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Instruction Manual for the Classic™ LAC Series

LAC Series Despatch Ovens are bench ovens to 260°C (500°F) with forced convection airflow.

Model	Volts	Heater watts	Amps	HZ	Phase
LAC 1-10	120	1,000	10.0	50/60	1
LAC 1-38A	120	1,600	16.0	50/60	1
LAC 1-38B	240*	1,800	9.2	50/60	1
LAC 1-67	240*	2,400	11.7	50/60	1
LAC 2-12	240*	3,600	18.1	50/60	1
LAC 2-18	240*	4,800	23.1	50/60	1

* Unit will operate on a 220V-1Ph-50Hz line. A kit is required for 240V-1Ph-50Hz operation.
Unit will operate on 208V with a 25% reduction in heater output.

Notice

Users of this equipment must comply with operating procedures and training of operation personnel as required by the Occupational Safety and Health Act (OSHA) of 1970, Section 6 and relevant safety standards, as well as other safety rules and regulations of state and local governments. Refer to the relevant safety standards in OSHA and National Fire Protection Association (NFPA), section 86 of 1990.

Caution

Setup and maintenance of the equipment should be performed by qualified personnel who are experienced in handling all facets of this type of system. Improper setup and operation of this equipment could cause an explosion that may result in equipment damage, personal injury or possible death.

Dear Customer,

Thank you for choosing Despatch Industries. We appreciate the opportunity to work with you and to solve your heat processing needs. In addition, we believe that you have selected the finest equipment available in the heat processing industry.

At Despatch, our service does not end after the purchase and delivery of our equipment. For this reason we have created the Service Products Division within Despatch. The Service Products Division features our Response Center for customer service. The Response Center will direct and track your service call to ensure satisfactory completion.

Whenever you need service or replacement parts, just contact the Response Center at 1-800-473-7373: FAX 612-781-5353.

Thank you for choosing Despatch.

Sincerely,

Despatch Industries

PREFACE

This manual is your guide to the Despatch oven. It is organized to give you the information you need quickly and easily.

The INTRODUCTION section provides an overview of the Despatch oven.

The THEORY OF OPERATION section details the function and operation of assemblies and subassemblies on the Despatch oven.

The INSTRUCTIONS section provides directions on unpacking, installing, operating and maintaining the Despatch oven.

The APPENDIX section contains Special Instructions for operating the control instrument, a Troubleshooting Table, a list of Accessories and a Warranty.

An efficient way to learn about the oven would be to read the manual while working with the corresponding oven control system. This will give you practical hands-on experience with information in the manual and the oven.

While reading this manual, if a term or section of information is not fully understood, look up that item in the appropriate section to familiarize yourself with that item. Then go back and reread that section again. Information skipped, not understood or misunderstood could create the possibility of operating the equipment in an unsafe manner. This can cause damage to the oven or personnel or reduce the efficiency of the equipment.

NOTE:
Read the entire INTRODUCTION and THEORY OF OPERATION before installing the oven.

WARNING:
Failure to heed warnings in this instruction manual and on the oven could result in personal injury, property damage or death.

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INTRODUCTION

This section provides an overview of the Despatch Classic™ LAC Series forced air oven. The LAC Series Ovens have the most effective heat distribution and the fastest processing time of any lab oven its size. Air is discharged from the left side wall of the oven and circulates through the chamber.

Special Features

The sturdy construction and three inch insulation of the Despatch LAC Series ovens contribute to excellent temperature uniformity.

Despatch LAC Series ovens also incorporate a modular microprocessor based digital control. The Despatch Protocol™ temperature controller features:

- PID tuning
- programmable up to 48 segments
- built-in manual reset Hi-limit control
- built-in process timer
- self-diagnostics
- digital display
- three (3) event outputs
- recursive profile capability
- RS-422/RS-485 capability

Special Features (Cont.)

Other special features include the following.

- Unique Despatch design to combine higher fan volume of forced recirculated air with a system of perforated stainless steel walls for the ultimate in temperature uniformity.
- Welded double wall construction and fiberglass insulation to reduce heat loss. Silicone rubber gaskets further minimize heat leakage.
- Rapid response heater with a five year warranty.
- Scratch-resistant Silver-Clay® baked enamel exterior and stainless steel interior for easy cleaning.
- Space-saving, stackable design.

Specifications

Dimensions

Table 1 Dimensions

LAC Model No.	Chamber Size in (cm)			Capacity feet ³ (liters)	Overall Size in (cm)			Max. Number of Shelf Positions	Exhaust Diameter Located on Back of Chamber (in)
	W	D	H		W	D	H		
1-10	14 (35)	12 (30)	12 (30)	1 (31)	23 (58)	21 (53)	29.5 (75)	5	1
1-38A	19 (48)	18 (46)	19 (48)	3.8 (106)	28 (71)	28 (71)	36.5 (93)	8	2
1-38B	19 (48)	18 (46)	19 (48)	3.8 (106)	28 (71)	28 (71)	36.5 (93)	8	2
1-67	24 (61)	20 (51)	24 (61)	6.7 (190)	36 (91)	30 (76)	41.5 (106)	11	2
2-12	24 (61)	24 (61)	36 (91)	12 (340)	36 (92)	33 (84)	53.5 (136)	17	2 - 2½
2-18	35.5 (90)	24 (61)	36 (91)	18 (500)	48 (122)	31 (79)	53.5 (136)	17	2 - 2½

Capacities

Table 2 Capacities

LAC Model Number		1-10	1-38 A & B	1-67	2-12	2-18
Maximum Load	Lbs	100	125	150	175	200
Maximum Shelf Load	Lbs	50	25	25	25	25
Exhaust	CFM	Adjustable to 5	Adjustable to 12	Adjustable to 12	Adjustable to 30	Adjustable to 40
Recirculating Fan	CFM H.P.	150 1/25	300 ¼	300 ¼	600 ¼ x 2	600 ¼ x 2
Approx. Weight Net	Lbs	95	165	203	285	500
	KG	43	75	92	130	227
Shipping Weight	Lbs	115	200	400	535	720
	KG	52	91	181	243	327

Temperature

Table 3 Temperature

LAC Model Number		1-10	1-38 A & B	1-67	2-12	2-18
Time to Temperature (approximate minutes with no load)	25°C - 100°C	8	7	5	5	6
	25°C - 200°C	25	25	20	20	10
	25°C - 260°C	40	40	35	35	35
Recovery Time - Door Open One Minute (approximate minutes with no load)	100°C	1	2	2	2	2
	200°C	4	7	6	6	5
	260°C	9	12	8	12	8
Temperature Uniformity at	100°C*	±1°C	±1°C			
	200°C*	±2°C	±2°C			
	260°C*	±2°C	±3°C			
Operating Range with 20°C Ambient		35°C - 260°C			50°C - 260°C	
Control Stability		±0.3°C				
Repeatability		±0.5°C				

* Figures are based on actual tests in an empty oven. Uniformity can vary slightly depending on unit and operating conditions.

Power

Line voltages may vary in some geographical locations. If your line voltage is much lower than the oven voltage rating, warm-up time will be longer and motors may overload or run hot. If your line voltage is higher than name plate rating, the motor may run hot and draw excessive amps.

If the line voltage varies more than 10% from the oven voltage rating, some of the electrical components such as relays, temperature controls, etc. may operate erratically.

Table 4 Power Requirements

Model	Volts	Amps	Hertz**	Phase	Heater KW	Cord and Plug
LAC 1-10	120	10.0	50/60	1	1	Included, 15 Amp
LAC 1-38A	120	16.0	50/60	1	1.6	Included, 20 Amp
LAC 1-38B*	240	9.2	50/60	1	1.8	Included, 15 Amp
LAC 1-67*	240	11.7	50/60	1	2.4	Included, 15 Amp
LAC 2-12*	240	18.1	50/60	1	3.6	None, Hardwired
LAC 2-18*	240	23.1	50/60	1	4.8	None, Hardwired

The LAC 2-12 and LAC 2-18 must be hardwired to the electric supply using 10 AWG or larger wires suitable for at least 75°C (167°F).

* Oven designed for 240 volts (see name plate on oven) will operate satisfactorily on a minimum of 208 volts, but with a 25% reduction in heater power. If your power characteristics are lower, contact Despatch Industries.

** A kit is required for 240V - 1PH - 50Hz operation. Standard 240V units will operate on a 220V - 1 PH - 50 Hz line.

THEORY OF OPERATION

This section details the function and operation of assemblies and subassemblies on the Despatch Classic™ LAC Series Ovens. These ovens have the most effective heat distribution system and the fastest processing time of any lab oven its size. They are especially useful for testing, preheating, sterilizing, drying, aging and curing as well as other production applications. Horizontal airflow with precision digital control delivers uniform, fast processing. The overall result is efficient productivity under strenuous conditions.

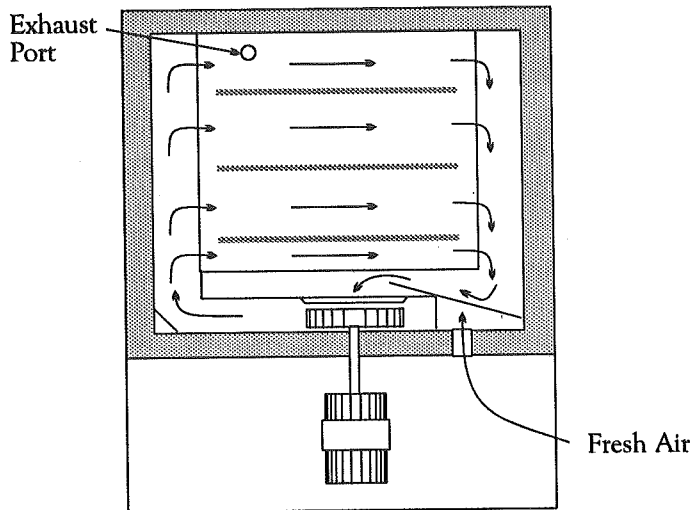


Figure 1 illustrates the precision horizontal airflow.

The unique Despatch computerized design, moves forced™ convected heat through perforated stainless steel walls. The air is recirculated with a high volume fan. Despatch LAC Series Ovens employ higher volume fans than any competitive model. The chamber can be densely loaded without interfering with the process. Air delivery temperature is within 1 °C of the number appearing on the digital display. Also, fresh air intake is regulated by a panel-mounted damper control, while the exhaust rate is fixed. The exhaust port, on the back of the oven, is covered by a hat bracket.

WARNING:

Do not remove the hat bracket as it distributes exhaust air and protects the exhaust opening from being completely covered.

Damper Control

The oven is equipped with a manually adjustable damper mechanism. The damper control arm is located on the front panel of the oven. The damper adjustment controls the flow of fresh air into the chamber. If the damper is in the full open position, the maximum amount of fresh air is distributed into the chamber. If the damper is in the fully closed position, no fresh air is distributed into the chamber.

Determining Damper Settings

To determine the optimum setting for the amount of fresh air that should be distributed into the chamber depends on several factors. These factors include ambient environment temperature, load conditions, load distribution, heat up rates, cool down rates, desired temperature uniformity and most importantly the desired operating temperature. To consider all of these variables at any one point in time is not practical and there are engineering tradeoffs that should be considered. Therefore guidelines should be used to determine the fresh air damper setting.

In general, the damper should be set so that the amount of fresh air flowing into the chamber agrees with the desired operating temperature conditions. The following outline shows the considerations involved with various damper position settings.

Full Closed Position

When the fresh air damper is in the full closed position, the chamber will be able to achieve the maximum attainable heat up rates for the chamber. In addition, the chamber will use the minimum amount of power to operate at the desired temperature. In almost all cases, the fresh air damper should be in the full closed position in order to efficiently operate at the maximum operating temperature for the chamber.

Full Open Position

When the fresh air damper is in the full open position, the chamber will be able to operate at its minimum operating temperature. Without the damper set to the full open position, the chamber has no way to readily dissipate the heat generated from the electronics compartment primarily due to the recirculation fan motor. Since the recirculation fan motor is mounted below the workspace, most of the heat generated from the running motor rises into the chamber. Therefore, the chamber temperature will rise slightly even though the heating system is not turned on. The result is that after the recirculation motor has been on for an extended period of time, the chamber will reach a thermal equilibrium temperature. With the fresh air damper fully open, the thermal equilibrium temperature is the minimum operating temperature of the chamber.

Other Damper Settings

The damper can be set to several other distinct operating positions. In most cases, the damper setting is influenced by two specific performance factors. The two performance factors are uniformity and cool down rates.

The uniformity of the chamber is influenced by the inside chamber pressure of the system. The pressure inside the chamber is dependant on the amount of fresh air flowing into the chamber. When a large volume of fresh air is flowing into the chamber, the chamber becomes slightly pressurized and the overall temperature uniformity improves. The slightly pressurized chamber produces the effect of "pushing" the air to the corners of the chamber. Typically, the corners of the chamber will improve with respect to temperature distribution while the core of the chamber will maintain excellent uniformity characteristics regardless of the damper position. Therefore, the pressurization of the chamber typically is a factor when the chamber is loaded heavily. In any case, the best uniformity results with respect to the product are achieved when no more than two-thirds of any inside chamber dimension are used. In other words, when the product(s) are located in the center of the chamber, the best overall results are achieved.

Protocol™

The ovens are equipped with a modular microprocessor based digital temperature controller.

