Controls, Operation, and Troubleshooting

CONTENTS

INTRODUCTION

This guide contains information on the electronic control system and control system troubleshooting for the 48DK and 50DK,DY024-074 variable-air volume (VAV) units.

> IMPORTANT: The field-supplied and installed switch (or timeclock) MUST BE CLOSED to put unit into the occupied mode. Unit WILL NOT START until this is accomplished. See base unit installation instructions literature for details.

VAV Control System — The 20 to 75-ton VAV rooftop units contain a microprocessor-based electronic control system that controls and monitors the rooftop unit functions.

The VAV control system is composed of several components:

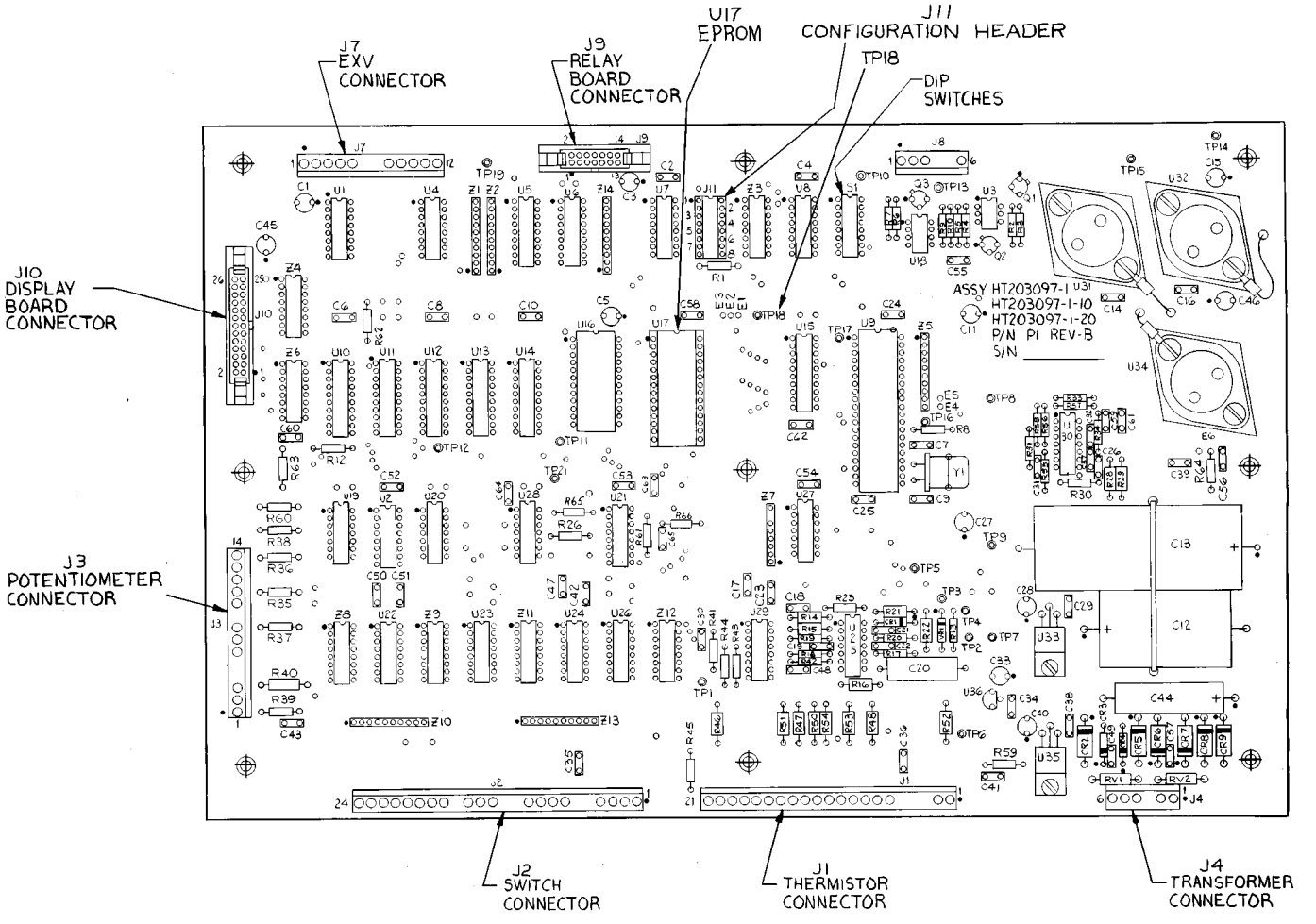
- processor board
- relay board
- display board
- thermistors
- compressor operation feedback (control relay)
- accessory board
- temperature reset package*
- single-step demand limit*
- two-step demand limit control module*

*Field-installed accessories.

The VAV control system monitors and controls the following functions of the rooftop unit:

- leaving-air temperature (unit capacity)
- morning warm-up or electric heat (if equipped)
- head pressure control, fan cycling (034-074)
- economizer position
- diagnostic display
- unit check-out (quick test)
- demand limiting (if equipped)
- temperature reset (if equipped)

Processor Board — The processor board, shown in Fig. 1, is the brain of the equipment. It contains the logic and the necessary hardware to drive the outputs and the display board. The processor board is enclosed by a sheet metal cover and a heater. The heater is controlled by a thermostat to keep the processor temperature above 32 F. All electrical connections are made to the processor board through wire and ribbon cables.



LEGEND

CR — Control Relay
DIP — Dual, In-Line Package
EPROM — Erasable, Programmable, Read-Only Memory
EXV — Electronic Expansion Valve
J — Pin Terminal Connectors
TP — Test Pin

Fig. 1 — Processor Board

Several temperature inputs are connected to the processor. There are either 4 or 5 thermistors (depending on the field-installed accessories) which input temperature data into the processor through pin terminal connector J1. See Table 1 and Fig. 2.

Several status switches are also monitored. These switches are connected to the processor at pin terminal connector J2. See Fig. 3 and Table 2.

Table 1 — Pin Terminal Connector J1 Thermistor Inputs

CONNECTOR J1 TERMINAL NO.	TEMPERATURE INPUT	UNIT SIZE	
		024-030	034-074
1,2	Reset Temperature*	T10	
14,15	Saturated Condensing Temp., Circuit 2	Fixed Resistor†	T4
16,17	Saturated Condensing Temp., Circuit 1	Fixed Resistor†	T3
18,19	Return-Air Temperature	T2	
20,21	Leaving-Air Temperature	T1	

T — Thermistor

*If equipped with accessory temperature reset package.
†The fixed resistor has a resistance value of 1200 ohms ± 5%.

NOTE: Terminal numbers 3-13 are not used on these units.

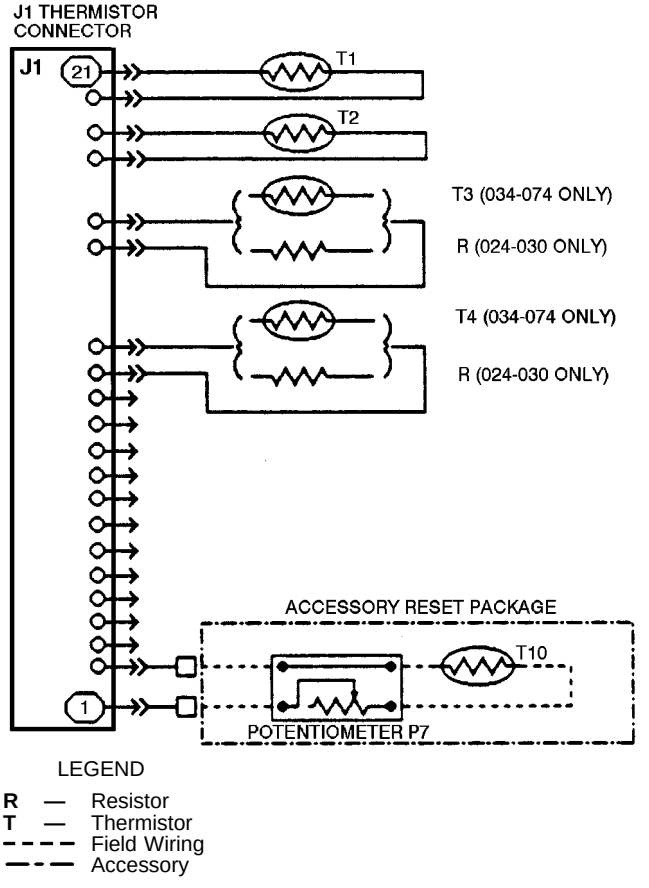


Fig. 2 — Pin Terminal Connector J1 Thermistor Inputs

Table 2 — Pin Terminal Connector J2 Status Switch Inputs

CONNECTOR J2 TERMINAL NO.	STATUS SWITCH	UNIT SIZE	
		024-030	034-074
1,2	Oil Pressure, Circuit 2	Jumpered	
3,4	Oil Pressure, Circuit 1	Jumpered	
7,8	Loss Of Charge, Circuit 2	Jumpered	LPS2
9,10	Loss of Charge, Circuit 1	Jumpered	LPS1
13,14	Economizer Changeover	ECR	EC
15,20	Compressor Fault Signal	CR2	
15,24	Compressor Fault Signal	CR1	

LEGEND

CR — Control Relay
EC — Enthalpy Control
ECR — Enthalpy Control Relay
LPS — Low-Pressure Switch

NOTE: Terminal numbers 5, 6, 11, 12, 16-19, and 21-23 are not used on these units.

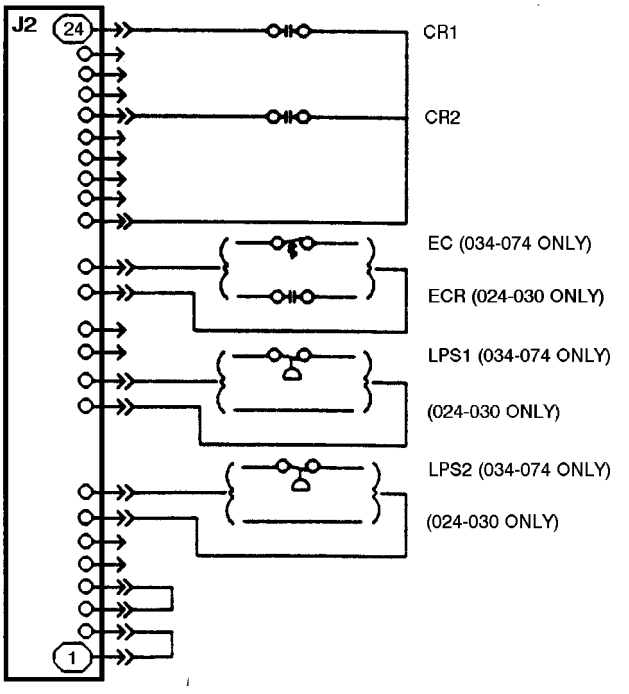


Fig. 3 — Pin Terminal Connector J2 Status Switch Inputs

Table 3 — Potentiometer Inputs and Ranges

POTENTIOMETER	DESCRIPTION	LOCATION	CONTROL VALID RANGE	DEFAULT VALUE
P1	Leaving Air Set Point	Display Board	45 to 70 F	45 F if -22 F < P1 < 45 F 70 F if P1 > 70 F OR IF P1 < -22 F
P2*	Economizer Position	Economizer Motor	0 to 100%	None (0 if P2 is bad)
P3	Reset Limit	Accessory Board	0 to 80 F	None
P4†	Demand Limit	Demand Limit Board	0 to 100%	None
P5*	Minimum Economizer Position	Accessory Board	0 to 100%	None
P6	Warm-Up Set Point	Accessory Board	40 to 80 F	40 F if 0°F < P6 < 40 F OR IF P6 > 95 F OR IF P6 < 0 80 F if 80 F < P6 < 95 F
P7**	Reset Temperature	Reset Board	40 to 100 F	None

*Optional factory-installed economizer is required.
†Accessory two-step demand limit module is required (which has 2 potentiometers), or a 5 to 20 Kohm field-supplied potentiometer is required for single-step demand limit.
**Accessory temperature reset is required.

NOTE: Potentiometers P1-P6 input data to pin terminal connector J3. Potentiometer P7 inputs data to pin terminal connector J7.

In addition to the unit status switch inputs, the processor board also accepts inputs from several potentiometers. See Table 3. These potentiometers control various operational characteristics of the system. Inputs are received by the processor through pin terminal connector J3. See Fig. 4.

All of the potentiometers must be set before the unit is started in order for the unit to function properly. Each of the potentiometers has a valid range that is used by the control. The valid range is defined as the potentiometer's resistance value that the control will not consider to be in error. This is usually between 10% and 90% of the potentiometer's total resistance. The control has been programmed to accept an operational range for the potentiometer, which may not be the same as the valid range.

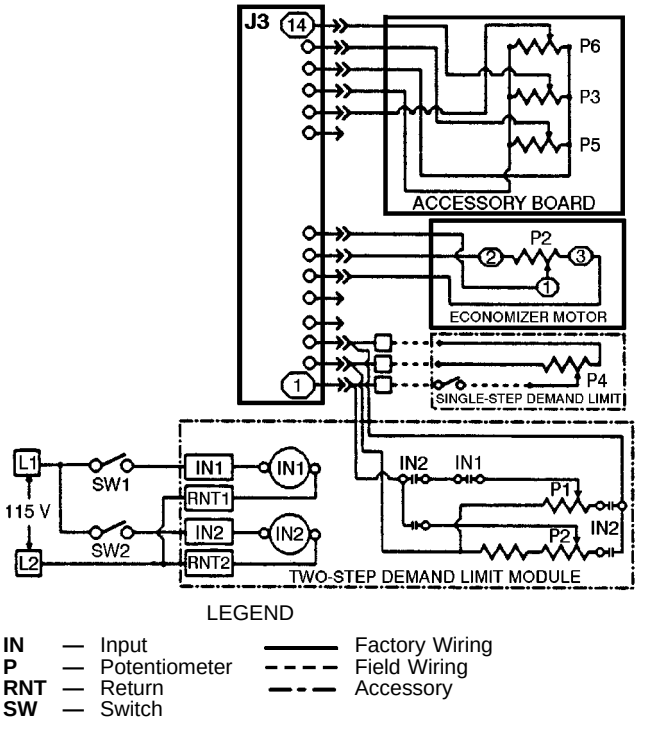


Fig. 4 — Pin Terminal Connector J3 Potentiometer Inputs

The potentiometer locations and functions are as follows:

P1 — LEAVING-AIR SET POINT — This potentiometer is located on the display board. The VAV control uses a valid control range of 45 to 70 F, and the potentiometer has a valid range of −22 F to 70 F. If the set point is between 22 F and 45 F, the control will use a value of 45 F. If the set point is outside of the valid range (less than −22 F or greater than 70 F), an alarm condition will be signaled and a default value of 70 F will be used.

P2 — ECONOMIZER POSITION — Economizer feedback potentiometer is located on the economizer motor. It has a valid range of 0 to 100%, which is also the operational range that the processor will accept. The microprocessor is programmed to indicate an alarm if the travel during initialization is less than 10% of the total potentiometer's resistance. An alarm condition will also be signaled if the potentiometer fails during operation, indicating that the damper blades are stuck. If either situation occurs, the processor will try to drive the economizer dampers closed.

P3 — RESET LIMIT — This potentiometer is located on the accessory board (provided standard from the factory) in the unit main control box and establishes the maximum amount of reset that can be applied to the leaving-air set point (P1). Reset is limited by the P1 default of 70 F. This potentiometer is used only when accessory, field-installed temperature reset is used. If temperature reset is used, DIP (dual, in-line package) switch 2 must be in the ON position. This potentiometer has a valid range of 0° F to 80 F. If the potentiometer is outside this range, an alarm condition will be signaled and reset will be terminated.

P4 — DEMAND LIMIT — The demand limit potentiometer is used only if accessory, field-installed demand limit is used, and if DIP switch 5 is in the ON position. The valid range is 0% to 100%, which is also the operational range. For single-step demand limit, a field-installed 5 to 20 Kohm potentiometer must be used. Mount the field-installed potentiometer in the unit main control box. Refer to accessory demand limit control module installation instructions for exact location.

The accessory two-step demand limit control is a 2-potentiometer system. If the potentiometer is out of the valid range, an alarm condition will be signaled and demand limit will be terminated.

P5 — ECONOMIZER MINIMUM POSITION — This potentiometer is on the accessory board (provided standard from the factory) located in the unit main control box. It has both a valid range and an operational range of 0% to 100%. If a fault condition is detected by the processor, an alarm condition will be signaled and the economizer dampers will close.

P6 — WARM-UP SET POINT — This potentiometer is on the accessory board (provided standard from the factory) located in the unit main control box, and DIP switch 4 must be in the ON position if morning warm-up heat is to be used. The valid range is 0° F to 95 F, but the processor is programmed to accept a range of 40 F to 80 F. If the set point is between 0° F and 40 F, a default value of 40 F will be used. If the range is between 80 F and 95 F, 80 F will be used. If the value is less than 0° F or greater than 95 F, 40 F will be used as a default and an alarm condition will result.

P7 — RESET TEMPERATURE — This 10 Kohm potentiometer is used only if the accessory, field-installed temperature reset package is installed, and DIP switch 2 is in the ON position. This potentiometer determines the temperature at which reset will begin. It is located on the accessory temperature reset board and has a valid range of 40 F to 100 F.

PROCESSOR BOARD OUTPUTS — The processor board also controls outputs through the relay board. The relay board plugs into the processor board using a ribbon cable.

In addition, the processor board controls the display board. The display board is connected to the processor board by a ribbon cable, and has an LED (light-emitting diode) display showing the status of the unit and diagnostic information.

CONFIGURATION HEADER AND DIP SWITCH ASSEMBLY — The processor board is programmed to control a variety of air conditioning units. To tailor the processor to the particular unit being controlled, 2 devices are used. One is the configuration header, and the other is the DIP switch assembly.

The configuration header is a series of 8 small wires that are broken or unbroken in a pattern to indicate several unique characteristics of the unit. The configuration header is factory set and should not be changed. Changing the factory setting may cause the unit to malfunction. The purpose of each jumper is listed in Table 4.

The DIP switches configure the unit for several field-installed options, as well as for several other options that may be unique to the unit. The DIP switches are located under a plastic enclosure which must be removed for access. The switches can be field adjusted, but must be adjusted only when the unit control circuit breaker is off. See Table 5 for DIP switch meanings and Table 6 for factory settings of both the configuration header and DIP switches.

Table 4 — Configuration Header Jumpers

JUMPER NUMBER	FUNCTION	FACTORY SETTING	MEANING
1,2	Unit Type	□ ■	VAV Rooftop Unit
3-5	Qty Compressors	■ □ □	2 Compressors
6	Expansion Valve	■	TXV
7	Power Frequency	□	60 Hz
8	Not Used	■	No Significance

LEGEND

TXV — Thermostatic Expansion Valve
VAV — Variable-Air Volume
□ — Broken Jumper (open circuit)
■ — Unbroken Jumper (closed circuit)

Table 5 — DIP Switches

SWITCH NO.	FUNCTION	FACTORY SETTING*	MEANING
1	Reset Mode	Off	Space or Outdoor-Air Reset
2	Reset Select	On Off	Reset Used Reset Not Used
3	Economizer	On Off	Enable Economizer Disable Economizer†
4	Morning Warm-Up	On Off	Enable Morning Warm-Up** Disable Morning Warm-Up**
5	Demand Limit	On Off	Enable Demand Limit Disable Demand Limit
6,7	Unloaders	Off, Off On, Off Off, On	No Unloaders 1 Unloader 2 Unloaders
8	Not Used	Off	No Significance

DIP — Dual, In-Line Package

*Control circuit breaker must be off before changing the setting of the DIP switch.
†No economizer.
**And/or electric heat (50 Series units only).

