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CRYOMED MODEL 1010 - OPERATING INSTRUCTIONS

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SECTION I
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INTRODUCTION

This manual provides descriptive information, operation and service instructions for the Model 1010 Micro Computer Programmable Freezing Controller, as shown in Figure 1-1. The controller is manufactured by CryoMed, a Stremikon Subsidiary, New Baltimore, MI 48047.

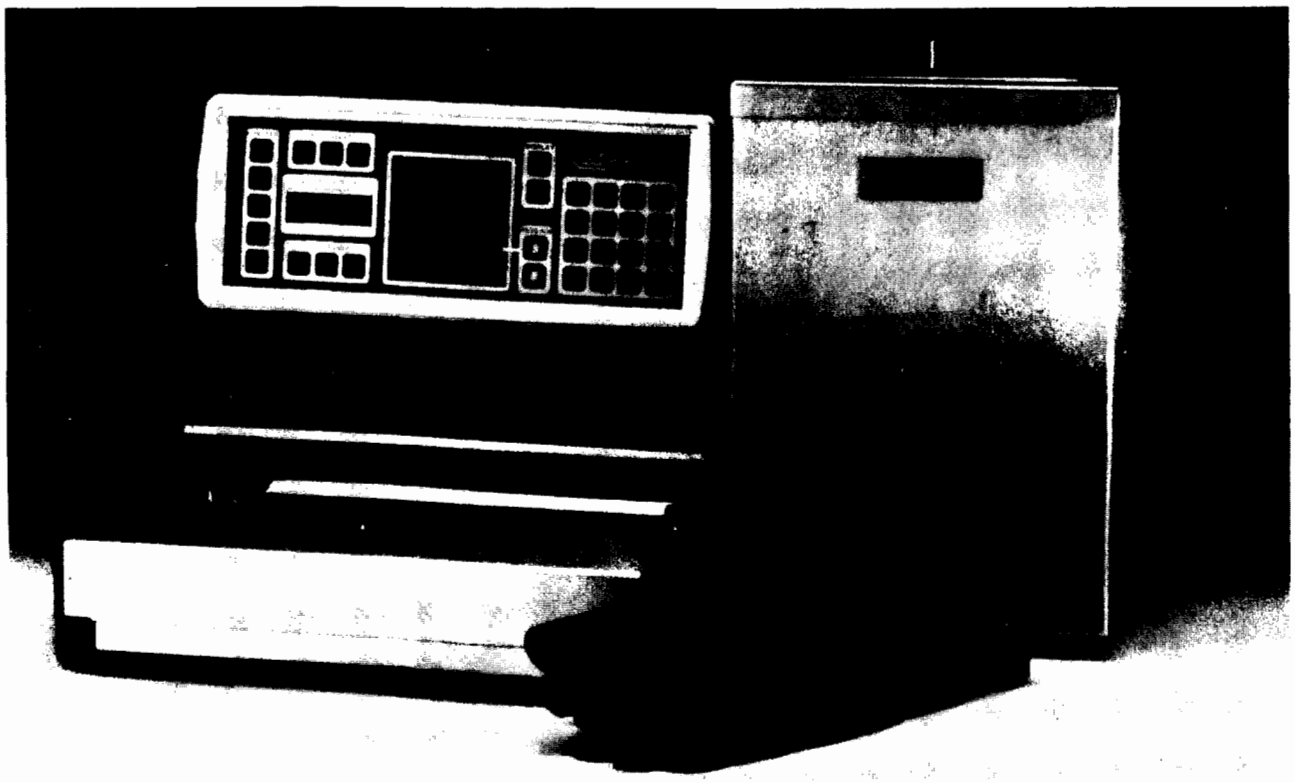


Figure 1-1. Model 1010 Micro Computer Programmable Freezing Controller shown with Model 6100 Strip Chart Recorder and Model 910C Freezing Chamber

FUNCTIONAL DESCRIPTION

The Model 1010 Micro Computer Programmable Freezing Controller is a selfcontained electronic device designed to control the cooling rate of the chamber so the specimen will follow the environment in the freezing chamber. The programmable feature of the controller enables this device to uniformly control sample cooling, at a preprogrammed rate, until the sample has frozen solid. At this point, the temperature can be rapidly dropped without affecting stability of the sample. The Model 1010 Micro Computer Controller is used in conjunction with a strip chart recorder and a freezing chamber.

SPECIFICATIONS FOR MODEL 1010 CONTROLLER

Dimensional Data:

Height	6	Inches
Width	14 1/2	Inches
Depth	10	Inches

Recommended Clearances:

Front	24	Inches
Rear	6	Inches
Side	2	Inches

Services Required:

Electrical	105-125 VAC at 50/60 Hz Standard three-prong grounded receptacle
Fuse	2 Amp (1 required)

Environmental Requirements:

Ambient Temperature Limits 60-110°F (16-43 C)

Area of Use:

Non-hazardous, sheltered, well ventilated

Weight: 30 pounds

SCOPE OF MANUAL

This manual covers the general installation, operation and service of Model 1010 Micro Computer Programmable Freezing Controller. It was written specifically for technicians who are trained and experienced in this type of equipment. Accordingly, calibration and repair instructions are limited to replacement of worn or damaged parts. When extensive adjustments are required to return equipment to an operational condition, it should be returned to the manufacturer for service.

STANDARD SERVICE PROCEDURES

Use standard electrical, electronic, and laboratory procedures when servicing this equipment. If, for any reason, servicing cannot be readily accomplished, notify CryoMed, so that servicing arrangements may be made.

UNPACKING

During unpacking, thoroughly inspect the controller, externally, for possible damage. Report any damage immediately to the carrier, and send a copy of that report to CryoMed. During this inspection, insure that:

a. All items on the shipper are accounted for.

b. The frame is not bent or distorted.

c. There is no broken glass or plastic.

