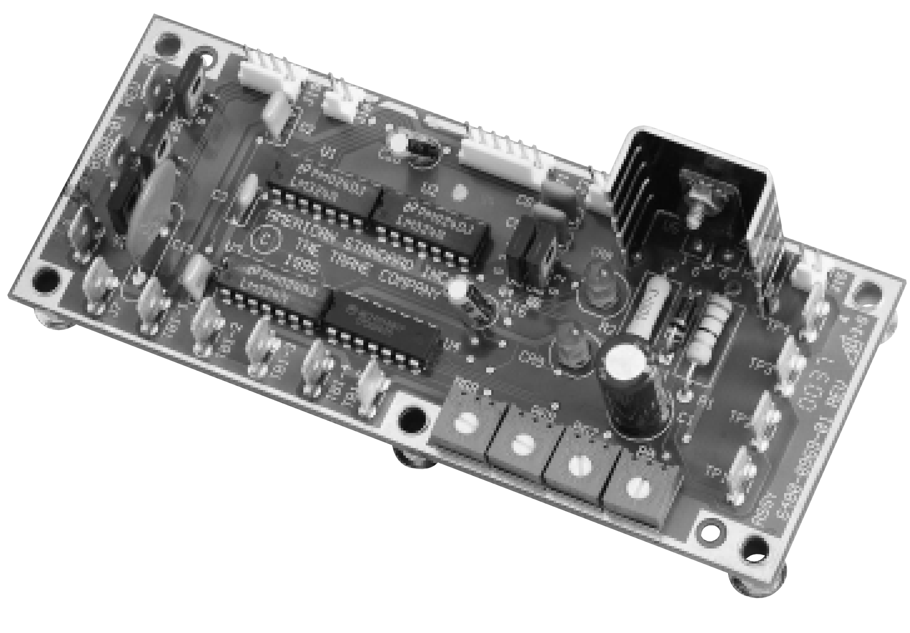
Installation/ Owner Programming

VariTrane™ Analog Electronic Controls



For use with:
Single-Duct Cooling & Reheat Units
Parallel & Series Fan-Powered Units
Low-Height Parallel & Series Fan-Powered Units

November 2001 VAV-SVX03A-EN

Contents

General Information

Literature Contents

This manual describes the operation, calibration and set-up of VariTrane VAV Single-Duct and Fan-powered units with Analog Electronic Controls.

Receiving and Handling

VariTrane units are shipped completely assembled with the exception of filters and accessories. Upon receiving, please inspect each unit and the components for shipping damage.

After receiving the units, complete the following:

- Locate the nameplate and model number and check that the correct units have been received.
- Inspect the control units and air damper casing for dents or punctures.
- Verify that all options have been included, such as filters, controls, heating coils, water valves, etc. Also check that unit voltages agree with the building parameters.
- Manually rotate the fan (if applicable) to assure that there are no obstructions within the housing.
- Claims for in-transit damage must be filed immediately with the delivery carrier.
- For re-heat units, check the coil fins and make sure the coils are not damaged.
- Locate and verify that the correct zone sensors are with the order. These will be marked with an orange “Accessories Enclosed” label. Store in a secure place until needed. Accessories lost at a jobsite are NOT covered by Trane’s warranty.
- If a discrepancy occurs between what was ordered and what is received, contact your local Trane representative immediately.
- Read the appropriate section in this manual for installation procedures prior to actual starting of installation.

NOTICE:

Warnings and Cautions appear at appropriate sections throughout this manual. Read these carefully.

⚠ WARNING — Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION — Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION:— May also be used to alert reader to a situation that could result in equipment or property only damage.

Unit Information

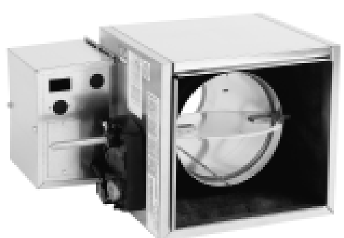
Unit Type Description

Analog Electronic VariTrane units use an electronically-controlled air damper for primary air modulation. The unit types available are single-duct units (VCCF, VCWF, VCEF), series fan-powered units (VSCF, VSWF, VSEF), parallel fan-powered units, (VPCF, VPWF, VPEF) and low-height fan-powered units (LSCF, LSWF, LSEF, LPCF, LPWF, LPEF).

Single-Duct Units

The basic unit consists of an air damper mounted in a sheet metal casing, which is used to control the volume of air introduced to the occupied zone. The unit is designed to modulate either cooling or heating air. The basic cooling-only unit can be equipped with reheat coils located at the discharge of the unit. Standard choices include an electric coil with up to three stages of heat or a hot-water coil.

Figure 1 – Typical Single-Duct Units



VCCF

VCWF

VCEF

Fan-Powered Units

VariTrane fan-powered units can be either parallel or series, with or without re-heat. See Figure 2.

Note: Low-Height is similar to the series and parallel fan-powered units. All series and parallel references from this point on will also include Low-Height unless noted.

The fan on a series unit runs continuously whenever the main air-handler unit is in operation. There are various options for starting the fan. The fan can be started three ways: 1) remotely, 2) by a duct-pressure switch, or 3) by a combination of both. The particular fan control method will vary from unit to unit, depending upon job needs.

