

ENGINEERING  
TOMORROW

*Danfoss*

Mining and minerals

Robust, reliable AC drives for significant  
**CAPEX and OPEX savings** in mining  
and mineral processing

**85% less**  
switchroom heat load

is achievable using  
high-efficiency AC  
drives equipped with  
innovative back-  
channel cooling.



# Save costs with VLT<sup>®</sup> and VACON<sup>®</sup> drives

Did you know that certain AC drives are designed for specifically the needs of mining and mineral processing plants, coping with extreme conditions, heavy loading and controlling equipment installed a long distance away?

When using VLT<sup>®</sup> and VACON<sup>®</sup> drives, often you can even **save on the cost of other equipment.**











No matter how well you have optimized your plant design, there is always a way to **drive down costs even further**. AC drives are used extensively for just that purpose, extending equipment lifetime, optimizing processes, reducing maintenance and saving energy costs.

The mining and minerals industry presents some of the most challenging environments for production. Mine sites, mineral processing facilities and associated stockyards and port facilities are large scale and often in remote locations.

#### **Expertise – the benefit of an experienced partner**

Want a partner who understands your issues in depth? And who can give you the winning edge? With the most dedicated mining drive solutions and expertise to offer, Danfoss Drives can be that valuable partner, helping you to create competitive solutions.

We ensure the optimum selection of products to fulfill all your mining and processing equipment application requirements. By optimizing AC drive applications we can provide solutions that significantly reduce initial project and ongoing operating costs.

Whatever low voltage AC drive you require, we can deliver it, on time, no matter where you are located. VLT® and VACON® drives operate reliably over decades of use in harsh environments saving maintenance costs, ensuring better asset availability and providing you with the lowest cost of ownership.

All our drives integrate seamlessly into all common PLC fieldbus networks. VLT® and VACON® drives are fully compatible with all AC motor makes and types. We ensure drive and motor compatibility on long cable installations, regardless of which motor supplier has been chosen, and mains supply compatibility through

harmonics calculations, reports and mitigation solutions.



Kolomela Mine

### **Standard design for long cables saves initial project costs**

The large-scale layout of mine processing plants and port facilities often results in cable lengths between AC drives and motors being long, relative to other industries. Cable lengths are typically 160 ft to 500 ft, and sometimes more.

These relatively long cable lengths can put electrical and thermal stress on the internal components of a drive if it is not designed for the purpose, resulting in unreliable operation or even failure of the AC drive.

Contractors and end users alike have learned that selecting a drive that is designed as standard to be installed with the length and type of cable required for the installation, helps to save initial project costs.

#### **When this drive also complies with international EMC standards for installations with long motor cables, you can**

- Ensure long-term, reliable operation
- Minimize the risk of affecting operation of other electrical equipment installed on site
- Save purchase and installation costs of external filters

*Read more on page 10.*

### **Significant cost-saving opportunities, both in CAPEX and OPEX**

Did you know that compact AC drives with intelligent heat management can deliver surprisingly significant savings to your mine site operations?

#### **Initial CAPEX savings opportunities**

- Compact enclosures often mean switchrooms can be designed and built smaller
- The back-channel cooling design of higher power drives results in significantly lower heat loads in switchrooms, enabling the purchase of a smaller, lower-cost air-conditioning system

#### **Long-term OPEX savings opportunities**

- The energy-efficient design of VLT® and VACON® drives ensures that they comply with the strictest requirements of the European standard defining efficiency classes for “power drive systems and motor starters”, EN 50598-2, and both are classified as IE2. The IE2 classification means that when you use VLT® and VACON® drives to control your equipment, you’re using AC drives that meet the highest benchmark for efficiency, minimized losses and lower operating costs
- Use of a smaller air-conditioning system results in lower operating costs

*Read more on page 8.*



## Local service

Once installed, Danfoss drives are backed up by our local service and support teams, manned by dedicated drive specialists with proven mine site application and installation experience. The DrivePro® range of services caters to your every need.

