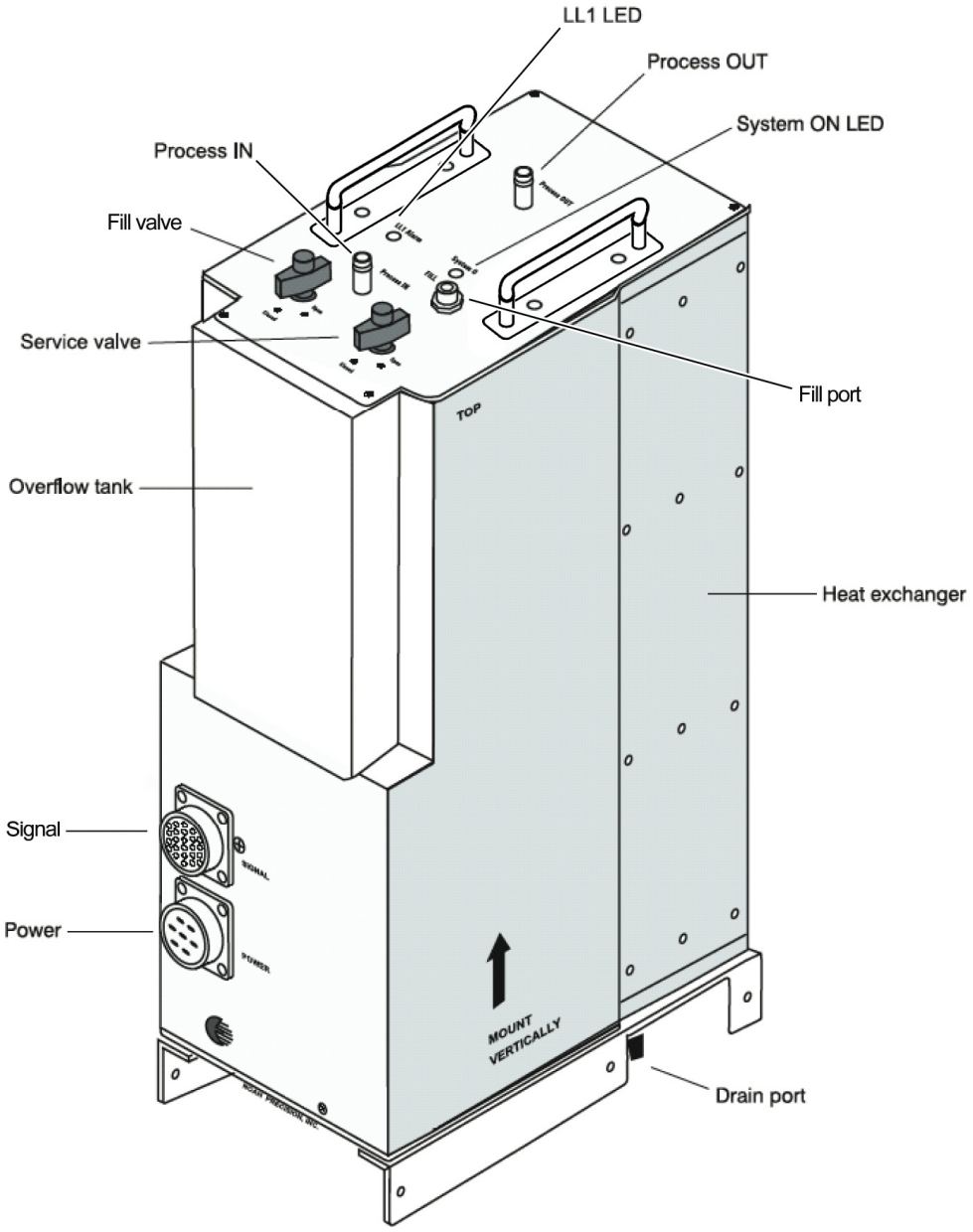


Figure 4-1. *3500 module features*

Hook-Up Procedure

Installing the Model 3500 system consists of installing the Point of Use™ module, power supply/controller, and Remote Communication Module (may be required for communications according to the host tool type).

CAUTION:
The Point of Use™ module is sealed in a protective plastic coating to prevent condensation. Do NOT puncture or remove this coating. The coating produces a slight, vanilla odor which is non-toxic.

CAUTION:
Do not attempt to power on the Model 3500 until it is properly grounded.

1. If using optional 90º process fittings, attach them carefully to the **Process IN** and **Process OUT** tube fittings on the top of the module.

   Position the 90º elbows over the straight tubes and tighten the fittings using a backup wrench.

   After the 90º elbow fittings are in place, insert tube-to-barb adapters. Hold each elbow fitting in place with a backup wrench while tightening the nut.

2. *Secure the temperature control module vertically.* The ports labeled **Process IN** and **Process OUT** must point upward. See Figure 4-2. Use the tapped holes on the back of the POU module for mounting. Refer to Figure 3-1 for the hole pattern.

When selecting the mounting location, the following requirements must be met:

- The process hose lengths between the chamber and the 3500 module must be 3.7 m (12') or less.
- The 3500 module must be mounted vertically below the chamber. This arrangement allows the process fluid to drain from the chamber into the module's reservoir during chamber maintenance once the POU system is idled and service valve is opened.

WARNING:
For earthquake safety, the module, controller, and RCM must be fastened securely.

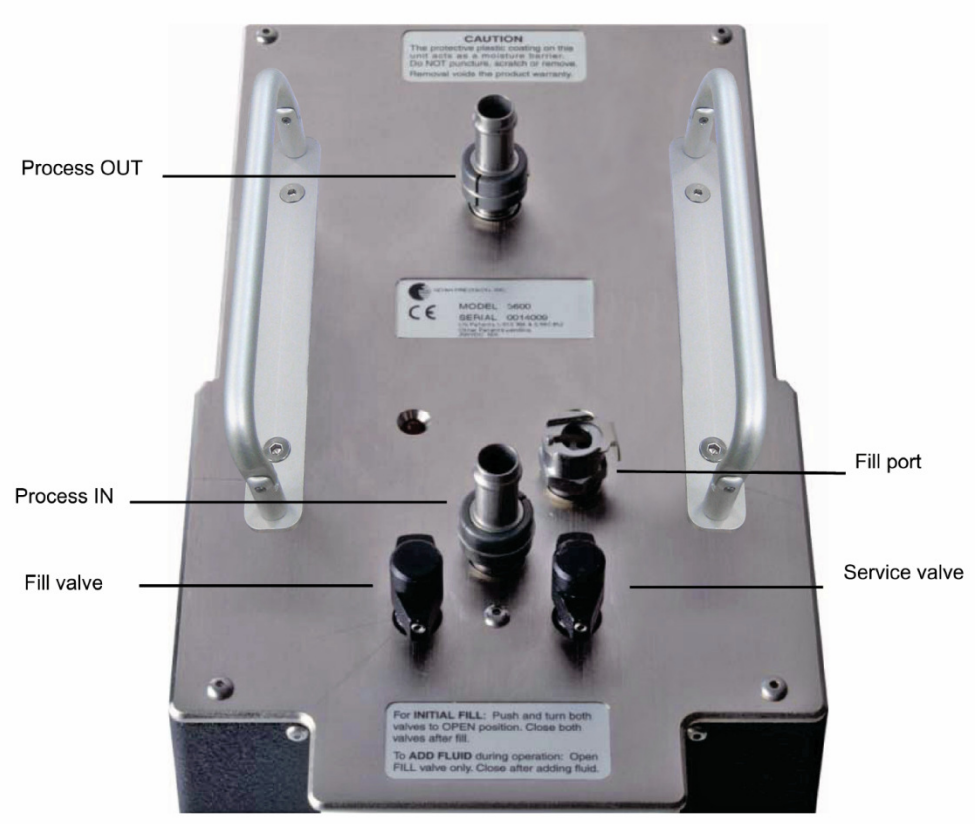


Figure 4-2. *Top view of the 3500 module*

3. Connect the 1/2 inch ID (inner diameter) silicone rubber hose between the chamber's return and supply fittings and the 1/2 inch barb labeled **Process IN** and **Process OUT** respectively. See Figure 4-2.

4. If possible, replace fittings on host equipment with 1/2 inch barbs. Use 1/2 inch ID hoses and non-perforated, stainless steel clamps over the barbs. Be sure that hoses are compatible with perfluorinated fluids and rated for the operating temperature range. LAUDA-Noah recommends 1/2 inch ID premium silicone heater hose.

   Note: To minimize leakage, LAUDA-Noah recommends that hoses be connected directly to the chamber without interconnecting tubing, fittings or valves.

5. Connect the facility water supply hose to the elbow fitting labeled **Facility Water IN** on the bottom of the module. Use 1/2 inch OD (outer diameter) tubing. See Figure 4-3. Turn the fitting into the straight thread of the bushing until the metal backup washer contacts the face of the bushing.

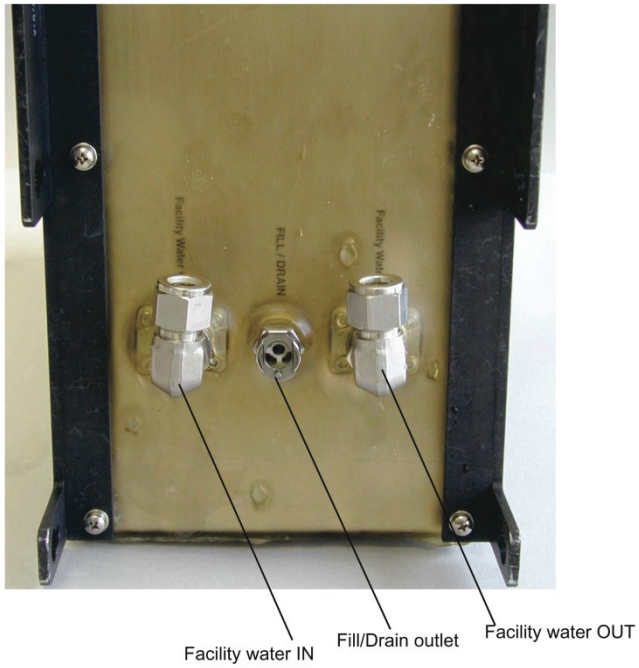


Figure 4-3. *Bottom view of the 3500 module*

6. Position the fitting by backing it out (not more than one turn) until the tube end is oriented in the proper direction. Hold the wrench pad with a backup wrench and tighten the locknut until the washer is against the face of the bushing.

7. If ½ inch ID hose is used instead of tubing, use hose barb adapters and stainless steel clamps. Optional PCW QD fitting kits (Noah part # 901-4161-KIT) are available.

8. Connect the facility water return hose to the elbow fitting labeled **Facility Water OUT** on the bottom of the module.

   Note: Elbow fittings can be rotated to face any direction to facilitate convenient installation.

9. Turn on the facility process chilled water supply and verify that there are no leaks.

Filling the Reservoir

Reservoir capacity is approximately one-third gallon not including external plumbing. Refer to Figure 4-4 for an illustration of the fill procedure for the 3500 module.

CAUTION:
Use only approved process fluids. Do *not* use water or a mixture of water and ethylene glycol. Refer to Table 3-1 for approved fluids.

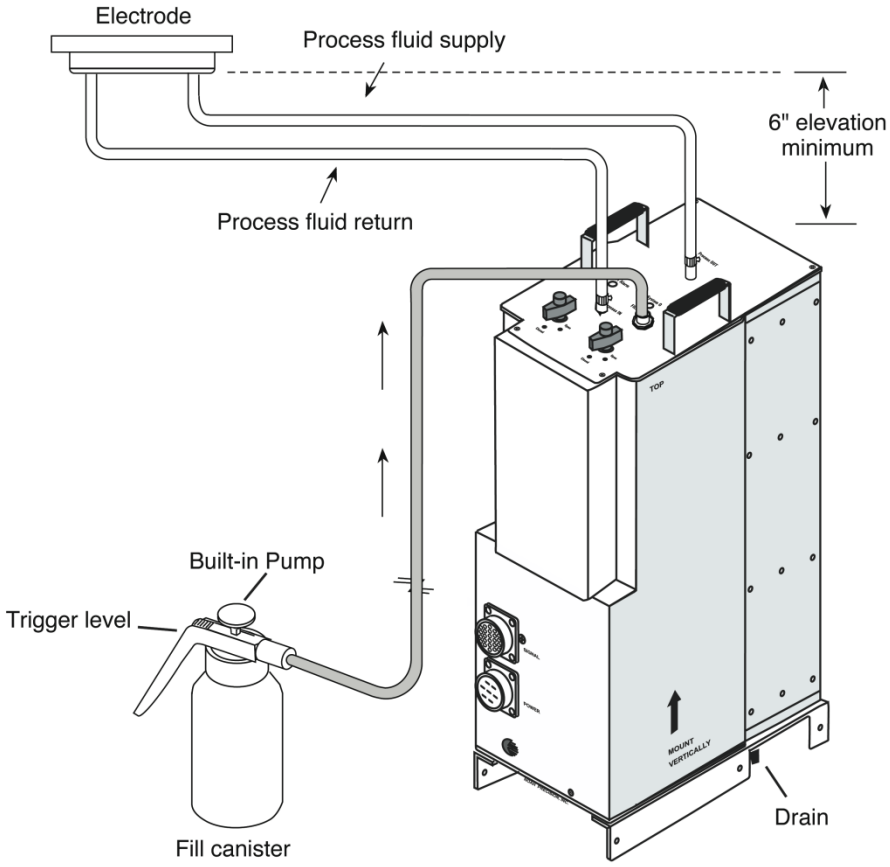


Figure 4-4. *Filling the 3500 module reservoir*

1. Fill the canister with process fluid to the 1 gallon mark. Do *not* top off. Leave room for air.

2. Connect the quick disconnect fitting on the fill canister's tube to the mating quick disconnect fill port on the top of the module.

3. Pressurize the fill canister with its hand pump.

4. Open both the **Fill** and **Service valves** on the top of the module by pushing in and turning the valves counter-clockwise to the **Open** position.

5. Press and hold the trigger lever on the canister to begin filling the reservoir. Continue to pressurize the canister, pumping slowly.

6. Be watchful for process fluid flowing into the overflow tank (~ 500ml after the LL1 LED goes out @ 20 ºC). Fill the overflow tank to about 1 inch from its bottom. When no more air bubbles come out, release the trigger and stop pumping. The reservoir is full.

7. Close both the **Fill** and **Service** valves by turning them clockwise to the **Closed** position.

Electrical Hook-up for a Single Installation

1. Install the power supply/controller in a 19-inch rack or other appropriate location. Orient the power supply/controller so that the electrical connections in the back and the front panel are accessible. Note that standard AC power cables are 3 m (10' long).

WARNING:
Heavy load. Power supply/controller can weigh up to 20 kg (44 lbs).

Lifting can cause muscle strain or back injury. Use lifting aids and proper lifting techniques when installing, removing or replacing.

2. Connect the DC power cable from the 7-pin connector on the 3500 module to the connector on the power supply/controller. Refer to Figure 4-5 and Figure 4-6.

3. Connect the signal cable from the module to the connector on the controller. This is a 25-pin circular connector, female end, connecting with the module and a 25-pin, D-subminiature connector connecting to the power supply/controller. The cable is labeled **Signal to Module**.

If applicable, connect the communication cable from the Remote Communication Module (RCM) to the power supply/controller. Both connectors are 9-pin, D-subminiature and are labeled **RS-485**. (*Note:The RCM communication and EMO cables are paired together as a cable assembly, with the communication cable having female connectors on both ends and the EMO cable being male-male.)*

4. If applicable, connect the **EMO** cable from the RCM to the 9-pin, D-subminiature connector labeled **EMO OUT** located to the right of the DC power cable. Also install the **EMO IN** jumper supplied with the system on the 9-pin, D-subminiature connector labeled **EMO IN**.