Table 6 — Configuration Header and DIP Switch Factory Settings

JUMPER OR SWITCH NO.	UNIT SIZES 024-034, 054-074		UNIT SIZE 044	
	Header Position	Switch Position	Header Position	Switch Position
1	□	Off	□	Off
2	■	Off	■	Off
3	■	On/Off*	■	On/Off*
4	□	On/Off*	□	On/Off*
5	□	Off	□	Off
6	■	Off	■	On
7	□	On	□	Off
8	■	Off	■	Off

LEGEND

DIP — Dual, In-Line Package
□ — Broken Jumper (open circuit)
■ — Unbroken Jumper (closed circuit)
*Depending on factory-installed options or field-installed accessories.

Relay Board — The relay board is used to control 24-v and 115-v loads. See Fig. 5. The relay board is connected to the processor board by a ribbon cable at pin J9. Electrical connections to the relay board are made through pins J5 (115 v) and J6 (24 v). The relay board has eight 24-v relays and five 115-v relays. See Table 7.

Display Board — The display board is located in the main unit control box and is connected to the J10 port of the processor board through a ribbon cable. The display board contains the leaving-air set point potentiometer P1; a 2-digit, LED display; and the display button (See Fig. 6). The LED display is used to convey the operating information and operational error codes.

Thermistors — The processor uses up to 5 thermistors to sense the temperatures at various points in the system. See Table 1 and Fig. 7-18. All the thermistors have identical temperature versus resistance and voltage drop characteristics, and are monitored by the processor for a short or open circuit. The valid range for a thermistor is 362,640 to 219 ohms. Thermistor details and locations are as follows:

T1 — LEAVING-AIR SET POINT THERMISTOR — This thermistor is located in the unit supply fan discharge. It provides information for the processor to stage the number of capacity steps required to maintain a desired leaving-air temperature.

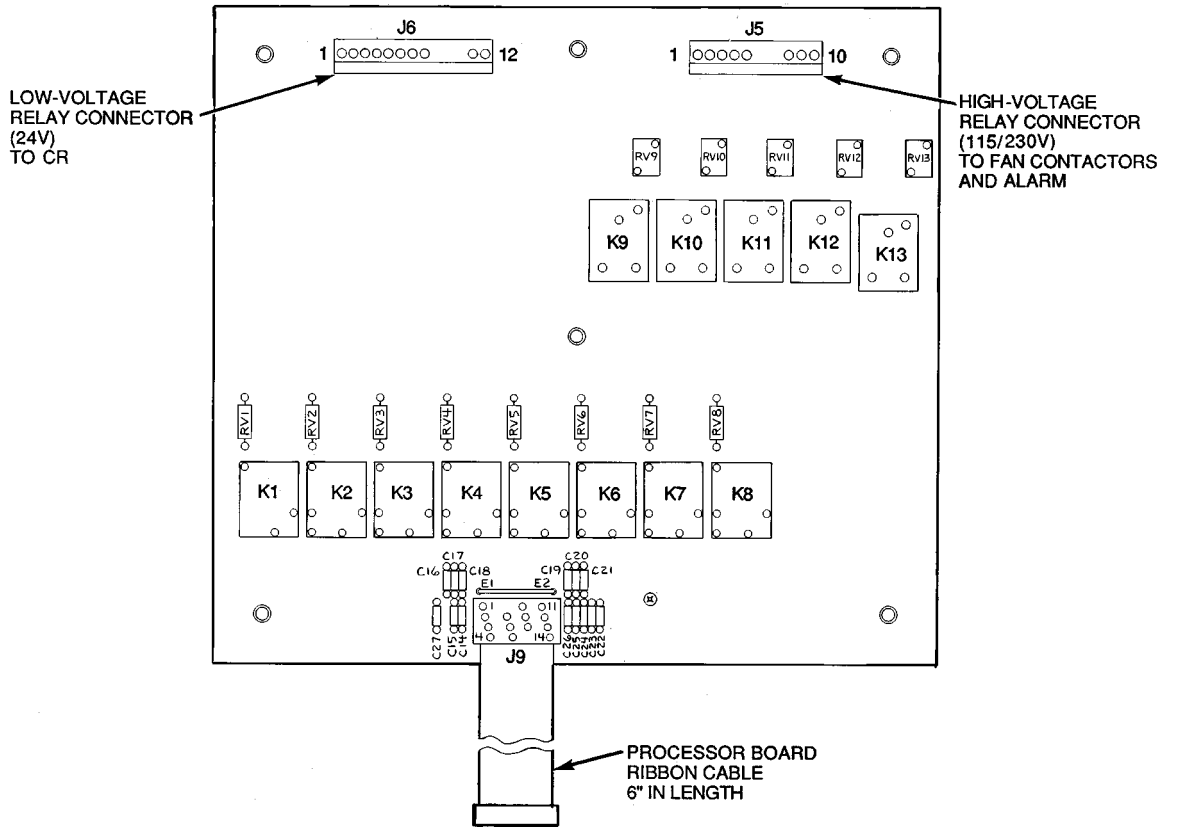
Table 7 — Output Pin and Terminal Assignments

OUTPUT PIN-TERMINAL	NAME	RATING	UNIT SIZES	
			024-030	034-074
J6-1	Stage 1 Compressor Relay (K1)*	24 vac	CR1	
J6-2	Stage 2 Compressor Relay (K2)*		U2**	
J6-3	Stage 3 Compressor Relay (K3)*		U1	
J6-4	Stage 4 Compressor Relay (K4)†		Not Used	
J6-5	Stage 5 Compressor Relay (K5)†		CR2	
J6-6	Stage 6 Compressor Relay (K6)†		Not Used	
J6-7	Economizer Open Relay (K7)		EM-2	EOR
J6-8	Economizer Close Relay (K8)		EM-3	ECR
J5-1	Supply Fan Relay (K9)	115 vac	IFC	
J5-2	Morning Warm-Up Relay (K10)		HIR	
J5-3	Stage 1 Condenser Fan Relay (K11)		OFC1/OFC2††	OFC2/OFC3 ‖
J5-4	Stage 2 Condenser Fan Relay (K12)		Not Used	OFC4 ¶
J5-5	External Alarm Relay (K13)		R	ALM

LEGEND

ALM — Alarm
CR — Control Relay
ECR — Economizer Close Relay
EM — Economizer Motor
EOR — Economizer Open Relay
HIR — Heat Interlock Relay
IFC — Indoor (Evaporator) Fan Contactor
OFC — Outdoor (Condenser) Fan Contactor
R — Alarm Relay
U — Unloader

*Circuit 1.
†Circuit 2.
**U2 is not used on 044 units.
††OFC2 is controlled by a temperature switch.
‖ OFC2 on 034,044 units; OFC3 on 054-074 units.
¶ Used on 054-074 units only.



LEGEND

CR — Control Relay
J — Terminal Pin Connectors
K — Relay

Fig. 5 — Relay Board

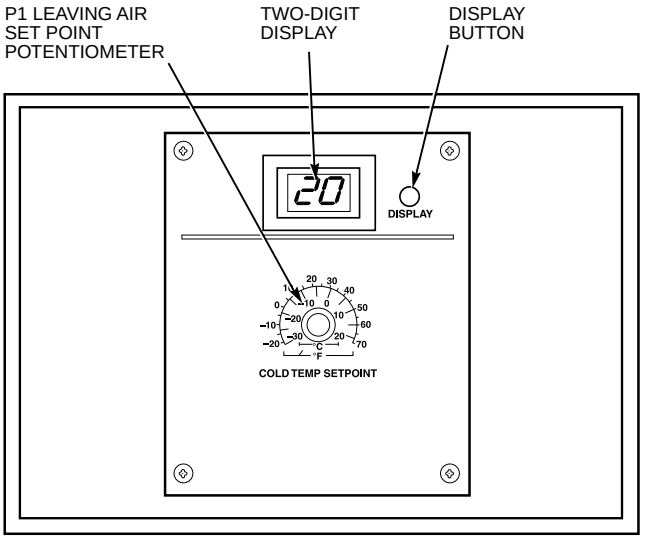


Fig. 6 — Display/Set Point Board

T2 — RETURN-AIR THERMISTOR — This thermistor is located in the mixed-air portion of the unit cabinet. The thermistor's primary function is to provide morning warm-up information. This sensor will also provide differential information for the processor during cooling operation (such as the rate of change for a capacity step).

T3 — SATURATED CONDENSING TEMPERATURE, CIRCUIT 1 — This thermistor is used only on 034-074 units, and is located on the condenser coil return bend. See Fig. 17 and 18. It controls the staging of the unit condenser fans based on the condensing temperature of the refrigerant at the designated position on the condenser coil. On 024-030 units, this thermistor is replaced with a fixed resistor.

T4 — SATURATED CONDENSING TEMPERATURE, CIRCUIT 2 — This thermistor is used only on 034-074 units, and is located on the condenser coil return bend. See Fig. 17 and 18. It controls the staging of the unit condenser fans based on the condensing temperature of the refrigerant at the designated position on the condenser coil. On 024-030 units, this thermistor is replaced with a fixed resistor.

T10 — RESET TEMPERATURE — This thermistor is used only if the accessory temperature reset package is used. It provides occupied space temperature information to the processor, which determines whether or not reset is required. The thermistor is remotely mounted outside the unit in the conditioned space.

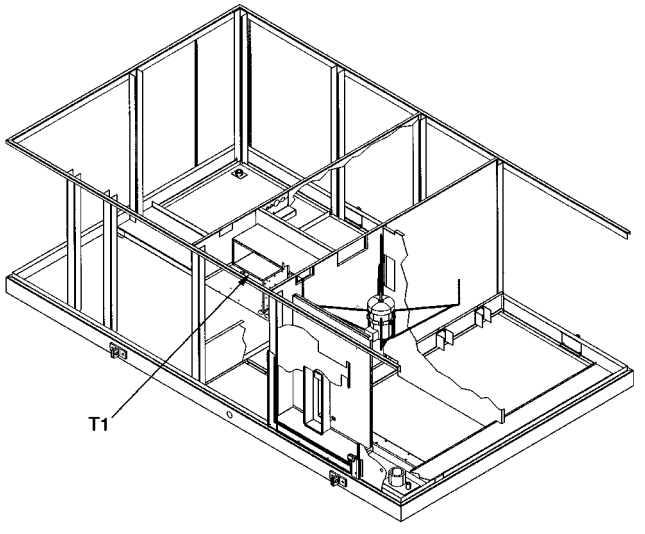


Fig. 7 — Thermistor T1 Location, 48DK024-030 Units

Compressor Operation

CONTROL RELAY (CR) — This relay provides information to the processor about compressor operation (one control relay per compressor). The relay controls and protects the compressor and also controls the crankcase heater.

A control signal to check the safety statuses and to start the compressor is sent from the relay board. This signal travels through all of the safeties: the high-pressure switch, the low-pressure switch (024-030 units), and the internal protector (06D compressors) or the discharge gas thermostat (06E compressors) and on to the control relay coil. Once the control relay coil has been energized, the control relay completes a feedback circuit for the processor, informs the processor of the status of the compressor safeties, energizes the compressor contactor coil, and deenergizes the crankcase heaters. A fault will be detected by the processor if the control relay opens during operation or start-up. The processor will lock the compressor or the circuit off by deenergizing the appropriate relay(s) on the relay board and energizing an alarm signal.

Accessory Board — The accessory board is standard (factory supplied) in the VAV rooftop units. See Fig. 19. This board is located in the control box of each unit. Each board has a prewired connector supplied with it to connect directly to the processor board. It has 3 potentiometers: P3, P5, and P6. See Table 3.

P3 — RESET LIMIT — The processor board is programmed for occupied space temperature reset. In order for reset to work, the accessory temperature reset board must be used. Potentiometer P3 is the maximum number of degrees (F) to which the supply air can be reset.

P5 — ECONOMIZER MINIMUM POSITION — This potentiometer controls the set point for the minimum position of the economizer.

P6 — MORNING WARM-UP TEMPERATURE — This potentiometer controls the morning warm-up temperature set point.

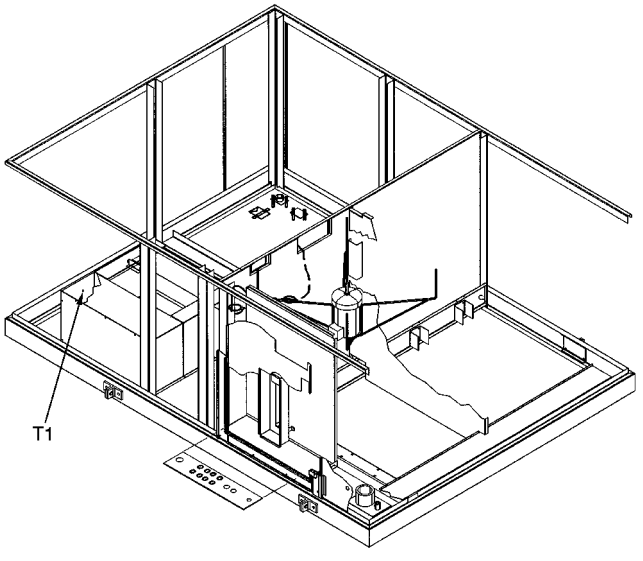


Fig. 8 — Thermistor T1 Location, 50DK024-030 Units

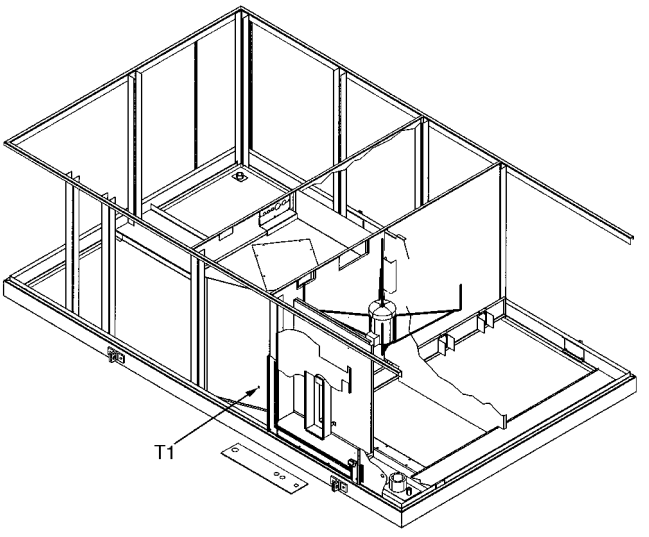


Fig. 9 — Thermistor T1 Location, 50DY024-030 Units

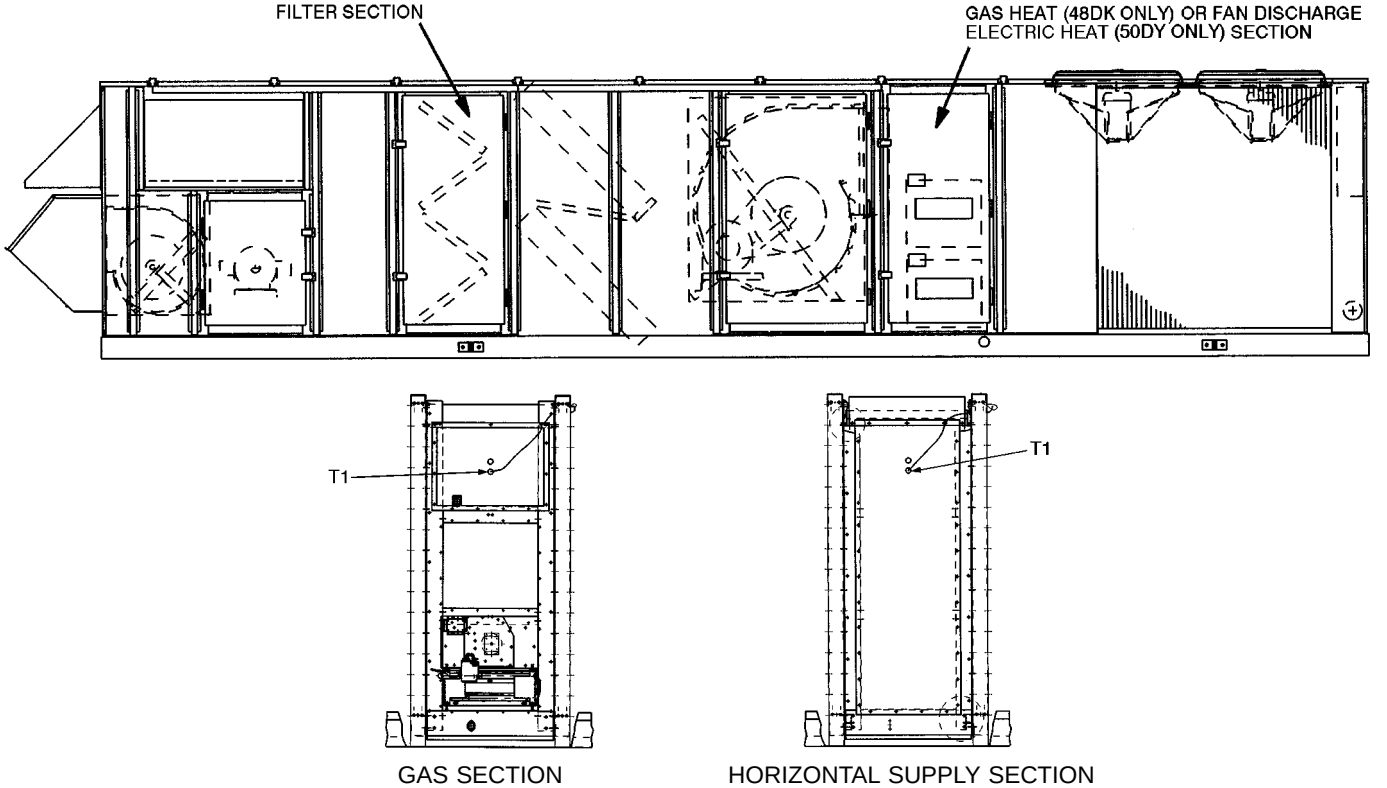
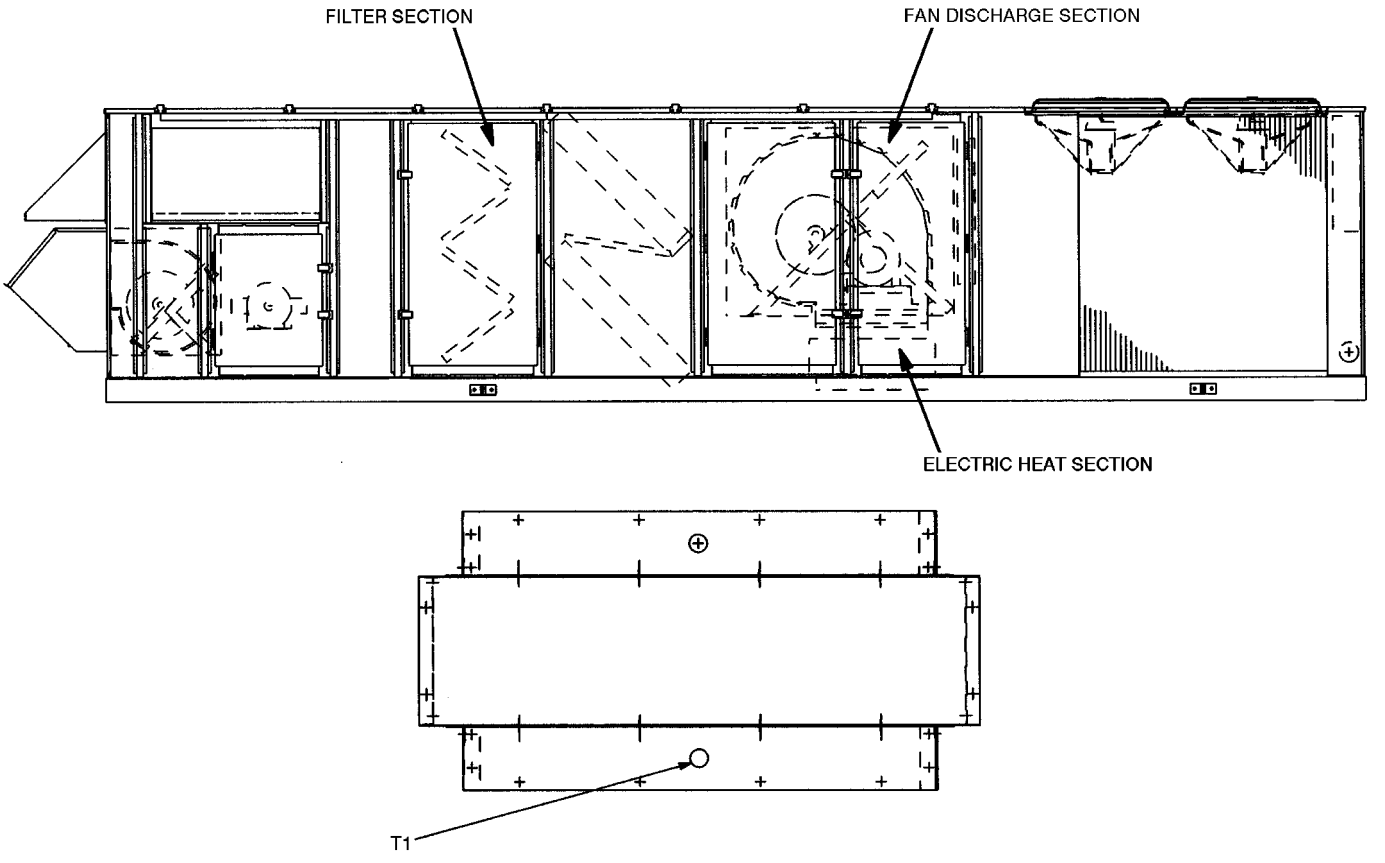
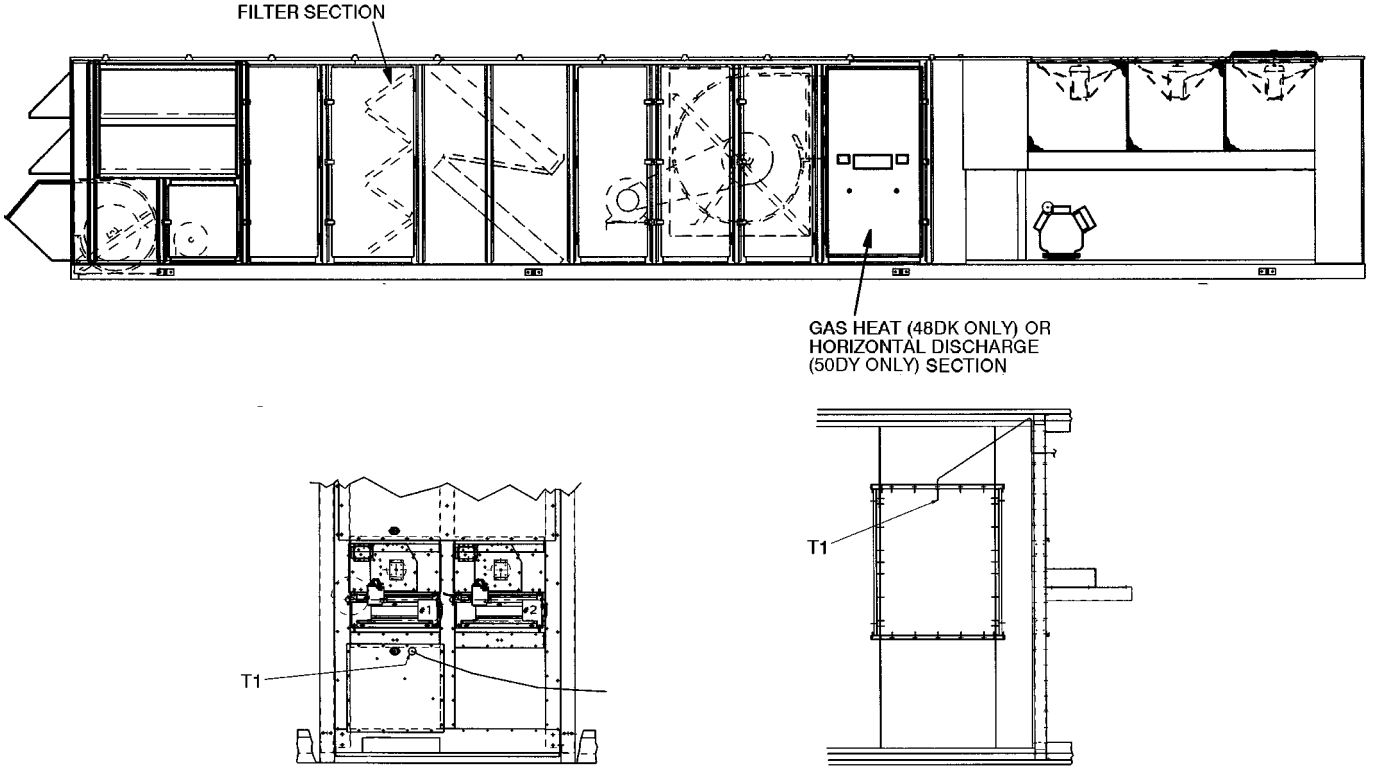


