

# New ways to improve productivity for heavy industries

PowerFlex® 6000 and 7000 medium voltage AC drives.  
Powerful performance. Flexible control.



**Allen-Bradley**

by ROCKWELL AUTOMATION



# The PowerFlex advantage

From complex, high-throughput automotive plants to oil and gas operations in remote and harsh locations, PowerFlex drives are trusted in the most demanding applications and by many of the world's biggest brands.

And it's not just the reliable performance of the drive that keeps production running. Smart PowerFlex drives also help predict downtime before it happens. Plus, integrated safety can reduce failure points. Efficient motor control reduces energy costs. And our unparalleled support is available to help solve your challenges.



## Application expertise

With thousands of applications in a wide variety of industries, our medium voltage drives deliver results that you can rely on. Our application and test engineers, project management teams, and field service engineers develop and deliver smart solutions.



## Connected insights

Our medium voltage drives offer built-in EtherNet/IP communication and support other typically used communication protocols. Flexible connectivity and control system compatibility helps deliver seamless control system integration. And access to real-time data lets you make decisions to improve safety, production and uptime.



## Exceptional quality & safety

Quality has always been a signature of the Allen-Bradley® brand. Our drive portfolio meets all relevant global UL and IEC standards. Arc-resistant enclosure options and functional safety options help optimize the safety for your personnel and processes.



## Reduced cyber risk

Increase security for your smart machines, network and equipment. CIP Security-enabled PowerFlex 6000T drives help improve the cyber security of your plant. A secure transport layer in the EtherNet/IP network helps protect from malicious communication.



## Easy drive integration

Whether you're designing, integrating or installing a machine or production line, time counts. Easy integration between our technologies with Studio 5000® and Connected Components Workbench™ software tools can save time and money – from programming to installation. Drives can also easily integrate into all common FactoryTalk® services via Common Data Models in the drive.

With this integration, smart PowerFlex VFDs provide constant information about drive health and process parameters to your control system.



## Proven reliability

Robust design guidelines, reliable components, low parts count, control power ride-through, and automatic restart capabilities inherently increase uptime. Redundant critical components and bypass options, coupled with factory testing on a dynamometer before shipment, all contribute to improved reliability.



## Energy efficiency

Eco design cooling fans and high efficiency isolation transformers maximize system efficiency and lower operating costs. Transformerless configurations help deliver the highest system efficiency.



## Global support

Our extensive installed base is supported by a worldwide service and support network to help wherever and whenever you need it.



# Common industries and applications

We support high-efficiency motor applications with up to 120 Hz output frequency. Plus, we offer power regeneration and arc-resistant drive solutions.

## Oil & gas

- Oil pipeline pumps
- Natural gas pipeline compressors
- Electrical submersible pumps
- Induced draft fans

## Power generation

- Feedwater pumps
- Induced draft fans
- Forced draft fans

## Forest products

- Fan pumps
- Induced draft fans
- Boiler feedwater pumps
- Pulpers
- Refiners

## Marine

- Main propulsion
- Positioning thrusters

## Water / wastewater

- Raw sewage pumps
- Effluent pumps
- Low service/raw water pumps
- High service/finished water pumps
- Aeration blowers
- Flood control pumps

## Commercial

- HVAC/OEM chillers/compressors
- Airport cogeneration
- Hospital cogeneration
- University cogeneration

## Mining, steel & cement

- Slurry pumps
- Ventilation fans
- Descaling pumps
- Conveyors
- Induced draft fans
- Mills

## More

- Test stands
- Wind tunnels
- Agitators
- Rubber mixers



# Selecting the right drive for your application



Choose a medium voltage drive based on your application requirements.

## All-purpose drives

Includes the performance characteristics required to operate fans, pumps, compressors, conveyors and mills and high-speed applications up to 120 Hz.

## Special-purpose

Includes enhanced characteristics to operate specialty applications such as conveyors, ball and sag mills, extruders and mixers.

