TRANE

General Service Bulletin

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Subject:

Control Operation, Setup and Troubleshooting for RTHB Units with UCP2 Controls

Introduction:

The purpose of this bulletin is to provide control operation and general troubleshooting information on the RTHB Liquid Chillers with the UCP2 control panel. Additional information on the UCP2 is located in the RTHB-IOM-1. It is recommended that the service technician be familiar with the UCP2 operation prior to servicing the microprocessor.

Discussion:

This bulletin is intended to serve as a supplement to the RTHB-IOM-1 manual, the operation and maintenance manual for the RTHB 130-450 ton units. Subjects covered in this bulletin are intended to provide more comprehensive information for the RTHB units.

IMPORTANT NOTICE

Effective July 1, 1992, all service operations must use recovery systems to minimize losses of refrigerant to the atmosphere when servicing units with Class I and Class II refrigerants.

Class I (CFC) and Class II (HCFC) refrigerants include CFC-12, HCFC-22, CFC-500, CFC-502, CFC-11, CFC113 and HCFC-123. Deliberate venting is prohibited by Section 608 of the Clean Air Act.

In the normal service of air conditioning systems, there are three major activities mandated by the EPA regulations: recovery, recycling and reclaiming.

1. **Recovery** - the act of removing refrigerant from the air conditioning unit so that losses of refrigerant to the atmosphere are minimized.

Whenever a refrigeration circuit is opened, the recovery of the refrigerant is required. If there is no reason to believe that the refrigerant is “bad”, such as during service of gaskets, expansion valves or solenoid valves, the refrigerant is often returned to the unit without treatment. (Note: Always follow the equipment manufacturers recommendations regarding replacement of unit filter driers during service.)

If there is reason to suspect that the refrigerant is bad, such as with a compressor failure, the refrigerant should either be replaced or recycled,

Recovery is also required when a piece of equipment is decommissioned. This prevents the loss of refrigerant upon disposal of the unit. The recovered refrigerant usually is sold to refrigerant reclaimers rather than reused in the customer's new equipment.

2. **Recycling** - the act of cleaning recovered refrigerant for use in the customer’s equipment.

First, the refrigerant is boiled to separate the oil. Then it is run through a filter drier to separate moisture and acid.

Because of limited field testing capability, the quality and identity of any recycled refrigerant is suspect. For this reason, the EPA will most likely allow recycling of refrigerant only when it is returned to its original owner. Resale of the recycled refrigerant to third parties will not be allowed.

As a result, most servicers will only recycle refrigerant when the quantity of the refrigerant to be recycled and the expertise of the technician make it attractive to do so. Most suspect refrigerant will be sold to a reclaimer rather than be serviced in the field.

3. **Reclaiming** - the act of purifying refrigerant and testing it to ARI 700 “new” refrigerant standards. With reclamation, each batch of refrigerant undergoes extensive laboratory tests and the waste streams are disposed of according to environmental regulations.

Most reclamation will be done at centralized processing facilities because of the testing, waste handling and EPA certification requirements for reclamation. The Trane Company and others offer reclamation services for most refrigerants.

Reclamation is probably the most attractive alternative for users with salvaged and suspect refrigerant.

REFRIGERANT EMISSION CONTROL

Evidence from environmental scientists indicates that the ozone in our upper atmosphere is being reduced, due to the release of CFC fully halogenated compounds.

The Trane Company encourages every effort to eliminate, if possible, or vigorously reduce the emission of CFC, HCFC and HFC refrigerants into the atmosphere that result from installation, operation, routine maintenance, or major services on this equipment. Always act in a responsible manner to conserve refrigerants for continued use, even when acceptable alternatives are available. Conservation and emission reduction can be accomplished by following recommended Trane operation, maintenance and service procedures, with specific attention to the following:

1. Refrigerant used in any type of air conditioning or refrigerating equipment should be recovered for reuse, recovered and/or recycled for reuse, reprocessed (reclaimed), or properly destroyed, whenever it is removed from equipment by an EPA certified Type 11 or Universal Technician. Never release refrigerant into the atmosphere.
2. Always determine possible recycle or reclaim requirements of the recovered refrigerant before beginning recovery by any method. Questions about recovered refrigerants and acceptable refrigerant quality standards are addressed in ARI Standard 700.
3. Use approved containment vessels and safety standards. Comply with all applicable transportation standards when shipping refrigerant containers.
4. To minimize emissions while recovering refrigerant, use recycling equipment. Always use methods which Will pull the required vacuum while recovering and condensing refrigerant into containment.
5. When leak checking with trace refrigerant and nitrogen, use HCFC-22 (R-22), rather than CFC-12 (R-12) or any other fully halogenated refrigerants. Be aware of any new leak test methods which eliminate refrigerant as a trace gas.
6. When cleaning system components or parts, avoid using CFC-11 (R-11) or CFC-113 (R-113). Refrigeration system cleanup methods which use filters and dryers are preferred. Do not use solvents which have ozone depletion factors. Properly dispose of used materials.
7. Take extra care to properly maintain all service equipment that directly supports refrigeration service work, such as gauges, hoses, vacuum pumps and recycling equipment.
8. Stay aware of unit enhancements, conversion refrigerants, compatible parts and manufacturer'srecommendations which will reduce refrigerant emissions and increase equipment operating efficiencies. Follow manufacturer's specific guidelines for conversion of existing systems.
9. In order to assist in reducing power generation emissions, always attempt to improve equipment performance with improved maintenance and operations that will help conserve energy resources.

READ IMPORTANT NOTICES BEFORE SERVICING THE RTHB

Warnings and Cautions

Warnings are provided to alert personnel to potential hazards that can result in personal injury or death; they do not replace the manufacturer's recommendations.

Cautions alert personnel to conditions that could result in equipment damage.

Your personal safety and reliable operation of this machine depend upon strict observance of these precautions. The Trane Company assumes no liability for installation or service procedures performed by unqualified personnel.

To prevent injury or death due to electrocution, use care when performing control setup, adjustments or any other service related operation when the electrical power is on. Position all electrical disconnects in the “OPEN” position and lock them.

WARNING
Disconnect and Lockout or Tagout all electrical power, including remote disconnects, before servicing. Failure to do so can cause severe personal injury or death.

CAUTION:It is essential to confirm that proper phase rotation is established - Phase A to Ll, Phase B to L2, and Phase C to L3. Phase rotation must be checked with a phase sequence indicator before start-up, otherwise catastrophic damage to the compressor may result.

CAUTION: Do not check the unit oil level with the unit operating. Severe oil loss will occur. Protective clothing must be worn when checking the oil level.

CAUTION: The compressor sump heater must be energized for a minimum of 24 hours prior to unit operation, to prevent compressor damage caused by liquid refrigerant in the compressor at start-up.

CAUTION: Do not use untreated or improperly treated water. To do so may result in equipment damage.

CAUTION: Proper water flow through the evaporator must be established prior to unit operation.

CAUTION: Do not charge the compressor with liquid refrigerant.

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10. DIAGNOSTIC TABLE

Section 1
OVERVIEW

1-1. GENERAL

The Unit Control Modules (UCMs) described in this troubleshooting guide provide a microprocessor based refrigeration control system, intended for use on the RTHB 130-450 ton units. The table below describes the various modules used.

Table 1-1: Unit Control Module Designations

Line Drawing Designator	Controller Name
1U1	UCM Chiller Module
1U2	UCM Circuit Module
1U3	UCM Stepper Module
1U4	Clear Language Display
1U5	UCM Options Module (optional)
1U6	TCI-IV Comm 4 (optional)
1U7	Printer Interface (optional)
1U8	TCI-IV Comm 3 (optional)
1U9	IPC Buffer (optional)
2U1	Starter Module
2U2	Solid State Starter Logic Module (SSS only)

1-2. SERVICE PHILOSOPHY

The intent of the troubleshooting bulletin is to determine which module is potentially at fault and then to confirm a module problem. This is done either through voltage or resistance measurements at the suspected input or output terminals, or by checking related wiring and external control devices in a process of elimination. Once a problem has been traced to a module, the module can easily be replaced using only basic tools. In general, all dip switch settings of the replaced modules should be copied onto the replacement module‘s dip switches before applying control voltage. Replacement of the 1U1 is more involved due to the numerous configuration and set-up items that need to be reprogrammed into UCP2.

If a module is requested to be returned, it is helpful to include with a returned module a brief explanation of the problem, sales office, job name, and a contact person for possible follow-up. The note should be slipped into the module enclosure. Early and timely processing of field returns allows for immediate reaction by our quality assurance department. Return the modules as specified by the local parts department.

1-3. SYSTEM DESCRIPTION

UCP2 control consists of a modular design partitioned by major functions. All modules communicate with each other through the IPC (interprocessor communication or twisted pair) link. Each microprocessor based control module is described below.

1-3a. 1U1 - UCM Chiller Module

The Chiller module is the main module, communicating commands to other modules and collecting data/status/diagnostic information from other modules over the IPC link. The Chiller module performs the leaving chilled water temperature and limit control algorithms controlling the load against any operating limits that occur. The 1U1 checks for valid setpoints. The non-volatile memory (NOVRAM) allows UCP2 to retain setpoints through a power loss and is contained in the 1U1 module. Some of the inputs and outputs of the 1U1 are evaporator and condenser water temperature, evaporator and condenser water pump control, status and alarm relays, and external auto/stop.

1-3b. 1U2 - Circuit Module

The Circuit module serves as an input/output expander and is normally assigned inputs and outputs associated with the refrigerant and lubrication circuits.

1-3c. 1U3 - Stepper Module

The Stepper module is designed to drive the stepper motor on the electronic expansion valve. The Stepper module contains the algorithm to control discharge superheat to a setpoint received from the Chiller module.

1-3d. 1U4 - Clear Language Display

The Clear Language Display provides a display of chiller data and access to the operator. This allows for control, setpoint adjustments and chiller set-up information. All information is then stored in the non-volatile memory located in the Chiller module.

1-3e. 1U5 - UCM Options Module

The Options module satisfies control or interface requirements for a number of options. Options support either additions or modifications to the chiller itself. Some of the features supported by the Options module are Ice Making, External Chilled Water Setpoint and External Current Limit Setpoint and Generic BAS interface.

1-3f. 1U6 - TCI Comm 4

The TCI Comm 4 is a 9600 Baud non-isolated communications link to Tracer Summit.

1-3g. 1U7 - Printer Interface

The Printer Interface module provides a preformatted chiller log output, as specified by ASHRAE 3, to a serial printer. The Printer Interface can be programmed through UCP2 to print a report from a command, at the time of a diagnostic and/or on a periodic basis.

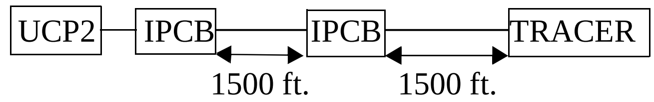
1-3h. 1U8 -TCI Comm 3

The TCI Comm 3 is a 1200 Baud isolated communications link to Tracer.

1-3i. 1U9 - IPC Buffer

The IPC buffer module is a relay station which provides electrical isolation between any remote devices (i.e.: Tracer, printer, etc.) and the unit control modules.

An IPC buffer can also be used to extend the distance between UCP2 and Tracer.



1-3j. 2U1 - Starter Module

The Starter module is the only module that is located in the compressor motor starter panel except on units using a slid state starter. It controls the starter while starting, running and stopping the compressor. The Starter module provides interface to, and control of, the Y-Delta, X-line and Solid State Starters. The Starter module also provides protection to both the compressor and motor through running overload, phase reversal, phase loss, phase unbalance, starting overload and momentary power loss diagnostics.

1-3k. 2U2- Solid State Starter Module

This module controls the ramp-up of the solid state starter and is covered in a separate bulletin.

Section 2
MENU ITEM DESCRIPTIONS

2-1. GENERAL

UCP2 has several added features that are new to the Series R product line. Some of those features are self-explanatory or were already discussed in the RTHB-IOM-1. Those will not be discussed below. Other items are not self-explanatory, those items are discussed below.

2-1a. Restart Inhibit Timer

The restart inhibit timer is used as short cycling protection. This feature in UCP2 uses a different logic than the UCP1 controllers used on the RTHA units. UCP2 uses a background timer (BT) as well as the motor winding temperatures to determine how quickly the compressor can be cycled back on.

In the fastest case, a compressor can be started after a 30 second off cycle if the motor windings are less then 165 F. If the compressor is cycling continuously, the restart inhibit timer will continue to increase. If the restart inhibit timer exceeds 15 minutes an informational warning will be produced.

The equations used to determine the variable restart inhibit timer are listed below:

RI = Restart Inhibit timer (in minutes)
RI_{bt} = Restart Inhibit timer from background timer
RI_{wt} = Restart Inhibit timer from motor winding temperatures
BT = Background Timer
MHC = Motor Heating Constant found in machine configuration group under service settings
MRI = Max. Restart Inhibit Timer Setting from the Field Start-up group (defaulted for 5 minutes)
Where:
RI = RI_{wt} following a reset or Momentary Power Loss
RI = RI_{bt} all times excluding reset and Momentary Power Loss
RI_{wt} = 5 minutes if motor winding temperature > 165F **or** 30 seconds if motor winding temperature < 165 F
RI_{bt} = BT - 8 minutes to a maximum of the MRI setting
BT = BT + MHC at compressor start

NOTE: BT is decreased by 1 for every minute of run time or decreased by one for every 5 minutes of off time depending on the mode.

2-1b. Extended Unloading

Extended unloading is a standard feature with UCP2 that allows additional unloading through the use of the electronic expansion valve. In this operating mode, the compressor will lock the slide valve in the unloaded position. The slide valve no longer controls off of leaving water temperature. The electronic expansion valve now controls off of leaving water temperature rather than discharge superheat. The expansion valve passes refrigerant gas to the evaporator which in turns degrades the efficiency of the evaporator. This allows the differential temperature across the evaporator to drop lower than that provided by the control of the slide valve alone.

Through UCP2 the following items are adjustable:

Located in Service Settings, Field Start-up Group (++--++):
- Extended Unloading (Enable/Disable)
- Extended Unload Timer (Enable, Disable)
- Max. Extended Unload Time (1 to 480 min)

Note: This option is factory defaulted to “Disable”.

For example, if extended unloading is enabled, the extended unload timer is enabled and the maximum extended unload time is set for 30 minutes. The chiller will enter extended unloading when the differential across the evaporator drops below approximately 15% of the design delta T. If the minimum load is constant, the chiller will remain in extended unloading only for the amount of time set in the max. extended unload timer (30 minutes in this example) and then cycle off the compressor.

If the extended unload timer is set to disable, the max. extended unload time is set to unlimited. The chiller could remain on line indefinitely if the load remained constant.

Remember, whether the timer is enabled or disabled, the chiller will return to normal operation if the load increases regardless of the timer. If the minimum load is not enough to keep the leaving water temperature above the stop differential setpoint, the chiller will cycle off as in normal operation.

2-1c. Soft Loading

When soft loading is enabled, it slows the rate of loading at start-up. Soft loading is factory set as disabled.When disabled, the compressor will load up as fast as needed to allow the chiller to reach setpoint. In situations where frequent cycling is an issue, soft loading can be enabled to slow the pull down process.

The items that can be set in UCP2 are:

Located in Service Settings, Field Start-up Group (++--++)

- Soft Load Control (Enable/Disable)
- Soft Load Starting Current Limit (40-100%)
- Soft Load Current Limit Rate of Change (0.5 to 5%/min)
- Soft Load Leaving Water Temperature Rate of Change (0.5 to 5 F/min)

Factory Defaults:

- Soft Load Control (Enable/Disable) = Disable
- Soft Load Starting Current Limit (40-100%) =100%
- Soft Load Current Limit Rate of Change (0.5 to 5%/min) =5%
- Soft Load Leaving Water Temperature Rate of Change (0.5 to 5 F/min) =2.5

For example, if soft load control is enabled, soft load starting current limit is set for 40%, soft load current limit rate of change is set for 5%/min and soft load leaving water temperature rate of change is set for 5 F/min. The chiller will start and load normally (i.e.: as fast as needed) until the soft load starting current limit (40%) is reached. At this point, UCP2 will monitor both the current draw and the leaving water temperature ensuring that neither exceed the rate of change set in the menu (5%/min and 5 F/min respectively in this example).

2-1d. Start to Transition Timing Logic

For ElectroMechanical Staters, the Start-to-Transition timing and logic shall be as shown in Figure 2-1 Normally, the transition timing will be based on the motor current decreasing to 85% RLA. At this time UCP2 shall time out 1-2 seconds and then transition. The exception to this rule is a Fixed Minimum Transition Time of 1.6 seconds; the starter shall never be transitioned at less than 1.6 seconds from start. If at 1.6 seconds the current is less then 85% RLA UCP2 shall transition immediately.

For Solid State Starters, the phase currents cannot be expected to rise above 85 percent RLA prior to 1.6 seconds following the closing of the “Start” contact and remain above 85 percent RLA until the compressor motor has come up to speed. The “Up-to-Speed” contact operation cannot be tied to the motor currents falling below 85% RLA. Therefore, regardless of motor current, the “Up-to-Speed” contact closure input shall be expected to close before the Maximum Acceleration Timer times out, otherwise an MMR diagnostic shall occur.

The Starting Overload is a timing function based on the Maximum Time to Transition permitted for a particular motor; this criteria requires that the motor can withstand a locked rotor condition for a particular starting method for the Maximum Transition Time. Therefore, UCP2 provides a field adjustable Maximum Time To Transition Setpoint. If the starter is not transitioned within the Maximum Transition Time Setpoint, there are two possible outcomes based on a Second Setting:

1. The starting sequence is aborted, the starter is de-energized, and a Latching Diagnostic (MMR) is generated.
2. The starter is transitioned (“thrown across the line”) and an Informational Diagnostic (IFW) is generated.

UCP2 provides a second setting to either “Shutdown” or “Transition” the Starter if the Maximum Acceleration Timer Times out.

The items that can be set in UCP2 are:

Located in Service Settings, Machine Configuration Group (+-+-+-)
- Maximum Acceleration Timer #1 (2- 64)
- Maximum Acceleration Timer #2 (191 - 253)
- Acceleration Time Out Action (shutdown, transition)

Factory Settings:
- Maximum Acceleration Timer #1 = 5
- Maximum Acceleration Timer #2 = 250
- Acceleration Time Out Action = Transition

2-1e. Leaving Water Temperature Control

Rather than having one setting for the leaving water temperature (LWT) control response, UCP2 has a separate setting for the three parts of the PID (Proportional, Integral, Derivative) algorithm.

The items that can be set in UCP2 are:

Located in Service Settings, Field Start-up Group (++--++)
- LWT Proportional Gain Setpoint (0-100% /F)
- LWT Integral Gain Setpoint (0-1% /F)
- LWT Derivative Gain Setpoint (0-1000%/F)

Factory Settings: The LWT settings are dependent on the unit size. Refer to the RTHB-IOM-1 for the correct settings.

It is strongly recommended that the factory defaults listed in RTHB-IOM-1 be used without adjustment.

