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Thermo Scientific NESLAB ThermoFlex™

Recirculating Chillers

Thermo Scientific Manual P/N U00933 Rev. 07/11/08

Installation
Operation
Basic Maintenance

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Product Service Information, Applications Notes, MSDS Forms, e-mail.

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Thermo Fisher Scientific

25 Nimble Hill Road
Newington, NH 03801
Tel : (800) 258-0830 or
(603) 436-9444
Fax : (603) 436-8411
www.thermo.com/tc

Sales, Service, and Customer Support

25 Nimble Hill Road
Newington, NH 03801
Tel: (800) 258-0830
Sales: 8:00 am to 5:00 pm
Service and Support: 8:00 am to 6:00 pm Monday through Friday (Eastern Time)
Fax: (603) 436-8411
service.tc.us@thermofisher.com

Dieselstrasse 4
D-76227 Karlsruhe, Germany
Tel : +49 (0) 721 4094 444
Fax : +49 (0) 721 4094 300
info.tc.de@thermofisher.com

Building 6, No. 27
Xin Jinqiao Rd., Shanghai 201206
Tel : +86(21) 68654588
Fax : +86(21) 64457830
info.china@thermofisher.com

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WARRANTY

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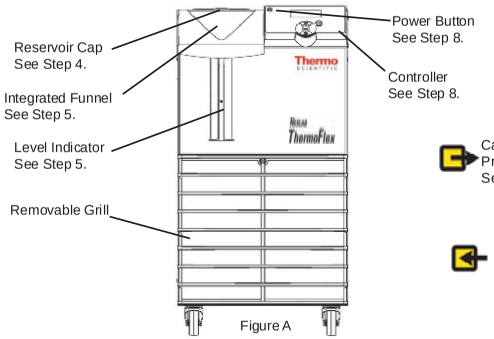


Figure A

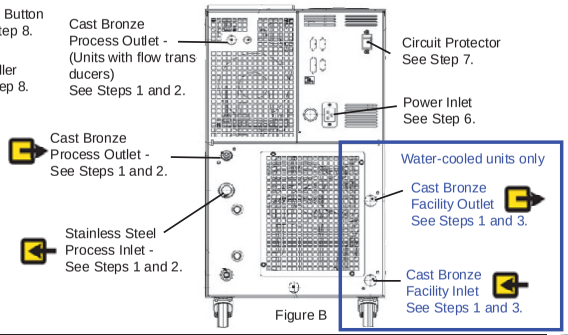
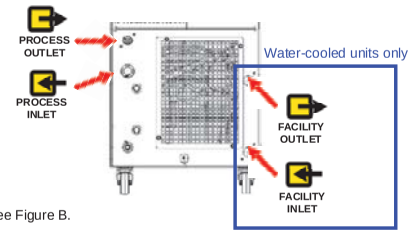


Figure B

What you need to get started:

- An adjustable wrench
- Facility water supply and return (water-cooled units)
- Appropriate hose or plumbing
- Appropriate size clamps or connection type
- Teflon® Tape or appropriate sealant

1 Pull out the plastic shipping plugs.



See Figure B.

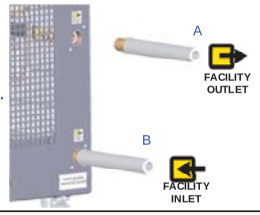
2 Connect the ThermoFlex PROCESS OUTLET (A) to the fluid inlet on your application. Connect the ThermoFlex PROCESS INLET (B) to the fluid outlet on your application. Ensure the connections are sealed and secure. **For air-cooled units skip to Step 4.**



See Figure B.

3 Connect the ThermoFlex FACILITY OUTLET (A) to your facility water return or drain. Connect the ThermoFlex FACILITY INLET (B) to your facility water supply. Ensure the connections are sealed and secure.

For water-cooled units only.



See Figure B.

4 Remove the reservoir cap by unscrewing it counter-clockwise.



See Figure A.

5 *Slowly* fill reservoir with clean process fluid (see Table 1), utilizing sight tube for easy fluid level monitoring. When the reservoir is full replace the reservoir cap. Since the reservoir capacity may be small compared to your application and air may need to be purged from the lines, have extra cooling fluid on hand to keep the system topped off when external circulation is started.

Note: Be careful not to fill the reservoir above MAX LEVEL fill line. This will result in a unit over flow error (O FLO) which will cause the unit to shut down.



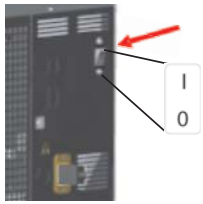
See Figure A.

6 Verify the appropriate voltage. Insert female end of power cord into chiller and then insert male end of power cord into power outlet.



See Figure B.

7 Place the circuit protector located on the rear of the unit to the on (**I**) position. The controller display will indicate a series of scrolling bars ( ). The bars will scroll upward indicating the controller is doing a self-test which takes approximately 15 seconds.



See Figure B.

8 Press .

The controller will display **SEtuP**.

Please see reverse side for additional steps.



See Figure A.

Safety Precautions:

The unit is designed for indoor use only.

Never place unit in a location where excessive heat, moisture, inadequate ventilation, or corrosive materials are present.

Never use flammable or corrosive fluids with this unit.

Never connect process fluid lines to your facility water supply or to any pressurized liquid source.

If your unit is equipped with a positive displacement pump, ensure your application plumbing lines and fittings are rated to withstand a minimum of 110 psi.

Before using any fluid or performing maintenance where contact with the fluid is likely refer to the manufacturer's MSDS for handling precautions.

Table 1.

Appropriate Fluids:
Filtered/Single Distilled Water
Deionized water (1-3 MΩcm, compensated)
0 – 95% Ethylene Glycol/Water
0 – 95% Propylene Glycol/Water

Quick Start - Used for Initial Start Up Only — perform steps 9 to 20 for all units.

NOTE: Once any Setup step is completed, meaning you pressed the enter key a second time, you cannot repeat the step to make corrections. You *can* make corrections after the unit is started, refer to the manual Section 4.

SEtuP — Press enter to continue the setup procedure.

9 Un itS — **UnitS are the temperature, fluid flow and pressure scales.**
Scales: °C/°F Gallons/Liters PSI/Bar/KPAS
Factory Defaults: °C, Gallons, PSI
- Press enter
- The display will flash between **UnitS** and **°C**
- If desired, use ▲ to change the scale to °F
- Press enter to sequence to the next display
- Do the same for **Gallons** and **PSI**

10 Hi t — **Hi t sets the fluid's High Temperature Alarm Limit.**
Range: +4°C to +42°C
Factory Default: +42°C
- Press enter
- The display will flash between **Hi t** and **42**
- If desired, use ▲▼ to adjust the value
- Press enter to sequence to the next display

11 Lo t — **Lo t sets the fluid's Low Temperature Alarm Limit.**
Range: +4°C to +40°C
Factory Default: +4°C
- Press enter
- The display will flash between **Lo t** and **4**
- If desired, use ▲▼ to adjust the value
- Press enter

12 Hi P1 — **Hi P1 sets the Pump's High Pressure Discharge Alarm Limit.**
Range: 4 to 100 psi
Factory Default: 100 psi
- Press enter
- The display will flash between **Hi P1** and **100**
- If desired, use ▲▼ to adjust the value
- Press enter

13 dELAY — **dELAY is the length of time the pump can exceed the Hi P1 Alarm Limit before shutting down.**
Range: 0 to 30 seconds
Factory Default: 0 seconds
- The display will flash between **dELAY** and **0**
- If desired, use ▲▼ to adjust the value
- Press enter

14 Lo P1 — **Lo P1 sets the Pump's Low Pressure Discharge Alarm Limit.**
Range: 4 to 40 psi
Factory Default: 4 psi
- Press enter
- The display will flash between **Lo P1** and **4**
- If desired, use ▲▼ to adjust the value
- Press enter

15 dELAY — **dELAY is the length of time the pump can exceed the Lo P1 Alarm Limit before shutting down.**
Range: 0 to 30 seconds
Factory Default: 10 seconds
- The display will flash between **dELAY** and **10**
- If desired, use ▲▼ to adjust the value
- Press enter

16 ALr — **ALr configures the unit's reaction to temperature, pressure, and flow (optional) alarm limits - either shut down (fLt) or continue to run (indC). See manual for more information.**
Range: fLt* or indC**
Factory Default: fLt
- Press enter
- The display will flash between **ALr** and **fLt**
- If desired, press ▼ to display **indC**
- Press enter

***fLt = fault (shut down)**
****indC = indicate (continue to run)**

17 Sound — **Turns the unit's audible alarm on or off.**
Range: on or OFF
Factory Default: on
- Press enter
- The display will flash between **Sound** and **on**
- If desired, press ▼ to display **OFF**
- Press enter

18 StArt — **StArt enables/disables auto restart.**
Range: on or OFF
Factory Default: on
- Press enter
- The display will flash between **StArt** and **on**
- If desired, press ▼ to display **OFF**
- Press enter

19 CArE — **CArE is used to set the preventative care cleaning frequency reminder for the unit's air and fluid filters.**
Range: off, L1 - 1000 hours, L2 - 2000 hours, L3 -3000 hours
Factory Default: L1
- Press enter
- The display will flash between **CArE** and **L1**
- If desired, use ▲▼ to change display to off, L2 or L3
- Press enter

(If applicable, see boxes on right to set up options)

20 StorE
- Press ▲ to save all settings

The unit will automatically start.

- Press ▼ to abort all settings
The display will go blank
Press ⏻ to restart the procedure

The Setup procedure is now complete.

When the unit starts the controller will display the process fluid temperature.

If desired, you can change/verify the unit's setpoint by pressing mode.

SP — **SP is used to adjust the setpoint.**
Range: +5°C to +40°C
Factory Default: +20°C
- The display will flash between **SP** and **20**
- If desired, use ▲▼ to change the setting
- Press enter to return to the temperature display

Option - Flow Transducer (Steps A and B)

A HiFLO — **HiFLO sets the high flow alarm limit.**
Range: 0.5 to 20.0 GPM
Factory Default: 5.0 GPM
- Press enter
- The display will flash between **HiFLO** and **5.0**
- If desired, use ▲▼ to adjust the value
- Press enter

B LoFLO — **LoFLO sets the low flow alarm limit.**
Range: 0.5 to 20.0 GPM
Factory Default: 0.5 GPM
- Press enter
- The display will flash between **LoFLO** and **0.5**
- If desired, use ▲▼ to adjust the value
- Press enter

If your unit does not have serial communications see Step 20.

Option - Serial Communications (Steps C to H)

C SEr — **SEr is used to enable/disable and to configure serial communications mode.**
Range: off, rS232, rS485
Factory Default: off
- Press enter
- The display will flash between **SEr** and **OFF**
- If desired, use ▲▼ to change the mode
- Press enter

D BAud — **BAud is used to select the speed rate for serial communication.**
Range: 9600, 4800, 2400, 1200, 600, or 300 bits per second.
Factory Default: 9600
- Press enter
- The display will flash between **BAud** and **9600**
- If desired, use ▲▼ to change the rate
- Press enter

E dAtA — **dAtA is used to display the number of bits per communication.**
Display: 8
- Press enter
- The display will flash between **dAtA** and **8**
- Press enter

F StoP — **StoP is used to indicate the end of a communication's packet.**
Range: 2 or 1
Factory Default: 2
- Press enter
- The display will flash between **StoP** and **2**
- If desired, use ▲▼ to change the setting
- Press enter

G PAr — **PAr is used as a means to check for communication errors.**
Range: even, odd, or none
Factory Default: none
- Press enter
- The display will flash between **PAr** and **none**
- If desired, use ▲▼ to change the setting
- Press enter

H u id — **u id (unit id) is used in RS485 only. Identifies devices connected to the RS485 port.**
Range: 1 to 32
Factory Default: 1
- Press enter
- The display will flash between **u id** and **1**
- If desired, use ▲▼ to change the setting
- Press enter

See Step 20.

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Preface

Compliance

CSA Approved - Laboratory equipment-electrical

File # 105974_C_000

CLASS: 8721-05 CAN/CSA-C22.2 No. 61010-1-04

CLASS: 8721-05 ANSI/UL Standard 61010-1

CSA approval for the ThermoFlex3500 & ThermoFlex5000 is pending.

Products tested and found compliant with the requirements defined in the EMC standards defined by 89/336/EEC as well as Low Voltage Directive (LVD) 73/23/EEC can be identified by the CE Mark on the rear of the unit. The testing has demonstrated compliance with the following directives:

- LVD, 73/23/EEC IEC/EN 61010-1
- EMC, 89/336/EEC IEC/EN 61326-1

WEEE/RoHS

For any additional information, refer to the Declaration of Conformity that shipped with the unit.

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:



Thermo Fisher Scientific has contracted with one or more recycling/ disposal companies in each EU Member State, disposed of or recycled this product through them. Further information on Thermo Fisher Scientific's compliance with these Directives, the recyclers in your country, and information on Thermo Scientific products which may assist the detection of substances subject to the RoHS Directive are available at:

www.thermo.com/WEEERoHS

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After-sale Support

Thermo Fisher Scientific is committed to customer service both during and after the sale. If you have questions concerning the unit operation, or questions concerning spare parts or Service Contracts, call our Sales, Service and Customer Support phone number, see inside cover for contact information.

When calling, please refer to the labels on the inside cover. These labels list all the necessary information needed to properly identify your unit.

Feedback

We appreciate any feedback you can give us on this manual. Please e-mail us at neslabmanuals@thermofisher.com. Be sure to include the manual part number and the revision date listed on the front cover.

Warranty

Thermo Scientific NESLAB ThermoFlex units have a warranty against defective parts and workmanship for 24 months from date of shipment. See back page for more details.

Unpacking

Retain all cartons and packing material until the unit is operated and found to be in good condition. If the unit shows external or internal damage contact the transportation company and file a damage claim. Under ICC regulations, this is your responsibility.

Out of Box Failure
An Out of Box Failure is defined as any product that fails to operate in conformance with sellers published specifications at initial power up. Install the unit in accordance with manufacturer's recommended operating conditions within 30 days of shipment from the seller.

Any Temperature Control product meeting the definition of an Out of Box Failure must be packed and shipped back in the original packaging to Thermo Fisher Scientific for replacement with a new unit; Seller to pay the cost of shipping. Customer must receive a Return Material Authorization (RMA) from Thermo Fisher prior to shipping the unit.

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Section 1 Safety

Safety Warnings



Warnings are posted throughout the manual. These warnings are designated by an exclamation mark inside an equilateral triangle and text highlighted in bold. Read and follow these important instructions. Failure to observe these instructions can result in permanent damage to the unit, significant property damage, or personal injury or death.



The lightning flash with arrow symbol, within an equilateral triangle, is intended to alert the user to the presence of non-insulated "dangerous voltage" within the unit's enclosure. The voltage may be of significant enough magnitude to constitute a risk of electrical shock.

Make sure you read and understand all instructions and safety precautions listed in this manual before installing or operating your unit. If you have any questions concerning the operation of your unit or the information in this manual, please contact us. See inside cover for contact information.

Never place the unit in a location where excessive heat, moisture, or corrosive materials are present. ▲

The unit construction provides protection against the risk of electrical shock by grounding appropriate metal parts. The protection may not function unless the power cord is connected to a properly grounded outlet. It is the user's responsibility to assure a proper ground connection is provided. ▲

Always turn the unit off and disconnect the supply voltage from its power source before moving the unit. ▲

Never connect the process fluid inlet or outlet fittings to your building water supply or any water pressure source. ▲

Never use flammable or corrosive fluids with this unit. Use of these fluids will void the manufacturer's warranty. ▲

Do not use automotive antifreeze. Commercial antifreeze contains silicates that can damage the pump seals. Use of automotive antifreeze will void the manufacturer's warranty. ▲

Before using any fluid or performing maintenance where contact with the fluid is likely refer to the manufacturer's MSDS for handling precautions. ▲

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Performance of installation, operation, or maintenance procedures other than those described in this manual may result in a hazardous situation and may void the manufacturer's warranty. ▲

Transport the unit with care. Sudden jolts or drops can damage the unit's components. ▲

Drain the unit before it is transported and/or stored in near or below freezing temperatures, see Draining in Section 8. Store the unit in the temperature range -25°C to 60°C (with packaging), and <80% relative humidity. ▲

The circuit protector located on the rear of the unit is not intended to act as a disconnecting means. ▲

Observe all warning labels. ▲

Never remove warning labels. ▲

Never operate damaged or leaking equipment. ▲

Never operate the unit without process fluid in the reservoir. ▲

Always turn off the unit and disconnect the power cord from the power source before performing any service or maintenance procedures, or before moving the unit. ▲

Never operate the unit with panels removed. ▲

Never operate equipment with damaged power cords. ▲

Refer service and repairs to a qualified technician. ▲

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Section 2 General Information

Description

The Thermo Scientific NESLAB ThermoFlex™ recirculating chiller is designed to provide a continuous supply of fluid at a constant temperature and volume. The unit consists of an air-cooled or water-cooled refrigeration system, heat exchanger, recirculating pump, polyethylene reservoir, and a microprocessor controller.

Specifications

	ThermoFlex900	ThermoFlex1400	ThermoFlex2500
Process Fluid Temperature Range	+ 5°C to +40°C +41°F to +104°F	+5°C to +40°C +41°F to +104°F	+5°C to +40°C +41°F to +104°F
Ambient Temperature Range	+ 10°C to +40°C + 50°F to +104°F	+10°C to +40°C +50°F to +104°F	+10°C to +40°C +50°F to +104°F
Temperature Stability	± 0.1°C	± 0.1°C	± 0.1°C
Cooling Capacity at 20°C			
60 Hz	900 W (3074 BTU)	1400 W (4781 BTU)	2500 W (8538 BTU)
50 Hz	750 W (2561 BTU)	1170 W (3996 BTU)	2200 W (7513 BTU)
Reservoir Volume			
Gallons	1.9	1.9	1.9
Liters	7.2	7.2	7.2
Footprint or Dimensions (HxWxD)			
Inches	27 5/16 x 14 3/16 x 24 9/16	27 5/16 x 14 3/16 x 24 9/16	28 15/16 x 17 1/8 x 26 1/2
Centimeters	69.4 x 36.0 x 62.4	69.4 x 36.0 x 62.4	73.6 x 43.6 x 67.3
Unit Weight (empty)			
lb	130.5	130.5	175.5
kg	59.2	59.2	79.6
Pumps			
P 1 - Positive Displacement			
60 Hz		2.1 gpm @ 60 psid	
50 Hz		1.7 gpm @ 60 psid	
P 2 - Positive Displacement			
60 Hz		4.1 gpm @ 60 psid	
50 Hz		3.3 gpm @ 60 psid	

- Specifications obtained at sea level using water as the recirculating fluid, at a 20°C process setpoint, 25°C ambient condition, at nominal operating voltage. Other fluids, fluid temperatures, ambient temperatures, altitude or operating voltages will affect performance.
- Air-cooled units retain their full rated capacity at 20°C setpoint in ambient temperatures up to 25°C (77°F). For ambient temperatures above 25°C please de-rate the cooling capacity 3% for every 1°C above 25°C (77°F), up to a maximum ambient temperature of 40°C (104°F). Please note that when operating at a process temperature lower than 20°C the de-rate percentage may increase due to additional gains from losses to ambient. For water-cooled units refer to Section 3.
- Additional dimensions are shown at the end of this section, add 1/8" (3 cm) to height for SEMI units.
- Unit weight is for air-cooled units. Subtract 30 pounds (14 kilograms) for water-cooled units.
- Thermo Fisher Scientific reserves the right to change specifications without notice.

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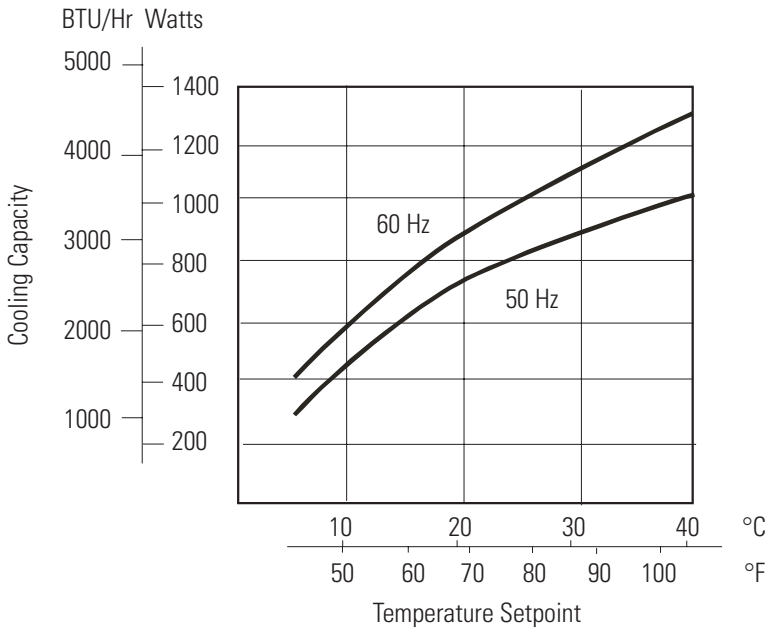
Specifications

	ThermoFlex3500	ThermoFlex5000
Process Fluid Temperature Range	+ 5°C to +40°C +41°F to +104°F	+5°C to +40°C +41°F to +104°F
Ambient Temperature Range	+ 10°C to +40°C + 50°F to +104°F	+10°C to +40°C +50°F to +104°F
Temperature Stability	± 0.1°C	± 0.1°C
Cooling Capacity at 20°C		
60 Hz	3500 W (11953 BTU)	5000 W (17076 BTU)
50 Hz	3050 W (10416 BTU)	4400 W (15027 BTU)
Reservoir Volume		
Gallons	1.9	1.9
Liters	7.2	7.2
Footprint or Dimensions (HxWxD)		
Inches	$38\ ^{7}/_{8}$ x $19\ ^{1}/_{4}$ x $30\ ^{3}/_{4}$	$38\ ^{7}/_{8}$ x $19\ ^{1}/_{4}$ x $30\ ^{3}/_{4}$
Centimeters	98.7 x 48.8 x 78.0	98.7 x 48.8 x 78.0
Unit Weight P 1/ P 2/P 3/P 4 (empty)		
lb	264/264/270/303	NA/264/270/303
kg	120/120/123/138	NA/120/123/138
Pumps		
P 1 - Positive Displacement		
60 Hz	2.1 gpm @ 60 psid	-
50 Hz	1.7 gpm @ 50 psid	-
P 2 - Positive Displacement		
60 Hz	4.1 gpm @ 60 psid	4.1 gpm @ 60 psid
50 Hz	3.3 gpm @ 60 psid	3.3 gpm @ 60 psid
P 3 - Centrifugal Pump		
60 Hz	10 gpm @ 34 psid	10 gpm @ 34 psid
50 Hz	10 gpm @ 22 psid	10 gpm @ 22 psid
P 4 - Centrifugal Pump		
60 Hz	15 gpm @ 59 psid	10 gpm @ 59 psid
50 Hz	15 gpm @ 38 psid	10 gpm @ 38 psid

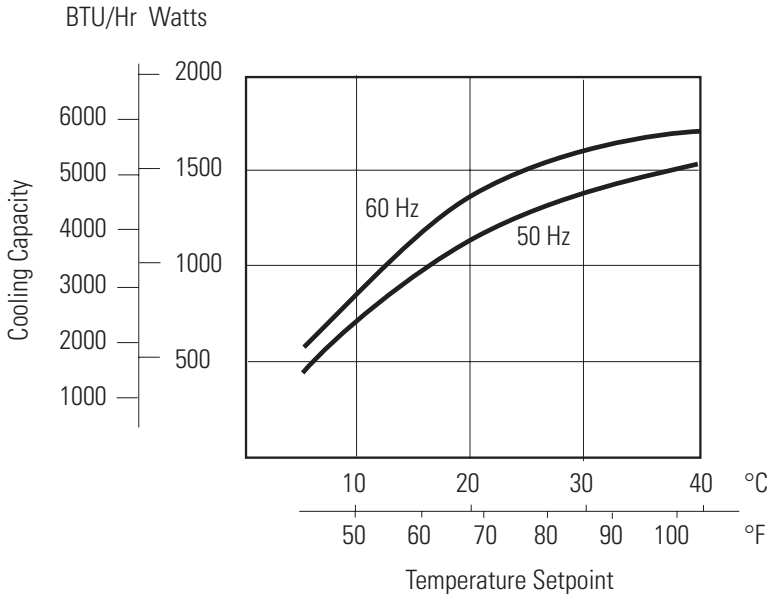
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- Air-cooled units retain their full rated capacity at 20°C setpoint in ambient temperatures up to 25°C (77°F). For ambient temperatures above 25°C please de-rate the cooling capacity 3% for every 1°C above 25°C (77°F), up to a maximum ambient temperature of 40°C (104°F). Please note that when operating at a process temperature lower than 20°C the de-rate percentage may increase due to additional gains from losses to ambient. For water-cooled units refer to Section 3.
- Additional dimensions are shown at the end of this section, add 1/8" (3 cm) to height for SEMI units.
- Unit weight is for air-cooled units. Subtract 30 pounds (14 kilograms) for water-cooled units. Add 27 pounds (12 kilograms) for global voltage units.
- Thermo Fisher Scientific reserves the right to change specifications without notice.

