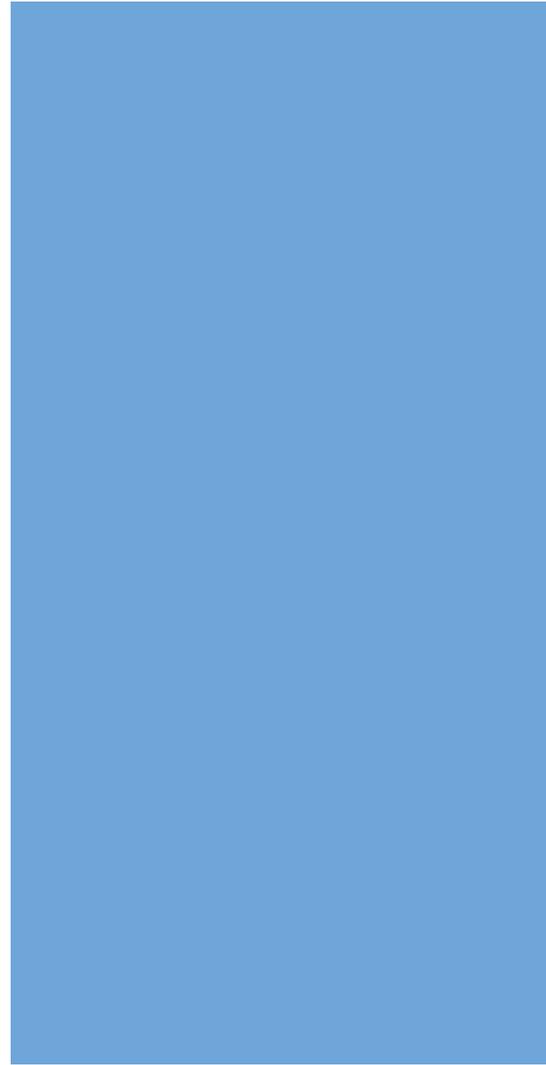


# Ventilation, Air-Conditioning, Refrigeration



Quiet and efficient air movers



[www.ebmpapst.us](http://www.ebmpapst.us)

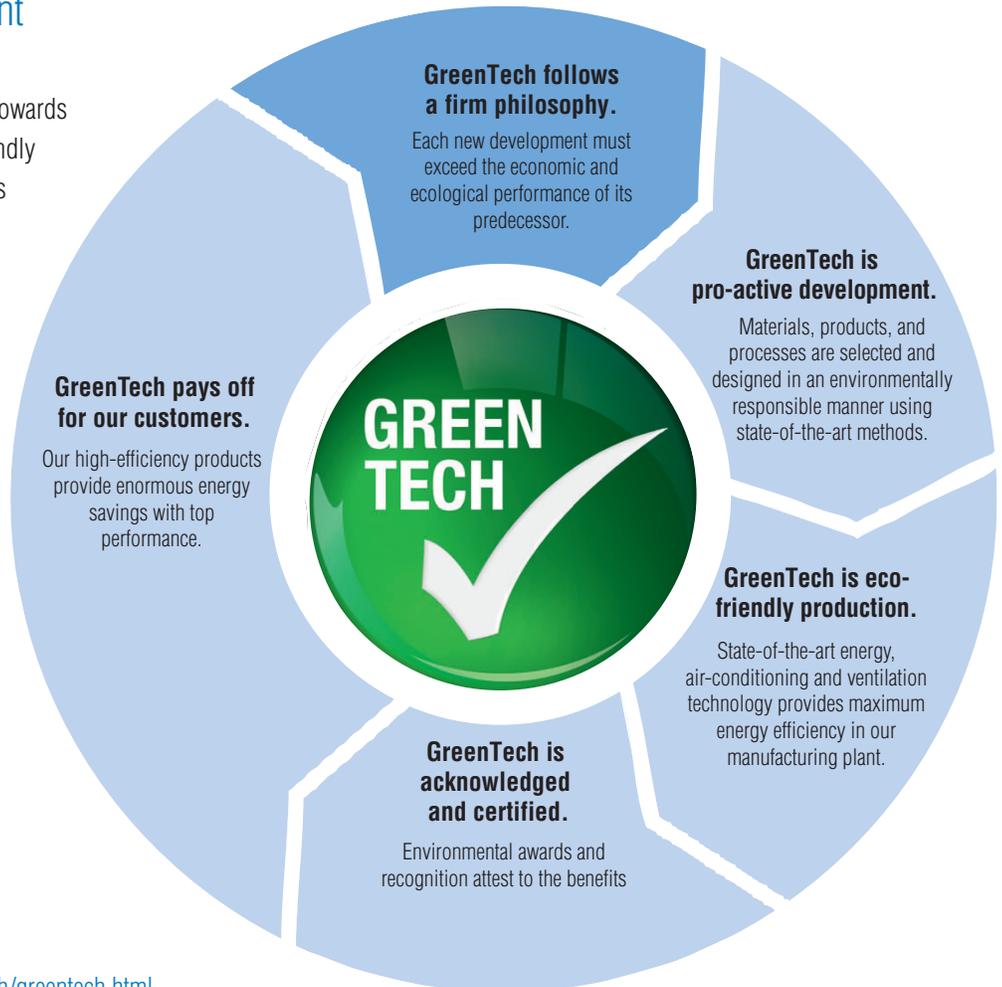
**ebmpapst**

# GreenTech

## The symbol of our commitment

GreenTech is the symbol of our philosophy towards the development and manufacture of eco-friendly products. It symbolizes our continuous commitment, achievements, and passion to provide customers with high quality products through the use of state-of-the-art methods, responsible business practices and initiatives that benefit not only the user, but the environment as well.

The heart of GreenTech beats in every ebm-papst EC product. EC technology means products with exceptional energy efficiency and the ability to flexibly respond to the performance requirements actually encountered.



