

Controls and Troubleshooting

50 and 60 Hertz

IMPORTANT. This publication contains troubleshooting data for 30GB040-200 and 30GT225-280 chillers.

30GB circuits are identified as circuits 1 and 2, and 30GB compressors are identified as compressors 1 through 8

30GT circuits are identified as circuits A and B, and 30GT compressors are identified as A1-A4 in circuit A, and B1-B4 in circuit B.

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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.

INTRODUCTION

This publication contains information on the electronic control system, and control system troubleshooting for the 30GB040-200 and 30GT225-280 Flotronic™ liquid chillers, and on Flotronic units with factory-installed options (FIOP)

The Flotronic chillers are equipped with electronic expansion valves (EXV) or, on FIOP units, conventional thermostatic expansion valves (TXV) and liquid line solenoid valves (LLS). 30GT225-280 chillers are not available with FIOPs.

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 30GB040-200 and 30GT225-280 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
- Display Board
- Thermistors
- Electronic Expansion Valve or FIOP Thermostatic Expansion Valve
- Compressor Protection Control System (CPCS, optional on 040-060 units) or Control Relay
- 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)
- Electronic Expansion Valve
- Condenser Fans (head pressure control)
- Demand Limiting
- Temperature Reset
- Pulldown Control
- Diagnostic Display
- Safety Functions
- Unit Checkout (Quick Test)

Processor Board — The processor board, shown in Fig. 1, 2 and 4, is the heart of the control system. 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. The use of the connectors is shown in Fig. 5.

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

The microprocessor also monitors several switches in the unit. These switches are listed in Table 1.

From one to 5 potentiometers are connected to the processor board. These potentiometers are used to input set points to the microprocessor. The potentiometers are listed in Table 2.

The microprocessor also controls outputs. All relay outputs are controlled through the relay board which plugs into the processor board through a ribbon connector. The microprocessor board also controls a 2-digit LED display located on the display board (see Fig. 1 and 2). The display board plugs into the processor board through a ribbon cable. The electronic expansion valves are controlled by the processor board.

The processor board has been programmed to control a large variety of chillers. To configure the processor board for the various chillers, 2 methods are used. A configuration header (see Fig. 1 and 4) is located on the processor board and is used to configure the control at the factory. The configuration header is a small plastic header that is plugged into a chip socket. The header contains 8 small wire jumpers that are selectively broken to configure the unit. The purpose of each jumper is listed in Table 3.

IMPORTANT: Do not change the factory configuration as it could result in improper operation of the unit.

To allow for field-selectable options, a second configuration method is also used. A small DIP switch assembly is located on the processor board as shown in Fig. 1 and 4. The header contains 8 DIP switches, protected by a plastic cover. The cover must be removed for access to the switches.

IMPORTANT: Always replace the plastic cover after adjusting the DIP switches. The switches should only be adjusted when the control circuit breaker is OFF.

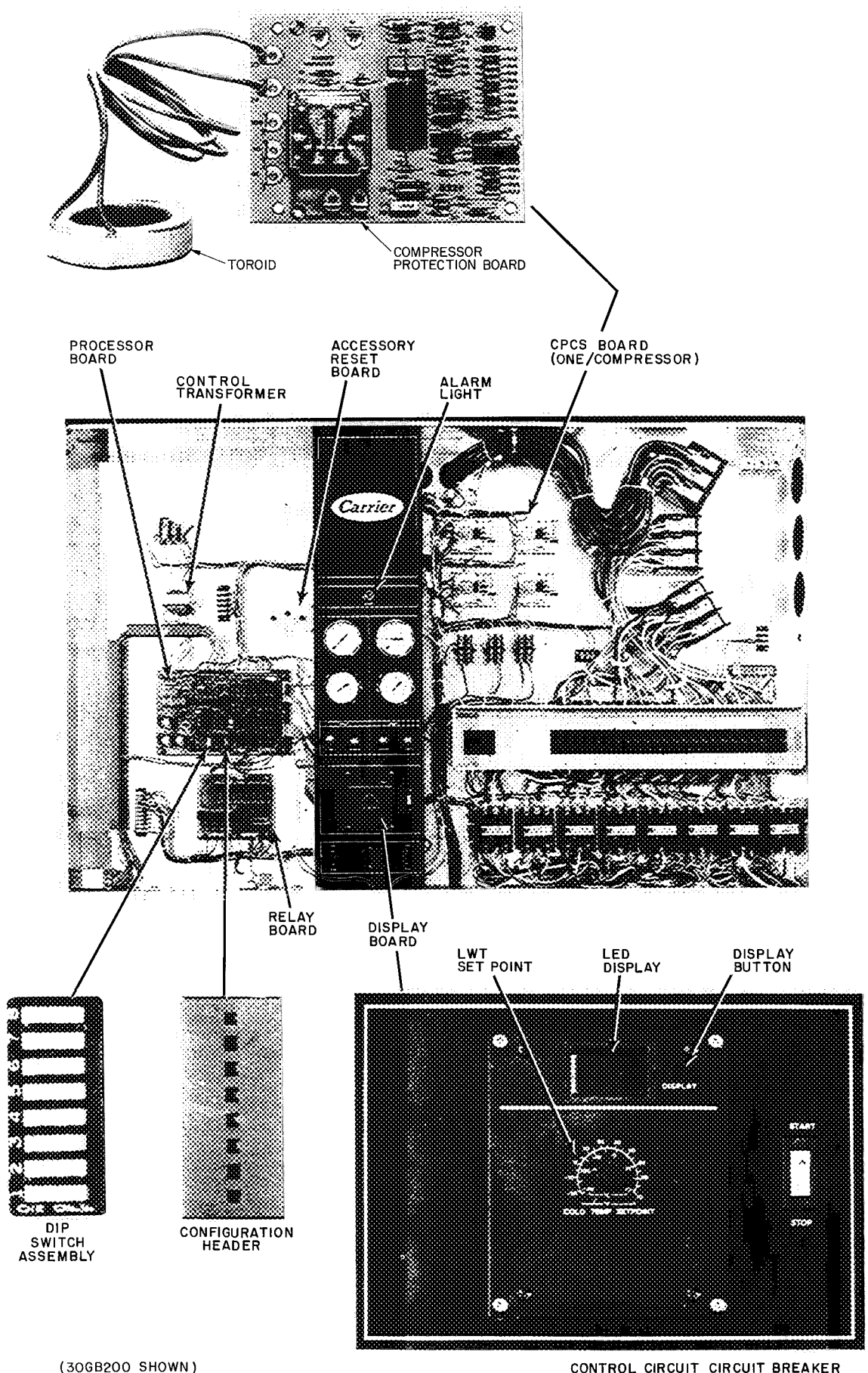
The purpose of the switches is listed in Table 4.

When the unit is shipped, the pulldown switch no. 3 (on all units), and the single unloader switch no. 6 (on 30GB040-080 units only), are in the ON position; all other switches are in the OFF position.

Relay Board — The relay board is used to control all 24-, 115- and 230-volt loads. The relay board is connected to the processor board through a ribbon cable, which is permanently attached to the relay board. The relay board is shown in Fig. 1 and 3. The electrical connections to the relay board are shown in Fig. 4 (J5 and J6).

The relay board contains eight 24-volt relays and five 115- or 230-volt relays. The relays and their use is listed in Table 5.

Display Board — The display board is located in the control box on 30GB040-070, on the gage panel on 30GB075-200 (as shown in Fig. 1), and in the control box on 30GT225-280 (Fig. 2). The board is connected to J10 on the processor board through a ribbon cable. The display board contains the cooler leaving water temperature set point potentiometer, a 2-digit, 7-segment display and the display switch. The display is used to convey operating information and error codes. Refer to the Operating Information section for further details.



NOTE On 30GB040-070 units, components connected to processor board are same as shown.
See Wiring Diagrams for location details

Fig. 1 — Typical Control Box for 30GB075-200 Units

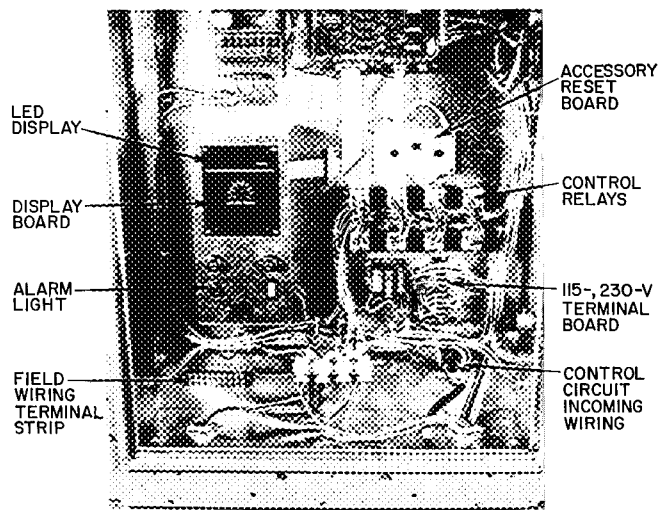
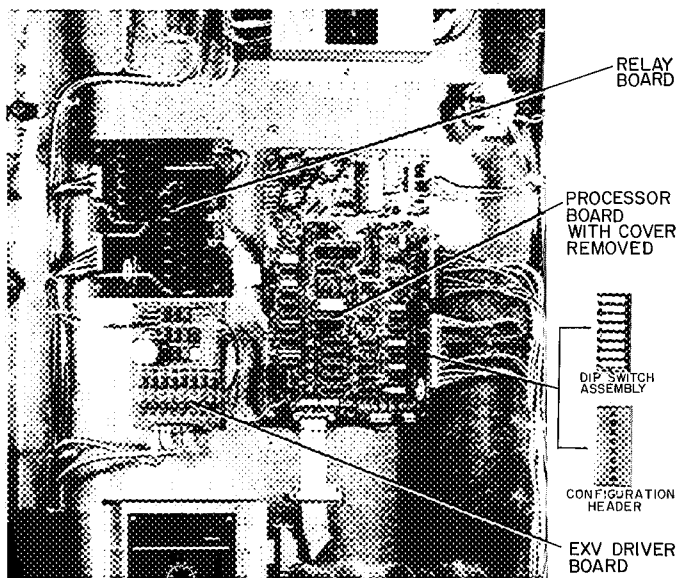
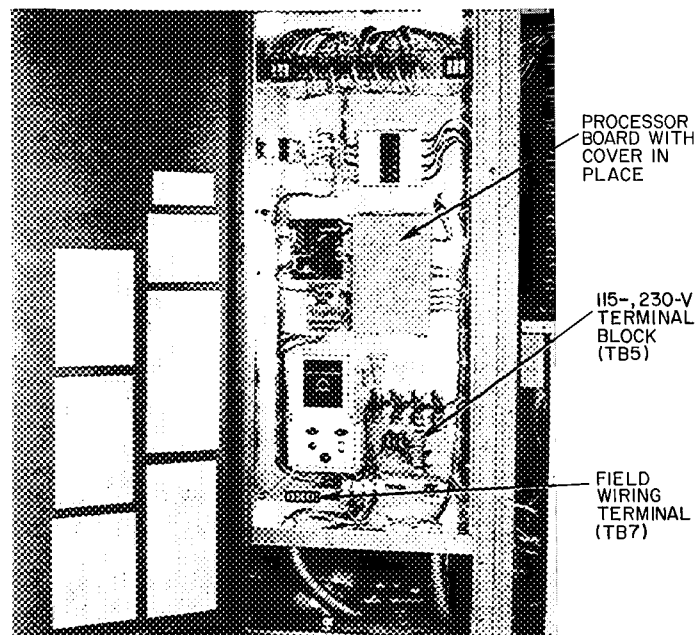


**Fig. 2 — Control Box Components
(30GT225-280)**

Table 1 — Input Switches

SWITCH CODE NAME	DESCRIPTION	LOCATION
S1*	Compr 1 or A1 Fault Signal	CPCS Board 1 or CR-A1
S2	Compr 2 or A2 Fault Signal	CPCS Board 2 or CR-A2
S3	Compr 3 or A3 Fault Signal	CPCS Board 3 or CR-A3
S4	Compr 4 or A4 Fault Signal	CPCS Board 4 or CR-A4
S5*	Compr 5 or B1 Fault Signal	CPCS Board 5 or CR-B1
S6	Compr 6 or B2 Fault Signal	CPCS Board 6 or CR-B2
S7	Compr 7 or B3 Fault Signal	CPCS Board 7 or CR-B3
S8	Compr 8 or B4 Fault Signal	CPCS Board 8 or CR-B4
S9	Remote On/Off	J2 Terminals 13, 14 †
S11	Loss-of-Charge Cir 1 or A	Lead Compr Cir 1 or A
S12	Loss-of-Charge Cir 2 or B	Lead Compr Cir 2 or B
S13 †	Oil Press Switch Cir 1 or A	Lead Compr Cir 1 or A
S14 †	Oil Press Switch Cir 2 or B	Lead Compr Cir 2 or B
S15	Display Switch	Display Board

*CR for 30GB040-060

†Accessory on 30GB040-060

‡See Fig 19 for 30GT225-280 location

NOTE: 30GT225-280 circuits are identified as A and B

Table 3 — Configuration Header

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

■ = Jumper broken (open circuit)

□ = Jumper not broken (closed circuit)

Table 2 — Adjustable Input Potentiometers

CODE NAME	DESCRIPTION	LOCATION	RANGE	STANDARD/OPTIONAL	DEFAULT VALUE
P1	Cooler LWT Set Point	Display Board	40 to 70 F (4.4 to 21 C) 15 to 70 F* (-9.4 to 21 C)*	Standard	70 F (21 C)
P3	Reset Limit Set Point	Accessory Board	0 to 80 F (0 to 44.4 C)	Optional	42 F (5.6 C)
P4	Demand Limit Set Point	Demand Limit Board †	0 to 100%	Optional	0 F (0 C)
P5	Reset Ratio Set Point	Accessory Board	0 to 100%	Optional	0%
P6	Reset Set Point	Accessory Board	0 to 95 F (-17.8 to 35 C)	Optional	0 F (-17.8 C)

*Second range for P1 is used on brine option

†Accessory

Table 4 — DIP Switch Assembly (see Fig. 1)

SWITCH NO.	FUNCTION	SETTING*	MEANING
1	Reset Mode	ON OFF	Return Reset Space or OA Reset
2	Reset Select	ON OFF	Reset Used Reset Not Used
3	Pulldown Select	ON OFF	Pulldown Used Pulldown Not Used
4	Not Used	OFF	
5	Demand Limit	ON OFF	Demand Limit Used Demand Limit Not Used
6, 7	Unloader	OFF, OFF ON, OFF OFF, ON	No Unloaders 1 Unloader † 2 Unloaders †
8	Brine Select	ON OFF	Brine Chiller Water Chiller

*Turn control circuit power OFF to change settings

†Unloaders not available on 30GB175-200 or 30GT225-280

WARNING Do not change brine selected DIP switch to brine unless unit has been factory modified for brine application. Unit damage can occur.

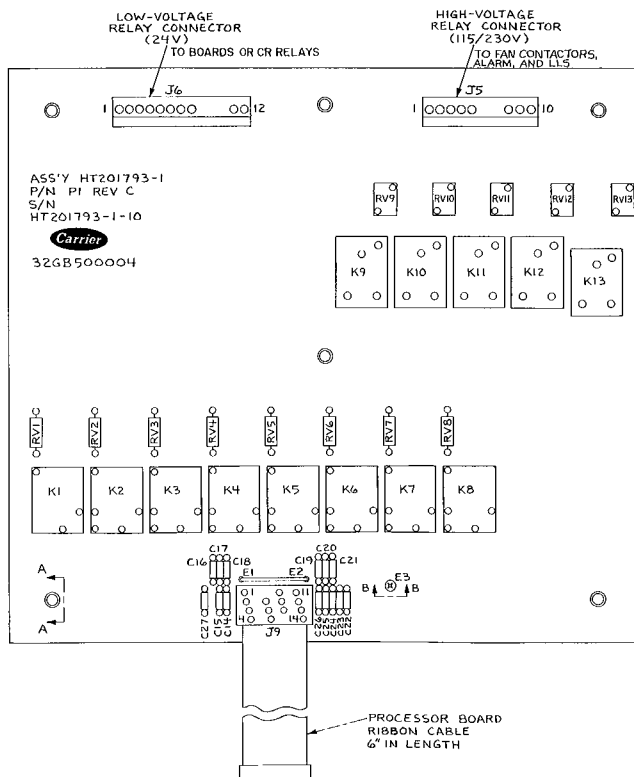


Fig. 3 — Relay Board

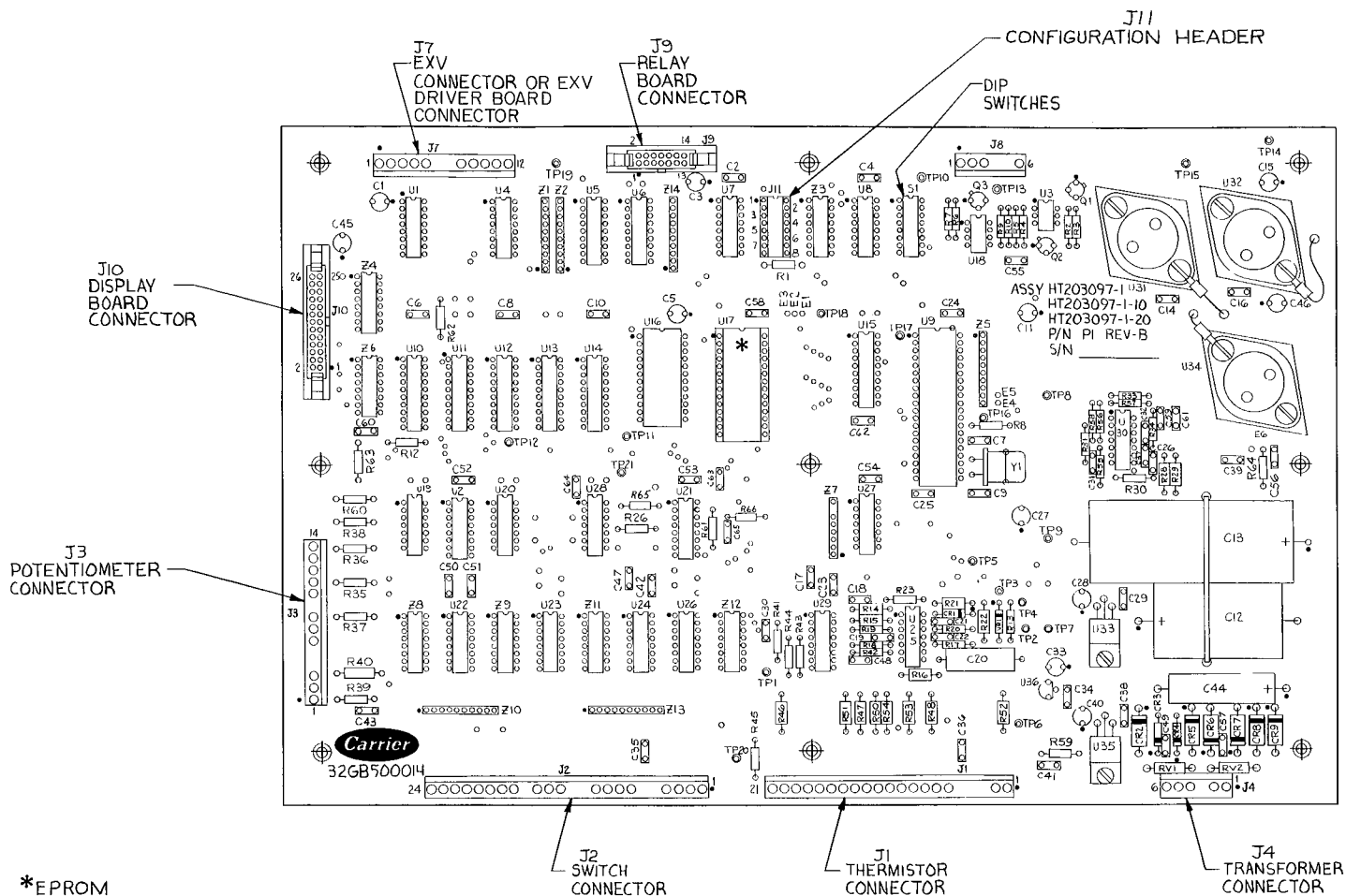


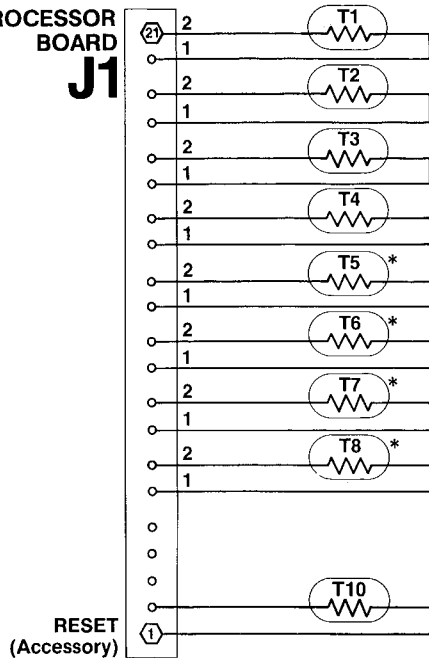
Fig. 4 — Processor Board

Table 5 — Output Assignments (J5 and J6)
(Refer to Fig. 5.)