INTERCONNECTIONS

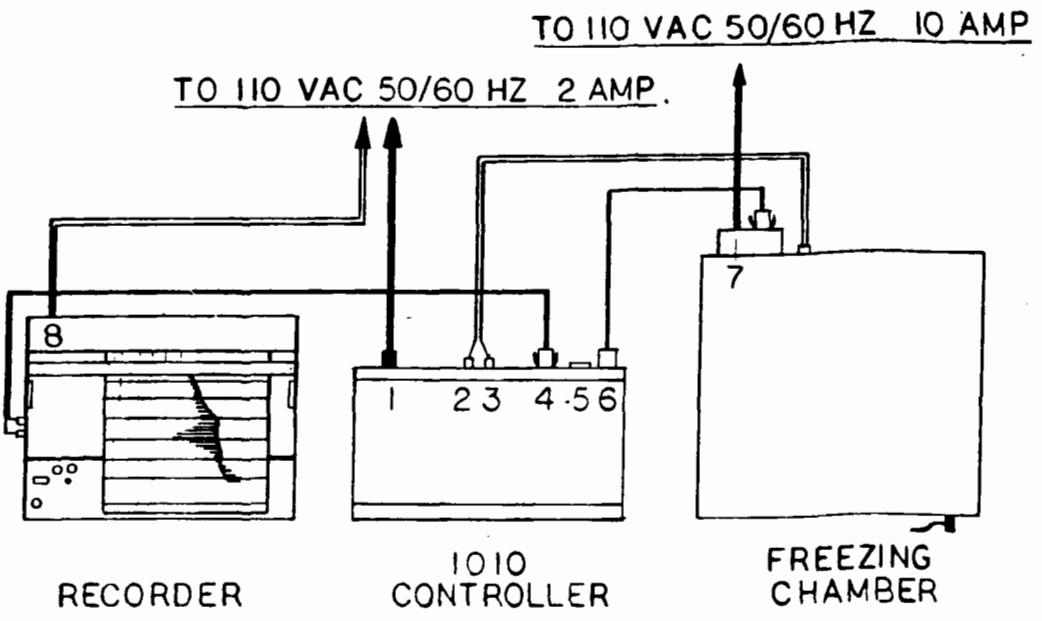
Connections are simple, straight forward, clearly labeled, and relatively foolproof. Refer to Figure 1-A when making interconnections.

CAUTION;

Do not force connectors together. If connectors do not join freely, check the pin and socket orientation of the plug and receptacle. Thermocouple leads are color coded to assure proper connection. Failure to follow these precautions may result in permanent connector damage.

WARNING: Use only a grounded (3-prong) receptacle. Do not try to defeat the grounding feature of the plug. Failure to follow these instructions can result in serious injury from electric shock during equipment malfunction.

BLOCK DIAGRAM 1-A



1 Power into Controller, connect to 110 VAC 50/60 supply

2 Chamber Thermocouple input. Provides chamber thermocouple signal to controller from freezing chamber.

3 Sample Thermocouple input. Provides sample thermocouple signal to controller from freezing chamber.

4 Recorder output. Provides chamber and/or sample temperature information to recorder to obtain hard copy graphs.

5 RS232 Port. Available for interfacing computers. Contact CryoMed for information.

6 Chamber output. Provides signal from controller to control fan, cool and cool+ solenoid valves, and heater in freezing chamber.

7 Power into freezing chamber. Provides power for fan, cool and cool+, solenoid valves and heater.

8 Power to recorder. Connect to 110 VAC 50/60 Supply.

CALIBRATION

The Model 1010 Controller is a solid state device employing microprocessor based technology; it does not normally require field calibration.

STORAGE

Whenever the Model 1010 Micro Computer Programmable Freezing Controller is to be stored, even for short periods of time, proceed as follows:

a. Unplug controller from its power supply, from freezing chamber, and from strip chart temperature recorder.

b. Cover with plastic sheeting.

c. Place in a suitable container, such as a strong cardboard box or shipping container.

d. Install a fresh pack of silica gel (dessicant) to absorb moisture.

SHIPMENT

The model 1010 Micro Computer Programmable Freezing Controller is designed to withstand, without damage or malfunction, normal commercial shipment and storage when prepared as follows:

a. Protect controller with at least two inches of padding and cushioning material, within its crate or box, to assure protection from shock and abbrasion.

b. Band, strap, or tape the container closed and mark: "Handle with Care - Delicate Electronic Instruments."

SECTION II
UNDERSTANDING THE FRONT PANEL

The controller faceplate comprises a sealed membrane keyboard with keys and windows appropriately positioned, small indicating LED's (Light Emitting Diodes) and digital displays. The keyboard is arranged in sections that separate groups of outlined keys by functions. The resulting data entry and feedback device allows the controller and operator to effectively communicate in a user friendly manner.

CONTROL SECTION OPERATING CONTROLS AND INDICATORS

Control Section. This grouping of operating controls and indicators is used to determine the overall operating mode and enables alarm, fan, and cooling mode operation. The function of each of these controls and indicators is listed below.

Control Name	Function
PWR	Illuminates when the unit is turned on.
ALRM *	Controls enabling and disabling of audible alarm circuit when controller is in IDLE mode. Illumination of red LED indicates alarm is enabled. Will silence audible alarm. Alarm sounds on end of cycle (freezing run) and error conditions.
FAN *	Controls enabling and disabling of freezing chamber fan power circuit when controller is in IDLE mode. Red LED illuminates only when fan is actually energized.

*It is not necessary to turn these on before each run. They will automatically function when in run.

Control Name	Function
Cool	Controls enabling of liquid nitrogen solenoid valve circuit in both automatic and manual modes, as follows: a. Automatic Operation: Enables COOL circuit when controller is in IDLE mode. This will always be enabled. b. Manual Operation: Opens the COOL liquid nitrogen solenoid valve when depressed and closes it when released when the following conditions exist: 1. The COOL circuit has been enabled (while running in the "unlimited access mode"). 2. The controller is running a program. NOTE The controller automatically takes over when the COOL keypad is released.
COOL +	Controls enabling of an additional liquid nitrogen solenoid valve circuit (for accelerated freezing rates) in both automatic and manual modes, as follows: a. Automatic Operation: Enables and disables the Cool + circuit when controller is in IDLE mode. Illumination of red LED indicates the Cool + circuit is enabled. This must be programmed into the memory in order to be enabled. The Cool + circuit must be programmed in for the computer to energize the Cool+ liquid nitrogen solenoid valve.

Control Name	Function

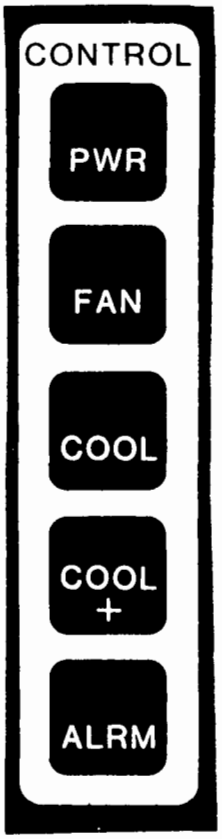
b. Manual Operation: Opens the Cool + liquid nitrogen solenoid valve when depressed and closes when released when the following conditions exist:

1. The Cool + circuit has been enabled (while running in the "unlimited access mode").

2. The controller is running a program.

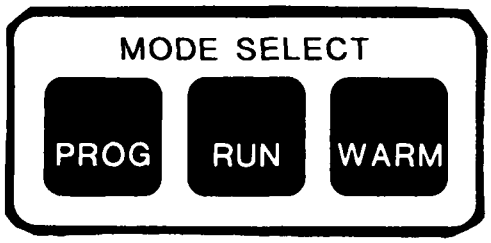
Note

The controller automatically takes over when the Cool+ keypad is released.