Learn more at [www.ebmpapst.com/en/greentech/greentech.html](http://www.ebmpapst.com/en/greentech/greentech.html)

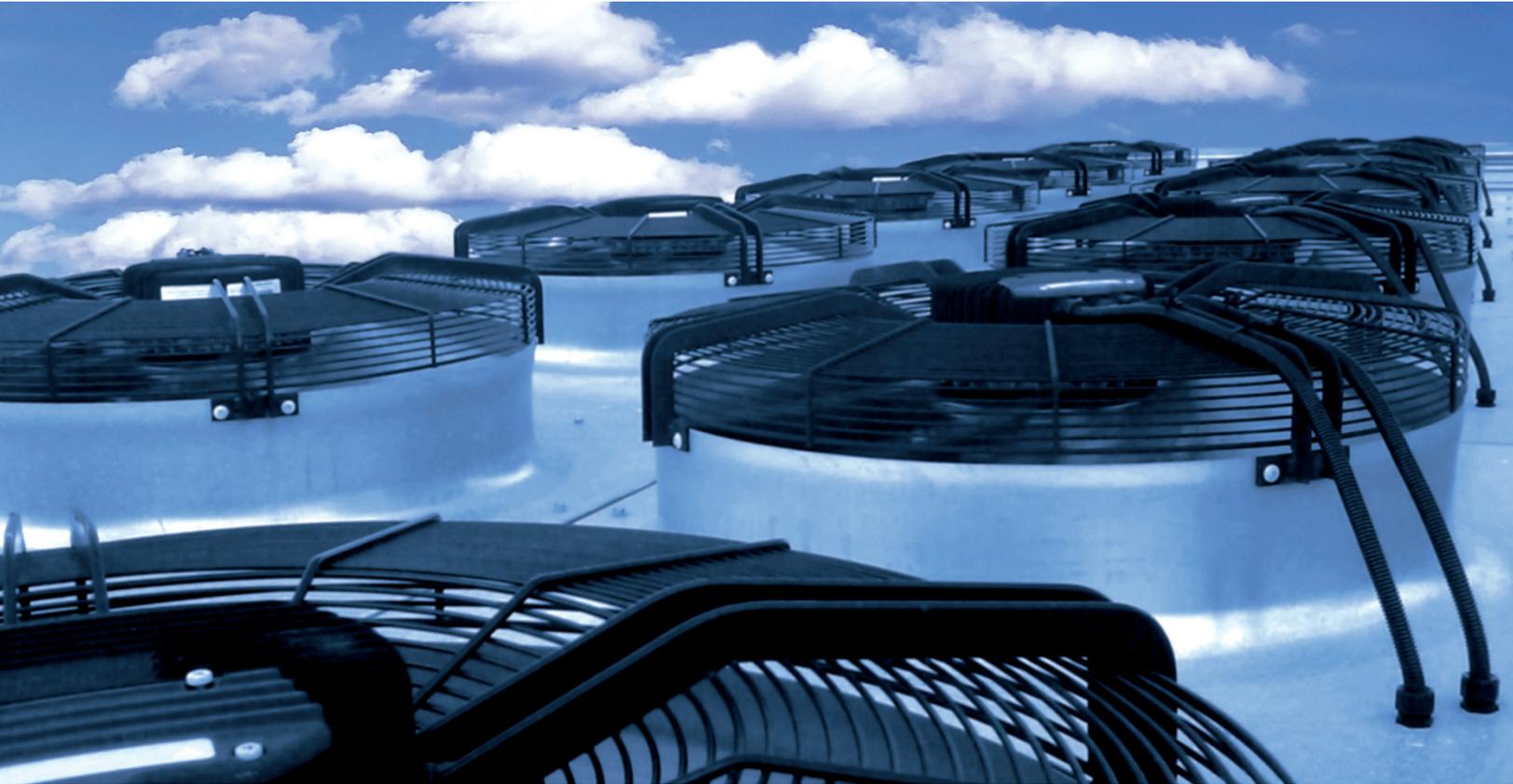


# Table of Contents

<u>Ventilation and Air-Conditioning Market Overview</u>	1 - 2
<u>Refrigeration Market Overview</u>	3 - 4
<u>EC Technology</u>	5 - 9
<u>VACR Product Solutions</u>	10 - 13
<u>Custom and Value Added Capabilities</u>	14
<u>About ebm-papst USA</u>	15



# Ventilation and Air-Conditioning Market Overview



The field of ventilation and air-conditioning technology in today's market is characterized by three main requirements: energy efficiency, controllability for adequate load matching, and the adaptability to meet a wide range of customer needs. Fan selection can play an essential role in determining whether or not ventilation and air-conditioning systems meet these requirements.

AC motors are the traditional choice as fan drives, however it's getting harder to ignore the substantial advantages of EC (Electronically Commutated) technology. Large 3-phase AC asynchronous motors are adequately efficient at full load operation, but fall short on single phase or smaller 3-phase motors where efficiency ratings can vary anywhere between 20% to 70%. AC motors also require the use of variable frequency drives to control rotational speed, which can contribute to power loss and require additional filtering to protect sensitive motor bearings. Asynchronous motors driven to part load by a variable frequency drive can often produce resonance noise that results in an undesired motor hum.

ebm-papst EC motors are brushless direct current devices that feature fully integrated drive electronics for ease of control and can achieve efficiency of up to 90% - including the drive electronics. The EC motor operates quietly and efficiently even under part load conditions. All fan control, programming, and monitoring typically needed throughout the ventilation and air-conditioning industry are available through the integrated motor electronics and can be operated via software and even accessed wirelessly.

The continual dedication towards advanced engineering, reduction of system operation and maintenance costs, and award winning EC technology has made ebm-papst the world leader in air moving technology. Our intelligent, single or 3-phase, AC line powered EC drive motors can attain full speed efficiency to 90% and maintain a high efficiency when operated at greatly reduced speeds. These EC motors are controllable and maintenance-free. A single motor design can drive several fan types, including axial impellers up to  $\varnothing 990\text{mm}$  (39"), backward-curved radial impellers up to  $\varnothing 710\text{mm}$  (28") and forward-curved centrifugal wheels up to  $\varnothing 450\text{mm}$  (17.7"). The product line covers a wide range of shaft power up to 6kW (8hp).

