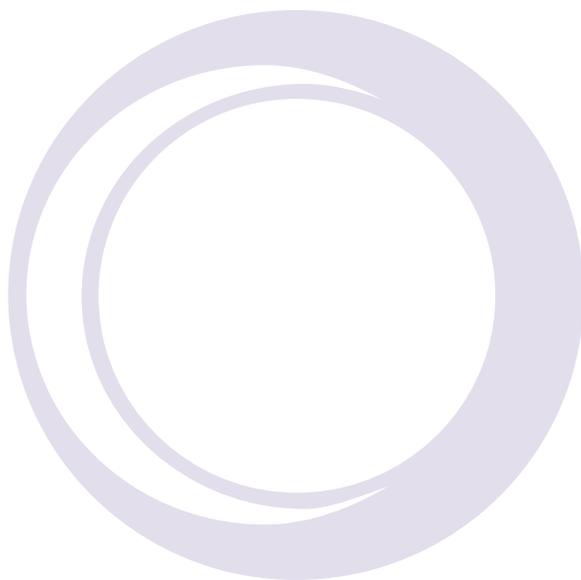


Users Manual

Model 2200

Automatic Cryopump Controller



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Revision History

Date	Revision	Description
August 2006	1.0.1	Conversion to new format.

Preface

1

1.1 About Austin Scientific

Austin Scientific, a wholly-owned subsidiary of Oxford Instruments, specializes in the manufacture and repair of cryogenic vacuum pumps, cryocoolers (refrigerators) and helium compressors for semiconductor, optical coating, linear accelerators, medical equipment, and R&D applications.

You can find just what you need from our range of products and support services.

- New equipment - cryopumps, compressors, cryocoolers, and cryopump controllers such as the Model 2200E Automatic Cryopump Controller described in this manual.
- Comprehensive range of accessories for the installation of whole systems and a complete range of spare parts to repair cryopumps and compressors.

1.2 Other Services from Austin Scientific

Austin Scientific offers a broad range of additional services:

- *Repair and refurbishment services* - Whatever brand of cryo-components you have, we offer fully warranted refurbishment, often with off-the-shelf availability.
- *Exchanges* - We offer our own quality products, as well as most makes of cryopumps and helium compressors, which are refurbished and fully warranted.
- *Technical Support* - Our support engineers will help determine if your cryopump system is operating correctly so that you can get your system back to optimum efficiency as soon as possible.

To contact Austin Scientific Technical Support:

Email: support@austinscientific.com

- Telephone: 1-512-441-9258 or Toll Free: 1-800-404-1055
- *Installation* - On-site installation services are available to guarantee performance and save you time.
- *Training* - We offer on-site training to help you and your staff to know more about your cryopump and compressor systems. Our training will give you confidence and the ability to maintain a highest possible uptime for your system.

1.3 About this Manual

The purpose of this manual is to provide our customers using the Model 2200E Automatic Cryopump Controller with the information needed to safely and efficiently operate the controller when operating as part of a cryogenic refrigeration system. Such a system is often comprised of the following equipment:

- Helium compressor such as the Austin Scientific Model 600, Model 125 and compatibles.

- Cryopump such as the Austin Scientific Cryo-Plex 8/8LP, Cryo-Plex 10, Cryo-Plex 16 and compatibles.
- Connecting Helium lines.
- Model 2200E Automatic Cryopump Controller

This manual describes the design, operation and maintenance of the Model 2200E Automatic Cryopump Controller.

1.4 Compatibility

The Model 2200E Automatic Cryopump Controller is designed for use with Austin Scientific Cryo-Plex series of cryopumps (or equivalent).

Safety Warnings

2

2.1 Safety Warnings

The following safety warnings must be observed during the operation of the Model 2200E Automatic Cryopump Controller:

- Warning:** High voltage is present inside the system and at the rear outlets. Do not connect power to the system until all wiring is complete. If DIP switches are to be changed, do so with the power cord removed.
- Warning:** Never make any connections or disconnections to the model 2200E automatic cryopump control when power is present to this unit or other unit connected in any way to the Model 2200E Automatic Cryopump Controller.
- Warning:** J2 and J3 on the back panel of the Model 2200E Automatic Cryopump Controller has high voltage capable of causing injury or death.
- Warning:** The mating connector to J3 on the Model 2200E may have high voltage from the control unit of the cryopump even if no power is present on the Model 2200E Automatic Cryopump Controller.