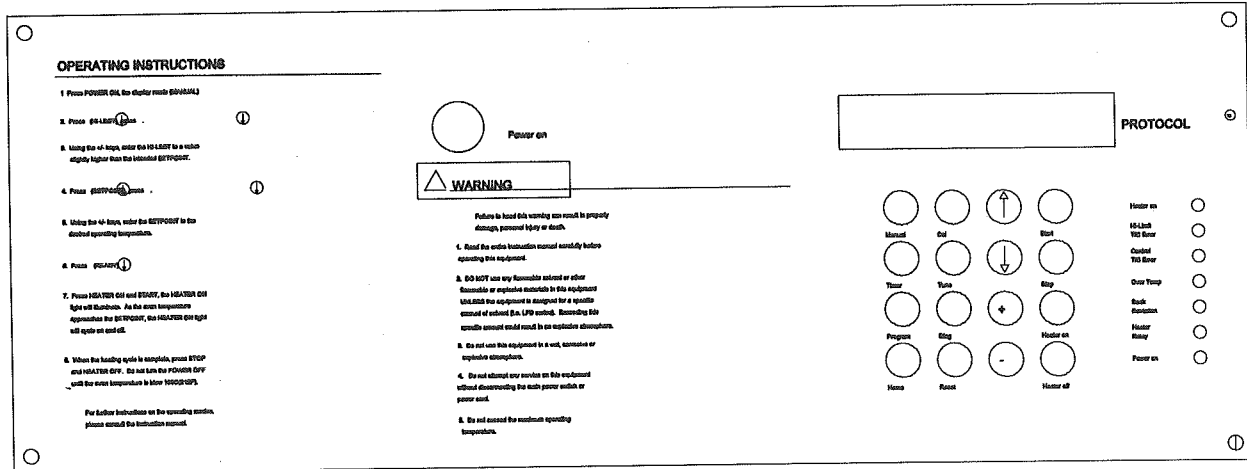


Figure 2 illustrates the main display and key pad on the Despatch Protocol™ temperature controller.

The Despatch Protocol™ temperature controller is a dual functioning controller/high limit instrument. The control portion of Protocol™ incorporates a microprocessor to digitally control process variables with minimal temperature fluctuations.

The high limit portion of Protocol™ protects the product and/or the oven itself. If the product being processed has a critical high temperature limit, the Hi-limit parameter should be set to a temperature somewhat below the temperature at which the product could be damaged. If the product does not have a critical high temperature limit, the Hi-limit parameter should be set to a value slightly higher than the highest programmed setpoint to protect the oven equipment.

Keypad Controls

The Despatch Protocol™ temperature controller has six keys that provide the six operating modes.

Table 5 Protocol™ Keypad Controls

Mode	Display Code	Function	Description
Manual	MANUAL	Operation	Single setpoint control
Timer	TIMER	Operation	Single setpoint control with process timer
Program	PROGRAM	Operation	Programmable control with three event outputs
Tune	TUNE	Configure	Set instrument parameters
Calibrate	CAL-MODE	Service	Performs instrument calibration
Diagnostics	DIAGNOSE	Service	Performs instrument thermocouple tests, SSR power level and event output tests.

The Despatch Protocol™ temperature controller also has ten (10) touch-keys so that the user can easily operate the controller.

Table 6 Protocol™ Touchkeys

Key	Description
↑	To move up through any mode
↓	To move down through any mode
+	To increase a setpoint or parameter
-	To decrease a setpoint or parameter
Home	To move to the beginning of any mode or segment
Reset	To reset the control when an error has been corrected or to view the profile number, segment number and the number of loops (repeat times) remaining.
Heater On	To initiate heater relay
Heater Off	To disengage heater relay
Start	To start an operating mode
Stop	To stop an operating mode

Status Indicator LEDs

Protocol™ has seven indicator LEDs that provide the following relevant information to the user.

Table 7 Protocol™ Indicator LEDs

LED	Function
Power on	Lights when the power on pushbutton is pressed.
Heater relay	Lights when a mode is ready for operation and the heater on key is pressed.
Soak Deviation	Lights when the process temperature is not held within the user specified soak deviation limits. The light turns off when the temperature is within the soak deviation limit.
Over Temp	Lights when the process temperature exceeds the high limit value. The over temperature light remains lit until the Reset key is pressed.
Control T/C Error	Lights when Protocol™ receives a control thermocouple error.
Heater on	Lights when the heater is activated by the control circuits.
Hi-limit T/C Error	Lights when Protocol™ receives a Hi-limit thermocouple error.

The Despatch Protocol™ temperature controller has been designed for ease of use while maintaining elaborate and versatile control capabilities.

Operating Modes

Protocol™ has three primary modes of operation: the Manual mode, the Timer mode and the Program mode.

Manual Mode

The manual mode is a single setpoint control mode that controls the process at the user specified setpoint for an indefinite period of time. The manual mode controls the oven temperature within close limits as specified by the PID tuning parameters.

Whenever the instrument is powered by the **Power on** pushbutton, Protocol™ starts at the manual mode.

Timer Mode

The timer mode is a single setpoint control mode with a built-in process timer that starts timing either at the beginning of the process or at a user specified temperature. As in the manual mode, the timer mode uses the PID parameters set in the tune mode.

Program Mode

The program mode is a programmable ramp and soak control consisting of up to eight profiles. Each profile consists of up to six segments for a total of 48 segments ($8 \times 6 = 48$). Also, any one profile may be run recursively from two to 99 cycles or even continuously if it is desired.

Each segment consists of a ramp and soak period. During the ramp period, the control will track oven temperature. For example, a ramp is entered to heat from 100°C to 150°C in 50 minutes. Protocol™ will track the temperature 1°C every minute for 50 minutes. During the soak period, temperature is maintained as specified by the tuning and soak deviation parameters.

Protocol™ will not allow a soak time to begin until the actual oven temperature is within the soak deviation limit. This process is called assured soak. The ramp and soak periods are adjustable from 0 to 99 hours, 59 minutes. Within each ramp and soak period, up to three event outputs can be programmed either on or off.

The event relay is used for factory installed modifications, then disconnected before shipping. Please consult the factory for information on connecting the event outputs. When the events are connected, the user has the capability of controlling relays, solenoid valves, etc., throughout the programming cycle.

Calibration Zero Offset

The Calibration Zero Offset (CZO) of Protocol™ has been preset and tested for the specified operating conditions. Special instructions for accessing the tune mode to change the CZO are referred to in the Appendix of this manual.

CZO 0.0

Figure 3 illustrates the CZO function in the tune mode of Protocol™.

The CZO may be useful to make the following small temperature corrections to the control system.

- Correction of known sensor calibration errors.
- Correction of any known steady temperature offset between the heated work-piece (load) and sensor. This is useful for applications where the sensor cannot be located exactly at the work-piece.
- Alignment of temperature indications in a multi-zone/multi-controller application, e.g., at ambient temperature.

Note that the CZO changes the value of the controlled temperature when used in closed loop control. The CZO function can be represented by the equations:

$$\text{Temp Indication (}^\circ\text{F)} = \text{Sensor Temp (}^\circ\text{F)} - \text{CZO\% [100 (}^\circ\text{F)} - \text{Sensor Temp (}^\circ\text{F)}]$$

$$\text{Temp Indication (}^\circ\text{C)} = \text{Sensor Temp (}^\circ\text{C)} - \text{CZO\% [38 (}^\circ\text{C)} - \text{Sensor Temp (}^\circ\text{C)}]$$

The CZO function is a straight line pivoted around 100°F (38°C). Thus, the CZO functions as an offset and has the ability to change the slope of a temperature range.

Calibration Zero Offset (Cont.)

Table 8 Calibration Zero Offset Examples

CZO Display	Temperature measured by sensor	Offset °F	Temperature Indication
0.0	100°F	0°	100°F
10.0	100°F	0°	100°F
-20.0	200°F	-20°	180°F

A more useful formula is one that the user can use to calibrate Protocol™ to match the center of the chamber. This requires the use of a temperature measuring device with its thermocouple junction located at the center of the chamber. CZO can be directly calculated by:

$$CZO = 100 \left(\frac{\text{Center Temp } (^\circ\text{F}) - \text{Protocol}^{\text{TM}} \text{ Display } (^\circ\text{F})}{\text{Center Temp } (^\circ\text{F}) - 100 (^\circ\text{F})} \right)$$

$$CZO = 100 \left(\frac{\text{Center Temp } (^\circ\text{C}) - \text{Protocol}^{\text{TM}} \text{ Display } (^\circ\text{C})}{\text{Center Temp } (^\circ\text{C}) - 38 (^\circ\text{C})} \right)$$

NOTE:

The CZO function is easily set for specific operating conditions.

Tune Setting

The Protocol™ has been preset and tested for normal operating conditions. Special instructions for changing the tune setting are referenced in the Appendix of this manual.

The Protocol™ on the oven can be manually tuned. For your convenience the factory has tested and preset the PID action to its optimum values. These values need not be changed under normal operating conditions.

Table 9 Factory PID Settings

Proportional Band	5°C
Reset Time	30 seconds/repeat
Rate Time	0 degrees/second

NOTE:

Reset times greater than 35 seconds/ repeat are not recommended.

Protocol™ Hi-limit

Protocol™ will not let the high limit value to drop below the setpoint value. In certain situations, it may be necessary to change the setpoint first and then adjust the high limit value.

It will be necessary to reset the Hi-limit whenever it has tripped. The Hi-limit may be reset by first allowing the oven chamber to cool slightly (or increasing the parameter by several degrees) and pushing the **Reset** key. During a high limit condition the Over Temp LED will turn on thus deactivating the heater.

WARNING:

Never operate the oven at a temperature in excess of the maximum operating temperature.

INSTRUCTIONS

The INSTRUCTIONS section provides directions on unpacking, installation, operation and maintenance of the Classic™ LAC Series oven.

Unpacking and Inspection

Remove all packing materials and thoroughly inspect the oven for damage of any kind that could have occurred during shipment.

- See whether the carton and plastic cover sheet inside carton are still in good condition.
- Look at all outside surfaces and corners of the oven for scratches and dents.
- Check the oven controls and indicators for normal movement, bent shafts, cracks, chips or missing parts such as knobs and lenses.
- Check the door and latch for smooth operation.

If there is damage, and it could have happened during shipment follow these instructions.

1. Contact the shipper immediately and file a written damage claim.
2. Contact Despatch Industries to report your findings and to order replacement parts for those that were damaged or missing.
3. Send a copy of your filed damage claims to Despatch.
4. Next, check to make sure you have received all the required materials. Your shipment should include:
 - One (1) Despatch oven,
 - One (1) Instruction manual,
 - One (1) Warranty card,
 - Two (2) Shelves
 - One (1) Package containing four rubber feet

Unpacking and Inspection (Cont.)

5. If any of these items are missing from the packaged contents, contact Despatch Industries to have the appropriate materials forwarded to you.
6. Finally, to protect the warranty on your new LAC Series Oven, complete the warranty card and mail it to Despatch within 15 days after receipt of the equipment.

Set-up

1. Remove adhesive backing sheet from the rubber feet.
2. Attach rubber feet to the bottom corners of the oven.
3. Place oven on a bench top or an optional cabinet base.

The oven must have a minimum of two (2) inches clearance in the rear to provide proper ventilation. The oven may be placed next to another cabinet, or next to another oven, with three (3) inch clearance (the doors will still open).

Make sure oven is level and plumb; this will assure proper heat distribution and operation of all mechanical components.

4. Identify correct power source indicated on the specification plate.
5. Plug or hardwire oven directly to the electric supply.

WARNING:

All grounding and safety equipment must be in compliance with applicable codes, ordinances and accepted safe practices.

WARNING:

Do not use the oven in a wet or corrosive, explosive atmosphere unless the oven has been specifically designed for a special atmosphere.

Operating

Users and operators of this oven must comply with operating procedures and training of operating personnel as required by the Occupational Safety and Health Act (OSHA) of 1970, Section 5 and relevant safety standards, as well as other safety rules and regulations of state and local governments. Refer to the relevant safety standards in OSHA and National Fire Protection Association (NFPA), Section 86 of 1990.

Loading the Oven

Despatch Industries cannot be responsible for either the process or process temperature used, or for the quality of the product being processed. It is the responsibility of the purchaser and operator to see that the product undergoing processing in a Despatch oven is adequately protected from damage.

Carefully following the instructions in this manual will assist the purchaser and operator in fulfilling that responsibility.

When loading the oven avoid spills of anything onto the heater elements or onto the floor of the oven. Do not place the load on the oven floor plate. This may cause the load to heat unevenly and the weight may cause shorting out of the heater elements. Use the shelves provided.

The two shelves are designed to be pulled out about half way without tipping. The support capacity of the shelves is listed in the Capacities Table in the Specifications section in this manual. Do not overload the shelves.

Distribute workload evenly so that airflow is not restricted. Do not overfill your oven. The workload should not take up more than two-thirds of any dimension of the inside cavity.

WARNING:

Do not use oven in wet, corrosive or explosive atmospheres unless this oven is specifically designed for a special atmosphere.

Pre-Start-Up Checklist

- ✓ Know the system. Read this manual carefully. Make use of its instructions and explanations. The know how of safe, continuous, satisfactory, trouble-free operation depends primarily on the degree of your understanding of the system and of your willingness to keep all parts in proper operating condition.
- ✓ Check line voltage. Voltage must correspond to name-plate requirements of motors and controls. Refer to the section on power connections in the INTRODUCTION of this manual.
- ✓ Fresh air and exhaust. Do not be careless about restrictions in and around the fresh air and exhaust openings and stacks. Under no condition permit them to become so filled with dirt that they appreciably reduce the air quantity. The proper ventilation clearances should be fulfilled at all times. Refer to the Set-up instructions in this manual.
- ✓ Ventilation There is an exhaust opening in the rear of the unit that is covered by a hat bracket. Do not remove the hat bracket as it protects the exhaust opening from being completely covered.
- ✓ Helpful hints
 - For drying ovens, open vent to prevent buildup of moisture.
 - For sample heating, close the vent when no ventilation is required.

