

4848 Reactor Controller

Operating Instruction Manual

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PREFACE

SCOPE

These instructions cover the installation, operation and maintenance of Model 4848 Reactor Controller as used with laboratory reactors and pressure vessels. They cover the basic functions provided in each of these controllers and describe the several optional control modules which can be added to these expandable units. The users should study the instructions carefully before using any of these controllers so that they will fully understand the capabilities and limitations of this equipment and the safety precautions to be observed in its operation.

RELATED INSTRUCTIONS

The following publications are also included to further your understanding of this instrument and its component parts:

No.	Description
201M	Limited Warranty
549M	4848 Controller Software Package

APPLICATIONS

Each 4848 Reactor Controller consists of a packaged temperature control unit completely wired and assembled with appropriate power and safety relays, switches and pilot lights.

These units are designed specifically for use with reactors and pressure vessels and are to be used only with equipment.

Controllers furnished with reactors equipped with variable speed, DC motors have a motor switch and a speed control knob on the front panel. Controllers to be used with an air motor do not have a speed control knob.

INTENDED USAGE

This controller has been designed for use with pressure vessels and reactors. It has been designed, built, and tested to strict physical and electrical standards. However, it is the user's responsibility to install and operate it in conformance with local pressure and electrical codes.

If the instrument is used in a manner not specified by Company, the protection provided by the equipment may be impaired.

SAFETY INFORMATION

To avoid electrical shock, always:

1. Use a properly grounded electrical outlet of correct voltage and current handling capability.
2. Ensure that the equipment is connected to electrical service according to local national electrical codes. Failure to properly connect may create a fire or shock hazard.
3. For continued protection against possible hazard, replace fuses with same type and rating of fuse.
4. Disconnect from the power supply before maintenance or servicing.

To avoid personal injury:

1. Do not use in the presence of flammable or combustible materials; fire or explosion may result. This device contains components which may ignite such material.
2. Refer servicing to qualified personnel.

EXPLANATION OF SYMBOLS

II	On position, full power heater switch
I	On position, half power heater switch
O	Off Position
~	Alternating Current (AC)
	This **CAUTION** symbol may be present on the Product Instrumentation and literature. If present on the product, the user must consult the appropriate part of the accompanying product literature for more information.
	This **CAUTION** symbol indicates that the surface may be hot.
	**Protective Earth (PE) terminal.** Provided for connection of the protective earth (green or green/yellow) supply system conductor.

GENERAL SPECIFICATIONS

Electrical Ratings: 115 VAC, 15.0 Amps, 50/60 Hz
230 VAC, 15.0 Amps, 50/60 Hz

Before connecting a controller to an electrical outlet, the user must be certain that the electrical outlet has an earth ground connection and that the line, load and other characteristics of the installation do not exceed the following limits:

Voltage: Fluctuations in the line voltage should not exceed 10% of the rated nominal voltage shown on the data plate.

Frequency: Controllers can be operated from either a 50 or 60 Hertz power supply without affecting their operation or calibration.

Current: The total current drawn should not exceed the rating shown on the data plate on the controller by more than 10 percent.

Thermocouple: Unless otherwise specified, all 4848 Controllers operate with a Type-J (Iron-Constantan) thermocouple. The total resistance of the thermocouple and the lead wires should not exceed 100 ohms. If the resistance of the thermocouple circuit is higher, it will not function properly.

4848 Reactor Controller Specifications	
Input Thermocouple type	Type-J
Operating Range	-100 to 1200 °C
Readout & Setpoint Resolution	1 °C
System Accuracy	+/-2 °C
Control action	three-term PID plus limit control
Control output 1	115 VAC or 230 VAC
Control output 2	.2 amp max 115 VAC or 230 VAC
Operating voltages	115 VAC or 230 VAC
Heater Loop	
Proportional Band:	11.8 °C
Integral time:	375 sec
Derivative:	93 sec
Cycle time:	5 sec
Cooling Loop	
Proportional Band:	11.8 °C
Cycle time:	5 sec

ENVIRONMENTAL CONDITIONS

This instrument is intended to be used indoors.



CAUTION! Do not use in hazardous atmospheres.

Operating: 15 °C to 35 °C; maximum relative humidity of 80% non-condensing. Installation Category II (over voltage) in accordance with IEC 664.

Pollution degree 2 in accordance with IEC 664.

Altitude Limit: 2,000 meters.

Storage: -25 °C to 65 °C; 10% to 85% relative humidity.

UNPACK CAREFULLY

Unpack the equipment carefully and check all the parts against the packing list. If shipping damage is discovered, report it immediately to the delivering carriers. Examine the components closely for any loose parts or shipping damage and be sure to check all layers of packing materials thoroughly so as not to overlook any parts which might otherwise be discarded.

PROVISIONS FOR LIFTING & CARRYING

Before moving the instrument, disconnect all connections from the rear of the apparatus. Lift the instrument by grabbing underneath each corner.

CLEANING & MAINTENANCE

Periodic cleaning may be performed on the exterior surfaces of the controller with a lightly dampened cloth containing mild soap solution. All power should be disconnected and the power cord should be unplugged when cleaning the 4848 Controller.

There are no user serviceable parts inside the product other than what is specifically called out and discussed in this manual. Advanced troubleshooting instructions beyond the scope of this manual can be obtained by calling Company in order to determine which part(s) may be replaced or serviced.



CAUTION! Ensure that any hot surfaces have had adequate time to cool before cleaning or maintaining the reactor and/or its components.

USER'S RESPONSIBILITY

All Reactors and Pressure Vessels are designed and manufactured with great care to assure safe operation when used within their prescribed temperature and pressure limits.

But…the basic responsibility for safety when using this equipment rests entirely with the user; who must:

1. **Select a reactor or pressure vessel** that has the capability, pressure rating, corrosion resistance, and design features that are suitable for its intended use. Our engineers will be glad to discuss available equipment and material options with prospective users, but the final responsibility for selecting a reactor or pressure vessel that will perform to the user's satisfaction in any particular reaction or test must rest with the user - not with Company.

   In exercising the responsibility for the selection of pressure equipment, the prospective user is often faced with the choice between over or under-designed equipment. The hazards introduced by under-designed pressure vessels are readily apparent, but the penalties that must be paid for over-designed apparatus are often overlooked. Recognizing these criteria, our reactors and pressure vessels are offered in several different styles, each designed for convenient use in daily operation within certain temperature and pressure limits, using gaskets, closures, and other elements carefully selected for safe operation within the limits specified for that design. But in order to preserve the validity of these designs, all temperature and pressure limits must be observed, and no attempt should be made to increase these limits by making alterations or by substituting components which are not recommended by Company.

2. **Install and operate** the equipment within a suitable barricade, if required, with appropriate safety accessories and in full compliance with local safety codes and rules.

   All standard pressure vessels are provided with either a suitable relief device or a means to attach one (typically in the form of a plugged opening). When a pressure vessel is delivered without a pressure venting device, it is the customer's responsibility to provide pressure relief in order to protect the operator and the equipment from destructive high pressures. If you need more information or need help in selecting a proper relief device, please contact Company.

3. **Establish training procedures** to ensure that any person handling the equipment knows how to use it properly.

4. **Maintain the equipment** in good condition and establish procedures for periodic testing to be sure the vessel remains structurally sound.

INSTALLATION

GENERAL INSTRUCTIONS

Set the controller on a sturdy bench or table where there is convenient access to an electrical outlet with the appropriate supply voltage and current ratings in accordance with national and local electrical code requirements. Leave a space of at least twelve inches between the controller and the heater of the reactor so that the controller will not be affected by radiant heat.

CONNECTIONS

Labeled connections are provided on the rear panel of the controller.



4848 Reactor Controller (115V), Back Side

COOLING ONLY

The cooling output connector is to be used only with Company cooling solenoid valve assemblies supplied with the appropriate cooling power cord.

HEATING ONLY

The heating output connector is to be used only with Company heater assemblies supplied with the appropriate heater power cord.

MOTOR

The motor output connector is to be used only with Company motor assemblies supplied with the appropriate motor power cord.

CAUTION! Before powering the controller, secure the clamp on motor cord to the controller with the provided screw next to the motor socket for safety purposes.

Other appropriate connectors are provided on the rear panel of the controller.

The **PRIMARY TEMP INPUT** connection is for the Primary Temperature Module sensor input.

The **TEMPERATURE INPUT** connection is for the Temperature Module or ETLM sensor input.

The **PRESSURE INPUT** connection is for the Pressure Module sensor input.

The **RPM INPUT** connection is for the RPM Module sensor input.

The **COMM** connection is for Communication output.

COMPONENT SUMMARY

SWITCHES AND INDICATORS



The **MAIN POWER** switch on the back of the controller will cut off power to the controller. Take care to position the controller such that the main power switch may be accessed easily when the controller needs to be disconnected.

The **HEATER** switch is a manual, three-position, illuminated switch which controls the amount of power sent to the heater. In the HIGH (**II**) position, full power is developed by the heater. In the middle (**O**) position the heater is off. In the LOW (**I**) position, a diode is switched into the system to allow only one-half of the rated voltage to be supplied to the heater. This low setting will be most useful when operating the reactor at temperatures below 175 °C. Power for the heater is supplied through a solid state relay controlled by the temperature control module. The light in the heater switch will glow only when current is flowing to the heater.

The **HIGH LIMIT indicator light** will glow when the **HIGH LIMIT RESET** is disengaged. When the light comes on, the user must find the source of the problem, correct it, and then manually reset the system using the high limit reset button on the front of the controller.

The **MOTOR CONTROL** consist of:

1. **AUTO**/**MANUAL** switch
2. **ON/OFF (I/O)** switch
3. **SPEED** control knob

The **SPEED** control knob should be turned down to a minimum setting before turning on the motor switch to minimize electrical surges within the speed control unit. A speed control knob is not included when the reactor is equipped with an air motor for stirring or when the controller is created for use with a non-stirred vessel.

If equipped with a motor control module, there will also be a **AUTO**/**MANUAL** **switch**. When the **auto/manual switch** is in **manual mode**, the speed control knob will adjust the motor stirring speed. When the **auto/manual switch** is in **auto mode**, the RPM module will adjust the motor stirring speed. If there is no motor control module installed, the auto/manual port will be plugged and the speed control knob is the sole control for the stirring speed.