2.2 Operator Instructions

Follow standard Model 2200E operating procedures as described in this manual. If after reading this manual, you still have questions regarding the safe operation of the Model 2200E Automatic Cryopump Controller, please contact Austin Scientific Technical Support using the contact information found in [Chapter 1, Section 1.2](#).

Introduction

3

3.1 General Information about the Model 2200E Controller

Since cryopumps are capture type pumps, they must be periodically warmed up and evacuated in order to remove the accumulated condensed and adsorbed gases. The process of warming up and evacuating gases from a cryopump is called regeneration. The Austin Scientific Model 2200E Automatic Cryopump Controller continuously monitors cold head temperature and pressure, and while the system is running in the Auto Mode, regeneration is automatically initiated whenever set points are exceeded.

Figure 3-1. Model 2200E



3.2 Features

All set points are adjustable from the Model 2200E front panel via touch pad.

- *LCD Display* is used instead of analog meters. A two lines by 16 characters LCD Display is used to give you more information and with more reliability than with analog meters.
- *Security* by requiring a *Password Number* that needs to be entered through the front panel before the *Clock*, *Setpoints*, *Regen Schedule* and *Regen* can be adjusted or initialized. You may also bypass this feature if you wish.
- *Scheduled Regeneration* by entering the day number, hour and minutes.
- *Regen Data History* of 10 regen cycles is stored in memory and recalled on the display when you wish to view and compare it to other regens.
- *Automatic recovery* after brief power outage.
- *Two Temperature Readings*. For cryopumps with two cold head diodes. Both diodes can be monitored at the same time.
- *Two heater controls* for cryopump regeneration process

- *Remote Compressor Relay* allows you to control a compressor from a central location.
- *Outputs* indicating the cold temperature has been reached and Regeneration is in process.
- *Zeroing capability* for calibrating thermal couple readings in high vacuum environment.

3.3 Specifications

The Model 2200E Automatic Cryopump Controller Specifications are listed in [Table 3-1](#).

Table 3-1. Model 2200E Controller Specifications

Feature/Component	Specification Description
Thermocouple vacuum gauge	DV6-TYPE (Model 2200E has two adjustable pressure set point).
Temperature diode	Silicon diode-type (Model 2200E has four adjustable temperature set points that can be used on a two-stage cryopump).
Status indication	Model 2200E top line on the display is used to display the cold head temperature and pressure. The bottom line of the displays is used to display the status in progress.
Outputs	Roughing Pump Relay - 1 Amp. @ 120/240 VAC Cryopump Relay - 1 Amp. @ 120V/240 VAC Purge Valve Relay - 1Amp. @ 120/240 VAC Roughing Valve Relay - 1 Amp @ 120/240 VAC Heater 1 and 2 - 500 Watts max. each
Relay Contacts	Cold Relay and Compressor Remote Relay both have N.O. and N.C. contacts rated at 5 Amps.
Input Power	120/240 VAC 50/60 Hz
Physical Dimensions	Height 3.5 in. (8.9 cm), Width 19 in. (48.3 cm), Depth 7.3 in. (18.5 cm).

3.4 Standard Equipment and Accessories

The Model 2200E Controller is shipped with the following components:

- Model 2200E Automatic Cryopump Controller
- Thermocouple cable, 10 ft. (3 m) (P/N 10341)
- Dual temperature diode cable, 10 ft. (3 m) (P/N 10348)
- AC power cord 6 ft.
- This manual

3.4.1 Optional Accessories

The customer can order the following optional accessories:

- Single relay contact in NEMA enclosure 30A, 3 poles for compressor or mechanical pump controller (P/N 55057)
- Purge gas valve (115 VAC - P/N 10185; 220 VAC - P/N 99-00006-220)
- Purge gas valve (24 VAC - P/N 99-00006-024; 24 VDC - P/N 99-00038-024)
- Purge gas heater (120 VAC - P/N 10340; 220 VAC - P/N 99-00007-220)
- Blanket heater [P/N BH- (size of cryopump flange)]
- Thermocouple gauge tube:
 - P/N TGT-6000-NTP
 - P/N TGT-6000-VCR
- Dual diode cable 10 ft. (P/N 10348)

Installation

4

4.1 Safety Warnings

Review the safety warnings found in [Chapter 2](#), before starting any installation activities.

