Parallel Flow Fan Powered Terminal (Model TVS)

Model TVS fan terminals are specifically designed for quiet operation. They also offer improved space comfort and flexibility for a wide variety of Heating, Ventilating, and Air Conditioning (HVAC) systems. This is critical in today's buildings where occupants are placing more emphasis on indoor acoustics.

Due to heightened interest in indoor air quality, many HVAC system designers are focusing on the effects of particulate contamination within a building's occupied space. Often, HVAC system noise is overlooked as a source of occupied space contamination. The TVS Terminal is specifically designed to eliminate obtrusive fan noise from reaching the occupants.

Occupants benefit from a TVS design that minimizes low frequency (125 - 250 Hz) sound levels that typically dominate the space sound level.

Bundled with the TVS terminal is a digital controller from the VAV Modular Assembly (VMA) Series or the LN Series. Each model in the VMA1400 Series and the LN Series combines a controller, pressure sensor, and actuator housed in one preassembled unit.

Unique features that reduce installation and commissioning time while enhancing Variable Air Volume (VAV) system operation make the VMA the product of choice for VAV systems.

The VMA and LN Series controls can be used in these types of applications:

- *Parallel Fan Powered*
- *Parallel Fan Powered with Reheat*

Note: *For more information on the VMA1400 Series, refer to the* Variable Air Volume Modular Assembly (VMA) 1400 Series Product Bulletin (LIT-635058).

Note: *For more information on the LN Series, refer to the* Metasys System LN Series VAV and VVT Profile Application Controllers Product Bulletin (LIT-1201910).

Figure 1: Parallel Flow Fan Powered Terminal (Model TVS)

Figure 2: VMA1420

Figure 3: LN Series Controller

Features and Benefits	
❑ **Factory-Provided Direct Digital Controls (DDC)**	An integrated VAV box with controls eliminates the coordination and difficulties associated with factory mounting
❑ **Factory-Commissioned DDC**	Downloading of software, setting of parameters, addressing and testing at the factory reduces startup time and lowers risk
❑ **Flexible Design**	Provides application flexibility, while providing options that can meet even the most stringent job requirements
❑ **Superior Flow Measuring**	Provides for lower minimum Cubic Feet per Minute (CFM) values, which reduces energy costs and noise while maintaining comfort in the zone
❑ **Integrated Module**	Includes controller, pressure sensor, and/or actuator, preassembled to reduce installation time
❑ **Enhanced Actuator**	Provides a fast response stepper motor that drives the damper from full open to close in 30 seconds (VMA Series)
❑ **Automated Commissioning**	Uses Proportional Adaptive (P-Adaptive) and Pattern Recognition Adaptive Control (PRAC) for continuous loop tuning (VMA Series)
❑ **Advanced Diagnostics**	Offers damper stall detection, starved box detection, actuator motor duty cycle, VAV box flow test, and other diagnostics on most models (VMA Series)
❑ **Multiple Network Communications**	Enables integration into a Building Automation System (BAS)
❑ **Standard Applications**	Provides proven designs and quick selection of proper variables to ensure proper operation
❑ **Quick Installation**	Installation time can be reduced with the low profile compact design and standard metal hanging straps
❑ **Agency Certified**	Wired in compliance with all applicable National Electrical Code (NEC) requirements and tested in accordance with Air Conditioning and Refrigeration Institute (ARI) Standard 880
❑ **Easy Maintenance and Service**	Requires no periodic maintenance and provides trouble-free operation

Model TVS Terminals

Flexibility

Selection and Layout

The TVS provides flexibility in system design. Reduced noise at the fan terminal allows the system designer to place properly sized units directly above occupied spaces. It is not necessary to use the crowded space above a hall or corridor to locate the equipment. This reduces lengthy and expensive discharge duct runs. The standard shallow casing height (14" up to 1,000 Cubic Feet per Minute [CFM]) minimizes conflict with other systems competing for ceiling space. The sensor ensures accurate control, even when space constraints do not permit long straight inlet duct runs to the terminal.

Sizes

Primary air valves and fans are available in various size combinations to provide fan capacities between 20 and 100% of the selected maximum primary airflow. Model TVS Terminals are available with primary valves handling up to 4,100 CFM. Six fan sizes provide a range of heating capacities between 50 and 2,400 CFM.

Convenience

Quality

All TVS Terminals are thoroughly inspected during each step of the manufacturing process, including a comprehensive pre-ship inspection, to ensure the highest quality product available. Each unit is also run tested before leaving the factory to ensure trouble-free field startup.

