TRANE

General Service Bulletin

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Troubleshooting and Checkout Procedures For CVHE/F/G Units with UCP2 Controls

Introduction:

The purpose of this service bulletin is to provide troubleshooting information on CVHE/F/G Centrifugal Chillers with UCP2 Control Panel. Additional UCP2 information is found in the following manuals:

CVHE-M-7, Operation/Maintenance Manual
CVHE-IN-8, Installation Manual
CVHE-W-8, Wiring Manual
CVHE-CLD-1, Clear Language Display Manual

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UCP2 Control Panel and Module Description

Unit Control Panel

Safety and operating controls are housed in the UCP2 Unit Control Panel, the Starter Panel and the Purge Control Panel (Control Panel layout is illustrated in Figure 1).

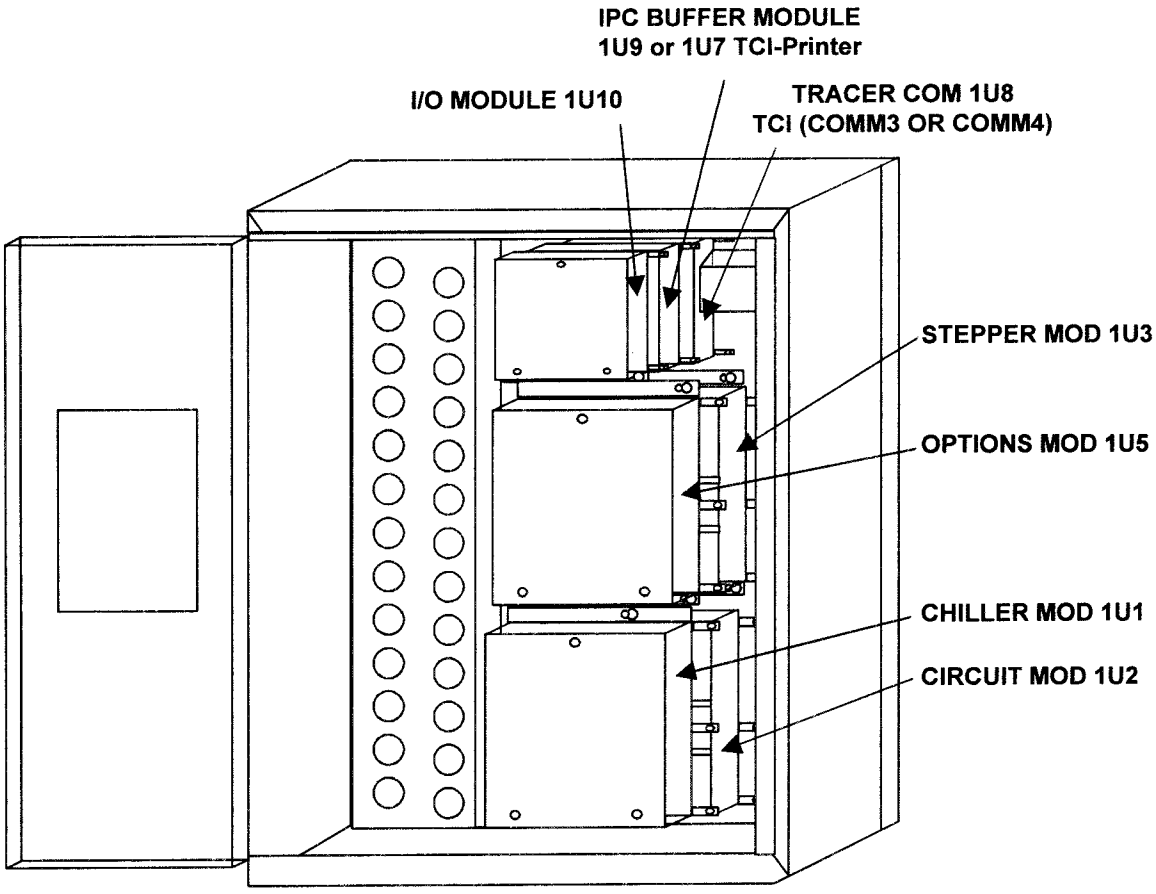
The UCP2 control consists of a modular design partitioned by major function or group of functions. All modules communicate with each other through the IPC circuit.

Major components within each of these control groups are described below.

Unit-mounted temperature sensors, pressure transducers and functional switches provide analog and binary inputs to the various modules.

The "microprocesser-based" modules are described as below: All wiring to the modules is to pluggable terminal blocks.

Figure 1
UCP2 Control Panel



UCP2 Control Panel and Module Description

Chiller Module

The Chiller Module is the Master-of-the-Chiller communicating commands to other modules and collecting data/status/diagnostic information from other modules over the IPC (Inter Processor Communications Link). The Chiller Module performs the leaving chilled water temperature and limit control algorithms arbitrating capacity against any operating limit the chiller may find itself working against. The Chiller Module checks for valid setpoints and contains non-volatile memory (NOVRAM), to retain them on any power loss. Inputs and Outputs are chilled water system level such as, but not limited to, evaporator and condenser water temperatures, evaporator and condenser water pump control, status and alarm relays, and external auto/stop.

Circuit Module

The Circuit Module serves as an input/output expander and is assigned inputs and outputs associated with the refrigerant and lubrication circuits. The Circuit Module also receives a 4-20mA signal from an external refrigerant level monitoring device. UCP2 then converts the signal to ppm for display at the Clear Language Display.

Stepper Module

The Stepper Module is designed to drive the stepper motor inlet guide vane actuator on CenTraVac chillers. On CenTraVac chillers the Stepper Module receives from the Chiller Module the direction and distance to drive the inlet guide vanes and then generates the appropriate signals to operate the stepper motor. The Stepper Module also has other I/O capabilities used to support functions on the stepper module and/or just I/O expansion. These are Evap. temperature, Cond. discharge, Bearing temperature and Cond. temperature.

Starter Module

The Starter Module physically resides in the Compressor Motor Starter Panel providing control of the starter when starting, running and stopping the motor. The Starter Module provides interface to and control of Y-Delta, X-Line, P-Reactor, A-Transformers, Solid State Starters and Trane® Adaptive Frequency Drive. The Starter Module also provides protection to both the motor and the compressor in the form of running overload, phase reversal, phase loss, phase unbalance, momentary power loss, and compressor surge, in addition to others.

Purge Module

The Purge Module provides control of the purge used on R11 and R123 low pressure CenTraVac models. The Purge Module provides all the inputs and outputs to control the purge optimizing both purge and chiller efficiency. The Purge Module resides in the purge control panel and communicates with the Chiller Module over the IPC (Inter processor Communications Link) uploading set points and downloading data and diagnostics.

Local Clear Language Display

The Local CLD (Clear Language Display) resides at the Chiller providing a display of chiller data and access to operator/serviceman controls, set points and chiller setup information. All information is stored in non-volatile memory in the Chiller Module. The Local Clear Language Display and the Chiller Module work together to display and store information requiring non-volatility.

Remote Clear Language Display Panel and Remote Clear Language Display Interface Module

As an option, the Remote Clear Language Display permits the operator to remotely operate 1-4 chillers. The Remote Clear Language Display Panel works like the Local Clear Language Display with two exceptions, (1) a Local Stop command takes precedence over all other remote or external devices, and (2) the Remote Clear Language Display's Custom Report and display language are independent of the Local Clear Language Display Panel.

UCP2 Control Panel and Module Description

Options Module

The Options Module satisfies control or interface requirements for a number of options. Some of these options are stand alone, such as Generic BAS Interface; other options support either additions or modifications to the chiller itself, such as Free Cooling. Features supported by the Options Module include Ice-Making, Heat Recovery, External Chilled Water Setpoint, and External Current Limit Setpoint.

Tracer Communications Interface

TCI COMM 3 is an optional module that provides a 1200 baud bi-directional serial communications link to Tracer 100/100i/CPM/Monitor BAS panels.

TCI COMM 4 (Tracer Summit) is an optional module that is also now available.

Printer Interface Module

The Printer Interface module provides a pre-formatted chiller log to a printer. The Printer Interface can be programmed via the Clear Language Display to print a chiller log on command, at the time of a diagnostic, and/or on a periodic basis. Each printed event is time and date stamped.

The preferred printer to be used is **OKIDATA Microline 184 Turbo**. It has been assigned a Trane number of 4150 2066.

Secondary Printer Options

Epson: Not all Epson printers support serial communications. For a low cost printer that does support serial communications, Epson recommends the LX810 Printer with the Serial interface option (C823032).

IBM ProPrinters: Use either the "2380" + or the "2390+" along with the Serial interface option "1363110".

Other: Any printer/computer with 232 capabilities should be capable interfacing with the TCI Printer module (allowing for different cables and jumper configurations).

General Troubleshooting Information

Problem 1. *Approach Temperature reads -40°F*

Corrective Action:

A CLD X13650448-04 or newer is required with a chiller module X13650450-04 or newer.

Problem 2. *Auto X-former starter: Runs (3) seconds and trips. Unit will not transition.*

Corrective Action:

Verify Starter Module. If -07 or later, it requires transition circuit.
No voltage on transition complete J4 circuit. Trace circuit path. Reference CVHE-SB-36.

Problem 3. *Bearing Temperatures 1 and 2 Locations.*

Corrective Action:

- Bearing temperature 1 (Stepper module J5-5, 6) goes to the front Journal bearing.
- Bearing temperature 2 (Stepper module J5-7, 8) goes to the rear Thrust bearing.

Problem 4. *Capacity Limited by High Current when the phase current as read from the Compressor report reads zero amps. Getting this message during the run mode.*

Note: This is what is happening: The Chiller module takes the three phase currents as sent by the Starter module, selects the highest one and limits based on this.

Corrective Action:

- Check the phase currents as displayed in the Compressor Report.
- Check the Active Current Limit Setpoint. It is possible it is a very low value or even zero amps is loaded in.
- If the current limit source is the external current limit setpoint, check this input on the Options module.

Problem 5. *Chiller Loss of Communication with Circuit module and IGV overdriving close.*

Corrective Action:

- IPC to Circuit module disconnected or reversed.
- Circuit module not powered
- Verify that a good ground exists between all modules including the CLD that needs a dedicated green wire ground.

Problem 6. *Check Clock (IFW) Informational Warning Diagnostics. On a loss of power the clock does not keep time, if there is an extended power loss (greater than 15 seconds).*

Corrective Action:

- This diagnostic is shown in active diagnostic menu.
  Note: If you clear this IFW diagnostic while the machine is running, you will shut down the unit. Wait to clear the diagnostic when the unit is off.

General Troubleshooting Information

Problem 7. *Chiller Loss of Communication with Purge and the IGV calibrates.*

Corrective Action:

- IPC to Starter module disconnected or reversed.
- Starter module not powered up
- Verify that a good ground exists between all modules including the CLD that needs a dedicated green wire ground.

Problem 8. *Circuit Loss of Communication with Starter or Circuit Loss of Communication with Chiller Diagnostics*

Corrective Action:

- The 120 VAC side of the 3KVA transformer should be grounded at only one spot and it is in the Starter. Both the 120 VAC and the 24 VAC in the UCP should not be grounded.
- Verify the IPC wire is shielded twisted pair between the Starter and Chiller module and its shield is grounded at the J1-6.
- Verify there is a dedicated ground between the remote starter and the chiller.
- Verify that a good ground exists between all modules including the CLD that needs a dedicated green wire ground.

Problem 9. *Clear Language Display won't go into Demo mode.*

Corrective Action:

You must press Custom report and Compressor report at the same time while the display is showing software part number on power-up. If it still does not go into the Demo Mode, check the IPC communication.

Problem 10. *Communication diagnostic; none or degraded communications.*

Corrective Action:

- Starter module must have the A phase on pin 2 of J2 24 vac
- IPC wires must be connected
- IPC wires must have correct (+ -) polarity on J1.
- The TCI and CLD modules have LEDs to indicate the sending and receiving of chiller packets.
- On TCI Green (RxA) is receive and should be blinking constantly. Red (TxA) is send and blinks every 1-2 seconds.

Problem 11. *Loss of Communication with Starter Diagnostics at Startup with no Inlet Guide Vane action. Mode is "Resetting" and can move through the menus.*

Corrective Action:

- IPC to Starter module disconnected or reversed
- Starter module not powered up.
- Verify that a good ground exists between all modules including the CLD that needs a dedicated green wire ground

General Troubleshooting Information

Problem 12. *Loss of Communication or Intermittent Communication between the Tracer and the UCMs. (If the TCI loses communication with the Tracer for 15 continuous minutes then you will get the "Tracer Communications Lost" message).*

Corrective Action:

- Verify that a TCI COM 3 is installed.
- Verify the Chiller and CLD versions are compatible with Tracer. Reference CTV-CSB-90 and CTV-CSB-92.
- ICS address at CLD should match with Tracer
- Are the DIP switches set correctly. They should be all off for COM 3.
- In the Tracer Module, verify the IPC LEDs near J1 are blinking. Red LED is transmit and should be blinking constantly showing lots of IPC action (even if not for the TCI). The green LED is for receive and should only be blinking rapidly in a row once every 1-2 seconds which is the IPC cycle time.
- Verify the COM 3 LEDs near J3 are blinking. Red LED is transmit and should be blinking showing lots of COM 3 action (even if not for the TCI). The green LED is for receive and should only be blinking rapidly in a row once every minute which is the Tracer cycle time.
- The Starter module or other modules are not grounded well. The IPC needs the modules to be grounded together.
- Go to service test menu and verify that Chiller thinks a TCI 4 is installed.
- Look at the voltage of each line with respect to ground. A logic 0 should be .5 V or less, a logic 1 should be 4.5 volts or more.
- For COM 3 lines less that 1000 Ft., a 300 Ohm terminating resistor put across the two wires is needed. Install the resistor first at the chiller end of the link.
- Radio frequencies generated from sources like airplanes and TV/radio towers may be inducing noise in the communication lines. Tie matched capacitors of around 200pF at either ends or both ends from each line to ground.
- TCI option is self installed. No need to enable it manually. If you do enable it manually and no TCI Tracer module on the line, then a loss of communication with TCI will be called. If installing TCI option, then IPC side diagnostics are called i.e. Loss of Communication with TCI. No Tracer diagnostics are called.
- De-install TCI option and power up and see it self install within 10 seconds. If not, something is wrong in TCI module.
- De-install Tracer option and power up and see if it self installs within three minutes. If not, something is wrong with the Tracer side.
- Tracer option is self installed. No need to enable it manually. If enabled manually and no Tracer on the communication line, then a Loss of Communication with Tracer will be called. If a Tracer is put on communication line, then communication side diagnostics are called Loss of Communication with Tracer.