Figure 4-1. Electrical Connections Schematics (Larger Print at the End of This Manual)

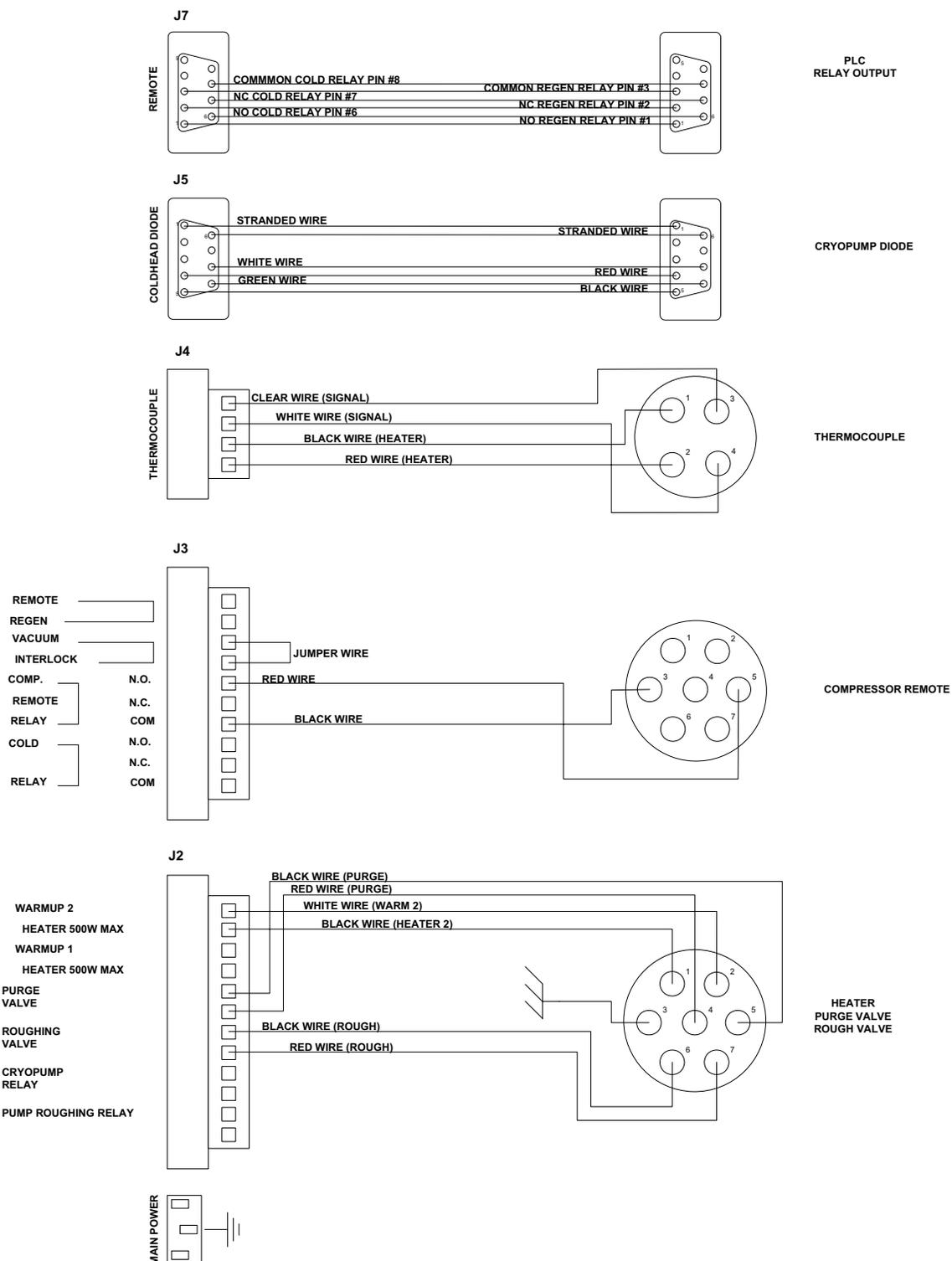
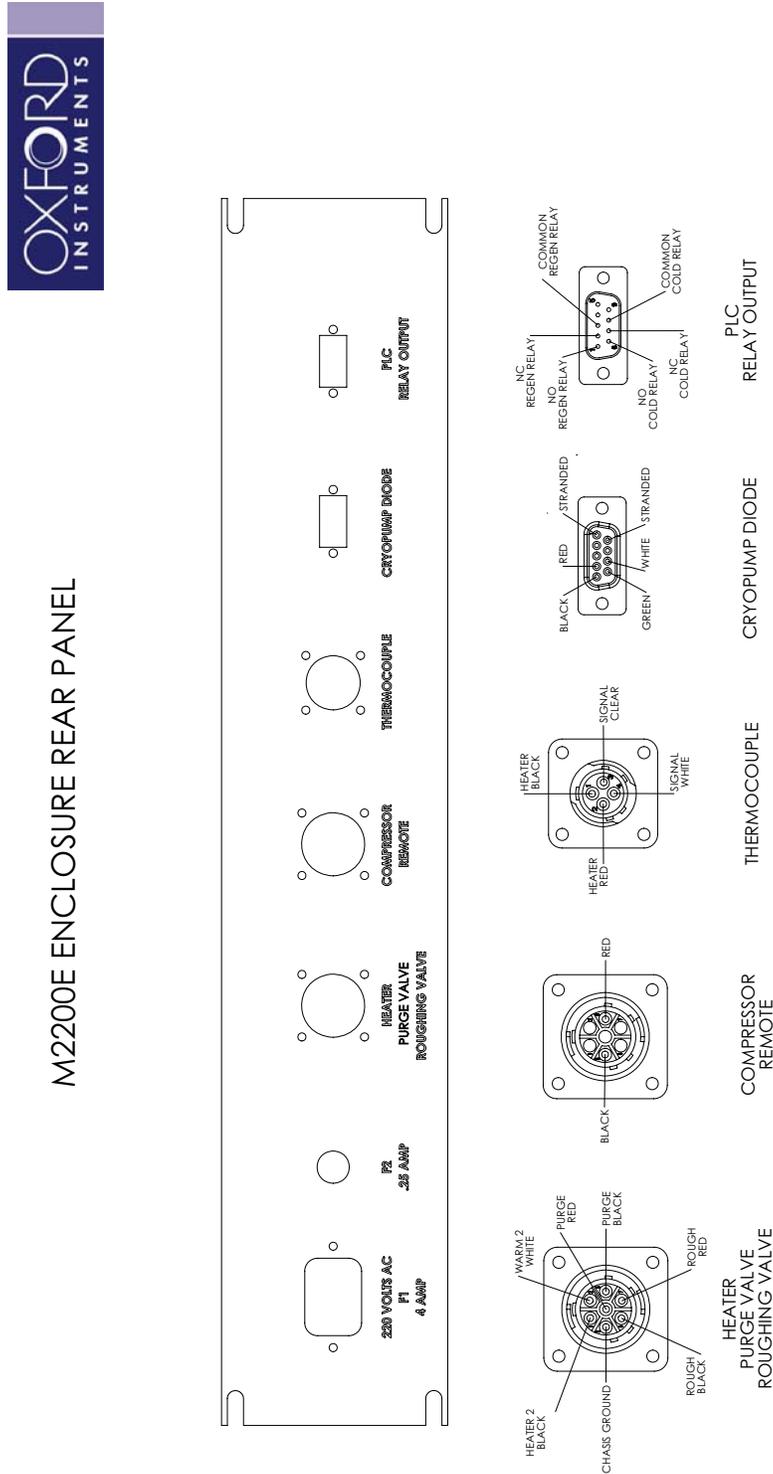