Wherever you are, you can rely on us. With more than 100 sites world-wide, we are never far away, however remote your mine site is. With over 18 million drives produced since 1968, we're a solid company you can trust to deliver.

## How we **add value** for you

Make the most of Danfoss Drives' application and engineering support to optimize your mining project from the initial feasibility study through to the detailed design, execution and operation stages.

## Proven

experience in all  
mine processing  
and bulk material  
handling facilities



# No matter what your needs are, we meet them

For mining applications, Danfoss Drives delivers the full package of proven experience, local availability for application design and service, and unequalled product quality.

Gain from Danfoss' proven experience in AC-drive technologies for mining applications. VLT® and VACON® drives have been installed and operating reliably for many years on mine sites, stockyards, bulk materials handling facilities, processing plants and related port facilities – experience used to optimize drive design.

At Danfoss we can supply absolutely any low voltage AC drive you need, for the mine or processing plant – or for equipment OEMs delivering to the industry.

## We offer the full range no matter what your requirements:

- You choose whether to incorporate the drives into a panel, switchboard or Motor Control Center (MCC); install directly on the wall or floor of your switchroom or substation; integrate air or liquid cooled drive modules into your mining equipment; or even install outside with suitable, simple sheltering from the elements
- Motor-independent drives, fully compatible with all AC motor makes and types
- Drives which are PLC-network independent and easy to integrate into networks, no matter which PLC you prefer
- You can also rely on our quality. VLT® and VACON® drives are mass-customized, factory assembled and fully factory tested.

On many mining projects across the globe this support has helped mining companies, consultants; engineering service providers and contractors design robust, reliable, energy-efficient drive solutions. These have resulted in significant initial project cost and ongoing operating cost savings.

## Reap the benefits of our specialized support services, based on decades of extensive experience. Our design skills include ensuring:

- Drive and motor compatibility on long cable installations, regardless of which motor supplier is preferred
- Mains supply compatibility through harmonics calculations, reports and mitigation solutions

*Mining companies around the globe have reduced costs and improved reliability. See more on page 16.*



# Why choose Danfoss drives for mine and mineral processing environments?

With our wide range of AC drives and a broad choice of supporting options we can match your specific requirements. The compact enclosures and robust design of our drives with built-in long motor cable capability, innovative heat management and other mine-site-relevant features can help you optimize your panel, switchboard, switchroom or substation design, saving costs and improving your competitive position.

## **Intelligent heat management for significantly lower switchroom costs**

With the increasing use of AC drives to efficiently control equipment on mine sites, the heat loads in switchrooms from those drives are demanding larger and more expensive air-conditioning systems. However, the unique back-channel cooling design of higher power VLT® drives and availability of VACON® liquid-cooled drives can result in significantly reduced heat loads in switchrooms, enabling the use of smaller, lower-cost air-conditioning systems.

VLT® drives rated 90 kW and higher incorporate an innovative back-channel cooling design. There are separate cooling paths for the power components and control electronics, separated by an IP54 seal. The back-channel cooling removes approximately 85% of the power loss directly through the heatsink, leaving only 15% of the total loss to be dissipated in the switchroom. Although separate cooling paths themselves are not innovative, the innovation in our VLT® drives comes from ensuring they are separated by an IP54 seal and making it easy to duct outside air into and out of the back-channel air path.

