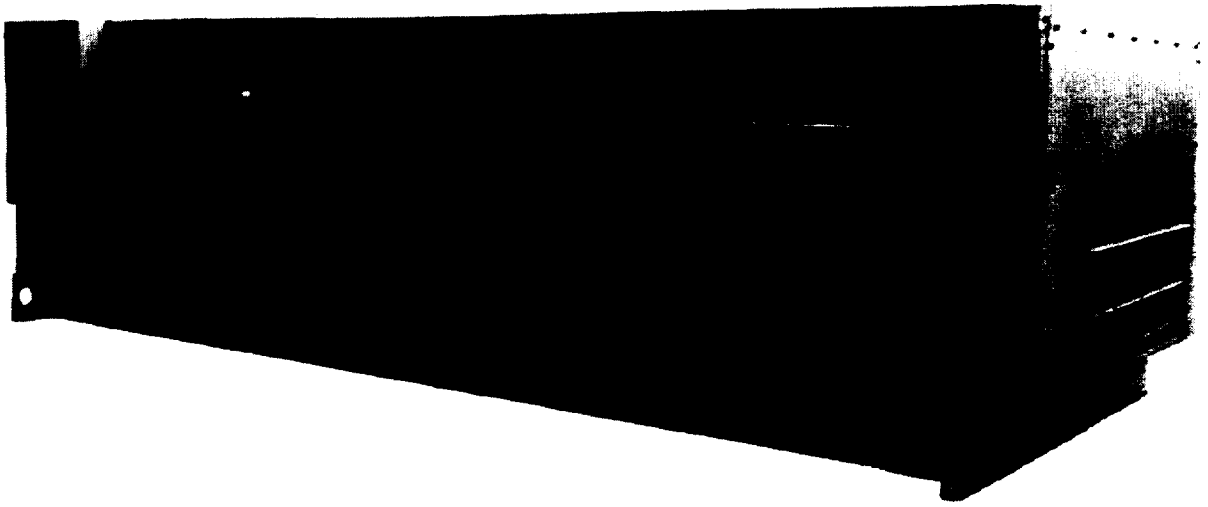
CLCH-IOP-1

TRANE

Installation/Operation/Programming for Modular and Penthouse Climate Changers

June 1992

PCM Based Direct Digital Control Systems For Modular and Penthouse Climate Changers



CLCH-IOP-1

Installation, Operation, and Programming Guide

PCM Based
Direct Digital Control Systems for
Modular and Penthouse Climate Changers

- Table of Contents -

Library	Service Literature
Product Section	Air Handling
Product	Modular Climate Changer
Model	CLCH
Literature Type	Installation/Operation/Programming
Sequence	1
Date	June 1992
File No.	PL-AH-CLCH-000-CLCH-IOP-1
Supersedes	(NEW)

- Specifications -

Power Requirements

The AHU DDC system requires 120V to the auxiliary control panel and a dedicated 20A circuit is recommended, refer to the "Wiring" section. The system is factory wired and includes 24 VAC control power transformers for all factory provided end devices.

Operating Environment

32° to 120° F - Standard Ambient
-40° to 158° F - Extended Ambient
5 to 95% relative humidity, non-condensing

Dimensions (PCM Circuit Board)

Height: 10"
Width: 13"
Depth: 2-1/4"

Communication Link Wiring

Communication link wiring must be 18 AWG twisted, shielded pair wire (BASD Part Number 400-20-28-F for plenum or Q-4166 for non-plenum) The maximum length is based on the capacitance between conductors and on the wire routing configuration. Refer to the "Wiring" section.

Unit Wiring

Use 22 AWG, teflon coated, plenum cable from the PCM or terminal strip to unit mounted end devices.

Analog Inputs

-30° to 220° F temperature sensor
4 to 20 mA, 200 ohm input impedance
0 to 10 VDC, 23,000 ohm imput impedance

Binary Inputs

Voltage provided: 12 VDC
Current provided: 12 mA (minimum)

Binary Outputs

24 VAC/VDC, 1 Amp, 24 VA Pilot Duty Relays
(gold plated contacts)

Analog Outputs

0 to 20 mA into a 500 ohm or lower impedance
0 to 10 VDC into a 500 ohm or greater load impedance

RS-232 Interface

1200 baud RS-232 interface to IBM Personal Computer (PC) with PCM Edit Software.

Typical System Architectures

Figure 1-1
Modular Climate Changers with Tracer (ICS)

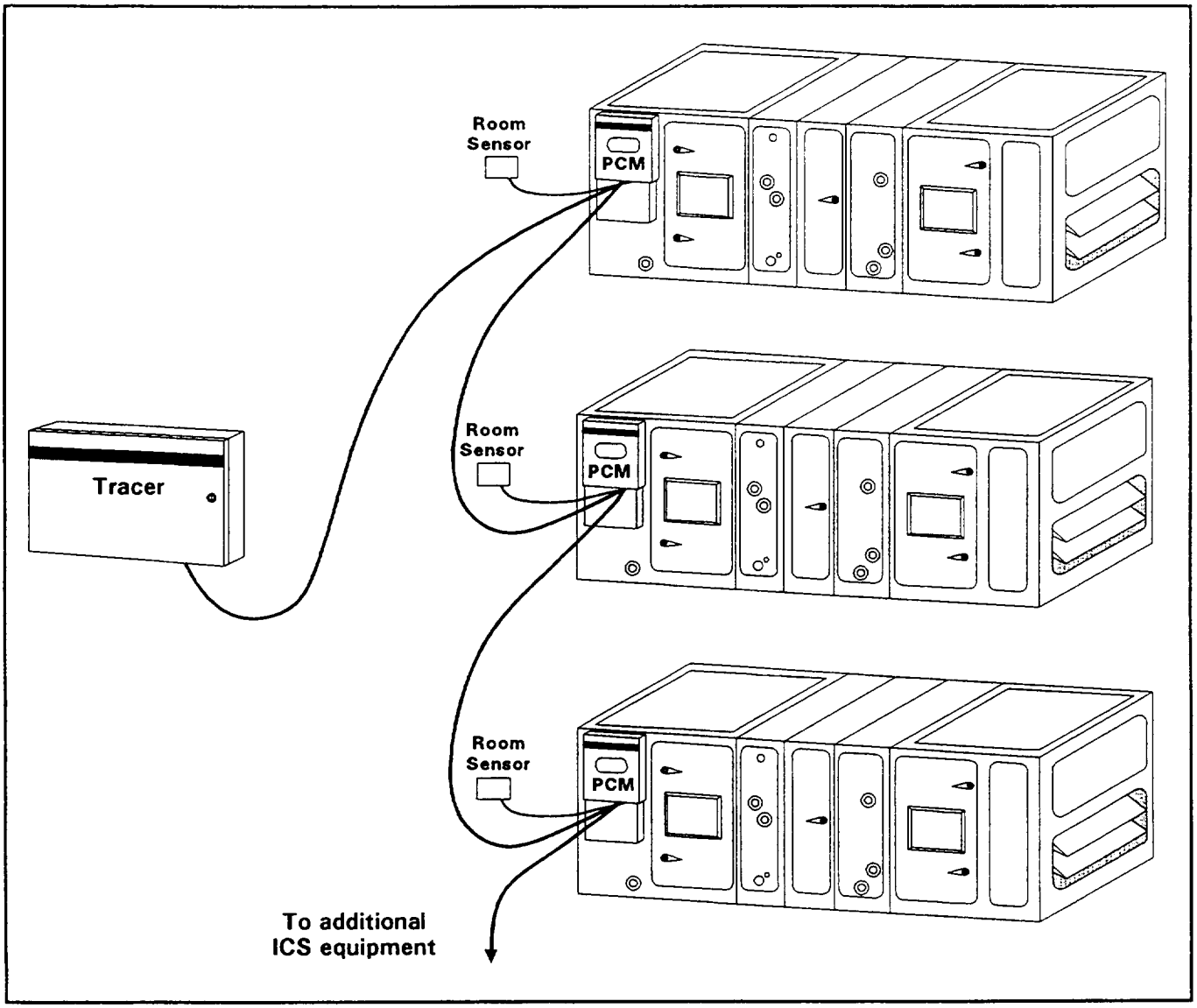


Figure 1-2
Stand-alone Modular Climate Changer

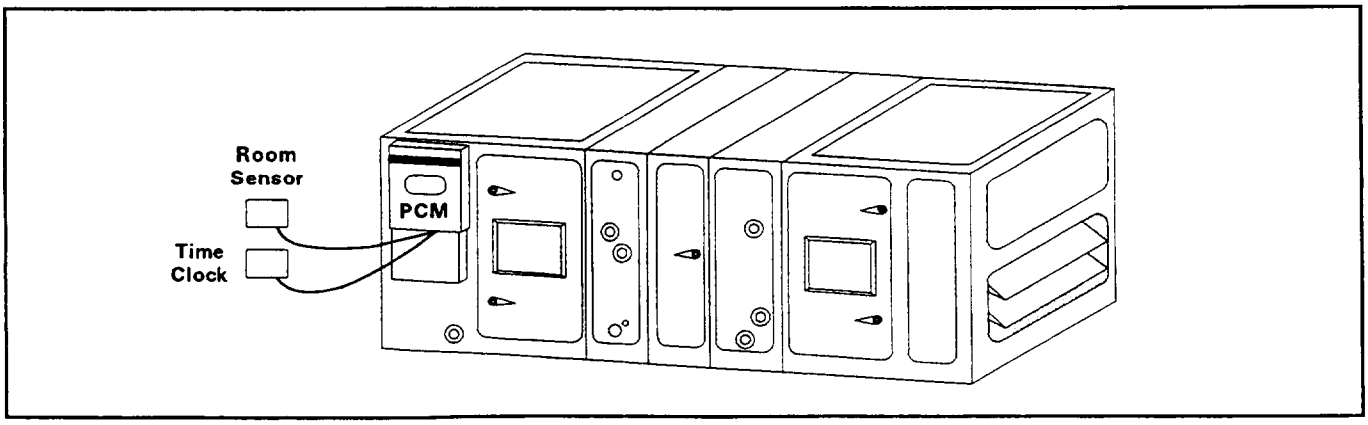


Figure 1-3
Penthouse Climate Changers with Tracer (ICS)

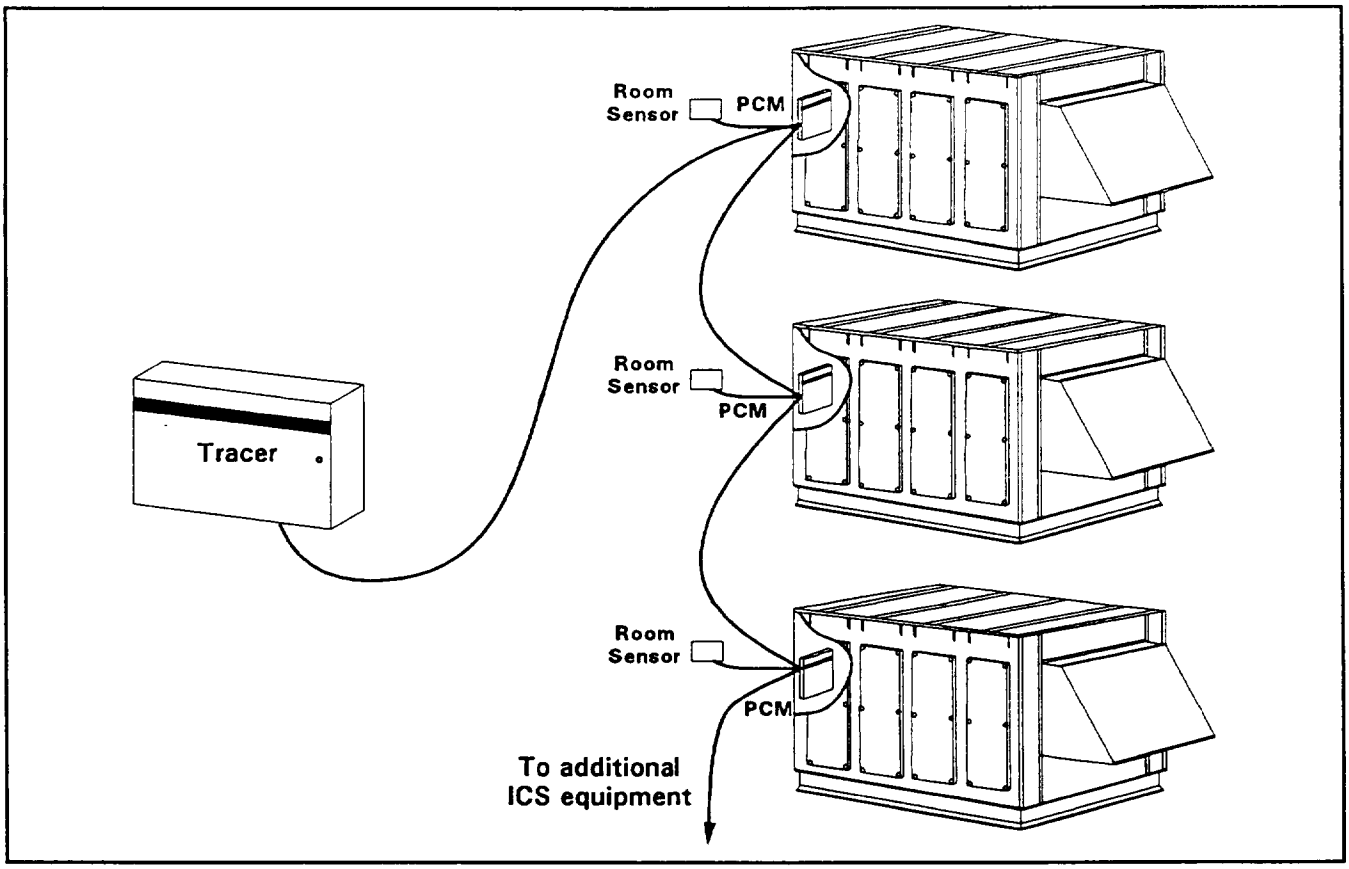
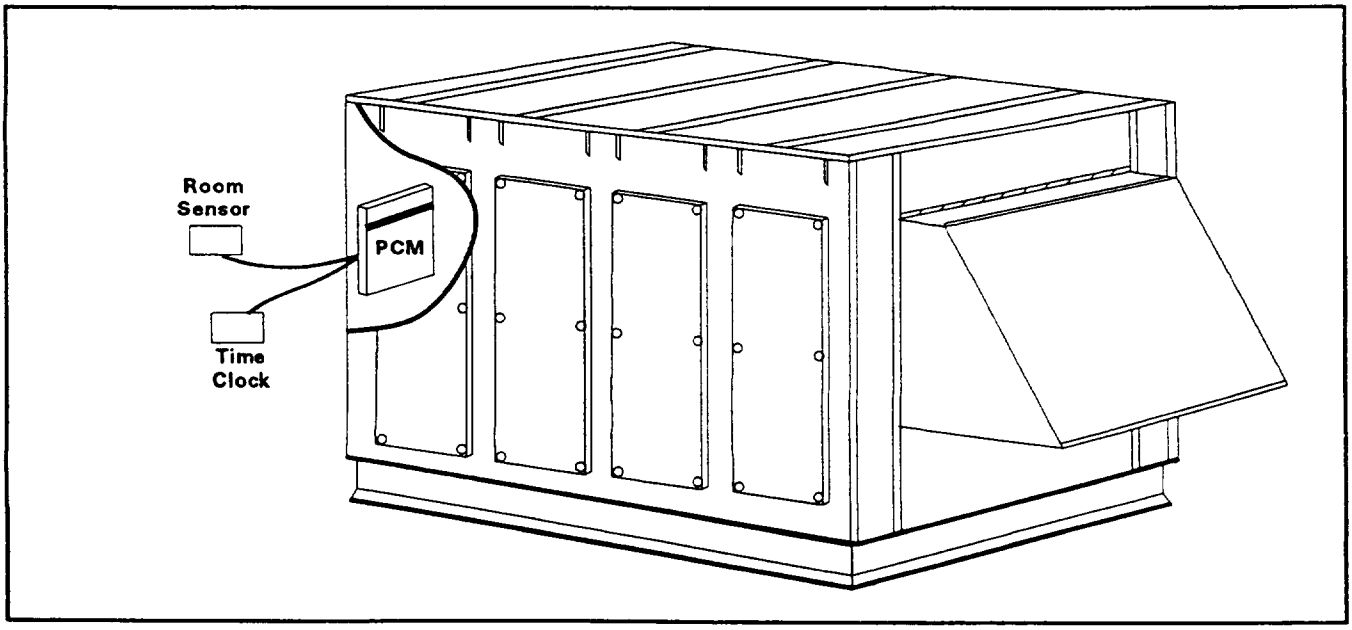


Figure 1-4
Stand-alone Penthouse Climate Changer



Overview

The Trane Modular and Penthouse Climate Changers® are Central Station Air Handlers custom designed for a variety of controlled air applications. Basic units consist of a fan, heating and/or cooling coils, filters, and dampers.

This manual is primarily written for Tracer® Programmable Control Module (PCM) applications as used by the Modular and Penthouse Climate Changers. Refer to the Central Station Air Handler Installation Maintenance manual for specific information about air handler units.

PCM Literature includes: PCM Installation Guide, PCM Edit Software and Programming Worksheets, and the PCM Cookbook.

PCM Features and Functions

PCMs are programmable Direct Digital Controllers that provide control and monitoring for the Modular and Penthouse Climate Changers in either stand-alone or Integrated Comfort™ System (ICS) applications with Tracer Building Management Systems.

An operator keypad interface option is also available. This interface has a 2 line by 20 character backlit liquid crystal display (LCD) and an operator keypad. The readout screen indicates the PCM name, time, date, communications status, and up to 32 items of point status and/or setpoints. Operator keypad interface can be limited for security purposes by a four keystroke password.

Method of Shipment

Most controls will be internally mounted. Depending on system configuration, these controls may include damper actuators, dirty filter switches, averaging temperature sensors, low limit switches, point temperature sensors, air flow switches, IGV actuators, etc.

PCMs, control transformers, static pressure transducers, DC power supplies, electronic/pneumatic transducers, customer interface relays, etc. will be mounted on the drive side of the fan module. These control panels will be surface mounted on unit sizes 3-17 and flush mounted on unit sizes 21-100.

Controls that are not factory mounted on the unit will ship with the air handler, usually inside the fan section. Depending on the system configuration, these controls may include heating valves, cooling valves, space temperature sensors, outside air temperature sensors, duct static pressure probes, conduit extensions, etc...

Storage

When a Modular or Penthouse Climate Changer unit and/or field installed accessories must be stored for a period of time prior to being installed, they must be protected from the elements. The PCM and all other electrical/electronic components need a storage temperature between -20° and 120° Fahrenheit - for Standard ambient, -20° to 120° Fahrenheit - for Extended Ambient, and a relative humidity between 5 and 95 percent, non-condensing.

The valves, sensors, electronic-pneumatic transducer, differential pressure transducers, actuators, and differential pressure switches have a safe storage range of -20° to 120° Fahrenheit.

The warranty will not cover damage to the unit or controls due to negligence during storage. A controlled indoor environment is recommended for proper storage. For further storage considerations, refer to the Central Station Air Handler Installation Maintenance manual.

CHAPTER 2: HARDWARE DESCRIPTIONS

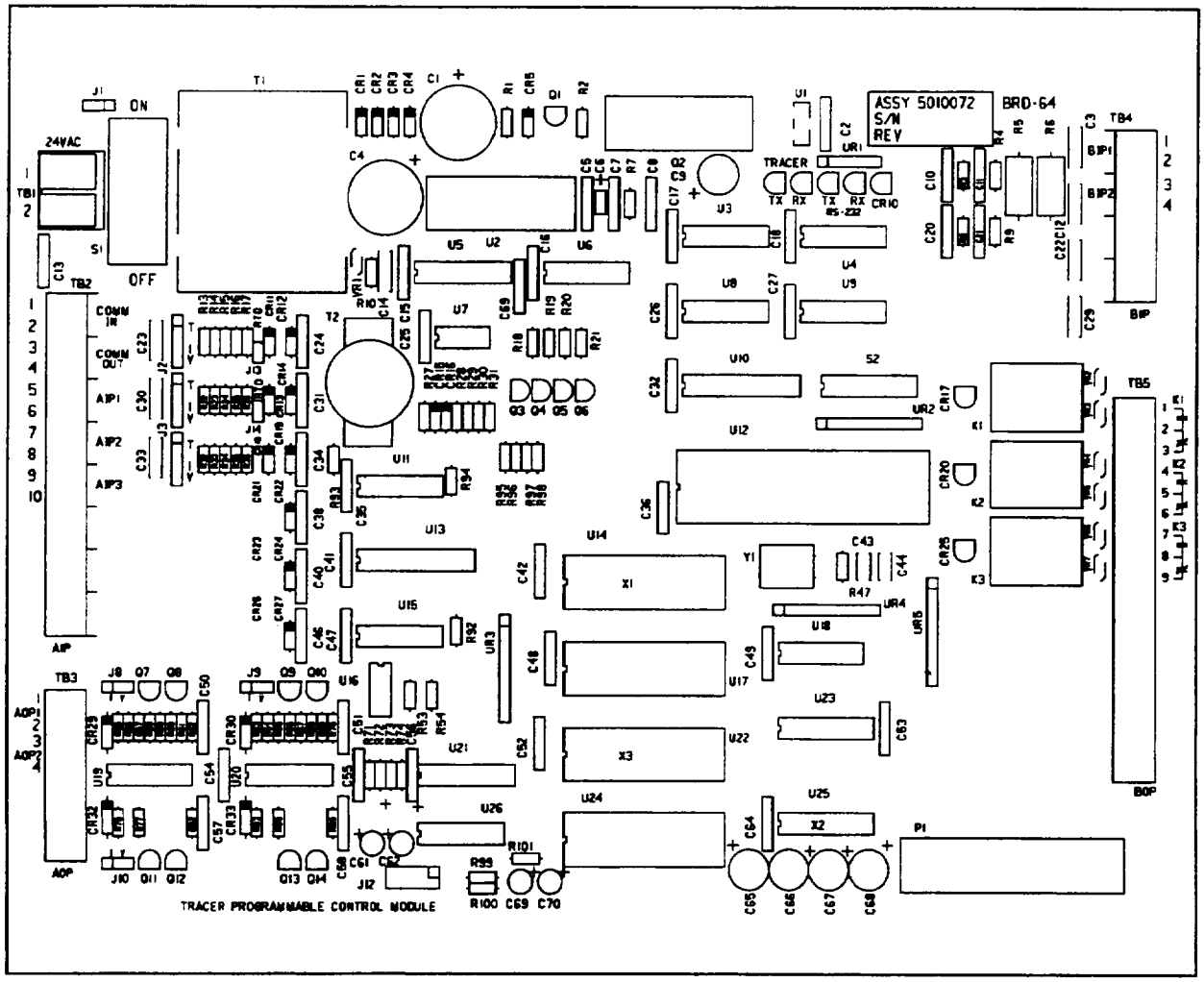
Chapter Overview

This chapter contains information about the following:

- The PCMs component layout
- Several of the PCMs features
- Description of the unit Control Valves
- Description of the unit Actuators
- Description of the unit Transducer
- Description of the unit Sensors
- Description of other control end devices

PCM Component Layout

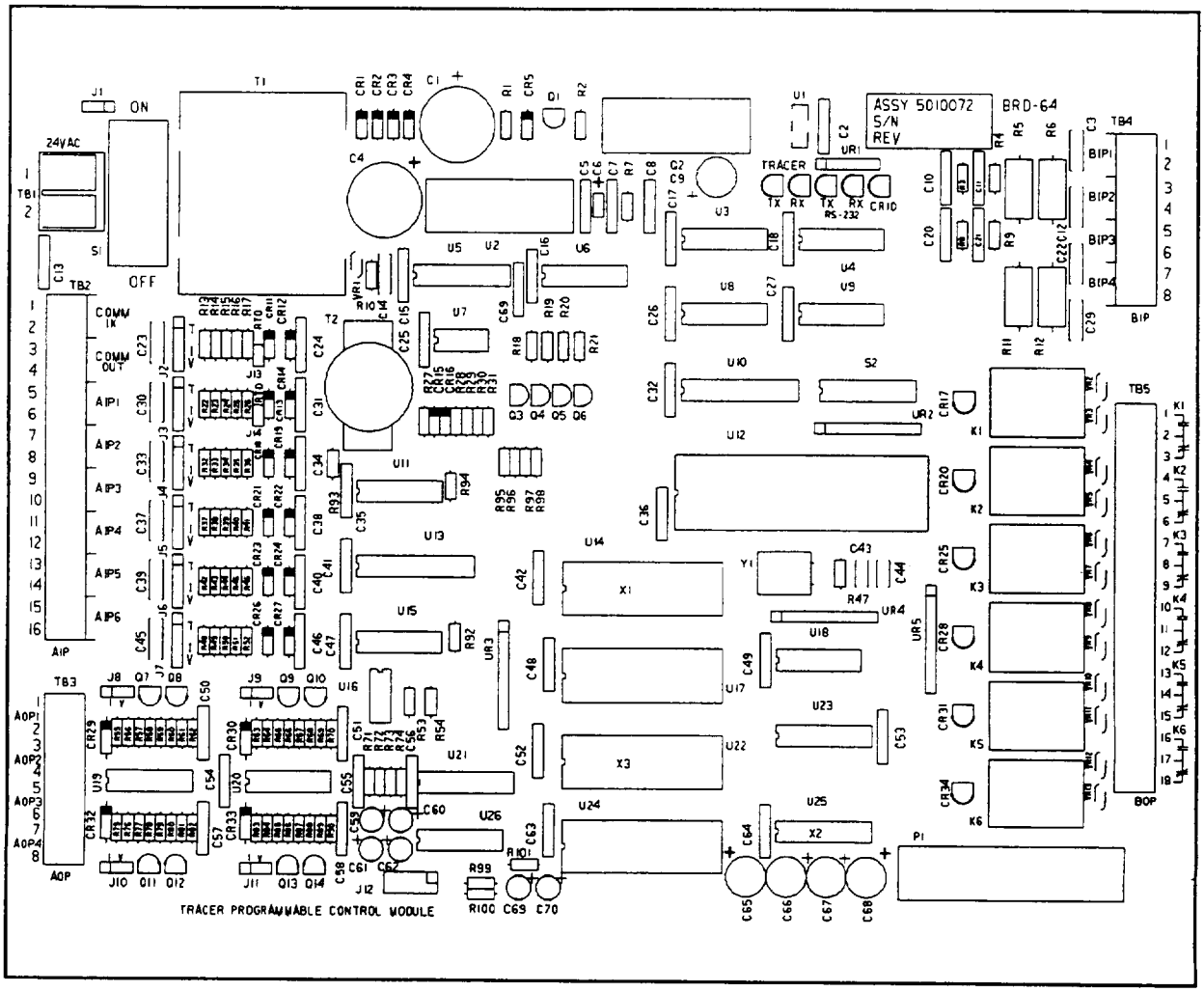
Figure 2-1
Tracer Programmable Control Module (PCM)
Component Layout (10 point)



10-pt PCM I/O Points

3 Analog Inputs
2 Analog Outputs
2 Binary Inputs
3 Binary Outputs

Figure 2-2
Tracer Programmable Control Module (PCM)
Component Layout (20 point)



20-pt PCM I/O Points

6 Analog Inputs
4 Analog Outputs
4 Binary Inputs
6 Binary Outputs

PCM Features

The PCM is available in either a 10 or 20 point version and can be ordered with a keypad operator interface. PCMs have four input/output terminal strips; one for each point type. Each strip has screw type fasteners for the wire terminations and plugs directly into the PCM circuit board for ease of installation and service.

Depending on the system's configuration, most controls are internally mounted and wired at the factory, usually on the drive side of the unit. Control systems are also provided with 120 to 24 VAC control transformers mounted and wired in the auxiliary control panel directly below the PCM enclosure.

The PCM Edit Software and Process Control Language (PCL) routines are explained in Chapter 5 of this manual.

Control Valves

Figure 2-3
Typical 2-Way Valve

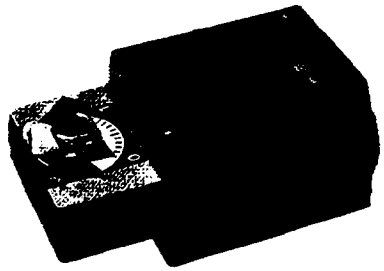
A 2-way valve is used for chilled water, hot water, and steam service. The valve consists of an inlet and outlet and can be piped either normally open or normally closed and comes in sizes 1/2" to 4". The 1/2" to 2" valves have a valve body rating of 250 PSI and 2-1/2" to 4" valves have a valve body rating of 125 PSI. When used in steam service, the valve has a 35 PSIG inlet maximum pressure limit. Regardless of service, the 2-way valve has a maximum temperature limit of 281° F.

Figure 2-4
Typical 3-Way Valve

A 3-way valve is used for chilled water or hot water service. The valve consists of two inlets and one outlet and can be piped either normally open or normally closed and comes in sizes 1/2" to 4". The 1/2" to 2" valves have a valve body rating of 250 PSI and 2-1/2" to 4" valves have a valve body rating of 125 PSI. Regardless of service, the 3-way valve has a maximum temperature limit of 281° F.

Actuators

Figure 2-5
Typical Damper Actuator

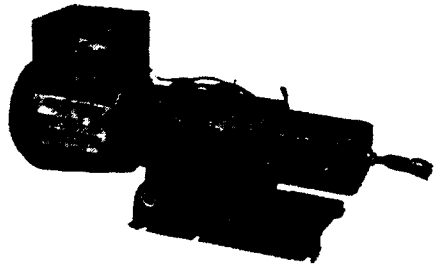


This electronic actuator is either a proportional, spring return, 15 VA actuator capable of providing 90 in/lb of torque using a 0 to 10 VDC input signal from a PCM controller or a proportional, non-spring return, 5 VA actuator capable of providing 133 in/lb of torque using a 0 to 10 VDC input signal from a PCM controller. The spring return actuator is used for fan module inlet vane modulation and mixing box damper modulation on a variety of unit sizes. The non-spring return actuator is used for face/bypass damper modulation and multizone damper modulation.

Figure 2-6
Typical Valve Actuator

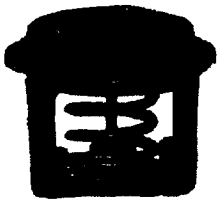
This electronic actuator is a proportional, spring return, 18 VA actuator capable of modulating 1/2" to 1-1/4" valve bodies using a 6 to 9 VDC (adjustable start point) input signal from a PCM controller. Valve close off pressure varies according to valve size.

Figure 2-7
Typical Valve/Damper Actuator



This electronic actuator is a proportional, spring return, 44 VA actuator capable of modulating 1-1/2" to 4" valve bodies, fan module inlet vanes, and mixing box dampers on a variety of unit sizes, using a 6 to 9 VDC (adjustable start point) input signal from a PCM controller. Valve close-off pressure varies according to valve size.

Figure 2-8
Typical Pneumatic Valve Actuator



This pneumatic actuator is a proportional spring return actuator capable of modulating 1/2" to 4" valve bodies, both 2-way and 3-way control valves. The actuator operating range is 4 to 11 PSI with a maximum safe air pressure of 25 PSI.

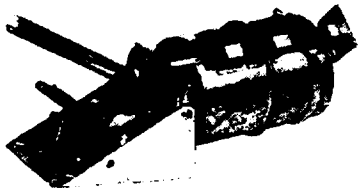
Actuators (continued)

Figure 2-9
Typical Pneumatic Damper

This smaller pneumatic actuator is a proportional spring return actuator capable of providing 33 lb. of force at 0 PSI and 53 lb. of force at 18 PSI. The actuator operating range is 5 to 10 PSI with a maximum safe air pressure of 29 PSI. The actuator is used for fan module inlet vane modulation, mixing box damper modulation, and face/bypass damper modulation on a variety of unit sizes.

Note: An actuator supplied with a positive positioner will allow operating range adjustment and will have an air consumption of .021 SCFM.

Figure 2-10
Typical Pneumatic Damper Actuator

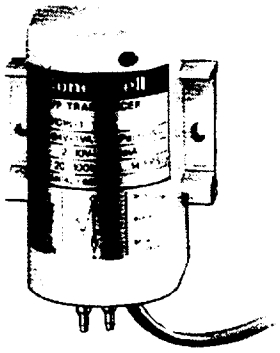


This larger pneumatic actuator is a proportional spring return actuator capable of providing 96 lb. of force at 0 PSI and 162 lb. of force at 18 PSI. The actuator operating range is 5 to 10 PSI with a maximum safe air pressure of 29 PSI. The actuator is used for fan module inlet vane modulation, mixing box damper modulation, and face/bypass damper modulation on a variety of unit sizes.

Note: An actuator supplied with a positive positioner will allow operating range adjustment and will have an air consumption of .021 SCFM.

Transducers

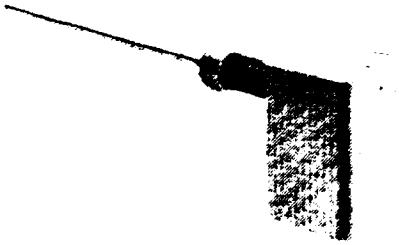
Figure 2-11
Typical Electronic-Pneumatic Transducer



This electronic-pneumatic transducer converts 2 to 10 VDC output signals into a 3 to 14.5 PSI pneumatic signal to operate a pneumatic valve or damper actuator. This device has an air consumption of .025 SCFM and an air capacity of .45 SCFM with a maximum safe air pressure of 29 PSI. This device is mounted internally on the control power panel for unit sizes 3 to 17 and is flush mounted on the control panel for unit sizes 21 to 100.

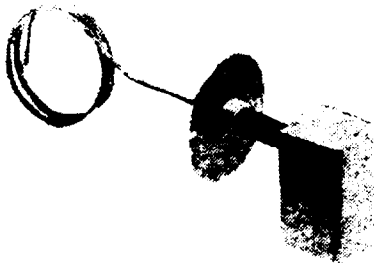
Sensors

Figure 2-12
Typical Duct Temperature Sensor



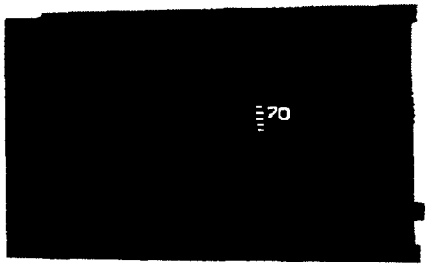
This duct temperature sensor is a 10,000 ohm thermistor at 77° F. It is used for supply air temperature control/monitoring in a supply air fan module. It is also used as a return air temperature control/monitoring in a return air fan module. The sensing element is located in the fan scroll.

Figure 2-13
Typical Averaging Temp. Sensor



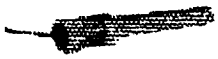
The averaging temperature sensor is a 1000 ohm RTD at 70° F, 2.2 Ohm per degree, 22 foot sensing element. The sensor is serpentined across a module for maximum coverage and can be mounted on the entering or leaving side of the module. Some modules may restrict sensor mounting locations.

Figure 2-14
Typical Adjustable/Override Sensor



These wall mounted temperature sensors (10,000 ohm thermistors at 77° F) can be ordered as one of four models: sensor only, sensor with override button, sensor with internal adjustable setpoint and override button, and sensor with external adjustable setpoint and override button as shown on left. See instructions shipped inside the sensor packaging for proper wall mounting.

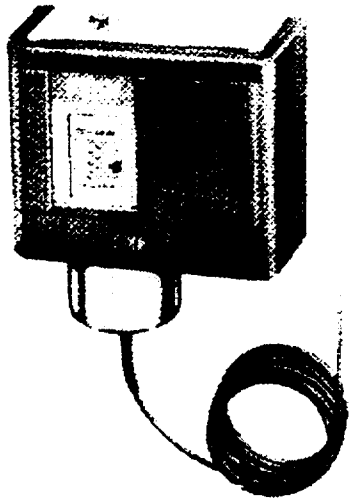
Figure 2-15
Typical Outdoor Air Sensor



The outdoor air temperature sensor is a 10,000 ohm thermistor at 77° F. Its mounting connection is a 1/2" conduit and is used to monitor the outside air temperature.

Control Switches

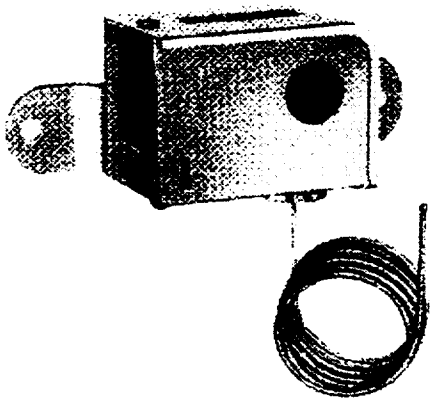
Figure 2-16
Typical Low Temp. Cutout
Two Circuit



The two circuit, low limit temperature cutout has a manual reset switch with a 24 foot capillary that responds to the lowest temperature on any 12 inch section of the capillary. The switch is mounted externally on the module to allow for field wiring to a normally closed contact of the switch to the motor starter.

The switch cutout temperature is adjustable from 15° to 55° F. The capillary is serpentined across a module for maximum coverage and can be mounted on the entering or leaving side of the module. Some modules may restrict mounting locations.

Figure 2-17
Typical Low Temp. Cutout
Single Circuit



The single circuit, low limit temperature cutout has a manual reset switch with a 24 foot capillary that responds to the lowest temperature on any 12 inch section of the capillary. The switch is mounted internally when the reset switch is accessable through an access door. If an access door is not provided, the switch will be located externally on the module.

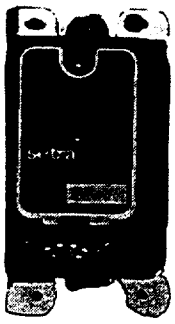
The switch cutout temperature is adjustable from 35° to 45° F. The capillary is serpentined across a module for maximum coverage and can be mounted on the entering or leaving side of the module. Some modules may restrict mounting locations.

Figure 2-18
Typical Differential Pressure Switch

This differential pressure switch is used for fan status and dirty filter indication. The switch is mounted internally on the filter or on the fan module which requires monitoring. The switch setpoint is adjustable from 0.05" to 5" W.G.

Pressure Transmitter

Figure 2-19
Typical Differential Pressure Transmitter



This differential pressure transmitter is used for duct static and building pressure control and/or monitoring. This device is located on the PCM backplate on unit sizes 3 to 17 and inside the flush mounted control panel on unit sizes 21 to 100. This device converts a 0" to 5" W.G. (duct static) or a -0.25" +/- 0.25" (building) differential pressure into a 4 to 20 mA output.

Control Relays

Figure 2-20
Typical Control Relay

This control relay is a DPDT, 24 VAC coil relay with silver-cadm oxide contacts and is rated for 1/3 HP at 120 VAC, 1/2 HP at 250 to 600 VAC, and 10 Amp at 240 VAC. It is mounted internally on the lower section of the flush mounted control panel provided on unit sizes 21 to 100.

CHAPTER 3: INSTALLATION

Chapter Overview

This chapter contains information about the following:

- Standard wiring diagrams

  AHV-001B- VAV Air Handling Unit with Tracer Monitoring

  AHV-002B- VAV Air Handling Unit with Stand-alone Control

  AHC-001B- Constant Volume AHU with Discharge Air Reset from Space Temperature with Tracer Monitoring

  AHC-002B- Constant Volume AHU with Discharge Air Reset from Space Temperature with Stand-alone Control

  AHC-003B- Constant Volume AHU with Space Temperature with Tracer Monitoring

  AHC-004B- Constant Volume AHU with Stand-alone Control

  AHV-001B- VAV Air Handling Unit with Tracer Monitoring (Remote PCM)

  Note: These standard wiring diagrams are typical and may not match a given Air Handler control system. Refer to the "As Built" wiring diagram for each Air Handler to determine the specific wiring for that unit.