Figure 4-2. Model 2200E Enclosure Rear Panel (Larger Print at the End of This Manual)



4.2 Configuring the 2200E Controller

Electrical connections are to be made in accordance with the diagrams shown in [Figure 4-1](#) and [Figure 4-2](#).

4.2.1 Thermocouple Calibration

To zero calibrate the thermocouple, it must be under high vacuum and then adjusted to read 0 micron.

Remove the top cover from the Model 2200E (see [Figure 4-4](#)) and set S2-4 to on. Setting the switches to On will allow the pressure reading to go to Zero and not reading HIVAC. Adjust the Thermocouple pot located next to J4 on the rear of the controller ¼ of a turn (maximum) and wait 10 seconds for the reading to stabilize. Repeat the same adjustment process until the meter reads 0. Then turn S2-4 back to Off and put the cover back on the model 2200E.

4.2.2 DIP Switch Settings

Password Number is set by S1 located inside the Model 2200E. If any of the four switches on S1 are on, then this *Password Number* must be entered by pressing the *Regen* or *Menu* key (*Regen Date*, *Regen Hour*, *Regen Minutes*, all *Clock* functions, all *Temp Setpoints* and all *Press Setpoints*) and by using the *Up* or *Down* keys. If all four switches on S1 are off then no *Password Number* is required to start any function listed above.

A *Password Number* equals the sum value of S1-1 to S1-4. For example a *Password Number* of 14 would require S1-2, S1-3 and S1-4 to be on ($2+4+8 = 14$).

Program Settings are set by using the S1-1 to S1-4 dip switches located inside the Model 2200E. See [Table 4-1](#) for the description of each dip switch setting.

Table 4-1. Model 2200E DIP Switch Settings

Switch	Off	On
S2-1	1 second CP on delay	10 second CP on delay
S2-2	One Stage Cryopump	Two-Stage Cryopump
S2-3	Not used	Not used
S2-4	T.C. Reads HIVAC < 6 mTORR	T.C. Zero Calibrate
S2-5	Roughing Pump On	Roughing Pump Auto
S2-6	Not Used	Not Used
S2-7	Not Used	Not Used

4.2.3 Coldhead Diodes 1 or 2

Apply a jumper on J7 (inside MODEL 2200E) A and B for a two-diode Cryopump. Apply a jumper on J7 B and C for a one-diode Cryopump.

Note: J7 jumper must be properly set to get correct temperature readings.

Operations and Controls

5

5.1 Model 2200E Basic Operations

The Model 2200E Automatic Cryopump Controller supports the following basic functionality:

- Controls cryopump regeneration activities

5.1.1 Regeneration Activities

Since cryopumps are capture type pumps, they must be periodically warmed up and evacuated in order to remove the accumulated condensed and adsorbed gases. The process of warming up and evacuating gases from a cryopump is called regeneration. The Austin Scientific Model 2200E Automatic Cryopump Controller continuously monitors cold head temperature and pressure, and while the system is running in the Auto Mode, regeneration is automatically initiated whenever set points are exceeded.

The *Mode Select Regen* key on the front panel can also initiate *Regeneration*. If S1 has one or more of its four switches set at the ON position then you must enter a number on the display to match the binary number set by S1 before regen can start. Regeneration can also be initiated by a remote contact closure of two pins on J3 labeled *Remote Regen* on the back panel of the Model 2200E. You can also do a *Schedule Regen* by pressing the *Menu* key and then entering the *Regen Date*, *Hour* and *Minutes* with the up and down keys.

The *Warm-Up* period of a cryopump regeneration process can vary considerably depending on the vapors collected and the warm-up method used. The Model 2200E Automatic Cryopump Controller provides power to operate a purge gas valve, a purge gas heater and external heater blanket to help with the warm-up process. The Warm-Up period terminates when the cold head temperature reaches *Temp Setpoint 3* (usually 290K) and at this point the evacuation of the cold head starts (ROUGH VALVE opens).

In order to optimize the evacuation phase of the regeneration, Model 2200E uses a Rate of Rise criteria (the default is 10 micron/min.) to determine when water vapor trapped in the charcoal adsorbent has been sufficiently released to permit a successful cool-down of the cryopump. To evacuate the cold head, the rough valve open until *Press Setpoint 1* (usually 50 microns) is reached and then it closes. At this point the display on the Model 2200 will read *Test Vac* indicating the "pressure rise" criteria. At the end of one minute, if the "Rate of Rise" criteria is not satisfied then the rough valve will open and close again for up to 20 such attempts. If the rate of rise passes the user defined criteria (default is 10 micron/min.), the cryopump turns on automatically and starts to cool down. If the Rate of Rise test fails 20 times, the 2200E will display the message "Regeneration Failed". This usually indicates that either there is a vacuum leak within the system or the cryopump needs service.

The Model 2200E can recover automatically from a brief power outage during a regeneration process.

5.2 Model 2200E Controller's Hardware Interface

The following sections describe the interfaces used to configure and operate the Model 2200E Automatic Cryopump Controller.

