

TECHNICAL MANUAL

LIQUID-TO-LIQUID COOLING SYSTEM MODEL LCS20



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TABLE OF CONTENTS

TABLE OF CONTENTS 3

INTRODUCTION 4

SAFETY PRECAUTIONS..... 5

LABEL AND SILKSCREEN MARKINGS (LOCATED IN THE BACK OF UNIT) 6

PART NUMBER DESCRIPTION 8

INSTALLATION REQUIREMENTS 9

INSTALLATION PROCEDURE..... 11

CONTROLLER..... 12

CHANGING TEMPERATURE UNITS..... 20

STARTUP PROCEDURE & SYSTEM OPERATION..... 21

SYSTEM MAINTENANCE AND SERVICE 22

TROUBLE SHOOTING GUIDE 24

SPARE PARTS LIST 25

ELECTRICAL SCHEMATIC 27

PLUMBING SCHEMATIC 28

BOYD COOLING SYSTEM SERVICE POLICY 29

BOYD WARRANTY 31

INTRODUCTION

Receiving Your Liquid Cooling System

Inspect your LCS (liquid cooling system) immediately upon receiving it. If the unit shows shipping damage, contact the transportation company and file a freight damage claim. Retain all cartons and packing material until the unit is operated and found to be in good condition. Your LCS has been fully tested at the Boyd factory with clean water. Although the system has been drained, some residual fluid may remain. This will not hinder the performance of the chiller.

About The Warranty

Refer to the end of manual for the LCS standard warranty. All units returned for warranty claims must have an RMA (Return Material Authorization) number on the outside of the container. Call Boyd Customer Service at +1-781- 933-7300 for an RMA number. Units should be drained of all fluids and packaged in its original packaging.

Customer Service Support

Boyd is committed to servicing the customer, both during and after the sale. If you have any questions concerning the operation of your unit, contact our Application Engineering Department at +1-781- 933-7300. To facilitate your call, please have the **model number** and **serial number** of the unit (located on the rear of the LCS) for the Boyd Applications Engineer. For a detailed description of Boyd's LCS service policy, refer to the back of this manual.

Service Hotline

Boyd has a 24-hour per day, 7 day per week service hotline to help you with questions on the startup and operation of your LCS. **(We recommend you review the troubleshooting guide before calling our service hotline.)** Boyd service can be reached by dialing +1-781- 933-7300. To facilitate your call please have the **model number** and **serial number** (located on rear of the LCS) of the unit for the Boyd Service Technician. For a detailed description of Boyd's LCS service policy, refer to the back of this manual.

SAFETY PRECAUTIONS

This system is designed to provide fluid cooling only as specified in this manual. If you use this system in a manner other than as specified, the safety protection of the system may be impaired.

Warnings are posted throughout the manual. Read and follow these important instructions. Failure to observe these instructions or use the LCS other than as specified may impair safety protection, void the warranty, and can result in permanent damage to the unit, significant property damage, personal injury and/or death.

Make sure you read, understand, and follow all instructions and safety precautions listed in this manual before operating your unit. If you have any questions concerning the operation of your unit or the information in this manual, please contact our Applications Engineering Department at +1-781-933-7300.

- **DO NOT USE AUTOMOTIVE ANTI-FREEZE IN THE LCS.** The rust inhibitors in the automotive type may cause premature failure of the pump seals. Use of automotive anti-freeze in a Boyd LCS will void the warranty.
- Never place the unit in a location where excessive heat, moisture, or corrosive materials are present.
- The unit must be plugged into a properly grounded power source.
- Do not connect the SUPPLY or RETURN fitting to your building water supply or any pressurized source.
- **DO NOT USE OR MAINTAIN THE LCS OUTDOORS.** These units were not designed to withstand outdoor weather conditions.
- Performance of installation, operation or maintenance procedures other than those described in this manual may result in a hazardous situation and may void the Boyd warranty.
- Transport the unit with care. Sudden jolts or drops can damage the unit.
- Drain the unit of all water when transporting, shipping, or leaving unused for long periods of time. This will prevent freezing and algae build up while idle.
- Observe all warning labels. Never remove warning labels.
- Do not operate damaged or leaking equipment.
- Do not operate the unit without fluid in the reservoir.
- Always turn the unit "OFF" and disconnect the power cord from the power source before performing any service, maintenance procedures or before moving the unit.
- Do not operate equipment with damaged power cords.
- A qualified technician should perform Service and repairs.

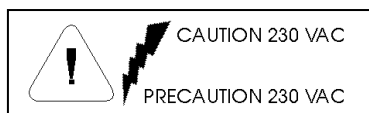
LABEL AND SILKSCREEN MARKINGS (Located in the back of unit)

RETURN

RETURN LABEL: This label identifies the connection where heated fluid is supplied from the user's machine.

SUPPLY

SUPPLY LABEL: This label identifies the connection where chilled fluid is supplied to the user's machine.



CAUTION LABEL: The triangle symbol tells maintenance personnel and users to consult the Technical Manual for more information. In this example, the symbol calls attention to the High Voltage Warning in the Control Box.



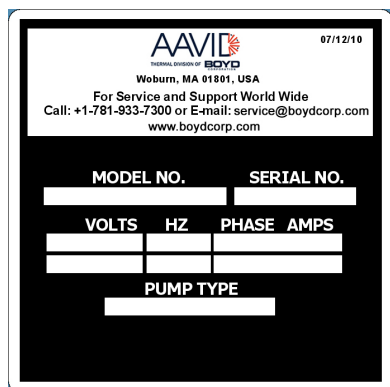
FUNCTIONAL/EARTH LABEL: (ground) Terminal.



GROUND LABEL: This symbol appears on the unit next to a protective earth ground terminal



CE LABEL: This symbol certifies that the Liquid Cooling System conforms to the EMC Directive and all applicable directives at the time of marking.



PRODUCT ID LABEL: Identifies the model number, serial number, electrical information, and pump type.



ATTENTION / WARNING LABEL



VOLTAGE LABEL: This symbol is to alert you of the presence of dangerous voltage within the unit's enclosure. The voltage is of sufficient magnitude to constitute a risk of electrical shock.

**FACILITY
WATER OUT**

FACILITY WATER OUT LABEL: Discharge facility water from LCS unit.

**FACILITY
WATER IN**

FACILITY WATER IN LABEL: Supply LCS unit with facility water from LCS unit.



ETL LABEL: The marking on this label certifies that the equipment has been certified to the UL standard 61010A-1 and CAN/CSA STD C22.2 No. 1010.1 standards.

**15A CIRCUIT BREAKER
SWITCH TO "ON" POSITION
TO OPERATE**

CIRCUIT BREAKER LABEL: Located on the backside of chiller. This label signifies that the 15A Circuit Breaker Switch must be in the "ON" position to operate.



WEEE LABEL: The crossed out wheeled bin label requires that the product be disposed of or recycled with the requirements of local law.

