The purpose of variable air volume (VAV) control is to regulate the air flow to a specific zone to maintain the dry bulb temperature for a desired level of occupant comfort. There are variations of this concept that include reheat, dual duct and fan induction applications.

There is a misconceived trend to oversize terminal units in favor of reducing pressure drops and noise levels. This fallacy has been proven wrong, not only in numerous publications, but over and over again in installations where this concept has been the basis of design. Over sizing of terminal units **is not recommended**.

The key design factor in a VAV system is the control of the supplied air. The terminal unit should be sized to take advantage of as much of its potential capacity as possible. Without this fundamental consideration, the customer has not received the best value for their VAV system design.

PRESSURE DEPENDENT CONTROL — Pressure dependent control represents the basic control of a VAV terminal unit. Pressure dependent controls require field calibration of air flows according to job system conditions. The terminal unit damper is positioned from a signal sent directly from the zone thermostat to the damper actuator without regard for system conditions. The resulting flow at any given moment through the unit is very dependent upon the system conditions at that moment. In a pressure dependent system, two zones on the same system are effected by the control of one another.

Example —

Room A and Room B are two conference rooms. Both are supplied by different VAV terminal units from the same central air supply. Assume that the initial condition has both rooms full of people which establishes a specific cooling load. The room thermostat is satisfied at the current air flow level:

If the people in room A were to disperse and leave the room, the cooling load would decrease and the thermostat would respond by sending a signal to the VAV terminal unit damper actuator to close down the damper and reduce the flow. The result would be an increase in the system static pressure which would increase the amount of air flow to room B. Room B would then start to over-cool until the thermostat sensed this drop in room temperature and reposition the terminal unit damper from room B to reduce the air flow.

PRESSURE INDEPENDENT CONTROL — Pressure independent control involves an additional input to the control of the VAV terminal unit. The pressure independent control options also monitor and respond to the velocity of the air flow, generally at the inlet of the unit.

The terminal unit damper is positioned from a signal sent from the zone thermostat through a velocity reset controller to the damper actuator. The velocity reset controller then responds to changes in the inlet pressure conditions to maintain the required air flow. Pressure independent controls are frequently used for single duct variable volume control. For a given thermostat setting the controller can position the damper further open if the air flow at the inlet is insufficient to meet the requirement or it can position the damper further closed if the inlet air flow is greater than the requirement.

As in the other example —

If the people in room A were to disperse and leave the room, the cooling load would decrease and the thermostat would respond by sending a signal to the VAV terminal unit damper actuator to close down the damper and reduce the air flow. The result would be an increase in the system static pressure which would increase the amount of air flow to the terminal unit serving room B. The terminal unit controller would immediately sense the increased air flow through the inlet sensor and begin to reposition the damper to maintain the required air flow.

Pneumatic and Electronic pressure independent controllers do have their limitations. Selection of air flows must be given careful consideration. The reset controllers respond to an input signal from the differential inlet sensor in the range of 0.0” WC to 1.35” WC which reflects the CFM range of a given terminal unit size. Both pneumatic and electronic controllers cannot accurately control the air flow when the differential pressure signal falls much below 0.03” WC. For this reason, Carnes publishes minimum air flow setting limitations and suggested air flow ranges for each unit size.

Another design consideration when using pressure independent controls is the state of the central system. When the central system is shut down or not supplying adequate air to meet the design requirements, the primary flow control damper can drive open looking to satisfy a minimum air flow condition as long as the controls remain active. This feature can be beneficial by providing open dampers at the start of the morning warm-up cycle. However, it may not be desirable in some fan terminal unit applications. Recirculated air could short circuit and flow back upstream.

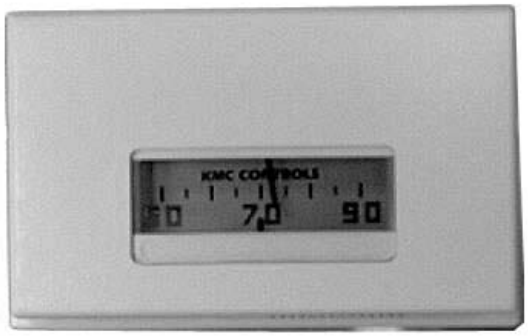
Pneumatically, the terminal unit damper can be configured to fail in the open or closed position on a loss of main control air pressure irregardless of the thermostat action required. Electrically or electronically the damper must be powered and driven to either of those conditions.

