Cool servers mean secure data.

Fans for data centers: quiet, reliable, and with no circuit feedback

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ebmpapst

engineering a better life

Image 1
One of the most important tasks of any data center operator is to monitor and control the indoor climate. Different solutions are used here, as no two data centers are the same in terms of the way they are constructed.

When it comes to cooling, which is vital for data centers, an energy-conscious approach is essential these days. Energy-efficient fans with state-of-the-art EC technology can help here. However, the fans need to have other properties to be able to be used in data centers. Most importantly, they must operate as quietly as possible and have a high level of availability. Condition monitoring, for example, can enable preventive maintenance measures. In addition, the control electronics of the EC motors should be designed to meet the demanding requirements in data centers regarding circuit feedback and the harmonic content of the input current, and it should also be easy to use natural, flammable refrigerants.

One of the most important tasks of any data center operator is to monitor and control climatic conditions in server rooms, as high temperatures and humidity damage the IT devices and result in failures. Air conditioning concepts have to counteract this. Different solutions are used here, as no two data centers are the same in terms of the way they are constructed. Typical cooling applications range from in-row cooling of the server racks to chillers, precision air-conditioning units and other air handling units (AHUs). ebm-papst has a number of suitable EC axial and centrifugal fans designed to meet the requirements in data centers for these different air-conditioning solutions.

Axial fans: quiet and suitable for high back pressure

Data centers are increasingly moving closer to both industrial and residential areas in order to keep data cables short and therefore as interference-free as possible. This has consequences for the operators, as the large chillers, dry coolers, or condensers have to comply with the applicable noise protection regulations in the relevant area. For the fans used, this means two things. Firstly, they themselves must operate as quietly as possible and not cause any unpleasant noise. And secondly, they must also cope with higher back pressure if the air conditioners require additional noise protection measures, for example because the compressor would otherwise be too loud. AxiBlade and AxiEco are two axial fan series that cover the different requirements here. The first boasts a high power density with low noise emissions, while the second series is particularly suitable for applications requiring an especially high pressure increase, for example due to additional noise protection measures or special exchanger geometries.

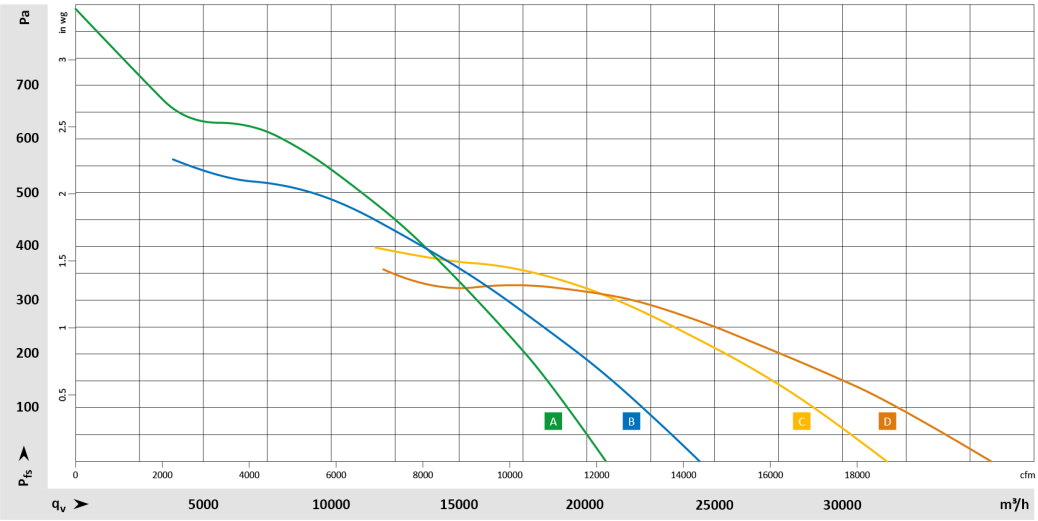


Image 2
The AxiEco (A and B) series is primarily used in applications where a high pressure increase is required, while the AxiBlade (C and D) axial fans offer an impressive combination of high power density and low noise emissions.

Centrifugal fans: high power density and wide optimum efficiency range

Centrifugal fans are also typically used in data centers. During the development of RadiPac centrifugal fans, for example, the actual installation situation in computer room air handlers (CRAH) and AHUs was taken into account. Specifically, the outflow characteristics of the impeller were optimized and both deflection losses in the air handling unit and outlet losses were reduced thanks to a special design. As a result, the fans can run at a lower speed at the same operating point, which in turn enables energy savings. Thanks to a wide optimum efficiency range and a high static overall efficiency level, the fans operate with low power consumption in a broad range of operating conditions.

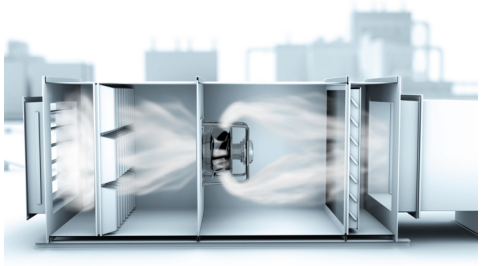


Image 3
The actual installation situation in computer room air handlers (CRAH) and air handling units (AHUs) was taken into account when developing RadiPac centrifugal fans.