PART NUMBER DESCRIPTION

LCS20 G01 BB 1 MXXX

Basic Model No.	Electrical Configurations	Pump Options	Controller Configuration	Std. Modification
LCS20 – 20 kW NOTE: Pump flows are rated at 60Hz. For 50Hz power capacity is reduced by 17%.	G01 = 100-120V, 1Ph, 50/60Hz J01 = 200-240V, 1Ph, 50/60Hz	BB (CB*) = 1.3 gpm Positive Displacement Pump BC (CC*) = 1.8 gpm Positive Displacement Pump BE (CE*) = 2.3 gpm Positive Displacement Pump BG (CG*) = 4.3 gpm Positive Displacement Pump DA† = CP-25 Centrifugal Pump EB (FB*) = Turbine Pump * Indicates high purity compatible pump. † Water filter and DI cartridge not recommended with Centrifugal and Turbine pumps.	1 = Temperature display, temperature set-point, over temp alarm light. 2 = Same as “1” above with the addition of : <ul style="list-style-type: none"> • Low-level alarm light. • Low flow alarm light. • Analog temperature output (0-5 V) 	

NOTE: Refer to the product ID label on the rear of your chiller for the configuration you have purchased.
 The table above refers to Boyd's standard product offering for the LCS product line.

INSTALLATION REQUIREMENTS

Coolant Requirements

- Boyd recommends using filtered clean water above 10°C/50°F as coolant.
- If the set point is 10°C/50°F or below, a freezing point depressant, such as ethylene glycol, is required. This unit is equipped with a low flow switch. This feature will shut the chiller down during a low flow situation to prevent freezing.
- **NOTICE DO NOT USE AUTOMOTIVE ANTI-FREEZE IN THE LCS.** The rust inhibitors in the automotive type may cause premature failure of the pump seals. Use of automotive anti-freeze in a Boyd LCS will void the warranty.
- Avoid using water with a high mineral content.
- If the coolant is exposed to sunlight add an algacide to control organic growth in lines.

Environmental Requirements

Non-operating

- Ambient Temperature: –20° to 50°C with a maximum positive/negative rate of change of 20°C/hour.
- Humidity: Between 5% and 100%, non-condensing, with the maximum allowable positive/negative rate of change of 30% per hour.
- Altitude: 30 m below sea level to 5000 m above sea level.

Operating

- Ambient Temperature: 10°- 35°C, with a maximum positive/negative rate of change of 10°C/hour.
- Humidity: Between 30% and 75%, non-condensing, with the maximum allowable positive/negative rate of change of 5% per hour.
- Altitude: 30 m below sea level to 2500 m above sea level

Electrical Requirements

Refer to the Specification section and to the product ID label on the rear of the LCS for the specific electrical requirements of your unit. The LCS power module is configured with a standard international IEC320/C20 inlet. To safely operate the LCS, use an SJT cord set with an IEC 320/C19 receptacle and an inlet plug that is compatible to the local power grid and the power requirements of the LCS. All Kodiak chillers should use SJT 3 conductor 12 AWG minimum power cord.

Selecting LCS Location

To minimize the heat gain and pressure drop through the connecting hoses, the LCS should be located as close as possible to the heat load (user equipment). This is more important for units with centrifugal pumps. Coolant lines are best run at or near the same level as the cooling system. Once the chiller is in position lock the casters.

The top clearance must be at least 6" for removal of the cover and at least 6" around four sides for removal of side panels and access of internal components.

Before moving the LCS cap all ports to prevent any coolant leakage. Unlock the casters and move to new location. Once in the new location lock the casters.

Storing LCS

NOTICE Do not operate or store chillers outside. These systems are not intended for outdoor use.

NOTICE To prevent freezing during storage drain water if the chiller is located in an area below 10°C (50°F).

If unit is to be out of use for more than 1 week, drain all liquid from chiller to prevent algae growth.

INSTALLATION PROCEDURE

Selecting and Locating Hoses

- The coolant ports are located on the rear of the system and are labeled as previously shown.
- To minimize the pressure loss in the coolant lines, use the largest practical diameter tubing. If substantial lengths of cooling lines are required, they should be pre-filled with coolant before connecting them to the chiller.
- To minimize heat gain, all lines should be as short as possible. Keep them away from heat sources such as radiators and hot water pipes. Lines that cannot be routed away from heat sources should be protected with thermal insulation, preferably at least 1/2" (12.7mm).
- Flexible tubing should be of heavy wall or reinforced construction. All tubing should be rated to withstand 125 psig at 186°F (30°C). Make sure all tubing connections are secured and leak-tight. Also, whenever possible use opaque lines to prevent algae growth during prolonged non-operating periods.

Connecting Plumbing

To connect the fluid lines to the chiller and user equipment follow these steps:

1. Remove the plastic caps covering the supply and return ports on the rear panel of the unit.
2. Attach coolant lines to the supply and return ports on the rear panel. Fittings should either be brass, stainless steel or nylon. Never use steel or cast iron fittings, as the corrosion will damage the chiller.

THE SUPPLY PORT:	Provides chilled coolant to the user's equipment.
THE RETURN PORT:	Connects to the outlet of the user's equipment.
*FACILITY WATER IN:	Supply LCS unit with Facilities water.
FACILITY WATER OUT:	Discharge Facility water from LCS unit.

***NOTE:** To maintain a process water temperature of 120° F. (49 C), the facility water should have a flow of 8.0 GPM minimum at a temperature of 80°. (27 C). Maximum facility water pressure should be 100 PSI and no greater than 35 psid across LCS.

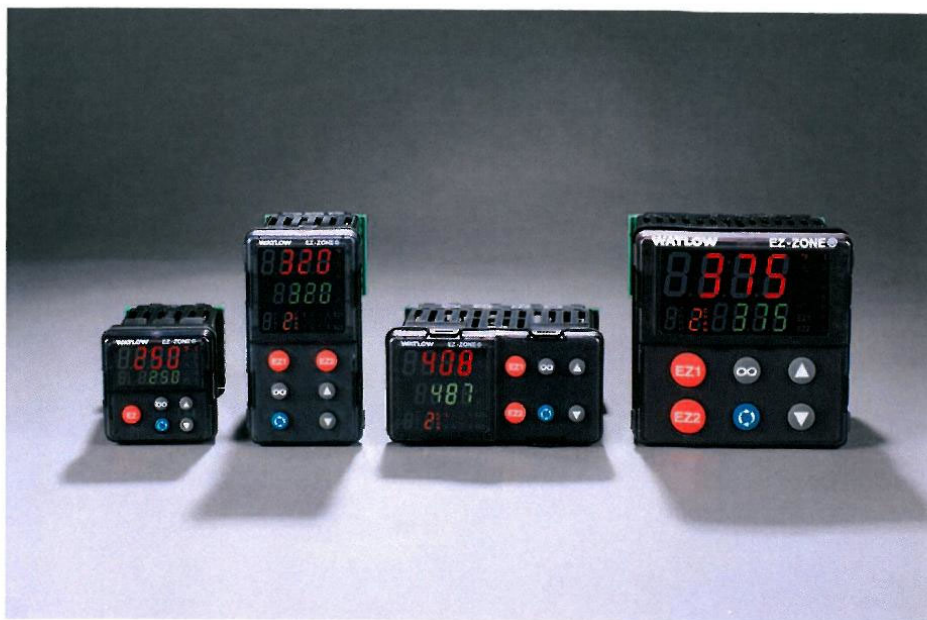
NOTICE A pressure drop of greater than 35 psid across the LCS facility circuit could result in premature valve wear and damage to equipment.