General Troubleshooting Information

Problem 13. *No Communication, on a power up, get message "No Communication, Data Not Valid" and no action in the IGV.*

Corrective Action:

- Chiller module not powered up
- IPC to Chiller module not connected
- IPC shorted
- Disconnect all modules from the IPC to CLD except the Chiller module. If a communication is received back, then try plugging one of the other modules one at a time, do a power up and if it then fails, this is the module that is pulling down the line.
- Check the LEDs at the rear of the CLD. The left one is "TEST" and should be on if all is normal.
- The second LED from the left is the "+5VDC" and should be on all the time if all is normal.
- The third LED from the left is the transmit and should only blink rapidly every 2 seconds when the CLD talks on the line.
- The fourth LED from the left is the receive and should be blinking rapidly all the time since there is constant buss action.
- Verify that the CLD is grounded to the other modules.
- Module Grounding Problem. On the Starter module DO NOT ground the IPC. IPC is grounded at the Chiller module.

Problem 14. *No Communication, on a power up, get message "No Communication, Data Not Valid" but the Inlet Guide Vane calibrates.*

Corrective Action:

- IPC to the Local Clear Language Display reversed
- IPC to Local Clear Language Displaydisconnected
- Verify that a good ground exists between all modules including the CLD which needs a dedicated green wire ground.

Problem 15. *Starter Loss of Communication with Chiller. No other diagnostic.*

Corrective Action:

- Verify IPC connections are good to Starter module and cable is shielded. Chiller module X13650450-01 is not compatible with Starter module X13650453-02 and later. X13650453-02 and later request chiller packet 20. Chiller module X13650450-01 does not support packet 20. All later Chiller modules do.

Problem 16. *TCI Loss of Communication with Chiller.*

Corrective Action:

Need a X13650460-02 or newer TCI module.

General Troubleshooting Information

Problem 17. *Cond. Pressure 2-10 VDC output will not work.*

Corrective Action:

The Chiller module must be a X13650450-04 or later. Earlier versions did not support this option.
Check wiring between transducer (located near the purge) and the circuit module J7.
Faulty transducer - follow transducer checkout procedure on page 58.

Problem 18. *Cond. Refrig. Temp. Sensor diagnostic, when the displayed Cond. Refrig. Temp. is reading fine.*

Corrective Action:

Chiller software found in X13650450-01 Rev. D or earlier mis-diagnose Cond. Refrig. Press.
Replace with new Chiller module.

Problem 19. *Condenser and Evaporator entering and leaving water temps. changing rapidly and reading incorrectly, i.e. -25° F to 90° F.*

Corrective Action:

Bad Chiller module, it must be replaced.

Problem 20. *Condenser Water Flow lost diagnostic. Unit will not restart until manually reset.*

Corrective Action:

Phase A and B Chiller module software were actually an MMR. Phase C (X13650450-04) changed to a MAR. Time changed from 3 minutes to 4-1/4 minutes.

Problem 21. *Custom menu - Unwanted items that you did not install and you cannot remove.*

Corrective Action:

- The initial problem was if you had installed an option, put it in the Custom menu, then de-installed it without first removing it from the Custom menu.
- Problem corrected on CLD X13650448-02, Rev. E.

Problem 22. *Display is locked up. No communication, Data Not Valid Diagnostic.*

Corrective Action:

1. Check the (4) LEDs on the back of the CLD. Left to right.
   #1 is the Test Light and should be on all the time.
   #2 is the 5VDC and should be on all the time.
   #3 is the Transmit and should blink every 2 seconds.
   #4 is the Receive and should blink continuously.
2. There probably is a IPC communication problem with one of the boards. Disconnect the IPC from all modules except leave the IPC connected from the CLD to Chiller module. Start connecting the IPC at one at a time until we find which one is the problem.
3. Check the Chiller module 24 VDC, 5 VDC and 24 VAC.
4. Check the CLD (Clear Language Display) grounding. It has to be grounded from the clear language display to the chassis/back panel.
5. Starter Module IPC should not be grounded. Ground is on the Chiller module end. A double ground will lock up the display.

General Troubleshooting Information

Problem 23. *Display on the CLD is flashing.*

Corrective Action:

- The inductor in the switching power supply may be shorted to its core. The switch is going in and out of thermal shut down.
- The +5V LED should also be flashing.
- Verify the 24 VAC delivered to the CLD is within range of 20-28 VAC. Disconnect the IPC to verify it is not causing this.

Problem 24. *External Chilled Water Setpoint does not work.*

Corrective Action:

1. Polarity must be (minus) (plus)
2. If the 4-20 MA and the 2-10 VDC are out of range, the active chilled water setpoint source reverts back to front panel and does not work.
3. Setpoints
   - SW3-1 should be:
     OFF for 2-10 VDC
     ON for 4-20 MA
   - Chilled Water Reset type is Disabled
   - Chilled Water Setpoint source is External
   - Setpoint source override is None.
   - External Chilled Water Setpoint is Install.

Problem 25. *Evaporator Water Temperatures are reversed. 2 pass units only.*

Corrective Action:

Reverse the sensor leads at the module.

Problem 26. *2F1, 2F2 and 2F3 Fuses blow - On 200-575 volt units when switching the starter disconnect from OPEN to CLOSED.*

Corrective Action:

See manual CVHE-CSB-31.

General Troubleshooting Information

Problem 27. *Hot Gas Bypass Does Not Work.*

Corrective Action:

1. Module Compatibility:
   Chiller must be X13650450-04 or newer
   CLD module must be X13650448-05 or newer
   Option module is a X13650452-01 or newer.
2. Hot Gas Bypass Option must be installed in the machine configuration
3. Hot Gas Valve Control in the service test menu must be in the Auto Mode.
4. Hot Gas Bypass Control enabled in field startup
5. The Inlet Guide Vane must be closed or at a minimum to go into Hot Gas.
6. The Chilled Water Setpoint minus the actual chilled water temperature must be 0.6 F or greater, i.e., Setpoint of 45° F and leaving temperature of 44° F for more than 20 seconds would show the need for Hot Gas.
7. Verify the Hot Gas Timer is installed and max HGBP time is greater than zero.
8. Verify that the module software numbers are being displayed in the Service Test Menu.
9. Verify that the IPC Communications wire is connected to J1 of all modules and we have good 24 VAC, 24 VDC and 5VDC.

Problem 28. *IGV will not move in the Service Test Manual mode.*

Corrective Action:

1. Verify the CLD LED comes on solid. Verify there are no Stepper module diagnostics.
2. Verify we are in a Stop mode, Diagnostic Stop mode, or Run mode.
   All other modes the Manual Vane Control will not work.
3. Is the IGV travel percentage increasing? If so there is a problem with the motor or Stepper Module drive circuit.
4. Are we in a "Stop" mode after being in a Limit mode. The limit bit may be set so do a power down to clear.
5. Will not work in post lube or initialization in preparing to start.
6. On power up, does the Stepper module do a BPI search. If not, the Stepper module could be held up in the Initialize mode internally. On a power up, the Stepper module looks for communication with the Chiller, Starter and Circuit modules. If it doesn't hear from any one of them, it stays in the Initialize mode and will not do BPI or Manual Vane Control. If no BPI, check the IPC wiring. Also, if trying to start the chiller, the mode will stay in initialize.

Problem 29. *IPC Buffer Diagnostics*

Corrective Action:

Clear Language Display is not communicating. Replace the CLD or the Chiller module is not communicating and needs replacing.

Problem 30. *KW reads high by a factor of 3, with optional PT installed.*

Corrective Action:

Software change made 11/93 to CLD. X13650448-02 Rev. E or later corrects the problem.

General Troubleshooting Information

Problem 31. *Loading Problems*

Corrective Action:

1. Unit is in External Stop and when released, requires 3.5 minutes to get the vanes to desired point of operation (typically 50 degrees). This is close to the maximum rate that the compressor can load because the fastest the vanes will move is 1250 steps every 5 seconds.
2. If Soft Load Control is Enabled, the Soft Control parameters can be adjusted to meet the requirements of the system. If the chiller is allowed to ramp up faster than needed it could over shoot the leaving chilled water temperature setpoint and potentially be current limited. If this overshoot is too rapid and causes excessive current draw, the adaptive control will force an unload to approximately 70 %. This could cycle several times before stabilizing.
3. If Soft Load Control is Disabled or the loading is not from initial startup, The LWT Control Proportional, Integral and Derivative gains can be adjusted to allow system adjustment to properly follow the load. Typical changes should be small. 1-2% proportional gain change or 0.01 % integral gain changes. Always adjust proportional gain first. This is the coarse adjustment, while integral is the fine and derivative is the micro adjustment.
4. Item 1 reference the mechanical limitation of the stepper motor while the software limitation is a pulldown rate of 5 F/minute of the leaving water temperature. This maximum cannot be overridden.

Problem 32. *Momentary Power Loss*

Corrective Action:

1. MPL is active for the Run mode. Not in the Start mode.
2. CT wiring on J5 of the Starter module must be wired White-Black per print and Phase A must be on Terminals 1 and 2, Phase B on 3 and 4 and Phase C on 5 and 6.
3. Check phasing of the supply voltage. The "A" phase must be delivered to J2-2 or 4 of the Starter module.
4. Look at the voltage on J2 for noise. J2 should be a smooth 24 VAC sign wave. If we get electrical noise from things such as inverters or high frequency generators, you will see noise blips off the sign wave.
5. Verify the polarity of the CT circuit is correct. For single CT circuits the White wire must be connected to J5-5 with the dot on the CT facing the line. For dual CTs. The "HI" polarity dot on the line CT must be facing the line, the Brown wire from the X13650266 transformer primary connected to X1 and the White wire from X13650266 secondary connected to J5-5.
6. Verify that there is voltage delivered to the J6 terminal, if not check the HPC circuit, circuit breaker or Starter Interlock.
7. Check for loose wires.
8. Check the wiring from J8 to 2K1 Coil and Auxiliary.
9. Two wiring errors will allow you to start and go out on Momentary Power Loss when the unit loads up. The CTs and 24 VAC may be wired up improperly. As the loading is changed due to vane movement, then MPL may be called.
10. If the unit trips on Momentary Power Loss, vanes stay where they were and then restarts without going through a Vane Closure or BPI search, (2) modules need to be changed:
    1. Chiller module needs to be a X13650451-04 or newer.
    2. Stepper module must be X13650455-04 or newer.

Problem 33. *Motor winding temperatures changing rapidly and randomly.*

Corrective Action:

Electrical noise problem in the circuit module. X13650451-04 Rev. D or later corrects the problem by adding a filtering circuit.

General Troubleshooting Information

Problem 34. *Differential Oil Pressure Calibration Diagnostic following post lube. Secondary problem may be the oil pump will not shut off after post lube.*

Corrective Action:

1. Diagnostics is active in all non-running modes and the unit has been off for 5 minutes. The UCP2 calibrates the oil pressure sensors and if an error is found greater than 3 PSID a diagnostic is called out.
   (1.1) Sensors
   (1.2) Changing system pressures caused by such things as a pressure or changing water temperatures.
2. If the oil pump is running and will not shut off in post lube, the problem is a wiring error on the starter module. One or both of the following apply.
   (2.1) 115 VAC is connected to terminal J6-3 of the Starter module. Check to see if it was connected incorrectly to Terminal J3-1.
   (2.2) Terminal J8 on the Starter module. J8-1 (Wire #13) goes to the 2K1 Contactor. J8-2 (Wire #15) goes to 2K1 Auxiliary. Check to see if Wire #13 and Wire #15 are reversed.

Problem 35. *Differential Oil Pressure Overdue Diagnostic immediately following a Remote Reset.*

Corrective Action:

- The Circuit module was clearing the 3 minute oil pressure establish timer during a remote RESET. This would result in a Oil Pressure Overdue diagnostic.
- Exists for Circuit modules X13650451-06 and earlier.

Problem 36. *Oil Pump Discharge Pressure Sensor Diagnostic and Oil Pressure Calibration.*

Corrective Action:

Chiller is in a high vacuum where one or both of the transducers read -14.9 PSIG. This is out of range and thus a sensor diagnostic is being called. The diagnostic may be cleared once the chiller is charged.

Problem 37. *Over/Under Voltage Diagnostic on Startup.*

Corrective Action:

You may get the diagnostic with the following Setup Sequence.

1. Unit Line Voltage enabled in Machine Configuration.
2. Under/Over Voltage is enabled in Field Startup.
3. If you then disable Unit Line Voltage, the Under/Over Voltage screen disappears but is still active. You have to then re-enable Unit Line Voltage in Machine Configuration and disable Over/Under Voltage.
4. Over/Under Voltage is used only with PTs installed. If you enable the option with "No" PTs installed you will get the diagnostics.
5. When the Line Voltage Sensing Option is not installed, the Unit Line Voltage menu item is not displayed nor is the Under/Over Voltage option installed.

Problem 38. *Phase Loss*

Corrective Action:

1. CT hooked incorrectly relative to incoming power.
2. Defective Primary CT.
3. 120 VAC missing from the Stop Relay circuit on J6 of Starter module.
4. Defective High Pressure switch. Wire may be off .
5. Problem in the Start Relay circuit on J8 of Starter module. Check all connections and circuit.
6. Verify currents are over 10% RLA.

7. Check the Starter Wiring diagram for other components i.e., power monitoring devices that may be taking us off.
8. The Starter contactors may be too slow to respond to the Start signal. Disabling the phase rotation will give us more time by taking out the 0.7 highly aggressive circuit but keeping in the primary phase protection. For Starter software X13650453-04 Rev. K , the time for detection of the highly aggressive circuit changed from 0.3 to 0.7 seconds.

Problem 39. Phase Reversal

Corrective Action:

Phase Rotation Protection is based on clockwise ABC Phasing. UCP2 picks up current phasing through the Starter Module Terminal J5.

Three possible causes are:

1. Phases actually revised
2. Noise on the Link which may inject an illegal state
3. Current imbalance, higher impedance on (1) phase caused by:
   - Bad Contactor
   - All the lighting on (1) circuit/phase
4. (2) of the CT wires revised on J5.

Problem 40. *Printer will not work.*

Corrective Action:

1. Verify Printer is compatible with a serial 9 pin RS232.
2. Verify printer setup in the CLD is correct
   - Machine Configuration Menu:
     Printer Option is Installed
   - Service Settings Menu:
     Set Baud Rate, Parity, Data Bits, Stop Bits, Handshaking
     For Handshaking: XON/XOFF is recommended.
3. Verify the printer settings match the CLD setup
   - Baud Rate, Parity, Dat Bits, Stop Bits, and Handshaking must be the same as in the CLD
4. Verify the printer interface is working properly
   - Verify there is IPC communication
     - RxA (Green LED near J1) is IPC *receive* and should be blinking
     - TxA (Red LED near J1) is IPC *transmit* and should not be blinking
     - Diagnostic LED (Red) is OFF
     - Check DIP switches, they should be OFF-OFF-ON
   - RxB (Green LED near J3) is printer receive and should be OFF
   - TxB (Red LED near J3) is printer transmit and blinks only when printing
5. Check the printer cable
   - Usually a 9-25 pin cable with RX (receive) to Rx, and Tx (transmit) to Tx connections
6. Try to print manually (in Operator Settings menu)

Problem 41. *Purge Compressor will not run in the manual "ON" mode.*

Corrective Action:

1. In the Operator Setting menu, select "ON" for Purge Operating Mode. Note that "ON" means that the purge compressor and condenser fan will run. The pumpout motor will run only when the Purge Suction temperature gets below 17° F and turns off when the temperature gets above 25° F.
2. If you get "Purge Pumpout Rate Exceeded" message then go to the Service Settings menu, go to Field Startup Group and set "Purge Service Excessive Pumpout Outride Timer" to the amount of time you would like the pump-out motor to run without it incrementing the pumpout rate.
   The maximum allowed time is 72 hours. When this time is reached, you will get the "Max Pumpout Rate Exceeded" message.
3. Clear all purge diagnostics.