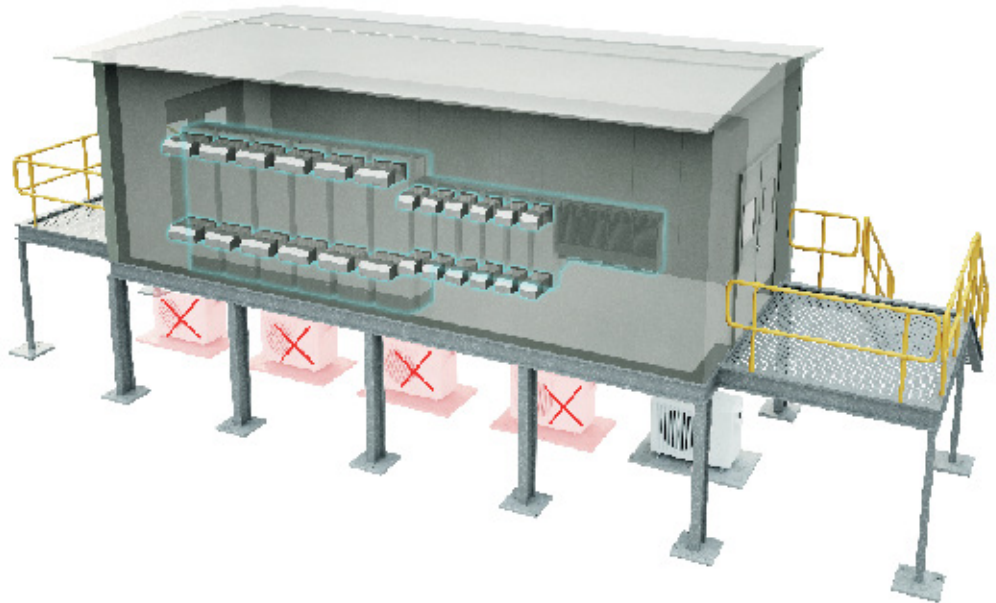
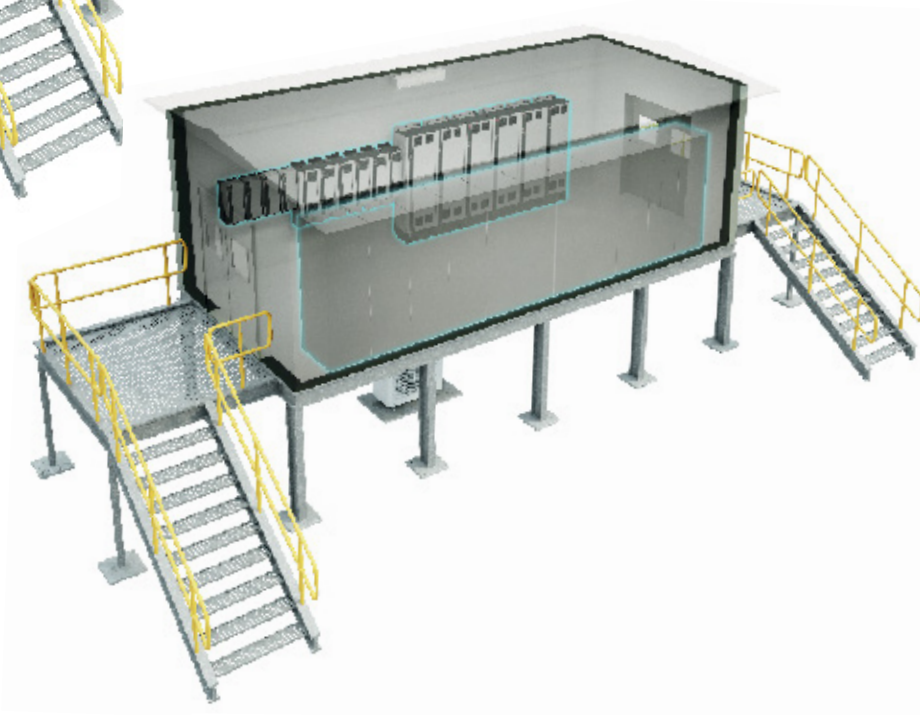
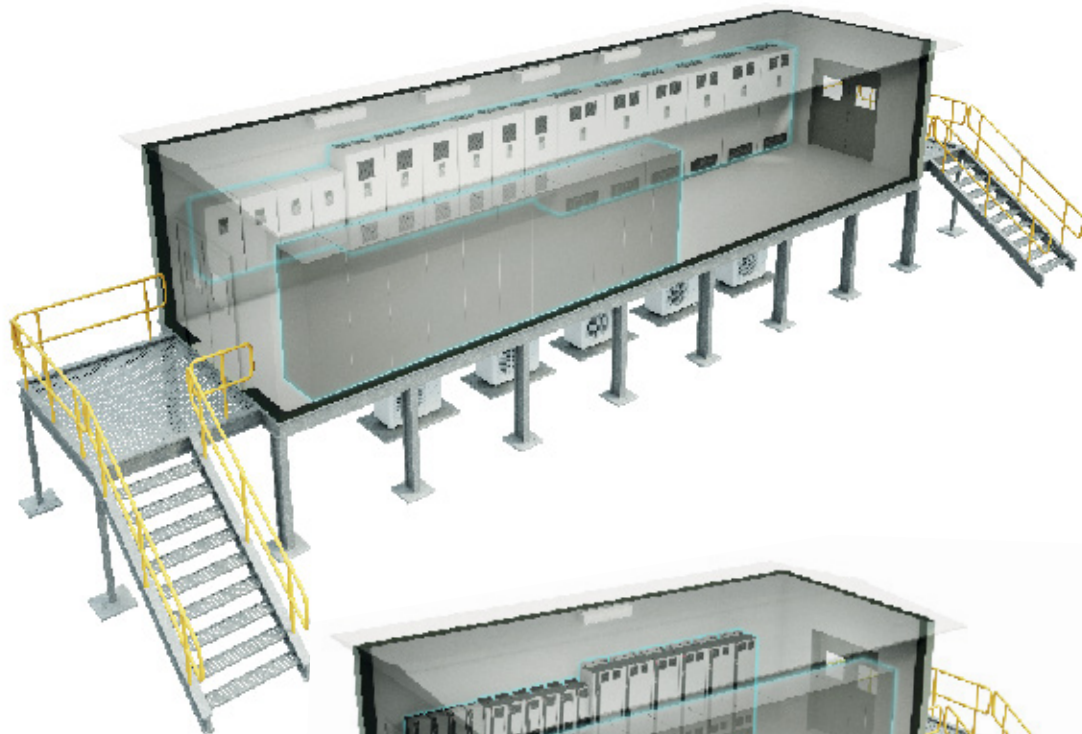
## **Reduced heat load in switchrooms**