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ThermoFlex900 Cooling Capacity



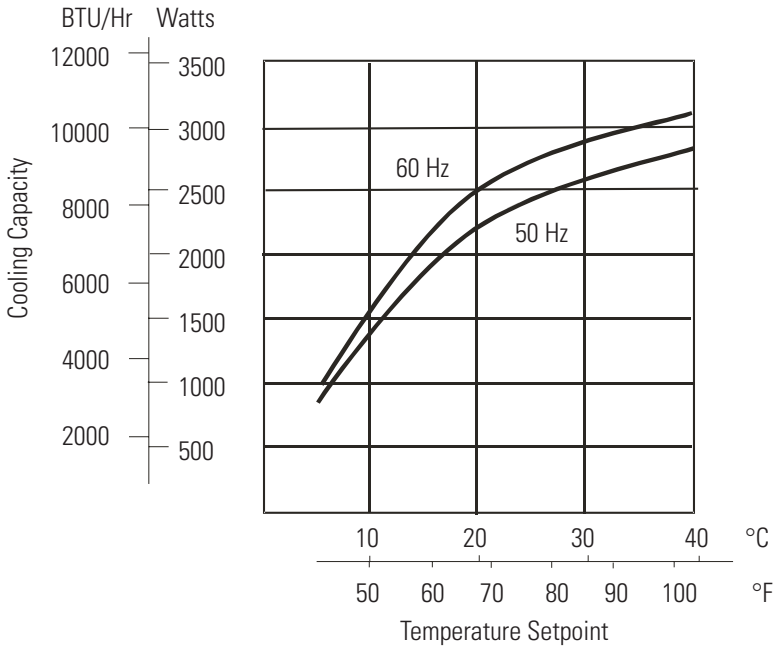
ThermoFlex1400 Cooling Capacity



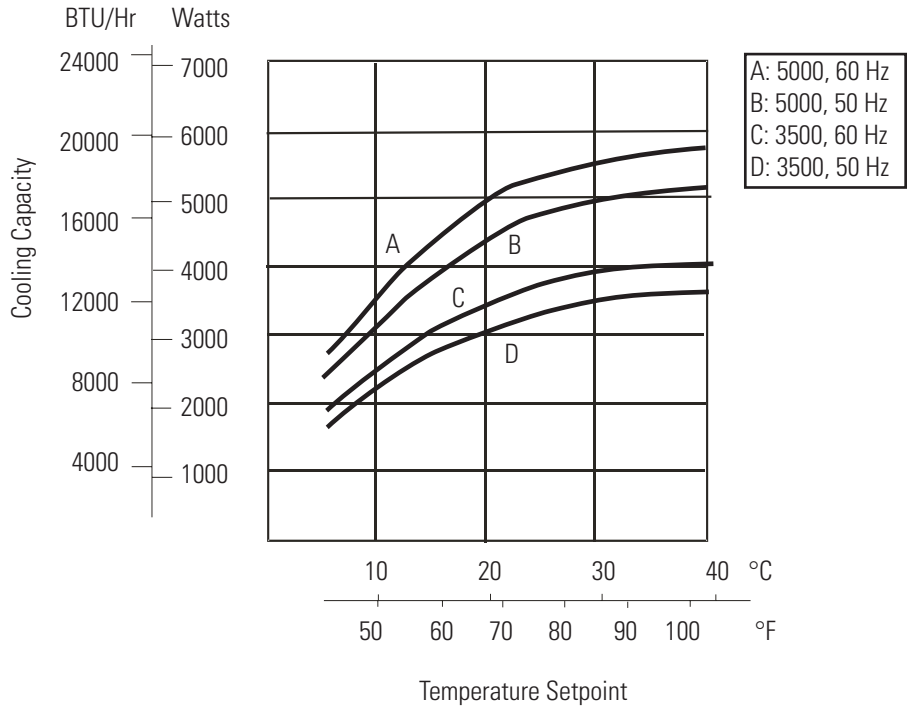
- Specifications obtained at sea level using water as the recirculating fluid, at a 20°C process setpoint, 25°C ambient condition, at nominal operating voltage. Other fluids, fluid temperatures, ambient temperatures, altitude or operating voltages will affect performance.
- Air-cooled units retain their full rated capacity at 20°C setpoint in ambient temperatures up to 25°C (77°F). For ambient temperatures above 25°C please de-rate the cooling capacity 3% for every 1°C above 25°C (77°F), up to a maximum ambient temperature of 40°C (104°F). Please note that when operating at a process temperature lower than 20°C the de-rate percentage may increase due to additional gains from losses to ambient. For water-cooled units refer to Section 3.
- Thermo Fisher Scientific reserves the right to change specifications without notice.

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ThermoFlex2500 Cooling Capacity



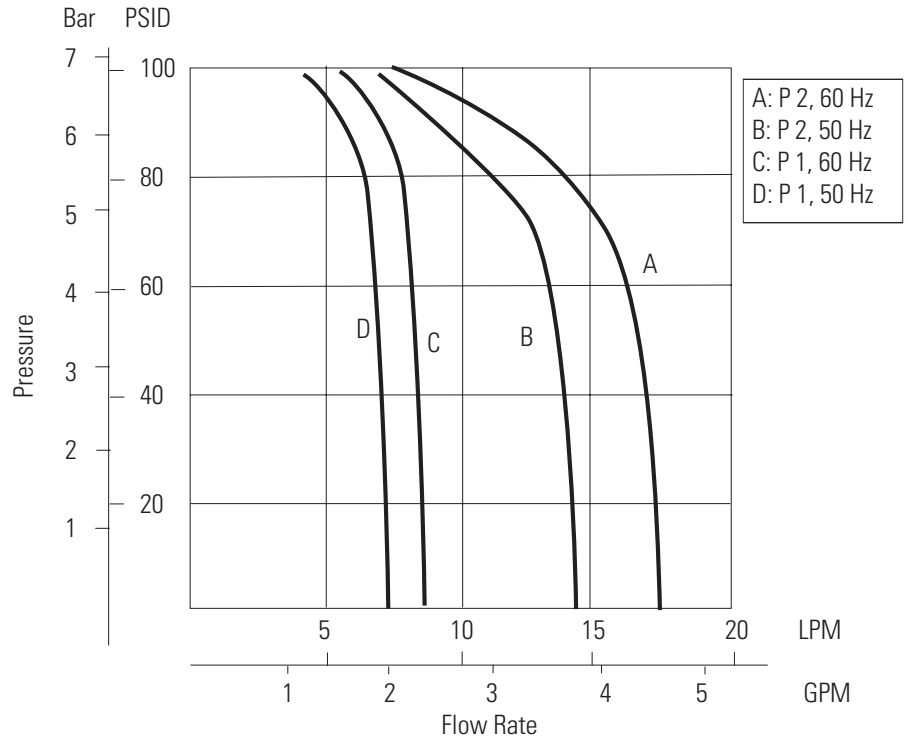
ThermoFlex3500/5000 Cooling Capacity



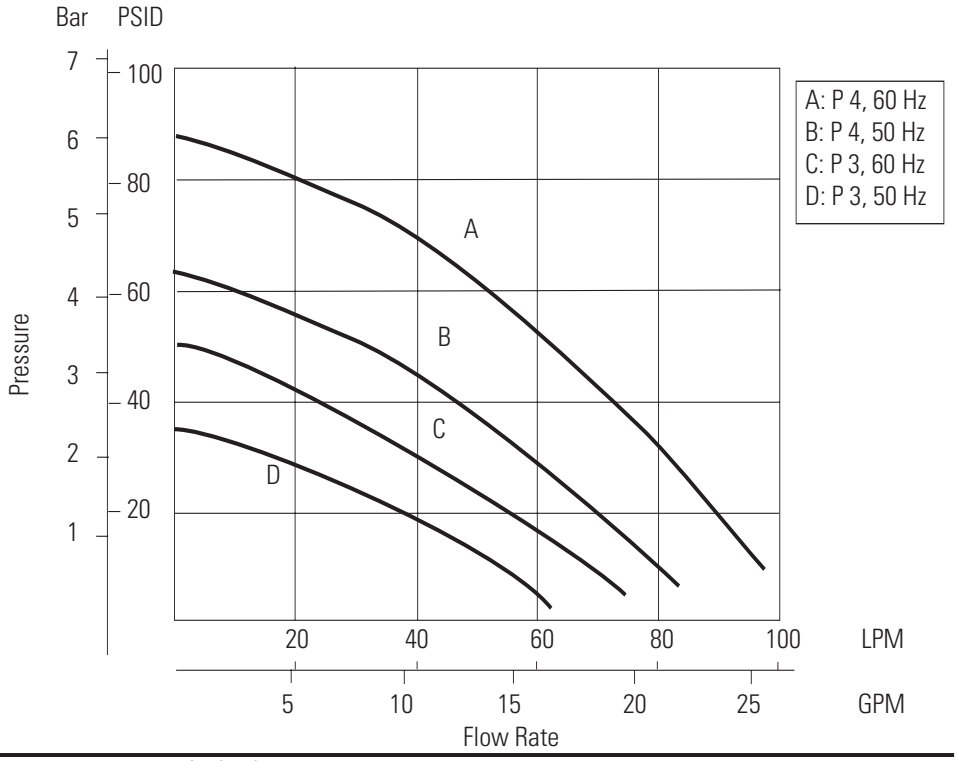
- Specifications obtained at sea level using water as the recirculating fluid, at a 20°C process setpoint, 25°C ambient condition, at nominal operating voltage. Other fluids, fluid temperatures, ambient temperatures, altitude or operating voltages will affect performance.
- Air-cooled units retain their full rated capacity at 20°C setpoint in ambient temperatures up to 25°C (77°F). For ambient temperatures above 25°C please de-rate the cooling capacity 3% for every 1°C above 25°C (77°F), up to a maximum ambient temperature of 40°C (104°F). Please note that when operating at a process temperature lower than 20°C the de-rate percentage may increase due to additional gains from losses to ambient. For water-cooled units refer to Section 3.
- Thermo Fisher Scientific reserves the right to change specifications without notice.

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Pumping Capacity P 1/P 2



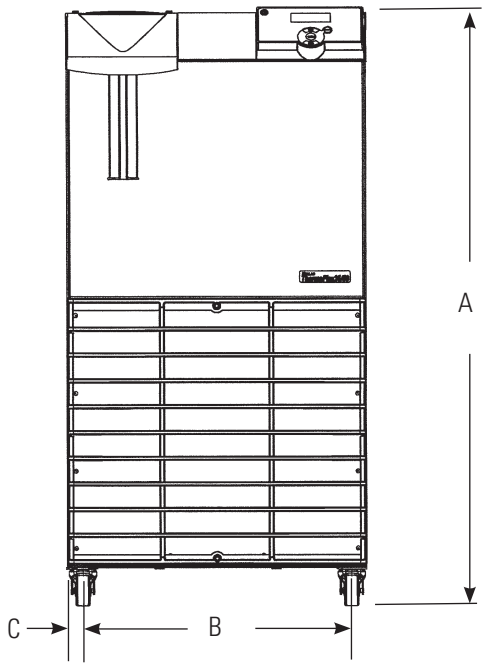
Pumping Capacity P 3/P 4



- Pump curves are nominal values.
- Pump performance results were obtained with no restrictions on the return to the system. Please note that utilizing either the external or internal DI option will result in a 0.5 gpm reduction of available flow.
- Specifications obtained at sea level using water as the recirculating fluid, at a 20°C process setpoint, 25°C ambient condition, at nominal operating voltage. Other fluids, fluid temperatures, ambient temperatures, altitude or operating voltages will affect performance.
- Thermo Fisher Scientific reserves the right to change specifications without notice.

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ThermoFlex900 - 5000
Dimensions
(Inches/Centimeters)



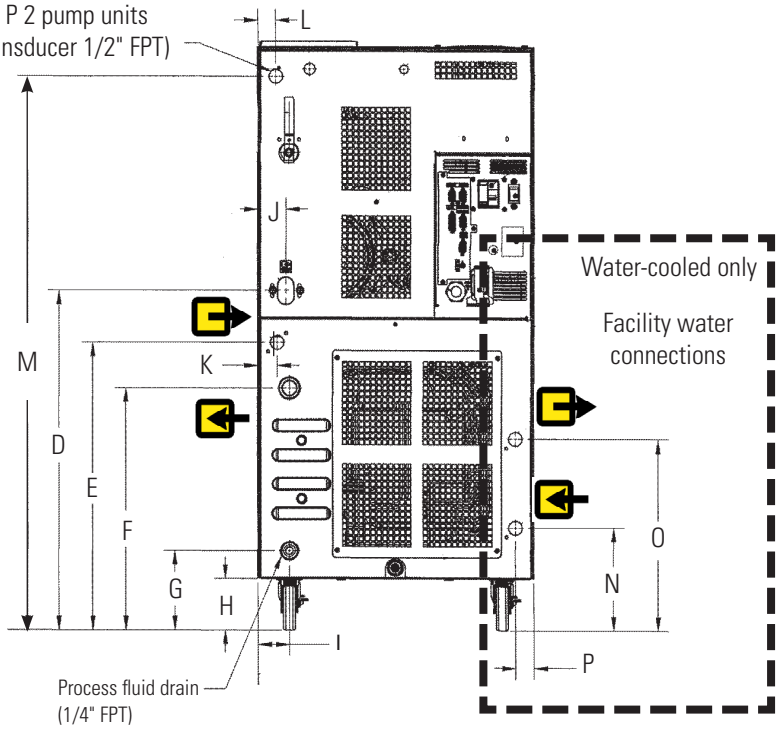
Front View

Process discharge fluid connection
(M and L - P 1, P 2 pump units
with a flow transducer 1/2" FPT)

Process fluid discharge connections
D and J - P 3, P 4 pumps 3/4" FPT
E and K - P 1, P 2 pumps 1/2" FPT

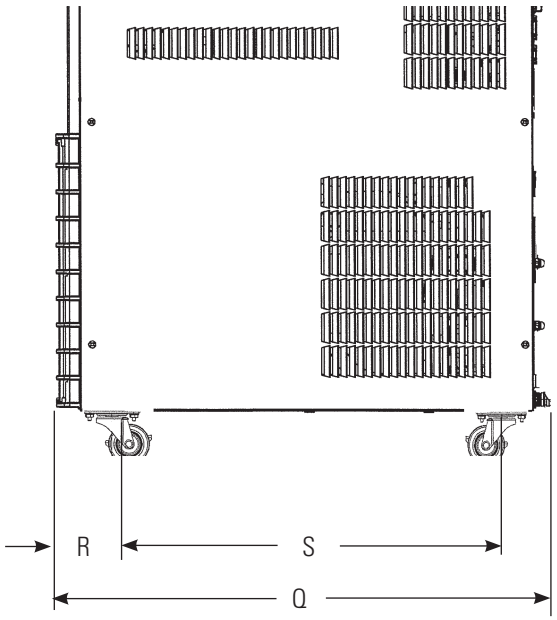
Process fluid return connection
F and I - P 3, P 4 pumps 3/4" FPT
F and I - P 1, P 2 pumps 1/2" FPT

See Section 3 for additional plumbing information

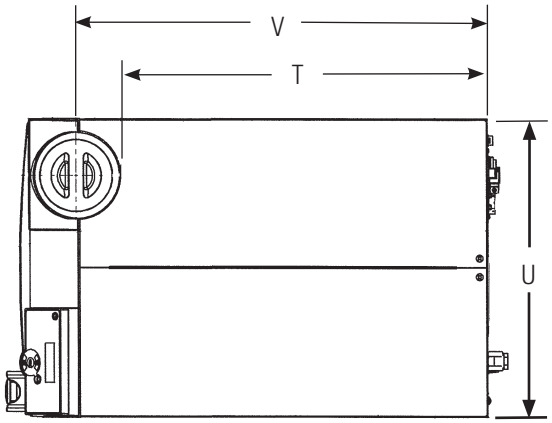


Rear View

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Side View



Top View

Shipping crate dimensions (approximate):

ThermoFlex900/1400	ThermoFlex2500	ThermoFlex 3500/5000
21" wide	23" wide	
35" tall	36" tall	
40" deep	40" deep	

	ThermoFlex900/1400		ThermoFlex2500		ThermoFlex3500/5000	
A*	27 5/16"	69.4 cm	28 15/16"	73.6 cm	38 7/8"	98.7 cm
B	12 3/16"	30.9 cm	15 1/8"	38.4 cm	17 3/16"	43.7 cm
C	15/16"	2.4 cm	1"	2.5 cm	1"	2.5 cm
D*	NA	NA	NA	NA	22"	55.9 cm
E*	14 9/16"	37.0 cm	16 1/8"	40.9 cm	18 1/2"	46.9 cm
F*	11 9/16"	29.4 cm	13 1/8"	33.3 cm	15 3/8"	39.1 cm
G*	4 3/8"	11.2 cm	5 15/16"	15.1 cm	4 3/8"	11.2 cm
H	2 1/2"	6.4 cm	2 1/2"	6.4 cm	2 1/2"	6.4 cm
I	1 5/8"	4.2 cm	1 5/8"	4.2 cm	2 3/16"	5.6 cm
J	NA	NA	NA	NA	1 15/16"	5.0 cm
K	1 5/8"	4.2 cm	1 5/8"	4.2 cm	1 5/16"	3.4 cm
L	1 5/16"	3.3 cm	1 1/4"	3.1 cm	1 1/4"	3.1 cm
M*	25 3/4"	65.4 cm	27 5/16"	69.4 cm	36 1/2"	92.7 cm
N*	3 15/16"	10.0 cm	5"	12.7 cm	6"	15.2 cm
O*	10 11/16"	27.2 cm	12 13/16"	32.5 cm	12"	30.5 cm
P	1 1/8"	2.9 cm	1 3/16"	3.0 cm	1 1/4"	3.2 cm
Q	24 9/16"	62.4 cm	26 1/2"	67.3 cm	30 3/4"	78.0 cm
R	3 3/8"	8.6 cm	3 5/8"	9.2 cm	3 7/16"	8.7 cm
S	18 1/2"	47.0 cm	20 1/16"	51.0 cm	24 1/2"	62.2 cm
T	17 3/16"	43.7 cm	19 3/16"	48.8 cm	23 1/2"	59.7 cm
U	14 3/16"	36.0 cm	17 1/8"	43.8 cm	19 1/4"	48.8 cm
V	20"	50.8 cm	22"	55.9 cm	26 3/8"	67.0 cm

* Add 1/8" (3 cm) for SEMI units.

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Section 3 Installation

Site Requirements

Ambient Temperature Range*	10°C to 40°C (50°F to 104°F)
Relative Humidity Range	10% to 80% (non-condensing)
Operating Altitude*	Sea Level to 8000 feet (2438 meters)
Overvoltage Category	II
Pollution Degree	2

Because of the decrease in air density, maximum temperature for the air entering the ThermoFlex is reduced by 1°C per 1,000 feet above sea level. In addition, cooling capacity is reduced 1.2% per 1,000 feet above sea level.



Never place the unit in a location where excessive heat, moisture, inadequate ventilation, or corrosive materials are present. ▲

NOTE Fluid temperatures at the application may differ from the chiller due to environmental heat loss/gain. Heat is also lost through the plumbing when the setpoint is at or below room temperature. Applications with long lengths of plumbing may need additional insulation. ▲

Units installed below the end-user application may enable system fluid to drain back into the chiller and cause spillage. Thermo Fisher offers an anti-drainback kit to prevent any spillage, see Section 5.

NOTE ThermoFlex2500 air-cooled units are equipped with a two-speed fan. Should the unit's internal ambient temperature reach 50°C for 30 seconds, or reach 53°C, the fan speed will switch from slow speed to high speed to maintain internal temperatures within acceptable limits. When the temperature reaches 44°C or below for at least 15 minutes the speed will return to low. When in high speed the unit's decibel level increases significantly. ▲

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Air-cooled units can be installed with both sides blocked, or one side and the rear. See illustration below. The front of the unit needs a minimum clearance of 24". Air will enter the front of the system and exit through the sides and rear.

Having two sides blocked can impact the unit's performance due to changes in air flow. If your installation requires two blocked sides please ensure that the following requirements are met:

Process Setpoint Temperature: Below 30°C

Ambient: Below 40°C

Before operating the unit in conditions outside any of those listed on this page please contact Thermo Fisher Scientific's Sales, Service and Customer Support to review your installation.

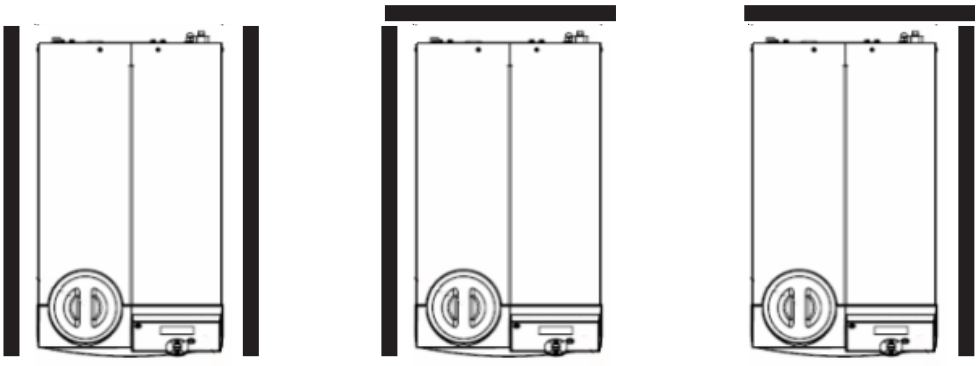


Figure 3-1 Minimum Clearance

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Electrical Requirements



The unit construction provides protection against the risk of electrical shock by grounding appropriate metal parts. The protection may not function unless the power cord is connected to a properly grounded outlet. It is the user's responsibility to assure a proper ground connection is provided. ▲

The user is responsible to ensure that the power cord provided meets local electrical codes. If not, contact qualified installation personnel.

The unit is intended for use on a dedicated outlet. The ThermoFlex has an internal circuit protection that is equivalent (approximately) to the branch circuit rating. This is to protect the ThermoFlex, and is not intended as a substitute for branch circuit protection.

Electrical Service Requirements (Standard units):

ThermoFlex900 Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
100 VAC	50 Hz	1Ø	15A	5-15P
115 VAC	60 Hz	1Ø	15A	5-15P
200 VAC	50 Hz	1Ø	15A	6-15P
208-230 VAC	60 Hz	1Ø	15A	6-15P
230 VAC	50 Hz	1Ø	*16A[1], 15A[2], 13A	-

ThermoFlex1400 Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
100 VAC	50 Hz	1Ø	20A	5-20P
115 VAC	60 Hz	1Ø	20A	5-20P
200 VAC	50 Hz	1Ø	15A	6-15P
208-230 VAC	60 Hz	1Ø	15A	6-15P
230 VAC	50 Hz	1Ø	*16A[1], 15A[2], 13A[3]	-

ThermoFlex2500/3500/5000 Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
200 VAC	50 Hz	1Ø	20A	6-20P
208-230 VAC	60 Hz	1Ø	20A	6-20P
208-230 VAC P4 Pump	60 Hz	1Ø	30A	6-30P
230 VAC	50 Hz	1Ø	*16A1, 15A2, 13A3	-

* Refer to Appendix A for country specific ratings.

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Electrical Service Requirements (Global Voltage units):

ThermoFlex900 Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
115 VAC	60 Hz	1Ø	15A	5-15P
100 VAC	50/60 Hz	1Ø	15A	5-15P
200/208/230 VAC	60 Hz	1Ø	15A	6-15P
200/230 VAC	50 Hz	1Ø	**16A[1], 15A[2], 13A[3]	6-15P

ThermoFlex1400 Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
115 VAC	60 Hz	1Ø	20A	5-20P
100 VAC	50/60 Hz	1Ø	20A	5-20P
200/208/230 VAC	60 Hz	1Ø	15A	6-15P
200/230 VAC	50 Hz	1Ø	**16A[1], 15A[2], 13A[3]	6-15P

ThermoFlex2500 Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
200/208/230 VAC	60 Hz	1Ø	20A	6-20P
200/230 VAC	50 Hz	1Ø	**16A[1], 15A[2], 13A[3]	6-20P

ThermoFlex3500/5000 Voltage	Frequency	Phase	Branch Circuit Requirements	Line Cord Plug
200 230 VAC	50 60 Hz	1Ø	20A	6-20P
208-230 VAC P4 Pump	60 Hz	1Ø	30A	6-30P

** Units selected for 230 VAC operation have a range of -10% to +7%. Refer to Appendix A for country specific ratings.

For installation information on Global Voltage units refer to Appendix B.

Refer to the nameplate label located on the rear of the unit for specific electrical requirements.

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Plumbing Requirements

Ensure that the shipping plugs are removed from all fittings before installation. ▲

Never connect the process fluid lines to your facility water supply or any pressurized liquid source. ▲

To prevent damage to the unit's plate exchanger, centrifugal pumps require a 3.8 gpm (14.9 lpm) minimum flow rate. ▲

NOTE To prevent a pump discharge pressure error code, ensure your plumbing installation will develop a back pressure greater than 4 PSI. ▲

The process fluid plumbing connections are located on the rear of the unit and are labeled (PROCESS OUTLET) and (PROCESS INLET). The connections for units with P1 and P2 pumps are ½" Female NPT, P3 and P4 pumps are ¾" FPT. The process outlet connection is cast bronze, the process inlet connection is stainless steel.

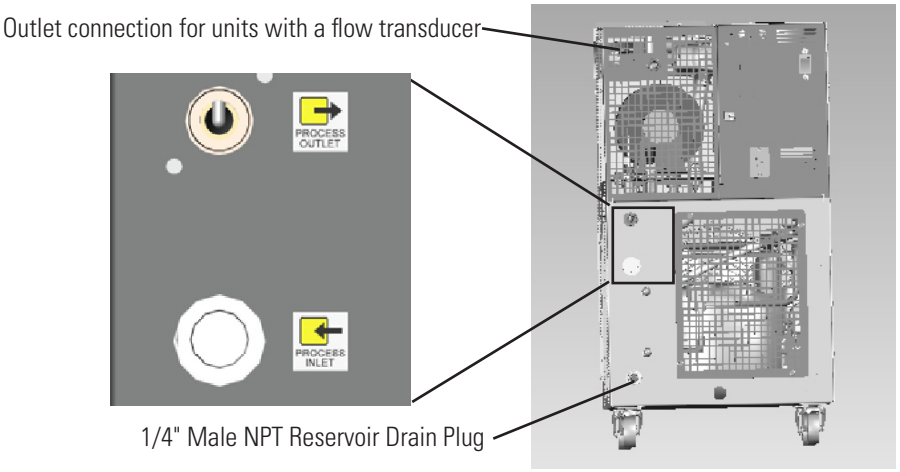


Figure 3-2 Plumbing Connections (1 of 2)

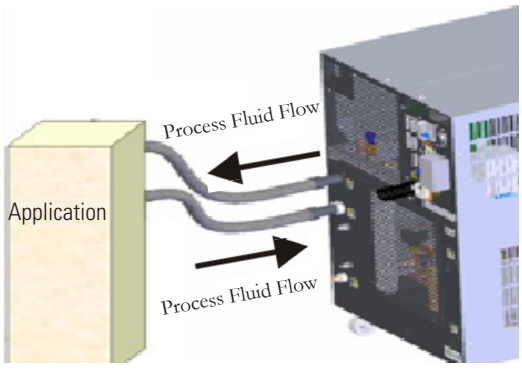


Figure 3-2 Plumbing Connections (2 of 2)

Connect the PROCESS OUTLET to the fluid inlet on your application. Connect the PROCESS INLET to the fluid outlet on your application. Ensure all connections are secure and that the proper sealant/lubricant for the fitting material is used.

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NOTE P1 and P2 pumps are capable of producing 110 psi. Ensure your plumbing is rated to withstand this pressure. An external pressure relief valve is available, see Section 5. ▲

Keep the distance between the unit and the instrument being cooled as short as possible. Ensure tubing is straight and without bends. If diameter reductions are required, make them at the inlet and outlet of your application, not at the ThermoFlex.

Water-Cooled Units

For water-cooled units the facility water plumbing connections are also located on the rear of the unit and are labeled FACILITY INLET and FACILITY OUTLET. The connections are also ½" Female NPT. Both connections are cast bronze.

Connect the FACILITY INLET to your facility water supply. Connect the FACILITY OUTLET to your facility water return or drain. Ensure all connections are secure and that the proper sealant/lubricant for the fitting material is used.

