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General Service Bulletin

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Subject: Control Operation, Setup and Troubleshooting for RTAA (Series R) Air-Cooled Chiller Control Panel.

Introduction:

The purpose of this Service Bulletin is to provide control operation and general troubleshooting information for Trane Model RTAA microprocessor control panels. It is recommended that the service technician be familiar with the UCM operation before servicing the microprocessor.

Discusion:

This bull tin is intended to serve as a supplement to the RTAA-IOM manual, the operation and maintenance for the RTAA units. Subjects covered in this bulletin are intended to provide more comprehensive information for RTAA units.

Caution: Be sure to refer to wiring diagrams that apply specifically to the design sequence of the unit being serviced when reading this manual.

IMPORTANT NOTICE

World environmental scientists have concluded, based on the best currently available evidence, that ozone in our upper atmosphere is being reduced, due to the release of CFC fully-halogenated compounds.

The Trane Company urges all HVAC servicers, working on Trane equipment and other manufacturer's products, to make every effort to eliminate, if possible, or vigorously reduce emissions of CFC HCFC and HFC refrigerants to the atmosphere resulting from installation, operation, routine maintenance, or major service 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 Trane operation, maintenance and service procedures, with specific attention to the following:

1. Refrigerants used in any type of air conditioning or refrigerating equipment should be recovered for reuse, recovered and/or recycled for reuse, reprocessed (reclaimed) , or property destroyed, whenever it is removed from equipment. Never release refrigerant to 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. In order to assist in reducing power generation emissions, always attempt to improve equipment performance with improved maintenance and operations, which will help conserve energy resources.

IMPORTANT NOTICES TO BE READ BEFORE SERVICING THE RTAA

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 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 L1, 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: A clear sight glass does not mean that the system is properly charged. Also check the system superheat, subcooling and unit operating procedures.

Caution: The compressor sump heaters 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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Overview

General

The Unit Control Modules (UCMs) described in this troubleshooting guide comprise of a microprocessor based refrigeration control system intended for use with Trane 130-400 ton helical rotor chillers. Four types of modules are used, and throughout this publication will **be** referred to by their abbreviations or their Line Wiring Drawing Designations.

Table 1.
Unit Control Module Designations

1U1	Chiller Module	CPM
1U4 thru 1U7	Compressor Module	MCSP A to D
1U3 & 1U8	Expansion Valve Module	EXV
1U2	Options Module	CSR

Service Philosophy

With the exception of the fuses, no other parts on or within the modules are serviceable. The intent of the troubleshooting 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 (connectors, sensors, transformers, contactors etc.) in a process of elimination. Once a problem has been traced to a module, the module can be easily 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 power. CPM replacement is more involved as there are numerous configuration and set-up items that must be programmed at the Operator Interface in order to insure proper unit operation.

It is helpful to include with the return of a module, a brief explanation of the problem, sales office, job name, and a contact person for possible follow-up. The note can be slipped into the module enclosure. Early and timely processing of Field Returns allows for real measurements of our product quality and reliability, providing valuable information for product improvement and possible design changes.

System Description

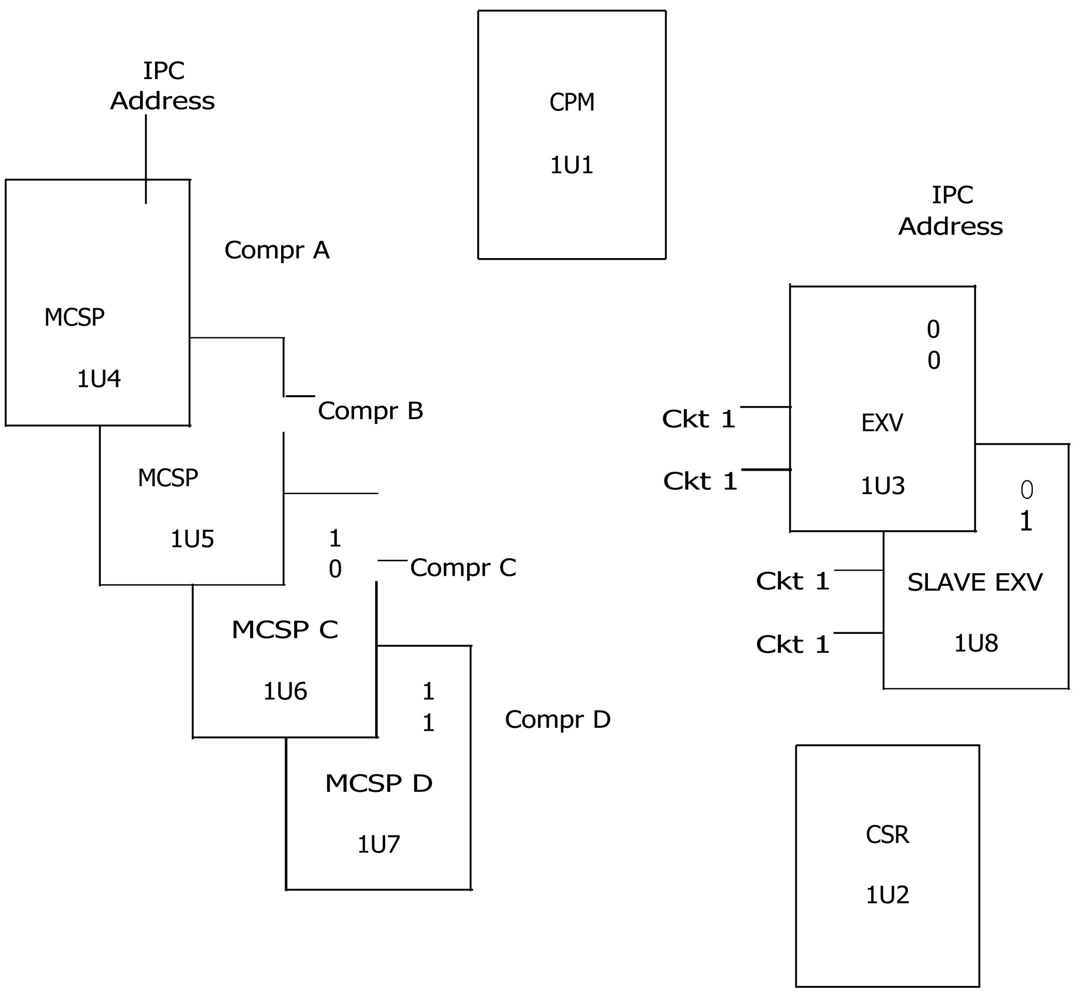
The CPM is the master module and coordinates operation of the entire system as well as handling of the Operator Interface (alpha-numeric display and pushbuttons). One is used per chiller. The MCSP is a compressor protection module with one being used for each of the compressors (2,3 or 4) in the chiller. The EXV is the expansion valve controller module which can control up to two Electronic Expansion Valves, one on each of the two refrigeration circuits, if a two compressor circuit is utilized.

As some larger tonnage refrigeration circuits employ two Expansion valves piped in parallel, a second "Slaved" EXV module will then be required to control the second valve on that circuit. The CSR is an optional communications module which allows for serial communications between the chiller and a remote building automation system.

All modules in the system communicate with each other over a serial interprocessor communications bus **(IPC)** consisting of a twisted wire pair "daisy chain" link and RS485 type signal levels and drive capability. Multiple modules of the same type (ie. MCSPs and EXVs) in an operating system are differentiated by address dip switches.

All the modules operate from 115VAC, 50 or 60Hz power and each have their own internal step-down transformer and power supply. Each is individually fused with an replaceable fuse. The modules also are designed to segregate their high and low voltage terminals by placing the high voltage on the right side of the module and the low voltage on the left. When stacked, segregation is maintained.

Figure 1.
Full System UCM for a 400 Ton Chiller



In addition to the modules, there are a number of "system level" components that are closely associated with the modules. These components were specifically designed and/or characterized for operation with the modules. For this reason, the exact Trane part must be used in replacement.

Module Interchanging

For simplicity when reading this manual, the following explanation provides guidelines for interchanging of micro modules. Each module in the control panel will have a white sticker with a model number and a revision letter, referred to as a "rev level". Close attention must be paid to the rev level when interchanging any module.

Below is an explanation of what is permissable when intechanging modules and what interchanging must not be performed.

Phase 1 Units.

On all design sequence "A" and "B" units, *the* following rev levels of modules are installed:

MCSP modules .... Rev-A, Rev-B, and Rev-C
EXV modules .... Rev-A, Rev-B, and Rev-C
CSR modules .... Rev-A, Rev-B, and Rev-C
CPM modules .... Rev-A, Rev-B, Rev-C, Rev-D, and Rev-E

Phase 2 Units.

MCSP modules .... Rev-D and later
EXV modules .... Rev-D and later
CSR modules .... Rev-D and later
CPM modules .... Rev-F and later

All Phase 1 modules and rev levels <u>cannot</u> replace any Phase 2 modules. However, all Phase 2 modules and rev levels can replace any Phase 1 modules. This provides backward compatibility.

To retrofit a Phase 1 unit with the extra features of Phase 2, all Phase 1 modules must be replaced with all Phase 2 modules.

The Deluxe CPM Module offers the following:

* Under/Over Voltage Protection (transformer needed)
* Compressor Starts and Hour Display
* Percent Line Voltage Display (transformer needed)
* Remote Alarm

The Communication Module Offers:

* Remote Demand Limiting
* Remote Chilled Water Reset/Setpoint
* Bi-Directional Communication
* Ice-Making Controls

System Level Components

Description

Transformer, Under/Over voltage
Current Transformer - Compressor
Evap Ent/Lvg Water Temp Sensor Pair
Sat Evap/Cprsr Suc Rfgt Temp. Sensor Pair
Sat Cond Rfgt Temp Sensor
Outdoor Air Temperature Sensor
Zone Temp Sensor
Differential Pressure Switch
Connector (UCM mating connectors)
Connector Keying Plug
Electronic Expansion Valve

Chiller Module (CPM) 1U1

The CPM module performs machine (chiller) level control and protection functions. It also provides for the display of operating states, parameters and diagnostics, the adjustment of setpoints, and the selection of operating states through the front panel user interface (Vacuum Fluorescent Display and pushbutton/rocker switches). Only one CPM is present in the chiller control system. The CPM acts as the master controller to the other modules, running top level machine control algorithms, initiating and controlling all inter-module communication over the IPC, and providing parameters and operational requests (ie. loading and unloading, starting and stopping) to the other modules in the system via the IPC. The CPM also contains non-volatile memory, which allows it to remember configuration and set-up values, setpoints, historical diagnostics etc. for an indefinite period of time following a power loss. Direct hard wired I/O associated with the CPM include seven low voltage analog inputs, two low voltage binary inputs, two 115V binary inputs and three 120V (rated) relay outputs.

Compressor Module (MCSP) 1U4 thru 1U7

The MCSP module employs the input and output circuits associated with a particular compressor and refrigeration circuit. From 2 to 4 MCSP modules are used in the UCM system. Included are low voltage analog and digital circuits, 115 V input, and 115V output switching devices. The output switching devices associated with the compressor motor controlling function are contained in this module. This is the only module in the system that contains safety circuits. For the 130-400 ton RTAA chiller, the outputs of this module control one compressor motor stop/start contactor, one compressor motor transition contactor, one oil heater, one oil line valve, two solenoid valves (compressor load and unload), and four fan motor contactors or groups of contactors. Refer to the chiller's line wiring diagrams for details. Dip switches are provided for redundant programming of the compressor overload gains, and for unique IPC address identification during operation.

Expansion Valve Module (EXV) 1U3 and 1U8

The EXV module provides power and control to the stepper motor driven electronic expansion valves of the chiller. Each module can handle up to two valves, one in each refrigeration circuit. If one or both of the circuit tonnages are in excess of 100 tons, parallel EXV valves are employed and an additional "Slave" EXV module is required to power the second valve on the circuit(s).

Input to the Master EXV Module is provided by four temperature sensors (two per refrigeration circuit). The sensors are located in the respective refrigeration circuits of the chiller and sense Saturated Evaporator and Suction temperatures and calculate the superheat temperatures. High level operational commands as well as superheat setpoints are received by the Master EXV Module over the IPC from the CPM module. The Slave EXV Module (if present) takes its commands from the Master EXV module to effectively modulate the second parralled EXV Valve simultaneously with the first.

Real time data for temperatures, EXV valve position status, diagnostics and control algorithms etc. are made available to the CPM and the other modules for display and for input to higher level functions. Dip switches are provided for unique address identification between the Master and Slave modules

Options Module (CSR) 1 U2

The CSR module is an optional part of the system and employs communications circuits for interface to Trane Building Automation Systems or Remote Display. The CSR also provides inputs for hard wired external setpoints and reset functions. Included are low voltage analog and digital input circuits.

Operating Codes and Diagnostics

Normal Operation and Operation Codes

When power is first applied to the module, the CPM display (1U1) will briefly turn all of its segments on, to provide a visual test of their operation. Following this, the display will show an "A 88" to indicate a reset has occured to the internal Micro-computer. Normally the display will quickly come out of the reset state and display the Chiller Operational Code of Menu 0, item A. An "A 00" (stop), "A 01" (auto/local) or "A 02" (auto/remote) will likely be displayed. However if an IPC communication problem exists, the display will remain in the "A 88" condition for 15 seconds, and then an IPC communication diagnostic will begin alternate flashing with the A code.

Interprocessor Communication (IPC)

Description

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

In the IPC communication protocol scheme, the CPM acts as the initiator and the arbitrator of all module communication. The CPM 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, they 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 CPM, or it will not talk.

The link is non-isolated, which means that a good common ground between all the modules is necessary for trouble-free operation (provided by the module enclosures' mounting using star washers). Also, the link requires consistent polarity on all of the module interconnections. Connections between modules are made at the factory, using unshielded #18 gauge twisted pair cable terminated into a 4-position MTA type connector (orange color code). This connector is plugged onto the 4 pin IPC connection jack designated as JI, 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 (J1-1 (+) internally connected to J1-3, and J1-2 (-) internally connected to J1-4) to allow for easy daisy chaining of the bus.

IPC Diagnostics

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

1) on its own, take specific action to safely shut-down (or to default) its controlled loads.

2) report a diagnostic to the CPM (over the IPC link). The CPM (if it properly receives such) will then report and display the diagnostic on the Operator Interface accordingly. The diagnostic will:

a) identify which module is reporting the communication problem and

b) identify which module was to have sent the missing information.

The CPM itself 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 displays are three number codes of the form "4xy" (x and y representing variables). (The code is prefixed by the menu item letters for diagnostics, ie. "b" for Last Diagnostic and "C" for Other Diagnostics (historic). The "x" represents which module has reported the communication problem, and the y represents the module that it isn't hearing from. The numbers used to represent the modules are the last digit of the Designation number (ie. the EXV Master module is designated as 1U3, thus for purposes of the IPC diagnostics, the number "3" represents the EXV Master module). On the following page is a list of all the IPC communication diagnostics, their description, and brief description of the action taken.

Table 2.
IPC Diagnostic Codes

412	CPM (1U1)	CSR (1U2)	IFW, Use default/local setpoints.	
413	CPM (1U1)	EXV MASTER(1U3)	MMR	Same
414	CPM (1U1)	MCSP A (1U4)	CMR, Ckt1	Same
415	CPM (1U1)	MCSP B (1U5)	CMR, Affected Ckt	Same
416	CPM (1U1)	MCSP C (1U6)	CMR, Ckt2	Same
*417	CPM (1U1)	MCSP D (1U7)	CMR, Ckt2	Same
#418	CPM (1U1)	EXV SLAVE (1U8)	CMR, Affected Ckt	Same
431	EXV (1U3)	CPM (1U1)	Attempt control	CMR both Ckts
434	EXV (1U3)	MCSP A (1U4)	Attempt cntrl Ckt1	CMR, Ckt1
435	EXV (1U3)	MCSP B (1U5)	Attempt cntrl Aff Ckt	CMR, Aff. Ckt
436	EXV (1U3)	MCSP C (1U6)	Attempt cntrl Ckt2	CMR, Ckt2
*437	EXV (1U3)	MCSP U (1U7)	Attempt cntrl Ckt2	CMR, Ckt2
441	MCSP A (1U4)	CPM (1U1)	Shutdown Compr & Fans	CMR, Ckt1
443	MCSP A (1U4)	EXV MSTR (1U3)	Shutdown Compr & Fans	CMR, Ckt1
*445	MCSP A (1U4)	MCSP B(1U5)	Shutdown Compr & Fans	CMR, Ckt1
451	MCSP B (1U5)	CPM (1U1)	Shutdown Compr & Fans	CMR, Aff Ckt
453	MCSP B (1U5)	EXV MSTR (1U3)	Shutdown Compr & Fans	CMR, Aff Ckt
*454	MCSP B (1U5)	MCSP A(1U4)	Shutdown Compr & Fans	CMR, Ckt1
461	MCSP C (1U6)	CPM (1U1)	Shutdown Compr & Fans	CMR, Ckt2
463	MCSP C (1U6)	EXV MSTR (1U3)	Shutdown Compr & Fans	CMR, Ckt2
*467	MCSP C (1U6)	MCSP D(1U7)	Shutdown Compr & Fans	CMR, Ckt2
*471	MCSP D (1U7)	CPM (1U1)	Shutdown Compr & Fans	CMR, Ckt2
*473	MCSP D (1U7)	EXV MSTR(1U3)	Shutdown Compr & Fans	CMR, Ckt2
*476	MCSP D (1U7)	MCSP C(1U6)	Shutdown Compr & Fans	CMR, Ckt2
#481	EXV SLAVE(1U8)	CPM (1U1)	Attempt cntrl Aff Ckt	CMR, Affec Ckt
#483	EXV SLAVE(1U8)	EXV MSTR(1U3)	Last position	CMR, Affec Ckt
#484	EXV SLAVE(1U8)	MCSP A (1U4)	Attempt cntrl Ckt1	CMR, Ckt1
#485	EXV SLAVE(1U8)	MCSP **B** (1U5)	Attempt cntrl Aff Ckt	CMR; Affec Ckt
#486	EXV SLAVE(1U8)	MCSP C (1U6)	Attempt Cntrl Ckt2	CMR, Ckt2
#*487	EXV SLAVE(1U8)	MCSP D (1U7)	Attempt Cntrl Ckt2	CMR, Ckt2

* These chagnostics will only occur when the compressors are in a manifolded pair.
# The CMR diagnostics will occur for a given Ckt only if the Ckt is employing paralleled EXV Valves.

It is often the case that when some problem exists with the IPC link or a module fails, there will be more than one of these IPC diagnostics. These diagnostics could all be read in the "C" register of the display. (Remember that only those diagnostics that are flashing are currently active, others not flashing are historic only and should be disregarded for purposes of this troubleshooting. Alternatively, all the historic diagnostics could be cleared before beginning this troubleshooting.)

Troubleshooting Modules using IPC diagnostics

Communication problems can result from any of the following:

1. Improperly set IPC address dip switches
2. Opens or shorts in the twisted pair IPC wiring or connectors
3. Loss of power to a module
4. Internal module failure
5. Improper connections on terminal J2
6. High levels of EMI (Electro-Magnetic Interference)

These are discussed in more detail in the following paragraphs.

1. Improperly set IPC address dip switches: This could result in more than one module trying to talk at the same time, or cause the mis-addressed module to not talk at all. Only the MCSP and the EXV module have IPC address dip switches, found in the upper left hand portion of the Module labeled as SW-1. The proper dip switch setups are shown in Table 3.