Typically, the re-heat is off while the air damper modulates primary air and responds to zone temperature. If zone temperature decreases to the point where a decrease in primary air will not maintain the desired temperature, the re-heat will be activated to increase the temperature of the discharge air.

On a parallel unit, the VariTrane air damper delivers primary cooling air to the unit outlet. When the space temperature decreases beyond air damper control, the fan is turned on as the first stage of heat. The fan delivers plenum air from above the occupied space to the unit outlet, which is mixed with primary air and delivered to the occupied space.

Note: Either the fan, the air damper or both can deliver airflow into the occupied space. In order to prevent primary airflow from exiting through the fan when the fan is not running on a parallel unit, a back-draft damper is provided. When the fan is not running, the efficiency of this system is the same as a standard single duct VAV unit.

Typically, the control systems applied to parallel units cause the air damper to close to zero or a minimum flow before the fan is activated. After the fan is activated, the heat will be activated upon further reduction in zone temperature. Therefore, little primary air is mixed with the heated air.

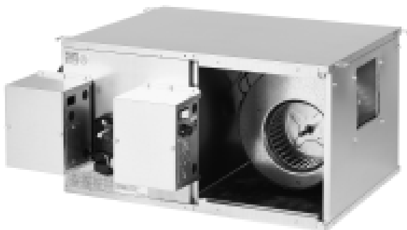
Fan-powered units are available with rectangular discharge connection only. Either straight flange or slip and drive is available with electric heat. The electric heater is mounted on the discharge of the unit. Hot water coils are connected to the plenum inlet on parallel units, and to the discharge of series units.

Table 1 – Maximum Fan Motor Amperage (FLA)

Fan Size	HP	115 VAC	277 VAC	347 VAC	208 VAC
Series/Parallel 01	1/8	1.6	0.7	0.7	—
Series/Parallel 02	1/8	1.6	0.7	0.7	—
Series/Parallel 03	1/3	5.4	1.8	1.5	—
Series/Parallel 04	1/3	5.4	1.8	1.5	—
Series/Parallel 05	1/2	7.6	2.6	2.1	—
Series/Parallel 06	1/2	—	3.8	3.8	6.3
Series/Parallel 07	1	—	4.7	3.6	6.9
Low Height 08	1/8	4.7	1.76	1.52	—
Low Height 09	2 x 1/8	2 x 2.1	2 x 0.79	2 x 0.62	—
Low Height 10	2 x 1/8	2 x 4.7	2 x 1.76	2 x 1.52	—

Unit Information

Figure 2 – Typical Fan-Powered Units



VSCF

VSWF

VSEF

VPCF

VPWF

VPEF

Analog Controls

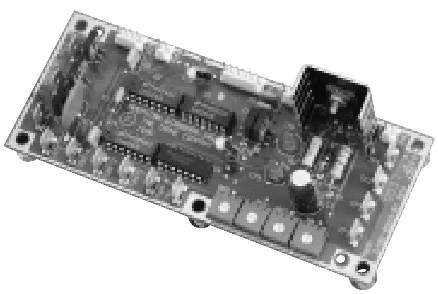
General

Electronic control systems offer pressure-independent operation for use on all single-duct and fan-powered VAV units (see Figure 3).

The electric air damper used with this control system has a stroke time (from open to close) of 90 seconds.

The pressure-independent system will control room temperature by adjusting airflow into the space as a function of zone temperature.

Figure 3 –Electronic Interface Circuit Boards



Electrical Data

INPUT:

24 VAC, 50 VA maximum

OUTPUT:

1st Stage – 24 VAC, 10 VA magnetic contactors/12 VA mercury contactors
2nd Stage – 24 VAC, 10 VA magnetic contactors/12 VA mercury contactors
3rd Stage – 24 VAC, 10 VA magnetic contactors/12 VA mercury contactors

Cfm Requirements

Control Type	Unit Size	Maximum Cfm Flow Setting	Minimum Cfm Flow Setting	Minimum Heating Cfm Flow Setting (VCEF Only)
Analog Electronic	4	38-225	0,38-225	45-225
	5	63-350	0,63-350	70-350
	6	73-500	0,73-500	100-500
	8	134-900	0,134-900	180-900
	10	215-1400	0,215-1400	280-1400
	12	300-2000	0,300-2000	400-2000
	14	408-2890	0,408-2890	578-2890
	16	536-3790	0,536-3790	758-3790
	24x16	1096-8000	0,1096-8000	1600-8000

Notes:
1. Minimum flow and maximum flow settings must have at least a 0.05 Delta P flow sensor signal difference.
2. Flow rings are provided with all unit sizes.
3. A minimum setting of zero is permissible, except for VCEF units.

⚠ WARNING

Hazardous Voltage!

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.

