



Instruction Manual RS75ZXXDD5 Chiller



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Product Description

The RS75ZXDD5 is a specially-designed, application-specific re-circulating chiller that provides temperature-controlled fluid over a -10° C to +110° C range. All Kinetics Thermal Systems chillers feature innovative design, high-quality construction and high reliability components.

Features include:

- Small Footprint
- Digital / RS-232 Control
- +/- 0.5°C stability
- Wide Temperature Range
- Air-cooled mechanical refrigeration

Model Number and Information

Model:	RS75ZXDD4
Refrigeration:	3/4HP Compressor
Pump:	4.3 gpm turbine, 50 psi
Heat:	2000W
Control:	Electronic Digital Controller (EDC)
Operating Voltage:	208-240V, 50/60Hz, Single-phase
Start up current draw	36 A approx.
Operating current draw:	15A
Line plug:	NEMA L21-30P (only uses X, Y & ground pins)
Temperature range:	-10°C to +110°C
Ambient Operating range:	+15° C to +25° C
Weight:	Approximately 120 lbs.
Miscellaneous features:	Flexible stainless-steel hose, hour meter, refill float

Safety Overview

The following symbols can be found on or within a system and its documentation. Please become familiar with them and their meanings.



General Alert symbol indicates the potential of personal hazards or equipment



Electric Shock / High Voltage symbol indicates the presence of high voltage or current and the potential for injury or death.



Hazardous Chemicals denotes a hazard that may cause irritation or burns if the substance comes into contact with the skin. Always refer to the substance's Material Safety Data Sheet.



Hot Surfaces symbol indicates a hazard that could cause injury or burns.



Eye Protection symbol indicates a hazard that could cause injury or irritation to the eyes. Eye protection must be worn.



High Pressure symbol indicates the potential for personal hazard or equipment failure if safe procedures are not followed.

Sound Levels

In testing, a maximum sound level pressure of 80 dB(A) was obtained at three feet from the right (pump) side of the unit with a background noise level of 57dB(A). This falls within OSHA (1910.95) and most international regulations for unprotected sound exposure. However, because of the variations in work site conditions, all DD5 installations should be sound level tested on-site to determine the possible need for hearing protection.

Environmental Concerns

The fluid used in this chiller wears out and needs to be changed on a periodic basis. Old fluid should not be recycled for re-use by the customer. It should be properly disposed of in accordance with local regulations.



Some service procedures may require breaking the sealed integrity of the refrigeration system. Reclamation of refrigerant is required by law and may only be undertaken by EPA-certified technicians. Please contact the Delta Design Service Division for further information or assistance.



The packaging materials for this system may be saved and reused for future shipping of the system. The foam can also be reused as carton fill. All materials are produced without CFCs or HCFCs and can be disposed of with regular municipal waste, subject to local regulations.

Installation



This unit weighs over 100 lbs. (45 kg). Any movement or handling of the unit must be done with a mechanical assistor.

Ambient Air Requirements

The environment should be well ventilated to prevent excessive build up of heat. Normal room air circulation and ventilation is usually adequate.

Space should be provided so that air can properly circulate around the unit. If obstacles are blocking the airflow, the compressor may overheat. This reduces performance, and can lead to early compressor failure.

This unit is designed for operation in a normal indoor environment. (Units should not be mounted outside or otherwise exposed to the elements). The environment should be free from air containing large amounts of moisture, salt or sulfur.

The ambient air temperature requirements are as follows:

Temperature Range	Status
59°F to 69°F (15°C to 21°C)	Acceptable
70°F to 74°F (21°C to 23°C)	Ideal
75°F to 77°F (24°C to 25°C)	Acceptable, but a reduction in the cooling capacity of the unit is to be expected (about a 1% cooling capacity reduction per degree above 72°F).
Above 77°F (26°C)	Expected reduced reliability. Warranty may be voided. Unit will not meet ramp-time specifications.

Seismic Data

The unit has four aluminum standoffs supporting the base. The upper end of each has a 3/8-16 external thread which is inserted through the base and secured with a lock washer and a nut. The lower end of each standoff has a 1/4-20 internal thread which is used to secure the unit to the parent unit.

The maximum sustainable shear reaction load has been determined to be a theoretical 720 lb. f.

Electrical Requirements

Cautions and Warnings

Caution! Installation of this unit should only be undertaken by qualified personnel!

The RS75ZXDD5 is designed as a sub-assembly and should NOT be used as a stand-alone unit.

The RS75ZXDD5 should NOT be powered directly from a facility connection.

This unit must be connected to a mains supply containing a 10,000 Amp Interrupting Capacity Ground Fault Interrupt circuit breaker.

This unit must be connected to the parent system's Emergency Machine Off (EMO) circuit. This can be accomplished by using a mains supply for the chiller that is tied into the EMO.

To lessen potential hazards in the servicing of the unit, the power outlet receptacle for the chiller MUST be readily accessible and within line-of-sight of the unit.



Electrical Connections

The voltage and frequency requirements for this unit are specified on the serial tag on the rear of the unit. Standard variances in frequency (+/-3 Hz) and voltage (-5%/ +10%) are allowed.

Verify that the facility voltage matches the requirement for the unit.

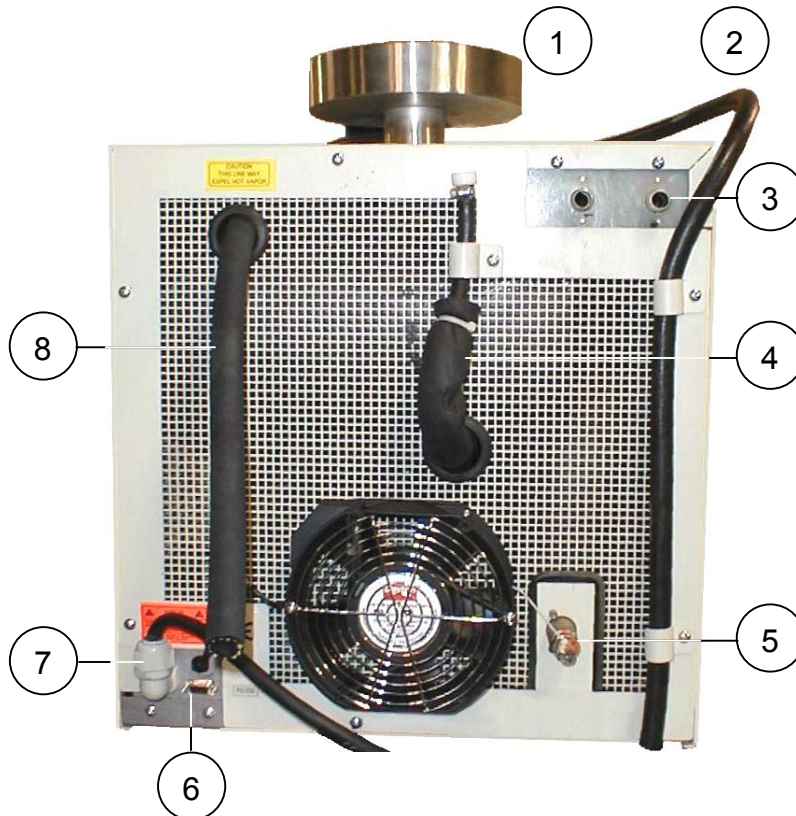
The electric service wiring for the unit must be of a large enough wire gauge to maintain the rated voltage even when a full load is applied to the receptacle. The receptacle voltage should be measured while that receptacle is under load.

This unit has a NEMA L21-30P plug on the line cord. Install an appropriate receptacle (NEMA L21-30R) in the location where the unit is to be run.

When the unit is plugged in and the breaker switch turned on, the amber “Mains” LED on the front panel should illuminate.

Connection to the Process

Connection Lines



1. Splash Guard
2. Splash Guard drain line
3. Process Fluid ports (labeled IN and OUT)
4. Reservoir Drain line
5. High-pressure bypass adjustment (See page 26)
6. RS-232 Communications receptacle
7. Mains power
8. High-pressure release line

Connecting the Fluid Lines

The DD5 is provided with input and output connections for the process fluid.

To tie these lines into your process, you will need:

3/8" Fittings for 3/8" male pipe thread on the Fluid I/O

1/2" ID tubing

Pipe insulation (Closed-cell pipe insulation will work for most applications. It can be purchased from any local refrigeration or plumbing supply house.)

Insulation glue (for the seams of the pipe insulation).

Pipe sealant appropriate to the application to seal all fittings.

Make sure that the "Liquid Out" port of the unit is connected to the inlet of the system to be cooled and that the "Liquid In" port is connected to the outlet of the system to be cooled.

Reservoir High-Pressure Release line



The reservoir High-pressure-release line is a valved outlet provided as a pressure safety blow-off for the unit's reservoir. Any vapor expelled through this line could be extremely hot (up to 110°C) and could provide exposure to the process fluid.



Because of these potential hazards, this line must be plumbed or securely connected to an appropriate containment vessel.

Fluid Containment



The unit must be installed in such a way that fluid spills from any cause will be contained. This secondary containment must be of adequate size and configuration to handle 110% of the combined volume of the chiller and process fluids.

Selecting a Process Fluid

This re-circulator is designed for operation with a mixture of 50% Dow Frost™ HD and 50% distilled water. Some basic properties of the fluid are as follows:

Temperature Range (°C)	-33.8 / +162
Flammability	Non-flammable
Toxicity	Low
Dielectric Strength	Medium

Process Fluid Properties

Expansion/Contraction

It is important to note that some fluids expand as much as 14% from +25°C to +125°C. Do not confuse contraction of the fluid with fluid losses.

Dissolved Gases

At room temperature the fluid contains dissolved gas. As the fluid temperature is increased the amount dissolved gas that the fluid can hold decreases dramatically causing excess gas to be released from the fluid. This released gas should not be mistaken for boiling of the fluid.

Water Solubility

Process fluids are water-soluble. After long periods of operation at low temperatures, water from the air will condense on and mix with the fluid. This decreases the performance of the unit. To remove the excess water, warm the fluid to room temperature and pump the fluid through a molecular sieve or desiccant material. Alternately, in units that are capable of temperatures over 100°C, run the unit at temperatures over 100°C. This will boil off any water present in the fluid.

Low Surface Tension and High Vapor Pressure

The fluid evaporates very easily and any improperly sealed joints will leak.

The red vent screw on the reservoir lid should be kept closed *unless you are in the process of adjusting the setpoint* to prevent excessive evaporation of the fluid.

Adding Fluid and Priming the System



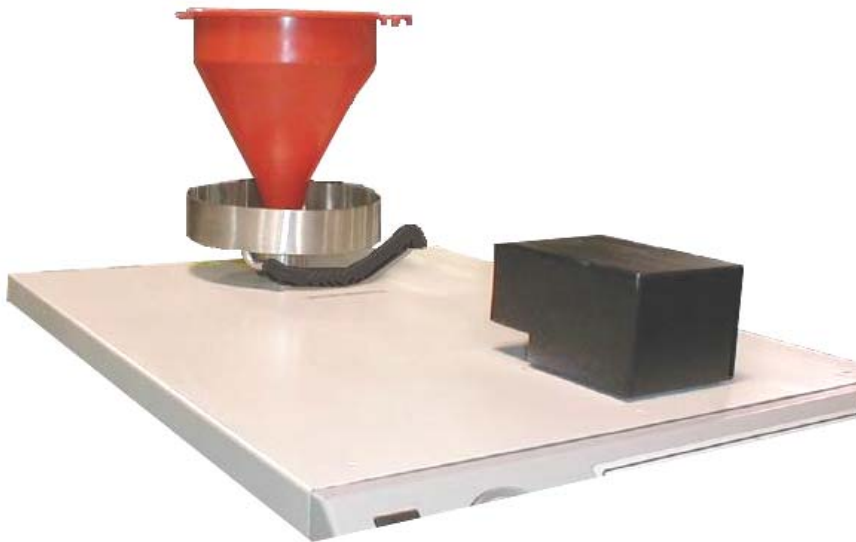
Caution! Always use care when handling fluids, filling or draining the reservoir, or working in or around the chiller. Always wear protective eyewear when operating the chiller.



