TRANE

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CVHE-SB-22 (9/88) - Original Service Bulletin.
CVHE-SB-22A (3/93) - Bulletin revised to update electrical schematics, cover UCP revisions and Purifier Purge implementation.

Subject: Control Operation, Setup and Troubleshooting for CVHB, CVHE and CVHF Centrifugal Chillers with UCP-695 Control Panels

Introduction:

The purpose of this service bulletin is to provide control operation and general troubleshooting information for Trane CenTraVac Model CVHB, CVHE and CVHF units that are equipped with Trane UPC-695 unit-mounted microprocessor control panel.

Discussion:

The following control information is only applicable to CVHE units that are "K" design sequence and later; CVHB units that are "V" design sequence and later, and to all CVHF units w/UCP695.

Although this information applies generally to all design sequences indicated above, the wiring diagrams that appear in this service bulletin apply to specific design sequences only. Check the 10th digit of the unit model number (stamped on the chiller nameplate) to determine its design sequence.

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

Table of Contents

Micro Module 1U3 Overview

The micro module (1U3) information presented in this section is subdivided into 4 categories:

[ ] **Operator Interface**, which provides information on control setpoints and display data that is typically accessed on a daily basis;

[ ] **Service Interface**, which contains information on control setpoints that are normally only adjusted at initial chiller start-up; and,

[ ] **Factory DIP Switch Settings**, which includes information about unit configuration. Control settings described in this subsection are provided for information only, and are normally performed in the factory so no field adjustments are normally required.

[ ] **Input Connections,** a description of the three micro module terminal strips (i.e., 1TB6, 1TB3 and 1TB4)--and the devices connected to them--comprises the remainder of this section.

Operator Interface

Monitoring devices and all chiller control components requiring adjustment for normal chiller operation are accessible without opening the unit control panel door. These components, which are a part of micro module 1U3, are illustrated in Figure 1 and discussed in the following paragraphs.

Chiller Switch

Located above the display window on the micro module, this 3-position switch enables the owner/operator to define chiller control mode:

[ ] **Standby/Reset.** When power is applied to the unit with the chiller switch set at STANDBY/RESET, the UCP is activated but unit operation is prohibited; operating code **A O** appears on the display. This switch position can be used by the operator or service technician to clear a latching diagnostic (i.e., fault that requires manual reset), or to shut down the unit.

[ ] **Auto/Local.** This switch position allows the chiller to run automatically, using the operational setpoints set at the unit.

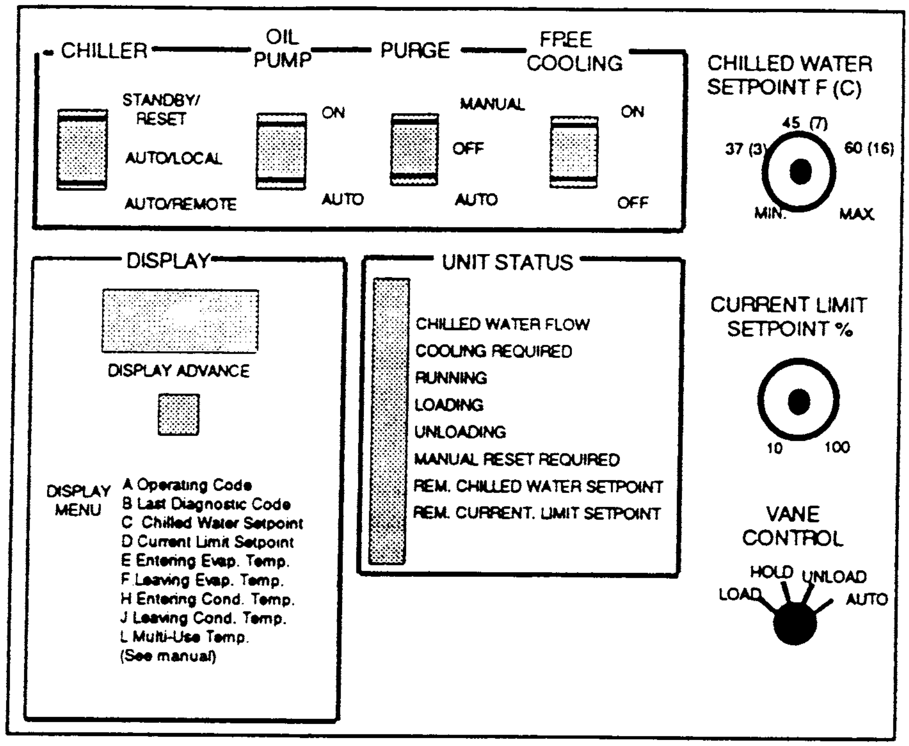
[ ] **Auto/Remote**. With the chiller switch in this position, the unit runs automatically using the setpoints established at a remote device and communicated to the chiller with the optional serial communication interface (SCI). (If no setpoints are sent by the remote controller, the UCP uses the operational setpoints set at the unit control panel.)

Note: When the unit is equipped with the SCI option, a SCP699 or Trane BAS can place the unit in the STANDBY/RESET mode even though the chiller switch is positioned at AUTO/REMOTE. However, a latching diagnostic condition at the unit cannot be cleared from a remote device.

Figure 1
Operator Control Panel

<u>**Notes**</u>:

1. Control panel shown applies to :
   CVHE = Des. Seq. 1C & later;
   CVHB = Des. Seq. 1D & later;
   CVHF = All Units.w/UCP695.
2. Item "L" on Display Menu available on above design sequences only.
3. Purge switch positions are MANUAL/OFF/TIMED for units of earlier design sequences.
4. All controls shown accessible without opening UCP door.
5. Free Cooling switch is optional.



Oil Pump Switch

A 2-position oil pump switch is located to the right of the chiller switch, above the display window. Switch position functions are described below:

[ ] **On.** This switch position provides continuous operation of the oil pump, even when the chiller switch is positioned at STANDBY/RESET.

Note: The ON switch position is designed for use by service personnel only; do not leave it in this position! The compressor will not start if the oil pump switch is in the ON position. Latching diagnostic code **b E8** will flash alternately with operating code **A 72** on the UCP's display.

[ ] **Auto.** Oil pump operation is controlled by the UCP, ensuring oil flow when the compressor is running. This is the normal switch operating position.

Purge Switch

Located next to the oil pump switch (Figure 1), the purge switch enables the owner/operator to select 1 of 3 purge operational modes.

[ ] **Manual.** This switch position provides continuous operation of the purge compressor, regardless of centrifugal compressor operation, or the position of the chiller switch.

[ ] **Off.** Purge operation will not occur when the purge switch is set at this position for CVHE units of design sequence "1C" and later, CVHB units, design sequence "1D" and and later, and all CVHF units (equipped with UCP695 and a Purifier Purge). For all units with design sequences earlier than this, purge operation will not occur when the switch is set in the OFF position, <u>unless</u> the purge compressor is already operating due to

closure of the purge run delay timer (3DL1) contacts. Refer to the chiller operation and maintenance literature for a further explanation of purge unit operation.

WARNING!: To prevent injury or death due to electrical shock, open unit disconnect switch before servicing to ensure purge unit is de-energized.

[ ] **Timed.** CVHE Units = Design Sequence "1B" and earlier only.
CVHB Units = Design Sequence "1C" and earlier only.

This is the normal switch operating position. When switch is in TIMED position, the purge compressor will operate for 5 minutes out of every 2-hour interval. Purge time is automatically extended whenever sufficient noncondensibles remain in the unit since the 4-minute purge timer (3DL1) is reset every time the purge pressure switch trips. (This is true even if the purge switch is readjusted to the OFF position.)

It is important to note that if the chiller is shut down when the purge switch is set at TIMED, the purge will continue to operate for 5 minutes out of every 2-hour period only if the chiller switch is set at either AUTO/LOCAL or AUTO/REMOTE and there is chilled water flow.

If the chiller switch is set at STANDBY/RESET and the purge switch is set at TIMED, the purge unit is also shut down (i.e., provided that 4-minute, purge run delay timer 3DL1 has timed out). However, if the chiller switch is set at STANDBY/RESET and the purge switch is set at MANUAL, the purge compressor will run continuously!

[ ] **Auto.** CVHE Units = Design Sequence "1C" and later only.
CVHB Units = Design Sequence "1D" and later only.
CVHF Units = All units with UCP695.

These units are equipped with the air-cooled Purifier Purge. AUTO is the normal switch operating position. (There is no TIMED switch position.) With this switch set at AUTO, the purge will run continuously when the CenTraVac is in powered cooling operation.

If the chiller switch is set at STANDBY/RESET and the purge switch is set at AUTO, the purge unit is also shut down. However, if the chiller switch is set at STANDBY/RESET and the purge switch is set at MANUAL, the purge compressor will run continuously! On those units equipped with more than one condenser, purge only from the active condenser. Use the manual valves provided to isolate the inactive condenser.

Note: The UCP must be properly configured for the type of purge system provided on the chiller at Dip Switch # 1 on switch block S9 of the UCP. This applies to CVHE units of design sequence "1C" and later, CVHB units, design sequence "1D" and and later, and all CVHF units with UCP695. Refer to "Factory Dip Switch Settings" in this bulletin.

Free Cooling Switch (Optional)

Free cooling enables the chiller to function as a simple heat exchanger, using refrigerant as the working fluid; however, it does not provide control of the leaving chilled water temperature. When condenser water is available at temperatures lower than the desired chilled water temperature, the free cooling option provides "average selection" chiller capacity without operating the compressor.

When the free cooling option is ordered, this two-position switch, located next to the purge switch, allows the operator to select 1 of 2 switch operating positions:

[ ] **On.** Placing the free cooling switch in this position forces the chiller to enter the free cooling mode (**A 9**); the compressor shuts down if the unit is operating in the powered cooling mode.

Note: Operating code **A 9** appears on the display once the free cooling valves are open; the unit cannot return to the powered cooling mode until these valves are closed. Remember, too, that when the unit is equipped with the SCI option, a remote device can "turn off" free cooling operation while the free cooling switch is set at ON.

[ ] **Off**. This setting enables normal chiller operation within the parameters established for the powered cooling mode. There is a 2-minute delay of the load pulse after start-up.

Note: When the unit is equipped with the SCI option, a remote device can "turn on" the free cooling function while the free cooling switch is positioned at OFF (i.e., provided that the chiller switch is set at AUTO/REMOTE).

Chilled Water Setpoint Potentiometer

Used to set the leaving chilled water temperature, this manually adjustable potentiometer is located at the right-hand side of the window in the control panel door (Figure 1). Available dial settings range from MIN to MAX, with intermediate temperatures indicated in degrees F as well as degrees C. Control deadband is ± 1 F.

To view the front panel chilled water setpoint, adjust the vane control switch to HOLD and press the display advance pushbutton until the "⊢ " code prefix appears on the display. The integer value (i.e., in increments of 1 F or 1 C) immediately to the right of "⊢ " is the UCP's chilled water setpoint. Standard operating range is 37 to 60 F (3 to 16 C), while the temperature range for extended operation is 20 to 70 F (- 6 to 22 C).

Note: To view the active chilled water setpoint, check the entry for code prefix "**C**" of the operator's menu. When the chiller is set at AUTO/REMOTE, and the "Remote Chilled Water Setpoint" status light is lit, the "**C**" value displayed was entered at a remote system control panel (SCP).

Current Limit Setpoint Potentiometer

Located directly below the chilled water setpoint control, this manually adjustable potentiometer is used to register the desired current limit setpoint. Dial settings range from 40% to 100% of the compressor rated-load-amps (RLA) value.

To view the front panel current limit setpoint, turn the vane control switch to HOLD and press the display advance pushbutton until the " ‾ " code prefix appears on the display; the integer value (i.e., indicated in increments of 1%) at the right of " ‾ " is the UCP's current limit setpoint.

Note: To check the active current limit setpoint, locate the entry for code prefix "**d**" in the operator's menu. Whenever the chiller switch is set at AUTO/REMOTE and the "Remote Current Limit Setpoint" status light is lit, the "**d**" value displayed was set at the a remote system control panel (SCP).

Vane Control Switch

The four-position, compressor inlet guide vane control switch is located beneath the current limit setpoint control. Each switch position is described below:

[ ] **Load.** As long as the vane control switch remains in this position, the "vanes open" (1U1Q7) relay is continuously energized and automatic vane control is suspended during the "Normal Run" mode (**A 74**). Manual loading does not take precedence over the current limit (**A 75**), condenser limit (**A 76**), or evaporator limit (**A 77**) modes of operation.

[ ] **Hold.** With the vane control switch set at HOLD, both the "vanes open" (1U1Q7) and "vanes close" (1U1Q8) relays are de-energized, so the inlet guide vanes remain at their current position. Automatic vane control is suspended when the unit is in the "Normal Run" mode (**A 74**). However, a current limit (**A 75**), condenser limit (**A 76**), or evaporator limit (**A 77**) mode will override the manual "hold" setting.

Note: Positioning the vane control switch at HOLD redefines the menu of codes appearing on the UCP's display. See " Operator's Display".

[ ] **Unload.** As long as the vane control switch remains in this position, the "vanes close" relay (1U1Q8) is continuously energized and automatic vane control is suspended regardless of the chiller's operating mode.

[ ] **Auto.** Inlet guide vane position is automatically controlled by the UCP when the vane control switch is in AUTO position.

Unit Status Lights

A series of eight status indicator lights are located directly below the purge switch. These blue lights, along with the operating and diagnostic information found on the display, allow the operator to monitor unit operation. The purpose of each status indicator light is described below.

[ ] **Chilled Water Flow.** Illumination of this light indicates that the chilled water flow switch 5S2 is closed.

[ ] **Cooling Required.** This light only illuminates when the UCP proves chilled water flow and detects a cooling requirement (i.e., leaving chilled water temperature exceeds the chilled water setpoint by a value greater than the differential-to-start criteria).

[ ] **Running.** Illumination of this status light indicates that:

- the unit is running (or is in one of the "run" modes);
- the chiller switch is set at AUTO/LOCAL or AUTO/REMOTE, and;
- the start sequence (or transition) is complete. It also remains lit through the chiller's post-lube cycle after the compressor shuts down.

[ ] **Loading.** When this light pulses (on and off), the UCP is loading the chiller (i.e., the vane actuator is driving the vanes open). There is a two-minute delay between unit start-up and load pulse initiation.

[ ] **Unloading.** When this light is on, the UCP is unloading the chiller (i.e., the vane actuator is driving the vanes closed).

Note: It is normal for the "Loading" and "Unloading" status lights to flash on and off in short pulses.

[ ] **Manual Reset Required.** Illumination of this light indicates that the UCP detected a "latching" diagnostic condition and shut down the chiller. Operation cannot resume until the UCP is manually reset (i.e., chiller switch is turned to STANDBY/RESET, then back to AUTO/LOCAL or AUTO/REMOTE).

[ ] **Remote Chilled Water Setpoint.** When this light is on, the UCP is ignoring its front panel chilled water setpoint, and is using the remote chilled water setpoint:

- determined by the optional chilled water reset module, or;
- entered at a remote source (i.e., an SCP699 system control panel or a Trane BAS).

It also illuminates if the chilled water reset function is active. If remote communications are severed, the UCP "defaults" to the control value of its chilled water setpoint potentiometer.

[ ] Remote Current Limit Setpoint. Illumination of this light indicates that the UCP is using a current limit setpoint communicated from a remote source (e.g., SCP or Trane BAS), and is ignoring its front panel current limit setpoint. Again, if remote communications are severed, the UCP "defaults" to the control value set with the current limit setpoint potentiometer.

Operator's Display

The UCP operator's display consists of a blue, four-digit vacuum fluorescent display and a display advance pushbutton. Both are located to the left of the unit status indicator lights. See Figure 1. The first letter of the four-character display identifies the type of data shown in the display window. A list of these indicator codes, along with their meanings, is provided in Table 1. An abbreviated version of this list is also provided on the face of the UCP, directly below the display advance pushbutton.

Table 1
UCP Display Menus

Operator's Menu		Serviceman's Menu (1, 2)	
Code Prefix	Parameter Description	Code Prefix	Parameter Description (and Display Range)
A	Operating Mode (see Table 2)	A	Operating Mode (see Table 2)
b	Last Diagnostic (see Table 3)	b	Last Diagnostic (see Table 3)
C	Active Chilled Water Setpoint: Std. Range = 37-60 F (3-16 C) Extd. Range = 20-70 F (-6-22 C)	⊢	Panel Chilled Water Setpoint (---, 20-70 F, ---)(---, -6-22 C, ---)
d	Active Current Limit Setpoint (40% thru 100% RLA)	‾	Panel Current Limit Setpoint (---, 40% thru 100% RLA, ---)
E	Entering Evap. Water Temp. (Opt.) (---, 12-91 F, ---)(---, -11-33 C, ---)	_	Evaporator Refrigerant Temp. (3) (b Ad, -4-42 F, ---)(b Ad, -20-6 C, ---)
F	Leaving Evap. Water Temperature (b Ab, 12-91 F, ---)(b Ab, -11-33 C, ---)	L	Control Response Setpoint (1 thru 237)
H	Entering Cond. Water Temp. (Opt.) (---, 28-142 F, ---)(---, -2-62 C, ---)	O	Start Differential Setpoint (2-10 F) ((-17 thru -12 C)
J	Leaving Cond. Water Temp. (Opt.) (---, 28-142 F, ---)(---, -2-62 C, ---)	P	Condenser Limit Setpoint (80-120% HPC)
L	Multi-Use Temperature (4) (---, -5-135 F, ---)	U	Evap. Refg. Trip Setpoint (b A3) Std. Range = 29-34 F (-1 thru 1 C) Extd. Range = 0-34 F (-18 thru 1 C)

Notes:
1. To redefine the "operator's menu" to the "serviceman's menu" turn vane control switch to HOLD.
2. For additional information on any item listed in the "serviceman's menu", contact a qualified service organization.
3. Actual measured evaporator refrigerant temperature.
4. "Multi-Use Temp." applications are: Cond. Lvg. Refg. Temp.; CWR Ambient Temp.; CWR Temp. from Analog Input. (This feature applies to CVHE units "1C" design sequence and later, CVHB units "1D" design sequence and later, and to all CVHF w/UCP695.)

The three remaining alphanumeric characters of the display indicate unit operating mode, diagnostic condition, setpoints or actual temperatures as defined by the code prefix. Refer to Tables 1, 2 and 3. A code prefix of "A" or "b" is followed by a space and a two-digit operating code (Table 2) or diagnostic code (Table 3), respectively.

Note: If the UCP detects a diagnostic condition, it alternately flashes the appropriate diagnostic code and the unit operating mode (at the time of shutdown) on the display. Latching diagnostic conditions can only be cleared manually at the unit, and not from a higher level device (i.e., SCP699 or Trane BAS). In the case of multiple diagnostic condition, only the last diagnostic is displayed.

Table 2
Codes for Unit Operating Modes

4-Character Code	Operating Mode Description
Blank	Power Off
A 0	Standby/Reset
A 1	Auto (Local or Remote)
A 9	Free Cooling
A 70	Restart Inhibit
A 71	Establish Cond. Water Flow
A 72	Start
A 74	Run: Normal
A 75	Run: Current Limit (1)
A 76	Run: Condenser Limit (2)
A 77	Run: Evaporator Limit (3)
A 78	Run: Surge Condition (4)
A 79	Post-Lube
A 88	Reset
A100 (5)	External Inhibit (Remote Start/Stop)

__Notes__:
1. As current limit setpoint is approached, 1U3 restricts further opening of the inlet guide vanes.
2. As condenser limit setpoint is reached, 1U3 restricts additional compressor loading to avoid shutdown on high condenser pressure (b F5) and initiates "head relief request" (i.e., optional relay).
3. 1U3 restricts further opening of the inlet guide vanes to avoid unit shutdown on low evaporator refrigerant temperature (b Fb).
4. 1U3 limits compressor loading and initiates "head relief request" (i.e., optional relay) when unit enters a surge condition. An automatic unit shutdown occurs if unit remains in surge for 15 minutes (b dA).
5. This feature provided on CVHE units, design sequences "1C" and later, CVHB units, design sequences "1D" and later and all CVHF units w/UCP695.

Table 3
Unit-Level Diagnostic Codes

Diag. Code	Diagnostic Explanation	Reset Type(1,2)	Diag. Code	Diagnostic Explanation	Reset Type(1,2)
b A3	Evaporator Refrig. Temp. Range	Manual	b E8	Differential Oil Pressure Switch	Manual
b A4	Motor Temperature Sensor # 1	Manual	b E9	Stop Relay	Manual
b A5	Max. Acceleration Time Range	Manual	b EA	High Inboard Brg. Temp. (Sen. # 1)	Manual
b A7	Motor Temperature Sensor # 2	Manual	b Eb	High Outbrd. Brg. Temp. (Sen. # 2)	Manual
b A8	Motor Temperature Sensor # 3	Manual	b EC	Running Overload	Manual
b A9	Oil Temperature Sensor	Manual	b Ed	Chilled Water Flow	Auto
b Ab	Leaving Water Temp. Sensor	Manual	b EE	Max. Acceleration Time Exceeded	Manual
b AC	Cond. Refrig. Pressure Sensor (3)	Manual	b F0	Transition	Manual
b Ad	Evap. Refrig. Temperature Sensor	Manual	b F1	Running External Interlock (3)	Manual
b AE	Ambient Temperature Sensor (3)	Manual	b F2	Low Oil Pressure	Manual
b AF	Bearing Sensor # 1 (Inboard) (3)	Manual	b F3	Low Oil Temperature	Auto
b b0	Bearing Sensor # 2 (Outboard) (3)	Manual	b F4	High Oil Temperature (4)	Manual
b d9	Extended Power Loss	Auto	b F5	High Condenser Refrig. Pressure	Manual
b dA	Surge	Manual	b F7	Condenser Water Flow	Auto
b dC	Condenser Water Flow Overdue	Manual	b F8	Improper Unit Identification	Manual
b E2	Momentary Power Loss	Auto	b F9	Free-Cooling Valves	Manual
b E3	Phase Imbalance	Manual	b FA	Actuator	Manual
b E4	Phase Loss	Manual	b Fb	Low Evaporator Refrig. Temp.	Manual
b E5	Phase Reversal	Manual	b Fd	External Interlock (5)	Manual
b E7	High Motor Temperature	Manual	b FF	Unit Control Module	Manual

Notes:
1. Check the "Manual Reset Required" status indicator light to determine if manual reset is necessary.
2. It is not possible to clear a latching diagnostic condition (i.e., one requiring manual system reset) at the unit from a higher-level device (e.g., an SCP699 or Trane BAS).
3. Optional feature.
4. Feature provided for CVHE units design sequence "1C" and later, CVHB units design sequence "1D" and later, and all CVHF units w/UCP695.
5. Feature provided for CVHE units before design sequence "1C"; CVHB units before design sequence "1D". Replaced by operating code A 100, "External Inhibit" (remote start/stop) at that time.

Codes prefixed by a "C" or "d" are followed by the corresponding setpoint value (i.e., chilled water or current limit, respectively) presently used to control the chiller. If the chiller switch is set at AUTO/LOCAL, setpoint values displayed are those set manually at the chiller's UCP. However, when the chiller switch is set at AUTO/REMOTE, and the proper status indicator lights are on, the setpoint values displayed were established at remote device (e.g., SCP699 or Trane BAS).

"E", "F", "H", "J" and "L" code prefixes are followed by an actual measurement of a system parameter (e.g., entering evaporator water temperature). (Code prefixes "E", "H" and "J" and "L" represent sensor options; if these sensors are not installed, a bar [—] appears on the display.)

Use the display advance pushbutton to scroll from one menu entry to the next. A blank display marks the end of the "operator's menu" for CVHE units of design sequence "1B" and earlier and CVHB units, design sequence "1C" and earlier. When the multi-use temperature sensor (4RT6) is ordered, the end of the operator's menu is indicated by the "L" operating code prefix for these units:

— CVHE Units = Design Sequence "1C" and later;
— CVHB Units = Design Sequence "1D" and later;
— CVHF Units = All units with UCP695.

If the multi-use temperature sensor option is not used, a bar [—] appears in the last position on the display.

To return to the top of the menu, press the pushbutton once.

Turning the vane control switch to the HOLD position redefines the display code prefixes to indicate the "local" (or front panel) chilled water and current limit setpoints, actual evaporator refrigerant temperature, and settings for control response, start differential, condenser limit and evaporator refrigerant "trip" point. See Table 1. Code prefixes "A" and "b" remain unchanged when the operating menu is redefined.

Important! Do not leave the vane control switch in HOLD. In this position, control of leaving chilled water is suspended. Only the "safety" features are functional!

Note: While in the serviceman's menu, the integer values displayed for the panel chilled water, condenser limit, and evaporator refrigerant trip setpoints represent the entire adjustment for these potentiometers. Unless the unit is specifically designed for "extended range" operation, the UCP will adhere to the parameters established for "standard range" chillers.

Important! Advancing past the "Last Diagnostic Code" entry in the menu automatically clears the code registered there from memory!

Service Interface

The following components can only be accessed by opening the control panel door. Each of these devices (Figure 2) is set at initial unit start-up by a qualified service technician.

Figure 2
UCP Service Interface and DIP Switch Locations
(Accessible Only With UCP Door Open)

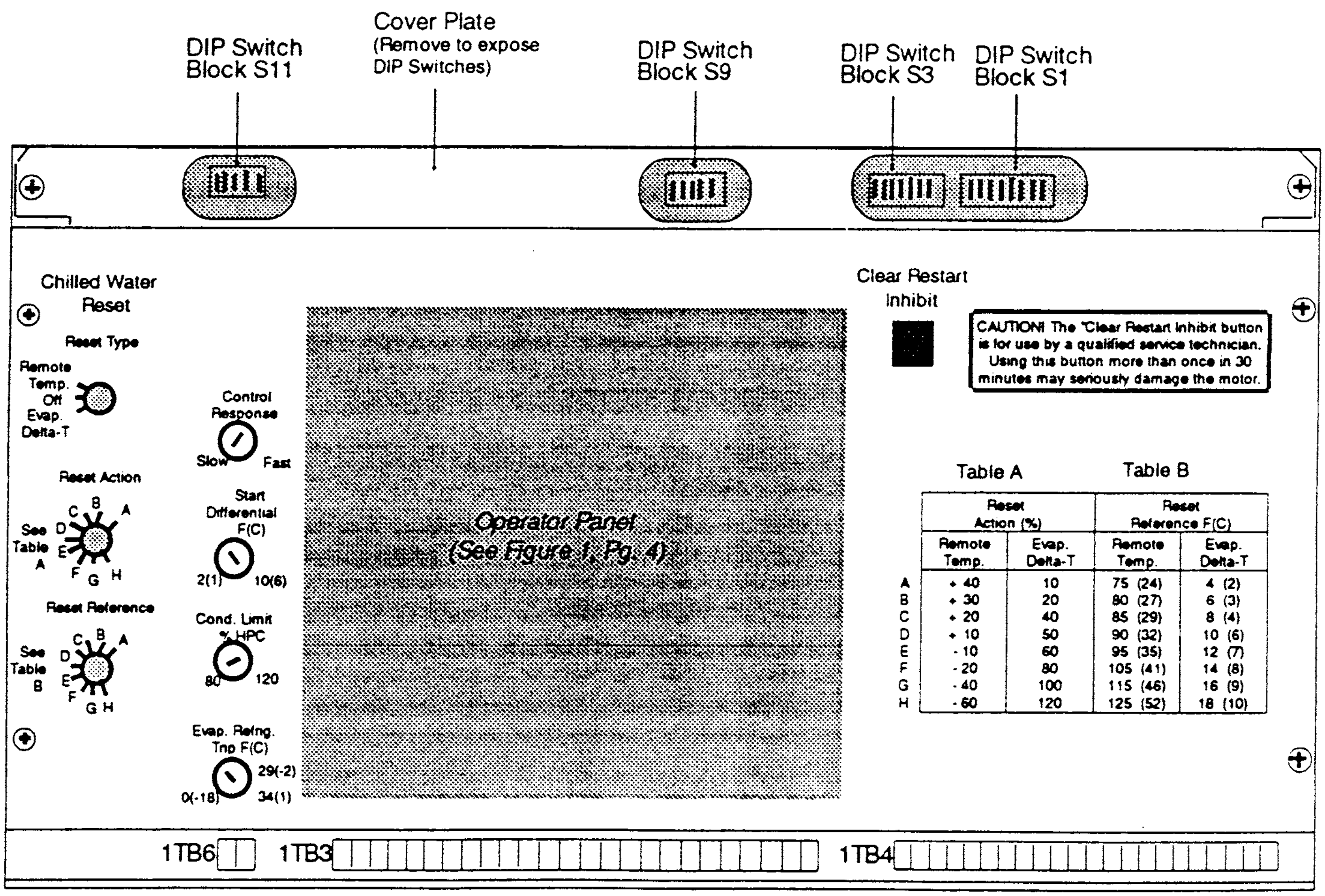


Table A / Table B

	Reset Action (%)		Reset Reference F(C)	
	Remote Temp.	Evap. Delta-T	Remote Temp.	Evap. Delta-T
A	+ 40	10	75 (24)	4 (2)
B	+ 30	20	80 (27)	6 (3)
C	+ 20	40	85 (29)	8 (4)
D	+ 10	50	90 (32)	10 (6)
E	- 10	60	95 (35)	12 (7)
F	- 20	80	105 (41)	14 (8)
G	- 40	100	115 (46)	16 (9)
H	- 60	120	125 (52)	18 (10)

WARNING! To prevent injury or death due to electrical shock, exercise extreme care whenever working with energized electrical components.

Caution: To ensure proper chiller operation, never tamper with any UCP-695 controls located behind panel door without first consulting a qualified service technician.

Clear Restart-Inhibit PushButton

By pressing this pushbutton, located to the right of the chilled water setpoint potentiometer, the service technician can clear the restart inhibit timer.

Caution: The clear restart inhibit pushbutton is for use only by a qualified service technician. Using this button more than once in 30 minutes may seriously damage the compressor motor.

Note: When the clear restart inhibit (CRI) button is pressed while the chiller switch is in the STANDBY/RESET position, only the remaining portion of the 30-minute anti recycle timer is cleared. Toggling the chiller switch to one of the AUTO positions results in the activation of either a 4- or 15-minute run-inhibit timer. If the CRI pushbutton is pressed while the chiller switch is in one of the AUTO positions, all restart-inhibit timers are cleared and the UCP will initiate a start sequence if cooling is required.

Control Response Setpoint Potentiometer

(To be set/calibrated by a qualified Trane service technician only.)
Located to the left of the display window, this manually adjustable potentiometer can be set at any position between 1 and 237. The units used to delimit these settings are arbitrary.)

The control response setting directly affects the vane controller's speed of response to changes in cooling requirements; the lower the control response setting, the slower the response time of the vane controller. To view the actual control response setting, position the vane control switch at HOLD and press the display advance pushbutton until code prefix "L " appears.

Use the following equation to determine the recommended control response setting for a particular unit application:

$$\text{Recommended Control Response Setpoint} = \frac{250}{\text{Design Delta-T}} \times \frac{\text{Actual Flow Rate}}{\text{Design Flow Rate}}$$

where "design delta-T" is the design temperature drop in the evaporator. For example, if a unit is designed for a 55 F entering evaporator temperature and a 45 F leaving evaporator temperature, its "design delta-T" is 10 F.

Start Differential Setpoint Potentiometer

With an adjustment range of 2 F to 10 F (1 C to 6 C), this manually adjustable potentiometer is used to establish the number of degrees that the chilled water temperature must rise above the setpoint before the unit will start. (It also determines the actual compressor "stop" point; see Table 4.)
To display the actual start differential in the display window, position the vane control switch at HOLD and press the display advance pushbutton until code prefix "O" appears.

Recommended differential to start setpoints, along with the corresponding compressor stop differential setpoints, are indicated in Table 4.

Table 4
Compressor "Start/Stop" Points

Chiller Delta-T F (C)	Recommended Differential to Start F (C)	Corresponding Differential to Stop F (C)
4 or less (2.2 or less)	2 (1)	2.0 (1.1)
5 or 6 (2.8 or 3.3)	3 (2)	2.0 (1.1)
7 or 8 (3.9 or 4.4)	4 (2)	2.0 (1.1)
9 or 10 (5.0 or 5.5)	5 (3)	2.0 (1.1)
11 or 12 (6.1 or 6.7)	6 (3)	2.0 (1.1)
13 or 14 (7.2 or 7.8)	7 (4)	2.0 (1.1)
15 or 16 (8.3 or 8.9)	8 (4)	2.4 (1.3)
17 or 18 (9.4 or 10.0)	9 (5)	3.2 (1.7)
19 or more (10.6 or more)	10 (6)	4.0 (2.2)

Condenser Limit Setpoint Potentiometer (% HPC; Optional)

The control range of this optional, adjustable potentiometer is 80% to 120% of the rated high pressure control setpoint. For standard units (i.e., with an HPC setting of 15 psig), then, the condenser limit setting range is 12 to 18 psig. The range for ASME units--with a 25 psig HPC setting--is 20 to 30 psig.

To display the actual condenser limit setpoint in the display window, turn the vane control knob to HOLD and press the display advance pushbutton until "P" appears on the display. The integer value immediately to the right of "P" is the condenser limit setpoint.

Note: The condenser high pressure cutout switch (1S1) remains active and will shut down unit operation on latching diagnostic **b F5** (i.e., high condenser refrigerant pressure) if its "trip" point is exceeded.

Recommended Condenser Limit Setpoint

The recommended condenser limit setpoint is 93% of the condenser high pressure cutout switch (1S1) setting.

Condenser Limit Operation (A 76)

Optional condenser limit control provides a means for maintaining chiller operation while high head pressure conditions exist. The control scheme used is outlined below, and an example follows:

1. Micro module 1U3 continually monitors condenser refrigerant pressure via condenser pressure transducer 1R1.

2. When condenser pressure rises to within 90% to 96% of the condenser limit setpoint, 1U3 slows the opening of the inlet vanes and allows for normal vane closure.

3. When condenser pressure rises to within 96% to 100% of the condenser limit setpoint, 1U3 prohibits further vane opening but allows vane closure.

4. If head pressure reaches the condenser limit setpoint, 1U3 initiates a **regulated vane closure** that continues until the condenser pressure is under control. (Notice that the micro module does not issue a "hard close" signal to the vane actuator--shutting the vanes to their minimum open position--at this time.)

5. If the controlled vane closure begun in Step 4 does not bring condenser pressure under control, the unit shuts down on latching diagnostic **b F5** when the high pressure switch (1S1) setpoint is exceeded.

[ ] **Example.** To better understand the condenser limit control scheme just described in Steps 1 through 5, calculate the condenser limit setpoint in psig--along with the "control points"--for a unit with these characteristics:

- [ ] Standard Unit
- [ ] Condenser Rating = 15 psig
- [ ] HPC Switch (1S1) Setpoint = 15 psig
- [ ] Condenser Limit Setpoint = 93% of HPC setpoint

a. Calculate the psig value of the condenser limit setpoint.

Condenser Limit Setpoint = Condenser Rating x % HPC
= 15 psig x 93%
= 14 psig (approximately)

b. Using the condenser limit setpoint just calculated, determine the condenser limit "control points".

90% x 14 psig = 12.6 psig
96% x 14 psig = 13.4 psig
100% x 14 psig = 14.0 psig

In this example, then:

a. The UCP will limit vane opening when condenser head pressure is between 12.6 and 13.4 psig.

b. The UCP will not allow the vanes to open further when condenser head pressure is between 13.4 and 14 psig, though vane closure is allowed.

c. When condenser head pressure reaches 14 psig, the UCP will initiate a controlled vane closure signal until the condenser pressure drops.

d. If condenser head pressure exceeds 15 psig, the unit is shut down on latching diagnostic **b F5**.

Evaporator Refrigerant Limit Potentiometer

With a standard adjustment range of 29 F to 34 F (-2 C to 1 C), this manually adjustable potentiometer is used to establish the chiller's low refrigerant temperature "trip" point. An optional "extended range" is also available which provides an adjustment range of 0 F to 34 F (-18 C to 1 C). To view the actual control setting, adjust the vane control knob to "HOLD" and press the display advance pushbutton until "U" appears on the display.

Note: Attempting to adjust the evaporator refrigerant "limit" point below the minimum range value will result in a latching diagnostic (i.e., requiring manual reset). Diagnostic code **b A3** will flash alternately on the display with the current operating code at the time the minimum range value was violated.

Caution: To assure proper chiller operation, adjustment of this control must always be performed by a qualified service technician.

Recommended Evaporator Refrigerant Limit Setting

Set the evaporator refrigerant "trip" point at 32 F unless a lower setpoint is required (i.e., because the design refrigerant temperature is less than 34 F).

Evaporator Refrigerant Limit Specifications

Adjustment Range:
- 29 F to 34 F for standard-range operation; and,
- 0 F to 34 F for extended-range operation.

Adjustment Resolution:
- 1.0 F or 1.0 C

Setpoint Out of Range:
- Too Low = Diagnostic **b A3** occurs.
- Too High = No diagnostic; UCP uses end-of-range value (i.e., 34 F).

Evaporator Refrigerant "Limit" Operation (A 77)

Freeze protection is provided by a multistep control algorithm built into the micro module. As the control point is approached, 1U3 sequentially initiates the following actions:

1. At 5-6 F above trip setting, limits the amount of vane opening, but allows vane closure;

2. At approximately 2 F above trip setting, prohibits additional vane opening, but allows vane closure;

3. At approximately 1 F above trip setting, initiates a regulated vane closure until evaporator refrigerant temperature is above the control point;

4. At trip setting, fully closes the inlet vanes; and,

5. Shuts down chiller operation while the vanes are fully closed if the setpoint violation persists.

Note: Chiller shutdown is not instantaneous; the micro module integrates to 30 F-seconds when the setpoint violation occurs.

This control scheme is designed to maintain chiller operation at the maximum capacity allowable without excessive vane modulation. Each of the five stages described above is further modified by the rate at which the refrigerant temperature is changing.

Note: The "control point" mentioned in Step 3 is 2 F above the evaporator refrigerant "trip" setpoint. However, if the evaporator refrigerant "trip" point is 29 F, then the "control point" is 1.5 F, relative, for standard-range units.

Evaporator Refrigerant Temperature Sensor Checkout

It is good practice to check the evaporator refrigerant temperature thermistor (4RT5) whenever setting up or adjusting the evaporator refrigerant "trip" setpoint. To check thermistor integrity:

1. Adjust the chiller switch to the STANDBY/RESET position.

2. Remove thermistor 4RT5 from its bulbwell but do not disconnect the thermistor leads from the micro module.

3. Place the thermistor in an ice bath along with an accurate thermometer. Use the thermometer to verify that the ice water is at 32 F.

4. View the refrigerant temperature display at the control panel. To do this, set the vane control switch at HOLD and press the display advance push button until "_" appears on the display.

Agitate the sensor in the ice bath for several minutes to allow the sensor temperature to stabilize; then check the display window. The evaporator refrigerant temperature displayed should be 32 ± 2 F.

Notes:

a. Evaporator refrigerant temperature "sensing system" accuracy is specified for ± 0.8 F accuracy at 29 F, although the accuracy of ± = 1.0 F at 30 F and ± 2.0 F at 32 F are acceptable.

b. If the sensor registers + 2.0 F (on the control panel display) at a 32 F temperature, and a control point above 32 F is desired--it may be necessary to compensate for the discrepancy by resetting the "trip" point upward.

5. Remove the 4RT5 thermistor sensor leads from terminals 1TB3-12 and 1TB3-13 on micro module 1U3; then check the resistance of sensor 4RT5.

Refer to the 4RT5 resistance table in the "Troubleshooting with Diagnostics" section of this bulletin, and find the measured resistance reading. The corresponding temperature in this table should match the actual temperature measured in Step 3 (i.e., within the accuracy criteria defined at the bottom of the 4RT5 resistance table).

Chilled Water Reset (CWR)

Chilled water reset is designed for those applications where the design chilled water temperature is not required when the chiller system is operating at part load. In these cases, the leaving chilled water temperature setpoint can be reset upward using the chilled water reset option.

Note: To enable CWR, the chiller switch must be set at AUTO/REMOTE. The remote chilled water setpoint status light will energize. CWR is active as long as the chiller switch is in AUTO/REMOTE even when the chiller is not operating.

The chilled water reset option consists of a factory-installed module in the unit control panel and a field-installed sensor. Sensor location is dependent on whether "load" or "ambient" chilled water setpoint reset is desired:

[ ] If "load" CWR is selected, the CWR sensor is field-installed in the return chilled water piping and connected to terminals 1TB3-3 and 1TB3-4 on micro module 1U3.

[ ] With the selection of "ambient" CWR, the sensor leads are connected to terminals 1TB3-14 and 1TB3-15 on micro module 1U3, and the sensor itself is typically field-installed just inside the building's fresh air intake duct, or on the north exterior wall of the building. In either case, shelter the sensor from direct sunlight and the elements.

Operator selection of the type of chilled water reset desired for a given application is accomplished at the unit control panel. See Figure 2, page 12; the conversion tables needed to determine the CWR control settings (i.e., Tables A and B) are provided on the face of the micro module, at the immediate right of the current limit setpoint potentiometer.

WARNING! To prevent injury or death due to electrical shock, use care when measurements, adjustments, or other service-related operations are performed with power on.

Load-Based CWR

When load-based chilled water reset is desired, the CWR controls must be adjusted as described below:

1. Reset Type Knob: Set at "Evap. Delta-T".

2. Reset Reference Knob: Set at the design delta-T (DDT) for the unit. Use the "Evaporator Delta-T" column of Table B (Figure 2, page 12) to convert the unit DDT value to a letter code (i.e., A through H).

Note: In those instances where the DDT value falls between the values listed, always use the next lower value.

Example: Chiller A is designed to operate with an entering chilled water temperature of 56 F, and a leaving chilled water temperature of 44 F.

a. Determine Chiller A's design delta-T.

DDT = Design Ent. Chilled Water Temp. - Design Lvg. Chilled Water Temp.
DDT = 56 F - 44 F
DDT = 12 F

b. Convert Chiller A's DDT to a letter code. Locate 12 F DDT in Table B under "Evap. Delta-T"; 12 F DDT = "E".
c. Turn the reset reference knob to control setting "E".

3. Reset Action Knob: Set at the amount of reset desired. Use the following equation and the "Evaporator Delta-T" column of Table A (Figure 2, page 12) to determine the amount of reset desired; then convert this amount to a letter code (i.e., A through H).

RCWS = PCWS + RAS [DDT - (ENT - LVG)] where:

RCWS = Reset Chilled Water Setpoint
PCWS = Front Panel Chilled Water Setpoint
RAS = Reset Action Setpoint
DDT = Design Delta-T
ENT = Entering Chilled Water Temperature
LVG = Leaving Chilled Water Temperature

Notes about this equation:

a. To convert the reset action values in Table A from percentages to decimal values, divide by 100. Decimal values must be used for the RAS variable in the equation.

b. System control will not allow chilled water reset downward even though it is possible in this equation.

c. Increasing the reset action setpoint (RAS) to a larger number results in more reset.

d. If you know how many degrees of chilled water reset are desired (i.e., RCWS), as well as the DDT, ENT and LVG, the equation can be rearranged to solve for the reset action setpoint (RAS):

$$RAS = \frac{RCWS - PCWS}{[DDT - (ENT - LVG)]}$$

Review Examples 1 and 2 below to ensure that it is understood both how to calculate a load-based reset chilled water setpoint, and how this reset value changes with the selected reset reference and reset action control settings.