If an RCM is not required (either CHX or no communication interfacing), install both the EMO jumpers supplied with the system onto the power supply/controller's 9-pin, D-subminiature connectors labeled **EMO IN** and **EMO OUT**.

5. To disable the EMO feature, turn the keylock clockwise until the red **EMO Disable** LED illuminates.

6. Connect the power supply/controller's AC power cable to either tool or facility power, via a breaker and receptacle box. (*Note*: A hardwired power connection is *NOT* recommended). The power cable is supplied with a NEMA L15-30 plug and the minimum service requirements are 190-230 VAC, 15 A, 3-phase, 4-wire.

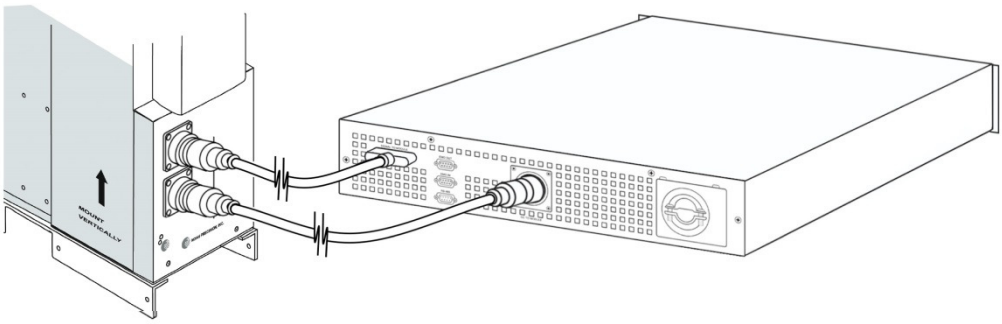


Figure 4-5. *3500 module to power supply/controller hook-up*

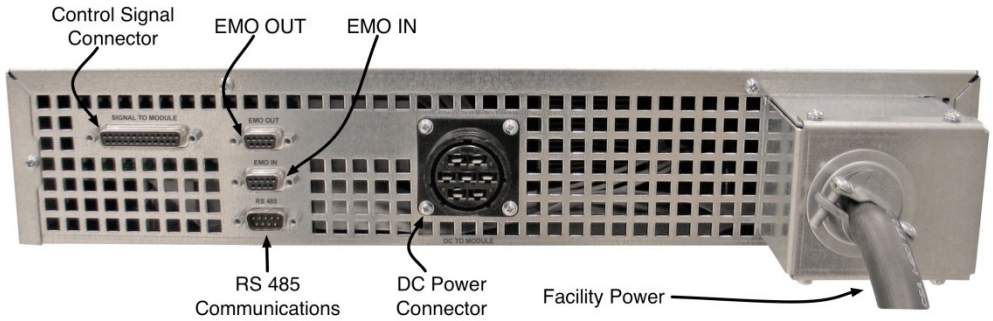


Figure 4-6. *Power supply/controller connections*

Electrical Hook-up for a Multi-system Installation

Installing the power supply/controller rack takes about 30 minutes, requiring only basic tools and a power source. See Figure 4-7.

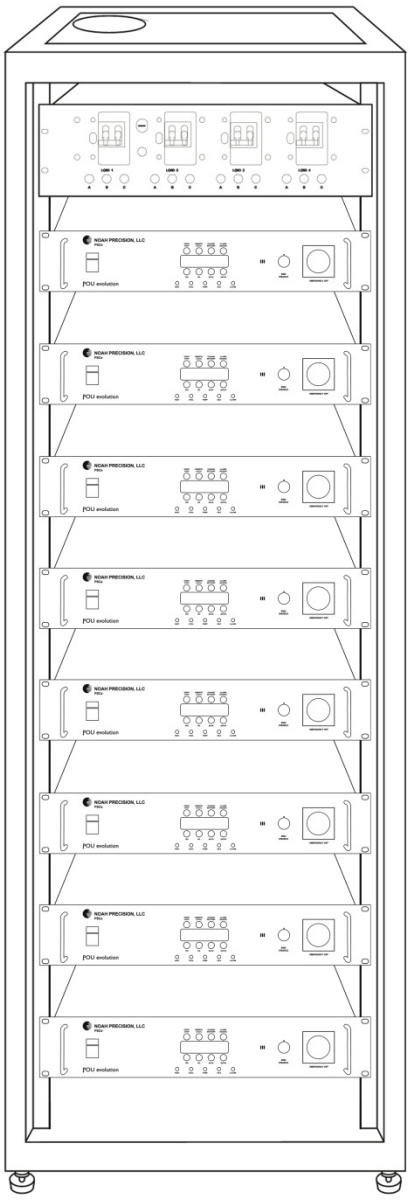


Figure 4-7. *Power supply/controller rack*

1. Place the rack so that electrical connections on the front and rear panels of the power supply/controllers are accessible. Note that standard AC cables are 3 m (10') long.

The top slot of the rack houses a Power Distribution Box that can accommodate eight (8) controllers. It has four switches labeled Load 1 to Load 4. Each is a 100 A, 3-pole switch, with its own lockout-tagout safety feature. The three (3) green lamps below each switch indicate whether or not the connected phases are active. See Figure 4-8 for a front view of the Power Distribution Box, Figure 4-9 for a back view, and Figure 4-10 for a top view.

Figure 4-8. *Front view of the Power Distribution Box*

Figure 4-9. *Back view of the Power Distribution Box*

Figure 4-10. *Top view of the Power Distribution Box*

The rack requires 192-230 VAC, 3-phase, 15 A per controller, 4-wire service. Power is distributed from the main power source through the Power Distribution Box to each power supply/controller.

WARNING:
Heavy load. Each power supply/controller can weigh up to 20 kg (44 lbs).

Lifting can cause muscle strain or back injury. Use lifting aids and proper lifting techniques when installing, removing or replacing.

2. Secure all power supply/controllers to the frame of the rack with #10-32 screws.

3. There are two options for connecting the main power source to the Power Distribution Box: single drop and multi-drop power cable hook-up.

DANGER:
High voltage is active in the system. Only authorized and qualified personnel should install or repair the controller rack.

Be sure switches are in OFF position before connecting any electrical service.

Hook service to the Power Distribution Box. Service must be 208 VAC, 3-phase, 4-wire, 50/60 Hz. Current requirements depend on the number of controllers to be installed. Each controller requires 15 A.

4. The terminal block in the Power Distribution Box is accessed through the top of the rack. Refer to Figure 4-11 for a single-drop hook-up and Figure 4-12 for a multi-drop hook-up. Remove the top cover. Connect the ground wire to the ground terminal block labeled **Ground**.

5. Connect each of the three phase voltage wires to an open slot in the terminal block located in the center of the Power Distribution Box. (Use a 3/16 inch Allen wrench.)

The lamp in the center of the front panel labeled **Main Power** comes on when power is provided to the Power Distribution Box.

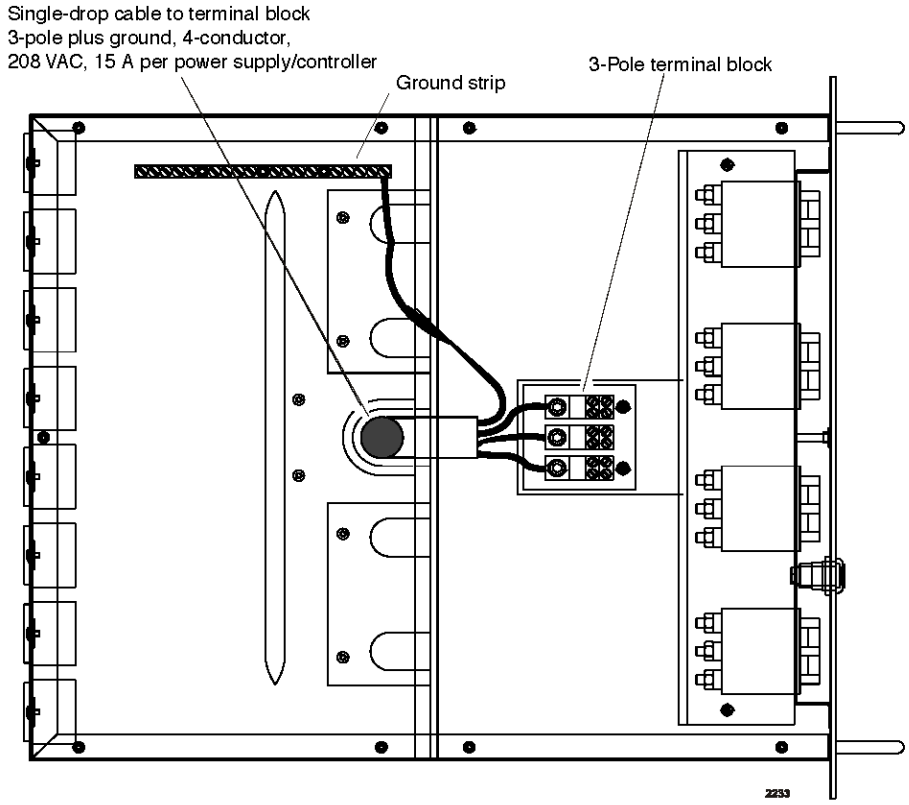


Figure 4-11. *Single-drop cable hook-up for the Power Distribution Box*

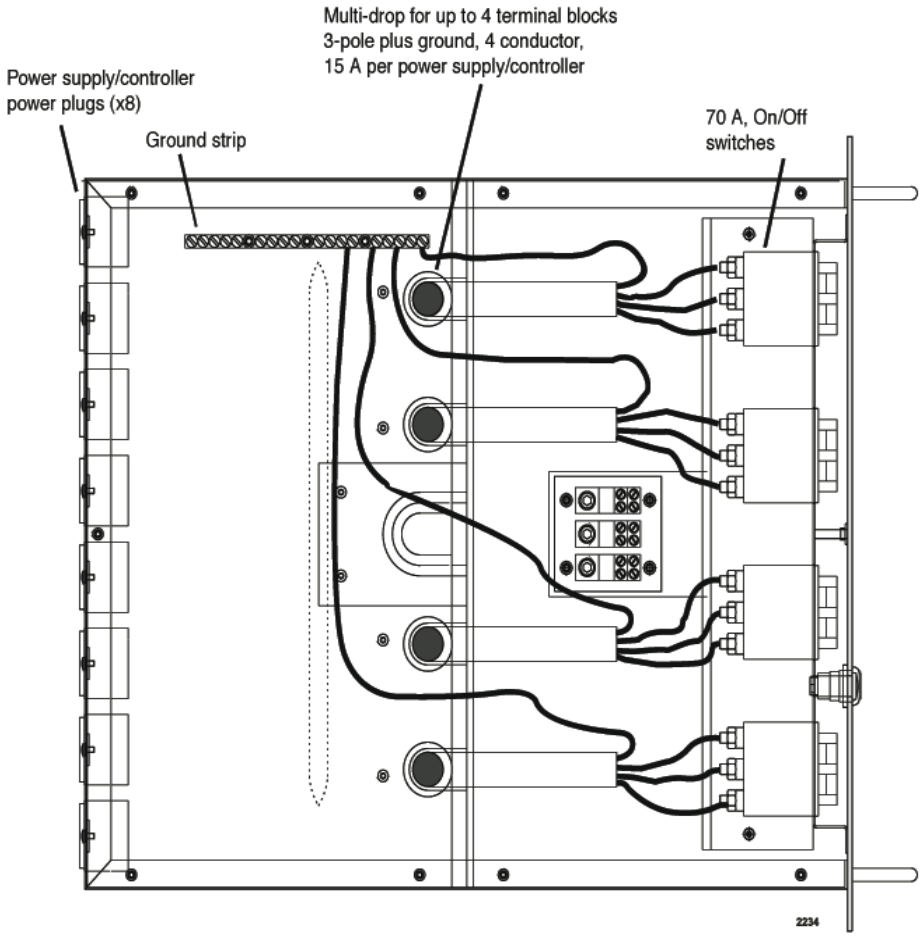


Figure 4-12. *Multi-drop cable hook-up for the Power Distribution Box*

6. Connect the power cords from the controllers to the Power Distribution Box power plugs. Refer to Figure 4-13. The recommended sequence is

Controller 1 (top controller)	to Receptacle 1
Controller 2	to Receptacle 1A
Controller 3	to Receptacle 2
Controller 4	to to Receptacle 2A
and so forth	
Controller 8	to Receptacle 4A

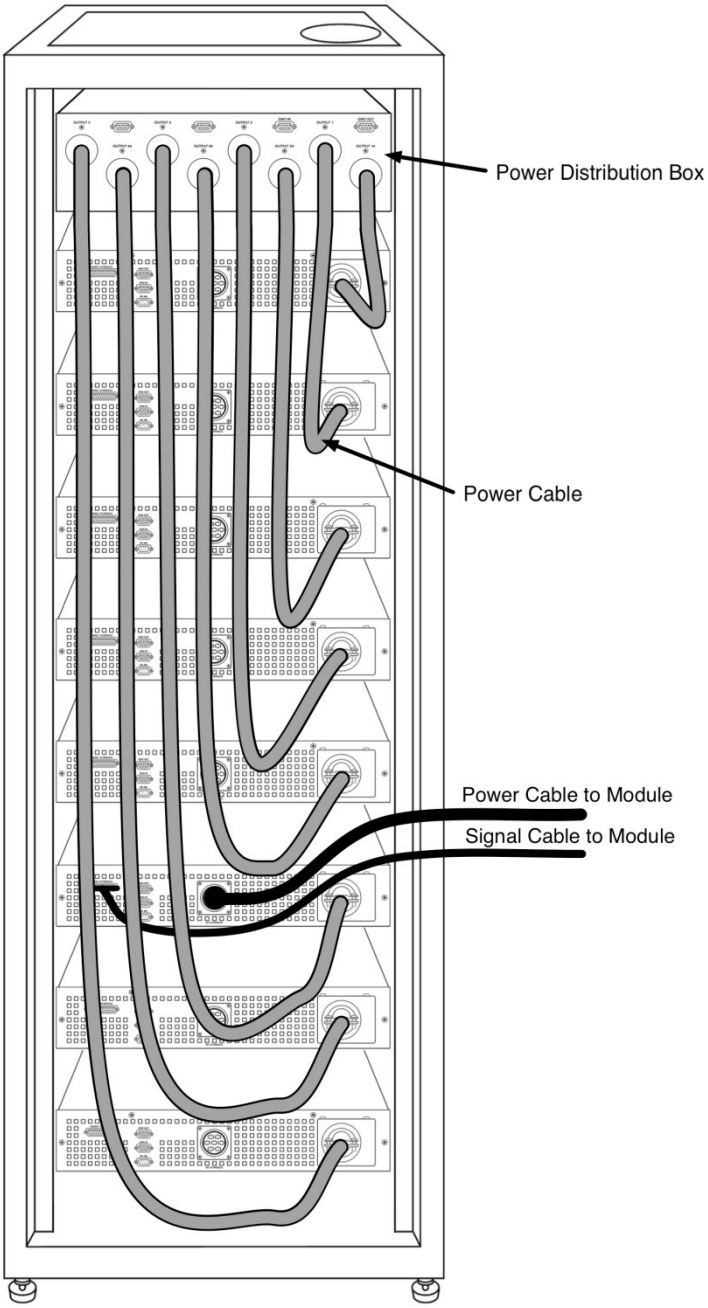


Figure 4-13. *Power and communication wiring for the power supply/controller rack*

(For clarity, EMO connections are not shown)

An EMO interlock disable circuit to the host tool is controlled by a keylock on the front panel of the Power Distribution Box. This circuit enables or disables the EMO circuitry to the host tool when applicable. When the red lamp below the EMO disable keylock is on, the circuit has been disabled.

CAUTION:
If the EMO interlock to the host tool is connected, be sure it is in the Enable position.

The controller's **EMO IN** and **OUT** connections are linked together in a daisychain fashion, **EMO IN** to **EMO OUT**. Controller 1 **EMO OUT** receptacle and the bottom controller **EMO IN** receptacle are jumpered.