General Troubleshooting Information

Problem 42. *Transition resistors stay in too long.*

Corrective Action:

- If the J8 terminal on the Starter module is loose, the control does not latch in and extends the timing keeping the resistors in longer.
- Reference Service Bulletin CVHE-CSB-35.

Problem 43. *Setpoints are not being stored, service tests will not work and we are calling many diagnostics on the CLD.*

Corrective Action:

- IPC to Starter module disconnected or reversed.
- Starter module not powered up.
- One wire of the IPC is not connected.

Problem 44. *Starter Contactor Interrupt Failure Diagnostic when powering up the UCP.*

Corrective Action:

1. Starter module is sensing motor current greater than 10% RLA when motor should be OFF on a power up or in OFF state.
2. Starter module is sensing motor current greater than 10% RLA .68 Sec. after initiating a shutdown.
3. Look at phase currents as read in the Compressor Report.
4. If power factor correction capacitors are used, these capacitors should be placed on the motor side of the 2K1 and 2K2 contactors so as to be disconnected from the line when the motor is off.

Problem 45. *Starter Dry Run Test Diagnostic upon entering a Starter Dry Run Test.*

Corrective Action:

The Starter module is sensing either the presence of line voltage from the PTs or line current from the CTs.

Problem 46. *Starter Dry Run will not work.*

Corrective Action:

1. If the PTs are installed they sense voltage and prevent dry run
2. A major diagnostic is present
3. Unit is not in Stop mode
4. Starter senses the presence of currents
5. There is a (MMR) diagnostic present

General Troubleshooting Information

Problem 47. *Stepper motor is humming.*

Corrective Action:

While in the hold mode, the stepper motor is driven with 1.0 amps.
This is the case even if the actuator is fully closed. The humming is normal.

Problem 48. *Pressure Transducer shift in calibration. Diagnostics will be sensor calibration related such as sensor failure or oil pressure sensor calibration.*

Corrective Action:

1. Wired incorrectly. Check diagram.
2. Corrosion on X-ducer contacts
3. Bad transducer
4. Disregard diagnostics when the unit is a deep vacuum prior to charging.

Problem 49. *Rapid Time of Day Scrolling or Date jumps back one day.*

Corrective Action:

1. Problem one is rapid time of day and year scrolling. The problem is in the CLD software when we reach December 29, 30 and 31. Fix: Replace the CLD (Local Clear Language Display) with a X13650448-03 or newer. To stop the scrolling press Enter to get a valid date and set before or after Dec. 29/30.
2. Problem two is when the date jumps back one day. The date of January 4, 1995 is set and it jumps back to January 3, 1995. This is because 1996 is a leap year and the problem only exists on the year prior to leap year. Replace the CLD with a X13650448-03 or newer.

Problem 50. *Unit did not Transition diagnostics.*

Corrective Action:

1. Do a Starter Dry Run Test.
2. Check for 24 VAC input to all modules
3. Check for 24 VDC and 5VDC on the Starter module
4. Check all wiring and connections
5. Check for 120 VAC on the Starter module J4-1 and 2. J4 is an OPTO input circuit that recognizes transition complete. If there is no signal on J4, the unit will not transition.
6. Could have a bad Starter module.

General Troubleshooting Information

Problem 51. *Unit Tons Read-out on CLD does not work.*

Corrective Action:

- Verify that the condenser solenoid is connected to the condenser.
- Verify that the entering port of the solenoid goes to the entering water line.
- Verify that the leaving port of the solenoid goes to the leaving water line.
- With the solenoid de-energized, the entering water line is monitored.
- Verify that the Evaporator Solenoid is connected to the evaporator.

Problem 52. *High Vacuum Lockout. The UCP2 looks at the oil tank pressure via the oil tank pressure transducers. On R-123 units, if the pressure is -11.6 PSIG (3.1 PSIA) or greater, we get the high vacuum lockout. On R-11 units it is -10.9 (3.8 PSIA).*

Corrective Action:

- In Machine Configuration make sure the correct refrigerant is selected.
- If the unit has a "PREVAC" installed and you get a high vacuum lockout at Startup, contact La Crosse Technical Service. A special Circuit Module chip may be required.

Module Compatibility

UCP2 Module Compatibility

1. Chiller modules X13650450-02 or greater when installed in a system with a CLD of X13650448-01 will call out a diagnostic of (Unknown Diagnostic 905). The machine requires a CLD of X136504489-02 or greater.

2. Starter module X13650453-02 and greater requires Chiller Packet 20.
   Chiller module X13650450-01 does not support Packet 20. You need a Chiller module of X13650450-02 or greater along with the Starter module X13650453-02 through 6 or you will get a diagnostic of starter loss of communication with chiller. Beginning with Starter module X13650453-07, the Starter module no longer expects to receive Chiller Packet 20.

3. Chiller module X13650450-03 and earlier do not have the bit that the Stepper module looks for to determine if it should do an inlet vane motor BPI search on startup. These modules will do a BPI search on each startup.

4. TCI COM3 module X13650460-01, the TCI packet time to receive the information from Tracer is 15 seconds. The information is sent out every 10 seconds and you may get repeat (IFW) informational warning diagnostics filling up the diagnostic logs. TCI COM3 module X13650460-02 or greater is required.

5. To read evaporator approach temperature, you need a CLD of X13650448-04 and later along with a Chiller module of X13650450-04 and later.

Description of UCP2 Options

1. **TRACER COMMUNICATIONS INTERFACE MODULE (COM 3 MODULE)**
   This option must be ordered if the chiller is to communicate over a serial communication link to a TRACER 100.

2. **TRACER COMMUNICATIONS INTERFACE MODULE (COM 4 MODULE)**
   This option must be ordered if the chiller is to communicate over a serial communication link to a TRACER Summit.

3. **REMOTE CLEAR LANGUAGE DISPLAY MODULE**
   Enables the UCP2 to communicate serially with the remote CLD.
   The remote CLD panel (COPT:RCPL) communicates serially with 1-4 UCP2 equipped chillers that have the optional remote CLD. The local CLD stop command function has precedence over the remote function. The Custom Report and display language at the local CLD and remote CLD are independent.

4. **OPTIONS MODULE**
   The Options module is required to implement any/all of the following Control options. Some require additional sensor/transducers.

   4.1 Chilled water setpoint by external/remote source. Allows a remote source to set the chilled water setpoint via 4-20 Ma or 2-10 Vdc signal. The range is 0 F to 65 F.

   4.2 Current limit setpoint by external source. Allows a remote source to set the current limit setpoint via a 4-20 MA or 2-10 VDC SIGNAL. Range is 40% to 120%.

   4.3 Compressor percent (%) RLA output. Allows a remote system to receive a 2-10 VDC signal proportional to the chillers % RLA. Range is 0% TO 120%.

   4.4 Head relief request output. Allows a remote system to receive a binary signal for use with compressor surge protection and condenser limit by requesting lower entering cond. water temp. This option requires an additional transducer on the condenser.

   4.5 Maximum capacity output. Allows a remote system to receive a binary signal indicating the chiller is at maximum capacity.

   4.6 Heat recovery/auxiliary condenser entering and leaving water temperatures. This option includes the Option module. Allows UCP2 to monitor the entering and leaving heat recovery or auxiliary cond. water temps which are displayed at the local CLD.

   4.7. Free cooling machine mode enable/disable and valve control. Allows a remote source to re-enable/disable the chillers free cooling.

Description of UCP2 Options

5. **PRINTER INTERFACE MODULE**
   This option must be ordered if the UCP2 is to have a direct connect serial printer. The printer and cable must be ordered separately. This option includes ASHRAE Guideline 3 Report.

6. **CHILLED WATER RESET - OUTDOOR AIR TEMPERATURES**
   Provides for outdoor air temperature reset of the UCP2 front panel chilled water setpoint. Includes display of outdoor air temperature.

7. **WATER PRESSURE SENSORS FOR EVAP AND COND SYSTEM PRESSURE LESS THAN 150 PSIG.**
   Includes sensing of the entering and leaving water pressures of the evaporator and condenser, factory mounted in the water boxes. The Options module is not required. The following data will be shown:
   - Entering/leaving evaporator & condenser water pressure (PSIG)
   - Evaporator and condenser differential water pressure (PSID)
   - Evaporator/condenser GPM
   - Evaporator tons (Approximate)

   WATER PRESSURE SENSORS FOR EVAP AND COND SYSTEM GREATER THAN 150 PSIG
   Includes sensing of the differential evaporator and condenser water pressures. The Options module is included and required. The following data will be shown:
   - Evaporator and condenser differential water pressure (PSID)
   - Evaporator/condenser GPM
   - Evaporator tons (Approximate)

8. **BEARING OIL TEMPERATURE SENSORS**
   Includes factory installed sensors and safety cutouts (On high temp) to monitor the leaving bearing oil temperature: Sensor (1) monitors the Journal bearing temperature and Sensor (2) monitors the Thrust bearing temperature.

9. **PHASE VOLTAGE SENSORS**
   Includes factory installed potential transformers in the starter for monitoring/displaying phase voltage and this provides over/under voltage protection. The following is displayed:
   - Compressor phase voltage; Kilowatts Power Factor.

10. **ENHANCED CONDENSER LIMIT**
    Includes factory installed cond pressure tranducer, piping and wiring.
    Provides enhanced high pressure cut-out over cond limit which is standard.
    The head relief request relay will energize when cond. limit is approached. The Options module is included.

11. **DISCHARGE TEMP SENSOR**
    Includes a factory installed sensor and safety cutout on high compressor discharge temp. Allows the UCP2 to monitor compressor discharge temperature. When the chiller is selected with hot gas bypass this sensor is included.

12. **STARTER BY OTHERS**
    When the starter is being furnished by others, Trane furnishes the Starter module in the UCP2, and other wiring/components as needed. The starter must be built per Trane starter specifications.

Module Voltages

Chiller Module

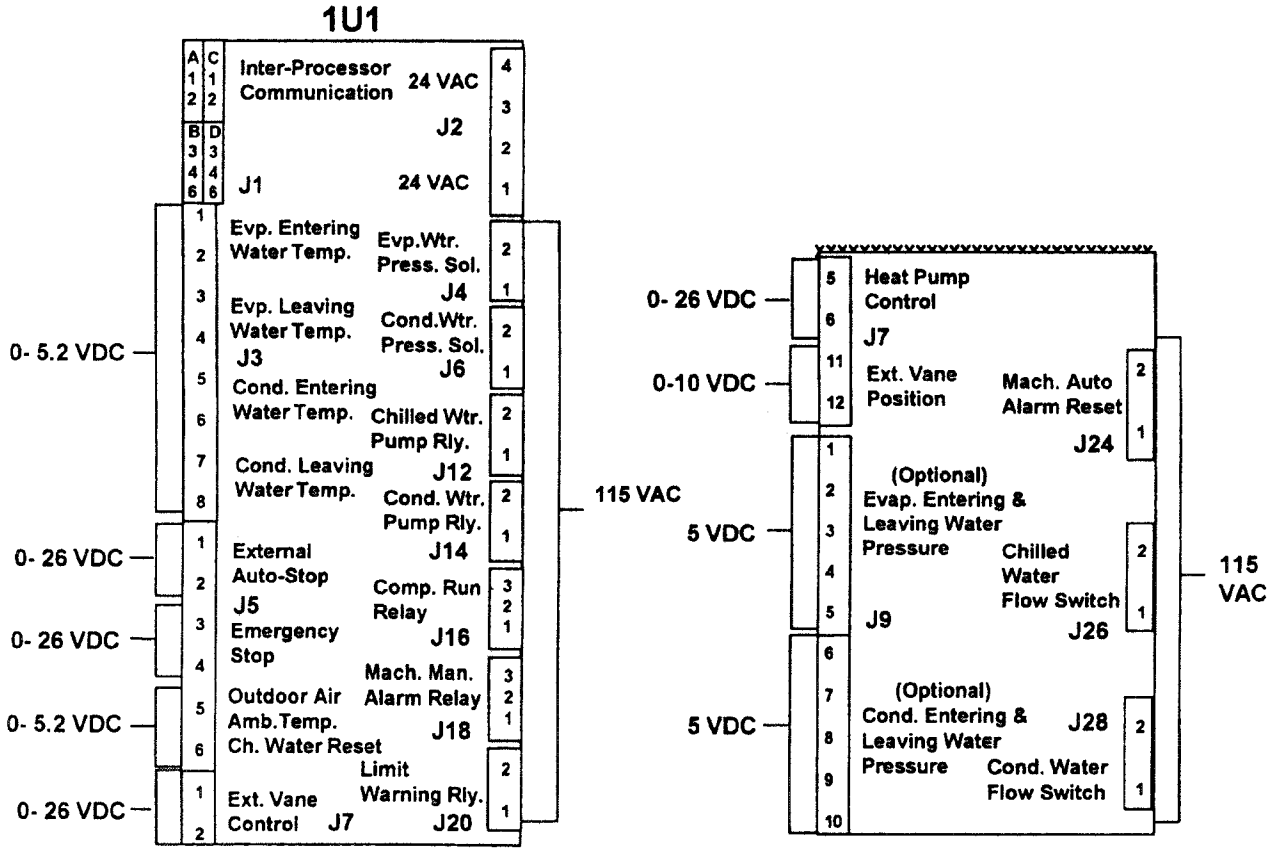
- 1U1 is the "Master module", collecting data, status conditions, diagnostic information, etc. from modules (over the IPC link) from sensors and remote contacts and in turn communicating commands to other modules.

- 1U1 performs leaving water temperature and limits control algorithms, trading off chiller capacity against various "limits" that the chiller may be working against.

- 1U1 checks for valid setpoints and identifies unit type for other modules.

