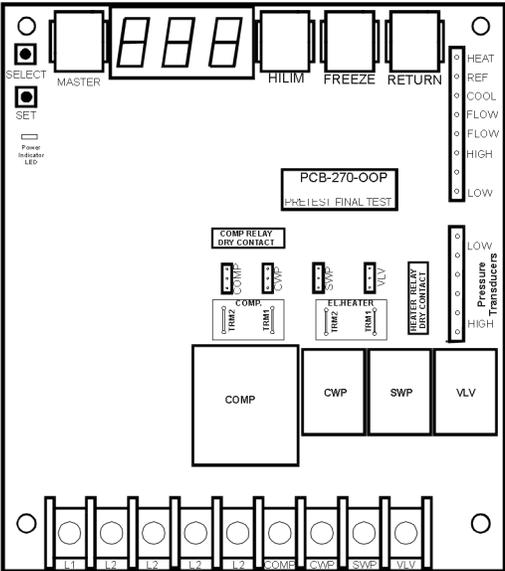


# DDC Digital Diagnostic Control

## Operations Manual

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# DDC Controls • Introduction

## DDC Features

DDC software revision A32 (or newer) supports PCB-270 OOP (or newer) with the following up-grades:

- Multi-layer PC board for improved noise immunity.
- SMT (surface mount technology) reduces component size and frees up space for hardware improvements.
- New AC Voltmeter ( $\pm 2$  volt accuracy) for brownout protection.
- Low Freon Pressure Failsafe locks out after four (4) consecutive faults.
- Pilot duty relays for compressor and heater outputs when the load requires contactors.
- “Euro signal terminals” eases wiring and reduces board space requirement.
- User-friendly push button programming interface replaces the trim pots and allows parameter viewing without disrupting settings.
- Universal 115/220-volt switch mode power supply eliminates large AC transformer, requires less board space and improves 115-volt brownout operation.
- Independent Freeze-Stat and High-Pressure failsafe hardware for protection during Bimini Jumper operation.

## Overview

The DDC Module is designed for use with single or multiple stage modular chiller assemblies to provide hot or cold water to air handlers while maintaining circulating water temperature at desired setpoint. The display alternates between the return and supply water temperatures unless a fault is detected or one of the settings is being adjusted. The circuit board includes the following inputs and outputs:

## System Inputs

### 1. Mode Switch

The mode switch (DDC remote switch is sold separately) allows heating, cooling or off mode to be selected.

**Cooling Mode** - The compressor will turn on when the return water temperature is two or more degrees ( $2^{\circ}\text{F}/1.1^{\circ}\text{C}$ ) above the setpoint and will turn off when the water temperature is equal or below the cooling setpoint.

**Heating Mode** - In heating the compressor and reversing valve will be turned on when the water temperature falls two degrees ( $2^{\circ}\text{F}/1.1^{\circ}\text{C}$ ) below the heating setpoint unless

the system is programmed for electric heat. When electric heat is selected the heater pilot relay and valve relay are turned on and the compressor remains off. The compressor or heater will be turned off when the return water is equal to or above the heating setpoint.

**Off Mode** - All outputs are turned off. The power indicator LED will remain on when the AC power to the board is on.

## 2. High Freon Pressure Switch

High Freon pressure fault **HiP** is indicated in the display during a cooling cycle. The compressor shuts down for a minimum time equal to its staging delay or until the fault is cleared. The compressor will automatically restart. However, after the fourth failure within a single cooling cycle the compressor will lockout. To clear the lockout condition turn the mode switch to off then back to cool or heat mode.

During the **HEAT MODE** the compressor shuts down and restarts after the time delay but does not lockout and **HiP** is not indicated.

## 3. Optional Low Freon Pressure Switch

When the system is equipped with a low Freon pressure switch, low Freon pressure detection should be enabled (see section “Program Low Freon Pressure Detection”). The **LoP** low Freon pressure fault is displayed if the switch opens and remains open for more than ten (10) minutes while the compressor is running. The **LoP** fault will shut down the compressor for a minimum time equal to the compressor staging delay or until the fault is cleared. The compressor will automatically restart. However, after the fourth failure within a single cooling cycle the compressor will lockout. To clear the lockout condition turn the mode switch to off then back to cool or heat mode.