Quick Installation

A standard single point electrical main power connection is provided. Electronic controls and electrical components are located on the same side of the casing for quick access, adjustment, and troubleshooting.

Finite fan speed adjustment is accomplished with an electronic Speed Controller Relay (SCR). The SCR fan speed controller is compatible with the fan motor. This minimizes electronic interference and harmonic distortion that occurs from non-compatible motor and SCR components. Increased motor life and efficiency result from the compatible design.

TVS Terminals use three-tap motors that accommodate a broad range of flow and static pressure field conditions while dramatically increasing efficiency.

The sensor ensures accurate airflow measurement, regardless of the field installation conditions. A calibration label and wiring diagram is located on the terminal for quick reference during startup.

Value and Security

Quality

All metal components are fabricated from premium grade G90 galvanized, chromate finished steel. Unlike most manufacturers' terminals, the steel used in the TVS is capable of withstanding a 125-hour salt spray test without showing any evidence of red rust.

Energy Efficiency

The highly amplified velocity pressure signal from the inlet sensor allows precise airflow control at low air velocities. The sensor's airfoil shape provides minimal pressure drop across the terminal. This allows the central fan to run at a lower pressure and with less brake horsepower. Energy efficient three-tap, three-winding, and permanent-split-capacitor fan motors are manufactured to ensure efficient, quiet, and reliable maintenance operation.

Three-tap motors provide superior energy efficiency over single speed motors by delivering three separate horsepower outputs. For example, a nominal 1/2 hp motor delivers 1/3 hp on medium tap and 1/4 hp on low tap. This allows the motor to operate at a higher efficiency when at a reduced fan capacity.

Fan terminals that use a single speed motor must rely solely on an SCR controller to obtain the reduction in fan capacity. At minimum turndown, they suffer from excessive power consumption and high motor-winding temperatures, significantly reducing the motor life.

Agency Certification

Model TVS Terminals, including those with electric heat, are listed with ETL as an assembly, and bear the ETL label. TVS Terminals comply with applicable NEC requirements, are tested in accordance with ARI Standard 880, and are certified by ARI.

Note: ETL is a mark issued by Intertek Testing Services (ITS) ETL SEMKO Division.

Maintenance and Service

TVS fan terminals require no periodic maintenance other than optional filter replacement. If component replacement becomes necessary, the unit is designed to minimize field labor. The bottom casing panel can be removed to provide easy access to the fan assembly, and the motor electrical leads are easily unplugged. Fan access is also provided through the induction air inlet, except for hot water coil units.

Standard Features

Construction

Standard construction features include:

- ARI 880 certified and labeled
- 22-gauge galvanized steel casing and valve
- 3/4" 4 lb·ft^3 skin, dual density fiberglass insulation

Fan Assembly

Standard fan assembly features include:

- forward curved, dynamically balanced, direct drive, galvanized blower wheel
- 115 to 277 volt single-phase, three-tap Permanent Split Capacitor (PSC) motor
- SCR fan speed controller
- quick-select motor speed terminal
- permanently lubricated motor bearings
- thermally protected motor
- vibration isolation motor mounts
- single point wiring

Primary Air Valve

Standard primary air valve features include:

- embossed rigidity rings
- non-thermal conducting damper shaft with position indicator
- mechanical stops for open and closed position
- center-averaging airflow sensor
- brass balancing tees
- plenum-rated sensor tubing

Hot Water Coils

Standard hot water coil features include:

- ARI 410 certified and labeled
- 1-, 2-, 3-, 4-row coils
- tested at a minimum of 350 psig under water

Electrical Components

Standard electrical components include:

- cETL listed for safety compliance
- National Electrical Manufacturers Association (NEMA) Type 1 wiring enclosure

Electric Heat

Standard electric heat features include:

- ETL listed as an assembly for safety compliance
- integral electric heat assembly
- automatic reset primary and back-up secondary thermal limits
- single-point power connection
- hinged electrical enclosure
- fusing per NEC

Optional Features

Construction

- 20-gauge galvanized steel construction
- 3/4” or 1” insulation
- scrim-reinforced, foil-faced insulation meeting American Society for Testing and Materials (ASTM) C1136 for mold, mildew, and humidity resistance
- double wall construction with 22-gauge liner
- mounting brackets to accept all thread hanging rods or wire hangers
- low velocity, low pressure drop induced air filter rack and filters located at induction inlet
- hot water, steam, or electric heating coils