- Low Voltage (<30VAC) Inputs:
- 24 VAC, IPC Links to Internal, to Purge and to Starter Modules; Evap. Ewt and Lwt; Cond. Ewt and Lwt; External Auto Stop; Emergency Stop; Ambient Air CWR; Heat Pump Control; Evap. Water Delta P; Cond. Water Delta P
- High Voltage (>30VAC) Outputs:
- Evap. Water Pressure Solenoid; Cond. Water Pressure Solenoid; Evap. Water Pump Relay; Cond. Water Pump Relay; Compressor Run Relay; MMR Alarm Relay; MAR Alarm Relay; Limit Warning Relay

Figure 2
Chiller Module



Module Voltages

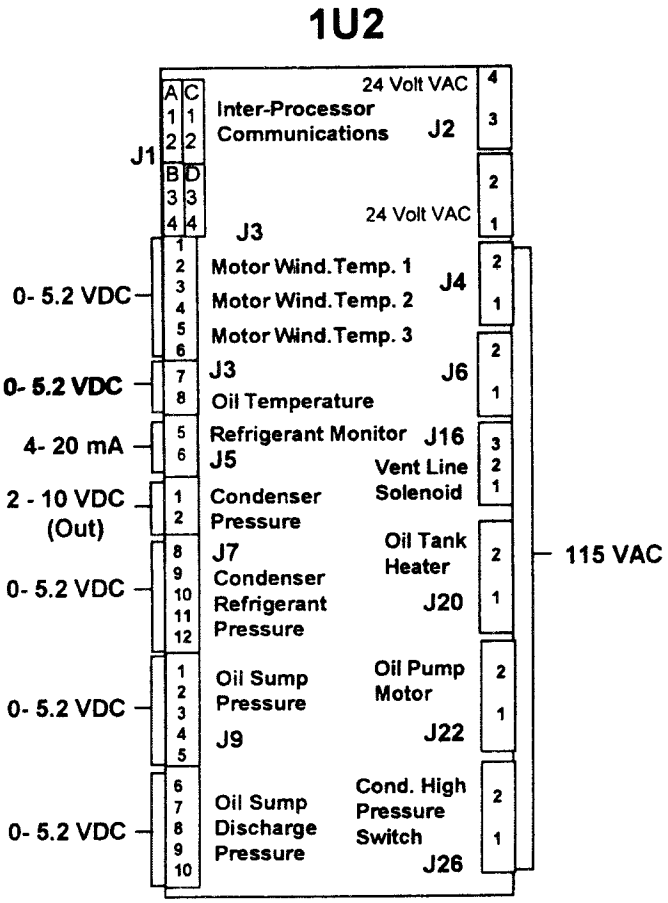
Circuit Module

- 1U2 assigned functions associated with compressor motor, lubrication system and refrigerant monitoring.

- Low Voltage (<3OVAC) Inputs:
- 24VAC; IPC link;
  Compressor motor winding temp. sensors 1, 2, 3;
  Oil tank temperature;
  Refrigerant monitor equipment room ppm level:
  Condenser refrigerant pressure;
  Oil sump pressure;
  Oil discharge pump pressure;

- High Voltage, High Amperage (120VAC) Inputs:
- High Condenser Pressure
- High Voltage, High Amperage (120VAC) Outputs:
- Vent line solenoid valve; oil tank heater; oil pump motor

Figure 3
Circuit Module

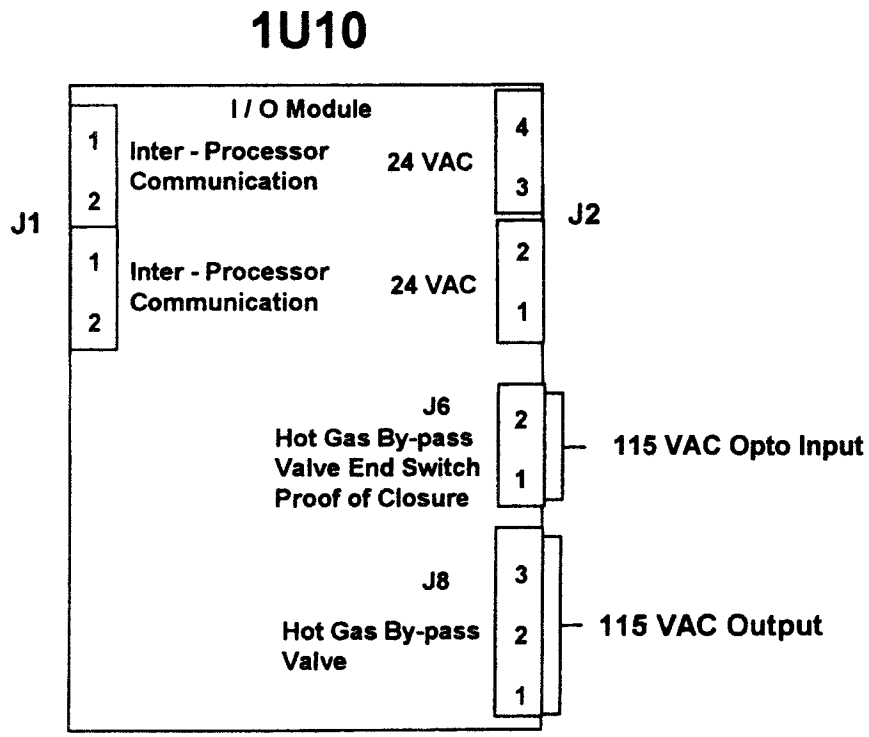


Module Voltages

Input/Output Module

- Provided only when chiller is equipped with Hot Gas Bypass (HGBP) option.
- The I/O Module (1U10) operates the Hot Gas Bypass valve on CVHE and CVHF units in response to signals from stepper module 1U3.
- The module also receives input on HGBP valve position from the HGBP valve end switch.
- Low Voltage (<30VAC) Inputs
- 115 V HGBP valve drive signal
- High Voltage (>30VAC) Inputs
- 110 V HGPB valve proof-of-closure signal from valve end switch
- High Voltage (>30VAC) Outputs
- HGBP Open Triac
- HGBP Close Triac

Figure 4:
Input/Output Module



Module Voltages

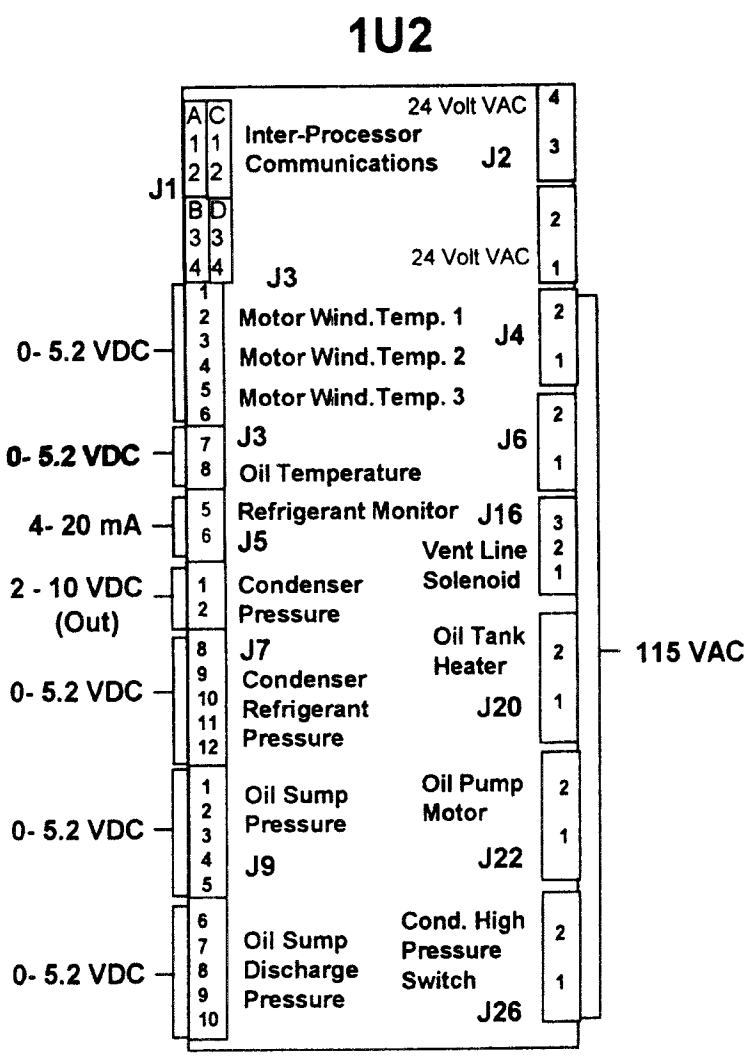
Options Module

- As its name indicates, 1U5 provides the control or interface requirements for many of the options available with the UCP2.

- Low Voltage (<3OVAC) Outputs:
  - Heat Recovery Actuator
    % RLA Compressor

- High Voltage (>3OVAC) Outputs:
- Ice-Making Relay; Head Relief Request Relay; Max. Capacity Relay;
  Free Cooling Actuator Relay I (Liquid Line Valve);
  Free Cooling Auxiliary Relay;
  Free Cooling Actuator Relay 2 (Gas Line Valve)

Figure 5
Options Module



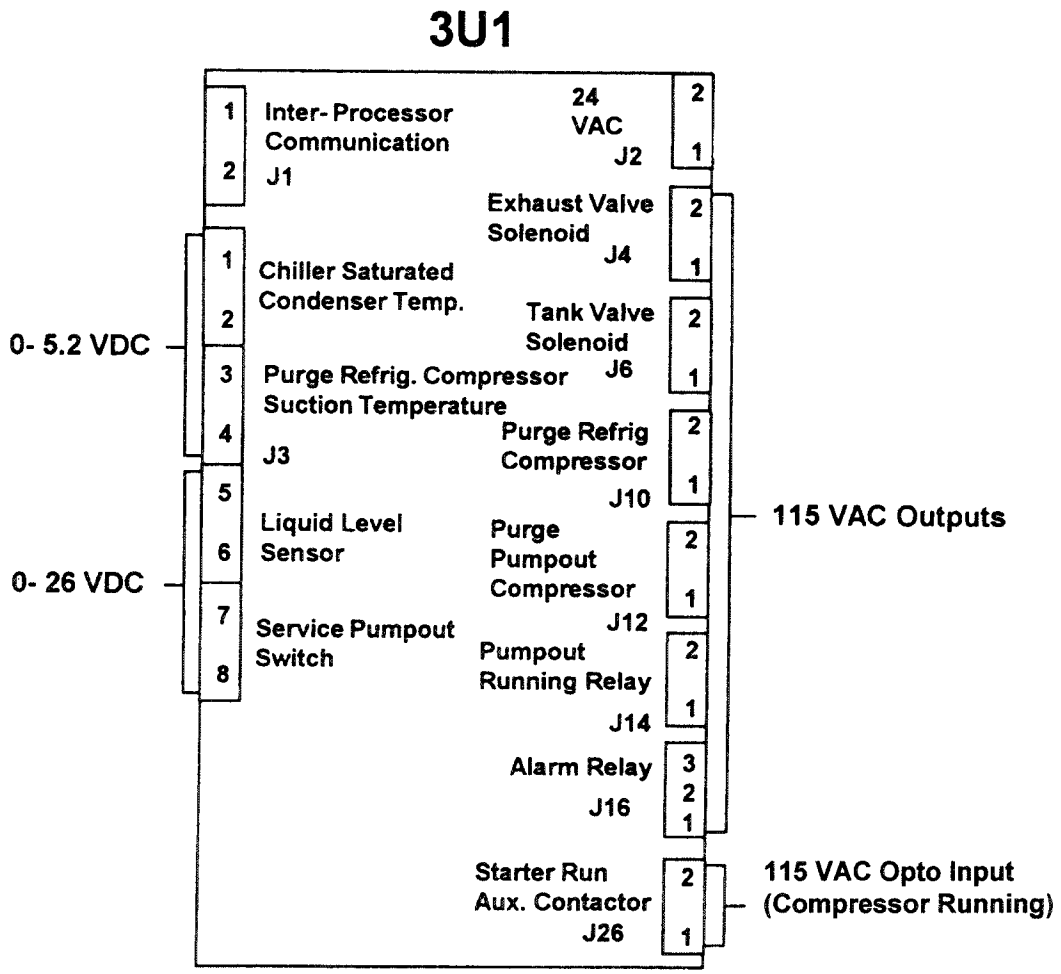
Module Voltages

Purge Module

- The purge module (3U1) is provided with the Trane Model PGRC Purifier Purge on CVHE and CVHF chillers. It is located in the purge control panel at the purge. It provides all inputs and outputs for the UCP2 to control purge operation.
- Low Voltage (<30VAC) Inputs:
- 24 VAC; IPC link to Chiller module
  Purge refrigeration compressor suction temperature;
  Purge tank liquid level sensor
  Service pumpout switch

- High Voltage (>3OVAC) Outputs:
- Exhaust valve solenoid; tank valve solenoid;
  Purge refrigerant compressor purge pumpout compressor;
  Purge pumpout running (Tracer); purge alarm

Figure 6
Purge Module



Module Voltages

Starter Module Values

- The starter module (2U1) is present in all Trane-provided starter panels, whether unit-mounted or remote. For CTV's, if no Trane starter is provided and the customer is providing the starter instead, 2U1 is mounted in an extension of the unit control panel. It is still designated as 2U1.

- 2U1 controls the starter when starting, running and stopping compressor motor and provides an interface to all types of starters and AFD's (adjustable frequency drives).

- 2U1 provides compressor motor protection for running overload, phase reversal, phase loss, phase unbalance and momentary power loss.

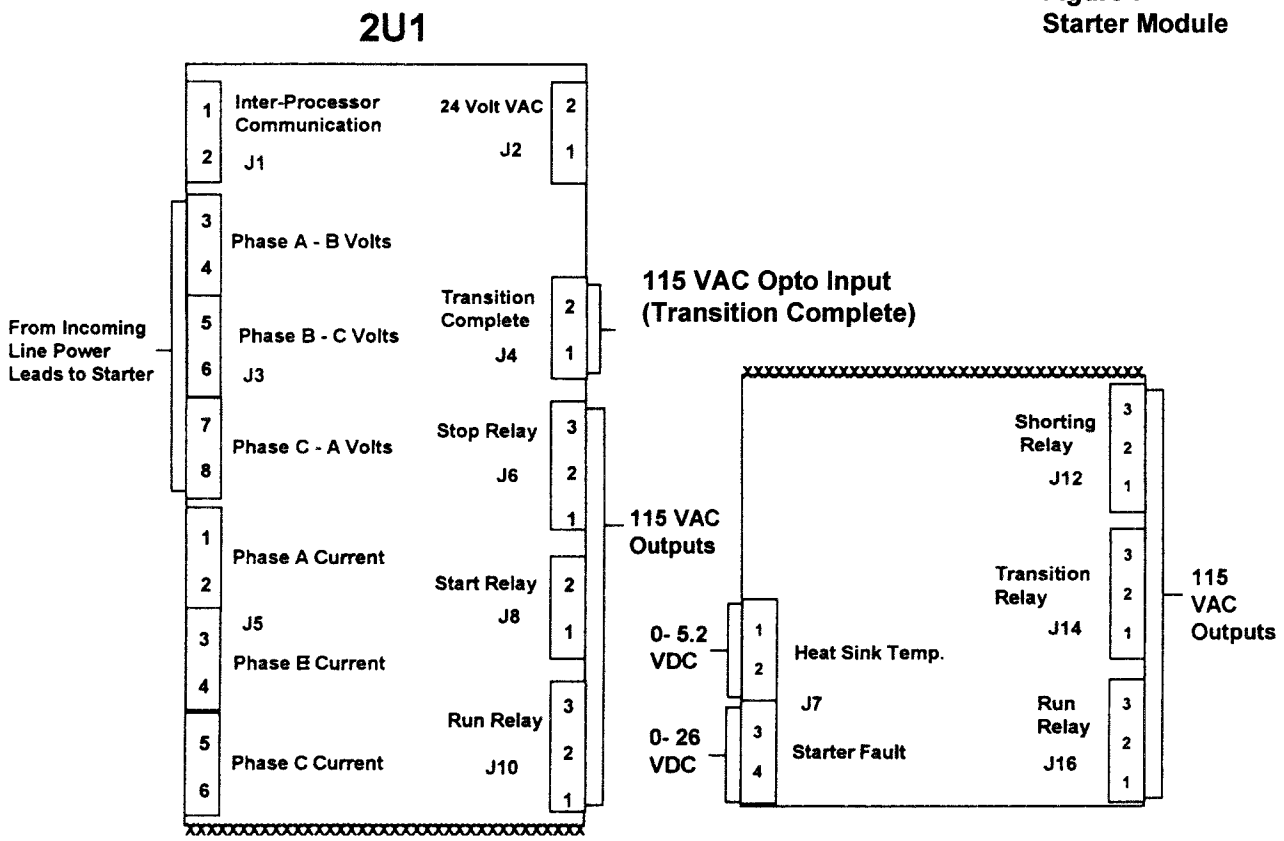
- Low Voltage (<30VAC) Inputs:
  - 24 VAC; IPC link to chiller module; phase voltages (optional); phase currents; solid-state heat sink temperature (optional); starter driver fault.