On larger axial and centrifugal EC models, fan communication is possible via free motor control software available for a laptop and/or PDA/Smartphone. This allows users to easily set a fixed motor speed or to program a closed-loop feedback system to maintain a constant set point. Fans can be equipped with an integrated PID (Proportional-Integral-Derivative) controller, external sensor input for speed modulation, sensor power supply, and RS485 Bus interface for programming and diagnostics.

ebm-papst understands that cost-effectively fulfilling the performance requirements of today's ventilation and air-conditioning applications can be a challenge. When true life cycle costs are compared, including total initial system costs, energy savings and servicing, ebm-papst EC fan systems provide the proper solution to meet and exceed the tough specifications of today's market.



## Commercial Applications

- Fan Coil Units
- Air Handling Units
- Unit Ventilators
- PTAC Systems
- Underfloor Systems
- Variable Air Volume (VAV) Systems
- Energy Recovery Ventilators (ERV)
- Evaporative Condensers
- Heat Pumps - Water Sourced, Geo Thermal, Air-to-Air
- HVAC Split Systems
- DX Unitary Packaged Rooftop Systems
- Vertical HVAC Self-Contained Systems
- Air Cooled Chillers

## Residential Applications

- Heat Pumps
- Packaged Units and Split Systems
- Furnaces/Boilers
- Air Handling Units
- Energy Recovery Ventilators (ERV)
- Air Purification
- Filtration Units
- Whole House Fans
- Bathroom Ventilator Fans
- Attic Fans

# Refrigeration Market Overview



With refrigeration units expected to run 24/7, energy efficiency is of vital importance to the commercial refrigeration industry. New legislative requirements and tax incentives affecting electric appliance and motor efficiency are pushing OEM's, ESCO's and end users in the refrigeration marketplace to re-examine their equipment choices in search of energy saving alternatives. ebmpapst fulfills the need for these alternatives by offering an array of products that address the present and future energy needs of new and legacy refrigeration equipment.

By incorporating EC technology into our standard shaded-pole refrigeration motor, we created an intelligent "iQ" motor. It uses only a third of the electricity of the original motor, adds closed loop speed control and keeps the exterior design unchanged for easy retrofits. In a complete fan platform, our W1G200-EC 8" diameter axial fan has been in production for almost a decade using a very efficient and programmable 2-speed Energy Saving Motor (ESM). During this time it has proven to be extremely robust under all refrigeration application conditions. Building on this success, the range has been expanded to include 6", 9", 10", and 12" diameter impellers.

Sometimes the low static pressure capability of an axial fan is insufficient for the application. Our new and unique K1G200 diagonal flow impeller with 45° air exhaust provides a solution. It doubles the static pressure capability of the 8" diameter axial fan and still fits in the same envelope. Larger sizes are available in full radial impeller designs for even higher pressures. All of these products use the same proven ESM design as the original 8" axial fan.

## Stop adding heat to your refrigeration system!

In the refrigeration industry, condenser and evaporator fan sizes of 12" and smaller are traditionally powered by AC shaded-pole fractional HP motors. These motors, though durable and inexpensive to produce, lose 70% or more of the electricity they consume to motor winding temperature rise. This wasted energy contributes directly to the heat load on your refrigeration equipment.

ebm-papst offers both fan motor and complete fan solutions that can improve this situation. Using AC line powered brushless DC motors, power lost as waste heat is cut in half or more compared to the old shaded-pole motors.

Our iQ fan motor solution, for example, is a direct descendent of our shaded-pole refrigeration motor and has the same form factor. Offered in 3W, 10W and 20W power output, it can drive standard metal blades from 6" to 12" diameters with motor efficiency up to 70%. Our complete fan solutions are built around the Energy Saving Motor (ESM). Integrating the ESM, housing and dynamically balanced impeller into a single assembly allows the aerodynamic efficiency and sound levels to be optimized. Overall length is greatly reduced and installation is effortless - meaning space savings and reduced labor cost for your application.



## Commercial Applications

- Reach-in Display Cases
- Walk-in Coolers
- Beverage Dispensers
- Freezer Cases
- Ice Machines
- Vending Machines
- Food Preparation Tables



*K1G200 Diagonal Flow Fan*

# EC technology

(Fans in this section refer to those models driven by our larger frame size, full featured EC motors.)

## Our full featured EC fan system package includes...

- » integrated PID controller (Proportional-Integral-Derivative)
- » 10:1 speed turndown
- » motor speed control without noise penalty
- » performance maintained over a wide voltage range (1~100-130 VAC, 1~200-277 VAC, 3~200-240 VAC, 3~380-480 VAC)
- » frequency independent; same performance on 50/60Hz
- » soft start keeps the startup current below FLA (Full Load Amperage)
- » phase failure protection
- » power factor correction and harmonics filters
- » maintenance-free
- » EMI & RFI filters
- » locked rotor and over-temperature protection
- » free programming software
- » real-time diagnostics (measured process value, motor speed, operating hours, power consumption, motor temperatures)
- » RS485 Bus communication (ebmBUS or MODBUS RTU)
- » one SPDT alarm relay that changes state for a motor temperature problem, locked rotor, low supply voltage or loss of phase on 3 ~ supply voltage
- » accepts 0-10 VDC or 4-20mA from external sensor
- » 10 VDC / stabilized 10mA and 20 VDC / 50mA power outputs
- » weatherized, outdoor rated, IP54 design

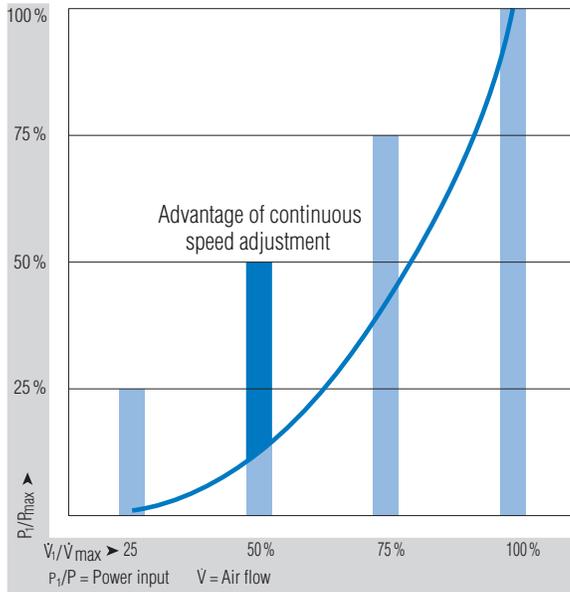
These features allow for a variable motor speed based on system demand, without the efficiency loss and additional equipment (VFDs, filters, or special inverter duty motors) commonly needed for speed control of AC induction motors. Based on the known relationship between airflow and pressure in air moving applications, the integrated PID control facilitates the installation of constant pressure or constant airflow systems.