Category	All-Purpose	Special-Purpose
	<p>PowerFlex 6000 Drives</p> 	<p>PowerFlex 7000 Drives</p> 
Typical Applications	Fans, Pumps, Compressors, Conveyors, Mills and Chillers	Fans, Pumps, Compressors, Chillers, Hoists, Cranes, Conveyors, Mixers, Extruders, Ball and SAG Mills, Electrical Submersible Pumps
Drive Cooling	Air	Air or Liquid
Topology	Cascaded H-Bridge	CSI PWM
Rectifier Type	18...54 Pulse Diode*	Active Front End SGCT or 18-Pulse SCR
Inverter Type	IGBT	SGCT
Power Range	100...11,000 kW (150...15,000 Hp)	150...6300 kW (200...8500 Hp)
Output Voltage	2.3...11 kV	2.3...6.6 kV
Output Frequency	0.3/0.6**...120 Hz	0.1**...90 Hz
Direction - Torque	Forward and Reverse, Motoring	Forward and Reverse, Motoring and Regeneration
Type of Motor	Induction and Permanent Magnet	Induction and Synchronous

\* Optional 72 Pulse up to 4.16 kV

\*\* With encoder



# PowerFlex 6000T AC drives

Smart. Reliable. Easy to integrate.

## A common control architecture with TotalFORCE® technology

TotalFORCE technology provides motor control through precise, adaptive control of velocity and torque. Plus, uses predictive maintenance alerts to ensure maximum drive and process uptime.

## PowerFlex 6000T medium voltage drives

- Support high-efficiency motor applications (including permanent magnet motors) up to 120 Hz output frequency
- Connected Components Workbench software full device profile support. Easy to configure, program and visualize in a single multi-language software package. Built-in EtherNet/IP communications
- Five option slots, with three flexible slots to easily add or reconfigure cards to suit process needs, like ENETR for Ethernet, 13TCOMMP1 for Profibus, Encoder Cards, I/O Module, etc.
- Simplified and intuitive local control, monitoring and diagnostics with a 10-inch (254 mm) color touch screen HIM that supports multiple languages
- Real-time alerts are available to monitor the device health
- Extensive input power monitoring functionality for kW, kVA, kVAR, elapsed kWh, MWh and power factor
- Quick and secure flash-over-fiber firmware updates for all main control boards and power cells from a single file
- More comprehensive and faster troubleshooting with Forensic Data Recorder functionality

**PowerFlex 6000T drives** are well suited for all-purpose, non-regenerative applications such as fans, pumps, mills, conveyors and compressors. They are an ideal solution motor control applications from 100...11,000 kW (150...15,000 Hp) and for motors rated from 2.3...11 kV.

Air-cooled PowerFlex 6000T drives are designed to maximize energy efficiency by enabling soft-starting and variable-speed control in normal-duty and heavy-duty applications.

To achieve low input harmonics and near-unity power factor, the drives use a Cascaded "H" Bridge topology. This topology combines an integrally mounted phase-shifting isolation transformer with series-connected power cells for each phase.

PowerFlex 6000T AC drives are available in many configurations based on motor voltage.

- Multiple control modes, including flux vector control – featuring up to 150% starting torque with an encoder
- Simple, air-cooled design at all voltage and power ratings
- Eco design main cooling fans provide higher efficiency and reduces losses
- Integrally mounted multi-pulse isolation transformer helps ensure low line-side harmonics
- Automatic power cell bypass helps minimize downtime in your critical applications
- Common modular power cells designed for easy removal, minimizing Mean Time To Repair
- Conserve space with secondary pre-charge support housed within the existing footprint



# TotalFORCE technology helps improve productivity, visibility and uptime

## Total command on one platform

Simplify your integration and operating experience with PowerFlex 6000T medium voltage drives. They share the same control hardware, firmware and network interface software as our latest generation of PowerFlex 755T low voltage drives.

Using a common control platform across your entire installed base of drives lowers integration, operation, training and spare parts costs.

## Total control over your motors

TotalFORCE technology provides motor control through precise, adaptive control of velocity and torque.

With excellent tracking, the drives follow speed or torque commands very closely. Plus, the combination of adaptive tuning, load observer and bus observer reduce commissioning time at start up and monitor your machine characteristics as your equipment operates.

As your machine's operating characteristics change over time,

the drives automatically adjust to compensate for these changes. This capability helps reduce mechanical wear and keeps your operation running at optimal production.

In addition, adaptive control features help isolate potentially harmful vibration and compensate for variances to help keep your application running.

## Total visibility into the health of drive components

PowerFlex 6000T drives continuously monitor operation, tracking the health of electrical components in the drive and motor to provide real-time diagnostic information to your control system. This helps you predict equipment failures and take action to prevent unplanned downtime.