Example #1:

DDT = 10.0 F
PCWS = 45.0 F
RAS = 0.5 (i.e., "50" in Table A)

When the unit is operating at full load, ENT is 55 F and LVG is 45 F, so:

RCWS = 45.0 F + 0.5 F [10.0 F - (55 F - 45 F)]
RCWS = 45.0 F + 0 F
RCWS = 45.0 F

Since LVG and RCWS are equal (i.e., both are 45 F), there is no reset at this full load condition.

If this same unit is only half loaded (i.e., ENT - LVG = 5.0 F), then:

RCWS = 45.0 F + 0.5 [10.0 F - 5.0 F]
RCWS = 45.0 F + 2.5 F
RCWS = 47.5 F

In this situation, the chilled water setpoint will be reset 2.5 F upward, and the chiller will operate with an entering chilled water temperature of 52.5 F and a leaving chilled water temperature of 47.5 F.

Example #2:

DDT = 10.0 F
PCWS = 45.0 F
RAS = 1.0 (i.e., "100" in Table A)

Chiller B is operating at full load, and the delta-T across the evaporator (ENT - LVG) is 10 F, so:

RCWS = 45.0 F + 1.0 [10.0 F - 10 F]
RCWS = 45.0 F + 0 F
RCWS = 45.0 F

Under this full load condition, LVG and RCWS are again equal (i.e., both are 45.0 F), so there is no reset.

If this same unit is only half loaded (i.e., ENT - LVG = 5.0 F), then:

RCWS = 45.0 F + 1.0 [10.0 F - 5.0 F]
RCWS = 45.0 F + 5.0 F
RCWS = 50.0 F

In this situation, the chilled water setpoint will be reset 5.0 F upward, and the chiller will operate with an entering chilled water temperature of 55.0 F and a leaving chilled water temperature of 50.0 F. Notice that an RAS of 1.0 yields a constant return temperature; as unit load varies, the leaving chilled water setpoint is reset so that the entering chilled water temperature is always 55 F.

Ambient-Based CWR

When ambient-based chilled water reset is desired, the CWR controls must be adjusted as described below:

1. Reset Type Knob: Set at "Remote Temp."

2. Reset Reference Knob: This knob is used to set the temperature below or above which reset begins (i.e., design ambient). Use the "Remote Temperature" column of Table B (Figure 2, page 12) to convert the desired design ambient temperature to a letter code (i.e., A through H).

Example: Chiller A's design ambient temperature is 90 F (i.e., chilled water reset is desired if the ambient temperature falls below 90 F).

a. Convert Chiller A's design ambient to a letter code. Locate 90 F in Table B under "Remote Temp."; 90 F = "D".
b. Adjust the reset reference knob to control setting "D".

3. Reset Action Knob: Set at the amount of reset desired. Use the following equation and the "Remote Temperature" column of Table A (Figure 2, page 12) to determine the amount of reset desired and then convert this amount to a letter code (i.e., A through H).

RCWS = PCWS + RAS (RRS - AMB) where:

RCWS = Reset Chilled Water Setpoint
PCWS = Front Panel Chilled Water Setpoint
RAS = Reset Action Setpoint
RRS = Reset Reference Setpoint
AMB = Outdoor Ambient Temperature

Notes about this equation:
a. To convert the reset action values in Table A from percentages to decimal values, divide by 100. Decimal values must be used for the RAS variable in the equation.
b. Increasing the RAS to a larger number results in more reset.
c. Using a negative RAS causes the chilled water setpoint to be reset upward whenever the ambient temperature exceeds the design ambient. System control will not allow the chilled water setpoint to be reset downward even though it is possible in this equation.

Review Example 3 below to ensure that the correlation between the reset action setting and the reset chilled water setpoint in ambient-based chilled water reset is understood.

Example #3:

PCWS = 45.0 F
RAS = 0.2 (i.e., "20" in Table A)
RRS = 90.0 F

When the outdoor air temperature is 80 F, then:

RCWS = 45.0 F + 0.2 (90.0 F - 80 F)
RCWS = 45.0 F + 2.0 F
RCWS = 47.0 F

If the outdoor air temperature drops to 70 F, then:

RCWS = 45.0 F + 0.2 (90.0 F - 70 F)
RCWS = 45.0 F + 4.0 F
RCWS = 49.0 F

Thus, a RAS of 0.2 (i.e., +20%) provides 2 F of reset for every 10 F drop in outdoor air temperature below the design ambient.

Factory DIP Switch Settings

Controls discussed in this section are factory-set, and do not normally require adjustment at initial start-up or during operation of the unit. Use the information provided here only to check the switch settings at initial start-up, or when a new micro module (1U3) is installed. To access the UCP control components described below, open the unit control panel door and remove the access cover strip located at the top of the micro module. All of the necessary factory inputs are set at four DIP switch blocks. See Figure 2 on page 12.

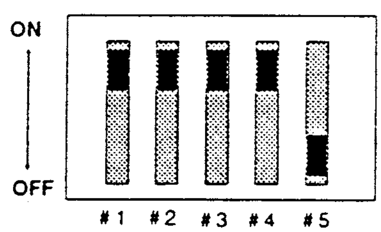
WARNING!: To prevent injury or death due to electrical shock, always open unit disconnect switch before opening control panel door.

Caution: To ensure proper chiller operation, never tamper with any UCP695 controls located behind panel door without first consulting a qualified service technician.

Switch Block S11: Unit Address

This DIP switch block Shown below in Figure 3, must be set when the unit is used with an SCP699 system control panel. The switches are set to "tag" the chiller with a binary address of either "1", "2" or "3" as indicated in Table 5 below:

Figure 3
Unit Address DIP Switch Block (S11)



Note: See Figure 2, Page 12 for DIP Switch Locations.

Table 5 - Settings for DIP Switch Block S11

Switch Block S11 DIP Switches					Corresponding Binary Unit Address
1	2	3	4	5	
NA	NA	NA	ON	OFF	1
NA	NA	NA	OFF	ON	2
NA	NA	NA	OFF	OFF	3

Note: All units communicating with an SCP must have separate, unique addresses. If 2 or more units connected to an SCP have identical addresses, SCP-UCP communications are automatically terminated.

Switch Block S9: Purge/Unit Identification; Temperature Range; Unit-of-Measure

Unit Identification For:

— CVHE Units = Design Sequence "1B" or earlier, only, and;
— CVHB Units = Design Sequence "1C" or earlier only.

For these units, DIP Switch Nos. 1, 2 and 3 on this block (S9) tell the micro module (1U3) what type of unit it is controlling. See Figure 4. Unit identification is established using various combinations of "On" and "Off" DIP switches. Unit type should match the corresponding code, as indicated in Table 6 below:

Figure 4
Unit Identification/Temperature Range/Unit-of-Measure DIP Switch Block (S9)

Note: See Figure 2, Page 12 for DIP Switch Locations.

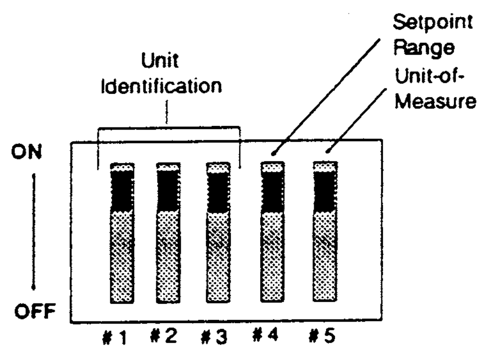


Table 6 - Settings for DIP Switches 1, 2, 3 On Switch Block S9

Switch Block S9 DIP Switches					Corresponding Unit Identification
1	2	3	4	5	
ON	ON	OFF	n/a	n/a	CVHE or CVHB (STD)
ON	OFF	OFF	n/a	n/a	CVHE or CVHB (ASME)

CVHE Units = Design Sequence "1B" or earlier, only, and;
CVHB Units = Design Sequence "1C" or earlier only.

Unit Identification For:

— CVHE Units = Design Sequence "1C" and later;
— CVHB Units = Design Sequence "1D" and later;
— CVHF Units = All units w/UCP695.

For these units, DIP Switch No. 1 on this block (S9) is used to identify (for the micro) the type of purge unit provided on the chiller (Table 7). DIP Switch Nos. 2 and 3 tell the micro module (1U3) what type of unit it is controlling. See Figure 5. Unit identification is established using various combinations of "On" and "Off" DIP switches. Unit type should match the corresponding code, as indicated in Table 7:

Figure 5a
Purge/Unit Identification/Temperature Range/
Unit-of-Measure DIP Switch Block (S9)

Note: See Figure 2, Page 12 for DIP Switch Locations.

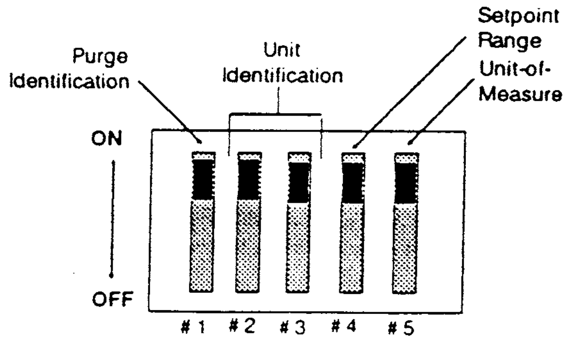


Table 7 - Settings for DIP Switch 1 On Switch Block S9

Switch Block S9 DIP Switches					Corresponding Unit Identification
1	2	3	4	5	
ON	n/a	n/a	n/a	n/a	Oilless/Hermetic Purge
OFF	n/a	n/a	n/a	n/a	Purifier Purge

Table 8 - Settings for DIP Switches 2 and 3 Switch Block S9

Switch Block S9 DIP Switches					Corresponding Unit Identification
1	2	3	4	5	
n/a	ON	OFF	n/a	n/a	CVHE or CVHB (CFC- 11/ HCFC-123)
n/a	OFF	OFF	n/a	n/a	CVHE or CVHB (ASME CFC-11/HCFC-123)

CVHE Units = Design Sequence "1C" or later, and;
CVHB Units = Design Sequence "1D" or later, and;
CVHF Units = All units w/UCP695

The position of DIP Switch No. 4 on switch block S9 (Figures 4 and 5a) determines the range of adjustability for the chilled water and evaporator refrigerant "trip" point potentiometers as shown in Table 9:

Table 9 - Settings for DIP Switch 4 On Switch Block S9

Switch Block S9 DIP Switches					Corresponding Temperature Range
1	2	3	4	5	
n/a	n/a	n/a	ON	n/a	Standard
n/a	n/a	n/a	OFF	n/a	Extended

The standard temperature range for the chilled water setpoint is 37 F to 60 F, and that of the evaporator refrigerant "trip" point is 29 F to 34 F. When the extended temperature range function is enabled, however, these control ranges are expanded to include 20 F to 70 F for the chilled water setpoint, and 0 F to 34 F for the evaporator refrigerant "trip" point.

Caution: DIP Switch No. 4 should be ON unless the unit is designed to operate beyond the standard temperature range. Improper chiller operation at "extended temperature range" conditions may result in catastrophic equipment failure!

English or SI Unit-of-Measure

DIP Switch No. 5 of switch block S9 (Figure 4 and 5a) determines whether the temperatures shown on the micro module's display are indicated in degrees F or degrees C. See Table 10 below:

Table 10 - Settings for DIP Switch 5 On Switch Block S9

Switch Block S9 DIP Switches					Corresponding Units-of-Measure
1	2	3	4	5	
n/a	n/a	n/a	n/a	ON	English (Degrees F)
n/a	n/a	n/a	n/a	OFF	SI (Degrees C)

Note: DIP Switch No. 5 should remain in the "ON" position for all domestic chiller applications.

Switch Block S3: Acceleration Time; Frequency; Phase Imbalance/Surge Protection

Maximum Acceleration Time

The positions of DIP Switch Nos. 1 through 5 on switch block S3 (Figure 5b) determine the maximum length of time which will be allowed for transition to occur. (Acceleration time is measured from compressor motor start to transition — that is, the point at which inrush current is reduced to 85% of RLA.) Following are "trip" setpoint specifications for the maximum acceleration time function:

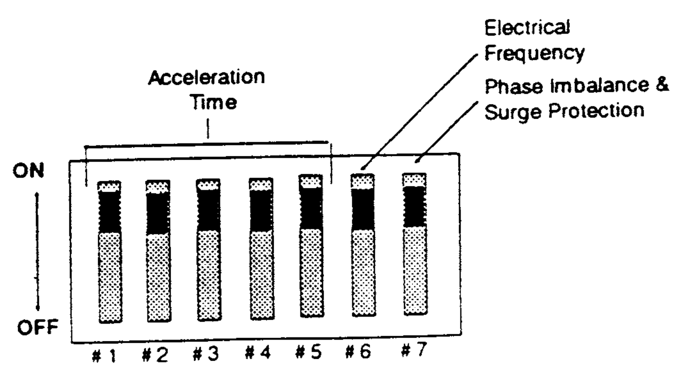
[ ] Adjustment Range:
6 seconds minimum to 65 seconds maximum

[ ] Adjustment Resolution:
3 seconds minimum

[ ] Timing Accuracy:
2.5 Seconds

Figure 5b - Acceleration Time/Electrical Frequency/ Surge Protection DIP Switch Block (S3)

Note: See Figure 2, Page 12 for DIP Switch Locations.



Note: Though this setpoint is factory-adjusted (i.e., based on starter type and available starting torque), it may be necessary to modify this setting in the field. Acceleration times and DIP switch settings are given in Table 11. Recommended maximum acceleration times for various starter types are as follows:

27 seconds for "star-delta" starters;
16 seconds for "auto-transformer" starters;
11 seconds for "primary reactor" starters
6 seconds for "across-the-line" starters.

Table 11
Available Max. Acceleration Time Settings for Switches 1- 5 On Switch Block S3 *(Note 1)*

Switch Block S3 DIP Switches					Corresponding Maximum Acceleration Time
1	2	3	4	5	
ON	ON	ON	ON	ON	6 Seconds
ON	ON	ON	ON	OFF	9 Seconds
ON	ON	ON	OFF	ON	11 Seconds
ON	ON	ON	OFF	OFF	13 Seconds
ON	ON	OFF	ON	ON	16 Seconds
ON	ON	OFF	ON	OFF	18 Seconds
ON	ON	OFF	OFF	ON	20 Seconds
ON	ON	OFF	OFF	OFF	23 Seconds
ON	OFF	ON	ON	ON	25 Seconds
ON	OFF	ON	ON	OFF	27 Seconds
ON	OFF	ON	OFF	ON	30 Seconds
ON	OFF	ON	OFF	OFF	32 Seconds
ON	OFF	OFF	ON	ON	33 Seconds
ON	OFF	OFF	ON	OFF	35 Seconds
ON	OFF	OFF	OFF	ON	38 Seconds
ON	OFF	OFF	OFF	OFF	39 Seconds
OFF	ON	ON	ON	ON	41 Seconds
OFF	ON	ON	ON	OFF	43 Seconds
OFF	ON	ON	OFF	ON	46 Seconds
OFF	ON	ON	OFF	OFF	47 Seconds
OFF	ON	OFF	ON	ON	48 Seconds
OFF	ON	OFF	ON	OFF	50 Seconds
OFF	ON	OFF	OFF	ON	52 Seconds
OFF	ON	OFF	OFF	OFF	53 Seconds
OFF	OFF	ON	ON	ON	55 Seconds
OFF	OFF	ON	ON	OFF	57 Seconds
OFF	OFF	ON	OFF	ON	58 Seconds
OFF	OFF	ON	OFF	OFF	60 Seconds
OFF	OFF	OFF	ON	ON	61 Seconds
OFF	OFF	OFF	ON	OFF	62 Seconds
OFF	OFF	OFF	OFF	ON	64 Seconds
OFF	OFF	OFF	OFF	OFF	65 Seconds

Notes:
1. Switches 6 & 7 on S3 not shown in this table.
2. CT network accuracy is approx. ± 5 percent. Some adjustment may be needed.

Frequency Adjustment (50/60 Hz)

DIP Switch No. 6 on switch block S3 allows the UCM to accept either 50- or 60-hertz supply power, depending on its position See Table 12 below. This DIP switch must be configured to match incoming power.

Table 12 - Settings for DIP Switch 6 On Switch Block S3

Switch Block S3 DIP Switches							Corresponding Frequency
1	2	3	4	5	6	7	
n/a	n/a	n/a	n/a	n/a	ON	n/a	50 Hertz
n/a	n/a	n/a	n/a	n/a	OFF	n/a	60 Hertz

Note: DIP Switch No. 6 should remain in the "Off" position for all domestic chiller applications.

Phase Imbalance and Surge Protection

DIP Switch No. 7 of switch block S3 determines whether or not this motor protection function is operational. Refer to Table 13.

Table 13 - Settings for DIP Switch 7 On Switch Block S3

Switch Block S3 DIP Switches							Motor Protection Function Status
1	2	3	4	5	6	7	
n/a	n/a	n/a	n/a	n/a	n/a	ON	Overriden
n/a	n/a	n/a	n/a	n/a	n/a	OFF	Operational

Note: DIP Switch No. 7 should remain in the "Off" position. However, if job site conditions cause nuisance "trips", this protection may be overridden temporarily until the problem is diagnosed and corrected.

Switch Block S1: Rated-Load-Amps (RLA) Setpoint

The RLA setpoint is factory-set using DIP Switch Nos. 1 through 8 of switch block S1 (Figure 3, page 12), and is based on nameplate RLA, current transformer ratio selection, and other design constants. Since all eight switches on switch block S1 are used, it is not illustrated here. Though the RLA setpoint is both accessible and resettable, field adjustment is discouraged. RLA "trip" point is based on current transformer (CT) selection. Adjustment resolution is 1% of RLA minimum. To determine the appropriate DIP switch setting combination, review the data provided in Tables 14 and 15. Use Steps 1 through 5 that follow — along with Table 14 — to determine the appropriate RLA "factor" for your unit; then locate that "factor" in Table 15 to verify that the factory-set S1 DIP switch arrangement is correct.

1. Check the unit nameplate (or design specifications) to establish the chiller's RLA.

2. Determine the appropriate "meter scale" value from Table 14. To do this, compare the unit RLA with the RLA range values in Table 14; select the appropriate RLA range and read across the table to find the corresponding meter scale value.

3. Use the following equation to determine the "RLA factor":

$$\text{RLA Factor} = \frac{\text{RLA} \times 1.4}{\text{Meter Scale}}$$

4. Use Table 15 to find the S1 DIP switch settings that correspond to the RLA factor determined in Step 3.

Note: Select the RLA factor in Table 15 that is closest to the RLA factor calculated in Step 3.

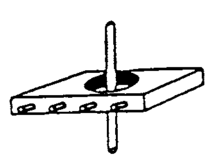
5. Compare the DIP switch settings identified in Table 15 (See "Step 4") with the factory-set S1 DIP switch setting combination.

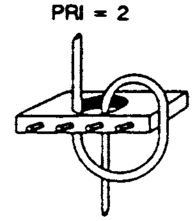
Table 14
Unit RLA Meter Scale Conversion

RLA Range	CT Ratio (1)	Primary Turns (2)	Meter Scale (3)
28.6 to 35.7	150 : 5	3	50
35.8 to 42.8	180 : 5	3	60
42.9 to 53.5	150 : 5	2	75
53.6 to 64.2	180 : 5	2	90
64.3 to 71.4	200 : 5	2	100
71.5 to 89.2	250 : 5	2	125
89.3 to 107.1	150 : 5	1	150
107.2 to 128.5	180 : 5	1	180
128.6 to 142.8	200 : 5	1	200
142.9 to 178.5	250 : 5	1	250
178.6 to 214.2	300 : 5	1	300
214.3 to 250.0	350 : 5	1	350
250.1 to 285.7	400 : 5	1	400
285.8 to 357.1	500 : 5	1	500
357.2 to 428.5	600 : 5	1	600
428.6 to 500.0	700 : 5	1	700
500.1 to 571.4	800 : 5	1	800
571.5 to 714.2	1000 : 5	1	1000
714.3 to 857.1	1200 : 5	1	1200
857.2 to 1071.4	1500 : 5	1	1500
1071.5 to 1285.7	1800 : 5	1	1800
1285.8 to 1500.0	2100 : 5	1	2100
1500.1 to 1785.7	2500 : 5	1	2500

Notes:
1. The CT ratio represents the size of the current transformers used with the specified RLA range.
2. Each "primary turns" (PRI) value indicates the number of time that the main power line passes through its current transformer.

Examples: PRI = 1 PRI = 2





3. If ampmeters are used with the CTs, their full-scale deflection will equal the "meter scale" values in this table.

Note: Meter Scale = CT Ratio (1) / Primary Turns

Table 15
RLA Factors/S1 DIP Switch Settings Conversion

RLA Factor	Switch Block S1 DIP Switches							
	1	2	3	4	5	6	7	8
0.799964	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
0.801220	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON
0.802480	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON
0.803743	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON
0.805011	OFF	OFF	OFF	OFF	OFF	ON	ON	ON
0.805022	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF
0.806294	OFF	OFF	OFF	OFF	ON	OFF	OFF	ON
0.807570	OFF	OFF	OFF	OFF	ON	OFF	ON	ON
0.808850	OFF	OFF	OFF	OFF	ON	ON	OFF	ON
0.810134	OFF	OFF	OFF	OFF	ON	ON	ON	ON
0.810180	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF
0.811468	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON
0.812761	OFF	OFF	OFF	ON	OFF	OFF	ON	ON
0.814058	OFF	OFF	OFF	ON	OFF	ON	OFF	ON
0.815359	OFF	OFF	OFF	ON	OFF	ON	ON	ON
0.815370	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF
0.816676	OFF	OFF	OFF	ON	ON	OFF	OFF	ON
0.817985	OFF	OFF	OFF	ON	ON	OFF	ON	ON
0.819299	OFF	OFF	OFF	ON	ON	ON	OFF	ON
0.820220	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF
0.820617	OFF	OFF	OFF	ON	ON	ON	ON	ON
0.821541	OFF	OFF	ON	OFF	OFF	OFF	OFF	ON
0.822867	OFF	OFF	ON	OFF	OFF	OFF	ON	ON
0.824197	OFF	OFF	ON	OFF	OFF	ON	OFF	ON
0.825531	OFF	OFF	ON	OFF	OFF	ON	ON	ON
0.825543	OFF	OFF	ON	OFF	ON	OFF	OFF	OFF
0.826881	OFF	OFF	ON	OFF	ON	OFF	OFF	ON
0.828224	OFF	OFF	ON	OFF	ON	OFF	ON	ON
0.829572	OFF	OFF	ON	OFF	ON	ON	OFF	ON
0.830924	OFF	OFF	ON	OFF	ON	ON	ON	ON
0.830972	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF
0.833228	OFF	OFF	ON	ON	OFF	OFF	OFF	ON
0.833689	OFF	OFF	ON	ON	OFF	OFF	ON	ON
0.835055	OFF	OFF	ON	ON	OFF	ON	OFF	ON
0.836425	OFF	OFF	ON	ON	OFF	ON	ON	ON
0.836437	OFF	OFF	ON	ON	ON	OFF	OFF	OFF
0.837812	OFF	OFF	ON	ON	ON	OFF	OFF	ON
0.839192	OFF	OFF	ON	ON	ON	OFF	ON	ON
0.840576	OFF	OFF	ON	ON	ON	ON	OFF	ON
0.841964	OFF	OFF	ON	ON	ON	ON	ON	ON

RLA Factor	Switch Block S1 DIP Switches							
	1	2	3	4	5	6	7	8
0.842654	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF
0.844050	OFF	ON	OFF	OFF	OFF	OFF	OFF	ON
0.845450	OFF	ON	OFF	OFF	OFF	OFF	ON	ON
0.846855	OFF	ON	OFF	OFF	OFF	ON	OFF	ON
0.848265	OFF	ON	OFF	OFF	OFF	ON	ON	ON
0.848278	OFF	ON	OFF	OFF	ON	OFF	OFF	OFF
0.849692	OFF	ON	OFF	OFF	ON	OFF	OFF	ON
0.851112	OFF	ON	OFF	OFF	ON	OFF	ON	ON
0.852536	OFF	ON	OFF	OFF	ON	ON	OFF	ON
0.853965	OFF	ON	OFF	OFF	ON	ON	ON	ON
0.854016	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF
0.855450	OFF	ON	OFF	ON	OFF	OFF	OFF	ON
0.856889	OFF	ON	OFF	ON	OFF	OFF	ON	ON
0.858333	OFF	ON	OFF	ON	OFF	ON	OFF	ON
0.859782	OFF	ON	OFF	ON	OFF	ON	ON	ON
0.859794	OFF	ON	OFF	ON	ON	OFF	OFF	OFF
0.861248	OFF	ON	OFF	ON	ON	OFF	OFF	ON
0.862707	OFF	ON	OFF	ON	ON	OFF	ON	ON
0.864171	OFF	ON	OFF	ON	ON	ON	OFF	ON
0.865198	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF
0.865640	OFF	ON	OFF	ON	ON	ON	ON	ON
0.866670	OFF	ON	ON	OFF	OFF	OFF	OFF	ON
0.868148	OFF	ON	ON	OFF	OFF	OFF	ON	ON
0.869631	OFF	ON	ON	OFF	OFF	ON	OFF	ON
0.871119	OFF	ON	ON	OFF	OFF	ON	ON	ON
0.871132	OFF	ON	ON	OFF	ON	OFF	OFF	OFF
0.872625	OFF	ON	ON	OFF	ON	OFF	OFF	ON
0.874123	OFF	ON	ON	OFF	ON	OFF	ON	ON
0.875627	OFF	ON	ON	OFF	ON	ON	OFF	ON
0.877136	OFF	ON	ON	OFF	ON	ON	ON	ON
0.877189	OFF	ON	ON	ON	OFF	OFF	OFF	OFF
0.878704	OFF	ON	ON	ON	OFF	OFF	OFF	ON
0.880223	OFF	ON	ON	ON	OFF	OFF	ON	ON
0.881748	OFF	ON	ON	ON	OFF	ON	OFF	ON
0.883278	OFF	ON	ON	ON	OFF	ON	ON	ON
0.883292	OFF	ON	ON	ON	ON	OFF	OFF	OFF
0.884828	OFF	ON	ON	ON	ON	OFF	OFF	ON
0.886369	OFF	ON	ON	ON	ON	OFF	ON	ON
0.887916	OFF	ON	ON	ON	ON	ON	OFF	ON
0.889468	OFF	ON	ON	ON	ON	ON	ON	ON

Table 15 (Cont'd.)
RLA Factors/S1 DIP Switch Settings
Conversion

RLA Factor	Switch Block S1 DIP Switches								RLA Factor	Switch Block S1 DIP Switches							
	1	2	3	4	5	6	7	8		1	2	3	4	5	6	7	8
0.890515	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	0.943922	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
0.892076	ON	OFF	OFF	OFF	OFF	OFF	OFF	ON	0.945680	ON	ON	OFF	OFF	OFF	OFF	OFF	ON
0.893643	ON	OFF	OFF	OFF	OFF	OFF	ON	ON	0.947444	ON	ON	OFF	OFF	OFF	OFF	ON	ON
0.895216	ON	OFF	OFF	OFF	OFF	ON	OFF	ON	0.949214	ON	ON	OFF	OFF	OFF	ON	OFF	ON
0.896794	ON	OFF	OFF	OFF	OFF	ON	ON	ON	0.950992	ON	ON	OFF	OFF	OFF	ON	ON	ON
0.896808	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF	0.951008	ON	ON	OFF	OFF	ON	OFF	OFF	OFF
0.898392	ON	OFF	OFF	OFF	ON	OFF	OFF	ON	0.952792	ON	ON	OFF	OFF	ON	OFF	OFF	ON
0.899981	ON	OFF	OFF	OFF	ON	OFF	ON	ON	0.954583	ON	ON	OFF	OFF	ON	OFF	ON	ON
0.901577	ON	OFF	OFF	OFF	ON	ON	OFF	ON	0.956381	ON	ON	OFF	OFF	ON	ON	OFF	ON
0.903178	ON	OFF	OFF	OFF	ON	ON	ON	ON	0.958185	ON	ON	OFF	OFF	ON	ON	ON	ON
0.903234	ON	OFF	OFF	ON	OFF	OFF	OFF	OFF	0.958249	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
0.904841	ON	OFF	OFF	ON	OFF	OFF	OFF	ON	0.960061	ON	ON	OFF	OFF	OFF	OFF	OFF	ON
0.906454	ON	OFF	OFF	ON	OFF	OFF	ON	ON	0.961880	ON	ON	OFF	ON	OFF	OFF	ON	ON
0.908073	ON	OFF	OFF	ON	OFF	ON	OFF	ON	0.963706	ON	ON	OFF	ON	OFF	ON	OFF	ON
0.909697	ON	OFF	OFF	ON	OFF	ON	ON	ON	0.965539	ON	ON	OFF	ON	OFF	ON	ON	ON
0.909712	ON	OFF	OFF	ON	ON	OFF	OFF	OFF	0.965555	ON	ON	OFF	ON	ON	OFF	OFF	OFF
0.911342	ON	OFF	OFF	ON	ON	OFF	OFF	ON	0.967395	ON	ON	OFF	ON	ON	OFF	OFF	ON
0.912979	ON	OFF	OFF	ON	ON	OFF	ON	ON	0.969242	ON	ON	OFF	ON	ON	OFF	ON	ON
0.914621	ON	OFF	OFF	ON	ON	ON	OFF	ON	0.971097	ON	ON	OFF	ON	ON	ON	OFF	ON
0.916270	ON	OFF	OFF	ON	ON	ON	ON	ON	0.972958	ON	ON	OFF	ON	ON	ON	ON	ON
0.915773	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	0.972397	ON	ON	ON	OFF	OFF	OFF	OFF	OFF
0.917426	ON	OFF	ON	OFF	OFF	OFF	OFF	ON	0.974264	ON	ON	ON	OFF	OFF	OFF	OFF	ON
0.919084	ON	OFF	ON	OFF	OFF	OFF	ON	ON	0.976138	ON	ON	ON	OFF	OFF	OFF	ON	ON
0.920749	ON	OFF	ON	OFF	OFF	ON	OFF	ON	0.978019	ON	ON	ON	OFF	OFF	ON	OFF	ON
0.922420	ON	OFF	ON	OFF	OFF	ON	ON	ON	0.979907	ON	ON	ON	OFF	OFF	ON	ON	ON
0.922435	ON	OFF	ON	OFF	ON	OFF	OFF	OFF	0.979924	ON	ON	ON	OFF	ON	OFF	OFF	OFF
0.924112	ON	OFF	ON	OFF	ON	OFF	OFF	ON	0.981820	ON	ON	ON	OFF	ON	OFF	OFF	ON
0.925795	ON	OFF	ON	OFF	ON	OFF	ON	ON	0.983723	ON	ON	ON	OFF	ON	OFF	ON	ON
0.927485	ON	OFF	ON	OFF	ON	ON	ON	OFF	0.985634	ON	ON	ON	OFF	ON	ON	OFF	ON
0.929180	ON	OFF	ON	OFF	ON	ON	ON	ON	0.987553	ON	ON	ON	OFF	ON	ON	ON	ON
0.929241	ON	OFF	ON	ON	OFF	OFF	OFF	OFF	0.987621	ON	ON	ON	ON	OFF	OFF	OFF	OFF
0.930943	ON	OFF	ON	ON	OFF	OFF	OFF	ON	0.989547	ON	ON	ON	ON	OFF	OFF	OFF	ON
0.932652	ON	OFF	ON	ON	OFF	OFF	ON	ON	0.991481	ON	ON	ON	ON	OFF	OFF	ON	ON
0.934367	ON	OFF	ON	ON	OFF	ON	OFF	ON	0.993423	ON	ON	ON	ON	OFF	ON	OFF	ON
0.936088	ON	OFF	ON	ON	OFF	ON	ON	ON	0.995372	ON	ON	ON	ON	OFF	ON	ON	ON
0.936103	ON	OFF	ON	ON	ON	OFF	OFF	OFF	0.995389	ON	ON	ON	ON	ON	OFF	OFF	OFF
0.937831	ON	OFF	ON	ON	ON	OFF	OFF	ON	0.997347	ON	ON	ON	ON	ON	OFF	OFF	ON
0.939566	ON	OFF	ON	ON	ON	OFF	ON	ON	0.999312	ON	ON	ON	ON	ON	OFF	ON	ON
0.941307	ON	OFF	ON	ON	ON	ON	OFF	ON	1.001284	ON	ON	ON	ON	ON	ON	OFF	ON
0.943054	ON	OFF	ON	ON	ON	ON	ON	ON	1.003265	ON	ON	ON	ON	ON	ON	ON	ON

Micro Module (1U3) Input Connections (and Terminal Designations)

All electrical connections made at micro module 1U3 are low voltage (i.e., 30 volts AC or less); never connect wires carrying more than 30 volts to terminal strips 1TB6, 1TB3 or 1TB4. Further, never route wiring carrying voltages exceeding 30 volts through the upper half of the unit control panel!

Caution: Connecting any device or wiring that carries more than 30 volts to 1TB6, 1TB3 or 1TB4 will destroy micro module 1U3.

Terminal strip connections for the micro module are illustrated in Figures 6 and 7 and described in the following paragraphs. Terminal strip 1TB3, -4, and, -6 locations are shown in these figures also.

Terminal Strip 1TB6

Bidirectional Communications Link (1TB6-1, -2)

This connection port is provided for a twisted-pair communications link; this link may be with another machine, or with a higher level control panel (e.g., an SCP699 system control panel).

Note: There are no polarity requirements when connecting communication wires.

Terminal Strip 1TB3

Note: See the individual sensor checkout procedures in "Troubleshooting With Diagnostics" for a breakdown of temperature and pressure input accuracies; only "displayed" accuracies are indicated below.

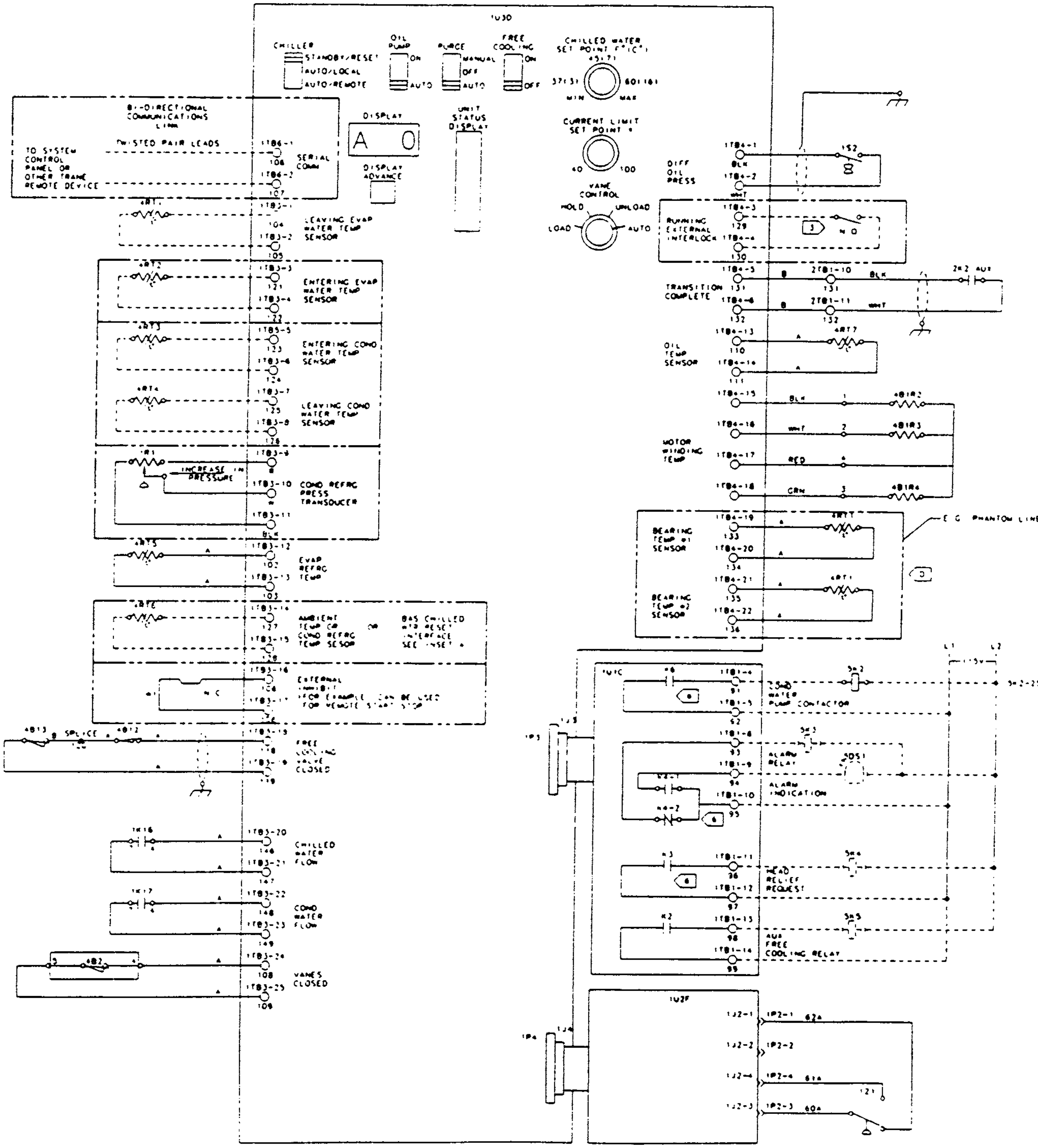
Leaving Evaporator Water Temperature Sensor (1TB3-1, -2)

Standard thermistor 4RT1, which monitors the temperature of the chilled water leaving the unit, is connected to these terminals.
Sensor and input specifications are as follows:

[ ] Operating Range:
  15 F to 90 F.
[ ] Displayed Accuracy:
  ± 1.5 F from 20 F thru 70 F;
  ± 2.5 F from 70 F thru 90 F; and,
  ± 2.5 F from 15 F thru 20 F.
[ ] Indication:
  At front panel display (i.e., Item "F" of operator's menu).
[ ] Shorted:
  No diagnostic; display reads "—".
[ ] Open:
  Diagnostic: **b Ab**.
[ ] Leaving Water Temperature Low Limit:
  35.3 F for standard-range units only.

Figure 6
Micro Module 1U3 Input Connections

This drawing is typical of:
CVHE units = Design Sequence "1C" and later;
CVHB units = Design Sequence "1D" and later;
CVHF units = All units with UCP695.



WARNING! Disconnect electrical power supply to prevent injury or death due to electrical shock.

Notes:

1. Terminals 1TB3-16, -17 must be jumpered if external interlock is not used.
2. 1TB3, 1TB4 and 1TB6 are located below the micro module faceplate (Figure 2, page 12).
3. Solid lines indicate Trane wiring: dashed lines (- - - -) represent field wiring; and , phantom lines(— - - —) enclose optional features.

Drg. X39470576D

Note: The UCP's "differential-to-stop" criteria are typically used to cycle off the chiller--not this "low limit" function! Notice, too, that the "Cooling Required" status indicator light goes out when a "low limit" occurs; no diagnostic is generated.

Entering Evaporator Water Temperature Sensor (1TB3-3, -4)

The optional thermistor (4RT2) connected to these terminals monitors the temperature of the chilled water entering the unit.
Sensor and input specifications are as follows:

[ ] Operating Range:
15 F to 90 F

[ ] Displayed Accuracy:
± 1.5 F from 20 F to 70 F;
± 2.5 F from 70 F to 90 F; and,
± 2.5 F from 15 F to 20 F.

[ ] Indication:
At front panel display (i.e., Item "E" of operator's menu).

[ ] Shorted:
No diagnostic; display reads "—".

[ ] Open:
No diagnostic; display reads "—".

Spare Temperature Sensors (1TB3-5, -6; 1TB3-7, -8)

Thermistors (i.e., 4RT3 and 4RT4) connected to terminals 5 through 8 on 1TB3 are optional. These "spare temperature" inputs are expected to be used for monitoring entering (1TB3-5, 1TB3-6) and leaving (1TB3-7, 1TB3-8) condenser water temperatures. Actual sensor temperatures can then be viewed on the UCP display (i.e., menu item "H" for entering condenser water, and "J" for leaving condenser water).
Sensor and input specifications follow:

[ ] Operating Range:
30 F to 140 F

[ ] Displayed Accuracy:
± 1.8 F from 60 F to 110 F;
± 2.5 F from 30 F to 60 F; and,
± 2.5 F from 110 F to 140 F.

[ ] Indication:
At front panel display (i.e., Items "H" and "J" of operator's menu).

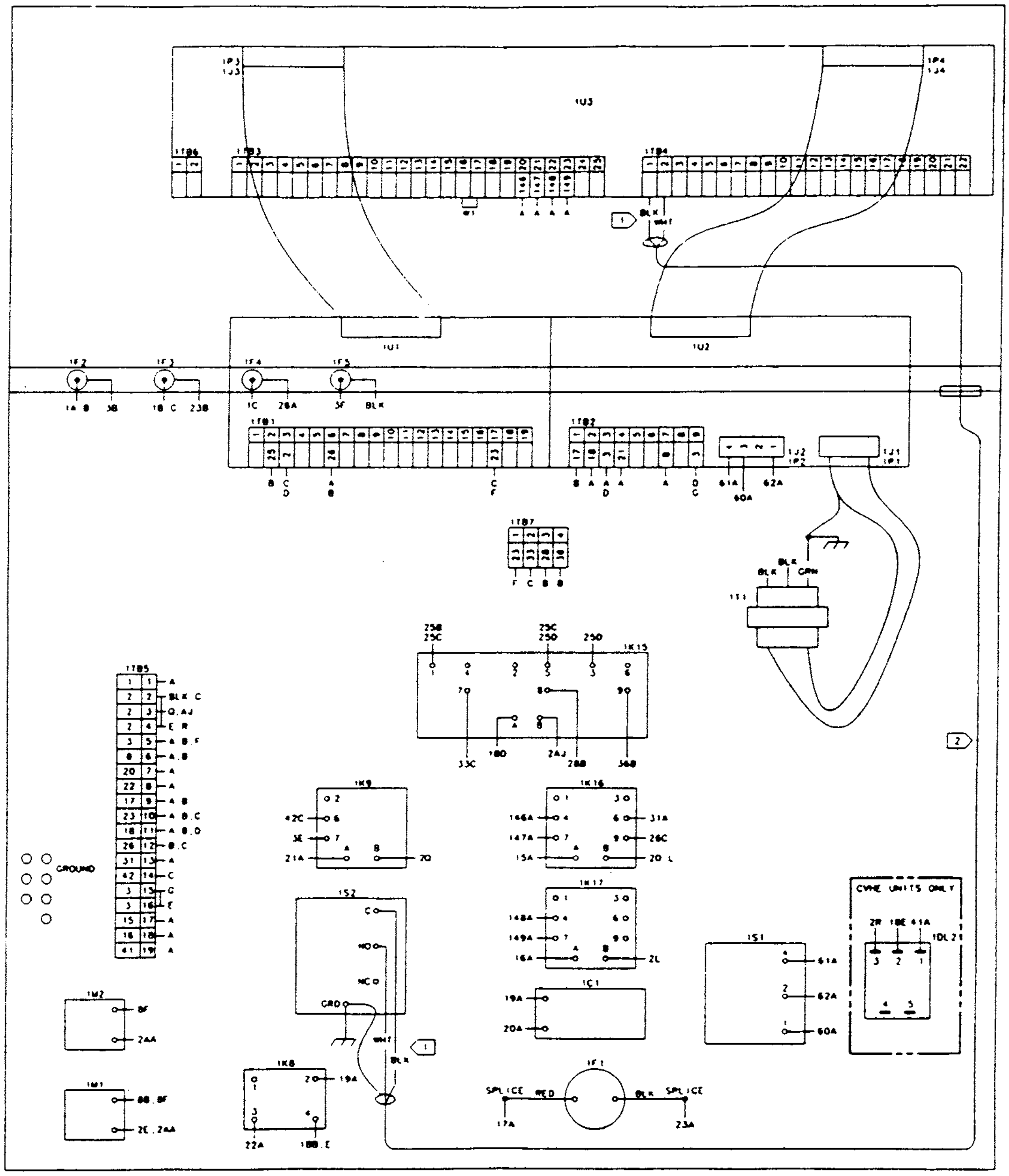
[ ] Shorted:
No diagnostic; display reads "—".