3. Check that fittings are tight to prevent leaks.
4. Remove water filler cover on top of the unit to access the reservoir.
5. Fill the reservoir. Use the reservoir sight tube on the front of the unit to see the coolant level in the tank as you are filling. Be sure to allow for the volume of coolant needed to fill the cooling lines between the chiller and the equipment, if they were not filled with coolant before installation.

NOTICE In order to maintain process setpoint facility water must be started before the LCS is turned on.

CONTROLLER

EZ-ZONE[®] PM User's Manual



Integrated Controller Models



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3

Chapter 3: Keys and Displays

Upper Display:

In the Home Page, displays the process value, otherwise displays the value of the parameter in the lower display.

Zone Display:

Indicates the controller zone.

1 to 9 = zones 1 to 9

A = zone 10 E = zone 14

b = zone 11 F = zone 15

C = zone 12 h = zone 16

d = zone 13

Lower Display:

Indicates the set point or output power value during operation, or the parameter whose value appears in the upper display.

EZ Key/s:

This key can be programmed to do various tasks, such as starting a profile.

Channel Display:

Indicates the channel for any given EZ-ZONE module.

- Available with the PM4, 8 and 9 only.

Advance Key

Advances through parameter prompts.

1/8 DIN (PM8) Horizontal



Temperature Units:

Indicates whether the temperature is displayed in Fahrenheit or Celsius.

Percent Units:

Lights when the controller is displaying values as a percentage or when the open-loop set point is displayed.

Output Activity:

Number LEDs indicate activity of outputs. A flashing light indicates output activity.

Profile Activity:

Lights when a profile is running. Flashes when a profile is paused.

1/16 (PM6) DIN



1/8 DIN (PM9) Vertical



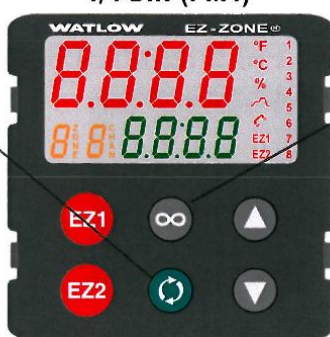
Communications Activity

Flashes when another device is communicating with this controller.

Up and Down Keys

In the Home Page, adjusts the set point in the lower display. In other pages, changes the upper display to a higher or lower value, or changes a parameter selection.

1/4 DIN (PM4)



Infinity Key

Press to back up one level, or press and hold for two seconds to return to the Home Page. From the Home Page clears alarms and errors if clearable.

Responding to a Displayed Message

Attention Codes

An active message (see Home Page for listing) will cause the display to toggle between the normal settings and the active message in the upper display and Attention **ATTN** in the lower display.

Your response will depend on the message and the controller settings. Some messages, such as Ramping and Tuning, indicate that a process is underway. If the message was generated by a latched alarm or limit condition, the message can be cleared when the

condition no longer exists by simply pushing the Infinity **∞** key or alternatively by following the steps below. If an alarm has silencing enabled, it can also be silenced.

Push the Advance Key **⏩** to display Ignore **IGN** in the upper display and the message source (such as Limit High **L.H.1**) in the lower display. Use the Up **▲** and Down **▼** keys to scroll through possible responses, such as Clear **CLR** or Silence **SIL**. Then push the Advance **⏩** or Infinity **∞** key to execute the action. See the Home Page for further information on the Attention Codes.

Display	Parameter Name Description	Setting	Range	Default	Appears If
ATTN	<p>Attention</p> <p>An active message will cause the display to toggle between the normal settings and the active message in the upper display and ATTN in the lower display.</p> <p>Your response will depend on the message and the controller settings. Some messages, such as Ramping and Tuning, indicate that a process is underway. If the message was generated by a latched alarm or limit condition, the message can be cleared when the condition no longer exists. If an alarm has silencing enabled, it can be silenced.</p> <p>Push the Advance Key ⏩ to display IGN in the upper display and the message source (such as L.H.1) in the lower display.</p> <p>Use the Up ▲ and Down ▼ keys to scroll through possible responses, such as Clear CLR or Silence SIL. Then push the Advance ⏩ or Infinity ∞ key to execute the action. Alternatively, rather than scrolling through all messages simply push the Infinity ∞ button to generate a clear.</p>		<p>ALL 1 ALL 2 ALL 3 ALL 4 Alarm Low 1 to 4</p> <p>ALH 1 ALH 2 ALH 3 ALH 4 Alarm High 1 to 4</p> <p>ALE 1 ALE 2 ALE 3 ALE 4 Alarm Error 1 to 4</p> <p>ERI 1 ERI 2 Error Input 1 or 2</p> <p>L.L.1 Limit Low 1</p> <p>L.H.1 Limit High 1</p> <p>L.E.1 Limit Error 1</p> <p>TUN 1 TUN 2 Tuning 1 or 2</p> <p>R.P.1 R.P.2 Ramping 1 or 2</p> <p>L.P.O.1 L.P.O.2 Loop Open Error 1 or 2</p> <p>L.P.R.1 L.P.R.2 Loop Reversed Error 1 or 2</p> <p>CER.1 Current Error</p> <p>HER.1 Heater Error</p>		an alarm or error message is active.

Parameters that appear only in the Home Page

Navigating the EZ-ZONE PM Integrated Controller



Home Page from anywhere: Press the Infinity Key **∞** for two seconds to return to the Home Page.



Operations Page from Home Page: Press both the Up ▲ and Down ▼ keys for three seconds.



Setup Page from Home Page: Press both the Up ▲ and Down ▼ keys for six seconds.



Profiling Page from Home Page: Press the Advance Key ⌂ for three seconds



Factory Page from Home Page: Press both the Advance ⌂ and Infinity ∞ keys for six seconds.

4

Chapter 4: Home Page

Default Home Page Parameters

Watlow's patented user-defined menu system improves operational efficiency. The user-defined Home Page provides you with a shortcut to monitor or change the parameter values that you use most often. The default Home Page is shown on the following page. When a parameter normally located in the Setup Page or Operations Page is placed in the Home Page, it is accessible through both. If you change a parameter in the Home Page, it is automatically changed in its original page. If you change a parameter in its original page it is automatically changed in the Home Page.

The Attention **[RELn]** parameter appears only if there is an active message. An example of an active message could be a Current Error **[CEr 1]**, or it could be for information only like Autotune **[UN 1]** taking place.

Use the Advance Key **[➡]** to step through the other parameters. When not in pairs the parameter prompt will appear in the lower display, and the parameter value will appear in the upper display. You can use the Up **[↑]** and Down **[↓]** keys to change the value of writable parameters, just as you would in any other menu.

If Control Mode is set to Auto, the Process Value is in the upper display and the Closed Loop Set Point (read-write) is in the lower display.

If a profile is running, the process value is in the upper display and the Target Set Point (read only) is in the lower display. If Control Mode is set to Manual, the Process Value is in the upper display and the output power level (read-write) is in the lower display.

If Control Mode is set to Off, the Process Value is in the upper display and **[OFF]** (read only) is in the lower display.

If a sensor failure has occurred, **[---]** is in the upper display and the output power level (read-write) is in the lower display.

Changing the Set Point

You can change the set point by using the Up **[↑]** or Down **[↓]** keys when a profile is not running.