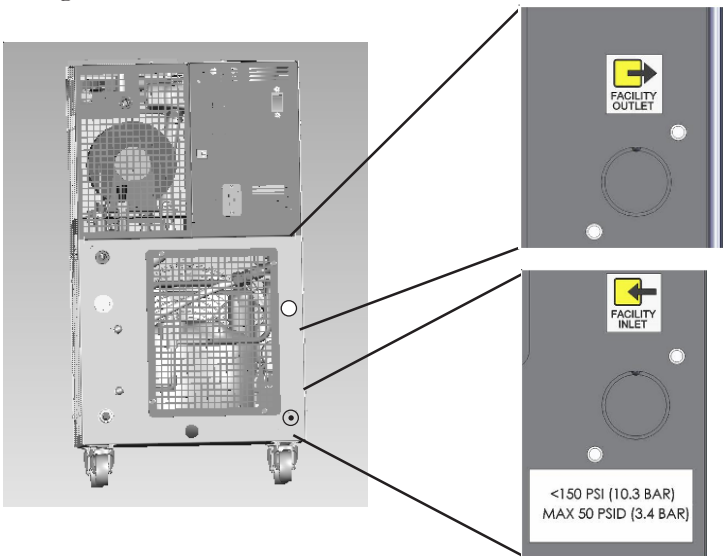


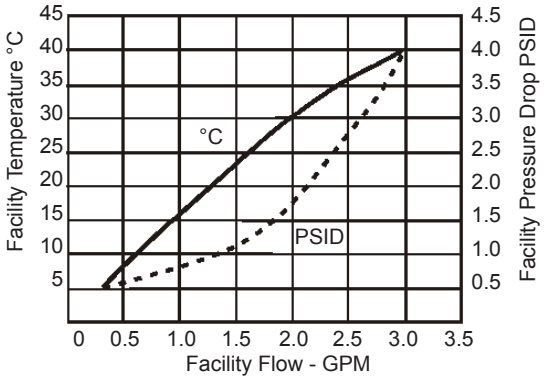
Figure 3-3 Plumbing Connections, Water-cooled Units

Facility Water Maximum Inlet Pressure must not exceed 150 PSIG.

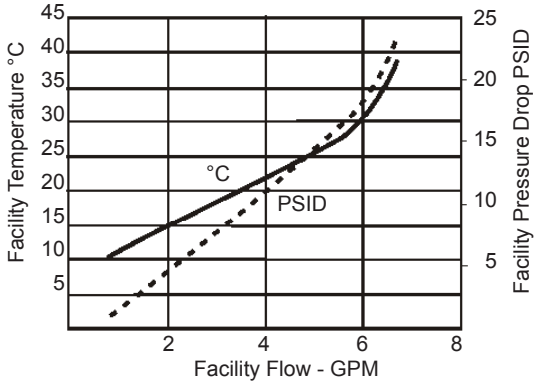
Facility Water Maximum Pressure Differential must not exceed 50 PSID under any condition.
(Pressure Differential = Inlet Pressure - Outlet Pressure)

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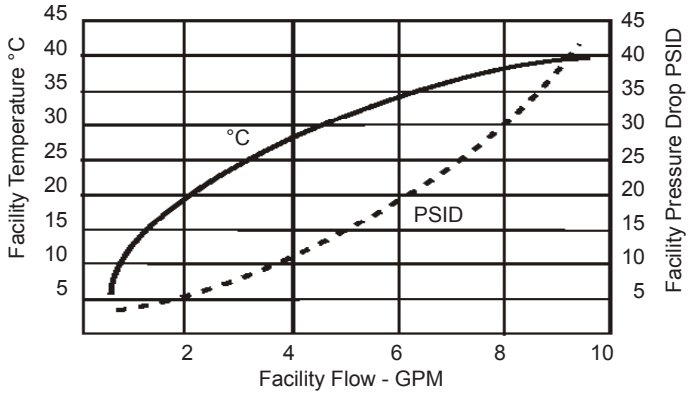
The facility water must meet the following conditions for the ThermoFlex1400 units to maintain its full rated capacity.



The facility water must meet the following conditions for the ThermoFlex2500 units to maintain its full rated capacity.



The facility water must meet the following conditions for the ThermoFlex3500 and ThermoFlex5000 units to maintain its full rated capacity.



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Fluid Requirements



Never use flammable or corrosive fluids with this unit. Do not use automotive antifreeze. Commercial antifreeze contains silicates that can damage the pump seals. Use of automotive antifreeze will void the manufacturer's warranty. ▲

Acceptable fluids are:

- Filtered/Single Distilled water
- 0 - 95% Ethylene Glycol/Water
- 0 - 95% Propylene Glycol/Water
- Deionized water (1 - 3 MΩcm, compensated)

Check the fluid concentration on a regular basis. Changes in concentration can impact system performance.



Before using any fluid or performing maintenance where contact with the fluid is likely refer to the manufacturer's MSDS for handling precautions. ▲



Ethylene glycol (EG) is hygroscopic, it will absorb water from its environment. This can affect the freezing point and boiling point of the fluid over time. This may result in system failure. ▲



When using EG/water or PG/water, top-off with EG/water or PG/water. Do not top-off with plain water. Topping-off with plain water can severely affect the freezing point and boiling point of the fluid. This may result in system failure. ▲



Do not use a Deionization (DI) filter cartridge with Inhibited EG or Inhibited PG. A DI filter will remove inhibitors from the solution rendering the fluid ineffective against corrosion protection. Also, inhibitors increase fluid conductivity. ▲

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Water Quality and Standards

Process Fluid	Permissible (PPM)	Desirable (PPM)
Microbiologicals		
(algae, bacteria, fungi)	0	0
Inorganic Chemicals		
Calcium	<25	<0.6
Chloride	<25	<10
Copper	<1.3	<1.0
0.020 ppm if fluid in contact with aluminum iron		
Iron	<0.3	<0.1
Lead	<0.015	0
Magnesium	<12	<0.1
Manganese	<0.05	<0.03
Nitrates\Nitrites	<10 as N	0
Potassium	<20	<0.3
Silicate	<25	<1.0
Sodium	<20	<0.3
Sulfate	<25	<1
Hardness	<17	<0.05
Total Dissolved Solids	<50	<10
Other Parameters		
pH	6.5-8.5	7-8
Resistivity	0.01*	0.05-0.1*

* MΩcm (Compensated to 25°C)

Unfavorably high total ionized solids (TIS) can accelerate the rate of galvanic corrosion. These contaminants can function as electrolytes which increase the potential for galvanic cell corrosion and lead to localized corrosion such as pitting. Eventually, the pitting will become so extensive that refrigerant will leak into the water reservoir.

As an example, raw water in the United States averages 171 ppm (of NaCl). The recommended level for use in a water system is between 0.5 to 5.0 ppm (of NaCl).

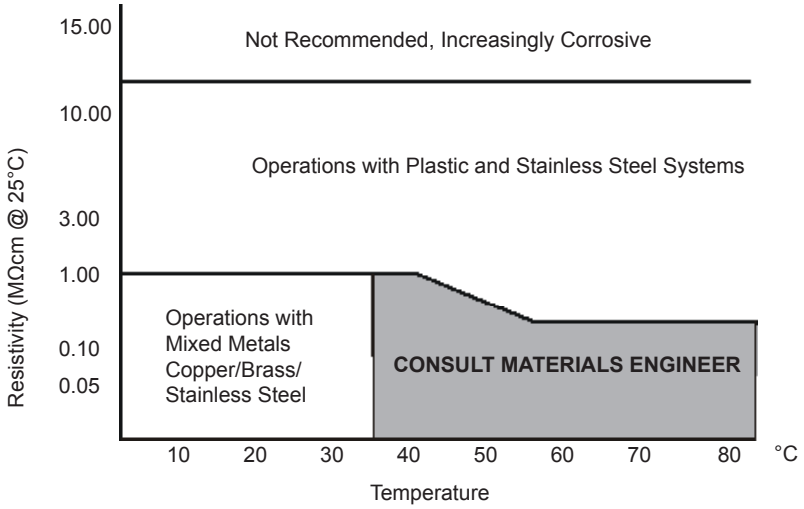
Recommendation: Initially fill the tank with distilled or deionized water. Do not use untreated tap water as the total ionized solids level may be too high.

Although the initial fill may be as high as 10 MΩcm (compensated to 25°C), the desired level for long time usage for units equipped with a deionization filter is 1 to 3 MΩcm (compensated to 25°C).

The above two recommendations will reduce the electrolytic potential of the water and prevent or reduce the galvanic corrosion observed.

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Water Quality/Materials Compatibility, units with in-line partial flow deionization filter



Facility Water	Permissible (PPM)	Desirable (PPM)
Microbiologicals		
(algae, bacteria, fungi)	0	0
Inorganic Chemicals		
Calcium	<40	<0.6
Chloride	<250	<25
Copper	<1.3	<1.0
0.020 ppm if fluid in contact with aluminum iron		
Iron	<0.3	<0.1
Lead	<0.015	0
Magnesium	<12	<0.1
Manganese	<0.05	<0.03
Nitrates\Nitrites	<10 as N	0
Potassium	<20	<0.3
Silicate	<25	<1.0
Sodium	<20	<0.3
Sulfate	<250	<50
Hardness	<17	<0.05
Total Dissolved Solids	<50	<10

NOTE A corrosion inhibitor is recommended if mixed metals are in the facility water loop. ▲

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Water Treatment Kit (North America Only)

A Thermo Fisher Treatment Kit is available and is designed to minimize the effects of corrosion, scale, fouling, and microbial contamination. It allows the system to continue providing reliable service with optimal efficiency for the life of the unit.

The kit includes a biocide and corrosion inhibitor capable of treating up to ten gallons of application water and is designed to provide protection for a period of six months. This kit is compatible with the following fluids:

- Filtered/Singled Distilled Water
- Uninhibited Ethylene Glycol/Water
- Uninhibited Propylene/Water
- Deionized (DI) Water*
- Reverse Osmosis (RO) Water

*Do not use the Thermo Fisher Water Treatment Kit with a DI filtered system; the filter will remove a portion of the reagent's active ingredients limiting its effectiveness.

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Compatibility with Recommended Fluids

Filtered/Singled Distilled water
This fluid is recommended primarily because it has all microorganisms that cause biological fouling removed through vaporizing and condensing the water. However, distilled water does not remain pure for very long when exposed to the atmosphere. Air-born spores can contaminate the water and activate algae growth. An effective maintenance plan would include switching out the fluid with newly distilled water every six months. The particulates that have been filtered out in the process are also preventive in keeping the system "clean" of contaminants.

NOTE Distilling water that contains an additive could increase the concentration of that additive in the water. ▲

Uninhibited Ethylene Glycol/Water
Ethylene glycol is used to depress the freezing point of water as a coolant. We recommend not using the uninhibited (no corrosion additives) ethylene glycol. It is more corrosive to copper than plain water so it is not recommended unless required for the application.

Inhibited Ethylene Glycol/ Water
Inhibited glycol can be used to increase the operating temperature range of the fluid but not as a "pre-mixed anticorrosive" solution. Industry standards use a pH standard of 8 to determine when the fluid has become corrosive. Dowtherm® is an ethylene based product that contains dipotassium phosphates in a 4% concentration. The recommended use of Dowtherm® is mixing with distilled or deionized water or water that contains less than 25 ppm chloride and sulfate and less than 100 ppm total hardness of CACO3.

The general term, inhibited glycol/water, is too close to meaning inhibited water. Inhibited water can have many types of additives including chromate that will quickly foul the cooling system. Some inhibitor additives can release the bonding agent in the carbon graphite in the P2 pumps so they are incompatible, such as Sodium Hydroxide.

Uninhibited Propylene Glycol/Water
Although the use of propylene glycol is similar to ethylene glycol, propylene glycol is considered "safe" to use in the food industry. Propylene is less dense than ethylene and will have a tendency to weep through mechanical seals.

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Inhibited Propylene Glycol/Water
Same issues as with uninhibited propylene and inhibited ethylene glycol.

Deionized Water (1-3 MΩcm, compensated)
Deionized water has had the conductive ions that cause galvanic corrosion between dissimilar metals removed.

NOTE This is not the normal state of water, so if it is too pure deionized water is aggressive to metal. The result is the leaching of metallic ions from metal surfaces which causes pitting. ▲



NEVER use flammable or corrosive fluids with this unit. Do not use automotive antifreeze. Commercial antifreeze contains silicates that can damage the pump seals. Use of automotive antifreeze will void the manufacturer's warranty. ▲

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Filling Requirements

Ensure the reservoir drain plug on the back of the unit is in place and that all plumbing connections are secure.

Before using any fluid refer to the manufacturer's MSDS for handling precautions. ▲

Locate and remove the reservoir cap by unscrewing it counterclockwise.

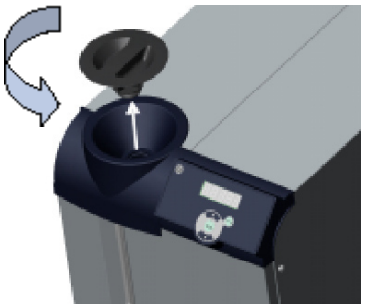


Figure 3-4 Reservoir Cap

To prevent the introduction of particulates into the system, fill the unit with the reservoir bag filter in place. Units are shipped with a bag filter in place. For information on changing the bag filter, see Section 6.

The polyethylene reservoir has a sight tube and ball for easy fluid level monitoring. *Slowly* fill the reservoir with clean process fluid through the funnel only, failure to comply may result in internal spillage.

NOTE Filling the reservoir above MAX LEVEL fill line will result in a unit over flow error (O FLO)causing the unit to shut down. ▲

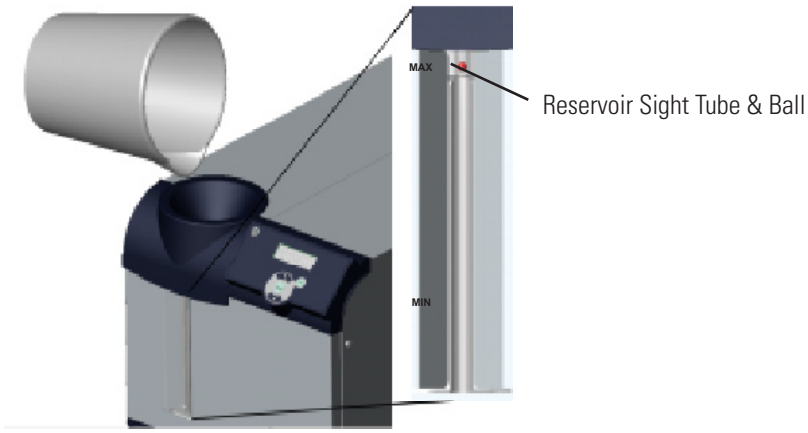


Figure 3-5 Reservoir Sight Tube & Ball

Since the reservoir capacity may be small compared to your application and air may need to be purged from the lines, have extra cooling fluid on hand to keep the system topped off when external circulation is started.

Replace the reservoir cap by screwing it clockwise. Cap should be hand tight.

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Section 4 Operation

Basic Controller

The controller controls temperature using a Proportional-Integral-Derivative (PID) algorithm. It is designed with self-diagnostic features and an easy to use operator interface.

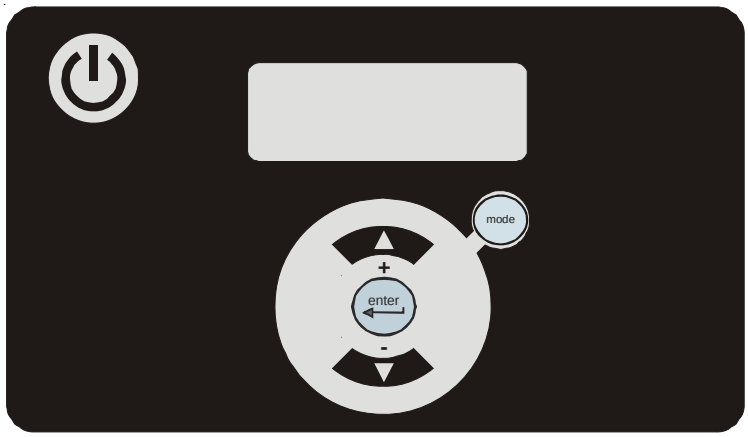


Figure 4-1 Basic Controller



This key is used to start and stop the unit.



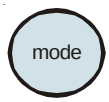
This key is used to navigate through the controller displays and to increase adjustable values.



This key is used to navigate through the controller displays and to decrease adjustable values.



This key has two functions. Press it once to make changes. Press it again after changes are made in order to continue onto other displays.



This key is also used to navigate through the controller loops.

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Setup

NOTE For first time use, please refer to the quick start instructions included with your unit or the copy in this manual. The manual's version follows the Table of Contents. ▲

Before starting the unit, double check all electrical and plumbing connections. Have extra recirculating fluid on hand. If the unit will not start refer to Section 7 Troubleshooting.

Start Up

- Place the circuit protector located on the rear of the unit to the on (I) position. The display will indicate a series of upward scrolling bars ( ) .
- The bars will scroll upward indicating the controller is initializing the unit. The initialization takes approximately 15 seconds.
- When the bars disappear the controller display will go blank.
- Press the key on the controller. The display will show the process fluid temperature. The pump and refrigeration system will also start.

If the auto restart is enabled and the unit shuts down as a result of a power failure, when power is restored the unit will automatically restart. Auto restart is enabled using the Setup Loop, see Setup Loop in this Section. ▲

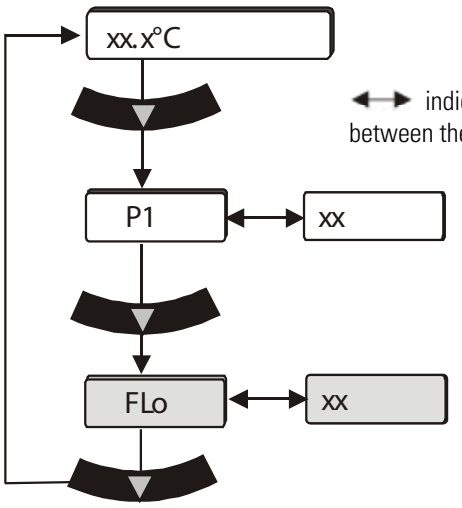
NOTE After initial start up, check your plumbing for leaks. ▲

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If desired, press the key to display the pump's discharge pressure - **P1**. The display will alternate between **P1** and the pump's discharge pressure value.

If the unit is equipped with an optional flow transducer, pressing the key again will display the flow rate - **FLo**. The display will alternate between **FLo** and the flow rate value.

Press the key again to display the process fluid temperature.



↔ indicates the controller display is alternating between the two displays.

P1 - Pump discharge pressure in PSI, bar or kPa*.

FLo - Flow rate in liters or gallons* (optional feature).

* See Setup Loop in this Section to select desired scales.

Figure 4-2 Main Loop

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Controller Loops

The controller has the capability to display various loops which indicate operating conditions and parameters within the unit. The loops are selected and changed by pressing the appropriate keys.

When the controller is first powered up it goes through a short initialization and then displays the process fluid temperature. Use the key combination shown below to scroll through the loops.

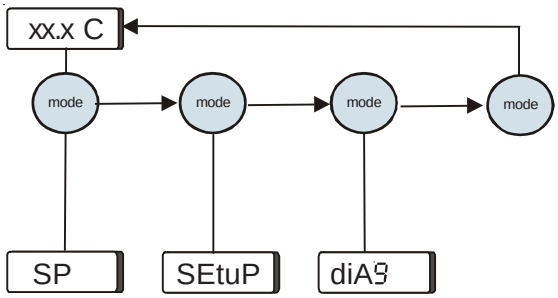


Figure 4-3 Controller Loops (Unit running)

SP is the Setpoint Loop and is used to display and change the setpoint. The setpoint is the desired process fluid temperature needed for your application. The Setpoint Loop is accessed by pressing the **mode** key, see next page.

SEtuP is the Setup Loop. The Setup Loop allows you to display and/or alter different parameters of the controller. The Setup Loop is accessed from the Setpoint Loop by pressing the **mode** key.

diA9 is the Diagnostic Loop. The Diagnostic Loop allows you to display the operating times for various components within the unit. The Diagnostic Loop is accessed from the Setup Loop by pressing the **mode** key.

NOTE The loops can be accessed and changed without the unit running as long as the circuit protector is in the on (**I**) position. ▲

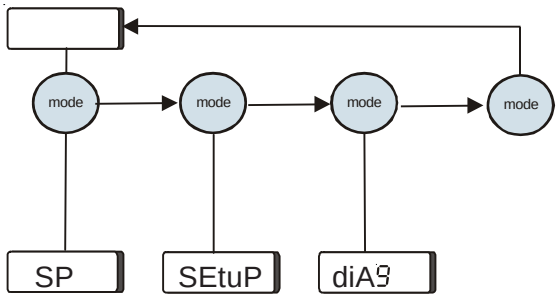


Figure 4-4 Controller Loops (Unit not running)

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Setpoint Loop (SP)

- Ensure the controller is either a blank screen (not yet initialized) or displaying the process fluid temperature.
- Press the mode key and the controller display will alternate between **SP** and the setpoint value.
- If no change is required press the enter key to return the display to the process fluid temperature.
- If a setpoint change is required, use the keys.

  The setpoint range is +5°C to +40°C.

NOTE If the keys are not used within one minute the controller will time out and return to the process fluid temperature display and any changes will not be accepted. ▲

- Once the desired value is displayed press the enter key to confirm the change.
- The display will return to the process fluid temperature.

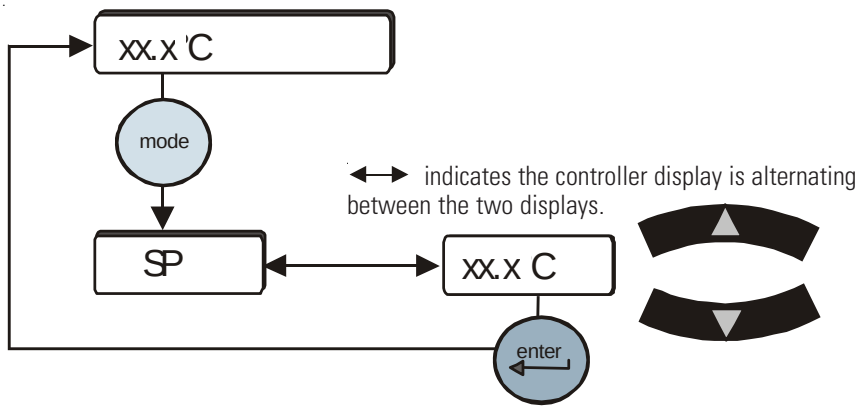


Figure 4-5 Setpoint Loop

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Setup Loop (SEtuP)

Use the Setup Loop to adjust/verify the following controller settings.

- Scales: °C or °F, Liters or Gallons, PSI, Bar or kPa
- High and low temperature alarm limits
- High and low pump discharge pressure alarm limits and time delays
- Fault reaction to a temperature, pressure or flow (optional) alarm limit (continue to run or shut down)
- Audible alarm enabled/disabled
- Auto restart feature enabled/disabled
- Preventive care cleaning frequency reminder for air and fluid filters

Optional Features:

- Analog I/O feature enabled/disabled
- Auto refill alarm
- DI filter cartridge preventive maintenance interval
- High/low flow alarm limits
- Serial communications feature enabled/disabled
- Anti drainback valve position
- **Save/abort all changes**

To enter the Setup Loop ensure the controller display is either a blank screen (unit off) or displaying the process fluid temperature. Press the key and the display will indicate **SP**, press it again to display **SEtuP**.

Press the 

key to continue, or press 

twice to return to the process fluid temperature or blank display.

Use  to sequence down through the loop. Use  to sequence back through the loop up to the **Hi T** display , see next page.

To change any parameter:

- Press the 

key.
- Use the  keys to change a displayed value.
- Press 

key to confirm the change.

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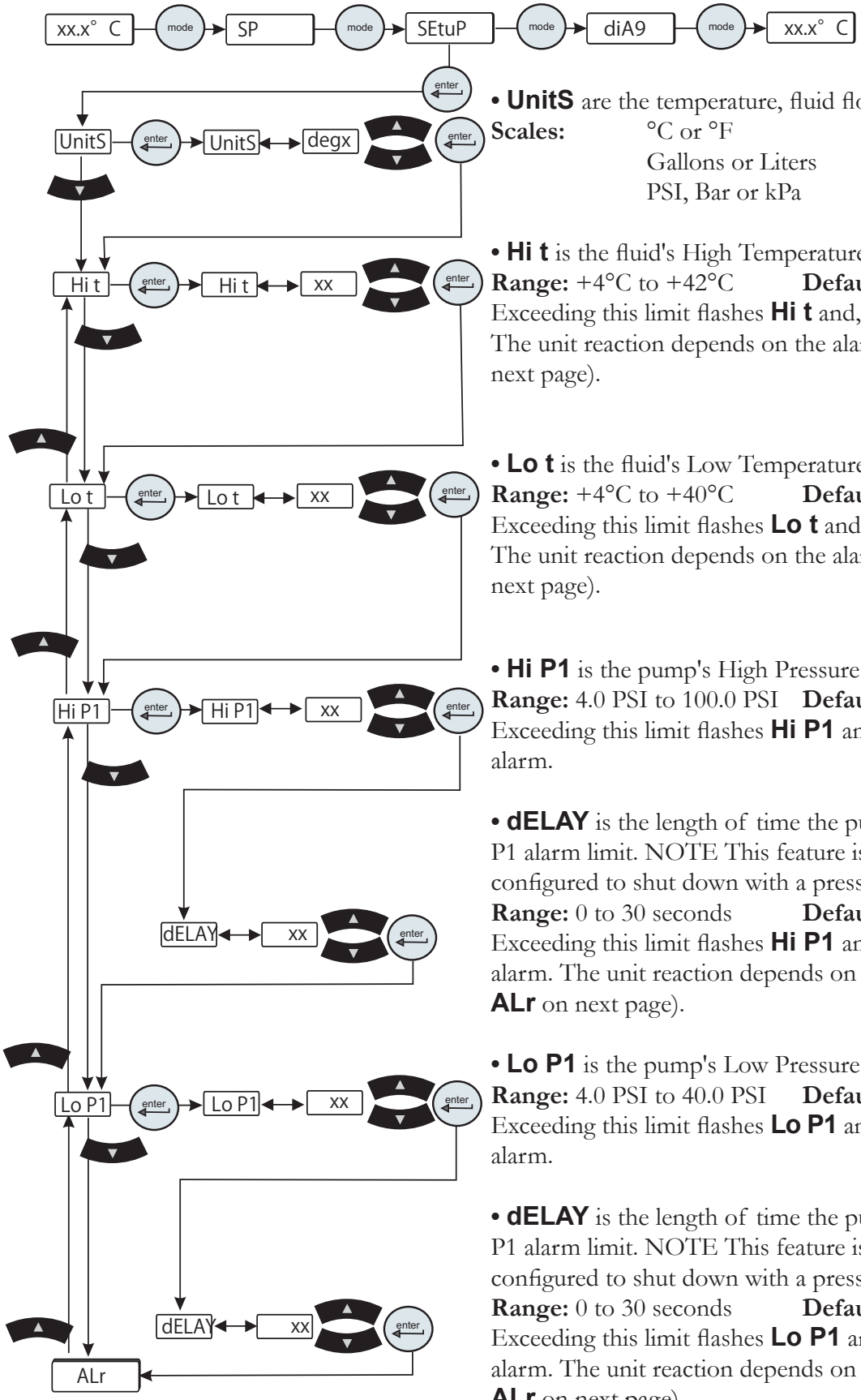


Figure 4-6 Setup Loop (All Units)

• **UnitS** are the temperature, fluid flow and pressure display scales.

Scales:		**Defaults:**	
	°C or °F		°C
	Gallons or Liters		Gallons
	PSI, Bar or kPa		PSI

• **Hi t** is the fluid's High Temperature alarm limit.
Range: +4°C to +42°C **Default:** +42°C
Exceeding this limit flashes **Hi t** and, if enabled, sounds the alarm. The unit reaction depends on the alarm configuration (see **ALr** on next page).