[ ] Open:
No diagnostic; display reads "—".

Condenser Refrigerant Pressure Transducer (1TB3-9, -10, -11)

This optional pressure transducer (1R1) is mounted inside the unit control panel (Figure 7), and is "T'd" into the condenser gauge line. Transducer output is of the 3-wire, variable resistance type. To assure proper operation, these 3 wires must be connected to terminals 9, 10 and 11 of 1TB3 in the order illustrated in Figure 6.
Pressure transducer and input specifications follow:

Figure 7
Typical UCP695 Panel Components (See 'Notes')



Notes:
1. Hot gas bypass unit shown.
2. This drawing typical of: CVHE - design sequence "1C" and later; CVHB - design sequence "1D" and later; CVHF - all designs w/UCP695. Refer to appropriate wiring manual for earlier designs.

LEGEND		
1C1 = Oil Pump Capacitor	1K17 = Condenser Water Pump Relay	1TB4 = Terminal Blk - Micro-Module Input
1DL2 = Vent Line Interval Timer	1M1 = Hourmeter	1TB5 = Terminal Block - Control Panel
1F1 = Oil Pump Fuse	1M2 = Start Counter (Meter)	1TB6 = Terminal Blk - Micro-Module Input
1F2-5 = Branch Circuit Fuses	1S1 = Condenser High Pressure Switch	1TB7 = Terminal Block - Hot Gas Bypass
1J1-4/1P1-4 = Post Header Power Supply	1S2 = Oil Pressure Switch	1U1 = Relay Output Module
1K8 = Oil Pump Start Relay	1T1 = Power Supply Transformer	1U2 = Power Supply Output Module
1K9 = Oil Tank Heater Relay	1TB1 = Terminal Block - Relay Output	1U3 = Micro Module
1K15 = Hot Gas Bypass Relay	1TB2 = Terminal Block - Power Supply	
1K16 = Chilled Water Pump Relay	1TB3 = Terminal Blk - Micro-Module Input	

[ ] Operating Range:
0 psig to 25 psig; see sensor checkout in "Troubleshooting With Diagnostics" for accuracies.
[ ] Indication:
None.
[ ] Shorted (1TB3-10 to -11):
Diagnostic **b AC**.
[ ] Open:
No diagnostic.

Evaporator Refrigerant Temperature Sensor (1TB3-12, -13)

This standard thermistor (4RT5) monitors evaporator refrigerant temperature. Following are sensor and input specifications:

[ ] Operating Range:
- 5 F to 150 F
[ ] Displayed Accuracy:
± 1.0 F at 29.0 F;
± 1.5 F at 30.0 F;
± 2.5 F from 0 F thru 28 F;
± 2.5 F from 31 F thru 34 F;
± 5.5 F from -5 F thru -1 F; and,
± 5.5 F from 35 F thru 40 F

As indicated by Table 1, page 8, the UCP displays evaporator refrigerant temperatures ranging from -4 F thru 42 F. See sensor checkout in "Troubleshooting With Diagnostics" for accuracies outside the display range.

[ ] Indication:
At front panel display (i.e., Item "__" of serviceman's menu).
[ ] Shorted:
Diagnostic **b Ad**; must not trip < 150 F.
[ ] Open:
Diagnostic **b Ad**; must not trip > -5 F.

Condenser Refrigerant Temperature Sensor; Ambient Temperature Sensor; Generic BAS Analog Input (1TB3-14, -15)

These three options are mutually exclusive of each other; that is, only one of these options can be functional at any given time. Actual sensor temperatures can be viewed on the UCP display as operator's menu item **"L"** on these units:

— CHVE Units = Design Sequence "1C" and later;
— CVHB Units = Design Sequence "1D" and later;
— CVHF Units = All units w/UCP695.

This display item is not available on earlier-design units.

CONDENSER REFRIGERANT TEMPERATURE SENSOR. This optional, field-installed thermistor (4RT6) must be used if the chiller is controlled by an SCP699 that is utilizing the SCP's "condenser limit" option. If this is done, these terminals cannot be used for an ambient sensor input or for a Generic BAS input. Refer to the SCP installation and operation literature.

AMBIENT TEMPERATURE SENSOR. This optional, field-installed thermistor (4RT6) is used with the optional, ambient-based, chilled water reset function.

GENERIC BAS ANALOG INPUT. This optional, interface device, designated the 1U4, is used to perform chilled water reset at the chiller level, based on a 0-10 VDC (or 4-20 mA) control signal issued by a generic BAS. This signal is translated into an "ambient temperature" input that the UCP uses to calculate a new chilled water setpoint. Sensor and input specifications follow:

[ ] Operating Range:
-40 F to 150 F; see sensor checkout in "Troubleshooting With Diagnostics" for accuracies.

[ ] Indication:
None

[ ] Shorted:
Diagnostic **b AE**; must not trip < 150 F.

[ ] Open:
No diagnostic.

External Interlock; External Inhibit (Remote On/Off Control) (1TB3-16, -17)

The external interlock input feature was provided on these units:

— CVHE Units = Design Sequence "1B" and earlier only, and;
— CVHB Units = Design Sequence "1C" and earlier only.

On later design units, the function of these terminals was changed to "External Inhibit". The external inhibit feature is provided on these chillers:

— CVHE Units = Design Sequence "1C" and later;
— CVHB Units = Design Sequence "1D" and later;
— CVHF Units = All units w/UCP695.

EXTERNAL INTERLOCK. Terminals 16 and 17 of 1TB3 accept a 2-position switch input used to indicate a system fault detected by a customer-supplied remote device . As long as the switch is closed (i.e., "shorted"), unit operation continues normally. However, if the micro module detects that this switch is open, it shuts down unit operation on latching diagnostic **b Fd**.

EXTERNAL INHIBIT. Terminals 16 and 17 of 1TB3 accept a 2-position switch input used to provide a chiller On/Off function from a customer-supplied remote controller and will allow an automatic chiller restart from the same controller. As long as these contacts remain closed, the chiller will run normally. If the contacts open, however, the chiller will go through its' shutdown cycle and remain off until the contacts reopen. When the chiller has shutdown on input at these terminals, the UCP will display operating code **A 100**, indicating that the external inhibit function is energized.

Note: Refer to Figure 7; notice that the unit ships from the factory with a jumper installed between the external interlock/external inhibit terminals. The unit will not operate unless Terminals 1TB3-16 and 1TB3-17 are shorted.. External interlock/external inhibit input specifications follow:

[ ] Circuit is monitored by a 12 VDC, 45 mA current.

[ ] Customer-supplied devices connected to these terminals must be compatible with current described above; gold-plated contacts are recommended to avoid oxidation resistance.

Note: Use an isolation relay to limit electrical noise interference, and to reduce the possibility of feeding voltage into micro module 1U3.

Free Cooling Valve Proof-of-Closure (1TB3-18, -19)

These terminals--used only on units equipped with the free cooling option--monitor the end switches on the free cooling valves to provide proof of valve closure. When this input is shorted, the free cooling valves are closed. If one or both of the free cooling valves are partially or fully open when the chiller is starting or running in the powered cooling mode, 1U3 responds to this open input by initiating latching diagnostic **b F9** to shut down unit operation. Specifications for the "free cooling valve closed" input are as follows:

[ ] The interlock circuit is monitored by a 12 VDC, 45 mA current.

Proof of Chilled Water Flow (1TB3-20, -21)

These terminals monitor the status of the chilled water pump relay (1K16) contacts.

If the contacts of 1K16 are closed (i.e., terminals 1TB3-20 and -21 are shorted), proof of closure is signalled by the illumination of the "chilled water flow" status indicator light. (These contacts must only close when there is actually chilled water flow--i.e., both chilled water flow switch 5S2 and auxiliary chilled water pump contactor 5K1 are closed.)

If 1K16's contacts are open, the input at terminals 1TB3-20 and -21 should also be open and the "chilled water flow" status indicator light off. Nonlatching diagnostic **b Ed** is generated if the chiller switch is set at one of the "Auto" positions and a start-up is attempted at this time. (The UCM will not generate a **b Ed** diagnostic if the chiller switch is set at STANDBY/RESET.)

Note: 1K16's contacts must open whenever the chilled water flow rate is either below the minimum acceptable level, or nonexistent (i.e., 5S2 or 5K1 are open).

Remember that the customer-supplied flow/pressure switch and pump interlock circuit must be connected to terminals 1TB5-14 and 1TB5-16 in the high-voltage section of the unit control panel; this circuit powers chilled water pump relay 1K16.

Caution: Do not connect the 120V flow switch interlock circuit to terminals 1TB3-20 and -21, or micro module 1U3 will be damaged.

Proof of Condenser Water Flow (1TB3-22, -23)

These terminals monitor the status of the condenser water pump relay (1K17) contacts.

If the contacts of 1K17 are closed (i.e., input terminals 1TB3-22 and -23 are shorted), proof of closure is signalled by advancement from operating code **A 71** (i.e., "establish condenser water flow") to **A 72** (i.e., "start").

Note: 1K17's contacts must only close when there is actually condenser water flow (i.e., proven by closure of both condenser water flow switch 5S3 and auxiliary condenser water pump contactor 5K2).

If 1K17's contacts are open, the input at terminals 1TB3-22 and -23 should also be open. In the event that condenser water flow is lost during chiller operation, the unit is shut down on nonlatching diagnostic **b F7** and a restart is attempted. Latching diagnostic **b dC** is generated if condenser water flow is not established within 3 minutes of initiation of operating mode **A 71**.

Note: 1K17's contacts must open whenever condenser water flow is either below the minimum acceptable rate, or nonexistent (i.e., both 5S3 and 5K2 are open).

Remember that the customer-supplied flow/pressure switch and pump interlock circuit must be connected to terminals 1TB5-15 and 1TB5-17 in the high-voltage section of the unit control panel; this circuit powers condenser water pump relay 1K17.

Caution: Do not connect the 120V flow switch interlock circuit to terminals 1TB3-22 and -23, or micro module 1U3 will be damaged beyond repair.

Proof of Inlet Vane Closure (1TB3-24, -25)

These terminals monitor the status of the "vanes closed" end switch on vane actuator motor 4B2. When the input at these terminals is shorted, the inlet vanes are fully closed; an open input indicates that the inlet vanes are either partially or fully open.

Micro module 1U3 checks the status of the inlet vanes during operating mode **A 71** (i.e., "establish condenser water flow"), and issues a "close" signal if they are open. Latching diagnostic **b FA** occurs if the vanes fail to close within 3 minutes.

Terminal Strip 1TB4

Differential Oil Pressure Switch 1S2 (1TB4-1, -2)

This terminal input (Figure 7, pg. 34) allows the micro module to monitor the status of the differential oil pressure switch (1S2) contacts. A shorted input at these terminals indicates that there is sufficient oil pressure available and 1S2's contacts are closed. If oil pressure is too low and 1S2's contacts are open, and the micro module detects an open input; chiller operation is shut down on latching diagnostic **b F2.**

Following is the specification for the differential oil pressure switch input to micro module 1U3:

[ ] The differential oil pressure switch circuit is monitored by a 12 VDC, 45 mA current.

Running External Interlock (1TB4-3, -4)

Terminals 3 and 4 of 1TB4 accept a switch input that indicates a system fault (i.e., detected by a customer-supplied remote device) requiring a unit shutdown. This function is only active when the unit is running and transition is complete.

Notice that as long as the micro finds an open input at Terminals 3 and 4, no fault is detected. If the input is shorted, however, a fault requiring unit shutdown occurred, and micro module 1U3 responds by initiating latching diagnostic condition **b F1**.

Specifications for the running external interlock input are as follows:

[ ] This fault circuit is monitored by a 12 VDC, 45 mA current.

[ ] Customer-supplied devices connected to these terminals must be compatible with the current described above; gold-plated contacts are recommended to avoid oxidation resistance.

Notes:
1. Use an isolation relay to limit noise interference, and to reduce the possibility of feeding voltage into micro module 1U3.
2. If the unit has hot gas bypass, discharge temperature switch 4S5 is connected to terminals 1TB4-3 and -4; this switch closes--yielding a "shorted" input-- if the discharge temperature exceeds 210 F.

"Transition Complete" Contacts (1TB4-5, -6)

This terminal input allows the micro module to monitor the main run starter contactor (2K2) to determine whether transition has occurred. A shorted input indicates that transition is complete, while an open input "tells" the micro that transition has not occurred.

Note: The shielded wire must be taped off at the 2K2 contacts and grounded to a ground lug provided in the starter panel (i.e., at the 2TB1 terminal strip end of these leads). These leads are not shielded between the starter panel and unit control panel.

Following is the specification for the "transition complete" input to micro module 1U3:

[ ] The "transition complete" circuit is monitored by a 12 VDC, 45 mA current.

3-Phase Current-Sensing Input (1TB4-7 thru -12)

These 6 terminals accept 3 AC signal inputs that are proportional to the compressor motor's AC current draw. Line current is stepped down by 2 sets of current transformers. Each set of current transformers contains 3 transformers; the first steps the line current down to a 0-5 amp signal, and the second further steps down the 0-5 amp signal to a milliamp (mA) signal.

Caution: Do not connect the 0-5 amp output signal of the primary transformer directly to micro module 1U3, or destruction of the module will result.

Following are specifications for the 3-phase current-sensing input:

[ ] Overall Accuracy:
15 to 140 ± 5% RLA
[ ] Open:
Diagnostic **b D9** (e.e., extended power loss),
Diagnostic **b E2** (i.e., momentary power loss), diagnostic **b E4** (i.e., phase loss), or diagnostic **b E5** (i.e., phase reversal).

Connections at terminals 7 through 12 are as follows:

[ ] Terminals 1TB4- 7 and - 8 are connected to secondary transformer 2T7 on L3.
[ ] Terminals 1TB4- 9 and -10 are connected to secondary transformer 2T6 on L2.
[ ] Terminals 1TB4-11 and -12 are connected to secondary transformer 2T5 on L1.

Note: It is essential that the correct polarity is maintained in all current transformer connections. Consult the appropriate starter wiring diagram to confirm that proper connection polarity is established.

Oil Temperature Sensor (1TB4-13, -14)

The temperature sensor that monitors oil sump temperature (i.e., thermistor 4RT7) is connected to these terminals.

Note: Remember that the oil temperature setting is not adjustable.

Specifications for the oil temperature sensor input are as follows:

[ ] Operating Range:
32 F to 180 F
[ ] Shorted:
Diagnostic **b A9**; must not trip < 180 F.

[ ] Open:
Diagnostic **b A9**; must not trip > 32 F.

[ ] Oil Heater Control:
140 F = "enable" point.
145 F = "off" point.
[ ] High Temperature Run Inhibit "Off" Point:
180 F; results in a latching diagnostic of **b F4**.

Motor Winding Temperature Sensors (1TB4-15 thru -18)

The leads of the 3 temperature sensors (4B1R2, 4B1R3, 4B1R4) imbedded in the compressor motor windings are connected to these input terminals. Check the unit wiring diagram to properly identify individual sensor wires.

Note: Notice that the "common" leg of each sensor is connected to Terminal 1TB4-17.
Specifications for the motor winding temperature sensor inputs are as follows:

[ ] Operating Range:
50 F to 310 F
[ ] Open:
Diagnostic **b A4**, **b A7** or **b A8**, as applicable.
[ ] Shorted:
No diagnostic.
[ ] Run Inhibit:
265 ± 15 F (i.e., UCP tolerance only); diagnostic **b E7**.
[ ] 15-Minute Start Delay:
> 165 ± 15 F (i.e., UCP tolerance only); operating code **A 70**.

Bearing Temperature Sensors (1TB4-19 thru -22)

The optional pair of sensors that monitor the temperature of the oil leaving the compressor motor bearings are connected to these terminals as described below:

a. Inboard sensor 4RT8 (i.e., sensor # 1) is connected to terminals 1TB4-19 and -20; and,
b. Outboard sensor 4RT9 (i.e., sensor # 2) is connected to terminals 1TB4-21 and -22.
Sensor and input specifications are as follows:

[ ] Range:
100 F to 180 F
[ ] Accuracy:
See sensor checkout in "Troubleshooting With Diagnostics" for MCSP temperature accuracies. ("MCSP" is the "motor/compressor start and protection" portion of micro module 1U3.)
[ ] Shorted:
Diagnostic **b AF** (4RT8) or **b b0** (4RT9); must not trip < 180 F.
[ ] Open:
No diagnostic.
[ ] Run Inhibit:
180 F; diagnostic **b EA** (4RT8) or **b Eb** (4RT9).

Tables 16 and 17 that follow, provide outpout voltage readings and contact status conditions for ribbon connectors 1P3 and 1P4 from the power supply output module (1U2) and relay output module 1U1.

Table 16
Ribbon Connector 1P4 Voltages (1) for Power Supply/Output Module 1U2

1P4 Terminal	VDC Signal		Description of Status	1U2 Output Terminals
	Min.	Max.		
1 1	0.0 0.85	0.1 1.6	Transition Off Transition On	5 and 6 Open 5 and 6 Closed
2 2	0.0 0.85	0.1 1.6	Oil Heater Off Oil Heater On	3 and 4 Open 3 and 4 Closed
3 3	0.0 0.85	0.1 1.6	Start Off Start On	7 and 8 Open 7 and 8 Closed
4 4	0.0 0.85	0.1 1.6	Oil Pump Off Oil Pump On	1 and 2 Open 1 and 2 Closed
5 6 7 8	0.85 0.0 0.0 1.0	1.6 0.7 0.1 1.8	Overload On HPC Closed (Normal Pressure) Stop Relay Off Reset Relay On	8 and 9 Closed
5 6 7 8	0.0 0.0 0.0 1.0	0.1 0.7 0.1 1.8	Overload Off HPC Open (High Pressure) Stop Relay Off Reset Relay On	8 and 9 Open
5 6 7 8	0.85 6.0 0.0 1.0	1.6 22.5 0.1 1.8	Overload On HPHC Open (High Pressure) Stop Relay Off Reset Relay On	8 and 9 Open
5 6 7 8	0.85 0.0 0.85 1.0	1.6 0.7 1.6 1.8	Overload On HPC Closed (Normal Pressure) Stop Relay On Reset Relay On	8 and 9 Open
5 6 7 8	0.85 0.0 0.0 0.0	1.6 0.7 0.1 0.1	Overload On HPC Closed (Normal Pressure) Stop Relay Off Reset Relay Off	8 and 9 Open
9	-----	-----	Keying Plug	--------------
10 10 (1) 11	-23.0 3.3 (1) Reference for 1P4-10	-11.9 4.1 (1) 	Filament Voltage Filament Voltage --------------------	-------------- -------------- --------------
12	-28	-18.9	-23 Volt Supply	--------------
13 14 15 16	13.7 ----- ----- 6.9	22.5 ----- ----- 16.8	+ 12 Volt Supply Common (+ 12 VDC), (Note 3) Not Used + 12V Unfiltered	-------------- -------------- -------------- --------------
17 18 19	----- 8.5 -13.0	----- 13.0 -8.5	Common (+ 8 VDC) + 8 Volt Supply -8 Volt Supply	-------------- -------------- --------------
20 21	5.34 -----	5.66 ----	+ 5 Volt Supply Common (+ 5 VDC)	-------------- --------------

Notes:
1. Voltage signal(s) in VAC with respect to Terminal 1P4-11 unless otherwise indicated.
2. Voltage values in this table apply only when ribbon connector 1P4 is connected to 1J4 of micro module 1U3.

Table 17
Ribbon Connector 1P3 Voltages (1) for Relay Output Module 1U1

1P3 Terminal	VDC Signal		Description of Status	1U2 Output Terminals
	Min.	Max.		
1 1	0.0 5.1	0.06 5.6	"Close Vanes" Off "Close Vanes" On	2 and 3 Open 2 and 3 Closed (2)
2 2	0.0 5.1	0.06 5.6	"Open Vanes" Off "Open Vanes" On	1 and 3 Open 1 and 3 Closed
3 3	0.0 0.85	0.1 1.6	Condenser Water Pump Off Condenser Water Pump On	4 and 5 Open 4 and 5 Closed
4 4	0.0 0.85	0.1 1.6	Purge Off Purge On	6 and 7 Open 6 and 7 Closed
5	-----	-----	Keying Plug	---------------
6	0.0	0.1	Alarm Off	8 and 10 Closed 9 and 10 Open
6	0.85	1.6	Alarm On	8 and 10 Open 9 and 10 Closed
7 7	0.0 0.85	0.1 1.6	Head Relief Off Head Relief On	11 and 12 Open 12 and 12 Closed
8 8	0.0 0.85	0.1 1.6	Free Cooling Auxiliary Off Free Cooling Auxiliary On	13 and 14 Open 13 and 14 Closed
9	0.0	0.1	Free Cooling Valves Off	16 and 17 Open 15 and 17 Closed 17 and 19 Open 17 and 18 Closed
9	0.85	1.6	Free Cooling Valves On	16 and 17 Open 15 and 17 Closed 17 and 19 Open 17 and 18 Closed
10	13.7	22.5	Relay Supply	---------------
11	13.7	22.5	Common	---------------

Notes:

1. The voltage values provided in this table apply only when ribbon connector 1P3 is connected to 1J3 of micro module 1U3.
2. This is a Triac output and cannot be checked in the same manner as a mechanical contact closure. Refer to "Vane Control Checkout Procedure" in this bulletin.
3. All voltages are to be measured with respect to 1P3-11.

Troubleshooting with UCP695 Control Panel Diagnostics

Note: This troubleshooting information is applicable only to those CVHB, CVHE, or CVHF units equipped with UCP695 control panels. These unit are:

— CVHE units; = "K" design sequence and later;
— CVHB units; = "V" design sequence and later;
— CVHF units; = All units.

UCP695 Overview

The microprocessor-based, UCP695 control panel visually indicates chiller operating and diagnostic codes on the operator display (refer to "Operator's Display" on page 8). If the UCP (i.e., unit control module) detects a diagnostic condition, it alternately flashes the 4-digit unit operating mode (i.e., code prefix **A**) that was in effect at the time the unit shutdown and the 4-digit diagnostic code (i.e., code prefix **b**) on the display. Use the information in the following section to identify and correct the cause of a unit shutdown.

Note: A latching diagnostic condition (i.e., one requiring manual reset) detected by the unit control panel cannot be cleared from a higher level device (i.e., an SCP, Tracer or generic BAS). The chiller must be manually reset at the UCP695 control panel.

Complete listings of the codes used to identify CVHE operating modes and diagnostic conditions--along with the display menus--are provided in Tables 1, 2 and 3 on pages 8, 9 and 10. For a more detailed explanation of UCP695 control panel features and functions, refer to the "System Control" portion of the CVHE operation and maintenance manual that shipped with the unit.

Troubleshooting

Note: Whenever checking any of the micro module's sensors, be sure to allow sufficient time for the sensor slew rate to "catch up" (i.e., 5 minutes maximum).

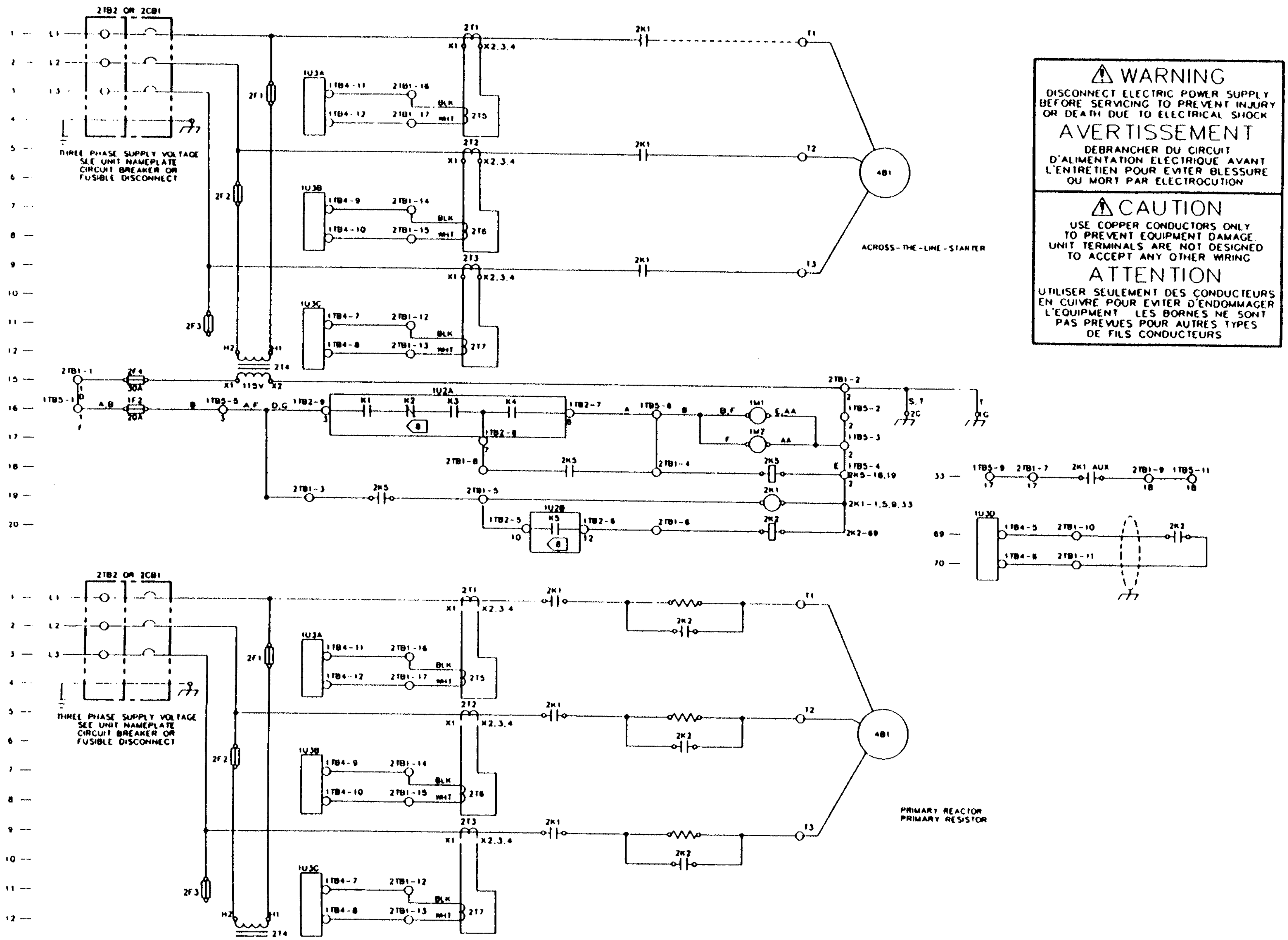
Unit troubleshooting information in this section is presented by diagnostic code, and follows the code sequence shown in Table 2 on page 9. Typical starter and chiller electrical schematics are provided in Figures 8 and 9 for reference. Terminal strip locations are shown in Figure 6 on page 34. Safety control cutout settings and operating time delay values are given in Table 18 on page 50.

WARNING: Failure to exercise caution when servicing unit may result in injury or death due to electrical shock.

Whenever micro module replacement is indicated by any of the following procedures, always check the power supply output module before replacing micro module 1U3 (See "Power Supply Checkout Procedure").

Note: When altering any of the micro module (1U3) settings, remember that none of the control setpoints can be changed if any of these diagnostic conditions exist: **b A3, b Ab, b AC, b Ad, b AE, b d9, b Ed, b F7, b F8, b F9, b FA, b Fb, b Fd** or **b FF**. In these instances, the condition that caused the diagnostic must be corrected first. For all other diagnostics, it is possible to change 1U3's control setpoints after manually resetting the chiller (i.e., adjust the chiller switch to STANDBY/RESET, then back to one of the AUTO positions).

Figure 8 - Starter-Section Electrical Schematics for Alternate Starter Types Used with CVHE Units



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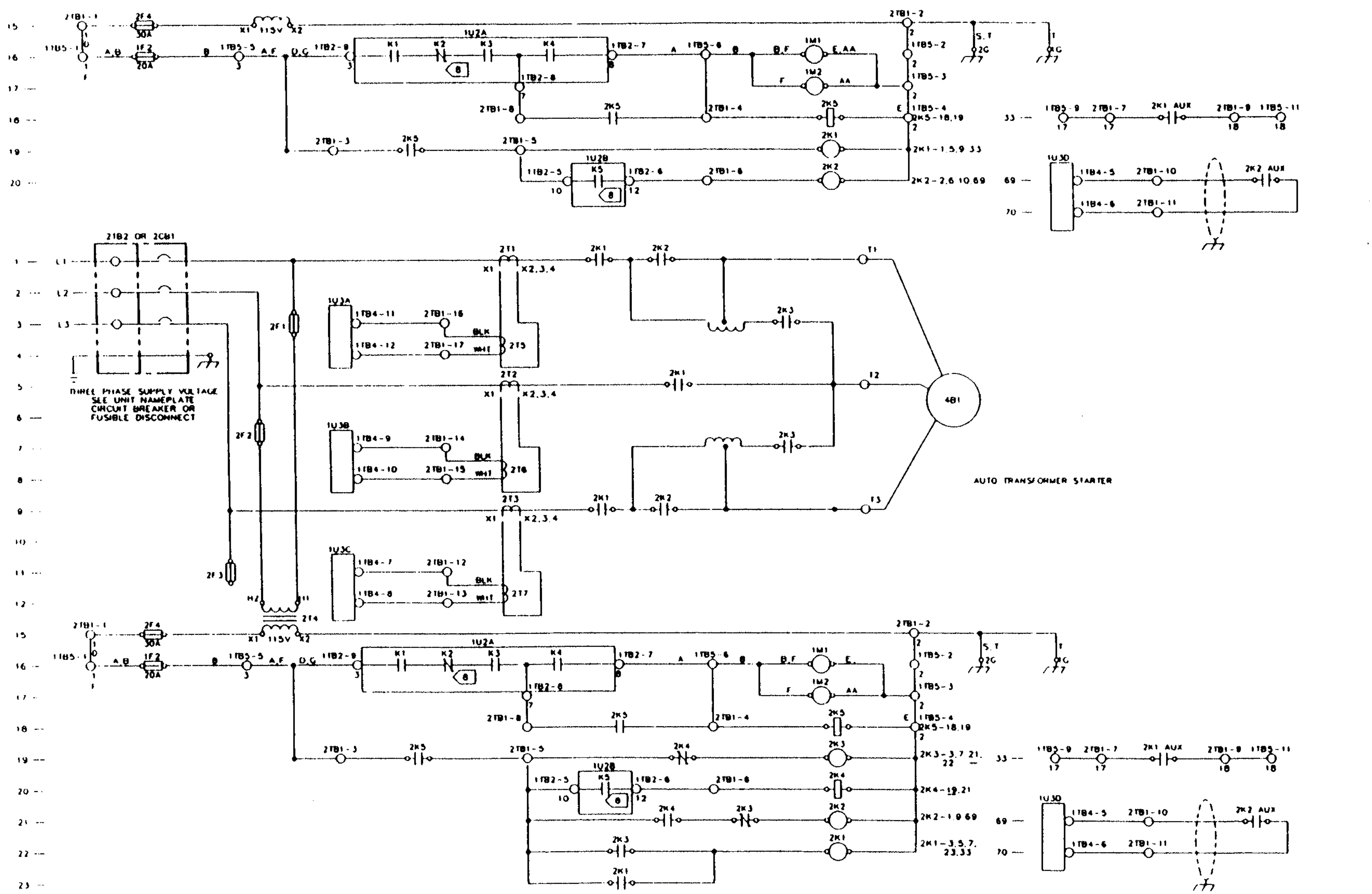

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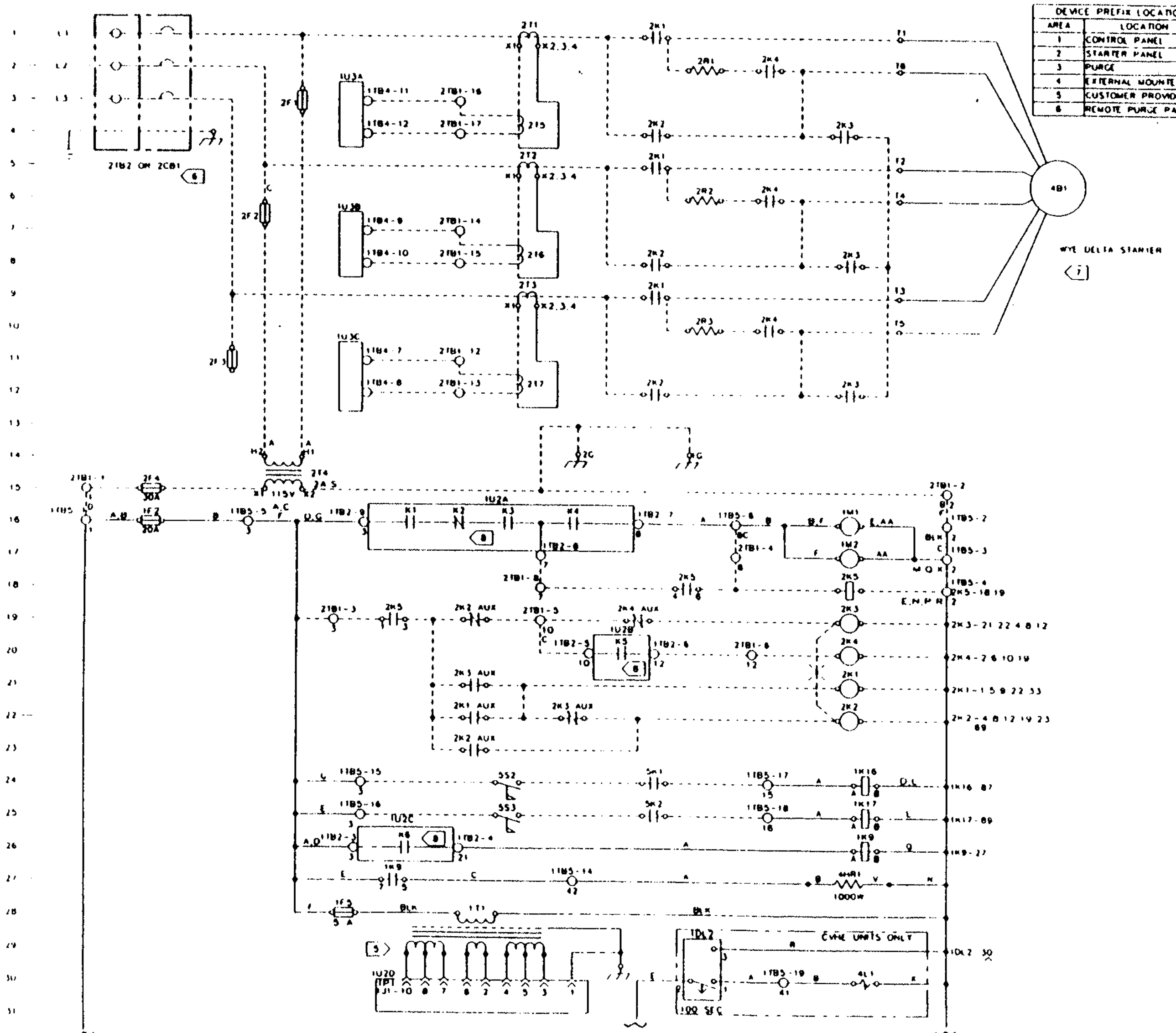
Figure 9 - Electrical Schematic for Standard CVHB/E/F w/Wye-Delta, Remote-Mounted Starter (Page 1)



DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	CONTROL PANEL
2	STARTER PANEL
3	PURGE
4	EXTERNAL MOUNTED
5	CUSTOMER PROVIDED
6	REMOTE PURGE PANEL

LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1C1	CAPACITOR, OIL PUMP	32
1DL2	VENT LINE INTERV TIMER	29
1F1	FUSE, OIL PUMP	33
1F2-5	BRANCH CIRCUIT FUSE	16 35 28 42
1J1-4/1P1-4	POST HEADER POWER SUPPLY	30 85 94
1K8	OIL PUMP STARTER RELAY	33
1K9	OIL TANK HTR RELAY	26
1K16	CHD WTR PUMP RELAY	24
1K17	COND WTR PUMP RELAY	25
1M1	HOUR METER	16
1M2	START METER	17
1R1	RESISTOR PRESS TRANSDUCER	75
1S1	COND HIGH PRESS SWITCH	85
1S2	OIL PRESS SWITCH	65
1T1	POWER SUPPLY TRANSFORMER	28
1TB1	TERM BLOCK REL OUTPUT	
1TB2	TERM BLOCK POWER SPLY	
1TB3	TERM BLOCK MICRO-MOD INPUT	
1TB4	TERM BLOCK MICRO-MOD INPUT	
1TB5	TERM BLOCK CONTROL PANEL	
1TB6	TERM BLOCK MICRO-MOD INPUT	65 66
1U1A-C	RELAY OUTPUT MODULE	SHEET 2
1U1K3	HEAD RELIEF RELAY	88
1U1K4	ALARM RELAY	85
1U1K6	COND WATER PUMP RELAY	87
1U1Q7	VANES OPEN (TRIAC)	35
1U1Q8	VANES CLOSED (TRIAC)	36
1U2A-F	POWER SUPPLY OUTPUT MOD	SHEET 2
1U2K1	RESET RELAY	16
1U2K2	STOP RELAY	16
1U2K3	OVERLOAD RELAY	16
1U2K4	COMPR START RELAY	16
1U2K5	COMPR TRANSITION RELAY	20
1U2K6	OIL HEATER RELAY	26
1U2K7	OIL PUMP RELAY	32
1U3A-D	MICRO MODULE	SHEET 2
1U4	BAS CHILLED WTR RESET	94
2CB1	STARTER CIRCUIT BREAKER	1 2 3
2F1,2,3	PRIMARY STARTER FUSE	3 6 11
2K1	START CONTACTOR	21
2K2	RUN CONTACTOR	22
2K3	SHORTING CONTACTOR	19
2K4	TRANSITION CONTACTOR	20
2K5	PILOT RELAY	18
2M3,4,5	VOLT METER	9 11 12
2M6,7,8	AMMETER	56 58 60
2R1-9	TRANSITION RESISTOR	2 6 10
2T1-3	CURRENT TRANSFORMERS	1 5 9
2T4	CONTROL POWER TRANSFORMER	14
2T5 6 7	CURRENT TRANSFORMERS	4 7 11
2TB1	CONTROL TERMINAL BLOCK	
2TB2	LINE TERMINAL BLOCK	1 2 3
3B5	CONDENSING UNIT	52
3B6	PUMPOUT COMPRESSOR	49
(6)3DL2	TIME DELAY RELAY	44
(6)3DS1	CONDENSER RUN LIGHT	53
(6)3DS2	FAULT INDICATION LIGHT	46
(6)3DS3	BYPASS LIGHT	47
(6)3K4	CONTROL RELAYS	45
3L1 & 3	SOLENOID VALVES	50 51
(6)3M1	MINUTE METER	48
(6)3S4	SERVICE SWITCH	51
(6)3S5	BYPASS SWITCH	45
(6)3S6	TIMER RESET SWITCH	44
3S15	TEMPERATURE SWITCH	49

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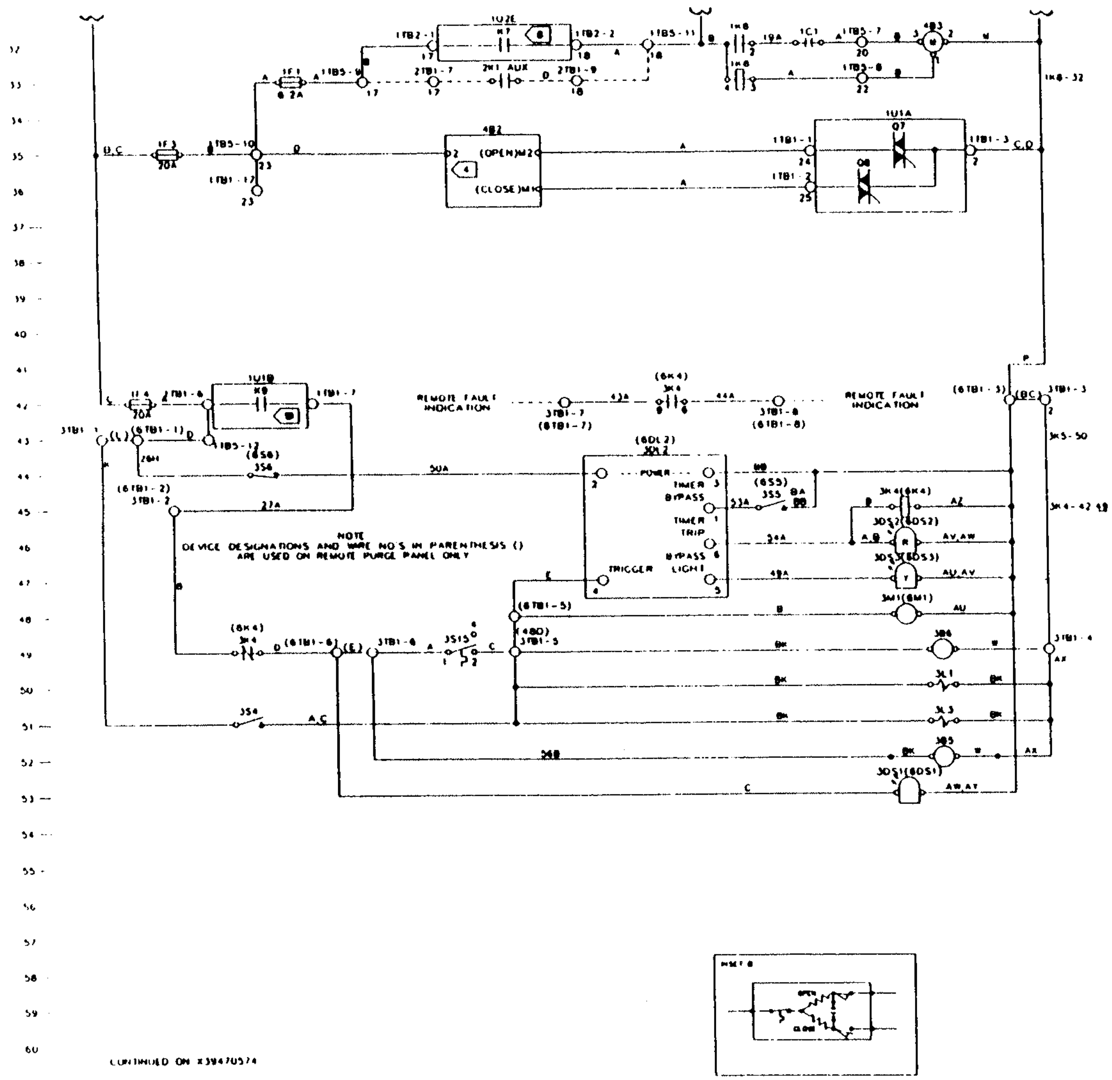