Modifying the Home Page

To modify the Home Page proceed to the Factory Menu by pushing and holding the Advance **[➡]** key and the Infinity **[∞]** key for approximately six seconds. Upon entering the Factory Page the first menu will be the Custom Menu **[CUSE]**. Once there push the Advance **[➡]** key where the lower display will show **[CUSE]** and the upper display will show **[f]**. Again, push the Advance **[➡]** button where the prompt for the

Process Value **[RCPw]** will be displayed on top and Parameter **[PRr]** in the bottom. Using the Up **[↑]** or Down **[↓]** arrow keys will allow for a customized selection of choice. There are twenty positions available that can be customized.

Modifying the Display Pairs

The Home Page, being a customized list of as many as 20 parameters can be configured in pairs of up to 10 via the Display Pairs **[dPr 5]** prompt found in the Diagnostic Menu **[d, 89]** (Factory Page). The listing in the table that follows is what one may typically find in the Home Page as defaults based on controller part numbers. It is important to note that some of the prompts shown may not appear simply because the feature is not being used or is turned off. As an example, the prompt shown in position 7 (loop 1) and position 12 (loop 2) **[LPr]** will not appear unless the Cool algorithm **[LAG]** is turned on in the Setup Page under the Loop menu.

If the ninth digit of the part number is C, J, L or M (PM _____ [C, J, L, M] _____) the Display Pairs **[dPr 5]** prompt will default to 2; otherwise, it will be equal to one.

As stated above, the user can define pairs of prompts to appear on the display every time the Advance **[➡]** key is pushed. The first pair will always be as defined in the Custom Menu and as stated will default (factory settings) to the Active Process Value loop 1 **[RCPw]**, and the Active Set Point loop 1 **[RSP]**. If two channels are present the first 2 pairs will be the same in that the first pair will represent channel 1 Active Process Value and Active Set Point and the second being the same for channel 2. If another pair is created where the Display Pairs **[dPr 5]** prompt is equal to 3 using the default prompts, when the Advance key **[➡]** is pushed two times from the Home Page the upper display will reflect the current control mode and the bottom display would show the output power. When configuring the Custom Menu to your liking it should be noted that if 2 changeable (writable) prompts are displayed in a Pair, i.e., Control Mode on top and Idle Set Point on the bottom, only the lower display (Idle Set Point) can be changed.

The display can be configured to scroll by going to the Factory Page under the Diagnostic Menu and changing the Display Time **[dTe]** prompt to something greater than 0. If set to 2, the display will scroll every 2 seconds from channel 1 to 2 (if present) and then through all of the custom pairs that are configured.

Chapter 11: Appendix

Troubleshooting Alarms, Errors and Control Issues

Indication	Description	Possible Cause(s)	Corrective Action
Alarm won't clear or reset	Alarm will not clear or reset with keypad or digital input	<ul style="list-style-type: none"> Alarm latching is active Alarm set to incorrect output Alarm is set to incorrect source Sensor input is out of alarm set point range Alarm set point is incorrect Alarm is set to incorrect type Digital input function is incorrect 	<ul style="list-style-type: none"> Reset alarm when process is within range or disable latching Set output to correct alarm source instance Set alarm source to correct input instance Correct cause of sensor input out of alarm range Set alarm set point to correct trip point Set alarm to correct type: process, deviation or power Set digital input function and source instance
Alarm won't occur	Alarm will not activate output	<ul style="list-style-type: none"> Alarm silencing is active Alarm blocking is active Alarm is set to incorrect output Alarm is set to incorrect source Alarm set point is incorrect Alarm is set to incorrect type 	<ul style="list-style-type: none"> Disable alarm silencing, if required Disable alarm blocking, if required Set output to correct alarm source instance Set alarm source to correct input instance Set alarm set point to correct trip point Set alarm to correct type: process, deviation or power
[ALE1] Alarm Error [ALE2] [ALE3] [ALE4]	Alarm state cannot be determined due to lack of sensor input	<ul style="list-style-type: none"> Sensor improperly wired or open Incorrect setting of sensor type Calibration corrupt 	<ul style="list-style-type: none"> Correct wiring or replace sensor Match setting to sensor used Check calibration of controller
[ALL1] Alarm Low [ALL2] [ALL3] [ALL4]	Sensor input below low alarm set point	<ul style="list-style-type: none"> Temperature is less than alarm set point Alarm is set to latching and an alarm occurred in the past Incorrect alarm set point Incorrect alarm source 	<ul style="list-style-type: none"> Check cause of under temperature Clear latched alarm Establish correct alarm set point Set alarm source to proper setting
[ALH1] Alarm High [ALH2] [ALH3] [ALH4]	Sensor input above high alarm set point	<ul style="list-style-type: none"> Temperature is greater than alarm set point Alarm is set to latching and an alarm occurred in the past Incorrect alarm set point Incorrect alarm source 	<ul style="list-style-type: none"> Check cause of over temperature Clear latched alarm Establish correct alarm set point Set alarm source to proper setting
[EC11] Error Input [EC12]	Sensor does not provide a valid signal to controller	<ul style="list-style-type: none"> Sensor improperly wired or open Incorrect setting of sensor type Calibration corrupt 	<ul style="list-style-type: none"> Correct wiring or replace sensor Match setting to sensor used Check calibration of controller
Limit won't clear or reset	Limit will not clear or reset with keypad or digital input	<ul style="list-style-type: none"> Sensor input is out of limit set point range Limit set point is incorrect Digital input function is incorrect 	<ul style="list-style-type: none"> Correct cause of sensor input out of limit range Set limit set point to correct trip point Set digital input function and source instance
[LE1] Limit Error	Limit state cannot be determined due to lack of sensor input, limit will trip	<ul style="list-style-type: none"> Sensor improperly wired or open Incorrect setting of sensor type Calibration corrupt 	<ul style="list-style-type: none"> Correct wiring or replace sensor Match setting to sensor used Check calibration of controller
[LL1] Limit Low	Sensor input below low limit set point	<ul style="list-style-type: none"> Temperature is less than limit set point Limit outputs latch and require reset Incorrect alarm set point 	<ul style="list-style-type: none"> Check cause of under temperature Clear limit Establish correct limit set point

