Controls Operation and Troubleshooting

CONTENTS

CONTENTS (cont)

SAFETY CONSIDERATIONS

Installing, starting up, and servicing this equipment can be hazardous due to system pressures, electrical components, and equipment location (roof, elevated structures, etc.). Only trained, qualified installers and service mechanics should install, start up, and service this equipment.

When working on this equipment, observe precautions in the literature; on tags, stickers, and labels attached to the equipment, and any other safety precautions that apply. Follow all safety codes. Wear safety glasses and work gloves. Use care in handling, rigging, and setting this equipment, and in handling all electrical components.

⚠ WARNING

Electrical shock can cause personal injury and death. Shut off all power to this equipment during installation and service. There may be more than one disconnect switch. Tag all disconnect locations to alert others not to restore power until work is completed.

⚠ WARNING

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

GENERAL

IMPORTANT: This literature contains controls, operation, and troubleshooting data for 48ZE,ZR,ZV and 50ZE,ZF,ZR,ZS,ZV,ZY variable air volume rooftop units. Use this guide in conjunction with the separate Installation Instructions literature packaged with the unit.

Carrier 48ZE,ZR,ZV and 50ZE,ZF,ZR,ZS,ZV,ZY units provide ventilation, cooling, and heating (when equipped) in Variable Air Volume (VAV) applications. These units contain factory-installed controls which provide full system management. The unit controls also perform self diagnostic tests at unit start-up, monitor operation of the unit, and provide alarms. Information on system operation and status are sent to the central processors by various sensors that are located at the unit and in the conditioned space. Each unit is equipped with a display board.

Rooftop Information — The rooftop controls cycle supply-fan motor, compressors, and unloaders to maintain the proper temperature conditions. The controls also cycle condenser fans to maintain suitable head pressure. Safeties are continuously monitored to prevent the unit from operating under abnormal conditions. The controls provide control of economizer and cycle or control heating as required.

The controls also allow the service person to operate a 'quick test' so that all the controlled components can be checked for proper operation.

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 30 to 105-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:

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

Processor Board — The processor board, shown in Fig. 1, 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 (0° C). All electrical connections are made to the processor board through wire and ribbon cables.

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.

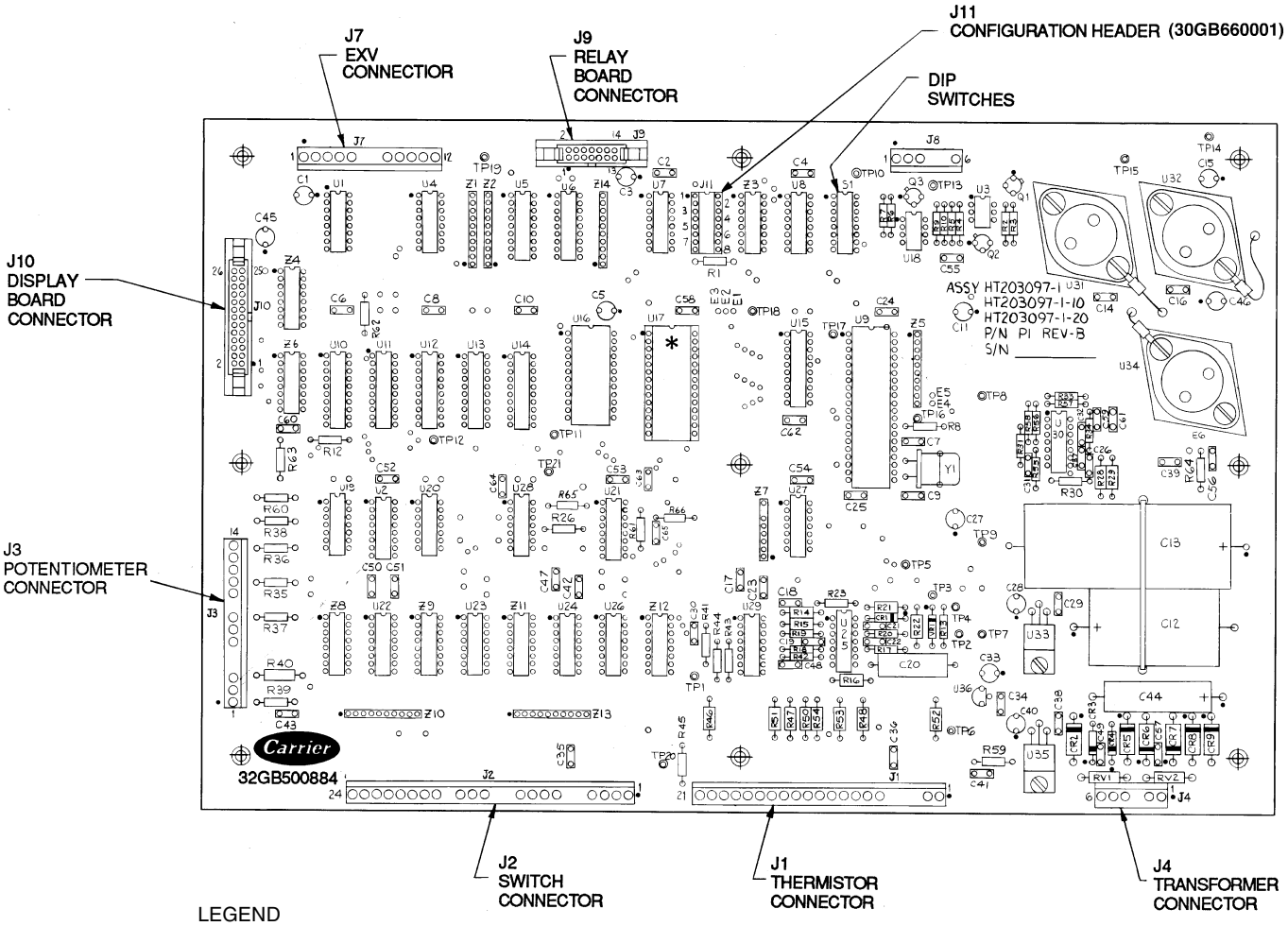
Several status switches are also monitored. These switches are connected to the processor at pin terminal connector J2. See Fig. 3 and Table 2.

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

Table 1 — Pin Terminal Connector J1 Thermistor Inputs

CONNECTOR J1 TERMINAL NO.	TEMPERATURE INPUT	THERMISTOR
1,2	Reset Temperature*	T10
14,15	Saturated Condensing Temp., Circuit 2	T4
16,17	Saturated Condensing Temp., Circuit 1	T3
18,19	Return-Air Temperature	T2
20,21	Supply-Air Temperature	T1

LEGEND
T — Thermistor
*If equipped with accessory temperature reset package.
NOTE: Terminal numbers 3-13 are not used on these units.



LEGEND
DIP — Dual In-Line Package
EPROM — Erasable, Programmable Read-Only Memory
EXV — Electronic Expansion Valve

*EPROM HT204485-1-XX where "XX" is the current revision number.
NOTE: Processor Board is positioned in unit with J3 and J10 connections at the bottom.

⚠ WARNING

Do not remove label covering EPROM. Removal causes program to be erased.

Fig. 1 — Processor Board

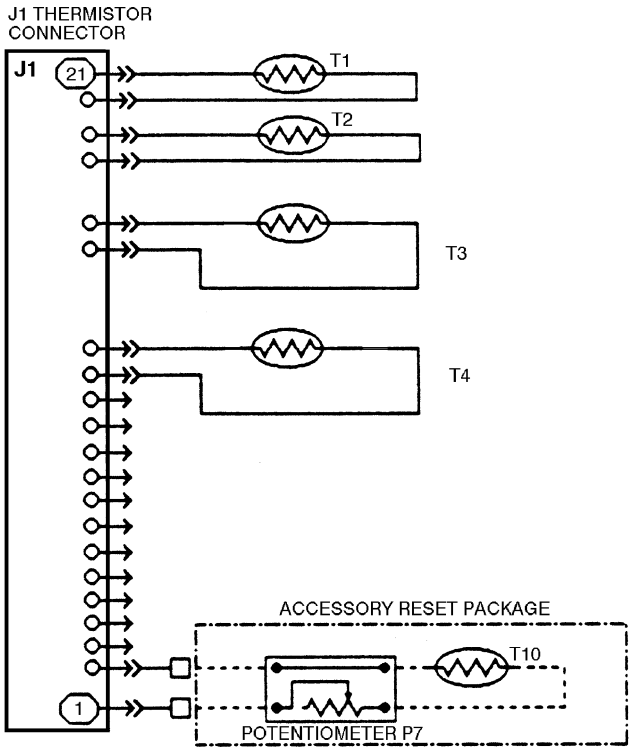


Fig. 2 — Pin Terminal Connector J1 Thermistor Inputs

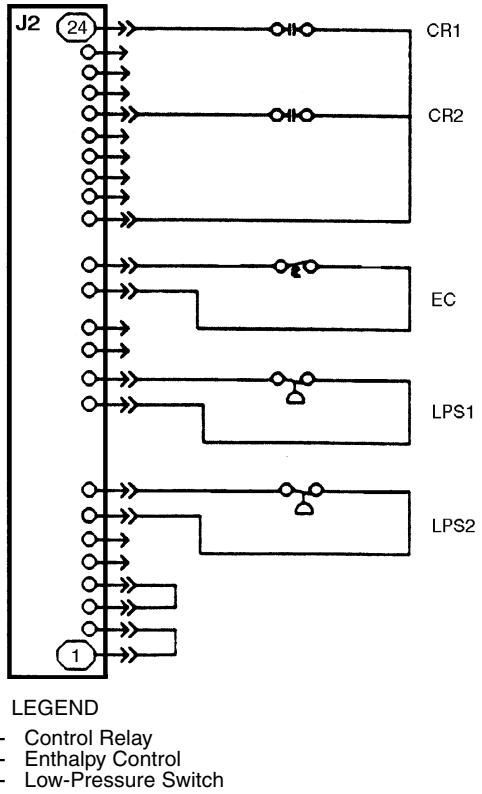


Fig. 3 — Pin Terminal Connector J2 Status Switch Inputs

Table 2 — Pin Terminal Connector J2 Status Switch Inputs

CONNECTOR J2 TERMINAL NO.	STATUS SWITCH	INPUT
1,2	Oil Pressure, Circuit 2	Jumpered
3,4	Oil Pressure, Circuit 1	Jumpered
7,8	Loss of Charge, Circuit 2	LPS2
9,10	Loss of Charge, Circuit 1	LPS1
13,14	Economizer Changeover	EC
15,20	Compressor Fault Signal	CR2
15,24	Compressor Fault Signal	CR1

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

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

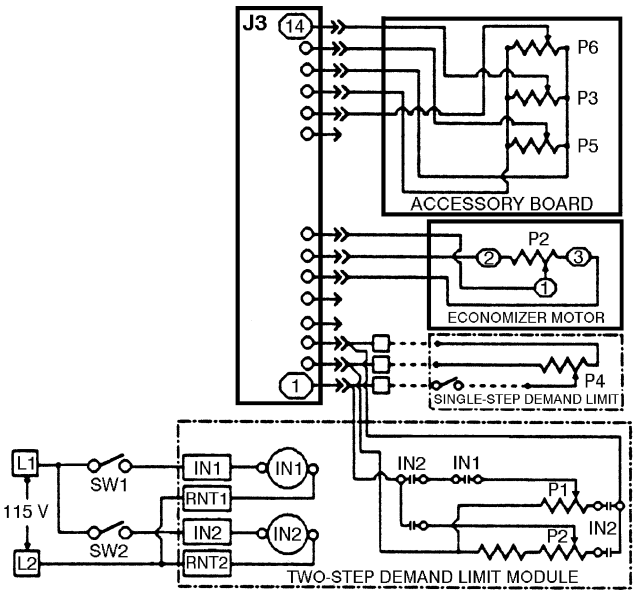


Fig. 4 — Pin Terminal Connector J3 Potentiometer Inputs

All of the potentiometers must be set before the unit is started in order for the unit to function properly. See Start Up, Potentiometers section on page 38 for information on establishing set points. 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.

The potentiometer locations and functions are as follows:

P1 — SUPPLY-AIR SET POINT — This potentiometer is located on the display board. The supply-air set point is the cooling mode control temperature which the VAV control system will attempt to maintain at Thermistor T1 by control of economizer position and/or cycling unloaders and compressors.

P2 — ECONOMIZER POSITION — Economizer feedback potentiometer is located on the economizer motor. 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 supply-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.

P4 — DEMAND LIMIT — This potentiometer is located near TRAN4 in the unit control box. 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. For single-step demand limit, a field-installed 5 to 20 K ohm potentiometer and switch must be used.

P5 — ECONOMIZER MINIMUM POSITION — This potentiometer is on the accessory board (provided standard from the factory) located in the unit main control box. This potentiometer specifies the minimum opening position for the optional economizer. 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. This potentiometer establishes the set point temperature for the Morning Warm-Up function. When the temperature is reached, Morning Warm-Up is terminated and VAV operation begins. DIP switch 4 must be in the ON position if morning warm-up heat is to be used.

P7 — SASP (SUPPLY AIR SET POINT) RESET TEMPERATURE — This 10 K ohm potentiometer is used only if the accessory, field-installed temperature reset package is installed. This potentiometer determines the temperature at which reset will begin. It is located on the accessory temperature reset board. DIP switch 2 must be in the ON position to enable SASP reset.

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 first is the configuration header (part number 30GB660001), which has eight circuits that are either broken or unbroken. The unit is configured at the factory to define the type of unit, number of compressors, and electrical power frequency (50 or 60 Hz). The configuration header should not need field attention unless the board is being replaced. Changing the factory setting may cause the unit to malfunction.

Secondly, 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.

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 3.

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 supply-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. Mounted above this board is the alarm light, to warn of fault conditions, and the processor control switch.

Thermistors — The processor uses up to 5 thermistors to sense the temperatures at various points in the system. See Table 1 and Fig. 7-14. 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 — SUPPLY-AIR TEMPERATURE 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 supply-air temperature.

T2 — RETURN-AIR TEMPERATURE 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 located on the condenser coil return bend. See Fig. 13 and 14. 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.

T4 — SATURATED CONDENSING TEMPERATURE, CIRCUIT 2 — This thermistor is located on the condenser coil return bend. See Fig. 13 and 14. 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.

T10 — RESET TEMPERATURE — This thermistor remotely located outside the unit in the conditioned space. It 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.

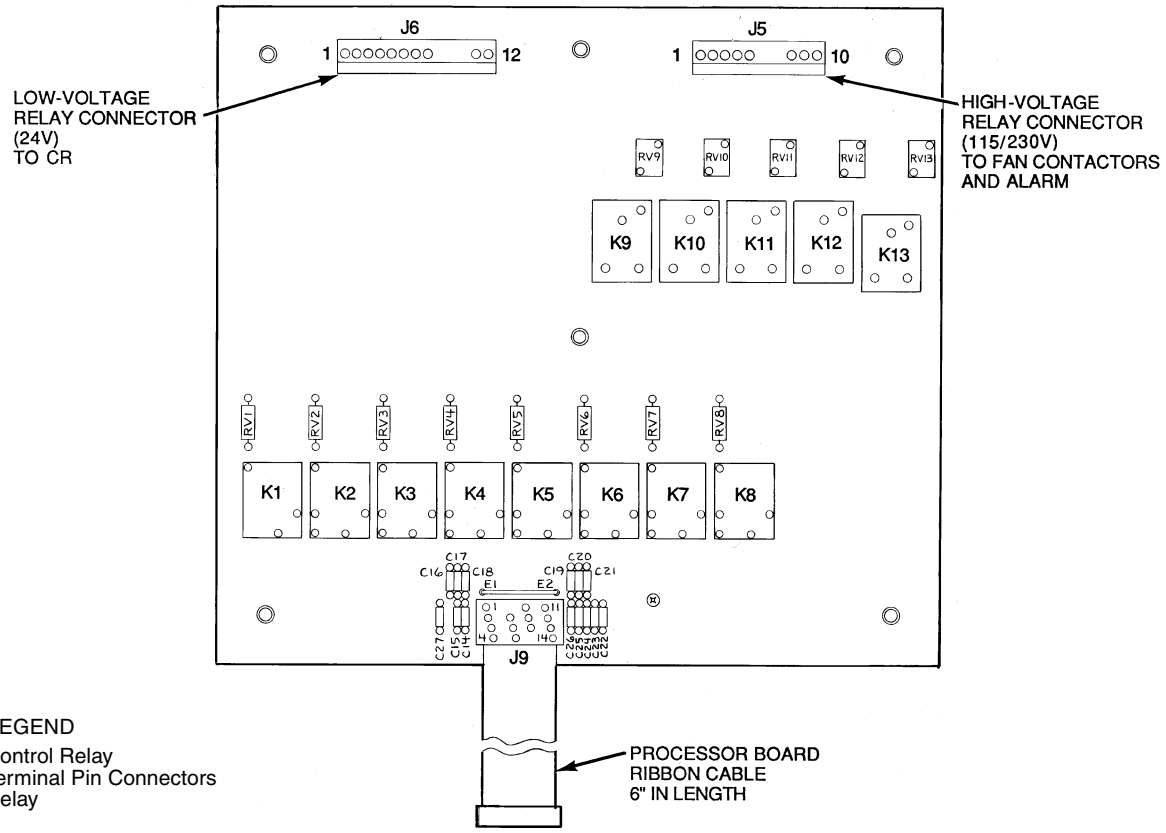
Table 3 — Output Pin and Terminal Assignments

OUTPUT PIN-TERMINAL	NAME	RATING	DEVICE
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	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)		EOR
J6-8	Economizer Close Relay (K8)		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)		OFC2/OFC3††
J5-4	Stage 2 Condenser Fan Relay (K12)		OFC4***
J5-5	External Alarm Relay (K13)		ALM

LEGEND

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

*Circuit 1.
†Circuit 2.
**U2 is not used on size 040 units.
††OFC2 on size 030-050 units; OFC3 on size 055-105 units.
***Used on size 055-105 units only.



LEGEND

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

Fig. 5 — Relay Board

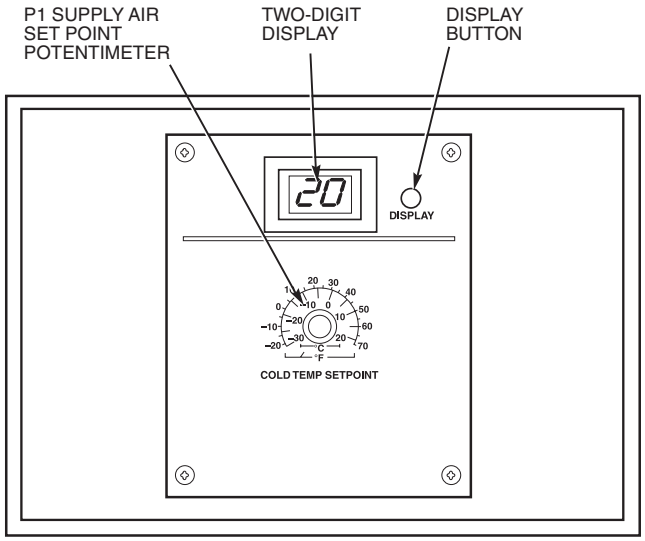


Fig. 6 — Display/Set Point Board

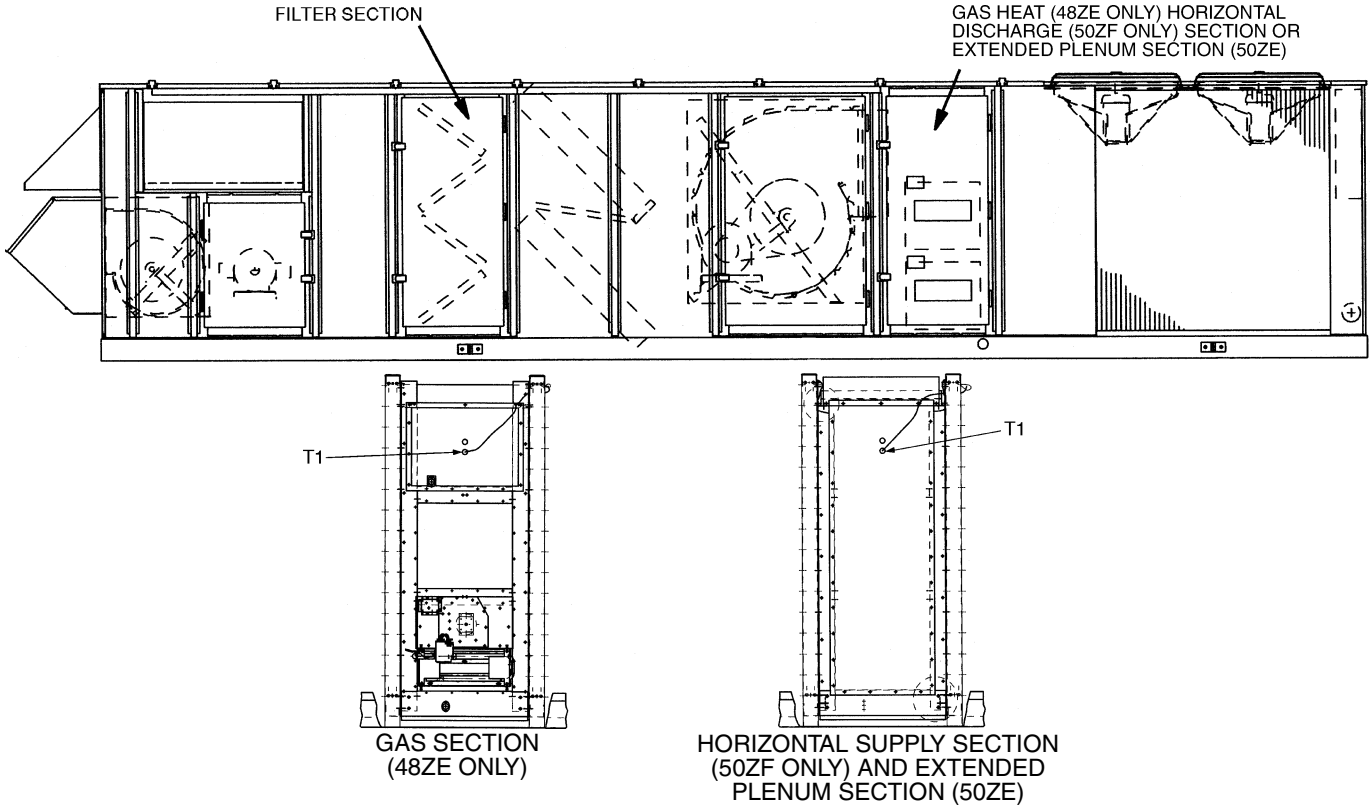


Fig. 7 — Thermistor T1 Location, 48ZE, 50ZF030-050 and 50ZE030-050 with Extended Plenum Units

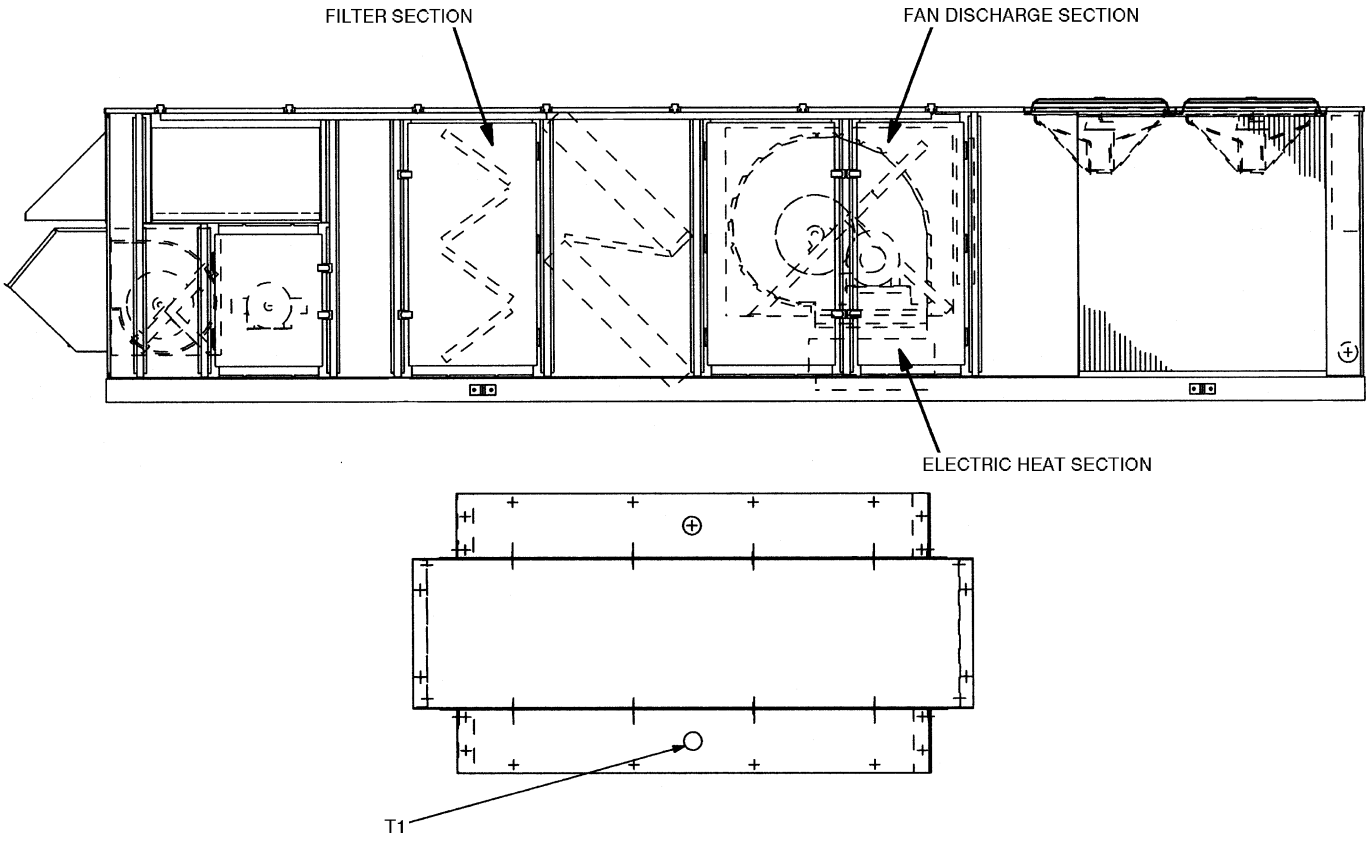


Fig. 8 — Thermistor T1 Location, 50ZE030-050 Units

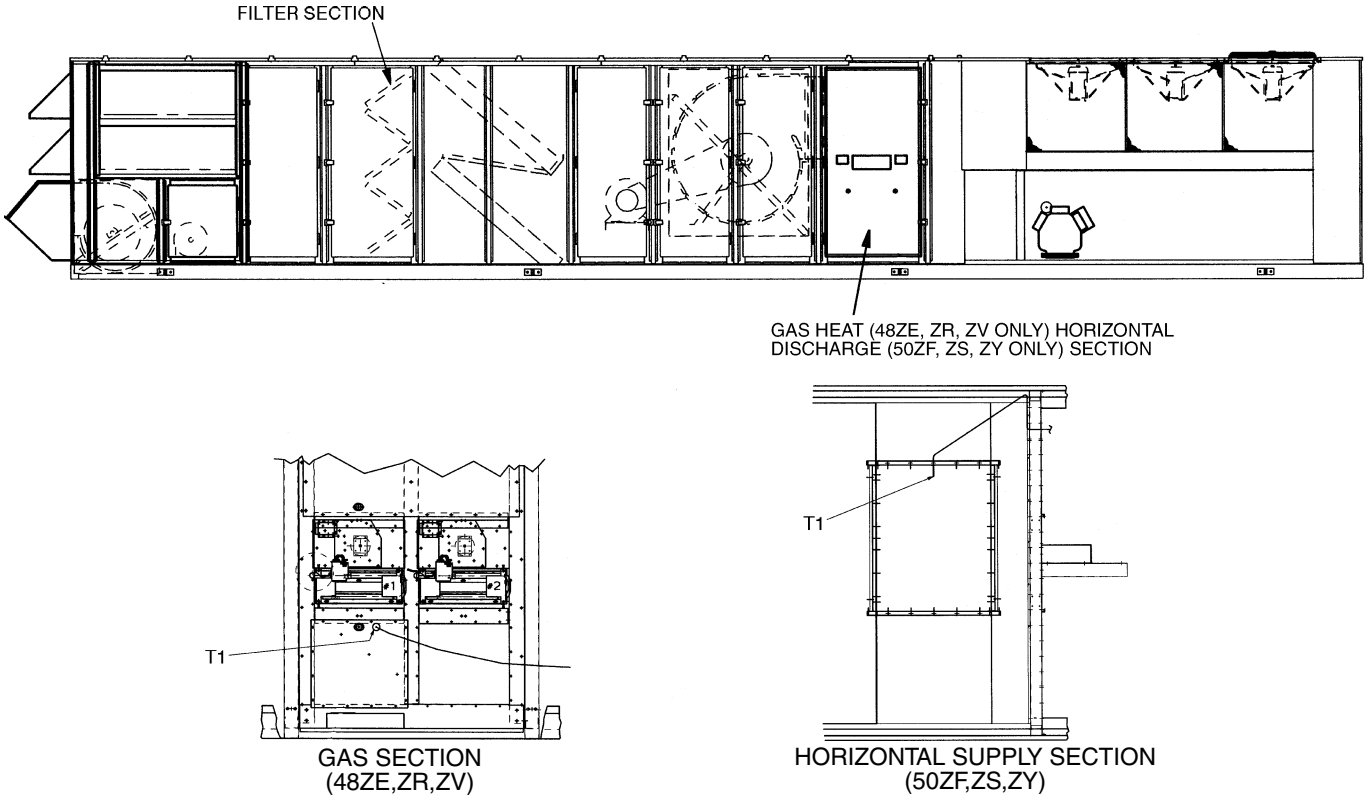


Fig. 9 — Thermistor T1 Location, 48ZE,ZR,ZV and 50ZF,ZS,ZY055-105 Units

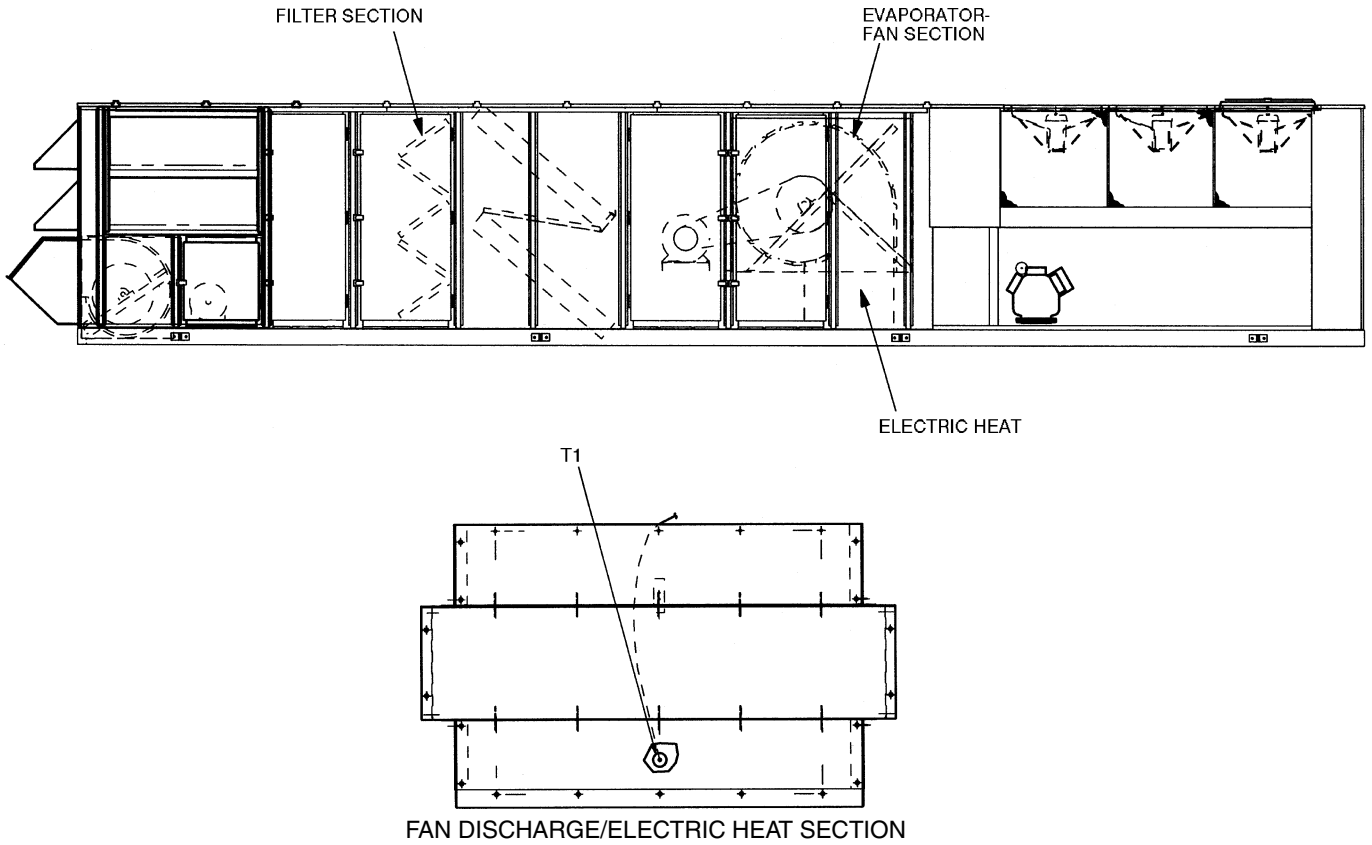


Fig. 10 — Thermistor T1 Location, 50ZE055-070 Units

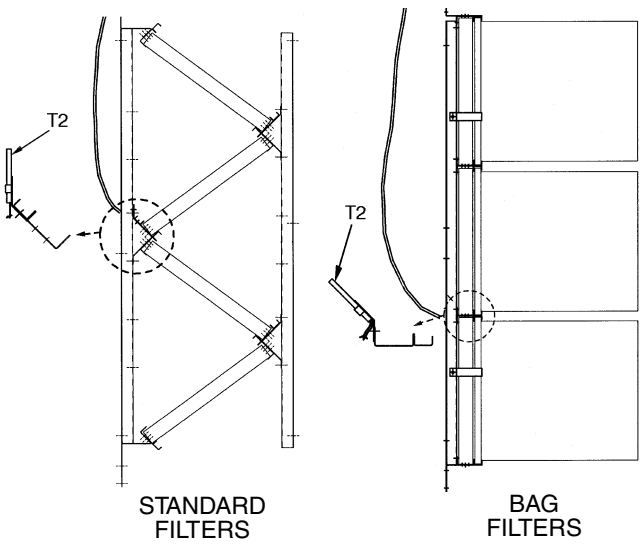


Fig. 11 — Thermistor T2 Location, Size 030-050 Units

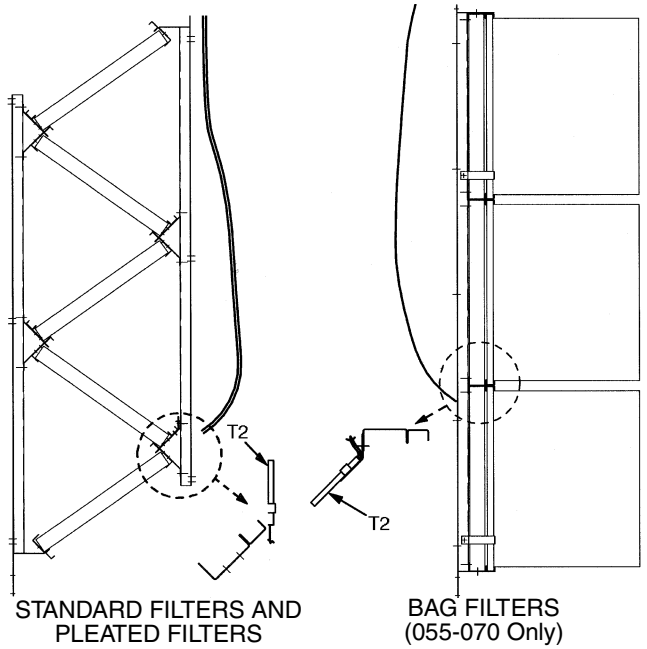


Fig. 12 — Thermistor T2 Location, Size 055-105 Units

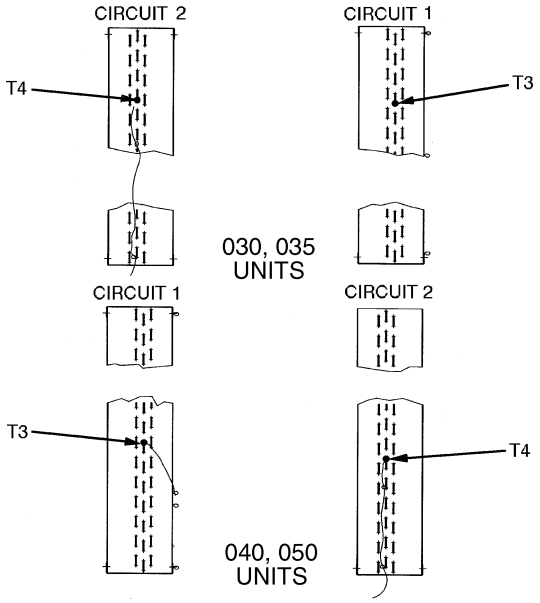


Fig. 13 — Thermistor T3 and T4 Locations, Size 030-050 Units

Optional Staged Gas Control

GENERAL — The 48Z series large rooftop units may be ordered with an optional factory-installed staged gas control system that monitors heating operation of the rooftop. The control system is composed of several components as listed in sections below. See Fig. 15 and 16 for the control schematic. Table 4 shows 48Z series Staged Gas implementation.

IMPORTANT: An accessory field-supplied Navigator™ display module is required for all staged gas control units.

STAGED GAS CONTROL BOARD (SGC) — See Fig. 17. The SGC is the center of the Staged Gas control system. It contains the major portion of the operating software and controls the operation of the unit. The SGC continuously monitors input/output channel information received from its inputs. The SGC receives inputs from thermistors (SAT1, SAT2, SAT3, LIMTTEMP). See Table 5. The staged gas control board discrete and digital inputs are shown in Table 6. The analog inputs are shown in Table 7. The outputs are shown in Table 8.

NAVIGATOR DISPLAY (Field-Installed Accessory) — Navigator display is a field-installed accessory. This device is the keypad interface that is used to access rooftop information, read sensor values, and test the unit. Navigator display is a 4-key, 4-character, 16-segment LED (light-emitting diode) display. Eleven mode LEDs are located on the display as well as an Alarm Status LED.

BOARD ADDRESSES — Staged Gas Control Board (SGC) has a 3-position instance jumper that is set at the factory to "1." Do not change this setting.

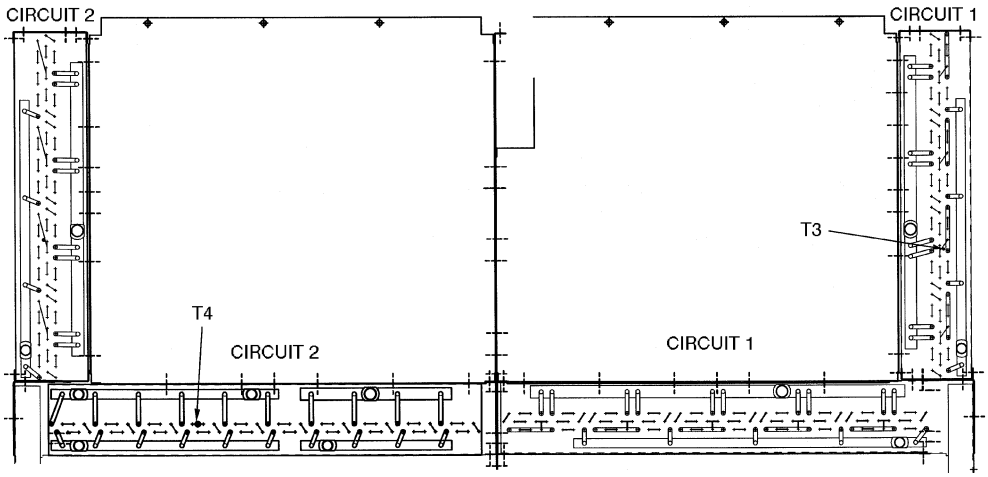
The staging pattern is selected based on Heat Stage Type (HTSTGTYP). Limit switch monitoring (LIMTMON1) default valve is YES. Limit switch thermistor default values are selected based on Limit Switch Thermistor High Temp (LIMTHIHT) and Limit Switch Thermistor Low Temp (LIMTLOHT). Maximum Capacity per changes default value is selected based on CAPMXSTG. Refer to Operating Information, Staged Gas Control Heating section on page 47 for detail information.