Fan Assembly

Optional fan assembly features include:

- 208, 230, 240, and 480 volt single-phase PSC motors
- 220/240 volt 50 Hz motors

Electrical Components

Optional electrical components include:

- full unit toggle disconnect and inline motor fusing
- primary and secondary transformer fusing

Electric Heat

Optional electric heat features include:

- proportional (Solid State Relay [SSR]) heater control
- mercury contactors
- door interlocking disconnect switches

Controls

Optional controls include:

- factory-provided controls
- Direct Digital Controls (DDC)
- pneumatic controls

VMA1400 Series Controllers

Actuator Enhancements

The VMA1420 uses an actuator with a fast response stepper motor, which is quiet (<35 dBA) and precise (23 K resolution). The stepper motor drives the damper from full open to full close in 30 seconds. This significantly reduces the time to commission and balance a VAV terminal box. The stepper motor quickly and accurately adjusts the damper position in response to new conditions, minimizing position hunting and motor runtime.

Applications

The VMA1400 Series controllers can be configured for most single duct VAV applications. The VMA1420 requires an additional damper actuator with Differential Pressure Transducer (DPT) sensor for supply/exhaust applications and dual duct applications.

Standard applications for the VMA1420 reside in the HVAC PRO library, which is a section of the Global Operations Support library. See Table 1 for more detailed application and control options. Also refer to the *Variable Air Volume Modular Assembly* (*VMA) 1400 Series Application Note (LIT-6375125).*

Advanced Diagnostics

The VMA1400 Series has several unique diagnostic features. Diagnostics include damper stall detection, starved box detection, actuator motor duty cycle, VAV box flow test, and others.

The VMA constantly monitors the space temperature and airflow and generates alarms to alert the operator of setpoint deviations. The operator can react quickly, taking corrective action to get the system back into desired operation. This ensures occupants better comfort control.

Factory Commissioning

Whenever the VMA Series controls are ordered on the TVS Series, the factory downloads the correct application into the controller. In addition, the factory also sets the Area and K Factor for the size of the box on which it is installed. If provided, the factory also sets the minimum/maximum Cubic Feet per Minute (CFM) and address. Each box is thoroughly tested at end-of-line prior to packaging.

Automated Commissioning

Because the VMA1420 performs loop tuning automatically, there is no need to set proportional bands and integration terms. There is no need to set any jumpers or switches. Even network addressing can be done via software, if desired.

The VMA1420 is configured to detect the damper end-stops automatically. On power up, the actuator drives to both hard stops on the VAV box and remembers these positions. These automated features get the system operating quickly.

LN Series Controllers

LN-VAVL-0 and LN-VAVC-0 Controllers

LN-VAVL-0 and LN-VAVC-0 controllers include an enclosure with actuator, pressure sensor, eight Input/Outputs (I/Os), and LONWORKS® Network Services (LNS®) plug-in.

Applications

The LN-VAVL-0 Series controllers can be configured for most single duct VAV applications. The LN-VAVC-0 requires an additional damper actuator with Differential Pressure Transducer (DPT) sensor for supply/exhaust applications and dual duct applications.

Standard applications for the LN-VAVL-0 and the LN-VAVC-0 reside in the Global Operations Support library.

Table 1: Applications

Applications	Control Options	VMA1400		LON	
		1410	1420	LN-VAVL-0	LN-VAVC-0
System Types	Fan Powered (Series)		X		X
	Pressure Independent		X		X
Heating (Terminal Box)	Floating 3-Wire Valve Actuator		X		X
	Proportional Valve Actuator		X		X
	Normally Open or Normally Closed Valve		X		X
	1- to 3-Stage Electric		X		
	2-Stage Electric		X		X
Heating (Supplemental)	Floating 3-Wire Valve Actuator		X		X
	Proportional Valve Actuator		X		X
	Normally Open or Normally Closed Valve		X		X
	Single Stage Electric		X		X
Cooling (Terminal Box)	Stepper Motor Damper Actuator		X		X
Floating/3-Wire (Incremental) Actuator	Valve only		X		X
Proportional Actuator	External Valve		X		X
Fan-Powered Terminal Box	Series, On/Off Control		X		X
	Series, Proportional Control		X		X
Lighting	On/Off (In Relation to Occupancy Mode)		X		X
Modes	Occ/Unocc		X		X
	Occ/Temp		X		X

Standard Terminal Construction

Model TVS

The TVS Terminal incorporates many standard features that are expensive options for other manufacturers. All unit configurations are listed with ETL for safety compliance.