2-1f. EXV Settings

The Electronic Expansion Valve (EXV) modulates off the discharge superheat control point which is determined by UCP2. If the actual superheat is below the control point, the EXV is commanded to close. If the actual superheat is above the control point, the EXV is commanded to open.

UCP2 only knows how many steps it has to work with from the settings in the UCP2 Field Start-up Group.

The items that can be set in UCP2 are:

Located in Service Settings, Field Start-up Group (++--++)
- EXV Maximum Travel Setpoint (0-20000 steps)
- EXV Minimum Travel Stop (0-100%)
- EXV Maximum Travel Stop (0-100%)
- EXV Deadband (0-100 steps)
- Control Error deadband (0-2 F)

Factory settings: The EXV settings are dependent on unit size. Refer to RTHB-IOM-1 and RTHB-SB-2 for correct settings.

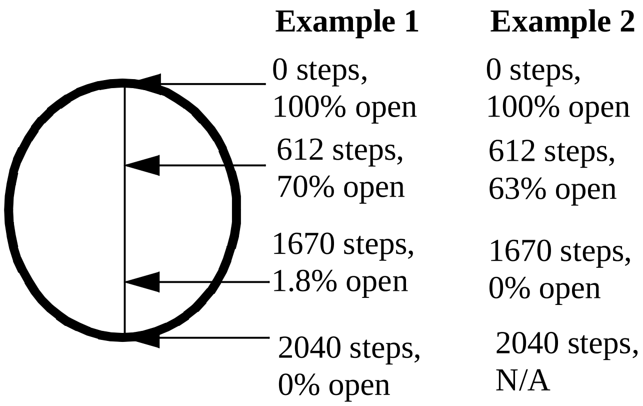
Refer to Figure *2-1.* for the following examples on the interpretation of the EXV steps and percent open of the EXV.

EXAMPLE 1:

EXV Maximum Travel Setpoint (2040 steps)
EXV Minimum Travel Stop (15.6%)
EXV Maximum Travel Stop (100%)
EXV Deadband (20 steps)
Control Error deadband (1 F)

With the preceding settings in UCP2, the EXV is 100% open at 0 steps and 0% open at 2040 steps. The percent open is always calculated from the number of EXV steps programmed in the EXV Maximum Travel Setpoint.

Figure 2-1. Diagram of EXV Steps



The EXV Minimum Travel Stop is only active in the Extended Unloading mode whereas the EXV Maximum Travel Stop is always active. If the EXV Maximum Travel Stop was set for 70%, the EXV would never open beyond that setting.

EXAMPLE 2

Example 2 shows the recalculations of the percent open of the EXV, if the EXV Maximum Travel Setpoint is changed from 2040 to 1670. It also shows how the EXV physically will never close 100% through commands of the UCP2.

NOTE: RTHB-SB-2 discusses adjustment of these points for resolving discharge superheat or low evaporator refrigerant trips.

The settings for the EXV deadband and the Control Error Deadband are used in the control algorithm. These settings should not be altered.

2-1g. Discharge Superheat Control

The settings for the Discharge Superheat Control are similar to that of the LWT Control. UCP2 has a separate setting for the three parts of the PID (Proportional, Integral, Derivative) algorithm. The three settings are:

The items that can be set in UCP2 are:

Located in Service Settings, Field Start-up Group (++--++)

- Discharge Superheat Proportional Gain Setpoint (2-200)
- Discharge Superheat Integral Reset Time (0-2000)
- Discharge Superheat Derivative Gain Setpoint (0-150)

Factory Settings: The superheat settings are dependent on the unit size. Refer to the RTHB-IOM-1 for the correct settings.

It is strongly recommended that the factory defaults listed in RTHB-IOM-1 be used without adjustment.

Section 3
TEMPERATURE SENSOR CHECKOUT

3-1. GENERAL

All of the temperature sensors used on UCP2 are negative temperature coefficients (NTC) thermistors and located in thermal wells. The thermistors all have a base resistance of 10 Kohms at 77 F (25C) and display a decreasing resistance with an increasing temperature. UCP2 reads the temperature by measuring the voltage developed across the thermistors in a voltage divider arrangement with a fixed internal resistance. The value of the “pull-up” resistor is different depending on the temperature range where the most accuracy is desired. The voltage source for this measurement is a closely regulated 5.0 VDC supply.

An open or shorted sensor will cause UCP2 to indicate the appropriate diagnostic. In most cases, an open or short will cause a MMR diagnostic that will result in a machine shutdown.

3-2. SENSOR CHECK-OUT PROCEDURE

All temperature sensors on the RTHB units are in thermal wells. Cycle the chiller off prior to testing the sensors.

1. Remove the sensor of concern from the thermal well.
2. Place the sensor, while still connected to the UCP2, in an ice bath.
3. Monitor the UCP2 and record which sensor reading approaches 32 F.
4. Confirm that the sensor in the ice bath is the sensor read-out on the display that approaches 32 F.
5. If the sensor is wired correctly but does not approach 32 F follow the steps below.
6. Re-install the sensor in the well with a suitable heat transfer paste.

NOTE: Heat transfer paste must be used on all sensors for an accurate reading.

7. Measure the temperature at the sensor with an accurate thermometer.
8. Record the temperature reading observed.
9. With the sensor leads connected to UCP2 and UCP2 powered, measure the DC voltage across the sensor leads at the terminal or probe the screws on the Phoenix connector.

CAUTION: Always use a digital volt-ohmmeter with 10 megohm or greater impedance to avoid “loading down” the voltage divider. Failure to do so will result in erroneously high temperature calculations.

10. Locate the appropriate sensor table and then compare the temperature in the table corresponding to the voltage reading recorded in step 9 with the actual temperature observed in step 8. If the actual measured temperature falls within the allowable tolerance range, both the sensor and the UCP2 input circuits are operating properly. However, if the actual temperature is outside the allowable sensor tolerance range, proceed with step 11.
11. Again measure the temperature at the sensor with an accurate thermometer; record the temperature reading observed.
12. Remove the sensor leads from the terminal strip or unplug the respective Phoenix connector. Measure the resistance of the sensor directly at the sensor leads or probe the Phoenix connector with a digital volt-ohmmeter. Record the resistance observed.
13. With the sensor still disconnected from the module, check the resistance from each of the sensor leads to the control panel chassis. Both readings should be more than 1 megohm. If not, the sensor or the wiring to the sensor is either shorted or leaking to chassis ground and should be repaired.
14. Select the appropriate sensor table and locate the resistance value recorded in step 12. Verify that the temperature corresponding to the resistance value matches the temperature measured in step 11. The values should fall with in the tolerance

ranges noted in the table.

15. If the temperature sensor is out of range, the problem is either the sensor, wiring, or the Phoenix connector. If the Phoenix connector is used and the thermistor reads open, first disconnect the leads from the Phoenix connector. Remove a small amount of insulation on the leads and repeat the measurements directly. Once the fault is isolated, install a new sensor, connector or both.
16. A decade box or resistor can be substituted for the sensor and any sensor table value used to relate the resistance to the temperature. By removing the Phoenix connector plug and applying the resistance to the proper pin terminals, the temperature, as sensed by UCP2, can be confirmed. Use the CLD to confirm that the input of the decade box or resistor matches the resistance tables.

NOTE: All displayed temperatures are slew rate limited, and only accurate within a specified normal range. It is important that the temperature being measured is stable and that adequate time (1 minute or longer) is allowed after step changes to resistance inputs are made.

Table 3-1: Entering and Leaving Evaporator Water Temperature Sensors

Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)
15	54635	3.42	**57**	16584	1.99	**99**	5958	0.9657
16	52987	3.39	**58**	16151	1.96	**100**	5825	0.95
17	51393	3.35	**59**	15736	1.93	**101**	5694	0.93
18	49852	3.32	**60**	15333	1.90	**102**	5567	0.91
19	48361	3.29	**61**	14942	1.87	**103**	5444	0.90
20	46920	3.25	**62**	14562	1.84	**104**	5324	0.88
21	45525	3.22	**63**	14193	1.81	**105**	5206	0.86
22	44176	3.18	**64**	13835	1.78	**106**	5092	0.85
23	42871	3.15	**65**	13487	1.75	**107**	4980	0.83
24	41608	3.11	**66**	13149	1.72	**108**	4871	0.82
25	40386	3.08	**67**	12820	1.69	**109**	4765	0.80
26	39203	3.04	**68**	12501	1.67	**110**	4662	0.79
27	38058	3.01	**69**	12190	1.64	**111**	4561	0.77
28	36951	2.97	**70**	11889	1.61	**112**	4462	0.76
29	35877	2.94	**71**	11596	1.58	**113**	4366	0.74
30	34839	2.90	**72**	11311	1.56	**114**	4273	0.73
31	33834	2.87	**73**	11034	1.53	**115**	4182	0.72
32	32862	2.83	**74**	10765	1.50	**116**	4092	0.70
33	31936	2.80	**75**	10503	1.48	**117**	4005	0.69
34	31039	2.76	**76**	10248	1.45	**118**	3921	0.68
35	30171	2.73	**77**	10001	1.43	**119**	3838	0.67
36	29330	2.69	**78**	9760	1.40	**120**	3757	0.65
37	28515	2.66	**79**	9526	1.38	**121**	3678	0.64
38	27726	2.62	**80**	9298	1.36	**122**	3602	0.63
39	26962	2.59	**81**	9076	1.33	**123**	3527	0.62
40	26221	2.55	**82**	8860	1.31	**124**	3454	0.61
41	25503	2.52	**83**	8650	1.29	**125**	3383	0.60
42	24808	2.49	**84**	8446	1.26	**126**	3313	0.59
43	24134	2.45	**85**	8248	1.24	**127**	3245	0.58
44	23480	2.42	**86**	8054	1.22	**128**	3179	0.57
45	22846	2.38	**87**	7866	1.20	**129**	3114	0.56
46	22232	2.35	**88**	7683	1.18	**130**	3051	0.55
47	21636	2.32	**89**	7505	1.16	**131**	2989	0.54
48	21059	2.28	**90**	7331	1.13	**132**	2929	0.53
49	20499	2.25	**91**	7162	1.11	**133**	2870	0.52
50	19955	2.22	**92**	6997	1.09	**134**	2813	0.51
51	19428	2.18	**93**	6836	1.07	**135**	2756	0.50
52	18917	2.15	**94**	6680	1.06	**136**	2701	0.49
53	18420	2.12	**95**	6528	1.04	**137**	2648	0.48
54	17939	2.09	**96**	6380	1.02	**138**	2595	0.47
55	17472	2.05	**97**	6236	1.00	**139**	2544	0.46
56	17018	2.02	**98**	6095	0.98	**140**	2494	0.46

Notes:
1. Overall accuracy for the sensor is at least +1 over the range shown.
2. As you compare a thermistor resistance (or input voltage) reading with the “actual” temperature indicated by the thermometer, be sure to consider the location and precision of the thermometer when you decide whether or not the thermistor is out of specified accuracy.
3. The thermistor resistances given do not account for the self-heating effects that are present when connected to the UCM. A connected ”operating” thermistor will read a slightly lower (less than 1%) resistance.

Table 3-2: Saturated Condenser Refrigerant Temperature Sensor and Leaving and Enter Condenser Water Temperature Sensors

Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)
15	54635	4.43	**57**	16578	3.51	**99**	5958	2.29
16	52987	4.41	**58**	16151	3.48	**100**	5825	2.26
17	51393	4.39	**59**	15736	3.45	**101**	5694	2.23
18	49852	4.38	**60**	15333	3.42	**102**	5567	2.21
19	48361	4.36	**61**	14942	3.39	**103**	5444	2.18
20	46920	4.34	**62**	14562	3.37	**104**	5324	2.15
21	45525	4.33	**63**	14193	3.34	**105**	5206	2.12
22	44176	4.31	**64**	13835	3.31	**106**	5092	2.10
23	42871	4.29	**65**	13487	3.28	**107**	4980	2.07
24	41608	4.27	**66**	13149	3.25	**108**	4871	2.04
25	40386	4.25	**67**	12820	3.22	**109**	4765	2.02
26	39203	4.24	**68**	12501	3.19	**110**	4662	1.99
27	38058	4.22	**69**	12190	3.17	**111**	4561	1.96
28	36951	4.20	**70**	11889	3.14	**112**	4462	1.94
29	35877	4.18	**71**	11596	3.11	**113**	4366	1.91
30	34839	4.16	**72**	11311	3.08	**114**	4273	1.89
31	33834	4.14	**73**	11034	3.05	**115**	4182	1.86
32	32862	4.11	**74**	10765	3.02	**116**	4092	1.84
33	31936	4.09	**75**	10503	2.99	**117**	4005	1.81
34	31039	4.07	**76**	10248	2.96	**118**	3921	1.79
35	30171	4.05	**77**	10001	2.93	**119**	3838	1.76
36	29330	4.03	**78**	9760	2.90	**120**	3757	1.74
37	28515	4.01	**79**	9526	2.87	**121**	3678	1.72
38	27726	3.98	**80**	9298	2.84	**122**	3602	1.69
39	26962	3.96	**81**	9076	2.81	**123**	3527	1.67
40	26221	3.94	**82**	8860	2.78	**124**	3454	1.65
41	25503	3.92	**83**	8650	2.75	**125**	3383	1.62
42	24808	3.89	**84**	8446	2.72	**126**	3313	1.60
43	24134	3.87	**85**	8248	2.69	**127**	3245	1.58
44	23480	3.84	**86**	8054	2.67	**128**	3179	1.56
45	22846	3.82	**87**	7866	2.64	**129**	3114	1.53
46	22232	3.79	**88**	7683	2.61	**130**	3051	1.51
47	21636	3.77	**89**	7505	2.58	**131**	2989	1.49
48	21059	3.74	**90**	7331	2.55	**132**	2929	1.47
49	20499	3.72	**91**	7162	2.52	**133**	2870	1.45
50	19955	3.69	**92**	6997	2.49	**134**	2813	1.43
51	19428	3.67	**93**	6836	2.46	**135**	2756	1.41
52	18917	3.64	**94**	6680	2.43	**136**	2701	1.39
53	18420	3.61	**95**	6528	2.40	**137**	2648	1.37
54	17939	3.59	**96**	6380	2.37	**138**	2595	1.35
55	17472	3.56	**97**	6236	2.35	**139**	2544	1.33
56	17018	3.53	**98**	6095	2.32	**140**	2494	1.31

Notes:

1. Overall accuracy for the sensor is at least +1 over the range shown.
2. As you compare a thermistor resistance (or input voltage) reading with the "actual" temperature indicated by the thermometer, be sure to consider the location and precision of the thermometer when you decide whether or not the thermistor is out of specified accuracy.
3. The thermistor resistances given do not account for the self-heating effects that are present when connected to the UCM. A connected "operating" thermistor will read a slightly lower (less than 1%) resistance.

Table 3-3: Compressor Motor Winding Temperature Sensors

Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)
-15	59.50	0.28	**80**	75.94	0.36	**175**	94.83	0.44
-10	60.29	0.29	**85**	76.87	0.36	**180**	95.88	0.44
-5	61.10	0.29	**90**	77.82	0.36	**185**	96.94	0.44
0	61.91	0.29	**95**	78.77	0.37	**190**	98.01	0.45
5	62.73	0.30	**100**	79.72	0.37	**195**	99.08	0.45
10	63.56	0.30	**105**	80.68	0.38	**200**	100.16	0.46
15	64.40	0.31	**110**	81.65	0.38	**205**	101.24	0.46
20	65.24	0.31	**115**	82.63	0.38	**210**	102.33	0.47
25	66.09	0.31	**120**	83.61	0.39	**215**	103.43	0.47
30	66.95	0.32	**125**	84.60	0.39	**220**	104.53	0.48
35	67.82	0.32	**130**	85.60	0.40	**225**	105.63	0.48
40	68.69	0.32	**135**	86.60	0.40	**230**	106.74	0.49
45	69.57	0.33	**140**	87.60	0.41	**235**	107.86	0.49
50	70.46	0.33	**145**	88.62	0.41	**240**	108.98	0.49
55	71.36	0.34	**150**	89.64	0.41	**245**	110.11	0.50
60	72.26	0.34	**155**	90.66	0.42	**250**	111.24	0.50
65	73.17	0.34	**160**	91.70	0.42	**255**	112.38	0.51
70	74.08	0.35	**165**	92.73	0.43	**260**	113.52	0.51
75	75.01	0.35	**170**	93.78	0.43	**265**	114.66	0.52

Notes:
1. Overall accuracy for the sensor is at least +1 over the range shown.
2. As you compare a thermistor resistance (or input voltage) reading with the “actual” temperature indicated by the thermometer, be sure to consider the location and precision of the thermometer when you decide whether or not the thermistor is out of specified accuracy.
3. The thermistor resistances given do not account for the self-heating effects that are present when connected to the UCM. A connected “operating” thermistor will read a slightly lower (less than 1%) resistance.

Table 3-4: Saturated Evaporator Temperature Sensor

Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)
-10	121326	3.78	**32**	32862	2.30	**74**	10764	1.09
-9	117371	3.75	**33**	31936	2.26	**75**	10503	1.07
-8	113555	3.72	**34**	31039	2.23	**76**	10248	1.05
-7	109877	3.69	**35**	30171	2.19	**77**	10001	1.03
-6	106328	3.65	**36**	29330	2.16	**78**	9760	1.01
-5	102905	3.62	**37**	28515	2.12	**79**	9526	0.99
-4	99603	3.59	**38**	27726	2.09	**80**	9298	0.97
-3	96417	3.56	**39**	26962	2.06	**81**	9076	0.96
-2	93342	3.52	**40**	26221	2.02	**82**	8861	0.94
-1	90375	3.49	**41**	25503	1.99	**83**	8651	0.92
0	87511	3.46	**42**	24808	1.96	**84**	8446	0.90
1	84746	3.42	**43**	24134	1.93	**85**	8248	0.88
2	82078	3.39	**44**	23480	1.89	**86**	8054	0.87
3	79501	3.36	**45**	22846	1.86	**87**	7866	0.85
4	77013	3.32	**46**	22232	1.83	**88**	7683	0.83
5	74610	3.29	**47**	21636	1.80	**89**	7504	0.82
6	72289	3.25	**48**	21059	1.77	**90**	7331	0.80
7	70048	3.21	**49**	20499	1.74	**91**	7162	0.79
8	67883	3.18	**50**	19955	1.71	**92**	6997	0.77
9	65790	3.14	**51**	19428	1.68	**93**	6837	0.76
10	63769	3.11	**52**	18917	1.65	**94**	6680	0.74
11	61816	3.07	**53**	18420	1.62	**95**	6528	0.73
12	59928	3.03	**54**	17939	1.59	**96**	6380	0.71
13	58104	3.00	**55**	17472	1.56	**97**	6236	0.70
14	56340	2.96	**56**	17018	1.53	**98**	6095	0.69
15	54635	2.92	**57**	16578	1.51	**99**	5958	0.67
16	52987	2.89	**58**	16151	1.48	**100**	5824	0.66
17	51393	2.85	**59**	15736	1.45	**101**	5694	0.65
18	49852	2.81	**60**	15333	1.42	**102**	5568	0.63
19	48361	2.78	**61**	14942	1.40	**103**	5444	0.62
20	46920	2.74	**62**	14562	1.37	**104**	5324	0.61
21	45525	2.70	**63**	14193	1.35	**105**	5206	0.60
22	44176	2.66	**64**	13835	1.32	**106**	5092	0.59
23	42871	2.63	**65**	13487	1.30	**107**	4980	0.57
24	41608	2.59	**66**	13149	1.27	**108**	4871	0.56
25	40386	2.55	**67**	12820	1.25	**109**	4765	0.55
26	39203	2.52	**68**	12501	1.23	**110**	4662	0.54
27	38058	2.48	**69**	12190	1.20	**111**	4561	0.53
28	36951	2.44	**70**	11889	1.18	**112**	4462	0.52
29	35877	2.41	**71**	11596	1.16	**113**	4366	0.51
30	34839	2.37	**72**	11311	1.14	**114**	4273	0.50
31	33834	2.33	**73**	11034	1.12	**115**	4181	0.49

Notes:
1. Overall accuracy for the sensor is at least +1 over the range shown.
2. As you compare a thermistor resistance (or input voltage) reading with the “actual” temperature indicated by the thermometer, be sure to consider the location and precision of the thermometer when you decide whether or not the thermistor is out of specified accuracy.
3. The thermistor resistances given do not account for the self-heating effects that are present when connected to the UCM. A connected “operating” thermistor will read a slightly lower (less than 1%) resistance.