MODE SELECT SECTION OPERATING CONTROLS AND INDICATORS

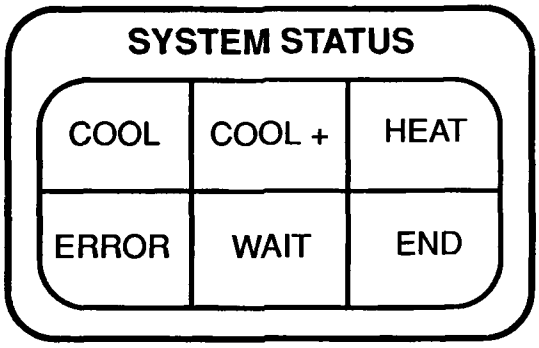
Mode Select Section. This group of keypads is used to select the specific operating mode of the controller, such as program, run and warm. Depressing a keypad whose LED's is already illuminated will cause the computer to exit from that mode. This action will return the controller to the IDLE mode.



Control Name	Function
PROG	Selects the programming mode. Is used when operator wishes to change any internal program memory.
RUN	Initializes the RUN mode; also is used during a WAIT program section.
WARM	Starts the automatic WARM cycle. Causes freezing chamber to warm to +25° C. Note: The PROGRAM NUMBER and SECTION NUMBER will display 0.0. When the freezing chamber reaches the temperature of +25° C, the controller will hold the temperature at +25° C. It will cycle LN2 if it is supplied. NOTE: The term IDLE MODE will be used during installation of this unit and troubleshooting. The "IDLE MODE" is when the PROG, RUN, and WARM in the Mode Select are not illuminated.

SYSTEM STATUS SECTION INDICATORS

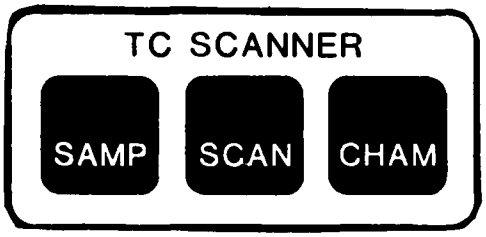
System Status Section. This group of six indicators displays the system status of various controller aspects. Each indicator consists of a rectangular printed panel which is backlighted by an LED module.



Control Name	Function
COOL	Illuminates when the COOL circuit is energized (COOL solenoid valve open, injecting liquid nitrogen into the freezing chamber).
COOL+	Illuminates when the COOL + circuit is energized (COOL + solenoid valve open, injecting liquid nitrogen into the freezing chamber).
HEAT	Illuminates when heating circuit is energized.
WAIT	Illuminates when the program being run, indexing through, or being edited contains a WAIT section.
ERROR	Illuminates when the controller senses the presence of an error condition.
END	Illuminates when the program being run, indexed through or being edited is programmed as an END section.

TC SCANNER OPERATING CONTROLS AND INDICATORS

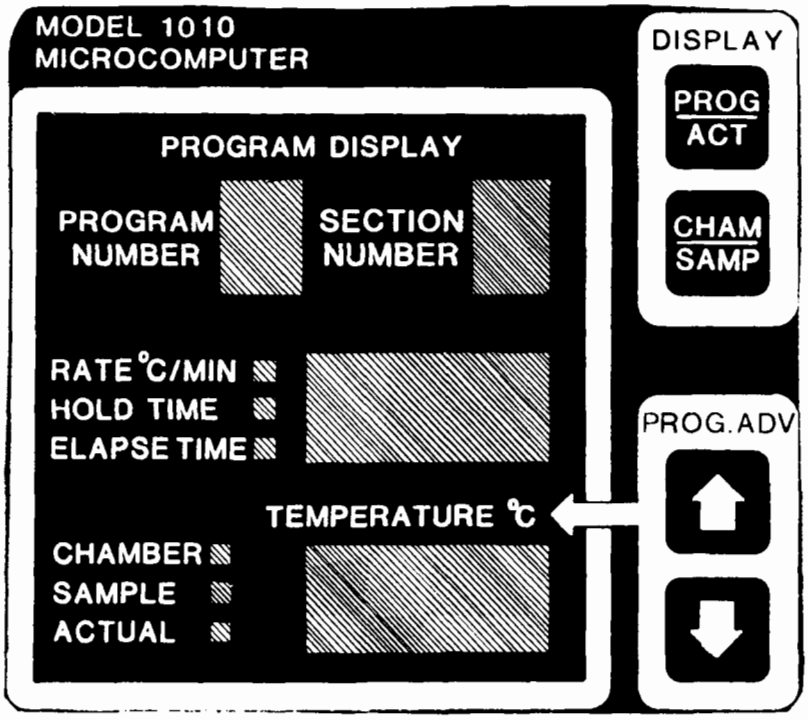
TC Scanner Section. This group of keypads is used to control thermocouple scanner operation. The output of the thermocouple selected is displayed, in degrees centigrade, in the PROGRAM DISPLAY section of the controller and is applied to the strip chart temperature recorder, producing a permanent record of the run.



Control Name	Function
SAMP	Selects the Sample Thermocouple as the temperature source. Its red LED illuminates when the controller is reading its output.
CHAM	Selects the Chamber Thermocouple as the temperture source. Its red LED illuminates when the controller is reading its output.
SCAN	Tells computer to scan both thermocouples at a fixed rate (two seconds for the chamber thermocouple, followed by ten seconds for the sample thermocouple, and so on) IMPORTANT NOTE; The SAMP and CHAM LED's will alternately illuminate during scanning to indicate the thermocouple being scanned at that moment. The SCAN keypad does not have an LED indicator.

DISPLAY SECTION CONTROLS AND INDICATORS

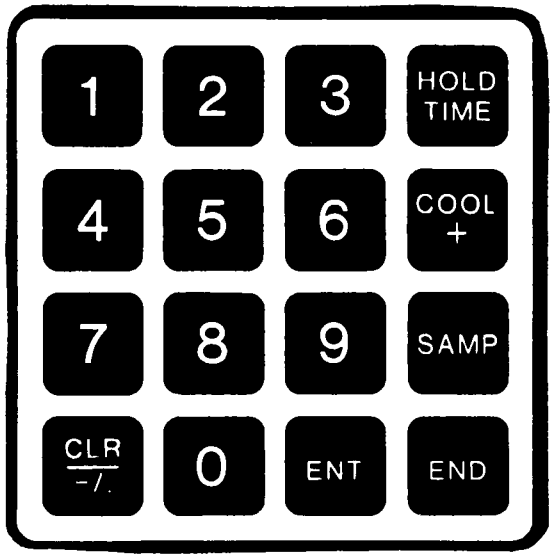
Program Display Section. This group of indicators comprises four windows containing digital displays and six LED's to indicate what the display currently represents, where applicable.