Indication	Description	Possible Cause(s)	Corrective Action
[L.H.I] Limit High	Sensor input above high limit set point	<ul style="list-style-type: none"> Temperature is greater than limit set point Limit outputs latch and require reset Incorrect alarm set point 	<ul style="list-style-type: none"> Check cause of over temperature Clear limit Establish correct limit set point
[LP.O.I] [LP.D.I] Loop Open Error	Open Loop Detect is active and the process value did not deviate by a user-selected value in a user specified period with PID power at 100%.	<ul style="list-style-type: none"> Setting of Open Loop Detect Time incorrect Setting of Open Loop Detect Deviation incorrect Thermal loop is open Open Loop Detect function not required but activated 	<ul style="list-style-type: none"> Set correct Open Loop Detect Time for application Set correct Open Loop Deviation value for application Determine cause of open thermal loop: misplaced sensors, load failure, loss of power to load, etc. Deactivate Open Loop Detect feature
[LP.R.I] [LP.R.D.I] Loop Reversed Error	Open Loop Detect is active and the process value is headed in the wrong direction when the output is activated based on deviation value and user-selected value.	<ul style="list-style-type: none"> Setting of Open Loop Detect Time incorrect Setting of Open Loop Detect Deviation incorrect Output programmed for incorrect function Thermocouple sensor wired in reverse polarity 	<ul style="list-style-type: none"> Set correct Open Loop Detect Time for application Set correct Open Loop Deviation value for application Set output function correctly Wire thermocouple correctly, (red wire is negative)
[R.P.I] Ramping 1 [R.P.D.I] Ramping 2	Controller is ramping to new set point	<ul style="list-style-type: none"> Ramping feature is activated 	<ul style="list-style-type: none"> Disable ramping feature if not required
[EUN.I] Autotuning 1 [EUN.D.I] Autotuning 2	Controller is autotuning the control loop	<ul style="list-style-type: none"> User started the autotune function Digital input is set to start autotune 	<ul style="list-style-type: none"> Wait until autotune completes or disable autotune feature Set digital input to function other than autotune, if desired
No heat/cool action	Output does not activate load	<ul style="list-style-type: none"> Output function is incorrectly set Control mode is incorrectly set Output is incorrectly wired Load, power or fuse is open Control set point is incorrect Incorrect controller model for application 	<ul style="list-style-type: none"> Set output function correctly Set control mode appropriately (Open vs Closed Loop) Correct output wiring Correct fault in system Set control set point in appropriate control mode and check source of set point: remote, idle, profile, closed loop, open loop Obtain correct controller model for application
No Display	No display indication or LED illumination	<ul style="list-style-type: none"> Power to controller is off Fuse open Breaker tripped Safety interlock switch open Separate system limit control activated Wiring error Incorrect voltage to controller 	<ul style="list-style-type: none"> Turn on power Replace fuse Reset breaker Close interlock switch Reset limit Correct wiring issue Apply correct voltage, check part number
No Serial Communication	Cannot establish serial communications with the controller	<ul style="list-style-type: none"> Address parameter incorrect Incorrect protocol selected Baud rate incorrect Parity incorrect Wiring error EIA-485 converter issue Incorrect computer or PLC communications port Incorrect software setup Wires routed with power cables Termination resistor may be required 	<ul style="list-style-type: none"> Set unique addresses on network Match protocol between devices Match baud rate between devices Match parity between devices Correct wiring issue Check settings or replace converter Set correct communication port Correct software setup to match controller Route communications wires away from power wires Place 120 Ω resistor across EIA-485 on last controller

Indication	Description	Possible Cause(s)	Corrective Action
Process doesn't control to set point	Process is unstable or never reaches set point	<ul style="list-style-type: none"> Controller not tuned correctly Control mode is incorrectly set Control set point is incorrect 	<ul style="list-style-type: none"> Perform autotune or manually tune system Set control mode appropriately (Open vs Closed Loop) Set control set point in appropriate control mode and check source of set point: remote, idle, profile, closed loop, open loop
Temperature runaway	Process value continues to increase or decrease past set point.	<ul style="list-style-type: none"> Controller output incorrectly programmed Thermocouple reverse wired Controller output wired incorrectly Short in heater Power controller connection to controller defective Controller output defective 	<ul style="list-style-type: none"> Verify output function is correct (heat or cool) Correct sensor wiring (red wire negative) Verify and correct wiring Replace heater Replace or repair power controller Replace or repair controller
100 Device Error EEEn	Controller displays internal malfunction message at power up.	<ul style="list-style-type: none"> Controller defective Sensor input over driven 	<ul style="list-style-type: none"> Replace or repair controller
hEr Heater Error	Heater Error	<ul style="list-style-type: none"> Current through load is above current trip set point Current through load is below current trip set point 	<ul style="list-style-type: none"> Check that the load current is proper. Correct cause of overcurrent and/or ensure current trip set point is correct. Check that the load current is proper. Correct cause of undercurrent and/or ensure current trip set point is correct.
LEr Current Error	Load current incorrect.	<ul style="list-style-type: none"> Shorted solid-state or mechanical relay Open solid-state or mechanical relay Current transformer load wire associated to wrong output Defective current transformer or controller Noisy electrical lines 	<ul style="list-style-type: none"> Replace relay Replace relay Route load wire through current transformer from correct output, and go to the [LCS] Source Output Instance parameter (Setup Page, Current Menu) to select the output that is driving the load. Replace or repair sensor or controller Route wires appropriately, check for loose connections, add line filters
Menus inaccessible	Unable to access [SEE] , [OPER] , [EKEY] or [PROF] menus or particular prompts in Home Page	<ul style="list-style-type: none"> Security set to incorrect level Digital input set to lockout keypad Custom parameters incorrect 	<ul style="list-style-type: none"> Check [LoC] settings in Factory Page Enter appropriate password in [ULoC] setting in Factory Page Change state of digital input Change custom parameters in Factory Page
EZ-Key/s don't work	EZ-Key/s does not activate required function	<ul style="list-style-type: none"> EZ-Key function incorrect EZ-Key function instance not incorrect Keypad malfunction 	<ul style="list-style-type: none"> Verify EZ-Key function in Setup Menu Check that the function instance is correct Replace or repair controller

Watlow Website: For further technical information regarding Controller features and operations visit www.watlow.com

CHANGING TEMPERATURE UNITS

1. Press both the Up-arrow and Down-arrow keys simultaneously on the Controller for 5 seconds until Set and A1 appears on the display and then release the buttons.
2. Press the UP arrow key to scroll down to gLbL.
3. Press the green arrows key and then either the up or down arrow key to toggle between the °F and °C setting.

Programming

The controller installed in the LCS has been factory set for optimal operation. Boyd recommends consulting Boyd Service Department prior to altering the factory settings.

STARTUP PROCEDURE & SYSTEM OPERATION

1. Verify that the coolant reservoir is full.
2. Start facility water flow to the LCS.
3. Verify that the unit is plugged into the correct operating voltage and the circuit breaker located on the rear panel is in the “on” position.
4. Check that the hose connections leading from the supply and return ports on the rear panel of the unit to the device being cooled are securely in place.
5. Turn the rocker switch located on the control panel to the “on” position. The controller will energize and go through a diagnostic test. The pump will start.
 - Press the “set” button on the controller once to display the current coolant temperature set point.
 - Press the “up” and “down” arrow key to get to the desired coolant temperature set point. Press “set” key to accept the set point and return to normal operation.
6. Operate the LCS for 2-3 minutes then check the coolant level. The coolant level should drop as a result of the water line filling up. Add water to bring coolant level up to top of tank.
7. Inspect all fittings and hoses for leaking. If a leak is detected, turn off LCS, disconnect power, and repair the leak.

SYSTEM MAINTENANCE AND SERVICE

⚠ WARNING A qualified service technician must perform all service and maintenance internal to the chiller. Unqualified individuals conducting service on the chiller could result in damage to the equipment, personal injury and/or death.

After your Liquid Cooling System is up and running, it takes only a small amount of care and maintenance to keep it running well.

Every installation is unique, and the conditions in your installation determine how often you should inspect and perform maintenance on your equipment. Here are some guidelines.

Weekly Inspections

Noise Level

Any abnormal sounds or a substantial increase in noise level since the last weekly inspection may indicate an impending pump or coolant blockage problem. Investigate the cause and perform the necessary service. Refer to the troubleshooting section located in this manual.