3TB1	PURGE TERMINAL BLOCK	
(6TB1)	(REMOTE PANEL TERM BLOCK)	
4B1	COMPRESSOR MOTOR	5
4B1R2 3 4	MOTOR WINDING TEMP SENSOR	69 71 73
4B2	VANE ACTUATOR MOTOR	35
4B3	OIL PUMP MOTOR	32
4HR1	OIL TANK HEATER	27
4L1	VENT LINE SOLENOID	30
4R11-9	THERMISTOR	69-80
5DS1	ALARM INDICATION	85
5K1	CHWD WATER PUMP CONT AUX	N/A
5K2	COND WATER PUMP CONT AUX	82
5K3	ALARM RELAY	84
5K4	HEAD RELIEF REQUEST CONT	88
5S2	CHWD WATER FLOW SWITCH	24
5S3	COND WATER FLOW SWITCH	75
5S4	INTERLOCK SWITCH	67

NOTES

1 SOLID LINES INDICATE TRANE WIRING DASHED LINES INDICATE FIELD WIRING PHANTOM LINES INDICATE OPTIONAL FEATURES OR ALTERNATE CIRCUITRY

2 UNLESS OTHERWISE NOTED ALL SWITCHES ARE SHOWN AT 25°C (77°F) AT ATMOSPHERIC PRESSURE AT 50% RELATIVE HUMIDITY WITH ALL UTILITIES TURNED OFF AND AFTER A NORMAL SHUTDOWN HAS OCCURED

3 NUMBERS ALONG THE RIGHT SIDE OF THE SCHEMATIC DESIGNATE THE LOCATION OF THE CONTACTS BY LINE NUMBER AN UNDERLINED NUMBER INDICATES A NORMALLY CLOSED CONTACT AN OPEN ARROWHEAD BELOW THE LINE NUMBER POINTING UPWARD INDICATES A TIMED CONTACT WHICH BEGINS TIMING WHEN ENERGIZED

4 SEE INSET D FOR TYPICAL INTERNAL WIRING OF ACTUATOR

5 SEE SERVICE MANUAL FOR INDIVIDUAL SECONDARY VOLTAGES

6 THREE PHASE POWER SUPPLY VOLTAGE - SEE UNIT NAMEPLATE

7 REMOTE Y-Δ STARTER SHOWN AND WIRING BETWEEN CONTROL PANEL AND STARTER REMAIN SIMILAR FOR VARIOUS TYPES OF STARTERS SEE STARTER MANUFACTURES WIRING DIAGRAM FOR SPECIFIC WIRING

8 RELAY COILS NOT SHOWN CONTACTS ARE CONTROLLED BY THE LOGIC OF THE MICRO-MODULE (1U3) SEE SEQUENCE OF OPERATION LINES 102 - 115 NEXT PAGE

⚠ WARNING

DISCONNECT ELECTRIC POWER SUPPLY BEFORE SERVICING TO PREVENT INJURY OR DEATH DUE TO ELECTRICAL SHOCK

AVERTISSEMENT

DEBRANCHER DU CIRCUIT D'ALIMENTATION ELECTRIQUE AVANT L'ENTRETIEN POUR EVITER BLESSURE OU MORT PAR ELECTROCUTION

⚠ CAUTION

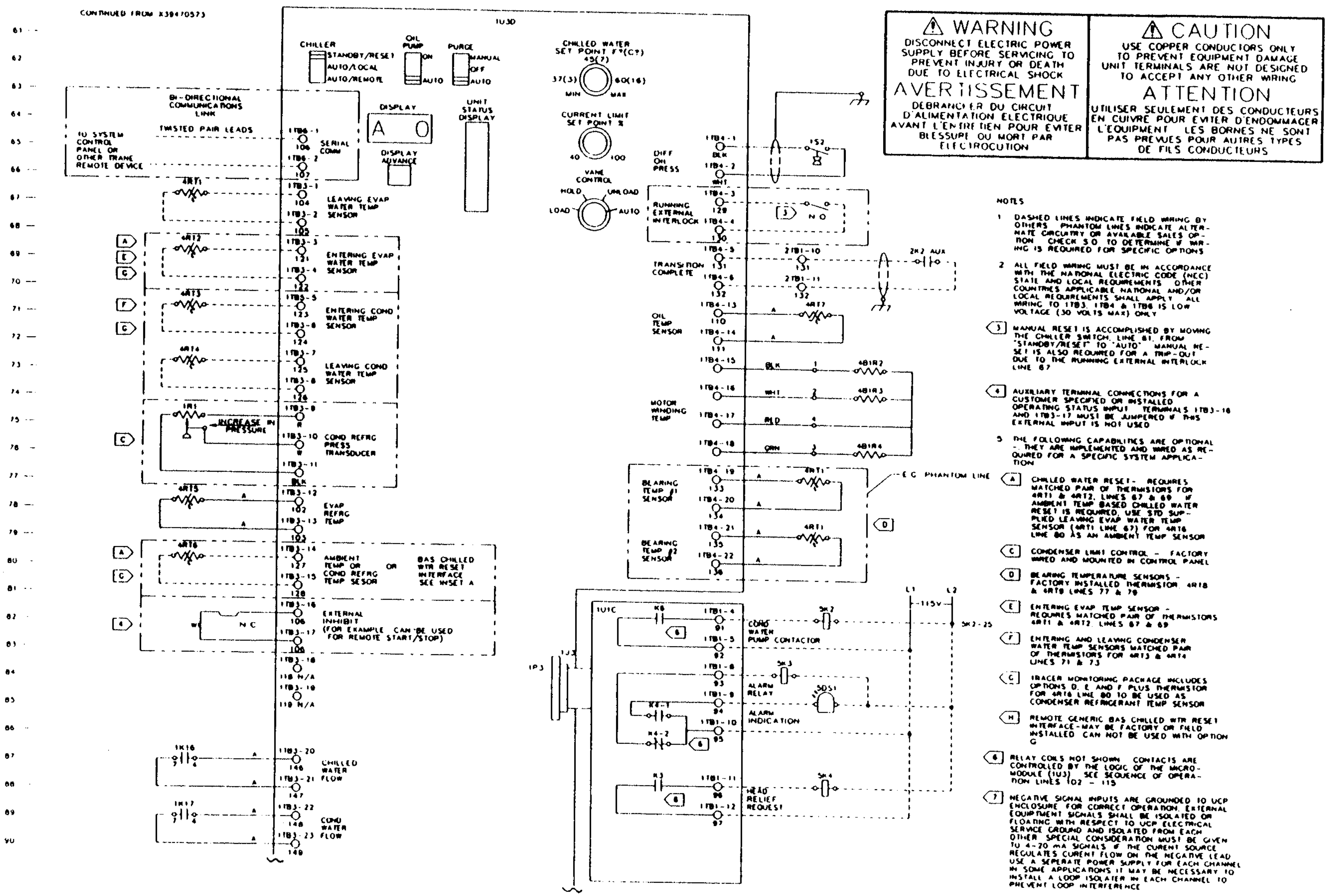
USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT ANY OTHER WIRING

ATTENTION

UTILISER SEULEMENT DES CONDUCTEURS EN CUIVRE POUR EVITER D'ENDOMMAGER L'EQUIPMENT LES BORNES NE SONT PAS PREVUES POUR AUTRES TYPES DE FILS CONDUCTEURS

Drwg. X39470573A

Figure 9 (Cont'd.) - Electrical Schematic for Standard CVHB/E/F w/Wye-Delta, Remote-Mounted Starter (Page 2)



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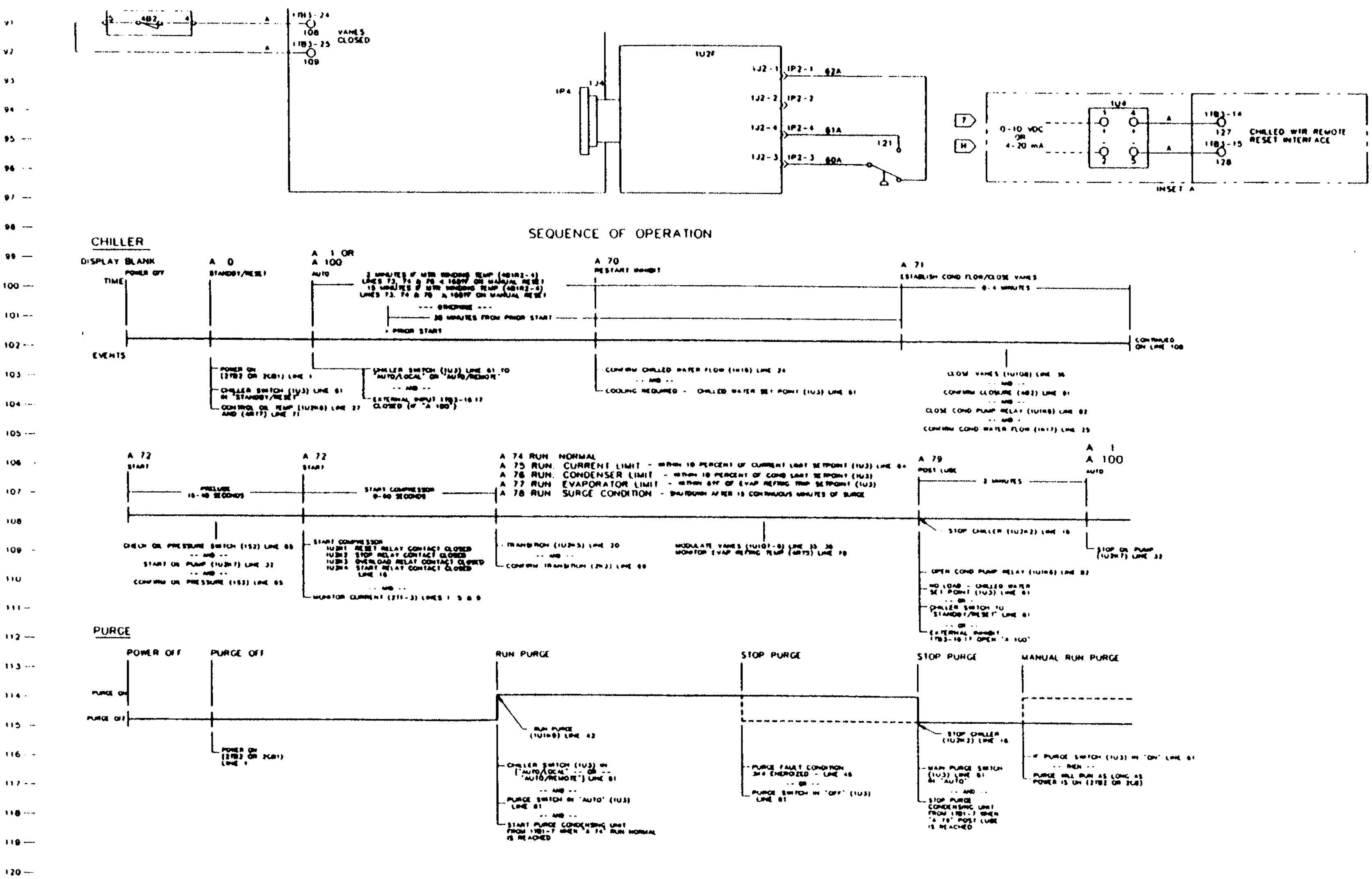

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Table 18
Unit Time Delays and Safety Control Cutout Settings

Operating Controls: "Timers"	Timing Interval	System Reset	Operating Code (1)
Prelube (2)	15 seconds	n/a	A 72
Restart Inhibit (3): Winding Temp. < 165 F (74 C) Winding Temp. $\geq$ 165 F Since Last Start	 4 minutes 15 minutes 30 minutes	 n/a n/a n/a	 A 70 A 70 A 70
Post-Lube	2 minutes	n/a	A 79
Free-Cool/Vane Open Inhibit (4)	3 minutes	n/a	A 9
Oilless Purge: (purge switch @ AUTO)(5)	5 minutes ON 115 min. OFF	n/a	n/a
Purifier Purge: (purge switch @ AUTO)	Controlled by purge timer (6)	manual (7)	n/a
Sump Vent-Line Interval (8)	100 seconds	n/a	n/a
Safety Controls: Fault Time-Outs	**Timing Interval**	**System Reset**	**Diagnostic Code (1)**
Oil Pressure Overdue (2)	33 seconds	manual	b F2
Transition Complete Overdue	2 seconds	manual	b FO
Transition-from-Start Complete	Max. accel. timer setting	manual	b EE
Condenser Water Flow Overdue	3 minutes	manual	b dC
No Evaporator Water Flow	2 seconds max. w/o flutter	auto	b Ed
Vane Closure Overdue	3 minutes	manual	b FA
Free-Cool Valve Closure Overdue	3 minutes	manual	b F9
Surge	15 minutes	manual	b dA
Safety Controls: Unit Cutouts	**Control "Trip" Point**	**System Reset**	**Diagnostic Code (1)**
Winding Temp. Run Inhibit	265 ± 15 F* 130 ± 15 C*	manual	b E7
Low Oil Temp. Run Inhibit	100± 2 F 38± 2 C	auto	b F3
High Oil Temp. Run Inhibit	180± 2 F 83± 2 C	manual	b F4
High Bearing Temp. Run Inhibit (Optional)	180± 2 F 83± 2 F	manual	b EA, Eb
Lvg. Water Temp. Low Limit (Std. Range)	35± 1 F 2± 1 C	auto	n/a
Differential Oil Closes Pressure Switch — Opens	11.5 - 15 psid 9± 1 psid	manual	b E8
High Pressure Std. Units Cutout Switch — ASME Units	15± 1 psig 25± 1 psig (9)	manual	b F5
Oilless Purge "Extend Closes Run" Press. Switch — Opens	20 psig 25 psig	n/a	n/a

__Notes__:
1. See Tables 2 and 3 on pages 9 and 10 for complete code listing.
2. Since prelube timing can begin at any point during 33- second "oil pressure overdue" interval, actual elapsed time to "establish oil pressure" and "prelube" can be anywhere from 15 to 48 seconds.
3. The 165 F inhibit applies only when unit is first powered-up, or if chiller switch is turned from STANDBY/RESET to AUTO/LOCAL or to AUTO/REMOTE. Otherwise, 30 minutes must elapse between compressor starts.
4. Operating code **A 9** will appear on operator display only when free cooling valve limit switches have opened.
5. See CVHB/E/F operation/maintenance manual for purge operation.
6. See "Electrical Sequence of Operation". Refer to Purifier Purge operation manual for details.
7. Reset at 3S6 or 6S6 on purge panel.
8. This timer closes sump vent line during prelube and during unit start sequence.
9. Fixed differential of 3-6 psid for switch closure on a rise in differential oil pressure.

Resetting Diagnostics

When instructed to RESET DIAGNOSTIC, turn chiller switch to STANDBY/RESET. (If the chiller switch is already at STANDBY/RESET, flip it to one of the AUTO positions--then back to STANDBY/RESET.) This should clear the diagnostic, and display operating code **A 0**.)

b A3
Evaporator Refrigerant Temperature Range

Diagnostic **b A3** is displayed if the selected evaporator refrigerant trip setpoint is below the minimum allowable setting. This setpoint is selected at the "Evap. Refrig. Trip" potentiometer on the UCP service interface (Figure 2, pg. 12). Minimum allowable setpoint is 29 F for standard range units; 0 F for extended range units. To reset the evaporator refrigerant temperature trip setpoint:

1. Turn evaporator refrigerant "trip" setpoint potentiometer fully clockwise.

2. Reset diagnostic.

3. Turn vane control switch to HOLD.

4. Press display advance pushbutton until evaporator trip setpoint code prefix **"U"** is displayed. Latching diagnostic **b A3** occurs if the setpoint is out-of-range low.

5. With the chiller switch still in STANDBY/RESET and the vane control switch at HOLD, reset the evaporator refrigerant trip setpoint by turning the potentiometer screw until the desired setpoint is reached.

If the display does not change when this adjustment is made, refer to the "b A3 Diagnostic Procedure" in Figure 10.

b A4, A7, A8
Motor Temperature Sensors

One of these diagnostics (i.e., **b A4, b A7 or b A8**) is displayed--and the unit shuts down--when the temperature measured at the corresponding sensor input (Figure 11) exceeds 310 F. To determine whether the sensor is open or malfunctioning, refer to the "b A4, b A7, b A8 Diagnostic Procedure" in Figure 11.

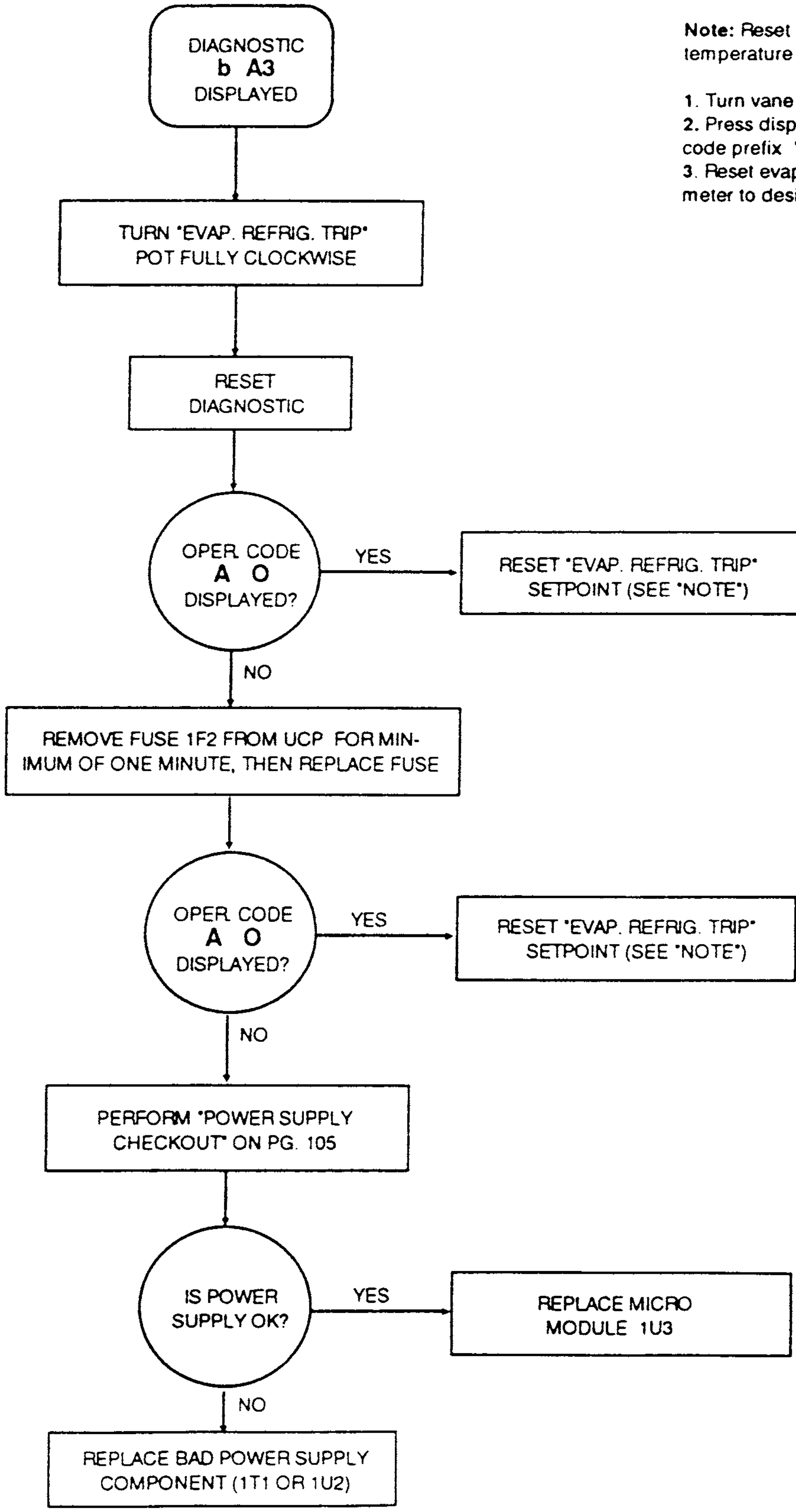
b A5
Maximum Acceleration Time Range

Latching diagnostic **b A5** is displayed if the acceleration time setpoint exceeds the maximum value allowable. The adjustment range for this setting--which is factory-set using DIP switch block S3-- is 6 to 65 seconds (± 2.5 seconds maximum). Refer to "Switch Block S3:.." on page 25.

Note: "Maximum acceleration time" is measured from compressor motor start to "transition" (i.e., when inrush current drops to 85% of compressor motor RLA). Starter type and available starting torque are used to determine this factory setpoint. Recommended maximum acceleration times for several starter types are:

27 seconds for "star-delta" starters;
16 seconds for "auto-transformer" starters;
11 seconds for "primary reactor" starters;
6 seconds for "across-the-line" starters.

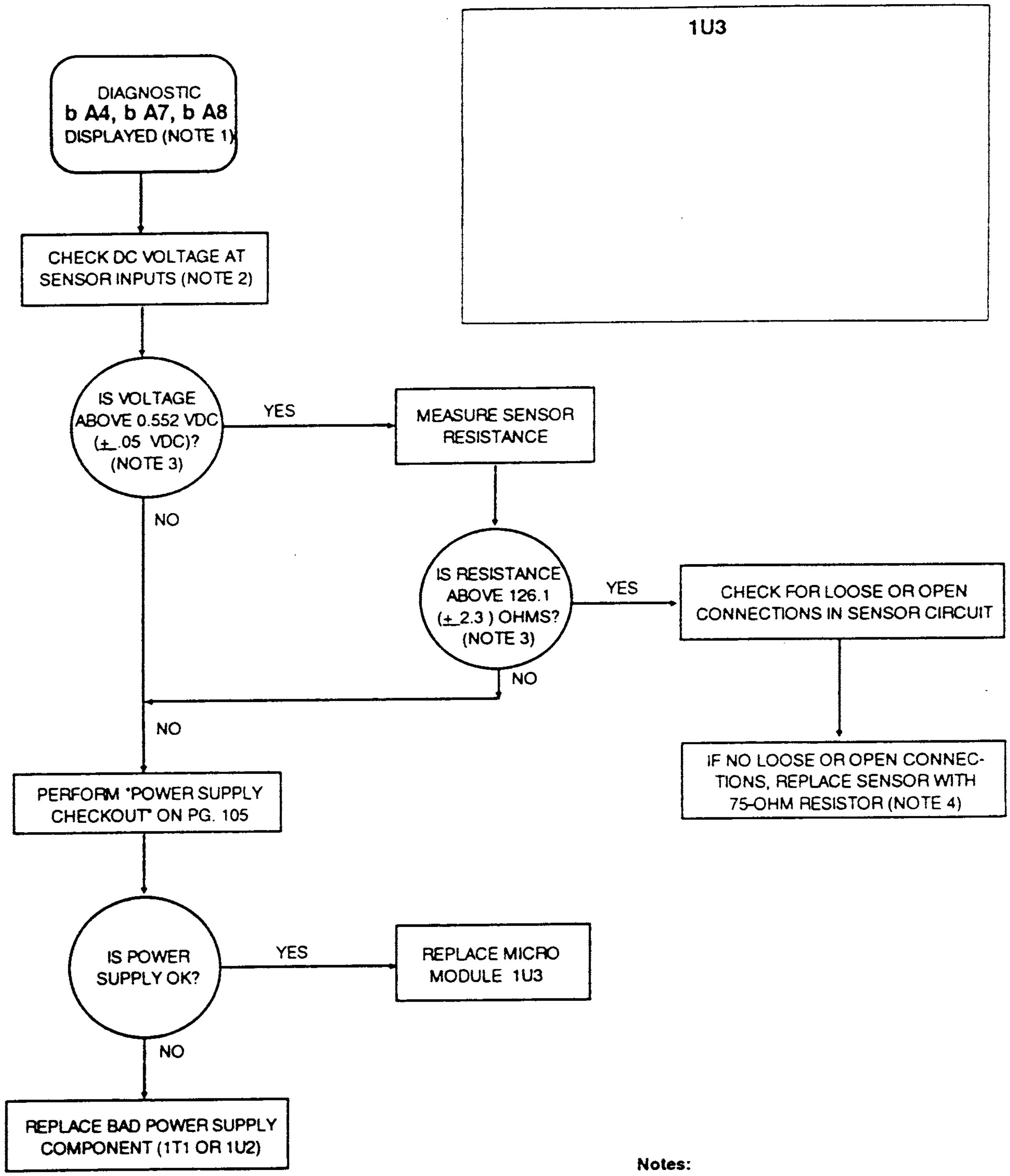
Figure 10 - Diagnostic "b A3"
Evaporator Refrigerant Temperature Range



Note: Reset evaporator refrigerant trip temperature as follows:

1. Turn vane control switch to HOLD.
2. Press display advance pushbutton until code prefix "_" is displayed.
3. Reset evaporator refrigerant trip potentiometer to desired setpoint.

Figure 11- Diagnostic "b A4, b A7, b A8" Motor Temperature Sensor # 1, # 2 or # 3



Sensor Designation	Electrical Designation	Electrical Connections	Diagnostic Code
Sensor # 1	4B1R2	1TB4-15, -17	b A4
Sensor # 2	4B1R3	1TB4-16, -17	b A7
Sensor # 3	4B1R4	1TB4-18, -17	b A8

Notes:
1. These diagnostics can occur when the chiller is in any of the "start" or "run" modes.
2. Terminal 1TB4-17 is ground reference point.
3. Table 19 on the next page gives actual voltage and resistance for these rtd's over a wide range of temperatures.
4. Only two of the three motor temperature sensors can be replaced with resistors. After that, contact CenTraVac technical service department in La Crosse.

Table 19
Motor Winding Temperature Sensor Conversion Data

Actual Temp. (F)	Sensor Voltage (± 0.05V)	Nominal Resistance (Ohms)	Acceptable Resistance Values (Ohms)	
			Minimum	Maximum
50	0.321	70.1± 2.7	67.4	72.8
55	0.326	71.1± 2.7	68.4	73.8
60	0.330	72.1± 2.7	69.4	74.8
65	0.334	73.1± 2.7	70.4	75.8
70	0.338	74.0± 2.6	71.4	76.6
75	0.342	75.0± 2.6	72.4	77.6
80	0.347	76.0± 2.6	73.4	78.6
85	0.351	77.0± 2.6	74.4	79.6
90	0.355	78.0± 2.6	75.4	80.6
95	0.359	79.0± 2.6	76.4	81.6
100	0.364	80.0± 2.6	77.4	82.6
110	0.372	82.0± 2.5	79.5	84.5
120	0.381	84.0± 2.5	81.5	86.5
130	0.390	86.0± 2.5	83.5	88.5
140	0.397	88.0± 2.5	85.5	90.5
150	0.407	90.2± 2.4	87.8	92.6
160	0.415	92.2± 2.4	89.8	94.6
170	0.424	94.3± 2.3	92.0	96.6
180	0.433	96.5± 2.3	94.2	98.8
190	0.441	98.5± 2.3	96.2	100.8
200	0.450	100.8± 2.3	98.5	103.1
210	0.459	103.0± 2.2	100.8	105.2
220	0.468	105.1± 2.2	102.9	107.3
230	0.476	107.2± 2.1	105.1	109.3
240	0.486	109.5± 2.0	107.5	111.5
250	0.494	111.6± 2.0	109.6	113.6
260	0.504	114.0± 2.0	112.0	116.0
270	0.514	116.4± 2.1	114.3	118.5
280	0.523	118.7± 2.2	116.5	120.9
290	0.532	121.1± 2.2	118.9	123.3
300	0.542	123.6± 2.3	121.3	125.9
310	0.552	126.1± 2.3	123.8	128.4

Note: To determine if thermistor is out of range, compare it's resistance (or voltage input) reading with "actual " temperature indicated by a thermometer, considering the thermometer's margin of error.

To check the maximum acceleration time setpoint:

1. Open the control panel door; then remove the narrow access strip immediately above the unit control module (Figure 2, page 12).

WARNING: Failure to exercise caution when servicing unit with power on may result in injury or death due to electrical shock.

2. With the DIP switch blocks exposed, check the maximum acceleration time setpoint established by the positions of Switches 1 through 5 on DIP switch block S3. Use Table 11 on page 26 to identify the proper switch positions for the recommended acceleration time settings.

Note: In the event that latching diagnostic **b A5** occurs, attempt to clear the diagnostic as described in the "b A5 Diagnostic Procedure" in Figure 12. If this diagnostic persists, micro module 1U3 is defective and must be replaced.

b A9
Oil Temperature Sensor

Diagnostic condition **b A9** occurs if the oil temperature sensor (4RT7) "reads" a temperature below 32 F or above 180 F. The oil temperature sensor is located in a bulbwell in the back of the oil sump, and its leads are connected to terminals 1TB4-13 and 1TB4-14 on micro module 1U3.

Use the instructions in the "**b A9** Diagnostic Procedure" in Figure 13 to determine whether 4RT7 is malfunctioning, shorted or open.

Note: It is unlikely that any machine's operating or nonoperating conditions would cause the oil temperature to fall below 32 F.

b Ab
Leaving (Evaporator) Water Temperature Sensor

Latching diagnostic **b Ab** occurs whenever the temperature measured by the leaving evaporator water temperature sensor (4RT1) drops below 15 F. (A leaving water temperature "low limit" stops chiller operation at 35.3 F on standard range units only).

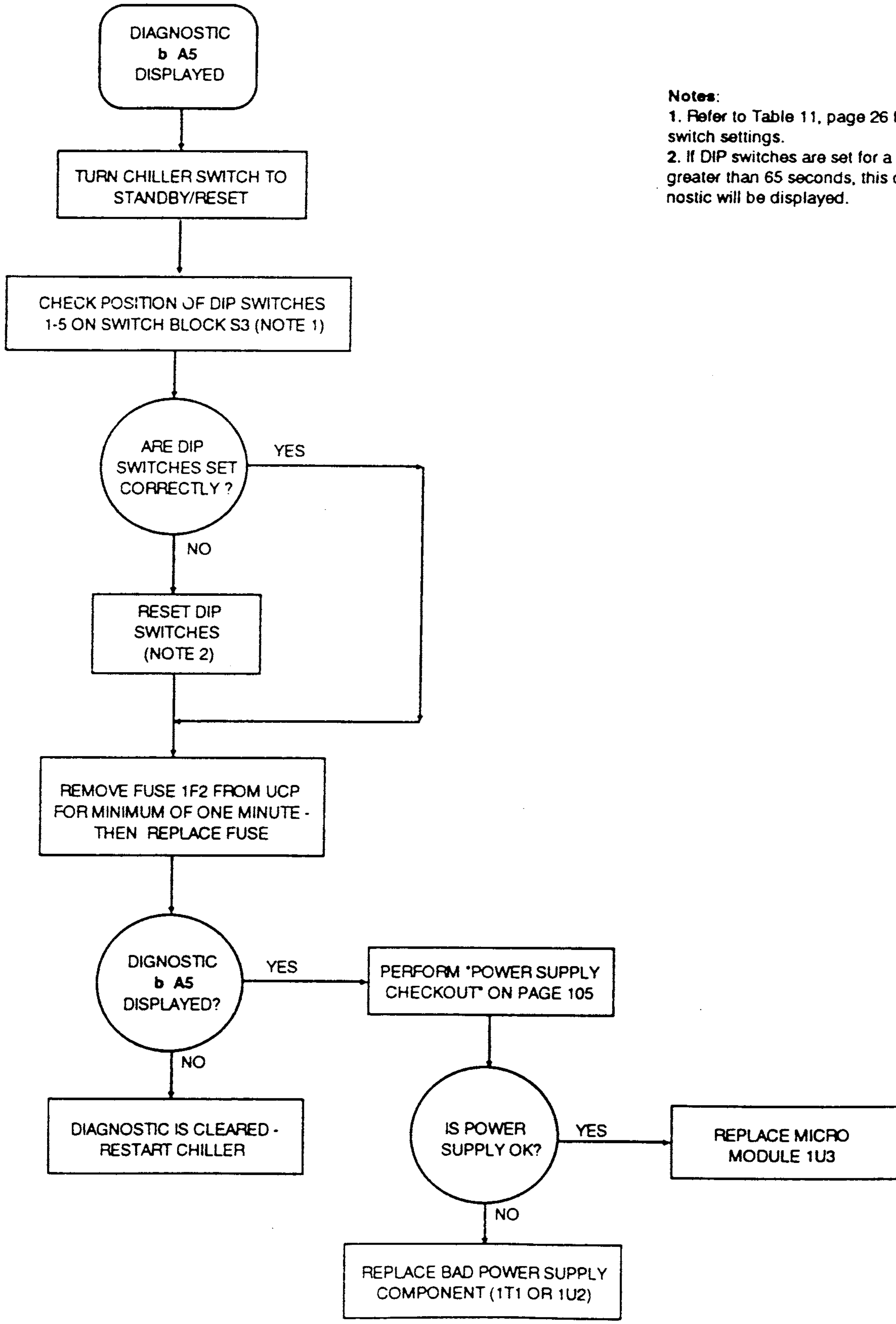
Use the instructions in the "**b Ab** Diagnostic Procedure" in Figure 14 to determine whether sensor 4RT1 is open or malfunctioning. (The sensor leads are connected to terminals 1TB3-1 and 1TB3-2 on micro module 1U3.)

If the results of the sensor checkout indicate that 4RT1 is functioning properly, determine why the leaving water temperature is so low; among the possible causes to consider are:

[ ] chilled water flow problems (e.g., plugged strainers or heat exchangers, bypassed water, pump malfunction, or erratic return water temperature).

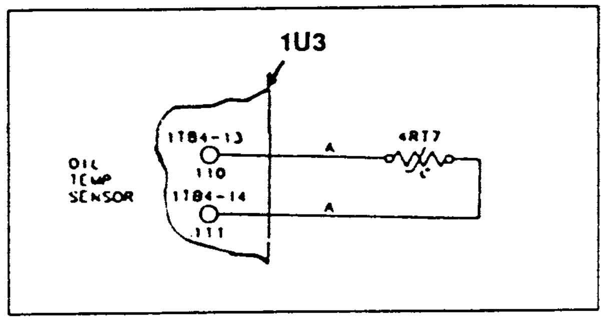
[ ] control module or vane actuator malfunction (i.e., a loss of setpoint or actuator control can cause excessive loading).

Figure 12 - Diagnostic "b A5" Maximum Acceleration Time Range



Notes:
1. Refer to Table 11, page 26 for DIP switch settings.
2. If DIP switches are set for a value greater than 65 seconds, this diagnostic will be displayed.

Figure 13 - Diagnostic "b A9"
Oil Temperature Sensor



DIAGNOSTIC b A9 DISPLAYED

CHECK DC VOLTAGE AT TERMINALS 1TB4-13, -14

IS VOLTAGE BETWEEN 2.1-5.21 VDC?
- YES → PERFORM POWER SUPPLY CHECKOUT ON PAGE 105
- NO → CHECK SENSOR RESISTANCE

DO VOLTAGE & RESISTANCE READINGS MATCH ? (NOTE 1)
- YES → CHECK FOR LOOSE OR OPEN CONNECTIONS IN SENSOR CIRCUIT
- NO → PERFORM POWER SUPPLY CHECKOUT ON PAGE 105

IS POWER SUPPLY OK?
- YES → REPLACE MICRO MODULE 1U3
- NO → REPLACE BAD POWER SUPPLY COMPONENT (1T1 OR 1U2)

ARE SENSOR CONNECTIONS OK?
- YES → REPLACE SENSOR 4RT7 (NOTE 2) → CHECK SENSOR RESISTANCE
- NO → REPAIR CONNECTION

DO VOLTAGE & RESISTANCE READINGS MATCH ? (NOTE 1)
- YES → RESET DIAGNOSTIC & RESTART CHILLER
- NO → REPLACE MICRO MODULE 1U3

Notes:
1. Compare voltage and resistance values given in Table 20 on next page.
2. Micro must be reset following 4RT7 replacement.

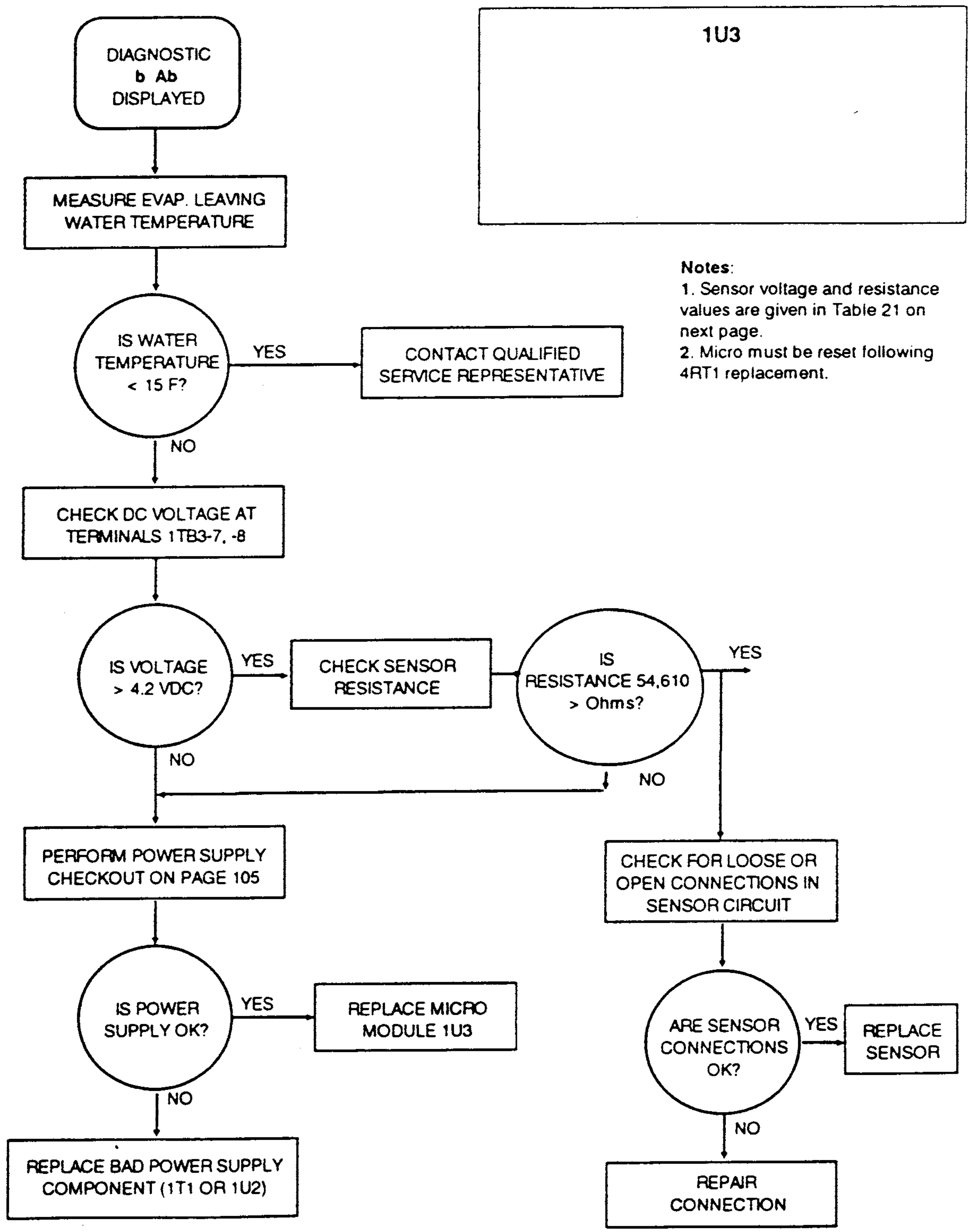
Table 20
Sensor Conversion Data: Oil Temperature (4RT7) and Optional Bearing Temperature Sensors(4RT8, 4RT9))

Actual Temp. (F)	Actual Resist. (Ohms)	Thermistor Voltage (Note 3)	Actual Temp. (F)	Actual Resist. (Ohms)	Thermistor Voltage (Note 3)	Actual Temp. (F)	Actual Resist. (Ohms)	Actual Voltage (Note 3)	Actual Temp. (F)	Actual Resist. (Ohms)	Actual Voltage (Note 3)
32	32,861.74	5.211	70	11,888.77	4.770	108	4,871.11	4.004	146	2,215.59	3.020
33	31,935.33	5.203	71	11,595.68	4.754	109	4,765.02	3.980	147	2,172.78	2.993
34	31,039.07	5.195	72	11,310.78	4.738	110	4,661.56	3.956	148	2,130.95	2.966
35	30,170.77	5.187	73	11,033.81	4.721	111	4,560.67	3.931	149	2,090.03	2.940
36	29,329.83	5.179	74	10,764.53	4.705	112	4,462.27	3.907	150	2,050.01	2.913
37	28,515.28	5.170	75	10,502.71	4.688	113	4,336.29	3.882	151	2,010.87	2.887
38	27,726.22	5.161	76	10,248.11	4.671	114	4,272.67	3.857	152	1,972.58	2.861
39	26,961.78	5.152	77	10,000.51	4.653	115	4,181.34	3.832	153	1,935.13	2.834
40	26,221.09	5.143	78	9,759.70	4.636	116	4,092.24	3.807	154	1,898.49	2.808
41	25,503.33	5.134	79	9,525.47	4.618	117	4,005.31	3.782	155	1,862.65	2.782
42	24,807.73	5.124	80	9,297.62	4.600	118	3,920.24	3.756	156	1,827.59	2.756
43	24,133.52	5.114	81	9,075.96	4.581	119	3,837.72	3.731	157	1,793.28	2.730
44	23,479.98	5.104	82	8,860.29	4.563	120	3,756.95	3.705	158	1,759.71	2.704
45	22,846.40	5.094	83	8,650.45	4.544	121	3,678.12	3.679	159	1,726.86	2.678
46	22,232.11	5.084	84	8,446.26	4.525	122	3,601.11	3.654	160	1,694.72	2.652
47	21,636.47	5.073	85	8,247.54	4.506	123	3,526.48	3.628	161	1,663.26	2.626
48	21,058.83	5.062	86	8,054.13	4.486	124	3,453.62	3.602	162	1,632.47	2.601
49	20,498.61	5.051	87	7,865.87	4.467	125	3,382.47	3.580	163	1,602.34	2.575
50	19,995.21	5.040	88	7,682.62	4.447	126	3,313.00	3.550	164	1,572.85	2.550
51	19,428.09	5.029	89	7,504.22	4.426	127	3,245.16	3.524	165	1,543.97	2.524
52	18,916.69	5.017	90	7,330.53	4.406	128	3,178.90	3.498	166	1,515.71	2.499
53	18,420.49	5.005	91	7,161.41	4.385	129	3,114.19	3.471	167	1,488.04	2.474
54	17,939.01	4.993	92	6,996.74	4.365	130	3,050.99	3.445	168	1,460.96	2.449
55	17.471.74	4.981	93	6,836.36	4.344	131	2,989.25	3.419	169	1,434.43	2.424
56	17,018.23	4.969	94	6,680.17	4.322	132	2,928.94	3.392	170	1,498.47	2.399
57	16,578.03	4.956	95	6,528.05	4.301	133	2,870.02	3.366	171	1,383.04	2.375
58	16,150.71	4.943	96	6,379.86	4.279	134	2,812.45	3.339	172	1,358.14	2.350
59	15,735.84	4.930	97	6,235.50	4.257	135	2,756.20	3.313	173	1,333.75	2.326
60	15,333.03	4.916	98	6,094.87	4.235	136	2,701.24	3.286	174	1,309.87	2.302
61	14,941.88	4.903	99	5,957.84	4.213	137	2,647.54	3.259	175	1,286.48	2.278
62	14,562.03	4.889	100	5,824.32	4.191	138	2,595.05	3.233	176	1,263.57	2.254
63	14,193.10	4.875	101	5,694.22	4.168	139	2,543.76	3.206	177	1,241.13	2.230
64	13,834.75	4.861	102	5,567.42	4.145	140	2,493.62	3.179	178	1,219.13	2.206
65	13,486.65	4.846	103	5,443.84	4.122	141	2,444.62	3.153	179	1,197.61	2.183
66	13,148.46	4.831	104	5,323.39	4.099	142	2.396.72	3.126	180	1,176.52	2.159
67	12,819.88	4.816	105	5,205.97	4.075	143	2,349.89	3.099	—	—	—
68	12,500.59	4.801	106	5,091.51	4.052	144	2,304.11	3.073	—	—	—
69	12,190.32	4.786	107	4,979.91	4.028	145	2,259.35	3.046	—	—	—

Notes:

1. Oil temperature sensor 4RT7 connected to 1U3 at 1TB4-13 and -14; overall accuracy is ± 2 F at 100-180 F, ± 5 F at 32-100 F.
2.. Bearing temperature sensors 4RT8 and 4RT9 connected to 1U3 at 1TB4-19, -20 and at 1TB4-21, -22; overall accuracy is + 2 F.
3. To determine if thermistor is out of range, compare resistance or voltage readings with "actual" temperature, considering the thermometer's margin of error.