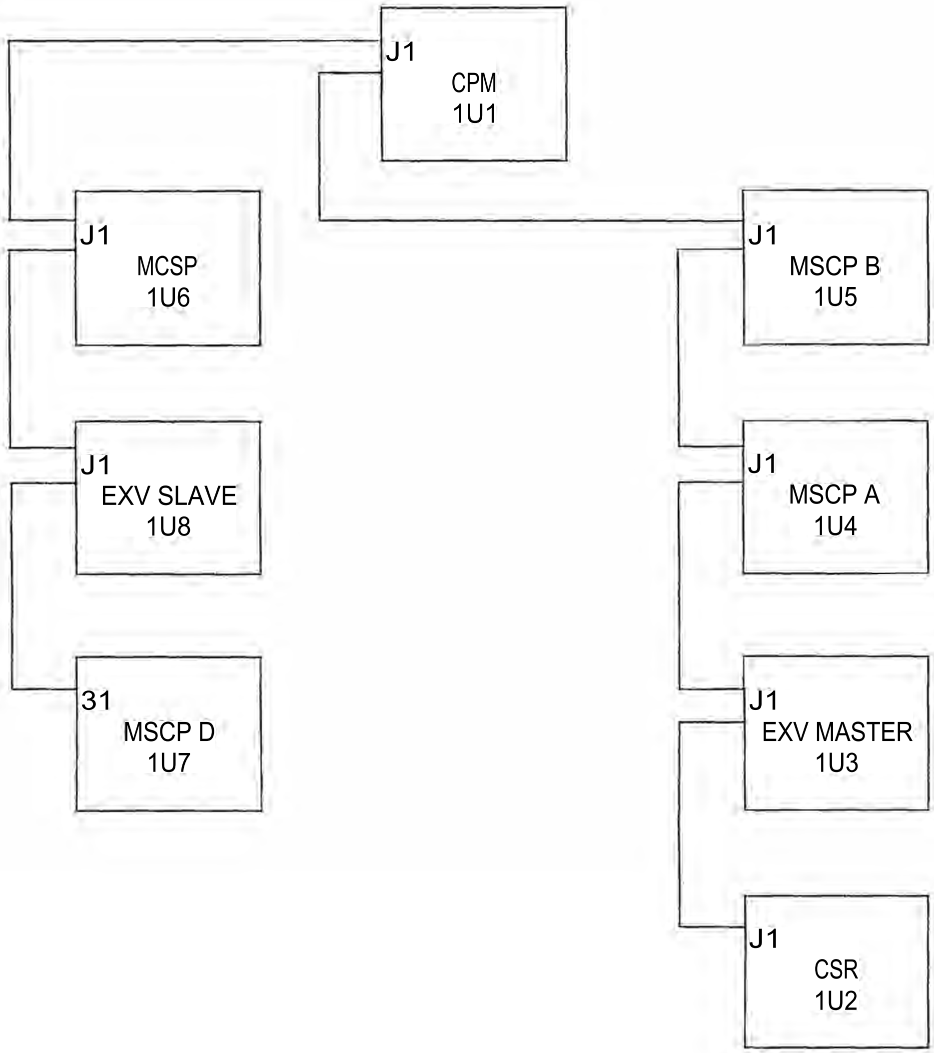
Table 3.
IPC Address Dip Switch (SW1) Settings
for MCSP and EXV Modules

CAUTION! Extreme care should be used in making any dip switch changes or when replacing MCSP modules. "Swapping" of addresses on the MCSPs cannot be detected by the communication diagnostics discussed above and serious chiller misoperation will result.

MODULE	DESIG.	CONTROLLING	DIP SWITCH SETTING SW1-1	SW1-2
MCSP "A"	1U4	COMPRESSOR A	OFF	OFF
MCSP "B"	1U5	COMPRESSOR B	OFF	ON
MCSP "C"	1U6	COMPRESSOR C	ON	OFF
MCSP "D"	1U7	COMPRESSOR D	ON	ON
EXV Mastr	103	CKTS. 1&2	OFF	OFF
EXV Slave	1U8	CKTS. 1&2	OFF	ON

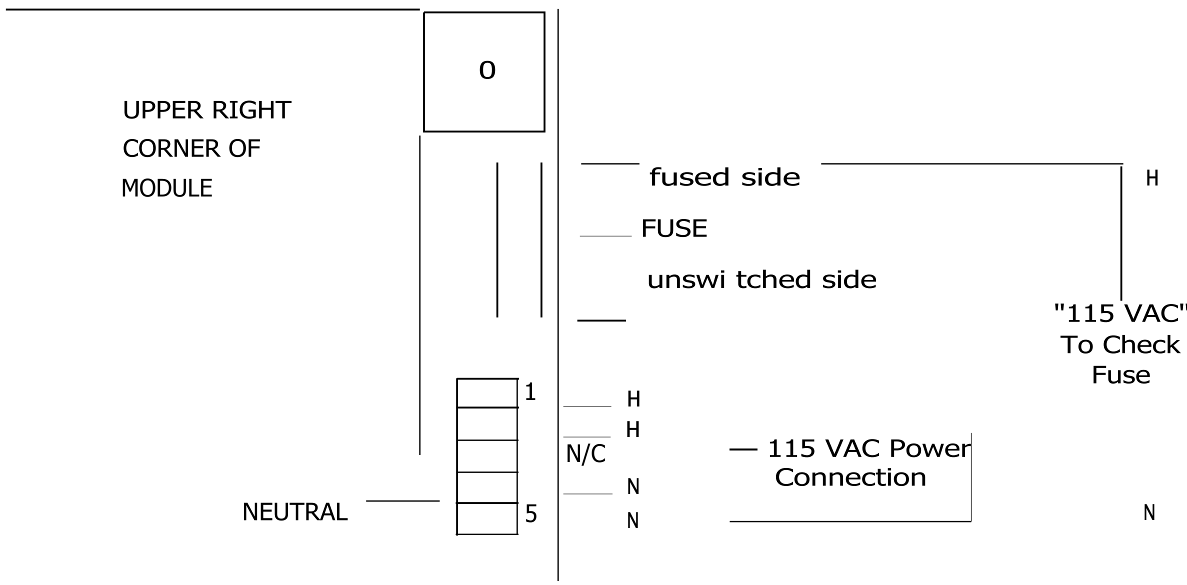
2. Opens or shorts in the twisted pair IPC wiring or connectors: One or more modules may be affected by an open or a short in the IPC wiring, depending on the location of the fault in the daisy chain. The diagram below shows the daisy chain order and is helpful in diagnosis of an open link.

Figure 2.
IPC Link Order For 400 Ton RTAA



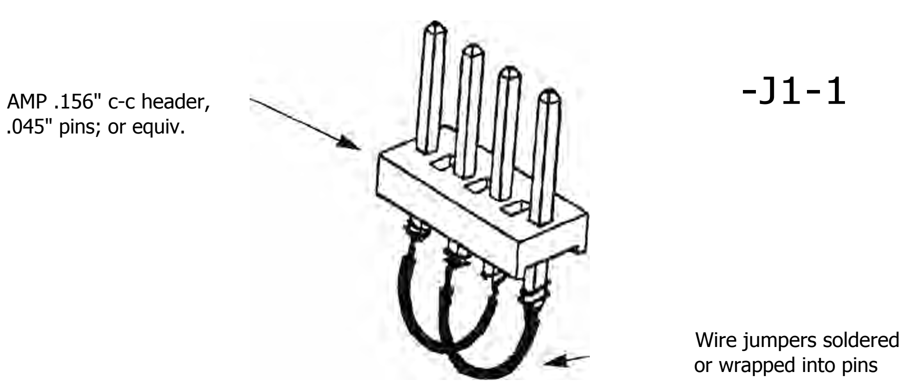
3. Loss of power to a module: Generally a power loss to a particular module will only affect communications with that module. The module can usually be identified by analysis of the IPC diagnostics. (When the display is blank, check power at the CPM). Loss of power can most directly be diagnosed then by measuring the AC voltage at the top of the fuse, with respect to the neutral of the power connection (pins 4 or 5) on the terminal just below the fuse:

Figure 3.
Module Fuse and Power Connection



4. 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 IPC diagnostics. The latter can be identified in a process of elimination, whereby each module, in turn, is taken out of the IPC link and a jumper installed in its place. The CPM can then be reset and the new IPC diagnostics that result can be analyzed.

Figure 4.
IPC Jumper For Bypassing Modules
(to be inserted into MTA connector
in place of module)



5. Improper connections to terminal J2: Jack J2, present on all modules, should have no connections. This input is for manufacturing test purposes only and any connections, shorts, etc. will potentially cause the module to not respond, respond to the wrong address, or (in the case of the CPM) fail to initiate any communications and thus fail the entire IPC.

6. High levels of Electro-Magnetic Interference: The modules and the IPC 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.

Troubleshooting Procedure

1. Place the CPM in "Stop/Reset." Record the active (flashing) IPC diagnostics (those that begin with the number 4) as shown in the "C" register of Menu 0 on the CPM. The communication failure diagnostics and their meanings are shown in IPC Diagnostics.

Note: The first number is always a 4, for communications diagnostics. The second number indicates which module detected the failure. The third number indicates which module was not heard from.

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 or blown fuse.

3. Determine which modules are still talking. Wiring up to these is likely to be OK.

4. Try disconnecting the link or jumping out modules in the link at various places (using diagram in Troubleshooting Module as a map). Reset the diagnostics and note which diagnostics reappear.

Here are some examples of IPC diagnostics:

Diagnostics present 413, 443, 453, 463, 473. The CPM and all four MCSP modules are detecting a loss of communications with the Master EXV. Suspect power to the Master EXV or its fuse or a wiring problem downstream of the MCSP A and B modules.

Diagnostics present: 412, 413, 414, 415, 416, 417, 418. The CPM is reporting that it cannot talk to any of the other modules. Suspect a shorted IPC bus or a module locking up the bus. The CPM 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. Refer to Item 4 in Troubleshooting Modules for the procedure and the IPC Jumper for bypassing the Modules.

Diagnostics present: 415, 435. The CPM and Master EXV have both detected a communication loss with MCSP B. Suspect the address switch on MCSP B or a power/fuse problem.

Diagnostics present 414, 415, 434, 435: The CPM and Master EXV have both detected a communication loss with MCSP A and MCSP B. Suspect that the address switches on both modules are set to the same address. Wiring is probably OK since the EXV can talk to the CPM.

Diagnostics present: 415, 414, 413 (also 483 would occur if paralleled EXV's are employed). The CPM has detected loss of communications with MCSP A, MCSP B, and Master EXV. Suspect an open early in the IPC link between the CPM and MCSP B.

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

Temperature Sensor Checkout

General

With the exception of the thermostats located in the motor windings of the screw compressors, all the temperature sensors used on the UCMs are negative temperature coefficient (NTC) thermistors. The thermistors employed all have a base resistance of 10 Kohms at 77F (25C) and display a decreasing resistance with an increasing temperature. The UCMs "read" the temperature by measuring the voltage developed across the thermistors in a voltage divider arrangement with a fixed internal resistance. The value of this "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 the UCM to indicate the appropriate diagnostic. In most cases, an open or short will cause a CMR or MMR diagnostic that will result in a machine or circuit shutdown. Open or shorts on less critical Outdoor Air or Zone Temperature sensors will result in an Informational Warning Diagnostics and the use of default values for that parameter.

Temperature Sensor Checkout Procedure

1. Measure the temperature at the sensor using an accurate thermometer. Record the temperature reading observed.

2. With the sensor leads connected to the UCM and the UCM powered. measure the DC voltage across the sensor leads at the terminal or probe the back of the MTA plug.

Note: Always use a digital volt-ohmeter with 10 megohm or greater input impedance to avoid "loading down" the voltage divider. Failure to do so will result in erroneously high temperature calculations.

3. Locate the appropriate sensor table. Table 4: Evaporator Water and Refrigerant Temperature Sensors, Table 5: Saturated Condenser Refrigerant Temperature Sensor and Table 6: Zone Temperature Sensor. Then compare the temperature in the table corresponding to the voltage reading recorded in Step 2 with the actual temperature observed in Step 1. If the actual temperature measured falls within the allowable tolerance range, both the sensor and the UCM's temperature input circuits are operating properly. However, if the actual temperature is outside the allowable sensor tolerance range, proceed to Step 4.

4. Again measure the temperature at the sensor with an accurate thermometer; record the temperature reading observed.

5. Remove the sensor leads from the terminal strip or unplug the respective MTA. Measure the resistance of the sensor directly or probe the MTA with a digital volt-ohmeter. Record the resistance observed.

6. Next, 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 must be repaired.

7. Select the appropriate sensor table and locate the resistance value recorded in Step 5. Verify that the temperature corresponding to this resistance value matches (i.e. within the tolerance range specified for that sensor) the temperature measured in Step 4.

8. If the sensor temperature is out of range, the problem is either with the sensor, wiring, or the MTA connector (if applicable). If an MTA connector is used and the thermistor reads open, first try cutting off the MTA, stripping a small amount of insulation from the sensor wire's end and repeating the measurement directly to the leads. Once the fault has been isolated in this manner, install a new sensor, connector or both. When replacing a sensor, it is easiest to cut the sensor wire near the MTA end and splice on a new sensor using wire nuts.

9. A decade box can be substituted for the sensor and any sensor table value used to relate resistance to temperature. By removing the MTA plug and applying the resistance to the proper pin terminals, the temperature as sensed by the UCM can be confirmed. Using the service menu display mode, scroll to the display of the temperature of interest.

Note: All displayed temperatures are slew rate limited, rounded off to the nearest degree F, and only accurate within a specified normal range. It is therefore important to be certain that the temperature readings are stable and that adequate time, up to 1 minute, is allowed after step changes in resistance inputs are made.

10. In all instances where module replacement is indicated, first perform the power supply/fuse check according to the information in Module Power and Miscellaneous I/O.

Table 4.
Sensor Conversion Data:
Outdoor Air (5RT3), Entering and Leaving Evaporator Water Temp Matched Pairs (6RT7,6RT8), and Saturated Evaporator and Compressor Suction Refrigeration Temp Matched Pairs (6RT9,6RT5;6RT10,6RT6)

-20.0	170040.3	4.448	30.0	34838.9	3.120	80.0	9297.5	1.533
-19.0	164313.4	4.434	31.0	33833.3	3.086	81.0	9075.9	1.509
-18.0	158796.5	4.414	32.0	32861.4	3.047	82.0	8860.2	1.484
-17.0	153482.9	4.395	33.0	31935.3	3.018	83.0	8650.4	1.460
-16.0	148365.0	4.380	34.0	31038.7	2.983	84.0	8446.2	1.436
-15.0	143432.2	4.360	35.0	30170.5	2.949	85.0	8247.5	1.411
-14.0	138679.6	4.341	36.0	29329.5	2.910	86.0	8054.1	1.387
-13.0	134098.6	4.321	37.0	28515.0	2.876	87.0	7865.8	1.362
-12.0	129684.9	4.302	38.0	27725.9	2.842	88.0	7682.5	1.343
-11.0	125428.5	4.282	39.0	26961.4	2.808	89.0	7504.2	1.318
-10.0	121326.1	4.263	40.0	26220.8	2.773	90.0	7330.5	1.294
-9.0	117369.6	4.238	41.0	25503.0	2.739	91.0	7161.4	1.274
-8.0	113554.9	4.219	42.0	24807.5	2.705	92.0	6996.7	1.250
-7.0	109876.5	4.194	43.0	24133.3	2.671	93.0	6836.3	1.230
-6.0	106328.1	4.175	44.0	23479.7	2.637	94.0	6680.1	1.211
-5.0	102904.9	4.150	45.0	22846.1	2.603	95.0	6528.0	1.187
-4.0	99602.3	4.126	46.0	22231.9	2.568	96.0	6379.8	1.167
-3.0	96416.1	4.106	47.0	21636.2	2.534	97.0	6235.5	1.147
-2.0	93341.6	4.082	48.0	21058.7	2.505	98.0	6094.8	1.128
-1.0	90374.2	4.058	49.0	20498.4	2.471	99.0	5957.8	1.108
0.0	87510.3	4.033	50.0	19955.0	2.437	100.0	5824.3	1.089
1.0	84745.9	4.004	51.0	19427.9	2.402	101.0	5694.2	1.069
2.0	82077.1	3.979	52.0	18916.5	2.368	102.0	5567.4	1.050
3.0	79500.5	3.955	53.0	18420.3	2.334	103.0	5443.8	1.030
4.0	77012.3	3.926	54.0	17938.8	2.305	104.0	5323.3	1.016
5.0	74609.7	3.901	55.0	17471.6	2.271	105.0	5205.9	0.996
6.0	72288.8	3.872	56.0	17018.0	2.236	106.0	5091.5	0.977
7.0	70047.4	3.848	57.0	16577.8	2.207	107.0	4979.9	0.962
8.0	67881.9	3.818	58.0	16150.5	2.173	108.0	4871.1	0.942
9.0	65790.2	3.789	59.0	15735.7	2.144	109.0	4765.0	0.928
10.0	63768.7	3.760	60.0	15332.9	2.109	110.0	4661.5	0.913
11.0	61815.3	3.730	61.0	14941.7	2.080	111.0	4560.6	0.894
12.0	59927.8	3.701	62.0	14561.9	2.046	112.0	4462.2	0.879
13.0	58103.1	3.672	63.0	14193.0	2.017	113.0	4366.3	0.864
14.0	56339.6	3.643	64.0	13834.6	1.987	114.0	4272.6	0.850
15,0	54634.7	3.608	65.0	13486.5	1.958	115.0	4181.3	0.835
16.0	52986.4	3.579	66.0	13148.3	1.924	116.0	4092.2	0.820
17.0	51392.6	3.550	67.0	12819.8	1.895	117.0	4005.3	0.806
18.0	49851.6	3.516	68.0	12500.5	1.865	118.0	3920.5	0.791
19.0	48360.9	3.486	69.0	12190.2	1.836	119.0	3837.7	0.776
20.0	46919.2	3.452	70.0	11888.7	1.807	120.0	3756.9	0.762
21.0	45524.6	3.418	71.0	11595.6	1.777	121.0	3678.1	0.747
22.0	44175.6	3.389	72.0	11310.7	1.753	122.0	3601.1	0.732
23.0	42870.3	3.354	73.0	11033.7	1.724	123.0	3526.5	0.723
24.0	41607.6	3.320	74.0	10764.4	1.694	124.0	3453,6	0.708
25.0	40385.3	3.286	75.0	10502.6	1.670	125.0	3382.4	0.698
26.0	39202.7	3.257	76.0	10248.0	1.641	126.0	3313.0	0.684
27.0	38057.9	3.223	77.0	10000.4	1.616	127.0	3245.1	0.674
28.0	36950.0	3.188	78.0	9759.6	1.587	128.0	3178.9	0.659
29.0	35877.4	3.154	79.0	9525.4	1.563	129.0	3114.2	0.649
						130.0	3051.0	0.635

Notes:
1. Overall accuracy for any of the sensors is at least + 2 F over the range shown. Accuracy of matched sensors is + 1F over specific ranges.
2. As you compare a thermistor resistance (or input voltage) reading with the "actual "temperature indicated by the thermometer, be sure to consider the precision and location 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 5.
Sensor Conversion Data:
Saturated Condenser Refrigeration Temperature
(6RT12,6RT13,6RT20)

0.0	87274	4.651	**50.0**	19826	3.765	**100.0**	5782	2.356
1.0	84511	4.641	51.0	19301	3.740	101.0	5653	2.327
2.0	81844	4.630	52.0	18791	3.715	102.0	5527	2.300
3.0	79270	4.619	53.0	18297	3.689	103.0	5404	2.272
4.0	76783	4.608	54.0	17818	3.664	104.0	5285	2.244
5.0	74382	4.596	55.0	17353	3.638	105.0	5169	2.217
6.0	72064	4.584	56.0	16901	3.611	106.0	5055	2.189
7.0	69824	4.572	57.0	16463	3.585	107.0	4945	2.162
8.0	67660	4.560	58.0	16038	3.558	108.0	4837	2.135
9.0	65570	4.547	59.0	15625	3.531	109.0	4732	2.108
10.0	63551	4.534	60.0	15225	3.504	110.0	4629	2.082
11.0	61600	4.521	61.0	14836	3.477	111.0	4529	2.055
12.0	59714	4.507	62.0	14458	3.450	112.0	4432	2.029
13.0	57891	4.494	63.0	14091	3.422	113.0	4337	2.003
14.0	56130	4.479	64.0	13734	3.394	114.0	4244	1.977
15.0	54427	4.465	65.0	13388	3.366	115.0	4153	1.951
16.0	52780	4.450	66.0	13052	3.338	116.0	4065	1.926
17.0	51189	4.435	67.0	12725	3.310	117.0	3979	1.901
18.0	49649	4.420	68.0	12408	3.282	118.0	3895	1.876
19.0	48161	4.404	69.0	12100	3.253	119.0	3813	1.851
20.0	46721	4.388	70.0	11800	3.225	120.0	3733	1.826
21.0	45329	4.372	71.0	11509	3.196	121.0	3655	1.802
22.0	43982	4.355	72.0	11226	3.167	122.0	3579	1.777
23.0	42679	4.338	73.0	10951	3.139	123.0	3505	1.754
24.0	41418	4.321	74.0	10683	3.110	124.0	3432	1.730
25.0	40198	4.303	75.0	10423	3.081	125.0	3362	1.707
26.0	39017	4.285	76.0	10170	3.051	126.0	3293	1.684
27.0	37875	4.266	77.0	9924	3.022	127.0	3226	1.661
28.0	36769	4.248	78.0	9685	2.993	128.0	3160	1.638
29.0	35698	4.229	79.0	9453	2.964	129.0	3096	1.615
30.0	34662	4.209	80.0	9227	2.935	130.0	3033	1.593
31.0	33659	4.190	81.0	9007	2.905	131.0	2972	1.571
32.0	32692	4.170	82.0	8793	2.876	132.0	2912	1.549
33.0	31768	4.150	83.0	8584	2.847	133.0	2854	1.528
34.0	30874	4.130	84.0	8382	2.817	134.0	2797	1.506
35.0	30008	4.109	85.0	8185	2.788	135.0	2741	1.485
36.0	29169	4.088	86.0	7993	2.759	136.0	2687	1.464
37.0	28357	4.067	87.0	7806	2.730	137.0	2633	1.444
38.0	27570	4.045	88.0	7624	2.700	138.0	2581	1.423
39.0	26808	4.024	89.0	7447	2.671	139.0	2530	1.403
40.0	26069	4.002	90.0	7275	2.642	140.0	2481	1.383
41.0	25354	3.979	91.0	7107	2.613	141.0	2432	1.364
42.0	24660	3.957	92.0	6944	2.584	142.0	2385	1.344
43.0	23988	3.934	93.0	6785	2.555	143.0	2338	1.325
44.0	23337	3.910	94.0	6630	2.526	144.0	2293	1.306
45.0	22706	3.887	95.0	6479	2.498	145.0	2248	1.287
46.0	22094	3.863	96.0	6332	2.469	146.0	2205	1.269
47.0	21500	3.839	97.0	6189	2.440	147.0	2162	1.250
48.0	20925	3.815	98.0	6050	2.412	148.0	2121	1.232
49.0	20367	3.790	99.0	5914	2.384	149.0	2080	1.215
						150.0	2041	1.197