## Examples of the use of EC fan technology

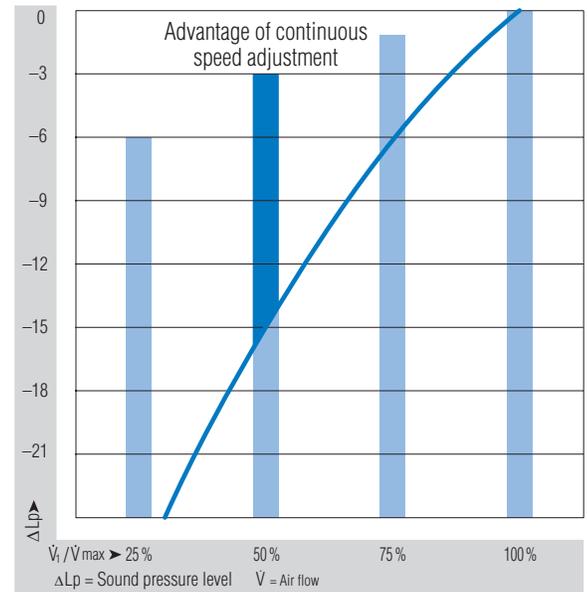
A **constant airflow system** can easily be set-up using ebm-papst plug fans. These are backward-curved radial impellers mounted with matching inlet nozzles into a metal bracket and plate structure for easy assembly into applications such as Air Handler Units. By using the pressure tap mounted in the inlet nozzle, the airflow through the plug fan can be determined indirectly by measuring the differential pressure across the nozzle with a differential pressure transducer (DPT). The available programming software allows the DPT range and units, PID settings and the desired differential pressure set point to be entered into the motor EEPROM. The motor speed will then close loop around this set point, maintaining a constant airflow with changing system conditions based on the feedback from the DPT.

In a similar manner, a **closed loop condensing pressure control system** can be set up with condenser fans. The refrigerant pressure signal is fed to the fan motor through the linear sensor input. The fan speed is adjusted based on the differential between this data and the desired set point, with the speed adjustment qualified by the PID settings. This type of fan speed modulation provides a much tighter control of condenser pressure compared to switching AC fans on/off, further increasing energy savings. It is also much easier to set-up than VFD control of an AC motor because all needed components are contained within a single unit and the motor controls are optimized for fan applications.

## Noise and power savings possible by modulating EC fan speed



**Low energy consumption:** The bars show the power input when individual fans are either operating at full speed or are switched completely off. The blue line shows the power input when all fans are speed modulated.



**Lower noise:** While shutting off half of the fans (one-half of the air flow) decreases the noise level by only 3 dB, speed reduction of all fans to one-half the air flow attains an improvement of 15 dB.

## Example of Switching AC Fans On/Off

Air Performance	Number of Fans in Operation	Speed	Power Input in kW
100%	4	100%	7.40
75%	3	100%	5.55
50%	2	100%	3.70
25%	1	100%	1.85

**On/Off operation:** To control the air performance according to various cooling requirements or to adapt it to those requirements, the current practice is to switch individual AC fans on or off.

## vs. Closed Loop Speed Control of all EC Fans

Air Performance	Number of Fans in Operation	Speed	Power Input in kW
100%	4	100%	6.68
75%	4	75%	2.84
50%	4	50%	0.84
25%	4	25%	0.11

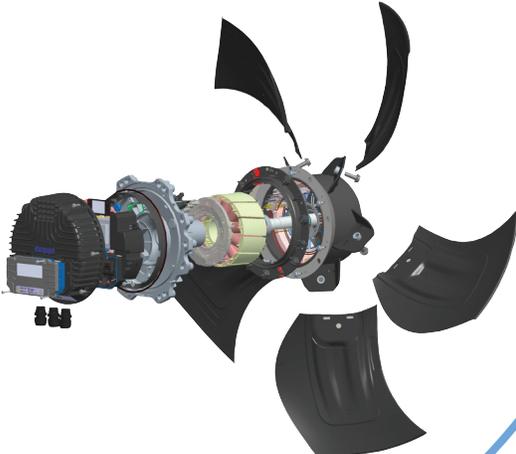
**Modulating operation:** All fans remain in operation at the lowest speed required to handle the heat load. The optimum cooling capacity is attained via closed loop speed control.

# EC technology

(Fans in this section refer to those models driven by our larger frame size, full featured EC motors.)