CARNES ET ANALOG ELECTRONIC VAV CONTROL

The ET control option consists of a stand alone, pressure independent VAV velocity controller with an integral direct coupled damper actuator. This combination device utilizes an on board air flow sensor which has platinum resistance temperature detectors. Air flow is sensed by the differential pressure (velocity) sensor located at the inlet of the air terminal unit. The ET control option is capable of controlling a velocity set point from 365 to 3000 fpm with an accuracy of 3%. Units may be ordered with a zero (full shut off) minimum setting although this is not recommended for units with reheat capability. For minimum and maximum CFM range by unit size refer to the selection procedure for each model.

The ET controller/actuator combination is used with the AXWCA, AXWCB, and AXWCC series room thermostats. The minimum and maximum air flow settings are field calibrated on the corresponding AXW wall thermostat. The integral actuator has adjustable end stops, magnetic clutch and a gear disengagement button to allow manual positioning of the damper. A tri-color LED indicates green for opening, red for closing, and white for satisfied damper positions. Units with ET control option are shipped with the damper in the open position.

ET CONTROLLER/ACTUATOR



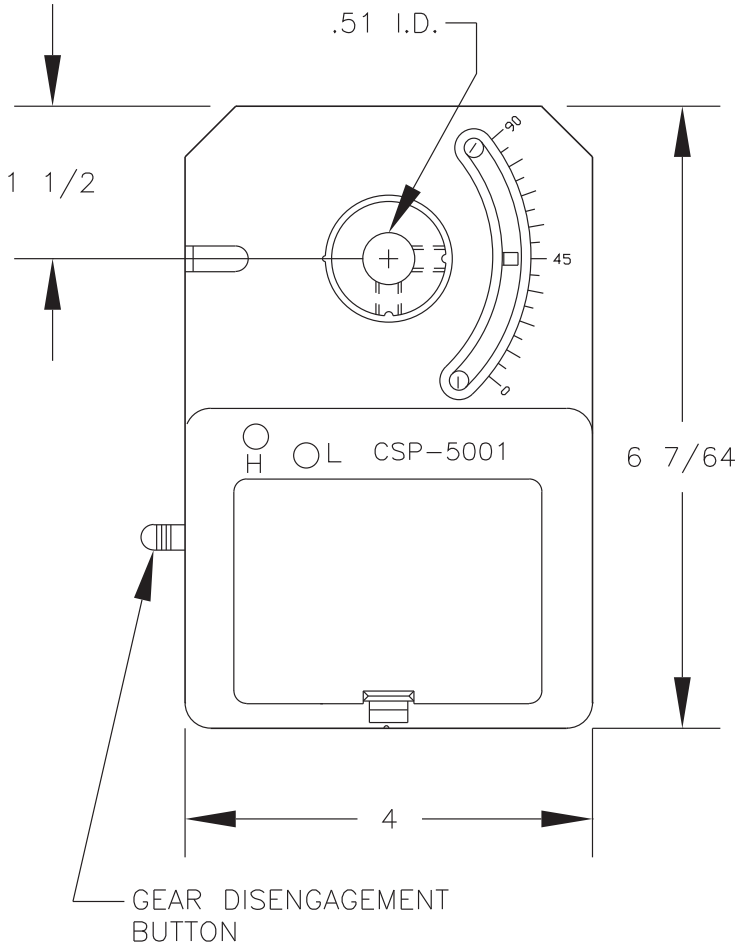
AXW ROOM THERMOSTAT

ELECTRONIC ET CONTROL AVAILABILITY

The table below indicates unit types that are available with the Carnes ET Electronic pressure independent controls. Component descriptions, wiring diagrams and control sequences are shown on the following pages. Contact factory for applications not shown.

ET CONTROL OPTION DESCRIPTION	SINGLE DUCT UNITS					DUAL DUCT	RETROFIT	FAN UNITS	
	AVC	AVW	AVE	ABB	ABW	ADCD ADCC	ARR	AS	AC
PRESSURE INDEPENDENT ELECTRONIC ANALOG VAV CONTROL, WITH INTEGRAL DAMPER ACTUATOR	X	X	X	X	X		X	X	X