Notes:
1. Overall accuracy for the sensor is at least + 2 F 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 6.
Sensor Conversion Data:
Optional Zone Temperature (6RT4)

10.0	63768.7	4.063	55.0	17471.6	2.910	100.0	5824.3	1.621
11.0	61815.3	4.043	56.0	17018.0	2.871	101.0	5694,2	1.602
12.0	59927.8	4.023	57.0	16577.8	2.832	102.0	5567.4	1.582
13.0	58103.1	4.004	58.0	16150.5	2.813	103.0	5443.8	1.543
14.0	56339.6	3.984	59.0	15735.7	2.773	104.0	5323.3	1.523
15.0	54634.7	3.965	60.0	15332.9	2.754	105.0	5205.9	1.504
16.0	52986.4	3.945	61.0	14941.7	2.715	106.0	5091.5	1.484
17.0	51392.6	3.926	62.0	14561.9	2.695	107.0	4979.9	1.465
18.0	49851.6	3.906	63.0	14193.0	2.656	108.0	4871.1	1.426
19.0	48360.9	3.867	64.0	13834.6	2.637	109.0	4765.0	1.406
20.0	46919.2	3.848	65.0	13486.5	2.598	110.0	4661.5	1.387
21.0	45524.6	3.828	66.0	13148.3	2.559	111.0	4560.6	1.367
22.0	44175.6	3.809	67.0	12819.8	2.539	112.0	4462.2	1.348
23.0	42870.3	3.789	68.0	12500.5	2.500	113.0	4366.3	1.328
24.0	41607.6	3.770	69.0	12190.2	2.480	114.0	4272.6	1.309
25.0	40385.3	3.730	70.0	11888.7	2.441	115.0	4181.3	1.289
26.0	39202.7	3.711	71.0	11595.6	2.422	116.0	4092.2	1.270
27.0	38057.9	3.691	72.0	11310.7	2.383	117.0	4005.3	1.250
28.0	36950.0	3.652	73.0	11033.7	2.363	118.0	3920.5	1.230
29.0	35877.4	3.633	74.0	10764.4	2.324	119.0	3837.7	1.211
30.0	34838.9	3.613	75.0	10502.6	2.305	120.0	3756.9	1.191
31.0	33833.3	3.594	76.0	10248.0	2.266	121.0	3678.1	1.172
32.0	32861.4	3.555	77.0	10000.4	2.246	122.0	3601.1	1.152
33.0	31935.3	3.535	78.0	9759.6	2.207	123.0	3526.5	1.133
34.0	31038.7	3.496	79.0	9525.4	2.188	124.0	3453.6	1.113
35.0	30170.5	3.477	80.0	9297.5	2.148	125.0	3382.4	1.094
36.0	29329.5	3.457	81.0	9075.9	2.129	126.0	3313.0	1.074
37.0	28515.0	3.418	82.0	8860.2	2.090	127.0	3245.1	1.055
38.0	27725.9	3.398	83.0	8650.4	2.070	128.0	3178.9	1.035
39.0	26961.4	3.359	84.0	8446.2	2.051	129.0	3114.2	1.035
40.0	26220.8	3.340	85.0	8247.5	2.012	130.0	3051.0	1.016
41.0	25503.0	3.320	86.0	8054.1	1.992	131.0	2989.2	0.996
42.0	24807.5	3.281	87.0	7865.8	1.953	132.0	2928.9	0.977
43.0	24133.3	3.262	88.0	7682.5	1.934	133.0	2870.0	0.957
44.0	23479.7	3.223	89.0	7504.2	1.895	134.0	2812.4	0.957
45.0	22846.1	3.203	90.0	7330.5	1.875	135.0	2756.2	0.938
46.0	22231.9	3.164	91.0	7161.4	1.855	136.0	2701.2	0.918
47.0	21636.2	3.145	92.0	6996.7	1.816	137.0	2647.5	0.898
48.0	21058.7	3.105	93.0	6836.3	1.797	138.0	2595.0	0.879
49.0	20498.4	3.086	94.0	6680.1	1.777	139.0	2543.7	0.879
50.0	19955.0	3.047	95.0	6528.0	1.738	140.0	2493.6	0.859
51.0	19427.9	3.027	96.0	6379.8	1.719	141.0	2444.6	0.840
52.0	18916.5	2.988	97.0	6235.5	1.699	142.0	2396.7	0.840
53.0	18420.3	2.969	98.0	6094.8	1.680	143.0	2349.9	0.820
54.0	17938.8	2.930	99.0	5957.8	1.641	144.0	2304.1	0.801

Notes:,

1. Sensor 6RT4 is connected between Terminals TB1-1 and -2 on Options Module 1U2.
2. Overall accuracy for the zone temperature sensor is + 2 F over the range shown.
3. 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.
4. 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.

Operation of Compressor Starting/Stopping, Anti-cycle Timing and Restart Inhibit Timer

This feature is called the Auto Lead/Lag and can be found in Menu 4, Item 43. When this function is disabled in the UCM, the UCM always starts compressor "A" first. When this function is enabled, the following occurs:

The UCM equalizes operating hours on the starting of a compressor. This will cause the compressor with the least amount of starts to be started first. When a compressor starts, it is always started unloaded.

When a compressor is stopped. it shuts down in an unloaded state, unless taken out by a manual reset diagnostic.

Once on line, the compressor is driven to a fully loaded state before starting another and, before the second compressor is started, the first compressor will be driven back to an unloaded state. For example, if compressor A is started and driven to 100% of its load, it will be driven back to an unloaded state and compressor B will start. Now both compressors will be driven to accommodate 50% of the load. The UCM will turn on another compressor when an increase in load pulses does not result in an increase in amp draw.

When the load drops off, the compressor with the most hours will always be the first to unload and turn off. The anti-recycle timer is approximately 5 minutes from unit off to restarting the unit. The minimum time between compressor shutdown and restart is approximately 10 seconds, but only if the compressor has been running over 5 minutes or longer prior to shutting down on temperature. Otherwise, it is 5 minutes.

Restart Inhibit Timer

If compressor operation is interrupted by an extended (not momentary) loss of power or a manual reset, there will be a two minute delay between the power up or manual reset and the start of a compressor, assuming there is a call for cooling. The timer is factory set at 2 minutes but can be field adjusted from 30 seconds to two minutes. This feature is supported on all Phase II modules.

Compressor Start/Stop Strategy for Normal Start and Shutdown (includes action the UCM takes for abnormal shutdowns and a procedure for checking the differential oil pressure switch)

To start a compressor after either a "normal' shutdown, a Unit Switch reset, or power-on-reset, the following sequence will occur:

1. On a call for a compressor, the Restart Inhibit Timer will time out, if any time remains.

2. The EXV is positioned to the initial start position. At the same time, the unload solenoid is energized and the load solenoid is de-energized. Timing is determined by the time required to position the EXV.

3. After the EXV is positioned:

* the compressor is turned on
* the oil control solenoid is energized
* the compressor heater is de-energized
* the saturated evaporator ref. temp. cutout ignore time is set, based on the saturated condenser temperature. Prior to start, this approximates the ambient temperature.
* the fan control algorithm is executed

To stop a compressor due to either the Unit Switch set to "STOP/RESET'' or an External/Remote "STOP", the sequence shall be as follows:

1. The unload solenoid is energized for 20 seconds and the load solenoid is de-energized. The compressor continues to run for the remaining 20 seconds. This is defined as the RUN:UNLOAD mode.

Note: If the RUN:UNLOAD mode had been initiated by the chiller switch being put in the STOP/RESET position, a RESET shall be queued up and executed only after the 20 second RUN:UNLOAD mode has been completed.

2. When the 20 second RUN:UNLOAD times out, the UCM will de- energized the oil line solenoid and set a 10 second timer. If differential pressure switch does not open within 10 seconds, the compressor shall be de-energized and a CMR diagnostic generated, not permitting the compressor to restart.

This is an indication that the differential oil pressure switch has malfunctioned. Some causes for this switch to malfunction are as follows:

1) Incorrect setting
2) Flare nut depressor to Schrader valve on high side of switch at main oil line feed is not seating correctly.
3) Faulty switch

The above test will serve to check the differential pressure switch, the switch wiring to the UCM, and closure of the oil line solenoid.

3. The compressor, the oil control solenoid and the fans are turned off. The crankcase heater is energized.

4. The unload solenoid remain energized for 60 minutes after the compressor stops. The load solenoid is de-energized.

5. The EXV is closed. Closing begins at maximum speed when the compressor is turned off. (Max. speed is 25 steps per second, full stroke is 757 steps.)

6. After 60 minutes, the unload solenoid de-energizes.

Note: It not necessary to queue up a RESET during the post RUN:UNLOAD period.

The RUN:UNLOAD mode is also be used to stop a compressor due to normal LWT control, Low Ambient Run Inhibit, or Freeze Avoidance,

Condenser Fan Control Operation via Microprocessor

Fan Staging

Each compressor has its own fans and independent staging control. Fans are controlled based on the high to low side pressure differential and/or saturated condensing temperature rate change. Evaporator and condenser temperatures will be sensed and used as inputs to the UCM for this function. Refer to Figure 5

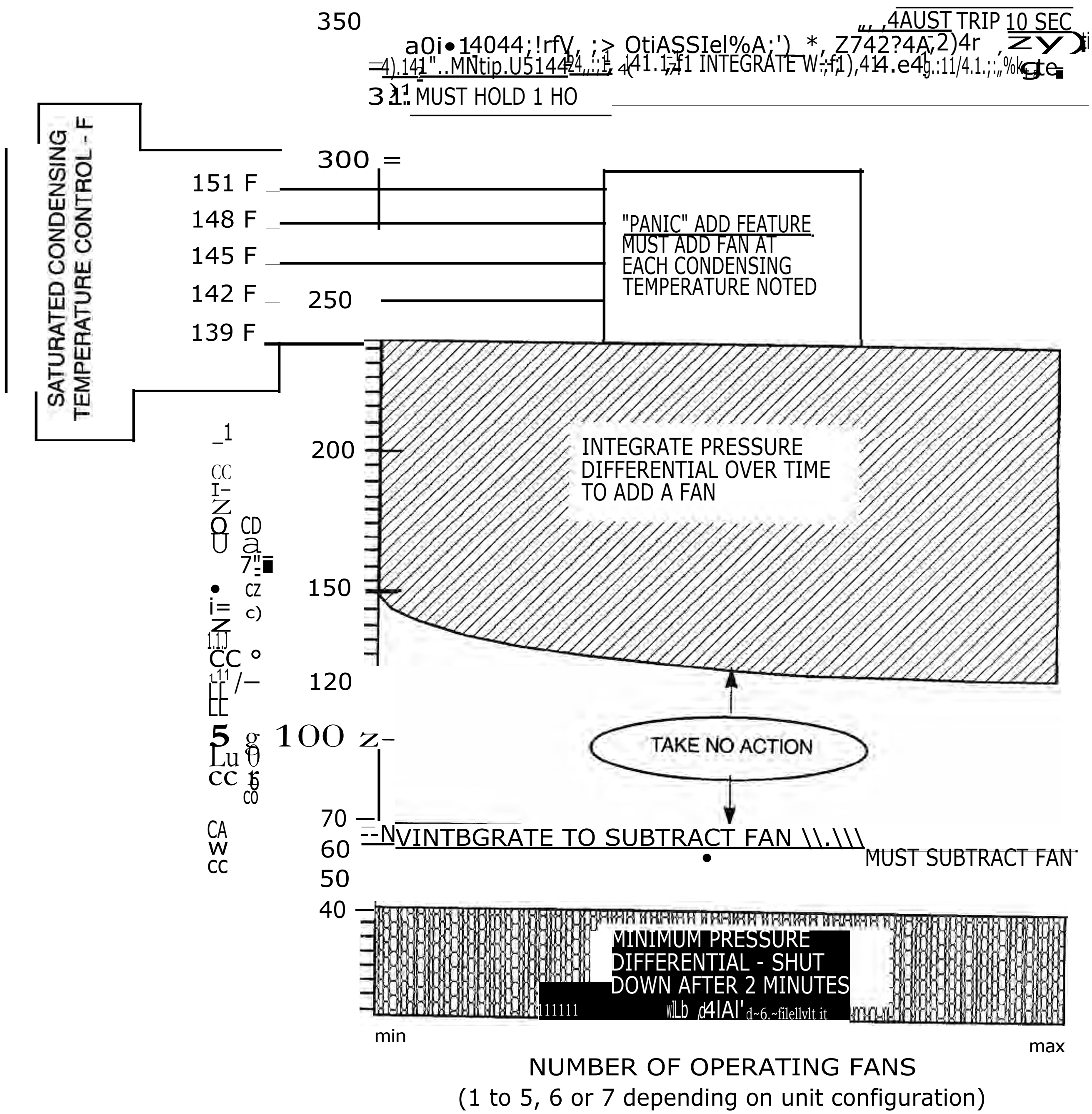
Note: The UCM monitors saturated condensing temperature and saturated evaporator temperature, to maintain sufficient pressure drop for oil flow and a minimum of 40 psi drop across the expansion valve.

For example, assume that the unit is operating at a part load point. The UCM will recognize if the system is operating well above the minimum pressure differential and will, in time, turn on an additional fan. This will result in a reduction of the condenser pressure and the total system power.

Fans per Compressor

70 ton units — 5 fans
85 ton units — 6 fans
100 ton units — 7 fans

Figure 5.
Fan Staging



Current Transformer And Current Input Checkout

General

Each compressor motor has all three of its line currents monitored by torroid (doughnut) current transformers. While the MCSP utilizes at three of the signals, it only displays the maximum phase at any given time. These currents are 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 (five available), the setting of the Compressor Current Overload dip switch (SW2) on the MCSPs, and the redundant programming of the decimal equivalent of these settings in Menu 5, items 56 A thru D, of the CPM display. (The term "Compressor Current Overload setting" is actually a misnomer. Instead the setting should be thought of as an internal software gain that normalizes the currents to a % RLA for a given CT and compressor rating. The true nominal steady state overload setting is fixed at 132%). Refer to Table 7 for setups details.

The current transformers provide the input for six basic functions of the MCSP:

1. Motor overload protection using a programmed "% RLA versus time to trip" characteristic. Refer to Table 8 for details. The steady state "must trip" value is 140% RLA and the "must hold" value is 125% RLA. The MCSP will trip out the compressor, and the CPM will then shut down the other compressor on the same refrigerant circuit (if applicable). The appropriate diagnostic codes bA, bb, bC or bD will be displayed.

2. Verifying contactor drop-out. If currents corresponding to less than 12 ±7% RLA are not detected on all three of the monitored compressor phases within approximately 5 seconds after an attempted contactor drop-out, the MCSP will attempt a shutdown of the other compressor of the refrigeration circuit (if applicable). The appropriate contactor failure diagnostic codes CA, Cb, CC, or Cd will be displayed.

3. Loss of Phase Current. If the detection of any or all of the three motor phase currents falls below 12 ±7% RLA for 2 ±1 seconds while the branch circuit should be "energized", the MCSP will trip out the compressor, and the CPM will then shut down the other compressor on the same refrigerant circuit (if applicable). The Phase Loss diagnostic codes 19C, 19d, 19E, or 19F or the Power Loss diagnostic codes 1AO, 1A1, 1A2, or 1A3 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 startup, as phase loss protection is not active during the 3 second transition time.

4. 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 startup, the MCSP will trip out the compressor, and the CPM will then shut down the other compressor on the same refrigerant circuit (if applicable). The Phase Rotation diagnostic codes 1d7, 1d8, 1d9 or 1dA will be displayed. This function is not sensitive to the current transformer's polarity.

5. Phase Unbalance. The MCSP will shut down the compressor if a phase current unbalance is detected by the current transformers while the compressor is running. A 15% unbalance, if protection is enabled, will cause the MCSP to trip out the compressor, and the CPM will then shut down the other compressor on the same refrigeration circuit (if applicable). The Phase Unbalance diagnostics 1 bA, 1 bb, 1 bC or 1Bd will be displayed. If this protection is disabled, a 30% phase unbalance will still be in effect with the diagnostic codes of 1b2, 1b3, 1b4, or 1b5.

6. Current Limit. The MCSP will begin to unload its compressor as the %RLA exceeds 120%. Further, the CPM will cause the compressors to automatically unload when the Chiller Current Limit Setpoint is reached. The Current Limit Setpoint is programmed at menu P1 item 13. Individual compressor phase currents are averaged and added together to compare to the Chiller Current Limit which is in terms of % Total of all of the Compressor RLA's.

Note: The current transformers are NOT polarity or directionally sensitive.

CT and MCSP Compressor Current Input Checkout Procedure

1. Check incoming 3-phase power for voltage within ± 10% of nominal per Chiller nameplate.

2. Interrogate the CPM for all of the presently active (flashing) diagnostic codes or the historic (not flashing) diagnostic codes in the C register of Menu P0. Narrow the problem down to a particular compressor or contactor as noted above. Write down all of the diagnostic codes stored in the "b" and "C" registers.

If there is any question as to which compressor or 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 in the "C" register. The diagnostics can be cleared by holding the "DISPLAY down" key while cycling the Chiller rocker switch to "STOP/RESET" and back to "AUTO LOCAL".

It is possible to "force" certain compressors to be the first or next compressor to stage on, using the "Compressor Test" feature of Menu P2. The Leaving Water Temperature must, however, be above the Chilled Water Setpoint by more than the "differential to start" setting, in order to stage on the first compressor.

At startup, verify the appropriate contactor(s) pull-in. Normally one can determine which MCSP will attempt to stage and when, by watching the Compressor indicator carats on the CPM display. With the display in Menu P0, the respective Compressor carat will light approximately 25 seconds prior to the compressor start. Note the diagnostic(s) that results, then place the Chiller into the "Stop" mode.

3. 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 of the suspect compressor in the control panel. Refer to the Component Location Drawing in the panel to identify the particular current transformer(s) of interest. Locate the part number/UL tag on the transformer leads and note the Trane part number which identifies the transformers. Note; all compressors of a given tonnage should have the same transformer extension number. Verify the proper current transformer using Table 7 in this section. Also check the setting of the dip switch (SW2) on each of the MCSP modules and verify these against Table 7 for each compressor. (Switch position SW2-1 is the Most Significant Bit). The decimal equivalent of this setting should also be verified in Menu P5 Item 56 A thru D, respectively on the CPM display. If the programmed value does not agree with the dip switch setting for each of the MCSP's, an informational diagnostic will result. The compressors will be allowed to run, but default settings (the most sensitive possible) will be used for the internal software compressor current gains.

4. Utilizing the Schematic Wiring Diagram, locate the termination of the transformer's wiring into the MTA plug at the appropriate MCSP module. at pin header J5. Pull off the appropriate MTA connector from the pin header on the MCSP.

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 MCSP input. Take care to properly reconnect the CT's MTA prior to attempted start of the compressors.

5. Using a digital volt-ohmeter, measure the resistance of the transformer(s) by probing the appropriate pair(s) of receptacles within the MTA. The receptacle pairs of the MTA are most easily measured by using meter leads with pointed probes and contacting the exposed metal of the connector through either the top or the side of the MTA. (It may be necessary to remove a cap over the top of the connector to gain access to the connector conductors.)

6. Refer to Table 9 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 MTA can be considered good. Go on to step 8.

7. If the resistance reading above is out of tolerance, the problem is either with the transformer, its wiring, or the MTA connector. First double check the schematic to be sure you are working the proper lead pair. Then cut the leads to the particular transformer near the MTA connector and repeat the resistance measurement by stripping insulation from the wire's end. Once the fault has been isolated in this manner, reconnect leads or install a new transformer or connector.

More than one current transformer is terminated to a single MTA. When replacing, take care to note the proper positions of the respective transformer wire terminations on the MTA for the re-termination. (The current transformers are NOT polarity or directionally sensitive however). The transformer lead wiring is #22 AWG, UL 1015 600V and the proper MTA connector (red color code) must be used to ensure a reliable connection. If the fault can be isolated to the current transformer or its wiring apart from the connector, the connector can be reused by cutting off the bad transformer and splicing in a new transformer using wire nuts.

8. 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 condition.

9. To perform the following test, you will need to use a digital voltmeter with a diode test function. With the transformer MTA disconnected and the power off to the MCSP, perform a diode test across the corresponding pair of current transformer input pins on the MCSP (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 MCSP module. If the diode voltage drops prove accurate, reconnect the transformers to the MCSP and renewer the unit.

10. With the CT's reconnected to the MCSP, attempt a restart of the chiller. As the given 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 MCSP (using a digital volt-meter on a 0-20 VAC scale). Refer to Table 10 for the compressor phase current to output voltage relationship for each extension current transformer. Using Table 10, look up to 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%.