PROTECTIVE FUSES AND RELAYS

An **INST FUSE** (instrument fuse) is mounted on the back panel. This is a Fast-acting, 250 VAC, 1.0 amp fuse, intended to protect the temperature control module and any installed display modules.

The **MOTOR RESET** provides overload protection for 0-90VDC motors. This is a re-settable breaker designed to protect the motor if it becomes overloaded. The breaker will have a rating selected to match the motor on the apparatus.

The **MOTOR FUSE** provides protection for 0-180 VDC motors. This lighted fuse holder has a light that will come on if the motor becomes overloaded and the fuse burns out. The fuse rating will be selected to match the motor on the apparatus.

A **LOAD FUSE** is mounted on the back panel on 115V systems. This fast-acting, 250 VAC, 20 amp fuse is intended to protect the controller and prevent electric shock hazard from fault from occurring.

The **LOAD FUSE** and **NEUTRAL FUSE** are mounted on the back panel on 230V systems. These fast-acting, 250 VAC, 20 amp fuses are intended to protect the controller and to prevent electric shock hazard from fault from occurring.

CAUTION! Unplug unit before servicing. For continued protection against possible hazard, replace fuses with same type and rating of fuse.

COMPONENT SUMMARY *(CONTINUED)*

Thermocouple burnout protection is included in each of these controllers. If the thermocouple should burn out, or if there is a break in the thermocouple circuit, power to the heater will be shut off. In most cases this will cause the controller to show a "no Conn" reading. A similar high reading will be displayed if the controller is turned on without an attached thermocouple. In either of these situations, the high limit reset will activate. The thermocouple break must then be corrected and the High Limit Reset must be reset in order to activate the system.

High Limit Reset

Each Series 4848 Controller has a high temperature limit control which will trip the High Limit Relay and shut off the heater if the temperature reaches a preset level. If tripped, the lockout relay will pop out, thereby preventing the system from heating the reaction when the temperature falls back below the limit setting. This must be manually reset before heating can occur again.

On Model 4848 Controllers the high temperature limit is preset at the factory to 375 °C for most systems. On these controllers an alarm condition is indicated by an illuminated red indicator labeled as "ALM" on the control module. If the temperature exceeds the limit, the controller alarm condition will appear, the High Limit Reset will be tripped, and power to the heater will be shut off.

Access to the Controller Cabinet

To open the controller cabinet, unplug the power cord and remove the two screws in the upper corners of the back panel. Then lift the top plate upwards, allowing the hinged top and front panel to swing forward, providing full access to all internal components.



CAUTION! The inside of the controller cabinet should be accessed by qualified personnel only.

Fuses

The 4848 Controller has a number of fuses which are intended to be field serviceable. See the Parts List Section on page 25 for more information.



CAUTION! Unplug unit before servicing. For continued protection against possible hazard, replace fuses with same type and rating of fuse.

INSTRUCTIONS FOR THE 4848 REACTOR CONTROLLER

CAUTION! Check that controller settings are set to factory defaults before operating for the first time. The default settings are listed on pages 20-23.

Note: *Controller parameters can be found in Appendix A on page 24 of this manual.*

TEMPERATURE CONTROL MODULE



PRIMARY TEMPERATURE

The 4848 Reactor Controllers are available with a microprocessor based control module that provides full three-term PID control with adjustable tuning parameters. The temperature control interface is labeled as **Primary Temperature** on front panel.

To facilitate start up with reasonably good PID control, parameters for both heating and cooling are pre programmed at the factory.

Output 1 on these controllers drives the heater. Output 2 can be used to activate a cooling system. The control parameters can be set independently for each of these outputs.

Two lines of information, labeled **PV** and **SV**, are shown on the display during normal operations. The upper line (PV) shows the actual temperature as read by the control thermocouple. The lower line (SV) shows the set point. When the controller is heating, the **Out1** light will illuminate or blink. When the controller is cooling, the **Out2** light will illuminate or blink. When an alarm condition has been reached, the High Limit Reset will trip, cutting power to the heater, and the **ALM** light will illuminate indicating a High Limit was activated.

Temperature Control

The easiest way to control temperature with the 4848 Controller is to use setpoint control. With setpoint control, the controller will attempt to bring the temperature to the value of the setpoint by adjusting the heater output.

The setpoint may be adjusted by doing the following:

1. Press the up or down arrow until the lower display shows the desired setpoint. The lower display will blink, showing the value has not been set yet.

2. Press the set button. The lower display will stop blinking, showing the new value has been set.

TEMPERATURE CONTROL MODULE *(CONT.)*

High Temperature Alarm Setpoint

The 4848 Reactor Controller also has a High Temperature Alarm built into it. When the temperature exceeds this limit, it will pop the High Limit Reset, preventing power from going to the heater. The High Temperature Alarm setpoint may be adjusted by doing the following:

1. Press the **circular** arrow key three times. The upper display will read **AL1H** and the lower display will read the High Temperature Alarm setpoint (usually 375C).

2. Use the up or down arrow to adjust this to the desired setpoint.

3. Press the up or down arrow until the lower display shows the desired setpoint. The lower display will blink, showing the value has not been set yet.

4. Press the **set** button. The lower display will stop blinking, showing the new value has been set.

5. Pressing the **set** button again will return the display to the main screen.

PID groups

a. The primary temperature controller contains 4 groups of PID parameters (PID0, PID1, PID2 and PID3), which can be used to store up to four different sets of PID parameters. Each group is identified by the SV used during the autotuning cycle.

b. The parameter displayed is the group in use with exception of PID4. When PID4 is set, the PID parameters will automatically switch between PID groups 0, 1, 2 and PID group 3, depending on which group's SV best matches the current temperature (PV).

c. All of PID parameters in the group can be obtained from auto-tuning or they can be set manually. When manually entering PID values into a particular group, the SV for that group can be manually entered as well.

Autotuning

1. Fill the vessel with an amount of liquid which well represents the intended process.



CAUTION! Refer to Manual 230M for safety information on the heating of liquids in Reactors and Pressure Vessels.

2. If you wish to autotune at different temperatures using the four available PID groups proceed with step 3, otherwise skip to step 4.

3. Press the set key once followed by the return key (circular arrow) twice. [PIdO] will be displayed on the screen in the top display. Use the up and down arrow keys to change between PID groups 0, 1, 2 and 3. Press the set key to solidify the change. Press the set key again to return to the main screen.

4. Heat the system to the desired temperature using set point control on the primary temperature controller. Let the temperature come to steady state which will typically occur 15 to 30 minutes after reaching the desired set point depending on the size of the reactor.

5. On the main screen of the controller, press the set key. The screen will show [AtL] on the top display and [oFF] on the bottom display. Press the up arrow to change the lower display to [on]. The display will blink, press set to solidify the change. Press set again to return to the main screen.

6. As the Autotune starts, the LED indicator under AT will blink, and Out 1 will fully engage attempting to heat the reactor 100% power. This will continue for a while, and the controller will go through a few cycles where it turns the power on at 100% and turns it off to see how the temperature responds.

7. A typical Autotune time is half an hour for liquid water systems, but it may take longer depending on the process. When the process is complete, the AT light will stop flashing, and the temperature will settle on the set point.

INSTRUCTIONS FOR THE 4848 REACTOR CONTROLLER *(CONTINUED)*

Temperature Profiles - Ramp and Soak

The 4848 Controller has a programming feature which allows more flexibility when compared to set point control. Rather than controlling temperature to a single set point, a ramp and soak program may be entered to control various soak times, ramp rates and set points. Within the programming mode there are eight patterns available with each pattern having up to eight steps which can be programmed. Patterns can be set to repeat and they can be linked to other patterns (or the same pattern which allows for infinite program cycles). This allows for up to 64 unique steps and thousands of possible program configurations.

To input a ramp and soak:

1. First set the controller's Run/Stop [r-S] parameter to Stop [StoP]. This will prevent the program from automatically starting after the program has been entered. You can do this by pressing the return key once and use the arrow keys to change the setting to "stop" and press the set key to solidify the change.

2. To enable the ramp and soak control mode, hold the set key for approximately three seconds. The upper display will change to indicate the Input [InPt] parameter, and the lower display will indicate the temperature sensor type.

3. Press the return key until the upper display indicates the control mode parameter [Cntl] and the lower display indicates the control method (default is PID [PId]). Use the arrows to change this value to the program [Prog] setting. The display will blink, and pressing the set key will solidify the change.

4. Press the return key once. The upper display will indicate the pattern [PAtn] parameter and the lower display will show the pattern number. The pattern parameter defines which pattern parameters are being viewed in steps 5 - 10. Setting the pattern parameter to off [oFF] allows you to skip the proceeding ramp/soak parameters. Use the arrow keys to change the pattern number and press the set key to solidify the change.

5. Press the return key once. The upper display will read [SP00], where the "00" represents the pattern and step number, respectively. The lower display will indicate the set point for indicated step. The set point can be adjusted using the arrow keys then press the set key to solidify the change.

   Note: *The first SP00 used must be a higher temperature than the current temperature (PV) or the program will not execute properly.*

6. Press the return key once. The upper display will read [tI00], where the "00" represents the pattern number and the step number, respectively. The lower display will show the time to execute the current set point in "hh:mm" format. The time setting can be changed by using the arrow keys then press the set key to solidify the change.

7. Repeat steps 4 and 5 for "SP01" through "SP07" and "tI01" through "tI07" as required. Once you have entered all the steps you want, you can leave the remaining "SP" and "tI" variables at zero and press the return key to advance.

***Temperature Profiles - Ramp and Soak** (Continued)*

8. Press the return key to display [PSy0] on the upper display, where "0" represents the current pattern number. This parameter determines the last step to execute in the pattern. For example, if PSy0 has a value of 3, Steps SP00 through SP03 will execute. Use the arrow keys to change the setting and press the set key to solidify the change.

9. Press the return key to display [cyc0], where "0" represents the pattern number. This parameter defines how many times you want the indicated pattern to repeat. If you would like the pattern to only execute once, set this value to zero. Use the arrow keys to change the setting and press the set key to solidify the change.

10. Press the return key to display [Lin0], where "0" represents the pattern number. This parameter allows you to link the indicated pattern another. If you would like more than seven separate steps in the process, set this to the next pattern number you wish to link to. Use the arrow keys to change the setting and press the set key to solidify the change.