Control Name	Function
PROG/ACT	Simultaneously toggles both the PROG and ACT keypads of the Program Display section for the programmed or actual temperature or value. (USED ONLY WHEN IN THE "RUN" MODE)
CHAM/SAMP	Simultaneously toggles between the CHAM and SAMP used in conjunction with the PROG/ACT Keypad.
UP ARROW	Moves forward (advances) through the program to the next section; repeats approximately three times per second if held depressed.
DOWN ARROW	Moves backward (retreats) through the program to the previous section; repeats approximately three times per second if held depressed.

NUMERICAL AND SPECIAL FUNCTIONS SECTION CONTROLS

This group of keypads is used to select and enter numerical values and functions when programming the controller.



Control Name	Function
1 2 3 4 5 6 7 8 9 0	Represent numerical values zero through nine.
HOLD TIME	Used when programming to enter a specific amount of time that the temperature, within a cycle, is to be held at.
COOL+	Used when programming to select a COOL+ function for rapid cooling.
SAMP	Used when programming to enter a setpoint value corresponding to the SAMPLE temperature.
ENT	Used to enter values and parameters, previously keyed in, into the computer memory (active only when in the program mode).
END	Used to program or "label" the end or last section of a program. (active only when in the program mode).
CLR	Used when programming to remove an entry (active only when in the PROG position). Used when programming a negative number. If it is not activated, the number will be entered as a positive. Enters a decimal point when entering a program number in the user definable half of the memory.

SECTION III
PRINCIPLES OF OPERATION

This section provides explanations for operating principles, controls, and adjustments necessary to assure proper operation and service of the Model 1010 Micro Computer Programmmable Freezing Controller.

PROGRAMMING.

The Model 1010 Micro Computer Programmable Freezing Controller has been designed with unique features which allow the user to create the required freezing programs specific to their needs. These programs are entered into the system by selectively touching the keypads located on the faceplate of the controller. These keypads are separated into functional groups and are used to enter the sequence of operating commands and parameters into the memory of the computer. This memory is retained, even without power applied to the controller, and is available on power up at the touch of a few keys.

MEMORY SECURITY.

The 162 sections of program memory are divided into two separate blocks of 81 sections. These blocks have different security levels, as follows:

a. The first 81 sections are protected from unauthorized editing. There are six freezing programs that are available in this section of the memory. They can be used as a starting point for various specimen freezing which can aid the user in finding the best program for their particular specimen. This block is identified as Program Number (1-9), followed by Section Number (1-9). These programs are listed on page number 28.

b. The second 81 sections are protected from unauthorized entry by a software combination lock; Prog, 1,2,3, entr. This section of the memory is the user programmable half. This block is identified as Program Number (1-9), decimal point, followed by Section Number (1-9).

NOTE

This arrangement provides nine separate programs, each consisting of nine sections, in each half of the memory.

PROGRAMMABLE MEMORY

The programmable memory consists of 81 individual memory sections. Each of these sections are designed to hold the information necessary to accomplish a single task. By programming one or more sections

together in sequence, the user can create programs. These programs, consisting of one or more sections, each accomplish a desired task. The total effect of all of the tasks, running one after another, is a totally flexible user programmable, freezing program.

PROGRAM SECTIONS.

Each program SECTION contains the information required to accomplish one task. Each task can consist of only one of the following:

a. A HOLD TIME, while maintaining a CHAMBER TEMPERATURE SETPOINT.

b. A WAIT function, while maintaining a CHAMBER TEMPERATURE SETPOINT.

c. A RATE °C/MIN temperature increase or decrease until a SAMPLE or CHAMBER TEMPERATURE SETPOINT is reached.

SYSTEM OPERATION

The Model 1010 Micro Computer Programmable Freezing Controller regulates the flow of liquid nitrogen (LN2) to the freezing chamber. Additionally, it supplies information on temperature to the strip chart recorder. A strip chart trace of a typical freezing cycle is shown on page 29.

FREEZING CYCLE.

The CryoMed freezing cycle consists of the following steps and operations:

a. STARTING TEMPERATURE. This is the initial temperature of the biological sample prior to loading in the freezing chamber. Typically, the biological sample is mixed with a solution of cryo-protective agent and is placed in a plastic cryoampule. The sample is usually at room temperature (+22° C) or ice bath temperature (+4° C).

b. LIQUID PHASE COOLING. This is the rate at which the liquid sample is cooled. A typical rate of cooling is 1.0° C/mn. A regulated flow of LN2, into the freezing chamber, is circulated by an internal electric fan; this assures even sample cooling.

c. SUPERCOOLING. This is the temperature drop achieved just prior to liquid-to-solid phase change. It is generally three to four degrees centigrade below the freezing point.

d. **PHASE CHANGE.** The beginning of the liquid-to-solid phase change process is characterized by a rapid increase in temperature from supercooled temperature to freezing point temperature. To minimize temperature rise during phase change, temperature within the freezing chamber is rapidly dropped. This rapid cooling absorbs latent heat of fusion, thus minimizing any temperature rise above the freezing point.

NOTE

During phase change, sudden temperature rise indicates formation of ice crystals (seeding of the sample). A rapid temperature drop and subsequent warming of freezing chamber is necessary to shorten phase change period. These procedures are required to maintain a steady decline in sample temperature.

e. SOLID PHASE I FREEZING. The freezing rate selected for solid phase cooling is independent of liquid phase cooling rate. This rate is determined by the operator, as required, and is typically the same as liquid phase cooling rate of 1.0° C/min.

f. END SOLID PHASE I TEMPERATURE. This is the final temperature achieved in Solid Phase I freezing cycle. It is typically set between -30° C and -50° C, as required by the operator.

g. SOLID PHASE II FREEZING RATE. This freezing rate is independant from the Solid Phase I freezing rate. At -30° C to -50° C, the sample is consider ed safe, so at this point, the temperature can be dropped at a much faster rate such as 10 to 20 degrees per minute.

NOTE

Researchers generally find that a Liquid Phase Cooling rate of 1° C/min, a Solid Phase I freezing rate of 1° C/min, and a Solid Phase II freezing rate of 10° C/min will provide maximum recovery of viable cells while minimizing freezing cycle time.

h. END FREEZE TEMPERATURE. This is the final tempera- ture achieved in Solid Phase II freezing cycle. It is typically set at -90° C, and maintains freezing chamber temperature until sample is ready to be trans- ferred to long term storage.