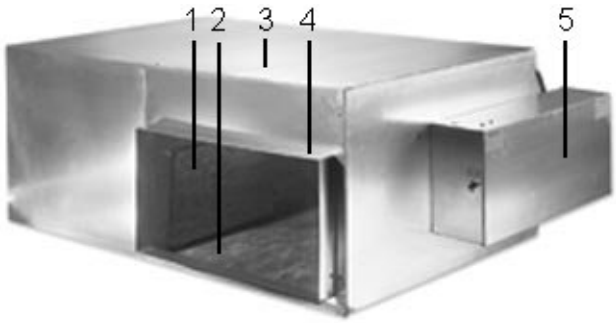

Figure 4: Model TVS – Standard Features (Front View)

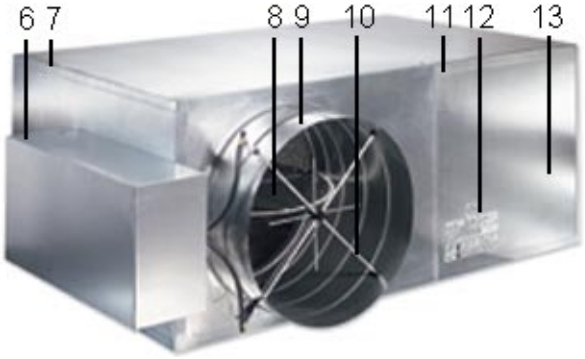

Figure 5: Model TVS – Standard Features (Rear View)

Table 2: Model TVS – Standard Features

Feature	Description
1	Gasketed fan backdraft damper
2	3/4" thick, 4 lb·ft^3 skin, dual density insulation complying with Underwriters Laboratories Inc.® (UL) 181, National Fire Protection Association (NFPA) 90A, and American Society for Testing and Materials (ASTM) C1071, mechanically fastened for added security
3	Premium grade, chromate coated, G90 galvanized steel casing withstands 125-hour salt spray test per ASTM B-117
4	Integral discharge collar for simplified field installation
5	Electrical devices installed within a NEMA Type 1 Enclosure, with single point power connection
6	Control enclosure standard with all electronic control sequences
7	Mechanical lock construction ensures lowest possible casing leakage
8	Low leakage damper incorporates closed cell foam gasket
9	Roll-formed inlet collar with integral stiffening ribs adds strength and rigidity
10	Patented airflow sensor
11	Terminal available with induction air filter
12	Product label includes tagging, airflow, and electrical information
13	Side access to fan (bottom access with hot water coil option)
(not shown)	Dynamically balanced, direct drive fan assembly
(not shown)	Factory-supplied and installed controls

Quiet, Energy Efficient Fan Assembly

A key to comfort is the extra quiet fan assembly. Each assembly is specifically designed and built for quiet, energy efficient air delivery.

What makes fan assemblies efficient is the use of three-tap, three-winding, permanent-split-capacitor fan motors. Each motor is specifically built for use with the TVS fan terminal. The three-tap motor is capable of delivering three separate horsepower outputs. For example, a nominal 1/2 hp motor delivers 1/3 hp on medium tap and 1/4 hp on low tap. This is a more efficient means of handling reduced fan capacities compared to single speed motors.

A quick-select terminal strip is provided for switching between the motor taps. Final air balance of the fan is achieved through field adjustment of the electronic SCR fan speed controller. The electronic SCR fan speed controller has been specifically designed for compatibility with the fan motor. The SCR includes a minimum voltage limiter for stall protection.

The combination of a three-tap fan motor and electronic SCR fan speed controller provides the most flexible and energy efficient means of balancing fan capacities with varying field conditions. This combination is preferred over single speed motor and SCR combinations, which cause excessive power consumption and high motor winding temperatures.

Each fan housing is specifically designed for compatibility with the fan motor and internal pressure loss of the TVS cabinet. This design provides proper motor loading and maximizes fan performance.