Table 4 — 48Z Series Staged Gas Implementation

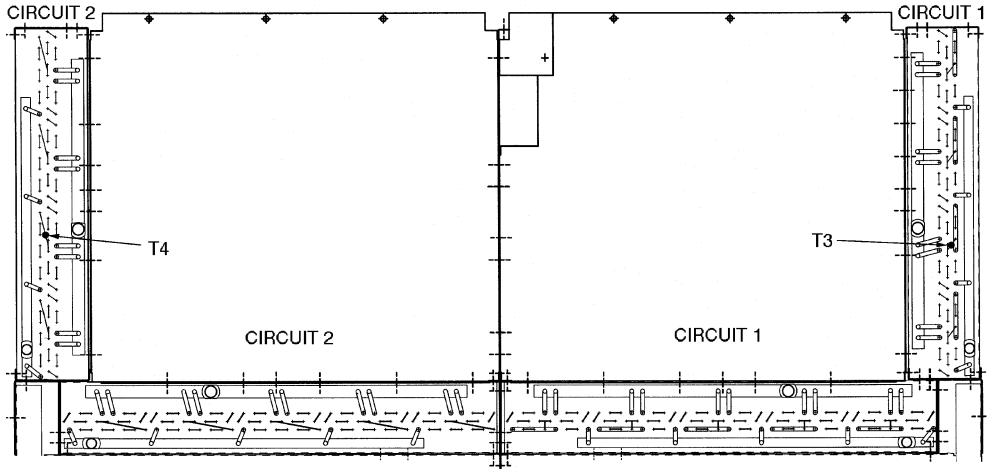
NO. OF STAGES	MODEL NUMBER POSITION				POINT				HEAT SIZE
	3	5	6,7,8	10	HTSTGTYP	CAPMXSTG	LIMTHIHT	LIMTLOHT	
2 stages	Z	H, K, W, Y	030 035 040 050		Default=0	Default=45	Default=170 F	Default=160 F	Low
5 stages	Z	J, L, X, Z	030 035 040 050		Default=1	Default=20	Default=170 F	Default=160 F	High
		H, K, W, Y	055 060 070		Default=1	Default=20	Default=135 F	Default=125 F	Low
		H, K	075 090 105	-,A,B C,D,E	Default=1	Default=20	Default=135 F	Default=125 F	
		H, K	075 090 105	G,H,J,K,L,M	Default=1	Default=20	Default=130 F	Default=120 F	
9 stages	Z	J, L, X, Z	055 060 070		Default=3	Default=15	Default=135 F	Default=125 F	High
		J, L	075 090 105	-,A,B C,D,E	Default=3	Default=15	Default=135 F	Default=125 F	
		J, L	075 090 105	G,H,J,K,L,M	Default=3	Default=15	Default=130 F	Default=120 F	

LEGEND

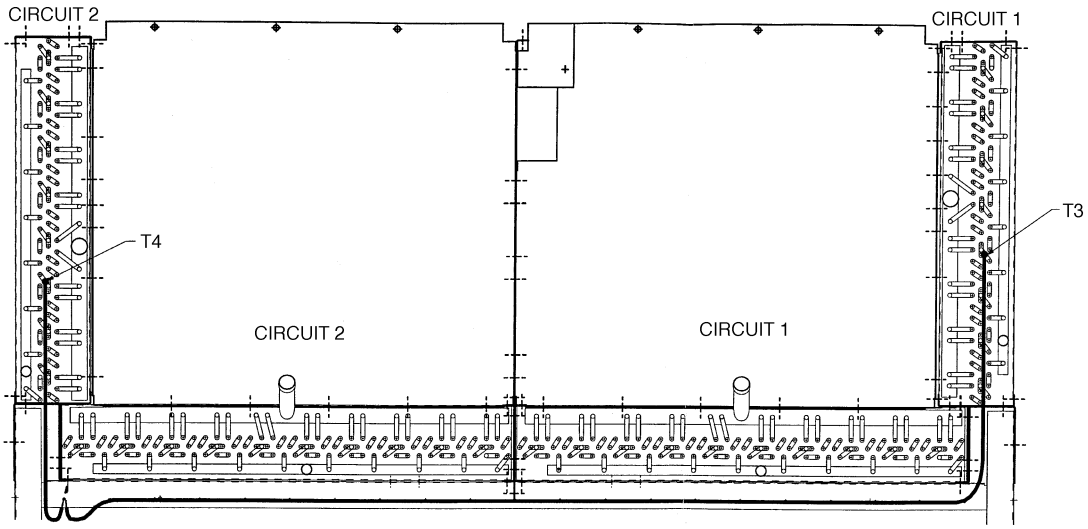
CAPMXSTG — Maximum Capacity per Changes
HTSTGTYP — Heat Stage Type
LIMTHIHT — Limit Switch Thermistor High Temperature
LIMTLOHT — Limit Switch Thermistor Low Temperature



055 UNITS



060, 070, 075 UNITS



090, 105 UNITS

Fig. 14 — Thermistor T3 and T4 Locations, Size 055-105 Units

CONTROL MODULE COMMUNICATION

Red LED — Proper operation of the control boards can be visually checked by looking at the red status LEDs. When operating correctly, the red status LEDs should blink in unison at a rate of once every 2 seconds. If the red LEDs are not blinking in unison, verify that correct power is being supplied to all modules. Also, be sure that the Staged Gas Control Board is supplied with the current software. If necessary, reload current software. If the problem still persists, replace the SGC. A board LED that is lit continuously or blinking at a rate of once per second or faster indicates that the board should be replaced.

Green LED — The SGC has one green LED. The Local Equipment Network (LEN) LED should always be blinking whenever power is on. If LEN LED is not blinking, check LEN connections for potential communication errors (J5 connector). Communication between modules is accomplished by a 3-wire sensor bus. These 3 wires run in parallel from module to module.

Yellow LED — The SGC has one yellow LED. The Carrier Comfort Network (CCN) LED will blink during times of network communication.

SUPPLY-AIR THERMISTORS (Staged Gas Units Only) — Supply-air thermistors are a field-installed, factory-provided component. Three supply-air thermistors are shipped with staged gas units inside the heating section. Thermistor wires must be connected to SGC in the heating section. See Table 5 and Fig. 15 and 16. The supply-air thermistors should be located in the supply duct with the following criteria:

- downstream of the heat exchanger cells
- equally spaced as far as possible from the heat exchanger cells
- a duct location where none of the supply air thermistors are within sight of the heat exchanger cells
- a duct location with good mixed supply air portion of the unit.

Table 5 — SGC Thermistor Designations

THERMISTOR	PIN CONNECTION POINT	FUNCTION AND LOCATION	PART NO.
		Thermistors	
SAT1	J8 – 1,2 (SGC)	Supply-Air Thermistor (SAT) — Inserted into supply section underneath the gas heat section (factory-provided, field-installed)	HH79NZ033
SAT2	J8 – 3,4 (SGC)	Supply-Air Thermistor (SAT) — Inserted into supply section underneath the gas heat section (factory-provided, field-installed)	
SAT3	J8 – 5,6 (SGC)	Supply-Air Thermistor (SAT) — Inserted into supply section underneath the gas heat section (factory-provided, field-installed)	
LIMTTEMP	J8 – 15,16 (SGC)	Limit Switch Thermistor (LIMTTEMP) — Inserted next the lower limit switch (factory-installed)	

Table 6 — SGC Discrete and Digital Inputs

INPUT	PIN CONNECTION POINT
COOL_IN1	J6, 3-4 (SGC)
COOL_IN2	J6, 5-6 (SGC)
SFANSTAT	J7, 1-2 (SGC)
HEAT_IN1	J7, 3-4 (SGC)
HEAT_IN2	J7, 5-6 (SGC)
DEHUMID	J7, 7-8 (SGC)

Table 7 — SGC Analog Inputs

INPUT	PIN CONNECTION POINT	TERMINAL CONNECTION POINT	COMMENT
Cool Set Point Top	J8, 7-8 (SGC)	—	Part No.= HT24AV121
Cool Set Point Bottom	J8, 9-10 (SGC)	—	
Heat Set Point Top	J8, 11-12 SGC)	—	Part No.= HT24AV121
Heat Set Point Bottom	J8, 13-14 (SGC)	—	

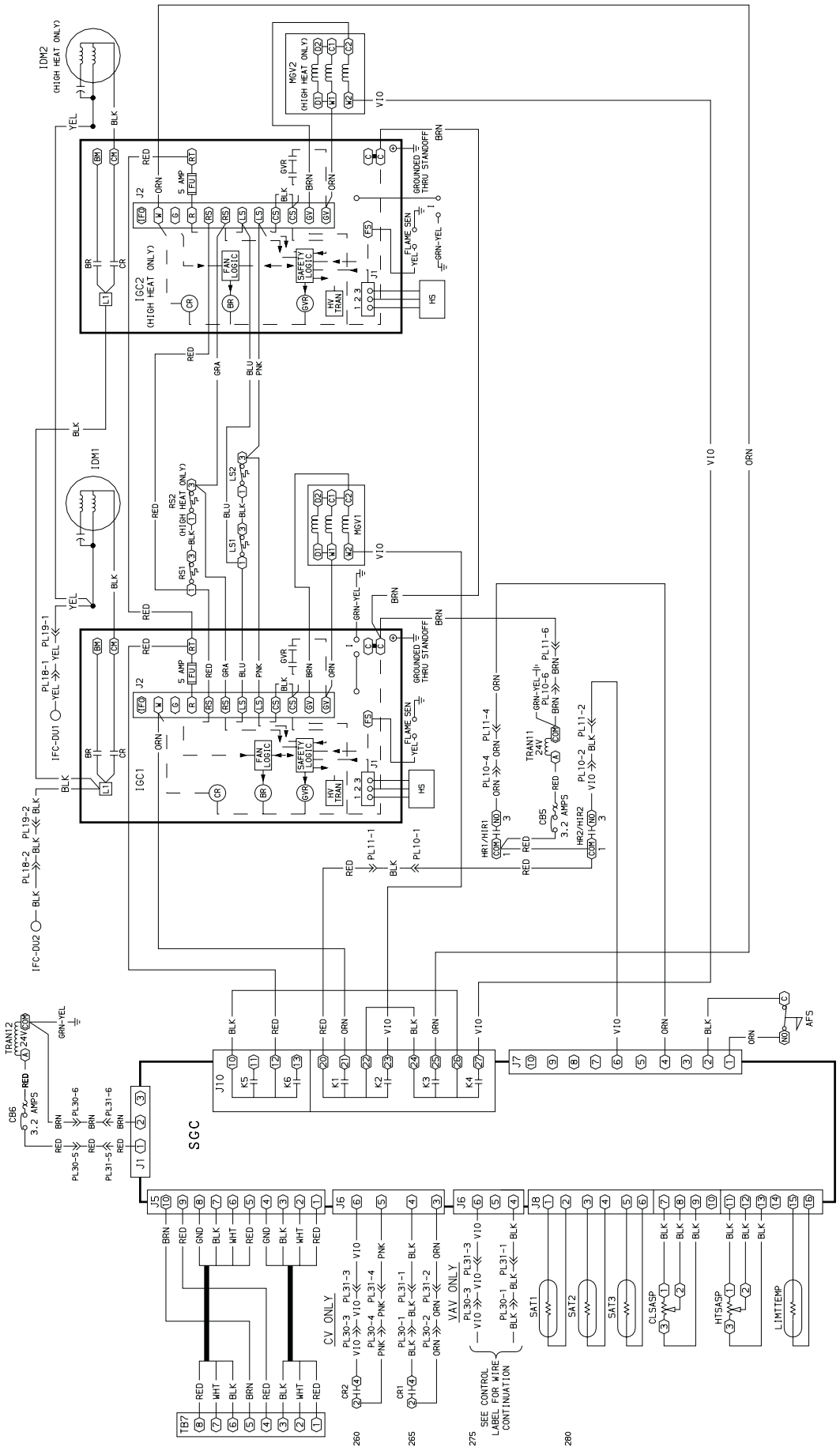


Fig. 15 — Label Diagram — Staged Gas Heat Units — Sizes 030-050

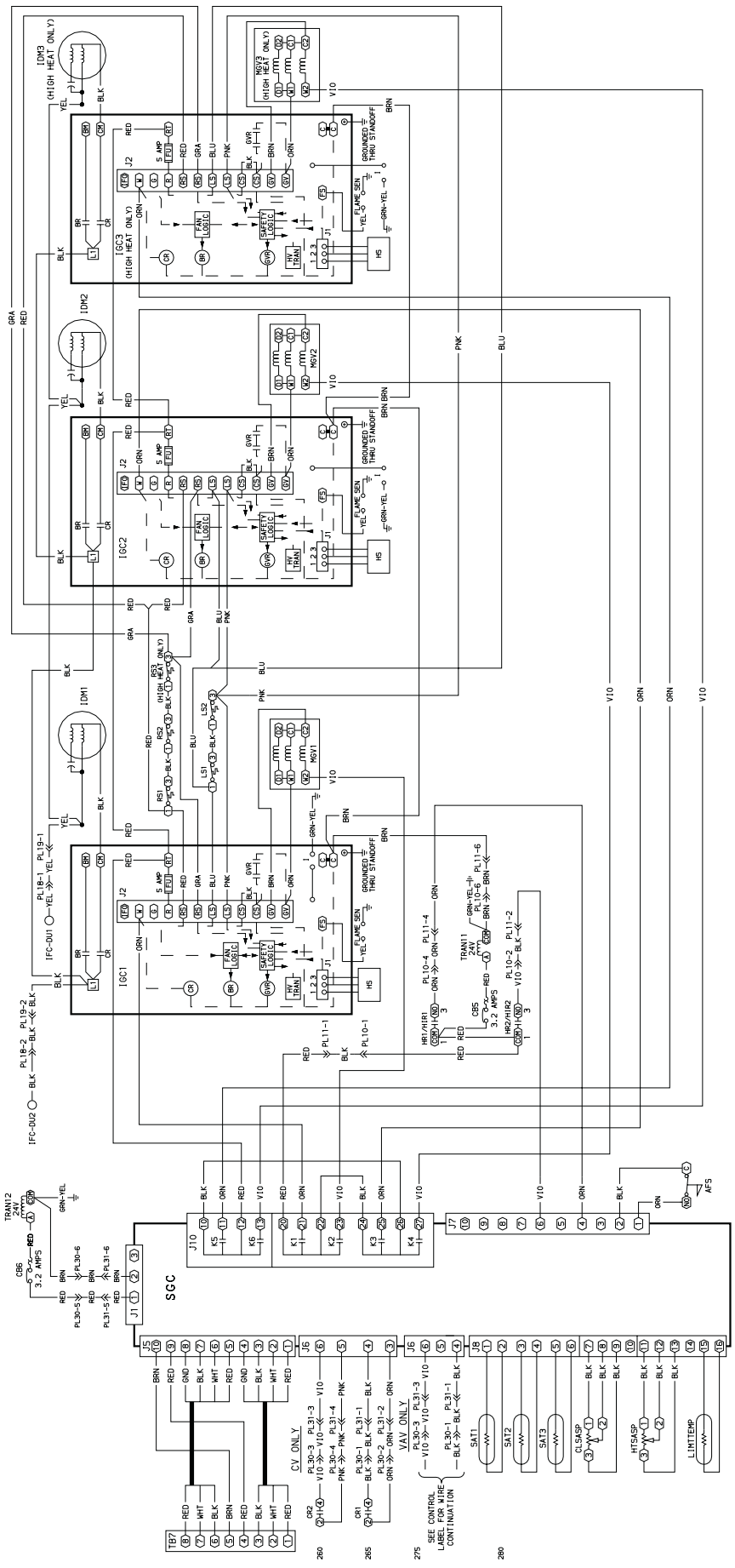


Fig. 16 — Label Diagram — Staged Gas Heat Units — Sizes 055-105

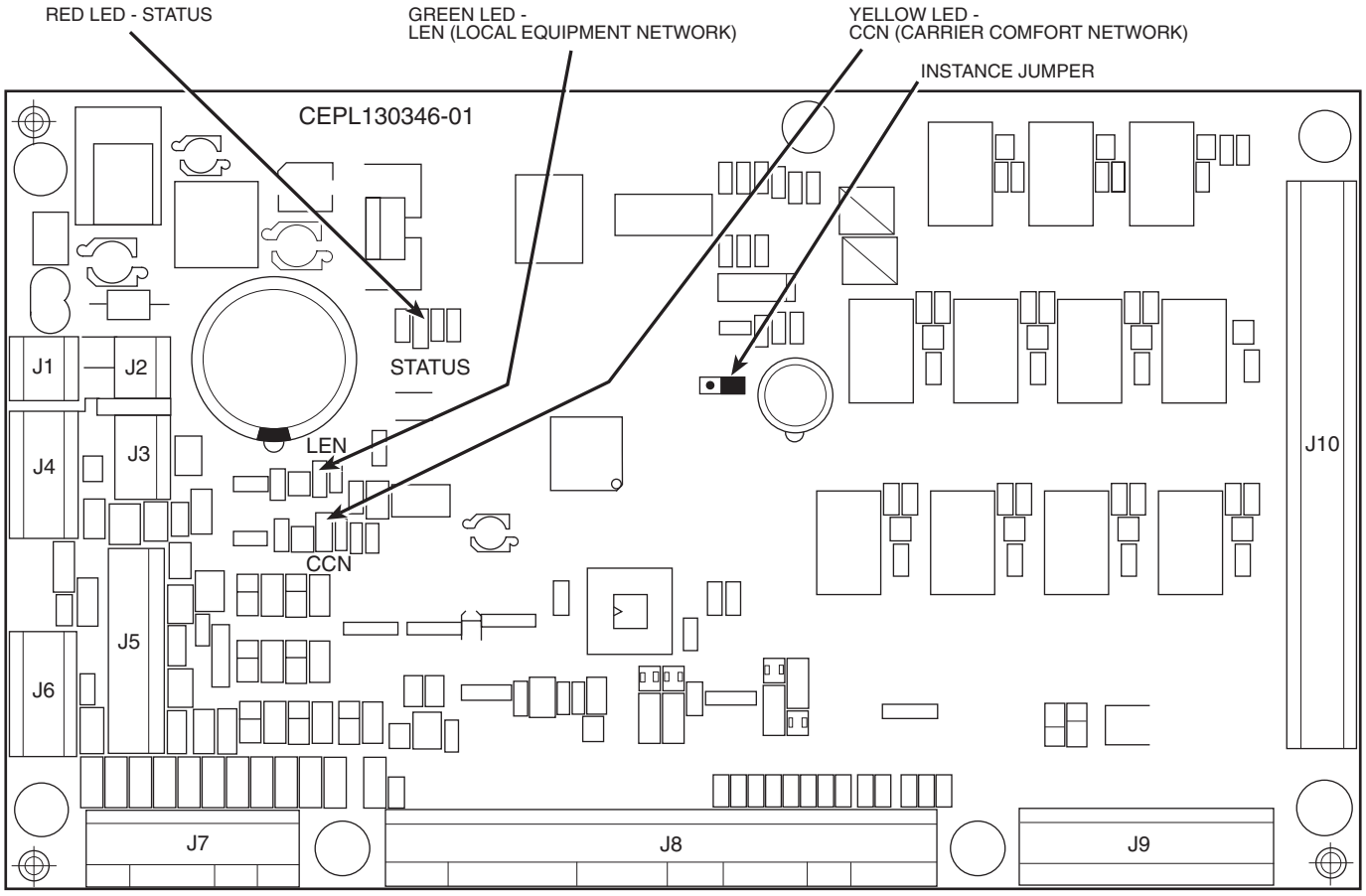


Fig. 17 — Staged Gas Control Board

Table 8 — SGC Outputs

OUTPUT	PIN CONNECTION POINT	DESCRIPTION
HEATOUT1	J10, 20-21 (SGC)	Heat Relay Output#1
HEATOUT2	J10, 22-23 (SGC)	Heat Relay Output#2
HEATOUT3	J10, 24-25 (SGC)	Heat Relay Output#3
HEATOUT4	J10, 26-27 (SGC)	Heat Relay Output#4
HEATOUT5	J10, 10-11 (SGC)	Heat Relay Output#5
HEATOUT6	J10, 12-13 (SGC)	Heat Relay Output#6

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, and the internal protector (where used) 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. 18. 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.

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 set point temperature 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.

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 K ohm, field-supplied potentiometer (P4) 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. The control switch is also field-supplied and installed.

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 two-step demand limit control using an external switch. The first step is between 50% and 100% of the maximum compressor displacement. See Fig. 19. 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 two-step 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.

Economizer — Economizer control is used to control the outside and return air dampers of the unit, to satisfy space cooling demand using all outside air (when permitted), and to satisfy cooling in conjunction with compressor operation (when conditions permit). During Occupied periods without cooling demand, the outside-air dampers will be at the user-configured Minimum Damper Position (at P5 on accessory board). During Unoccupied periods, the outside-air dampers will be closed.

The economizer is a standard feature on 48ZR,ZV and 50ZR,ZS,ZV,ZY units and is available as a factory-installed option on 48ZE and 50ZE,ZF units.

The user can install an accessory differential enthalpy sensor to enhance economizer control. Refer to the installation section for field wiring of the sensor.

ENTHALPY CONTROL

48ZE and 50ZE,ZF Units — Outside air enthalpy control is standard with the factory-installed economizer option. Enthalpy is sensed by a controller located behind the end outside air hood. The control can be accessed by removing the upper hood filter. See Fig. 20.

48ZR,ZV and 50ZR,ZS,ZV,ZY Units — The control is located on the metal upright between the two economizer hoods, on the right hand side of the unit, and can be accessed by removing the filter on either economizer hood.

DIFFERENTIAL ENTHALPY — Added efficiencies in economizer control can be gained by installing a differential enthalpy sensor in the return air duct. When differential enthalpy control is installed, the economizer control will use the air stream with lower enthalpy (outside air or return air) to provide for lower compressor operating costs during integrated economizer cycle operation. The differential enthalpy sensor is installed in the return-air duct.

Supply Fan Variable Frequency Drive (VFD) — The optional VFD is used to modulate supply fan airflow to maintain duct static pressure on VAV applications. The VFD is located in the supply fan section (see Fig. 21 and 22), and can be accessed by opening the fan section access door.

The unit is supplied with a pressure transducer capable of measuring from 0.0 to 5.0 in. wg. The pressure transducer will send a 4 to 20 mA signal to the VFD to modulate the speed of the indoor-fan motor to precisely control the fan to the desired static pressure set point. The VFD is factory set at 2.5 in. wg duct static pressure. Refer to the Operating Sequence section for more information on the VFD.

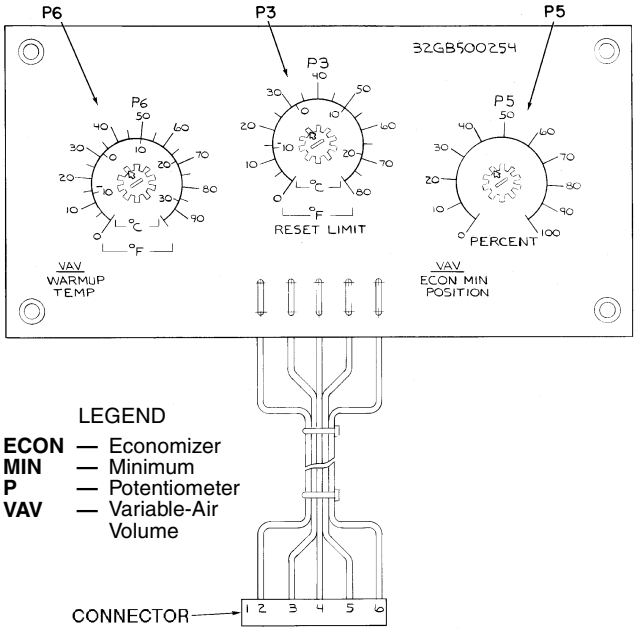


Fig. 18 — Accessory Relay Board (Standard; Factory Supplied)

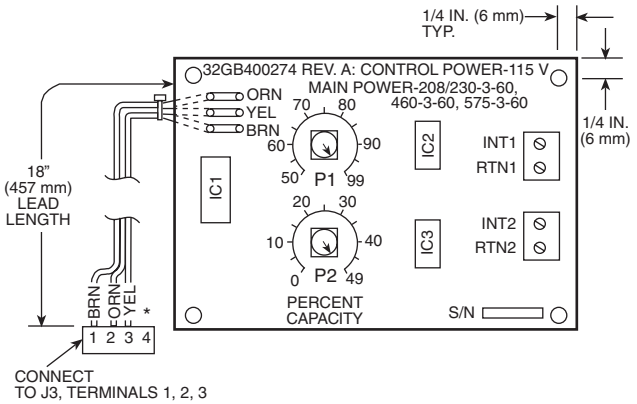


Fig. 19 — Two-Step Demand Limit Module

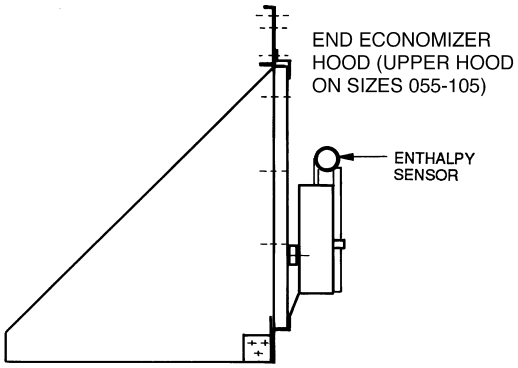


Fig. 20 — Enthalpy Sensor Location (48ZE and 50ZE,ZF Units Only)

The VFD has been programmed and wired at the factory for this application. No further adjustments (except for Duct Static Pressure Set Point) should be necessary at start-up. Factory jumper wire configurations are shown in the Supply Fan Control with VFD Option section on page 39.

A separate service manual for the factory-installed VFD is supplied with each unit. Refer to the VFD manual for more information on the VFD controls.

High Capacity Modulating Power Exhaust Variable Frequency Drive (48ZV and 50ZV,ZY Units Only) — The power exhaust VFD (PE VFD) is used to modulate the power exhaust fan motor no. 1 and stage the power exhaust fan motor no. 2 in order to maintain building static pressure. The PE VFD is located at the return air end of the unit of the opposite side from the auxiliary control box and can be accessed by opening the access door.

The unit is supplied with a pressure transducer capable of measuring from –0.5 to +0.5 in. wg. The pressure transducer will send a 4 to 20 mA signal to the PE VFD to modulate the speed of the power exhaust motor no. 1 and also stage on/off the power exhaust motor no. 2 to precisely maintain the desired building pressure set point. The PE VFD is factory set at 0 in. wg. Refer to Operating Sequence section for more information on the PE VFD.

The PE VFD has been programmed and wired at the factory for this application. No further adjustments (except for Building Pressure Set Point) should be necessary at start-up. Factory jumper wire configurations are shown in the Power Exhaust Variable Frequency Drive section in the Troubleshooting section on page 70.

A separate service manual for the factory-installed PE VFD is supplied with each unit. Refer to PE VFD manual for more information on the PE VFD.

Return/Exhaust Fan Variable Frequency Drive — The return/exhaust fan VFD (RE VFD) is used to modulate return/exhaust fan airflow to maintain return air pressure set point at the mixing box. The RE VFD is located at the return end of the unit, on the opposite side from the auxiliary control box, and can be accessed by opening the access door.

The unit is supplied with a pressure transducer capable of measuring from –0.5 to +0.5 in. wg. The pressure transducer will send a 4 to 20 mA signal to the RE VFD to modulate the speed of the return/exhaust fan motor to precisely control the fan to the desired static pressure set point. The RE VFD is factory set at –0.15 in. wg. Refer to Operating Sequence section for more information on the RE VFD.

The RE VFD has been programmed and wired at the factory for this application. No further adjustments should be necessary at start-up. Factory jumper wire configurations are shown in the Return/Exhaust Variable Frequency Drive section in the Troubleshooting section on page 73.

A separate service manual for the factory-installed RE VFD is supplied with each unit. Refer to the RE VFD manual for more information on the RE VFD controls.

Temperature Reset — Accessory temperature reset allows the unit to automatically adjust (“reset”) the supply-air temperature set point to a higher value once most of the space cooling load has been met. When the space conditions are satisfied, the VAV terminals will close to the minimum position. All VAV units will sense the decrease in actual supply-air temperature and the unit controls respond by reducing capacity stages to maintain user-established supply-air set point temperature. When VAV units are also equipped with optional supply duct pressure controls (either inlet guide vanes [IGV] or variable frequency drive package), the unit also senses an increase in duct static pressure and responds by closing IGV dampers or slowing fan wheel speed to maintain user-configured set points for supply duct pressure. Allowing the supply-air temperature to be reset to a higher value maintains air circulation in the space without costly overcooling.

The accessory package is required for temperature reset. The accessory includes:

- thermistor T10, to monitor space temperature
- reset temperature potentiometer P7, to establish start temperature for reset operation
- reset limit potentiometer P3, to establish maximum level of modified supply-air temperature

More than one space sensor may be used if an average space temperature is desired for initiating temperature reset. Refer to installation section for sensor part number and wiring schematic.

Temperature reset will start when space temperature (at T10) drops to the set point at P7. When Temperature Reset is active, the LED (light-emitting diode) display will show code 21. Automatic adjustment of supply-air temperature set point (SASP) will end when modified SASP equals reset limit set point at P3. (See formula for automatic modification of SASP in Controls Installation, Space Temperature Reset section on page 18.)

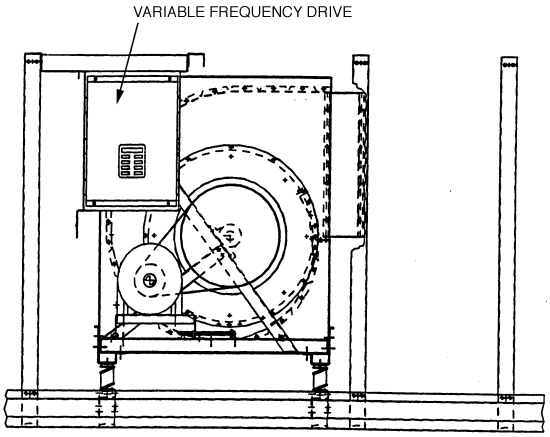


Fig. 21 — Variable Frequency Drive, Sizes 030-050 and 075-105

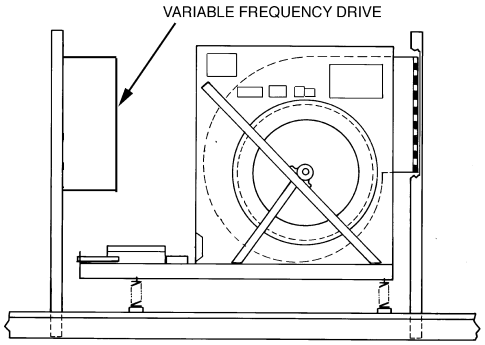


Fig. 22 — Variable Frequency Drive, Sizes 055-070

CONTROLS INSTALLATION

The VAV units may be used in applications with additional control features, options, or accessories. Refer to the appropriate accessory installation instructions for more information on installing that accessory. Unit control box component arrangement is shown in Fig. 23-26. Control options and accessories available for VAV units are:

- smoke control modes
- differential enthalpy sensor
- electric heaters (50 series units only)
- modulating power exhaust
- Motormaster® I control
- space temperature reset
- night setback thermostat (field-supplied)
- single step demand limit (field-supplied)
- two-step demand limit
- inlet guide vanes
- variable frequency drive
- variable frequency drive remote display kit

Control Wiring — A switch or timeclock (field supplied) must be wired in to control when unit will go into and out of Occupied mode. Connect switch or timeclock between terminals 1 and 2 on terminal block 3 (sizes 030-050) or terminal block 4 (sizes 055-105) in unit control box. See Fig. 27. The circuit potential is 24 v.

Variable air volume units equipped with warm-up heat require that room terminals be controlled to go fully open when unit goes into the Heating mode. Heating interlock relay (HIR) is provided for this function. The relay is located in the unit control box. When unit goes into Heating mode, the heat interlock relay is energized providing switch closure or opening (depending on how field power source is set up) to open the room terminals. Field connections for heat interlock relays are terminals 3 and 4 (for normally open contacts) and terminals 3 and 7 (for normally closed contacts) on terminal block 3 (sizes 030-050) or terminal block 4 (sizes 055-105). See Fig. 28. Note that a field-supplied power source is required.

There are no required 115-volt field wiring connections, therefore no provisions have been made in the unit for running 115-volt wiring. If any of the field-installed options requiring 115-volt connections are desired, the unit must be modified in the field for 115-volt wiring.

NIGHT SETBACK THERMOSTAT — Wire field-supplied thermostat (suitable for 24-v circuit) between terminals 1 and 2 on terminal block 3 (sizes 030-050) or terminal block 4 (sizes 055-105). This thermostat is used to bypass the timeclock occupied/unoccupied switch and is used to operate unit during unoccupied times at more economical temperatures. (See Fig. 27.)

SPACE TEMPERATURE RESET ACCESSORY (50DJ900021) — Consists of a thermistor (T10) and a reset board with a potentiometer (P7) that is used to set space temperature at which reset starts. Mount reset board in unit control box or other convenient place. Wire thermistor in series with P7 and connect to terminals 12 and 15 on terminal block 3 (sizes 030-050) or terminal block 4 (sizes 055-105) in unit control box. If there is a long run to conditioned space, it is necessary to splice additional wire to thermistor. The reset board has 2 pressure connectors for field wiring. (See Fig. 29.)

Space Temperature Reset

INSTALLATION — Install the accessory temperature reset package in accordance with instructions provided with the accessory kit.

Mount the reset board in the unit control box (or other suitable location) per instructions.

Locate the thermistor T10 in a suitable location in the occupied space per instructions.

Wire T10 to the reset board and to the unit control terminal block per Fig. 29. Wire the other terminal on the reset board to the unit control terminal block per Fig. 29.

If multiple sensors are required to average the space temperature, see Fig. 30. Use only Carrier Part Number HH79NZ014 sensor, in arrangements of 4 or 9 sensors, with total wiring not to exceed 1000 ft.

To enable reset function, change DIP (dual in-line package) switch 2 to position ON. (Disconnect control power before changing DIP switch positions; reconnect power after all changes have been made.)

CONFIGURATION — Set points for reset operation are established at potentiometers P7 and P3 (on the reset board).

Potentiometer P7 — Reset temperature set point (temperature at which reset function will start). Maximum of 80 F, minimum 0° F. Set below normal room cooling set point level to sense overcooling in the occupied space.

NOTE: It is difficult to accurately set the P7 potentiometer to the desired set point. Use the procedure below.