When the Remote Communication Module is used, the EMO cable from the RCM connects to the **EMO OUT** receptacle of controller 1.

Refer to Figure 4-14 (for RCM) and Figure 4-15 (for CHX) to connect the EMO circuitry for RCM configurations. For CHX configurations, leave jumpers on **EMO IN** and **EMO OUT** connectors in place.

Each controller can operate with the EMO button enabled or disabled.

To operate with the EMO button *enabled*, use the following procedure.

1. Install jumpers on the **EMO IN** and **EMO OUT** connectors if the controller is used in a stand-alone configuration. If several controllers are used in a multi-channel configuration, they must be daisychained.

2. Put all EMO keylocks in the enabled position.

To *disable* an EMO button, turn the EMO keylock on the front panel of the controller to the disabled position.

CAUTION:
The disabled EMO configuration must be used during replacement of one of the controllers to prevent the unintended loss of service for the other loops.

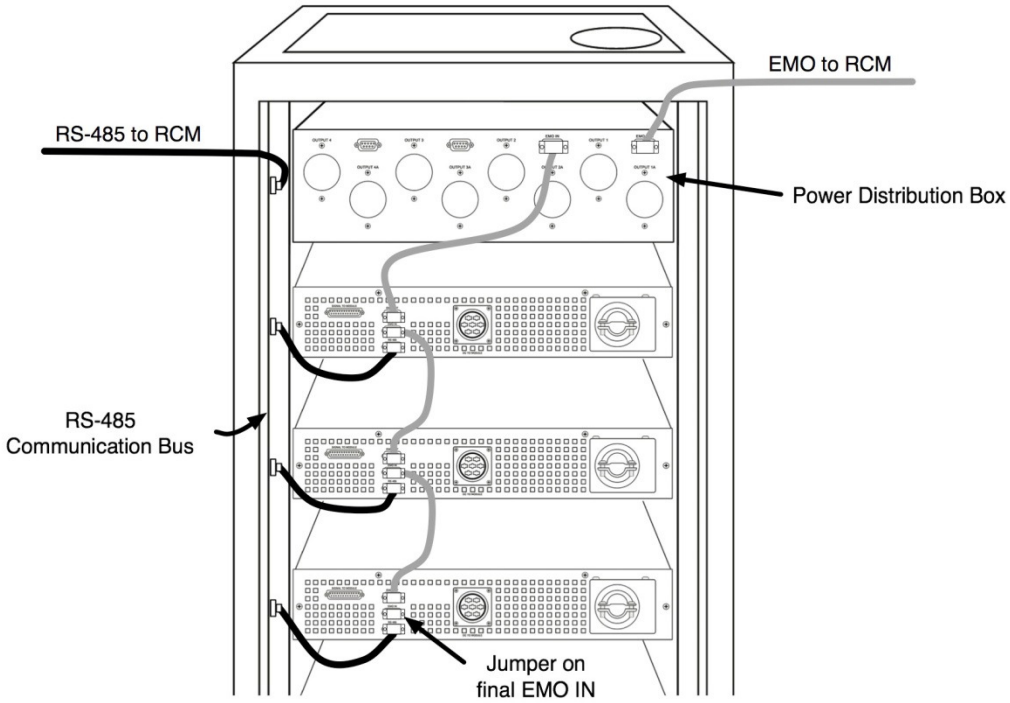


Figure 4-14. *EMO and communication connections for RCM configuration*

(For clarity, Signal/Power connections are not shown)

To replace one of the controllers in a rack, use the following procedure. Actions *must be performed in the correct sequence.*

1. Turn the **EMO** keylock on the Power Distribution Box to the **Disable** position.
2. Turn all **EMO** keylocks on the front panels of the controllers to the **Disable** position.
3. Turn the power on/off switches of the controller(s) to be replaced to the **OFF** position.
4. Disconnect all cables to controller(s) that are being replaced.
5. Replace controller(s) and reconnect cables.
6. Power on replaced controller(s) and verify operation.
7. Enable all **EMO** keylocks.

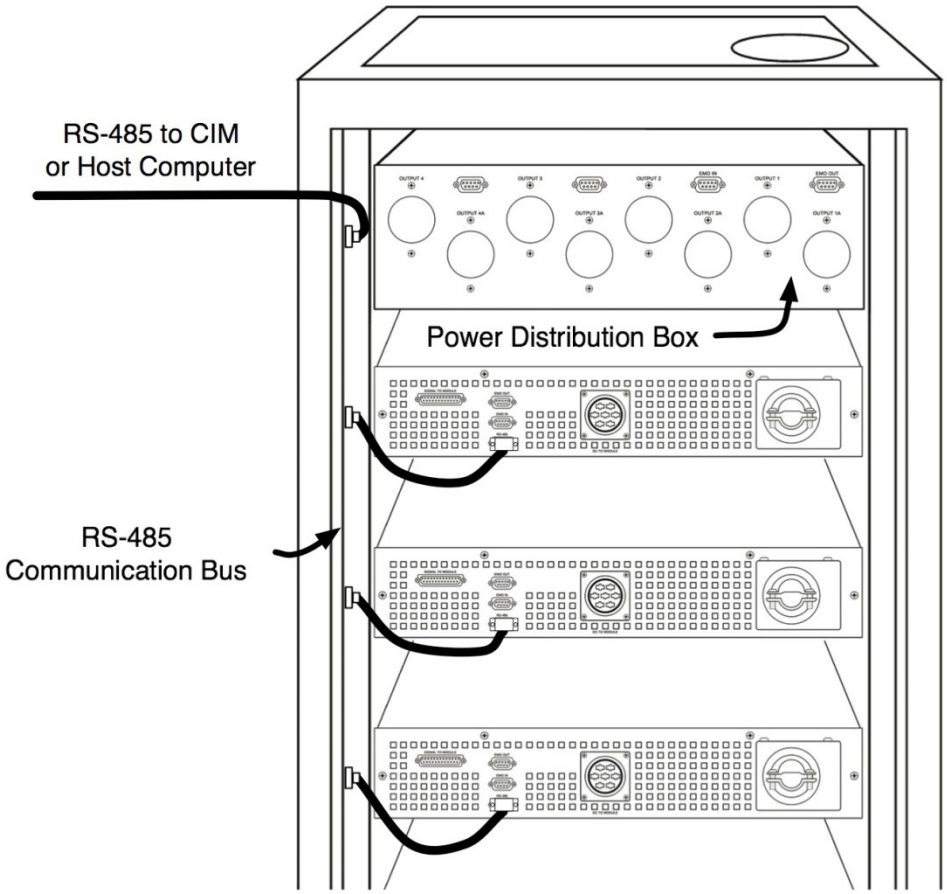


Figure 4-15. *EMO and communications for CHX configuration*

(For clarity, Signal/Power connections are not shown)

RS-485 Bus Installation

1. Connect a 9-wire, flat ribbon cable from each controller to the RS-485 communication bus strip on the side wall of the rack.

2. Connect the incoming communication cable from the host tool to the topmost 9-pin, D-subminiature connector on the communication connector strip labeled **RS-485**.

The Model 3500 features an RS-485 serial (Host) communication port with a 9-pin, male, D-subminiature connector for interfacing with the host equipment. The connection can be to the tool itself or a Remote Communication Module (RCM) depending upon the tool's communication protocol. Figure 4-16 shows the RS-485 port connector. Table 4-2 lists pin descriptions.

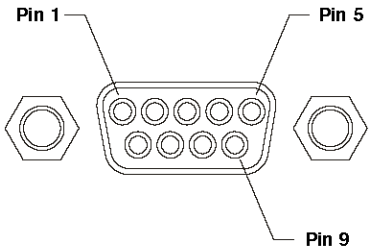


Figure 4-16. *RS-485 connector*

Table 4-2. *RS-485 pin descriptions*

Pin	Pin Name	Description
1	RxT (-)	Transmit/receive data
5	SG	Signal ground
9	RxT (+)	Transmit/receive data

3. Insert a terminating resistor plug on the last (bottom) connector on the communication bus if not already in place. This plug is supplied with the controller rack. See Figure 4-12.

SYSTEM START-UP

Use the following procedure to start the system.

1. Check that the EMO button (located on the right side of the controller front panel) is protruding. If pressed in, twist clockwise to reset. (The **EMO Disable** key is used during servicing only.)

2. Turn the unit on (refer to section "Turning the System On" in chapter 5) and ensure that the fluid loop is completely filled. Due to the small size of the POU module's reservoir, more fluid is required, the red LED on top of the module will come on. This is an LL1 alarm, a soft alarm called **Liquid Level 1**, an information only alarm.

   If the green system LED turns off, the fluid level is at LL2. Fill the system (see step 3 below) and restart. The pump continues to run if only LL1 is active.

   Note: LL2 is normally a hard alarm except when in CHX mode. In CHX mode, LL2 is a soft alarm for 15 minutes, then reverts to a hard alarm.

3. Open the **Fill** valve, and, using the fill canister, add process fluid. The red LED goes out when the reservoir is half filled. Continue to fill until the fluid flows into the overflow tank. Continue filling until the fluid level in the overflow tank is 2 inches from the bottom.

4. Close the fill valve and disconnect the fill canister. Empty the excess process fluid into an authorized storage container.

All configuration functions are programmed through the controller. Controllers leave the factory with a standard default configuration stored in the power supply/controller's EPROM. Parameters must be changed as required during installation. Refer to Figure 4-17 for the location of keys on the controller interface used to program the system.

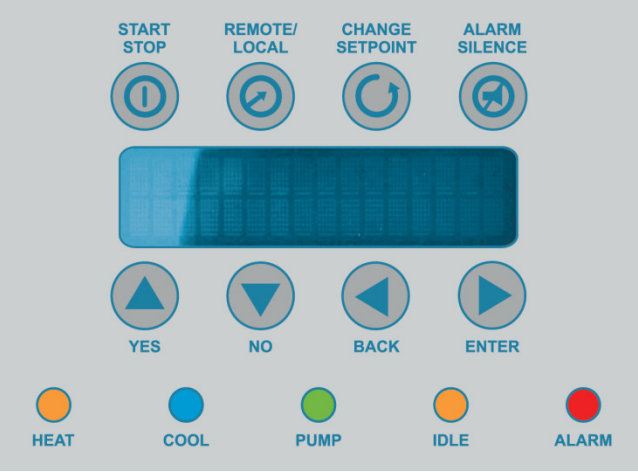


Figure 4-17. *Controller interface*

The following three displays appear in sequence during system start-up.

The factory model number appears on the controller display for approximately two seconds while the unit initializes and enables previous parameters. See Figure 4-18.

Figure 4-18. *Initial display*

1. When initialization is complete, the System Status Screen appears. The top line of the display indicates system status: **Idle** or **Active** followed by the current temperature of the process fluid.

   The second line indicates either Local or Remote control followed by the process set point. Initial system status is Idle mode under Local control. See Figure 4-19. The green LED on the top of the module comes on when the system is in Active mode.

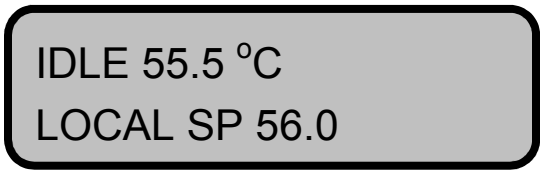


Figure 4-19. *Idle Local mode system status screen*

   To access the setup menus, enter the following three-key sequence on the display pad: Enter, Alarm Silence, Change Setpoint.

2. Information about the EPROM version in the controller appears on the display. Refer to Figure 4-20. The first line describes the controller model (CLS4). The second line is the version of the firmware installed and the checksum.

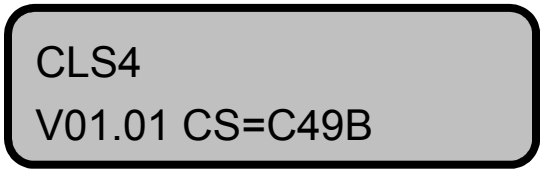


Figure 4-20. *Example EPROM description*

The display as shown in Figure 4-21 shows the PROM version of the power supply processor.

Figure 4-21. *Power Supply PROM description*

Use the following procedure to complete the start-up sequence.

1. Press the **Yes** or **No** key to access the next screen which is a power meter display. See Figure 4-22.

Figure 4-22. *Power meter display*

   The power meter display shows power usage and the amount of time the system has been in Active mode.

2. Press the **Yes** key to access the next screen requesting a three-digit password. Refer to Figure 4-23.

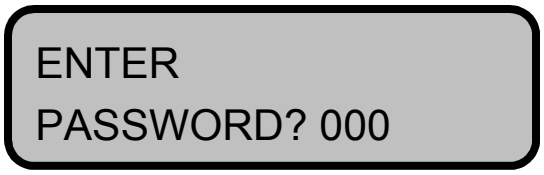


Figure 4-23. *Request for password*

3. The power supply/controller has several levels of access. Press the **Yes** key to enter a password. The display changes to show an equals sign in place of the blinking question mark. See Figure 4-24.

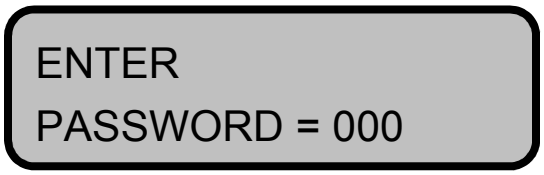


Figure 4-24. *Display for entering password*

4. Use the **Yes** (Up) and **No** (Down) keys to scroll through each digit. When the correct digit appears, press the **Enter** key to advance to the next digit of the password.

   (Only users with valid passwords have access to the setup menus.)

CAUTION:
ACCESSING SETUP MENUS WHILE IN REMOTE CONTROL.

Once the system is operating, switching to Local control causes the system to break communications with the host tool and can cause a CHAMBER FAULT.

Controllers can be programmed while in Remote control. Controllers with older EPROMs must be switched to Local control BEFORE programming. This means that PROCESSING IN THE CHAMBER OF THE ASSOCIATED TOOL MUST BE HALTED BEFOREHAND.

Parameter Setup Menus

There are four setup menus.

- Setup Global Parameters
- Setup Loop Input
- Setup Loop Control Parameters
- Setup Loop Alarms

Table 4-3 shows the menu structure for the parameter setup menus. Password access determines access to various parameters. The parameters in the shaded boxes are set in the factory. Parameters in the [ ] brackets are default values.

Note: The controller automatically exits from Setup mode with no keypad activity after a few minutes.

The range of values for each parameter is listed in Table 4-3. EPROM default values are in brackets. Descriptions of each parameter follow.

To scroll through the parameters within a menu, use the **Yes** and **No** keys. Pressing the **No** key in response to a blinking question mark causes the system to scroll to the next parameter.

Press the **Yes** key to change parameter settings. The question mark will be replaced by an equal sign. Then use the **Yes (Up)** and **No (Down)** keys until the required value appears. Press the **Enter** key to set the parameter and move to the next parameter.

Press the **Back** key to return to the top of the setup menu. Press the **Back** key a second time to exit the setup menus and return to the System Status display.

Table 4-3. *Setup menus*

Setup Global Parameters
Startup alarm delay? 0 to 60 mins [20]
Controller address? 1 to 247 [1]
Communications protocol? [CHX], RCM, RTU, RCMT, RCMe
Model type? [3300] 3500
Audio alarm enabled? [Enabled] Disabled
New user PW? 0 to 499 [000]
Real time clock settings? Yes, [No] if answer yes, follow menu at right and continue down that submenu
Op. hrs = [0] Read Only Tot. hrs = [0] Read Only
Short term power loss = [0] # of occurrences Read Only
Facility temperature [PCW temp] Read Only
CRC PWR = [0] Read Only CRC CLS = [0] Read Only
Reset to defaults? Yes, [No] Reset the Power Meter? Yes, [No]
New Factory PW? 500 to 999 [777]

Setup Loop Input
RTD offset? ±9.9˚C [0.0˚C]
Input filter? 0 to 255 [12] scans

Real time clock settings submenu

Time 0:00 Set hours ?
Time 0:00 Set minutes ?
Date 00-00-00 Set month ?
Date 00-00-00 Set day ?
Date 00-00-00 Set year ?

