
TWLC - Tempered Water Logic Controller

The Intelligent Control

Cruisair[®]



 Dometic

Cruisair[®]

MARINE AIR SYSTEMS[®]
AIR 

Features:

- Up to six (6) stages: individual board for each stage maximizes redundancy.
- Menu driven access and programming.
- Fault history.
- Up to 14 inputs.
- Connect to on-board computer.
- Fully automatic temperature staging and chiller rotation.
- **New for 2009!**
Latest firmware revision V40 has new features and improved chiller protection.

TWLC Tempered Water Logic Control



- Microprocessor controlled
- Same reliability as the SMX logic boards
- Chiller boards can be networked together
- Only one keypad needed to control up to six chiller units.
- Additional keypads can be added up to the number of units in the system.
- Up to six heat and cool temperature set point stages
- Easy to use display keypad with menu-driven screens



 Dometic

 Cruisair

MARINE AIR SYSTEMS


- Capable of operating immersion heaters with high limit protection
- Automatic compressor stage rotation to achieve even run-time
- Automatic start up time delay on compressors
- Ability to monitor the control system locally or remotely via a computer, a modem, and a dedicated phone line
- Complete system fault logs with run time reference
- If network is lost, each chiller operates independently
- When replacing a board, an initializing routine automatically integrates the new board into the system



The Board (features and outputs)

- Removable terminal strips - ease of board replacement
- Removable EPROM – software upgrade
- Two LED's - indicate network cable integrity
- One display keypad hook up
- One serial port connection for computer or modem hook up for local or remote monitoring
- Six outputs:
 - Compressor
 - Reversing Valve
 - Circulating pump
 - Seawater pump
 - Immersion Heat
 - Fault warning (for external alarm, i.e. light or buzzer)