Proper setting of the P7 potentiometer may be made on a resistance basis. The microprocessor initiates reset when it detects a resistance of the thermistor plus the potentiometer of 13,084 ohm. The potentiometer set point may be calculated using the following formula:

$P7_R = 13{,}084 - T10_R$

Where:

$P7_R$ = the desired set point of the P7 potentiometer in ohms

$T10_R$ = the resistance of the T10 thermistor for the desired set point

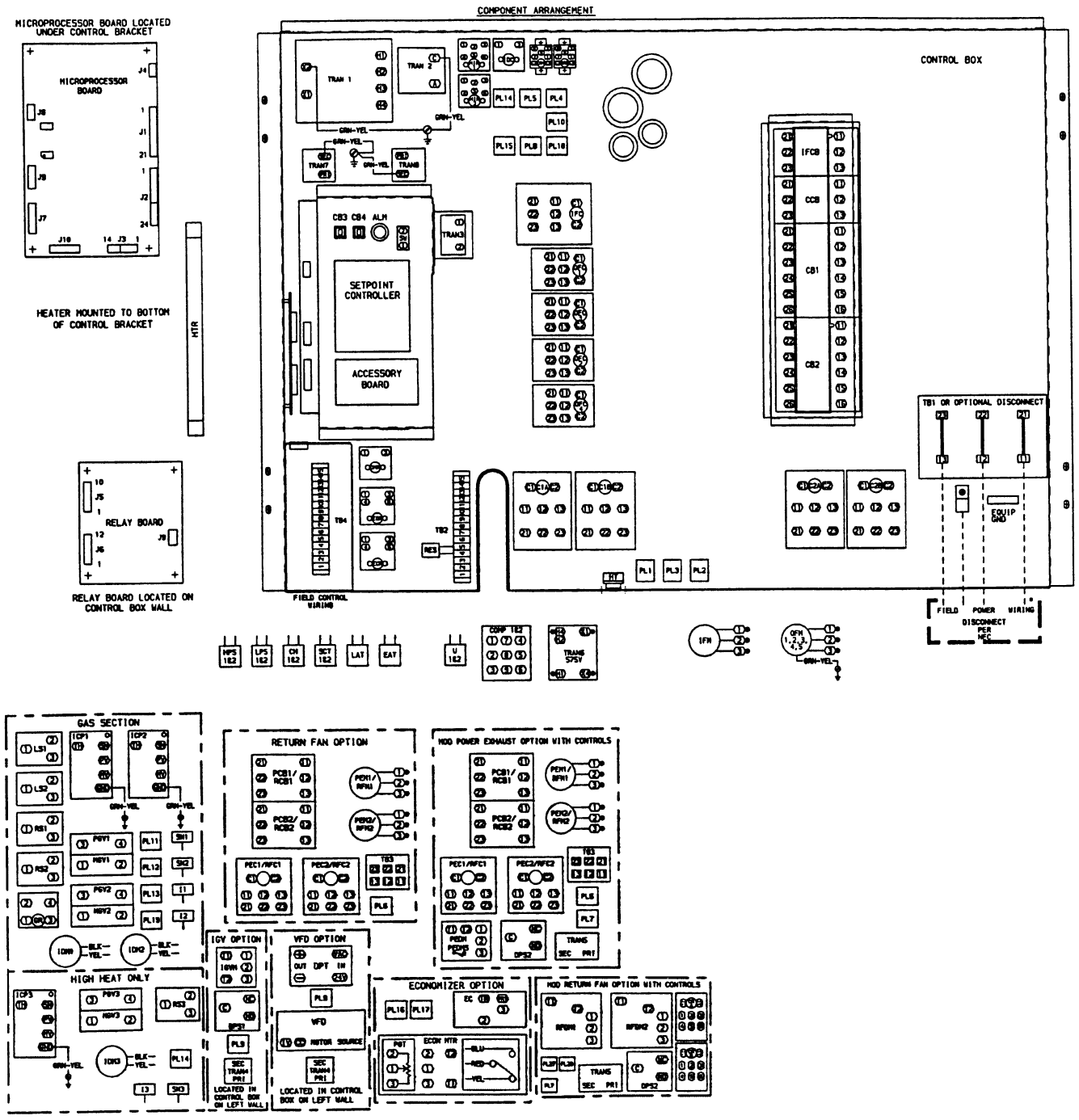


Fig. 23 — Unit Control Box Arrangement, Sizes 030-050

LEGEND FOR FIG. 23-26

ALM	— Alarm	
C	— Contactor	
CB	— Circuit Breaker	
CCB	— Control Circuit Breaker	
COMP	— Compressor	
CH	— Crankcase Heater	
CR	— Control Relay	
DPS	— Differential Pressure Switch	
DPT	— Discharge Pressure Transducer	
EAT	— Entering-Air Temperature	
EC	— Enthalpy Control	
ECR	— Economizer Close Relay	
EOR	— Economizer Open Relay	
EQUIP	— Equipment	
FS	— Fan Status Switch	
GND	— Ground	
HIR	— Heat Interlock Relay	
HPS	— High-Pressure Switch	
HR	— Heater Relay	
HTR	— Heater	
IDC	— Induced Draft Contactor	
IDM	— Induced Draft Motor	
IFC	— Indoor (Evaporator) Fan Contactor	
IFCB	— Indoor Fan Circuit Breaker	
IFM	— Indoor Fan Motor	
IFR	— Indoor (Evaporator) for Relay	
IGV	— Inlet Guide Vanes	
IGVM	— Inlet Guide Vanes Motor	
LAT	— Leaving-Air Temperature	
LPS	— Low-Pressure Switch	
MTR	— Motor	
MV	— Main Valve	
NC	— Normally Closed	
NEC	— National Electrical Code	
NO	— Normally Open	
OFC	— Outdoor Fan Contactor	
OFM	— Outdoor (Condenser) Fan Motor	
OMR	— Outdoor Motor Relay	
PCB	— Power Exhaust Circuit Breaker	
PEC	— Power Exhaust Contactor	
PEDM	— Power Exhaust Damper Motor	
PEM	— Power Exhaust Motor	
P, PL	— Plug	
RCB	— Return Fan Circuit Breaker	
RES	— Resistor	
RFC	— Return Fan Contactror	
RFM	— Return Fan Motor	
SCT	— Saturated Condensing Thermistor	
TB	— Terminal Block	
TRAN	— Transformer	
U	— Unloader	
VFD	— Variable Frequency Drive	
	— Field Wiring	
	— Factory Wiring	

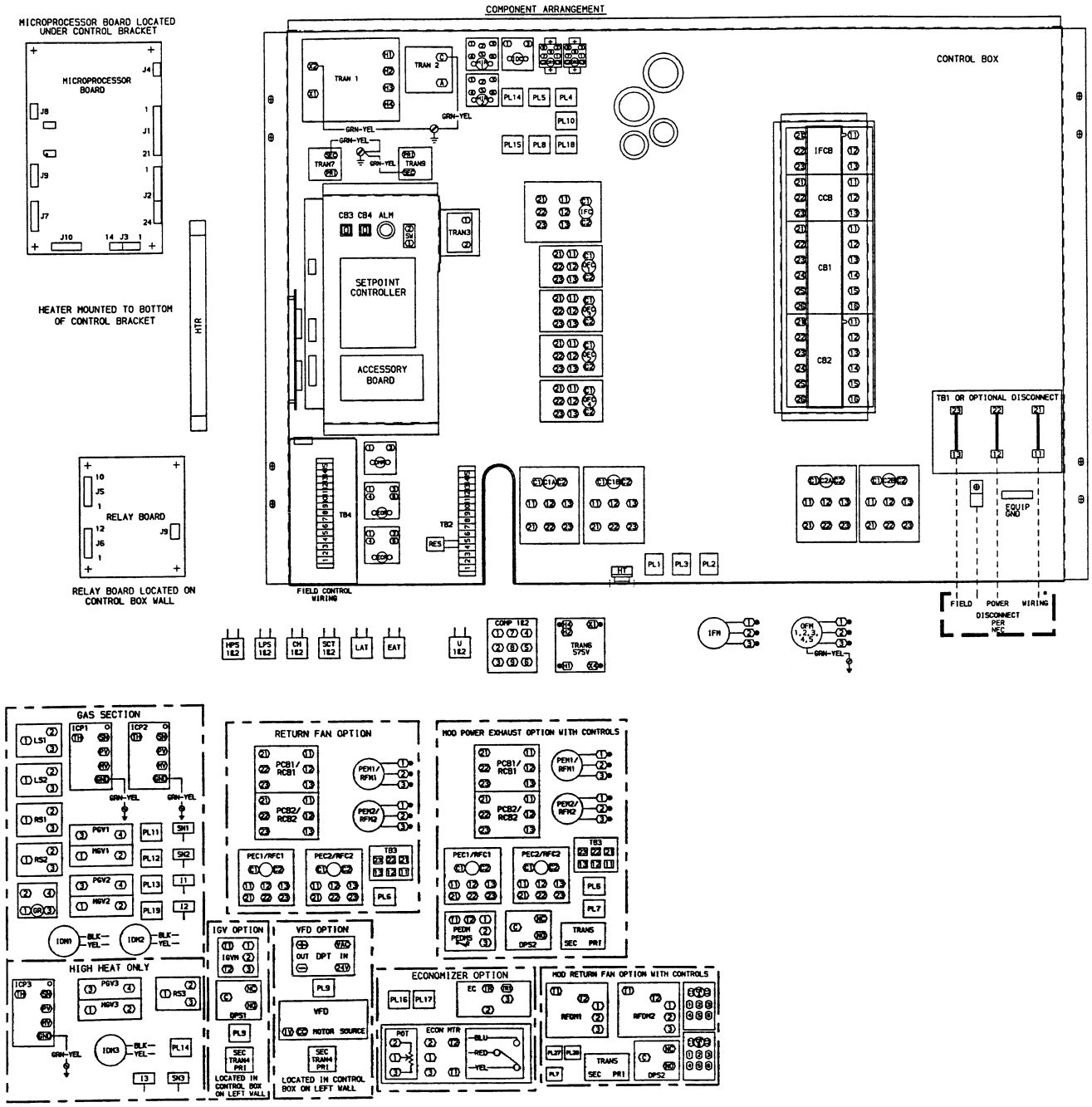


Fig. 24 — Unit Control Box Arrangement, Sizes 055-075

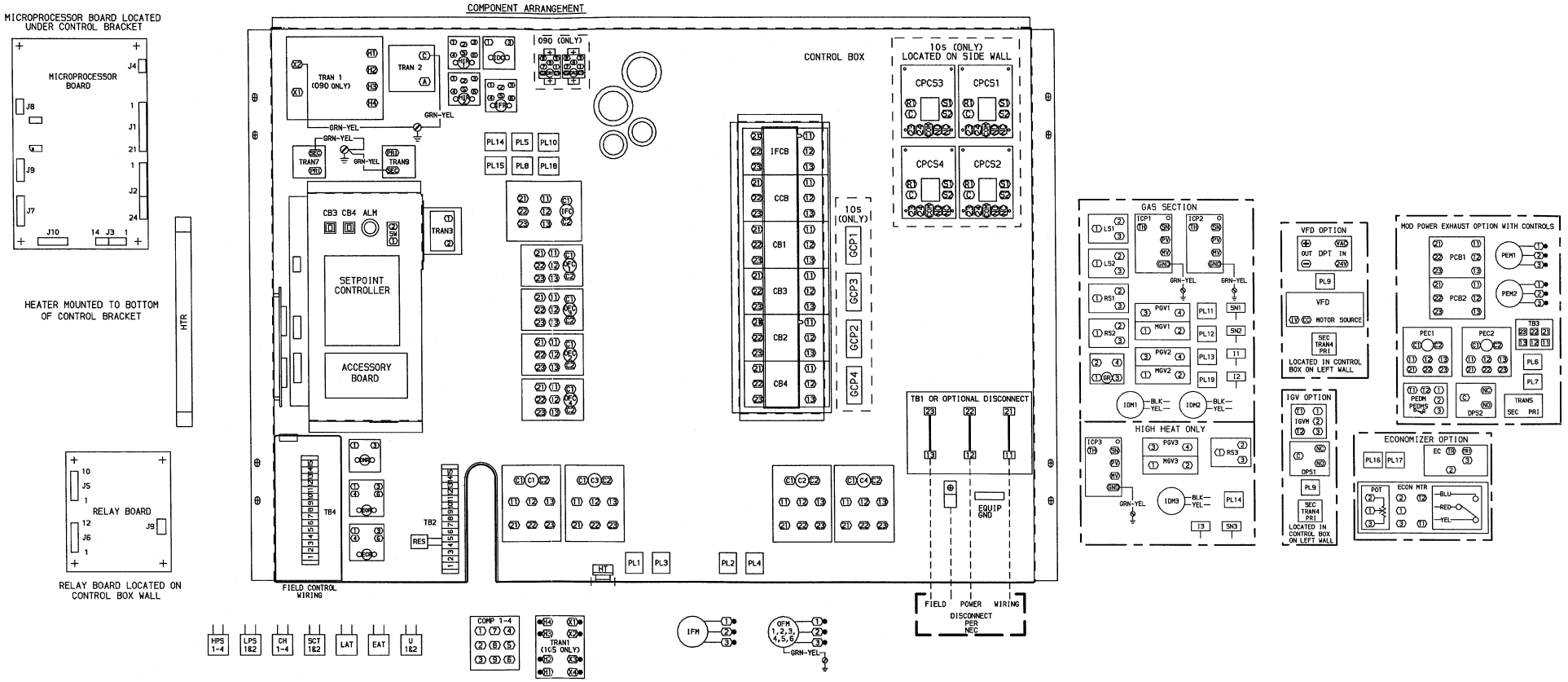


Fig. 25 — Unit Control Box Arrangement, Sizes 090 and 105

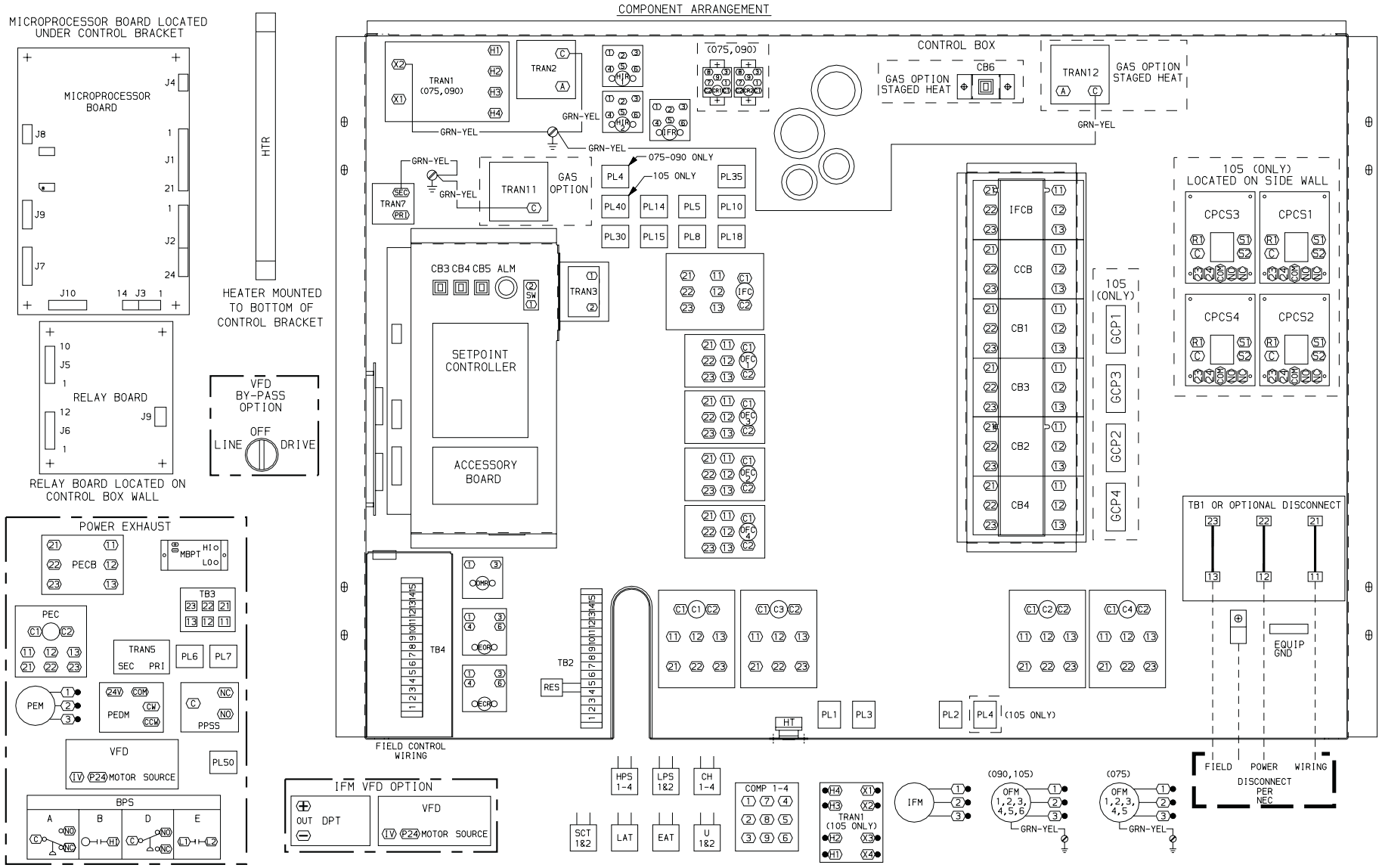
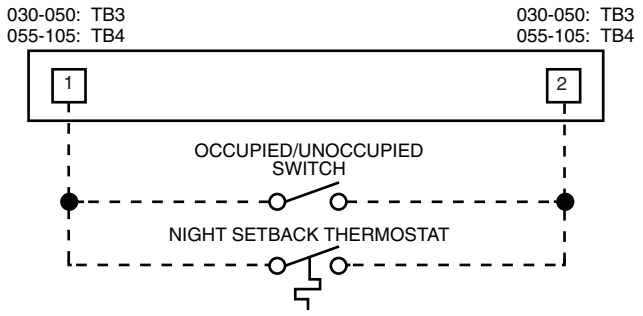


Fig. 26 — Unit Control Box Arrangement, Sizes 075-105 with Return/Exhaust Fan



NOTES:
1. Occ/Unocc switch closes when occupied.
2. Night setback thermostat closes when in night setback heating.

Fig. 27 — Occupied/Unoccupied Switch with Night Setback Thermostat

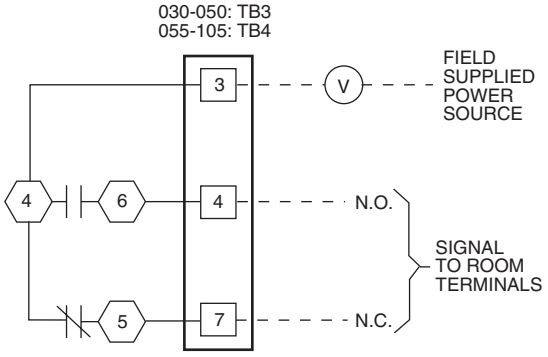


Fig. 28 — Heat Interlock Relay

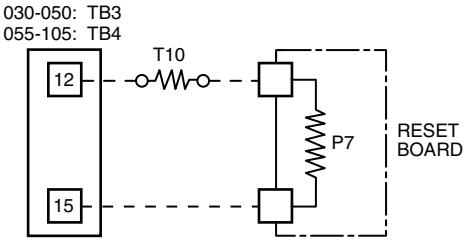


Fig. 29 — Accessory Reset Board

EXAMPLE:

T10 desired set point is 70 F.

$T10_R$ from Table 9 for 70 F is 5929 ohms.

$P7_R$ = 13,084 – 5929

$P7_R$ = 7155 ohms

Using an ohmmeter, set the P7 potentiometer to 7155 ohms to achieve a reset initiation set point of 70 F.

Potentiometer P3 — Reset limit set point (maximum temperature value for modified supply air set point). Maximum of 70 F, minimum 40 F. Set between leaving air set point (P1) and 70 F (maximum range permitted by control).

OPERATING SEQUENCE — If space temperature is above reset set point (T10 > P7), no reset will occur.

If space temperature is equal to or less that reset set point (T10 < P7), the LED will display 20 and reset will begin.

Control will automatically adjust leaving air temperature by the following formula:

MSP = SP + [(P3 - SP) / 3] x (P7 – T10)
where:
MSP = Modified Leaving-Air Set Point
SP = Supply-Air Set Point
P3 = Maximum Supply-Air Temperature (reset limit)
P7 = Reset Initiation Temperature (reset set point)
T10 = Actual Space Temperature
3 = Ratio for reset (F) (fixed parameter)

Table 9 — Thermistor Resistance and Voltage Drop Characteristics

TEMP (F)	RESISTANCE (Ohms)	VOLTAGE DROP (v)
31.0	16813.8	3.582
32.0	16345.7	3.553
33.0	15892.2	3.523
34.0	15452.7	3.494
35.0	15026.7	3.464
36.0	14613.9	3.434
37.0	14213.6	3.404
38.0	13825.5	3.373
39.0	13449.2	3.343
40.0	13084.2	3.312
41.0	12730.1	3.281
42.0	12386.6	3.250
43.0	12053.3	3.219
44.0	11730.0	3.187
45.0	11416.1	3.156
46.0	11111.5	3.124
47.0	10815.8	3.093
48.0	10528.7	3.061
49.0	10250.0	3.029
50.0	9979.3	2.997
51.0	9716.5	2.965
52.0	9461.3	2.933
53.0	9213.4	2.901
54.0	8972.6	2.869
55.0	8738.6	2.837
56.0	8511.4	2.805
57.0	8290.6	2.772
58.0	8076.1	2.740
59.0	7867.7	2.708
60.0	7665.1	2.676
61.0	7468.3	2.644
62.0	7277.1	2.612
63.0	7091.2	2.581
64.0	6910.6	2.549
65.0	6735.1	2.517
66.0	6564.4	2.486
67.0	6398.6	2.454
68.0	6237.5	2.423
69.0	6080.8	2.391
70.0	5928.6	2.360
71.0	5780.6	2.329
72.0	5636.8	2.299
73.0	5497.0	2.268
74.0	5361.2	2.237
75.0	5229.1	2.207
76.0	5100.8	2.177
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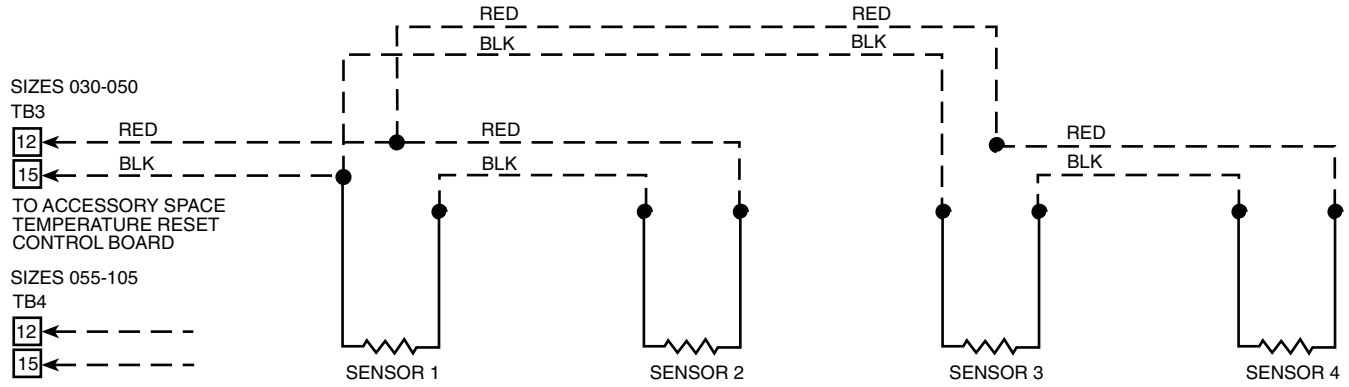
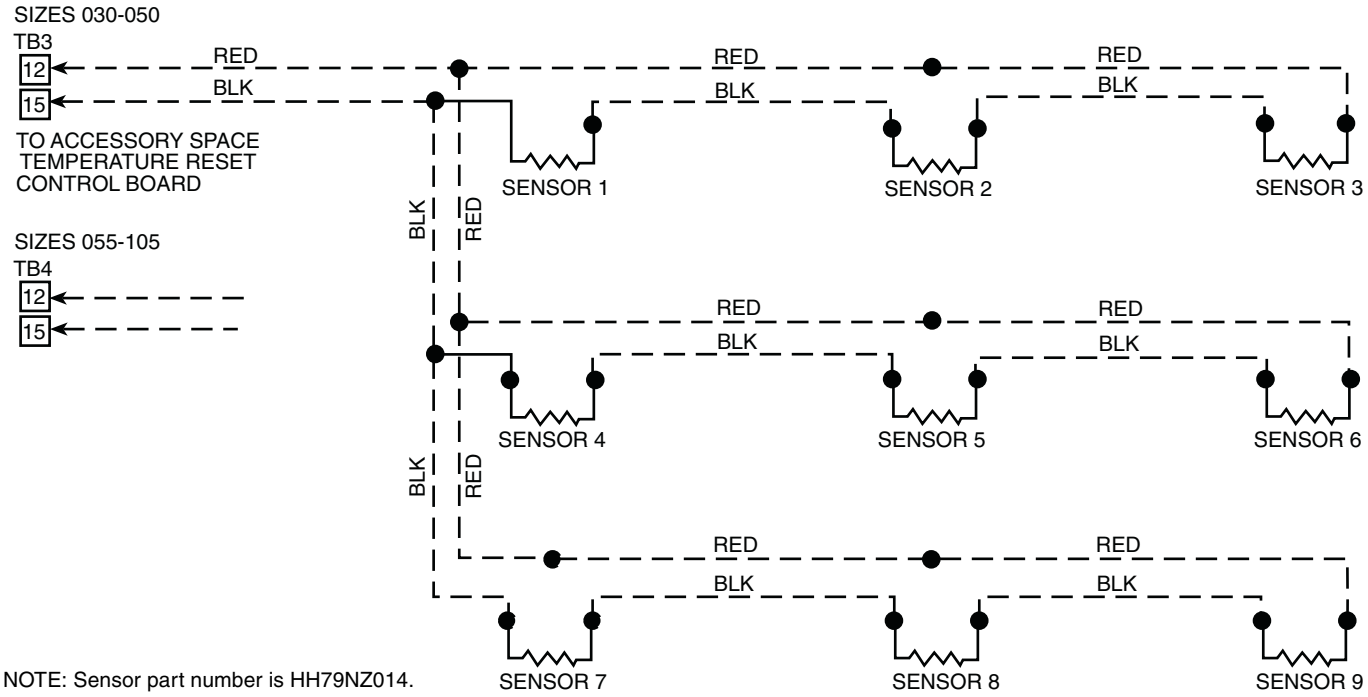
78.0	4854.8	2.117
79.0	4736.9	2.088
80.0	4622.4	2.058



SPACE TEMPERATURE RESET — 4 SENSOR AVERAGING APPLICATION



NOTE: Sensor part number is HH79NZ014.

SPACE TEMPERATURE RESET — 9 SENSOR AVERAGING APPLICATION

Fig. 30 — Space Temperature Sensor Averaging

Demand Limit — The demand limit function provides a means to limit the cooling capacity of the VAV unit using an external discrete switch function. When enabled by the closure of the external switch, the control will limit the available compressor staging capacity according to user set points established at demand limit potentiometer(s).

The unit controls support two types of demand limit: single-step and 2-step control.

SINGLE-STEP DEMAND LIMIT — This function will limit the total compressor staging based on the ratio of the set point potentiometer's wiper arm position to the full scale resistance of the potentiometer. The exact percentage of capacity reduction differs depending on the number of capacity steps.

A field-supplied potentiometer and control switch are required for this function. See installation section for specification on potentiometer and field wiring.

TWO-STEP DEMAND LIMIT — Two-step demand limit is provided with the installation of the accessory Demand Limit Control Module kit plus installation of 2 field-supplied control switches (SPST-NO each). This accessory control provides for a first step reduction of 50% to 100% of the maximum compressor staging; the second step provides for reduction between 0% and 49%. The exact percentage of capacity reduction differs depending on the number of capacity steps.

When demand limit is active, the LED display will show code 22.

INSTALLATION

Single-Step Demand Limit — A 3-wire 5 to 20 K ohm potentiometer must be field-supplied and installed. A single-pole normally open switch is also required (field-supplied and -installed). Locate the potentiometer (designated P4) and the switch in a suitable location (external from the unit or in the unit control box).

Connect the potentiometer end terminals to terminals 8 and 9 on control terminal block TB3 (sizes 030-050) or TB4 (sizes 055-105) (see Fig. 31). Connect the switch terminals to the potentiometer wiper arm terminal and to terminal 10 on TB3 or TB4.

To enable demand limit function, change DIP switch 5 to position ON. (Disconnect control power before changing DIP switch positions. Reconnect power after all changes have been made.)

Set the potentiometer P4 to desired capacity reduction value.

Two-Step Demand Limit — Install the demand limit control module (DLCM) according to the installation instructions provided with the accessory. Disconnect existing leads at connector J3 on the processor board (see instructions) and connect the plug from the DLCM harness to connector J3.

Connect the field input control power wires (from the external control relays) at the terminal strips marked IN1, RTN1, IN2 and RTN2 (see Fig. 32 and 33).

To enable demand limit function, change DIP switch 5 to position ON. (Disconnect control power before hanging DIP switch positions. Reconnect power after all changes have been made.)

Set the potentiometers DLCM-P1 and DLCM-P2 to desired capacity reduction values.

Check the operation of demand limit function by using the Quick Test procedures.

CONFIGURATION

Single-Step Demand Limit — Field-installed potentiometer P4 establishes capacity reduction value for demand limit operation. Set this potentiometer between 0% and 100%. The exact percentage of capacity reduction differs depending on the number of capacity steps.

Two-Step Demand Limit — Potentiometer P1 and P2 (located on the accessory demand limit control module) establish the capacity reduction values for each step of demand limit. Set potentiometer DLCM-P1 between 50% and 100%. Set potentiometer DLCM-P2 between 0% and 49%. The exact percentage of capacity reduction differs depending on the number of capacity steps.

OPERATING SEQUENCE

Single-Step Demand Limit — If the field control switch to the wiper arm terminal is open, all capacity stages will be available (no demand limit in effect). When the field control switch is closed, the compressor cooling capacity is reduced by the amount set on potentiometer P4.

When demand limit is in effect, the LED display will show code 22. If a potentiometer setting or input is out of range, the control will terminate the demand limit function and show code 84 at the display LED.

Two-Step Demand Limit — If the field control switches are both open (no power supplied to the Demand Limit Control Module), all capacity stages will be available (no demand limit in effect). When control power is supplied to terminal IN1 only (field switch SW1 closes), the first step of the demand limit is energized and the compressor cooling capacity is reduced by the amount set on potentiometer DLCM-P1. When control power is supplied to terminal IN2 (field switch SW2 closes), the second step of the demand limit is energized and compressor cooling capacity is reduced by the amount set on potentiometer DLCM-P2.

When demand limit is in effect, the LED display will show code 22. If a potentiometer setting or input is out of range, the control will terminate the demand limit function and show code 84 at the display LED.

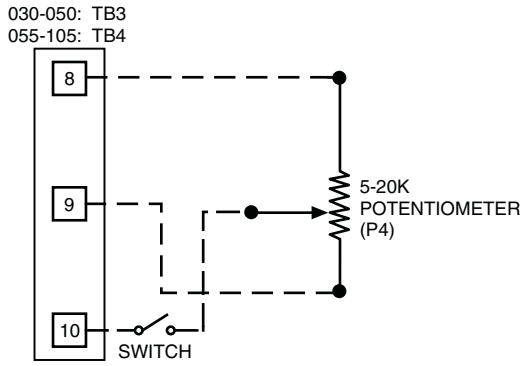


Fig. 31 — Single-Step Demand Limit

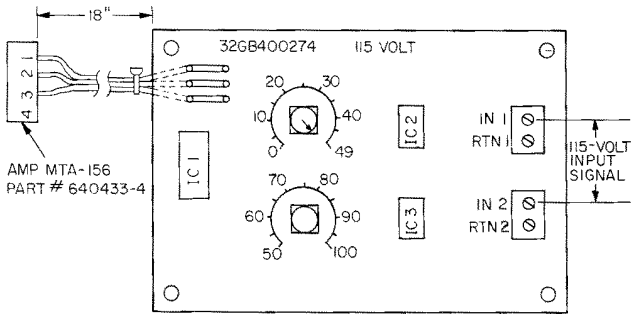
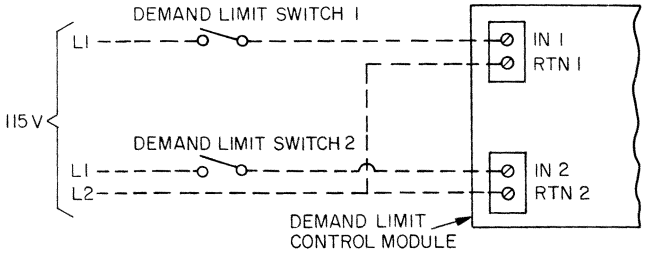


Fig. 32 — Two-Step Demand Limit Module



NOTES:
1. Demand limit switches are field supplied and wired.
2. Demand limit control module terminal blocks will accept up to 12-gage wire.
3. ---- is field wiring.

Fig. 33 — 115-Volt Field Wiring to Accessory 2-Step Demand Limit Control Module

Control From Remote Building Management System (BMS) — The unit control system is not a communicating control system, and it cannot be accessed directly by a DDC (Direct Digital Control) control system (or by a BACnet communication system). However, it is possible to control some functions of these units via 4 to 20 mA or 2 to 10 vdc signals and discrete inputs (relay contact closures).

Functions that can be managed from or accessed from an external control system include:

- Occupied/Unoccupied Status
- Night Setback Control
- Unit Supply Air Set Point Adjustment
- Demand Limit (single-step or two-step)
- Supply Duct Pressure Set Point Adjustment
- External Alarm Signal

Remote control of the economizer cycle on these units is *not recommended.* Refer to the Operating Sequence section on page 46 for a discussion on the economizer cycle operation.

OCCUPIED/UNOCCUPIED — The unit control system will initiate normal occupied mode functions (including Morning Warm-up, Economizer Minimum Position, and Cooling Cycle) whenever a contact closure is made that emulates the normal timeclock contacts. See Fig. 27 (''Occupied/Unoccupied Switch''). The contact closure from the BMS must be an isolated contact set, normally open, and suitable for 24 volts AC pilot duty.

NIGHT SETBACK CONTROL — Night setback control is used to control the space to a set point level that is typically lower than during normal occupied periods (Heating Only mode). Some applications also require a limitation on the maximum space temperature during unoccupied periods (Cooling mode). Both modes are possible by closing the same contacts used in the Occupied/Unoccupied control, or by installing a dedicated contact set in parallel with the Occupied/ Unoccupied control contacts, and using the BMS space temperature sensing system and its logic to determine when to initiate unit operation.

Once the unit operation has been initiated by the BMS contact closure, the unit operates in its normal occupied mode manner, initiating morning warm-up if needed (as sensed by return-air temperature to the unit) or cooling (controlling to current SASP value). The Night Setback Control contacts will interrupt normal unit operation when the BMS senses that space temperatures have returned to unoccupied set point levels, and the unit will shut down normally.

The contact closure from the BMS must be an isolated contact set, normally open, suitable for 24 volts AC pilot duty.

NOTE: If the rooftop unit is equipped with a VFD and night setback cooling operation is intended, the fan system must be controlled to permit FULL SUPPLY FAN AIR DELIVERY during unoccupied cooling operation. This is most conveniently attained by replicating the heat interlock relay function of the rooftop unit. An HIR control sequence will force all room terminals to their minimum heating CFM position, thus assuring adequate airflow through the rooftop unit during night setback cooling operation. During night setback cooling operation, the return-air temperature (RAT) will be well above normal levels. The higher RAT means that the air temperature leaving the evaporator coil will also be well above normal levels. This situation is interpreted by the unit control system as a demand for additional cooling stages. The unit control responds to this demand by bringing on more stages, until typically all stages are active. If the VFD is not working in-step with the refrigeration system demand, it is possible to produce low suction pressures and local frosting on the evaporator coil during the night setback cooling operation.

UNIT SUPPLY AIR SET POINT (SASP) ADJUSTMENT — The minimum Supply Air Set Point temperature is established by the setting at Potentiometer P1 on the unit display board (see Fig. 6). The control point can also be adjusted upward by emulating the function of the accessory Space Temperature Reset package. The BMS can be used to cause this reset by adjusting the resistance value in a variable resistance transducer with a 4 to 20 mA or 2 to 10 vdc signal generated by the BMS.

This emulation requires the following field-supplied parts:

- Variable resistance transducer (Kele RES-1 or equivalent, range 0 to 1000 ohms)
- Series resistance with potentiometer, suitable for manual adjustment to 12.5 to 13.0 K ohms total resistance

Field Connections (see Fig. 34) — Connect manual potentiometer and variable resistance transducer in series.

Connect wiring to rooftop unit at:
Size 030-050: TB3-12 and TB3-15
Size 055-105: TB4-12 and TB4-15

Configuration — Configure as follows:

1. Set DIP switch no. 2 to ON.
2. Adjust manual potentiometer to 12.6 to 12.8 k-ohm.
3. Configure transducer for job site input signal from BMS.
4. Adjust Potentiometer (P3) on the rooftop to MAXIMUM SASP value (typically 65 to 70 F). The maximum P3 SASP control limit is 70 F.

Operation — Unit will initiate SASP Reset (adjust configured SASP upward) when the sum of the resistance (fixed resistance + potentiometer + transducer) exceeds 13.1 k-ohm. Once reset is initiated, full range of reset (P3 setting minus configured SASP) will be reached with 500-ohm increase in transducer resistance (TR).

During Reset mode operation, Code 21 will appear on unit display board.

Formula:

$$MSP = SASP + \left[\frac{(P3 - SASP)}{(3)} \times \frac{(0.6\ F)}{(100\ ohm)} \times (TR - R@13.1) \right]$$

MSP: Modified SASP (SASP plus Reset)
TR: Resistance at transducer

R@13.1: TR required to reach 13.1 k-ohm start level

DEMAND LIMIT (Single-Step or Two-Step) — Both of the Demand Limit functions on the units rely on external switches to initiate the reset functions. Contact closures by the BMS can be used in place of these switches. Contacts must be isolated and suitable for 115-vac pilot duty operation.

For Single-Step Demand Limit, emulate function of switch SW with contact closure controlled by the BMS. Set potentiometer P4 manually at the unit control box. Alternatively, potentiometer P4 might also be emulated by a variable resistance transducer, with the BMS now able to adjust the amount of demand limit.

For Two-Step Demand Limit, install the accessory Demand Limit Control Module (DLCM) according the instructions on page 24. Replace switch functions Switch 1 and Switch 2 with contact closures controlled by the BMS (see Fig. 33).

Follow unit control configuration instructions in the Demand Limit section on page 24.

SUPPLY DUCT PRESSURE SET POINT ADJUSTMENT — Supply duct pressure set point adjustment from a remote BMS is possible when the unit has been equipped with a factory option VFD (variable frequency drive). There are two methods available:

- Direct 4 to 20 mA signal
- DDC direct to the VFD

Direct 4 to 20 mA Signal — During normal unit operation, the factory-installed VFD receives a 4 to 20 mA signal from the Duct Pressure (DP) transducer which indicates current supply duct pressure. The VFD then determines the appropriate fan speed (using its internal PID logic feature) and adjusts its output to the supply fan motor to suit. It is possible to emulate this 4 to 20 mA control signal by the BMS, which will transfer control of the VFD to the BMS.

NOTE: When providing a direct 4 to 20 mA signal to the VFD from a BMS with DP logic, disable the PID (proportion integrated derivative calculation process) feature of the VFD.

DDC (Direct Digital Controls) Direct to the VFD — Several accessory interface boards are available for the VFDs that permit direct communication between the VFD and several BMS communication systems. Contact your Carrier representative for information on selecting an appropriate accessory interface board and the name of the local service office (for sale and installation of the accessory boards).

EXTERNAL ALARM SIGNAL — The unit controls provide an external alarm status signal via a 115-vac output signal at the relay board J5, available at TB2-4 and TB2-5 (common). This signal can be forwarded to the BMS by adding a signal relay at the alarm output, placing its coil across terminals TB2-4 and TB2-5 and using its contacts to control a discrete input to the BMS (see Fig. 35).

The alarm signal output is energized when any of the diagnostic codes is tripped.

REMOTE ECONOMIZER CONTROL — Economizer control is tightly integrated into the unit's capacity control algorithms and diagnostic routines. Consequently, control modifications that interfere with this standard operating sequence are *not recommended.*

Economizer position is determined by the unit processor board based on current outdoor air enthalpy status and cooling capacity demand. The economizer damper actuator is a floating point device with an internal brake and spring return. Its position is determined by the sequencing of relays EOR (Economizer Open Relay) and ECR (Economizer Close Relay). The economizer's current position is sensed by the processor board through position feedback potentiometer P2.

Whenever the economizer position potentiometer signal is not consistent with the processor board's commanded position, a fault condition is determined by the processor board and an alarm signal is initiated. The processor board also attempts to return the economizer damper to its fully closed position during this fault condition by energizing the ECR relay.

Any attempt to effect an external control of the economizer actuator will lead to an alarm condition and an automatic response by the unit control to attempt to close the dampers.

Optional Staged Gas Unit Control (48 Series Units Only)

ACCESSORY NAVIGATOR™ DISPLAY — The accessory Navigator display module provides the user interface to the Staged Gas control system and is required for all staged gas control units. See Fig. 36. The display has up and down arrow keys, an ESC key, and an ENTER key. These keys are used to navigate through the different levels of the display structure. See Table 10. Press the ESC key until the display is blank to move through the top 11 mode levels indicated by LEDs on the left side of the display.

Pressing the ESC and ENTER keys simultaneously will scroll a text description across the display indicating the full meaning of each display acronym. Pressing the ESC and ENTER keys when the display is blank (Mode LED level) will return the display to its default menu of rotating display items. In addition, the password will be disabled requiring that it be entered again before changes can be made to password protected items.

When a specific item is located, the display will flash showing the operator, item, item value, and then followed by the item units (if any). Press the ENTER key to stop the display at the item value. Items in the Configuration and Service Test modes are password protected. The display will flash PASS and WORD when required. Use the ENTER and arrow keys to enter the 4 digits of the password. The default password is 1111.

Changing item values or testing outputs is accomplished in the same manner. Locate and display the desired item. Press the ENTER key to stop the display at the item value. Press the ENTER key again so that the item value flashes. Use the arrow keys to change the value or state of an item and press the ENTER key to accept it. Press the ESC key and the item,

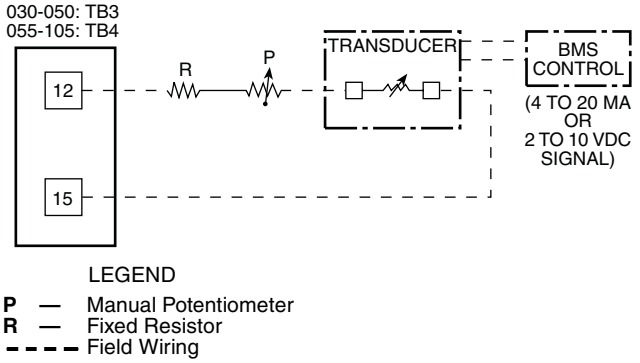


Fig. 34 — Remote SASP Wiring

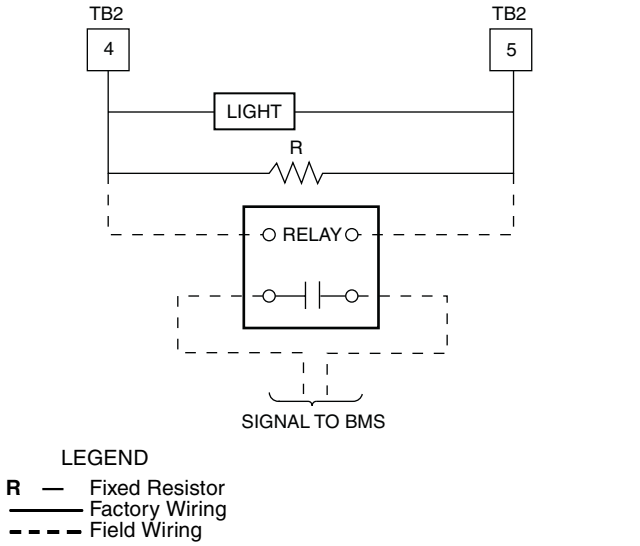


Fig. 35 — External Alarm Indication

value, or units display will resume. Repeat the process as required for other items. See Tables 11-22 for further details.

CLEARING UNIT ALARMS — The unit alarms can be cleared through Navigator display. To check the current alarms, enter the Alarms menu. The first submenu is the CRNT submenu. The CRNT function displays the list of current alarms (maximum of 25). The second submenu item is the RCRN (Reset All Current Alarms) function. Press ENTER to reset the current alarms. The next submenu item, HIST, displays the list of cleared alarms (maximum of 20). HIST function can be cleared with the RHIS function.