11. Press set to return to the main screen. Note that the lower display of the main screen has changed to show the program step.

    ***Note:** The program will attempt to hold the temperature at the set point determined by the last step executed. So, if you wish for the reactor cool to room temperature once the program has finished, the last executed step must have a set point consistent with room temperature and the time for the last step can be set to 00:00.*

Engaging a Program

1. From the main screen, press the return key two times to display [Prun] on the upper display. The lower display will indicate the pattern at which you wish to execute.

2. Press the return key until the run/stop parameter [r-S] is on the upper display. The lower display will indicate the setting of the run/stop parameter. Change this value to [run] in order to start the program determined in step 1. Press set to return to the main screen.

   If you wish to stop the program completely, you may change this value to [Stop]. Changing the run/stop mode back to stop will restart the program from the beginning.

   If you wish to stop the program and continue controlling the temperature at the current set point, you may change this value to program stop [PSTP]. Changing back to run mode from a program stop will restart the program from the beginning.

   If you wish to hold the program at the current temperature, you may change this to program hold [Phod]. Changing back to run mode from a program hold will continue the program from its current step.

3. The main screen will now show the current set point on the lower display. Pressing the arrows will allow you to change between: [P-St] to display the current pattern and step, [r-tC] to display the remaining time in the current pattern step, or [SP] to display the set point for the current pattern step. Press set will solidify this display change.

INSTRUCTIONS FOR THE 4848 REACTOR CONTROLLER *(CONTINUED)*

Appendix: sample programs

A sample program to ramp from 25 °C to 250 °C in 2 hours:

Variable	Value	Meaning
ptrn	00	Pattern 0
SP00	25	Setpoint of 25 °C (first step is a soak by default)
tI00	00:01	Hold for 1-min
SP01	250	Setpoint of 250 °C
tI01	02:00	Ramp to setpoint in 2 hours
SP02	250	Setpoint of 250 °C
tI02	00:40	Ramp to setpoint in 40-min*
SP03	25	Setpoint of 25 °C
tI03	00:00	Ramp to setpoint immediately**
SP04	25	Setpoint of 25 °C
tI04	00:00	
SP05	25	Setpoint of 25 °C
tI05	00:00	
SP06	25	Setpoint of 25 °C
tI06	00:00	
SP07	25	Setpoint of 25 °C
tI07	00:00	
PSy0	3	Execute steps 0-3 only***
CyC0	0	Do not re-cycle program
Lin0	off	Do not execute another program upon completion

* The beginning and final setpoint are equal, making this a soak step.

** The time is zero, making this a step function instead of a ramp.

*** Steps 4-7 are not executed here.

**** The SP_0 vaue must be higher than the initial temperature (PV) of the reactor or the program will not initiate correctly.

A sample program to heat to 200 °C as fast a possible, hold for 2 hours, and come back down as quickly as possible:

Variable	Value	Meaning
ptrn	00	Pattern 0
SP00	200	Setpoint of 200 °C (first step is a soak by default)
tI00	00:00	Move setpoint to 200 °C immediately
SP01	200	Setpoint of 200 °C
tI01	01:00	Ramp from 200°C to 200 °C over 1 hour*
SP02	200	Setpoint of 200 °C
tI02	02:00	Ramp from 200 °C to 200 °C over 2 hours **
SP03	25	Setpoint of 25 °C
tI03	00:00	Ramp to setpoint immediately***
SP04	25	Setpoint of 25 °C
tI04	00:00	
SP05	25	Setpoint of 25 °C
tI05	00:00	
SP06	25	Setpoint of 25 °C
tI06	00:00	
SP07	25	Setpoint of 25 °C
tI07	00:00	
PSy0	3	Execute steps 0-3 only****
CyC0	0	Do not re-cycle program
Lin0	off	Do not execute another program upon completion of this program

* The physical system will take some time to go from room temp to 200 °C. Step 01 is presented as a "heat up" step. The time value in this step should be adjusted after the first run is complete and the operator knows the expected heat up time.

** It is useful to keep this step 02 separate from step 01 so you can adjust step 01 to match the heat up time.

*** The time is zero, making this a step function instead of a ramp.

**** Steps 4-7 are not executed here.

PRESSURE DISPLAY MODULE (PDM)



PRESSURE

When this optional module is present, the left display in red shows the pressure, and the right hand display in green shows the Pressure Alarm setpoint. If the reactor pressure exceeds this setpoint, the pressure module will trip the High Limit Alarm, cutting power to the heater.

This module provides a digital read out for continuously monitoring the pressure within the reactor, plus a backup safety feature which will terminate power to the heater if a preset maximum is reached. Pressure is displayed with a 1 psi resolution and a 1% FS accuracy. The safety cut-out feature offers excellent protection against accidental over-pressure by allowing the user to set a maximum pressure which, if reached, will activate the high limit relay and turn off the heater immediately.

The signal for the pressure display is generated by a transducer in a stainless steel housing mounted on the reactor. The transducer must not be heated above 120 °C; an elevated temperature can caused the accuracy of the transducer to suffer. A water cooling sleeve attached to the transducer mounting body can be used to keep the transducer below this limit when operating the reactor at higher temperatures.

For applications involving reactants corrosive to stainless steel, the transducer body can be replaced with an isolator of special alloys which will keep the reactants away from the transducer. Users should consult with the Technical Support before purchasing one of these.

The Pressure Alarm setpoint may be adjusted by doing the following:

1. Press the up or down arrow until the lower display shows the desired setpoint. The lower display will blink, showing the value has not been set yet.

2. Press the set button. The lower display will stop blinking, showing the new value has been set.

When ordering a pressure display module separately or installed in any controller, always specify the reactor on which the transducer will be installed so that the proper mounting hardware can be furnished.

> ***Note:*** *if the pressure transducer is not attached to the 4848 Controller, the High Limit Reset may trip or show a fixed but incorrect value. We recommend always operating with the transducer attached.*

TACHOMETER DISPLAY MODULE (TDM)



RPM

This optional feature can be included in any 4848 Controller to provide a means for continuously monitoring the stirring speed in a reactor. It consists of an optical sensor installed in the overarm drive on the reactor which is then connected to the 4848 Controller.

The connecting cable has a plug which fits the marked socket on the back panel of the controller. The digital display will show the stirring speed over a range of 0-2200 rpm with a 1 rpm resolution and +/- 10 rpm accuracy.

Note: The SV display serves no function on a TDM

Users wishing to control the stirring speed remotely with setpoint control ought to consider the Motor Control Module (MCM) in lieu of the TDM.

INSTRUCTIONS FOR THE 4848 REACTOR CONTROLLER *(CONTINUED)*

MOTOR CONTROL MODULE (MCM)



RPM

When this optional module is present, the left display in red shows the stirring speed, and the right hand display in green shows the rpm setpoint. The 4848 Controller is designed to run in either Auto or Manual stirring mode. The auto/manual switch on the front panel will toggle between these two modes.

In Manual mode, the stirring speed is controlled by turning the speed control knob on the front panel. The rpm setpoint has no bearing on the stirring speed.

In Auto mode, the motor will stir at the rpm setpoint using closed loop PI control. The speed control knob has no bearing on the stirring speed. The RPM setpoint may be adjusted by doing the following:

1. Press the up or down arrow until the lower display shows the desired setpoint. The lower display will blink, showing the value has not been set yet

2. Press the set button. The lower display will stop blinking, showing the new value has been set.

   Note: The MCM leaves the factory in STOP mode. Before the MCM may be used in auto mode it must be set to RUN mode. Press the circular arrow key to display the RUN/STOP screen.

   For best results, use the RUN/STOP mode as the final switch. Return the MCM to STOP mode when the setpoint motor control is not desired, and return it to RUN mode as the last step to initiate the setpoint motor control.

MOTOR TORQUE MODULE (MTM)

This module provides a means for continuously monitoring the motor output percent to the stirrer motor. When used with a Motor Control Module (MCM), the motor speed control will provide a constant stirring speed at a given setting. Changes in the power required by the motor will correspond to changes in the viscosity of the fluids in the vessel. This will be a useful option for users who want to monitor the progress of a polymerization reaction in which there are viscosity changes as the reaction proceeds.

HIGH-TEMP CUT-OFF MODULE (HTM)



TEMPERATURE

This module provides a redundant high temperature safety cut-off which will shut down the reactor heater if an unusual malfunction should develop in the primary control system. It is a completely independent safety backup system, operating in addition to the high-limit control built into each temperature controller. It has its own thermocouple, digital display and wiring, and can be preset to shut down the heater at any desired temperature.

If the secondary temperature (PV) exceeds the alarm setpoint (SV), the alarm indicator on this display will illuminate and the High Limit breaker will trip, interrupting power to the heater.

The High Temp Cut-Off Alarm setpoint may be adjusted by doing the following:

1. Press the up or down arrow until the lower display shows the desired setpoint. The lower display will blink, showing the value has not been set yet.

2. Press the set button. The lower display will stop blinking, showing the new value has been set.

HIGH-TEMP CUT-OFF MODULE (HTM)

This secondary temperature module does not control the heater. It is used as an alarm only. When ordering this option separately or installed in the 4848 Controller, always specify the reactor with which it will be used so that a thermocouple of the proper style and length can be furnished.

EXTERNAL TEMPERATURE LIMIT CONTROL MODULE (ETLM)



TEMPERATURE ETLM

This module should be considered in systems with large thermal lags or long dead times such as gas phase reactions or other systems where temperature control is difficult.

This configuration is similar to the High Temperature Cut Off Module (HTM), but the display will now turn off the heater if it exceeds a pre-set adjustable setpoint. This non-latching setpoint will establish a maximum wall temperature, and combined with the main temperature control module will help suppress overshoot in difficult to control processes.

As an added safety feature, there is also a secondary alarm which will trip the High Limit Reset when breached. This secondary alarm provides a redundant high temperature safety cut-off which will shut down the reactor heater if an unusual malfunction should develop in the primary control system. It is a completely independent safety backup system, operating in addition to the high limit control built into each temperature controller. It has its own thermocouple, digital display and wiring, and can be preset to shut down the heater at any desired temperature.

To set the primary (non-latching) temperature limit, press the up or down arrow on the display. The setpoint value on the right will flash. Press the set button to solidify this display and complete the change.