- Field wiring applications
- Connecting/piping Control Valves for field mounted applications
- Switch and Sensor wiring for field mounted applications
- Installation checklist

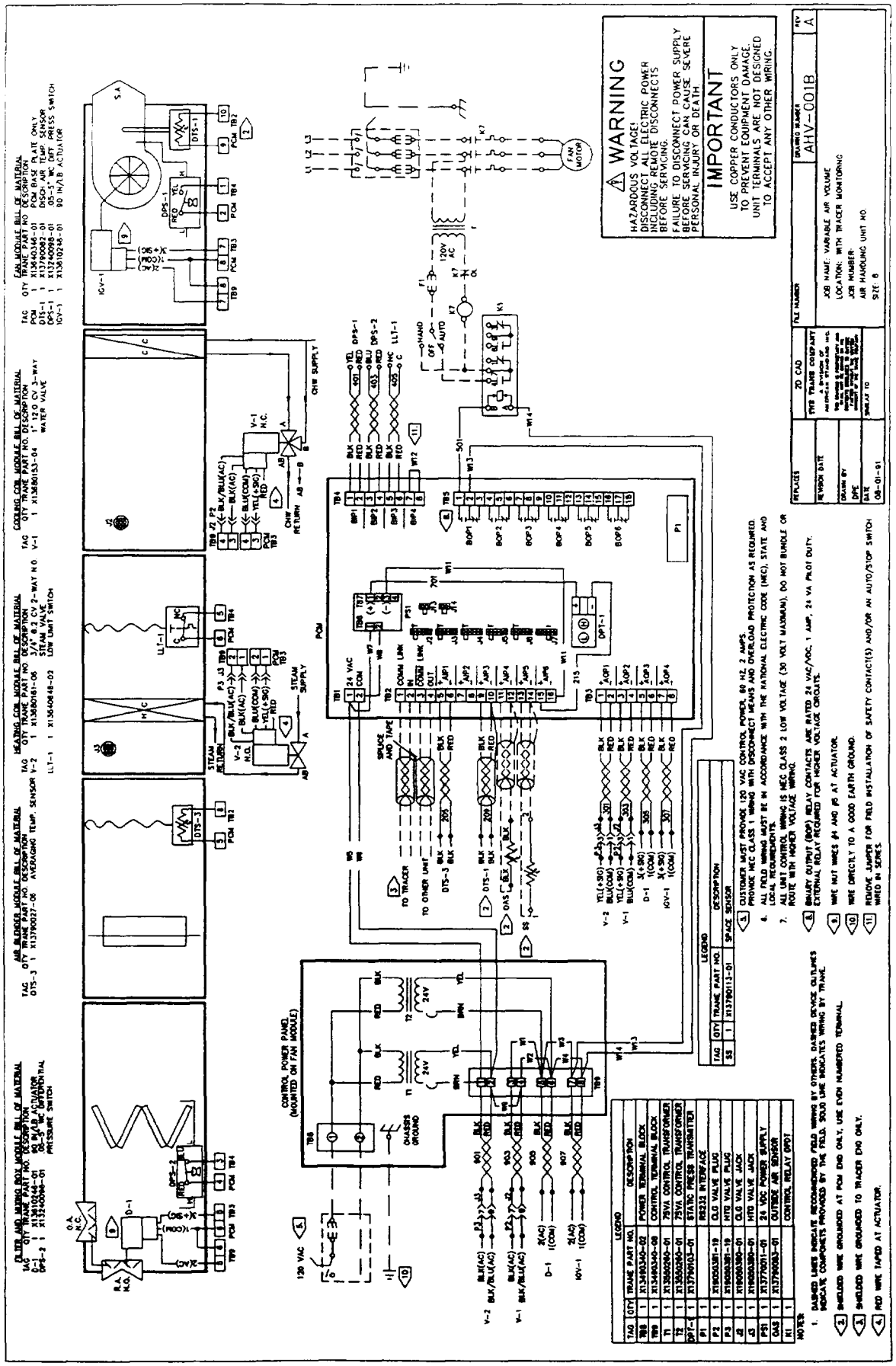
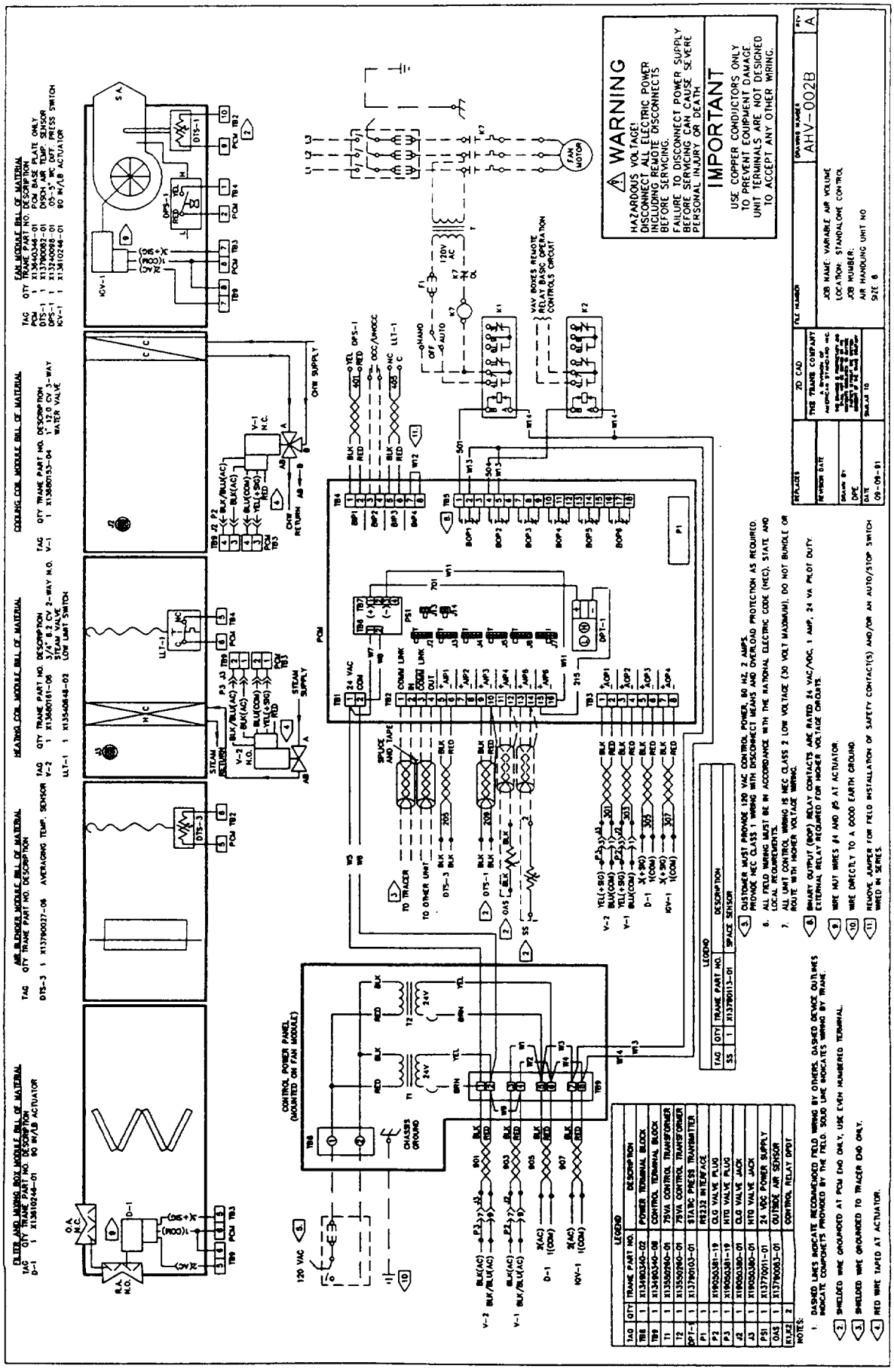


Figure 3-1
Variable Air Volume with Tracer Monitoring

Figure 3-2
Variable Air Volume
Stand-alone Control



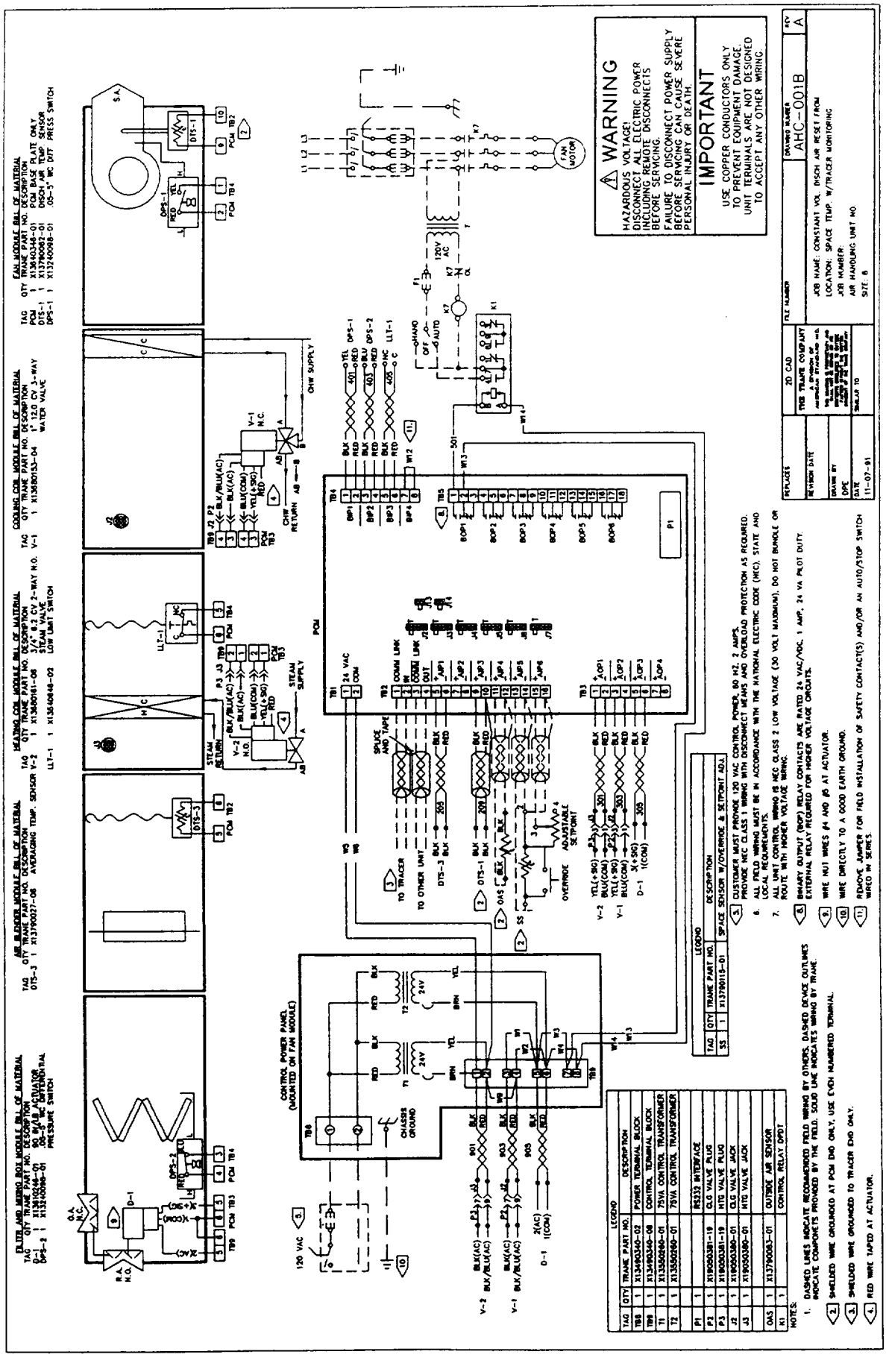


Figure 3-3
Constant Volume Discharge Air Reset from Space Temp. with Tracer Monitoring

Figure 3-4
Constant Volume Discharge Air Reset from Space Temp., Stand-alone

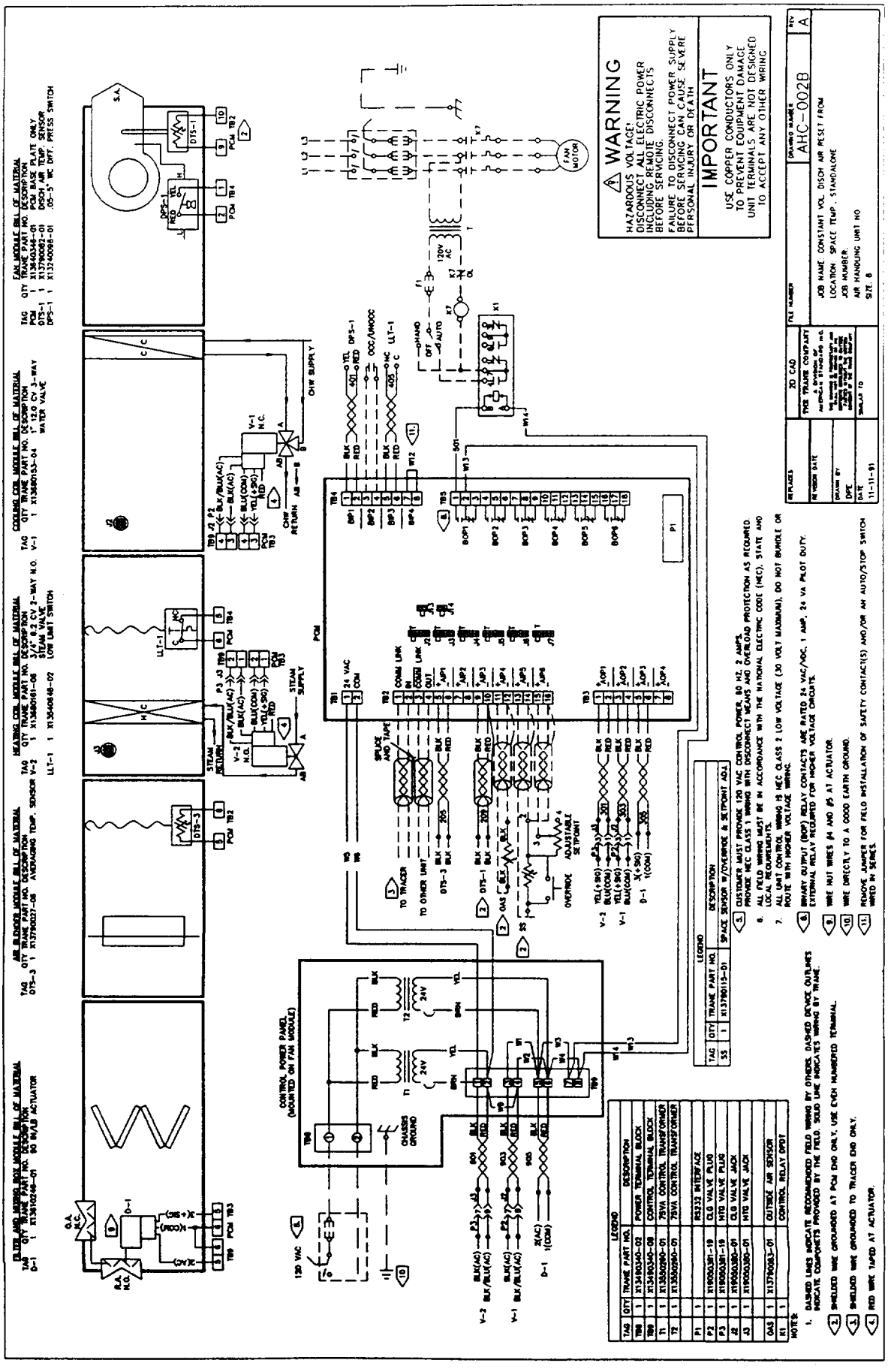


Figure 3-5
Constant Volume Space Temperature Control with Tracer Monitoring

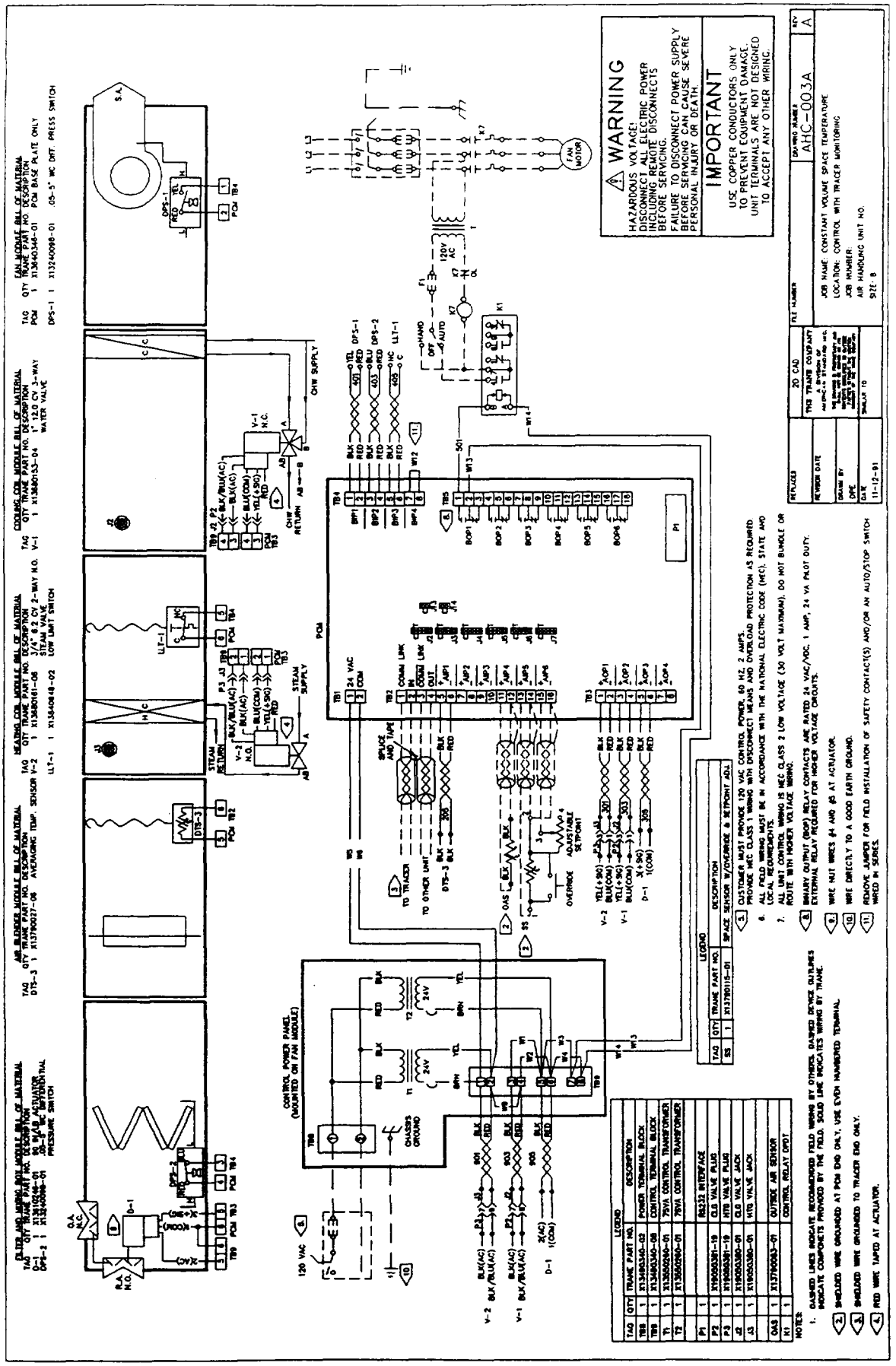
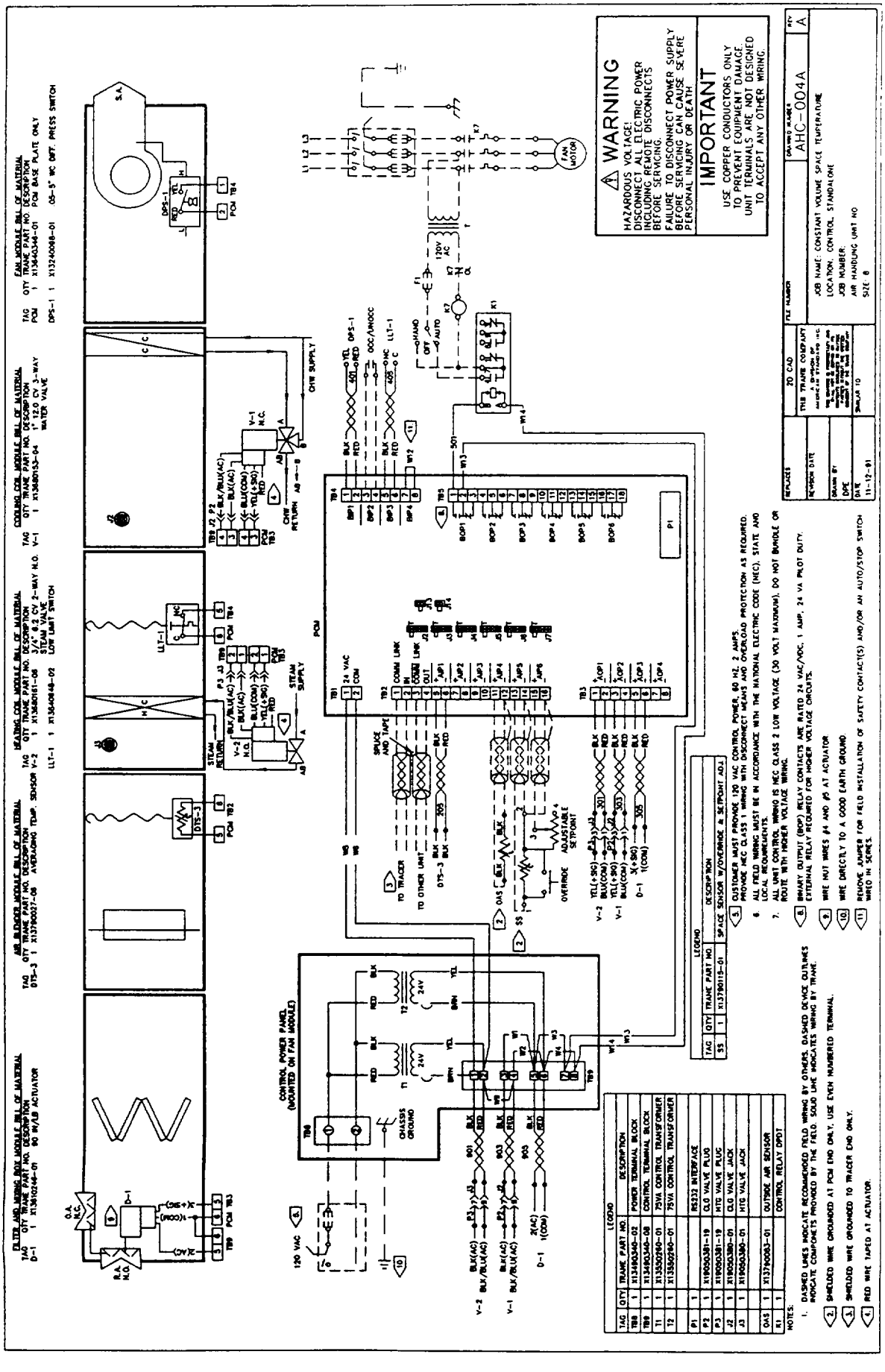


Figure 3-6
Constant Volume Space Temperature Control, Stand-alone



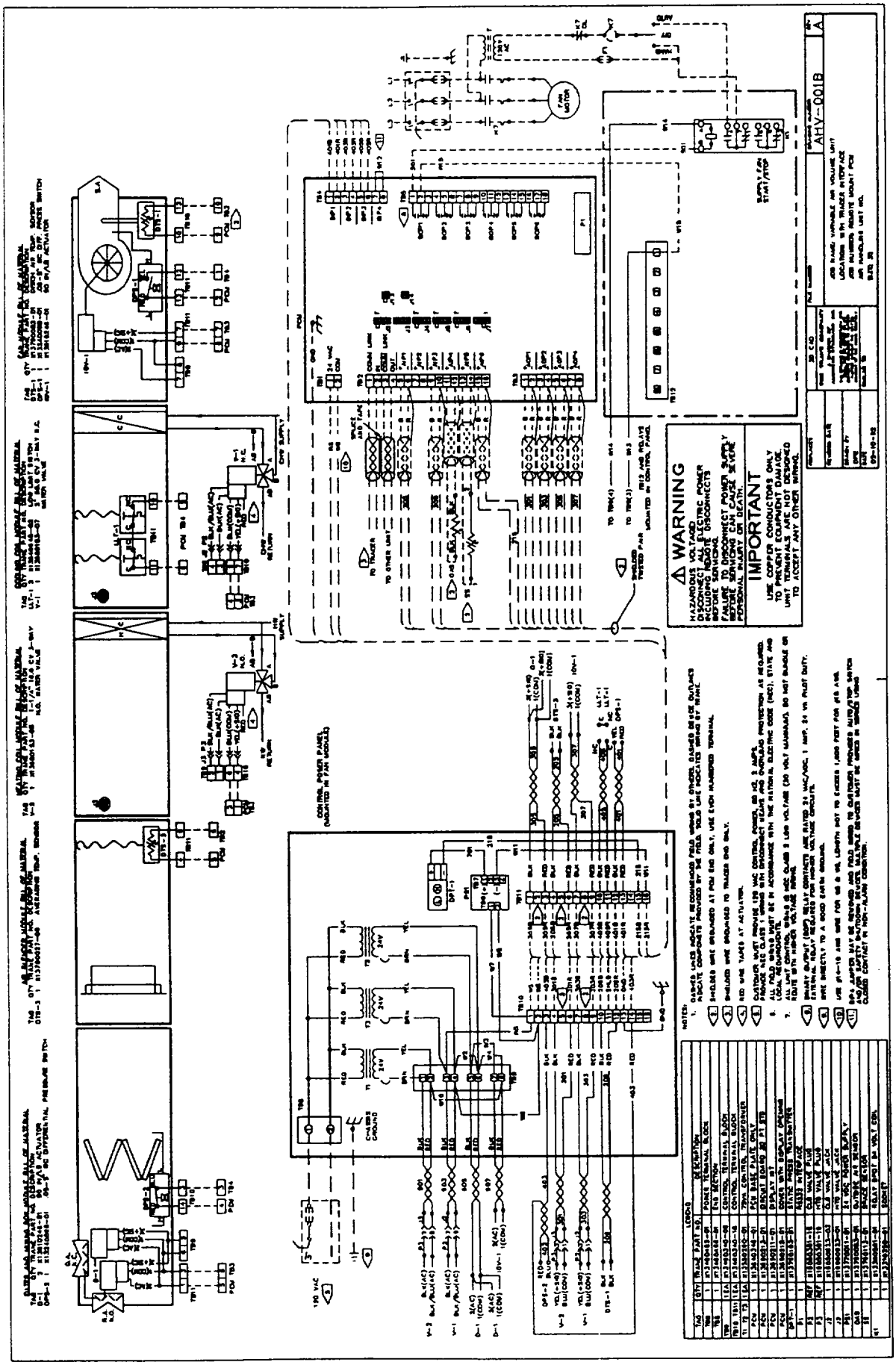


Figure 3-7
Variable Air Volume with Tracer Monitoring (Remote PCM)

Field Wiring

Warning: ***Disconnect all electrical power before servicing unit to prevent injury or death due to electrical shock.***

Caution: *All wiring must comply with national and local electrical codes.*

Caution: *To prevent damage to the unit, refer to the "As Built" drawings provided on the unit for specific wiring information. Field installed wiring is indicated by dashed lines on the "As Built" wiring diagrams.*

Separate AC power wiring from all DC wiring. Do not run DC wiring near RFI/EMI generating devices. The DC wiring should be shielded cable (Beldon #8422 or equivalent).

Supply Power

Caution: *Use copper conductors only. Use of aluminum wiring may cause galvanic corrosion, overheating, and result in equipment failure.*

Factory mounted 120 VAC to 24 VAC Class II transformers are properly sized to accommodate factory furnished 24 VAC devices such as PCMs, valves, and actuators. Additional 24 VAC field furnished devices require additional field furnished transformers.

Note: 120 VAC - 20 amp dedicated circuits with good earth grounding for system control power are recommended.

Communication Link/ Wire Selection

Caution: *Running communication link wiring in the same conduit or wire bundle with any AC power wires may cause a malfunction due to electrical noise!*

1. All communication link wiring is low-voltage Class 2 and must comply with all national and local electrical codes.
2. Communication link wiring must be 18 AWG twisted, shielded pair wire (BASD Part Number 400-200-28F for plenum or Q-4166 for non-plenum).
3. The shield on the communication link wiring should be connected to the designated shield terminal at the Tracer BMS. At the PCM, the shield should be spliced with the shield from the next section of communication link wiring and taped to prevent any connection between the shield and ground. At the last PCM on the link, the shield should be cut and taped back.
4. The wire capacitance between conductors (picofarads per foot) must be in accordance to the capacitance tables on the next page.
5. The maximum total wire length is 5,000 feet for the communication link.
6. The communication link wiring cannot pass between buildings.
7. At the PCM, the communication link wires must be connected to terminals TB2-1 and TB2-2, or TB2-3 and TB2-4. Additional terminals are provided to facilitate daisy-chaining communication link wiring. There is no polarity requirement for this connection.

Communication Link/ Wiring Selection (continued)

8. PCMs on the communication link can be connected in a "daisy-chain" configuration.

9. Verify that the PCM address is properly set on DIP Switch S2. See the Tracer BMS Installation manual for DIP switch settings.

Maximum Communication Link Wire Length (feet)	Maximum Capacitance between Conductors (picofarads/foot)
1,000	60
2,000	50
3,000	40
4,000	30
5,000	25

Type of Wire (Mfg. and Part #)	Capacitance (picofarads/foot)
BASD # 400-200-28F (plenum)	24
BASD # Q-4166 (non-plenum)	38

Input/Output Wiring Requirements

Follow these requirements for all field installed Outside Air Sensors, Space Sensors, and any other field installed I/O devices.

Note: All I/O wiring must comply with applicable electrical codes. Metal conduit may be required by local codes when running wires for analog inputs, binary inputs, or binary outputs.

Use only stranded, tinned 18 AWG copper conductors for I/O wiring. Check all I/O wiring for stray AC or DC voltages for shorts to earth ground. Do not run I/O wires in the same conduit or wire bundle with any AC power wires other than PCM 24 VAC power.

Caution: *Running I/O wires in the same conduit or wire bundle with any AC power wires other than PCM 24 VAC power could cause the PCM to malfunction due to electrical noise.*

For the NEMA 1 enclosure, the I/O wires should enter the cabinet through the 7/8" conduit entry holes.

For the NEMA 4 enclosure, the 24 VAC wiring, analog input wiring, and communication wiring should enter the cabinet through the 1-3/32" conduit entry hole on the lower left. Binary I/O wiring should enter through the 1-3/32" conduit entry hole on the lower right.

Note: Weatherproof conduit (such as "seal-tite") should be used to run wiring to the weatherproof NEMA 4 PCM.

Control Valves

Heating or cooling valves may be either a 3-way mixing type valve with actuator assembly or a 2-way normally open/normally closed valve with actuator assembly.

The actuator is generally installed in an upright position and may be swiveled to any convenient position to accommodate wiring. **The actuator should not be installed below the center line of the valve.**

Install all valves maintaining proper flow direction. Flow direction is usually indicated by an arrow on the valve body. Always install the 3-way mixing valve on the return side of the mixing configuration. Piping determines whether 3-way valves are normally open or normally closed to the coil. The control valves are connected to the PCM with quick connect plugs. Refer to Climate Changer Installation Manual for further information about coil piping.

Sensor and Switch Wiring

Refer to the I/O Wiring Requirements section for these field installed devices. Also refer to the PCM Installation Guide for binary and analog I/O wiring.

Several different types of wall sensors can be used with these units. Mount all sensors on a wall with good air circulation and at an average temperature. A twisted, shielded pair wire is required for all sensor wiring and is recommended that less than 1,000 feet of 18 AWG wire be used. Refer to the mounting instructions shipped with the sensor unit.

Caution: *Do not run sensor wires along with AC power wires in the same conduit or bundle, doing so could cause a malfunction due to electrical noise!*

Installation Checklist

Shipment

- ☐ Inspect all unit and factory installed control components for shipping damage, then file a claim if necessary.

Unit Location

- ☐ PCM is installed in an environment that meets temperature and humidity requirements.
- ☐ PCM is securely mounted to unit when factory mounted, on wall, or other mounting location when field installed.
- ☐ Proper clearances around PCM.

Control Valves

- ☐ Valves installed on return side of coil with proper flow direction.
- ☐ Valve actuators installed above the center line of valve.
- ☐ Valve wiring plugs connected.

AC Power Wiring

- ☐ Field installed AC power wiring complies with all applicable codes.
- ☐ Recommended 120 VAC 20 amp dedicated circuit breaker with good earth ground connected to factory provided input power terminals.
- ☐ Voltage measured at factory provided TB9 odd numbered terminal to even numbered terminal is 20 to 30 VAC.

24 VDC Sensor Power Supply (optional)

- ☐ 24 VDC power supply is properly mounted in the PCM enclosure when PCM unit mounted at the factory or in the control power panel when the PCM is field remote mounted.
- ☐ 24 VAC power wiring from TB1 (on PCM circuit board) to TB6 (on power supply) properly installed.
- ☐ 24 VDC wiring from TB7 to analog sensors (only those requiring 24 VDC power) properly installed.

Input/Output Wiring

- ☐ Field installed I/O wiring complies with all applicable codes.
- ☐ Field installed binary inputs are wired with twisted, shielded pair wiring.
- ☐ Field installed analog inputs are wired with twisted, shielded pair wiring.
- ☐ Analog input jumper plugs J2-J7 are properly set for the type of analog input used. Jumpers J13 and J14 installed for RTDs on AIP1 and AIP2. See PCM Installation Guide for details.
- ☐ Binary outputs are properly wired.
- ☐ Field installed analog outputs are wired with twisted, shielded pair wiring.
- ☐ Analog output jumper plugs J8-J11 are properly set for the type of analog output used.

Communication Wiring

- ☐ Field installed communication wiring complies with all applicable codes.
- ☐ Communication link installed with approved twisted, shielded pair wiring.
- ☐ Tracer communication link wiring connected to PCM at TB2-1 and TB2-2, or TB2-3 and TB2-4.
- ☐ Communication link wire shields spliced at PCM and taped.
- ☐ Tracer communication link wiring connected to proper terminals at Tracer BMS.
- ☐ PCM DIP Switch S2 set for PCM address.

CHAPTER 4: START-UP AND CHECK-OUT PROCEDURES

Chapter Overview

This chapter contains information about the following:

- The pre-startup checkout procedure
- The commissioning procedure
- The start-up procedure

The Pre-Startup Checkout Procedure

- ☐ Inspect all electrical connections. They should be clean and secure, then compare actual wiring with the "As Built" control wiring diagram provided on the unit.
- ☐ Verify that the factory set PCM analog input jumper plugs J2-J7 and J13-J14, and analog plugs J8-J11 match the "As Built" wiring diagram provided on the unit.
- ☐ Install and terminate any factory furnished field wiring devices (space sensor, outside air sensor, time-clock contact, etc...) to the PCM as shown on the "As Built" wiring diagram provided on the unit.
- ☐ Verify that the factory installed jumper on binary input #4, is still intact. This jumper may be removed and wired to a field provided auto/stop switch and/or safety shutdown devices.
- ☐ Verify that the control power source is 120 VAC, single phase, before applying to the unit.
- ☐ Verify that the VAV Unit's duct static differential pressure transducer duct probe, from the transducer's high port, is installed three/fourths the distance down the longest duct run that serves the VAV boxes.

Commissioning

After completing all the prestart-up checks, the power may be applied to the PCM and associated end devices through the factory furnished control power transformers.

> **Note: These transformers are sized at the factory for load requirement of factory furnished control end devices (actuators, valves, etc...) and should not be used as a 24 VAC power source for any field provided and installed devices. Transformer failure resulting from an inappropriate use will void all warranty.**

All factory installed control components have already been factory commissioned and should require minimal commissioning. It is recommended to use a laptop computer to run the PCM Edit Software Version 3 (or higher). Run the software to manually check all PCM inputs and outputs to verify that the factory installed and wired components were not damaged during shipment. Also verify that the field installed devices have been properly terminated to the PCM. Refer to the PCM Edit Software Operator's Guide for further details.

Connect the laptop computer to the PCM circuit board using a 25 pin RS-232 cable. Start the computer and run the PCM Edit Software, then begin the selection process to enable the input/output test feature. The input/output test automatically puts the PCM into manual mode, suspends all PCL routine executions, and freezes the outputs at the last specified values.

Commissioning (continued)

Proceed with the commissioning as follows:

☐ Review all analog inputs to verify that the terminated inputs do not indicate "YES" to failure. Check that the sensor readings are within a reasonable range.

☐ Initiate auto-test and select each analog output wired to an end device as shown on the "As Built" drawing. The selected output should be driven in increments of 0%, 25%, 50%, and 100%. Inspect the end devices for proper operation.

☐ Using a test bulb, manually trigger a contact change for the dirty filter switch and/or air flow switch by causing a differential pressure between the components high and low ports. Review the input/output test screen to verify that the present value for the correct binary input has changed.

Note: Do not use the test bulb on the static pressure transducer.

☐ Manually trigger a contact change for a low limit device by pushing the switch contact down, then release the pressure on the switch contact for an auto-reset switch or push the reset button for a manual-reset switch. Review the input/output test screen to verify that the present value for the correct binary input has changed.

☐ Command all wired binary outputs to "ON" then "OFF" to verify control of the component end device (typically a pilot relay).

Note: All six standard factory programs designate binary output #1 as a fan start/stop. The stand-alone, variable air volume factory program also designates binary output #2 as VAV box override.

☐ If required, modify the custom status display to customize the LCD and keypad functions to individual unit operation particulars.

☐ Adjust the device setpoint per individual unit operation at the differential pressure switch (s) and/or low limit switch (s).

Start-Up

All six standard factory programs require the hand-off-auto switch to be in the "AUTO" position to allow PCM control of the air handling unit. Placing the hand-off-auto switch into the "HAND" position enables the supply fan to run, but the air handling unit control is still based on the PCM initiated modes of operation.

Place the unit starter hand-off-auto switch in the "AUTO" position and initiate the unit to occupied through the Tracer Building Management System (BMS) or time clock input for stand-alone applications. After air flow is established for a 30 second time period, the PCM will enable the unit controls. Use the laptop computer or an optional PCM LCD/display to verify proper air handling unit control.

If the unit control is excessively slow or is cycling rapidly, use the laptop computer to adjust the corresponding PCM DDC loop parameters.

Note: A ratio of 4 to 1 should be maintained between the proportional gain and integral gain respectively.

If a particular control loop is responding too slowly, increase the DDC loop gains for that loop. If a control loop is responding too rapidly (causing excessive overshoots and cycling of the control valve or damper) decrease the DDC loop gains for that loop.

Most control loops will provide satisfactory performance without adjusting the factory default DDC Loop Gains.

CHAPTER 5: PROGRAMMING

Chapter Overview

This chapter contains information about the following:

- Sequence of Operations
- Process Control Language (PCL) Routines

  AHV-001B - VAV Air Handling Unit with Tracer Interface (pages 5-2 to 5-19)

  AHV-002B - VAV Air Handling Unit with Stand-alone Control (pages 5-20 to 5-36)

  AHC-001B - Constant Volume AHU with Discharge Air Reset from Space Control with Tracer Interface (pages 5-37 to 5-54)

  AHC-002B - Constant Volume AHU with Discharge Air Reset from Space Control with Stand-alone Control (pages 5-55 to 5-72)

  AHC-003B - Constant Volume AHU with Space Control with Tracer Interface (pages 5-73 tp 5-89)

  AHC-004B - Constant Volume AHU with Stand-alone Control (pages 5-90 to 5-107)

- Detailed information about the six standard PCL Routines
- A brief description about the PCM Edit Software

The intent of offering these six standard factory installed PCM programs is to allow "Turnkey" constant and variable air volume Direct Digital Control (DDC) for Modular and Penthouse Climate Changers. Please review the standard control programs, point summaries, sequence of operations, and program routine descriptions to determine which of the standard PCM programs will best fit your application. **These factory installed PCM programs may also be field modified.** Refer to the "As Built" drawings and program documentation for your specific installation to determine the actual hardware and control sequences installed.

> Note: **In areas where outdoor temperatures drop below 35° F, the six standard programs are intended for use on air handling units having an air blender when economizer control is required. Failure to use an air blender in an economizer control application may require field customization of a factory program.**

PCL Programming

The Modular and Penthouse Climate Changers with PCM operate from Process Control Language (PCL) Routines which are programmed into the PCM at the factory. This chapter explains what is actually programmed into the PCM, what operations the PCM performs, and a brief description about the operations that occur. If you are not familiar with PCM PCL routines, refer to the PCM Edit Software Operator's Guide for further information.

All PCL routines are in continuous operation whenever the PCM is in the AUTO/REMOTE or AUTO/LOCAL mode. These routines will process all the current informaton available and determine what actions should occur.

VAV Air Handling Unit with Tracer Interface

Control Sequence for AHV-001B

Occupied Cooling Mode
When the AHU is indexed to the Occupied Cooling Mode, the Supply Fan will operate continuously, the Inlet Vanes will modulate to maintain the Duct Static Pressure (1.5" W.C. nominal), the Outdoor Air Damper will be at its minimum position (unless economizing), and the Discharge Air Temperature (55° F nominal) will be maintained by modulating the Chilled Water Valve, the Hot Water, or Steam Valve and the Outdoor Air Damper.

Night Setback/Morning Warmup Heating Mode
When the AHU is indexed to the Night Setback/Morning Warmup Heating Mode, the Supply Fan will operate continuously, the Inlet Vanes will modulate to maintain the Duct Static Pressure (1.5" W.C. nominal), the Outdoor Air Damper will be fully closed, the Chilled Water Valve will be fully closed and the Hot Water or Steam Valve will modulate to maintain the Discharge Air Temperature (104° F nominal).

Supply Fan Control
The Supply Fan will operate continuously whenever the AHU is indexed to either the Occupied Cooling Mode or the Night Setback/Morning Warmup Heating Mode. The Supply Fan will be OFF whenever the AHU is indexed to the Unoccupied Mode, the AHU is Demand Limited or Duty Cycled by the Tracer Building Management System (BMS), the AHU is put in the Priority Shutdown mode by the Tracer BMS, the Run-Auto/Stop interlock is open, the Mixed Air Low Limit is tripped, or the Supply Fan Status indicates a failure (after a 2 minute delay). The fan failure indication requires a manual reset, which can be done at the Tracer BMS, the local PCM keypad/display, or by opening the Run-Auto/Stop interlock.

AHV-001B continued...

Inlet Vane Control
When the Supply Fan is ON, the Inlet Vanes will modulate, as commanded by the PCM controller, to maintain the Duct Static Pressure as sensed three/fourths the distance down the longest duct serving the VAV boxes. The Duct Static Setpoint is sent from the Tracer BMS to the AHU PCM controller, and is limited to the range of 0.0 to 3.0" W.C. If the Duct Static Pressure Sensor is failed or if the Supply Fan is OFF, the Inlet Vanes shall be fully closed. If Duct Static Pressure goes 1.0" W.C. above the PCM controller setpoint, the Inlet Vanes will be positioned to 50% of their current position.

Heat/Cool Mode Control
The Heat/Cool Mode of the AHU is determined based on a selected Morning Warmup Sensor from the Tracer BMS and the Tracer BMS Zone Occupied Heating Setpoint. If the Morning Warmup Sensor Temperature is greater than the Occupied Heating Setpoint or if the Tracer BMS Zone is in the Cooling mode, the mode of the AHU will be COOL. If the Morning Warmup Sensor temperature is less than the Occupied Heating Setpoint minus the Morning Warmup Differential and the Tracer BMS Zone is in the Heating mode, the mode of the AHU will be HEAT. The AHU will be allowed to switch between the Heating and Cooling modes at any time during operation, based on this logic.

If the AHU is indexed to the Unoccupied or Night Setback Mode, the Heat/Cool Mode will be HEAT whenever the Morning Warmup Sensor temperature is less than 72° F. If the Supply Fan is OFF, the Heat/Cool mode will be HEAT whenever the Tracer BMS Zone mode is heating. If local PCM Keypad setpoints are selected, the Tracer BMS Zone mode will be ignored, and the AHU Heat/Cool mode will be based solely on the Keypad Morning Warmup Setpoint and the Morning Warmup Sensor temperature.

Outdoor Air Damper Control
When the Tracer BMS enables the Economizer function and the Outdoor Air Temperature is less than the changeover setpoint minus 2° F, the Outdoor Air Damper will modulate, as commanded by the PCM controller, between minimum position and full open to maintain the Discharge Air Temperature at the Economizer Setpoint (Discharge Cooling Setpoint minus 2° F). The Outdoor Air Damper will be modulated closed as required (overriding the minimum position) to maintain the Mixed Air Temperature (averaging element) at or above the Mixed Air Setpoint (48° F nominal). A Mixed Air Low Limit manual reset device (sensing the coldest one-foot section) will turn the Supply Fan OFF if its sensed temperature is below its setpoint (36° F nominal).

If the Economizer function is disabled or if the Discharge Air Temperature Sensor is failed, the Outdoor Air Damper will be set to minimum position. The minimum position will be set to zero for all Tracer BMS control modes except Occupy and Coastdown. If the AHU mode is Heating, the Supply Fan is OFF or the Mixed Air Temperature Sensor is failed, the Outdoor Air Damper will be fully closed.

AHV-001B continued...

Chilled Water Valve Control
The Chilled Water Valve will modulate, as commanded by the PCM controller, to maintain the Discharge Air Temperature at the Discharge Cooling Setpoint. The Discharge Setpoint is sent to the AHU from the Tracer BMS, and is limited to the range of 50° to 80° F. A local PCM keypad Discharge Setpoint is user selectable in place of the Tracer BMS setpoint. If the Economizer function is enabled and the Outdoor Air Damper is not fully opened, the Chilled Water Valve will be closed. The Chilled Water Valve will also be closed if the Tracer BMS control mode is Coastdown or Purge, or the mode of the AHU is Heating. If the Discharge Air Temperature Sensor has failed, the chilled water valve shall be positioned to 50%. If the Supply Fan is OFF, the Chilled Water Valve will be either fully open or closed, as selected by a user entry.

Hot Water or Steam Valve Control
The Hot Water Valve will modulate, as commanded by the PCM controller, to maintain the Discharge Air Temperature at the Heating Setpoint. If the AHU is in the Heating mode, the Heating Setpoint is 104° F. If the AHU is in the Cooling mode, the Heating Setpoint is equal to the Economizer Setpoint minus 2° F. If the Outdoor Air Damper is open past the minimum position, if the Chilled Water Valve is not fully closed, or if the Discharge Air Temperature sensor is failed, the Hot Water or Steam Valve will be closed. If the Supply Fan is OFF, the Hot Water Valve will either be fully opened or closed, as selected by a user entry.

Unoccupied Mode
When the AHU is indexed to the Unoccupied Mode, the Supply Fan will be turned OFF, the Inlet Vanes and Outdoor Air Damper will be fully closed. The Chilled Water Valve will be either fully closed or fully open, as selected by user entry. The Hot Water Valve will be either fully open or fully closed, as selected by user entry.

Tracer BMS Setpoint Interface (optional)
The Tracer BMS sends the AHU a Discharge Air Cooling Setpoint (default = 55° F), a Duct Static Pressure Setpoint (default = 1.5" W.C.), the Tracer BMS Zone Current Active Setpoint (default = 71° F), and a user-selected Morning Warmup Temperature Sensor Value (default = 75° F).

The Tracer BMS also sends the AHU an Economizer Enable/Disable command (default = Enable), the Tracer BMS Zone Heat/Cool status (default = Cooling) and puts the AHU into one of nine Tracer BMS control modes: Occupy, Unoccupy, Startup, Coastdown, Demand Limit, Duty Cycle, Night Setback, Purge, and Priority Shutdown (default = Occupy).

If communication with the Tracer BMS is lost, the AHU uses the default setpoints and operates in the Occupied Cooling mode. The Economizer function is enabled based on the AHU Outdoor Air Temperature Sensor.

Local Parameters
The following additional set points (Parameters) are stored in the AHU PCM and can be accessed manually at the Tracer BMS or through the optional Local PCM Keypad/Display:

Analog Parameters

- Local Discharge Setpoint (50-80° F)
- Local Duct Static Setpoint (0.0-3.0" W.C.)
- Local Morning Warmup Setpoint (0-100° F)
- Mixed Air Setpoint (45-100° F)
- Outdoor Air Changeover Setpoint (-100-100° F)
- Outdoor Air Minimum Position (0-100%)
- Morning Warmup Differential (1-20° F)

Binary Parameters

- Manual Reset Point (OFF/ON)
- Local Keypad Setpoints (NO/YES)
- Heat Valve/Fan OFF (CLOSED/OPEN)
- Cool Valve/Fan OFF (CLOSED/OPEN)
- AOP Calibrate Mode (OFF/ON)

Local PCM Keypad/Display (optional)

A Local PCM Keypad/Display can be installed at the AHU to provide dedicated local access to AHU operating status and/or selected setpoints. The same custom display data that is available at the Local PCM Keypad/Display is also available in a status display at the Tracer BMS. The Tracer BMS status display is available regardless of whether the AHU has a Local PCM Keypad/Display.