Electronic Controls Installation

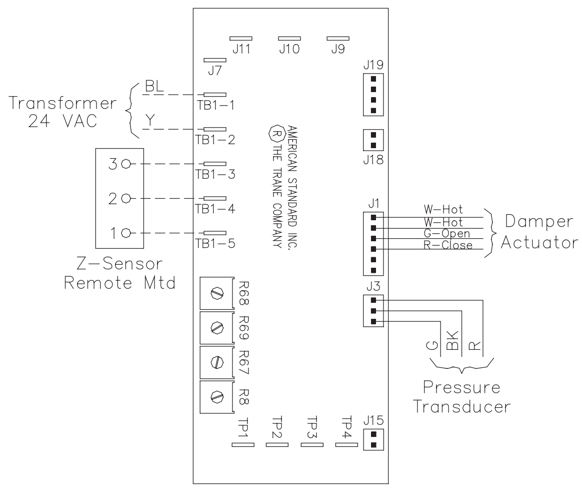
Check the wiring on the unit with the wiring diagram and wiring information label. Insure that all jumpers are to the proper location and that the actual unit wiring matches the wiring diagram and wiring label information. See Figure 4.

Units with electronic control options must use Trane zone sensors to be compatible with the unit circuitry. **The analog zone sensor electronics are designed specifically to operate with the Trane electronic controls; other zone sensors will not work properly with this unit. The Trane analog zone sensor must be used in conjunction with these electronic controls.** Typically, field controls wiring include the following:

1. 24 VAC-powered connection to terminals TB1-1 and TB1-2. These are stab terminals marked one and two on the five-pole terminal strip located in the corner of the circuit card.
2. Zone sensor connections are to TB1-3,4,5.
3. Heater contact wiring is normally installed in the factory. Should field installation be required, each wiring diagram shows the field alternate wiring requirements.

Analog Controls

Figure 4 – Typical Analog Electronic Control Wiring Diagram



CAUTION:

Avoid Wiring Errors!

It is important to connect power and zone sensor control voltage wiring to the proper terminals since improper connection will cause failure of the circuit board. To help prevent errors, the 24 VAC power to circuit board zone sensor connections are labeled.

Minimum and Maximum Potentiometers Adjustments

The minimum and maximum flow (or position) setpoints may require field setting to obtain desired cfm settings. Refer to the calibration section of this manual for proper adjustment procedures.

On single-duct boxes where transformers are optional, the transformer must be NEC Class 2, energy-limiting, 24VAC. Refer to electrical data for proper sizing.

⚠ WARNING

Hazardous Voltage!

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury. Prior to replacing the zone sensor, follow warning instructions above.

Zone Sensor Wiring

Each unit must be controlled by a wall- or unit-mounted zone sensor which is designed specifically for use with a solid-state circuit board that is provided by the factory.

Two types of zone sensors are available with analog electronic controls. One has the thumbwheel visible, while the other is hidden by the cover.

NOTE: Analog electronic zone sensors are not interchangeable with DDC zone sensors.

The three wires required for the wall zone sensor to the terminal block are to be furnished and completed by the installer.

If local codes require enclosed conductors, the zone sensor wires should be installed in conduit. Do not route zone sensor wires in conduit with 24-volt or any high-powered conducting wires. This will cause electrical noise and result in erratic operation of the controls.

CAUTION:

Circuit Board Damage!

Before handling the circuit board, discharge any static electricity you may have accumulated by touching the unit casing. Static charges produce voltages high enough to damage the electronic components.

Location and Installation

A zone sensor in each control zone should be located in the most critical area of the zone. Sensors should not be installed in direct sunlight or in the area's supply air stream. Subdivision of the zone may be necessary for adequate control and comfort.

Avoid installing zone sensors in areas subject to the following:

- Drafts or "dead spots" behind doors or corners.
- Hot or cold air ducts.
- Radiant heat from the sun or appliances.
- Concealed pipes or chimneys.
- Unheated or uncooled surfaces behind the sensor such as outside walls.
- Air flows from adjacent zones or other units.

Sequence of Operation

Single-Duct Units

The air damper is controlled between minimum and maximum flow setpoints proportionally. When the zone temperature is approximately 0.5°F above the setpoint, the air damper will begin to modulate to a maximum position, providing more cool air to the zone until the zone temperature reaches the zone setpoint. Once satisfied, the air damper will start to modulate to the minimum position. When the zone temperature is 0.5°F below the setpoint, the damper begins to modulate to a minimum position. When the damper is at the cooling minimum and the zone temperature is still below setpoint (cold), up to three stages of heat may be energized on a reheat unit. The first stage is activated at approximately 2°F below the setpoint, the second stage is activated approximately 3°F below the setpoint, and the third stage is activated approximately 4°F below the setpoint.

Series Fan-Powered Untis

The series fan-powered unit is a constant volume, variable temperature device. The fan is energized whenever the zone is occupied. It delivers design cfm regardless of the load. The air damper controls primary air proportionally between minimum and maximum flow setpoints. When the zone temperature is approximately 0.5°F above setpoint, the air damper will begin to modulate to a maximum position, providing more cool air and less plenum air to the zone until the zone temperature reaches the zone setpoint. When zone temperature is 0.5°F below the setpoint, the damper begins to modulate to its minimum position, supplying less cold air and more warm plenum air. When the air damper is at minimum and zone temperature is still below setpoint (cold), up to two additional stages of electric heat may be energized. On an electric reheat unit, the first stage is activated approximately 2°F below the setpoint. The second stage is activated approximately 3°F below the setpoint. On Hot Water Reheat just one stage of heat, in addition to the fan, will be activated approximately 2°F below the setpoint.