Start-Up

For fastest oven heat-up time, close the fresh-air vent. After the desired temperature is reached, the vent may be adjusted as needed. An outline and examples for the Manual mode, Timer mode and Program mode are referenced in the Appendix. A completed typical program worksheet accompanies all programmable event outputs installed at the factory.

WARNING:
Do not use flammable solvent or flammable material in this oven. Do not process closed containers of any substance or liquid in this oven because they may explode under heat.

1. Start Fan.
 - a. Open oven door.
 - b. Press **Power on** pushbutton. You will hear the recirculating fan start.
 - c. Shut oven door.
 - d. Check that the green **Power on** LED is on.

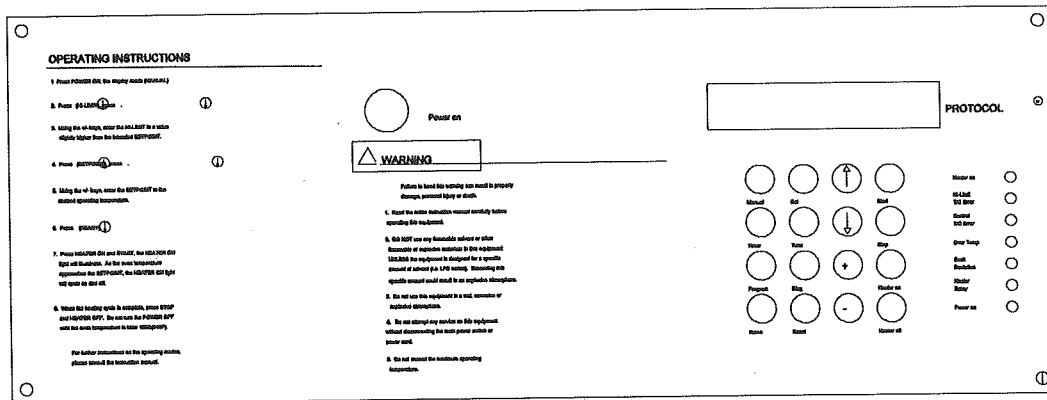


Figure 4 illustrates the control panel on the LAC Series oven.

2. Program Protocol™ for the desired operating mode. Refer to the following instructions for the Manual mode, the Timer mode and the Program mode.

Manual Mode

Start-up

The following are start-up instructions for the Manual mode.

1. Select the Manual mode.
 - a. Press the **Power on** key or the **Manual** key. **MANUAL** will be displayed.
2. Enter the high limit temperature.
 - a. Press the ↓ key. **HI-LIMIT** will be displayed.
 - b. Press the ↓ key.
 - c. Use the + or - keys to enter the high limit temperature to a value slightly higher than the intended setpoint.
3. Enter the setpoint.
 - a. Press the ↓ key. **SETPOINT** will be displayed.
 - b. Press the ↓ key.
 - c. Use the + or - keys to enter the Setpoint to the desired operating temperature.

NOTE:

For safety reasons, Protocol™ will not let the operator set the Hi-limit below the setpoint. It may be necessary to adjust the Protocol™ setpoint first, then adjust the Hi-limit.

NOTE:

During processing the display shows setpoint on the left and actual oven temperature on the right.

Run

The following are run instructions for the Manual mode.

1. Press ↓ key. **READY** will be displayed.
2. Press the **Heater on** key. The **Heater Relay** LED will illuminate.
3. Press **Start** key. The **Heater on** LED will illuminate and the setpoint and actual temperature will be displayed. As oven temperature approaches setpoint, the **Heater on** LED will cycle on and off.

NOTE:

When Protocol™ is run in the Manual mode, the setpoint can be adjusted without stopping the operation. The setpoint is adjusted by using the + or - keys.

Stop

The following are stop instructions for the Manual mode.

1. Press **Heater off** key. The **Heater Relay** LED will shut off.
2. Wait for oven temperature to fall below 100°C (212°F).
3. When Manual mode is complete, press the **Reset** key to display the final process temperatures.
4. Press the **Stop** key.
5. Press **Power on** pushbutton to turn power off.

An example of the Manual mode is referenced in the Appendix.

Timer Mode

Start-up

The following are start-up instructions for the Timer mode.

1. Select the Timer mode.
 - a. Press the **Timer** key. **TIMER** will be displayed.
2. Enter the high limit temperature.
 - a. Press the ↓ key. **HI-LIMIT** will be displayed.
 - b. Press the ↓ key.
 - c. Use the + or - keys to enter the high limit temperature to a value slightly higher than the intended setpoint.
3. Enter the setpoint.
 - a. Press the ↓ key. **SETPOINT** will be displayed.
 - b. Press the ↓ key.
 - c. Use the + or - keys to enter the setpoint to the desired operating temperature.
4. Enter the process time.
 - a. Press the ↓ key. **TIME** will be displayed.
 - b. Use the + or - keys to enter the time of the process. (HHMM (hours/minutes) or MMSS (minutes/ seconds) selected in the tune mode).

NOTE:

For safety reasons, Protocol™ will not let the operator set the Hi-limit below the Protocol™ setpoint. It may be necessary to adjust the Protocol™ setpoint first, and then the Hi-limit.

Start-up (Cont.)

5. Enter timer starting temperature.
 - a. Press the ↓ key. TEMP YES/NO will be displayed.
 - b. Use the + or - keys to select either YES or NO.
 - Press the - key to display NO and begin timing at ambient.
 - Press the + key to display YES and begin timing at the following input temperature.
 - c. Press the ↓ key. TEMP and the begin timing temperature will be displayed.
 - d. If YES was selected in step b, use the + or - keys to enter the temperature at which the process timer begins timing.

If NO was selected in step b, this setpoint has no bearing on oven operation.

Run

The following are run instructions for the Timer mode.

1. Press the ↓ key. READY will be displayed.
2. Press the **Heater on** key. The **Heater Relay** LED will illuminate.
3. Press the **Start** key. The **Heater on** LED will illuminate and the setpoint and the actual temperature will be displayed. As the oven temperature approaches the setpoint, the **Heater on** LED will cycle on and off.

NOTE:

During processing the display shows the setpoint on the left and the actual oven temperature on the right.

NOTE:

When the Timer mode is running, pressing the Start key will display the time remaining in the cycle. The display will show TRHHMMSS which stands for the time remaining, hours, minutes and seconds.

Manually Stop

The following are manual stop instructions for the Timer mode.

1. Press the **Heater off** key.
2. Wait for oven temperature to fall below 100°C (212°F).
3. When the Timer mode is complete, press the **Reset** key to display the final process temperatures.
4. Press the **Stop** key.
5. Press the **Power on** pushbutton to turn power off.

An example of the Timer mode is referenced in the Appendix of this manual.

Program Mode

Start-up

The following are start-up instructions for the Program mode. In any one segment, if the ramp and soak times are zero, Protocol™ ignores the remaining segments of the profile. A soak period will not begin until the actual oven temperature is within the soak deviation limit. During any segment of a profile, if the actual oven temperature falls outside of the soak deviation limit, the Soak Deviation LED will be illuminated.

1. Select the Program mode.
 - a. Press the **Program** key. PROGRAM will be displayed.
2. Enter the high limit temperature.
 - a. Press the ↓ key. HI-LIMIT will be displayed.
 - b. Press the ↓ key. The high limit temperature will be displayed.
 - c. Use the + or - keys to enter the high limit temperature to a value higher than the intended setpoints.
3. Enter the profile number.
 - a. Press the ↓ key. PROFILES will be displayed.
 - b. Press the ↓ key. PRO - 1 will be displayed.
 - c. Use the + or - keys to enter the profile number to program.

NOTE:

All profiles entered can be cleared by using the PROF CLR function in the TUNE mode.

NOTE:

For safety reasons, Protocol™ will not let the operator set the Hi-limit below the setpoint. It may be necessary to adjust the Protocol™ setpoint first, then adjust the Hi-limit.

Start-up (Cont.)

4. Program the profile.
 - a. Press the ↓ key. SEG - 1 will be displayed.
 - b. Program the ramp rate.
 - i. Press the ↓ key. RAMP0001 will be displayed.
 - ii. Use the + or - keys to enter the ramp time.
 - c. Program the events desired during the ramp time.
 - i. Press the ↓ key. EVENTS will be displayed.
 - ii. Press the ↓ key for each event.
 - iii. Use the + or - keys to program the event outputs ON or OFF for the ramp period.
 - d. Program the ramp ending temperature.
 - i. Press the ↓ key. TEMP and the ramp ending temperature will be displayed.
 - ii. Use the + or - keys to enter the desired ramp ending temperature.
 - e. Program the soak time.
 - i. Press the ↓ key. SOAK and the soak time will be displayed.
 - ii. Use the + or - keys to enter the soak time.
 - f. Program the events desired during the soak time.
 - i. Press the ↓ key. EVENTS will be displayed.
 - ii. Press the ↓ for each event.
 - iii. Use the + or - keys to program the event ON or OFF for the soak period.

NOTE:

During processing, the display shows the setpoint on the left and the actual oven temperature on the right.

NOTE:

If all event relays are disconnected or no modifications involving event relays have been made to your particular oven, programming the events has no effect on oven operation.

WARNING:

Never operate the oven at a temperature in excess of the maximum operating temperature.

Start-up (Cont.)

- g. Enter the remaining segments 2-6 by following steps a through f.
5. Enter the Soak-Deviation.
 - a. Press the ↓ key until SOAK-DEV is displayed.
 - b. Press the ↓ key. The symbol ± will be displayed.
 - c. Use the + or - keys to enter the soak deviation limit.
6. Enter the next profile to continue to.
 - a. Press the ↓ key. GOTO will be displayed.
 - b. Use the + or - keys to enter the profile number to continue to.

Options include END and 1 through 8. Select End to stop at the end of this profile. For continuous profiles enter the same number of the profile that is currently being programmed.

7. Enter the number of profile recursions.
 - a. Press the ↓ key. REPEAT will be displayed.
 - b. Press the ↓ key. TIMES will be displayed.
 - c. Use the + or - keys to enter the number of times to complete the profile being programmed (1 - 99).
8. Enter the profile end condition. The hold command is contingent on the final segment of the last profile to be run only.
 - a. Press the ↓ key. HOLD will be displayed.
 - b. Use the + or - keys to select YES or NO.
 - Selecting YES will hold at last setpoint. The event outputs will be held at their last value.
 - Selecting NO will not hold at last setpoint. The event outputs will be turned off.

NOTE:

The SOAK-DEV limit is also the assured soak limit. This means that the soak times will not begin until the process temperature is within the SOAK-DEV parameter.

NOTE:

If the Protocol™ is in a hold condition, pressing the **Reset** key will display that the control is in segment 7 (HOLD).

Run

The following are run instructions for the Program mode.

1. Press the **Home** key until PROGRAM is displayed.
2. Press the ↓ key until PRO - 1 is displayed.
3. Make sure the correct starting profile is entered by pressing + or -.
4. Press the ↑ key until READY is displayed.
5. Press the **Heater on** key. The **Heater Relay** LED will illuminate.
6. Press the **Start** key. The **Heater on** LED will illuminate. As the oven temperature approaches the setpoint, the Heater on LED will cycle on and off. During processing, the display shows the setpoint on the left and the actual oven temperature on the right.

NOTE:

When in the Program mode, pressing the **Start** key will display the time remaining in the cycle (TRHHMMSS). Pressing the **Reset** key will display the profile number, segment number and the loops (REPEAT TIMES) remaining.

Manually Stop

The following are manual stop instructions for the Program mode.

1. Press **Heater off** key.
2. Wait for oven temperature to fall below 100°C (212°F).
3. Press the **Reset** to display the final process temperature.
4. Press **Stop** key.
5. Press **Power on** pushbutton to turn power off.

Examples of the Program mode are referenced in the Appendix of this manual.

Maintenance

Do not attempt any service on this oven before opening the main power disconnect switch.

Checklist

- ✓ Keep equipment clean. Gradual dirt accumulation retards air flow. A dirty oven can result in unsatisfactory operation such as unbalanced temperature in the work chamber, reduced heating capacity, reduced production, overheated components, etc. Keep the walls, floor and ceiling of the oven work chamber free of dirt and dust. Floating dust or accumulated dirt may produce unsatisfactory work results. Keep all equipment accessible. Do not permit other materials to be stored or piled against it.
- ✓ Protect controls against excessive heat. This is particularly true of controls, motors or other equipment containing electronic components. Temperatures in excess of 51.5°C (125°F) should be avoided.
- ✓ Establish maintenance & check-up schedules. Do this promptly and follow them faithfully. Careful operation and maintenance will be more than paid for in continuous, safe and economical operation.
- ✓ Maintain equipment in good repair. Make repairs immediately. Delays may be costly in added expense for labor and materials and in prolonged shut down.
- ✓ Practice safety. Make it a prime policy to know what you are doing before you do it. Make CAUTION, PATIENCE, and GOOD JUDGEMENT the safety watchwords for the operation of your oven.
- ✓ Lubrication Fan motor bearings are permanently lubricated. All door latches, hinges, door operating mechanisms, bearing or wear surfaces should be lubricated to ensure easy operation.

Tests

Tests should be performed carefully and regularly. The safety of personnel as well as the condition of equipment may depend upon the proper operation of any one of the functions of Protocol™. Test the Protocol™ every 40 hours. Check that the heater LED is cycling on and off, indicating that the heater is working. In the manual mode, enter the Hi-limit to the same value as the setpoint. Run manual mode. When the oven temperature reaches setpoint, the Hi-limit should shut down the system. The Hi-limit must be manually reset by pushing the **Reset** key.

WARNINGS:

Failure to heed warnings in this manual and on the oven could result in death, personal injury or property damage.

