

ENGINEERING  
TOMORROW

*Danfoss*

Crane and hoist movements

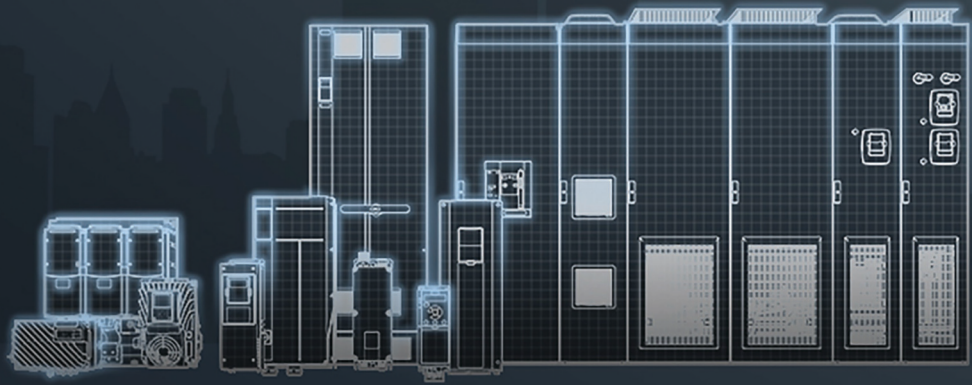
# Safety and performance optimization of industrial cranes

**15%**  
improved  
productivity  
with anti-sway  
functionality

danfoss.com

**VLT** | **VACON**





# Do It **Differently**

At Danfoss Drives, we focus on AC drives. It's what we do best, and it helps you to focus on what you do best.

To ensure you engineer the best possible AC-drive solutions without compromises, and find the optimum outcome for your challenges, we give you the freedom to optimize your systems, the power to equip your drives and the choice to collaborate with your drives partner differently.

You decide the best equipment for your application, we'll make sure the AC drive fits that choice and support you every step along the way.

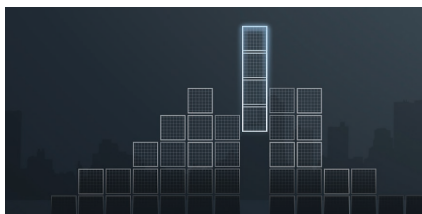


## **Optimize differently**

You have the freedom to optimize and create the system that suits your application best. Whether off the shelf or purpose built, we provide all the support and software necessary so that you can tailor your drive so that its form, fit and function meet your needs exactly.

We offer:

- The widest portfolio of AC drives
- Fast, simple tools for customization
- Programmable drives and special software
- DrivePro® service and maintenance support

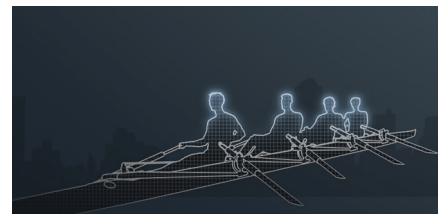


## **Equip differently**

Choosing a Danfoss AC drive gives you the power to configure, modify and combine it with any motor type PLC and fieldbus. This allows you to match the drive to your specific application and to ensure you get the best mix of efficiency, speed and torque.

We offer:

- Compliance with the motor you need
- Compliance with the fieldbus you need
- Outstanding harmonic solutions expertise
- Innovation in energy storage projects



## **Collaborate differently**

Choosing a Danfoss AC drive means selecting a vendor who goes the extra mile, who truly values your success and who works with you on your terms. To give you the power to engineer the optimal solution, we place a high emphasis on speed and agility in all areas of our operation.

We offer:

- Independence and 100% drives expertise
- A non-competitive relationship with you on system solutions
- Global presence and local support

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# Higher and higher!

## Raising the levels of safety and reliability in the crane industry

Looking for safe and reliable operation in cranes? With over 25 years of experience and over 100,000 cranes in the field, Danfoss is here to help you.

### Safety

Safety is of utmost priority in cranes. It is crucial the load is held, stopped, controlled (raised, lowered) safely all the time.

Therefore, every product recommended for crane applications meets all relevant safety standards ensuring safe and reliable operation.

Use the integrated safety option to achieve SIL 3-IEC61508/62061 and ensure certified levels of safety and reliability.