SECTION IV
A. PROGRAMMING - MODEL 1010

This section will provide user with step-by-step instructions on HOW TO enter information into the Model 1010.

Following is a sample freezing program for a 2ml sample with a pre determined freezing point of -4 degrees.

EXAMPLE PROGRAM;

Program #1

Section #1: 4 Degrees start temperature
Section #2: 1 Degrees per minute to -4 degrees sample
Section #3: 30 Degrees per minute to -60 degrees
Section #4: 15 Degrees per minute to -12 degrees
Section #5: 1 Degrees per minute to -45 degrees
Section #6: 10 Degrees per minute to -90 degrees
Section #7: End

Programming Notes:

Cool Plus should be programmed into every section. This is done by depressing cool plus on the keypad in the second step of each section.

When programming a sample switchpoint it is necessary to depress samp on the keypad. IT WILL AUTOMATICALLY BE A CHAMBER SETPOINT UNLESS SAMP IS DEPRESSED.

ENTERING A PROGRAM;

KEYSTROKE SEQUENCE	EXPLANATION
Beginning-Selection of Program Number and Section Number	
Press Prog, 1,2,3,ent.	This is the factory programmed access code.
Press Desired Program Number, Section Number, For example; Program 1 Section 1, ent	The controller will automatically put the decimal point in which indicates you are in the "user programmable half of the memory.

PROGRAMMING SECTION #1

Start Temp	Press: 0, Ent	When 0 is entered, the display area goes blank and the word "wait" appears. This indicates that you are instructing the controller to go to the start temp and maintain that temp until further instructions.
	Press: 4, Cool+, Ent	This indicates that the start temperature selected is +4 degrees C.

PROGRAMMING SECTION #2

Liquid Phase Rate	Press: 1, 0, Ent	This enters a rate of 1 degree per minute. The 0 must be pressed to move the decimal point to the proper position.
	Press: -,4,SAMP,Cool+ Ent	This is the "start phase change" which is usually a predetermined setpoint. (Refer to Determining Freezing Point in Section IV, B) This is the only temperature setting which is recommended to be a "sample switchpoint".

PROGRAMMING SECTION #3

Temp Drop	Press: 3,0,0,Ent	This is selecting a rate of 30 degrees per minute.
	Press: -,6,0,Cool+, Ent	Temp Drop Temperature of -60 degrees.

PROGRAMMING SECTION #4

End of Phase Change	Press: 1,5,0, Ent	This is selecting a rate of 15 degrees per minute.
	Press: -,1,2,Cool+, Ent	This is the End of Phase Change temperature which is generally eight to ten degrees colder than the start of phase change.

PROGRAMMING SECTION #5

Solid Phase Freezing Rate	Press: 1,0, Ent	This enters a rate of 1 degree per minute. The 0 must be pressed to move the decimal point to the proper position.
	Press: -,4,5,Cool+, Ent	This indicates to the controller to run the above rate until -45 degrees. The sample is generally considered safe when it reaches between -30 and -50 degrees.

PROGRAMMING SECTION #6

Solid Phase Freezing Rate II	Press: 1,0,0, Ent	This is selecting a rate of 10 degrees per minute.
	Press: -,9,0,Cool+ Ent	Target Temperature of -90.

PROGRAMMING SECTION #7

END	Press: End, Cool +, Ent	

To recheck your program use the arrow keys on the display area to look over each section. (UP Arrow- Increase in Numbers, DOWN Arrow- Decrease in Numbers)

PROGRAMMING - TRACKING ERROR LIMITS

Tracking Error Limits are used to detect when the CHAMBER or SAMPLE temperature is not where it is supposed to be, and to alert the operator by sounding an audible alarm within the controller. Alarm conditions could result from loss of cooling source (liquid nitrogen), sensor (thermocouple or wiring) failure, freezing chamber (e.g., solenoid valve stuck open or closed, fan motor overloads tripped, exhaust blockage, etc,) failure, etc.

The alarm condition is entered only when both of the programmable Tracking Error Limits of time and temperature are simultaneously exceeded. While executing a program, the controller compares the current temperature of the controlled source (CHAMBER or SAMPLE) with that of the Temperature Setpoint. If the value of the controlled source differs by more than the programmed temperature error limit for longer than the programmed time limit, the alarm condition is automatically activated.

The Tracking Error Limit setpoints have been entered at the factory. They are set for one (1) minute for plus/minus (5) degrees. CRYOMED STRONGLY RECOMMENDS THAT THESE DO NOT BE CHANGED.

They are programmed as follows:

EXAMPLE: 1 minute, plus/minus 5 degrees

Keystrokes: Prog, 1,2,3, Ent, 0, Ent
1 Ent, 5 Ent

Only one set of error limits can be stored in the memory at one time. They are applicable to all the programs.

PROGRAMMING - ACCESS CODE

The access code of 1,2,3 is preset at the factory prior to shipment of of the Model 1010. Following are instructions to change it if you so desire.

Example of New Access Code Desired: 4,5,6.

Depress keys as follows: Prog, 1,2,3, Ent, CLR, 4,5,6, Ent.

If the new code consisting of three numbers is not entered within ten seconds, the controller will automatically revert back to 1,2,3,.

CLEARING KEYBOARD ERRORS

Depressing the CLR Keypad will clear programming entries in the buffer (scratch pad memory). It clears the last (most recent) entry made. The CLR keypad is functional only during programming.

SECTION IV
B. DETERMINING THE START PHASE CHANGE TEMPERATURE

The Start Phase Change Temperature is the temperature at which the SAMPLE freezes. Therefore the controller must run the freezing cycle, during phase change, from the temperature information obtained by the SAMPLE thermocouple (i.e., it is the reading from the SAMPLE thermocouple which activates the controller during the phase change period).

For a new biological SAMPLE, the freezing point can be determined by referring to Table A-1 or by programming and executing a SAMPLE freezing run as follows:

PROGRAMMING A SAMPLE FREEZING POINT DETERMINATION RUN;

Keystrokes: Depress Prog, 1,2,3, Ent; the Program display will flash on and off, select a program number and section number, then ent.

Depress 0, Ent, 4, Cool+, Ent. (This is entering a "wait" function with a start temperature of +4).

Depress 1,0, Ent, -, 5,0, Cool+, Ent.

Depress End, Ent.

After the run has been completed as per instructions in section 2 the curve will need to be analyzed. Review the strip chart cooling trace made; it should be similar to Chart #10.

Observe the temperature trace on the strip chart recorded. When the phase change portion of the cycle has been reached, the trace will show a sudden rise in temperature.