RELAY NO	DESCRIPTION	LOCATION	TYPE	VOLTAGE
K1	Compressor Relay 1 or A1	Relay Board	SPST Contacts	24 vac
K2	Compressor Relay 2 or A2	Relay Board	SPST Contacts	24 vac
K3	Compressor Relay 3 or A3	Relay Board	SPST Contacts	24 vac
K4	Compressor Relay 4 or A4	Relay Board	SPST Contacts	24 vac
K5	Compressor Relay 5 or B1	Relay Board	SPST Contacts	24 vac
K6	Compressor Relay 6 or B2	Relay Board	SPST Contacts	24 vac
K7	Compressor Relay 7 or B3	Relay Board	SPST Contacts	24 vac
K8	Compressor Relay 8 or B4	Relay Board	SPST Contacts	24 vac
K9	Liquid Line Solenoid Circuit 1 or A	Relay Board	SPST Contacts	115/230 vac*
K10	Liquid Line Solenoid Circuit 2 or B	Relay Board	SPST Contacts	115/230 vac*
K11	Condenser Fan Stage 1	Relay Board	SPST Contacts	115/230 vac*
K12	Condenser Fan Stage 2	Relay Board	SPST Contacts	115/230 vac*
K13	Alarm Relay	Relay Board	SPST Contacts	115/230 vac*
—	EXV Output Circuit 1 or A	Processor Board	Logic Level Driver	12 vdc
—	EXV Output Circuit 2 or B	Processor Board	Logic Level Driver	12 vdc
—	LED Output	Display Board	2-Digit LED	5 vdc

*There are separate boards for 115 and 230 vac

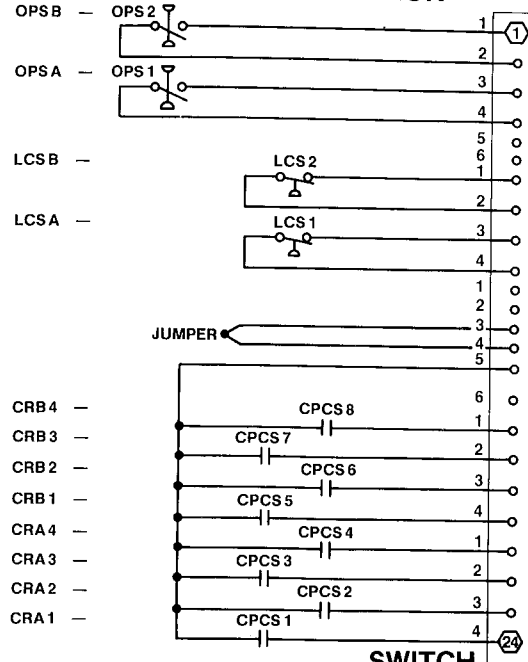
PROCESSOR BOARD
J1



THERMISTORS

*Not used on FIOP unit with TXV

30GT 30GB 5-VOLT SECTION

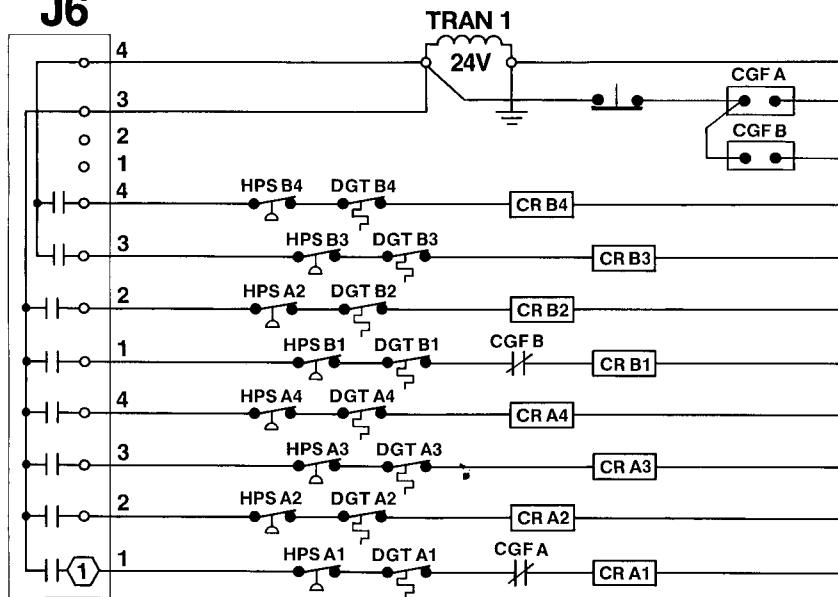


SWITCH INPUTS
(Typical)

PROCESSOR BOARD
J2

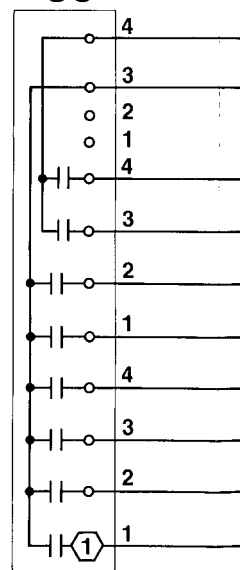
RELAY BOARD
J6

24-VOLT SECTION



30GT RELAY OUTPUTS (Typical)

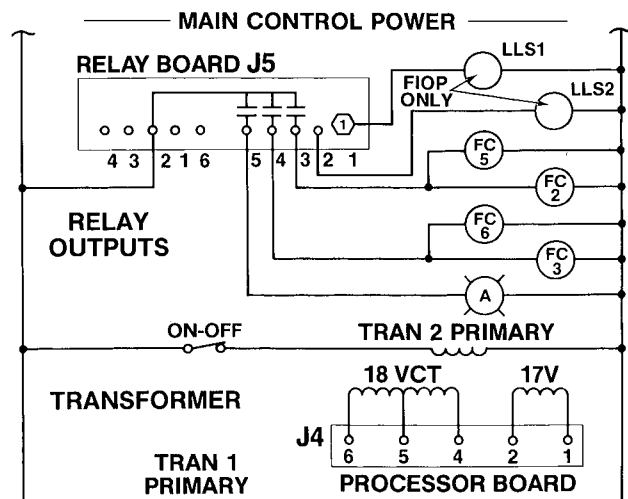
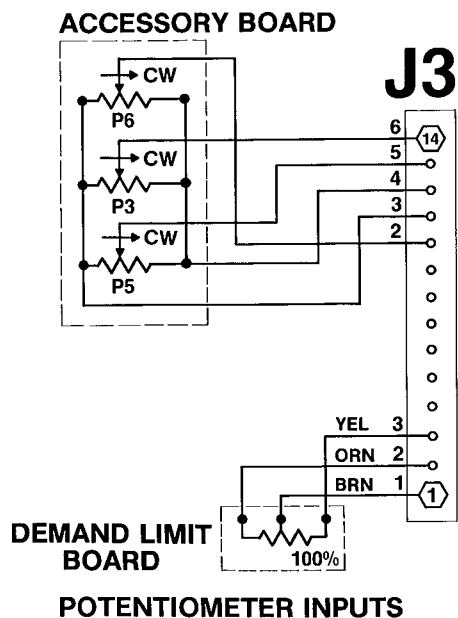
RELAY BOARD
J6



NOTE: 30GB040-060 fac

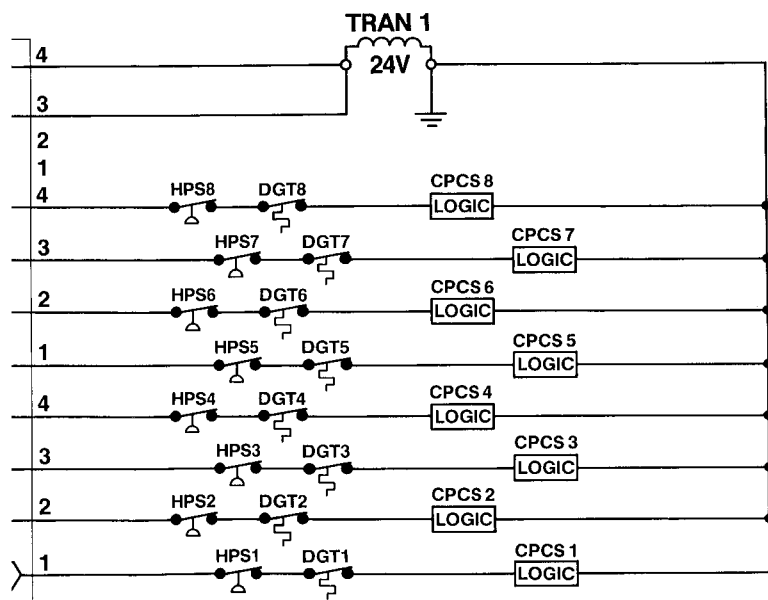
Fig. 5 — Printed-Circuit f

PROCESSOR
)



BOARD

24-VOLT SECTION



30GB RELAY OUTPUTS (Typical)

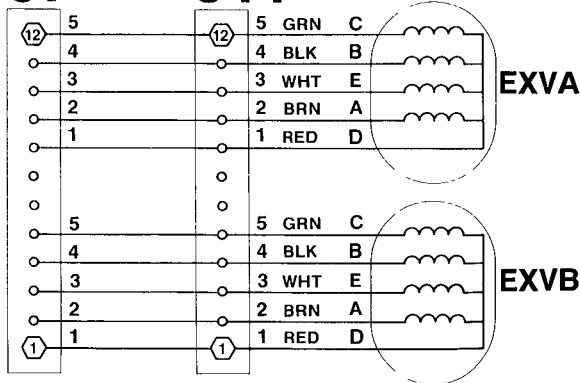
3B040-060 factory equipped with CR (Control Relay) instead of CPCS

PROCESSOR BOARD

DRIVER BOARD (NOT APPLICABLE TO ALL UNITS)

J7

J11



ELECTRONIC EXPANSION VALVES

ted-Circuit Board Connectors

Thermistors — The electronic control uses up to 9 thermistors to sense temperature. These sensors are:

CODE NO.	PURPOSE
T1	Cooler Leaving Water
T2	Cooler Entering Water
T3	Saturated Condensing Temperature — Circuit 1 or A
T4	Saturated Condensing Temperature — Circuit 2 or B
T5*	Cooler Saturation Temperature — Circuit 1 or A
T6*	Cooler Saturation Temperature — Circuit 2 or B
T7*	Compr Return Gas Temperature — Circuit 1 or A
T8*	Compr Return Gas Temperature — Circuit 2 or B
T10	Reset Temperature Sensor (Accessory)

*Not used on FIOP units with TXV

The general location of the thermistors is shown in Fig. 6 (30GB040-070) or Fig. 7 (30GB075-200) or Fig. 8 (30GT225-280). All thermistors are identical in the temperature vs resistance and voltage drop performance. See Thermistor Troubleshooting for temperature vs resistance and voltage drop characteristics.

T1 — COOLER LEAVING WATER SENSOR — This thermistor is located in the leaving water nozzle. The thermistor probe is immersed directly in the water. Actual location is shown in Fig. 6, 9, 10.

T2 — COOLER ENTERING WATER SENSOR — This thermistor is located in the cooler shell in the first baffle space in close proximity to the cooler tube bundle. Actual location is shown in Fig. 6, 9, 10.

T3, T4 — SATURATED CONDENSING TEMPERATURE SENSORS — These 2 thermistors are clamped to the outside of a return bend of the condenser coils. The exact locations are shown in Fig. 6 and 11.

T5, T6 — COOLER SATURATION TEMPERATURE SENSORS — These thermistors are located next to the refrigerant inlet in the cooler head. The thermistors are immersed directly into the refrigerant. Actual location is shown in Fig. 6, 7, 8, 9, 10. (Not used on FIOP units.)

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 through the motor and is entering the cylinders. See Fig. 12. (Not used on FIOP units.)

T10 — RESET 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.

Electronic Expansion Valve (EXV) Standard Unit — The Flotronic™ chiller is equipped with the new Carrier-designed electronic expansion valve. A cutaway view of the valve is shown in Fig. 13.

The high-pressure refrigerant enters the valve through the bottom. A group of calibrated slots have been machined into the side of the orifice assembly. As the refrigerant passes through the orifice, it drops in pressure and changes to a 2-phase refrigerant. To control the flow of refrigerant for different operating conditions, the sleeve moves up and down over the orifice and modulates the size of the orifice. This sleeve is moved by a linear stepper motor. The stepper motor moves in increments and is controlled directly by the processor board. As the stepper motor rotates, the motion is translated into linear movement of the lead screw. Through the stepper motor and lead screw, 760 discrete steps of motion are obtained. The large number of steps and the long stroke result in very accurate control of the refrigerant flow.

The valve is controlled by the microprocessor. Two thermistors are used to determine the suction superheat. One thermistor is located in the cooler and the other is located after the compressor motor in a passage entering the cylinders. The difference between the 2 sensors is used to control the suction superheat. On normal TXV systems the superheat leaving the evaporator is normally 10 F (5.6 C). The motor then adds approximately 20 F (11 C) superheat resulting in 30 F (16.7 C) superheat entering the compressor cylinders. With the electronic valve, superheat of refrigerant entering the cylinders is controlled to 20 F (11 C) which results in 0° to 5 F (2.8 C) superheat leaving the cooler. This results in cooler performance improvement through the reduction of superheating in cooler.

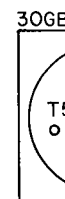
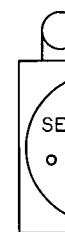
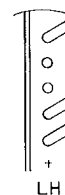
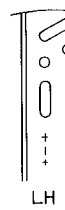
Because the valves are controlled by the processor board, it is possible to keep track of the valve position. The valve position is used to control head pressure and to monitor the system refrigerant charge.

During initial start-up, the valve is initialized by cycling the valve to the fully closed position. After the initialization period, the position is monitored by the processor board by keeping track of the amount of valve movement.

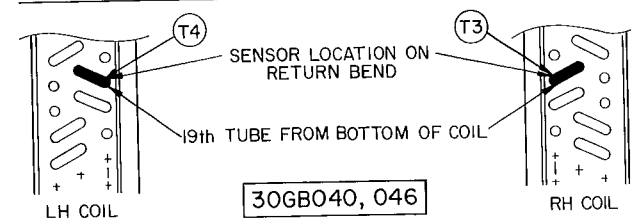
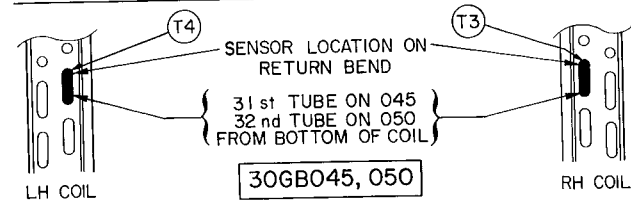
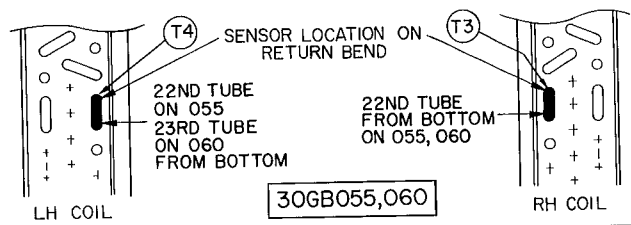
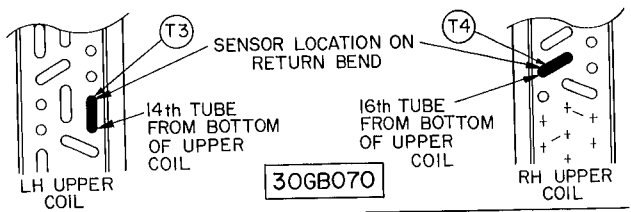
The electronic valve is also used to limit the maximum cooler saturated suction temperature to 55 F (12.8 C). This makes it possible for the chiller to start at high cooler water temperatures without overloading the compressor. This is commonly known as an MOP. (maximum operating pressure)

Thermostatic Expansion Valve (TXV, 30GB only) — The Flotronic FIOP chiller is equipped with conventional thermostatic expansion valves, one per circuit. This control system necessitates the use of a liquid line solenoid valve. The TXV is factory set to maintain 8 F to 10 F (4.4 C to 5.6 C) superheat of vapor leaving the cooler by controlling flow of refrigerant into the cooler. *Superheat can be reset but should be done only if absolutely necessary.* When the TXV is used, thermistors T5, T6, T7 and T8 are not required.

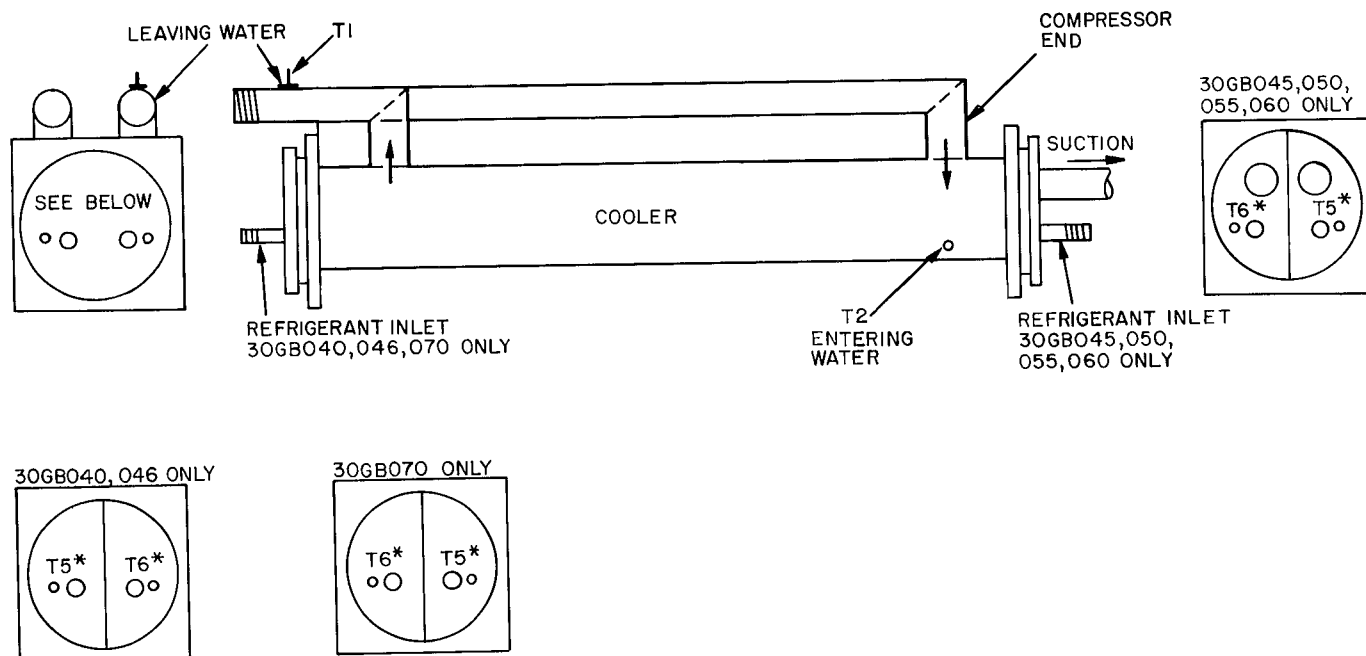
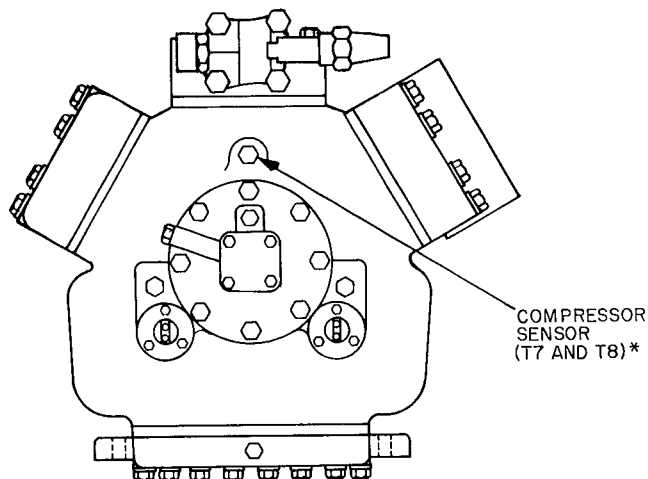
The TXV incorporates an MOP. feature to limit the cooler suction to 55 F (12.8 C), making it possible for the compressor to start at high cooler water temperatures without overloading.