When the Local PCM Keypad/Display is installed, the user can select between Tracer BMS setpoints and Local Keypad setpoints by switching the binary parameter "Local PCM Keypad Setpoints" (Disable/Enable) from the keypad. The Local Keypad setpoints are:

- Discharge Air Setpoint (50-80° F)
- Duct Static Setpoint (0.0-3.0" W.C.)
- Morning Warmup Setpoint (0-100° F)

In addition, other setpoints (Parameters) are available at the Local PCM Keypad (such as the Outdoor Air Minimum Position) and are used at all times, since no corresponding values are sent from the Tracer BMS. Refer to Local Parameters (above) for a list of these Parameters.

Analog Output Calibrate Mode

When the Run-Auto/Stop input is Open (AHU OFF), the user can select a special Analog Output Calibrate Mode, typically from the Local PCM Keypad/Display. When in the Calibrate Mode, all Analog Outputs (HW Valve, CW Valve, OA Damper, and Inlet Vanes) will be set to 0% to allow valve and/or linkage adjustments to be made.

Note: AIP and AOP Range and Offset entries shown on the next page may vary, depending on the actual input sensors and output actuators used.

POINT DATA DEFINITIONS

PCM: AHV-001B Date: 03-FEB-92
Location: Page: 1 of 2

PULSE METER INPUTS:

Name	Weight
PAC1	.0
PAC2	.0

ANALOG INPUTS:

	Name	Conv Type	Range	Offset
AIP1	MIXEDTMP	BAL	102.4	.0
AIP2	SPARE	BAL	102.4	.0
AIP3	DISCHTMP	THM	102.4	.0
AIP4	OATEMP	THM	102.4	.0
AIP5	SPACETMP	THM	102.4	.0
AIP6	STATICPR	LIN	6.2	-1.2

ANALOG OUTPUTS:

	Name	Range	Offset
AOP1	HWVALVE	-333.3	300.0
AOP2	CWVALVE	333.3	-200.0
AOP3	OADAMPER	125.0	-25.0
AOP4	IGVANES	125.0	-25.0

ANALOG SETPOINTS: *(from Tracer BMS)*

	Name	Communications Loss Value		Name	Communications Loss Value
ASP1	DISCHSP	55.0	ASP5		.0
ASP2	STATICSP	1.5	ASP6		.0
ASP3	MWUTEMP	75.0	ASP7		.0
ASP4		.0	ASP8	ZONESP	71.0

ANALOG PARAMETERS: *(adjusted by operator)*

	Name	Value		Name	Value
ANP1	DISCHSPK	55.0	ANP5	MIXEDSP	48.0
ANP2	STATSPK	1.5	ANP6	OAECONSP	70.0
ANP3	MWUSPK	71.0	ANP7	OAMINPOS	15.0
ANP4		.0	ANP8	MWUDIFF	5.0

ANALOG VARIABLES: *(calculated by PCL routines)*

	Name		Name		Name		Name
AV1	COOLSP	AV5	MINPOS	AV9		AV13	OADCALC
AV2	ECONSP	AV6	MWUSP	AV10		AV14	HEATCALC
AV3	HEATSP	AV7	STATSP	AV11	IGVCALC	AV15	COOLCALC
AV4	MIXAIRSP	AV8		AV12	MIXCALC	AV16	

POINT DATA DEFINITIONS

PCM: AHV-001B Date: 03-FEB-92
Location: Page: 2 of 2

BINARY INPUTS:

	Name	Open Means
BIP1	SUPFANST	OFF
BIP2	FILTER	OFF
BIP3	MIXLOLIM	ON
BIP4	RUN-AUTO	OFF

BINARY OUTPUTS:

	Name	Relay Off Means	Minimum On Time	Minimum Off Time
BOP1	SUPFANSS	OFF	0	5
BOP2		OFF	0	0
BOP3		OFF	0	0
BOP4		OFF	0	0
BOP5		OFF	0	0
BOP6		OFF	0	0

BINARY SETPOINTS: *(from Tracer BMS)*

	Name	Communications Loss State		Name	Communications Loss State
BSP1	ECONOMIZ	ON	BSP13	PURGE	OFF
BSP2		OFF	BSP14	NITSBK	OFF
BSP3		OFF	BSP15	DMDLIM	OFF
BSP4		OFF	BSP16	DTYCYC	OFF
BSP5		OFF	BSP17	SHUTDN	OFF
BSP6		OFF	BSP18		OFF
BSP7		OFF	BSP19		OFF
BSP8	COOLING	ON	BSP20		OFF
BSP9	OCCUPY	ON	BSP21		OFF
BSP10	UNOCCU	OFF	BSP22		OFF
BSP11	STARTU	OFF	BSP23		OFF
BSP12	COASTD	OFF	BSP24		OFF

BINARY PARAMETERS: *(adjusted by operator)*

	Name	State		Name	State
BNP1	MANRESET	OFF	BNP5	HEATOPEN	ON
BNP2	KEYPADSP	OFF	BNP6	COOLOPEN	OFF
BNP3		OFF	BNP7	CALIBRTE	OFF
BNP4		OFF	BNP8		OFF

BINARY VARIABLES: *(calculated by PCL routines)*

	Name		Name		Name		Name
BV1	HEAT	BV5	ECONENAB	BV9		BV13	
BV2	COOL	BV6		BV10		BV14	
BV3	FANON	BV7		BV11	FANFAIL	BV15	

DDC LOOP PARAMETERS

PCM: AHV-001B Date: 03-FEB-92

Location:

DDC Loop # 1	DUCT STATIC	DDC Loop # 2	ECONOMIZER
Proportional Gain	40.00	Proportional Gain	4.00
Integral Gain	10.00	Integral Gain	1.00
Derivative Gain	.00	Derivative Gain	.00
Action	REVERS	Action	DIRECT
Proportional Bias	.0	Proportional Bias	.0
Minimum Output Value	-10.0	Minimum Output Value	-10.0
Maximum Output Value	100.0	Maximum Output Value	100.0
Error Deadband	.1	Error Deadband	.5

DDC Loop # 3	COOL VALVE	DDC Loop # 4	HEAT VALVE
Proportional Gain	4.00	Proportional Gain	4.00
Integral Gain	1.00	Integral Gain	1.00
Derivative Gain	.00	Derivative Gain	.00
Action	DIRECT	Action	REVERS
Proportional Bias	.0	Proportional Bias	.0
Minimum Output Value	-10.0	Minimum Output Value	-10.0
Maximum Output Value	100.0	Maximum Output Value	100.0
Error Deadband	.5	Error Deadband	.5

DDC Loop # 5	MIXED AIR	DDC Loop # 6	
Proportional Gain	4.00	Proportional Gain	.00
Integral Gain	1.00	Integral Gain	.00
Derivative Gain	.00	Derivative Gain	.00
Action	DIRECT	Action	REVERS
Proportional Bias	.0	Proportional Bias	.0
Minimum Output Value	-10.0	Minimum Output Value	.0
Maximum Output Value	100.0	Maximum Output Value	.0
Error Deadband	.5	Error Deadband	.0

```
                          PCL ROUTINE DEFINITION

  PCM: AHV-001B                                    Date: 03-FEB-92
  Location:

  Routine Name: FAIL DETECT                    Routine Number:  1
                              Freq:   0 Hrs.   0 Mins.   5 Secs.

Result    1st Arg  Operator 2nd Arg    Description of Statement
------    -------  -------- ---------- ------------------------------
*L0     =          NOT      RUN-AUTO   *L0 TRUE IF RUN-AUTO/STOP BIP = STOP
*L1     =          NOT      SUPFANST   *L1 TRUE IF SUPFANST BIP IS OFF
*IFT    = SUPFANSS AND       *L1        IF SUPPLY FAN BOP IS ON AND BIP OFF
*R0     = *R0      +         *1.0       INCREASE COUNTER *R0 BY ONE
*ELSE   =                               IF NOT (I.E. BOP IS OFF OR BIP ON
*R0     = *0                            RESET COUNTER TO ZERO
*IFT    = *R0      GT        *24        IF COUNTER > 24 (24 X 5 SEC = 2 MIN)
FANFAIL= TRUE                           SET BINARY VARIABLE "FANFAIL" TRUE
*IFT    = MANRESET OR        *L0        IF MANRESET BNP ON OR AUTO BIP OFF
FANFAIL= FALSE                          SET BINARY VARIABLE "FANFAIL" FALSE
*END    =                               END OF *IFT STRING
LOWTEMP= MIXLOLIM                       LOWTEMP VARIABLE = MIXLOLIM BIP
*END    =                               END OF ROUTINE
```

Routine #1 Description:

This routine monitors the supply fan for fan failure. Should the supply fan start/stop "SUPFANSS" binary output be "ON" and the supply fan status binary input "SUPFANST" be "OFF" for a two minute time period, the "FANFAIL" binary variable will be triggered to "ON" and initiate fan failure.

Once initiated, the "FANFAIL" binary variable can only be reset to "OFF" by one of the following methods:

1. Toggle the manual reset, "MANRESET", binary parameter to "ON" then "OFF". Typically accomplished through the LCD display.
2. Trigger the "RUN/AUTO" binary input to "OFF" then "ON". Typically accomplished be either removing and re-installing the factory installed jumper or switching a field installed toggle switch to "OFF" then "ON".
3. Toggle the PCM circuit board on-off switch to "OFF" then "ON".

The "LOWTEMP" variable is triggered to "ON" whenever the "MIXLOLIM" binary input is ON (open circuit). The "LOWTEMP" variable can only be cleared by manually resetting the Mixed Air Low Limit Device.

```
                        PCL ROUTINE DEFINITION

 PCM: AHV-001B                                  Date: 03-FEB-92
 Location:

 Routine Name: FAN CONTROL                 Routine Number:  2
                           Freq:   0 Hrs.   0 Mins.   5 Secs.

Result       1st Arg    Operator 2nd Arg    Description of Statement
---------- ---------- -------- ---------- ------------------------------
*L0        =            NOT      RUN-AUTO   *L0 TRUE IF RUN-AUTO/STOP BIP = STOP
*L1        = *L0        OR       SHUTDN     \*L1 TRUE IF STOP OR "SHUTDN" MODE
           = FANFAIL             LOWTEMP    /    OR FANFAIL OR LOWTEMP
*L2        = DMDLIM     OR       DTYCYC     *L2 TRUE IF DMDLIM OR DTYCYC MODE
*IFT       = UNOCCU     OR       *L2        IF UNOCCU OR DMDLIM OR DTYCYC MODE
SUPFANSS   =            CONTROL  OFF        CONTROL SUPPLY FAN BOP TO "OFF"
*ELSE      =                                IF NOT
SUPFANSS   =            CONTROL  ON         CONTROL SUPPLY FAN BOP TO "ON"
*IFT       = *L1                            IF STOP, SHUTDN, FANFAIL, OR LOWTEMP
SUPFANSS   = NOMIN      CONTROL  OFF        BOP "OFF" OVERRIDING MIN ON TIMER
*IFT       = SUPFANSS   AND      SUPFANST   IF FAN BOP AND STATUS "ON"
*R0        = *R0        +        *1.0       INCREASE COUNTER *R0 BY ONE
*ELSE      =                                IF NOT (FAN BOP OR STATUS BIP OFF)
*R0        = *0                             RESET COUNTER TO *R0 TO ZERO
*END       =                                END OF *IFT STRING
FANON      = *R0        GT       *6         "FANON" = TRUE IF *R0 > 6 (30 SEC)
FANOFF     =            NOT      FANON      "FANOFF" = OPPOSITE OF "FANON"
*END       =                                END OF ROUTINE
```

Routine #2 Description:

This routine starts and stops the supply fan. After air flow is established for a 30 second time period, the "FANON" binary variable is set to "TRUE". The "FANOFF" binary variable (used in other routines) is set to the opposite state of "FANON".

The supply fan "SUPFANSS" binary output will be controlled to "ON" and remain on until indexed to be "OFF" by one of the following triggers:

1. "RUN-AUTO" binary input is open or "OFF" (shutdown).
2. "FANFAIL" binary variable is "ON".
3. "LOWTEMP" binary variable is "ON".
4. "SHUTDN" binary setpoint is "ON" (Tracer BMS interface).

   Note: The above fan "OFF" triggers will stop the supply fan instanteously overriding minimum ON/OFF timers.

5. "DMDLIM" binary setpoint is "ON" (Tracer BMS interface).
6. "DTYCYC" binary setpoint is "ON" (Tracer BMS interface).
7. "UNOCCU" binary setpoint is "ON" (Tracer BMS interface).

PCL ROUTINE DEFINITION

PCM: AHV-001B Date: 03-FEB-92
Location:

Routine Name: LOCAL SETPTS Routine Number: 3
Freq: 0 Hrs. 0 Mins. 5 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
*IFT	=	KEYPADSP			IF KEYPADSP BNP IS ON (LOCAL SETPTS)
COOLSP	=	DISCHSPK			COOLING SETPT = KEYPAD DISCH SETPT
STATSP	=	STATSPK			STATIC SETPT = KEYPAD STATIC SETPT
MWUSP	=	MWUSPK			WARMUP SETPT = KEYPAD WARMUP SETPT
*ELSE	=				IF NOT (USING TRACER SETPOINTS)
COOLSP	=	DISCHSP			COOLING SETPT = TRACER DISCH SETPT
STATSP	=	STATICSP			STATIC SETPT = TRACER STATIC SETPT
MWUSP	=	ZONESP			WARMUP SETPT = TRACER ZONE SETPT
*END	=				END OF *IFT STRING
STATSP	=	STATSP	MIN	*3.0	STATIC SETPOINT HIGH LIMIT OF 3.0"
COOLSP	=	COOLSP	MIN	*80	COOL SETPOINT HIGH LIMIT OF 80 DEG
COOLSP	=	COOLSP	MAX	*50	COOL SETPOINT LOW LIMIT OF 50 DEG
*END	=				END OF ROUTINE

Routine #3 Description:

This routine establishes the values of the Cooling Setpoint "COOLSP", the Duct Static Setpoint "STATSP", and the Morning Warmup Setpoint "MWUSP" Analog Variables to be used in other routines.

Tracer BMS values communicated through Analog Setpoints "DISCHSP", "STATICSP", and "ZONESP" values are used for "COOLSP", "STATSP", and "MWUSP", respectively, unless Binary Parameter "KEYPADSP" is "ON". With "KEYPADSP" on, PCM Analog Parameters "DISCHSPK", "STATSPK", and "MWUSPK" values are used for "COOLSP", "STATSP", and "MWUSP", respectively. Analog Parameter values are adjustable through the PCM LCD display.

This routine also limits "COOLSP" value adjustment to 50° F to 80° F and "STATSP" value adjustment to a maximum of 3.0" W.G.

PCL ROUTINE DEFINITION

PCM: AHV-001B Date: 03-FEB-92
Location:

Routine Name: HEAT/COOL Routine Number: 4
Freq: 0 Hrs. 0 Mins. 10 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
*R0	=	MWUSP	-	MWUDIFF	*R0 = MWU SETPT - MWU DIFFERENTIAL
*IFT	=	MWUTEMP	GE	MWUSP	IF MWUTEMP SENSOR > MWU SETPOINT
*L0	=	TRUE			SET *L0 TO "TRUE" (INDICATES WARM)
*IFT	=	MWUTEMP	LE	*R0	IF MWUTEMP SENSOR > LOW SETPOINT *R0
*L0	=	FALSE			SET *L0 TO "FALSE" (INDICATES COLD)
*IFT	=	UNOCCU	OR	NITSBK	IF MODE IS UNOCCUPY OR NITE SETBACK
*L0	=	MWUTEMP	GE	*72	*L0 TRUE IF MWUTEMP SENSOR > 72 DEG
*IFT	=	KEYPADSP			IF KEYPADSP BNP IS ON (LOCAL SETPTS)
COOL	=	*L0			COOL MODE IS TRUE IF *L0 IS TRUE
*ELSE	=				IF NOT (USING TRACER SETPOINTS)
COOL	=	*L0	OR	COOLING	COOL MODE IF *L0 OR ZONE IS COOLING
*END	=				END OF *IFT STRING
*L1	=		NOT	COOLING	*L1 TRUE IF TRACER ZONE IS HEATING
*IFT	=	FANOFF	AND	*L1	IF FAN IS OFF AND ZONE IS HEATING
COOL	=	FALSE			AHU HEAT/COOL MODE IS HEAT
*END	=				END OF *IFT STRING
HEAT	=		NOT	COOL	HEAT MODE = OPPOSITE OF COOL MODE
*END	=				*END OF ROUTINE

Routine #4 Description:

This routine establishes an "ON" or "OFF" value for the "COOL" and "HEAT" Binary Variables with the "HEAT" value always being the opposite of the "COOL" value. The "HEAT" Binary Variable is used by the SETPOINTS, OADAMPER, COOL VALVE, and HEAT VALVE routines.

With "KEYPADSP" Binary Parameter set to "OFF", the "COOL" and "HEAT" Binary Variables are determined as follows:

If the Morning Warmup Temperature "MWUTEMP" Analog Setpoint value from the Tracer BMS is greater than the Morning Warmup Setpoint "MWUSP" Analog Variable value as set from the Tracer BMS through Analog Setpoint "ZONESP" (see Routine #3) or Binary Setpoint "COOLING" is "ON" from the Tracer BMS, Binary Variable "COOL" is set to "ON" and the mode of the AHU will be cool. If "MWUTEMP" value is less than the "MWUSP" value minus the Morning Warmup Differential "MWUDIFF" Analog Parameter value and Binary Setpoint "COOLING" is "OFF", Binary Variable "HEAT" is set to "ON" and the mode of the AHU will be heat.

If Binary Setpoints "UNOCCU" or "NITSBK" are set to "ON" from the Tracer BMS, Binary Variable "HEAT" is set to "ON" and the mode of the AHU will be heat whenever "MWUTEMP" morning warmup temperature value is less than 72° F. If Binary Variable "FANOFF" is set to "ON" and Binary Setpoint "COOLING" is "OFF", the mode of the AHU will be heat.

With "KEYPADSP" Binary Parameter set to "ON", the "COOL" Binary Variable value is determined solely by the comparison of Morning Warmup Temperature "MWUTEMP" Analog Setpoint value from the Tracer BMS to the Morning Warmup Setpoint "MWUSP" Analog Variable value from the PCM through Analog Parameter "MWUSPK" (see routine #3 description).

If "MWUTEMP" value is greater than the "MWUSP" value ", the mode of the AHU will be cool. If "MWUTEMP" value is less than the "MWUSP" value minus Analog Parameter "MWUDIFF" Morning Warmup Differential value, the mode of the AHU will be heat.

PCL ROUTINE DEFINITION

PCM: AHV-001B Date: 03-FEB-92
Location:

Routine Name: SETPOINTS Routine Number: 5
Freq: 0 Hrs. 0 Mins. 10 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
ECONSP	=	COOLSP	-	*2	ECONOMIZER S.P. = COOL S.P. - 2 DEG
MIXAIRSP	=	MIXEDSP	MAX	*45	MIXED AIR SETPT LOW LIMIT OF 45 DEG
HEATSP	=	ECONSP	-	*2	HEAT S.P. = ECONOMIZER S.P. - 2 DEG
*IFT	=	HEAT			IF AHU IS IN HEATING MODE
HEATSP	=	*104			HEAT SETPOINT = 104 DEG
*END	=				END OF *IFT STRING
*R0	=	OAECONSP	-	*2.0	*R0 = OA CHANGEOVER S.P. - 2.0 DEG
*IFT	=	OATEMP	LE	*R0	IF OA TEMP IS COOL (LESS THAN R0)
*L0	=	TRUE			SET *L0 TO TRUE (INDICATES COOL)
*IFT	=	OATEMP	GE	OAECONSP	IF OA TEMP IS WARM (GREATER THAN SP)
*L0	=	FALSE			SET *L0 TO FALSE
*END	=				END OF *IFT STRING
*L1	=	*L0	AND	ECONOMIZ	TRUE IF COOL AND TRACER ECON. ENABLE
ECONENAB	=	*L1	OR	PURGE	ECON ENABLE IF *L1 OR PURGE MODE
*IFT	=	OCCUPY	OR	COASTD	IF OCCUPY OR COASTDOWN MODE
MINPOS	=	OAMINPOS			ECON MIN POSITION = OPERATOR ENTRY
*ELSE	=				IF NOT OCCUPY OR COASTDOWN
MINPOS	=	*0			ECON MIN POSITION = 0 %
*END	=				END OF ROUTINE

Routine #5 Description:

This routine establishes setpoint values for the following Analog and Binary Variables; Economizer Setpoint "ECONSP" Analog Variable, Mixed Air Setpoint "MIXAIRSP" Analog Variable, Heating Setpoint "HEATSP" Analog Variable, Outside Air Damper Minimum Position Setpoint "MINPOS" Analog Variable, and Economizer Enable "ECONENAB" Binary Variable. These Analog and Binary Variables are used in routines #7 through #9.

The Economizer Setpoint "ECONSP" Analog Variable is equal to the Cooling Setpoint "COOLSP" Analog Variable minus 2° F. If the mode of the AHU is cooling, the Heating Setpoint "HEATSP" Analog Variable is equal to the Economizer Setpoint "ECONSP" Analog Variable minus 2° F. If Binary Variable "HEAT" is set to "ON" (the mode of the AHU is heating) the Heating Setpoint "HEATSP" Analog Variable is set equal to 104° F. The Mixed Air Setpoint "MIXAIRSP" Analog Variable is equal to Analog Parameter "MIXEDSP" or 45° F, which ever is of larger value. Analog Parameter "MIXEDSP" is adjustable through the LCD PCM display.

If Outside Air Temperature "OATEMP" Analog Input value is 2° F less than the Outside Air Economizer Change-over Setpoint "OAECONSP" Analog Parameter value and Economizer "ECONOMIZ" Binary Setpoint is indexed to "ON" by the Tracer BMS or Binary Setpoint "PURGE" is indexed to "ON" by the Tracer BMS, Economizer Enable "ECONENAB" Binary Variable will be set to "ON" (enabled). If the Outside Air Temperature "OATEMP" Analog Input value is greater than Outside Air Economizer Switch-over Setpoint "OAECONSP" value, Economizer "ECONOMIZ" Binary Setpoint is indexed to "OFF" by the Tracer BMS or Binary Setpoint "PURGE" is indexed to "OFF" by the Tracer BMS, Economizer Enable "ECONENAB" Binary Variable will be "OFF" (disabled).

The Outside Air Damper Minimum Position Setpoint "MINPOS" Analog Variable is set equal to 0 %, unless, either the "OCCUPY" or "COASTD" Binary Setpoint is indexed to "ON" by the Tracer BMS. With "OCCUPY" or "COASTD" indexed to "ON", Outside Air Damper Minimum Position Setpoint "MINPOS" Analog Variable is set equal to Analog Parameter "OAMINPOS" value. "OAMINPOS" is adjustable through the PCM LCD display.

PCL ROUTINE DEFINITION

PCM: AHV-001B Date: 03-FEB-92
Location:

Routine Name: INLET VANES Routine Number: 6
Freq: 0 Hrs. 0 Mins. 5 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
IGVCALC	=	STATICPR	DDC:1	STATSP	EXECUTE INLET VANE CONTROL DDC LOOP
*R0	=	STATSP	+	*1.0	*R0 = STATIC SETPOINT + 1.0" W.C.
*IFT	=	STATICPR	GE	*R0	IF STATIC PRESSURE > SETPOINT + 1.0"
IGVCALC	=	IGVCALC	*	*0.5	REDUCE INLET VANE VALUE BY ONE HALF
*IFT	=	FANOFF			IF SUPPLY FAN OFF OR IN STARTUP TIME
IGVCALC	=	*-10			INLET VANE VALUE = -10% (FULL CLOSE)
*IFT	=	STATICPR	FAIL		IF STATIC PRESSURE SENSOR IS FAILED
IGVCALC	=	*-10			INLET VANE VALUE = -10% (FULL CLOSE)
*END	=				END OF *IFT STRING
IGVANES	=		CONTROL	IGVCALC	SET IGVANES AOP = CALCULATED VALUE
*END	=				END OF ROUTINE
	=				

Routine #6 Description:

This routine controls the inlet guide vane position through Analog Output "IGVANES" to the Calculated Inlet Guide Vane Position "IGVCALC" Analog Variable. "IGVCALC" value is equal to the output of DDC loop #1 which compares the Duct Static Pressure "STATICPR" Analog Input value to the Static Pressure Setpoint "STATSP" Analog Variable value as set in routine #3. DDC loop #1 output will change as required to maintain the Static Pressure Setpoint. If the Duct Static Pressure "STATICPR" Analog Input is 1" W.C. above setpoint, "IGVCALC" value will be reduced by one half.

If Binary Variable "FANOFF" is "ON" or the Duct Static Pressure "STATICPR" Analog Input is failed, "IGVCALC" value will be set equal to -10 % and cause the inlet guide vanes to close.

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                          PCL ROUTINE DEFINITION

 PCM: AHV-001B                                  Date: 03-FEB-92
 Location:

 Routine Name: OA DAMPER                  Routine Number:  7
                            Freq:   0 Hrs.   0 Mins.  10 Secs.

Result        1st Arg     Operator 2nd Arg     Description of Statement
----------    ----------  -------- ----------  -----------------------------------
OADCALC     = DISCHTMP    DDC:2    ECONSP      DDC LOOP FOR OADAMPER, USE OADCALC
OADCALC     = OADCALC     MAX      MINPOS      OADCALC LO LIMIT = ECON MIN POSITION
*L0         =             NOT      ECONENAB    *L0 TRUE IF ECONOMIZER IS DISABLED
*L1         = DISCHTMP    FAIL                 *L1 TRUE IF DISCH TEMP SENSOR FAILED
*IFT        = *L0         OR       *L1         IF ECON DISABLE OR DISCH SENSOR FAIL
OADCALC     = MINPOS                           SET CALC DAMPER POSITION AT MINIMUM
*END        =                                  END OF *IFT STRING
MIXCALC     = MIXEDTMP    DDC:5    MIXAIRSP    DDC LOOP FOR MIXED AIR, USE MIXCALC
OADCALC     = OADCALC     MIN      MIXCALC     SELECT MINIMUM OF OADCALC & MIXCALC
*L2         = MIXEDTMP    FAIL                 *L2 TRUE IF MIXED SENSOR FAILED
*L3         = FANOFF      OR       HEAT        *L3 TRUE IF FAN OFF OR HEAT MODE
*IFT        = *L2         OR       *L3         IF MIXEDTMP FAIL, FAN OFF OR HEAT
OADCALC     = *-10                             SET CALC DMPR POSITION TO FULL CLOSE
*END        =                                  END OF *IFT STRING
OADAMPER    =             CONTROL  OADCALC     SET OADAMPER AOP TO CALC DMPR POS.
MIXCALC     = OADCALC                          SET MIXCALC = OADCALC VALUE
*END        =                                  *END OF ROUTINE
```

Routine #7 Description:

This routine controls the Outside Air Damper through Analog Output "OADAMPER" to the Calculated Outside Air Damper position "OADCALC" Analog Variable value.

Initially, "OADCALC" value is set equal to the output of the economizer DDC loop #2 which compares the Discharge Air Temperature "DISCHTMP" Analog Input value to the Economizer Setpoint "ECONSP" Analog Variable value (2° F less than the Discharge Air Setpoint per routine #5). DDC loop #2 output will change as required to maintain the Economizer Setpoint. "OADCALC" value is limited to the Outside Air Damper Minimum Position "MINPOS" Analog Variable value and will be set to the Damper Minimum Position "MINPOS" value should the Discharge Temperature Sensor "DISCHTMP" Analog input fail or the Economizer "ECONENAB" Binary Variable be "OFF" (disabled) per routine #5.

"OADCALC" value is then set equal to the lesser value of "OADCALC" as determined above or the Calculated Mixed Air "MIXCALC" Analog Variable value. "MIXCALC" is set equal to the output of the mixed air DDC loop #5 which compares the Mixed Air Temperature "MIXEDTMP" Analog Input value to the Mixed Air Setpoint "MIXAIRSP" Analog Variable value as set in routine #5. DDC loop #5 output will change as required to maintain the Mixed Air Setpoint.

Should Binary Variable "HEAT" be "ON" (AHU in heat mode), the Binary Variable "FANOFF" be set to "ON" per routine #2 or the Mixed Air Temperature Sensor "MIXEDTMP" Analog Input be failed, "OADCALC" value as previously determined is ignored and is set to -10%. An "OADCALC" value of -10% will cause closure of the outside air damper.

"MIXCALC" value is set equal to the "OADCALC" value at the end of this routine to provide a smooth transfer of control between the two DDC loops.

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                        PCL ROUTINE DEFINITION

  PCM: AHV-001B                                  Date: 03-FEB-92
  Location:

Routine Name: COOL VALVE                  Routine Number:  8
                          Freq:   0 Hrs.   0 Mins.  10 Secs.

Result       1st Arg     Operator 2nd Arg    Description of Statement
---------    ----------  -------- ---------- -----------------------------------
COOLCALC   = DISCHTMP    DDC:3    COOLSP     RUN DDC LOOP FOR COOL VALVE CONTROL
*IFT       = OADAMPER    LE       *70        IF OA DAMPER POSITION > 70%
*L0        = TRUE                            SET *L0 TO TRUE
*IFT       = OADAMPER    GE       *90        IF OA DAMPER POSITION > 90%
*L0        = FALSE                           SET *L0 TO FALSE
*END       =                                 END OF *IFT STRING
*L1        = *L0         AND      ECONENAB   *L1 TRUE IF *L0 TRUE AND ECON ENABLE
*L2        = *L1         OR       HEAT       \ *L2 TRUE IF: *L1 TRUE OR HEAT MODE
           = FANOFF                COASTD      OR FAN IS OFF OR COASTDOWN MODE
           = PURGE                            / OR PURGE MODE
*IFT       = DISCHTMP    FAIL                IF TRUE DISCH TEMP SENSOR FAILED
COOLCALC   = *50                             IF *L2 IS TRUE
*IFT       = *L2                             IF *L2 TRUE
COOLCALC   = *-10                            CALC COOL VALVE POS. = FULL CLOSED
*IFT       = FANOFF      AND      COOLOPEN   IF FANOFF AND COOLOPEN ARE BOTH TRUE
COOLCALC   = *100                            CALC COOL VALVE POS. = FULL OPEN
*END       =                                 END OF *IFT STRING
CWVALVE    =             CONTROL  COOLCALC   SET COOL VALVE AOP = CALC POSITION
*END       =                                 END OF ROUTINE
```

Routine #8 Description:

This routine controls the Chilled Water Valve through Analog Output "CWVALVE" to the Calculated Chilled Water Valve Position "COOLCALC" Analog Variable. "COOLCALC" value is equal to the output of DDC loop #3 which compares the Discharge Air Temperature Sensor "DISCHTMP" Analog Input value to the Cooling Setpoint "COOLSP" Analog Variable value as set in routine #5. DDC loop #3 output will change as required to maintain the cooling setpoint.

Should the Discharge Air Temperature Sensor "DISCHTMP" Analog Input fail, Analog Variable "COOLCALC" is set equal to 50%.

Regardless of Discharge Air Temperature Sensor failure or DDC loop #3 output, Analog Variable "COOLCALC" is set equal to -10% should the Outside Air Damper "OADAMPER" Analog Output value be less than 70% and Economizer Enable "ECONENAB" Binary Variable is "ON" (enabled per routine #5) or one of the following Binary Variables or setpoints is "ON"; Binary Variable "HEAT" per routine #4, Binary Variable "FANOFF" per routine #2, Binary Setpoints "PURGE" and "COASTD" per Tracer BMS.

Previously determined Analog Variable "COOLCALC" value is ignored and is set to 100% should Binary Variable "FANOFF" be "ON" and Binary Parameter "COOLOPEN" be "ON" (open). "COOLOPEN" is adjustable through the PCM LCD display.

Note: If Disch Sensor Fail and Economizer Enabled, then COOLCALC = -10% (Full Closed) and OADAMPER = Minimum Position.

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                          PCL ROUTINE DEFINITION

 PCM: AHV-001B                                    Date: 03-FEB-92
 Location:

 Routine Name: HEAT VALVE                    Routine Number:  9
                              Freq:   0 Hrs.   0 Mins.  10 Secs.

Result        1st Arg     Operator 2nd Arg     Description of Statement
----------    ----------  -------- ----------  -----------------------------------
HEATCALC    = DISCHTMP    DDC:4    HEATSP      RUN DDC LOOP FOR HWVALVE CONTROL
*L0         = DISCHTMP    FAIL                 *L0 TRUE IF DISCH TEMP SENSOR FAILED
*R0         = MINPOS      +        *1          *R0 = OA DAMPER MIN. POS. + 1%
*L1         = OADAMPER    GE       *R0         *L1 TRUE IF OADAMPER POS. > *R0
*L2         = CWVALVE     GT       *0          *L2 TRUE IF CWVALVE NOT FULLY CLOSED
*L3         = *L0         OR       *L1         \  IF SELECTED SENSOR IS FAILED OR
            = *L2                  FANOFF      >  OADAMPER  MINPOS OR CWVALVE IS
*IFT        = *L3                              /  NOT FULLY CLOSED OR FANOFF
HEATCALC    = *-10                             CALC HEAT VALVE POS. IS FULL CLOSED
*IFT        = FANOFF      AND      HEATOPEN    IF SUPPLY FANOFF AND HEATOPEN TRUE
HEATCALC    = *100                             CALC HEAT VALVE POS. IS FULL OPEN
*END        =                                  END OF *IFT STRING
HWVALVE     =             CONTROL  HEATCALC    SET HWVALVE AOP = CALC. POSITION
*END        =                                  END OF ROUTINE
```

Routine #9 Description:

This routine controls the Hot Water Valve through Analog Output "HWVALVE" to the Calculated Hot Water Valve position "HEATCALC" Analog Variable. "HEATCALC" value is equal to the output of DDC loop #4 which compares the Discharge Air Temperature Sensor "DISCHTMP" Analog Input value to the Heating Setpoint "HEATSP" Analog Variable value as set per routine #5. DDC loop #4 output will change as required to maintain the heating setpoint.

Regardless of DDC loop #4 output, Analog Variable "HEATCALC" is set equal to -10% if the Discharge Air Temperature Sensor "DISCHTMP" Analog Input is failed, the Outside Air Damper "OADAMPER" Analog Output is greater than Outside Air Damper Minimum Postion "MINPOS" Analog Variable value as set in routine #5 or Binary variable "FANOFF" IS "ON" per routine #2.

Analog Variable "HEATCALC" as previously determined is ignored and is set to 100% should Binary Variable "FANOFF" be "ON" and Binary Parameter "HEATOPEN" be "ON" (open). "HEATOPEN" is adjustable through the PCM LCD display.

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                          PCL ROUTINE DEFINITION

 PCM: AHV-001B                                  Date: 03-FEB-92
 Location:

 Routine Name: CALIBRATION                 Routine Number: 10
                          Freq:   0 Hrs.   0 Mins.  60 Secs.

Result       1st Arg     Operator 2nd Arg    Description of Statement
---------- ---------- -------- ---------- ------------------------------------
*L0        =           NOT      RUN-AUTO   *L0 TRUE IF AUTO/STOP BIP IS STOP
*IFT       = CALIBRTE  AND      *L0        IF CALIBRATE BNP ON AND STOP
HWVALVE    =           CONTROL  *0         SET HOT WATER VALVE POSITION = 0%
CWVALVE    =           CONTROL  *0         SET CHILLED WTR VALVE POSITION = 0%
OADAMPER   =           CONTROL  *0         SET OA DAMPER POSITION = 0%
IGVANES    =           CONTROL  *0         SET INLET VANE POSITION = 0%
*END       =                               END OF ROUTINE
```

Routine #10 Description:

With Binary Input "RUN/AUTO" indicating "OFF" and Binary Parameter "CALIBRTE" set to "ON" all Analog Outputs (HW valve, CW valve, OA damper, and inlet guide vanes) will be set to 0% to allow valve and/or linkage adjustments to be made. Binary Parameter "CALIBRTE" is typically adjusted from the PCM LCD display.

CUSTOM DISPLAY SETUP

PCM: AHV-001B Date: 03-FEB-92
Location:

PCM System Password: +-+-

Display Line	Point Name	Expanded Description	Desc/ Units	Adjust	Adjustment Limits Low	High
1	RUN-AUTO	AUTO/STOP INPUT	7			
2	SUPFANSS	SUPPLY FAN START	0			
3	SUPFANST	SUPPLY FAN STATUS	0			
4	COOL	COOLING MODE	4			
5	DISCHTMP	DISCHARGE AIR TEMP	0			
6	COOLSP	DISCH COOLING STPT	0			
7	STATICPR	DUCT STATIC PRESS	9			
8	STATSP	DUCT STATIC SETPT	9			
9	IGVANES	INLET GUIDE VANES	4			
10	ECONENAB	ECONOMIZER STATUS	2			
11	OADAMPER	OA DAMPER POSITION	4			
12	MIXEDTMP	MIXED AIR TEMP	0			
13	HWVALVE	H.W. VALVE POS	4			
14	CWVALVE	C.W. VALVE POS	4			
15	SPACETMP	SPACE TEMPERATURE	0			
16	OATEMP	OUTDOOR AIR TEMP	0			
17	MWUTEMP	MORNING WRMUP TEMP	0			
18	FANFAIL	SUPPLY FAN FAILURE	4			
19	FILTER	DIRTY FILTER	4			
20	MIXLOLIM	MIXED AIR LO LIMIT	5			
21	KEYPADSP	KEYPAD SETPOINTS	4	Y		
22	DISCHSPK	KEYPAD DISCH SETPT	0	Y	50.0	80.0
23	STATSPK	KEYPAD STATIC STPT	9	Y	.0	3.0
24	MWUSPK	KEYPAD WARMUP STPT	0	Y	.0	100.0
25	MWUDIFF	MORN. WARMUP DIFF.	0	Y	1.0	20.0
26	OAMINPOS	OA MIN POSITION SP	4	Y	.0	100.0
27	OAECONSP	OA ECON ENABLE SP	0	Y	-100.0	100.0
28	MIXEDSP	MIXED AIR SETPOINT	0	Y	45.0	100.0
29	HEATOPEN	FAN OFF HW VLV POS	1	Y		
30	COOLOPEN	FAN OFF CW VLV POS	1	Y		
31	CALIBRTE	AOP CALIBRATE MODE	0	Y		
32	MANRESET	MANUAL RESET POINT	0	Y		

Binary Descriptor Table:

0 = OFF/ON	1 = CLOSED/OPEN	2 = DISABL/ENABLE
3 = AUTO/MANUAL	4 = NO/YES	5 = NORMAL/ALARM
6 = UNOCC/OCCUPY	7 = SHUTDN/NORMAL	8 = HEAT/COOL

Analog Units Table:

0 = DEG	1 = PSI	2 = KW	3 = KWH	4 = PCT	5 = CFM
6 = AMP	7 = VOL	8 = HG	9 = IN	10 = RH	11 = Blank

VAV Air Handling Unit with Stand-alone Control

Control Sequence for AHV-002B

Occupied Cooling Mode:
When the AHU is indexed to the occupied cooling mode, the supply fan will operate continuously, the inlet vanes will modulate to maintain the duct static pressure (1.5"W.C. nominal), the outside air damper will be at its minimum position (unless economizing), and the discharge air temperature (55°F nominal) will be maintained by modulating the Chilled Water Valve, the Hot Water or Steam Valve and the outdoor air damper. VAV boxes override is off.

Night Setback/Morning Warmup Heating Mode:
Night setback mode is determined based on the space temperature sensor and night setback setpoint. The night setback setpoint is adjustable at the local PCM keypad/display. If the space sensor temperature is less than the night setback setpoint, the AHU will be indexed to the night setback mode. When the AHU is in the night setback/morning warmup heating mode, the supply fan will operate continuously, the inlet vanes will modulate to maintain the duct static pressure (1.5"W.C. nominal), the outdoor air damper will be fully closed, the chilled water valve will be fully closed and the hot water or steam valve will modulate to maintain the discharge air temperature (104°F nominal). VAV boxes override is on.

Supply Fan Control:
The supply fan will operate continuously whenever the AHU is indexed to either the occupied cooling mode or the night setback/morning warmup heating mode. The supply fan will be off whenever the AHU is indexed to the unoccupied mode, the run-auto/stop interlock is open, the mixed air low limit is tripped, or the supply fan status indicates a failure (after a 2 minute delay). The fan failure indication requires a manual reset, which can be done at the local PCM keypad/display or by opening the run-auto/stop interlock.

Inlet Vane Control:
When the supply fan is on, the inlet vanes will modulate, as commanded by the PCM controller, to maintain the duct static pressure as sensed three/fourths the distance down the longest duct serving the VAV boxes. The duct static setpoint is adjustable at the local PCM keypad/display, and is limited to the range of 0.0 to 3.0"W.C. If the duct static pressure sensor is failed or if the supply fan is off, the inlet vanes will be fully closed. If duct static pressure goes 1.0"W.C. above the setpoint, the inlet vanes will be positioned to 50% of their current position.

Heat/Cool Mode Control:
The heat/cool mode of the AHU is determined based on the space temperature sensor and the morning warmup setpoint. The morning warmup setpoint is adjustable at the local PCM keypad/display. If the space sensor temperature is greater than the morning warmup setpoint, the mode of the AHU will be cool. If the space sensor temperature is less than the morning warmup setpoint less the morning warmup differential, the mode of the AHU will be heat. The AHU will be allowed to switch between the heating and cooling modes at any time during operation, based on this logic. If the supply fan is off, the heat/cool mode is heating. If the space temperature sensor is failed, the mode of the AHU will be cool.

AHV-002B continued...

Outdoor Air Damper Control:
The economizer function is enabled when the outdoor air temperature is less than the changeover setpoint minus 2°F. When the economizer function is enabled, the outdoor air damper will modulate, as commanded by the PCM controller, between minimum position and fully open to maintain the discharge air temperature at the economizer setpoint (discharge cooling setpoint minus 2°F). The outdoor air damper will be modulated closed as required (overriding the minimum position) to maintain the mixed air temperature (averaging element) at or above the mixed air setpoint (48°F nominal). A mixed air low limit manual reset device (sensing the coldest one-foot section) will turn the supply fan off if its sensed temperature is below its setpoint (36°F nominal).

If the economizer function is disabled by the outdoor air temperature being above the changeover setpoint or the discharge air temperature sensor is failed, the outdoor air damper will be set to minimum position. If the AHU mode is heating, the supply fan is off or the mixed air temperature sensor is failed, the outdoor air damper will be fully closed.

Chilled Water Valve Control:
The chilled water valve will modulate, as commanded by the PCM controller, to maintain the discharge air temperature at the discharge cooling setpoint. The discharge cooling setpoint is adjustable at the local PCM keypad/display and is limited to a range of 50° to 80°F. If the economizer function is enabled and the outdoor air damper is not fully opened or the mode of the AHU is heating, the chilled water valve will be closed. If the discharge air temperature sensor is failed, the chilled water valve shall be positioned to 50%. If the supply fan is off, the chilled water valve will be either fully open or closed, as selected by a user entry.

Hot Water or Steam Valve Control:
The hot water or steam valve will modulate, as commanded by the PCM controller, to maintain the discharge air temperature at the heating setpoint. If the AHU is in the heating mode, the heating setpoint is 104°F. If the AHU is in the cooling mode, the heating setpoint is equal to the economizer setpoint minus 2°F. If the outdoor air damper is open past the minimum position, if the chilled water is not fully closed, or if the discharge air temperature sensor is failed, the hot water or steam valve will be closed. If the supply fan is off, the hot water or steam valve will either be fully opened or closed, as selected by a user entry.

Unoccupied Mode:
When the AHU is indexed to the unoccupied mode, the supply fan will be turned off, the inlet vanes and outside air damper will be fully closed. The chilled water valve will be either fully closed or fully open, as selected by user entry. The hot water or steam valve will be either fully open or fully closed, as selected by user entry.

The unoccupied mode is triggered by the occupy binary input (closed = occupy), typically from an external system or time clock. If enabled, the space sensor timed override switch momentary closure places the AHU in the occupied (or morning warmup) mode for a two hour period overriding the occupied input.

AHV-002B continued...

Local PCM Keypad/Display:
The following setpoints (parameters) are stored in the AHU PCM and can be accessed through the local PCM keypad/display:

Analog Parameters

- Discharge Setpoint (50-80° F)
- Duct Static Setpoint (0.0 - 3.0"W.C.)
- Morning Warmup Setpoint (0 - 100° F)
- Morning Warmup Differential (1 - 20° F)
- Mixed Air Setpoint (45 - 100° F)
- Outdoor Air Changeover Setpoint (-100 - 100° F)
- Night Setback Setpoint (45 - 80° F)

Binary Parameters

- Manual Reset Point (OFF/ON)
- Heat Valve/Fan Off (CLOSED/OPEN)
- Cool Valve/Fan Off (CLOSED/OPEN)
- AOP Calibrate Mode (OFF/ON)
- Space Sensor TOV Switch Enable (NO/YES)

Analog Output Calibrate Mode:
When the run-auto/stop input is open (AHU OFF) the user can select a special analog output calibrate mode from the local PCM keypad/display. When in the calibrate mode, all analog outputs (HW valve, CW valve, OA Damper and inlet vanes) will be set to 0% to allow valve and/or linkage adjustments to be made.