### Crane-specific features

Cranes require special attention and need key parameters to operate smoothly, while moving from one direction to another under load.

These are for example mechanical brake control, catching the dropping load, tandem operation, anti-sway and many more.

With the Danfoss crane application software, you get all crane-specific features in a single software allowing you to address the needs of most crane types. The user can enable parameters according to crane type and application demand.

### Serviceability and support

Our DrivePro® Life Cycle Services are designed to help you get the most out of your crane application. We go beyond simple device maintenance, repairs and replacements to proactively offer you added value that directly improves your business.

Our comprehensive portfolio of services, that spans the entire life-cycle of your drives, is based on extensive experience and expertise. These services are customized to your requirements whenever and wherever you need them.









# VACON® NXP

## Air Cooled

### Precise and powerful performance

VACON® NXP Air Cooled drives offer precision and power to applications that require a robust and dynamic performance. Available in a complete power range up to 2 MW, they are provided as wall-mounted, standalone enclosed and IP00 modules.

The drives provide optimized motor control for both induction and permanent magnet motors, and gearless drive applications and paralleling solutions for high-power motors. Fast fieldbus options and exceptional programming flexibility ensure the drives are easily integrated into any system. Engineering time and costs can be saved due to the high number of standardized options and reduced system complexity.

- Dedicated crane application
- Easy parameter setting
- Optimized for both open and closed loop operation



# VACON® NXP

## Common DC Bus

### Easy integration – ultimate flexibility

The VACON® NXP range of common DC bus drive products includes a number of active front-ends, inverters and brake chopper units. They ensure all energy within a system is effectively utilized and redistributed.

Common DC bus components can be used in many different combinations. In a regenerative DC bus system, the active front-end unit generates power back to the mains network. This is suitable for processes where braking is needed often and the braking power is relatively high.

Also available as VACON® NXP System Drive - a comprehensive configured common DC bus drive line up for heavy-industry needs where round-the-clock activity is required leaving little time for maintenance.

- Extremely flexible system design





# VLT® AutomationDrive

## FC 301 / FC 302

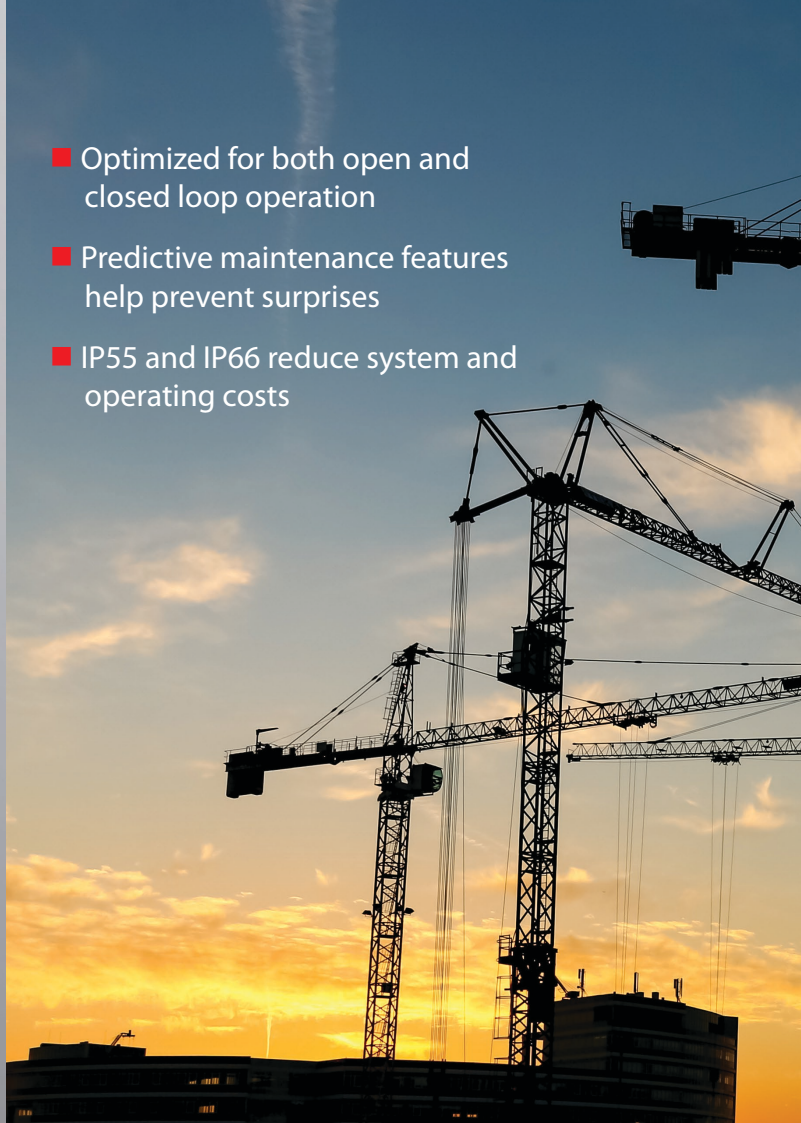
### Versatile, reliable and consistently awesome