5.2.1 Front Panel Switches And Functions

Main Power Switch, switches power to the Model 2200E Automatic Cryopump Controller and all active outputs on the rear panel. The Model 2200E always starts in the *Auto Mode* when power is turned on, therefore if a power failure occurs the Model 2200E will re-start in the *Auto Mode* once the power is restored.

Mode Select determines the three operating modes of the Model 2200E Automatic Cryopump Controller, which are *CP On*, *Auto* and *Regen*.

The *CP On Mode* forces the *CP On* relay, *Cold* relay and *Compressor Remote* relay to turn on under any condition. *CP On* and *Cold* will appear on the bottom line of the display. Note a yellow LED indicates the system is operating in an unprotected mode (*CP On*). *Regen* will flash on and off on the bottom line of the display whenever the *Temp 2* set point is exceeded. The flashing *Regen* on the display indicates that the system is in a condition outside normal operating parameters but it will not go into *Regen* because the system is in the *CP On Mode*.

Note: The *CP On* relay and *Compressor Remote* relay turn on at the same time.

The *Auto Mode* will sequence the Model 2200E until the *CP On* relay, *Compressor Remote* relay and then the *Cold* relay are all turned on. Once the *CP On* relay and *Cold* relay are on, regeneration is automatically initiated if *Temp 2* set point is exceeded. (In the *Auto Mode*, regeneration may also be initiated by momentarily shorting across J3 *Remote Regen* pins on the rear panel.)

Note: A green LED is used for the *Auto Mode* to indicate the system is operating in a safe protected condition. Also from a distance a user will be able to tell what *Mode* the system is in by the color of the LED.

The *Regen Mode* places the Model 2200E into an automatically controlled regen cycle. *Regen* will flash on the display until the end of the regen cycle, which will occur when the *CP ON* appears on the display. If the *Regen Dip Switch* inside the MODEL 2200E has any of the 4 switches set to on, then every time the *Regen Mode* switch is pressed the display will require a number to be entered with the *Up* or *Down* key until the correct password number is entered (see [Section 4.2.2](#) for how to set *Password Numbers*).

Note: A red LED is used to indicate that the system is operating in the *Regen Mode*.

Menu, *Up*, *Down* and *Data Regen* keys allow you to input and view data on the display. The function of these switches will be explained in detail under the Display section.

5.2.2 Purge Time

This function allows you to continue to purge and heat the cryopump after the *Temp 3* set point is reached. It is also the purge time used when the controller is powered on.

Press the *Menu* key until "*Set: Purge Time*" appears, then press the *Up* key until the desired time (in minutes) to extend the purge is selected.



After *Temp 3* setpoint is reached, the Purge Valve will remain on for the time duration set under “*Set: Purge Time*”, and the heater 2 will turn on if the temperature goes below *Temp 3* setpoint. Heater 2 will turn off if the temperature goes above *Temp 3* setpoint.

5.2.3 LCD Display - Normal Operating Condition

TEMP 2 TEMP1 mTORR

15K	50K	HIVAC
CP ON	COLD	

The top line of the display reads TEMP 2 (cold head temperature Stage 2), TEMP 1 (cold head temperature stage 1) and mTORR (cold head pressure). If a cryopump has only one cold head diode then the middle TEMP 1 will be blank. (Do not confuse the words above the display TEMP 2 and TEMP 1 with the temperature set points *Temp 1*, *Temp 2* and *Temp 3* that appear on the MENU display.)

The bottom line of the display will show the system status such as *Warmup*, *Rough*, *CP On*, *Cold*, *Regen*, *Test Vac*, *Standby*, *Vac Intlk*.

Once the "MENU" or "DATA REGEN" key is pressed then the top and bottom lines are used for displaying MENU functions or DATA REGEN (HISTORY) information that you can either view or enter new parameters with the UP or DOWN keys.

5.2.4 LCD Display - Menu Functions

The *Menu* key will scroll or step through the following 16 displays when pressed continuously or pressed and then released.

1. REGEN DATE

REGEN	DATE
NO	17:30

Note: If the message "NO" appears on the display, this indicates that no date number has been entered. Press the *Up* or *Down* key to enter a date. The user can enter parameters in the remaining 15 displays via the front display panel.

2. REGEN HOURS

REGEN	DATE
13:00	

Press the *Up* or *Down* key to set the REGEN HOUR.