*Only



Compressor End — Headers Removed
CONDENSER COILS



*Only on Flotronic™ Chiller (with EXV)

Fig. 6 — Sensor Locations; 30GB040-070

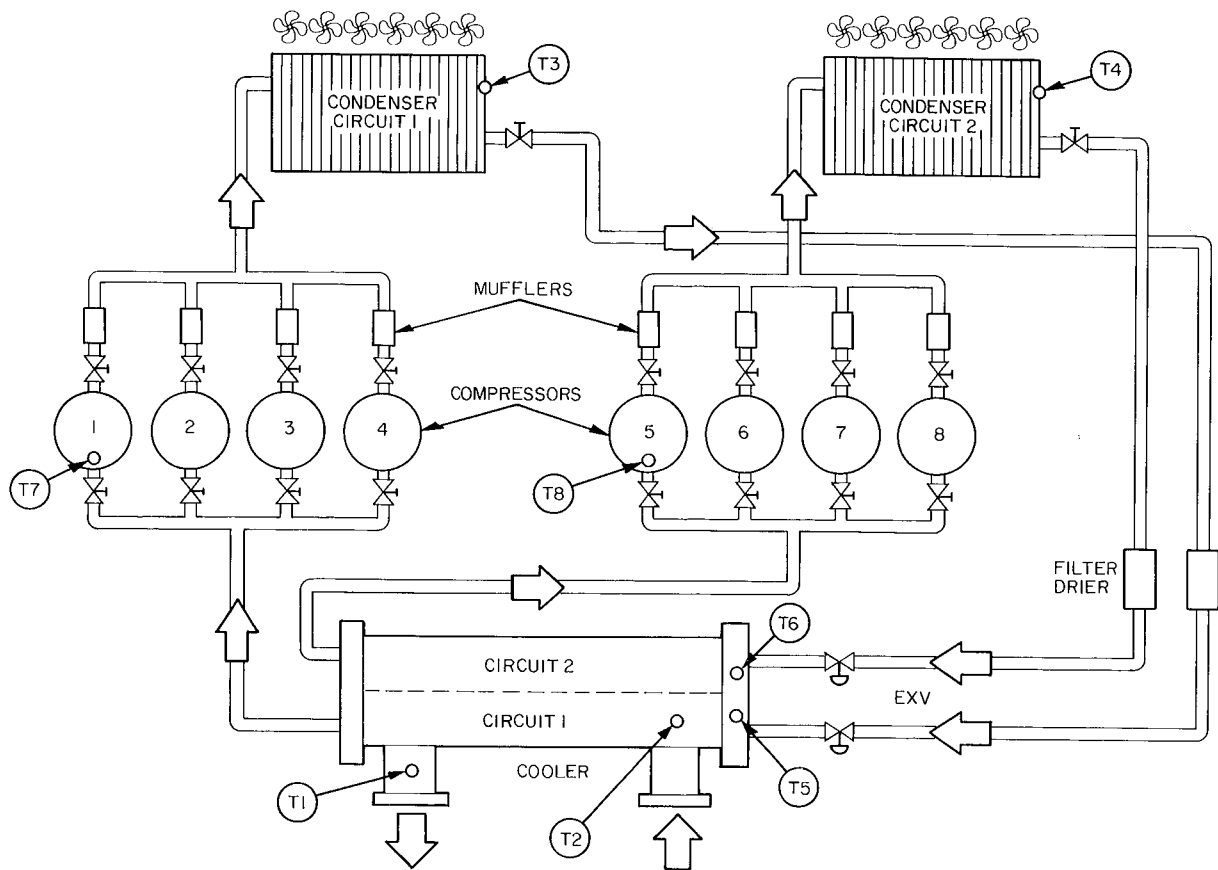


Fig. 7 — Typical Thermistor Locations; 30GB075-200

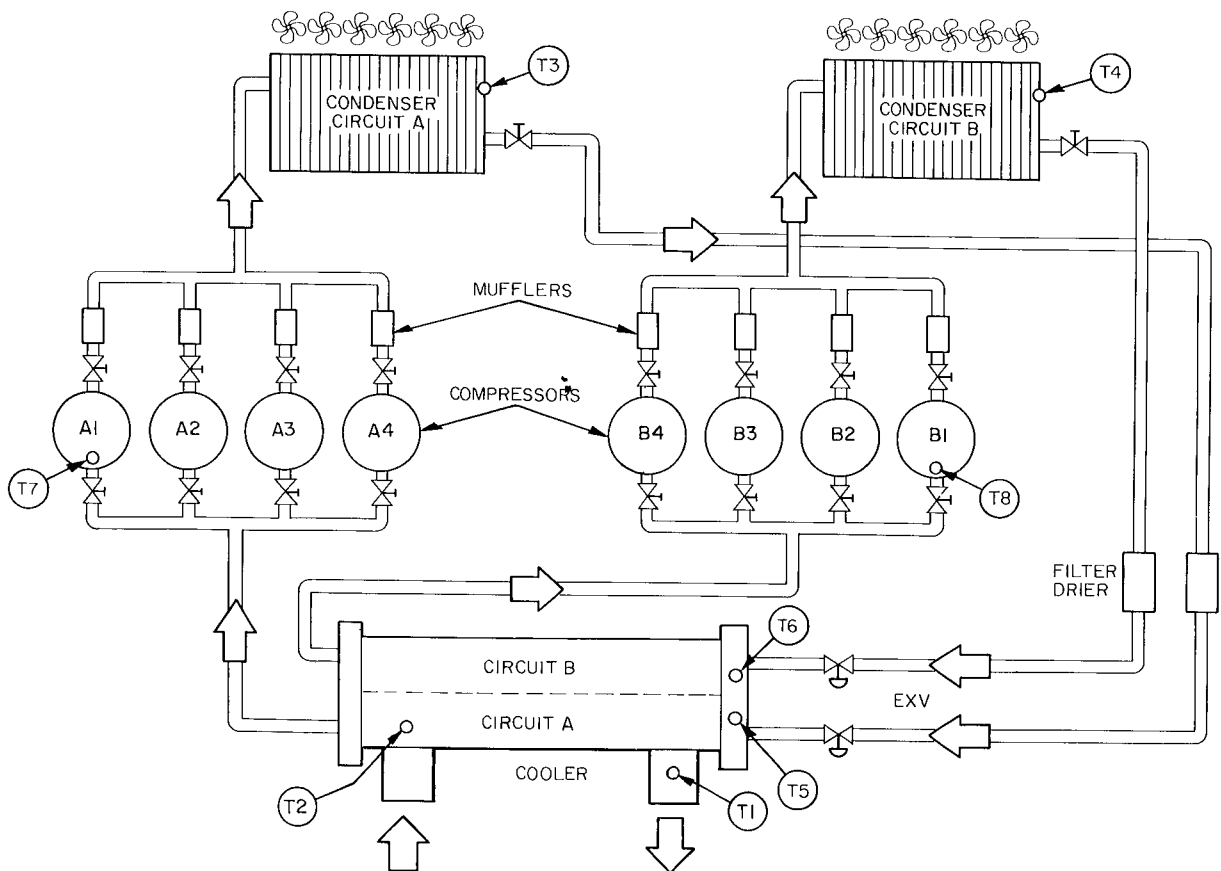
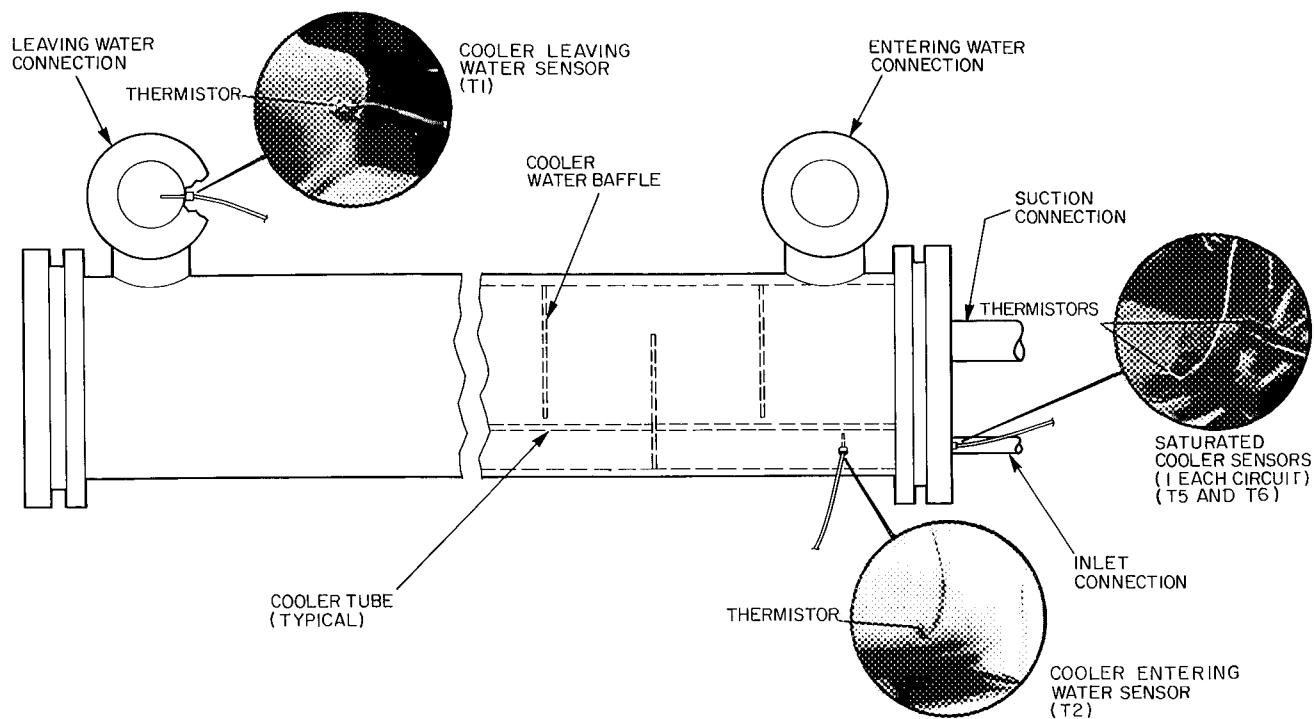
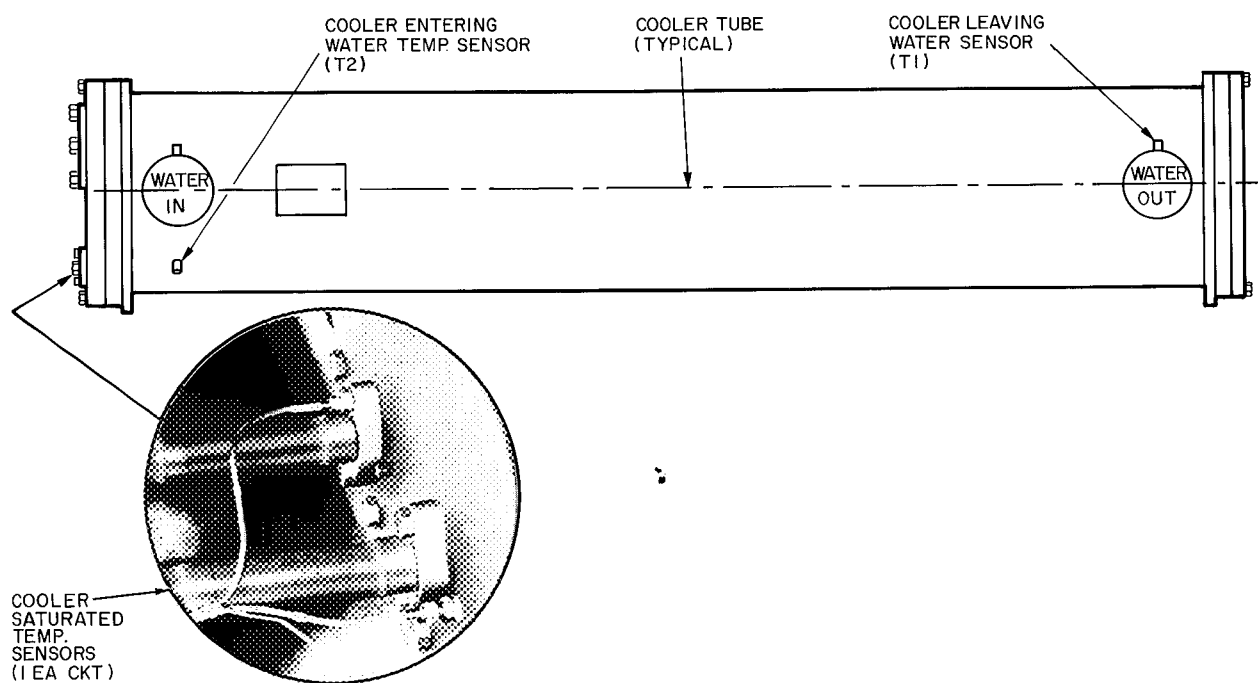


Fig. 8 — Typical Thermistor Locations; 30GT225-280



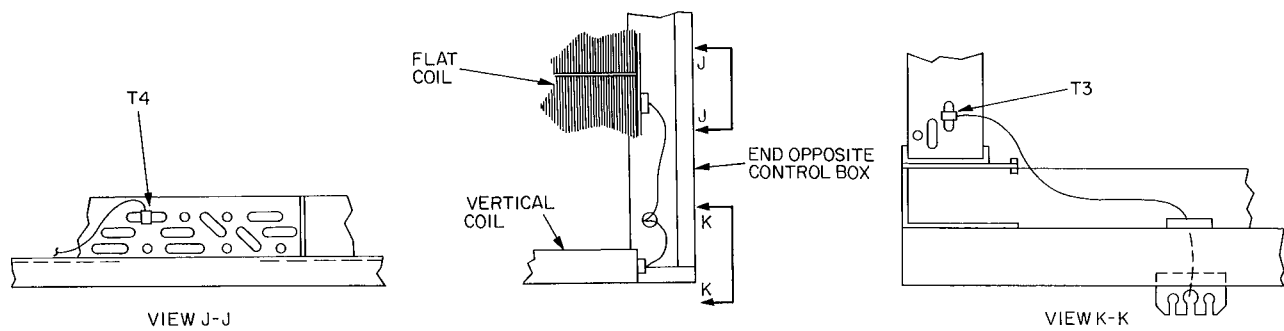
30GB075-200

Fig. 9 — Typical Cooler Thermistor Locations

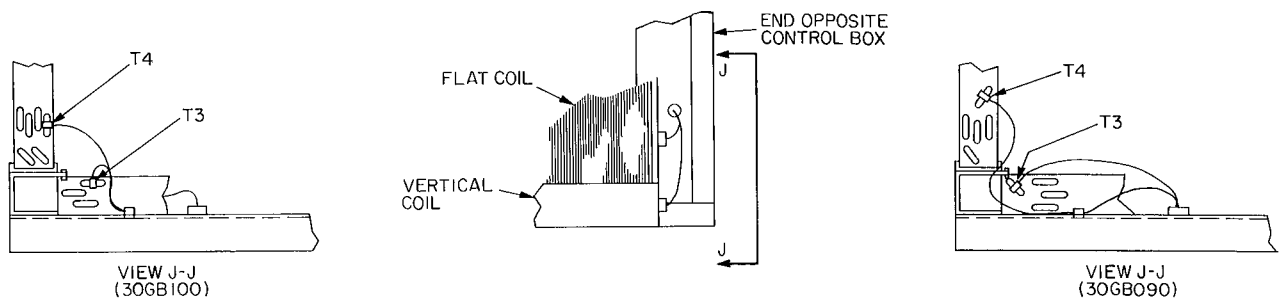


30GT225-280

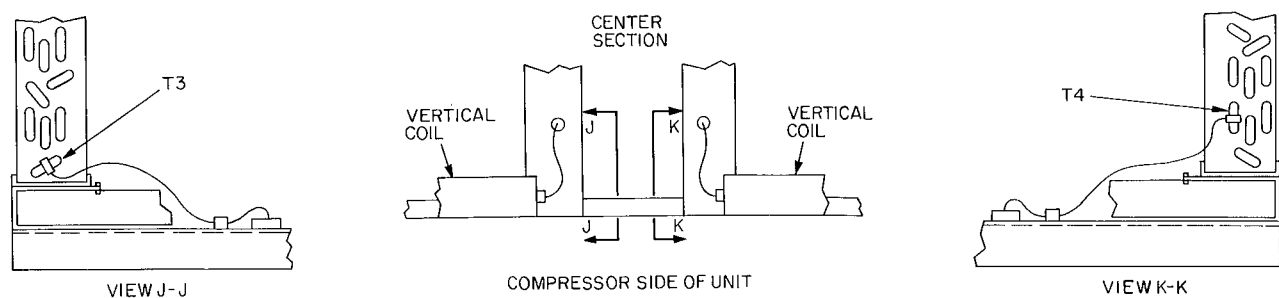
Fig. 10 — Cooler Sensor Locations



30GB075,080

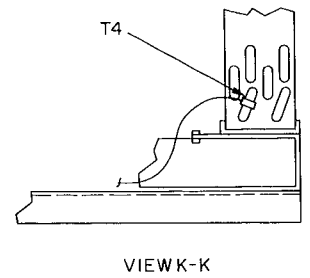
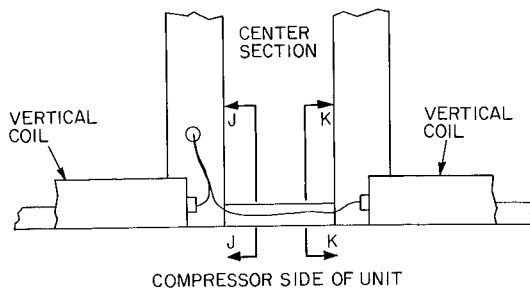
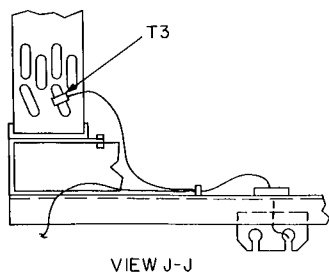


30GB090,100

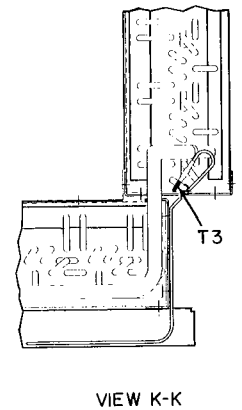
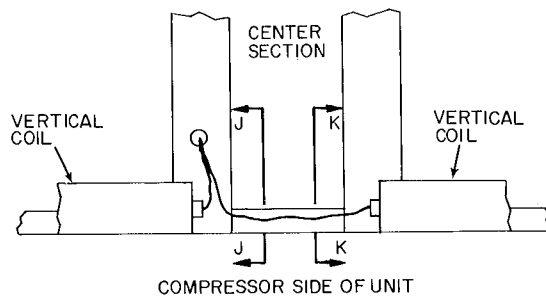
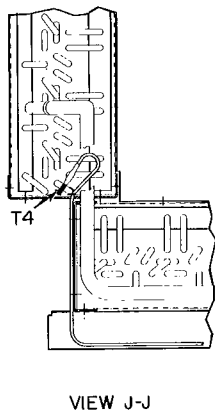


30GB110,125

Fig. 11 — Condenser Se

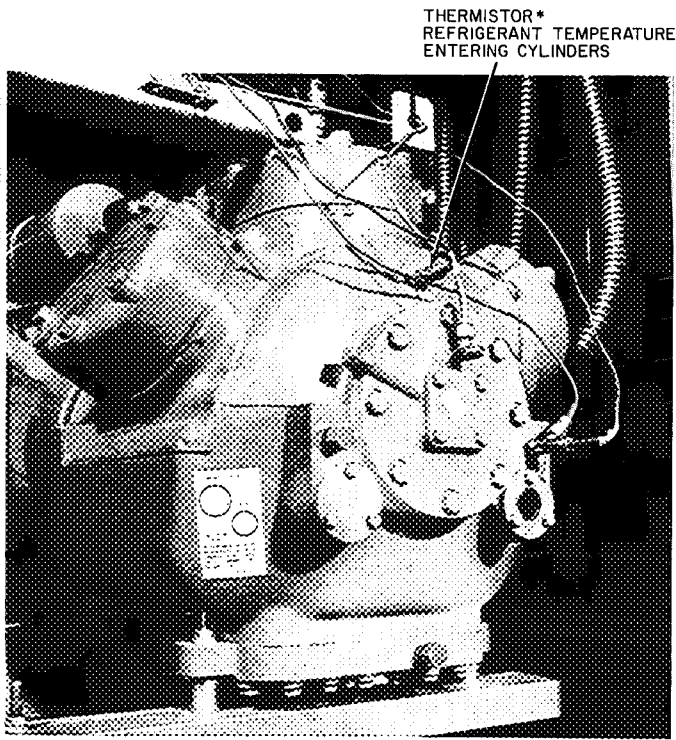


30GB150,175,200



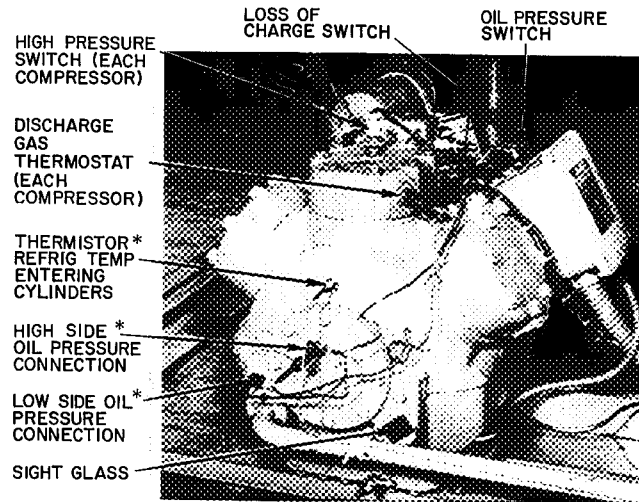
30GT225-280

Condenser Sensor Locations (SCT)



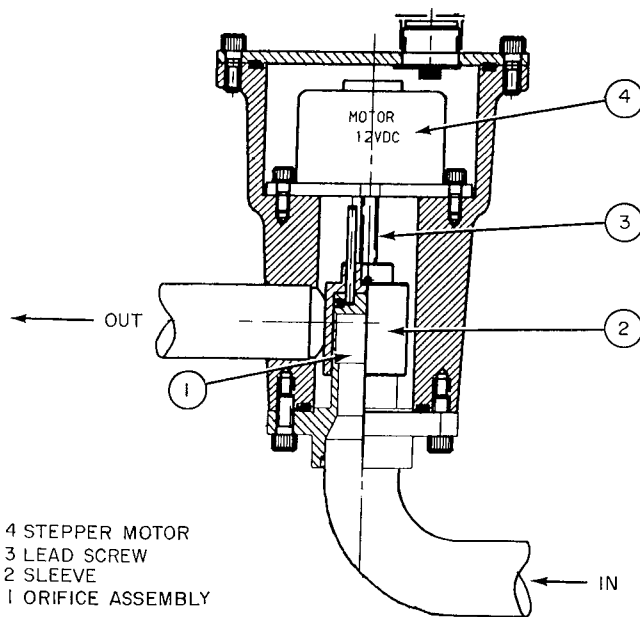
*Lead compressor only

30GB040-200



30GT225-280

Fig. 12 — Compressor Sensor Location



- 4 STEPPER MOTOR
- 3 LEAD SCREW
- 2 SLEEVE
- 1 ORIFICE ASSEMBLY

Fig. 13 — Electronic Expansion Valve

Compressor Protection Control System (CPCS) or Control Relay (CR) — The CPCS control system is standard on 30GB070-200 units and available as an accessory on 30GB040-060 units. The 30GB040-060 units are factory equipped with a control relay which operates same as the CPCS except that

ground current refrigerant circuit protection is not provided.