Table 3-5: Compressor Discharge Temperature Sensor

Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)
75	10503	2.99	**117**	4006	1.81	**159**	1727	0.99
76	10248	2.96	**118**	3921	1.79	**160**	1695	0.97
77	10001	2.93	**119**	3838	1.76	**161**	1663	0.96
78	9760	2.90	**120**	3757	1.74	**162**	1633	0.94
79	9525	2.87	**121**	3679	1.72	**163**	1603	0.93
80	9298	2.84	**122**	3601	1.69	**164**	1573	0.92
81	9076	2.81	**123**	3527	1.67	**165**	1544	0.90
82	8861	2.78	**124**	3454	1.65	**166**	1516	0.89
83	8650	2.75	**125**	3383	1.62	**167**	1488	0.88
84	8446	2.72	**126**	3313	1.60	**168**	1461	0.86
85	8248	2.69	**127**	3245	1.58	**169**	1435	0.85
86	8054	2.66	**128**	3179	1.56	**170**	1409	0.84
87	7866	2.64	**129**	3115	1.53	**171**	1383	0.82
88	7683	2.61	**130**	3051	1.51	**172**	1359	0.81
89	7505	2.58	**131**	2990	1.49	**173**	1334	0.80
90	7330	2.55	**132**	2929	1.47	**174**	1310	0.79
91	7161	2.52	**133**	2870	1.45	**175**	1287	0.78
92	6997	2.49	**134**	2813	1.43	**176**	1264	0.76
93	6837	2.46	**135**	2756	1.41	**177**	1241	0.75
94	6680	2.43	**136**	2701	1.39	**178**	1220	0.74
95	6528	2.40	**137**	2648	1.37	**179**	1198	0.73
96	6380	2.37	**138**	2595	1.35	**180**	1177	0.72
97	6236	2.35	**139**	2544	1.33	**181**	1156	0.71
98	6095	2.32	**140**	2494	1.31	**182**	1136	0.70
99	5958	2.29	**141**	2445	1.29	**183**	1116	0.69
100	5824	2.26	**142**	2397	1.27	**184**	1097	0.68
101	5695	2.23	**143**	2350	1.25	**185**	1078	0.67
102	5568	2.21	**144**	2304	1.24	**186**	1059	0.66
103	5444	2.18	**145**	2260	1.22	**187**	1040	0.65
104	5323	2.15	**146**	2216	1.20	**188**	1023	0.64
105	5206	2.12	**147**	2173	1.18	**189**	1005	0.63
106	5092	2.10	**148**	2131	1.16	**190**	988	0.62
107	4980	2.07	**149**	2090	1.15	**191**	971	0.61
108	4871	2.04	**150**	2050	1.13	**192**	954	0.60
109	4765	2.02	**151**	2011	1.11	**193**	938	0.59
110	4662	1.99	**152**	1973	1.10	**194**	922	0.58
111	4561	1.97	**153**	1936	1.08	**195**	906	0.57
112	4463	1.94	**154**	1899	1.07	**196**	891	0.57
113	4367	1.91	**155**	1863	1.05	**197**	876	0.56
114	4273	1.89	**156**	1828	1.03	**198**	862	0.55
115	4182	1.86	**157**	1794	1.02	**199**	847	0.54
116	4092	1.84	**158**	1760	1.00	**200**	833	0.53

Notes:
1. Overall accuracy for the sensor is at least +1 over the range shown.
2. As you compare a thermistor resistance (or input voltage) reading with the “actual” temperature indicated by the thermometer, be sure to consider the location and precision of the thermometer when you decide whether or not the thermistor is out of specified accuracy.
3. The thermistor resistances given do not account for the self-heating effects that are present when connected to the UCM. A connected “operating” thermistor will read a slightly lower (less than 1%) resistance.

Table 3-6: Outdoor Air Temperature Sensor

Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Volts DC)
-10	121326	4.72	**32**	32862	4.11	**74**	10764	3.02
-9	117371	4.71	**33**	31936	4.09	**75**	10503	2.99
-8	113555	4.70	**34**	31039	4.07	**76**	10248	2.96
-7	109877	4.69	**35**	30171	4.05	**77**	10001	2.93
-6	106328	4.69	**36**	29330	4.03	**78**	9760	2.90
-5	102905	4.68	**37**	28515	4.01	**79**	9526	2.87
-4	99603	4.67	**38**	27726	3.98	**80**	9298	2.84
-3	96417	4.66	**39**	26962	3.96	**81**	9076	2.81
-2	93342	4.65	**40**	26221	3.94	**82**	8861	2.78
-1	90375	4.63	**41**	25503	3.92	**83**	8651	2.75
0	87511	4.62	**42**	24808	3.89	**84**	8446	2.72
1	84746	4.61	**43**	24134	3.87	**85**	8248	2.69
2	82078	4.60	**44**	23480	3.84	**86**	8054	2.66
3	79501	4.59	**45**	22846	3.82	**87**	7866	2.64
4	77013	4.58	**46**	22232	3.79	**88**	7683	2.61
5	74610	4.57	**47**	21636	3.77	**89**	7504	2.58
6	72289	4.55	**48**	21059	3.74	**90**	7331	2.55
7	70048	4.54	**49**	20499	3.72	**91**	7162	2.52
8	67883	4.53	**50**	19955	3.69	**92**	6997	2.49
9	65790	4.51	**51**	19428	3.67	**93**	6837	2.46
10	63769	4.50	**52**	18917	3.64	**94**	6680	2.43
11	61816	4.49	**53**	18420	3.61	**95**	6528	2.40
12	59928	4.47	**54**	17939	3.59	**96**	6380	2.37
13	58104	4.46	**55**	17472	3.56	**97**	6236	2.35
14	56340	4.44	**56**	17018	3.53	**98**	6095	2.32
15	54635	4.43	**57**	16578	3.51	**99**	5958	2.29
16	52987	4.41	**58**	16151	3.48	**100**	5824	2.26
17	51393	4.39	**59**	15736	3.45	**101**	5694	2.23
18	49852	4.38	**60**	15333	3.42	**102**	5568	2.21
19	48361	4.36	**61**	14942	3.39	**103**	5444	2.18
20	46920	4.34	**62**	14562	3.37	**104**	5324	2.15
21	45525	4.33	**63**	14193	3.34	**105**	5206	2.12
22	44176	4.31	**64**	13835	3.31	**106**	5092	2.10
23	42871	4.29	**65**	13487	3.28	**107**	4980	2.07
24	41608	4.27	**66**	13149	3.25	**108**	4871	2.04
25	40386	4.25	**67**	12820	3.22	**109**	4765	2.02
26	39203	4.24	**68**	12501	3.19	**110**	4662	1.99
27	38058	4.22	**69**	12190	3.17	**111**	4561	1.97
28	36951	4.20	**70**	11889	3.14	**112**	4462	1.94
29	35877	4.18	**71**	11596	3.11	**113**	4366	1.91
30	34839	4.16	**72**	11311	3.08	**114**	4273	1.89
31	33834	4.14	**73**	11034	3.05	**115**	4181	1.86

Notes:
1. Overall accuracy for the sensor is at least +1 over the range shown.
2. As you compare a thermistor resistance (or input voltage) reading with the “actual” temperature indicated by the thermometer, be sure to consider the location and precision of the thermometer when you decide whether or not the thermistor is out of specified accuracy.
3. The thermistor resistances given do not account for the self-heating effects that are present when connected to the UCM. A connected “operating” thermistor will read a slightly lower (less than 1%) resistance.

Section 4
CURRENT TRANSFORMER AND CURRENT INPUT CHECKOUT

4-1. GENERAL

Each compressor motor has all three of its line currents monitored by torroid (doughnut) current transformers. The Starter module utilizes all of the signals and displays the phases under the compressor report. These currents are also normalized with respect to the Rated Load Amps of the respective compressor and thus are expressed in terms of % (percent) RLA. The currents are "normalized" thru the proper selection of the Current Transformer and the setting of the Current Overload Settings #1 and #2 in the Machine Configuration Group. The following procedure is used to set the current overload setting #1 and #2 in the UCP2 menu items. First determine the CT Factor:

$$\text{CT Factor} = \frac{\text{(Unit nameplate RLA)}}{\text{CT Rating (from Table 4-1)}} \times 100$$

Refer to Table 4-1 for the CT Rating. It should be larger than the unit nameplate RLA. The CT Factor must be 66% or greater but no more than 100%. On some cases, more than one selection is possible: select the CT Rating that gives the lowest CT Factor.

Table 4-1: Current Transformer Selection

CT Extension # (X13580253-)	CT Rating (Amps)	Winding Resistance (Ohms)
01	100 A	23.5
02	150 A	35.0
03	200 A	46.0
04	275 A	67.0
05	400 A	68.0
06	500 A	84.0
07	700 A	128.0
08	1000 A	235.0
09	50 A	11.5
10	75 A	17.0

From the calculated CT Factor, the Motor Current Overload Settings #1 and #2 can be found in Table 4-2.

The current transformers provide the input for seven basic functions of the Starter module:

1. Verifying contactor drop-out. If currents corresponding to greater than 12 ±7% RLA are detected on all three of the monitored compressor phases within approximately 5 seconds after an attempted contactor drop-out, the compressor will continue to be commanded off, the unload solenoid will be pulsed, the EXV will be opened to its fullest position, and the condenser water pump and chilled water pump will remain operating if controlled through UCP2. This condition will exist until the diagnostic is manually reset.
2. Loss of phase current. If the detection of any or all of the three motor phase currents falls below 12 ±7% RLA for 2 ±l seconds while the branch circuit should be "energized", UCP2 will trip out the compressor. The Phase Loss diagnostic will be displayed. Failure of a contactor to pull in will cause the Phase Loss diagnostic. However when reduced voltage starting is employed, it may take an additional 3 seconds to detect a phase loss at start-up, as phase loss protection is not active during the 3 second transition time.
3. Phase Rotation. Screw compressors cannot be allowed to run in reverse direction. To protect the compressors, the phase rotation is detected by the current transformers immediately at start up. If improper phasing is detected, within 1 second of start-up, UCP2 will trip out the compressor. The Phase Reversal diagnostics will be displayed.

Table 4-2: Current Overload Settings #1 and #2 as a Function of CT Factor

CT Factor	Setting #1	Setting #2
66	00	255
67	01	254
68	02	253
69	03	252
70	04	251
71	06	249
72	07	248
73	08	247
74	09	246
75	10	245
76	11	244
77	12	243
78	13	242
79	15	240
80	15	240
81	16	239
82	17	238
83	18	237
84	19	236
85	20	235
86	21	234
87	22	233
88	22	233
89	23	232
90	24	231
91	25	230
92	25	230
93	26	229
94	27	228
95	28	227
96	28	227
97	29	226
98	30	225
99	30	225
100	31	224

Table 4-2: Current Overload Settings #1 and #2 as a Function of CT Factor

4. Phase Unbalance. Using the current inputs, UCP2 provides Phase Unbalance Protection based on average three phase current. The ultimate phase unbalance trip point shall be 30% (not including individual phase sensing error) based on the following calculation:

$$\% \text{ unbalance} = \frac{(I0x - Iave) \times 100}{Iave}$$

where:

$$Iave = \frac{I01+I02+I03}{3}, \text{ and}$$

I0x = the phase with the largest difference from Iave. Individual phase sensing error: 3% maximum (or 6% phase-to-phase max)

The 30% Unbalance trip criteria is active down to 10% RLA for the chiller. In addition to the Ultimate 30% Unbalance trip criteria, the RLA of the motor shall be derated by resetting the Active Current Limit Setpoint based on the Current Unbalance. The UCP2 provides means to disable the RLA DeRate in the field.

The 30% Phase Unbalance trip criteria shall be Non-Defeatable for the purpose of eliminating critical components from the Compressor Overload circuitry and providing Ultimate protection for the motor.

Both the deRate and the 30% Phase Unbalance Protection shall be active in all modes.

The Starter module will shut down the compressor if a phase current unbalance of 30% is detected by the current transformers for a period of 90 seconds. The Phase Unbalance diagnostics will be displayed.

NOTE: Starter modules X13650453-07 and earlier had software (software rev. 08 or earlier) which was more aggressive. The phase unbalance trip point was 25% unbalance and the trip time was 15 seconds. Consider updating the module if the original software appears too aggressive for the application.

5. Current Limit. This is a multistage control that acts to prevent chiller shutdown when the compressor motor current approaches the cutout setpoint by reducing chiller capacity. Chiller capacity is reduced via the following steps, providing increasingly aggressive action as the trip point is approached:

- Limit requests for capacity increases. (10% to 8% below Current Limit Setpoint)
- Prohibit requests for capacity increases. (2% to 0% below CLS)
- Initiate stepped capacity reduction. (0% to 2% above CLS)
- Initiate maximum capacity reduction. (more than 2% above CLS)

   The intent of this control is to provide maximum capacity while preventing chiller shutdown due to high compressor motor currents.

6. Momentary power loss. Power losses of 2.5 line cycles (.042 seconds) or longer will be detected and cause the unit to shutdown. The unit shall be disconnected from the line within 6 line cycles of detection. If enabled, Momentary Power Loss shall be active anytime the compressor is running. MPL shall not be active on wye-delta starters from the initial start signal through transition. Once the Transition complete input is satisfied MPL is active.
7. Current overload. The type of current overload protection that exists depends on whether the mode is starting or running. In the starting mode, the overload protection is the maximum acceleration time. If the motor is in a locked rotor condition or the currents do not drop below 85% RLA within the maximum acceleration time, a diagnostic will be called.In the run mode, a ‘time-to-trip’ curve is looked at to determine if a diagnostic should be called. The UCM shall continuously monitor compressor current to provide running overcurrent and locked rotor protection. Overcurrent protection shall be based on the phase with the highest current. It shall trigger a manually resettable diagnostic shutting down the affected compressor and associated refrigerant circuit when the current exceeds a specified time trip curve. The compressor overload shall be based on unit RLA.

- Overload Must Hold = 102% RLA
- Overload Must Trip in 20 +0 -3 seconds = 112% RLA
  Note: The above gives a nominal 20 second must trip point of 107% RLA.
- Overload Must Trip in 1.5 seconds = 140% RLA (Nominal)

NOTE: The current transformers are polarity and directionally sensitive. Visually inspect the current transformer for a dot that should be facing the incoming power line.

4-2. CT AND STARTER MODULE CURRENT INPUT CHECKOUT PROCEDURE

1. Check incoming 3-phase power for voltage within 10% of nominal per chiller nameplate.
2. Confirm that the Overload Settings #1 and #2 are set correctly. Determine the CT Factor. Refer to paragraph 4-1.

If there is any question as to which current transformer is causing a problem, or simply to verify and “witness” the problem, an attempt should be made to restart the chiller after clearing diagnostics. The diagnostics can be cleared by entering the Diagnostics Menu and stepping to the “Press Enter to Clear Active Diagnostics” display.

3. At start-up, verify that the appropriate contactor(s) pull-in. Record the exact diagnostic(s) produced.
4. For the next portion of the procedure, pull the unit's disconnect and interrupt all high voltage power to the control panel. Locate the torroid (doughnut) current transformers encircling the compressor power wiring and branching to the compressor contactors in the control panel. Refer to the Component Location Drawing in the panel

to identify the current transformer(s). Locate the part number/UL tag on the transformer leads and note the Trane part number which identifies the transformers. Verify the proper current transformer using Table 4-1 in this section.

5. Utilizing the schematic wiring diagram, locate the termination of the transformer's wiring into the Phoenix connector on the Starter module. Unplug the appropriate connector from the Starter module.

CAUTION: Current Transformers can be damaged and high voltages can result due to running the compressors without a suitable burden load for the CTs. This load is provided by the Starter module. Take care to properly reconnect the CT's back to the Phoenix connector prior to attempted start of the compressor.

6. Using a digital volt-ohmmeter, measure the resistance of the transformers by probing the appropriate wires off of the Phoenix connector. Use the leads on the meter and probe the screws used in the Phoenix connector to measure the resistances.
7. Refer to Table 4-1 which lists the normal resistance range for each extension of current transformer. Check the measured resistance against the value listed per transformer extension. If the resistance is within tolerance, the transformer and Phoenix connector can be considered good. Go to step 9.
8. If the resistance reading is out of tolerance, the problem is either with the transformer, its wiring, or the Phoenix connector. First, double check the schematic to be sure you are working on the proper lead pair. Then disconnect the leads of the particular transformer at the Phoenix connector and repeat the resistance measurement by stripping insulation from the wire's end. Once the fault has been isolated, install a new transformer and/or install a new phoenix connector.

   More than one current transformer is terminated to a single Phoenix connector. When replacing, take care to note the proper positions of the respective transformer wire terminations on the Phoenix connector for the re-termination. The current transformers are polarity and directionally sensitive. The transformer lead wiring is #22 AWG, UL 1015 600V. If the fault can be isolated to the current transformer or its wiring apart from the connector, the connector can be reused.
9. If the transformer/connector resistance proves accurate, recheck the resistance with the connector held at different angles and with a light lead pull (less than 5 lb.) to test for an intermittent connection.
10. To perform the following test, you will need to use a digital voltmeter with a diode test function. With the transformer’s Phoenix connector disconnected and the power off to UCP2, perform a diode test across the corresponding pair of current transformer input pins on the Starter module (header J5). The meter should read from 1.0 to 1.5 volts for each current transformer input. Repeat using the opposite polarity. The same reading should result. Extreme errors suggest a defective Starter module. If the diode voltage drops prove accurate, reconnect the transformers to the Starter module and re-power the unit.
11. With the CTs reconnected to the Starter module, attempt a restart of the chiller. As the compressor is started, and the inrush locked rotor transient has passed, (locked rotor transient should last less than one second) simultaneously monitor the actual compressor phase current(s) (using a clamp-on type ammeter) and the voltage developed at the respective current transformer's termination at the Starter module (using a digital volt-meter on a 0-20 VAC scale). Refer to Table 4-3 for the compressor phase current to output voltage relationship for each extension current transformer. Using Table 4-3, look up the current that corresponds to the output voltage read by the voltmeter and compare to ammeter reading. Assuming relatively accurate meters, the values should agree to within 5%.
12. If the measured current and the output voltage from the CT agree within the tolerance specified, the CT is good. If diagnostics, overload trips, or other problems potentially involving current sensing continue to occur with all phase currents to the compressors verified to be within the nor-

mal range, then the problem is either with the CT selection, Current Overload Settings #1 and #2, or the starter module's current input. Since the first two items were verified above, that leaves only the Starter module circuitry as an issue. It is advisable to replace the Starter module at this point unless the unit has a remote mounted starter. If there is a remote mounted starter proceed with the next step.