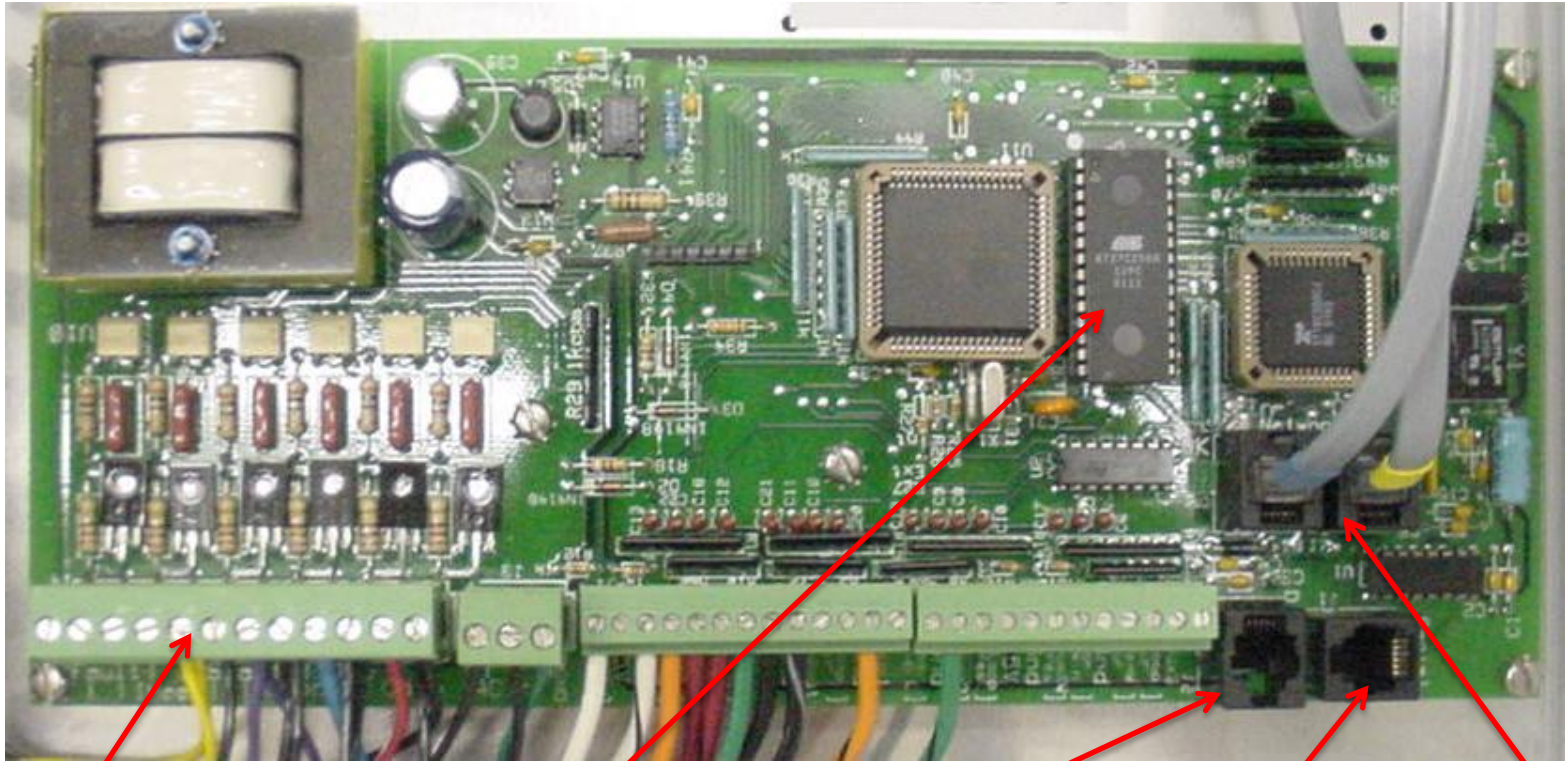


 Dometic

 Cruisair

MARINE AIR SYSTEMS


TWLC Power Logic Board



Removable Terminal Strip

Removable E-Prom

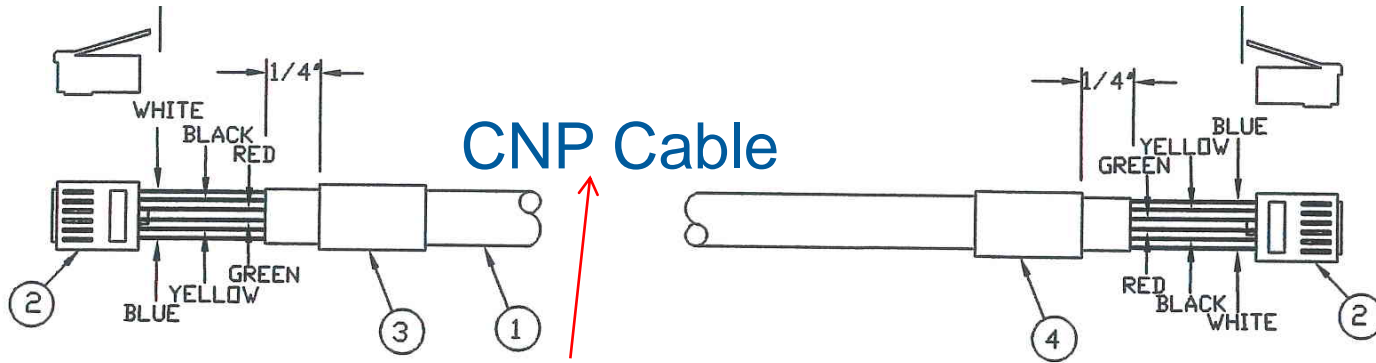
Display cable
Jack

Computer or
Modem Jack

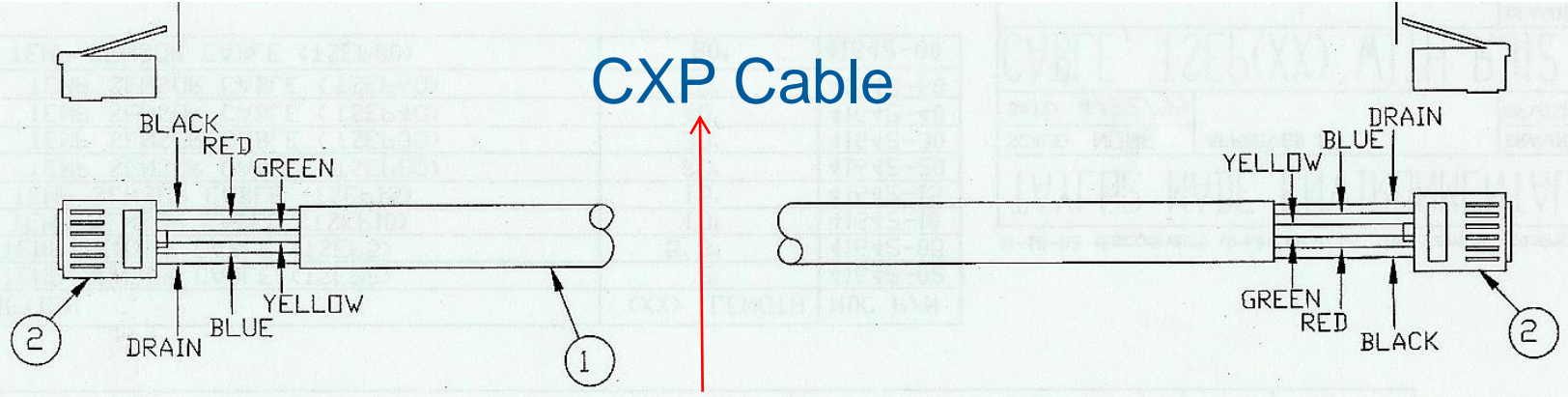
Network cable
Jacks



Cables Used To Connect TWLC Control And Circuit Boards



Use to connect keypad in same enclosure and network connections between boards



Use to connect remote mounted keypad to circuit board



The board contains 16 inputs

- Common loop water return temperature sensor
- Loop water out temperature sensor
- Sea water out temperature sensor
- Flow switch
- Discharge pressure switch/transducer - Automatically recognizable
- Suction pressure switch/transducer - Automatically recognizable
- Compressor current transducer
- Common loop water supply temperature sensor



Inputs (Cont'd.)

- Immersion heater loop water temperature sensor
- Common sea water in temperature sensor
- Sea water pump current transducer
- Loop water pump current transducer
- Loop water pressure transducer
- Sea water pressure transducer
- Two additional auxiliary inputs – future enhancements



Menu-driven display screen

- 4 lines of text, 20 characters per line
- **Cool light** - Indicates Cool mode
- **Heat light** - Indicates Heat, Reverse Cycle/Heaters, or Heaters Only modes
- **Fault light** - Indicates system faults
- **Alarm buzzer** - Indicates system faults
- **Up and Down buttons** - Changing parameter values and navigating through menu screens and items within a menu
- **Enter button** - clearing a fault, advancing to another menu screen, and selecting an item
- **Back button** - jump back to previous screen or condition



- **Off**
- **Cool**
- **Heat**
- **RevCyc/Heaters**

Activates compressors first when sea water is 38 °F (3.33 °C), compressors turn off, and immersion heaters turn on

- **Heaters Only** – activates immersion heaters only



 **Dometic**

Cruisair

MARINE AIR SYSTEMS
AIR

- Displays which compressor or heater is on, disabled, or in sustained shutdown
- Displays which mode the system is operating
- Displays the common loop water supply temperature
- Displays the loop water return temperature