- Low Voltage (<30VAC) Outputs:
  - Speed signal output (0-10 VDC - optional)

- High Voltage (>30VAC) Inputs:
  - Transition complete (CTV only)

- High Voltage (>30VAC) Outputs:
  - Stop relay; starter relay; run relay; shorting relay; transition relay, shunt trip relay.

Figure 7
Starter Module



Module Voltages

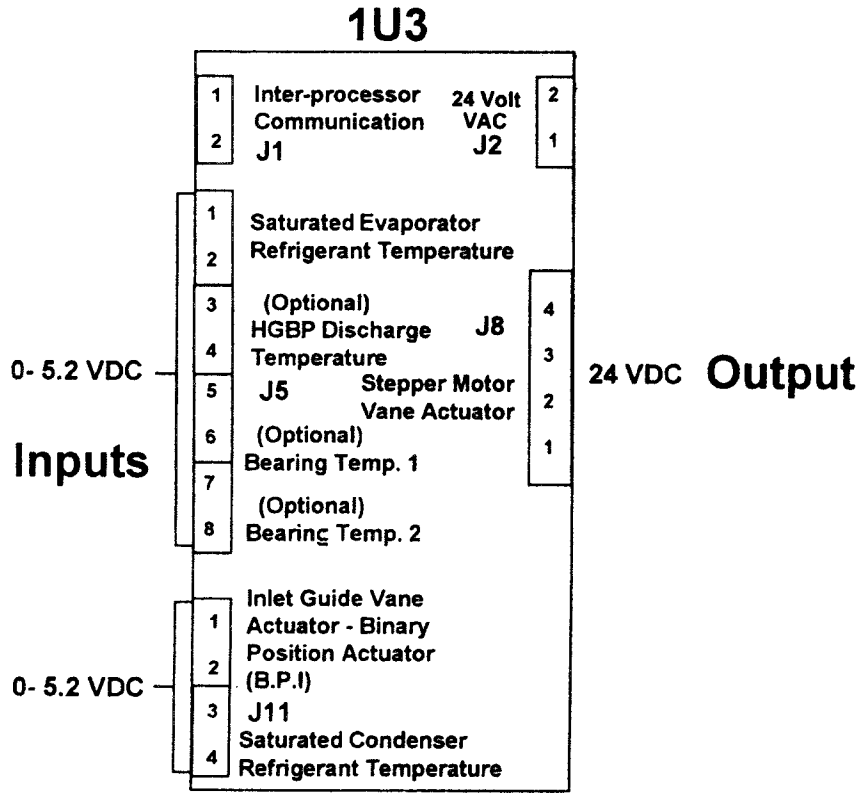
Stepper Module

- The main function of 1U3 is to drive the Inlet Guide Vane Stepper motor (CTV) along with other functions. It does this in response to signals received from Chiller module 1UI.

- Low Voltage (<30VAC) Inputs:
- 24VAC; IPC link;
  Evaporator saturated refrigerant temperature;
  Compressor discharge temperature (optional);
  Bearing temps, 1 and 2;
  Inlet guide vane actuator; Binary position indicator
  Condenser saturated refrigerant temperature;

- Low Voltage, High Amperage (<30VAC) Outputs:
- Vane actuator stepper motor

Figure 8
Stepper Module



Module Dip Switch Settings

UCP2 Board Dip Switch Settings

Several of the UCP2 modules have dip switch settings on them, used to set up the board for 2-10 VDC or 4-20 MA signal inputs and/or outputs of the boards. The following are the various switch settings.

Chiller Module

External Vane Position	Switch	0-10V	4-20MA
	SW2-1	OFF	ON (SW2-2 and SW2-3 are not used)

Options Module

External Current Limit External Chilled Water	Switch	0-10V	4-20MA
	SW2-1	OFF	ON(SW2-2 and SW2-3 are not used).
	SW3-1	OFF	ON (SW3-2 and SW3-3 are not used)

Tracer COM 3

Switch	-1	-2	-3
SW1	OFF	OFF	OFF

Tracer COM 4

Switch	-1	-2	-3
SW1	OFF	ON	OFF

IPC BUFFER

Switch	-1	-2	-3
SW1	OFF	OFF	ON

PRINTER

Switch	-1	-2	-3
SW1	OFF	OFF	ON

Diagnosing A Non-Working Stepper Module

Method to Troubleshoot a UCP2 Stepper Module and Actuator

I. Overview

The UCP2 Stepper Module is used to drive a Stepper Motor, which is used to open and close a valve or actuator. The big difference between a Stepper Motor and other types of motors, is that instead of just making the motor turn, you can control the angular position of the rotor inside the motor, and therefore control the position of your valve or actuator.

The Stepper Motor has two windings inside. To distinguish between the two, we call them Winding 1 and Winding 2. The Stepper Module contains one drive circuit for each winding. Most of the failures you will probably deal with will result in the two internal fuses, Fl and F2, inside the Stepper Module to open. These fuses protect the motor from damage, and are not easily accessible. Replacing these fuses in the field right now is not an acceptable option, because the original fuses have been through some special UL testing. We cannot guarantee safety to the customer if a blown fuse is replaced with another of a different type.

The Stepper Motor three states: Moving, Holding and Off:

1. In the moving state, current flows bi-directionally through each of the two windings. The frequency and amount of current is electronically controlled by the Stepper Module.

2. In the Holding State, current flows one way through each of the two windings. The amount of current is electronically controlled by the Stepper Module.

3. The Off state occurs only when the Stepper Module power is cycled. Until the Stepper receives an order from the Chiller Module to move, no current flows through the Stepper Motor windings.

II. Quick Test of Stepper Board

A. This section will show how to test the main power points of the Stepper Board to get an idea of where the problem is.

   1. If the UCP2 Control Panel is unpowered, unplug the J2 connectors from the Stepper board and continue to Section III to check motor and wiring resistance's.

   2. If the UCP2 Control Panel is powered, measure and compare the Power Input (J2) and the 4 Test Points at the right side of the Stepper board with Table 1.

Diagnosing A Non-Working Stepper Module

Table 1: UCP2 Stepper Module Test Point Voltage Limits

Connector		Vac	Vdc
J2 - (1 to 2) or (3 to 4)		20.4 to 33.12 Vac	=0 Vdc
J2 - (1 to case) or (2 to case)		10 to 17 Vac	13.12 to 21.81 Vdc
TP2: 5V to ground	≅	0 Vac	4.8 to 5.2 Vdc
TP4: 24 V to ground	≅	0 Vac	23.2 to 25.1 Vdc
TP3: 14 V to ground	≅	0 Vac	11.45 to 15.75 Vdc
TP1: 35 V to ground		100 m Vac to 72 m Vac	26 to 48 Vdc

If any of the voltages are out of range, there is a malfunction on the Stepper Board.
The majority of these malfunctions may be diagnosed by using Table 2. The ones marked with a star have been seen in the field before:

Table 2: UCP2 Stepper Module Troubleshooting

Condition(s)	Possible Problem	Possible Cause(s)	(Solution(s)
Voltage at Test Points TP1-TP4 on Stepper Module ≅0. Motor winding resistance check pin to conduit ≅0. Motor does not move.	Wiring between Stepper Module and actuator motor is shorted to ground.	1. Wire insulation bared inside conduit. 2. Wire insulation bared or pinched inside motor junction box.	1. Seal wire or run new wire through conduit. 2. Seal wire, or restrip and rewire motor junction box. See Table 4 for wiring diagram.

Diagnosing A Non-Working Stepper Module

Continuation of Table 2: UCP2 Stepper Module Troubleshooting

Condition(s)	Possible Problem	Possible Cause(s)	Solution(s)
Voltage at Test Points TP1-TP4 on Stepper Module ≅0. Motor winding restance check pin to pin fails. Motor does not move.	Wiring shorted together inside conduit between Stepper Module and actuator motor.	Insulation bared.	Seal wire or run new wire through conduit. See Table 4 for wiring diagram.
	Wiring shorted together at board edge connector J6 or J8	*1. metal shavings from drilling into UCP2 Panel form bridge. 2. Loose wire strands form bridge.	1. Inspect J6 and J8 connectors. Remove any metal shavings bridging the wires before powering module. 2. Restrip and rewire the board edge connector.
	Wires shorted together inside motor junction box.	Insulation bared.	Seal wire or run new wire through conduit. See Table 4 for wiring diagram.
Stepper Module TP1 - TP4 OK. Motor winding resistance check OK. Motor does not move.	Motor does not move and steps display does not change on CLD when using manual vane control.	UCP2 is not in Stop Mode and Chiller Module is overriding manual vane control.	Hit stop button on CLD, and try again.

Diagnosing A Non-Working Stepper Module

Continuation of Table 2: UCP2 Stepper Module Troubleshooting

Condition(s)	Possible Problem	Possible Cause(s)	Solution(s)
Stepper Module TP1 - TP4 OK. Motor winding resistance check OK. Motor runs backward.	Motor runs backwards.	Motor is miswired.	Unplug the motor connector (J6 or J8) from the Stepper Module. Use Table 3 and Table 4 to swap wire pairs (1, 3) or (2, 4) so that the motor is wired properly.
Stepper Module TP1 - TP4 OK. Motor winding resistance check of W1 or W2 open circuit. CLD shows steps are changing in manual mode. Motor does not move.	1. Open circuit in wiring to motor. 2. Open in one or both of the two actuator windings.	*1. Loose or disconnected wireat J6 or J8 connector, or at Motor terminal. 2. Wiring from Stepper to Motor is open-circuited. 3. Winding 1 or 2 open inside motor.	1. Check wiring with Table 4. Reconnect any loose wires. 2. Check wiring with Table 4. Replace any open wires. 3. Replace motor.

III. Check Stepper Motor and Wiring for Shorts and Opens

A. During this stage, motor winding and wire resistance's will be measured to ensure proper continuity.

1. If the unit is powered, hit the stop button on the CLD and use manual mode in the service tools menu to step the actuators all the way to position 0.

2. Unplug power (J2 connector) from the Stepper Module.

3. Unplug J6 and J8 from the board.

4. Measure the DC resistance of one of the motor windings by measuring between what would be Pin (1,3) or Pin (2,4) on the Stepper Board at the unplugged connector (See Table 3).

5. If the resistance is lower than the limits in Table 3 there is a short in the wiring between the Stepper Module and the motor or the in motor winding. Note that nominal values are not including wire resistance's.

6. If the resistance is higher than the limits in Table 3 the wiring between the Stepper Module and the motor or a winding is open. Note that nominal values are not including wire resistance's.

Table 3: Motor Winding Resistance

J6 or J8 Connector Pin	Acceptable DC Resistance Range	CTV Nominal Resistance
(4 to 3)	Open Circuit	NA
(4 to 2): W1	50 mOhm to 5 Ohm	1.68 Ohm
(4 to 1)	Open Circuit	N/A
(3 to 2)	Open Circuit	N/A
(3 to 1): W2	50 mOhm to 5 Ohm	1.68 Ohm
(2 to 1)	Open Circuit	N/A
(4 to conduit)	Open Circuit	N/A
(3 to conduit)	Open Circuit	N/A
(2 to conduit)	Open Circuit	N/A
(1 to conduit)	Open Circuit	N/A

7. If the winding resistance is in the range, plug the j connector back into the appropriate socket.

8. Perform steps 3-7 for each winding of the motor on the Stepper Module.

9. If there is a short or an open, you will need to check the wiring to the motor, and then check the motor.

10. If the windings resistance check passes, and you have not measured the Stepper Module voltages while it is powered, then plug J2 back into the module and go back to Section II, Quick Test of Stepper Board.

B. If you need to disconnect the wires going to the motor for any reason, Table 4 is a wiring table you can use to reconnect them.

Table 4: Stepper Motor Connections

J6 or J8 Connector Pin# on Stepper	Motor Winding Output Signal Name	Stepper Motor Terminal Connection
4	1+	3
3	2+	5
2	1-	1
1	2-	4

IV. Motor Voltages for CTV Stepper Motor

A. With the motor connector J6 (or J8) connected to the Stepper Board, and the Stepper powered, measure the AC and DC voltages of the connector pins, and compare to Table 5 and 6.

Table 5: Motor Voltages with Actuator Holding

Connector Pin	AC Voltage	DC Voltage
J6 - (4 to 3)	≅ 0 or (5.8 - 10)	- 400 m V to +400 m V
J6 - (4 to 2)	5.8 - 8.2	≅ ± 400 m V, but not 0 m V
J6 - (3 to 1)	≅ 0 or (5.8 - 10)	- 400 m V to +400 m V
J6 - (3 to 2)	≅ 0 or (5.8 - 10)	- 400 m V to +400 m V
J6 - (3 to 1)	5.8 to 8.2	≅ ± 400 m V, but not 0 m V
J6 - (2 to 1)	≅ 0 or (5.8 - 10)	- 400 m V to +400 m V
J6 - (4 to conduit)	≅ 0 or (5.8 - 8)	(0.3 - 0.43) or (1.04 - 1.135)
J6 - (3 to conduit)	≅ 0 or (5.8 - 8)	(0.3 - 0.43) or (1.04 - 1.135)
J6 - (2 to conduit)	≅ 0 or (5.8 - 8)	(0.3 - 0.43) or (1.04 - 1.135)
J6 - (1 to conduit)	≅ 0 or (5.8 - 8)	(0.3 - 0.43) or (1.04 - 1.135)

Table 6: Motor Voltages with Actuator Moving

Connector Pin	AC Voltage	DC Voltage
J6 - (4 to 3)	(16.6 - 25.9)	-720 m V to +720 m V
J6 - (4 to 2)	(20.8 - 27.5)	-720 m V to +720 m V
J6 - (4 to 1)	16.6 - 25.9)	-720 m V to +720 m V
J6 - (3 to 2)	16.6 - 25.9)	-720 m V to +720 m V
J6 - (3 to 1)	20.8 - 27.5)	-720 m V to +720 m V
J6 - (2 to 1)	(16.6 - 25.9)	-720 m V to +720 m V
J6 - (4 to conduit)	(11.4 - 17.3)	(9.1 - 10.1)
J6 - (4 to conduit)	(11.4 - 17.3)	(9.1 - 10.1)
J6 - (4 to conduit)	(11.4 - 17.3)	(9.1 - 10.1)
J6 - (4 to conduit)	(11.4 - 17.3)	(9.1 - 10.1)

Module Set-Up Procedures For:

External Current Limit Setpoint

- Option Module J7-11, -12 (-, +)

- Isolated 2-10 Vdc or 4-20 ma

- UCP2 shall accept either a 2-10 Vdc or 4-20 ma analog input suitable for customer connection to set the unit external current limit setpoint. 2-10 Vdc and 4-20 ma shall each correspond to a 40 to 120% RLA range. CTV UCP2 will limit the maximum ECLS to 100%.