Leakage

Remove cover and side panels and inspect system for internal leaks. Focus on the deck and the base, as this is where fluid will collect. If fluid is detected, disconnect the power cord. Find and repair any leaks immediately.

If you notice coolant on the floor near the chiller or dripping from the chiller enclosure turn off the chiller. Disconnect the power cord. Find and repair any leaks immediately.

Coolant Level

Inspect the level of fluid in the reservoir. If coolant level is low, fill to capacity.

Any significant drop in the coolant level should be investigated further. If there is no visible system leak, then the loss may be due to equipment leakage elsewhere. Find source of fluid loss and repair. Fluid reservoir should be kept filled to recommended capacity.

Monthly Inspections

Water Filter

With a new system the filter quickly accumulates foreign matter introduced during system setup. This can lead to a decrease in system performance in a short period of time. Inspect the filter cartridge one day after you set up a new system to ensure the filter is clean and the system runs at maximum capacity. After this initial filter inspection, check the filter weekly. For replacement filters contact Boyd's Customer Service at +1-781-933-7300.

Pump Strainer

All positive displacement pumps have a strainer to protect the vanes inside the pump. For pumps less than 2.5 GPM it is located in the pump housing. For larger PD pumps it is installed in the hose between the pump and the tank. Periodically inspect and clean the positive strainer. If it becomes fouled the flow rate will decrease and the pump may wear prematurely.

Deionization Package

The cartridge life is a function of the user's application. Check the water resistivity weekly and change the cartridge as required. For replacement filters contact Boyd's Customer Service at 781-933-7305.

Low Level Switch

The level switch protects the pump in the event of accidental fluid loss. Since this switch is "passive" during normal operation, it is advisable to check it every 6 months. Open the tank cover and push down on the switch to see if the low level alarm is activated.

Quarterly Inspections:

Algae

Inspect tank and hose for evidence of algae growth. Boyd recommends the use of an algae inhibitor to prevent growth in the reservoir.

Inspection and Cleaning of the System and Reservoir

Inspect the tank and water lines for solids contamination and algae growth. If cleaning is required, follow the steps below:

To clean the system follow these steps:

1. Drain the entire unit including the hoses and equipment being cooled.
2. Replace the coolant with clean water.
3. Run the unit with the clean water for 10 minutes.
4. Drain the unit again.
5. Replace all filters.
6. Refill unit with either water or a water and freezing point depressant.

Pumps

As a precaution, the pump must be periodically replaced. This will avoid damaging the unit and the cost associated with excessive downtime. Typical operating life of the pump depends on pump type.

Pump Model	Typical Operating Life
Positive Displacement	7,000 Hours
Centrifugal	28,000 Hours
Turbine	28,000 Hours

Note: Please contact Boyd for pump pricing and delivery.

TROUBLE SHOOTING GUIDE

PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
UNIT DOES NOT START	No power to LCS UNIT	Make sure Power and signal cables are properly connected.
	Power Switch "OFF"	Energize the Pump by moving the Power Switch to the "ON" position
UNIT DOES NOT MAINTAIN TEMPERATURE OR LIGHT "ON" FRONT PANEL	Facility water flow rate is too low.	Set facility water flow rate to 7.5 GPM. Min. (<i>Gallons per minute</i>)
	Facility water temperature is too high.	Check to be sure facility water temperature is $\leq 80^{\circ}\text{ F}$, (27° C).
	Low water level in Reservoir.	Fill Reservoir to the proper level. If the problem still exists, open the front panel and look for a water leak.
	Electronic Controller faulty	Contact Boyd Service Dept.
	Mixing Valve Assembly faulty	Contact Boyd Service Dept.
	Temperature Sensor faulty	Contact Boyd Service Dept.
LEAKING PUMP	Pump Seal or O-Rings leaking.	Tighten through bolts on front face of pump casing.
	Pump Seal or O-Rings leaking.	Replace seals or Pump. Contact Boyd for spare part.
PUMP MOTOR OVERHEATS	Improper voltage to the system	Check to be sure pump is receiving the required electrical voltage. For electrical requirements, see rear of unit for nameplate information.
PUMP HAS A HIGH PITCHED WHINE	This is typical of a regenerative turbine pump. The intensity should increase as pressure increases.	Over a period of a few weeks the noise level will diminish and will become noticeably quieter as the pump approaches a "run in" condition.