If the heater temperature exceeds the ETLM setpoint (non-latching), the output to the heater will be interrupted. This will not trip the High Limit Reset, and when the heater temperature falls back below the primary setpoint, it will allow power to flow to the heater again.

To set the secondary (latching) temperature limit, press the **circular** arrow key three times. The left-hand display will read **ALIH** and the right-hand display will read the secondary temperature limit setpoint (usually 375 °C). Press the up or down arrow on the display. The setpoint value on the right will flash. Press the set button to solidify this display and complete the change.

When ordering this option separately or installed in the 4848 Controller, always specify the reactor with which it will be used so that a thermocouple of the proper style and length can be furnished.

MOTOR SPEED CONTROL

4848 Controllers are equipped with a solid state speed control module for use with the variable speed, DC motors installed on stirred reactors. The module itself (approximately 4 inches square) is mounted inside the chassis on the bottom plate. A motor switch and a speed adjustment potentiometer are mounted on the front panel. Each module also requires a resistor matched to the horsepower of the motor with which it will be used, as listed in the following table:

Part No.	Motor Rating	Motor Voltage	Resistor
876E6	1/17 HP	90 VDC	0.25 ohm
876E3	1/8 HP	90 VDC	0.10 ohm
876E	1/4 HP	90 VDC	0.05 ohm
876E3	1/4 HP	180 VDC	0.10 ohm
876E2	1/2 HP	90 VDC	0.025 ohm
876E	1/2 HP	180 VDC	0.05 ohm
876E5	3/4 HP	180 VDC	0.035 ohm

INSTRUCTIONS FOR THE 4848 REACTOR CONTROLLER *(CONTINUED)*

4848 Controllers furnished as a part of a complete stirred reactor system will have the proper resistor installed at the factory. Any controller sold separately will require a motor specification so that the proper resistor may be provided.

Always turn the speed control knob fully counterclockwise to the off position before turning on the motor switch, then advance the knob clockwise slowly to develop the desired speed. Do not overload the motor. Any high speed or high viscosity load which trips the circuit breaker (90 VDC motors) is too heavy. Reduce the speed to avoid overloading and use the reset button on the rear panel to restart the motor.

Adjustments To Speed Control Board

There are five trimpots in the speed control module that can be used to adjust the performance of the motor. These are set at the factory for optimum performance and should not be disturbed unless customized settings are required to match a particular set of operating conditions. The instructions below should be followed carefully if these controls are to be readjusted.

The CL, current limiting/torque adjustment is set at the factory to 1.5 times the motor rating. It is intended to protect both the module and the motor against overloads and heavy surge currents during startup. It can also serve as a torque limiting device by reducing the maximum power output of the system.

The IR, compensation adjustment is used to improve motor control under varying load conditions. If the loads do not fluctuate, this control can remain at approximately one-fourth of full setting. But if the motor speed drops more than 2% under load, this adjustment should be increased. If it is set too high, the motor speed will fluctuate in a cyclical manner.

The MAX, maximum speed adjustment controls the maximum speed of the motor. To increase the motor speed, turn the control knob on the front panel to its maximum setting, then use the MAX trimpot to raise the speed to the desired level. Note, however, that the motor may become dangerous if the speed is raised above the motor's rated rpm.

The MIN, minimum speed adjustment can be used to raise the minimum motor speed. To change this setting, turn the control knob on the front panel to its minimum setting, then adjust the MIN trimpot to obtain the desired minimum speed, this adjustment will also affect the maximum setting, making it necessary to adjust both MAX and MIN trimpots to obtain the desired spread.

The ACCEL, acceleration adjustment is normally set to provide controlled acceleration from zero to full speed in 2 seconds. It can be adjusted to higher or lower acceleration times anywhere between 0.5 and 4 seconds, but changing this setting will affect the MAX speed and IR compensation which will have to be readjusted. If the acceleration time is reduced to 0.5 seconds (6 o'clock trimpot position), increase the IR trimpot one quarter turn clockwise and decrease the MAX trimpot one fifth turn counterclockwise. If the acceleration time is increased to the maximum time of 4 seconds (full rotation), the IR trimpot must be decreased and the MAX increased in the same rotation amounts mentioned above.

SOLENOID VALVE MODULE

This module provides a solenoid valve, a metering valve and all parts needed to assemble an automatic cooling system for any reactor. It usually is installed in a cold water line with a flow connection to the cooling coil and an electrical connection to the cooling socket on the back of the 4848 Controller. Coolant will then be admitted to the coil whenever cooling is called for by the controller, thereby minimizing any temperature overshoot. This system is particularly advantageous when holding fixed temperatures below 150 °C or for controlling exothermic reactions. Compressed air can be used as a coolant if the amount of heat to be removed is not large.

COMMUNICATION WITH PC

The 4848 Controller is provided with RS-485 port (labeled comm) and may be connected to a USB port on a PC with optional A1925E4 communication cable.

Quick Start Instructions for Connecting with PC

1. Download the software from website. The link to the proper software was sent on a physical paper document along with the 4848 controller. If this cannot be found, contact technical support.

2. Connect the A1925E4 communication cable between the comm port on the back of the 4848 Controller and an open USB slot on the PC.

3. The PC should open an "Install Hardware" wizard automatically when the cable is connected to the USB slot. If it does not, go to the Control Panel and select "Add Hardware" to start the wizard.

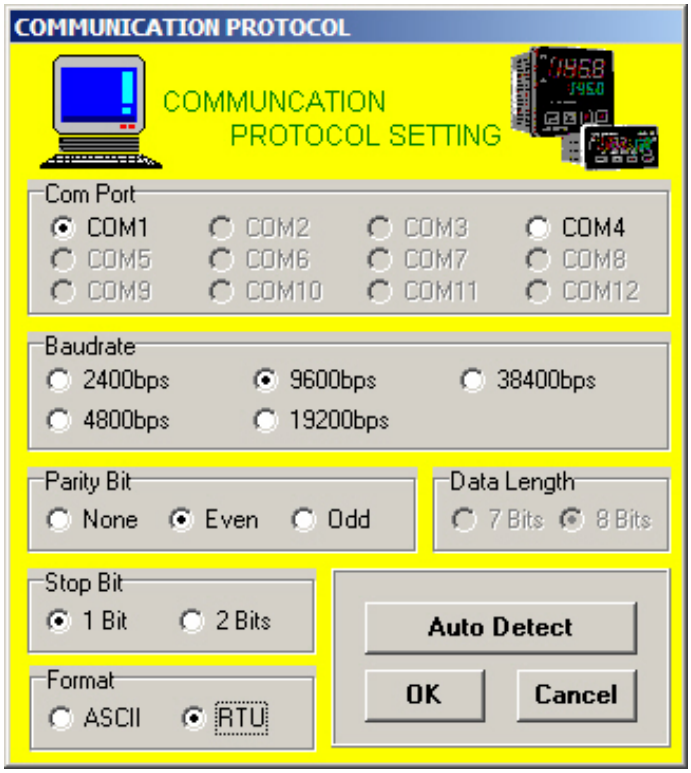
4. When prompted for a driver location, select "browse" and select the folder where the 549M software was downloaded in step 1. It may prompt that the driver has not been validated; select "continue anyway" to continue the installation. After this it may repeat the installation process for the RS-485 converter.

5. Copy the "___com.exe" and "convert.exe" software to the PC.

6. Once copied to the PC, open the ___Com.exe file. No installation is necessary.

7. At the main ___Com program screen, select "protocol >> set PC". Ensure that the following values are set:

Baud:	9600
Data length:	8
Parity:	even
Stop bit:	1
ASCII:	RTU



Click **OK** to return to the main screen.

8. At the main screen, select "Program >> Monitor". The Monitor screen will come up. There will be a generic icon on the left, and four mini screens on the right. Each mini screen can be used to connect to a different module on the 4848 Controller.

9. In the first mini screen, select 1 for the Address, and click Connect. It should connect to the Primary Temperature module on the 4848 Controller, and the bottom half of the screen should show parameters for the controller. These may be modified here. Of most interest will be the "Input >> SV" value, which is the setpoint for temperature. Also, the "Alarm >> Alarm 3" value will show the High Limit alarm for this module.

10. Any other modules on the 4848 Controller may be accessed through the remaining available mini screens. The modules have addresses numbered 1-4 starting from the left most module on the 4848 Controller.

INSTRUCTIONS FOR THE 4848 REACTOR CONTROLLER *(CONTINUED)*

Datalogging and Charting

The 4848 Controller comes equipped with a charting and datalogging program. This program cannot be run simultaneously with the control program, but once the user is satisfied that the controller is set, the control program may be closed, allowing the charting and datalogging program to run. The modules on the 4848 may still be modified manually at the physical panel during datalogging and charting.

1. Open the ___Com.exe file. No installation is necessary.

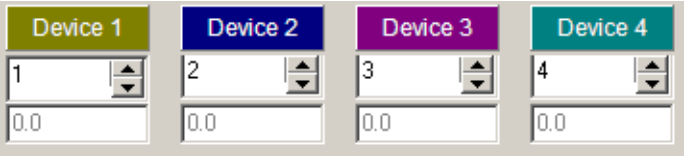
2. At the main program screen, select "protocol >> set PC" (if you have already done previously, you may skip this step). Ensure that the following values are set:

Baud:	9600
Data length:	8
Parity:	even
Stop bit:	1
ASCII:	RTU

Click **OK** to return to the main screen.

3. At the main screen, select "Program >> Recorder". The Recorder screen will come up.

4. Select the proper address for the Devices you wish to chart. The primary temperature has address 1, and each additional module would have an address numbered 2-4 going from left to right on the physical 4848 Controller.



5. Click the Save button and save a REC file to an appropriate place on the PC. When the chart is generated, it will write to this file.



6. When you return to the main Recorder screen, notice that the Save button is depressed. Hit the Start button to begin recording.



7. The chart will show the process values of each module represented. As the values change, the chart will automatically scale to show the values.

8. When you wish to stop recording, click the stop button. The chart has already been saved in the REC file created in step 5. You may view the chart by clicking the recorder button.



9. You can convert the file to a TXT file for export to a spreadsheet as well.

Converting a Chart File to TXT

Once a chart REC file has been created, you can convert it to a TXT file for export into a spreadsheet.