When outside air quality on the mine site is suitable, using the heatsink cooling fans and appropriate mounting and ducting, filtered external air at temperatures up to 122 degrees F can be used to exhaust approximately 85% of the heat loss from the VLT® drive. The heat loss can easily be exhausted directly outside the switchroom with no effect on the switchroom pressurization. The switchroom air-conditioning system only needs to be sized for the remaining 15% heat losses into the switchroom.

## **Compact enclosures reduce project costs**

The compact size of VLT® and VACON® drives, both designed as standard for long motor cables without requiring additional options, often means smaller switchrooms can be built, providing opportunities for significant switchroom cost savings. Ask us, to find out how contractors and mining companies have saved significant project and operating costs through the use of these innovative design features.







# Why choose Danfoss drives for mine and mineral processing environments?

## High-temperature reliability

Danfoss VLT® and VACON® drives are designed as standard to operate in high ambient temperature conditions without de-rating and compared to many other drives, to be installed in environments containing relatively high levels of contaminants. Through the most innovative internal cooling systems available, they also ensure their internal components are cooled efficiently and effectively whilst minimizing the air flow across the sensitive, small electronic components mounted on the printed circuit boards inside. This, combined with their standard design enabling them to operate reliably even when installed with long cables between the drive and motor, makes them an optimum choice for mine site installations.

## Designed for harsh environments

Robust design, inclusion of harmonic and radio frequency interference (RFI) filters and ability to be installed with long motor cables are standard features for all VLT® and VACON® drives.

Harsh, dusty conditions and extreme temperatures are common and can create challenges for any electronic product. Although it is increasingly common practice on modern mine sites to install drives in relatively clean, pressurized, air-conditioned switchrooms and substations, it has become well-recognized that a drive designed for harsh environments will have a significantly longer, trouble-free lifetime. This ultimately ensures better asset availability and saves maintenance costs for the mining company.