13. Unit with remote mounted starters must not exceed the maximum lead length. Refer to table 4-4 for specifications on lead lengths.
14. If no phase currents are measured with the amprobe on any or all of the legs to a given compressor immediately following the attempted staging of that compressor by the Starter module, the problem lies either with the contactor, motor circuit or the Starter module relay outputs. Refer to Section 9 for module checkout procedures.

Table 4-3: Line Current vs. Current and Volts

Table 4-3: Line Current vs. Current and Volts

Line Current (%)	**Terminal Input Current (mA RMS)**	**Terminal Volts (VAC RMS)** (±5)
0	0	0
5	5	1.2
10	10	1.4
15	15	1.5
20	20	1.7
25	25	1.8
30	30	2.0
35	35	2.1
40	40	2.2
45	45	2.4
50	50	2.5
55	55	2.6
60	60	2.8
65	65	2.9
70	70	3.0
75	75	3.2
80	80	3.3
85	85	3.4
90	90	3.6
95	95	3.7
100	100	3.8
105	105	4.0
110	110	4.1
115	115	4.2
120	120	4.4
125	125	4.5
130	130	4.6
135	135	4.8
140	140	4.9
145	145	5.0
150	150	5.1
160	160	5.4
170	170	5.7
180	180	6.0
190	190	6.2
200	200	6.5
210	210	6.7
220	220	7.0
230	230	7.3
240	240	7.5
250	250	7.8
260	260	8.0
270	270	8.3
280	280	8.6
290	290	8.8
300	300	9.1

Table 4-4: Maximum Wire Length for Remote Mounted Starters

Wire Gauge	MAX Lead Length (ft.)	MAX Lead Length (m)
8	1362	415
9	1080	329
10	856	261
11	679	207
12	538	164
13	427	130
14	338	103
15	268	81
16	213	65
17	169	51
18	134	40
19	106	32
20	84	25

Section 5
UNDER-OVER VOLTAGE TRANSFORMER

5-1. GENERAL

The hardware required for the Under-Over voltage sensing function of UCP2 is optional on the RTHB 130-450 units. This feature must be enabled in the Field Start-up Group in the Service Settings Menu for it to be active. Three custom designed transformers whose primary is connected across the Line Voltage phases, provides a stepped down and isolated AC voltage to the Starter module at input J3. This secondary voltage is directly proportional to the line voltage applied to the primary.

The Compressor Report on the CLD can display the Compressor Phase Voltages and, when so enabled, can cause an MAR (machine shutdown-automatically resettable) diagnostic for High and Low Line voltage conditions. With the Under-Over Voltage Protection Function enabled, an Over Voltage diagnostic will start integrating to trip if the line voltage is above 10% of the nominal voltage set in the Machine Configuration Group under Service Settings menu. The Under Voltage diagnostic will start integrating to trip if the line voltage drops below 10% of the nominal voltage. Trip time is a minimum of 1 minute to a maximum of 5 minutes.

WARNING
HIGH VOLTAGE

5-2. UNDER-OVER VOLTAGE TRANSFORMER CHECKOUT

1. Locate the Under-Over Voltage Transformers [2T6, 2T7, 2T8] in the panel by referring to the Component Location Drawing. Carefully measure the primary voltage across each transformer and note the value in VAC rms.
2. Next disconnect the transformer’s secondary from J3 on the Starter module. Using voltmeter probes, measure and note the unloaded secondary voltage (VAC rms) (low voltage class 2 less than 32 VAC).
3. The ratio of the primary or line voltage to the open circuity secondary voltage should be 20 to 1. If the unloaded turns ratio is not within 2% of this value, replace the transformer.
4. Reconnect the secondary back to J3 and re-measure the loaded (connected) secondary voltage. The new loaded ratio should be approximately 20.2 to 1. If not within 2% of this ratio, the transformer's secondary should be disconnected from the Starter module and a 1 kOhm resistor connected across the secondary. Measuring the voltage across the 1 kOhm resistor should yield a voltage ratio of 20.17. Ratios more than ±2% in error suggest a bad transformer. If the 1kOhm loaded ratio is within tolerance, but the UCP2 connected ratio is out of tolerance, suspect a bad Starter module. Before replacing the Starter module, double check the Unit Line Voltage programed in the Machine Configuration Group under Service Settings. It should match the nameplate unit line voltage.
5. If the Under-Over Voltage Protection function continues to trip the unit, and all of the above measured ratios are within tolerance, and all CLD Under-Over Voltage setups have been verified, replace the Starter module.

Section 6
COMPRESSOR LOAD/UNLOAD SOLENOID CHECKOUT

6-1. GENERAL

The 130 to 450 ton compressors on RTHB units are loaded and unloaded by means of an internal slide valve. In simple terms, the valve can regulate the amount of "bite" of the compressor rotors as they turn at relatively constant speeds.

The slide valve is moved by a hydraulic cylinder and piston internal to the compressor (the hydraulic fluid is oil). The movement of the cylinder is controlled by the load and unload solenoid valves, which either add oil at compressor discharge pressures, or withdraw oil to suction pressures.

Although the solenoids are "on - off" devices, effective modulation and high resolution of the slide valve (under steady state conditions) is possible by pulsing the solenoid valves on and off and varying the displaced volume of the cylinder/piston. When the compressor is operating, the 1U2 Circuit module will energize (apply 115 VAC) either the load or the unload solenoid, if necessary. The solenoids are energized for a period of between 40 and 400 milliseconds, once every 10 seconds to control the leaving evaporator water temperature or limit conditions.

After a compressor stop, the unload solenoid valve will remain energized to prevent slide valve movement due to changing cylinder/compressor pressures.

The procedure below will allow the checkout of the Circuit module load and unload outputs. The subsequent procedure will allow the checkout of the load and unload solenoid valves located on the compressor as well as the operation of the slide valve piston.

6-2. CHECKOUT PROCEDURE FOR 1U2 LOAD/UNLOAD OUTPUTS

The 1U2 controls the load and unload solenoid valves on the compressor with 115 VAC triacs (solid state relays). Unlike mechanical relays, a triac has a rather high leakage current when off, comparatively speaking. While this leakage is not nearly enough to actuate a solenoid valve, it may, under no load conditions (as would be experienced when a solenoid coil failed open), look like it was stuck "on" when using a voltmeter to test it. It is important to verify that the solenoid coil is providing a normal load. Connecting a known good load, such as a low wattage 115 Volt lamp, to the terminals when testing the outputs may help. Refer to the chiller control wiring diagrams and component location drawings for the following procedure.

WARNING

The following procedure is done with power applied to the modules and control circuits. Use extreme caution when performing this procedure. As mentioned above, the unload solenoid valve will be powered by the 1U2 and remain energized if the compressor is off. Also the compressor and associated solenoids etc. may be started or energized at any time under automatic control.

When a triac is off, about 0 Vac should be measured on its terminal with the solenoid load connected. When it is on, the voltage should be close to 115 Vac (the drop across the triac is about 1-2 volts).

To determine if the solenoids are being energized perform the following steps:

1. Wire a low wattage lamp in series with the solenoids. If a low wattage lamp is not available, check for magnetism on top of the solenoids during each pulse with the tip a of a screwdriver.
2. Enter the Service Test Menu and change the "Slide Valve Control Setting is:" from Auto to Load.

NOTE: The red diagnostic light will energize and remain steady anytime an item in the Service Test menu is set to something other than “AUTO”.

NOTE: Adaptive control can alter the test if the chiller is in a limit or near setpoint. Monitor the operating mode to verify that the test is accurate.

3. Increase the next menu item, under the Service Test Menu, “Manual Load/Unload Duty Cycle”, up to 50%. This will increase the rate of pulses sent to the solenoids to ease in testing.
4. Measure the voltage from terminal J4-1 (load) to neutral. The voltage should increase to approximately 115 VAC for a short period every ten seconds and then decrease back to 0 VAC. Ensure that only the load solenoid is being energized.
5. Change the “Slide Valve Control” under Service Tests from “Load” to “Unload”.
6. Measure the voltage from terminal J6-1 (unload) to neutral. The voltage should increase to approximately 115 VAC for a short period every ten seconds and then decrease back to 0 VAC. Ensure that only the unload solenoid is being energized.
7. If either solenoid is not being energized when commanded check all wiring to and from the solenoids.
8. Measure the power supplied to the Starter module. Measure the voltage from J4-2 to ground and J6-2 to ground. The 115 VAC should be present at all times. If it is not present, the problem is either from the wiring or a faulty 2T4 120 V control power transformer.

If the solenoids and the 1U2 board pass the electrical test but the unit is still not loading properly, proceed to the next section.

6-3. CHECKOUT PROCEDURE FOR THE SLIDE VALVE AND LOAD/ UNLOAD SOLENOIDS

1. Connect a manifold gauge set to the schrader valve located near the load and unload solenoid valves. This schrader allows access to the pressure behind the piston. Use hoses that are long enough to allow reading the gauges while viewing the CLD.
2. Clamp on an ammeter to monitor the actual amp draw during this procedure.
3. Allow the compressor to start under normal conditions. At start-up, the pressure behind the piston must be close to suction pressure under normal operation.
4. Enter the Service Test menu on the CLD and scroll down to “Slide Valve Control is:”. Change the setting to “Load”.

NOTE: The red diagnostic light will energize and remain steady anytime an item in the Service Test menu is set to something other than “AUTO”.

5. Scroll to the next display “Manual Load/Unload Duty Cycle” and increase the percentage to 50%. This will increase the rate of pulses sent to the solenoids to load and unload the compressor faster.
6. Monitor the pressure behind the piston and the amp draw of the unit. Both should gradually increase with each pulse of the load solenoid. Ensure that the load solenoid is actually being energized.

NOTE: All limits are still active. If the chiller enters into a condenser, current or evaporator limit it will effect the load signals sent to the solenoid. Continuously monitor the operating mode under the Chiller Report during this process.

7. After monitoring the unit for 5-10 minutes change the “Slide Valve Control is:” display under Service Tests from “Load” to “Hold”, after recording the pressure behind the piston.
8. In the “Hold” mode, the pressure behind the piston should remain relatively constant. (No more than 10-15 psi variation).
9. After monitoring for 5-10 minutes, change the “Slide Valve Control is:” display to “Unload”. The pressure behind the piston and the RLA of the unit should gradually decrease with each pulse sent to the unload solenoid.

NOTE: The pressure behind the piston should be approximately suction pressure when the compressor is fully unloaded. The RLA will be dependent on the application.

10. After monitoring the system in the three positions of load, hold and unload, change the “Slide

Valve Control Is:" display back to "Auto" to allow for automatic control of the slide valve.

With the results from the above checkout procedure use Table 6-1 to determine the possible causes of the loading problem.

Table 6-1: Possible Causes to Loading Problem

Possible Operation	Recorded Measurement	Load	Unload	Hold
Operating properly	**Piston Pressure**	increase	decrease	remain constant
	Amp Draw	increase	decrease	remain constant
Stuck piston	**Piston Pressure**	increase	decrease	remain constant
	Amp Draw	remain constant	remain constant	remain constant
Leaking load solenoid, internal leak or leaking piston	**Pressure**	increase	increase	increase
	Amp Draw	increase	increase	increase
Leaking unload solenoid	**Pressure**	remain constant or decrease	decrease	decrease
	Amp Draw	remain constant or decrease	decrease	decrease

Section 7

ELECTRONIC EXPANSION VALVE CHECKOUT

7-1. GENERAL

The Electronic Expansion Valve is an electronic flow device which replaces one set of the fixed orifices used on earlier RTHA units. The valve uses a stepper motor consisting of two windings to modulate.

The Chiller module monitors discharge superheat under normal operating conditions and modulates the EXV in accordance with the actual discharge superheat. If the superheat rises above the discharge superheat control point, the Chiller module sends a signal to the Stepper module to open the EXV. If the superheat falls below the discharge superheat control point, the Chiller module sends a signal to the stepper module to close the EXV.

A malfunctioning EXV can exhibit several different diagnostics. A diagnostic will appear if the EXV is failing mechanically or electrically or if the stepper module is defective. Use the following procedure to determine the cause of the diagnostic.

7-2. STEPPER MODULE CHECKOUT PROCEDURE

The Stepper module must be powered for the operation of the electronic expansion valve. If any of the voltages listed in Table 7-1 are out of range, either the 1U3 is not receiving any power, or the 1U3 Stepper module is malfunctioning.

Table 7-1: Stepper Module Voltage Limits for EXV

Connector	Voltage (VAC)	Voltage (VDC)
J2-1 to J2-2	20.4 to 33.12	0
J2-1 to case	10 to 17	13.12 to 21.81
TP1 (35V) to ground	100 mVAC to 72 mVAC	26 to 48
TP2 (5V) to ground	0	4.8 to 5.2
TP3 (14V) to ground	0	11.45 to 15.75
TP4 (24V) to ground	0	23.2 to 25.1

Table 7-1: Stepper Module Voltage Limits for EXV

7-3. EXV MOTOR AND WIRING CHECKOUT PROCEDURE

If the integrity of the EXV motor is suspect, use the following procedure to check the expansion valve motor and wiring.

7-3a. Motor Winding Resistance Checkout

1. With UCP2 powered, press the "STOP" button once.
2. In the Service Test menu, change "EXV Control is:" to "Manual".

NOTE: The red diagnostic light will energize and remain steady anytime an item in the Service Test menu is set to something other than "AUTO".

3. In the Service Test menu, change "Expansion Valve Position:" to 100% open.
4. Unplug the J2 connector (power) on the 1U3 stepper module.
5. Unplug the J8 connector from the 1U3.
6. Measure the resistance of the EXV motor windings across the disconnected J8 connector. Use Table 7-2 for acceptable resistance values.

Table 7-2: EXV Resistance Values

Pin Connections	Acceptable Resistance Range (milli Ohms/ Ohms)	Nominal Resistance (Ohms)
W1: J8-4 to J8-2	50 milliΩ to 5Ω	1.68
W2: J8-3 to J8-1	50 mileΩ to 5Ω	1.68
NOTE: All other points to each other and to ground are open circuits.		

7. If the valve does not pass the resistance test, either the connector, wiring to the valve, or the valve is defective.
8. Re-connect all plugs and change “EXV control is:” back to “Auto”.

7-3b. Motor Voltage Checkout Procedures

If the resistance values are correct and the stepper module is being powered correctly, the motor voltages need to be measured while the valve is stroking.

1. In the Service Test menu, change “Expansion Valve Test:” to “Enabled”. With the test enabled, wait for the timing test to begin before recording voltages.
2. Use Table 7-3 to check voltages.

Table 7-3: EXV Motor Voltages

Connector Pin	Voltage (VAC)	Voltage (VDC)
J8-4 to J8-3	16.7 to 23.3	-250mV to 250 mV
J8-4 to J8-2	18.2 to 24.0	-30 mV to 30 mV
J8-4 to J8-1	16.7 to 23.3	-250 mV to 250 mV
J8-3 to J8-2	16.7 to 23.3	-250 mV to 250 mV
J8-3 to J8-1	18.2 to 24	-30 mV to 30 mV
J8-2 to J8-1	16.7 to 23.3	-250 mV to 250 mV
J8-4 to ground	11.1 to 15.7	6.6 to 7.0
J8-3 to ground	11.1 to 15.7	6.6 to 7.0
J8-2 to ground	11.1 to 15.7	6.6 to 7.0
J8-1 to ground	11.1 to 15.7	6.6 to 7.0

3. If the voltages do not fall within the acceptable range, the 1U3 stepper module needs to be replaced.

Section 8
INTERPROCESSOR COMMUNICATION (IPC) CHECKOUT

8-1. DESCRIPTION

The respective modules communicate with each other via an InterProcessor Communication link (IPC). The IPC link allows the modules to work in a coordinated manner with the 1U1 directing overall chiller operation while each module handles specific subfunctions. This IPC link is integral and necessary to the operation of UCP2 and should not be confused with the Optional ICS (Integrated Comfort System) communication.

In the IPC communication protocol scheme, the 1U1 acts as the initiator and the arbitrator of all module communication. The 1U1 essentially requests all the possible “packets” of information from each module in turn, (including itself), in a predefined serial sequence. The other modules act as “responders” only and cannot initiate communication. Modules which are not currently responding to a specific request, can listen to the data and thus, indirectly, communicate with each other. It is helpful to remember when troubleshooting that a module must be able to hear a request for its information from the 1U1, or it will not answer.

1. The link is non-isolated, which means that a good common ground between all modules is necessary for trouble-free operation (provided by the module enclosures' mounting using star washers). Also, the link requires consistent polarity on all module interconnections. Connections between modules are made at the factory, using unshielded 18 gauge twisted pair cable. This connector is plugged onto the 4 pin IPC connection jack designated as Jl, located in the upper left corner of the PC board edge on all of the modules. The 4 pins actually represent 2 pairs of communications terminals (Jl-l (+) internally connected to Jl-3, and Jl-2 (-) internally connected to Jl-4) to allow for easy daisy chaining of the buss.

8-2. IPC DIAGNOSTICS

The modules, in order to work together to control the chiller, must constantly receive information from each other over the IPC link. Failure of certain modules to communicate or degradation of the communication link, could potentially result in chiller malfunction. To prevent this situation, each module monitors how often it is receiving information from other designated modules. If a module fails to receive another module's transmitted data over a 15 second time period it will:

1. Take specific action to safely shut-down (or to default) its controlled loads.
2. Report a diagnostic to the 1U1 (over the IPC link).

The 1U1 (if it properly receives such) will then report and display the diagnostic on the Clear Language Display. The diagnostic will:

1. Identify which module is reporting the communication problem.
2. Identify which module was to have sent the missing information.

The 1U1 will then send out further commands to the other modules to shutdown or take default actions as the particular case may warrant.

All IPC diagnostics are displayed in the Clear Language Display's diagnostics section. For example, “Chiller: Loss of Comm with Options” indicates that the 1U1 has detected a loss of IPC communication from the Options module. When some problem exists with the IPC link or a module fails, it is common for more than one of these IPC diagnostics to be displayed. Note that only those diagnostics that are indicated to be active currently exist. All other historic diagnostics should be disregarded for the purpose of the following troubleshooting discussion.

