design FAQs

Yaskawa Matrix Drives

FREQUENTLY ASKED QUESTIONS

Q: What are the benefits of matrix drives and how are they different from conventional drives?

A. Matrix drives create a variable output by switching directly from the input power and by providing direct AC to AC conversion. This differs from conventional drives since they require a DC bus for AC conversion whereas matrix drives do not. While conventional drives have a good displacement power factor and are compact by themselves, they provide poor input harmonics, lose significant amounts of energy via the DC bus, lack power regeneration, and require other accessories to provide clean power making the overall system very large. Matrix drives lower input harmonics; diminishing distortion to 3 to 5% producing an improved waveform. This is a significant reduction when compared to conventional AC drives that range from approximately 35 – 90%, depending on design. Matrix drives also create energy savings by energy regeneration. Power that is not utilized is returned to main power source instead of being lost.

Q: When does harmonic distortion become important?

A. As nonlinear loads (harmonic producers) consume a significant portion of the power system, other system components experience additional stress. For example, a total nonlinear load of 100HP will cause problems on a small power system. In contrast, the same 100HP nonlinear load might be negligible on a very large power system.

Harmonic distortion also affects Power Factor – the amount of power actually transferred to the load. With harmonics present, True Power Factor is inversely proportional to distortion levels; therefore, low harmonic distortion = High (good) true power factor = improved system efficiency.

Q: How does a matrix drive system achieve lower harmonics?

A. A matrix drive achieves lower harmonics by combining active switching from the power source along with integrated input filtering. This combination results in very low current distortion, making IEEE-519 system compliance very achievable without the use of additional harmonic countermeasures.

Q: In what cases does power regeneration become important?

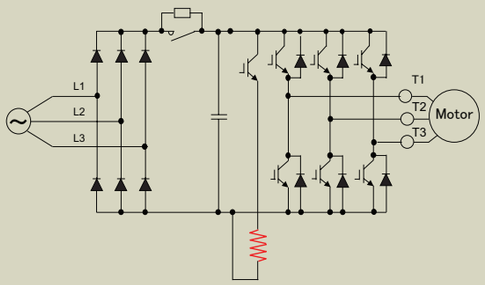
A. A wide variety of applications can benefit from regeneration back to the power system. Examples of high cycle applications, where heavy loads must suddenly start and stop, are elevators and machine tool spindles. Large fans and centrifuges are low cycle applications, but with very large inertia, and therefore a large amount of energy to return to the power system less frequently.

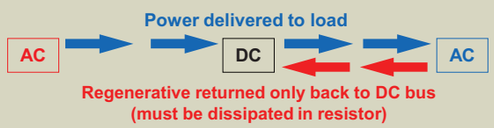
Eccentric loads, like oil field pumps and punch presses, contain sudden and regular load forces that also cause backwards power flow. Additionally, some applications continuously regenerate for long periods, such as unwinders and downhill conveyors.

Q: How do matrix drives help improve the overall system?

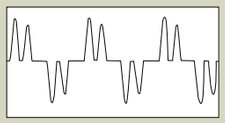
A. Matrix drives provide a highly efficient and compact solution for low harmonic distortion and/or full regeneration. Not only do Matrix drives avoid the high cost and complexity of component based systems such as multi-pulse topologies and regenerative rectifiers, but physical space savings are often 50% or more. Energy savings from regenerative applications often result in payback of less than 1 year. ■

Conventional Drive Topology

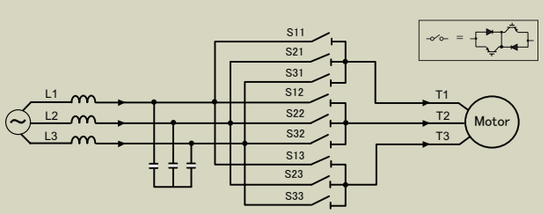


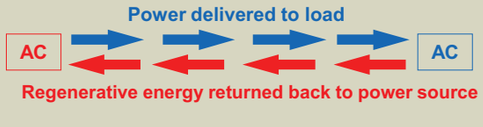


Typical Input Current Waveform
(significant harmonic distortion)

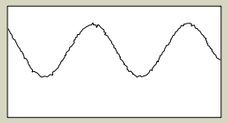


Matrix Drive Topology





Typical Input Current Waveform
(very low harmonic distortion)



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