VLT® and VACON® drives are developed to meet the vast majority of mining and processing equipment application and installation requirements with no need for tailored solutions. Their reliability in the typical arduous environments found on mine sites is proven over many years' service.

VLT® and VACON® drives incorporate:

- Electronics coating protection that ensures the drives are suitable for installation in mine-site environments
- No external forced draft cooling across internal components, for IP54/55 versions of lower power drives. External cooling air from the temperature-controlled cooling fans is blown across the external heatsink and not through the internal electronics of the drive
- Back-channel cooling for VLT® high-power drives. This greatly reduces contamination of the control electronics area, resulting in longer life and higher reliability. The remaining heat losses are removed from the control electronics area using door fans and, because these heat losses are relatively low, only a low volume of air needs to be blown through the control electronics area

## Long motor cable capability as standard

Without the need for additional components, standard VLT® or VACON® drives provide trouble-free operation with cable lengths of up to at least 500 ft for screened cables and 1000 ft for unscreened cables.

No additional output filters are required for the drive to reliably operate with these cable lengths. This saves space and installation time and costs compared to traditional AC drive solutions.

With the built-in RFI filters, VLT® and VACON® drives comply with EMC standards, ensuring reliable operation of all other electrical equipment on the same installation. No additional RFI filters are required on the input of the drive.

Being designed for long motor cable installations as standard typically results in a more compact solution compared to AC drives that need to add options to operate reliably with long motor cables. This often results in considerable initial project cost savings as a result of being able to use smaller switchrooms.



Even for motor cables up to 150 m long, VLT® drives comply with EMC standards









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# Applications



- 1 Long conveyors
- 2 Stockpile reclaim feeders
- 3 Borehole pumps
- 4 Stacker/reclaimer
- 5 Conveyors
- 6 Ship loader
- 7 Dewatering pump skids
- 8 Thickeners (pinion drives, feed, overflow and underflow (slurry) pumps)
- 9 Ball mills; flotation cells; apron feeders, conveyors, slurry pumps (e.g. transfer pumps, feed pumps, concentrate pumps, tailings pumps); process water pumps
- 10 Train unloader
- 11 Excavator
- 12 Tripper car
- 13 Train loadout conveyor
- 14 Slurry pumps; process water feed pumps; dosing pumps; filters
- 15 Primary ventilation fans
- 16 Underground conveyors
- 17 Booster fans
- 18 Crusher
- 19 Slurry pumps (e.g. cyclone feed pumps; transfer pumps; thickener underflow pumps); feeders; screens
- 20 Stacker
- 21 River water pumps
- 22 **Underground mines**
  - Mine ventilation fans
  - Conveyors
  - Pumps
  - Winders



# Robust mine ventilation

Ensuring reliable ventilation of the mine is paramount for the health and safety of workers in the underground mine. This is necessary to ensure particulates from diesel engines are adequately diluted, for example. Ventilation operating costs are often a significant proportion of the total electrical energy costs on site, and being able to ventilate in the most efficient manner saves significant operating costs.

AC drives are well recognized to be the most flexible, energy-efficient, low-maintenance method for controlling mine ventilation fans. They are used to control the air flow of main ventilation fans on the surface as well as auxiliary ventilation and booster fans underground, and can be easily integrated into Ventilation on Demand (VOD) control systems.

Both VLT® and VACON® drives incorporate a number of features that make them especially suitable for mine ventilation fan applications. These ensure reliable operation of the fan even in abnormal operating conditions and the optimum use of energy

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## Long conveyor capability

Smoothly controlling the acceleration and deceleration of long conveyors reduces mechanical stress through all drive-train components and within the conveyor belt itself. This leads to longer lifetime for the belt and other drive components, increasing asset availability and lowering maintenance and operating costs. Having the flexibility to control the speed of long conveyors can help optimize the complete system, reduce bottlenecks and maximize the efficiency of a material flow process, resulting in operating cost savings.

### Maximize belt life

It's common practice to install multiple motors on long conveyors and the drives need to ensure load sharing between each motor for reliable operation and to maximize belt life.