Built to last, this robust drive operates effectively and reliably even with the most demanding applications and in the most challenging environments.

VLT® AutomationDrive takes full advantage of all that the new digital age has to offer to ensure it completely fulfills the requirements of your applications and optimizes your processes throughout the entire lifecycle.



- Optimized for both open and closed loop operation
- Predictive maintenance features help prevent surprises
- IP55 and IP66 reduce system and operating costs



# VLT® Midi Drive

## FC 280

### Flexible, communicative and easy to use - to fit your application

Reach new levels of performance with the VLT® Midi Drive FC 280. Profit from new savings with a wide range of features designed to make installing, using and maintaining the AC drive as simple and as easy as possible.

For precise and efficient motor control for machine builders, the VLT® Midi Drive is ideal. It is strong on control performance, functional safety and flexible fieldbus communication.

- Optimized for open loop operation in simple cranes
- Special hoist mode makes commissioning very easy



## General product information

### Air- and liquid-cooled AC drives

- Current range: 230-690 V
- Power range: 0.25-5300 kW
- Ingress protection rating: IP00, IP20, IP21, IP54, IP55, IP66



#### Long cable capability

With no need for additional components, Danfoss drives provide flexible installation with cable lengths up to 150 m screened and 300 m unscreened to reduce installation costs.



#### Scalable harmonic mitigation

The savings gained on the installation costs and the installed efficiency of the Danfoss solution for harmonics mitigation exceed the improved energy efficiency achieved by investing in IE3 motors instead of IE2 motors.



#### Motor and system independent

A master of all motor technologies, Danfoss helps you save commissioning time and fine-tune for optimal system control.



# Why use VACON® NX Active Front End

The VACON® NX Active Front End is used to transfer power between the AC input and intermediate DC circuit. The VACON® NX Active Front End has a two-way function. This means that when power is transferred from the AC input to the intermediate DC circuit, the VACON® NX Active Front End rectifies the alternating current and voltage. When power is transferred from the intermediate DC circuit to the AC input, the VACON® NX Active Front End inverts the direct current and voltage. The difference between VACON® NX Active Front End and other front ends is that the unit creates low current distortion (THDi).

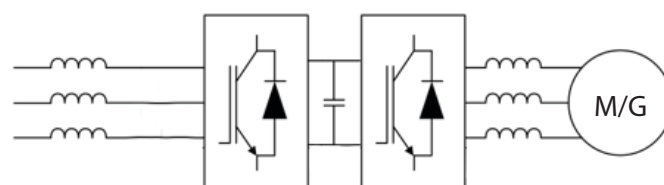
## VACON® NX Active Front End saves money

The low THDi reduces supply currents and allows supply transformers, protection devices and power cables to be dimensioned according to the actual active power. It creates savings for both new and retrofit projects.

## Benefits of using Danfoss AFE solution:

- Regeneration of energy back to the grid improves system efficiency. The AFE is typically used for cyclic applications, like cranes and elevators to eliminate the need for resistors and cabling. Thereby reducing cooling and space requirements.
- Variable frequency operation enables operation with variable speed generator supplies for further energy savings.
- Robust operation in networks with poor quality enables uninterruptible process.
- Stable DC-voltage for motor inverter units to guarantee trouble-free process control.
- DC-voltage control and boosting enable standardization of motor voltage classes and further reduction of supported motor variants by customers.
- Paralleling of independent AFE units enables easy system building, power scaling and system redundancy.
- Sinusoidal line current with low THDi in the supply reduces the need for supply component overdimensioning and helps reduce power loss.
- Ease of use and system configuration.
- Independent operation simplifies the drive system control.
- Robust control with simple parameter adjustments makes system commissioning easy and immune from condition changes.
- Works in systems fed by permanent magnet or externally excited synchronous generators.