## Comparison to a 3-phase AC motor

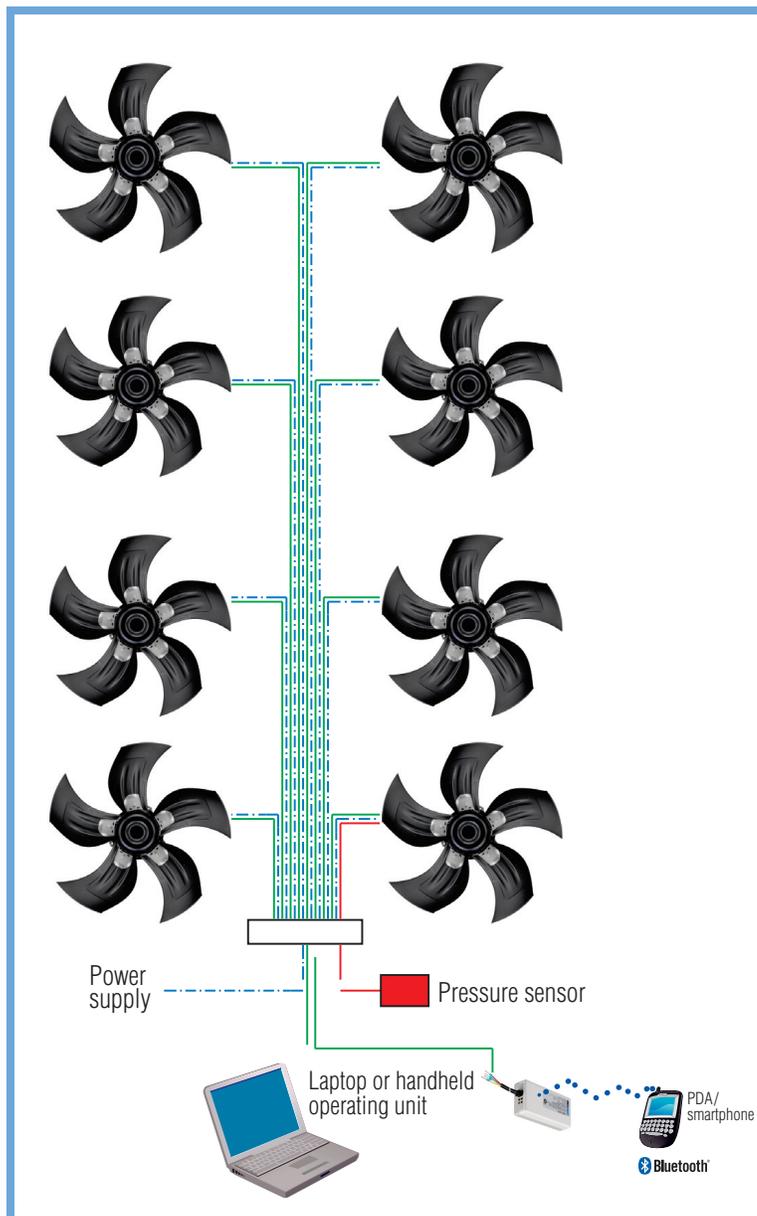
- » Same performance from the EC motor over a wide voltage range and 50/60Hz operation can reduce the number of variations needed in user systems, especially if supplying both domestically and overseas.
- » If speed controlling an AC motor, optimum control requires the use of an Adjustable Speed Drive, typically a VFD. Simpler, less expensive methods like the use of a Triac distort the motor supply current and typically create higher motor temperature rise, motor noise, EMI and harmonics issues.
- » A VFD may require filters for EMI/RFI, a supply voltage for an external sensor, a motor protection switch, filters to prevent common mode currents from damaging the motor bearings or use of an inverter-duty rated AC motor. None of these are needed with the EC motor.
- » Part load conditions do not significantly impact the efficiency of ebm-papst EC motors.
- » Reverse logic speed control is possible with the EC motor, meaning the motor can be set to either increase speed or decrease speed with an increasing control signal input.
- » Lower EC motor temperature rise at reduced speed results in longer motor bearing life and less heat load on the air-conditioned space.
- » Soft-start keeps the EC motor startup current from exceeding the Full Load Amps (FLA), reducing the load on power supply components. A startup current of 3.5x FLA or higher is not unusual for AC motors.
- » The EC fan with integrated electronics is an all inclusive solution, eliminating the components required to speed control a typical AC fan.

EC Fan - all inclusive with integrated electronics	AC Fan - extra components needed for speed control
	<ul style="list-style-type: none"><li>» adjustable speed drive (ASD)</li><li>» motor filter (or inverter duty rated motor)</li><li>» sensor supply*</li><li>» emc filter*</li><li>» line reactor*</li></ul>
	* may or may not be included in the ASD

## Integrated and networked

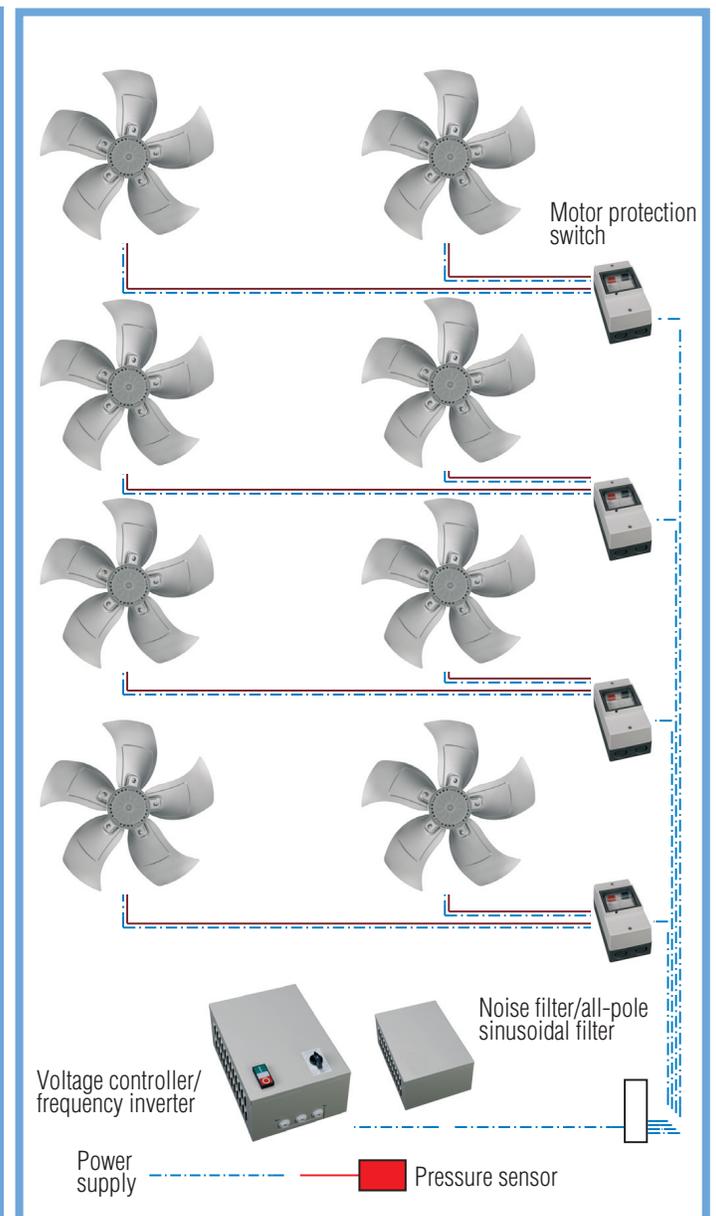
### EC technology: Simple network

By using ebm-papst EC fans, it is easy to implement a networked system of many fans. Redundant operation of all EC fans is based on greatly simplified wiring and uncomplicated connections. Each EC fan can do it all - master with PID controller or slave. Convenient monitoring options using a laptop, desktop computer or Bluetooth enabled PDA/Smartphone.