Note: AIP and AOP Range and Offset entries shown on the next page may vary, depending on the actual input sensors and output actuators used.

POINT DATA DEFINITIONS

PCM: AHV-002B
Location:

Date: 03-FEB-92
Page: 1 of 2

PULSE METER INPUTS:

Name	Weight
PAC1	.0
PAC2	.0

ANALOG INPUTS:

	Name	Conv Type	Range	Offset
AIP1	MIXEDTMP	BAL	102.4	.0
AIP2	SPARE	BAL	102.4	.0
AIP3	DISCHTMP	THM	102.4	.0
AIP4	OATEMP	THM	102.4	.0
AIP5	SPACETMP	THM	102.4	.0
AIP6	STATICPR	LIN	6.2	-1.2

ANALOG OUTPUTS:

	Name	Range	Offset
AOP1	HWVALVE	-333.3	300.0
AOP2	CWVALVE	333.3	-200.0
AOP3	OADAMPER	125.0	-25.0
AOP4	IGVANES	125.0	-25.0

ANALOG SETPOINTS: ***(from Tracer BMS)***

Name	Communications Loss Value	Name	Communications Loss Value
ASP1	.0	ASP5	.0
ASP2	.0	ASP6	.0
ASP3	.0	ASP7	.0
ASP4	.0	ASP8	.0

ANALOG PARAMETERS: ***(adjusted by operator)***

	Name	Value		Name	Value
ANP1	DISCHSPK	55.0	ANP5	MIXEDSP	48.0
ANP2	STATSPK	1.5	ANP6	OAECONSP	70.0
ANP3	MWUSPK	71.0	ANP7	OAMINPOS	15.0
ANP4	NITESP	60.0	ANP8	MWUDIFF	5.0

ANALOG VARIABLES: ***(calculated by PCL routines)***

	Name		Name		Name		Name
AV1		AV5	MINPOS	AV9		AV13	OADCALC
AV2	ECONSP	AV6		AV10		AV14	HEATCALC
AV3	HEATSP	AV7		AV11	IGVCALC	AV15	COOLCALC
AV4	MIXAIRSP	AV8		AV12	MIXCALC	AV16	

POINT DATA DEFINITIONS

PCM: AHV-002B
Location:

Date: 03-FEB-92
Page: 2 of 2

BINARY INPUTS:

	Name	Open Means
BIP1	SUPFANST	OFF
BIP2	OCCUPY	OFF
BIP3	MIXLOLIM	ON
BIP4	RUN-AUTO	OFF

BINARY OUTPUTS:

	Name	Relay Off Means	Minimum On Time	Minimum Off Time
BOP1	SUPFANSS	OFF	0	5
BOP2	VAVBOXES	OFF	0	0
BOP3		OFF	0	0
BOP4		OFF	0	0
BOP5		OFF	0	0
BOP6		OFF	0	0

BINARY SETPOINTS: *(from Tracer BMS)*

	Name	Communications Loss State		Name	Communications Loss State
BSP1		OFF	BSP13		OFF
BSP2		OFF	BSP14		OFF
BSP3		OFF	BSP15		OFF
BSP4		OFF	BSP16		OFF
BSP5		OFF	BSP17		OFF
BSP6		OFF	BSP18		OFF
BSP7		OFF	BSP19		OFF
BSP8		OFF	BSP20		OFF
BSP9		OFF	BSP21		OFF
BSP10		OFF	BSP22		OFF
BSP11		OFF	BSP23		OFF
BSP12		OFF	BSP24		OFF

BINARY PARAMETERS: *(adjusted by operator)*

	Name	State		Name	State
BNP1	MANRESET	OFF	BNP5	HEATOPEN	ON
BNP2		OFF	BNP6	COOLOPEN	OFF
BNP3		OFF	BNP7	CALIBRTE	OFF
BNP4		OFF	BNP8	ENABLTOV	ON

BINARY VARIABLES: *(Calculated by PCL routines)*

Name	Name	Name	Name	Name	Name
BV1	HEAT	BV5	ECONENAB	BV9	BV13
BV2	COOL	BV6	FANREQ	BV10	BV14
BV3	FANON	BV7	TOVREQ	BV11 FANFAIL	BV15
BV4	FANOFF	BV8		BV12 LOWTEMP	BV16

DDC LOOP PARAMETERS

PCM: AHV-002B
Location:

Date: 03-FEB-92

DDC Loop # 1	DUCT STATIC
Proportional Gain	40.00
Integral Gain	10.00
Derivative Gain	.00
Action	REVERS
Proportional Bias	.0
Minimum Output Value	-10.0
Maximum Output Value	100.0
Error Deadband	.1

DDC Loop # 2	ECONOMIZER
Proportional Gain	4.00
Integral Gain	1.00
Derivative Gain	.00
Action	DIRECT
Proportional Bias	.0
Minimum Output Value	.0
Maximum Output Value	100.0
Error Deadband	.5

DDC Loop # 3	COOL VALVE
Proportional Gain	4.00
Integral Gain	1.00
Derivative Gain	.00
Action	DIRECT
Proportional Bias	.0
Minimum Output Value	-10.0
Maximum Output Value	100.0
Error Deadband	.5

DDC Loop # 4	HEAT VALVE
Proportional Gain	4.00
Integral Gain	1.00
Derivative Gain	.00
Action	REVERS
Proportional Bias	.0
Minimum Output Value	-10.0
Maximum Output Value	100.0
Error Deadband	.5

DDC Loop # 5	MIXED AIR
Proportional Gain	4.00
Integral Gain	1.00
Derivative Gain	.00
Action	DIRECT
Proportional Bias	.0
Minimum Output Value	.0
Maximum Output Value	100.0
Error Deadband	.5

DDC Loop # 6	
Proportional Gain	.00
Integral Gain	.00
Derivative Gain	.00
Action	REVERS
Proportional Bias	.0
Minimum Output Value	.0
Maximum Output Value	.0
Error Deadband	.0

PCL ROUTINE DEFINITION

PCM: AHV-002B Date: 03-FEB-92
Location:

Routine Name: FAIL DETECT Routine Number: 1
Freq: 0 Hrs. 0 Mins. 5 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
*L0	=		NOT	RUN-AUTO	*L0 TRUE IF RUN-AUTO/STOP BIP = STOP
*L1	=		NOT	SUPFANST	*L1 TRUE IF SUPFANST BIP IS OFF
*IFT	=	SUPFANSS	AND	*L1	IF SUPPLY FAN BOP IS ON AND BIP OFF
*R0	=	*R0	+	*1.0	INCREASE COUNTER *R0 BY ONE
*ELSE	=				IF NOT (I.E. BOP IS OFF OR BIP ON)
*R0	=	*0			RESET COUNTER TO ZERO
*IFT	=	*R0	GT	*24	IF COUNTER 24 (24 X 5 SEC = 2 MIN)
FANFAIL	=	TRUE			SET BINARY VARIABLE "FANFAIL" TRUE
*IFT	=	MANRESET	OR	*L0	IF MANRESET BNP ON OR AUTO BIP OFF
FANFAIL	=	FALSE			SET BINARY VARIABLE "FANFAIL" FALSE
*END	=				END OF *IFT STRING
LOWTEMP	=	MIXLOLIM			LOWTEMP VARIABLE = MIXLOLIM BIP
*END	=				END OF ROUTINE

Routine #1 Description:

This routine monitors the supply fan for fan failure. Should the supply fan start/stop "SUPFANSS" binary output be "ON" and the supply fan status binary input "SUPFANST" be "OFF" for a two minute time period, the "FANFAIL" binary variable will be triggered to "ON" and initiate fan failure. Once initiated, the "FANFAIL" binary variable can only be reset to "OFF" by one of the following methods:

1. Toggle the manual reset, "MANRESET", binary parameter to "ON" then "OFF". Typically accomplished through the LCD display.
2. Trigger the "RUN/AUTO" binary input to "OFF" then "ON". Typically accomplished be either removing and re-installing the factory installed jumper or switching a field installed toggle switch to "OFF" then "ON".
3. Toggle the PCM circuit board on/off switch to "OFF" then "ON".

The "LOWTEMP" variable is triggered to "ON" whenever the "MIXLOLIM" binary input is ON (open circuit). The "LOWTEMP" variable can only be cleared by manually resetting the Mixed Air Low Limit Device.

PCL ROUTINE DEFINITION

PCM: AHV-002B Date: 03-FEB-92
Location:

Routine Name: FAN REQUEST Routine Number: 2
Freq: 0 Hrs. 0 Mins. 10 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
*R0	=	NITESP	+	*3.0	*R0 = NITE SETBACK SETPOINT + 3.0
*IFT	=	SPACETMP	LT	NITESP	IF SPACETMP LESS THAN NITE SBK SETPT
*L0	=	TRUE			*L0 IS TRUE
*IFT	=	SPACETMP	GT	*R0	IF SPACETMP GREATER THAN *R0
*L0	=	FALSE			*L0 IS FALSE
*IFT	=	SPACETMP	GT	*85.0	IF SPACETMP GREATER THAN *85.0
*L1	=	TRUE			*L1 IS TRUE
*IFT	=	SPACETMP	LT	*82.0	IF SPACETMP LESS THAN *82.0
*L1	=	FALSE			*L1 IS FALSE
*IFT	=	SPACETMP	TOV		IF SPACETMP TOV TRUE
*R1	=	*720			SET *R1 TO 720 (720 X 10 SEC = 2 HR)
*ELSE	=				IF NOT IN TOV
*R1	=	*R1	-	*1.0	DECREASE COUNTER *R1 BY ONE
*IFF	=	ENABLTOV			IF ENABLTOV BNP = FALSE
*R1	=	*-1.0			SET *R1 TO *-1.0
*END	=				*END OF *IFF STRING
*R1	=	*R1	MAX	*-1.0	*R1 LOW LIMIT OF *-1.0
TOVREQ	=	*R1	GT	*0	TOVREQ TRUE IF *R1 GREATER THAN *0
FANREQ	=	*L0	OR	*L1	\FANREQ TRUE IF SPACETMP LT NITESP
	=	OCCUPY		TOVREQ	/OR GT *85.0 OR OCCUPY BIP OR TOVREQ

Routine #2 Description:

This routine establishes the fan request "FANREQ" binary variable value to be use in the fan control routine #3.

Fan request "FANREQ" binary variable is set to "OFF" unless set to "ON" by any one of the following triggers:

1. **Nite setback** - If the space temperature sensor "SPACETMP" analog input value is less than the nite setback setpoint "NITESP" analog parameter value. "NITESP" analog parameter is adjustable through the PCM LCD display. "FANREQ" binary variable will remain "ON" by the above described trigger until the "SPACETMP" analog input value is 3° F greater than the "NITESP" analog parameter value.

2. **Nite setup** - If the space temperature sensor "SPACETMP" analog input value is greater than 85° F. "FANREQ" binary variable will remain "ON" by the above described trigger until the "SPACETMP" analog input value is less than 82° F.

3. **Timed override** from space sensor (if enabled) - With timed override enable "ENABLTOV" binary parameter set to "ON", momentary closure of the space temperature sensor override switch for a 2 second or greater interval will place "SPACETMP" analog input into timed override (TOV) status for a two minute interval. "SPACETMP" analog input timed override status initiates a 2 hour counter and timed override request "TOVREQ" binary variable is set to "ON" until the counter expires. "FANREQ" binary variable will remain set to "ON" as long as "TOVREQ" binary variable is set to "ON".

4. **Occupy mode initiated** - Occupied/unoccupied "OCCUPY" binary input is set to "ON". "FANREQ" will remain "ON" by the above described trigger until the "OCCUPY" binary input is set to "OFF".

PCL ROUTINE DEFINITION

PCM: AHV-002B Date: 03-FEB-92
Location:

Routine Name: FAN CONTROL Routine Number: 3
Freq: 0 Hrs. 0 Mins. 5 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
SUPFANSS	=		CONTROL	FANREQ	SUPFANSS BOP =FANREQ BINARY VARIABLE
*L0	=		NOT	RUN-AUTO	*L0 TRUE IF RUN-AUTO/STOP BIP = STOP
*L1	=	FANFAIL	OR	LOWTEMP	*L1 TRUE IF FANFAIL OR LOWTEMP
*IFT	=	*L0	OR	*L1	IF STOP, FANFAIL OR LOWTEMP TRUE
SUPFANSS	=	NOMIN	CONTROL	OFF	BOPS "OFF" OVERRIDING MIN ON TIMER
*IFT	=	SUPFANSS	AND	SUPFANST	IF FAN BOP AND STATUS "ON"
*R0	=	*R0	+	*1.0	INCREASE COUNTER *R0 BY ONE
*ELSE	=				IF NOT (FAN BOP OR STATUS BIP OFF)
*R0	=	*0			RESET COUNTER TO *R0 TO ZERO
*END	=				END OF *IFT STRING
FANON	=	*R0	GT	*6	"FANON" = TRUE IF *R0 6 (30 SEC)
FANOFF	=		NOT	FANON	"FANOFF" = OPPOSITE OF "FANON"
*END	=				END OF ROUTINE

Routine #3 Description:

This routine starts and stops the supply fan. After air flow is established for a 30 second time period, the "FANON" binary variable is set to "TRUE". The "FANOFF" binary variable (used in other routines) is set to the opposite state of "FANON".

The supply fan "SUPFANSS" binary output will be controlled to fan request "FANREQ" binary variable value as set in routine # 2.

Regardless of a fan request to have the supply fan "ON", the supply fan "SUPFANSS" binary output will be indexed to "OFF" by one of the following triggers:

1. "RUN/AUTO" binary input is open for "OFF" (shutdown).
2. "FANFAIL" binary variable is "ON".
3. "LOWTEMP" binary variable is "ON".

Note: The above fan "OFF" trigger will stop the supply fan instanteously overriding minimum ON/OFF timers.

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                        PCL ROUTINE DEFINITION

  PCM: AHV-002B                                  Date: 03-FEB-92
  Location:

Routine Name: HEAT/COOL                  Routine Number:  4
                                  Freq:   0 Hrs.   0 Mins.  10 Secs.

Result       1st Arg     Operator 2nd Arg    Description of Statement
----------   ----------  -------- ---------- ----------------------------------
*R0        = MWUSPK      -        MWUDIFF    *R0 = MWU SETPT - MWU DIFFERENTIAL
*IFT       = SPACETMP    GE       MWUSPK     IF MWUTEMP SENSOR  MWU SETPOINT
COOL       = TRUE                            SET COOL TO "TRUE"(INDICATES WARM)
*IFT       = SPACETMP    LE       *R0        IF MWUTEMP SENSOR  LOW SETPOINT *R0
COOL       = FALSE                           SET COOL TO "FALSE"(INDICATES COLD)
*IFT       = SPACETMP    FAIL               IF SPACE SENSOR FAILS
COOL       = TRUE                            SET COOL TO "TRUE"
*IFT       = FANOFF                          IF FAN IS OFF
COOL       = FALSE                           SET COOL TO "FALSE"
*END       =                                 END OF *IFT STRING
HEAT       =             NOT      COOL       HEAT MODE = OPPOSITE OF COOL MODE
VAVBOXES   =             CONTROL  COOL       CONTROL VAVBOXES BOP TO "COOL"
*END       =                                 *END OF ROUTINE
```

Routine #4 Description:

This routine establishes an "ON" or "OFF" value for the "COOL" and "HEAT" binary variables with the "HEAT" value always being the opposite of the "COOL" value. The "HEAT" binary variable is used by the OADAMPER, COOL VALVE, and HEAT VALVE routines.

If the space temperature sensor "SPACETMP" analog input value is greater than the morning warmup setpoint "MWUSPK" analog parameter value, binary variable "COOL" is set to "ON" and the mode of the AHU will be cool. If "SPACETMP" analog input value is less than the "MWUSPK" analog parameter value minus the morning warmup differential "MWUDIFF" analog parameter value, binary variable "HEAT" is set to "ON" and the mode of the AHU will be heat. Both "MWUSPK" and "MWUDIFF" analog parameter are adjustable through the PCM LCD display.

Should the space temperature sensor "SPACETMP" analog input fail, binary variable "COOL" is set to "ON" and the mode of the AHU will be cool.

If the fan off "FANOFF" binary variable is set to "OFF", binary variable "COOL" is set to "OFF" and the mode of the AHU is heat.

VAV boxes "VAVBOXES" binary output is controlled to binary variable "COOL" value.

PCL ROUTINE DEFINITION

PCM: AHV-002B Date: 03-FEB-92
Location:

Routine Name: SETPOINTS Routine Number: 5
Freq: 0 Hrs. 0 Mins. 10 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
ECONSP	=	DISCHSPK	-	*2	ECONOMIZER S.P. =DISCH S.P. - 2 DEG
MIXAIRSP	=	MIXEDSP	MAX	*45	MIXED AIR SETPT LOW LIMIT OF 45 DEG
HEATSP	=	ECONSP	-	*2	HEAT S.P. = ECONOMIZER S.P. - 2 DEG
*IFT	=	HEAT			IF AHU IS IN HEATING MODE
HEATSP	=	*104			HEAT SETPOINT = 104 DEG
*END	=				END OF *IFT STRING
*R0	=	OAECONSP	-	*2.0	*R0 = OA CHANGEOVER S.P. - 2.0 DEG
*IFT	=	OATEMP	LE	*R0	IF OA TEMP IS COOL (LESS THAN R0)
ECONENAB	=	TRUE			SET ECONENAB TO TRUE(INDICATES COOL)
*IFT	=	OATEMP	GE	OAECONSP	IF OA TEMP IS WARM (GREATER THAN SP)
ECONENAB	=	FALSE			SET ECONENAB TO FALSE
*IFT	=	OCCUPY	OR	TOVREQ	IF OCCUPY BIP "ON" OR UNIT IN TOV
MINPOS	=	OAMINPOS			ECON MIN POSITION = OPERATOR ENTRY
*ELSE	=				IF NOT OCCUPY OR COASTDOWN
MINPOS	=	*0			ECON MIN POSITION = 0 %
*END	=				END OF ROUTINE

Routine #5 Description:

This routine establishes setpoint values for the following analog and binary variables; economizer setpoint "ECONSP" analog variable, mixed air setpoint "MIXAIRSP" analog variable, heating setpoint "HEATSP" analog variable, outside air damper minimum position setpoint "MINPOS" analog variable, and economizer enable "ECONENAB" binary variable. These analog and binary variables are used in routines #7 through #9.

The economizer setpoint "ECONSP" analog variable is equal to the discharge air setpoint "DISCHSPK" analog parameter minus 2° F. If the mode of the AHU is cooling, the heating setpoint "HEATSP" analog variable is equal to the economizer setpoint "ECONSP" analog variable minus 2° F. If binary variable "HEAT" is set to "ON" and the mode of the AHU is heating, the heating setpoint "HEATSP" analog variable is set equal to 104°F.

The mixed air setpoint "MIXAIRSP" analog variable is equal to analog parameter "MIXEDSP" or 45° F, which ever is of larger value. Analog parameter "MIXEDSP" is adjustable through the LCD PCM display.

If outside air temperature "OATEMP" analog input value is 2° F less than the outside air economizer change-over setpoint "OAECONSP" analog parameter value, economizer enable "ECONENAB" binary variable will be set to "ON" (enabled). If the outside air temperature "OATEMP" analog input value is greater than outside air economizer switch-over setpoint "OAECONSP" analog parameter value, economizer enable "ECONENAB" binary variable will be "OFF" (disabled). "OAECONSP" analog parameter is adjustable through the PCM LCD display.

The outside air damper minimum position setpoint "MINPOS" analog variable is set equal to 0 %, unless, either the occupy/unoccupy "OCCUPY" binary input or timed override request "TOVREQ" binary variable is indexed to "ON". With "OCCUPY" binary input or "TOVREQ" binary variable indexed to "ON", the outside air damper minimum position setpoint "MINPOS" analog variable is set equal to analog parameter "OAMINPOS" value. "OAMINPOS" is adjustable through the PCM LCD display.

PCL ROUTINE DEFINITION

PCM: AHV-002B Date: 03-FEB-92
Location:

Routine Name: INLET VANES Routine Number: 6
Freq: 0 Hrs. 0 Mins. 5 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
IGVCALC	=	STATICPR	DDC:1	STATSPK	EXECUTE INLET VANE CONTROL DDC LOOP
*R0	=	STATSPK	+	*1.0	*R0 = STATIC SETPOINT + 1.0" W.C.
*IFT	=	STATICPR	GE	*R0	IF STATIC PRESSURE SETPOINT + 1.0"
IGVCALC	=	IGVCALC	*	*0.5	REDUCE INLET VANE VALUE BY ONE HALF
*IFT	=	FANOFF			IF SUPPLY FAN OFF OR IN STARTUP TIME
IGVCALC	=	*-10			INLET VANE VALUE = -10% (FULL CLOSE)
*IFT	=	STATICPR	FAIL		IF STATIC PRESSURE SENSOR IS FAILED
IGVCALC	=	*-10			INLET VANE VALUE = -10% (FULL CLOSE)
*END	=				END OF *IFT STRING
IGVANES	=		CONTROL	IGVCALC	SET IGVANES AOP = CALCULATED VALUE
*END	=				END OF ROUTINE

Routine #6 Description:

This routine controls inlet guide vane position through analog output "IGVANES" to the calculated inlet guide vane position "IGVCALC" analog variable. "IGVCALC" value is equal to the output of DDC loop #1 which compares the duct static pressure "STATICPR" analog input to the static pressure setpoint "STATSPK" analog parameter value. DDC loop #1 output will change as required to maintain the static pressure setpoint. If the duct static pressure "STATICPR" analog input is 1" W.C. above setpoint, "IGVCALC" value will be reduced by one half. "STATSPK" analog parameter value is adjustable through the PCM LCD display.

If binary variable "FANOFF" is "ON" or the duct static pressure "STATICPR" analog input is failed, "IGVCALC" value will be set equal to -10 % and cause the inlet guide vanes to close.

PCL ROUTINE DEFINITION

PCM: AHV-002B Date: 03-FEB-92
Location:

Routine Name: OA DAMPER Routine Number: 7
Freq: 0 Hrs. 0 Mins. 10 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
OADCALC	=	DISCHTMP	DDC:2	ECONSP	DDC LOOP FOR OADAMPER, USE OADCALC
OADCALC	=	OADCALC	MAX	MINPOS	OADCALC LO LIMIT - ECON MIN POSITION
*L0	=		NOT	ECONENAB	*L0 TRUE IF ECONOMIZER IS DISABLED
*L1	=	DISCHTMP	FAIL		*L1 TRUE IF DISCH TEMP SENSOR FAILED
*IFT	=	*L0	OR	*L1	IF ECON DISABLE OR DISCH SENSOR FAIL
OADCALC	=	MINPOS			SET CALC DAMPER POSITION AT MINIMUM
*END	=				END OF *IFT STRING
MIXCALC	=	MIXEDTMP	DDC:5	MIXAIRSP	DDC LOOP FOR MIXED AIR, USE MIXCALC
OADCALC	=	OADCALC	MIN	MIXCALC	SELECT MINIMUM OF OADCALC & MIXCALC
*L2	=	MIXEDTMP	FAIL		*L2 TRUE IF MIXED SENSOR FAILED
*L3	=	FANOFF	OR	HEAT	*L3 TRUE IF FAN OFF OR HEAT MODE
*IFT	=	*L2	OR	*L3	IF MIXEDTMP FAIL, FAN OFF OR HEAT
OADCALC	=	*-10			SET CALC DMPR POSITION TO FULL CLOSE
*END	=				END OF *IFT STRING
OADAMPER	=		CONTROL	OADCALC	SET OADAMPER AOP TO CALC DMPR POS.
MIXCALC	=	OADCALC			SET MIXCALC = OADCALC VALUE
*END	=				*END OF ROUTINE

Routine #7 Description:

This routine controls the outside air damper through analog output "OADAMPER" to the calculated outside air damper position "OADCALC" analog variable value. "OADCALC" value is equal to the minimum value of the economizer DDC loop #2 or the mixed air DDC loop #5.

Initially, "OADCALC" value is set equal to the output of the economizer DDC loop #2 which compares the discharge air temperature "DISCHTMP" analog input value to the economizer setpoint "ECONSP" analog variable value (2° F less than the discharge air setpoint per routine #5). DDC loop #2 output will change as required to maintain the economizer setpoint. "OADCALC" value is limited to the outside air damper minimum position "MINPOS" analog variable value and will be set to the damper minimum position "MINPOS" value should the discharge temperature sensor "DISCHTMP" analog input fail or the economizer "ECONENAB" binary variable be "OFF" (disabled) per routine #5.

"OADCALC" value is then set equal to the lesser value of "OADCALC" as determined above or the calculated mixed air "MIXCALC" analog variable value. "MIXCALC" is set equal to the output of the mixed air DDC loop #5 which compares the mixed air temperature "MIXEDTMP" analog input value to the mixed air setpoint "MIXAIRSP" analog variable value. DDC loop #5 output will change as required to maintain the mixed air setpoint.

Should binary variable "HEAT" be "ON" (AHU in heat mode), the binary variable "FANOFF" be set to "ON" per routine #3 or the mixed air temperature sensor "MIXEDTMP" analog input be failed, "OADCALC" value as previously determined is ignored and is set to -10%. An "OADCALC" value of -10% will cause closure of the outside air damper.

"MIXCALC" value is set equal to the "OADCALC" value at the end of this routine to provide a smooth transfer of control between the two DDC loops.

```
                        PCL ROUTINE DEFINITION

   PCM: AHV-002B                                  Date: 03-FEB-92
   Location:

Routine Name: COOL VALVE                    Routine Number:  8
                          Freq:   0 Hrs.   0 Mins.  10 Secs.

Result        1st Arg    Operator 2nd Arg    Description of Statement
----------    ---------- -------- ---------- ----------------------------------
COOLCALC    = DISCHTMP   DDC:3    DISCHSPK   RUN DDC LOOP FOR COOL VALVE CONTROL
*IFT        = OADAMPER   LE       *70        IF OA DAMPER POSITION  70%
*L0         = TRUE                           SET *L0 TO TRUE
*IFT        = OADAMPER   GE       *90        IF OA DAMPER POSITION  90%
*L0         = FALSE                          SET *L0 TO FALSE
*END        =                                END OF *IFT STRING
*L1         = *L0        AND      ECONENAB   *L1 TRUE IF *L0 TRUE AND ECON ENABLE
*L2         = *L1        OR       HEAT       \ *L2 TRUE IF: *L1 TRUE OR HEAT MODE
            = FANOFF                         / FAN IS OFF
*IFT        = DISCHTMP   FAIL                IF TRUE DISCH TEMP SENSOR FAILED
COOLCALC    = *50                            CALC COOL VALVE POS. = HALF OPEN
*IFT        = *L2                            IF *L2 IS TRUE
COOLCALC    = *-10                           CALC COOL VALVE POS. = FULL CLOSED
*IFT        = FANOFF     AND      COOLOPEN   IF FANOFF AND COOLOPEN ARE BOTH TRUE
COOLCALC    = *100                           CALC COOL VALVE POS. = FULL OPEN
*END        =                                END OF *IFT STRING
CWVALVE     =            CONTROL  COOLCALC   SET COOL VALVE AOP = CALC POSITION
*END        =                                END OF ROUTINE
```

Routine #8 Description:

This routine controls the chill water valve through analog output "CWVALVE" to the calculated chill water valve position "COOLCALC" analog variable. "COOLCALC" value is equal to the output of DDC loop #3 which compares the discharge air temperature sensor "DISCHTMP" analog input value to the discharge air setpoint "DISCHSPK" analog parameter value. DDC loop #3 output will change as required to maintain the cooling setpoint. "DISCHSPK" analog parameter is adjustable through the PCM LCD display.

Should the discharge air temperature sensor "DISCHTMP" analog input fail, analog variable "COOLCALC" is set equal to 50%.

Regardless of discharge air temperature sensor failure or DDC loop #3 output, analog variable "COOLCALC" is set equal to -10% should the outside air damper "OADAMPER" analog output value be less than 70% and economizer enable "ECONENAB" binary variable is "ON" (enabled per routine #5) or one of the following binary variables is "ON"; binary variable "HEAT" per routine #4 or binary variable "FANOFF" per routine #3.

Previously determined analog variable "COOLCALC" value is ignored and is set to 100% should binary variable "FANOFF" be "ON" and binary parameter "COOLOPEN" be "ON" (open). "COOLOPEN" is adjustable through the PCM LCD display.

Note: If Discharge Sensor FAIL and Economizer ENABLED, then COOLCALC = -10% (Full Closed) and OADAMPER = Minimum position.

```
                          PCL ROUTINE DEFINITION

   PCM: AHV-002B                                  Date: 03-FEB-92
   Location:

Routine Name: HEAT VALVE                  Routine Number:  9
                          Freq:   0 Hrs.   0 Mins.  10 Secs.

Result       1st Arg    Operator 2nd Arg    Description of Statement
----------   ---------- -------- ---------- -----------------------------------
HEATCALC   = DISCHTMP   DDC:4    HEATSP     RUN DDC LOOP FOR HWVALVE CONTROL
*L0        = DISCHTMP   FAIL                *L0 TRUE IF DISCH TEMP SENSOR FAILED
*R0        = MINPOS     +        *10        *R0 = OA DAMPER MIN. POS. + 10%
*L1        = OADAMPER   GE       *R0        *L1 TRUE IF OADAMPER POS.  *R0
*L2        = CWVALVE    GT       *0         *L2 TRUE IF CWVALVE NOT FULLY CLOSED
*L3        = *L0        OR       *L1        \  IF SELECTED SENSOR IS FAILED OR
           = *L2                 FANOFF     >  OADAMPER  MINPOS OR CWVALVE IS
*IFT       = *L3                            /  NOT FULLY CLOSED OR FANOFF
HEATCALC   = *-10                           CALC HEAT VALVE POS. IS FULL CLOSED
*IFT       = FANOFF     AND      HEATOPEN   IF SUPPLY FANOFF AND HEATOPEN TRUE
HEATCALC   = *100                           CALC HEAT VALVE POS. IS FULL OPEN
*END       =                                END OF *IFT STRING
HWVALVE    =            CONTROL  HEATCALC   SET HWVALVE AOP = CALC. POSITION
*END       =                                END OF ROUTINE
```

Routine #9 Description:

This routine controls the hot water valve through analog output "HWVALVE" to the calculated hot water valve position "HEATCALC" analog variable. "HEATCALC" value is equal to the output of DDC loop #4 which compares the discharge air temperature sensor "DISCHTMP" analog input value to the heating setpoint "HEATSP" analog variable value as set per routine #5. DDC loop #4 output will change as required to maintain the heating setpoint.

Regardless of DDC loop #4 output, analog variable "HEATCALC" is set equal to -10% if the discharge air temperature sensor "DISCHTMP" analog input is failed, the outside air damper "OADAMPER" analog output percent is 10% greater than outside air damper minimum postion "MINPOS" analog variable value as set in routine #5 or binary variable "FANOFF" is "ON" per routine #3.

Analog variable "HEATCALC" as previously determined is ignored and is set to 100% should binary variable "FANOFF" be "ON" and binary parameter "HEATOPEN" be "ON" (open). "HEATOPEN" is adjustable through the PCM LCD display.

```
                          PCL ROUTINE DEFINITION

  PCM: AHV-002B                                   Date: 03-FEB-92
  Location:

Routine Name: CALIBRATION                  Routine Number: 10
                           Freq:   0 Hrs.   0 Mins.  60 Secs.

Result        1st Arg    Operator 2nd Arg    Description of Statement
----------    ---------- -------- ---------- -----------------------------------
*L0         = CALIBRTE   NOT      RUN-AUTO   *L0 TRUE IF AUTO/STOP BIP IS STOP
*IFT        = CALIBRTE   AND      *L0        IF CALIBRATE BNP ON AND STOP
HWVALVE     =            CONTROL  *0         SET HOT WATER VALVE POSITION = 0%
CWVALVE     =            CONTROL  *0         SET CHILLED WTR VALVE POSITION = 0%
OADAMPER    =            CONTROL  *0         SET OA DAMPER POSITION = 0%
IGVANES     =            CONTROL  *0         SET INLET VANE POSITION = 0%
*END        =                                END OF ROUTINE
```

Routine #10 Description:

With binary input "RUN/AUTO" indicating "OFF" and binary parameter "CALIBRTE" set to "ON" all analog outputs (HW valve, CW valve, OA damper, and inlet guide vanes) will be set to 0% to allow valve and/or linkage adjustments to be made. Binary parameter "CALIBRTE" is typically adjusted from the PCM LCD display.

CUSTOM DISPLAY SETUP

PCM: AHV-002B Date: 03-FEB-92
Location:

PCM System Password: +-+-

Display Line	Point Name	Expanded Description	Desc/ Units	Adjust	Adjustment Limits Low	High
1	RUN-AUTO	AUTO/STOP INPUT	7			
2	OCCUPY	OCCUPIED MODE	4			
3	TOVREQ	UNIT IN TIMED OVRD	4			
4	SUPFANSS	SUPPLY FAN START	0			
5	SUPFANST	SUPPLY FAN STATUS	0			
6	COOL	COOLING MODE	4			
7	DISCHTMP	DISCHARGE AIR TEMP	0			
8	DISCHSPK	DISCHARGE AIR STPT	0	Y	50.0	80.0
9	STATICPR	DUCT STATIC PRESS	9			
10	STATSPK	DUCT STATIC SETPT	9	Y	.0	3.0
11	IGVANES	INLET GUIDE VANES	4			
12	ECONENAB	ECONOMIZER STATUS	2			
13	OADAMPER	OA DAMPER POSTION	4			
14	MIXEDTMP	MIXED AIR TEMP	0			
15	HWVALVE	H.W. VALVE POS	4			
16	CWVALVE	C.W. VALVE POS	4			
17	SPACETMP	SPACE TEMPERATURE	0			
18	OATEMP	OUTDOOR AIR TEMP	0			
19	FANFAIL	SUPPLY FAN FAILURE	4			
20	MIXLOLIM	MIXED AIR LO LIMIT	5			
21	VAVBOXES	VAV BOX MODE	8			
22	MWUSPK	MORN. WARMUP SETPT	0	Y	.0	100.0
23	MWUDIFF	MORN. WARMUP DIFF.	0	Y	1.0	20.0
24	OAMINPOS	OA MIN POSITION SP	4	Y	.0	100.0
25	OAECONSP	OA ECON ENABLE SP	0	Y	-100.0	100.0
26	MIXEDSP	MIXED AIR SETPOINT	0	Y	45.0	100.0
27	NITESP	NITE SETBACK SETPT	4	Y	45.0	80.0
28	HEATOPEN	FAN OFF HW VLV POS	1	Y		
29	COOLOPEN	FAN OFF CW VLV POS	1	Y		
30	ENABLTOV	TOV SWITCH ENABLE	4	Y		
31	CALIBRTE	AOP CALIBRATE MODE	0	Y		
32	MANRESET	MANUAL RESET POINT	0	Y		

Binary Descriptor Table:

0 = OFF/ON	1 = CLOSED/OPEN	2 = DISABL/ENABLE
3 = AUTO/MANUAL	4 = NO/YES	5 = NORMAL/ALARM
6 = UNOCC/OCCUPY	7 = SHUTDN/NORMAL	8 = HEAT/COOL

Analog Units Table:

0 = DEG	1 = PSI	2 = KW	3 = KWH	4 = PCT	5 = CFM
6 = AMP	7 = VOL	8 = HG	9 = IN	10 = RH	11 = Blank

Constant Volume AHU with Discharge Air Reset from Space Control with Tracer Interface

Control Sequence for AHC-001B

Occupied Cooling Mode:
When the AHU is indexed to the occupied cooling mode, the supply fan will operate continuously, the outside air damper will be at its minimum position (unless economizing), and the space air temperature setpoint (74° F nominal) will be maintained by resetting the discharge air temperature setpoint. The discharge air temperature will be maintained by modulating the chilled water valve, the hot water or steam valve and the outdoor air damper. When the AHU is in the cooling mode, the discharge air temperature setpoint will be reset from 50° F (minimum) to the space cooling setpoint (maximum).

Occupied Heating Mode:
When the AHU is indexed to the occupied heating mode, the supply fan will operate continuously, the outside air damper will be at its minimum position (fixed), and the space air temperature setpoint will equal the Space Setpoint minus the Heat Offset (3° F nominal). The discharge air temperature will be maintained by modulating the hot water or steam valve. When the AHU is in the heating mode, the discharge air temperature setpoint can vary between the space heating setpoint (minimum) and 104° F (maximum).

Night Setback/Morning Warmup Heating Mode:
When the AHU is indexed to the night setback/morning warmup heating mode, the supply fan will operate continuously, the outdoor air damper will be fully closed, the chilled water valve will be fully closed and the hot water or steam valve will modulate to maintain the discharge air temperature.

Night Setback/Morning Cooldown Cooling Mode:
When the AHU is indexed the night setback/morning cooldown mode, the supply fan will operate continuously, the outdoor air damper will be fully closed (unless economizing), the Hot Water or Steam Valve will be fully closed and the Chilled Water Valve will modulate to maintain the discharge air temperature.

Supply Fan Control:
The supply fan will operate continuously whenever the AHU is indexed to either the occupied, night setback, or morning warmup/cooldown mode. The supply fan will be off whenever the AHU is indexed to the unoccupied mode, the AHU is demand limited or duty cycled by the Tracer BMS, the AHU is put in the priority shutdown mode by the Tracer BMS, the run-auto/stop interlock is open, the mixed air low limit is tripped, or the supply fan status indicates a failure (after a 2 minute delay). The fan failure indication requires a manual reset, which can be done at the Tracer BMS, the local PCM keypad/display, or by opening the run-auto/stop interlock.

AHC-001B continued...

Heat/Cool Mode Control:
The heat/cool mode of the AHU is determined based on the space temperature sensor and the space cooling and heating setpoints. The space heating setpoint is the space cooling setpoint minus the heating offset. The heating offset is adjustable from 0°to 15° F at the local PCM keypad/display. If the space sensor temperature is greater than the space cooling setpoint plus 1° F, the mode of the AHU will be cool. If the space sensor temperature is less than the space heating setpoint minus 1° F, the mode of the AHU will be heat. The AHU will be allowed to switch between the heating and cooling modes at any time during operation, based on this logic. The space cooling setpoint is adjustable by the Tracer BMS, room sensor adjustment knob or local PCM keypad/display. If room setpoint adjustment is enabled, Tracer BMS space cooling setpoint adjustment will be ignored. If local PCM keypad/display is enabled, the Tracer BMS and room space cooling setpoint adjustment will be ignored.

Outdoor Air Damper Control:
When the Tracer BMS enables the Economizer function and the outdoor air temperature is less than the changeover setpoint minus 2° F, the outdoor air damper will modulate, as commanded by the PCM controller, between minimum position and fully open to maintain the discharge air temperature at the economizer setpoint (discharge cooling setpoint minus 2°F). The outdoor air damper will be modulated closed as required (overriding the minimum position) to maintain the mixed air temperature (averaging element) at or above the mixed air setpoint (48° F nominal). A mixed air low limit manual reset device (sensing the coldest one-foot section) will turn the supply fan off if its sensed temperature is below its setpoint (36° F nominal).

If the Economizer function is disabled, the discharge air temperature sensor is failed, or the AHU is in the heat mode, the outdoor air damper will be set to minimum position. The minimum position will be set to zero for all Tracer BMS modes except occupy and coastdown. If the supply fan is off or the mixed air temperature sensor is failed, the outdoor air damper will be fully closed.

Chilled Water Valve Control:
The chilled water valve will modulate, as commanded by the PCM controller, to maintain the discharge air temperature at the discharge cooling setpoint. If the Economizer function is enabled and the outdoor air damper is not fully opened, the chilled water valve will be closed. The chilled water valve will also be closed if the Tracer BMS control mode is coastdown or purge, the mode of the AHU is heating, or the discharge air temperature sensor is failed. If the supply fan is off, the chilled water valve will be either fully open or closed, as selected by a user entry.

AHC-001B continued...

Hot Water or Steam Valve Control:
The Hot Water or Steam Valve will modulate, as commanded by the PCM controller to maintain the discharge air temperature at the discharge heating setpoint. The discharge heating setpoint is equal to the Economizer setpoint minus 2°F. If the outdoor air damper is open past the minimum position, the chilled water valve is not fully closed, or the discharge air temperature sensor is failed, the hot water or steam valve will be closed. If the supply fan is off, the hot water or steam valve will either be fully opened or closed, as selected by a user entry.

Unoccupied Mode:
When the AHU is indexed to the unoccupied mode, the supply fan will be turned off and outside air damper will be fully closed. The chilled water valve will be either fully closed or fully open, as selected by user entry. The Hot Water or Steam valve will be either fully opened or fully closed, as selected by user entry.

Tracer BMS Setpoint Interface:
The Tracer BMS sends the AHU a space cooling setpoint (default = 74°F). The Tracer BMS also sends the AHU an Economizer Enable/Disable command (default = Enable), and puts the AHU into one of nine Tracer BMS control modes: occupy, unoccupy, startup, coastdown, demand limit, duty cycle, night setback, purge, and priority shutdown (default = occupy).

If communication with the Tracer BMS is lost, the AHU uses the default setpoints (or local setpoints as selected by the operator) and operates in the occupied mode. The Economizer function is enabled based on the AHU outdoor air temperature sensor.

Local Parameters
The following setpoints (parameters) are stored in the AHU PCM and can be accessed manually at the Tracer BMS or through the optional local PCM keypad/display:

Analog Parameters
- Local Space Cooling Setpoint (45°−100° F)
- Heating Offset (0° − 15° F)
- Space Setpoint Low Limit (45° − 100° F)
- Space Setpoint High Limit (45° − 100° F)
- Mixed Air Setpoint (45° − 100° F)
- Outdoor Air Changeover Setpoint (-100° − 100° F)
- Outdoor Air Minimum Position (0 - 100%)

Binary Parameters
- Manual Reset Point (OFF/ON)
- Local Keypad Setpoints (NO/YES)
- Room Sensor Setpoint Adjustment (NO/YES)
- Heat Valve/Fan Off (CLOSED/OPEN)
- Cool Valve/Fan Off (CLOSED/OPEN)
- AOP Calibrate Mode (OFF/ON)

AHC-001B continued...

Local PCM Keypad/Display (Optional):
A local PCM keypad/display can be installed at the AHU to provide dedicated local access to AHU operating status and/or selected setpoints. The same custom display data that is available at the local PCM keypad/display is also available in a status display at the Tracer BMS. The Tracer BMS status display is available regardless of whether the AHU has a local PCM keypad/display.

Local Keypad Setpoints:
When the local PCM keypad/display is installed, the user can select between Tracer BMS space cooling setpoint, local PCM keypad/display cooling setpoint, or space sensor cooling setpoint by switching binary parameters "Local Keypad Setpoints" (NO/YES) and "Space Sensor Setpoint" (NO/YES).

In addition, other setpoints (parameters) are available at the local PCM keypad/display (such as the outdoor air minimum position) and are used at all times, since no corresponding values are sent from the Tracer BMS. Refer to Local Parameters for a list of these parameters.

Analog Output Calibrate Mode:
When the run-auto/stop input is open (AHU OFF) the user can select a special analog output calibrate mode from the local PCM keypad/display. When in the calibrate mode, all analog outputs (HW valve, CW valve, and OA damper) will be set to 0% to allow valve and/or linkage adjustments to be made.

Note: AIP and AOP Range and Offset entries shown on the next page may vary, depending on the actual input sensors and output actuators used.

POINT DATA DEFINITIONS

PCM: AHC-001B
Location:

Date: 03-FEB-92
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PULSE METER INPUTS:

Name	Weight
PAC1	.0
PAC2	.0

ANALOG INPUTS:

	Name	Conv Type	Range	Offset
AIP1	MIXEDTMP	BAL	102.4	.0
AIP2	SPARE	BAL	102.4	.0
AIP3	DISCHTMP	THM	102.4	.0
AIP4	OATEMP	THM	102.4	.0
AIP5	SPACETMP	THM	102.4	.0
AIP6	ROOMSP	RES	-50.0	95.0

ANALOG OUTPUTS:

	Name	Range	Offset
AOP1	HWVALVE	-333.3	300.0
AOP2	CWVALVE	333.3	-200.0
AOP3	OADAMPER	125.0	-25.0
AOP4		.0	.0

ANALOG SETPOINTS: *(from Tracer BMS)*

	Name	Communications Loss Value		Name	Communications Loss Value
ASP1	SPACESP	74.0	ASP5		.0
ASP2		.0	ASP6		.0
ASP3		.0	ASP7		.0
ASP4		.0	ASP8	ZONESP	71.0

ANALOG PARAMETERS: *(adjusted by operator)*

	Name	Value		Name	Value
ANP1	SPACESPK	74.0	ANP5	MIXEDSP	48.0
ANP2	HEATOFST	3.0	ANP6	OAECONSP	70.0
ANP3	ROOMLOW	55.0	ANP7	OAMINPOS	15.0
ANP4	ROOMHIGH	85.0	ANP8		.0

ANALOG VARIABLES: *(calculated by PCL routines)*

	Name		Name		Name		Name
AV1	COOLSP	AV5	MINPOS	AV9		AV13	OADCALC
AV2	ECONSP	AV6	SPACESPA	AV10		AV14	HEATCALC
AV3	HEATSP	AV7	HEATNGSP	AV11		AV15	COOLCALC
AV4	MIXAIRSP	AV8		AV12	MIXCALC	AV16	

POINT DATA DEFINITIONS

PCM: AHC-001B
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BINARY INPUTS:

	Name	Open Means
BIP1	SUPFANST	OFF
BIP2	FILTER	ON
BIP3	MIXLOLIM	ON
BIP4	RUN-AUTO	OFF

BINARY OUTPUTS:

	Name	Relay Off Means	Minimum On Time	Minimum Off Time
BOP1	SUPFANSS	OFF	0	5
BOP2		OFF	0	0
BOP3		OFF	0	0
BOP4		OFF	0	0
BOP5		OFF	0	0
BOP6		OFF	0	0

BINARY SETPOINTS: *(from Tracer BMS)*

	Name	Communications Loss State		Name	Communications Loss State
BSP1	ECONOMIZ	ON	BSP13	PURGE	OFF
BSP2		OFF	BSP14	NITSBK	OFF
BSP3		OFF	BSP15	DMDLIM	OFF
BSP4		OFF	BSP16	DTYCYC	OFF
BSP5		OFF	BSP17	SHUTDN	OFF
BSP6		OFF	BSP18		OFF
BSP7		OFF	BSP19		OFF
BSP8	COOLING	ON	BSP20		OFF
BSP9	OCCUPY	ON	BSP21		OFF
BSP10	UNOCCU	OFF	BSP22		OFF
BSP11	STARTU	OFF	BSP23		OFF
BSP12	COASTD	OFF	BSP24		OFF

BINARY PARAMETERS: *(adjusted by operator)*

	Name	State		Name	State
BNP1	MANRESET	OFF	BNP5	HEATOPEN	ON
BNP2	KEYPADSP	OFF	BNP6	COOLOPEN	OFF
BNP3	ROOMADJ	OFF	BNP7	CALIBRTE	OFF
BNP4		OFF	BNP8		OFF

BINARY VARIABLES: *(calculated by PCL routines)*

	Name		Name		Name		Name
BV1	HEAT	BV5	ECONENAB	BV9		BV13	
BV2	COOL	BV6		BV10		BV14	
BV3	FANON	BV7		BV11	FANFAIL	BV15	

DDC LOOP PARAMETERS

PCM: AHC-001B
Location:

Date: 03-FEB-92

DDC Loop # 1	DISCH SETPT
Proportional Gain	20.00
Integral Gain	5.00
Derivative Gain	.00
Action	REVERS
Proportional Bias	.0
Minimum Output Value	50.0
Maximum Output Value	104.0
Error Deadband	.5

DDC Loop # 2	ECONOMIZER
Proportional Gain	4.00
Integral Gain	1.00
Derivative Gain	.00
Action	DIRECT
Proportional Bias	.0
Minimum Output Value	.0
Maximum Output Value	100.0
Error Deadband	.5

DDC Loop # 3	COOL VALVE
Proportional Gain	4.00
Integral Gain	1.00
Derivative Gain	.00
Action	DIRECT
Proportional Bias	.0
Minimum Output Value	-10.0
Maximum Output Value	100.0
Error Deadband	.5

DDC Loop # 4	HEAT VALVE
Proportional Gain	4.00
Integral Gain	1.00
Derivative Gain	.00
Action	REVERS
Proportional Bias	.0
Minimum Output Value	-10.0
Maximum Output Value	100.0
Error Deadband	.5

DDC Loop # 5	MIXED AIR
Proportional Gain	4.00
Integral Gain	1.00
Derivative Gain	.00
Action	DIRECT
Proportional Bias	.0
Minimum Output Value	.0
Maximum Output Value	100.0
Error Deadband	.5

DDC Loop # 6	
Proportional Gain	.00
Integral Gain	.00
Derivative Gain	.00
Action	REVERS
Proportional Bias	.0
Minimum Output Value	.0
Maximum Output Value	.0
Error Deadband	.0

PCL ROUTINE DEFINITION

PCM: AHC-001B Date: 03-FEB-92
Location:

Routine Name: FAIL DETECT Routine Number: 1
Freq: 0 Hrs. 0 Mins. 5 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
*L0	=		NOT	RUN-AUTO	*L0 TRUE IF RUN-AUTO/STOP BIP = STOP
*L1	=		NOT	SUPFANST	*L1 TRUE IF SUPFANST BIP IS OFF
*IFT	=	SUPFANSS	AND	*L1	IF SUPPLY FAN BOP IS ON AND BIP OFF
*R0	=	*R0	+	*1.0	INCREASE COUNTER *R0 BY ONE
*ELSE	=				IF NOT (I.E. BOP IS OFF OR BIP ON)
*R0	=	*0			RESET COUNTER *R0 TO ZERO
*IFT	=	*R0	GT	*24	IF COUNTER 24 (24 X 5 SEC = 2 MIN)
FANFAIL	=	TRUE			SET BINARY VARIABLE "FANFAIL" TRUE
*IFT	=	MANRESET	OR	*L0	IF MANRESET BNP ON OR AUTO BIP OFF
FANFAIL	=	FALSE			SET BINARY VARIABLE "FANFAIL" FALSE
*END	=				END OF *IFT STRING
LOWTEMP	=	MIXLOLIM			LOWTEMP VARIABLE = MIXLOLIM BIP
*END	=				END OF ROUTINE

Routine #1 Description:

This routine monitors the supply fan for fan failure. Should the supply fan start/stop "SUPFANSS" binary output be "ON" and the supply fan status binary input "SUPFANST" be "OFF" for a two minute time period, the "FANFAIL" binary variable will be triggered to "ON" and initiate fan failure. Once initiated, the "FANFAIL" binary variable can only be reset to "OFF" by one of the following methods:

1. Toggle the manual reset, "MANRESET", binary parameter to "ON" then "OFF". Typically accomplished through the LCD display.
2. Trigger the "RUN/AUTO" binary input to "OFF" then "ON". Typically accomplished be either removing and re-installing the factory installed jumper or switching a field installed toggle switch to "OFF" then "ON".
3. Toggle the PCM circuit board on-off switch to "OFF" then "ON".

The "LOWTEMP" variable is triggered to "ON" whenever the "MIXLOLIM" binary input is ON (open circuit). The "LOWTEMP" variable can only be cleared by manually resetting the Mixed Air Low Limit Device.