Warning! Reservoir cap must only be removed after bringing the unit to ambient temperature. System fluid may be at high temperature and under pressure. Breaking the fluid system seal (e.g. via reservoir cap) could result in serious injury from spraying fluid and vapor.

Once the fluid supply loop that runs to the process and back to the RS75ZXXDD5 is in place and sealed, fluid can be added to the reservoir and the unit primed.

The RS75ZZXXDD5 is equipped with a splash guard and funnel to facilitate the filling of the reservoir.



The funnel fits into the unit's reservoir opening in the splash guard. The splash guard is supplied with a plugged drain hose to ease clean-up and disposal of fluid spills.

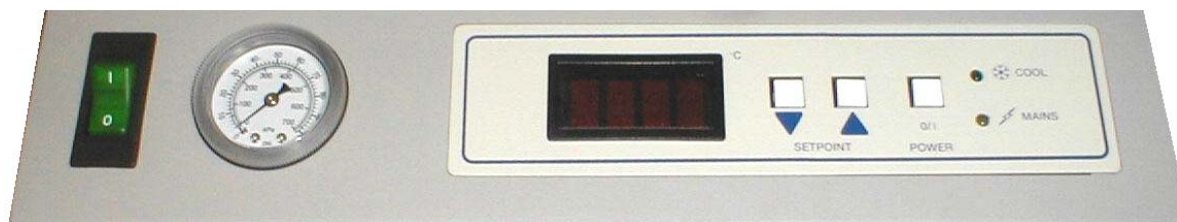
Filling and Priming Procedure:

1. Remove the reservoir cap (with the plugged drain line in place).
2. Place the filling funnel, fitted with a clean filter, in the neck of the splash guard. See the image on the facing page.
3. Press and hold either the up ▲ or the down ▼ button on the front panel to enter the programming routine.
4. Press either the up ▲ or the down ▼ button to scroll through the menu headings until “**Etc**” is displayed.
5. Press the **O/I** button until “**rEFL**” is displayed (This is the first option in the **Etc** menu).
6. Press the up ▲ or the down ▼ buttons to change the value to 1.
7. Press the **O/I** button to enter the value and to step through the remaining options and exit the menu.
8. Begin pouring fluid into the reservoir. Before fluid is added the display will have one horizontal bar illuminated. After filling to above the low fluid safety level the second and third bars will illuminate simultaneously. When the reservoir is full a fourth bar will illuminate.
9. Remove funnel.
10. Replace the reservoir cap.
11. Repeat steps 3 through 5, above
12. Press the up or down buttons to set **rEFL** to 0
13. Press the **O/I** button to enter the value and to step through the remaining options and exit the menu.
14. After starting the pump and circulating the fluid, additional fluid may be needed. If so, repeat steps 1 through 13, above.

Note: If fluid has been spilled into the splash guard, it should be drained into a container by removing the plug from the drain hose and allowing the fluid to flow out. Replace the drain plug and dispose of fluid according to proper material handling procedure.

Unit Controls

Controls Panel



1

2

3

4

5

6

1. Main Power Switch
2. Temperature Gauge
3. Display Window
4. Setpoint controls (▲ ▼ Buttons)
5. O/I Button
6. Indicator lights—Amber ----- Power
Green ----- Cool/Run

Operation

Unit Preparation and Start-up

In most situations the operation of this unit is accomplished via the RS-232 communications system. The following information is provided in the unlikely event direct access to the unit control panel is required.

Preparation

- ◆ Turn on the Green Main Power switch in the front panel.
- ◆ The unit is now in Idle. The display will be blank and the amber Power light will be illuminated.

Start Up

- ◆ Press the **O/I** button.
- ◆ The display will alternately flash **SP** (setpoint) and the current setpoint temperature for five seconds. (The setpoint is the temperature at which the unit will maintain the fluid.)

Adjusting Setpoint

- ◆ Open the red vent screw on the reservoir lid.
- ◆ When the unit is running touch the ▲ ▼ buttons to bring up the current setpoint.
- ◆ Adjust the setpoint using the ▲ or ▼ button.
- ◆ The new setpoint value is automatically accepted after 4 seconds of inactivity.
- ◆ Once the unit has stabilized at the new setpoint, tighten the red vent screw on the reservoir lid.

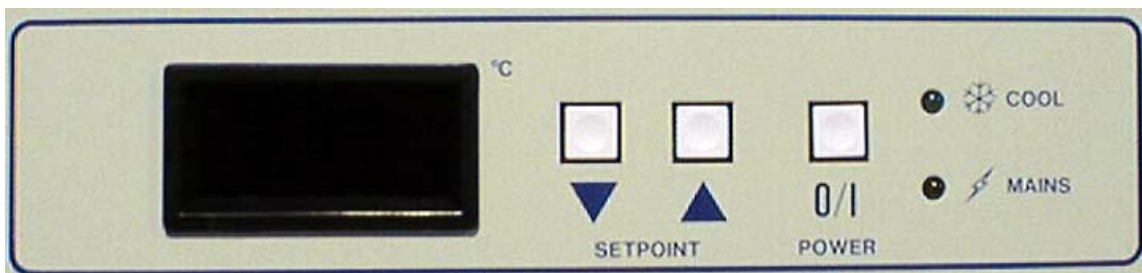
Placing the Unit in Idle

- ◆ Press the **O/I** button to place the unit into Idle.
- ◆ The refrigeration and pump will shut down and the display will blank.
- ◆ The amber Power light will remain lit.

EDC Controller User Menu

This unit is equipped with an EDC digital control package. Varying the parameters in the EDC Controller's User Menu allows the operation of the unit to be fine-tuned to meet the needs of a specific application. A variety of parameters such as Ramp Rate, Auto-Power Recovery, High- and Low-Temperature Alarms, Parameter Lock, Setpoint Limits, readout options, Proportional Control parameters, and several Communications options can all be adjusted from the User Menus.

The layout of the menus and the parameters contained in those menus is shown on the following pages. They are navigated using the three buttons on the front panel of the EDC Controller.

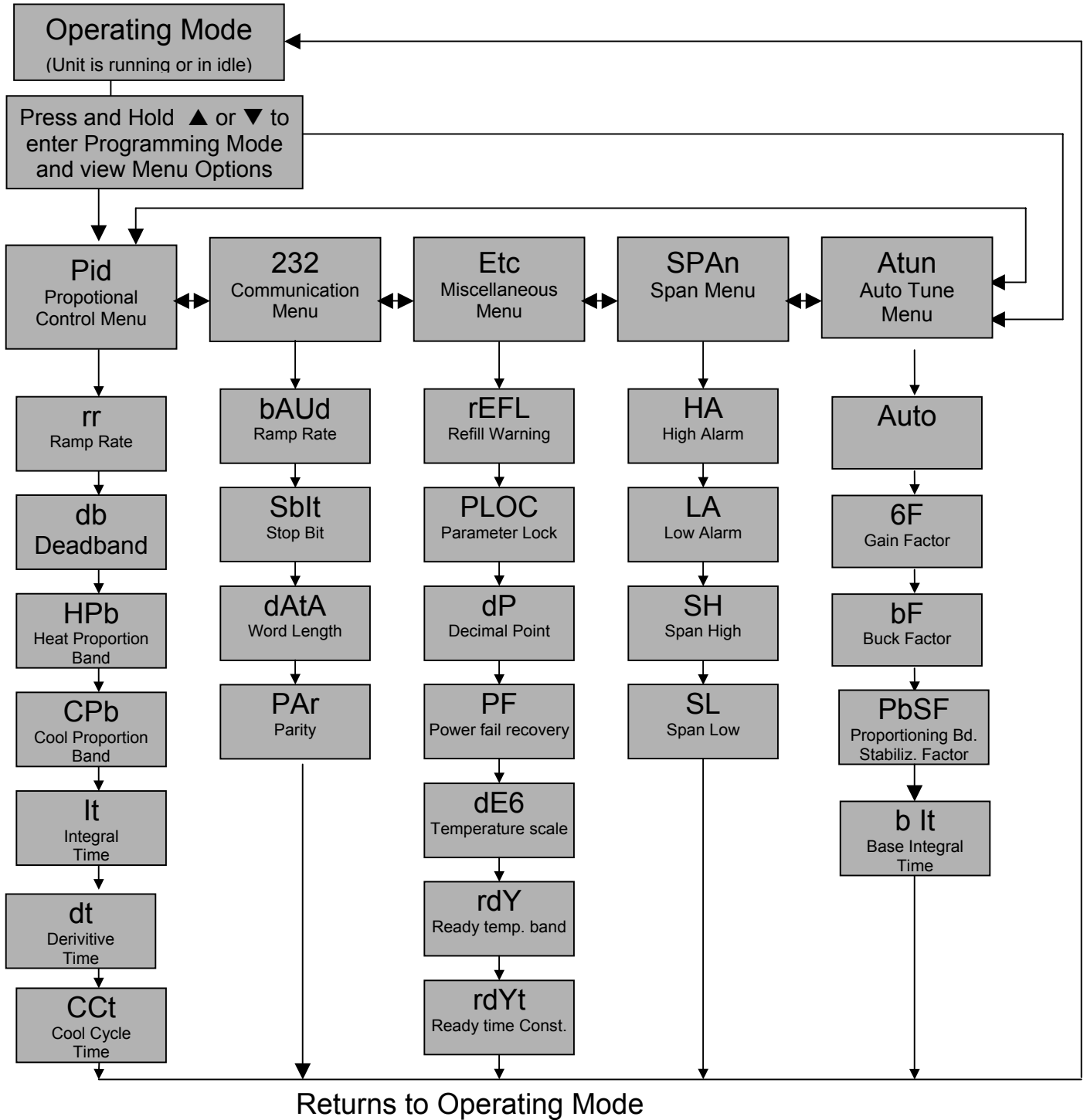


Section Contents

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Proportional Control Menu (Pid)	16	RS232 Menu	19
Span Menu	17	Auto Tune (ATUN) Menu	20

User Menu Lay-out

Press either the up ▲ or the down ▼ button to enter the programming routine and view the menus.
 Use the O/I button to move down through a menu to the desired menu option.
 Use the up ▲ or the down ▼ button to adjust parameter values.
 Use the O/I button again to lock in the setting and move onto the next option.