- The following must be "Set".

1. SW2-1 OFF for 2-10 Vdc
   ON for 4-20 ma
2. Current Limit Setpoint Source: External Source

3. External Current Limit Setpoint: Installed

4. External Setpoint Inputs: 2-10 Vdc or 4-20 ma.

Module Set-Up Procedures For:

Refrigerant Monitor Input

- Analog type input
  4-20ma input signal to the Circuit module J5-5 and J5-6. This represents 0-100 ppm.
  Under machine configuration "Refrigerant Monitor Type" is '01' for Analog.
  Typical input if using an RMWC generation Monitor.

- IPC Monitor (Requires RMWD monitor with Version 2 Software)
  Direct communication to the CLD via the IPC.
  Under Machine Configuration "Refrigerant Monitor Type" is '02' for IPC Monitor.
  Also allows monitor calibration and setup. Please note that the monitor cannot have a local display and communicate with the UCP2. If the customer requires a local display, he can connect an RMWD style monitor up like an analog type previously described.

Load Indication Output

- Options Module J7-3,-4

- 2-10 Vdc

- As an option, the UCM shall provide a 0-10 Vdc analog output to indicate % RLA. The transfer function shall be 2 to 10 Vdc corresponding to 0 to 120% RLA.

Module Set-Up Procedures For:

External Chilled Water Setpoint

GENERIC INTERFACE, ALLOWS THE CUSTOMER TO CHANGE THE CHILLED WATER SETPOINT FROM A REMOTE LOCATION.

UCP2 SHALL ACCEPT EITHER A 2-10 VDC OR 4-20 MA ISOLATED ANALOG INPUT SUITABLE FOR CUSTOMER CONNECTION TO SET THE UNIT LEAVING CHILLED WATER SETPOINT. THE 2-10 VDC AND
4-20 MA ANALOG INPUT EACH CORRESPONDS TO A 0 TO 65 F (- 17.8 TO 18.3 C) CWS RANGE.
SEE LINEAR RELATIONSHIP ON CHART.

THE ISOLATED ANALOG INPUT SHOULD BE CONNECTED AT THE J9 PLUG, PINS 4 (NEG) AND 5 (POS) ON THE OPTIONS MODULE.

THE FOLLOWING ITEMS NEED TO BE "SET".

1. SW3-1 OFF FOR 2-10 VDC.
   ON FOR 4-20 MA.

2. CHILLED WATER RESET TYPE:
   DISABLE - OPERATOR SETTINGS GROUP

3. CHILLED WATER SETPOINT SOURCE :
   EXTERNAL - OPERATOR SETTINS GROUP

4. SETPOINT SOURCE OVERRIDE :
   NONE - OPERATOR SETTINGS GROUP

5. EXTERNAL CHILLED WATER SETPOINT :
   INSTALLED - SERVICE SETTINGS GROUP
   - MACHINE CONFIGURATION

4-20 MA	2-10 VDC	°F	C°
20	10	65.00	18.33
19.75		63.98	17.77
19.5	9.75	62.97	17.20
19.25		61.95	16.64
19	9.5	60.94	16.08
18.75		59.92	15.51
18.5	9.25	58.91	14.95
18.25		57.89	14.38
18	9	56.88	13.82
17.75		55.86	13.26
17.5	8.75	54.84	12.69
17.25		53.83	12.13
17	8.5	52.81	11.56
16.75		51.80	11.00
16.5	8.25	50.78	10.43
16.25		49.77	9.87
16	8	48.75	9.31
15.75		47.73	8.74
15.5	7.75	46.72	8.18
15.25		45.70	7.61
15	7.5	44.69	7.05
14.75		43.67	6.48
14.5	7.25	42.66	5.92
14.25		41.64	5.36
14	7	40.63	4.79
13.75		39.61	4.23
13.5	6.75	38.59	3.66
13.25		37.58	3.10
13	6.5	36.56	2.53
12.75		35.55	1.97
12.5	6.25	34.53	1.41
12.25		33.52	0.84
12	6	32.50	0.28
11.75		31.48	-0.29
11.5	5.75	30.47	-0.85
11.25		29.45	-1.41
11	5.5	28.44	-1.98
10.75		27.42	-2.54
10.5	5.25	26.41	-3.11
10.25		25.39	-3.67
10	5	24.38	-4.24
9.75		23.36	-4.80
9.5	4.75	22.34	-5.36
9.25		21.33	-5.93
9	4.5	20.31	-6.49
8.75		19.30	-7.06
8.5	4.25	18.28	-7.62
8.25		17.27	-8.19
8	4	16.25	-8.75
7.75		15.23	-9.31
7.5	3.75	14.22	-9.88
7.25		13.20	-10.44
7	3.5	12.19	-11.01
6.75		11.17	-11.57
6.5	3.25	10.16	-12.14
6.25		9.14	-12.70
6	3	8.13	-13.26
5.75		7.11	-13.83
5.5	2.75	6.09	-14.39
5.25		5.08	-14.96
5	2.5	4.06	-15.52
4.75		3.05	-16.09
4.5	2.25	2.03	-16.65
4.25		1.02	-17.21
4	2	0.00	-17.78

Analog Input Table Abbreviations

The information below is an explanation of abbreviations used in Analog Input Tables which are shown in this section.

-- Oil Pressures

-- Water Pressures

A1: Entering and Leaving Evap Temp.
Purge Compressor Suction Temp.

A2: Oil Temp.
Entering and Leaving Condenser
Aux HR Entering and Leaving Temp.
Compressor Discharge Ref Temp.
Bearing Temps 1 and 2
Saturated Cond. Refrigerant Temp.
Outdoor Air Temperature.

A4: Saturated Evap Temp.

A6: Compressor Motor Winding Temp 75 Ohm

Note: A1, A2 and A4 are the same sensor.

Note:

1. Min. Res. and Max. Res. = Minimum and Maximum Resistance in Ohms.
2. Min Vterm. and Max. Vterm = Minimum and Maximum DC Voltage measure at the appropriate module terminal.

Table 7: Pressure vs Voltage for Oil Pressures

Oil Pressure (PSIG)	Differential Voltage (DC)		
	Min	Nom	Max
-15	-0.0017	0.0000	0.0017
-10	0.0033	0.0050	0.0067
-5	0.0083	0.0100	0.0117
-4	0.0093	0.0110	0.0127
-3	0.0103	0.0120	0.0137
-2	0.0113	0.0130	0.0147
-1	0.0122	0.0140	0.0158
0	0.0132	0.0150	0.0168
1	0.0142	0.0160	0.0178
2	0.0151	0.0170	0.0189
3	0.0161	0.0180	0.0199
4	0.0171	0.0190	0.0209
5	0.0180	0.0200	0.0220
6	0.0190	0.0210	0.0230
7	0.0199	0.0220	0.0241
8	0.0209	0.0230	0.0251
9	0.0218	0.0240	0.0262
10	0.0228	0.0250	0.0272
11	0.0237	0.0260	0.0283
12	0.0247	0.0270	0.0293
13	0.0256	0.0280	0.0304
14	0.0266	0.0290	0.0314
15	0.0275	0.0300	0.0325
16	0.0285	0.0310	0.0335
17	0.0294	0.0320	0.0346
18	0.0303	0.0330	0.0357
19	0.0313	0.0340	0.0367
20	0.0322	0.0350	0.0378
25	0.0369	0.0400	0.0431
30	0.0417	0.0450	0.0483
35	0.0464	0.0500	0.0536

Voltages and Resistances of Oil Pressure Input Terminals			
	Min	Nom	Max
+5v to GND	4.75	5.0	5.25
V- to GND	1.6	2.0	2.5
V+ to GND	1.6	2.0	2.5

Table 8: Pressure vs Voltage for Water Pressures

Voltages and Resistances of Water Pressure Transducers Input Terminals			
	Min	**Nom**	**Max**
+5V to GND	4.75	5.0	5.25
V- to GND	1.6	2.0	2.5
V+ to GND	1.6	2.0	2.5

Water Pressure (PSIG)	**Nom**
0	0.0000
1	0.0003
2	0.0007
3	0.0010
4	0.0013
5	0.0017
6	0.0020
7	0.0023
8	0.0027
9	0.0030
10	0.0033
11	0.0037
12	0.0040
13	0.0043
14	0.0047
15	0.0050
16	0.0053
17	0.0057
18	0.0060
19	0.0063
20	0.0067
21	0.0070
22	0.0073
23	0.0077
24	0.0080
25	0.0083
26	0.0087
27	0.0090
28	0.0093
29	0.0097
30	0.0100
31	0.0103
32	0.0107
33	0.0110
34	0.0113
35	0.0117
36	0.0120
37	0.0123
38	0.0127
39	0.0130
40	0.0133
41	0.0137
42	0.0140
43	0.0143
44	0.0147
45	0.0150
46	0.0153
47	0.0157
48	0.0160
49	0.0163
50	0.0167

Table 8: Pressure vs Voltage for Water Pressures

Water Pressure (PSIG)	Nom
51	0.0170
52	0.0173
53	0.0177
54	0.0180
55	0.0183
56	0.0187
57	0.0190
58	0.0193
59	0.0197
60	0.0200
61	0.0203
62	0.0207
63	0.0210
64	0.0213
65	0.0217
66	0.0220
67	0.0223
68	0.0227
69	0.0230
70	0.0233
71	0.0237
72	0.0240
73	0.0243
74	0.0247
75	0.0250
76	0.0253
77	0.0257
78	0.0260
79	0.0263
80	0.0267
81	0.0270
82	0.0273
83	0.0277
84	0.0280
85	0.0283
86	0.0287
87	0.0290
88	0.0293
89	0.0297
90	0.0300
91	0.0303
92	0.0307
93	0.0310
94	0.0313
95	0.0317
96	0.0320
97	0.0323
98	0.0327
99	0.0330
100	0.0333
101	0.0337
102	0.0340
103	0.0343
104	0.0347
105	0.0350

Table 8: Pressure vs Voltage for Water Pressures

Water Pressure (PSIG)	Nominal
106	0.0353
107	0.0357
108	0.0360
109	0.0363
110	0.0367
111	0.0370
112	0.0373
113	0.0377
114	0.0380
115	0.0383
116	0.0387
117	0.0390
118	0.0393
119	0.0397
120	0.0400
121	0.0403
122	0.0407
123	0.0410
124	0.0413
125	0.0417
126	0.0420
127	0.0423
128	0.0427
129	0.0430
130	0.0433
131	0.0437
132	0.0440
133	0.0443
134	0.0447
135	0.0450
136	0.0453
137	0.0457
138	0.0460
139	0.0463
140	0.0467
141	0.0470
142	0.0473
143	0.0477
144	0.0480
145	0.0483
146	0.0487
147	0.0490
148	0.0493
149	0.0497
150	0.0500

Voltages and Resistances of Pressure Input Terminals			
	Min	Nom	Max
+5V to GND	4.75	5.0	5.25
V- to GND	1.6	2.0	2.5
V+ to GND	1.6	2.0	2.5

Water Pressure			
Rin	420	470	520
Rout	600	900	1.2K

Table 9: Purge Compressor Suction Temp.

A1 Analog Input
Thermistor Accuracy = 0.54 ° F from -14 to 79 ° F
Type U Thermistor Temperature Versus Resistance and Terminal Voltage Table for a pullup resistor of 24900 Ohms.
Used to sense temperatures at the following point:
1. Purge Compressor Suction Temp. - CVHE/F/G

Temp F	Min Res	Max Res	Min Vterm	Max Vterm
-10.0	119172	123480	4.115	4.145
-5.0	101107	104703	3.992	4.024
-4.0	97868	101337	3.966	3.999
-3.0	94743	98090	3.940	3.973
-2.0	91726	94957	3.913	3.946
-1.0	88816	91934	3.886	3.920
0.0	86006	89016	3.858	3.893
1.0	83293	86199	3.830	3.865
2.0	80675	83480	3.802	3.837
3.0	78146	80855	3.773	3.809
4.0	75705	78320	3.743	3.780
5.0	73347	75873	3.714	3.751
10.0	62706	64832	3.560	3.600
15.0	53738	55532	3.399	3.441
16.0	52119	53854	3.366	3.408
17.0	50554	52231	3.332	3.375
18.0	49040	50663	3.299	3.341
19.0	47577	49145	3.265	3.308
20.0	46161	47678	3.231	3.274
25.0	39742	41029	3.058	3.102
30.0	34292	35386	2.881	2.926
35.0	29713	30628	2.705	2.750
40.0	25830	26611	2.532	2.577
45.0	22512	23180	2.361	2.405
50.0	19668	20242	2.194	2.237
55.0	17225	17718	2.033	2.075
60.0	15120	15546	1.879	1.919
65.0	13303	13670	1.731	1.770
70.0	11729	12048	1.592	1.629
75.0	10364	10641	1.462	1.496

Table 10: Evap. Entering and Leaving Water Temp.