### Set predictive alerts for:

- Transformers, air flow, motors and machine bearings and lubrication
- Runtime alerts for critical components

\*Requires initial setup based on system design

## Leverage digital advantages of the 6000T drive

- Easy integration to Rockwell Automation services from FactoryTalk suite
- Remote VFD monitoring
- CIP Security compliant to help protect against malicious cyber threats
- Simplified commissioning experience through startup wizards in the HMI, adaptive control option and local language support
- Flexible motor control for single or multi-motor configuration for induction and permanent magnet motors
- Embedded device health updates for critical drive components such as transformer, air filters and fans

## Expand predictive maintenance to your plant

By combining FactoryTalk®Analytics™ GuardianAI™ with PowerFlex 6000T VFDs, you can get an unprecedented view into the health of your plant assets.

This solution continuously monitors variable frequency drives and plant assets and alerts you to problems before they occur, giving you more time to plan and act. With actionable

insights, you can reduce risk, optimize maintenance plans and keep applications running more reliably.

- Analyze live electrical signal data from your existing PowerFlex 6000T VFDs, at high speeds right at the edge without the overhead of cloud infrastructure
- Predict and identify failures of your pump, fan or blower
- Get notifications of flow restrictions, cavitation, loose mounting, blade misalignments, bearing faults, etc.



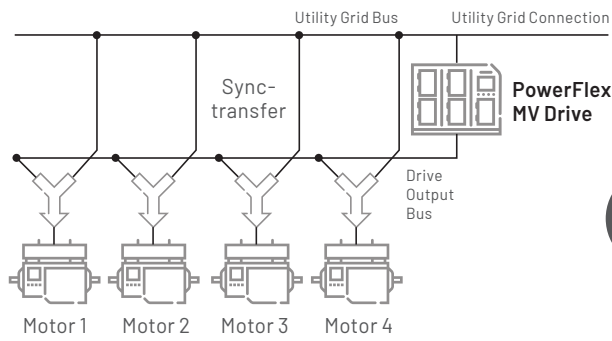
# Maximize efficiency, conserve energy and reduce hardware costs with sync-transfer control

Synchronous transfer is used for controlled starting and speed control of multiple motors, with just one drive.

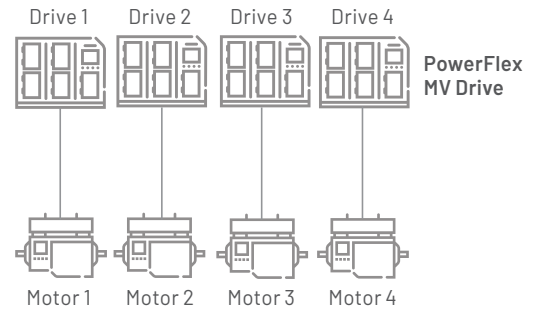
The drive can be used for soft-starting large motors to limit inrush current or for speed control of multiple motors, one at a time, as required by your operating conditions. Synchronous transfer helps limit mechanical wear and tear on the motor, which prolongs the life of the motor. It also reduces your investment and operating costs.

- Available from 2.3...11 kV
- Start up to 10 motors with one drive, up to a maximum of 680 A for each motor (totaling up to 3000 A)
- Provides bumpless transfer using either open or closed transition (optional)
- Ideal for natural gas or oil pipeline applications

## Sync-transfer system design architecture



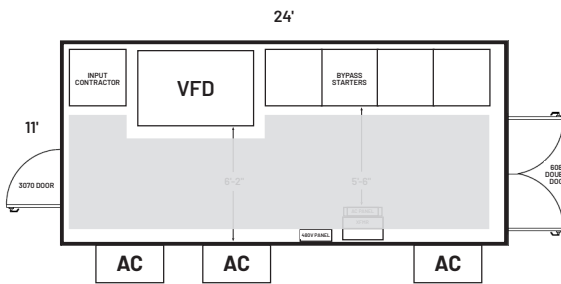
1 medium voltage drive and sync-transfer system for 4 motors



4 medium voltage drives for 4 motors

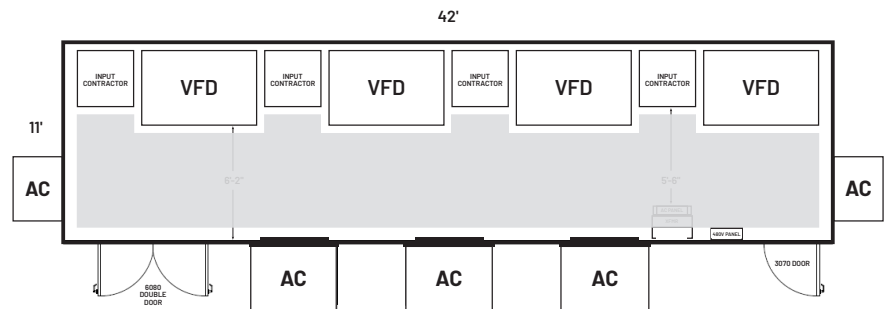


## A 4-motor sync-transfer system ehouse



- 24 x 11 ft (7.3 x 3.4 m) footprint
- 35,000 lbs (15,900 kg) equip. installed
- 3 x 6-ton air conditioning units