Increased operational reliability thanks to resonance detection

Fans are used in a wide range of applications in data centers. Depending on the installation situation, resonance can occur in unpredictable speed ranges. If the fan is often operated in such critical ranges, the bearing system may be damaged, leading to premature fan failure. Although these vibrations can be measured by system operators, they cannot simply be eliminated. ebm-papst solves this problem with automatic resonance detection, which prevents fans from operating at critical speeds, increasing their service life and operational reliability. For this purpose, a test start-up can be performed during commissioning in which the vibration speed is analyzed over the entire speed progression from standstill to nominal speed. If excessive vibration speeds are detected in certain ranges, the control software adjusts itself after activation by the customer so that these speed ranges are „passed over“ in the future. This means that the ranges are passed through, but continuous operation in them is avoided. Operators can manually edit the software settings at any time, meaning that they always have full control. The integrated vibration sensor can also be used for condition monitoring, which enables preventive maintenance and service assignments to be better planned.

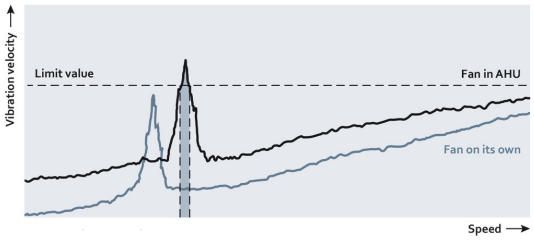
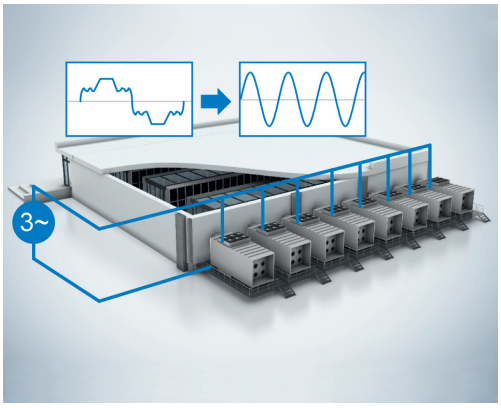


Image 4
Automatic resonance detection prevents fans from operating at critical speeds, thereby increasing their service life and operational reliability.

Active “Power Factor Correction” minimizes circuit feedback

Speed control is mandatory for demand-based air conditioning. However, the operation of speed-controlled drives always generates current harmonics, which can become problematic in critical infrastructures when combined with an inadequately dimensioned power supply. The resulting harmonics lead to an increased load on the supply network and to losses due to reactive power. There may also be a negative impact on other devices in the system network. In the past this used to mean that operators had to fit external filters, ensure adequate power factor correction, and possibly make use of larger cable cross-sections.

These kinds of external measures are now no longer required. To minimize the problem of harmonics with the parallel operation of EC fans, ebm-papst has come up with a solution where the harmonic filter is already integrated: namely, active PFC (Power Factor Correction).



The approach is to prevent current harmonics from occurring at all instead of laboriously filtering them out afterwards with additional components. This allows infrastructure components for energy and emergency power supply, such as transformers and emergency power generators, to be designed to be smaller, making them more cost-effective. The results that can be achieved with active PFC are remarkable: with a power factor of over 0.99, the THD(I) is typically approx. 2% at rated output, and remains below 5% all the way down to 10% of the rated output. THD(I) stands for Total Harmonic Distortion of Current.

Equipped for natural refrigerants

The use of natural and flammable refrigerants is another issue that data center operators have to deal with and the fans described can also be equipped for this purpose. Their electronics circuits would then be designed to comply with EN 60335-2-40 for air conditioners with flammable refrigerants, i.e. the maximum surface temperature in the event of a fault must be at least 100 kelvins below the ignition temperature of the refrigerant used. Propane, which is very well suited to many applications due to its good heat transfer capacity and its low GWP value, has an ignition temperature of 470°C. The electronic assemblies, which have been tested and certified accordingly, ensure that their maximum surface temperature always remains below 370°C, even if a fault occurs, and as a result they do not become an ignition source.

Image 5
Active PFC (Power Factor Correction) takes the approach of preventing current harmonics from occurring at all instead of laboriously filtering them out afterwards with additional components. .

Image 6
Staying cool for maximum performance. This is ensured by precision air-conditioning units, each with three integrated RadiPac centrifugal fans.

Excursion: A real-life example

NTT Global Data Centers EMEA GmbH is one of the world's leading IT service providers with four data center locations in Frankfurt alone. The Frankfurt 1 data center campus, for example, is one of the largest data center sites in Europe, with around 50,000 square meters of IT space featuring precision air-conditioning units providing cooling. The units draw in exhaust air at a temperature of around 36 to 39°C, filter, cool, and humidify it, then direct the air, which has been cooled to 23 to 24°C, through a raised floor and outlets directly to the server racks. Three EC centrifugal fans from the ebm-papst RadiPac series are responsible for continuously conveying air in each air conditioner. In total, these fans have been in operation in Frankfurt 1 for almost 10 years.

There is one special thing to note here, though: the standby precision air-conditioning units are not only provided for redundancy reasons, they also always run at low speed in parallel. This increases both the service life of the fans and their efficiency. Thanks to precise differential pressure control in the range of four to six pascals, the fan speed of all air conditioners automatically adjusts when a precision air-conditioning unit fails or if the server performance changes dynamically. As a result, all the fans consume an impressive 30 percent less power, thereby playing their role in ensuring a good EER value, which indicates the cooling capacity of an air conditioner compared to the current consumption.

About ebm-papst
The ebm-papst Group, a family-run company headquartered in Mulfingen, Germany, is the world's leading manufacturer of fans and motors. Since it was founded in 1963, the technological leader has set international industry standards with its core competencies in motor technology, electronics, digitalization, and aerodynamics. ebm-papst offers sustainable, intelligent, and tailor-made solutions for virtually every requirement in ventilation and heating technology.