A1 Analog Input
Thermistor Accuracy = 0.54 ° F from 15 to 140 ° F
Type U Thermistor Temperature Versus Resistance and Terminal Voltage Table for a pullup resistor of 24900 Ohms.
Used to sense temperatures at the following point:
1. Evap. Entering and Leaving Water Temp. Pair - CVHE/F/G

Temp F	Min Res	Max Res	Min Vterm	Max Vterm
15.0	53738	55532	3.399	3.441
20.0	46161	47678	3.231	3.274
21.0	44791	46259	3.196	3.240
22.0	43466	44886	3.162	3.206
23.0	42183	43558	3.127	3.171
24.0	40943	42273	3.092	3.137
25.0	39742	41029	3.058	3.102
26.0	38580	39826	3.022	3.067
27.0	37455	38661	2.987	3.032
28.0	36367	37534	2.952	2.997
29.0	35312	36442	2.916	2.962
30.0	34292	35386	2.881	2.926
31.0	33304	34363	2.845	2.891
32.0	32358	33365	2.810	2.855
33.0	31448	32423	2.775	2.820
34.0	30566	31511	2.740	2.785
35.0	29713	30628	2.705	2.750
36.0	28886	29773	2.671	2.715
37.0	28086	28944	2.636	2.681
38.0	27310	28142	2.601	2.646
39.0	26559	27364	2.566	2.611
40.0	25830	26611	2.532	2.577
41.0	25125	25881	2.497	2.542
42.0	24441	25174	2.463	2.508
43.0	23778	24489	2.429	2.473
44.0	23135	23824	2.395	2.439
45.0	22512	23180	2.361	2.405
46.0	21908	22556	2.327	2.371
47.0	21322	21950	2.294	2.337
48.0	20754	21363	2.260	2.304
49.0	20203	20794	2.227	2.270
50.0	19668	20242	2.194	2.237
55.0	17225	17718	2.033	2.075
60.0	15120	15546	1.879	1.919
65.0	13303	13670	1.731	1.770
70.0	11729	12048	1.592	1.629
75.0	10364	10641	1.462	1.496
80.0	9177	9418	1.339	1.372

Table 11: Saturated Cond. Refrigerant Temp.

A2 Analog Input
Thermistor Accuracy = 0.54 ° F from 15 to 140 ° F
Type U Thermistor Temperature Versus Resistance and Terminal Voltage Table for a pullup resistor of 6980 Ohms.
Saturated Cond. Refrigerant Temp - CVHE/F/G

Temp F	Min Res	Max Res	Min Vterm	Max Vterm
15.0	53738	55532	4.416	4.435
17.0	50554	52231	4.384	4.404
19.0	47577	49145	4.350	4.372
21.0	44791	46259	4.316	4.338
23.0	42183	43558	4.280	4.303
25.0	39742	41029	4.242	4.266
27.0	37455	38661	4.204	4.228
29.0	35312	36442	4.163	4.189
31.0	33304	34363	4.122	4.149
33.0	31448	32423	4.080	4.107
35.0	29713	30628	4.037	4.065
37.0	28086	28944	3.992	4.021
39.0	26559	27364	3.946	3.976
41.0	25125	25881	3.900	3.930
43.0	23778	24489	3.852	3.883
45.0	22512	23180	3.803	3.835
47.0	21322	21950	3.752	3.785
49.0	20203	20794	3.701	3.735
51.0	19150	19706	3.649	3.684
53.0	18158	18682	3.596	3.631
55.0	17225	17718	3.542	3.578
57.0	16346	16810	3.488	3.524
59.0	15517	15955	3.432	3.469
61.0	14735	15148	3.376	3.413
63.0	13998	14388	3.319	3.357
65.0	13303	13670	3.262	3.300
67.0	12646	12993	3.204	3.243
69.0	12026	12354	3.146	3.185
71.0	11441	11750	3.088	3.127
73.0	10887	11180	3.029	3.068
75.0	10364	10641	2.970	3.010
77.0	9870	10131	2.911	2.951
79.0	9402	9649	2.851	2.891
81.0	8959	9193	2.792	2.832
83.0	8539	8761	2.733	2.773
85.0	8142	8353	2.674	2.714
87.0	7766	7965	2.615	2.655
89.0	7410	7599	2.557	2.597
90.0	7239	7422	2.528	2.567

Table 11: Saturated Cond. Refrigerant Temp.

Temp F	Min Res	Max Res	Min Vterm	Max Vterm
91.0	7072	7251	2.498	2.538
92.0	6910	7084	2.470	2.509
93.0	6751	6921	2.441	2.480
94.0	6597	6763	2.412	2.452
95.0	6447	6608	2.383	2.423
96.0	6301	6458	2.355	2.394
97.0	6159	6312	2.326	2.366
98.0	6020	6169	2.298	2.337
99.0	5885	6030	2.270	2.309
100.0	5754	5895	2.242	2.281
101.0	5625	5763	2.214	2.253
102.0	5500	5634	2.187	2.225
103.0	5378	5509	2.159	2.198
104.0	5260	5387	2.132	2.170
105.0	5144	5268	2.105	2.143
107.0	4921	5039	2.051	2.089
109.0	4709	4821	1.999	2.036
111.0	4507	4614	1.946	1.983
113.0	4315	4417	1.895	1.931
115.0	4133	4230	1.845	1.880
117.0	3959	4051	1.795	1.830
119.0	3794	3882	1.747	1.781
121.0	3636	3720	1.699	1.733
123.0	3487	3566	1.653	1.686

Table 12: Bearing Temp., Oil Temp. and Compressor Discharge Temp.

A2 Analog Input
Thermistor Accuracy = 3.24 ° F from 32 to 100 ° F.
Thermistor Accuracy = 0.72 ° F from 100 to 201 ° F.
Type U Thermistor Temperature Versus Resistance and Terminal Voltage Table for a pullup resistor of 6980 Ohms.

Used to sense temperatures at the following points:
1. Bearing #1 Temp - CVHE/F/G
2. Bearing #2 Temp - CVHE/F/G
3. Oil Temp - CVHE/F/G
4. Compressor Discharge Temp - CVHE/F/G

Temp F	Min Res	Max Res	Min Vterm	Max Vterm
90.0	6798	7862	2.453	2.642
91.0	6643	7679	2.424	2.613
92.0	6492	7501	2.395	2.583
93.0	6345	7328	2.367	2.554
94.0	6201	7159	2.338	2.525
95.0	6062	6994	2.310	2.496
96.0	5925	6834	2.282	2.467
97.0	5793	6678	2.254	2.438
98.0	5663	6526	2.226	2.409
99.0	5537	6378	2.199	2.381
100.0	5730	5918	2.238	2.285
101.0	5603	5786	2.210	2.257
102.0	5478	5657	2.183	2.229
103.0	5357	5531	2.155	2.202
104.0	5238	5408	2.128	2.174
105.0	5123	5289	2.101	2.147
106.0	5011	5172	2.074	2.120
107.0	4901	5058	2.048	2.093
108.0	4794	4948	2.021	2.066
109.0	4690	4840	1.995	2.039
110.0	4589	4734	1.969	2.013
111.0	4490	4632	1.943	1.987
112.0	4393	4532	1.917	1.961
113.0	4299	4434	1.892	1.935
114.0	4207	4339	1.866	1.909
115.0	4117	4246	1.841	1.884
116.0	4029	4155	1.816	1.859
117.0	3944	4067	1.792	1.834
118.0	3861	3980	1.767	1.809
119.0	3779	3896	1.743	1.785
120.0	3700	3814	1.719	1.760

Table 12: Bearing Temp., Oil Temp. and Compressor Discharge Temp.

Temp F	Min Res	Max Res	Min Vterm	Max Vterm
121.0	3623	3734	1.696	1.736
122.0	3547	3655	1.672	1.712
123.0	3474	3579	1.649	1.689
124.0	3402	3505	1.626	1.666
125.0	3332	3433	1.604	1.643
126.0	3264	3362	1.581	1.620
127.0	3197	3293	1.559	1.598
128.0	3132	3226	1.537	1.575
129.0	3069	3160	1.516	1.553
130.0	3006	3096	1.494	1.531
131.0	2946	3033	1.473	1.510
132.0	2886	2971	1.452	1.488
133.0	2828	2912	1.431	1.467
134.0	2772	2853	1.411	1.447
135.0	2716	2796	1.391	1.426
136.0	2662	2740	1.371	1.406
137.0	2610	2685	1.351	1.385
138.0	2558	2632	1.331	1.365
139.0	2508	2580	1.312	1.346
140.0	2458	2529	1.293	1.326
141.0	2410	2479	1.274	1.307
142.0	2363	2431	1.256	1.288
143.0	2317	2383	1.237	1.269
144.0	2272	2336	1.219	1.251
145.0	2228	2291	1.201	1.233
146.0	2185	2246	1.184	1.215
147.0	2143	2203	1.166	1.197
148.0	2101	2160	1.149	1.179
149.0	2061	2119	1.132	1.162
150.0	2022	2078	1.115	1.145
151.0	1983	2039	1.099	1.128
153.0	1909	1962	1.066	1.095
155.0	1837	1888	1.035	1.063
157.0	1769	1818	1.004	1.031
159.0	1704	1750	0.975	1.001
161.0	1641	1685	0.946	0.971
163.0	1581	1624	0.917	0.942
165.0	1524	1564	0.890	0.915
167.0	1468	1508	0.864	0.887
169.0	1416	1453	0.838	0.861
171.0	1365	1401	0.813	0.835

Table 12: Bearing Temp., Oil Temp. and Compressor Discharge Temp.

Temp F	Min Res	Max Res	Min Vterm	Max Vterm
173.0	1316	1351	0.789	0.810
175.0	1270	1303	0.765	0.786
177.0	1225	1257	0.742	0.763
179.0	1182	1213	0.720	0.740
181.0	1141	1170	0.699	0.718
183.0	1102	1130	0.678	0.697
185.0	1064	1091	0.658	0.676
187.0	1027	1053	0.638	0.656
189.0	992	1017	0.619	0.636
191.0	959	983	0.601	0.617
193.0	926	949	0.583	0.599
195.0	895	917	0.565	0.581
197.0	865	887	0.549	0.564
199.0	837	857	0.532	0.547
201.0	809	829	0.517	0.531

Table 13: Auxiliary HR Ent. and Condenser Ent. and Leaving Water Temp.

A2 Analog Input
Thermistor Accuracy = 0.54 ° F from 15 to 140 ° F
Type U Thermistor Temperature Versus Resistance and Terminal Voltage Table for a pullup resistor of 6980 Ohms.
Used to sense temperatures at the following point:
1. Auxiliary HR Entering and Leaving Water Temp. Pair - CVHE/F
2. Condenser Ent. and Leaving Water Temp. Pair - CVHE/F.

Temp F	Min Res	Max Res	Min Vterm	Max Vterm
60.0	15120	15546	3.404	3.441
61.0	14735	15148	3.376	3.413
62.0	14361	14762	3.348	3.385
63.0	13998	14388	3.319	3.357
64.0	13645	14024	3.291	3.329
65.0	13303	13670	3.262	3.300
66.0	12970	13327	3.233	3.272
67.0	12646	12993	3.204	3.243
68.0	12332	12669	3.175	3.214
69.0	12026	12354	3.146	3.185
70.0	11729	12048	3.117	3.156
71.0	11441	11750	3.088	3.127
72.0	11160	11461	3.058	3.098
73.0	10887	11180	3.029	3.068
74.0	10622	10907	2.999	3.039
75.0	10364	10641	2.970	3.010
76.0	10113	10383	2.940	2.980
77.0	9870	10131	2.911	2.951
78.0	9632	9887	2.881	2.921
79.0	9402	9649	2.851	2.891
80.0	9177	9418	2.822	2.862
81.0	8959	9193	2.792	2.832
82.0	8746	8974	2.763	2.803
83.0	8539	8761	2.733	2.773
84.0	8338	8554	2.704	2.744
85.0	8142	8353	2.674	2.714
86.0	7952	8156	2.645	2.685
87.0	7766	7965	2.615	2.655
88.0	7586	7779	2.586	2.626
89.0	7410	7599	2.557	2.597

Table 13: Auxiliary HR Ent. and Condenser Ent. and Leaving Water Temp.

Temp F	Min Res	Max Res	Min Vterm	Max Vterm
90.0	7239	7422	2.528	2.567
91.0	7072	7251	2.498	2.538
92.0	6910	7084	2.470	2.509
93.0	6751	6921	2.441	2.480
94.0	6597	6763	2.412	2.452
95.0	6447	6608	2.383	2.423
96.0	6301	6458	2.355	2.394
97.0	6159	6312	2.326	2.366
98.0	6020	6169	2.298	2.337
99.0	5885	6030	2.270	2.309
100.0	5754	5895	2.242	2.281
101.0	5625	5763	2.214	2.253
102.0	5500	5634	2.187	2.225
103.0	5378	5509	2.159	2.198
104.0	5260	5387	2.132	2.170
105.0	5144	5268	2.105	2.143
106.0	5031	5152	2.078	2.116
107.0	4921	5039	2.051	2.089
108.0	4813	4929	2.025	2.062
109.0	4709	4821	1.999	2.036
110.0	4607	4716	1.972	2.009
111.0	4507	4614	1.946	1.983
112.0	4410	4514	1.921	1.957
113.0	4315	4417	1.895	1.931
114.0	4223	4322	1.870	1.906
115.0	4133	4230	1.845	1.880
116.0	4045	4139	1.820	1.855
117.0	3959	4051	1.795	1.830
118.0	3876	3965	1.771	1.806
119.0	3794	3882	1.747	1.781
120.0	3714	3800	1.723	1.757
121.0	3636	3720	1.699	1.733
122.0	3561	3642	1.676	1.709
123.0	3487	3566	1.653	1.686
124.0	3415	3492	1.630	1.662
125.0	3345	3420	1.607	1.640
126.0	3276	3350	1.585	1.617

Table 13: Auxiliary HR Ent. and Condenser Ent. and Leaving Water Temp.

Temp F	Min Res	Max Res	Min Vterm	Max Vterm
127.0	3209	3281	1.562	1.594
127.0	3209	3281	1.562	1.594
127.0	3209	3281	1.562	1.594
128.0	3144	3214	1.540	1.572
129.0	3080	3148	1.519	1.550
130.0	3017	3084	1.497	1.528
131.0	2956	3022	1.476	1.507
132.0	2897	2961	1.455	1.486
133.0	2839	2901	1.434	1.464
134.0	2782	2843	1.414	1.444
135.0	2726	2786	1.393	1.423
136.0	2672	2730	1.373	1.403
137.0	2619	2676	1.354	1.383
138.0	2567	2623	1.334	1.363
139.0	2517	2571	1.315	1.343
140.0	2467	2520	1.296	1.324

Table 14: Outdoor Air Temp.

A2 Analog Input
Thermistor Accuracy = 0.90 ° F from -10 to 0 ° F
Thermistor Accuracy = 0.54 ° F from 0 to 70 ° F
Thermistor Accuracy = 1.80 ° F from 70 to 150 ° F
Type U Thermistor Temperature Versus Resistance and Terminal Voltage Table for a pullup resistor of 6980 Ohms.
Used to sense temperatures at the following point:
1. Outdoor Air Temp. - CVHE/F/G

Temp F	Min Res	Max Res	Min Vterm	Max Vterm
-10.0	117759	124893	4.713	4.729
-5.0	99928	105882	4.666	4.685
0.0	86006	89016	4.617	4.630
5.0	73347	75873	4.557	4.573
10.0	62706	64832	4.490	4.508
15.0	53738	55532	4.416	4.435
20.0	46161	47678	4.333	4.355
25.0	39742	41029	4.242	4.266
30.0	34292	35386	4.143	4.169
35.0	29713	30628	4.037	4.065
40.0	25830	26611	3.923	3.953
45.0	22512	23180	3.803	3.835
50.0	19668	20242	3.675	3.709
55.0	17225	17718	3.542	3.578
60.0	15120	15546	3.404	3.441
65.0	13303	13670	3.262	3.300
70.0	11367	12410	3.083	3.190
75.0	10049	10956	2.935	3.044
80.0	8903	9692	2.787	2.896
85.0	7903	8592	2.640	2.748
90.0	7029	7632	2.494	2.601
95.0	6264	6792	2.350	2.456
100.0	5592	6056	2.210	2.313
105.0	5002	5410	2.074	2.174
110.0	4482	4841	1.943	2.039
115.0	4022	4340	1.816	1.909
120.0	3616	3897	1.696	1.784
125.0	3259	3506	1.581	1.665
130.0	2941	3161	1.473	1.552
135.0	2658	2854	1.371	1.446
140.0	2406	2581	1.274	1.345
145.0	2181	2337	1.184	1.250
150.0	1980	2120	1.099	1.161

Table 15: Saturated Evap. Refrigerant Temp.

