

REPLACED BY

30GT-2T

DATE

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SAFETY CONSIDERATIONS

Installing, starting up and servicing this equipment can be hazardous due to system pressures, electrical components and equipment location (roofs, elevated structures, etc.).

Only trained, qualified installers and service mechanics should install, start-up and service this equipment.

Untrained personnel can perform basic maintenance functions, such as cleaning coils. All other operations should be performed by trained service personnel.

When working on the equipment, observe precautions in the literature and on tags, stickers and labels attached to the equipment.

- Follow all local safety codes.
- Wear safety glasses and work gloves.
- Use care in handling, rigging and setting bulky equipment.
- Use care in handling electronic components.



ELECTRIC SHOCK HAZARD

Open all remote disconnects before servicing this equipment.

hand

INTRODUCTION

This publication contains information on the electronic control system, and control system troubleshooting for the 30GT040- 110 Flotronic™ liquid chillers and Flotronic units with factory-installed options (FIOP).

The Flotronic chillers are equipped with electronic expansion valves (EXVs) or, on FIOP units, conventional thermostatic expansion valves (TXVs). The FIOP chillers are also equipped with liquid line solenoid (LLS) valves.

Differences in operations and controls between standard and FIOP units are noted in appropriate sections in this publication. Refer to the Installation, Start-Up and Service Instructions and the Wiring Diagrams for further details.

⚠ WARNING

This unit uses a microprocessor-based electronic control system. Do not use jumpers or other tools to short out components, bypass or otherwise depart from recommended procedures+ Any short-to-ground of the control board or accompanying wiring may destroy the board or electrical component.

FLOTRONIC™ CONTROL SYSTEM

General — The 30GT air-cooled reciprocating chillers contain a microprocessor-based electronic control system that controls and monitors all operations of the chiller, **except** as noted on FIOP units.

The control system is composed of several components as listed below and identified in Fig. 1, 2 and 3.

- processor board
- relay board
- electronic expansion valve driver board
- display board
- thermistors
- electronic expansion valves or FIOP thermostatic expansion valve
- liquid line solenoid valve (FIOP TXV units only)
- compressor protection control system (CPCS) (standard on size 070, 50 Hz, and on 080-110 sizes)
- accessory board (field installed)
- demand limit board (field installed)

The Flotronic control system monitors and controls the following:

- cooler leaving water temperature control (compressor capacity control)
- electronic expansion valves
- condenser fans (head pressure control)
- demand limiting
- temperature reset
- pulldown control
- pumpdown on unit shutdown
- diagnostic display
- safety functions
- unit checkout (Quick Test)

Processor Board — The processor board, shown in Fig. 1, 2 and 3, is the chiller system's main control center. It contains the microprocessor, microprocessor memory, power supplies, analog-to-digital converters, electronic expansion valve drivers, relay drivers and display drivers.

The processor board is covered with a sheet metal cover that contains heaters that are used to keep the processor board above 32 F (0° C).

All electrical connections to the processor board are made through wire and ribbon cable connectors, located around the outside of the board. See Fig. 4(A,B)-6 for processor board wiring connections.

Connected to the microprocessor are 4 to 9 thermistors that are used to sense various temperatures throughout the system. See Table 1.

Table 1 — System Thermistors

J1 PIN CONNECTOR	THERMISTOR INPUT	THERMISTOR NO.
1, 2	Remote Thermistor	T10
6, 7	Compressor, Ckt B (EXV Only)	T8
8, 9	Compressor, Ckt A (EXV Only)	T7
10, 11	Evaporator, Ckt B (EXV Only)	T6
12, 13	Evaporator, Ckt A (EXV Only)	T5
14, 15	Saturated Condensing, Ckt B	T4
16, 17	Saturated Condensing, Ckt A	T3
18, 19	Cooler Entering Water	T2
20, 21	Cooler Leaving Water	T1

LEGEND

EXV — Electronic Expansion Valve

The microprocessor also monitors several status switches in the unit. These switches are listed in Table 2.

From one to 6 potentiometers are connected to the processor board. These potentiometers are used to input set points to the microprocessor. The potentiometers are listed in Table 3.

Table 2 — Status Switches

J2 PIN CONNECTOR	STATUS SWITCH	040-060 (50 Hz) 040-070 (60 Hz)	070 (50 Hz) 080	090-110
1, 2	Oil Pressure, Ckt B	Not Used	OPSB	OPSB
3, 4	Oil Pressure, Ckt A	Not Used	OPSA	OPSA
7, 8	Loss of Charge, Ckt B	LCSB	LCSB	LCSB
9, 10	Loss of Charge, Ckt A	LCSA	LCSA	LCSA
13, 14	Remote On/Off	Jumper	Jumper	Jumper
15, 19	Compressor Fault Signal, B2	Not Used	Not Used	CPCS-B2
15, 20	Compressor Fault Signal, B1	CPCS-B1	CPCS-B1	CPCS-B1
15, 23	Compressor Fault Signal, A2	Not Used	CPCS-A2	CPCS-A2
15, 24	Compressor Fault Signal, A1	CPCS-A1	CPCS-A1	CPCS-A1

LEGEND

CPCS — Compressor Protection Control System
LCS — Loss-of-Charge Switch, Circuit A or B
OPS — Oil Pressure Switch, Circuit A or B

Table 3 — Potentiometers

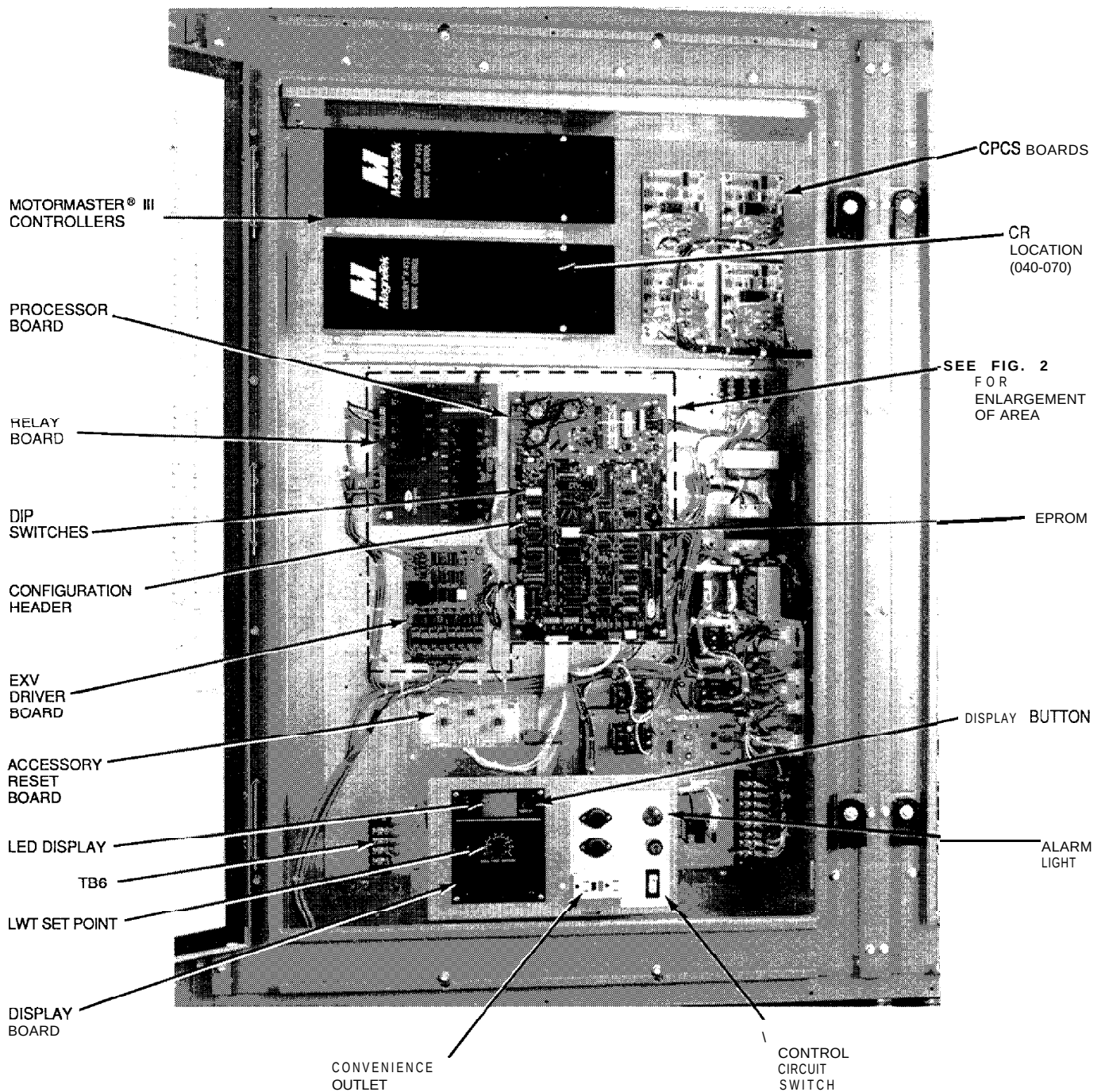
POTENTIOMETER	DESCRIPTION	LOCATION	VALID RANGE	DEFAULT VALUE
P1	Cooler Leaving Water Set Point	Display Board	Water: 40 — 70 F (4.4 — 21 C) Brine: 15 — 70 F (-9.4 — 21 C)	70 F (21 C) 42 F (5.6 C)
P3*	Reset Limit Set Point	Accessory Reset Board	0° — 80 F (0° — 44.4 C)	0° F (0° C)
P4†	Demand Limit Set Point	Field Supplied Potentiometer or Demand Limit Control Board	0-100%	0%
P5*	Reset Ratio Set Point	Accessory Reset Board	0-100%	0%
P6*	Reset Set Point	Accessory Reset Board	0° — 95 F (-17.8 — 35 C)	0° F (-17.8 C)

*Accessory reset board required for reset options.

†Accessory 2-Step Demand Limit Module is required for 2-step demand limit which has 2 potentiometers.

The microprocessor also controls several outputs. All relay outputs are controlled through relay board which plugs into processor board through a ribbon cable. The processor also controls a 2-digit LED (light-emitting diode) display located on display board. The display board also plugs into processor board with a ribbon cable. The electronic expansion valves are controlled by the microprocessor through the EXV driver board. See Fig. 4A,B for wiring schematic of microprocessor inputs and outputs.

The microprocessor has been programmed to control a large variety of chillers. To configure processor for a unique chiller, 2 methods are used; a configuration header, and a DIP switch assembly. The configuration header is a small plastic header plugged into a chip socket. The header contains 8 small wire jumpers (see Tables 4 and 5) selectively broken to configure unit. The purpose of each jumper is outlined below. Do not change factory configuration as it could result in improper operation of unit.



LEGEND

CPCS	■ Compressor Protection Control System
CR	■ Control Relay
DIP	■ Dual In-Line Package
EPROM	■ Erasable, Programmable Read-Only Memory
EXV	■ Electronic Expansion Valve
LWT	■ Leaving Water Temperature

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Fig. 1 — Typical Control Box

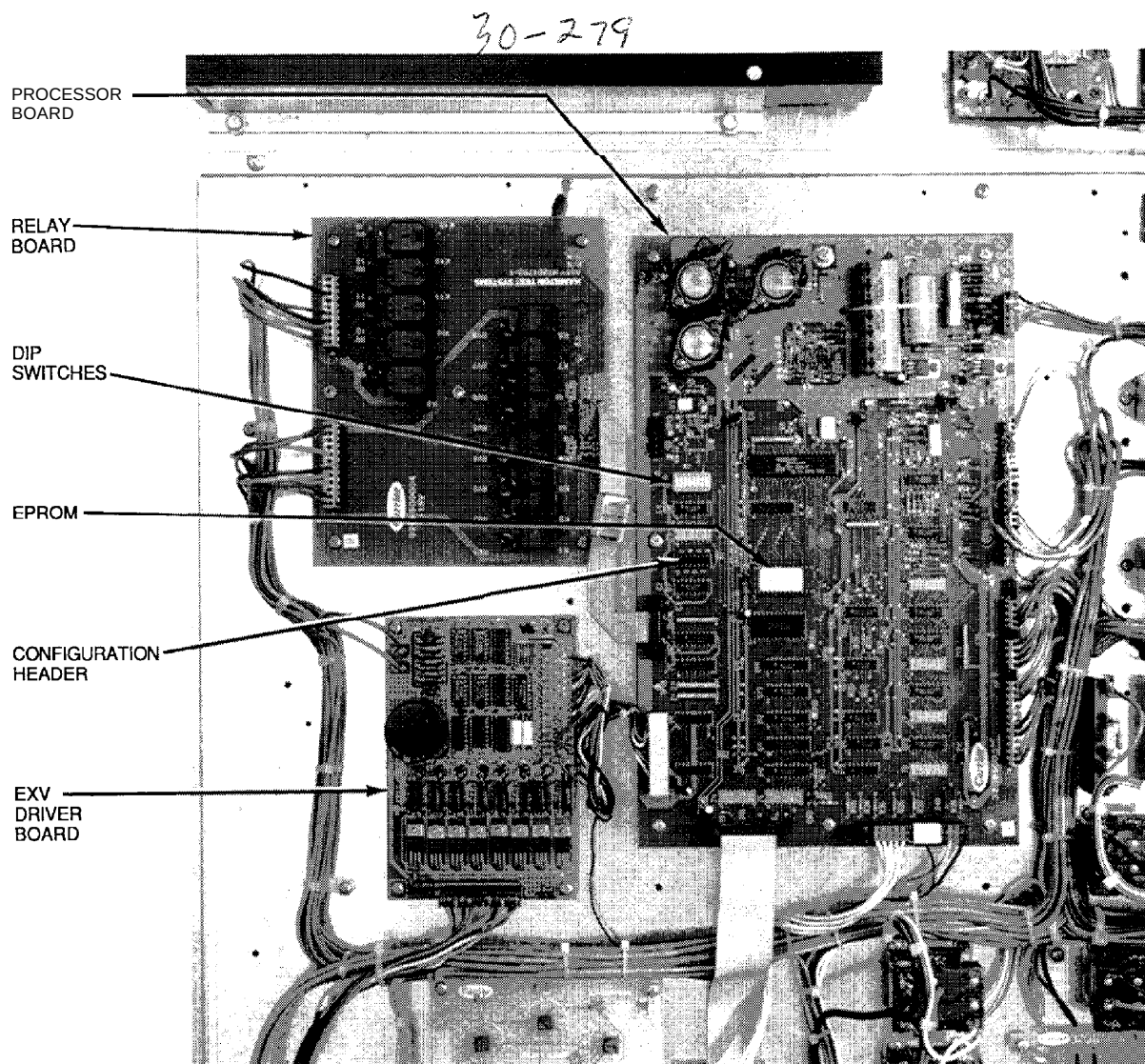


Fig. 2 – Photo Inset Enlargement for Fig. 1

Table 4 – Configuration Header

JUMPER NO.	FUNCTION	SETTING	MEANING
1, 2	Unit Type	☐ ☒ ☐	Air-Cooled Chiller
3, 4, 5	Number of Compressors	☐ ☒ ☐ ☐ ☐	3 Compressors 4 Compressors
6	Expansion Valve	☒ ☐	EXV TXV
7	Power Frequency	☐ ☒	60 Hz 50 Hz
8	Not Used	☒	No Significance

LEGEND

- ☐ -- Broken Jumper (Open Circuit)
☒ -- Unbroken Jumper (Closed Circuit)

Table 5 – Configuration Header Settings

UNIT SIZE	CONFIGURATION HEADER							
	1	2	3	4	5	6	7	8
040,045,050,060 – 60 Hz (EXV)	☐	☐	☒	☐	☐	☒	☐	☒
040,045,050,060 – 50 Hz (EXV)	☐	☐	☒	☐	☐	☒	☒	☒
040,045,050,060 – 60 Hz (TXV)	☐	☐	☒	☐	☐	☐	☐	☒
040,045,050,060 – 50 Hz (TXV)	☐	☐	☒	☐	☐	☐	☒	☒
070 – 60 Hz (EXV)	☐	☐	☒	☐	☐	☒	☐	☒
070 – 50 Hz (EXV)	☐	☐	☐	☒	☐	☒	☒	☒
070 – 60 Hz (TXV)	☐	☐	☒	☐	☐	☐	☐	☒
070 – 50 Hz (TXV)	☐	☐	☐	☒	☐	☐	☒	☒
080 – 60 Hz (EXV)	☐	☐	☐	☐	☐	☒	☐	☒
080 – 50 Hz (EXV)	☐	☐	☐	☒	☐	☒	☒	☒
080 – 60 Hz (TXV)	☐	☐	☐	☒	☐	☐	☐	☒
080 – 50 Hz (TXV)	☐	☐	☐	☒	☐	☐	☒	☒
090-110 – 60 Hz (EXV)	☐	☐	☒	☒	☐	☒	☐	☒
090-110 – 50 Hz (EXV)	☐	☐	☒	☒	☐	☒	☒	☒
090-110 – 60 Hz (TXV)	☐	☐	☒	☒	☐	☐	☐	☒
090-110 – 50 Hz (TXV)	☐	☐	☒	☒	☐	☐	☒	☒

LEGEND

- ☐ -- Broken Jumper (Open Circuit)
☒ -- Unbroken Jumper (Closed Circuit)
EXV -- Electronic Expansion Valve
TXV -- Thermostatic Expansion Valve

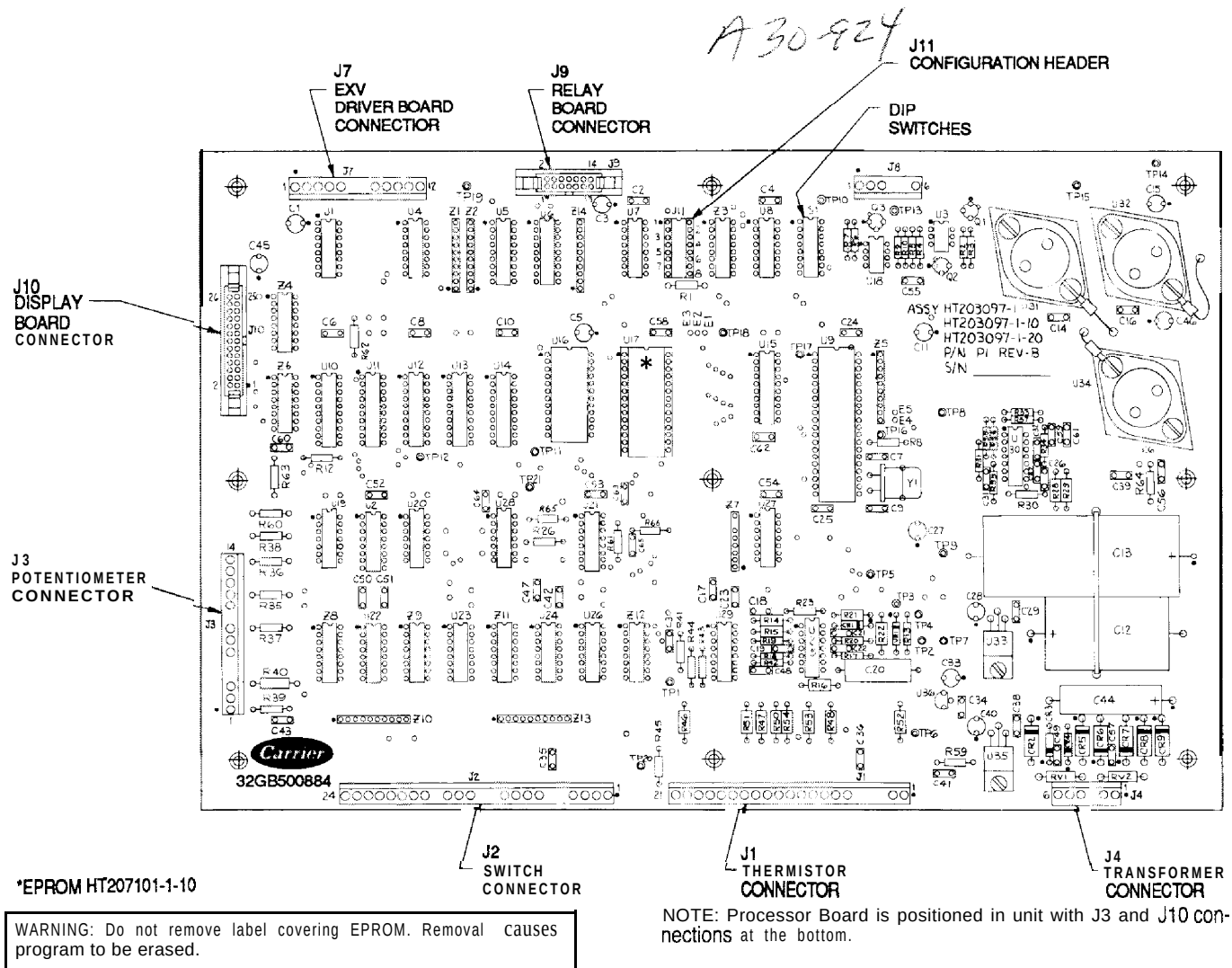


Fig. 3 — Processor Board

To allow for field-selectable options, a second configuration method is used. A small DIP (dual in-line package) switch assembly is located on processor board. The header contains 8 DIP switches protected by a plastic cover. The cover must be removed to access switches. Always replace plastic cover after adjusting DIP switches. Switches should be adjusted only when control circuit switch is OFF. Do not change DIP switch 8 in field unless unit has been factory-modified for brine applications. Unit damage may occur due to expansion device being improperly sized for low flow conditions. See Table 6.

All units are shipped from factory with DIP switches in the following positions. Control circuit must be OFF before changing a DIP switch setting. See Table 7.

Table 6 — DIP Switch

SWITCH NO.	FUNCTION	SETTING*	PURPOSE
1	Reset Mode	On Off	Return Reset Space or Outdoor Air Reset
2	Reset Select	On Off	Enable Reset Disable Reset
3	Pulldown Select	On Off	Enable Pulldown Disable Pulldown
4	Not Used	Off	—
5	Demand Limit	On Off	Enable Demand Limit Disable Demand Limit
6, 7	Unloaders	off, off On, Off Off, On	No Unloaders 1 Unloader 2 Unloaders
8	Brine Select	On Off	Brine Chiller Water Chiller

*Control Circuit switch must be OFF before changing setting of DIP switch.