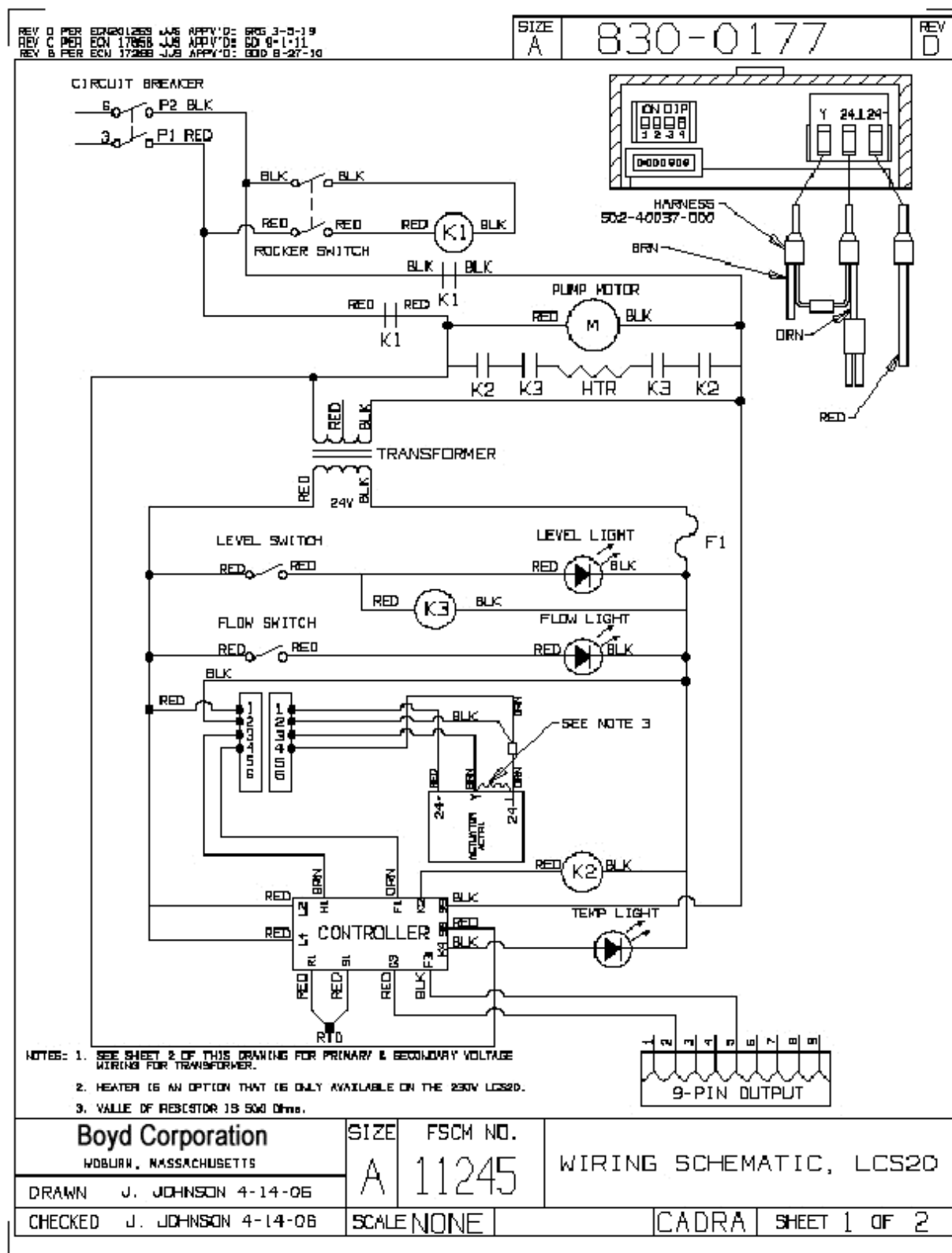
SPARE PARTS LIST

1.	3-way Mixing Valve Assembly	102242
2.	Caster	531-0017
3.	Flow Switch	*
4.	Pressure Relief Valve	*
5.	Digital Temperature Control	*
6.	Neon Lamp	230-0130
7.	Front Bottom Plastic Grill	340-0017
8.	Heater	*
9.	Tank Level Switch	230-0892
10.	Transformer 10Va	230-1093
11.	Fuse 3/10 Amp	230-1094-01
12.	Rocker Switch	230-0892
13.	Rocker Switch Cover	230-0893
14.	Replacement Filter Element	*
15.	Filter Housing Wrench	102240
16.	Replacement DI Cartridge	*
PD Pumps		
17.	1.3 GPM brass PD pump	410-0101
18.	1.8 GPM brass PD pump	410-0103
19.	2.3 GPM brass PD pump	410-0112
20.	2.8 GPM brass PD pump	410-0300
21.	4.4 GPM brass PD pump	410-0108
22.	5.3 GPM brass PD pump	410-0092
23.	1.3 GPM SS PD pump	410-0221
24.	1.8 GPM SS PD pump	410-0135
25.	2.3 GPM SS PD pump	410-0143
26.	2.8 GPM SS PD pump	410-0422
27.	4.3 GPM SS PD pump	410-0222
PD Pump Motors		
28.	GE 1/3 HP 115/230V	230-0215
29.	GE 1/2 HP 115/230V	230-0203
**Pump & Motor Assemblies		
30.	Iwaki centrifugal 115V	101773-06
31.	Iwaki centrifugal 230V	101773-07
32.	Gould centrifugal 115/230V	410-0195
33.	MTH Turbine T31G 1/2 HP	410-0229
34.	MTH Turbine T41GAB 1 HP	410-0328
35.	MTH Turbine T41L 1-1/2 HP	410-0327

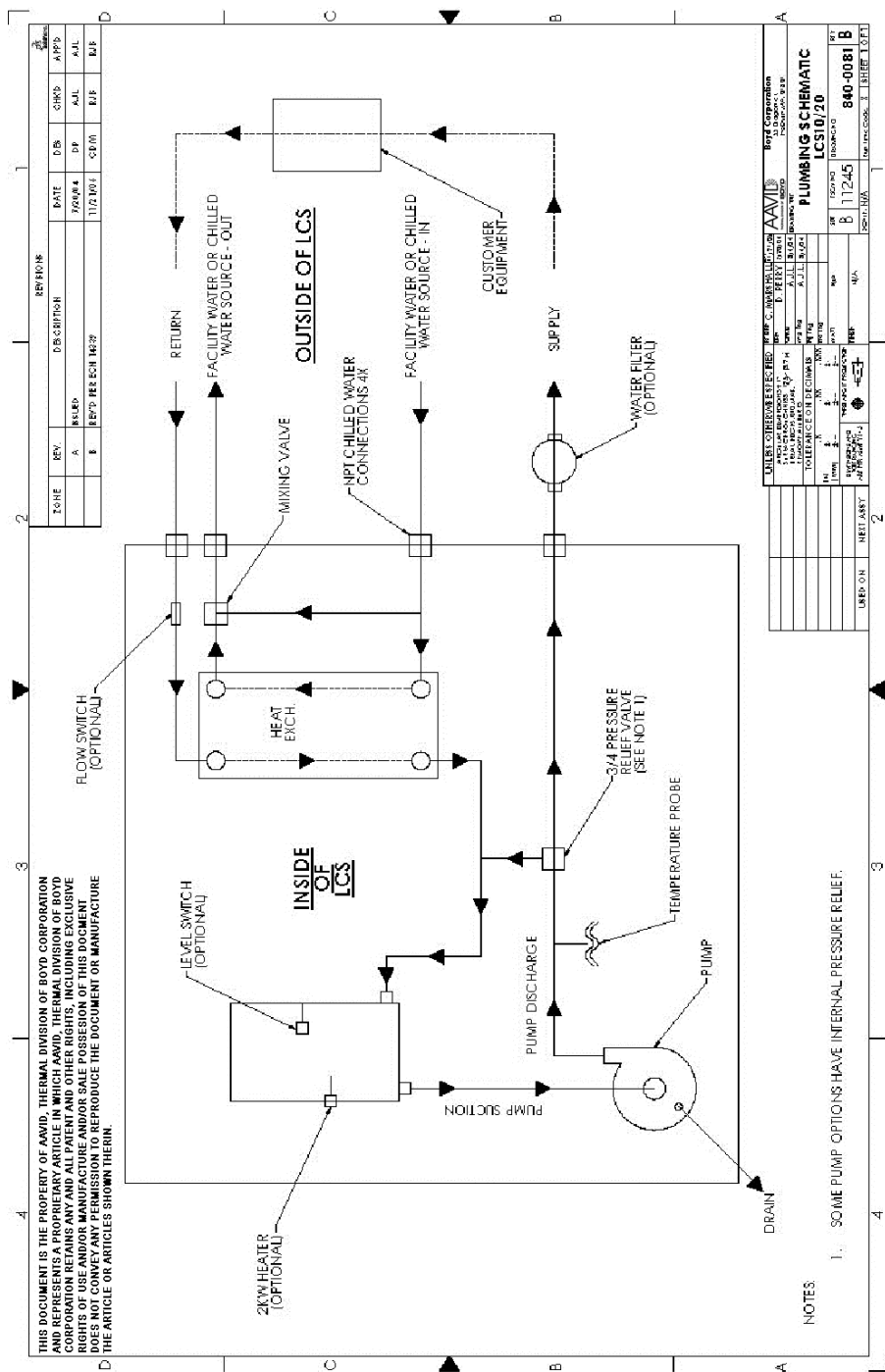
* These components may not be standard for all LCS models. Please contact Boyd's Service Department for your LCS's specific replacement part number. To expedite the process, please have the LCS model number and serial number prior to calling. This information is located on the foil tag located on the rear panel of the LCS. Our service department can be reached by calling +1-781-933-7300 and following the menu. Service technicians are available 24 hours/7 days for consultation.

** The pump assemblies listed above are standard pump configurations. Your LCS may have a custom pump and motor. Please contact Boyd's Service Department for your LCS's specific replacement pump/motor part number. To expedite the process, please have the LCS model number and serial number prior to calling.