Parallel Fan-Powered Units

The parallel fan-powered unit is a variable-volume, constant-temperature device at high cooling loads and a constant-volume, variable-temperature device at low cooling and heating loads. The air damper controls primary air proportionally between minimum and maximum flow setpoints. When the zone temperature is approximately 0.5°F above setpoint, the air damper will begin to modulate to a maximum position, providing more cool air and less plenum air to the zone until the zone temperature reaches the zone setpoint. When the zone temperature is approximately 0.5°F below the setpoint, the damper will begin to modulate to a minimum position, reducing the cooling capacity. If the cooling capacity is reduced and zone temperature is still below the heating setpoint, the fan will be energized at approximately 2°F below the cooling setpoint acting as the first stage of heat. The second stage of heat (electric or hot water) is activated at approximately 3°F below the cooling setpoint and the third stage (electric) is activated at approximately 4°F below the cooling setpoint.

Control Options

CONTROL OPTIONS

Constant Volume

With this feature, when jack J15 Pin A is connected to Pin B, the electronics will cause the airflow to go to the maximum setting and stay there. The influence of the thermostat is removed and maximum flow is maintained at all times. The operation of the three reheat relays is unaffected. Connecting Pins A and B of jack J15 will only affect the signal which goes into the section of the electronics which controls the air damper movement. The maximum flow option is obtained by saturating the temperature voltage signal so that the maximum limit is always sent on to the section of the electronics, which compares the temperature voltage to the flow voltage.

Auto Dual Minimum

The auto dual minimum enables the unit to change the minimum automatically without an outside signal. The minimum changes when the first stage relay is activated. The electronics have been designed so that when jack J18 Pins A and B are connected together, Minimum B (Potentiometer R69) will control whenever the first relay stage activated. Therefore, no matter what minimum was in control before the relay stage was activated, after being activated, Minimum B (R69) will be the determining minimum flow. This option can be used effectively with fan-powered units where a minimum flow is set as the damper modulates and when the first stage comes on, the air damper is then closed. In this manner, airflow to the space is never interrupted; however, the energy associated with maintaining a minimum air damper airflow at all times is saved.

Calibration

The following tools are required to properly adjust and calibrate the electronic controls:

- Digital voltmeter
- 0-2 in. wg magnehelic gage (or inclined manometer)
- Tubing and fitting to connect gage to flow ring tees (5/32" and 1/4" tubing).
- Mechanical tools (screwdriver, pliers, etc.)

⚠ WARNING

Hazardous Voltage!

Certain tests or calibration procedures described in this section may involve working in close proximity to live electrical terminals. Only qualified and licensed electrician or other properly trained in electrical safety when working with live voltage should perform these procedures. Failure to follow all electrical safety precautions when exposed to live terminal could result in death or serious injury.

Transducer Operation

This section discusses how airflow through the damper is transformed into a voltage signal that can be used by the controller. The first transition from flow to voltage occurs at the Trane flow ring, where a delta P signal is generated as a function of airflow through the unit. The delta P signal consists of a high-pressure signal from a total-pressure tap of the airflow ring and a low-pressure signal from the wake-pressure side of the flow ring.

The transducer converts the pressure differential signal to an output voltage. The output of the transducer with no flow or zero delta P is .250 volts DC (+ .100). As flow increases, the delta P signal increases; therefore, the output voltage of the transducer increases. The gain of the transducer is 0.75 volts per inch of delta P.

Null Voltage

The tolerance for the output voltage of the transducer with zero delta P signal from the flow ring is referred to as the null voltage of the transducer. The transducer has three wires leading from it to the control board. The wires include a common (green wire), an input (red wire), and an output (black wire). The input (supply) voltage to the transducer is 5 volts (+ .5). The acceptable voltage range of the output voltage with zero flow (between black and green) can range from .100 volts to .400 volts. To allow the controllers to coordinate with the transducer voltage, internal calibration is necessary. To accomplish this, potentiometer R8 (zero flow adjustment) is used. The flow voltage signal should be 4.8 volts at test points #1 and #3 of the test point terminals (next to R8) with zero delta P applied. R8 is used to adjust the flow voltage to 4.8 volts when zero delta P is applied to the transducer. In this manner, variability of the null point of the transducer is compensated for. The importance of this becomes evident when minimum and maximum flows are discussed.

PROCEDURE FOR MAXIMUM AND MINIMUM CALIBRATION

Initialization

1. Monitor thermostat voltage and check it by rotating the thermostat to full heating and full cooling.
    a. Connect a voltmeter to TB1-4 (+) and TB1-3 (-).
    b. Rotate the thermostat fully clockwise (full heating). Observe the voltage. It should be less than or equal to 5.4 volts DC.
    c. Rotate the thermostat fully counter-clockwise (full cooling); voltage should go up to 6.3 volts DC or greater.
2. Set the min/max pots as follows:
    a. Rotate the max pot (R67) full clockwise.
    b. Rotate min A (R68) full counter-clockwise
    c. Rotate min B (R69) full counter-clockwise
3. With both of the transducer ports open to ambient (0 delta P), read the output voltage at TP4. (Ground is either TP3, TB1-2, or TB1-3.) The value of the null transducer voltage output must be between 0.1 and 0.4 volts DC. Nominal is .250 volts DC.
4. Monitor TP1 (+) voltage (zero flow adjustment) and adjust R8 until 4.8 volts DC + .010 volts is read at TP1.