1. Open the "convert.exe" file copied to the PC earlier.

2. Click the "CONVERT" button. Locate the REC file to be converted, and click "Open".

3. The conversion program will create a new TXT file in the same location as the REC file with the name "CONVFILE.TXT".

4848 FACTORY DEFAULTS

NAVIGATING THE MENU SYSTEM

There are three broad categories of functions in the 4848 Controller modules. They are Regulation, Operation, and Initial Settings. From the main screen, Regulation mode is accessed by pressing the set button. The Initial Setting mode is accessed by holding the set button for three seconds. Operation mode is accessed by pressing the circular arrow.

In each mode, you can cycle through the variables by pressing the circular arrow. To change a value, use the up or down arrow, which causes the value to flash. Then press the set button to solidify the choice. Return to the main screen by pressing set again.

Keys command:



SET RETURN DOWN UP

1. Press the "SET" key to select
2. Press return key move to next operation mode
3. Up/Down arrow keys to select type or adjust value

Abbreviation Guide:

Abbreviation	Meaning
Op.	Operation
Type/Value	Select Type or Adjust Value
T/C	Thermocouple
TBD	To be Determined
temp.	temperature
comm.	communication

PRIMARY TEMPERATURE MODULE

Press return key and release

Op. Mode	Type/Value	Comment
r-S	Run	Run/Stop
SP	0**	Decimal point position
AL1H	375	Upper alarm setting
LoC	OFF	Lock mode (lock all keys or only up/down arrow able to use)
Out1	- (read-only)	Heater output %
Out2	- (read-only)	Cooling output %

** If using a type-J or type-K thermocouple, SP = 0
If using an RTD, SP = 1

Press and hold down "SET" for 5-sec

Op. Mode	Type/Value	Comment
InPt	J**	Input type
tPUn	C	Temp. unit
tP-H	1200**	Upper-limit temp. range
tP-L	-100**	Lower-limit temp. range
CTRL	PID	Control mode (ON/OFF, MANUAL, PID and PID PROG)
S-HC	H1C2	Output 1 is Heating and output 2 is Cooling
ALA1	6	Absolute upper limit alarm operates when PV value is higher than AL1H setting
ALA2	0	Alarm 2 is disabled
SALA	OFF	System alarm
CoSH	ON	Comm. write function that able to use set point from software
C-SI	RTU	Format type
C-no	1	Comm. address
bPS	9600	Comm. baud rate
Len	8	Data length setting
PrtY	Even	Parity bit setting
StoP	1	Stop bit setting

**

Temperature Sensor	InPt	tP-H	tP-L
Type-J thermocouple	J	1200	-100
Type-K thermocouple	K	1300	-200
RTD	Pt	600	-200

4848 FACTORY DEFAULTS *(CONTINUED)*

PRIMARY TEMPERATURE MODULE *(CONT.)*

Press "SET" and release

Op. Mode	Type/Value	Comment
At	OFF	Auto Tuning ON/OFF
PID0	0	The 0th PID Parameter
SV	0	The 0th SV
P0	11.8	Proportional control
I0	375	Integral control
D0	93	Derivative control
IoF0	0	Integral value offset
HtPd	5	Heat cycle control
HcPd	5	Cool cycle control
CoEF	1	1 & 2 value output group during dual loop output control
dEAd	0	Dead band
tPoF	0	PV Offset

TDM / MCM MODULE

Press return key and release

Op. Mode	Type/Value	Comment
r-S	Stop	Run/Stop
SP	0	Decimal point position
LoC	OFF	Lock mode (lock all keys or only up/down arrow able to use)
Out1	- (read-only)	Motor output %

Press and hold down "SET" for 5-sec

Op. Mode	Type/Value	Comment
InPt	v5	Input type (v5 = 0-5V, v10 = 0-10V, nA0 = 0-20mA, nA4 = 4-20mA, nV =0-50mV)
tP-H	2206	Upper-limit range
tP-L	0	Lower-limit range
CTRL	PID	Control mode (ON/OFF, MANUAL, PID and PID PROG)
S-HC	Heat	Heat/Cool control
ALA1	0	Alarm 1 is disabled
SALA	OFF	System alarm
CoSH	ON	Comm. write function that is able to use set point from software
C-SI	RTU	Format type
C-no	2	Comm. address
bPS	9600	Comm. baud rate
Len	8	Data length setting
PrtY	Even	Parity bit setting
StoP	1	Stop bit setting

Press "SET" and release

Op. Mode	Type/Value	Comment
At	OFF	Auto Tuning ON/OFF
PID0	0	The 0th PID Parameter
SV	0	The 0th SV
P0	170	Proportional control
C0	1	Integral control
D0	0	Derivative control
CoF0	0	Integral value
HtPd	.5	Heat/Cool cycle control
tPoF	0	PV Offset
CrHI	0	Analog output high
CrLo	0	Analog output low

4848 FACTORY DEFAULTS *(CONTINUED)*

PDM MODULE

Press return key and release

Op. Mode	Type/Value	Comment
r-S	Stop	Run/Stop
SP	TBD**	Decimal point position
AL1H	0	Upper-limit alarm 1
LoC	OFF	Lock mode (lock all keys or only up/down arrow able to use)

** If units are psi, SP = 0
If units are Bar, SP = 1

Press and hold down "SET" for 5-sec

Op. Mode	Type/Value	Comment
InPt	V5	Input type (V5 = 0-5V, V10 = 0-10V, nA0 = 0-20mA, nA4 = 4-20mA, nV = 0-50mV)
tP-H	TBD**	Upper-limit pressure range
tP-L	0	Lower-limit pressure range
CTRL	ON/OFF	Control mode (ON/OFF, MANUAL, PID and PIDPROG)
S-HC	Heat	Heat/Cool control
ALA1	2	Alarm operates when PV value is higher than SV Value + ALH setting
SALA	OFF	System alarm
CoSH	ON	Comm. write function that able to use set point from software
C-SI	RTU	Format type
C-no	3	Comm. address
bPS	9600	Comm. baud rate
Len	8	Data length setting
PrtY	Even	Parity bit setting
StoP	1	Stop bit setting

** Set tP-H according to the following:

Transducer range (psi)	tP-H (psi)	tP-H (Bar)
200	200	13.79
500	500	34.47
1000	1000	68.95
2000	2000	137.9
3000	3000	206.8
5000	5000	344.7
7500	7500	517.1

Press "SET" and release

Op. Mode	Type/Value	Comment
HtS	0	Heating hysteresis setting
tPoF	0	PV Offset

HTM/ETLM MODULE

Press return key and release

Op. Mode	Type/Value	Comment
r-S	Stop	Run/Stop
SP	0**	Decimal point position
AL1H	0 [HTM] 375 [ETLM]	Upper-limit alarm 1
LoC	OFF	Lock mode (lock all keys or only up/down arrow able to use)
Out1	- (read-only)	Heater Output %

** If using a type-J or type-K thermocouple, SP = 0
If using an RTD, SP = 1

Press and hold down "SET" for 5-sec

Op. Mode	Type/Value	Comment
InPt	J**	Input type
tPUn	C	Temperature unit
tP-H	1200**	Upper-limit temp. range
tP-L	-100	Lower-limit temp. range
CTRL	ON/OFF	Control mode (ON/OFF, MANUAL, PID and PID PROG)
S-HC	Heat	Heat/Cool control
ALA1	2 [HTM] 6 [ETLM]	Alarm operates when PV value is higher than AL1H value
SALA	ALA1	System alarm
CoSH	ON	Comm. write function that able to use set point from software
C-SI	RTU	Format type
C-no	4	Comm. address
bPS	9600	Comm. baud rate
LEn	8	Data length setting
PrtY	Even	Parity bit setting
StoP	1	Stop bit setting

**

Temperature Sensor	InPt	tP-H	tP-L
Type-J thermocouple	J	1200	-100
Type-K thermocouple	K	1300	-200
RTD	Pt	600	-200

Press "SET" and release

Op. Mode	Type/Value	Comment
HtS	0	Heating hysteresis setting
tPoF	0	PV Offset

4848 FACTORY DEFAULTS *(CONTINUED)*

MTM MODULE

Press return key and release

Op. Mode	Type/Value	Comment
r-S	Stop	Run/Stop
SP	1	Decimal point position
LoC	OFF	Lock mode (lock all keys or only up/down arrow able to use)

Press and hold down "SET" for 5-sec

Op. Mode	Type/Value	Comment
InPt	v10	Input type (v5 = 0-5V, v10 = 0-10V, nA0 = 0-20mA, nA4 = 4-20mA, nV =0-50mV)
tP-H	TBD**	Upper-limit range
tP-L	0	Lower-limit range
CTRL	ON/OFF	Control mode (ON/OFF, MANUAL, PID and PID PROG)
S-HC	Heat	Heat/Cool control
ALA1	0	Alarm mode
SALA	OFF	System alarm
CoSH	ON	Comm. write function that able to use set point from software
C-SI	RTU	Format type
C-no	4	Comm. address
bPS	9600	Comm. baud rate
Len	8	Data length setting
PrtY	Even	Parity bit setting
StoP	1	Stop bit setting

** For 90VDC motor, 115 VAC, tP-H = 142.9
For 180VDC motor, 230 VAC, tP-H = 120.4
For 90VDC motor, 230 VAC, tP-H = 153.2

Press "SET" and release

Op. Mode	Type/Value	Comment
HtS	0	Hysteresis
TPoF	0	PV Offset
CrHI	0	Analog output high
CrLo	0	Analog output low

APPENDIX A: CONTROLLER PARAMETERS

INITIAL SETTING MODE

Press ↵ to advance

InPt	Set input type
tPUn	Set temperature unit (Does not display when analog input)
tP-H	Set upper-limit of temp. range
tP-L	Set lower-limit of temp. range
Ctrl	Select control mode
S-HC	Select heating/cooling control or dual loop output control
ALA1	Alarm 1 mode setting
ALA2	Alarm 2 mode setting (Only available on Primary Temperature Controller)
ALA3	Alarm 3 mode setting (Only available on Primary Temperature Controller)
SALA	Set system alarm
CoSH	Communication write function enable/disable
C-SL	ASCII, RTU communication format selection
C-no	Communication address setting
bPS	Communication baud rate setting
LEn	Data length setting
PrtY	Parity bit setting
StoP	Stop bit setting