VLT® and VACON® drives include both Master-Master and Master-Follower control solutions for this. Selection of the control solution depends on the configuration of the conveyor drives on the conveyor (for example, all drives at the head end or drives at both the head and tail end).

They are both easy to implement and have proven to be robust, reliable solutions for long conveyors.

### Bulk handling

For downhill conveyors, where continuous regenerative braking operation is typically required, an Active Front End (AFE) drive or alternatively a regenerative drive panel solution, using a standard 6-pulse drive with separate regenerative module, is the best solution.

VLT® and VACON® drives are used extensively on many long conveyors in excess of 1-km length, which are common on bulk material applications on mine sites, processing plants and port facilities such as:

- Run-of-mine (ROM) bin feeder conveyors
- Stockyards
- Train loadout conveyors
- Pipe conveyors
- Long overland conveyors





# The optimum choice for electric-driven dewatering pump skids

For environmental and lower maintenance and operating cost reasons, many mine sites prefer to use an electric-driven pump skid instead of the traditional diesel-engine-driven pump skid. This is possible when there is an electrical supply close to the dewatering pump skid location.

An electric driven pump skid typically uses an AC motor and drive to set the flow rate of the dewatering pump instead of a diesel engine. Typically the initial cost of an electric-driven skid will be higher, but the operating costs are significantly lower. The higher initial investment is recovered very quickly, often within months. As there is no need to change the oil of a diesel engine every few hundred operating hours, or pay for refueling trucks and labor, this results in even greater savings in maintenance and operating costs.

Common challenges for drives on electric-driven pump skids include the space available (because the size of the drive often impacts the size and therefore cost of the pump skid) and the harsh, dusty and often hot environment where the pump skid is installed.

VLT® and VACON® drives address these challenges with ease and are used extensively on dewatering pump skids on many mine sites. Their compact enclosures often enable the pump skid manufacturer to minimize the size and cost of the skid. Their robust, high ambient temperature design ensures reliable, long lifetime of operation even when installed on a dewatering pump skid out in the open, on a hot, humid mine site with mining trucks kicking up dust as they pass by every few minutes. IP66 enclosures for a wide power range make it easy to install them on the

pump skid, with a simple weather shield to provide shading. For higher power sizes, the back-channel cooling design of the VLT® drives often means that for many mine sites, even in hot climates, they can be installed on the pump skid in a simple weather-proofing enclosure without any additional cooling fans or air-conditioning system, ensuring a robust, reliable, low-maintenance solution.

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## Reliable operation of slurry pumps throughout your processing facility

Slurry pumps are used extensively throughout many processing facilities, and AC drives are often used to control them. The AC drives provide flexibility in control and optimize yields from equipment, and therefore enhance the overall efficiency of the plant. For example, use of a drive to control the flow of feed pumps to a dense medium cyclone on a coal handling and preparation plant (CHPP) helps deliver greater yield.

A slurry pump is typically a centrifugal pump and for many applications, under normal operating conditions, AC drives will operate reliably if they have been selected based on what is typically referred to as a normal overload or normal duty rating.

However, normal operating conditions do not always prevail on a mine site.

- Mains supply interruptions or emergency stop conditions which cause equipment to stop in an uncontrolled manner can result in slurry pumps and pipelines being full of the slurry when the pump stops
- If the slurry is particularly dense, and the duration of downtime is long, the dense material in the slurry settles to the bottom of the pump and pipeline, often making it difficult to restart.

For such situations, best practice in selecting AC drives for slurry pumps is to select them based on an overload rating that at least ensures 150% motor torque for 30 seconds. All VLT® and VACON® drives are suitably rated to ensure reliable operation of all slurry pumps throughout your facility



# References

## **30% energy reduction for Yamana Gold in Bahia, Brazil**

VACON® AC drives improve the operation of underground ventilation and pumping systems and cut energy consumption of many application processes.

## **80 kW power savings at Kolomela mine, South Africa**

Back-channel cooling in VLT® AutomationDrives reduces substation heat load enabling use of a smaller air-conditioning system with lower power consumption.