Observe the linear temperature trace just after the sudden temperature rise (Release of Latent Heat). This is the FREEZING POINT or Phase Change Temperature (Heat of Fusion Plateau Temp).

DETERMINING THE START PHASE CHANGE TEMPERATURE

CHART NUMBER 10

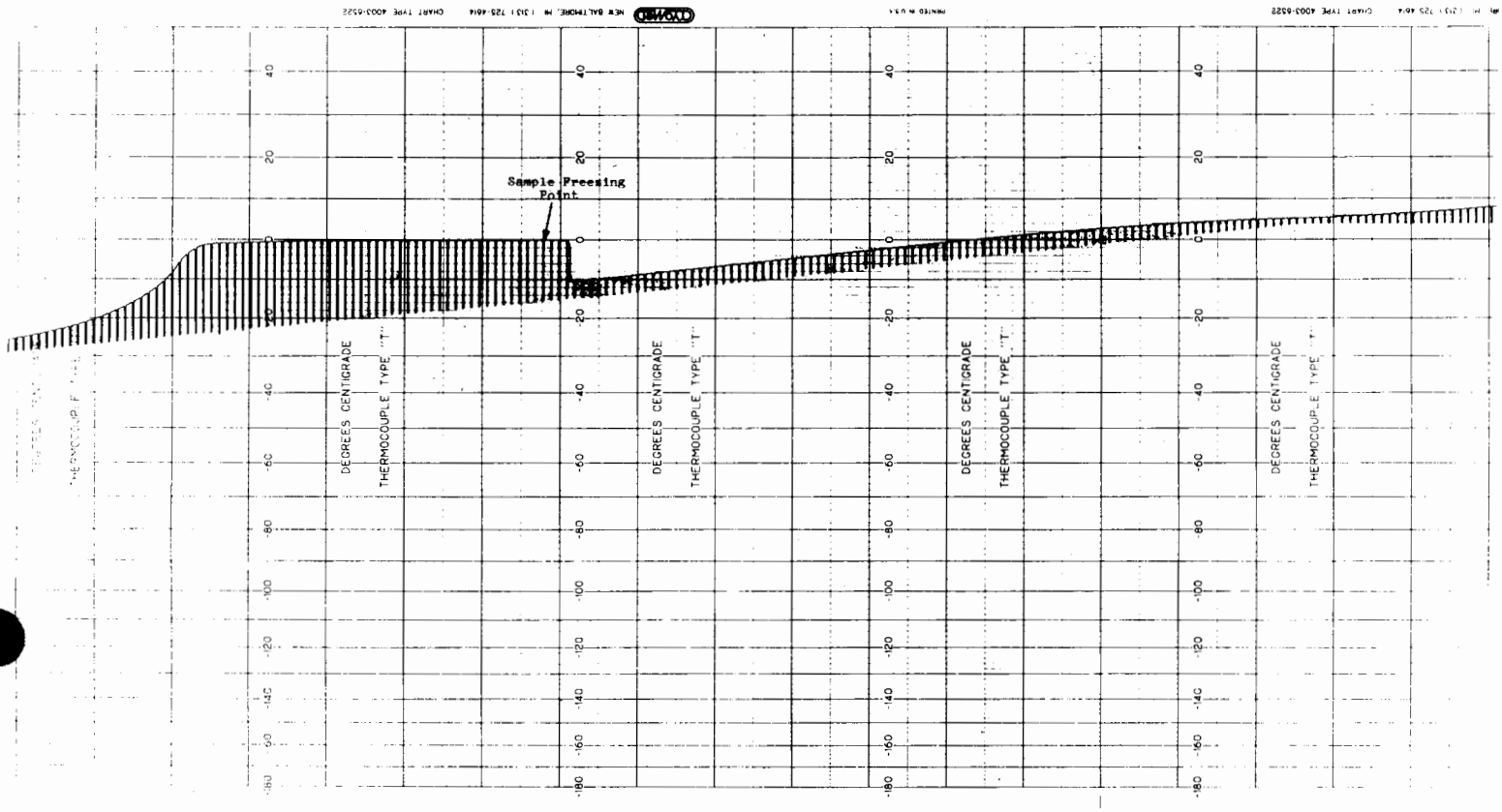


TABLE A-1
CONCENTRATION OF CRYOPROTECTIVE AGENT VS. FREEZING POINT TEMPERATURE

Percent of Cryoprotective Agent (DMSO, Glycerol, Etc.)	Freezing Point Temperature
0	0° C
5%	-2° C
7.5%	-3° C
10%	-4° C
12.5%	-5° C
15%	-6° C
20%	-8° C
30%	-12° C

NOTE: Phase Change or freezing point is defined as a process where a liquid is changed into a solid at constant temperature. Biological samples which are composed basically of water have a freezing point temperature of 0°C when no other substances are added to the sample. Adding a cryoprotectant agent, such as dimethysulfoxide (DMSO) or glycerol, will lower the freezing point temperature. CryoMed has observed the above relationship between the percentage of cryoprotective agent added to a biological specimen and the freezing point temperature.

SECTION V
INITIATING A FREEZING RUN

Once the system has been connected as per figure 3-1, proceed as follows;

1. Depress the power switch located on the back panel at the upper left rear corner of the Model 1010.

   NOTE: At this time the unit will run through a complete lamp test and return to the "Idle Mode". Idle meaning no lights are illuminated in the "Mode Select" section on the front panel.

2. Depress the power switch on the strip chart recorder. (It is advised that the system be warmed up for approximately twenty minutes. Uncap the pen and lower it. (place the cap on the chart drive on/off switch - this is just to help keep from losing the cap.)

3. Calibrate Unit as follows:

   a. Depress CHAM in the TC SCANNER section - The pen on the recorder should move to zero on the strip chart recorder. If it does not, dial it in to zero using the black knob on the recorder.

   b. Depress SAMP in the TC SCANNER section - The pen on the recorder should move to minus one hundred eighty degrees. (-180 degrees centigrade). If it is off, calibrate by using the set screw next to the zero knob and dialing it until the pen reaches minus one hundred eighty degrees.

   c. Recheck zero calibration as per directions in 3a.

4. Using the PROG ADV Key, ↑↓ locate the program number and section number that you wish to run. (Up arrow ↑ means increase in numbers; down arrow ↓ means decrease in numbers.

   NOTE: INSTRUCTIONS FOR QUICK ACCESS TO DESIRED PROGRAM TO BE RUN; IF IT IS IN THE USER PROGRAMMABLE HALF OF THE MEMORY: Depress PROG, 1, 2,3,Ent. (Prog light flashing) Depress desired program number and and section number, and ent. Depress PROG. This returns the controller to the IDLE mode (no lights on in "MODE SELECT") with the desired program number and section number being displayed.