8-3. TROUBLESHOOTING MODULES USING IPC DIAGNOSTICS

Communication problems can result from any of the following:

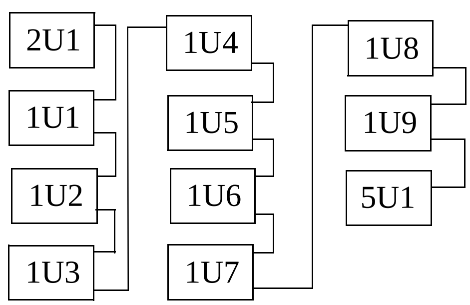
1. Opens or shorts in the twisted pair IPC wiring or

connectors
2. Loss of power to a module
3. Internal module failure
4. Incorrect polarity
5. High levels of EMI (Electro-Magnetic Interference)
6. Module specific function selected without the Options module.
7. Loss of ground

These are discussed in more detail in the following paragraphs.

8-3a. Opens or shorts in the twisted pair IPC wiring or connectors:

One or more modules may be affected by an open or a short in the IPC wiring, depending on the location of the fault in the daisy chain. The diagram below shows the daisy chain order and is helpful in the diagnosis of an open link.



8-3b. Loss of power to a module:

Generally, a power loss to a particular module will only affect communications with that module. The module can usually be identified by analysis of the IPC diagnostics.

NOTE: If the CLD is blank, check power to the CLD.

Loss of power can most directly be diagnosed by measuring the 24 VAC voltage at the 4 pin J2 connector on all modules. Each module will have between 20 and 28 VAC across J2 1-2 and J2 3-4.

8-3c. Internal module failure:

Internal module failures usually result only in communication loss to the failed module, but could, in some cases, affect all the modules because the failed module may lock-up the IPC bus and prevent all communications. The former can be identified by analyzing all of the active diagnostics. The latter can be identified through a process of elimination, whereby each module, in turn, is taken out of the IPC link and a jumper is installed in its place. Reset the 1U1 and analyze the new diagnostics produced.

8-3d. Incorrect Polarity:

Refer to the wiring schematic and confirm that all black wires in the twisted pair connect to the positive (+) terminals (either pin 1 or 3) of all the modules. Then confirm that all of the white wires of the twisted pair connect to the negative (-) terminals (either pin 2 or 4) of all the modules.

8-3e. High levels of Electro-Magnetic Interference:

The modules and the IPC link have been qualified under numerous and severe EMI (both radiated and conducted) and the system judged to be immune to all but extremely high noise levels. Always be sure to close and latch the control panel cabinet doors as the panel enclosure provides significant shielding and is integral in the overall noise immunity of the control system.

8-3f. Module specific function selected without the Options Module:

If any of the functions on the Options module are selected but the Options Module is not present, UCP2 will look for this module and generate an error. The Options module functions include Chilled Water Reset, Ice Machine Control, External Chilled Water Setpoint, External Current Limit Setpoint, and Tracer/Summit Communications.

8-3g. Loss of common ground:

Verify that a good ground exists between all modules. The CLD requires a dedicated green wire ground. Verify that it is place and has a good connection. The starter module also has a dedicated grounding strap. Ensure that the grounding strap on the starter module is secured tightly to the starter panel and that all paint under the grounding strap is removed.

8-4. TROUBLESHOOTING PROCEDURE

8-4a. Troubleshooting Loss of Communication Diagnostics

1. Place the UCP2 in “Stop” by pressing the stop key once. Record the active IPC diagnostics as shown in the Diagnostics Report of the CLD. The communication failure diagnostics and their meanings are shown in IPC Diagnostics of the RTHB-IOM-1 manual.
2. Determine which modules are not talking. These modules must be affected by one of the previously stated problems. If there is a group of modules not talking, suspect a wiring problem early in the daisy chain link. If only one module is not talking, suspect a loss of power.
3. Determine which modules are still talking. Wiring to these is likely to be OK.
4. Try disconnecting the link or jumping out modules in the link at various places. Reset the diagnostics and note which diagnostics reappear. Here are some examples of IPC diagnostics:

Diagnostics present:
[ ] Circuit: Loss of Comm with Starter
[ ] Chiller: Loss of Comm with Starter
[ ] Options: Loss of Comm with Starter

The Chiller, Circuit And Options module are unable to communicate with the starter module. Suspect a power problem to the starter module or a wiring problem with the IPC link.

Diagnostics present:
[ ] Chiller: Loss of Comm with Starter
[ ] Chiller: Loss of Comm with Circuit
[ ] Chiller: Loss of Comm with Stepper
[ ] Chiller: Loss of Comm with Options

The Chiller module is reporting that it cannot talk to any of the other modules. Suspect a shorted IPC buss or a module locking up the bus. The Chiller module could also be bad and not be sending recognizable tokens. Discriminating between these possibilities is done by disconnecting the link or jumping out modules in the link at various places.

There are a large number of possible combinations of diagnostics. One must deduce what is causing the problem using all available information.

8-4b. Troubleshooting Data Not Valid Diagnostics

If the IPC link between the CLD and the chiller module is broken it will produce:

No Communication, Data Not Valid

1. Check the IPC link between the Chiller module and the CLD. If it is OK proceed with the next step.
2. Perform the above checkout procedure.
3. If the message still did not go away, unplug all of the IPC connections from the Chiller module except for the IPC link that goes to the Clear Language Display.
4. Establish communication with only the Chiller module and then plug the other IPC connections back onto the Chiller module one at a time. If the “No Communication, Data Not Valid” message suddenly reappears when you plug one of the connections back in, the IPC link that is causing the fault is identified. Carefully check that link for a lead to lead short or a short to ground.

Section 9
MODULE POWER AND MISCELLANEOUS I/O CHECKOUT

9-1. GENERAL

This section details the normal voltage levels present on each of the modules' inputs and outputs under various conditions or states. Typical operation of the I/0 will be discussed in terms of chiller operation. This should help the serviceman determine when and how the modules should function. Certain inputs have been presented in greater detail in earlier sections, and these are referenced where applicable.

9-2. POWER SUPPLY

All of the modules are powered from 24 VAC control power. This power is provided by a factory installed control power transformer. The modules have incoming power connected to J2. The terminal is arranged with two hot pins (1 and 3) and two neutral pins (4 and 2), for ease of "daisy chaining" power from one module to another. Pins 1 and 3 and pins 2 and 4 are internally jumpered. Incoming power can be verified by measuring the voltage between J2-1 or 3 to J2- 2 or 4. The voltage should read be approximately 24 VAC rms.

If some modules have power and some do not, the "daisy chain" wiring or power connections should be suspected. Refer to the Unit Wiring diagrams for the specifics on the power wiring.

Generally a power loss to a particular module will first be noticed as a communications loss with that module. The module can be identified by analysis of the IPC diagnostics as displayed by the UCP2. Refer to Section 8 Interprocessor Communication for more information about Communication diagnostics. If the CLD's display is blank, 24 VAC power should be checked at the CLD.

9-3. CLEAR LANGUAGE DISPLAY (CLD) KEYPAD OVERVIEW (1U4)

9-3a. General

Local operator interface with the system is accomplished using the 16 keys on the front of the Clear Language Display panel. The readout screen is a two line, 40 character liquid crystal display with a backlight. The backlight allows the operator to read the display in low-light conditions. Depressing any key will activate the backlight. The backlight will stay activated for 10 minutes after the last key is pressed.

9-3b. Select Report Group

This group of four keys allows the operator to select and view the following reports:

[ ] Custom Report
[ ] Chiller Report
[ ] Refrigerant Report
[ ] Compressor Report

The Custom Report is the only report that is defined by the operator. Any display under the other three reports can be added to the Custom Report by pressing the plus (+) key while the desired read-out is on the display. A maximum of 20 entries can be contained under the Custom Report. Items can be deleted from the Custom Report by pressing the minus (-) key when the desired read-out is on the display. The operator must be in the Custom Report menu to delete the desired item.

The Chiller, Refrigerant and Compressor Reports are informational reports showing current status. Each report and its contents are discussed in detail on the following pages.

When any of the four report keys are pressed, the first readout on the display will be the header. The header identifies the title of the report and summarizes the items in the report. If the headers are disabled the display will be the display listed after the heading.

The Next and Previous keys allow the operator to scroll up and down through the display items listed under the report menus. When the last item of a report is displayed and the Next key is pressed, the display will wrap around to the header of the report. When the first item of a report is displayed and the Previous key is pressed, the display will wrap around to the last item.

9-3c. Select Settings Group

The first three keys on the second row - Operator Settings, Service Settings and Service Tests - allow the operator to adjust various setpoints and perform various tests. Certain items in these groups are password protected. Refer to the Password section for additional information.

When a setpoint key is pressed, a header will be displayed.The setpoint headers identify the available items and setpoint functions.

The Next and Previous keys function in the same manner as that described in Selected Report Group, above.

Setpoint values are increased by pressing the Plus (+) key and decreased by pressing the Minus (-) key. Once a setpoint is changed, press the Enter key to accept the new setting. If the Cancel key is pressed, the setpoint value on the display will be ignored and the original setpoint will remain. The display will not advance until either the Enter or Cancel is pressed.

9-3d. Passwords

Passwords are needed to enter into the Service Setup Menu and the Machine Configuration Menu. Both of these menus are accessed through the Service Settings key. If access into these menus is necessary, follow the list of steps below:

1. Press Service Settings
2. Press Next until the readout in the display is:

PASSWORD REQUIRED FOR FURTHER ACCESS
PLEASE ENTER PASSWORD

3. To enter into the Field Start-up Group, press:
4.

+ + - - + + Enter

5. To enter into the Machine Configuration Group, press:

+ - + - + - Enter

Refer to the IOM for the list of items found in Start-up Group and Machine Configuration Group.

9-3e. Select Report Group and Select Settings Group Flowcharts

Refer to the IOM for the display readouts found under each menu. The first block of the flowchart is the header which is shown on the display after the menu key is pressed. For example:

Press Chiller Report and the readout on the display will be

CHILLER: STATUS, WTR TEMPS & SETPTS
“PRESS (NEXT) (PREVIOUS) TO CONTINUE”

Press Next to move down through the Chiller Report.
As shown in the figures, the flowchart explains the conditions that the UCP2 looks at to determine which readout is to be displayed next. For example:

Press Chiller Report to display the header

Press Next to display

OPERATING MODE	[LINE 1]
OPERATING MODE	[LINE 2]

Press Next to display

ACTIVE CHILLED WATER SETPT:	[XXX.X F/C]
EVAP LEAVING WATER TEMP:	[XXX.X F/C]

If the chiller is in the Ice Making or Ice Making Complete mode, the following display is substituted for the above display:

```
ACTIVE ICE TERMINATION SETPT:     [XXX.X F/C]
EVAP RETURN WATER TEMP:           [XXX.X F/C]
```

9-3f. Auto/Stop Keys

The chiller will go through a “STOPPING” mode when the Stop key is pressed if the compressor is running. This key has a red background color surrounding it to distinguish it from the others.

If the chiller is in the Stop mode, pressing the Auto key will cause UCP2 to go into the Auto mode.The Auto key has a green back-ground color.

When either the Auto or Stop key is pressed, Chiller Operating Mode (Chiller Report Menu) will be shown on the display.

9-3g. Power Up

When power is first applied to the control panel, the Clear Language Display goes through a self-test. For approximately five seconds, the readout on the display will be

```
SELF TEST IN PROGRESS
```

During the self-test, the backlight will not be energized. When the tests are successfully complete, the readout on the display will be:

```
6200 xxxx-xx [TYPE] configuration
Updating Unit Data, Please Wait
```

NOTE: X’s will be replaced with appropriate software revision numbers.

When updating is successfully completed, the system will default to the first display after the Chiller Report header:

```
OPERATING MODE                [LINE 1]
OPERATING MODE                [LINE 2]
```

and the backlight will be activated.

9-3h. LEDs

There are four LEDs located to the right of J1 of the CLD module. The left most TST LED should be on continuously.

CAUTION: If the TST LED blinks, it indicates the processor is repeatedly being reset. The module needs to be replaced if this is occurring.

The second LED from the left is the +5 VDC LED and should also be on continuously. It will go out if power drops below normal operating voltage. The TX LED (third from the left) should blink every second or two, as the CLD transmits on the IPC. The RX LED (fourth from the left) should blink continuously, indicating that other modules are communicating.

Table 9-1: CLD Nominal Terminal Voltage (1U4)

Terminal Designation	Description of Circuit	Nominal Terminal Voltages for Various Conditions
J1-1 (BK) J1-2 (W)	IPC Communication	19.2K Baud serial data 5 V signal level
J2-1, 2	24 VAC Power	18-30 VAC, neither side grounded

9-4. CHILLER MODULE (1U1)

9-4a. Test Points

There are two test points (TP) associated with the Chiller module. They are easily read with a DC voltmeter by probing the PC board solder pads found in the upper left hand corner of the module. The positive meter lead should be connected to the pad while referencing the negative meter lead to the board edge ground plane.

CAUTION:Do not use the aluminum module enclosure as the reference as it has an anodized surface with insulating properties.

The DC voltages shall be within the following tolerances. If not, replace the module.

9-4b. I/O Terminals

For the checkout of the I/O, refer to the Chiller Wiring Diagrams for both high and low voltage circuits. All voltages are measured between terminal pairs specified unless otherwise indicated. Nominal voltages are given and may vary by ±5%. Unregulated voltages (unreg) or 115 VAC voltages may vary by ± 15%.

Table 9-2: Test Point Voltages for 1U1 Module

Test Point	Voltage (VDC)
TP1	4.8 to 5.2
TP2	23 to 25

Table 9-3: Chiller Module Nominal Terminal Input and Output (1U1)

Terminal Designation	Description of Circuit	Normal Terminal Voltages for Various Conditions
J1A-1, 3 (BK) J1A-2, 4 (W) J1B-3 (BK) J1B-4 (W)	IPC Communications	19.2 kbaud serial data, 5 volt signal level. Refer to Interprocessor Communication (IPC)
J2-1 or 3 to J2-2 or 4	Input Power	115 VAC, Refer to Power Supply
J3-1, 2	Evap. Entering Water Temp. Sensor	Refer to Temperature Sensor Checkout
J3-3, 4	Evap.Leaving Water Temp. Sensor	Refer to Temperature Sensor Checkout
J3-5, 6	Condenser Entering Water Temp. Sensor	Refer to Temperature Sensor Checkout
J3-7, 8	Condenser Leaving Water Temp. Sensor	Refer to Temperature Sensor Checkout
J5-1, 2	External Auto Stop	open: 115 VAC - stop closed: < 5VAC - Auto Must be jumpered if feature is not used
J5-3, 4	Emergency Stop	open: 20.6 VDC unreg -stopped closed: 0 VDC - normal Must be jumpered if feature is not used
J5-5, 6	Outdoor Air Temp. Sensor	Refer to Temperature Sensor Checkout
J12-1, 2	Chilled water pump starter (N.O. contact)	Dry SPST contact closes when chilled water demand switch closes, opens after time delay specified in UCP2 Evap Pump Off Delay specified under the Service Settings Menu.
J14-1, 2	Condenser water pump starter (N.O. contacts)	Dry SPST contact closes when call for cooling is established. Contact opens on compressor shutdown.

Table 9-3: Chiller Module Nominal Terminal Input and Output (1U1)

Terminal Designation	Description of Circuit	Normal Terminal Voltages for Various Conditions
J16-3, 2	Compressor Running (N.C. contacts)	Dry SPDT contact opens once a compressor is energized. Intended for 115 VAC customer control circuit.
J16-3, 1	Compressor Running (N.O. contacts)	Dry SPDT contact closes once a compressor is energized. Intended for 115 VAC customer control circuit.
J18-3, 2	Alarm Relay (N.C. contacts)	Dry SPDT contact opens on alarm to produce a latching diagnostic on the controller. Intended for 115 VAC customer control circuit.
J18-3, 1	Alarm Relay (N.O. contacts)	Dry SPDT contact closes on alarm to produce a latching diagnostic on the controller. Intended for 115 VAC customer control circuit.
J20-1, 2	Limit Warning Relay (N.O. contacts)	Any time the UCP2 calls out a limit in the operating mode the dry SPST contact closes. Intended for 115 VAC customer control circuit.
J26-1, 2	Chilled Water Flow Switch input	open: 115 VAC - means no flow closed: <5 VAC - means flow (Software imposes a 6 second delay before responding to an open or closed contact.)
J28-1, 2	Condenser Water Flow Switch input	open: 115 VAC - means no flow closed: <5 VAC - means flow (Software imposes a 6 second delay before responding to an open or closed contact.)

9-5. CIRCUIT MODULE (1U2)

9-5a. Test Points

There are two test points (TP) associated with the Circuit module. They are easily read with a DC voltmeter by probing the PC board solder pads found in the upper left hand corner of the module. The positive meter lead should be connected to the pad while referencing the negative meter lead to the board edge ground plane.

CAUTION:Do not use the aluminum module enclosure as the reference as it has an anodized surface with insulating properties.

The DC voltages shall be within the following tolerances. If not replace the module.

Table 9-4: Test Point Voltages for 1U2 Module

Test Point	Voltage (VDC)
TP1	4.8 to 5.2
TP2	23 to 25

9-5b. I/O Terminals

For the checkout of the I/O, refer to the Chiller Wiring Diagrams for both high and low voltage circuits. All voltages are measured between terminal pairs specified unless otherwise indicated. The “A” phase connects to J2-2 or J2-4 and the “B” phase connects to J2-1 or J2-3. Nominal voltages are given and may vary by ±5%. Unregulated voltages (unreg) or 115 VAC voltages may vary by ± 15%.

Table 9-5: Circuit Module Nominal Terminal Voltages (1U2)

Terminal Designation	Description of Circuit	Normal Terminal Voltages for Various Conditions
J1A-1, 3 (BK) J1A-2, 4 (W) J1B-3 (BK) J1B-4 (W)	IPC Communications	19.2 kbaud serial data, 5 volt signal level. Refer to Interprocessor Communication (IPC)
J2-1 or 3 to J2-2 or 4	Input Power	115 VAC, Refer to Power Supply
J3-6 (common) 5, 3,1	Motor Winding Temperature Sensors	Refer to Temperature Sensor Checkout
J4-1, 2	Load solenoid output	Triac output. Refer to Section 6, Compressor Load/ Unload Solenoid Checkout
J5-1, 2	Oil Differential Pressure Switch (N.C.)	Open: 24 VDC - Differential pressure > 50 psid Closed: 0 VDC - Differential pressure < 50 psid Closed indicates normal pressure drop across oil line service valve, oil filter and master solenoid.
J5-5, 6	Refrigerant Monitor input signal	4-20 MA for 0-100 PPM
J6-1, 2	Unload Solenoid	Triac output. Refer to Section 6, Compressor Load/ Unload Solenoid Checkout
J7-1, 2	Percent Condenser Pressure	2-10 VDC output 2 VDC = 0 psig 10 VDC = 100% of HPC as set in UCP2
J20-1, 2	Oil Tank heater	Normally open contact, powers heater when compressor is off.
J22-1, 2	Master oil line solenoid	Normally open contact, closes to power solenoid when compressor is running. Master solenoid valve is closed when de-energized.
J26-1, 2	High Pressure Cutout Input	Closed: 0 VDC - Condensing pressure is < 405 psi Open: 24 VDC - Condensing pressure > 405 psi

9-6. STEPPER MODULE (1U3)

9-6a. Test Points

There are four test points (TP) associated with the Stepper module. They are easily read with a DC voltmeter by probing the PC board solder pads found in the upper left hand corner of the module. The positive meter lead should be connected to the pad while referencing the negative meter lead to the board edge ground plane.