Chiller Status

- Displays the value of all input sensors that is connected to the board
Board output status, Software version number, Unit stage on each chiller
- Aids in troubleshooting the chiller system

Parameter Setting

- Displays heat and cool stage temperature set points and differentials (adjustable)
- Displays loop water temperature limits (non-adjustable)
- Displays high and low refrigerant pressure limits (non-adjustable)
- Displays sea water temperature limit (adjustable)
- Disable / enable alarm buzzer
- Select heavy or light load temperature set points
- Restore all settings to factory default
- Clear information that are logged by the board (password protected)

Initial Setup

- Displays how many chillers the control system recognizes
- What stage a chiller is in, and if the chiller is set to automatically rotate
- Initialize the boards for networking



Degrees Fahrenheit / Celsius (selectable)

Fault Log – **Displays how many and what type of faults a chiller has encountered**

Fault History – **Displays up to the latest 300 system faults on each chiller**

Input/Output Log

- **Displays compressor, water pump, heater, and reversing valve run-times**
- **Minimum and maximum loop water temperatures**
- **Minimum and maximum sea water temperatures**
- **Minimum and maximum high and low refrigerant pressures**
- **Minimum and maximum AC voltage**

Chiller On/Off – manually enable or disable a chiller

Output Status – displays board outputs (on or off)



- Low AC Voltage condition
- Defective Temperature Sensors
- Loop Water Temperatures
- Extremely Low Loop Water Temperature Condition
- Extremely High Loop Water Temperature Condition
- Extremely High Immersion Heater Loop Water Temperature Condition
- Loop Water Flow Switch
- Improper In And Out Loop Water Temperature Differences On Each Chiller
- Loss Of System Network
- EPROM Errors
- Loop Water Pressure (w/ optional upgrade)
- Sea Water Temperatures (w/ optional upgrade)
- Sea Water Pressure (w/ optional upgrade)
- Suction Refrigerant Pressure (w/ optional upgrade)
- Discharge Refrigerant Pressure (w/ optional upgrade)
- Improper In And Out Sea Water Temperature Differences On Each Chiller (w/ optional)