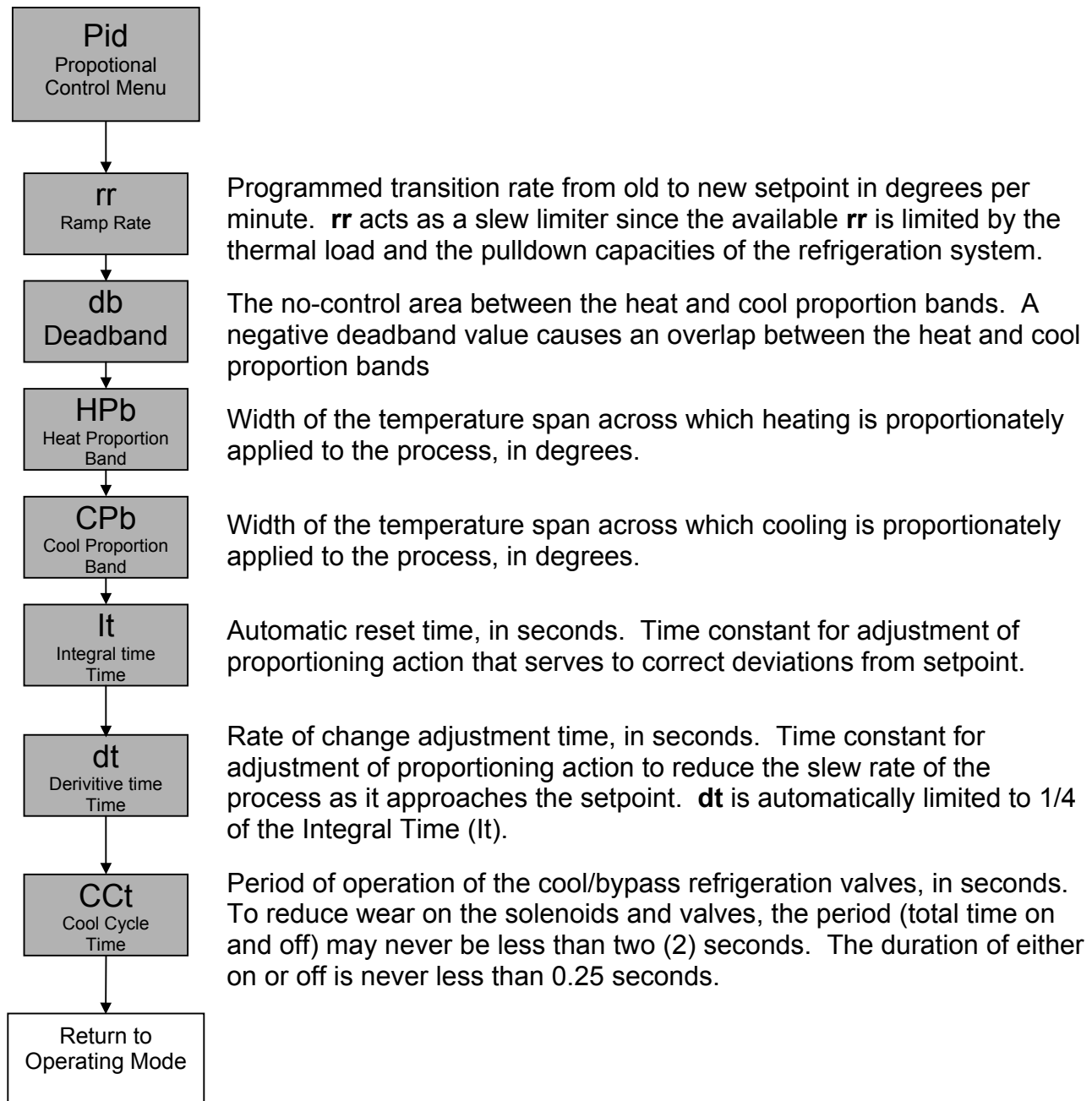


Proportional Control Menu (Pid)

Use the O/I button to move down through a menu to the desired option.

Use the up ▲ or the down ▼ button to adjust parameter values.

Use the O/I button again to lock in the setting and move onto the next option.

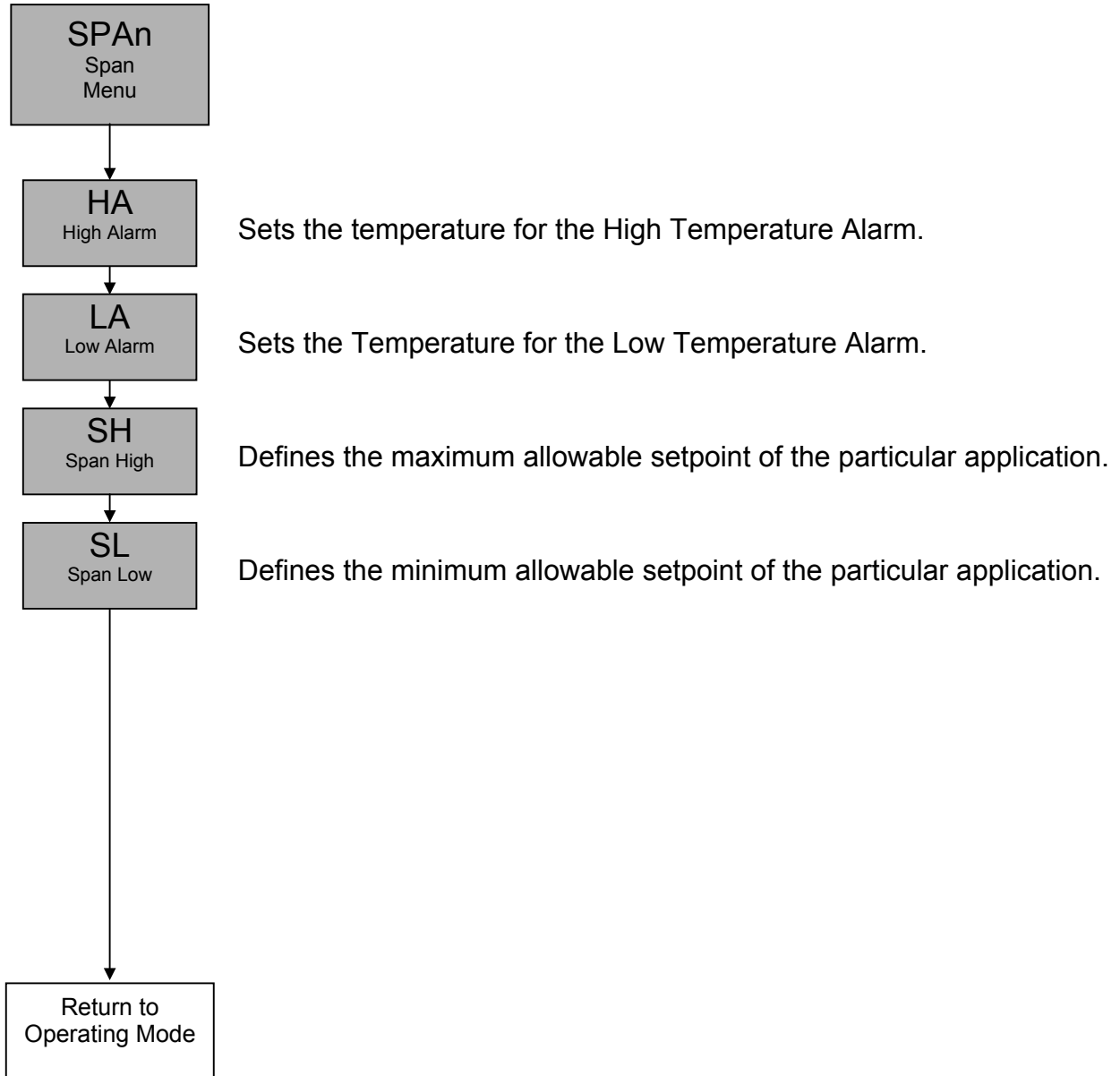


Span Menu

Use the O/I button to move down through a menu to the desired option.

Use the up ▲ or the down ▼ button to adjust parameter values.

Use the O/I button again to lock in the setting and move onto the next option.

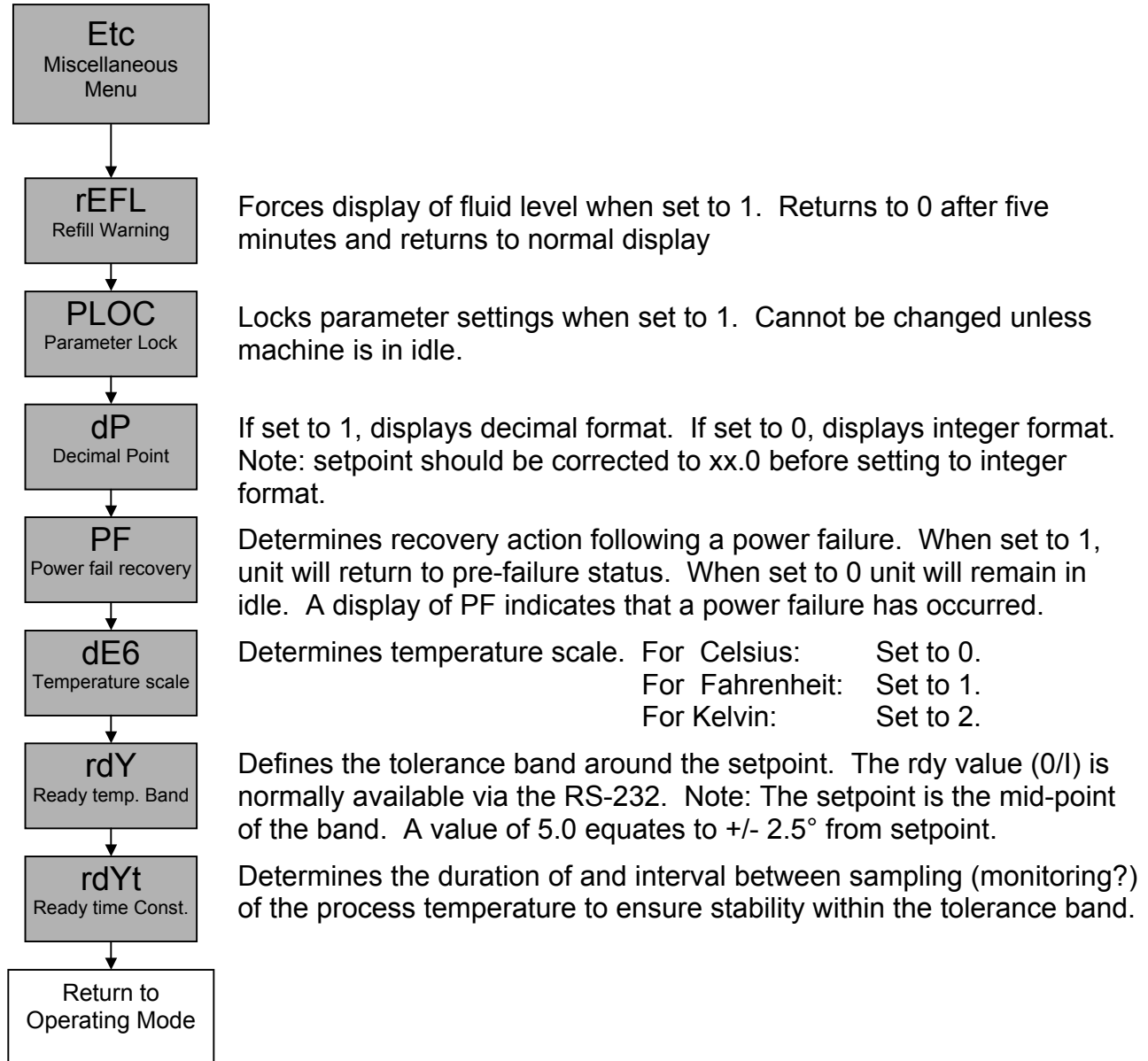


Etc Menu

Use the O/I button to move down through a menu to the desired option.

Use the up ▲ or the down ▼ button to adjust parameter values.

Use the O/I button again to lock in the setting and move onto the next option.

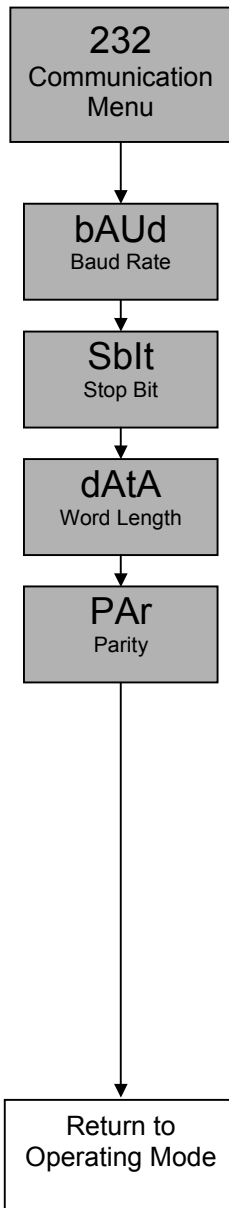


RS232 Menu

Use the O/I button to move down through a menu to the desired option.

Use the up ▲ or the down ▼ button to adjust parameter values.

Use the O/I button again to lock in the setting and move onto the next option.



Setting: ... 0 Baud Rate 300
 1 1200
 2 2400
 3 9600

Number of stop bits. A Stop bit setting of 1, 1.5 or 2 may be selected.

Data word length may be set to 7 bit or 8 bit.