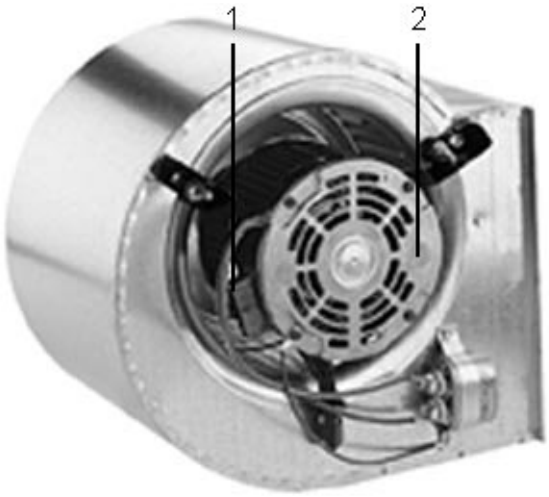

Figure 6: Fan Assembly (Front View)

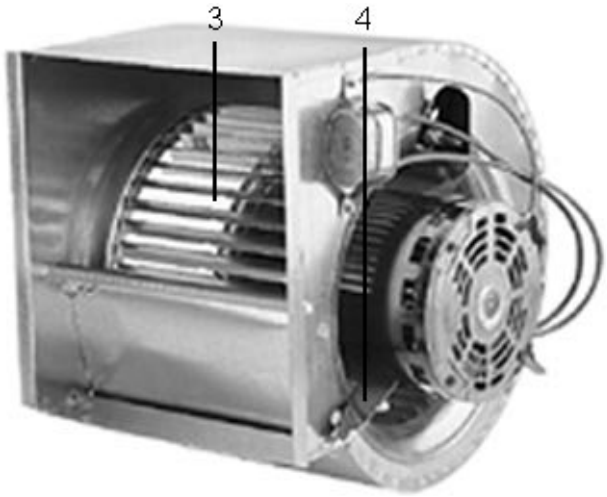

Figure 7: Fan Assembly (Rear View)

Table 3: Model TVS – Fan Assembly Features

Feature	Description
1	Motor plug allows quick, convenient change out
2	High efficiency permanently lubricated PSC three-tap (hp) fan motor with thermal overload protection — medium and low motor taps are used most often, allowing substantial power savings
3	Dynamically balanced, galvanized fan wheel
4	Vibration dampening mounting brackets with rubber grommeted feet

Application and Selection

Purpose of Parallel Flow Fan Terminals

Parallel flow fan terminals offer improved space comfort and flexibility in a wide variety of applications. Substantial operating savings can be realized by recovering waste heat and night setback operation.

Heat Recovery

The TVS Terminal recovers heat from lights and core areas to offset heating loads in perimeter zones. Additional heat is available using electric, steam, or hot water heating coils. Available controls energize remote heating devices like wall fins, fan coils, radiant panels, and roof load plenum unit heaters.

Typical Sequences of Operation

The TVS provides variable volume, constant temperature air in the cooling mode, and constant volume, variable temperature air in the heating mode. At the design cooling condition, the primary air valve handles maximum scheduled airflow capacity while the unit fan is off. As the cooling load decreases, the primary air valve throttles toward the minimum scheduled airflow capacity. A further decrease in the cooling load causes the unit fan to start, inducing warm air from the ceiling plenum and increasing the discharge air temperature to the zone. When heating load increases, the optional hot water coil or electric heater is energized to maintain comfort conditions.

Indoor Air Quality (IAQ)

The TVS enhances indoor air quality of a building by providing higher air volumes in heating mode than typically provided by straight VAV single duct terminals. Higher air capacity provides greater air motion in the space and lowers heating discharge air temperature, which improves air circulation and prevents accumulation of carbon dioxide concentrations in stagnant areas. Increased air motion improves occupant comfort. The higher air capacity also improves the performance of diffusers and minimizes diffuser dumping.

Selection Guidelines

The TVS product line is designed to provide maximum flexibility in matching primary air valve capacities (cooling loads) with unit fan capacities (heating loads). The overall unit size is dictated by the primary air valve sizes (cooling design capacity). With each unit size, various fan sizes are available to handle a wide range of fan capacities from relatively low heating airflow capacities (25% of maximum primary capacity) all the way up to relatively high heating airflow capacities (100% of maximum primary capacity).

Size the primary air valve first to determine the unit size. Typically, primary air valve sound is insignificant relative to the unit fan sound performance. Selection typically involves choosing an air valve size that is as small as possible while yielding acceptable sound levels and pressure drop. For non-acoustically sensitive applications like shopping malls and airports, the primary air valve can be sized at the maximum rated capacity.