```
                        PCL ROUTINE DEFINITION

  PCM: AHC-001B                                  Date: 03-FEB-92
  Location:

Routine Name: FAN CONTROL                  Routine Number:  2
                          Freq:   0 Hrs.   0 Mins.   5 Secs.

Result        1st Arg     Operator 2nd Arg    Description of Statement
----------    ----------  -------- ---------- ----------------------------------
*L0         = .           NOT      RUN-AUTO   *L0 TRUE IF RUN-AUTO/STOP BIP = STOP
*L1         = *L0         OR       SHUTDN     \*L1 TRUE IF STOP OR "SHUTDN" MODE
            = FANFAIL              LOWTEMP    /    OR FANFAIL OR LOWTEMP
*L2         = DMDLIM      OR       DTYCYC     *L2 TRUE IF DMDLIM OR DTYCYC MODE
*IFT        = UNOCCU      OR       *L2        IF UNOCCU OR DMDLIM OR DTYCYC MODE
SUPFANSS    =             CONTROL  OFF        CONTROL SUPPLY FAN BOP TO "OFF"
*ELSE       =                                 IF NOT
SUPFANSS    =             CONTROL  ON         CONTROL SUPPLY FAN BOP TO "ON"
*IFT        = *L1                             IF STOP, SHUTDN, FANFAIL, OR LOWTEMP
SUPFANSS    = NOMIN       CONTROL  OFF        BOP "OFF" OVERRIDING MIN ON TIMER
*IFT        = SUPFANSS    AND      SUPFANST   IF FAN BOP AND STATUS "ON"
*R0         = *R0         +        *1.0       INCREASE COUNTER *R0 BY ONE
*ELSE       =                                 IF NOT (FAN BOP OR STATUS BIP OFF)
*R0         = *0                              RESET COUNTER TO *R0 TO ZERO
*END        =                                 END OF *IFT STRING
FANON       = *R0         GT       *6         "FANON" = TRUE IF *R0 > 6 (30 SEC)
FANOFF      =             NOT      FANON      "FANOFF" = OPPOSITE OF "FANON"
*END        =                                 END OF ROUTINE
```

Routine #2 Description:

This routine starts and stops the supply fan. After air flow is established for a 30 second time period, the "FANON" binary variable is set to "TRUE". The "FANOFF" binary variable (used in other routines) is set to the opposite state of "FANON".

The supply fan "SUPFANSS" binary output will be controlled to "ON" and remain on until indexed to be "OFF" by one of the following triggers:

1. "RUN-AUTO" binary input is open or "OFF" (shutdown).
2. "FANFAIL" binary variable is "ON".
3. "LOWTEMP" binary variable is "ON".
4. "SHUTDN" binary setpoint is "ON" (Tracer BMS interface).

   Note: The above fan "OFF" trigger will stop the supply fan instanteously overriding minimum ON/OFF timers.

5. "DMDLIM" binary setpoint is "ON" (Tracer BMS interface).
6. "DTYCYC" binary setpoint is "ON" (Tracer BMS interface).
7. "UNOCCU" binary setpoint is "ON" (Tracer BMS interface).

PCL ROUTINE DEFINITION

PCM: AHC-001B Date: 03-FEB-92
Location:

Routine Name: LOCAL SETPTS Routine Number: 3
Freq: 0 Hrs. 0 Mins. 5 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
*L0	=	ROOMSP	FAIL		*LO TRUE IF ROOM SETPT INPUT FAILED
*L1	=		NOT	*L0	*L1 TRUE IF ROOM SETPT INPUT OK
*IFT	=	ROOMADJ	AND	*L1	IF ROOMADJ BNP TRUE AND SPT INPUT OK
SPACESPA	=	ROOMSP			SPACE SETPT = ROOM SETPT INPUT
*ELSE	=				IF NOT (I.E. DISABLED OR FAILED)
SPACESPA	=	SPACESP			SPACE SETPT = TRACER SPACE SETPOINT
*END	=				END OF *IFT STRING
SPACESPA	=	SPACESPA	MAX	ROOMLOW	SPACE SETPT LOW LIMIT = ROOMLOW
SPACESPA	=	SPACESPA	MIN	ROOMHIGH	SPACE SETPT HIGH LIMIT = ROOMHIGH
*IFT	=	KEYPADSP			IF KEYPAD BNP IS ON (LOCAL SETPTS)
SPACESPA	=	SPACESPK			SPACE SETPT = KEYPAD SPACE SETPT
*END	=				END OF *IFT STRING
HEATNGSP	=	SPACESPA	-	HEATOFST	HEATING SETPT = SPACE SETPT - OFFSET
HEATNGSP	=	HEATNGSP	MAX	*45.0	HEATING SETPT LOW LIMIT = 45 DEG
HEATNGSP	=	HEATNGSP	MIN	SPACESPA	HEATING SETPT HI LIMIT = SPACE SETPT
*END	=				END OF ROUTINE

Routine #3 Description:

This routine establishes the space setpoint "SPACESPA" and heating setpoint "HEATNGSP" analog variable values to be used in the discharge air reset routine #6. The space setpoint "SPACESPA" analog variable value is set equal to the Tracer BMS communicated space setpoint "SPACESP" analog setpoint value, unless the room setpoint adjust "ROOMADJ" binary parameter is "ON" and the space sensor setpoint adjustment knob "ROOMSP" analog input is not failed. With "ROOMADJ" binary parameter set to "ON" and the space sensor setpoint adjustment knob "ROOMSP" analog input not failed, the space setpoint "SPACESPA" analog variable value is set equal to the ajustment knob "ROOMSP" analog input value.

The "SPACESPA" analog variable is limited by the room low limit "ROOMLOW" and the room high limit "ROOMHIGH" analog parameter values should "ROOMSP" or "SPACESP" exceed these limits. "ROOMLOW" and "ROOMHIGH" analog parameters are adjustable through the PCM LCD display.

Regardless of the "SPACESPA" analog variable value as established above, the space setpoint "SPACESPA" analog variable is set equal to the keypad space setpoint "SPACESPK" analog parameter value should the keypad setpoint adjustment "KEYPADSP" binary parameter be set to "ON".

Note: The room low and high limits do not apply when "KEYPADSP" binary parameter is set to "ON". "SPACESPK" analog parameter is adjustable through the PCM LCD display.

The heating setpoint "HEATNGSP" analog variable value is set equal to space setpoint "SPACESPA" analog variable value as set above minus the heating offset "HEATOFST" analog parameter value. "HEATNGSP" analog variable has a low limit of 45° F and a high limit of the space setpoint "SPACESPA" analog variable value as set above.

PCL ROUTINE DEFINITION

PCM: AHC-001B Date: 03-FEB-92
Location:

Routine Name: HEAT/COOL Routine Number: 4
Freq: 0 Hrs. 0 Mins. 60 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
*R0	=	SPACESPA	+	*1	*R0 = SPACE COOLING SETPT + 1 DEG
*R1	=	HEATNGSP	-	*1	*R1 = SPACE HEATING SETPT - 1 DEG
*IFT	=	SPACETMP	GT	*R0	IF SPACE TEMP > COOL SETPT + 1 DEG
COOL	=	TRUE			SET COOLING MODE = TRUE
*IFT	=	SPACETMP	LT	*R1	IF SPACE TEMP < HEAT SETPT - 1 DEG
COOL	=	FALSE			SET COOLING MODE = FALSE (HEATING)
*END	=				END OF *IFT STRING
HEAT	=		NOT	COOL	HEATING MODE = OPPOSITE OF COOLING
*END	=				END OF ROUTINE

Routine #4 Description:

This routine establishes an "ON" or "OFF" value for the "COOL" and "HEAT" binary variables with the "HEAT" value always being the opposite of the "COOL" value. These variables are used by the discharge setpoints, OADAMPER, COOL VALVE, and HEAT VALVE routines.

If the space temperature sensor "SPACETMP" analog input value is greater than the space setpoint "SPACESPA" analog variable plus 1° F, binary variable "COOL" is set to "ON" and the mode of the AHU will be cool. If "SPACETMP" analog input value is less than the heating setpoint "HEATNGSP" analog variable value minus 1° F, binary variable "HEAT" is set to "ON" and the mode of the AHU will be heat.

PCL ROUTINE DEFINITION

PCM: AHC-001B Date: 03-FEB-92
Location:

Routine Name: SETPOINTS Routine Number: 5
Freq: 0 Hrs. 0 Mins. 10 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
MIXAIRSP	=	MIXEDSP	MAX	*45.0	MIXED AIR SETPT LOW LIMIT OF 45 DEG
*R0	=	OAECONSP	-	*2.0	*R0 = OA CHANGEOVER S.P. - 2.0 DEG
*IFT	=	OATEMP	LE	*R0	IF OA TEMP IS COOL (LESS THAN R0)
*L0	=	TRUE			SET *L0 TO TRUE (INDICATES COOL)
*IFT	=	OATEMP	GE	OAECONSP	IF OA TEMP IS WARM (GREATER THAN SP)
*L0	=	FALSE			SET *L0 TO FALSE
*END	=				END OF *IFT STRING
*L1	=	*L0	AND	ECONOMIZ	TRUE IF COOL AND TRACER ECON. ENABLE
ECONENAB	=	*L1	OR	PURGE	ECON ENABLE IF *L1 OR PURGE MODE
*IFT	=	OCCUPY	OR	COASTD	IF OCCUPY OR COASTDOWN MODE
MINPOS	=	OAMINPOS			ECON MIN POSITION = OPERATOR ENTRY
*ELSE	=				IF NOT OCCUPY OR COASTDOWN
MINPOS	=	*0			ECON MIN POSITION = 0 %
*END	=				END OF ROUTINE

Routine #5 Description:

This routine establishes setpoint values for the following analog and binary variables; mixed air setpoint "MIXAIRSP" analog variable, outside air damper minimum position setpoint "MINPOS" analog variable, and economizer enable "ECONENAB" binary variable. These analog and binary variables are used in routines #7 through #9.

The mixed air setpoint "MIXAIRSP" analog variable is equal to analog parameter "MIXEDSP" or 45° F, which ever is larger. Analog parameter "MIXEDSP" is adjustable through the LCD PCM display.

If outside air temperature "OATEMP" analog input value is 2° F less than the outside air economizer change-over setpoint "OAECONSP" analog parameter and economizer "ECONOMIZ" binary setpoint is indexed to "ON" by the Tracer BMS or binary setpoint "PURGE" is indexed to "ON" by the Tracer BMS, economizer enable "ECONENAB" binary variable will be set to "ON" (enabled). If the outside air temperature "OATEMP" analog input value is greater than outside air economizer switch-over setpoint "OAECONSP" value, economizer "ECONOMIZ" binary setpoint is indexed to "OFF" by the Tracer BMS or binary setpoint "PURGE" is indexed to "OFF" by the Tracer BMS, economizer enable "ECONENAB" binary variable will be "OFF" (disabled).

The outside air damper minimum position setpoint "MINPOS" analog variable is set equal to 0 %, unless, either the "OCCUPY" or "COASTD" binary setpoint is indexed to "ON" by the Tracer BMS. With "OCCUPY" or "COASTD" indexed to "ON", outside air damper minimum position setpoint "MINPOS" analog variable is set equal to analog parameter "OAMINPOS" value. "OAMINPOS" is adjustable through the PCM LCD display.

PCL ROUTINE DEFINITION

PCM: AHC-001B Date: 03-FEB-92
Location:

Routine Name: DISCH SETPT Routine Number: 6
Freq: 0 Hrs. 0 Mins. 60 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
*IFT	=	COOL			IF MODE IS COOLING
*R0	=	SPACESPA			DDC LOOP SETPT *R0 = COOLING SETPT
*ELSE	=				IF MODE IS HEATING
*R0	=	HEATNGSP			DDC LOOP SETPT *R1 = HEATING SETPT
*END	=				END OF *IFT STRING
COOLSP	=	SPACETMP	DDC:1	*R0	RUN DDC LOOP FOR DISCH COOLING SETPT
*L0	=	SPACETMP	FAIL		*L0 TRUE IF SPACE SENSOR FAILED
*IFT	=	COOL			IF MODE IS COOLING
COOLSP	=	COOLSP	MIN	SPACESPA	COOLSP HIGH LIMIT = SPACE SETPT
*IFT	=	HEAT			IF MODE IS HEATING
COOLSP	=	COOLSP	MAX	HEATNGSP	COOLSP LOW LIMIT = HEATING SETPT
*IFT	=	*L0	OR	FANOFF	IF SPACE SENSOR FAILED OR FAN IS OFF
COOLSP	=	SPACESPA			DISCH COOLING SETPT = SPACE SETPT
*END	=				END OF *IFT STRING
ECONSP	=	COOLSP	-	*2.0	DISCH ECON SETPT = COOLSP - 2 DEG
HEATSP	=	ECONSP	-	*2.0	DISCH HEAT SETPT = ECONSP - 2 DEG
*END	=				END OF ROUTINE

Routine #6 Description:

This routine establishes setpoint values for the following analog variables; discharge air cooling setpoint "COOLSP" analog variable, economizer setpoint "ECONSP" analog variable, and heating setpoint "HEATSP" analog variable. These analog variables are used in routines #7 through #9.

The discharge air cooling setpoint "COOLSP" analog variable is reset from the space temperature "SPACETMP" analog input through DDC loop #1. "COOLSP" analog variable value is equal the output of DDC loop #1 which compares the space temperature "SPACETMP" analog input value to the space setpoint "SPACESPA" or heating setpoint "HEATNGSP" based on the mode of the AHU being cool or heat, respectively. If the mode of AHU is cool, "COOLSP" analog variable is reset from DDC loop #1, 50° F minimum output to the space setpoint "SPACESPA" analog variable value as the maximum. If the mode of the AHU is heat, "COOLSP" analog variable is reset from the heating setpoint "HEATNGSP" analog variable value minimum to the DDC loop #1, 104° F maximum output as the maximum.

Should the space temperature "SPACETMP" analog input be failed or the "FANOFF" binary variable be set to "ON", the discharge air cooling setpoint "COOLSP" analog variable is set to space setpoint "SPACESPA" analog variable. The economizer setpoint "ECONSP" analog variable is equal to the cooling setpoint "COOLSP" analog variable minus 2° F. The heating setpoint "HEATSP" analog variable is equal to the economizer setpoint "ECONSP" analog variable minus 2° F.

PCL ROUTINE DEFINITION

PCM: AHC-001B Date: 03-FEB-92
Location:

Routine Name: OA DAMPER Routine Number: 7
Freq: 0 Hrs. 0 Mins. 10 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
OADCALC	=	DISCHTMP	DDC:2	ECONSP	DDC LOOP FOR OADAMPER, USE OADCALC
OADCALC	=	OADCALC	MAX	MINPOS	OADCALC LO LIMIT - ECON MIN POSITION
*L0	=		NOT	ECONENAB	*L0 TRUE IF ECONOMIZER DISABLED
*L1	=	DISCHTMP	FAIL		*L1 TRUE IF DISCH SENSOR IS FAILED
*L2	=	*L0	OR	*L1	*L2 TRUE IF SENSOR FAIL OR ECON DIS
*IFT	=	*L2	OR	HEAT	IF SENSOR FAIL OR ECON DIS OR HEAT
OADCALC	=	MINPOS			SET CALC DAMPER POSITION AT MINIMUM
*END	=				END OF *IFT STRING
MIXCALC	=	MIXEDTMP	DDC:5	MIXAIRSP	DDC LOOP FOR MIXED AIR, USE MIXCALC
OADCALC	=	OADCALC	MIN	MIXCALC	SELECT MINIMUM OF OADCALC & MIXCALC
*L3	=	MIXEDTMP	FAIL		*L3 TRUE IF MIXED SENSOR FAILED
*IFT	=	FANOFF	OR	*L3	IF FAN IS OFF OR MIXED SENSOR FAILED
OADCALC	=	*-10			SET CALC DMPR POSITION TO FULL CLOSE
*END	=				END OF *IFT STRING
OADAMPER	=		CONTROL	OADCALC	SET OADAMPER AOP TO CALC DMPR POS.
*END	=				END OF *IFT STRING
MIXCALC	=	OADCALC			SET MIXCALC = OADCALC VALUE
*END	=				*END OF ROUTINE

Routine #7 Description:

This routine controls the outside air damper through analog output "OADAMPER" to the calculated outside air damper position "OADCALC" analog variable value. "OADCALC" value is equal to the minimum value of the economizer DDC loop #2 or the mixed air DDC loop #5.

Initially, "OADCALC" value is set equal to the output of the economizer DDC loop #2 which compares the discharge air temperature "DISCHTMP" analog input value to the economizer setpoint "ECONSP" analog variable value (2° F less than the discharge air setpoint per routine #6). DDC loop #2 output will change as required to maintain the economizer setpoint. "OADCALC" value is limited to the outside air damper minimum position "MINPOS" analog variable value and will be set to the damper minimum position "MINPOS" value should the discharge temperature sensor "DISCHTMP" analog input fail, the economizer "ECONENAB" binary variable be "OFF" (disabled) per routine #5 or "HEAT" binary variable be set to "ON" per routine #4.

"OADCALC" value is then set equal to the lesser value of "OADCALC" as determined above or the calculated mixed air "MIXCALC" analog variable value. "MIXCALC" is set equal to the output of the mixed air DDC loop #5 which compares the mixed air temperature "MIXEDTMP" analog input value to the mixed air setpoint "MIXAIRSP" analog variable value. DDC loop #5 output will change as required to maintain the mixed air setpoint.

Should the binary variable "FANOFF" be set to "ON" per routine #2 or the mixed air temperature sensor "MIXEDTMP" analog input be failed, "OADCALC" value as previously determined is ignored and is set to -10%. An "OADCALC" value of -10% will cause closure of the outside air damper.

"MIXCALC" value is set equal to the "OADCALC" value at the end of this routine to provide a smooth transfer of control between the two DDC loops.

```
                          PCL ROUTINE DEFINITION

  PCM: AHC-001B                                  Date: 03-FEB-92
  Location:

Routine Name: COOL VALVE                    Routine Number:  8
                          Freq:   0 Hrs.   0 Mins.  10 Secs.

Result        1st Arg     Operator 2nd Arg    Description of Statement
----------    ----------  -------- ---------- ----------------------------------
COOLCALC    = DISCHTMP    DDC:3    COOLSP     RUN DDC LOOP FOR COOL VALVE CONTROL
*IFT        = OADAMPER    LE       *70        IF OA DAMPER POSITION  70%
*L0         = TRUE                            SET *L0 TO TRUE
*IFT        = OADAMPER    GE       *90        IF OA DAMPER POSITION  90%
*L0         = FALSE                           SET *L0 TO FALSE
*END        =                                 END OF *IFT STRING
*L1         = *L0         AND      ECONENAB   *L1 TRUE IF *L0 TRUE AND ECON ENABLE
*L2         = DISCHTMP    FAIL               *L2 TRUE IF DISCH TEMP SENSOR FAILED
*L3         = *L1         OR       *L2       \ *L3 TRUE IF: *L1 TRUE OR SENSOR
            = HEAT                 FANOFF      >FAIL OR HEAT MODE OR FAN IS OFF
            = COASTD               PURGE      / COASTDOWN MODE OR PURGE MODE
*IFT        = *L3                             IF *L3 IS TRUE
COOLCALC    = *-10                            CALC COOL VALVE POS. = FULL CLOSED
*IFT        = FANOFF      AND      COOLOPEN   IF FANOFF AND COOLOPEN ARE BOTH TRUE
COOLCALC    = *100                            CALC COOL VALVE POS. = FULL OPEN
*END        =                                 END OF *IFT STRING
CWVALVE     =             CONTROL  COOLCALC   SET COOL VALVE AOP = CALC POSITION
*END        =                                 END OF ROUTINE
```

Routine #8 Description:

This routine controls the chilled water valve through analog output "CWVALVE" to the calculated chilled water valve position "COOLCALC" analog variable. "COOLCALC" value is equal to the output of DDC loop #3 which compares the discharge air temperature sensor "DISCHTMP" analog input value to the cooling setpoint "COOLSP" analog variable value. DDC loop #3 output will change as required to maintain the cooling setpoint.

Regardless of DDC loop #3 output, analog variable "COOLCALC" is set equal to -10% should the discharge air temperature sensor "DISCHTMP" analog input be failed, the outside air damper "OADAMPER" analog output value be greater than 90% and economizer enable "ECONENAB" binary variable is "ON" (enabled per routine #5) or one of the following binary variables or setpoints is "ON"; binary variable "HEAT" per routine #4, binary variable "FANOFF" per routine #2, binary setpoints "PURGE" and "COASTD" per Tracer BMS system.

Previously determined analog variable "COOLCALC" value is ignored and is set to 100% should binary variable "FANOFF" be "ON" and binary parameter "COOLOPEN" be "ON" (open). "COOLOPEN" is adjustable through the PCM LCD display.

```
                          PCL ROUTINE DEFINITION

  PCM: AHC-001B                                  Date: 03-FEB-92
  Location:

Routine Name: HEAT VALVE                  Routine Number:  9
                                  Freq:   0 Hrs.   0 Mins.  10 Secs.

Result        1st Arg     Operator 2nd Arg    Description of Statement
----------    ----------  -------- ---------- -----------------------------------
HEATCALC    = DISCHTMP    DDC:4    HEATSP     RUN DDC LOOP FOR HWVALVE CONTROL
*L0         = DISCHTMP    FAIL                *L0 TRUE IF DISCH TEMP SENSOR FAILED
*R0         = MINPOS      +        *1.0       *R0 = OA DAMPER MIN. POS. + 1%
*L1         = OADAMPER    GE       *R0        *L1 TRUE IF OADAMPER POS.  *R0
*L2         = CWVALVE     GT       *0         *L2 TRUE IF CWVALVE NOT FULLY CLOSED
*L3         = *L0         OR       *L1        \  IF SELECTED SENSOR IS FAILED OR
            = *L2                  FANOFF      > OADAMPER  MINPOS OR CWVALVE IS
*IFT        = *L3                              /  NOT FULLY CLOSED OR FANOFF
HEATCALC    = *-10                             CALC HEAT VALVE POS. IS FULL CLOSED
*IFT        = FANOFF      AND      HEATOPEN   IF SUPPLY FANOFF AND HEATOPEN TRUE
HEATCALC    = *100                             CALC HEAT VALVE POS. IS FULL OPEN
*END        =                                  END OF *IFT STRING
HWVALVE     =             CONTROL  HEATCALC   SET HWVALVE AOP = CALC. POSITION
*END        =                                  END OF ROUTINE
```

Routine #9 Description:

This routine controls the hot water valve through analog output "HWVALVE" to the calculated hot water valve position "HEATCALC" analog variable. "HEATCALC" value is equal to the output of DDC loop #4 which compares the discharge air temperature sensor "DISCHTMP" analog input value to the heating setpoint "HEATSP" analog variable value as set per routine #6. DDC loop #4 output will change as required to maintain the heating setpoint.

Regardless of DDC loop #4 output, analog variable "HEATCALC" is set equal to -10% if the discharge air temperature sensor "DISCHTMP" analog input is failed, the outside air damper "OADAMPER" analog output percent is 1% greater than outside air damper minimum postion "MINPOS" analog variable value as set in routine #5 or binary variable "FANOFF" is "ON" per routine #2.

Analog variable "HEATCALC" as previously determined is ignored and is set to 100% should binary variable "FANOFF" be "ON" and binary parameter "HEATOPEN" be "ON" (open). "HEATOPEN" is adjustable through the PCM LCD display.

```
                        PCL ROUTINE DEFINITION

  PCM: AHC-001B                                  Date: 03-FEB-92
  Location:

Routine Name: CALIBRATION                 Routine Number: 10
                          Freq:   0 Hrs.   0 Mins.  60 Secs.

Result        1st Arg     Operator 2nd Arg    Description of Statement
----------    ----------  -------- ---------- ----------------------------------
*L0         =             NOT      RUN-AUTO   *L0 TRUE IF AUTO/STOP BIP IS STOP
*IFT        = CALIBRTE    AND      *L0        IF CALIBRATE BNP ON AND STOP
HWVALVE     =             CONTROL  *0         SET HOT WATER VALVE POSITION = 0%
CWVALVE     =             CONTROL  *0         SET CHILLED WTR VALVE POSITION = 0%
OADAMPER    =             CONTROL  *0         SET OA DAMPER POSITION = 0%
*END        =                                 END OF ROUTINE
```

Routine #10 Description:

With binary input "RUN/AUTO" indicating "OFF" and binary parameter "CALIBRTE" set to "ON" all analog outputs (HW valve, CW valve, and OA damper) will be set to 0% to allow valve and/or linkage adjustments to be made. Binary parameter "CALIBRTE" is typically adjusted from the PCM LCD display.

CUSTOM DISPLAY SETUP

PCM: AHC-001B Date: 03-FEB-92
Location:

PCM System Password: +-+-

Display Line	Point Name	Expanded Description	Desc/ Units	Adjust	Adjustment Limits Low	High
1	RUN-AUTO	AUTO/STOP INPUT	7			
2	SUPFANSS	SUPPLY FAN START	0			
3	SUPFANST	SUPPLY FAN STATUS	0			
4	COOL	COOLING MODE	4			
5	SPACESPA	SPACE CLG SETPOINT	0			
6	HEATNGSP	SPACE HTG SETPOINT	0			
7	SPACETMP	SPACE TEMPERATURE	0			
8	DISCHTMP	DISCHARGE AIR TEMP	0			
9	ECONENAB	ECONOMIZER STATUS	2			
10	OADAMPER	OA DAMPER POSITION	4			
11	MINPOS	OA DAMPER MIN POS	4			
12	MIXEDTMP	MIXED AIR TEMP	0			
13	HWVALVE	H.W. VALVE POS	4			
14	CWVALVE	C.W. VALVE POS	4			
15	OATEMP	OUTDOOR AIR TEMP	0			
16	FANFAIL	SUPPLY FAN FAILURE	4			
17	FILTER	DIRTY FILTER	4			
18	MIXLOLIM	MIXED AIR LO LIMIT	5			
19	KEYPADSP	KEYPAD SETPOINTS	4	Y		
20	SPACESPK	KEYPAD SPACE SETPT	0	Y	45.0	100.0
21	ROOMADJ	ROOM SETPT ENABLE	4	Y		
22	ROOMSP	ROOM SETPOINT KNOB	0			
23	HEATOFST	HEATING OFFSET	0	Y	.0	15.0
24	OAMINPOS	OA MIN POSITION SP	4	Y	.0	100.0
25	OAECONSP	OA ECON ENABLE SP	0	Y	-100.0	100.0
26	MIXEDSP	MIXED AIR SETPOINT	0	Y	45.0	100.0
27	ROOMLOW	SPACE SETPT LO LIM	0	Y	45.0	100.0
28	ROOMHIGH	SPACE SETPT HI LIM	0	Y	45.0	100.0
29	CALIBRTE	AOP CALIBRATE MODE	0	Y		
30	MANRESET	MANUAL RESET POINT	0	Y		
31						
32						

Binary Descriptor Table:

0 = OFF/ON 1 = CLOSED/OPEN 2 = DISABL/ENABLE
3 = AUTO/MANUAL 4 = NO/YES 5 = NORMAL/ALARM
6 = UNOCC/OCCUPY 7 = SHUTDN/NORMAL 8 = HEAT/COOL

Analog Units Table:

0 = DEG 1 = PSI 2 = KW 3 = KWH 4 = PCT 5 = CFM
6 = AMP 7 = VOL 8 = HG 9 = IN 10 = RH 11 = Blank

Constant Volume AHU with Discharge Air Reset from Space Control with Stand-alone Control

Control Sequence for AHC-002B

Occupied Cooling or Heating Mode:
When the AHU is indexed to the occupied, cooling, or heating mode, the supply fan will operate continuously, the outside air damper will be at its minimum position (unless economizing), and the space air temperature (74° F nominal) will be maintained by resetting the discharge air temperature setpoint. The discharge air temperature will be maintained by modulating the chilled water valve, the hot water or steam valve, and the outdoor air damper. When the AHU is in the cooling mode, the discharge air setpoint is reset from 50° F (minimum) to the space cooling setpoint (maximum). When the AHU is in the heating mode, the discharge air setpoint temperature is reset from the space heating setpoint (minimum) to 104° F (maximum).

The occupied mode is triggered by the occupy binary input (closed=occupy), typically from an external system or time clock. If enabled, the space sensor timed override switch momentary closure will place the AHU in the occupied mode for a 2 hour period, overriding the occupy input.

Night Setback /Morning Warmup Heating Mode:
Night setback mode is determined based on the space temperature sensor and night setback setpoint. The night setback setpoint is adjustable at the local PCM keypad/display. If the space sensor temperature is less than the night setback setpoint, the AHU will be in the night setback mode. When the AHU is indexed to the night setback/morning warmup heating mode, the supply fan will operate continuously, the outdoor air damper will be fully closed, the chilled water valve will be fully closed and the hot water or steam valve will modulate to maintain the discharge air temperature.

Supply Fan Control:
The supply fan will operate continuously whenever the AHU is indexed to either the occupied mode or the night setback/morning warmup heating mode. The supply fan will be off whenever the AHU is indexed to the unoccupied mode, the run-auto/stop interlock is open, the mixed air low limit is tripped, or the supply fan status indicates a failure (after a 2 minute delay). The fan failure indication requires a manual reset which can be done at the local PCM keypad/display or by opening the run-auto/stop interlock.

Heat/Cool Mode Control:
The heat/cool mode of the AHU is determined based on the space temperature sensor and the space cooling and heating setpoints. The space heating setpoint is the space cooling setpoint minus the heating offset differential. The heating offset differential is adjustable from 0° to 15° F at the local PCM keypad/display. If the space sensor temperature is greater than the space cooling setpoint plus 1° F, the mode of the AHU will be cool. If the space sensor temperature is less than the heating setpoint minus 1° F, the mode of the AHU will be heat. The AHU will be allowed to switch between the heating and cooling modes at any time during operation, based on this logic. The space cooling setpoint is adjustable by the space sensor setpoint adjustment knob. If space sensor setpoint adjustment knob is failed or local PCM keypad setpoint is selected, the setpoint is adjustable at the local PCM keypad/display.

AHC-002B continued...

Outdoor Air Damper Control
The economizer function is enabled when the outdoor air temperature is less than the changeover setpoint minus 2°F. When the economizer function is enabled, the outdoor air damper will modulate, as commanded by the PCM controller, between minimum position and full open to maintain the discharge air temperature at the economizer setpoint (discharge cooling setpoint minus 2°F). The outdoor air damper will be modulated closed as required (overriding the minimum position) to maintain the mixed air temperature (averaging element) at or above the mixed air setpoint (48°F nominal). A mixed air low limit manual reset device (sensing the coldest one-foot section) will turn the supply fan off if its sensed temperature is below its setpoint (36°F nominal).

The economizer function is disabled by the outdoor air temperature being above the changeover setpoint. If the economizer function is disabled, the discharge air temperature sensor is failed, or the AHU is in the heat mode, the outdoor air damper will be set to minimum position. If the space temperature is 2°F less than the space heating setpoint, the supply fan is off, or the mixed air temperature sensor is failed, the outdoor air damper will be fully closed.

Chilled Water Valve Control:
The chilled water valve will modulate, as commanded by the PCM controller, to maintain the discharge air temperature at the discharge cooling setpoint. If the economizer function is enabled and the outdoor air damper is not fully opened, the chilled water valve will be closed. The chilled water valve will also be closed if the mode of the AHU is heating or the discharge air temperature sensor is failed. If the supply fan is off, the chilled water valve will be either fully open or closed, as selected by a user entry.

Hot Water or Steam Valve Control:
The hot water or steam valve will modulate to maintain the discharge air temperature at the discharge heating setpoint. The discharge heating setpoint is equal to the economizer setpoint minus 2°F. If the outdoor air damper is open past the minimum position, the chilled water valve is not fully closed, or the discharge air temperature sensor is failed, the hot water or steam valve will be closed. If the supply fan is off, the hot water or steam valve will either be fully opened or closed, as selected by a user entry.

Unoccupied Mode:
When the AHU is indexed to the unoccupied mode, the supply fan will be turned off and outside air damper will be fully closed. The chilled water valve will be either fully closed or fully open, as selected by user entry. The hot water or steam valve will be either fully open or fully closed, as selected by user entry.

Local PCM Keypad/Display:
The following setpoints (parameters) are stored in the AHU PCM and can be access through the local PCM keypad/display:

Analog Parameters

- Space Cooling Setpoint (45°–100° F)
- Heating Offset Differential (0° – 15° F)
- Space Setpoint Low Limit Adjustment (45° – 100° F)
- Space Setpoint High Limit Adjustment (45° – 100° F)
- Mixed Air Setpoint (45° – 100° F)
- Outdoor Air Changeover Setpoint (-100° – 100° F)
- Outdoor Air Minimum Position (0 - 100%)
- Night Setback Setpoint (45° – 80° F)

Binary Parameters

- Manual Reset Point (OFF/ON)
- Heat Valve/Fan Off (CLOSED/OPEN)
- Cool Valve/Fan Off (CLOSED/OPEN)
- AOP Calibrate Mode (OFF/ON)
- Space Sensor TOV Switch Enable (NO/YES)

Analog Output Calibrate Mode:
When the run-auto/stop input is open (AHU OFF) the user can select a special analog output calibrate mode from the local PCM keypad/display. When in the calibrate mode, all analog outputs (HW valve, CW valve, OA Damper) will be set to 0% to allow valve and/or linkage adjustments to be made.

Note: AIP and AOP Range and Offset entries shown on the next page may vary, depending on the actual input sensors and output actuators used.

POINT DATA DEFINITIONS

PCM: AHC-002B Date: 03-FEB-92
Location: Page: 1 of 2

PULSE METER INPUTS:

Name	Weight
PAC1	.0
PAC2	.0

ANALOG INPUTS:

	Name	Conv Type	Range	Offset
AIP1	MIXEDTMP	BAL	102.4	.0
AIP2	SPARE	BAL	102.4	.0
AIP3	DISCHTMP	THM	102.4	.0
AIP4	OATEMP	THM	102.4	.0
AIP5	SPACETMP	THM	102.4	.0
AIP6	ROOMSP	RES	-50.0	95.0

ANALOG OUTPUTS:

	Name	Range	Offset
AOP1	HWVALVE	-333.3	300.0
AOP2	CWVALVE	333.3	-200.0
AOP3	OADAMPER	125.0	-25.0
AOP4		.0	.0

ANALOG SETPOINTS: ***(from Tracer BMS)***

	Name	Communications Loss Value		Name	Communications Loss Value
ASP1		.0	ASP5		.0
ASP2		.0	ASP6		.0
ASP3		.0	ASP7		.0
ASP4		.0	ASP8		.0

ANALOG PARAMETERS: ***(adjusted by operator)***

	Name	Value		Name	Value
ANP1	SPACESPK	74.0	ANP5	MIXEDSP	48.0
ANP2	HEATOFST	3.0	ANP6	OAECONSP	70.0
ANP3	ROOMLOW	55.0	ANP7	OAMINPOS	15.0
ANP4	ROOMHIGH	85.0	ANP8	NITESP	60.0

ANALOG VARIABLES: ***(calculated by PCL routines)***

	Name		Name		Name		Name
AV1	COOLSP	AV5	MINPOS	AV9		AV13	OADCALC
AV2	ECONSP	AV6	SPACESPA	AV10		AV14	HEATCALC
AV3	HEATSP	AV7	HEATNGSP	AV11		AV15	COOLCALC
AV4	MIXAIRSP	AV8		AV12	MIXCALC	AV16	

POINT DATA DEFINITIONS

PCM: AHC-002B
Location:

Date: 03-FEB-92
Page: 2 of 2

BINARY INPUTS:

	Name	Open Means
BIP1	SUPFANST	OFF
BIP2	OCCUPY	OFF
BIP3	MIXLOLIM	ON
BIP4	RUN-AUTO	OFF

BINARY OUTPUTS:

	Name	Relay Off Means	Minimum On Time	Minimum Off Time
BOP1	SUPFANSS	OFF	0	5
BOP2		OFF	0	0
BOP3		OFF	0	0
BOP4		OFF	0	0
BOP5		OFF	0	0
BOP6		OFF	0	0

BINARY SETPOINTS: *(from Tracer BMS)*

Name	Communications Loss State	Name	Communications Loss State
BSP1	OFF	BSP13	OFF
BSP2	OFF	BSP14	OFF
BSP3	OFF	BSP15	OFF
BSP4	OFF	BSP16	OFF
BSP5	OFF	BSP17	OFF
BSP6	OFF	BSP18	OFF
BSP7	OFF	BSP19	OFF
BSP8	OFF	BSP20	OFF
BSP9	OFF	BSP21	OFF
BSP10	OFF	BSP22	OFF
BSP11	OFF	BSP23	OFF
BSP12	OFF	BSP24	OFF

BINARY PARAMETERS: *(adjusted by operator)*

	Name	State		Name	State
BNP1	MANRESET	OFF	BNP5	HEATOPEN	ON
BNP2	KEYPADSP	OFF	BNP6	COOLOPEN	OFF
BNP3		OFF	BNP7	CALIBRTE	OFF
BNP4		OFF	BNP8	ENABLTOV	ON

BINARY VARIABLES: *(calculated by PCL routines)*

	Name		Name		Name		Name
BV1	HEAT	BV5	ECONENAB	BV9		BV13	
BV2	COOL	BV6	FANREQ	BV10		BV14	
BV3	FANON	BV7	TOVREQ	BV11	FANFAIL	BV15	

DDC LOOP PARAMETERS

PCM: AHC-002B Date: 03-FEB-92
Location:

DDC Loop # 1	DISCH SETPT	DDC Loop # 2	ECONOMIZER
Proportional Gain	20.00	Proportional Gain	4.00
Integral Gain	5.00	Integral Gain	1.00
Derivative Gain	.00	Derivative Gain	.00
Action	REVERS	Action	DIRECT
Proportional Bias	.0	Proportional Bias	.0
Minimum Output Value	50.0	Minimum Output Value	.0
Maximum Output Value	104.0	Maximum Output Value	100.0
Error Deadband	.5	Error Deadband	.5

DDC Loop # 3	COOL VALVE	DDC Loop # 4	HEAT VALVE
Proportional Gain	4.00	Proportional Gain	4.00
Integral Gain	1.00	Integral Gain	1.00
Derivative Gain	.00	Derivative Gain	.00
Action	DIRECT	Action	REVERS
Proportional Bias	.0	Proportional Bias	.0
Minimum Output Value	-10.0	Minimum Output Value	-10.0
Maximum Output Value	100.0	Maximum Output Value	100.0
Error Deadband	.5	Error Deadband	.5

DDC Loop # 5	MIXED AIR	DDC Loop # 6	
Proportional Gain	4.00	Proportional Gain	.00
Integral Gain	1.00	Integral Gain	.00
Derivative Gain	.00	Derivative Gain	.00
Action	DIRECT	Action	REVERS
Proportional Bias	.0	Proportional Bias	.0
Minimum Output Value	.0	Minimum Output Value	.0
Maximum Output Value	100.0	Maximum Output Value	.0
Error Deadband	.5	Error Deadband	.0

PCL ROUTINE DEFINITION

PCM: AHC-002B Date: 03-FEB-92
Location:

Routine Name: FAIL DETECT Routine Number: 1
Freq: 0 Hrs. 0 Mins. 5 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
*L0	=		NOT	RUN-AUTO	*L0 TRUE IF RUN-AUTO/STOP BIP = STOP
*L1	=		NOT	SUPFANST	*L1 TRUE IF SUPFANST BIP IS OFF
*IFT	=	SUPFANSS	AND	*L1	IF SUPPLY FAN BOP IS ON AND BIP OFF
*R0	=	*R0	+	*1.0	INCREASE COUNTER *R0 BY ONE
*ELSE	=				IF NOT (I.E. BOP IS OFF OR BIP ON)
*R0	=	*0			RESET COUNTER *R0 TO ZERO
*IFT	=	*R0	GT	*24	IF COUNTER > 24 (24 X 5 SEC = 2 MIN)
FANFAIL	=	TRUE			SET BINARY VARIABLE "FANFAIL" TRUE
*IFT	=	MANRESET	OR	*L0	IF MANRESET BNP ON OR AUTO BIP OFF
FANFAIL	=	FALSE			SET BINARY VARIABLE "FANFAIL" FALSE
*END	=				END OF *IFT STRING
LOWTEMP	=	MIXLOLIM			LOWTEMP VARIABLE = MIXLOLIM BIP
*END	=				END OF ROUTINE

Routine #1 Description:

This routine monitors the supply fan for fan failure. Should the supply fan start/stop "SUPFANSS" binary output be "ON" and the supply fan status binary input "SUPFANST" be "OFF" for a two minute time period, the "FANFAIL" binary variable will be triggered to "ON" and initiate fan failure. Once initiated, the "FANFAIL" binary variable can only be reset to "OFF" by one of the following methods:

1. Toggle the manual reset, "MANRESET", binary parameter to "ON" then "OFF". Typically accomplished through the LCD display.
2. Trigger the "RUN/AUTO" binary input to "OFF" then "ON". Typically accomplished be either removing and re-installing the factory installed jumper or switching a field installed toggle switch to "OFF" then "ON".
3. Toggle the PCM circuit board on/off switch to "OFF" then "ON".

The "LOWTEMP" variable is triggered to "ON" whenever the "MIXLOLIM" binary input is ON (open circuit). The "LOWTEMP" variable can only be cleared by manually resetting the Mixed Air Low Limit Device.

PCL ROUTINE DEFINITION

PCM: AHC-002B Date: 03-FEB-92
Location:

Routine Name: FAN REQUEST Routine Number: 2
Freq: 0 Hrs. 0 Mins. 10 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
*R0	=	NITESP	+	*3.0	*R0 = NITE SETBACK SETPOINT + 3.0
*IFT	=	SPACETMP	LT	NITESP	IF SPACETMP LESS THAN NITE SBK SETPT
*L0	=	TRUE			*L0 IS TRUE
*IFT	=	SPACETMP	GT	*R0	IF SPACETMP GREATER THAN *R0
*L0	=	FALSE			*L0 IS FALSE
*IFT	=	SPACETMP	GT	*85.0	IF SPACETMP GREATER THAN *85.0
*L1	=	TRUE			*L1 IS TRUE
*IFT	=	SPACETMP	LT	*82.0	IF SPACETMP LESS THAN *82.0
*L1	=	FALSE			*L1 IS FALSE
*IFT	=	SPACETMP	TOV		IF SPACETMP TOV TRUE
*R1	=	*720			SET *R1 TO 720 (720 X 10 SEC = 2 HR)
*ELSE	=				IF NOT IN TOV
*R1	=	*R1	-	*1.0	DECREASE COUNTER *R1 BY ONE
*IFF	=	ENABLTOV			IF ENABLTOV BNP = FALSE
*R1	=	*-1.0			SET *R1 TO *-1.0
*END	=				*END OF *IFF STRING
*R1	=	*R1	MAX	*-1.0	*R1 LOW LIMIT OF *-1.0
TOVREQ	=	*R1	GT	*0	TOVREQ TRUE IF *R1 GREATER THAN *0
FANREQ	=	*L0	OR	*L1	\FANREQ TRUE IF SPACETMP LT NITESP
	=	OCCUPY		TOVREQ	/OR GT *85.0 OR OCCUPY BIP OR TOVREQ

Routine #2 Description:

This routine establishes the fan request "FANREQ" binary variable value used in the fan control routine #3.

Fan request "FANREQ" binary variable is set to "OFF" unless set to "ON" by any one of the following triggers:

1. **Nite setback** - If the space temperature sensor "SPACETMP" analog input value is less than the nite setback setpoint "NITESP" analog parameter value. "NITESP" analog parameter is adjustable through the PCM LCD display. "FANREQ" binary variable will remain "ON" by the above described trigger until the "SPACETMP" analog input value is 3° F greater than the "NITESP" analog parameter value.
2. **Nite setup** - If the space temperature sensor "SPACETMP" analog input value is greater than 85° F. "FANREQ" binary variable will remain "ON" by the above described trigger until the "SPACETMP" analog input value is less than 82° F.
3. **Timed override** from space sensor (if enabled) - With timed override enable "ENABLTOV" binary parameter set to "ON", momentary closure of the space temperature sensor override switch for a 2 second or greater interval will place "SPACETMP" analog input into timed override (TOV) status for a two minute interval. "SPACETMP" analog input timed override status initiates a 2 hour counter and timed override request "TOVREQ" binary variable is set to "ON" until the counter expires. "FANREQ" binary variable will remain set to "ON" as long as "TOVREQ" binary variable is set to "ON".
4. **Occupy mode** initiated - Occupied/unoccupied "OCCUPY" binary input is set to "ON". "FANREQ" will remain "ON" by the above described trigger until the "OCCUPY" binary input is set to "OFF".

PCL ROUTINE DEFINITION

PCM: AHC-002B Date: 03-FEB-92
Location:

Routine Name: FAN CONTROL Routine Number: 3
Freq: 0 Hrs. 0 Mins. 5 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
SUPFANSS	=		CONTROL	FANREQ	SUPFANSS BOP =FANREQ BINARY VARIABLE
*L0	=		NOT	RUN-AUTO	*L0 TRUE IF RUN-AUTO/STOP BIP = STOP
*L1	=	FANFAIL	OR	LOWTEMP	*L1 TRUE IF FANFAIL OR LOWTEMP
*IFT	=	*L0	OR	*L1	IF STOP, FANFAIL OR LOWTEMP TRUE
SUPFANSS	=	NOMIN	CONTROL	OFF	BOPS "OFF" OVERRIDING MIN ON TIMER
*IFT	=	SUPFANSS	AND	SUPFANST	IF FAN BOP AND STATUS "ON"
*R0	=	*R0	+	*1.0	INCREASE COUNTER *R0 BY ONE
*ELSE	=				IF NOT (FAN BOP OR STATUS BIP OFF)
*R0	=	*0			RESET COUNTER TO *R0 TO ZERO
*END	=				END OF *IFT STRING
FANON	=	*R0	GT	*6	"FANON" = TRUE IF *R0 6 (30 SEC)
FANOFF	=		NOT	FANON	"FANOFF" = OPPOSITE OF "FANON"
*END	=				END OF ROUTINE

Routine #3 Description:

This routine starts and stops the supply fan. After air flow is established for a 30 second time period, the "FANON" binary variable is set to "TRUE". The "FANOFF" binary variable (used in other routines) is set to the opposite state of "FANON".

The supply fan "SUPFANSS" binary output will be controlled to fan request "FANREQ" binary variable value as set in routine # 2.

Regardless of a fan request to have the supply fan "ON", the supply fan "SUPFANSS" binary output will be indexed to "OFF" by one of the following triggers:

1. "RUN/AUTO" binary input is open for "OFF" (shutdown).
2. "FANFAIL" binary variable is "ON".
3. "LOWTEMP" binary variable is "ON".

Note: The above fan "OFF" trigger will stop the supply fan instanteously overriding minimum ON/OFF timers.

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                          PCL ROUTINE DEFINITION

  PCM: AHC-002B                                   Date: 03-FEB-92
  Location:

Routine Name: LOCAL SETPTS                 Routine Number:  4
                           Freq:   0 Hrs.   0 Mins.   5 Secs.

Result       1st Arg    Operator 2nd Arg    Description of Statement
----------   ---------- -------- ---------- -----------------------------------
*IFT       = ROOMSP     FAIL                IF ROOM SETPT INPUT FAILED
SPACESPA   = SPACESPK                       SPACE SETPT = KEYPAD SPACE SETPOINT
*ELSE      =                                IF NOT FAILED
SPACESPA   = ROOMSP                         SPACE SETPT = ROOM SETPT INPUT
*END       =                                END OF *IFT STRING
SPACESPA   = SPACESPA   MAX       ROOMLOW   SPACE SETPT LOW LIMIT = ROOMLOW
SPACESPA   = SPACESPA   MIN       ROOMHIGH  SPACE SETPT HIGH LIMIT = ROOMHIGH
*IFT       = KEYPADSP                       IF KEYPAD BNP IS ON (LOCAL SETPTS)
SPACESPA   = SPACESPK                       SPACE SETPT = KEYPAD SPACE SETPOINT
*END       =                                IF LOCAL SETPOINT DISABLED
HEATNGSP   = SPACESPA   -         HEATOFST  HEATING SETPT = SPACE SETPT - OFFSET
HEATNGSP   = HEATNGSP   MAX       *45.0     HEATING SETPT LOW LIMIT = 45 DEG
HEATNGSP   = HEATNGSP   MIN       SPACESPA  HEATING SETPT HI LIMIT = SPACE SETPT
*END       =                                END OF ROUTINE
```