Parity detection. Setting 0 Parity none
 1 odd
 2 even

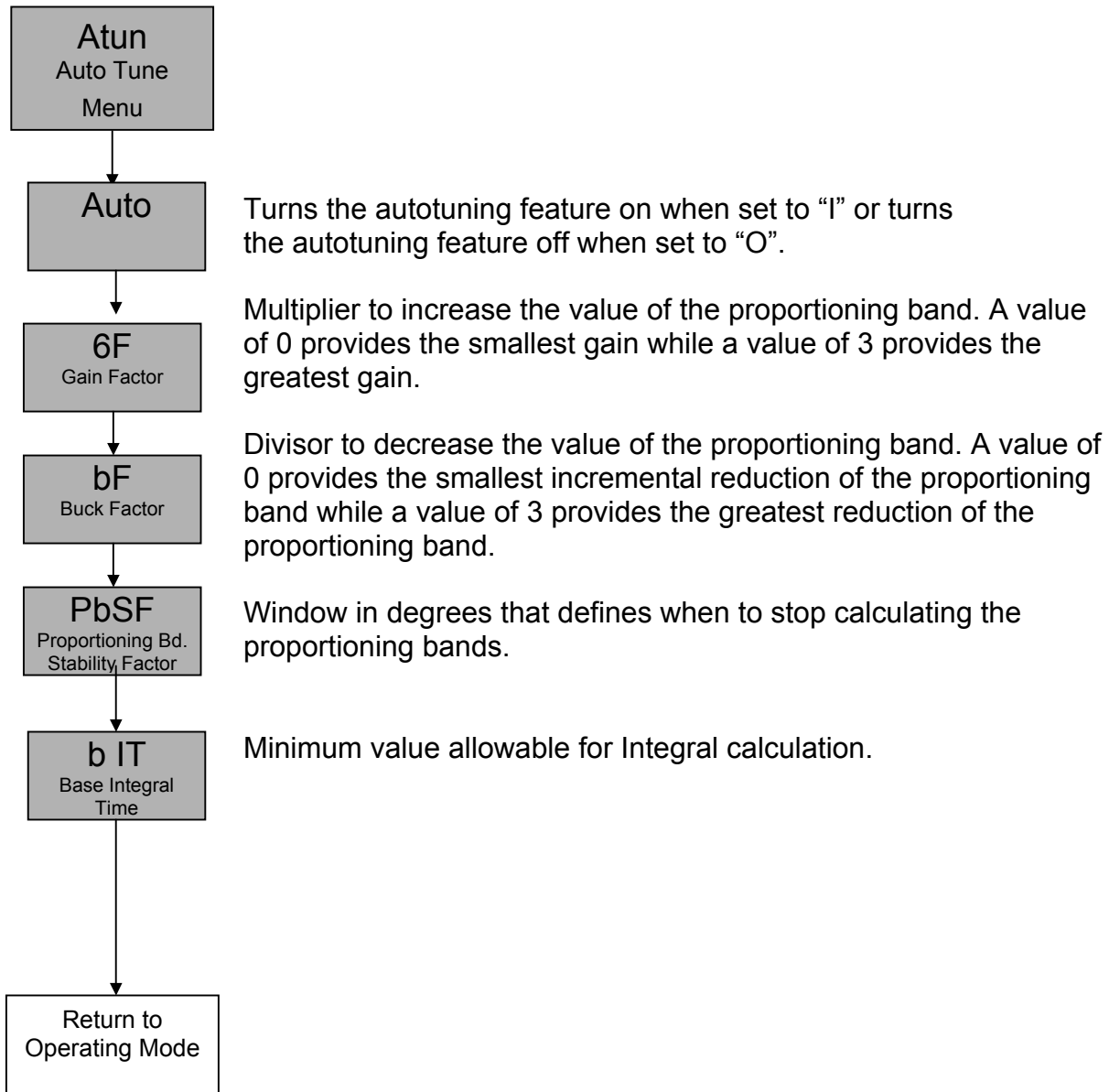
NOTE: Data word length of 8 bit has parity of "none".

Auto Tune Menu

Use the O/I button to move down through a menu to the desired option.

Use the UP ▲ or the DOWN ▼ button to adjust parameter values.

Use the O/I button again to lock in the setting and move onto the next option.



Proportional Control Tuning

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Heat Proportion band (HPb)	22	Cool Cycle time (CCt)	25
Cool Proportioning band (CPb).....	23		

Because each installation has unique requirements, the factory PID settings do not always provide optimum control.

The following pages contain the basics of how to begin with the default values and tune the unit for your specific application. (NOTE: In most cases it is sufficient to calculate a new Integral Time (It) and enter that value into the It menu option.

Refer to page 16 for menu layout and navigation.

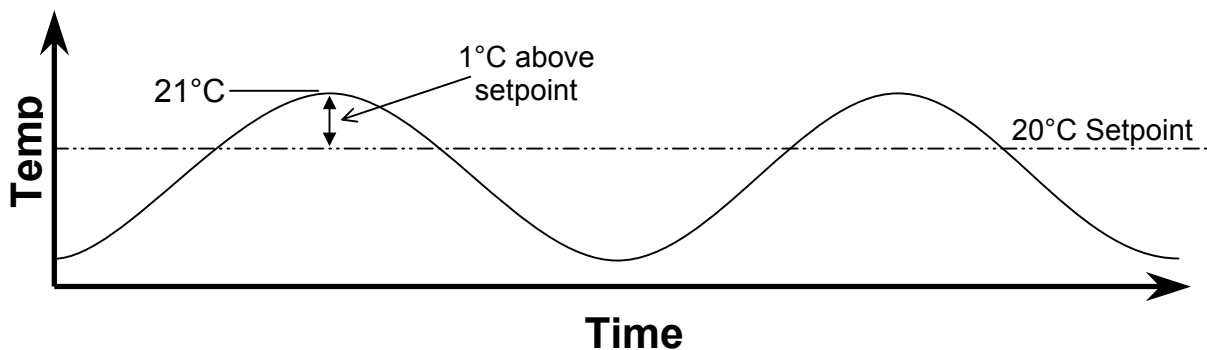
Deadband (Db)

The deadband should not exceed one-half of the smaller of the two values of CPb/HPb. See the following.

Heat Proportion band (HPb)

Take note of the temperature swing **above** the setpoint. This variation from setpoint is used to calculate the Heat Proportioning band.

HPb = Temperature variation above setpoint + 10% of that variation



For this example,

$$\text{HPb} = 1^{\circ}\text{C} + (0.1 \times 1^{\circ}\text{C}) = 1 + 0.1 = 1.1$$

Enter the result into the in the HPb option in the Proportional Control Menu.

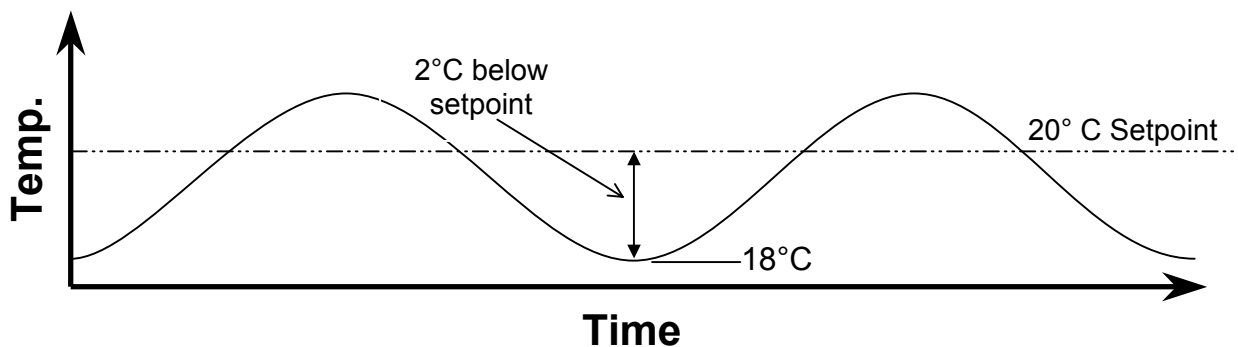
Cool Proportioning band (CPb)

Take note of the temperature swing **below** the setpoint. This variation from setpoint is used to calculate the Cool Proportioning band.

CPb = Temperature variation below setpoint + 10% of that variation.

Enter the results into the in the appropriate option in the Proportional Control Menu

Example:



For this example,

$$\text{CPb} = 2\text{ }^{\circ}\text{C} + (0.1 \times 2^{\circ}\text{C}) = 2^{\circ}\text{C} + 0.2^{\circ} = 2.2^{\circ}\text{C}$$

Enter the result into the in the CPb option in the Proportional Control Menu

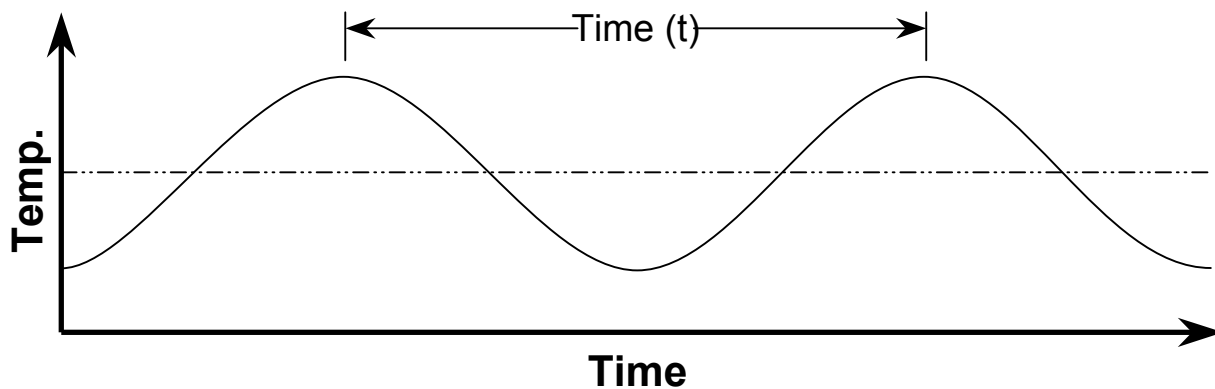
Integral Time (It) & Derivative Time (dt)

Measure the period of the temperature oscillation from peak temperature to peak temperature.

$$I_t = \frac{t}{4}$$

$$d_t \leq \frac{I_t}{4}$$

(NOTE: This represents the maximum value for derivative time. Smaller values are preferred.)



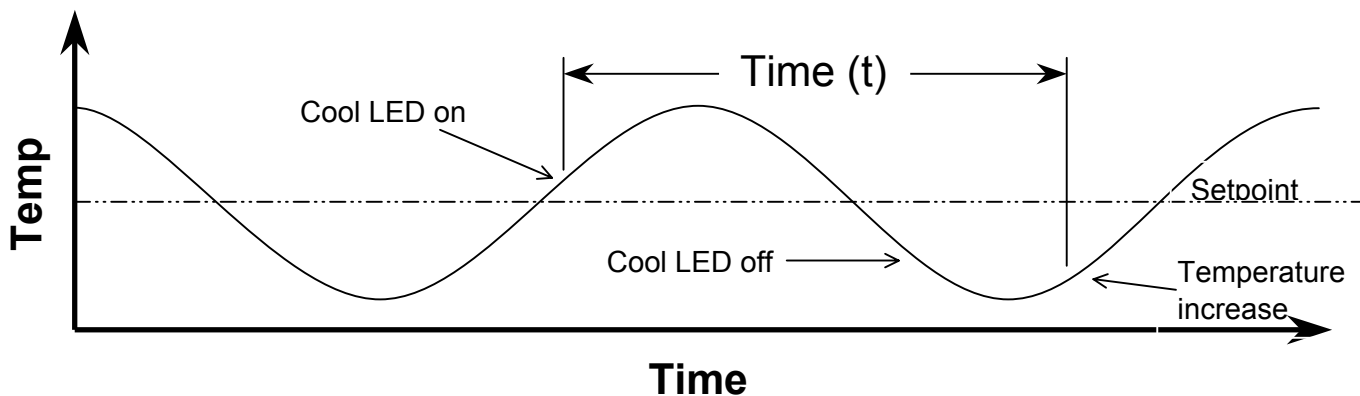
Enter the results into the appropriate options in the Proportional Control Menu.