Setup Loop Control Parameters
Autotune? Yes, [No]
Heat control PB? 0 to 375˚C [11˚C]
Heat control TI? 0 to 6000 s/R [60]
Heat control TD? 0 to 255 s [0]
Heat control filter 0 to 255 s [3]
Heat spread? 0 to 25.5˚C [0.5˚C]
Cool control PB? 0 to 375˚C [9.9]
Cool control TI? 0 to 6000 s/R [60]
Cool control TD? 0 to 255 s [0]
Cool control filter? 0 to 255 [3]
Cool spread? 0 to 25.5˚C [0.5˚C]
SELECT EXCLUSIVE GROUP? **1-4 [1]**
EXCL SP? -50 to 600 [160]
RTD O.S.? ±9.9˚C [.0]
HT Pb? 0 to 375˚C [11.0˚C]
HTTi? 0 to 6000 sec/R [60]

Setup Loop Alarms
HI proc alarm setpt? -40 to 120˚C [95˚C]
Dev alarm value? 0 to 10˚C [5˚C]
LO proc alarm setpt? -40 to 120˚C [-25˚C]
Alarm delay? 0 to 255 sec [240]
LL alarm delay? 0 to 255 sec [240]

HTTd? 0 to 255 sec [0 sec]
HT SPRD? 0 to 25.5˚C [0.5˚C]
CL Pb? 0 to 375˚C [11.0˚C]
CLTi? 0 to 6000 sec/R [60]
CLTd? 0 to 255 sec [0 sec]
CL SPRD? 0 to 25.5˚C [0.5˚C]

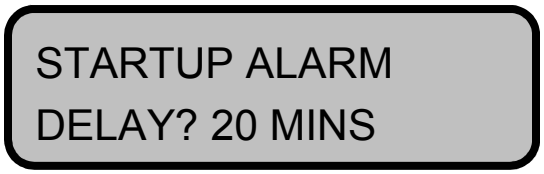
Notes:
1) Parameters in [ ] brackets are default values.
2) Parameters in the shaded cells are accessible only when the factory password is used to enter the setup menus.

Global Setup Parameters

Global Setup parameters determine the operational configuration of the controller.

Startup Alarm Delay

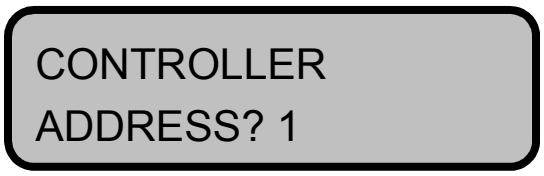
The Startup Alarm Delay parameter sets a start-up delay for the process temperature and deviation alarms. The controller does not report these alarm conditions after power on until the specified number of minutes has elapsed. This parameter does not affect other alarms.



Accepted range is 0 to 60 minutes. Factory default is 20.

Controller Address

The Controller Address parameter sets the controller address for various communication protocols. For example, each controller on an RS-485 bus must have a unique address. It is standard practice to use address 1 for the first controller and assign each subsequent controller the next higher address.



Accepted range is 1 to 247. Factory default is 1.

Note: When the system is configured with a Remote Communication Module (RCM), each controller *must* be configured with a specific address according to the process module with which it is installed. Refer to the RCM User Manual for correct addresses.

Communications Protocol

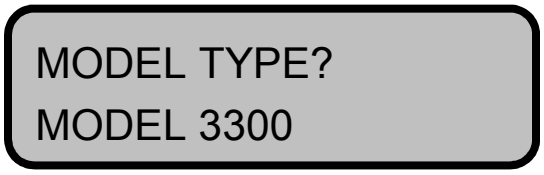
The Communications Protocol parameter sets the type of communications protocol used by the host equipment. There are five options:

- RTU (Modbus RTU, for factory use only)
- CHX (Modbus ASCII protocol, RS 485)
- RCM (Remote Communication Module)
- RCMT (Remote Communication Module, RS232C)
- RCMe (Remote Communication Module, LonWorks)

The factory default is CHX.

Model Type

The Model Type parameter selects the model number of the Point of Use™ module connected to the controller. The Model Type must match the model number of the Point of Use™ module to display the percentage of power demand accurately.



Options are Models 3300 and 3500. Factory default is 3300.

Audio Alarm Enable

The Audio Alarm Enable parameter enables or disables the audio alarm.

The factory default is Enabled.

New User PW

The New User PW parameter provides password identification for new users. Only users with valid three-digit passwords have access to the setup menus.

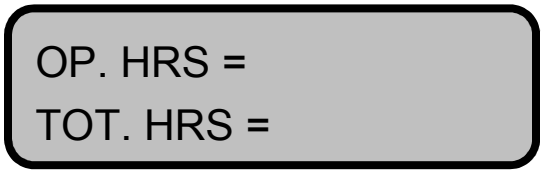
Accepted range is 000 to 499. Factory default is 000.

Real Time Clock Settings

The Real Time Clock Settings parameter allows the user to set the correct date and time for the clock which measures the total time (in hours) elapsed since system power on, whether in Idle or Active mode. This is the **Tot. hrs =** reading.

This parameter also measures the total number of hours that the system has been operating in Active mode (mode in which the voltage outputs to the pump and thermoelectrics are active). This is the **Op. hrs. =** reading.

Options are Yes and No. Factory default is No.



Short Term Power Loss

The Short Term Power Loss parameter displays the number of short term power loss occurrences. If a power loss is six seconds or less, the system continues to operate from the last system state as though there were no power interruption.

Resetting the time/date clears this register.

Range is 0 to 9999.

Facility Temperature

The Facility Temperature parameter displays the PCW temperature measured from the POU module's PCW return port.

This temperature will rise when the module is in the cooling mode and fall when in the heating mode. The displayed reading is a snapshot of the temperature taken at the time this parameter is first viewed. Press the Enter key to take another snapshot and update the reading.

CRC PWR and CRC CLS

The CRC PWR and CRC CLS counts the number of times a cyclic redundancy check (CRC) error is detected by the TE power supply processor (PWR) or by the controller processor (CLS).

Reset to Defaults

The Reset to Defaults parameter resets all programmable parameter values to the EPROM default values. It can be used any time.

Options are Yes and No. Factory default is No.

Reset the Power Meter

The Reset the Power Meter parameter resets the total kilowatt hours and total hours back to zero.

Options are Yes and No. Factory default is No.

New Factory PW

The New Factory PW parameter provides password identification for new factory personnel. Only users with valid three-digit factory passwords have access to the entire menu structure.

Accepted range is 500 to 999.

Loop Input Setup Parameters

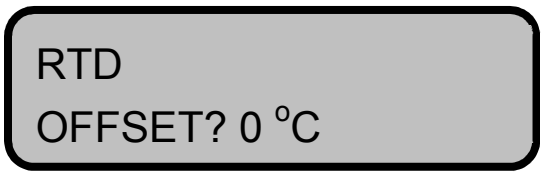
Loop Input Setup parameters affect RTD input sensors.

RTD Offset

The RTD offset parameter is used to provide a temperature offset value to the process RTD reading.

To calibrate the process RTD to a reference temperature, record the difference between the process RTD reading and a reference sensor's reading (the reference temperature). If the process RTD reading is lower than the reference sensor's, enter the difference as a positive value into the RTD offset parameter using the **Yes** and **No** keys. If the process RTD reading is higher than the reference sensor's, enter the difference as a negative value into the RTD offset parameter.

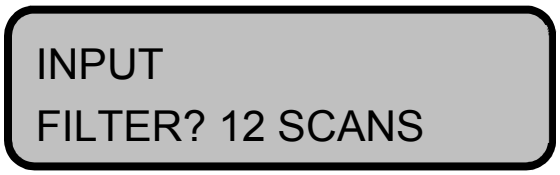
CAUTION:
Only authorized and qualified personnel should perform RTD Offset calibrations.



The range is +9.9 ºC to - 9.9 ºC. Factory default is 0 ºC.

Input Filter

The Input Filter is a digital filter for the RTD input signal. It can be used to filter out erratic swings in the temperature readout due to overly noisy RTD input signals.



The range is 0 to 255 scans. Factory default is 12 scans.

Loop Control Setup Parameters

Loop Control Setup parameters affect control algorithms, tuning, and how the system responds to process temperature changes. Refer to Table 4-3 for default values.

Autotune

The Autotune parameter adjusts the temperature control parameters for optimal system performance.

Options are Yes and No, to activate or deactivate autotuning. Factory default is No.

To activate Autotune, use the following procedure to calculate both heating and cooling PID values.

1. Put the system in Local control. The system can be switched back to Remote control after tuning.
2. Program the **Setpoint** for room temperature (~25˚ C).
3. When the temperature approaches room temperature, press the **Start/Stop** key to put the system back to Idle mode.

   If the unit has trouble stabilizing in Active mode, put it in Idle mode and wait until the temperature stabilizes.
4. Set the Input Filter parameter to **0**. Default is 12.
5. Change the **Setpoint** to **70˚C**. Remain in Idle mode.
6. Set the Autotune parameter to **Yes**. The controller enters Active mode and the top line of the display reads “TUNING” while the heating PID values are being calculated. When complete, the display reads “ACTIVE.”
7. Change the Input Filter back to **12**.
8. Make sure the system is holding the set point (70˚). If it is oscillating, set the Cool Control PB parameter to **375** (max), the Cool Control TI parameter to **0**, and the Cool Control TD parameter to **0**. Refer to page 4-33 to adjust PID cooling parameters.
9. Increase the Heat Control PB parameter in increments of 5 until the oscillations stop. Then change the Cool Control PB parameter to **0** and the set point to **25˚C**. Put the system back in Idle mode when the system reaches set point. Refer to page 4-31 to adjust PID heating parameters.

   Record the values for the heating PIDs.
10. Set the Input Filter parameter to **0** again.
11. Change the set point to **10˚C**. Remain in Idle mode.
12. Set the Autotune parameter to **Yes**. When tuning is complete, change the Input Filter parameter back to **12**.

13. Make sure the system is holding the set point (10˚). If not, set the Heat Control PB parameter to **375** (max), the Heat Control TI parameter to **0**, and the Heat Control TD parameter to **0**.

14. Increase the Cool Control PB parameter in increments of 5 until oscillations stop.

15. Change both the heating and cooling PIDs back to the values that were recorded. Change the set point to a value that will be used in the process and observe the system response. If the heating and cooling LEDs are flashing rapidly and simultaneously, and the temperature is still oscillating, increase the Heat/Cool Spread parameter to **1.0** to stabilize the temperature. (Default is 0.5.)

16. If the temperature still oscillates, increase the PB values for both heating and cooling in increments of 5 until the oscillations stop. If the system responds too slowly, decrease the PB values.

17. If the oscillations stop but there is a difference between the process temperature and the set point, increase the TI values for both heating and cooling until reaching set point.

Heat control PB

The Proportional Band (or gain) parameter for heating determines the proportioning range for the controller in degrees Celsius. This band indicates the range over which the controller varies the heating output from 0% to 100% in proportion to the process temperature's deviation from the set point.

Range is 0 to 375. The larger the number entered, the less proportional action for a given deviation.

Heat Control TI

The Integral term (or reset) parameter for heating sets the integration time for the second mode in the three mode PID control scheme. Integral action eliminates the offset between the process temperature and the set point that can result if only proportional action is used. Setting this parameter to 0.0 eliminates the reset function.

Range is 0 to 6000 seconds/repeat. The larger the number, the greater the integral action.

Heat Control TD

The Derivative (or rate) parameter for heating sets the differentiation constant for the third mode of the three mode PID control scheme. This action corrects for overshooting in the control scheme. Setting this parameter to 0.0 eliminates the rate function.

Range is 0 to 255 seconds. The larger the number, the greater the derivative action.

Heat Control Filter

The Heat Control Filter parameter dampens the heat output response. Heat output responds to a step change by dropping to approximately two-thirds of its final value within the number of scans set. The heat control filter is a digital filter for the heat output signal, applied after the PID functions.

Range is 0 to 255 scans (or measurement cycles). The larger the number of scans, the slower, or more dampened response to changes in the process variable.

Heat Spread

The Heat Spread parameter is used by the controller to determine when heat PID parameters are used. When the process temperature falls below the setpoint minus the heat spread, PID calculations begin to use the heat PID parameters.

Range is 0 ºC to 25.5 ºC.

Cool Control PB

The Proportional Band (or gain) parameter for cooling determines the proportioning range for the controller in degrees Celsius. This band indicates the range over which the controller varies the cooling output from 0% to 100% in proportion to the process temperature's deviation from the set point.

Range is 0 to 375. The larger the number entered, the less proportional action for a given deviation.

Cool Control TI

The Integral term (or reset) parameter for cooling sets the integration time for the second mode in the three mode PID control scheme. Integral action eliminates the offset between the process temperature and the set point that can result if only proportional action is used. Setting this parameter to 0.0, eliminates the reset function.

Range is 0 to 6000 seconds/repeat. The larger the number, the greater the integral action.

Cool Control TD

The Derivative (or rate) parameter for cooling sets the differentiation constant for the third mode of the three mode PID control scheme. This action corrects for overshooting in the control scheme. Setting this parameter to 0.0 eliminates the rate function.

Range is 0 to 255 seconds. The larger the number, the greater the derivative action.

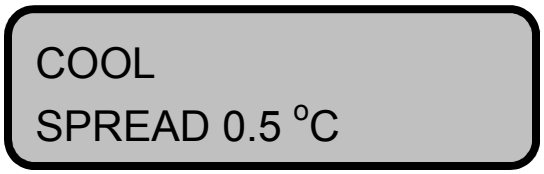
Cool Control Filter

The Cool Control Filter parameter dampens the cooling output response. Cooling output responds to a step change by dropping to approximately two-thirds of its final value within the number of scans set.

Range is 0 to 255 scans (or measurement cycles). The larger the number of scans, the slower, or more dampened response to changes in the process variable.

Cool Spread

The Cool Spread parameter is used by the controller to determine when the cool PID parameters are used. When the process temperature rises above the setpoint plus the cool spread, PID calculations begin to use the cool PID parameters.



Range is 0 ºC to 25.5 ºC.

Exclusive Setpoints with unique PID and temperature offsets

EXCLUSIVE GROUP

The EXCLUSIVE GROUP # sub-menu provides the ability to set up unique PID and temperature offset groups for four exclusive setpoints.

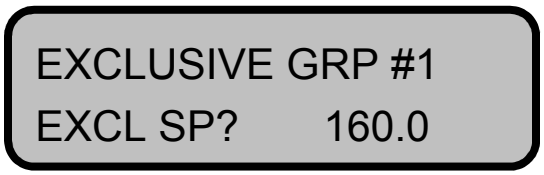
Range is 1 to 4. Factory default is 1.

EXCL SP

The Exclusive Setpoint (EXCL SP) parameter is the temperature setpoint for an exclusive group. Each group's PID and offset setting will be used only when the setpoint entered is: -50.0 °C > EXCL SP < 160.0 °C.

If the setpoint entered is outside this range, the group's PID and offset settings will not be used and the default settings will apply. For example:

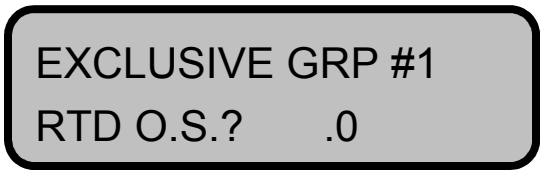
- If Group #1 setpoint = 20.0 °C, group settings will apply.
- If Group #1 setpoint = 160.0 °C, group settings will not apply.