Set Maximum Flow

Set the thermostat knob to the full-cool position (fully counter-clockwise) thermostat voltage should go over 6.2V DC. Connect a pressure gage teed into the high- and low-port flow ring of the transducer and input the maximum delta P. Refer to the flow vs. delta P chart on the unit to obtain the proper delta P signal desired. Adjust the max pot (R67) so that both the amber and green lights are out, this indicates that equilibrium has been established with the delta P input to the transducer.

Calibration

Set Minimum Flow(s)

In this section, two procedures for setting minimums will be discussed.

No Dual Minimum

Adjust the thermostat knob to the full-heat position (full clockwise). Monitor the delta P of the transducer with a pressure gage (high port first and low port). Refer to the calibration label on the side of the unit, which relates CFM to delta P. Adjust R68 (minimum A) so that both the red and green lights are out at the desired minimum flow delta P. If the minimum setting is to be zero flow, then leave the minimum pot (R68) full counter-clockwise so that the red light remains on even when no delta P is applied to the transducer. This will ensure that the unit will always go to closed when minimum is desired.

Auto Dual Minimum

Place jumper on J18-A to B.

The heating minimum is the minimum at which the damper is controlled to when the fan on a fan-powered unit is activated or when the first relay is activated on a reheat unit.

Set the thermostat to the full-heat position (full clockwise).

Adjust minimum potentiometer R69 (Minimum B) to desired heating minimum. If this setting is to be zero, leave the potentiometer fully counter-clockwise so that the amber light remains on with no delta P applied to the transducer.

Remove the jumper from J18-A to J18-B. This puts the unit into the mode where minimum A is now in control (cooling minimum).

Adjust R68 (Minimum A) when both lights are off when the condition is satisfactory. If zero minimum is desired, leave pot R68 full counter-clockwise so that the amber light is on continuously with zero delta P applied to the transducer.

Replace J18 jumper.

Balancing

The following tools are required to properly adjust and calibrate the electronic controls:

- Digital voltmeter
- 0 to 2 in. wg magnehelic gage
- Tubing and fitting to connect gage to flow ring tees.
- Mechanical tools i.e. screwdriver, pliers, etc.

Balancing Procedure

1. Check the 24-volts AC supply voltage to the circuit card, terminals TB1-1 to TB1-2. Acceptable range = 21.6 to 26.4 volts AC.
2. Check the 12-volts DC power supply of the circuit card terminals TB1-5 (+) to TB1-3 (-). Acceptable range = 11.6 to 12.4 volts DC.
3. Install the magnehelic gage to observe delta P. When connecting to the test tees, be careful not to create an excessively low pressure on the transducer (when used). The following procedure should be followed:
    a. Remove low-pressure cap from test tee.
    b. Remove high-pressure cap from test tee.
    c. Connect gage to high-pressure side.
    d. Connect gage to low-pressure side.

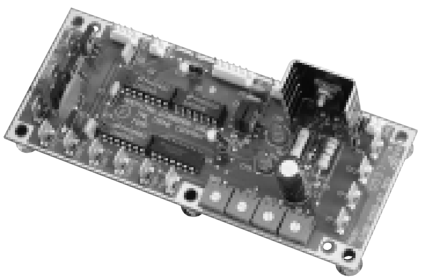
Adjustments (Set Maximum and Minimum Flows)

To set minimum and maximum flows to the desired setting, refer to the calibration section.

Installation and Wiring

The general layout of the analog circuit board is shown in Figure 5. The layout of the circuit card shows the physical location of each item. Basic connections are as follows (see Figure 4, page 7):

Figure 5 – Analog Electronic Controller



1. Power is connected to TB1-1 and TB1-2. The power requirement is 24 volts AC (+ 10%).
2. The zone sensor is connected to terminals TB1-3, 4, and 5. It is very important not to connect power to these terminals, since applying power to the wrong terminal will destroy the card.
3. The motor is connected via jack J1.
4. The transducer (pressure-independent) is connected at jack J3.
5. Reheat stages (or fan on fan-powered units) are connected at jacks J7 (24 VAC), J9, J10, and J11.
6. Various options to cause changes to the operation of unit are input at jack J15.
7. There are various adjustments on the circuit card as discussed in detail in the Calibration section.
   a. Maximum flow (or position) adjustment is R67. Turning clockwise increases the maximum flow.
   b. There are two minimum flow adjustments labeled R68 and R69. Turning clockwise increases the minimum flow.
   c. There is a zero-flow adjustment used in initial calibration and set-up of the circuit card. This is R8.
8. There are four test points for the convenience of servicing in the field. These test points include:

- TP4: Transducer output
- TP1: Flow voltage (null calibration)
- TP2: Temperature voltage
- TP3: A common to make application of clip leads easy.

Zone Sensor

Zone Sensor Operation

This section explains how the zone sensor operates.