## Control principles:



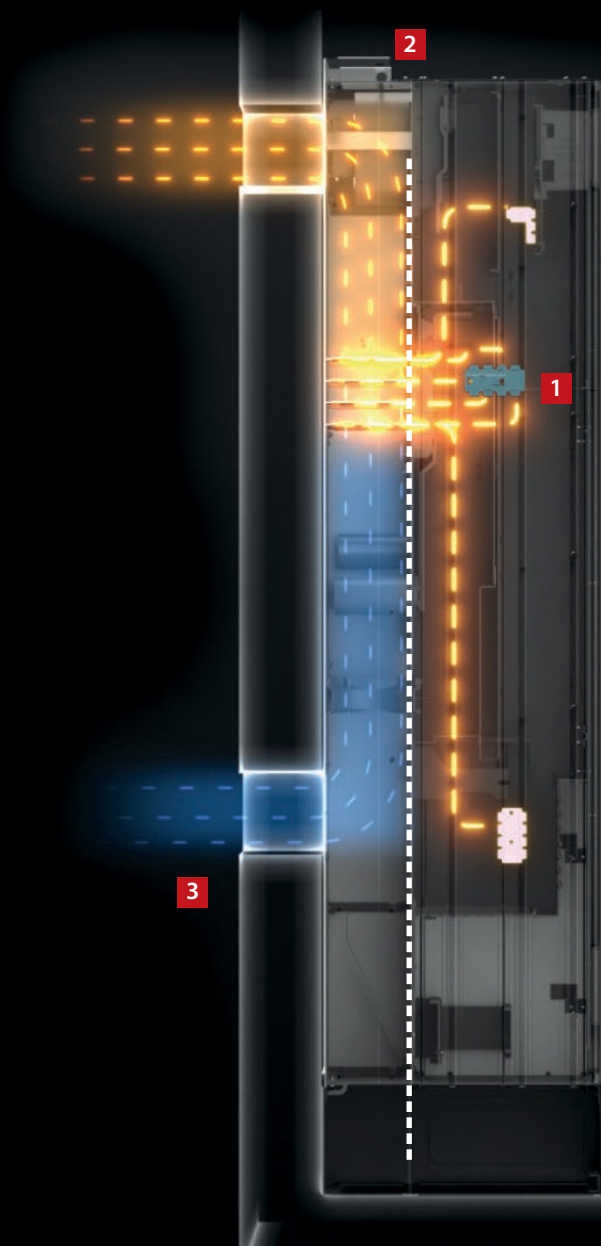
## Main features:

High quality control with

- bidirectional power flow
- sinusoidal line currents
- low current harmonics
- direct active and reactive current control
- automatic line synchronization



# Back-channel cooling: Efficient and economic heat management



**90% reduction** in air conditioning system and  
**90% reduction** in energy use for air conditioning

**1 Reduced dust over electronics**  
Complete separation between cooling air and internal electronics, ensures trouble-free operation and longer intervals between service.

**2 Panel-through cooling**  
An accessory mounting kit for small and mid-range drives enables heat losses to be directed outside the panel room and into designated air ducts.

**3 Back-channel cooling**  
By directing air through a rear cooling channel, up to 90% of the drive's heat loss is removed directly outside the installation room.



WATCH THE ANIMATION

# Loading efficiency, unloading risk in every crane application

## Hoist applications



**Hoist** - Lifting & lowering

Feature	Description
Motor control	Open loop (sensorless) control and closed loop control with optimal performance
Parallel motors	Parallel motors can be connected to one drive or different drives, synchronized by drooping or master/follower setup
Tandem hoist	Speed and torque sync are available for coordinated movements
Mechanical brake control	Smooth and precise mechanical brake control with ID run ensures optimum performance Advanced mechanical brake control ensures bump-less movements
Load dependent speed	Speed can be increased, for example four times the nominal speed, depending on actual load
Catch dropping load	Drive takes over load from mechanical brake in case of unintended movement
Bump-less transfer CL-OL	Drive changes control "on the fly" from closed loop to open loop in case of encoder failure
Slack rope prevention	Drive detects when load hits the ground and prevents further movement
Shock load protection	Drive detects if no load is connected and reduces the speed until load can be measured