The CPCS is shown in Fig. 1. There is one for each compressor. They are used to control and protect the compressors and crankcase heaters. The CPCS provides the following functions:

- Compressor Contactor Control
- Crankcase Heater Control
- Ground Current Protection
- Status Communication to Processor Board
- High-Pressure Protection
- 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 de-energizing the proper 24-volt 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 so, it shuts down the compressor.

A high-pressure switch and discharge gas thermostat are wired in series with the compressor board. If these switches open during operation of a compressor, the compressor will be stopped and the failure will be detected through the signal contacts and the compressor will be locked off. If the lead compressor in either circuit is shut down by the high-pressure switch, discharge gas thermostat, ground current protector or oil safety switch, all compressors in that circuit are blocked via the oil pressure switch.

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Compressor Ground Fault (CGF) Protection Board and Control Relay (CR) — The 30GT 225-280 units contain one ground fault protection board (CGF) for each refrigeration circuit. The CGF board contains logic that can detect if the current-to-ground of any compressor winding exceeds 2.5 amps. If this occurs, the lead compressor in that circuit is shut down. This blocks all compressors in that circuit via the oil safety switch.

A high-pressure switch and discharge gas thermostat are wired in series with a control relay (CR) for each compressor. The lead compressor in each circuit also has the CGF contacts described above. If any of these switches open during operation of a compressor, the CR relay is de-energized, stopping the compressor and signaling the processor at the J2 inputs to lock out the compressor. If the lead compressor in either circuit is shut down by these safeties, all compressors in that circuit are blocked via the oil safety switch.

Accessory Reset Board (See Fig. 1, 2 and 14)

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

- Return Water Reset
- Outside 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 box is predrilled to accept the board.

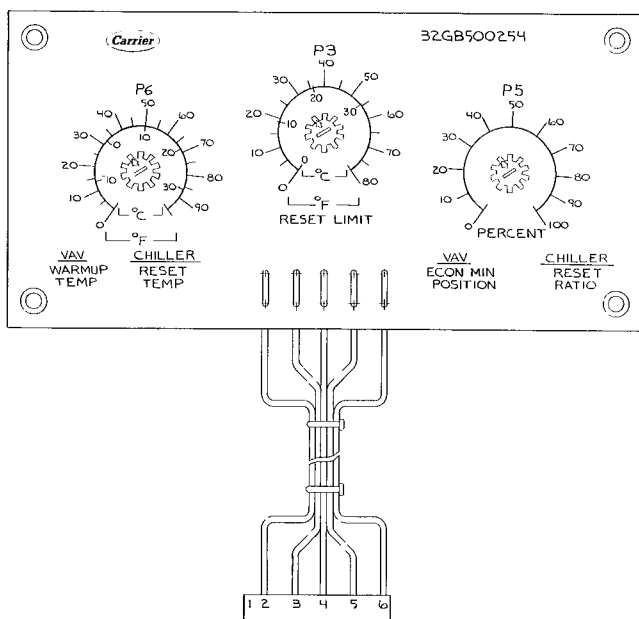


Fig. 14 — Accessory Board

Demand Limit Board — The demand limit board, or demand limit control module (DLCM), provides 2 demand limit steps. The first step is between 50% and 100% of maximum compressor displacement and the second step is between 0% and 50% displacement. The 2 steps must be controlled through an external switching device that determines when to limit unit capacity.

Refer to separate Accessory Demand Limit Control Module Installation Instructions for additional information.

OPERATING INFORMATION

Digital Display — The electronic control system uses a 2-digit LED display located on the display board (see Fig. 1 and 2) 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 initialized and 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 for details.

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
0-12	Capacity Stage
20-26	Operational Information
51-87	Overload Information

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

Under normal operation, only the 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. Overload 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. There

Table 6 — 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

are categories of display codes shown during normal operation. During Quick Test, these codes do not apply

0-12 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 the installation book 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. 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 6.

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

Temperature Reset — This 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 return water, outside air temperature or space temperature.

Demand Limit — This indicates that the capacity of the unit is being limited by the demand limit potentiometer. The unit may not be able to produce the desired leaving water temperature and the unit may not load to full capacity.

Pulldown Control — If this option is being used and the cooler water temperature is warm, this option will limit the capacity so that the water temperature leaving the cooler does not decrease faster than 1°F (0.6°C) per minute.

Remote On/Off — This indicates unit is under control of a field-installed remote ON/OFF switch.

51-87 OVERLOAD CODES — The control contains extensive diagnostic capabilities. If something is not functioning properly, the control will energize the alarm light (see Fig. 1 and 2) 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 Control Troubleshooting and Service section (see Table 10).

Quick Test (Table 7) — The Quick Test program utilizes the 2-digit LED display (Fig. 1 and 2) on the display set point board to show status of all input and output signals to the microprocessor control

Display action and Quick Test procedure are described below.

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 control switches are in proper working order.

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 code as shown in Table 7 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).

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 breaker 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 and shown in Table 7.

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 3) and cannot be changed in the field. The dip switch assembly contains 8 microswitches that must be set in accordance with various options and accessories selected by the customer. All dip switches should be checked and set to the proper position for options selected during the Quick Test. Dip switch functions and display codes are shown in Fig. 1 and in Tables 4 and 7.

This section of the Quick Test also checks the loss-of-charge switches and the low oil pressure switches.

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 that 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 219 ohms. Normal display code for good sensors 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.**, 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 Tables 3 and 8.

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; unit wiring.

Table 7 — Quick Test **88**
SECTION A — CONFIGURATION AND SWITCH CHECK

QUICK TEST STEP NO.	NORMAL DISPLAY	STEP DESCRIPTION	CONTROL SWITCH
1.	00	Type Unit — Air-Cooled Chiller	Configuration Header
2.	2 to 8	Number of Compressors	Configuration Header
3.	0, 1 or 2	Number of Unloaders 0 — Switches 6 and 7 Off 1 — Switch 6 On; Switch 7 Off 2 — Switch 6 Off, Switch 7 On	DIP Switches 6 and 7
4.	0 or 1	0 — Standard Chiller (Switch Off) 1 — Brine Chiller* (Switch On)	DIP Switch 8
5.	1 or 0	1 — EXV 0 — TXV	Configuration Header
6.	50 or 60	50 — 50-Hertz Power 60 — 60-Hertz Power	Configuration Header
7.	0 or 1	0 — External Reset (Switch Off) 1 — Return Water Reset (Switch On)	DIP Switch 1
8.	0 or 1	0 — No Reset (Switch Off) 1 — Reset Used (Switch On)	DIP Switch 2
9.	0 or 1	0 — Pulldown Not Used (Switch Off) 1 — Pulldown Used (Switch On)	DIP Switch 3
10.	0 or 1	0 — Demand Limit Not Used (Switch Off) 1 — Demand Limit Used (Switch On)	DIP Switch 5
11.	0 or 1	0 — Remote On/OFF (Switch Open or Jumper not in place) 1 — Remote On/OFF (Switch Closed or Jumper in place)	J2 Terminals 13 and 14 Jumper† (See Fig. 19 for 30GT225-280 location).
12.	1	1 — Loss-of-Charge Switch Closed 0 — Loss-of-Charge Switch Open	Circuit 1 or A Loss-of-Charge Switch
13.	1	1 — Loss-of-Charge Switch Closed 0 — Loss-of-Charge Switch Open	Circuit 2 or B Loss-of-Charge Switch
14.	0 †	1 — Low Oil Pressure Switch Closed 0 — Low Oil Pressure Switch Open	Circuit 1 or A Low Oil Pressure Switch
15.	0 †	1 — Low Oil Pressure Switch Closed 0 — Low Oil Pressure Switch Open	Circuit 2 or B Low Oil Pressure Switch

*Do not change select switch to brine on units that do not have modifications for brine. Special modifications are required. Contact Carrier for details.

†Will always display 1 for 30GB040-060 unless accessory OPS is installed.

‡See Fig. 4, page 6 for location of EPROM. Jumper must be used to connect terminals J2-13 and J2-14 on the processor board whenever an EPROM HT204247-1-12, HT204247-1-13 or HT204247-1-14 is installed on the processor board. In some cases the EPROMs are labeled Code 328, Code 329, Code 331. If a new processor board is installed, be sure to check part number of the EPROM on the board. If EPROM is one of the above, a jumper must be installed if not already installed.

IMPORTANT: If 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 pins 13 and 14 is open, processor is programmed to initiate a shutdown and hold machine in standby. This feature makes remote shutdown of chiller easier. If jumper is installed when older software is in unit, chiller operates normally except alarm light remains on and Code 83 is displayed. To remove alarm light and Code 83 display, remove jumper.

Table 7 — Quick Test 88 (cont)

SECTION B — THERMISTOR AND POTENTIOMETER CHECKOUT

QUICK TEST STEP NO.	NORMAL DISPLAY	STEP DESCRIPTION	THERMISTOR OR POTENTIOMETER
1.6.	1	1 — Thermistor OK 0 — Thermistor Faulty	Cooler Leaving Water Thermistor (T1)
1.7.	1	1 — Thermistor OK 0 — Thermistor Faulty	Cooler Entering Water Thermistor (T2)
1.8.	1	1 — Thermistor OK 0 — Thermistor Faulty	Condenser Thermistor, Circuit 1 or A (T3)
1.9.	1	1 — Thermistor OK 0 — Thermistor Faulty	Condenser Thermistor, Circuit 2 or B (T4)
2.0.	1 or 0	1 — Thermistor OK 0 — Thermistor Faulty or Not Used	Cooler Thermistor, Circuit 1 or A (T5**)
2.1.	1 or 0	1 — Thermistor OK 0 — Thermistor Faulty or Not Used	Cooler Thermistor, Circuit 2 or B (T6**)
2.2.	1 or 0	1 — Thermistor OK 0 — Thermistor Faulty or Not Used	Compr Thermistor, Circuit 1 or A (T7**)
2.3.	1 or 0	1 — Thermistor OK 0 — Thermistor Faulty or Not Used	Compr Thermistor, Circuit 2 or B (T8**)
2.4.	1 or 0	1 — Thermistor OK 0 — Thermistor Faulty or Not Used	Accessory Reset Thermistor (T10)
2.5.	1	1 — Potentiometer OK 0 — Potentiometer Faulty	Leaving Water Set Point Potentiometer
2.6.	0	No Significance	—
2.7.	1 or 0	1 — Potentiometer OK 0 — Potentiometer Faulty or Not Used	Accessory Reset Limit Potentiometer
2.8.	1 or 0	1 — Potentiometer OK 0 — Potentiometer Faulty or Not Used	Accessory Demand Limit Potentiometer
2.9.	1 or 0	1 — Potentiometer OK 0 — Potentiometer Faulty or Not Used	Accessory Reset Ratio Potentiometer
3.0.	1 or 0	1 — Potentiometer OK 0 — Potentiometer Faulty or Not Used	Accessory Reset Set Point Potentiometer

**Only on Flotronic™ units (with EXV).

Table 7 — 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 (See Table 8)	K11
3.2.	1	Energize Second Stage of Condenser Fans (See Table 8).	K12
3.3.	1	Energize Liquid Line Solenoid, Circuit 1 or A††	K9
3.4.	1	Energize Liquid Line Solenoid, Circuit 2 or B††	K10
3.5. through 4.2.	0 then 1 then 0	These steps energize compressors according to chart below for 10 seconds. Display shows status of compressor board feedback contacts 0 — Compressor Board or Relay Off 1 — Compressor Board or Relay On	K1 through K8

UNIT 30GB										UNIT 30GT
STEP	RELAY	040-060	070	075,080	090,100	110,125	150	175	200	225-280
Compr Number										
3.5. ‡‡	K1	1	1	1	1	1	1	1	1	A1
3.6.	K2	—	2	2	2	2	2	2	2	A2
3.7.	K3	—	—	—	—	3	3	3	3	A3
3.8.	K4	U1***	U1***	U1***	U1†††	U1†††	U1†††	4	4	A4
3.9. ‡‡	K5	2	3	3	3	4	4	5	5	B1
4.0.	K6	—	—	—	4	5	5	6	6	B2
4.1.	K7	—	—	—	—	—	6	7	7	B3
4.2.	K8	U2†††	U2†††	U2†††	U2†††	U2†††	U2†††	—	8	B4

U — Unloader

††(If used)

‡‡Steps 35 and 39 also turn on a condenser fan (see Table 8)

***Standard unloader

†††Accessory unloader

NOTES:

1 When unloader is energized, **0** will be displayed

2 Unloaders cannot be used on 30GB175 and 200 or 30GT225-280 units

Table 8 — Condenser Fan Sequence

FAN ARRANGEMENT	FAN NO.	FAN CON-TACTOR	During Quick Test*	CONTROLLED BY Normal Control
30GB040,046 □ — COMPRESSOR 	1	FC1	3 5	CR1
	2	FC2	3 9	CR2
	3,4	FC3	3 1	First Stage of Microprocessor
30GB045,050,055,060 □ — COMPRESSOR 	1	FC1	3 5	CR1
	2	FC2	3 9	CR2
	3,4	FC3	3 1	First Stage of Microprocessor
	5,6	FC4	3 2	Second Stage of Microprocessor
30GB070 □ — COMPRESSOR 	1,2	FC1	3 5	CPCS1
	1,2	FC2	3 9	CPCS3
	3,4	FC3	3 1.	First Stage of Microprocessor
	5,6	FC4	3.2	Second Stage of Microprocessor
30GB075,080 	1	FC1	3.5	Compressor No 1
	2	FC4	3 9.	Compressor No 3
	3,5	FC2	3 1	First Stage of Microprocessor
	4,6	FC3	3.2.	Second Stage of Microprocessor
30GB090,100 	1	FC1 FC4	3 5 & 3 9.	Compressor No. 1 or 3
	3,5,7	FC2	3 1	First Stage of Microprocessor
	2,4,6,8	FC3	3 2	Second Stage of Microprocessor
30GB110,125 	1	FC1	3.5	Compressor No 1
	7	FC4	3 9	Compressor No 4
	3,5,9	FC2 FC5	3 1	First Stage of Microprocessor
	2,4,6, 8,10	FC3 FC6	3 2	Second Stage of Microprocessor
30GB150,175,200 	1	FC1	3 5	Compressor No 1
	7	FC4	3 9	Compressor No 4 (150)
				Compressor No 5 (175-200)
	3,5, 9,11	FC2 FC5	3 1	First Stage of Microprocessor
	2,4,6 8,10,12	FC3 FC6	3 2	Second Stage of Microprocessor

CPCS — Compressor Protection Control System (30GB)

CR — Control Relay

*Quick Test display numbers

Table 8 — Condenser Fan Sequence (cont)

FAN ARRANGEMENT	FAN NO.	CONTROLLED BY	
		During Quick Test*	Normal Control
30GT225 	7,8	3.5.	Compressor A1
	9,10	3.9.	Compressor B1
	5,6,11,12	3 1	First Stage of Microprocessor
	1,2,3,4,13,14,15,16	3 2	Second Stage of Microprocessor
30GT250 	7,8,10	3.5.	Compressor A1
	9,17,18	3.9.	Compressor B1
	5,6,11,12,19	3.1.	First Stage of Microprocessor
	1,2,3,4,13,14,15,16,20	3 2	Second Stage of Microprocessor
30GT280 	7,8,10	3.5.	Compressor A1
	9,17,18	3.9.	Compressor B1
	5,6,11,12,19,20	3 1	First Stage of Microprocessor
	1,2,3,4,13,14,15,16,21,22	3 2	Second Stage of Microprocessor

*Quick Test display numbers

†Control Box

‡Power Box

Capacity Control — Operating Sequence —

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**. When the **20** disappears from the display, the control will begin to bring compressors on when necessary.

The rate at which the compressors are turned on will depend on the leaving water temperature difference from the set point, the rate of change of leaving water temperature, the return water temperature and the number of compressor stages on. The control is primarily from leaving water temperature and the other factors are used as compensation. Because the control is from leaving water, the chiller is independent of cooler gpm and outside air temperature. It is a true droopless control.

30GB — When compressor capacity is first added, the control will randomly select either circuit 1 or circuit 2, on units with no unloaders or with 2 unloaders. On units with one unloader, circuit 1 will always be started first.

30GT — When compressor capacity is first added, the control will randomly select either circuit A or circuit B (30GT225-280 units do not have unloaders).

If circuit has been off for 15 minutes then the electronic expansion valve or LLS will not open for 10 seconds while the cooler and suction lines are purged of any liquid refrigerant. The electronic expansion valve and/or LLS will then open. Otherwise, the EXV and/or LLS will be opened when the compressor starts.

The electronic expansion valve will open gradually to provide a controlled start-up to prevent liquid flood-back to the compressor. Also during this period, the low oil pressure switch will be bypassed for one minute.

As additional stages of compression are required, the control will add compressors and unloaders as shown in Table 9.

If a circuit is to be stopped, the control will first start to close the electronic expansion valve and/or close LLS. The compressor will continue to run for 10 seconds to purge the cooler of any liquid refrigerant.

Electronic Expansion Valve — The microprocessor controls the electronic expansion valve directly. Inside the expansion valve is a linear actuator stepper motor. To control the stepper motor's position, the thermistor in the cooler and the thermistor in the lead compressor in each circuit are used to maintain a 20 F (11 C) difference. Because the compressor sensor is after the compressor motor, which adds approximately 15 F (8.3 C) superheat, the 20 F (11 C) control temperature results in 0° to 5 F (2.8 C) superheat leaving the cooler. This improves the performance of the cooler.

At initial start-up the valve position is initialized to 0. After that, the microprocessor keeps accurate track of the valve position in order to use it for the other control functions in the unit.

The actual control logic is very complex but basically it monitors the superheat and the rate of change of superheat to control the position of the valve. The valve stroke is very large which results in very accurate control of the superheat.

The electronic expansion valve is also used to limit the maximum saturated suction temperature to 55 F (12.8 C) to keep from overloading the compressor during high cooler water temperatures. This allows the unit to start with very warm water temperatures.

Head Pressure Control

FLOTRO™ 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 fan stage, the control 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 as sensed by T3 or T4 is between 50 F and 70 F (10 C 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 Table 8

UNITS WITH TXV (FIOP) — The logic to cycle microprocessor-controlled fans is based on saturated condensing temperature only, sensed by thermistors T3 and T4 (see Fig. 6 and 7). When either T3 or T4 is greater and 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 or T4 is greater than 125 F (51.6 C), in which case all microprocessor-controlled fans start immediately.

Table 9 — Capacity Control Steps

UNIT 30GB	CONTROL STEPS	% DISPLACEMENT (Approx)	LOADING SEQUENCE A				LOADING SEQUENCE B			
			Operating				Operating			
			No. of Compr	No. of Cyl	Compressor No.		No. of Compr	No. of Cyl	Compressor No.	
					Circuit 1	Circuit 2			Circuit 1	Circuit 2
040 Standard (One Unloader)	1	25.0	1	2	1*	—	—	—	—	—
	2	50.0	1	4	1	—	—	—	—	—
	3	75.0	2	6	1*	2	—	—	—	—
	4	100.0	2	8	1	2	—	—	—	—
040 Accessory Unloader Added to Compressor No. 2	1	25.0	1	2	1*	—	1	2	—	2*
	2	50.0	2	4	1*	2*	2	4	1*	2*
	3	75.0	2	6	1*	2	2	6	1	2*
	4	100.0	2	8	1	2	2	8	1	2
045,046 Standard (One Unloader)	1	20.0	1	2	1*	—	—	—	—	—
	2	40.0	1	4	1	—	—	—	—	—
	3	80.0	2	8	1*	2	—	—	—	—
	4	100.0	2	10	1	2	—	—	—	—
045,046 Accessory Unloader Added to Compressor No. 2	1	A 20.0 B 40.0	1	2	1*	—	1	4	—	2*
	2	60.0	2	6	1*	2*	2	6	1*	2*
	3	80.0	2	8	1*	2	2	8	1	2*
	4	100.0	2	10	1	2	2	10	1	2
050,055,060 Standard (One Unloader)	1	33.3	1	4	1*	—	—	—	—	—
	2	50.0	1	6	1	—	—	—	—	—
	3	83.3	2	10	1*	2	—	—	—	—
	4	100.0	2	12	1	2	—	—	—	—
050,055,060 Accessory Unloader Added to Compressor No. 2	1	33.3	1	4	1*	—	1	4	—	2*
	2	66.7	2	8	1*	2*	2	8	1*	2*
	3	83.3	2	10	1*	2	2	10	1	2*
	4	100.0	2	12	1	2	2	12	1	2
60 Hz 070 Standard (One Unloader)	1	25.0	1	4	1*	—	—	—	—	—
	2	37.5	1	6	1	—	—	—	—	—
	3	62.5	2	10	1*	3	—	—	—	—
	4	75.0	2	12	1	3	—	—	—	—
	5	87.5	3	14	1*,2	3	—	—	—	—
	6	100.0	3	16	1,2	3	—	—	—	—
60 Hz 070 Accessory Unloader Added to Compressor No. 3	1	25.0	1	4	1*	—	1	4	—	3*
	2	50.0	2	8	1*	3*	2	8	1*	3*
	3	62.5	2	10	1*	3	2	10	1	3*
	4	75.0	2	12	1	3	2	12	1	3
	5	87.5	3	14	1*,2	3	3	14	1*,2	3
	6	100.0	3	16	1,2	3	3	16	1,2	3
50 Hz 070 Standard (One Unloader)	1	22.2	1	4	1*	—	—	—	—	—
	2	33.3	1	6	1	—	—	—	—	—
	3	55.6	2	10	1*	3	—	—	—	—
	4	66.7	2	12	1	3	—	—	—	—
	5	88.9	3	16	1*,2	3	—	—	—	—
	6	100.0	3	18	1,2	3	—	—	—	—
50 Hz 070 Accessory Unloader Added to Compressor No. 3	1	22.2	1	4	1*	—	1	4	—	3*
	2	44.4	2	8	1*	3*	2	8	1*	3*
	3	55.6	2	10	1*	3	2	10	1	3*
	4	66.7	2	12	1	3	2	12	1	3
	5	88.9	3	16	1*,2	3	3	16	1*,2	3
	6	100.0	3	18	1,2	3	3	18	1,2	3