11. 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 their normal range, then the problem is either with the CT selection, MCSP Compressor Overload Dip Switch Setting, or the MCSP's current input, analog to digital (ND), or dip switch input circuitry. Since the first two items were verified in Step 2 using Table 7, that leaves only the MCSP circuitry as an issue. It is advisable to replace the MCSP module at this point. However if verification of the MCSP Current sensing operation is desired, go to step 12 below.

12. There are two ways that the MCSP's current sensing can be checked. Both methods use the CPM display of the %RLA from each MCSP (Menu P2 Items 27 A thru D) for indication of the sensed current. The first is straightforward equation and assumes that the proper Compressor Overload dip switch setting and current transformer have been selected:

$$\%RLA = \frac{\text{Measured Comer. amps of max. phase}}{\text{Nameplate Compressor RLA}}$$

To check the displayed % RLA as a function of the output voltage from the current transformers (as connected at the MCSP), Tables 10 and 11 are utilized. In Table 10 look up (or interpolate) the "% of CT rating" corresponding to the maximum of the three CT Input Voltages (VAC rms) as read at the MCSP. (The table is necessary because the voltage developed at the MCSP is not linearwith the CT's secondary current). Next, check the Compressor Current Overload setting of switch SW2 on the MCSP and find the corresponding "SOFTWARE GAIN" in Table 11. The % RLA displayed by the CPM should be:

$$\%RLA = \%\ \text{CT Rating X SOFTWARE GAIN}$$

The preceding equations should only be applied during steady state current draws (after transition). Inrush transient currents and associated CT output voltages can be expected to be from 3 to 6 times the steady state values, and the displayed value only reads up to 255% RLA. The accuracy of the displayed value should be within ± 5% of that predicted using the Input voltage. However, the end to end accuracy of the displayed value compared to the actual %RLA max. phase current is ±- 3.3% over the range of 50 to 150% of CT rating.

13. 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 MCSP, the problem lies either with the contactor, motor circuit or the MCSP relay outputs. Refer to MCSP Checkout Procedure.

Table 7.
Compressor Overload Dip Switch Settings
And Current Transformer Selection

Comp Tons	Volts,Hz	Line Wye LRA	Line Delta LRA	Line Delta RLA	CT Ext	Overload Setting Dip Sw/Decimal
70	200/230,60	563	1689	280	-05	00100/04
	380,60	255	766	147	-02	11110/30
	460,60	211	633	122	-02	10000/16
	575,60	169	506	98	01	11110/30
	346,50	231	738	141	-02	11011/27
	380/415,50	200	638	122	02	10000/16
85	200/230,60	681	2044	306	-05	01011/11
	380,60	309	927	165	-03	10001/17
	460,60	255	766	133	-02	10110/22
	575,60	204	613	107	-02	00110/06
	346,50	280	881	154	-03	01100/12
	380/415,50	242	762	133	-02	10110/22
100	200/230,60	797	2391	375	-05	11010/26
	380,60	362	1085	200	-03	11111/31
	460,60	299	896	163	-03	10000/16
	575,60	239	717	131	-02	10110/22
	346,50	323	1022	189	-03	11011/27
	380/415,50	279	884	163	-03	10000/16

Table 8.
Trip Times Vs. % Current

MOTOR CURRENT (% RATED RLA)	TRIP TIME (SEC) MINIMUM	NOMINAL	MAXIMUM
127.7 or below	No trip	No Trip	No Trip
132.0	27.2	No Trip	No Trip
132.1	27.2	30.08	No Trip
140.0 (must trip pt.)	22.8	25.28	28.09
150.0	18.8	20.48	22.89
160.0	16.0	17.28	19.29
170.0	14.0	15.28	16.89
180.0	12.4	13.28	14.89
190.0	11.2	12.08	13.29
200.0	10.4	10.88	12.09
210.0	9.6	10.08	10.89
220.0	8.8	9.28	10.09
230.0	8.0	8.48	9.69
240.0	7.6	8.08	8.89
250.0	7.2	7.68	8.49
260.0	6.8	6.88	7.69
270.0	6.4	6.88	7.29
280.0	6.0	6.48	6.89
290.0	5.6	6.08	6.89
300.0	4.0	5.68	6.49
300.1	4.0	4.08	6.49
310.2 or above	4.0	4.08	4.49

Table 9.
Current Transformers Ratings and Resistance

EXT	RATING	USABLE RANGE	RESISTANCE OHMS ± 10%
01	100A	66.67 - 100A	23.33
02	150A	100 - 150A	36.55
03	200A	134 - 200A	48.45
04	275A	184 - 275A	67.90
05	400A	267 - 400A	102.24

Table 10.
Compressor Phase Current Vs.
AC Input Voltage at **MCSP**

ACTUAL COMPRESSOR PHASE AMPS THRU CT					TERMINAL	% OF
EXT -01	EXT -02	EXT -03	EXT -04	EXT -05	VOLTAGE (AC RMS)	CT RATING
0	0	0	0	0	0.00	0
5	8	10	14	20	1.19	5
10	15	20	28	40	1.37	10
15	23	30	41	60	1.53	15
20	30	40	55	80	1.67	20
25	38	50	69	100	1.81	25
30	45	60	83	120	1.95	30
35	53	70	96	140	2.09	35
40	60	80	110	160	2.23	40
45	68	90	124	180	2.36	45
50	75	100	138	200	2.50	50
55	83	110	151	220	2.63	55
60	90	120	165	240	2.77	60
65	98	130	179	260	2.90	65
70	105	140	193	280	3.03	70
75	113	150	206	300	3.17	75
80	120	160	220	320	3.30	80
85	128	170	234	340	3.43	85
90	135	180	248	360	3.57	90
95	143	190	261	380	3.70	95
100	150	200	275	400	3.83	100
105	158	210	289	420	3.96	105
110	165	220	303	440	4.10	110
115	173	230	316	460	4.23	115
120	180	240	330	480	4.36	120
125	188	250	344	500	4.49	125
130	195	260	358	520	4.62	130
135	203	270	371	540	4.75	135
140	210	280	385	560	4.88	140
145	218	290	399	580	5.02	145
150	225	300	413	600	5.15	150
160	240	320	440	640	5.41	160
170	255	340	468	680	5.67	170
180	270	360	495	720	5.94	180
190	285	380	523	760	6.20	190
200	300	400	550	800	6.46	200
210	315	420	578	840	6.72	210
220	330	440	605	880	6.99	220
230	345	460	632	920	7.25	230
240	360	480	660	960	7.51	240
250	375	500	687	1000	7.77	250
260	390	520	715	1040	8.03	260
270	405	540	742	1080	8.29	270
280	420	560	770	1120	8.56	280
290	435	580	797	1160	8.82	290
300	450	600	825	1200	9.08	300

Table 11.
Overload Dip Switch Setting Vs.
Internal Sortware Gain

CPRSR RATED RLA AS A % OF CT RATING	OVERLOAD DIP SWITCH SETTING	DECIMAL SETTING	SOFTWARE GAIN
66	00000	00	1.500000
67	00001	01	1.483870
68	00010	02	1.467743
69	00011	03	1.451613
70	00100	04	1.435483
71	00110	06	1.403226
72	00111	07	1.387097
73	01000	08	1.370969
74	01001	09	1.354839
75	01010	10	1.338709
76	01011	11	1.322580
77	01100	12	1.306452
78	01101	13	1.290323
79	01111	15	1.258065
80	01111	15	1.258065
81	10000	16	1.241936
82	10001	17	1.225806
83	10010	18	1.209678
84	10011	19	1.193549
85	10100	20	1.177419
86	10101	21	1.161291
87	10110	22	1.145162
88	10110	22	1.145162
89	10111	23	1.129032
90	11000	24	1.112903
91	11001	25	1.096775
92	11001	25	1.096775
93	11010	26	1.080645
94	11011	27	1.064516
95	11100	28	1.048387
96	11100	28	1.048387
97	11101	29	1.032258
98	11110	30	1.016128
99	11110	30	1.016128
100	11111	31	1.000000

Under-over Voltage Transformer

General

The Under-Over voltage function of the CPM module is optional. A custom designed transformer whose primary is connected across the Line Voltage phases B To C, provides a stepped down and isolated AC voltage to the CPM at input J4. This secondary voltage is directly proportional to the line voltage applied to the primary. The voltage is rectified and AID converted. The CPM can directly display the % Line Voltage and, when so enabled, can cause automatically reset MAR diagnostics for High and Low Line condition. The % Line Voltage is internally calculated by dividing the selected nominal voltage rating (only certain discrete values are selectable in Menu P4 item 45) by the actual line voltage as read and processed by the CPM. With the Under-Over Voltage Protection Function enabled, an Over Voltage diagnostic "d7" will occur if the calculated % Line Voltage equals or exceeds 114%, or an Under Voltage "d8" diagnostic will occur if it equals or falls below 87% for 15 continuous seconds. Reset differential is set at 3%.

WARNING: HIGH VOLTAGE

Under-Over Voltage Transformer Checkout

1. Locate the Under-Over Voltage Transformer [1T2] in the panel by referring to the Component Location Drawing. Carefully measure the primary voltage across the Transformer (Line Voltage Phase B to C) and note the value in Vac rms.

2. Next disconnect the transformers secondary from J4 on the CPM. 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 J4 and remeasure the loaded (connected) secondary voltage. The new loaded ratio should be approximately 20.2 to 1. If not with ±2% of this ratio the transformer's secondary should be disconnected from the CPM and a 1 Kohm resistor connected across the secondary. Measuring the voltage across the 1 Kohm resistor should give us a voltage ratio of 20.17. Ratios more that ±2% in error suggest a bad transformer. If the 1 Kohm loaded ratio is within tolerance, but the CPM connected ratio is out of tolerance suspect a bad CPM. Before replacing CPM, double check the Under-Over Voltage Function's Nominal Line Voltage Setup in Menu P5.

5. If the Under-Over Voltage Protection function continues to misoperate, and all of the above measured ratios are within tolerance, and all CPM Under Over Voltage setups have been verified, replace the CPM. It is a good idea, before replacing the CPM, however, to copy down all of setup data of Menus P1 P3 P4 and P5. This data will be very helpful in making the necessary setup on the replacement CPM.

Compressor Slide Valve (Load/Unload) Checkout Procedure

General

The helical rotory screw compressors are loaded and unloaded by means of an internal slide valve. In simple terms, the slide valve can regulate the amount of "bite" of the compressor rotors as they turn at relatively constant speeds. This slide valve is moved by a hydraulic cylinder and piston internal to the compressor (the hydraulic fluid is oil from the refrigerant system). 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. These solenoid valves are electrically controlled by the MCSP module to handle compressor startup and shutdown, maintain chilled water temperature setpoints and limit current, condenser pressures, and evaporator temperatures etc. Although the solenoids are an "on - off" device, effective modulation and high resolution of the slide valve (under steady state conditions) is possible by pulsing on and off the solenoid valves and varying the displaced volume of the cylinder/piston. When a given compressor is operating, the MCSP will energize (apply 115 VAC) either the load or the unload solenoid, if necessary, for a period of between 40 and 400 milliseconds, once every 10 seconds to control water temperature or limit conditions. Just prior to and just after a compressor start, and just before a compressor stop, the MCSP will continuously energize the unload solenoid for 20 to 30 seconds to assure unloaded starts. After a compressor stop, the unload solenoid valve will remain energized for approximately one hour to prevent slide valve movement due to changing cylinder/compressor pressures.

The first procedure following will allow the checkout of the MCSP load and unload outputs. The next 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 modulating unloader.

Checkout Procedure for MCSP Load / Unload Outputs

The MCSP controls the Load and Unload Solenoid valves on the respective compressor with 115 V triacs (solid state relays). Unlike mechanical relays however, 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. Thus it is important to verify that the solenoid coil is continuous and providing a normal load or to connect a known good load, such as a low wattage 115 Volt lamp, to the terminals when testing the outputs. 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 MCSP and remained energized for 1 hour following a compressor stop. Also compressors and associated solenoids etc. may be started or energized at any time under automatic control.

With the particular compressor running, the triacs may be checked (under load as explained above) by measuring the voltage from terminals E7 or E8 to 115 neutral. The triacs operate in the high side and switch 115 Vac power from J7-1 to either E7 (load solenoid) or E8 (unload solenoid) to move the slide valve in the appropriate direction. Except during compressor starts and stops, in normal operation, the solenoid valves can only be energized for a period of between 40 and 400 milliseconds once every 10 seconds. Often, if the chilled water setpoint is being met under steady state conditions, they may not energize at all. To assure loading and unloading is occuring it may be necessary to make slight adjustments to the chilled water setpoints to force action. As the pulsed on-time is potentially short it may be difficult to see, especially if using a meter movement type voltmeter. (Use of a low wattage 115 Vac test lamp may be of some help for a visual indication of output triac operation.)

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).

The best time to check the unload solenoid is immediately after a power-up reset of the MCSP. For the first 30 seconds after applying power the unload solenoid should be on continuously. The next best time to check it is after the compressor starts. For the first 30 seconds after a start the unload solenoid should be on continuously.

Checking the load solenoid is more difficult. 30 seconds after a start, the compressor will usually start loading, until water temperatures are satisfied. Remember however, that under certain conditions, the MCSP may prevent a compressor from loading even if the chilled water setpoint is not satisfied. Refer to the IOM for discussion on these limit controls.

Checkout Procedure for the Slide Valve and Load / Unload Solenoids

Make sure unit is off and there is no power in the control panel before beginning this procedure.

Setup.

1. Identify the MCSP Module associated with the compressor to be tested (1U4 thru 1U7). Disconnect the stake-on terminals for the Load and Unload Solenoid Valves at the MCSP UCM (E7 and E8 respectively) but take care to identify the wires so as to prevent crosswiring when reconnecting.

Caution: Open disconnect to remove all power from the control panel

2. Install a toggle switch between Control Power HOT (1TB3-8,9) and the Load and Unload Solenoid Valve leads (previously connected to E7 and E8). Initially make sure that the Load toggle switch is open and the Unload toggle switch is closed.

3. Install a pressure gauge with a refrigerant hose (hose should be long enough to read the gauge from the control panel) to the compressor cavity Schrader valve located on the front of the compressor.

4. Place the chiller in the "Stop" mode and reapply power to the unit. Using the CPM Operator Interface, select and enable the "Compressor Test" (Menu item 2b) for the compressor that is desired to be run. Additionally, if it is desirable to prevent the opposite refrigeration circuit from running, the circuit can be locked out through the Operator Interface by enabling Menu Item 1A (on Phase II UCMs only) for the appropriate circuit. Next place the Chiller into the "Auto Local" mode and provide all necessary interlocks and a load (or adjust chilled water setpoint) to start the chiller. The selected compressor will be the first to stage on (after the restart inhibit timer has expired).

Note: The enabling of the "Compressor Test" only affects which compressor will be cycled on next and is not an overide mode. The chiller will continue to operate normally (not withstanding circuit lockout) and will stage compressors on and off, as well as attempt to modulate running compressors to maintain chilled water setpoint. Be aware that during manual control of the load/unload solenoids, as explained in item 6, below, other compressors may stage and/or attempt to modulate and thus will affect the leaving chilled water temperature. However, all diagnostics are still active. No specific action, other than reconnecting the solenoid valves to their respective outputs on the MCSP, is required to return the Chiller to normal operation. For modules with date codes earlier than 91Hxxx, the above mentioned features do not exist and it may be necessary to disable the compressor of the other refrigeration circuit, by disconnecting the high pressure cutout terminal at the other MCSP, and force a diagnostic.

5. Allow the compressor to start and monitor compressor currents either at the UCM display (maximum phase % RLA) or with a clamp-on type ammeter.

Load.

6. Once the compressor has started, allow the Unload Solenoid Valve to remain energized for approximately 30 seconds, then open the Unload toggle switch to de-energize the valve. Verity that at least one condenser fan is on before continuing with the checkout, as low differential refrigerant pressures will preclude proper Slide Valve operation. Record the cavity pressure and the compressor currents.

7. Manually close and open the Load toggle switch, to energize the Load Solenoid, in 4 or 5 short "pulses". Each load pulse should be approximatly one second in duration, with approximately 10 seconds between pulses.

Note: Loading the compressor faster than this rate could cause control instability and possible diagnostics. Leave the toggle switch open, i.e., valve de-energized.

A. If the %RLA or current increases, then the Load Solenoid and Slide Valve are operating properly.

13. If the %RLA or current does not increase, read the pressure at the compressor cavity. Pressure increases to approximately condenser pressure (condenser pressure read via the UCM) indicate the Slide Valve is bound.

C. If cavity pressure does not increase, check the coil of the Load Solenoid.

D. If the coil checks out, then one of two problems exist. Either the Load Solenoid Valve is malfunctioning or the Unload Valve is stuck open.

Note: Refer to the flow chart shown in Figure 6.

Figure 6.
Manual Slide Valve Diagnostic Flow Chart - Load

1. Install toggle switches across load and unload solenoid valves.
2. Install Pressure Gage on compressor Cavity Pressure Port.
3. Start Unit.

Load:

4. Manually load compressor in short increments.

Yes Good

5. Does RLA increase? Check UCM --to- Repeat procedure for unload

No Bad

Replace UCM

Yes

6. Does Cavity Press increase to a level close to discharge pressure? Slide valve mechanism bound

No

Yes

7. Does Magnetic Field on Solenoid Coil exist? Solenoid valve mechanism bound or unloader valve stuck open

No

Yes

8. Is wiring to valve OK? Check for open sol coil

No

9. Repair and reverify.

Unload

Note: the following assumes that the compressor's slide valve is already at some loaded position and %RLA is higher than the minimum noted in step 7.

8. Manually close the Unload toggle switch to continuously energize the Unload Solenoid Valve.

A. If the %RLA decreases, then the Unload Valve and Slide Valve are operating properly.

B. If the %RLA does not decrease observe the cavity pressure reading.

C. If cavity pressure reading decreases to approximately the suction pressure, then the Slide Valve is either bound or leaking.

D. If cavity pressure does not decrease or is at suction pressure before the Unload toggle switch was closed, the problem lies with either the solenoid coil or valve.

E. Check coil

F. If coil checks out, change the valve.

Note: Refer to the Flow Chart in Figure 7.

Figure 7.
Manual Slide Valve Diagnostic Flow Chart

Unload:

10. Manually unload compressor.

11. Does RLA Decrease? — Yes → Check UCM — Good → Stop

  Check UCM — Bad → Replace UCM

  No

12. Does Cavity Press decrease to a level close to suet pressure? — Yes → Slide valve mechanism bound slide valve seal is leaking

  No

13. Does Magnetic Field on Solenoid Coil exist? — Yes → Solenoid valve mechanism bound

  No

14. Is wiring to valve OK? — Yes → Check for open sol coil

  No

15. Repair and reverify.

Module Power And Miscellaneous I/O

General

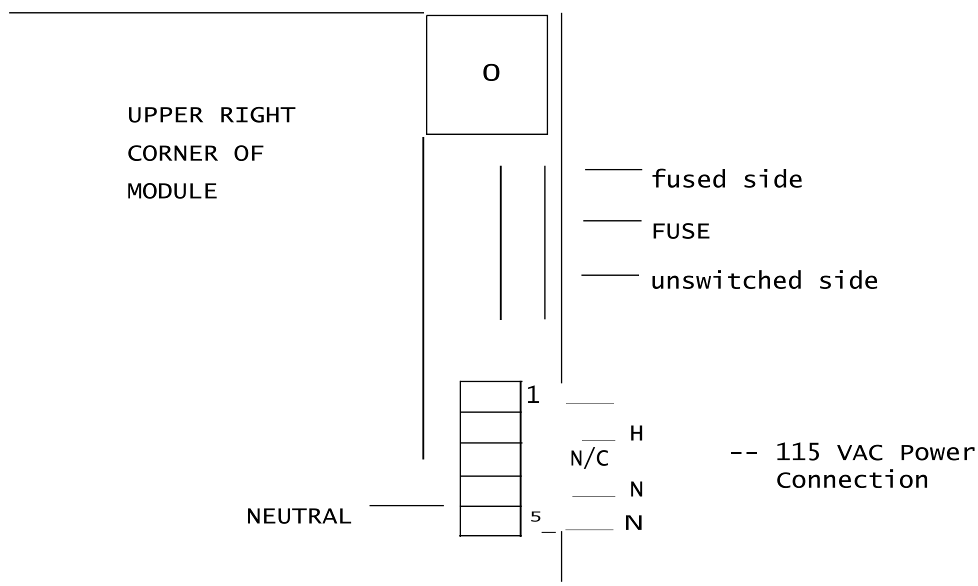
This section will detail the normal voltage levels present on each of the modules inputs and outputs under various conditions or states. Typical operation of the I/O will be discussed in terms of chiller operation. This should help the serviceman determine when and how they should function. Certain inputs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

Power Supply

All of the modules are powered from 115 VAC 50-60hz Control Power. This power is provided by either a control power transformer or is customer supplied. The modules have incoming power connected to the upper-most terminal on the right hand side of the module, just below the fuse. The terminal is arranged with two hot pins (1 and 2) , a keying pin (3), and two neutral pins (4 and 5), for ease of "daisy chaining" power from one module to another. incoming power can be verified by measuring the voltage between the fuse bottom (hot side) and the connector's neutral (pins 4 or 5). The voltage should read between 97.8 to 132.2 volts AC rms. Refer to the diagram below. (The ±15% voltage criteria is most important for the EXV module's operation, as the Electronic Expansion Valve's available torque is directly related to this value).