Replacement

Parts

To order or return parts, contact the Service Products Division at Despatch. The Service Products features our Response Center for customer service. When returning parts, the Despatch representative will provide you with an MRA (Material Return Authorization) number. The MRA number must be attached to the returned part for identification. When you are ordering parts, be sure to give the model number, serial number and the part number. This will expedite the process of obtaining a replacement part. When you have a service need, just contact the Response Center at 1-800-473-7373: FAX 612-781-5353.

WARNING:

Disconnect the main power switch or power cord before attempting any repair or adjustment.

Protocol™ Instrument

(Tools needed: one quarter (1/4) inch socket set)

1. Disconnect the power.
2. Remove the screws from the face of the control panel and slide it forward.
3. Disconnect the thermocouple wires and the ground wire.
4. Disconnect any event output wires, noting the proper connections.
5. Disconnect the control panel from the oven by unplugging the quick disconnect plug.

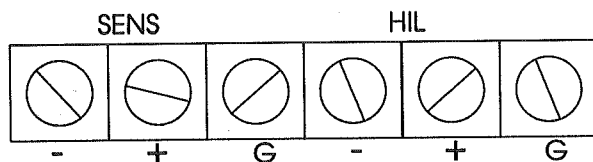


Figure 5 shows the top view of the J type thermocouple inputs on Protocol™.

6. Connect the new control panel to the quick disconnect plug.
7. Connect the thermocouple wires and ground wire.
8. Connect the event output wires (if applicable).
9. Replace the control panel.

Heater Unit

(Tools needed: Crescent wrench, screwdriver, one quarter (1/4) inch socket set)

1. Remove the floor plate.
 - a. Remove the screws from the floor plate.
 - b. Lift the floor plate out of the oven.
2. Disconnect the heater leads from heater element with a wrench. Note which wires go on which terminals.
3. Unscrew the screws holding the heater frame to the oven body.
4. Remove the heater and discard.
5. Screw down the new heater frame.
6. Attach the heater leads to appropriate terminals.
7. Replace the interior floor and screws.

Fan Motor

(Tools needed: Screwdriver, 5/32 inch Allen wrench, one quarter (1/4) inch socket set)

1. Remove the floor plate.
 - a. Remove the screws from the floor plate.
 - b. Lift the floor plate out of the oven.
2. Remove the left side wall.
3. Remove the fan inlet plate.
4. Loosen the set screws (2) on fan wheel in middle of oven bottom. You can reach the fan wheel by going through the heater or by disconnecting and removing the heater. Refer to the Heater Unit instructions.
5. Place the oven on its back.
6. Remove the bottom plate. This will reveal the fan motor.
7. Remove the fan motor.
 - a. Unscrew the screws (4) holding motor mounts to the body.
 - b. Disconnect the motor leads from the terminal strip on the power panel.
 - c. Lift the fan motor from the oven body.

After the fan wheel has run at temperature for awhile, it will stick to the shaft. Some force may be required to separate the fan wheel from the fan motor shaft.

8. Take the motor mounts off old motor.
9. Put the motor mounts onto new motor.

Fan Motor (Cont.)

10. Replace the fan motor.
 - a. Insert the shaft into shaft collar. Put the fan wheel onto shaft from inside oven.
 - b. Reattach the motor mounts to the oven body, making sure grommets are in place.
 - c. Reattach the motor lead wires to the terminal strip.
11. Replace the oven bottom.
12. Turn the oven right side up.
13. Adjust the fan wheel for 3/16 inch clearance between the wheel and the inlet ring.
14. Tighten the set screws on the fan wheel.
15. Check that the set screws hit the flats machined into the motor shaft.
16. Replace the floor plate.

APPENDIX

Special Instructions

The Protocol™ has been preset and tested at the factory for normal operating conditions. In most applications, it will not be necessary to alter oven settings. This section contains additional information and reference for special operating conditions.

Control Instrument

Tune Mode

Various functions of the control instrument are set by parameters in the tune mode. To access the tune mode, it is necessary to enter the proper code.

1. Press **Tune** key. The display reads TUNE.
2. Press ↓ key. CODE *** will be displayed.
3. Enter + . . + - +. PID TUNE will be displayed.

The PID tuning parameters may be entered. The units are listed below.

P = degrees
I = seconds/repeat
D = degrees/second

Tuning Outline

Table 10 Tuning Outline

Display	Description
TUNE	Selects tune mode.
CODE ***	Enter + - - + - +
PID TUNE	Enter tuning parameters.
P-1	Proportional band in degrees (+ or - keys).
I-1	Reset in seconds/repeat (+ or - keys).
D-1	Rate in degrees/second (+ or - keys).
DEG -	Select °C or °F (+ or - keys).
SPL -	Setpoint limit, set to maximum temperature of oven (+ or - keys)
CZO -	Calibration zero offset -99.9 to 99.9 (+ or - keys).
DIS	Time set in MMSS (minutes/seconds) or HHMM (hours/minutes).
BEEP	Select beep on or off (+ or - keys).
PF-RECVR	Power failure recovery mode. Use + or - keys to select from STOP, RESUME or HOLD STOP Program terminates. Must restart from the beginning of the program RESUME When power is restored, program resumes at the point where power failure occurred. HOLD Program waits for the operator. The operator has a choice of terminating or resuming the program.
DIG COMM	Digital communications option. Disregard unless Protocol™ is supplied with optional digital communications interface. For proper setting, refer to the Protocol™ software manual or the Digital Communication User Guide. Select from NO COMM, CPIOF or ASCII (+ or - keys). Select from RS232C or RS422A (+ or - keys). Select address (ADDR) from 1 to 999 (+ or - keys)
RECONFIG	For saving changes to DIG COMM options in memory.
PROF CLR	Entering code clears all profiles to default values.
VARS CLR	Entering code clears the SRAM in Protocol™. All parameters must be reset. Should be done in EXTREME circumstances only. Recalibration is essential.
CODE *E*	For factory installed modifications. Do not change the code setting.

Experience and experimentation with tuning parameters will guide the user in determining the proper settings when normal conditions are not present.

Tuning Worksheet

In most applications it is not necessary to alter tuning parameters. To enter the tune mode, press **Tune**. **TUNE** will be displayed. Press ↓ and enter + - - + - +. Using the ↓ key and the + or - keys, enter the desired settings. Press **Home** when finished.

Display	Setting	Factory Setting	Units
P-1	_____	5	degrees
I-1	_____	30	seconds/repeat
D-1	_____	0	degrees/second
DEG -	_____	C	°F (°C)
SPL -	_____	343	°F (°C)
CZO -	_____	varies	% degrees - calibrated to center chamber at 300°C
DIS -	_____	HHMM	minutes/seconds (hours/minutes)
BEEP	_____	On	off (on)

Notes:

1. The alternate is listed in ().
2. See Table 10, Tuning Outline, for further information regarding display codes.
3. Tuning parameters may change from those set at the factory. Load mass, fresh air and exhaust damper settings will affect tuning parameters. Some experimentation is required to determine optimum settings.

Reset times greater than 35 seconds/repeat are not recommended.

Calibration Mode

Protocol™ has been tested and calibrated at the factory. Under normal operating conditions, recalibration should not be necessary. However, if the instrument does not comply with known standards, recalibration may be necessary.

Calibration Instructions

We recommend using a certified analog thermocouple simulator/calibration source with less than $\pm 1^\circ\text{F}$ noise. We have experienced signal stability problems with some micro-processor based thermocouple simulator/calibrators which induce an error during the calibration procedure. This error generally results in a non-linear shift in the controller's indicated temperature.

15. Disconnect AC power to the oven.
16. Remove Protocol™ controller to expose thermocouple input terminals.
17. Disconnect control and hi-limit thermocouples from controller thermocouple input terminals (**Control T/C**, and **Hi-limit T/C**).

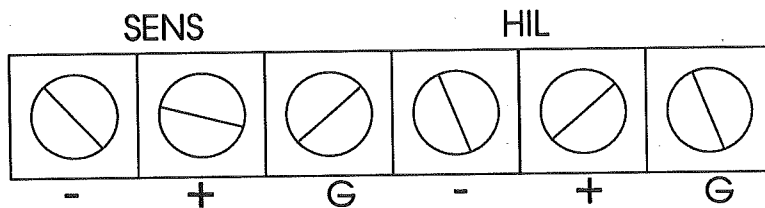


Figure 6 shows the top view of the J type thermocouple inputs on Protocol™.

18. Mark thermocouple leads if not labeled.
19. Connect a 6 foot piece of type J thermocouple lead wire to each of the **Control T/C** and **Hi-limit T/C** terminals.
20. Twist together or jumper the lead wire end not connected to the **Control T/C** and **Hi-limit T/C** terminals. This create a junction and prevents a control sensor error [S-T/C ERR] and hi-limit sensor error [H-T/C ERR] caused by an open thermocouple.
21. Loosely fasten the Protocol™ controller to the oven.
22. Re-connect AC power to the oven.
23. Press the **Power On** pushbutton to energize oven.

WARNING:

Calibration equipment without internal ambient compensation provisions requires subtracting the ambient mV signal from the calibration temperature mV signal to calibrate Protocol™ properly.

All error's must be cleared to perform calibration. Any active error will inhibit the calibration function. To clear a hi-limit control error [HL ERROR] caused by lost of calibration (hi-limit indication of 500°C or 932°F in the diagnostic mode):

1. Increase the hi-limit setpoint to 500°C or 932°F.
2. Press the **Reset** key.

Calibration Instructions (Cont.)

24. Press the **Tune** key. The display reads [TUNE].
25. Use the ∇ and \blacktriangle keys to scroll through the tune mode configuration. The controller must be configured to operate in °F (Fahrenheit) and CZO should be set to zero (0.0).
 - a. Record initial tune mode parameters prior to making any changes.
 - b. Press the ∇ key. The display reads [CODE ***].
 - c. Press the following key sequence: +, -, -, +, -, +. The display reads [PID TUNE]. Protocol™ is in the tune mode.
 - d. Use the following table to change the tune mode parameters.

NOTE:
or ##.# represents a numeric value or parameter.

Table 11 Tune Mode Parameter Calibration

Press	Display	Factory Default Setting	Actual Setting	Press	Adjustable Range
∇ key	P-1 ###	5		+ or - keys	0°C to 500°C 32°F to 932°F
∇ key	I-1 ###	30		+ or - keys	0 to 999 seconds/repeat
∇ key	D-1 ###	0		+ or - keys	0 to 999 degrees/second
∇ key	DEG - C	C		+ key for C or - key for F.	
∇ key	SPL - ###	maximum de- signed operating temperature ¹		+ or - keys	0°C to 500°C 32°F to 932°F
∇ key	CZO - ##.#	can vary		+ or - keys to change parameter to 0.0	-99.9 to 99.9 degrees
∇ key	DIS HHMM	HHMM		+ key for HHMM (hours and minutes) or the - key for MMSS (minutes and seconds).	
∇ key	BEEP ON	ON		+ key for ON or the - key for OFF.	

¹ 204°C/400°F, 260°C/500°F, 343°C/650°F

Calibration Instructions (Cont.)

- e. Press the **Manual** key. The display reads [MANUAL].
 - f. Allow the controller a thirty (30) minute warm up time before proceeding to the step #13 - CAL MODE.
26. Press the **Cal** key. The display reads [CAL-MODE].
27. Press the **▼** key. The display reads [CODE ***].
28. Press the following key sequence: +, -, -, +, -, +. The display reads [HCAL ###].
29. To calibrate the control, press the **▼** key. The display reads [SCAL ###].
- a. Connect the piece of type J thermocouple lead wire, wired to the **Control T/C** terminals, to a thermocouple simulator.
 - b. Set the simulator to output a type J thermocouple signal.
 - c. Twist together or jumper the piece of type J thermocouple lead wire, wired to the **Hi-limit T/C** terminals. This creates a junction and prevents a hi-limit sensor error [H-T/C ERR] caused by an open thermocouple. Press the **Reset** key to clear a hi-limit sensor error [H-T/C ERR] caused by an open thermocouple.
 - d. Adjust the simulator to supply a 250°F signal.
 - e. Press and hold the **-** key for approximately three (3) seconds until display indicates 250. If display indicates 932, continue to step f. However, you should verify that the display indicates 250 on step h.
 - f. Adjust the simulator to supply a 450°F signal.
 - g. Press and hold the **+** key for approximately three (3) seconds until display indicates 450.
 - h. Repeat steps d through g.

Calibration Instructions (Cont.)

30. To calibrate the hi-limit control, press the Δ key. The display reads [HCAL ###].
 - a. Connect the piece of type J thermocouple lead wire, wired to the **Hi-limit T/C** terminals, to a thermocouple simulator.
 - b. Set the simulator should be set to output a type J thermocouple signal.
 - c. Twist together or jumper the piece of type J thermocouple lead wire wired to the, **Control T/C** terminals to create a junction and prevent a control sensor error [S-T/C ERR] caused by an open thermocouple. Press the **Reset** key to clear a control sensor error [S-T/C ERR] caused by an open thermocouple.
 - d. Adjust the simulator to supply a 250°F signal.
 - e. Press and hold the - key for approximately three (3) seconds until display indicates 250. If display indicates 932, continue to step f. However, you should verify that the display indicates 250 on step h.
 - f. Adjust the simulator to supply a 450°F signal.
 - g. Press and hold the + key for approximately three (3) seconds until display indicates 450.
 - h. Repeat steps d through g.
 - i. Press the **Manual** key. The display reads [MANUAL].
31. Press the **Power On** pushbutton to de-energize oven.
32. Disconnect AC power to the oven.
33. Remove Protocol™ controller to expose thermocouple inputs terminals.

Calibration Instructions (Cont.)