NOTE: Re-circulating coolers, in general, respond negatively to derivative action. If any is desired, the value should be kept small.

Cool Cycle time (CCt)

To determine the Cool Cycle Time (CCt):

- ◆ Run the unit at the temperature at which the process requires the greatest degree of control. There will be some fluctuation in temperature as the controller attempts to maintain the temperature at the setpoint.
- ◆ Watch the Cool Light
- ◆ When the Cool Light illuminates, begin timing with a stop-watch.
- ◆ When the Cool Light goes out and the temperature begins to rise, stop the stop-watch and record the time (t).
- ◆ Following the instructions on the Proportional Control Menu (See page 16), set the value of CCt to equal the time (t) recorded with the stop-watch.



NOTE: The CCt is primarily a function of system hardware and the factory setting should be correct.

High Pressure Bypass Adjustment

The High-pressure Bypass adjustment is preset at the factory for optimum performance of the unit. It should NOT be adjusted from this setting without prior authorization from Kinetics Thermal Systems.

UNAUTHORIZED TAMPERING WILL VOID UNIT WARRANTY.

Alarms

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Refill Warning

Display flashes **rEFL**.

Description

The level of the process fluid in the reservoir has dropped below acceptable limits. A float switch installed in the reservoir triggers the alarm.

Decreasing levels could result from normal evaporation, or could be the result of a leak in the chiller, the process equipment, or the lines in between. In addition, certain process fluids have extremely high coefficients of expansion. Low temperatures can cause a dramatic drop in the overall volume (See Process Fluid Properties, page 9).

Appropriate Response



Warning! Refer to Adding Fluid on page 13 prior to opening the reservoir or adding fluid.

Action to Recover

Verify that the drop in fluid level is not due to any leaks. The operator should inspect the chiller, internally and externally, to ensure that there are no leaks that might be allowing fluid to escape the system. Once the system has been verified intact, additional coolant should be added to the reservoir.

Add fluid to the reservoir to raise the level of the fluid to the acceptable level (See page 13). The warning will automatically clear when the reservoir fluid level is adequate.

Low Fluid Level

Display flashes **FLUi** and the pump, compressor and heater will shut down.

Description The level of the process fluid in the reservoir has dropped to a dangerously low level. The Low Fluid alarm is designed to protect the pump, system and process equipment if the fluid level drops. A float switch installed in the reservoir triggers the alarm.

Decreasing levels could result from normal evaporation, or could be the result of a leak in the chiller, the process equipment, or the lines in between. In addition, certain process fluids have extremely high coefficients of expansion. Low temperatures can cause a dramatic drop in the overall volume.

Appropriate Response

Warning! Refer to Adding Fluid on page 13 prior to opening the reservoir or adding fluid.



Action to Recover Verify that the drop in fluid level is not due to any leaks. The operator should inspect the chiller, internally and externally, to ensure that there are no leaks that might be allowing fluid to escape the system. Once the system has been verified intact, additional coolant should be added to the reservoir.

The alarm requires a manual reset with the ▼ button.

Do not attempt to add fluid until the alarm goes away.

Over Temperature Alarm

Display flashes **OT** and the heater will shut off.

Description This alarm indicates that the heater has reached an unsafe temperature. This will generally be due to a component failure. Sensor(s) within the heater and/or heater body trigger the alarm.

Appropriate response The chiller and process should be brought to a controlled stop. Power should be removed from the chiller and the Kinetics Thermal Systems Service department contacted.

Action to Recover After investigation and/or repair, the alarm must be manually cleared by pressing the down-arrow button ▼ .

High Temperature Alarm

Display flashes **HA** and the unit will go to full cool.

Description This alarm indicates that the temperature of the process fluid going to the equipment is higher than the temperature of the High Alarm (HA) setting. An RTD which monitors the temperature of the fluid leaving the chiller triggers the alarm

This is a user feature that can be adjusted to the desired temperature by altering the value of **HA** in the **SPAN** menu.

If the thermal load is greater than the chiller's heat removal capacity, the unit will not be able to hold the setpoint temperature. This situation is potentially damaging to the equipment, so the High Alarm setting should be set to a value just above the maximum process setpoint.

Appropriate response Check the setting of the High Alarm.

Action to Recover Press and hold either the ▼ or ▲ button to enter the programming mode. Use the ▼ ▲ buttons to scroll through the menu headings until **SPAN** is displayed.

Press the **O/I** button to scroll through the **SPAN** menu parameters until **HA** is displayed.

Use the ▼ ▲ buttons to set the new **HA** value.

Press **O/I** to enter the value. Continue pressing the **O/I** button to step through the remaining parameters and exit the menu.

Low Temperature Alarm

Display flashes **LA** and the unit will unconditionally stop cooling.

Description This alarm indicates that the temperature of the process fluid going to the equipment is lower than the temperature of the Low Alarm setting. An RTD which monitors the temperature of the fluid leaving the chiller triggers the alarm.

This is a user feature that can be adjusted to the desired temperature by altering the value of **LA** in the **SPAN** menu.

Appropriate response Check the setting of the Low Alarm.

Action to Recover Press and hold either the ▲ or ▼ button to enter the programming mode.

Use the ▲ or ▼ button to scroll through the menu headings until **SPAN** is displayed.

Press the **O/I** button to scroll through the **SPAN** menu parameters until **LA** is displayed.

Use the ▲ or ▼ button to set the new **LA** value that it is lower than the desired setpoint.

Press **O/I** to enter the value. Continue pressing the **O/I** button to step through the remaining parameters and exit the menu.

Contact the Delta Design Service Division if the condition persists.

Maintenance

Section Contents

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Verification of Lock-out/Tag-out.....	33	Draining Fluid	35
Removal of Cabinet Panels	33	Battery Replacement	35

Due to the specialized nature of this unit and the environmental hazards attendant on the mishandling of its components, it is strongly recommended that all maintenance functions be carried out only by *qualified and experienced technicians*.



Caution: This unit weighs over 100 lbs. (45 kg). Any movement or handling of the unit must be done with a mechanical assistor.

Warning! Hazardous voltages present. Risk of electric shock. Disconnect all power before servicing this unit. Refer servicing to qualified Service personnel.



Notice! Only qualified service personnel should perform maintenance on the refrigeration system itself. Only EPA certified technicians may evacuate or charge refrigerants.



Hazardous Material/Contact Hazard! The chemicals used in this unit are contained within fully enclosed systems. No maintenance activities involving the refrigeration system are to be performed by the end-user.



Hot surface! The compressor and associated tubing in the lower portion of the unit are likely to be hot and pose a potential burn hazard.



Lock-out/Tag-out Procedure



To prevent accidental or unauthorized starting of this unit during maintenance, disconnect the power cord and install an appropriate lock-out device on the end of the power cord. The necessary equipment should be available to allow the user to comply with OSHA 29 CFR 1910.147 (Control of Hazardous Energies, Lock-out/Tag-out) and 29 CFR 1910.331-335 (Electrical Safety –Related Work Practices) as related to lock-out/tag-out.

Verification of Lock-out/Tag-out

The best method of ensuring electrical system isolation is by disconnecting the plug from the power outlet and following proper lock-out/tag-out procedures.

To verify that the unit is de-energized, turn the Green Main Power switch ON. If the Green Main Power and the amber mains LED do not illuminate, then the unit is de-energized. Upon removal of case panels, the de-energized state of the unit can be further verified by applying an AC voltmeter across terminals 1 and 2 of TB1 (where the linecord enters the unit) or across the blue and brown wires at the Green Power switch.

Removal of Cabinet Panels

Allow unit to come to ambient temperature. Remove panels in this order:

Rear grill

- ◆ Ensure that the line cord is unplugged and locked-out.
- ◆ Loosen and remove screws along edges of rear panel and grill.
- ◆ Pull off rear grill taking care not to stress the lines or cord.

Top

- ◆ Remove the reservoir fill/splash guard assembly.
- ◆ Remove screws in top.
- ◆ Carefully raise top and disconnect fan wires.
- ◆ Lift off top.

Sides

- ◆ Remove screws in sides.
- ◆ Pull off sides.

To replace panels, follow the above procedure in reverse.

Cleaning

Warning! Hazardous Voltages. Risk of electric shock. Disconnect the power before servicing this unit. Refer servicing to qualified service personnel.



Notice! Only qualified personnel should perform maintenance on the unit.



Caution! Proper safety equipment—eye and face protection, gloves and dust mask—should be worn.



The following procedure should be followed on a routine basis, from weekly to monthly, depending upon the operating environment.

- ◆ Disconnect electric utilities, observing proper Lock-out/Tag-out Procedures
- ◆ Wipe down all exterior cabinet surfaces with a clean damp cloth.
- ◆ Check Main Breaker switch for proper operation.
- ◆ Vacuum dust from the refrigeration condenser as well as from all screens and openings.
- ◆ Remove cabinet panels. (See page 33)
- ◆ Blow compressed air systematically from the top to the bottom of the unit. Allow the air to settle for several minutes and repeat.
- ◆ Check for areas that may have frosted during operation and insulate as required.
- ◆ Replace cabinet panels.
- ◆ Connect electric utilities.

Draining Fluid



Always use caution when handling fluids, filling or draining the unit reservoir, or working in or around the chiller. Always wear protective eyewear when operating the chiller.



The fluid used in this chiller wears out and needs to be changed on a periodic basis. Old fluid should not be recycled for re-use by the customer. It should be properly disposed of in accordance with local regulations.

To drain the reservoir:

- ◆ Allow unit to come to ambient temperature.
- ◆ Place a large, low pan underneath the black drain hose (the hose pulls out for easier access). The pan should be large enough to contain 110% of the total volume of the system.
- ◆ Use a screw-driver to loosen the clamp on the end of the drain hose.
- ◆ Remove the plug and allow fluid to flow into the pan.
- ◆ When the reservoir is drained:
- ◆ Replace the plug.
- ◆ Reposition and tighten the hose clamp.

The drain hose only empties the reservoir. It does not drain the heater, heat-exchanger, tubing, etc. To complete the draining:

- ◆ Make sure reservoir lid is installed and the bleed screw is closed.
- ◆ Disconnect the process fluid lines.
- ◆ Replace the process fluid outlet line with a hose leading to the drain pan.
- ◆ Blow compressed air into the liquid-in port. Fluid will exit from the fluid outlet line into the drain pan.

Battery Replacement

The controller assembly (FES-100-D-92) contains a battery backed RAM chip. The battery in this chip ensures data integrity for the controller when the power is off. While completely encapsulated and guaranteed for 10 years, this chip may need to be changed at some point. It is socketed in position U13 on the controller board. A replacement device is available through the Delta Design Service Division. The old device should be disposed of in the same manner as other batteries and items which may pose an environmental hazard

Troubleshooting

WARNING! Only qualified personnel should perform maintenance on the refrigeration system. **Only EPA certified technicians should evacuate or charge refrigerants.**



WARNING! Hazardous voltages present within. Risk of electric shock. Disconnect power before servicing. **Refer servicing to qualified service personnel.**



Problem	Possible Cause	Solution
UNIT WILL NOT START	Power is not connected.	Check power connections (e.g. unit is plugged in, etc.).
	Circuit breaker at machine is in the "off" position.	Turn circuit breaker "on".
	Circuit breaker at the parent unit is in the "off" position.	Turn circuit breaker "on".
PUMP WILL NOT START	Power is not connected properly.	Follow steps under UNIT WILL NOT START (above)
	Inadequate fluid in reservoir/system.	Add fluid; clear Low Fluid alarm, if necessary. See pages 11 and 28
	Pump is not primed.	Prime pump. See page 11
	Impeller is jammed.	<ul style="list-style-type: none"> ◆ Verify that fluid temperature is above freezing point. If not, turn off system and allow it to warm up. ◆ Verify unit settings. ◆ Verify that fluid is appropriate to the desired temperature range.