Table 7 — DIP Switch Settings

UNIT	FACTORY DIP SWITCH SETTING							
	1	2	3	4	5	6	7	8
Water	Off	Off	On	Off	Off	Off	On	Off
Brine	Off	Off	On	Off	Off	Off	On	On

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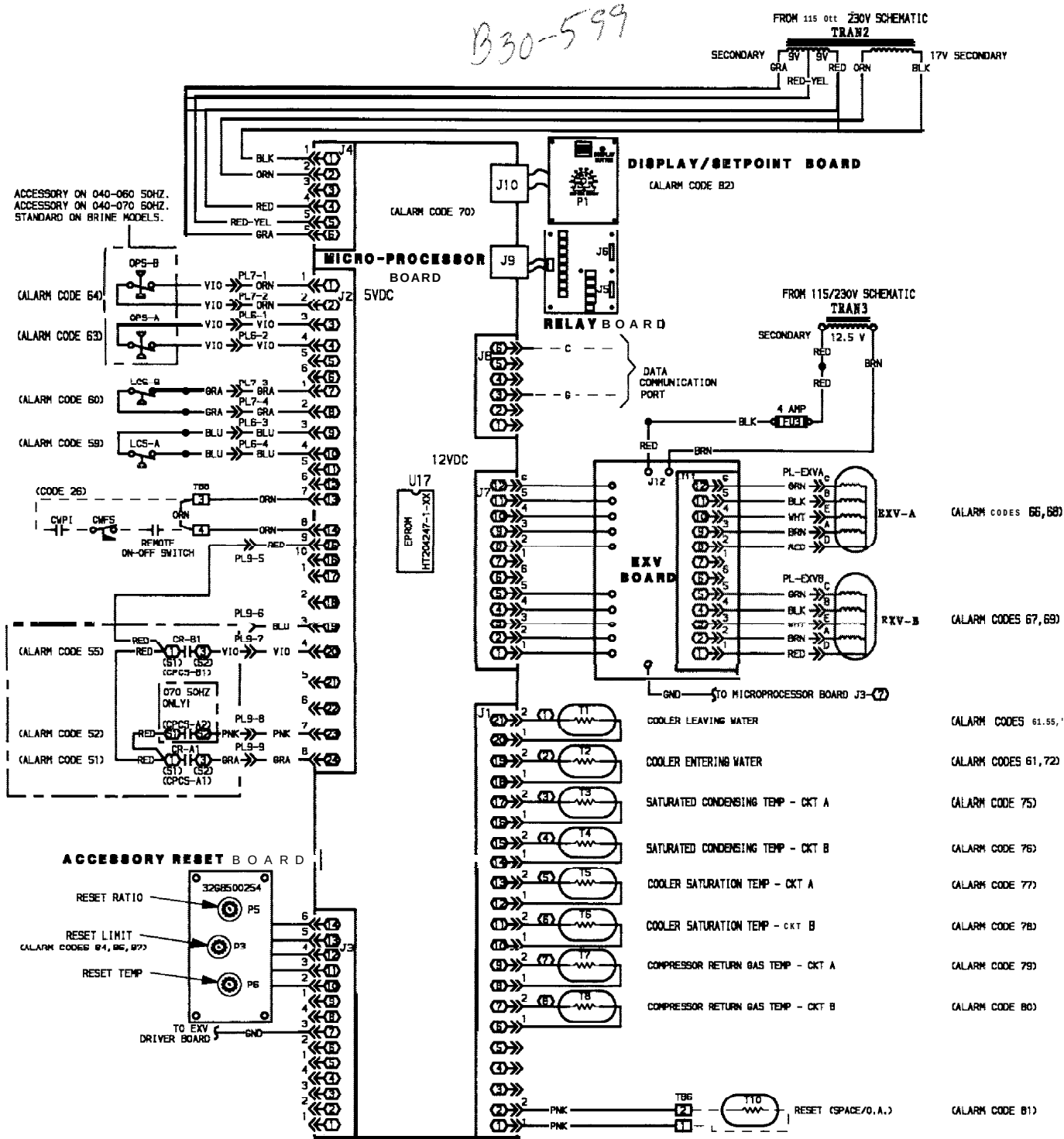


Fig. 4A - Processor Input/Output (040-070)

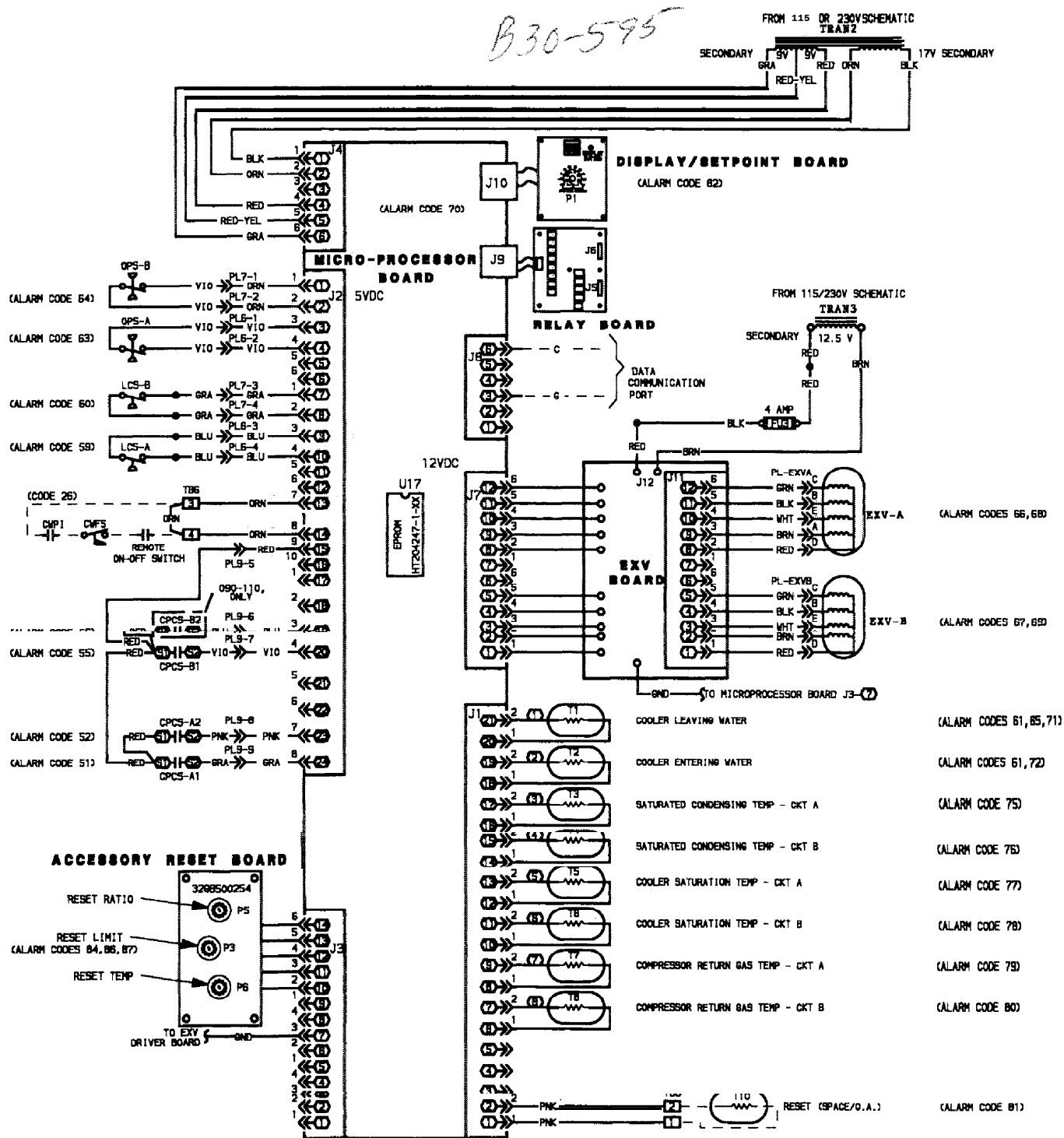
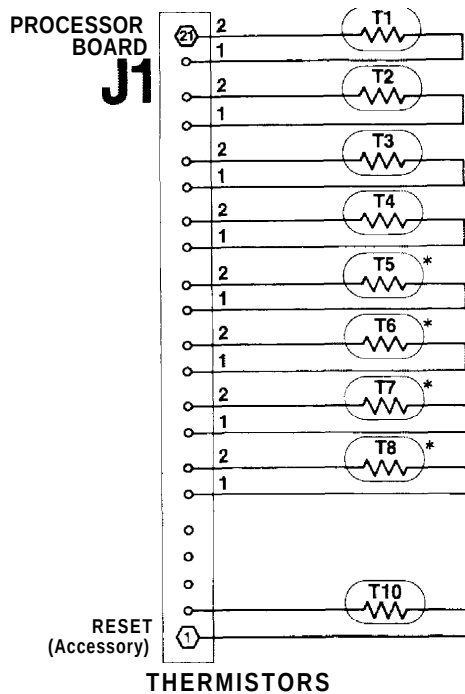
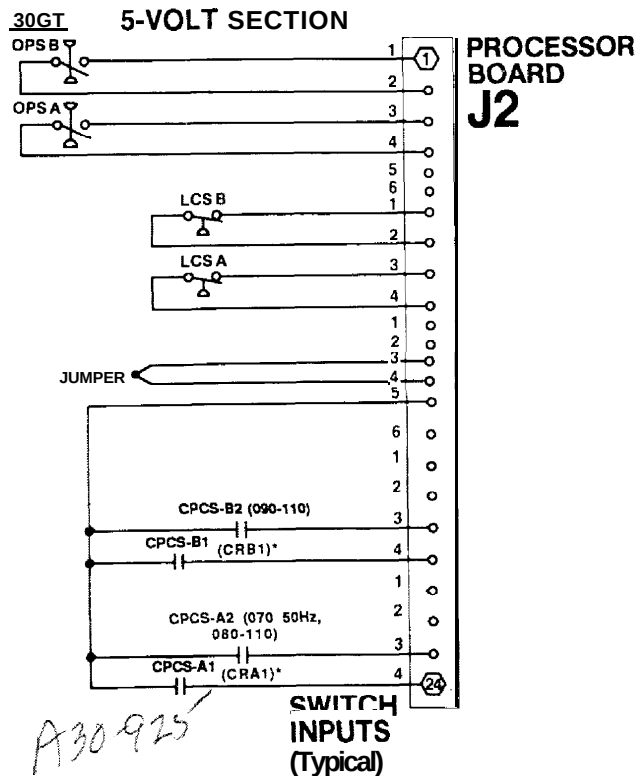


Fig. 4B - Processor Input/Output (080-1 10)



*Not used on FIOP (Factory-Installed Options) unit with TXV (Thermostatic Expansion Valve).

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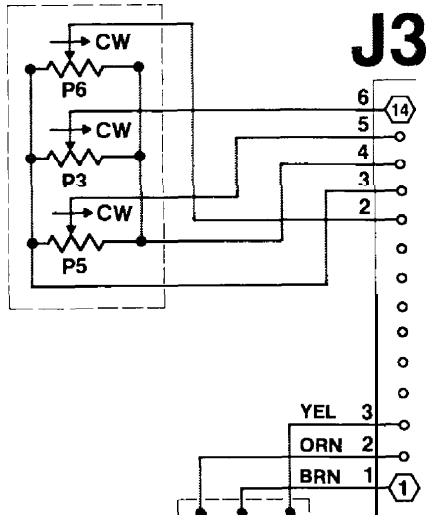


*On 040-060 50 Hz, and 040-070 60 Hz.

LEGEND

- OPS — Oil Pressure Switches
- LCS — Loss-of-Charge Switches
- CPCS — Compressor Protection Control System (Circuit)
- CR — Control Relay

ACCESSORY BOARD



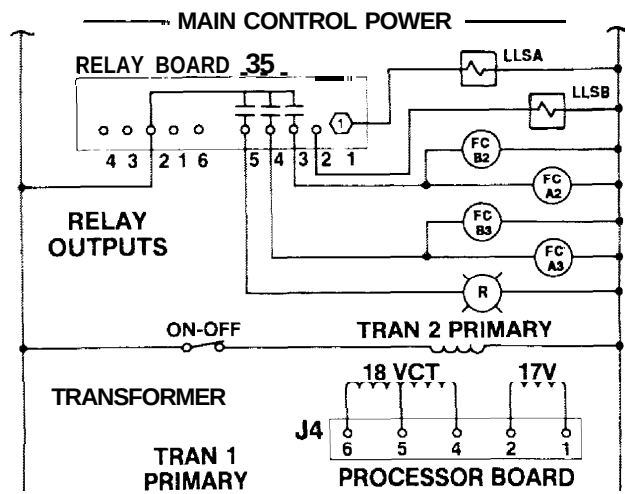
DEMAND LIMIT BOARD

POTENTIOMETER INPUTS

LEGEND

- c w — Clockwise

A30-521



LEGEND

- FC — Fan Contactor
- LLS — Liquid Line Solenoid (FIOP units only)
- R — Red (Light)
- VCT — Voltage Center Tap

A30-926

Fig. 5 — Printed-Circuit Board Connectors

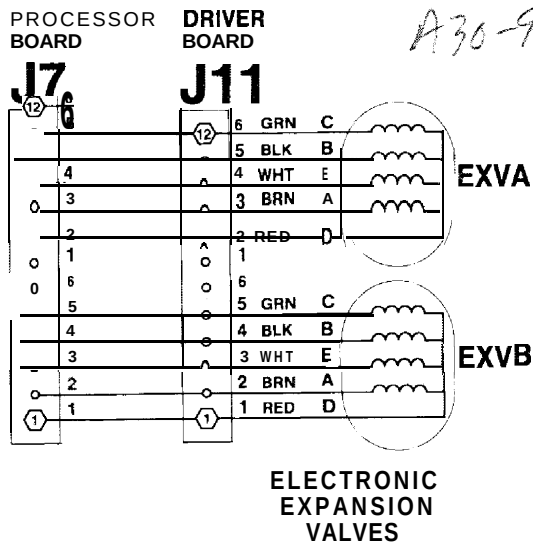


Fig. 6 — Printed-Circuit Board Connectors

Relay Board — The Relay Board is used to control all 24-, 115-, and 230-v loads. The Relay Board is connected to processor board through a ribbon cable. See Fig. 7 for electrical connections. The relay board contains eight 24-v relays and five 115- or 230-v relays. The relays and their use are listed in Table 8.

Display Board — The display board is located in control box. The board is connected to J10 on processor board through a ribbon cable. The display board contains cooler leaving fluid temperature set point potentiometer, a 2-digit, 7-segment display, and display switch. The display is used to convey operating information and error codes. See Operating Information.

Table 8 — Output Relay

RELAY NO.	DESCRIPTION
K1	Energize Compressor A1 and OFM1
K2	No Action (040-060, 50 Hz; 040-070, 60 Hz) Energize Compressor A2
K3	No Action
K4	Energize Unloader A1
K5	Energize Compressor B1 and OFM2
K6	No Action (040-080) Energize Compressor B2
K7	No Action
K8	Energize Unloader B1
K9	Energize Liquid Line Solenoid Valve for Circuit A (if used)
K10	Energize Liquid Line Solenoid Valve for Circuit B (if used)
K11	Energize First Stage of Condenser Fans: 040-050 — OFM3 060-090 — OFM3, OFM4 100-110 — OFM3, OFM4
K12	Energize Second Stage of Condenser Fans: 040-050 — OFM4 060-090 — OFM5, OFM6 100-110 — OFM5, OFM6, OFM7, OFM8
K13	Alarm

LEGEND

OFM — Outdoor Fan Motor

Thermistors — The electronic control uses 4 to 9 thermistors to sense temperatures for controlling chiller operation. These sensors are outlined on page 11. See Fig. 8-11 for thermistor locations. All thermistors are identical in temperature versus resistance and voltage drop performance. See Thermistor Troubleshooting for temperature-resistance-voltage drop characteristics.

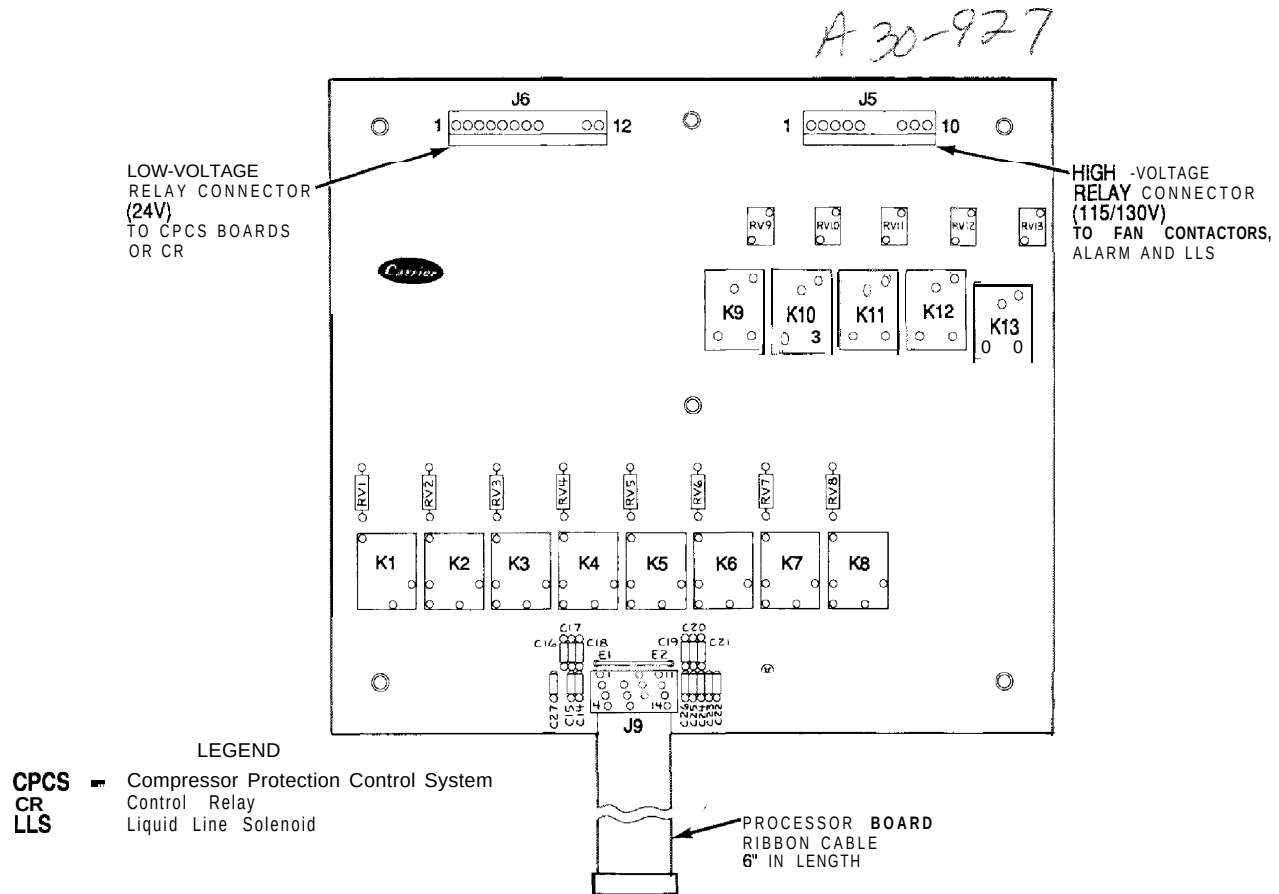


Fig. 7 — Relay Board

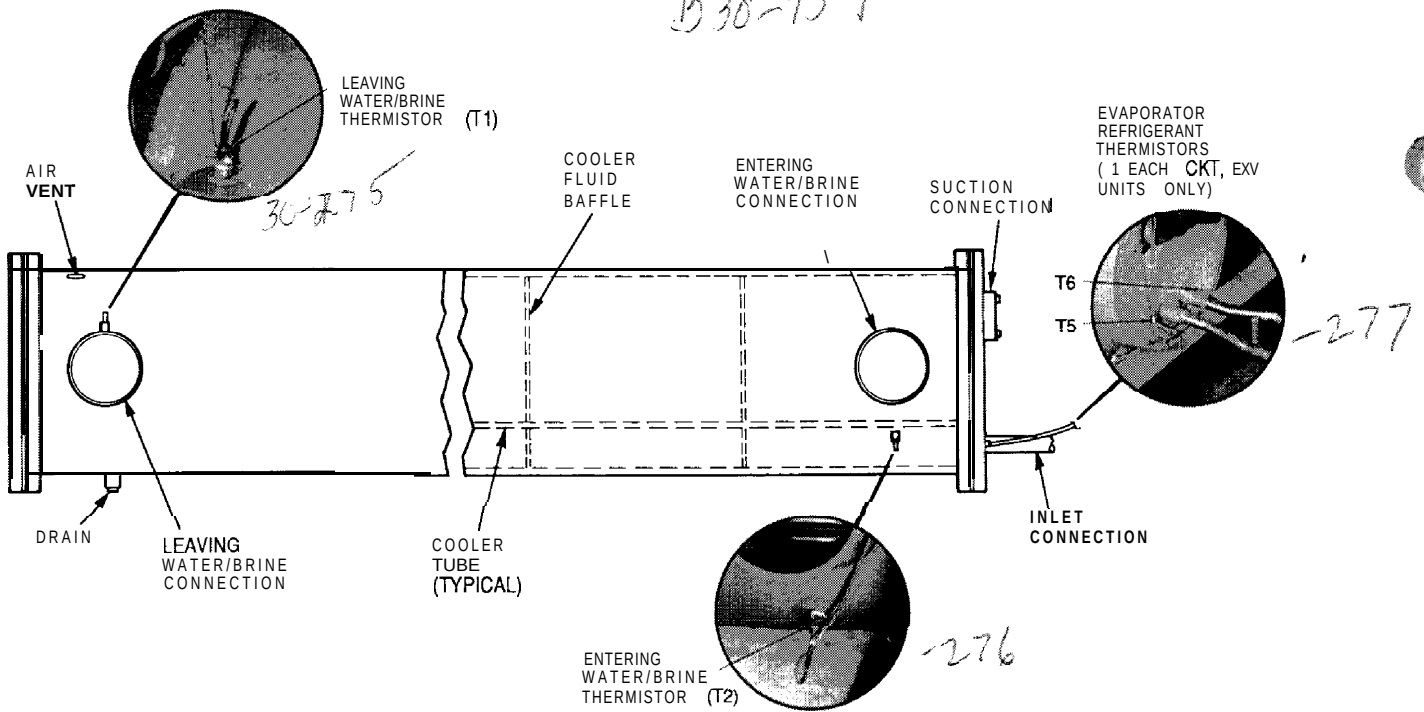


Fig. 8 - Cooler Thermistor Locations

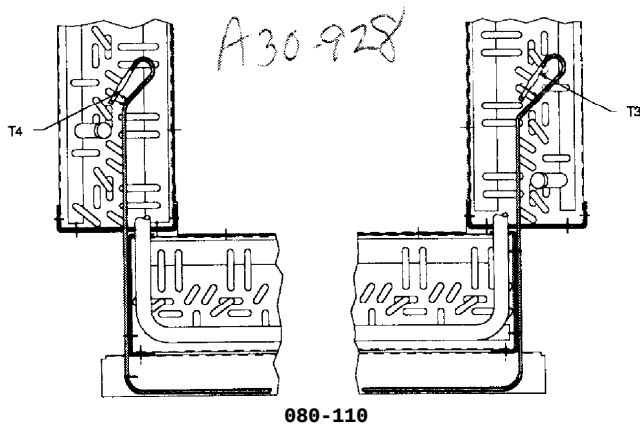
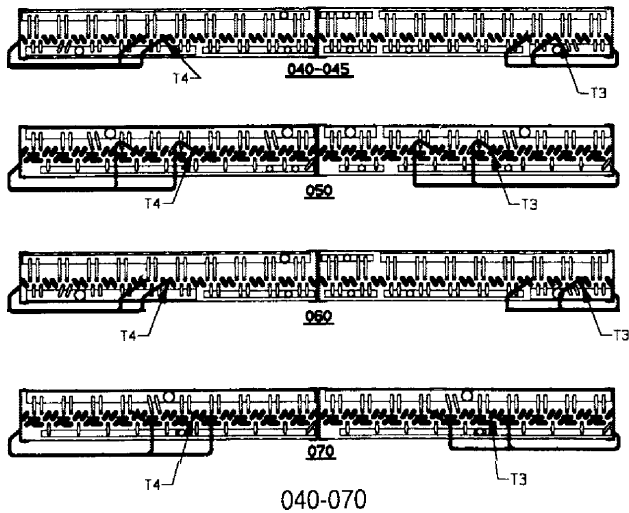