Figure 14 - Diagnostic "b Ab"
Leaving Water Temperature Sensor



Notes:
1. Sensor voltage and resistance values are given in Table 21 on next page.
2. Micro must be reset following 4RT1 replacement.

Table 21
Sensor Conversion Data: Evaporator Leaving Water Temperature (4RT1) and Optional Entering Water Temperature Sensors (4RT2)

Actual Temp. (F)	Actual Resist. (Ohms)	Thermistor Voltage (Note 3)	Actual Temp. (F)	Actual Resist. (Ohms)	Thermistor Voltage (Note 3)
15	54,635.59	4.236	53	18,420.49	2.992
16	52,987.21	4.208	54	17,939.01	2.957
17	51,393.36	4.180	55	17,471.74	2.922
18	49,852.12	4.152	56	17,018.23	2.887
19	48,361.55	4.123	57	16,578.03	2.852
20	46,919.86	4.094	58	16,150.71	2.817
21	45,525.32	4.064	59	15,735.84	2.782
22	44,176.24	4.034	60	15,333.03	2.747
23	42,871.04	4.004	61	14,941.88	2.713
24	41,698.12	3.973	62	14,562.03	2.678
25	40,386.01	3.942	63	14,193.10	2.643
26	39,203.26	3.911	64	13,834.75	2.609
27	38,058.56	3.879	65	13,486.65	2.575
28	36,950.50	3.847	66	13,148.46	2.541
29	35,877.84	3.814	67	12,819.88	2.507
30	34,839.39	3.782	68	12,500.59	2.473
31	33,833.91	3.749	69	12.190.32	2.440
32	32,861.74	3.715	70	11,888.77	2.406
33	31,935.73	3.683	71	11,595.68	2.373
34	31,039.07	3.649	72	11,310.78	2.340
35	30,170.77	3.616	73	11,033.81	2.308
36	29,329.83	3.582	74	10,764.53	2.275
37	28,515.28	3.549	75	10,502.71	2.243
38	27,726.22	3.515	76	10,248.11	2.211
39	26,961.78	3.481	77	10,000.51	2.179
40	26,221.09	3.446	78	9,759.70	2.148
41	25,503.33	3.412	79	9,525.47	2.117
42	24,807.73	3.377	80	9,297.62	2.086
43	24,133.52	3.343	81	9.075.96	2.055
44	23,479.98	3.308	82	8,860.30	2.024
45	22,846,40	3.273	83	8,650.45	1.994
46	22,232.11	3.238	84	8,446.26	1.964
47	21,636.47	3.203	85	8,247.54	1.935
48	21,058.83	3.168	86	8,054.13	1.906
49	20,498.61	3.133	87	7,865.87	1.877
50	19,955.21	3.098	88	7,682.62	1.848
51	19,428.09	3.062	89	7,504.22	1.820
52	18,916.69	3.027	90	7,330.53	1.791

Notes:
1. Sensor 4RT1 is connected between Terminals 1TB3-1 and -2 on micro 1U3; optional sensor 4RT2 is connected between Terminals 1TB3-3 and -4.
2. Overall accuracy for sensors 4TR1 and 4RT2 is ± 1 F from 20-70 F; ± 2 F from 70-90 F; and, ± 2 F from 15-20 F.
3. To determine if thermistor is out of range, compare resistance or voltage readings with "actual" temperature, considering the thermometer's margin of error.

b AC
Condenser Refrigerant Pressure Sensor (Optional)

The **b AC** diagnostic indicates that the micro module (1U3) has detected a problem with the optional pressure transducer (1R1). The diagnostic will be displayed if the transducer circuit between Terminals 1TB3-9 and 1TB3-10 — or between Terminals 1TB3-10 and 1TB3-11 — is shorted.

Troubleshooting A "b AC" Diagnostic

1. Remove the transducer wires connected to Terminals 1TB3-9, -10 and -11. Check the terminals for stray wires or other short circuits.

2. Reset (clear) the diagnostic at the control panel. If the diagnostic cannot be reset with the transducer disconnected, the micro module (1U3) is defective and must be replaced.

Note: Be sure to perform the power supply checkout procedure before replacing 1U3.

3. Check the wiring between the transducer and the terminal strip for any frayed or smashed areas that could cause a short. Repair same if found.

4. Measure the voltage between Terminals 1TB3-9 and 1TB3-11. This voltage should be 5.0 VDC or greater. If the voltage is less than 5.0 VDC, the micro module (1U3) is defective and must be replaced.

Note: Be sure to perform the power supply checkout procedure before replacing 1U3.

5. Reconnect the black wire to Terminal 1TB3-11 and the red wire to Terminal 1TB3-9. Measure the voltage between Terminals 1TB3-9 and -11. This voltage should be 5.0 VDC or greater. If it is not, the transducer is bad and must be replaced.

6. Connect the white wire to Terminal 1TB3-10. Measure the voltage at 1TB3-10 with respect to 1TB3-11. This voltage should be 2.5 VDC or greater. If it is less than 2.5 VDC, the transducer is bad; replace it. Check leads to ground for shorts in the transducer.

Table 22
Conversion Data for Condenser Pressure Transducer 1R1

Actual Pressure (PSIG)	Input Volts @ 1TB3-10,-11	Actual Pressure (PSIG)	Input Volts @ 1TB3-10,-11	Actual Pressure (PSIG)	Input Volts @ 1TB3-10,-11	Actual Pressure (PSIG)	Input Volts @ 1TB3-10,-11
0.0	4.759	8.0	4.036	16.0	3.313	24.0	2.590
1.0	4.669	9.0	3.946	17.0	3.223	25.0	2.500
2.0	4.579	10.0	3.855	18.0	3.132	26.0	2.409
3.0	4.488	11.0	3.765	19.0	3.042	27.0	2.319
4.0	4.398	12.0	3.675	20.0	2.951	28.0	2.228
5.0	4.307	13.0	3.584	21.0	2.861	29.0	2.138
6.0	4.217	14.0	3.494	22.0	2.771	30.0	2.048
7.0	4.127	15.0	3.403	23.0	2.680	---------	---------

Notes:
1. Optional transducer 1R1 is connected to Terminals 1TB3-9, -10 and -11 on micro module 1U3.
2. Overall accuracy of 1R1 is ± 1 psig from) psig to 25 psig.
3. To determine if the transducer is out of range, compare an input voltage reading withthe "actual" pressure reading indicated by the pressure gauge, considering the precision of the pressure gauge.
4. Due to the type of transducer used, the resistance generated cannot be read with a standard ohmmeter. However, the total resistance measured between the black and red wires should be approximately 10K.

b Ad
Evaporator Refrigerant Temperature Sensor

The evaporator refrigerant temperature sensor (4RT5) is factory-installed in a bulbwell located below the unit control panel, near the bottom of the evaporator shell. Latching diagnostic **b Ad** is initiated prior to start if 4RT5 senses an evaporator refrigerant temperature below -5 F or above 150 F.

Should this occur, use the sensor checkout procedure in Figure 15 to determine whether 4RT5 is open/shorted or malfunctioning. (4RT5 is connected to terminals 1TB3-12 and 1TB3-13 on micro module 1U3.)

Note: The **b Ad** sensor diagnostic normally occurs only during a nonoperating mode, since the evaporator trip setpoint is much higher than -5 F. No normal machine operating conditions will yield an evaporator refrigerant temperature lower than -5 F.

b AE
Ambient Temperature Sensor (Optional)

Latching diagnostic **b AE** occurs when the optional ambient temperature sensor (4RT6) registers an outdoor air temperature exceeding 150 F. If **b AE** appears on the display, determine whether or not 4RT6 is shorted or malfunctioning as described in Figure 16.

The optional ambient temperature sensor is connected between micro module (1U3) terminals 1TB3-14 and 1TB3-15.

b AF, b b0
Bearing Temperature Sensors (Optional)

Two optional sensors (4RT8 and 4RT9) are factory-installed in the oil drain lines of the compressor to monitor bearing temperature. Latching diagnostic **b AF** or **b b0** is displayed if the corresponding sensor (Figure 17, page 67) detects a temperature above the accepted range (i.e., 180 F).

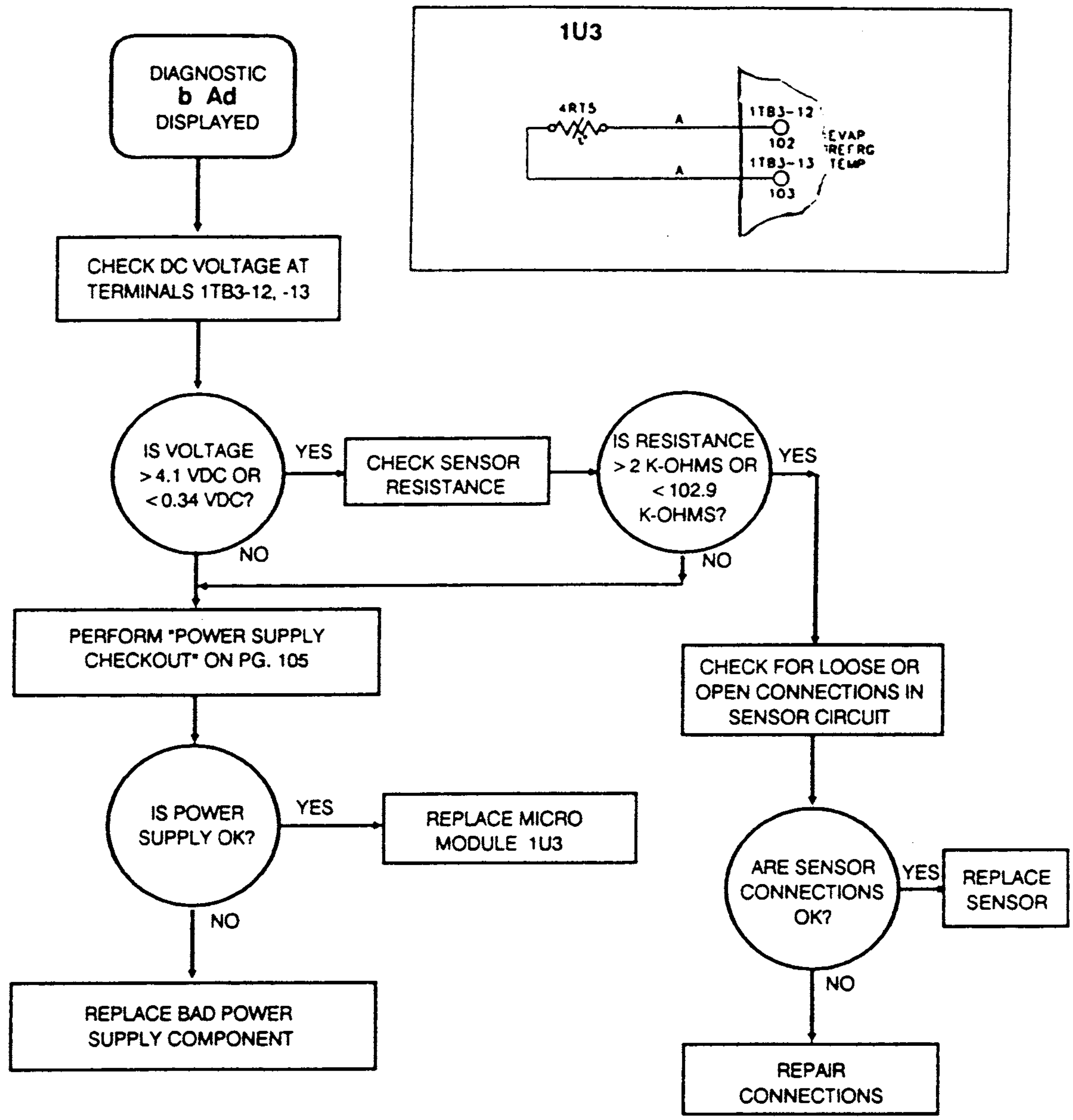
The UCP (i.e., unit control module) checks these sensor inputs before start-up; a diagnostic is generated if either sensor registers a temperature exceeding 180 F. If a **b AF** or **b b0** diagnostic occurs, check the corresponding sensor for a malfunction or electrical short. See Figure 17, page 67 for sensor checkout instructions.

b d9
Extended Power Loss

Occurrence of this nonlatching, "power-up" diagnostic indicates that the UCP detected a power loss lasting 30 line-cycles or longer. All micro inputs are fixed so that memory is retained regardless of power outage duration. No action is required.

Once power is restored, the **b d9** diagnostic is retained in the "Last Diagnostic Code" register, and the UCP automatically initiates a "power-on" reset and the chiller will return to normal operation. Power losses lasting less than 30 line-cycles are considered "momentary". See "b E2: Momentary Power Loss" for further information.

Figure 15 - Diagnostic "b Ad"
Evaporator Refrigerant Temperature Sensor



Notes:
1. Sensor voltage and resistance values are given in Table 23 on next page.
2. Micro must be reset following 4RT5 replacement.

Table 23
Sensor Conversion Data: Evaporator Refrigerant Temperature Sensor (4RT5)

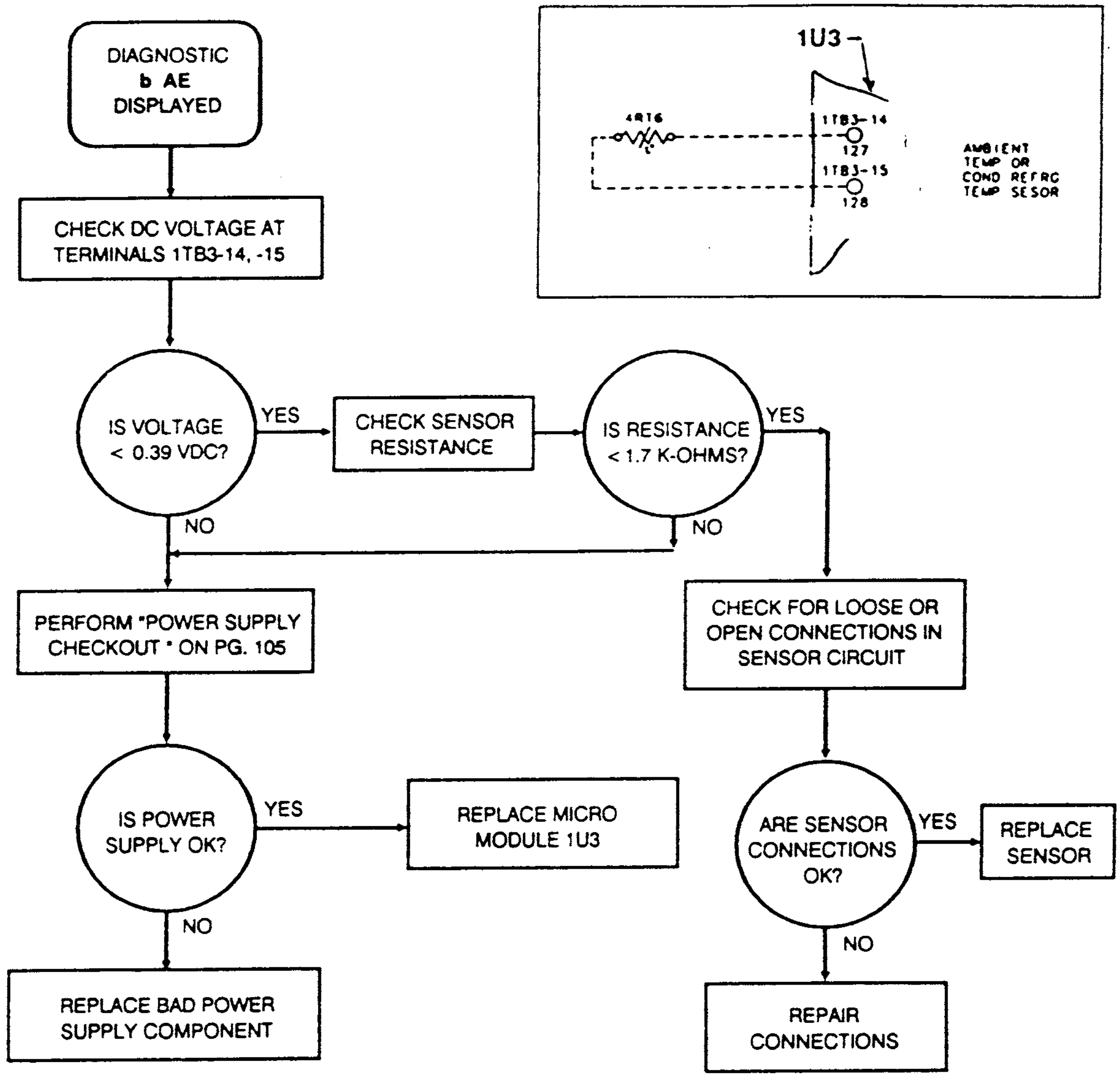
Actual Temp. (F)	Actual Resist. (Ohms)	Thermistor Voltage (Note 3)	Actual Temp. (F)	Actual Resist. (Ohms)	Thermistor Voltage (Note 3)	Actual Temp. (F)	Actual Resist. (Ohms)	Actual Voltage (Note 3)	Actual Temp. (F)	Actual Resist. (Ohms)	Actual Voltage (Note 3)
-5	102,906.40	4.082	34	31,039.07	2.693	73	11,033.81	1.429	112	4,462.27	0.690
-4	99,604.04	4.052	35	30,170.77	2.655	74	10,764.53	1.404	113	4,366.29	0.677
-3	96,417.76	4.022	36	29,329.83	2.618	75	10,502.71	1.379	114	4,272.67	0.664
-2	93,343.04	3.991	37	28,515.28	2.581	76	10,248.11	1.354	115	4,181.34	0.652
-1	90,375.79	3.960	38	27,726.22	2.545	77	10,000.51	1.330	116	4,092.24	0.640
0	87,511.82	3.928	39	26,961.78	2.508	78	9,759.70	1.305	117	4,005.31	0.628
1	84,747.29	3.896	40	26,221.09	2.471	79	9,525.47	1.282	118	3,920.49	0.616
2	82,078.42	3.864	41	25,503.33	2.435	80	9,297.62	1.258	119	3,837.72	0.604
3	79,501.66	3.831	42	24,807.73	2 [illegible]9	81	9,075.96	1.236	120	3,756.95	0.593
4	77,013.47	3.798	43	24,133.52	2.363	82	8,860.30	1.213	121	3,678.12	0.582
5	74,610.62	3.764	44	23,479.98	2.328	83	8,650.45	1.191	122	3,601.11	0.571
6	72,290.00	3.730	45	22,846.40	2.292	84	8,446.26	1.169	123	3,526.48	0.561
7	70,048.44	3.700	46	22,232.11	2.257	85	8,247.54	1.147	124	3,453.62	0.550
8	67,883.04	3.661	47	21,636.47	2.222	86	8,054.13	1.126	125	3,382.47	0.540
9	65,790.95	3.626	48	21,058.83	2.187	87	7,865.87	1.105	126	3,313.00	0.530
10	63,769.60	3.591	49	20,498.61	2.153	88	7,682.62	1.085	127	3,245.16	0.520
11	61,816.30	3.555	50	19,955.21	2.119	89	7,504.22	1.065	128	3,178.90	0.511
12	59,928.60	3.520	51	19,428.09	2.085	90	7,330.53	1.045	129	3,114.19	0.501
13	58,104.07	3.484	52	18,916.69	2.052	91	7,161.41	1.026	130	3,050.99	0.492
14	56,340.49	3.447	53	18,420.49	2.019	92	6,996.74	1.007	131	2,989.25	0.483
15	54,635.59	3.411	54	17,939.01	1.986	93	6,836.36	0.988	132	2,928.94	0.474
16	52,987.21	3.374	55	17,471.74	1.953	94	6,680.17	0.970	133	2,870.02	0.466
17	51,393.36	3.337	56	17,018.74	1.921	95	6,528.05	0.951	134	2,812.45	0.457
18	49,852.12	3.300	57	16,578.03	1.889	96	6,379.86	0.934	135	2,756.20	0.449
19	48,361.55	3.262	58	16,150.71	1.858	97	6,235.50	0.916	136	2,701.24	0.440
20	46,919.86	3.225	59	15,735.84	1.827	98	6,094.87	0.899	137	2,647.54	0.432
21	45,525.32	3.187	60	15,333.03	1.796	99	5,957.84	0.882	138	2,595.05	0.425
22	44,176.24	3.149	61	14,941.88	1.766	100	5,824.32	0.866	139	2,543.76	0.417
23	42,871.04	3.111	62	14,562.03	1.736	101	5,694.22	0.850	140	2,493.62	0.409
24	41,608.12	3.073	63	14,193.10	1.706	102	5,567.42	0.834	141	2,444.62	0.402
25	40,386.01	3.035	64	13,834.75	1.677	103	5,443.84	0.818	142	2,396.72	0.395
26	39,203.26	3.000	65	13,486.65	1.648	104	5,323.39	0.803	143	2,349.89	0.387
27	38,058.56	2.959	66	13,148.46	1.619	105	5,205.97	0.788	144	2,304.11	0.380
28	36,950.50	2.920	67	12,819.88	1.591	105	5,091.51	0.733	145	2,259.35	0.374
29	35,877.84	2.882	68	12,500.59	1.563	107	4,979.91	0.758	146	2,215.59	0.367
30	34,839.39	2.844	69	12,190.32	1.536	108	4,871.11	0.744	147	2,172.80	0.360
31	33,833.91	2.806	70	11,888.77	1.508	109	4,765.02	0.730	148	2,130.95	0.354
32	32,861.74	2.768	71	11,595.68	1.482	110	4,661.56	0.717	149	2,090.03	0.347
33	31,935.73	2.730	72	11,310.78	1.455	111	4,560.67	0.703	150	2,050.01	0.341

Notes:

1. Refrigerant temperature sensor 4RT5 is connected to 1U3 at 1TB4-12 and -13; overall accuracy is ± 0.80 F at 29 F, ± 1.0 F at 30.0 F, ± 2.0 from 0-26 F, and from 31-34 F, ± 5 F from -10 to -1 F and from 35-70 F.

2. To determine if thermistor is out of range, compare resistance or voltage readings with "actual" temperature, considering the thermometer's margin of error.

Figure 16 - Diagnostic "b AE" Ambient Temperature Sensor (Optional)



Notes:
1. Sensor voltage and resistance values are given in Table 24 on next page.
2. Micro must be reset following 4RT6 replacement.

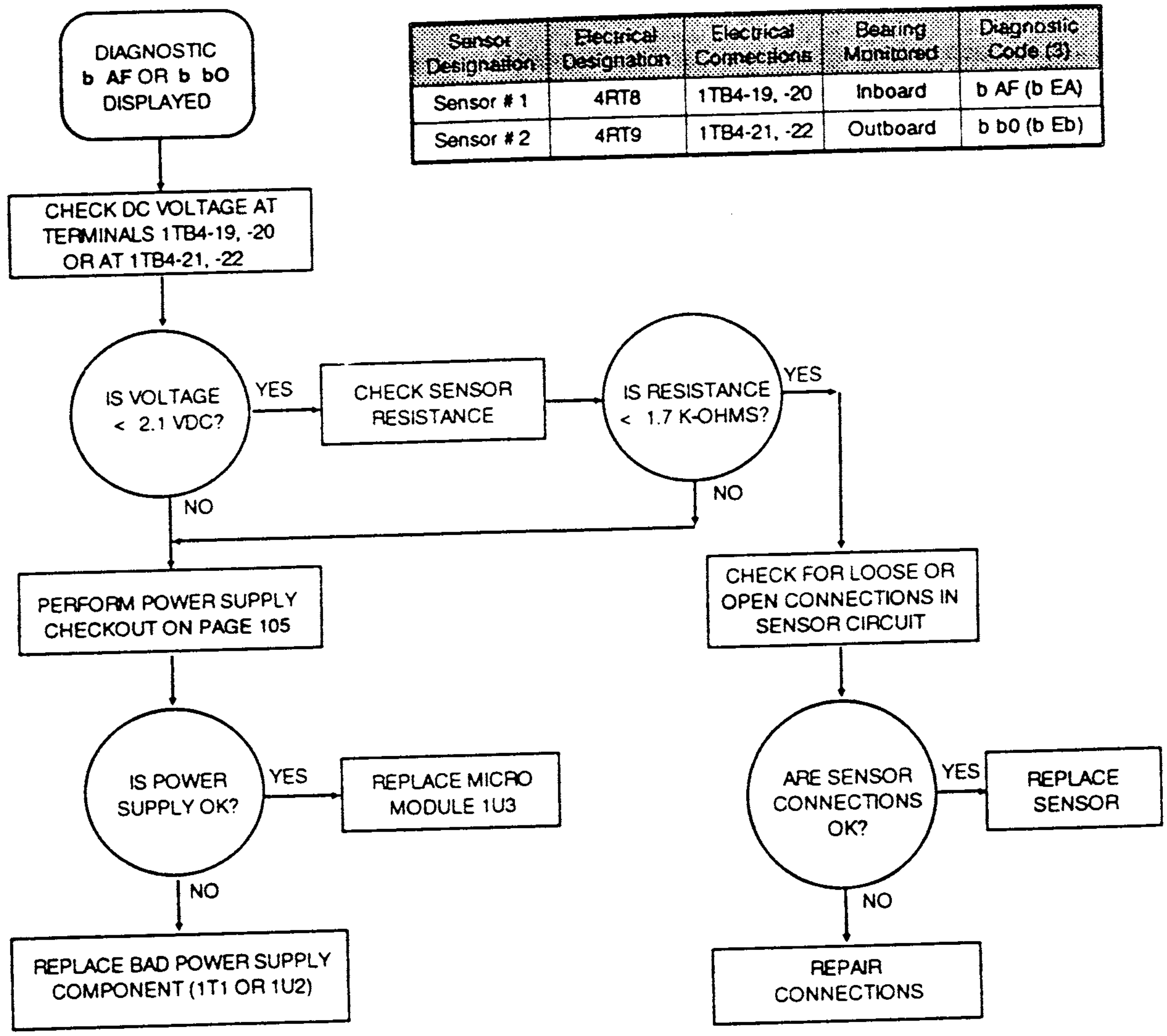
Table 24
Sensor Conversion Data: Optional Ambient Temperature Sensor (4RT6)

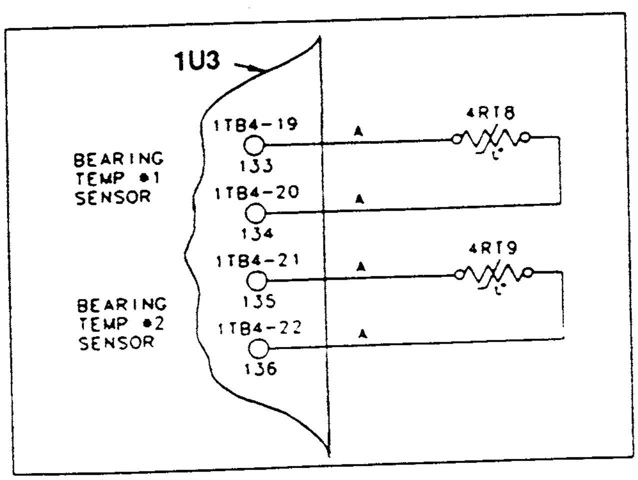
Actual Temp. (F)	Actual Resist. (Ohms)	Thermistor Voltage (Note 3)	Actual Temp. (F)	Actual Resist. (Ohms)	Thermistor Voltage (Note 3)	Actual Temp. (F)	Actual Resist. (Ohms)	Actual Voltage (Note 3)	Actual Temp. (F)	Actual Resist. (Ohms)	Actual Voltage (Note 3)
-5	102,906.40	4.449	31	33,833.91	3.201	67	12,819.88	1.900	103	5,443.84	1.007
-4	99,604.04	4.421	32	32,861.74	3.162	68	12,500.59	1.868	104	5,323.39	0.988
-3	96,417.76	4.393	33	31,935.73	3.123	69	12,190.32	1.837	105	5,205.97	0.970
-2	93,343.04	4.364	34	31,039.07	3.085	70	11,888.77	1.807	106	5,091.51	0.953
-1	90,375.79	4.335	35	30,170.77	3.046	71	11,595.68	1.777	107	4,979.91	0.935
0	87,511.82	4.305	36	29,329.83	3.008	72	11,310.78	1.747	108	4,871.11	0.918
1	84,747.29	4.274	37	28,515.28	2.969	73	11,033.81	1.718	109	4,765.02	0.902
2	82,078.42	4.244	38	27,726.22	2.931	74	10,764.53	1.688	110	4,661.56	0.885
3	79,501.66	4.212	39	26,961.78	2.893	75	10,502.71	1.660	111	4,560.67	0.869
4	77,013.47	4.181	40	26,221.09	2.885	76	10,248.11	1.631	112	4,462.27	0.853
5	74,610.62	4.149	41	25,503.33	2.816	77	10,000.51	1.604	113	4,366.29	0.838
6	72,290.00	4.116	42	24,807.73	2.778	78	9,759.70	1.576	114	4,272.67	0.822
7	70,048.44	4.083	43	24.133.52	2.741	79	9,525.47	1.549	115	4,181.34	0.807
8	67,883.04	4.050	44	23,479.98	2.703	80	9,297.62	1.522	116	4,092.24	0.793
9	65,790.95	4.016	45	22,846.40	2.665	81	9,075.96	1.496	117	4,005.31	0.778
10	63,769.60	3.982	46	22.232.11	2.628	82	8,860.30	1.470	118	3,920.49	0.764
11	61,816.30	3.948	47	21,636.47	2.591	83	8,650.45	1.444	119	3,837.72	0.750
12	59,928.60	3.913	48	21,058.83	2.553	84	8,446.26	1.419	120	3,756.95	0.736
13	58,104.07	3.878	49	20,498.61	2.517	85	8,247.54	1.394	121	3,678.12	0.723
14	56,340.49	3.843	50	19,955.21	2.480	86	8,054.13	1.369	122	3,601.11	0.710
15	54,635.59	3.807	51	19,428.09	2.444	87	7,865.87	1.345	123	3,526.48	0.697
16	52,987.21	3.771	52	18,916.69	2.407	88	7,682.62	1.321	124	3,453.62	0.694
17	51,393.36	3.734	53	18,420.49	2.372	89	7,504.22	1.300	125	3,382.47	0.672
18	49,852.12	3.698	54	17,939.01	2.336	90	7,330.53	1.275	126	3,313.00	0.660
19	48,361.55	3.661	55	17,471.74	2.300	91	7,161.41	1.252	127	3,245.16	0.648
20	46,919.86	3.623	56	17,018.23	2.265	92	6,996.74	1.230	128	3,178.90	0.636
21	45,525.32	3.590	57	16,578.03	2.231	93	6,836.36	1.208	129	3,114.19	0.625
22	44,176.24	3.548	58	16,150.71	2.196	94	6,680.17	1.186	130	3.050.99	0.614
23	42,871.04	3.510	59	15,735.84	2.162	95	6,528.05	1.165	131	2,989.25	0.602
24	41,608.12	3.472	60	15,333.03	2.128	96	6,379.86	1.144	132	2,928.94	0.592
25	40,386.01	3.434	61	14,941.88	2.094	97	6,235.50	1.123	133	2,870.02	0.581
26	39,203.26	3.395	62	14,562.03	2.061	98	6,094.87	1.103	134	2,812.45	0.571
27	38,058.56	3.357	63	14,193.10	2.028	99	5,957.84	1.083	135	2,756.20	0.560
28	36,950.50	3.318	64	13,834.75	1.995	100	5,824.32	1.063	—	—	—
29	35,877.84	3.279	65	13,486.65	1.963	101	5,694.22	1.044	—	—	—
30	34,839.39	3.240	66	13,148.46	1.931	102	5,567.42	1.025	—	—	—

Notes:
1. Optional ambient temperature sensor 4RT6 is connected to 1U3 at 1TB3-14 and -15; overall accuracy is ± 3 from 0-70 F, ± 5 F from -5 to 0 F, ± 8 F from 70-135 F .**2.** To determine if thermistor is out of range, compare resistance or voltage readings with "actual" temperature, considering the thermometer's margin of error. **3.** As you compare a thermistor resistance (or input voltage) reading with the actual temperature indicated by the thermometer, be sure to consider the precision of the thermometer when you decide whether or not the thermistor is out of range.

Figure 17 - Diagnostics "b AF" and "b bO" Bearing Temperature Sensors (Optional)

Sensor Designation	Electrical Designation	Electrical Connections	Bearing Monitored	Diagnostic Code (3)
Sensor # 1	4RT8	1TB4-19, -20	Inboard	b AF (b EA)
Sensor # 2	4RT9	1TB4-21, -22	Outboard	b b0 (b Eb)





Notes:
1. Sensor voltage and resistance values are given in Table 20 on page 58.
2. Micro must be reset following 4RT8 or 4RT9 replacement.
3. Diagnostic codes **b AF** and **b bO** occur only during non-operating modes; diagnostics **b EA** and **b Eb** are "running" diagnostics that are generated whenever the UCP detects a high bearing temperature (i.e., > 180 F).

b dA
Surge

Occurrence of latching diagnostic **b dA** indicates that the UCP detected a surge condition during unit operation. Surge detection is based on current fluctuations in one of the three motor phases. To trigger the surge diagnostic, 5 fluctuations exceeding a special RMS-average current value and rate must occur within a 60-second time frame.

Initial detection of surge results in the energizing of an optional head relief request relay (i.e., K3 on relay output module 1U1). If the surge condition continues for 15 minutes, the UCP shuts down unit operation on latching diagnostic **b dA**.

"Surge" results from an unusually high pressure differential across the compressor. A partial list of chiller operating conditions that can produce surge is provided below:

[ ] high condenser water temperature
[ ] excessive air in the unit;
[ ] insufficient condenser water flow;
[ ] fouled condenser tubes; and,
[ ] a shortage of refrigerant.

If the unit locks out on a surge diagnostic, check for--and correct--these problem conditions before restarting the chiller.

Note: To override the surge protection (and phase imbalance) feature, move DIP switch no. 7 on DIP switch block S3 to the ON position.

b dc
Condenser Water Flow Overdue

During the start sequence, the UCP closes condenser water pump relay K6 (i.e., located between terminals 1TB1-4 and 1TB1-5 on relay output module 1U1). Closure of the K6 contacts issues a signal to start the condenser water pump. As the UCP checks for condenser water flow, the operating code appearing on the display changes from **A 70** (restart inhibit) to **A 71** (establish condenser water flow).

If flow is not proven (i.e., condenser water flow switch 5S3 does not close) within 3 minutes of K6 contact closure, the unit will shut down on latching diagnostic **b dc**.

A number of component malfunctions and operating problems can result in a "condenser water flow overdue" diagnostic; below is a partial list:

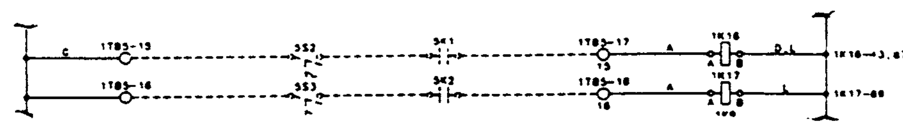
1. faulty condenser water pump relay (K6);
2. faulty condenser water pump contactor (5K2);
3. faulty condenser water pump auxiliary contactor (5K2);
4. faulty condenser water flow switch (5S3);
5. faulty condenser water pump relay (1K17);
6. closed condenser water circuit valves;
7. condenser water circuit valves are open to too many machines; and,
8. plugged condenser water circuit strainers.

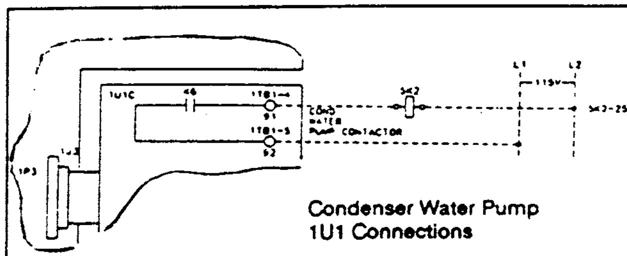
Before restarting the chiller, determine why condenser water flow was not established and correct the problem.

Note: To troubleshoot the condenser water pump electrical circuit, (i.e., Items 1 through 5 above), refer to Figure 18 on the next page.

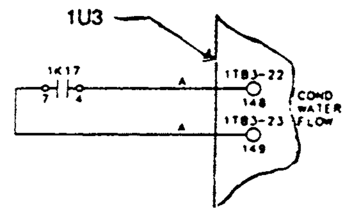
Figure 18 - Diagnostic "b dc" Condenser Water Flow Overdue

Electrical Schematic - Condenser Water Pump Circuit





Condenser Water Pump
1U1 Connections



DIAGNOSTIC **b dc** DISPLAYED

IS WATER PUMP RUNNING?
- YES → CHECK DC VOLTAGE AT TERMINALS 1TB3-22, -23 → IS VOLTAGE > 0.7 VDC?
  - YES → MEASURE AC VOLTAGE AT 1K17 COIL → DOES 1K17 COIL HAVE 115 VAC?
    - YES → REPLACE 1K17 RELAY
    - NO → MEASURE AC VOLTAGE AT TERMINALS 1TB5-16, -2 → IS 115 VAC PRESENT?
      - YES → CHECK FLOW SWITCH, PUMP AUXILIARY & ALL WIRING
      - NO → CHECK FUSE 1F2 AND WIRING
  - NO → PERFORM POWER SUPPLY CHECKOUT ON PAGE 105
- NO → IS 1U1 CLOSED?
  - YES → CHECK WATER PUMP WIRING AND STARTER
  - NO → CHECK DC VOLTAGE AT TERMINALS 1P3-3, -11 → IS VOLTAGE BETWEEN .85-1.6 VDC?
    - NO → PERFORM POWER SUPPLY CHECKOUT ON PAGE 105 → IS POWER SUPPLY OK?
      - YES → REPLACE MICRO MODULE 1U3
      - NO → REPLACE BAD POWER SUPPLY COMPONENT (1T1 OR 1U2)

b E2
Momentary Power Loss

Occurrence of this nonlatching diagnostic indicates that there was a brief loss of power. The CT input to the micro must drop below 15% of RLA for a period of at least 2 or 3 line-cycles in order for the micro module to detect it; 1U3 will then take the chiller off-line within 6 line-cycles (i.e., including detection time). Momentary power losses of this type are usually caused by an automatic switching gear in the main power lines.

A power loss lasting from 1 to 30 line-cycles results in a normal unit shutdown (i.e., the oil pump continues to run). The UCP undergoes a "power-on" reset and follows the normal start-up criteria. Diagnostic **b E2** is then stored in the "Last Diagnostic Code" entry of the display menu.

If the power interruption lasts more than 30 line-cycles, the UCP identifies this as an "extended power loss" and initiates a "power-on" reset after power is restored. The **b d9** diagnostic is retained in the "Last Diagnostic Code" register, and the unit follows the normal start-up criteria (e.g., restart inhibit, differential-to-start, etc.). (See "b d9: Extended Power Loss".) To troubleshoot an occurence of this diagnostic, refer to Figure 19 on the next page.

Note: The UCP identifies a "momentary power loss" condition when the incoming current is below 15% of the rated load amps (RLA) and the "main run" starter contactor (2K1) is closed.

b E3
Phase Imbalance (Optional)

Latching diagnostic **b E3** occurs when a phase imbalance exceeding 23% occurs. The UCP recognizes that a phase imbalance condition exists when the following criteria are met:

[ ] the chiller is operating in one of the "run" modes (see Table 2, page 9);
[ ] the average 3-phase current is greater than 80% of the RLA;
[ ] the imbalance exists for longer than 1 second; and,
[ ] the percent of imbalance is greater than 23%.