After selecting the primary air valve, select the fan from the various sizes available for that unit size. Selection is made by cross plotting the specified fan capacity and external static pressure on the appropriate fan performance curves. Terminals using hot water heating coils require the summation of the coil air pressure drop and the design External Static Pressure (ESP) to determine the total ESP. It is common to have more than one fan size that can meet the design requirements. Typically, selection begins with the smallest fan meeting capacity. If the selection does not meet acoustical requirements, select the next larger fan size.

Fan selections can be made anywhere in the non-shaded areas. Each fan performance curve depicts the actual performance of the relative motor tap without any additional fan balance adjustment. Actual specified capacities, which fall below a particular fan curve (low, medium, or high), are obtained by adjustment of the electronic SCR fan speed controller.

System Pressure Considerations

The central fan is required to produce sufficient inlet static pressure to force the air through the primary air valve, unit casing, downstream ductwork and fittings, and diffusers with the unit fan off. The TVS has been designed to reduce central fan power consumption by placing the optional hot water heating coil in the induction air stream, eliminating the coil from these central system pressure considerations. The industry standard for testing and rating air terminal units (ARI 880) requires that published pressure drop performance be measured with hard, straight, unlined duct entering and leaving the terminal unit. On many projects, due to the limited available space, terminal units are not installed in this optimum manner. Frequently, flexible duct is used at the terminal inlet and a metal transition is used at the discharge. The entrance and exit losses in these instances exceed the actual terminal unit pressure loss. It is important to consider terminal unit pressure loss, as well as those losses associated with the entire distribution ductwork (as outlined in applicable American Society of Heating, Refrigerating and Air-Conditioning Engineers [ASHRAE] handbooks) when sizing central system fan requirements.

Electric Heat

Model TVS-E

Model TVS-E Standard Features

Model TVS-E standard features include:

- cETL Listed as an Assembly
- primary auto-reset high limit
- secondary high limit
- hinged control panel
- ni-chrome elements
- primary/secondary power terminations
- fusing per NEC
- wiring diagram
- fan interlock device (relay or Pneumatic Electric [PE] switch)
- single point power connection
- Available kW increments are as follows:
  0.5 to 10.0 - .50 kW; 10.0 to 25.0 - 1.0 kW; above 25.0 - 2.0 kW

Model TVS-E Optional Features

Model TVS-E optional features include:

- disconnect (toggle or door interlocking)
- PE switches
- mercury and magnetic contactors
- manual reset secondary limit
- proportional control (SSR)
- 24 volt control transformer
- special watt densities
- airflow switch

Table 4: Pressure Drop – ΔPs (Inches wg)

Unit Size	CFM	ΔPs	Unit Size	CFM	ΔPs
0404	100	.01	**1006, 1011, 1018**	600	.02
	150	.01		800	.03
	200	.02		1000	.04
	250	.03		1200	.06
0504	100	.01		1400	.08
	200	.02		1600	.11
	300	.05	**1211, 1218, 1221**	800	.02
	350	.07		1100	.03
0604, 0606	200	.02		1400	.05
	250	.03		1700	.07
	300	.05		2000	.11
	350	.07		2300	.14
	450	.11	**1411, 1418, 1421, 1424**	1100	.01
	550	.17		1500	.02
0804, 0806, 0811	300	.02		1900	.03
	400	.04		2300	.04
	500	.06		2700	.05
	600	.09		3100	.07
	800	.16	**1621, 1624**	1600	.01
	1000	.25		2100	.02
				2600	.03
				3100	.05
				3600	.06
				4100	.08

Table 5: Pressure Drop – ΔPs (Inches wg)

Unit Size	Max. kW	Unit Size	Max. kW
0404, 0504, 0604	5.5	**1411**	15
		1018, 1218	26
0804	6	**1418**	27
0606	8	**1221**	28
0806, 1006	8.5	**1421, 1621**	29
0811	14	**1424, 1624**	34
1011, 1211	16		

Model TVS-E Selection Procedure

With standard heater elements, the maximum capacity (kW) is obtained by dividing the heating (fan) Standard Cubic Feet per Minute (SCFM) by 70. In other words, the terminal must have at least 70 SCFM per kW. Optional heater elements are available to handle applications requiring less CFM per kW. In addition, each size terminal has a maximum allowable kW based upon the specific heater element configuration (for example, voltage, phase, and number of steps).

Heaters require a minimum of 0.07" wg downstream static pressure to ensure proper operation.

For optimum diffuser performance in overhead heating applications, the supply air temperature should be within 20°F of the desired space temperature. This typically requires a higher air capacity that provides higher air motion in the space increasing thermal comfort. The electric heater should be selected with this in mind, keeping the Leaving Air Temperature (LAT) as low as possible.