ELECTRICAL SCHEMATIC



PLUMBING SCHEMATIC



BOYD COOLING SYSTEM SERVICE POLICY

Boyd's cooling systems are the product of over 50 years of thermal engineering and manufacturing experience. We designed them to provide superior reliability, easy maintenance, and worry-free operation. However, occasionally a system may need repair. To ensure your process is back up and running quickly, Boyd has implemented the following cooling system service policy.

Boyd's Standard Warranty

Boyd's warranty is set forth in the Terms and Conditions included with each system quotation and are available here <https://www.boydcorp.com/terms-and-conditions-of-sale.html>

Diagnostic Consultation:

At no cost, Boyd will attempt to diagnose the problem over the phone. Our service department can be reached by calling 781-933-7305 and following the menu or contacting one of our regional [Service-Depots](#). Service technicians are available 24 hours/7 days for consultation. Boyd strongly encourages customers to take advantage of this service before returning a cooling system to Boyd for evaluation. Often a problem with a system can be fixed quickly in-house or it is determined that it is an application problem. By utilizing our service hotline, you can avoid the downtime and expense associated with returning the system to our factory. Phone diagnosis can be difficult and may actually be a trial and error process. Boyd will not assume any liability for misdiagnosis when diagnosing over the phone.

Warranty and Non-warranty Returns:

To return a cooling system, a Boyd Return Material Authorization (RMA) number must be obtained from Boyd's service department which can be reached by calling 781-933-7300, or by completing the [Request-for-RMA](#) form and e-mailing it to service@boydcorp.com. Prior to calling Boyd, the system part number, serial number, and a detailed description of the problem must be collected, as this information is required to assign an RMA number.

A credit card or, for existing customers, a purchase order, (PO), is also required for the evaluation and repair charges if Boyd determines the system is not defective as defined by the warranty (see below for more details). The amount suggested will cover the evaluation fee and most repair charges for non-warranty repairs.

The RMA number should be indicated on the outside packaging of the returned unit. Systems must be returned clean, dry, and free from chemicals to Boyd's factory, shipping costs prepaid. Boyd is not responsible for any damage incurred in the return shipment. Coolant disposal fees may apply for returned units. Please contact your service representative for details.

Debit memos should not be issued for any repair, either warranty nor non-warranty repairs.

Boyd ordinarily will evaluate the unit within 2 or 3 business days of receipt. Boyd will use reasonable effort to repair the unit promptly, in most cases within one week of receiving all of the required parts. Boyd's warranty covers repair of the unit but Boyd's warranty does not cover cosmetic issues. If upon examination Boyd determines the system has not failed as defined by the warranty, an evaluation fee will be charged. The evaluation fee will be charged regardless of disposition (i.e.: scrap) and will be credited towards the total repair cost. Once the unit has been evaluated by our Service Group, all work will be quoted to the customer.

before proceeding with the repair. This quote will not cover the repair of cosmetic issues unless specifically requested to do so.

Repair warranty:

Boyd warranties the replacement parts and labor for 90 days from the repair date under the terms of our standard warranty or the balance of the original warranty, whichever is longer.

Product Specific, Defined Refurbishment Program:

Boyd warranties the replacement parts and labor per the specific quoted length of time from the refurbishment date under the terms of our standard warranty or the balance of the original warranty, whichever is longer. The refurbishment of the unit(s) must be quoted as such with a defined bill of material listing the items covered and the length of the extended warranty.

Return Shipments:

Boyd's warranty covers payment for standard, ground return shipment of warranted repairs. The incremental difference for expedited return shipments, if requested, are the responsibility of the customer. After non-warranty repair, Boyd will ship the system back using the customer's preferred shipping method.

Field Service/Commissioning Charges

Where available, Boyd can arrange field service for cooling system commissioning or repair. Under no circumstances does Boyd's warranty cover on-site service. All on-site service must be arranged through Boyd's service department. The charges for this service include an administrative fee, a charge for on-site services provided, any related travel charges, and parts not covered under warranty.

All requests for On-Site Services require a PO or credit card authorization before services will be scheduled.

When using Boyd-arranged, on-site service, Boyd warranties the replacement parts and repair labor for 90 days from the repair date under the terms of our standard warranty or for the balance of the original warranty, whichever is longer. If non-authorized labor repairs the system or installs replacement parts, Boyd does not warranty the parts or work and this action potentially voids any remaining warranty.

Boyd is expanding its worldwide service presence. Please contact the Service Department for the latest areas where on-site service is available.

Replacement Parts:

Replacement parts can be ordered using a credit card or purchase order. Parts being returned from systems under warranty should be returned using a Boyd issued RMA number. If the parts are found to be defective and the claim is within the warranty period, credit will be issued for the price of the parts and one-way ground shipping charges. If the parts are not defective or indicate end user damage, no credit will be issued. Boyd will not cover the incremental cost of air shipment of replacement parts, regardless of warranty status.

In-stock parts will normally ship the next business day; non-stocked parts will be shipped as quickly as reasonably possible.

This policy is subject to change. Please check with Boyd's service department for the current policy.

BOYD WARRANTY

Boyd agrees that the apparatus manufactured by it will be free from defects in materials and workmanship for the warranty period under normal use and service and when properly installed. The warranty period for Kodiak[®] standard, RM, and XL recirculating chillers is two years from date of shipment of such apparatus to the original purchaser, maintenance items excluded, and one year from date of shipment of such apparatus to the original purchaser for all other products Boyd sells. See Boyd's Cooling System Service Policy (F7.02.25) for additional warranty details on systems. Boyd's obligation under this agreement is limited solely to repair or replacement, at its option, at its factories, of any part or parts thereof, returned to Boyd with transportation charges prepaid, which examination shall disclose to Boyd's satisfaction to have been defective. THE FOREGOING EXPRESS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. BOYD'S OBLIGATION UNDER THIS WARRANTY IS STRICTLY AND EXCLUSIVELY LIMITED TO THE REPAIR OR REPLACEMENT OF DEFECTIVE COMPONENT PARTS AND BOYD DOES NOT ASSUME OR AUTHORIZE ANYONE TO ASSUME FOR IT ANY OTHER OBLIGATION. BOYD ASSUMES NO RESPONSIBILITY FOR INCIDENTAL, CONSEQUENTIAL, OR OTHER DAMAGES INCLUDING, BUT NOT LIMITED TO LOSS OR DAMAGE TO PROPERTY, LOSS OF PROFITS OR REVENUE, LOSS OF THE UNIT, LOSS OF TIME, OR INCONVENIENCE. Boyd's liability does not include any labor charges for replacement of parts, adjustments, repairs, or any other work done outside its factories or service centers and its liability does not include any resulting damage to persons, property, equipment, goods or merchandise arising out of any defect in or failure of its apparatus. Boyd's obligation to repair or replace shall not apply to any apparatus which shall have been repaired or altered outside of its factory or service centers in any way, or which has been subject to negligence, to misuse, or to pressures in excess of stated limits. On parts not of Boyd's manufacture, such as motors, controls, etc., Boyd extends only those warranties given to Boyd, Corporation to the extent Boyd can do so. Boyd's agreement hereunder runs only to the immediate purchaser from Boyd, Corporation and does not extend, expressly or by implication, to any other person.