## 4. Flow Switch

Detects circulating water failure if the flow switch remains open for ten (10) seconds. This fault shuts down the compressor for a minimum time equal to the staging delay and **FLO** is shown in the display. The compressor will restart after the staging delay and the flow fault is cleared.

## 5. Return Water Sensor

This sensor is required for proper operation. The heating or cooling cycle requirement is based on return water temperature. Should the sensor become shorted or open a **Sen** sensor fault is displayed and the system shuts down until the problem is corrected.

## 6. Water Out Sensor

The water out sensor is required for proper operation and is plugged into the freeze sensor jack. Senses output water temperature and the controller generates a **FrE** freeze fault if the temperature drops below 38°F (3.3°C) in cool mode. DDC generates a **HiL** high limit fault if the water temperature rises above 125°F in heat mode. Should the water out sensor fail, **FSn** is displayed indicating the sensor is shorted open. The compressor will shut down until the fault is cleared or for a minimum time equal to the staging delay after which the compressor will restart. The **FrE** fault will clear when the water temperature rises above 49°F (9.4°C). The **HiL** fault will clear when the water temperature drops below 110°F (43.3°C).

## 7. High Water Limit Electric Heat Sensor - Required with Electric Heat

Senses water out temperature and DDC generates a **HiL** high limit fault if the water temperature rises above 125°F (51.7°C) while in the electric heat mode. The electric heater shuts down for a minimum time equal to the staging delay or until the water temperature drops below 110°F (43.3°C). **HSn** is generated when the sensor is open or shorted and the heater is shut down until the problem is corrected.

## 8. Low Freon Pressure Transducer - Optional

Used to report suction side pressure to the Chilled Water Master Control (CWMC) for diagnostic use when equipped with the optional CWMC.

## 9. High Freon Pressure Transducer - Optional

Used to report discharge pressure to the Chilled Water Master Control (CWMC) for diagnostic use when equipped with the optional CWMC.

## System Outputs

### 1. Compressor

System can be directly connected to compressors up to two horsepower at 230 VAC; 115 VAC systems can be up to one horsepower.

DDC hardware includes a set of pilot duty compressor dry contacts for other starting devices.

### 2. Chillwater pump

The Chillwater circulating pump is on when heating or cooling is selected.

The Chillwater circulating pump output is rated 10 amps @ 230 VAC and 15 amps @ 115 VAC.

Note: For resistive loads, see specifications for motor load ratings.

### 3. Seawater pump

The seawater pump is on whenever the compressor is running unless otherwise programmed (see section "Program Seawater Pump Operation").

The seawater pump output is rated 10 amps @ 230 VAC and 15 amps @ 115 VAC.

Note: For resistive loads, see specifications for motor load ratings.

### 4. Reversing valve

The reversing valve output is pilot duty only and it will be energized when heating is called for. In addition, the valve is toggled briefly to the opposite mode when heating or cooling is required to equalize refrigerant pressures and reduce the starting load. The valve will only toggle when heating or cooling is called for and the system has been off for less than 75 seconds (unless the system is configured with an electric heater). System should be switched into heat mode at least once a month to prevent reversing valve from sticking in cool mode. If reversing valve does get stuck, use a rubber mallet to *very lightly* tap it while switching from cool to heat.

### 5. Electric heater dry contacts

DDC hardware includes a set of pilot duty dry contacts for electric heater operation. These contacts will be energized only when ELECTRIC heating is called for. The reversing valve relay will also be energized in parallel with this relay in electric heat mode.

## Special Features

The right most LED decimal point will turn on when the compressor or heater is called for.

### **Freeze Stat Protection**

Open @ 38°F (3.3°C), Close @ 50°F (10°C)

NOTE: Freeze Stat is ignored in heat mode. The Freeze Stat will still protect the system even if the microprocessor is not functioning.

### **High Temp Limit**

Open @ 125°F (51.7°C), Close @ 110°F (43.3°C) NOTE: High limit is ignored in cool mode.

### **Operating Voltages**

The standard unit is 115/230 dual voltage operation.