*Compressor unloaded

NOTE Accessory unloaders cannot be added to 30GB175 and 200 units

Table 9 — Capacity Control Steps (cont)

UNIT 30GB	CONTROL STEPS	% DISPLACEMENT (Approx)	LOADING SEQUENCE A				LOADING SEQUENCE B			
			Operating				Operating			
			No. of Compr	No. of Cyl	Compressor No		No. of Compr	No. of Cyl	Compressor No	
					Circuit 1	Circuit 2			Circuit 1	Circuit 2
075,080 Standard	1	22	1	4	1*	—	—	—	—	—
	2	33	1	6	1	—	—	—	—	—
	3	56	2	10	1*	3	—	—	—	—
	4	67	2	12	1	3	—	—	—	—
	5	89	3	16	1*,2	3	—	—	—	—
	6	100	3	18	1,2	3	—	—	—	—
075,080 Accessory Unloader Added to Compressor No. 3	1	22	1	4	1*	—	1	4	—	3*
	2	44	2	8	1*	3*	2	8	1*	3*
	3	56	2	10	1*	3	2	10	1	3*
	4	67	2	12	1	3	2	12	1	3
	5	89	3	16	1*,2	3	3	16	1*,2	3
	6	100	3	18	1,2	3	3	18	1,2	3
090,100 Standard	1	25	1	6	1	—	1	6	—	3
	2	50	2	12	1	3	2	12	1	3
	3	75	3	18	1,2	3	3	18	1	3,4
	4	100	4	24	1,2	3,4	4	24	1,2	3,4
090,100 Accessory Unloader Added to Compressor No. 1	1	17	1	4	1*	—	—	—	—	—
	2	25	1	6	1	—	—	—	—	—
	3	42	2	10	1*	3	—	—	—	—
	4	50	2	12	1	3	—	—	—	—
	5	67	3	16	1*,2	3	—	—	—	—
	6	75	3	18	1,2	3	—	—	—	—
	7	92	4	22	1*,2	3,4	—	—	—	—
	8	100	4	24	1,2	3,4	—	—	—	—
090,100 Accessory Unloaders Added to Compr No. 1 & 3	1	17	1	4	1*	—	1	4	—	3*
	2	33	2	8	1*	3*	2	8	1*	3*
	3	42	2	10	1*	3	2	10	1	3*
	4	50	2	12	1	3	2	12	1	3
	5	67	3	16	1*,2	3	3	16	1	3*,4
	6	75	3	18	1,2	3	3	18	1	3,4
	7	92	4	22	1*,2	3,4	4	22	1,2	3*,4
	8	100	4	24	1,2	3,4	4	24	1,2	3,4
110,125 Standard	1	20	1	6	1	—	1	6	—	4
	2	40	2	12	1	4	2	12	1	4
	3	60	3	18	1,2	4	3	18	1	4,5
	4	80	4	24	1,2	4,5	4	24	1,2	4,5
	5	100	5	30	1,2,3	4,5	5	30	1,2,3	4,5
110,125 Accessory Unloader Added to Compr No. 1	1	13	1	4	1*	—	—	—	—	—
	2	20	1	6	1	—	—	—	—	—
	3	33	2	10	1*	4	—	—	—	—
	4	40	2	12	1	4	—	—	—	—
	5	53	3	16	1*,2	4	—	—	—	—
	6	60	3	18	1,2	4	—	—	—	—
	7	73	4	22	1*,2	4,5	—	—	—	—
	8	80	4	24	1,2	4,5	—	—	—	—
	9	93	5	28	1*,2,3	4,5	—	—	—	—
	10	100	5	30	1,2,3	4,5	—	—	—	—
110,125 Accessory Unloaders Added to Compr No. 1 & 4	1	13	1	4	1*	—	1	4	—	4*
	2	27	2	8	1*	4*	2	8	1*	4*
	3	33	2	10	1*	4	2	10	1	4*
	4	40	2	12	1	4	2	12	1	4
	5	53	3	16	1*,2	4	3	16	1	4*,5
	6	60	3	18	1,2	4	3	18	1	4,5
	7	73	4	22	1*,2	4,5	4	22	1,2	4*,5
	8	80	4	24	1,2	4,5	4	24	1,2	4,5
	9	93	5	28	1*,2,3	4,5	5	28	1,2,3	4*,5
	10	100	5	30	1,2,3	4,5	5	30	1,2,3	4,5

*Compressor unloaded

NOTE: Accessory unloaders cannot be added to 30GB175 and 200 or 30GT225-280 units

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 F and 70 F (10 C 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 Table 8.

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.

Table 9 — Capacity Control Steps (cont)

UNIT 30GB	CONTROL STEPS	% DISPLACEMENT (Approx)	LOADING SEQUENCE A				LOADING SEQUENCE B			
			Operating				Operating			
			No. of Compr	No. of Cyl	Compressor No.		No. of Compr	No. of Cyl	Compressor No.	
					Circuit 1	Circuit 2			Circuit 1	Circuit 2
150 Standard	1	17	1	6	1	—	1	6	—	4
	2	33	2	12	1	4	2	12	1	4
	3	50	3	18	1,2	4	3	18	1	4,5
	4	67	4	24	1,2	4,5	4	24	1,2	4,5
	5	83	5	30	1,2,3	4,5	5	30	1,2	4,5,6
	6	100	6	36	1,2,3	4,5,6	6	36	1,2,3	4,5,6
150 Accessory Unloader Added to Compr No. 1	1	11	1	4	1*	—	—	—	—	—
	2	17	1	6	1	—	—	—	—	—
	3	28	2	10	1*	4	—	—	—	—
	4	33	2	12	1	4	—	—	—	—
	5	44	3	16	1*,2	4	—	—	—	—
	6	50	3	18	1,2	4	—	—	—	—
	7	61	4	22	1*,2	4,5	—	—	—	—
	8	67	4	24	1,2	4,5	—	—	—	—
	9	78	5	28	1*,2,3	4,5	—	—	—	—
	10	83	5	30	1,2,3	4,5	—	—	—	—
	11	94	6	34	1*,2,3	4,5,6	—	—	—	—
	12	100	6	36	1,2,3	4,5,6	—	—	—	—
150 Accessory Unloaders Added to Compr No. 1 & 4	1	11	1	4	1*	—	1	4	—	4*
	2	22	2	8	1*	4*	2	8	1*	4*
	3	28	2	10	1*	4	2	10	1	4*
	4	33	2	12	1	4	2	12	1	4
	5	44	3	16	1*,2	4	3	16	1	4*,5
	6	50	3	18	1,2	4	3	18	1	4,5
	7	61	4	22	1*,2	4,5	4	22	1,2	4*,5
	8	67	4	24	1,2	4,5	4	24	1,2	4,5
	9	78	5	28	1*,2,3	4,5	5	28	1,2	4*,5,6
	10	83	5	30	1,2,3	4,5	5	30	1,2	4,5,6
	11	94	6	34	1*,2,3	4,5,6	6	34	1,2,3	4*,5,6
	12	100	6	36	1,2,3	4,5,6	6	36	1,2,3	4,5,6
175 Standard	1	14	1	6	1	—	1	6	—	5
	2	29	2	12	1	5	2	12	1	5
	3	43	3	18	1,2	5	3	18	1	5,6
	4	57	4	24	1,2	5,6	4	24	1,2	5,6
	5	71	5	30	1,2,3	5,6	5	30	1,2	5,6,7
	6	86	6	36	1,2,3	5,6,7	6	36	1,2,3	5,6,7
	7	100	7	42	1,2,3,4	5,6,7	7	42	1,2,3,4	5,6,7
200 Standard	1	13	1	6	1	—	1	6	—	5
	2	25	2	12	1	5	2	12	1	5
	3	38	3	18	1,2	5	3	18	1	5,6
	4	50	4	24	1,2	5,6	4	24	1,2	5,6
	5	63	5	30	1,2,3	5,6	5	30	1,2	5,6,7
	6	75	6	36	1,2,3	5,6,7	6	36	1,2,3	5,6,7
	7	88	7	42	1,2,3,4	5,6,7	7	42	1,2,3	5,6,7,8
	8	100	8	48	1,2,3,4	5,6,7,8	8	48	1,2,3,4	5,6,7,8

*Compressor unloaded

NOTE: Accessory unloaders cannot be added to 30GB175 and 200 or 30GT225-280 units

To use the return reset, the accessory reset board must be added to the unit. Refer to the accessory installation section for installation details. Also, dip switch 1 (reset mode select) and dip switch 2 (reset select) should be in the ON position (see Fig. 1).

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 from 0 to 100% the entering cooler water will change in proportion to the load as shown in Fig. 15. 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.

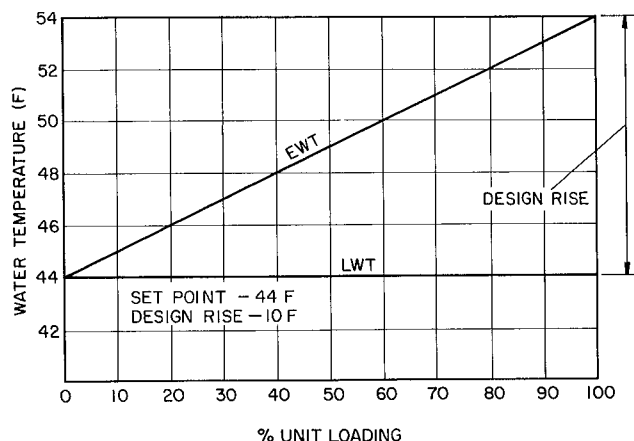


Fig. 15 — Standard Chilled Water Temperature Control — No Reset

Table 9 — Capacity Control Steps (cont)

UNIT 30GT	CONTROL STEPS	% DISPLACEMENT (Approx)	LOADING SEQUENCE A				LOADING SEQUENCE B			
			Operating				Operating			
			No. of Compr	No. of Cyl	Compressor No.		No. of Compr	No. of Cyl	Compressor No.	
					Circuit A	Circuit B			Circuit A	Circuit B
225 (60 Hz)	1	12	1	6	A1	—	1	6	—	B1
	2	23	2	12	A1	B1	2	12	A1	B1
	3	35	3	18	A1,A2	B1	3	18	A1	B1,B2
	4	46	4	24	A1,A2	B1,B2	4	24	A1,A2	B1,B2
	5	58	5	30	A1,A2,A3	B1,B2	5	30	A1,A2	B1,B2,B3
	6	69	6	36	A1,A2,A3	B1,B2,B3	6	36	A1,A2,A3	B1,B2,B3
	7	85	7	42	A1,A2,A3,A4	B1,B2,B3	7	42	A1,A2,A3	B1,B2,B3,B4
	8	100	8	48	A1,A2,A3,A4	B1,B2,B3,B4	8	48	A1,A2,A3,A4	B1,B2,B3,B4
250 (60 Hz)	1	11	1	6	A1	—	1	6	—	B1
	2	22	2	12	A1	B1	2	12	A1	B1
	3	32	3	18	A1,A2	B1	3	18	A1	B1,B2
	4	43	4	24	A1,A2	B1,B2	4	24	A1,A2	B1,B2
	5	57	5	30	A1,A2,A3	B1,B2	5	30	A1,A2	B1,B2,B3
	6	72	6	36	A1,A2,A3	B1,B2,B3	6	36	A1,A2,A3	B1,B2,B3
	7	86	7	42	A1,A2,A3,A4	B1,B2,B3	7	42	A1,A2,A3	B1,B2,B3,B4
	8	100	8	48	A1,A2,A3,A4	B1,B2,B3,B4	8	48	A1,A2,A3,A4	B1,B2,B3,B4
225 (50 Hz)	1	10 (A), 13 (B)	1	6	A1	—	1	6	—	B1
	2	23	2	12	A1	B1	2	12	A1	B1
	3	36	3	18	A1,A2	B1	3	18	A1	B1,B2
	4	48	4	24	A1,A2	B1,B2	4	24	A1,A2	B1,B2
	5	61	5	30	A1,A2,A3	B1,B2	5	30	A1,A2	B1,B2,B3
	6	74	6	36	A1,A2,A3	B1,B2,B3	6	36	A1,A2,A3	B1,B2,B3
	7	87	7	42	A1,A2,A3,A4	B1,B2,B3	7	42	A1,A2,A3	B1,B2,B3,B4
	8	100	8	48	A1,A2,A3,A4	B1,B2,B3,B4	8	48	A1,A2,A3,A4	B1,B2,B3,B4
250 (50 Hz) and 280 (60 Hz)	1	13	1	6	A1	—	1	6	—	B1
	2	25	2	12	A1	B1	2	12	A1	B1
	3	38	3	18	A1,A2	B1	3	18	A1	B1,B2
	4	50	4	24	A1,A2	B1,B2	4	24	A1,A2	B1,B2
	5	63	5	30	A1,A2,A3	B1,B2	5	30	A1,A2	B1,B2,B3
	6	75	6	36	A1,A2,A3	B1,B2,B3	6	36	A1,A2,A3	B1,B2,B3
	7	88	7	42	A1,A2,A3,A4	B1,B2,B3	7	42	A1,A2,A3	B1,B2,B3,B4
	8	100	8	48	A1,A2,A3,A4	B1,B2,B3,B4	8	48	A1,A2,A3,A4	B1,B2,B3,B4

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

CODE	DESCRIPTION	LOCATION	RANGE
P1	Chilled Water Set Point	Display Board	40 to 70 F (4.4 to 21 C) 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 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

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

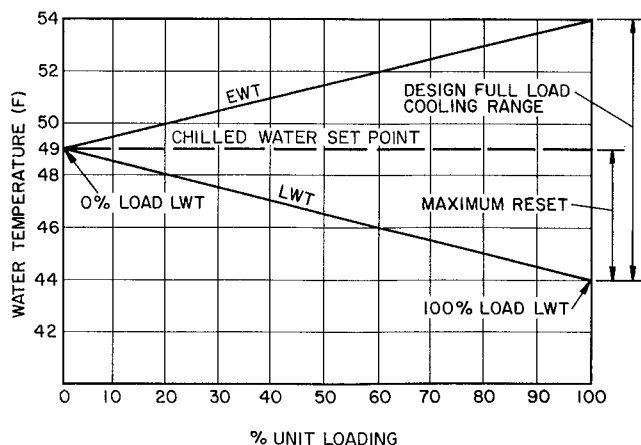
The 100% load LWT point should be determined as if the LWT was not being limited by the reset limit potentiometer.

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

Water Chillers — 40 F to 70 F
Brine Chillers — 15 F to 70 F

The following examples will explain several reset profiles:

EXAMPLE 1



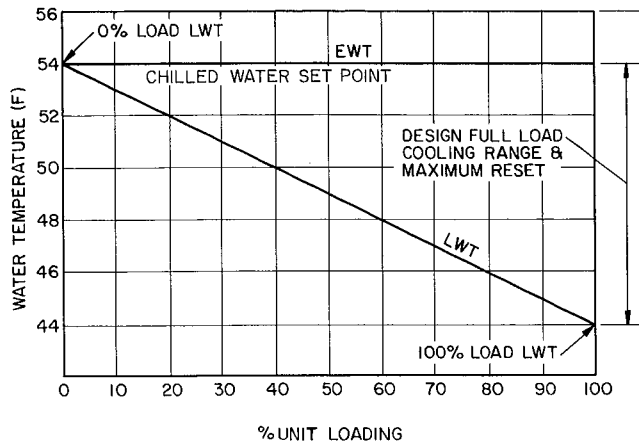
- The Chilled Water Set Point Potentiometer (P1)
= 0% Load LWT = 49 F
- The Reset Limit Potentiometer (P3)
= Maximum Reset = 5 F
- Reset Ratio Potentiometer (P5) = X%

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



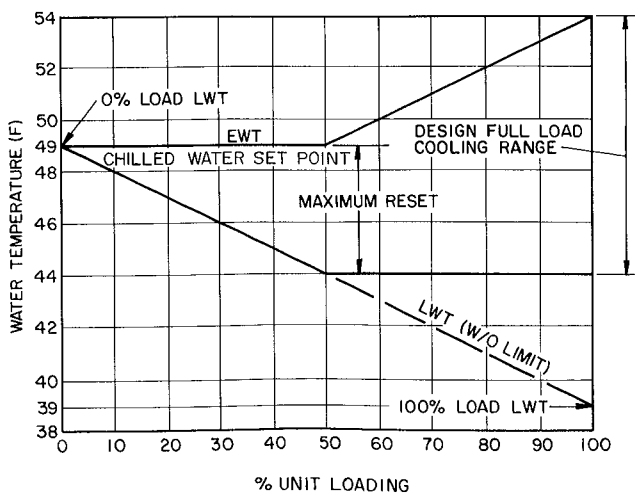
- The Chilled Water Set Point Potentiometer (P1)
= 0% LWT = 54 F
- The Reset Limit Potentiometer (P3)
= Maximum Reset = 10 F
- Reset Ratio Potentiometer (P5) = X%

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 Outside Air Temperature Reset —
Space temperature reset and outside air temperature reset allows for the reset of the leaving water temperature based on an external temperature sensor.

The accessory board must be installed to use this option. Refer to the accessory installation section for installation details. Also, dip switch 1 (reset mode select) should be off and dip switch 2 (reset select) should be on (see Fig. 1).

Under normal operation the chiller will maintain a constant leaving water temperature approximately equal to the chilled water temperature set point 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 outside air or an internal building temperature.

The external temperature is sensed through the accessory reset sensor.

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

CODE	DESCRIPTION	LOCATION	RANGE
P1	Chilled Water Set Point	Display Board	40 to 70 F (4.4 to 21 C) 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	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 the full load design leaving water temperature.

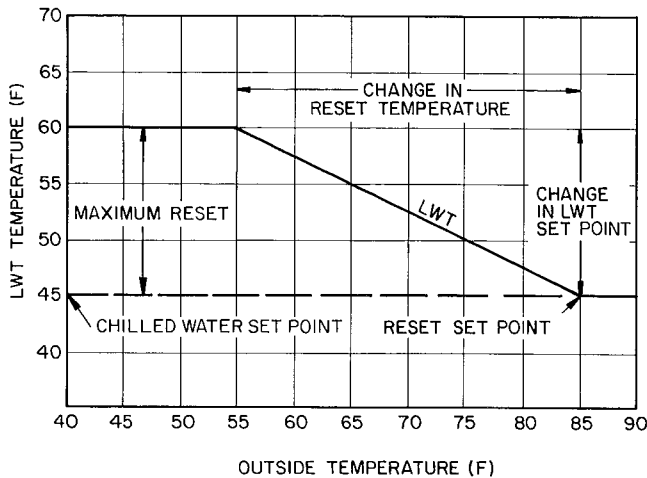
P3, RESET LIMIT POTENTIOMETER — This potentiometer should be set at the maximum desired amount of leaving water reset. As the reset temperature sensor drops in temperature below its set point, the chilled water set point is reset higher until the maximum reset (reset limit) is reached

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:

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

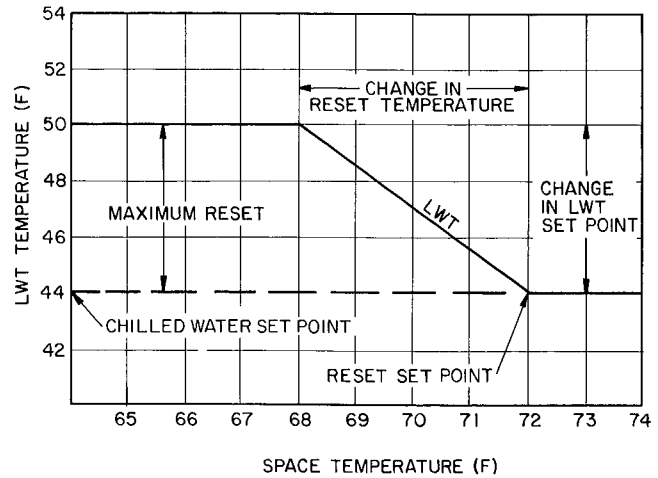
P6, RESET SET POINT — This potentiometer should be set at the temperature measured by the accessory reset sensor below which temperature reset will occur.

The following is an example of outside 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 50% to 0% of capacity. The capacity steps are controlled by an external, field-supplied switch. For additional information, refer to the separate Accessory Demand Limit Control Module Instructions.

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 pull 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 is on. If the capacity is being limited by pulldown, the control will display **24** when the display button is pressed.

ACCESSORIES AND OPTIONAL CONTROL 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 Fig. 1).

The switch is in the ON position when the unit is shipped. The switch position can only be changed when the unit is off. To change the switch setting, remove the sheet metal heater cover over the processor board. Locate the dip switch assembly and remove the plastic cover over the switches. Quick Test can be used to verify the switch setting.

⚠ WARNING

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

After the switch has been set, replace the plastic cover and the metal heater cover over the processor board.

Start the unit and make sure it functions properly.