Fig. 9 - Thermistor T3 and T4 Locations

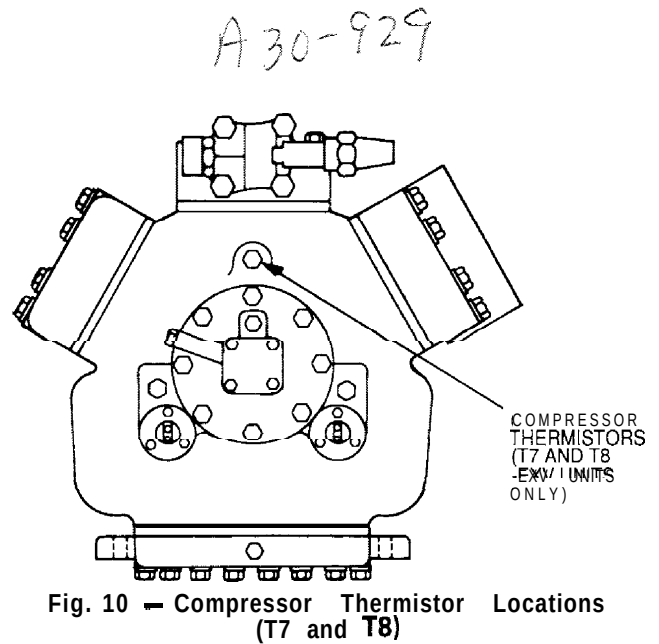


Fig. 10 - Compressor Thermistor Locations (T7 and T8)

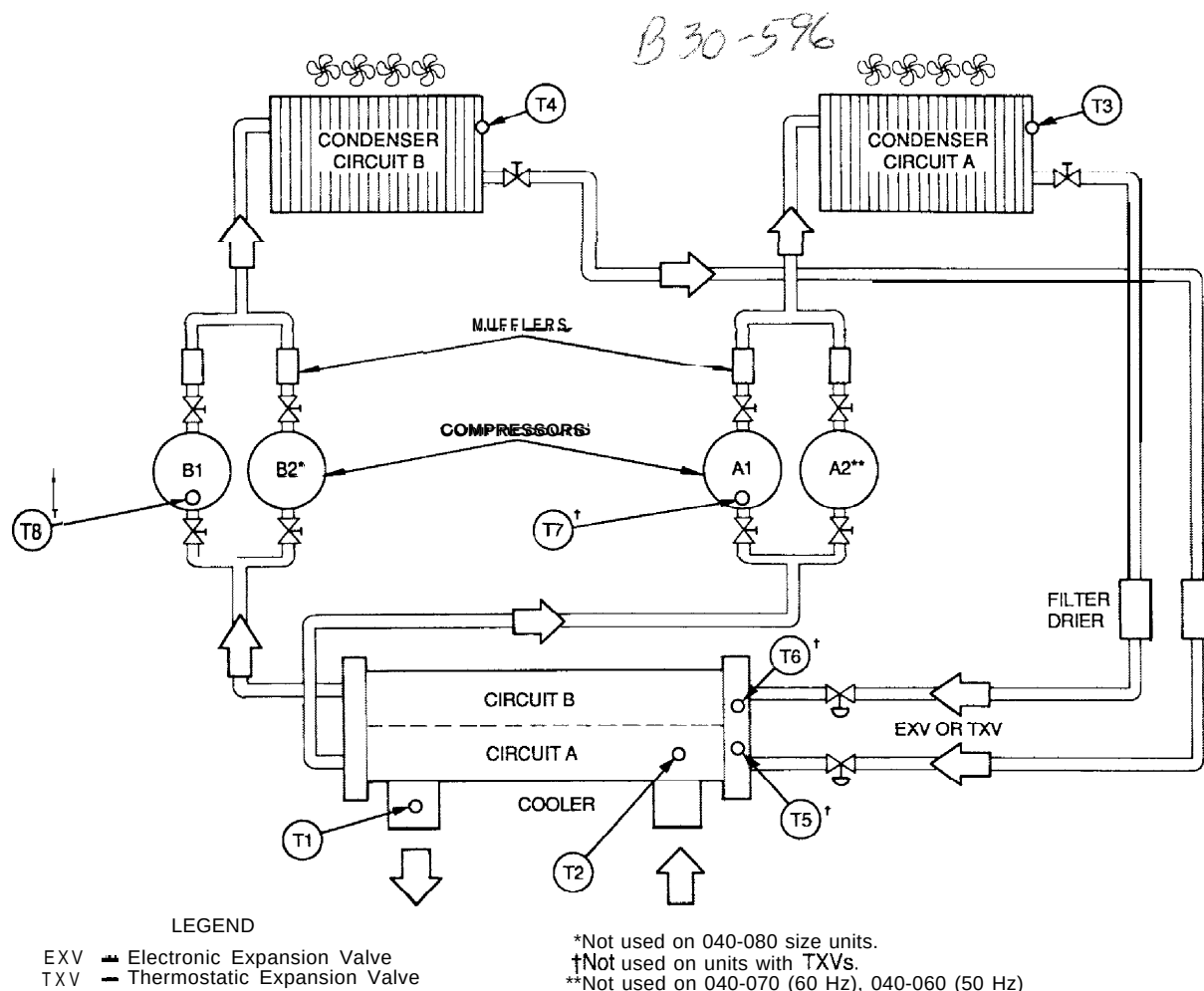


Fig. 11 — Thermistor Locations

T1 — COOLER LEAVING WATER/BRINE SENSOR — This thermistor is located in the leaving water nozzle. The thermistor probe is immersed directly in the water.

T2 — COOLER ENTERING WATER/BRINE SENSOR — This thermistor is located in the cooler shell in the first baffle space in close proximity to the cooler tube bundle.

T3, T4 — SATURATED CONDENSING TEMPERATURE SENSORS — These 2 thermistors are clamped to the outside of a return bend of the condenser coils.

T5, T6 — EVAPORATOR REFRIGERANT TEMPERATURE SENSORS — These thermistors are located next to the refrigerant inlet in the cooler head. The thermistors are inserted into a friction-fit well. The sensor well is located directly in the refrigerant path. These thermistors are not used on units with TXVs.

T7, T8 — COMPRESSOR RETURN GAS TEMPERATURE SENSORS — These thermistors are located in the lead compressor in each circuit in a suction passage after the refrigerant has passed over the motor and is about to enter the cylinders. These thermistors are inserted into friction-fit wells. The sensor wells are located directly in the refrigerant path. These thermistors are not used on units with TXVs.

T10 — REMOTE SENSOR — This is an accessory sensor and is mounted remotely from the unit. It is used for outside air or space temperature reset.

All thermistors are checked by the processor board to see that they are not open or shorted, and have a valid resistance range value.

Electronic Expansion Valves (EXV) — See description of electronic expansion valve in Operating Information section of this publication.

Electronic Expansion Valve Driver Board — The processor board controls the operation of the electronic expansion valves through the EXV driver board. The EXV driver board amplifies the signal from processor board to electronic expansion valve by increasing the voltage to the EXV stepper motor. This results in an increase in the available torque output of the stepper motor. The EXV driver board is powered by a separate 12.5-v transformer. See Fig. 2.

Thermostatic Expansion Valves (TXV) — Model 30GT units are available from the factory with conventional thermostatic expansion valves with liquid line solenoids. The liquid line solenoid valves are not intended to be a mechanical shut-off. When service is required, it is recommended the liquid line service valve be used to pump down the system.

The TXV is set at the factory to maintain approximately 8 to 12° F (4.4 to 6.7° C) suction superheat leaving the cooler, by monitoring proper amount of refrigerant into the cooler. All TXVs are adjustable, **but should not be adjusted unless absolutely necessary**. When TXV is used, thermistors T5, T6, T7 and T8 are not required.

The TXV is designed to limit the cooler saturated suction temperature to 55 F (12.8 C). This makes it possible for unit to start at high cooler water temperatures without overloading the compressor.

Compressor Protection Control System (CPCS) or Control Relay (CR) —

Each compressor has its own CPCS module. See Fig. 12. The modules are used to control and protect the compressors and crankcase heaters. The CPCS provides the following functions:

- compressor contactor control
- crankcase heater control
- compressor ground current protection
- status communication to processor board
- high-pressure protection
- high discharge gas temperature protection

One large relay is located on the CPCS board. This relay controls the crankcase heater and compressor contactor, and also provides a set of signal contacts that the microprocessor monitors to determine the operating status of the compressor. If the processor board determines that the compressor is not operating properly through the signal contacts, it will lock the compressor off by deenergizing the proper 24-v control relay on the relay board. The CPCS board contains logic that can detect if the current-to-ground of any compressor winding exceeds 2.5 amps. If this condition occurs, the CPCS module shuts down the compressor.

A high-pressure switch with a trip pressure of 426 ± 7 psig ($2,936 \pm 48$ kPa) and a discharge gas thermostat with a trip temperature of 295 ± 5 F (146 ± 2.8 C) are wired in series with the CPCS module or control relay (CR). If any of these switches open during operation, the compressor stops and the failure is detected by the processor when the signal contacts open. The compressor is locked off. If the lead compressor in either circuit is shut down by the high pressure switch, discharge gas thermostat, ground current protector, loss of charge switch, or oil pressure switch, *all* compressors in the circuit are locked off.

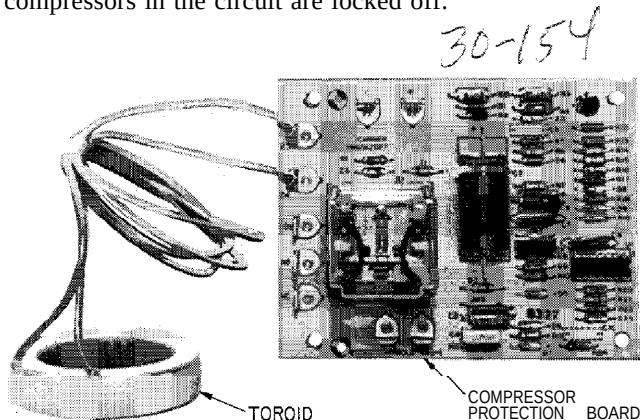


Fig. 12 — Compressor Protection Control System Module

Accessory Reset Board (See Fig. 1, 5, and 33)

— The processor board is programmed to handle several types of temperature reset. The following 3 types of reset may be used:

- return water reset
- outdoor-air temperature reset
- space temperature reset

The accessory board is required to use temperature reset. The board contains the following potentiometers:

CODE	NAME	DESCRIPTION	RANGE
P3	Reset Limit Set Point		0° — 80 F (0° — 44.4 C)
P5	Reset Ratio Set Point		0° — 100 %
P6	Reset Set Point		0° — 95 F (-17.8 — 35 C)

The board is equipped with a prewired cable and connector, and the control panel in the control box is predrilled to accept the board.

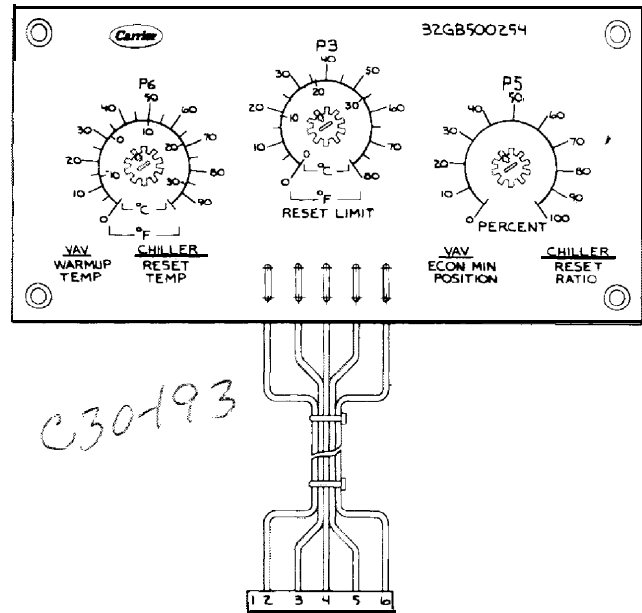


Fig. 13 — Accessory Board

Demand Limit Control Module — The demand limit board or demand limit control module (DLCM) provides a 2-step demand limit control with an external switch to enable the device. The first step is between 50 and 100% of the maximum compressor displacement. The second step is between 0 and 49% of the maximum compressor displacement. The exact percentage differs, depending on the number of capacity steps of the machine. The external switching device controls the 2 steps and determines when to limit unit capacity.

Two adjustable potentiometers are used to set the 2 demand limit points. Potentiometer P1 is used to set the first step and P2 sets the second step. Also refer to Operating Information and Fig. 14. See separate accessory Demand Limit Control Module Installation Instructions.

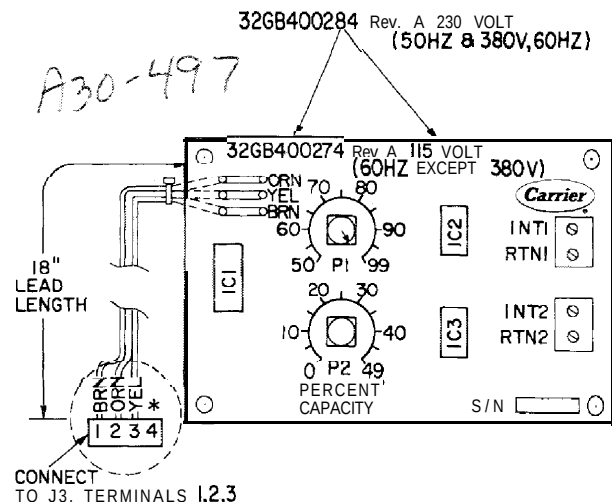


Fig. 14 — Accessory Demand Limit Control Module

OPERATING INFORMATION

Digital Display — The electronic control system uses a 2-digit LED display located on the display board (see Fig. 1) to display operational information and diagnostic codes.

When the control ON-OFF switch is turned on, the display shows a **20** for 2 minutes to indicate that the control is in the initialization mode. During this period, the electronic expansion valve position is closed and initialized. The water temperatures are allowed to stabilize+

IMPORTANT: If the display button is pressed during the 2-minute period the control goes into Quick Test mode. See Quick Test section on this page for de-

After the 2-minute period, the display turns off and the unit is allowed to start approximately 90 seconds after the display is shut off. If the button is pressed after the 20 has been removed from the display, the diagnostic information is shown as long as the button is held in. The numbers that are shown in the display have the following significance:

CODE NO.	OPERATIONAL STATUS
0-1 2	Capacity Stage
20-26	Operational Codes
51-87	Diagnostic Disolav Codes

Refer to the unit's label diagram and the diagnostic display code section of this book for further details.

Under normal operation, only the capacity stage number is displayed when display button is pressed. If a status code or an overload code is displayed, the display will rotate every 2 seconds and will display up to 3 codes. Diagnostic display information takes priority over all other codes. The codes are stored by the microprocessor as long as the board remains energized,

IMPORTANT: The memory is cleared when power is removed from the processor board.

DISPLAY CODES — The digital display shows up to 3 codes as described in the digital display section above. There are categories of display codes shown during normal operation. During Quick Test, these codes do not apply.

0- 12 CAPACITY STAGE NUMBER — The capacity stage number is always displayed when the display button is pressed unless there are 3 diagnostic codes. Diagnostic codes override the stage number and operating information codes.

Refer to Capacity Control — Operating Sequence section on page 18 for the number of stages and loading sequence for the chiller.

20-26 OPERATIONAL CODES The operational codes are displayed to indicate that the unit is operating in a special mode of operation. During these special modes of operation, the set point and number of active stages may be controlled by another signal other than just the cooler leaving water temperature. The operational codes are listed in Table 9.

Table 9 — Operational Codes

CODE NO.	DESCRIPTION
20	Initialization Mode
21	Temperature Reset in Effect
22	Demand Limit in Effect
24	Pulldown Control in Effect
26	Remote On/Off in Effect, Open CWFS, or CWPI

LEGEND

CWFS — Chilled Water Flow Switch
CWPI — Chilled Water Pump Interlock

Initialization Mode Code 20 is displayed **only** during the first 2 minutes of operation after the power ON-OFF switch has been turned ON. The display is always lighted. If the display button is pressed during this period, the unit goes into Quick Test.

Temperature Reset — Code 21 indicates that the unit is using temperature reset to adjust the set point. The leaving water temperature may not equal the cooler leaving-water temperature set point potentiometer setting. The set point can be adjusted based on 3 different temperatures; return water, outside air temperature or space temperature.

Demand Limit — Code 22 indicates that the capacity staging of the unit is being limited by the demand limit potentiometer. The unit may not be able to produce the desired leaving water temperature, nor load to its full capacity.

Pulldown Control — Code 24 indicates this option is being used, the cooler water temperature is warm, and unit is limiting the capacity staging so that the water temperature leaving the cooler does not decrease faster than 1° F (0.6° C) per minute. This option is selected in the factory, but may be turned off in the field.

Remote On-Off — Code 26 indicates unit is under control of a field-installed remote ON-OFF switch, or an open CWFS or CWPI is detected.

51-87 DIAGNOSTIC DISPLAY CODES — The control contains extensive diagnostic capabilities. If something is not functioning properly, the control will energize the alarm light (see Fig. 1) and will display a diagnostic code from 51 to 87. These codes, the action to be taken and the reset method are described in the Controls Troubleshooting and Service section, page 25.

Quick Test (Table 10) — The Quick Test is a 42-step program that provides a means of checking all input and output signals of the microprocessor control prior to unit start-up. This check ensures that all control options, thermistors and switches are in proper working order. The Quick Test utilizes the 2-digit LED display (Fig. 1 and 2) on the display set point board.

To initiate the Quick Test program, first turn the unit control switch to the ON position. When a 20 appears in the display, immediately press the display button once. An 88 will appear in the display and the alarm light will be energized. This indicates that the microprocessor in the control system is ready to run the Quick Test program.

IMPORTANT: Do not allow the unit control circuit to remain energized with 20 showing in the display for more than 2 minutes. If the display button is not pressed within this time, the control will attempt to start the unit.

For each step of the 42-step program, the display button must be pressed twice. On the first press, the step number is displayed; the second press initiates the required action, and the appropriate Quick Test code is displayed.

NOTE: The step number is a numeral followed by a decimal point (a 2-digit number has a decimal point after *each* numeral). The action code number is one or 2 digits with no decimal point(s). Example: A "1." or "1.6." is a step number. A "1" or "0" or "00" is an action number.

IMPORTANT: Once the Quick Test is initiated, the display button must be pressed at least once every 10 minutes for the control to remain in the Quick Test mode. If the button is not pressed within this time, the control will attempt to start the unit.

To recheck any step in the Quick Test, the control must be recycled by turning the unit control circuit switch OFF for a few seconds, then ON again. Restart the Quick Test program as described above and proceed through the Quick Test steps. Press the display button *twice* for each step until the step to be rechecked is reached.

The Quick Test program is divided into 3 sections as described below.

A. QUICK TEST STEPS 1.-1.5 — UNIT CONFIGURATION — The microprocessor in the unit control system is programmed by 2 switch assemblies located on the processor board (Fig. 1). The configuration header is factory set (Table 4 and 5) and must not be changed in the field. The DIP switch assembly contains 8 microswitches that must be factory set in accordance with various options and accessories selected by the customer. All DIP switches should be verified in the field for proper position for options selected during the Quick Test. See Fig. 1 and Tables 6 and 7.

This section of the Quick Test also checks the loss-of-charge switches and the low oil pressure switches, located on the lead compressor of each circuit.

B. QUICK TEST STEPS 1.6-3.0 — THERMISTORS AND SET POINT POTENTIOMETERS — In these steps, the microprocessor checks the resistance values of all sensors and set point potentiometers to ensure they are functional, connected properly and set within the proper range for the unit configuration.

Nominal resistance values for all sensors range from 363,000 to 216 ohms. Normal display code for a good sensor or potentiometer is 1. Display code 0 indicates a faulty potentiometer, thermistor or wiring. A 0 display could also indicate the option is not being used.

Ohm settings within 10% to 90% of full-scale resistance are within acceptable range limits.

C. OUTPUT RELAYS, STEPS 3.1-4.2 — These Quick Test steps allow the microprocessor to check the output signals from the various relay boards in the unit control system. In addition, the operation of all condenser fans and compressors is checked at each step.

Normal display code for steps **3.1.** through **3.4.** is **1.** In steps 3.5. through **4.2.**, where appropriate, each compressor is started and allowed to run for approximately 10 seconds. At start-up, 0 will appear, followed by a **1** in a few seconds. At the end of the 10-second test, code 0 returns to the display, indicating that the test step has been successfully completed. The code **1** indicated that the compressor protection circuit was tested.

Fan and compressor operating sequence for Quick Test steps 3.1, through 4.2. are shown in Table 10 and Fig. 15.

If Quick Test steps do not operate as described, a defect exists in one or more of the following: Relay being tested, the electronic control, and unit wiring.

Table 10 — Quick Test 88
SECTION A. — Configuration and Switch Check

QUICK TEST STEP NO.	NORMAL DISPLAY	STEP DESCRIPTION	HEADER POSITION OR CONTROL SWITCH
1	00	Type Unit — Air-Cooled Chiller	Configuration Header: 1 and 2
2	2 3 or 4	No. of Compressors 2 = 040-060 (50 Hz), 040-070 (60 Hz) 3 = 070 (50 Hz), 080 4 = 090-110	Configuration Header: 3, 4 and 5
3	2	No. of Unloaders	DIP Switches 6 and 7
4	0 or 1	0 = Water 1 = Brine*	DIP Switch 8
5	1 or 0	1 = EXV 0 = TXV	Configuration Header: 6
6	50 or 60	50 = 50 Hz 60 = 60 Hz	Configuration Header: 7
7	0 or 1	0 = External Reset 1 = Return Water Reset	DIP Switch 1
8	0 or 1	0 = Reset Disabled 1 = Reset Enabled	DIP Switch 2
9	0 or 1	0 = Putldown Disabled 1 = Pulldown Enabled	DIP Switch 3
10	0 or 1	0 = Demand Limit Disabled 1 = Demand Limit Enabled	DIP Switch 5
11	0 or 1	0 = Remote On-Off — Switch/Jumper Open 1 = Remote On-Off — Switch/Jumper Closed	TB6-3 and TB6-4
12	0 or 1	0 = Loss-of-Charge Switch A Open 1 = Loss-of-Charge Switch A Closed	Circuit A Loss-of-Charge Switch
13	0 or a	0 = Loss-of-Charge Switch B Open 1 = Loss-uf-Charge Switch B Closed	Circuit B Loss-of-Charge Switch
14	0 or 1	0 = Low Oil Pressure Switch A Open 1 = Low Oil Pressure Switch A Closed	Circuit A Low Oil Pressure Switch
15	0 or 1	0 = Low Oil Pressure Switch B Open 1 = Low Oil Pressure Switch B Closed	Circuit B Low Oil Pressure Switch

*Do not change select switch to brine on units that do not have mod-ifications for brine. Special modifications are required. Contact Car-rier for details.