 Dometic

 Cruisair

MARINE AIR SYSTEMS


Single Chiller Unit Control Panel Standard Features

- Requires 230VAC 1-PH power for control circuits
- Field-configured to run 230VAC 1-PH or 3-PH, or 380/460VAC 3-PH chiller units
- Does not include compressor, loop and sea water pump breakers
- Includes loop and sea water pump 230VAC signal outputs to activate water pump triggers
- Does not include loop or sea water pump contactor
- Does not include a display keypad (purchase separately)
- Includes a 2 FT display keypad cable
- Compressor current transducer can be added inside the box
- Includes a 10 FT length 12 conductor control cable to hook up to a chiller unit



 Dometic

 Cruisair

MARINE AIR SYSTEMS


System Faults For Version 33 and Earlier Eproms

- **Flow switch** (opens for more than 5 seconds)
Sustain shutdown after 5 faults
- **Loop water low temperature limit** (36 °F (2.22 °C))
Sustained shutdown after 3 faults
- **Loop water high temperature limit** (130 °F (54.4 °C))
Sustained shutdown after 3 faults
- **Immersion heater loop water high temperature limit** (150 °F (65.5 °C))
Sustained shutdown after 3 faults
- **High discharge refrigerant pressure** (exceeded 426 PSI)
Sustained shutdown after 5 faults



 Dometic

 Cruisair

MARINE AIR SYSTEMS


System Faults For Version 33 and Earlier Eproms (cont'd.)

- **Low suction refrigerant pressure** (at 30 PSI)
No sustained shutdown
- **Loss of network**
Defective network cable and/or chiller board; each chiller still operates independently
- **In and Out Loop water temperature difference limit**
In cool mode, if temperature difference is 14 °F (7.8 °C) or greater for 2 minutes, the chiller goes into sustained shutdown
- **In and Out Sea water temperature difference limit**
In cool mode, if temperature difference greater than 16 °F (8.9 °C) and less than 20 °F (11 °C) for 5 minutes, or greater than 20 °F (11°C) for 2 minutes, the chiller will go into sustained shutdown



System Faults for Sensors (cont'd.)

- **Loop water out sensor**

Sustained shut down on first fault

- **Common loop water return sensor**

With multiple chillers if the #1 sensor fails the system will use the next available water return sensor and the unit will continue to run.

If all the return sensors fail, the system will use the common loop water supply sensor to monitor stage set points.

- **Common loop water supply sensor**

The system will continue to operate

- **Sea water out sensor**

The system will continue to operate

- **Sea water in sensor**

The system will continue to operate and will use the next available sea water in sensor, if available.

- **Immersion heater loop water sensor**

Will use next available immersion heater loop water sensor and system continue to run.

If extra sensor is not available, then all heaters will be sustained shutdown.



Temperature Sensors Locations For The MTC Model Units

• Loop water out sensor

- Located on the water outlet pipe on the top of the plate coil
- This sensor is used to sense the Loop water low temperature limit (Freeze sensor)
- Sensor is marked (Supply)



• Common loop water return sensor

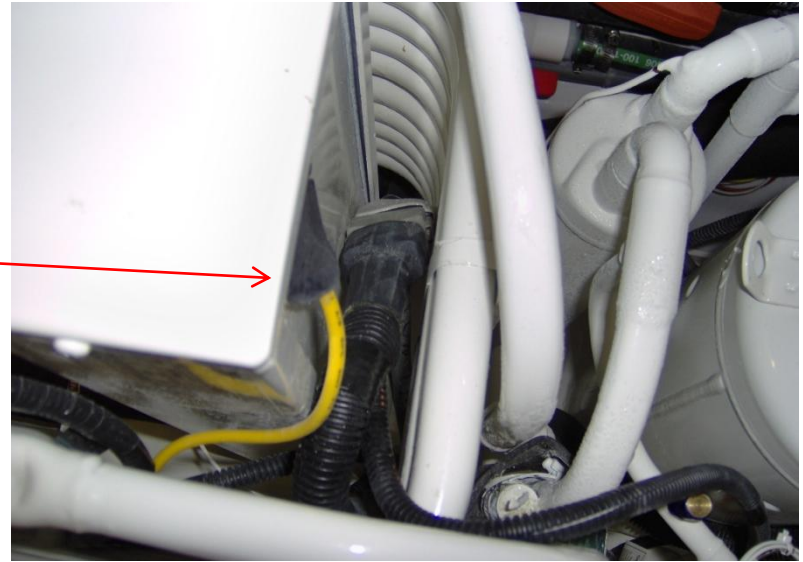
- Located on the water inlet pipe on the bottom of the plate coil
- The chiller cycles on it's set points by this sensor
- All chillers read off of the #1 chiller.