• **Lo t** is the fluid's Low Temperature alarm limit.
Range: +4°C to +40°C **Default:** +4°C
Exceeding this limit flashes **Lo t** and, if enabled, sounds the alarm. The unit reaction depends on the alarm configuration (see **ALr** on next page).

• **Hi P1** is the pump's High Pressure discharge alarm limit.
Range: 4.0 PSI to 100.0 PSI **Default:** 100.0 PSI
Exceeding this limit flashes **Hi P1** and, if enabled, sounds the alarm.

• **dELAY** is the length of time the pump can exceed the Hi P1 alarm limit. NOTE This feature is active only if the unit is configured to shut down with a pressure alarm. ▲
Range: 0 to 30 seconds **Default:** 0 seconds
Exceeding this limit flashes **Hi P1** and, if enabled, sounds the alarm. The unit reaction depends on the alarm configuration (see **ALr** on next page).

• **Lo P1** is the pump's Low Pressure discharge alarm limit.
Range: 4.0 PSI to 40.0 PSI **Default:** 4.0 PSI
Exceeding this limit flashes **Lo P1** and, if enabled, sounds the alarm.

• **dELAY** is the length of time the pump can exceed the Lo P1 alarm limit. NOTE This feature is active only if the unit is configured to shut down with a pressure alarm. ▲
Range: 0 to 30 seconds **Default:** 10 seconds
Exceeding this limit flashes **Lo P1** and, if enabled, sounds the alarm. The unit reaction depends on the alarm configuration (see **ALr** on next page).

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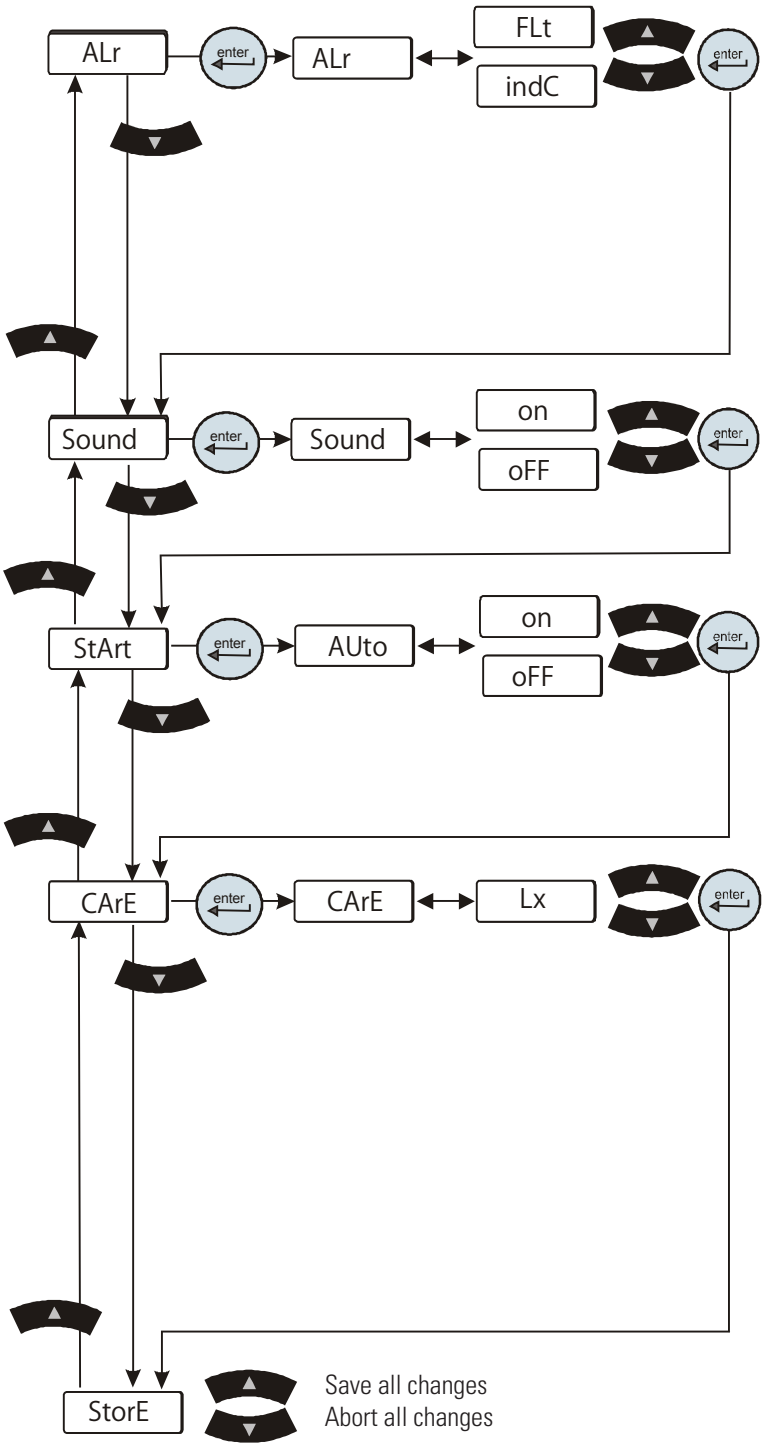


Figure 4-6 Setup Loop (All Units)

• **ALr** is used to configure the unit's reaction for exceeding an alarm limit (temperature, pressure and flow (optional). The selected configuration will apply to all the alarms. The unit will either shut down (**FLt**) or continue to run (**indC**). In each configuration, the controller will display the error code and sound the audible alarm, if enabled.
Range: FLt or indC **Default:** FLt

• **Sound** is used to turn the audible alarm on or off.
Range: on or off **Default:** on

• **StArt** is used to enable/disable the auto restart.
Range: on or off **Default:** off

• **CArE** is used to set the preventive care cleaning frequency reminder for the unit's air and fluid filters, in hours. The time selected is based on your operating environment, see Section 6.
Range: off **Default:** L1
L1 (1000 hours)
L2 (2000 hours)
L3 (3000 hours)

Exceeding this limit flashes **FLtrS,** see Section 6.

NOTE If your unit is equipped with any of the **Optional Features** refer to the next page. ▲

When the display indicates **StorE** press ▲ to save *all* changes or press ▼ to abort *all* changes. The display will return either the process fluid temperature or, if the unit was off when you entered the loop, a blank screen.

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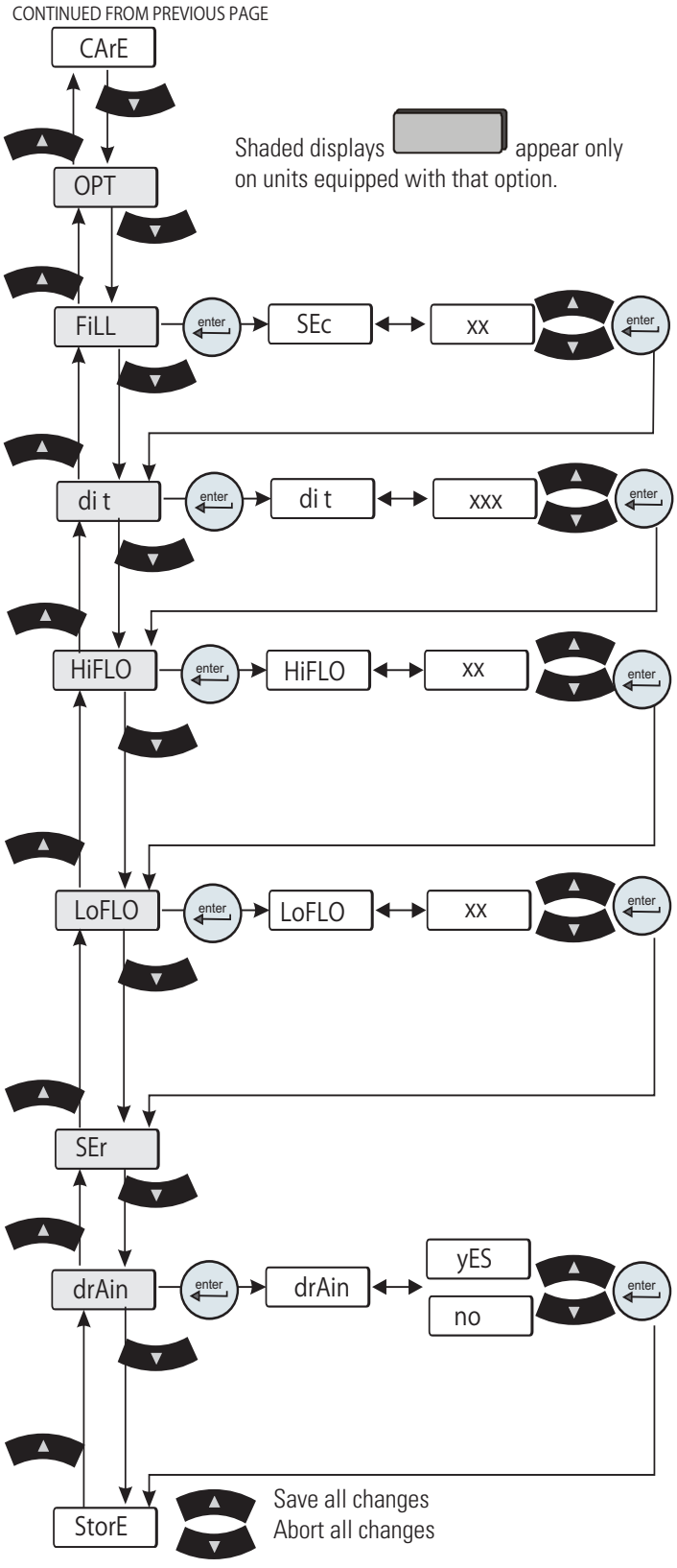


Figure 4-7 Setup Loop (Optional Features)

• **OPt** is used to configure the analog in/out mode of operation. See Appendix C.

• **FiLL** is used to set the time limit the auto refill has for filling the unit's reservoir to the normal operating level.
Range: 0 to 900 seconds **Default:** 45 seconds
Exceeding the time limit flashes **rEFiL** and the auto refill will shut down.

• **di t** is used to set the preventive care cleaning frequency reminder for the unit's DI filter cartridge.
Range: 0 to 9999 hours **Default:** 448 hours
Exceeding the limit flashes **Di,** see Section 6.

• **HiFLO** is used to set the high flow alarm limit.
Range: 0.5 to 20.0 GPM **Default:** 5.0 GPM
Exceeding this limit flashes **HiFLO** and, if enabled, sounds the alarm. The unit's reaction depends on the alarm (**ALr**) setting.

• **LoFLO** is used to set the low flow alarm limit.
Range: 0.5 to 20.0 GPM **Default:** 0.5 GPM

NOTE Centrifugal pumps require a minimum flow rate of 3.8 gpm (14.4 lpm). ▲

Exceeding this limit flashes **LoFLO** and, if enabled, sounds the alarm. The unit's reaction depends on the alarm (**ALr**) setting.

• **SEr** is used to configure the serial communications mode of operation. See Appendix D.

• **drAin** is used to open and close the unit's anti drainback valve for draining, see Section 5.
Range: yes or no **Default:** no

NOTE The valve automatically closes when you exit the **drAin** display. ▲

When the display indicates **StorE** press ▲ to save *all* changes or press ▼ to abort *all* changes. The display will return either the process fluid temperature or, if the unit was off when you entered the loop, a blank screen.

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Diagnostic Loop (di A9)

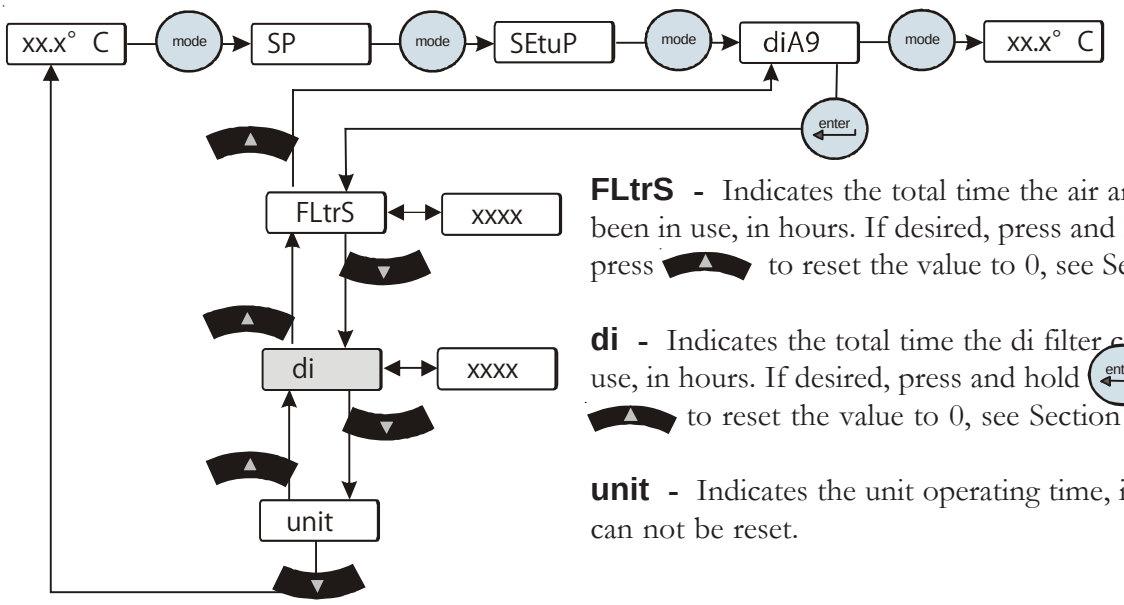
The Diagnostic Loop is used to view or reset the operating times of various unit components.

To enter the Diagnostic Loop ensure the controller display is either a blank screen (unit off) or displaying the process fluid temperature.

Press the mode key and the display will indicate **SP**, press mode again to display **SEtuP**, press mode again to display di A9.

Press enter to enter the loop or press mode to return to the process fluid temperature or blank display.

Use the ▼ key to sequence down through the loop. Use the ▲ key to sequence up through the loop.



FLtrS - Indicates the total time the air and fluid filters have been in use, in hours. If desired, press and hold enter and then press ▲ to reset the value to 0, see Section 6.

di - Indicates the total time the di filter cartridge has been in use, in hours. If desired, press and hold enter and then press ▲ to reset the value to 0, see Section 6.

unit - Indicates the unit operating time, in hours. This value can not be reset.

Figure 4-8 Diagnostic Loop

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Shut Down

Press the key on the controller.

NOTE To protect the unit's compressor, the unit will enter a 20 second shut down cycle before the refrigeration system and pump shut down. During this time the display will indicate OFF. The bars will scroll downward indicating the controller is in the shut down cycle. ▲

When the display goes blank it is safe to place the circuit protector located on the rear of the unit to the off (**0**) position.

Using any other means to shut the unit down can reduce the life of the compressor.



Always turn the unit off and disconnect it from its supply voltage before moving the unit. ▲



The circuit protector located on the rear of the unit is not intended to act as a disconnecting means. ▲

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Section 5 Options/Accessories

Auto Refill

The Auto Refill provides makeup fluid to replace any fluid lost to evaporation, etc. It requires a pressurized fluid source connection to the ¼" Female Pipe Thread fitting on the rear of the unit.



Figure 5-1 Auto Refill Fitting

The auto refill fluid must also meet water quality standards or the valve may fail to operate as designed, see Section 3.

The auto refill valve input pressure must be < 80 PSI to ensure the valve functions properly.

The auto refill operates when all of the following conditions are met:

- Fluid is available
- The unit is turned on
- The fluid reaches a low level condition.

The auto refill shuts off when:

- The fluid reaches the correct operating level.

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Internal DI Cartridge

A partial flow DI filter cartridge is designed to provide between 1 and 3 MΩcm water resistivity.

NOTE The DI option results in a 0.5 gpm reduction of available flow. ▲

NOTE The Puralite sensor that comes with the DI cartridge requires a separate power source. ▲

Do not use a Deionization (DI) filter cartridge with Inhibited EG or Inhibited PG. A DI filter will remove inhibitors from the solution rendering the fluid ineffective against corrosion protection. Also, inhibitors increase fluid conductivity. ▲

Remove the two thumbscrews securing the DI access panel to the top of the unit. If there is a cartridge in place, first undo the hose fitting by pressing on the quick disconnect located on the top white connection.

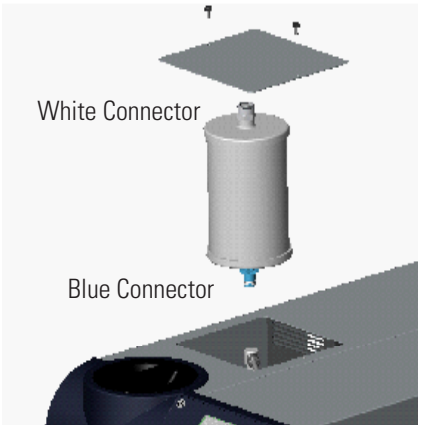


Figure 5-2 Internal DI Cartridge

The DI Cartridge will overpressure if it is removed from the unit before removing the hose fitting. ▲

Next rotate the cartridge ¼ turn counterclockwise to remove it.

Remove the new cartridge from the shipping bag. The cartridge has a blue and a white connector. Lower the cartridge into the unit with the blue connector facing downward. Press down on the cartridge lightly to engage and then rotate it ¼ turn clockwise or until you feel the filter clock into place.

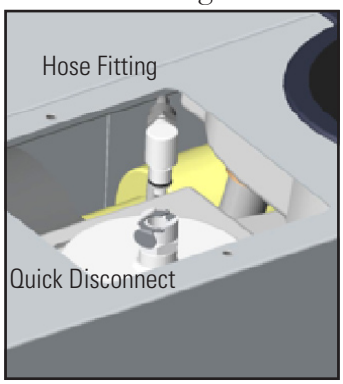


Figure 5-3 DI Fittings

Push the hose fitting into the quick disconnect located on the white end of the cartridge.

Replace the access panel and thumbscrews.

The Puralite sensor on the back of the unit turns red when the cartridge needs changing.

NOTE The cartridge can be changed with the unit running, however, since the cartridge runs in a parallel arrangement, disconnecting the cartridge adds to the main flow (0.5 GPM for positive displacement pumps). The additional flow will cause an increase in system pressure which may cause a high fluid pressure fault. ▲

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External DI Cartridge

A partial flow DI filter cartridge is designed to provide between 1 and 3 MΩcm water resistivity.

NOTE The DI option results in a 0.5 gpm reduction of available flow. ▲

NOTE: The Puralite sensor that comes with the DI cartridge requires a separate power source. ▲

Do not use a Deionization (DI) filter cartridge with Inhibited EG or Inhibited PG. A DI filter will remove inhibitors from the solution rendering the fluid ineffective against corrosion protection. Also, inhibitors increase fluid conductivity. ▲

If there is a cartridge in place, first undo the hose fitting by pressing on the quick disconnect located on the top white connection.

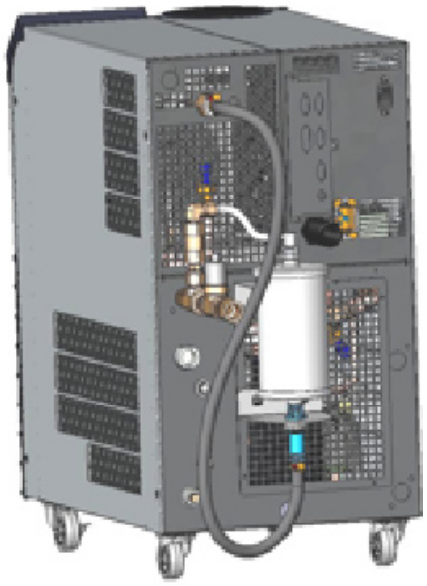


Figure 5-4 External DI Cartridge

The DI Cartridge will overpressure if it is removed from the unit before removing the hose fitting. ▲

Remove the new cartridge from the shipping bag. The cartridge has a blue and a white connector. Lower the cartridge into the bracket with the blue connector facing downward. Press down on the cartridge lightly to engage and then rotate it ¼ turn clockwise or until you feel the filter click into place.

Push the hose fitting into the quick disconnect located on the white end of the cartridge.

The Puralite sensor turns red when the cartridge needs changing.

NOTE The cartridge can be changed with the unit running, however, since the cartridge runs in a parallel arrangement, disconnecting the cartridge adds to the main flow (0.5 GPM for positive displacement pumps). The additional flow will cause an increase in system pressure which may cause a high fluid pressure fault. ▲

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P1 and P2 Pump Pressure Relief Valve (Internal Configuration)

The pressure relief valve, located on the top left rear of the unit, is used to set the desired system back pressure to your application. The valve is factory preset to 80 ± 5 psi (550 ± 1 kPa).

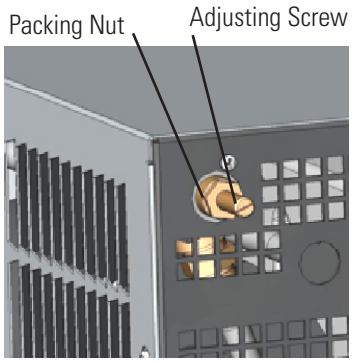


Figure 5-5 Nut and Screw

If the unit is not plumbed to an application, set the pressure by installing a loop of hose equipped with a shut-off valve between the supply and return fittings. Start the unit and allow it to prime, then close the valve.

Use the controller's  to display P1, it should display 80 ± 5 psi.

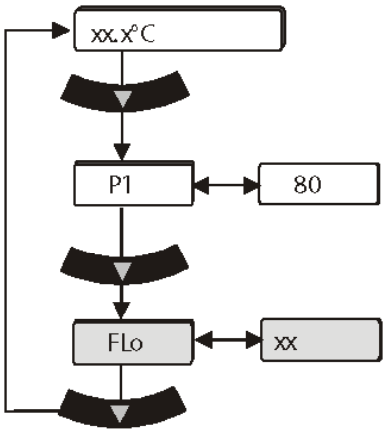


Figure 5-6 Main Loop

Use a screwdriver to turn the adjusting screw (counterclockwise to reduce pressure) until the controller displays the desired setting.

NOTE Due to internal back pressure, the minimum pressure setting for a deadheaded pump is 32 psi for a P 2 pump, and 8 psi for a P 1 (these settings prohibit external flow from the unit). ▲

If the unit is plumbed to an application, ensure the unit is off. Then back out the adjusting screw counterclockwise to reduce pressure. Turn the unit on. Ensure that there is back pressure in the system. Turn the adjusting screw until the controller displays the desired setting.

Do not exceed 100 psi. ▲

When complete, inspect the area around the $^{5}/_{8}$" packing nut for fluid. If fluid is present, slightly tighten the nut and reinspect.

NOTE Should the unit start to vibrate the valve setting may be the cause. Changing the pressure setting ± 5 psi will eliminate the vibration. ▲

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P1 and P2 Pump Pressure Relief Valve (External Configuration)

The pressure relief valve is used to set the desired system back pressure (P1) to your application. The valve is factory preset to 80 ± 5 psi (550 ± 1 kPa).

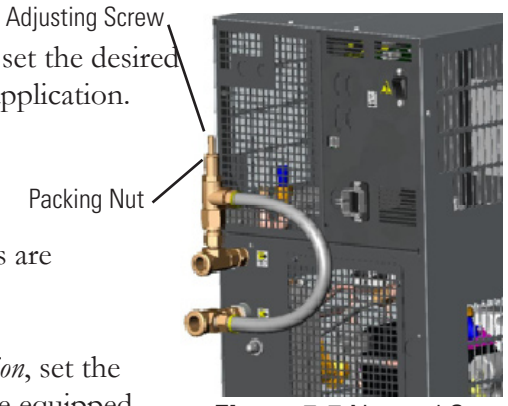


Figure 5-7 Nut and Screw

The valve's inlet/outlet connections are ½" FNPT.

If the unit is not plumbed to an application, set the pressure by installing a loop of hose equipped with a shut-off valve between the supply and return fittings. Start the unit and allow it to prime, then close the valve.

Use the controller's to display P1, it should display 80 ± 5 psi.

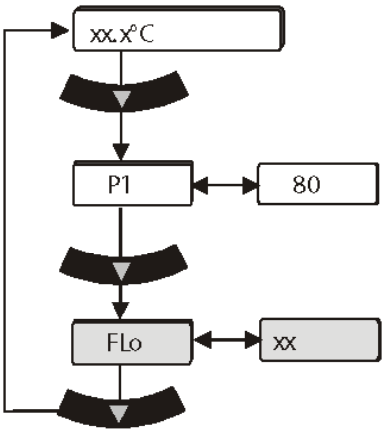


Figure 5-8 Main Loop

Use a screwdriver to turn the adjusting screw (counterclockwise to reduce pressure) until the controller displays the desired setting.

NOTE Due to internal back pressure, the minimum pressure setting for a deadheaded pump is 40 psi for a P 2 pump, and 22 psi for a P 1 (these settings prohibit external flow from the unit). ▲

If the unit is plumbed to an application, ensure the unit is off. Then back out the adjusting screw counterclockwise to reduce pressure. Turn the unit on. Ensure that there is back pressure in the system. Turn the adjusting screw until the controller displays the desired setting.

Do not exceed 100 psi. ▲

When complete, inspect the area around the $^{5}/_{8}$" packing nut for fluid. If fluid is present, slightly tighten the nut and reinspect.

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Flow Control with Flow Readout

Flow control is achieved using a 3-way valve plumbed to the auxiliary port on the rear of the unit.

The valve's outlet connection is ½" FNPT for P1 and P2 pumps, ¾" FNPT for P3 and P4 pumps.

Press the controller's down arrow twice to display the controller's **FLo** display, see previous page. Turn the valve handle until the desired rate is displayed.



Figure 5-9 Flow Control

NOTE The valve is sensitive to slight adjustments. ▲

P1 and P2 Pump Pressure Relief with Flow Readout

The Pressure Control with Flow Readout works just like the Pressure Relief Valve discussed on the previous page. It allows you to control the pressure going to your application.

This valve is plumbed into the unit's auxiliary port, allowing you to also monitor the flow rate to your application using the controller's **FLo** display, see previous page.

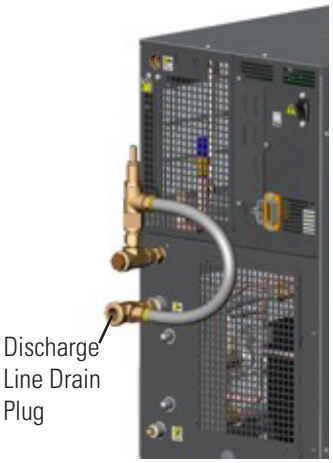


Figure 5-10 Pressure Control

The valve's outlet connection is ½" FNPT.

Anti Drainback

Units installed below the end-user application may allow system fluid to drain back into the chiller and cause spillage. The anti-drainback valve is designed to prevent any such spillage.

The valve automatically closes anytime the unit is powered down or if the pump shuts down.

This option is required if your unit is more than 24 feet below your application, or if there is a possibility of flood back due to the occasional opening of the process lines for either application swaps or unit servicing. See Section 8 for additional draining information.

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SEMI

SEMI units were evaluated and found compliant with:

SEMI S2-0703 Product Safety Assessment
SEMI S8-0705 Ergonomic Assessment
SEMI S14-0704 Fire Risk Assessment

Emergency Off (EMO)

A guarded red mushroom shaped push-button switch with twist-to-reset is provided in the front of the unit to turn off the unit in case of an emergency. The button head is engraved with "EMO" in large white filled letters.