LEGEND

DIP — Dual In-Line Package
EXV — Electronic Expansion Valve
TXV — Thermostatic Expansion Valve

IMPORTANT: If TB6-3 and TB6-4 jumper is not installed, chiller remains in standby mode. No compressors or fans start and Code 26 is displayed. This is not a fault code. If circuit between TB6-3 and TB6-4 is open, processor is programmed to initiate a shutdown and hold machine in standby. This feature makes remote shutdown of chiller easier.

Table 10 — Quick Test 88 (cont)
SECTION B. — Thermistor and Potentiometer Checkout

QUICK TEST STEP NO.	NORMAL DISPLAY	STEP DESCRIPTION	THERMISTOR OR POTENTIOMETER
16.	1	1 — Thermistor OK 0 — Thermistor Faulty	T1 — Cooler Leaving Water Thermistor
17.	1	1 — Thermistor OK 0 — Thermistor Faulty	T2 — Cooler Entering Water Thermistor
18.	1	1 — Thermistor OK 0 — Thermistor Faulty	T3 — Saturated Condensing Thermistor, Circuit A
19.	1	1 — Thermistor OK 0 — Thermistor Faulty	T4 — Saturated Condensing Thermistor, Circuit B
20.	1 or 0	1 — Thermistor OK 0 — Thermistor Faulty or Not Used	T5 — Cooler Thermistor, Circuit A (EXV Units)
21.	1 or 0	1 — Thermistor OK 0 — Thermistor Faulty or Not Used	T6 — Cooler Thermistor, Circuit B (EXV Units)
22.	1 or 0	1 — Thermistor OK 0 — Thermistor Faulty or Not Used	T7 — Compressor Thermistor, Circuit B (EXV Units)
23.	1 or 0	1 — Thermistor OK 0 — Thermistor Faulty or Not Used	T8 — Compressor Thermistor, Circuit B (EXV Units)
24.	1 or 0	1 — Thermistor OK 0 — Thermistor Faulty or Not Used	T10 — Accessory Remote Thermistor
25.	1	1 — Potentiometer OK 0 — Potentiometer Faulty	P1 — Leaving Fluid Set Point Potentiometer
26.	0	No Significance	
27.	a or 0	1 — Potentiometer OK 0 — Potentiometer Faulty or Option Not Used	P3 — Accessory Reset Limit Potentiometer
28.	1 or 0	1 — Potentiometer(s) OK 0 — Potentiometer(s) Faulty or Option Not Used	P4 — Accessory Demand Limit Potentiometer(s)
29.	1 or 0	1 — Potentiometer OK 0 — Potentiometer Faulty or Option Not Used	P5 — Accessory Reset Ratio Potentiometer
30.	1 or 0	1 — Potentiometer OK 0 — Potentiometer Faulty or Option Not Used	P6 — Accessory Reset Set Point Potentiometer

†Display is 1 for Flotronic™ EXV units only.

Display is 0 for Flotronic FIOP units (with TXV).

LEGEND

EXV — Electronic Expansion Valve
TXV — Thermostatic Expansion Valve

Table 10 – Quick Test **88** (cont)

SECTION C. – Output Relay Check

QUICK TEST STEP NO.	NORMAL DISPLAY	STEP DESCRIPTION	RELAY NO.
3.1	1	Energize First Stage of Condenser Fans 040, 045, 050 – OFM3 060, 070, 080, 090 – OFM3, OFM4 100, 110 – OFM3, OFM4	K11
3.2	1	Energize Second Stage of Condenser Fans 040, 045, 050 – OFM4 060, 070, 080, 090 – OFM5, OFM6 100, 110 – OFM5, OFM6, OFM7, OFM8	K12
3.3	1	Energize Liquid Line Solenoid Valve (TXV only), Circuit A	K9
3.4	1	Energize Liquid Line Solenoid Valve (TXV only), Circuit B	K10
3.5	0 → 1 → 0 **	Energize Compressor A1, and OFM1	K1
3.6	0 → 1 → 0 **	Energize Compressor A2	K2
	0	No Action (040-060, 50 Hz), 040-070 (60 Hz)	
3.7	0	No Action	K3
3.8	0	Energize Unloader A1	K4
3.9	0 → 1 → 0 **	Energize Compressor B1, and OFM2	K5
4.0	0 → 1 → 0 **	Energize Compressor B2	K6
	0	No Action (040-080)	
4.1	0	No Action	K7
4.2	0	Energize Unloader B1	K8

Compressors will be energized for 10 seconds. **0 indicates open CPCS module contacts;

1 indicates closed CPCS module contacts.

LEGEND

CPCS – Compressor Protection Control System
OFM – Outdoor Fan Motor
TXV – Thermostatic Expansion Valve

FAN ARRANGEMENT	FAN NO.	CONTROLLED BY	
		During Quick Test*	Normal Control
A30-9412 CONTROL BOX 3 1 4 2	1	3.5	Compressor No. A1
	2	3.9	Compressor No. B1
	3	3.1	First Stage of Condenser Fans
	4	3.2	Second Stage of Condenser Fans
922 CONTROL BOX 5 3 1 6 4 2	1	3.5	Compressor No. A1
	2	3.9	Compressor No. B1
	3,4	3.1	First Stage of Condenser Fans
	5,6	3.2	Second Stage of Condenser Fans
923 CONTROL BOX 7 5 3 1 8 6 4 2	1	3.5	Compressor No. A1
	2	3.9	Compressor No. B1
	3,4	3.1	First Stage of Condenser Fans
	5,6,7,8	3.2	Second Stage of Condenser Fans

*Quick Test display numbers.

Fig. 15 – Condenser Fan Sequence

Capacity Control – Operating Sequence

— During the OFF cycle, each compressor's crankcase heater is energized. If the ambient temperature is below 36 F (2.2 C), cooler heaters and the microprocessor heater strips will be energized. When the ON-OFF switch is turned ON, the control will first go through a 2-minute initialization period. During this period, the display will continuously be energized with a 20. During initialization, the processor checks all potentiometers and thermistors for valid readings. Once the initialization is complete, the control will not start any compression for 90 seconds. During this time, the control is monitoring the water temperatures to determine the steady-state temperature of the water. Once the 90-second period is complete, the control will start the first stage of compression, if required.

The temperatures are monitored and the rate at which additional compressors are brought on depends on the leaving water temperature, how fast the temperature is changing, and the number of compressor stages on. With the automatic lead-lag feature in the unit, the control determines randomly which circuit will start first, A or B. At the first call for cooling, the lead compressor crankcase heater will be deenergized, a condenser fan will start, and the compressor will start unloaded.

If the circuit has been off for 15 minutes, and the unit is a TXV unit, liquid line solenoid will remain closed for that circuit for 10 seconds while the cooler and suction lines are purged of any liquid refrigerant. For units with EXVs, the process is essentially the same. The lead compressor will be signaled to start. The EXV will remain closed for 10 seconds before it is allowed to modulate.

After the purge period, the electronic expansion valve will begin to meter the refrigerant, or the liquid line solenoid will open allowing the thermostatic expansion device to meter the refrigerant to the cooler. If the off-time is less than 15 minutes, the electronic expansion valve or liquid line solenoid will be opened as soon as the compressor starts.

The electronic expansion valves will open gradually to provide a controlled start-up to prevent liquid flood-back to the compressor. During the start-up, the oil pressure switch is bypassed for one minute to allow for the transient changes during start-up. As additional stages of compression are required, the processor control will add them. See Table 11.

If a circuit is to be stopped, the control will first start to close the electronic expansion valve or close the liquid line solenoid valve.

For units with TXVs, the lag compressor will be shut down, and the lead compressor will continue to operate for 10 seconds to purge the cooler of any refrigerant.

For units with EXVs, the lag compressor will be shut down and the lead compressor will continue to run. After the lag compressor has shut down, the EXV is signaled to close. The lead compressor will remain on until the EXV is less than 300 steps open, and the saturated suction temperature is less than 25 F (–4 C) as sensed by the cooler thermistor T5 or T6, or one minute has elapsed.

During both algorithms, TXV and EXV, all diagnostic conditions will be honored. If a safety trip or alarm condition is detected before pumpdown is complete, the circuit will be shut down.

Table 11 – Capacity Control Steps

040-070

UNIT SIZE	CON-TROL STEPS	LOADING SEQUENCE A		LOADING SEQUENCE B	
		% Displace-ment (Approx)	Compres-sors	% Displace-ment (Approx)	Compres-sors
040 (60 Hz) 1 Unloader A1†	1	25	A1	—	—
	2	50	A1	—	—
	3	75	A1*, B1	—	—
	4	100	AI, B1	—	—
040 (60 Hz) 2 Unloaders A1†, B1**	1	25	A1*	25	B1*
	2	50	A1	50	B1
	3	75	A1, B1	75	A1, B1*
	4	100	AI, B1	100	AI, B1
040 (50 Hz) 045 (60 Hz) 1 Unloader A1†	1	21	A1*	—	—
	2	42	A1	—	—
	3	99	A1*, B1	—	—
	4	100	AI, B1	—	—
040 (50 Hz) 045 (60 Hz) 2 Unloaders A1†, B1**	1	21	A1*	38	B1*
	2	42	A1	58	B1
	3	60	A1*, B1*	60	A1*, B1*
	4	79	A1*, B1	81	A1, B1*
	5	100	AI, B1	100	AI, B1
045 (50 Hz) 050 (60 Hz) 1 Unloader A1†	1	32	A1*	—	—
	2	48	A1	—	—
	3	84	A1*, B1	—	—
	4	100	AI, B1	—	—
045 (50 Hz) 050 (60 Hz) 2 Unloaders A1†, B1**	1	32	A1	35	B1*
	2	48	A1	52	B1
	3	67	A1*, B1*	67	A1*, B1*
	4	83	AI, B1*	83	A1, B1*
	5	94	AI, B1	84	A1*, B1
	6	100	AI, B1	100	AI, B1
050 (50 Hz) 060 (60 Hz) 1 Unloader A1†	1	29	A1*	—	—
	2	43	A1	—	—
	3	86	A1*, B1	—	—
	4	100	AI, B1	—	—
050 (50 Hz) 060 (60 Hz) 2 Unloaders A1†, B1**	1	29	A1	38	B1*
	2	43	A1	57	B1
	3	67	A1*, B1*	67	A1*, B1*
	4	86	A1*, B1	81	A1, B1*
	5	100	AI, B1	100	AI, B1
060 (50 Hz) 1 Unloader A1†	1	38	A1*	—	—
	2	50	A1	—	—
	3	83	A1*, B1	—	—
	4	100	AI, B1	—	—
060 (60 Hz) 070 (60 Hz) 2 Unloaders A1†, B1**	1	33	A1*	33	B1*
	2	50	A1	50	B1
	3	83	A1*, B1	83	A1, B1*
	4	100	AI, B1	100	AI, B1
070 (50 Hz) 1 Unloader A1†	1	19	A1*	—	—
	2	29	A1	—	—
	3	48	A1*, A2	—	—
	4	62	AI, B1	—	—
	5	71	AI, B1	—	—
	6	90	A1*, A2, B1	—	—
070 (50 Hz) 2 Unloaders A1†, B1**	7	100	AI, A2	—	—
	1	19	A1*	28	B1*
	2	29	A1	47	B1
	3	47	A1*, B1*	57	A1*, B1*
	4	48	A1*, A2	71	A1, B1*
	5	58	AI, A2	76	AI, B1
	6	61	AI, B1	86	AI*, A2, B1*
	7	71	AI, B1	86	AI, A2, B1*
	8	90	A1*, A2, B1	100	AI, A2, B1
	9	100	AI, A2, B1	—	—

080-1 10

UNIT SIZE	CON-TROL STEPS	LOADING SEQUENCE A		LOADING SEQUENCE B	
		% Displace-ment (Approx)	Compres-sors	% Displace-ment (Approx)	Compres-sors
080 (60 Hz) 2 Unloaders A1†, B1†	1	22	A1*	29	B1*
	2	52	A1*, B1*	52	A1*, B1*
	3	67	AI*, B1	63	A1, B1*
	4	78	AI, B1	78	A1, B1
	5	99	AI, A2, B1	89	AI*, A2, B1
	6	100	AI, A2, B1	100	AI, A2, B1
080 (50 Hz) 2 Unloaders A1†, B1†	1	16	A1*	25	B1*
	2	42	A1*, B1*	42	A1*, B1*
	3	54	AI*, B1	50	AI, B1*
	4	62	AI, B1	62	AI, B1
	5	92	AI, A2, B1	92	AI*, A2, B1
	6	100	AI, A2, B1	100	AI, A2, B1
090 (60 Hz) 2 Unloaders A1†, B1†	1	18	A1*	18	B1*
	2	35	A1*, B1*	35	A1*, B1*
	3	44	AI*, B1	44	AI, B1*
	4	53	AI, B1	53	AI, B1
	5	65	AI, A2, B1	71	AI, B1*, B2
	6	73	AI, A2, B1	80	AI, B1, B2
	7	91	A1*, A2, B1, B2	91	AI, A2, B1*, B2
	8	100	AI, A2, B1, B2	100	AI, A2, B1, B2
090 (50 HE) 2 Unloaders A1†, B1†	1	14	A1*	14	B1*
	2	29	A1*, B1*	29	A1*, B1*
	3	36	AI*, B1	36	AI, B1*
	4	43	AI, B1	43	AI, B1
	5	68	A1*, A2, B1	60	AI, B1*, B2
	6	75	A1*, A2, B1	67	AI, B1, B2
	7	93	A1*, A2, B1, B2	93	AI, A2, B1*, B2
	8	100	AI, A2, B1, B2	100	AI, A2, B1, B2
100 (60 Hz) 2 Unloaders A1†, B1†	1	15	A1*	15	B1*
	2	31	A1*, B1*	31	A1*, B1*
	3	39	AI*, B1	39	AI, B1*
	4	46	AI, B1	46	AI, B1
	5	65	AI*, A2, B1	65	AI, B1*, B2
	6	73	AI, A2, B1	73	AI, B1, B2
	7	92	AI, A2, B1, B2	92	AI, A2, B1*, B2
	8	100	AI, A2, B1, B2	100	AI, A2, B1, B2
100 (50 Hz) 2 Unloaders A1†, B1†	1	13	A1*	13	B1*
	2	26	A1*, B1*	26	AI*, B1*
	3	33	AI*, B1	33	AI, B1*
	4	40	AI, B1	40	AI, B1
	5	63	AI*, A2, B1	63	AI, B1*, B2
	6	70	AI, A2, B1	70	AI, B1, B2
	7	93	AI*, A2, B1, B2	93	AI, A2, B1*, B2
	8	100	AI, A2, B1, B2	100	AI, A2, B1, B2
110 (60 Hz) 2 Unloaders A1†, B1†	1	14	A1*	14	B1*
	2	29	A1*, B1*	29	AI*, B1*
	3	36	AI*, B1	36	AI, B1*
	4	43	AI, B1	43	AI, B1
	5	68	A1*, A2, B1	60	AI, B1*, B2
	6	75	AI, A2, B1	67	AI, B1, B2
	7	93	AI*, A2, B1, B2	93	AI, A2, B1*, B2
	8	100	AI, A2, B1, B2	100	AI, A2, B1, B2
110 (50 Hz) 2 Unloaders A1†, B1†	1	17	AI	17	B1*
	2	33	A1*, B1*	33	A1*, B1*
	3	42	AI*, B1	42	AI, B1*
	4	50	AI, B1	50	AI, B1
	5	67	AI*, A2, B1	67	AI, B1*, B2
	6	75	AI, A2, B1	75	AI, B1, B2
	7	92	AI*, A2, B1, B2	92	AI, A2, B1*, B2
	8	100	AI, A2, B1, B2	100	AI, A2, B1, B2

*Compressor unloaded.
†Compressor unloader, standard.
**Compressor unloader, accessory.

NOTES:

- The microprocessor has a random number generator that selects loading sequence A or B, which in turn determines the compressor circuit that is energized first. This evens out operating hours on each circuit over an extended period of time.
- If unit operation is anticipated with system load below minimum unloaded capacity of chiller:
 - Consider using 2 smaller units in place of the larger unit.
 - Increase wafer loop volume to ensure adequate run time (see Application Data in Product Data literature).
 - Consider adding accessory hot gas bypass package.

Electronic Expansion Valve (EXV) (See Fig. 16)

— Standard units are equipped with a bottom seal electronic expansion valve. The use of this device eliminates the use of the liquid line solenoid pumpdown at unit shutdown. An O-ring has been added to bottom of orifice assembly to complete a seal in the valve on shutdown. This is not a mechanical shut-off. When service is required it is recommended that the liquid line service valve be used to pump down the system.

High pressure refrigerant enters bottom of valve where it passes through a group of machined slots in side of orifice assembly. As refrigerant passes through orifice, it drops in pressure. To control flow of refrigerant, the sleeve slides up and down along orifice assembly, modulating the size of orifice. The sleeve is moved by a linear stepper motor that moves in increments controlled directly by processor. As stepper motor rotates, the motion is translated into linear movement of lead screw. There are 760 discrete steps with this combination. The valve orifice begins to be exposed at 160 steps. Since there is not a tight seal with the orifice and the sleeve, the minimum position for operation is 60 steps.

Two thermistors are used to determine suction superheat. One thermistor is located in cooler and the other is located in cylinder end of compressor after refrigerant has passed over motor. The difference between the 2 thermistors is the suction superheat. These machines are set up to provide approximately 5 to 7° F (2.8 to 3.9° C) superheat leaving the cooler. Motor cooling accounts for approximately 22° F (12.2° C), resulting in a superheat entering compressor cylinders of approximately 30° F (16.7° C). This increases performance of cooler by reducing the amount of superheat needed.

Because the valves are controlled by the processor, it is possible to track position of valve. Valve position is used to control head pressure and system refrigerant charge.

During initial start-up, valve is initialized by cycling valve fully closed. After initialization period, position is monitored by processor.

The electronic expansion valve is used to limit the maximum cooler saturated suction temperature to 55° F (12.8° C). This makes it possible for chiller to start at high cooler fluid temperatures without overloading compressor.

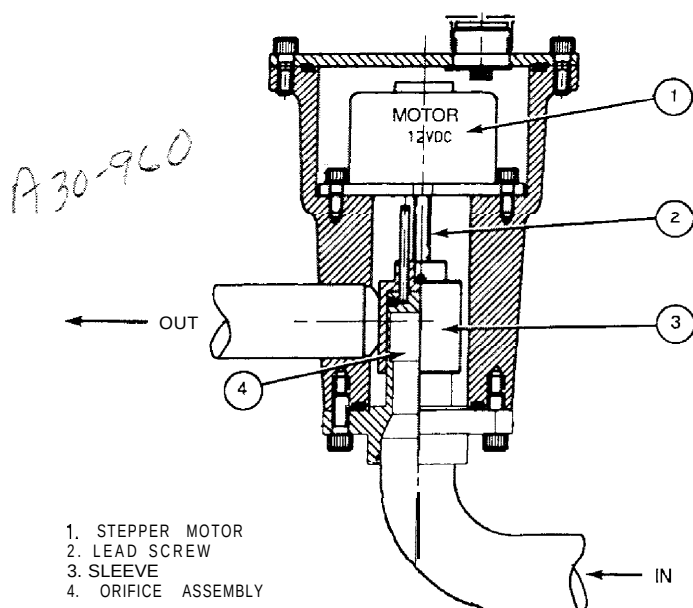


Fig. 16 — Electronic Expansion Valve

Head Pressure Control

FLOTRONIC™ UNITS (WITH EXV) — The microprocessor controls the condenser fans to maintain the lowest condensing temperature possible, and thus the highest unit efficiency. Instead of using the conventional pressure method, the fans are controlled by the position of the electronic expansion valves and the saturated condensing temperature. When the position of the expansion valve is fully open, T3 and T4 are less than 78° F (25.6° C), and superheat greater than 40° F (22.2° C), fan stages will be removed. When the valve is approximately 1/2 open, or T3 and T4 are greater than 113° F (45° C), fan stages will be added. At each change of the fan stage, the system will wait one minute to allow the head pressure to stabilize unless either T3 or T4 is greater than 125° F (51.6° C), in which case all microprocessor-controlled fans will start immediately. This method allows the unit to run at very low condensing temperatures at part load.

During unit start-up, microprocessor-controlled fans are turned on to prevent excessive discharge pressure during pulldown. If outdoor ambient temperature is sensed by T3 or T4 between 50 and 70° F (10 and 21° C), first-stage condenser fans are turned on. If ambient is above 70° F (21° C), second-stage fans also are turned on. Fan sequences are shown in Fig. 15.

UNITS WITH TXV (FIOP) — The logic to cycle microprocessor-controlled fans is based on saturated condensing temperature only, as sensed by thermistors T3 and T4 (see Fig. 9 and 11). When either T3 or T4 is greater than 113° F (45° C), the microprocessor will turn on an additional stage of fans. It will turn off a fan stage when T3 and T4 are both below 73° F (22.8° C). At each change of a fan stage the control will wait for one minute for head pressure to stabilize unless T3 and T4 is greater than 125° F (51.6° C), in which case all microprocessor-controlled fans start immediately.

During unit start-up, microprocessor-controlled fans are turned on to prevent excessive discharge pressure during pulldown. If outdoor ambient as sensed by T3 or T4 is between 50 and 70° F (10 and 21° C), first-stage fans are turned on. If ambient is above 70° F (21° C), second-stage fans also are turned on. Fan sequences are shown in Fig. 15.

Return Temperature Reset — The control system is capable of handling leaving-water temperature reset based on return cooler water temperature. Because the change in temperature through the cooler is a measure of the building load, the return temperature reset is in effect an average building load reset method.

To use the return reset, the accessory reset board must be added to the unit. Refer to Accessories and Optional Controls Installation section, page 23. Also, DIP switch 1 (reset mode select) and DIP switch 2 (reset select) should be in the ON position (see Tables 6 and 7).

Under normal operation, the chiller will maintain a constant leaving water temperature approximately equal to the chilled water set point. As the cooler load varies, the entering cooler water will change in proportion to the load as shown in Fig. 17. Usually the chiller size and leaving-water temperature set point are selected based on a full-load condition. At part load, the water temperature set point may be colder than required. If the leaving water temperature was allowed to increase at part load, the efficiency of the machine would increase.

Return temperature reset allows for the leaving temperature set point to be reset upward as a function of the return water temperature or, in effect, the building load.

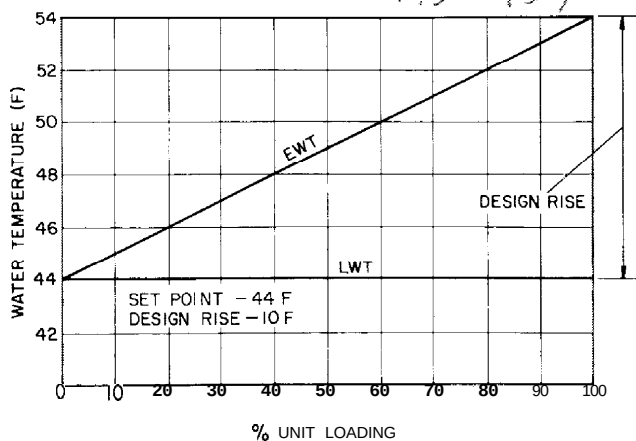


Fig. 17 — Standard Chilled Water Temperature Control — No Reset

Three set point potentiometers are used for this purpose. They are listed below.