3. REGEN MINUTES

REGEN DATE 13:27

Press the *Up* or *Down* key to set the REGEN MINUTES.

4. TEMP SETPOINT 1

REGEN DATE 25 Kelvin

Press the *Up* or *Down* key to set the TEMP SETPOINT 1.

5. TEMP SETPOINT 2

REGEN DATE 40 Kelvin

Press the *Up* or *Down* key to set the TEMP SETPOINT 2.

6. TEMP SETPOINT 3

REGEN DATE 290 Kelvin

Press the *Up* or *Down* key to set the TEMP SETPOINT 3.

7. TEMP SETPOINT 4

REGEN DATE 60 Kelvin

Press the *Up* or *Down* key to set the TEMP SETPOINT 4. This setpoint controls the stage 1 heater on the cryopump.

8. PURGE TIME

SET PURGE TIME 30 minutes

Press the *Up* or *Down* key to set the PURGE TIME.

9. RATE OF RISES

RATE OF RISE 10 u/minute

Press the *Up* or *Down* key to set the RATE OF RISE.

10. PRESS SETPOINT 1

PRESS SETPOINT 1 50 microns

Press the *Up* or *Down* key to set the PRESSURE SETPOINT 1.

11. PRESS SETPOINT 2

PRESS SETPOINT 2 microns

This setpoint is not used.

12. TIME: HOURS

SET: HOURS 19:59 27-MAR-06

Press the *Up* or *Down* key to set the HOURS.

13. TIME: MINUTES

SET: MINUTES 19:59 27-MAR-06

Press the *Up* or *Down* key to set the MINUTES.

14. TIME: DAY

SET: DAY 19:59 27-MAR-06

Press the *Up* or *Down* key to set the DAY.



15. TIME: MONTH

SET: MONTH 19:59 27-MAR-06

Press the *Up* or *Down* key to set the MONTH.

16. TIME: YEAR

SET: YEAR 19:59 27-MAR-06

Press the *Up* or *Down* key to set the YEAR.

5.2.5 Display Status Conditions

Status conditions appear on the bottom line of the display as listed below.

5.2.5.1 WARMUP Status

The *WARMUP* status indicates that the cryopump is in the regeneration period, during this time the *Warm-Up* relay is on and this gives power to J2 pins labeled *Purge Valve* and *Heater # 2* on the back panel [120 VAC or 240 VAC].

5.2.5.2 ROUGH Status

The *ROUGH* status indicates that the *Rough Valve* relay is on and this gives power to J2 pins labeled *Roughing Valve* on the back panel [120VAC or 240VAC].

5.2.5.3 CP ON Status

The *CP ON* status indicates that the Cryopump relay is on, which provides power to J2 pins labeled the *Cryopump Relay* on the back panel [120VAC or 240VAC].

5.2.5.4 COLD Status

The *COLD* status indicates that the cryopump temperature is below *TEMP 1* setpoint (usually 20 Kelvin) and the *Cold Relay* is on. J3 pins labeled *Cold Relay* (COM, N.O. and N.C.) on the back panel can be used for a system ready interlock.

5.2.5.5 REGEN Status

The *REGEN* Status indicates the initiation of a *REGEN* cycle or a warning that the system is outside its set operating set points. If the system is in *CP ON* mode and the *REGEN* status is flashing, this will not start a *REGEN* cycle. But the *REGEN* status does warn the user that the temperature or pressure (or both) are not within the set points.



5.2.5.6 PUMP Status

The *PUMP* status indicates that the *Pump Roughing* relay is on and there is power on the *Pump Roughing Relay* terminals on the back panel [120VAC or 240VAC]. *PUMP* may not appear on the display if other information needs to be displayed. But, in any case the *Pump Roughing Relay* on the back panel will have power if the *Pump Roughing Relay* is on. If the dip switch S2-5 is in the off position then the *Pump Roughing Relay* will automatically turn on and off, but if S2-5 is in the on position then the *Pump Roughing Relay* will always be on as long as the Model 2200E has power.

5.2.5.7 TEST VAC Status

The *TEST VAC* status indicates that the *Roughing Pressure* is in a one-minute *pressure rise criteria* test mode.