### **Bimini Jumpers**

The system is equipped with four Bimini Jumpers allowing any or all of the relay outputs to be forced on for trouble shooting or emergency operation. The Bimini Jumpers are:

- COMP = Compressor
- CWP = Chillwater pump
- SWP = Seawater pump
- VLV = Reversing Valve (is forced open in reverse cycle heat position)

CAUTION: Never allow the system to run unattended while any of these outputs are forced on.

# DDC Controls • Operation

When the circuit breaker is turned on the unit will display the revision code for two (2) seconds. The display will go blank for one (1) second and remain blank if the mode switch is off.

During normal operation the display alternates between the water in and water out temperature readings. The supply water temperature is displayed followed by the return water temperature:

**rtr** = return water temperature (water in):  
*RETURN jack on PCB*

**SUP** = supply water temperature (water out):  
*FREEZE jack on PCB or HILIM jack (when equipped with electric heater)*

The unit will cool when the mode switch is in cool and the return water temperature is 2°F (1.1°C) more than the cool set point.

The unit will heat when the mode switch is in heating and the return water temperature is 2°F (1.1°C) lower than the heat set point.

The chillwater pump operates continuously when the unit in the heat or cool mode.

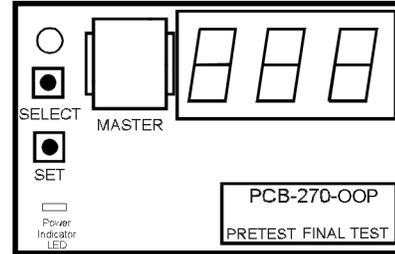
The seawater pump turns on 10 seconds before the compressor starts and turns off 10 seconds after the compressor cycle is completed. However, the seawater pump can be programmed to run continuously.

The reversing valve is toggled to relieve head pressure if the previous cycle ended within 75 seconds of a new cycle (unless the system is configured with an electric heater).

No cycle will be started if any fault is detected.

## Programming the DDC

To program the DDC press the SELECT button to show program item from the following list then press and hold the SET button until the desired setting is displayed.



**CSP** - cool setpoint

**HSP** - heat setpoint

**dl** - staging delay

**°F or °C** - Fahrenheit/Celsius selection

**rc or EH** - reverse cycle or electric heat

**clc or con** - cycled or continuous seawater pump operation

**LPE or LPd** - Low Freon pressure detection enabled or disabled

**AC** - AC line voltage monitor (read only)

Reset the factory default programming pressing the SELECT button followed by pressing the SELECT and SET buttons simultaneously.

Parameter mneumonic	Description	Default	Range
<b>CSP</b>	Cooling Set Point	48°F	40°F - 58°F
<b>HSP</b>	Heating Set Point	110°F	95°F - 120°F
<b>dl</b>	Staging Delay	15sec	10sec – 200sec
<b>°F or °C</b>	Fahrenheit/Celsius selection	°F	°F or °C
<b>rc or EH</b>	Reverse Cycle or Electric Heat	rc	rc or EH
<b>dc or con</b>	Cycled or Continuous seawater pump operation	clc	clc or con
<b>LPE or LPd</b>	Low Freon pressure detection enable or disable	LPE	LPE or LPd
<b>AC</b>	AC Line Voltage Monitor	(AC Line Voltage Reading)	Please refer to detailed section on AC Line Voltage Monitor.

## Program Return Water Temperature

With the system on or off press and release the SELECT button to show program item CSP.

With **CSP** showing in the display press and hold the SET button until the desired cool setpoint appears in the display. To move the setting in the opposite direction release then press and hold, within ten seconds, and the setting will move in the other direction.

The setting will remain in the display for 10 seconds after the adjustment is completed.

The cooling set point range is 40°F to 58°F (4.4°C to 14.4°C).

Press and release the SET button again to move to the heating setpoint.

Follow the same procedure for the heating set point **HSP**.

The heating set point range is 95°F to 120°F (35.0°C to 48.9°C).

Programming the cooling or heating set points too low or too high might cause the system to run continuously if the set points cannot be reached due to other factors.

## Program The Compressor Staging Delay

With the system on or off press and release the SELECT button to show program item dl.

Press and hold the SET button to select the desired compressor staging delay. The staging delay will remain in the display 10 seconds after the adjustment is completed.

The staging adjustment range is 10 to 200 seconds.

## Program Display Fahrenheit or Celsius

With the system on or off press and release the SELECT button to show program item °F or °C.