CODE	DESCRIPTION	LOCATION	RANGE
P1	Chilled Water Set Point	Display Board	15 to 70 F (-9.4 to 21 C)
P3	Reset Limit Set Point	Accessory Board	0° to 80 F (0° to 44.4 C)
P5	Reset Ratio Set Point	Accessory Board	0 to 100%

The basic rules for setting the potentiometers are as follows:

P1, CHILLED WATER SET POINT POTENTIOMETER

This should always be set at the desired LWT (leaving water temperature) at the **zero load condition**.

P3, RESET LIMIT POTENTIOMETER — This should be set at the maximum desired amount of leaving water reset. Reset is always zero at zero load and the leaving water temperature is decreased up to the reset limit as the load increases (for return temperature reset).

P5, RESET RATIO POTENTIOMETER — This potentiometer is used to set the rate at which the leaving water temperature is reset. To determine the setting for the reset potentiometer use the following equation:

Reset Ratio

$$= \frac{(0\% \text{ Load LWT}) - (100\% \text{ Load LWT})}{\text{Design Full Load Cooling Range}} \times 100$$

The 100% load LWT point should be determined as if the LWT was not being limited by the reset limit potentiometer.

NOTE: The chilled water set point (P1) and the adjusted set point (modified by reset) cannot exceed the following limits:

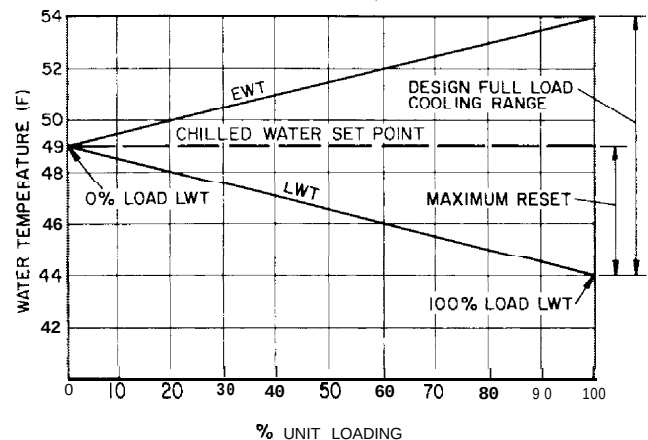
NOTE: A brine chiller is defined as a chiller with the LWT set point below 40 F (4 C). See Table 6 for proper DIP switch setting. Other factory modifications may also be necessary. The brine chiller LWT range of 15 F to 70 F (-9 C to 21 C) allows for dual set point operation.

Water Chillers — 40 F to 70 F (4 C to 21 C)

Brine Chillers — 15 F to 70 F (-9 C to 21 C)

The following examples will explain several reset profiles:

EXAMPLE 1

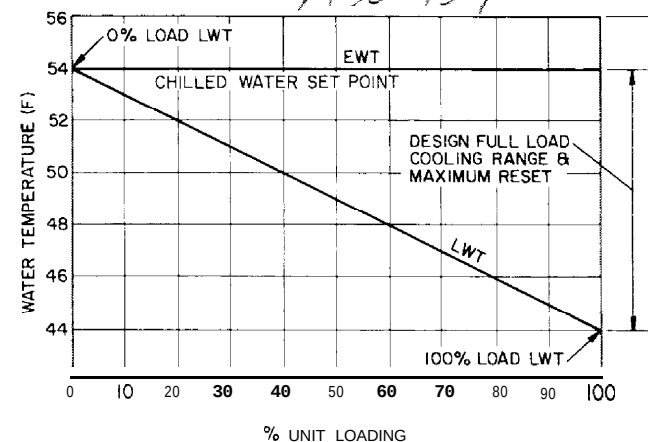


- The Chilled Water Set Point Potentiometer (P1) = 0% Load LWT = 49 F
- The Reset Limit Potentiometer (P3) = Maximum Reset = 5 F
- Reset Ratio Potentiometer (P5) = X%

$$\text{Reset Ratio} = \frac{(0\% \text{ Load LWT}) - (100\% \text{ Load LWT})}{\text{Design Full Load Cooling Range}} \times 100$$

$$= \frac{49 \text{ F} - 44 \text{ F}}{54 \text{ F} - 44 \text{ F}} \times 100 = 50\%$$

EXAMPLE 2



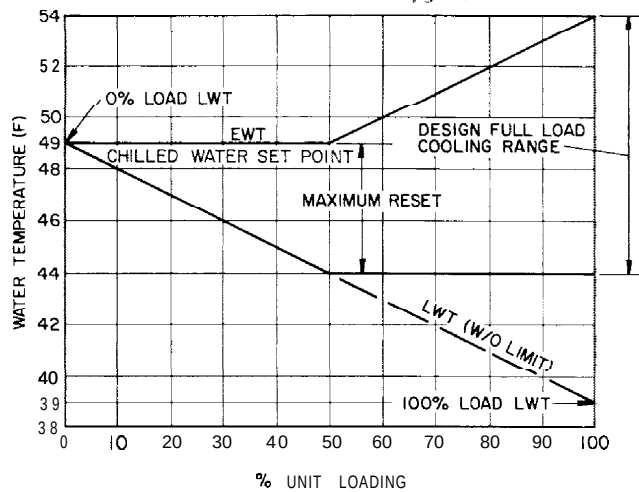
- The Chilled Water Set Point Potentiometer (P1) = 0% LWT = 54 F
- The Reset Limit Potentiometer (P3) = Maximum Reset = 10 F
- Reset Ratio Potentiometer (P5) = X%

Reset Ratio

$$= \frac{(0\% \text{ Load LWT}) - (100\% \text{ Load LWT})}{\text{Design Full Load Cooling Range}} \times 100$$

$$= \frac{54 \text{ F} - 44 \text{ F}}{54 \text{ F} - 44 \text{ F}} \times 100 = 100\%$$

EXAMPLE 3



- The Chilled Water Set Point Potentiometer (P1) = 0% Load LWT = 49 F
- The Reset Limit Potentiometer (P3) = Maximum Reset = 5 F
- Reset Ratio Potentiometer (P5) = X%

Reset Ratio

$$= \frac{(0\% \text{ Load LWT}) - (100\% \text{ Load LWT})}{\text{Design Full Load Cooling Range}} \times 100$$

$$= \frac{49 \text{ F} - 39 \text{ F}}{54 \text{ F} - 44 \text{ F}} \times 100 = 100\%$$

Space and Outdoor Air Temperature Reset

— Space temperature reset and outdoor air temperature reset allows for the reset of the leaving water temperature based on an external temperature sensor.

The accessory board and an external temperature sensor must be installed to use this option. Also, DIP switch 1 (reset mode select) should be off and DIP switch 2 (reset select) should be on (see Table 6).

Under normal operation the chiller will maintain a constant leaving water temperature approximately equal to the leaving chilled water temperature set point potentiometer on the display board. This temperature is usually selected based on full-load conditions. At part-load conditions, it may be desirable to reset the leaving water set point up to improve the efficiency of the chiller. The control is capable of resetting the chilled water set point up in response to an external temperature. This external temperature can be outdoor air or an internal building temperature.

The external temperature is sensed through the accessory reset sensor.

Space and outdoor air reset requires the use of the following potentiometer inputs:

CODE	DESCRIPTION	LOCATION	RANGE
P1	Chilled Water Set Point	Display Board	15 to 70 F (-9.4 to 21C)
P3	Reset Limit Set Point	Accessory Board	0° to 80 F (0° to 44.4 C)
P5	Reset Ratio Set Point	Accessory Board	0 to 100%
P6	Reset Set Point	Accessory Board	0° to 95 F (-17.8 to 35 C)

The basic rules for setting the potentiometer are:

P1, CHILLED WATER SET POINT POTENTIOMETER — This should be set at full load design leaving water temperature.

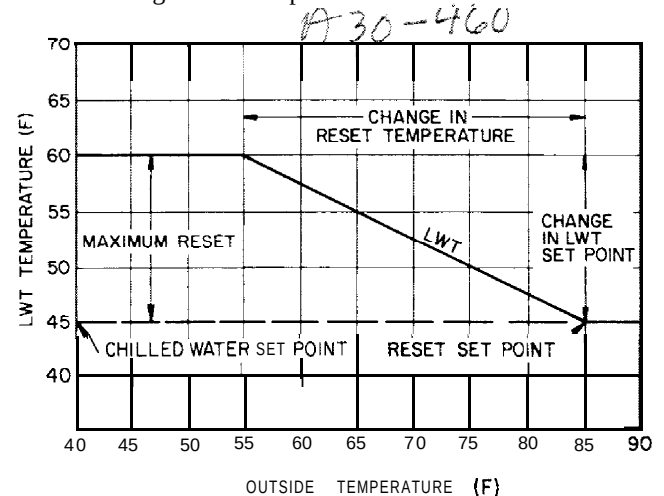
P3, RESET LIMIT POTENTIOMETER — This potentiometer should be set at the maximum desired amount of leaving water reset. As the reset temperature sensor drops in temperature below its set point, the chilled water set point is reset higher until the maximum reset (reset limit) is reached.

P5, RESET RATIO POTENTIOMETER — This potentiometer is used to set the rate at which the leaving water temperature is reset for a change in reset sensor temperature. To determine the setting use the following:

$$\frac{\text{Change in LWT Set Point}}{1^\circ \text{ F Change in Reset Temperature}} \times 20 = \text{Reset Ratio}$$

P6, RESET SET POINT — This potentiometer should be set at the temperature measured by the accessory reset sensor below which temperature reset will occur.

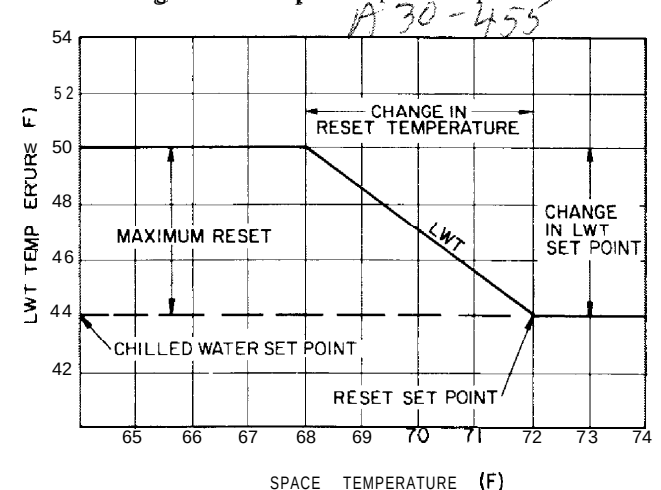
The following is an example of outdoor air reset:



- Reset Set Point Potentiometer (P6) = 85 F
- Chilled Water Set Point Potentiometer (P1) = Full Load LWT = 45 F
- Reset Limit Potentiometer (P3) = Maximum Reset = 15 F
- Reset Ratio Potentiometer (P5)

$$= \frac{60 - 45}{85 - 55} \times 20 = 10\%$$

The following is an example of space temperature reset:



- Reset Set Point (P6) = 72 F
- Chilled Water Set Point Potentiometer (P1) = Full Load LWT = 44 F
- Reset Limit Potentiometer (P3) = 50 44 = 6 F
- Reset Ratio (P5)

$$\frac{50 - 44}{72 - 68} \times 20 = 30\%$$

Demand Limiting — The control has been designed to accept demand limit signals.

The accessory demand limit control module (DLCM) provides 2 demand limit steps. Two adjustable potentiometers are used to set the 2 demand limit set points, one in the range of 100% to 50% of capacity, the second in the range of 49% to 0% of capacity. The capacity steps are controlled by an external, field-supplied switch. For additional information, refer to Accessories and Optional Controls Installation. When demand limit is in effect, the display shows a Code 22 when display button is pushed.

Pulldown Control — Pulldown control is used to reduce the peak kW that occurs at start-up, when the cooler water temperature is very warm, but the load is small. Without pulldown, the chiller will load rapidly and chill the water temperature down quickly. During this time, high kW will be used, which could result in a peak kW charge. To prevent this, the control will limit the rate of leaving-water temperature drop to 1° F (0.6° C) per minute if the demand limit DIP switch 3 is on. If the capacity is being limited by pulldown, the control will display 24 when the display button is pressed.

Dual Set Point Requirement — For installations requiring dual set point capability, the demand limit control module (DLCM), and the accessory reset board are required. Contact your Carrier representative for further details, and refer to product wiring book.

ACCESSORIES AND OPTIONAL CONTROLS INSTALLATION

Pulldown Control — Pulldown control requires no additional hardware to use this option. The pulldown control feature can be accomplished by using DIP switch 3 (see Table 6).

⚠ WARNING

Care should be used when changing the switch position. Use a small screwdriver or similar tool.

To change the switch setting be sure that all electrical disconnects are opened and tagged before any work begins. Open the left side control box door and remove inner panel. Remove cover over the processor board, *being care&Z not to allow cover to hang by the heater wires*. Locate the DIP switch assembly. Remove protective plastic cover. Change position of DIP switch setting to desired position. Replace the protective cover over DIP switch assembly. Replace cover over the processor board. Secure inner panel of control box. Restore power to unit.

Check setting of DIP switch by performing the Quick Test.

Start unit and check that it is operating properly.

Return Temperature Reset

ACCESSORY CONTENTS	
Reset Board	32GB-500---254--
Sensor, For Outside or Space Temperature Reset Ontv	30GB-660---002--
FIELD-SUPPLIED MATERIAL	
4 Screws	8B-18 x 3/4" long

The processor is programmed to perform several types of temperature reset: Return Water Reset; Outdoor Air Temperature Reset; or Space Temperature Reset. The Accessory Reset Board is required to use temperature reset. The Accessory Reset Board has the following potentiometers:

- P3 — Reset Limit Set Point
- P5 — Reset Ratio Set Point
- P6 — Reset Set Point

INSTALLATION — Be sure all electrical disconnects are opened and tagged before any work begins. Inspect package for any damage during shipping. File a claim with shipper if damage has occurred.

Open the left side control box door. Remove the sheet metal access cover over the microprocessor, then remove cover over the processor board. Do not allow processor cover to hang by the heater strip wires. Remove plastic cover over the DIP switches. Set DIP switches 1 and 2 to On for Return Water Temperature Reset. For Space or Outdoor Air Temperature Reset, set DIP switch 1 to OFF and switch 2 to ON.

Mount Reset Board in lower left side of control panel assembly. See Fig. 1. Fasten Accessory Reset Board to panel with field-supplied 8B-18 screws. Accessory Board is not designed for remote mounting.

Attach connector at end of Accessory Reset Board plug to microprocessor J3, pins 9 through 14 plug receptacle. See Fig. 18. Replace processor cover.

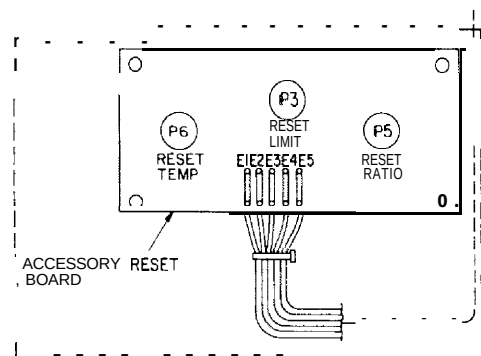
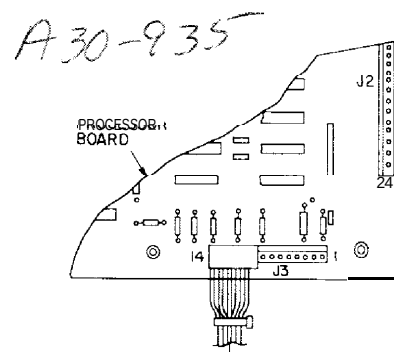


Fig. 18 — Accessory Reset Board Wiring

For space or outdoor temperature reset, the additional sensor (30GB660002) must be installed. The thermistor is provided from factory with 30 ft (9.1 m) of 22 gage twisted pair cable. The thermistor must be connected to TB6-1 and TB6-2. See Fig. 19.

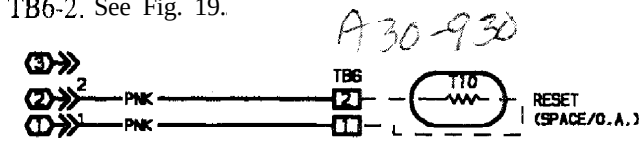


Fig. 19 — Space/Outdoor Thermistor Wiring

To avoid electrical interference, do not run the thermistor wire near line voltage, electrical machinery, large contactors, or other similar devices. If outdoor temperature reset is used, mount thermistor in an area that is shielded from direct sunlight. When using space temperature reset, the sensor should be located where it will sense freely circulating air.

Determine the settings of the potentiometers for the desired temperature reset. Refer to Table 12.

Table 12 — Temperature Reset Potentiometer Settings

POTENTIOMETER	DESCRIPTION	LOCATION	RANGE
P1	Chilled Water Set Point	Display Board	Water: 40 to 70 F (4.4 to 21 C) Brine: 15 to 70 F (-9.4 to 21 C)
P3	Reset Limit Set Point	Accessory Board	0° to 80 F (0° to 44.4 C)
P5	Reset Ratio Set Point	Accessory Board	0 to 100%
P6 (Required for Space or Outdoor Air Reset)	Reset Set Point	Accessory Board	0° to 95 F (-17.8 to 35 C)

RETURN WATER RESET Set potentiometers as shown on page 21.

OUTDOOR OR SPACE TEMPERATURE RESET Set potentiometers as shown on page 22.

Replace inner control panel cover and secure panel. Restore power to unit. Verify that DIP switches, potentiometers, and additional sensor are working and are properly set, using the Quick Test procedure. See Table 10. Confirm that unit functions properly. Close and secure control box door.

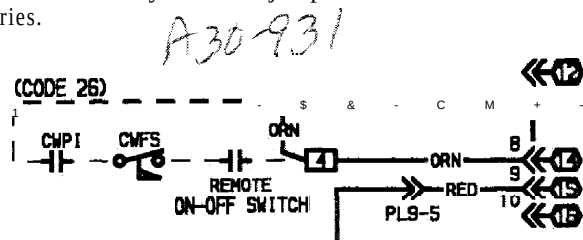
OPERATION — When reset begins, Code **21** will appear on display screen. The chilled water temperature may not be the same as the set point of PI.

SERVICE — There are several diagnostic display codes that can appear if reset package fails. See Controls Troubleshooting and Servicing, page 25.

Demand Limit Control Module — See separate installation instructions for demand limit control module packaged with the accessory.

Remote ON-OFF Control — If remote ON-OFF unit control is required, a field-supplied relay must be installed in unit control box and wired as shown in Fig. 20.

Terminals TB6-3 and TB6-4 are provided as the circuit for Remote ON-OFF switch wiring. To use this feature, remove the factory-installed jumper and install the device in series.



LEGEND

CWFS — Chilled Water Flow Switch
CWPI — Chilled Water Pump Interlock

Fig. 20 — Interlock Circuit

External Interlocks — The unit is equipped with provisions for external interlock devices such as pump starters. See Fig. 20 for wiring instructions.

Remove the jumper between TB6-3 and TB6-4 and install the remote interlock contacts across pins or terminals. Several devices can be connected in series.

Contacts must be rated for dry circuit application capable of handling a 5 vdc 1 mA to 20 mA load.

⚠ WARNING

Do not use the pump starter as a remote ON-OFF switch.

Remote Alarm — The unit is equipped with a master alarm circuit that is energized any time that a diagnostic code of 51 to 87 is displayed. It is also energized during the Quick Test. The alarm circuit is powered by a 115- or 230-v relay on the relay board. This relay is determined by control circuit voltage. The 208/230-, 460- and 575-v units use 115-v relay. The 380-, 346- and 400-v units use 230-v relay. This same relay energizes the alarm light.

To install a remote alarm light or similar device, it can be connected to TB5-1 and TB5-2. See Fig. 21. A resistor is installed across these terminals to provide a minimum current draw through the contacts of the relay board. When an external alarm is installed, remove this resistor. The maximum load that the relay can handle is 75 va sealed, 360 va inrush for both 115 and 230 v.

If a load with a greater va is to be used, an interface pilot duty relay must be used.

If a remote audible alarm is used, it is recommended that a remote alarm-off switch be installed.

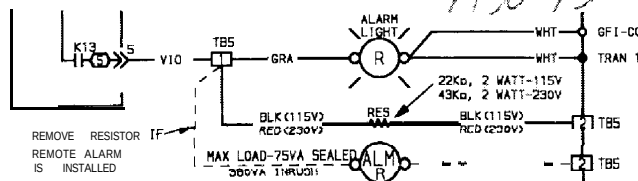


Fig. 21 — Remote Alarm Wiring

CONTROLS TROUBLESHOOTING AND SERVICING

General — The electronic controls used in this unit contain extensive diagnostic capabilities. The 2-digit LED display on the display board (see Fig. 1) will display useful diagnostic codes that can be used to help troubleshoot the system. Refer to Table 10 and diagnostic codes for details.

The control has also been preprogrammed with a Quick Test Procedure that allows for the checkout of all inputs and outputs to and from the microprocessor.

Troubleshooting charts are also contained in this book to help in the troubleshooting of this control.

If a problem is suspected, always check the display for diagnostic information. When a diagnostic code is tripped, the alarm light is energized.

IMPORTANT: The microprocessor memory and the display will be cleared if the power is turned off.

⚠ WARNING

Do not attempt to bypass, short or modify the control circuit or electronic boards in any way to correct a problem. This could result in component failures or a hazardous operating condition.

Diagnostic Display Codes — The following is a detailed description of each diagnostic error and the possible cause. Also see Table 13 (page 30) for action to be taken and reset method.