NOTE The EMO is controlled by a safety circuit and is not influenced by the unit's firmware/software. ▲

Activation of the EMO button will remove power from the main contactor coil stopping operation of the unit. The controller will display **Er 48**.

Resetting the EMO button will not restart the unit. After all hazards have been removed reset the unit by pushing the RESET button on the control panel. In the local mode, the unit will restart by pressing the START STOP button again. In the serial communications mode, send the appropriate start command. In the analog/digital I/O mode, cycle the on/off input.

Unit Circuit Breaker Interrupt Rating

The rear panel mounted unit main power circuit breaker has an Interrupting Capacity (AIC) of 3,000 amps.

Lockout/Tagout (LOTO)

Before performing Chiller maintenance, the energy sources associated with the Chiller system must be lockout and tagged out (LOTO). Hazard control features added to the system (e.g., safety interlocks, EMO) are not a substitute for turning off and locking out electrical or fluid energy.

For units rated 20 Amps or less, electrical LOTO is accomplished by removing the power cord and closing the locking device on the power receptacle located on the rear of the unit. For other units, electrical LOTO is the responsibility of the user and can be provided by:

- Using the main disconnect (knife switch at system control cabinet).
- Disconnecting main power at the facility power source prior to the system controller cabinet.
- In addition, follow all OSHA and local facility LOTO directives.

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Drip Pan and Drain

The unit is equipped with a secondary containment (drip pan) in case there is a leak. The drip pan drain located on the rear of the unit. Install the supplied nylon 1/4 turn quick disconnect (QD) fitting into the drain fitting. The QD is barbed for a 1/2" ID hose.

Since the pan will not hold more than 110% of the reservoir volume connect the drain to guide the fluid to an appropriate spillage location.

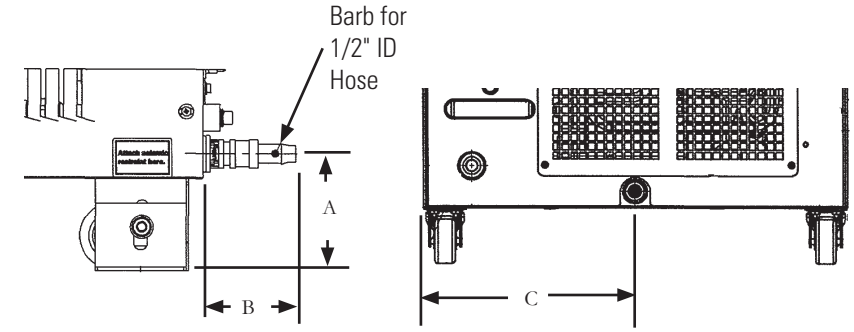


Figure 5-11 Drip Pan Drain

	ThermoFlex900/1400		ThermoFlex2500		ThermoFlex3500/5000	
A	3 1/2"	8.8 cm	4"	10.1 cm	3 3/8"	11.3 cm
B	2 3/4"	7.0 cm	2 11/16"	6.8 cm	2 3/4"	7.1 cm
C	6 15/16"	17.7 cm	6 9/16"	16.7 cm	9 9/16"	24.3 cm

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Seismic Tie-Downs

Install the seismic tie-downs to the unit as shown below. Then secure the unit to the floor with user-supplied hardware.

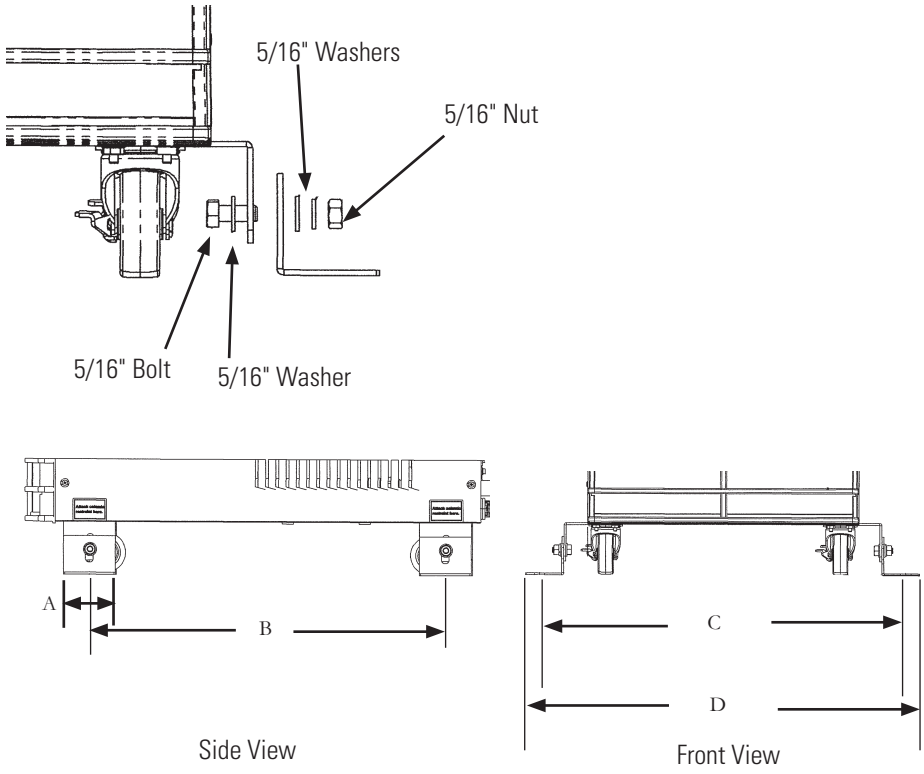


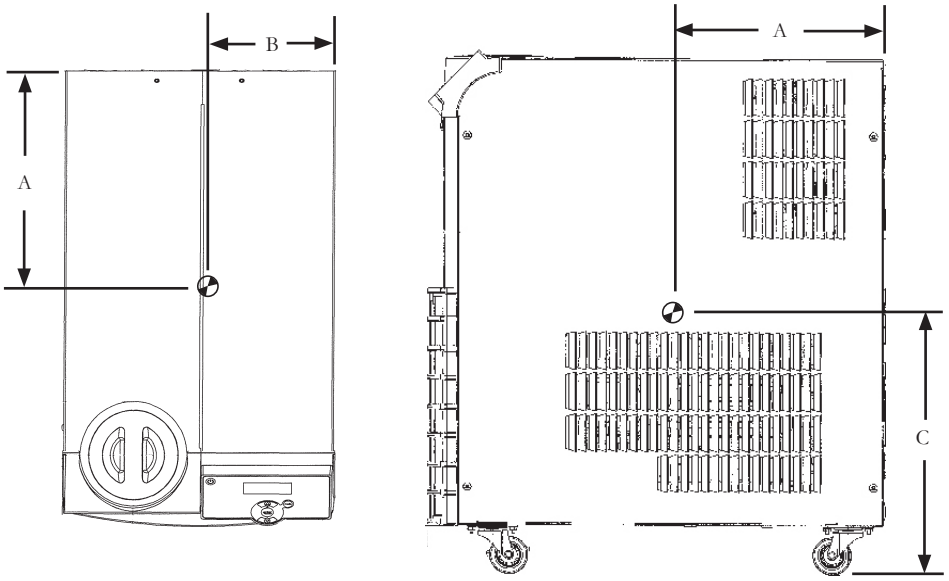
Figure 5-12 Seismic Tie-Downs

	ThermoFlex900/1400		ThermoFlex2500		ThermoFlex3500/5000	
A	2 11/16"	6.8 cm	2 11/16"	6.8 cm	2 11/16"	6.8 cm
B*	18 ½ "	47.0 cm	20 1/16"	51.0 cm	24 ½"	62.2 cm
C*	19 1/16"	48.4 cm	22 1/16 "	56.1 cm	24 1/8"	61.3 cm
D	20 9/16"	52.2 cm	23 9/16"	59.9 cm	25 5/8"	65.1 cm

* Distance between Ø.53 Seismic mounting holes

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Center of Gravity (± ½", P 2 pump, standard unit, no fluid in tank)



Top View Side View

Figure 5-13 Center of Gravity

	ThermoFlex900/1400		ThermoFlex2500		ThermoFlex3500/5000	
A	10 ¾ "	27.3 cm	12"	30.5 cm	13 3/8"	34.0 cm
B	6 ¾ "	17.2 cm	8 3/8"	21.3 cm	9"	22.9 cm
C	13 ½"	34.3 cm	13 ½"	34.3 cm	16"	40.6 cm

Weight Distribution*

	ThermoFlex900/1400		ThermoFlex2500		ThermoFlex3500/5000	
Left Front	29.5 lbs	13.4 kg	42.8 lbs	19.5 kg	56.6 lbs	25.7 kg
Left Rear	28.8 lbs	13.1 kg	43.6 lbs	19.8 kg	66.4 lbs	30.1 kg
Right Front	34.3 lbs	15.6 kg	46.9 lbs	21.3 kg	64.9 lbs	29.4 kg
Right Rear	33.4 lbs	15.1 kg	47.7 lbs	21.6 kg	76.1 lbs	34.6 kg

* Standard unit, P 2 pump, no fluid in tank

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Other Options

There are many other options available for your system that can improve its performance in your application. Please contact Thermo Fisher Scientific's Sales, Service and Customer Support to assist you with questions that you may have regarding upgrading your ThermoFlex, see inside cover for contact information.

Other Accessories

Installation kit - includes replacement air and fluid filters

Maintenance kit - includes a set of hoses, adaptor fittings and Teflon® tape

Fluids

Fluid treatment kit

Please contact Thermo Fisher Scientific's Sales, Service and Customer Support to assist you with questions that you may have regarding accessories for your ThermoFlex, see inside front cover for contact information.

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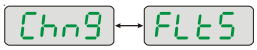
Section 6 Preventive Maintenance

Preventive Maintenance Timer (CArE)

The ThermoFlex chiller has an integrated preventive maintenance timer that will alert you when it is time to perform preventive maintenance. This unique feature will remind you to change your air and fluid filters.

Based on the environment in which your chiller is located, you can choose from four levels of preventive maintenance off, L1, L2, and L3:

- off – Disables the alert
- L1 – 1,000 hours - default setting
  - · Heavy manufacturing environment
  - · Airborne particulate created during manufacturing process
- L2 – 2,000 hours
  - · Typical production environment
- L3 – 3,000 hours
  - · Clean environment – filtered air
  - · Typically laboratory or research environment

Change/set the level using the Setup Loop, see Section 4. When the unit exceeds the chosen limit, the controller will flash 

and (if enabled) an audible alarm will sound.

To clear this message press 

. This will automatically restart the preventive maintenance timer for your filters. Each time the unit exceeds the chosen time, the controller will remind you that it is time to change your filters.

If you change your filters before the preventive timer trips, you can clear the timer by using the Diagnostic Loop, see Section 4.

NOTE For air-cooled units, both the air and fluid filters in the ThermoFlex can be changed while the unit is running. For water-cooled units, only the fluid filter can be changed while the unit is running. ▲

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Fluid Filter Bag

The reservoir has a fluid bag filter designed to prevent the introduction of particulates into the system. Units are shipped with a bag filter in place.

NOTE The fluid bag filter can be removed with the unit operating. ▲

Before using any fluid or performing maintenance where contact with the fluid is likely refer to the manufacturer's MSDS for handling precautions. ▲

When it is time to replace the bag, gently pull up on the plastic funnel housing to remove it and simply pull the bag out of the unit. Replacement bags are available from Thermo Fisher Scientific.

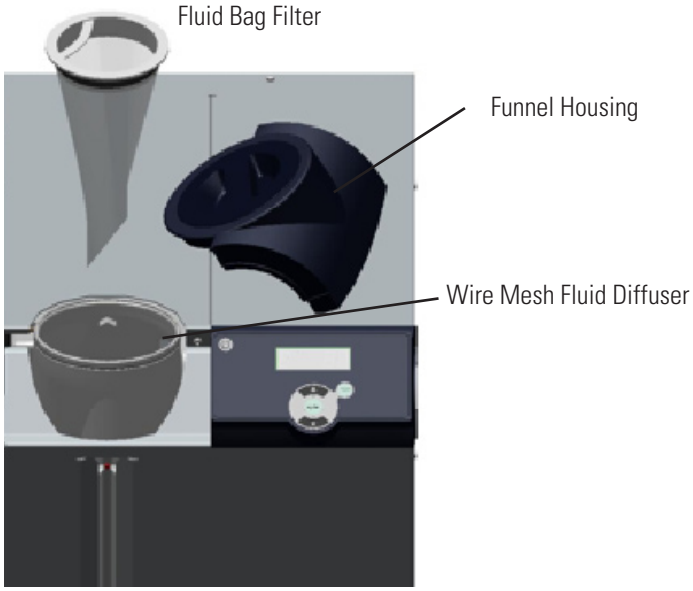


Figure 6-1 Fluid Filter Bag and Diffuser

Fluid Diffuser

When you remove the bag you will notice a wire mesh fluid diffuser inside the reservoir supply line. The diffuser is used to help streamline the flow into the reservoir. After several bag replacements turn the unit off and remove the diffuser to inspect it for debris/damage.

The fluid velocity into the reservoir will rapidly increase with the diffuser removed and cause splashing. Turn the unit off before removing the diffuser. This is especially critical when using ethylene or propylene glycol. ▲

NOTE To prevent particulates from entering the reservoir, ensure the fluid bag filter is in place before removing the diffuser. ▲

Do not operate the unit unless the diffuser is installed. ▲

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Reservoir Cleaning

The user is responsible for maintaining reservoir fluid quality. Check the fluid on a regular interval. Start with frequent checks until a regular interval (based on your application) is established.

If cleaning is necessary, flush the reservoir with a fluid compatible with the process fluid and the unit's wetted parts, see Section 8.

Before using any fluid or performing maintenance where contact with the fluid is likely refer to the manufacturer's MSDS for handling precautions. ▲

Reservoir Sight Tube

Clean the sight tube by gently pulling up on the plastic funnel housing to remove it (see illustration on previous page) and then gently pulling out the black sight ball stopper from the tube. Use a long soft-bristle ¼" brush. Use caution not to scratch the glass.

For easier replacement, wet the stopper first and then use a twisting motion to install it in the sight tube.

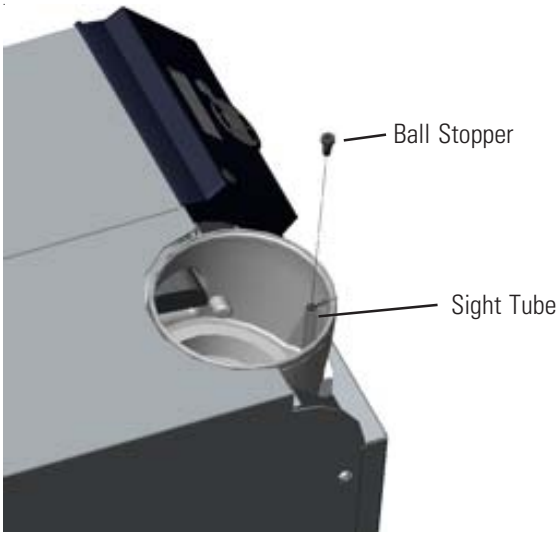


Figure 6-2 Reservoir Cleaning

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Condenser Filter

Clean the filter through the grille using a vacuum with a soft-bristle brush. Remove the one-piece grille assembly when it is time for a more thorough cleaning To remove it first pull the bottom of the assembly away from the unit and then pull it away from the top.

Failure to clean/replace the condenser filter will lead to a loss of cooling capacity and lead to premature failure of the cooling system. ▲

NOTE Water-cooled units have an embedded screw located at the top of the grille securing it to the unit. Loosen the screw to remove the grille. ▲

The condenser framing and fins located behind the grille assembly are very sharp. Use caution when removing the assembly. ▲

Water- cooled units also have a fan with sharp blades, ensure the unit is off before removing the assembly. ▲

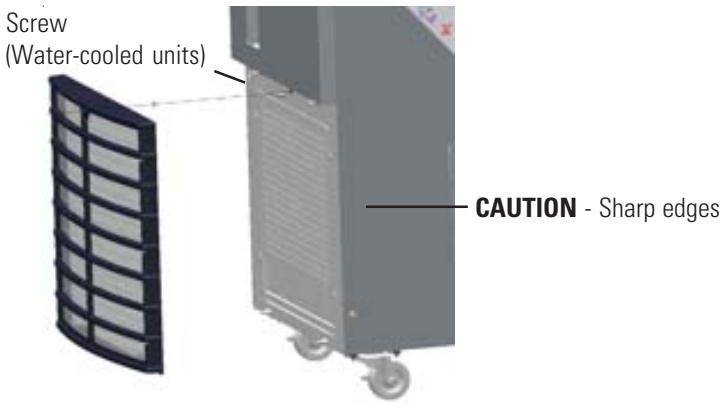


Figure 6-3 Screen Removal

Once removed, vacuum the filter with a soft-bristle brush or wash it Shake off as much of the excess water as possible before reinstalling.

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To change the filter remove the three screws securing the filter to the grille assembly and then pull on the filter's plastic brace to remove it.

The easiest way to replace the filter is to bow it as shown below and slide one end under the tabs on the grille, then under the other end. Replace the screws. Press the grille back into place.

For water cooled units tighten the screw at the top of the grille.

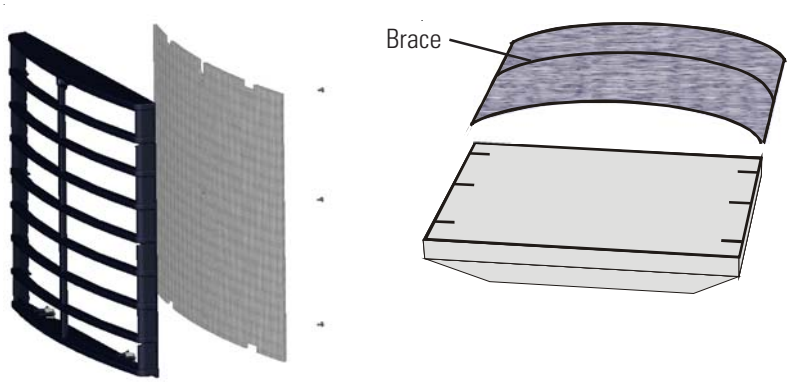


Figure 6-4 Condenser Filter

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DI Filter (Optional)

Establish a preventive maintenance schedule for the DI filter cartridge based on your specific application.

A Puralite sensor is located on the back of your chiller. The sensor will illuminate red when it is time to change the DI filter cartridge.



Figure 6-5 Puralite

The unit also has a *separate* integrated audible alarm that works independently of the Puralite. The alarm is based on unit run hours that will alert you when it is time to change your filter. This feature is especially helpful if the Puralite sensor is not readily accessible, see Setup Loop in Section 4.

If you already know how often your DI filter needs changing, you can input the number of hours into the Setup Loop's **di t** display, see Section 4. When your unit exceeds this time, the controller will flash **DI** and the audible alarm, if enabled, will sound.

To clear this message and stop the audible alarm press enter .

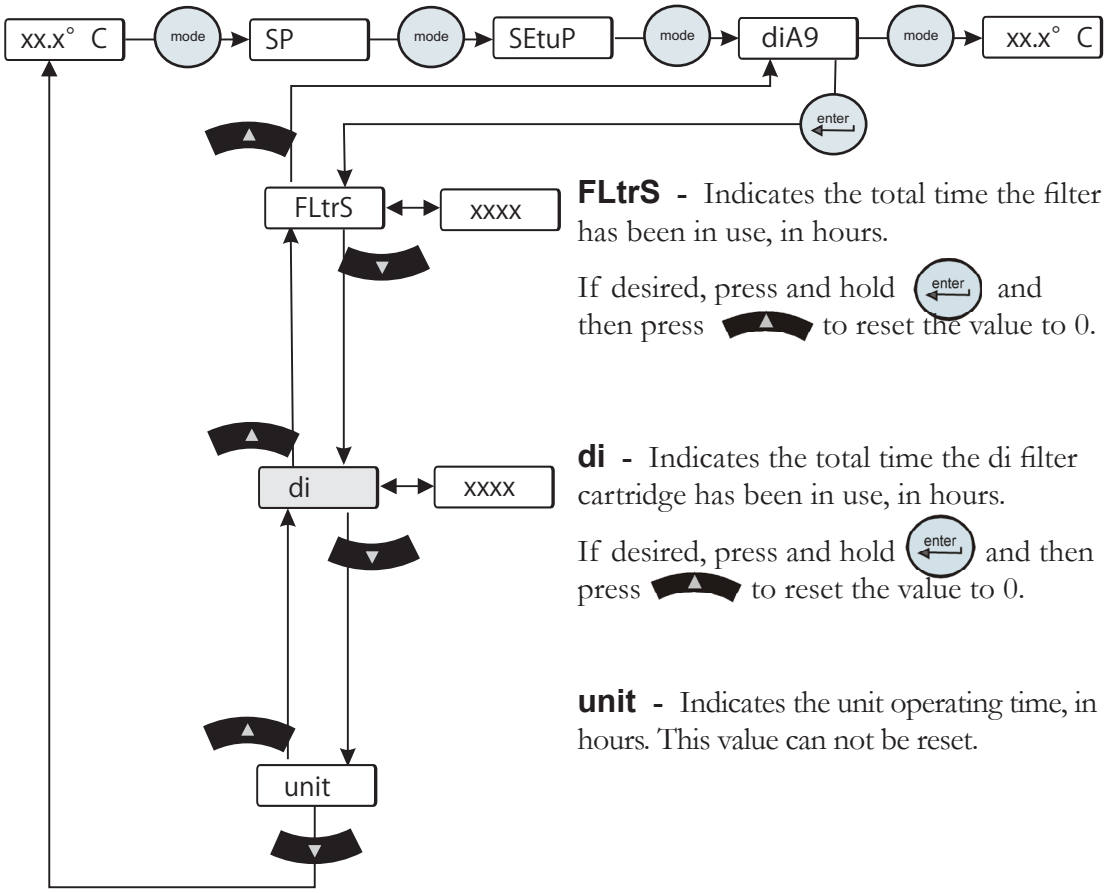
This will automatically restart the preventive maintenance timer for your DI filter. If you change the filter before the preventive maintenance timer alerts you, you can clear the timer by accessing the Diagnostic Loop **di** display see Section 4.

If you aren't sure how often to change your DI filter cartridge use the Setup Loop's default time of 448 hours. When alerted, check the Puralite sensor on the back of the unit to see if it is illuminated. If it is not illuminated reset the timer for another 448 hours by pressing enter and

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then checking the Puralite periodically. If the Puralite has turned red and the controller alarm has not gone off, access the Diagnostic Loop **unit** display, see below. Check the system run hours, this will give you an accurate DI replacement time. Adjust the DI filter alarm to match the time needed between filter cartridge changes.

NOTE It may be necessary to monitor the Puralite three or four times to establish an accurate changing schedule. Also, DI filter operating time is reduced every time new fluid is added. ▲



FLtrS - Indicates the total time the filter has been in use, in hours.

If desired, press and hold enter and then press ▲ to reset the value to 0.

di - Indicates the total time the di filter cartridge has been in use, in hours.

If desired, press and hold enter and then press ▲ to reset the value to 0.

unit - Indicates the unit operating time, in hours. This value can not be reset.

Figure 6-6 Filter Timer Reset

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Service Codes

The controller also displays Service Codes. These codes are based on the component run time and are established to avoid unplanned failures. The unit will continue to run. Contact Thermo Fisher Scientific's Customer Support when any of these codes are displayed.

SEr 1

SEr 2

SEr 3

SEr 4

SEr 5

SEr 6

You can press the enter key to clear any service code. Note the service code number because once cleared, the code will not reappear.

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Section 7 Troubleshooting

Error Codes

The controller can display Error Codes. If the unit is still running press **enter** to see if the code clears, a limit may have been only temporarily exceeded. If the unit shut down the controller will continue to flash the error code. Press **enter** to clear the display and silence any alarm. Once the cause of the shut down is identified and corrected, start the unit. If the cause was not corrected the error code will reappear.

Error Code	Reaction	Cause	Actions
di	Unit continues to run.	Internal DI cartridge may need replacing.	•Check the Puralite sensor on the rear of the unit, if the light is red change the cartridge. See Section 6. •If the Puralite sensor is green, see Section 6 to revise DI cartridge run time.
FLtrS	Unit continues to run.	Air and fluid filters require preventive maintenance/ replacement.	•Check air and fluid filters. If required, clean/change air and fluid filters, see Section 6. •If your filters do not need cleaning, you may increase the number of hours between preventive care reminders. There are three levels, see Section 6.
HiFLO	Unit reaction depends on HiFLo adjustable setting chosen in the Setup Loop, Alr setting. See Section 4.	The process fluid flow rate has exceeded the adjustable setting's value.	•If the unit is still running press enter to see if the code clears, the limit may have been only temporarily exceeded. •Verify your HiFLo setting, see Section 4, and adjust setting if necessary. •Check all application and plumbing shut off valves for correct position. •Adjust flow if unit is equipped with a flow control valve (option), see Section 5. •If flow transducer was recently calibrated double check calibration, see Section 8. •Contact our Sales, Service and Customer Support.

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Error Code	Reaction	Cause	Actions
Hi P1	Unit reaction depends on Hi P1 adjustable setting chosen in the Setup Loop, *Alr setting*. See Section 4.	The pump's discharge pressure exceeded Setup Loop alarm value.	• If the unit is still running press enter to see if the code clears, the limit may have been only temporarily exceeded. •Verify your Hi P1 setting, see Section 4. •Check application valves and ensure that they have not changed or been closed. **NOTE** If routine shut-off of the process flow is required then an external pressure relief valve should be added, see Section 5. ▲ • May occur as a result of changing the internal DI cartridge. Disconnecting the cartridge adds an additional 0.5 gpm to the main flow (for positive displacement pumps). See Section 5. • Check for debris in the application or external filters. • Double check fluid lines. Excessive bends, long tubing and diameter reductions can affect the pump's discharge pressure. **NOTE** If diameter reductions must be made, they should be made at the inlet and outlet of your application, not at the chiller.▲ •Contact our Sales, Service and Customer Support.
Hi t	Unit reaction depends on Hi t adjustable setting chosen in the Setup Loop, *Alr setting*. See Section 4. **NOTE** If the unit does shut down it can be restarted, but it will shut down again if the process fluid temperature goes above the customer adjustable setting within two minutes.▲	The process fluid temperature exceeded Setup Loop alarm value. If operating at high altitude note that heat removal capacity decreases 1.2% per 1,000 feet above sea level. Also, the maximum temperature of the air entering the unit must be reduced by 1°C per 1,000 feet above sea level.	• If the unit is still running press enter to see if the code clears, the limit may have been only temporarily exceeded. •Verify your Hi t setting, see Section 4. •Ensure the unit meets all environmental requirements, see Section 3. •Clean air filter. Dirt and debris on filter can prevent the unit from functioning at full capacity, see Section 6. •Ensure that the heat load being applied to the chiller is not too high. Contact Thermo Fisher for assistance on calculating heat loads. •Bring cooler air in from another area or exhaust the hot air into another location using an auxiliary fan. •Ensure unit has adequate ventilation, see Section 3. •Verify/adjust controller PID values, see Section 7. •If the internal process temperature sensor (RTD1) was recently calibrated, double check calibration to ensure that it was done properly, see Section 8. •Contact our Sales, Service and Customer Support.