Range is -50 to 600. Factory default is 160.0.

RTD O.S.

The RTD offset (RTD O.S.) parameter is used to provide a temperature offset value to the process RTD reading. This setting is relative to the non-exclusive RTD Offset parameter in the Setup Loop Input Menu.



The range is +9.9 ºC to - 9.9 ºC. Factory default is .0 ºC.

HT Pb

The Proportional Band (HT Pb) parameter for heating determines the proportioning range for the controller in degrees Celsius. This band indicates the range over which the controller varies the heating output from 0% to 100% in proportion to the process temperature's deviation from the set point.

Range is 0 to 375. The larger the number entered, the less proportional action for a given deviation.

HTTi

The Integral term (HTTi) parameter for heating sets the integration time for the second mode in the three mode PID control scheme. Integral action eliminates the offset between the process temperature and the set point that can result if only proportional action is used. Setting this parameter to 0.0 eliminates the reset function.

Range is 0 to 6000 seconds/repeat. The larger the number, the greater the integral action.

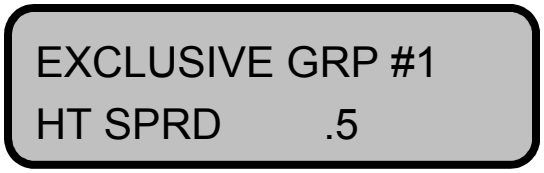
HTTd

The Derivative (HTTd) parameter for heating sets the differentiation constant for the third mode of the three mode PID control scheme. This action corrects for overshooting in the control scheme. Setting this parameter to 0.0 eliminates the derivative function.

Range is 0 to 255 seconds. The larger the number, the greater the derivative action.

HT SPRD

The Heat Spread (HT SPRD) parameter is used by the controller to determine when heat PID parameters are used. When the process temperature falls below the setpoint minus the heat spread, PID calculations begin to use the heat PID parameters.



Range is 0 ºC to 25.5 ºC.

CL Pb

The Proportional Band (CL Pb) parameter for cooling determines the proportioning range for the controller in degrees Celsius. This band indicates the range over which the controller varies the cooling output from 0% to 100% in proportion to the process temperature's deviation from the set point.

Range is 0 to 375. The larger the number entered, the less proportional action for a given deviation.

CLTi

The Integral term (CLTi) parameter for cooling sets the integration time for the second mode in the three mode PID control scheme. Integral action eliminates the offset between the process temperature and the set point that can result if only proportional action is used. Setting this parameter to 0.0 eliminates the reset function.

Range is 0 to 6000 seconds/repeat. The larger the number, the greater the integral action.

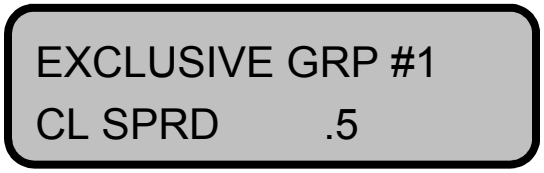
CLTd

The Derivative (CLTd) parameter for cooling sets the differentiation constant for the third mode of the three mode PID control scheme. This action corrects for overshooting in the control scheme. Setting this parameter to 0.0 eliminates the derivative function..

Range is 0 to 255 seconds. The larger the number, the greater the derivative action.

CL SPRD

The Cool Spread (CL SPRD) parameter is used by the controller to determine when cool PID parameters are used. When the process temperature falls below the setpoint minus the cool spread, PID calculations begin to use the cool PID parameters.



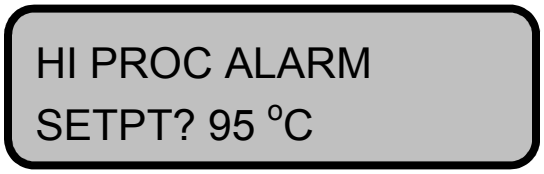
Range is 0 ºC to 25.5 ºC.

Alarm Setup Parameters

The Alarm Setup parameters set alarm functions including alarm responses for different types of alarms. See “Alarms” on page 5-10.

Hi Proc Alarm Setpt

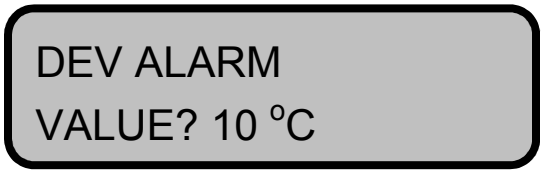
The Hi Proc Alarm Setpt parameter sets the High temperature alarm set point. The process temperature is continually compared with this setting. If exceeded, the High Process Temperature alarm is activated.



Range is -40 to 120˚C. Factory default is 95 ºC.

Dev Alarm Value

The Dev Alarm Value parameter sets the deviation band width with respect to the process set point. If the process temperature rises above or falls below this limit, a High deviation or Low deviation alarm is activated. For example, if the Dev Alarm Value is set to 5ºC and the set point is 20ºC, and the process temperature rises above 25ºC or falls below 15˚C, then the Hi or Low deviation alarm comes on. (If the set point changes, the deviation band moves with it.)



Range is 0 to 10˚C. Factory default is 10 ˚C.

Lo Proc Alarm Setpt

The Lo Proc Alarm Setpt parameter sets the Low temperature alarm set point. The process temperature is continually compared with this setting. If exceeded, the Low Process Temperature alarm is activated.

Range is -40 ˚C to 120 ˚C. Factory default is -25 ˚C.

Alarm Delay

The Alarm Delay parameter delays failed sensor and process alarms until these alarm conditions have been present continuously for a longer period than this parameter's setting.

Range is 0 to 255 seconds. Factory default is 10 seconds.

Saving Parameter Changes

Pressing the **Enter** key automatically saves parameter changes. Setup parameters are stored into EPROM memory. This is a permanent (10 year minimum life) memory that does not require battery backup.

This feature allows OEM users to specify the initial condition parameters set at the factory. It also allows the user to modify appropriate parameters from the keypad without the risks associated with manual adjustments.

Checking for Leaks

When setup is complete, press the **Start/Stop** key to put the system in Active mode. The pump begins circulating the process fluid through the host equipment. As the process fluid circulates, the fittings and hoses *must* be checked for leakage. (This includes fittings and hoses both on the temperature control module and the host equipment.)

1. If alarms occur, refer to "Alarms" on page 5-10 to clear alarms.

2. Visually check for leaks.

3. Because Fluorinert and Galden are clear fluids and evaporate almost immediately, LAUDA-Noah recommends using a halogen leak detector, such as a TIF Model 560A, to verify leak-free connections.

4. Be sure the sensing tip of the leak detector is in a Fluorinert or Galden-free environment when pressing the Reset Button on the leak detector. *Never* touch the tip directly to these fluids.

5. Using the leak detector, check along the hoses and the hose connections. Continue to check along the entire plumbing loop, from the temperature control module to the chamber and back. Be sure to check every point on the closed loop system. The visual indicator provides the most accurate indication of leakage.

CAUTION:

Do not use plastic fittings in the process fluid loop.

SYSTEM SHUT-DOWN

System shut-down requires two steps.

1. Press the Start/Stop key on the keypad. The green LED on the top of the module goes off when the system is in Idle mode.

2. Turn off power to all circuits with the power switch located on the left front side of the power supply/controller.

OPTIONAL EQUIPMENT

The Model 3500 has several options available.

- Remote Communication Module
- Power supply/controller rack
- Subfloor tile mount
- Communication isolation module

Remote Communication Module

An optional Remote Communication Module (RCM) provides an interface between the power supply/controller and host tools which do not use RS-485 communications. LAUDA-Noah offers RCMs for various OEM communication protocols. Figure 4-25 shows one of the RCM models available.

Figure 4-25. *Remote Communication Module (RCM)*

RCM installations require both facility installation and RCM configuration. (The most commonly used RCM has four pairs of signal and EMO connectors that can accommodate up to eight Point of Use™ systems.) Refer to the RCM manual for more

information. The RCM can be mounted vertically or horizontally. Figure 4-26 illustrates the basic concept of the RCM.

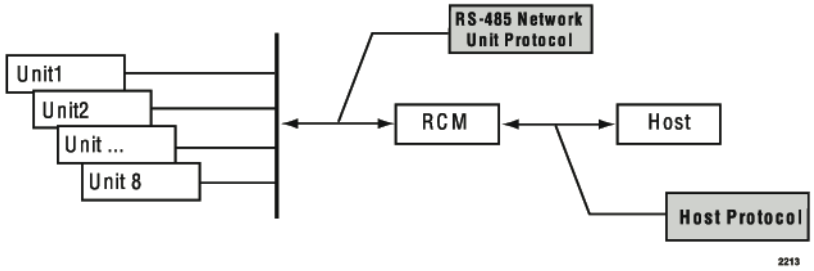


Figure 4-26. *Typical RCM configuration*

Power Supply/Controller Rack

The power supply/controller rack houses up to eight controllers under one Power Distribution Box. The controller rack has removable top and side panels for easy access and convenient installation.

There is one power supply/controller rack size: 62 inches (157 cm) which holds eight power supply/controllers. See Figure 4-27.

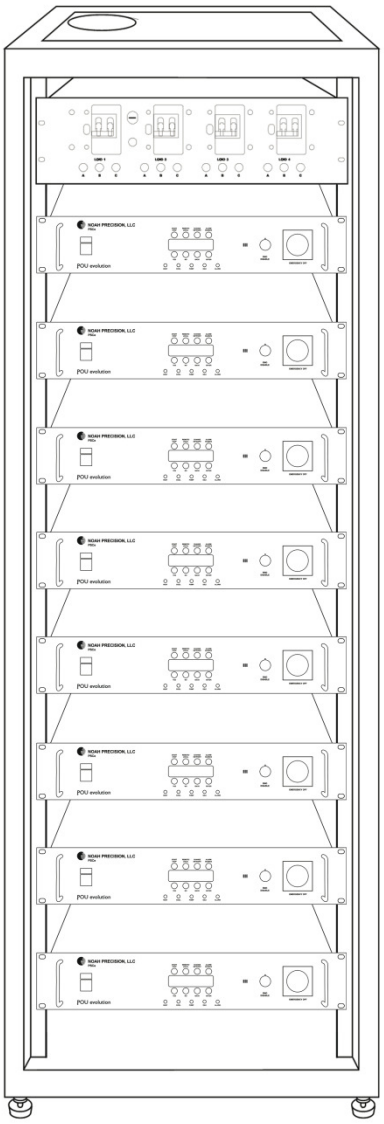


Figure 4-27. *Power supply/controller rack*

Optional Subfloor Tile Mount

LAUDA-Noah Point of Use™ modules are designed for convenient installation. They are compact and easily installed. Installations include:

- Frame-integrated
- Mounted under floor tiles
- Installed as far away as twelve (12) feet

Subfloor tile mounting requires only basic tools: a screwdriver, crescent wrench, and Allen wrenches.

Before beginning the installation, floor tiles must be fitted for the subfloor tile mount insert plate. This plate is square measuring 508 mm (20.00 inches) on each side.

The customer provides the cut out floor tile. Call the factory for dimension drawing of the 20x20 floor tile.

To install the subfloor tile mount with two modules, use the following procedure. Refer to Figure 4-28 and Figure 4-29.

1. Connect the four support legs to the insert plate with four 1/2-13 x 1” socket head cap screws. Tighten until secure.

2. Place the insert plate (with legs) near the installation location.

3. Attach the two handle assemblies to the sides of the top of the insert plate. Use four standoffs and #10-32 x 3/8” sockethead cap screws and #10 flat washers.

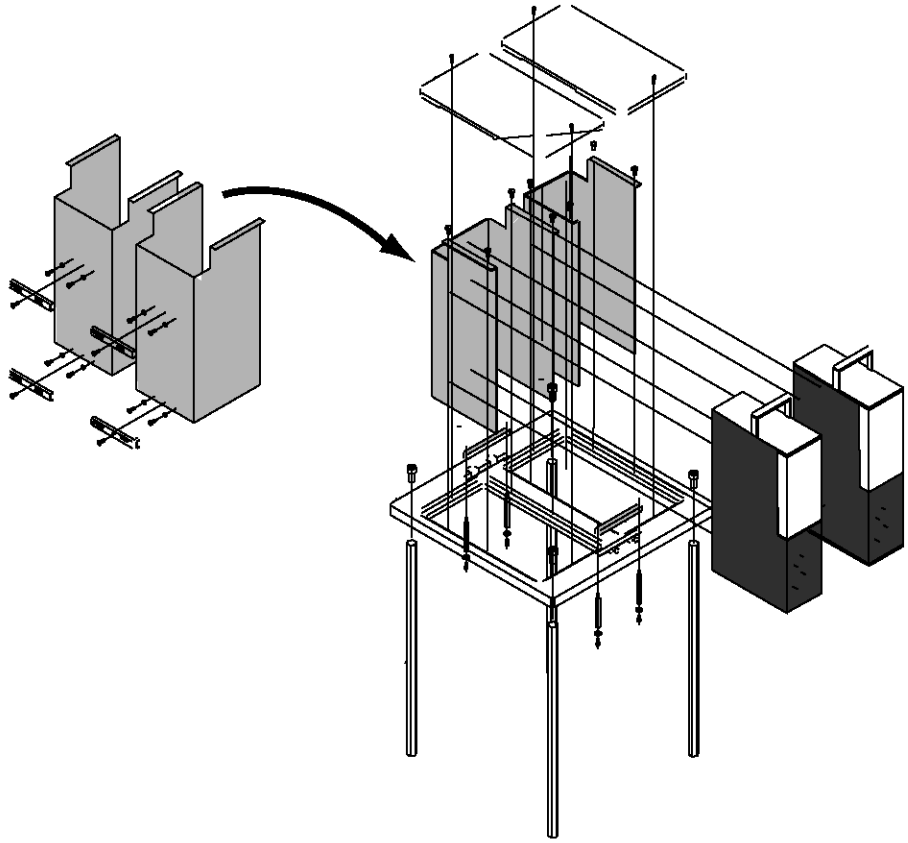


Figure 4-28. *Subfloor tile mount assembly, exploded view*

Note: For illustration purposes only, 3300 modules are shown instead of 3500 modules

4. Place the subfloor tile mount into the floor frame without the Point of Use™ modules.

WARNING:
Two people are required to lift and place the Subfloor Tile Mount into the floor tile. Lift only by handles.

Lifting can cause muscle strain or back injury. Use lifting aids and proper lifting techniques when installing, removing or replacing.

5. Attach the two modules to the bulkhead brackets with eight #10-32 x 1/2” hex head machine screws and #10 lock washers.

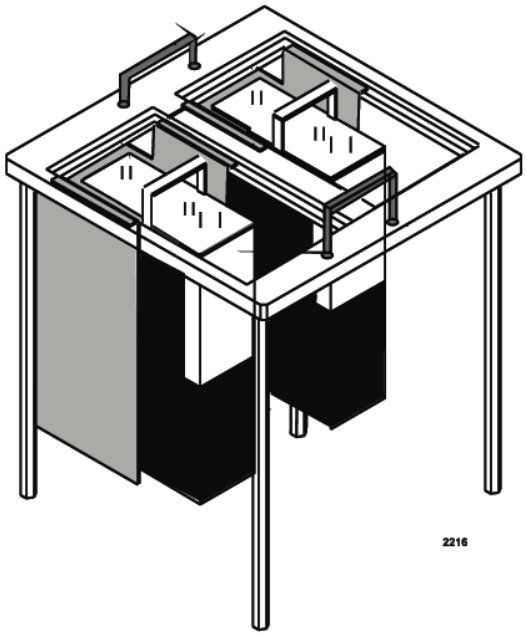


Figure 4-29. *Subfloor tile mount*

Note: For illustration purposes only, 3300 modules are shown instead of 3500 modules

6. Attach four safety plates to the back of each bulkhead bracket. Use #10-32 x 3/4" flat socket head screws.

7. Using 1/2" OD tubing, connect facility water to the Swagelok fittings on the bottom of the Point of Use™ modules.

8. Attach the two bulkhead brackets (with the modules) to the insert plate with eight 1/4-20 x 1/2" hex head machine screws.