CARNES ET ANALOG ELECTRONIC VAV CONTROLLER WITH INTEGRAL ACTUATOR

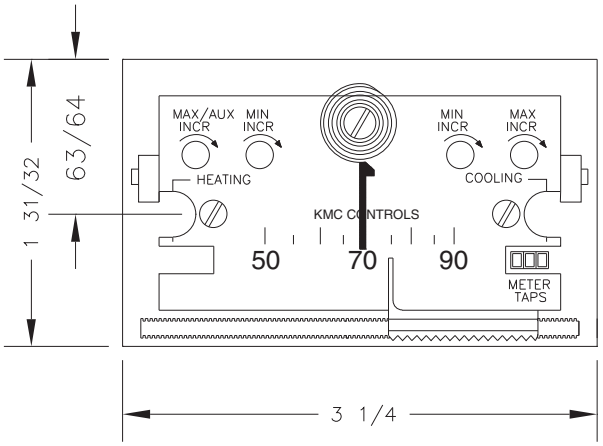


SPECIFICATIONS

Supply Voltage	24 VAC, -15%/+20%, 50/60 Hz
Input Power	4 VA
Output Supply	16 VDC (22 mA)
Output Torque	50 in. lb. min., 70 in. lb. max. (5.6 Nm min., 7.9 Nm max.)
Velocity Range	0 to 3,300 fpm (16.76 m/s), dependent on ΔP pick-up, tubing size/length and connections
Velocity Output	0 to 10 VDC (0 to 100% flow) VNOM adj. to box size
Reset Voltage	0 to 10 VDC
Reset Limits	Adjustable 0 to 100%
Connections	Wire clamp type; 14 to 22 AWG

Angular Rotation	0 to 95°, both end stops adjustable
Stroke Time	18°/minute @ 60 Hz. 15°/minute @ 50 Hz.
Mounting	Direct to 1/2" (13mm) diameter shaft or 3/8" (10mm) diameter with adaptor
Material	Flame retardant polymer; UL94-5V plenum rated; blue housing with white cover
Weight	2.4 lb. (1 kg)
Ambient Limits	
Operating	32°F to 120°F (0°C to 49°C)
Shipping	-40°F to 140°F (-40°C to 60°C)

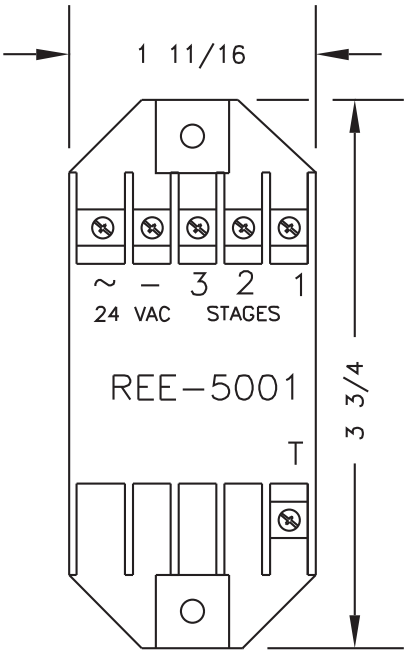
CARNES AXW SERIES ELECTRONIC THERMOSTATS



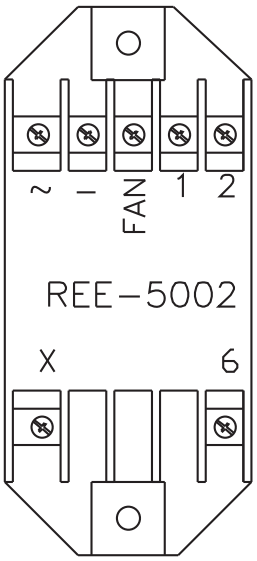
SPECIFICATIONS

Supply Voltage	16 VDC (14-20 VDC)
Output Range	0-10 VDC
Connections	Wire clamp type; 14-22 AWG
Temperature Range	55°F to 85°F (13°C to 29°C)
Proportional Band	
AXWCA, AXWCB	2°F (1.1°C) w/limits output (T1/T2) 4°F (2.2°C) w/o limits output (T3/T4)
AXWCC	2°F (1.1°C) w/ and w/o limits outputs (T1/T2/T3)
Thermostat Action and Part Numbers	
AXWCA	Direct Acting (DA) T1/T3
AXWCB	Direct Acting (DA) T1/T3 Reverse Acting (RA) T2/T4
AXWCC	Direct Acting (DA) T1/T3 Reverse Acting (RA) T2
Base Material	Blank ABS
Size	2-9/16" (65mm) x 3-7/16" (87mm)
Ambient Limits	
Operating	40°F to 120°F (4.5°C to 49°C)
Shipping	-40°F to 140°F (-40°C to 60°C)

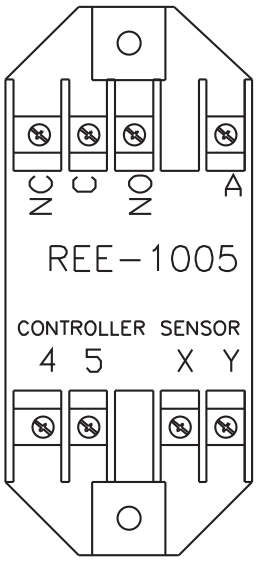
ELECTRONIC RELAY MODULES



3-STAGE REHEAT
REE-5001
999-2671



FAN POWERED WITH 2 STAGE REHEAT
REE-5002
999-2672



HEATING/COOLING CHANGEOVER
REE-1005
999-2665