## Space requirements for 4 VFDs in an ehouse



- 42 x 11 ft (12.8 x 3.4 m) footprint
- 72,000 lbs (32,700 kg) equip. installed
- 5 x 12.5-ton air conditioning units



# Take advantage of the top five sync-transfer control benefits

## Save money

- Reduce hardware cost by up to 50%
- Reduce size and cost of an ehouse by up to 50%

## Save time

Reduce project time associated with multiple-drive systems

- Specifying
- Purchasing
- Manufacturing
- Labor
- Shipping
- Installing
- Testing
- Commissioning
- Maintenance
- Spare parts

## Save energy

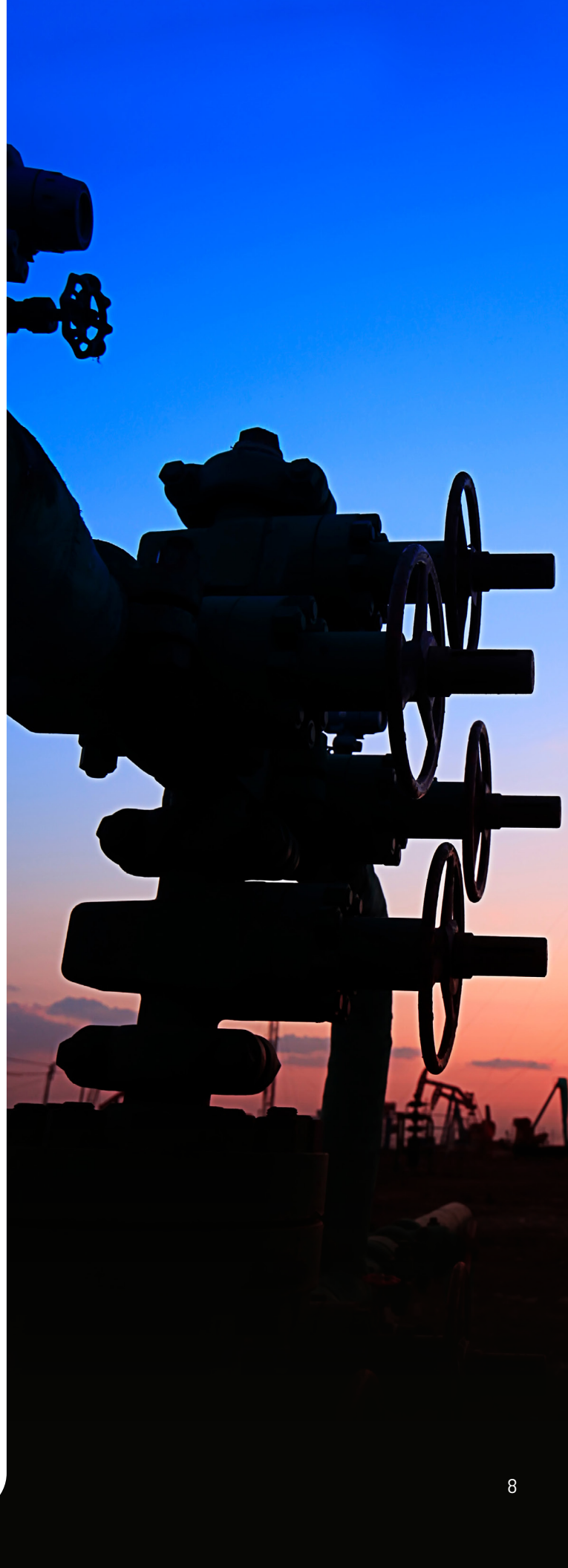
- Reduce peak energy charges
- Reduce air conditioning equipment size, cost and energy use up to 60%
- Match power output to utility's line power with seamless sync-up and sync-down transition