Note: The percent of imbalance is calculated using this equation--

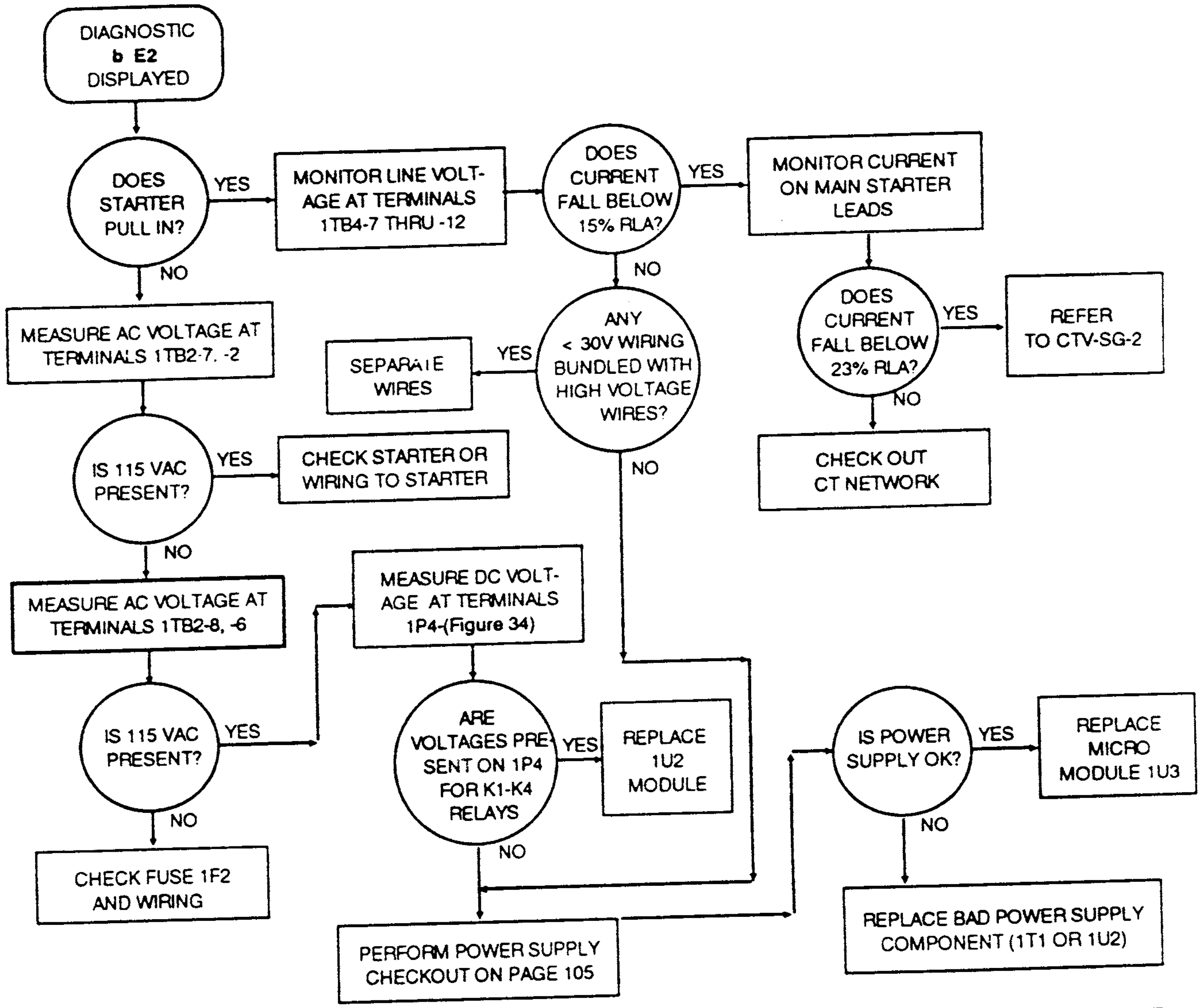
$$\frac{I_{Ph\#} - I_{Avg}}{I_{Avg}} \times 100$$

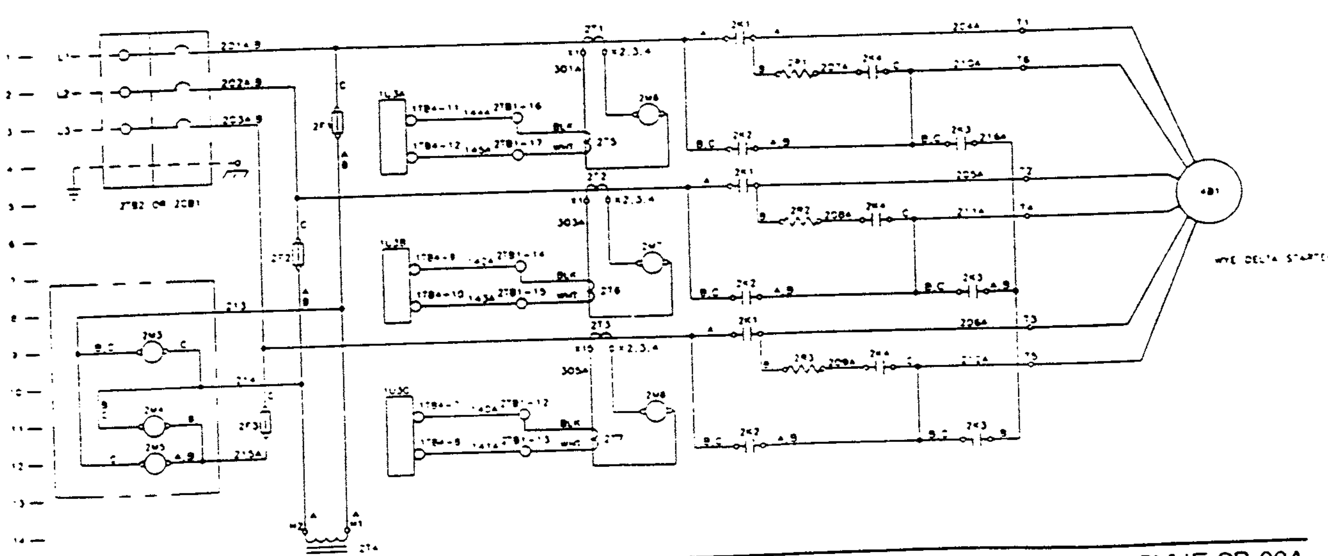
where $I_{Ph\#}$ is one of the 3 phases, and $I_{Avg} = \frac{IPh1 + IPh2 + IPh3}{3}$

Two possible (but not the only) causes of a phase imbalance are: (1) a voltage imbalance of the incoming power, and (2) a resistance imbalance of the compressor motor windings. (The latter is very rare because of the stringent specifications employed by the motor manufacturer during the winding and testing of new motors.)

If unit is equipped with an optional PFCC be sure to check for proper wire routing or refer to CVHE-IN-6 for additional information on PFCC.

Figure 19 - Diagnostic "b E2" Momentary Power Loss





To determine whether the fault lies with the line power or the motor, follow this procedure:

WARNING: To prevent injury or death due to electrical shock, use extreme care when working with energized electrical equipment.

Note: Amperage measured must be line current (not phase current), and should be measured at the line side of the starter (i.e., incoming power lines). Measure voltage at the motor terminals while the unit is operating; any voltage imbalance related to the starter or to wiring resistance will be included in the imbalance calculations.

1. Voltage imbalance can be caused by a voltage drop across any of the starter panel components:

a. Measure voltage across each of the starter components to the motor terminals on each phase while the unit is operating.

b. Use the low (i.e., 0 to 5 volts) scale of a volt-ohmmeter to read the voltage on either side of the same electrical phase on all contactors, fuses, circuit breakers, leads, etc. There should not be any appreciable voltage drop across any of these circuits.

If a measured voltage drop is observed across a lead or contactor, a poor connection or worn contact is indicated. Repair or replace as necessary.

c. If the results of Steps 1a and 1b indicate that the voltage imbalance is not caused by the starter or motor leads, contact the power company.

2. If there is a current imbalance with no measurable voltage imbalance, determine whether a motor or line problem exists. To do this, rotate the motor leads to verify whether the current imbalance stays with one particular motor winding, or follows one set of phase leads as the wires are rotated. Operate the motor just long enough to obtain current readings. (Since some motors have unidirectional bearings, rotate the motor leads twice to maintain proper motor rotation.)

If the current imbalance follows one set of phase leads, the incoming power is at fault and may be the result of unbalanced impedance or resistance somewhere in the power system.

Contact the power company for assistance.

If the current imbalance remains with a particular motor winding, contact the La Crosse Service Department with complete nameplate information.

Note: To override the phase imbalance (and surge) feature, move DIP switch no. 7 on DIP switch block S3 to the ON position.

b E4
Phase Loss

Occurrence of this latching diagnostic indicates that 1 leg of the 3-phase power supply has been lost. The phase loss "threshold" recognized by the UCM is any phase that drops below 15% of the RLA for more than 1 second.

A variety of causes can result in a phase loss condition; three of these include: (1) a blown fuse or breaker in one leg; (2) an incomplete or open line connector to one leg; and (3) a burned or open motor winding.

Be sure to determine and correct the fault condition that created the phase loss before restarting the unit.

b E5
Phase Reversal

Latching diagnostic **b E5** is generated by the UCM within 1 second of its detection of a counterclockwise phase rotation in the incoming power. (For proper machine operation, the incoming power must be phased for clockwise rotation.)

Possible reasons for a phase reversal condition include--but are not limited to--these:

1. incoming power is phased for counterclockwise rotation;

2. current transformer polarity (i.e., primary or secondary) is reversed;

3. a current transformer wiring error; and,

4. an electrical connection error between the current transformer and micro module 1U3.

If phase rotation is incorrect, the unit will shut down on the **b E5** diagnostic when a start-up is attempted. To reverse the rotation, change the phasing at the incoming power to the starter. Do not attempt to change rotation at the motor terminals!

WARNING: To prevent injury or death due to electrical shock, open chiller disconnect switch before reversing phasing.

If you determine that the incoming power is phased correctly, conduct a thorough checkout of the current transformer polarity and wiring. (Current transformer checkout is provided in the "Checkout Procedure for Compressor Transition Relay" section of this bulletin.)

b E7
High Motor Temperature

Three RTD-type sensors embedded in the motor windings enable the UCM to monitor the temperature of the compressor motor. If the UCM detects a motor winding temperature exceeding 265 F (i.e., ± 15 F, UCM error only), it initiates a latching diagnostic. Code **b E7** flashes on the control panel display and the unit is shut down.

Below is a list of some of the circumstances that can result in a "high motor temperature" diagnostic:

1. inaccurate sensor response or open sensor (i.e., check the sensors and micro module 1U3);

2. plugged motor cooling orifice;

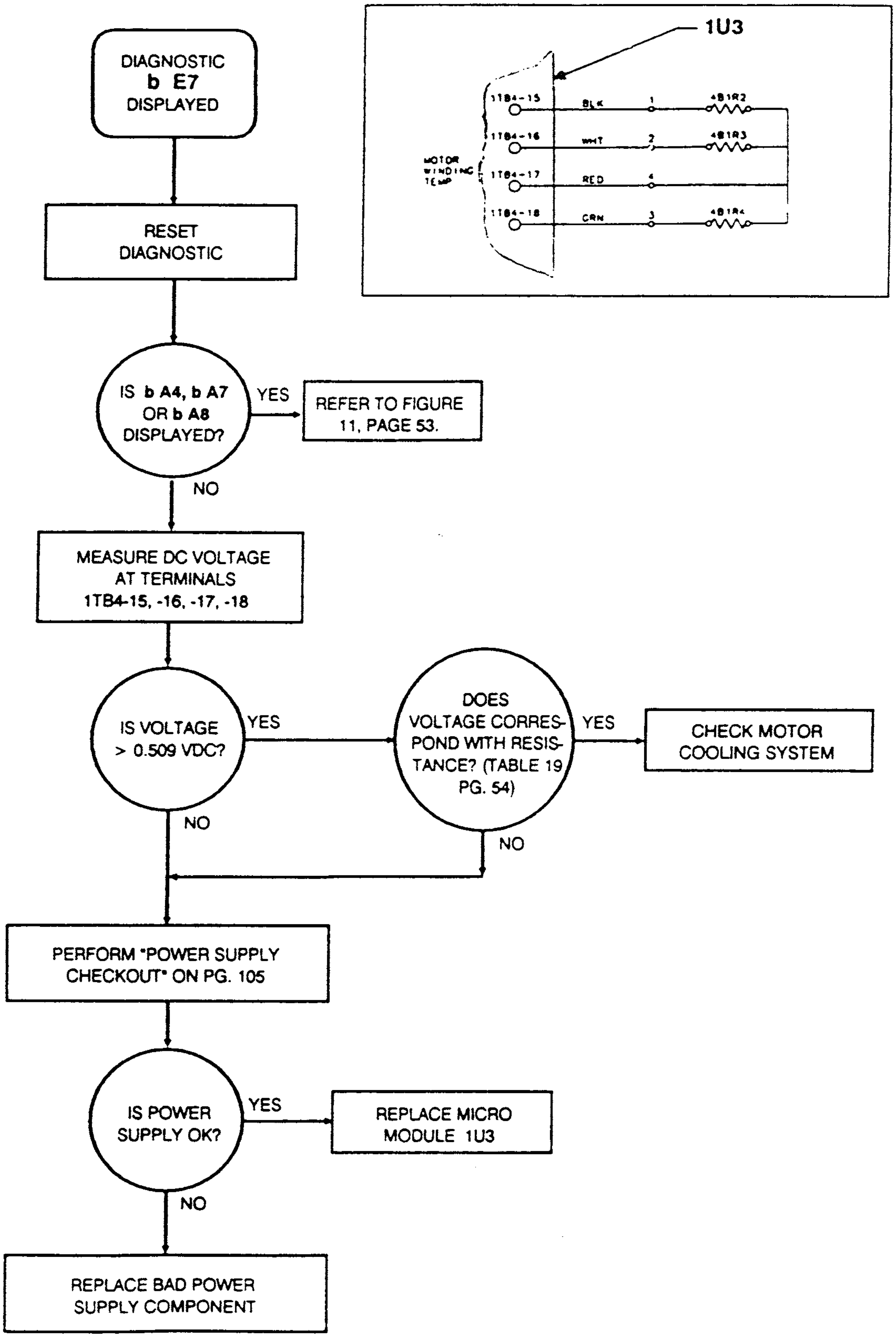
3. plugged motor cooling drain lines;

4. "low voltage" condition, resulting in over-amperage; and,

5. motor operation in excess of the RLA.

To diagnose an occurence of this diagnostic, refer to Figure 20 on the next page.

Figure 20 - Diagnostic "b E7" High Motor Temperature



b E8
Differential Oil Pressure Switch

One of the UCP695 control panel's safety features requires micro module 1U3 to check the status of the differential oil pressure switch (1S2) between compressor starts: it must open after each compressor shutdown. If switch 1S2 does not open before the UCM initiates oil pump operation during the next unit start sequence, a latching diagnostic occurs. Code **b E8** flashes on the display and the chiller start sequence is aborted. This diagnostic condition will occur if the oil pump switch (i.e., on the control panel front) is set at "On" when a start-up is attempted. To diagnose an occurence of this diagnostic, refer to Figure 21 on the next page.

To check for proper operation of switch 1S2, monitor terminals 1TB4-1 and 1TB4-2 while manually starting and stopping the oil pump with the oil pump switch. If 1S2 is functioning correctly, the differential oil pressure switch will close when the pressure differential rises to 15 psid and open when it falls to 9 psid. Before condemning micro module 1U3, ensure that the contacts of switch 1S2 are clean and dry, and that there are no wiring errors (e.g., a strand crossover at the terminal strip).

Note: Diagnostic **b E8** normally occurs only during the chiller start sequence. It does not occur when a low oil pressure condition is detected. (See "b F2: Low Oil Pressure".)

b E9
Stop Relay

This latching diagnostic is generated if you attempt to shut down the chiller, but the UCM continues to detect current; when this situation occurs, the UCM takes the chiller off-line by opening the overload relay.

During the normal stop sequence, the micro module opens both the stop relay (1U2K2) and the overload relay (1U2K3), which interrupts the "run" signal to the starter. If the motor current does not drop to zero when the "run" signal is interrupted, the micro module will display the latching diagnostic **b E9**.

Probable causes for a **b E9** diagnostic include:

a. failure of starter pilot relay 2K5;
b. failure of main starter contactors 2K1 and 2K2;
c. failure of control modules 1U3 and/or 1U2.

Note: The **b E9** diagnostic indicates a serious problem with the control system. If the module is displaying the **b E9** diagnostic and the chiller is still running, operation will have to be interrupted using the main disconnect switch. Use caution when opening the disconnect as they generally are not designed to interrupt large current flows.

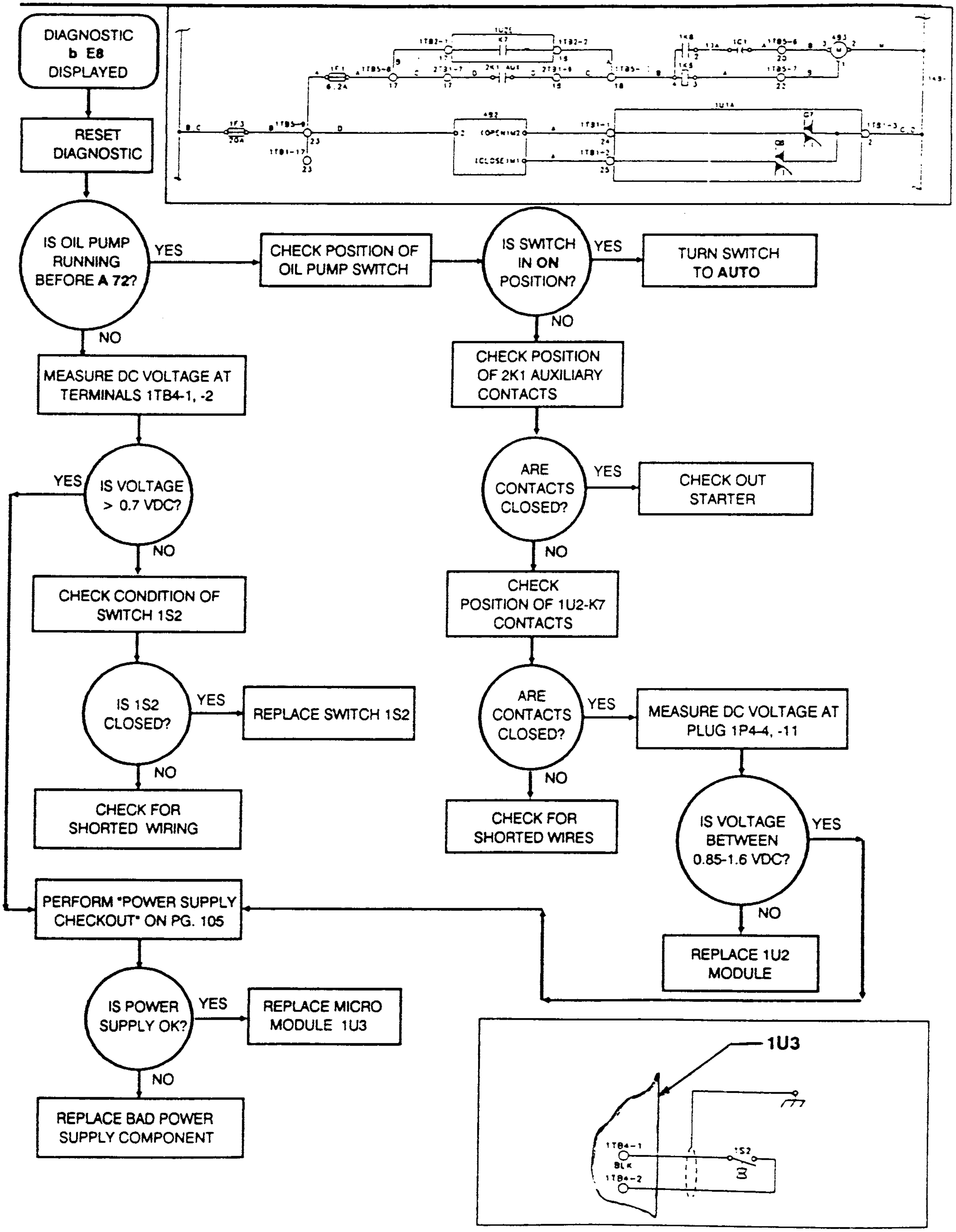
1. With the main disconnect open, inspect the starter contactors 2K1, 2K2, 2K3, 2K4 and 2K5. If any of these contactors are in the closed position, determine what caused the failure and correct it. Be certain that none of the contactors are closed or can pass current through their contacts before continuing.

WARNING: To prevent personal injury or death due to electrocution, be certain that contacts of starter contactors are open.

2. Remove Wire #3 from the starter-side of 2TB1-3 in the starter panel. (**Note**: This wire provides the control voltage to the starter circuit through the N.O. 2K5 relay contacts.)

3. With the chiller switch in the STANDBY/RESET position, close the main disconnect switch to energize the control panel.

Figure 21 - Diagnostic "b E8" Differential Oil Pressure Switch



4. Check and record the voltages at the following pins on ribbon connector 1P4:

a. Pin 5 with respect to Pin 14 = should be 0.0-0.1 VDC;
b. Pin 7 with respect to Pin 14 = should be 0.0-0.1 VDC;
c. Pin 8 with respect to Pin 14 = should be 0.85 to 1.6 VDC.

i) If any of the measured voltages are out of range, module 1U3 is bad; replace it.
ii) If the measured voltages are in range, go to Step 5.

5. Check the control voltage at Terminals 1TB2-9 and 1TB2-8 with respect to Terminal 1TB5-3.

i) If control voltage is not present at 1TB2-9, check fuses 1F2 and 1F4, and the power supply transformer 2T4.
ii) If control voltage (115 VAC) is measured at both terminals, 1U2 is bad; replace it.
iii) If control voltage is measured at 1TB2-9 but not at 1TB2-8, go to Step 6.

6. If no problems have been found in the previous steps, the problem may be intermittent. The following items may help isolate the problem:

a. With the start signal disconnected from the starter (as in Step 2), run the chiller through the normal start sequence. Confirm that pilot relay 2K5 pulls in momentarily and then drops out. Non-latching diagnostic **b E2** should be displayed.

b. Perform the starter "dry run" procedure as described in the "Initial Start-Up Procedure" section of the appropriate service guide. Confirm that all contactors are reacting in the proper sequence. Check the resistance through the main contactors to confirm their proper operation. Repeat the sequence several times.

b EA, Eb
High Bearing Temperature (Optional Sensors # 1, # 2)

The occurrence of latching diagnostic **b EA** or **b Eb** indicates that one of the optional bearing temperature sensors registered a leaving oil temperature (from the motor bearings) exceeding the 180 F trip point.
If the UCP detects a high bearing temperature:

1. Check bearing temperature sensors 4RT8 and 4RT9 for proper operation using the checkout instructions in Figure 17 on page 67.

Note: Determine which bearing (i.e., inboard or outboard) is running hot by noting which sensor tripped. See Table 20 on page 58. Shorting 4RT8 or 4RT9 at the sensor should result in a sensor failure diagnostic (i.e., b AF or b b0). Be sure to allow enough time for the sensor slew rate to "catch up" (i.e., 5 minutes, maximum).

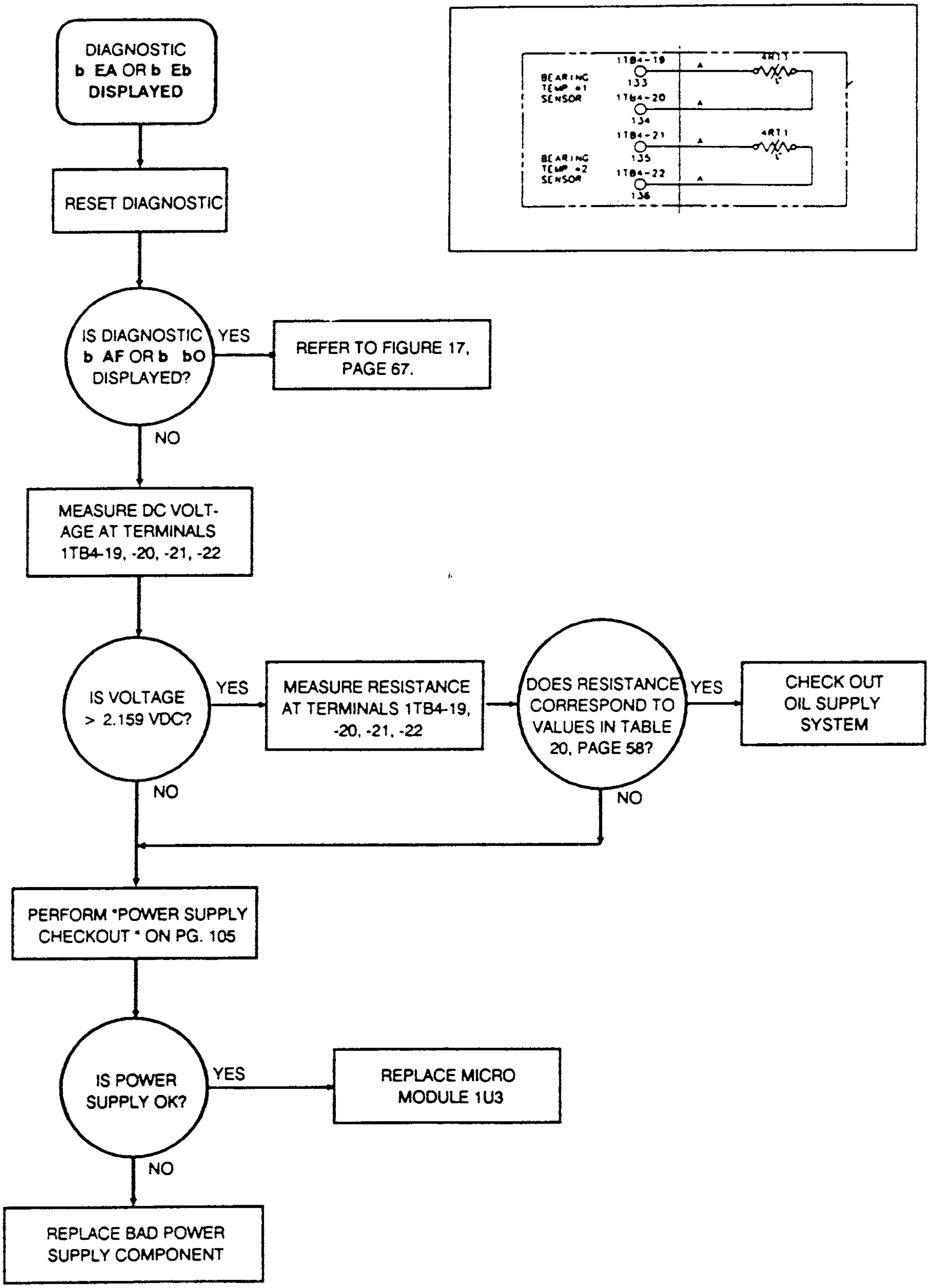
2. Check the oil sump temperature. Normal sump temperature ranges are 140 to 145 F when the unit is off, and 115 to 150 F while the chiller is running.

If the oil sump temperature reading is above the normal range:

a. Check the oil cooler for proper operation (CVHE 036 thru 125 only).
b. Verify that the oil heater control is functioning correctly. (See "b F4: High Oil Temperature".)

Other possible causes of a high bearing leaving oil temperature include: (1) an insufficient flow of oil to the bearings, and (2) a progressive bearing failure. Refer to the diagnostic chart in Figure 22 on the next page.

Figure 22 - Diagnostics "b EA" & "b Eb" High Bearing Temperature (Optional)



b EC
Running Overload

Latching diagnostic **b EC** is generated by the UCM when the average 3-phase current drawn by the compressor motor exceeds 107% of the RLA. The "time-to-trip" interval graduates from 20 seconds at 107% RLA to 1 second at 140% RLA

Chiller control near the compressor RLA is comprised of a 5-step "corrective action" control sequence designed to minimize the likelihood of overload lockouts caused by normal operating fluctuations in amperage. The 5 steps in this corrective action sequence are: (1) vane opening limited; (2) vane opening prevented; (3) modulated vane closure; (4) "hard" vane closure; and, (5) chiller shutdown on latching diagnostic **b EC**.
A motor overload may result from a vane control failure or a motor/bearing failure, though these are not the only possible causes of an overload condition.

b Ed
Chilled Water Flow

Code **b Ed** represents a nonlatching diagnostic condition caused when the chilled water flow interlock circuit opens. A built-in time delay of 2 seconds (i.e., maximum without flow) is designed to eliminate nuisance tripouts caused by a fluttering flow switch.

Because this diagnostic is nonlatching, the chiller automatically attempts to restart when the interlock circuit closes. The **b Ed** code is then stored in the "Last Diagnostic Code" register of the display menu. Manual (i.e., from a remote source) start-up of the chilled water pump(s) is required.

Use the steps outlined below to determine why the chilled water flow diagnostic occurred (Also, refer to the diagnostic chart in Figure 23 on the next page):

1. Verify that the chilled water pump is turned on.

a. If the pump is not running, check for blown fuses, open disconnect switches, etc.
b. If the pump is running, check for closed valves and plugged strainers. Also, ensure that pump capacity is sufficient to handle all of the chillers piped into the chilled water circuit.

2. Check the status of chilled water flow switch 5S2; if it is open, see Step 1b. In addition, be sure that the proper pressure drop is provided to the unit. If the flow rate is correct, flow switch 5S2 may be defective.

3. Check the status of the chilled water pump contactor auxiliary (5K1); it should be closed whenever the pump is running.

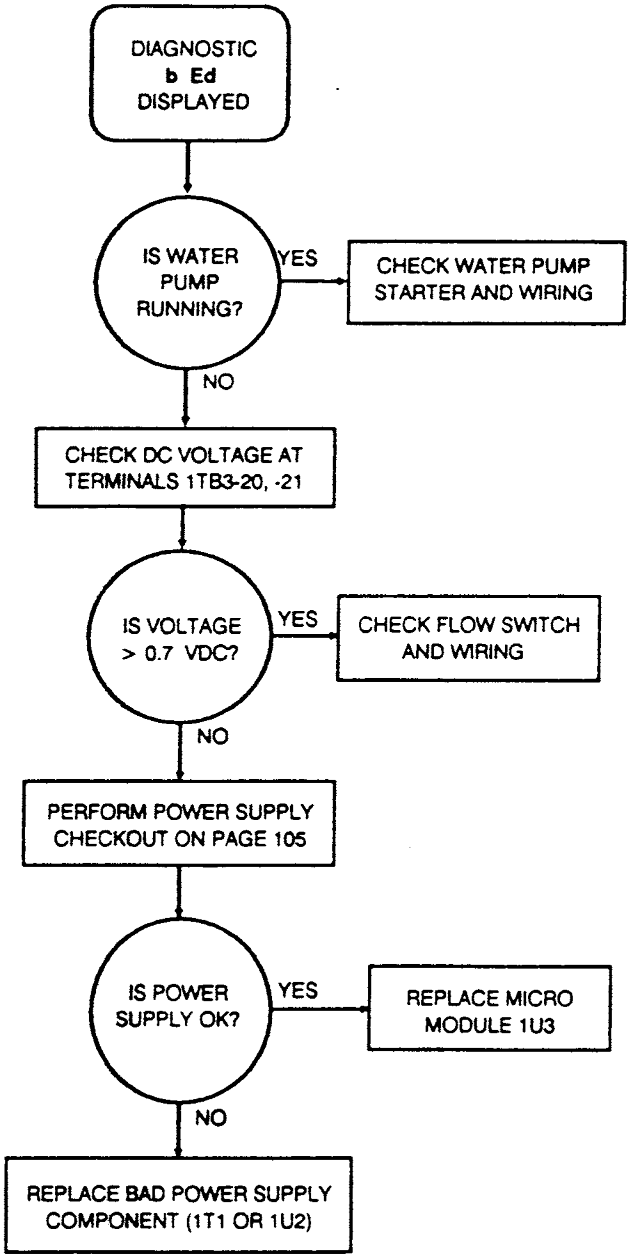
4. Verify that chilled water pump relay 1K16, is energized and that its contacts are closed. Relay 1K16's contacts are connected between terminals 1TB3-20 and 1TB3-21 on micro module 1U3.

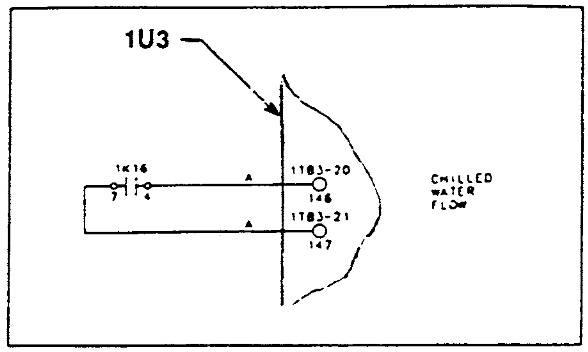
5. Determine whether micro module 1U3 is functioning correctly. To do this, install a jumper between terminals 1TB3-20 and 1TB3-21, and set the chiller switch at one of the AUTO positions.

If the **b Ed** diagnostic code is cleared from this display, 1U3 is operating properly. However, if **b Ed** remains on the display, micro module 1U3 is defective and must be replaced.

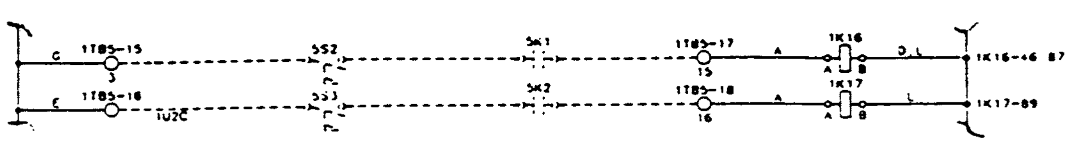
Caution: To ensure proper chiller protection, never start the unit when the chilled water flow interlock circuit is jumpered! If jumper installation clears the diagnostic, remove the jumper immediately. If the diagnostic does not clear within three (3) minutes, remove the jumper and replace 1U3.

Figure 23 - Diagnostic "b Ed" Chilled Water Flow





Electrical Schematic - Water Pump Interlock Circuit



b EE
Exceeded Maximum Acceleration Time

This latching diagnostic occurs when motor amperage draw does **not** drop to 85% of the compressor RLA within the acceleration time limit. Long acceleration times result from a greater-than-normal load on the compressor during the start sequence. Possible causes for this increased load include--but are not limited to--these:

[ ] Maximum acceleration time setpoint is incorrectly set.
Check the positions of switches 1 through 5 on DIP switch block S3; see "b A5: Maximum Acceleration Time Range".

[ ] Inlet guide vanes are not fully closed.
This may be the result of an improperly adjusted actuator, broken linkage, sheared linkage pins, or inlet vane damage.

[ ] Warm evaporator and a cool condenser.
This condition creates a high differential pressure across the compressor, and forces a greater-than-normal flow of refrigerant gas through it.

[ ] Transition relay K5 (i.e., on power supply output module 1U2) fails to close.

If the compressor motor amperage draw drops below 85% of the RLA during the start sequence but the motor fails to transition, follow the transition relay checkout instructions in on page 96

b FO
Transition

Latching diagnostic **b FO** occurs when the starter fails to complete transition. Micro module 1U3 monitors the status of a normally-open set of auxiliary contacts on the "run" contactor (2K2). (Relay 2K2 is located in the starter panel.) If these contacts do not close within 2 seconds after the transition signal is sent to the starter, the UCM shuts down unit operation on the **b FO** diagnostic. The auxiliary on contactor 2K2 is tied to terminals 2TB1-10 and 2TB1-11 in the starter panel and-- from there--to terminals 1TB4-5 and 1TB4-6 on micro module 1U3 in the unit control panel). Refer to the typical wiring schematics on pages 46 thru 49. Among the possible reasons for a failure to transition are these:

[ ] Faulty wiring or bad connections in the proof-of-transition circuit.

WARNING: To prevent injury or death due to electrical shock, disconnect main starter power supply before checking this circuit.

[ ] Defective "run" contactor auxiliary (2K2).
Check for closure of the 2K2 auxiliary contacts when the main contactor closes.

[ ] Defective compressor transition relay (K5; located on power supply output module 1U2 in the unit control panel).

Note: Micro module 1U3 will not generate a **b FO** diagnostic unless it sees the conditions necessary for transition and initiates the transition signal.

Monitor the status of the K5 relay contacts at terminals 1TB2-5 and 1TB2-6 on power supply output module 1U2. If the K5 contacts do not close, follow the transition relay troubleshooting instructions on page 96. If the K5 contacts do close, the problem lies either in the starter or in the wiring connections to the starter. Use the "Electrical Sequence of Operation" in the unit Operation/ Maintenance manual and the wiring diagrams provided with the starter as a guide for determining proper starter operation.

b F1
Running External Interlock (Optional) or HGBP High Discharge Temperature Switch (4S5)

Units w/o Hot Gas Bypass

The UCM generates latching diagnostic condition **b F1** when the field-supplied and -installed run spare fault switch (5S4) closes during chiller operation. This switch input becomes active 1 second after transition, but is ignored by micro module 1U3 before and during start-up.

In the event that a **b F1** diagnostic occurs, check the electrical connections made at terminals 1TB4-3 and 1TB4-4. Verify that these terminals are not jumpered, and that the device connected to them--if any--is functioning properly. Refer to the diagnostic chart in Figure 24 on the next page.

If the external circuit appears to be okay, remove the wires from 1TB4-3 and 1TB4-4 and operate the chiller. Disappearance of the **b F1** diagnostic indicates that the problem is somewhere in the external circuit, while its reoccurrence implies that micro module 1U3 is defective and must be replaced.

Units w/Hot Gas Bypass

A temperature-monitoring device is located on the compressor discharge line of units equipped with optional hot gas bypass. If the discharge temperature rises above 210 F, this device closes its contacts and causes the chiller to shut down on latching diagnostic **b F1**.

Check the operation and setpoint of high discharge temperature switch 4S5; if the switch is functioning properly, the hot gas bypass valve requires adjustment to correct the high discharge temperature condition.

If unit operation and the external circuit appear to be okay, remove the wires from 1TB4-3 and 1TB4-4 and operate the chiller. Disappearance of the **b F1** diagnostic indicates that the problem is somewhere in the external circuit, while its reoccurrence implies that micro module 1U3 is defective and must be replaced.

Caution: High discharge temperature switch 4S5 must be reconnected into the circuit after test is complete. Unit operation without 4S5 connected can result in serious machine damage.

Note: Refer to Figure 24. Run spare fault switch 5S4 is connected at the same terminals used for the hot gas bypass temperature switch (4S5). A unit cannot be factory-equipped with both of these optional switches, but may be modified ~~in the field~~ so that both 5S4 and 4S5 are wired in parallel to terminals 1TB4-3 and 1TB4-4.

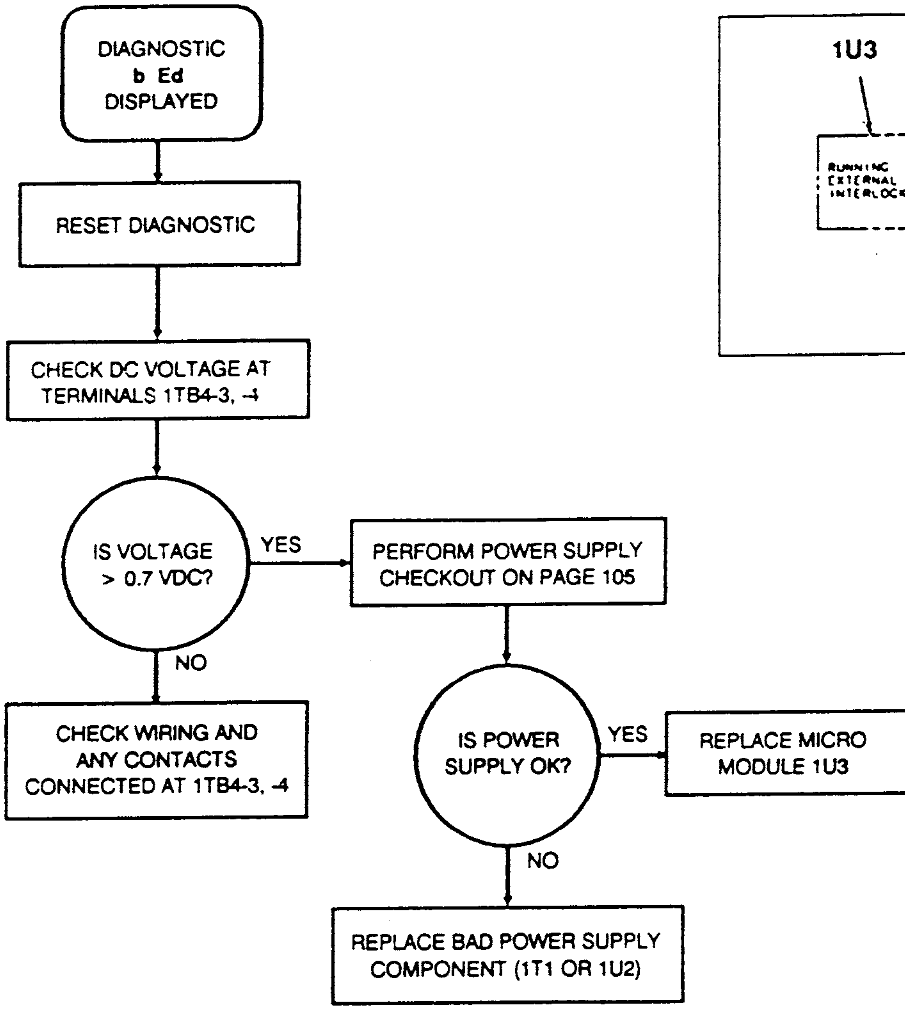
b F2
Low Oil Pressure

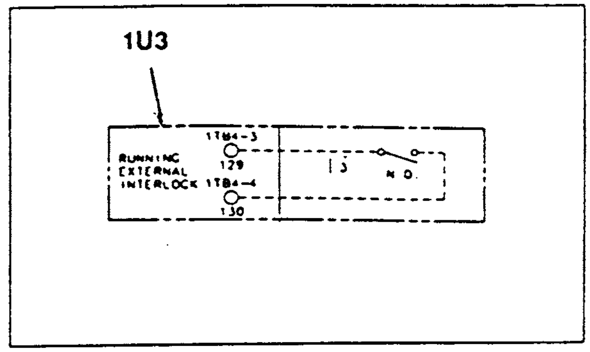
Latching diagnostic **b F2** indicates that the UCM detected a problem with the oil pressure either at start-up or during the run mode.

Micro module 1U3 starts the oil pump during the chiller start-up routine by closing the K7 oil pump relay contacts on power supply output module 1U2. 1U3 then monitors the contacts of the differential oil pressure (1S2) for closure; as soon as they close, 1U3 starts a 15-second timer.

If the 1S2 contacts remain closed throughout this 15-second interval, a "start" signal is sent to the starter. However, if the contacts open during this period, the timer is reset to zero and the 1S2 contacts must close again to reactivate the timer. In the event that the 15-second timer is not satisfied within 48 seconds of the initial K7 contact closure, the start sequence is aborted on a **b F2** latching diagnostic.

Figure 24 - Diagnostic "b F1" Running External Interlock





This diagnostic will also occur if the differential oil pressure switch (1S2) opens during any of the run modes of operation.

Note: Switch 1S2 should be adjusted to close on a differential pressure of 15 psid, and open when the pressure differential falls to 9 psid. Also, if 1S2 is wired properly, it is connected between terminals 1TB4-1 and 1TB4-2 on micro module 1U3 in the unit control panel.

To diagnose an occurrence of a **b F2** code, refer to Figure 25 and the following procedure. Determine whether or not the oil pump is operational. If the oil pump motor (4B5) will not run, it may be the result of–but not limited to–one of the malfunctions listed below. (If the oil pump does run but fails to build sufficient pressure, go to Item 3.)

1. Defective oil pump relay (K7).

Verify that oil pump relay K7 on power supply output module 1U2 is functioning correctly. To do this:

a. Remove the wires from terminals 1TB2-1 and 1TB2-2.

WARNING: To prevent injury or death due to electrical shock, open chiller disconnect before removing leads from terminals.

b. Check for continuity between these terminals while switching the oil pump switch (on the control panel front) between the ON and AUTO positions.

c. If the K7 contacts do not close when the oil pump switch is set at ON, check the voltage at pins 4 and 14 on ribbon connector 1P4. These voltage readings should be observed:

Oil Pump Switch "Off" = 0.0 VDC min. to 0.1 VDC max.
Oil Pump Switch "On" = 0.85 VDC min. to 1.6 VDC max.

If these voltages are not obtained, micro module 1U3 is defective and must be replaced.

If these voltages are observed and the (1U2)K7 relay still does not operate, power supply output module 1U2 is defective and must be replaced.

d. If the oil pump runs (and the oil pressure is satisfactory) when the oil pump switch is set at ON (manual mode) but does not operate during the start-up sequence, monitor the K7 relay as described in Step 1c to verify whether 1U3 is sending a "start" signal to the oil pump.

2. Oil pump motor-related problem. Check for:

[ ] a blown oil pump fuse (1F1) in the unit control panel;
[ ] faulty wiring and loose or broken connectors;
[ ] a blown oil pump capacitor (1C1);
[ ] a defective oil pump starter relay (1K8);
[ ] the resistance of the oil pump motor windings with the motor leads removed. Resistance readings obtained should be as follows:

2.2 ohms between terminals 1 and 2 (run);
4.8 ohms between terminals 1 and 3 (start); and,
7.0 ohms between terminals 2 and 3.

WARNING: To prevent injury or death due to electrical shock, open chiller disconnect switch before reversing motor leads.

Proceed to Items 3 through 7 if a check of the oil pump motor reveals that the oil pump runs but does not build sufficient pressure.

3. Low oil level.

Check the oil level in the sump using the 2 sight glasses provided in the oil sump head. Add oil as necessary to raise the level to better than half of the lower sight glass while the pump is running.