CODE 51, 52, 55, OR 56 — COMPRESSOR FAILURE

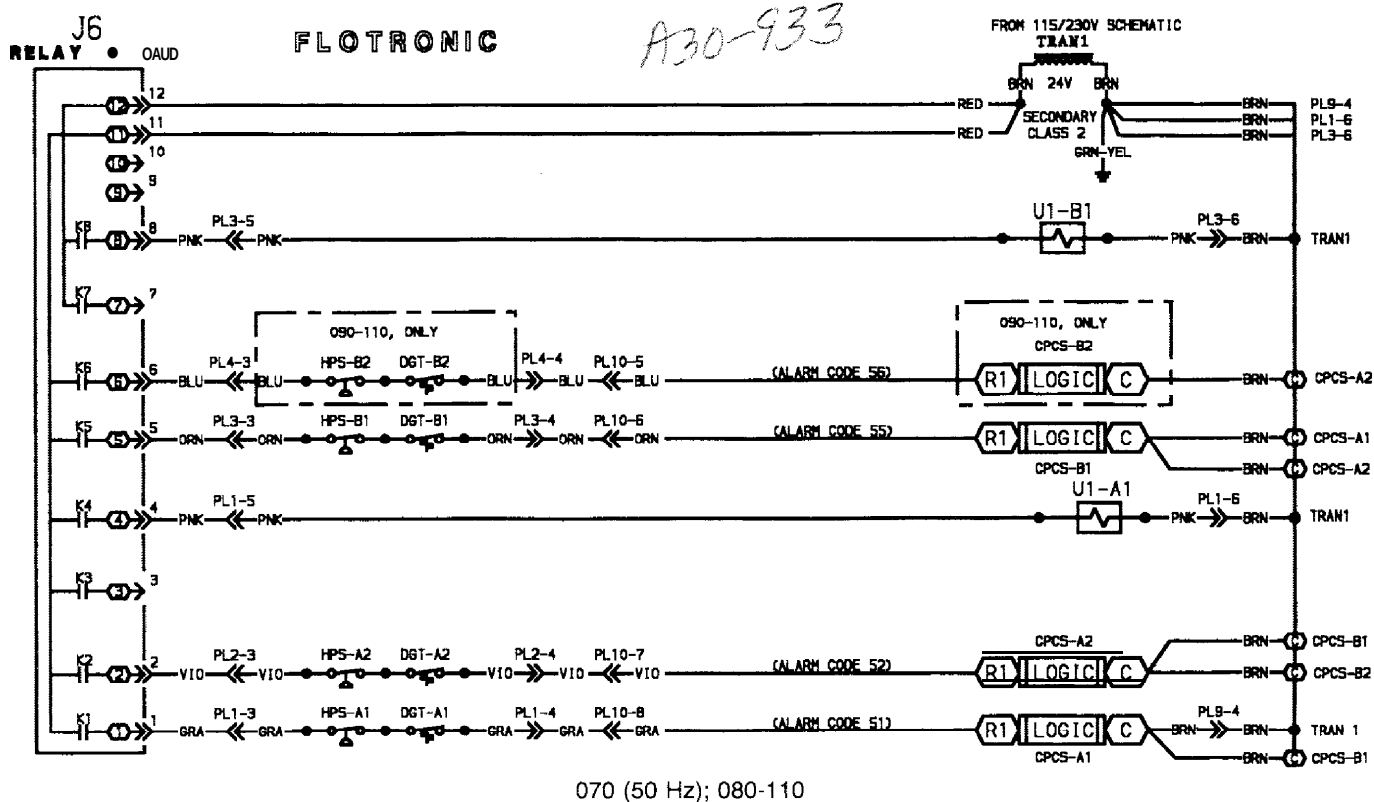
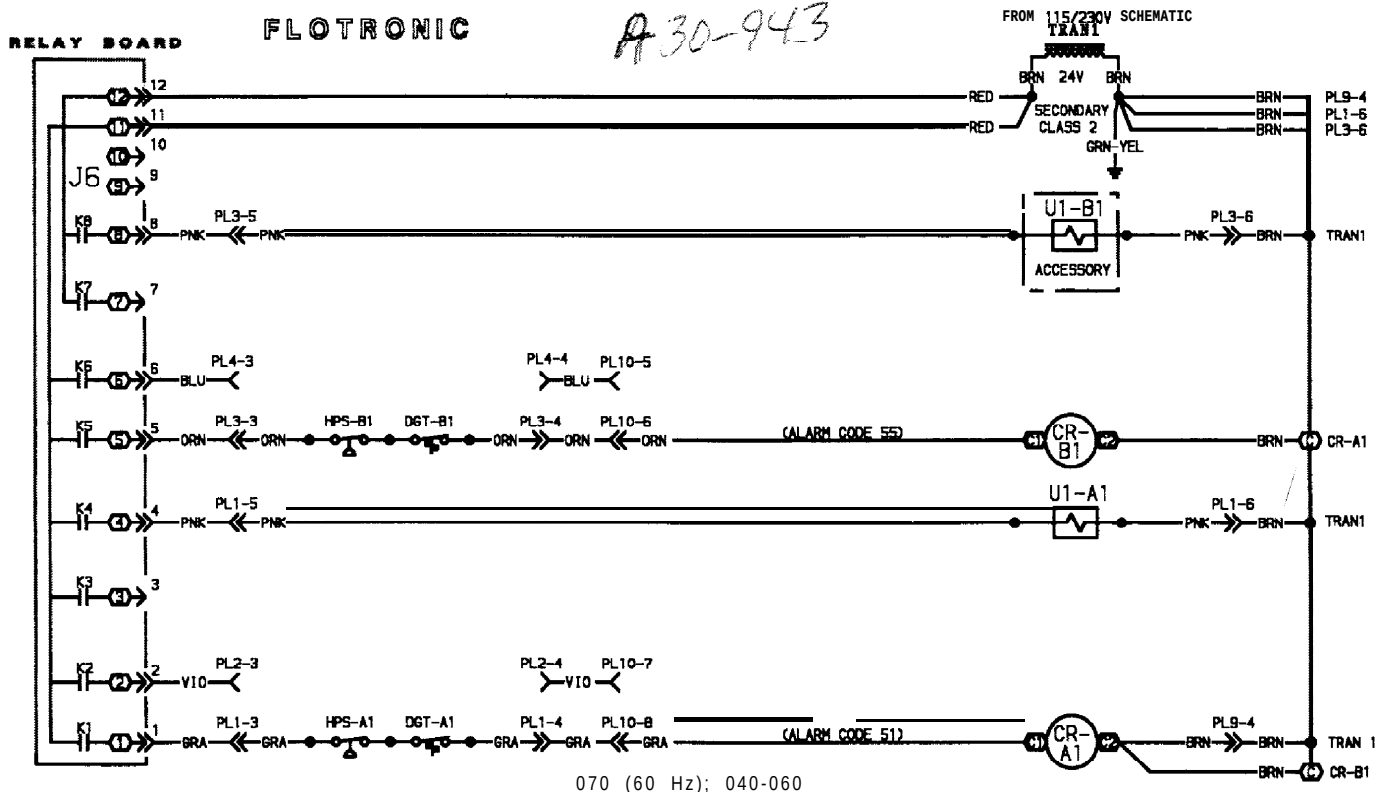
If the CPCS module should open before or during operation, an alarm code and light will be indicated. Codes 51 and 55 will shut off all compressors of that circuit. For Codes 52 and 56, the processor will shut down only the compressor involved. These display codes will be shown only when the display button is pressed. To reset the circuit, the ON-OFF switch must be turned off, then on.

Code 51 indicates an operational failure of compressor A1. If compressor A2, the second compressor of Circuit A, has an operational failure, Code 52 will be displayed. Code 55 indicates an operational failure of compressor B1. On 30GT090-110 units, if compressor B2 (not included in size 080), the second compressor of Circuit B has an operational failure, Code 56 will be displayed.

If a failure occurs, there are several possible causes in addition to the normal service problems for a compressor, circuit breaker, or contactor.

High-Pressure Switch Open — The high-pressure switch is wired in series with the CPCS relay coils or control relay (CR). If the switch falls or opens, this will be detected by the processor through the feedback contacts. Refer to Fig. 22 wiring schematic.

Discharge Gas Thermostat Open — On the 06E compressors, a discharge gas thermostat is wired in series with the coil of the CPCS module or CR. If the thermostat fails or opens, this will be detected by the processor through the feedback contacts.



LEGEND

CPCS — Compressor Protection Control System
CR — Control Relay
DGT — Discharge Gas Thermostat
HPS — High-Pressure Switch
PL — Plug
TRAN — Transformer

Fig. 22 — Low Voltage Control Circuit

Ground Current Failure — The CPCS modules have the ability to detect currents-to-ground. If this current is > 2.5 amps as detected by the current toroids, an alarm condition will be signaled when the CPCS module stops the compressor.

CPCS Module or CR Failure — If the CPCS module or CR fails, and indicates operation of a compressor that actually is off, an alarm condition will be signaled. The affected compressor will be locked off.

Possible causes for this alarm:

Wiring Problem — A wiring error or a loose wire may cause the feedback circuit to be broken.

Relay Board Failure — If a relay on the Relay Board fails, the processor will detect the failure through the feedback circuit.

Processor Failure — If the hardware fails to energize the proper relay, an alarm condition may be signaled.

CODES 59 AND 60 LOSS OF CHARGE SWITCH — The processor monitors the Loss of Charge switch. If the switch opens either by low refrigerant charge or failure, a wiring error, a switch or a processor board failure, the circuit is locked off. Code 59 indicates a failure of Circuit A and, as a result, that circuit will be shut down.

Code 60 indicates a failure of Circuit B and, as a result, that circuit will be shut down. These codes will be displayed only when the display button is pressed. To reset the circuit, the ON-OFF switch must first be turned off, then on.

CODE 61 — NO COOLER FLOW — The processor monitors the temperature in the cooler barrel. Logic internal to the board protects the cooler against loss of cooler flow. The entering and leaving water thermistors are used for this purpose. The leaving water thermistor is located in the leaving water nozzle. The entering water is in the first baffle spacing close to the cooler tube bundle. No cooler flow will be detected by no temperature change between the leaving water thermistor and a rapid drop in the entering water temperature when the compressors are on. When the entering water temperature drops 5° F (2.8° C) below the leaving water temperature, all compressors stop and Code 61 is displayed. To reset this error, the ON-OFF switch must be turned off, then on, when cooler water flow returns. This error occurs for low, or no cooler flow, or if cooler water flow is in the wrong direction. The cooler heaters, if installed, may have enough heat to raise the leaving water temperature above the entering water temperature, thereby satisfying the above conditions. In these instances, check for a faulty cooler heater thermostat or contactor.

CODES 63 AND 64 — OIL PRESSURE SWITCH — If the oil pressure switch opens, either by low oil pressure ($< 5 \pm 1$ psig [34.5 ± 6.8 kPa]), low oil level, switch failure, compressor circuit breaker trip, processor board failure or wiring error, the circuit is locked off. Normal oil pressure for an 06E compressor is 16-22 psig (110-152 kPa) above the suction pressure. Code 63 indicates a failure of Circuit A and results in circuit shut-down. Code 64 indicates a failure of Circuit B and results in circuit shut-down. These codes are displayed only when the display button is pressed. To reset the circuit, the ON-OFF switch must be turned off, then on.

CODE 65 — FREEZE PROTECTION — If leaving water temperature is below 35 F (1.7 C) for a water chiller, or 6° F (3.3° C) below set point for brine applications, all

compressors stop. This safety automatically resets when the temperature is 6° F (3.3° C) above set point.

The causes for this failure are usually due to low cooler flow or rapid changes in building load.

CODES 66 AND 67 — HIGH SUCTION SUPERHEAT (EXV Units Only) — The microprocessor has the following logic: If all of the conditions occur, all compressors in that circuit stop. Code 66 indicates a failure of Circuit A, Code 67 indicates a failure of Circuit B.

Conditions are: If suction superheat is greater than 75° F (41.7° C); saturated cooler suction temperature is less than 55 F (12.8 C); and, these 2 conditions have existed for more than 5 minutes. To reset this alarm, turn ON-OFF switch off, then on.

Possible causes for this alarm:

Low Refrigerant Charge — A low refrigerant charge will not allow the correct amount of refrigerant to be fed to the evaporator, resulting in high suction superheat.

Plugged Filter Drier — If liquid line filter drier becomes plugged, it can result in not enough refrigerant being fed to the evaporator, resulting in high superheat.

EXV Failure — EXV fails to open properly, it may not be able to feed enough refrigerant+

Processor Board Failure — If processor board fails, the valve will not move.

Bad Thermistor — Thermistor is mislocated or out of calibration.

CODES 68 AND 69 — LOW SUCTION SUPERHEAT (EXV Units Only) — If suction superheat is equal to 0° F (0° C), or saturated suction temperature is greater than 58 F (14.4 C), and either condition is true for more than 5 minutes, then all compressors in the circuit stop.

Code 68 indicates a failure of Circuit A, Code 69, indicates a failure of Circuit B. To reset this alarm, turn ON-OFF switch off, then on.

Possible causes for this alarm:

EXV Failure — EXV fails to close properly, or is stuck.

Processor Board Failure — If processor board fails, valve does not move.

Bad Thermistor — Thermistor is mislocated or out of calibration.

CODE 70 — ILLEGAL UNIT CONFIGURATION — If unit configuration header is improperly installed, improperly configured, or DIP switch settings are not properly set, alarm Code 70 is displayed when display button is pushed. Unit does not start. Check settings of configuration header and DIP switches.

CODES 7 1-8 1 — THERMISTOR FAILURE — If measured resistance of a thermistor is outside the valid range, (363,000 to 216 ohms), the appropriate sensor alarm code is energized when display button is pushed. All codes reset automatically when problem is corrected. There are several possible causes. All the codes result in unit shut-down, except Entering Water Thermistor failure, in which case the processor uses the default value.

Possible causes for this alarm:

Thermistor Failure — A shorted or open thermistor.

Wiring Problem — Circuit is open.

Processor Board Failure — Hardware of processor board fails.

The following chart shows the failure codes and corresponding sensor name:

Code **71** Leaving Water/Brine Thermistor (T1)
Code 72 Entering Water/Brine Thermistor (T2)
Code 75 Circuit A Saturated Condensing Thermistor (T3)
Code 76 Circuit B Saturated Condensing Thermistor (T4)
Code 77 Circuit A Evaporator Refrigerant Thermistor (T5)
Code 78 Circuit B Evaporator Refrigerant Thermistor (T6)
Code 79 Circuit A Compressor Return Gas Thermistor (T7)
Code 80 Circuit B Compressor Return Gas Thermistor (T8)
Code **81** Remote Temperature Thermistor (T10)

The remote thermistor is an optional thermistor and is only used with outdoor or space temperature reset. DIP Switch 1 must be on and DIP Switch 2 must be off. If thermistor T10 failure should occur, diagnostic Code **81** appears on display screen when display button is depressed, and reset will be terminated. This is an automatic reset failure when the situation is corrected. The thermistor can also be checked during the Quick Test routine.

CODE 82 — LEAVING-WATER SET POINT POTENTIOMETER FAILURE — If this potentiometer fails, the processor uses the default supply water set point value of 70 F (21 C) for water, or 42 F (5.6 C) for brine units to operate the machine. This potentiometer is located on the display board. If a failure of this potentiometer is detected, the processor displays Code 82 when the display button is pushed. If the potentiometer is outside the valid range of 22 to 70 F (- 30 to 21 C), an alarm condition is signaled.

The full scale resistance of this potentiometer is 10-K ohms. The operational set point range is 45 to 70 F. If the potentiometer is outside the operational set point range, but within the valid range, the control uses the default value without energizing an alarm code.

Possible causes for this alarm:

Incorrect Potentiometer Setting — Potentiometer is turned fully clockwise, or fully counterclockwise, outside the valid range.

Wiring Problem — Wiring between potentiometer and processor is incorrect.

Potentiometer Failure — Potentiometer is shorted or open.

CODE 83 NO FAILURE — This failure code is used for EPROMs prior to the one used in 30GT080-110 units.

CODE 84 — RESET LIMIT POTENTIOMETER FAILURE — This code is applicable if reset is being used. If a failure occurs, alarm Code 84 is displayed when display button is pressed. P3 has a full-scale resistance of 10-K ohms, but when installed in parallel with other 2 potentiometers on Accessory Reset Board, its measured resistance is 3.3-K ohms. This potentiometer has a valid range of 0° to 80 F (0° to 44.4 C). Failure automatically resets when problem is corrected.

Possible **causes** for this alarm:

DIP Switch 2 — Switch is on and accessory board is missing from unit.

Incorrect Potentiometer Setting — Potentiometer is turned fully clockwise, or fully counterclockwise, outside the valid range.

Wiring Problem — Wiring between potentiometer and processor is incorrect.

Potentiometer Failure — Potentiometer is shorted or open.

CODE 85 — DEMAND LIMIT POTENTIOMETER FAILURE — This code is applicable only if Demand Limit is being used. DIP Switch 5 must be on. Two-Step Demand

Limit is a 2-potentiometer system. For both potentiometers, the control recognizes only 10-90% of the potentiometer's full range resistance. If resistance value is outside this range, the processor energizes alarm light and displays alarm Code **85** when display button is pressed. Failure automatically resets when problem is corrected.

Possible causes for this alarm:

DIP Switch 5 — Switch is on and Demand Limit option potentiometers are not used.

Incorrect Potentiometer Setting — Potentiometer is turned fully clockwise, or fully counterclockwise, outside the valid range.

Wiring Problem — Wiring between potentiometer and processor is incorrect.

Potentiometer Failure — Potentiometer is shorted or open.

If a problem is suspected in DLCM board, use the following test procedure and a digital volt-ohmmeter. If a digital volt-ohmmeter is unavailable, a good quality analog meter is acceptable.

The board can be checked only when it is connected to processor, and microprocessor is energized so that DLCM is supplied with 5 vdc power. The terminals referenced are those of the DLCM connector. Caution should be exercised to avoid damaging connector or processor board when taking voltage readings. P1 and P2 refer to the potentiometers of the DLCM.

Be careful to avoid damaging connector or processor board when taking voltage readings.

Condition 1 : No power to INT1 or INT2.

Terminal 1 to 2 — 4.5 vdc $\pm$ 0.1 v

Terminal 2 to 3 — 5.0 vdc $\pm$ 0.1 v

Condition 2 : Power to INT2 or to both INT1 and INT2, and P2 set at 25%.

Terminal 1 to 2 — 1.5 vdc $\pm$ 0.1 v

Voltage should vary between 0.5 vdc and 2.5 vdc as the setting of P2 varies between 0 and 49%.

Terminal 2 to 3 — 5.0 vdc $\pm$ 0.1 v

Condition 3 : Power to INT 1 only, P1 set at 50%.

Terminal 1 to 2 — 2.5 vdc $\pm$ 0.1 v

Terminal 2 to 3 — 5.0 vdc $\pm$ 0.1 v

Voltage should vary between 2.5 vdc and 4.5 vdc as the setting of P1 varies between 50 and 100%.

If the voltages listed above are not obtained during this check, the board must be replaced.

CODE 86 — RESET RATIO POTENTIOMETER FAILURE — This code is used only if reset is used (DIP Switch 2 is on). If this potentiometer (P5) fails, processor energizes alarm light and alarm Code 86 is displayed when display button is pressed. P5 has a full-scale resistance of 10-K ohms but when installed in parallel with other 2 potentiometers on Accessory Reset Board, its measured resistance is 3.3-K ohms. This potentiometer has a valid range of 0 to 100%. Failure automatically resets when problem is corrected.

Possible causes for this alarm:

DIP Switch 2 — Switch is on and accessory board is missing from unit.

Incorrect Potentiometer Setting — Potentiometer is turned fully clockwise, or fully counterclockwise, outside the valid range.

Wiring Problem — Wiring between potentiometer and processor is incorrect.

Potentiometer Failure — Potentiometer is shorted or open.

CODE 87 — RESET SET POINT POTENTIOMETER FAILURE — This failure code is applicable only if reset is used. DIP Switch 2 must be on, and DIP Switch 1 off. P6 has a full scale resistance of 10-K ohms, but when installed in parallel with other 2 potentiometers on Accessory Board, its measured resistance is 3.3-K ohms. The potentiometer has a valid range of 0° to 95 F (−17.8 to 35 C). If failure of this potentiometer is detected, Code 87 is displayed when display button is pushed. If potentiometer is outside the valid range of 0° to 95 F (−17.8 to 35 C), an alarm is signaled. Full scale resistance of this potentiometer is 10-K ohms.

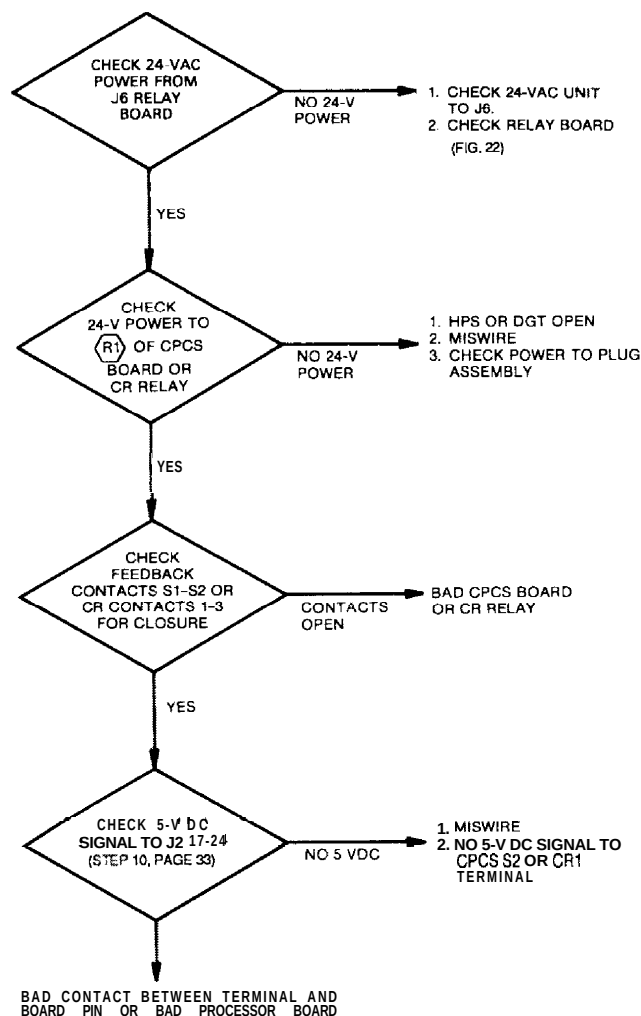
Possible causes for this alarm:

DIP Switch 2 — Switch is on and accessory board is missing from unit.

Incorrect Potentiometer Setting — Potentiometer is turned fully clockwise, or fully counterclockwise, outside the valid range.

Wiring Problem — Wiring between potentiometer and processor is incorrect.

Potentiometer Failure — Potentiometer is shorted or open.