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Error Code	Reaction	Cause	Actions
HPC	Unit will shut down.	High refrigeration pressure.	**Air-cooled units** •Clean air filter. Dirt and debris on filter can prevent the filter from functioning at full capacity, see Section 6. •Ensure that the ambient temperature is not exceeding the recommended range, see Section 3. •Bring cooler air in from another area or exhaust the hot air into another location using an auxiliary fan. •Ensure unit has adequate ventilation, see Section 3. •Contact our Sales, Service and Customer Support. **Water-cooled units** •Ensure facility water is on and connected •Check facility water flow rate and pressure •Contact our Sales, Service and Customer Support.
Lo P1	Unit reaction depends on Lo P1 adjustable setting chosen in the Setup Loop, *Alr setting*. See Section 4.	Pump's discharge pressure is below Setup Loop alarm value.	•If the unit is still running press enter to see if the code clears, the limit may have been only temporarily exceeded. •Verify your LoP1 setting, see Section 4. •Ensure that chiller reservoir is not empty. •Unit requires >5 PSIG application pressure drop. If a bypass valve has been installed, some restriction may need to be added to the bypass line. •Contact our Sales, Service and Customer Support.

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Error Code	Reaction	Cause	Actions
Lo t	Unit reaction depends on Lo t adjustable setting chosen in the Setup Loop, *Alr setting*. See Section 4. **NOTE** If the unit does shut down it can be restarted, but it will shut down again if the process fluid temperature goes below the customer adjustable setting within two minutes. ▲	Process fluid temperature is below Setup Loop alarm value. Unit may not to be able to reach setpoint in low ambient temperatures.	• If the unit is still running press enter to see if the code clears, the limit may have been only temporarily exceeded. •Verify your Lo t setting, see Section 4. •Ensure that the ambient temperature is not exceeding the recommended low-range, see Section 3. If your application load is constant and/or the lower temperature can be temporarily tolerated, then continue operation. (The ThermoFlex will control setpoint when sufficient heat is added.) •Verify/adjust controller PID values, see Section 7. •Add insulation to external plumbing lines to reduce the heat-loss to the environment. •Install insulation to external plumbing lines to reduce heat loss. •For water-cooled units check facility water temperature. •Contact our Sales, Service and Customer Support.
LoFLo	Unit reaction depends on LoFLo adjustable setting chosen in the Setup Loop, *Alr setting*. See Section 4.	The process fluid flow rate has gone below the adjustable setting's value.	• If the unit is still running press enter to see if the code clears, the limit may have been only temporarily exceeded. •Verify your LoFLo setting, see Section 4. •Adjust flow if unit is equipped with a flow control valve (option), see Section 5. •Check all valves in your application and plumbing lines to ensure that they have not changed or closed. **NOTE** If routine shut-off of the process flow is required then disable the low flow alarm by setting the alarm to 0.5 gpm, see Section 4. ▲ •If flow transducer has recently been calibrated, double check calibration to ensure it was done properly, see Section 8. •Contact our Sales, Service and Customer Support.

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Error Code	Reaction	Cause	Actions
LLF	Unit will shut down.	Reservoir fluid level too low for normal operation.	•Excessive evaporation. Ensure the unit is operating with the funnel and cap in place. •Check for leaks. •Check auto refill operation, see Section 5. •Check the supply pressure on the auto refill supply line. With low pressure the auto refill time span setting may be set too low and the reservoir does not have time to fill. Check rEFiL settings and adjust if necessary, see Section 4. •Contact our Sales, Service and Customer Support.
O FLO	Unit will shut down.	There is an overflow condition in the reservoir.	•Ensure the reservoir was not filled above the MAX LEVEL line. •Check for clogged reservoir filter. •Contact our Sales, Service and Customer. Support.
rEFiL	Auto refill will shut off.	The auto refill did not reach the minimum operating level within the time chosen for the customer adjustable *fill* setting, chosen in the Setup Loop, see Section 4. The auto refill successfully filled within the time frame chosen for the customer adjustable *fill* setting, but the unit tries to refill 5 times in 40 hours.	•Check for leaks •Check the supply pressure on the auto refill supply line. With low pressure the auto refill time span setting may be set too low and the reservoir does not have time to fill. Check **rEFiL** settings and adjust if necessary, see Section 4. •Contact our Sales, Service and Customer Support. •Check **rEFil** settings and adjust if necessary, see Section 4. •Contact our Sales, Service and Customer Support.
SEr X	Unit will continue to run.	Service code.	•See Service Codes in Section 6.
Er 4	Unit willl not start.	Normal if new software installed.	•Clear the error code. •If error remains, contact our Sales, Service and Customer Support.

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Error Code	Reaction	Cause	Actions
Er 15	Communications error.	No, or bad, connection.	•Check the serial communication connection. •Contact our Sales, Service and Customer Support.
Er 16	Unit continues to run.	Bad temperature sensor calibration.	•Redo calibration, see Section 8. •Contact our Sales, Service and Customer Support.
Er 22	Unit will shut down.	Reservoir fluid temperature exceeded the factory preset value of +43°C. If operating at high altitude note that heat removal capacity decreases 1.2% per 1,000 feet above sea level. Also, the maximum temperature of the air entering the unit must be reduced by 1°C per 1,000 feet above sea level.	•Clean air filter. Dirt and debris on filter can prevent the unit from functioning at full capacity, see Section 6. •Ensure the unit meets all environmental requirements, see Section 3. •Ensure that the heat load being applied to the chiller is not too high. Contact Thermo Fisher for assistance on calculating heat loads. •Bring cooler air in from another area or exhaust the hot air into another location using an auxiliary fan. •Ensure unit has adequate ventilation, see Section 3. •Verify/adjust controller PID values, see Section 7. •If the internal process temperature sensor (RTD1) was recently calibrated, double check calibration to ensure that it was done properly, see Section 8. •Contact our Sales, Service and Customer Support.
Er 23	Unit will shut down.	Refrigeration temperature sensor shorted.	•Contact our Sales, Service and Customer Support.
Er 24	Unit will shut down.	Refrigeration temperature sensor open.	•Contact our Sales, Service and Customer Support.
Er 25	Unit will shut down.	Internal temperature sensor shorted.	•Contact our Sales, Service and Customer Support.
Er 26	Unit will shut down.	Internal temperature sensor open.	•Contact our Sales, Service and Customer Support.
Er 32	Unit will shut down.	Refrigeration suction gas temperature exceeded 50°C.	•Contact our Sales, Service and Customer Support.

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Error Code	Reaction	Cause	Actions
Er 33	Unit will shut down.	Reservoir fluid temperature below the factory preset value of +3°C.	•Check ambient temperature. Unit may not to be able to reach setpoint at low ambient temperatures. If your load is constant, then turn your unit on. Unit will control setpoint when sufficient heat is added. •Verify/adjust controller PID values, see Section 7. •Add insulation to external plumbing lines to reduce the heat-loss to the environment. •Ensure that the ambient temperature is not exceeding the recommended range, see Section 3. •Install insulation if necessary. •For water-cooled units check facility water temperature. •Contact our Sales, Service and Customer Support.
Er 35	Unit will shut down.	Process pressure (P1) exceeded factory preset value of 105 psi for greater than 30 seconds. NOTE: A lower Hi P1 dELAY time overrides the 30 seconds and will shut down the unit sooner, see Section 4.	•Check application valves and ensure that they have not changed or been closed. **NOTE:** If routine shut-off of the process flow is required then an external pressure regulator accessory should be added - contact Thermo Fisher. ▲ •May occur as a result of changing the internal DI cartridge. Disconnecting the cartridge adds an additional 0.5 GPM to the main flow (for positive displacement pumps), see Section 5. •Check for debris in the application or clogged external filters. •Double check fluid lines. Excessive bends, long tubing and diameter reductions can affect the pump's discharge pressure. **NOTE:** If diameter reductions must be made, they should be made at the inlet and outlet of your application, not the chiller. ▲ •Contact our Sales, Service and Customer Support.
Er 36	Unit will shut down.	Process pressure (P1) below factory preset limit of 3 psi.	•Ensure that the chiller reservoir is not empty. •Unit requires >5 PSIG application pressure drop. If a bypass valve has been installed, some restriction may need to be added to the bypass line. •Contact our Sales, Service and Customer Support.

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Error Code	Reaction	Cause	Actions
Er 41	Unit will shut down.	Communication error between display and main control board.	•Cycle circuit protector on rear of unit off and on. •Contact our Sales, Service and Customer Support.
Er 42	Unit will shut down.	Internal communications error.	•Contact our Sales, Service and Customer Support.
Er 48	Unit will shut down.	Unit's EMO button depressed.	•When able, reset EMO.
Er 58	Unit will shut down.	Low flow fault. Flow dropped below 0.1 GPM for more than 15 seconds.	•Adjust flow if unit is equipped with a flow control valve (option), see Section 5. •Check all valves in your application and plumbing lines to ensure that they have not changed or closed. **NOTE:** If regular shut-off of the process flow is required then disable the low flow alarm or by setting the alarm to 0.5 GPM, see Section 4. ▲ •If flow transducer has recently been calibrated, double check calibration to ensure it was done properly, see Section 8. •Contact our Sales, Service and Customer Support.
Er 59	Unit will shut down.	Invalid level fault. Unit sensed both a high level and low level reservoir fluid level.	•Contact our Sales, Service and Customer Support.
Er 62	Unit willl not start.	Shorted remote temperature probe.	•Contact our Sales, Service and Customer Support.
Er 63	Unit willl not start.	Open remote temperature probe.	•Contact our Sales, Service and Customer Support.
Er 64	Unit will continue to run using the last valid setpoint received.	Analog remote setpoint is enabled and the unit receives a voltage or current level that is outside the unit's set point range.	•The error can be cleared only after a valid set point is received, or the remote analog setpoint is turned off.

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Checklist

Unit will not start

For first time use, please refer to the quick start instructions included with your unit or the copy in this manual. The manual's copy follows the Table of Contents.

Check the controller for error codes, see Error Codes in this section.

Ensure the circuit protector is in the on (I) position.

For Global Voltage units ensure the unit is properly configured, see Appendix B.

Make sure supply voltage is connected and matches the unit's nameplate rating ±10%.

NOTE Once RS232 or RS485 is activated, all keypad operations are disabled except for turning the unit off and changing the serial communication's settings. ▲

Unit shuts down

Ensure  button wasn't accidently pressed.

Ensure the circuit protector is in the on (I) position.

Check the controller for error codes, see Error Codes in this section.

Make sure supply voltage is connected and matches the unit's nameplate rating ±10%.

Restart the unit.

Clearing Error Codes

Note the code in case it cleares before you are done troubleshooting.

If desired, silence the audible alarm by pressing any key.

If the unit shut down the controller will continue to flash the error code. Press **enter** to clear the display and silence any alarm. Refer to Error Codes in this section. Once the cause of the shut down is identified and corrected, start the unit. If the cause was not corrected the error code will reappear.

If the unit is still running press **enter** to see if the code clears, a limit may have been only temporarily exceeded. If the error code does not clear press  until the display flashes between the error code and the temperature and then press **enter.** If the code still does not clear refer to Error Codes in this section.

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Unit will not circulate process fluid

Check the reservoir level. Fill, if necessary.

Unit requires >5 PSIG application pressure drop. If a bypass valve has been installed, some restriction may need to be added to the bypass line.

Check the application for restrictions in the cooling lines.

Ensure the reservoir bag filter is not clogged.

The pump motor overloaded. The internal overtemperature/ overcurrent device will shut off the pump causing the flow to stop. This can be caused by low fluid, debris in system, operating unit in a high ambient temperature condition or excessively confined space. Allow time for the motor to cool down.

Make sure supply voltage matches the unit's nameplate rating ±10%.

Inadequate temperature control

Verify the setpoint.

Make sure the condenser/air filter is free of dust and debris.

Ensure your unit's installation complies with the site requirements listed in Section 3.

Make sure supply voltage matches the unit's nameplate rating ±10%.

If the temperature continues to rise, make sure your application's heat load does not exceed the rated specifications.

Check for high thermal gradients (i.e., the application load is being turned on and off or rapidly changing).

If operating at high altitude note that heat removal capacity decreases 1.2% per 1,000 feet above sea level. Also, reduce the maximum temperature for the air entering the ThermoFlex by 1°C per 1,000 feet above sea level.

Verify/adjust controller PID values, see Section 7.

Ensure the unit was shut down properly, see Section 4. If not the compressor may be damaged.

Unit vibration

The optional pressure relief valve setting may be the cause. If it is, change the pressure setting ± 5 psi to eliminate the vibration.

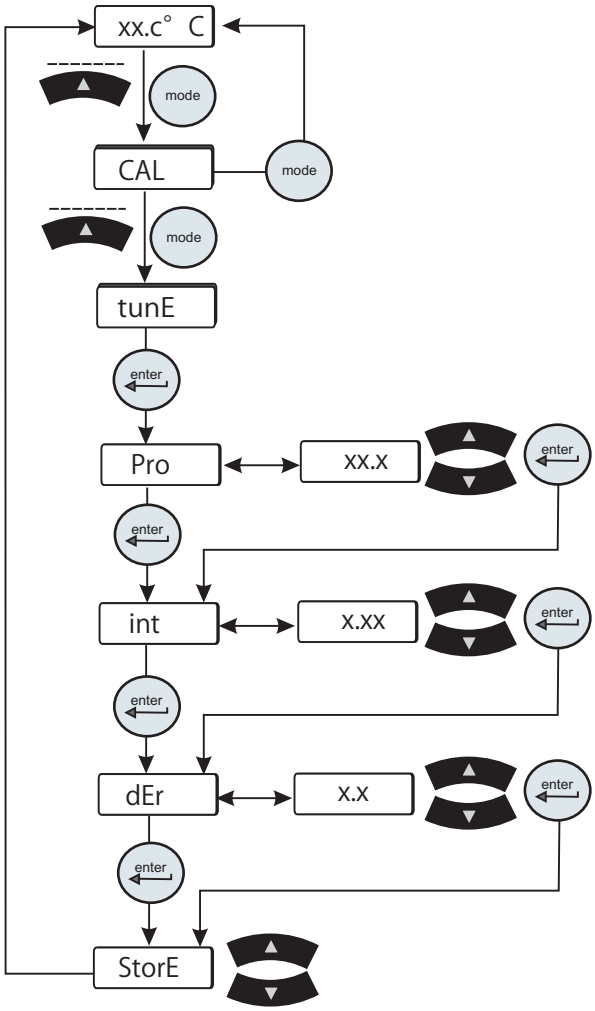
Please contact Thermo Fisher Scientific Sales Service and Customer Support if you need any additional information, see inside cover for contact instructions.

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Adjusting the Controller PID Values

The controller controls temperature using a Proportional-Integral-Derivative (PID) algorithm. Should your unit experience temperature control issues, adjusting the controller's PID values may correct the condition.

NOTE Thermo Fisher recommends that only a qualified technician adjust the PID values. Incorrect values will hamper unit performance. ▲



- **Pro**
  proportional value
  Range: 0.0 to 99.9
  Factory Preset: 10.0

- **int**
  integral value
  Range: 0.00 to 9.99
  Factory Preset: 0.50

- **dEr**
  derivative value
  Range: 0.0 to 9.9

Figure 7-1 Adjusting PID Values

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Section 8 Additional Information

Draining

Before using any fluid or performing maintenance where contact with the fluid is likely refer to the manufacturer's MSDS for handling precautions. ▲

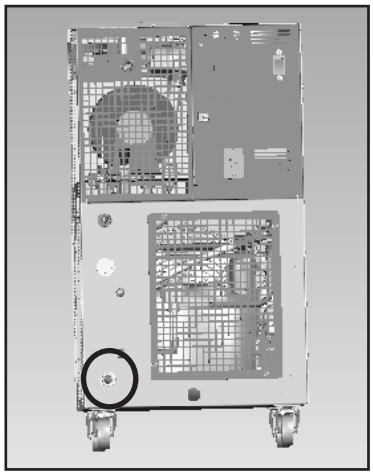
Position a suitable pan beneath the drain port at the rear of the unit. The drain pan must be shallow (under 3½" in height) and have a volume of approximately 3 gallons. Remove ¼" Male NPT pipe plug from drain port. This will drain the return line, reservoir, plate exchanger, and the suction side of the pump.

To drain the discharge side of the pump disconnect the ½" Female NPT outlet connection (the brass fitting) on the rear of the unit.

NOTE Internally the unit does not contain a large quantity of fluid on the discharge side however take care to contain what fluid does drain, a wet-vac can be employed to minimize the potential for spillage. ▲

If the unit is equipped with the flow control or pressure relief with flow control option, open the valve or remove the drain plug in order to drain the discharge line.

If the unit is equipped with the anti drainback option, enter the Setup Loop and utilize the **drAin** display to open the valve, see Section 4. Opening the valve allows the fluid to drain out of the unit.



Reinstall ¼" Male NPT pipe plug using a sealant suitable for the wetted materials prior to refilling the unit.

Figure 8-1 1/4" Male NPT Reservoir Drain Plug

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Water-Cooled

Draining water-cooled units is accomplished by removing the right side panel. Use a Philips head screwdriver to remove the five screws indicated in the illustration below. Slide the panel back approximately one inch, then lift slightly from the rear to disengage the panel's two tabs from their slots.

Install a $^{7}/_{16}$" ID tube on the drain petcock valve located on the lower end of the exchanger. Open the valve to allow fluid to drain into an external device. When draining is complete close the valve and replace the panel.

A wet-vac is needed on the facility water inlet connection to thoroughly drain any remaining fluid from the lines.



Figure 8-2 Water-Cooled

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Internal Fluid Temperature Sensor (rdt1) Calibration

The ThermoFlex has been designed to minimize the need for calibration. However, if calibration is desired or recommended by our Sales, Service and Customer Support, please use the following procedure.

This procedure requires a running unit and a calibrated reference thermometer.

NOTE Uninsulated applications may cause the internal temperature and an external reference temperature to differ and to fluctuate. If inaccurate calibration is suspected, place the reference thermometer as close to the ThermoFlex process outlet as possible. ▲

NOTE If it is more convenient, perform the low-end calibration before doing the high-end. ▲

Do not pick calibration points that are outside the safe operating limits of the fluid in your application. For example with water, 40°C and 5°C are typical high and low calibration points.

Run the unit to a suitable high-end calibration point. Place a calibrated reference thermometer in the reservoir. Ensure the fluid temperature is stabilized.

To enter the Calibration Loop ensure the controller display is displaying the process fluid temperature, see the diagram on next page. Press and hold the  and then press the 

key. The display will indicate **CAL**.

Press the 

key and the controller will display **rtd1**. Press 

again and the controller will display **r1 H** (high-end calibration). Press 

again and the controller will flash between **r1 H** and the temperature. Use  to adjust the temperature to match the reference thermometer. Press the 

key again to accept the value.

Press the  key until **StorE** is displayed, press  to accept the new value, press  to abort it.

Run the unit to a suitable low-end calibration point. At the **r1 L** (low-end calibration) display repeat the procedure.

Press the  key until **StorE** is displayed, press  to accept the new value, press  key to abort it.

NOTE After pressing the  button at the **StorE** prompt wait several seconds before proceeding to ensure that a bad calibration message (**Er 16**) does not appear. Premature use of the keypad after pressing  may cancel the bad calibration error message. ▲

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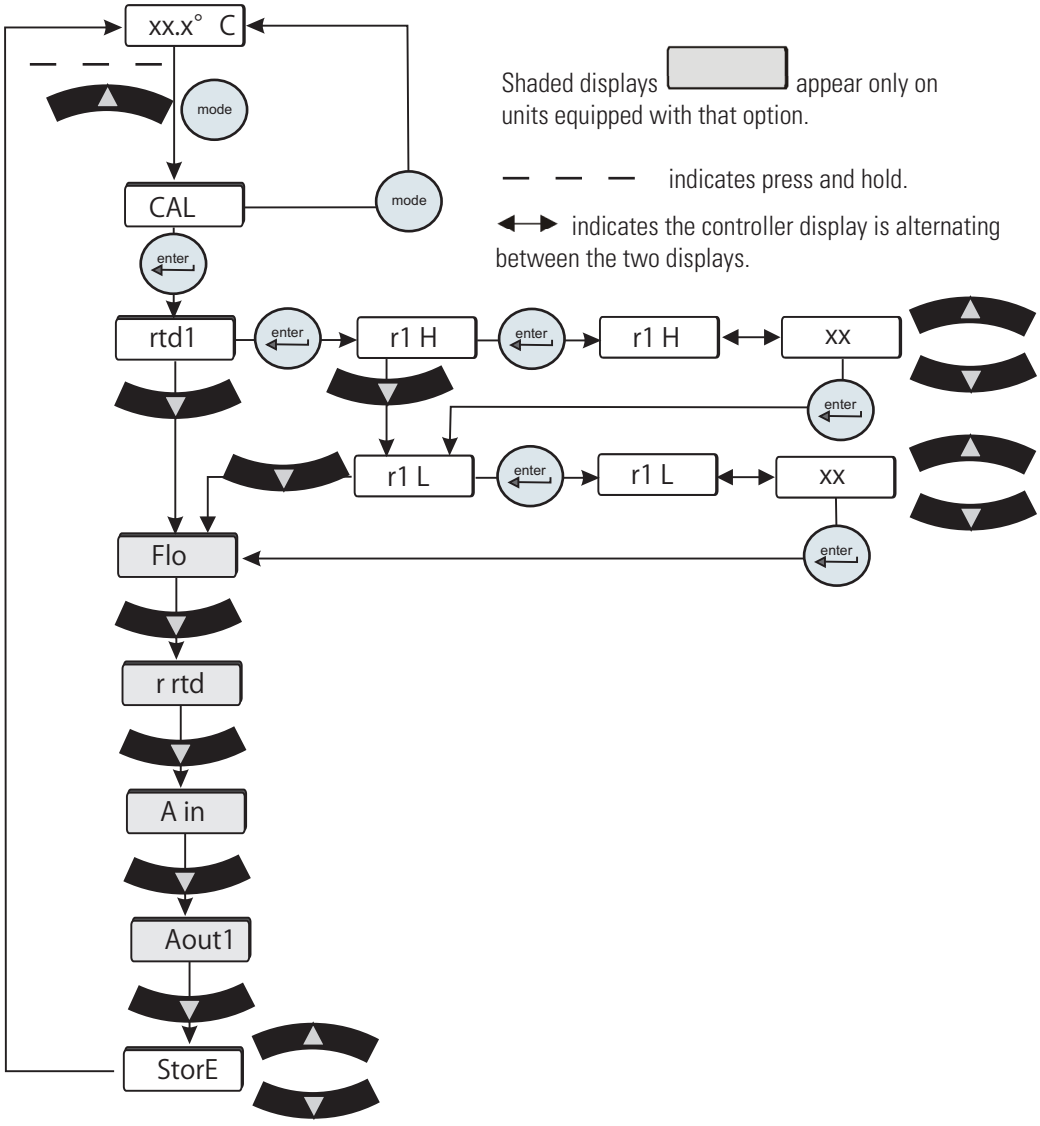


Figure 8-3 Internal Temperature Sensor Calibration

If you have any questions please contact Thermo Fisher Scientific's Sales, Service and Customer Support.

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Optional Process Fluid Flow Transducer (FLo) Calibration

The ThermoFlex has been designed to minimize the need for calibration. However, if calibration is desired or recommended by our Sales, Service and Customer Support, please use the following procedure.

This procedure requires a running unit, a calibrated reference flowmeter and an external flow control valve.

Connect a calibrated reference flowmeter to the outlet line. Using an external flow control valve, increase the flow to a suitable high-end calibration point. Ensure the flow is stabilized.

To enter the Calibration Loop ensure the controller display is displaying the process fluid temperature, see the diagram on the next page. Press and hold the  and then press the  key. The display will indicate **CAL**. Press the  key and the controller will display **rtd1**. Press  until the controller displays **FLo**. Press  and the controller will flash between **HiFLo** and the flow rate. Use  to adjust the rate to match the reference flowmeter.

Decrease the flow to a suitable low-end calibration point (avoid a zero flow rate). Ensure the flow is stable.

Press the  key and the controller will flash between **LoFLo** and the flow rate. Use  to adjust the rate to match the reference flowmeter.

Press the  key and **StorE** is displayed, press  to accept both values, press  to abort them.

NOTE After pressing the  button at the **StorE** prompt wait several seconds before proceeding to ensure that a bad calibration message (**Er 16**) does not appear. Premature use of the keypad after pressing  may cancel the bad calibration error message. ▲

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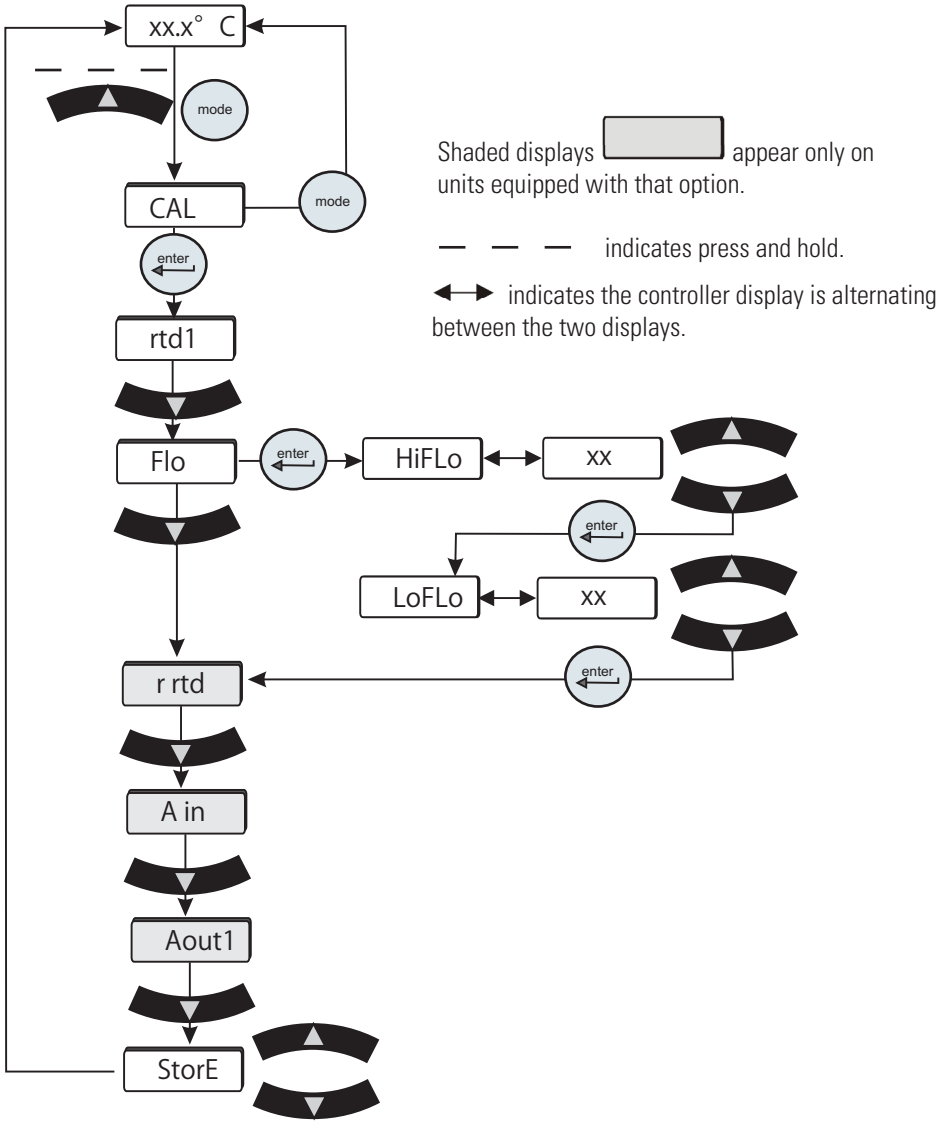


Figure 8-4 Flow Transducer Calibration

If you have any questions please contact Thermo Fisher Scientific's Sales, Service and Customer Support.