4. Oil sump temperature is out of range.

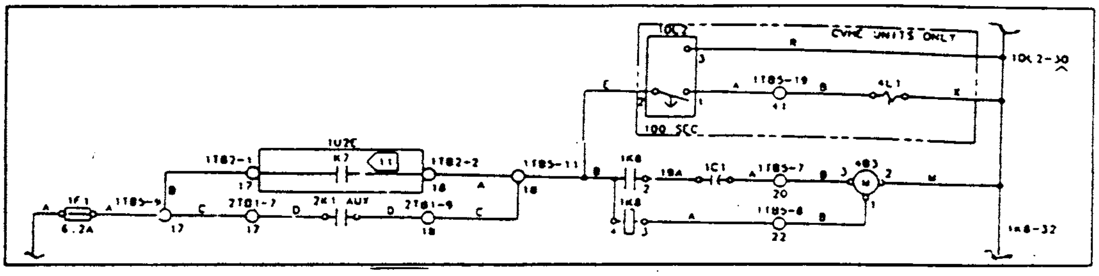
Check oil temperature at the sump; the temperature should be 140 to 145 F when the chiller is shut down, and 115 to 150 F while the unit is running.

5. Faulty or improperly adjusted oil pressure regulator.

With the unit off, adjust the oil pressure regulator to provide 20 to 22 psid. Then monitor the pressure change during the chiller start and run modes to verify that the reulator is working properly.

6. Defective differential oil pressure switch (1S2).

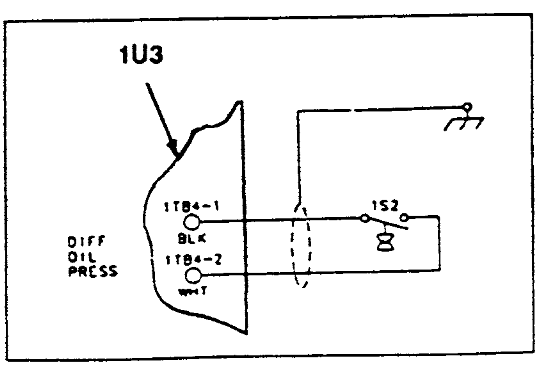
Figure 25 - Diagnostic "b F2" Low Oil Pressure



DIAGNOSTIC b F2 DISPLAYED

RESET DIAGNOSTIC

DOES OIL PRESSURE DROP < 9 PSI?
- YES: MEASURE AC VOLTAGE AT TERMINALS 1TB5-8, -2
  - IS 115 VAC PRESENT?
    - YES: CHECK OIL PUMP AND LUBRICATION SYSTEM
    - NO: MEASURE AC VOLTAGE AT TERMINALS 1TB2-2 & 1TB5-2
      - IS 115 VAC PRESENT?
        - YES: CHECK WIRING FROM 1TB2-2 TO OIL PUMP MOTOR
        - NO: MEASURE AC VOLTAGE AT TERMINALS 1TB2-1 & 1TB5-2
          - IS 115 VAC PRESENT?
            - YES: CHECK WIRING AND FUSES 1F1 & 1F3
            - NO: MEASURE DC VOLTAGE AT PLUG 1P4-4, -14
              - IS VOLTAGE BETWEEN 0.85-1.6 VDC?
                - (YES): REPLACE 1U2 MODULE
                - NO: PERFORM POWER SUPPLY CHECKOUT ON PAGE 105
- NO: MEASURE DC VOLTAGE AT TERMINALS 1TB4-1, -2
  - IS VOLTAGE > 0.7 VDC?
    - YES: CHECK DIFFERENTIAL PRESSURE SWITCH AND WIRING
    - NO: PERFORM POWER SUPPLY CHECKOUT ON PAGE 105
      - IS POWER SUPPLY OK?
        - YES: REPLACE MICRO MODULE 1U3
        - NO: REPLACE BAD POWER SUPPLY COMPONENT (1T1 OR 1U2)



Monitor the status of switch 1S2's contacts while manually starting and stopping the oil pump with the oil pump switch. Check for a broken switch, bad contacts, and plugged pressure- sensing lines.

7. Defective oil pump.

a. Disconnect the high oil pressure gauge and connect a pressure gauge capable of registering 100 psi in its place.

b. Remove and cap bearing oil supply lines (i.e., the oil pump is "deadheaded" except for the relief bypass).

c. Start the oil pump and tighten down the oil pressure regulator adjusting screw completely to increase oil pressure.

d. Check the pressure gauge installed in Step 7a; the oil pressure should exceed 60 psi.

If the oil pressure does not exceed 50 psi--and the regulator is blocking all bypass flow, the oil pump is faulty and must be replaced.

Note: The oil pump is a positive-displacement-type device designed to pump at a rate of 2 to 3 gallons per minute. Since "deadheading" will cause the motor amp draw to rise, run the pump only long enough to complete the test.

b F3
Low Oil Temperature

(This diagnostic provided on CVHE units, "1C" and later design sequences only ; CVHB units, "1D" and later design sequences only; and all CVHF units with UCP695.)

An occurence of this of this non-latching diagnostic indicates that the oil temperature sensor 4RT7 is sensing a temperature less than 100 F. Micro module 1U3 will not allow a chiller start with an existing oil temperature that is lower than 100 F. When oil temperature rises above 100 F, the UCP will initiate a start sequence. In the even that a **b F3** diagnostic occurs, the following steps may be necessary:

1. Wait for oil temperature to rise above 100 F. If temperature does not increase in a reasonable amount of time, check for proper oil heater and control operation as follows (refer to appropriate wiring schematics for the chiller).

a. Check Fuse 1F2.

b. Check condition of oil heater. Check for voltage to the heatrer, burned out heater, loose connections or machanical problem.

c. Determine acutal oil temperature using oil temperature sensor 4RT7, located in the bulbwell at the rear of the oil sump. Read voltages on terminals 1TB3-13, -14 on micro module 1U3. Convert this voltage DC to temperature, using Table 20 on page 58. If the actual temperature does not agree with the measured resistance of if the measured resistance does not agree with the thermistor voltage, perform the power supply checkout procedure on page 105. If the power supply is functioning properly, replace the oil temperature sensor.

d. Check for proper operation of 1U2-K6, and the 1K9 relay. Some UCP micro panels do not use a 1K9 relay.

e. Confirm that the micro issending a signal to the oil heater relay K6. Measure the DC voltage on Pins 2, -14 of ribbon connector 1P4. If oil temperature is less than 100 F, this voltage should be 0.85-1.6 VDC.

b F4
High Oil Temperature

Occurrence of this latching diagnostic indicates that oil temperature thermistor 4RT7 sensed a temperature exceeding 180 F during chiller operation. This sensor is located in a bulbwell at the rear of the oil sump, and its leads are connected to terminals 1TB4-13 and 1TB4-14 on micro module 1U3.

In the event that a "high oil temperature" (**b F4**) diagnostic occurs, refer to Figure 26 on the next page and:

1. Check the oil temperature at the sump to determine if it is normal. Use the checkout instructions in Figure 13 on page 57 to verify that 4RT7 is functioning correctly.

2. If the oil temperature measured in Step 1 is excessive, check the oil heater for proper operation.

a. Oil heater relay K6 (i.e., on power supply output module 1U2) should energize when sump temperature is less than 140 F, and de-energize when it exceeds 145 F.

Note: Oil heater operation is governed by the temperature the UCM "sees" at sensor 4RT7. The temperature observed on the gauge located on the oil sump may not match the temperature measured by 4RT7. When troubleshooting the oil heater circuit, always read the voltage at terminals 1TB4-13 and 1TB4-14 and convert this voltage to a temperature (Table 20 on page 58).

b. If the sump temperature is greater than 145 F and oil heater relay (1U2)K6 is closed, determine: (1) if micro module 1U3 is calling for the contact closure, and (2) whether power supply output module 1U2 is defective.

To do this:

(1) Measure the DC voltage signal at pins 2 and 14 of ribbon connector 1P4. The following voltage readings should be observed:

Relay (1U2)K6's contacts <u>open</u> = 0.0 VDC min. to 0.1 VDC max.
Relay (1U2)K6's contacts <u>closed</u> = 0.85 VDC min. to 1.6 VDC max.

(2) If the status of the K6 relay contacts does not match the voltage signals shown above, power supply output module 1U2 is defective and must be replaced.

If 1U3 is sending a "closed" signal to K6 (i.e., a voltage signal of 0.85 to 1.6 VDC) and sensor 4RT7 is functioning properly--and is reading a temperature above 145 F, then micro module 1U3 is defective and must be replaced.

Note: To "force" micro module control of oil heater relay K6, substitute fixed resistances for oil temperature sensor 4RT7. For example:

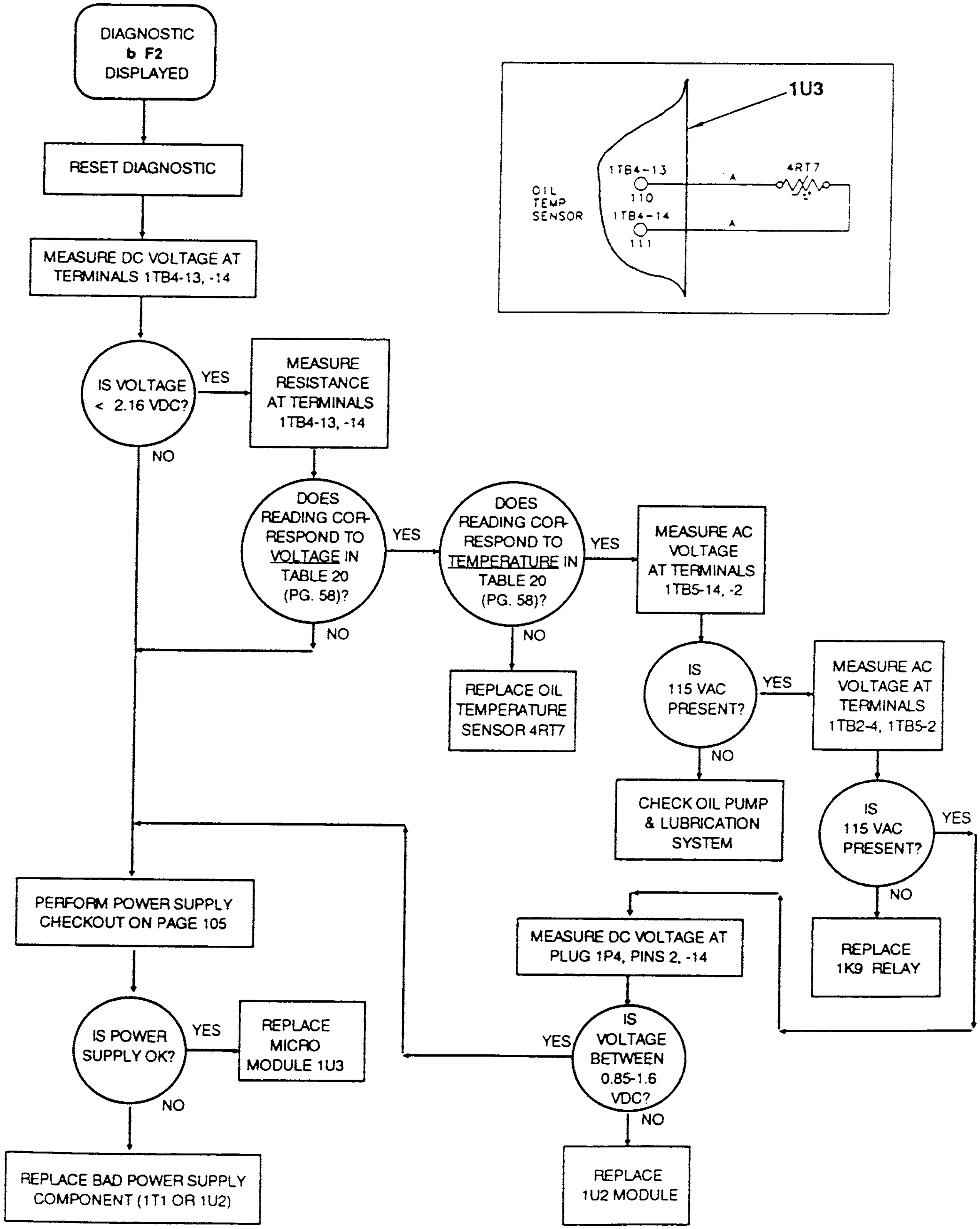
Relay (1U2)K6 should <u>open</u> at 2,000 ohms = 151.5 F;
Relay (1U2)K6 should <u>close</u> at 3,000 ohms = 131.5 F.

Be sure to allow sufficient time for micro module 1U3 to respond (i.e., 5 minutes).

Caution: To prevent possible equipment damage, remove fixed resistances and reconnect sensor 4RT7 as soon as the tests are complete.

3. Check for machine operating conditions that could result in an increased oil temperature. (See "b EA, Eb: High Bearing Temperature" for possible causes.)

Figure 26 - Diagnostic "b F4"
High Oil Temperature



b F5
High Condenser Pressure

This diagnostic indicates that the condenser high pressure switch (1S1) has closed its N.O. contacts, indicating excessive condenser pressure. 1S1 is located in the control panel and is connected to output module 1U2 via the 1J2 connector cable. Note that all 3 leads from 1S1 (common, N.O. and N.C.) must be connected to 1U2 for proper operation.

1. Check for operating conditions that would drive the condensing pressure upward. These include — but are not limited to:

[ ] air or noncondensibles in the machine (check the purge);
[ ] low condenser water flow;
[ ] condenser water temperature too high;
[ ] fouled condenser tubes.

If no operational problems can be found, the pressure switch should be checked for proper operation.

a. Check all wiring connections for accuracy and tightness. See the appropriate wiring diagram.
b. Connect the pressure switch to a source of compressed air or nitrogen through a pressure regulator. Slowly increase the pressure from 0 psi to the trip pressure (15 $\pm$ 1 psi standard; 25 $\pm$ 1 psi ASME). If the switch does not operate at the trip pressure, recalibrate or replace it.

b F7
Condenser Water Flow

This diagnostic indicates that the condenser water flow interlock circuit opened during chiller operation.

Note: This diagnostic is nonlatching; therefore, chiller restart will be attempted. If condenser water is still not available upon restart, the chiller will shut down on the latching diagnostic **b dC** (condenser water flow overdue).

Start-up of the condenser water pump is normally done by the chiller during the start-up sequence.

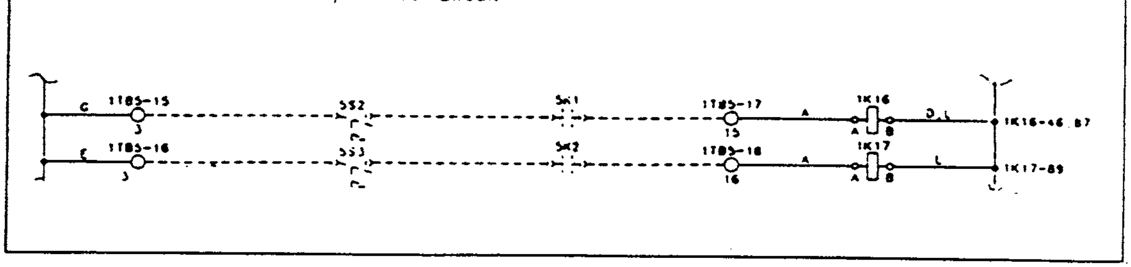
Possible causes of a **b F7** diagnostic include:

[ ] closed condenser water valves;
[ ] low condenser water flow;
[ ] plugged condenser water system filters;
[ ] faulty condenser water pump relay (K6);
[ ] faulty condenser water pump contactor (5K2);
[ ] faulty condenser water pump contactor auxiliary (5K2);
[ ] faulty condenser water pump relay (1K17);
[ ] faulty condenser water flow switch (5S3).

To troubleshoot an occurrence of a **b F7** diagnostic, refer to the procedure in Figure 27 on the next page.

Figure 27 - Diagnostic "b F7" Condenser Water Flow

Electrical Schematic - Water Pump Interlock Circuit



DIAGNOSTIC b F7 DISPLAYED

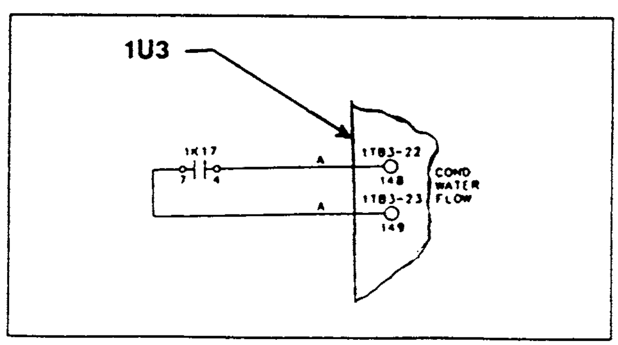
→ RESET DIAGNOSTIC

→ IS CONDENSER WATER PUMP RUNNING?

- YES → MEASURE DC VOLTAGE AT TERMINALS 1TB3 -22, -23 → IS VOLTAGE > 0.7 VDC?
  - YES → CHECK OUT FLOW SWITCH AND WIRING
  - NO → PERFORM "POWER SUPPLY CHECKOUT" ON PG. 105
- NO → MEASURE AC VOLTAGE AT TERMINALS 1TB1-4, -5 → IS 115 VAC PRESENT?
  - YES → CHECK OUT WATER PUMP STARTER AND WIRING
  - NO → MEASURE DC VOLTAGE AT PLUG 1P3, PIN-3, -11 → IS VOLTAGE BETWEEN 0.85-1.6 VDC?
    - YES → REPLACE 1U1 MODULE
    - NO → PERFORM "POWER SUPPLY CHECKOUT" ON PG. 105

PERFORM "POWER SUPPLY CHECKOUT" ON PG. 105 → IS POWER SUPPLY OK?

- YES → REPLACE MICRO MODULE 1U3
- NO → REPLACE BAD POWER SUPPLY COMPONENT



b F8
Improper Unit Identification

This diagnostic indicates that the micro was configured for a different type of chiller than it is installed on. Check the unit I.D. switches on DIP switch S9 for proper position. See "Factory DIP Switch Settings" starting on page 22.

If the switches are set in the correct positions and the diagnostic will not clear, try moving the switches up and down several times. This may clear any oxidation that may have formed on the switches.

If the diagnostic still does not clear, replace micro module 1U3.

b F9
Free Cooling Valves

This diagnostic occurs when the free cooling valves do not close prior to a powered cooling start. Free cooling valves 4B12 and 4B13 have full-closed end switches wired in series and connected to Terminals 1TB3-18 and 1TB3-19 of the 1U3 module. Prior to a powered cooling start, the FC valves are given a "close" signal via the normally-closed contacts of relay 1U1K1. If the valve end switches do not close within the preset 3-minute time period, the **b F9** diagnostic will result.

Possible causes of a **b F9** diagnostic include:

[ ] end switches are not properly adjusted;
[ ] free cooling valves(s) jammed;
[ ] signal to close valves not being sent either because:

- 1U1K1 relay malfunction
- 1U3 not calling for 1U1K1

Troubleshooting the **b F9** diagnostic:

1. Set chiller switch at STANDBY/RESET and free cooling switch at OFF.

2. Check the free cooling valve end switch circuit.

Remove wires 118 and 119 from Terminals 1TB3-18, -19. Check for continuity through the end switch circuit.

a. If continuity exists, then the valves have closed, but the 1U3 module does not recognize the closure. Replace the 1U3 micro module.

Note: Whenever 1U3 replacement is indicated, always perform the power supply checkout procedure.

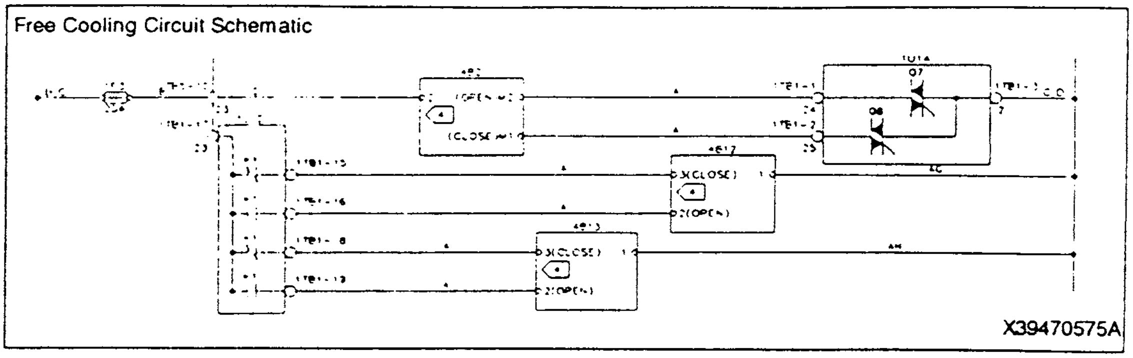
b. If there is no continuity, go to Step 3.

3. Check for power at Terminal 1TB1-17.

a. If there is no power, check Fuse 1F3 and the power supply wiring.

b. If there is power, go to Step 4.

Figure 28 - Diagnostic "b F9"
Free Cooling Valves



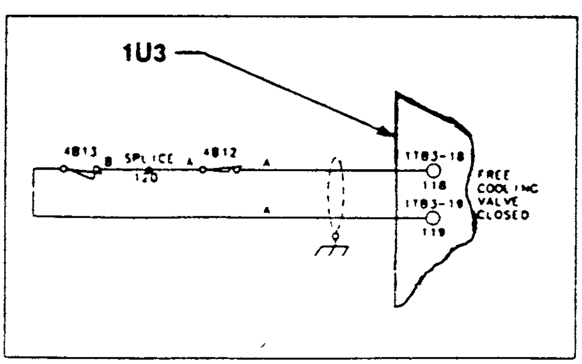
DIAGNOSTIC b F9 DISPLAYED

RESET DIAGNOSTIC

CHECK DC VOLTAGE AT TERMINALS 1TB3-18, -19

IS VOLTAGE > 0.7 VDC?

- YES → MEASURE AC VOLTAGE AT 1TB1-15, 1TB5-2 AND AT 1TB1-18, 1TB5-2
  - IS 115 VAC PRESENT AT THESE TERMINALS?
    - YES → CHECK FC VALVES, END SWITCHES AND WIRING
    - NO → CHECK AC VOLTAGE AT TERMINALS 1TB1-17 & 1TB5-2
      - IS 115 VAC PRESENT AT THESE TERMINALS?
        - YES → CHECK DC VOLTAGE AT PLUG 1P1-9, -10
          - IS VOLTAGE BETWEEN 0.85-1.6 VDC?
            - YES → REPLACE 1U1 MODULE
            - NO → PERFORM POWER SUPPLY CHECKOUT ON PAGE 105
        - NO → CHECK WIRING AND FUSE 1F3
- NO → PERFORM POWER SUPPLY CHECKOUT ON PAGE 105
  - IS POWER SUPPLY OK?
    - YES → REPLACE MICRO MODULE 1U3
    - NO → REPLACE BAD POWER SUPPLY COMPONENT (1T1 OR 1U2)



4. Check for power at both terminals, then check the free cooling valves for faulty end switches for incomplete operation.

a. If there is power at both terminals, then check the free cooling valves for faulty end switches or incomplete operation.

b. If there is no power at either or both terminals, go to Step 5.

5. Check for a voltage signal at ribbon cable 1P3, Pin 9 (with respect to Pin 11).

a. If voltage is less than 0.1 VDC, then relay output module 1U1 is bad; replace it.

Note: Whenever 1U1 replacement is indicated, always perform the power supply checkout procedure first!

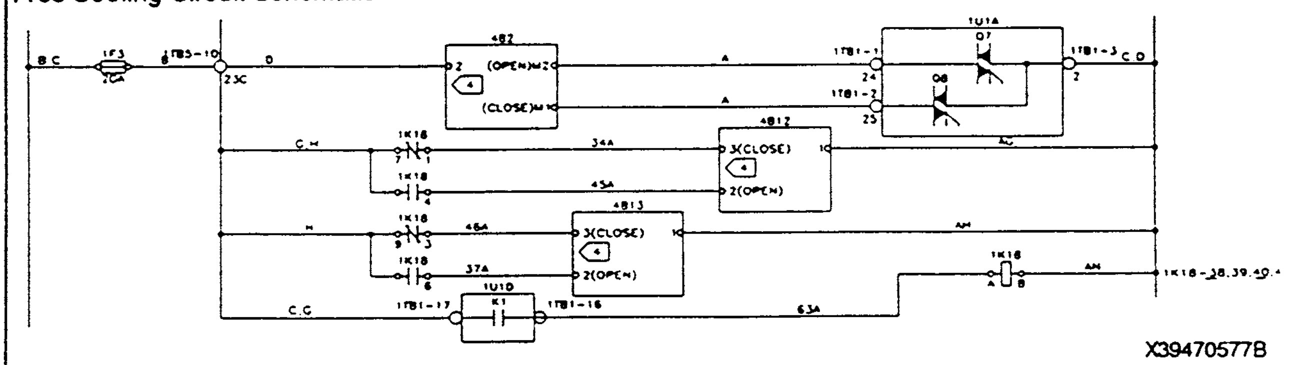
b. If voltage is greater than 0.5 VDC <u>and</u>:

— the chiller switch is in the STANDBY/RESET or AUTO/LOCAL position, <u>and</u>
— the free cooling switch is set at the OFF position;

then, micro module 1U3 is bad and must be replaced.

Note: Whenever 1U3 replacement is indicated, always perform the power supply checkout procedure first!

Free Cooling Circuit Schematic



IMPORTANT: After April 1992 the 1K1 relay in the 1U1 module is no longer used to actuate the free cooling valve. The 1K1 relay is now used to close a heavier relay 1K18 as shown above in X39470577B.

b FA
Actuator

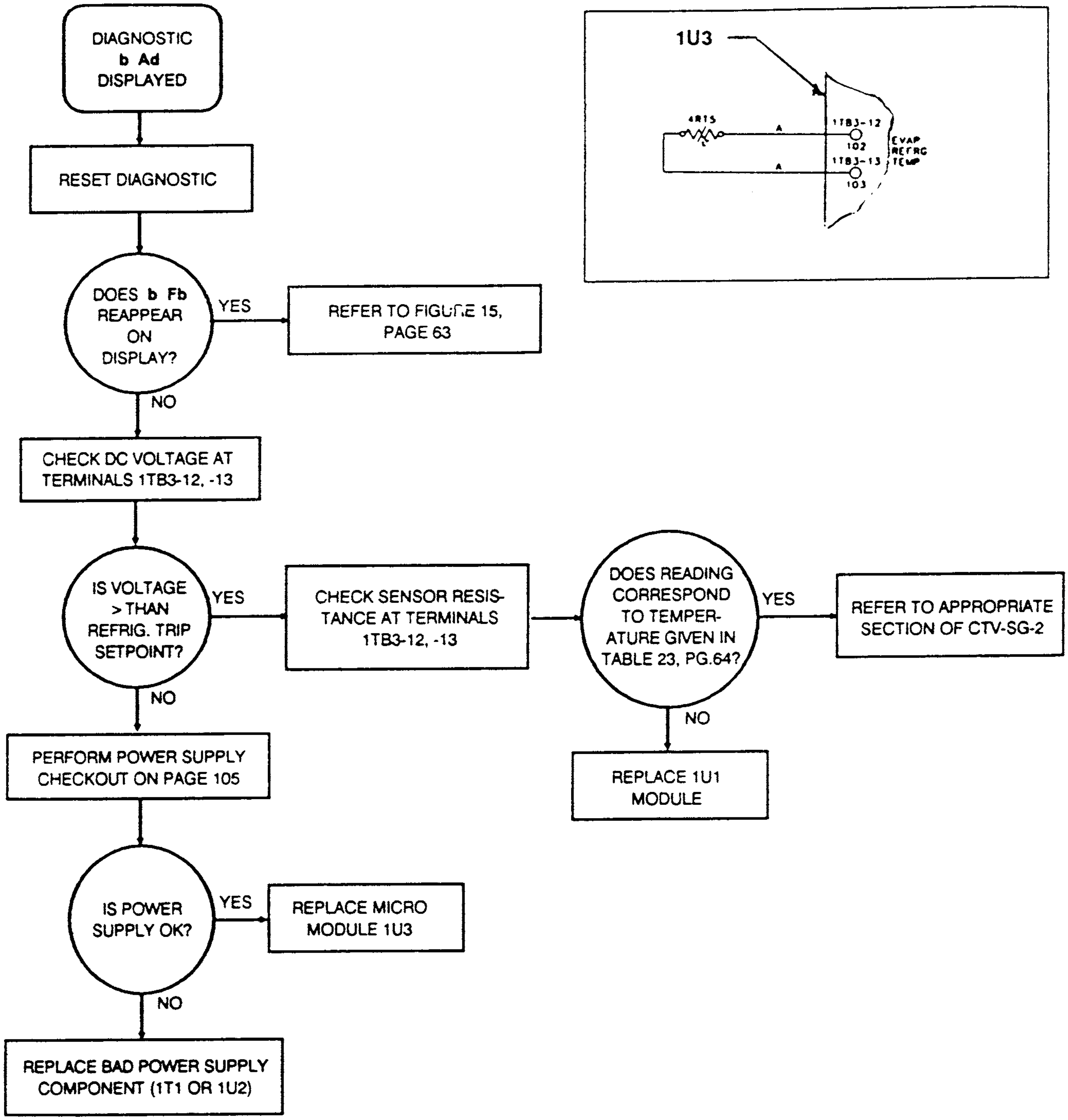
Diagnostic **b FA** occurs when the vane actuator (4B2) fails to close during the (powered or free cooling) start sequence.

The start sequence for the unit incudes an "establish condenser flow/close vanes" operating mode (**A 71**). During the **A 71** operating mode, the micro module 1U3 sends a "vanes close" signal to the vane actuator and monitors an end switch on 4B2. If the end switch does not close within the preset 4-minute window, latching diagnostic **b FA** results.

To diagnose an occurrence of this diagnostic, refer to "Vane Control Checkout Procedure" on page 111.

Note: If the **b FA** diagnostic is intermittent, the problem will likely be the vane actuator end switch.

Figure 29 - Diagnostic "b Fb"
Low Evaporator Refrigerant Temperature



b Fb
Low Evaporator Refrigerant Temperature

Evaporator refrigerant temperature is continuously monitored and compared to the trip point during chiller operation. If the trip point is violated for a period of 30 F-seconds, the chiller will shut down on latching diagnostic **b Fb**. To diagnose an occurrence of a **b Fb** diagnostic, refer to Figure 29 .

Probable causes for a **b Fb** diagnostic include:

[ ] chilled water setpoint too low;
[ ] sensor failure;
[ ] unit low on refrigerant;
[ ] refrigerant stacked in condenser;
[ ] evaporator tubes fouled.

b Fd
External Interlock (Optional)

The UCP (1U3) generates latching diagnostic condition **b Fd** any time the circuit between Terminals 1TB3-16, -17 opens while the control panel is powered. The unit is shipped with a jumper between 1TB3-16, and -17; however, the jumper may have been removed and replaced with a field-supplied interlock circuit.

In the event that a **b Fd** diagnostic occurs, check the electrical connections to Terminals 1TB3-16, -17. If the jumper is installed, verify that the terminals connections are tight. If the diagnostic cannot be reset (cleared) with the input jumpered, micro module 1U3 is bad and must be replaced.

If Terminals 1TB3-16 and -17 are wired to an external circuit, find the remote device that opened the circuit and reset it. Verify that there is continuity through the circuit by removing the wires from 1TB3-16 and -17 and checking for continuity. If the diagnostic cannot be reset after the remote device is reset, remove the external circuit and connect a jumper wire to 1TB3-16 and -17. If the diagnostic still cannot be reset, the problem is with the 1U3 model; replace it. If the diagnostic can be reset, check the contact fo the remote device.

Note: The external interlock circuit is monitored with a low-voltage signal. Contacts in the external circuit must be compatible with a dry circuit, 12 VDC, 45 mA. Gold-plated contact are recommended.

b FF
Unit Controller

The UCP (1U3) runs a continuous self-diagnostic routine that monitors the functions and communications within the micro module (1U3). Latching diagnostic **b FF** is displayed when the self-test routine locates a problem.

The **b FF** diagnostic can also be seen when a noise spike enters the system and disrupts the controller.

Reset (clear) the diagnostic by toggling the chiller switch to STANDBY/RESET and back to one of the AUTO positions. If the diagnostic cannot be reset, power down the control panel for 2 minutes and power it back up with the chiller switch in the STANDBY/RESET position. If the **b FF** diagnostic returns immediately, replace micro module 1U3.

Note: If this condition occurs at initial unit start-up, carefully check all inputs to the low-voltage terminal strips (1TB3, 1TB4, 1TB6) for misconnections and noise interference.

If the **b FF** diagnostic can be reset but recurs frequently, check the low-voltage wiring for proper isolation from noise sources.

Compressor Transition Relay 1U2K5 and Current Transformer Checkout Procedures

(UCP695 Control Panels Only)

Note: The following compressor transition relay and current transformer checkout procedures are only applicable for those CVHE units equipped with UCP695 control panels (i.e., chillers of "K" or later design sequence). Check the tenth digit of the model number stamped on the chiller nameplate to determine its design sequence.

To effectively use the compressor transition relay (1U2K5) and current transformer (2T1, 2T2, 2T3, 2T5, 2T6 and 2T7) checkout procedures described in this section, it is important to first understand the normal operation of the control panel during the start sequence. Review the start sequence outlined below (along with the typical electrical schematic in Figure 9 on pages 46-49) or using the electrical diagrams that shipped with the chiller, before attempting to check the integrity of 1U2K5.

1. Micro module 1U3 initiates a "start" signal.

Once all of the prestart criteria are satisfied (i.e., condenser and chilled water flows proven, oil pressure established, etc.), micro module 1U3 initiates a "start" signal by "telling" the K1, K2, K3 and K4 relay contacts in power supply output module 1U2 to close. See Line 16 of the electrical schematic.

Proper response of all 4 sets of contacts allows control voltage to flow from Terminal 1TB2-9 to 1TB2-7; from there, current passes through Terminal 1TB5-5 (and 2TB1-4) and energizes the coil of pilot relay 2K5 in the starter panel.

2. "Star" windings of chiller compressor motor 4B1 energize.

Once energized, pilot relay 2K5 begins the compressor motor start process by energizing the coil of shorting contactor 2K3; this, in turn, energizes start contactor 2K1. (See Lines 19 and 21 of the schematic). Closure of 2K1's normally-open contacts allows line voltage to flow through the "star" windings of the compressor motor (4B1). Lines 1, 5 and 9.

3. Micro module 1U3 initiates transition.

Milliamp signal inputs at Terminals 1TB4-7 through -12 allow micro module 1U3 to monitor compressor motor amperage draw via 3 pairs of current transformers. (Refer to Lines 1 through 12 of the schematic.)

Keep in mind that 1U3's control logic prevents it from initiating transition unless these 2 conditions are met:

a. first, motor amp draw must exceed 100% of the rated load amps (RLA); and,

b. motor amp draw must then fall below 85% of the RLA.

If both of these requirements are satisfied, 1U3 initiates transition by energizing the compressor transition relay (1U2K5) in the power supply output module (Line 20).

Note: 1U2K5 is energized when the voltage signal at Pin 1 (with respect to Pin 14) on ribbon connector 1P4 is 0.85 to 1.6 VDC.

4. Transition occurs successfully, and compressor motor 4B1 is operating in the normal run configuration.

Closure of the K5 compressor transition relay contacts in 1U2 allows current to reach the coil of the starter panel's transition contactor (2K4). As 2K4 energizes, its normally-closed auxiliary contacts (Line 19) open to de-energize shorting contactor 2K3.

Run contactor 2K2 energizes when 2K3's normally-closed auxiliary contacts (Line 22) reclose. (Notice that the 2K4 transition contactor de-energizes as soon as the normally-open 2K2 auxiliary contacts in the transition circuit--Lines 19 and 20--close.)

When line voltage flows across the now-closed 2K2 contacts to the "delta" windings of 4B1 (Lines 4, 8 and 12), the compressor motor is in its normal "run" configuration.

5. Micro module 1U3 confirms that transition was successfully completed.

Refer to Line 69 of the schematic; notice that a normally-open set of auxiliary contacts on run contactor 2K2 is located in a "proof- of-transition" circuit connected to micro module input Terminals 1TB4-5 and -6.

Closure of these auxiliary 2K2 contacts "tells" micro module 1U3 that transition occurred successfully.

If these contacts do not close within 2 seconds after the transition signal is sent to the starter (see Step 3), micro module 1U3 assumes that the compressor motor failed to transition, and shuts down unit operation on latching diagnostic **b** FO.

Any one (or all!) of the malfunctions listed below can cause micro module 1U3 to abort a start-up attempt with the "transition failure" (**b** F0)--or "exceeded max. accel. time" (**b** EE)-- diagnostic.

[ ] Faulty current-sensing inputs (1TB4-7 thru -12).

Recall that in Step 3 of the preceding start sequence, 1U3 monitors the milliamp signals it receives at input Terminals 1TB4-7 through -12 to determine whether or not compressor motor amp draw exceeds 100%--then falls below 85%--of RLA. Control logic prevents 1U3 from initiating the transition signal unless these prerequisites are met.

Faulty current-sensing inputs may prevent 1U3 from "seeing" this change in amp draw (i.e., causing it to shut down unit operation on either a **b** **EE** diagnostic, or a **b** **E2** diagnostic if all 3 inputs are bad).

[ ] Defective micro module (1U3).

Latching diagnostic **b** **EE** can also occur if micro module 1U3 receives the appropriate current-sensing inputs at Terminals 1TB4-7 through -12, but-- because of an internal malfunction-- either: (1) fails to issue a "close" signal to the normally-open 1U2K5 contacts; or (2) continuously sends this "close" signal.

Review Step 3 of the start sequence again. Notice that the existence of a 0.85 to 1.6 VDC voltage signal at Pin 1P4-1--with respect to Pin 1P4-14--confirms that 1U3 did tell the 1U2K5 contacts to close.)

[ ] Defective power supply output module (1U2).

Even though motor amp draw requirements are satisfied and 1U3 successfully transmits a "transition" signal to the power supply output module (1U2), transition will not occur if 1U2 is defective and fails to close its K5 compressor transition relay contacts.

[ ] Faulty starter component(s) or wiring.

Refer again to Step 4 of the start sequence. Notice that closure of the 1U2K5 contacts should provide current to transition contactor 2K4 (and, ultimately, run contactor 2K2) in the starter panel. If the electrical connections between 1U2 and the starter panel are faulty--or if either 2K4, 2K3 or 2K2 is defective--transition will not occur, and 1U3 will generate a **b F0** or **b EE** diagnostic.

[ ] Faulty "proof-of-transition" circuit.

Keep in mind that the existence of a **b F0** diagnostic may not necessarily mean that the starter failed to transition. It is equally possible that transition was completed successfully, but micro module 1U3 is not receiving "proof of transition" at input Terminals 1TB4-5 and -6. (Lines 69 and 70.) In this situation, either the auxiliary 2K2 contacts are malfunctioning, the "transition complete" electrical circuit is faulty, or 1U3 is defective.

Whenever a **b F0** or **b EE** chiller diagnostic condition exists, use the following checkout procedure to isolate the source of the transition-related failure.

1U2K5 Checkout Procedure

Note: The steps in this procedure were purposely arranged for ease of completion, and do not reflect the sequence of events previously described for a normal, attempted start-up.

WARNING: Use extreme care when performing this checkout procedure while the chiller is energized. Carelessness can result in injury or death.

1. Check the input voltage at ribbon connector Pin 1P4-1 (red VOM lead) with respect to Pin 1P4-14 (black VOM lead) while the unit is not running.

If the voltage measured is 0.85 to 1.6 VDC, module 1U3 is defective and must be replaced.

If the voltage reading is 0.0 to 0.1 VDC, use an ohmmeter to check for continuity between Terminals 1TB2-5 and -6. If the resistance reading obtained indicates that the K5 contacts between these terminals are closed, power supply output module 1U2 is defective and must be replaced.

2. Connect a voltmeter—adjusted to read 115 VAC—to Terminals 1TB2-6 and 1TB5-2; then initiate the chiller start sequence. The voltmeter should initially register 0 VAC until the 1U2K5 contacts close during the start sequence; at that point, the meter should register control voltage (approximately 115 VAC).

If the K5 compressor transition relay contacts do close, and:

a. the 2K4 starter transition contacts pull in but drop out again within 2 seconds (causing 1U3 to trip on **b F0**), then go to Step 3.

b. the starter does not transition at all (causing 1U3 to trip on **b EE**), then the problem lies either in the starter itself, or the wiring connections to the starter. (In this situation, it is not necessary to complete Steps 3 through 9 of this checkout procedure.)

However, if the K5 contacts do not close, complete Steps 4 through 9 to isolate the malfunction at power supply output module 1U2, micro module 1U3, or the current transformers (i.e., 2T1, 2T2, 2T3, 2T5, 2T6 and 2T7).

3. Monitor the status of 1U3's "proof-of-transition" circuit during the chiller start sequence. To do this, connect the black lead of a digital VOM to 1U3 Terminal 1TB4-6 and the red lead to 1TB4-5; then initiate another start-up.

a. Check the voltage between Terminals 1TB4-5 and -6 before the oil pump starts to determine the status of the auxiliary 2K2 contacts (Line 69 of the schematic). Since these contacts should be open at this point in the start sequence, you should obtain a voltage reading of 6.9 to 16.8 VDC.

(If the auxiliary 2K2 contacts are already closed, micro module 1U3 should "lock out" on the **b F0** latching diagnostic for transition.)

b. Recheck the voltage between these terminals when motor amp draw falls below 85% of the RLA. (When this occurs, 1U3 should send a "close" signal to the K5 contacts; the auxiliary 2K2 contacts should then close within 2 seconds.)

Since the auxiliary 2K2 contacts should now be closed, you should see a voltage reading of 0.0 to 0.1 VDC.

If you do obtain the voltage readings just described in (a) and (b) above--but the unit still "locks out" on the **b F0** diagnostic, micro module 1U3 is defective and must be replaced. Otherwise, the problem lies either in the starter or the wiring connections to the starter. (In either case, it is not necessary to complete Steps 4 through 9 of this checkout procedure.)

4. Set a digital VOM to register DC voltage; then connect the black (negative) VOM lead to Pin 1P4-14 and the red lead to Pin 1P4-1.

5. Repeat the chiller start sequence. Verify that compressor motor amp draw actually exceeds 100% of the compressor RLA, and check the VDC signal at Pin 1P4-1 when amp draw falls below 85% of RLA. (Instructions for calculating %RLA are provided in Note 1 of Table 25.)

If the signal measured at Pin 1P4-1 does not increase from 0.0-0.1 VDC to 0.85-1.6 VDC when the amp draw falls below 85% of RLA, go to to Step 6.

Note: If input voltage at Pin 1P4-1 does increase to 0.85-1.6 VDC when amp draw drops below 85% of RLA but the 1U2K5 contacts do not close, power supply output module 1U2 is not functioning properly. Before replacing 1U2, perform the power supply checkout procedure described in the next section of this bulletin. (An improper voltage supply to 1U2 can cause a good module to produce erratic output responses.)

6. Use the unit's design RLA value in conjunction with the data in Table 26 to verify that:

a. the line current transformers (CTs; 2T1, 2T2 and 2T3) are properly sized;

b. each line CT is provided with the correct number of "primary turns" (i.e., number of times that the main power line passes through its CT); and,

c. the DIP switches used to establish the unit's RLA setpoint (i.e., DIP switch block S1, switch nos. 1 through 8) are properly positioned. (A step-by-step, RLA-setpoint verification procedure is provided in the CVHE Service Guide (CTV-SG-2.)