## Increase productivity

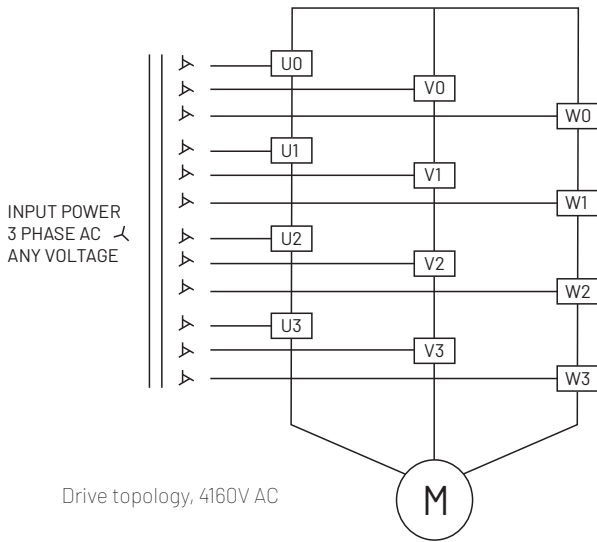
- Simplify control system setup and integration
- Eliminating current and torque transients increases process uptime
- Built-in VFD bypass and redundancy capabilities

## Improve sustainability

- Reduce impact on the environment
- Increase infrastructure efficiency
- Reduce peak energy consumption
- Extend motor and equipment life
- Responsible supply chain management







### An automatic power cell bypass is available within the existing footprint

In the unlikely event of a power cell failure, the automatic power cell bypass option allows the PowerFlex 6000T drive to bypass that power cell, along with the corresponding power cells in the other two phases, so that the drive will remain running at a reduced capacity, providing time to plan for a scheduled shut-down.

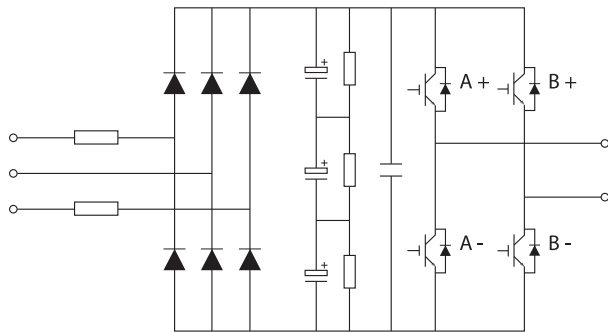
- Helps maximize uptime in your critical applications
- Solid-state bypass circuit reduces process interruption time

### Cascaded "H" bridge (CHB) topology

The proven CHB topology combines an integrally mounted phase-shifting isolation transformer and series-connected power cells for each phase.

In addition to stepping down the input voltage, the isolation transformer also provides two other principal functions:

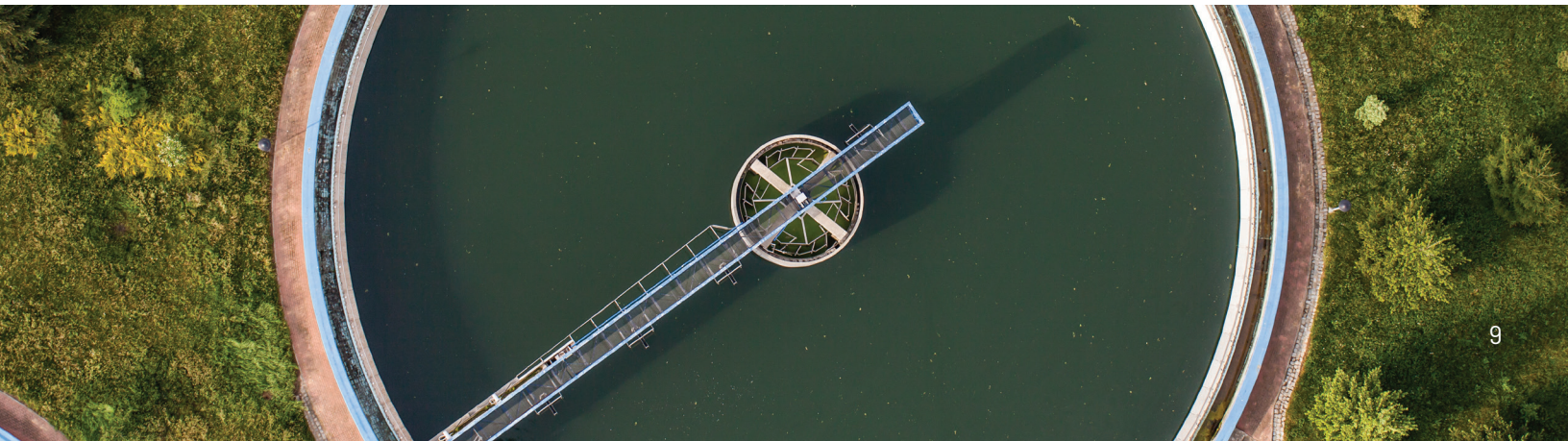
- Mitigate common mode voltage stress, so motors with standard insulation levels can be used
- Reduce total harmonic distortion, due to the phase shifting of its secondary windings, so input side harmonics don't negatively impact the plant or utility power grid



