Terminology

EC Fans

JOHNSON ELECTRIC

Introduction

Johnson Electric EC fans offer adjustable speed settings, allowing fine-tuning of airflow to match different ventilation needs.

Types of speed control include:

- **O-10v**
- **Pulse Width Modulation (PWM)**
- **Universal Asynchronous Receiver-Transmitter (UART)**
- **Field Oriented Control (FOC)**

JOHNSON ELECTRIC

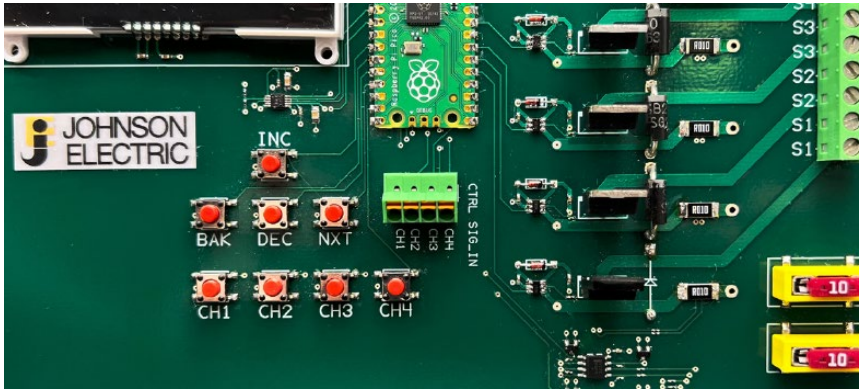
Deep Dive

EC Fan Speed Control

JOHNSON ELECTRIC

0-10v Control

The term "0-10V for EC fan" refers to a common method of controlling the speed of an (EC) fan using a 0-10V analog signal. This control method is widely used in various industrial and commercial applications to adjust the fan's speed based on external inputs or system requirements.



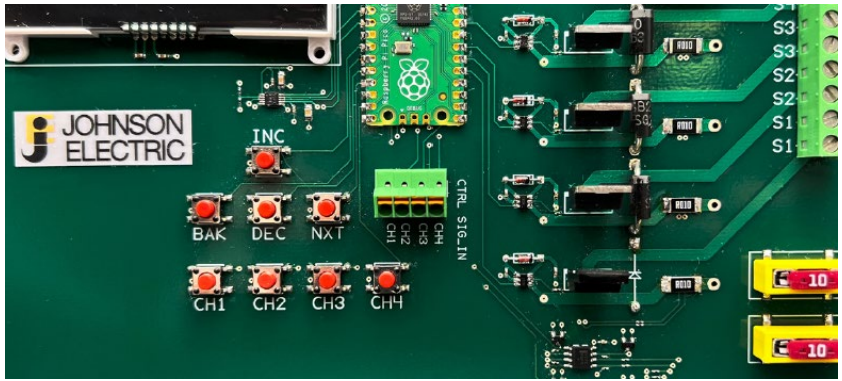
JOHNSON ELECTRIC

How 0-10v works for an EC Fan

- **Voltage Signal**
  - The 0-10V control system generates an analog voltage signal that varies between 0 volts (representing 0% speed) and 10 volts (representing 100% speed).
- **Speed Regulation**
  - The EC fan's motor controller receives the analog voltage signal as an input. Based on the voltage level it receives, the controller adjusts the fan's speed accordingly. For example, a 5V signal would correspond to 50% of the fan's maximum speed.
- **Linear Relationship**
  - The relationship between the voltage signal and the fan's speed is usually linear. That means the fan's speed increases or decreases proportionally to the voltage level in the 0-10V range.
- **External Control**
  - The 0-10V control allows for external control of the fan's speed. It means that other systems or devices (e.g., building management systems, thermostats, or sensors) can provide the voltage signal to regulate the fan's speed based on various conditions such as temperature, humidity, or user preferences.
- **Versatility**
  - Using the 0-10V control method provides flexibility in integrating the EC fan into various HVAC (Heating, Ventilation, and Air Conditioning) and industrial systems. It allows for centralized control of multiple fans, which is particularly beneficial in large-scale applications.
- **Energy Efficiency**
  - One of the significant advantages of EC fans with 0-10V control is their energy efficiency. By adjusting the fan's speed based on actual demand, the fan consumes only the necessary amount of power, resulting in energy savings and reduced operating costs.