Temperature Sensors Locations For The New MTD Model Units

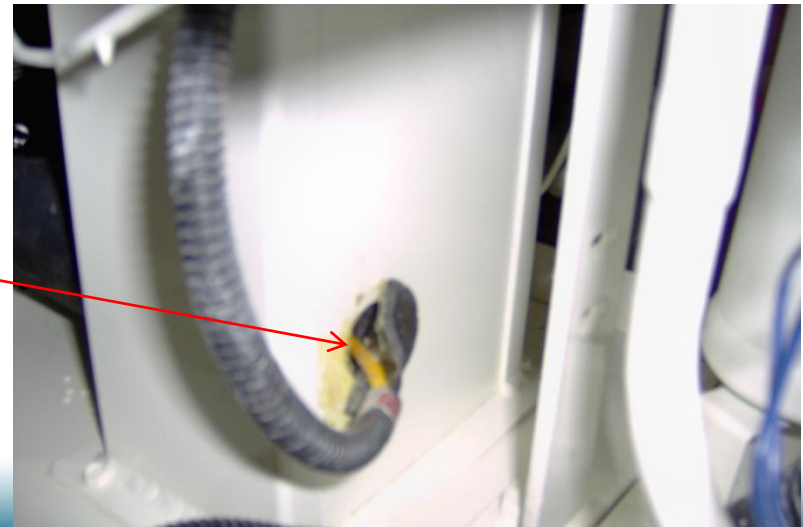
▪ **Loop water out sensor**

- Sensor is inserted in a well in the back of the plate coil on the top
- Sensor should be marked (Supply)