## Travel application



**Bridge Gantry Long travel**

Carries trolley



**Trolley Cross travel**

Carries hoisting mechanism

Feature	Description
Motor control	Open loop (sensorless) control and closed loop control with optimal performance
Parallel motors	Parallel motors can be connected to one drive or different drives, synchronized by drooping or master/follower setup
Mechanical brake control	Smooth and precise mechanical brake control with ID run ensures optimum performance and an advanced mechanical brake control ensures bump-less movements
Sensorless anti-sway	Increases safety and productivity without extra sensors



## Smart features that are **second to none**



Mechanical brake control



Hybridization



Integrated sensorless anti-sway



Bump-less transfer



Catch dropping load



Integrated functional safety  
with advanced safety option



Tandem hoist



Tandem with torque control



Shock load protection



Slack rope prevention





## Mechanical brake control

### Prevent load slip while hoisting

Danfoss drives have a dedicated application feature for the mechanical brake, which enables excellent speed accuracy and brake control. This feature is used in hoisting and long travel applications, both at standstill and while running.

Mechanical brake control supports building up torque smoothly against the closed brake before releasing the mechanical brake for smooth start up. The AC drive will continue to deliver the torque until mechanical brake control takes over the command. The AC drive automatically calculates brake opening and closing time.

This feature prevents load slip at start and stop of load lifting. For vertical motion, mechanical brake control provides smooth torque ramping to ensure that the load is held, stopped, raised and lowered in a perfectly safe mode.

#### Benefits:

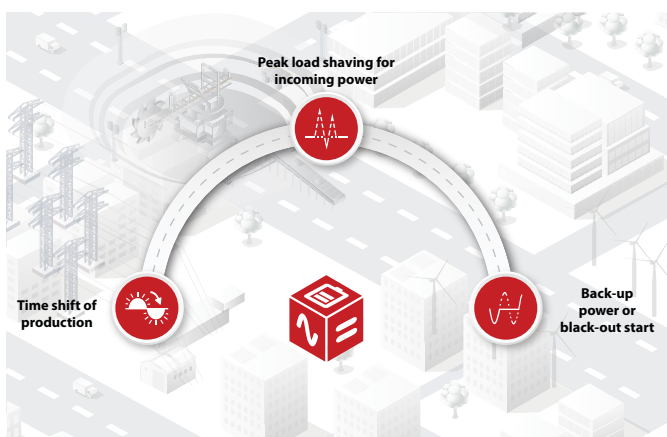
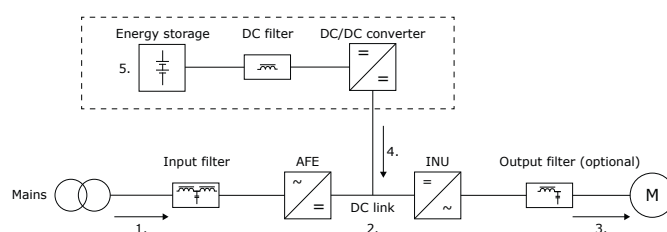
- Safe and reliable crane operation



## Hybridization

Hybridization is increasingly influencing the crane sector, using energy storage to optimize energy supply.

Using a combination of diesel and battery-stored electrical energy creates opportunities to shave peak loads, optimize use of cheaper off-peak power, and maintain operation in the event of power cuts. Hybrid or fully electric port cranes will help ports meet the emission control area targets set by the