5. Open liquid nitrogen supply tank. Check to assure pressure does not exceed 22 psig and that there is liquid in the supply tank. The pressure should not drop below 12 psig.

6. Depress SCAN in the TC SCANNER.

7. Turn on recorder CHART DRIVE switch.

8. Depress RUN. At this time liquid nitrogen will start to cycle in to the chamber. Once the chamber has reached the target temperature in the first section the valves will cycle on and off to maintain the target temperature that is programmed in.

   The first section in a program is typically a "wait". This means that the controller will go to the programmed temperature and "wait" there until further instructions, from the user. Once the temperature is achieved, the samples have been loaded into the chamber and have equilibrated to within two degrees of the chamber temperature, depress RUN for a second time. This advances the controller to the next section. At this point the controller will advance automatically thru each section until an end function is reached.

9. When the controller reaches the end, the alarm will sound. Depress ALRM keypad to silence aubible alarm only. The controller will maintain the end temperature for as long as there is liquid nitrogen available.

10. When the user is ready to transfer samples, depress RUN, this will shut the unit off.

11. Unload and transfer samples.

12. Depress WARM on the mode select. This is advised to bring the chamber back to room temperature, which helps dry the inside out, therefore helping to keep it clean. Once the unit reaches room temperature, (+25 degrees centigrade) the controller will start to cycle liquid nitrogen. At this time the unit is ready for another freeze operation or to be turned off.

USING THE "UNLIMITED ACCESS MODE" &
IMPORTANT INFORMATION REGARDING EXITING IN THE MIDDLE OF A RUN.

Under normal running conditions, the unit is in a "locked" or "limited" mode. This is PROTECTION for the user as there cannot be any changes made during the run -- NO MANUAL OPERATIONS, including aborting the run. Therfore, to exit in the middle of a run the steps are listed below:

1. Depress Prog.,1,2,3, ent. - At this time the run light will blink on and off, while it continues to run. This blinking indicates that the unit is running in the UNLIMITED ACCESS MODE. While operating in this mode, heat and coolant can be MANUALLY injected to the chamber. Also, at this time the unit can be shut down by depressing run.

   NOTE; If the unit is in a "wait" section, it will be necessary to depress run twice as the first time only advances it to the next section.

RUNNING THE PROGRAM IN THE UNLIMITED ACCESS MODE

Once the machine is in this mode, it will continue to run as it is programmed. The RUN light will blink on and off, which is the indication that it is in "UNLIMITED ACCESS". What this means is that the front panel is unprotected from manual operations. Following are the manual operations which can be performed in this mode of running:

1. Add coolant by depressing COOL and COOL+ on the left side of the of the unit under CONTROL.

2. Add Cool+ to a section (if it was not entered at programming) by depressing Cool+ on the numerical display on the right side of the controller. This will add Cool+ into the section for this section only, this run only.

3. Add heat or coolant by using the UP Arrow for increase in temperature and the DOWN Arrow for decrease in temperature.

IMPORTANT NOTE; CryoMed advises not to use manual operations. What will happen is once the manual operations are stopped, the machine will try to find where it is suppose to be according to what is programmed. Example: if excessive coolant is used, once it is stopped, the controller will add heat in order to get to where it should be as per the program.

SECTION VI
TROUBLESHOOTING PROCEDURES

Model 1010 Control Self Test Program

Upon power up, the 1010 Controller will test all of its internal circuits for proper operation. If there is a problem, the controller will sound an audible alarm and display one of the following error conditions:

PROBLEM:	CAUSE & SUGGESTED REMEDY
1) ERR 1	Internal Ram Test Failed. Turn unit off, wait one minute, turn unit back on, if ERR 1 reappears, call the factory. The unit will have to be returned for repair.
2) ERR 2	External Ram Test Failed. Turn unit off, wait one minute, turn unit back on, if ERR 2 reappears, call the factory. The unit will have to be returned for repair.
3) ERR 3	EPROM Check-sum Test Failed. Turn unit off, wait one minute, turn unit back on, if ERR 3 reappears, call the factory. The unit will have to be returned for repair.
4) ERR 4	Real Time Clock Test Failed. Turn unit off, wait one minute, turn unit back on, if ERR 4 reappears, call the factory. The unit will have to be returned for repair.
5) ERR 5	This test will fail if both thermocouples are NOT attached to the controller when it is turned on. Check all thermocouple connections.
6) ERR 6	Non-Volatile Ram Test Failed. This could appear in a low voltage situation or a brown out. Turn unit off, wait one minute, turn unit back on. All the memory that has been programmed into the user programmable half will have to be reprogrammed. The factory preset programs will not be lost.
7) ERR 7	This is a result of electrical disturbance. The controller should be turned off, wait one minute, turn the unit back on. If it reappears, call the factory. If will have to be returned for repair.

PRE-SET PROGRAMS

PROGRAM #1 (Standard 1.2/2.0ml w/7% to 12% Cryoprotectant Agent)

Section 1	Wait @ +4° Cool+
Section 2	1 degrees/minute to -4° Sample
Section 3	25 degrees/minute to -40° Cool+
Section 4	15 degrees/minute to -12°
Section 5	1 degree/minute to -40°
Section 6	10 degrees/minute to -90° Cool+
Section 7	End

PROGRAM #2 (Standard Microtest Tray Freeze)

Section 1	Wait @ +4° Cool+
Section 2	1 degrees/minute to -40°
Section 3	10 degrees/minute to -90° Cool+
Section 4	End

PROGRAM #3 (Standard Embryo Freeze using .25 or .50ml straw)

Section 1	Wait @ +20° Cool+
Section 2	1 degrees/minute to -4°
Section 3	.5 degrees/minute to -7°
Section 4	5 minute hold time at -7°
Section 5	.3 degrees/minute to -35°
Section 6	.1 degree/minute to -37°
Section 7	End

PROGRAM #4 (Standard Blood Bag/Bone Marrow 75-150ml, 7%-10% Cryoprotectant Agent)

Section 1	Wait @ +20° Cool+
Section 2	1 degrees/minute to -6° Sample
Section 3	25 degrees/minute to -50° Cool+
Section 4	15 degrees/minute to -14°
Section 5	1 degrees/minute to -45°
Section 6	10 degrees/minute to -90° Cool+
Section 7	End