Routine #4 Description:

This routine establishes the space setpoint "SPACESPA" and heating setpoint "HEATINGSP" analog variable values to be used in the discharge air reset routine #7. The space setpoint "SPACESPA" analog variable value is set equal to the space setpoint "ROOMSP" analog input value, unless the space setpoint "ROOMSP" analog input is failed. With "ROOMSP" analog failed, "SPACESPA" analog variable value is set equal to the keypad space setpoint "SPACESPK" analog parameter value.

The "SPACESPA" analog variable value is limited and set equal to the room low limit "ROOMLOW" and the room high limit "ROOMHIGH" analog parameter values should "SPACESPA" value exceed the limits. "ROOMLOW" and "ROOMHIGH" analog parameters are adjustable through the PCM LCD display.

Regardless of the "SPACESPA" analog variable value as established above, the space setpoint "SPACESPA" analog variable is set equal to the keypad space setpoint "SPACESPK" analog parameter value should the keypad setpoint adjustment "KEYPADSP" binary parameter be set to "ON". The room low and high limits do not apply when "KEYPADSP" binary parameter is set to "ON". "SPACESPK" analog parameter is adjustable through the PCM LCD display.

The heating setpoint "HEATNGSP" analog variable value is set equal to the space setpoint "SPACESPA" analog variable value as set above minus the heating offset differential "HEATOFST" analog parameter value. "HEATNGSP" analog variable value is limited to a low limit of 45° F and a high limit of the space setpoint "SPACESPA" analog variable value as set above.

PCL ROUTINE DEFINITION

PCM: AHC-002B Date: 03-FEB-92
Location:

Routine Name: HEAT/COOL Routine Number: 5
Freq: 0 Hrs. 0 Mins. 60 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
*R0	=	SPACESPA	+	*1	*R0 = SPACE COOLING SETPT + 1 DEG
*R1	=	HEATNGSP	-	*1	*R1 = SPACE HEATING SETPT - 1 DEG
*IFT	=	SPACETMP	GT	*R0	IF SPACE TEMP COOL SETPT + 1 DEG
COOL	=	TRUE			SET COOLING MODE = TRUE
*IFT	=	SPACETMP	LT	*R1	IF SPACE TEMP HEAT SETPT - 1 DEG
COOL	=	FALSE			SET COOLING MODE = FALSE (HEATING)
*END	=				END OF *IFT STRING
HEAT	=		NOT	COOL	HEATING MODE = OPPOSITE OF COOLING
*END	=				END OF ROUTINE

Routine #5 Description:

This routine establishes an "ON" or "OFF" value for the "COOL" and "HEAT" binary variables with the "HEAT" value always being the opposite of the "COOL" value. The "HEAT" binary variable is used by the outside air damper, cool valve, and heat valve routines and effects operation of those routines as described under those routines.

If the space temperature sensor "SPACETMP" analog input value is greater than the space setpoint "SPACESPA" analog variable value established in routine #2 plus 1° F, binary variable "COOL" is set to "ON" and the mode of the AHU will be cool. If "SPACETMP" analog input value is less than the heating setpoint "HEATSP" analog variable value minus 1° F, binary variable "HEAT" is set to "ON" and the mode of the AHU will be heat.

PCL ROUTINE DEFINITION

PCM: AHC-002B Date: 03-FEB-92
Location:

Routine Name: SETPOINTS Routine Number: 6
Freq: 0 Hrs. 0 Mins. 10 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
MIXAIRSP	=	MIXEDSP	MAX	*45.0	MIXED AIR SETPT LOW LIMIT OF 45 DEG
*R0	=	OAECONSP	-	*2.0	*R0 = OA CHANGEOVER S.P. - 2.0 DEG
*IFT	=	OATEMP	LE	*R0	IF OA TEMP IS COOL (LESS THAN R0)
ECONENAB	=	TRUE			SET ECONENAB TO TRUE(INDICATES COOL)
*IFT	=	OATEMP	GE	OAECONSP	IF OA TEMP IS WARM (GREATER THAN SP)
ECONENAB	=	FALSE			SET ECONENAB TO FALSE
*IFT	=	OCCUPY	OR	TOVREQ	IF OCCUPY BIP "ON" OR UNIT IN TOV
MINPOS	=	OAMINPOS			ECON MIN POSITION = OPERATOR ENTRY
*ELSE	=				IF NOT OCCUPY OR UNIT IN TOV
MINPOS	=	*0			ECON MIN POSITION = 0%
*END	=				END OF *IFT STRING
*R1	=	HEATNGSP	-	*2.0	*R1 = SPACE HEATING SETPT - 2 DEG
*IFT	=	SPACETMP	LT	*R1	IF SPACE TEMP IS LESS THAN *R1
MINPOS	=	*0			ECON MIN POSITION = 0%
*END	=				END OF ROUTINE

Routine #6 Description:

This routine establishes setpoint values for the following analog and binary variables; mixed air setpoint "MIXAIRSP" analog variable, outside air damper minimum position setpoint "MINPOS" analog variable, and economizer enable "ECONENAB" binary variable. These analog and binary variables are used in routines #8 through #10.

The mixed air setpoint "MIXAIRSP" analog variable is equal to analog parameter "MIXEDSP" or 45° F, which ever is of larger value. Analog parameter "MIXEDSP" is adjustable through the LCD PCM display.

If outside air temperature "OATEMP" analog input value is 2° F less than the outside air economizer change-over setpoint "OAECONSP" analog parameter value, economizer enable "ECONENAB" binary variable will be set to "ON" (enabled). If the outside air temperature "OATEMP" analog input value is greater than outside air economizer switch-over setpoint "OAECONSP" value, economizer enable "ECONENAB" binary variable will be "OFF" (disabled).

The outside air damper minimum position setpoint "MINPOS" analog variable is set equal to 0 %, unless, either the occupy/unoccupy "OCCUPY" binary input or timed override request "TOVREQ" binary variable is indexed to "ON". With "OCCUPY" binary input or "TOVREQ" binary variable indexed to "ON", the outside air damper minimum position setpoint "MINPOS" analog variable is set equal to analog parameter "OAMINPOS" value. "OAMINPOS" is adjustable through the PCM LCD display.

Previously determined analog variable "MINPOS" value is ignored and set equal to 0 % should the space temperature "SPACETMP" analog input value be 2° F less than the heating setpoint "HEATSP" analog variable value as determined in routine #4.

PCL ROUTINE DEFINITION

PCM: AHC-002B Date: 03-FEB-92
Location:

Routine Name: DISCH SETPT Routine Number: 7
Freq: 0 Hrs. 0 Mins. 60 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
*IFT	=	COOL			IF MODE IS COOLING
*R0	=	SPACESPA			DDC LOOP SETPT *R0 = COOLING SETPT
*ELSE	=				IF MODE IS HEATING
*R0	=	HEATNGSP			DDC LOOP SETPT *R1 = HEATING SETPT
*END	=				END OF *IFT STRING
COOLSP	=	SPACETMP	DDC:1	*R0	RUN DDC LOOP FOR DISCH COOLING SETPT
*L0	=	SPACETMP	FAIL		*L0 TRUE IF SPACE SENSOR FAILED
*IFT	=	COOL			IF MODE IS COOLING
COOLSP	=	COOLSP	MIN	SPACESPA	COOLSP HIGH LIMIT = SPACE SETPT
*IFT	=	HEAT			IF MODE IS HEATING
COOLSP	=	COOLSP	MAX	HEATNGSP	COOLSP LOW LIMIT = HEATING SETPT
*IFT	=	*L0	OR	FANOFF	IF SPACE SENSOR FAILED OR FAN IS OFF
COOLSP	=	SPACESPA			DISCH COOLING SETPT = SPACE SETPT
*END	=				END OF *IFT STRING
ECONSP	=	COOLSP	-	*2.0	DISCH ECON SETPT = COOLSP - 2 DEG
HEATSP	=	ECONSP	-	*2.0	DISCH HEAT SETPT = ECONSP - 2 DEG
*END	=				END OF ROUTINE

Routine #7 Description:

This routine establishes setpoint values for the following analog variables: discharge air cooling setpoint "COOLSP" analog variable, economizer setpoint "ECONSP" analog variable, and heating setpoint "HEATSP" analog variable. These analog variables are used in routines #8 through #10.

The discharge air cooling setpoint "COOLSP" analog variable is reset from the space temperature "SPACETMP" analog input through DDC Loop #1. "COOLSP" analog variable value is equal to the output of DDC Loop #1 which compares the space temperature "SPACETMP" analog input value to the space setpoint "SPACESPA" or heating setpoint "HEATNGSP" based on the mode of the AHU being cool or heat, respectively. If the mode of the AHU is cool, "COOLSP" analog variable is reset from DDC Loop #1, 50° F minimum output to the space setpoint "SPACESPA" analog variable value as the maximum. If the mode of the AHU is heat, "COOLSP" analog variable is reset from the heating setpoint "HEATNGSP" analog variable value minimum to the DDC Loop #1, 104° F maximum.

Should the space temperature "SPACETMP" analog input be failed or the "FANOFF" binary variable be set to "ON", the discharge air cooling setpoint "COOLSP" analog variable is set to space setpoint "SPACESPA" analog variable.

The economizer setpoint "ECONSP" analog variable is equal to the cooling setpoint "COOLSP" analog variable minus 2° F. The heating setpoint "HEATSP" analog variable is equal to the economizer setpoint "ECONSP" analog variable minus 2° F.

PCL ROUTINE DEFINITION

PCM: AHC-002B Date: 03-FEB-92
Location:

Routine Name: OA DAMPER Routine Number: 8
Freq: 0 Hrs. 0 Mins. 10 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
OADCALC	=	DISCHTMP	DDC:2	ECONSP	DDC LOOP FOR OADAMPER, USE OADCALC
OADCALC	=	OADCALC	MAX	MINPOS	OADCALC LO LIMIT - ECON MIN POSITION
*L0	=		NOT	ECONENAB	*L0 TRUE IF ECONOMIZER DISABLED
*L1	=	DISCHTMP	FAIL		*L1 TRUE IF DISCH SENSOR IS FAILED
*L2	=	*L0	OR	*L1	*L2 TRUE IF SENSOR FAIL OR ECON DIS
*IFT	=	*L2	OR	HEAT	IF SENSOR FAIL OR ECON DIS OR HEAT
OADCALC	=	MINPOS			SET CALC DAMPER POSITION AT MINIMUM
*END	=				END OF *IFT STRING
MIXCALC	=	MIXEDTMP	DDC:5	MIXAIRSP	DDC LOOP FOR MIXED AIR, USE MIXCALC
OADCALC	=	OADCALC	MIN	MIXCALC	SELECT MINIMUM OF OADCALC & MIXCALC
*L3	=	MIXEDTMP	FAIL		*L3 TRUE IF MIXED SENSOR FAILED
*IFT	=	FANOFF	OR	*L3	IF FAN IS OFF OR MIXED SENSOR FAILED
OADCALC	=	*-10			SET CALC DMPR POSITION TO FULL CLOSE
*END	=				END OF *IFT STRING
OADAMPER	=		CONTROL	OADCALC	SET OADAMPER AOP TO CALC DMPR POS.
MIXCALC	=	OADCALC			SET MIXCALC = OADCALC VALUE
*END	=				*END OF ROUTINE

Routine #8 Description:

This routine controls the outside air damper through analog output "OADAMPER" to the calculated outside air damper position "OADCALC" analog variable value. "OADCALC" value is equal to the minimum value of the economizer DDC loop # 2 or the mixed air DDC loop # 5.

Initially, "OADCALC" value is set equal to the output of the economizer DDC loop #2 which compares the discharge air temperature "DISCHTMP" analog input value to the economizer setpoint "ECONSP" analog variable value (2°F less than the discharge air setpoint per routine #7). DDC loop #2 output will change as required to maintain the economizer setpoint. "OADCALC" value is limited to the outside air damper minimum position "MINPOS" analog variable value and will be set to the damper minimum position "MINPOS" value should the discharge temperature sensor "DISCHTMP" analog input fail, the economizer "ECONENAB" binary variable be "OFF" (disabled) per routine # 6 or "HEAT" binary variable be set to "ON" per routine # 5.

"OADCALC" value is then set equal to the lesser value of "OADCALC" as determined above or the calculated mixed air "MIXCALC" analog variable value. "MIXCALC" is set equal to the output of the mixed air DDC loop #5 which compares the mixed air temperature "MIXEDTMP" analog input value to the mixed air setpoint "MIXAIRSP" analog variable value. DDC loop #5 output will change as required to maintain the mixed air setpoint.

Should the binary variable "FANOFF" be set to "ON" per routine #3 or the mixed air temperature sensor "MIXEDTMP" analog input be failed, "OADCALC" value as previously determined is ignored and is set to -10%. An "OADCALC" value of -10% will cause closure of the outside air damper.

"MIXCALC" value is set equal to the "OADCALC" value at the end of this routine to provide a smooth transfer of control between the two DDC loops.

```
                          PCL ROUTINE DEFINITION

  PCM: AHC-002B                                  Date: 03-FEB-92
  Location:

Routine Name: COOL VALVE                  Routine Number:  9
                          Freq:   0 Hrs.   0 Mins.  10 Secs.

Result        1st Arg     Operator 2nd Arg    Description of Statement
----------    ----------  -------- ---------- ----------------------------------
COOLCALC    = DISCHTMP    DDC:3    COOLSP     RUN DDC LOOP FOR COOL VALVE CONTROL
*IFT        = OADAMPER    LE       *70        IF OA DAMPER POSITION  70%
*L0         = TRUE                            SET *L0 TO TRUE
*IFT        = OADAMPER    GE       *90        IF OA DAMPER POSITION  90%
*L0         = FALSE                           SET *L0 TO FALSE
*END        =                                 END OF *IFT STRING
*L1         = *L0         AND      ECONENAB   *L1 TRUE IF *L0 TRUE AND ECON ENABLE
*L2         = DISCHTMP    FAIL               *L2 TRUE IF DISCH TEMP SENSOR FAILED
*L3         = *L1         OR       *L2       \ *L3 TRUE IF: *L1 TRUE OR SENSOR
            = HEAT                 FANOFF     / FAIL OR HEAT MODE OR FAN IS OFF
*IFT        = *L3                             IF *L3 IS TRUE
COOLCALC    = *-10                            CALC COOL VALVE POS. = FULL CLOSED
*IFT        = FANOFF      AND      COOLOPEN   IF FANOFF AND COOLOPEN ARE BOTH TRUE
COOLCALC    = *100                            CALC COOL VALVE POS. = FULL OPEN
*END        =                                 END OF *IFT STRING
CWVALVE     =             CONTROL  COOLCALC   SET COOL VALVE AOP = CALC POSITION
*END        =                                 END OF ROUTINE
```

Routine #9 Description:

This routine controls the chill water valve through analog output "CWVALVE" to the calculated chill water valve position "COOLCALC" analog variable. "COOLCALC" value is equal to the output of DDC loop #3 which compares the discharge air temperature sensor "DISCHTMP" analog input value to the cooling setpoint "COOLSP" analog variable value. DDC loop #3 output will change as required to maintain the cooling setpoint.

Regardless of DDC loop #3 output, analog variable "COOLCALC" is set equal to -10% should the discharge air temperature sensor "DISCHTMP" analog input be failed, the outside air damper "OADAMPER" analog output value be less than 70% and economizer enable "ECONENAB" binary variable is "ON" (enabled per routine #6) or one of the following binary variables or setpoints is "ON"; binary variable "HEAT" per routine #5, binary variable "FANOFF" per routine #3.

Previously determined analog variable "COOLCALC" value is ignored and is set to 100% should binary variable "FANOFF" be "ON" and binary parameter "COOLOPEN" be "ON" (open). "COOLOPEN" is adjustable through the PCM LCD display.

```
                          PCL ROUTINE DEFINITION

  PCM: AHC-002B                                  Date: 03-FEB-92
  Location:

Routine Name: HEAT VALVE                  Routine Number: 10
                          Freq:   0 Hrs.   0 Mins.  10 Secs.

Result        1st Arg     Operator 2nd Arg    Description of Statement
----------    ----------  -------- ---------- ----------------------------------
HEATCALC    = DISCHTMP    DDC:4    HEATSP     RUN DDC LOOP FOR HWVALVE CONTROL
*L0         = DISCHTMP    FAIL                *L0 TRUE IF DISCH TEMP SENSOR FAILED
*R0         = MINPOS      +        *10        *R0 = OA DAMPER MIN. POS. + 10%
*L1         = OADAMPER    GE       *R0        *L1 TRUE IF OADAMPER POS.  *R0
*L2         = CWVALVE     GT       *0         *L2 TRUE IF CWVALVE NOT FULLY CLOSED
*L3         = *L0         OR       *L1        \  IF SELECTED SENSOR IS FAILED OR
            = *L2                  FANOFF     >  OADAMPER  MINPOS OR CWVALVE IS
*IFT        = *L3                             /  NOT FULLY CLOSED OR FANOFF
HEATCALC    = *-10                            CALC HEAT VALVE POS. IS FULL CLOSED
*IFT        = FANOFF      AND      HEATOPEN   IF SUPPLY FANOFF AND HEATOPEN TRUE
HEATCALC    = *100                            CALC HEAT VALVE POS. IS FULL OPEN
*END        =                                 END OF *IFT STRING
HWVALVE     =             CONTROL  HEATCALC   SET HWVALVE AOP = CALC. POSITION
*END        =                                 END OF ROUTINE
```

Routine #10 Description:

This routine controls the hot water valve through analog output "HWVALVE" to the calculated hot water valve position "HEATCALC" analog variable. "HEATCALC" value is equal to the output of DDC loop #4 which compares the discharge air temperature sensor "DISCHTMP" analog input value to the heating setpoint "HEATSP" analog variable value as set per routine #7. DDC loop #4 output will change as required to maintain the heating setpoint.

Regardless of DDC loop #4 output, analog variable "HEATCALC" is set equal to -10% if the discharge air temperature sensor "DISCHTMP" analog input is failed or the outside air damper "OADAMPER" analog output percent is 10% greater than outside air damper minimum postion "MINPOS" analog variable value as set in routine #6 or binary variable "FANOFF" is "ON" per routine #3.

Analog variable "HEATCALC" as previously determined is ignored and is set to 100% should binary variable "FANOFF" be "ON" and binary parameter "HEATOPEN" be "ON" (open). "HEATOPEN" is adjustable through the PCM LCD display.

```
                        PCL ROUTINE DEFINITION

 PCM: AHC-002B                                  Date: 03-FEB-92
 Location:

Routine Name: CALIBRATION                 Routine Number: 11
                          Freq:   0 Hrs.   0 Mins.  60 Secs.

Result        1st Arg     Operator 2nd Arg    Description of Statement
----------    ----------  -------- ---------- ----------------------------------
*L0         =             NOT      RUN-AUTO   *L0 TRUE IF AUTO/STOP BIP IS STOP
*IFT        = CALIBRTE    AND      *L0        IF CALIBRATE BNP ON AND STOP
HWVALVE     =             CONTROL  *0         SET HOT WATER VALVE POSITION = 0%
CWVALVE     =             CONTROL  *0         SET CHILLED WTR VALVE POSITION = 0%
OADAMPER    =             CONTROL  *0         SET OA DAMPER POSITION = 0%
*END        =                                 END OF ROUTINE
```

Routine #11 Description:

With binary input "RUN/AUTO" indicating "OFF" and binary parameter "CALIBRTE" set to "ON" all analog outputs (HW valve, CW valve, and OA damper) will be set to 0% to allow valve and/or linkage adjustments to be made. Binary parameter "CALIBRTE" is typically adjusted from the PCM LCD display.

CUSTOM DISPLAY SETUP

PCM: AHC-002B Date: 03-FEB-92
Location:

PCM System Password: +-+-

Display Line	Point Name	Expanded Description	Desc/ Units	Adjust	Adjustment Limits Low	High
1	RUN-AUTO	AUTO/STOP INPUT	7			
2	OCCUPY	OCCUPIED MODE	4			
3	TOVREQ	UNIT IN TIMED OVRD	4			
4	SUPFANSS	SUPPLY FAN START	0			
5	SUPFANST	SUPPLY FAN STATUS	0			
6	COOL	COOLING MODE	4			
7	SPACESPA	SPACE CLG SETPOINT	0			
8	SPACETMP	SPACE TEMPERATURE	0			
9	DISCHTMP	DISCHARGE AIR TEMP	0			
10	ECONENAB	ECONOMIZER STATUS	2			
11	OADAMPER	OA DAMPER POSITION	4			
12	MIXEDTMP	MIXED AIR TEMP	0			
13	HWVALVE	H.W. VALVE POS	4			
14	CWVALVE	C.W. VALVE POS	4			
15	OATEMP	OUTDOOR AIR TEMP	0			
16	FANFAIL	SUPPLY FAN FAILURE	4			
17	MIXLOLIM	MIXED AIR LO LIMIT	5			
18	ROOMSP	ROOM SETPOINT KNOB	0			
19	KEYPADSP	KEYPAD SETPOINTS	4	Y		
20	SPACESPK	KEYPAD SPACE SETPT	0	Y	45.0	100.0
21	HEATOFST	HEATING OFFSET	0	Y	.0	15.0
22	OAMINPOS	OA MIN POSITION SP	4	Y	.0	100.0
23	OAECONSP	OA ECON ENABLE SP	0	Y	-100.0	100.0
24	MIXEDSP	MIXED AIR SETPOINT	0	Y	45.0	100.0
25	ROOMLOW	SPACE SETPT LO LIM	0	Y	45.0	100.0
26	ROOMHIGH	SPACE SETPT HI LIM	0	Y	45.0	100.0
27	NITESP	NITE SETBACK SETPT	0	Y	45.0	80.0
28	HEATOPEN	FAN OFF HW VLV POS	1	Y		
29	COOLOPEN	FAN OFF CW VLV POS	1	Y		
30	ENABLTOV	TOV SWITCH ENABLE	0	Y		
31	CALIBRTE	AOP CALIBRATE MODE	0	Y		
32	MANRESET	MANUAL RESET POINT	0	Y		

Binary Descriptor Table:

0 = OFF/ON	1 = CLOSED/OPEN	2 = DISABL/ENABLE
3 = AUTO/MANUAL	4 = NO/YES	5 = NORMAL/ALARM
6 = UNOCC/OCCUPY	7 = SHUTDN/NORMAL	8 = HEAT/COOL

Analog Units Table:

0 = DEG	1 = PSI	2 = KW	3 = KWH	4 = PCT	5 = CFM
6 = AMP	7 = VOL	8 = HG	9 = IN	10 = RH	11 = Blank

Constant Volume AHU with Space Control with Tracer Interface

Control Sequence for AHC-003B

Occupied Cooling Or Heating Mode
When the AHU is indexed to the occupied mode, the supply fan will operate continuously and the outside air damper will be at its minimum position (unless economizing). When the AHU is indexed to the occupied cooling mode, the space air temperature will be maintained to the space cooling setpoint (74° F nominal) by modulating the chilled water valve and the outdoor air damper. When the AHU is in the heating mode, the space air temperature will be maintained to the space heating setpoint (71° F nominal) by modulating the hot water or steam valve.

Night Setback/Morning Warmup Heating Mode
When the AHU is indexed to the night setback/morning warmup heating mode, the supply fan will operate continuously, the outdoor air damper will be fully closed, the chilled water valve will be fully closed and the hot water or steam valve will modulate to maintain the space air temperature.

Night Setback/Morning Cooldown Cooling Mode
When the AHU is indexed to the night setback/morning cooldown cooling mode, the supply fan will operate continuously, the outdoor air damper will be fully closed (unless economizing), the hot water or steam valve will be fully closed and the chilled water valve will modulate to maintain the space air temperature.

Supply Fan Control
The supply fan will operate continuously whenever the AHU is indexed to either the occupied mode or the night setback/morning warmup heating mode. The supply fan will be off whenever the AHU is indexed to the unoccupied mode, the AHU is demand limited or duty cycled by the Tracer BMS, the AHU is put in the priority shutdown by the Tracer BMS, the run-auto/stop interlock is open, the mixed air low limit is tripped, or the supply fan status indicates a failure (after a 2 minute delay). The fan failure indication requires a manual reset, which can be done at the local PCM keypad/display or by opening the run-auto/stop interlock.

Heat/cool Mode Control
The heat/cool mode of the AHU is determined based on the space temperature sensor and the space cooling and heating setpoints. The space heating setpoint is the space cooling setpoint minus the heating offset differential. The heating offset differential is adjustable from 0° to 15° F at the local PCM keypad/display. If the space sensor temperature is greater than the space cooling setpoint plus 1° F, the mode of the AHU will be cool. If the space sensor temperature is less than the heating setpoint minus 1° F, the mode of the AHU will be heat. The AHU will be allowed to switch between the heating and cooling modes at any time during operation, based on this logic. The space cooling setpoint is adjustable by the Tracer BMS, room sensor adjustment knob, or local PCM keypad/display. If room setpoint adjustment is enabled, Tracer BMS space cooling setpoint adjustment will be ignored. If local PCM keypad/display is enabled, the Tracer BMS and room space cooling setpoint adjustment will be ignored.

AHC-003B continued...

Outdoor Air Damper Control
When Tracer BMS enables the economizer function and the outdoor air temperature is less than the changeover setpoint minus 2° F, the outdoor air damper will modulate, as commanded by the PCM controller, between minimum position and full open to maintain the space cooling setpoint. The outdoor air damper will be modulated closed as required (overriding the minimum position) to maintain the mixed air temperature (averaging element) at or above the mixed air setpoint (48° F nominal). A mixed air low limit manual reset device (sensing the coldest one-foot section) will turn the supply fan off if its sensed temperature is below its setpoint (36° F nominal).

If the economizer function is disabled, the space air temperature sensor is failed, or the AHU is in the heat mode, the outdoor air damper will be set to minimum position. The minimum position will be set to zero for all Tracer BMS modes except occupy and coastdown. If the supply fan is off or the mixed air temperature sensor is failed, the outdoor air damper will be fully closed.

Chilled Water Valve Control
The chilled water valve will modulate, as commanded by the PCM controller, to maintain the space air temperature at the space cooling setpoint. If the economizer function is enabled and the outdoor air damper is not fully opened, the chilled water valve will be closed. The chilled water valve will also be closed if the Tracer BMS control mode is coastdown or purge, the mode of the AHU is heating or the space air temperature sensor is failed. If the supply fan is off, the chilled water valve will be either fully open or closed, as selected by a user entry.

Hot Water or Steam Valve Control
The hot water or steam valve will modulate, as commanded by the PCM controller, to maintain the space air temperature at the space heating setpoint. If the mode of the AHU is cooling or the space air temperature sensor is failed, the hot water or steam valve will be closed. If the supply fan is off, the hot water or steam valve will either be fully opened or closed, as selected by a user entry.

Unoccupied Mode
When the AHU is indexed to the unoccupied mode, the supply fan will be turned off and the outside air damper will be fully closed. The chilled water valve will be either fully closed or fully open, as selected by user entry. The hot water or steam valve will be either fully open or fully closed, as selected by user entry.

Local PCM Keypad/display
The Tracer BMS sends the AHU a space cooling setpoint (default = 74°F). The Tracer BMS also sends the AHU an economizer Enable/Disable command (default = Enable), and puts the AHU into one of nine Tracer BMS control modes: occupy, unoccupy, startup, coastdown, demand limit, duty cycle, night setback, purge, and priority shutdown (default = occupy).

If communication with the Tracer BMS is lost, the AHU uses the default setpoints (or local setpoints as selected by the operator) and operates in the occupied mode. The economizer function is enabled based on the AHU outdoor air temperature sensor.

The following setpoints (parameters) are stored in the AHU PCM and can be accessed through the local PCM keypad/display:

Analog Parameters

- Local Space Cooling Setpoint (45°−100° F)
- Heating Offset Differential (0°−15° F)
- Space Setpoint Low Limit Adjustment (45°−100° F)
- Space Setpoint High Limit Adjustment (45°−100° F)
- Mixed Air Setpoint (45°−100° F)
- Outdoor Air Changeover Setpoint (-100°−100° F)
- Outdoor Air Minimum Position (O-100%)

Binary Parameters

- Manual Reset Point (OFF/ON)
- Local Keypad Setpoints (NO/YES)
- Room Sensor Setpoint Adjustment (NO/YES)
- Heat Valve/Fan Off (CLOSED/OPEN)
- Cool Valve/Fan Off (CLOSED/OPEN)
- AOP Calibrate Mode (OFF/ON)

Local PCM Keypad/display (optional)
A local PCM keypad/display can be installed at the AHU to provide dedicated local access to AHU operating status and/or selected setpoints. The same custom display data that is available at the local PCM keypad/display is also available in a status display at the Tracer BMS. The Tracer BMS status display is available regardless or whether the AHU has a local PCM keypad/display.

Local PCM Keypad Setpoints
When the local PCM keypad/display is installed, the user can select between Tracer BMS space cooling setpoint, local PCM keypad/display cooling setpoint, or space sensor cooling setpoint by switching binary parameters "local keypad setpoints" (no/yes) and "space sensor setpoint" (no/yes).

In addition, other setpoints (parameters) are available at the local PCM keypad/display (such as the outdoor air minimum position) and are used at all times, since no corresponding values are sent from the Tracer BMS. Refer to Tracer BMS setpoint interface (above) for a list of these parameters.

Analog Output Calibrate Mode
When the run-auto/stop input is open (AHU off) the user can select a special analog output calibrate mode from the local PCM keypad/display. When in the calibrate mode, all analog outputs (HW valve, CW valve, OA damper) will be set to 0% to allow valve and/or linkage adjustments to be made.

Note: AIP and AOP Range and Offset entries shown on the next page may vary, depending on the actual input sensors and output actuators used.

POINT DATA DEFINITIONS

PCM: AHC-003B
Location:

Date: 03-FEB-92
Page: 1 of 2

PULSE METER INPUTS:

Name	Weight
PAC1	.0
PAC2	.0

ANALOG INPUTS:

	Name	Conv Type	Range	Offset
AIP1	MIXEDTMP	BAL	102.4	.0
AIP2	SPARE1	BAL	102.4	.0
AIP3	SPARE2	THM	102.4	.0
AIP4	OATEMP	THM	102.4	.0
AIP5	SPACETMP	THM	102.4	.0
AIP6	ROOMSP	RES	-50.0	95.0

ANALOG OUTPUTS:

	Name	Range	Offset
AOP1	HWVALVE	-333.3	300.0
AOP2	CWVALVE	333.3	-200.0
AOP3	OADAMPER	125.0	-25.0
AOP4		.0	.0

ANALOG SETPOINTS: ***(from Tracer BMS)***

	Name	Communications Loss Value		Name	Communications Loss Value
ASP1	SPACESP	74.0	ASP5		.0
ASP2		.0	ASP6		.0
ASP3		.0	ASP7		.0
ASP4		.0	ASP8	ZONESP	71.0

ANALOG PARAMETERS: ***(adjusted by operator)***

	Name	Value		Name	Value
ANP1	SPACESPK	74.0	ANP5	MIXEDSP	48.0
ANP2	HEATOFST	3.0	ANP6	OAECONSP	70.0
ANP3	ROOMLOW	55.0	ANP7	OAMINPOS	15.0
ANP4	ROOMHIGH	85.0	ANP8		.0

ANALOG VARIABLES: ***(calculated by PCL routines)***

	Name		Name		Name		Name
AV1	COOLSP	AV5	MINPOS	AV9		AV13	OADCALC
AV2	ECONSP	AV6	SPACESPA	AV10		AV14	HEATCALC
AV3	HEATSP	AV7		AV11		AV15	COOLCALC
AV4	MIXAIRSP	AV8		AV12	MIXCALC	AV16	

POINT DATA DEFINITIONS

PCM: AHC-003B
Location:

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BINARY INPUTS:

	Name	Open Means
BIP1	SUPFANST	OFF
BIP2	FILTER	ON
BIP3	MIXLOLIM	ON
BIP4	RUN-AUTO	OFF

BINARY OUTPUTS:

	Name	Relay Off Means	Minimum On Time	Minimum Off Time
BOP1	SUPFANSS	OFF	0	5
BOP2		OFF	0	0
BOP3		OFF	0	0
BOP4		OFF	0	0
BOP5		OFF	0	0
BOP6		OFF	0	0

BINARY SETPOINTS: *(from Tracer BMS)*

	Name	Communications Loss State		Name	Communications Loss State
BSP1	ECONOMIZ	ON	BSP13	PURGE	OFF
BSP2		OFF	BSP14	NITSBK	OFF
BSP3		OFF	BSP15	DMDLIM	OFF
BSP4		OFF	BSP16	DTYCYC	OFF
BSP5		OFF	BSP17	SHUTDN	OFF
BSP6		OFF	BSP18		OFF
BSP7		OFF	BSP19		OFF
BSP8	COOLING	ON	BSP20		OFF
BSP9	OCCUPY	ON	BSP21		OFF
BSP10	UNOCCU	OFF	BSP22		OFF
BSP11	STARTU	OFF	BSP23		OFF
BSP12	COASTD	OFF	BSP24		OFF

BINARY PARAMETERS: *(adjusted by operator)*

	Name	State		Name	State
BNP1	MANRESET	OFF	BNP5	HEATOPEN	ON
BNP2	KEYPADSP	OFF	BNP6	COOLOPEN	OFF
BNP3	ROOMADJ	OFF	BNP7	CALIBRTE	OFF
BNP4		OFF	BNP8		OFF

BINARY VARIABLES: *(calculated by PCL routines)*

	Name		Name		Name		Name
BV1	HEAT	BV5	ECONENAB	BV9		BV13	
BV2	COOL	BV6		BV10		BV14	
BV3	FANON	BV7		BV11	FANFAIL	BV15	

DDC LOOP PARAMETERS

PCM: AHC-003B
Location:

Date: 03-FEB-92

DDC Loop # 1	
Proportional Gain	.00
Integral Gain	.00
Derivative Gain	.00
Action	REVERS
Proportional Bias	.0
Minimum Output Value	.0
Maximum Output Value	.0
Error Deadband	.0

DDC Loop # 2 ECONOMIZER	
Proportional Gain	20.00
Integral Gain	5.00
Derivative Gain	.00
Action	DIRECT
Proportional Bias	.0
Minimum Output Value	.0
Maximum Output Value	100.0
Error Deadband	.5

DDC Loop # 3 COOL VALVE	
Proportional Gain	20.00
Integral Gain	5.00
Derivative Gain	.00
Action	DIRECT
Proportional Bias	.0
Minimum Output Value	-10.0
Maximum Output Value	100.0
Error Deadband	.5

DDC Loop # 4 HEAT VALVE	
Proportional Gain	20.00
Integral Gain	5.00
Derivative Gain	.00
Action	REVERS
Proportional Bias	.0
Minimum Output Value	-10.0
Maximum Output Value	100.0
Error Deadband	.5

DDC Loop # 5 MIXED AIR	
Proportional Gain	4.00
Integral Gain	1.00
Derivative Gain	.00
Action	DIRECT
Proportional Bias	.0
Minimum Output Value	.0
Maximum Output Value	100.0
Error Deadband	.5

DDC Loop # 6	
Proportional Gain	.00
Integral Gain	.00
Derivative Gain	.00
Action	REVERS
Proportional Bias	.0
Minimum Output Value	.0
Maximum Output Value	.0
Error Deadband	.0

PCL ROUTINE DEFINITION

PCM: AHC-003B Date: 03-FEB-92
Location:

Routine Name: FAIL DETECT Routine Number: 1
Freq: 0 Hrs. 0 Mins. 5 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
*L0	=		NOT	RUN-AUTO	*L0 TRUE IF RUN-AUTO/STOP BIP = STOP
*L1	=		NOT	SUPFANST	*L1 TRUE IF SUPFANST BIP IS OFF
*IFT	=	SUPFANSS	AND	*L1	IF SUPPLY FAN BOP IS ON AND BIP OFF
*R0	=	*R0	+	*1.0	INCREASE COUNTER *R0 BY ONE
*ELSE	=				IF NOT (I.E. BOP IS OFF OR BIP ON)
*R0	=	*0			RESET COUNTER *R0 TO ZERO
*IFT	=	*R0	GT	*24	IF COUNTER 24 (24 X 5 SEC = 2 MIN)
FANFAIL	=	TRUE			SET BINARY VARIABLE "FANFAIL" TRUE
*IFT	=	MANRESET	OR	*L0	IF MANRESET BNP ON OR AUTO BIP OFF
FANFAIL	=	FALSE			SET BINARY VARIABLE "FANFAIL" FALSE
*END	=				END OF *IFT STRING
LOWTEMP	=	MIXLOLIM			LOWTEMP VARIABLE = MIXLOLIM BIP
*END	=				END OF ROUTINE

Routine #1 Description:

This routine monitors the supply fan for fan failure. Should the supply fan start/stop "SUPFANSS" binary output be "ON" and the supply fan status binary input "SUPFANST" be "OFF" for a two minute time period, the "FANFAIL" binary variable will be triggered to "ON" and initiate fan failure. Once initiated, the "FANFAIL" binary variable can only be reset to "OFF" by one of the following methods:

1. Toggle the manual reset, "MANRESET", binary parameter to "ON" then "OFF". Typically accomplished through the LCD display.
2. Trigger the "RUN/AUTO" binary input to "OFF" then "ON". Typically accomplished be either removing and re-installing the factory installed jumper or switching a field installed toggle switch to "OFF" then "ON".
3. Toggle the PCM circuit board on/off switch to "OFF" then "ON".