### AC technology: More expenses, fewer possibilities

AC fans require a greater expense for wiring connections, networking and additional motor protection. For mains inverter operation, an all-pole sinusoidal filter is needed. For voltage controlled fans, the use of a noise filter is used in order to reduce unwanted motor resonance.



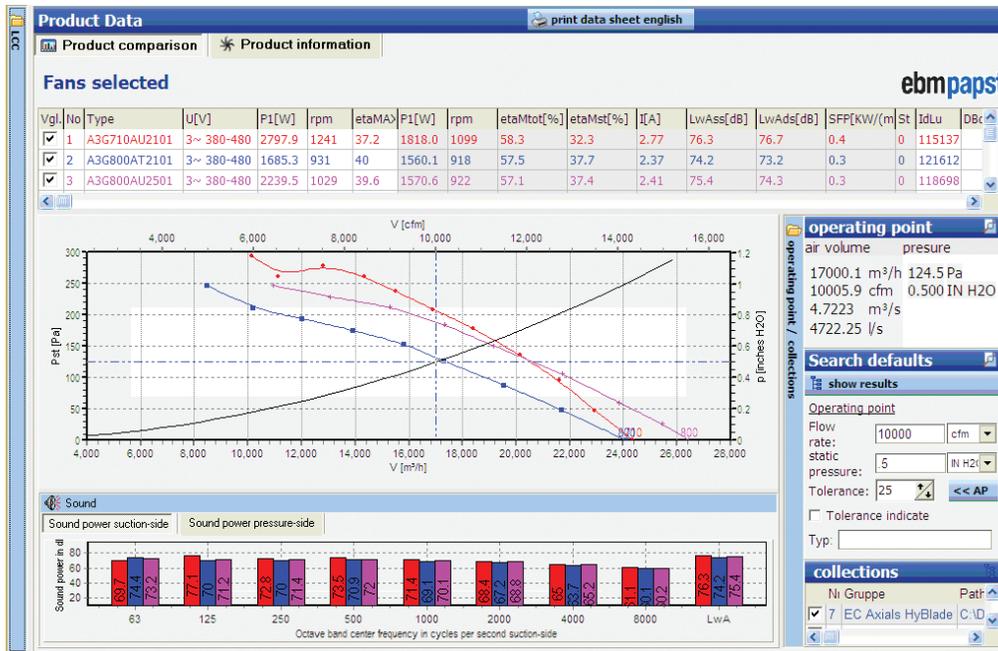
# EC technology

(Fans in this section refer to those models driven by our larger frame size, full featured EC motors.)

## Product Selection Software

Our product selection software (download at [www.ebmpapst.us/downloads](http://www.ebmpapst.us/downloads)) makes it easy to find the ebm-papst product that best suits your requirements. Once a final product is selected, a complete data package including specs, technical features, drawing and wiring information is quickly available from our Application Engineers.

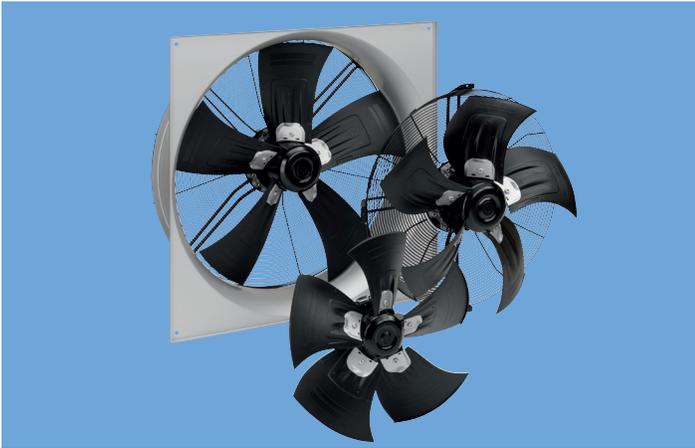
### Examples of selection software screens;



Product search based on operating conditions



Detailed performance information for a specific model at actual load conditions



## Axial Fans

Axial fans supply air flow at relatively low system pressures, without changing the air direction. The ebm-papst external rotor motor allows the impeller to be directly mounted to the rotor, eliminating the need for an external driveshaft and forming a very compact assembly. The motor and impeller assembly is often mounted into a wall plate with integrated venturi and a grill guard. This complete fan package provides easy mounting, minimal depth, low noise levels and high efficiency. ebm-papst axial fans are now available with our new HyBlade® hybrid impellers. Each blade consists of a structural aluminum center surrounded in fiberglass reinforced plastic. HyBlade® manufacturing lowers environmental pollution and energy use compared to full metal blades.

### Technical data

Input Voltage Range:	1~115, 230, 277; 3~230, 460 VAC
Air Flow Range:	100 to 21,000 CFM
Diameter Range:	9.8 to 39 inches
Speed Range:	275 to 3,050 rpm
Power Input:	1 to 3,200 Watts
Frequency:	50/60 Hz



## ESM / iQ

The iQ EC motor offers efficiency up to 70% with closed loop speed control to maintain constant speed under varying loads. Available with 3W, 10W, and 20W shaft power to handle impellers from 6" to 12".

Everything required for ease of incorporation into the application is included in our complete fan series based on the Energy Saving Motor. Since the plastic molded impeller and venturi are a matched set, the aerodynamic efficiency is also optimized. The motor is programmable for two selectable speed steps, which can be adjusted by the end user according to the application needs. Axial fans are available in 6" to 12" impeller diameters. Backward curved impellers with radial discharge are also available for applications with more restricted air paths.