Fig. 10 — Thermistor T1 Location, 48DK/50DY034,044 Units



FAN DISCHARGE/ELECTRIC HEAT SECTION

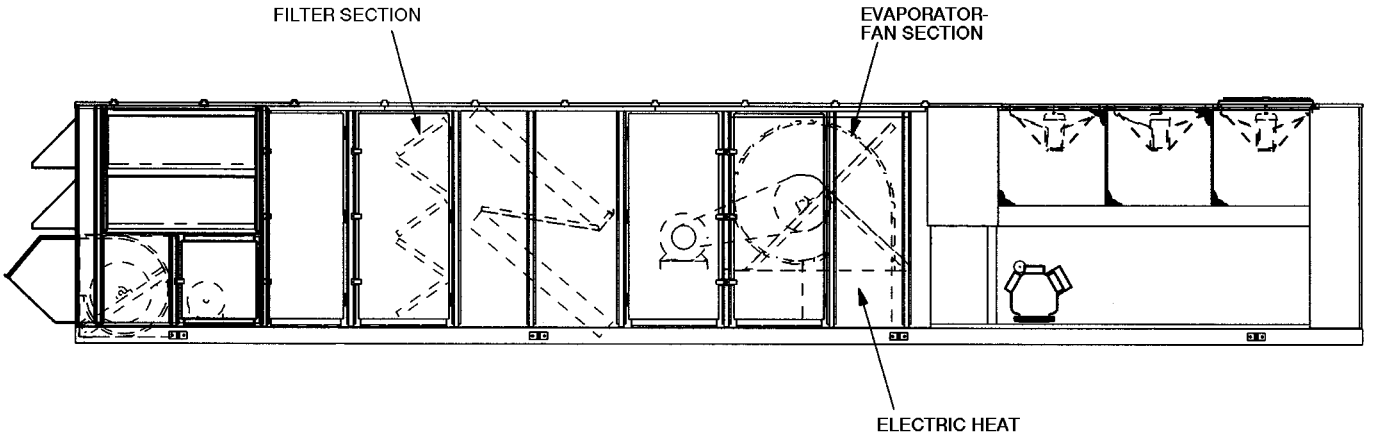
Fig. 11 — Thermistor T1 Location, 50DK034,044 Units

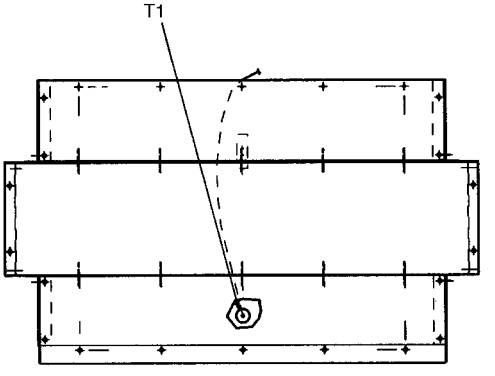


GAS SECTION (48DK)

FAN DISCHARGE/ELECTRIC HEAT SECTION (50DY)

Fig. 12 — Thermistor T1 Location, 48DK/50DY054-074 Units





FAN DISCHARGE/ELECTRIC HEAT

Fig. 13 — Thermistor T1 Location, 50DK054-074 Units

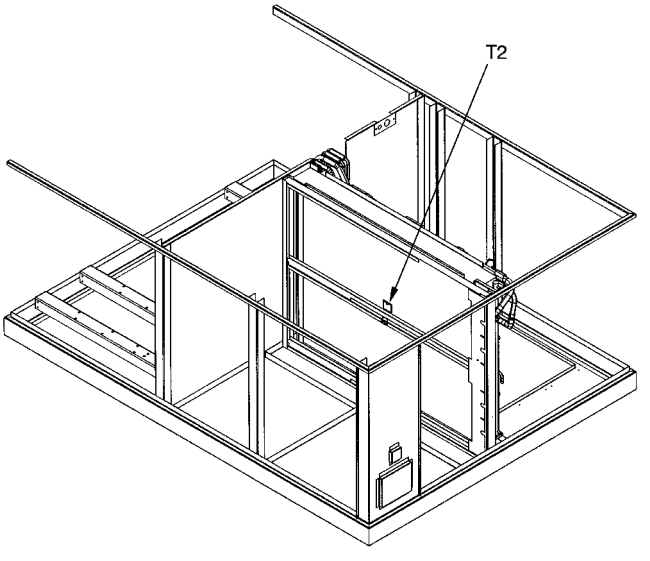
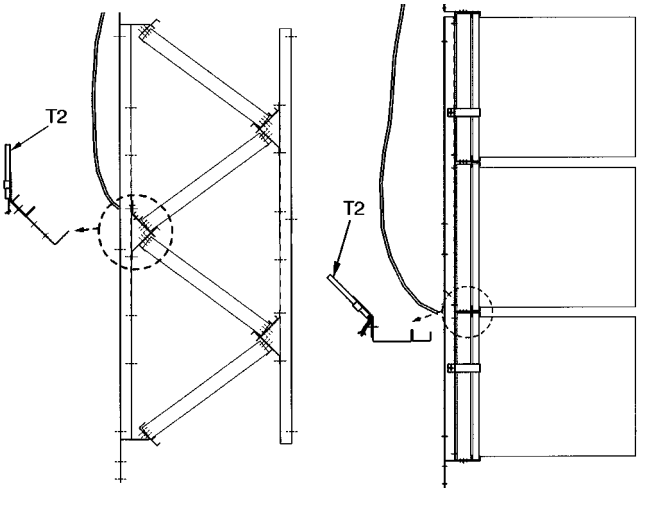


Fig. 14 — Thermistor T2 Location, 024-030 Units



STANDARD FILTERS

BAG FILTERS

Fig. 15 — Thermistor T2 Location, 034,044 Units

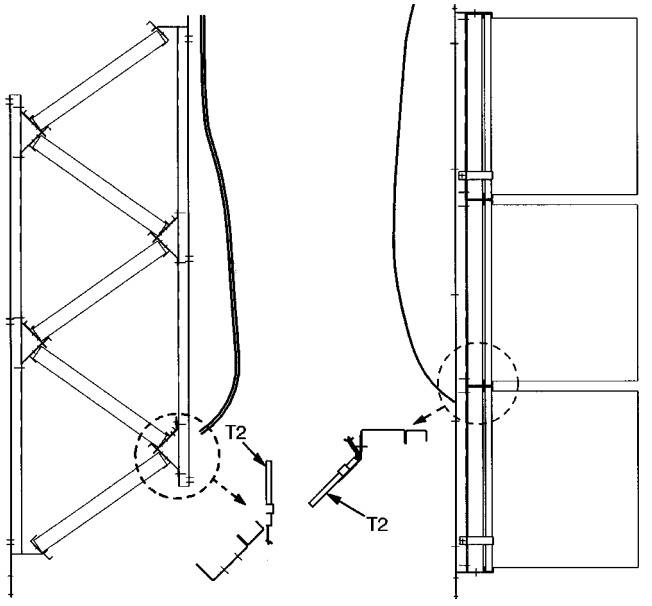


Fig. 16 — Thermistor T2 Location, 054-074 Units

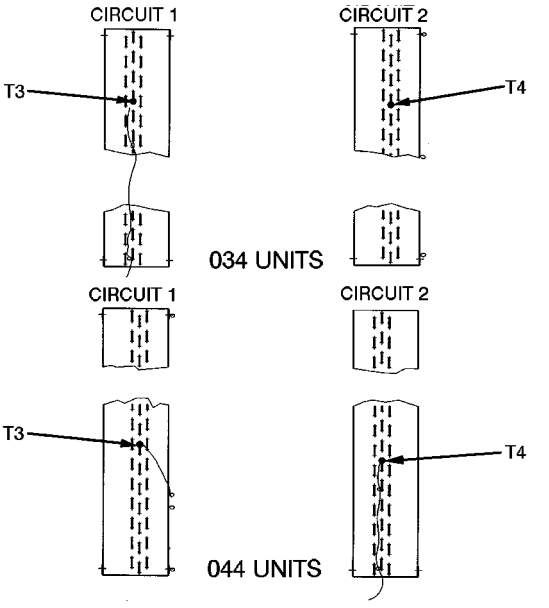


Fig. 17 — Thermistor T3 and T4 Locations, 034,044 Units

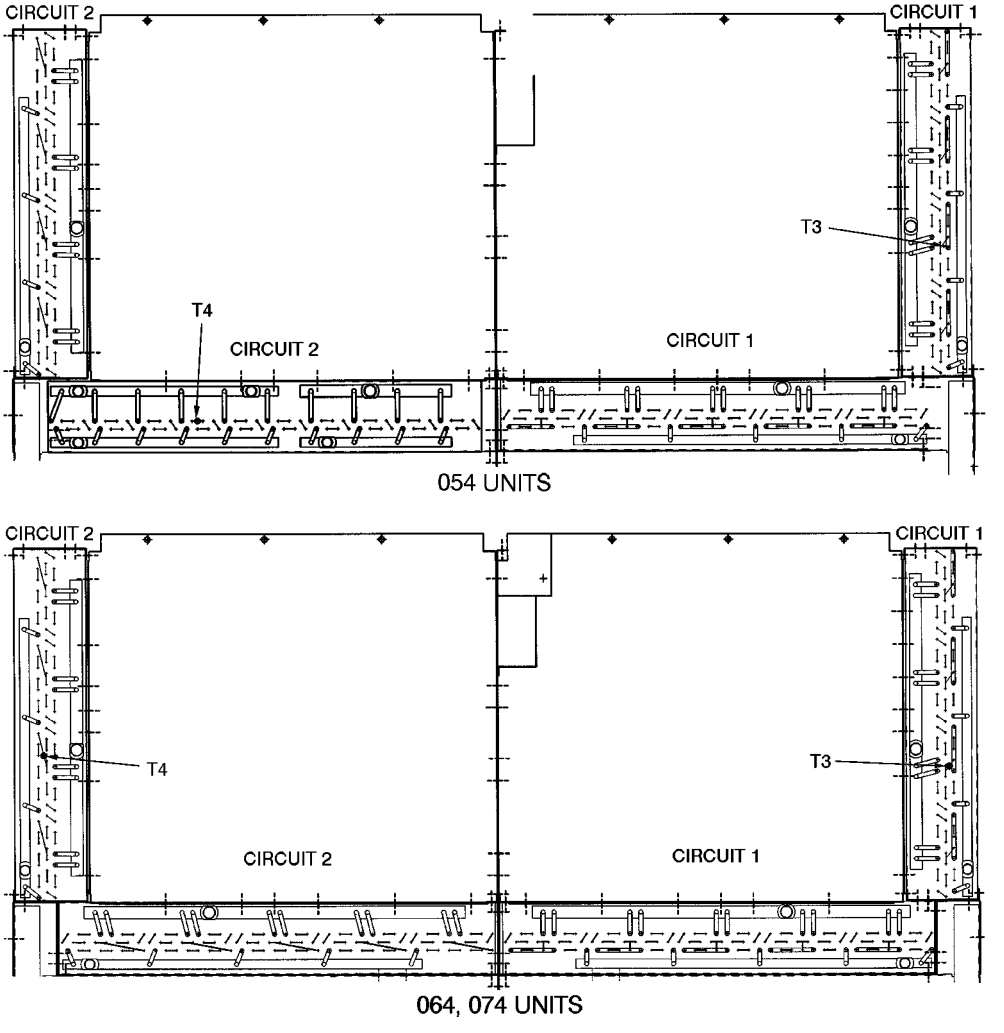


Fig. 18 — Thermistor T3 and T4 Locations, 054-074 Units

Single-Step Demand Limit — The single step demand limit provides a means to limit the capacity of the VAV unit using an external switch. Single step demand limit will limit the compressor displacement based on the ratio of the wiper arm to the full scale resistance. The exact percentage of capacity reduction differs depending on the number of capacity steps.

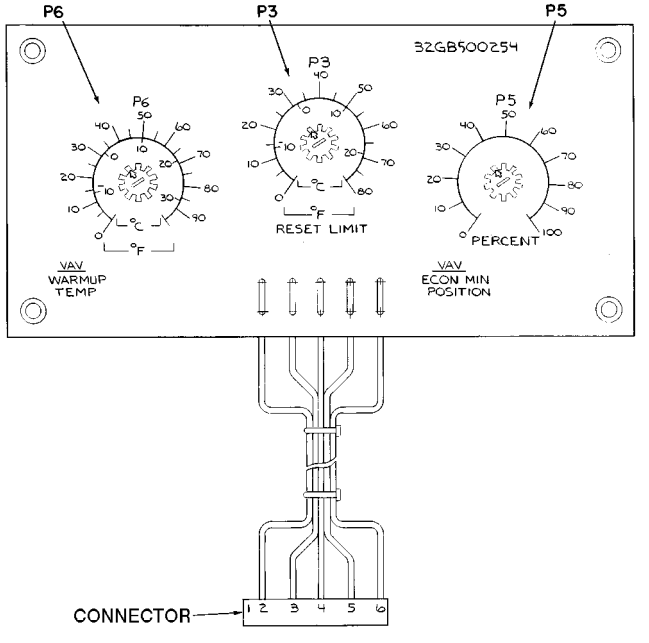
A 3-wire, 5 to 20 Kohm, field-supplied potentiometer is required for this option. The potentiometer should be wired to the processor J3 connections. In order to control the demand limit, the wiper arm of the potentiometer should be switched open and closed based on the demand limit requirement.

If the wiper arm wire is open, all capacity stages can be used. When the wiper arm wire is closed, the capacity is reduced by the amount set on potentiometer P4.

Demand Limit Control Module (DLCM) — The DLCM provides a 2-step demand limit control using an external switch. The first step is between 50% and 100% of the maximum compressor displacement. See Fig. 20. The second step is between 0% and 49% of the maximum compressor displacement. The exact percentage differs depending on the number of capacity steps.

Two adjustable potentiometers are used to set the 2 demand limit points. Potentiometer P1 is used to set a demand limit between 50% and 100% of the unit capacity. Potentiometer P2 is used to set a demand limit between 0% and 49% of unit capacity.

If no power is supplied to the demand limit control module, all capacity stages can be used. When power is supplied to terminal IN1 only, the first step of the demand limit control is energized and the capacity is reduced by the amount set on potentiometer P1. When power is supplied to terminal IN2 only, or to both IN1 and IN2, the capacity is reduced by the amount set on potentiometer P2.



LEGEND

ECON — Economizer
MIN — Minimum
P — Potentiometer
VAV — Variable-Air Volume

Fig. 19 — Accessory Relay Board (Standard; Factory Supplied)

OPERATING INFORMATION

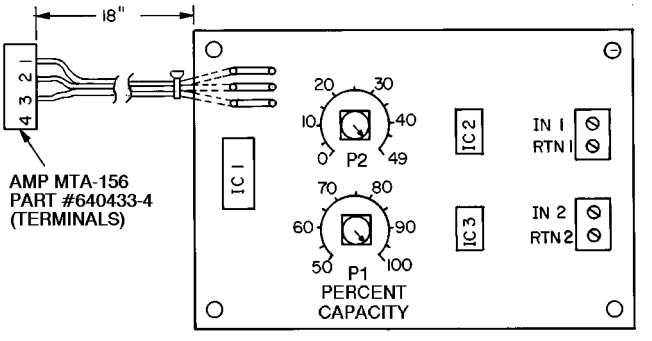
Digital Display — The VAV control system uses a 2-digit LED display located on the display board to display operational information and diagnostic codes.