▪ **Common loop water return sensor**

- Sensor is inserted in a well in the back of the plate coil on the bottom



Temperature Sensors Locations For The New TWC Model Units

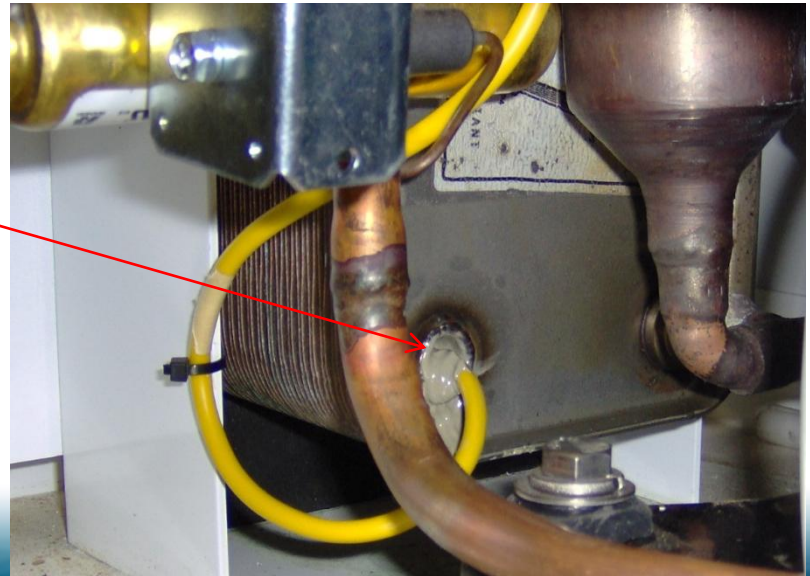
▪ **Common loop water return sensor**

- Sensor is inserted in a well in the back of the plate coil on the top



▪ **Loop water out sensor**

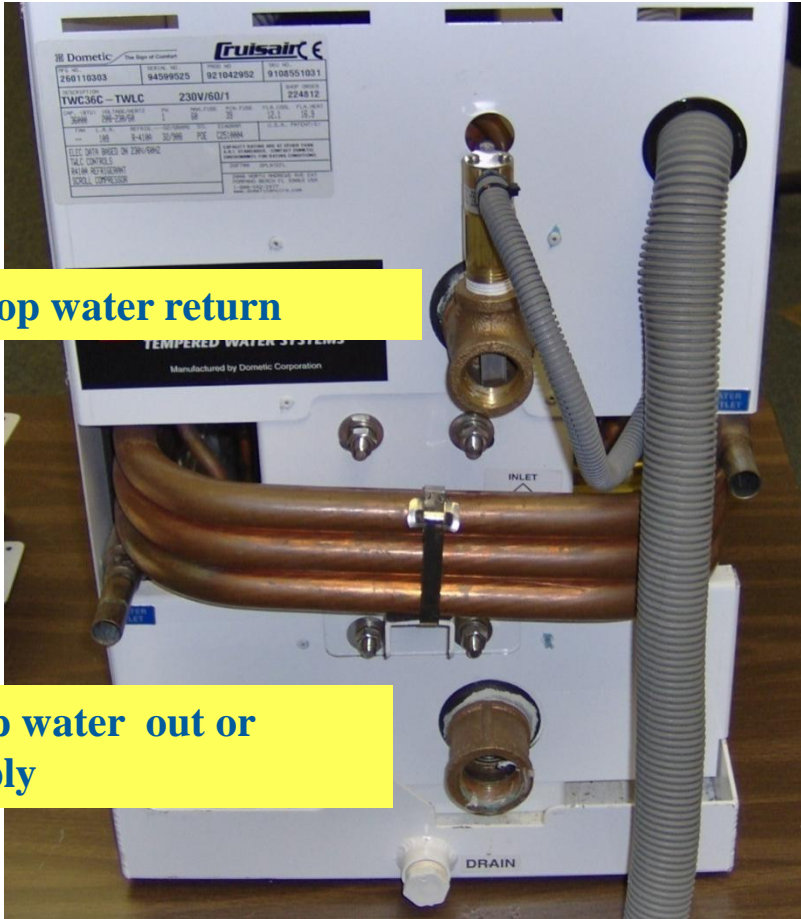
- Sensor is inserted in a well in the back of the plate coil on the bottom



New TWC Model Units

Units are plumbed backwards from standard units

Notice the arrow on the flow switch



Loop water return

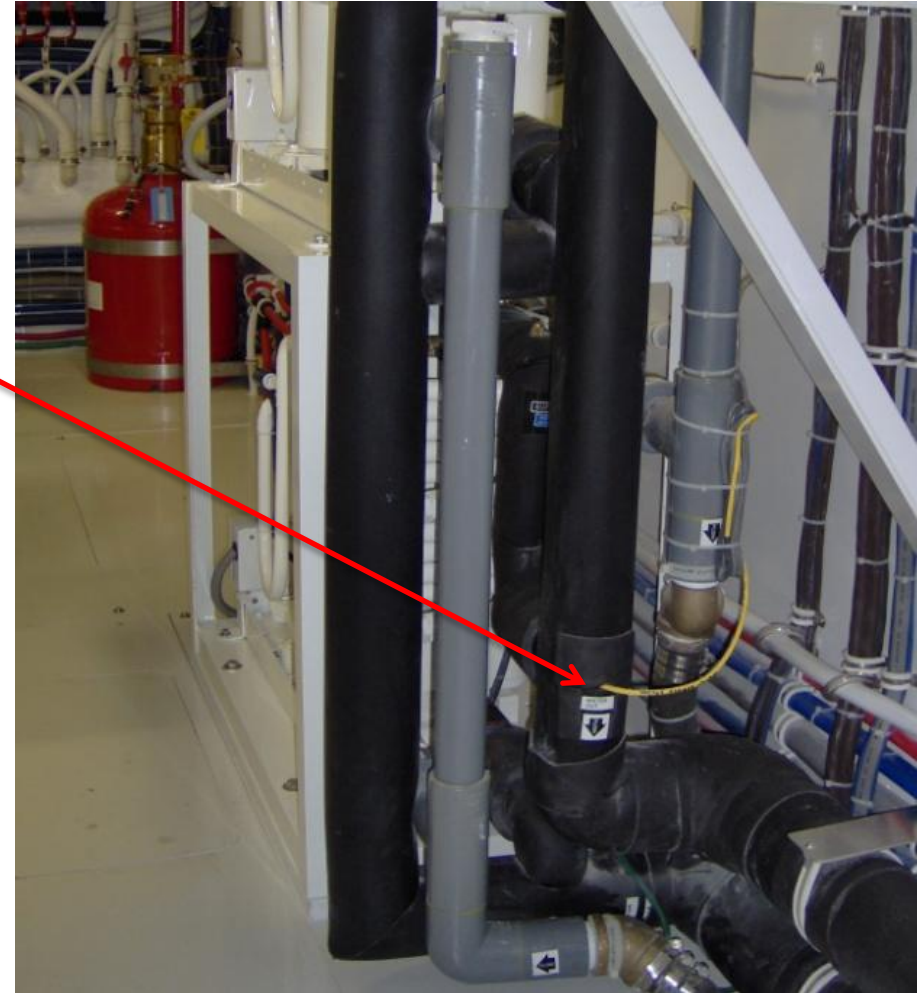
Loop water out or supply



Common Loop Sensors Location

Common loop water supply sensor

- The sensor should be located on the supply line right after all the chillers are plumbed together
- The sensor should always be wired up to the #1 chiller board