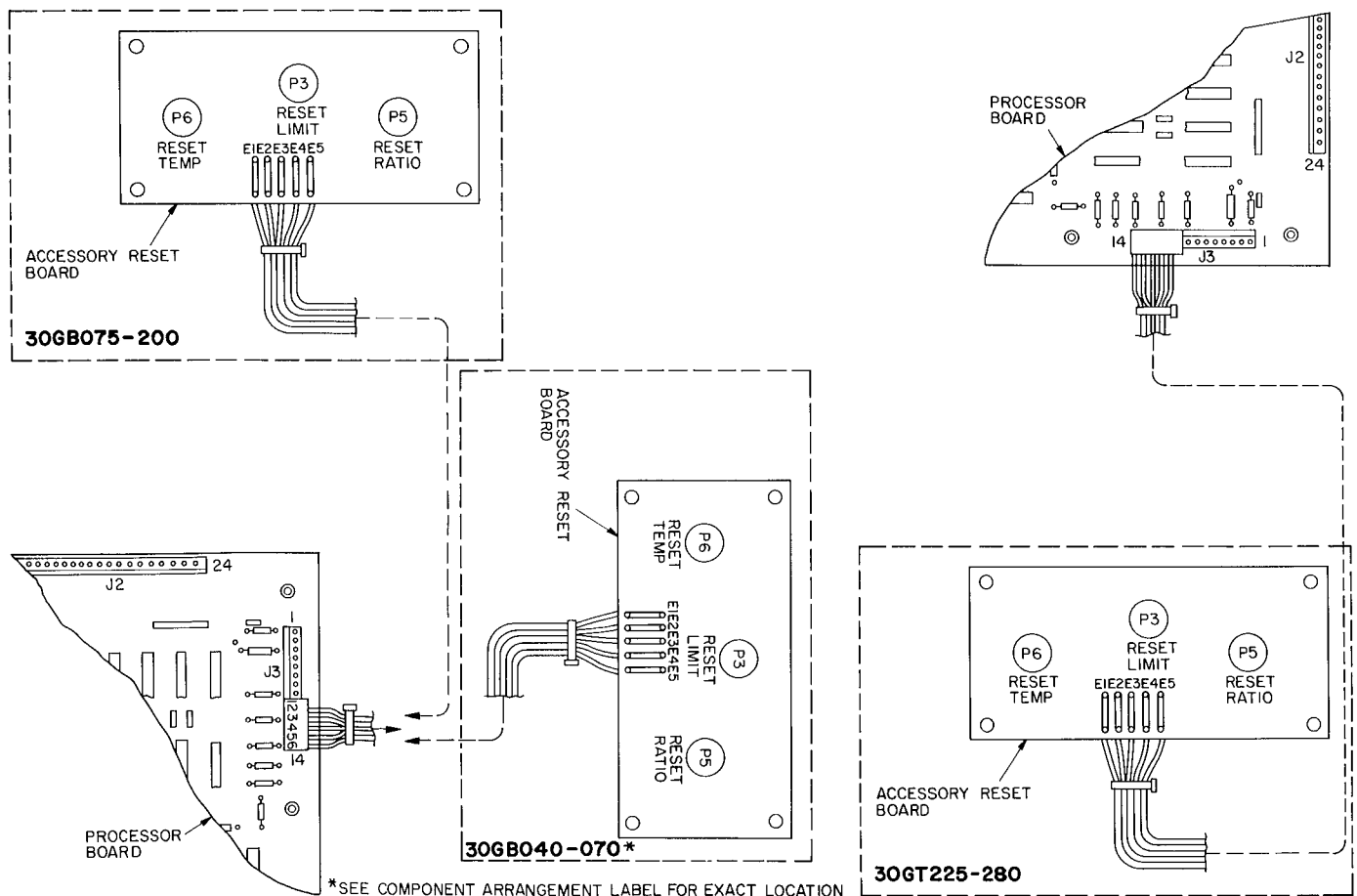
Return Temperature Reset Option — If return temperature reset is to be used, follow the procedure outlined below.

1. Turn off all power to the chiller.
2. Open the control box doors and remove the sheet metal cover over the processor board (see Fig. 1 and 2).

3. Remove the accessory board (Carrier Part No. 32GB500254) from its packaging and install it in the unit. The board should be mounted on the panel adjacent to J3 on the processor board as shown in Fig. 16, using the 4 predrilled holes provided. Use 4 pan head Phillips drive #8B-18 x 3/4-in. long screws. Exercise care in installing the screws to avoid damaging the board.

(The exact location of the board varies slightly depending on the chiller model as shown in Fig. 16.) *The board is not designed for remote mounting.*

4. The board is equipped with a 15-in. (381-mm) long wire harness and connector. Route the wires down along the side of the processor board and connect to the connector J3 on the processor board as shown in Fig. 16.
5. Remove the cover from the dip switch assembly and set dip switches 1 and 2 to the ON position.
6. Determine the settings of the reset ratio, reset limit and cold set point potentiometer as defined in the Return Reset Operating Instructions (page 22).
7. Use the Quick Test to verify that dip switches 1 and 2 are set properly and that the cold set point, reset ratio and reset limit potentiometers are working properly.
8. Replace the plastic cover over the dip switches and reinstall the sheet metal cover over the board.
9. Close the control box covers and start the unit to confirm that the unit operates properly.



NOTE Connector and 15-in. wire are preinstalled on the accessory board. Connect to terminal strip J3 on the processor board. Terminals 9 through 14 should be used on the processor board. Location 9 does not have a pin and is used for polarization.

Fig. 16 — Accessory Reset Board Location and Wiring

Space and Outside Air Temperature Reset Option — If space and outside air reset is to be used, follow the procedure outlined below:

1. Turn off all power to the chiller.
2. Open the control box doors and remove the sheet metal cover over the processor board (see Fig 1 and 2).
3. Remove the accessory board (Carrier Part No 32GB500254) from its packaging and install it in the unit. The board should be mounted on the panel adjacent to J3 on the processor board as shown in Fig 16, using the 4 predrilled holes provided. Use 4 pan head Phillips drive #8B-18 x 3/4-in. long screws. Exercise care in installing the screws to avoid damaging the board.

(The exact location of the board varies slightly, depending on the chiller model as shown in Fig 16.)
The board is not designed for remote mounting.

4. The board is equipped with a 15-in (381-mm) long wire harness and connector. Route the wires down along the side of the processor board and connect to the connector J3 on the processor board as shown in Fig. 16.
5. Remove the cover from the dip switch assembly and set dip switch 1 to the OFF position and 2 to the ON position
6. To use space temperature reset or outside air reset, an additional thermistor must be installed. Carrier Part No. HH79NZ014 should be used for this purpose (see Fig. 17), it is included in Service Parts package no. 30GB660002. The thermistor should be connected to the terminal block as shown in Fig. 18. To avoid electrical interference DO NOT run the thermistor wire near line voltage wiring, electrical machinery, large contactors or other devices. Wire lengths up to 1000 ft (304 m) may be used with 22-gage wire.

The accessory thermistor is equipped with 30 ft (9.1 m) of 22-gage twisted-pair cable. If additional length is required, use twisted-pair wire with a minimum of one twist per inch. The additional wire

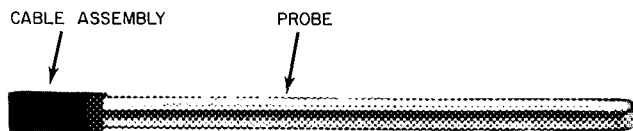


Fig. 17 — Reset Thermistor

should be spliced onto the end of the 30-ft (9.1-m) wire. All connections should be soldered.

When outside air reset is used, the thermistor should be mounted in a location that is shielded from the sun.

When using space reset, the thermistor should be mounted in an area within the space where it will sense freely circulating air.

7. Determine the settings of the reset ratio, reset limit, reset set point and cold set point as defined in the Space and Outside Air Reset Operating Instructions.
8. Use the Quick Test to verify that dip switches 1 and 2 are set properly and that the cold set point, reset ratio, reset limit, and reset set point are set properly.
9. Replace the plastic cover over the dip switches and reinstall the sheet metal cover over the board.
10. Close the control box covers and start the unit to make sure it operates properly.

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 19.

NOTE. Units produced prior to April 1987 (S/N Q7-----) require software (EPROM) change in order to use remote ON-OFF function

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

On units 30GB040-070, an orange jumper connects terminals 4 and 5 on terminal board TB2.

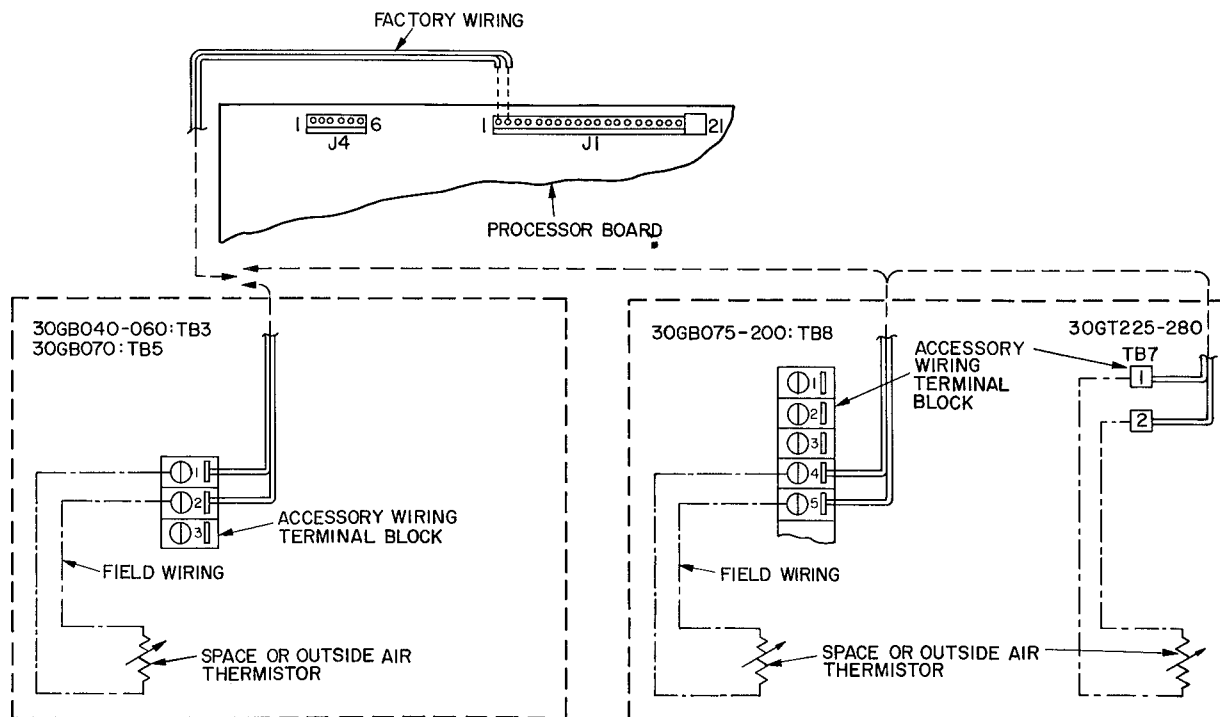


Fig. 18 — Space/Outside Air Thermistor Wiring Diagram

On units 30GB075-200, an orange jumper connects terminals 5 and 6 on terminal board TB3.

On units 30GT225-280, an orange jumper connects terminals 7 and 8 on terminal board TB7.

Remove the jumper and install remote interlock contacts across terminals. Several devices can be connected in series.

⚠ 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 depending on unit. The relay is located on the relay board. The same relay is used to energize the alarm light.

To install a remote alarm light or other device, it can be connected to TB3 terminals **7** and **10** on 30GB075-200 units or TB2 terminals **2** and **7** on 30GB040-070 units or TB5 terminals **1** and **2** on 30GT225-280 (see Fig. 20). A resistor is installed across these same terminals to provide a minimum current draw through the contacts of the relay board. When an external alarm is not installed, remove this resistor. The maximum load that the relay can handle is 75 va sealed, 360 va inrush at 115 and 230 volts.

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.

Accessory Unloaders — Units 30GB090, 100, 110, 125, 150, 175 and 200 do not have unloaders as standard. Units 30GB040 through 080 have one unloader as standard. It is possible to add one additional unloader to units 30GB040 through 080 and one or 2 unloaders 59 units 30GB090, 100, 110, 125 and 150. Unloaders cannot be used on 30GB175 and 200 or 30GT225-280 units.

If unloaders are desired, an accessory unloader package should be used. This package includes a suction cutoff unloader head package. In addition, a 24-volt unloader coil should be ordered. The 115-volt coil in the

unloader package will not be used. Consult Carrier price pages for appropriate part numbers.

The first unloader must always be connected to the lead compressor in circuit 1 and second unloader must be connected to the lead compressor in circuit 2.

Use the following procedure to install the unloaders:

1. The microprocessor will have to be reprogrammed to account for the additional unloaders. Remove the heater cover over the microprocessor board. Remove the plastic cover over the DIP switches and adjust DIP switches 6 and 7 as follows.

NO. OF UNLOADERS	DIP SWITCH 6	DIP SWITCH 7
0	OFF	OFF
1	ON	OFF
2	OFF	ON

If both switch 6 and 7 are ON or if the unit has 7 or 8 compressors, a **70** will be displayed (illegal unit configuration).

The loading sequences are listed in Table 9.

2. Use the Quick Test to check the settings of the dip switches.
3. Replace the plastic cover over the dip switches and reinstall the sheet metal cover.
4. Valve off all the compressors in the circuit and blow the charge in that circuit. Install the unloader head using standard 06E compressor service procedures.
5. Evacuate the compressor and bleed refrigerant into the compressor. Check for leaks.
6. To simplify installation, the unit has been prewired at the factory. Two wires have been run to the lead compressor junction box. In circuit 1, connect the unloader coil to the pink wires in the junction box of the lead compressor. In circuit 2, connect the second unloader (if used) to the grey wires in the junction box of the lead compressor.
7. Before starting the unit, check the operation of the unit and the unloaders using the Quick Test procedure.
8. Start the unit and confirm that the unit operates properly.

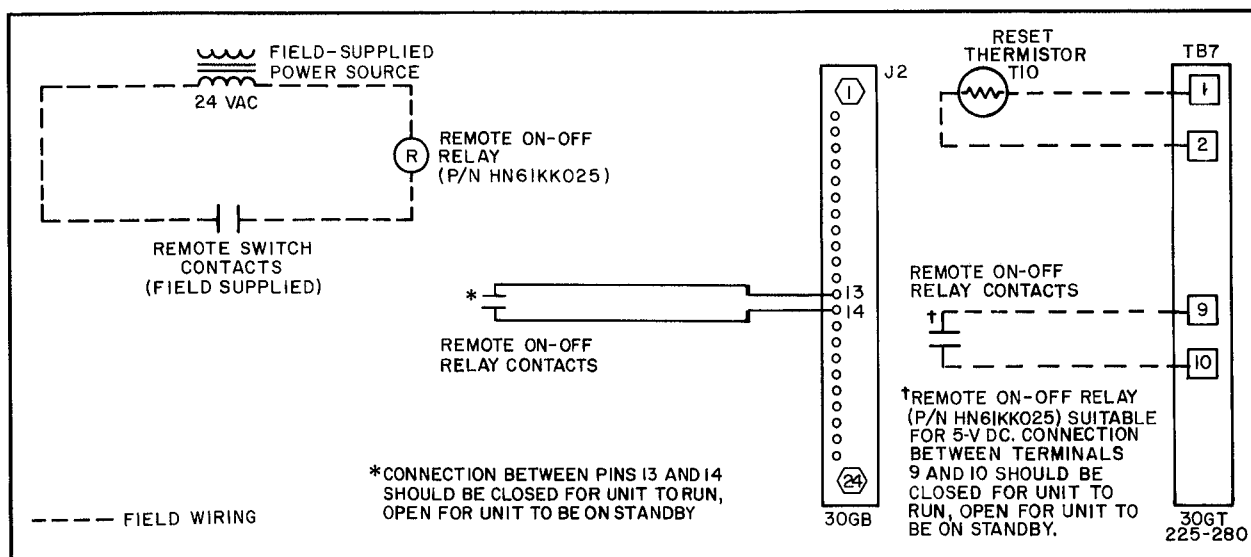
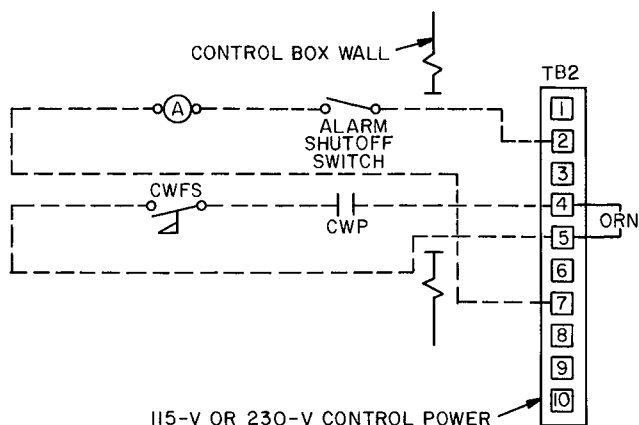


Fig. 19 — Remote On/Off Wiring



A — Alarm
 CWFS — Chilled Water Flow Switch
 CWP — Chilled Water Pump Starter Auxiliary Contacts
 CWPI — Chilled Water Pump Interlock
 TB — Terminal Block

NOTE Remove ORN jumper between terminals 5 and 6 on TB3 (30GB075-200) or 4 and 5 on TB2 (30GB040-070) or 7 and 8 on TB7 (30GT225-280) when installing interlocks

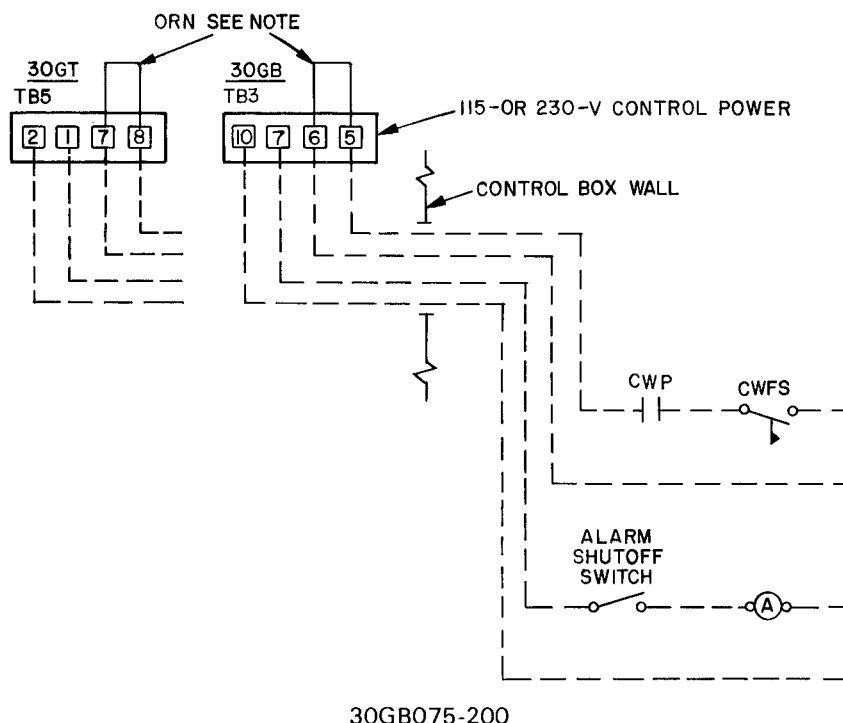


Fig. 20 — Field Wiring; Remote Interlocks and Alarm

CONTROL TROUBLESHOOTING AND SERVICING

General — The electronic controls used in this unit contain extensive diagnostic capabilities. The 2-digit display on the display board (see Fig. 1 and 2) 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.

⚠ 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.

Overload Codes — The following is a detailed description of each diagnostic error and the possible cause:

CODES 51-58, COMPRESSOR FAILURE — If the CPCS board or control relay feedback switch opens during operation of a compressor, the microprocessor will detect this and will stop the compressor, energize the alarm light, and display a code of **51** to **58**, depending on the compressor. The compressor will be locked off; to reset, the ON-OFF circuit breaker must be turned OFF and then ON again.

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

Table 10 — Overload Codes

DISPLAY	DESCRIPTION OF FAILURE							ACTION TAKEN BY CONTROL	RESET METHOD	PROBABLE CAUSE
	30GB						30GT			
		040 to 060	070	075 to 100	110 to 150	175, 200	225 to 280			
51	Compr	1	1	1	1	1	A1 Failure	Circuit 1 or A Shut Off	Manual	High-Pressure Switch Trip, or High Discharge Gas Temperature Switch, Trip, or Compressor Ground Current > 2.5 Amp or Compr Board Relay on when it is not supposed to be on Wiring Error between Electronic Control and Compressor Protection Module.
52	Compr	—	2	2	2	2	A2 Failure	Compr Shut Off	Manual	
53	Compr	—	—	—	3	3	A3 Failure	Compr Shut Off	Manual	
54	Compr	—	—	—	—	4	A4 Failure	Compr Shut Off	Manual	
55	Compr	2	3	3	4	5	B1 Failure	Circuit 2 or B Shut Off	Manual	
56	Compr	—	—	4	5	6	B2 Failure	Comp Shut Off	Manual	
57	Compr	—	—	—	6	7	B3 Failure	Compr Shut Off	Manual	
58	Compr	—	—	—	—	8	B4 Failure	Compr Shut Off	Manual	
59	Loss of Charge Circuit 1 or A							Circuit 1 or A Shut Off	Manual	Low Refrigerant Charge, or Low-Pressure Switch Failure
60	Loss of Charge Circuit 2 or B							Circuit 2 or B Shut Off	Manual	
61	Low Cooler Flow							Unit Shut Off	Manual	No Cooler Flow or Reversed Cooler Flow
63	Low Oil Pressure Circuit 1 or A							Circuit 1 or A Shut Off	Manual	Oil Pump Failure or Low Oil Level, or Switch Failure, or Compressor CB Tripped.
64	Low Oil Pressure Circuit 2 or B							Circuit 2 or B Shut Off	Manual	
65	Freeze Protection							Unit Shut Off	Auto.	Low Cooler Flow
66	High Suction Superheat Circuit 1 or A							Circuit 1 or A Shut Off	Manual	Low Charge, or Plugged Filter Drier, or EXV Failure, or Bad Thermistor
67	High Suction Superheat Circuit 2 or B							Circuit 2 or B Shut Off	Manual	
68	Low Suction Superheat Circuit 1 or A							Circuit 1 or A Shut Off	Manual	EXV Failure, or Bad Thermistor
69	Low Suction Superheat Circuit 2 or B							Circuit 2 or B Shut Off	Manual	
70	Illegal Unit Configuration							Unit Will Not Start	Manual	Configuration Error (See Note 3.)
71	Leaving Water Thermistor Failure							Unit Shut Off	Auto	Thermistor Failure, or Wiring Error, or Thermistor not connected to Processor Board
72	Entering Water Thermistor Failure							Use Default Value	Auto	
75	Saturated Cond Thermistor Failure Circuit 1 or A							Unit Shut Off	Auto	
76	Saturated Cond Thermistor Failure Circuit 2 or B							Unit Shut Off	Auto	
77	Cooler Thermistor Failure Circuit 1 or A							Unit Shut Off	Auto	
78	Cooler Thermistor Failure Circuit 2 or B							Unit Shut Off	Auto	
79	Compressor Thermistor Failure Circuit 1 or A							Unit Shut Off	Auto	
80	Compressor Thermistor Failure Circuit 2 or B							Unit Shut Off	Auto.	
81	Reset Temperature Failure							Stop Reset	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 Set Point Potentiometer Failure							Stop Reset	Auto	
85	Demand Limit Potentiometer Failure							Stop Demand Limit	Auto	
86	Reset Ratio Potentiometer Failure							Stop Reset	Auto	
87	Reset Set Point Potentiometer Failure							Stop Reset	Auto	
83	None							Unit Operates Normally	—	Wrong EPROM

NOTES:

- 1 In 30GT225-280 units Circuit 1 is Circuit A and Circuit 2 is Circuit B
- 2 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
- 3 Illegal unit configuration caused by missing programmable header or both unloader dip switches on
- 4 All AUTO reset failures that cause the unit to stop will restart the unit when the error has been corrected
- 5 All manual reset errors must be reset by turning the control circuit breaker off and on
- 6 Valid resistance range for thermistors is 362939 Ω to 216 65 Ω

If the lead compressor in a circuit is shut down, all the other compressors in the circuit will be stopped and locked off. Only the error code for the lead compressor will be displayed.