The fuses can be checked by looking for the supply voltage at the top of the fuse (fused side) with respect to the connector neutral.

Figure 8.
AC Power Connection To Modules



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 CPM. Referto Interprocessor Communication for more information about Communication (IPC) diagnostics. If the GPM's display is blank, power should be checked at the GPM.

Chiller Module (CPM) (1U1)

Vacuum Fluorescent Display

The seven segment, seven digit vacuum fluorescent display should be lit, displaying alphanumeric operating codes, diagnostics, setpoints or temperatures at all times when power is applied to the CPM. A flashing display is indicative of a diagnostic, or an attempt to violate margins for cutout setpoints. If the display is blank, dim, or scrambled, or badly "ghosting" (images bleed from one character into another) replace the CPM. An inoperative display however, does not necessarily imply an inoperative CPM. It may be possible to allow a CPM and chiller to operate normally, even though the display itself is malfunctioning, until a new one can be installed. Problems with the CPM (or any module) that effect chiller operation will always result is a safe shutdown of the compressors regardless of the display status.

Display Up/Down Keys

These momentary pushbuttons should always cause an up/down scan of the display within the current menu. A tactile click when depressed and released is indicative of normal operation. Holding the up or down key depressed will result in a fast scan within the menu that will stop at the top of the menu. Replace CPM if display is stuck or scans involuntarily.

Note: In Menu P0, when observing the "C" register of "Other Diagnostics" it is not possible to "back up" thru the list using the Up display key. To see the entire list of Other Diagnostics you must move downward thru the register using the Down display key.

Set Point Up/Down keys

These keys will not function when in Menu 0, and will function in the other Menus only when the display is on an item which is either a Menu Selection (P), setpoint, programmable parameter, or has an enable/disable function. All setpoints and parameters have a limited adjustment range. Replace the CPM if setpoints are "stuck" or change involuntarily when displayed.

Note: Some setpoints are additionally limited by the settings of other setpoints and are indicated as such by flashing of the setpoint in the display when an attempt is made to violate certain margins.

Chiller Switch

This rocker type switch serves four functions:

1. If indexed to the "Stop/Reset" position, the chiller will, if running, go thru a safe shutdown sequence to result in all compressors and fans off in 20-30 seconds.No compressors or fans can start in this mode.

2. With the switch in the "Auto/Local" position, the chiller will run normally, as dictated by the load, using locally programmed CPM setpoints.

3. With the switch in the "Auto/Remote" position, the chiller will use setpoints as communicated to it by a Tracer Building Automation System and will, for most parameters, default to local setpoints upon a communication loss from the Tracer.

4. The switch provides for a reset function to the UCM's Microprocessors and is used in clearing active or latching diagnostics. When the switch is moved from the Stop/Reset position to the Auto/Local position, a reset is queued to all the microprocessors in the system. The actual reset will occur immediately if the compressors are off, or will be delayed until the running compressors have completed a safe shutdown sequence. The reset is indicated by a brief display of A88 in the display

If, while the compressors are off, the above Chiller switch transition is made while also holding down the Display Down Button, the historical record of past diagnostics in the "C" register will also be cleared (this will not work if the compressors are running).

Note: Active diagnostics that are flashing in the C register may take a normal reset, followed by a "Display Down Button depressed reset", to clear from history.

If the Chiller rocker switch does not function as described above, replace the CPM. Keep in mind, however, that certain external faults can cause diagnostics to recur immediately after a reset. It may appear as though the diagnostic couldn't *be* cleared, when in fact the original fault is causing an immediate recurrence of the diagnostic.

Test Points

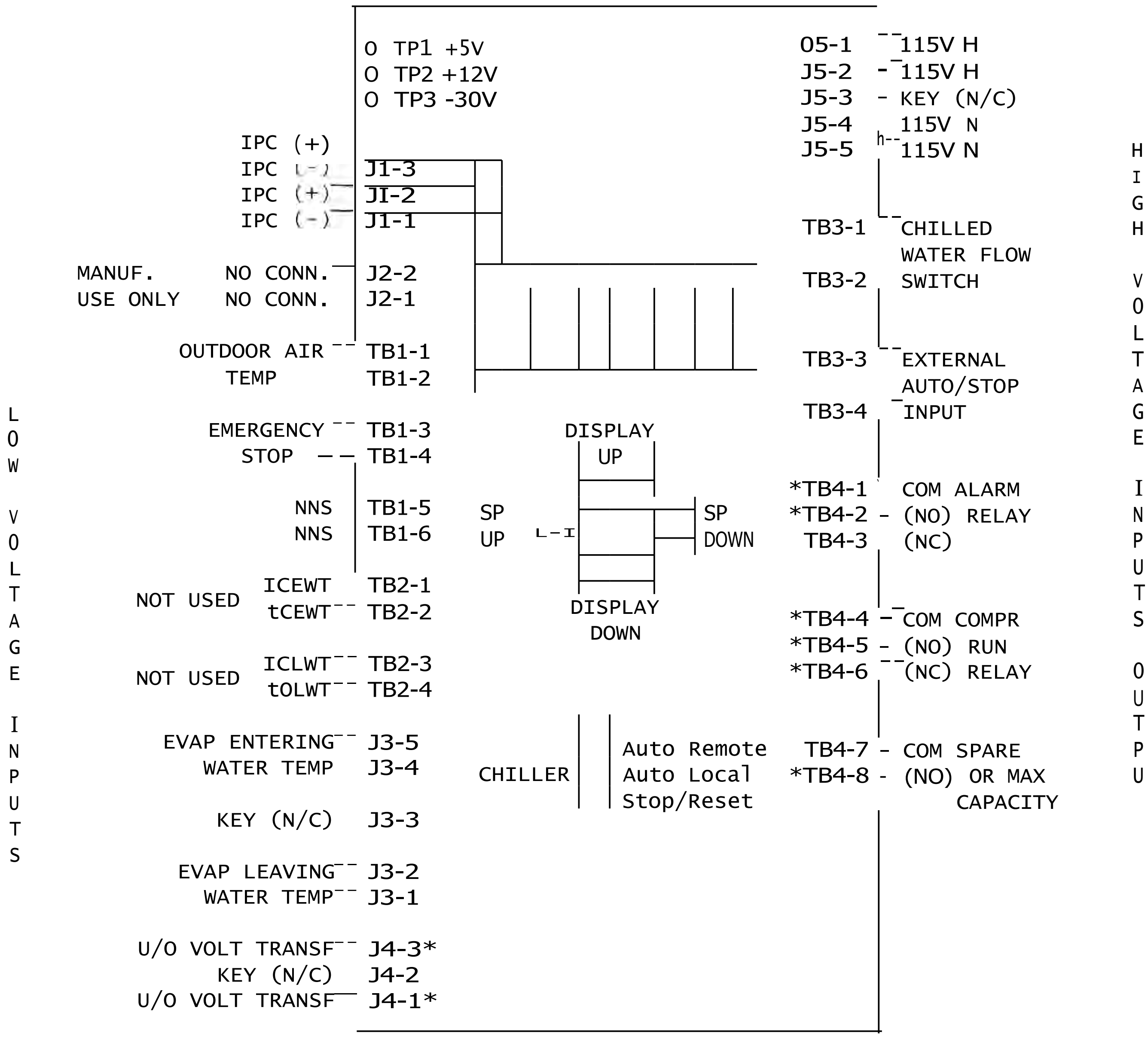
There are three test points associated with the CPM module. They are easily read with a DC voltmeter by probing the PC board solder pads found in the upper left hand corner of the module. The positive meter lead should be connected to the pad while referencing the negative meter lead to the board edge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

Note: Don't use the aluminum module enclosure as a reference as it has an anodized surface with insulating properties.

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

TP1: +5 volts DC ± 5%
TP2: +12 volts **DC ± 5%**
TP3: -30 volts DC ± 15')/0

Figure 9.
CPM Module (1U1)



* DELUXE CPM

I/O terminals

For the checkout of the I/O, refer to the block diagram of the module in Figure 6 and the Chiller Wiring Diagrams for both high and low voltage circuits. All voltages are measured differentially between terminal pairs specified unless otherwise indicated. The first terminal in the pair is the positive (or hot) terminal. Voltages given are nominals and may vary by ±5%. Unregulated Voltages (unreg) or 115 VAC voltages may vary by ±15%.

Table 12.
CPM Nominal Terminal Voltages (1U1)

Terminal Designation	Description of Circuit	Normal Terminal Voltages for Various Conditions
J1-4 to 3 or J1-2 to 1	IPC Communications	19.2 kbaud serial data, 5 volt signal level.
32-2,1	Manufacturing Address Use Only	+5 VDC No connection intended.
TB1-1,2	Outdoor Air Temperature	Refer to Interprocessor Communication (IPC)
TB1-3,4	Emergency Stop	open: 20.6 VDC unreg: Stopped closed: 0 VDC: Normal
TB1-5,6	NNS (Not Used)	open: 20.6 Vdc unreg: Normal closed: 0 VDC: Setback
TB2-1,2	ECWT (Not Used)	Refer to Interprocessor Communication (IPC)
TB2-3,4	LCWT (Not Used)	Refer to Interprocessor Communication (IPC)
J3-5,4	Entering Evaporator Water Temperature	Refer to Interprocessor Communication (IPC)
J3-2,1	Leaving Evaporator Water Temperature	Refer to Interprocessor Communication (IPC)
J4-3,1	*Under/Over Voltage Transformer Input	Refer to Current Transformer and Current Input Checkout
J5-1 or 2 to J5-4 or 5	Input Power	115 VAC, Refer to Power Supply, above
TB3-2,1	Chilled Water Flow Switch Input	open: 115VAC : No Flow closed: < 5VAC: Flow (Software imposes a 6 second delay to respond to opening or closing.
TB3-3,4	External Auto/Stop Input	open: 115VAC : Stop closed: < 5VAC: Auto

*DELUXE CPM

Table 12.
CPM Nominal Terminal Voltages (1U1)(cont.)

Terminal Designation	Description of Circuit	Nominal Terminal Voltages for Various Conditions
TB4-1,2	*Chiller Alarm or Alarm Ckt 1 (N.O. Contact)	Dry SPDT Contact closes on Alarm, intended for 115 VAC customer control circuit
TB4-1,3	*Chiller Alarm or Alarm Ckt 1 (N.C. Contact)	Dry SPDT Contact opens on Alarm, intended for 115 VAC customer control circuit
TB4-4,5	*Compressor Running or Alarm Ckt 2 (N.O. Contact)	Dry SPDT Contact closes on Compressor Running or Alarm Ckt 2, intended for 115 VAC customer control circuit
TB4-4,6	*Compressor Running or Alarm Ckt 2 (N.C. Contact)	Dry SPDT Contact opens on Compressor Running or Alarm Ckt 2, intended for 115 VAC customer control circuit
184-7.8	*Maximum Capacity Indication (N.O. Contact)	Dry SPST Contact Closes with Max Chiller Capacity

* These output relays are programmable and may have other definitions depending on CPM configuration. Those listed are most typical. Refer to the 10M for definitions and setup.

Options Module (CSR) (1U2)

Test Points

There are three test points associated with the CSR 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.

Note: Don't use the aluminum module enclosure as a reference as it has an anodized surface with insulating properties. The DC voltages shall be within the tolerance specified below. If not replace the module.

TP1: +5 volts DC ±5%

TP2: +6 volts DC ±5%

TP3: +13 volts DC ±25%

Switch SW-1

Switch SW1 is used to configure the External Chilled Water Setpoint input and the External Current Limit Setpoint input for either a 2-10Vdc, or a 4- 20ma signal. With the respective switch closed (on), a shunt resistor is switched into the input circuit to provide a fixed low value input impedance (499 ohms) for current loop operation. With the switch off, the input impedance is differentially 40Kohms.

External Setpoint Inputs (4-20ma/2-10VDC)

Note: The chiller switch should always be set in the AUTO LOCAL position when using any external inputs, except a Tracer. When using a Tracer, always put the chiller switch in the AUTO REMOTE position.

These inputs accept either a 4-20mA or 2-10V signal from an external controller or programming resistor connected to an internal +5V source. The switches SW1-1 and SW1-2 are used to select either the voltage or current option for External Chilled Water Setpoint and External Current Setpoint respectively. See Test Points, above. Alternately, either input may be used with a resistor or potentiometer.

Note: For proper operation, the 4-20mA/2-10V 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 between the source and input.

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

1. Enable External Chilled Water Setpoint and/or External Current Limit Setpoint in Menu 3 on the front panel of the CPM. Advance display to Active Chilled Water Setpoint or Active Current Limit Setpoint to observe the respective setpoint.

2. With all wiring in place, apply an external voltage or current to the External Chilled Water Setpoint inputs (TB1-4 & 5) or the External Current Limit Setpoint (TB1-7 & 8). The voltage measured at the terminals and the resulting setpoint, as read on the CPM display, should agree with the Table 13 for Chilled Water Setpoint inputs and Table 14 for Current Limit Setpoints inputs. Be sure to wait long enough when reading the display as the values are slew rate limited.

3. Disconnect all wiring to these inputs. The setpoints should slew back to the minimums.

4. Disconnect all wiring and install fixed resistors of values near those shown in the following tables across TB1-3,5 or TB1-6,8. The resulting setpoints should agree with the table values.

Table 13.
Input Values Vs.
External Chilled Water Setpoint

INPUTS Resist(ohms)	Current(ma)	Voltage(Vdc)	Resulting Current Water Setpt (F)±4F
94433	4.0	2.0	0.0
68609	5.2	2.6	5.0
52946	6.5	3.2	10.0
42434	7-7	3.9	15.0
34889	8.9	4.5	20.0
29212	10.2	5.1	25.0
24785	11.4	5.7	30.0
21236	12.6	6.3	35.0
18327	13.8	6.9	40.0
15900	15.1	7.6	45.0
13844	16.3	8.2	50.0
12080	17.5	8.8	55.0
10549	18.8	9.4	60.0

Table 14.
Input Values Vs.
External Current Limit Setpoint

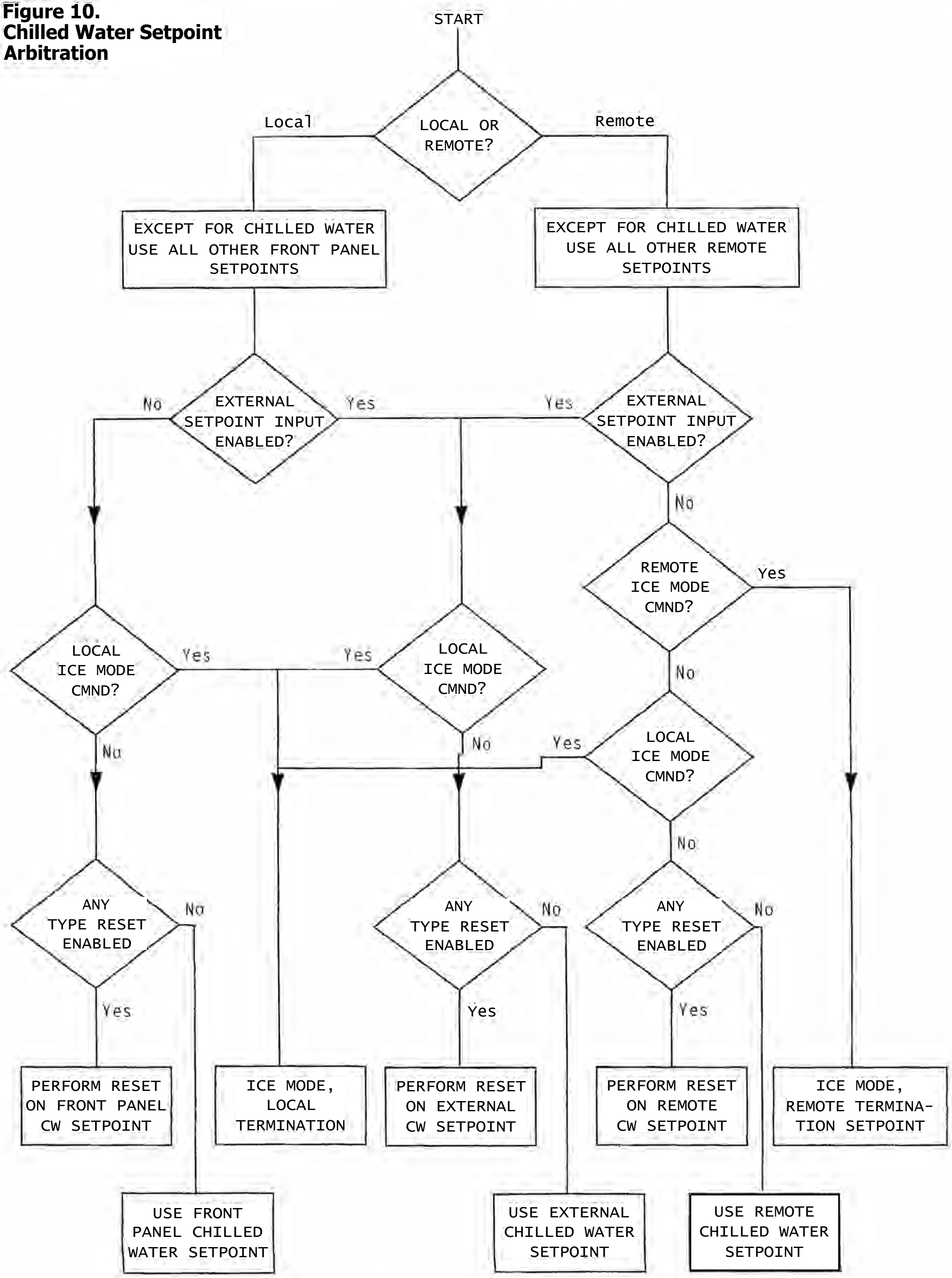
INPUTS			
Resist (ohms)	Current (ma)	Voltage (Vdc)	Resulting Chilled Limit Setpt (%RLA)±5%
49000	4.0	2.0	40
29000	6.0	3.0	50
19000	8.0	4.0	60
13000	10.0	5.0	70
9000	12.0	6.0	80
6143	14.0	7.0	90
4010	16.0	8.0	100
2333	18.0	9.0	110
1000	20.0	10.0	120

Note: This table will only apply to Options and Chiller Modules manufactured after May of '91, Options Module software part number starting with 6200-0023-03 and higher, and Chiller Module software part number 6200-0010-03 and higher. Previous units had an 80 to 120% range for the same inputs above. It is not advisable to mix earlier Chiller Modules with newer Options modules

Setpoint Priority

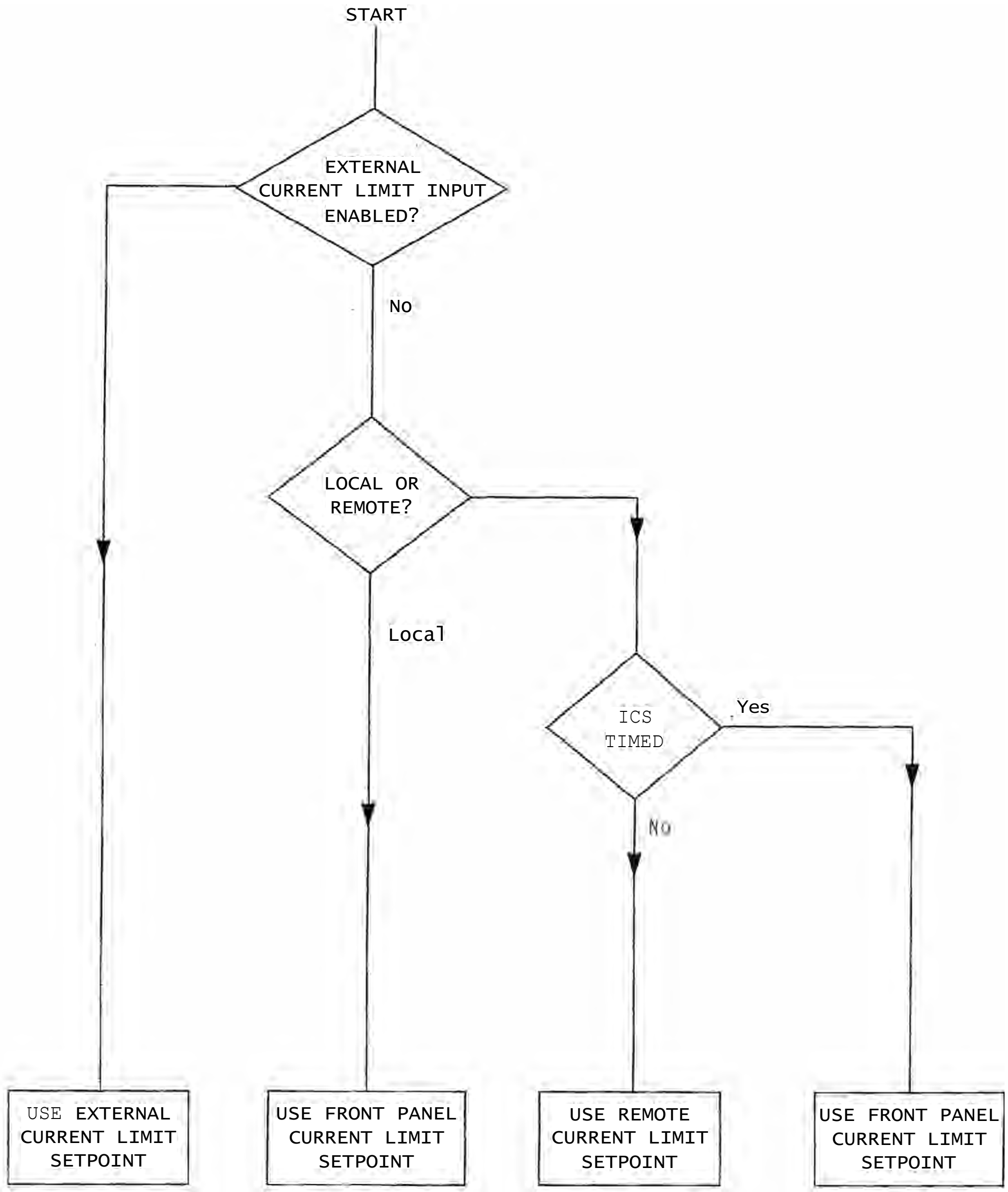
There are many ways in which the Chilled Water and Current Limit setpoints can be adjusted or reset when the Options Module is present in the Chiller control system. The following flow charts show how these methods are prioritized and arbitrated under normal operating conditions. When abnormal conditions are present, such as loss of Tracer communications or out of range values on external setpoint inputs, the system will default to other methods.