## **Minimal energy use at Shanxi Zhongxi Cement, Xiaan Province, China**

VLT® Drives move a 10.5-km-long conveyor belt. Load sharing between drives and the use of regenerative modules transfers energy from downhill segments to the uphill parts.

## **Other references**

### **First Quantum Minerals Ltd sites**

- Kansanshi Copper, Zambia
- Kevitsa Mine, Finland
- Guelb Moghrein, Mauritania

### **Energy Resources of Australia**

Ranger Uranium site, Australia.

**Alcoa of Australia** bauxite mines and alumina refineries.

### **St. Barbara Limited**

- Simberi Operations, Solomon Islands

### **Heathgate Resources**

- Beverley Uranium Mine, South Australia

## **75% cost reduction in mining barge at Kovin, Serbia**

Replacing the barge's diesel engine with an electrical motor controlled by a VLT® AutomationDrive increased reliability and reduced costs.

## **Optimized production at KWB Coal Mine, Konin, Poland**

90 kW VLT® Drives ease the mechanical stress on the heavy equipment and improve steering when the excavator turns sideways.









# Products

## Robust, reliable AC drives for mining and mineral processing

VLT® and VACON® drives are available for all low voltage mains supplies, from fractional kW to more than 2 MW for all mining and mineral processing equipment applications. They are available as standard in a wide range of wall-mounted and floor-standing, IP and NEMA/UL-type-rated enclosures to meet your specific installation needs, and air-cooled and liquid-cooled modules for integrating into your mining equipment. Regenerative drives for regenerative applications and a wide range of harmonic mitigation products provide you with an optimum solution that meets your requirements.

### Communications functionality

This legend indicates the communication interface and fieldbus protocol functionality which is specific to each product. For details, please refer to the individual product brochures.

#### Integrated

BAC	BACnet
META	Metasys N2
MOD	Modbus RTU
TCP	Modbus TCP
BIP	BACnet/IP

#### Optional

PB	PROFIBUS DP V1
PN	PROFINET
PL	Powerlink
DN	DeviceNet
CAN	CANopen
AKD	LONworks for AKD
LON	LONworks
BAC	BACnet (MSTP)
TCP	Modbus TCP
EIP	EtherNet/IP
ECAT	EtherCAT
DCP	DCP 3/4
DSP	CANopen DSP 417
BIP	BACnet/IP







# VLT® drives

The VLT® AutomationDrive FC 302, VLT® AQUA Drive FC 202 and VLT® HVAC Drive FC 102 are all built on the same modular platform, allowing for highly-customized drives that are mass-produced, fully-tested, and delivered from our factories.

As standard they are designed to operate reliably with up to at least 150 m screened or 300 m unscreened cable lengths, with no need for additional output filters. They include a built-in DC link choke harmonic filter and can be configured with built-in RFI filters, providing different levels of EMC performance as required. Compliance with the most commonly specified international EMC standard for mining and mineral processing facilities, IEC 61800-3 Category C3, with 150 m screened cable, is standard.

Their robust design ensures that as standard they are suitable for installation in harsh environments as defined by IEC 60721-3-3 Class 3C2 and are available with an optional, higher grade PCB coating, making them suitable for installation in even harsher, Class 3C3, environments of that standard. With only a few exceptions, all drive sizes are designed for operation at their full nominal current ratings in ambient temperatures up to 50 °C (high overload) and 45 °C (normal overload) without derating.

The back-channel cooling feature for powers ≥90 kW (high overload) / 110 kW (normal overload) has proven to save significant initial and ongoing operating costs on mining projects across the globe.

## Additional harmonic mitigation

12-pulse versions or low harmonic drive versions, incorporating a parallel-connected advanced active filter (AAF) in the same enclosure as the drive, are available as well as standalone AAFs for central compensation of harmonics and passive Advanced Harmonic Filters (AHF) for installation on the input of a drive.

## VLT® Soft Starter MCD 500

The VLT® Soft Starter MCD 500 is the comprehensive solution for soft starting and stopping three-phase induction motors. Integrated current transducers measure the motor current and provide important data for optimal start and stop ramps. A built-in bypass is available up to 961 A.