The "LOWTEMP" variable is triggered to "ON" whenever the "MIXLOLIM" binary input is ON (open circuit). The "LOWTEMP" variable can only be cleared by manually resetting the Mixed Air Low Limit Device.

```
                          PCL ROUTINE DEFINITION

  PCM: AHC-003B                                   Date: 03-FEB-92
  Location:

Routine Name: FAN CONTROL                  Routine Number:  2
                           Freq:   0 Hrs.   0 Mins.   5 Secs.

Result        1st Arg     Operator 2nd Arg    Description of Statement
----------    ---------- -------- ---------- ----------------------------------
*L0         =             NOT      RUN-AUTO   *L0 TRUE IF RUN-AUTO/STOP BIP = STOP
*L1         = *L0         OR       SHUTDN     \*L1 TRUE IF STOP OR "SHUTDN" MODE
            = FANFAIL              LOWTEMP    /    OR FANFAIL OR LOWTEMP
*L2         = DMDLIM      OR       DTYCYC     *L2 TRUE IF DMDLIM OR DTYCYC MODE
*IFT        = UNOCCU      OR       *L2        IF UNOCCU OR DMDLIM OR DTYCYC MODE
SUPFANSS    =             CONTROL  OFF        CONTROL SUPPLY FAN BOP TO "OFF"
*ELSE       =                                 IF NOT
SUPFANSS    =             CONTROL  ON         CONTROL SUPPLY FAN BOP TO "ON"
*IFT        = *L1                             IF STOP, SHUTDN, FANFAIL, OR LOWTEMP
SUPFANSS    = NOMIN       CONTROL  OFF        BOPS "OFF" OVERRIDING MIN ON TIMER
*IFT        = SUPFANSS    AND      SUPFANST   IF FAN BOP AND STATUS "ON"
*R0         = *R0         +        *1.0       INCREASE COUNTER *R0 BY ONE
*ELSE       =                                 IF NOT (FAN BOP OR STATUS BIP OFF)
*R0         = *0                              RESET COUNTER TO *R0 TO ZERO
*END        =                                 END OF *IFT STRING
FANON       = *R0         GT       *6         "FANON" = TRUE IF *R0  6 (30 SEC)
FANOFF      =             NOT      FANON      "FANOFF" = OPPOSITE OF "FANON"
*END        =                                 END OF ROUTINE
```

Routine #2 Description:

This routine starts and stops the supply fan. After air flow is established for a 30 second time period, the "FANON" binary variable is set to "TRUE". The "FANOFF" binary variable (used in other routines) is set to the opposite state of "FANON".

The supply fan "SUPFANSS" binary output will be controlled to "ON" and remain on until indexed to be "OFF" by one of the following triggers:

1. "RUN/AUTO" binary input is open for "OFF" (shutdown).
2. "FANFAIL" binary variable is "ON".
3. "LOWTEMP" binary variable is "ON".
4. "SHUTDOWN" binary setpoint is "ON" (Tracer BMS interface).

   Note: The above fan "OFF" trigger will stop the supply fan instanteously overriding minimum ON/OFF timers.

5. "DMDLIM" binary setpoint is "ON" (Tracer BMS interface).
6. "DTYCLC" binary setpoint is "ON" (Tracer BMS interface).
7. "UNOCCU" binary setpoint is "ON" (Tracer BMS interface).

PCL ROUTINE DEFINITION

PCM: AHC-003B Date: 03-FEB-92
Location:

Routine Name: LOCAL SETPTS Routine Number: 3
Freq: 0 Hrs. 0 Mins. 5 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
*L0	=	ROOMSP	FAIL		*LO TRUE IF ROOM SETPT INPUT FAILED
*L1	=		NOT	*L0	*L1 TRUE IF ROOM SETPT INPUT OK
*IFT	=	ROOMADJ	AND	*L1	IF ROOMADJ BNP TRUE AND SPT INPUT OK
SPACESPA	=	ROOMSP			SPACE SETPT = ROOM SETPT INPUT
*ELSE	=				IF NOT (I.E. DISABLED OR FAILED)
SPACESPA	=	SPACESP			SPACE SETPT = TRACER SPACE SETPOINT
*END	=				END OF *IFT STRING
SPACESPA	=	SPACESPA	MAX	ROOMLOW	SPACE SETPT LOW LIMIT = ROOMLOW
SPACESPA	=	SPACESPA	MIN	ROOMHIGH	SPACE SETPT HIGH LIMIT = ROOMHIGH
*IFT	=	KEYPADSP			IF KEYPAD BNP IS ON (LOCAL SETPTS)
SPACESPA	=	SPACESPK			SPACE SETPT = KEYPAD SPACE SETPT
*END	=				END OF *IFT STRING
HEATSP	=	SPACESPA	-	HEATOFST	HEATING SETPT = SPACE SETPT - OFFSET
HEATSP	=	HEATSP	MAX	*45.0	HEATING SETPT LOW LIMIT = 45 DEG
HEATSP	=	HEATSP	MIN	SPACESPA	HEATING SETPT HI LIMIT = SPACE SETPT
COOLSP	=	SPACESPA			COOLING SETPOINT = SPACE SETPOINT
ECONSP	=	SPACESPA			ECONOMIZER SETPOINT = SPACE SETPT
*END	=				END OF ROUTINE

Routine #3 Description:

This routine establishes setpoint values for the following analog variables: the economizer setpoint "ECONSP" analog variable, the space cooling setpoint "COOLSP" analog variable, and the space heating setpoint "HEATSP" analog variable, these analog variables are used in routines 6, 8 and 9, respectively. The space setpoint "SPACESPA" analog variable value is set equal to the Tracer BMS communicated space setpoint "SPACESP" analog setpoint value, unless the room setpoint adjust "ROOMADJ" binary parameter is "ON" and the space sensor space setpoint adjustment knob "ROOMSP" analog input is not failed. With "ROOMADJ" binary parameter set to "ON" and the space sensor setpoint adjustment knob "ROOMSP" analog input not failed, the space setpoint "SPACESPA" analog variable value is set equal to the ajustment knob "ROOMSP" analog input value.

The "SPACESPA" analog variable value is limited and set equal to the room low limit "ROOMLOW" and the room high limit "ROOMHIGH" analog parameter values should "SPACESPA" value exceed the limits. "ROOMLOW" and "ROOMHIGH" analog parameters are adjustable through the PCM LCD display. Regardless of the "SPACESPA" analog variable value as established above, the space setpoint "SPACESPA" analog variable is set equal to the keypad space setpoint "SPACESPK" analog parameter value should the keypad setpoint adjustment "KEYPADSP" binary parameter be set to "ON".

Note: The room low and high limits do not apply when "KEYPADSP" binary parameter is set to "ON". "SPACESPK" analog parameter is adjustable through the PCM LCD display.

The heating setpoint "HEATSP" analog variable value is set equal to space setpoint "SPACESPA" analog variable value as set above minus the heating offset differential "HEATOFST" analog parameter value. "HEATSP" analog variable value is limited to a low limit of 45° F and a high limit of the space setpoint "SPACESPA" analog variable value as set above.

The space cooling setpoint "COOLSP" analog variable value and economizer setpoint "ECONSP" analog variable are set equal to the space setpoint "SPACESPA" analog variable value established per the above description.

PCL ROUTINE DEFINITION

PCM: AHC-003B Date: 03-FEB-92
Location:

Routine Name: HEAT/COOL Routine Number: 4
Freq: 0 Hrs. 0 Mins. 60 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
*R0	=	SPACESPA	+	*1	*R0 = SPACE COOLING SETPT + 1 DEG
*R1	=	HEATSP	-	*1	*R1 = SPACE HEATING SETPT - 1 DEG
*IFT	=	SPACETMP	GT	*R0	IF SPACE TEMP COOL SETPT + 1 DEG
COOL	=	TRUE			SET COOLING MODE = TRUE
*IFT	=	SPACETMP	LT	*R1	IF SPACE TEMP HEAT SETPT - 1 DEG
COOL	=	FALSE			SET COOLING MODE = FALSE (HEATING)
*END	=				END OF *IFT STRING
HEAT	=		NOT	COOL	HEATING MODE = OPPOSITE OF COOLING
*END	=				END OF ROUTINE

Routine #4 Description:

This routine establishes an "ON" or "OFF" value for the "COOL" and "HEAT" binary variables with the "HEAT" value always being the opposite of the "COOL" value. The "HEAT" binary variable is used by the OADAMPER, COOL valve, and HEAT valve routines and effects operation of those routines as described under those routines.

If the space temperature sensor "SPACETMP" analog input value is greater than the space setpoint "SPACESPA" analog variable value established in routine #3 plus 1° F, binary variable "COOL" is set to "ON" and the mode of the AHU will be cool. If "SPACETMP" analog input value is less than the heating setpoint "HEATSP" analog variable value minus 1° F, binary variable "HEAT" is set to "ON" and the mode of the AHU will be heat.

PCL ROUTINE DEFINITION

PCM: AHC-003B Date: 03-FEB-92
Location:

Routine Name: SETPOINTS Routine Number: 5
Freq: 0 Hrs. 0 Mins. 10 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
MIXAIRSP	=	MIXEDSP	MAX	*45.0	MIXED AIR SETPT LOW LIMIT OF 45 DEG
*R0	=	OAECONSP	-	*2.0	*R0 = OA CHANGEOVER S.P. - 2.0 DEG
*IFT	=	OATEMP	LE	*R0	IF OA TEMP IS COOL (LESS THAN R0)
*L0	=	TRUE			SET *L0 TO TRUE (INDICATES COOL)
*IFT	=	OATEMP	GE	OAECONSP	IF OA TEMP IS WARM (GREATER THAN SP)
*L0	=	FALSE			SET *L0 TO FALSE
*END	=				END OF *IFT STRING
*L1	=	*L0	AND	ECONOMIZ	TRUE IF COOL AND TRACER ECON. ENABLE
ECONENAB	=	*L1	OR	PURGE	ECON ENABLE IF *L1 OR PURGE MODE
*IFT	=	OCCUPY	OR	COASTD	IF OCCUPY OR COASTDOWN MODE
MINPOS	=	OAMINPOS			ECON MIN POSITION = OPERATOR ENTRY
*ELSE	=				IF NOT OCCUPY OR COASTDOWN
MINPOS	=	*0			ECON MIN POSITION = 0 %
*END	=				END OF ROUTINE

Routine #5 Description:

This routine establishes setpoint values for the following analog and binary variables; mixed air setpoint "MIXAIRSP" analog variable, outside air damper minimum position setpoint "MINPOS" analog variable, and economizer enable "ECONENAB" binary variable. These analog and binary variables are used in routines #6 through #9.

The mixed air setpoint "MIXAIRSP" analog variable is equal to analog parameter "MIXEDSP" or 45° F, which ever is of larger value. Analog parameter "MIXEDSP" is adjustable through the LCD PCM display.

If outside air temperature "OATEMP" analog input value is 2° F less than the outside air economizer change-over setpoint "OAECONSP" analog parameter value and economizer "ECONOMIZ" binary setpoint is indexed to "ON" by the Tracer BMS or binary setpoint "PURGE" is indexed to "ON" by the Tracer BMS, economizer enable "ECONENAB" binary variable will be set to "ON" (enabled). If the outside air temperature "OATEMP" analog input value is greater than outside air economizer switch-over setpoint "OAECONSP" value, economizer "ECONOMIZ" binary setpoint is indexed to "OFF" by the Tracer BMS or binary setpoint "PURGE" is indexed to "OFF" by the Tracer BMS, economizer enable "ECONENAB" binary variable will be "OFF" (disabled).

The outside air damper minimum position setpoint "MINPOS" analog variable is set equal to 0 %, unless, either the "OCCUPY" or "COASTD" binary setpoint is indexed to "ON" by the Tracer BMS. With "OCCUPY" or "COASTD" indexed to "ON", outside air damper minimum position setpoint "MINPOS" analog variable is set equal to analog parameter "OAMINPOS" value. "OAMINPOS" is adjustable through the PCM LCD display.

PCL ROUTINE DEFINITION

PCM: AHC-003B Date: 03-FEB-92
Location:

Routine Name: OA CALC Routine Number: 6
Freq: 0 Hrs. 0 Mins. 60 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
OADCALC	=	SPACETMP	DDC:2	ECONSP	DDC LOOP FOR OADAMPER, USE OADCALC
OADCALC	=	OADCALC	MAX	MINPOS	OADCALC LO LIMIT - ECON MIN POSITION
*L0	=		NOT	ECONENAB	*L0 TRUE IF ECONOMIZER DISABLED
*L1	=	SPACETMP	FAIL		*L1 TRUE IF SPACE TEMP SENSOR FAILED
*L2	=	*L0	OR	*L1	*L2 TRUE IF SENSOR FAIL OR ECON DIS
*IFT	=	*L2	OR	HEAT	IF SENSOR FAIL OR ECON DIS OR HEAT
OADCALC	=	MINPOS			SET CALC DAMPER POSITION AT MINIMUM
*END	=				END OF ROUTINE

Routine #6 Description:

This routine establishes the calculated outside air damper position "OADCALC" analog variable value to be used in routine #7.

"OADCALC" value is set equal to the output of the economizer DDC loop #2 which compares the space temperature "SPACETMP" analog input value to the economizer setpoint "ECONSP" analog variable value as set in routine #3. DDC loop #2 output will change as required to maintain the economizer setpoint. "OADCALC" value is limited to the outside air damper minimum position "MINPOS" analog variable value and will be set to the damper minimum position "MINPOS" value should the space temperature sensor "SPACETMP" analog input fail, the economizer "ECONENAB" binary variable be "OFF" (disabled) per routine #5 or "HEAT" binary variable be set to "ON" per routine #4.

PCL ROUTINE DEFINITION

PCM: AHC-003B Date: 03-FEB-92
Location:

Routine Name: OA DAMPER Routine Number: 7
Freq: 0 Hrs. 0 Mins. 10 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
MIXCALC	=	MIXEDTMP	DDC:5	MIXAIRSP	DDC LOOP FOR MIXED AIR, USE MIXCALC
OADCALC	=	OADCALC	MIN	MIXCALC	SELECT MINIMUM OF OADCALC & MIXCALC
*L3	=	MIXEDTMP	FAIL		*L3 TRUE IF MIXED SENSOR FAILED
*IFT	=	FANOFF	OR	*L3	IF FAN IS OFF OR MIXED SENSOR FAILED
OADCALC	=	*-10			SET CALC DMPR POSITION TO FULL CLOSE
*END	=				END OF *IFT STRING
OADAMPER	=		CONTROL	OADCALC	SET OADAMPER AOP TO CALC DMPR POS.
*END	=				END OF *IFT STRING
MIXCALC	=	OADCALC			SET MIXCALC = OADCALC VALUE
*END	=				*END OF ROUTINE

Routine #7 Description:

This routine controls the outside air damper through analog output "OADAMPER" to the calculated outside air damper position "OADCALC" analog variable value.

"OADCALC" value is set equal to the lesser value of "OADCALC" as determined in routine #6 or the calculated mixed air "MIXCALC" analog variable value. "MIXCALC" is set equal to the output of the mixed air DDC loop #5 which compares the mixed air temperature "MIXEDTMP" analog input value to the mixed air setpoint "MIXAIRSP" analog variable value. DDC loop #5 output will change as required to maintain the mixed air setpoint.

Should the binary variable "FANOFF" be set to "ON" per routine #2 or the mixed air temperature sensor "MIXEDTMP" analog input be failed, "OADCALC" value as previously determined is ignored and is set to -10%. An "OADCALC" value of -10% will cause closure of the outside air damper.

"MIXCALC" value is set equal to the "OADCALC" value at the end of this routine to provide a smooth transfer of control between the two DDC loops.

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                          PCL ROUTINE DEFINITION

  PCM: AHC-003B                                  Date: 03-FEB-92
  Location:

Routine Name: COOL VALVE                  Routine Number:  8
                          Freq:   0 Hrs.   0 Mins.  60 Secs.

Result        1st Arg     Operator 2nd Arg    Description of Statement
----------    ----------  -------- ---------- -----------------------------------
COOLCALC    = SPACETMP    DDC:3    COOLSP     RUN DDC LOOP FOR COOL VALVE CONTROL
*IFT        = OADAMPER    LE       *70        IF OA DAMPER POSITION  70%
*L0         = TRUE                            SET *L0 TO TRUE
*IFT        = OADAMPER    GE       *90        IF OA DAMPER POSITION  90%
*L0         = FALSE                           SET *L0 TO FALSE
*END        =                                 END OF *IFT STRING
*L1         = *L0         AND      ECONENAB   *L1 TRUE IF *L0 TRUE AND ECON ENABLE
*L2         = SPACETMP    FAIL               *L2 TRUE IF SPACE TEMP SENSOR FAILED
*L3         = *L1         OR       *L2       \ *L3 TRUE IF: *L1 TRUE OR SENSOR
            = HEAT                 FANOFF     >  FAIL OR HEAT MODE OR FAN IS OFF OR
            = COASTD               PURGE      / COASTDOWN MODE OR PURGE MODE
*IFT        = *L3                             IF *L3 IS TRUE
COOLCALC    = *-10                            CALC COOL VALVE POS. = FULL CLOSED
*IFT        = FANOFF      AND      COOLOPEN   IF FANOFF AND COOLOPEN ARE BOTH TRUE
COOLCALC    = *100                            CALC COOL VALVE POS. = FULL OPEN
*END        =                                 END OF *IFT STRING
CWVALVE     =             CONTROL  COOLCALC   SET COOL VALVE AOP = CALC POSITION
*END        =                                 END OF ROUTINE
```

Routine #8 Description:

This routine controls the chilled water valve through analog output "CWVALVE" to the calculated chilled water valve position "COOLCALC" analog variable. "COOLCALC" value is equal to the output of DDC loop #3 which compares the space temperature sensor "SPACETMP" analog input value to the cooling setpoint "COOLSP" analog variable value. DDC loop #3 output will change as required to maintain the cooling setpoint.

Regardless of DDC loop #3 output, analog variable "COOLCALC" is set equal to -10% should the space temperature sensor "SPACETMP" analog input be failed, the outside air damper "OADAMPER" analog output value be greater than 90% and economizer enable "ECONENAB" binary variable is "ON" (enabled per routine #5) or one of the following binary variables or setpoints is "ON"; binary variable "HEAT" per routine #4, binary variable "FANOFF" per routine #2, binary setpoints "PURGE" and "COASTD" per Tracer BMS.

Previously determined analog variable "COOLCALC" value is ignored and is set to 100% should binary variable "FANOFF" be "ON" and binary parameter "COOLOPEN" be "ON" (open). "COOLOPEN" is adjustable through the PCM LCD display.

```
                          PCL ROUTINE DEFINITION

  PCM: AHC-003B                                    Date: 03-FEB-92
  Location:

Routine Name: HEAT VALVE                    Routine Number:  9
                          Freq:   0 Hrs.   0 Mins.  60 Secs.

Result        1st Arg     Operator 2nd Arg    Description of Statement
----------    ----------  -------- ---------- ----------------------------------
HEATCALC    = SPACETMP    DDC:4    HEATSP     RUN DDC LOOP FOR HWVALVE CONTROL
*L0         = SPACETMP    FAIL                *L0 TRUE IF SPACE TEMP SENSOR FAILED
*L1         = *L0         OR       COOL       \  IF SELECTED SENSOR IS
            = FANOFF                          > FAILED OR COOL MODE OR
*IFT        = *L1                             /  FAN IS OFF
HEATCALC    = *-10                            CALC HEAT VALVE POS. IS FULL CLOSED
*IFT        = FANOFF      AND      HEATOPEN   IF SUPPLY FANOFF AND HEATOPEN TRUE
HEATCALC    = *100                            CALC HEAT VALVE POS. IS FULL OPEN
*END        =                                 END OF *IFT STRING
HWVALVE     =             CONTROL  HEATCALC   SET HWVALVE AOP = CALC. POSITION
*END        =                                 END OF ROUTINE
```

Routine #9 Description:

This routine controls the hot water valve through analog output "HWVALVE" to the calculated hot water valve position "HEATCALC" analog variable. "HEATCALC" value is equal to the output of DDC loop #4 which compares the space temperature sensor "SPACETMP" analog input value to the heating setpoint "HEATSP" analog variable value as set per routine #3. DDC loop #4 output will change as required to maintain the heating setpoint.

Regardless of DDC loop #4 output, analog variable "HEATCALC" is set equal to -10% if the space temperature sensor "SPACETMP" analog input is failed or the outside air damper "OADAMPER" analog output percent is 10% greater than outside air damper minimum postion "MINPOS" analog variable value as set in routine #5 or binary variable "FANOFF" is "ON" per routine #2.

Analog variable "HEATCALC" as previously determined is ignored and is set to 100% should binary variable "FANOFF" be "ON" and binary parameter "HEATOPEN" be "ON" (open). "HEATOPEN" is adjustable through the PCM LCD display.

PCL ROUTINE DEFINITION

PCM: AHC-003B Date: 03-FEB-92
Location:

Routine Name: CALIBRATION Routine Number: 10
Freq: 0 Hrs. 0 Mins. 60 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
*L0	=		NOT	RUN-AUTO	*L0 TRUE IF AUTO/STOP BIP IS STOP
*IFT	=	CALIBRTE	AND	*L0	IF CALIBRATE BNP ON AND STOP
HWVALVE	=		CONTROL	*0	SET HOT WATER VALVE POSITION = 0%
CWVALVE	=		CONTROL	*0	SET CHILLED WTR VALVE POSITION = 0%
OADAMPER	=		CONTROL	*0	SET OA DAMPER POSITION = 0%
*END	=				END OF ROUTINE

Routine #10 Description:

With binary input "RUN/AUTO" indicating "OFF" and binary parameter "CALIBRTE" set to "ON", all analog outputs (HW valve, CW valve, and OA damper) will be set to 0% to allow valve and/or linkage adjustments to be made. Binary parameter "CALIBRTE" is typically adjusted from the PCM LCD display.

CUSTOM DISPLAY SETUP

PCM: AHC-003B Date: 03-FEB-92
Location:

PCM System Password: +-+-

Display Line	Point Name	Expanded Description	Desc/ Units	Adjust	Adjustment Limits Low	High
1	RUN-AUTO	AUTO/STOP INPUT	7			
2	SUPFANSS	SUPPLY FAN START	0			
3	SUPFANST	SUPPLY FAN STATUS	0			
4	COOL	COOLING MODE	4			
5	SPACESPA	SPACE CLG SETPOINT	0			
6	HEATSP	SPACE HTG SETPOINT	0			
7	SPACETMP	SPACE TEMPERATURE	0			
8	ECONENAB	ECONOMIZER STATUS	2			
9	OADAMPER	OA DAMPER POSITION	4			
10	MINPOS	OA DAMPER MIN POS	4			
11	MIXEDTMP	MIXED AIR TEMP	0			
12	HWVALVE	H.W. VALVE POS	4			
13	CWVALVE	C.W. VALVE POS	4			
14	OATEMP	OUTDOOR AIR TEMP	0			
15	FANFAIL	SUPPLY FAN FAILURE	4			
16	FILTER	DIRTY FILTER	4			
17	MIXLOLIM	MIXED AIR LO LIMIT	5			
18	KEYPADSP	KEYPAD SETPOINTS	4	Y		
19	SPACESPK	KEYPAD SPACE SETPT	0	Y	45.0	100.0
20	ROOMADJ	ROOM SETPT ENABLE	4	Y		
21	ROOMSP	ROOM SETPOINT KNOB	0			
22	HEATOFST	HEATING OFFSET	0	Y	.0	15.0
23	OAMINPOS	OA MIN POSITION SP	4	Y	.0	100.0
24	OAECONSP	OA ECON ENABLE SP	0	Y	-100.0	100.0
25	MIXEDSP	MIXED AIR SETPOINT	0	Y	45.0	100.0
26	ROOMLOW	SPACE SETPT LO LIM	0	Y	45.0	100.0
27	ROOMHIGH	SPACE SETPT HI LIM	0	Y	45.0	100.0
28	CALIBRTE	AOP CALIBRATE MODE	0	Y		
29	MANRESET	MANUAL RESET POINT	0	Y		
30						
31						
32						

Binary Descriptor Table:

0 = OFF/ON	1 = CLOSED/OPEN	2 = DISABL/ENABLE
3 = AUTO/MANUAL	4 = NO/YES	5 = NORMAL/ALARM
6 = UNOCC/OCCUPY	7 = SHUTDN/NORMAL	8 = HEAT/COOL

Analog Units Table:

0 = DEG	1 = PSI	2 = KW	3 = KWH	4 = PCT	5 = CFM
6 = AMP	7 = VOL	8 = HG	9 = IN	10 = RH	11 = Blank

Constant Volume AHU with Stand-alone Control

Control Sequence for AHC-004B

Occupied Cooling Or Heating Mode
When the AHU is indexed to the occupied mode, the supply fan will operate continuously and the outside air damper will be at its minimum position (unless economizing). When the AHU is indexed to the occupied cooling mode, the space air temperature will be maintained to the space cooling setpoint (74° F nominal) by modulating the chilled water valve and the outdoor air damper. When the AHU is in the heating mode, the space air temperature will be maintained to the space heating setpoint (71° F nominal) by modulating the hot water or steam valve.

The occupied mode is triggered by the occupy binary input (closed=occupy), typically from an external system or time clock. If enabled, the space sensor timed override switch momentary closure will place the AHU in the occupied mode for a 2 hour period, overriding the occupy input.

Night Setback/morning Warmup Heating Mode
Nite setback mode is determined based on the space temperature sensor and nite setback setpoint. The nite setback setpoint is adjustable at the local PCM keypad/display. If the space sensor temperature is less than the nite setback setpoint, the AHU will be in the nite setback mode. When the AHU is indexed to the night setback/morning warmup heating mode, the supply fan will operate continuously, the outdoor air damper will be fully closed, the chilled water valve will be fully closed and the hot water or steam valve will modulate to maintain the space air temperature.

Supply Fan Control
The supply fan will operate continuously whenever the AHU is indexed to either the occupied mode or the night setback/morning warmup heating mode. The supply fan will be off whenever the AHU is indexed to the unoccupied mode, the run-auto/stop interlock is open, the mixed air low limit is tripped, or the supply fan status indicates a failure (after a 2 minute delay). The fan failure indication requires a manual reset, which can be done at the local PCM keypad/display or by opening the run-auto/stop interlock.

Heat/cool Mode Control
The heat/cool mode of the AHU is determined based on the space temperature sensor and the space cooling and heating setpoints. The space heating setpoint is the space cooling setpoint minus the heating offset differential. The heating offset differential is adjustable from 0° to 15° F at the local PCM keypad/display. If the space sensor temperature is greater than the space cooling setpoint plus 1° F, the mode of the AHU will be cool. If the space sensor temperature is less than the heating setpoint minus 1° F, the mode of the AHU will be heat. The AHU will be allowed to switch between the heating and cooling modes at any time during operation, based on this logic. The space cooling setpoint is adjustable by the space sensor setpoint adjustment knob. If space sensor setpoint adjustment knob is failed or local PCM keypad setpoint is selected, the setpoint is adjustable at the local PCM keypad/display.

AHC-004B continued...

Outdoor Air Damper Control
The economizer function is enabled when the outdoor air temperature is less than the changeover setpoint minus 2° F. When the economizer function is enabled, the outdoor air damper will modulate, as commanded by the PCM controller, between minimum position and full open to maintain the space cooling setpoint. The outdoor air damper will be modulated closed as required (overriding the minimum position) to maintain the mixed air temperature (averaging element) at or above the mixed air setpoint (48° F nominal). A mixed air low limit manual reset device (sensing the coldest one-foot section) will turn the supply fan off if its sensed temperature is below its setpoint (36° F nominal).

The economizer function is disabled by the outdoor air temperature being above the changeover setpoint. If the economizer function is disabled, the space air temperature sensor is failed, or the AHU is in the heat mode, the outdoor air damper will be set to minimum position. If the space temperature is 2° F less than the space heating setpoint, the supply fan is off or the mixed air temperature sensor is failed, the outdoor air damper will be fully closed.

Chilled Water Valve Control
The chilled water valve will modulate, as commanded by the PCM controller, to maintain the space air temperature at the space cooling setpoint. If the economizer function is enabled and the outdoor air damper is not fully opened, the chilled water valve will be closed. The chilled water valve will also be closed if the mode of the AHU is heating or the space air temperature sensor is failed. If the supply fan is off, the chilled water valve will be either fully open or closed, as selected by a user entry.

Hot Water or SteamValve Control
The hot water or steam valve will modulate, as commanded by the PCM controller, to maintain the space air temperature at the space heating setpoint. If the mode of the AHU is cooling or the space air temperature sensor is failed, the hot water or steam valve will be closed. If the supply fan is off, the hot water or steam valve will either be fully opened or closed, as selected by a user entry.

Unoccupied Mode
When the AHU is indexed to the unoccupied mode, the supply fan will be turned off and outside air damper will be fully closed. The chilled water valve will be either fully closed or fully open, as selected by user entry. The hot water or steam valve will be either fully open or fully closed, as selected by user entry.

Local PCM Keypad/display
The following setpoints (parameters) are stored in the AHU PCM and can be accessed through the local PCM keypad/display:

Analog Parameters

- Space Cooling Setpoint (45°−100° F)
- Heating Offset Differential (0°−15° F)
- Space Setpoint Low Limit Adjustment (45°−100° F)
- Space Setpoint High Limit Adjustment (45°−100° F)
- Mixed Air Setpoint (45°−100° F)
- Outdoor Air Changeover Setpoint (-100°-100° F)
- Outdoor Air Minimum Position (0-100%)
- Nite Setback Setpoint (45°-80° F)

Binary Parameters

- Manual Reset Point (OFF/ON)
- Heat Valve/Fan Off (CLOSED/OPEN)
- Cool Valve/Fan Off (CLOSED/OPEN)
- Aop Calibrate Mode (OFF/ON)
- Space Sensor TOV Switch Enable (NO/YES)

Analog Output Calibrate Mode
When the run-auto/stop input is open (AHU OFF) the user can select a special analog output calibrate mode from the local PCM keypad/display. When in the calibrate mode, all analog outputs (HW valve, CW valve, OA damper) will be set to 0% to allow valve and/or linkage adjustments to be made.

Note: AIP and AOP Range and Offset entries shown on the next page may vary, depending on the actual input sensors and output actuators used.

POINT DATA DEFINITIONS

PCM: AHC-004B Date: 03-FEB-92
Location: Page: 1 of 2

PULSE METER INPUTS:

Name	Weight
PAC1	.0
PAC2	.0

ANALOG INPUTS:

	Name	Conv Type	Range	Offset
AIP1	MIXEDTMP	BAL	102.4	.0
AIP2	SPARE1	BAL	102.4	.0
AIP3	SPARE2	THM	102.4	.0
AIP4	OATEMP	THM	102.4	.0
AIP5	SPACETMP	THM	102.4	.0
AIP6	ROOMSP	RES	-50.0	95.0

ANALOG OUTPUTS:

	Name	Range	Offset
AOP1	HWVALVE	-333.3	300.0
AOP2	CWVALVE	333.3	-200.0
AOP3	OADAMPER	125.0	-25.0
AOP4		.0	.0

ANALOG SETPOINTS: ***(from Tracer BMS)***

	Name	Communications Loss Value		Name	Communications Loss Value
ASP1		.0	ASP5		.0
ASP2		.0	ASP6		.0
ASP3		.0	ASP7		.0
ASP4		.0	ASP8		.0

ANALOG PARAMETERS: ***(adjusted by operator)***

	Name	Value		Name	Value
ANP1	SPACESPK	74.0	ANP5	MIXEDSP	48.0
ANP2	HEATOFST	3.0	ANP6	OAECONSP	70.0
ANP3	ROOMLOW	55.0	ANP7	OAMINPOS	15.0
ANP4	ROOMHIGH	85.0	ANP8	NITESP	60.0

ANALOG VARIABLES: ***(calculated by PCL routines)***

	Name		Name		Name		Name
AV1	COOLSP	AV5	MINPOS	AV9		AV13	OADCALC
AV2	ECONSP	AV6	SPACESPA	AV10		AV14	HEATCALC
AV3	HEATSP	AV7		AV11		AV15	COOLCALC
AV4	MIXAIRSP	AV8		AV12	MIXCALC	AV16	

POINT DATA DEFINITIONS

PCM: AHC-004B
Location:

Date: 03-FEB-92
Page: 2 of 2

BINARY INPUTS:

	Name	Open Means
BIP1	SUPFANST	OFF
BIP2	OCCUPY	OFF
BIP3	MIXLOLIM	ON
BIP4	RUN-AUTO	OFF

BINARY OUTPUTS:

	Name	Relay Off Means	Minimum On Time	Minimum Off Time
BOP1	SUPFANSS	OFF	0	5
BOP2		OFF	0	0
BOP3		OFF	0	0
BOP4		OFF	0	0
BOP5		OFF	0	0
BOP6		OFF	0	0

BINARY SETPOINTS: *(from Tracer BMS)*

Name	Communications Loss State	Name	Communications Loss State
BSP1	OFF	BSP13	OFF
BSP2	OFF	BSP14	OFF
BSP3	OFF	BSP15	OFF
BSP4	OFF	BSP16	OFF
BSP5	OFF	BSP17	OFF
BSP6	OFF	BSP18	OFF
BSP7	OFF	BSP19	OFF
BSP8	OFF	BSP20	OFF
BSP9	OFF	BSP21	OFF
BSP10	OFF	BSP22	OFF
BSP11	OFF	BSP23	OFF
BSP12	OFF	BSP24	OFF

BINARY PARAMETERS: *(adjusted by operator)*

	Name	State		Name	State
BNP1	MANRESET	OFF	BNP5	HEATOPEN	ON
BNP2	KEYPADSP	OFF	BNP6	COOLOPEN	OFF
BNP3		OFF	BNP7	CALIBRTE	OFF
BNP4		OFF	BNP8	ENABLTOV	ON

BINARY VARIABLES: *(calculated by PCL routines)*

	Name		Name		Name		Name
BV1	HEAT	BV5	ECONENAB	BV9		BV13	
BV2	COOL	BV6	FANREQ	BV10		BV14	
BV3	FANON	BV7	TOVREQ	BV11	FANFAIL	BV15	

DDC LOOP PARAMETERS

PCM: AHC-004B Date: 03-FEB-92
Location:

DDC Loop # 1		DDC Loop # 2 ECONOMIZER	
Proportional Gain	.00	Proportional Gain	20.00
Integral Gain	.00	Integral Gain	5.00
Derivative Gain	.00	Derivative Gain	.00
Action	REVERS	Action	DIRECT
Proportional Bias	.0	Proportional Bias	.0
Minimum Output Value	.0	Minimum Output Value	.0
Maximum Output Value	.0	Maximum Output Value	100.0
Error Deadband	.0	Error Deadband	.5

DDC Loop # 3 COOL VALVE		DDC Loop # 4 HEAT VALVE	
Proportional Gain	20.00	Proportional Gain	20.00
Integral Gain	5.00	Integral Gain	5.00
Derivative Gain	.00	Derivative Gain	.00
Action	DIRECT	Action	REVERS
Proportional Bias	.0	Proportional Bias	.0
Minimum Output Value	-10.0	Minimum Output Value	-10.0
Maximum Output Value	100.0	Maximum Output Value	100.0
Error Deadband	.5	Error Deadband	.5

DDC Loop # 5 MIXED AIR		DDC Loop # 6	
Proportional Gain	4.00	Proportional Gain	.00
Integral Gain	1.00	Integral Gain	.00
Derivative Gain	.00	Derivative Gain	.00
Action	DIRECT	Action	REVERS
Proportional Bias	.0	Proportional Bias	.0
Minimum Output Value	.0	Minimum Output Value	.0
Maximum Output Value	100.0	Maximum Output Value	.0
Error Deadband	.5	Error Deadband	.0

PCL ROUTINE DEFINITION

PCM: AHC-004B Date: 03-FEB-92
Location:

Routine Name: FAIL DETECT Routine Number: 1
Freq: 0 Hrs. 0 Mins. 5 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
*L0	=		NOT	RUN-AUTO	*L0 TRUE IF RUN-AUTO/STOP BIP = STOP
*L1	=		NOT	SUPFANST	*L1 TRUE IF SUPFANST BIP IS OFF
*IFT	=	SUPFANSS	AND	*L1	IF SUPPLY FAN BOP IS ON AND BIP OFF
*R0	=	*R0	+	*1.0	INCREASE COUNTER *R0 BY ONE
*ELSE	=				IF NOT (I.E. BOP IS OFF OR BIP ON)
*R0	=	*0			RESET COUNTER *R0 TO ZERO
*IFT	=	*R0	GT	*24	IF COUNTER 24 (24 X 5 SEC = 2 MIN)
FANFAIL	=	TRUE			SET BINARY VARIABLE "FANFAIL" TRUE
*IFT	=	MANRESET	OR	*L0	IF MANRESET BNP ON OR AUTO BIP OFF
FANFAIL	=	FALSE			SET BINARY VARIABLE "FANFAIL" FALSE
*END	=				END OF *IFT STRING
LOWTEMP	=	MIXLOLIM			LOWTEMP VARIABLE = MIXLOLIM BIP
*END	=				END OF ROUTINE

Routine #1 Description:

This routine monitors the supply fan for fan failure. Should the supply fan start/stop "SUPFANSS" binary output be "ON" and the supply fan status binary input "SUPFANST" be "OFF" for a two minute time period, the "FANFAIL" binary variable will be triggered to "ON" and initiate fan failure. Once initiated, the "FANFAIL" binary variable can only be reset to "OFF" by one of the following methods:

1. Toggle the manual reset, "MANRESET", binary parameter to "ON" then "OFF". Typically accomplished through the LCD display.
2. Trigger the "RUN/AUTO" binary input to "OFF" then "ON". Typically accomplished be either removing and re-installing the factory installed jumper or switching a field installed toggle switch to "OFF" then "ON".
3. Toggle the PCM circuit board on/off switch to "OFF" then "ON".

The "LOWTEMP" variable is triggered to "ON" whenever the "MIXLOLIM" binary input is ON (open circuit). The "LOWTEMP" variable can only be cleared by manually resetting the Mixed Air Low Limit Device.

```
                        PCL ROUTINE DEFINITION

 PCM: AHC-004B                                  Date: 03-FEB-92
 Location:

Routine Name: FAN REQUEST                Routine Number:  2
                          Freq:   0 Hrs.   0 Mins.  10 Secs.

Result        1st Arg     Operator 2nd Arg    Description of Statement
----------    ----------  -------- ---------- ------------------------------------
*R0         = NITESP      +        *3.0       *R0 = NITE SETBACK SETPOINT + 3.0
*IFT        = SPACETMP    LT       NITESP     IF SPACETMP LESS THAN NITE SBK SETPT
*L0         = TRUE                            *L0 IS TRUE
*IFT        = SPACETMP    GT       *R0        IF SPACETMP GREATER THAN *R0
*L0         = FALSE                           *L0 IS FALSE
*IFT        = SPACETMP    GT       *85.0      IF SPACETMP GREATER THAN *85.0
*L1         = TRUE                            *L1 IS TRUE
*IFT        = SPACETMP    LT       *82.0      IF SPACETMP LESS THAN *82.0
*L1         = FALSE                           *L1 IS FALSE
*IFT        = SPACETMP    TOV                 IF SPACETMP TOV TRUE
*R1         = *720                            SET *R1 TO 720 (720 X 10 SEC = 2 HR)
*ELSE       =                                 IF NOT IN TOV
*R1         = *R1         -        *1.0       DECREASE COUNTER *R1 BY ONE
*IFF        = ENABLTOV                        IF ENABLTOV BNP = FALSE
*R1         = *-1.0                           SET *R1 TO *-1.0
*END        =                                 *END OF *IFF STRING
*R1         = *R1         MAX      *-1.0      *R1 LOW LIMIT OF *-1.0
TOVREQ      = *R1         GT       *0         TOVREQ TRUE IF *R1 GREATER THAN *0
FANREQ      = *L0         OR       *L1        \FANREQ TRUE IF SPACETMP LT NITESP
            = OCCUPY                TOVREQ     /OR GT *85.0 OR OCCUPY BIP OR TOVREQ
```

Routine #2 Description:

This routine establishes the fan request "FANREQ" binary variable value used in the fan control routine #3.

Fan request "FANREQ" binary variable is set to "OFF" unless set to "ON" by any one of the following triggers:

1. **Nite setback** - If the space temperature sensor "SPACETMP" analog input value is less than the nite setback setpoint "NITESP" analog parameter value. "NITESP" analog parameter is adjustable through the PCM LCD display. "FANREQ" binary variable will remain "ON" by the above described trigger until the "SPACETMP" analog input value 3° F greater than the "NITESP" analog parameter value.
2. **Nite setup** - If the space temperature sensor "SPACETMP" analog input value is greater than 85° F. "FANREQ" binary variable will remain "ON" by the above described trigger until the "SPACETMP" analog input value is less than 82° F.
3. **Timed override** from space sensor (if enabled) - With timed override enable "ENABLTOV" binary parameter set to "ON", momentary closure of the space temperature sensor override switch for a 2 second or greater interval will place "SPACETMP" analog input into timed override (TOV) status for a two minute interval. "SPACETMP" analog input timed override status initiates a 2 hour counter and timed override request "TOVREQ" binary variable is set to "ON" until the counter expires. "FANREQ" binary variable will remain set to "ON" as long as "TOVREQ" binary variable is set to "ON".
4. **Occupy mode** initiated - Occupied/unoccupied "OCCUPY" binary input is set to "ON". "FANREQ" will remain "ON" by the above described trigger until the "OCCUPY" binary input is set to "OFF".

PCL ROUTINE DEFINITION

PCM: AHC-004B Date: 03-FEB-92
Location:

Routine Name: FAN CONTROL Routine Number: 3
Freq: 0 Hrs. 0 Mins. 5 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
SUPFANSS	=		CONTROL	FANREQ	SUPFANSS BOP =FANREQ BINARY VARIABLE
*L0	=		NOT	RUN-AUTO	*L0 TRUE IF RUN-AUTO/STOP BIP = STOP
*L1	=	FANFAIL	OR	LOWTEMP	*L1 TRUE IF FANFAIL OR LOWTEMP
*IFT	=	*L0	OR	*L1	IF STOP, FANFAIL OR LOWTEMP TRUE
SUPFANSS	=	NOMIN	CONTROL	OFF	BOPS "OFF" OVERRIDING MIN ON TIMER
*IFT	=	SUPFANSS	AND	SUPFANST	IF FAN BOP AND STATUS "ON"
*R0	=	*R0	+	*1.0	INCREASE COUNTER *R0 BY ONE
*ELSE	=				IF NOT (FAN BOP OR STATUS BIP OFF)
*R0	=	*0			RESET COUNTER TO *R0 TO ZERO
*END	=				END OF *IFT STRING
FANON	=	*R0	GT	*6	"FANON" = TRUE IF *R0 6 (30 SEC)
FANOFF	=		NOT	FANON	"FANOFF" = OPPOSITE OF "FANON"
*END	=				END OF ROUTINE

Routine #3 Description:

This routine starts and stops the supply fan. After air flow is established for a 30 second time period, the "FANON" binary variable is set to "TRUE". The "FANOFF" binary variable (used in other routines) is set to the opposite state of "FANON".

The supply fan "SUPFANSS" binary output will be controlled to fan request "FANREQ" binary variable value as set in routine # 2.

Regardless of a fan request to have the supply fan "ON", the supply fan "SUPFANSS" binary output will be indexed to "OFF" by one of the following triggers:

1. "RUN/AUTO" binary input is open for "OFF" (shutdown).
2. "FANFAIL" binary variable is "ON".
3. "LOWTEMP" binary variable is "ON".

Note: The above fan "OFF" trigger will stop the supply fan instanteously overriding minimum ON/OFF timers.