OPERATION MODE

Press ↵ to advance

1234	Use ▼ ▲ key to set temperature set point
r-S	Control setting RUN or STOP
Ptrn	Start pattern setting (PID program control and PStP Time setting)
SP	Decimal point position selection (except for B, S, R type inputs, all the other types can be set)
AL1H	Upper-limit alarm 1 (This parameter is available only when ALA1 function is enabled)
AL1L	Lower-limit alarm 1 (This parameter is available only when ALA1 function is enabled)
AL2H	Upper-limit alarm 2 (This parameter is available only when ALA2 function is enabled)
AL2L	Lower-limit alarm 2 (This parameter is available only when ALA2 function is enabled)
AL3H	Upper-limit alarm 3 (This parameter is available only when ALA3 function is enabled)
AL3L	Lower-limit alarm 3 (This parameter is available only when ALA3 function is enabled)
LoC	Setting lock mode
oUt1	Display output value of 1st output group
oUt2	Display output value of 2nd output group

REGULATION MODE

Press ↵ to advance

At	Auto-tuning (Available in PID control and RUN mode)
Pidn	4 groups PID modes (n=0~3). When n=4, PID control is auto regulated.
PdoF	PD control offset setting (Available when PID control is ON and Ti=0, set the value of PdoF)
HtS	Heating hystereisis setting (Available in ON/OFF control mode)
CtS	Cooling hystereisis setting (Available in ON/OFF control mode)
HtPd or CtPd	Heating & Cooling control cycle (Available in PID control mode)
HCPd	Control cycle setting of 2nd output group. (Available in PID control and Dual Loop output control mode)
CoEF	P value of 1st & 2nd output group during dual loop output control. P value of 2nd output group = (P value of 1st output group) x CoEF
dEAd	Dead Band (Available in Dual Loop output control mode)
tPoF	Regulate temperature deviation value
CrHc	Regulate upper-limit of analog output value (Display when equipped with an analog output)
CrLo	Regulate lower-limit of analog output value. (Display when equipped with an analog output)

PARTS LIST

FUSES

Part No	Fuse	Rating
139E6	Instrument Fuse	Fast acting, 1 Amp, 250 VAC
139E10	Cooling Fuse	Fast acting, .25 Amp, 250 VAC
2074E	Load/Neutral Fuse(s)	Fast acting, 20 Amp, 250 VAC
959E5	Motor Board Fuse (A+)	Very fast acting, 8 Amp, 250 VAC
185E2	Motor Board Fuse (L)	Fast acting, 10 Amp, 250 VAC
Motor Fuse/Motor Breaker		
139E8	1/2 hp, 180VDC	Slo-blo, 2.5 Amp, 250 VAC
139E19	1/4 hp, 180VDC	Slo-blo, 1.5 Amp, 250 VAC
139E20	3/4 hp, 180VDC	Slo-blo, 4.0 Amp, 250 VAC
801E	1/12 hp, 90VDC	Circuit breaker, 1.0 Amp
801E	1/17 hp, 90VDC	Circuit breaker, 1.0 Amp
801E3	1/8 hp, 90VDC	Circuit breaker, 1.5 Amp
801E2	1/4 hp, 90VDC	Circuit breaker, 2.5 Amp
801E4	1/2 hp, 90VDC	Circuit breaker, 5.0 Amp

CAUTION! For continued protection against possible hazard, replace fuses with same type and rating of fuse.

COMMUNICATION

Part No	Description
A1925E4	RS-485 to USB Conversion Cable
A1925E6	RS-485 to USB Conversion Cable, Isolated
A2208E	RS-485 Daisy Chain Harness, 10 ft

COOLING SOLENOIDS

Part No	Description
A160HW3EB	Solenoid Valve Pkg 115V 5FT
A160HW3EE	Solenoid Valve Pkg 230V 5FT
A160HW7EB	Solenoid Valve Pkg 115V 10FT
A160HW7EE	Solenoid Valve Pkg 230V 10FT
A160HW8EB	Solenoid Valve Pkg 115V 20FT
A160HW8EE	Solenoid Valve Pkg 230V 20FT
A160HW9EB	Solenoid Valve Pkg 115V 30FT
A160HW9EE	Solenoid Valve Pkg 230V 30FT

MODULE ACCESSORIES

Primary Temperature Module (PTM) and High-Temp Cut-Off Module (HTM)

Part No.	Description
A470E2	Thermocouple extension wire, type-J, 5-ft
A470E4	Thermocouple extension wire, type-J, 10-ft
A470E7	Thermocouple extension wire, type-J, 15-ft
A470E5	Thermocouple extension wire, type-J, 20-ft
A470E8	Thermocouple extension wire, type-J, 25-ft
A470E6	Thermocouple extension wire, type-J, 30-ft
A470E9	Thermocouple extension wire, type-J, 35-ft
A470E10	Thermocouple extension wire, type-J, 40-ft
A472E4	Thermocouple, type-J, 5-1/2" length
A472E2	Thermocouple, type-J, 9-1/2" length
A472E3	Thermocouple, type-J, 11-1/2" length
A472E	Thermocouple, type-J, 7-1/2" length
A472E5	Thermocouple, type-J, 21-1/2" length
A472E6	Thermocouple, type-J, 15-1/2" length
A490E4	Dual T/C, type-J, 5-1/2" length
A490E	Dual T/C, type-J, 7-1/2" length
A490E2	Dual T/C, type-J, 9-1/2" length
A490E3	Dual T/C, type-J, 11-1/2" length
A490E6	Dual T/C, type-J, 15-1/2" length
A490E2	Dual T/C, type-J, 21-1/2" length

External Temperature Limit Module (ETLM)

Part No.	Description
A511E2	Heater thermocouple, type-J, bayonet style
A511E4	Heater thermocouple, dual, type-J, bayonet style

PARTS LIST *(CONTINUED)*

Pressure Display Module (PDM)

Part No.	Description
A1905E5	Pressure harness, 5-ft, covered
A1905E	Pressure harness, 10-ft, covered
A1905E8	Pressure harness, 15-ft, covered
A1905E3	Pressure harness, 20-ft, covered
A1905E9	Pressure harness, 25-ft, covered
A1905E7	Pressure harness, 30-ft, covered
A1905E10	Pressure harness, 35-ft, covered
A1905E11	Pressure harness, 40-ft, covered
A1906EP02	Transducer, 200 psi
A1906EP05	Transducer, 500 psi
A1906EP10	Transducer, 1000 psi
A1906EP20	Transducer, 2000 psi
A1906EP30	Transducer, 3000 psi
A1906EP50	Transducer, 5000 psi
A2599HC2	Transducer cooling body assembly
A2685HC	Cooling sleeve assembly
2083HC	Cooling sleeve for A2599HC2
827HC	O-rings for cooling sleeve
2714HC	Hose nipple

Note: *Additional Pressure Ranges are available upon request.*

Tachometer Disaplay Module (TDM) or Motor Control Module (MCM)

Part No.	Description
A1001E	Optical sensor for cart reactor
A1001E2	Optical sensor for bench reactor
A1001E3	Optical sensor for gear box drives
A1001E4	Optical sensor for 4553/54/77/78
A1001E6	Optical sensor for 5100 reactor
A1001E8	Optical sensor for 3:1 gear box drive
A1001E9	Optical sensor for 4555 reactor
A1001E10	Optical sensor for 10:1 gear box drive
A1831E	Optical sensor for 5500 Compact Lab Reactor
1564HC	Slotted wheel for cart, bench, and low pressure (1:1) reactors
1564HC2	Slotted wheel for low pressure (2:1) reactors
3056HC	Slotted wheel for 5500 Compact Lab Reactor
A1177E8	Tachometer harness, 5-ft
A1177E	Tachometer harness, 10-ft
A1177E4	Tachometer harness, 15-ft
A1177E2	Tachometer harness, 20-ft
A1177E5	Tachometer harness, 25-ft
A1177E3	Tachometer harness, 30-ft
A1177E6	Tachometer harness, 35-ft
A1177E7	Tachometer harness, 40-ft