CODES 0 THROUGH 6, CAPACITY STEPS — These codes indicate the number of cooling stages active at the time the display button is pressed. The highest code indicated on the display will be 6 for the 024-034 and 054-074 units, and 4 for the 044 units.

Capacity steps are directly related to pin terminal connector J6 output. At step zero, the unit has no mechanical cooling on, and the economizer may or may not be operating (depending on the outdoor air conditions). Once a cooling load is detected (T1 thermistor reads above the supply-air set point), the economizer will begin modulating to meet the load if the outdoor enthalpy is good. As long as the outdoor-air enthalpy is acceptable, no mechanical cooling will take place until the economizer dampers are fully open. The rest of the steps and the operational sequence vary due to the number of compressors and unloaders. Refer to Operating Sequence section on page 13 for the unit stages of operation.

CODES 20 THROUGH 30 AND 88, OPERATIONAL STATUS — These codes indicate special operational modes, such as initialization, morning warm-up, temperature reset, demand limit, or an internal failure of the board. Codes 23-25 and 27-29 are not used on these units.

Initialization — When the control is turned on, the display shows a 20 for approximately 2 minutes to indicate that the control is in the initialization mode. During this time, the economizer dampers open and close to determine the resistance range of the economizer position potentiometer (P2) for full economizer operation. The processor loads the necessary constants for proper unit operation and checks the thermistors and other potentiometers for their values and validity. After the initialization period, the display screen goes blank until the display button is pressed. If the display button is pressed during the 2-minute initialization period, the control goes into the quick test mode.



LEGEND

IC — Integrated Circuit
IN — Input
P — Potentiometer
RTN — Return

Fig. 20 — Two-Step Demand Limit Module

Temperature Reset — If the unit is equipped with the accessory temperature reset package, and DIP switch 2 is in the ON position, the unit will reset the supply-air temperature to a calculated value when necessary. When this condition is in effect, a 21 will appear in the display.

Demand Limit — If the unit is equipped with the accessory demand limit control module or the field-supplied, single-step demand limit potentiometer, and DIP switch 5 is in the ON position, the unit will limit the capacity stages to a predetermined value. When this condition is in effect, a 22 will appear in the display.

Morning Warm-Up —If the morning warm-up heat routine is enabled using DIP switch 4, and conditions of the occupied space warrant, the unit will begin the morning warm-up routine. When this condition is in effect, a 26 will appear in the display.

Internal Failure — If the unit detects an internal fault (such as a time measurement failure), or detects an incorrect voltage on an input channel, a 30 will be displayed, and the unit will shut down.

Quick Test — If the display button is pressed during the initialization period of the processor, the unit will run its self-diagnostic routine. When this is in effect, an 88 will appear in the display screen.

CODES 51 THROUGH 87, OVERLOAD INFORMATION — These codes indicate diagnostic information when there is a unit problem such as a faulty thermistor, potentiometer, or compressor fault. Refer to Service and Troubleshooting section on page 21 for more details. Codes 52-54, 56-58, 61, 62, 65-69, 73, 74, and 77-80 are not used on these units.

Under normal operation, only the stage number is displayed when the display button is pressed. If a status or 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 in the microprocessor as long as the board remains energized.

Operating Sequence — The sequence presented below assumes that the unit is equipped with heat for morning warm-up and an economizer. If these items are not enabled with the appropriate DIP switches, the processor bypasses these subroutines. This sequence is also based on an EPROM (erasable, programmable, read-only memory) processor chip with the identification 'HT204485-1-XX,' where 'XX' is replaced by a 2-digit number representing the current software version. See Fig. 1 for EPROM chip location.

When power is applied to the occupied mode relay (OMR) through the closure of either a field-installed timeclock or a field-installed switch in the occupied space, the unit will begin its initialization mode.

A 20 will appear in the display screen, and the initialization period will last approximately 2 minutes. During this time, the economizer dampers open and close to determine the resistance range for full economizer operation of the economizer position potentiometer (P2). The processor loads the necessary constants for unit operation, and also checks the thermistors and other potentiometers for their values and validity. After the initialization period, the screen goes blank until the display button is pressed.

⚠ CAUTION

Use caution during this time (after initialization when the screen is blank), because the unit supply and return fans could start at any time.

Once the initialization period is complete, the supply and return fans begin operation. While the fans are operating, the economizer dampers are closed and return air from the building is being circulated. After 2 minutes, the processor checks the resistance value of thermistor T2. If T2 temperature sensed is 5° F or more below the set point of the morning warm-up potentiometer (P6), the unit will begin the morning warm-up routine, and a 26 will be displayed.

Unit heat will be energized through the heat interlock relay (HIR), and all of the occupied space air terminals open. The unit will continue heating the space until the return-air temperature is within 2° F of set point. The unit will then shut off the heat and continue to circulate air. The unit will cycle in and out of the heating mode until the return-air temperature reaches the morning warm-up set point (P6). Once morning warm-up has been terminated, the unit cannot return to morning warm-up until the unit is powered down and restarted. This action signals a return to the occupied mode.

NOTE: Occupied heat is NOT AVAILABLE on these units.

Once out of the morning warm-up routine, the unit will begin its cooling routine based on the leaving-air set point (P1). At step zero, the unit has no mechanical cooling on, and the economizer may or may not be operational. The economizer will move to the minimum position determined by potentiometer P5 if no cooling load is detected. Once a cooling load is detected by thermistor T1 sensing a temperature higher than the cooling demand set point (P1), the economizer will begin modulating to meet the load if the outdoor enthalpy is good. The processor will attempt to maintain a supply-air temperature of P1 ± 2° F by modulating the economizer dampers.

No mechanical cooling will take place until the economizer dampers are fully open (if the outdoor-air enthalpy permits). If the economizer is unable to meet the cooling demand, then mechanical cooling is used in conjunction with the economizer. If the economizer was unable to meet the load due to poor outdoor-air enthalpy, the dampers will return to the minimum position as determined by P5.

Compressors, unloaders, and condenser fans will be cycled to maintain a leaving-air temperature 2° F below the potentiometer P1 set point once the mechanical cooling stages begin. Each unit's cycling is slightly different, and is based on the number of compressors and unloaders. The operational loading sequence of compressors is as follows:

During the start-up of the lead compressor for each circuit, the low-pressure switch will be bypassed for 180 seconds (034-074 only) to prevent nuisance trips of the low-pressure switch. After start-up, a low-pressure trip will be ignored for 30 seconds by the processor.

SIZE 024-034 AND 054-074 UNITS — These units have 2 compressors and 2 unloaders on compressor 1. See Fig. 21-23 for compressor and condenser fan motor locations. The operating sequence is as follows:

Stage 1 Relays K1, K2, and K3 are energized. Compressor no. 1 starts with both unloaders energized. Compressor no. 1 runs at ⅓ capacity. The crankcase heater for this compressor has been deenergized, and the first stage of condenser fans have been energized. Outdoor (condenser) fan motor no. 1 (OFM1) has started on all units.

Stage 2 Relays K1 and K3 are energized. Compressor no. 1 is running with unloader 1 (U1) energized. The compressor is now operating at ⅔ capacity.

Stage 3 Relay K1 is energized. Compressor no. 1 is fully loaded.

Stage 4 Relays K1, K2, K3, and K5 are energized. Compressor no. 1 is running at ⅓ capacity, and compressor no. 2 is running at full capacity. The crankcase heater for compressor no. 2 has been deenergized.

Stage 5 Relays K1, K3, and K5 are energized. Compressor no. 1 is running at ⅔ capacity, and compressor no. 2 is running at full capacity.

Stage 6 Relays K1 and K5 are energized. Both compressors are running fully loaded.

The 024-030 units have 2 condenser fans and use a fixed resistor in place of the T3 and T4 thermistors. The resistor is set at 1200 ohms (a saturated temperature of approximately 142 F). This temperature will ensure that the K11 relay will remain energized during compressor operation. The OFM2 will be cycled on an outdoor-ambient temperature of 60 F. At outdoor temperatures below 60 F, OFM2 will be locked out.

The 034 unit has 2 condenser fans, one of which is controlled by the microprocessor. The OFM1 is energized with compressor no. 1. The OFM2 is controlled by the processor and is cycled based on input from circuit thermistor T3 or T4.

On the 054,064 units, the first 2 condenser fans energize with the compressors; compressor no. 1 controls OFM1, and compressor no. 2 controls OFM2. The OFM3 and OFM4 are staged by the microprocessor based on the condensing temperature input from thermistor T3 or T4.

On the 074 units, the first 3 condenser fans energize with the compressors; compressor no. 1 controls OFM1, and compressor no. 2 controls OFM2 and OFM3. The OFM4 and OFM5 are staged by the microprocessor based on condensing temperature input from either circuit's T3 or T4 thermistor.

SIZE 044 UNITS — These units have 2 compressors and 1 unloader on compressor no. 1. See Fig. 22 for compressor and condenser fan motor locations. The 044 unit operating sequence is as follows:

Stage 1 Relays K1 and K3 are energized. Compressor no. 1 starts with the unloader energized. Compressor no. 1 is running at ½ capacity. The crankcase heater on compressor no. 1 has been deenergized, and the first stage condenser fan has been energized. Outdoor (condenser) fan motor no. 1 (OFM1) has started.

Stage 2 Relay K1 is energized. Compressor no. 1 is fully loaded.

Stage 3 Relays K1, K3, and K5 are energized. Compressor no. 1 is running at ½ capacity, and compressor no. 2 is running at full capacity. The crankcase heater for compressor no. 2 is deenergized. The second stage condenser fan has been energized. Both OFM1 and OFM3 are operating.

Stage 4 Relays K1 and K5 are energized. Both compressors are running fully loaded.

The 044 unit has one fan that can be controlled by the processor. The other 2 are controlled by the compressors. The OFM1 is energized by compressor no. 1, and OFM3 is energized by compressor no. 2. The OFM2 is cycled by the processor based on input from either circuit (thermistors T3 and T4).

Head Pressure Control — All units have as standard a basic head pressure control function which allows the units to operate in cooling down to 45 F. If cooling is required at outdoor ambient temperatures lower than 45 F, refer to accessory head pressure control literature for details.

SIZE 024-030 UNITS — All units have a fan cycling thermostat which cycles OFM2 (located over the control box). The thermostat switch opens at 60 F ± 3 F and closes at 70 F ± 3 F.

SIZE 034-074 UNITS — Head pressure control is handled by the processor. The processor attempts to maintain the head pressure by cycling the condenser fan motors. No condenser fans will be running without a call for mechanical cooling. Thermistors T3 and T4 provide the condensing temperature information to the processor. These VAV rooftop units have dual refrigeration circuits, and the higher circuit temperature will govern unit operation. If the condensing temperature is above 133 F (236 psig), a condenser fan stage will be added. If the condensing temperature is 78 F (142 psig) or less, the number of condenser fans operating will be decreased. After each fan stage, the processor will wait one minute for the head pressures to stabilize before changing again, unless thermistor T3 or T4 senses a temperature greater than 125 F (278 psig), in which case all condenser fans are started.

During start-up, if the outdoor ambient is above 70 F (as sensed by thermistor T3 or T4), the first-stage, processor-controlled fans are turned on to prevent excessive discharge pressures.

Inlet Guide Vanes — In most VAV units, the supply fan static pressure is controlled by inlet guide vanes. The inlet guide vanes operate independently from the microprocessor. The supply static pressure is controlled by a differential pressure switch. If the unit is equipped with a return fan, building pressure is controlled by another differential pressure switch.

Temperature Reset — Accessory temperature reset allows the unit to reset the leaving-air set point to a higher value once most of the cooling load has been met. When the space conditions are satisfied, the VAV terminals will begin to throttle down. The unit senses this as an increase in the supply static pressure, and if equipped, the inlet guide vanes will begin to close in response to the increasing pressure. Allowing the supply temperature to be reset to a higher value maintains the air circulation in the space. The accessory reset package is required for temperature reset, and includes:

- a thermistor (T10)
- a reset temperature potentiometer (P7)
- a reset limit potentiometer (P3)

NOTE: In order for temperature reset to operate, DIP switch 2 must be set to the ON position.

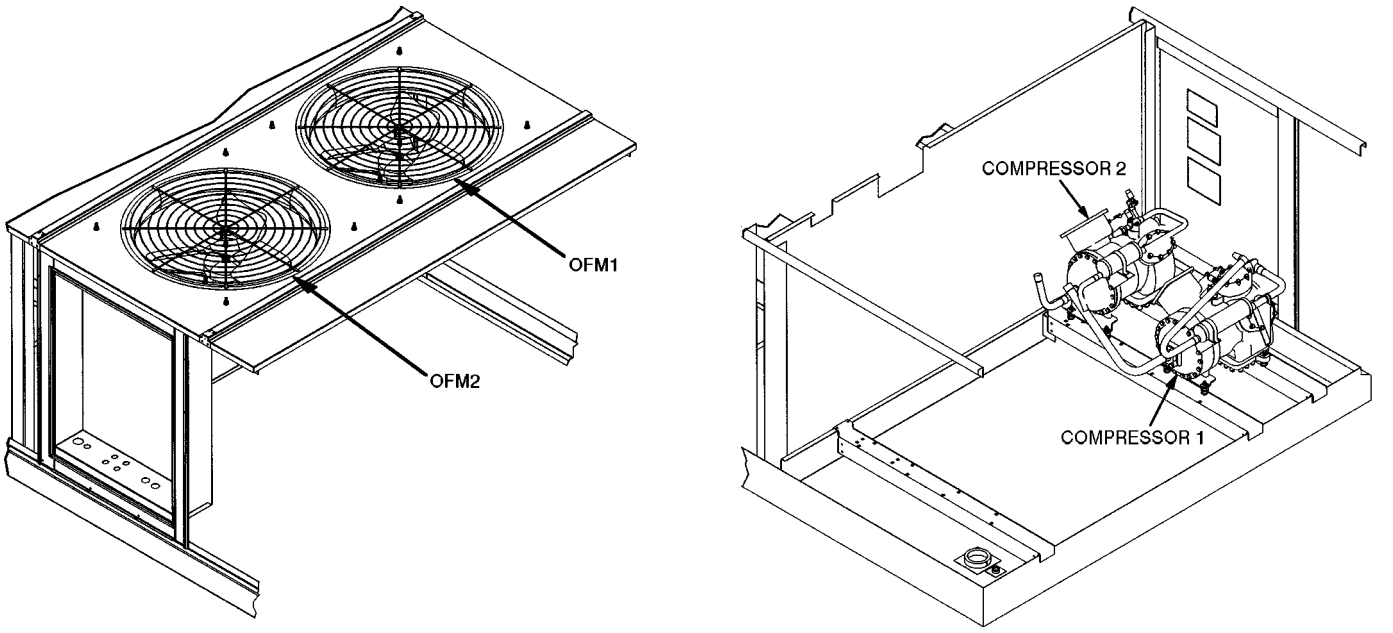
If multiple sensors are required to average the space temperature to determine when to start reset, see Fig. 24. Only Carrier part no. HH79NZ014 sensors are to be used, in arrangements of 4 or 9 sensors, with total sensor wiring not to exceed 1000 ft.

NOTE: The modified leaving-air set point can be reset no higher than the potentiometer P1 limit of 70 F. If the space temperature (as sensed by thermistor T10) is greater than the reset temperature (P7), no reset occurs.

When the space temperature is equal to the reset temperature setting of potentiometer P7, the LED display will show the code 21, at which point reset is initiated. The leaving-air set point will be modified by the following formula:

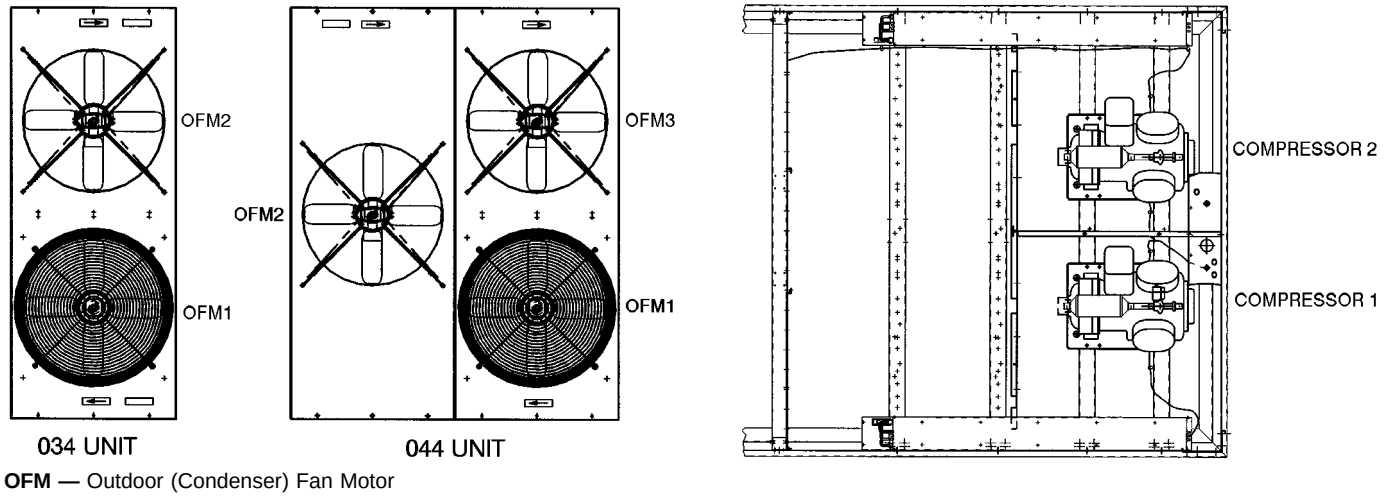
MSP = SP + [(P7 - T10) x P3 x ⅓]

Where: MSP — Modified Leaving-Air Set Point
SP — Leaving-Air Set Point
P7 — Temperature to Start Reset
T10 — Space Temperature
P3 — Reset Limit



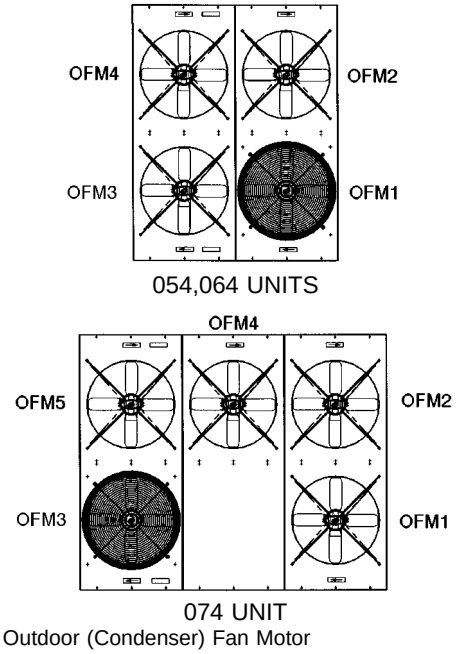
OFM — Outdoor (Condenser) Fan Motor

Fig. 21 — Component Arrangement, 024-030 Units



OFM — Outdoor (Condenser) Fan Motor

Fig. 22 — Component Arrangement, 034,044 Units



OFM — Outdoor (Condenser) Fan Motor

Fig. 23 — Component Arrangement, 054-074 Units

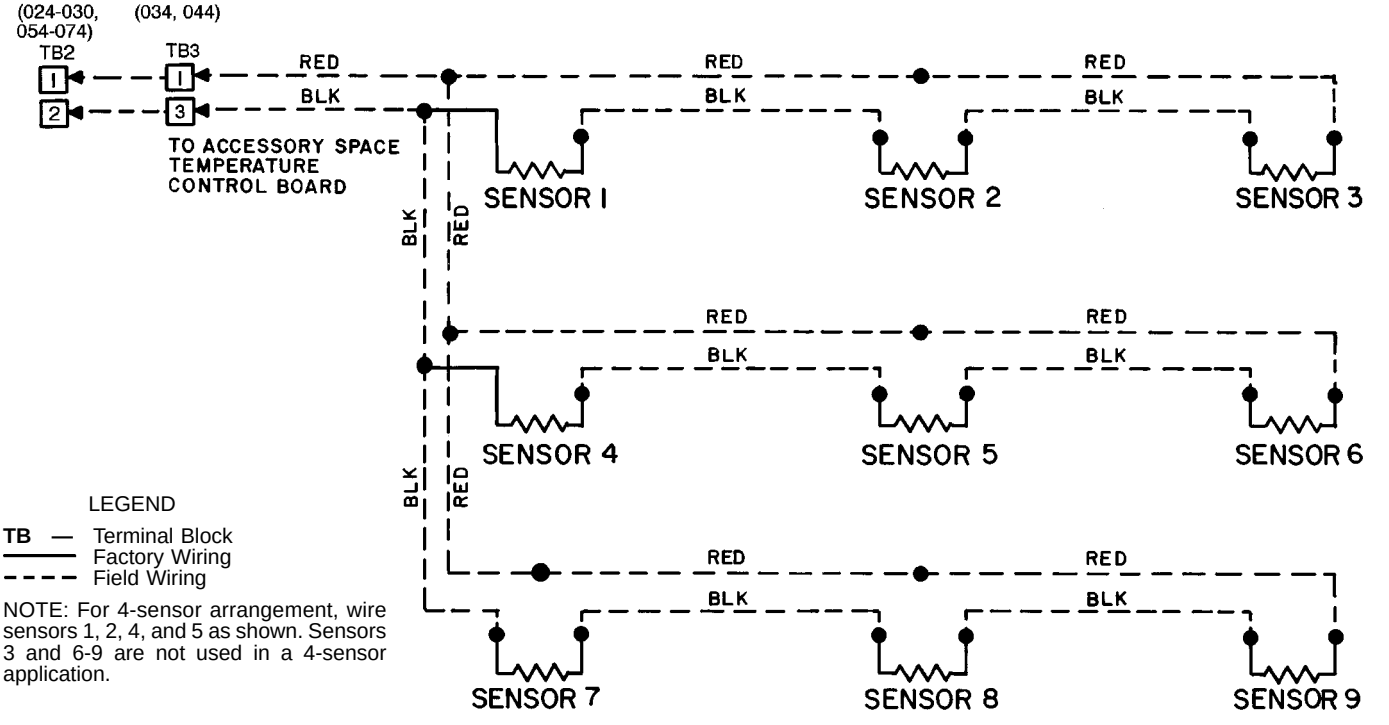


Fig. 24 — Multiple Space Temperature Reset Sensors

Demand Limit Control — Demand limit is a method to limit the capacity of the VAV unit. Two options are available for this method. Single-step demand limit control is a field-supplied 5 to 20 Kohm potentiometer, which provides a single-step capacity reduction based on the setting of the potentiometer. The Carrier accessory two-step demand limit control module utilizes 2 potentiometers and provides 2 steps of capacity reduction.