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Wetted Materials

P1 and P2 Pumps

300 Series Stainless Steel
Bronze
Carbon Graphite
Ceramic
Fluorocarbon (Viton®)
Polysulfone

Tank

Polyethylene
Brass
Pyrex®

Plumbing

300 Series Stainless Steel
Bronze
Fluorocarbon (Viton®)
Nickel
Polypropylene
EPDM
Brass
Copper
Teflon®
PPS (flow transducer)
Nitrile (Buna-n®)

Funnel

Acetac Copolymer (Celcon®)

P3 and P4 Pumps

316 Series Stainless Steel
Carbon
Silicon Carbide
Fluorocarbon (Viton®)

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Shipment/Storage



Transporting and/or storing the unit in near or below freezing temperatures requires draining, see Draining in this Section. Store the unit in the temperature range of -25°C to 60°C (with packaging), and <80% relative humidity. ▲



Do not store the unit for more than 90 days. ▲

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Appendix A Country Specific 230 VAC, 50 Hz, 1Ø Requirements

Refer to the nameplate label located on the rear of the unit for specific electrical requirements.

1. Units shipped to the following locations require a **16 Amp service**:

Afghanistan, Albania, Algeria, Andorra, Angola, Argentina, Armenia, Austria, Azerbaijan, Belarus, Belgium, Benin, Bolivia, Bosnia and Herzegovina, Brazil, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Chile, Comoros, Congo, Croatia, Czech Republic, Denmark, Djibouti, DR Congo, Ecuador, Egypt, Eritrea, Estonia, Ethiopia, Finland, France, French Guiana, Gabon, Georgia, Germany, Greece, Guinea, Hungary, Iceland, Indonesia, Iran, Iraq, Israel, Italy, Ivory Coast, Jordan, Kazakhstan, Kyrgyzstan, Latvia, Lebanon, Liberia, Libya, Liechtenstein, Lithuania, Luxembourg, Madagascar, Mali, Mauritania, Moldova, Monaco, Mongolia, Morocco, Mozambique, Namibia, Nepal, Netherlands, Niger, North Korea, Norway, Paraguay, Peru, Poland, Portugal, Romania, Russia, Rwanda, Saint Vincent and the Grenadines, San Marino, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Slovakia, Slovenia, Somalia, South Africa, South Korea, Spain, Sweden, Switzerland, Syria, Tajikistan, Thailand, Togo, Tunisia, Turkey, Turkmenistan, Ukraine, Uruguay, Uzbekistan, Vanuatu, Vatican City, Vietnam.

2. Units shipped to the following locations require a **15 Amp service**:

Australia, China, Fiji Islands, Nauru, New Zealand, Papua New Guinea, Solomon Island, Tonga, Tuvalu.

3. Units shipped to the following locations require a **13 Amp service**:

Abu Dhabi, Bahrain, Bangladesh, Botswana, Brunei, Cyprus, Dominica, Gambia, Ghana, Gibraltar, Grenada, Hong Kong, India, Ireland, Kenya, Kiribati, Kuwait, Lesotho, Malawi, Malaysia, Maldives, Malta, Mauritius, Myanmar, Nigeria, Oman, Pakistan, Qatar, Saint Lucia, Seychelles, Sierra Leone, Singapore, Sri Lanka, Sudan, Swaziland, Tanzania, Uganda, United Arab Emirates, United Kingdom Yemen, Zambia, Zimbabwe.

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Appendix B Global Voltage Configuration Instructions

Units equipped with the Global Voltage option have a voltage configuration panel located behind the refrigeration access panel on the rear of the unit.

- Use a 1/4" socket to remove the four screws securing the access panel to the unit.
- The configuration panel has two 3-position toggle switches, one for voltage and one for frequency. All units are shipped with the toggle switch in the center **SHIP** position. Place each switch to the settings that match the voltage/frequency supplied to the unit.
- Reinstall the refrigeration access panel.

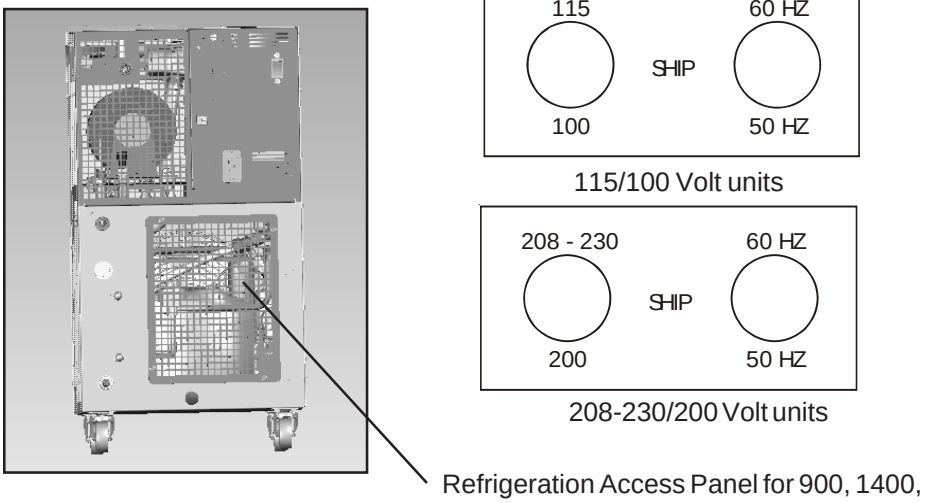
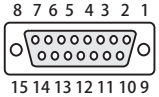


Figure B-1 Global Voltage

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Appendix C Analog I/O and Remote Sensor

Analog I/O Connector Pinout ♀



Install your analog input/output device to the 15-pin female connector on the rear of the unit. Analog I/O is activated using the Setup Loop, see page C-3.

PIN	NAME	NOTES	DEFINITION
1	DIGITAL INPUT COMMON		Common for digital inputs (pins 12, 13 and 14)
2	Not Used		
3	LOW LEVEL (Only if option chosen)	Note 1	Dry Relay Contact: Reference to pin 11. Closes if either level switch is in the "low" position for more than 1 second.
4	CONFIGURABLE RELAY 2	Note 1	Dry Relay Contact: Reference to pin 11. Closes when any configured fault or warning occurs, see Table 2.
5	PUMP ON	Note 1	Dry Relay Contact: Reference to pin 11. Closes when pump is turned on. Opens when pump is turned off.
6	ANALOG GROUND		Common for analog signals (pins 2, 7 and 15)
7	RESERVOIR TEMP OUT **OR** EXTERNAL SENSOR TEMPERATURE IF EXTERNAL SENSOR ENABLED	Note 2	Analog Voltage Output 0-10VDC, 10mV/°C, or 4-20mA: Reference to pin 6. This voltage output is proportional to the reservoir fluid temperature: Default scale= 0–10V (where: 0V = Low Temp Span, 10V = Hi Temp Span) Optional Range = 10mV/ ^{0}C. (Ex: 200mV = 20°C) (Max Load @ 10V = 5mA) or 4-20mA, 4mA = low temp span, 20 mA = high temp span (maximum output current = 5mA @10VDC. Contact us for details.
8	LOW FLOW (Only if option chosen)	Note 1	Dry Relay Contact: Reference to pin 11. Closes when a low flow occurs while the pump is on. Note: To allow the pump to get up to speed at startup, the pump runs for 3 - 5 seconds before the low flow sensor is read.
9	CONFIGURABLE RELAY 1 (Normally Open)	Note 1	Dry Relay Contact: Reference to pin 11. Closes when any of the configured faults occur, see Table 1.
10	CONFIGURABLE RELAY 1 (Normally Closed)	Note 1	Dry Relay Contact: Reference to pin 11. Complement of pin 9 (open when pin 9 is closed).
11	RELAY COMMON		Common for all relay contacts (pins 3, 4, 5, 8, 9, 10).
12	REMOTE START ENABLE	Note 3	Digital Input (Isolated): Reference to pin 1. Connect to pin 1 to allow unit to be remotely turned on/off through pin 14 REMOTE START.

Note 1: All relay contacts (except for Pin 10) are normally OPEN when power is off. Pin 10 contacts are normally CLOSED when power is off. Relay contacts are rated: 24V AC/DC, 2A, <= 0.08 Ohm maximum each or 5A total for all relays combined, 1mA minimum, switching capacity: 48VA/48W (Resistive load only).

Note 2: Jumper Configurable (Default = 10mV/°C)

Note 3: Sink 0.5mA @ 5VDC (Rated for signal level gold contact or TTL device)

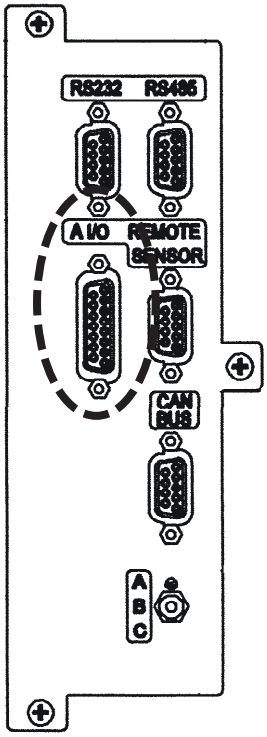
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PIN	NAME	NOTES	DEFINITION
13	REMOTE SETPOINT ENABLE	Note 3	Digital Input (Isolated): Reference to pin 1. Connect to pin 1 to allow the setpoint to be changed remotely through pin 15 REMOTE SETPOINT.
14	REMOTE START	Note 3	Digital Input (Isolated): Reference to pin 1. Connect to pin 1 to turn unit on. Disconnect to turn unit off. Note: Pins 1 and 12 must be connected to allow operation from this pin.
15	REMOTE SETPOINT	Note 2	Analog Voltage Input 0-10VDC, 10mV/°C, or 4-20mA: Reference to pin 6. Apply a DC voltage to this pin to adjust the unit's setpoint: Default Range = 0 – 10V (where: 0V = Low Temp Span, 10V = Hi Temp Span) (Input Impedance > 600K) Optional Range = 10mV/ ^{0}C. (Ex: 200mV = 20°C) (Max Input Voltage = 10VDC, or 4-20mA, 4mA = low temp span, 20 mA = high temp span. Contact us for details.

Note 1: All relay contacts (except for Pin 10) are normally OPEN when power is off. Pin 10 contacts are normally CLOSED when power is off. Relay contacts are rated: 24V AC/DC, 2A, <= 0.08 Ohm maximum each or 5A total for all relays combined, 1mA minimum, switching capacity: 48VA/48W (Resistive load only).

Note 2: Jumper configurable (default = 10mV/°C)

Note 3: Sink 0.5mA @ 5VDC (rated for signal level gold contact or TTL device)



NOTE When making your connection to the ThermoFlex Analog I/0 connector, in order to comply with the EMC directive:

- Use a shielded I/0 cable
- Connect the remote end of the cable shield to earth ground.
- Connect cable shield to ThermoFlex end connector. ▲

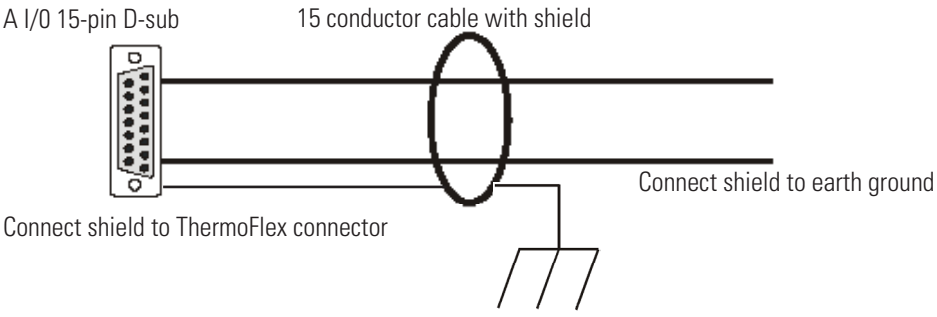
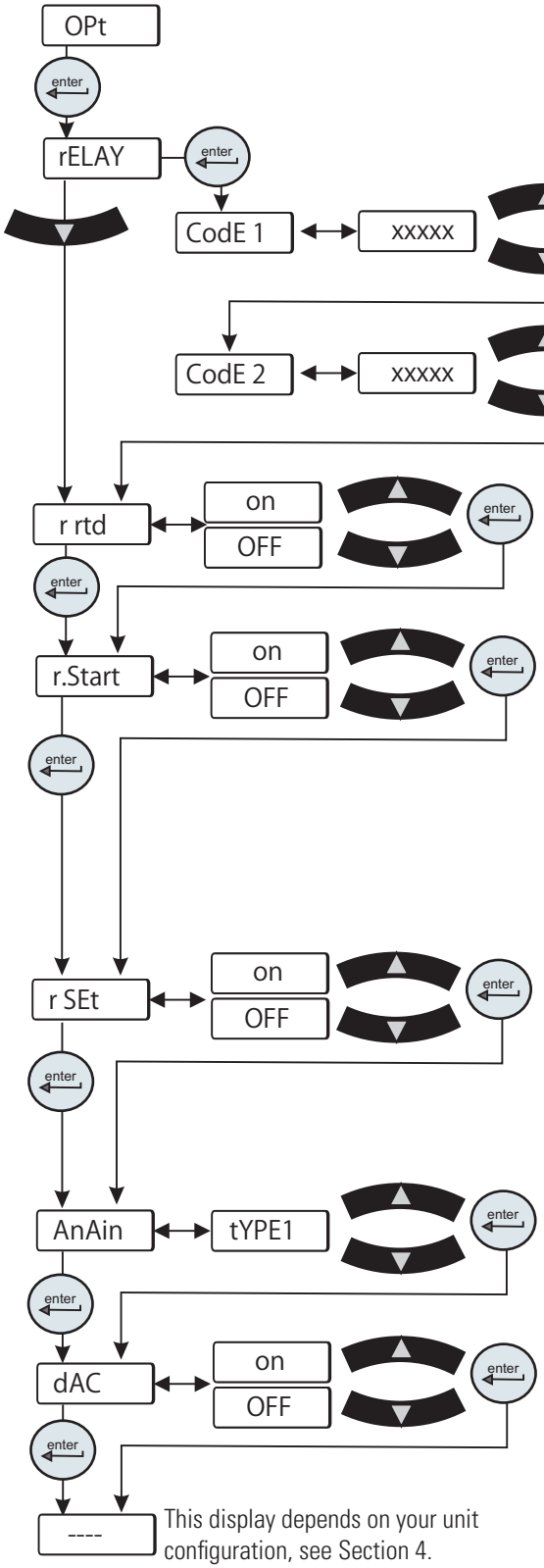


Figure C-1 Analog I/0 Connector

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• **rELAY** is used to configure the code for relays 1 and 2, see Tables 1 and 2 on the next page.

(Example: To have just the tank overflow **or** drip pan error fault activated for either relay you would enter code 6.)

• **r rtd** is used to enable/disable the remote temperature sensor. See Table 3 for pin out information.

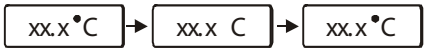
NOTE There is no other indication on the unit that the remote sensor is enabled. ▲

• **r.Start** is used to enable/disable the remote start/stop.

NOTE The analog I/O remote start/stop capability has priority over the controller's start/stop, as well as any serial communications start/stop message. ▲

• **r SEt** is used to enable/disable the remote setpoint.

NOTE When remote setpoint is enabled a flashing dot will appear on the controller's display as shown below. ▲



• **AnAin** is used to configure the analog voltage input type.

Type 1: 0 - 10 VDC (Default)

Type 2: 10 mV/°C

Type 3: 4 - 20 mA

• **dAC** is used to enable/disable the digital to analog converter. Once enabled, the desired output type can be selected.

Type 1: 0 - 10 VDC (Default)

Type 2: 10 mV/°C

Type 3: 4 - 20 mA

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Table 1	Configurable Relay #1		
Error	Error Number	Factory Default	Code 1
Low Level (option)	31	Enable	1 (Default)
Tank Overflow	44	Disable	2
Drip Pan Full (option)	57	Disable	4
Low Temp	19*	Disable	8
High Temp	21*	Disable	16
Low Flow (option)	27*	Enable	32 (Default)
High Flow (option)	29*	Disable	64
Low Resistivity (option)	28*	Disable	128
High Resistivity (option)	30*	Disable	256
High Pressure	60*	Disable Analog Input	
Low Pressure	61*	Disable	1024
Unit Fault	Any Fault	Enable	2048 (Default)
Pump/Unit Shut Off	Status bit(s)	Disable	4096
Refrigeration Shut Off	Status Bit	Disable	8192
Limit Fault (option)	39, 40, 45, 46, 47, 48	Enable	16384 (Default)
Sensor Fault	17, 18, 23, 24, 25, 26+ external sensor opened or shorted	Enable	32768 Default Relay Code 1 = 18465

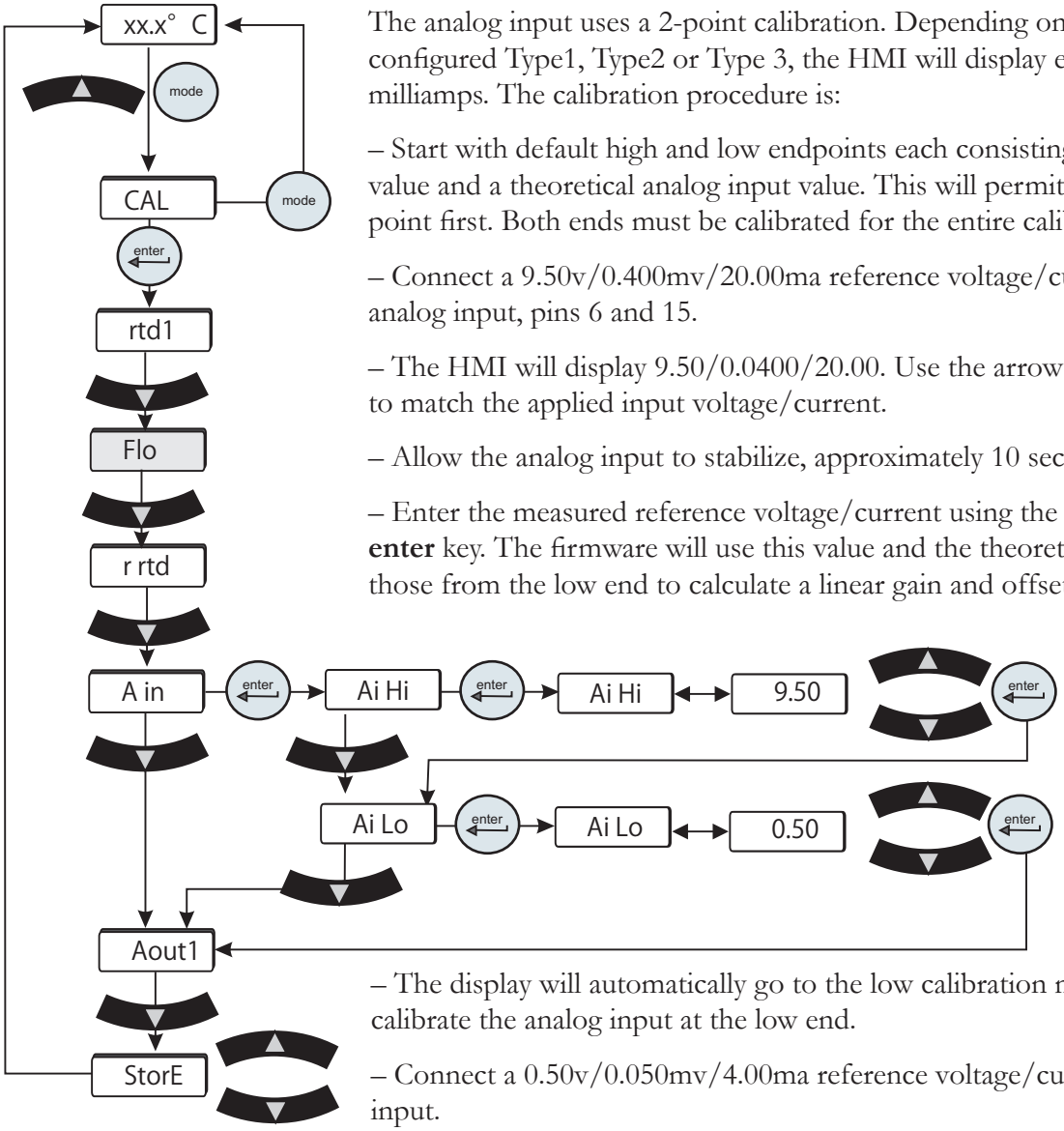
*Regardless of alarm setting - fault or indicator

Table 2	Configurable Relay #2		
Error	Error Number	Factory Default	Code 2
Low Level (option)	20	Disable	1
Tank Overflow	44	Disable	2
Drip Pan Full (option)	57	Disable	4
Auto Refill Error (option)	43	Disable	8
Low Temp	19*	Enable	16 (Default)
High Temp	21*	Enable	32 (Default)
Low Flow (option)	27*	Disable	64
High Flow (option)	29*	Disable	128
Low Resistivity (option)	28*	Disable	256
High Resistivity (option)	30*	Enable	512(Default)
High Pressure	60*	Disable	1024
Low Pressure	61*	Disable	2048
Indicator (warning)	Any Indicator	Enable	4096
PM Timer (option)	50 - 56	Disable	8192
Comm Error	15, 41, 42	Disable	16384
Sensor Fault	17, 18, 23, 24, 25, 26+ external sensor opened or shorted	Enable	32768 (Default) Default Relay Code 2 = 33328

*Regardless of alarm setting - fault or indicator

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Analog Input Calibration



The analog input uses a 2-point calibration. Depending on how the analog input is configured Type1, Type2 or Type 3, the HMI will display either volts, millivolts or milliamps. The calibration procedure is:

– Start with default high and low endpoints each consisting of a voltage/current value and a theoretical analog input value. This will permit calibration of either point first. Both ends must be calibrated for the entire calibration to be valid.

– Connect a 9.50v/0.400mv/20.00ma reference voltage/current source to the analog input, pins 6 and 15.

– The HMI will display 9.50/0.0400/20.00. Use the arrow keys to adjust the display to match the applied input voltage/current.

– Allow the analog input to stabilize, approximately 10 seconds.

– Enter the measured reference voltage/current using the HMI by pressing the **enter** key. The firmware will use this value and the theoretical analog value and those from the low end to calculate a linear gain and offset.

– The display will automatically go to the low calibration message. Press **enter** to calibrate the analog input at the low end.

– Connect a 0.50v/0.050mv/4.00ma reference voltage/current source to the analog input.

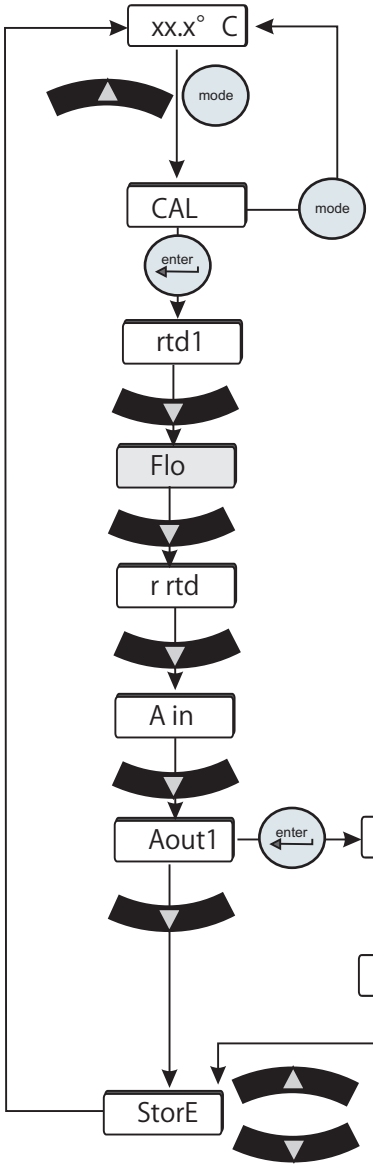
– The HMI will display 0.50/0.050/4.00. Use the arrow keys to adjust the display to match the applied input voltage/current. Allow the analog input to stabilize, approximately 10 seconds.

– Enter the measured reference voltage/current using the HMI by pressing the **enter** key. The firmware will use this value and the theoretical analog input value and those from the high end to calculate a linear gain and offset.

– If the gain and offset are acceptable, the calibration is accepted and the calibration is now valid at the low end. Otherwise, the calibration is rejected and a bad calibration error message is displayed.

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Analog Output Calibration



The analog output uses a 2-point calibration. Depending on how the analog output is configured Type1, Type2 or Type 3, the HMI will display either volts, millivolts or milliamps. The calibration procedure is:

– Start with default high and low endpoints each consisting of a voltage/current value and a theoretical DAC value. This will permit calibration of either point first. Both ends must be calibrated for the entire calibration to be valid.

– Connect a 9.50v/0.400mv/20.00ma reference voltage/current meter to the DAC output, pins 6 and 7.

– The HMI will display 9.50/0.0400/20.00. Use the arrow keys to adjust the output to match the display of 9.50v/0.400mv/20.00ma.

– Allow the DAC output and voltage reading to stabilize, approximately 10 seconds.

– Enter the measured reference voltage/current using the HMI by pressing the **enter** key. The firmware will use this value and the theoretical DAC value and those from the low end to calculate a linear gain and offset.

– The display will automatically go to the low calibration point.

– Use the arrow keys to adjust the output to match the displayed value. Allow the DAC output and voltage to stabilize, approximately 10 seconds .

– Enter the measured reference voltage/current using the HMI by pressing the **enter** key. The firmware will use this value and the theoretical DAC value and those from the high end to calculate a linear gain and offset.

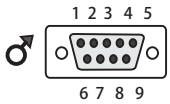
– If the gain and offset are acceptable, the calibration is accepted and the calibration is now valid at the low end. Otherwise, the calibration is rejected and a bad calibration error message is displayed.