### Technical data

Input Voltage Range:	1~115, 1~230 VAC
Air Flow Range:	100 to 825 CFM
Diameter Range:	6 to 12 inches
Speed Range:	500 to 2,500 rpm
Power Input:	1 to 35 Watts
Frequency:	50/60 Hz

# VACR Solutions



## Centrifugal Fans and Blowers

Centrifugal fans and blowers supply relatively low air flow at high system pressure compared to axial fans. The air is drawn in parallel to the drive axis, deflected 90° by the rotation of the centrifugal impeller and discharged radially. The ebm-papst external rotor motor allows the impeller to be directly mounted to the motor without an external driveshaft, forming a compact assembly. Centrifugal fans with backward curved blades do not require a scroll housing and are used primarily for intake suction. They come in a variety of blade shapes to meet demanding performance requirements with good efficiency. Centrifugal fans and blowers with forward curved blades always require a scroll housing. Blowers are available with single or dual inlets.

### Technical data

Input Voltage Range:	1~115, 230, 277; 3~230, 460 VAC
Air Flow Range:	50 to 10,870 CFM
Diameter Range:	5.24 to 28 inches
Speed Range:	100 to 4,350 rpm
Power Input:	1 to 3,100 Watts
Frequency:	50/60 Hz

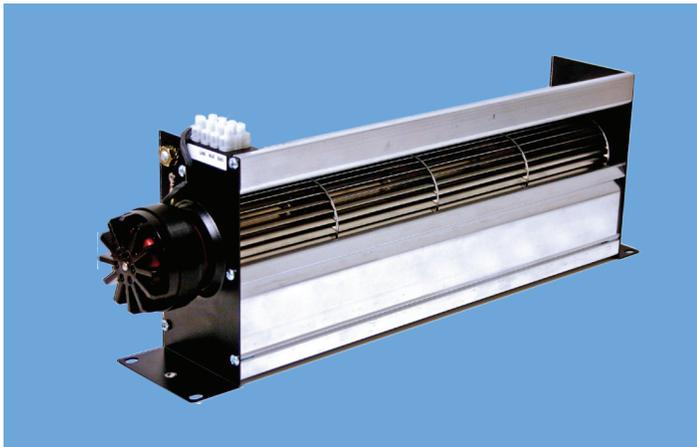


## Plug Fans

Plug fans take convenience to a new level by placing the backward curved centrifugal fans into modular assemblies. These assemblies include the EC motor, impeller and required inlet ring mounted between two sheet metal plates. Extruded aluminum posts running between the two plates provide structural support and spacing for setting the proper impeller to inlet ring gap, a key to getting the best performance. Inlet rings with pressure taps are available to facilitate air flow measurement for data acquisition or even setting up a closed-loop air flow system. Choice of motor cable exit through grommet holes in either metal plate.

### Technical data

Input Voltage Range:	1~277, 3~230, 3~460 VAC
Air Flow Range:	150 to 10,000 CFM
Diameter Range:	9.84 to 22 inches
Speed Range:	150 to 4,100 rpm
Power Input:	1 to 5,370 Watts
Frequency:	50/60 Hz



## Crossflow

Crossflow blowers provide even, low velocity air distribution over a wide area. They have a narrow footprint and come in many different lengths. Grills and filter media are available on some models. EC versions are speed-controllable using a 0-10 VDC input or through a built-in potentiometer.

### Technical data

Input Voltage Range:	1~115, 230 VAC
Air Flow Range:	185 to 649 CFM
Impeller Length Range:	11.8 to 32.4 inches
Power Input:	24 to 120 Watts
Frequency:	115V - 60Hz; 230V - 50/60Hz



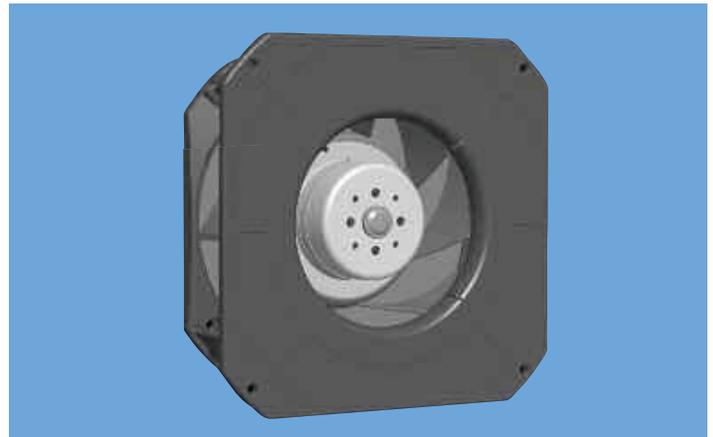
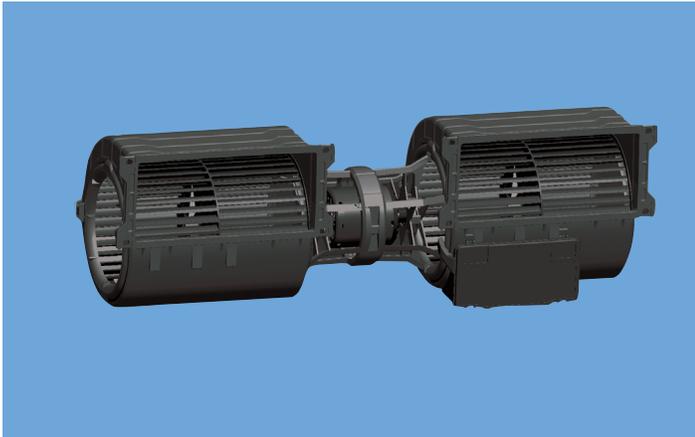
## ACmaxx

Although brushless DC motors power the ACmaxx series of tubeaxial fans, they are designed for direct connection to all AC voltages and frequencies worldwide. These fans provide the same performance when operated anywhere within an 85-265VAC, 50-60Hz range and at motor efficiencies up to 75% higher than conventional AC fans. This reduces the heat load in the application and improves bearing life, which extends service life as much as 85% beyond standard AC fans. The brushless DC motor allows great flexibility via options. Versions with analog, PWM or temperature sensor speed control, tach output and failure detection are all possible.