CAUTION: Do not use the aluminum module enclosure as the reference. The enclosure has an anodized surface with insulating properties.

The DC voltages shall be within the tolerances specified below. If not replace the module.

Table 9-6: Test Point Voltages for 1U3 Module

Test Point	Voltage (VDC)
TP1	26 to 48
TP2	4.8 to 5.2

Table 9-6: Test Point Voltages for 1U3 Module

Test Point	Voltage (VDC)
TP3	11 to 16
TP4	23 to 25

9-6b. I/O Terminals

For the checkout of the I/O, refer to the Chiller Wiring Diagrams for both high and low voltage circuits. All voltages are measured between terminal pairs specified unless otherwise indicated. Nominal voltages are given and may vary by ±5%. Unregulated voltages (unreg) or 115 VAC voltages may vary by ± 15%.

9-7. OPTIONS MODULE (1U5)

9-7a. Test Points

There are two test points (TP) associated with the Options module. They are easily read with a DC voltmeter by probing the PC board solder pads found in the upper left hand corner of the module. The positive meter lead should be connected to the pad while referencing the negative meter lead to the board edge ground plane.

CAUTION: Do not use the aluminum module enclosure as the reference as it has an anodized surface with insulating properties.

The DC voltages shall be within the following tolerances. If not, replace the module.

Table 9-7: Test Point Voltages for 1U5 Module

Test Point	Voltage (VDC)
TP1	4.8 to 5.2
TP2	23 to 25

9-7b. I/O Terminals

For the checkout of the I/O, refer to the Chiller Wiring Diagrams for both high and low voltage circuits. All voltages are measured between terminal pairs specified unless otherwise indicated. Nominal voltages are given and may vary by ±5%. Unregulated voltages (unreg) or 115 VAC voltages may vary by ± 15%.

Table 9-8: Stepper Module Nominal Terminal Voltages (1U3)

Terminal Designation	Description of Circuit	Normal Terminal Voltages for Various Conditions
J1-1, 3 (BK) J1-2, 4 (W)	IPC Communications	19.2 kbaud serial data, 5 volt signal level. Refer to Interprocessor Communication (IPC) NOTE: Polarity sensitive
J2-1 or 3 to J2-2 or 4	Input Power	115 VAC, Refer to Power Supply
J5-1, 2	Saturated Evaporator Temperature Sensor	Refer to Temperature Sensor Checkout
J5-3, 4	Compressor Discharge Sensor	Refer to Temperature Sensor Checkout
J8-2, 4	EXV winding 1	Refer to Section 7: Electronic Expansion valve Checkout
J8-1, 3	EXV Winding 2	Refer to Section 7: Electronic Expansion valve Checkout
J11-1, 2	Low Pressure Cutout	open: 24 VAC: Trip closed: 0 VAC: Normal operation If the switch is open for more than 0.5-2 seconds unit will trip on Low Evap Rfgt Pressure.

Table 9-9: Options Module Nominal Terminal Voltages (1U5)

Terminal Designation	Description of Circuit	Normal Terminal Voltages for Various Conditions
J1-3 (BK) J1-4 (W)	IPC Communications	19.2 kbaud serial data, 5 volt signal level. Refer to Interprocessor Communication (IPC)
J2-1 or 3 to J2-2 or 4	Input Power	115 VAC, Refer to Power Supply
J3-7, 8	Ice Machine Control Input	open: 24 VDC: standard comfort cooling closed: 0 VDC: Ice making mode Unit remains in ice making unit contacts open or until the entering evap. water sensor reaches the ice termination setpoint. **NOTE**: “Ice Building Options” under Service Settings, Machine Configuration Group must be Enabled. The “Ice Building: (Enable/Disable)” under Operator Settings needs to be Disabled for normal operation. This option should only be enabled when the operator wants to put the chiller into ice making immediately (i.e.: for testing).
J7-3, 4	% Compressor RLA output	2-10 VDC output signal. 2 V = 0% RLA 10 V = 120% RLA NOTE: 4-20 mA is not available.
J7-7, 8	Tracer Temp. Sensor Input	An additional temperature sensor input to tie to Tracer. Not used on stand alone units.
J7-11, 12	External Current Limit Setpoint Input (Current or voltage option)	Refer to External Setpoint Inputs
J8-1, 2	Ice Machine Relay (N.O.)	Open: Normal operation Closed: Unit running in Ice Making mode The contacts are rated for a max. of 250 VAC or 30 VDC.
J9-4, 5	External Chilled Water Setpoint (Current or voltage option)	Refer to External Setpoint Inputs
J12-1, 2	Head Relief Request Relay (N.O.)	Open: Normal operation Closed: Operating mode of Condenser Limit The contacts are rated for a max. of 250 VAC or 30 VDC.
J18-1, 3	Tracer Controlled Relay (N.C.)	On Tracer applications Tracer controls status of relay. Not used on stand alone units.
J18-2, 3	Tracer Controlled Relay (N.O.)	On Tracer applications Tracer controls status of relay. Not used on stand alone units.

9-7c. Switch SW2

Switch SW2 is used to configure the External Current Limit Setpoint input for either a 2-10VDC, or a 4- 20mA signal. For use of a 2-10 VDC signal, set SW2-1 to "OFF". For use of a 4-20 mA signal, set the SW2-1 to "ON". SW2-2 and 3 are not used.

9-7d. Switch SW3

Switch SW3 is used to configure the External Chilled Water Setpoint input for either a 2-10VDC, or a 4- 20 mA signal. For use of a 2-10 VDC signal, set SW3-1 to "OFF". For use of a 4-20 mA signal, set the SW3-1 to "ON". SW3-2 is not used.

9-7e. External Setpoint Inputs (4-20mA/2-10VDC)

The chiller setpoint source should always be set to LOCAL when using any external inputs, except Tracer. When using Tracer, always set the chiller setpoint source to the Tracer mode. The setpoint source can be found in the Operator Settings Menu.

These inputs accept either an isolated 4-20 mA or 2-10 VDC signal from an external controller or programming resistor connected to an internal +5V source. The switches SW2-1 and SW3-1 are used to select either the voltage or current option for External Current Limit Setpoint and External Chilled Water Setpoint respectively.

Items that must be set in UCP2 are:

Located in Service Settings, Machine Configuration Group (+-+-+-):
Ext Chilled Wtr Setpt: (Installed, Not Installed)
Ext Current Limit Setpt: (Installed, Not Installed)
External Analog Inputs: (4-20 mA, 2-10 VDC)

Note:For proper operation, the 4-20 mA/2-10 VDC inputs are required to be used with a current or voltage source that:

1. Is isolated (floats) with respect to ground, or
2. Has its negative terminal tied to chassis ground.

If the intended source does not meet the above requirement, an isolation module must be used.

The 4-20 mA/2-10 VDC inputs may be tested in the following ways:

1. Enable External Chilled Water Setpoint and/or External Current Limit Setpoint in the Operator Settings Menu. Advance display to Active Chilled Water Setpoint or Active Current Limit Setpoint to observe the respective setpoint in the Chiller Report.
2. With all wiring in place, **apply** an external voltage or current to the External Chilled Water Setpoint inputs (J9-4,5) or the External Current Limit Setpoint (J7-11, 12). The voltage measured at the terminals and the resulting setpoint, as read on the CLD, should agree with the Table 9-10 for Chilled Water Setpoint inputs and Table 9-11 for Current Limit Setpoints inputs. Be sure to wait long enough when reading the display as the values are filtered.

NOTE: A 9 volt battery works well when trying to diagnose a 2-10 VDC signal problem. Disconnect the signal and wire in the battery to simulate a 9 VDC signal.

3. Disconnect all wiring to these inputs. The setpoints should slew back to the chiller's Front Panel settings.

Table 9-10: Input values for External Chilled Water Setpoints

Current (mA)	Voltage (VDC)	Resulting Chilled Water Setpt (F) ±4F
4.0	2.0	0.0
5.2	2.6	5.0
6.5	3.2	10.0
7.7	3.9	15.0
8.9	4.5	20.0
10.2	5.1	25.0
11.4	5.7	30.0
12.6	6.3	35.0
13.8	6.9	40.0
15.1	7.6	45.0
16.3	8.2	50.0
17.5	8.8	55.0
18.8	9.4	60.0
20.0	10.0	65.0

Table 9-11: Input values for External Current Limit Setpoints

Input Current (mA)	Voltage (VDC)	Resulting Current Limit Setpt (%RLA) ±5%
4.0	2.0	40
6.0	3.0	50
8.0	4.0	60
10.0	5.0	70
12.0	6.0	80
14.0	7.0	90
16.0	8.0	100
18.0	9.0	110
20.0	10.0	120

9-8. TCI-COMM 3 AND 4 (1U6 AND 1U8)

9-8a. Test Points

There are two test points (TP) associated with the TCI modules. They are easily read with a DC voltmeter by probing the PC board solder pads found in the upper left hand corner each module. The positive meter lead should be connected to the pad while referencing the negative meter lead to the board edge ground plane.

Table 9-12: Test Point Voltages for 1U6 and 1U8 Modules

Test Point	Voltage (VDC)
TP1	4.8 to 5.2
TP2	23 to 25

CAUTION: Do not use the aluminum module enclosure as the reference as it has an anodized surface with insulating properties.

The DC voltages shall be within the following tolerances. If not, replace the module.

9-8b. ICS Communications

ICS communication is handled the same as on previous products using the Trane proprietary Comm3 or Comm4 standard isolated serial communication link. The following are some things to check when experiencing loss of ICS communications:

1. If ICS control is desired, check that Tracer has been selected in Setpoint Source of the Operator Settings Menu. In any case, the ICS Tracer should be able to communicate to the chiller for monitoring purposes, regardless of the Setpoint Source selection.
2. Check for the proper ICS address in the Service Settings Menu and compare to the address programmed at the ICS device.
3. Check for proper termination of the twisted pair communication link wiring to J3-1and 2 and J3-3 and 4.

Table 9-13: TCI-COMM 3 or 4 Module Nominal Terminal Voltages (1U6 or 1U8)

Terminal Designation	Description of Circuit	Normal Terminal Voltages for Various Conditions
J1A-3 (BK) J1A-4 (W) *J1A-1(BK) *J1A-2 (W) * If additional modules are used.	IPC Communications	19.2 kbaud serial data, 5 volt signal level. Refer to Interprocessor Communication (IPC)
J2-1 or 3 to J2-2 or 4	Input Power	115 VAC, Refer to Power Supply
J3-1, 2	Twisted Pair to Tracer	Comm 3 or Comm 4 signal
J3-3, 4	Twisted Pair to tracer	Comm 3 or Comm 4 signal

4. Check for a diagnostic at the display indicating loss of IPC communications with the TCI module. This could indicate IPC buss problems or a dead TCI module. The TCI module needs to receive 4 good packets of data from the Chiller before it will talk on the ICS link.

9-8c. I/O Terminals

For the checkout of the I/O, refer to the Chiller Wiring Diagrams for both high and low voltage circuits. All voltages are measured between terminal pairs specified unless otherwise indicated. Nominal voltages are given and may vary by ±5%. Unregulated voltages (unreg) or 115 VAC voltages may vary by ± 15%.

9-9. PRINTER INTERFACE (1U7)

9-9a. Test Points

There are two test points (TP) associated with the Printer Interface module. They are easily read with a DC voltmeter by probing the PC board solder pads found in the upper left hand corner of the module. The positive meter lead should be connected to the pad while referencing the negative meter lead to the board edge ground plane.

Table 9-14: Test Point Voltages for 1U7 Module

Test Point	Voltage (VDC)
TP1	4.8 to 5.2
TP2	23 to 25

CAUTION: Do not use the aluminum module enclosure as the reference as it has an anodized surface with insulating properties.

The DC voltages shall be within the following tolerances. If not, replace the module.

9-9b. Recommended Printer Setup

A serial printer must be used with the printer interface module. Several settings in the UCP2 must match the printer settings identically.

The suggested serial communications settings in the UCP2 are as follows:
Located in Service Settings menu:
Printer Option: (Installed, Not Installed)
NOTE: This setting is under the password protected Machine Configuration Group (+-+-+-) which must be "Installed" before the remaining displays will appear under the non-password protected items in Service Settings.

[ ] Print on Time Interval: (Enable, Disable)
[ ] Print Time Interval: (1-24 hrs)
[ ] Print on Diagnostic: (Enable, Disable)
[ ] Number of Pre-Diagnostic Reports: (1-5)
[ ] Printer, Baud Rate: **9600**
[ ] Printer, Parity: **None**
[ ] Printer, Data Bits: **8**
[ ] Printer, Stop Bits: **1**
[ ] Printer Handshaking: **XON-XOFF**

Table 9-15: Required Cable Part Numbers

Trane Part Number	Description
35914264	DB25 male/RJ-12 female
35914262	DB9 female/RJ-12 female
35914260	6 conductor cable with two RJ-12 male

The recommended parts needed to make the appropriate connection using Trane parts are listed in Table 9-15. If Trane parts are not used, a DB25 male to DB9 female serial printer cable is needed to make the connection.

CAUTION: For proper operation, do not use a null modem cable.

9-9c. I/O Terminals

For the checkout of the I/O, refer to the Chiller Wiring Diagrams for both high and low voltage circuits. All voltages are measured between terminal pairs specified unless otherwise indicated. Nominal voltages are given and may vary by ±5%. Unregulated voltages (unreg) or 115 VAC voltages may vary by ± 15%.

Table 9-16: Printer Interface Module Nominal Terminal Voltages (1U7)

Terminal Designation	Description of Circuit	Normal Terminal Voltages for Various Conditions
J1A-3 (BK) J1A-4 (W) OR *J1A-1 (BK) *J1A-2 (W) * Dependent on other modules used with system, refer to unit wiring for details.	IPC Communications	19.2 kbaud serial data, 5 volt signal level. Refer to Interprocessor Communication (IPC)
J2-1 or 3 to J2-2 or 4	Input Power	115 VAC, Refer to Power Supply
J4-1 thru 9	RS 232 Port	Standard RS232 signal

9-10. IPC BUFFER MODULE (1U9)

9-10a. Test Points

There are two test points (TP) associated with the IPC Buffer module. They are easily read with a DC voltmeter by probing the PC board solder pads found in the upper left hand corner of the module. The positive meter lead should be connected to the pad while referencing the negative meter lead to the board edge ground plane.

Table 9-17: Test Point Voltages for 1U9 Module

Test Point	Voltage (VDC)
TP1	4.8 to 5.2
TP2	23 to 25

CAUTION:Do not use the aluminum module enclosure as the reference as it has an anodized surface with insulating properties.

The DC voltages shall be within the tolerances specified below. If not replace the module.

9-10b. I/O Terminals

For the checkout of the I/O, refer to the Chiller Wiring Diagrams for both high and low voltage circuits. All voltages are measured between terminal pairs specified unless otherwise indicated. Nominal voltages are given and may vary by ±5%. Unregulated voltages (unreg) or 115 VAC voltages may vary by ± 15%.

Table 9-18: IPC Buffer Module Nominal Terminal Voltages (1U9)

Terminal Designation	Description of Circuit	Normal Terminal Voltages for Various Conditions
J1A-3 (BK) J1A-4 (W) OR *J1A-3 (BK) *J1A-4 (W) *J1A-1 (BK) *J1A-2 (W) OR *J1A-1 (BK) *J1A-2 (W) * Dependent on other modules used with system, refer to unit wiring for details.	IPC Communications	19.2 kbaud serial data, 5 volt signal level. Refer to Interprocessor Communication (IPC)
J2-1 or 3 to J2-2 or 4	Input Power	115 VAC, Refer to Power Supply
J3-1 (BK) J3-2 (W) J1-6 (ground shielding)	Buffered IPC	Field IPC wiring.

9-11. Starter Module (2U1)

9-11a. Test Points

There are two test points (TP) associated with the Starter module. They are easily read with a DC voltmeter by probing the PC board solder pads found in the upper left hand corner of the module. The positive meter lead should be connected to the pad while referencing the negative meter lead to the board edge ground plane.

Table 9-19: Test Point Voltages for 2U1 Module

Test Point	Voltage (VDC)
TP1	4.8 to 5.2
TP2	23 to 25

CAUTION:Do not use the aluminum module enclosure as the reference as it has an anodized surface with insulating properties.

The DC voltages shall be within the tolerances specified below. If not replace the module.

9-11b. I/O Terminals

For the checkout of the I/O, refer to the Chiller Wiring Diagrams for both high and low voltage circuits. All voltages are measured between terminal pairs specified unless otherwise indicated. Nominal voltages are given and may vary by $\pm$5%. Unregulated voltages (unreg) or 115 VAC voltages may vary by $\pm$ 15%.

Table 9-20: Stater Module Nominal Terminal Voltages (2U1)

Terminal Designation	Description of Circuit	Normal Terminal Voltages for Various Conditions
J1-1 (BK) J1-2 (W)	IPC Communications	19.2 kbaud serial data, 5 volt signal level. Refer to Interprocessor Communication (IPC)
J2-1 to J2-2	Input Power	24 VAC, Refer to Power Supply
J3-3 and J3-4 J3-5 and J3-6 J3-7 and J3-8	Under-Over Voltage transformers	Refer to Section 5.
J5-1 and J5-2 J5-3 and J5-4 J5-5 and J5-6	Current transformers	Refer to Section 4.
J7-1 and J7-2	Heat Sink Temperature Sensor (Solid State Starters only)	Refer to solid state starter service bulletin.
J7-3 and J7-4	Starter Fault Relay (Solid State Starters only)	Refer to solid state starter service bulletin.
J10-1 to J10-3	Run contact	Open: 115 VAC - Normally open at start-up, Close: 0VDC -Refer to Table 9-20 Use Starter Dry Run under Service Tests to confirm operation.
J12-1 to J12-3	Shorting contact	Open: 115 VDC - Normally open at start-up. Close: 0VDC -Refer to Table 9-20 Use Starter Dry Run under Service Tests to confirm operation.