Temperature is sensed using a thermistor. The thermistor changes resistance with a change in temperature. The resistance of a thermistor decreases as temperature increases. By using a voltage divider circuit, the deviation from the room setpoint is determined.

1. 12-volts DC is supplied from TB1-5 on the circuit card to terminal 1 on the zone sensor.
2. The zone sensor output signal is connected from terminal 2 of the zone sensor to TB1-4 on the circuit card.
3. A common (ground) is supplied from TB1-3 on the circuit card to terminal 3 on the zone sensor. At setpoint, the input to the circuit card is 6 volts measured across terminals 2 and 3. Therefore, with 12 volts input between terminals 1 and 3, the voltage drop across the thermistor will equal the voltage drop between terminal 2 and terminal 3. With the voltages being equal, the room temperature is considered satisfied and all output relays are de-energized. If the temperature in the zone goes up, the resistance of the thermistor will go down, causing a voltage increase, which will drive the air damper open. Conversely, if the room temperature goes down, the thermistor resistance goes up, causing a decrease in the output signal, which will drive the air damper to minimum and energize the relay output. To determine the setpoint, the setpoint potentiometer is moved, changing the resistance between terminals 2 and 3. By changing the setpoint potentiometer, the temperature at which the output signal equals 6 volts will be changed. Therefore, the setpoint potentiometer moves the setpoint up and down.

Degrees Fahrenheit	Thermistor Nominal Resistance (Ohms)
65	4070
66	3960
67	3850
68	3750
69	3660
70	3580
71	3500
72	3420
73	3330
74	3250
75	3170
76	3080
77	3000
78	2940
79	2870
80	2810

Troubleshooting

Symptom	Probable Cause	Recommended Action
Fan not running	Faulty connection	Check wiring diagrams and inspect all connections.
	Incorrect voltage input	Compare actual voltage with supply requirement.
	Faulty fan motor	Check motor and power to the fan motor. If power is present and fan does not run, replace the motor.
Fan motor noise	Incorrect voltage input	Compare actual voltage input with supply requirement.
	Loose fan wheel	Adjust and tighten fan wheel
Low cfm to unit	Supply fan not providing adequate cfm	Adjust supply fan speed. Check for proper rotation.
	Leaky duct work	Repair leak.
	Dirty Filters	Replace air filters
Improper cfm to zone	Debris is jamming valve	Clear valve damper travel.
	Damage to valve casing	Repair casing or replace valve.
	Improper wiring	Check unit diagrams for correct connection.
	Faulty circuit board	Check and replace if necessary.
	Faulty valve motor	Check and replace if necessary.
	cfm setting incorrect	Recalibrate circuit board.
Incorrect air temperature delivered to the zone	Incorrect wiring to reheat coil	Check and replace if necessary. Compare wiring with diagram on unit.
	Faulty zone sensor	Check for correct zone sensor resistance.
	Faulty circuit board	Recalibrate and replace if necessary.
	Incorrect supply air temperature	Check leaving air temperature from air handling unit.
Coils do not engage on Call for heat	Faulty relay or Triac	Check for voltage to heating coil and relay(s). Verify supply voltage matches coil voltage.
	Board not calibrated	Calibrate.
Room temperature differs from reading on zone Sensor (PI)	Erratic zone sensor	Check zone sensor voltage 12-volts DC between terminals 1 and 3. Check DC voltage at zone sensor terminal 2 and 3 (6 volts DC). Turn zone sensor to full heating voltage; it should be equal to or less than 5.4 volts DC. Turn zone sensor to full cooling voltage should be equal to or greater than 6.5 volts DC. If DC voltage is not attainable, replace the zone sensor.
	Zone sensor miscalibrated.	Check calibration of zone sensor. See also calibration section.

Tools and Equipment

When repairing a VariTrane product (analog control), it is important to have the necessary tools and instruments.

1. 0-2" magnehelic gauge with fittings for two ¼" outside diameter (OD) tubing
2. Voltmeter
3. Four jumper leads
4. Small screwdriver 1/8" blade

⚠ WARNING

Hazardous Voltage!

Certain tests or calibration procedures described in this section may involve working in close proximity to live electrical terminals. Only qualified and licensed electrician or other properly trained in electrical safety when working with live voltage should perform these procedures. Failure to follow all electrical safety precautions when exposed to live terminal could result in death or serious injury.

Troubleshooting

System Check

Improper room control may be caused by areas other than the VAV boxes. Before replacing the air damper or control box, make sure that the entire system is operating properly and is supplying sufficient air to the damper. Complete the following checks.

1. Look for obvious leaks in the duct system. Assure that sufficient static pressure is present at the air Damper.
2. Inspect the supply fan and VAV fan filters. Clean or replace, if necessary.
3. Check zone sensor location, outside wall, appliances, direct sunlight or the supply air stream may be artificially heating or cooling the zone sensor.
4. Evaluate diffuser should have 15" of flat ceiling surface on either side of the slot to assure proper air distribution. Check that airflow from grills or diffusers is properly balanced.
5. For accurate flow control, there must be at least two duct diameters of straight ductwork before the air damper inlet. Electric coils require four feet of straight ductwork downstream of the coil.
6. Compare voltage requirements, as specified on the side of unit with actual voltage supplied to the unit. The control voltage requirement is 24-volts AC + 10%.