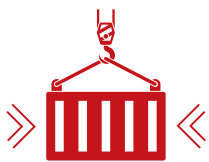
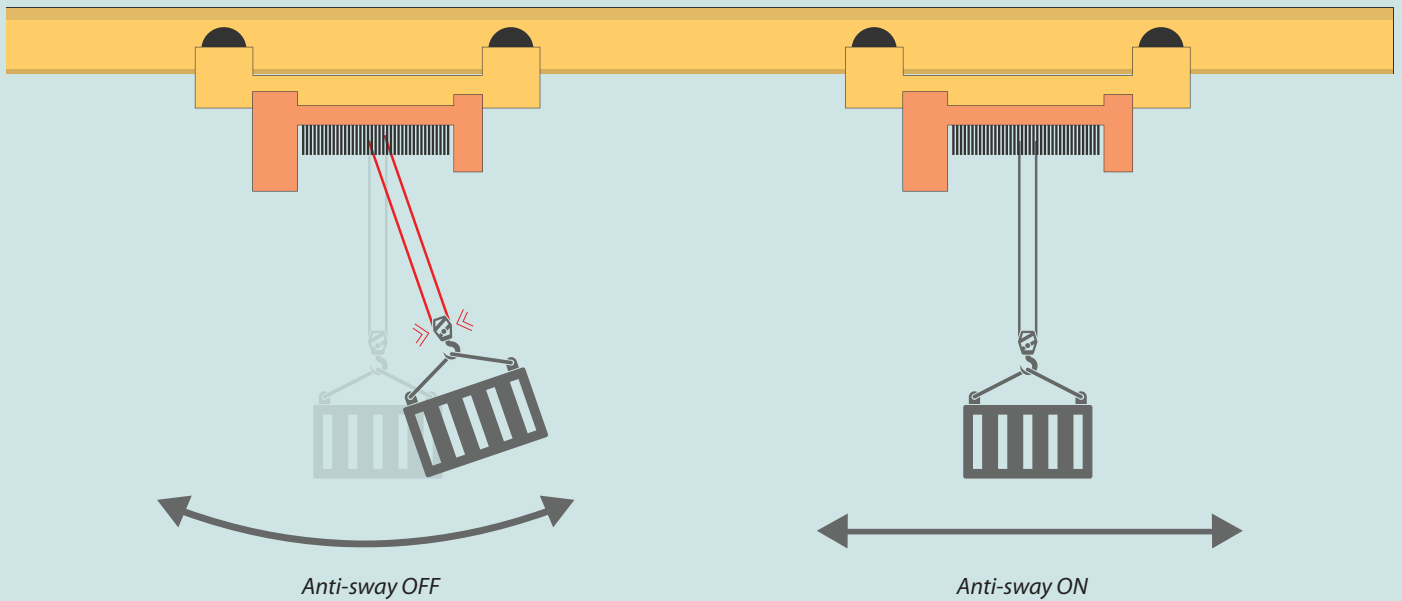


International Maritime Organization as well as ensure not only clean air to breathe but also a noise-free environment.

#### Benefits:

- Energy efficiency gains
- Compliance to emission regulation
- Cost saving, e.g. no need for overdimensioning





## Integrated sensorless anti-sway

### Improve load positioning accuracy and safety by preventing load sway

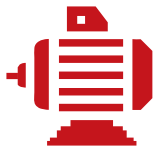
In overhead travelling cranes or a gantry crane, the load is suspended on the cables by a gripping device that acts as a pendulum. Swaying of the load during crane movement is a severe problem which affects its ability to operate efficiently. It also aggravates load control and positioning problems. Delay in production can be greatly reduced when load sway is prevented.

Integrated sensorless anti-sway software eliminates sway to ensure the load remains stable irrespective of load types and hoist height. The anti-sway function supports faster load handling and reduces the risk of damage to the load and surrounding areas. In safety-critical situations, it also ensures rapid response of the mechanical brake.

**Up to 15% improved productivity**  
with anti-sway functionality

#### Benefits:

- Better user experience - no skilled operator required for commissioning and operation
- Improve productivity by reducing cycle time indirectly
- High return on investments
- Reduce structural stress and lower risk of accidents



## Bump-less transfer

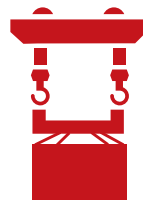
### Smooth load handling if encoder fails

Bump-less transfer switches control mode from closed loop to sensorless control in the event of encoder failure/error. Last speed value before the encoder failure will be the output speed in sensorless control.

Simultaneously with the smooth changeover from closed loop to sensorless control, the operator is given an "encoder loss" warning.

#### Benefits:

- Controlled load management - auto changeover "on the fly"
- Activated by parameter setting
- Manage maintenance schedules, no need for unscheduled stops



## Catch dropping load

### Prevent free fall of load during brake fails

Catch dropping load is designed to prevent the fast motion of lowering load during brake fails and keeps it below motor rate. In case of mechanical brake failure, the drive automatically detects, takes over and brings the load down to the ground in a controlled motion.