9. Using 1/2" ID silicone heater hose, connect the process fluid lines to the barbs on the top of the modules.

10. Connect the power and signal cables to the fronts of the modules.

11. Fill the reservoirs in the Point of Use™ modules with process fluid using a fill canister. See “Filling the Reservoir” on page 4-6.

12. Verify machine operation.

13. Attach the two Lexan windows to the insert plate with #8-32 x 1/2" ss cap screws.

WARNING:
Heavy load. The total assembly with modules can weigh in excess of 170 lbs.

Chapter 5 - Operation

Chapter 5

Refer to "System Start-up" on page 4-19 for Setup procedures.

TURNING THE SYSTEM ON

To power on the system, execute the following procedure.

1. Check that the **EMO** button is protruding. If not, turn clockwise to reset. The **EMO** button is located on the right front of the controller.

2. Turn the power switch ON.

   The power switch is the rocker switch located on the left side of the controller. The thermoelectric module, heater element and pump motor automatically reset to the Idle state when the system is powered on. The green LED labeled **IDLE** on the front of the controller lights up when the system is in Idle mode.

   When initialization is complete, the System Status Screen appears. System status can be Active mode in Local control, Active mode in Remote control, Idle mode in Local control, or Idle mode in Remote control. The top line of the display indicates system status: **Idle** or **Active** followed by the current temperature of the process fluid.

   The second line indicates either **Local** or **Remote** communication control followed by the process set point. See Figure 5-1 for an example System Status display.

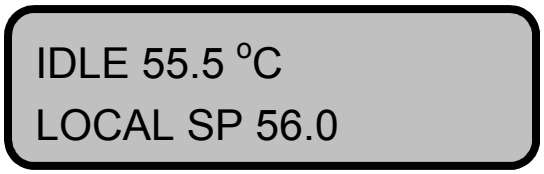


Figure 5-1. *Example system status display*

3. Press the **Start/Stop** key to enter Active mode.

   This key is located on the controller keypad. The green LED on top of the Point of Use™ module lights up when the system is active. Figure 5-2 is an example of the display when the system is in Active mode.

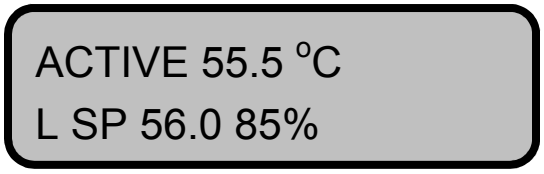


Figure 5-2. *Example of an Active mode display*

The first line displays **ACTIVE** status and the temperature of the process fluid. The second line displays **L** (local) or **R** (remote) communication control, the set point, and the percentage of heating or cooling power demand.

The System Status display remains until the user enters the setup function or an alarm condition occurs.

The thermoelectric cooling/heating outputs vary according to the Loop Control Setup parameters.

PROCESS OPERATION

The Model 3500 controls temperature by circulating the process fluid between the Point of Use™ module and the chamber. When the unit is activated, the system pumps process fluid from its reservoir through the thermoelectric heat pump. The heat pump either removes or adds heat to the process fluid to control temperature. The process fluid then flows to the chamber. After it leaves the chamber, it returns to the reservoir where the temperature of the process fluid is monitored by an RTD sensor. The temperature signal from the RTD is the feedback signal for the PID controller.

The pump runs continuously during process operation and the thermoelectric output is active for most operational set points. The LEDs under the controller display screen provide information about the power supply.

The **Pump LED** lights when that the power supply for the pump is on.
The **Idle LED** lights when the system is in Idle mode.

The **Heat LED** lights when the system is in Heating mode.
The **Cool LED** lights when the system is in Cooling mode.

System operation is controlled through the power supply/controller. Refer to Figure 5-3 for key locations.

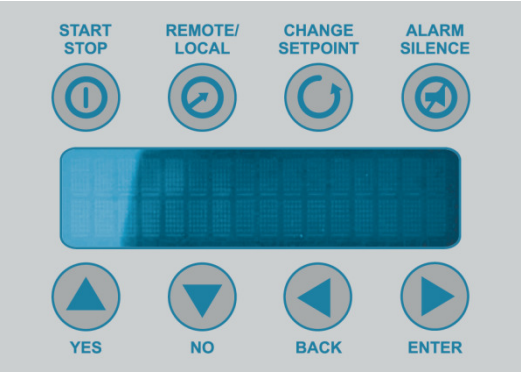


Figure 5-3. *Controller key locations*

Controller Keys

There are eight controller keys on the keypad.

REMOTE/LOCAL Key

The **REMOTE/LOCAL** key toggles the system between Local and Remote communication control. The system must be in Local control to change from Active to Idle mode from the keypad, or to change the Local temperature set point.

START/STOP Key

The **START/STOP** key starts and stops system operation by switching between Active and Idle modes. If the system is in Idle mode, pressing this key puts the system in Active mode. If the system is in Active mode, pressing this key puts the system back in Idle mode.

If a soft alarm condition occurs, this key continues to toggle the system between Active and Idle modes.

If the system has a hard alarm, pressing this key has no effect on system operation because the system automatically goes into Idle mode when a hard alarm condition occurs. The system stays latched in Idle mode until the alarm condition is cleared. Once the alarm condition is cleared, press this key to reenter Active mode.

CHANGE SET POINT Key

The **CHANGE SETPOINT** key is used to change the system's temperature set point while in Local control. Pressing this key brings up the following display.

The top line is the prompt with a blinking question mark; the second line is the current local set point. Press the **YES** key to make a change. The blinking question mark changes to an equal sign.

Use the **YES** (Up) and **NO** (Down) keys to reach the required set point. Press the **ENTER** key to save the new value.

YES Key

The **YES** key is used while programming the controller to request a parameter change. Press this key and the blinking question mark after the parameter name changes to an equal sign. Then the parameter value can be changed.

This key is also used to change parameter values. Pressing once and releasing allows the user to increase the value. Holding the key down causes the value to increase automatically.

NO Key

The **NO** key is used while programming the controller to scroll to the next parameter. Press this key and the blinking question mark after a parameter name, and the next parameter in the menu appears. Pressing the **NO** key at the end of a menu stack returns the display to the current menu prompt.

This key is also used to change parameter values. Pressing once and releasing allows the user to decrease the value. Holding the key down causes the value to decrease automatically.

BACK Key

The **BACK** key is used while programming the controller to return to the current menu prompt. Pressing the **BACK** key again returns the display to the system status display.

ENTER Key

The **ENTER** key is used to save a parameter value after a value change. When pressed, it automatically activates an EPROM save.

ALARM SILENCE Key

The **ALARM SILENCE** key eliminates the audio portion of an alarm message. If one or more soft alarm conditions occur, pressing once turns off the alarm buzzer.

If there is a combination of soft and hard alarm conditions, it shuts off both alarm buzzer warnings. If more than one hard alarm conditions occur, this key has to be pressed for each hard alarm to shut off the alarm buzzer.

After a hard alarm condition has been cleared, use this key to remove the alarm message from the display screen.

If a hard alarm can be cleared by changing a parameter setting, the alarm message must still be cleared by pressing this key.

Modes of Operation

There are six basic operating modes on the Model 3500.

- Active Local and Active Remote
- Idle Local and Idle Remote
- Setup
- Alarm condition

ACTIVE MODE

The system enters the Active mode when the **Start** key is pushed and there is no alarm condition. This is the Model 3500's normal operating mode.

In Active mode, the system applies power to the pump and thermo electrics, and controls process temperature. The system also monitors facility water and process fluid return temperatures, output power, and all hard and soft alarm conditions.

If a hard alarm occurs, the system enters Idle mode. The alarm must be cleared and silenced (**Alarm Silence** key) before the system can be reactivated. Press the **Start** key to return to Active mode. (All menus are available during an alarm condition.)

IDLE MODE

When the system is powered up, it automatically enters Idle mode. Pushing the **Start/Stop** key while the system is in Active mode, returns the system to Idle mode.

In Idle mode, power to the thermoelectrics and pump is deactivated. The system continues to monitor facility water and process fluid temperatures, output power, and all hard and soft alarm conditions.

If an alarm occurs in Idle mode and is cleared, the system automatically remains in Idle mode. All menus are available during an alarm condition.

LOCAL AND REMOTE CONTROLS

In Local control, controller parameters can only be modified from the keypad on the power supply/controller. All serial communications are ignored.

In Remote control, controller parameters can only be modified through the communications link (RS-485). However, the **Local/Remote** key and the **Alarm Silence** key on the controller are always active, and can only be toggled through the keypad on the controller.

SETUP

To enter the setup menus, a three-key sequence (**Enter, Alarm Silence, Change Setpoint**) brings up the prompt to enter a password.

Once in Setup mode, the **Yes** and **No** keys access the various menus and parameters. Once a parameter setting is changed, press the **Enter** key to move to the next parameter.

There are four setup menus.

- **Setup Global Parameters** which determines the operational configuration of the controller.
- **Setup Loop Input** which affects the process RTD calibration.
- **Setup Loop Control Parameters** which affects control algorithms, tuning, and how the system responds to process temperature changes.
- **Setup Loop Alarms** which sets alarm functions including alarm responses for different types of alarms.

If an alarm occurs while in one of the Setup menus, the alarm display indicates the type of alarm but the system stays in the Setup mode. Refer to Table 4-3 on page 4-24 for Setup menus.

Alarm Conditions

If the system senses a problem, an alarm condition occurs. The display screen identifies the type of alarm. An external audio buzzer also sounds unless it has been deactivated during setup.

Alarms act in conjunction with Active or Idle mode. If the alarm is a hard alarm, the system automatically changes from Active mode to Idle mode. If it is an information only or soft alarm, the system remains in its current mode. The screen, however, always identifies the alarm.

CAUTION:
When the power supply/controller is powered on, three alarms are disabled: Temperature Deviation, High Process, and Low Process. These are disabled for the time period designated in the Startup Alarm Delay parameter. See "Startup Alarm Delay" on page 4-25.

The operator must monitor the temperature of the chamber to be sure it does not exceed temperature limits until these alarms become active.

Refer to "Alarms" on page 5-10 for detailed explanations of Model 3500 alarms and the correct procedures to clear alarms.

Optional Power Supply/Controller Rack

Information in this section applies only to installations using the optional power supply/controller rack.

TURNING THE SYSTEM ON

CAUTION:
***Before* turning on the power, be sure Point of Use™ module installations are complete.**

Be sure switches on the front of the Power Distribution Box are in the Off position. Turn on facility power. The lamp labeled **Main Power** lights up. (If the lamp does not light up, check connections and voltages across the phases.) 2. Turn on switches. The three lamps below each switch must be on. (If not, check voltages on the output side of the switches.) 3. Turn on and program individual controllers. Be sure to configure for remote control operation if communication with the tool is required.

TURNING THE SYSTEM OFF

1. Turn off individual controllers.
2. Shut off switches.
3. Shut off main power.

Filling the Reservoir While the System is Running

If the red LED on the module lights up, the module is low on process fluid. Use the following procedure to fill the fluid loop while the module continues to operate.

1. Add process fluid to the fill canister. Fill to the 1 gallon mark. Do *not* top off the canister. Leave room for air.
2. Connect the quick disconnect on the fill canister tubing to the mating quick disconnect fill port on the top of the module.
3. Pressurize the canister with the hand pump on top of canister.
4. Open both the **Fill** and **Service** valves on the top of the module by pushing in and turning the valves counterclockwise to the **Open** position.
5. Press and hold the trigger lever on the canister to begin filling the reservoir. Continue to pressurize the canister, pumping slowly.

6. Note when the process fluid begins to flow into the overflow tank. Fill the overflow tank about 2 inches from the bottom; be sure no air bubbles come out. Release the trigger and stop pumping. The reservoir is full.

7. Close the **Fill** valve by turning clockwise to the **Closed** position.

Disconnect the canister and empty the excess process fluid into an authorized storage container.

CAUTION:
Use only approved process fluids. Do not use water or a mixture of water and ethylene glycol. Refer to Table 3-1 on page 3-3 for approved fluids.

Tuning the PID Controller

PID COMPONENTS

The controller uses a Proportional, Integral, Derivative (PID) control scheme to provide constant temperature control. In addition, a value called the heat-cool spread determines when the heating or cooling parameters are active.

The PID control scheme when properly tuned eliminates the differential, or error, between the set point and the actual temperature by assigning appropriate gain levels to the three PID components. Each component works to eliminate the error in a characteristic way. The effects of each component are added together to make the complete temperature control algorithm.

The **Proportional component** provides uniform error-correcting gain based solely on the temperature differential. The proportional component is linear in its response and does not provide adequate temperature control by itself. For example, the proportional component cannot compensate for small steady-state errors. Additionally, without a secondary stabilizing component, oscillations occur if the proportional gain is set too high. *The lower the proportional value, the higher the gain.*

The **Integral component** provides error-correcting gain based on the magnitude and length of time an error exists. In math terms, the magnitude of the integral gain varies as the area under the error (y-axis) versus time (x-axis) curve. The integral component is especially effective in resolving small steady-state errors. *The lower the integral value, the higher the gain.*

The **Derivative component** provides error-correcting gain that acts as an accelerator or brake, depending on how far and how quickly the temperature approaches the set point. When the error is large, the derivative gain is positive; however, as the error decreases, the gain also decreases and can even become negative. This means that if the derivative gain is set too high, efficient temperature control is impeded. *The higher the derivative value, the higher the gain.*

The **heat and cool spread** parameters establish an upper and lower band around the setpoint. When the process temperature rises above the setpoint plus the cool spread, the PID calculation begins to use the cool PID parameters. When the process temperature falls below the setpoint minus the heat spread, the PID calculation begins to use the heat PID parameters.

PROGRAMMING PID VALUES

Programming PID values to establish fast, stable temperature control is critical. Because the PID control scheme is a product of several components, more than one set of values can produce effective results.

Table 5-1 lists trial sets of values that should satisfy the majority of tool applications. If temperature oscillations occur with the defaults, try the next set which has less gain.

Typical reasons for an application to require less gain for stability include:

- Plumbing restrictions that reduce flow
- High RF power processes with low thermal impedance chucks
- Room temperature set points
- RF compensation cooling applications or combinations of these factors

If the sets of PID values in Table 5-1 do not provide adequate temperature control, contact LAUDA-Noah customer service.

Table 5-1. *Quick trial value sets for PID programming*

	Heating			Cooling			Heat-Cool Spread
Trial Sets	**Proportional**	**Integral**	**Derivative**	**Proportional**	**Integral**	**Derivative**	
Default	15.0	60	0	11.0	60	0	0.5
Less Gain #1	15.0	75	0	11.0	75	0	0.5
Less Gain #2	17.0	90-105	0	12.5	75-95	0	1.0
Less Gain #3	19.0	90-105	3-8	15.0	90-105	2-5	1.0 - 2.0

The heating and cooling filter factor variables not mentioned in this manual must be set to **3** with the trial sets listed in Table 5-1.

TURNING THE SYSTEM OFF

To turn the Model 3500 off, press the **Start/Stop** key on the keypad. The green LED on the top of the module goes off when the system is in Idle mode. If an alarm is active and operation must be stopped, the alarm automatically reappears when the system is turned on again.

Turn off power to all circuits with the power switch located on the left side of the front panel of the PSC2.

ALARMS

The Model 3500 monitors for alarm conditions automatically and continually. If an alarm occurs, system status display immediately changes to an **ALARM** condition displaying the specific alarm. As an added precaution, an audio buzzer sounds. (The audio alarm can be disabled in the Global Setup Parameter menu. See Table 4-3 on page 4-24.)

Press the **Alarm Silence** key to activate an AutoSilence feature that turns off the audio alarm.