Table 6: Model TVS-E – Selection Equations

Equations			
KW	=	$\frac{CFM \times \Delta T \times 1.085^*}{3413}$	* Air density at sea level - reduce by 0.036 for each 1,000 feet of altitude above sea level.
CFM	=	$\frac{kW \times 3413}{\Delta T \times 1.085^*}$	
ΔT	=	$\frac{kW \times 3413}{CFM \times 1.085^*}$	

Table 7: Model TVS-E – Calculating Line Amperage

Equations		
Single Phase Amperes	=	$\frac{kW \times 1,000}{Volts}$
Three Phase Amperes	=	$\frac{kW \times 1,000}{Volts \times 1.73}$

Hot Water Coil Data

Model TVS-W

Figure 8: Model TVS-W

Table 8: Model TVS-W – Definition of Terms

Term	Definition
EAT	Entering Air Temperature (°F)
EWT	Entering Water Temperature (°F)
LWT	Leaving Water Temperature (°F)
LAT	Leaving Air Temperature
CFM	Air Capacity (Cubic Feet per Minute)
GPM	Water Capacity (Gallons per Minute)
MBH	1,000 BTUH
BTUH	Coil Heating Capacity (British Thermal Units per Hour)
ΔT	EWT minus EAT

Model TVS-W Standard Features

Model TVS-W standard features include:

- aluminum fin construction with die-formed spacer collars for uniform spacing
- mechanically expanded copper tubes leak tested to 350 psig air pressure
- male sweat type water connections
- 1-, 2-, 3-, and 4-row configurations

Model TVS-W Optional Features

Model TVS-W optional features include:

- steam coils
- multi-circuit coils for reduced water pressure drop
- opposite hand water connections

Model TVS-W Selection Procedure

Table 10 gives correction factors for various entering ΔTs (difference between EWT and EAT). Multiply MBH values obtained from selection tables by the appropriate correction factor to obtain the actual MBH value. Air and water pressure drop can be read directly from the selection tables.

The leaving air and leaving water temperatures can be calculated from the following fundamental formulas.

Table 9: LAT/LWT Fundamental Formulas

Formulas				
LAT	**=**	EAT	+	$\frac{\text{BTUH}}{1.085 \times \text{CFM}}$
LWT	**=**	EWT	-	$\frac{\text{BTUH}}{500 \times \text{GPM}}$

Table 10: Correction Factors

Entering Water - Air Temperature Differential (ΔT) Correction Factors															
ΔT	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**
Factor	0.15	0.19	0.23	0.27	0.31	0.35	0.39	0.43	0.47	0.51	0.55	0.59	0.63	0.67	0.71
ΔT	**85**	**90**	**95**	**100**	**105**	**110**	**115**	**120**	**125**	**130**	**135**	**140**	**145**	**150**	**155**
Factor	0.75	0.79	0.83	0.88	0.92	0.96	1	1.04	1.08	1.13	1.17	1.21	1.25	1.29	1.33