Air Damper and Motor Check

If problems occur with damper actuation, perform the following steps:

1. Visually inspect the damper for loose gaskets, casing damage, or restriction to damper travel.

⚠ WARNING

Hazardous Voltage!

Certain tests or calibration procedures described in this section may involve working in close proximity to live electrical terminals. Only qualified and licensed electrician or other properly trained in electrical safety when working with live voltage should perform these procedures. Failure to follow all electrical safety precautions when exposed to live terminal could result in death or serious injury.

2. Be sure that there is proper voltage supplied by checking for 24 volts at terminal 1 and 2 on the circuit board. Acceptable voltage range is 21.6 to 26.4-volts AC.
3. To open the damper, apply 24-volts AC to the white and green wires on the motor plug coming from the actuator. The drive takes a maximum of 90 seconds to fully open.
4. To close the damper, apply 24-volts AC to the white and red wires on the motor plug coming from the actuator.
5. If the motor fails to operate from a direct 24-volts AC power source, and there is neither binding nor obstructions, then the actuator is defective and should be replaced.

Control Check

⚠ WARNING

Hazardous Voltage!

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.

1. Disconnect power source and remove zone sensor wires 3, 4, and 5. Be sure to mark the wires so that they will be correctly replaced.
2. Reconnect power to the unit. The damper should move to its minimum or fully closed position.
3. Jumper terminals 4 and 5. The green LED should light. This should cause the damper to move fully open or to its maximum flow setting.
4. Disconnect the jumper from terminals 4 and 5.
5. Jumper terminals 3 and 4. The amber LED should light. The damper should close to minimum and the relays (or reheat) should energize.
6. Remove Jumper terminals 3 and 4.
7. If everything operates correctly, disconnect power and reconnect all wires. Check the air damper or zone sensor for further trouble analysis.

Zone Sensor Check

To troubleshoot the zone sensor, make sure that 24 volts are available at the control unit board and then complete the following procedure:

1. Move the zone sensor to full cooling. The damper should open completely. If the action is reverse, check the proper zone sensor connection.
2. Rotate the zone sensor knob to full heat. This should cause the damper to close and fan to come on. When the room setpoint is above the actual room temperature, stages of heat will be energized, if enabled.
3. If the zone sensor does not operate at all, check the wiring from the board to the sensor. Reference the zone sensor section.
4. Check DC voltage at zone sensor terminals 2 and 3 (6-volts DC). Turn the zone sensor to full heating voltage; it should be equal to or less than 5.4-volts DC. Turn the zone sensor to full cooling; voltage should be equal to or greater than 6.5-volts DC.

Heater Contactor Check

To troubleshoot heater contacts on units with electric reheat, complete the following procedure:

1. Disconnect power source.

⚠ WARNING

Hazardous Voltage!

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.

2. Disconnect wires from the contactor.
3. Connect an ohmmeter to the contacts.
4. Apply 24 volts (from independent power supply) to the coil of relays. Check for contact closure. If the contact does not close, replace the contactors.

TRANE

Troubleshooting

Fan Motor Check

To troubleshoot the fan motor, complete the following procedure:

1. Disconnect the power, check all wiring diagrams provided on the unit.
2. Turn the power back on. Operate the zone sensor to see if the proper voltage is being supplied to the motor relay. If the motor does not start, check the capacitor and fan motor.
3. Check the motor relay by attaching a voltmeter across the 24-volt coil of the relay. For parallel fan-powered, operate the zone sensor to energize the fan and confirm the voltage to the relay is turned on. Check for supply voltage between the common and hot side of the relay.
4. Attach a Voltmeter to the white common wire on the terminal block and the blue, black or red wires from the fan motor. If line voltage is present, check for fan obstruction.
5. With the power off, spin the fan wheel. If it does not run freely, check shaft alignment or housing clearances.

Circuit Board Check

1. Remove the control box cover. Inspect all wiring and compare with the label on the control box cover. The label also indicates jumper connections. Make sure that all wiring and jumpers are connected exactly as shown on the diagram.
2. Measure the voltage a terminals TB1 –1 (+) and TB1 –2 (-) on the circuit board. The voltage reading should be 24-volts AC +/- 10%.
3. Measure the voltage at terminal TB1-5 (+) and TB1-3 (-) on the circuit board. Voltage reading should be 12-volts DC + 10% tolerance. This voltage is the output power for the zone sensor. If these voltage readings are not shown, it could indicate a defective board.
4. If 12-volts DC is present, rotate the zone sensor thumbwheel and check for voltage change across zone sensor terminals 2 and 3.
5. Adjust the minimum fully counter-clockwise and the maximum fully clockwise.
6. Verify the amber and green lights change when rotating the thumbwheel.
7. If any step does not work, replacement of the board may be necessary. If all steps work, proceed with further component checks.

Transducer Check

1. Disconnect the tubing to the flow sensor, remove the low-pressure line first, then the high side. Transducer damage may result if procedure is not followed.
2. Attach the voltmeter to terminals TP4 (+) and ground, B1-2 or 3, or TP3. Voltage on these terminals should be between .1- to .4-volts DC; the ideal is .254 volts DC.