The microprocessor has also been programmed to indicate a compressor failure if the feedback switch is closed when the compressor is not supposed to be on.

If a failure does happen, the following are possible causes:

High-Pressure Switch Open — The high-pressure switch for each compressor is wired in series with the 24-volt power that energizes the compressor board. If the high-pressure switch opens during operation, the CPCS board or control relay will stop the compressor and this will be detected by the microprocessor through the feedback contacts.

Discharge Gas Thermostat — The discharge gas thermostat switch in each compressor is also wired in series with the 24-volt power that energizes the CPCS board or CR. If the switch opens during operation of the compressor, the compressor will be stopped and the failure will be detected through the feedback contacts.

Ground Current Failure — The compressor boards or CGF boards have logic to detect current-to-ground greater than 2.5 amps as measured through the current toroids around the 3 or 6 power leads to each compressor. The CPCS board then stops the compressor and the microprocessor detects this through the feedback contacts. On 30GT225-280 units, the CGF board shuts down all the compressors in the circuit having the fault, via the oil safety switch on the lead compressor.

CPCS Board or CR Failure — If the CPCS board or CR fails with the large relay either open or closed, the microprocessor will detect this and lock the compressor off and indicate an error.

Wiring Errors — If a wiring error exists such that the CPCS board, CR or feedback switch does not function properly, the microprocessor will indicate an error.

Relay Board Failure — If the small 24-volt relay on the relay board fails, the microprocessor will detect this through the feedback contacts and indicate an error

Processor Board Failure — If the hardware that monitors the feedback switch fails and the processor board fails to energize the relay board relay to ON, an error may be indicated.

NOTE. The control does not detect circuit breaker failures. If a circuit breaker trips on the lead compressor in a circuit, a low oil pressure failure will be indicated; on the other compressors, no failure will be indicated.

Checkout Procedure (Codes 51-58) — Shut off the main power to the unit. Turn on control power, then step through the Quick Test to the proper compressor number (e.g. Failure code 53 is Quick Test 3 7) Next, energize the step. If the step works correctly, then the failure code is due to:

HPS open,
DGT open,
ground fault circuit open, or
S1-S2 terminals closed on CPCS board when CPCS is not energized (30GB units only)

If a 0 is always displayed, follow the flow chart below. The circuit will only remain energized for 10 seconds, so you must step through the sequence after each step of the flow chart

CODE 59 AND 60, LOSS OF REFRIGERANT CHARGE — A loss-of-charge switch is connected to the high-pressure side of the refrigerant system. The microprocessor monitors this switch directly; if it opens, all the compressors in the circuit will be locked off, the alarm will be energized and the display code will be shown when the display button is pressed. To reset, the control circuit circuit breaker must be turned OFF then ON again. The following are some possible causes:

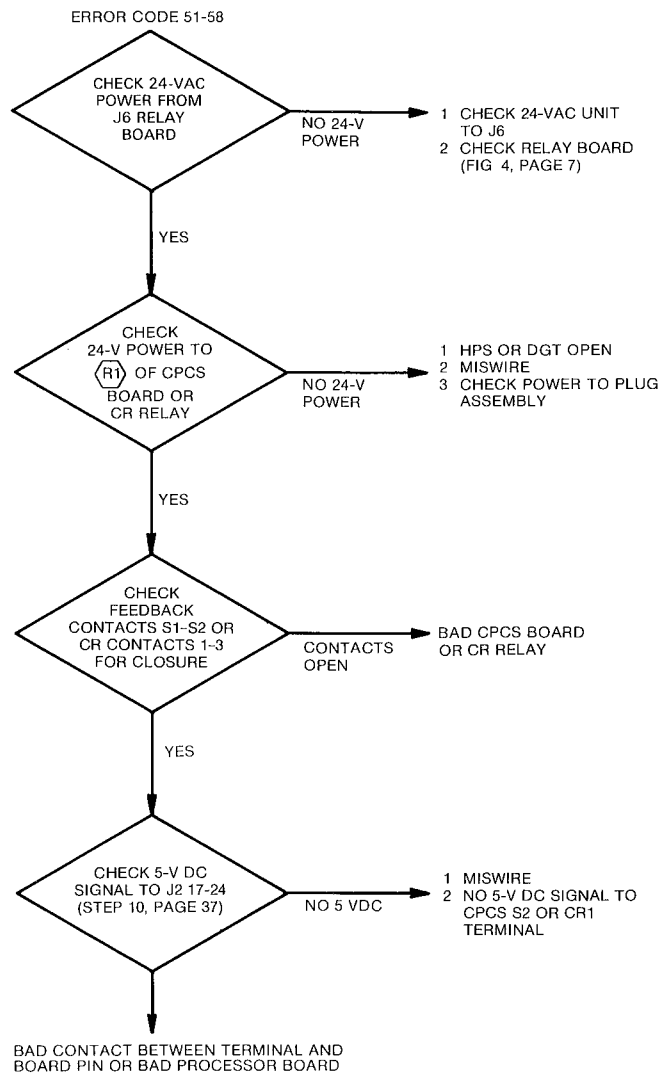
Low Refrigerant Charge — If the system refrigerant charge is very low, the microprocessor will detect this through the switch and indicate the error.

Switch Failure — If the switch fails to open, the microprocessor will detect this and indicate an error.

Wiring Error — If there is a wiring error that causes an open circuit, the microprocessor will treat this as an open switch and indicate an error.

Processor Board Failure — If the hardware on the processor board fails in a manner that the switch cannot be read properly, an error may be indicated.

CODE 61, NO COOLER FLOW — The microprocessor contains logic that protects the cooler against loss of cooler flow. The cooler entering and leaving water temperature sensors are used for this purpose. The leaving thermistor is located in the leaving water nozzle and the entering sensor is located in the first cooler baffle space in close proximity to the cooler tubes as shown in Fig 6, 9 and 10. When there is no cooler water flow and the compressors are operating, the leaving water temperature thermistor will indicate no temperature change. But the temperature of the entering water will drop rapidly and the entering water thermistor will detect this. When the entering water temperature drops to 5 F (2.8 C) below the leaving water temperature, all the compressors will



stop and code no. **61** will be displayed. The control circuit ON-OFF switch must be reset (turn to OFF then to ON again) to correct this error (after cooler water flow is resumed).

The error will be caused either by no cooler flow or if the water is flowing in the wrong direction through the cooler or if the thermistors are installed backwards.

CODE 63 AND 64, LOW OIL PRESSURE — A low oil pressure switch is installed on the lead compressor in each circuit. If the switch opens during operation of the compressor, all the compressors in the circuit will be shut off, the alarm light will be energized and the appropriate display code shown. The switch will be bypassed for one minute at all times during start-up and normal operation. The ON-OFF circuit breaker must be cycled to reset this safety.

Possible causes for the failure could be:

Loss of Oil Pressure — If the oil pressure is below 5 ± 1 psig (34.5 ± 6.9 kPa), the switch will open.

Switch Failure — If the switch fails open, a failure will be indicated.

Compressor is not running.

Wiring Error — If a wiring error exists that causes an open circuit, an error will occur.

Processor Board Failure — If the hardware on the processor board fails in a manner that the switch cannot be read properly, an error may be indicated.

CODE 65, COOLER FREEZE PROTECTION — If the leaving water temperature is below 35 F (1.7 C) for a water chiller or is 6 F (3.3 C) below the set point for brine applications, all compressors will be stopped. This safety will automatically reset when the water temperature is 6 F (3.3 C) above the set point.

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

CODE 66 AND 67, HIGH SUCTION SUPERHEAT — EXV Units only. The microprocessor contains the following logic and if it is satisfied, all the compressors in the circuit will be stopped:

Suction superheat is greater than 75 F (41.7 C), and saturated cooler suction is less than 55 F (12.8 C) and these 2 conditions have been true for more than 5 minutes.

To reset this, cycle the ON-OFF circuit breaker.

Causes for this failure could be:

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

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

EXV Failure — If the EXV fails to open enough to feed the proper amount of refrigerant, the error will occur.

Processor Board Failure — If the processor board hardware that controls the EXVs fails, the valve will not move.

Bad Thermistor — Thermistors mis-located or out of calibration.

CODE 68 AND 69, LOW SUCTION SUPERHEAT — EXV Units only: If the following logic is satisfied, then all the compressors on the circuit will be stopped.

Suction superheat is equal to 0°F (0°C) or the saturated suction is greater than 58 F (14.4 C) and either condition has been true for more than 5 minutes.

Possible causes for this failure are a stuck electronic expansion valve or thermistors mis-located or out of calibration.

CODE 70, ILLEGAL UNIT CONFIGURATION — If the unit configuration header is not installed or if the unloader dip switches are both on, the unit will not start and a code of **70** will be displayed.

CODE 71 TO 81, THERMISTOR FAILURE — If the measured temperature of a thermistor is less than -60 F (-51 C) (363,000 ohms) or greater than 240 F (116 C) (216 ohms), the appropriate sensor error code will be displayed and the unit will be stopped. The thermistor failures will automatically reset. The following is a summary of possible causes:

Thermistor Failure — A shorted or open circuit thermistor will cause the failure.

Wiring Failure — A shorted or open circuit will cause the failure.

Microprocessor Failure — If the circuitry on the processor board fails, the error could occur.

NOTE. The reset thermistor is an optional thermistor and is only used with outside or space temperature reset. Dip switch 1 must be on and dip switch 2 must be off.

CODE 82, LEAVING WATER TEMPERATURE SET POINT FAILURE — If the leaving water temperature set point potentiometer fails, the control will use a default value of 70 F (21 C) for water chillers and 42 F (5.6 C) for

brine units. A failure will cause the display to show error code **82** and the alarm will be energized. A failure is determined by establishing a range of -22 F (-30 C) to 70 F (21 C) as a valid range. Anything outside this range will be treated as a failure. If the setting is outside the -22 F to 70 F (-30 C to 21 C) range, the alarm will be energized. If the potentiometer returns to normal, the control will automatically reset.

NOTE The full range of the potentiometer is not used for the cooling set point range of 40 F to 70 F (4.4 C to 21 C) and the brine set point of 15 F to 70 F (-9.4 C to 21 C). The full-scale resistance of the potentiometer is 10-K ohms.

Typical causes for the error are:

Incorrect Potentiometer Setting — A potentiometer turned fully clockwise or counterclockwise.

Faulty Wiring from the processor to set point board.

Potentiometer Failure — A shorted or open potentiometer.

CODE 83, (NO FAILURE) — This failure code is displayed if a jumper is installed between terminals 13 and 14 or J2, and the EPROM is HT204247-1-11 or earlier. Unit runs normally. Remove jumper or update EPROM to remove the fault code. See footnotes (†) page 16.

CODE 84, RESET LIMIT POTENTIOMETER FAILURE — Only if reset is being used (dip switch 2 on) will this error be displayed. The potentiometer is located on the accessory board. If the potentiometer setting is less than 0°F (-17.8 C) or greater than 80 F (26.7 C) the alarm will be energized, the diagnostic code will be displayed and reset-limit set to 0°F (-17.8 C). The potentiometer full-scale resistance is 10 K ohms, but when installed on the accessory board all 3 potentiometers are wired in parallel, and the measured resistance will only be 3.3 K ohms.

This failure will automatically reset.

Typical causes for the error are:

Dip Switch 2 in ON position and accessory board not installed.

Incorrect Potentiometer Setting — A potentiometer turned fully clockwise or counterclockwise.

Faulty Wiring — If faulty wiring exists, this causes the potentiometer to be out of range.

Potentiometer Failure — If the potentiometer is faulty.

CODE 85, DEMAND LIMIT POTENTIOMETER FAILURE — Only if demand limiting is being used (dip switch 5 ON) will this error be displayed. The potentiometer is located on the demand limit board. If the resistance of the potentiometer is less than 10% or greater than 90%, the alarm will be energized and the diagnostic code will be displayed.

This failure will automatically reset.

Typical causes are:

Potentiometer Failure — If the potentiometer fails open or shorted.

Faulty Wiring — If faulty wiring exists that causes the potentiometer to be out of range, the error will occur.

Dip Switch in ON position and potentiometer not installed.

CODE 86, RESET RATIO POTENTIOMETER FAILURE — Only if reset is being used (dip switch 2 ON) will this error be displayed. The potentiometer is located on the accessory board. If the potentiometer setting is less than 0% or greater than 100%, the alarm will be

energized and the diagnostic code will be displayed and reset stopped

NOTE. The full range of the potentiometer is not used. The potentiometer full-scale resistance is 10 K ohms, but when installed on the accessory board all 3 potentiometers are wired in parallel and the measured resistance will only be 3.3 K ohms

The failure will automatically reset

Typical causes for the error are

Accessory Board Not Installed — If reset is not being used, dip switch 2 should be off.

Incorrect Potentiometer Setting — A potentiometer turned fully clockwise or counterclockwise.

Faulty Wiring — If faulty wiring exists, this causes the potentiometer to be out of range.

Potentiometer Failure — If the potentiometer is faulty.

CODE 87, RESET SET POINT POTENTIOMETER FAILURE — Only if space or outside air temperature reset is being used (dip switch 2 ON, 1 OFF) will this error be displayed. The potentiometer is located on the accessory board. If the potentiometer setting is less than 0° F (–17.8 C) or greater than 95 F (35 C), the alarm will be energized and the diagnostic code will be displayed and reset stopped.

NOTE. The full range of the potentiometer is not used. The potentiometer full-scale resistance is 10 K ohms, but when installed on the accessory board all 3 potentiometers are wired in parallel and the measured resistance will only be 3.3 K ohms

The failure will automatically reset.

Typical causes for the error are:

Accessory Board Not Installed — If reset is not being used, dip switch 2 should be OFF

Incorrect Potentiometer Setting — A potentiometer turned fully clockwise or counterclockwise.

Faulty Wiring — If faulty wiring exists, this causes the potentiometer to be out of range; then the error will occur

Potentiometer Failure — If the potentiometer is faulty, then the error code will be displayed.

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. 21) is used to connect the control transformer to the micro-processor board. Set your volt-ohmmeter to ac voltage with a range setting of approximately 30 volts. 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 a wiring error.

STEP 2 — CHECK PROCESSOR BOARD POWER SUPPLIES — The processor board has 6 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 TP20 (see Fig. 21). 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 $\pm$ 0.25 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

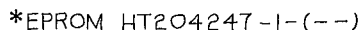
STEP 3 — CHECK VOLTAGE TOLERANCE CIRCUITRY — The board includes hardware to check for low control circuit voltage. First turn the ON-OFF switch OFF and connect the negative test probe to TP20. Turn power ON and enter Quick Test mode. Check the voltage at test pin TP9. If the voltage measured is greater than one volt, 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 TP20. Turn power ON and enter Quick Test mode. Check the voltage at test pin TP11. If the voltage is greater than +3 volts, there is a problem. Reset the ON-OFF switch and recheck. If still greater than +3 volts, 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 TP19. Turn power on and enter Quick Test mode. Check voltage at terminal 14 on connector J9 (see Fig. 22). 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:

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

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



STEP 6 — ELECTRONIC EXPANSION VALVE OUTPUTS — Some units may have an EXV driver board wired between the electronic expansion valves and the processor board J7 terminals. For those units, check the EXV outputs beginning with paragraph “a” below. For units without the EXV driver board, proceed to paragraph “b”

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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 volts, remove the connector and recheck. 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 according to paragraph b

To test circuit 2 or B outputs, follow the procedure for circuit 1 or 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 2 or B valve energizes for approximately 50 seconds immediately after circuit 1 or A valve

- b. **PROCESSOR BOARD OUTPUTS** — Turn power off. Connect the positive lead of the meter to terminal 8 on connector J7 or 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 1 or 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 0 volts, replace the processor board. If the outputs are correct, and the driver board (if supplied) outputs are not correct, replace the driver board. If the driver board is not supplied and the processor board outputs are correct, then the expansion valve should be checked.

To test circuit 2 or B outputs, follow the procedure for circuit 1 or 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 2 or B valve energizes for approximately 50 seconds immediately after circuit 1 or A valve

STEP 7 — DISPLAY BOARD CONNECTION CHECKOUT — Turn power OFF and *disconnect ribbon cable*. Connect the negative test lead to TP20 on the processor board. Turn power ON. You should get the following voltages at connector J10 (see Fig 23)

TERMINAL PINS (J10)	VOLTAGE (vdc $\pm$ 0.25 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 CHECKOUT — Turn power OFF and disconnect plugs from J3. Connect negative test lead to terminal TP20 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 21).

TERMINAL PINS (J3)	VOLTAGE (vdc $\pm$ 0.25 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

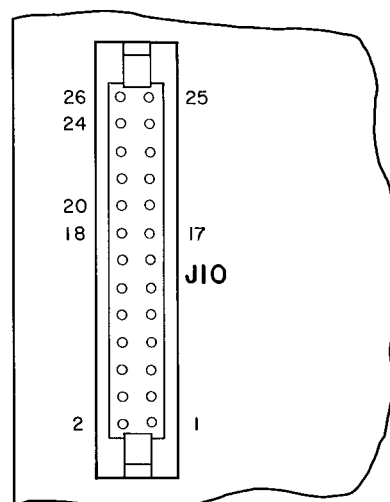


Fig. 23 — Display Board Connector

If these voltages are not obtained, replace the processor board

STEP 9 — THERMISTOR INPUT CONNECTOR CHECKOUT — Turn power OFF and remove thermistor connections from J1 (identify for replacing). Connect negative test lead to TP20. Turn power on and enter Quick Test. Check for the following voltages at connector J1 (see Fig 21).

TERMINAL PINS (J1)	VOLTAGE (vdc $\pm$ 0.25 v)	TERMINAL PINS (J1)	VOLTAGE (vdc $\pm$ 0.25 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 CHECKOUT** — Turn power OFF and disconnect all plugs from J2. Connect negative test lead to test pin TP20. Turn power on and enter Quick Test. Check for the following voltages at connector J2 (see Fig 5 and 21):

TERMINAL PINS (J2)	VOLTAGE (vdc $\pm$ 0.25 v)	TERMINAL PINS (J2)	VOLTAGE (vdc $\pm$ 0.25 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

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

1. Remove the sheet metal heater cover over the processor board.
2. Disconnect all the electrical connectors from the processor board and label them.
3. Remove the processor from the unit by removing the screws that hold the processor mounting plate to the control box.
4. Remove the old processor board from mounting plate and install new board.
5. Install processor and processor mounting plate in the unit. Use extreme care in installing.
6. 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 because the processor is not capable of determining whether the correct thermistor is connected to the correct set of pins on the board.

7. 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 install the header in the new board. The orientation of the header should be as shown in Fig. 24. Use extreme care in handling the header.
8. Adjust the DIP switches on the new board to match those on the old board. Be sure to replace the plastic cover over the switches.
9. Replace the sheet metal cover over the processor board.
10. Use the Quick Test procedure to check the operation of the unit.
11. Start unit and confirm operation.

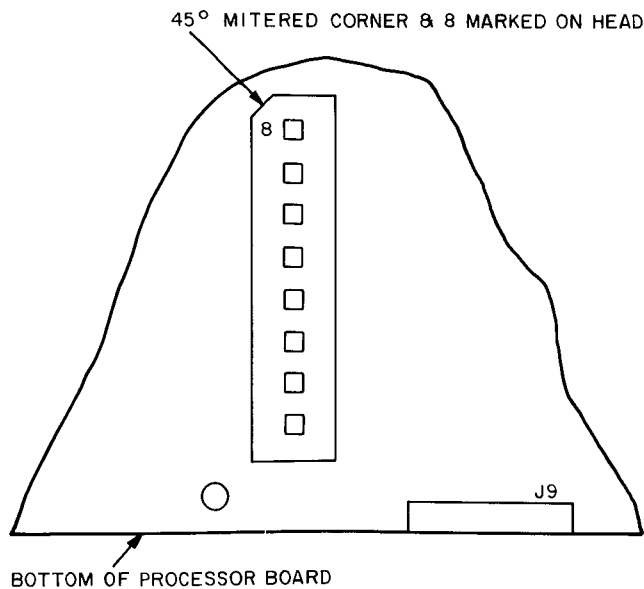


Fig. 24 — Configuration Header

Relay Board Troubleshooting — The relay board contains 13 electro-mechanical relays. The small relays are 24-volt ac. The large relays are 115 volts on boards marked 32GB500004 and 230 volts on boards marked 32GB500034. 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. 3). 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 Troubleshooting 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 $\pm$ 0.25 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 others ∞ (infinity).