Alarms have a variable delay period. This means that the alarm must exist for a set number of consecutive seconds before the system enters an alarm condition.

When a soft alarm is cleared, the system recovers as if no alarm had occurred. If a hard alarm condition is cleared, the alarm message must also be cleared by pressing the **Alarm Silence** key.

For systems on host tools with *RS-485 digital communication*, the alarm can be acknowledged from the host tool.

If an alarm has not been cleared, pressing the **Alarm Silence** key acknowledges and silences the alarm, but the alarm is not cancelled until cleared.

If an alarm is present when the system is turned on, the system stays in Idle mode and the alarm condition is automatically displayed. If the alarm occurs while the system is in Active mode, the system remains in Active mode or defaults to Idle mode depending on whether the alarm is soft or hard.

Types of Alarms

There are two or three types of alarms on the power supply/controller depending on the communication protocol of the host tool. Host tools with RS-485 communication can acknowledge alarms directly from the tool; other tool configurations require acknowledging the alarms from the front panel of the controller.

Soft alarms do not affect the operation of the host tool with RS-485 digital communication.

Soft alarms are information-only alarms. They do not affect system operation. When a soft alarm condition occurs, the set point can be changed and the operator has full access to all menus.

A hard alarm condition automatically deactivates outputs to the heater, pump and thermoelectrics.

Table 5-2 lists alarms for 100 mV/ºC analog communications protocol and Table 5-3 lists alarms for RS-485 digital communication protocol. Descriptions of each alarm follow.

CAUTION:
When the power supply/controller is powered on, three alarms are disabled: Temperature Deviation, High Process, and Low Process. These are disabled for the time period designated in the Startup Alarm Delay parameter. See "Startup Alarm Delay" on page 4-25.

The operator must monitor the temperature of the chamber to be sure it does not exceed temperature limits until these alarms become active.

The controller reports an alarm and its respective status according to the communications protocol parameter. Systems with RS-485 digital communication require a CHX setting. Systems with 100 mV/ ºC analog communication require an RCM setting.

Table 5-2. *Alarm status for 100 mV/˚C analog communication*

Soft Alarm Display	Description
"LIQUID LEVEL #1"	Low fluid level below liquid level switch #1
"LOW DEVIATION"	Process temperature below low limit but temperature control is still active
"HIGH DEVIATION"	Process temperature above high limit but temperature control is still active
Hard Alarm Display	**Description**
"THERMOELECTRIC POWER SUPPLY FAULT"	Power supply for thermoelectrics fails self-diagnostics, or there is a short from voltage outputs to ground
"PUMP POWER SUPPLY FAULT"	Failure in power supply for pump
"PROCESS SENSOR FAULT [RTD]"	Open RTD sensor
"LOW PROCESS FLOW"	Low flow condition in process flow
"LOW FLOW HOUSE WATER"	Low flow condition in facility water flow
"LIQUID LEVEL #2"	Low fluid level below liquid level switch #2

Table 5-2. *Alarm status for 100 mV/˚C analog communication (Continued)*

Hard Alarm Display	Description
"TE_OPEN"	Open in thermoelectric circuit
"TE_SHORT"	Short in thermoelectric circuit
"TE FAULT MUST CYCLE POWER"	Short in thermoelectric circuit to ground
"HIGH PROCESS"	Process temperature above high limit. When the process temperature exceeds this value, the power supply outputs (pump, thermoelectrics, heater) are turned off.
"LOW PROCESS"	Process temperature below low limit. When the process temperature falls below this value, the power supply outputs (pump, thermoelectrics, heater) are turned off.
"THERMOELECTRIC OVERTEMP"	Open thermoelectric snap switch
"FAILSAFE RELAY"	Power supplies for pump and thermoelectric shut off
"PUMP CURRENT FAULT"	Short on line to pump or in pump
"TE PWR SUPPLY PBUS TIMEOUT"	Parallel bus data update error. TE PS processor not responding.
"TE PWR SUPPLY PBUS CRC ERROR"	Parallel bus data update error. CRC error between controller processor and TE PS processor.
"TE PS FAULT"	TE power supply fault codes
"LOW POWER"	Power to controller from internal power supply is too low.

Table 5-3. *Alarm status for RS-485 digital communication*

Information Only Alarm Display	Description
"LIQUID LEVEL #1"	Low fluid level below liquid level switch #1
Soft Alarm Display	**Description**
"LOW DEVIATION"	Process temperature below low limit but temperature control is still active
"HIGH DEVIATION"	Process temperature above high limit but temperature control is still active
"LOW PROCESS FLOW"	Low flow condition in process flow
"LIQUID LEVEL #2"	Low fluid level is below liquid level switch #2. This alarm is soft for 15 minutes, then becomes a hard alarm.

Table 5-3. *Alarm status for RS-485 digital communication (Continued)*

Hard Alarm Display	Description
"THERMOELECTRIC POWER SUPPLY FAULT"	Power supply for thermoelectrics fails self-diagnostics, or there is a short from voltage outputs to ground
"PUMP POWER SUPPLY FAULT"	Failure in power supply for pump
"PROCESS SENSOR FAULT [RTD]"	Open RTD sensor
"LOW FLOW HOUSE WATER"	Low flow condition in facility water flow
"TE_OPEN"	Open in thermoelectric circuit
"TE_SHORT"	Short in thermoelectric circuit
"TE FAULT MUST CYCLE POWER"	Short in thermoelectric circuit to ground
"HIGH PROCESS"	Process temperature above high limit, the power supply outputs (pump, thermoelectrics, heater) are turned off
"LOW PROCESS"	Process temperature below low limit, the power supply outputs (pump, thermoelectrics, heater) are turned off
"THERMOELECTRIC OVERTEMP"	Open thermoelectric snap switch
"FAILSAFE RELAY"	Power supplies for pump and thermoelectric shut off
"PUMP CURRENT FAULT"	Short on line to pump or in pump
"TE PWR SUPPLY PBUS TIMEOUT"	Parallel bus data update error. TE PS processor not responding.
"TE PWR SUPPLY PBUS CRC ERROR"	Parallel bus data update error. CRC error between controller processor and TE PS processor.
"TE PS FAULT"	TE power supply fault codes
"LOW POWER"	Power to controller from internal power supply is too low.

Alarm Descriptions and Resolutions

Alarm descriptions are listed in alphabetical order.

FAILSAFE RELAY

The **FAILSAFE RELAY** alarm occurs when the power supply self diagnostics circuit detects a fault condition in the power supply.

To clear:

1. Turn the system off and then on again.
2. If the alarm is still active, perform a controller hard reset.

DANGER:
High voltage is active in this system. Troubleshoot components only if power has been *turned off*.

HIGH DEVIATION

The **HIGH DEVIATION** alarm is activated when the process temperature exceeds the process set point plus the Dev alarm value. See "Dev Alarm Value" on page 4-35. This alarm is a soft alarm.

To clear:

- Readjust the Dev alarm value so that the process temperature does not exceed the deviation bandwidth. See Table 5-1 on page 5-9

HIGH PROCESS

The **HIGH PROCESS** alarm indicates that the process temperature has exceeded the high temperature limit.

To clear:

1. Check that the set point is not set above the high temp limit. See "CHANGE SET POINT Key" on page 5-3 to adjust the set point. Raise the high temp limit if necessary.
2. Check for other problems such as low facility water flow.
3. Replace the controller.
4. Replace the Point of Use™ module. Call LAUDA-Noah Customer Support (see "Returning Units for Repair" on page 6-8).

LIQUID LEVEL #1

The **LIQUID LEVEL #1** alarm is the Low process fluid alarm. It indicates that the process fluid level is low but that the system has enough to continue operating. The red **LL1** LED on top of the module lights up.
To clear:

1. Fill the reservoir. Refer to "Filling the Reservoir" on page 4-6 for instructions.

2. Be sure to add enough process fluid so that at least 2" flows into the overflow tank.

LIQUID LEVEL #2

The **LIQUID LEVEL #2** alarm indicates that the process fluid level is below the Liquid level switch #2. The red **LL1** LED on top of the module lights. The LL2 alarm deactivates the pump and thermoelectric output.

To clear:

1. Add process coolant liquid to the system. Refer to Table 3-1 on page 3-3 for a list of approved process fluids.

2. Be sure to add enough process fluid so that at least 2" flows into the overflow tank.

3. Check process plumbing for leaks.

LOW DEVIATION

The **LOW DEVIATION** alarm is activated when the process temperature falls below the process set point minus the Dev alarm value setting. This alarm is an information-only alarm.

To clear:

- Readjust the Dev alarm value (see "Dev Alarm Value" on page 4-35) so that the process temperature does not fall below the deviation bandwidth.

LOW FLOW HOUSE WATER

The **LOW FLOW HOUSE WATER** alarm indicates a low flow condition in the facility water flow.

To clear:

1. Check the facility water lines and the equipment for any flow restrictions. Flow must be at least 3.0 gpm.

2. Verify that the facility water is plumbed correctly and turned on.

LOW POWER

The **LOW POWER** alarm indicates the power to controller from internal power supply is too low.

To clear:

1. Reboot the power supply by turning the power supply/controller off and then on with the switch on the front panel.

2. If the alarm is not cleared, perform a controller hard reset.

3. Replace the controller if the alarm is not cleared.

LOW PROCESS

The **LOW PROCESS** alarm indicates that the process temperature has fallen below the low temperature limit.

To clear:

1. Check that the set point is not set below the low temperature limit. Reduce the low temperature limit if necessary. See "Lo Proc Alarm Setpt" on page 4-35.

2. Replace the controller. Call LAUDA-Noah Customer Support (see "Returning Units for Repair" on page 6-8).

3. Replace the Point of Use™ module. Call LAUDA-Noah Customer Support.

LOW PROCESS FLOW

The **LOW PROCESS FLOW** alarm indicates a low flow condition for the process fluid.

To clear:

1. Reboot the power supply by turning the power supply/controller off and then on with the switch on the front panel.

2. Check the power cable.

3. Check the connections for the signal cable between the module and controller for continuity (pins 10 and 11).

4. Replace the Point of Use™ module. Call LAUDA-Noah Customer Support (see "Returning Units for Repair" on page 6-8).

TE PWR SUPPLY PBUS CRC ERROR

The **TE PWR SUPPLY PBUS CRC ERROR** alarm indicates a TE PS processor error status.

Alarm Display	**Alarm Description**
00 XX YY ZZ	00 - No errors
01 XX YY ZZ	01 - TE processor hardware fault
02 XX YY ZZ	02 - TE processor software fault
03 XX YY ZZ	03 - TE processor I2C comm. To DAC fault
04 XX YY ZZ	04 - TE processor ADC error

Note: XX YY ZZ = Additional fault codes

To clear:

1. Reboot the power supply by turning the power supply/controller off and then on with the switch on the front panel.

2. If the alarm is not cleared, perform a controller hard reset.

3. Replace the controller if the alarm is not cleared.

TE PWR SUPPLY PBUS TIMEOUT

The **TE PWR SUPPLY PBUS TIMEOUT** alarm indicates a parallel bus update error or TE PS processor not responding.

To clear:

1. Reboot the power supply by turning the power supply/controller off and then on with the switch on the front panel.

2. If the alarm is not cleared, perform a controller hard reset.

3. Replace the controller if the alarm is not cleared.

PROCESS SENSOR FAULT [RTD]

The **PROCESS SENSOR FAULT** [RTD] alarm indicates a bad or missing temperature sensor input. This alarm deactivates thermoelectrics output.

To clear:

1. Check the process RTD and the signal cable for proper connections and continuity.

   With the cable disconnected from the module, use a volt-ohm meter to check the resistance between the following pins:

Across pins 12 and 13	Resistance should be < 0.5 Ω
Across pins 12 and 14	Resistance should be ~ 110 Ω
Across pins 13 and 14	Resistance should be ~ 110 Ω

2. Check the facility water RTD and the signal cable for proper connections and continuity.With the cable disconnected from the module, use a volt-ohm meter to check the resistance between the following pins:

Across pins 7 and 9	Resistance should be < 0.5 Ω
Across pins 7 and 8	Resistance should be ~ 110 Ω
Across pins 8 and 9	Resistance should be ~ 110 Ω

3. If any of the values measured in steps 1 and 2 differ from the recommended values, replace the Point of Use™ module.

4. If the measurements are within specifications, check the signal cable for continuity through the same pins. If continuity is broken, replace the cable.

5. If all measurements are within specifications, and cable continuity is established, replace the controller.

PUMP CURRENT FAULT

The **PUMP CURRENT FAULT** alarm is activated by an over current condition in the pump power supply.

To clear:

1. Check pump impedance for a short (Pins 5 and 6 on the power connector). If there is a short, replace the Point of Use™ module.

2. If there is no short, perform a controller hard reset.

3. If the alarm is not cleared, replace the controller.

PUMP POWER SUPPLY FAULT

The **PUMP POWER SUPPLY FAULT** alarm activates when there is a failure in the power supply for the pump

To clear:

1. Reboot the power supply by turning the power supply/controller off and then on with the switch on the front panel to be sure it is not a software problem.

2. If the alarm is still active, perform a controller hard reset.

3. If the alarm is still active, replace the controller.

TE_OPEN

The **TE_OPEN** alarm indicates an open in the thermoelectric circuit.

To clear:

1. Use an AC ohm meter to check the impedance of the thermoelectrics (pins 1 and 4 and 2 and 3 on the power connector). Impedance must be between 21 ohms and 25 ohms.

2. If an open occurs, or the reading is considerably higher than the limits, replace the Point of Use™ module.

3. If the alarm is not cleared, perform a controller hard reset.

4. If the alarm is still active, replace the controller.

TE_SHORT

The **TE_SHORT** alarm indicates a short in the thermoelectric circuit.

To clear:

1. Use an AC ohm meter to check the impedance of the thermoelectrics (pins 1 and 4 and pins 2 and 3). It must be between 21 ohms and 25 ohms.

2. If a short is measured, or the reading is considerably smaller than the limits, replace the Point of Use™ module.

3. If the alarm is not cleared, perform a controller hard reset.

4. If the alarm is still active, replace the controller.

TE FAULT MUST CYCLE POWER

The **TE FAULT** alarm indicates a potential thermoelectric short to ground.

To clear:

1. Reboot the power supply by turning the power supply/controller off and then on with the switch on the front panel to be sure it is not a software problem.

2. Use an ohm meter to check continuity between ground (pin 7) and TE leads (pins 1, 2, 3, 4). If there is a short, replace the Point of Use™ module.

3. If the alarm is not cleared, perform a controller hard reset.

4. If the alarm is still active, replace the controller.

TE PS FAULT

The **TE PS FAULT** alarm indicates a TE power supply fault.

Alarm Display	**Alarm Description**
00100000	- Parallel bus watchdog timeout error
00010000	- Zero voltage switch timeout error
00001000	- Line fault
00000100	- TE under current
00000010	- TE over current
00000001	- TE over voltage

Parallel bus watchdog timeout error
Response time from the TE PS processor to the controller exceeded 2 seconds.

Zero voltage switch timeout error
TE output voltage fails to reach less than 20 V in less than 2 seconds during a polarity change

Line fault
Loss of a single phase or line sag below 190 VAC.

TE under current
TE current less than 10% of setting.

TE over current
TE current greater than 120% of setting

TE over voltage
TE output voltage greater than 220 V

To clear:

1. Reboot the power supply by turning the power supply/controller off and then on with the switch on the front panel to be sure it is not a software problem.

2. To clear **Line Fault**, check that line voltage is within specifications: 220 ± 10% VAC, 3 phase, 15A, 4 wire.

3. If the alarm is not cleared, perform a controller hard reset.

4. Replace the controller if the alarm is not cleared

THERMOELECTRIC OVERTEMP

The **THERMOELECTRIC OVERTEMP** alarm indicates an OPEN on the thermoelectric snap switch input.

To clear:

- Check the facility water for proper flow (3.0 gpm) and check that the temperature is not above 30ºC.