CONTROLLER DIAGRAMS

REACTOR CONTROLLER, 115 VAC & 230 VAC

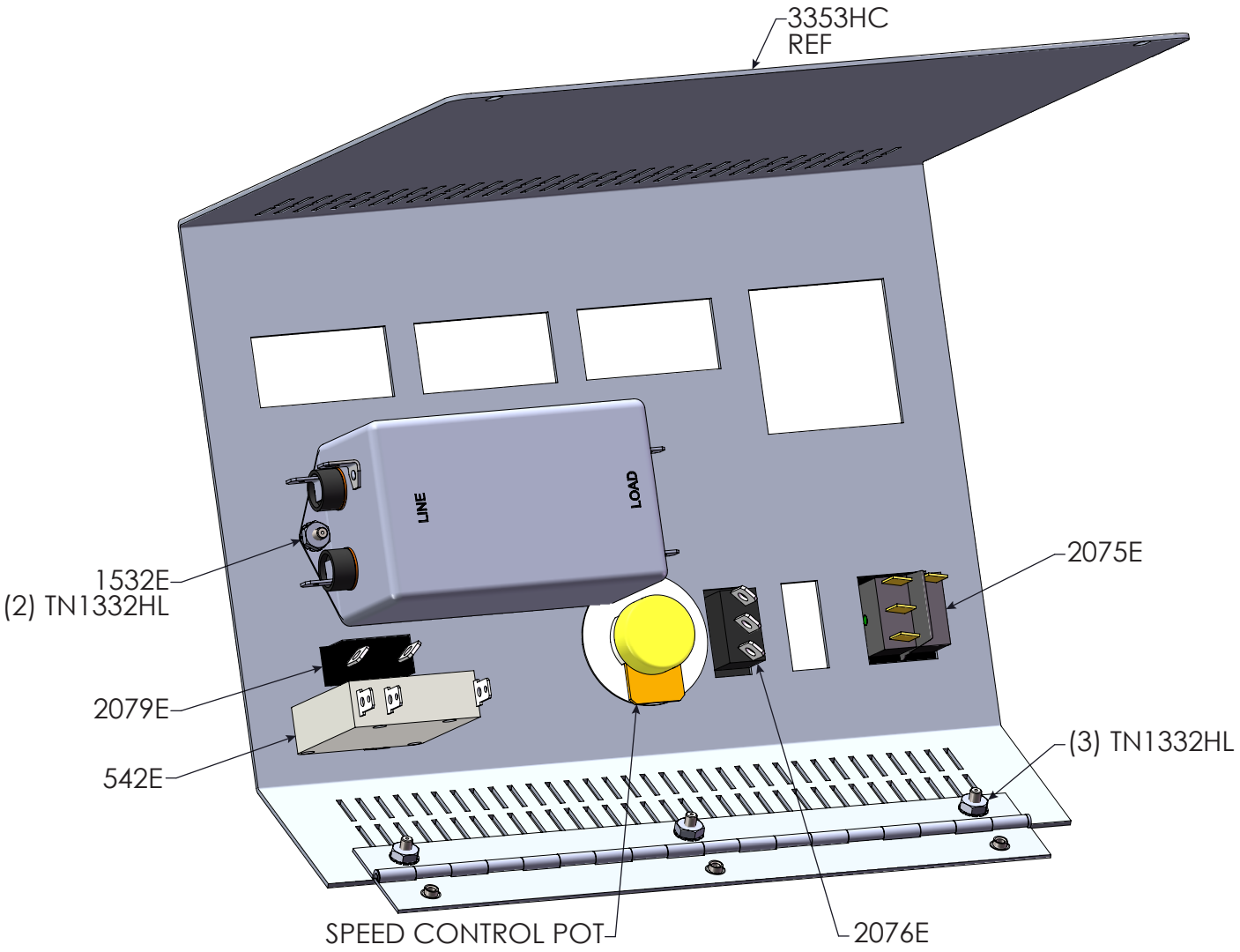


Diagram 1: Front Panel, 115V & 230V

Part No.	Description
1532E	Filter
2075E	Heater switch
2076E	Motor switch
2079E	High Limit Light
3353HC	Front Panel plate
542E	High Limit breaker
TN1332HL	Hex Nut

REACTOR CONTROLLER, 115 VAC

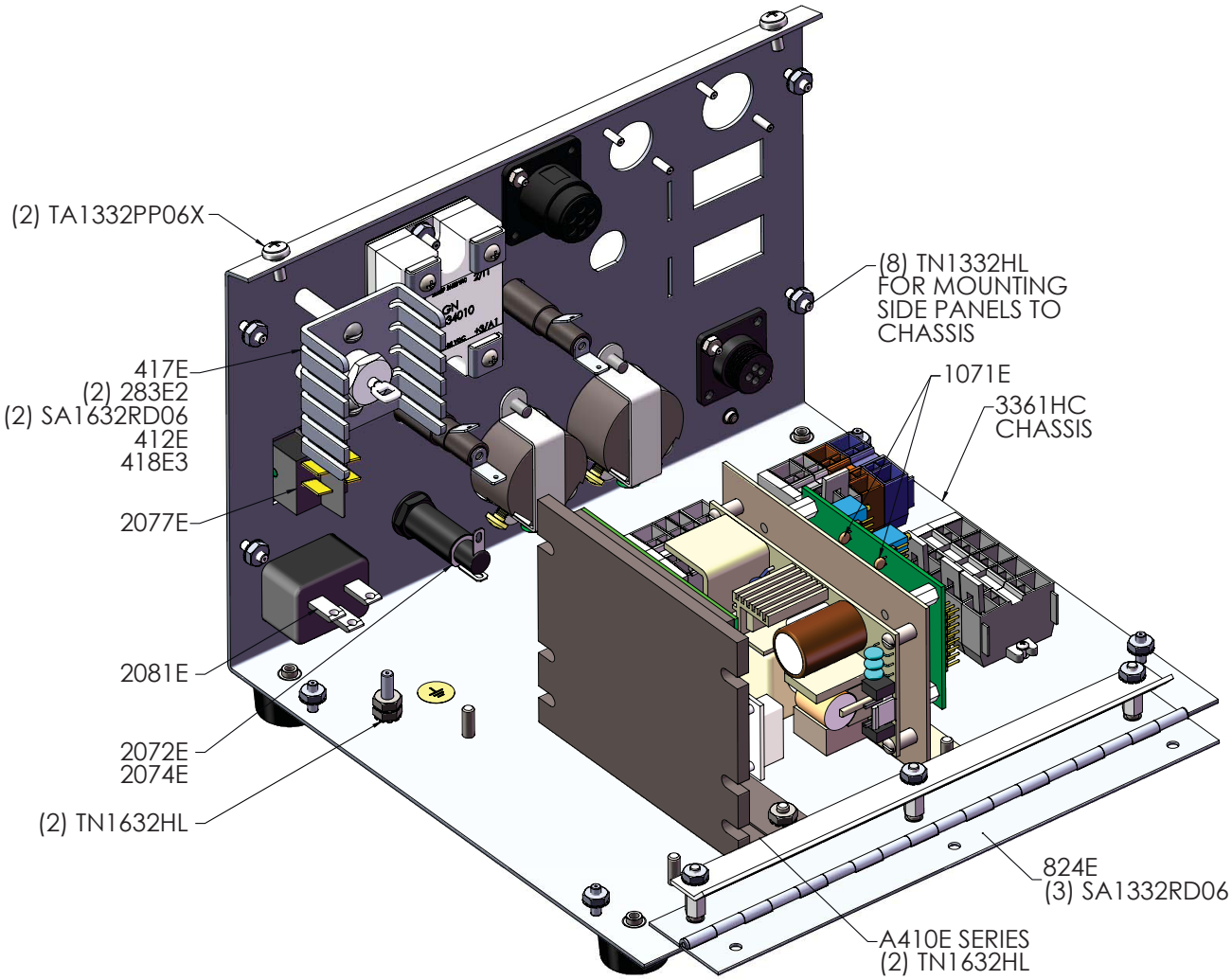


Diagram 2: Chassis, 115 VAC

Part No.	Description
A410E Series Speed Control Board	
A410E10EB	Board, 1/8 hp, 90VDC
A410E8EB	Board, 1/4 hp, 90VDC
A410E9EB	Board, 1/2 hp, 90VDC
3361HC	Chassis
2072E	Fuse holder
2074E	Fuse, 20 amp

Part No.	Description
417E	Heat sink
412E	Diode
283E2	Spacer
824E	Hinge
2077E	Main switch
2081E	Power receptacle
1071E	Capacitor

Part No.	Description
SA1332RD06	Screw
SA1632RD06	Screw
SB1332BT06	Hex nut
SN2520HX	Hex nut
SW25NL	Lock washer
TN1332HL	Chassis screw
TN1632HL	Hex nut

CONTROLLER DIAGRAMS *(CONTINUED)*

CONTROLLERS, 115 VAC *(CONTINUED)*

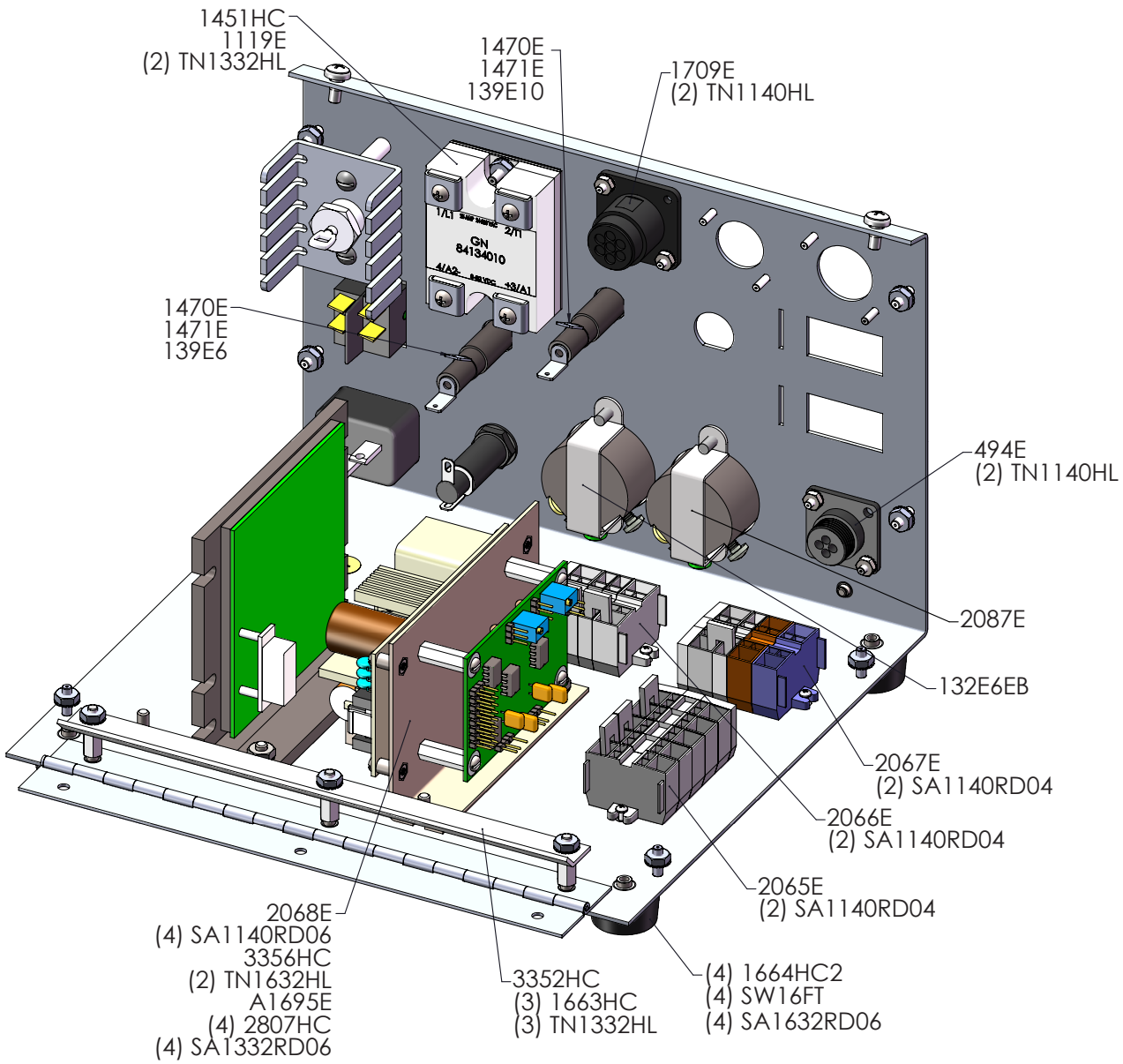


Diagram 3: Chassis, 115 VAC

Part No.	Description
1119E	Solid State Relay
A1695E	Excitation board
139E6	Fuse, 1 amp
139E10	Fuse, 1/4 amp
1470E	Fuse holder
1471E	Fuse carrier
494E	Receptacle
1709E	Receptacle
2065E	Terminal block