```
                          PCL ROUTINE DEFINITION

 PCM: AHC-004B                                    Date: 03-FEB-92
 Location:

Routine Name: LOCAL SETPTS                  Routine Number:  4
                          Freq:   0 Hrs.   0 Mins.   5 Secs.

Result       1st Arg    Operator 2nd Arg    Description of Statement
----------   ---------- -------- ---------- -----------------------------------
*IFT       = ROOMSP     FAIL                IF ROOM SETPT INPUT FAILED
SPACESPA   = SPACESPK                       SPACE SETPT = KEYPAD SPACE SETPOINT
*ELSE      =                                IF NOT FAILED
SPACESPA   = ROOMSP                         SPACE SETPT = ROOM SETPT INPUT
*END       =                                END OF *IFT STRING
SPACESPA   = SPACESPA   MAX       ROOMLOW   SPACE SETPT LOW LIMIT = ROOMLOW
SPACESPA   = SPACESPA   MIN       ROOMHIGH  SPACE SETPT HIGH LIMIT = ROOMHIGH
*IFT       = KEYPADSP                       IF KEYPAD BNP IS ON (LOCAL SETPTS)
SPACESPA   = SPACESPK                       SPACE SETPT = KEYPAD SPACE SETPOINT
*END       =                                IF LOCAL SETPOINT DISABLED
HEATSP     = SPACESPA   -         HEATOFST  HEATING SETPT = SPACE SETPT - OFFSET
HEATSP     = HEATSP     MAX       *45.0     HEATING SETPT LOW LIMIT = 45 DEG
HEATSP     = HEATSP     MIN       SPACESPA  HEATING SETPT HI LIMIT = SPACE SETPT
COOLSP     = SPACESPA                       COOLING SETPOINT = SPACE SETPOINT
ECONSP     = SPACESPA                       ECONOMIZER SETPOINT = SPACE SETPT
*END       =                                END OF ROUTINE
```

Routine #4 Description:

This routine establishes setpoint values for the following analog variables: the economizer setpoint "ECONSP" analog variable, the space cooling setpoint "COOLSP" analog variable, and the space heating setpoint "HEATSP" analog variable, these analog variables are used in routines 6, 7, 9, and 10.

The space setpoint "SPACESPA" analog variable value is set equal to the space setpoint "ROOMSP" analog input value, unless the space setpoint "ROOMSP" analog input is failed. With "ROOMSP" analog input failed, "SPACESPA" analog variable value is set equal to the keypad space setpoint "SPACESPK" analog parameter value.

The "SPACESPA" analog variable value is limited and set equal to the room low limit "ROOMLOW" and the room high limit "ROOMHIGH" analog parameter values should "SPACESPA" value exceed the limits. "ROOMLOW" and "ROOMHIGH" analog parameters are adjustable through the PCM LCD display.

Regardless of the "SPACESPA" analog variable value as established above, the space setpoint "SPACESPA" analog variable is set equal to the keypad space setpoint "SPACESPK" analog parameter value should the keypad setpoint adjustment "KEYPADSP" binary parameter be set to "ON".

Note: The room low and high limits do not apply when "KEYPADSP" binary parameter is set to "ON". "SPACESPK" analog parameter is adjustable through the PCM LCD display.

The heating setpoint "HEATSP" analog variable value is set equal to space setpoint "SPACESPA" analog variable value as set above minus the heating offset differential "HEATOFST" analog parameter value. "HEATSP" analog variable value is limited to a low limit of 45° F and a high limit of the space setpoint "SPACESPA" analog variable value as set above.

The space cooling setpoint "COOLSP" analog variable value and economizer setpoint "ECONSP" analog variable are set equal to the space setpoint "SPACESPA" analog variable value established per the above description.

```
                          PCL ROUTINE DEFINITION

  PCM: AHC-004B                                   Date: 03-FEB-92
  Location:

Routine Name: HEAT/COOL                    Routine Number:  5
                           Freq:   0 Hrs.   0 Mins.  60 Secs.

Result        1st Arg     Operator 2nd Arg    Description of Statement
----------    ----------  -------- ---------- -----------------------------------
*R0         = SPACESPA    +        *1         *R0 = SPACE COOLING SETPT + 1 DEG
*R1         = HEATSP      -        *1         *R1 = SPACE HEATING SETPT - 1 DEG
*IFT        = SPACETMP    GT       *R0        IF SPACE TEMP  COOL SETPT + 1 DEG
COOL        = TRUE                            SET COOLING MODE = TRUE
*IFT        = SPACETMP    LT       *R1        IF SPACE TEMP  HEAT SETPT - 1 DEG
COOL        = FALSE                           SET COOLING MODE = FALSE (HEATING)
*END        =                                 END OF *IFT STRING
HEAT        =             NOT      COOL       HEATING MODE = OPPOSITE OF COOLING
*END        =                                 END OF ROUTINE.
```

Routine #5 Description:

This routine establishes an "ON" or "OFF" value for the "COOL" and "HEAT" binary variables with the "HEAT" value always being the opposite of the "COOL" value. The "HEAT" binary variable is used by the OADAMPER, COOL valve, and HEAT valve routines and effects operation of those routines as described under those routines.

If the space temperature sensor "SPACETMP" analog input value is greater than the space setpoint "SPACESPA" analog variable value established in routine #2 plus 1° F, binary variable "COOL" is set to "ON" and the mode of the AHU will be cool. If "SPACETMP" analog input value is less than the heating setpoint "HEATSP" analog variable value minus 1° F, binary variable "HEAT" is set to "ON" and the mode of the AHU will be heat.

```
                          PCL ROUTINE DEFINITION

  PCM: AHC-004B                                   Date: 03-FEB-92
  Location:

Routine Name: SETPOINTS                    Routine Number:  6
                          Freq:   0 Hrs.   0 Mins.  10 Secs.

Result        1st Arg     Operator 2nd Arg    Description of Statement
----------    ----------  -------- ---------- ----------------------------------
MIXAIRSP    = MIXEDSP     MAX      *45.0      MIXED AIR SETPT LOW LIMIT OF 45 DEG
*R0         = OAECONSP    -        *2.0       *R0 = OA CHANGEOVER S.P. - 2.0 DEG
*IFT        = OATEMP      LE       *R0        IF OA TEMP IS COOL (LESS THAN R0)
ECONENAB    = TRUE                            SET ECONENAB TO TRUE(INDICATES COOL)
*IFT        = OATEMP      GE       OAECONSP   IF OA TEMP IS WARM (GREATER THAN SP)
ECONENAB    = FALSE                           SET ECONENAB TO FALSE
*IFT        = OCCUPY      OR       TOVREQ     IF OCCUPY BIP "ON" OR UNIT IN TOV
MINPOS      = OAMINPOS                        ECON MIN POSITION = OPERATOR ENTRY
*ELSE       =                                 IF NOT OCCUPY OR UNIT IN TOV
MINPOS      = *0                              ECON MIN POSITION = 0%
*END        =                                 END OF *IFT STRING
*R1         = HEATSP      -        *2.0       *R1 = SPACE HEATING SETPT - 2 DEG
*IFT        = SPACETMP    LT       *R1        IF SPACE TEMP IS LESS THAN *R1
MINPOS      = *0                              ECON MIN POSITION = 0%
*END        =                                 END OF ROUTINE
```

Routine #6 Description:

This routine establishes setpoint values for the following analog and binary variables; mixed air setpoint "MIXAIRSP" analog variable, outside air damper minimum position setpoint "MINPOS" analog variable, and economizer enable "ECONENAB" binary variable. These analog and binary variables are used in routines #7 through #10.

The mixed air setpoint "MIXAIRSP" analog variable is equal to analog parameter "MIXEDSP" or 45° F, which ever is of larger value. Analog parameter "MIXEDSP" is adjustable through the LCD PCM display.

If outside air temperature "OATEMP" analog input value is 2° F less than the outside air economizer change-over setpoint "OAECONSP" analog parameter value, economizer enable "ECONENAB" binary variable will be set to "ON" (enabled). If the outside air temperature "OATEMP" analog input value is greater than outside air economizer switch-over setpoint "OAECONSP" value, economizer enable "ECONENAB" binary variable will be "OFF" (disabled).

The outside air damper minimum position setpoint "MINPOS" analog variable is set equal to 0 %, unless, either the occupy/unoccupy "OCCUPY" binary input or timed override request "TOVREQ" binary variable is indexed to "ON". With "OCCUPY" binary input or "TOVREQ" binary variable indexed to "ON", the outside air damper minimum position setpoint "MINPOS" analog variable is set equal to analog parameter "OAMINPOS" value. "OAMINPOS" is adjustable through the PCM LCD display.

Previously determined analog variable "MINPOS" value is ignored and set equal to 0 % should the space temperature "SPACETMP" analog input value be 2° F less than the heating setpoint "HEATSP" analog variable value as determined in routine #4.

```
                          PCL ROUTINE DEFINITION

  PCM: AHC-004B                                  Date: 03-FEB-92
  Location:

Routine Name: OA CALC                      Routine Number:  7
                           Freq:   0 Hrs.   0 Mins.  60 Secs.

Result        1st Arg     Operator 2nd Arg    Description of Statement
----------    ---------- -------- ---------- ----------------------------------
OADCALC     = SPACETMP    DDC:2    ECONSP     DDC LOOP FOR OADAMPER, USE OADCALC
OADCALC     = OADCALC     MAX      MINPOS     OADCALC LO LIMIT - ECON MIN POSITION
*L0         =             NOT      ECONENAB   *L0 TRUE IF ECONOMIZER DISABLED
*L1         = SPACETMP    FAIL                *L1 TRUE IF SPACE SENSOR IS FAILED
*L2         = *L0         OR       *L1        *L2 TRUE IF SENSOR FAIL OR ECON DIS
*IFT        = *L2         OR       HEAT       IF SENSOR FAIL OR ECON DIS OR HEAT
OADCALC     = MINPOS                          SET CALC DAMPER POSITION AT MINIMUM
*END        =                                 END OF ROUTINE
```

Routine #7 Description:

This routine establishes the calculated outside air damper position "OADCALC" analog variable value to be used in routine #8.

"OADCALC" value is set equal to the output of the economizer DDC loop #2 which compares the space temperature "SPACETMP" analog input value to the economizer setpoint "ECONSP" analog variable value as set in routine #4. DDC loop #2 output will change as required to maintain the economizer setpoint. "OADCALC" value is limited to the outside air damper minimum position "MINPOS" analog variable value and will be set to the damper minimum position "MINPOS" value should the space temperature sensor "SPACETMP" analog input fail, the economizer "ECONENAB" binary variable be "OFF" (disabled) per routine #6 or "HEAT" binary variable be set to "ON" per routine #5.

PCL ROUTINE DEFINITION

PCM: AHC-004B Date: 03-FEB-92
Location:

Routine Name: OA DAMPER Routine Number: 8
Freq: 0 Hrs. 0 Mins. 10 Secs.

Result		1st Arg	Operator	2nd Arg	Description of Statement
MIXCALC	=	MIXEDTMP	DDC:5	MIXAIRSP	DDC LOOP FOR MIXED AIR, USE MIXCALC
OADCALC	=	OADCALC	MIN	MIXCALC	SELECT MINIMUM OF OADCALC & MIXCALC
*L3	=	MIXEDTMP	FAIL		*L3 TRUE IF MIXED SENSOR FAILED
*IFT	=	FANOFF	OR	*L3	IF FAN IS OFF OR MIXED SENSOR FAILED
OADCALC	=	*-10			SET CALC DMPR POSITION TO FULL CLOSE
*END	=				END OF *IFT STRING
OADAMPER	=		CONTROL	OADCALC	SET OADAMPER AOP TO CALC DMPR POS.
MIXCALC	=	OADCALC			SET MIXCALC = OADCALC VALUE
*END	=				*END OF ROUTINE

Routine #8 Description:

This routine controls the outside air damper through analog output "OADAMPER" to the calculated outside air damper position "OADCALC" analog variable value.

"OADCALC" value is set equal to the lesser value of "OADCALC" as determined in routine #7 or the calculated mixed air "MIXCALC" analog variable value. "MIXCALC" is set equal to the output of the mixed air DDC loop #5 which compares the mixed air temperature "MIXEDTMP" analog input value to the mixed air setpoint "MIXAIRSP" analog variable value. DDC loop #5 output will change as required to maintain the mixed air setpoint.

Should the binary variable "FANOFF" be set to "ON" per routine #3 or the mixed air temperature sensor "MIXEDTMP" analog input be failed, "OADCALC" value as previously determined is ignored and is set to -10%. An "OADCALC" value of -10% will cause closure of the outside air damper.

"MIXCALC" value is set equal to the "OADCALC" value at the end of this routine to provide a smooth transfer of control between the two DDC loops.

```
                          PCL ROUTINE DEFINITION

 PCM: AHC-004B                                  Date: 03-FEB-92
 Location:

Routine Name: COOL VALVE                  Routine Number:  9
                          Freq:   0 Hrs.   0 Mins.  60 Se

Result        1st Arg     Operator 2nd Arg    Description of Statement
----------    ----------  -------- ---------- ----------------------------------
COOLCALC    = SPACETMP    DDC:3    COOLSP     RUN DDC LOOP FOR COOL VALVE CONTROL
*IFT        = OADAMPER    LE       *70        IF OA DAMPER POSITION  70%
*L0         = TRUE                            SET *L0 TO TRUE
*IFT        = OADAMPER    GE       *90        IF OA DAMPER POSITION  90%
*L0         = FALSE                           SET *L0 TO FALSE
*END        =                                 END OF *IFT STRING
*L1         = *L0         AND      ECONENAB   *L1 TRUE IF *L0 TRUE AND ECON ENABLE
*L2         = SPACETMP    FAIL               *L2 TRUE IF SPACE TEMP SENSOR FAILED
*L3         = *L1         OR       *L2       \ *L3 TRUE IF: *L1 TRUE OR SENSOR
            = HEAT                 FANOFF     / FAIL OR HEAT MODE OR FAN IS OFF
*IFT        = *L3                             IF *L3 IS TRUE
COOLCALC    = *-10                            CALC COOL VALVE POS. = FULL CLOSED
*IFT        = FANOFF      AND      COOLOPEN   IF FANOFF AND COOLOPEN ARE BOTH TRUE
COOLCALC    = *100                            CALC COOL VALVE POS. = FULL OPEN
*END        =                                 END OF *IFT STRING
CWVALVE     =             CONTROL  COOLCALC   SET COOL VALVE AOP = CALC POSITION
*END        =                                 END OF ROUTINE
```

Routine #9 Description:

This routine controls the chilled water valve through analog output "CWVALVE" to the calculated chilled water valve position "COOLCALC" analog variable. "COOLCALC" value is equal to the output of DDC loop #3 which compares the space temperature sensor "SPACETMP" analog input value to the cooling setpoint "COOLSP" analog variable value. DDC loop #3 output will change as required to maintain the cooling setpoint.

Regardless of DDC loop #3 output, analog variable "COOLCALC" is set equal to -10% should the space temperature sensor "SPACETMP" analog input be failed, the outside air damper "OADAMPER" analog output value be greater than 90% and economizer enable "ECONENAB" binary variable is "ON" (enabled per routine #6) or one of the following binary variables or setpoints is "ON"; binary variable "HEAT" per routine #5, binary variable "FANOFF" per routine #3.

Previously determined analog variable "COOLCALC" value is ignored and is set to 100% should binary variable "FANOFF" be "ON" and binary parameter "COOLOPEN" be "ON" (open). "COOLOPEN" is adjustable through the PCM LCD display.

```
                          PCL ROUTINE DEFINITION

 PCM: AHC-004B                                  Date: 03-FEB-92
 Location:

Routine Name: HEAT VALVE                  Routine Number: 10
                          Freq:   0 Hrs.   0 Mins.  60 Secs.

Result        1st Arg     Operator 2nd Arg    Description of Statement
----------    ----------  -------- ---------- ----------------------------------
HEATCALC    = SPACETMP    DDC:4    HEATSP     RUN DDC LOOP FOR HWVALVE CONTROL
*L0         = SPACETMP    FAIL               *L0 TRUE IF SPACE TEMP SENSOR FAILED
*L1         = *L0         OR       COOL      \  IF SELECTED SENSOR IS
            = FANOFF                         >  FAILED OR COOL MODE OR
*IFT        = *L1                            /  FAN IS OFF
HEATCALC    = *-10                           CALC HEAT VALVE POS. IS FULL CLOSED
*IFT        = FANOFF      AND      HEATOPEN  IF SUPPLY FANOFF AND HEATOPEN TRUE
HEATCALC    = *100                           CALC HEAT VALVE POS. IS FULL OPEN
*END        =                                END OF *IFT STRING
HWVALVE     =             CONTROL  HEATCALC  SET HWVALVE AOP = CALC. POSITION
*END        =                                END OF ROUTINE
```

Routine #10 Description:

This routine controls the hot water valve through analog output "HWVALVE" to the calculated hot water valve position "HEATCALC" analog variable. "HEATCALC" value is equal to the output of DDC loop #4 which compares the space temperature sensor "SPACETMP" analog input value to the heating setpoint "HEATSP" analog variable value as set per routine #4. DDC loop #4 output will change as required to maintain the heating setpoint.

Regardless of DDC loop #4 output, analog variable "HEATCALC" is set equal to -10% if the space temperature sensor "SPACETMP" analog input is failed or the outside air damper "OADAMPER" analog output percent is 10% greater than outside air damper minimum postion "MINPOS" analog variable value as set in routine #6 or binary variable "FANOFF" is "ON" per routine #3.

Analog variable "HEATCALC" as previously determined is ignored and is set to 100% should binary variable "FANOFF" be "ON" and binary parameter "HEATOPEN" be "ON" (open). "HEATOPEN" is adjustable through the PCM LCD display.

```
                          PCL ROUTINE DEFINITION

 PCM: AHC-004B                                  Date: 03-FEB-92
 Location:

Routine Name: CALIBRATION                Routine Number: 11
                         Freq:   0 Hrs.   0 Mins.  60 Secs.

Result       1st Arg    Operator 2nd Arg    Description of Statement
----------   ---------- -------- ---------- -----------------------------------
*L0        =            NOT      RUN-AUTO   *L0 TRUE IF AUTO/STOP BIP IS STOP
*IFT       = CALIBRTE   AND      *L0        IF CALIBRATE BNP ON AND STOP
HWVALVE    =            CONTROL  *0         SET HOT WATER VALVE POSITION = 0%
CWVALVE    =            CONTROL  *0         SET CHILLED WTR VALVE POSITION = 0%
OADAMPER   =            CONTROL  *0         SET OA DAMPER POSITION = 0%
*END       =                                END OF ROUTINE
```

Routine #11 Description:

With binary input "RUN/AUTO" indicating "OFF" and binary parameter "CALIBRTE" set to "ON" all analog outputs (HW valve, CW valve, and OA damper) will be set to 0% to allow valve and/or linkage adjustments to be made. Binary parameter "CALIBRTE" is typically adjusted from the PCM LCD display.

CUSTOM DISPLAY SETUP

PCM: AHC-004B Date: 03-FEB-92
Location:

PCM System Password: +-+-

Display Line	Point Name	Expanded Description	Desc/ Units	Adjust	Adjustment Limits Low	High
1	RUN-AUTO	AUTO/STOP INPUT	7			
2	OCCUPY	OCCUPIED MODE	4			
3	TOVREQ	UNIT IN TIMED OVRD	4			
4	SUPFANSS	SUPPLY FAN START	0			
5	SUPFANST	SUPPLY FAN STATUS	0			
6	COOL	COOLING MODE	4			
7	SPACESPA	SPACE CLG SETPOINT	0			
8	HEATSP	SPACE HTG SETPOINT	0			
9	SPACETMP	SPACE TEMPERATURE	0			
10	ECONENAB	ECONOMIZER STATUS	2			
11	OADAMPER	OA DAMPER POSITION	4			
12	MIXEDTMP	MIXED AIR TEMP	0			
13	HWVALVE	H.W. VALVE POS	4			
14	CWVALVE	C.W. VALVE POS	4			
15	OATEMP	OUTDOOR AIR TEMP	0			
16	FANFAIL	SUPPLY FAN FAILURE	4			
17	MIXLOLIM	MIXED AIR LO LIMIT	5			
18	ROOMSP	ROOM SETPOINT KNOB	0			
19	KEYPADSP	KEYPAD SETPOINTS	4	Y		
20	SPACESPK	KEYPAD SPACE SETPT	0	Y	45.0	100.0
21	HEATOFST	HEATING OFFSET	0	Y	.0	15.0
22	OAMINPOS	OA MIN POSITION SP	4	Y	.0	100.0
23	OAECONSP	OA ECON ENABLE SP	0	Y	-100.0	100.0
24	MIXEDSP	MIXED AIR SETPOINT	0	Y	45.0	100.0
25	ROOMLOW	SPACE SETPT LO LIM	0	Y	45.0	100.0
26	ROOMHIGH	SPACE SETPT HI LIM	0	Y	45.0	100.0
27	NITESP	NITE SETBACK SETPT	0	Y	45.0	80.0
28	HEATOPEN	FAN OFF HW VLV POS	1	Y		
29	COOLOPEN	FAN OFF CW VLV POS	1	Y		
30	ENABLTOV	TOV SWITCH ENABLE	0	Y		
31	CALIBRTE	AOP CALIBRATE MODE	0	Y		
32	MANRESET	MANUAL RESET POINT	0	Y		

Binary Descriptor Table:

0 = OFF/ON	1 = CLOSED/OPEN	2 = DISABL/ENABLE
3 = AUTO/MANUAL	4 = NO/YES	5 = NORMAL/ALARM
6 = UNOCC/OCCUPY	7 = SHUTDN/NORMAL	8 = HEAT/COOL

Analog Units Table:

0 = DEG	1 = PSI	2 = KW	3 = KWH	4 = PCT	5 = CFM
6 = AMP	7 = VOL	8 = HG	9 = IN	10 = RH	11 = Blank

PCM Edit Software

PCM Edit Software is required to setup and/or service a PCM. An IBM personal computer (PC or PS/2) or 100% compatible is required to operate the PCM Edit Software.

The PCM uses an enhanced version of the Tracer BMS Process Control Language (PCL) which provides the operation of custom control strategies.

Input/Output point definitions, PCL routines, and other required PCM setup information are defined using PCM Edit Software. All of this setup information is "downloaded" to the PCM after completion of editing with PCM Edit Software. Refer to the PCM Edit Software Operator's Guide for further information.

The PCM Edit Software package provides the following functions:

- Three level system security.
- Organize PCM data files with DOS subdirectories.
- Copy PCM data.
- Input/Output point definitions.
- Software point definitions.
- Input/Output test mode which includes the ability to manually override all outputs and review the status of all inputs.
- Direct Digital Control loop definition.
- Process Control language definition.
- Custom status display.
- Upload and download all data to/from a PCM.
- Print out all PCM data.
- Test PCL routines.
- Test DDC loops with point graphing.

All of these functions can be accomplished with a PCM connection through a modem, "direct-connection" through a Tracer BMS, or directly at the PCM. A connection to a Tracer BMS could also be through a head-end system with Building Management Network (BMN) software or unit-to-unit Tracer BMS.

CHAPTER 6: OPERATION

Chapter Overview

This chapter contains information about the following:

- PCM Keypad Display Operation
- LCD Displays
- Date and Time display
- PCM Name and Status Display
- PCM Logon/Logoff
- PCM Point Displays (1 to 32)

PCM Display and Keypad Operation

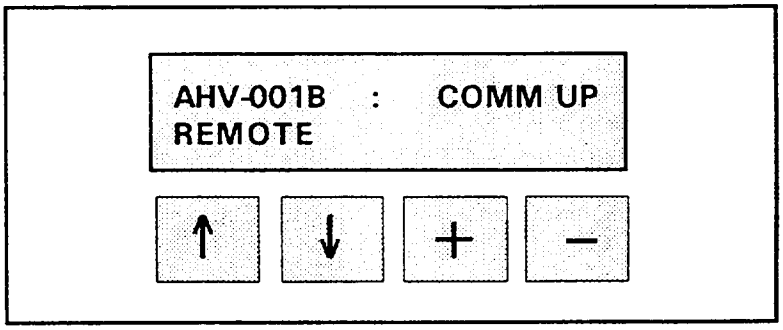
The operator interface option (a front panel Liquid Crystal Display with keypad) is available only on Standard Ambient PCMs which have shipped after February 1, 1990. This option is compatible with Tracer Building Management Systems (BMS) software, Version 9.0 or higher, and with PCM Edit Software, Version 2.0 or higher.

Note: The following PCMs are not compatible with the operator interface option: PCMs shipped before February 1, 1990, Extended Ambient PCMs, and PCMs in NEMA 4 enclosures.

Description

The PCM operator interface option allows display and local adjustment of PCM operating parameters and setpoints. It can either be installed at the factory or be field retrofitted to compatible PCMs.

The Liquid Crystal Display (LCD) with keypad is bracket mounted in a "window" in the cover of the PCM enclosure. It is connected to the PCM board with cables and plug connectors. The LCD readout is two lines by twenty characters with a backlit display. There are four keypad push buttons: Up, Down, Plus, and Minus.



Keypad Operation

The "Up" and "Down" buttons, as shown above, are used to scroll between the PCM displays. These displays appear in the following order:

First: Date and Time Display
Second: PCM Name and Status Display
Next: Point Displays 1 to 32

When the "Down" button scrolls past the last display, the first display (Date and Time) is automatically selected. When the "Up" button scrolls past the first display, the last "Point" display is automatically selected. Once a display is selected, it stays there until a new display is selected.

Keypad Operation (continued)

Any display with a blinking cursor (■) is user adjustable.

To adjust a point value:

1. Logon (see PCM Logon/Logoff section).
2. Select the desired PCM displays with the "Up" and "Down" buttons.
3. Adjust the parameter with the "Plus" and "Minus" buttons.

For binary values, the "Plus" and "Minus" buttons toggle points between states when pressed. For analog values, they increase or decrease the values and the time of day when pressed. Holding a button down while modifying an analog value changes the value at an increasing rate.

For date and time changes, the "Minus" key selects the field to change and the "Plus" key increases the date or time in that field.

The value can be changed within the user defined low and high adjustment limits. The value or state on the display will be saved in memory five seconds after the last key is pressed, or whenever the operator scrolls to another line. If the operator is not logged on, or if the value is not adjustable, the displayed value will not change when the "Plus" or "Minus" keys are pressed, and the blinking cursor will not appear.

Pressing any of the four buttons will turn on the backlighting for the display. The backlighting will remain on for approximately five minutes after the last key was pressed.

LCD Displays

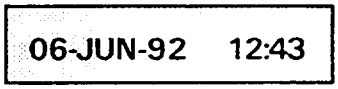
The PCM operator interface allows the operator to view the Date, Time, PCM Name and Status, and to view or edit up to 32 internal data points. These internal data points may be analog or binary inputs, analog or binary outputs, setpoints, global variables, or parameters. No other PCM data types (such as DDC loop parameters, point setup parameters, etc.) can be displayed.

Only the PCM date and time (found on the first display) and analog or binary parameters may be changed using the keypad.

Date and Time Display

Note: The PCM clock does not increment the time during a power failure. The time displayed after the power failure will be the same as displayed before the power failure. If the PCM is connected to a Tracer BMS, the Tracer will automatically update the PCM clock once a day and after a power failure.

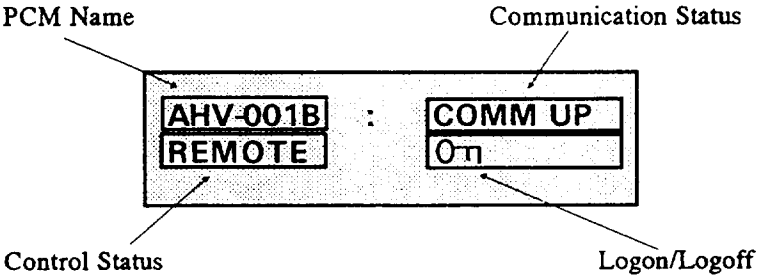
The PCM automatically displays the date and time following a power interruption. The date and time display has five "fields" which can be changed independently of each other: day, month, year, hours, and minutes. See the example below.



Use the following procedure to change the PCMs Date and Time:

1. Logon (see PCM Logon/Logoff section).
2. Use the "Minus" key to move the cursor to the right side of the field to be changed.
3. Use the "Plus" key to change the information in that field.

PCM Name and Status Display



This display has four fields which provide an overview of the status of the PCM. These fields show the name of the PCM, whether the PCM is communicating with a Tracer BMS, the PCM control status (local, remote, or manual), and whether the operator is logged on or logged off.

Note: When shipped, a factory assigned PCM Name is displayed on the LCD showing the factory order number. The PCM Name can be cutomized in the field using PCM Edit Software.

PCM Name
The PCM name has a maximum of 8 characters and is assigned using PCM Edit Software. It is not changeable from this display.

PCM Communication Status
This field indicates whether or not the PCM is communicating with the Tracer BMS (Comm Up or Comm Down). This field is automatically updated once each minute.

PCM Control Status
This field indicates the status of the automatic control routines of the PCM. The status (local, remote, or manual) can be changed either through the Tracer BMS or the PCM Edit Software. When the control status is "LOCAL", the PCM automatic control routines use control values stored in the PCM. When the control status is "REMOTE", the PCM automatic control routines use the control values sent from the Tracer BMS. When the control status is "MANUAL", the PCM automatic control routines are disabled and all PCM outputs are overridden to their manual override values.

PCM Logon/Logoff

When the operator is logged on, a key O⊓ is displayed. When the operator is logged off, a broken key O⊐ is displayed.

PCM Logon

1. Use the "Up" and "Down" arrow keys to move to the display containing the Logon/Logoff Status.
   (a O⊓ for logged on or O⊐ for logged off)
2. Press the "Plus" and "Minus" keys to enter the four-keystroke password. The factory default password (plus, minus, plus, minus) can be changed using PCM Edit Software.
3. If an error is made while entering the password, simply re-enter the password.
4. The O⊓ symbol will be displayed indicating that the operator is logged on.

PCM Logoff

1. Use the "Up" and "Down" arrow keys to move to the display containing the Logon/Logoff Status.
   (a O⊓ for logged on or O⊐ for logged off)
2. Press the "Minus" key once. Use the arrow keys to leave this display and return again.
3. The O⊐ symbol will be displayed indicating that the operator is logged off.

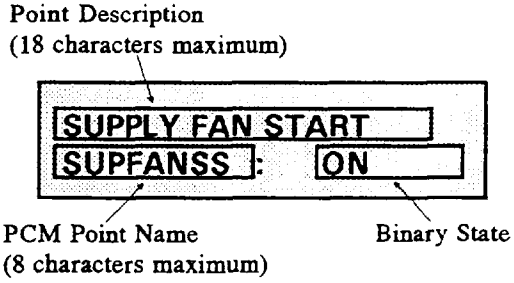
PCM Point Displays (1-32)

The PCM can have up to 32 binary and analog point displays. The Point Description and PCM Point Name for each of these displays is entered using the PCM Edit Software. A point display will have three fields if it is a binary point or four fields if it is an analog point.

In addition, if the point has values which can be changed with the PCM operator interface, a blinking cursor will appear on the display beside the adjustable value.

Binary Point Displays

A binary point appears as follows:

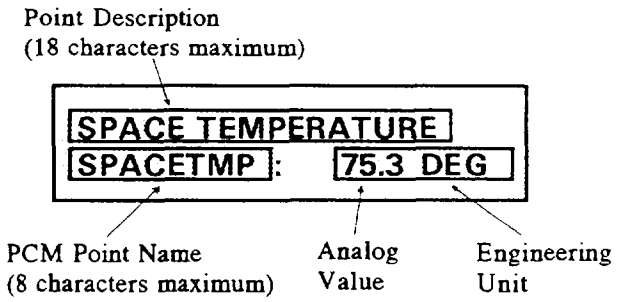


To change the state of a binary point:

1. Logon (see PCM Logon/Logoff section).
2. Use the "Up" and "Down" arrow keys to move to the display of the desired binary point. If the point value is changeable, a blinking cursor will appear to the right of the current state.
3. Press the "Plus" key for the ON descriptor (such as ON, ENABLE, START), or press the "Minus" key for the OFF descriptor (such as OFF, DISABL, STOP). The value is automatically entered when no keystrokes have been pressed for five seconds or when the operator moves to a different display.

Analog Point Displays

An analog point would appear as follows:



To change the state of an analog point:

1. Logon (see PCM Logon/Logoff section).
2. Use the "Up" and "Down" arrow keys to move to the display of the desired analog point. If the point value is changeable, a blinking cursor will appear to the right of the current value.
3. Press the "Plus" key to increase the analog value, or press the "Minus" key to decrease the value. If the "Plus" or "Minus" key is held down, the value will change at an increasing rate. The value is automatically entered when no keystrokes have been pressed for five seconds or when the operator moves to a different display.

The engineering units cannot be changed from the PCM front panel display.

Blinking Cursor

On displays with adjustable values, a blinking cursor will be on the right side of the value like shown below:

The bilnking cursor only appears if the operator is logged on.

Scroll and Refresh Features

The LCD does not have an auto scroll function. It will remain on the last current display until an operator scrolls it or until a power failure occurs. After power is restored, the time and date will be displayed. Dynamic data on the display (i.e. temperatures, valve positions, etc...) will be refreshed at least once every five seconds.

CHAPTER 7: TROUBLE ANALYSIS

Chapter Overview

This chapter contains information about the following:

- PCM Controls Problems
- Unit Controls Problems
- Symptoms, Probable Causes, and Recommended Actions.

Note: Refer to the Modular/Penthouse Climate Changer Installation Manual for trouble analysis regarding AHU problems.

Use the tables in this chapter to assist in identifying the cause or causes of a malfunction in the PCM controls for Modular and Penthouse Climate Changers. The column header "Recommended Action" suggests repair procedures.

These tables are intended as a diagnostic aid only. For detailed repair procedures, contact your local Trane Service Company.

Warning: ***Disconnect the electrical power source and allow all rotating equipment to stop completely before inspecting or servicing the unit. Failure to do so may result in personal injury or death from electrical shock or moving parts.***

Warning: ***Disconnect all electrical power prior to access into a fan or duct work. Even when locked out electrically, fans may cause injury or damage if the impeller is subject to "windmilling". The impeller should be secured to physically restrict rotational movement. Failure to secure the impeller can cause severe personal injury or death.***

PCM and Unit Controls Trouble Analysis Table

Symptom (s)	Probable Cause (s)	Recommended Action (s)
Unit controls not working.	PCM is not functioning.	See symptom for PCM not working.
	Standard factory program has enabled a software safety interlock (i.e. FANFAIL or LOWTEMP is "ON" or RUN-AUTO/STOP is "OFF").	Reset interlock and determine the reason interlock was ENABLED.
PCM not working.	Unit 120 VAC - 20 amp power source not wired or energized.	Wire, to unit control power panel, the recommended 120 VAC - 20 amp dedicated circuit breaker with good earth ground.
	PCM circuit board ON/OFF switch in the OFF position.	Put the PCM ON/OFF switch to the ON position.
	Control transformer furnishing the PCM board 24 VAC power is failed.	Replace transformer.
LCD/Keypad not working.	LCD/Keypad to PCM interconnecting cable with plug connectors not installed.	Install interconnecting cable.
	LCD/Keypad is failed.	Replace LCD/Keypad.
LCD/Keypad adjustments not working.	Not currently logged on.	Input correct password.
	PCM is in MANUAL mode.	Use laptop computer with compatible PCM Edit Software and place PCM into AUTO/LOCAL or AUTO/REMOTE mode.
Mixed air dampers not working.	Damper linkage is loose.	Tighten damper linkage.
	Damper blade hitting obstruction.	Remove obstruction.
	Damper blade bent.	Replace damper.
	Damper actuator is malfunctioning.	See symptoms for mixed air damper actuator not working.

PCM and Unit Controls Trouble Analysis Table (continued)

Symptom (s)	Probable Cause (s)	Recommended Action (s)
Mixed air dampers actuator not working, 24 VAC power supply not present at the actuator.	Control transformer furnishing the damper actuator 24 VAC is failed.	Replace transformer.
	24 VAC power wiring is broken or shorted.	Repair wiring.
Mixed air dampers actuator not working, 0 to 10 VDC input signal to actuator not present.	0 to 10 VDC input signal wiring broken or shorted.	Repair wiring.
	PCM is in MANUAL mode.	Put PCM in AUTO-LOCAL or AUTO-REMOTE mode.
	AOP Jumper incorrect or missing.	Refer to "As Built" wiring diagram for correct jumper placement.
Mixed air dampers actuator not working, unit operating with outside air damper closed (0 to 10 VDC input signal verified through MANUAL command)	Standard factory program has the unit operating in night setback or morning warm-up mode.	None required.
	Standard factory program mixed air DDC loop has 0% output - Mixed air sensor analog input substantially lower than setpoint.	None required.
Mixed air dampers actuator not working, unit operating with economizer ENABLED, but outside air damper remains at minimum position.	Factory program software interlock enabled due to discharge air sensor or space sensor failure.	Replace failed sensor.
Inlet guide vane not working.	Inlet guide vane linkage is loose.	Tighten inlet guide vane linkage.
	Inlet guide vane linkage hitting on obstruction.	Remove obstruction.
	Inlet guide vane blade bent.	Replace inlet guide vane.
	Inlet guide vane actuator is malfunctioning.	See symptoms for inlet guide vane actuator not working.

PCM and Unit Controls Trouble Analysis Table (continued)

Symptom (s)	Probable Cause (s)	Recommended Action (s)
Inlet guide vane actuator not working, 0 to 10 VDC input signal to actuator not present.	0 to 10 VDC input signal wiring broken or shorted.	Repair wiring.
	PCM is in MANUAL mode.	Put PCM in AUTO-LOCAL or AUTO-REMOTE mode.
	AOP Jumper incorrect or missing.	Refer to "As Built" wiring diagram for correct jumper placement.
Inlet guide vane actuator not working, unit operating with inlet guide vane closed. (0 to 10 VDC input signal verified through MANUAL command)	Standard factory program duct static DDC loop has 0% output - Duct static transmitter analog input substantially over setpoint.	None required. If condition persists, check supply air duct work for obstruction.
	Factory program software interlock enabled due to duct static pressure sensor or 24 VDC power supply failure.	Replace failed sensor or failed 24 VDC power supply.
Cooling valve not working.	Cooling valve not piped per recommended flow arrangement.	Re-pipe valve to recommended flow arrangement.
	Cooling valve seat hitting an obstruction in pipe.	Remove obstruction.
	Cooling valve actuator is malfunctioning.	See symptoms for cooling valve actuator not working.
Cooling valve actuator not working, 24 VAC power supply not present at the actuator.	Control transformer furnishing the cooling valve actuator 24 VAC power is failed.	Replace transformer.
	24 VAC power wiring broken or shorted.	Repair wiring.
Cooling valve actuator not working, 0 to 10 VDC input signal to actuator not present.	0 to 10 VDC input signal wiring broken or shorted.	Repair wiring.
	PCM is in MANUAL mode.	Put PCM in AUTO-LOCAL or AUTO-REMOTE mode.
	AOP Jumper incorrect or missing.	Refer to "As Built" wiring diagram for correct jumper placement.

PCM and Unit Controls Trouble Analysis Table (continued)

Symptom (s)	Probable Cause (s)	Recommended Action (s)
Cooling valve actuator not working, unit operating with cooling valve closed to flow through the coil. (0 to 10 VDC input signal verified through MANUAL command)	Standard factory program cool valve DDC loop has 0% output - Analog input (discharge air or space sensor) substantially over setpoint.	None required.
	Factory program software interlock enabled due to analog input sensor failure.	Replace failed sensor.
	Standard factory program has the unit operating in the purge, coastdown, heat mode or the outside air damper is not open more than 90% with economizer enabled.	None required.
Cooling valve actuator not working, unit operating with cooling valve positioned to 50% of flow through the coil. (0 to 10 VDC input signal verified through MANUAL command.	Variable air volume Tracer or stand-alone standard factory program software interlock enabled due to discharge air sensor failure.	Replace failed sensor.
Heating valve not working.	Heating valve not piped per recommended flow arrangement.	Re-pipe valve to recommended flow arrangement.
	Heating valve seat hitting an obstruction in pipe.	Remove obstruction.
	Heating valve actuator is malfunctioning.	See symptoms for heating valve actuator not working.
Heating valve actuator not working, 24 VAC power supply not present at the actuator.	Control transformer furnishing the heating valve actuator 24 VAC power is failed.	Replace transformer.
	24 VAC power wiring broken or shorted.	Repair wiring.

PCM and Unit Controls Trouble Analysis Table (continued)

Symptom (s)	Probable Cause (s)	Recommended Action (s)
Heating valve actuator not working, 0 to 10 VDC input signal to actuator not present.	0 to 10 VDC input signal wiring broken or shorted.	Repair wiring.
	PCM is in MANUAL mode.	Put PCM in AUTO-LOCAL or AUTO-REMOTE mode.
	AOP Jumper incorrect or missing.	Refer to "As Built" wiring diagram for correct jumper placement.
Heating valve actuator not working, unit operating with heating valve closed to flow through the coil. (0 to 10 VDC input signal verified through manual command.	Standard factory program heat valve DDC loop has 0% output - Analog input (discharge air or space sensor) substantially over setpoint).	None required.
	Factory program software interlock enabled due to analog input sensor failure.	Replace failed sensor.
	Standard factory program has the outside air damper output 10% greater than minimum position or the cooling valve output is greater than 0%.	None required.

CHAPTER 8: APPENDIX

Commonly Used Acronyms

AHU - Air Handling Unit

AIP - Analog Input

AOP - Analog Output

BIP - Binary Input

BMN - Building Management Network

BMS - Building Management System

BOP - Binary Output

CW - Chilled Water (used as CW Valve)

DDC - Direct Digital Control

DIP - Dual In-line Package (used as DIP Switch)

HW - Hot Water (used as HW Valve)

ICS - Integrated Comfort System

IGV - Inlet Guide Vane

I/O - Input/Output

LCD - Liquid Crystal Display

NEMA - National Electrical Manufacturing Association

OA - Outside Air (used as OA Damper)

PC - Personal Computer

PCL - Process Control Language

PCM - Programmable Control Module

RTD - Resistance Temperature Detector

VAV - Variable Air Volume