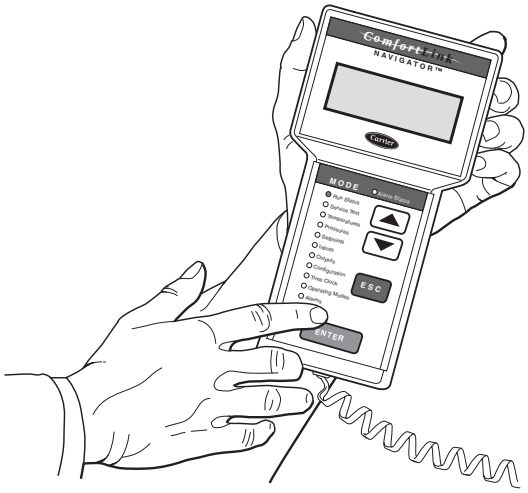


Fig. 36 — Accessory Navigator Display Module

Table 10 — Navigator Display Menu Structure

RUN STATUS	SERVICE TEST	TEMPERATURES	PRESSURES	SET POINTS	INPUTS	OUTPUTS	CONFIGURATION	TIME CLOCK	OPERATING MODES	ALARMS
Auto Display (VIEW)	SERVICE TEST	SUPPLY AIR TEMPERATURE	N/A	SETPOINT SELECT	COOL INPUT#1	HEAT OUTPUT 1	Display Configuration (DISP)	Time (DAY)	N/A	Currently Active Alarms (CRNT)
Software Version (VERS)	HEAT OUTPUT#1	SUPPLY AIR TEMPERATURE 1		COOLING SETPOINT 1	COOL INPUT#2	HEAT OUTPUT 2	CCN Configuration (CCN)	Date (DATE)		Reset all Current Alarms (RCRN)
	HEAT OUTPUT#2	SUPPLY AIR TEMPERATURE 2		COOLING SETPOINT 2	HEAT INPUT#1	HEAT OUTPUT 3	Stage Gas Configuration (CNFG)	Occupancy and Unoccupancy Schedule Number (SCH.D)		Alarm History (HIST)
	HEAT OUTPUT#2	SUPPLY AIR TEMPERATURE 3		HEATING SETPOINT 1	HEAT INPUT#2	HEAT OUTPUT 4				Reset Alarm History (RHIS)
	HEAT OUTPUT#3	LIMIT SWITCH TEMPERATURE		HEATING SETPOINT 2	SUPPLY FAN STATUS	HEAT OUTPUT 5				
	HEAT OUTPUT#4				DEHUMIDIFY INPUT	HEAT OUTPUT 6				
	HEAT OUTPUT#5									
	HEAT OUTPUT#6									

Table 11 — “Run Status” Mode and Sub-Mode Directory

SUB-MODE	KEYPAD ENTRY	ITEM	DISPLAY	ITEM EXPANSION	COMMENT
VIEW	ENTER			Auto View of Run Status	
	▼	SAT	XXX.X	Supply Air Temperature	
	▼	SETP	XXX.X	Control Setpoint	
	▼	MODE		Control Mode	
	▼	CAPA	XXX	Current Running Capacity	%
	▼	HEAT	X	Current Heat Stage	
	▼	H.MAX	X	Maximum Heat Stages	
	▼	LIM.M	ON/OFF	Hi Limit Switch Tmp Mode	
	▼	LIM.S	ON/OFF	Sat Cutoff Mode	
	▼	LIM.C	ON/OFF	Capacity Clamp Mode	
	▼	OCC	YES/NO	Occupied	
	▼	ALRM	XX	Current Alarms & Alerts	
	▼	TIME	XX.XX	Time of Day	00.0-23.59
	▼	MNTH		Month of Year	1=Jan, 2=Feb, etc.
	▼	DATE	XX	Day of Month	Range 1-31
	▼	YEAR	XXXX	Year	
VERS	ENTER			Software Version Numbers	
	▼	MBB		CESR131274-XX-YY	
	▼	NAVI		CESR130227-XX-YY	

Table 12 — "Service Test" Mode and Sub-Mode Directory

SUB-MODE	KEYPAD ENTRY	ITEM	DISPLAY	ITEM EXPANSION	COMMENT
	▼	TEST	YES/NO	Field Service Test Mode	Use to Enable/Disable Manual Mode
	▼	OUT.1	ON/OFF	Heat output #1	
	▼	OUT.2	ON/OFF	Heat output #2	
	▼	OUT.3	ON/OFF	Heat output #3	
	▼	OUT.4	ON/OFF	Heat output #4	
	▼	OUT.5	ON/OFF	Heat output #5	
	▼	OUT.6	ON/OFF	Heat output #6	

Table 13 — "Temperatures" Mode and Sub-Mode Directory

SUB-MODE	KEYPAD ENTRY	ITEM	DISPLAY	ITEM EXPANSION	COMMENT
	▼	SAT	XXX.X	Supply Air Temperature	
	▼	SAT.1	XXX.X	Supply Air Temperature 1	
	▼	SAT.2	XXX.X	Supply Air Temperature 2	
	▼	SAT.3	XXX.X	Supply Air Temperature 3	
	▼	LIMT	XXX.X	Limit Switch Temperature	

Table 14 — "Pressures" Mode and Sub-Mode Directory

SUB-MODE	KEYPAD ENTRY	ITEM	DISPLAY	ITEM EXPANSION	COMMENT
	ENTER	N/A	N/A	N/A	N/A

Table 15 — "Set points" Mode and Sub-Mode Directory

SUB-MODE	KEYPAD ENTRY	ITEM	DISPLAY	ITEM EXPANSION	COMMENT
	▼	SP.SL	X	Setpoint Select	0= Setpoint Adjust 1= Single 2=Dual 7 Day 3=Dual CCN
	▼	CSP.1	XXX.X	Cooling Setpoint 1	Default: 45.0
	▼	CSP.2	XXX.X	Cooling Setpoint 2	Default: 47.0
	▼	HSP.1	XXX.X	Heating Setpoint 1	Default: 102.5
	▼	HSP.2	XXX.X	Heating Setpoint 2	Default: 100.5

Table 16 — "Inputs" Mode and Sub-Mode Directory

SUB-MODE	KEYPAD ENTRY	ITEM	DISPLAY	ITEM EXPANSION	COMMENT
	▼	CL.1	ON/OFF	Cool Input #1	
	▼	CL.2	ON/OFF	Cool Input #2	
	▼	HT.1	ON/OFF	Heat Input #1	
	▼	HT.2	ON/OFF	Heat Input #2	
	▼	FAN.I	ON/OFF	Supply Fan Status	
	▼	DEHU	ON/OFF	Dehumidify Input	

Table 17 — "Outputs" Mode and Sub-Mode Directory

SUB-MODE	KEYPAD ENTRY	ITEM	DISPLAY	ITEM EXPANSION	COMMENT
	▼	HT_1	ON/OFF	Heat Output 1	
	▼	HT_2	ON/OFF	Heat Output 2	
	▼	HT_3	ON/OFF	Heat Output 3	
	▼	HT_4	ON/OFF	Heat Output 4	
	▼	HT_5	ON/OFF	Heat Output 5	
	▼	HT_6	ON/OFF	Heat Output 6	

Table 18 — "Configuration" Mode and Sub-Mode Directory

SUB-MODE	KEYPAD ENTRY	ITEM	DISPLAY	ITEM EXPANSION	COMMENT
DISP	ENTER			Display Configuration	
	▼	TEST	ON/OFF	Test Display LEDs	
	▼	METR	ON/OFF	Metric Display	Default: OFF ON = Metric OFF = English
	▼	LANG	X	Language Selection	Default: 0 0 = English 1 = Espanol 2 = Francais 3 = Portuguese
	▼	PAS.E	Enable/Disable	Password Enable	Enable
	▼	PASS	XXXX	Service Password	Default = 1111
CCN	ENTER			CCN Configuration	
	▼	CCN.A	XXX	CCN Address	Default: 1 Range: 1 to 239
	▼	CCN.B	XXX	CCN Bus Number	Default: 0 Range: 1 to 239
	▼	BAUD	X	CCN Baud Rate	Default: 3 1 = 2400 2 = 4800 3 = 9600 4 = 19,200 5 = 38,400

Table 18 — "Configuration" Mode and Sub-Mode Directory (cont)

SUB-MODE	KEYPAD ENTRY	ITEM	DISPLAY	ITEM EXPANSION	COMMENT
CNFG	ENTER			Stage Gas Configuration	
	▼	TYPE	X	Heat Stage Type	
	▼	CAP.M	XX.X	Max Cap Change Per Cycle	%
	▼	RATE	XXX	PID Algorithm Rate	Range: 60-300 Default:90
	▼	P	X.X	Proportional Gain	Range:0.5-1.5 Default:1
	▼	D	X.X	Derivative Gain	Range:05-1.5 Default:1
	▼	UP.DB	X.X	Upper Temp Deadbnd Limit	Range:0-5 Default: 2
	▼	LO.DB	X.X	Lower Deadband Limit	Range:-5-0 Default: -2
	▼	MR.DB	X.X	Abs.Min Rate for Deadbnd	%, Range: 0-5 Default: 0.5
	▼	HI.HT	XXX.X	Limit Switch High Temp	
	▼	LO.HT	XXX.X	Limit Switch Low Temp	
	▼	SAT.C	XX.X	SAT Limit Config	Range:0-20 Default:10
	▼	HT.RS	X.XX	Heat Rise dF/sec Clamp	Range:0.05-0.2 Default:0.06

Table 19 — "Time Clock" Mode and Sub-Mode Directory

SUB-MODE	KEYPAD ENTRY	ITEM	DISPLAY	ITEM EXPANSION	COMMENT
TIME	ENTER	TIME	XX.XX	Hour and Minute	Military (00.00-23.59)
DATE	ENTER			Current Date	
	▼	MNTH	XX	Month of Year	1=Jan, 2=Feb, etc.
	▼	DOM	XX	Day of Month	Range 1-31
	▼	DAY	XX	Day of Week	1=Mon, 2=Tue, etc.
	▼	YEAR	XXXX	Year	
SCH.D	ENTER			Local Occupancy Schedule	
	▼	MON.O	XX.XX	Monday In Occupied Time	Range: 00.00 to 23.59; Default: 00.00
	▼	MON.U	XX.XX	Monday in Unoccupied Time	Range: 00.00 to 23.59; Default: 00.00
	▼	TUE.O	XX.XX	Tuesday In Occupied Time	Range: 00.00 to 23.59; Default: 00.00
	▼	TUE.U	XX.XX	Tuesday in Unoccupied Time	Range: 00.00 to 23.59; Default: 00.00
	▼	WED.O	XX.XX	Wednesday In Occupied Time	Range: 00.00 to 23.59; Default: 00.00
	▼	WED.U	XX.XX	Wednesday in Unoccupied Time	Range: 00.00 to 23.59; Default: 00.00
	▼	THU.O	XX.XX	Thursday In Occupied Time	Range: 00.00 to 23.59; Default: 00.00
	▼	THU.U	XX.XX	Thursday in Unoccupied Time	Range: 00.00 to 23.59; Default: 00.00
	▼	FRI.O	XX.XX	Friday In Occupied Time	Range: 00.00 to 23.59; Default: 00.00
	▼	FRI.U	XX.XX	Friday in Unoccupied Time	Range: 00.00 to 23.59; Default: 00.00
	▼	SAT.O	XX.XX	Saturday In Occupied Time	Range: 00.00 to 23.59; Default: 00.00
	▼	SAT.U	XX.XX	Saturday in Unoccupied Time	Range: 00.00 to 23.59; Default: 00.00
	▼	SUN.O	XX.XX	Sunday In Occupied Time	Range: 00.00 to 23.59; Default: 00.00
	▼	SUN.U	XX.XX	Sunday in Unoccupied Time	Range: 00.00 to 23.59; Default: 00.00

Table 20 — "Operating Modes" Mode and Sub-Mode Directory

SUB-MODE	KEYPAD ENTRY	ITEM	DISPLAY	COMMENT
	N/A	N/A	N/A	N/A

Table 21 — "Alarms" Mode and Sub-Mode Directory

SUB-MODE	KEYPAD ENTRY	ITEM	ITEM EXPANSION	COMMENT
CRNT	ENTER	AXXX or TXXX	Currently Active Alarms	Alarms are shown as AXXX Alerts are shown as TXXX
RCRN	ENTER	YES/NO	Reset All Current Alarms	
HIST	ENTER	AXXX or TXXX	Alarm History	Alarms are shown as AXXX Alerts are shown as TXXX
RHIS	ENTER	YES/NO	Reset Alarm History	

Table 22 — Example of Changing the CCN Configuration

SUB-MODE	KEYPAD ENTRY	ITEM	DISPLAY	ITEM EXPANSION	COMMENT
CCN	ENTER	CCN.A	1	CCN Address	Default: 1
	ENTER		1		Scrolling Stops
	ENTER				Value flashes
	▲				Select 2
	ENTER				Change accepted
	ESCAPE	CCN.A			Item/Value/Units scroll again
	▼	CCN.B		CCN Bus Number	No change
	▼	BAUD		CCN Baud Rate	Default:3 = 9600
	ENTER	BAUD	3	CCN Baud Rate	Default: 75
	ENTER		3		Scrolling Stops
	ENTER		3		Value flashes
	▲				Select 5 = 38,400
	ENTER		5		Change accepted
	ESCAPE	BAUD	5	CCN Baud Rate	Item/Value/Units scroll again

Smoke Control Modes — It is common practice to use rooftop units for aid in building smoke control in the event of a building fire. The available functions include: Fire Shutdown, Pressurization, Evacuation, and Smoke Purge. These functions are enhanced when multiple rooftop units are used to zone a building.

Implementation of the various Smoke Control modes on these units requires the installer to modify the unit wiring to add contacts (via either manual switches or relays) that will selectively interrupt and override standard factory control sequences. See Table 23.

Smoke control mode Pressurization requires the economizer function. Evacuation and Smoke Purge modes require both economizer and power exhaust functions. Both functions are standard features on 48ZR,ZV and 50ZR,ZS,ZV,ZY units. These functions require factory-installed options, field-installed accessories and/or field-supplied exhaust systems on 48ZE and 50ZE,ZF units. Consult price pages for specific details.

FIRE SHUTDOWN MODE — Fire Shutdown mode terminates all unit operation (cooling, heating, supply fan and power exhaust). This mode prevents recirculation of contaminated air back into the space or the admission into the space of unsuitable outside air.

PRESSURIZATION MODE — Pressurization mode is intended to keep smoke out of a zone. The economizer is required for this function. The economizer is standard on 48ZR,ZV and 50ZR,ZS,ZV,ZY units. The economizer is a factory-installed option on 48ZE and 50ZE,ZF units. Pressurization is accomplished by:

- opening the economizer
- running the supply fan (optional inlet guide vanes open or optional VFD [variable frequency drive] at normal duct static pressure set point)
- shutting off the power exhaust fans (Standard on 48ZR,ZV and 50ZR,ZS,ZV,ZY units. Factory-installed option or field-installed accessory on 48ZE and 50ZE,ZF units)

This allows the space to be overpressurized relative to adjacent zones and prevents or slows entry of smoke into this space from adjacent zones.

EVACUATION MODE — Evacuation mode removes smoke or undesirable air from interior spaces without reintroducing unsuitable air. The economizer and power exhaust are required for this function. The economizer and power exhaust are standard on 448ZR,ZV and 50ZR,ZS,ZV,ZY units. The economizer is a factory-installed option and the power exhaust is a factory-installed option or field-installed accessory on 48ZE and 50ZE,ZF units. Evacuation is accomplished by:

- turning supply fan off
- opening the economizer
- running the exhaust fans
- opening the exhaust dampers

SMOKE PURGE MODE — Smoke Purge mode removes smoke from the interior spaces and replaces it with fresh outside air. The economizer and power exhaust are required for this function. The economizer and power exhaust are standard on 48ZR,ZV and 50ZR,ZS,ZV,ZY units. The economizer is a factory-installed option and the power exhaust is a factory-installed option or field-installed accessory on 48ZE and 50ZE,ZF units. Smoke purge is accomplished by:

- turning supply fan on
- opening the economizer
- running the exhaust fans
- opening the exhaust dampers

INSTALLATION — To enable one or more of the possible smoke control modes available with these units, determine the switches required for the desired mode(s) from Table 24, field-supply and install the appropriate switches and field wire per Fig. 37. Switch functions are shown in Table 25.

Table 23 — Smoke Control Modes

FUNCTION	MODE			
	Fire Shutdown	Pressurization	Evacuation*	Smoke Purge*
Supply Fan	Off	On	Off	On
IGV/VFD†	—	Open/On	—	Open/On
Economizer	Closed	Open	Open	Open
Return Air Damper	Open	Closed	Closed	Closed
Exhaust Fans	Off	Off	On	On
Exhaust Damper	Closed	Closed	Open	Open

LEGEND

IGV — Inlet Guide Vane
VAV — Variable Air Volume
VFD — Variable Frequency Drive

*Power exhaust function required for this mode.
†Applicable to VAV units with appropriate options.

Table 24 — Smoke Control Switches Required for Each Mode

FIRE SHUTDOWN	PRESSURIZATION	EVACUATION (Modulating Power Exhaust)	SMOKE PURGE
SW-1	SW-1	SW-1	SW-1
SW-2	SW-2	SW-2	SW-2
	SW-4	SW-3	SW-3
	SW-5	SW-5	SW-4
	SW-6	SW-6	SW-9A/B
	SW-9A/B	SW-7	
		SW-8*	

*Not required on 48ZR,ZV and 50ZR,ZS,ZV,ZY units (high capacity power exhaust units).

NOTE: All switches are shown in “as installed” (power OFF or deenergized) position. In these positions, none of these modes will be activated; normal unit operation is permitted by the base unit controls. To initiate any mode, all switches listed under this mode in the table must be energized, causing the depicted contact position to change from depicted positions to energized positions. Switches may be manually or electrically operated.

CONFIGURATION — No set points required for Smoke Control modes. Modes are activated by energizing all switches appropriate for each Smoke Control mode.

OPERATING SEQUENCE

Fire Shutdown — At command from the field switches (see Table 23), all unit operation (cooling, heating, supply fan and power exhaust) will terminate.

Pressurization — At command from the field switches for Pressurization mode (see Table 23):

1. Economizer dampers will open.
2. The HIR function will energize, opening room terminals to full-open (heating) positions.
3. Supply fan will run. (If equipped with IGV: control vanes will open. If equipped with VFD: the VFD will control to duct static set point or best available with all terminals open.)
4. Power exhaust dampers (if equipped) will close.
5. Power exhaust fans (if equipped) will turn off.

Evacuation — At command from the field switches for Evacuation mode (see Table 23):

1. Supply fan will turn off.
2. Economizer dampers will open.
3. Exhaust fans will run at maximum capacity.
4. Exhaust dampers will open.

Smoke Purge — At command from the field switches for Smoke Purge mode (see Table 23):

1. Economizer dampers will open.
2. The HIR function will energize, opening room terminals to full-open (heating) positions.
3. Supply fan will run. (If equipped with IGV: Control vanes will open. If equipped with VFD: the VFD will control to duct static set point or best available with all terminals open.)
4. Exhaust fans will run at maximum capacity.
5. Exhaust dampers will open.

Air Pressure Tubing — Before options such as inlet guide vanes (IGV), variable frequency drive (VFD), and/or modulating power exhaust can operate properly, the pneumatic tubing for pressure sensing must be installed. Use fire-retardant plenum tubing (field-supplied). Tubing size depends on type of control device (see Table 26 below). Tubing must be run from the appropriate sensing location (in the duct or in the building space) to the control device location in the unit.

Table 26 — Tubing Size

OPTION	UNITS	NOMINAL TUBE SIZE (in.)
Inlet Guide Vanes (IGV)	ALL	3/8
Supply Fan Variable Frequency Drive (VFD)	ALL	1/4
Modulating Power Exhaust	ZE,ZF	3/8
	ZV,ZY	1/4
Return/Exhaust	ZR,ZS	3/8

INLET GUIDE VANES — The tubing for the duct pressure (DP) control option should sample supply duct pressure about 2/3 of the way out from the unit in the main trunk duct, at a location where a constant duct pressure is desired.

The inlet guide vanes are controlled by a differential pressure switch (DPS). On sizes 030-050, the DPS is located in the auxiliary control box at the economizer end of the unit (see Fig. 38). On sizes 055-105, the DPS is located in the supply fan section. See Fig. 39. Use a nominal 3/8-in. plastic tubing.

SUPPLY FAN VARIABLE FREQUENCY DRIVE — The tubing for the duct pressure (DP) control option should sample supply duct pressure about 2/3 of the way out from the unit in the main trunk duct, at a location where a constant duct pressure is desired.

The duct pressure is sensed by a pressure transducer. The pressure transducer output is directed to the VFD. On 030-050 units the DP transducer is located in the auxiliary control box. On 055-105 units, the DP transducer is located in the supply fan section. See Fig. 39. Use a nominal 1/4-in. plastic tubing.

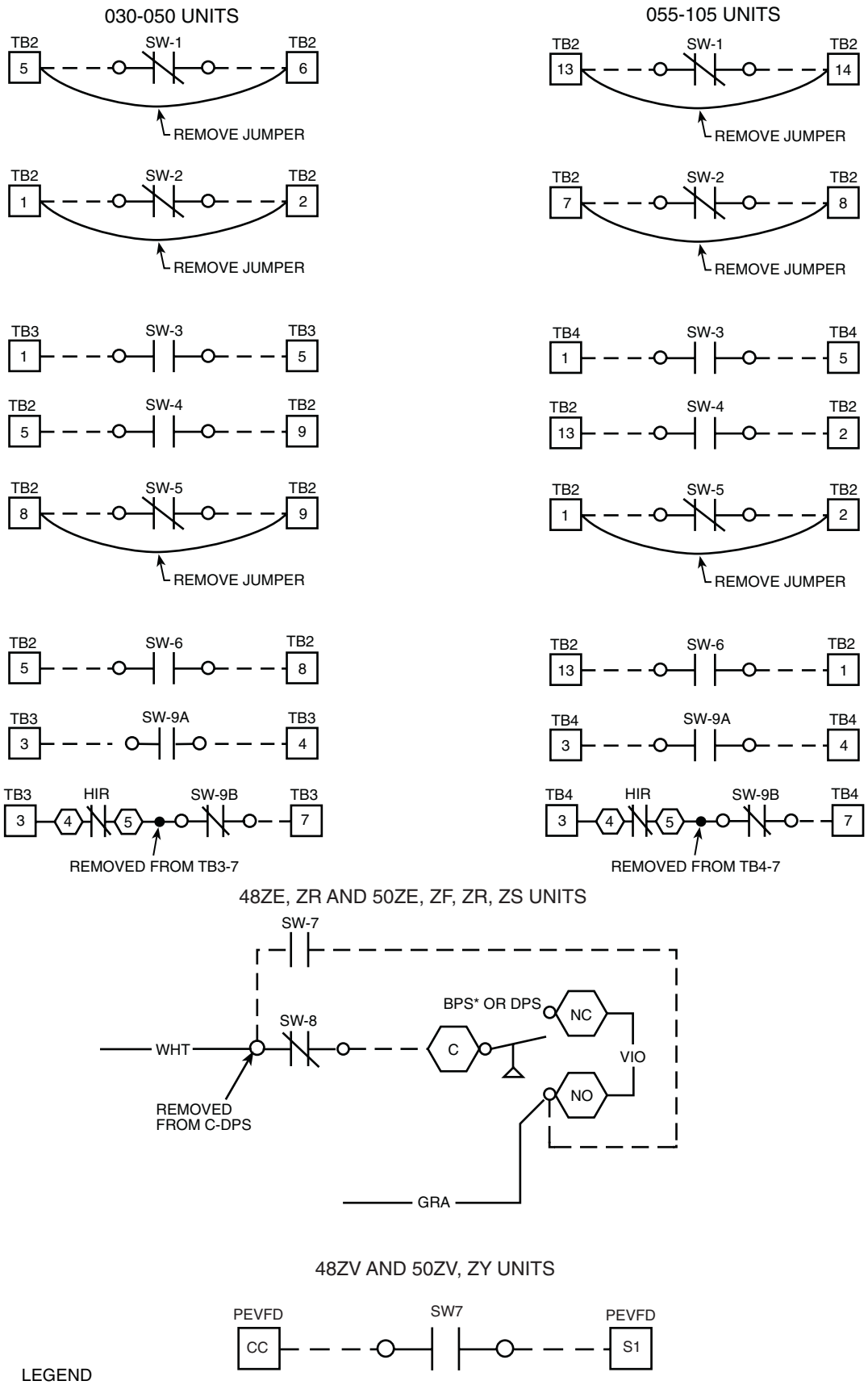
Table 25 — Switch Functions

SWITCH NUMBER	CONFIGURATION	VOLTAGE	FUNCTION
SW-1	N.C.	115	Deenergize 115-v (OFC, Comp, IFC, Electric Heaters)
SW-2	N.C.	115	Deenergize TRAN7 (Process Board)
SW-3	N.O.	24	Energize EOR (Open Economizer Outside Air Dampers)
SW-4	N.O.	115	Energize IFC and CR-3 (IGV/VFD)
SW-5	N.C.	115	Isolate IFC and PEC for Separate Operation
SW-6	N.O.	115	Energize PEC (Power Exhaust)
SW-7	N.O.	24	Open PED at DPS or BPS (48ZE and 50ZE,ZF Units) Force Power Exhaust VFD to Maximum Speed (48ZR,ZV and 50ZR,ZS,ZV,ZY Units)
SW-8*	N.C.	24	Block Auto-Close at DPS (Due to Low BP)
SW-9A/B	A: N.O. B: N.C.	115 max	Signal Room Terminals to Open (HIR1)

*Not required on 48ZV and 50ZV,ZY units (units with high capacity power exhaust).

LEGEND

BP — Building Pressure
BPS — Building Pressure Switch
DPS — Differential Pressure Switch
EOR — Economizer Open Relay
HIR — Heat Interlock Relay
IFC — Indoor Fan Contactor
IGV — Inlet Guide Vane
N.C. — Normally Closed
N.O. — Normally Open
PEC — Power Exhaust Contactor
PED — Power Exhaust Damper
OFC — Outdoor Fan Contactor
TRAN — Transformer
VFD — Variable Frequency Drive



LEGEND

BPS — Building Pressure Switch
DPS — Differential Pressure Switch
HIR — Heat Interlock Relay
PEVFD — Power Exhaust Variable Frequency Drive
SW — Switch
TB — Terminal Block

*48ZR and 50ZR,ZS units only.

Fig. 37 — Smoke Control Wiring

MODULATING POWER EXHAUST

48ZE and 50ZE,ZF Units — The tubing for the building pressure control (achieved via the Modulating Power Exhaust option/accessory) should sample building pressure in the area near the entrance lobby (or other appropriate and sensitive location) so that location is controlled as closely to design pressures as possible.

A differential pressure switch (DPS) is used to control the actuator on the modulating discharge damper in exhaust fan no. 1. The building pressure (BP) DPS is located in the auxiliary control box of the unit. See Fig. 38 and 40. Use a nominal $^3/_8$-in. plastic tubing.

For instructions on adjusting BP control set points, refer to Start-Up, Modulating Power Exhaust section in this book.

48ZV and 50ZV,ZY Units — The tubing for the building pressure control (achieved through the High Capacity Modulating Power Exhaust) should sample the building pressure in the area near the entrance lobby (or other appropriate and sensitive location) so that the location is controlled as closely to design pressures as possible.

A building pressure transducer (BPT) is used to sense the building pressure and supply a 4 to 20 mA signal to the power exhaust VFD (PE VFD) which controls the speed of exhaust fan motor no. 1 and stages on/off power exhaust fan motor no. 2 to maintain the building pressure. The BPT is located in the auxiliary control box. Use a nominal $^1/_4$-in. plastic tubing.

For instructions on adjusting the BP control set point, refer to Start-Up, High Capacity Modulating Power Exhaust section in this book.

RETURN POWER EXHAUST (48ZR and 50ZR,ZS Units) — The tubing for the building pressure control (achieved via the return/exhaust option) should sample building pressure in the area near the entrance lobby (or other appropriate and sensitive location) so that location is controlled as closely to design pressures as possible.

A building pressure switch (BPS) is used to control the actuator on the power exhaust damper at the plenum section. The BPS is located in the auxiliary control box of the unit. See Fig 40. Use nominal $^3/_8$-in. plastic tubing.

For instructions on adjusting BP control set points, refer to Return/Exhaust Fan Variable Frequency Drive section on page 73.

START-UP

Initial Check

IMPORTANT: Do not attempt to start unit, even momentarily, until all items on the Controls Start-Up Checklist (in installation instructions) and the following steps have been completed.

1. Verify unit has been installed per the Installation Instructions included in the unit installation packet.
2. Verify that all auxiliary components (sensors, controls, etc.) have been installed and wired to the unit control boxes per these instructions, the unit Installation Instructions, and the unit wiring label diagrams.
3. Verify that air pressure hoses (static, duct, etc.) are properly attached, routed, and free from pinches or crimps that may affect proper control operation.
4. Set any control configurations that are required (field-installed accessories, etc.). The unit is factory configured for all appropriate factory-installed options with the applicable controls programmed to the default values.
5. Check and adjust unit set points. See Table 27.
6. Check tightness of all electrical connections.
7. Perform quick test (see Quick Test Program section on page 42).

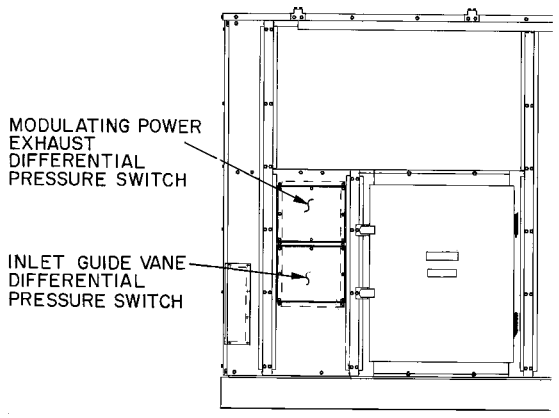


Fig. 38 — Modulating Power Exhaust and Inlet Guide Vane Differential Pressure Switch (Sizes 030-050)

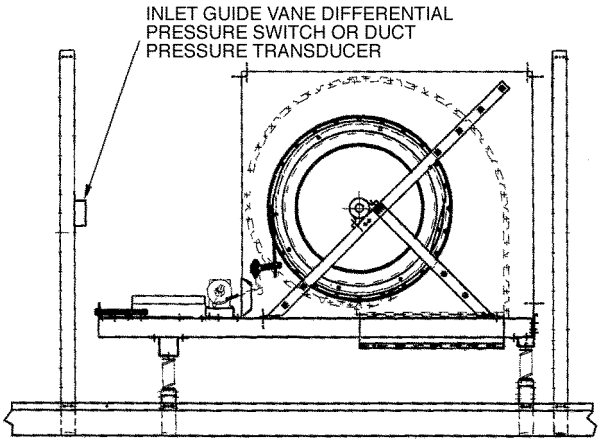


Fig. 39 — Inlet Guide Vane Differential Pressure Switch and Variable Frequency Drive (Sizes 055-105)

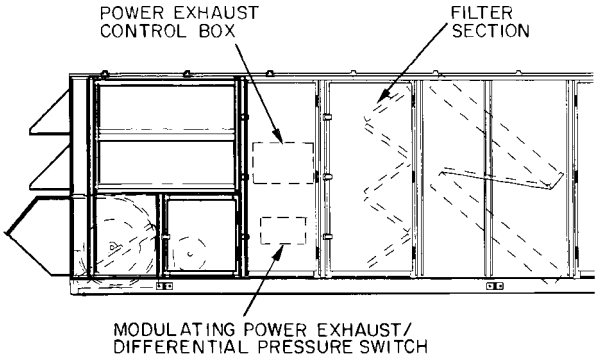


Fig. 40 — Modulating Power Exhaust Differential Pressure Switch and Building Pressure Switch (Sizes 055-105)

Table 27 — Potentiometer Inputs and Ranges

POTENTIOMETER	DESCRIPTION	LOCATION	CONTROL VALID RANGE	DEFAULT VALUE
P1	Supply 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 (limited to 70 F maximum)
P4†	Demand Limit, Single-Step	Main Control Box	0 to 100%	None
DLCM-P1	Demand Limit, 2-Step	DLCM Board	50 to 100%	None
DLCM-P2		DLCM Board	0 to 49%	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. Potentiometer P2 is not a set point.
†Accessory two-step demand limit module is required (which has 2 potentiometers), or a 5 to 20 k-ohm 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 J1.

Configuration Header — The configuration header is a series of 8 small wires that are broken (open circuit) or unbroken (closed circuit) 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.

Before start-up, visually check the configuration header against the factory setting for the unit size. See Table 28 for factory settings. See Table 29 for purpose for each jumper.

Table 28 — Configuration Header and DIP Switch Factory Settings

JUMPER OR SWITCH NO.	UNIT SIZES 030,035, 050-090		UNIT SIZE 040		UNIT SIZE 105	
	Header Position	Switch Position	Header Position	Switch Position	Header Position	Switch Position
1	□	Off	□	Off	□	Off
2	■	Off	■	Off	■	Off
3	■	On/Off*	■	On/Off*	■	On/Off*
4	□	On/Off*	□	On/Off*	■	On/Off*
5	□	Off	□	Off	□	Off
6	■	Off	■	On	■	On
7	□	On	□	Off	□	Off
8	■	Off	■	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.

Table 29 — Configuration Header Jumpers

JUMPER NUMBER	FUNCTION	FACTORY SETTING	MEANING
1,2	Unit Type	□ ■	VAV Rooftop Unit
3,4,5	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)

DIP Switches — The DIP switches configure the unit for several factory-installed options and field-installed accessories, plus factory unloaders. The DIP switches are located under a plastic enclosure which must be removed for access. See Fig. 1. The switches can be field adjusted. Switches must only be adjusted when control power is deenergized. See Table 30 for DIP switch purposes and Table 28 for factory settings of the switch positions.

⚠ CAUTION

Disconnect control power before changing the settings of the DIP switches. To disconnect control power, open the control circuit breaker.

DIP SWITCH NO. 1 — Supply Air Set Point (SASP) Reset Type. Factory setting is OFF. Do not change.

DIP SWITCH NO. 2 — SASP Reset Enabled. Factory setting is OFF (SASP reset disabled). If SASP reset has been installed, enable it by changing switch position to ON.

DIP SWITCH NO. 3 — Economizer option. If economizer option has been installed, this switch will be ON. If there is no economizer installed, this switch will be OFF. For all 48ZR,ZV and 50ZR,ZS,ZV,ZY units, this switch will be ON. Confirm setting per Table 28. Change only if in error.

DIP SWITCH NO. 4 — Morning Warm-Up. For 48ZE units, this switch will be ON (morning warm-up enabled). For 50ZE units with factory-installed electric heaters, this switch will be ON. For all other units, this switch will be OFF. If accessory electric heaters are installed (for 50ZE030-070 units without plenum option), change this switch to ON.

DIP SWITCH NO. 5 — Demand Limit option. Factory setting is OFF (demand limit disabled). If Demand Limit (single-step or two-step accessory) has been installed, change this switch to ON.

DIP SWITCHES NO. 6 AND NO. 7 — Unloader Configuration. These are factory set to match unit size. Confirm settings per Table 30. Change only if in error.

Table 30 — DIP Switches

SWITCH NO.	FUNCTION	SWITCH POSITION*	MEANING
1	Reset Mode	Off	Space or Outdoor-Air Reset (DO NOT CHANGE)
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

LEGEND

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 (50ZE030-070 units without plenum only).

Adjusting Set Points — Set points for unit operation are established via potentiometer settings. Set points for Supply Fan controls are set at the VFD keypad (if installed) or at the IGV differential pressure switch (DPS1) (if IGV option installed). Set points for modulating power exhaust (option or accessory) are set at the differential pressure switch (DPS2).

Set points for high capacity modulating power exhaust (48ZR,ZV and 50ZR,ZS,ZV,ZY units) are set at the power exhaust VFD keypad.

Potentiometers — All of the set point 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.

Potentiometer inputs and ranges are summarized in Table 27. Information on individual set point potentiometers (including function, location and range data) are shown below:

SUPPLY AIR SET POINT (Leaving-Air Temperature) (P1) — This potentiometer establishes the set point for cooling cycle operation of the VAV unit. The VAV control uses a valid control range of 45 to 70 F, and the potentiometer has a valid range of –22 to 70 F. If the set point is between –22 and 45 F, the control will use a value of 45 F. If the set point is outside 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.

ECONOMIZER MINIMUM POSITION (P5) — This potentiometer specifies the minimum opening position for the optional economizer during running periods. It has both a valid range and an operational range of 0 to 100%.

SASP RESET TEMPERATURE (P7) — This potentiometer establishes the space temperature at which the control will initiate the reset of the SASP (i.e., the unit control begins to raise the base SASP, to prevent overcooling of the space). The potentiometer has a valid range of 40 to 100 F. Refer to Space Temperature Reset section on page 18 for further discussion of SASP Reset operation.

RESET LIMIT (P3) — Used in conjunction with P7 potentiometer, this potentiometer establishes the maximum temperature for the modified SASP value during the Reset function. This potentiometer has a valid range of 0° to 80 F.

DEMAND LIMIT, SINGLE-STEP (P4) — This potentiometer establishes the maximum amount of compressor capacity permitted by the unit control when single-step demand limit operation is implemented (by closing contact set to potentiometer wiper arm). This potentiometer is field-supplied and -installed and will be located in the main control box. The valid range is 0% to 100%, which is also the operational range.

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

DEMAND LIMIT, TWO-STEP — The accessory two-step demand limit control is a 2-potentiometer system. The demand limit control board (DLCM) accessory board is field-installed in the main control box; the 2 control potentiometers are located on the DLCM. Potentiometer DLCM-P1 establishes the maximum amount of compressor capacity available when SW1 is closed and has a valid range is 50% to 100%. Potentiometer DLCM-P2 establishes the maximum amount of compressor capacity available when SW2 is closed and has a valid range is 0% to 49%.

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

MORNING WARM-UP (P6) — This potentiometer establishes the set point temperature for the Morning Warm-Up function. This is the temperature at which the morning warm-up sequence is terminated and VAV cooling operation begins. The valid control range is 0° to 95 F, but the control is programmed to accept a range of 40 to 80 F. If the set point is between 0° and 40 F, the control will use a value of 40 F. If the set point is between 80 and 95 F, the control will use a value of 80 F. If the set point is outside the valid range (less than 0° F or greater than 95 F), an alarm condition will be signaled and a default value of 40 F will be used.

Supply Fan Control with IGV Option — The inlet guide vane (IGV) option will modulate the supply fan airflow in order to maintain the static pressure in the supply duct. The set point for duct static pressure is established at the differential pressure switch for the IGV control.

SIZE 030-050 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. 41 and 42.

SIZE 055-105 UNITS — The inlet guide vane differential pressure witch is mounted on an upright located behind the supply-fan motor. See Fig. 41-43.

The IGV differential pressure switch has an adjustable set point range of 1.1 to 3.5 in. wg. and a factory setting of 1.9 in. wg.

To adjust set point, turn set point adjusting screw (see Fig. 44) 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 a null adjusting screw (Fig. 44) 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.

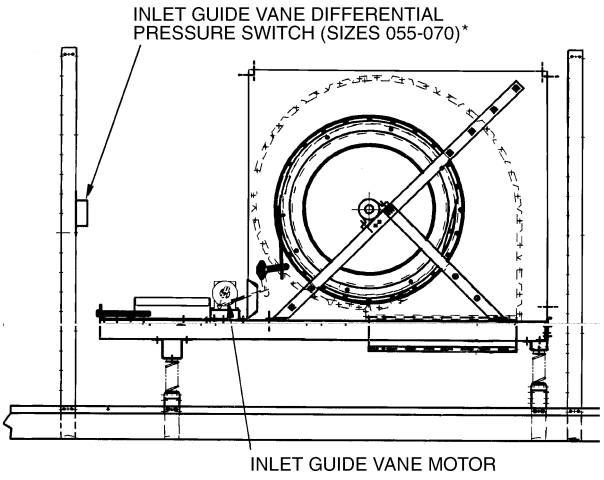
Supply Fan Control with VFD Option — The VFD option will modulate Supply Fan motor (and thus wheel) speed to maintain the static pressure in the ductwork. Set point for the VFD option is set at the VFD, using the display keypad on the front of the VFD enclosure. See Fig. 45.