A4 Analog Input
Type U Thermistor Temperature Versus Resistance and Terminal Voltage Table for a pullup resistor of 38300 Ohms.
Used to sense temperatures at the following point:
1. Saturated Evap. Refrigerant Temp. - CVHE/F/G

Temp F	Min Res	Max Res	Min Vterm	Max Vterm
10.0	62706	64832	3.084	3.129
11.0	60788	62843	3.047	3.093
12.0	58935	60921	3.011	3.057
13.0	57144	59063	2.974	3.020
14.0	55412	57268	2.937	2.984
15.0	53738	55532	2.900	2.947
16.0	52119	53854	2.863	2.910
17.0	50554	52231	2.826	2.873
18.0	49040	50663	2.789	2.836
19.0	47577	49145	2.752	2.799
20.0	46161	47678	2.715	2.762
21.0	44791	46259	2.678	2.725
22.0	43466	44886	2.641	2.688
23.0	42183	43558	2.604	2.651
24.0	40943	42273	2.567	2.614
25.0	39742	41029	2.530	2.577
26.0	38580	39826	2.493	2.540
27.0	37455	38661	2.457	2.503
28.0	36367	37534	2.420	2.467
29.0	35312	36442	2.384	2.430
30.0	34292	35386	2.347	2.394
31.0	33304	34363	2.311	2.357
32.0	32358	33365	2.276	2.321
33.0	31448	32423	2.240	2.286
34.0	30566	31511	2.206	2.250
35.0	29713	30628	2.171	2.216
36.0	28886	29773	2.137	2.181
37.0	28086	28944	2.102	2.146
38.0	27310	28142	2.069	2.112
39.0	26559	27364	2.035	2.078

Table 15: Saturated Evap. Refrigerant Temp.

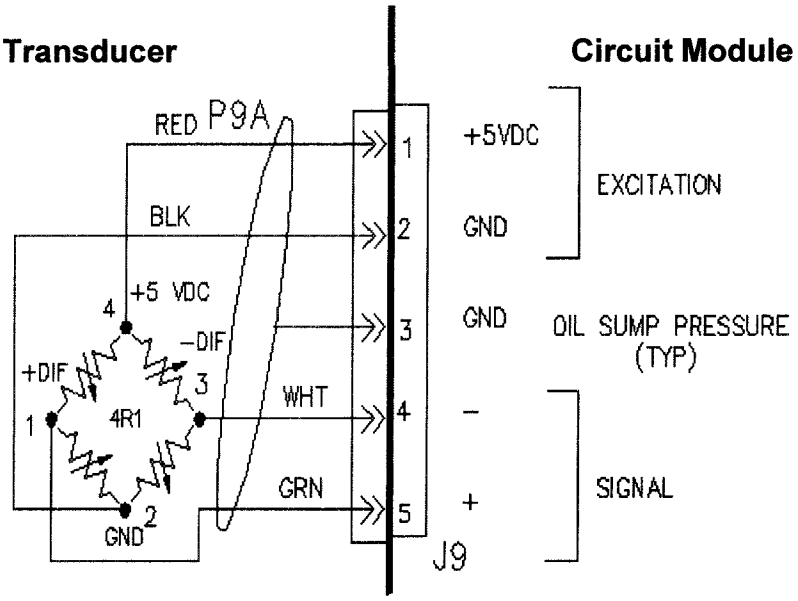
Temp F	Min Res	Max Res	Min Vterm	Max Vterm
40.0	25830	26611	2.002	2.045
41.0	25125	25881	1.969	2.012
42.0	24441	25174	1.936	1.979
43.0	23778	24489	1.904	1.946
44.0	23135	23824	1.872	1.913
45.0	22512	23180	1.840	1.881
46.0	21908	22556	1.809	1.850
47.0	21322	21950	1.778	1.818
48.0	20754	21363	1.747	1.787
49.0	20203	20794	1.717	1.756
50.0	19668	20242	1.687	1.726
51.0	19150	19706	1.657	1.696
52.0	18647	19186	1.628	1.666
53.0	18158	18682	1.599	1.637
54.0	17685	18193	1.570	1.608
55.0	17225	17718	1.542	1.579
56.0	16779	17257	1.515	1.551
57.0	16346	16810	1.487	1.523
58.0	15925	16376	1.460	1.496
59.0	15517	15955	1.434	1.469
60.0	15120	15546	1.407	1.442
65.0	13303	13670	1.282	1.314
70.0	11367	12410	1.140	1.222
75.0	10049	10956	1.036	1.111
80.0	8903	9692	0.940	1.009
85.0	7903	8592	0.853	0.915
90.0	7029	7632	0.773	0.830
95.0	6264	6792	0.701	0.753
100.0	5592	6056	0.635	0.682
105.0	5002	5410	0.576	0.619
110.0	4482	4841	0.523	0.561
115.0	4022	4340	0.474	0.509
120.0	3616	3897	0.430	0.462

Table 16: Compressor Motor Winding Temp.

A6 Analog Input
Motor Winding RTD Temperature Versus Resistance and Terminal Voltage Table for a pullup resistor of 1000 Ohms.
Used to sense temperatures at the following point:
1. Compressor Motor Winding Temp. #1- CVHE/F/G
2. Compressor Motor Winding Temp. #2 CVHE/F/G

Temp F	Nom. Resistance	Nom. Vterm
50.0	70.4616	0.3322
55.0	71.3567	0.3361
60.0	72.2589	0.3400
65.0	73.1679	0.3439
70.0	74.0839	0.3479
75.0	75.0067	0.3519
80.0	75.9363	0.3559
85.0	76.8727	0.3600
90.0	77.8158	0.3640
95.0	78.7656	0.3681
100.0	79.7219	0.3722
105.0	80.6848	0.3763
110.0	81.6542	0.3805
115.0	82.6301	0.3846
120.0	83.6124	0.3888
125.0	84.6011	0.3930
130.0	85.5960	0.3973
135.0	86.5972	0.4015
140.0	87.6047	0.4058
145.0	88.6183	0.4100
150.0	89.6380	0.4143
155.0	90.6638	0.4187
160.0	91.6955	0.4230
165.0	92.7333	0.4273
170.0	93.7770	0.4317
175.0	94.8265	0.4361
180.0	95.8818	0.4405
185.0	96.9430	0.4449
190.0	98.0098	0.4493
195.0	99.0823	0.4538
200.0	100.1604	0.4582
205.0	101.2441	0.4627
210.0	102.3333	0.4672
215.0	103.4280	0.4717
220.0	104.5281	0.4762
225.0	105.6336	0.4807
230.0	106.7444	0.4852
235.0	107.8604	0.4898
240.0	108.9817	0.4944
245.0	110.1082	0.4989
250.0	111.2398	0.5035
255.0	112.3765	0.5081
260.0	113.5182	0.5127
265.0	114.6648	0.5173
270.0	115.8164	0.5220

Transducer
Checkout Procedure



QUICK TEST PROCEDURE FOR MEDIAMATE WATER PRESSURE TRANSDUCER

1. Set regulated power supply to 5 VDC. Connect 5 VDC to Pins 2 and 4 on the Transducer.

2. Check zero balance at ambient pressure by attaching Transducer lead wires of a Digital Volt Meter to Pin 1 and Pin 3 of the Transducer.

Pin 4:	+ Excitation	(Supply)	> Connect 5 VDC Power Supply
Pin 2:	- Excitation	(Supply)	
Pin 1:	+ Signal		> Connect Volt Meter
Pin 3:	- Signal		

(A cable assembly with a mating Hirschmann connector could be made up and used for all tests.)
Allow transducer to stabilize under power (approximately 15 - 30 seconds).

Readings:

1. Transducer used for Condenser Pressure, Oil Discharge Pressure and Oil Sump. Trane Part Number TDR0272. A good Transducer reading is: 15 mV ± 1mV

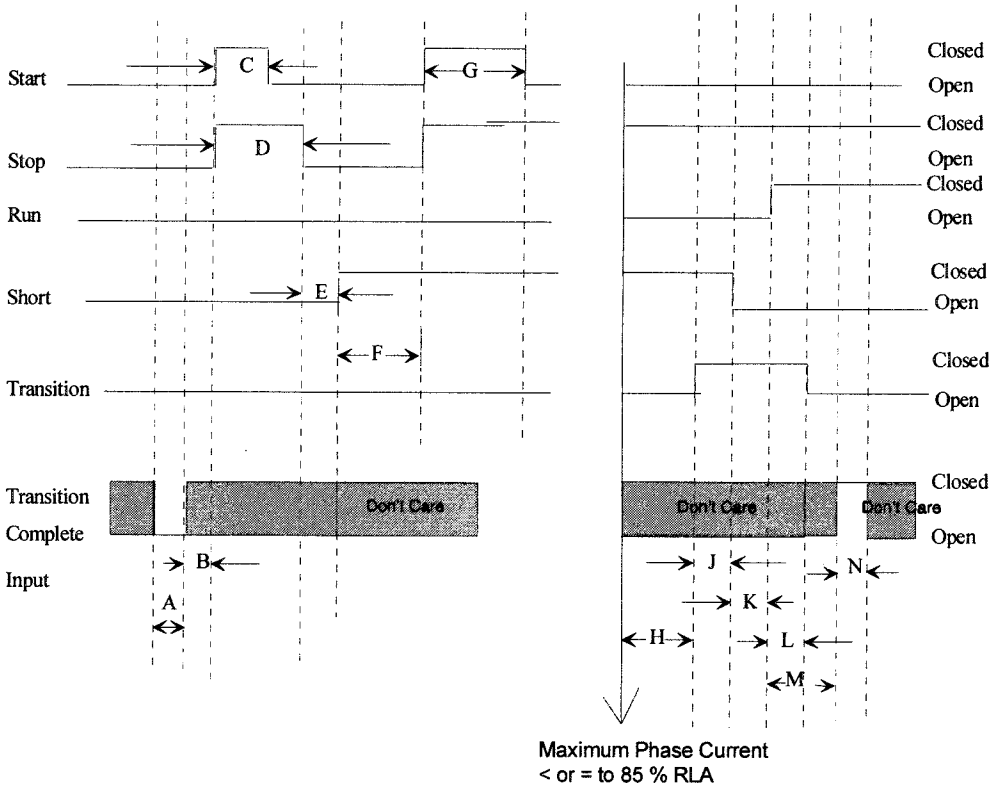
2. Evaporator and Condenser Water Flow Transducer and Part Number TDR0274 A good Transducer reading is: 0 mV ± 1mV.

4. Insert a Q-Tip or small wooden dowel into the pressure port and gently apply force to the diaphragm and watch the DVM for a corresponding change in output.

Starter
Contactor Sequence

Implemented in CTV Upgrade 2, Phase C release X13650453-07

Timing requirements to operate the "Stop", "Start", "Short", "Transition", and "Run" contact closure outputs are shown below. Prior to closing the "Short" contact, the transition complete input shall be verified to be open, otherwise an MMR diagnostic shall be generated.



Interval	Minimum	Maximum	Units	Actual
A. (Test for transition complete input open)				120 to 180 msec
B. (Just delay time)				20 msec
C. Close 1M (2K1) Contactor and test for no current.) (Starter integrity test)				500 msec
D.				1 sec
E. (Open 1M (2K1)				200 msec
F. (Close Shorting Contactor (2K3) and test for no current, then wait for Start command) (Starter integrity test)	100 (1)			1.0 sec (Min.)
G. (Close 1M (2K1))	2.0		sec	2 sec
H. (Wait 1.5 sec after phase currents drop to 85%)	1	2	sec	1.5 sec
J. (Close 2K4 Transition Contactor)	85	100	msec	100 msec
K. (Open S (Shorting) Contactor	250	300	msec	260 msec
L. (Close 2M (2K2) Contactor)				140 msec
M. (Wait to look for Transition complete)	(2)		msec	2.32 to 2.38sec
N. (Filtering time on Transition complete input)	(2)		msec	120 to 180 sec

(1) This timer period must long enough to verify the absence of phase currents caused by the closing of the "Short" contacts.

(2) The sum of intervals M and N are designed to be 2.5 seconds.

Note: The transition complete contact closure is expected to be an auxiliary contact to the "Run Contactor" (2K2).

Starter Module
CT Voltage and Currents

There are two configurations of CT's used. One is the single stage, the other is the dual stage. A different transfer function exists depending on whether a single or dual stage configuration is used. The two configurations appear the same to the UCP2 by normalizing each. Thus a different equation is used to take the actual line current and convert it to a common 'Normalized Line Current' that may be used in Table 19. Note that the 'Terminal Volts' is the AC voltage seen at the current input terminal pairs of the Starter module. These pairs are J5-1,2, J5-3,4 and J5-5,6.

For a single stage CT:

$$\text{Normalized Line Current (\%)} = \frac{\text{Actual Line Current(Amps)*100\%*Primary Turns}}{\text{CT Rated Primary Current (Amps)}}$$

For a two stage CT:

$$\text{Normalized Line Current (\%)} = \frac{\text{Actual Line Current(Amps)*138.89\%*Primary Turns}}{\text{Line CT Rated Primary Current (Amps)}}$$

Table 19 - Current Input Transfer Function

Normalized Line Current %	Terminal Input Current (mA RMS)	Terminal Volts (V RMS) (± 5%)	Normalized Line Current %	Terminal Input Current (mA RMS)	Terminal Volts (V RMS) (± 5%)
0	0	0	115	115	4.23
5	5	1.19	120	120	4.36
10	10	1.37	125	125	4.49
15	15	1.53	130	130	4.62
20	20	1.67	135	135	4.75
25	25	1.81	140	140	4.88
30	30	1.95	145	145	5.02
35	35	2.09	150	150	5.15
40	40	2.23	160	160	5.41
45	45	2.36	170	170	5.67
50	50	2.50	180	180	5.94
55	55	2.63	190	190	6.20
60	60	2.77	200	200	6.46
65	65	2.90	210	210	6.72
70	70	3.03	220	220	6.99
75	75	3.17	230	230	7.25
80	80	3.30	240	240	7.51
85	85	3.43	250	250	7.77
90	90	3.57	260	260	8.03
95	95	3.70	270	270	8.29
100	100	3.83	280	280	8.56
105	105	3.96	290	290	8.82
110	110	4.10	300	300	9.08