Once either method is signaled to begin, code 22 will appear on the display screen. The unit capacity will then be reduced by the amount set for the demand limit.

Building Pressurization Mode — Building pressurization is used to pressurize conditioned space in the event of a fire or smoke condition. On a large building with multiple zones, it may be desirable to pressurize a zone that does not have smoke in it to keep smoke from entering the zone from other zones that may be filled with smoke.

In building pressurization mode, supply-air fan operates with outdoor-air dampers wide open (on units with economizer) and if unit is equipped with return or exhaust fan option, exhaust damper opens, and the fan is off. This pumps outdoor air into the zone but does not exhaust it; resulting in the zone becoming positively pressurized.

All switches and wiring required for building pressurization must be field supplied and wired. Terminals are provided to make this job easier.

To go into pressurization mode, power to the control circuit must be interrupted. This can be done using alarm relay contacts described in Fig. 25. These contacts can be energized by a relay in a smoke detector, a firestat, or by a relay that is manually energized in a central control room. Switches must be field installed to energize supply-air fan and drive economizer dampers and supply-air fan inlet guide vanes wide open. After power to control circuit is interrupted, these switches must be manually closed to put unit into pressurization mode; switches would probably be located in a central control room. If unit is equipped with return or exhaust fan option, return-air fan should be off.

Smoke Purge Mode — In order to use smoke purge, unit must be equipped with return or exhaust fan option.

Smoke purge is used to exhaust smoke from a zone in the event of a fire or heavy smoke condition. In this mode, power exhaust fan runs, supply fan is shut off, and economizer dampers are wide open. With power exhaust fan running and exhaust damper wide open, smoke-filled air is exhausted out of the conditioned space to the outside.

With smoke purge mode, it is necessary to interrupt power to unit control circuit as described in Building Pressurization Mode section on this page. All switches and wiring for putting unit into smoke purge mode must be field supplied and installed. Terminals have been provided in unit control box to facilitate field hookups.

The field-supplied switches must energize exhaust fans and drive power exhaust damper (if so equipped) and economizer damper wide open. After power is interrupted to unit control circuit, these switches must be manually closed to place unit into smoke purge mode. As with building pressurization switches, these switches would probably be located in a central control room.

Units Equipped with Static Pressure Control Option — If unit is equipped with static pressure control option, differential pressure switch will modulate fan inlet guide vanes to vary airflow to maintain set point of the switch. See Differential Pressure Switch Set Point and Null Span sections on pages 23 and 23 for details on setting switch set point and null span.

For example, assume that set point on supply fan differential switch is 1.9 in. wg. If pressure in supply duct goes above 1.9 in. wg, switch will make to the normally-open contact and energize inlet guide vane motor to drive inlet guide vanes to a more closed position, thus reducing airflow and lowering duct pressure. Once set point pressure is reached, switch will open and deenergize inlet guide vane motor. If pressure in supply duct is below 1.9 in. wg, the switch will make to the normally-closed contact and energize inlet guide vane motor to drive inlet guide vane to a more open position; increasing airflow and raising duct pressure. Once again, once desired pressure has been reached, switch will open and deenergize inlet guide vane motor. How far above or below the set point setting the switch goes before energizing depends on setting of null span (null span is pressure change that can be made without contacts opening or closing). If null span is at maximum position, pressure will vary from 0.17 in. wg to 0.31 in. wg depending on set point (if set point is at minimum setting, null span will be 0.17 in. wg, while if it is at maximum position, the null span will be 0.31 in. wg) before switch acts. If null span is adjusted to a minimum setting, duct pressure will vary from 0.06 in. wg to 0.11 in. wg (again depending on switch set point) before switch acts. Setting null span to minimum position will result in a smaller pressure fluctuation than if it is set at maximum position.

The modulating power exhaust option switch operates in same manner as supply switch except that it has a different set point range and null span.

Quick Test Program — Turn on power to unit.

IMPORTANT: The field-supplied switch (or time-clock) must be closed to put unit into the occupied mode.

The quick test program utilizes the 2-digit LED display (see Fig. 6) on the set point board to show status of all input and output signals to microprocessor. Display action and quick test procedures are described below.

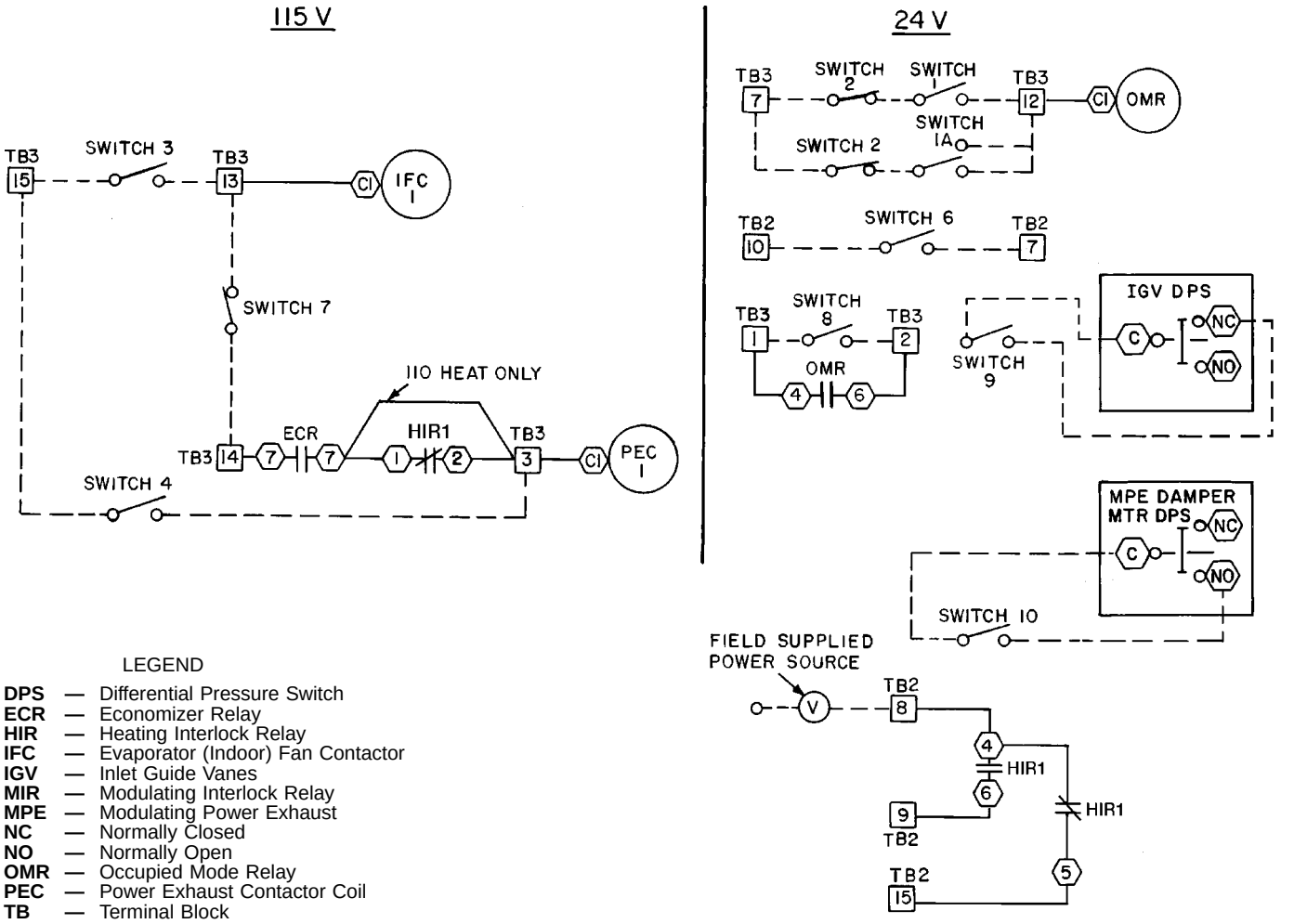
The quick test program is a 33-step program that provides a means of checking all input and output signals of controls prior to unit start-up. This check ensures that all control options, thermistors, and control switches are in proper working order.

When unit control circuit is switched to occupied mode, a 20 will appear on the display. Immediately press display button once. An 88 will appear on the display and alarm light on display board will be energized. This indicates that control system is ready to run quick test program.

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

For each step of the 33-step program, display button must be pressed twice. On first press, step number is displayed; second press initiates required action and appropriate code is displayed.

NOTE: The step number is a numeral followed by a decimal point (a 2-digit number has a decimal point after each numeral). The action code number is one or 2 digits with no decimal point(s).



LEGEND

DPS — Differential Pressure Switch
ECR — Economizer Relay
HIR — Heating Interlock Relay
IFC — Evaporator (Indoor) Fan Contactor
IGV — Inlet Guide Vanes
MIR — Modulating Interlock Relay
MPE — Modulating Power Exhaust
NC — Normally Closed
NO — Normally Open
OMR — Occupied Mode Relay
PEC — Power Exhaust Contactor Coil
TB — Terminal Block

BUILDING PRESSURIZATION
Switch 2
Switch 3
Switch 6
Switch 7
Switch 8
Switch 9

SMOKE PURGE
Switch 2
Switch 4
Switch 6
Switch 7
Switch 8
Switch 10

Switch 1 and 1A — Field-supplied ON-OFF switch (timeclock) and night thermostat (see Note 1).
Switch 2 — Firestat or smoke detector — normally closed.
Switch 3 — Building pressurization switch (energize indoor fan motor) — normally open.
Switch 4 — Smoke purge switch (energize power exhaust motor) — normally open.
Switch 6 — Switch to drive economizer outdoor-air damper fully open — normally open.
Switch 7 — Switch to isolate evaporator-fan motor from power exhaust motor — normally closed.
Switch 8 — Switch to provide 24-v power to inlet guide vane motor and modulating power exhaust damper motor — normally open.
Switch 9 — Switch to drive inlet guide vanes fully open — normally open.
Switch 10 — Switch to drive modulating power exhaust dampers fully open — normally open.

NOTES:
1. Switches 1 and 1A are for timeclock and night thermostat and are not part of building pressurization or smoke purge.
2. Power exhaust option available *only* on 48/50NP units.
3. ---- is field wiring.
4. ———— is factory wiring.
5. All switches are field supplied.
6. For building pressurization, field-supplied power source must drive room terminals wide open.
7. Install field-supplied dry contacts between TB2 terminals 8 and 9 and at TB2 terminal 15 to drive open room terminals when HIR1 contacts are energized.

Fig. 25 — Field Wiring for Building Pressurization and Smoke Purge

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

To recheck any step in quick test program, control must be recycled by turning unit control switch off for a few seconds, and then turning it back on again. Restart quick test program as described above and proceed through quick test steps. Press display button twice for each step until step to be rechecked is reached.

The quick test program is divided into 3 sections as described below and shown in Tables 8-10.

1. Quick Test Steps 1.-1.3. — Unit Configuration and Switch Check

   The microprocessor in unit control system is programmed by 2 switch assemblies located on processor board (Fig. 1). The configuration header is factory set and cannot be changed in the field. The DIP switch assembly contains 8 microswitches that must be set in accordance with the various options selected by the customer. All DIP switches should be checked and set to proper position for options selected prior to the quick test. See Configuration of Header and DIP Switch Assembly section on page 5 for factory switch settings. The DIP switch functions and display codes are shown in Table 8.

2. Quick Test Steps 1.4.-2.3. — Thermistor and Set Point Potentiometers

   In these steps, the microprocessor checks resistance values of all sensors and set point potentiometers to ensure that they are functional, connected properly, and set within proper range for unit configuration.

   Nominal resistance values for all sensors range from 363,000 to 219 ohms in accordance with Table 11. Normal display code for good sensors and potentiometers is 1. A display code of 0 indicates a faulty potentiometer, thermistor or wiring. A 0 display also indicates that option is not being used.

   Table 9 shows thermistor and set point potentiometer functions and quick test display codes.

Table 8 — Quick Test, Unit Configuration and Switch Check

QUICK TEST STEP NO.	NORMAL DISPLAY	DESCRIPTION	CONTROL SWITCH
1.	01	Type Unit — Air-Cooled VAV	Configuration Header
2.	2	No. of Compressors	Configuration Header
3.	2 1	No. of Unloaders (024-034, 054-074) (044)	DIP Switch No. 6 and 7
4.	60	60-Hertz Power	Configuration Header
5.	0 or 1	0 — No Reset (Switch Off) 1 — Reset On (Switch On)	DIP Switch No. 2
6.	0 or 1	0 — No Economizer (Switch Off) 1 — Economizer On (Switch On)	DIP Switch No. 3
7.	0 or 1	0 — No Warm-Up (Switch Off) 1 — Warm-Up Used (Switch On)	DIP Switch No. 4
8.	0 or 1	0 — Demand Limit Not Used (Switch Off) 1 — Demand Limit Used (Switch On)	DIP Switch No. 5
9.	0 or 1	0 — Enthalpy Switch Open 1 — Enthalpy Switch Closed	ECR (024-030) EC (034-074)
1.0.	1	1 — Low-Pressure Switch Closed	Jumper (024-030) Low-Pressure Switch 1 (034-074)
1.1.	1	1 — Low-Pressure Switch Closed	Jumper (024-030) Low-Pressure Switch 2 (034-074)
1.2.	1	No Circuit 1 Oil Pressure Switch	None*
1.3.	1	No Circuit 2 Oil Pressure Switch	None*

LEGEND

DIP — Dual, In-Line Package
EC — Enthlapy Contol
ECR — Enthalpy Control
VAV — Variable Air Volume
*Units are not equipped with oil pressure switches.

Table 9 — Quick Test, Thermistor and Potentiometer Check

QUICK TEST STEP NO.	NORMAL DISPLAY	DESCRIPTION	THERMISTOR OR POTENTIOMETER*
1.4.	1	1 — Thermistor OK 0 — Thermistor Faulty	Leaving Air Thermistor (T1)
1.5.	1	1 — Thermistor OK 0 — Thermistor Faulty	Entering Air Thermistor (T2)
1.6.	1	024-030 1 — Resistor OK 0 — Resistor Faulty 034-074 1 — Thermistor OK 0 — Thermistor Faulty	Circuit 1 Condenser Thermistor (T3) or Resistor
1.7.	1	024-030 1 — Resistor OK 0 — Resistor Faulty 034-074 1 — Thermistor OK 0 — Thermistor Faulty	Circuit 2 Condenser Thermistor (T4) or Resistor
1.8.	1	1 — Thermistor or Potentiometer OK 0 — Thermistor or Potentiometer Faulty or Option not used	Accessory Space Temperature Thermistor (T10) or Accessory Reset Potentiometer (P7)
1.9.	1	1 — Potentiometer OK 0 — Potentiometer Faulty	Supply-Air Set Point Potentiometer (P1)
2.0.	1	1 — Potentiometer OK 0 — Potentiometer Faulty or Option not used	Accessory Reset Limit Potentiometer (P3)
2.1.	1	1 — Potentiometer OK 0 — Potentiometer Faulty or Option not used	Accessory Demand Limit Potentiometer (P4)
2.2.	1	1 — Potentiometer OK 0 — Potentiometer Faulty or Option not used	Minimum Position Economizer Potentiometer (P5)
2.3.	1	1 — Potentiometer OK 0 — Potentiometer Faulty or Option not used	Warm-Up Set Point Potentiometer (P6)

*Potentiometer P2 is not listed since it is not part of the quick test. If on unit start-up a Code 83 is displayed, check potentiometer P2.

Table 10 — Quick Test, Output Relay Check

QUICK TEST STEP NO.	NORMAL DISPLAY	DESCRIPTION	RELAY NUMBER
2.4.	1	1 — Open Economizer or Open Relay if no Economizer	K7
2.5.	1	1 — Close Economizer or Close Relay if no Economizer	K8
2.6.	1	1 — Energize Fan Relay and Heat Relay	K9* and K10
2.7.	1	Energize Stage 1 Condenser Fan(s)	K11
2.8.	1	Energize Stage 2 Condenser Fan(s) — 034-074 Only	K12
2.9.	0 then 1 then 0	Energize Compressor 1†	K1
3.0.	0	Energize Unloader 2 (024-034, 054-074); Not Used (044)	K2
3.1.	0	Energize Unloader 1	K3
3.2.	0 then 1 then 0	Energize Compressor 2†	K5
3.3.	0	Not Used	K6

CR — Control Relay

*K9 (fan relay) will remain on for duration of quick test.
†Compressor will be energized for 10 seconds. Zero indicates open CR; 1 indicates closed CR.