NOTE: The VFD will always provide the proper phase sequence to the supply-fan motor. The supply-fan motor operates in proper rotation regardless of the phase sequence to the unit. If, upon start-up, the outdoor fans operate backwards but the supply fan operates in the correct direction, reverse any two leads to the main terminal block. All fans will then operate in the correct direction.

The supply duct pressure transducer has a range of 0.0 to 5.0 in. wg. Its output is a 4 to 20 mA signal, scaled to this range. The VFD translates this 4 to 20 mA input signal to represent a frequency value over the control range of 0 to 60 Hz. The factory default set point is 30 Hz, representing a supply duct pressure of 2.5 in. wg.

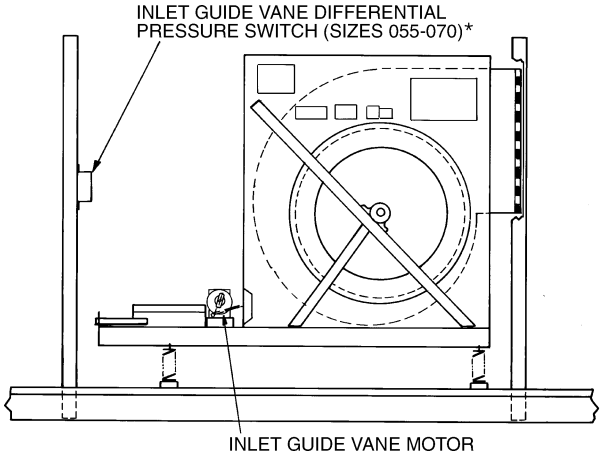
⚠ WARNING

Factory-installed optional VFD is located near the supply fan and motor. During any service work or programming at the VFD, operation of the fan and motor is not desirable and may be dangerous. Either disable the unit supply fan (following instructions below) or install the accessory VFD remote display accessory.



*The inlet guide vane differential pressure switch for the 030-050 units is located in the back of the unit in the auxiliary control box. Its location is not shown in this figure.

Fig. 41 — Inlet Guide Vane Motor, 50ZE030-070 Units



*The inlet guide vane differential pressure switch for the 030-050 units is located in the back of the unit in the auxiliary control box. Its location is not shown in this figure.

Fig. 42 — Inlet Guide Vane Motor, 48ZE and 50ZF Units and 50ZE Units with Extended Plenum

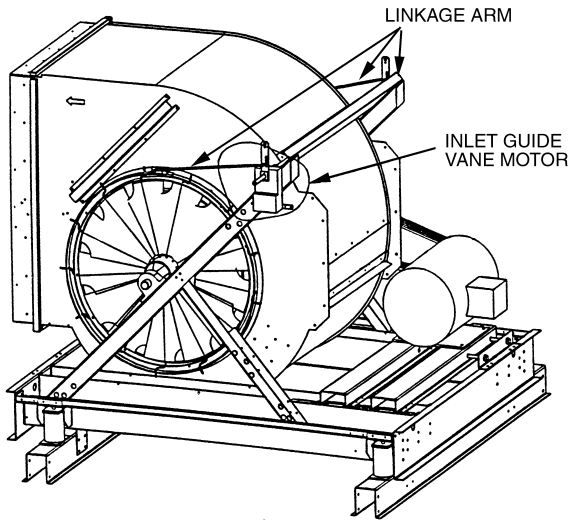
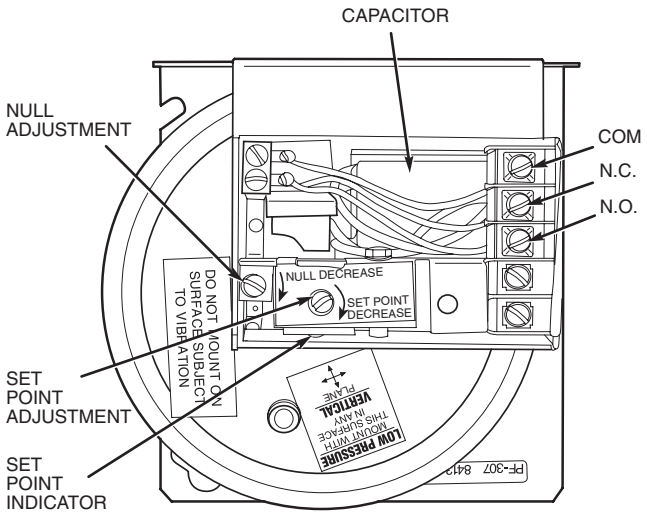


Fig. 43 — Inlet Guide Vane Motor, Size 075-105 Units



LEGEND

COM — Common
N.C. — Normally Closed
N.O. — Normally Open

Fig. 44 — Differential Pressure Switch for Inlet Guide Vane and Static Pressure Control Option and Modulating Power Exhaust Option

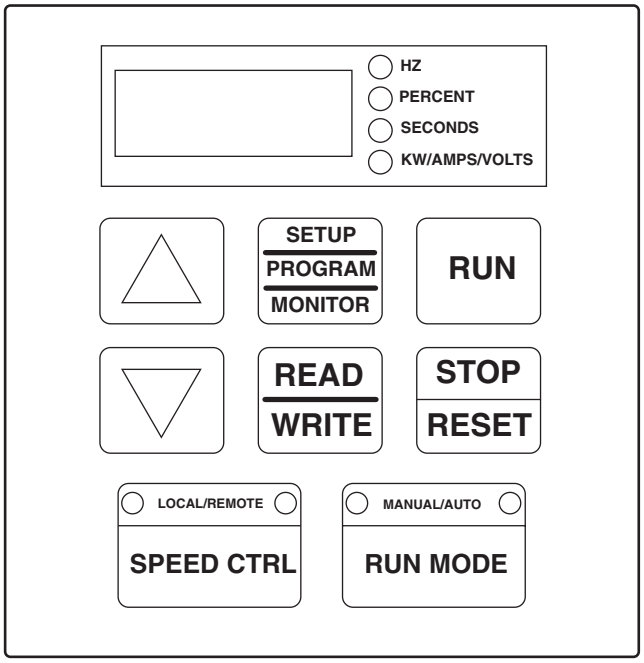


Fig. 45 — Toshiba TOSVERT130-E3 Variable Frequency Drive Keypad

DETERMINE VFD SET POINT — The unit of measure for the Duct Pressure set point at the VFD is output frequency (Hz), corresponding to the desired DP set point (DPSP) in inches of water gage (in. wg). To convert desired DPSP into the VFD set point, refer to Table 31. Locate the pressure value in the table closest to the desired DPSP for this installation and use the corresponding VFD set point (Hz) value. If necessary, interpolation between duct static pressure values is permissible.

ADJUST VFD SET POINT — To adjust the VFD set point, the VFD must be powered; however, since it is located near the supply fan and motor, operation of the fan and motor is not desirable. Either disable the Supply Fan or install the accessory VFD remote display accessory.

DISABLE SUPPLY FAN MOTOR — To disable the supply fan motor and change programming of VFD set point:

1. Turn off Indoor Fan Circuit Breaker (IFCB). This will remove power to the VFD.

⚠ WARNING

Ensure the "CHARGE" lamp on the VFD is unlit. This may take up to 4 minutes. The "CHARGE" lamp indicates that the main capacitors in the VFD are charged. Internal components of the VFD should not be touched until the "CHARGE" lamp is completely out. Electrical shock can cause injury or death.

2. Wait for the VFD display to go blank and remove VFD cover without touching any interior components.
3. Ensure that the charge indicator lamp is out which indicates that the VFD is discharged. The lamp is located on the upper right hand corner of the terminal block. If still lit, wait until lamp goes completely out. This may take several minutes.
4. Remove jumper from terminals ST-CC (see Fig. 46) and replace VFD cover.
5. Turn on IFCB.
6. The drive output will now be disabled but the programming can be changed.
7. Change VFD set point according to Table 32.
8. Once the program changes are completed, turn off IFCB.
9. Wait for the VFD display to go blank and remove VFD cover without touching any interior components.
10. Ensure that the charge indicator lamp is out which indicates that the VFD is discharged. The lamp is located on the upper right hand corner of the terminal block. If still lit, wait until lamp goes completely out. This may take several minutes.
11. Replace jumper to terminals ST-CC.
12. Replace VFD cover.
13. Turn on IFCB to enable the drive.

For additional information on the VFD (including basic troubleshooting, factory jumper arrangements, and Carrier factory defaults programming), refer to Troubleshooting, Supply Fan Variable Frequency Drive section (page 68).

IMPORTANT: The Carrier factory default values for the VFD may be different than the default values of the manufacturer. Refer to the Troubleshooting, Supply Fan Variable Frequency Drive section when checking default values.

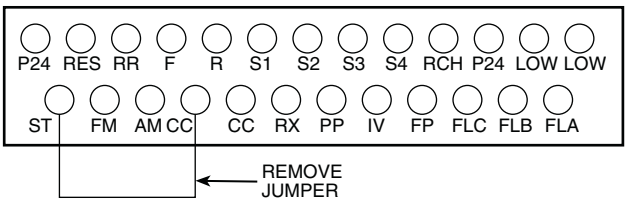


Fig. 46 — Jumper Removal to Disable Motor

Table 31 — VFD Set Point (Frequency Command) for Duct Pressure

PRESSURE (in. wg)	VFD SET POINT (Hz)	CONTROL SIGNAL (mA)	PRESSURE (in. wg)	VFD SET POINT (Hz)	CONTROL SIGNAL (mA)
0.00	0	4.0	**2.00**	24	10.4
0.25	3	4.8	**2.25**	27	11.2
0.50	6	5.6	**2.50**	30	12.0
0.75	9	6.4	**2.75**	33	12.8
1.00	12	7.2	**3.00**	36	13.6
1.25	15	8.0	**3.25**	39	14.4
1.50	18	8.8	**3.50**	42	15.2
1.75	21	9.6			

Table 32 — Changing the VFD Set Point (Frequency Command)*

KEY OPERATION	LED MESSAGE	EXPLANATION
	XX.X or OFF	Standard Monitor Mode (output frequency). If drive is disabled, display will read “OFF”. If enabled, display will show current output frequency.
↓	60.0	Pressing arrow key once will display the current frequency set point.
↓↑	45.0 (flashing)	Pressing up/down arrow keys changes the desired set point.
READ / WRITE	FC and 45.0 (flashing)	When the Read/Write key is pressed, the parameter name (FC) and the new value (45.0) will alternately flash to indicate that the new value has been stored. After 2 cycles, the display will return to the standard monitor mode.
	XX.X or OFF	Standard Monitor Mode (output frequency). If drive is disabled, display will read “OFF”. If enabled, display will show current output frequency.

*Choose set point from Table 31 according to desired duct pressure or Table 33 according to desired building pressure.

Modulating Power Exhaust (Option or Accessory) (48ZE and 50ZE Units) — The Modulating Power Exhaust system will maintain space pressure by modulating power exhaust fan no. 1 and staging power exhaust fan no. 2. Building pressure set point is established at the modulating power exhaust differential pressure switch (DPS).

SIZE 030-050 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. 38.

SIZE 055-105 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. 40.

DIFFERENTIAL PRESSURE SWITCH — The modulating power exhaust DPS has a set point range of 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. 44) 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. 44) 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.

High Capacity Power Exhaust (48ZV and 50ZV,ZY Units) — The power exhaust VFD will modulate the power exhaust fan motor no. 1 speed and stage (on/off) power exhaust fan motor no. 2 to maintain the building pressure. The set point for the building pressure control is set at the power exhaust VFD using the keypad on the front of the power exhaust VFD enclosure. See Fig. 45.

NOTE: The VFD will always provide the proper phase sequences to the power exhaust fan motor.

The exhaust fan motor operates in proper rotation regardless of the phase sequence to the unit. If, upon start-up, the outdoor fans operate backwards but the exhaust fan operates in the correct direction, reverse any two leads on the main terminal block. All fans will then operate in the correct direction.

The building pressure transducer has a range of –0.5 to +0.5 in. wg. The output is a 4 to 20 mA signal, scaled to this range. The VFD translates the 4 to 20 mA signal to represent a frequency value over the control range of 0 to 60 Hz. See Table 33 The set point for duct pressure control is established at the power exhaust VFD keypad in terms of Hz. The factory default set point is 30 Hz, representing a building pressure of 0.0 in. wg.

DETERMINE POWER EXHAUST VFD SET POINT — The unit of measure for the building pressure set point (BPSP) at the power exhaust VFD is output frequency (Hz), representing the desired BPSP (in. wg). To convert the desired BPSP into the power exhaust VFD set point, refer to Table 33. Locate the pressure value in the table closet to the desired BPSP for the application and use the corresponding set point (Hz) value. If necessary, interpolation between duct static pressure values is permissible.

ADJUST PE VFD SET POINT — To adjust the PE VFD set point, the PE VFD must be powered. Since it is located in the indoor section of the unit, use caution to ensure that the service access door is blocked open and will not close suddenly.

Change PE VFD set point according to Table 32 and 33.

Table 33 — PE VFD Set Point (Frequency Command) for Building Pressure

PRESSURE (in. wg)	VFD SET POINT (Hz)	CONTROL SIGNAL (mA)	PRESSURE (in. wg)	VFD SET POINT (Hz)	CONTROL SIGNAL (mA)
0.50	0.0	4.00	**0.00**	30.0	12.00
0.45	3.0	4.80	**–0.05**	33.0	12.80
0.40	6.0	5.60	**–0.10**	36.0	13.60
0.35	9.0	6.40	**–0.15**	39.0	14.40
0.30	12.0	7.20	**–0.20**	42.0	15.20
0.25	15.0	8.00	**–0.25**	45.0	16.00
0.20	18.0	8.80	**–0.30**	48.0	16.80
0.15	21.0	9.60	**–0.35**	51.0	17.60
0.10	24.0	10.40	**–0.40**	54.0	18.40
0.05	27.0	11.20	**–0.45**	57.0	19.20
			–0.50	60.0	20.00

Return/Exhaust Fan (48ZR and 50ZR,ZS Units) — The Return/Exhaust Fan system will maintain space pressure by modulating the power exhaust damper opening. Building pressure set point is established at the return/exhaust building pressure switch (BPS).

RETURN/EXHAUST BUILDING PRESSURE SWITCH — The building pressure switch (BPS) is mounted below the auxiliary control box next to the access door labeled FILTER SECTION. See Fig. 40.

The return/exhaust BPS has a set point range limit of –0.25 in. wg to +0.25 in. wg. The building pressure can be set up at any range not exceeding the upper and lower limits of the BPS. Factory setting is 0.0 in. wg lower limit and 0.1 in. wg upper limit. To adjust lower limit (left) set point, use the left adjusting knob located at the bottom of the front cover to point the left set point pointer to desired pressure reading. To adjust upper limit (right) set point, use the right adjusting knob located at the bottom of the front cover. The smaller the lower/upper range is, the closer the pressure will be maintained to desired set point range. See Fig. 47.

To set the pressure indicating pointer to zero, use the zero adjust screw located at the bottom of the front cover. This adjustment can only be made with the high and low pressure taps both open to atmosphere.

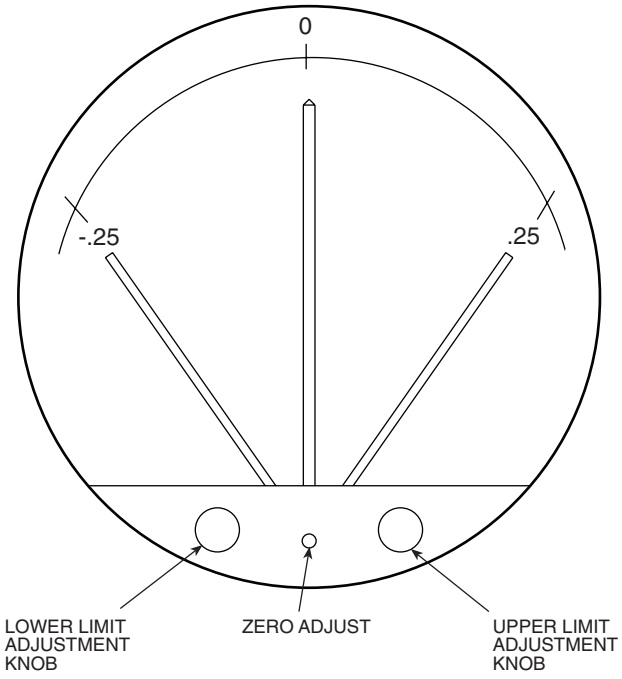


Fig. 47 — Building Pressure Switch

START UNIT

To start unit:

1. Close the unit-mounted ON/OFF switch (located in the main control box).
2. Close the field-supplied and -installed timeclock (or control) switch (contacts located at Terminals 1 and 2 (TB3 for 030-050, TB4 for 055-105).

> IMPORTANT: The field-supplied and installed switch (or timeclock) MUST BE CLOSED to put unit in Occupied mode. Unit WILL NOT START until this is accomplished.

3. Initialization mode begins (see Operating Information section on page 45 for complete description of sequences and display codes).
4. Run Quick Test. If the display button is pressed during the initialization mode period, the unit will run its self-diagnostic routine. When this is in effect, an 88 will appear in the display screen. Refer to Quick Test Program section below, for instructions on completing the Quick Test program.

Quick Test Program — Turn on power to unit.

> IMPORTANT: The field-supplied switch (or timeclock) 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).

> 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 34-36.

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 34.

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

   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 37. 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 35 shows thermistor and set point potentiometer functions and quick test display codes.

Table 34 — 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 2-2 Unloaders (030,035,050-090) 1-1 Unloader (040,105)	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	EC
1.0.	1	1 — Low-Pressure Switch Closed	Low-Pressure Switch 1
1.1.	1	1 — Low-Pressure Switch Closed	Low-Pressure Switch 2
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 — Enthalpy Control
VAV — Variable Air Volume

*Units are not equipped with oil pressure switches.

Table 35 — 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	Supply Air Thermistor (T1)
1.5.	1	1 — Thermistor OK 0 — Thermistor Faulty	Return Air Thermistor (T2)
1.6.	1	1 — Thermistor OK 0 — Thermistor Faulty	Circuit 1 Condenser Thermistor (T3)
1.7.	1	1 — Thermistor OK 0 — Thermistor Faulty	Circuit 2 Condenser Thermistor (T4)
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 36 — 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)	K12
2.9.	0 then 1 then 0	Energize Compressor 1†	K1
3.0.	0	Energize Unloader 2; Not Used (040,105)	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

LEGEND

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 37 — 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 Relay Check

   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 36.

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.

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 8, 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 030,035 and 050-090 units, 4 for the 040 units, and 8 for the 105 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 46 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.

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, DIAGNOSTIC INFORMATION — These codes indicate diagnostic information when there is a unit problem such as a faulty thermistor, potentiometer, or compressor fault. Refer to Diagnostic Codes section on page 60 for more details. Codes 53, 54, 57, 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. Personal injury could result from contact with rotating fans.

Once the initialization period is complete, the supply fan begins operation. While the fan is 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 will 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 supply-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 is unable to meet the load due to unacceptable 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 supply-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 120 seconds 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 030,035 AND 050-090 UNITS — These units have 2 compressors and 2 unloaders on compressor 1. See Fig. 48 and 49 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 1/3 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 2/3 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 1/3 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 2/3 capacity, and compressor no. 2 is running at full capacity.

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

Size 030,035 units have 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.

Size 050 units have 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).

On size 055,060 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 size 070,075 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.

On Size 090 units, the first 4 condenser fans energize with the compressors; compressor no. 1 controls OFM1 and OFM3, and compressor no. 2 controls OFM2 and OFM4. The OFM5 and OFM6 are staged by the microprocessor based on condensing temperature input from either circuit's T3 or T4 thermistor.

SIZE 040 UNITS — These units have 2 compressors and 1 unloader on compressor no. 1. See Fig. 48 for compressor and condenser fan motor locations. The 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 1/2 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 1/2 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.

Size 040 units have 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).

SIZE 105 UNITS — These units have 4 compressors and 1 unloader on compressor no. 1. See Fig. 49 for compressor and condenser fan motor locations. The unit operating sequence is as follows:

Stage 1 Relays K1 and K3 are energized. Compressor no. 1 starts with unloader energized. Compressor no. 1 runs at 2/3 capacity. The crankcase heater for this compressor has been deenergized, and first stage of condenser fans has been energized. Outdoor (condenser) fan motor no. 1 (OFM1) and outdoor fan motor no. 3 (OFM3) have 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 runs at 2/3 capacity and compressor no. 2 is running at full capacity. The crankcase heater for compressor no. 2 is deenergized. The first stage of condenser fans on circuit 2 has been energized. Fans OFM1, OFM2, OFM3, and OFM4 are operating.

Stage 4 Relays K1 and K5 are energized. Both compressors no. 1 and no. 2 are running fully loaded.

Stage 5 Relays K1, K3, K5, and K5 are energized. Compressor no. 1 runs at 2/3 capacity and compressors no. 2 and no. 4 are running at full capacity. The crankcase heater on compressor no. 4 is deenergized. Fans OFM1, OFM2, OFM3, and OFM4 are operating.

Stage 6 Relays K1, K5, and K6 are energized. Compressors no. 1, no. 2, and no. 4 are running fully loaded.

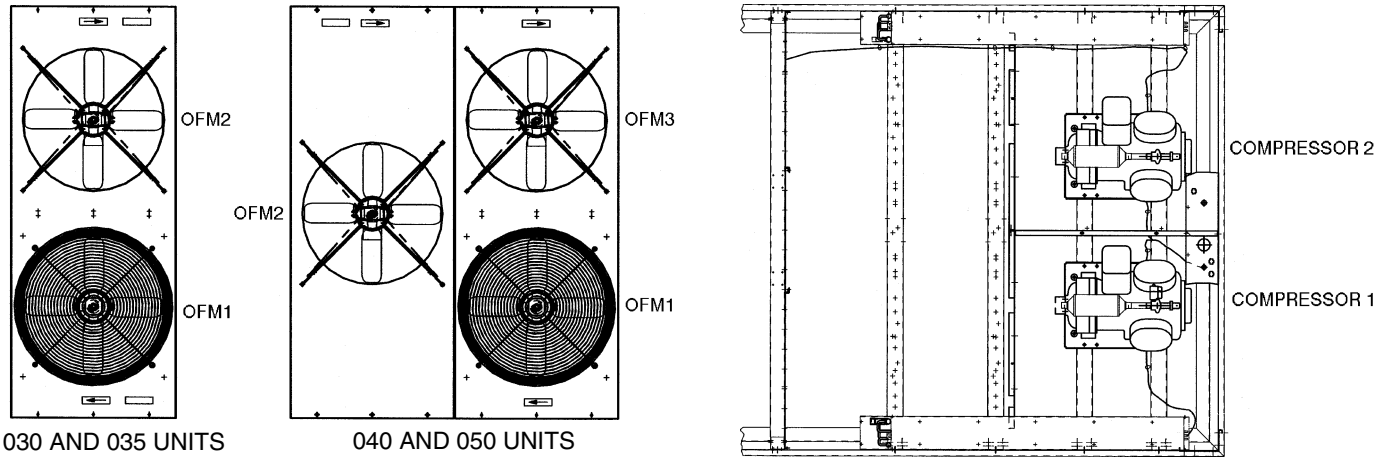
Stage 7 Relays K1, K2, K3, K5, and K6 are energized. Compressor no. 1 runs at 2/3 capacity and compressors no. 2, no. 3, and no. 4 are running at full capacity. Fans OFM1, OFM2, OFM3, and OFM4 are operating. Crankcase heater for compressor no. 3 is deenergized.

Stage 8 Relays K1, K2, K5, and K6 are energized. Compressors no. 1, no. 2, no. 3, and no. 4 are running fully loaded.

On size 105 units, the first 4 condenser fans energize with the compressors; circuit no. 1 compressors control OFM1 and OFM3, and circuit no. 2 compressors control OFM2 and OFM4. The OFM5 and OFM6 are staged by the microprocessor based on condensing temperature input from either circuit's T3 or T4 thermistor.

Staged Gas Control Heating (Units with Optional Staged Gas Only) — The Staged Gas Control option adds the capability to control the gas heating system to a specified Supply Air Temperature Set Point for purposes of tempering a cool mixed-air condition. The gas heating systems employ multiple heating sections. Each section is equipped with a two-stage gas valve. The gas valves are sequenced by a factory-installed staged gas controller (SGC) as required to maintain the user-specified Supply Air Set Point. Up to nine stages of heating control are available, based on quantity and heating capacity sizes of the individual heat exchanger sections provided in the base unit. In addition to providing system control for tempering heat operation, the SGC also controls Demand Heat sequences for both First-Stage (W1) and Second-Stage (W2 or full-fire) operation.

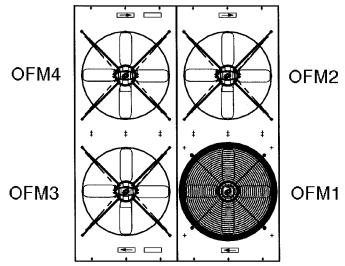
Tempering of supply air is desirable when rooftop units are operating in ventilation mode (economizer only operation) at low outdoor temperatures. At low outdoor temperatures, the mixed air temperature (combination of return-from-space temperature and outdoor/ventilation air temperature) may become too low for the comfort of the occupants or for the terminal reheat systems. The tempering function adds incremental steps of heat capacity to raise the temperature of the mixed air up to levels suitable for direct admission into the occupied space or to levels consistent with reheat capabilities of the space terminals.



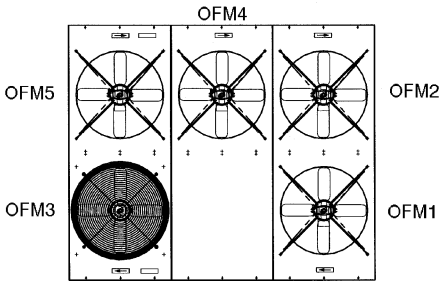
LEGEND

OFM — Outdoor (Condenser) Fan Motor

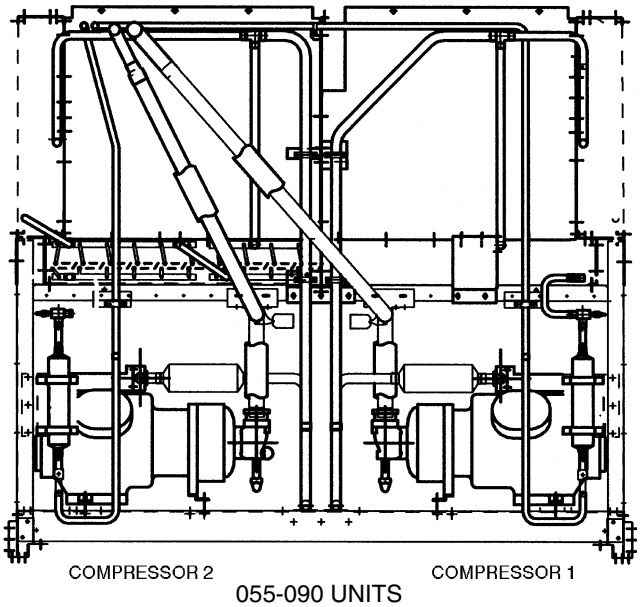
Fig. 48 — Component Arrangement, 030-050 Units



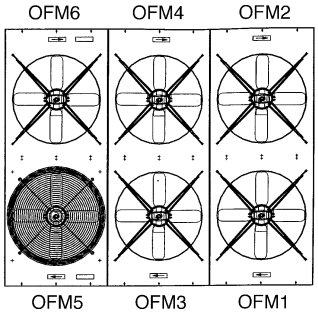
055,060 UNITS



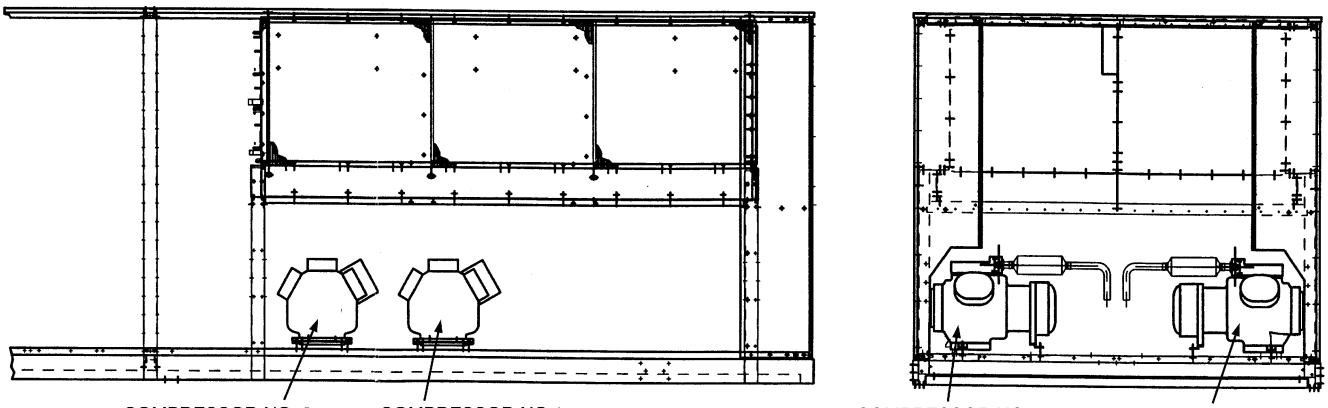
070,075 UNITS



055-090 UNITS



090,105 UNITS



105 UNITS

Fig. 49 — Component Arrangement, 055-105 Units

The SGC outputs consist of six relays (K1 through K6) which control the individual gas valves. See Table 38.

OPERATING MODES — The SGC will operate the unit in one of the following operating modes:

- no mode
- Cool Mode
- Heat1 Mode
- Heat2 Mode

No Mode — In this mode, none of the heat stages are turned on. No mode occurs if the Cool, Heat or Fan inputs are off or the Cool input(s) are on.

Tempering (Cool) Mode — In this mode, the SGC tempers in incoming supply air to maintain the cooling supply air set point. Tempering mode occurs if the Fan input is ON or if the dehumidify input is selected, and all Cool and Heat inputs are off.

When the SGC determines that the fan is on and the base unit control is not calling for heat or mechanical cooling, the SGC will stage heat to maintain the cooling set point which is set on the CLSASP potentiometer of the SGC. This set point should be slightly below the supply air set point of the base unit VAV control. Note that the supply-air temperature will still be in the "cooling range".

Heat1 Mode — In this mode, heat is staged to control supply air temperature to HTSASP. Heat1 mode occurs only if Heat1 is ON and Heat2 is OFF and Cool1 and Cool2 are OFF.

When the base unit control calls for first stage of heat the SGC will stage heat to maintain the heating set point set on the potentiometer of the SGC. The HIR will be energized to command the zone terminals to open to maintain minimum heating airflow.

Heat2 Mode — Heat2 mode would only be used on CV (Constant Volume) and PIC (Product Integrated Controls) applications as they have 2 heat stages on the base unit control. VAV units have only 1 heat stage and will not operate under Heat2 mode.

CONTROL LOGIC OF STAGED GAS UNITS

The following are the general descriptions of the control logic for staged gas units sequences of operation.

1. Set Point Determination — The set point determination task is responsible for assigning the correct set point to the control set point variable SETP.

Inputs:
Set point select (SETPTSEL)
Cool set point #1 (COOLSP1)
Cool set point #2 (COOLSP2)
Heat set point #1 (HEATSP1)
Heat set point #2 (HEATSP2)
Occupancy (OCC)

Outputs:
Set point (SETP)

Process (Algorithm)

In all of the cases below, the heating set point will be assigned in Heat1 mode and the cooling set point will be assigned in Cool mode.

If SETPTSEL=0

Set point adjustment is accomplished via the control potentiometers. Both the heat and cool set points are calculated from these potentiometers.

If SETPTSEL=1

The set points are HEATSP1 and COOLSP1. Adjustment is accomplished via the Navigator or network tool.

If SETPTSEL=2

The set points are HEATSP1, HEATSP2, COOLSP1 and COOLSP2. The selection of set point one or two is based on the state determined by the 7-day occupancy schedules. If state is occupied, then use set point 1. If state is unoccupied use set point 2.

If SETPTSEL=3

The set points are HEATSP1, HEATSP2, COOLSP1 and COOLSP2. The selection of set point one or two is based on the state determined by the CCN time schedules.

2. Capacity Calculation — The heat control loop is a PID design with exceptions, overrides and clamps. Capacity rises and falls based on set point and supply-air temperature.

Inputs:
Control Mode (MODE)
Set point (SETP)
Supply Air Temperature (SAT)
Max Capacity Change per Cycle (CAPMXSTG)
PID rate (HEATPIDR)
Proportional Gain (P_GAIN)
Rate Gain (D_GAIN)
Upper Deadband Temperature (UPPER_DB)
Lower Deadband Temperature (LOWER_DB)
Minimum Rate required in deadband (MINRT_DB) in %

Outputs:

Capacity desired (CAP_CALC) in %

Process (Algorithm)

When the staged gas control is in Heat1 mode or Cool mode (MODE), this algorithm shall calculate the desired heat capacity.

The basic factors that govern the controlling technique are:

1. How fast this algorithm is run (HEATPIDR) (integral effect)
2. The amount of proportional and derivative gain applied (P_GAIN, D_GAIN)
3. The maximum allowed capacity change each time algorithm is run (CAPMXSTG)
4. Deadband hold off range when rate is low (UPPER_DB,LOWER_DB, MINRT_DB)

The routine is run once every "HEATPIDR" seconds. Every time the routine is run, the calculated sum is added to the control output value (CAP_CALC). In this manner, the integral effect is achieved. Every time this algorithm is run, the following calculation performed:
error=SETP-SAT
error_last= error calculated previous time through
P=P_GAIN*(error)
D=D_GAIN*(error-error_last)

P override:

If
  error < UPPER_DB AND
  error >LOWER_DB AND
  D< MINRT_DB AND
  D>MINRT_DB
Then
  P=0
End If

"P+D" are then clamped. This sum can be no larger or no smaller than CAPMXSTG or CAPMXSTG respectively.

Finally, the desired capacity is calculated:

CAP_CAL="P+D" +CAP_CAL_old

Table 38 — Staged Gas Control Specifications

HEATING STAGES	% FULL-FIRE	OUTPUT CAPACITY (MBtuh)	OUTPUT CPACITY PER SECTION (MBtuh)			FIRING STAGE			HEATING STAGES	SGC RELAY SEQUENCE					
			Sect 1	Sect 2	Sect 3	Sect 1	Sect 2	Sect 3		K1	K2	K3	K4	K5	K6
48Z030-050 LOW HEAT															
1	75	197.0	197.0	N/A	N/A	LF	N/A	N/A	1	On	Off	N/A	N/A	N/A	N/A
2	100	263.5	263.5	N/A	N/A	HF	N/A	N/A	2	On	On	N/A	N/A	N/A	N/A
48Z030-050 HIGH HEAT															
1	37	197.0	197.0	N/A	N/A	LF	N/A	N/A	1	On	Off	Off	Off	N/A	N/A
2	50	263.5	263.5	N/A	N/A	HF	N/A	N/A	2	On	On	Off	Off	N/A	N/A
3	75	394.0	197.0	197.0	N/A	LF	LF	N/A	3	On	Off	On	Off	N/A	N/A
4	87	460.5	263.5	197.0	N/A	HF	LF	N/A	4	On	On	On	Off	N/A	N/A
5	100	527.0	263.5	263.5	N/A	HF	HF	N/A	5	On	On	On	On	N/A	N/A
48Z055-070 LOW HEAT															
1	37	197.0	197.0	N/A	N/A	LF	N/A	N/A	1	On	Off	Off	Off	N/A	N/A
2	50	263.5	263.5	N/A	N/A	HF	N/A	N/A	2	On	On	Off	Off	N/A	N/A
3	75	394.0	197.0	197.0	N/A	LF	LF	N/A	3	On	Off	On	Off	N/A	N/A
4	87	460.5	263.5	197.0	N/A	HF	LF	N/A	4	On	On	On	Off	N/A	N/A
5	100	527.0	263.5	263.5	N/A	HF	HF	N/A	5	On	On	On	On	N/A	N/A
48Z055-070 HIGH HEAT															
1	25	197.0	197.0	N/A	N/A	LF	N/A	N/A	1	On	Off	Off	Off	Off	Off
2	33	263.5	263.5	N/A	N/A	HF	N/A	N/A	2	On	On	Off	Off	Off	Off
3	50	394.0	197.0	197.0	N/A	LF	LF	N/A	3	On	Off	On	Off	Off	Off
4	58	460.5	263.5	197.0	N/A	HF	LF	N/A	4	On	On	On	Off	Off	Off
5	67	527.0	263.5	263.5	N/A	HF	HF	N/A	5	On	On	On	On	Off	Off
6	75	591.0	197.0	197.0	197.0	LF	LF	LF	6	On	Off	On	Off	On	Off
7	83	657.5	197.0	263.5	197.0	LF	HF	LF	7	On	Off	On	On	On	Off
8	92	724.0	263.5	263.5	197.0	HF	HF	LF	8	On	On	On	On	On	Off
9	100	790.5	263.5	263.5	263.5	HF	HF	HF	9	On	On	On	On	On	On
48Z075-105 LOW HEAT															
1	37	197.0	197.0	N/A	N/A	LF	N/A	N/A	1	On	Off	Off	Off	N/A	N/A
2	50	263.5	263.5	N/A	N/A	HF	N/A	N/A	2	On	On	Off	Off	N/A	N/A
3	75	394.0	197.0	197.0	N/A	LF	LF	N/A	3	On	Off	On	Off	N/A	N/A
4	87	460.5	263.5	197.0	N/A	HF	LF	N/A	4	On	On	On	Off	N/A	N/A
5	100	527.0	263.5	263.5	N/A	HF	HF	N/A	5	On	On	On	On	N/A	N/A
48Z075-105 HIGH HEAT															
1	25	197.0	197.0	N/A	N/A	LF	N/A	N/A	1	On	Off	Off	Off	Off	Off
2	33	263.5	263.5	N/A	N/A	HF	N/A	N/A	2	On	On	Off	Off	Off	Off
3	50	394.0	197.0	197.0	N/A	LF	LF	N/A	3	On	Off	On	Off	Off	Off
4	58	460.5	263.5	197.0	N/A	HF	LF	N/A	4	On	On	On	Off	Off	Off
5	67	527.0	263.5	263.5	N/A	HF	HF	N/A	5	On	On	On	On	Off	Off
6	75	591.0	197.0	197.0	197.0	LF	LF	LF	6	On	Off	On	Off	On	Off
7	83	657.5	197.0	263.5	197.0	LF	HF	LF	7	On	Off	On	On	On	Off
8	92	724.0	263.5	263.5	197.0	HF	HF	LF	8	On	On	On	On	On	Off
9	100	790.5	263.5	263.5	263.5	HF	HF	HF	9	On	On	On	On	On	On

LEGEND

HF — High Fire
LF — Low Fire

3. Staging — Different rooftop units will “heat stage” differently based on the amount of heating capacity included. See Table 38. These “staging patterns” are known and are selected based on the model numbers. The selection of a set of staging patterns is controlled via the heat stage type configuration parameter (HTSTGTYP). As the heating capacity desired (CAP_CALC) rises and falls based on demand, the gas control will stage the heat relay patterns up and down, respectively.

Inputs:
Capacity desired (CAP_CALC) in %
Heating Stage Type (HTSTGTYP)
Maximum Heating Stages (HTMAXSTG)

Outputs:
Heat Stage (HT_STAGE)
Capacity generated by selected heat stage pattern (CAPACITY)
Heat Relay Outputs
(HEATOUT1, HEATOUT2, HEATOUT3, HEATOUT4, HEATOUT5, HEATOUT6)

Process (Algorithm)

As the staged gas control’s desired capacity rises, it is continually checked against the capacity of the next staging pattern. When the desired capacity is greater than or equal to the capacity of the next staging pattern, the next heat stage is selected. (HT_STAGE=HT_STAGE+1). Similarly, as the capacity of the control drops, the desired capacity is continually checked against the next lower stage. When the desired capacity is less than or equal to the next lower staging pattern, the next lower heat stage pattern is selected (HT_ STAGE=HT_STAGE-1).

The heat stage selected (HT_STAGE) is clamped between 0 and the maximum number of stages possible for the chosen set of staging patterns (HTMAXSTG).