34. Disconnect the two pieces of type J thermocouple lead wire connected to the **Control T/C** and **Hi-limit T/C** terminals.
35. Re-connect control and hi-limit thermocouples to the controller thermocouple terminals (**Control T/C**, and **Hi-limit T/C**).
36. Re-install the Protocol™ controller onto the oven.
37. Re-connect AC power to the oven.
38. Press the **Power On** pushbutton to energize oven.
39. Press the **Tune** key. The display reads [TUNE].
40. Reset any tune mode parameters that were changed in step 25. to perform calibration (examples: DEG = F and CZ0 = 0 .0).
41. When changes have been completed, press the **Manual** key. The display reads [MANUAL].

The calibration procedure is complete.

Diagnostics Mode

The diagnostics mode is provided to give certain relative information about Protocol™. The following gives an outline of the diagnostics mode.

Table 12 Diagnostics Mode Outline

Display	Description
DIAGNOSE	Select Diagnostics mode.
SSR	Protocol™ SSR output level.
EVENTS	Events 1-3 follow
E-1	Event 1 output
E-2	Event 2 output
E-3	Event 3 output
SENS-T/C	Control thermocouple display follows
GOOD	Control thermocouple test and input reading
HL - T/C	Hi-limit thermocouple display follows
GOOD	Hi-limit thermocouple test and input reading
PWR	% output
SEN	AD conversion code for control thermocouple
HIL	AD conversion code for Hi-limit thermocouple

Items that can be adjusted by the user include SSR (ON or OFF), Events E-1, E-2 and E-3(ON or OFF) and PWR. The SSR and PWR items can be used to test the solid state relay for proper operation. The SSR item allows the SSR to output 100% (ON) or 0% (OFF). The PWR item allows for adjustable output from 0% to 100%. To implement, adjust the PWR level with the +/- keys and turn on the heater relay.

Power Failure

In the event that the power supplied to Protocol™ is insufficient at any point during a running mode, the display will read PWR-FAIL. In the tune mode, the user can choose the Power Fail Recovery mode form Stop, Resime and Hold. To restart after a power failure in the hold mode, press teh Start key to resume oven operation. Otherwise, press the **Reset** key to clear the PWR-FAIL display. Do not shut off the power during a running mode. This creates an error condition and PWR-FAIL will be displayed the next time Protocol™ is powered up. Instead, press the **Stop** key and the **Heater Off** key. This will power off Protocol™ without creating an error condition.

Programming Examples and Outline

The following examples show a step by step procedure for programming Protocol™ in the Manual, Timer and Program modes. Example 1 covers the Manual mode and example 2 covers the Timer mode. A detailed outline covers the Program mode with a programming worksheet and examples 3-5 following the outline.

NOTE:
Do not turn the power off until the oven temperature is below 100°C (212°F).

Example 1 - Manual Mode

Control the process at 250°F.

NOTE:
°F is selected in the tune mode.

Table 13 Manual Mode Example

Key	DISPLAY	Description
Manual	MANUAL	Select Manual mode
↓	Hi-limit	Enter the high limit temperature
↓	HL 200	High limit temperature currently set at 200°F
+	HL 275	Increase high limit temperature to 275°F
↓	SETPOINT	Enter the setpoint
↓	180 75	Setpoint at 180°F, actual oven temperature at 75°F
+	250 75	Increase setpoint to 250°F
↓	READY	Protocol™ is ready to run Manual mode
Heater On	READY	Heater relay initiated, heater ready for power
Start	250 75	Setpoint = 250°F, actual oven temperature = 75°F
Stop	READY	Stop Manual mode
Heater Off	READY	Heater relay LED is off, heater secured off

Example 2 - Timer Mode

Control the process at 200°C for three hours and 15 minutes with the timer beginning at 195°C. Protocol™ will stop automatically when run in Timer mode.

NOTE:
°C and HHMM
(hours/minutes) is selected in
the tune mode.

Table 14 Timer Mode Example

Key	DISPLAY	Description
Timer	TIMER	Select timer mode
↓	Hi-limit	Enter the high limit temperature
↓	HL 225	Hi-limit currently set at 225°C
-	HL 215	Decrease high limit to 215°C
↓	SETPOINT	Enter the setpoint
↓	210 25	Setpoint at 210°C, actual oven temperature at 25°C
-	200 25	Decrease setpoint to 200°C
↓	TIME0010	Timer currently set for ten minutes
+	TIME0315	Increase timer to three hours and 15 minutes
↓	TEMP NO	Timer currently set to begin timing at ambient
+	TEMP YES	Timer set to begin timing at the following temperature.
↓	TEMP 79	Timer currently set to begin timing at 79°C
+	TEMP 195	Timer set to begin timing at 195°C
↓	READY	Protocol™ is ready to run Timer mode
Heater On	READY	Heater relay LED on, heater ready for power
Start	200 25	Setpoint = 200°C, actual oven temperature = 25°C
Stop	READY	Stop Timer mode
Heater Off	READY	Heater relay LED is off, heater secured off.

Program Mode

Table 15 Program Mode Outline

Display	Description
PROGRAM	Select Program mode
Hi-limit	Hi-limit for Program mode
HL	Enter high limit temperature (+ or - keys)
PROFILES PRO-	Enter profile number (1-8)
SEG-	Segment number of profile (1-6)
RAMP	Ramp time entered
EVENTS	Event status for ramp time
E-1	Event 1 status (ON or OFF)
E-2	Event 2 status (ON or OFF)
E-3	Event 3 status (ON or OFF)
TEMP	Ramp ending temperature
SOAK	Soak period of ramp ending temperature
EVENTS	Event status for soak period
E-1	Event 1 status (ON or OFF)
E-2	Event 2 status (ON or OFF)
E-3	Event 3 status (ON or OFF)
SOAK-DEV	Soak-Deviation limit for profile (Also assured soak limit)
+/-	Enter soak-deviation limit
GOTO	Enter profile to GOTO End = Move to REPEAT TIMES command 1 = GOTO profile 1 2 = GOTO profile 2 : 8 = GOTO profile 8
REPEAT TIMES	Enter number of recursions (1-99) 1 = Execute profile 1 times 2 = Execute profile 2 times : 99 = Execute profile 99 times
HOLD	Hold at last setpoint?
YES	Hold at last setpoint indefinitely. Holds event outputs at last value
NO	No hold at last setpoint. Event outputs turn OFF

Program Mode (Cont.)

Notes on the Program mode.

1. The profile number is manually entered using the + or - keys.
2. Six segments exist for each profile.
3. If the ramp time and soak time for any one segment is zero, Protocol™ ignores the remaining segments.
4. The REPEAT TIMES command is the number of times to execute the profile being programmed.
5. The HOLD command is contingent on the final segment of the last profile to be run only.
6. A soak time will not begin until the actual temperature is within the soak-deviation limit. (Assured soak limit).
7. Make sure the proper starting profile number is displayed in the PRO- prompt before executing the profile to be run.

While a program is being executed, pressing the **Reset** key will display the profile number, segment number and the number of loops (REPEAT TIMES) remaining. Pressing the **Start** key will display the appropriate ramp or soak time remaining (TR).

If Protocol™ is in a HOLD condition, pressing the **Reset** key will display that the control is in segment 7 (HOLD).

Program Worksheet

The program worksheet serves as a guide to the input parameters for the program mode.

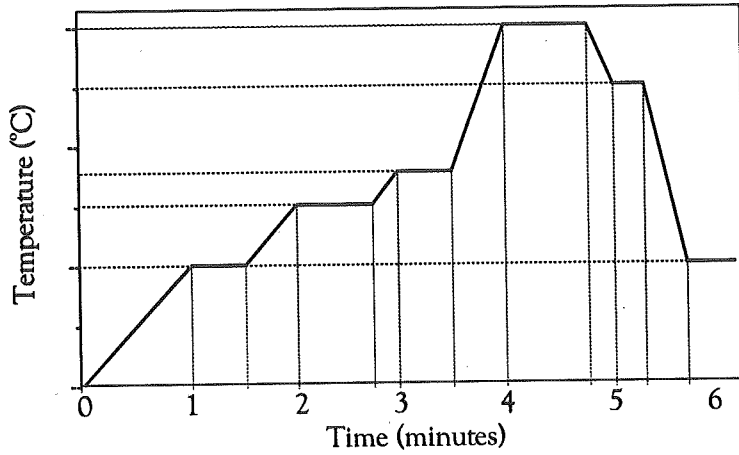
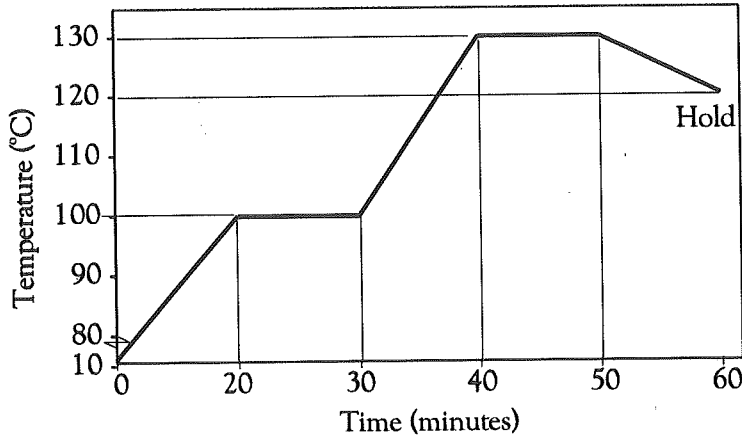


Figure 7 illustrates a sample profile.

Display	Setting(s)					
HL	_____					
PRO-	_____					
SEG-	1	2	3	4	5	6
RAMP	_____	_____	_____	_____	_____	_____
E-1	_____	_____	_____	_____	_____	_____
E-2	_____	_____	_____	_____	_____	_____
E-3	_____	_____	_____	_____	_____	_____
TEMP	_____	_____	_____	_____	_____	_____
SOAK	_____	_____	_____	_____	_____	_____
E-1	_____	_____	_____	_____	_____	_____
E-2	_____	_____	_____	_____	_____	_____
E-3	_____	_____	_____	_____	_____	_____
SOAK-DEV	_____					
GOTO	_____					
REPEAT TIMES	_____					
HOLD	_____					

Example 3 - Program Mode

Follow the characteristic curve listed below.



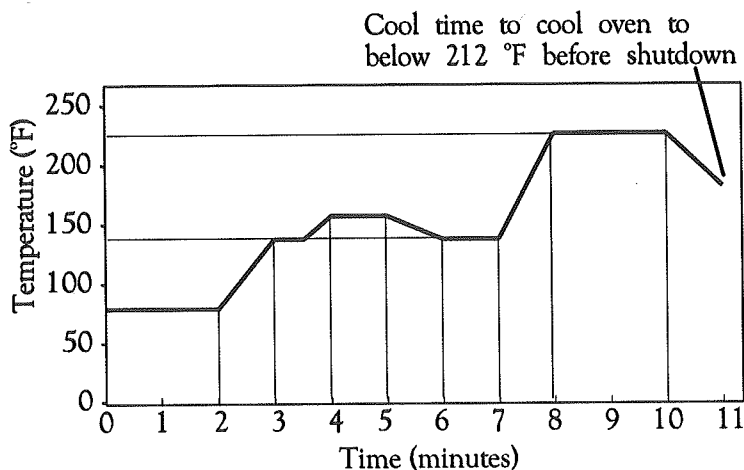
NOTES:
 HHMM (hours/minutes) and °C selected in the tune mode.
 No event outputs are being used.
 Soak-Deviation limit = $\pm 7^{\circ}\text{C}$
 (also assured soak limit). Hold at last setpoint. Ramp and soak times of zero in any one segment ignores remaining segments.

Figure 8 illustrates an example temperature profile.

Display	Setting(s)					
HL	<u>150</u>					
PRO-	<u>1</u>					
SEG-	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
RAMP	<u>0020</u>	<u>0010</u>	<u>0010</u>	<u>0000</u>	_____	_____
E-1	_____	_____	_____	_____	_____	_____
E-2	_____	_____	_____	_____	_____	_____
E-3	_____	_____	_____	_____	_____	_____
TEMP	<u>100</u>	<u>130</u>	<u>120</u>	<u>120</u>	_____	_____
SOAK	<u>0010</u>	<u>0010</u>	<u>0001</u>	<u>0000</u>	_____	_____
E-1	_____	_____	_____	_____	_____	_____
E-2	_____	_____	_____	_____	_____	_____
E-3	_____	_____	_____	_____	_____	_____
SOAK-DEV	<u>7</u>					
GOTO	<u>End</u>					
REPEAT TIMES	<u>1</u>					
HOLD	<u>Yes</u>					

Example 4 - Program Mode

Autostart the oven after two hours and follow the characteristic curve below.



NOTES:
MMSS (minutes/seconds) and °F selected in the tune mode.
Event 1 wired properly for autostart, events 2 - 3 are not used. No hold at last setpoint.

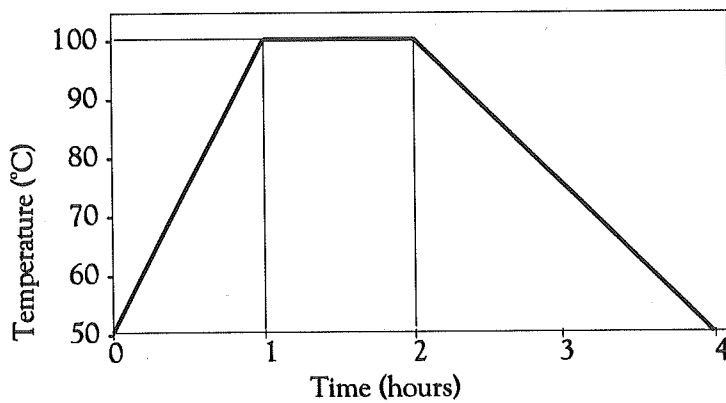
Soak-Deviation = $\pm 5^{\circ}\text{F}$ (also assured soak limit). Minimum operating temperature is 70°F .

Figure 9 illustrates an example temperature profile.

