MachineDesign

Top Tips

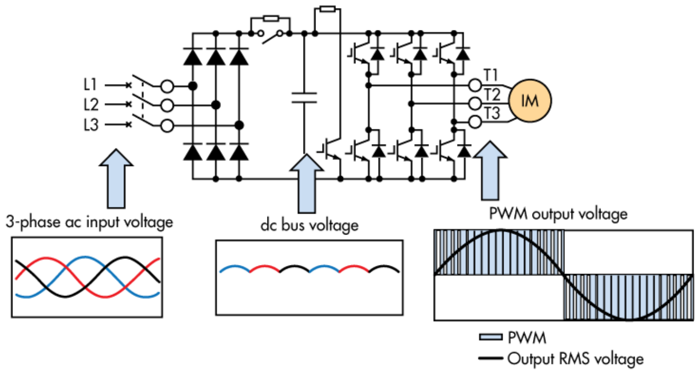
Understanding and Using Matrix Drive Technology

Whether used in simple applications like pumps and fans or more complicated applications like winders and dynamometers, Variable Speed Drives (VSDs) need to provide new and improved process control, while also boosting power factor and overall system efficiency. This requires the clean and efficient use of line power—something Matrix Drive Technology can provide.

1 Understand the basic method used by conventional drives for power conversion.

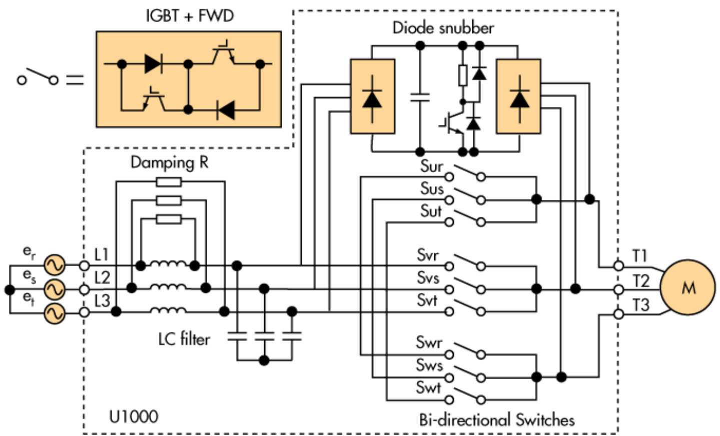
A conventional drive converts ac to dc using diodes, which only conduct when the voltage at the anode (ac side) is greater than the cathode (dc side). Because dc generated from a diode rectifier is not uniform (only the peaks of the ac input voltages are higher than the dc supply) a dc ripple occurs from the conversion process. Therefore, a conventional drive is forced to incorporate a large number of electrolytic capacitors to smooth the dc ripple.

This smoothed dc voltage is used to generate an output voltage waveform to control a motor at the requested frequency. The output is a pulsed dc voltage waveform known as pulse width modulation (PWM). These pulses are filtered by the impedance of the motor, which allows the motor to react to the PWM voltage as if it were sinusoidal.



2 Understand the matrix difference.

Unlike conventional VSDs that convert ac to dc through a rectifier and then back to an ac output suitable for control, Matrix Drives use a system of nine bi-directional switches (IGBTs) to convert a three-phase ac input voltage *directly* into a three-phase ac output voltage. A compact input PWM filter isolates the switches from the supply and mitigates the regenerative PWM waveform to provide a clean sine wave back to the line.



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Understand the makeup of a matrix drive.

Breaking down the Matrix drive can help to better understand how it works. The Matrix drive can be described as using three sets of matrices, each of which connects between the input power and one output phase. The matrix consists of three of the nine bi-directional IGBTs. A simple way to think of this is that the supply voltage is outputted to the motor by closing one of the three IGBTs. Therefore, no more than one IGBT can be turned ON at the same time. Since each of the matrices represents a connection to only one output phase, the drive incorporates three sets of matrices for each output phase to the motor.

All three matrices are also connected to the same power source; therefore, each input phase can be connected at a common point simplifying the overall circuit. Plus, each motor phase has independent access to the line. This is how the matrix drive achieves its three-wire input and three-wire output power wiring capability.

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Understand the advantages of matrix drives.

Unlike other harmonic current solutions, the matrix drive does not force current into the drive to reduce harmonics. The drive draws current with low harmonic content naturally. This allows the matrix drive to operate at rated power with less than 5% iTHD at the input of the drive with a near unity power factor of 0.98 or better at rated load. The matrix drive is an all-around green solution. This means that the matrix drive's input current draw contains low harmonics throughout the load profile. The low harmonic capabilities of the matrix drive easily facilitates IEEE 519 compliance.

Other advantages include full continuous regeneration; compact size; higher efficiency compared to equivalent performing systems; across-the-line operation through the drive; and induction motor and permanent magnet motor control.

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Understand the breadth of applications that could benefit from matrix drives.

Matrix drives are suitable for applications where reducing input current harmonics, boosting power factor, and/or simplifying installation are critical requirements prior to purchase. Two common applications that benefit from these specific Matrix drive attributes are pumps and fans. Matrix drives are also useful for applications that experience regeneration, such as test dynamometers. Regenerative energy is seamlessly and automatically put back onto the line by the matrix drive to be distributed to other loads on the system and reduce utility billing. Depending on the regenerative application, users may also desire reduced harmonics, reduced size, and a boost in efficiency.