THERMOELECTRIC POWER SUPPLY FAULT

The **THERMOELECTRIC POWER SUPPLY FAULT** alarm activates when there is a faulty power supply board. It also activates if there is a voltage output short to ground.

To clear:

1. Reboot the power supply by turning the power supply/controller off and then on with the switch on the front panel to be sure it is not a software problem.

2. Use an ohm meter to check continuity between ground (pin 7) and TE leads (pins 1, 2, 3, 4). If there is a short, replace the Point of Use™ module.

3. If the alarm is not cleared, perform a controller hard reset.

4. If the alarm is still active, replace the controller.

MAINTENANCE

The Model 3500 requires minimal maintenance. However, process fluids must be changed and added periodically as necessary. Completely replace the process fluid every two years.

Draining the Process Fluid for Service

To drain the process fluid when servicing the machine, use the following procedure:

1. Press the **Start/Stop** key to enter idle mode, then toggle the power switch off.

2. Depressurize the fill canister by unscrewing the trigger assembly from the top of the canister. Leave the bottom hose of the trigger assembly in the canister but do not screw back in place.

3. Connect the fill canister hose to the quick disconnect fitting on the bottom of the module labeled **Drain**.

4. Open the **Fill** and **Service** valves.

5. Press the trigger on the canister and the process fluid will drain into the canister. Disconnect hose when process fluid is completely drained from the module.

6. Close the **Fill** and **Service** valves. The equipment is dry and ready for servicing.

Replacing the Process Fluid

The dielectric process fluid (Fluorinert or Galden) must be replaced every two years.

1. Press the **Start/Stop** key to enter idle mode, then toggle the power switch off.

2. Depressurize the fill canister by unscrewing the trigger assembly from the top of the canister. Leave the bottom hose of the trigger assembly in the canister but do not screw back in place.

3. Connect the fill canister hose to the quick disconnect fitting on the bottom of the module labeled **Drain**.

4. Open the **Fill** and **Service** valves.

5. Press the trigger on the canister and the process fluid will drain into the canister. Disconnect hose when process fluid is completely drained from the module.

6. Refill with new process fluid.

Refer to "Filling the Reservoir" on page 4-6 for complete instructions to refill the reservoir.

Chapter 6

Chapter 6 - Support

This chapter contains basic troubleshooting information, as well as procedures for returning a unit for repair.

SERIAL NUMBER

Temperature control systems include the model number and the serial number on the serial label. This serial label is located on the top plate of the 3500 module and on the front panel of the PSC2. See Figure 6-1.

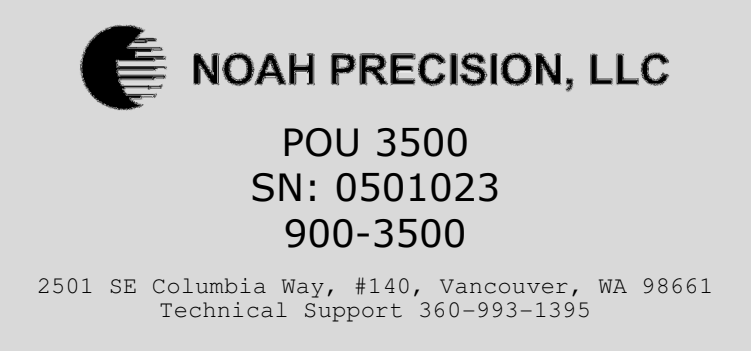


Figure 6-1. *Serial Number Label*

TROUBLESHOOTING

This section discusses the following topics to help troubleshoot any problems that might occur when operating the Model 3500. A troubleshooting guide is provided in Table 6-1. If following these procedures does not solve the problem, do not hesitate to call LAUDA-Noah Customer Support.

- LEDs
- EMO input
- Alarm inputs
- Standard temperature input
- System power outputs

DANGER:
RISK OF DEATH OR BODILY INJURY. Disconnect all sources of input power before working on this unit or anything connected to it.

LEDs

There are four LEDs on the front of the power supply/controller. The **Heat** LED indicates that the power supply is heating. The **Cool** LED indicates that the power supply is cooling. The **Pump** LED indicates that the pump's power supply is on. The **Idle** LED indicates that the pump's power supply is off. LEDs are especially useful when viewing several controllers in a controller rack.

EMO Input

If a controller needs servicing, the EMO keylock on the front panel of the controller disables the EMO feature. An *open* on this input shuts down system power. (If the unit does not connect to the host EMO, both in and out connections must be jumpered.)

To service, disable the EMO on the Power Distribution Box to prevent the host tool from shutting down.

Be sure to disable each controller's EMO feature with the keylock. When the LED labeled **EMO Disable** is on, the EMO is disabled. This prevents the other controllers from shutting down when the EMO link is disconnected.

Alarm Inputs

WARNING INPUTS

The **LIQUID LEVEL #1** alarm indicates that the process fluid is below normal level. The LL1 alarm switch is closed when the process fluid is at acceptable levels. It is an informational alarm, with RS-485 communications with 100 mV/^{o}C analog communication, this is a soft alarm.

The **LIQUID LEVEL#2** alarm responds differently depending on the communication protocol of the host tool. With RS-485 communication, this alarm is a soft alarm for 15 minutes, then becomes a hard alarm (failure). With 100 mV/^{o}C analog communication, the Liquid Level #2 alarm is always a hard alarm.

INPUTS THAT CAUSE SHUTDOWN (HARD ALARMS)

The Model 3500 has six inputs for safety.

- RTD Inputs (process fluid and facility water)
- LIQUID LEVEL #2 (100 mV/^{o}C analog tools only) (switch)
- OVER TEMPERATURE (switch)
- UNDER TEMPERATURE (switch)
- PROCESS FLOW

Each input is monitored. If a switch opens or an alarm condition occurs, the microprocessor is alerted and an alarm appears on the controller display. If more than one of these safety alarms is active, alarms are displayed in the order they occur.

The process fluid RTD monitors the process fluid temperature. If the process temperature exceeds the high or low temperature limits, the controller shuts off the outputs to the thermoelectrics and pump.

The facility water RTD is also located in the module. It monitors the facility water temperature. If the water temperature becomes too cold or hot, the controller shuts off the outputs to the thermoelectrics and pump.

The Liquid Level #2 switch is located in the reservoir of the module. It is a float switch that opens when the reservoir's liquid level falls below the level of this switch.

Over Temperature switches are located on the heat exchanger, reservoir and facility with monitor bracket in the module. The switches open if their temperature trip points are exceeded.

An under temperature switch is located in the facility water monitor bracket in the module. It opens when the bracket temperature falls below the trip point of the switch. Process fluid flow is measured by the power supply/controller through a tachometer input that monitors the rotations of the pump motor. If the pump is inoperative, the Low Flow process alarm activates.

The controller does not monitor the circuit breaker **On/Off** switch. If an overcurrent condition occurs, the breaker opens and power to the system is shut off.

Standard Temperature Input

The Process sensor is the main process temperature sensor feeding the 3-mode control loop. It is a 3-wire, 100 ohm, α6-3=0.00385 Ω/Ω/ ºC, platinum RTD.

System Power Outputs

There are two power outputs from the controller/power supply.

- T/E power supply
- Pump power supply

The T/E power supply output drives the thermoelectrics in the module. This output varies from -200 VDC to +200 VDC with a maximum load capacity of 33A for the PSC2. The varying voltage drives the module from maximum heating capacity to maximum cooling capacity.

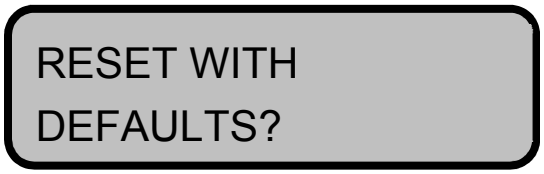
The pump output is a fixed 48 VDC output rated at 8 A maximum. It drives the pump in the module and is controlled by the microprocessor and safety circuits in the controller.

Controller Hard Reset

If the controller is behaving abnormally or erratically, it could be reset to its default settings by performing the steps below. Before doing this, record the Setup parameter settings so that they can be re-entered after the controller is reset. If no changes are made the default settings will be used.

1) Using the ON/OFF switch on the front panel, turn the PSC2 off.

2) While pressing the NO (down arrow) key, turn the PSC2 on.
3) The screen below will appear:



4) Press the YES button at the “Reset With Defaults?” prompt.
5) After the controller resets and completes initialization the system status screen appears.
6) Turn the PSC2 off then on again.
7) If necessary, enter the Setup parameter menus and reprogram the appropriate parameters.

Troubleshooting Guide

DANGER:
High voltage is active in the system. Safety covers provide protection for the user and the machine. If bypassed, only authorized and qualified personnel should repair or test the system.

Table 6-1. *Troubleshooting*

Problem	Possible Cause	Possible Solution
Controller does not turn on when the power switch is on	1. Power for facility is not correct or missing. 2. The EMO button is pressed in. 3. EMO IN jumper is not connected. 4. EMO OUT jumper is not connected.	1. Check the voltages at the power receptacle. The phase voltages should be about 208 VAC. 2. Turn the EMO button clockwise to end EMO condition. 3. If the EMO IN input is not used, it must be jumpered. Connector is a 9-pin D-subminiature connector labeled **EMO IN** on the back of the controller. Connector is supplied with the unit. 4. If the EMO OUT input is not used, it must be jumpered. Connector is a 9-pin D-subminiature connector labeled **EMO OUT** on the back of the controller. Connector is supplied with the unit.
Process temperature fluctuates	1. PID parameters are not properly tuned for the process. 2. Controller software needs to be reset.	1. Adjust the heating and cooling PID parameters. Use Autotune procedure ("Autotune" on page 4-30.) 2. Perform this step only when tool is not processing. a. Record all process parameters, since this step will reset the controller to its default state. b. Turn controller off with power switch. c. While holding down "NO" key, turn controller on with power switch. d. Reprogram controller.
Process fluid cannot be pumped into the reservoir	1. Fill valve is not completely open. 2. Fill canister is faulty	1. Follow the procedure "Filling the Reservoir" on page 4-6 for filling the reservoir. 2. Use another fill canister.

Table 6-1. *Troubleshooting (Continued)*

Problem	Possible Cause	Possible Solution
Repeated Liquid Level #1 alarms and the reservoir needs filling	Leakage on the process plumbing loop	LAUDA-Noah recommends using an automatic leak detector to locate Fluorinert™ leakages. 1. Follow the operating instructions in the leak detector manual. 2. Check along the process plumbing, especially the fitting and connectors. 3. Repair any leaks. If leakage problems persist, try using two continuous hoses between the module and the process equipment.
Controller does not communicate with host equipment	1. Controller is not in Remote mode 2. Communication connector is not attached securely 3. Communication protocol is not correct 4. Controller address set incorrectly	1. Press the **Remote/Local** key on the controller. 2. Check communication connectors. 3. Select the appropriate protocol in the Global Setup Menu. See “Communications Protocol” on page 4-26. 4. CHX - Match address to tool setting RCM - Refer to RCM manual for addressing scheme.

LAUDA-Noah World Wide Web Site

For additional product information, consult LAUDA-Noah’s World Wide Web site at

http://www.noahprecision.com

LAUDA-NOAH CUSTOMER SUPPORT

Please contact one of the following offices in Table 6-2 for technical support.

Note: When calling LAUDA-Noah Customer Support, make sure to have the unit serial number and part number. These numbers are available on unit labels.

Table 6-2. *Customer Support locations*

Office	Contact
LAUDA-Noah, LP 2501 SE Columbia Way Suite 140 Vancouver, WA 98661	Phone: +1 360 993 1395 Fax: +1 360 993 1399 Email: sales@noahprecision.com service@noahprecision.com Web: www.noahprecision.com
Teltec SA 224 Boulevard John Kennedy Batiment B1 - Room 401-403 91105 Corbeil-Essonnes FRANCE	Phone: +33 1 60 88 73 00 Fax: +33 1 64 96 44 03
Teltec SA Le Hameau du Parc - Batiment D Rousset Parc Club 13790 Rousset FRANCE	Phone: +33 4 42 53 23 82 Fax: +33 4 42 53 26 89
Teltec Gmbh Am Moosbach 6 74535 Mainhardt GERMANY	Phone: +49 7903 91 44-0 Fax: +49 7903 91 44-11
MCU Via Borgazzi, 13 Monza (MI) ITALY	Phone: +39 039 322351 Fax: +39 039 322351

Table 6-2. *Customer Support locations (Continued)*

Office	Contact
Muramatsu Integrated Technology 102, 3-14-9, Aoki Kawaguchi-shi, Saitamaken 332-0031 JAPAN	Phone: +81 48 259 3730 Fax: +81 48 259 1203
Challentech No. 1, Lane 9, Pateh Road Hsin-Chu TAIWAN 300	Phone: +886 3 5614211 Fax: +886 3 5614210
APP Systems Services, PTE LTD 11 Toh Guan Road East #03-01 APP Enterprise Building Singapore 608603	Phone: +65 6425 6611 Fax: +65 6560 6616

RETURNING UNITS FOR REPAIR

Detailed information regarding returns, repairs and warranty can be found at:
http://www.noahprecision.com/support/RMA_info.shtml

An RMA Request Form can be completed at:
http://www.noahprecision.com/support/form_RMA.php

BEFORE returning any product for repair or adjustment, **follow all troubleshooting procedures**. If, after following these procedures, the problem still exists, or if the procedure instruction advises contacting LAUDA-Noah Customer Support, call and discuss the problem with a representative or visit the links listed above. Be prepared to give the model number and serial number of the unit, as well as the reason for the proposed return. This consultation call allows LAUDA-Noah Customer Support to determine whether the problem can be corrected in the field or if the unit must be returned. Such technical consultation is always free of charge.

If a unit is returned without first getting authorization from LAUDA-Noah Customer Support and that unit is found to be functional, there is a re-test and calibration fee plus shipping charges.

To ensure years of dependable service, LAUDA-Noah products are thoroughly tested and designed to be among the most reliable and highest quality systems available worldwide.

WARRANTY

LAUDA-Noah, LPproducts are warranted to be free from failures due to defects in material and workmanship after they are shipped from the factory (please see warranty statement below, for details) for the period of time defined in the purchase order.

To claim shipping or handling damage, inspect the delivered goods and report such damage to LAUDA-Noah within 30 days of receipt of the goods. Please note that failing to report any damage within this period is the same as acknowledging that the goods were received undamaged.

For a warranty claim to be valid, it must:

- Be made within the applicable warranty period
- Include the product serial number and a full description of the circumstances giving rise to the claim
- Have been assigned return material authorization number (see below) by LAUDA-Noah Customer Support

All warranty work will be performed at an authorized LAUDA-Noah service center (see list of contacts at the beginning of this chapter). You are responsible for obtaining authorization to return any defective units, prepaying the freight costs, and ensuring that the units are returned to an authorized LAUDA-Noah service center.

Warranty Statement

The seller makes no express or implied warranty that the goods are merchantable or fit for any particular purpose except as specifically stated in printed LAUDA-Noah specifications. The sole responsibility of the Seller shall be that it will manufacture the goods in accordance with its published specifications and that the goods will be free from defects in material and workmanship. The seller's liability for breach of an expressed warranty shall exist only if the goods are installed, started in operation, and tested in conformity with the seller's published instructions. The seller expressly excludes any warranty whatsoever concerning goods that have been subject to misuse, negligence, or accident, or that have been altered or repaired by anyone other than the seller or the seller's duly authorized agent. This warranty is expressly made in lieu of any and all other warranties, express or implied, unless otherwise agreed to in writing. The warranty period is defined in the purchase order and begins on the date the goods are shipped from LAUDA-Noah. In all cases, the seller has sole responsibility for determining the cause and nature of the failure, and the seller's determination with regard thereto shall be final. The LAUDA-Noah Warranty Statement may be superseded by a service agreement entered into between LAUDA-Noah and the buyer.

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