### Technical data

Input Voltage Range:	1~85-265 VAC
Air Flow Range:	47 to 206 CFM
Size:	3.15 to 6.77 inches
Speed Range:	2,850 to 6,800 rpm
Power Input:	7.5 to 14 Watts
Frequency:	50/60 Hz

# VACR Solutions



## Fan Coil Units

Our new Fan Coil units are available in single and dual motor shaft designs with AC or highly efficient EC technology. The EC designs are equipped with integrated speed control, tach-out options and wiring harnesses. AC designs feature integrated capacitor, wiring harness, and 5-speed PSC motors.

Light, durable and sound absorbent plastic materials are used for both the housing and impeller so no paint or finish is necessary. The EC motors operate with up to 90% efficiency, include soft start to limit start-up current and accept both 0-10 VDC / PWM inputs for speed control down to 10% of maximum speed.

### Technical data

Input Voltage Range:	1~115, 230 VAC
Air Flow Range:	325 to 1,300 CFM
Diameter Range:	5.2 to 6.3 inches
Speed Range:	750 to 1,500 rpm
Power Input:	40 to 250 Watts
Frequency:	50/60 Hz

## Compact Centrifugal Modules

Compact Centrifugal Modules with backward-curved blades are an all inclusive air moving solution. Featuring a compact design, square mounting plate, integrated inlet nozzle, and motor suspension, all components are pre-installed for easy plug-and-play use.

Available with AC (2-pole PSC), DC or EC motors. Shallow depth and easy to install. An optional snap-on grill guard is available for the intake side if needed.

### Technical data

Input Voltage Range:	24 & 48 VDC / 1~115, 230 VAC
Air Flow Range:	60 to 870 CFM
Diameter Range:	6.9 to 8.9 inches
Speed Range:	2,170 to 5,420 rpm
Power Input:	1 to 248 Watts
Frequency:	50/60 Hz (AC/EC versions)

# Custom and Value Added Solutions

## Expert design and manufacturing capability

From initial product conception through final production, our customers can count on our engineering expertise and innovative solutions to build the most cost-efficient high quality products. Our staff of design, electrical, and application engineers possess a wealth of knowledge and experience enabling exceptional guidance and support to our customers and their projects. We can provide comprehensive test data to show how well your product functions.

Our engineers and custom assembly solutions can help our customers to:

- » reduce costs
- » increase airflow
- » lower energy consumption
- » reduce noise
- » quickly develop prototypes

## Sheet metal fabrication and finishing

Cutting-edge measurement technology, qualified staff and a process-oriented quality management system compliant with ISO 9001.2000 - these are the criteria that enable us to satisfy the high demands our customers place on quality.

ebm-papst monitors and documents all activities from the initial manufacturing study in the design phase to the balancing of the completed custom fan assembly. That is how we achieve the highest standards of quality known throughout the world.

- » custom design: PCB's, power supplies, electronic filters, air filters, wire harnesses and labeling
- » state-of-the-art machinery: CNC punch presses, laser cutting, flexibend folding
- » precision measurements and digitizer
- » CAD drawings and layout using Pro-E
- » electrostatic powder paint booth and 5-stage phosphate washer
- » airflow and acoustic test chambers



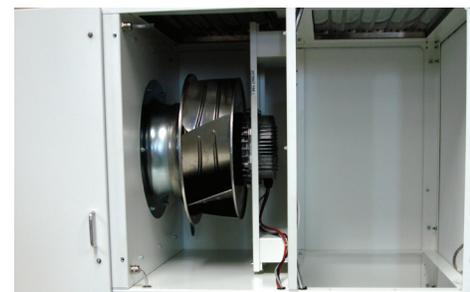
EC Production Line



Air Test Chamber



Electrostatic Paint Booth



Value-added Assembly

# About ebm-papst North America

## Headquarters - Farmington, CT

- » 250K sq ft
- » 20 Regional Offices
- » Acoustic chamber
- » Complete Air Testing Lab On Site
- » ISO 9001 and 14001 Certification
- » Distribution from Farmington (CT), Toronto, and Dublin

With offices in major cities throughout North America and Ireland, our highly-skilled and experienced team of professionals are ready to tackle your air moving challenges with solutions that meet all your requirements at a reasonable price. ebm-papst serves all markets including IT & Telecommunications, Ventilation, Air-Conditioning, Refrigeration, Gas & Heating, Household Appliances, Industrial, Drive Systems, Transportation, Agriculture, Medical, and more. Our customers can always count on prompt, courteous service. Customer satisfaction is our number one priority.

## Expert support when and where you need it

Knowledgeable field sales professionals are close by for face-to-face meetings. Dedicated inside sales associates fulfill all your ordering requirements. To assist you with order management, our customer service department provides automated services such as shipment notifications, reorder notifications, and invoicing.

To find the right air moving solution for your needs, our experienced application engineers are at your service to answer all your product application questions. Our on-site testing lab is available to our customers for product / prototype testing. We offer air flow, noise, environmental (including Salt Fog chambers), and temperature testing. Burn-in ovens are also available.

Our electrical engineering team, with diverse industry and product design backgrounds, provides a full range of services including hardware and software design, analysis, testing and electronics manufacturing. Some of the services performed in our on-site lab are circuit analysis, reliability and environmental testing, prototype build and testing, test equipment design and build.

## Logistics and inventory management programs

ebm-papst, Farmington CT has over 90,000 sq ft of climate-controlled warehousing facilities offering real-time inventory transactions and bar-coded inventory. Inventory management programs such as Kanban, demand/pull, safety stock, consignment, and local warehousing can be customized to customer requirements.





WIN



WIN



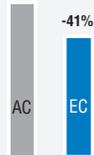
CO<sub>2</sub> Emission\*



\* Detailed calculations on our website

- conventional technology
- ebm-papst EC technology

Operating expenses\*



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# ebmpapst