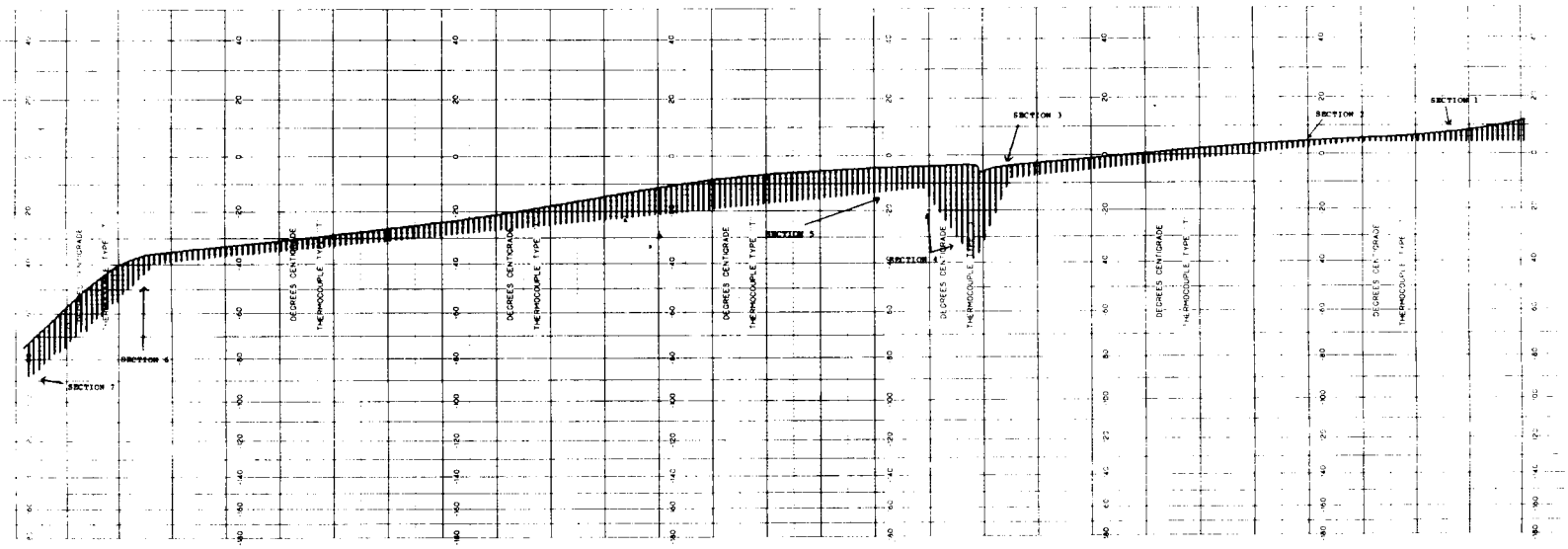
PROGRAM #5 (Skin Packet 4"x6" w/10% Cryoprotectant Agent)

Section 1	Wait @ +4° Cool+
Section 2	1 degree/minute to -5° Sample
Section 3	20 degrees/minute to -40° Cool+
Section 4	10 degrees/minute to -10°
Section 5	1 degree/minute to -35°
Section 6	10 degrees/minute to -90° Cool+
Section 7	End

PROGRAM #6 (2ml Sample w/7%-12% Cryoprotectant Agent)

Section 1	Wait @ +4° Cool+
Section 2	1 degrees/minute to -4° Sample
Section 3	20 degrees/minute to -45°
Section 4	15 degrees/minute to -10°
Section 5	.5 degrees/minute to -20°
Section 6	1 degree/minute to -80°
Section 7	End

TYPICAL FREEZING CURVE



WRITING YOUR OWN PROGRAM

The outline below may be used in writing your own program, prior to programming it into the Model 1010.

PROGRAM #_____ Type of Sample_____

				Circle One:
Section #_____	_____	_____	Cool +	SAMP/CHAM
Section #_____	_____	_____	Cool +	SAMP/CHAM
Section #_____	_____	_____	Cool +	SAMP/CHAM
Section #_____	_____	_____	Cool +	SAMP/CHAM
Section #_____	_____	_____	Cool +	SAMP/CHAM
Section #_____	_____	_____	Cool +	SAMP/CHAM
Section #_____	_____	_____	Cool +	SAMP/CHAM
Section #_____	_____	_____	Cool +	SAMP/CHAM
Section #_____	_____	_____	Cool +	SAMP/CHAM

Info To Change Chart Speed

CRYO-MED
49659 Leona Drive
MT. CLEMENS, MI 48045
(313) 949-4507

JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

MODEL 500 RECORDER CHART SPEED

1.) Take off hood by removing two end screws.

2.) Take off bottom cover by removing ground screws and four retaining clips

3.) Find stepper motor circuit board (located under chart drive and power toggle switches).

4.) Move jumper (see drawing) to desired position. Chart speed is determined by moving the jumper between the common (position g) and any of the following points:

a.) 2.5 inches per minute

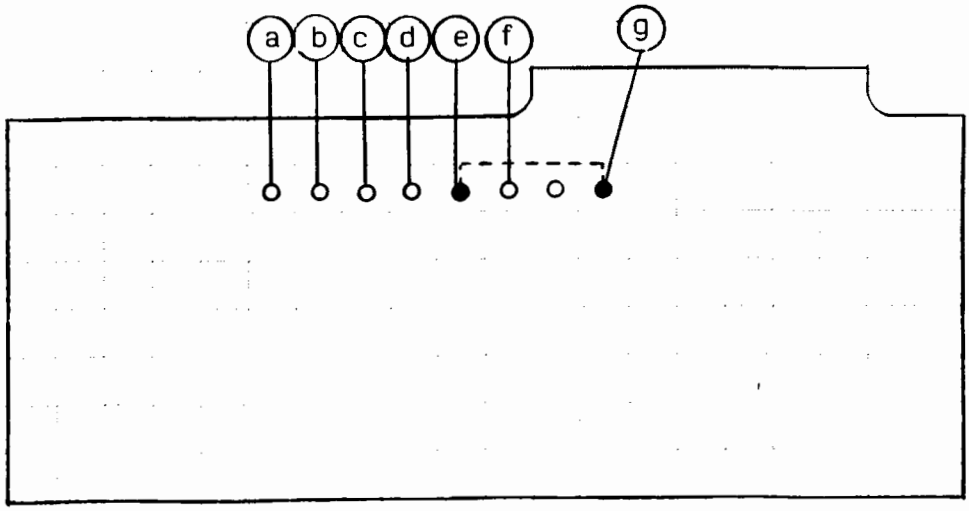
b.) 2.0 inches per minute

c.) 1.25 inches per minute

d.) 1.0 inches per minute

* e.) .50 inches per minute

f.) .25 inches per minute



STEPPER MOTOR CIRCUIT BOARD

NOTE: The jumper position shown will result in a chart speed of .50 inches per minute.

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