Figure 10.
Chilled Water Setpoint Arbitration



"REMOTE" implies Trane Integrated Comfort System remote device (ICS) using the digital communication link.
"EXTERNAL" implies generic building automation system or process controller interface using a 4-20ma loop or a 2-10 Volt analog signal.

Figure 11.
Current Limit Setpoint Arbitration



"REMOTE" implies Trane Integrated Comfort System remote device (ICS) using the digital communication link.
"EXTERNAL" implies generic building automation system or process controller interface using a 4-20ma loop or a 2-10 Volt analog signal.

ICS Communications

ICS Tracer communication is handled the same as on previous products using the Trane proprietary Comm3 standard 1200 baud 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 the Chiller Switch of the Chiller Module (CPM) is set in the "Auto Remote" position. In any case, the ICS Tracer should be able to communicate to the chiller for monitoring purposes, regardless of the Chiller Switch position. Refer to Figures 7 and 8 for a description of the normal operation of setpoint and setpoint reset arbitration.

2. Check for the proper ICS address on the CPM display (Menu item 4C.) and compare to the address programmed at the ICS device.

3. Check for proper termination of the twisted pair communication link wiring to terminals TB2-1 and TB2-2 (or TB2-3 and TB2-4)

4. Check for a 412 diagnostic at the display indicating loss of I PC communications with the CSR module. This could indicate IPC bus problems or a dead CSR module.
(See Inter-processor Communication (IPC)). The CSR needs to receive 4 good packets of data from the CPM before it will talk on the ICS link.

5. Check power to the CSR module and the condition of the fuse. (See Power Supply, above)

6. Check the Test Point voltages on the module. (See Switch SW-1, above)

Note: The red LED on the module blinks each time a proper message or query is received from the Remote ICS device.

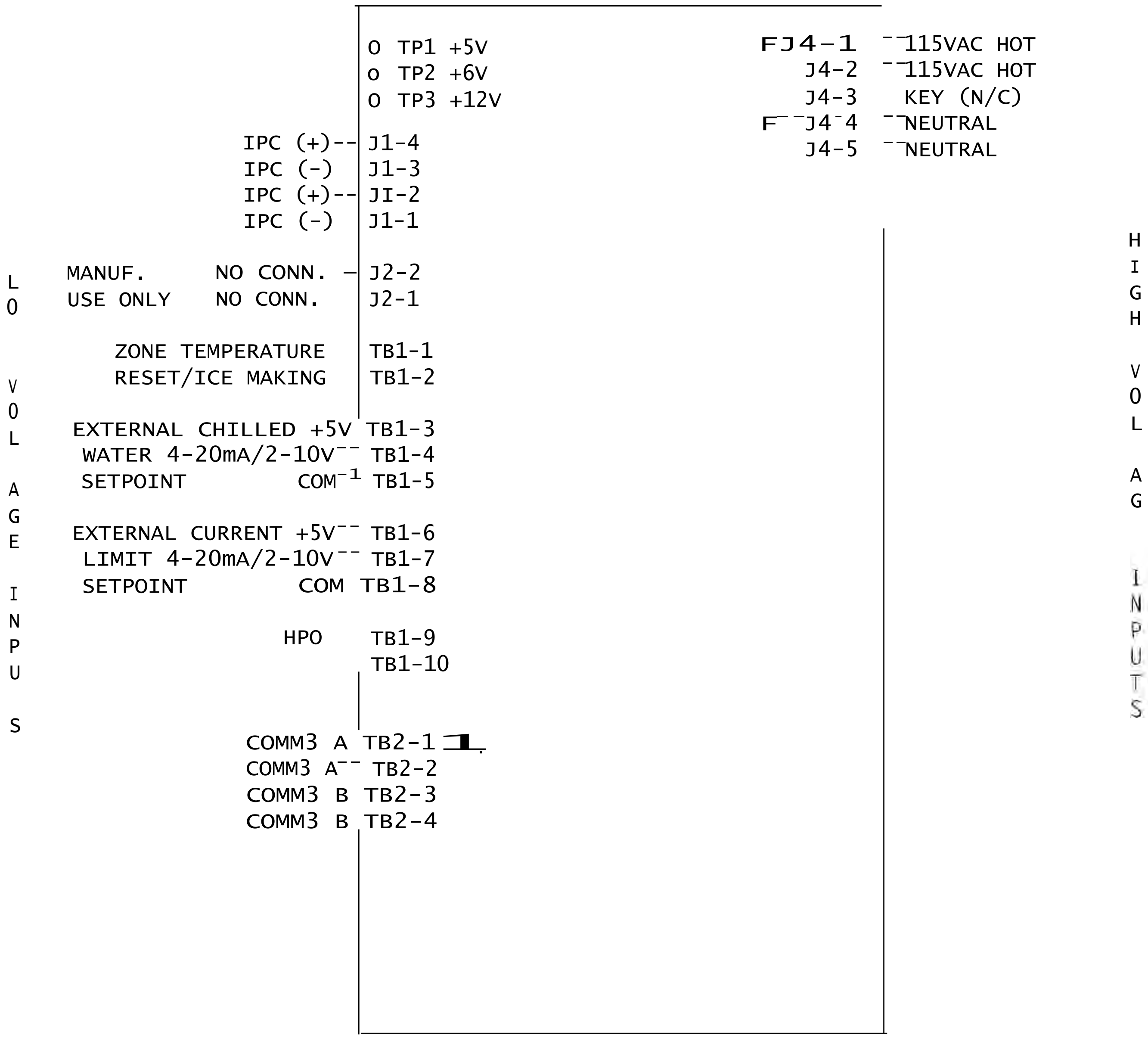
I/O terminals

For the checkout of the I/O refer to the block diagram of the module on the following page and the Chiller Wiring Diagrams for low and high voltage circuits. All voltages are measured differentially between terminal pairs specified unless otherwise indicated. The first terminal in the pair is the positive (or hot) terminal. Voltages given are nominals and may vary by ±5%. Unregulated Voltages (unreg) may vary by ±25% and 115 VAC voltages may vary by ±15%.

Table 15.
CSR Normal Terminal Voltages For Options Module 1U2

Terminal Designation	Description of Circuit	Normal Terminal Voltages for Various Conditions
J1-4 to 3 or J1-2 to 1	IPC Communications	19.2 kbaud serial data, 5 volt signal level.
J2-2,1	Manufacturing Address Use Only	+5 VDC No connection intended.
TB1-1,2	Zone Temperature	Refer to Interprocessor Communication (IPC)
TB1-3	+5V Source for use with Resistor programming of CW setpoint	+5VDC open circuit with respect to chassis ground
TB1-3,5	Ext. Chilled Water Setpoint (Resistive option)	Refer to External Setpoint Inputs, above
TB1-4,5	Ext. Chilled Water Setpoint (Current or Voltage option)	Refer to External Setpoint Inputs, above
TB1-6	+5V Source for use with Resistor programming of CL setpoint	+5VDC open circuit
TB1-6,8	Ext. Current Limit Setpoint (Resistive option)	Refer to'External Setpoint Inputs, above
TB1-7,8	Ext. Current Limit Setpoint (Current or Voltage option)	Refer to External Setpoint Inputs, above
TB1-9,10	Unused	
A5-TB2A-1,2 or TB23-3,4	Serial Comm. Input	Refer to ICS Communications, above
J5-1 or 2 to J5-4 or 5	Input Power	115 VAC, Refer to Power Supply, above

Figure 12.
CSR Module (1U2)

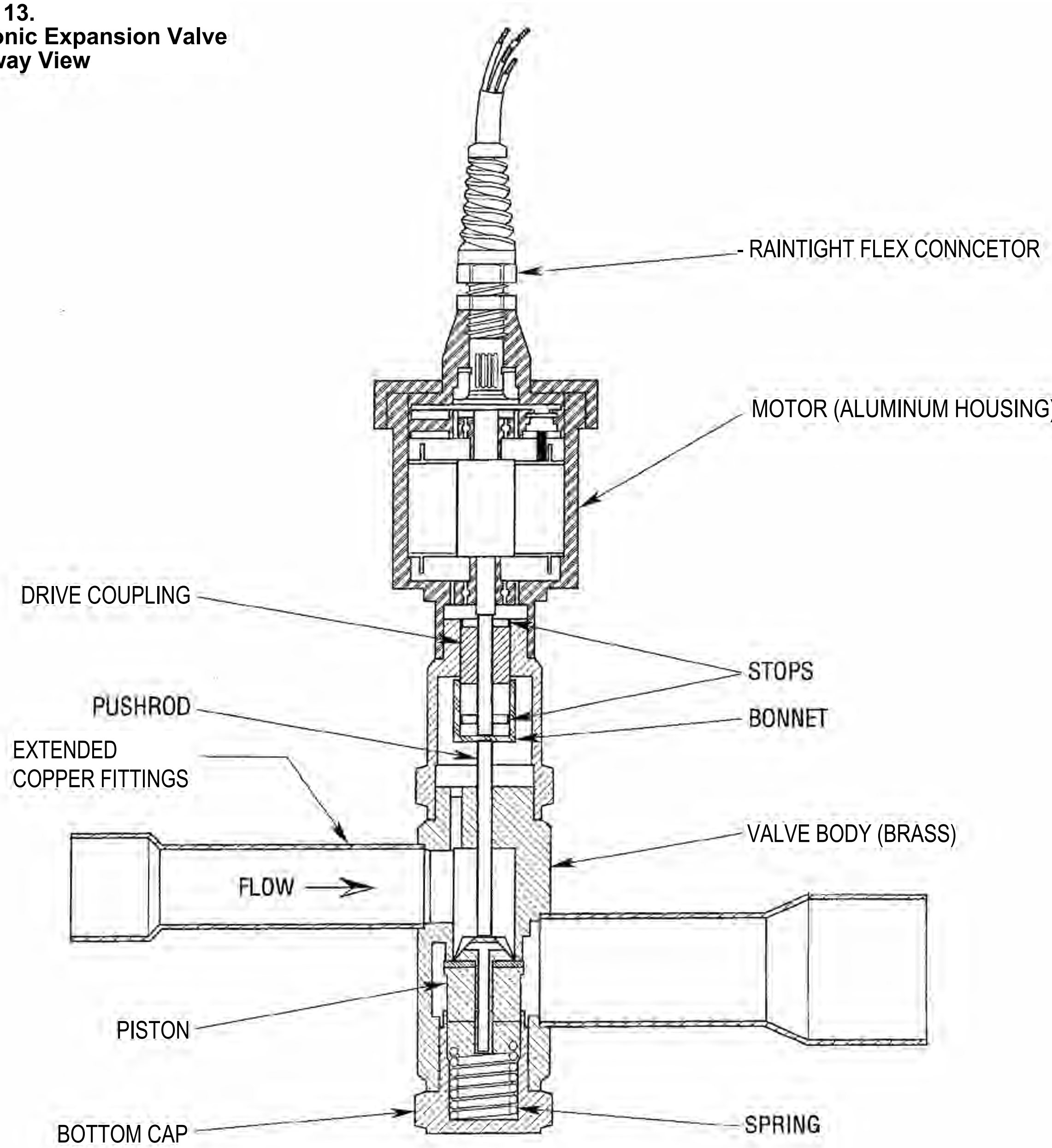


Electronic Expansion Valve Module (EXV) (1U3 and 1U8)

Valve Operation

The electronic expansion valve is an electronic flow device that replaces the thermostatically controlled expansion valve and liquid line solenoid. A sectional view of the valve is shown in Figure 13.

Figure 13.
Electronic Expansion Valve Cut-Away View



The valve is a stepper-motor type, direct acting valve. It uses a three-phase motor (not to be confused with 3-phase AC), with each phase having 40 ohms of resistance. The supply voltage (24 VDC) is switched on and off to each phase, to step the valve open or closed.

Each step is 0.0003' of stroke, with a full stroke of 757 steps. The control method uses two sensors that measure the temperature difference between the inlet and outlet evaporator refrigerant temperature. This enables the system to control the temperature difference and maintain superheat.

The motor's rotary motion is translated into linear movement through a lead screw and drive coupling arrangement. A clockwise rotation of the motor shaft creates a downward movement of the drive coupling. This presses the pushrod and piston against the return spring, opening the valve. A counterclockwise rotation of the motor shaft retracts the drive coupling. The return spring moves the piston and pushrod in the closing direction.

A "FLAG" stop is located at either end of the threaded portion of the motor shaft. The stops interfere with the milled flag on the drive coupling, restricting rotation of the motor shaft and producing a clicking sound when the valve is driven fully OPEN or CLOSED.

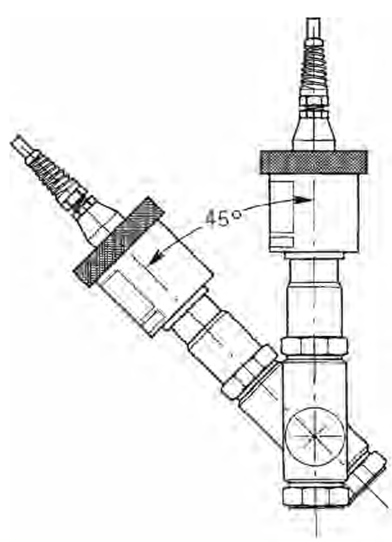
Electronic Expansion Valve Location

The valve should be installed with the motor in a vertical position, or no greater than 45 F from vertical, as shown in Figure 14. This will prevent oil logging and the possibility of contamination reaching the motor cavity. The valve should also be installed as close to the evaporator as possible.

If a refrigerant distributor is used with the valve, best performance is achieved when the distributor is mounted directly to the valve outlet. If the distributor cannot be mounted directly to the valve outlet, the distance between the valve outlet and the evaporator inlet should not exceed 24 inches, to avoid refrigerant distribution problems.

The tubes connecting the valve outlet and distributor can be sized smaller, to maintain refrigerant velocity and better distribution. Elbows located between the expansion valve and distributor will hinder proper distribution and therefore are not recommended.

Figure 14.
Electronic Expansion Valve Location



Test Points

There is only one test point associated with the EXV module. It is easily read with a DC voltmeter by probing the PC board solder pad 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.

Note: Don't use the aluminum module enclosure as a reference as it has an anodized surface with insulating properties. The DC voltage shall be within the tolerance specified below. If not replace the module.

TP1: -F5 volts DC ±5%

Additionally Terminal Pins J4-5 or J5-6 are the EXV power supply output pins which can *be* easily measured similiar to the test point. The positive meter lead's probe can pick up the voltage by touching it to the respective receptacle on the back of the EXV valve connector, which is plugged onto the pin header. Alternatively, the valve's connector can be removed and the pin probed directly. The negative meter lead should be connected to the board edge ground plane. With both EXV valve connectors disconnected (J4 and J5), or neither valve running, the voltage should read 30 VDC ± 17%. With the valves connected and running, this voltage will dip down to about 24.25 ± 17% VDC with 10% ripple. Both of these voltages are unregulated and will directly vary with the incoming AC voltage magnitude (Terminal J6-1 to J6-4). The above listed nominal values and tolerances assume a nominal incoming line voltage of 115 VAC ±15%..

EXV Test

The EXV module has a built in test which is designed to allow the service technician to confirm a problem with the EXV control system and to identify which of the components of the system (the Valve/Stepper Motor assembly, the EXV Module, or the inter-connecting wiring) is at fault. The directions to perform this test are given below:

EXV Test Procedure

1. Place the Chiller in the "STOP/RESET' mode using the Chiller Switch of the CPM module.

2. Determine which refrigeration circuit is associated with the EXV valve(s) you want to test. Move the CPM Display to Menu 2 item 26, Circuit 1 or item 26, Circuit 2,. as desired. A triangular carat on the display will be flashing to indicate which circuit is to be tested.

Note: If both Master (1U3) and Slave (1U8) EXV Modules are employed, the test will automatically test first the Master and then the Slaved EXV valve on the circuit indicated.

3. Press the Setpoint Up key to change the displayed "d" to an "E", which will enable or initiate the preprogrammed procedure. Display will automatically return the item to disabled when the test is completed.

Electrical Integrity Test

4. Initially the UCM will perform an Electrical Integrity test on the valve's stepper motor phases and associated wiring. If a failure is detected, it will report a diagnostic code "1A9" or "1AA", ldb" or "1dC" at this time. This diagnostic suggests that there is a problem with the valve or the valve wiring. To confirm this, it is necessary to continue the procedure. The Electrical Integrity test will be completed in about 2 seconds. Regardless of whether or not a diagnostic occurs, the UCM will proceed with the stroke timing portion of the test.

Stroke Timing Test

5. At this time the UCM will drive the valve closed by executing a total of 1250 steps at a rate of 50 steps/sec. Thus the total closing time, including clicking time, will be 25 seconds. Due to mechanical characteristics of the valve, it will make a clicking sound when it reaches its end stops (either full open or full closed). In most cases, the valve will already be closed when this this test is initiated, so a normally operating valve will exhibit the clicking for approximately 25 seconds.

Note: The loudness of the clicking varies from one valve to another and ambient noise can muffle the clicking sound. Therefore, it may be necessary to use a tool to aid in the hearing of the clicking (such as a screwdriver held between the EXV and the ear.)

6. Following the 25 seconds of closing, the valve will immediately be stepped open for the same period of time (25 seconds). As soon as the valve begins it opening movement the clicking should stop while it moves through its stroke. The service technician would then note the time between when the clicking stopped until the time it restarts. This would give an indication of the opening stroke time.

Note: If the valve and switching circuitry is operating properly, the silent valve movement should last for approximately 15 seconds.

End of stroke clicking should be heard for 35 seconds for the SEO type, followed by 10 seconds of "end of stroke" clicking.

7. The module will then reverse direction and the valve will be stepped closed again for a full 25 seconds. Since the valve should have started from the full open position, the time to stroke closed should be noted and it should be approximately the same as the opening time above.

8. If a Slave EXV Module (1U8) and Valve is employed, the second (paralleled) EXV valve of the same refrigeration circuit will be indexed immedeatly following the completion of the first valve's test. The stroke timing of the slaved valve should be verified with the same procedure as described above.

If both opening and closing stroke times are correct to within ±5 seconds of the time specified, no further testing is required. If any valve fails this test, the service technician should perform the EXV Valve Winding Resistance Check, steps 9 thru 11 below.

EXV Valve Winding Resistance Check

9. Disconnect the appropriate EXV valve from the pin header of the appropriate EXV module.

10. With a digital ohm-meter, check the resistance of the valve windings and associated leads/connector by measuring the resistance of pin pairs at the connector plug. Pin pairs are #5 and #3, #5 and #2, and #5 and #1. Pin numbers are indicated by corresponding position # on the board or by the raised numbers of the connector block. The resistances should all be 40 ohms ±4 ohms at 75F winding temperature. (At a valve winding temp of 148F the resistance would be no more than 54 ohms; at a valve winding temp of 32F the resistance would be no less than 33 ohms).

11. Next check the resistance between pin #5 and chassis ground. It should be 100K ohms or more.

If the valve/wiring/connector combination fails the above tests, suspect the connector or the wiring first. At the valve for circuit #1; wire color black corresponds to pin #5, red to pin #3, white to #2 and green to #1. For circuit #2: black to pin #6, red to pin #3, white to #2, and green to pin #1.