4. Limit Switch Temperature Monitoring — VAV applications in the tempering mode can experience low airflow and as a result it is possible for the radiant heat of the gas units to trip the installed limit switch, thereby shutting off all gas stages. At certain times when the unit is in heat1 mode, the application can experience low airflow. Therefore Limit Switch Temperature Monitoring will be ON during heat1 mode as well as tempering mode. In order to accomplish consistent heating in a tempering mode and heat mode1, a thermistor (LIMTTEMP) is placed next to the limit switch and monitored for overheating.

Inputs:
Supply-Air Temperature (SAT)
Supply-Air Temperature above supply air control point configuration (LIMT_SAT)
Limit Switch (LIMTTEMP)
Limit Switch Trip Point Temperature Configuration (LIMHIHT)
Limit Switch Return to Normal Operation Temperature (LIMTLOHT)

Outputs:
Desired heating Capacity (CAP_CALC)
Limiting Mode Active Flag (LIMTMODE)
SAT Limiting Mode Active Flag (SATCMODE)
Capacity Clamping Mode Active Flag (CAPMODE)
Internal heat staging timer (heat_staging_timer)

Process (Algorithm)

In order to control a tempering application where the limit switch temperature has risen above either the upper or lower configuration parameters (LIMTLOHT, LIMTHIHT), the staged gas control will respond to clamp or drop all gas stages.

If LIMTTEMP rises above LIMTLOHT or

If (SAT-SAT the last time through the capacity calculation) is greater than 0.06 °F per second, the capacity routine will not add stages and turn on the CAPMODE.

If LIMTTEMP rises above LIMTHIHT, the capacity routine will be run immediately and drop all heat stages and turn on the LIMTMODE.

If LIMTTEMP falls below LIMLOHT, CAPMODE and LIMTMODE will be turned OFF with one exception. If (SAT-SAT the last time through the capacity calculation) is greater than 0.06 °F per second, CAPMODE will stay ON.

If LIMTMODE is ON and ten LIMTTEMP fell below LIMTLOHT, and SAT is not rising quickly, which is unlikely, the capacity calculation routine will be run immediately and allow a full stage to come back on if desired the first time through upon recovery. This shall effectively override the "max capacity stage" clamp.

In addition to the above checks, it is also possible at low CFM for the supply air temperature to rise and fall radically between capacity calculations, thereby exacerbating the limit switch temperature. In the case where supply air temperature (SAT) rises above the control point (SETP)+ the cutoff point (LIMT_SAT) the capacity calculation routine will be run immediately and drop a stage of heat. Thereafter, every time the capacity calculation routine runs, provided the SATCMODE will be ON, a stage will dropped each time through. Falling back below the cutoff point will turn off the SATCMODE.

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.

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.

Supply Fan Control with IGV — 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.

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.

Supply Fan Control with VFD — When equipped with the VFD option, the supply fan static pressure is controlled by modulating the fan wheel speed. The VFD operates independently from the microprocessor. A duct pressure transducer monitors duct static pressure. The transducer output (4 to 20 mA) is directed into the VFD. The VFD adjusts supply fan motor speed (which changes wheel speed) as measured duct pressure varies from set point as established at the VFD. The VFD will modulate fan speed until the duct pressure set point is achieved.

NOTE: The VFD will always provide the proper phase sequence to the supply fan motor. This motor will operate in proper rotation regardless of the phase sequence to the unit. If, upon start-up, the outdoor fans operate backwards but the indoor fan operates in the correct direction, reverse any two leads to the main terminal block. All fans will then operate in the correct direction.

Modulating Power Exhaust (48ZE and 50ZE Units Option or Accessory) — The power exhaust assembly consists of two parallel and independent belt-drive forward curve fans. The fans, motors, and drives are located over the return air opening of the unit, in a plenum beneath the outside air intake plenum. The fans discharge air horizontally out the back of the unit through individual barometric backdraft dampers with hoods. (See Fig. 50 and 51.) Operation is interlocked with economizer operation. Sheet metal installation is shown in Fig. 52 and 53.

Fan no. 1 is equipped with a variable position discharge damper located in the outlet of the fan housing. This damper is controlled by an actuator (PEDM), based on signals from the building pressure differential pressure switch (DPS). Available range on the DPS is –0.50 to +0.50 in. wg, adjustable. Building pressure is sensed by a pick-up (field-supplied and -installed) located in the occupied space.

Operation of the modulating power exhaust is a combination modulating/staged control, with fan no. 1 providing modulating control from 0 to 50% of total exhaust capability, and fan no. 2 being staged On/Off (for a step of 50% of total exhaust capability) according to damper position on fan no. 1.

As the economizer actuator opens past 17% open, auxiliary switch DMS1 closes, energizing fan contactor PEC1. Fan motor no. 1 starts and runs.

Capacity of fan no. 1 is controlled by the position of the outlet damper. As building pressure increases above set point, the DPS will close its contact and drive the power exhaust damper motor (PEDM) open until set point is achieved. DPS then opens its control contacts and PEDM maintains current position.

When space demand moves PEDM to 90% of full-open position, auxiliary switch PEDMS closes, energizing fan contactor PEC2. Fan motor no. 2 starts and runs. Increased exhaust airflow will lower space pressure, causing DPS to drive PEDM back towards its closed position, until the set point is achieved.

If space pressure decreases until PEDM position is reduced to 10% of open position, PEDMS will open, deenergizing fan contactor PEC2 and shutting off fan no. 2.

High Capacity Modulating Power Exhaust (48ZV and 50ZV,ZY Units) — The high-capacity modulating power exhaust assembly consists of two parallel and independent belt-drive large diameter forward curve fans. The fans, motors, and drives are located in a cabinet extension (not over the return air opening of the unit), in a plenum beneath the outside air intake plenum. The fans discharge horizontally out the back of the unit through individual barometric backdraft dampers with hoods. Operation is interlocked with economizer operation. Space pressure is monitored by a factory-installed differential pressure transducer. See Fig. 54 for component locations and sheet metal details.

The high-capacity modulating power exhaust is also available on horizontal 50ZY units. Return duct opening is located on the left-hand side of the unit; exhaust air exits the unit out the back.

Control of the high-capacity modulating power exhaust system is accomplished via a combination modulated capacity fan/staged fan. Modulation is provided by a variable frequency drive controlling the direct output to fan no. 1 and controlling the ON/OFF status of fan no. 2.

Fan no. 1 is equipped with a Variable Frequency Drive, matched to the motor size. VFD output is determined by the VFD's internal PID logic in response to actual space pressure as monitored by the Building Pressure (BP) transducer. Set point for BP control is established at the PE VFD. Available set point range is –0.50 to +0.50 in. wg. Building Pressure is sensed by a pick-up (field-supplied and -installed) located in the occupied space and connected to the BP transducer by $^1/_4$-in. tubing (field-supplied and -installed).

Operation of the modulating power exhaust is a combination modulating/staged control, with fan no. 1 providing modulating control from 0 to 50% of total exhaust capability, and fan no. 2 being staged On/Off (for a step of 50% of total exhaust capability) according to VFD output level on fan no. 1.

As the economizer actuator opens past 17% open, auxiliary PEC1. Fan motor no. 1 starts and runs.

Capacity of fan no. 1 is controlled by the output level from the BP VFD. As building pressure increases above set point, the VFD logic will increase the output level to fan no. 1 until set point is reachieved.

When space demand moves PE VFD output to 100% (60 Hz), VFD internal relay closes, energizing fan contactor PEC2. Fan motor no. 2 starts and runs. Increased exhaust airflow will lower space pressure, causing PE VFD to reduce its output to fan no. 1 until set point is reachieved.

If space pressure decreases until PE VFD output is reduced to 25% of maximum output (15 Hz), VFD internal relay will open, deenergizing fan contactor PEC2 and shutting off fan no. 2.

Return/Exhaust Fan (48ZR and 50ZR,ZS Units) — The return/exhaust fan power exhaust assembly consists of one belt-drive plenum fan. The fan, motor and drive are located over the return air opening of the unit, in a plenum beneath the outside air intake plenum. The plenum fan pressurizes the plenum section so that the air can either be discharged horizontally out the back of the unit through motorized exhaust damper with hood or discharged through the return air section of the economizer. See Fig. 55 for component locations and sheet metal details.

The return/exhaust fan is equipped with a variable frequency drive (RE VFD), matched to the motor size. The VFD output is determined by the internal PID logic of the VFD in response to the actual space pressure which is monitored by the Mixing Box Pressure Transducer (MBPT). The set point for MBPT control is established at the RE VFD (factory configured). Mixing box pressure is sensed by a pick-up tube located in the filter section and connected to the transducer by $^1/_4$-in. tubing (factory installed).

The return/exhaust fan is also equipped with a motorized power exhaust damper at the end of the unit. This damper is controlled by a motor actuator (PEDM), based on signals from the building pressure switch (BPS). Available range on the BPS is ± 0.25 in. wg (64 Pa), which is adjustable. Building pressure is sensed by a pick-up (field-supplied and -installed) located in the occupied space. The BPS will sense the occupied space pressure and control the power exhaust damper to open or close.

The return/exhaust fan will turn on and off simultaneously with the supply fan, and the fan speed will modulate automatically to meet the return/exhaust air volume needs.

Operation of the return/exhaust fan is controlled by the MBPT through the RE VFD. The MBPT will maintain the plenum fan at certain speed in order to keep the mixing box pressure set point. When the power exhaust damper is closed, all return air will be discharged through the economizer into the mixing box. The set point is a slightly negative pressure in the mixing box so that certain amount of outside air can be brought in. During the situation when the supply fan speed is increased, or when economizer opens, the MBPT will command the RE VFD to increase the return/exhaust fan speed in order to maintain the set point. When the power exhaust is open, the return air will be discharged partially through the power exhaust damper to the outside and returned partially through the economizer. The return/exhaust fan will increase speed at the situation when the power exhaust damper is open.

Unit Staging — Compressor loading and unloading sequences are shown in Table 39.

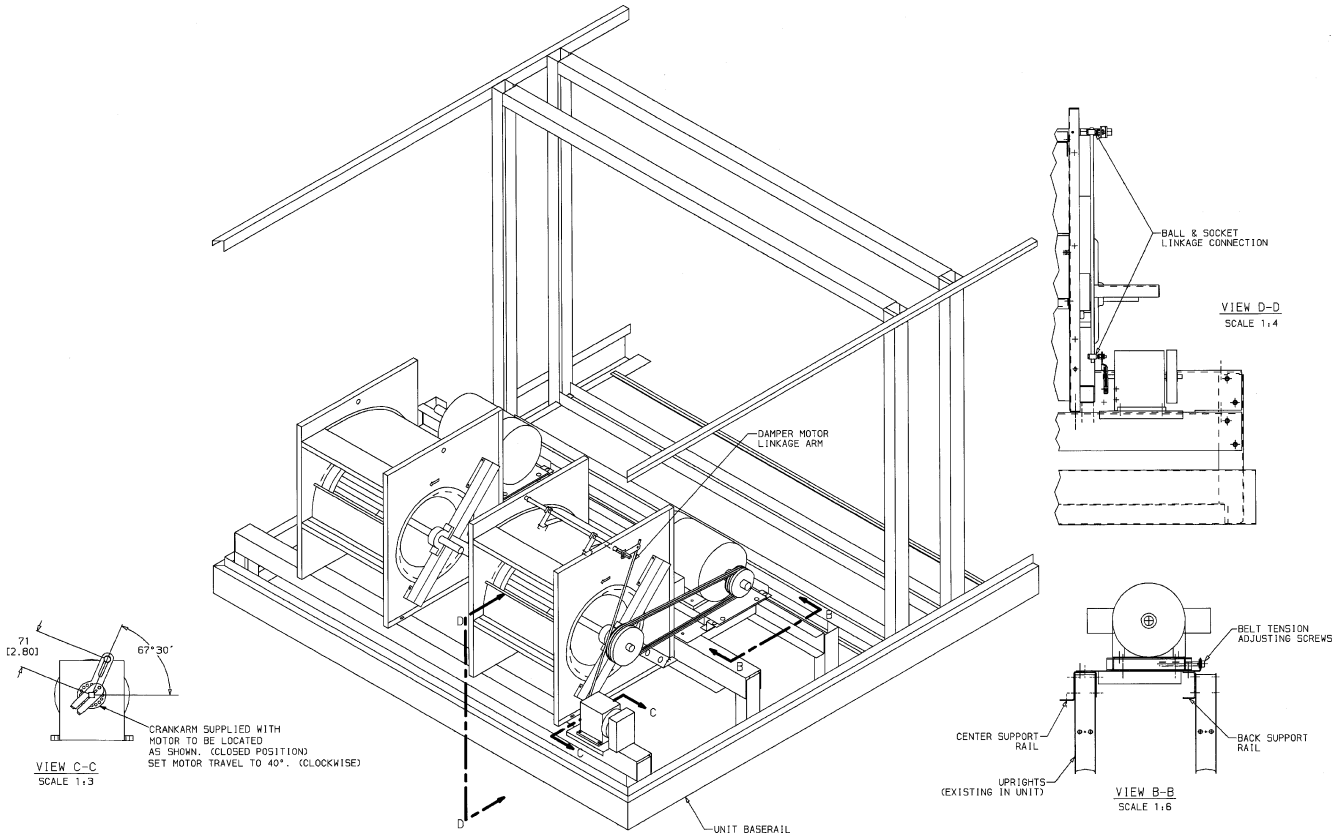


Fig. 50 — Modulating Power Exhaust Component Locations; Sizes 030-050

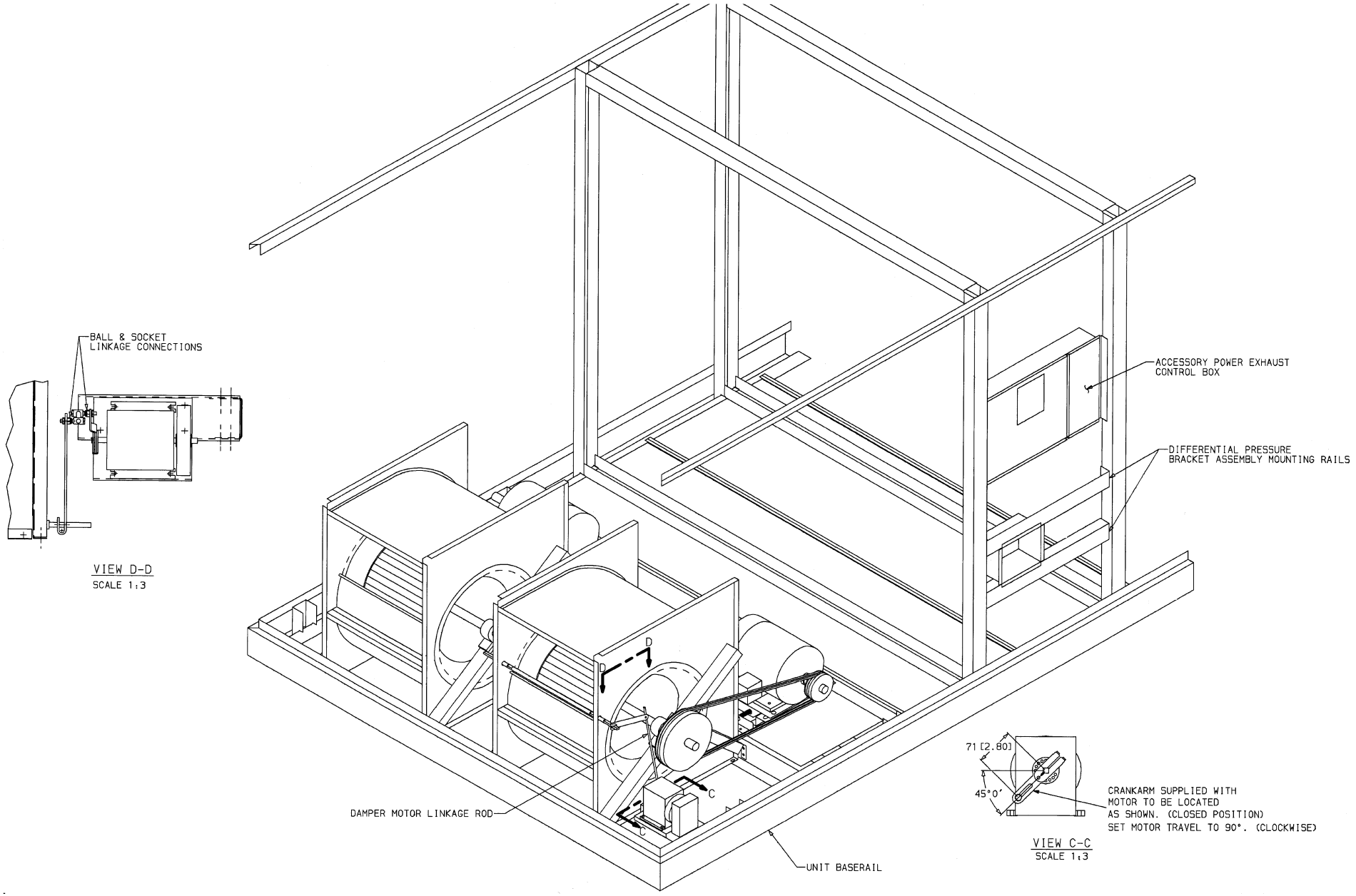


Fig. 51 — Modulating Power Exhaust Component Locations; Sizes 055-105 (48ZE, 50ZE Shown)

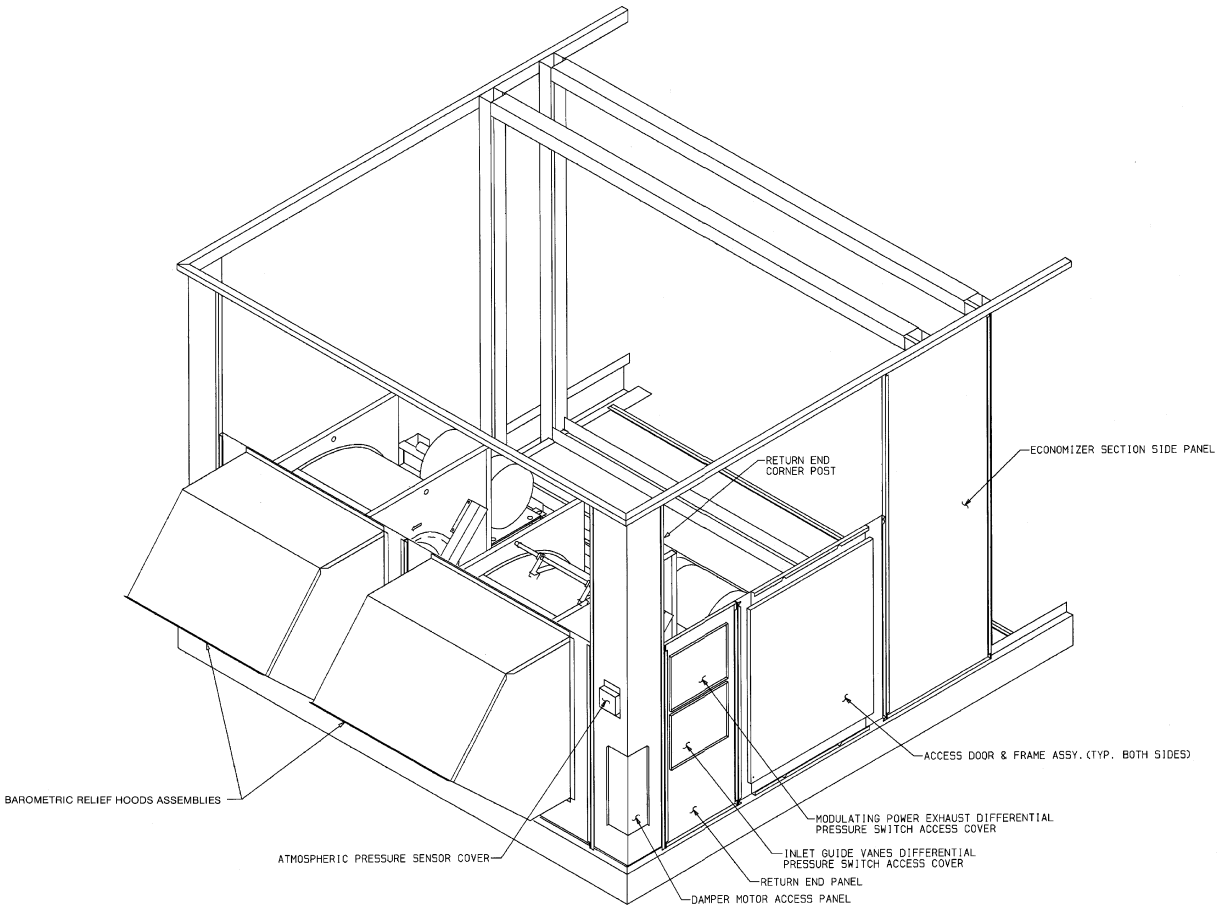


Fig. 52 — Modulating Power Exhaust Return End Sheet Metal Skin Detail; Sizes 030-050

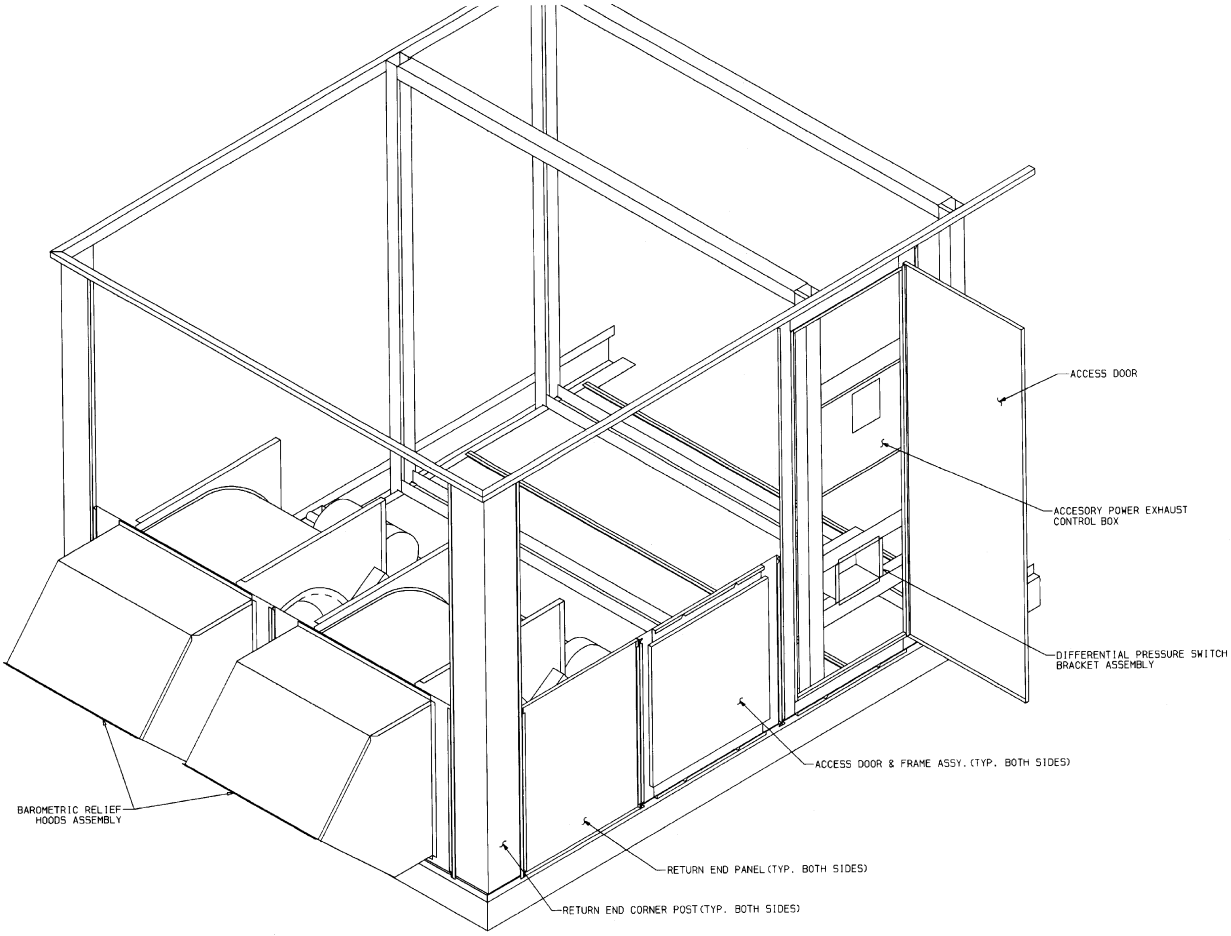


Fig. 53 — Modulating Power Exhaust Return End Sheet Metal Skin Detail; Sizes 055-105

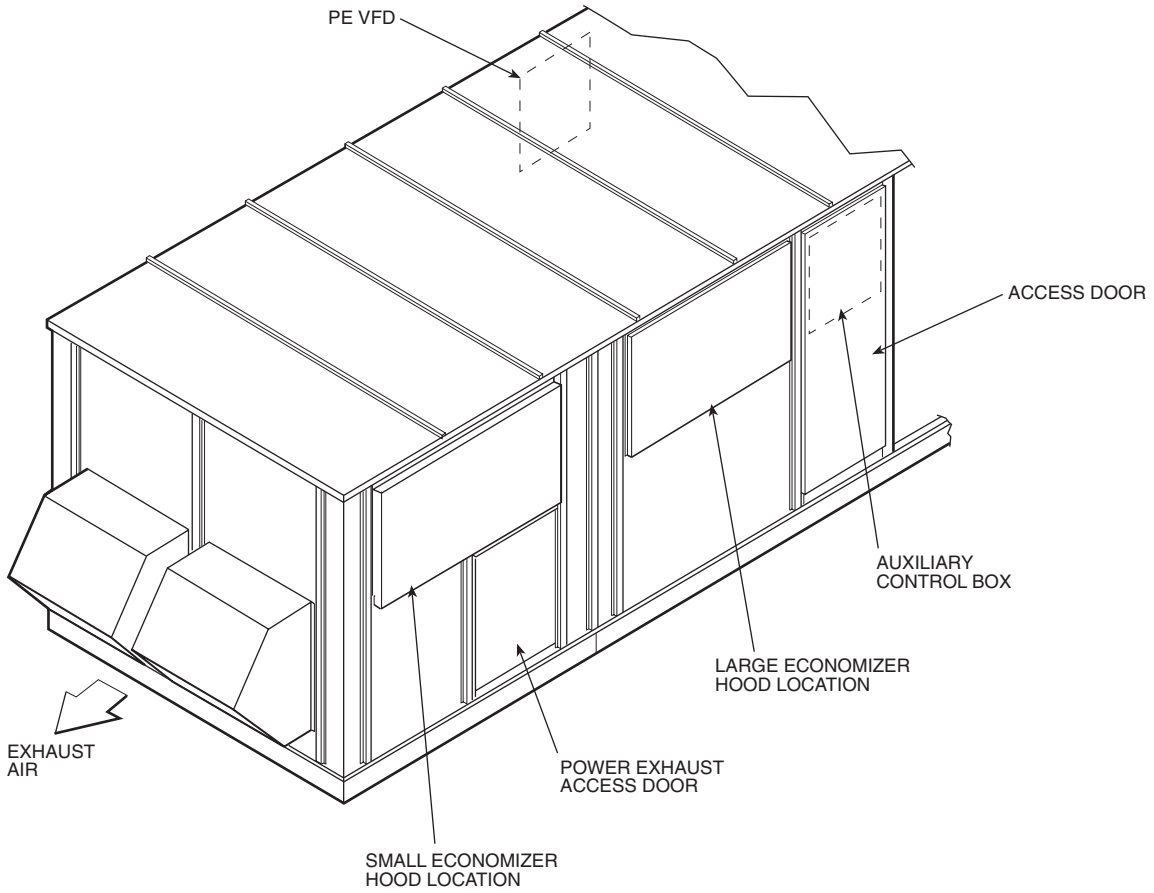


Fig. 54 — Modulating Power Exhaust Return End Sheet Metal Skin Detail; 48ZV and 50ZV,ZY Units

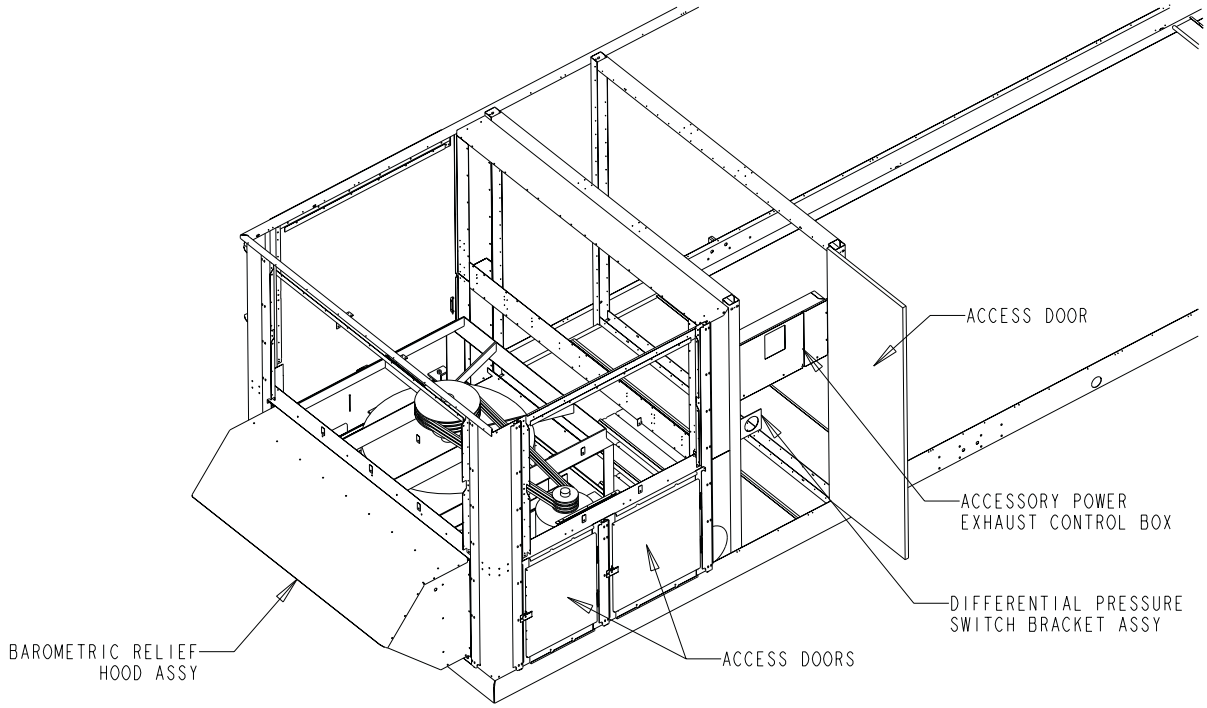


Fig. 55 — Return/Exhaust Fan Return End Sheet Metal Skin Detail; 48/50ZR,ZS075-105 Units

Table 39 — Compressor Loading and Unloading Sequences

COOLING STAGE	SIZE 030 UNITS					
	Lead Circuit			Lag Circuit	Active Cylinders	Percent Capacity
	Comp 1	Unloader U1	Unloader U2	Comp 2		
0	OFF	OFF	OFF	OFF	0	0
1	ON	ON	ON	OFF	2	17
2	ON	ON	OFF	OFF	4	33
3	ON	OFF	OFF	OFF	6	50
4	ON	ON	ON	ON	8	67
5	ON	ON	OFF	ON	10	83
6	ON	OFF	OFF	ON	12	100

COOLING STAGE	SIZE 035 UNITS					
	Lead Circuit			Lag Circuit	Active Cylinders	Percent Capacity
	Comp 1	Unloader U1	Unloader U2	Comp 2		
0	OFF	OFF	OFF	OFF	0	0
1	ON	ON	ON	OFF	2	14
2	ON	ON	OFF	OFF	4	28
3	ON	OFF	OFF	OFF	6	42
4	ON	ON	ON	ON	6	72
5	ON	ON	OFF	ON	8	86
6	ON	OFF	OFF	ON	10	100

COOLING STAGE	SIZE 040 UNITS				
	Lead Circuit		Lag Circuit	Active Cylinders	Percent Capacity
	Comp 1	Unloader U1	Comp 2		
0	OFF	OFF	OFF	0	0
1	ON	ON	OFF	2	25
2	ON	OFF	OFF	4	50
3	ON	ON	ON	6	75
4	ON	OFF	ON	8	100

COOLING STAGE	SIZE 050 UNITS					
	Lead Circuit			Lag Circuit	Active Cylinders	Percent Capacity
	Comp 1	Unloader U1	Unloader U2	Comp 2		
0	OFF	OFF	OFF	OFF	0	0
1	ON	ON	ON	OFF	2	19
2	ON	ON	OFF	OFF	4	38
3	ON	OFF	OFF	OFF	6	58
4	ON	ON	ON	ON	6	62
5	ON	ON	OFF	ON	8	81
6	ON	OFF	OFF	ON	10	100

COOLING STAGE	SIZE 055 UNITS					
	Lead Circuit			Lag Circuit	Active Cylinders	Percent Capacity
	Comp 1	Unloader U1	Unloader U2	Comp 2		
0	OFF	OFF	OFF	OFF	0	0
1	ON	ON	ON	OFF	2	20
2	ON	ON	OFF	OFF	4	40
3	ON	OFF	OFF	OFF	6	60
4	ON	ON	OFF	ON	10	80
5	ON	OFF	OFF	ON	12	100

Table 39 — Compressor Loading and Unloading Sequences (cont)

COOLING STAGE	SIZE 060 UNITS					
	Lead Circuit			Lag Circuit	Active Cylinders	Percent Capacity
	Comp 1	Unloader U1	Unloader U2	Comp 2		
0	OFF	OFF	OFF	OFF	0	0
1	ON	ON	ON	OFF	2	17
2	ON	ON	OFF	OFF	4	33
3	ON	OFF	OFF	OFF	6	50
4	ON	ON	ON	ON	8	67
5	ON	ON	OFF	ON	10	83
6	ON	OFF	OFF	ON	12	100

COOLING STAGE	SIZE 070, 075 UNITS					
	Lead Circuit			Lag Circuit	Active Cylinders	Percent Capacity
	Comp 1	Unloader U1	Unloader U2	Comp 2		
0	OFF	OFF	OFF	OFF	0	0
1	ON	ON	ON	OFF	2	14
2	ON	ON	OFF	OFF	4	29
3	ON	OFF	OFF	OFF	6	43
4	ON	ON	ON	ON	8	71
5	ON	ON	OFF	ON	10	86
6	ON	OFF	OFF	ON	12	100

COOLING STAGE	SIZE 090 UNITS					
	Lead Circuit			Lag Circuit	Active Cylinders	Percent Capacity
	Comp 1	Unloader U1	Unloader U2	Comp 2		
0	OFF	OFF	OFF	OFF	0	0
1	ON	ON	ON	OFF	2	16
2	ON	ON	OFF	OFF	4	33
3	ON	OFF	OFF	OFF	6	50
4	ON	ON	ON	ON	8	66
5	ON	ON	OFF	ON	10	83
6	ON	OFF	OFF	ON	12	100

COOLING STAGE	SIZE 105 UNITS						
	Lead Circuit			Lag Circuit		Active Cylinders	Percent Capacity
	Comp 1	Unloader U1	Comp 3	Comp 2	Comp 4		
0	OFF	OFF	OFF	OFF	OFF	0	0
1	ON	ON	OFF	OFF	OFF	4	20
2	ON	OFF	OFF	OFF	OFF	6	30
3	ON	ON	OFF	ON	OFF	10	50
4	ON	OFF	OFF	ON	OFF	12	60
5	ON	ON	OFF	ON	ON	14	70
6	ON	OFF	OFF	ON	ON	16	80
7	ON	ON	ON	ON	ON	18	90
8	ON	OFF	ON	ON	ON	20	100

TROUBLESHOOTING

By using the display module, actual operating conditions of the unit are displayed while it is running. The Quick Test function allows proper operation of compressors, compressor unloaders, fans, and other components to be checked while unit is stopped. If an operating fault is detected, an alarm is generated and an alarm code(s) is displayed. For checking specific items, see Table 40.

Checking Display Codes — To view the digital display codes, press the button located to the right of the LED display/set point board in the control box. See Table 41 for Operational Status Codes. See Table 42 for Diagnostic Codes.

Complete Unit Stoppage — If the unit is off, there are several conditions that can cause this situation to occur:

- Remote ON/OFF circuit in Unoccupied mode.
- Unit ON/OFF switch moved to OFF position.
- Programmed schedule at the timeclock.
- General power failure.
- Blown fuse in the control power feed.
- Open control circuit fuse.
- Operation of the unit blocked by the demand limit function.
- Unit supply-air temperature (T1) thermistor failure.
- Supply-air fan is not operating.
- High duct static pressure.

Single Circuit Stoppage — If a single circuit stops, there are several potential causes:

- Open contacts in the compressor high-pressure switch.
- Low refrigerant pressure.
- Thermistor failure.
- Unit supply-air temperature thermistor (T1) failure.
- Compressor circuit breaker trip.
- Operation of the circuit blocked by the demand limit function.

Restart Procedure — Before attempting to restart the machine, check the display for alarm codes to determine the cause of the shutdown. If the unit, circuit, or compressor stops more than once as a result of a safety device, determine and correct the cause before attempting to start the unit again.

After the cause of the shutdown has been corrected, unit restart may be automatic or manual depending upon the fault.

Table 41 — Operation Status Codes

CODE	MEANING
0	0 cooling stages active
1	1 cooling stage active
2	2 cooling stages active
3	3 cooling stages active
4	4 cooling stages active
5	5 cooling stages active
6	6 cooling stages active
7	7 cooling stages active
8	8 cooling stages active
20	Initialization mode (Allow 2 minutes for initialization. To initiate Quick Test, press the Display button while 20 is displayed.)
21	Temperature Reset in effect
22	Demand Limit in effect
26	Morning Warm-Up in effect
30	Internal failure detected
88	Self-diagnostic mode in effect

Table 40 — Controls Troubleshooting

SYMPTOM(S)	PROBABLE CAUSE(S)	SOLUTION(S)
Controls do not seem to be operating.	Remote on-off function may be keeping controls off.	Check status.
Evaporator fan does not run.	1. Circuit breaker open. 2. Inverter overload (if equipped).	1. Find cause and reset circuit breaker. 2. Find cause and reset.
Compressor does not run.	1. Circuit breaker is open. 2. There is no demand for cooling. 3. The control is locking out cooling operation. 4. Demand Limit in effect.	1. Find cause and reset circuit breaker. 2. Correct operation. 3. Check rotating display for alarm codes. Resolve alarm cause and reset control by changing to standby and back to run mode. 4. Check Demand Limit Settings.
Condenser fans do not turn on.	Circuit breaker is open.	Find cause and reset circuit breaker
Cooling demand exists and economizer modulates, but compression is not operating.	Compression cannot be initiated until economizer damper is 90% open.	Correct operation.

Diagnostic Codes — Diagnostic codes are warnings of abnormal or fault conditions, and may cause either one circuit or the whole unit to shut down. They are assigned code numbers as described below.

Table 42 contains a description of each diagnostic code error and possible cause. Manual reset is accomplished by moving the ON/OFF Switch to the OFF position, then back to ON.

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.

NOTE: Codes 53, 54, 57, 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, 52, 55, 56: 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, 52, 55 or 56 (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.

If lead compressor in a refrigerant circuit is shut down, the other compressor in that circuit will also be shut down and locked off. Only the error code for the lead compressor will be displayed.

Code 51 is for compressor 1, and Code 55 is for compressor 2. Codes 52 and 56 are used for compressors 3 and 4, respectively, on size 105 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 06D 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 (size 030 and 035 only).

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.

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.

Table 42 — Diagnostic Codes

DISPLAY	DESCRIPTION OF FAILURE	ACTION TAKEN BY CONTROL	RESET METHOD	PROBABLE CAUSE
51 **55** **52** **56**	Compressor 1 failure Compressor 2 failure Compressor 3 failure Compressor 4 failure	Compressor 1 shut off Compressor 2 shut off Compressor 3 shut off Compressor 4 shut off	Manual Manual Manual 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	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**	Supply-air thermistor failure Return-air thermistor failure Circuit 1 saturated condensing thermistor Circuit 2 saturated condensing thermistor Reset temperature thermistor failure	Unit shut off Use default value Unit shut off Unit shut off Stop reset	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**	Supply-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:
5. Illegal unit configuration caused by missing programmable header or both unloader DIP switches on.
6. All auto. reset failures that cause the unit to stop will restart when the error has been corrected.
7. All manual reset errors must be reset by turning the control switch off and then back on.
8. Valid resistance range for the thermistors is 363,000 to 585 ohms.
9. Codes 53, 54, 57, 58, 61, 62, 65-69, 73, 74, and 77-80 are not used on these units.