Table 11 — Sensor Resistance Values

TEMP (F)	RESISTANCE (Ohms)	TEMP (F)	RESISTANCE (Ohms)	TEMP (F)	RESISTANCE (Ohms)
−60	362,640	**45**	11,396	**150**	1,020
−55	297,140	**50**	9,950	**155**	929
−50	245,245	**55**	8,709	**160**	844
−45	202,841	**60**	7,642	**165**	768
−40	168,250	**65**	6,749	**170**	699
−35	139,960	**70**	5,944	**175**	640
−30	116,820	**75**	5,249	**180**	585
−25	98,420	**80**	4,644	**185**	535
−20	82,665	**85**	4,134	**190**	490
−15	69,685	**90**	3,671	**195**	449
−10	58,915	**95**	3,265	**200**	414
−5	50,284	**100**	2,913	**205**	380
0	42,765	**105**	2,600	**210**	350
5	36,475	**110**	2,336	**215**	323
10	31,216	**115**	2,092	**220**	299
15	26,786	**120**	1,879	**225**	276
20	23,164	**125**	1,689	**230**	255
25	19,978	**130**	1,527	**235**	236
30	17,276	**135**	1,377	**240**	219
35	14,980	**140**	1,244		
40	13,085	**145**	1,126		

3. Quick Test Steps 2.4.-3.3. — Output Relays

   These quick test steps allow microprocessor to check output signals from relay boards in unit control system. In addition, operation of all the condenser fans, compressors, and economizer (if equipped) are checked at each step.

   Normal display for Steps 2.4. through 2.8. is 1. In Steps 2.9. through 3.2., each compressor and unloader is started and allowed to run for approximately 10 seconds. At start-up, a 0 will appear on the display followed by a 1 (Steps 2.9. and 3.2.) in a few seconds. Steps 3.0. and 3.1. will always be 0 since there are unloaders, and Step 3.3. will always be zero since it is not used.

   At end of the 10-second time period, a 0 will return to the display board indicating that test step has been successfully completed (Steps 2.9. and 3.2.). The 1 indicates that was tested.

   Fan and compressor operating sequence for quick test Steps 2.4. through 3.3. are shown in Table 10.

If the quick test steps do not operate as described above,a defect exists in one or more of the following: relay being tested, electronic control, or unit wiring. Determine problem and correct.

SERVICE AND TROUBLESHOOTING

NOTE: The service and troubleshooting instructions in this section apply specifically to VAV rooftop units. For information regarding service and troubleshooting which is common to all 20 to 75 ton rooftop units, refer to base unit installation instruction literature.

Inlet Guide Vane Motor (Units with Inlet Guide Vanes and Static Pressure Control Option) —

The inlet guide vane motor is located next to the evaporator fan. Access is through the 2 doors labeled FAN SECTION on the left side of the unit (024-030) or on both sides of the unit (034-074). See Fig. 26-29 for location of the inlet guide vane damper motor.

Modulating Power Exhaust Differential Pressure Switch

SIZE 024-030 UNITS — The modulating power exhaust differential pressure switch is located in the small control box mounted on the corner post next to the access door labeled FILTER SECTION. See Fig. 30. To gain access to this box, remove the small control box cover. When replacing cover, be sure to properly secure it in order to prevent water from being drawn into the unit.

This box also contains a pressure gage and a 24-v transformer for powering the modulating power exhaust damper motor.

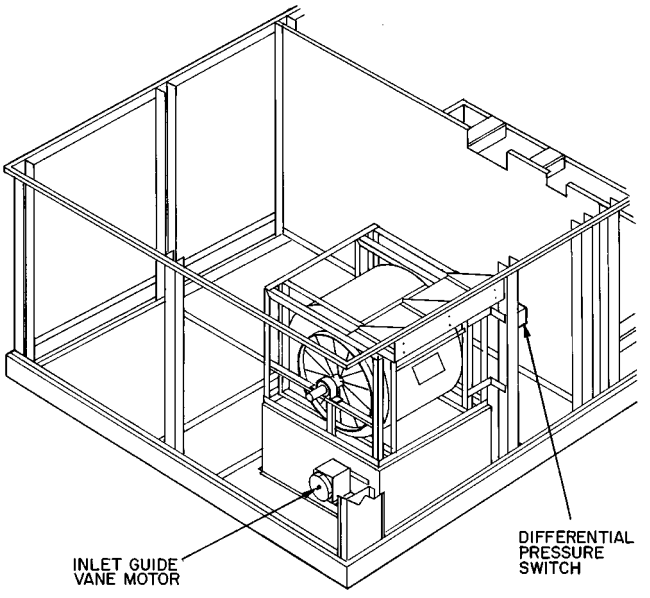


Fig. 26 — Location of Differential Pressure Switch and Inlet Guide Vane Motor (50DK024-030 Units)

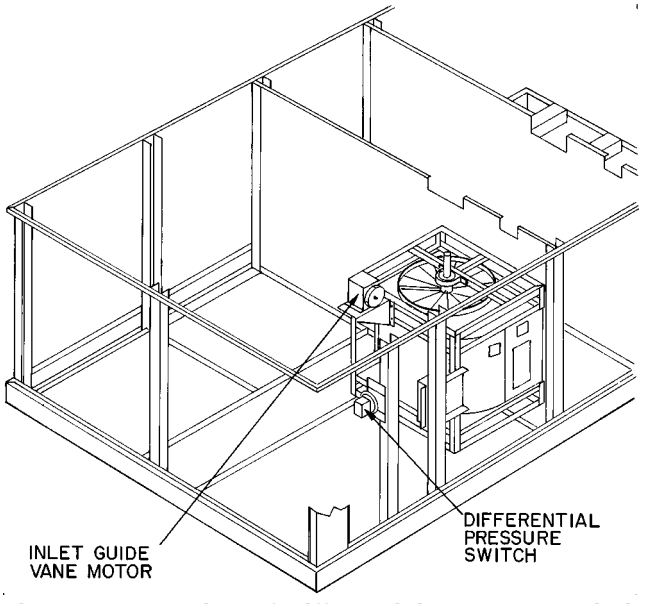


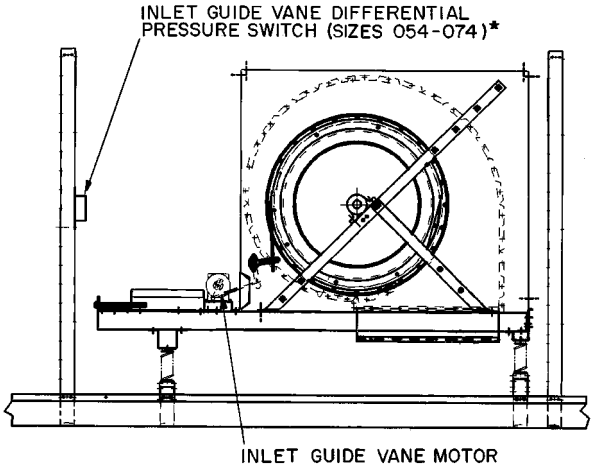
Fig. 27 — Location of Differential Pressure Switch and Inlet Guide Vane Motor (48DK/50DY024-030 Units)

SIZE 034,044 UNITS — The modulating power exhaust differential pressure switch is located in the auxiliary control box mounted in the corner next to the power exhaust motor door. To gain access to this control box, remove the auxiliary control box cover. When replacing cover, be sure to properly secure it in order to prevent water from being drawn into the unit. See Fig. 28 and 29.

SIZE 054-074 UNITS — The modulating power exhaust differential pressure switch is mounted below the auxiliary control box next to the access door labeled FILTER SECTION. See Fig. 28 and 29.

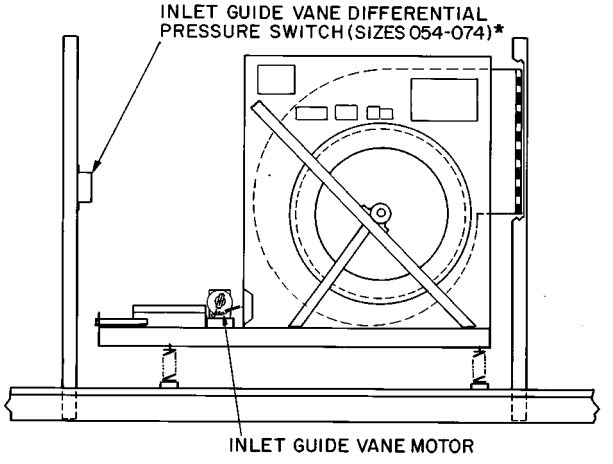
Inlet Guide Vane Differential Pressure Switch (Units with Inlet Guide Vane and Static Pressure Control Option)

SIZE 024-030 UNITS — On the 50DK units, the inlet guide vane motor differential pressure switch is located on the post on the right-hand side of the blower assembly (when facing the blower assembly). Access is through the access door labeled FAN SECTION. This access door is right next to the access door to the main unit control box. See Fig. 26.



*The inlet guide vane differential pressure switch for the 034,044 units and the modulating power exhaust differential pressure switch (034-074 units) are located in the back of the unit in the auxiliary control box. Their locations are not shown in this figure.

Fig. 28 — Inlet Guide Vane Motor, 50DK034-074 Units



*The inlet guide vane differential pressure switch for the 034,044 units and the modulating power exhaust differential pressure switch (034-074 units) are located in the back of the unit in the auxiliary control box. Their locations are not shown in this figure.

Fig. 29 — Inlet Guide Vane Motor, 48DK/50DY034-074 Units

On the 48DK/50DY units, the inlet guide vane motor differential pressure switch is located on the post on the left-hand side of the blower assembly (when facing the blower assembly). Access is through the access door labeled FAN SECTION on the end of the unit (opposite condenser section of the unit). See Fig. 27.

SIZE 034,044 UNITS — The inlet guide vane differential pressure switch is located in the auxiliary control box mounted in the corner under the side air hood that is next to the access door marked FILTER SECTION. To gain access to this control box, remove the auxiliary control box cover. When replacing cover, be sure to properly secure it in order to prevent water from being drawn into the unit. See Fig. 28 and 29.

SIZE 054-074 UNITS — The inlet guide vane differential pressure switch is mounted on an upright located behind the evaporator-fan motor. See Fig. 29 and 30.

Differential Pressure Switch Set Point and Null Span (Units Equipped with Inlet Guide Vane and Static Pressure Control Option) — See Fig. 26-30 for location of switches in unit. Differential pressure switch has an adjustable set point range of 1.1 in. wg to 3.5 in. wg. Factory setting is 1.9 in. wg. To adjust set point, turn set point adjusting screw (see Fig. 31) clockwise to decrease set point and counterclockwise to increase set point. This switch also has an adjustable null span. The null span is the pressure change that can be made without contacts opening or closing. It is adjustable from 0.06 in. wg to 0.17 in. wg when set point is at minimum position (1.1 in. wg) and 0.11 in. wg to 0.31 in. wg when set point is at maximum position (3.5 in. wg). To adjust null span, turn null adjusting screw (Fig. 31) clockwise to decrease span and counterclockwise to increase span. All switches leave factory with null span set at maximum position. The smaller the null span, the closer the pressure will be maintained to desired set point.

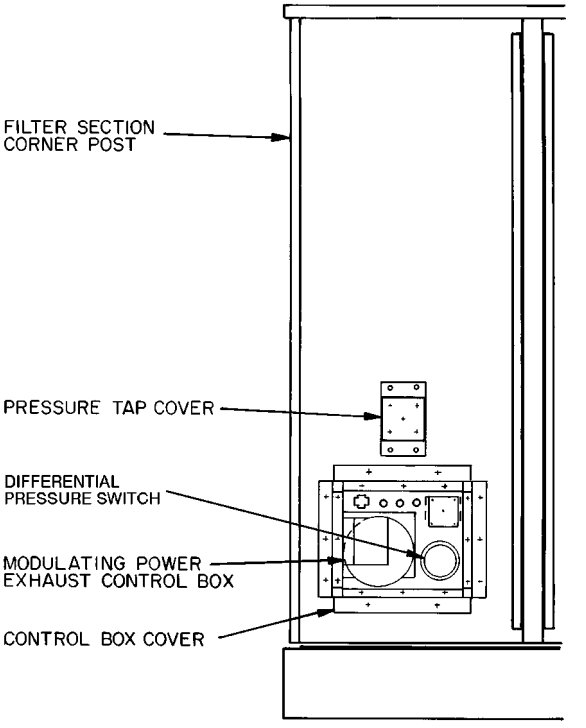
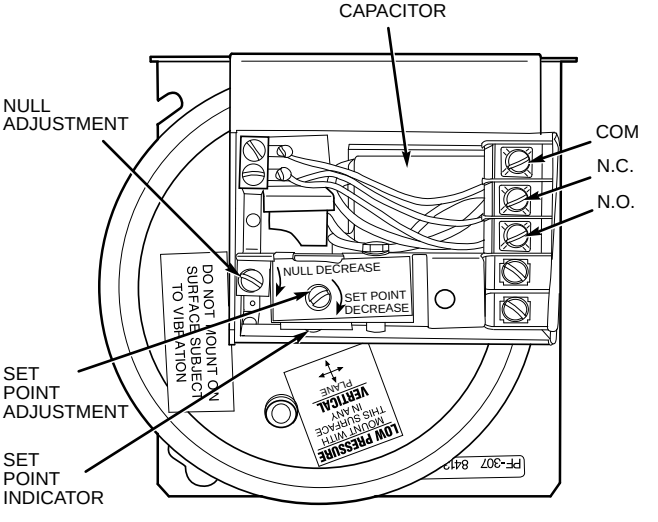


Fig. 30 — Location of Modulating Power Exhaust Control Box, 024-030 Units



COM — Common
NC — Normally Closed
NO — Normally Open

Fig. 31 — Differential Pressure Switch for Inlet Guide Vane and Static Pressure Control Option and Modulating Power Exhaust Option

Differential Pressure Switch Set Point and Null Span (Units Equipped with Modulating Power Exhaust Option) — The set point range for this switch is −0.5 in. wg to +0.5 in. wg. Factory setting is +0.1 in. wg. To adjust set point, turn set point adjusting screw (See Fig. 31) clockwise to decrease set point and counterclockwise to increase set point. This switch also has an adjustable null span. The null span is the pressure change that can be made without contacts opening or closing. It is adjustable from 0.06 in. wg to 0.14 in. wg when set point is at minimum position (−0.5 in. wg) and 0.07 in. wg to 0.14 in. wg when set point is at maximum position (+0.5 in. wg). To adjust null span, turn null adjusting screw (Fig. 31) clockwise to decrease span and counterclockwise to increase span. All switches leave factory with null span set at maximum position. The smaller the null span, the closer the pressure will be maintained to desired set point.

VAV Diagnostic Information — The microprocessor contains extensive self-diagnostic information. The 2-digit LED display is used to display the diagnostic codes and the alarm light (located next to display) is energized whenever a diagnostic code is tripped. When a problem is suspected, always check the display first for diagnostic information.

Table 12 details diagnostic codes and a brief description of the possible causes.

NOTE: Codes 52-54, 56-58, 61, 62, 65-69, 73, 74, and 77-80 are not used on these units.

IMPORTANT: The microprocessor memory and the display will be cleared if the power to the microprocessor is shut off. 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 a hazardous operating condition.

CODES 51 AND 55: COMPRESSOR FAILURE — If control relay (CR) opens while compressor should be operating, compressor will stop and microprocessor will energize alarm light and display a code of 51 or 55 (depending on compressor) when display button is pushed. The compressor will be locked off; to reset, the ON-OFF switch must be turned to OFF and then to ON position.

Code 51 is for compressor 1, and Code 55 is for compressor 2. Other codes are not used for 024-074 units.

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

If a failure occurs, the following are possible causes:

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

Internal Thermostat — The internal thermostat in each compressor is also wired in series with 24-v power that energizes CR. If thermostat fails or switch opens during operation of compressor, compressor will shut down and failure is detected through feedback contacts.

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

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

Table 12 — Overload Codes

DISPLAY	DESCRIPTION OF FAILURE	ACTION TAKEN BY CONTROL	RESET METHOD	PROBABLE CAUSE
51 **55**	Compressor 1 failure Compressor 2 failure	Circuit 1 shut off Circuit 2 shut off	Manual	High-pressure switch or high discharge gas thermostat switch trip, compressor ground current > 2.5 amp or compressor board relay on when it is not supposed to be on. Wiring error between electronic control and compressor protection module.
59 **60**	Loss-of-charge circuit 1 Loss-of-charge circuit 2	Circuit 1 shut off Circuit 2 shut off	Manual Manual	Not used on 024-030 units. Check jumper on processor board. For 034-074 units, this indicates either a low refrigerant charge, or a loss-of-charge switch failure.
63 **64**	Low oil pressure circuit 1 Low oil pressure circuit 2	Circuit 1 shut off Circuit 2 shut off	Manual Manual	Not used; Check jumper on processor board.
70	Illegal unit configuration	Unit will not start	Manual	Configuration error (see Note 1).
71 **72** **75** **76** **81**	Leaving-air thermistor failure Entering-air thermistor failure Circuit 1 Resistor (024-030) Circuit 1 Saturated Condensing Thermistor (034-074) Circuit 2 Resistor (024-030) Circuit 2 Saturated Condensing Thermistor (034-074) Reset temperature thermistor failure	Unit shut off Use default value Unit shut off Unit shut off Stop reset	Auto. Auto. Auto. Auto. Auto. Auto. Auto.	Thermistor or resistor failure, wiring error, or thermistor or resistor not connected to the processor board.
82 **83** **84** **85** **86** **87**	Leaving-air set point potentiometer failure Economizer potentiometer failure Reset limit set point potentiometer failure Demand limit potentiometer failure Minimum economizer potentiometer failure Warm-up set point potentiometer failure	Use default value Close economizer Stop reset Stop demand limit Close economizer Use default value	Auto. Auto. Auto. Auto. Auto. Auto.	Potentiometer improperly connected, potentiometer setting out of range, potentiometer failure or wiring error.

NOTES:
1. Illegal unit configuration caused by missing programmable header or both unloader DIP switches on.
2. All auto. reset failures that cause the unit to stop will restart when the error has been corrected.
3. All manual reset errors must be reset by turning the control switch off and then back on.
4. Valid resistance range for the thermistors is 363,000 to 219 ohms.
5. Codes 52-54, 56-58, 61-69, 73, 74, and 77-80 are not used on these units.

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

The control does not detect compressor circuit breaker failures.

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

CODES 59 AND 60: LOW-PRESSURE SWITCH — These codes are used to indicate a low-pressure switch failure. Since the 024-030 units have low-pressure switches but are not monitored individually by the processor, these codes are not used for the 024-030 units.

NOTE: If these codes appear on the 024-030 units, check to be sure that the jumper is in place (J2-7 to J2-8 for a code 59, or J2-9 to J2-10 for a code 60). To reset the circuit, the ON-OFF switch must be turned to OFF, then ON position.

On the 034-074 units, the processor monitors the low-pressure switch. If the switch opens, either by low refrigerant charge, circuit failure, or wiring error, the circuit is locked off. Code 59 indicates a failure of the lead circuit, and as a result, that circuit will be shut down. Code 60 indicates a failure of the lag circuit, and as a result, that circuit will be shut down. These codes will only be displayed when the display button is pressed. To reset the circuit, the ON-OFF switch must be turned to OFF, then ON position.

CODES 63 AND 64: OIL PRESSURE SWITCH — These codes are used to indicate an oil pressure switch failure. Since the units do not have oil pressure switches, these codes are not used. The terminals on the processor board must be jumpered together or an error will occur. If these errors occur, check jumper between J2-1 and J2-2 for a code 63, or between J2-3 and J2-4 for a code 64 to be sure jumper is properly connected. To reset the circuit, the ON-OFF switch must be turned to OFF and then to ON position.

CODE 70: ILLEGAL UNIT CONFIGURATION — If the unit configuration header is not installed and properly configured, and/or if DIP switches are not properly set, unit will not start, and an error code of 70 will be indicated on display board when display button is pushed. Check the header and DIP switch settings.

CODES 71 TO 76: THERMISTOR/RESISTOR FAILURE — If measured temperature of a thermistor is less than −60 F (363,000 ohms) or greater than 180 F (585 ohms), the appropriate sensor error code (Table 12) will be displayed when the display button is pushed. The unit will be shut down. Thermistor failures will automatically reset once the error has been corrected. If a failure occurs, the following are possible causes:

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

Wiring Failure — If a wiring error exists that causes a shorted or open circuit, this will cause a failure.

Processor Board Failure — If circuitry on processor board fails, this could cause an error.