Technical Specifications

Product Name	**VAV Modular Assembly (VMA) 1400 Series**
Product Code Number	Cooling w/Reheat and/or Fan:
Single Unit:	AP-VMA1420-0
Bulk Pack:	AP-VMA1420-0D
Buy American:	AP-VMA1420-0G
Supply Voltage	20-30 VAC at 50 or 60 Hz
Optional Fuse Current	2.0 amperes for a VMA1420
Power Consumption	VMA1420: 10 VA maximum (Relay and valve requirements not included.)
Ambient Operating Conditions	0 to 50°C (32 to 122°F)
Ambient Storage Conditions	-40 to 70°C (-40 to 158°F)
Terminations	6.3 mm (1/4 in.) spade lugs (Communication has screw terminals.)
Serial Interfaces	N2 Bus and Zone Bus
N2 Controller Addressing	DIP switch set (1-253) Addresses 254 and 255 are reserved. Software addressable with HVAC PRO software, Release 7.02 or later.
Communications Bus	N2 between VMA and NCM or N30 Zone Bus between VMA and room sensor (8-pin phone jack or wire to spade lugs or optional plug-on terminals) (Not available when the TE-7720 RF Receiver is applied.)
Mounting	One screw (included) mounts the VMA1420 to the VAV box. One screw attaches the damper shaft to the actuator, 8 mm (5/16 in.) square head set screw with 44 N·m (389.4 lb·in.) of axial holding power for up to 13 mm (1/2 in.) round damper shafts. Minimum damper shaft length is 44.5 mm (1-3/4 in.).
Housing	Plastic housing for controller/actuator with UL94-5VB Plenum Flammability Rating
Dimensions (L x W x H)	VMA1420: 153 x 102 x 102 mm (6 x 4 x 4 in.)
Actuator Torque	4 N·m (35 lb·in.) minimum (VMA1420 only)
Shipping Weight	VMA1420: 13.1 kg (29 lb) for a box of ten, 1.3 kg (2.8 lb) each
Electrical Inputs	Analog Inputs: Nickel, silicon, platinum (1 K ohm), or NTC (2.25 K) RTD room sensors, 1.6 K setpoint potentiometer (2-wire) Voltage input for 0-10 VDC (humidity or pressure sensor) Binary Inputs: Dry contacts Input configurations vary based on model type.
Velocity Pressure	Velocity Pressure for 374 Pascal (0-1.5 in. W.C.)
Outputs	Binary outputs, 24 VAC triac switched, 25-500 mA loads Stepper drive, 2 to 767 steps per second (23,000 step resolution) (VMA1420 only) Analog output, 0-10 VDC @ 10 mA maximum
Standards Compliance	CSA 22.2 No. 205, UL 916, UL 864 (UUKL), UL 94-5VB, FCC Part 15, Subpart B, Class A and B, C-tick Australia/NZ, AS/NZS 4251.1, CISPR 22, Class B, CE Directive (89/336/EEC, EN50081-1, EN50082-2) Industrial, IEEE 472, IEEE518, IEEE587 Category A/B, IEC-950, IEC 801-2, -3, -4, -6, -7, -8, ANSI C62.41 A/B

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

Technical Specifications (Cont.)

Product Name	Metasys System LN Series Variable Air Volume Profile Application Controller (LN-VAVLx-0)
Power Requirements	Voltage: 24 VAC, ±15%, 50/60 Hz Typical Consumption: 5 VA Maximum Consumption: 10 VA Protection: 5 Ampere removable fuse
Environmental	Operating Temperature: 0 to 70°C, 32 to 158°F Storage Temperature: -20 to 70°C, -4 to 158°F Relative Humidity: 0 to 90% Noncondensing
General	Standard: LONMARK® Functional Profile VAV #8010 Processor: Neuron® 3150; 8 bits, 10 MHz Memory: Nonvolatile Flash 64 K (APB application and configuration properties) Communication: LonTalk® Protocol Transceiver: TP/FT-10; 78 kbps Battery (for clock only): Real-time Clock Chip Enclosure: Material: PVC, flammable class VO Dimension: 4.88 x 8.9 x 2.48 inches (124 x 226 x 63 mm) Weight: 1.84 lbs (0.835 kg) Safety: CSA and UL Listed
Damper Motor	Motor: LM24-Mus Torque: 35 in·lb, 4 N·m Angle of Rotation: 95° adjustable Fits shaft diameter: 8.5 mm to 18.2 mm; 5/16” to 3/4” Power Supply from Controller
Inputs	Number: 4 Universal Digital: Dry Contact Voltage: 0-10 VC, Accuracy ±0.5% Current: 4-20 mA with 500 K ohms external resistor, Accuracy: ±0.5% Resistor: Thermistor Type 2 10 K ohms Accuracy: ±0.5°C; ±0.9°F Resolution: 0.1°C; 0.18°F Range: -40 to 55°C; -40 to 131°F Potentiometer 10 K ohms Linear 2-point setpoint adjustment Min/Max linear configuration Configurable on several points Input Resolution: 12 bits analog/digital converter 1 Differential pressure: Range 125-250-500 Pa (0.5-1-2’’ H_20), Accuracy ±3% full scale

Continued on next page. . .

Technical Specifications (Cont.)

Outputs	Number: 4
	3 Digital: Triac 24 VAC ±15%, 50/60 Hz, maximum charge 1.0 Ampere, internal or external supply
	1 Tri-mode Analog:
	0-10 VDC (linear), PWM or digital 0-12 VDC
	60 mA maximum @ 12 VDC (60°C; 140°F)
	Maximum load: 200 ohms
	Auto reset fuse: 60 mA @ 60°C; 140°F, 100 mA @ 20°C; 68°F
	Analog Output Resolution: 8 bits digital/analog converter

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

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