⚠ WARNING

Hazardous Voltage!

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. Failure to disconnect power before servicing could result in death or serious injury.

3. Connect the voltmeter to terminals TP1 (+) and ground. Voltage at these terminals should be 4.78 to 4.82 volts DC. If the voltage at these terminals is lower or greater than the specified tolerance, this could be the cause for not obtaining correct minimum or maximum flow. This causes the controller to not operate within the specified minimum and maximum values, even with the minimum potentiometer fully counter-clockwise. Adjust R8 for 4.8 volts DC.
4. Reconnect the air valve actuator and drive to maximum position. Voltage should increase on TP4 to TP3.
5. If voltage does not increase, verify with a magnehelic that the delta P is increasing.
6. Replace the transducer if delta P increases and voltage does not change.

Note: A faulty transducer will cause the air damper to function improperly.

Triac Output Check

1. Make sure that the zone sensor operation is correct and, if applicable, which zone sensor is under control. Refer to prior sections for step-by-step procedures.
2. Remove all connections from J9, J10, and J11. In addition, remove J19 if it is a series fan-power unit.
3. Set the zone sensor to the full cooling position.
4. Place a 500-1000 ohm resistor between the connectors J7 and J9 and measure the voltage between these points. It should be less than 10 volts AC.
5. Slowly increase the zone sensor setting from full cooling to heating. At a position on the zone sensor near room temperature, Triac #1, which connects J7 to J9 should close. Next, Triac 2, which connects J7 to J10, should energize and finally Triac 3, which connects J7 to J11, should energize. When the zone sensor is rotated to the full heating position, a voltage check should show that contact closures between J7 and J9, J7 and J10, and J7 and J11 have been made (closed).
6. If continuity is not present at all stages, replace the board.

Auto Dual Minimum Check

A digital voltmeter will be required to make the voltage checks described in this procedure. Note the following differences in labeling of adjustment potentiometer described in the following steps:

Circuit Board Label	
R8	Null Voltage Calibration
R67	Max Flow
R68	Min Flow A
R69	Min Flow B

1. Refer to calibration setup steps 1 through 4. Make changes as described in the following steps:
2. Rotate the zone sensor to the full cool position. The green LED should be illuminated on the circuit board and voltage present at terminals J1-3 to J1-1. The voltage at terminal TP2 to ground should be 5.9 volts DC or higher.

Troubleshooting

3. Slowly rotate the zone sensor until the amber LED on the circuit board illuminates. Voltage at terminal TP2 to ground should be approximately 3.2 volts DC.
4. Continue rotating the zone sensor until the first stage of heat energizes. This can be determined by voltage across terminals J7 to J9. At this point, the green LED on the circuit board should illuminate. Voltage at terminal TP2 to ground should be 3.9 volts DC or higher. R68 should be in control.
5. Now adjust the zone sensor so that the output voltage at terminals 2 and 3 is 6.0 volts DC, +.01 volts DC, -.01 volts DC.
6. Compare the actual zone sensor to the indicated setpoint on the dial of the zone sensor. If the two readings are within 3°F of each other, then the zone sensor is within standard calibration tolerance. Calibration procedures are described in the Calibration Section in this manual.
7. Note position of R69. Rotate potentiometer R69 clockwise and counter-clockwise while watching the amber and green LED's to make sure that the control is now with minimum potentiometer R69.
8. Return R69 to its original position.

Electronic Zone Sensor Check

Note: The following checkout procedures will be used when power is applied to the electronic zone sensor.

1. Room temperature must be between 65°F and 80°F. Make sure also that placement of the zone sensor is satisfactory. It should not be located in direct sunlight, on cold or hot wall surfaces, etc. A zone sensor or other accurate temperature measuring device should be installed next to the zone sensor. It is preferable to mount the temperature sensing element under the zone sensor cover next to the thermistor of the zone sensor. (the Thermistor is a small electronic temperature sensing device imbedded in a glob of silicone cement.)
2. Remove the zone sensor cover.
3. Attach a volt meter to terminals 2 (+) and terminal 3 (-).
4. Record temperature in zone. It should be between 65°F and 80°F.
5. Check the voltage a terminals 2 (+) and terminal 3 (-). If the zone temperature and the zone sensor setpoint are at equilibrium, the voltage at this point should be 6.00-volts DC.
6. Rotate the zone sensor to the full-heating position. Allow five minutes for the zone sensor to equalize setpoint. The voltage on terminals 2 and 3 should drop to 5.5-volts DC or less.
7. Rotate the zone sensor to the full cooling position. The voltage on terminals 2 and 3 should rise to 6.3-volts DC or higher.

Jack Numbering Designations for Analog Control Boards

Jack	Function
J1	Motor
J3	Transducer
J9	Stage 1 Contact
J10	Stage 2 Contact
J11	Stage 3 Contact
J15	Drive MAX (constant volume)
J18	Auto Dual Minimum
J19	Output Override
TB1	Field Connections: Power and Zone Sensor

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Literature Order Number	VAV-SVX03A-EN
File Number	SL-TD-VAV-000-SBX03A-EN-1101
Supersedes	New
Stocking Location	La Crosse