Display	Setting(s)					
HL	<u>240</u>					
PRO-	<u>1</u>					
SEG-	1	2	3	4	5	6
RAMP	<u>0001</u>	<u>0100</u>	<u>0030</u>	<u>0100</u>	<u>0100</u>	<u>0030</u>
E-1	<u>OFF</u>	<u>ON</u>	<u>ON</u>	<u>ON</u>	<u>ON</u>	<u>ON</u>
E-2	_____	_____	_____	_____	_____	_____
E-3	_____	_____	_____	_____	_____	_____
TEMP	<u>70</u>	<u>130</u>	<u>160</u>	<u>130</u>	<u>220</u>	<u>100</u>
SOAK	<u>0200</u>	<u>0030</u>	<u>0100</u>	<u>0100</u>	<u>0200</u>	<u>0000</u>
E-1	<u>OFF</u>	<u>ON</u>	<u>ON</u>	<u>ON</u>	<u>ON</u>	<u>OFF</u>
E-2	_____	_____	_____	_____	_____	_____
E-3	_____	_____	_____	_____	_____	_____
SOAK-DEV	<u>5</u>					
GOTO	<u>End</u>					
REPEAT						
TIMES	<u>1</u>					
HOLD	<u>NO</u>					

Example 5 - Program Mode

Complete characteristic curve five times.



NOTES:
 HHMM (hours/minutes) and °C selected in the tune mode.
 No events used. Soak-Deviation = 10°C (also assured soak limit).
 Minimum operating temperature = 50°C. Ramp and soak times of zero in any one segment ignores remaining segments.

Figure 10 illustrates an example temperature profile.

Display	Setting(s)
HL	<u>115</u>
PRO-	<u>1</u>
SEG-	1 2 3 4 5 6
RAMP	<u>0100</u> <u>0200</u> <u>0000</u> _____
E-1	_____
E-2	_____
E-3	_____
TEMP	<u>100</u> <u>50</u> <u>50</u> _____
SOAK	<u>0100</u> <u>0001</u> <u>0000</u> _____
E-1	_____
E-2	_____
E-3	_____
SOAK-DEV	<u>10</u>
GOTO	<u>End</u>
REPEAT TIMES	<u>5</u>
HOLD	<u>NO</u>

Troubleshooting

Any equipment operating for as many hours a day are likely to have problems now and then. Below are possible problems and suggested solutions. If you have a problem not listed and do not know what to do, contact Despatch Industries at our toll free Help Line 800-473-7373.

<u>Difficulty</u>	<u>Probable Cause</u>	<u>Suggested Remedy</u>
Failure to heat	No power	Check power source and/or oven and wall fuses.
	Broken or frayed cord	Replace with new cord.
	Burned out heater	Replace heater (see warranty)
	Protocol™ malfunction	Replace controller
	Loose wire connections	Disconnect power and check connections behind control panel.
Slow heat up	Improperly loaded	Reduce load or redistribute load in chamber.
	Low line voltage	Supply sufficient power and proper connections. Check for circuit overload.
	Heating element(s) are burned out	Replace burned out element (see warranty statement, back page).
	240 volt oven is connected to a 208V line	Raise line voltage to a 240 volt line.
	Fan motor failure	Replace fan motor.
Frequent heater element out	Harmful fumes generated by load	Increase vent opening or discontinue process.
	Spillage or splattering of material on heater elements	Disconnect power and clean oven chamber and elements.
	Overheating oven	Check the Hi-limit.

Troubleshooting (Cont.)

Difficulty	Probable Cause	Suggested Remedy
Erratic temp. Inaccurate temp.	Protocol™ malfunction	Replace Protocol™.
	Improper tuning parameters	Check tuning parameters.
	Protocol™ miscalibration	Recalibrate Protocol™ (see section on Calibration mode).
	Hi-limit setting	Hi-limit should be 10-25°C higher than set point.
Excess surface or door temp.	Improper offset	Check calibration zero offset.
	Door seal deterioration	Replace door seal.
Improper airflow	Fan motor failure	Replace fan motor.
	Unbalanced fan wheel	Replace fan wheel.
Excessive vibration	Dirty fan wheel	Clean fan.
	Unbalanced fan wheel	Replace fan wheel.
Oven will not control at setpoint	Hi-limit set too low	Set the Hi-limit higher.
	Protocol™ malfunction	Replace control.
	SSR malfunction	Replace SSR and/or check control output voltage
	Air friction of recirculation fan	Open exhaust air vent. Unit will not control below minimum operating temperature with vent closed.
Heater does not shutdown until temp. reaches the Hi-limit setting	Protocol™ malfunction	Replace Protocol™.
	SSR malfunction	Replace SSR.

Accessories

The ovens have options that can easily be field installed.

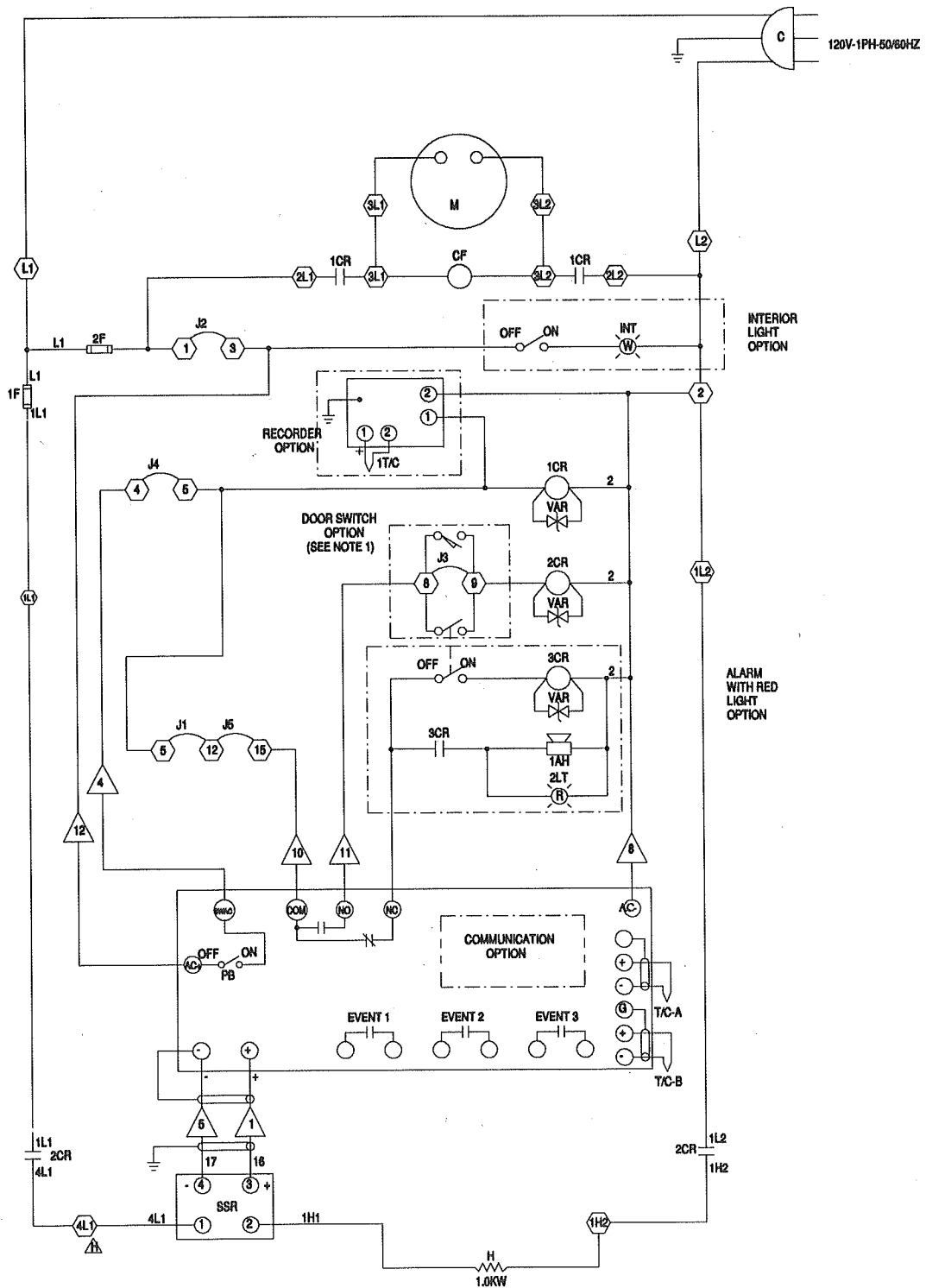
Table 16 Accessories

Option	Functional Description
Recorder kit	The round chart recorder follows the temperature changes and records them for permanent record.
Door switch	Disables heater when the door is opened.
Extra shelves	
Stands	This support frame includes one open shelf.
Base cabinets	These steel, 22 inch high cabinets are painted to match the ovens. The cabinets store supplies and hold workloads. A magnetic latch secures the door. Standard Despatch shelves fit in the cabinets. Shelves for base cabinets must be ordered separately.
Stacking kit	Allows ovens to be stacked to save space. Kit includes angles mounted on top of the lower oven to stabilize the upper oven.

The above items can all be field installed. For further information on these items or other available options, please contact your Despatch representative.

Drawings

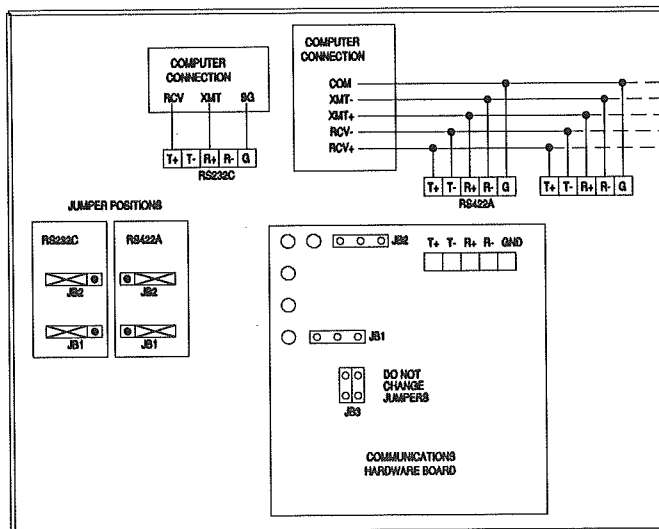
LAC1-10



Material List

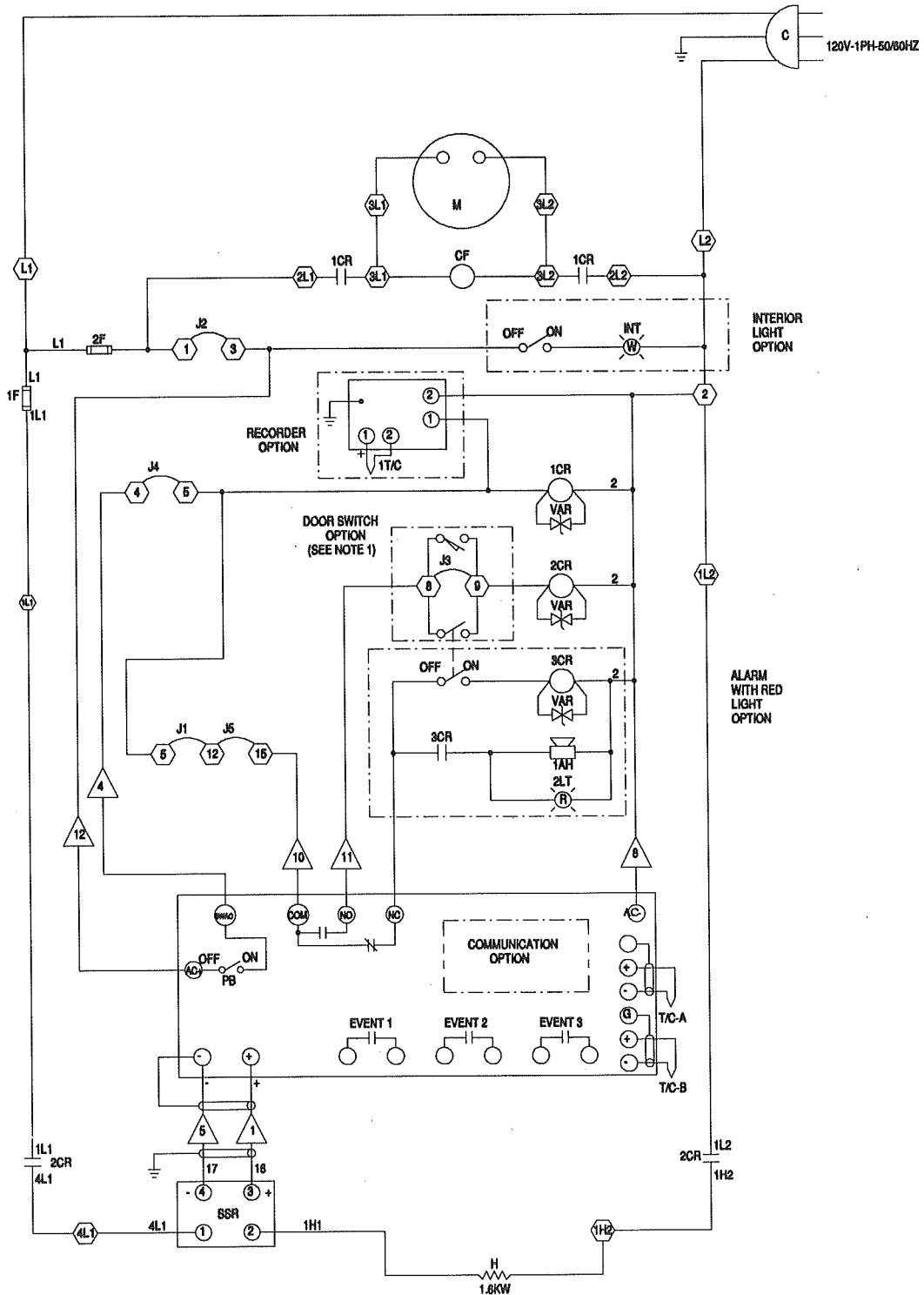
Item	Part Number	Quantity	Description
CL/HL	118320	1	Despatch Protocol™ CONTROL/HILIMIT 115VAC 50/60Hz J T/C
PB	097313	1	Pushbutton model EMF (inc. in 118320)
T/C	110629	1	JJ39008E-00-16Z-25048-2 T/C
H	007773	1	1000 watt heater
M	008333	1	00.04 HP motor
1&2F	007471	1	F030A2SP fuseblock
1F	007609	1	250V 10 amp fuse
2F	007453	1	250V 6 amp fuse
CF	006049	1	MU2A1 cabinet fan
1-2CR		1	30A 240V DPST relay (incl in 116079)
SSR	057345	1	50A solid state relay
C	031233	1	Power cord
PCB	116079	1	Relay board assembly