Replace valve wiring, connector, or valve/wiring/connector assembly, as determined necessary. If valve replacement is indicated, however, the entire valve must be replaced, as the stepper motor is not serviceable. Note also that the valve motor is exposed to the high side refrigerant pressure and any attempt to service the valve or wiring at the motor will result in charge loss. In any case, if valve replacement is indicated, the test procedure should probably be repeated for confirmation. The Test Results Logic Table below prescribes the actions to be taken given various outcomes of the tests performed in the above steps. See Table 16.

Table 16.
Test Results Logic Table

PASS	PASS	NOT.REQ.	VALVE/BOARD ARE WORKING PROPERLY - NO ACTION REO.
PASS	FAIL	PASS	VALVE IS MECHANICALLY′ STUCK - REPLACE / REPAIR VALVE
PASS	FAIL	FAIL	HIGHLY UNLIKELY CONDITION-RETEST-REPLACE MODULE
FAIL	PASS	PASS	HIGHLY UNLIKELY CONDITION-RETEST-NO ACTION REQ.
FAIL	FAIL	PASS	CHECK CONNECTION AT MODULE-RETEST-REPLACE MODULE
FAIL	FAIL	FAIL	SUSPECT WIRING, PLUG OR VALVE-REPLACE/REPAIR SAME

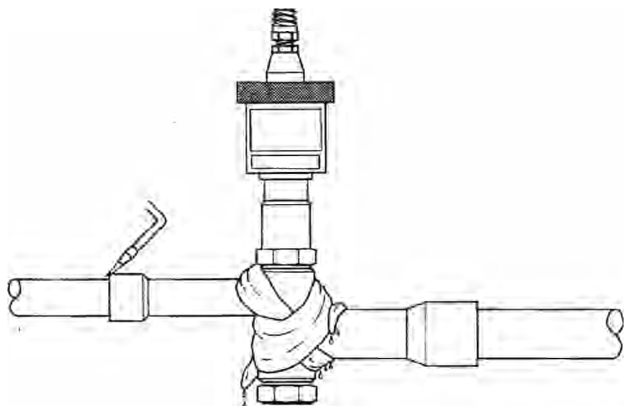
* INDICATION OF PASS OR FAIL OF THIS TEST IS DISPLAYED AT THE CPM WITH THE DIAGNOSTIC CODES 1A9, IAA, 1db, or 1dc

Solder Techniques for Installation

It is not necessary to disassemble the valve when soldering to the connecting lines. Most commonly used types of solder (eg. Sil-Fos, Easy-Flow, Phos-Copper or equivalent) are satisfactory. Regardless of the solder used, it is important to direct the flame away from the valve body. See Figure 15.

A wet cloth should be wrapped around the body during soldering to provide extra protection. This will help prevent overheating and damage to the synthetic seals and subsequent degradation in valve performance. Valves are shipped in the full-open position, to allow for the flow of inert gas while soldering.

Figure 15.
Electronic Expansion Valve Soldering



Electronic Expansion Valve Servicing

The procedures listed below are to be followed for proper disassembly, inspection, cleaning and reassembly to the valve. The valve does not need to be removed from the refrigerant piping before servicing.

1. Before disassembly of the valve, be sure the refrigerant pressure in the system has been reduced to a safe level (0 psig) on both sides of valve.

2. Disconnect all the line voltage to the power supply of this unit.

3. Refer to the exploded view in Figure 16 while performing the remaining instructions.

Warning: Refer to Figure 16. The pushrod is under spring pressure and will be accelerated out of the top or bottom of the valve body assembly if the activator assembly or bottom cap is removed. When unscrewing either the activator assembly or bottom cap, make sure these assemblies are kept in line with the valve body and moved away from the valve body very slowly in the vertical direction, until you feel the pressure is relieved from the pushrod. At this time hold the pushrod with one hand and then move the activator or bottom cap away from the valve body.

*** Do not try to remove either the activator assembly or bottom cap under any system pressure. System pressure must be at 0 psig on both sides of the valve before attempting any disassembly of this valve.**

4. Remove the actuator assembly from the valve body.

Caution: DO NOT attempt to disassemble the motor or separate the motor and adaptor. Either of these actions may cause damage to motor wiring or the drive coupling.

5. Remove pushrod and check for excessive wear or scratches. The pushrod must move freely in the valve body.

6. Remove the bottom cap, spring and piston. Inspect these parts for foreign matter and physical damage.

7. Clean all parts with a suitable solvent and blow dry with clean compressed air.

8. To reassemble, carefully install the piston, spring and bottom cap. Be sure that the piston nose guides are on the inside diameter of the port.

Caution: The seating surface may be damaged if the piston is improperly installed.

9. Check that the sealing surfaces are free of foreign material or nicks that may prevent a leak-tight joint. Tighten the bottom cap approximately 1/8 turn past hand tight to seal the knife edge joint.

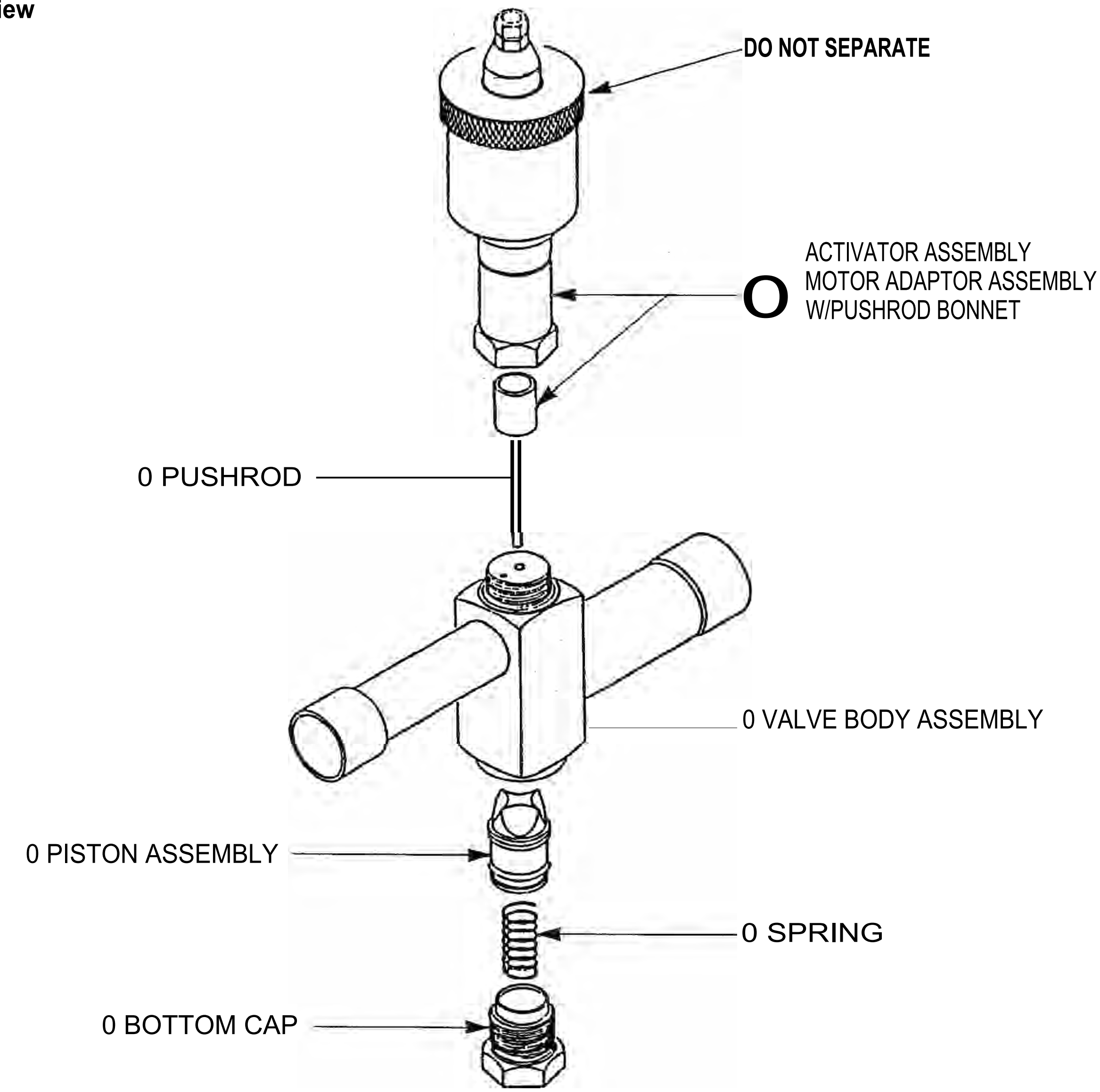
10. Place the pushrod in the valve body. Press the pushrod down to open the valve and insure proper piston installation. Approximately 8 lb-ft are required to open the valve. If the valve cannot be opened, repeat steps 9 and 10.

If a new pushrod is to be installed, place the pushrod in the valve body and use the furnished pushrod gauge (internal parts kit) to determine the correct height of the push rod. Mark the pushrod, remove it from the valve body and grind it to the required length.

Clean with a suitable solvent, blow dry with clean compressed air and replace the pushrod in the valve body.

11. Before replacing the actuator assembly, be sure that all sealing surfaces are free of foreign material or nicks that may prevent a leak-tight joint. Carefully install the pushrod bonnet and thread the actuator assembly on to the valve body until the sealing surfaces make contact. Tighten the actuator approximately 1/8 turn to seal the knife edge joint.

Figure 16.
Electronic Expansion Valve
Exploded View



	[illegible]
1	MOTOR/ADAPTOR ASSEMBLY
2	PUSHROD
3	VALVE ASSEMBLY BODY
4	PISTON ASSEMBLY
5	SPRING
6	BOTTOM CAP

Figure 17.
Electronic Expansion valve
(1U3) Master

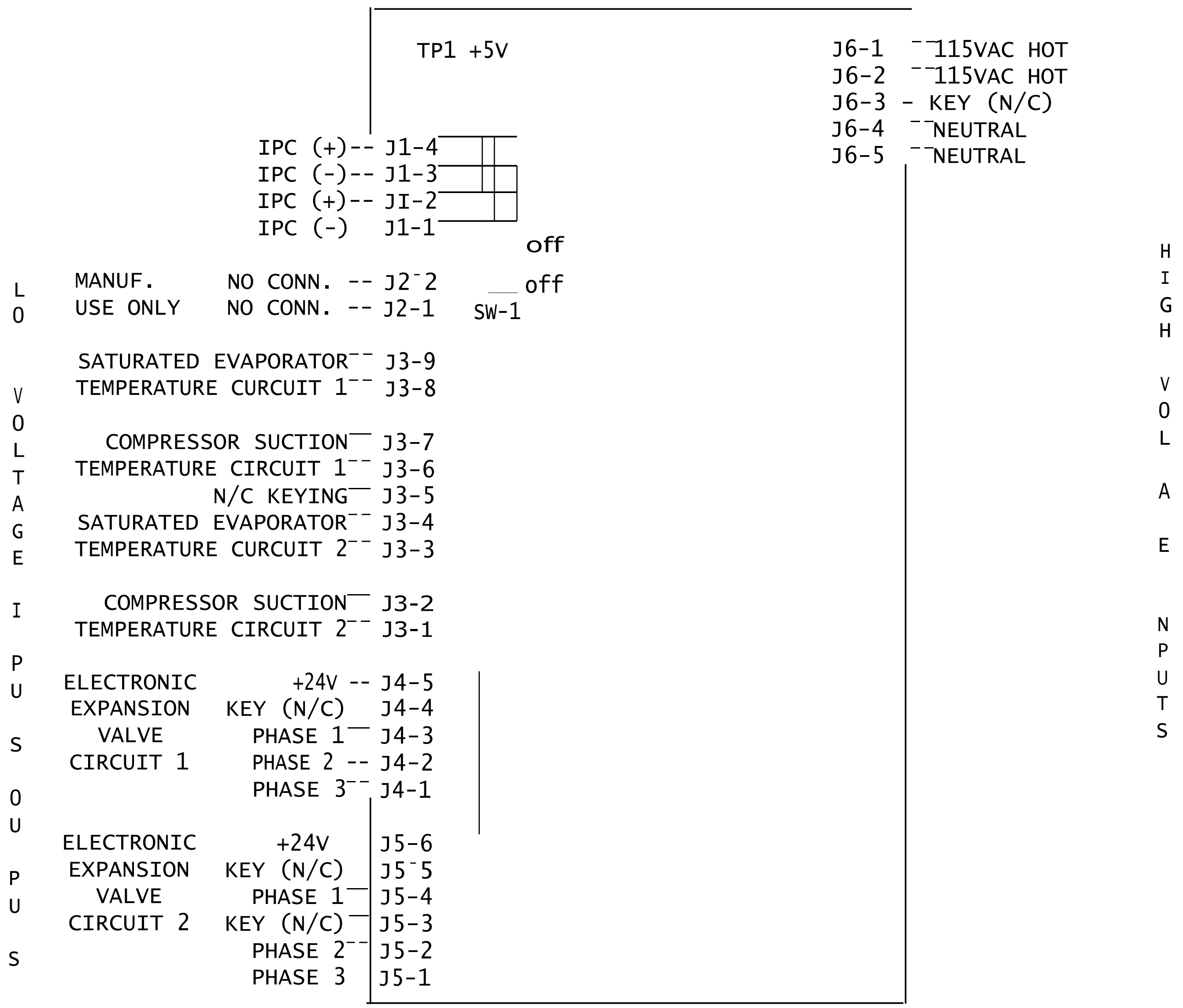
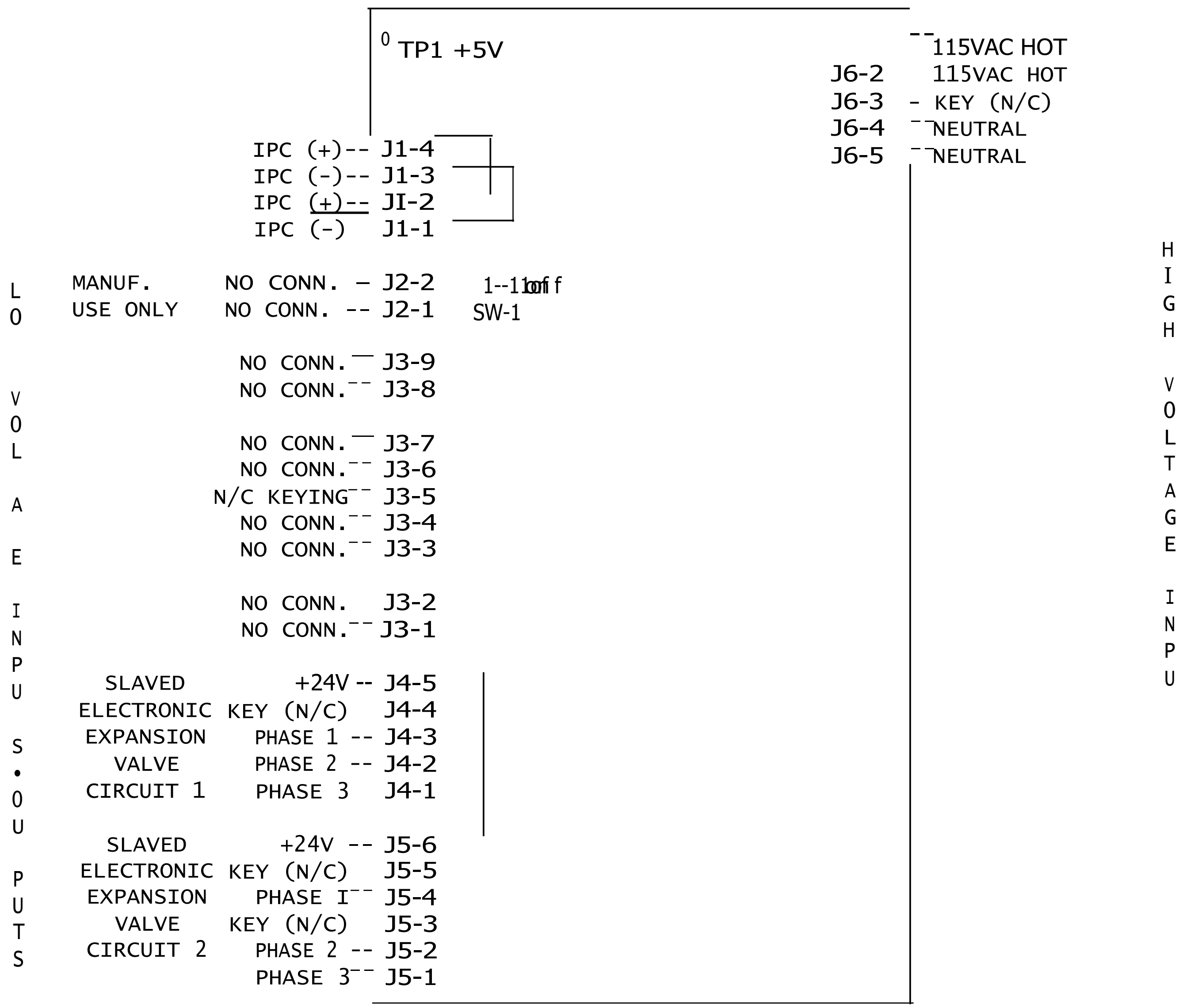


**Figure 18.
Electronic Expansion valve
(1U8) Slave**



terminals

For the checkout of the I/O, refer to the block diagram of the EXV module i n Figure 17 and the Chiller Wiring Diagrams for both high and low voltage circuits. All voltages are measured differentially between terminal pairs specified, unless otherwise indicated. The first terminal in the pair is the positive (or hot) terminal. Voltages given are nominals and may vary by ±5%. Unregulated Voltages (unreg) or 115 VAC voltages may vary by ±15%.

Table 17.
EXV Module Normal Terminal Voltages

J1-4 to 3 or J1-2 to 1	IPC Communications	19.2 kbaud serial data, 5 volt signal level.
J2-2,1	Manufacturing Address Use Only	+5 VDC No connection intended.
J3¯9,8	Saturated Evap. Rfrg. Temp CKT 1 (Master only, No connect for Slave)	Refer to Interprocessor Communication (IPC)
J3-7,6	Compressor Suct. Rfrg. Temp. CKT 1 (Master only, No connect for Slave)	Refer to Interprocessor Communication (IPC)
J3-4,3	Saturated Evap. Rfrg. Temp. CKT 2 (Master only, No connect for Slave)	Refer to Interprocessor Communication (IPC)
J3-2,1	Compressor Suct. Rfrg. Temp. CKT2 (Master only, No connect for Slave)	Refer to Interprocessor Communication (IPC)
J4-5	EXV CKT1 Power	30VDC Unregulated open circuit (valves unconnected) with respect to chassis ground. With valves connected and running, voltage should be 24.25 +/- 17% VDC with 10% ripple. These voltages are highly dependent on line voltage applied to module.

I/O

Table 17.
EXV Module Normal Terminal Voltages (cont.)

J4-3	EXV CKT1 Phase 1	0 VDC open circuit (with valves unconnected) with respect to chassis. With valves connected and running*, voltage will vary between the above 24.2 ±17% VDC to .5 volts or less as the phase is "stepped" on and off. A square wave with a period of 60 cosec and a 1/3 duty cycle low (on) and a 2/3 duty cycle high (off) should be observable with an oscilliscope (an averaging DC voltmeter would show fluctuations but average around 16 volts).
J4-2	EXV CKT1 Phase 2	Same as above.
J4-1	EXV CKT1 Phase 3	Same as above.
J5-6	EXV CKT2 Power	Same power source as J4-5 above.
J5-4	EXV CKT2 Phase 1	Same a CKT 1 Phase 1
J5-2	EXV CKT2 Phase 2	Same as above.
J5-1	EXV CKT2 Phase 3	Same as above.
J6-1 or 2 to J6-4 or 5	Input Power	115 VAC, Refer to Power Supply, above.

***Note:** Valves powered from the same EXV module never run simultaneously but instead time share by alternating their movement on a 1 second basis. On a power up or a front panel reset, the valves will always be driven closed in this manner for approximately 1000 steps During this time, approximately 40 seconds, an alternating audible clicking sound can be observed on all the valves.

Compressor Module (MCSP) (1U4, 1U5, 1U6, and 1U7)

Test Points

There are two test points associated with the MCSP 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.

Note: Don't use the aluminum module enclosure as a reference as it has an anodized surface with insulating properties.

The DC voltage shall be within the tolerance specified below. If not replace the module.

TP1: +5 volts DC ±5%

TP2: +12 volts DC ±5%

IPC Address Switch SW1

Refer to Troubleshooting Modules in Interprocessor Communication (IPC)

Current Gain (or Overload) Dip Switch SW2

The Compressor phase current inputs on the individual MCSP modules are "normalized" thru the proper setting on this switch. The term "Compressor Current Overload setting" is actually a misnomer. Instead the setting should be thought of as an internal software gain that normalizes the currents to a % RLA for a given CT and compressor rating. The true nominal steady state overload setting is fixed at 132%.