JOHNSON ELECTRIC

Pulse Width Modulation (PWM) Control



PWM for EC fan is another common method of controlling the speed of an Electronically Commutated (EC) fan. PWM is a digital control technique that uses square-wave pulses to regulate the fan's speed, and it is widely used in various applications where precise speed control is required.

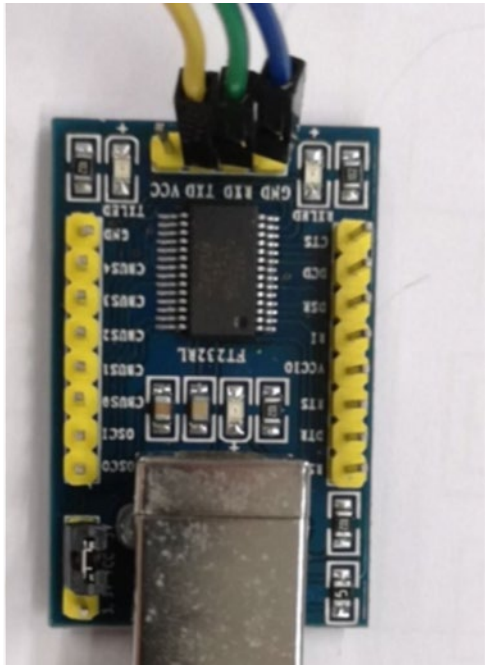
JOHNSON ELECTRIC

How PWM works for an EC Fan

- **Digital Signal**
  - PWM control generates a digital signal that consists of a series of square-wave pulses. The duty cycle of these pulses determines the fan's speed.
- **Duty Cycle**
  - The duty cycle represents the percentage of time the signal is in its high state (ON) compared to the total period of the pulse. For example, a 50% duty cycle means the signal is ON for 50% of the time and OFF for the other 50%.
- **Speed Regulation**
  - The EC fan's motor controller receives the PWM signal as an input. Based on the duty cycle of the pulses, the controller adjusts the fan's speed accordingly. A higher duty cycle means the fan runs at a higher speed, while a lower duty cycle slows down the fan.
- **Linear Relationship**
  - Like the 0-10V control, the relationship between the duty cycle and the fan's speed is usually linear. The fan's speed increases or decreases proportionally to the duty cycle.
- **Precision and Flexibility**
  - PWM control offers precise speed regulation and allows for fine-tuning the fan's performance. It can be easily integrated with digital control systems and microcontrollers, providing flexibility in fan speed adjustment.
- **Pulse Frequency**
  - The frequency at which the pulses are generated is also essential. Higher pulse frequencies provide smoother and quieter fan operation, reducing audible noise and potential vibrations.
- **Dynamic Response**
  - EC fans with PWM control offer excellent dynamic response, enabling rapid speed adjustments in response to changing conditions or system requirements.

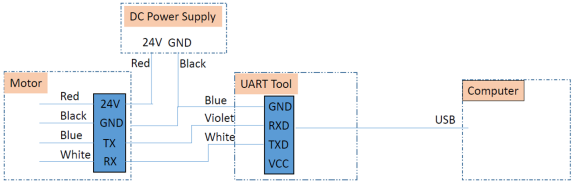
Universal Asynchronous Receiver-Transmitter (UART) Control

In the context of EC fans, UART is a communication protocol and interface that enables control and communication between the fan and a controlling device, such as a microcontroller or a computer, through serial communication. This allows for real-time adjustments of fan speed, direction, and other parameters, enhancing the precision and efficiency of the fan's operation in various applications like HVAC systems, electronics cooling, and more.