Unit Faults out on “Loop Low Temp” version 33 and earlier

“Loop water out” temperature is at 36 degrees F or below

- Go to the **parameter setting screen** to make sure the light load set points are in use.
- Light load set points start at 45 degrees F (7.22C), heavy load at 43 F (6.11C)
- If light load set points are in use, you may have to increase the set points for the different stages.
- But before you leave the unit, these checks should be made.
- Go to the **chiller status screen** and scroll down to “Loop Water Out” to check the temperature at the outlet of the chiller barrel.
- Also check the temperature difference from “Loop Water Out” and “Com Loop Return”

Do not use the default screen



Use the Chiller Status screen



- In cool mode the difference should be around 8 to 10 F (4C-5.5C) for a MTC style chiller, 6 to 8 F (3C-4C) for a MTD or TWC
- If more than 10F (5.5C), there maybe a water flow problem or the sensors may not reading the correct temperature



Water Flow Problems

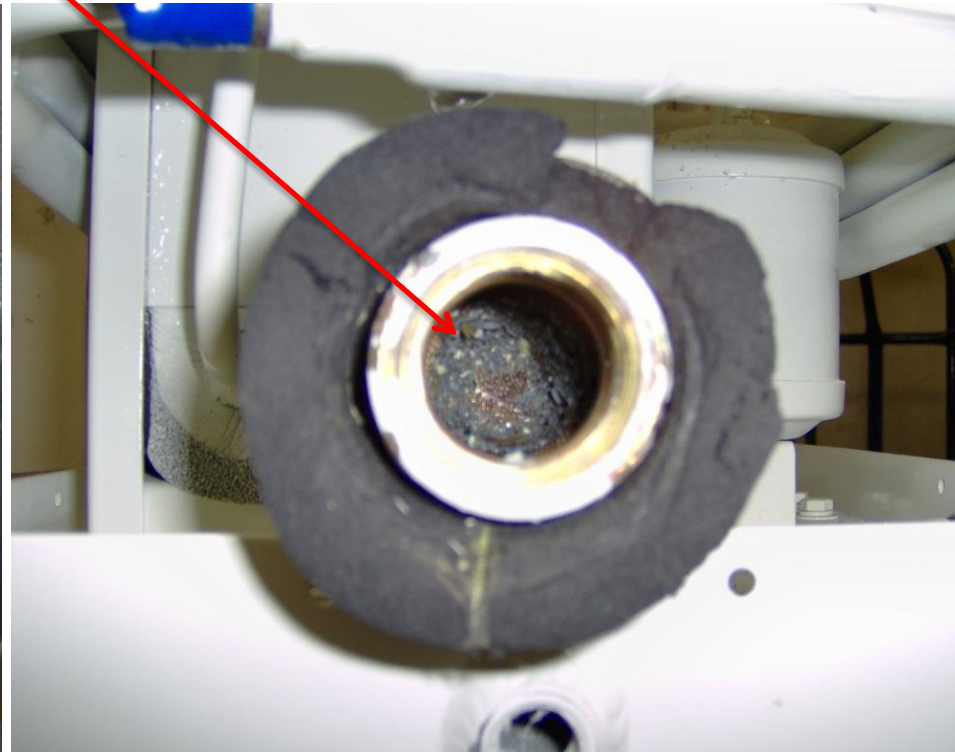
- Check the water pressure on the gauge before the pump
- It should read between 12-18 PSI, in some installs with 30 tons and above may go to 20 psi max
- The discharge gauge should be double the suction pressure (if installed)



- Check for proper phase rotation on 3-phase pumps
- Check the common loop strainer (if installed) for trash or debris



Check the individual strainer at the inlet of the chiller barrel for trash or debris
(Only on MTC or earlier models)



Sensors are not reading the correct temperature

- Go to the chiller status screen and scroll down to “Loop Water Out” to see the temperature of the supply sensor and compare it to the actual temperature of the outlet pipe
- First thing to check is to tighten all of the connections on the terminal strip on the circuit board

- Unplug sensor out of the wire harness and ohm it out per chart
- If sensor is bad, borrow the common loop supply sensor to replace it till you get a new one.