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Remote Sensor Connector Pinout

Table 3

Pin	
1	White
2	NA
3	NA
4	White
5	NA
6	NA
7	Red
8	NA
9	Red (4th wire not connected to the control board)



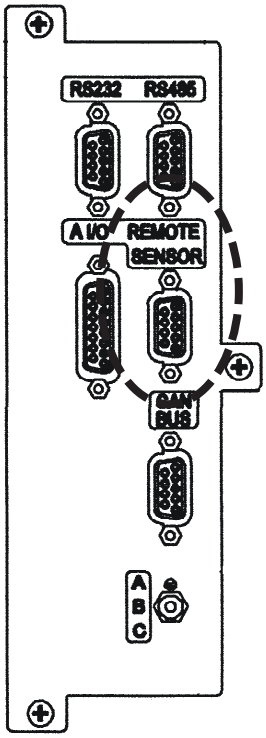
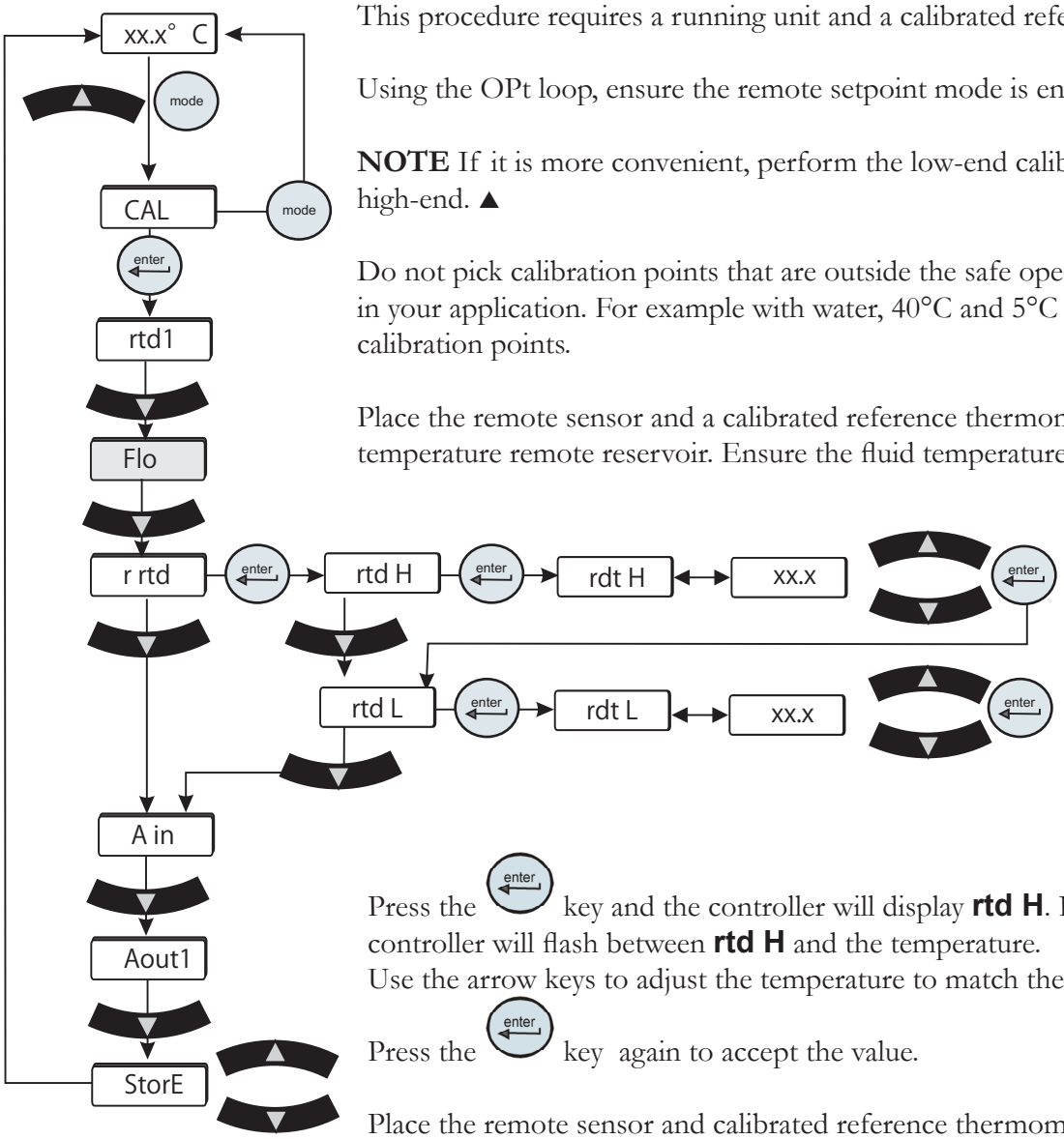


Figure C-2 Remote Sensor Connector

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Remote Sensor Calibration



This procedure requires a running unit and a calibrated reference thermometer.

Using the OPt loop, ensure the remote setpoint mode is enabled (rSEt)

NOTE If it is more convenient, perform the low-end calibration before doing the high-end. ▲

Do not pick calibration points that are outside the safe operating limits of the fluid in your application. For example with water, 40°C and 5°C are typical high and low calibration points.

Place the remote sensor and a calibrated reference thermometer in the high temperature remote reservoir. Ensure the fluid temperature is stabilized.

Press the enter key and the controller will display **rtd H**. Press enter again and the controller will flash between **rtd H** and the temperature.
Use the arrow keys to adjust the temperature to match the reference thermometer.

Press the enter key again to accept the value.

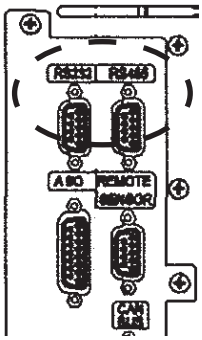
Place the remote sensor and calibrated reference thermometer in a low temperature reservoir. At the **rtd L** (low-end calibration) display repeat the procedure.

Press the down arrow key until **StorE** is displayed, press the up arrow to accept the calibration, press the down arrow key to abort it.

NOTE After pressing the up arrow button at the **StorE** prompt wait several seconds before proceeding to ensure that a bad calibration message (**Er 16**) does not appear. Premature use of the keypad after pressing may cancel the bad calibration error message. ▲

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Appendix D NC Serial Communications Protocol

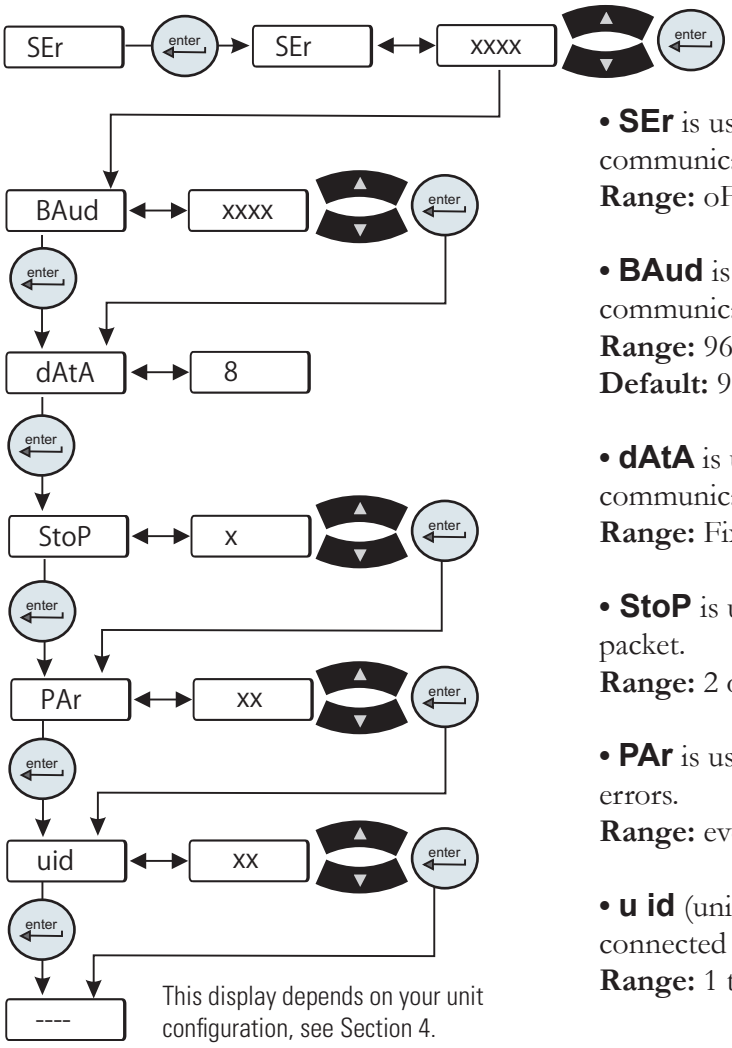


NOTE Appendix D assumes you have a basic understanding of communications protocols. ▲

Connect your PC to the applicable connector on the rear of the unit. Use the Setup Loop, see Section 4, to enable serial communications.

NOTE Once RS232 or RS485 is activated, all keypad operations are disabled except for turning the unit off and changing the serial communication's settings. ▲

Figure D-1 Connectors



This display depends on your unit configuration, see Section 4.

• **SEr** is used to enable/disable and to configure serial communications.
Range: oFF, rS232, rS485 **Default:** oFF

• **BAud** is used to select the speed rate for serial communications.
Range: 9600, 4800, 2400, 1200, 600, or 300 bits
Default: 9600

• **dAtA** is used to display the number of bits per communication.
Range: Fixed at 8

• **StoP** is used to indicate the end of the communication packet.
Range: 2 or 1 **Default:** 2

• **PAr** is used as a means to check for communication errors.
Range: even, odd, or none **Default:** none

• **u id** (unit id) is used in RS485 only. Identifies devices connected the the RS 485 port.
Range: 1 to 99 **Default:** 1

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All data is sent and received in binary form, do not use ASCII. In the following pages the binary data is represented in hexadecimal (hex) format.

The NC Serial Communications Protocol is based on a master-slave model. The master is a host computer, while the slave is the chiller's controller. Only the master can initiate a communications transaction (half-duplex). The slave ends the transaction by responding to the master's query. The protocol uses RS-232/RS-485 serial interface with the default parameters: 9600 baud, 8 data bits, 1 stop bit, and no parity. RS-485 offers a a slave address selection, default parameter: 1.

The unit can be controlled through your computer's serial port by using the unit's standard female 9-pin connection.

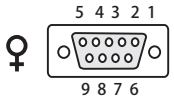
RS-232 COMM

Pin #	Function
1	No connection
2	TX
3	RX
4	No connection
5	GND = Signal ground
6	No connection
7	No connection
8	No connection
9	No connection

TX = Transmitted data from controller
RX = Received data to controller.

RS-485 COMM

Pin #	Function
1	No connection
2	No connection
3	No connection
4	No connection
5	No connection
6	No connection
7	No connection
8	T+
9	T-



Hardware **Mating Connector**
AMP Part# 745492-2 or equivalent

Communication cables are available from Thermo Fisher. Contact us for additional information.

All commands must be entered in the exact format shown in the tables on the following pages. The tables show all commands available, their format and responses. Controller responses are either the requested data or an error message. The controller response *must* be received before the host sends the next command.

The host sends a command embedded in a single communications packet, then waits for the controller's response. If the command is not understood or the checksums do not agree, the controller responds with an error command. Otherwise, the controller responds with the requested data. If the controller fails to respond within 1 second, the host should resend the command.

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NOTE All byte values are shown in hex, hex represents the binary values that must be sent to the chiller. **Do not use ASCII.**

The framing of the communications packet in both directions is:

	Checksum region						
Lead char OxCA/OxCC	Addr-MSB	Addr-LSB	Command	n d-bytes	d-byte 1 ...	d-byte n	Checksum

Lead char	**0xCA (RS-232) 0xCC (RS-485)**
	Device address is 1 (RS-232)
Addr-msb	Most significant byte of slave address (RS-232: 0)
Addr-lsb	Least significant byte of slave address (RS-232: 1)
Command	Command byte (see Table of Commands)
n d-bytes	Number of data bytes to follow
d-byte 1	1st data byte (the qualifier byte is considered a data byte)
...	...
d-byte n	nth data byte.
Checksum	Bitwise inversion of the 1 byte sum of bytes beginning with the most significant address byte and ending with the byte preceding the checksum. (To perform a bitwise inversion, "exclusive OR" the one byte sum with FF hex.)

When a command has no value associated with it (e.g. REQ ACK), "n d-bytes" will be set to 0. Values such as temperature and flow are sent as either 2 or 4 byte signed integers, depending on how they are stored in the controller RAM.

When the controller sends a value, a qualifier byte is sent first, followed by a 2 or 4 byte integer (the least significant byte is sent last). The qualifier indicates the precision and units of the value. The host does not send the qualifier byte; it must send the value using the correct precision, units and number of bytes. The host first inquires about a value it wants to change, then uses the number of data bytes and the qualifier byte it receives to generate the proper integer to send.

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Analog Values

*Qualifier Byte	
b.7 b.6 b.5 b.4	Precision of measurement
b.3 b.2 b.1 b.0	Unit of measure index

	Unit of Measure
Index	Unit
0	NONE
1	Temperature in °C
2	Temperature in °F
3	Flow liters per minute
4	Flow in gallons per minute
5	Time in seconds
6	Pressure in PSI
7	Pressure in bars
8	Resistivity in MW-cm

E.g., A qualifier byte of 0x12 indicated that the value contains one decimal point and the units are °F , i.e. 98.6°F.

Examples to set setpoint to 25°C:

A. The precision and units are 1°C; a 2 byte integer is used. If you already know this, skip to step 3.

1. Master sends: CA 00 01 70 00 8E (Request Setpoint 1)
2. Slave responds: CA 00 01 70 03 01 00 14 76 Precision =1, units =°C, value=20 (20 x 1°C=20°C)
   Response indicates:
   uses a 2 byte integer (nn=03)
   precision and units are 1°C (d1=01)
3. Master sends: CA 00 01 F0 02 00 19 F3 (Set Setpoint 1 to 25°C)
4. Slave responds: CA 00 01 F0 03 01 00 19 F1 Precision =1, units =°C, value=250 (250 x 1°C=25°C)

B. The precision and units are 0.1°C; a 2 byte integer is used. If you already know this, skip to step 3.

1. Master sends: CA 00 01 70 00 8E (REQ SETPOINT1)
2. Slave responds: CA 00 01 70 03 11 00 C8 B2 Precision =0.1, units =°C, value=200 (200 x 0.1°C=20.0°C)
   Response indicates:
   uses a 2 byte integer (nn=03)
   precision and units are 0.1°C (d1=11)
3. Master sends: CA 00 01 F0 02 00 FA 12 (Set Setpoint 1 to 25.0°C)
4. Slave responds: CA 00 01 F0 03 11 00 FA 00 Precision =0.1, units =°C, value=250 (250 x 0.1°C=25.0.0°C)

See Additional Command Examples in this Appendix.

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Table of Commands

Command	M: Master Sends S: Slave Responds	Notes
Request Status		
REQ ACK	M: lc a1 a2 **00** 00 cs S: lc a1 a2 **00** 02 v1 v2 cs	protocol version v1=0; v2=1
REQ UNIT SW VER	M: lc a1 a2 **02** 00 cs S: lc a1 a2 **02** nn d1 … dn cs	Unit SW version in ASCII
REQ DISPLAY MSG	M: lc a1 a2 **07** 00 cs S: lc a1 a2 **07** nn d1 … dn cs	Display message in ASCII
REQ STATUS	M: lc a1 a2 **09** 00 cs S: lc a1 a2 **09** nn d1 … dn cs	see Request Status Table in this Appendix
ERROR	M: S: lc a1 a2 **0F** 02 en ed cs	Response Only! ed = Error Data en = Error Number 1: Bad Command 2: Bad Data 3: Bad Checksum See Error in this Appendix
Request Measurements		
REQ FLOW1	M: lc a1 a2 **10** 00 cs S: lc a1 a2 **10** 03 d1 d2 d3 cs	Process Fluid Supply Pressure (P1)
REQ TEMP1	M: lc a1 a2 **20** 00 cs S: lc a1 a2 **20** 03 d1 d2 d3 cs	Process Fluid Supply Temperature (RTD1)
REQ TEMP2	M: lc a1 a2 **21** 00 cs S: lc a1 a2 **21** 03 d1 d2 d3 cs	Refrigeration Suction Temperature (RTD2)
REQ TEMP3 S: lc a1 a2 **22** 03 d1 d2 d3 cs	M: lc a1 a2 **22** 00 cs	Refrigeration Ambient Temperature (RTD3)
REQ ANALOG1	M: lc a1 a2 **28** 00 cs S: lc a1 a2 **28** 03 d1 d2 d3 cs	Process Fluid Supply Pressure (P1)
REQ ANALOG2	M: lc a1 a2 **29** 00 cs S: lc a1 a2 **29** 03 d1 d2 d3 cs	Refrigeration Suction Pressure (P2)

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Request Low Alarm Values

REQ LO FLOW1	M: lc a1 a2 **30** 00 cs S: lc a1 a2 **30** 03 d1 d2 d3 cs	Process Alarm
REQ LO TEMP1	M: lc a1 a2 **40** 00 cs S: lc a1 a2 **40** 03 d1 d2 d3 cs	Process Alarm
REQ LO ANALOG1	M: lc a1 a2 **48** 00 cs S: lc a1 a2 **48** 03 d1 d2 d3 cs	Pressure Process Supply Alarm

Request High Alarm Values

REQ HI FLOW1	M: lc a1 a2 **50** 00 cs S: lc a1 a2 **50** 03 d1 d2 d3 cs	Process Alarm
REQ HI TEMP1	M: lc a1 a2 **60** 00 cs S: lc a1 a2 **60** 03 d1 d2 d3 cs	Process Alarm
REQ HI ANALOG1	M: lc a1 a2 **68** 00 cs S: lc a1 a2 **68** 03 d1 d2 d3 cs	Pressure Process Supply Alarm

Request PID Settings

REQ SETPT1	M: lc a1 a2 **70** 00 cs S: lc a1 a2 **70** 03 d1 d2 d3 cs	Process Fluid Setpoint
REQ COOL P TERM1	M: lc a1 a2 **74** 00 cs S: lc a1 a2 **74** 03 d1 d2 d3 cs	
REQ COOL I TERM1	M: lc a1 a2 **75** 00 cs S: lc a1 a2 **75** 03 d1 d2 d3 cs	
REQ COOL D TERM1	M: lc a1 a2 **76** 00 cs S: lc a1 a2 **76** 03 d1 d2 d3 cs	

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Set Status Settings

SET KEYSTROKE	M: lc a1 a2 **80** 02 d1 d2 cs S: lc a1 a2 **80** 02 d1 d2 cs	See Keystroke in this Appendix
SET ON/OFF ARRAY	M: lc a1 a2 **81** nn d1 … dn cs S: lc a1 a2 **81** nn d1 … dn cs	See Set On/Off Array in this Appendix di: 0 = OFF, 1 = ON, 2 = no change
SET CALIBRATION	M: lc a1 a2 **82** 05 d1 … d5 cs S: lc a1 a2 **82** 07 d1 … d7 cs	See Calibration in this Appendix
SET COPY CALIBRATION S: lc a1 a2 **84** nn d1 d2 d3 cs	M: lc a1 a2 **84** 03 d1 d2 d3 cs	Copy calibration data between unit, backup and reset calibration memory. See Set Copy Calibration in this Appendix.

Set Low Alarm Values

SET LO FLOW1	M: lc a1 a2 **B0** 02 d1 d2 cs S: lc a1 a2 **B0** 03 d1 d2 d3 cs	Process Alarm
SET LO FLOW3	M: lc a1 a2 **B2** 02 d1 d2 cs S: lc a1 a2 **B2** 03 d1 d2 d3 cs	Process Fault
SET LO TEMP1	M: lc a1 a2 **C0** 02 d1 d2 cs S: lc a1 a2 **C0** 03 d1 d2 d3 cs	Process Alarm
SET LO ANALOG1	M: lc a1 a2 **C8** 02 d1 d2 cs S: lc a1 a2 **C8** 03 d1 d2 d3 cs	Pressure Process Supply Alarm

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SET High Alarm Values

SET HI FLOW1	M: lc a1 a2 **D0** 02 d1 d2 cs S: lc a1 a2 **D0** 03 d1 d2 d3 cs	Process Alarm
SET HI TEMP1	M: lc a1 a2 **E0** 02 d1 d2 cs S: lc a1 a2 **E0** 03 d1 d2 d3 cs	Process Alarm
SET HI ANALOG1	M: lc a1 a2 **E8** 02 d1 d2 cs S: lc a1 a2 **E8** 03 d1 d2 d3 cs	Pressure Process Supply Alarm
SET SETPT1	M: lc a1 a2 **F0** 02 d1 d2 cs S: lc a1 a2 **F0** 03 d1 d2 d3 cs	Process Fluid Setpoint

SET PID Settings

SET COOL P TERM1	M: lc a1 a2 **F4** 02 d1 d2 cs S: lc a1 a2 **F4** 03 d1 d2 d3 cs	Cool P Term
SET COOL I TERM1	M: lc a1 a2 **F5** 02 d1 d2 cs S: lc a1 a2 **F5** 03 d1 d2 d3 cs	Cool I Term
SET COOL D TERM1	M: lc a1 a2 **F6** 02 d1 d2 cs S: lc a1 a2 **F6** 03 d1 d2 d3 cs	Cool D term

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Request Status Table

Basic

nn	4	
	b0	Unit Running
	b1	RTD1 open or shorted
	b2	RTD2 open or shorted
d1	b3	RTD3 open or shorted
	b4	High Temp fixed fault
	b5	Low Temp fixed fault
	b6	High Temp fault or warn
	b7	Low Temp fault or warn
	b0	High Pressure fault or warn
	b1	Low Pressure fault or warn
	b2	Drip Pan fault
d2	b3	High Level fault
	b4	Phase Monitor fault
	b5	Motor Overload fault
	b6	LPC fault
	b7	HPC fault
	b0	External EMO fault
	b1	Local EMO fault
	b2	Low Flow fault
d3	b3	AutoRefill fault
	b4	Sense 5V fault
	b5	Invalid level fault
	b6	Low fixed flow warn
	b7	Low pressure fault (set at factory)
	b0	Low pressure fault (set at factory)
d4	b1	Unit powering up
	b2	Unit powering down

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Error

The slave detected an error in the message it received from the master, so it returns this command instead of echoing the command sent by the master. The slave returns the command it received from the master in the *ed* byte, and an error code in the *en* byte.

en	Error
1	Bad command – not recognized by slave
2	Bad data
3	Bad checksum

Some errors may not result in any response. The slave ignores incoming bytes until it sees the valid lead character and its slave address. Then it must receive the correct number of bytes (determined by the length byte) before it can respond. If an incomplete frame is received, the slave will timeout and clear its input buffer without responding.

Set On/Off Array

This command is used to set the state of various features of the unit, such as whether the unit is on or off, and whether the remote probe is enabled or disabled. The number of features and their position in the array is product specific. Sending a 0 in the array turns off or disables the feature while sending a 1 turns on or enables it. Sending a 2 does not change the state of the feature. In all cases, the array is returned showing the state of each feature after the command has been carried out. Sending all 2's effectively turns this command into a request status command.

nn	1
d1	Unit On/Off

Set Keystroke

This command is used to effect a keystroke remotely as if someone pressed the key on the HMI.

Value	
0	Null
1	Enter
2	Up/Yes
3	Down/No
4	Mode
5	On/Off
6	
7	

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Set Calibration

This command is used to do a two-point calibration. The command contains the identification of the item to calibrate (RTD1, ANALOG IN 2, etc.), whether it is the high or low point, and the entered calibration value. The controller takes the entered value and the current reading along with the entered value and reading at the other calibration point, and calculates calibration constants. If successful, the pass status byte and the new entered value are returned and the new calculated value matches the new entered value. Otherwise, the fail status byte and the old entered value are returned and the new calculated value matches the old entered value. The return message also includes a qualifier byte that indicates the unit of measure and number of decimal places in the entered value.

Master Sends: lc a1 a2 **82** 05 d1 d2 d3 d4 d5 cs

Slave Returns: lc a1 a2 **82** 07 d1 d2 d3 d4 d5 d6 d7 cs

Master

Byte		Notes
d1	Identifier Byte	Indicates the item to calibrate and whether it is the high or low point.
d2	Entered Value (m.s.b.)	The calculated value should match this after the calibration is complete. This is a 32 bit int which is the value x1000. For example, 20°C is d3 Entered Value represented by 20000.
d4	Entered Value	
d5	Entered Value (l.s.b.)	

Slave

Byte		Notes
d1	Identifier Byte	Indicates the item to calibrate and whether it is the high or low point.
d2	Pass / Fail Byte	0 = Fail; 1 = Pass
d3	Qualifier Byte	Appropriate units; precision=3
d4	Entered Value (m.s.b.)	Returns the most recently accepted calibration point. This is a 32 bit int which is the value x1000. For example, 20°C is represented by 20000.
d5	Entered Value	
d6	Entered Value	
d7	Entered Value (l.s.b.)	

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Identifier Byte

Bits	Notes
b.7 (m.s.b)	Low or High 0 = Low; 1 = High
b.6-b.0	7 bit ID:

00h	RTD1	Process
01h	RTD2	Suction
02h	RTD3	Ambient / Water
03h	RTD4	
04h	RTD5	
05h	RTD6	
06h	RTD7	
07h	RTD8	
10h	ANALOG IN 1	
11h	ANALOG IN 2	
12h	ANALOG IN 3	
13h	ANALOG IN 4	
14h	ANALOG IN 5	
15h	ANALOG IN 6	
16h	ANALOG IN 7	
17h	ANALOG IN 8	
18h	RESISTIVITY 1	
19h	RESISTIVITY 2	
20h	FLOW1	
21h	FLOW2	
30h	ANALOG IN 9	
31h	ANALOG IN 10	
32h	ANALOG IN 11	
33h	ANALOG IN 12	
38h	ANALOG OUT 1	
39h	ANALOG OUT 2	

Example: Calibrate the low point of RTD2 at 20°C using RS-232.

Master Sends: CA 00 01 **82** 05 01 00 00 4E 20 08

Slave Returns: CA 00 01 **82** 07 01 01 31 00 00 4E 20 D4

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Set Analog Out Cal

This command is used to do a two-point calibration of the analog output.

Master Sends: lc a1 a2 **83** 06 d1 d2 d3 d4 d5 d6 cs

Slave Returns: lc a1 a2 **83** 01 d1 cs

Byte	Master	Slave
d1	ID (1 = ANALOG_OUT1)	Status (1=OK)
d2	MODE see table below	
d3	Entered Value MSB	
d4	Entered Value	
d5	Entered Value	
d6	Entered Value LSB	

MODE	Function	Entered Value
0	Exit	-
1	Set output to high point voltage	-
2	Enter actual high point voltage	Volts x10000
3	Set output to low point voltage	-
4	Enter actual low point voltage	Volts x10000
5	Calibrate	-
6	Set output to mid point voltage	-

Procedure:

– Use mode 1 to set the output to the high point voltage (10V). Use the previous calibration to calculate the DAC value for 10V.

– After the output settles, read it and use mode 2 to send the actual voltage x10000 to the controller.

– Use mode 3 to set the output to the low point voltage (0V). Use the previous calibration to calculate the DAC value for 0V.

– After the output settles, read it and use mode 4 to send the actual voltage x10000 to the controller.

– Use mode 5 to calculate the new calibration constants. The calibration uses the entered voltages and the actual DAC values to calculate the new calibration parameters.

– Use modes 1, 3 and 6 to set the output to 0V, 5V and 10V respectively to check the calibration.

– Exit Analog Output Calibration using mode 0.

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Set Copy Calibration

This command is used to copy calibration parameters from one location to another. The source and destination must be different. Use the 7 bit Identifier Byte from the SET CALIBRATION command.

d1	Source	0=Reset; 1=Backup; 2=Unit
d2	Destination	
d3	Calibration ID	See 7 bit Identifier Byte from SET CALIBRATION command.

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