Table 9-20: Stater Module Nominal Terminal Voltages (2U1)

Terminal Designation	Description of Circuit	Normal Terminal Voltages for Various Conditions
J14-1 to J14-3	Transition contact	Open: 115 VDC - Normally open at start-up, Close: 0VDC -Refer to Table 9-20 Use Starter Dry Run under Service Tests to confirm operation.
J4-2 to J4-1	Opto Input (Up to speed signal and At Speed Signal)	Prior to transition (wye-delta only): J4-2 to GND = 0 VAC J4-1 to GND = 0 VAC After transition (wye-delta only): J4-2 to GND = 115 VAC J4-1 to GND = 115 VAC Prior to closure of Run contacts (Across-line rev 07 or later only): J4-2 to GND = 0 VAC J4-1 to GND = 0 vac After closure of Run contacts (Across the line Rev 07 of later only): J4-2 to GND = 115 VAC J4-1 to GND = 115 VAC
J6-3 to J8-2	Stop contacts	Open: 115 VAC - Normally open Close: 0VDC -Refer to Table 9-20 Use Starter Dry Run under Service Tests to confirm operation.
J6-3 to chassis ground	Power supply for Stop and Start contacts	Normal operation: 115VAC Loss of power: 0 VAC - Confirm operation and wiring of High Pressure Cutout switch
J10-1 to J4-2	Jumper	Required on Across the Line Starters with modules of X13650453-07 (software revision -07) or later.

Table 9-21: Wye Delta Starter Sequence of Events

Interval	Description	Minimum	Maximum	Actual Design
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	Close 1M (2K2) Contactor and test for no current. Starter integrity test.			1 sec

NOTES:
(1)This time period must be long enough to verify the absence of phase currents caused by the closing of the “Short” contacts.
(2)The sum of intervals L and M are designed to be 2.5 Seconds.

The transition complete contact closure is expected to be an auxiliary contact to the “Run Contactor” (2K2).

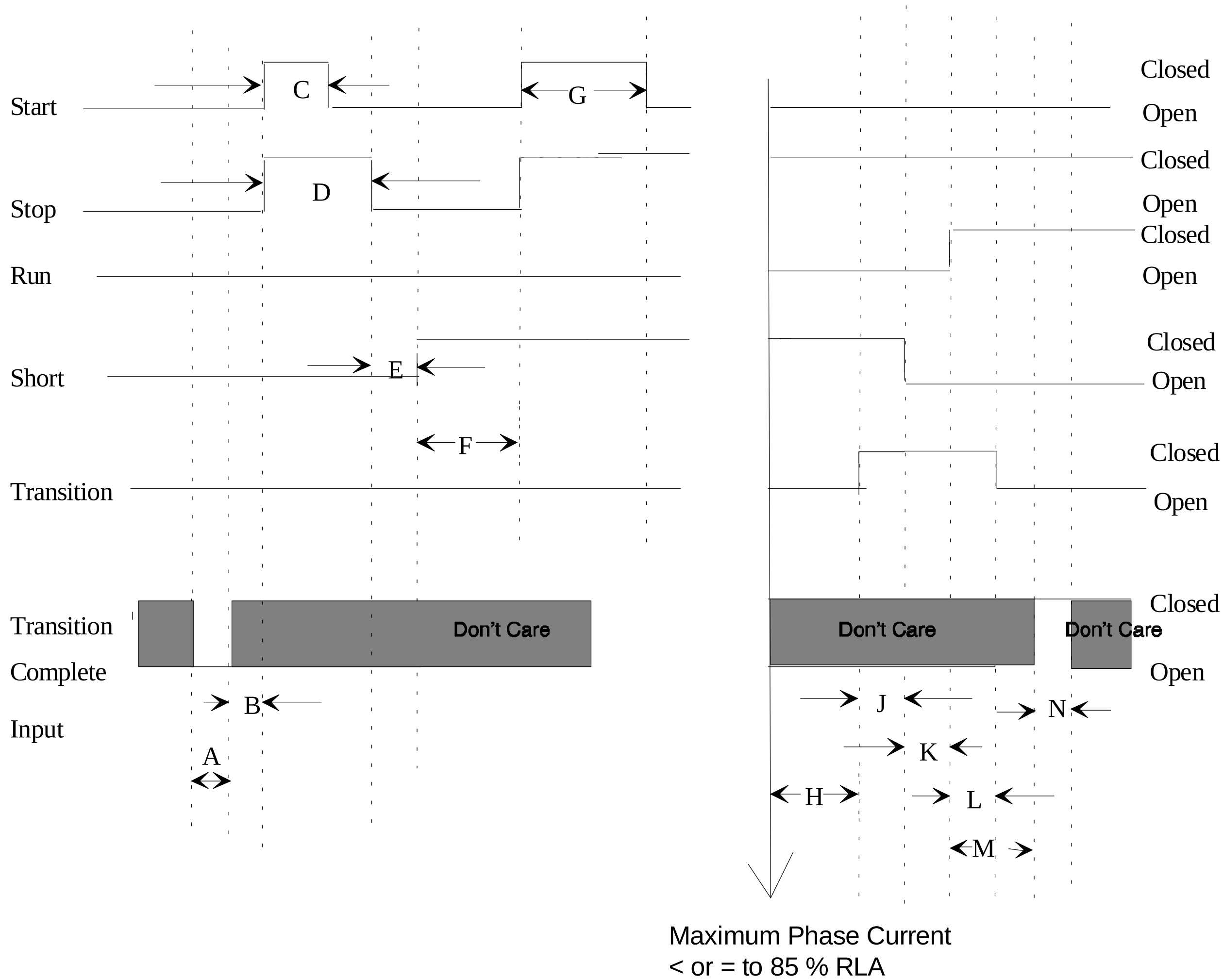
Table 9-21: Wye Delta Starter Sequence of Events

Interval	Description	Minimum	Maximum	Actual Design
E	Open 1M (2K1) Just delay time			200 msec
F	Close Shorting Contactor (2K3) and test for no current, then wait for Start command. Starter integrity test.	100 msec (1)	1	1.0 sec (Min.)
G	Close 1M (2K1)	2 sec		2 sec
H	Wait 1.5 sec after phase currents drop to 85% to Transition	1 sec	2 sec	1.5 sec
J	Begin Transition sequence	85 msec	100 m sec	100 msec
K	Open Shorting Contactor	250 msec	300 msec	260 msec
L	Wait to look for Transition complete	(2)		2.32 to 2.38 sec
M	Filtering time on Transition complete input.	(2)		120 to 180 msec

NOTES:
(1)This time period must be long enough to verify the absence of phase currents caused by the closing of the “Short” contacts.
(2)The sum of intervals L and M are designed to be 2.5 Seconds.

The transition complete contact closure is expected to be an auxiliary contact to the “Run Contactor” (2K2).

Figure 9-1.Schematic of Starter Sequence of Events (Refer to Table 9-20 for description of intervals)



Section 10
DIAGNOSTIC TABLE

10-1. GENERAL

There are three diagnostic types listed in the following table. A latching diagnostic called an MMR will shutdown the entire unit and need a manual reset to come back on line. A non-latching diagnostic called an MAR will shut the entire machine down when the condition exists but will allow the unit to come back on line automatically once the diagnostic has cleared. The third type of diagnostic is informational only, the microprocessor will let you know that a condition exists but will allow the unit to operate.

Table 10-1: Diagnostic Types and Action

Diagnostic Type	Action	Reset
MMR	Machine Shutdown	Manual Reset
MAR	Machine Shutdown	Automatic Reset
IFW	Informational Warning - no action	None required

Table 10-2: Diagnostic Table

Diagnostic Description	Type/ Shutdown Action	Module Calling Out Diag.	Operating Modes Diagnostic is Active	Cause	Help Message
At Speed Input Opened	MMR immediate	starter	All running modes	The At Speed input was found opened with the compressor running after successfully obtaining an at speed condition. Applies to solid state starters only	Refer to the solid state starter service bulletin. Refer to Sec. 9 for the starter module check-out.
At Speed Input Shorted	MMR n/a	starter	Pre-start	The At Speed input was found shorted before the compressor was started. Applies only to the solid state starters.	Refer to the solid state starter service bulletin. Refer to Sec. 9 for the starter module check-out.
Check Clock	IFW n/a	chiller	All	On loss of power the clock does not keep time, if there is an extended power loss (greater than 15 seconds) this diag. is also generated to alert the operator to check the clock.	Check Main Power Supply, Reset Clock
Chilled Water Flow Lost	MAR immediate	chiller	All modes except STOP and EXTERNAL STOP	a) The chilled water flow switch input was open for more than 6-10 contiguous seconds. b) 6-10 seconds of contiguous flow shall clear this diagnostic.	Check Pump, Valves, Flow Switch
Chiller: Loss of Comm with Rfgt Monitor	IFW n/a	chiller	All	The Chiller module lost communications with the Refrigerant Monitor for 15 contiguous seconds.	Check IPC Wiring/Connections. Refer to Sec 8 and 9.
Chiller: Loss of Comm with TCI	IFW/ n/a	chiller	All	The Tracer was setup as “installed” at the CLD and the chiller module lost communications with the TCI (comm 3 or comm 4) module for 15 contiguous seconds	Check IPC Wiring/Connections. Refer to Sec 8 and 9.
Chiller: Loss of Comm with Circuit	MMR friendly	chiller	All	The chiller module lost communications with the Circuit module for 15 contiguous seconds.	Check IPC Wiring/Connections. Refer to Sec 8 and 9.

Table 10-2: Diagnostic Table

Diagnostic Description	Type/ Shutdown Action	Module Calling Out Diag.	Operating Modes Diagnostic is Active	Cause	Help Message
Chiller: Loss of Comm with Local CLD	IFW n/a	chiller	All	The chiller module lost communications with the LCLD module for 15 contiguous seconds.	Check IPC Wiring/Con-nections. Refer to Sec 8 and 9.
Chiller: Loss of Comm with Options	IFW n/a	chiller	All	The chiller module lost communications with the Options module for 15 contiguous seconds.	Check IPC Wiring/Con-nections. Refer to Sec 8 and 9.
Chiller: Loss of Comm with Options	MMR friendly	chiller	All	The chiller module lost communications with the Options module for 15 contiguous seconds.	Check IPC Wiring/Con-nections. Refer to Sec 8 and 9.
Chiller: Loss of Comm with Starter	MMR friendly	chiller	All	The chiller module lost communications with the Starter module for 15 contiguous seconds.	Check IPC Wiring/Con-nections. Refer to Sec 8 and 9.
Chiller: Loss of Comm with Stepper #1	MMR friendly	chiller	All	The chiller module lost communications with the Stepper #1 module for 15 contiguous seconds.	Check IPC Wiring/Con-nections. Refer to Sec 8 and 9.
Circuit: Loss of Comm with Chiller	MMR friendly	circuit	All	The circuit module lost communications with the Chiller module for 15 contiguous seconds. On loss of communications, the circuit module shall continue to control the oil heater.	Check IPC Wiring/Con-nections. Refer to Sec 8 and 9.
Circuit: Loss of Comm with Starter	MMR friendly	circuit	All	The circuit module lost communications with the Starter module for 15 contiguous seconds.	Check IPC Wiring/Con-nections. Refer to Sec 8 and 9.
Cond Entering Wtr Temp Sen-sor	IFW n/a	chiller	All	Open or Short	Check sensor, wiring and connections. Refer to Sec. 3.
Cond Leaving Wtr Temp Sen-sor	IFW n/a	chiller	All	Open or Short.	Check sensor, wiring and connections. Refer to Sec. 3.
Condenser Rfgt Temp Sensor	MMR friendly	stepper	All	Open or Short	Check sensor, wiring and connections. Refer to Sec. 3.
Condenser Water Flow Lost	MMR friendly	chiller	Chilled Water Control, Start and All Run Modes	The condenser water flow switch input was open for more than 6-10 contiguous seconds, 6-10 seconds of contiguous flow shall clear this diagnostic.	Check pumps, valves, and flow switch
Condenser Water Flow Overdue	MMR friendly	chiller	Estab. Cond Water Flow	Condenser water flow was not proven within 4.25 minutes of the condenser pump relay being energized.	Check pumps, valves, and flow switch
Cprsr did not Accelerate Fully	MMR friendly	starter	Starting	Used with Solid State Starters only. The UCM did not receive an Up to Speed or At Speed Sig-nal within the Maximum Acceleration Timer Set-ting. Up to speed or At speed signals are received at the Starter module on J4-1 and 2.	Determine if SSS is ramp-ing properly. Confirm compressor is starting unloaded. Confirm opera-tion of current transform-ers. Refer to Sec. 9 for Starter module checkout.

Table 10-2: Diagnostic Table

Diagnostic Description	Type/ Shutdown Action	Module Calling Out Diag.	Operating Modes Diagnostic is Active	Cause	Help Message
Cprsr did not Accelerate: Shutdown	MMR friendly	starter	Start Mode	The compressor did not come up to speed in the allotted time defined by the Maximum Acceleration Timer. The Human Interface setups defined “Shutdown” as the action when the Maximum Acceleration Timer was exceeded.	The 2K2 aux contacts did not close in the allotted time. Check main power supply & wiring. Check 2K2 aux. contacts. Check Starter module. Refer to Sec. 9.
Cprsr Did Not Accelerate: Transition (The Motor is put across the line.)	IFW n/a	starter	Start Mode	The compressor did not come up to speed in the allotted time defined by the Maximum Acceleration Timer. The Human Interface setups defined “Transition” as the action when the Maximum Acceleration Timer was exceeded.	The 2K2 aux. contacts did not close in the allotted time. Check main power supply & wiring. Check 2K2 aux. contacts. Check Starter module. Refer to Sec. 9.
Current Overload	MMR friendly	starter	All Running Modes	Motor current exceeded overload time vs. trip characteristic.	Check CT's, refer to Sec. 4. Confirm compressor is starting unloaded. Confirm refrigerant charge, refer to RTHB-SB-6.
Current Overload Setpts Error	IFW n/a	starter	All	The redundant overload settings did not agree for 30 contiguous seconds.	Review Overload Set Up.
CWS/Leaving Wtr Temp. Cutout Setpt Overlap also Overlap of CWS and Low Refrigerant Temp Cutout.	None n/a	chiller	All	No diagnostic, limit value to last legal value.	N/A
Discharge Temp Sensor	MMR friendly	stepper	All	Open or Short	Check Sensor Wiring And Connections. Refer to Sec. 3.
Emergency Stop Input	MMR friendly	chiller	All	EMERGENCY STOP input is open. An external interlock has tripped. Time to trip from input opening to unit stop is 2 seconds.	Check Emergency Stop Input Device. Confirm Chiller Module operation, refer to Sec. 9.
Evap Entering Wtr Temp Sensor	IFW n/a	chiller	All	Open or Short. Normal operation-no effects on control. Chilled Water Reset-will run at either normal CWS or will run at maximum reset permitted.	Check sensor wiring and connections. Refer to Sec. 3.
Evap Leaving Water Temp Sensor	MMR friendly	chiller	All	Open or Short	Check sensor wiring and connections. Refer to Sec. 3.
Evap Rfgt Temp Sensor	MMR friendly	stepper	All	Open or Short	Check sensor wiring and connections. Refer to Sec. 3.
Evaporator Water Flow Overdue	MAR n/a	chiller	Estab. Evap. Water Flow on going from STOP to AUTO.	Evaporator water flow was not proven within 4.25 minutes of the Evaporator pump relay being energized.	Check pump, valves and flow switch

Table 10-2: Diagnostic Table

Diagnostic Description	Type/ Shutdown Action	Module Calling Out Diag.	Operating Modes Diagnostic is Active	Cause	Help Message
Extended Power Loss	IFW n/a	chiller	All	The unit lost power for an extended period of time.	Check Main Power Supply & Wiring
External Chilled Water Setpoint	IFW n/a	options	All	Not “Enabled”-no diagnostics. “Enabled“- Out-Of-Range Low or High, set diagnostic, default CWS to next level of priority (e.g. Front Panel SetPoint). This IFW diagnostic will automatically reset if the input returns to the normal range.	Check signal at input on the Option module. Refer to Sec. 9.
External Current Limit Setpoint	IFW n/a	options	All	Not “Enabled”- no diagnostics. “Enabled “- Out-Of-Range Low or High, set diagnostic, default CLS to next level of priority (e.g. Front Panel Setpoint. This IFW diagnostic will automatically reset if the input returns to the normal range.	Check signal at input on the Option module. Refer to Sec. 9.
EXV EIT Adjacent Terminal Short	MMR friendly	stepper	LOCAL STOP	The Expansion Valve Test detected that two adjacent outputs on J8 have been shorted.	Check Stepper module, wiring, & motor. Refer to Sec. 7.
EXV EIT, Coil 1 Open	MMR friendly	stepper	LOCAL STOP	The Expansion Valve Test detected no current flowing in Coil 1 of the stepping motor. The failure could be an open between module pin J8-4 to motor connection 1 or an open between J8-2 to motor connection 2.	Check Stepper module, wiring, & motor. Refer to Sec. 7.
EXV EIT, Coil 2 Open	MMR friendly	stepper	LOCAL STOP	The Expansion Valve Test detected no current flowing in Coil 2 of the stepping motor. The failure could be an open between module pin J8-3 to motor connection 3 or an open between J8-1 to motor connection 4.	Check Stepper module, wiring, & motor. Refer to Sec. 7.
EXV EIT, Current Setpoint Error	IFW n/a	stepper	LOCAL STOP	The Expansion Valve Test measured a step current that was not within 20% of the expected stepping motor current setpoint. A low current setpoint would result in lower confidence that a commanded step will move the valve.	Check Stepper module, wiring, & motor. Refer to Sec. 7.
EXV EIT, Module Short	MMR n/a	stepper	LOCAL STOP	The Expansion Valve Test has detected a internal module short in the Stepper Module output drive circuitry. Reset the unit and re-test the expansion valve. If subsequent tests give this error replace the Stepper module.	Check Stepper module, wiring, & motor. Refer to Sec. 7.
EXV Electrical Drive Circuit Open	MMR n/a	stepper	On Demand and Pre-Start	Run the EXV electrical drive circuit test both on demand from the human interface and just before a start.	Check Stepper module, wiring, & motor. Refer to Sec. 7.
Heat Sink Temp Sensor	IFW n/a	starter	All	Open or Short and Solid State Starter installed. Note: The Solid State Starter is expected to be protected from overheating via a thermal cutout. Since this sensor is not used to protect the starter, the failure of the sensor is treated as an IFW.	Refer to the SSS service Bulletin.