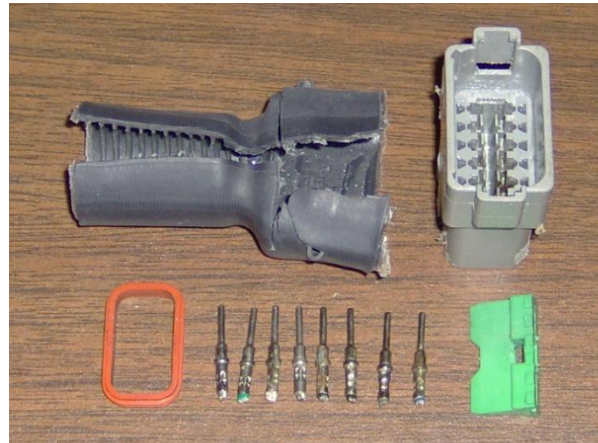
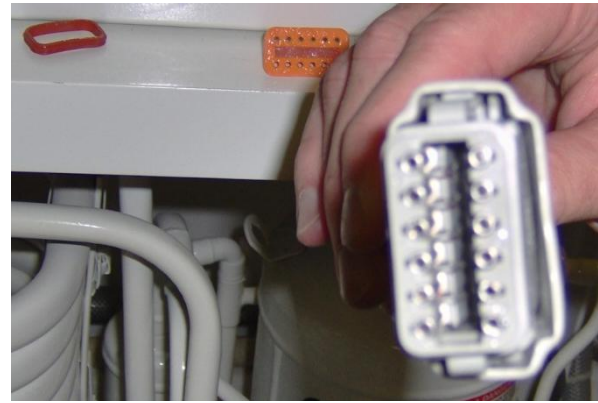
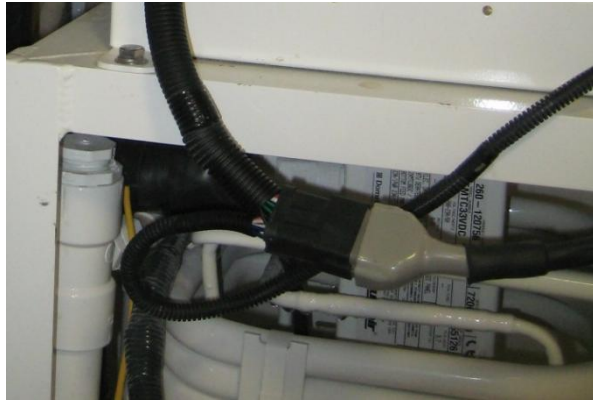


- Sensor is a negative temperature coefficient thermistor
- Resistance decreases with temperature increase

Temperature		Resistance	Temperature		Resistance
F	C	Ohms	F	C	Ohms
-29.2	-34	682,800	100.4	38	17,325
-20.2	-29	498,900	109.4	43	14,178
-9.4	-23	347,400	120.2	49	11,226
-0.4	-18	259,470	129.2	54	9,297
10.4	-12	185,190	140.0	60	7,464
19.4	-7	141,180	150.8	66	6,033
30.2	-1	103,110	159.8	71	5,079
32.0	0	97,950	170.6	77	4,155
39.2	4	80,040	179.6	82	3,531
50.0	10	59,700	190.4	88	2,921
60.8	16	45,000	199.4	93	2,506
69.8	21	35,820	210.2	99	2,096
80.6	27	27,495	212.0	100	2,036
89.6	32	22,209	219.2	104	1,814



Sensors are not reading the correct temperature
Check main harness 12 pin plug for moisture and corrosion



- If plugs are not too bad, clean with electronic contact cleaner and blow out with compressed air
- If corroded badly, cut the plugs out and butt connect the wires and heat shrink
- Or replace harness with part #'s 4160051 (chiller harness) and 263200004 (MPE harness)



Unit faults out on “Loop TD Max Limit” version 33 and earlier

Faults out when loop water temperature between inlet and outlet or common loop supply is more than 14 degrees F, (8C) for more than 2 minutes

- Go to the chiller status screen and check the Common Loop Return against the Loop Water Out and the Common Loop Supply temperatures
- 14F degree (8C) split would be below Common Loop Return temp in the cool mode, and above for heat mode
- Check to make sure all the sensors are in the correct location and are in good contact to the piping
- Check all the connections at the terminal strip at the circuit board
- Follow the previous procedures for a bad sensor reading, or a water flow problem