Press the SET button until the desired Fahrenheit or Celsius selection appears in the display. The °F or °C selection will remain in the display 10 seconds after the adjustment is completed.

## Program Electric Heat Option

With the system on or off press and release the SELECT button to show program item rc or EH.

Press the SET button until the desired **rc** reverse cycle heat or **EH** electric heat selection appears in the display. The **rc** or **EH** selection will remain in the display 10 seconds after the adjustment is completed.

## Program Seawater Pump Operation

With the system on or off press and release the SELECT button to show program item clc or con.

Press the SET button until the desired **clc** cycle the pump or **con** continuous pump selection appears in the display. The **clc** or **con** selection will remain in the display 10 seconds after the adjustment is completed.

## Program Low Freon Pressure Detection

With the system on or off press and release the SELECT button to show program item LPd or LPE.

Press the SET button until the desired **LPd** low Freon pressure detection disabled or **LPE** low Freon pressure detection enabled selection appears in the display. The **LPd** or **LPE** selection will remain in the display 10 seconds after the adjustment is completed.

## AC Line Voltage Monitor (Read Only)

With the system on or off press the release the SELECT button to show program item AC.

The actual AC line voltage as measured at the L1 and L2 input terminals will be displayed. **CAUTION: This voltage reading is calibrated at the factory and should not be adjusted. Only an authorized service technician should make any adjustments if they are required. If set incorrectly, the operation of the control and brownout protection of the compressor may be compromised.** Voltage calibration adjustment can be made by pressing and holding the SET button. To move the setting in the opposite direction, release then press and hold the SET button again.

## Fault Display Codes

The following lists the fault mnemonic and the displayed code:

1. High Freon pressure fault = **HiP**
2. Low Freon pressure fault = **LoP**
3. Chilled water flow failure = **FLO**
4. Return Water Sensor failure = **Sen**
5. High Water Limit Sensor failure = **HSn**
6. Freeze stat = **FrE**
7. Freeze Sensor Failure = **FSn**
8. High Water Limit fault = **HiL**
9. Low AC Voltage fault = **LAC**

## Fault Handling Protocol

1. When a fault occurs, the staging delay is initiated and the appropriate mnemonic flashes in the display.
2. At the end of a staging delay the unit will restart if all faults have cleared.
3. Four consecutive **HiP** or **LoP** faults will cause the system to shut down.
4. The stored fault count is cleared if a cycle is completed successfully.
5. Restore operation by correcting the fault and resetting the unit by turning the mode switch or AC power off and on.
6. **LAC** is displayed if line voltage is less than 85 VAC for 115 volt units or less than 170 VAC for 230 volt units. This fault has a ten (10) minute shut down delay.
7. **LoP** has a ten (10) minute shut down delay.
8. **FrE** is displayed when the unit is off on freeze protection.
9. **HiL** is displayed when the unit is off on High Temperature Limit protection.
10. **FLO** has a ten (10) second shut down delay.

# DDC Control • Specifications

Cooling Set Point Range .....	40°F to 58°F (4.4°C to 14.4°C)
Heating Set Point Range .....	95°F to 120°F (35.0°C to 48.9°C)
Ambient Temperature Operating Range Displayed.....	0°F to 150 F (-17.8°C to 65.6°C)
Sensor Accuracy.....	± 2°F at 77°F (±1.1°C at 25.0°C)
Low Voltage Limit 115 volt units .....	85 VAC
Low Voltage Limit 220 volt units.....	170 VAC
Line Voltage .....	115 or 230 VAC
Frequency .....	50 or 60 Hz
Valve Output .....	1/2 Amp @ 115 VAC
Valve Output .....	1/4 Amp @ 230 VAC
Pump Output .....	1/4 HP @ 115 VAC
Pump Output .....	1/2 HP @ 230 VAC
Compressor Output .....	1 HP @ 115 VAC
Compressor Output .....	2 HP @ 230 VAC
Minimum Ambient Operating Temperature .....	0°F (-17.8°C)
Maximum Ambient Operating Temperature .....	180°F (82.2°C)
Maximum Rh Conditions .....	99% Non Condensing
Power Consumption .....	Less Than 5 Watts

## Dimensions

PCB..... 5.25" X 5.875" X 2.0"(133mm X 149mm X 51 mm)