QUICK TEST STEP NUMBER	VOLTAGE (vdc $\pm$ 0.25 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. 14) 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. As 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 Ground Fault Board (CGF) (30GT only) — One board is used for each circuit of 30GT225-280 units. Each board receives input from 4 toroids wired in series, one toroid per compressor. With 24 volts supplied at terminals A and B, a current imbalance (ground fault) sensed by any toroid causes the NC (normally closed) contacts to open, shutting down the lead compressor in the affected circuit. All other compressors in that circuit shut down as a result. The NC contacts remain open until the circuit is reset by momentarily de-energizing the board using the pushbutton switch.

If the NC contacts open, it is necessary to remove toroids from the T1-T2 circuit to determine which toroid is causing the trip. The chiller circuit can then be put back on the line after the circuit breaker of the faulty compressor is opened. The compressor problem can then be diagnosed by normal troubleshooting procedures.

Compressor Protection Control System (CPCS) Board (30GB only) — The compressor protection board controls the compressor and compressor crankcase heater. The board provides the following functions.

- Compressor Contactor Control
- Crankcase Heater Control

- Ground Current Protection
- Status Communication to Processor Board
- High-Pressure Protection
- Discharge Gas Protection

The discharge gas thermostats are wired in series with the 24-volt 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 control the contactor and crankcase heater and 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 contactor will be turned on. Also, the feedback contacts will close, but it will take approximately 3 to 6 seconds for the microprocessor to read the feedback contacts. The status of the feedback switch is displayed by a ☐ or **1** in the display. A ☐ 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 wires connected to the compressor.

Thermistor Troubleshooting — The Flotronic™ control system uses thermistors to measure temperatures at various points in the refrigeration circuit as shown in Fig. 6 through 11 on pages 9 through 12.

The resistance vs temperature and electrical characteristics for all thermistors in the system are identical.

The thermistors in the Flotronic control system (Fig. 5, 11, page 7) have a 5-volt 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, measure the dc voltage drop across the appropriate thermistor using a high quality digital voltmeter. Use voltage reading obtained to determine thermistor temperature from Table 11 (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 F to 240 F (-51 C to 116 C) (363,000 ohms to 216 ohms), then 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.

Electronic Expansion Valve (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 J11 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. 5, EXV).

1. Check color coding and wire connections. Make sure that they are connected to correct terminals at J7 and EXV plug connections. Check for correct wiring at driver board input and output terminals if provided.
2. Check for continuity and tight connection at all pin terminals.
3. Check plug connections at J7 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. 5). 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 no. 1 or A thermistors are T5 and T7, circuit no. 2 or B thermistors are T6 and T8. Refer to Fig. 7 and 8 for location.

1. Use Quick Test steps 20 through 23 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 Table 11.
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 (Fig. 7 and 8).

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 insure that 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 circuit breaker 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 circuit breaker and compressor circuit breaker(s). Close compressor service valves and vent 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. 13). 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 1/4 in. to 3/4 in. above the top of the motor.
5. Recycle the control by turning the control circuit circuit breaker to the ON position. This puts the control in the initialization mode **20**. During the first 100 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 counter-clockwise (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 full open to the fully closed position.

This process of opening and closing the EXV can be repeated by repeating this Quick Test steps 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), stuck liquid line solenoid valve(s) or restricted metering slots in the EXV. 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.

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.

Table 11 — Thermistor Resistance and Voltage Drop Characteristics (F)

TEMP (F)	RESISTANCE (Ohms)	VOLTAGE DROP (v)	TEMP (F)	RESISTANCE (Ohms)	VOLTAGE DROP (v)	TEMP (F)	RESISTANCE (Ohms)	VOLTAGE DROP (v)	TEMP (F)	RESISTANCE (Ohms)	VOLTAGE DROP (v)
-25.0	98009 6	4 684	38.0	13825 5	3 373	101.0	2834 9	1 500	164.0	765 3	0 527
-24.0	94707 1	4 673	39.0	13449 2	3 343	102.0	2773 2	1 476	165.0	749 5	0 518
-23.0	91521 5	4 662	40.0	13084 2	3 312	103.0	2713 1	1 453	166.0	734 2	0 509
-22.0	88448 9	4 651	41.0	12730 1	3 281	104.0	2654 7	1 430	167.0	719 2	0 501
-21.0	85485 5	4 640	42.0	12386 6	3 250	105.0	2597 8	1 407	168.0	704 6	0 493
-20.0	82627 2	4 628	43.0	12053 3	3 219	106.0	2542 3	1 385	169.0	690 4	0 484
-19.0	79870 6	4 616	44.0	11730 0	3 187	107.0	2488 3	1 362	170.0	676 6	0 476
-18.0	77212 0	4 604	45.0	11416 1	3 156	108.0	2435 8	1 341	171.0	663 3	0 468
-17.0	74647 9	4 591	46.0	11111 5	3 124	109.0	2384 5	1 319	172.0	650 3	0 461
-16.0	72175 1	4 578	47.0	10815 8	3 093	110.0	2334 6	1 298	173.0	637 7	0 453
-15.0	69790 3	4 565	48.0	10528 7	3 061	111.0	2285 9	1 277	174.0	625 5	0 446
-14.0	67490 4	4 551	49.0	10250 0	3 029	112.0	2238 5	1 256	175.0	613 8	0 438
-13.0	65272 4	4 537	50.0	9979 3	2 997	113.0	2192 2	1 236	176.0	602 3	0 431
-12.0	63133 3	4 523	51.0	9716 5	2 965	114.0	2147 0	1 216	177.0	591 3	0 424
-11.0	61070 3	4 509	52.0	9461 3	2 933	115.0	2103 0	1 196	178.0	580 7	0 417
-10.0	59080 6	4 494	53.0	9213 4	2 901	116.0	2060 0	1 176	179.0	570 3	0 410
- 9.0	57161 7	4 479	54.0	8972 6	2 869	117.0	2018 0	1 157	180.0	560 5	0 403
- 8.0	55310 9	4 463	55.0	8738 6	2 837	118.0	1977 0	1 138	181.0	550 9	0 397
- 7.0	53525 8	4 448	56.0	8511 4	2 805	119.0	1936 9	1 120	182.0	541 7	0 390
- 6.0	51804 0	4 431	57.0	8290 6	2 772	120.0	1897 8	1 101	183.0	532 9	0 384
- 5.0	50143 2	4 415	58.0	8076 1	2 740	121.0	1859 5	1 083	184.0	524 4	0 378
- 4.0	48541 1	4 398	59.0	7867 7	2 708	122.0	1822 1	1 065	185.0	516 2	0 371
- 3.0	46995 6	4 381	60.0	7665 1	2 676	123.0	1785 5	1 048	186.0	508 4	0 365
- 2.0	45504 7	4 363	61.0	7468 3	2 644	124.0	1749 7	1 030	187.0	500 8	0 360
- 1.0	44066 3	4 345	62.0	7277 1	2 612	125.0	1714 7	1 013	188.0	493 6	0 354
0.0	42678 5	4 327	63.0	7091 2	2 581	126.0	1680 4	0 997	189.0	486 5	0 348
1.0	41339 3	4 308	64.0	6910 6	2 549	127.0	1646 8	0 980	190.0	479 9	0 342
2.0	40047 1	4 289	65.0	6735 1	2 517	128.0	1613 8	0 964	191.0	473 4	0 337
3.0	38800 0	4 270	66.0	6564 4	2 486	129.0	1581 6	0 948	192.0	467 2	0 332
4.0	37596 4	4 250	67.0	6398 6	2 454	130.0	1550 0	0 932	193.0	461 2	0 326
5.0	36434 7	4 230	68.0	6237 5	2 423	131.0	1519 0	0 917	194.0	455 6	0 321
6.0	35313 3	4 209	69.0	6080 8	2 391	132.0	1488 6	0 902	195.0	450 0	0 316
7.0	34230 7	4 188	70.0	5928 6	2 360	133.0	1458 8	0 887	196.0	444 5	0 311
8.0	33185 4	4 167	71.0	5780 6	2 329	134.0	1429 6	0 872	197.0	439 2	0 306
9.0	32176 2	4 145	72.0	5636 8	2 299	135.0	1400 9	0 857	198.0	434 4	0 301
10.0	31201 5	4 123	73.0	5497 0	2 268	136.0	1372 7	0 843	199.0	429 2	0 297
11.0	30260 1	4 101	74.0	5361 2	2 237	137.0	1345 1	0 829	200.0	424 1	0 292
12.0	29350 9	4 078	75.0	5229 1	2 207	138.0	1318 0	0 815	201.0	419 4	0 288
13.0	28472 5	4 055	76.0	5100 8	2 177	139.0	1291 3	0 802	202.0	414 6	0 283
14.0	27623 8	4 032	77.0	4976 0	2 147	140.0	1265 2	0 788	203.0	410 2	0 279
15.0	26803 7	4 008	78.0	4854 8	2 117	141.0	1239 5	0 775	204.0	405 3	0 274
16.0	26011 2	3 984	79.0	4736 9	2 088	142.0	1214 3	0 762	205.0	400 8	0 270
17.0	25245 1	3 959	80.0	4622 4	2 058	143.0	1189 5	0 750	206.0	396 2	0 266
18.0	24504 6	3 934	81.0	4511 1	2 029	144.0	1165 2	0 737	207.0	391 2	0 262
19.0	23788 7	3 909	82.0	4402 9	2 000	145.0	1141 3	0 725	208.0	386 4	0 258
20.0	23096 4	3 883	83.0	4297 7	1 972	146.0	1117 8	0 713	209.0	381 6	0 254
21.0	22426 9	3 858	84.0	4195 5	1 943	147.0	1094 8	0 701	210.0	376 7	0 250
22.0	21779 3	3 831	85.0	4096 1	1 915	148.0	1072 2	0 689	211.0	371 6	0 247
23.0	21152 8	3 805	86.0	3999 6	1 887	149.0	1049 9	0 678	212.0	366 1	0 243
24.0	20546 7	3 778	87.0	3905 7	1 859	150.0	1028 1	0 666	213.0	360 7	0 239
25.0	19960 2	3 751	88.0	3814 4	1 832	151.0	1006 8	0 655	214.0	355 6	0 236
26.0	19392 5	3 723	89.0	3725 8	1 805	152.0	985 8	0 644	215.0	349 8	0 232
27.0	18843 0	3 696	90.0	3639 5	1 778	153.0	965 2	0 634	216.0	343 7	0 229
28.0	18311 0	3 668	91.0	3555 7	1 751	154.0	945 0	0 623	217.0	337 6	0 225
29.0	17795 8	3 639	92.0	3474 2	1 725	155.0	925 3	0 613	218.0	331 7	0 222
30.0	17297 0	3 611	93.0	3395 0	1 699	156.0	905 9	0 602	219.0	325 0	0 219
31.0	16813 8	3 582	94.0	3318 0	1 673	157.0	887 0	0 592	220.0	318 4	0 215
32.0	16345 7	3 553	95.0	3243 1	1 647	158.0	868 3	0 582	221.0	311 4	0 212
33.0	15892 2	3 523	96.0	3170 3	1 622	159.0	850 2	0 573	222.0	304 4	0 209
34.0	15452 7	3 494	97.0	3099 4	1 597	160.0	832 4	0 563	223.0	296 9	0 206
35.0	15026 7	3 464	98.0	3030 5	1 572	161.0	815 1	0 554	224.0	289 4	0 203
36.0	14613 9	3 434	99.0	2963 5	1 548	162.0	798 1	0 545	225.0	282 1	0 200
37.0	14213 6	3 404	100.0	2898 4	1 523	163.0	781 5	0 536			
38.0	13825 5	3 373	101.0	2834 9	1 500	164.0	765 3	0 527			

Table 11 — Thermistor Resistance and Voltage Drop Characteristics (C)

TEMP (C)	RESISTANCE (Ohms)	VOLTAGE DROP (v)	TEMP (C)	RESISTANCE (Ohms)	VOLTAGE DROP (v)	TEMP (C)	RESISTANCE (Ohms)	VOLTAGE DROP (v)	TEMP (C)	RESISTANCE (Ohms)	VOLTAGE DROP (v)	TEMP (C)	RESISTANCE (Ohms)	VOLTAGE DROP (v)
-32.0	100049 0	4 690	- 4.0	20075 9	3 756	24.0	5203 2	2 201	52.0	1694 0	1 003	80.0	602 4	0 431
-31.5	97006 4	4 680	- 3.5	19560 8	3 732	24.5	5088 1	2 174	52.5	1663 5	0 988	80.5	592 4	0 425
-31.0	94060 8	4 671	- 3.0	19060 6	3 707	25.0	4976 0	2 147	53.0	1633 5	0 974	81.0	582 8	0 418
-30.5	91209 3	4 661	- 2.5	18574 8	3 682	25.5	4866 8	2 120	53.5	1604 1	0 959	81.5	573 4	0 412
-30.0	88449.0	4.651	- 2.0	18102 9	3 656	26.0	4760 2	2.094	54.0	1575 2	0 945	82.0	564 4	0.406
-29.5	85777 0	4 641	- 1.5	17644 5	3 631	26.5	4656 4	2 067	54.5	1546 9	0 931	82.5	555 7	0 400
-29.0	83190 7	4 630	- 1.0	17199 1	3 605	27.0	4555 2	2 041	55.0	1519 0	0 917	83.0	547 2	0 394
-28.5	80687 1	4 620	- 0.5	16766 3	3 579	27.5	4456 6	2 015	55.5	1491 6	0 903	83.5	539 1	0 388
-28.0	78263 9	4 609	0.0	16345 7	3 553	28.0	4360 4	1 989	56.0	1464 7	0 890	84.0	531 2	0 383
-27.5	75918 3	4 597	0.5	15936 9	3 526	28.5	4266 7	1 963	56.5	1438 3	0 876	84.5	523 6	0 377
-27.0	73648 0	4 586	1.0	15539 5	3 500	29.0	4175 4	1 938	57.0	1412 3	0 863	85.0	516 2	0 371
-26.5	71450 6	4 574	1.5	15153 1	3 473	29.5	4086 3	1 912	57.5	1386 8	0 850	85.5	509 2	0 366
-26.0	69323 7	4 562	2.0	14777 5	3 446	30.0	3999 6	1 887	58.0	1361 6	0 837	86.0	502 3	0 361
-25.5	67265 0	4 550	2.5	14412 2	3 419	30.5	3915 0	1 862	58.5	1336 9	0 825	86.5	495 7	0 355
-25.0	65272 4	4 537	3.0	14056 9	3 392	31.0	3832 5	1 837	59.0	1312 6	0 812	87.0	489 4	0 350
-24.5	63343 7	4 525	3.5	13711 4	3 364	31.5	3752 1	1 813	59.5	1288 7	0 800	87.5	483 2	0 345
-24.0	61476 9	4 512	4.0	13375 3	3 337	32.0	3673 7	1 789	60.0	1265 2	0 788	88.0	477 4	0 340
-23.5	59670 0	4 499	4.5	13048 3	3 309	32.5	3597 3	1 764	60.5	1242 1	0 776	88.5	471 6	0 335
-23.0	57920 9	4 485	5.0	12730 1	3 281	33.0	3522 9	1 741	61.0	1219 3	0 765	89.0	466 1	0 331
-22.5	56227 9	4.471	5.5	12420 5	3 253	33.5	3450 2	1 717	61.5	1196 9	0 753	89.5	460 8	0.326
-22.0	54589 1	4 457	6.0	12119 2	3 225	34.0	3379 4	1 693	62.0	1174 8	0 742	90.0	455 6	0 321
-21.5	53002 7	4 443	6.5	11826 0	3 197	34.5	3310 4	1 670	62.5	1153 2	0 731	90.5	450 6	0 317
-21.0	51467 0	4 428	7.0	11540 5	3 169	35.0	3243 1	1 647	63.0	1131 8	0 720	91.0	445 7	0 312
-20.5	49980 4	4 413	7.5	11262 7	3 140	35.5	3177 5	1 624	63.5	1110 9	0 709	91.5	440 9	0 308
-20.0	48541.1	4.398	8.0	10992.1	3.112	36.0	3113 4	1 602	64.0	1090 2	0 698	92.0	436 3	0 303
-19.5	47147 7	4 383	8.5	10728 8	3 083	36.5	3051 0	1 579	64.5	1069 9	0 688	92.5	431 8	0 299
-19.0	45798 6	4 367	9.0	10472 3	3 054	37.0	2990 1	1 557	65.0	1050 0	0 678	93.0	427 4	0 295
-18.5	44492 4	4 351	9.5	10222 6	3 026	37.5	2930 7	1 536	65.5	1030 3	0 667	93.5	423 0	0 291
-18.0	43227 6	4 334	10.0	9979 3	2 997	38.0	2872 8	1 514	66.0	1011 0	0 657	94.0	418 8	0 287
-17.5	42002.9	4.318	10.5	9742.5	2.968	38.5	2816.2	1.492	66.5	992.1	0.648	94.5	414.5	0.283
-17.0	40816 9	4 301	11.0	9511 7	2 939	39.0	2761 1	1 471	67.0	973 4	0 638	95.0	410 3	0 279
-16.5	39668 3	4 283	11.5	9287 0	2 911	39.5	2707 2	1 450	67.5	955 1	0 628	95.5	406 0	0 275
-16.0	38555 9	4 266	12.0	9068 0	2 882	40.0	2654 7	1 430	68.0	937 1	0 619	96.0	401 8	0 271
-15.5	37478 4	4 248	12.5	8854 7	2 853	40.5	2603 4	1 409	68.5	919 4	0 609	96.5	397 6	0 267
-15.0	36434.7	4.230	13.0	8646.9	2.824	41.0	2553.3	1.389	69.0	902.1	0.600	97.0	393.3	0.264
-14.5	35423 7	4 211	13.5	8444 5	2 795	41.5	2504 4	1 369	69.5	885 1	0 591	97.5	389 0	0 260
-14.0	34444 2	4 193	14.0	8247 2	2 766	42.0	2456 6	1 349	70.0	868 4	0 582	98.0	384 7	0 257
-13.5	33495 2	4 174	14.5	8055 0	2 737	42.5	2410 0	1 330	70.5	852 0	0 574	98.5	380 3	0 253
-13.0	32575 6	4 154	15.0	7867 7	2 708	43.0	2364 4	1 311	71.0	836 0	0 565	99.0	375 8	0 250
-12.5	31684.6	4.135	15.5	7685 1	2 680	43.5	2319 9	1 292	71.5	820 2	0 557	99.5	371 1	0 246
-12.0	30821 0	4 115	16.0	7507 2	2 651	44.0	2276 3	1 273	72.0	804 8	0 548	100.0	366 5	0 243
-11.5	29984 0	4 094	16.5	7333 9	2 622	44.5	2233 8	1 254	72.5	789 8	0 540	100.5	361 6	0 240
-11.0	29172 7	4 074	17.0	7164 9	2 593	45.0	2192.2	1 236	73.0	775 0	0 532	101.0	356 7	0.236
-10.5	28386 3	4 053	17.5	7000 3	2 565	45.5	2151 5	1 218	73.5	760 6	0 524	101.5	351 5	0 233
-10.0	27623.8	4.032	18.0	6839.8	2.536	46.0	2111.7	1.200	74.0	746.5	0.516	102.0	346.3	0.230
- 9.5	26884 4	4 010	18.5	6683 4	2 508	46.5	2072 8	1 182	74.5	732 6	0 508	102.5	341 1	0 227
- 9.0	26167 5	3 989	19.0	6530 9	2 479	47.0	2034 7	1 165	75.0	719 2	0 501	103.0	335 3	0 224
- 8.5	25472 2	3 967	19.5	6382 3	2 451	47.5	1997 4	1 148	75.5	706 1	0 493	103.5	329 7	0 221
- 8.0	24797 8	3 944	20.0	6237 5	2 423	48.0	1960 9	1 131	76.0	693 3	0 486	104.0	323 8	0 218
- 7.5	24143.6	3.922	20.5	6096.3	2.395	48.5	1925 1	1 114	76.5	680.8	0.479	104.5	317.9	0.215
- 7.0	23509 0	3 899	21.0	5958 7	2 367	49.0	1890 1	1 098	77.0	668 6	0 472	105.0	311 6	0 212
- 6.5	22893 2	3 876	21.5	5824 6	2 339	49.5	1855 7	1.081	77.5	656 8	0 465	105.5	305 3	0 209
- 6.0	22295 6	3 852	22.0	5693 9	2 311	50.0	1822 1	1 065	78.0	645 2	0 458	106.0	298 6	0 206
- 5.5	21715 7	3 829	22.5	5566 4	2 283	50.5	1789 1	1 049	78.5	634 0	0 451	106.5	292 1	0 204
- 5.0	21152.8	3.805	23.0	5442.2	2.256	51.0	1756 8	1 034	79.0	623 2	0 444	107.0	285.2	0.201
- 4.5	20606 4	3 781	23.5	5321 2	2 228	51.5	1725 1	1 019	79.5	612 6	0 437			
- 4.0	20075 9	3 756	24.0	5203 2	2 201	52.0	1694.0	1 003	80.0	602 4	0 431			

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