The codes are designated as follows:

Code 71 Supply-Air Thermistor Failure

Code 72 Leaving-Air Thermistor Failure

Code 73 Not used

Code 74 Not used

Code 75 Circuit 1 Resistor (024-030)
Circuit 1 Saturated Condensing Thermistor (034-074)

Code 76 Circuit 2 Resistor (024-030)
Circuit 2 Saturated Condensing Thermistor (034-074)

CODE 81: RESET THERMISTOR OR POTENTIOMETER FAILURE — This is a unique code since the reset temperature potentiometer (P7) is in series with the space temperature thermistor (T10). If either one of these components fail, reset will be terminated. This error will automatically reset once the situation is corrected. If an error is detected, the most probable cause is one of the following:

- Thermistor Failure — A shorted or open thermistor will cause the failure.
- Potentiometer Failure — If the potentiometer is outside of the valid range (40 to 90 F), a failure will result.
- Wiring Problem — If the circuit is open, a failure will be detected.
- Processor Board Failure — If the processor board fails (hardware), an alarm will be detected.

CODE 82: LEAVING-AIR TEMPERATURE SET POINT POTENTIOMETER FAILURE — If leaving-air set point potentiometer (P1 — located on display board) fails, control will use a default value. A failure will cause an error code of 82 to be displayed on display board when display button is pushed; alarm light will also be energized. A failure is determined by establishing a range of −22 F to 70 F as a valid range. Anything outside this range will be treated as a failure. If setting is outside the −22 F to 70 F range, alarm light will be energized and an error code of 82 will be displayed when display button is pushed; the control will use a set point of 70 F. If set point is between −22 F and 45 F, control will use a set point of 45 F and no error code will be indicated. If potentiometer returns to normal, control will automatically reset.

NOTE: The full range of the potentiometer is not used for the cooling set point range of 45 F to 70 F. The full scale resistance of the potentiometer is 10 Kohms.

If a failure occurs, one of the following is a probable cause:

Incorrect Potentiometer Setting — A potentiometer turned fully clockwise or counterclockwise is outside the valid range and will cause a failure.

Faulty Wiring — If wiring is incorrect between potentiometer and processor board or display board, a failure will result.

Potentiometer Failure — If potentiometer is shorted or open, a failure will result.

CODE 83: ECONOMIZER FEEDBACK POTENTIOMETER FAILURE — If potentiometer on economizer motor (P2) fails, control will use a default value of 0% and economizer outdoor-air dampers will close. The failure will energize alarm light and cause an error code of 83 to be displayed when display button is pushed. This potentiometer is a 5 to 15 Kohm potentiometer. If potentiometer returns to normal, control will automatically reset. If a failure occurs, one of the following is the probable cause.

Faulty Wiring — If the wiring between processor board and potentiometer is wrong, this will cause a failure.

Potentiometer Failure — If potentiometer is shorted or open, this will cause a failure.

Economizer Damper Stuck — The control has been programmed to indicate an error if potentiometer travel is less than 10% of the full range. This would happen if dampers or damper linkage were hung up and could not move properly.

CODE 84: RESET LIMIT POTENTIOMETER FAILURE — This code is applicable only if reset is being used. If reset is being used, DIP switch 2 must be in the ON position. This potentiometer (P3) is located on the accessory board. If potentiometer setting is less than 0° F or greater than 80 F, alarm light will be energized, a diagnostic code of 84 will

be displayed if display button is pushed, and reset will be terminated. The full-scale resistance of potentiometer is 10 Kohms, but when installed on the accessory board in parallel with the other 2 potentiometers, measured resistance will be 3.3 Kohms. This failure will automatically reset once potentiometer returns to normal. If a failure occurs, one of the following is the probable cause:

DIP Switch Problem — DIP switch 2 is in the ON position and the accessory board is not installed (accessory board is standard on these units so it should always be on the unit).

Incorrect Potentiometer Setting — A potentiometer turned fully clockwise or counterclockwise is outside the valid range and will result in a failure.

Faulty Wiring — If the wiring between the potentiometer and the processor board is incorrect, a failure will result.

Potentiometer Failure — If potentiometer is shorted or open, a failure will occur.

CODE 85: DEMAND LIMIT POTENTIOMETER (P4) FAILURE — Used only if demand limit is being used. If demand limit is used, DIP switch 5 must be in the ON position.

Two types of demand limit are available: a field-supplied and installed single-step control consisting of a 10 Kohm, 3-wire linear potentiometer and an accessory 2-step control are available from Carrier. The single-step control has a single potentiometer while 2-step control has 2 potentiometers (mounted on the demand limit board, see Fig. 20).

For both types of demand limit, the control uses only 80% of the total potentiometer resistance. If resistance of potentiometer is less than 10% or greater than 90%, alarm light will be energized, a diagnostic code of 85 will be displayed when the display button is pushed, and demand limit will be terminated. If a failure occurs, it is probably due to one of the following:

Potentiometer Failure — If a potentiometer is shorted or open, a failure will occur.

Incorrect Potentiometer Setting — A potentiometer turned fully clockwise or counterclockwise will put potentiometer out of range resulting in an error.

Faulty Wiring — If wiring between the potentiometer and the processor board is incorrect, an error will occur.

DIP Switch 5 — If DIP switch 5 is in the ON position and potentiometer is not installed, an error will occur.

CODE 86: MINIMUM POSITION ECONOMIZER POTENTIOMETER FAILURE — If potentiometer P5 (on accessory board) setting is less than 0% or greater than 100%, alarm light will be energized, a code of 86 will be displayed when display button is pushed and economizer outdoor air dampers will move to the fully closed position.

The potentiometer full-scale resistance is 10 Kohm, but when installed in parallel with the other 2 potentiometers on the accessory board, measured resistance will be 3.3 Kohm.

This failure will automatically reset when potentiometer returns to normal.

If a failure occurs, one of the following is the probable cause:

DIP Switch 3 — If this switch is in the ON position and the accessory board is not installed (accessory board is standard on these units, so it should always be on the unit).

Incorrect Potentiometer Setting — If potentiometer is turned fully clockwise or counterclockwise, potentiometer will be out of the allowable range, and an error will result.

Faulty Wiring — If wiring between the potentiometer and the processor board is incorrect, an error will occur.

Potentiometer Failure — If potentiometer is shorted or open, potentiometer will be out of range and an error will result.

CODE 87: WARM-UP TEMPERATURE SET POINT FAILURE — Applicable only if morning warm-up is used. Whether or not unit is equipped with electric resistance heaters, use of the morning warm-up function is recommended if the unit is shut down at night or over weekends. In this application, cooling will remain off and the outdoor-air damper will stay closed until heat load from the occupied space elevates return-air temperature to the warm-up set point. If warm-up function is used, DIP switch 4 must be in the ON position. The potentiometer (P6) is located on the accessory board. If potentiometer is set at less than 0° F or more than 95 F, alarm light will be energized, a diagnostic code of 87 will appear on the display when display button is pushed, and control will use a default value of 40 F. If setting is between 0° F and 40 F, control will use a value of 40 F but no diagnostic code will be displayed; if setting is between 80 F and 95 F, control will use a value of 80 F but no diagnostic code will be displayed.

The potentiometer full-scale resistance is 10 Kohm, but when wired in parallel with other potentiometers on the accessory board, measured resistance is 3.3 Kohm.

The failure will automatically reset once potentiometer returns to normal. If a failure occurs, one of the following is the probable cause:

DIP Switch 4 — If this switch is in the ON position and the accessory board is not installed (accessory board is standard on these units, so it should always be on the unit).

Incorrect Potentiometer Setting — If potentiometer is turned fully clockwise or counterclockwise, potentiometer will be out of the allowable range, resulting in an error.

Faulty Wiring — If the wiring between the potentiometer and the processor board is incorrect, an error will occur.

Potentiometer Failure — If potentiometer is shorted or open, potentiometer will be out of range, resulting in an error.

Electronic Controls Checkout — The following will help determine whether a processor board, a relay board, display set point board, accessory board, or 2-step demand limit module is faulty.

Before checking out any board, do the following:

1. At initial start-up, enter the quick test mode. This test will determine if all components are connected and operating properly.
2. If system has been operating and a malfunction occurs, check display for diagnostic codes. Use diagnostic chart located on inner panel of access door to control box section of unit; this chart will help determine probable cause of failure.

   These 2 steps will help determine if a component other than a board is at fault or if the problem is external to control circuit.

A volt-ohmmeter will be needed to troubleshoot boards. A digital meter is preferred but a Simpson 260 or equivalent will work.

⚠ CAUTION

To prevent damage to solid-state electronic components on boards, meter probes should only be placed on terminals and test points listed in following sections. Do not short the electrical components, and use extreme care while working on the processor board.

PROCESSOR BOARD CHECKOUT — Refer to Fig. 32 and 33 for location of terminal pins and test points.

Step 1 — Check transformer input to the board.

Connector J4 is used to connect the control transformer to the processor board.

1. Set the volt-ohmmeter to ac voltage with a range setting of approximately 30 v.
2. Turn control switch to ON position.
3. Check voltage at following terminals on pin terminal connector J4:

TERMINALS	VOLTAGE (AC)
1 to 2	15.3 to 20.9
4 to 6	16.2 to 22.0
5 to 6	8.1 to 11.0
5 to 4	8.1 to 11.0

4. If voltage is not within range, check primary side.

   115-v transformer — 104 to 127 vac
   230-v transformer — 207 to 254 vac
5. If primary voltage is not correct, check system fuse, transformer, ON-OFF switch, and wiring. If these are okay, contact power company.
6. If primary voltage is correct, but secondary voltage (24 v ± 10%) is incorrect, replace transformer.
7. Turn control switch to OFF position.

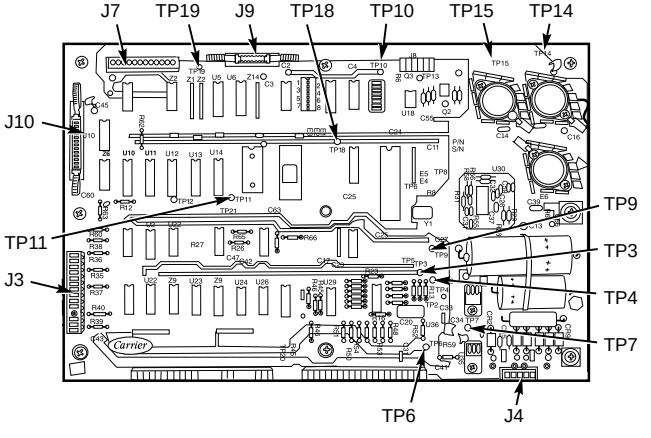
Step 2 — Check processor board power supply.

1. Set meter to approximately 20 vdc.
2. Turn power to OFF position.
3. Connect negative lead to TP18.
4. Turn power switch to ON position and press display button to enter quick test mode.
5. Check voltage between TP18 and each of the following test pins:

TEST PIN	VOLTAGE (DC)
TP3	+10
TP4	+12
TP6	+5
TP10	+5
TP14	+12
TP15	+12
TP7	−5*

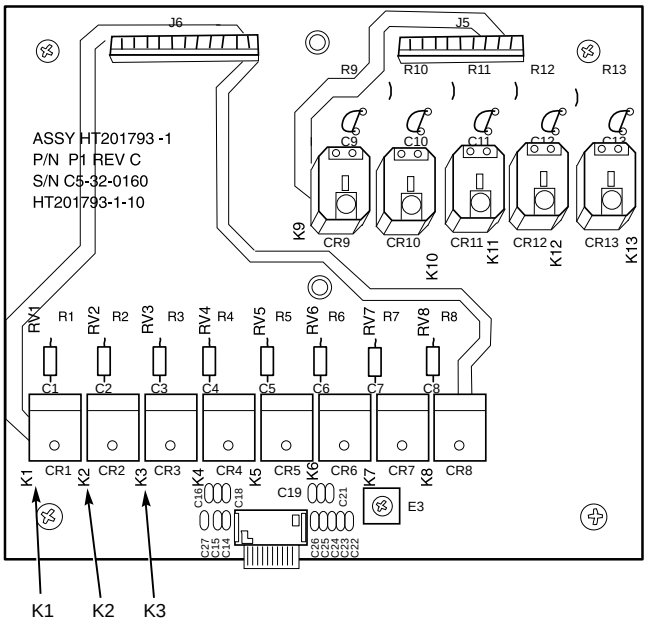
*If not using a digital meter, leads must be reversed.

6. If voltage is incorrect, replace processor board.
7. Turn power to ON position.



J — Pin Terminal Strip
TP — Test Pin

Fig. 32 — Processor Board Test Points



CR — Control Relay
J — Pin Terminal Strip
K — Relay

Fig. 33 — Relay Board Test Points

Step 3 — Check voltage tolerance circuitry.

1. Turn power to OFF position.
2. Negative test probe on TP18 and system in quick test mode.
3. Check voltage TP18 to TP9.
4. If voltage is greater than +1 vdc, recheck transformer input voltage.
5. If transformer is okay, replace processor board.
6. Turn power to ON position.

Step 4 — Check processor reset line.

1. Turn power to OFF position.
2. Negative probe on TP18.
3. Check voltage TP18 to TP11.
4. If voltage is greater than +3 vdc, reset power and recheck.
5. If voltage is still incorrect, replace processor board.
6. Turn power to ON position.

Step 5 — Check relay board outputs from the processor board.

This step involves checking the output signals from relays K1-K3 on the relay board.

1. Turn power to OFF position.
2. Connect negative test probe to TP19 (meter still set to dc).
3. Turn switch to ON position and enter quick test mode.
4. Connect positive test probe to terminal 14 on pin terminal connector J9, and check voltage from TP19 to terminal 14 on pin terminal connector J9.
5. If not +12 ± 1 vdc, replace processor board.
6. Turn switch to OFF position.
7. Remove negative test probe from TP19. Connect positive test probe to TP15.
8. Turn switch to ON position and go into quick test mode.
9. Place negative lead on terminals shown in Table 13, and check voltage between TP15 and terminals shown in Table 13 on pin terminal connector J9. See Fig. 34 for J9 details.

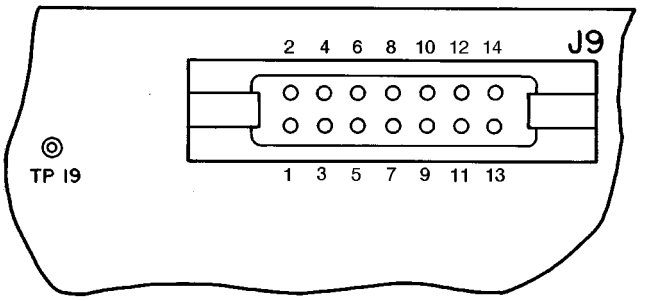


Fig. 34 — Relay Board Pin Terminal Connector (J9)

Table 13 — Voltage Reading

QUICK TEST STEP NO.	J9 PIN NUMBERS												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1.-2.3.	0	0	0	0	0	0	0	0	0	0	0	0	12
2.4.	0	0	0	0	0	0	12	0	0	0	0	0	12
2.5.	0	0	0	0	0	0	0	12	0	0	0	0	12
2.6.	0	0	0	0	0	0	0	12	0	12	0	0	12
2.7.	0	0	0	0	0	0	0	12	0	0	12	0	12
2.8.	0	0	0	0	0	0	0	12	0	0	0	12	12
2.9.	**12**	0	0	0	0	0	0	12	0	0	0	0	12
3.0.	0	**12**	0	0	0	0	0	12	0	0	0	0	12
3.1.	0	0	**12**	0	0	0	0	12	0	0	0	0	12
3.2.	0	0	0	0	**12**	0	0	12	0	0	0	0	12
3.3.	0	0	0	0	0	**12**	0	12	0	0	0	0	12

NOTES:
1. 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 routine for 10 minutes unless the display button is pressed.
2. Acceptable range for the voltage reading:
   0 v — 0 to 4 v
   12 v — 11 to 13 v
3. If any of these voltages are not measured, replace the processor board.

Step 6 — Display board connection checkout.

1. Turn power to OFF position.
2. Disconnect the ribbon cable.
3. Connect negative lead of meter to TP18.
4. Turn power to ON position and go into quick test mode.
5. Place the other lead on terminals shown in table below, and check voltage at pin terminals on pin terminal connector J10 (see Fig. 35 for pin terminal connector J10 details):

PIN TERMINAL	VOLTAGE (DC)
17	5
18	5
20*	2.5
22*	2.5
24	5

*Voltage reading is dependent on the meter's impedance. Readings may vary with different meters.

6. If voltage is not correct, replace processor board.

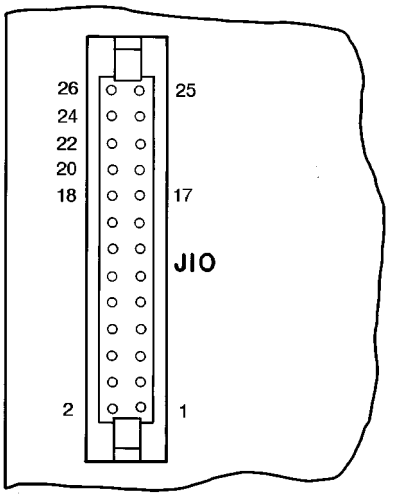


Fig. 35 — Display Board Pin Terminal Connector (J10)

Step 7 — Potentiometer connection checkout.

1. Turn power to OFF position.
2. Remove plug connection from pin terminal strip J3.
3. Connect negative meter lead to terminal 2 of J3.
4. Turn switch to ON position and go into quick test mode.
5. Place the other lead on terminals shown in table below, and check voltage at pin terminals on terminal connector J3:

PIN TERMINAL	VOLTAGE (DC)
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 the meter's impedance. Readings may vary with different meters.

6. If voltage is not correct, replace processor board.

Step 8 − Thermistor Input Connector Checkout

1. Turn power to OFF position.
2. Remove the thermistor connections from pin terminal connector J1, and mark them for later replacement.
3. Connect the negative test lead to test pin TP18.
4. Turn power to ON position, and enter the quick test routine.
5. Place the other lead on terminals shown in Table 14, and check the voltages.
6. If voltages are incorrect (per Table 14), replace processor board.
7. Turn power to OFF position, and replace the thermistor connections removed in Step 2.
8. Turn power to ON position.

Table 14 — Pin Terminal Connector J1 Voltages

PIN TERMINAL	VOLTAGE (vdc ± 0.25 v)
1	0
2	5
6	0
7	5
8	0
9	5
10	0
11	5
12	0
13	5
14	0
15	5
16	0
17	5
18	0
19	5
20	0
21	5

Step 9 – Thermistor Input Connector Checkout

1. Turn power to OFF position.
2. Disconnect all plugs for pin terminal connector J2 and mark them for later replacement.
3. Connect a negative test lead to test pin TP18.
4. Turn power to ON position, and enter the quick test routine.
5. Place the other lead on terminals shown in Table 15, and check the voltages.
6. If voltages are incorrect (per Table 15), replace processor board.
7. Turn power to OFF position, and replace the plugs removed in Step 2.
8. Turn power to ON position.

Table 15 — Pin Terminal Connector J2 Voltages

PIN TERMINAL	VOLTAGE (vdc ± 0.25 v)
1	0
2	5
3	0
4	5
7	0
8	5
9	0
10	5
13	0
14	5
15	5
17	5
18	5
19	5
20	5
21	5
22	5
23	5
24	5

If Steps 1 through 9 have been competed and the unit still will not function properly, replace the processor board.

RELAY BOARD TROUBLESHOOTING — The relay board contains 13 electromechanical relays. The small relays are 24 vac, and the large relays are 115 vac. These 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, turn the control ON/OFF switch to the OFF position, and remove the wiring connectors connected to pin terminal connectors J5 and J6. Set the meter for resistance. If the contacts do not close at the required quick test step, check the relay outputs from the processor board.

Relay Board Checkout

Step 1 — Low-voltage relay resistance check.

1. Turn switch to OFF position.
2. Remove plug connection from terminal strip J6.
3. Set meter to measure resistance. Connect negative test lead to both terminals 11 and 12 of J6.
4. Turn switch to ON position and go into quick test mode.
5. Place other meter lead on terminals shown in Table 16 and check resistances at each quick test step.
6. If these resistances are not correct and relay board outputs from processor board have been checked out, replace relay board.