Table 25
Current Transformer Input to Micro Module 1U3 (1)

Primary Current (I1) to Auxiliary CTs 2T5, 2T6 & 2T7	Input Voltage @ 1TB4-11, -12; 1TB4-9, -10; & 1TB4-7, -8 Respectively (Note 3)
0.50 amps RMS	1.34 ± 0.05 volts RMS
1.00 amps RMS	1.83 ± 0.05 volts RMS
1.25 amps RMS	2.06 ± 0.05 volts RMS
1.50 amps RMS	2.28 ± 0.05 volts RMS
1.75 amps RMS	2.51 ± 0.05 volts RMS
2.00 amps RMS	2.73 ± 0.05 volts RMS
2.25 amps RMS	2.95 ± 0.05 volts RMS
2.50 amps RMS	3.17 ± 0.05 volts RMS
2.75 amps RMS	3.39 ± 0.05 volts RMS
3.00 amps RMS	3.62 ± 0.05 volts RMS
3.25 amps RMS	3.84 ± 0.05 volts RMS
3.50 amps RMS	4.06 ± 0.05 volts RMS
3.75 amps RMS	4.28 ± 0.05 volts RMS
4.00 amps RMS	4.51 ± 0.05 volts RMS
4.25 amps RMS	4.71 ± 0.05 volts RMS
4.50 amps RMS	4.93 ± 0.05 volts RMS
4.75 amps RMS	5.14 ± 0.05 volts RMS
5.00 amps RMS	5.37 ± 0.05 volts RMS
5.50 amps RMS	5.80 ± 0.05 volts RMS
6.00 amps RMS	6.24 ± 0.05 volts RMS
8.00 amps RMS	7.96 ± 0.05 volts RMS

Notes:

1. To calculate primary current (I1), use the following equation:

$$(I1) = \frac{\text{Line Current}}{\text{CTRA}} \times 5$$

where: (I1) is the primary current to the auxiliary current transformer (CT); the "CTRA" value to for 2T1, 2T2, and 2T3 respectivaly (Table 26); and "Line Current" is the primary current thru the line CTs (2T2, 2T2 and 2T3).

To calculate %RLA, measure line current directly; then use the following equation:

$$\%RLA = \frac{\text{Line Current}}{\text{100\% of Unit RLA Rating}} \times 100\%$$

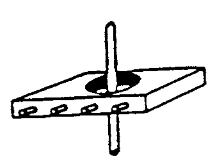
2. Accuracy of the line CT is ± 1%.
3. Excludes meter error.
4. RMS = root mean square ((i.e., standard AC meter units).

Table 26
Line CT Ratios (2T1, 2T2 and 2T3)

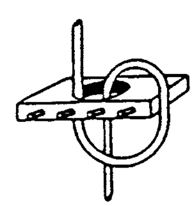
RLA Range	CT Ratio (Note 1)	Line CTRA Value (Note 3)	Primary Turns (PR1; Note 2)	Meter Scale (3)
28.6 to 35.7	150 : 5	150	3	50
35.8 to 42.8	180 : 5	180	3	60
42.9 to 53.5	150 : 5	150	2	75
53.6 to 64.2	180 : 5	180	2	90
64.3 to 71.4	200 : 5	200	2	100
71.5 to 89.2	250 : 5	250	2	125
89.3 to 107.1	150 : 5	150	1	150
107.2 to 128.5	180 : 5	180	1	180
128.6 to 142.8	200 : 5	200	1	200
142.9 to 178.5	250 : 5	250	1	250
178.6 to 214.2	300 : 5	300	1	300
214.3 to 250.0	350 : 5	350	1	350
250.1 to 285.7	400 : 5	400	1	400
285.8 to 357.1	500 : 5	500	1	500
357.2 to 428.5	600 : 5	600	1	600
428.6 to 500.0	700 : 5	700	1	700
500.1 to 571.4	800 : 5	800	1	800
571.5 to 714.2	1000 : 5	1,000	1	1000
714.3 to 857.1	1200 : 5	1,200	1	1200
857.2 to 1071.4	1500 : 5	1,500	1	1500
1071.5 to 1285.7	1800 : 5	1,800	1	1800
1285.8 to 1500.0	2100 : 5	2,100	1	2100
1500.1 to 1785.7	2500 : 5	2,500	1	2500

Notes:
1. The CT ratio represents the size of the current transformers used with the specified RLA range.
2. Each "primary turns" (PRI) value indicates the number of times that the main power line passes through its current transformer.

Examples: PRI = 1



PRI = 2



3. If ampmeters are used with the CTs, their full-scale deflection will equal the "meter scale" values in this table.

Note: $\text{Meter Scale} = \frac{\text{Line CTRA}}{\text{PRI Turns}}$

where "Line CTRA" is the first number of the line CT ratio.

7. Calculate the "I1" values for primary current to the auxiliary CTs at 100% and 85% of design RLA using the following equations:

$$I1 \text{ for } 100\% \text{ RLA} = \text{Design RLA} \times \frac{5}{\text{Meter Scale}}$$

$$I1 \text{ for } 85\% \text{ RLA} = 0.85 \times \text{Design RLA} \times \frac{5}{\text{Meter Scale}}$$

where,

"I1" is the primary current to the auxiliary CTs (2T5, 2T6, and 2T7); "Meter Scale" is the effective line CT ratio (see Table 26); and "Design RLA" is the RLA value stamped on the chiller nameplate.

8. Use Table 25 to determine the input voltage values that correspond to the 100% and 85% RLA values calculated in Step 7.

9. Monitor--and record--the micro module's phase current voltage inputs at Terminals 1TB4-7 and -8, 1TB4-9 and -10, and 1TB4-11 and -12, respectively, during the start sequence. Use Table 25 to convert the recorded input voltages to corresponding "I1" values for primary current to the auxiliary CTs.

If primary current to the auxiliary CTs drops from more than 100% RLA to less than 85% of RLA (see Step 7 of this procedure)--but the input voltage at Pin 1P4-1 does not increase from 0.0-0.1 VDC to 0.85-1.6 VDC, micro module 1U3 may be defective. Perform the power supply checkout procedure described in the next section of this bulletin before condemning 1U3.

If primary current to the auxiliary CTs does not drop from over 100% to less than 85% RLA, then check the integrity (i.e., including wiring and part numbers) of each current transformer. See "Current Transformer Checkout" that follows.

Current Transformer Checkout

Each phase of the incoming power supply to the compressor motor is provided with line (2T1, 2T2, 2T3) and auxiliary (2T5, 2T6, 2T7) current transformers. All of these CTs are mounted in the starter panel; current transformer connections are shown in Figure 30.

Note: Polarity is critical for proper setup of both line and auxiliary current transformers. Be sure to check each CT for proper polarity--and all CT wiring for faulty connections--before performing the checkout procedure described below. Also, use Table 26 to verify that the correct line CTs are in use, and that the proper terminals are connected.

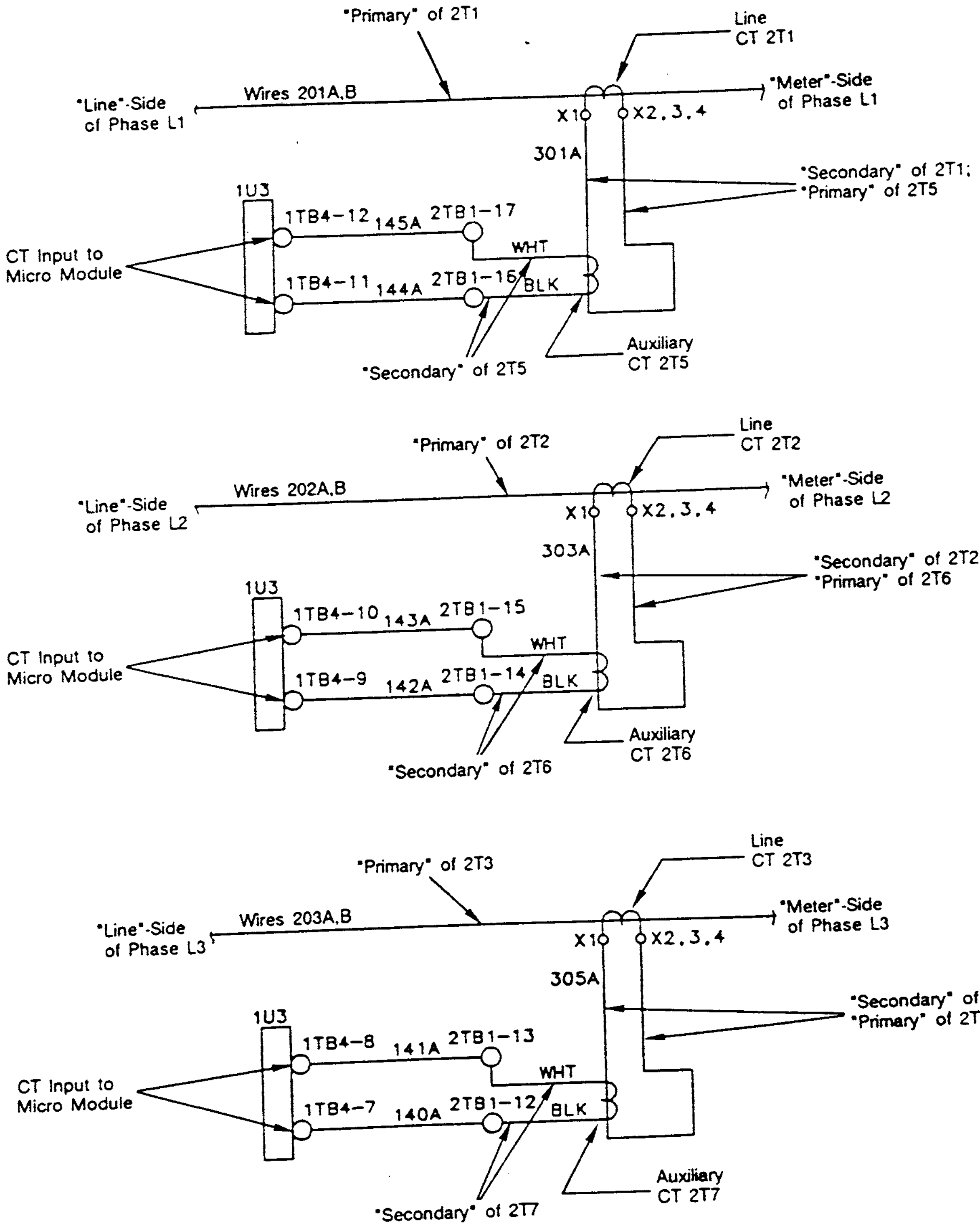
WARNING: Use extreme care when performing this checkout procedure while the chiller is energized. Carelessness can result in injury or death.

1. Use a series ammeter to monitor the output of Phase L1's line current transformer (2T1).

Note: This check cannot be made reliably with a clamp-on ammeter; always use a series ammeter on the line CT secondary!

2. Check the CT ratio, and verify that the measured input and output values conform to this ratio.

Figure 30
Current Transformer (CT) Connections



If these values do not conform, determine why and make the necessary repairs. (In some cases, the primary winding is wound more than once through the current transformer. This reduces the primary-to-secondary ratio by a factor equalling the number of loops through the transformer. See Table 26.)

Note: In order to check CT input and output voltages, CT line and secondary amp flows must be monitored while the unit is running.

3. Check the voltage at Terminals 1TB4-11 and -12 on micro module 1U3, and compare this value to the corresponding auxiliary CT primary current (I1) value in Table 25 to verify the integrity of 2T5.

4. Repeat Steps 1 through 3 for Phase L2 and Phase L3. Check the integrity of auxiliary CT 2T6 and 2T7 as described in Step 3 by measuring the voltage at Terminals 1TB4-9 and -10, and Terminals 1TB4-7 and -8, respectively.

Power Supply Checkout Procedure

(UCP695 Control Panels Only)

Note: The following power supply checkout procedure is only applicable for those CVHE units equipped with UCP695 control panels (i.e., chillers of "K" or subsequent design). Check the tenth digit of the model number stamped on the chiller nameplate to determine its design sequence.

Overview

Refer to the UCP layout illustration in Figure 7 on page 34. The UCP695 control panel utilizes a power supply transformer (1T1) and power supply output module (1U2) that furnish power to micro module 1U3. The information in this section describes a method for verifying that both of these components (i.e., 1T1 and 1U2) are operating properly. A typical control panel connection diagram is shown in Figure 31. Refer to the electrical schematic in Figure 9 on pages 46-49 or to the electrical diagrams that shipped with the chiller.

Note: It is good practice to check the power supply components (i.e., 1T1 and 1U2) whenever troubleshooting the micro module. Refer to the procedure illustrated by Figure 32 on the page 106. An improper voltage input to 1U3 can cause a good micro module to produce erratic output responses.

Power Transformer (1T1) Checkout

1. Check branch circuit fuse 1F5 for continuity.

2. Confirm that 120 VAC power is available across the 2 black leads of transformer 1T1.

3. Verify that the output cable (1P1) from power supply transformer 1T1 is firmly and correctly attached to 1J1 on power supply output module 1U2.

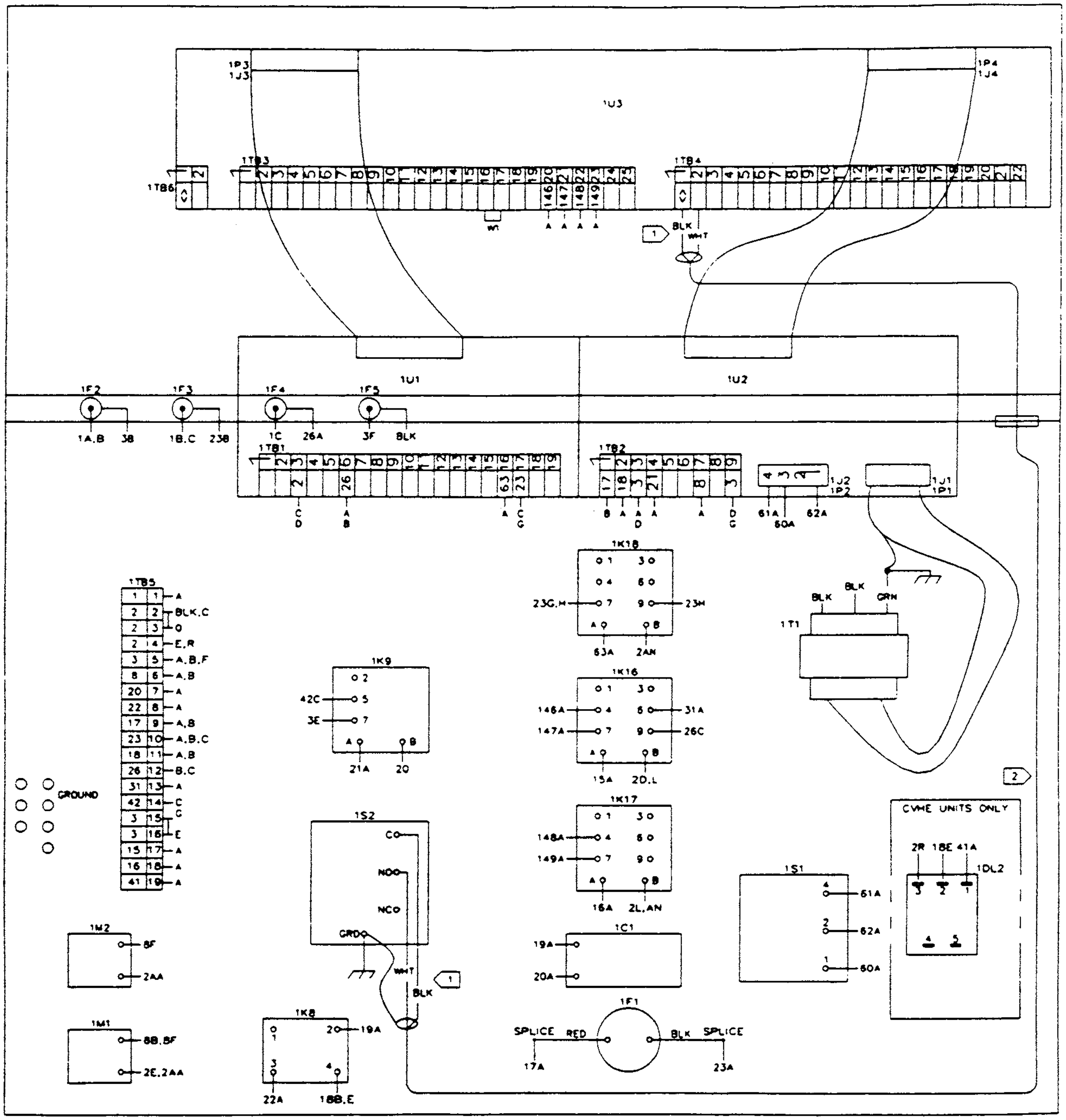
Before proceeding to Steps 4, 5 and 6, keep these points in mind when taking the requested measurements: (1) the pins on 1P1 are numbered from right to left; and, (2) be sure that good contact is made with the metal of the pin.

4. Connect the black (negative) lead of a digital VOM--set to measure DC voltage--to Pin 1P1-1 (i.e., chassis common). Then, measure the voltages at Pins 1P1-3, -4 and -5, and compare the measured values with the allowable signal ranges shown in Figure 33.

Note: If any of the voltages measured in Step 4 are out of range--and the voltages measured in Steps 5 and 6 are in range, transformer 1T1 is okay but power supply output module 1U2 may be malfunctioning. Check 1U2's output before replacing either component.

5. Switch the digital VOM to register AC voltage, and--with the black VOM lead still connected to Pin 1P1-1--measure the voltages at Pins 1P1-2, -3, -4 and -6. Compare these measured voltages with the allowable signal ranges indicated in Figure 33.

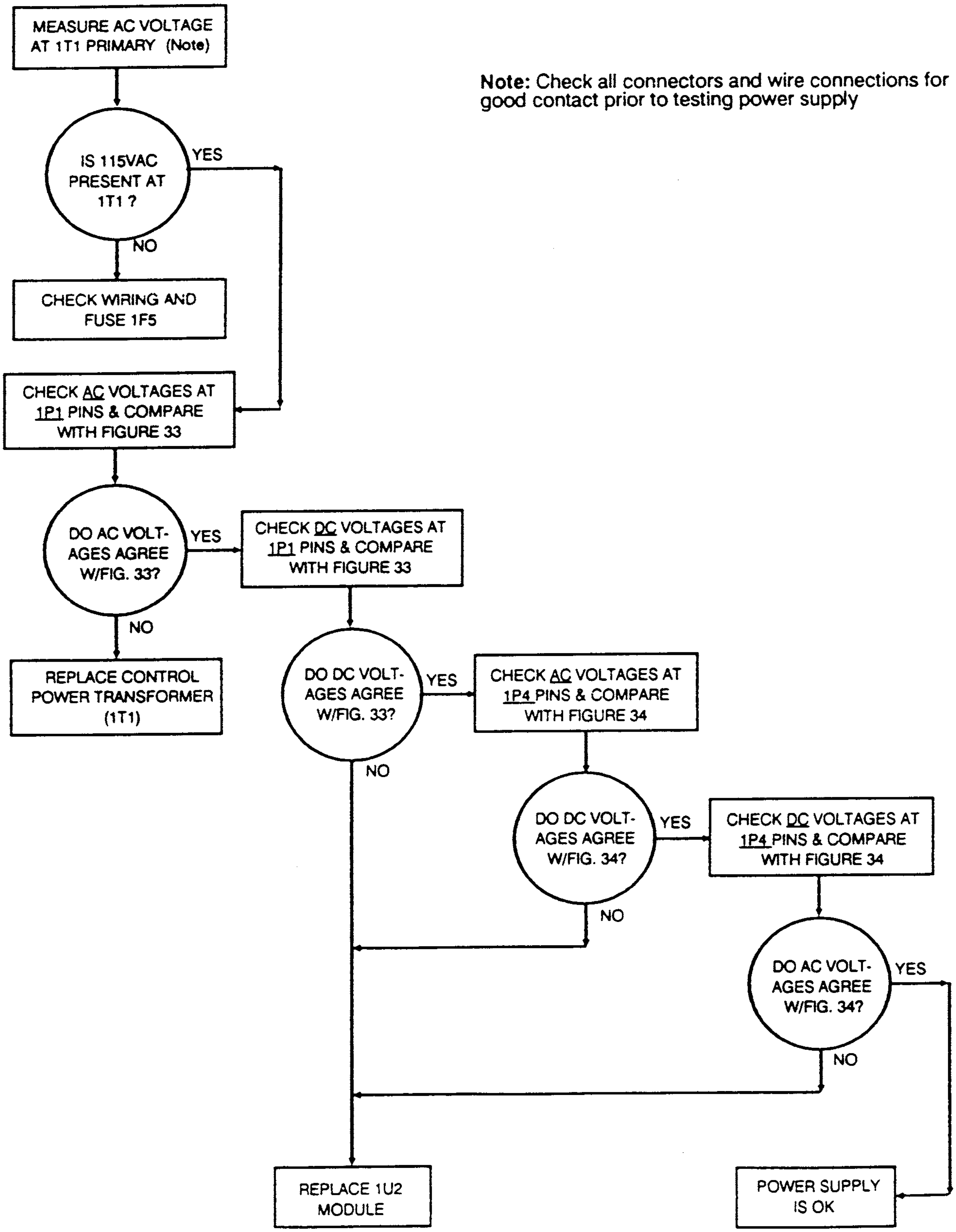
Figure 31
Typical UCP695 Control Panel Connections



Note: This drawing typical of: CVHE - design sequence "1C" and later; CVHB - design sequence "1D" and later; CVHF - all designs w/UCP695. Refer to appropriate wiring manual for earlier designs.

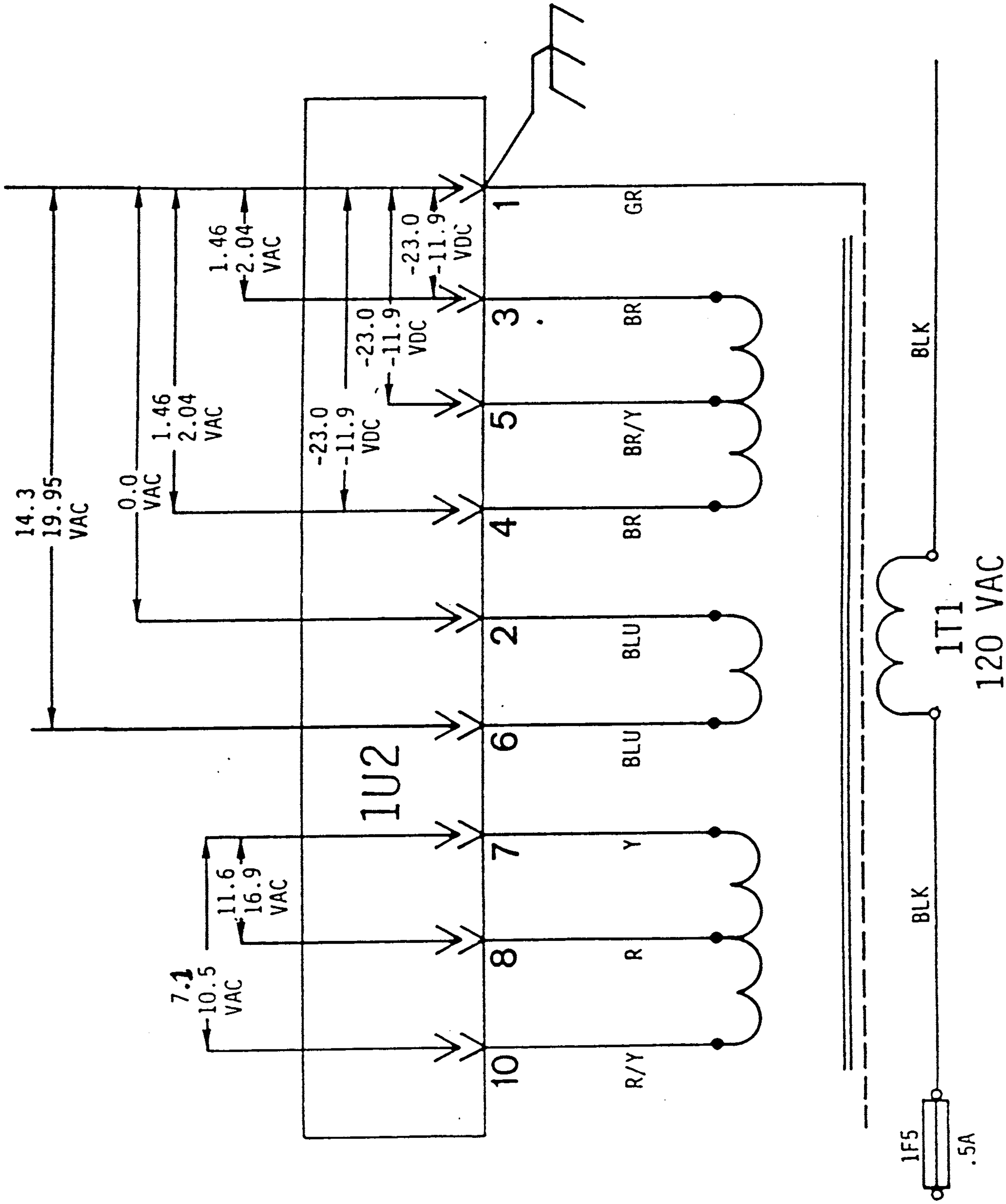
LEGEND		
1C1 = Oil Pump Capacitor	1K17 = Condenser Water Pump Relay	1TB3 = Terminal Blk - Micro Module Input
1DL2 = Vent Line Interval Timer	1K18 = Free Cooling Relay	1TB4 = Terminal Blk - Micro-Module Input
1F1 = Oil Pump Fuse	1M1 = Hourmeter	1TB5 = Terminal Block - Control Panel
1F2-5 = Branch Circuit Fuses	1M2 = Start Counter (Meter)	1TB6 = Terminal Blk - Micro-Module Input
1J1-4/1P1-4 = Post Header Power Supply	1S1 = Condenser High Pressure Switch	1TB7 = Terminal Block - Hot Gas Bypass
1K8 = Oil Pump Start Relay	1S2 = Oil Pressure Switch	1U1 = Relay Output Module
1K9 = Oil Tank Heater Relay	1T1 = Power Supply Transformer	1U2 = Power Supply Output Module
1K15 = Hot Gas Bypass Relay	1TB1 = Terminal Block - Relay Output	1U3 = Micro Module
1K16 = Chilled Water Pump Relay	1TB2 = Terminal Block - Power Supply	

Figure 32 - Power Supply Checkout Procedure



Note: Check all connectors and wire connections for good contact prior to testing power supply

Figure 33
Voltages for Power Supply Transformer Connector 1P1



6. Move the black (negative) lead of the VOM to Pin 1P1-7; then measure the voltages at Pins 1P1-8 and -10. Compare the voltage readings obtained with the allowable signal ranges indicated in Figure 33.

Note: If any of the voltages measured in Steps 5 and 6 are out of range, a problem with power supply transformer 1T1 is indicated. Before replacing 1T1, use the blade of a small screwdriver to press the wires of 1J1 firmly into their sockets. Occasionally, the wire insulation is not cut completely when the wires were initially inserted into the connector.

Power Supply Output Module 1U2 Checkout

1. Remove the cover strip located along the top of micro module 1U3, and find ribbon cable connector 1P4. See Figure 31. Verify that ribbon cable 1P4 is firmly and correctly connected to 1J4.

Note: Notice that--in this instance--the pins are numbered from left to right.

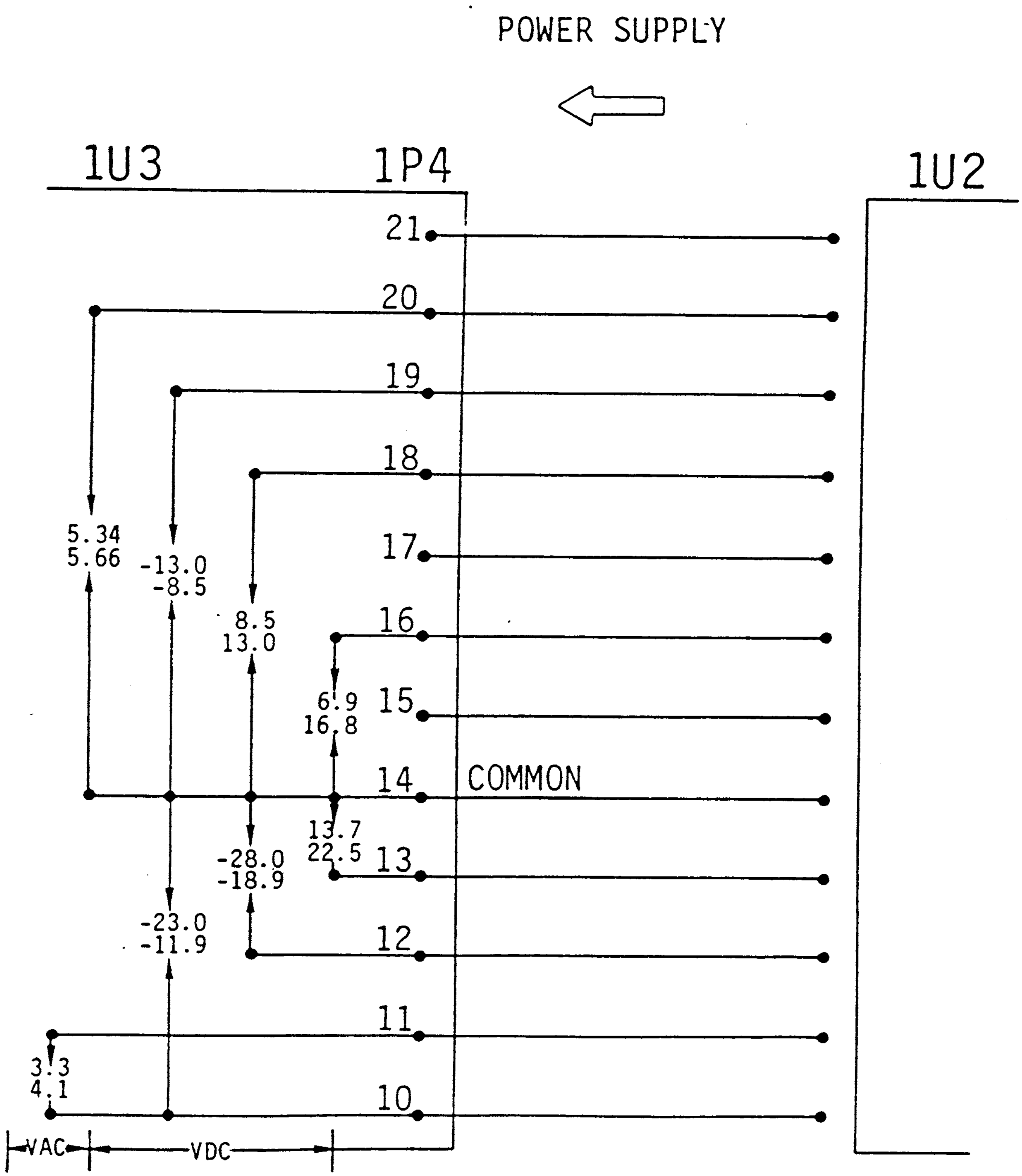
2. Using a digital VOM set to register DC voltage signals, connect the black (negative) VOM lead to Pin 1P4-14.

3. Measure the voltages at Pins 1P4-10, -11, -12, -13, -16, -18, -19 and -20. Compare these voltage readings with the allowable voltage signal ranges indicated in Figure 34.

4. Set the VOM to register AC voltage signals; then connect the black VOM lead to Pin 1P4-11 and the red VOM lead to Pin 1P4-10. Measure the voltage between these pins, and compare this value to the "AC component" range shown for Pins 10 and 11 in Figure 34.

Note: If any of the voltages measured in Steps 3 and 4 are out of range--and the power transformer checked out okay, a problem with the power supply output module is indicated.

Figure 34
Voltages for Ribbon Cable Connector 1P4



Checkout Procedure for Vane Control Operation

(UCP695 Control Panels Only)

Note: Use the checkout procedure described in this section when the vane actuator does not respond to the vane control switch on the front of the unit control panel. Keep in mind that this procedure is only applicable for those CVHE units equipped with UCP695 control panels (i.e., chillers of "K" or subsequent design). Check the tenth digit of the model number stamped on the chiller nameplate to determine its design sequence.

Several equipment "fault" conditions can prevent the chiller from controlling properly; these include:

[ ] a blown branch circuit fuse (1F3);
[ ] faulty actuator wiring;
[ ] a mechanically or electrically defective actuator;
[ ] a Triac switch failure in relay output module 1U1; and,
[ ] a micro module (1U3) malfunction.

To determine whether or not any of these components are responsible for inhibiting proper chiller control, follow the step-by-step instructions provided below. (Refer to Figure 9 on pages 46-49 for a typical electrical schematic. The UCP695 control panel layout is shown in Figure 31 on page 106.)

1. Verify that branch circuit fuse 1F3 is intact; to do this, check for 115 VAC at Terminal 1TB5-9. See Line 35 in the electrical schematic.

2. Adjust the chiller switch to STANDBY/RESET and the vane control switch to AUTO; then remove power from the vane actuator circuit by removing Fuse 1F3.

WARNING: To prevent injury or death due to electrical shock, lock power supply disconnect open before opening control panel door. Also, remember that terminals connected to remote equipment (e.g., condenser water pump) may remain energized when power is removed from panel. Always check for voltage before disconnecting wires!

3. Disconnect Wire Nos. 24A and 25A from Terminals 1TB1-1 and 1TB1-2, respectively. (Refer to the typical connection diagram in Figure 35 on the next page.)

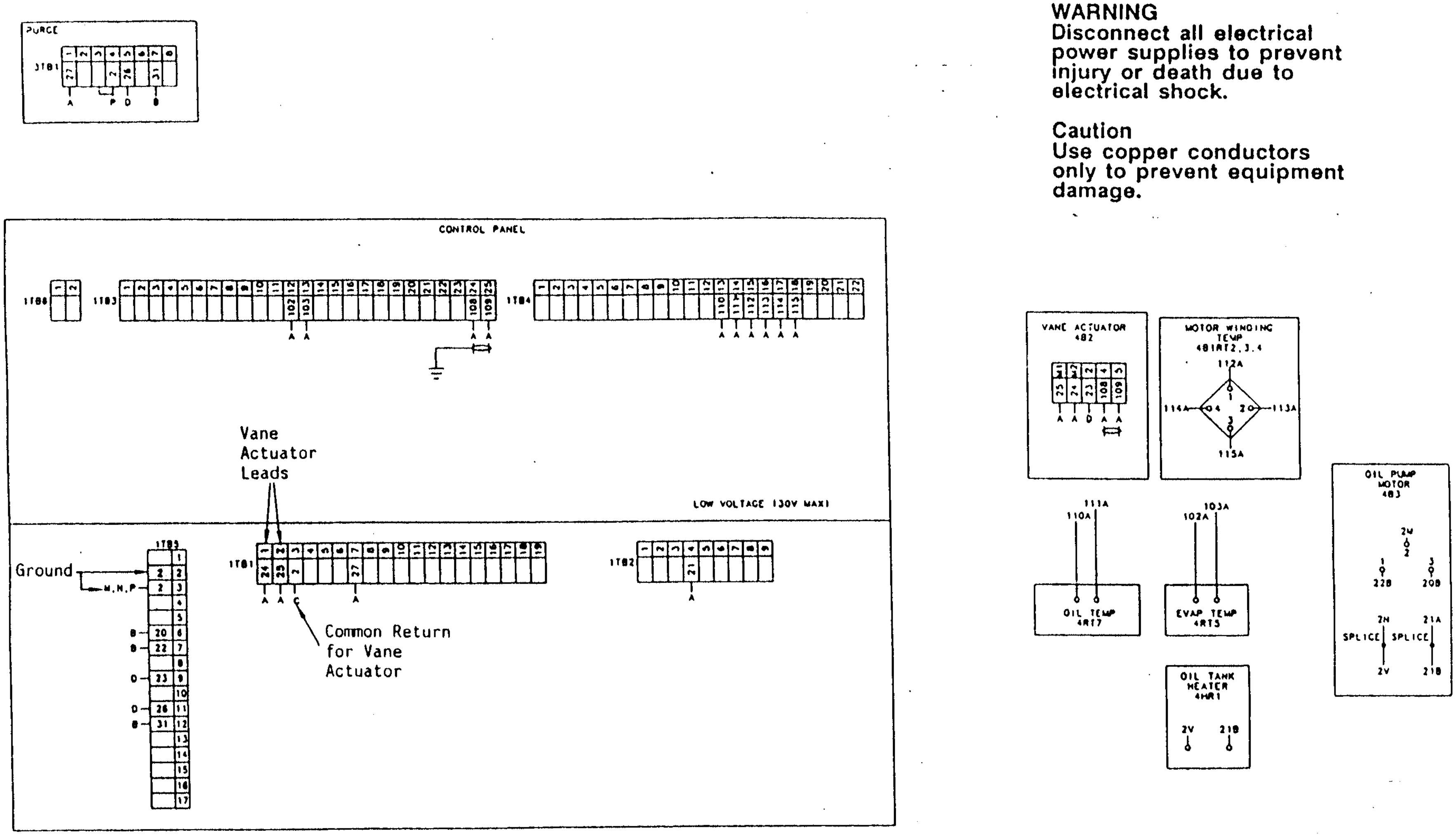
4. Reinstall Fuse 1F3 and apply power to the UCP695 panel; be sure to exercise care since Wire Nos. 24A and 25A are now "hot" (i.e., each carries 115 VAC).

WARNING: Use extreme care when performing the following checkout procedure with power on; carelessness can result in injury or death due to electrical shock.

5. Check the operation of vane actuator 4B2; to do this:

a. Short Wire No. 24A to ground (Terminal 1TB1-3; see Figure 35), and check for actuator movement. Unless it is already fully open, the actuator should drive open. Proceed to Step 5b.

Figure 35
Typical Connection Diagram for Standard CVHE Units



WARNING
Disconnect all electrical power supplies to prevent injury or death due to electrical shock.

Caution
Use copper conductors only to prevent equipment damage.

Drwg. X39470468

If the actuator does not move--and is not already fully open, thoroughly check the vane actuator assembly (including end switches) and actuator wiring for defects. Make sure that the wire connected to Terminal 1TB1-3 is common with the wire connected to Terminal 1TB5-2 (ground). Repair or replace as necessary.

b. Short Wire 25A to ground (Terminal 1TB5-2), and check for actuator movement. The actuator should drive closed unless it is already in the full-closed position.

If the actuator does not move--and is not already fully closed, check the actuator (including end switches) and actuator wiring for defects. Again, verify that the wire connected to Terminal 1TB1-3 is common with the wire connected to Terminal 1TB5-2 (ground). Repair or replace as necessary.

After verifying the integrity of the actuator, complete Steps 6 through 11 to confirm that micro module 1U3 is functioning properly.

Note: If the results obtained in Step 5 indicated a defective actuator or faulty actuator wiring, remove power from the unit and perform the necessary repairs before completing this checkout procedure!

WARNING: To prevent injury or death due to electrical shock, lock power supply disconnect open before servicing unit.

6. With the control panel energized and the chiller switch set at STANDBY/RESET", turn the vane control switch to the HOLD position.

WARNING: Use extreme care when performing this checkout procedure with power on; carelessness can result in injury or death due to electrical shock.

7. Check the voltage at Pin 1--with respect to Pin 11--of the 1P3 post header power supply plug. (Figure 31 on page 106) indicates the relative position of 1P3 in the UCP695 chiller control panel.)

The voltage signal measured at Pin 1 should be 0.0 to 0.06 VDC if micro module 1U3 is functioning properly.

If the measured voltage at Pin 1 is outside this range, 1U3 may be defective. Perform the "Power Supply Checkout Procedure" (pages 105-110) before condemning 1U3!

Note: Whenever micro module replacement is indicated, always perform the "Power Supply Checkout Procedure to confirm that 1U3 is actually defective.

8. Readjust the vane control switch to the UNLOAD position.

9. Again check the voltage at Pin 1-- with respect to Pin 11-- of 1P3; this time, the measured voltage should be 5.1 to 5.6 VDC if micro module 1U3 is operating correctly.

If the measured voltage at Pin 1 is outside this range, 1U3 may be defective. See the "Power Supply Checkout Procedure" on pages 105-110.

10. Adjust the vane control switch to HOLD, and check the voltage at Pin 2--with respect to Pin 11--of 1P3. If micro module 1U3 is operating properly, the measured voltage should be 0.0 to 0.06 VDC.

If the voltage reading obtained is outside this range, 1U3 may be defective. See the "Power Supply Checkout Procedure" on pages 105-110.

11. Turn vane control switch back to LOAD, and again check the voltage at Pin 2--with respect to Pin 11--of 1P3. This time, the measured voltage should be 5.1 to 5.6 VDC if micro module 1U3 is functioning correctly.

If the meter indicates a voltage outside outside this range, 1U3 may be defective. See the "Power Supply Checkout Procedure" on pages 105-110.

Vane position is governed by two Triac switches (1U1Q7, "vanes open"; 1U1Q8, "vanes closed") inside relay output module 1U1. See Lines 35 and 36 of the electrical schematic. To verify whether or not both of these Triacs are operational, complete Steps 12 through 16.

Note: If the results obtained in Steps 6 through 11 indicate a defective micro module (1U3)--and completion of the "Power Supply Checkout Procedure" (pages 105-110) confirms this diagnosis, remove power from the unit and replace 1U3 before completing this checkout procedure!

WARNING: To prevent injury or death due to electrical shock, lock power supply disconnect open before servicing unit.

12. With the control panel energized and the chiller switch set at STANDBY/RESET, adjust the vane control switch to the HOLD position (i.e., both Triac switches should now be open).

WARNING: Use extreme care when performing this checkout procedure with power on; carelessness can result in injury or death due to electrical shock.

Note: Review Steps 13 through 17 below. In each of these steps, be sure to remove Branch Circuit Fuse 1F3 before disconnecting or reconnecting Wire No. 24A or 25A.

13. Connect Wire No. 24A to Terminal 1TB1-1; see Figure 35. (Remember that both Wire No. 24A and Wire No. 25A were disconnected in Step 3.)

Check for actuator movement. If the actuator drives open (assuming that it is not already fully open), the "vanes open" Triac switch (1U1Q7) is shorted; since 1U1Q7 is an integral part of the relay output module, 1U1 is defective and must be replaced.

14. Disconnect Wire No. 24A from Terminal 1TB1-1, and connect Wire No. 25A to Terminal 1TB1-2; again, check for actuator movement.

If the actuator drives closed (assuming that it is not already fully closed), the "vanes closed" Triac switch (1U1Q8) is shorted; since 1U1Q8 is an integral part of the relay output module, 1U1 is defective and must be replaced.

15. With Wire No. 25A still connected to Terminal 1TB1-2, readjust the vane control switch to the UNLOAD position and check for actuator movement.

If the actuator does not drive closed--and it is not already in the full-closed position, Triac switch 1U1Q8 failed open; replace relay output module 1U1.

16. Disconnect Wire No. 25A from Terminal 1TB1-2 and set the vane control switch at LOAD; then connect Wire No. 24A to Terminal 1TB1-1 and check for actuator movement.

If the actuator does not drive open--and it is not already in the full-open position, Triac switch 1U1Q7 failed open; replace relay output module 1U1.

17. Remove power from the UCP695 control panel and complete any repairs indicated in Steps 12 through 16; then:

a. Connect Wire No. 24A to Terminal 1TB1-1 and Wire No. 25A to Terminal 1TB1-2.

b. Adjust the vane control switch to the AUTO position.

c. Set the chiller switch at either AUTO/LOCAL or AUTO/ REMOTE, as desired.

d. Restore power to the UCP695 control panel.

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