LEGEND

CPCS — Compressor Protection Control System
CR — Control Relay
DGT — Discharge Gas Thermostat
HPS — High Pressure Switch

Fig. 23 — Error Code 51, 52, 55, 56 Troubleshooting Chart

A 30-934

Table 13 – Diagnostic Display Codes

DISPLAY	DESCRIPTION OF FAILURE					ACTION TAKEN BY CONTROL	RESET METHOD	PROBABLE CAUSE
		Unit Sizes 040-I 10						
		040-070 60 Hz	040-060 50 Hz	070-50 Hz, 080	090-I 10			
51	Compr	A1	A1	A1	A1	Failure: Circuit A Shut Off	Manual	040-I 10: High-Pressure Switch Trip, or High Discharge Gas Temperature Switch Trip. In addition (if CPCS) is installed), Compressor Ground Current > 2.5 amps, Compressor Board Delay on when it is not supposed to be on, or Wiring Error between Electronic Control and Compressor Protection Module.*
52	Compr	—	—	A2	A2	Failure: Compressor Shut Off	Manual	
53	Compr	—	—	—	—	Failure: Compressor Shut Off	Manual	
54	Compr	—	—	—	—	Failure: Compressor Shut Off	Manual	
55	Compr	B1	B1	B1	B1	Failure: Compressor B Shut Off	Manual	
56	Compr	—	—	—	B2	Failure: Compressor Shut Off	Manual	
57	Compr	—	—	—	—	Failure: Compressor Shut Off	Manual	
58	Compr	—	—	—	—	Failure: Compressor Shut Off	Manual	
59	Loss of Charge Circuit A					Circuit A Shut Off	Manual	Low Refrigerant Charge, or Low-Pressure Switch Failure
60	Loss of Charge Circuit B					Circuit B Shut Off	Manual	
61	Low Cooler Flow					Unit Shut Off	Manual	No Cooler Flow or Reversed Cooler Flow
63	Low Oil Pressure Circuit A					Circuit A Shut Off	Manual	Oil Pump Failure or Low Oil Level, or Switch Failure, or Compressor CB Tripped
64	Low Oil Pressure Circuit B					Circuit B Shut Off	Manual	
65	Freeze Protection					Unit Shut Off	Auto.	Low Cooler Flow
66	High Suction Superheat Circuit A					Circuit A Shut Off	Manual	Low Charge, or Plugged Filter Drier, or EXV Failure, or Bad Thermistor
67	High Suction Superheat Circuit B					Circuit B Shut Off	Manual	
68	Low Suction Superheat Circuit A					Circuit A Shut Off	Manual	EXV Failure, or Bad Thermistor
69	Low Suction Superheat Circuit B					Circuit B Shut Off	Manual	
70	Illegal Unit Configuration					Unit Will Not Start	Manual	Configuration Error (See Note 2.)
71	Leaving Water/Brine Thermistor Failure					Unit Shut Off	Auto.	Thermistor Failure, or Wiring Error, or Thermistor not connected to Processor Board.
72	Entering Water/Brine Thermistor Failure					Use Default Value	Auto.	
75	Saturated Cond. Thermistor Failure Circuit A					Unit Shut Off	Auto.	
76	Saturated Cond. Thermistor Failure Circuit B					Unit Shut Off	Auto.	
77	Evaporator Thermistor Failure Circuit A					Unit Shut Off	Auto.	
78	Refrigerant Thermistor Failure Circuit B					Unit Shut Off	Auto.	
79	Compressor Thermistor Failure Circuit A					Unit Shut Off	Auto.	
80	Compressor Thermistor Failure Circuit B					Unit Shut Off	Auto.	
81	Remote Temperature Failure					Stop Beset	Auto.	Potentiometer improperly connected, or Potentiometer setting out of range, or Potentiometer Failure, or Wiring Error.
82	Leaving Water Set Point Potentiometer Failure					Use Default Value	Auto.	
84	Reset Limit Potentiometer Failure					Stop Reset	Auto.	
85	Demand Limit Potentiometer Failure					Stop Demand Limit	Auto.	
86	Beset Ratio Potentiometer Failure					Stop Reset	Auto.	
87	Reset Set Point Potentiometer Failure					Stop Reset	Auto.	
83	None					Unit Operates Normally	—	Wrong EPROM

LEGEND

EPROM — Erasable, Programmable Read-Only Memory
EXV — Electronic Expansion Valve

*See Fig. 23 Compressor Troubleshooting Chart (Error Code 51, 52, 55, 56)

NOTES:

- Freeze protection trips at 35 F (1.7 C) for water and 6° F (3.3° C) below set point for brine units. Resets at 6° F (3.3° C) above set point.
- Illegal unit configuration caused by missing programmable header or both unloader DIP switches on.
- All AUTO. reset failures that cause the unit to stop will restart the unit when the error has been corrected.
- All manual reset errors must be reset by turning the control circuit breaker off and on.
- Valid resistance range for thermistors is 363,000 to 216 ohms.

Processor Board Checkout Procedure — Before using this procedure, check the display for diagnostic codes. If a display is present, refer to the diagnostic section of this book for further details.

If there are no diagnostic codes, first check the Quick Test Procedure before using the following test procedure. The following procedure should only be used if the processor board is suspected of being faulty.

A digital volt-ohmmeter is useful in the following procedure, but a good quality analog meter will be acceptable.

⚠ WARNING

You will be working with solid-state electronic components. Do not short devices. Extreme care should be used while working with the board. Follow the procedure exactly as listed.

STEP 1 — CHECK TRANSFORMER INPUT TO PROCESSOR BOARD — Connector J4 (see Fig. 23) is used to connect the control transformer to the microprocessor board. Set your volt-ohmmeter to the ac voltage with a range setting of approximately 30 v. Turn the control ON-OFF switch ON and check the voltages at the connector. They should be as follows:

TERMINAL PINS (J4)	VOLTAGE VAC
1 to 2	15.0 — 20.6
4 to 6	16.0 — 21.8
5 to 6	8.0 — 10.9
5 to 4	8.0 — 10.9

If the voltage is not as listed, the problem is not with the processor board, but could be due to a blown fuse, faulty transformer or wiring error.

STEP 2 — CHECK PROCESSOR BOARD POWER SUPPLIES — The processor board has 7 separate dc voltage power supplies, all of which are required for the processor to operate properly.

Set meter for approximately 20 vdc.

Connect the negative test lead to test pin TP18, (see Fig. 24). Turn the control switch on and press the display button so that the control enters the Quick Test mode. Check the voltage at each of the test pins listed. If the voltage is not as specified, replace the processor board.

TEST PIN NO.	VOLTAGE (vdc ±0.5 v)
TP3	+10
TP4	+12
TP6	+5
TP10	-5
TP14	+12
TP15	+12
TP7	-5*

*If you are not using a digital voltmeter, you will have to reverse leads on the meter.

STEP 3 — CHECK VOLTAGE TOLERANCE CIRCUITRY — The board includes hardware to check for low control circuit voltage. First turn the ON-OFF switch to OFF and connect the negative test probe to TP18. Turn power ON and enter Quick Test mode. Check the voltage at test pin TP9. If the voltage measured is greater than one v, there is a problem. Recheck transformer input voltage and if still within specifications, replace the processor board.

STEP 4 — CHECK PROCESSOR RESET LINE — First turn control switch OFF. Connect negative test probe to test pin TP 18. Turn power ON and enter Quick Test mode. Check the voltage at test pin TP1 1. If the voltage is greater than + 3 v, there is a problem. Reset the ON-OFF switch and recheck the value. If still greater than + 3 v, replace the processor board.

STEP 5 — CHECK RELAY BOARD OUTPUTS — This step involves checking the output signals to relays K1-13 on the relay board. Disconnect cable from relay board to processor board at J9.

Set meter for approximately 20 vdc. Connect the negative lead to test pin PT19. Turn power on and enter Quick Test mode. Check voltage at terminal 14 on connector J9 (see Fig. 25). If it is not 12 ± 1 vdc, replace the processor board.

Next, turn the power OFF, and connect the positive test lead to TP15. Turn power ON and enter Quick Test mode. Check the voltage at connector J9 pins. Voltages should be as follows:

QUICK TEST STEP NUMBER	VOLTAGE (vdc)												
	Terminal Pins (J9)												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1. TO 3.0.	0	0	0	0	0	0	0	0	0	0	0	0	12
3.1.	0	0	0	0	0	0	0	0	0	0	12	0	12
3.2.	0	0	0	0	0	0	0	0	0	0	0	12	12
3.3.	0	0	0	0	0	0	0	0	12	0	0	0	12
3.4.	0	0	0	0	0	0	0	0	0	12	0	0	12
3.5.	12	0	0	0	0	0	0	0	12	0	0	0	12
3.6.	0	12	0	0	0	0	0	0	12	0	0	0	12
3.7.	0	0	12	0	0	0	0	0	12	0	0	0	12
3.8.	0	0	0	12	0	0	0	0	12	0	0	0	12
3.9.	0	0	0	0	12	0	0	0	0	12	0	0	12
4.0.	0	0	0	0	0	12	0	0	0	12	0	0	12
4.1.	0	0	0	0	0	0	12	0	0	12	0	0	12
4.2.	0	0	0	0	0	0	0	12	0	12	0	0	1 2

NOTE: Pins shown in **boldface type** will be energized for only 10 seconds. All other pins will be energized continuously while at the proper Quick Test step. The control will stand in the Quick Test mode for only 10 minutes unless the display button is pressed.

Acceptable range for voltage reading:

zero v — zero-4 v
12 v — 11-13 v

If any of the above voltages are not measured, replace the processor board.

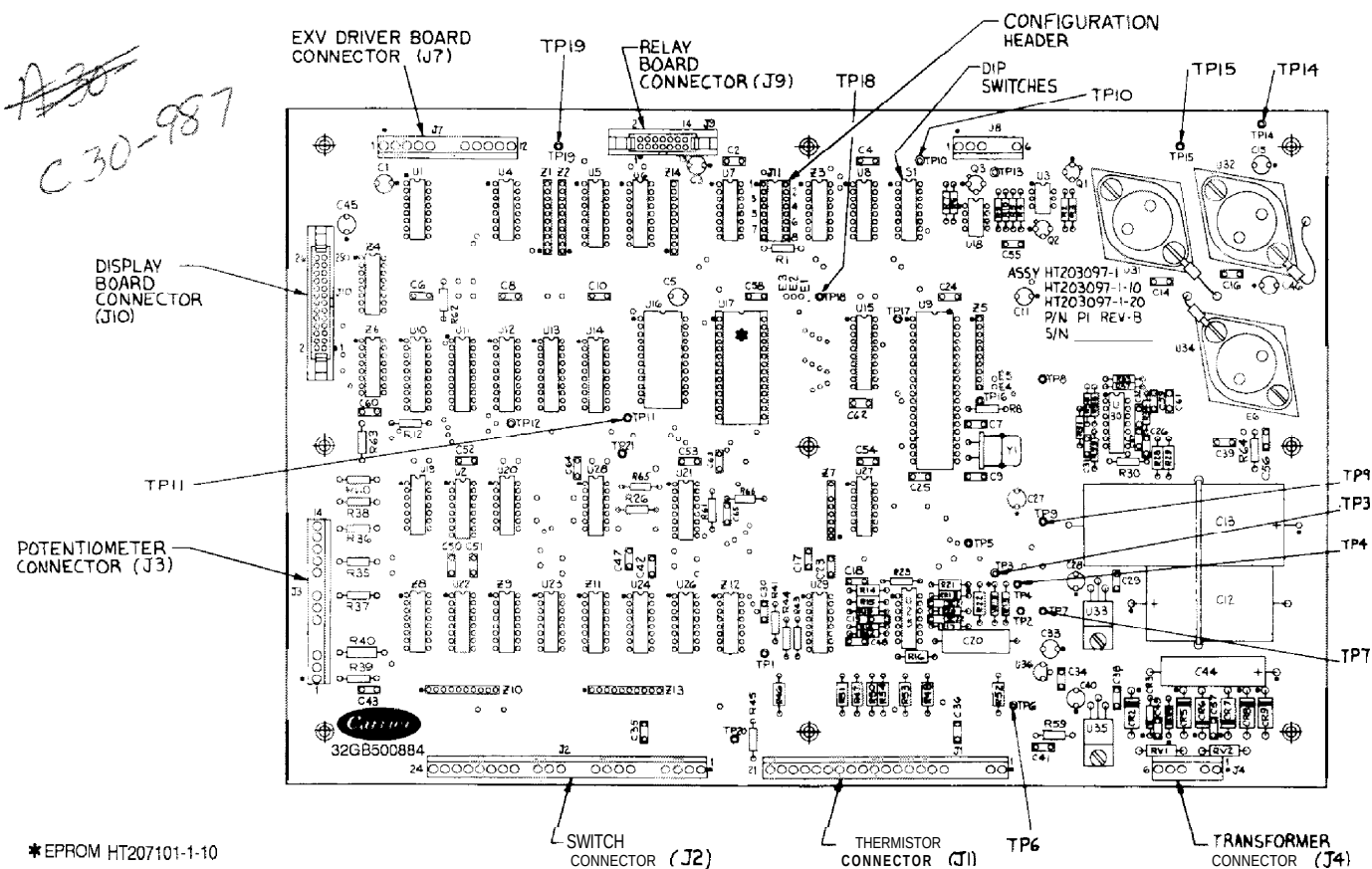


Fig. 24 — Processor Board Test Pins and Connectors

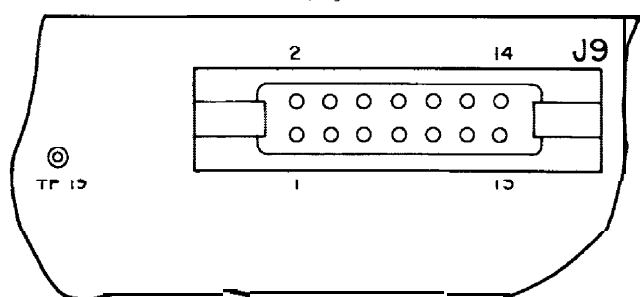


Fig. 25 — Relay Board Connector

STEP 6 — ELECTRONIC EXPANSION VALVE OUTPUTS

Driver Board Outputs — Turn power off. Connect positive test lead of meter to terminal 8 on connector J1 of the driver board. Set meter for approximately 20 vdc. Turn power on, but do not enter the Quick Test mode. For the first 50 seconds the valve windings alternately energize to close the valve in Circuit A. During this time, connect the negative test lead to terminals 9, 10, 11, and 12 in succession. The voltage should fluctuate at each pin. If it remains constant at a voltage or at zero v, remove the connector and re-check. If the outputs are correct, the expansion valve should be checked. If the outputs are not correct, disconnect driver

board plugs P3 and P7 from the processor board and check the processor board EXV outputs. See Processor Board Outputs below.

To test Circuit B outputs, follow the procedure for Circuit A, except connect the positive lead of the meter to terminal 1, and the negative lead to terminals 2, 3, 4, and 5 in succession. The Circuit B valve energizes for approximately 50 seconds immediately after Circuit A valve.

Processor Board Outputs — Turn power off. Connect the positive lead of the meter to terminal 8 on connector J7 on the processor board. Set meter for approximately 20 vdc. Turn power on, but do not enter the Quick Test mode. For the first 50 seconds the valve windings alternately energize to close the valve in Circuit A. During this time, connect the negative test lead to terminals 9, 10, 11, and 12 in succession. The voltage should fluctuate at each pin. If it remains constant at a voltage or at zero v, replace the processor board. If the outputs are correct, and the driver board outputs are not correct, replace the driver board. If the driver board and processor board outputs are correct, then the expansion valve should be checked.

To test Circuit B outputs, follow the same procedure for Circuit A, except connect the positive lead of the meter to terminal 1, and the negative lead to terminals 2, 3, 4, and 5 in succession. The Circuit B valve energizes for approximately 50 seconds immediately after Circuit A valve.

STEP 7 — DISPLAY BOARD CONNECTION CHECK-OUT Turn power OFF and disconnect ribbon cable. Connect the negative test lead to TP18 on the processor board. Turn power ON. You should get the following voltages at connector J10 (see Fig. 26).

TERMINAL PINS (J10)	VOLTAGE (vdc $\pm$ OS v)
17	5
18	5
20*	2-5
22*	2-5
24	5

*Voltage reading is dependent on meter impedance. Reading may vary with different meters.

STEP 8 — POTENTIOMETER CONNECTION CHECK-OUT Turn power OFF and disconnect plugs from J3. Connect negative test lead to terminal TP18 on the processor board. Turn power on and enter Quick Test mode. You should get the following voltages at each pin on connector J3 (see Fig. 24).

TERMINAL PINS (J3)	VOLTAGE (vdc $\pm$ 0.5 v)
1*	2-5
3	5
6	5
8*	2-5
10*	2-5
12	5
13*	2-5
14*	2-5

*Voltage reading is dependent on meter impedance. Reading may vary with different meters.

If these voltages are not obtained, replace the processor board.

STEP 9 — THERMISTOR INPUT CONNECTOR CHECK-OUT Turn power OFF and remove thermistor connections from J1 (identify for replacing). Connect negative test lead to TP18. Turn power on and enter Quick Test. Check for the following voltages at connector J1 (see Fig. 24).

TERMINAL PINS (J1)	VOLTAGE (vdc $\pm$ 0.25 v)	TERMINAL PINS (J1)	VOLTAGE (vdc $\pm$ 0.5 v)
1	0	13	5
2	5	14	0
6	0	15	5
7	5	16	0
8	0	17	5
9	5	18	0
10	0	19	5
11	5	20	0
12	0	21	5

If anything different is found, replace the processor board.

STEP 10 — SWITCH INPUT CONNECTION CHECK-OUT Turn power OFF and disconnect all plugs from J2. Connect negative test lead to test pin TP18. Turn power on and enter Quick Test. Check for the following voltages at connector J2 (see Fig. 5 and 24):

TERMINAL PINS (J2)	VOLTAGE (vdc $\pm$ 0.25 v)	TERMINAL PINS (J2)	VOLTAGE (vdc $\pm$ 0.5 v)
1	0	15	0
2	5	17	5
3	0	18	5
4	5	19	5
7	0	20	5
8	5	21	5
9	0	22	5
10	5	23	5
		24	5

If any other voltage is obtained, replace the processor board.

If the above procedure is completed successfully, but the unit will not function properly, replace the processor board.

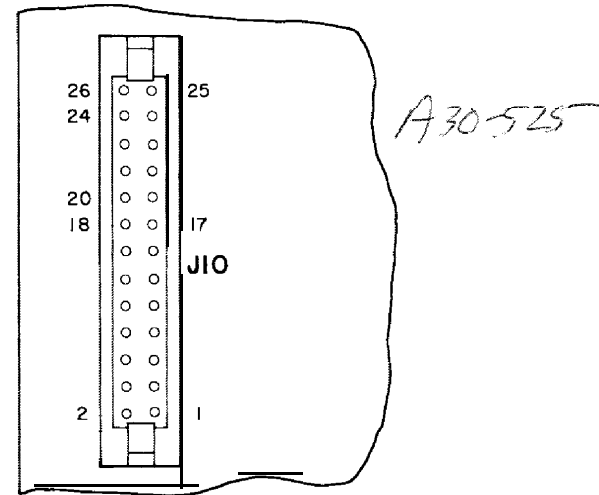


Fig. 26 — Display Board Connector

Processor Board Replacement — If it is necessary to replace the processor board, the following procedures should be followed:

1. Before any work begins, be sure that all disconnects are open and tagged. Open the control box cover and remove the inner panel.
2. Remove the sheet metal cover over the processor board. Be careful not to allow the cover to hang near the heater wires.
3. Disconnect all the electrical connectors from the processor board and label them for replacement.
4. Remove the processor from the unit by removing the screws that hold the processor to the control box panel.
5. Remove the old processor board from the unit.
6. Install new processor in the unit. Use extreme care in installing.
7. Remove the protective shipping material from the board connectors and reconnect all plugs.

IMPORTANT: When installing thermistors make sure the thermistors are connected to the correct pins on the processor board. The processor is not capable of determining whether the correct thermistor is connected to the correct set of pins on the board.

8. Remove the factory-installed configuration header from the old processor board. Use a small screwdriver to wedge under the configuration header to remove it; then re-install the header in the new board. The orientation of the header should be as shown in Fig. 27. Use extreme care in handling the header.
9. Adjust the DIP switches on the new board to match those on the old board. Be sure to replace the plastic cover over the DIP switch assembly. Check that all connections are proper and tight.
10. Replace the sheet metal cover over the processor board.
11. Replace inner panel to control box and restore power to unit.

12. Use the Quick Test procedure to check the operation of the unit. When operation is confirmed, close and secure the control box door.
13. Start unit and confirm operation.

45 DEGREE MITERED CORNER AND 8 MARKED ON HEAD

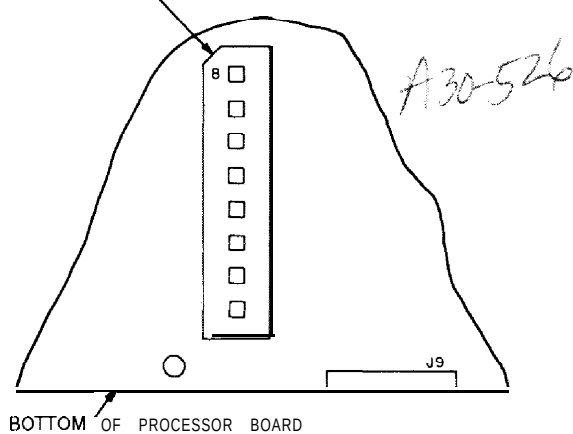


Fig. 27 – Configuration Header

Relay Board Troubleshooting — The relay board contains 13 electro-mechanical relays. The small relays are 24-v ac. The large relays are 115 v or 230 v depending on control voltage. The relays are controlled by the processor through the ribbon cable attached to the relay board.

The following procedure can be used to check out the operation of the relays. To do this, first turn off the control ON-OFF switch and remove the wiring connectors connected to J5 and J6 (see Fig. 7). Set meter for resistance.

If the contacts do not close at the required Quick Test step, check the relay outputs from the processor board (see Processor Board Checkout procedure).

LOW-VOLTAGE RELAYS — Connect the negative test lead to terminals 11 and 12 of connector J6. At the following indicated Quick Test steps, the resistance should be zero, and at all others ∞ (infinity). Turn power ON and proceed through Quick Test.

QUICK TEST STEP NUMBER	VOLTAGE (vdc $\pm$ 0.5 v)							
	Terminal Pins (J6)							
	1	2	3	4	5	6	7	8
1. to 3.4.	∞	∞	∞	∞	∞	∞	∞	∞
3.5.	0	∞	∞	∞	∞	∞	∞	∞
3.6.	∞	0	∞	∞	∞	∞	∞	∞
3.7.	∞	∞	0	∞	∞	∞	∞	∞
3.8.	∞	∞	∞	0	∞	∞	∞	∞
3.9.	∞	∞	∞	∞	0	∞	∞	∞
4.0.	∞	∞	∞	∞	∞	0	∞	∞
4.1.	∞	∞	∞	∞	∞	∞	0	∞
4.2.	∞	∞	∞	∞	∞	∞	∞	0

0 The resistance will stay at zero ohms for only 10 seconds on each step.

HIGH-VOLTAGE RELAY CHECK — Connect the negative test lead to either terminal 8, 9 or 10 on connector J5. Check resistance between terminals 8 and 5 before entering Quick Test. Resistance should be ∞ (infinity). At the following Quick Test steps noted, resistance should be zero ohms; at all other ∞ (infinity).

QUICK TEST STEP NUMBER	VOLTAGE (vdc $\pm$ 0.5 v)				
	Terminal Pins (J5)				
	1	2	3	4	5
1. to 3.0	∞	∞	∞	∞	0
3.1.	∞	∞	0	∞	0
3.2.	∞	∞	∞	0	0
3.3.	0	∞	∞	∞	0
3.4.	∞	0	∞	∞	0
3.5.	0	∞	∞	∞	0
3.6.	0	∞	∞	∞	0
3.7.	0	∞	∞	∞	0
3.8.	0	∞	∞	∞	0
3.9.	∞	0	∞	∞	0
4.0.	∞	0	∞	∞	0
4.1.	∞	0	∞	∞	0
4.2.	∞	0	∞	∞	0

Display Board Checkout — The display board can be completely checked out using the Quick Test procedure.

The display should first be checked when entering the Quick Test mode. The display should read 88. If it does not, replace the display board.

The set point potentiometer can be checked using Step 25 of the Quick Test.

The display button is a normally closed switch. Failures of the switch will usually result in the switch not clicking. The other method that can be used to check the switch is to connect an ohmmeter to the 2-switch terminals that have leads connected to them. The center terminal is not used. The contacts should be closed when the switch is not depressed and open when the switch is depressed.

Accessory Reset Board Checkout — The accessory reset board (see Fig. 13) is only required when temperature reset is used. It can be completely checked out using the Quick Test procedure, Steps 27, 29 and 30.