Problem	Possible Cause	Solution
PUMP WILL NOT START cont'd.	Pump motor has overheated.	The pump motor is provided with thermal overload protection. If the motor overheats it will shut down and restart after it has cooled down. This is usually a result of the pump being overworked. Check solutions under "FLUID FLOW IS INADEQUATE".
	Pump motor has burned out.	Refer problem to a qualified service technician.
UNIT IS NOT COOLING PROPERLY	Temperature setpoint is above the fluid temperature.	Check setpoint and adjust to proper setting.
	Condenser is dirty or clogged.	Clean condenser.
	Plumbing is incorrectly connected to process.	Check that the "Liquid Out" port of the unit is connected to the inlet of the system to be cooled and that the "Liquid In" port is connected to the outlet of the system to be cooled
	Improper fluid.	Verify that a mixture of 50% Dow Frost™ HD and 50% distilled water is being used in the unit.
	Heat load is above unit's rating.	Check to see that all fluid lines have adequate insulation and that there are no local sources of heat that may be contributing to the load.
	Refrigerant leak.	Refer problem to a qualified service technician.
	Insufficient fluid flow.	See FLUID FLOW IS INADEQUATE.
	Heater will not turn off.	Refer problem to a qualified service technician.
	Compressor is on thermal cut-out.	If the motor overheats it will shut down and restart after it has cooled down. This is usually a result of lack of air flow. Check fan and clean condenser. Allow unit to cool and restart. If problem persists, refer to a qualified service technician.

Problem	Possible Cause	Solution
FLUID FLOW IS INADEQUATE	Improper fluid.	Verify that a mixture of 50% Dow Frost™ HD and 50% distilled water is being used in the unit.
	Plumbing lines have become restricted or broken.	Refer problem to a qualified service technician.
POOR TEMPERATURE CONTROL	Insufficient fluid flow.	See FLUID FLOW IS INADEQUATE, above.
	Improper tuning parameters.	See Proportional Control Tuning on page 21.
	The cool, bypass or liquid injection valve is sticking.	Refer problem to a qualified service technician.
	Heater will not turn on/off.	Check front panel for “OT” alarm. If it exists, bring unit to a safe stop (See page 13) and refer problem to a qualified service technician.
	Open sensor.	Refer problem to a qualified service technician.
	A connection to the controller has become loose.	Refer problem to a qualified service technician.
	Defective solenoid valve.	Refer problem to a qualified service technician.
	Damaged temperature controller output.	Refer problem to a qualified service technician.
HEATER NOT OPERATING	Temperature setpoint is below the fluid temperature.	Check setpoint and adjust to proper setting.
	Over-temperature condition.	Check front panel for “OT” alarm. If it exists, bring unit to a safe stop (See page 13) and refer problem to a qualified service technician.

Warranty Information

Standard Limited Warranty

The Kinetics Thermal Systems standard domestic warranty follows. This warranty covers parts and labor for a period of one year, commencing the date of invoice, for any repairs deemed resultant of a defect in materials and/or workmanship by Kinetics Thermal Systems, F.O.B. Stone Ridge.

Any factory approved changes or extensions to this warranty should be received in writing from Kinetics Thermal Systems and filed with this warranty. If your system is eligible for coverage, please review this warranty thoroughly and contact the Kinetics Thermal Systems Service Division with any questions you may have. If your system is not covered by our standard warranty, or you are seeking optional or additional coverage, see the sections below for the service plans offered.

Covered

- Parts and labor for a period of one (1) year from date of delivery. Any part found defective will be either repaired or replaced at Kinetics Thermal Systems discretion, free of charges by Kinetics Thermal Systems at Stone Ridge, NY.
- On-site labor if repairs require that Kinetics Thermal Systems personnel travel to the equipment.
- Necessary parts and reasonable labor charges, if Kinetics Thermal Systems agrees that local service is preferable. These parts and labor charges are subject to written approval prior to initiating the repair.

Not Covered

- Travel time, travel expenses and mileage expended by Kinetics Thermal Systems personnel if repairs require on-site labor. The customer shall prepay such expenses to Kinetics Thermal Systems.
- Transportation of the equipment for repair.
- Kinetics Thermal Systems is not responsible for incidental or consequential damages.

This writing is a final and complete integration of the agreement between the customer and Kinetics Thermal Systems. Kinetics Thermal Systems makes no other warranties

express or implied, of merchantability, fitness or otherwise with respect to the goods sold under this agreement, which extend beyond the description of this limited warranty.

Kinetics Thermal Systems will have the right to inspect the equipment and determine the repairs or replacements necessary. The customer will be notified within a reasonable time of any damages incurred that are not covered by this warranty prior to initiation of any such repairs. Any customer modification of this equipment, or any repairs undertaken without prior written consent of Kinetics Thermal Systems will render this limited warranty void.

Service Options

Extended Warranty

This plan is an extension to the original new purchase warranty. You may extend the original warranty for six or twelve months up to a maximum of two years total coverage. This plan does not provide Preventive Maintenance, nor does it cover travel or any freight expenses incurred.

Preventive Maintenance

This plan provides our customers with two onsite visits per year. We would perform a thorough preventive maintenance on your Kinetics Thermal Systems equipment. You will be provided with a PM checklist and a certificate of calibration, which is traceable to NIST. The purchase of this plan also provides discounted parts and labor rate for additional service, if required.

Full Service Agreement

This plan covers 100% of expenses for travel, lodging, parts and labor. The Full Service Agreement is your total protection plan. This plan enables the end user to contact Kinetics Thermal Systems without going through the purchasing department (because the plan is prepaid). A thorough Preventive Maintenance visit is included with the Full Service Agreement. The Preventive Maintenance visit includes calibration of your equipment and a certificate of calibration that is traceable to NIST. The purchase of a Full Service Agreement ensures premium service for any repair performed on-site or at Kinetics Thermal Systems.

Contact Kinetics Thermal Systems Service Division at 845.687.5400 or 800.722.7721 for details.

Return of Equipment

If it should be necessary to return the equipment to our factory for any reason, please contact the Kinetics Thermal Systems Service Division at 800.722.7721 for a Return Authorization (RA) number and instructions on returning the unit. Please provide the model number, serial number and order number.

After securing an RA number, return the unit to Kinetics Thermal Systems, freight prepaid, at the following address:

Kinetics Thermal Systems

3538 Main Street

P.O. Box 158

Stone Ridge, NY 12484

USA

Attn: Service Division RA# _____

Make sure that the RA number and the declared value of the unit is plainly marked on your shipping label.

Kinetics Thermal Systems will refuse any equipment returned without an RA number, without freight prepaid, or with an expired RA number. This number is valid for 30 days. If your RA number expires you must request a new number.

Before working on systems that are not under warranty, the Service Division will provide you with an estimate of the time and cost for the repair of your unit. No work will be started until Kinetics receives a hardcopy of your purchase order for the repair work. This also applies to warranty work when the customer is responsible for the shipping costs.

Normally, we will repair your unit and return it within twenty working days of receipt. If your repair is urgent, you may authorize an emergency repair fee, which guarantees repair and return of your unit within seven working days of receipt.

Unless you specify otherwise, we will return the repaired unit F.O.B. from our Stone Ridge, NY factory, via ground transportation.

EDC RS-232 Programmer's Reference

Kinetics Thermal Systems
Stone Ridge, NY 12484 USA

18 February 1993 R.V.Dvorak

Revision 1.01, 7 January 1994

Revision 1.10, 31 August 1994

Revision 1.20, 9 May 1996

Revision 1.30, 21 December 1998

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Overview

The MPC and EDC controllers are used in a variety of cooling products manufactured by Kinetics Thermal Systems. The commands used by a specific unit will vary per the descriptions at the end of this reference, but the operational aspects, hardware and software, of the interface are consistent across the product line. This document details the communications interface between the microcontroller and the [independent] intelligent host processor.

At the end of this document (or chapter, when embedded within a larger manual) is a sample program which will execute on an IBM-compatible PC within either GWBASIC or QBASIC. It is suggested, should initial attempts to communicate be unsuccessful, that this program be tried. It is as unencumbered as a program may be and will aid in locating the source of difficulty: if this program runs successfully, then the difficulty must be due to one of the "extras" or "features" of the unsuccessful driver.

Hardware

The hardware of the RS-232 interface meets or exceeds the specifications of EIA standard RS-232-E-1991, with regard to electrical characteristics (impedance, open-circuit characteristics, voltages, etc.).

The physical interface connector is a 9-position female D-subminiature connector, with pin-out as specified by the IBM Corporation for the "PC-AT" [COM1] communication port.

The connections used within the interface will be limited to:

GND	Signal Ground
TXD	Transmit Data
RXD	Receive Data

All other signals of the RS-232 standard are immaterial to this application, or terminated, as appropriate.

COMMUNICATIONS

Communication operates at a user-definable BAUD rate selectable from 300, 1200, 2400, 9600.

Parity may be odd, even, or none. The interface uses one Start bit and either one, one-and-a-half, or two Stop bits (user-selectable).

Data word length is selectable at 7-bit data with designated parity, or 8-bit data without parity. All data in both directions is transmitted in ASCII.

Selections of BAUD rate, parity, and stop bits are made to the micro-controller via the control panel of the target (application) system.

Communication Data

All programmable, selectable, or switchable functions of the target system are accessible via the RS-232, with the exception of the RS-232 configuration itself, which may not be programmed from the host.

All data, programmed values, status, and system errors are accessible by the host, i.e., an appropriate query by the host will result in a data stream returned from the system as defined below.

DATA FORMAT

All data is transmitted in ASCII. All data values are transmitted via decimal character strings. Upper and lower case alphabetic characters will be accepted interchangeably. Data descriptions are identified by direction from the perspective of the system controller:

Received (from the host system to the MPC/EDC) and Transmitted (from the MPC/EDC to the host) data.

RECEIVED DATA

Data may be transmitted at any time by the host. Status queries will be answered whether or not the unit is in local or remote. Any change in system status (except "Goto Remote") requested via the RS-232, however, will require that the unit be in the "remote" state; otherwise an error will be reported to the host.

Data uses a "line" format, consisting of the following:

CMD <opt CMD> <opt CMD> <...> CR <opt LF>

where:

CMD is any valid transmitted data string

CR is an ASCII "Carriage Return"

LF is an ASCII "Line Feed"

Data commands may be grouped within a "line" command, or transmitted singly.

A data string must be terminated by a "Carriage Return" (ASCII 013 decimal / 0D hex). "Line Feed" (ASCII 010 decimal / 0A hex) may be optionally inserted by the host, but will be ignored. A "line" may not exceed 128 characters.

A listing and description of the available CMD statements appears in a later section.

Data commands which are grouped on a line must be separated by a single "Space" (ASCII 032 decimal / 20 hex).

The Delete/Rubout character (ASCII 127 decimal / 7F hex) will NOT be recognized. Unrecognized characters will result in an error acknowledge.

ANY error in transmission/reception of a "line" will assume corruption of the ENTIRE line, and ALL commands in that line will be ignored. This includes not only transmission (e.g., parity) errors, but values out-of-bounds, undefined commands, etc. This ensures that state changes are not presented to the system (e.g., new Setpoint SP) without all corresponding desired changes (such as corresponding PID values).

All data received by the target system will be presented by the host system as a character string of one of the following formats:

1) Absolute Command

Basic system functions/commands will consist of a fixed character string.

Examples:

"START"	--	Wake up system
"STOP"	--	Shut down system
"POLL"	--	Force a response from the system

2) Parametric Command

A parametric command describes a function/command for which a value must be specified. The command characters must be followed by an "equals sign" ("=") (ASCII 061 decimal / 3D hex), and a data string of decimal value.

The value may optionally contain a decimal point (except where required to define decimal fractions). Negative values require a "minus sign" ("-", ASCII 045 decimal / 2D hex) between the "equals sign" and the value. A plus sign ("+") may be used, but is not required.