Communication Option and Options List



Part Number	Description
114737	Chart recorder
111361	Interior light
111362	Door switch
114388	HI-LIMIT/end of cycle alarm
118321	RS232/RS422 Communications

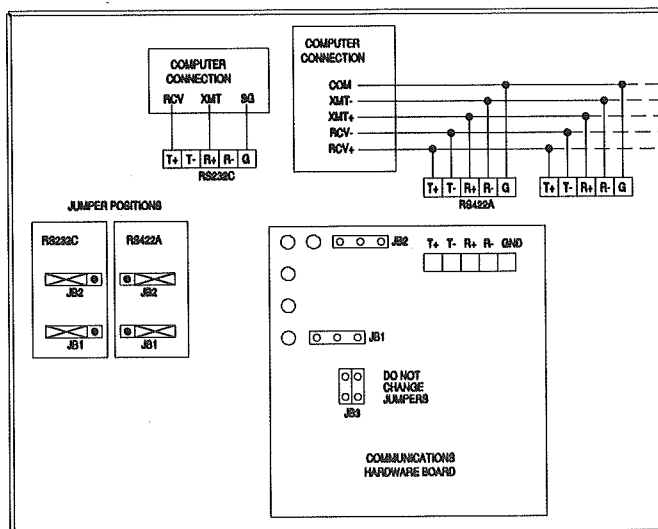
LAC1-38A



Material List

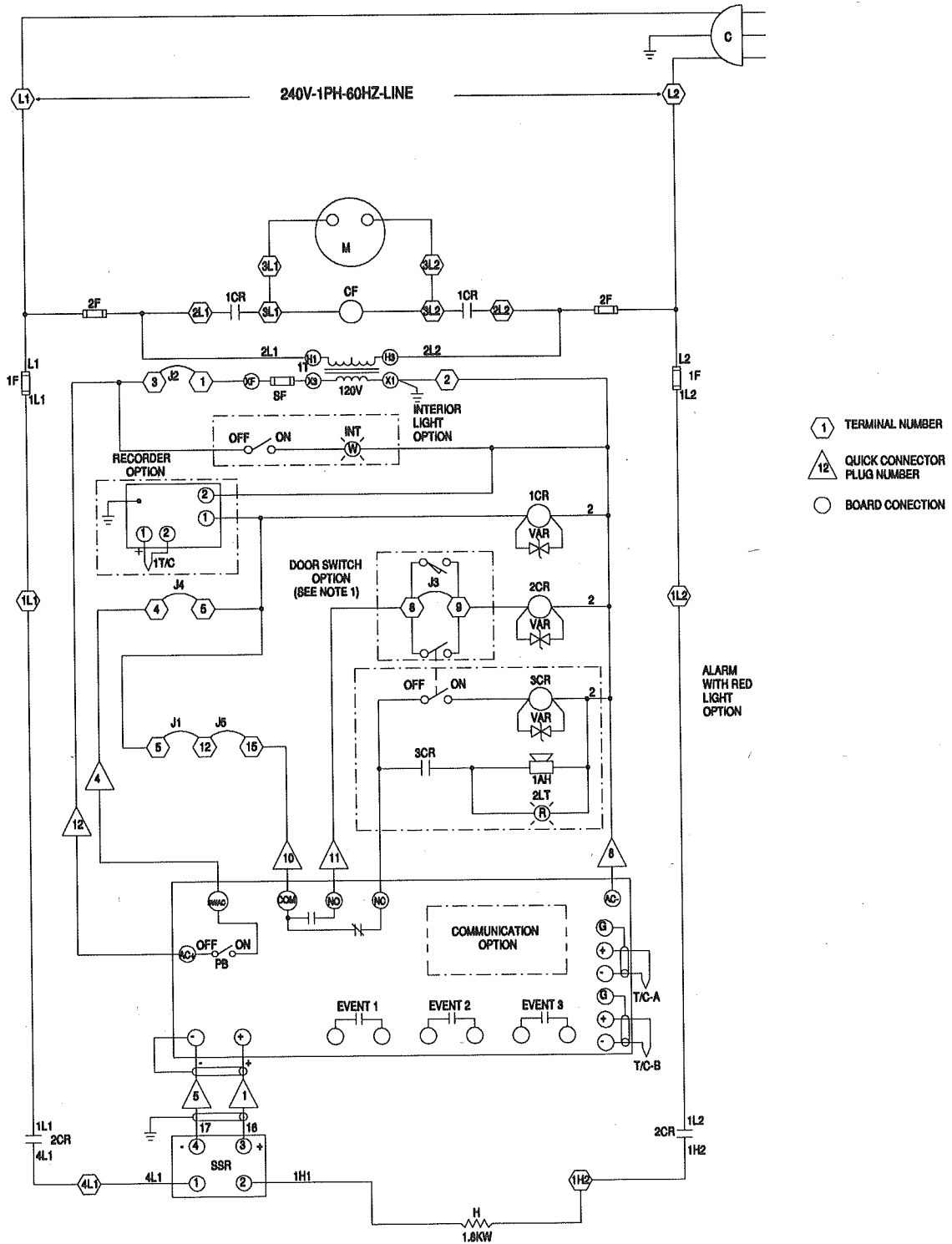
Item	Part Number	Quantity	Description
CL/HL	118320	1	Despatch Protocol™ CONTROL/HILIMIT 115VAC 50/60Hz J T/C
PB	097313	1	Pushbutton model EMF (inc. in 118320)
T/C	110629	1	JJ39008E-00-16Z-25048-2 T/C
H	007774	1	1600 watt heater
M	097273	1	00.25 HP motor
1&2F	007471	1	F030A2SP fuseblock
1F	007609	1	250V 10 amp fuse
2F	007529	1	250V TR-3.5 amp fuse
CF	006049	1	MU2A1 cabinet fan
1-2CR		1	30A 240V DPST relay (incl in 116079)
SSR	057345	1	50A solid state relay
C	074496	1	Power cord
PCB	116079	1	Relay board assembly

Communication Option and Options List



Part Number	Description
114737	Chart recorder
111361	Interior light
111362	Door switch
114388	HI-LIMIT/end of cycle alarm
118321	RS232/RS422 Communications

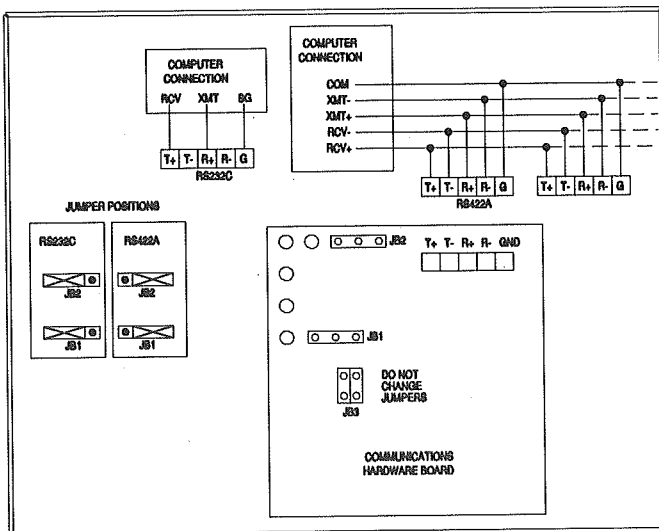
LAC1-38B



Material List

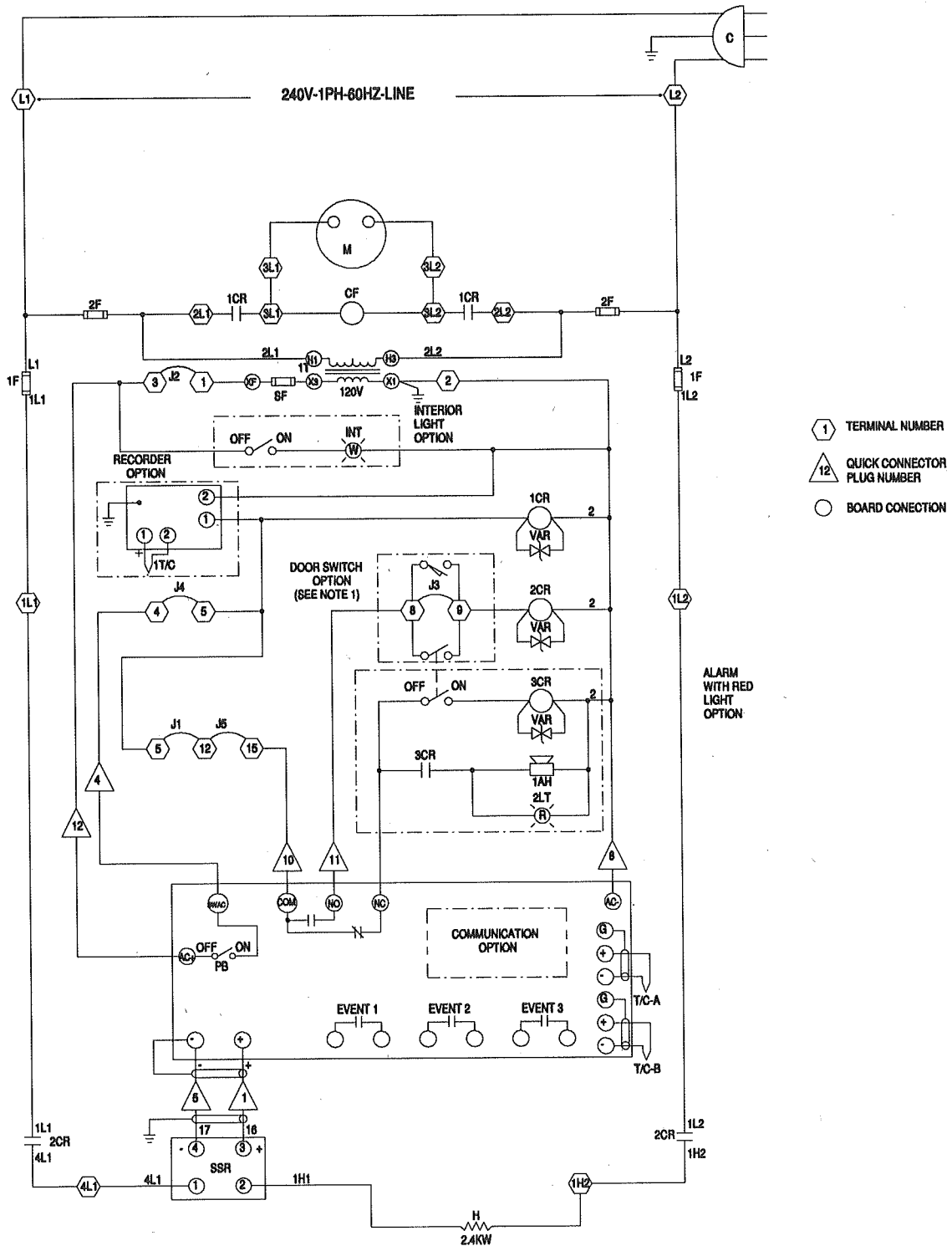
Item	Part Number	Quantity	Description
CL/HL	118320	1	Despatch Protocol™ CONTROL/HILIMIT 115VAC 50/60Hz J T/C
PB	097313	1	Pushbutton model EMF (inc. in 118320)
T/C	110629	1	JJ39008E-00-16Z-25048-2 T/C
H	007775	1	1800 watt heater
M	097273	1	00.25 HP motor
1F	007471	1	F030A2SP fuseblock
	007609	1	250V 10 amp fuse
2F	007471	1	F030A2SP fuseblock
	007525	2	250V TR-2.5 amp fuse
CF	015229	1	MU3A1 cabinet fan
1T	116082	1	75VA 240/208V transformer
1-2CR		1	30A 240V DPST relay (incl in 116079)
SSR	057345	1	50A solid state relay
C	105115	1	Power cord
SF	116083	1	0.8 amp trans sec. fuse
PCB	116079	1	Relay board assembly

Communication Option and Options List



Part Number	Description
114737	Chart recorder
111361	Interior light
111362	Door switch
114388	HI-LIMIT/end of cycle alarm
118321	RS232/RS422 Communications

