

Vertical farming as a promising future concept

In vertical indoor farming, ventilation, air conditioning, and automation solutions ensure that plants always have ideal conditions for growth. For such applications, EBM-Papst offers fans, drives, and automation solutions with CANopen connectivity.



Vertical indoor farming is regarded as an agricultural concept with a future. The yield per unit area is significantly higher, as the implemented systems enable required climatic conditions and can be operated throughout the year. Efficient and smart automation systems are essential for this.

To use the existing resources more efficiently, plants are produced above one another in buildings, containers, or in air-conditioned supermarket cabinets. This allows urban spaces to be used sustainably for agriculture, saving additional transportation time and costs. The potential of this technology can be only exploited if the light, nutrients, ventilation, temperature and humidity are right. The basic prerequisite for this are economic systems that always operate according to the demand, also in automated product handling and transport. EBM-Papst offers a number of smart fans and drives (including software) suitable for different vertical farming concepts. The specialist is also available as an engineering partner and system provider and offers support on complete automation solutions.

Ventilation and air conditioning

The concepts for ventilation and air conditioning include tunnel ventilation, which pushes the air through the building. However, central ventilation units installed on roofs

are also common as they provide individual plants or floors with a targeted air supply via pipe and tube systems. Different fans are required here. Compact axial fans move high air flows of up to 65000 m³/h and operate at back pressures of up to 1500 Pa. They are therefore particularly suitable for the tunnel supply. Centrifugal fans enable high back pressures up to 5200 Pa and air flow rates up to 30000 m³/h. Compact fans have proven their worth for air conditioning in supermarket cabinets, for ventilation of individual shelves and for cooling LEDs.

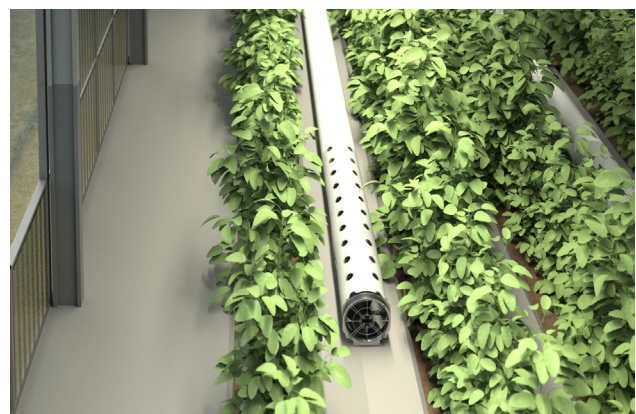


Figure 1: A hose ventilation system supplies the plants with air (Source: EBM-Papst)



Figure 2: Axial fans (left) e.g. for tunnel ventilation systems and centrifugal fans (right) typically implemented in central ventilation units (Source: EBM-Papst)

Drive solutions

Decentralized drive solutions reduce costs for transport or handling systems in vertical indoor farming. This ranges from automated product handling with autonomous driving vehicles to conveyor belts and access control systems. Such solutions rely on good control characteristics and precise positioning. Reliable, compact, and dynamic drive systems that withstand strong loads are required to open and close barriers, gates, and windows, for example. Drive systems with a high degree of networking possibilities are indispensable.

EBM-Papst offers a modular drive system for this application field, consisting of a motor, transmission (planetary or angular), and electronics. For example, the electronically-commutated ECI motors cover a power range from 30 W to 750 W in sizes 42 mm, 63 mm, and 80 mm. Different transmissions ensure the necessary reduction

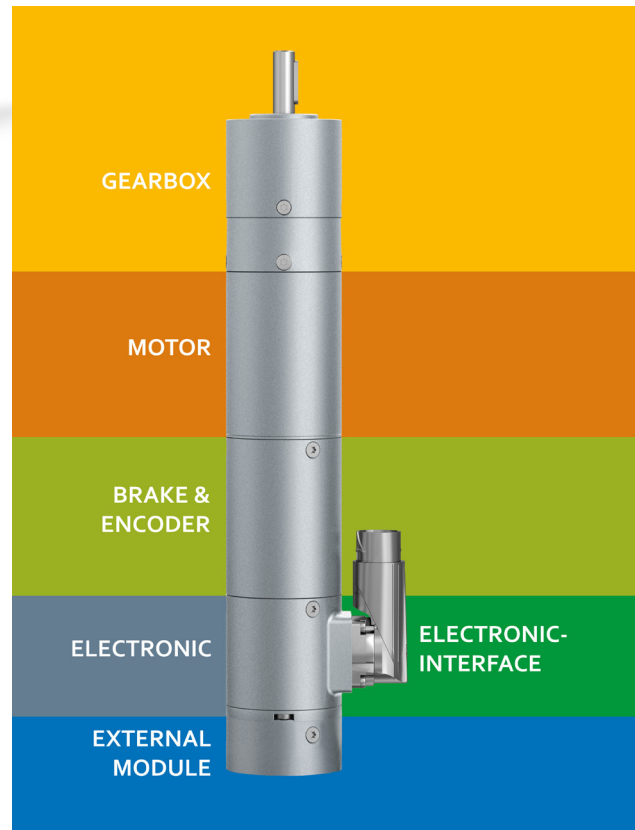


Figure 3: The modular drive system enables standard solutions to be implemented for many applications (Source: EBM-Papst)