CODES 59 AND 60: LOW-PRESSURE SWITCH — These codes are used to indicate a low-pressure switch failure.

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 42) 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 Return-Air Thermistor Failure

Code 73 Not used

Code 74 Not used

Code 75 Circuit 1 Saturated Condensing Thermistor

Code 76 Circuit 2 Saturated Condensing Thermistor

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: SUPPLY-AIR TEMPERATURE SET POINT POTENTIOMETER FAILURE — If supply-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 K ohms.

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 K ohm 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 K ohms, but when installed on the accessory board in parallel with the other 2 potentiometers, measured resistance will be 3.3 K ohms. 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 K ohm, 3-wire linear potentiometer and an accessory 2-step control. The single-step control has a single potentiometer while 2-step control has 2 potentiometers (mounted on the demand limit board, see Fig. 32).

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 K ohm, but when installed in parallel with the other 2 potentiometers on the accessory board, measured resistance will be 3.3 K ohm.

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 K ohm, but when wired in parallel with other potentiometers on the accessory board, measured resistance is 3.3 K ohm.

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.

Staged Gas Units Troubleshooting

The Navigator display shows the actual operating conditions of the unit while it is running. If there are alarms or there have been alarms, they will be displayed in either the current alarm list or the history alarm list. See Table 43.

COMPLETE UNIT STOPPAGE — There are several conditions that can cause the unit not to provide heating or cooling.

- If an alarm is active which causes the unit to shut down, diagnose the problem using the information provided in Alarms and Alerts section below.
- Cooling and heating loads are satisfied.
- Programmed schedule.
- General power failure.
- Tripped CB6 (24-Volt transformer circuit breaker).
- Unit is turned off through the CCN network.

RESTART PROCEDURE — Before attempting to restart the machine, check the alarm list to determine the cause of the shutdown. If the shutdown alarm for a particular function has occurred, determine and correct the cause before allowing the unit to run under its own control again.

ALARMS AND ALERTS — Alarms and alerts are warnings of abnormal or fault conditions, and may cause either one function or the entire unit to shut down. They are assigned code numbers and descriptions as described below. A prefix of A denotes an alarm. A prefix of T denotes an alert. See Table 43. The description for an alarm can be viewed from Navigator display by pressing ESCAPE and ENTER keys simultaneously while displaying the alarm code number.

Table 43 — SGC Alarm Codes

ALARM CODE	DESCRIPTION	ACTION TAKEN BY CONTROL	RESET METHOD	PROBABLE CAUSE
A152	Unit down	Unit Shutdown*	Automatic	Unit down due to failure. Check for alarm A700. Check for alerts 705 or 706. If SETPSEL=0, check for alarm A157.
A152	Critical Serial EEPROM Failure Error	Unit Shutdown*	Automatic	Hardware problem.
T153	Real Time Clock Hardware Failure	None	Automatic	Hardware problem.
A154	Serial EEPROM Hardware Failure	Unit Shutdown*	Automatic	Hardware problem.
T155	Serial EEPROM Failure Error	None	Automatic	Hardware problem.
A157	A/D Hardware Failure	Unit Shutdown*	Automatic	Hardware problem.
A700	Supply Air Temperature-All Thermistors have failed	Unit Shutdown*	Automatic	All supply air thermistors have failed
T701	Supply Air Temperature Thermistor 1 Failure	None	Automatic	Faulty, shorted, or open thermistor caused by wiring error or loose connection.
T702	Supply Air Temperature Thermistor 2 Failure	None	Automatic	Faulty, shorted, or open thermistor caused by wiring error or loose connection.
T703	Supply Air Temperature Thermistor 3 Failure	None	Automatic	Faulty, shorted, or open thermistor caused by wiring error or loose connection.
T705	Cooling Setpoint Ratio Input Error	Unit Shutdown	Automatic	Faulty potentiometer or incorrect wiring.
T706	Heating Setpoint Ratio Input Error	Unit Shutdown	Automatic	Faulty potentiometer or incorrect wiring.
T707	Limit Switch Thermistor Failure	None†	Automatic	Faulty, shorted, or open thermistor caused by wiring error or loose connection.

*Alarm generated.
†No limit switch monitoring will occur.

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 37 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 splice the wires or repair the assembly.

Thermistor Troubleshooting (Staged Gas Units) — The electronic control uses five 5K-Ω thermistors to sense temperatures used to control operation of the unit. See Fig. 15 and 16. Resistances at various temperatures are listed in Table 44. Thermistor pin connection points are shown in Table 2.

THERMISTOR/TEMPERATURE SENSOR CHECK — A high quality digital ohmmeter is required to perform this check.

1. To determine temperatures at the various thermistor locations, disconnect the thermistor from SGC board at the J8 terminal strip (see Fig. 15 and 16) and measure the resistance across the appropriate thermistor.
2. Using the resistance reading obtained, read the sensor temperature from Table 44.
3. To check thermistor accuracy, measure temperature at probe location with an accurate thermocouple-type temperature-measuring instrument. Insulate thermocouple to avoid ambient temperatures from influencing reading. Temperature measured by thermocouple and temperature determined from thermistor resistance reading should be close, 5° F (3° C) if care was taken in applying thermocouple and taking readings.

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

VERIFY SUPPLY AIR TEMPERATURE (SAT) SENSOR AND LIMIT SWITCH TEMPERATURE (LIMTTEMP) THERMISTOR PERFORMANCE — Verify that SAT thermistors and LIMTTEMP thermistor are reading correctly. The SAT and LIMTTEMP values can be accessed through Navigator display in the Temperatures menu.

Table 44 — 5K Thermistor Temperature (°C, °F) vs Resistance (Staged Gas Units)

TEMP (C)	TEMP (F)	RESISTANCE (Ohms)
–40	–40	168,250
–35	–31	122,350
–30	–22	88,500
–25	–13	65,200
–20	–4	48,535
–15	5	36,476
–10	14	27,665
–5	23	21,165
0	32	16,325
5	41	12,695
10	50	9,950
20	68	6,245
25	77	5,000
30	86	4,208.5
35	95	3,265.0
40	104	2,663.3
45	113	2,185.0
50	122	1,801.5
55	131	1,493.0
60	140	1,224.0
65	149	1,041.5
70	158	876.0
75	167	739.5
80	176	627.5

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. 56 and 57 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.

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 11 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.

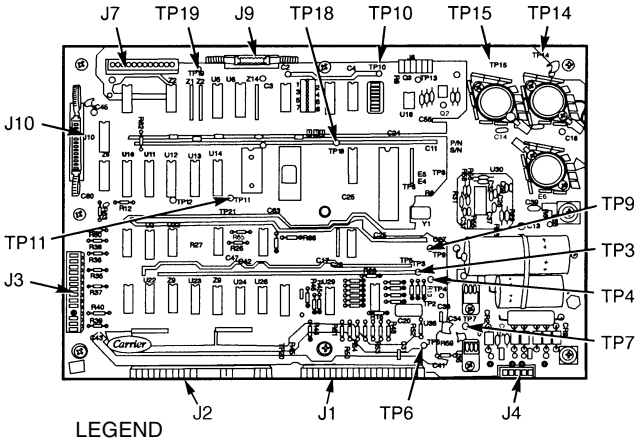


Fig. 56 — Processor Board Test Points

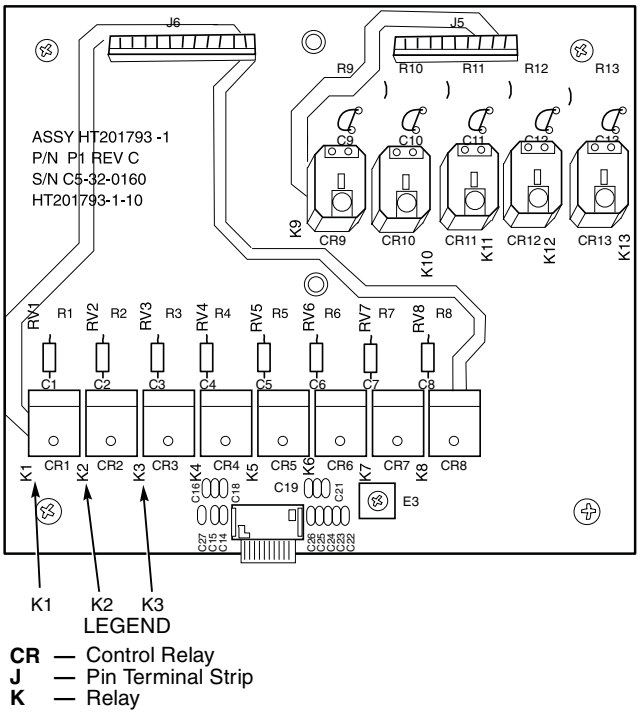


Fig. 57 — Relay Board Test Points

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 112 ± 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 24, and check voltage between TP15 and terminals shown in Table 45 on pin terminal connector J9. See Fig. 58 for J9 details.

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. 59 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.

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.

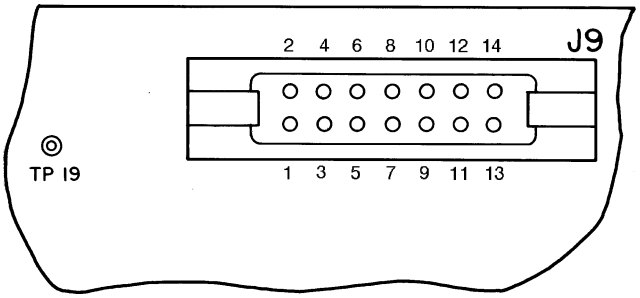


Fig. 58 — Relay Board Pin Terminal Connector (J9)

Table 45 — 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 stay 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 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.

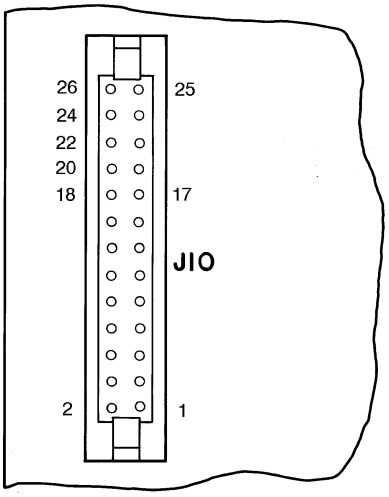


Fig. 59 — Display Board Pin Terminal Connector (J10)

4. Turn power to ON position, and enter the Quick Test routine.
5. Place the other lead on terminals shown in Table 46, and check the voltages.
6. If voltages are incorrect (per Table 46), 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 46 — 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 47, and check the voltages.
6. If voltages are incorrect (per Table 47), replace processor board.
7. Turn power to OFF position, and replace the plugs removed in Step 2.
8. Turn power to ON position.

Table 47 — 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 (Fig. 5)

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 48 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 49 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 64, 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 65.

Table 48 — 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	∞	∞

LEGEND

∞ — Infinity

Table 49 — 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

LEGEND
∞ — 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. 18.
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. 19. 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.

Enthalpy Sensor Checkout — To test operation of enthalpy sensor, see Table 50.

Table 50 — Enthalpy Sensor Checkout

TEST	EXPECTED RESULT AND RESPONSE
Outdoor-air sensor: Enthalpy sensor + terminal should be connected to + terminal on motor. Connect the positive terminal of a DC milliammeter to the S terminal of the sensor and the negative terminal of the meter to S_O terminal of the enthalpy board.	Milliammeter reading should be between 3 and 24 mA if sensor is operating correctly. If reading is 0 mA, the sensor is either wired backwards or is defective.
Indoor-air sensor: Enthalpy sensor + terminal should be connected to + terminal on motor. Connect the positive terminal of a DC milliammeter to the S terminal of the sensor and the negative terminal of the meter to S_R terminal of the enthalpy board.	Milliammeter reading should be between 3 and 24 mA if sensor is operating correctly. If reading is 0 mA, the sensor is either wired backwards or is defective.

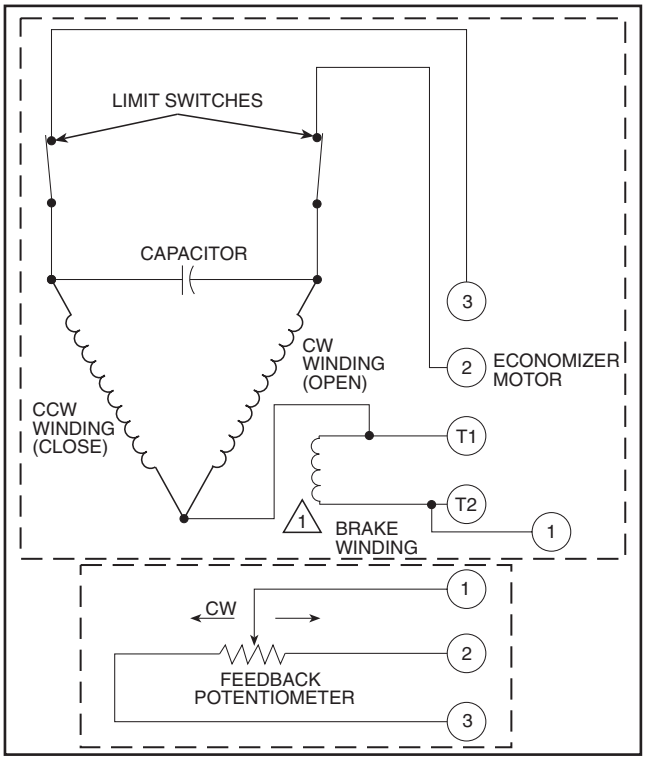
Economizer Motor — All control of the motor (i.e., enthalpy changeover, minimum position control and mixed air control) is accomplished from the main unit microprocessor through a relay board. Service and installation instructions for the unit should be consulted to verify proper operation of these controls. The economizer motor may be checked out separately. See Fig. 60 for VAV economizer motor connection information.

Motor Test

Apply 24 volt AC power to terminals T1 and T2 of motor. Connections to motor terminals 2 and 3 must be disconnected

A Motor Test A	Expected Result and Response
Jumper 1 to 2 at motor.	Motor drives open; if not, replace motor

B Motor Test B	Expected Result and Response
Jumper 1 to 3 at motor.	Motor drives closed; if not, replace motor.



LEGEND

CCW — Counterclockwise
CW — Clockwise

Fig. 60 — Damper Motor Connection Diagram (VAV)

Supply Fan Variable Frequency Drive

⚠ WARNING

Factory-installed optional VFD is located near the supply fan and motor. During any service work or programming at the VFD, operation of the fan and motor is not desirable. Either disable the supply fan or install an accessory VFD remote display.

NOTE: The VFDs (part no. TOSVERT130-E3) are specially modified for use on Carrier equipment. Some specifications and control configuration defaults for Carrier applications will differ from the VFD manufacturer manual included in the packet. See Table 51 for listing of Carrier-specific default values.

STANDARD TRANSDUCER CONTROL — The VFD monitors and controls duct pressure (DP) via a differential pressure transducer. The pressure transducer is located in the auxiliary control box (030-050 units) or in the supply fan compartment (see Fig. 39). The pressure transducer's low pressure reference port is connected to the outside of the unit cabinet by a factory-installed tubing section. The pressure transducer's high pressure reference point must be field-connected to the duct pressure pick-up (field-supplied and installed in the supply duct).

The DP transducer monitors the static pressure in the supply duct and provides a 4 to 20 mA signal directly to the VFD. (Refer to Table 31 for transducer output signal [mA] for actual duct static pressure.) The internal logic of the VFD compares this signal representing actual duct pressure to the user-configured DP set point. The VFD automatically adjusts its output to the supply fan motor to maintain the desired DP set point. When operating with the factory-standard DP transducer, the internal PID logic of the VFD is enabled.

EXTERNAL SIGNAL CONTROL — If the VFD is to be controlled by an external control system other than the factory supplied pressure transducer, the internal PID logic function of the VFD must be disabled. To disable the PID control:

1. Disconnect and lock out all power to the Carrier rooftop unit.
2. Remove the VFD access cover.

⚠ WARNING

Ensure the "CHARGE" lamp on the VFD is unlit. This may take up to 4 minutes. The "CHARGE" lamp indicates that the main capacitors in the VFD are charged. Internal components of the VFD should not be touched until the "CHARGE" lamp is completely out. Electrical shock can cause injury or death.

3. Install a jumper across S2-CC (see Fig. 61 and 62 for VFD terminal board connections).
4. Remove factory-supplied cable attached to IV and P24 (sizes 030-050) or IV and CC (sizes 055-105).
5. Remove other end of the same cable from the pressure sensor.
6. Connect field-supplied speed reference (4 to 20 mA) across terminals IV and P24 (sizes 030-050) or IV and CC (sizes 055-105).
7. Disable the supply fan motor operation.
8. Reconnect power to the unit and VFD.
9. Reprogram the VFD to accept an external reference (in the Utility parameters group [Gr.Ut], set parameter item Fnod [no.312] = 4).
10. Enable supply fan motor and return power to the unit.

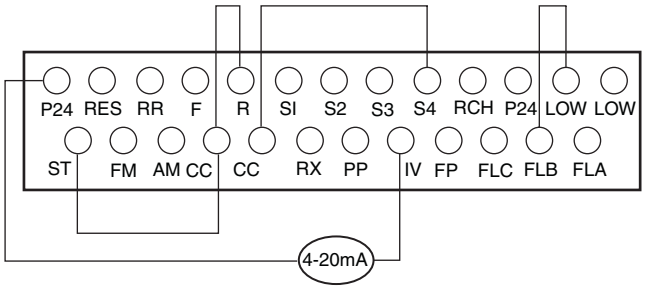


Fig. 61 — Supply Fan Variable Frequency Drive Terminal Block (Size 030-050 Units)

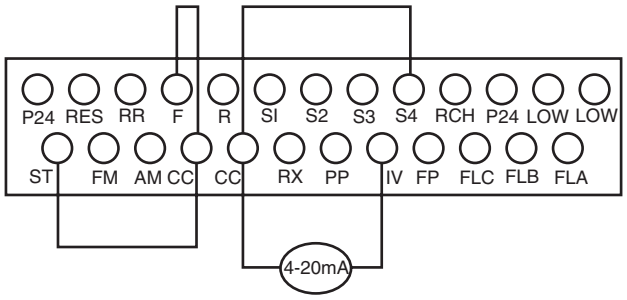


Fig. 62 — Supply Fan Variable Frequency Drive Terminal Block (Size 055-105 Units)

Table 51 — Carrier Default Program Parameter Values (Supply Fan VFD)

PARAMETER GROUP	PARAMETER	DEFAULT VALUE
SEtP (Setup)	ACC1	60.0 Sec
	DEC1	60.0 Sec
	UL	60.0 Hz
	LL	10.0 Hz*
	Luln	1
	P3	20%
	F-P3	0.0 Hz
	P4	100%
	F-P4	60 Hz
	tHr1	See Tables 53 and 54
	StC1	0
	StL1	110%
	OLN	1
	tYP	5*
Gr.F (Fundamental)	FH	60 Hz
	Pt	2
Gr.Fb (Feedback)	FbP1	1*
	Fbln	2
	GP	.30
	GI	2 sec
	GA	0
	GFS	80
	P1LL	10
	PuL	1
	PuUl	10
	PuLL	10
Gr.SF (Frequency Settings)	Fsor	60 Hz
	Sr.n	1* (055-105 only)
	SrN1	0* (055-105 only)
Gr.Pn (Panel Control)	Fr	0*
Gr.St (Terminal Selection)	1t	1
	1t0	0
	1t1	56
	1t2	13
	1t3	3
	1t4	10
Gr.Pr (Protection)	UuC	1*
	UuCt	2
	ArSt	3
Gr.Ut (Utility)	Cnod	1*
	bLSF	1* (055-105 only)
	Fnod	2*
	bLPn	1*

*These settings differ from the Toshiba defaults and are required for Carrier applications.

NOTE: To restore original factory settings, change tYP to 6 in Setup mode (SEtP). This restores the VFD original factory settings.

SUPPLY FAN MOTOR OVERLOAD PROTECTION — The VFD provides operating overload protection for the supply fan motor. The factory has programmed the VFD overload function to match the factory-installed motor (motor size and efficiency). If the supply fan motor is changed from the original factory selection, the overload value may need to be changed by the service person. Contact your local Carrier representative for assistance in determining the proper overload setting.

NOTE: Variable frequency drive size is matched to factory-installed motor size. Do not increase motor size without also changing to equivalent VFD size.

VFD OPERATION — When troubleshooting the VFD, check first that all required conditions for VFD operation are satisfied.

For the VFD to run, the following conditions must be met at the VFD:

1. Drive enable jumper is installed from terminals CC-ST (factory supplied) (see Fig. 61 and 62).
2. Proper rotation jumper is installed at terminals R-CC (reverse rotation, factory supplied) or terminals F-CC (forward rotation, factory supplied).

UNIT SIZES	ROTATION	JUMPER
030-050	Reverse	R-CC
055-070	Forward	F-CC
075-105	Forward	F-CC

3. Emergency stop jumper is installed from terminals S4-CC (factory supplied).
4. A 4 to 20 mA signal is applied across terminals IV-CC (from pressure transducer, factory supplied).
5. DIP switch SW1 (located on the VFD's printed circuit control panel) must be set to "I" (indicating usage of a 4 to 20 mA input signal at terminals "IV").
6. Speed Control (located on the VFD's keypad/display) set for "Remote" (press the "Speed Ctrl" button until LED "Remote" is illuminated).
7. Programmed according to Carrier defaults.
8. Duct Pressure set point established by user, or use factory default (30 Hz indicating 2.50-in. wg) (see Table 31).

VFD OPERATIONAL STATUS — The VFDs contain extensive self-diagnostic functions which are accessed through the VFD display panel (located on the front of the VFD or at a remote location when the accessory remote display package has been installed).

⚠ CAUTION

If using the VFD display panel, **disconnect all power to the unit and the VFD before entering unit,** or use the accessory remote display module. Disable supply fan and motor operation before accessing VFD-mounted display module.

When power is first supplied to the VFD, the display automatically starts with the frequency monitor function of its standard monitor mode. In the frequency monitor function, the output frequency is displayed. Push the **S/P/M (Setup/Program/Monitor)** key to switch to the Mode Selection menu. Push the **S/P/M** key again to toggle the display back to the standard monitor mode.

From the Mode Selection menu, the service person can view all of the monitored status variables, including up to four user-selected variables and any trip history in the memory.

Refer to the separate VFD Operation Manual for detailed instructions on accessing diagnostic information, initiating troubleshooting, and clearing any trip history.

RESTORING FACTORY VFD DEFAULTS — The original factory configuration values are saved in the memory of the VFD and can be restored by the service person if required. There are two types of saved file data: Carrier-factory settings (factory programmed settings made to the VFD which apply specifically to the unit it is installed on) and standard defaults for general Carrier unit use.

The Carrier-factory settings are maintained as user settings. These can be restored by entering the Setup mode (in the **S/P/M** menu) and setting parameter tYP = 6 on the keypad/display. This will recall the specific factory defaults for this unit.

Occasionally it may be necessary to restore the VFD defaults to the general Carrier use values. These are stored in an OPTION ROM (read-only memory chip). However, some variables may need to be manually changed to match the specific unit's factory default settings. To recall the general Carrier defaults, enter the Setup mode and set parameter tYP = 3. Refer to Table 52 for items requiring manual adjustment.

Power Exhaust Variable Frequency Drive (48ZV and 50ZV,ZY)

NOTE: The VFDs (part no. TOSVERT130-E3) are specially modified for use on Carrier equipment. Some specifications and control configuration defaults for Carrier applications will differ from the VFD manufacturer manual included in the packet. See Table 55 for listing of Carrier-specific default values.

BUILDING PRESSURE TRANSDUCER CONTROL — The VFD monitors and controls building pressure (BP) via a differential pressure transducer. The pressure transducer is located in the auxiliary control box. The pressure transducer's high-pressure reference port is connected to the outside of the unit cabinet by a factory-installed tubing section. The pressure transducer's low-pressure reference point must be field-connected to the building pressure pick-up (field-supplied and installed in the building).

The BP transducer monitors the static pressure in the occupied space and provides a 4 to 20 mA signal directly to the power exhaust VFD. (Refer to Table 31 for transducer output signal [mA] for actual building static pressure.) The internal logic of the power exhaust VFD compares this signal representing actual duct pressure to the user-configured BP set point. The power exhaust VFD automatically adjusts its output to the power exhaust fan motor to maintain the desired BP set point. When operating with the factory-standard BP transducer, the internal PID logic of the power exhaust VFD is enabled.

EXTERNAL SIGNAL CONTROL — If the power exhaust VFD is to be controlled by an external control system other than the factory-supplied pressure transducer, the internal PID logic function of the power exhaust VFD must be disabled. To disable the PID control:

1. Disconnect and lock out all power to the Carrier rooftop unit.
2. Remove the VFD access cover.

⚠ WARNING

Ensure the "CHARGE" lamp on the VFD is unlit. This may take up to 4 minutes. The "CHARGE" lamp indicates that the main capacitors in the VFD are charged. Internal components of the VFD should not be touched until the "CHARGE" lamp is completely out. Electrical shock can cause injury or death.

3. Install a jumper across S2-CC (see Fig. 63 for power exhaust VFD terminal board connections).
4. Remove factory-supplied cable attached to IV and CC.

5. Remove other end of the same cable from the pressure sensor.
6. Connect field-supplied speed reference (4 to 20 mA) across terminals IV-P24.
7. Disable the supply fan motor operation.
8. Reconnect power to the unit and power exhaust VFD.
9. Reprogram the power exhaust VFD to accept an external reference (in the Utility parameters group [GR.Ut], set parameter item Fnod [no.312] = 4).
10. Enable supply fan motor and return power to the unit.

Table 52 — Supply Fan VFD Required User Adjusted Defaults

SIZES	ITEM
All	Motor overload settings (see Table 53 and 54)
055-105	1. Check jumper CC-F 2. Gr.UT/bLSF = 1 3. Gr.SF/Sr.n = 1 4. Gr.SF/SrN1 = 0 5. SEtP/tYP = 5 (Save User Settings) 6. SEtP/LL = 10.0 7. Gr. Fb/FbP1 = 1 8. Gr. Pn/Fr = 0 9. Gr. Pr/UuC = 1 10. Gr. Ut/Cnod = 1 11. Gr. Ut/Fnod = 2 12. Gr. Ut/bLPn = 1

Table 53 — Supply Fan Motor Overload Settings (tHr1) — Sizes 030 to 070

MOTOR (hp)	HIGH EFFICIENCY				PREMIUM EFFICIENCY		
	IFM Letter*	230V	460V	575V	IFM Letter*	230V	460V
7.5	A†	96.0	80.0	76.0	H†	96.0	80.0
10	B†	96.6	97.3	90.9	J†	96.6	97.3
15	C	78.3	100.0	100.0	K	78.3	100.0
20	D	87.3	100.0	95.1	L	87.3	100.0
25	E	85.7	93.5	100.0	M	85.7	93.5
30	F	99.0	92.3	100.0	N	99.0	92.3
40	G**	88.7	84.6	100.0	P**	88.7	84.6

*IFM letter refers to the Supply Fan Motor Option of the unit model number in the 16th position.
†030-050 units only.
**055-070 units only.

Table 54 — Supply Fan Motor Overload Settings (tHr1) — Sizes 075 to 105

MOTOR (hp)	HIGH EFFICIENCY			PREMIUM EFFICIENCY	
	IFM Letter*	460V	575V	IFM Letter*	460V
30	A	92.3	100.0	F	92.3
40	B	84.6	90.1	G	84.6
50	C	92.2	—	H	92.2
60	D	86.0	—	J	86.0
30	L	92.3	100.0	R	92.3
40	M	84.6	90.1	S	84.6
50	N	92.2	—	T	92.2
60	P	86.0	—	V	86.0
75	Q	—	—	W	—

*Supply Fan Motor Option of the unit model number in the 15th Position.

POWER EXHAUST FAN MOTOR NO. 1 OVERLOAD PROTECTION — The VFD provides operating overload protection for the supply fan motor. The factory has programmed the power exhaust VFD overload function to match the factory-installed motor (motor size and efficiency). If the power exhaust fan motor is changed from the original factory selection, the overload value may need to be changed by the service person. Contact your local Carrier representative for assistance in determining the proper overload setting.

NOTE: Variable frequency drive size is matched to factory-installed motor size. Do not increase motor size without also changing to equivalent VFD size.

POWER EXHAUST VFD OPERATION — When troubleshooting the power exhaust VFD, check first that all required conditions for power exhaust VFD operation are satisfied.

For the power exhaust VFD to run, the following conditions must be met at the power exhaust VFD:

1. Drive enable jumper is installed from terminals ST-CC (factory supplied) (see Fig. 63).
2. Proper rotation jumper is installed at terminals R-CC (reverse rotation, factory supplied).
3. Emergency stop jumper is installed from terminals S4-CC (factory supplied).
4. A 4 to 20 mA signal is applied across terminals IV-P24 (from pressure transducer, factory supplied).
5. DIP switch SW1 (located on the VFD's printed circuit control panel) must be set to "I" (indicating usage of a 4 to 20 mA input signal at terminals "IV").
6. Speed Control (located on the VFD's keypad/display) set for "Remote" (press the "Speed Ctrl" button until LED "Remote" is illuminated).
7. Programmed according to Carrier defaults.
8. Building Pressure set point established by user, or use factory default (30 Hz indicating 0.0 in. wg) (see Table 33).

POWER EXHAUST VFD OPERATIONAL STATUS — The power exhaust VFDs contain extensive self-diagnostic functions which are accessed through the power exhaust VFD display panel (located on the front of the power exhaust VFD or at a remote location when the accessory remote display package has been installed.)

⚠ CAUTION

If using the VFD display panel, **disconnect all power to the unit and the VFD before entering unit**, or use the accessory remote display module. Disable supply fan and motor operation before accessing VFD-mounted display module.

When power is first supplied to the power exhaust VFD, the display automatically starts with the frequency monitor function of its standard monitor mode. In the frequency monitor function, the output frequency is displayed. Push the **S/P/M (Setup/Program/Monitor)** key to switch to the Mode Selection menu. Push the **S/P/M** key again to toggle the display back to the standard monitor mode.

From the Mode Selection menu, the service person can view all of the monitored status variables, including up to four user-selected variables and any trip history in the memory.

Refer to the separate VFD Operation Manual for detailed instructions on accessing diagnostic information, initiating troubleshooting, and clearing any trip history.

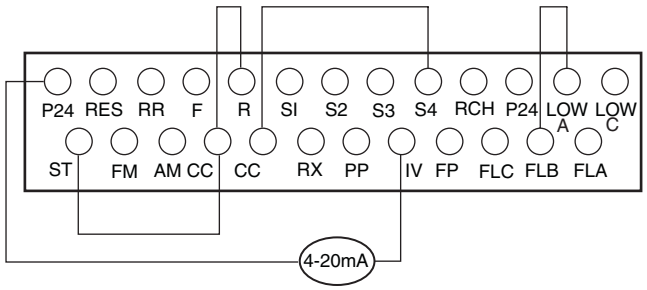


Fig. 63 — Power Exhaust Variable Frequency Drive Terminal Block

Table 55 — Carrier Power Exhaust VFD Default Program Parameter Values

PARAMETER GROUP	PARAMETER	DEFAULT VALUE
SEtP (Setup)	ACC1	60.0 Sec
	DEC1	60.0 Sec
	UL	60.0 Hz*
	LL	10.0 Hz*
	LuIn	1
	P3	20%
	F-P3	0.0 Hz
	P4	100%*
	F-P4	60 Hz
	tHr1	See Tables 57 and 58
	StC1	0
	StL1	110%
	OLN	1
	tYP	5*
Gr.F (Fundamental)	FH	60 Hz
	Pt	12
Gr.Fb (Feedback)	FbP1	1*
	Fbin	2
	GP	.30
	GI	2 sec
	GA	0
	GFS	80
	P1LL	10
	PuL	1
	PuUl	10
	PuLL	10
Gr.SF (Frequency Settings)	Fsor	60 Hz
Gr.Pn (Panel Control)	Fr	0*
Gr.St (Terminal Selection)	1t	1
	1t0	0
	1t1	56
	1t2	13
	1t3	3
	1t4	10
	Ot1	4*
	Ot2	2*
	Ot2d	5*
	Ot2H	100*
	LF	15*
Gr.Pr (Protection)	UuC	1*
	UuCt	2
	ArSt	3
Gr.Ut (Utility)	Cnod	1*
	Fnod	2*
	bLPn	1*

*These settings differ from the Toshiba defaults and are required for Carrier applications.

NOTE: To restore original factory settings, change tYP to 6 in SEtup mode (SEtP).
This restores the VFD original factory settings.

RESTORING FACTORY POWER EXHAUST VFD DEFAULTS — The original factory configuration values are saved in the memory of the power exhaust VFD and can be restored by the service person if required. There are two types of saved file data: Carrier-factory settings (factory programmed settings made to the power exhaust VFD which apply specifically to the unit it is installed on) and standard defaults for general Carrier unit use.

The Carrier-factory settings are maintained as user settings. These can be restored by entering the Setup mode (in the **S/P/M** menu) and setting parameter tYP = 6 on the keypad/display. This will recall the specific factory defaults for this unit.

Occasionally it may be necessary to restore the power exhaust VFD defaults to the general Carrier use values. These are stored in an OPTION ROM (read-only memory chip). However, some variables may need to be manually changed to match the specific unit's factory default settings. To recall the general Carrier defaults, enter the Setup mode and set parameter tYP = 3. Refer to Tables 56-58 for items requiring manual adjustment.

Table 56 — Power Exhaust VFD Required User Adjusted Defaults

UNIT	ITEM
ALL	Motor Overload Settings (See Table 57 and 58)
	Gr.St/Ot1 = 4
	Gr.St/Ot2 = 2
	Gr.St/Ot2d = 5
	Gr.St/Ot2H = 100
	Gr.St/LF = 15
	SEtP/UL = 60.0
	SEtP/P4 = 100
	SetP/LL = 10.0
	SetP/tYP = 5
	Gr. Fb/FbP1 = 1
	Gr. Pn/Fr = 0
	Gr. Pr/UuC = 1
	Gr. Ut/Cnod = 1
	Gr. Ut/Fnod = 2
	Gr. Ut/bLPn = 1

Table 57 — Power Exhaust Fan Motor Overload Setting (tHr1) — Sizes 030-070

MOTOR (hp)	HIGH EFFICIENCY				PREMIUM EFFICIENCY		
	PE Letter*	230V	460V	575V	PE Letter*	230V	460V
6	G†	98.4	75.08	84.04	Q†	98.4	75.08
10	H	96.6	97.3	90.9	R	96.6	97.3
15	J	78.3	100.0	100.0	S	78.3	100.0
20	K	87.3	100.0	95.1	T	87.3	100.0

*Outdoor Air Power Exhaust Option of the unit model number in the 16th Position.
†030-050 units only.

Table 58 — Power Exhaust Fan Motor Overload Setting (tHr1) — Sizes 075 to 105

MOTOR (hp)	HIGH EFFICIENCY			PREMIUM EFFICIENCY	
	PE Letter*	460V	575V	PE Letter*	460V
10	F	97.3	90.9	M	97.3
15	G	100.0	100.0	N	100.0
20	H	100.0	95.1	P	100.0
High-Capacity Power Exhaust (Size 75 to 105 ton)					
20	—	100.0	95.1	E	100.0
30	A	92.3	100.0	F	92.3
40	B	84.6	90.1	G	84.6
50	C	92.2	—	H	92.2
60	D	86.0	—	J	86.0
High-Capacity Power Exhaust with Plenum (Size 75 to 105 ton)					
20	Q	100.0	95.1	V	100.0
25	R	93.5	100.0	W	93.5
30	S	92.3	100.0	Z	92.3
40	T	84.6	90.1	Y	84.6

*Outdoor Air Power Exhaust Option of the unit model number in the 16th Position.

Return/Exhaust Fan Variable Frequency Drive (48ZR and 50ZR,ZS)

⚠ WARNING

Factory-installed optional VFD is located near the return/exhaust fan and motor. During any service work or programming at the VFD, operation of the fan and motor is not desirable. Either disable the return/exhaust fan or install an accessory VFD remote display. Physical injury could result.

NOTE: The RE VFD (part no. TOSVERT130-E3) is specially modified for use on Carrier equipment. Some specifications and control configuration defaults for Carrier applications will differ from the VFD manufacturer manual included in the packet. See Table 59 for listing of Carrier-specific default values.

TRANSDUCER CONTROL — The VFD monitors and controls the mixing box pressure at the filter section via a differential pressure transducer. The pressure transducer is located in the auxiliary control box. The pressure transducer's high-pressure reference port is connected to the outside of the unit cabinet. The pressure transducer's low-pressure reference port is connected to the pick-up sensor at the filter section. Both ports are factory-installed.

The mixing box pressure transducer (MBPT) monitors the static pressure in the mixing box and provides a 4 to 20 mA signal directly to the return/exhaust VFD. The internal logic of the RE VFD compares this signal representing actual mixing box pressure to the pressure set point. The RE VFD automatically adjusts its output to the power exhaust fan motor to maintain the desired set point.

The MBPT has a range of –0.5 to +0.5 in. wg. The output is a 4 to 20 mA signal, scaled to this range. The RE VFD translates the 4 to 20 mA signal to represent a frequency value over the control range of 0 to 60 Hz. See Table 31. The set point for the mixing box pressure control is established at the RE VFD keypad in terms of Hz. The factory default set point is 21 Hz, representing a mixing box pressure of –0.15 in. wg.

DETERMINE RE VFD SET POINT — The mixing box pressure set point will control the amount of outside air volume at a given minimum economizer damper position. By increasing the set point, there will be less outside air coming in from the economizer. Decreasing the set point will bring in more outside air. The factory default set point should meet most of the application needs, but it can be changed through the VFD keypad. To convert the desired MBP into the RE VFD set point, refer to Table 33. Locate the pressure value in the table closest to the desired MBP for the application and use the corresponding set point (Hz) value. If necessary, interpolation between duct static pressure values is permissible. The set point should always be lower than 30 Hz (0.0 in. wg).

ADJUST RE VFD SET POINT — To adjust the RE VFD set point, the RE VFD must be powered. Since it is located in the indoor section of the unit, use caution to ensure that the service access door is blocked open and will not close suddenly. Change RE VFD set point according to Table 32.

RETURN/EXHAUST FAN MOTOR OVERLOAD PROTECTION — The VFD provides operating overload protection for the supply fan motor. The factory has programmed the RE VFD overload function to match the factory-installed motor (motor size and efficiency). If the power exhaust fan motor is changed from the original factory selection, the overload value may need to be changed by the service person. Contact your local Carrier representative for assistance in determining the proper overload setting.

NOTE: Variable frequency drive size is matched to factory-installed motor size. Do not increase motor size without also changing to equivalent VFD size.

RETURN/EXHAUST VFD OPERATION — When troubleshooting the power exhaust VFD, check first that all required conditions for RE VFD operation are satisfied.

For the RE VFD to run, the following conditions must be met at the power exhaust VFD (see Fig. 64):

1. Drive enable jumper is installed from terminals ST-CC (factory supplied).
2. Proper rotation jumper is installed at terminals F-CC (forward rotation, factory installed).
3. Emergency stop jumper is installed from terminals S4-CC (factory installed).
4. A 4 to 20 mA signal is applied across terminals IV-P24 (from pressure transducer, factory supplied).
5. DIP switch SW1 (located on the VFD's printed circuit control panel) must be set to "I" (indicating usage of a 4 to 20 mA input signal at terminals "IV").
6. Speed Control (located on the VFD's keypad/display" set to "Remote" (press the "Speed Ctrl" button until LED "Remote" is illuminated).
7. Programmed according to Carrier defaults.
8. Mixing Box Pressure set point established by user, or use factory default (21 Hz indicating –0.15 in. wg).

RETURN/EXHAUST VFD OPERATIONAL STATUS — The RE VFDs contain extensive self-diagnostic functions which are accessed through the RE VFD display panel (located on the front of the RE VFD or at a remote location when the accessory remote display package has been installed).