#### Benefits:

- Assured safe operation at all times even during mechanical brake failure
- Safe shut down of the operation – no uncontrolled speed, no load drop



# 50%

cost reduction  
compared to external  
components



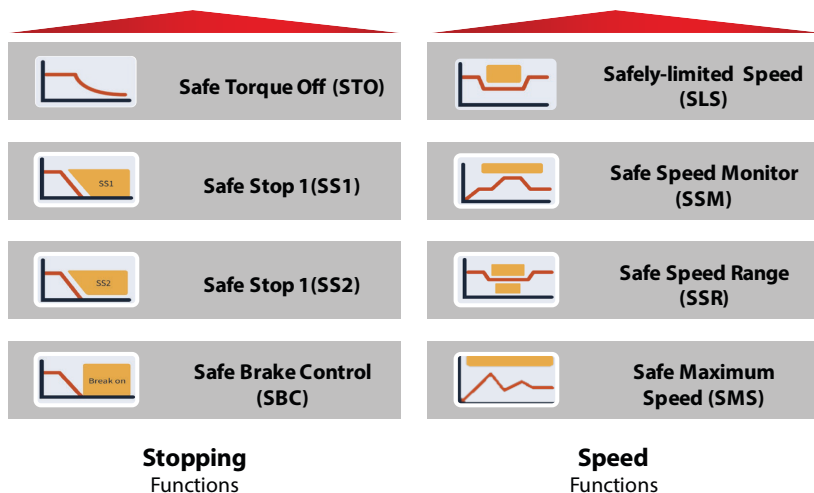
## Integrated functional safety with advanced safety option

### Optimize the system cost using less space, wiring and components

Functional safety is a property of an active safety function, carried out by a safety system at a certain risk-reduction safety integrity level (SIL).

In practice, this means that when functional safety is applied to a function, the risk of the function failing dangerously is reduced.

For instance, SIL 3 means that the probability of a function failing dangerously is reduced by a factor 1000-10000.



Danfoss Advanced Safety Options will enable you to fulfill safety requirements according to safety levels up to SIL3, PLc, Cat.4 (TUV SUD certified).

Advanced safety option board supports safe stop and safe speed monitoring functions like,

- **Safe stop functions:** Safe Torque Off (STO), Safe Brake Control (SBC), Safe Stop 1 (SS1), Safe Stop 2 (SS2), Safe Quick Stop (SQS)
- **Safe speed monitoring functions:** Safe limit speed (SLS), Safe maximum speed (SMS), Safe speed monitoring (SSM), Safe Speed Range (SSR)

### Benefits:

- Certified level of reliability
- Less space, wiring and components which optimize the system cost



## Tandem hoist

### Enhance productivity by shaft synchronization

Tandem hoist function is used to lift higher capacity loads by synchronizing more than one hoist axis at the same time. It is used where loads have to be transported with more than one lifting-gear unit at the same time and delivered to an exact location. In tandem hoist operation, the crane operator will be able to control up to four units simultaneously.

#### Benefits:

- Precise and fast synchronization
- Optimized mechanical design



## Tandem torque control

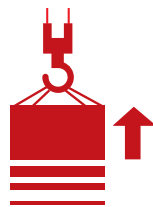
In tandem control, when the motor shafts are mechanically coupled to each other for running a common load, the torque should be shared between the two axes. This is mostly used in trolley or travel motion.

For closed loop operation, the master drive is speed controlled and transmits torque reference to the follower drives via analog output or fieldbus. The follower drive works in torque control mode and the master drive works in speed control mode.

#### Benefits:

- Smooth operation with no jerk or oscillation during start-up or ramping
- Optimized mechanical design
- Easy commissioning





## Shock load prevention

### Smooth load lift-off while hoisting

When there is a sudden load change or rapid load lift, a shock is created in the crane system. This will create structural stress on the hoist mechanism.

Shock load prevention ensures smooth load pick-up and prevents shock in hoist mechanism. The hoist drive monitors the load. If the load is picked up abruptly, the hoisting speed is automatically reduced until the load is lifted smoothly. This feature is applicable only for hoisting.

#### Benefits:

- Reduce mechanical stress on hoist mechanism which extends component lifetime
- Safe and stable load handling



## Slack rope prevention

### Prevents slack and sliding of lifting cables while lowering

When the load reaches ground, there could be a slack at the rope or a sliding from the hook potentially leading to damage of the rope or load.