Each programmable value within the system is assigned a set of limits by the system. Certain of these limits may be further modified by other program commands. Values which exceed the boundaries of either of these limits will result in an error.

The number of characters attached to the "value" field may not exceed eight; an error will result accordingly. Leading zeroes, or trailing zeroes behind a decimal point, may be added without effect, up to the character limit.

Examples:

```
SP=20      ;Adjust Setpoint to 20 degrees
SP=+20.    ;Adjust Setpoint to 20 degrees
SP=020.00 ;Adjust Setpoint to 20 degrees
SP=-60.3   ;Adjust Setpoint to -60.3 degrees
CPB=3.6    ;Adjust Cooling Proportioning Band to 3.6 degrees
```

Controllable features which are not system "program parameters", such as switches, use the values "0" to represent "off" and "-1" to represent "on" (byte false = \$00 = 0, byte true = \$FF = -1).

Examples:

```
PUMPSW=-1;Turn pump switch on
PUMPSW=0  ;Turn pump switch off
```

3) Query Command (request for information)

A request for information from the MPC to the host is an absolute command.

However, all commands which expect data in reply to the command end with a question mark ("?"). The format of the reply is defined below (under "Transmitted Data"). With few exceptions, the query command replicates the mnemonic for the corresponding parametric command, merely substituting the "?" for the "=" in the string.

TRANSMITTED DATA

It is anticipated that in a remote-controlled operation of the target system, the actual controlling "device" may be either a computer with a software program, or a human being working interactively. The format of returned data has been optimized for evaluation by a computer program, although it can be intelligently read by a human working in an interactive mode.

The content of transmitted data to the host is dependent upon the type of received data to which the system is answering. The returned message consists of one or more segments:

- a) Acknowledge: receipt and acceptance of a message which is syntactically correct, meets all constraints or limits imposed by the system, and which has been subsequently processed, is acknowledged by the character string "OK". **Exception:** certain absolute commands may result in a "runtime" error (in other words, will result in an error when the software attempts to actually execute the statement). These will result in both "OK" and the error message described below.
- b) Error Message: receipt of a message which is syntactically incorrect, exceeds system limits, or is otherwise faulty (such as Parity Error), will result alternately in an error message.

- c) Parameter Message: in response to a query, the parameter and its value will be returned to the host. If multiple value/status queries are transmitted in a single statement, the multiple replies will be transmitted on multiple lines (i.e., separated by carriage returns).
- d) Terminator Character: All messages will be terminated by an exclamation point ("!") (ASCII 033 decimal / 21 hex). This character is appended to a single-line message, including "OK", or to the end of the last line of a multiline message if the host has transmitted queries.

The controller is capable of "full-duplex" operation; i.e., it is capable of receiving data while transmitting data. However, it is strongly suggested that the host wait for the message
OK

and the exclamation point ("!") before proceeding to its next transmission, to ensure correlation between information sent and the replies.

The Command POLL has been provided as a non-operative command (similar to an assembly-language NOP or BASIC-language REM) to verify establishment of communications between the host and the slave. The POLL command will have no effect on the state of the controller or its system, and can result in an error only if the RS-232 connection itself is not correct (e.g., wrong BAUD rate, parity error, etc.).

Once the POLL command has been issued, and the string "OK!" has been received by the host, the software may be assumed to be synchronized.

User software should be configured to transmit a message (received data), receive the reply (transmitted data), and verify the integrity of the exchange before proceeding to the next transmission.

Transmitted Data Format

ACKNOWLEDGE

The explicit characters "OK" acknowledge receipt of a valid message, followed by 11 spaces (not counting the space for line continuation, described below).

ERROR

The line begins with the character "E", followed by a 3-digit decimal value defining the error number. It is up to the user to provide necessary messages defining the error, if desired. A full listing and description of error numbers is provided in a later section of this document.

An "equals sign" ("=") follows, and is then followed by a "plus" ("+") and 7-digit explanation code. For character-traceable errors, the number indicates the column position of the character which resulted in the error. Positions are numbered 0-127, 0 representing the first character and 127 the last permissible character. If the error is due to a general error (e.g., "LINE TOO LONG"), the character-trace code is 128.

Example A:

```
Received string:      START
Transmitted string:  E030+=+0000128!<CR>
                    (Error 30 = "Unit Not in Remote")
```

Example B:

Received string: SP=25 CPB=2.5 IT=35,0 DT=6
 Transmitted message: E021=+0000019!<CR>
 (Error 21, Illegal character, in position 19)

VALUE

The line begins with the character "F" (Function), followed by a 3-digit decimal code defining the opcode number assigned to the parameter.

Following the function code is an "equals sign" and an 8-character value. This value will ALWAYS begin with a polarity sign ("+" or "-"), followed by either a) 7 digits; or b) 6 digits with an embedded decimal point.

The value 0 will always be "positive".

All temperatures are internally resolved to 0.01 degrees F. Temperature values will always be returned with full resolution on the RS-232 regardless of the resolution of the control panel display or the user display options. Temperature values will be transmitted to the host in the units (C, F, K scale) selected by the DEGREES= command (or via the dEG setting in the control panel "Etc" menu).

Values for system characteristics which are not programmable parameters: e.g.: switches, on/off status, etc., will be returned as byte status. In other words, if the state is "true", the returned value will be +0000255 (byte true hex FF); if the queried status is false, or off, the returned value will be +0000000 (byte false hex 00).

Example:

Received string: SP?
 Transmitted message: OK <CR>
 F057=-0030.00!<CR>
 (Function #57, Setpoint, is currently -30 degrees)

TERMINATOR

The exclamation point ("!") is issued prior to the last <CR> to indicate "end of message", so that multiline messages may be accommodated. To facilitate message parsing by column position, this position is left with a "space" if the line is not the last of the message.

Command Set

The following commands are defined to the interface. Certain commands, while syntactically acceptable to the parser, will result in the error code "Not Yet Implemented" (nyi); these have been defined for future expansion or options.

The command opcode (function "F" number) which will be returned by a query appears in curly-brackets following each query command.

UPPERCASE is used to note other [referenced] commands.

- ALARMH= / ALARMH? {F001} Set or query the user setting of the over-temperature (high) alarm condition, in degrees. Limits are imposed by FLUID= and the factory-set system span (SSPANH).
- ALARML= / ALARML? {F002} Set or query the user setting of the under-temperature (low) alarm condition, in degrees. Limits are imposed by FLUID= and the factory-set system span (SSPANL).
- ALMCODE? {F076} Query the status of the system alarm table. A reply of 0 indicates a no-alarm condition. Other codes are documented in a separate section, below.
- BAUD? {F003} Report the present BAUD rate in use in the communication link. Values returned will be the same as those programmed via the system control panel: 0=300, 1=1200, 2=2400, 3=9600.
- CASC? (Service Use) {F004} Report the existence of a two-stage refrigeration system (0=single compressor, 1=cascade).
- CBLI? (Service Use) {F005} Report the configuration of cool/bypass/liquid injection valves in a given system configuration.
- CCT= / CCT? {F006} Set or query the Cool Cycle Time: the on/off period assigned to the proportioning cooling valves, in seconds.
- CH= / CH? (Not Yet Implemented) {F007} Define steering of loop-dependent commands to ch.1 or ch.2 in a dual-loop system.
- CLOCK= / CLOCK? (Not Yet Implemented) {F008} Define or query the existence of Real Time Clock hardware.
- CLRALARM Clear alarm conditions from the system, if any exist. Restore ALMCODE? to 0. If the condition creating the alarm state persists, however, the system will restore the alarm until that condition is corrected.
- CPB= / CPB? {F010} Set or query the width, in degrees, of the band about setpoint (SP) over which the control system will proportion the cooling valves (Cool Proportioning Band).
- CTLREM= / CTLREM? {F011} Set or query the use of the remote sensor for temperature control of the system. Value 0 (off) means "control from the internal sensor"; 1 (on) means "control from the remote sensor". If the remote sensor is not connected (open circuit), the system will automatically revert to internal-sensor control and an alarm will result.
- CURRSNS? (Service Use) {F012} Query the existence of pump/compressor current sensors as defined by the system hardware complement (factory set). 0 = off/don't exist; 1 = on.
- DATE= / DATE? (Not Yet Implemented) {F013} Set or query date in Real Time Clock option.
- DB= / DB? {F014} Set or query the deadband, in degrees, between the heat and cool proportioning bands (HPB/CPB). This value is usually negative, implying overlap.
- DEFAULT (Not Yet Implemented) Restore factory default values to the programmable parameter table.
- DEGREES= / DEGREES? {F016} Set or query the temperature scale used on the display and in further RS-232 communications. 0 = Celsius, 1 = Fahrenheit, 2 = Kelvin.

- DP= / DP? {F017} Set or query the use of integer/decimal format on the control panel display. 0 (decimal point off) displays temperature rounded to the nearest integer; 1 (decimal point on) displays temperature with 0.1 resolution.
- DT= / DT? {F018} Set or query, in seconds, the [derivative] time constant applied to the proportioning band adjustment, as a function of rate of change in the process temperature.
- FLUID= / FLUID? {F019} Set or query the number defining the fluid type in use in the system (see system programming documentation for a listing). Fluid definition automatically sets FSPANH and FSPANL, subject to SSPANH and SSPANL, to limit the permissible bounds of the setpoint SP and the alarm temperatures ALARMH and ALARML.
- FORMAT= / FORMAT? (Not implemented / obsolete) {F020} Describes the format of transmitted data. Task offloaded to the host processor.
- FSPANH? {F021} Query the high temperature limit (degrees) established by the FLUID definition.
- FSPANL? {F022} Query the low temperature limit (degrees) established by the FLUID definition.
- GNREM= / GNREM? {F023} Adjust or query the calibration gain factor applied to the remote [external] temperature sensor.
- GNRTD= / GNRTD? {F024} Adjust or query the calibration gain factor applied to the system [internal] temperature sensor.
- HEATER? (Service Use) {F025} Query the system heater configuration and phase connection definition.
- HLPC? (Service Use) {F026} Query the existence of high-low-pressure cutout on the system compressor(s). Used in water-cooled units. 0 = not used, 1 = exists.
- HPB= / HPB? {F027} Set or query the width, in degrees, of the band about setpoint (SP) over which the system will proportion the power applied to the heater (Heat Proportioning Band).
- HYSTLI? (Service Use) {F028} Query the hysteresis, in degrees, applied to activation of the liquid injection valve.
- HYSTST2? (Service Use) {F029} Query the hysteresis, in degrees, applied to measurement of the cascade condenser (first refrigeration stage output), for operation of the second-stage refrigeration.
- IT= / IT? {F030} Set or query the [integral] time constant, in seconds, applied to the adjustment of the proportioning band, governing the automatic reset ("droop" correction) of the process temperature to setpoint. Note: the IT value is applied only to the internal temperature-control sensor. If the remote sensor is in use (CTLREM=1), the command ITREM should be used. The proper selection of IT or ITREM is automatically performed by the system software per the CTLREM command.
- ITREM= / ITREM? {F031} Set or query the [integral] time constant, in seconds, applied to the adjustment of the proportioning band, governing the automatic reset ("droop" correction) of the process temperature to setpoint, when the remote sensor is in use (Cf. IT=).

LOCK= / LOCK? {F032} Set or query the state of the Local / Remote lockout. If set to 0, the LOCREM= command may be asserted. If set to 1, the LOCREM= command will result in an error message.

LOCREM= / LOCREM? {F033} Set or query the local / remote control status of the system. If set to 0, the system may only be programmed from the [local] control panel. If set to -1, the system may only be programmed from the remote communication link. If the system is in local control (LOCREM=0), all commands AAAAAAAA=, except the LOCREM= command, will result in the error message "unit is in local". Queries will perform normally. If LOCK=1 the LOCREM= message will return the error message "unit is locked in local/remote".

LOOP2? (Service Use) (Not Yet Implemented) {F034} Query existence of a second control loop, in dual-loop systems.