CANopen drive

Miniaturization and distributed intelligence are also current trends in plant engineering. Users are looking for compact, Industry-4.0-compatible drives that receive commands from higher-level controller via a network and return actual values and status to the control system. The compact ECI 63.xx K5 brushless DC motor with integrated electronics is suitable for demands in plant engineering. Variants with 180 W to 370 W are available.

As soon as the number of nodes in a system increases the proven CANopen device is the solution of choice. Systems interconnected via standardized CANopen interfaces offer cost advantages with regard to hardware and implementation. The integrated K5 electronics module equips the ECI 63.xx motor with a standardized CANopen interface. The drive implements the CiA 402 CANopen device profile for drives and motion control also internationally standardized in IEC 61800-7-201/-301. Supported are the operating modes for positioning, speed, current, and torque control. Interpolated positioning for cyclical set value requirements is also possible. Standardized homing methods and reduced-speed travel to mechanical stop (blockade) can be used to reference the drive position. An encoder system is integrated to resolve the drive shaft positioning as a 12-bit value.

Due to the integrated K5 electronics module, the drive is programmable like a PLC. Thus, it relieves the higher-level control system or can replace it in some cases. In CANopen networks, it can be used as a

CANopen NMT (network management) manager enabling standalone applications without a higher-level PLC. This allows to reduce system costs.

Using the Eptools startup and parameterization software, the drive can be configured via CANopen using a PC. The common parameters are visualized in the configuration window. Additional parameters can be added to the GUI (graphical user interface) and uploaded to the drive. The configured parameters set can be saved on a PC. The status window displays the relevant drive measurements and status information. In the activation window, users can operate the drive in various operating modes, enable the controller, and specify set values directly. They can also set digital inputs and outputs. Application-specific programs for integrated control can be compiled in a further window and uploaded to the drive.

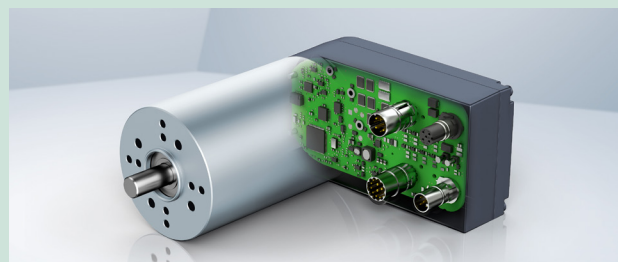


Figure: The ECI63 motor with an integrated electronics module provides a standardized CANopen interface (Source: EBM-Papst)

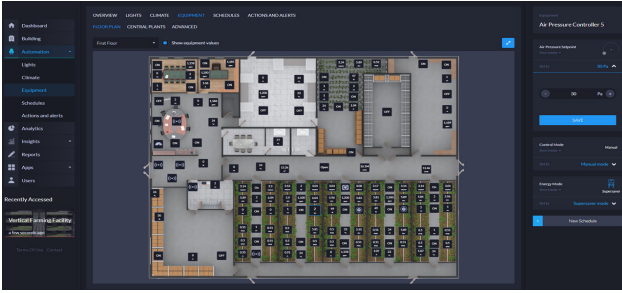


Figure 4: Digital services help to monitor growth conditions, initiate targeted changes, or quickly eliminate problems (Source: EBM-Papst)

quickly eliminate problems if required. EBM-Papst helps to achieve this using its digital services. Sensors and hubs ensure that all necessary data is digitized, whether it is the status of technical systems or monitoring of the air and water quality. This enables the data on air conditioning, nutrient supply, or lighting to be visualized in real time. For example, using an app, it is also possible to test settings or automatically receive current messages on a cell phone. The specially developed cloud applications provide the appropriate information and control options to optimize production and make it economical and sustainable. ◀

ratio of the high-speed internal rotor motors. The modular drive system enables standard solutions to be implemented for many applications. For example, the ECI internal rotor motors are suited for use as shuttle traction drives, depending on the required power either in size 63 mm or 80 mm. They achieve high torques at 24 V_{DC} or 48 V_{DC}, and are able to deliver three times the nominal power for a short time. The K5 electronics module with a CANopen communication interface is installed in the drive. It enables the drive system to communicate with other connected drives or a PLC (programmable logic controller).

Real-time production monitoring

For a high-yield harvest, the conditions for growth must be continually monitored to initiate targeted changes or



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