The setting of the dip switch SW2 on each of the MCSP modules should match those of Table 7 for each compressor. Switch position SW2-1 is the Most Significant Bit. The decimal equivalent of this setting should also be verified in Menu PS Item 56 A thru D, respectively, on the CPM display. If the programmed value does not agree with the dip switch setting for each of the MGSP's, an informational diagnostic will result. The compressors will be allowed to run, but default settings (the most sensitive possible) will be used for the internal software compressor current gains. Refer to Current Transformer and Current Input Checkout for more details.

Compressor Module (MCSP) (1U4, 1U5, 1U6, and 1U7)

Test Points

There are two test points associated with the MCSP 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

Binary Inputs

Table 18.
Binary Inputs

Circuit Inhibit*	No diagnostic but Circuit Lockout caret will be lit in Menu 0 and Compressor Mode Menu item 20 will indicate lockout whenever this input is open with the feature enabled (Menu item 3b). For manifolded compressor pairs either MCSP's input can cause a circuit lockout if open.
Tansition Complete	180 Starter Transition - Cprsr A 181 Starter Transition - Cprsr B 182 Starter Transition - Cprsr C 183 Starter Transition - Cprsr D 1A0 Power Loss - Cprsr A 1A1 Power Loss - Cprsr B 1A2 Power Loss - Cprsr C 1A3 Power Loss - Cprsr D
Oil Flow Proving	1A5 Oil Flow Control - Cprsr A 1A6 Oil Flow Control - Cprsr B 1A7 Oil Flow Control - Cprsr C 1A8 Oil Flow Control - Cprsr D
Discharge Temperature	1C2 Discharge Temp - Cprsr A 1C3 Discharge Temp - Cprsr B 1C4 Discharge Temp - Cprsr C 105 Discharge Temp - Cprsr D

*Note: This feature is only available in Compressor Modules or Chiller Modules manufactured after May 91.

The above binary inputs all use the same basic circuit. A pullup resistor to the 12V power supply is connected to the higher numbered input pin. The lower numbered pin is connected to ground. The voltage between the two pins is sensed by the microprocessor.

To check the input, measure the voltage between the two associated pins. With the external switch open, approximately 12 Vdc should be measured. With the switch closed, 0 Vdc should be measured.

Temperature Inputs

Table 19.
Temperature Inputs

Sat. Cond. Rfgt. Temp.	8F Cond. Rfgt. Temp. Sensor - Ckt 1 90 Cond. Rfgt. Temp. Sensor - Ckt 2
Sat. Evap. Rfgt. Temp.	None

These inputs use Trane's standard thermistor, an NTC device giving 10,000 ohms at 25 C. Refer to Temperature Sensor Checkout for a table of temperature vs. resistance vs. voltage. At this time, the Sat. Evap. Ref. Temp input is not used.

Three measurements can be made:

1. With the probe connected, the voltage across the input terminals may be measured. The voltage should agree with the table values in Temperature Sensor Checkout

2. The probe may be disconnected from the module and its resistance measured. It should agree with the table values.

3. With the probe disconnected, the terminal voltage may be measured with a high impedance voltmeter. It should be between 4.975 and 5.025 Vdc. If the meter loads the input, a slightly lower voltage may be expected.

Refer to Temperature Sensor Checkout for more details.

Current Inputs

Table 20.
Current Inputs

Phase A, B, C Current Xfmr	bA Overload Trip - Cprsr A bb Overload Trip - Cprsr B bC Overload Trip - Cprsr C bd Overload Trip - Cprsr D CA Contactor - Cprsr A Cb Contactor - Cprsr B CC Contactor - Cprsr C Cd Contactor - Cprsr D 184 Phase Rotation - Cprsr A 185 Phase Rotation - Cprsr B 186 Phase Rotation - Cprsr C 187 Phase Rotation - Cprsr D 19C Phase Loss - Cprsr A 19d Phase Loss - Cprsr B 19E Phase Loss - Cprsr C 19F Phase Loss - Cprsr D 1A0 Power Loss - Cprsr A 1A1 Power Loss - Cprsr B 1A2 Power Loss - Cprsr C 1A3 Power Loss - Cprsr D IbA Phase Unbalance - Cprsr A Ibb Phase Unbalance - Cprsr B IbC Phase Unbalance - Cprsr C Ibd Phase Unbalance - Cprsr D			

The following tests may be used to check a current input circuit:

1. With the compressor off, the AC voltage across the terminals with the current transformer connected should read 0 V. The corresponding current as read on the CPM display should read 0.

2. With the compressor on, the AC voltage across the terminals should agree with the data of Table 10. The %RLA read on the CPM display will depend on the setting of the gain switch. If the gain switch is set to 11111, the percent CT rating values should agree with the display. For any other switch setting, the gain factor as found in Table **11** must be taken into account using one of the following procedures:

a. Start with the displayed %RLA. Multiply by .67 and divide by the gain where the gain is found in Table 11. The result is the percent CT rating. Use this and the Table 10 to find the corresponding terminal voltage.

b. Start with an actual current measurement (such as from a clamp-on ammeter). Determine which CTs are being used and use the Table 10 to find the corresponding terminal voltage and percent CT rating. Multiply the percent CT rating by the gain and divide by .67 to find the %RLA that should be displayed.

Note: If the MCSP gain switch and CPM gain setting do not agree, a diagnostic will be generated and the MCSP will continue operating using a default gain setting of 00000 (max gain). This will result in the MCSP thinking the currents are higher than actual and will show up as an error in the %RLA displayed by the CPM. The compressor will operate safely but may unload due to the current limit function.

Refer to Current Transformers and Current Inputs for more details on operation and troubleshooting.

Isolated Binary Input: Winding Temperature

This input may be checked by disconnecting all wiring from the terminals and measuring the open circuit voltage. It should read *between* 10 and 15 Vac. A 1 bE, 1bF, 1C0 or 1C1 diagnostic should appear on the CPM's display depending on which compressor module it is. A jumper may then be placed across the input to short it out. After clearing diagnostics, the diagnostic should no longer be present. It a diagnostic continues to occur, the module needs replacement.

Relay Outputs

Relays may be checked by measuring the voltage drop across the contacts. 115 Vac should *be* seen when the relay is off. 0 Vac should be seen when the relay is on. Before condemning a module for bad relays, make sure to check all diagnostics, power to the module, communications, and the state of the high pressure cutout. Refer to the units' schematic wiring diagram for the control circuitry.

Triac Outputs

The triacs may be checked by measuring the voltage from terminals E7 or E8 to 115 V neutral, with a load connected. The triacs operate in the high side and switch 115 Vac power from J7-1 to either E7 or E8 to turn on the appropriate slide valve solenoid.

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). Except during a start or stop, the triacs normally pulse on for short durations (as low as 40mS) once every 10 seconds. If chiller load is satisfied the triacs may not pulse. Because of this, it may be difficult to see the pulses on a meter. A low wattage 115 Vac test lamp may be of help.

The best time to check the unload solenoid is immediately after a power-up reset. For the first 30 seconds after applying power, the unload solenoid should be on continuously. The next best time to check it is after the compressor starts. For the first 30 seconds after a start, the unload solenoid should be on continuously.

Checking the load solenoid is more difficult. Shortly after a start, the compressor will usually start loading. If, however, water temperature is dropping rapidly enough, it will stay unloaded. It may take a while to begin seeing load pulses.

Refer to Slide Valve Checkout Procedure for a more detailed procedure on how to accomplish the load / unload solenoid and slide valve check on the MCSP and associated compressor.

I/O Terminals

For the checkout of the I/O, refer to the block diagram of the MCSP module in Figure 16 and the Chiller Wiring Diagrams for both high and low voltage circuits. All voltages are measured differentially between terminal pairs specified unless otherwise indicated. The first terminal in the pair is the positive (or hot) terminal. Voltages given are nominals and may vary by ±5%. Unregulated Voltages (unreg) or 115 VAC voltages may vary by ±15%.

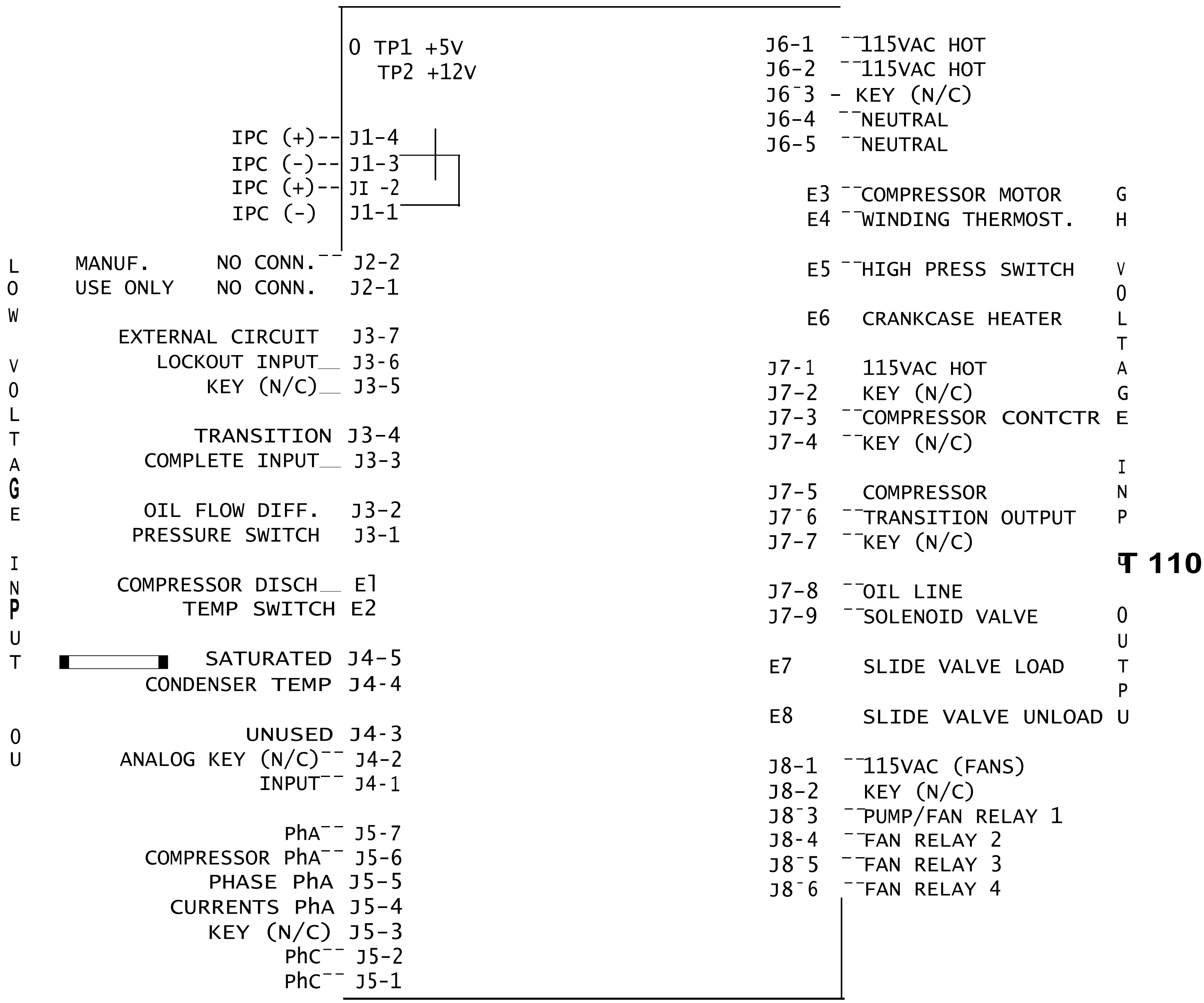
Table 21.
Compressor Module Normal Terminal Voltages (IU4, 1U5, 1U6 and 1U7)

Terminal Designation	Description of Circuit	Normal Terminal Voltages for Various Conditions
J1-4 to 3 or J172 to 1	IPC Communications	19.2 kbaud serial data, 5 volt signal level.
J2-2,1	Manufacturing Address Use Only	+5 VDC No connection intended.
J3-7,6	External Circuit Lockout	Open= 12 VDC: ckt lockout Closed= 0 VDC: normal (ckt. lockout only if feature is enabled at Menu item 3b)
J3-4,3	Transition Complete	Open= 12 VDC: pre-transition Closed= 0 VDC: transition complete (only used with reduced voltage starters)
J3-2,1	Oil Flow Proving	Open= 12 VDC: high diff oil press Closed= 0 VDC: low diff oil press Closed indicates normal pressure drop across oil filter and oil line solenoid When oil line sol. is de-energized at compressor stage off, MCSP looks for a momentary close of this switch as proof of oil line valve and pressure switch operation.
El, E2	Discharge Temperature	Open= 12vdc PTC thermistor input. Low resistance indicates low discharge temp. High resistance (over 363 ohms) indicates high discharge temp (trip condition). Refer to Interprocessor Communicatior (IPC)
J4-5,4	Saturated Condenser Refrigerant Temp	Open = 5 Vdc NTC ThermiStor input. Refer to Interprocessor Communication (IPC)
J4-3,1	Saturated Evaporator Refrigerant Temp	Open = 5 Vdc NTC Thermistor input. Refer to Interprocessor Communication (IPC)
J5-7,6	Phase A Current Transformer Input	Input for 100-400:0.1 Ratio CT Using digital VOM in diode test mode open circuit input should read between 1.0 to 1.5 Volts. Refer to Temperature Sensor Checkout
J5-5,4	Phase B Current Transformer Input	Same as above
J5-2,1	Phase C Current Transformer Input	Same as above

Table 21.
Compressor Module Normal Terminal Voltages (IU4, 1 U5, 1U6 and 1U7) (cont.)

J6-1 or 2 to J6-4 or 5	Input Power	115 VAC, Refer to Power Supply in Module Power and Miscellaneous I/O
E3, E4	Compressor Motor Winding Temp. Thermostat	Internally powered Isolated input Open = 16 Vac : high temp Closed = 0 Vac : Ok temp
E5 to 06-4 or 5	High Pressure Cutout Input	Externally powered isolation transformer input, 2 VA, 115 Vac 115 volts input: normal 0 volts : trip
E5, J7-3	Compressor Contactor Output	Normally open contact, closes for compressor start Uses same power input as High Pressure Cutout input above
E6, J7-1	Crankcase Heater Output	Normally closed contact, powers crankcase heater when compressor is off.
J7-5,6	Transition Command Output	Normally open contact, closes to initiate Wye to Delta Starter transition if configured for Reduced Voltage start.
07-8,9	Oil Line Sol. Valve Output	Normally open contact, closes to energize and open the Oil Line Solenoid Valve with compressor start. Opens 20 seconds prior to compressor stop to allow test of Solenoid Valve and Oil Flow Pressure switch
J7-1, E7	Slide Valve Open (Load Solenoid) Output	Triac Output, Refer to Checkout Procedure for MCSP Load/Unload Outputs
J7-1, E8	Slide Valve Close (Unload Solenoid) Output	Triac Output, Refer to Checkout Procedure for MCSP Load/Unload Outputs
J8-1,3	Fan Relay 1 Output	Normally open contact for fan contactor(s) control
08-1,4	Fan Relay 2 Output	Same as above
J8-1,5	Fan Relay 3 Output	Same as above
J8-1,6	Fan Relay 4 Output	Same as above

Figure 19.
Compressor Module (1U4, IU5, 1U6 and 1U7)



Other Service Features

Phase I Pueblo Pilot Production UCM's (Aug. 1990) and First Production UCM's (Jan. 1991), designed for 130-200T chillers, do not have the features presented in this section. Only UCM's with date codes 91Hxxx or later will have the Phase II software, as first released in July 1991 with the following features. See Module Interchanging section, Page 10.

Service Pumpdown

The UCM provides for a "onetime" Service Pumpdown mode, in which a service-technician can direct a particular compressor to start and run for one minute, to accomplish pumpdown of the low side of the refrigeration system (evaporator and EXV).

To aid in accomplishing this pumpdown, certain non-critical diagnostics will be ignored or disabled during this mode. Critical diagnostics such as those associated with motor protection, high pressure, and chilled water flow, will still be enforced and may prevent or terminate the sequence.

Service Pumpdown Procedure

1. Place the Chiller Switch into the "Stop/Reser' position and allow the Chiller, if currently running, to go through its shutdown sequence.

2. Manually close the liquid line shutoff valve on the circuit to be pumped down.

3. Use the CPM's Operator Interface to begin the mode specifically for the compressor/circuit you wish to pumpdown by selecting and "Enabling" it at menu item 19 (The VFD carats should be flashing over both the compressor to be run and the circuit that the compressor is on.) The CPM will then be displaying an Operating Code "17' for Service Pumpdown in Menu 0 Item A.

4. The UCM shall then begin the start sequence (without restart inhibit) and turn on the selected compressor once the EXV has opened to its pre- position. The compressor shall run for a period of 1 minute at its minimum load and the condenser fans will stage under normal fan control. The UCM will automatically shut off the compressor and condenser fans, close the EXV, and return the chiller to the normal stop mode once the 1 minute timer has expired. The pumpdown sequence cannot be repeated again without a UCM power down reset.

Note: The unload solenoid is always kept energized for approximatley 1 hour after any compressor shutdown and the oil sump heater is continuously energized.

5. Manually close the discharge line shutoff valve and the oil line shutoff valve.

6. Remove all power to the chiller and service as required.

Caution: Be sure that all voltage hazards have been positively removed from the areas to *be* serviced when following the instructions below.

Note: If it is necessary to service the circuit/compressor while allowing the opposite circuit to start and run, first temporarily disconnect all power to the chiller and then disconnect all control power connections to the compressor and associated controls, by pulling off all the control power voltage connectors on the right hand side of the associated MCSP module. Control power to the associated contactor should also be disconnected, as should the power lead(s) to the high pressure switch at the control power terminal block. Repower the chiller, and lockout the circuit you are servicing by using the Operator Interface Menu item 1A (See 1.3.1 below). Placing the chiller switch into the Auto/Local mode will then allow the opposite circuit to run.

7. Return all valves to their normal position. Temporarily remove all power and reconnect all wiring when servicing is completed.

8. Reset the chiller to clear diagnostics (and diagnostic history if desired) to resume normal operation.

Compressor Test

The UCM provides for a Compressor Test feature which is designed to allow a service-technician to direct a particular compressor to be the next compressor to stage on, run and modulate. This allows the temporary override of the lead/lag sequencing currently in effect and relieves the technician from forcing staging of compressors thru load or setpoint changes. It is important to note that invoking this feature does not put the chiller into any kind of override "mode" and no action is required to return to "normal operation". The chiller will continue to run normally and the current lead/lag sequence will again be in effect, once the selected compressor has started. This feature is used in the Slide Valve Checkout Procedure detailed in Slide Valve Checkout Procedure.

Invoking Compressor Test

1. With the Chiller in the Auto/Local Mode, regardless of whether or not other compressors are currently running, use the Operator Interface to enable the desired compressor in Menu item 2b Compressor A,B,C or D. The selected compressor will automatically stage on, once the anti-recycle or restart inhibit timer is satisfied and the EXV is prepositioned (if not already controlling). Most often the stage-on will be accompanied by a controlled stage-off of an already running compressor. Since normal operation is in effect, a constant load or setpoint change may be required to keep the compressor from staging off later.

Circuit Lockout

The UCM provides for a circuit lockout feature which prevents the compressor(s) of the selected refrigeration circuit(s) from starting or running. If currently running, the compressor(s) and circuit will go through a controlled shutdown. This lockout can be initiated with either an external hardware interlock on either MCSP of a given circuit or can be invoked through the front panel Operator Interface. When in Menu 0, the display will indicate CKT LOCKOUT by lighting the the appropriate carat.

Invoking Circuit Lockout

To invoke circuit lockout manually, simply move the display to item lb Ckt 1 or Ckt 2, and "enable" the circuit lockout for the appropriate circuit. Scroll to Menu 0 and check to see that the CKT LOCKOUT indicator carat is lit. The circuit will remained locked out until manually "disabled" at the same place in the menu.

To use an external hardwired interlock to accomplish lockout, refer to the IOM or system wiring diagrams for the field installed interlock connections. The external interlock feature must also "enabled" however, at the Operator Interface Menu item 3b, for the interlock to work. (Open = locked out, and closed= normal).

Circuit Diagnostic Reset

The UCM provides for a Circuit Diagnostic Reset feature which unlike the Chiller Reset, does not require a complete chiller shutdown to clear CMR diagnostics. By using this feature it is possible to service and restart a circuit that has been latched out on a circuit diagnostic while allowing the alternate circuit to remain on-line making chilled water.

Invoking Circuit Diagnostic Reset

Using the Operator Interface, scroll to Menu item lb Ckt 1 or Ckt 2, and "enable" circuit reset on the appropriate circuit. This will clear all latching diagnostics for that circuit (but will not remove them from the "Other Diagnostics" historical list. Clearing the "Other Diagnostic" list can still only be accomplished when no compressors are running, by depressing the "Display Down" key and simultaneously transitioning the Chiller switch from "Stop/Reset" into "Auto/Local").

For further information on this product or other Trane products, refer to the "Trane Service Literature Catalog", ordering number IDX-10M-1. This catalog contains listings and prices for all service literature sold by Trane. The catalog may be ordered by sending a $15.00 check to:
The Trane Company, Service Literature Sales, #600 Pammel Creek, La Crosse, WI 54601.

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