JOHNSON ELECTRIC

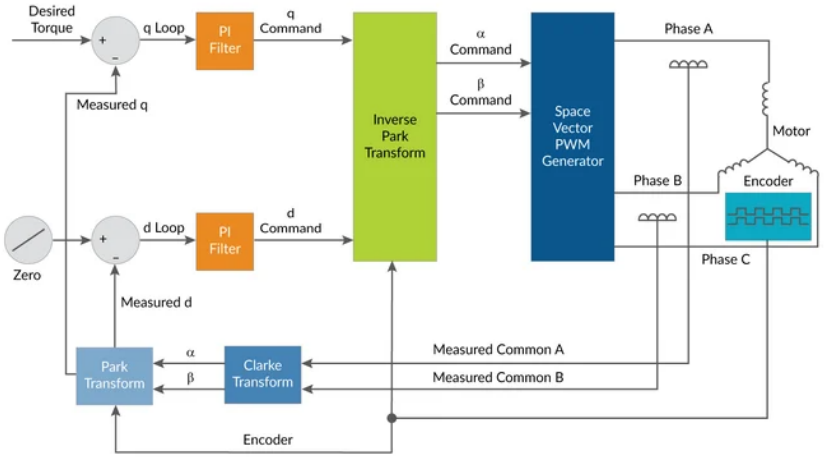
How UART works for an EC Fan



- **Hardware Connection**
  - The EC fan is equipped with a microcontroller or control circuit that supports UART communication. This microcontroller has UART transmit (TX) and receive (RX) pins, which are connected to the corresponding TX and RX pins on the controlling device (e.g., microcontroller, computer, or control board).
- **Serial Data Communication**
  - UART operates using a simple serial communication protocol, which involves sending and receiving individual bits of data one after another. The communication consists of a start bit, a fixed number of data bits (typically 8 bits), an optional parity bit for error checking, and a stop bit. Since EC fans operate asynchronously, they don't require a separate clock signal.
- **Data Transmission**
  - To control the EC fan, the controlling device sends commands or control parameters using the UART interface. These commands might include instructions to set the fan speed, change the direction of rotation, enable or disable specific features, and more.
- **Data Reception**
  - The EC fan's microcontroller receives the serial data through the RX pin and processes the received commands. It interprets the commands and adjusts the fan's operation accordingly. This could involve changing the voltage or current supplied to the fan's motor, altering the pulse-width modulation (PWM) duty cycle, or adjusting other parameters based on the control command.
- **Feedback and Monitoring**
  - Many EC fans also support bi-directional UART communication, allowing the fan to send feedback and status information back to the controlling device. This enables real-time monitoring of the fan's operating conditions, such as its current speed, temperature, and any potential faults or errors.

JOHNSON ELECTRIC

Field Oriented Control (FOC) Control



FOC is a control strategy used in motor control systems, including those for EC fans, to achieve efficient and precise control of motor speed and torque. In the context of EC fans, FOC involves aligning the stator current with the rotor magnetic field to optimize motor performance and efficiency.

JOHNSON ELECTRIC

How FOC works for an EC Fan

- **Sensing Rotor Position**
  - FOC requires information about the rotor position to accurately control the motor. Some EC fans use position sensors (such as encoders or Hall effect sensors) to provide this information. These sensors help determine the position of the rotor's magnetic field.
- **Transforming Coordinates**
  - FOC involves transforming the coordinates of the motor currents from the stationary reference frame (where the windings are fixed) to the rotating reference frame (aligned with the rotor magnetic field). This transformation simplifies control calculations.
- **Control of Currents**
  - In FOC, the motor's current components are controlled independently: the torque-producing "q-axis" current and the "d-axis" current. The "q-axis" current generates torque, while the "d-axis" current helps control the motor's magnetic flux.
- **Current Regulation**
  - FOC uses control algorithms to adjust the "q-axis" and "d-axis" currents in response to the desired torque and speed. By adjusting these currents, the control system can achieve the desired motor performance while minimizing energy losses.
- **Sensorless Control**
  - Some EC fans use sensorless FOC, which eliminates the need for external rotor position sensors. Instead, the control system estimates the rotor position based on the motor's electrical characteristics and back EMF (electromotive force).
- **Efficiency and Performance**
  - FOC allows for smoother control of motor speed and torque, reducing torque ripple and improving energy efficiency. It enables precise control across a wide range of operating conditions and provides better performance compared to traditional control methods.

JOHNSON ELECTRIC

For More Information

Contact us: Ventilationus@johnsonelectric.com

JOHNSON ELECTRIC