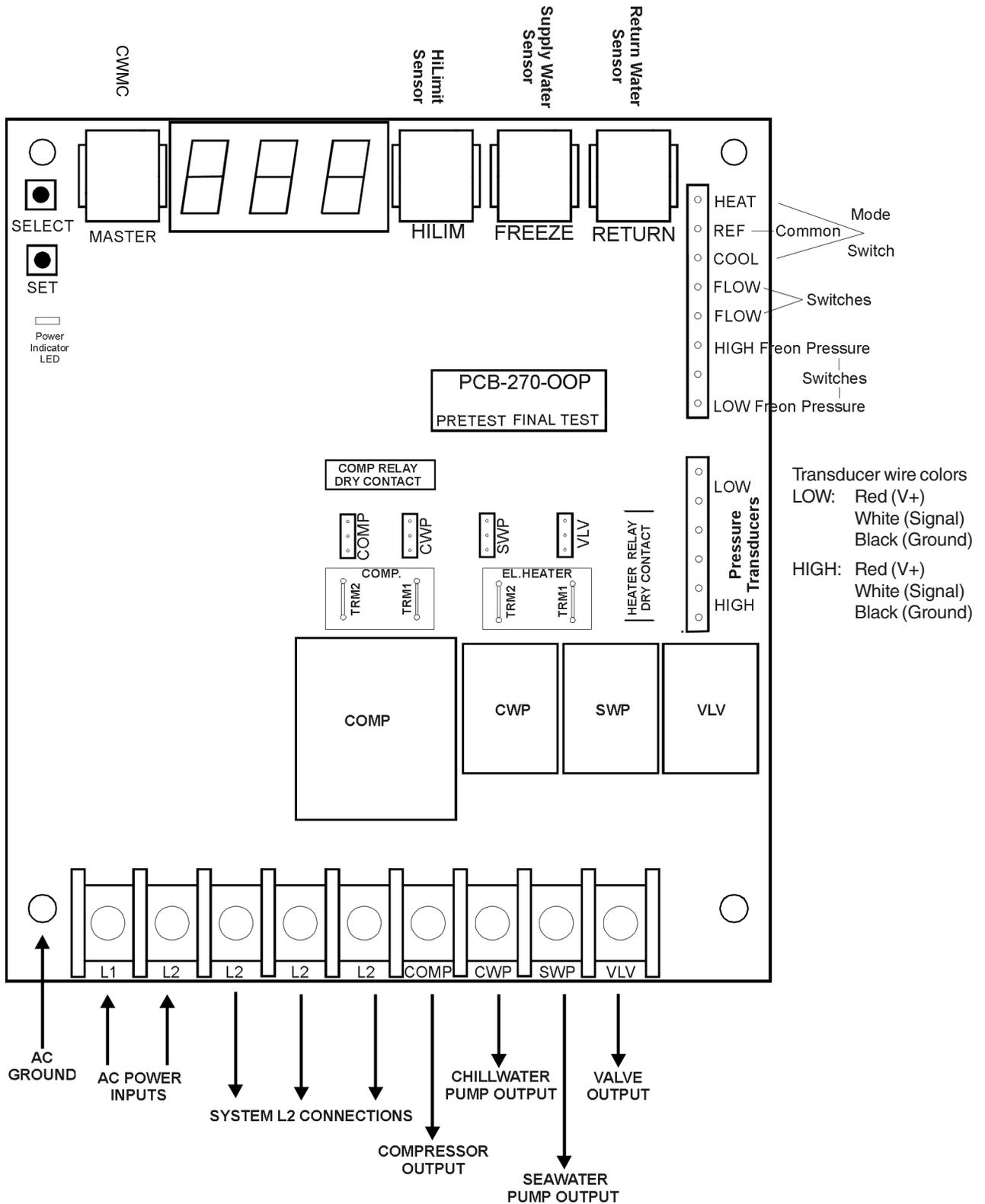
## Cable Lengths

Water Sensor.....2' (0.61m) Standard

## System Inputs

Return Water Sensor .....	1
Optional High Freon Pressure.....	1
Optional Low Freon Pressure .....	1
Supply Water (Freeze) Sensor.....	1
High Limit Sensor .....	1

# PCB Inputs and Outputs



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