⚠ CAUTION

If using the VFD display panel**, disconnect all power to the unit and the VFD before entering unit**, or use the accessory remote display module. Disable supply fan and motor operation before accessing VFD-mounted display module.

When power is first supplied to the return/exhaust fan VFD, the display automatically starts with the frequency monitor function of its standard monitor mode. In the frequency monitor function, the output frequency is displayed. Push the S/P/M **(Setup/Program/Monitor)** key to switch to the Mode Selection menu. Push the S/P/M key again to toggle the display back to the standard monitor mode.

From the Mode Selection menu, the service person can view all of the monitored status variables, including up to four user-selected variables and any trip history in the memory.

Refer to the separate VFD Operation Manual for detailed instructions on accessing diagnostic information, initiating troubleshooting and clearing any trip history.

RESTORING FACTORY RE VFD DEFAULTS — The original factory configuration values are saved in the memory of the RE VFD and can be restored by the service person if required. There are two types of saved file data: Carrier-factory settings (factory programmed settings made to the RE VFD which apply specifically to the unit it is installed on) and standard defaults for general Carrier unit use.

The Carrier-factory settings are maintained as user settings. These can be restored by entering the Setup mode (in the S/P/M menu) and setting parameter tYP=6 on the keypad/display. This will recall the specific factory defaults for this unit.

Occasionally it may be necessary to restore the RE VFD defaults to the general Carrier use values. These are stored in an OPTION ROM (read-only memory chip). However, some variables may need to be manually changed to match the specific unit's factory default settings. To recall the general Carrier defaults, enter the Setup mode and set parameter tYP=3. Refer to Tables 60 and 61 for items requiring manual adjustment.

Table 59 — Carrier Default Program Parameter Values (Return Fan VFD)

PARAMETER GROUP	PARAMETER	DEFAULT VALUE
SEtP (Setup)	ACC1	120.0 Sec*
	DEC1	120.0 Sec*
	UL	60.0 Hz
	LL	10.0 Hz*
	Luln	1
	P3	20%
	F-P3	0.0 Hz
	P4	100%
	F-P4	60 Hz
	tHr1	See Table 61
	StC1	0
	StL1	110%
	OLN	1
	tYP	5*
Gr.F (Fundamental)	FH	60 Hz*
	Pt	2
Gr.Fb (Feedback)	FbP1	1*
	Fbln	2
	GP	.30
	GI	2 sec
	GA	0
	GFS	80
	P1LL	5*
	PuL	1
	PuUl	10
	PuLL	10
Gr.St (Terminal Selection)	1t	1
	1t0	0
	1t1	56
	1t2	13
	1t3	3
	1t4	10
Gr.Pr (Protection)	UuC	1*
	UuCt	2
	ArSt	3
Gr.Ut (Utility)	Cnod	1*
	bLSF	1*
	Fnod	2*
	bLPn	1*

*These settings differ from the Toshiba defaults and are required for Carrier applications.

NOTE: To restore original factory settings, change tYP to 6 in Setup mode (SEtP). This restores the VFD original factory settings.

Table 60 — Return/Exhaust Fan VFD Required User Adjusted Defaults

UNIT	ITEM
	Motor Overload Settings (see Table 61)
48/50ZR,ZS075-105 Units	1. Check jumper CC-F 2. Gr. UT/bLSF = 1 3. SetP/tYP = 5 (Save User Settings) 4. SetP/ACC1 = 120.0 5. SetP/DEC1 = 120.0 6. SetP/LL = 10.0 7. Gr. F/FH = 60 8. Gr. Fb/FbP1 = 1 9. Gr. Fb/P1LL = 5 10. Gr. Pr/UuC = 1 11. Gr. Ut/Cnod = 1 12. Gr. Ut/Fnod = 2 13. Gr. Ut/bLPn = 1

Table 61 — Return/Exhaust Fan Motor Overload Settings

UNIT 48/50	UNIT VOLTAGE DESIGNATION Model No. Position 12		MOTOR HP DESIGNATION Model No. Position 16	tHr1 SETTING
ZR,ZS	6	and	Q,V	98.0
	6	and	R,W	87.0
	6	and	S,X	82.0
	6	and	T,Y	85.0

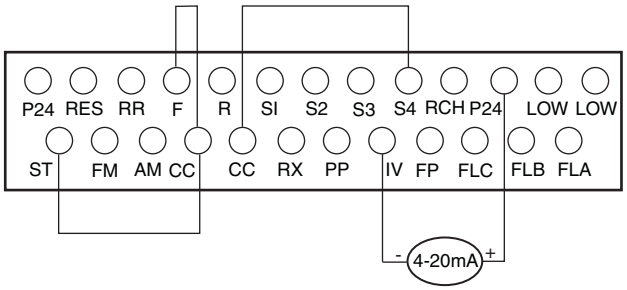


Fig. 64 — Return Fan Variable Frequency Drive Terminal Block

RETURN/EXHAUST FAN PLENUM PRESSURE SAFETY SWITCH (48ZR AND 50ZR,ZS) — The return/exhaust fan Plenum Pressure Safety Switch (PPSS) is used to control the plenum pressure where the return/exhaust fan is at. The PPSS is located at the return end of the unit in auxiliary control box and can be accessed by opening the access door. The high-pressure reference port of the PPSS is connected to a static pressure pick-up tube located in the return/exhaust fan plenum. The low-pressure port of the PPSS is connected to the outside of the unit cabinet. Both ports tubing are factory-installed.

The PPSS has a factory-set point of 5 in. wg. The PPSS monitors the static pressure in the plenum section and compares it to the set point. If the plenum pressure goes higher than the set point, the pressure switch will trip off and disconnect the power supply to the power exhaust contactor (PEC) and the return exhaust fan will be shut off. After the pressure drops below the set point, the PPSS can be reset by pressing the reset button on the back of the switch. See Fig. 65.

During normal operation, the return/exhaust fan plenum pressure will never go higher than the set point. If the economizer is open and the building pressure stays low, the power exhaust damper will not open and the plenum pressure could go higher than the set point, which would trigger the PPSS to trip off. Always check if the power exhaust damper and the building pressure switch work properly before reset the switch.

⚠ WARNING

The economizer is located near the return/exhaust fan and motor. During any service work, operation of the fan and motor is not desirable. Always disable the supply fan and the return/exhaust fan before starting the service work.

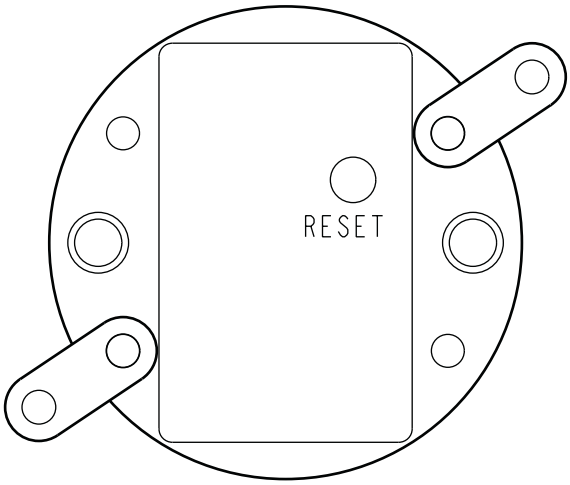


Fig. 65 — Return/Exhaust Fan Plenum Pressure Safety Switch

If the PPSS trips off very often due to the above reason, the economizer linkage setup can be changed. The economizer linkage can be accessed from the filter section doors on both sides of the unit. As shown in Fig. 66, make sure the economizer damper is 100% open (outside air damper is fully open and return air damper is fully closed). Loosen the linkage adjusting screws on both damper assemblies and open up the return air damper about 15 degrees, and re-tighten the adjusting screws. In this way, the return damper on the economizer will never go fully closed, so the plenum pressure will stay under the PPSS set point. If the trip-off problem persists, continue to open up the linkage. The linkage adjustment should not exceed 30 degrees.

Unit Wiring — A typical wiring schematic is shown in Fig. 67.

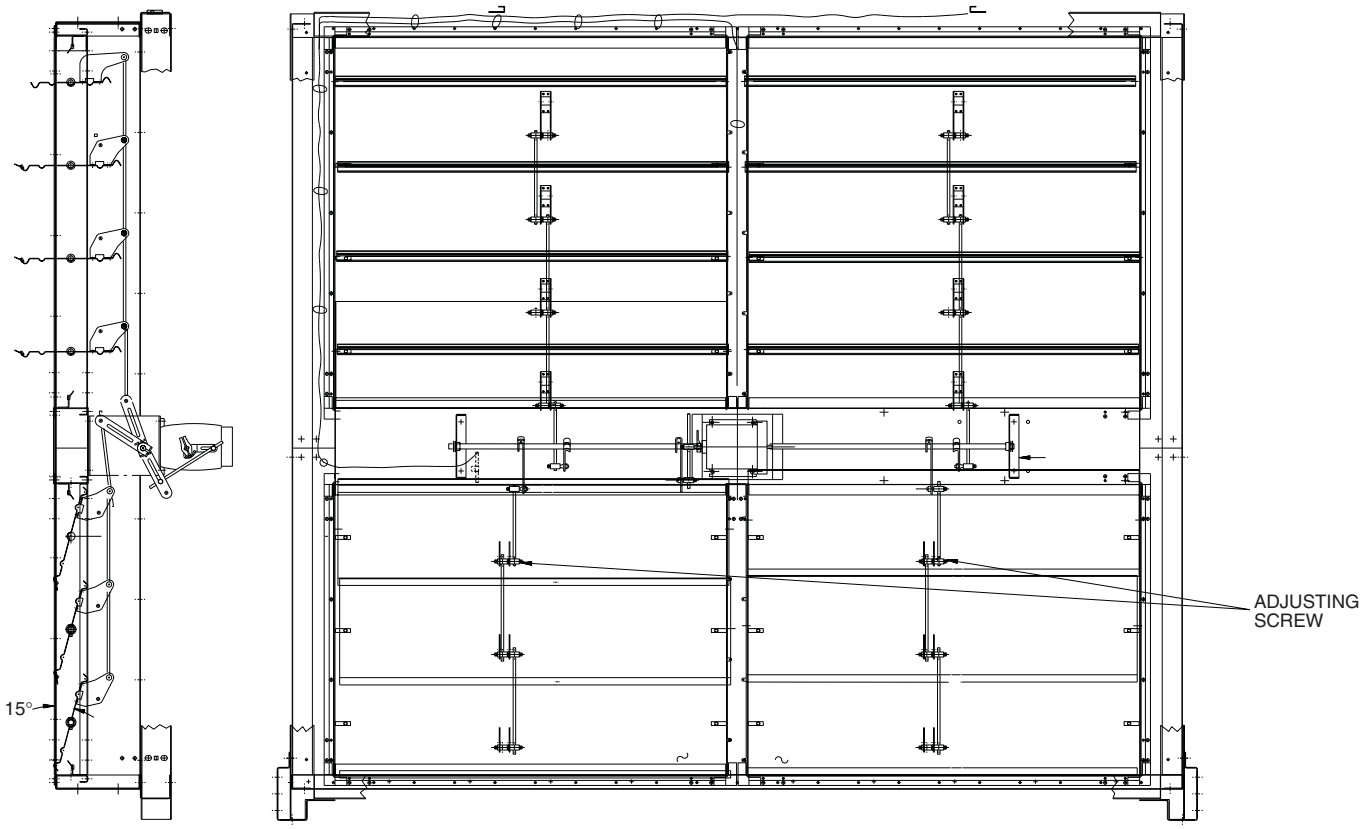


Fig. 66 — Economizer Linkage Adjustment

LEGEND AND NOTES FOR FIG. 67

ALM — Alarm
C — Contactor
CB — Circuit Breaker
CCB — Control Circuit Breaker
COMP — Compressor
CH — Crankcase Heater
CR — Control Relay
DMS — Damper Motor Switch
DPS — Differential Pressure Switch
DPT — Discharge Pressure Transducer
EAT — Entering-Air Temperature
EC — Enthalpy Control
ECR — Economizer Close Relay
EOR — Economizer Open Relay
EQUIP — Equipment
FS — Fan Status Switch
GND — Ground
GR — Gas Relay
HIR — Heat Interlock Relay
HPS — High-Pressure Switch
HT — Heater Thermistor
HTR — Heater
IDC — Induced Draft Contactor
IDM — Induced Draft Motor
IFC — Indoor (Evaporator) Fan Contactor
IFCB — Indoor Fan Circuit Breaker
IFM — Indoor Fan Motor
IGVM — Inlet Guide Vanes Motor
LAT — Leaving-Air Temperature
LS — Limit Switch
MTR — Motor
NC — Normally Closed
NO — Normally Open
OFC — Outdoor Fan Contactor
OFM — Outdoor (Condenser) Fan Motor
OMR — Outdoor Motor Relay
PCB — Power Exhaust Circuit Breaker
PEC — Power Exhaust Contactor
PEDM — Power Exhaust Damper Motor
PEM — Power Exhaust Motor
P, PL — Plug
RCB — Return Fan Circuit Breaker
RES — Resistor
RFC — Return Fan Contactror
RFDM — Return Fan Damper Motor
RFM — Return Fan Motor
SCT — Saturated Condensing Thermistor
TB — Terminal Block
TRAN — Transformer
U — Unloader
VFD — Variable Frequency Drive
– – – – Field Wiring
——— Factory Wiring

NOTES:
1. Connect TRAN1 to ⟨H4⟩ for 460 v units. Connect to ⟨H3⟩ for 230 v units. If 208/230 v units are run with a 208 v power supply connect to ⟨H2⟩.
2. Connect TRAN2 to BLK lead for 460 v units. Connect to ORN lead for 230 v units. If 208/230 v units are run with a 208 v power supply connect to RED lead.
3. Circuit breaker must trip amps are equal to or less than 156% FLA (full load amps) for CB1 and CB2. All others are 140%.
4. If any of the original wire furnished must be replaced, it must be replaced with type 90° C wire or its equivalent.
5. Number(s) indicates the line location of contacts. A bracket over (2) numbers signifies single pole double throw contacts. An underlined number signifies a normally closed contact. Plain numbers (no lines), signify a normally opened contact.
6. Condenser fan motors are thermally protected.
7. Three phase motors are protected under primary single phasing conditions.

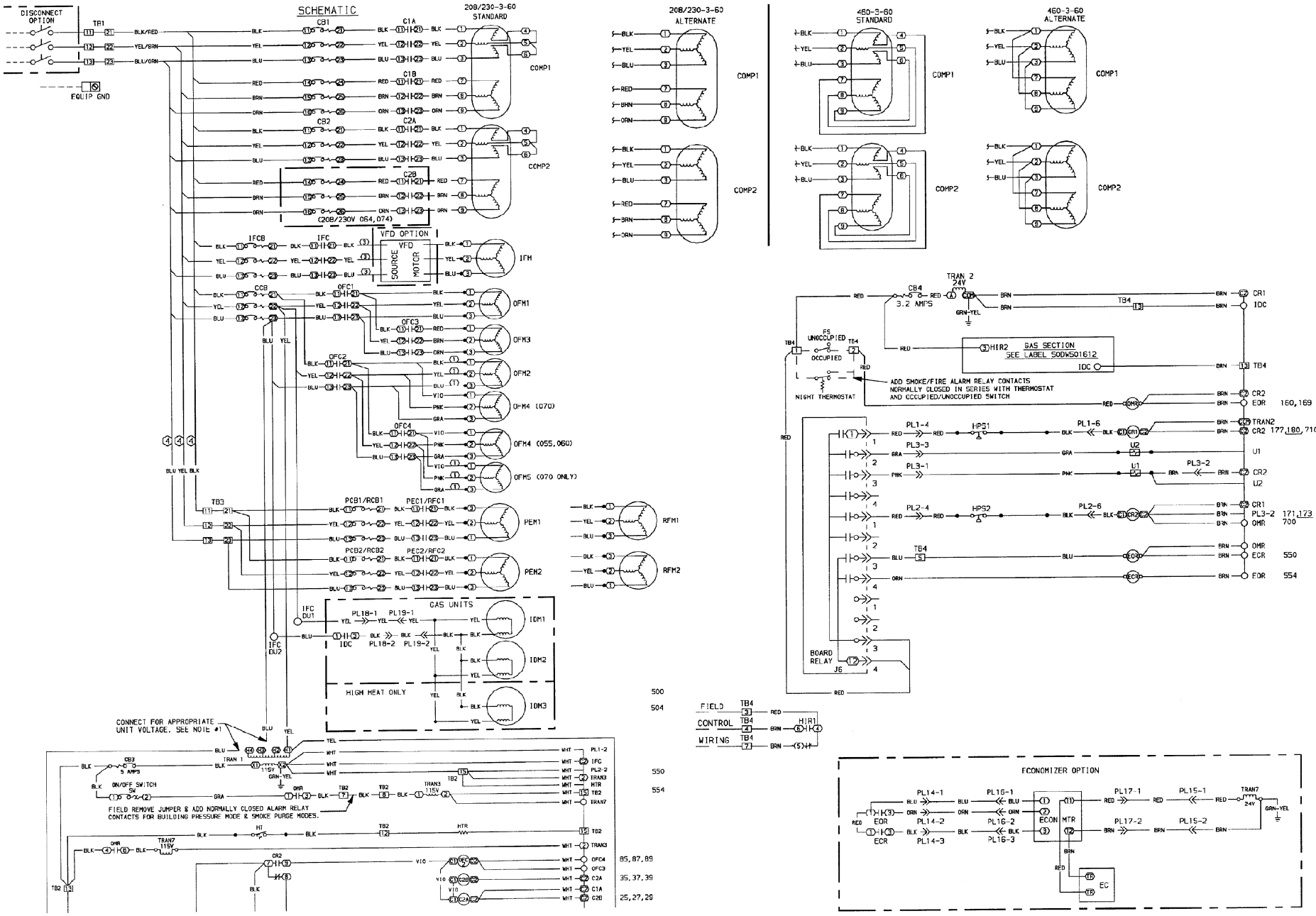


Fig. 67 — Typical Wiring Schematic; 48ZE and 50ZE,ZF Units (055-070 Shown)

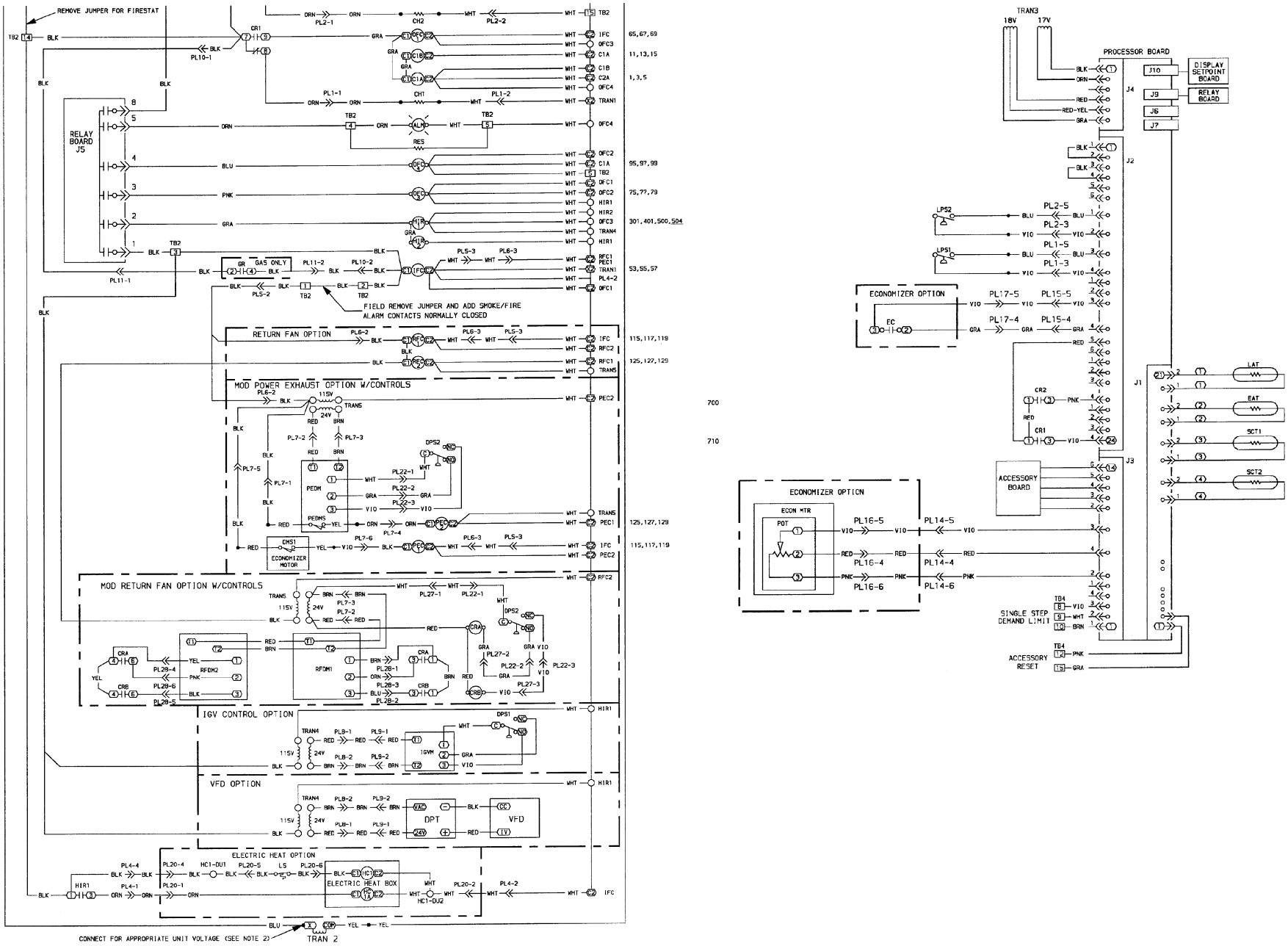


Fig. 67 — Typical Wiring Schematic; 48ZE and 50ZE,ZF Units (055-070 Shown) (cont)

APPENDIX A — CARRIER COMFORT NETWORK TABLES FOR STAGED GAS CONTROLLER

CONFIGURATION

DESCRIPTION	STATUS	DEFAULT	UNITS	POINT
Setpoint Select	0=SetpointAdjust 1=Single Setpoint 2=Dual 7 Day 3=Dual CCN	0	None	SETPTSEL
Heat Stage Type	0=2 stages 1=5 stages 2=7 stages 3=9 stages 4=11 stages	0	None	HTSTGTYP
Max Cap Change per Cycle	5-30	45	%	CAPMXSTG
PID Algorithm Rate	60-300	90	sec	HEATPIDR
Proportional Gain	0.5-1.5	1		P_GAIN
Derivative Gain	0.5-1.5	1		D_GAIN
Abs. Min Rate for Deadbnd	0-5	0.5	%	MINRT_DB
Upper Temp. Deadbnd Limit	0-5	2	dF	UPPER_DB
Lower Temp. Deadbnd Limit	–5-0	–2	dF	LOWER_DB
Limit Switch Monitoring	YES/NO	YES	None	LIMTMON1
Limit Switch High Temp	110-180	170	dF	LIMTHIHT
Limit Switch Low Temp	100-170	160	dF	LIMTLOHT
SAT Limit Config	0-20	10	dF	LIMT_SAT
Heat Rise dF/sec clamp	0.05-0.2	0.06	dF/sec	HEATRISE

DISPLAY (NAVIGATOR SETUP)

DESCRIPTION	STATUS	DEFAULT	UNITS	POINT
Display Password	Nnnn	1111		PASSWORD
Password Enable	enable/disable	enable		PASS_EBL
Metric Display	Off/On	Off		DISPUNIT
Language	0=ENGLISH 1=FRANCAIS 2=ESPANOL 3=PORTUGUES	0		LANGUAGE

SCHEDOVR (TIMED OVERRIDE SETUP)

DESCRIPTION	STATUS	DEFAULT	UNITS	POINT
Schedule Number	0-99	0		SCHEDNUM
Override Time Limit	0-4	0	hours	OTL
Timed Override Hours	0-4	0	hours	OVR_EXT
Time Override	YES/NO	NO		TIMEOVER

7 DAY_OCC (7 Day Occupancy)

DESCRIPTION	STATUS	DEFAULT	UNITS	POINT
Monday Occupied	0-24:00	0		MON_OCC
Monday Unoccupied	0-24:00	0		MON_UNC
Tuesday Occupied	0-24:00	0		TUE_OCC
Tuesday Unoccupied	0-24:00	0		TUE_UNC
Wednesday Occupied	0-24:00	0		WED_OCC
Wednesday Unoccupied	0-24:00	0		WED_UNC
Thursday Occupied	0-24:00	0		THU_OCC
Thursday Unoccupied	0-24:00	0		THU_UNC
Friday Occupied	0-24:00	0		FRI_OCC
Friday Unoccupied	0-24:00	0		FRI_UNC
Saturday Occupied	0-24:00	0		SAT_OCC
Saturday Unoccupied	0-24:00	0		SAT_UNC
Sunday Occupied	0-24:00	0		SUN_OCC
Sunday Unoccupied	0-24:00	0		SUN_UNC

NOTE: The time is set and displayed in military time.

HOLIDAY (30 Holidays….01S-30S)

DESCRIPTION	STATUS	DEFAULT	UNITS	POINT
Holiday Start Month	0-12	0		HOL-MON
Start Day	0-31	0		HOL-DAY
Duration (days)	0-99	0		HOL-LEN

ALARMDEF (Alarm Definition Table)

DESCRIPTION	STATUS	DEFAULT	UNITS	POINT
Alarm Routing Control	00000000	000000000		ALRM_CNT
Equipment Priority	0 to 7	5		EQP_TYPE
Comm Failure Retry Time	1 to 240	30	min	RETRY_TM
Re-alarm Time	1 to 225	30	min	RE-ALARM
Alarm System Name	XXXXXXXX	STAGEGAS		ALRM_NAM

BRODEFS (Broadcast POC Definition Table)

DESCRIPTION	STATUS	DEFAULT	UNITS	POINT
CCN Time/Date Broadcast	Yes/No	No		CCNBC
CCN OAT Broadcast	Yes/No	No		OATBC
Global Schedule Broadcast	Yes/No	No		GSBC
CCN Broadcast Acknowledger	Yes/No	No		CCNBCACK
Daylight Savings Start				
Month	1 to 12	4		STARTM
Week	1 to 5	1		SATARTW
Day	1 to 7	7		STARTD
Minutes to add	0 to 99	60	min	MINADD
Daylight Savings Stop				
Month	1 to 12	10		STOPM
Week	1 to 5	5		STOPW
Day	1 to 7	7		STOPD
Minutes to subtract	0 to 99	60	min	MINSUB

SETPOINT

DESCRIPTION	STATUS	DEFAULT	UNITS	POINT
Cooling Setpoint 1	35-70	45.0	dF	COOLSP1
Cooling Setpoint 2	35-70	47.0	dF	COOLSP2
Heating Setpoint 1	80-125	102.5	dF	HEATSP1
Heating Setpoint 2	80-125	100.5	dF	HEATSP2

VERSIONS

DESCRIPTION	VERSION NUMBER	STATUS
MBB	CESR131274-	XX-YY*
MARQUEE	CESR131171-	XX-YY
NAVIGATOR	CESR130227-	XX-YY

*XX=major revision field; YY=minor revision field.

STAGEMON

DESCRIPTION	STATUS	UNITS	POINT
Internal Calculated Cap	0-100	%	CAP_CALC
Current Running Capacity	0-100	%	CAPACITY
Proportional Cap. Change	0-CAPMXSTG	%	P
Derivative Cap. Change	0-CAPMXSTG	%	D
PID Timer in Seconds	0-300	sec	RATETIMR
Current Heat Stage	0-HTMAXSTG		HT_STAGE
Control Setpoint	~30-~125	dF	SETP
Supply Air Temperature	–40-240	dF	SAT
Limit Switch Temperature	–40-240	dF	LIMTTEMP
Hi Limit Switch Tmp Mode	On/Off		LIMTMODE
SAT Cutoff Mode	On/Off		SATCMODE
Capacity Clamp Mode	On/Off		CAPMODE

ALARMS

DESCRIPTION	STATUS	UNITS	POINT
Active Alarm #1	Axxx*		ALARM01C
Active Alarm #2	Axxx		ALARM02C
Active Alarm #3	Axxx		ALARM03C
Active Alarm #4	Axxx		ALARM04C
Active Alarm #5	Axxx		ALARM05C
Active Alarm #6	Axxx		ALARM06C
Active Alarm #7	Axxx		ALARM07C
Active Alarm #8	Axxx		ALARM08C
Active Alarm #9	Axxx		ALARM09C
Active Alarm #10	Axxx		ALARM10C
Active Alarm #11	Axxx		ALARM11C
Active Alarm #12	Axxx		ALARM12C
Active Alarm #13	Axxx		ALARM13C
Active Alarm #14	Axxx		ALARM14C
Active Alarm #15	Axxx		ALARM15C
Active Alarm #16	Axxx		ALARM16C
Active Alarm #17	Axxx		ALARM17C
Active Alarm #18	Axxx		ALARM18C
Active Alarm #19	Axxx		ALARM19C
Active Alarm #20	Axxx		ALARM20C
Active Alarm #21	Axxx		ALARM21C
Active Alarm #22	Axxx		ALARM22C
Active Alarm #23	Axxx		ALARM23C
Active Alarm #24	Axxx		ALARM24C
Active Alarm #25	Axxx		ALARM25C

*Alarms preceded with A, Alerts preceded with T.

NOTE: This table is for display only.

OCCDEFM

DESCRIPTION	STATUS	UNITS	POINT
Current Mode (1=Occup.)	N	none	MODE
Current Occup. Period #	Nn	none	PER-NO
Timed Override in Effect	YES/NO	none	OVERLAST
Timed Override Duration	Nn	none	OVR_HRS
Current Occupied Time	HH:MM	none	STRTIME
Current Unoccupied Time	HH:MM	none	ENDTIME
Next Occupied Day	DOW	none	NXTOCDAY
Next Occupied Time	HH:MM	none	NXTOCTIM
Next Unoccupied Day	DOW	none	NXTUNDAY
Next Unoccupied Time	HH:MM	none	NXTUNTIM
Previous Unoccupied Day	DOW	none	PRVUNDAY
Previous Unoccupied Time	HH:MM	none	PRVUNTIM

TESTMODE

DESCRIPTION	STATUS	POINT	FORCIBLE
Service test	Yes/No	SERVTEST	Y
Heat Output #1	On/Off	HEATTST1	Y
Heat Output #2	On/Off	HEATTST2	Y
Heat Output #3	On/Off	HEATTST3	Y
Heat Output #4	On/Off	HEATTST4	Y
Heat Output #5	On/Off	HEATTST5	Y
Heat Output #6	On/Off	HEATTST6	Y

HEATOUTS

DESCRIPTION	STATUS	POINT	FORCIBLE
Heat Output 1	On/Off	HEATOUT1	N
Heat Output 2	On/Off	HEATOUT2	N
Heat Output 3	On/Off	HEATOUT3	N
Heat Output 4	On/Off	HEATOUT4	N
Heat Output 5	On/Off	HEATOUT5	N
Heat Output 6	On/Off	HEATOUT6	N

INPUTS

DESCRIPTION	STATUS	POINT	FORCIBLE
Cool Input #1	On/Off	COOL_IN1	N
Cool Input #2	On/Off	COOL_IN2	N
Supply Fan Status	On/Off	SFANSTAT	N
Heat Input #1	On/Off	HEAT_IN1	N
Heat Input #2	On/Off	HEAT_IN2	N
Dehumidify Input	On/Off	DEHUMID	N

SATTEMPS

DESCRIPTION	STATUS	POINT	FORCIBLE
Supply Air Temperature	–40-240dF	SAT	N
Supply Air Temperature 1	–40-240dF	SAT1	N
Supply Air Temperature 2	–40-240dF	SAT2	N
Supply Air Temperature 3	–40-240dF	SAT3	N

GAS_DISP

DESCRIPTION	STATUS	POINT	FORCIBLE
Control Mode	No Mode Heat Mode #1 Heat Mode #2 Cool Mode Test Mode	MODE	N
Control Setpoint	~35-125dF	SETP	N
Supply Air Temperature	–40-240dF	SAT	N
Current Running Capacity	0-100%	CAPACITY	N
Current Heat Stage	0-max allowed	HT_STAGE	N
Maximum Heat Stages	2-max allowed	HTMAXSTG	N
Cooling Setpoint	~35-70dF	COOLSETP	N
Heating Setpoint	~80-125dF	HEATSETP	N
Limit Switch Temperature	~40-240dF	LIMTTEMP	N
Hi Limit Switch Tmp Mode	On/Off	LIMTMODE	N
SAT Cutoff Mode	On/Off	SATCMODE	N
Capacity Clamp Mode	On/Off	CAPMODE	N
Occupied	On/Off	OCC	Y
Emergency Stop	Enable/Emstop	EMSTOP	Y

TIME SCHEDULE CONFIG.

PERIOD	DAY FLAGS	OCCUPIED TIME	UNOCCUPIED TIME
	MTWTFSSH	00:00-23:59	00:00-23:59
Period 1:	00000000	0000	0000
Period 2:	00000000	0000	0000
Period 3:	00000000	0000	0000
Period 4:	00000000	0000	0000
Period 5:	00000000	0000	0000
Period 6:	00000000	0000	0000
Period 7:	00000000	0000	0000
Period 8:	00000000	0000	0000

NOTE: Time is set and displayed in military time.

SERVICE TRAINING

Packaged Service Training programs are an excellent way to increase your knowledge of the equipment discussed in this manual, including:

- Unit Familiarization
- Maintenance
- Installation Overview
- Operating Sequence

A large selection of product, theory, and skills programs are available, using popular video-based formats and materials. All include video and/or slides, plus companion book.

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START-UP CHECKLIST

MODEL NO.: _____ SERIAL NO.: _____

DATE: _____ TECHNICIAN:_____

I. PRE-START-UP:

- ☐ VERIFY THAT UNIT IS LEVEL
- ☐ VERIFY THAT ALL PACKING MATERIALS HAVE BEEN REMOVED FROM UNIT
- ☐ LOOSEN ALL SHIPPING HOLDDOWN BOLTS AND REMOVE SHIPPING BRACKETS PER INSTRUCTIONS
- ☐ VERIFY THAT COMPRESSOR SUSPENSION SPRINGS HAVE BEEN LOOSENED PER INSTRUCTIONS
- ☐ VERIFY OPENING OF ECONOMIZER HOODS
- ☐ VERIFY INSTALLATION OF EXHAUST HOODS
- ☐ CONFIRM THAT TUBING FOR SPACE AND SUPPLY DUCT PRESSURES HAS BEEN INSTALLED
- ☐ VERIFY THAT CONDENSATE CONNECTION IS INSTALLED PER INSTRUCTIONS
- ☐ VERIFY THAT POWER SUPPLY MATCHES UNIT DATA PLATE
- ☐ VERIFY THAT ALL ELECTRICAL CONNECTIONS AND TERMINALS ARE TIGHT
- ☐ CHECK GAS PIPING FOR LEAKS (48ZE,ZR,ZV ONLY)
- ☐ CHECK THAT INDOOR-AIR FILTERS ARE CLEAN AND IN PLACE
- ☐ CHECK FAN WHEEL AND PROPELLER FOR LOCATION IN HOUSING/ORIFICE, AND VERIFY SET SCREWS ARE TIGHT
- ☐ VERIFY THAT FAN SHEAVES ARE ALIGNED AND BELTS ARE PROPERLY TENSIONED
- ☐ OPEN SUCTION, DISCHARGE, AND LIQUID LINE SERVICE VALVES
- ☐ CHECK COMPRESSOR OIL LEVEL SIGHT GLASS AND VERIFY PROPER LEVEL
- ☐ VERIFY THAT CRANKCASE HEATERS HAVE BEEN ENERGIZED FOR 24 HOURS
- ☐ CHECK VOLTAGE IMBALANCE

  LINE-TO-LINE VOLTS: AB _____ V AC _____ V BC _____ V

  (AB + AC + BC)/3 = AVERAGE VOLTAGE = _____ V

  MAXIMUM DEVIATION FROM AVERAGE VOLTAGE = _____ V

  VOLTAGE IMBALANCE = 100 X (MAX DEVIATION)/(AVERAGE VOLTAGE) = _____ %

  IF OVER 2% VOLTAGE IMBALANCE, DO NOT ATTEMPT TO START SYSTEM!
  CALL LOCAL POWER COMPANY FOR ASSISTANCE.

II. PRELIMINARY CHECKLIST ITEMS:

CONTROL SETTINGS

- ☐ DIP SWITCHES SET TO MATCH INSTALLED ACCESSORIES:
  - SUPPLY AIR SET POINT RESET (DIP SWITCH NO. 4 ON)
  - MORNING WARM-UP (DIP SWITCH NO. 4 ON)
  - DEMAND LIMIT (DIP SWITCH NO. 5 ON)
- ☐ SUPPLY AIR SET POINT (P1) SET BETWEEN 45 AND 70 F
- ☐ ECONOMIZER MINIMUM POSITION (P5) SET PER PLANS
- ☐ SUPPLY AIR SET POINT RESET SETTINGS:
  - RESET INITIATION TEMPERATURE (P7) (TYPICALLY 68 TO 72 F)
  - RESET LIMIT TEMPERATURE (P3) (TYPICALLY 60 TO 70 F)
- ☐ MORNING WARM-UP TEMPERATURE (TYPICALLY 50 TO 65 F)
- ☐ IGV/VFD DUCT PRESSURE SET POINT PER PLANS
- ☐ BUILDING PRESSURE (MODULATING POWER EXHAUST) SET PER PLANS
- ☐ DEMAND LIMIT SETTINGS PER PLAN:
  - SINGLE STEP DEMAND LIMIT (P4) SET (TYPICALLY 25 TO 50%)
  - TWO-STEP DEMAND LIMIT
    - DLCM-P1 SET (TYPICALLY 50 TO 75%)
    - DLCM-P2 SET (TYPICALLY 0 TO 25%)
- ☐ OCCUPIED/UNOCCUPIED SWITCH INSTALLED PER FIG. 27 (CLOSE TO START UNIT)

III. START-UP

CHECK EVAPORATOR FAN SPEED AND RECORD. _____

CHECK CONDENSER FAN SPEED AND RECORD. _____

AFTER AT LEAST 10 MINUTES RUNNING TIME, RECORD THE FOLLOWING MEASUREMENTS:

	COMP A1	COMP A2	COMP B1	COMP B2
OIL PRESSURE				
SUCTION PRESSURE				
SUCTION LINE TEMP				
DISCHARGE PRESSURE				
DISCHARGE LINE TEMP				
ENTERING CONDENSER AIR TEMP				
LEAVING CONDENSER AIR TEMP				
EVAP ENTERING AIR DB TEMP				
EVAP ENTERING AIR WB TEMP				
EVAP LEAVING AIR DB TEMP				
EVAP LEAVING AIR WB TEMP				
COMPRESSOR AMPS (L1)				
COMPRESSOR AMPS (L2)				
COMPRESSOR AMPS (L3)				

ELECTRICAL

SUPPLY FAN AMPS _____ EXHAUST FAN AMPS _____

ELECTRIC HEAT AMPS L1 _____ L2 _____ L3 _____ (50 SERIES UNITS ONLY)

TEMPERATURES

OUTDOOR-AIR TEMPERATURE _____ F DB (Dry-Bulb)

RETURN-AIR TEMPERATURE _____ F DB _____ F WB (Wet-Bulb)

COOLING SUPPLY AIR _____ F

PRESSURES

GAS INLET PRESSURE _____ IN. WG (48 SERIES UNITS ONLY)

GAS MANIFOLD PRESSURE STAGE NO. 1 _____ IN. WG STAGE NO. 2 _____ IN. WG (48 SERIES UNITS ONLY)

REFRIGERANT SUCTION CIRCUIT NO. 1 _____ PSIG CIRCUIT NO. 2 _____ PSIG

REFRIGERANT DISCHARGE CIRCUIT NO. 1 _____ PSIG CIRCUIT NO. 2 _____ PSIG

☐ VERIFY REFRIGERANT CHARGE USING CHARGING CHARTS IN UNIT INSTALLATION INSTRUCTIONS

GENERAL

☐ ECONOMIZER MINIMUM VENT SETTING TO JOB REQUIREMENTS

NOTES

CUT ALONG DOTTED LINE

CUT ALONG DOTTED LINE