Table 10-2: Diagnostic Table

Diagnostic Description	Type/ Shutdown Action	Module Calling Out Diag.	Operating Modes Diagnostic is Active	Cause	Help Message
High Superheat in Extended Unloading (original software)	MAR friendly	stepper	Extended Unloading	The Discharge Superheat was more than 13 degrees F (7.2 C) above the Discharge Superheat Setpt for more than 7500 degree F Seconds. At the time the Integral threshold was reached the EXV was either fully open or NOT fully open.	Only applicable on original superheat software. Chiller modules X13650499-07 Rev H and earlier. Stepper modules X13650501-05 Rev G and earlier. Refer to RTHB-SB-2 for details on revised software. Diagnostic eliminated on revised software.
High Cprsr Discharge Temp.	MMR friendly	stepper	All	a. The discharge temp. exceeded the trip value; 190 F + or - 5 F. B. Time to trip is 0.5 to 2.0 seconds.	Confirm operation of discharge temperature sensor. Confirm refrigerant and oil charges, refer to RTHB-SB-6.
High Diff. Rfgt Pressure	MMR friendly	stepper	Cprsr Energized	a. The difference between the condenser pressure and the evaporator pressure exceeded 300 PSID for 0.8-5.0 seconds. 270 PSID must hold, 270+ to trip in one hour.	Confirm operation of Sat. Evap and sat. cond. rftg. sensors. Confirm operation of EXV, refer to Sec. 7.
High Discharge Superheat (original software)	MMR friendly	stepper	Any Running Mode	**Normal operating mode** - The discharge superheat was greater than 50 degrees F (nominally) for more than 1800 degree F seconds. The must hold value is 47 F while the must trip value is 53 F. **Extended unloading** - the discharge superheat was greater than 50 F for 6000 degree F seconds.	Only applicable on original superheat software. Chiller modules X13650499-07 Rev H and earlier. Stepper modules X13650501-05 Rev G and earlier. Refer to RTHB-SB-2 for details on revised software.
High Discharge Superheat (revised software)	MMR friendly	stepper	Any Running Mode	**Normal operating mode** - The discharge superheat was greater than 55-60 degrees F for more than 6500 degree F seconds. **Extended unloading** - the discharge superheat was greater than 55-60 F for 6500 degree F seconds.	Confirm EXV operation, refrigerant charge, discharge temp. sensor.
High Motor Temp Position #1	MMR immediate	circuit	Any Start and Run Mode	The Motor winding temp. at sensor #1 exceeded 265 F + or - 15 F for 0.5 - 2 seconds.	Check motor winding sensors. Refer to Sec. 3.
High Motor Temp Position #2	MMR immediate	circuit	Any Start and Run Mode	The Motor Winding Temp. at sensor #2 exceeded 265 F + or - 15 F for 0.5 - 2 seconds.	Check motor winding sensors. Refer to Sec. 3.
High Motor Temp Position #3	MMR immediate	circuit	Any Start and Run Mode	The Motor Winding Temp. at sensor #3 exceeded 265 F + or - 15 F for 0.5 - 2 seconds.	Check motor winding sensors. Refer to Sec. 3.
High Pressure Cutout Tripped	MMR immediate	circuit	All	A high pressure cutout was detected. Trip point = 270 psi.	Check Condenser Water Temp. Check Circuit module. Refer to Sec. 9.
High Restart Inhibit Timer Warning	IFW n/a	starter	All	The Restart Inhibit timer has reached a maximum threshold for the host chiller. This is 15 minutes. This indicates excessive chiller cycling, steps should be taken to correct this.	Check for excessive chiller cycling.

Table 10-2: Diagnostic Table

Diagnostic Description	Type/ Shutdown Action	Module Calling Out Diag.	Operating Modes Diagnostic is Active	Cause	Help Message
Loss of Discharge Superheat Control (original software)	MMR friendly	stepper	All Running Modes except Extended Unloading	During Running Normal the Discharge Superheat was more than 13 degrees F (7.2 C) above the Discharge Superheat Setpt for more than 4128 degree F seconds and, at the time the integral threshold was reached, the EXV was less than 100 % open.	Only applicable on original superheat software. Chiller modules X13650499-07 Rev H and earlier. Stepper modules X13650501-05 Rev G and earlier. Refer to RTHB-SB-2 for details on revised software. Diagnostic is eliminated on later revisions.
Low Chilled Water Temp: Unit Off (Unit in Auto but not Starting or Running)	IFW n/a	chiller	Unit in Auto	The chilled water temp. fell below the cutout setpoint while the compressor was not running for 30 degree F Seconds. Automatic Reset of the IFW diag shall occur 2 degrees F (1.1 C) above the cutout setpoint.	Check flow, sensor, & wiring.
Low Chilled Water Temp: Unit On (Unit Starting or Running)	MAR friendly	chiller	Unit starting or running	The chilled water temp. fell below the cutout setpoint while the compressor (or Solution Pump) was running for 30 degree F Seconds. Automatic Reset of the MAR diag shall occur 2 degrees F (1.1 C) above the cutout setpoint.	Check flow, sensor, & wiring.
Low Differential Rfgt Pressure	MMR friendly	stepper	Cprsr Energized	A Low differential Temperature/Pressure condition was detected that existed for more than 600 contiguous seconds. Trip point is 10 PSID.	Confirm operation of EXV, refer to sec. 7. Confirm operation of sensors, refer to Sec. 3.
Low Discharge Superheat (original software)	MMR friendly	stepper	Any Running Mode except Extended Unloading	Normal operating mode - the discharge superheat was less than 10 degrees F (nominally) for more than 6500 degree F seconds. The must hold value is 13 F while the must trip value is 7 F.	Only applicable on original superheat software. Chiller modules X13650499-07 Rev H and earlier. Stepper modules X13650501-05 Rev G and earlier. Refer to RTHB-SB-2 for details on revised software.
Low Discharge Superheat (revised software)	MMR friendly	stepper	Any Running Mode except Extended Unloading	Normal operating mode - the discharge superheat was less than 6 degrees F (nominally) for more than 7500 degree F seconds.	Confirm oil and refrigerant charges, refer to RTHB-SB-6. Confirm EXV operation, refer to Sec. 7.
Low Evap Rfgt Pressure	MMR immediate	stepper	All	The Low Pressure Cutout opened for more than 0.5-2 Seconds. Switch opens at 24 psig.	Confirm operation of LPC, EXV and Stepper module, refer to Sec. 9. Confirm refrigerant charge, RTHB-SB-6.
Low Evap Rfgt Temp.	MMR immediate	stepper	Starter Contactor Energized	a. The Saturated Evap Rfgt Temp dropped below the Low Rfgt Temp. Cutout Setpoint when the circuit was running for 30 degree F seconds.	Confirm operation of sensor, EXV and Stepper module, refer to Sections 3, 7 and 9. Confirm refrigerant charge, RTHB-SB-6.

Table 10-2: Diagnostic Table

Diagnostic Description	Type/ Shutdown Action	Module Calling Out Diag.	Operating Modes Diagnostic is Active	Cause	Help Message
Low Oil Flow	MMR friendly	circuit	Cprsr Energized	a. The differential oil pressure switch remained opened for more than 20 contiguous seconds on Cprsr A. Switch is normally closed to open at or above 50 psid.	Confirm pressure drop across oil line. Change oil filter. Check calibration and wiring of differential pressure switch. Check condensing pressure.
Low Rfgt Charge #1 (original software)	IFW n/a	stepper	All Running Modes except Extended Unloading	The Discharge Superheat was more than 5 degrees F (2.8 C) above the Discharge Superheat Setpt for more than 6498 degree F Seconds and, at the time the Integral threshold was reached the EXV was fully open.	Only applicable on original superheat software. Chiller modules X13650499-07 Rev H and earlier. Stepper modules X13650501-05 Rev G and earlier. Refer to RTHB-SB-2 for details on revised software.
Low Rfgt Charge #1 (revised software)	IFW n/a	stepper	All Running Modes except Extended Unloading	The Discharge Superheat was more than 10 degrees F (2.8 C) above the Discharge Superheat Setpt for more than 6498 degree F Seconds and, at the time the Integral threshold was reached the EXV was fully open.	Check refrigerant charge. Refer to RTHB-SB-6.
Low Rfgt Charge #2 (original software)	MMR friendly	stepper	All Running Modes	a. During Running Normal the Discharge Superheat was more than 13 degrees F (7.2 C) above the Discharge Superheat Setpt for more than 4128 degree F seconds and, at the time the integral threshold was reached, the EXV was fully open.	Only applicable on original superheat software. Chiller modules X13650499-07 Rev H and earlier. Stepper modules X13650501-05 Rev G and earlier. Refer to RTHB-SB-2 for details on revised software. Diagnostic eliminated on later revisions.
Max Acceleration Setpts Error	IFW n/a	starter	All	a. The redundant Maximum Acceleration settings did not agree for 30 contiguous seconds. (Continue to use the previous value for the 30 second time-out.) When this diagnostic occurs the affected Starter Module shall use 6 seconds as a default until either	Review Max Acceleration Set Up.
Memory Error Type I: NOVRAM	MMR friendly	chiller	On UCM Power Up or following a Type II Memory error diag.	On UCM power up a Type II Memory Error a NOVRAM memory error was detected. The UCM is operating on all Engineering ROM defaults for all setup parameters. Check all setup parameters and continue to run chiller. Replace the Chiller module ASAP.	Reprogram all menus.
Memory Error Type II: Shadow RAM	IFW n/a	chiller	All	The UCM is operating on all last valid values (pulled from NOVRAM) for all setup parameters. Settings are not lost but if diagnostic is re-occurring replace the Chiller module.	Confirm settings are accurate.
Memory Error Type III	IFW n/a	chiller	All	The UCM is operating on all last valid values (pulled from NOVRAM) for all setup parameters. Settings are not lost but if diagnostic is re-occurring replace the Chiller module.	Settings changed in the last 24 hours lost.

Table 10-2: Diagnostic Table

Diagnostic Description	Type/ Shutdown Action	Module Calling Out Diag.	Operating Modes Diagnostic is Active	Cause	Help Message
Memory Error Type IV	IFW n/a	chiller	All	A page time-out error was detected while trying to write data into EPROM. There will likely be a recall of Engineering ROM defaults on the next reset or power transition. Replace the Chiller Module as soon as a replacement is available.	Reprogram all menus.
Momentary Power Loss	MAR immediate	starter	All Running Modes	The current transformers experienced a loss of power.	Check incoming power. Check operation of HPC. Check Starter module, refer to Sec. 9.
Motor Temp Sensor #1	MMR friendly	circuit	All	Open or Short	Check sensor, wiring and connections. Refer to Sec. 3.
Motor Temp Sensor #2	MMR friendly	circuit	All	Open or Short	Check sensor, wiring and connections. Refer to Sec. 3.
Motor Temp Sensor #3	MMR friendly	circuit	All	Open or Short	Check sensor, wiring and connections. Refer to Sec. 3.
MPL Detect Circuit Inopera-tive	MMR friendly	Friendly	All	Internal component in Starter module detecting a fault.	Replace the Starter mod-ule. Refer to Sec. 9.
Options: Loss of Comm with Chiller	IFW n/a	options	All	The options module lost communications with the Chiller module for 15 contiguous seconds.	Check IPC Wiring/Con-nections. Refer to Sec. 8.
Options: Loss of Comm with Starter	IFW n/a	options	All	The options module lost communications with the Starter module for 15 contiguous seconds.	Check IPC Wiring/Con-nections. Refer to Sec. 8.
Options Mod Off-Brd 5V Range	IFW n/a	options	All	An improper Off Board 5v voltage was detected at the Options Module. A 5vdc is used for off-board devices such as the External CWS and CLS, and pressure transducers. The micro checks to see that the A/D value falls within an acceptable range.	Check Options Module Voltages. Refer to Sec. 9.
Outdoor Air Temp Sensor	None n/a	chiller	All	Open or Short. Display end of range value. (dashes “-----“%	Check sensor. Refer to Sec. 3.
Over Voltage	MAR friendly	starter	Pre-Start	a. Line voltage above + 10% of nominal. (Must hold = + 10 % of nominal. Must trip = + 15 % of nominal. Reset differential = min. of 2% and max. of 4%. Time to trip = minimum of 1 min. 10 sec. and maximum of 5 min. 20 seconds) Design: Nominal trip: 60 s	Check main power sup-ply & wiring. Check Under-Over Voltage Transformer, refer to Sec. 5.
Phase Loss	MMR immediate	starter	Contactor Energized or all Start, and Run modes.	No current was sensed on one or more of the CT inputs. (Must hold = 20% RLA. Must trip = 5% RLA.) Time to trip shall be 1 second mini-mum, 3 seconds maximum. Actual design trip point is 10%.	Check main power sup-ply & wiring. Check cur-rent transformers, refer to Sec. 4.
Phase Rever-sal	MMR immediate	starter	Contactor energized to transition command	A phase reversal was detected on the incoming current. On a compressor start-up the phase reversal logic must detect and trip in a maximum of 0.3 second from compressor start for RTHB.	Check main power sup-ply & wiring. Check cur-rent transformers, refer to Sec. 4.

Table 10-2: Diagnostic Table

Diagnostic Description	Type/ Shutdown Action	Module Calling Out Diag.	Operating Modes Diagnostic is Active	Cause	Help Message
Phase Reversal Protection Lost	MMR immediate	starter	Starter Contactor energized to transition command	The phase reversal protection on the compressor has become inoperative. The phase rotation protection system failed to detect 2 in a row of one of the four phase circuit states; Phase reversal, Phase rotation OK, Phase A lost, Phase B lost.	Check Starter Module. Refer to Sec. 9.
Phase Seq Monitor: Phase Reversal	MMR immediate	starter	Contactor energized to transition command	**Remote mounted starters** - At start-up the Phase Sequence Monitor detected a voltage based phase reversal in the compressor motor terminal box. **Unit mounted starters** - Diagnostic is not applicable. Jumper must be installed on the Starter module between J3-1 and 2.	Check phase rotation of interconnecting wiring between the remote starter and the compressor. Confirm operation of the Starter module and the phase sequence monitor. Check wiring and module. Refer to Sec. 9.
Severe Phase Unbalance	MMR friendly	starter	All Running Modes	A 30% Phase Unbalance diagnostic has been detected.	Check the current transformers, refer to Sec. 4. Check line voltage phase balance, all power wiring connections, the contactors and the motor. Check Starter module, refer to Sec. 9.
Solid State Starter Fault Relay Open	MMR immediate	starter	Any Start and Run Mode	The SSS fault relay is open.	See Solid State Starter Service Bulletin, check for an open wire.
Starter Contactor Interrupt Failure	MMR n/a	starter	Starter Contact not Energized	Welded starter contactor. Detected a welded compressor contactor when the compressor was commanded off but the current did not go to zero. Detection time shall be 5 second minimum and 10 seconds maximum.	Complete starter checkout required.
Starter did not Transition	MMR immediate	starter	On the first check after transition.	**During start** -the UCM did not receive a transition complete signal in the designated time from the UCM command to transition. The must hold time from the UCM transition command is 1 second. The Must trip time from the transition command is 6 seconds. **Prior to start** - Transition complete input shorted.	Complete starter checkout required.
Starter Dry Run Test	MMR immediate	starter	Starter Dry Run Mode	While in the Starter Dry Run Mode either 50 % Line Voltage was sensed at the Potential Transformers or 10 % RLA Current was sensed at the Current Transformers.	Current or Voltage Detected. Complete starter checkout required.
Starter Fault Type I	MMR immediate	starter	Starting	This is a specific starter test where 1M (2K1) is closed first and a check is made to ensure that there are no currents detected by the CT's. If currents are detected when only 1M is closed first at start, then one of the other contactors is shorted.	Complete starter checkout required.

Table 10-2: Diagnostic Table

Diagnostic Description	Type/ Shutdown Action	Module Calling Out Diag.	Operating Modes Diagnostic is Active	Cause	Help Message
Starter Fault Type II	MMR immediate	starter	Starting	This is a specific starter test where the Shorting Contactor (S)(2K3) is individually energized and a check is made to ensure that there are no currents detected by the CT's. If current is detected when only S is energized at Start, then 1M is shorted.	Complete starter check-out required.
Starter Fault Type III	MMR immediate	starter	Starting	As part of the normal start sequence to apply power to the compressor the Shorting Contactor (S) and then the Main Contactor (1M) were energized. 1.6 seconds later there were no currents detected by the CT's for the last 1.2 Seconds on all three phases.	Complete starter check-out required.
Starter: Loss of Comm with Chiller	MMR immediate	starter	All	The starter module lost communications with the Chiller module for 15 contiguous seconds.	Check IPC wiring and connections. Refer to Sec. 8 and 9.
Starter: Loss of Comm with Circuit	MMR immediate	starter	All	The starter module lost communications with the Circuit module for 15 contiguous seconds.	Check IPC wiring and connections. Refer to Sec. 8 and 9.
Stepper #1:Loss of Comm with Chiller	MMR friendly	stepper	All	The Stepper #1 module lost communications with the Chiller module for 15 contiguous seconds.	Check IPC wiring and connections. Refer to Sec. 8 and 9.
Stepper #1:Loss of Comm with Starter	MMR friendly	stepper	All	The Stepper #1 module lost communications with the Starter module for 15 contiguous seconds.	Check IPC wiring and connections. Refer to Sec. 8 and 9.
TCI: Loss of Comm with Chiller	IFW n/a	TCI	All	The TCI module lost communications with the Chiller module for 15 contiguous seconds.	Check IPC wiring and connections. Refer to Sec. 8 and 9.
TCI: Loss of Comm with Circuit	IFW n/a	TCI	All	The TCI module lost communications with the Circuit module for 15 contiguous seconds.	Check IPC wiring and connections. Refer to Sec. 8 and 9.
TCI: Loss of Comm with Options	IFW n/a	TCI	All	The TCI module lost communications with the Options module for 15 contiguous seconds.	Check IPC wiring and connections. Refer to Sec. 8 and 9.
TCI: Loss of Comm with Starter	IFW n/a	TCI	All	The TCI module lost communications with the Starter module for 15 contiguous seconds.	Check IPC wiring and connections. Refer to Sec. 8 and 9.
TCI: Loss of Comm with Stepper #1	IFW n/a	TCI	All	The TCI module lost communications with the Stepper #1 module for 15 contiguous seconds.	Check IPC wiring and connections. Refer to Sec. 8 and 9.
Tracer Communications Lost	IFW n/a	TCI	All	The Tracer was setup as “installed” at the CLD and the TCI lost communications with the Tracer for 15 contiguous minutes after it had been established. Continue to run the chiller with the last valid Tracer Setpoints/Mode.	Check Tracer to UCP wiring and connections.
Tracer failed to Establish Comm	IFW n/a	TCI	At power-up	The Tracer was setup as “installed” at the CLD and the Tracer did not communicate with the TCI within 2 minutes after power-up.	Check Tracer to UCP wiring and connections.

Table 10-2: Diagnostic Table

Diagnostic Description	Type/ Shutdown Action	Module Calling Out Diag.	Operating Modes Diagnostic is Active	Cause	Help Message
Tracer Out-door Air Temp Sensor Fail	IFW n/a	chiller	All	Tracer sensor open or shorted.	Check sensor, wiring, and connections.
Tracer Temper-ature Sensor	IFW n/a	TCI	All	Input Shorted.	Check sensor, wiring, and connections.
Transition Complete Input Opened	MMR immediate	starter	All running modes	Transition complete input was found open with compressor running after a successful completion of transition. This is only applicable on Y-Delta starters.	Check the transition complete input and the starter module. Refer to Sec. 9.
Transition Complete Input Shorted	MMR n/a	starter	Pre-start	Transition complete input was found shorted before the compressor was started. This is only applicable on Y-Delta starters.	Check the transition complete input and the starter module. Refer to Sec. 9.
Under Voltage	MAR friendly	starter	Pre-Start	Line voltage below - 10% of nominal or the Under/Overvoltage transformer is not connected. (Must hold = - 10 % of nominal. Must trip = - 15 % of nominal. Reset differential = min. of 2% and max. of 4%. Time to trip = min. of 1 min. and max. of 5 min.	Check main power supply & wiring. Check Under-Over Voltage Transformer, refer to Sec. 5.