Part No.	Description
2066E	Terminal block
2067E	Terminal block
2068E	Power supply
2087E	Receptacle
2807HC	Spacer
1663HC	Aluminum spacer
3352HC	Wire retainer
3356HC	Mounting bracket
1664HC2	Rubber foot

Part No.	Description
132E6EB	Receptacle
SA1140RD04	Screw
SA1140RD06	Screw
SA1332RD04	Screw
SA1632RD06	Screw
SW16FT	Washer
TN1140HL	Hex nut
TN1332HL	Hex nut
TN1632HL	Hex nut

REACTOR CONTROLLER, 230 VAC

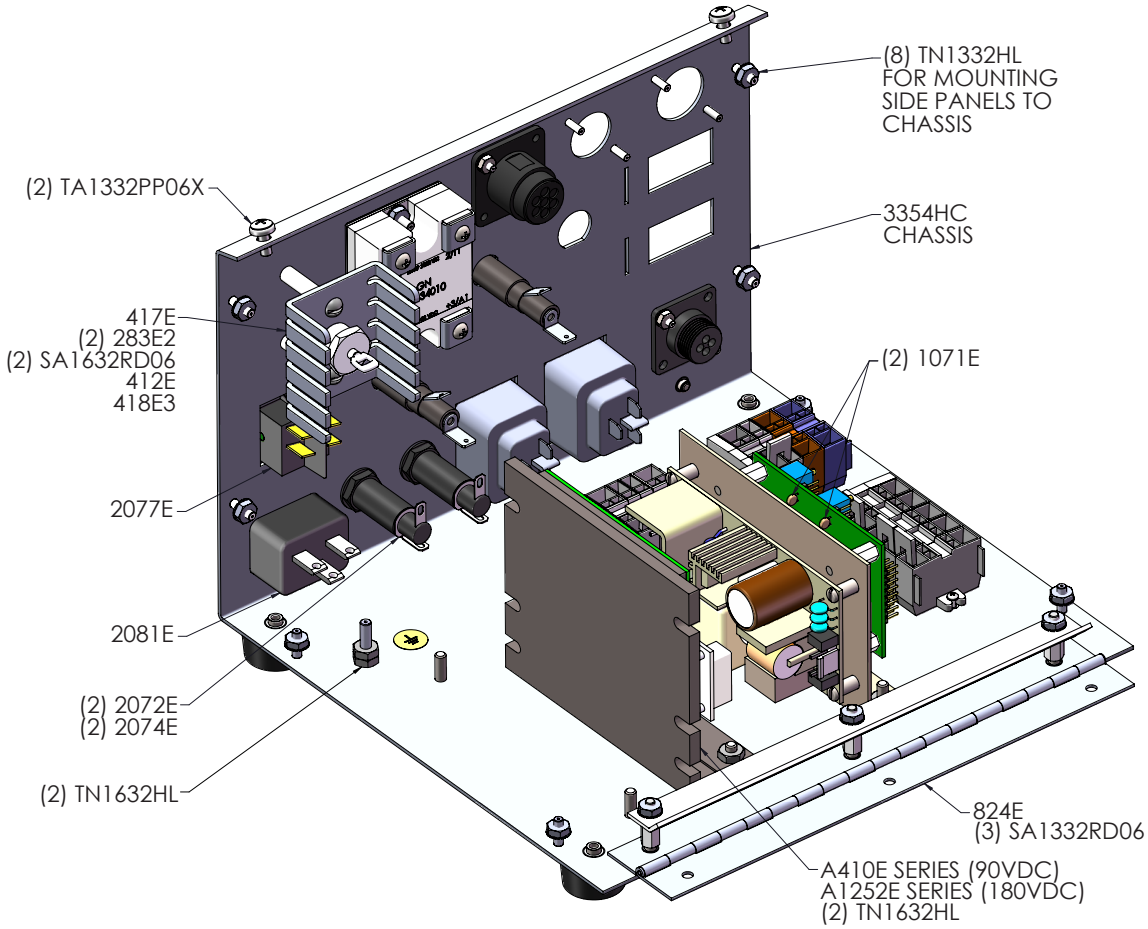


Diagram 4: Chassis, 230 VAC

Part No.	Description
1071E	Capacitor
2072E	Fuse holder
2074E	Fuse, 20 amp
2077E	Main switch
2081E	Power receptacle
283E2	Spacer
3354HC	Chassis
412E	Diode
417E	Heat sink

Part No.	Description
824E	Hinge
SA1332RD06	Screw
SA1632RD06	Screw
SB1332BT06	Hex nut
SN2520HX	Hex nut
SW25NL	Lock washer
TN1332HL	Chassis screw
TN1632HL	Hex nut

Part No.	Description
A410E Series Speed Control Board	
A410E10EE	Board, 1/8 hp, 90VDC
A410E8EE	Board, 1/4 hp, 90VDC
A410E9EE	Board, 1/2 hp, 90VDC
A1252E Series Speed Control Board	
A1252EEE	Board, 1/2 hp, 180VDC
A1252E2EE	Board, 1/4 hp, 180VDC
A1252E3EE	Board, 3/4 hp, 180VDC

CONTROLLER DIAGRAMS *(CONTINUED)*

REACTOR CONTROLLER, 230 VAC *(CONTINUED)*

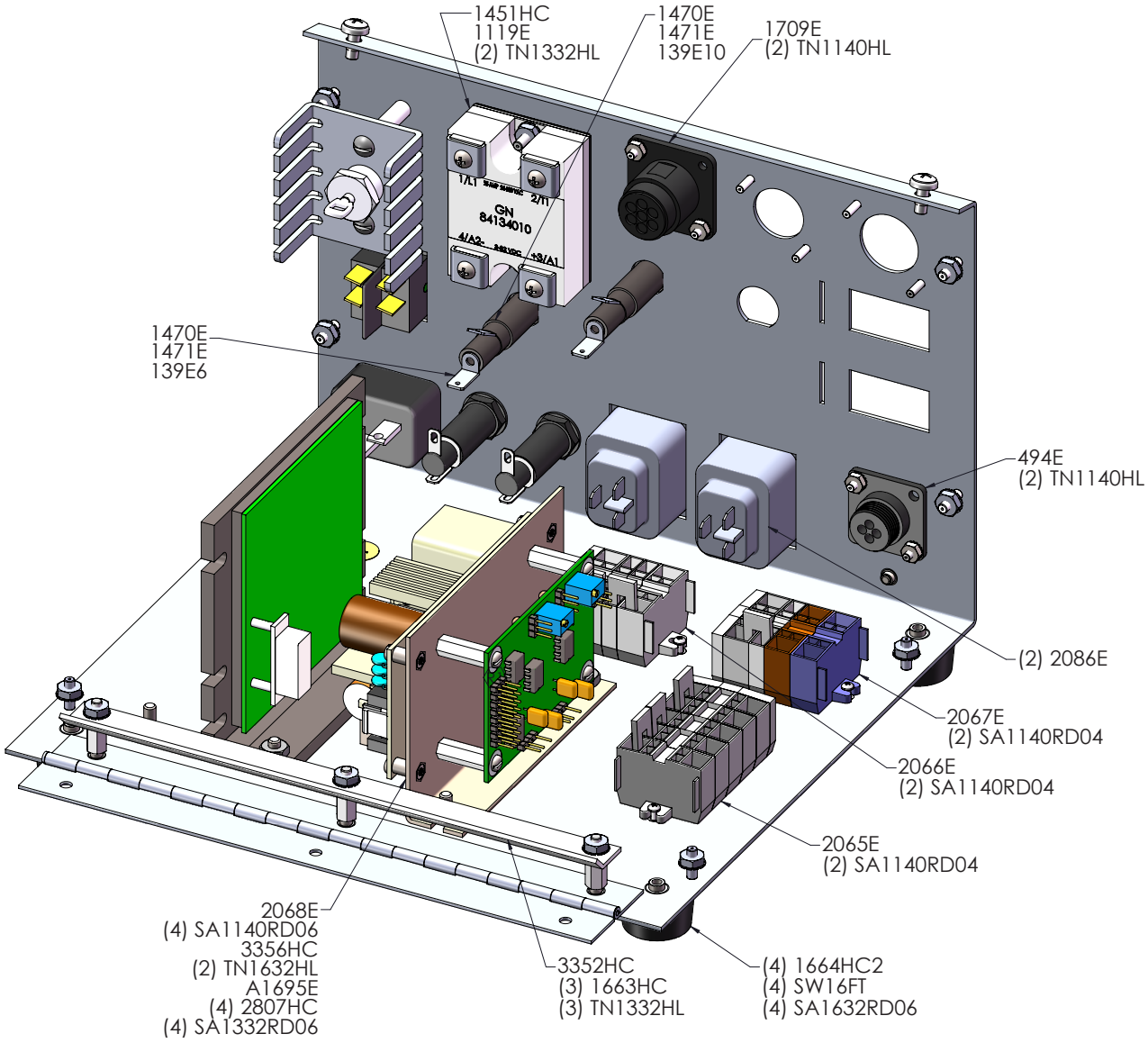


Diagram 5: Chassis, 230 VAC

Part No.	Description
1119E	Solid State Relay
1129E	T/C panel
1259E	Fuse holder, lit
139E6	Fuse, 1 amp
139E10	Fuse, 1/4 amp
1470E	Fuse holder
1471E	Fuse carrier
1664HC2	Rubber foot
1790E	Receptacle

Part No.	Description
206E	Terminal block
2066E	Terminal block
2067E	Terminal block
2068E	Power supply
2086E	Receptacle
2807HC	Spacer
283E5	Aluminum spacer
3352HC	Wire retainer
3356HC	Mounting bracket

Part No.	Description
494E	Receptacle
A1695E	Excitation board
SA1140RD04	Screw
SA1332RD04	Screw
SA1632RD06	Screw
TN1140HL	Hex nut
TN1332HL	Hex nut
TN1632HL	Hex nut