It can also be checked using the following procedure:

1. Remove connector from processor board (see Fig. 1) and connect an ohmmeter to terminals 3 and 4 on the connector. Numbers are marked on the connector. Set the meter for 10,000 ohms. You should obtain a resistance of 3,333 ohms. Adjust the potentiometers on the board, Resistance should remain constant at 3,333 ohms.
2. Connect the ohmmeter to terminals 3 and 6. As the reset limit potentiometer is turned clockwise, resistance should increase from 0 ohms to approximately 3,400 ohms.
3. Connect the ohmmeter to terminals 3 and 5. If the reset ratio potentiometer is turned clockwise, resistance should increase from 0 ohms to approximately 3,400 ohms.
4. Connect the ohmmeter to terminals 3 and 2. As the reset set point potentiometer is turned clockwise, resistance should increase from 0 ohms to approximately 3,400 ohms.

If any of the above steps are incorrect, replace the board; it cannot be serviced.

Compressor Protection Control System (CPCS) Board — The compressor protection board controls the compressor and compressor crankcase heater.

The discharge gas thermostats are wired in series with the 24-v power supplied to the compressor board by the relay board. The ground current protection is provided by the compressor board.

The large relay located on the board is used to provide a feedback signal to the processor board.

The operation of the compressor board can be checked using the Quick Test procedure. When the Quick Test step (3.5. to 4.2.) that turns on the compressor board is energized, the compressor board will be energized for 10 seconds and will then be turned off. During the 10 seconds, the crankcase heater will be turned off and the compressor contactor will be turned on. The feedback contacts will close, but it will take approximately 3 to 6 seconds for the microprocessor to read the feedback contacts. The status for the feedback switch is displayed by a 0 or 1 in the display, A 0 means open contacts and a 1 means closed contacts.

If the board does not perform properly, use standard wiring troubleshooting procedures to check the wiring for open circuits. Refer to Operating Information section for diagnostic codes for possible causes for failure.

If a compressor short-to-ground exists, the compressor board may detect the short before the circuit breaker trips. If this is suspected, check the compressor for short-to-ground failures with an ohmmeter. The ground current is sensed with a current toroid (coil) around all 3 or 6 wires between the main terminal block and the compressor circuit breaker(s).

Thermistor Troubleshooting — The Flotronic™ control system uses thermistors to measure temperatures at various points in the refrigeration circuit as shown in Fig. 8-11.

The resistance vs temperature and electrical characteristics for all thermistors in the system are identical. To obtain an accurate reading, a high-impedance meter (such as a digital meter) must be used.

The thermistors in the Flotronic control system (Fig. 5, J1) have a 5-v dc signal applied across them any time unit control circuit is energized. The voltage drop across the thermistor is directly proportional to the temperature and resistance of the thermistor.

To determine temperatures at the various thermistor locations, disconnect the thermistor from the processor board, and measure the resistance across the appropriate thermistor using a high quality digital voltmeter. Use resistance reading obtained to determine thermistor temperature from Tables 14 or 15 (°F or °C).

The microprocessor has been programmed to check the operation of the thermistors. If the measured temperature is outside the range of -60 to 240 F (-51 to 116 C) (363,000 ohms to 216 ohms), it will be treated as a sensor failure and a diagnostic code will be displayed. It is also possible to check the operation of the thermistors using the Quick Test procedure.

IMPORTANT: If a thermistor has failed or the wire damaged, replace the complete thermistor assembly. Do not attempt to splice wires or repair assembly. For thermistor replacement instructions, see separate Installation, Start-Up and Service Instructions.

EXV Troubleshooting — If it appears that the electronic expansion valve is not properly controlling operating suction pressure or superheat, there are a number of checks that can be made using the Quick Test and initialization features built into the Flotronic microprocessor control,

Follow the procedure below to diagnose and correct EXV problems.

STEP 1 — CHECK PROCESSOR EXV OUTPUTS — Check EXV output signals at the J7 terminals of the processor board, and the J1 terminals of the EXV driver board (if provided). This procedure is described in Step 6 of Processor Board Checkout Procedure.

STEP 2 — CHECK EXV WIRING — Check wiring to electronic expansion valves from J7 terminal strip on processor board (see Fig. 6).

1. Check color coding and wire connections. Make sure that they are connected to correct terminals at J7 terminal strip and EXV plug connections. Check for correct wiring at driver board input and output terminals.
2. Check for continuity and tight connection at all pin terminals.
3. Check plug connections at J7 terminal strip and at EXVs. Be sure EXV connections are not crossed.

STEP 3 — CHECK RESISTANCE OF EXV MOTOR WINDINGS — Remove plug at J7 terminal strip and check resistance between common lead (red wire, terminal D) and remaining leads A, B, C and E (see Fig. 6). Resistance should be 25 ohms $\pm$ 2 ohms.

STEP 4 — CHECK THERMISTORS THAT CONTROL EXV — Check Thermistors that control processor output voltage pulses to the EXVs. Circuit A thermistors are T5 and T7, Circuit B thermistors are T6 and T8. Refer to Fig. 8, 10 and 11 for location.

1. Use Quick Test steps 2.0. through 2.3. to determine if thermistors are shorted or open.
2. Check thermistor calibration at known temperature by measuring actual resistance and comparing value measured with values listed in Tables 14 or 15.
3. Make sure that thermistor leads are connected to the proper pin terminals at the J1 terminal strip on processor board and that thermistor probes are located in proper position in the refrigerant circuit.

When the above checks have been completed, the actual operation of the EXV can be checked by using the procedures outlined in Step 5. During Quick Test steps 3.5. and 3.9. each EXV is opened approximately 250 steps by the processor. This Quick Test feature, along with the initialization mode **20** can be used to verify proper valve operation.

STEP 5 — CHECK OPERATION OF THE EXV — Use the following procedure to check the actual operation of the electronic expansion valves.

1. Close the liquid line service valve for the circuit to be checked and run through the appropriate Quick Test step 3.5. or 3.9. to pump down the low side of the system. Repeat the Quick Test step 3 times to ensure all refrigerant has been pumped from the low side and that the EXV has been driven fully open (760 steps).

NOTE: Do not use the control ON-OFF switch to recycle the control during this step, and be sure to allow the compressors to run the full 10 seconds at each step.

2. Turn OFF control circuit switch and compressor circuit breaker(s). Close compressor service valves and remove any remaining refrigerant from the low side of the system.

3. Remove screws holding top cover of EXV. Carefully remove top cover, using caution to avoid damage to the O-ring seal and motor leads. If EXV plug was disconnected during this process, reconnect it after the cover is removed.
4. Note position of lead screw (see Fig. 16). If valve has responded properly to processor signals in Step 5.1 above, the valve should be fully open and the lead screw should protrude approximately $\frac{1}{4}$ in. to $\frac{3}{4}$ in. above the top of the motor.
5. Recycle the control by turning the control circuit switch to the ON position. This puts the control in the initialization mode 20. During the first 10 seconds of the initialization mode, each valve is driven to the fully closed position (760 steps) by the processor. With the cover lifted off the EXV valve body, observe the operation of the valve motor and lead screw. The motor should turn in the counterclockwise (CCW) direction and the lead screw should move down into the motor hub until the valve is fully closed. Lead screw movement should be smooth and uniform from the fully open to the fully closed position.
6. When test has been completed, carefully reassemble expansion valve. Be careful not to damage motor or O-ring when reassembling valve. Open compressor service valves and close compressor circuit breakers. Open liquid line service valve. Turn control circuit switch to ON, and allow unit to operate. Verify proper operation of unit.

This process of opening and closing the EXV can be repeated by repeating this Quick Test step 3.5. or 3.9. and recycling the control as described in the preceding steps. If the valve does not operate as described when properly connected to the processor and receiving the correct signals, it should be replaced.

If operating problems persist after reassembly, they may be due to out-of-calibration thermistor(s), or intermittent connections between the processor board terminals and the EXV plug. Recheck all wiring connections and voltage signals,

Other possible causes of improper refrigerant flow control could be restrictions in the liquid line. Check for plugged filter drier(s), restricted metering slots in the EXV, or partially closed liquid line service valves. Formation of ice or frost on the lower body of the electronic expansion valve is one symptom of restricted metering slots. Clean or replace the valve if necessary. Wrap a wet cloth around the valve if it is to be replaced, to prevent the heat from damaging the internal components of the valve.

NOTE: Frosting of the valve is normal during Quick Test steps 3.5. and 3.9. and at initial start-up. The frost should dissipate after 5 to 10 minutes operation of a system that is operating properly.

NOTE: The EXV orifice is a screw-in type and may be removed for inspection and cleaning. Once the top cover has been removed, the EXV motor may be taken out by removing the 2 cap screws securing motor to valve body. Pull motor, lead screw and the slide assembly up off the orifice assembly. See Fig. 16. A slot has been cut in top of orifice assembly to facilitate removal using a large screwdriver. Turn orifice assembly counterclockwise to remove.

When cleaning or reinstalling orifice assembly, care must be taken not to damage orifice assembly seals. The bottom seal acts as a liquid shut-off, replacing a liquid line solenoid valve.

Reassembly of valve is made easier by screwing the slide and lead screw assembly out of the motor. Align hole in top of slide with the guide pin in orifice assembly and gently push slide and lead screw onto orifice assembly about halfway. Screw motor onto lead screw and secure EXV motor with cap screws. Care must be taken not to twist or pull on wires from EXV motor to valve cover pin connections. Check EXV operation in Quick Step steps.

Table 14 — Sensor Temperature (°F) vs Resistance/Voltage Drop; Flotronic™

TEMPERATURE (F)	VOLTAGE DROP (V)	RESISTANCE (OHMS)	TEMPERATURE (F)	VOLTAGE DROP (V)	RESISTANCE (OHMS)	TEMPERATURE (F)	VOLTAGE DROP (V)	RESISTANCE (OHMS)
-25	4.684	98,010	59	2.708	7,868	143	0.750	1,189
-24	4.673	94,707	60	2.676	7,665	144	0.737	1,165
-23	4.662	91,522	61	2.644	7,468	145	0.725	1,141
-22	4.651	88,449	62	2.612	7,277	146	0.713	1,118
-21	4.640	85,485	63	2.581	7,091	147	0.701	1,095
-20	4.628	82,627	64	2.549	6,911	148	0.689	1,072
-19	4.616	79,871	65	2.517	6,735	149	0.678	1,050
-18	4.604	77,212	66	2.486	6,564	150	0.666	1,028
-17	4.591	74,648	67	2.454	6,399	151	0.655	1,007
-16	4.578	72,175	68	2.423	6,237	152	0.644	986
-15	4.565	69,790	69	2.391	6,081	153	0.634	965
-14	4.551	67,490	70	2.360	5,929	154	0.623	945
-13	4.537	65,272	71	2.239	5,781	155	0.613	925
-12	4.523	63,133	72	2.299	5,637	156	0.602	906
-11	4.509	61,070	73	2.268	5,497	157	0.592	887
-10	4.494	59,081	74	2.237	5,361	158	0.582	868
-9	4.479	57,162	75	2.207	5,229	159	0.573	850
-8	4.463	55,311	76	2.177	5,101	160	0.563	832
-7	4.448	53,526	77	2.147	4,976	161	0.554	815
-6	4.431	51,804	78	2.117	4,855	162	0.545	798
-5	4.415	50,143	79	2.088	4,737	163	0.536	782
-4	4.398	48,541	80	2.058	4,622	164	0.527	765
-3	4.381	46,996	81	2.029	4,511	165	0.518	749
-2	4.363	45,505	82	2.000	4,403	166	0.509	734
-1	4.345	44,066	83	1.972	4,298	167	0.501	719
0	4.327	42,678	84	1.943	4,195	168	0.493	705
1	4.308	41,339	85	1.915	4,096	169	0.484	690
2	4.289	40,047	86	1.887	4,000	170	0.476	677
3	4.270	38,800	87	1.859	3,906	171	0.468	663
4	4.250	37,596	88	1.832	3,814	172	0.461	650
5	4.230	36,435	89	1.805	3,726	173	0.453	638
6	4.209	35,313	90	1.778	3,640	174	0.446	626
7	4.188	34,231	91	1.751	3,556	175	0.438	614
8	4.167	33,185	92	1.725	3,474	176	0.431	602
9	4.145	32,176	93	1.699	3,395	177	0.424	591
10	4.123	31,201	94	1.673	3,318	178	0.417	581
11	4.101	30,260	95	1.647	3,243	179	0.410	570
12	4.078	29,351	96	1.622	3,170	180	0.403	560
13	4.055	28,472	97	1.597	3,099	181	0.397	551
14	4.032	27,624	98	1.572	3,031	182	0.390	542
15	4.008	26,804	99	1.548	2,964	183	0.384	533
16	3.984	26,011	100	1.523	2,898	184	0.378	524
17	3.959	25,245	101	1.500	2,835	185	0.371	516
18	3.934	24,505	102	1.476	2,773	186	0.365	508
19	3.909	23,789	103	1.453	2,713	187	0.360	501
20	3.883	23,096	104	1.430	2,655	188	0.354	494
21	3.858	22,427	105	1.407	2,598	189	0.348	487
22	3.831	21,779	106	1.385	2,542	190	0.342	480
23	3.805	21,153	107	1.362	2,488	191	0.337	473
24	3.778	20,547	108	1.341	2,436	192	0.332	467
25	3.751	19,960	109	1.319	2,385	193	0.326	461
26	3.723	19,392	110	1.298	2,335	194	0.321	456
27	3.696	18,843	111	1.277	2,286	195	0.316	450
28	3.668	18,311	112	1.256	2,238	196	0.311	444
29	3.639	17,796	113	1.236	2,192	197	0.306	439
30	3.611	17,297	114	1.216	2,147	198	0.301	434
31	3.582	16,814	115	1.196	2,103	199	0.297	429
32	3.553	16,346	116	1.176	2,060	200	0.292	424
33	3.523	15,892	117	1.157	2,018	201	0.288	419
34	3.494	15,453	118	1.138	1,977	202	0.283	415
35	3.464	15,027	119	1.120	1,937	203	0.279	410
36	3.434	14,614	120	1.101	1,898	204	0.274	405
37	3.404	14,214	121	1.083	1,860	205	0.270	401
38	3.373	13,826	122	1.065	1,822	206	0.266	396
39	3.343	13,449	123	1.048	1,786	207	0.262	391
40	3.312	13,084	124	1.030	1,750	208	0.258	386
41	3.281	12,730	125	1.013	1,715	209	0.254	382
42	3.250	12,387	126	0.997	1,680	210	0.250	377
43	3.219	12,053	127	0.980	1,647	211	0.247	372
44	3.187	11,730	128	0.964	1,614	212	0.243	366
45	3.156	11,416	129	0.948	1,582	213	0.239	361
46	3.124	11,111	130	0.932	1,550	214	0.236	356
47	3.093	10,816	131	0.917	1,519	215	0.232	350
48	3.061	10,529	132	0.902	1,489	216	0.229	344
49	3.029	10,250	133	0.887	1,459	217	0.225	338
50	2.997	9,979	134	0.872	1,430	218	0.222	332
51	2.965	9,717	135	0.857	1,401	219	0.219	325
52	2.933	9,461	136	0.843	1,373	220	0.215	318
53	2.901	9,213	137	0.829	1,345	221	0.212	311
54	2.869	8,973	138	0.815	1,318	222	0.209	304
55	2.837	8,739	139	0.802	1,291	223	0.206	297
56	2.805	8,511	140	0.788	1,265	224	0.203	289
57	2.772	8,291	141	0.775	1,239	225	0.200	282
58	2.740	8,076	142	0.762	1,214			

Table 15 — Sensor Temperature (°C) vs Resistance/Voltage Drop; Flotronic™

TEMPERATURE (°C)	VOLTAGE DROP (V)	RESISTANCE (OHMS)	TEMPERATURE (°C)	VOLTAGE DROP (V)	RESISTANCE (OHMS)	TEMPERATURE (°C)	VOLTAGE DROP (V)	RESISTANCE (OHMS)
-32.0	4.690	100 049	14.5	2.737	8055	61.0	0.765	1219
-31.5	4.680	97006	15.0	2.708	7868	61.5	0.753	1193
-31.0	4.671	94061	15.5	2.680	7685	62.0	0.742	1153
-30.5	4.661	91 209	16.0	2.651	7507	62.5	0.731	1132
-30.0	4.651	88449	16.5	2.622	7334	63.0	0.720	1111
-29.5	4.641	85 777	17.0	2.593	7165	63.5	0.709	1090
-29.0	4.630	83 191	17.5	2.565	7000	64.0	0.698	1070
-28.5	4.620	80 687	18.0	2.536	6840	64.5	0.688	1050
-28.0	4.609	78 264	18.5	2.508	6683	65.0	0.678	1030
-27.5	4.597	75 918	19.0	2.479	6531	65.5	0.667	1011
-27.0	4.586	73 648	19.5	2.451	6382	66.0	0.657	992
-26.5	4.574	71 451	20.0	2.423	6237	66.5	0.648	973
-26.0	4.562	69 324	20.5	2.395	6096	67.0	0.638	955
-25.5	4.550	67 265	21.0	2.367	5959	67.5	0.628	937
-25.0	4.537	65 272	21.5	2.339	5825	68.0	0.619	919
-24.5	4.525	63 344	22.0	2.311	5694	68.5	0.609	902
-24.0	4.512	61 477	22.5	2.283	5566	69.0	0.600	885
-23.5	4.499	59 670	23.0	2.256	5442	69.5	0.591	868
-23.0	4.485	57 921	23.5	2.228	5321	70.0	0.582	852
-22.5	4.471	56 228	24.0	2.201	5203	70.5	0.574	836
-22.0	4.457	54 589	24.5	2.174	5088	71.0	0.565	820
-21.5	4.443	53 003	25.0	2.147	4976	71.5	0.557	805
-21.0	4.428	51 467	25.5	2.120	4867	72.0	0.548	790
-20.5	4.413	49 980	26.0	2.094	4760	72.5	0.540	775
-20.0	4.398	48 541	26.5	2.067	4656	73.0	0.532	761
-19.5	4.383	47148	27.0	2.041	4555	73.5	0.524	746
-19.0	4.367	45 799	27.5	2.015	4457	74.0	0.516	733
-18.5	4.351	44492	28.0	1.989	4360	74.5	0.508	719
-18.0	4.334	43 228	28.5	1.963	4267	75.0	0.501	706
-17.5	4.318	42 003	29.0	1.938	4175	75.5	0.493	693
-17.0	4.301	40817	29.5	1.912	4086	76.0	0.486	681
-16.5	4.283	39 668	30.0	1.887	4000	76.5	0.479	669
-16.0	4.266	38 556	30.5	1.862	3915	77.0	0.472	657
-15.5	4.248	37478	31.0	1.837	3832	77.5	0.465	645
-15.0	4.230	36435	31.5	1.813	3752	78.0	0.458	634
-14.5	4.211	35424	32.0	1.789	3674	78.5	0.451	623
-14.0	4.193	34444	32.5	1.764	3597	79.0	0.444	613
-13.5	4.174	33495	33.0	1.741	3523	79.5	0.437	602
-13.0	4.154	32 576	33.5	1.717	3450	80.0	0.431	592
-12.5	4.135	31 685	34.0	1.693	3379	80.5	0.425	583
-12.0	4.115	30 821	34.5	1.670	3310	81.0	0.418	573
-11.5	4.094	29 984	35.0	1.647	3243	81.5	0.412	564
-11.0	4.074	29173	35.5	1.624	3177	82.0	0.406	556
-10.5	4.053	28 386	36.0	1.602	3113	82.5	0.400	547
-10.0	4.032	27 624	36.5	1.579	3051	83.0	0.394	539
-9.5	4.010	26 884	37.0	1.557	2990	83.5	0.388	531
-9.0	3.989	26 168	37.5	1.536	2931	84.0	0.383	524
-8.5	3.967	25 472	38.0	1.514	2873	84.5	0.377	516
-8.0	3.944	24 798	38.5	1.492	2816	85.0	0.371	509
-7.5	3.922	24144	39.0	1.471	2761	85.5	0.366	502
-7.0	3.899	23 509	39.5	1.450	2707	86.0	0.361	496
-6.5	3.876	22 893	40.0	1.430	2655	86.5	0.355	489
-6.0	3.852	22 296	40.5	1.409	2603	87.0	0.350	483
-5.5	3.829	21 716	41.0	1.389	2553	87.5	0.345	477
-5.0	3.805	21 153	41.5	1.369	2504	88.0	0.340	472
-4.5	3.781	20 606	42.0	1.349	2457	88.5	0.335	466
-4.0	3.756	20 076	42.5	1.330	2410	89.0	0.331	461
-3.5	3.732	19 561	43.0	1.311	2364	89.5	0.326	456
-3.0	3.707	19 061	43.5	1.292	2320	90.0	0.321	451
-2.5	3.682	18575	44.0	1.273	2276	90.5	0.317	446
-2.0	3.656	18103	44.5	1.254	2234	91.0	0.312	441
-1.5	3.631	17645	45.0	1.236	2192	91.5	0.308	436
-1.0	3.605	17 199	45.5	1.218	2152	92.0	0.303	432
-0.5	3.579	16766	46.0	1.200	2112	92.5	0.299	427
0.0	3.553	16346	46.5	1.182	2073	93.0	0.295	423
0.5	3.526	15937	47.0	1.165	2035	93.5	0.291	419
1.0	3.500	15539	47.5	1.148	1997	94.0	0.287	415
1.5	3.473	15153	48.0	1.131	1961	94.5	0.283	410
2.0	3.446	14 777	48.5	1.114	1925	95.0	0.279	406
2.5	3.419	14 412	49.0	1.098	1890	95.5	0.275	402
3.0	3.392	14057	49.5	1.081	1856	96.0	0.271	398
3.5	3.364	13 711	50.0	1.065	1822	96.5	0.267	393
4.0	3.337	13 375	50.5	1.049	1789	97.0	0.264	389
4.5	3.309	13 048	51.0	1.034	1757	97.5	0.260	385
5.0	3.281	12 730	51.5	1.019	1725	98.0	0.257	380
5.5	3.253	12 420	52.0	1.003	1694	98.5	0.253	376
6.0	3.225	12119	52.5	0.988	1663	99.0	0.250	371
6.5	3.197	11 826	53.0	0.974	1634	99.5	0.246	367
7.0	3.169	11 541	53.5	0.959	1604	100.0	0.243	362
7.5	3.140	11 263	54.0	0.945	1575	100.5	0.240	357
8.0	3.112	10 992	54.5	0.931	1547	101.0	0.236	352
8.5	3.083	10 729	55.0	0.917	1519	101.5	0.233	346
9.0	3.054	10472	55.5	0.903	1492	102.0	0.230	341
9.5	3.026	10223	56.0	0.890	1465	102.5	0.227	335
10.0	2.997	9 979	56.5	0.876	1438	103.0	0.224	330
10.5	2.968	9 742	57.0	0.863	1412	103.5	0.221	324
11.0	2.939	9 512	57.5	0.850	1387	104.0	0.218	318
11.5	2.911	9 287	58.0	0.837	1362	104.5	0.215	312
12.0	2.882	9 068	58.5	0.825	1337	105.0	0.212	305
12.5	2.853	8 855	59.0	0.812	1313	105.5	0.209	299
13.0	2.824	8 647	59.5	0.800	1289	106.0	0.206	292
13.5	2.795	8 444	60.0	0.788	1265	106.5	0.204	285
14.0	2.766	8 247	60.5	0.776	1242	107.0	0.201	