5.2.5.8 STANDBY STATUS

The *STANDBY* status indicates the M2200E is in a power up mode. During this period the *Mode Switch* is ignored and all outputs are disabled for 1 or 10 seconds depending on the setting of S2-1 (OFF=1sec., ON=10sec.).

5.2.5.9 VACINTLK Status

The *VACINTLK* status indicates that the vacuum interlock is not closed. The vacuum interlock signal could be from a switch on the gate valve. A jumper across J3 *VAC INTLK* on the back panel will bypass this vacuum interlock safety feature.

5.2.5.10 Display REGEN DATA

The *REGEN DATA* key, when pressed, will display the history of up to 10 *REGEN* cycles. This information allows you to compare *REGEN* data from the last regeneration process to one from 6 or 9 month or even a year ago depending on how often the regeneration process was performed. With this information you will know if the cryopump needs to be serviced. Austin Scientific can service not only the cryopumps but also compressors that are used to run the cryopumps.

The *DATA REGEN* key, when pressed, will make the display look like this if there is any regen history stored is in memory.

<p>HIST: 19-JAN-06</p> <p>02:15 01:30 10K</p>

The information fields displayed are:

- *HIST: 19-JAN-06* on the display indicates the date when the *REGEN* took place.
- *02:15* is the time from the initiation of *REGEN* until the *CP ON* turns on (warm-up and evacuation time).
- *01:30* is the time from *CP ON* until the *COLD* relay turns on (cooldown time).
- *10K* is the temperature 30 minutes after the *COLD* turns on (base temperature).

The *Up* and *Down* keys allow you to scroll or step through the complete regeneration history stored in M2200E controller.

5.2.6 Setpoints

All set points are entered through the front panel keys. DO NOT ADJUST ANY POTENTIOMETERS INSIDE THE CONTROLLER UNIT.

All set points are pre-set but they may be changed by pressing the *MENU* key until the display shows the set point desired.

- *TEMP SETPOINT 1* is set at 20K (default value at turn-on) but can be adjusted from 15K to 30K. *TEMP SETPOINT 1* is the temperature below which the COLD relay is energized during cool down.
- *TEMP SETPOINT 2* is set at 40K but can be adjusted from 30K to 50K. *TEMP SETPOINT 2* sets the point above which the regeneration cycle is initiated when the Cryopump is cold and then the temperature goes above this set point.
- *TEMP SETPOINT 3* is set at 290K but can be adjusted from 280K to 300K. *TEMP SETPOINT 3* determines the point above which the PURGE VALVE and HEATER #2 turn off and evacuation begin (ROUGH VALVE turns on).
- *TEMP SETPOINT 4* is adjustable from 0 to 60K. *TEMP SETPOINT 4* determines when the heater on the first stage cryopump turns on. If the TEMP 1 temperature goes below *TEMP SETPOINT 4* then the first stage heater will turn on until the temperature goes above *TEMP SETPOINT 4*.
- *PRESS SETPOINT 1* is set at 50 microns but it can be adjusted from 50 to 100 microns. *PRESS SETPOINT 1* determines the point below which the ROUGH VALVE closes during evacuation in a regeneration process.
- *PRESS SETPOINT 2* is currently not used.
- *SET PURGE TIME* is set at 30 minutes but can be adjusted from 0 to 120 minutes. SET
- *PURGE TIME* sets the amount of purge time that is used for the initial purge time.
- *RATE OF RISE (ROR)* is set at 10 (micron/minute) but can be adjusted from 10 to 99. Rate of rise is the value used to determine if the regeneration process was adequate.

Troubleshooting

6

6.1 Diagnosis Activities

Table 6-1 describes some problems that users might encounter while operating the Model 2200E Automatic Cryopump Controller and provides solutions to those problems.

Table 6-1. Troubleshooting Procedures

Problem	Possible Cause	Corrective Action
One or both temperatures reads 10K at room temperature	Diode Cable Disconnected	a. Check diode cable connection at rear of 2200E b. Check diode connection at cryopump
Unit fails to end extended purge	Room temperature below Temperature Setpoint 3	Lower Temperature Setpoint 3 to below room temperature.
Unit will not reach HIVAC	Poor vacuum	Check for pump, gate valve, or chamber leaks
Controller only displays 1 Temperature reading	Dip switch not set correctly	Set S2-2 to ON
Reading atmospheric pressure all the time	Rough valve open Leaky gate valve	Close rough valve Leak check gate valve