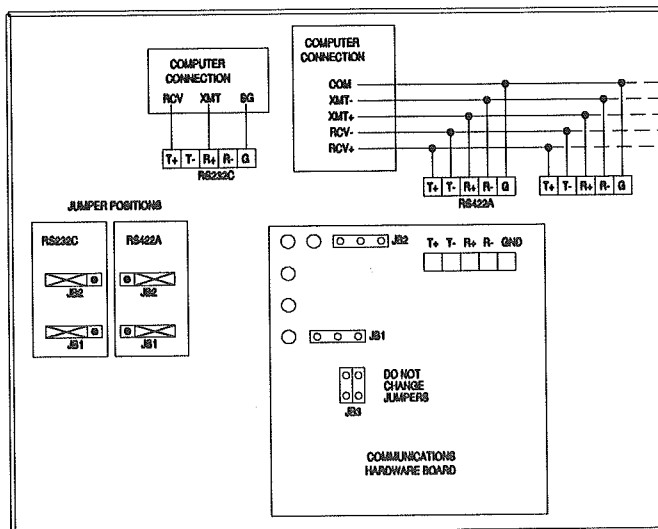
LAC1-67



Material List

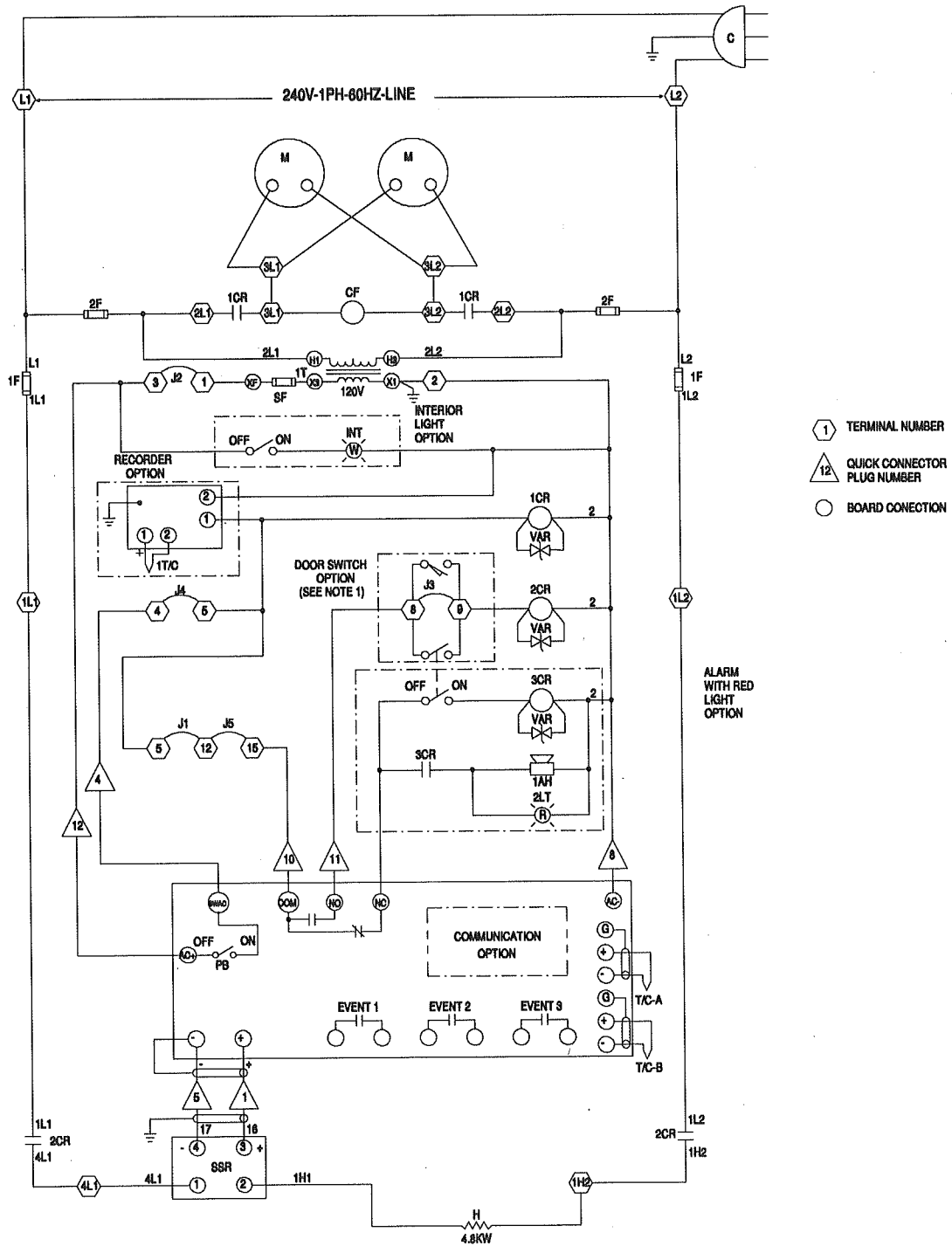
Item	Part Number	Quantity	Description
CL/HL	118320	1	Despatch Protocol™ CONTROL/HILIMIT 115VAC 50/60Hz J T/C
PB	097313	1	Pushbutton model EMF (inc. in 118320)
T/C	110629	1	JJ39008E-00-16Z-25048-2 T/C
H	007776	1	2400 watt heater
M	097273	1	00.25 HP motor
1F	007471	1	F030A2SP fuseblock
	007611	1	250V 15 amp fuse
2F	007471	1	F030A2SP fuseblock
	007525	2	250V TR-2.5 amp fuse
CF	015229	1	MU3A1 cabinet fan
1T	116082	1	75VA 240/208V transformer
1-2CR		1	30A 240V DPST relay (incl in 116079)
SSR	057345	1	50A solid state relay
C	105115	1	Power cord
SF	116083	1	0.8 amp trans sec. fuse
PCB	116079	1	Relay board assembly

Communication Option and Options List



Part Number	Description
114737	Chart recorder
111361	Interior light
111362	Door switch
114388	HI-LIMIT/end of cycle alarm
118321	RS232/RS422 Communications

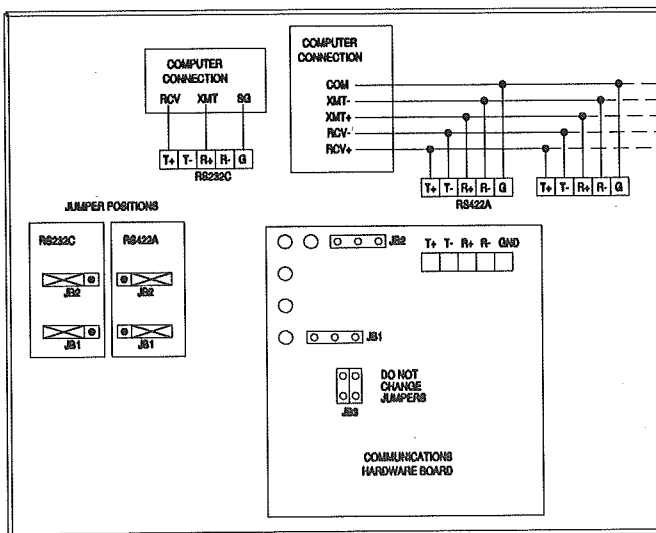
LAC2-18



Material List

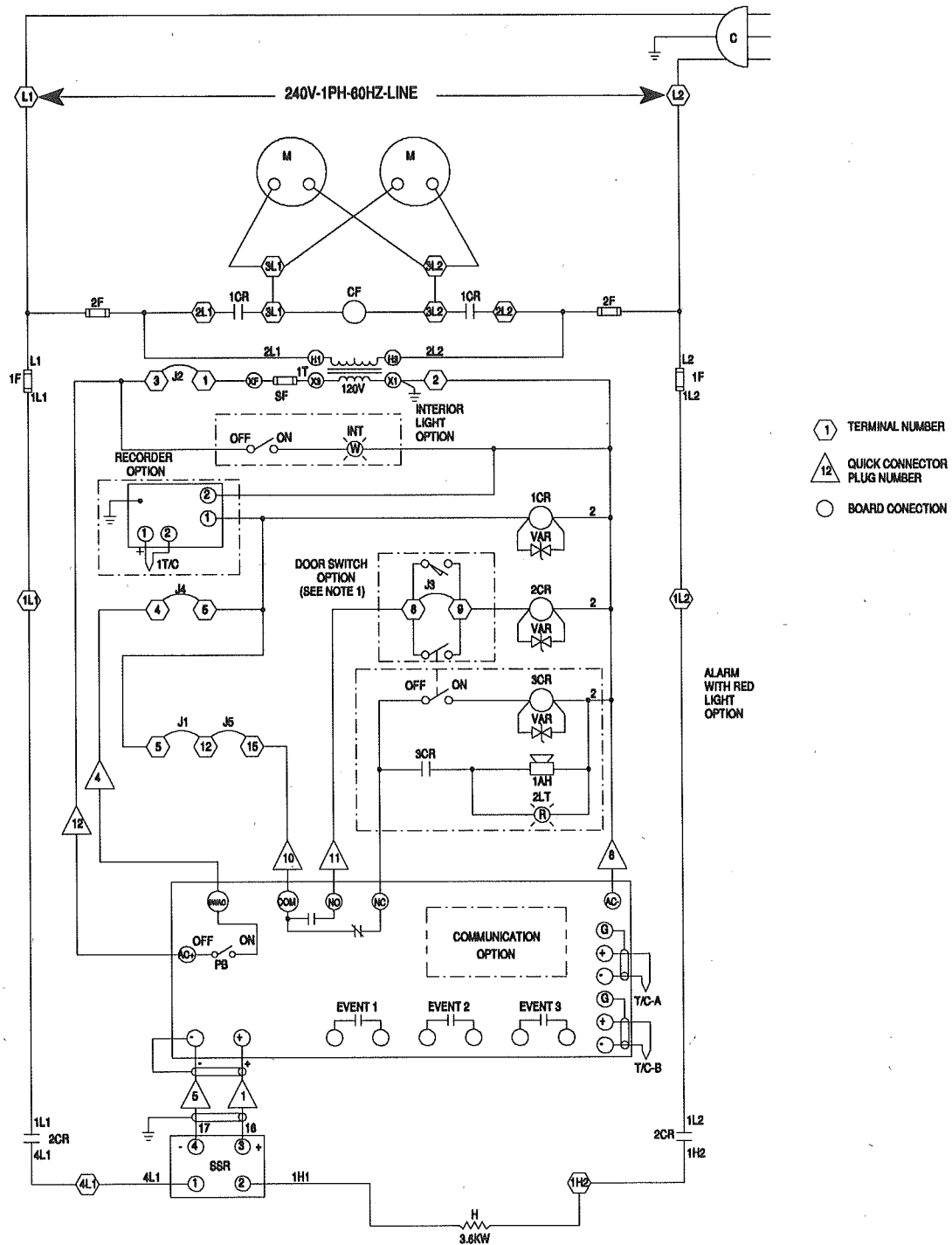
Item	Part Number	Quantity	Description
CL/HL	118320	1	Despatch Protocol™ CONTROL/HILIMIT 115VAC 50/60Hz J T/C
PB	097313	1	Pushbutton model EMF (inc. in 118320)
T/C	110629	1	JJ39008E-00-16Z-25048-2 T/C
H	007776	2	2400 watt heater
M	097273	2	00.25 HP motor
1F	007471	1	F030A2SP fuseblock
	007615	1	250V 25 amp fuse
2F	007471	1	F030A2SP fuseblock
	007431	2	250V TR-4.5 amp fuse
CF	015229	1	MU3A1 cabinet fan
1T	116082	1	75VA 240/208V transformer
1-2CR		1	30A 240V DPST relay (incl in 116079)
SSR	057345	1	50A solid state relay
SF	116083	1	0.8 amp trans sec. fuse
PCB	116079	1	Relay board assembly

Communication Option and Options List



Part Number	Description
114737	Chart recorder
111361	Interior light
111362	Door switch
114388	HI-LIMIT/end of cycle alarm
118321	RS232/RS422 Communications

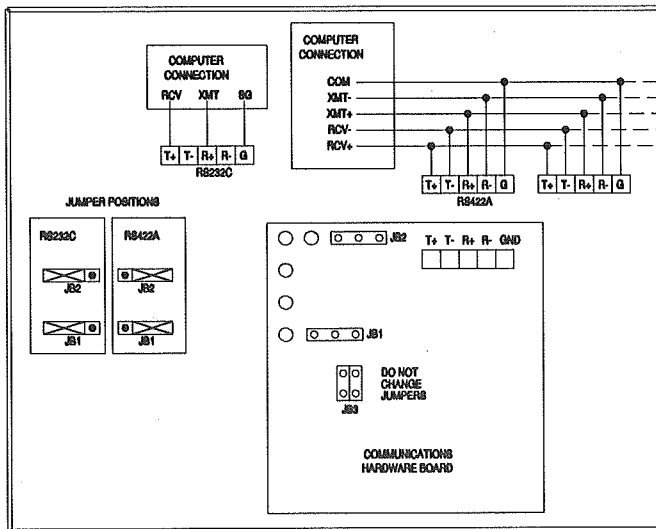
LAC2-12



Material List

Item	Part Number	Quantity	Description
CL/HL	118320	1	Despatch Protocol™ CONTROL/HILIMIT 115VAC 50/60Hz J T/C
PB	097313	1	Pushbutton model EMF (inc. in 118320)
T/C	110629	1	JJ39008E-00-16Z-25048-2 T/C
H	007778	1	3600 watt heater
M	097273	2	00.25 HP 11523015060 motor
1F	007471	1	F030A2SP fuseblock
	007613	1	250V 20 amp fuse
2F	007471	1	F030A2SP fuseblock
	007531	2	250V TR-4.5 amp fuse
CF	015229	1	MU3A1 cabinet fan
1T	116082	1	75VA 240/208V transformer
1-2CR		1	30A 240V DPST relay (incl in 116079)
SSR	057345	1	50A solid state relay
SF	116083	1	0.8 amp trans sec. fuse
PCB	116079	1	Relay board assembly

Communication Option and Options List



Part Number	Description
114737	Chart recorder
111361	Interior light
111362	Door switch
114388	HI-LIMIT/end of cycle alarm
118321	RS232/RS422 Communications