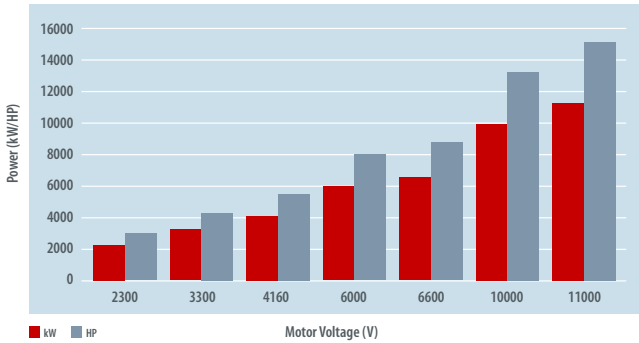
Standard power cell

A number of identical low voltage power cells are series-connected (cascaded) together to produce the medium voltage levels required to operate the motor. The voltage step for each power cell is relatively small and a pulse width modulation switching pattern is used so output harmonics and torque pulsations at the motor are minimal, even at lower speeds. This technology allows standard motors to be used for new applications and it is ideal for retrofitting existing motors. This allows for longer motor cable lengths, without the requirement for output filtering.

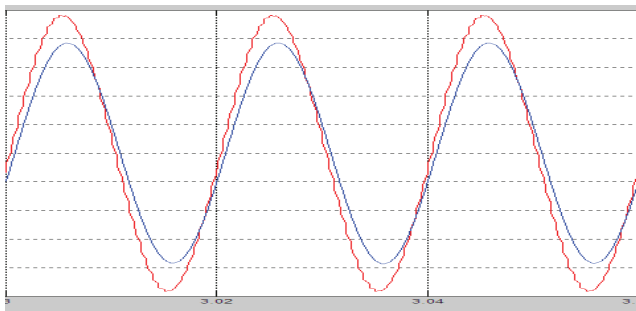
This power cell concept makes maintenance quick and easy. Each power cell has built-in diagnostics to identify and isolate a cell needing replacement, in the unlikely event of a failure. This minimizes power cell replacement time, so process uptime is maximized. A number of system bypass options are also available.



## PowerFlex 6000T maximum power vs. voltage rating



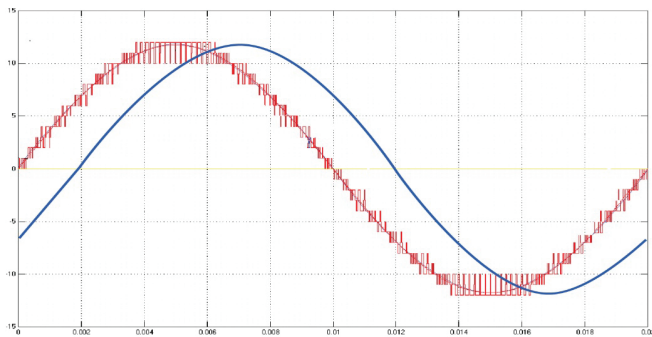
## Line side waveforms



6.6 kV Input (36 Pulse) — Phase Current — Phase-to-Phase Voltage

Power system friendly input current and voltage waveforms comply with IEEE 519-2014 Harmonic Guidelines.

## Motor waveforms



6.6 kV Output — U Phase Current — U-V Phase Voltage

Motor friendly current and voltage waveforms are suitable for operation with new or existing standard motors. Inverter duty motors not required.