Slack rope prevention provides smooth load placement on ground. As the load descends, this feature will detect when the load reaches the ground and automatically stops lowering movement. This prevents hoist ropes from slacking and falling off. This feature is applicable only for lowering.

#### Benefits:

- Smooth load placement on ground prevents damage of lifting cable and free fall of lifting devices on the loads
- Enhanced safety and productivity



# DrivePro® Life Cycle Services

## Delivering a customized service experience



We understand that every application is different. Having the ability to build a customized service package to suit your specific needs is essential.

DrivePro® Life Cycle Services is a collection of tailor-made products designed around you. Each one engineered to support your business through the different stages of your AC drive's life cycle.

From optimized spare-part packages to condition-monitoring solutions, our products can be customized to help you achieve your business goals.

With the help of these products, we add value to your application by ensuring you get the most out of your AC drive.

When you deal with us, we also offer you access to training, as well as the application knowledge to help you in planning and preparation. Our experts are at your service.





# You're covered

## with DrivePro® Life Cycle service products



### **DrivePro® Site Assessment** **Efficient management of your AC drive installed base**

Having the ability to manage your installed base of AC drives and plan for the future is now easier than ever. DrivePro® Site Assessment provides you with a detailed survey of all your AC drives, delivering a clear picture of current and future maintenance needs.



### **DrivePro® Start-up** **Fine-tune your drive for optimal performance today**

Save on installation and commissioning time and cost. Get help from professional drives experts during start-up, to optimize drives safety, availability and performance.



### **DrivePro® Retrofit** **Minimize the impact and maximize the benefit**

Manage the end of product lifecycle efficiently, with professional help to replace your legacy drives. The DrivePro® Retrofit service ensures optimal uptime and productivity during the smooth replacement process.



### **DrivePro® Preventive Maintenance** **Take preventive action**

You receive a maintenance plan and budget, based on an audit of the installation. Then our experts perform the maintenance tasks for you, according to the defined plan.



### **DrivePro® Spare Parts** **Plan ahead with your spare part package**

In critical situations, you want no delays. With DrivePro® Spare Parts you always have the right parts on hand, on time. Keep your drives running at top efficiency, and optimize system performance.



### **DrivePro® Remote Expert Support** **You can rely on us every step of the way**

DrivePro® Remote Expert Support offers speedy resolution of on-site issues thanks to timely access to accurate information. With the secure connection, our drives experts analyze issues remotely reducing the time and cost involved in unnecessary service visits.



### **DrivePro® Extended Warranty** **Long-term peace of mind**

Get the longest coverage available in the industry, for peace of mind, a strong business case and a stable, reliable budget. You know the annual cost of maintaining your drives, up to six years in advance.



### **DrivePro® Remote Monitoring** **Fast resolution of issues**

DrivePro® Remote Monitoring offers you a system that provides online information available for monitoring in real time. It collects all the relevant data and analyzes it so that you can resolve issues before they affect your processes.



### **DrivePro® Exchange** **The fast, most cost-efficient alternative to repair**

You obtain the fastest, most cost-efficient alternative to repair, when time is critical. You increase uptime, thanks to quick and correct replacement of the drive.

To learn which products are available in your region, please reach out to your local Danfoss Drives sales office or visit our website <http://drives.danfoss.com/danfoss-drives/local-contacts/>

# Crane and hoist movements **driven by drives**

More than 100,000 AC drives from Danfoss ensure speed and efficiency control of cranes across the world today. From the smallest crane to the largest of mobile cranes, with a lifting capacity of up to 10,000 tonnes we are supporting our

customers through dimensioning and configuration tools, drives and system expertise and comprehensive support and life cycle management.

## Controlling a **3000t** **slew crane**

World's most advanced pipe-laying technology



Read the case study

## Burj Khalifa **reaches for the sky**

The tallest building in the world



Read the case study

## Massive **grabber crane** in control at Tata Steel

Liquid-cooled VACON® active front-end drives control Tata Steel grabber crane



Read the case study

Discover more case studies of drives for industrial crane and hoist movement here:

<https://www.danfoss.com/en/markets/industry/dds/drives-for-movements/#tab-case-studies>

Certificates:

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