MODE? {F035} Query the control configuration of the system (factory-set per configuration). 0 = heat and cool, 1 = cool only, 2 = heat only.

NOISE= / NOISE? {F036} Set or query the action of the audible alarm (activated under fault conditions in conjunction with the red alarm lamp on the control panel). 0 = "off", 1 = intermittent "chirp", 2 = continuous "on".

OSREM= / OSREM? {F037} Set or query the calibration offset factor applied to the remote [external] temperature sensor.

OSRTD= / OSRTD? {F038} Set or query the calibration offset factor applied to the system [internal] temperature sensor.

PARITY? {F039} Query the parity setting of the communication link. 0 = no parity, 1 = odd, 2 = even.

PF= / PF? {F040} Set or query the selection of the automatic power recovery algorithm. 0 = disabled, 1 = enabled.

PLOCK= / PLOCK? {F041} Set or query the status of the parameter lockout feature of the control panel. If set to 1, menu values may not be changed from the control panel while the system is running, even if the unit is in "local" operation. If set to 0, the system may be fully programmed from the control panel at any time if the unit is in "local". If PLOCK has been set to 1, system operating parameters may only be changed from the control panel if the unit is first turned off (STOP).

POLLA non-operative command which may be used to test or synchronize the communications interface.

PT? {F043} Query the current process temperature (as defined by the control point CTLREM).

PTLOC? {F044} Query the current local process temperature (per the internal sensor).

PTREM? {F045} Query the current remote process temperature (per the remote sensor).

PUMP? {F046} Query the status of the circulating pump. 0 = off, -1 = on.

PUMPSW= / PUMPSW? {F047} Set or query the state of the pump switch. 0 = (turn) off, -1 = (turn) on.

RAMZERO (Not Yet Implemented) Command to zero out the microprocessor memory for restart of a "dead" unit.

- READY? {F077} Query state of process ready-determination stability algorithm (0 = not ready/stable, 1= ready/stable) per program values SP, WINDOW, and WINTIME.
- REFR? {F050} Query state of refrigeration. Returned 0 = off, 1 = 1st stage on, 2 = 2nd stage on (if cascade system).
- REFRHRS? {F078} Query running hours of system refrigeration.
- REFRSW= / REFRSW? {F051} Set or query state of refrigeration switch. 0 = off, -1 = on.
- REV? {F052} Query [embedded] software revision level in system program ROM.
- RFC Command to restore factory-determined calibration constants.
- RR= / RR? {F054} Set or query setpoint transition rate (Ramp Rate), in degrees per second.
- STOPBITS? {F055} Query the programmed number of Stop bits in the RS-232 communication definition. Values may be 1, 1.5, or 2.
- SP= / SP? {F057} Query or set the system temperature setpoint, in degrees.
- SSPANH? {F058} Query the factory-set maximum allowable setpoint, in degrees (determined by system hardware complement).
- SSPANL? {F059} Query the factory-set minimum allowable setpoint, in degrees (determined by system hardware complement).
- START / START? {F060} Command to turn the system on (subject to positions of PUMPSW and REFRSW) and to initiate the system temperature control software. Query to determine whether the system is running (0 = off, -1 = on).
- STATUS? (Not implemented, obsolete).
- STOP Command to turn the system off, restore displays and controls to idle.
- SYSHOURS? {F063} Query number of running hours accumulated on the system, as determined by the number of running hours on the pump.
- TEMPLI? (Service use) {F064} Query temperature, in degrees, of suction line, for control of liquid-injection valve in refrigeration hardware.
- TEMPST1? (Service use) {F065} Query temperature, in degrees, of the cascade condenser (heat-exchanger output of the first refrigeration stage in a two-stage system).
- TIME= / TIME? (Not yet implemented) {F066} Set or query time of day in Real-Time Clock option.
- TRIPLI? (Service use) {F067} Query factory-programmed trip temperature of suction line, to determine operation of the liquid injection valve.
- TRIPST2? (Service use) {F068} Query trip temperature, in degrees, of cascade condenser, for turn-on of the second stage refrigeration.
- UPHOURS? {F069} Query total hours of system operation (including off), from engagement of Emergency Off switch.
- USPANH= / USPANH? {F079} Set or query SP upper operating limit, in degrees, as determined by the user's requirement. This limit may not exceed the value FSPANH? or SSPANH?
- USPANL= / USPANL? {F080} Set or query SP lower operating limit, in degrees, as determined by the user's requirement. This limit may not be more negative than the value FSPANL? or SSPANL?

WAKE= / WAKE? (Not Yet Implemented) {F070} Set or query the status of the automatic-wakeup function.

WAKEMINS= / WAKEMINS? (Not Yet Implemented) {F071} Set or query the elapsed time to automatic wakeup.

WAKETIME= / WAKETIME? (Not Yet Implemented) {F072} Set or query the automatic-wakeup time set via Real-Time Clock option.

WINDOW= / WINDOW? {F073} Set or query the window, in degrees, used to determine process stability (conformance to setpoint), as reported by the system "Alarm/Ready" contacts.

WINTIME= / WINTIME? {F074} Set or query the time constant, in seconds, used to determine process stability (conformance to setpoint), as reported by the system "Alarm/Ready" contacts. This time is a time constant used in the stability integration and determination algorithm, not an absolute time value. Small movements in process temperature will be determined to be stable more rapidly than large swings. This value is used to prevent over/undershoot of the setpoint temperature from yielding a premature "ready" result.

ZEROCAL (Not Yet Implemented) Command to restore all calibration constants to the unbiased state (zero offset, unity gain).

Alarm Codes

Numeric codes are returned to the query ALMCODE? per the following alarm conditions. Alarms, once set, are maintained until explicitly cleared, even if the alarm condition has been corrected.

MPC/EDC Code 0: No outstanding alarm condition.

MPC/EDC Code 1: Low fluid level in system.

MPC/EDC Code 2: Low fluid flow in system (inadequate pressure in return line).

EDC RS75ZXXDDn Code 2: Overtemp alarm

MPC Code 3:

EDC Code 3: High temperature alarm. Process temperature exceeds ALARMH?

MPC Code 4: Stage 1 Refrigeration is not powered, as determined by current sensors. This failure can be due to [internal] overtemp cutouts, trip of a circuit breaker, etc.

EDC Code 4: Low temperature alarm. Process temperature has fallen below ALARML?

MPC Code 5: Stage 2 Refrigeration is not powered. See Code 4.

EDC Code 5: Overtemp. Indicates activation of fail-safe [control-independent] over-temperature safety device.

MPC Code 6: Pump is not powered. May be not powered, fuse may be blown, etc.

EDC Code 6: Insufficient cooling water in water-cooled system.

MPC Code 7: System has been programmed for control from Remote sensor. Remote sensor is open-circuit.

MPC Code 8:

MPC Code 9:

MPC Code 10: Same as MPC Code 4, for a single-stage (only one compressor) system.

MPC Code 11:

MPC Code 12: 4-20mA Alarm. Indicates disconnect of 4-20mA current source to remote analog programming input, if such interface is specified.

RS-232 Error Codes

The following error codes are returned Ennn if the parser/syntaxer/limits-checking software finds fault with the received string.

Group 0 Errors: UART Transmit/Receive and General Receive errors.

- E001 UART Overrun. Character received by UART before previous character has been retrieved from the character input buffer. Microprocessor hardware failure.
- E002 Parity Error. Character detected has incorrect parity as defined by control-panel programming. See PARITY?
- E003 Frame Error. Incorrect number of Stop Bits detected on received character. See STOPBITS?
- E004 Break Error. UART detects loss of RS-232 line with host. This error is only reported if such a break occurs after the receipt of valid data, and before receipt of a <CR> (carriage return). Line break is otherwise ignored.
- E005 Line Too Long. Received "line" (character string) exceeds 128 characters without receipt of <CR> (carriage return).
- E006 Receive Buffer Overrun. 1KB character input buffer is full. Commands are being received faster than they can be processed.
- E007 Line Buffer Overrun. Lines are being received faster than they can be processed.
- E008 Break Error. See E004.

Group 1 Errors: General Parsing and Transmission Errors

- E010 Transmit Buffer Overflow. Requests for information (queries) result in information being buffered faster than it can be transmitted to the host (Baud-Rate dependent). 1KB buffer exceeded.
- E011 Parse Buffer Overflow. Too many commands (>32) on a single line.

Group 2 Errors: Command Parsing Errors

- E020 Undefined String. Character string not identified as valid command, in position indicated by trailing argument.

- E021 Illegal Character. Character in string not a recognized character (A-Z, a-z, 0-9, "=", "?", ":", "+", "-", <SP> (space), <LF> (line feed), or <CR> (carriage return).
- E022 Illegal Operand. Keyword string followed by illegal operation (command, program, query). E.g., TEMPST1 may only be queried; is a temperature which exists in the system and is measured. Attempt to program via TEMPST1= will yield E022.
- E023 Question Mark (?) Followed by Argument. Query will not accept an argument.
- E024 Value Too Long. Programmed value may not exceed 8 characters.
- E025 Illegal Sign Placement or Excess Decimal Points. Polarity indication (+,-) must be first character. Only one decimal point permitted per number.
- E026 Too Many Decimal Places. Too many digits supplied after decimal point.
- E027 Value Out of Bounds. Programmed number exceeds limits fixed internally or by superseding limits (e.g., FSPANH will limit USPANH).
- E028 Excessive number. The previous filters will allow certain [illegal] ranges of numeric possibility to get through. This error traps these ranges before they cause software mathematics errors (due to register overflow, etc.).

Group 3 Errors: Security Errors

- E030 Unit Not in Remote. Attempt has been made to program a value which may not be altered if system is presently switched to "local" operation.
- E031 Not a User Function. Certain program statements are reserved for factory access. Error 31 reports an attempt to program values requiring [factory] security-code access.

Group 4 Errors: Operational and Miscellaneous Errors

- E040 Not Yet Implemented. Use of a command which is defined to the parser but not presently implemented by Kinetics Systems.
- E041 Stop Error. System already stopped has received a "STOP" command.
- E042 Start Error. System already started has received a "START" command.
- E043 Not a User Function. Certain operational commands are defined to the system and reserved for factory use. Error 43 reports use of such a command without proper security access.
- E044 Local Lockout. Unit is locked in local. Removal of this lock may only be accomplished from the system control panel before changes to system state may be made from the RS-232.

Sample Program

The following program is supplied to assist in troubleshooting should the user's attempts to communicate via the RS-232 be unsuccessful. It will execute properly from either GWBASIC or QBASIC on an IBM-compatible PC. If this program runs, the alternate driver has a software or configuration problem. If this program does not run properly, a hardware problem (usually a mis-wire) is indicated.

This program was designed to be as simple as possible. It therefore performs no syntax checking or error detection. It will prompt "COMMAND?", to which the user should type the string desired to send (e.g., "SP?<CR>"). The character string returned by the MPC will be displayed on the user's terminal. Users will note that the transmit/receive strings appear to be "out of synch" on the terminal display; this is also to keep the program as short and unencumbered as possible.

The Rubout, Backspace, and Delete keys will NOT work. They will be transmitted like any other character (and will result in an error message "Illegal Character").

Once the program has been typed into BASIC (or loaded from disk), it may be run from GWBASIC by typing "RUN", or from QBASIC from ALT-R-S or Shift-F5. To stop the program, use CTL-BREAK.

```
5 OLINE$=""
10 OPEN "COM1:9600,N,7,1,RS" AS #1
20 PRINT "COMMAND: ";
30 A$=INKEY$
40 IF A$="" THEN GOTO 110
50 PRINT A$;
60 OLINE$=OLINE$+A$
70 IF A$ <> CHR$(13) THEN GOTO 30
80 PRINT #1,OLINE$;
90 OLINE$=""
100 GOTO 20
110 WHILE NOT EOF(1)
120 B$=INPUT$(LOC(1),#1)
130 PRINT B$;
140 WEND
150 GOTO 30
```