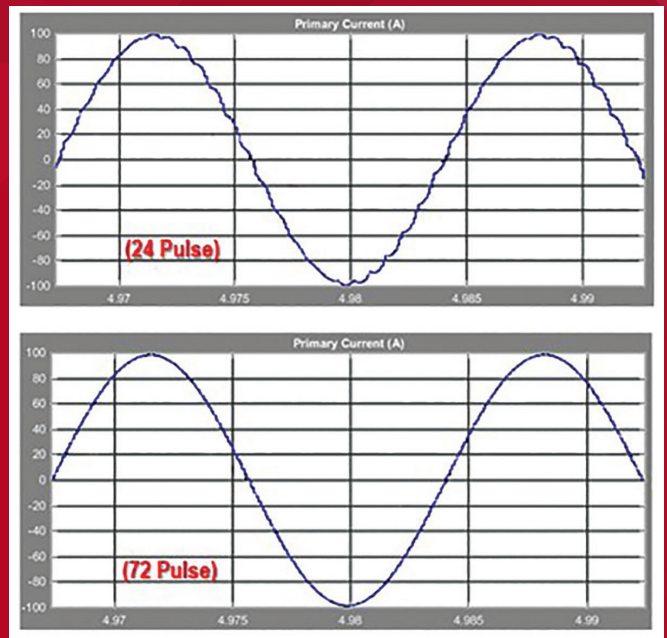
# Reduce input harmonics with the RealSine™ solution

Improve system efficiency, reduce energy costs and minimize power distribution issues.

Available from 2.4...4.16 kV up to 215 A, without changing the number of drive transformer secondary windings, each secondary winding is specially phase-shifted to achieve 54 pulse or 72 pulse respectively, compared to traditional 18 pulse or 24 pulse designs for this voltage range.

This option does not require additional hardware or change the drive footprint.

For 2400V, 3000/3300V or 4160V, the new design offers up to 30% improvement in input Total Harmonic Current Distortion (THDi). A cleaner spectrum improves the drive operational efficiency and makes it more sustainable to the environment.



The comparison of primary current waveform between 24 pulse and 72 pulse.



# PowerFlex 7000 AC drives

Efficient, integrated high-power performance

**PowerFlex 7000 medium voltage AC drives deliver flexibility and high-power performance in a single solution for motor control applications from 150...6300 kW (200...8500 Hp), rated 2.4...6.6 kV.**

To help reduce energy costs and motor wear, PowerFlex 7000 drives enable soft-starting and variable-speed control of processes with high power demands. Our portfolio provides virtually perfect output current and voltage waveforms to allow the use of standard or existing motors and motor cables.

## High performance control, power regeneration and arc flash resistance

- EtherNet/IP communications provide full integration with Logix control platform
- Choose a configuration with Direct-to-Drive™ technology and connect a motor directly to the drive without an isolation transformer
- Features a touchscreen interface to monitor and control your processes
- PowerCage™ inverter and rectifier modules allow SGCT replacement in under 10 minutes
- Sync-transfer architecture lets one VFD control multiple motors
- Provides power regeneration capabilities without additional hardware. Puts energy back to the utility grid. Regenerative braking eliminates the need for braking resistors
- Supports motor cable length up to 30 km (18 mi)
- ArcShield™ arc-resistant enclosures

## The PowerFlex 7000 drive portfolio

### Air-cooled drives

For motors from 150...6000 kW (200...8000 Hp) at 2.4...6.6 kV. This drive offers different frame sizes and heat sink or heat pipe configurations to accommodate various power ranges.

### Liquid-cooled drives

For motors from 2240...6340 kW (3000...8500 Hp\*) at 4.16...6.6 kV. This option uses a closed-loop liquid-cooling system with liquid-to-air or liquid-to-liquid heat exchanger options and provides redundant pumps for optimal reliability.

### Marine drives

With power ratings from 600...24,000 kW (800...32,000 Hp), these liquid-cooled marine drives

use Direct-to-Drive technology to conserve space and weight and are built to withstand the rigors at sea.

### Extended power configurations

Available up to 25,400 kW (34,000 Hp), these high power air- and liquid-cooled drive modules are effective solutions for hot back-up and redundancy, Load Commutated Inverter retrofits and power upgrades.

### Control Options:

- Safe Torque Off
- High performance torque control with TorqProve™ technology
- Synchronous transfer

### Enclosure Options:

- Arc flash resistant enclosures
- IP42

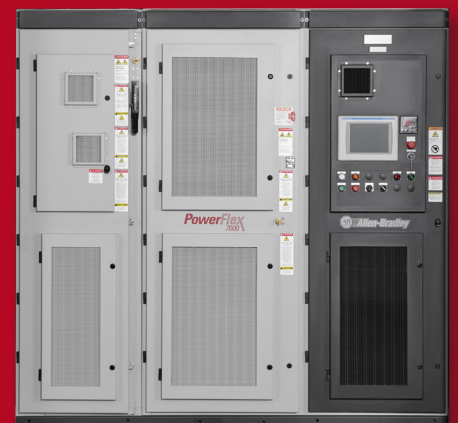
## Control options

### Safe torque off

Help save time and costs through decreased downtime, while helping to protect personnel and property from preventable accidents by increasing the functional safety of your system with Safe Torque Off. This feature is TÜV Certified and helps achieve requirements for SIL 3/PLe/IEC 61508/ISO 13849-1. This option is available for AFE PowerFlex 7000 drives.