Step 2 — High-voltage relay resistance check.

1. Turn switch to OFF position.
2. Remove plug connection from terminal connector J5.
3. Connect negative test lead to terminal 8.
4. Check the resistance between terminals 8 and 5 before entering quick test mode. The resistance should be infinity.
5. Turn switch to ON position and go into quick test mode.
6. Place other meter lead on terminals shown in Table 17 and check resistance at each quick test step.
7. If these resistances are not correct and relay board outputs from processor board have been checked per Processor Board Checkout section on page 26, replace relay board.

DISPLAY BOARD CHECKOUT

Step 1 — Check the output voltage from processor board to the relay board — Refer to Step 6 — Display Board Connection Checkout section on page 27.

Table 16 — Pin Terminal Strip J6 Connection Resistance Reading

QUICK TEST STEP NO.	J6 PIN NUMBERS							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. to 2.3.	∞	∞	∞	∞	∞	∞	∞	∞
2.4.	∞	∞	∞	∞	∞	∞	0	∞
2.5.	∞	∞	∞	∞	∞	∞	∞	0
2.6.	∞	∞	∞	∞	∞	∞	∞	∞
2.7.	∞	∞	∞	∞	∞	∞	∞	∞
2.8.	∞	∞	∞	∞	∞	∞	∞	∞
2.9.	**0**	∞	∞	∞	∞	∞	∞	∞
3.0.	∞	**0**	∞	∞	∞	∞	∞	∞
3.1.	∞	∞	**0**	∞	∞	∞	∞	∞
3.2.	∞	∞	∞	∞	**0**	∞	∞	∞
3.3.	∞	∞	∞	∞	∞	**0**	∞	∞

∞ — Infinity

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

Table 17 — Terminal Strip J5 Connector Resistance Reading

QUICK TEST STEP NO.	J5 PIN NUMBERS				
	1	2	3	4	5
1. to 2.5.	∞	∞	∞	∞	0
2.6	0	0	∞	∞	0
2.7.	0	∞	0	∞	0
2.8.	0	∞	∞	0	0
2.9. to 3.3.	0	∞	∞	∞	0

∞ — Infinity

Step 2 — Check the display LEDs.

1. Enter quick test mode.
2. If 88 is not displayed, replace display board.

Step 3 — Check set point potentiometer — Advance the display to quick test step 1.9. to determine if this potentiometer is set and connected properly.

Step 4 — Check display switch — Press switch. If switch does not click, it is faulty and the display will be energized continuously. The switch is an integral part of display board and cannot be replaced separately.

ACCESSORY BOARD CHECKOUT — The accessory board can be completely checked using quick test steps 2.0., 2.2., and 2.3. It can also be checked out as follows:

1. Remove the accessory board connector from the processor board and connect an ohmmeter to terminals 3 and 4 on the connector. Numbers are marked on the connector. See Fig. 19.
2. Set the meter to 10,000 ohms. The resistance value obtained should be 3,333 ohms. Adjust the potentiometers and the resistance value should not change.
3. Connect the ohmmeter to terminals 3 and 6. As the reset limit potentiometer is turned clockwise, resistance should increase from 0 to approximately 3,400 ohms.
4. Connect the ohmmeter to terminals 3 and 5. As the economizer minimum position potentiometer is turned clockwise, resistance should increase from 0 to approximately 3,400 ohms.
5. Connect the ohmmeter to terminals 3 and 2. As the warm-up set point potentiometer is turned clockwise, resistance should increase from 0 to approximately 3,400 ohms.

If any of the Steps 1 through 5 result in any other ohm reading, replace the board; it cannot be serviced.

TWO-STEP DEMAND LIMIT CONTROL MODULE (DLCM) TROUBLESHOOTING — If a problem is suspected in the DLCM board, use the following test procedure:

The board can only be checked when it is connected to the processor and the processor is energized so that the DLCM is supplied with 5 vdc power. The terminals referenced are shown in Fig. 20. Potentiometers P1 and P2 refer to the DLCM potentiometers.

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

Test under the following conditions:

- No power to IN1 or IN2
  Terminal 1 to 2 should read 4.5 vdc ±0.1 v
  Terminal 2 to 3 should read 5.0 vdc ±0.1 v
- Power to IN2 or to both IN1 and IN2, and P2 set at 24%
  Terminal 1 to 2 should read 1.5 vdc ± 0.1 v

  NOTE: Voltage should vary between 0.5 vdc and 2.5 vdc as the setting of P2 is varied between 0% and 49%.

  Terminal 2 to 3 should read 5.0 vdc ± 0.1 v
- Power to IN1 only and P1 set at 50%
  Terminal 1 to 2 should read 2.5 vdc ± 0.1 v
  Terminal 2 to 3 should read 5.0 vdc ± 0.1 v

  NOTE: Voltage should vary between 0.5 vdc and 2.5 vdc as the setting of P2 is varied between 50% and 100%.

NOTE: If the voltages listed in these 3 tests are not obtained during testing, the DLCM board must be replaced.

Thermistor Troubleshooting — The VAV control system uses thermistors to measure temperatures of the entering and supply air, as well as the saturated condensing temperatures of the refrigerant circuits. The resistance versus temperature and electrical characteristics for all thermistors in the system are identical. To obtain an accurate reading, a high-impedance meter (such as a digital meter) must be used.

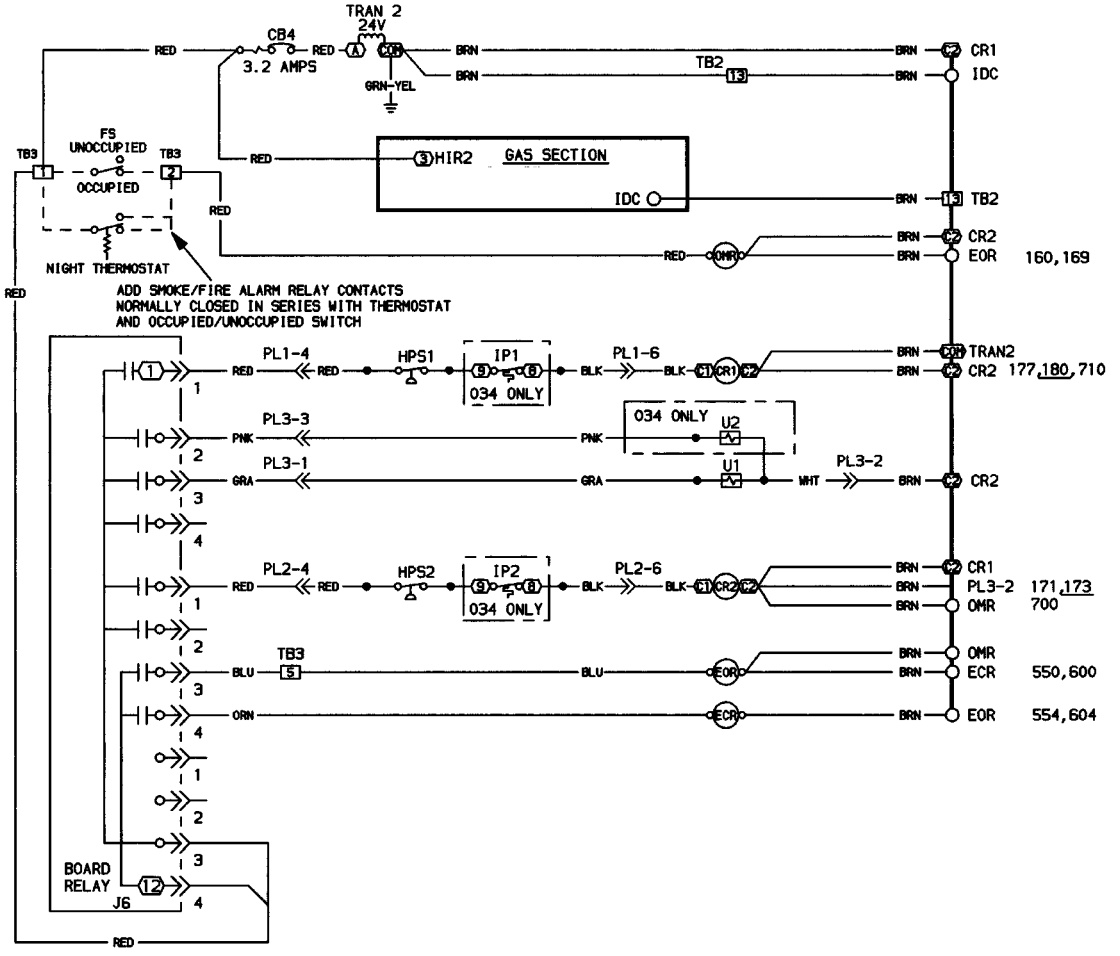
Thermistors in the VAV control system have a 5 vdc signal applied across them any time the unit control circuit is energized. The voltage drop across the thermistor is directly proportional to the temperature and resistance of the thermistor.

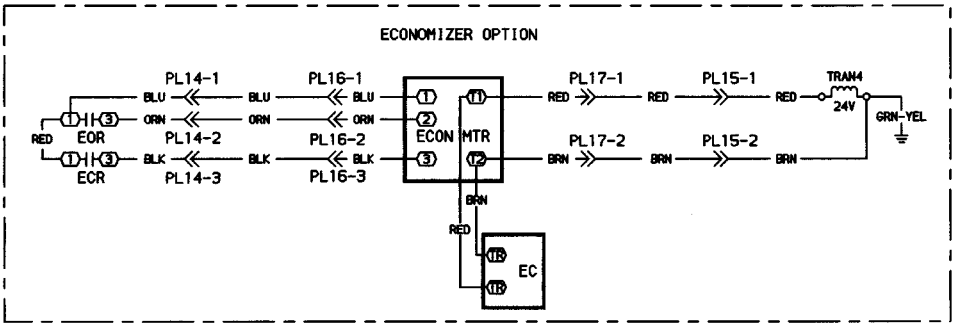
To determine temperatures at the various thermistor locations, disconnect the thermistor from the processor board and measure the resistance across the appropriate thermistor using a high-quality digital ohmmeter. Use the resistance reading to determine the thermistor temperature.

The microprocessor has been programmed to check the operation of the thermistors. If the measured temperature is outside of the range of −24 to 225 F or 98,010 to 282 ohms, then it will be treated as a sensor failure and a diagnostic code will be displayed. See Table 11 for sensor temperatures versus resistance drop. It is also possible to check the operation of the thermistors using the quick test routine.

If a thermistor has failed or the wire is damaged, replace the complete assembly. Do not attempt to spice the wires or repair the assembly.

Control Wiring — For assistance in troubleshooting unit control wiring, refer to Fig. 36 for typical unit control wiring, and to label diagram attached to unit.





LEGEND

ALM	— Alarm	**J**	— Pin Terminal Connector
CB	— Circuit Breaker	**LAT**	— Leaving-Air Temperature
COM	— Common	**LPS**	— Low-Pressure Switch
CR	— Control Relay	**LS**	— Limit Switch
DMS	— Damper Motor Switch	**MTR**	— Motor
DPS	— Discharge Pressure Switch	**NC**	— Normally Closed
DU	— Dummy Terminal	**NO**	— Normally Open
EAT	— Entering-Air Temperature	**OFC**	— Outdoor (Condenser) Fan Contactor
EC	— Enthalpy Control	**OMR**	— Outdoor (Condenser) Fan Motor Relay
ECON	— Economizer	**PEC**	— Power Exhaust Contactor
ECR	— Economizer Control Relay	**PEDM**	— Power Exhaust Damper Motor
EOR	— Economizer Outdoor-Air Relay	**PEDMS**	— Power Exhaust Damper Motor Switch
FS	— Fan Switch	**PL**	— Plug
HC	— Heater Contactor	**POT**	— Potentiometer
HIR	— Heat Interlock Relay	**RES**	— Resistor
IDC	— Induced Draft Contactor	**SCT**	— Safety Circuit
IFC	— Indoor (Evaporator) Fan Contactor	**TB**	— Terminal Block
IGVM	— Inlet Guide Vane Motor	**TRAN**	— Transformer
IP	— Internal Protector	**U**	— Unloader

Fig. 36 — Typical Control Wiring; 034,044 Units Shown

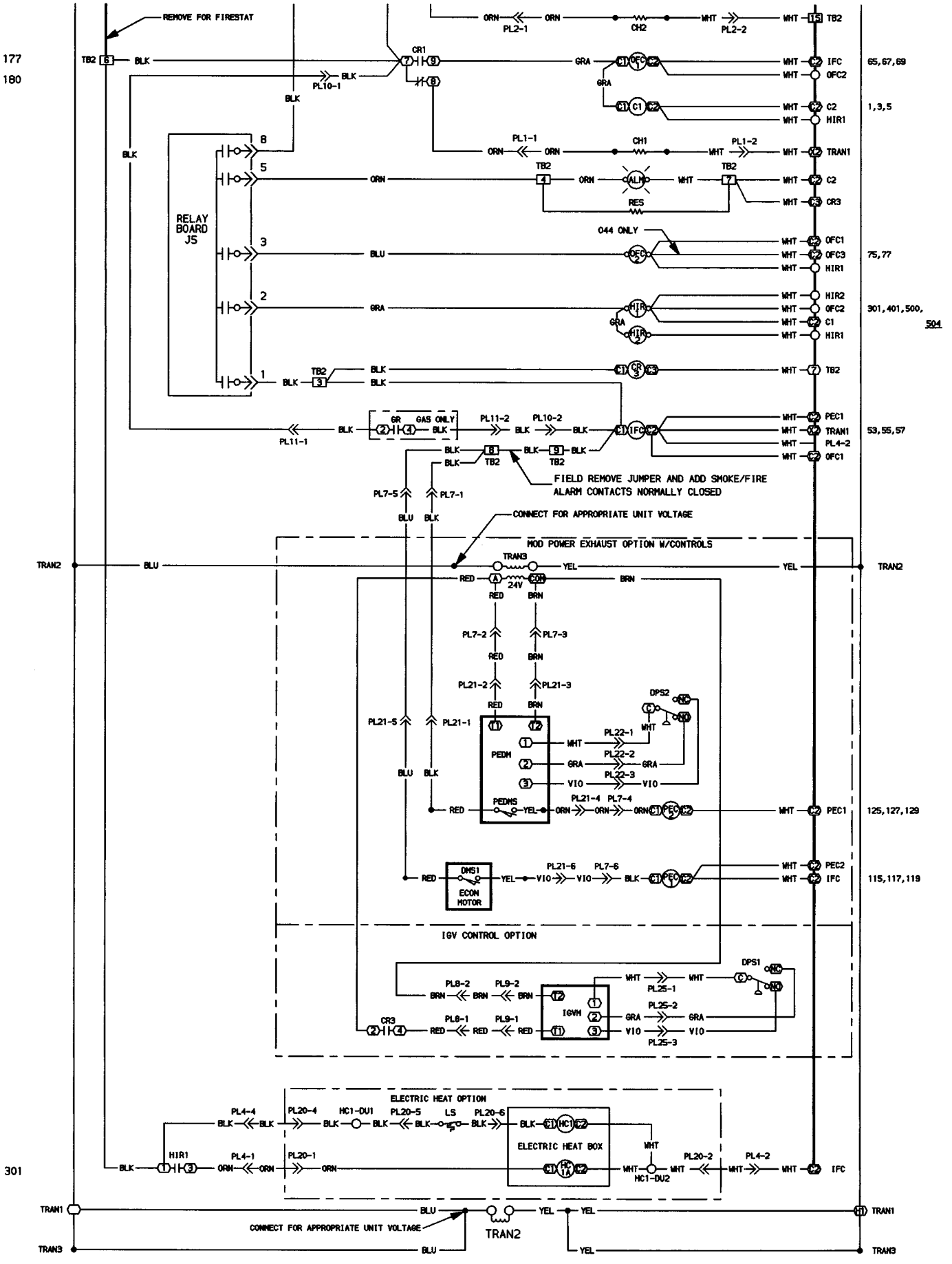


Fig. 36 — Typical Control Wiring; 034,044 Units Shown (cont)

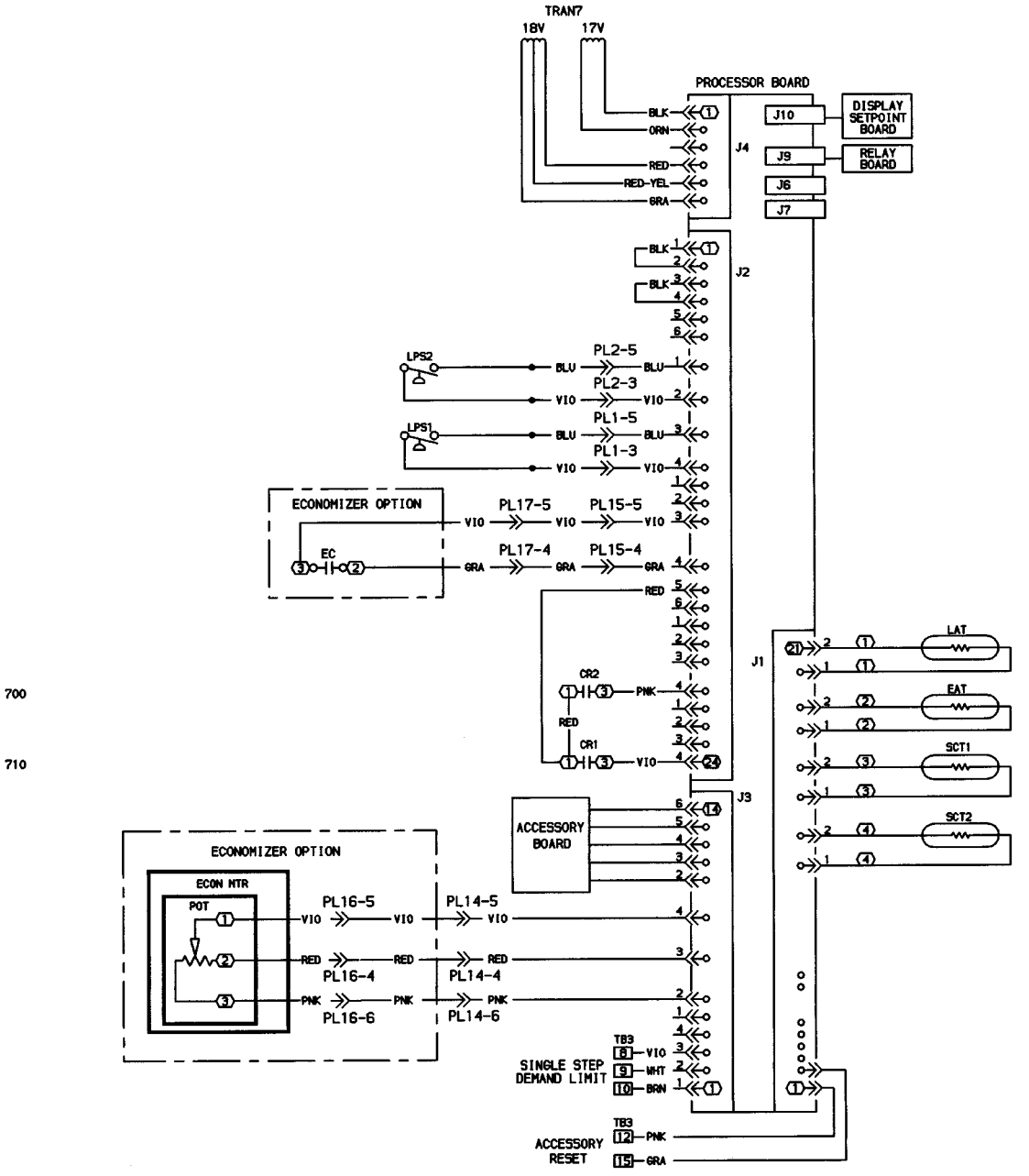


Fig. 36 — Typical Control Wiring; 034,044 Units Shown (cont)