### High Performance torque control

PowerFlex 7000 drives offer the option of zero speed holding torque control capabilities and TorqProve control. Ideal for applications such as hoists, drag lines, winches and test stands, the drive can deliver 100% torque at zero speed. This capability helps control torque around zero speed and provides a higher drive speed and torque response required for these applications. This option is available for AFE PowerFlex 7000 drives.



\* Ratings for a single drive channel configuration

# A drive system with ArcShield technology

## Meeting safety standards with an effective design

The PowerFlex 7000 drive system with ArcShield technology is a fully integrated Allen-Bradley CENTERLINE® starter and PowerFlex 7000 drive combination. Standalone, fully integrated systems and systems that are designed to work with existing Allen-Bradley medium voltage starter lineups are available – providing either a 40 kA or 50 kA arc fault rating.

Designed to redirect the energy that is created from an arc flash event, out the top of the enclosure and away from personnel, Type 2B accessibility helps protect personnel while in front, at the side, or behind the enclosure in the event of an arcing fault. Additionally, Type 2B protection is maintained when the low voltage control door is open for maintenance purposes.

- 1 Pressure relief vents direct arc gases and material away from the front, rear and sides of the enclosure during an arc flash.
- 2 Gases and materials are vented up and out of the top of the enclosure through the plenum exhaust system.
- 3 Patented self-closing vent plates prevent arc flash gases from escaping through the fan exhaust vents.
- 4 Cabinet doors are reinforced with welded channels designed to maintain structural integrity during an arc flash.
- 5 Robust cabinet construction, including reinforced side sheets, doors, roof, and back plates are designed to increase rigidity to contain the arc fault energy.
- 6 High strength hinges, latches and bolts securely attach door to cabinet for added protection.
- 7 Patented self-closing vent plates prevent arc flash gases from escaping out through front air intake vents.



Fully integrated 50 kA rated PowerFlex 7000 drive system with ArcShield technology



# The right expertise, at the right time.

Professional and managed services that expand your capabilities to help you achieve business outcomes.



## DIGITAL THREAD

Connect business processes, systems, equipment and products with data

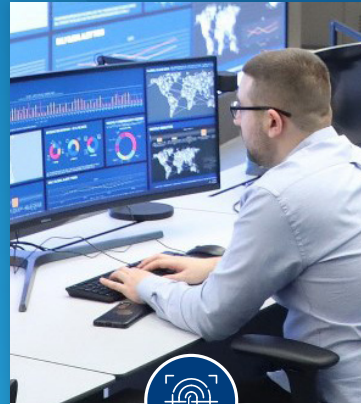
- Digital strategy & organizational change management
- Data science & artificial intelligence
- Manufacturing execution systems (MES)
- Product lifecycle management (PLM)
- Extended reality (AR/VR/MR)
- Supply chain management (SCM)
- Enterprise resource planning (ERP)



## PRODUCTION AUTOMATION

Automate manufacturing and production operations

- Industrial automation control systems
- Distributed control systems (DCS)
- Power systems
- Drive systems
- Safety systems
- Custom/configured panel solutions



## CYBERSECURITY & NETWORK INFRASTRUCTURE

Enable and secure industrial network connectivity

- Industrial cybersecurity
- Industrial network infrastructure & remote support
- Industrial data centers



## ASSET OPTIMIZATION & WORKFORCE

Optimize performance of machines, equipment, systems and people





- Equipment repair & remanufacturing
- Asset & equipment inventory management
- Remote support & monitoring
- On-site & field services
- Safety solutions
- Training & learning

For more information about how we can help you solve your unique business challenges, contact your local authorized Allen-Bradley distributor or Rockwell Automation sales office, or visit: [rok.auto/services](https://www.rockwellautomation.com/rok.auto/services)

Services vary by region.



Learn more about PowerFlex medium voltage drives at [rockwellautomation.com](https://www.rockwellautomation.com)

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[rockwellautomation.com](https://www.rockwellautomation.com)

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