Adaptive Acceleration Control (AAC), adjusted to the respective load, ensures the best possible start and stop ramps in order to avoid water hammering.

Integrated monitoring functions provide comprehensive protection, including: phase error detection, thyristor monitoring and bypass contact overload.

## Technical data

Input ..... 3 x 200-690 V  
 Control voltage ..... 24 V DC or  
 110-240 V AC  
 Power ..... 7.5-850 /2400\* (1600A) kW  
 ..... \*"Inside delta connection"

## Fieldbus

DN	PB	MOD
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## Protection rating

IP00	IP20	IP21/Type 1
■	■	
IP54/Type 12	IP55/Type 12	IP66/Type 4X





### VLT® AutomationDrive FC 302

Used extensively for all mining and mineral processing equipment applications and on stockyards and bulk material handling facilities, VLT® AutomationDrive FC 302 ensures optimal operation of all equipment, including conveyors, feeders, crushers, mills, screens, slurry pumps, flotation cells, paste thickeners, ship loaders, stackers, reclaimers, and more.

All kW ratings below are based on high overload ratings.

#### Power range

3 x 200-240 V .....	0.25-37 kW
3 x 380-500 V .....	0.37-800 kW
3 x 525-600 V .....	0.75-75 kW
3 x 525-690 V .....	1.1-1200 kW

#### Power range – Low harmonic drive

3 x 380-480 V .....	132-630 kW
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#### Power range – 12-pulse drive

3 x 380-500 V .....	250-800 kW
3 x 525-690 V .....	250-1200 kW

#### Fieldbus

MOD				
DN	CAN	PB	TCP	EIP
ECAT	PN	PL		

#### Protection rating

IP00	IP20	IP21/Type 1
■	■	■
IP54/Type 12	IP55/Type 12	IP66/Type 4X
■	■	■

### VLT® AQUA Drive FC 202

Used on mine sites and mineral processing plants, VLT® AQUA Drive controls all types of pumps, including centrifugal pumps (with quadratic loads) and displacement and screw pumps (with constant torque load). On mine sites VLT® AQUA Drive is commonly used for mine de-watering pumps and borehole pump applications, often installed outdoors on pump skids or next to borehole pumps, with appropriate enclosures providing protection from the weather and shading from the sun. Pump protection functions are built in and the Automatic Energy Optimization function ensures the motor, not only the pump, is operating at its best efficiency point.

All kW ratings below are based on normal overload ratings.

#### Power range

3 x 200-240 V .....	0.25-45 kW
3 x 380-480 V .....	0.37-1000 kW
3 x 525-600 V .....	0.75-90 kW
3 x 525-690 V .....	1.1-1400 kW

#### Power range – Low harmonic drive

3 x 380-480 V .....	160-710 kW
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#### Power range – 12-pulse drive

3 x 380-500 V .....	315-1000 kW
3 x 525-690 V .....	450-1400 kW

#### Fieldbus

MOD				
PN	DN	PB	TCP	EIP

#### Protection rating

IP00	IP20	IP21/Type 1
■	■	■
IP54/Type 12	IP55/Type 12	IP66/Type 4X
■	■	■

### VLT® HVAC Drive FC 102

Used to control the air flow of main ventilation fans on the surface as well as auxiliary ventilation and booster fans underground, VLT® HVAC Drive can be easily integrated into Ventilation on Demand (VOD) control systems. Built-in functions ensure reliable, continued operation of the fan even in abnormal operating conditions. The Automatic Energy Optimization function improves the overall efficiency of the drive and motor combined at all loads and speeds, resulting in lower operating costs and the optimum use of energy. Efficiency gains of >0.5% for the total system (switchroom + AC drive + motor + fan) are common compared to other “standard” AC drives. And as main ventilation fans are high energy users, an improvement in total efficiency of just 0.5% translates to significant operating cost savings.

All kW ratings below are based on normal overload ratings.

#### Power range

3 x 200-240 V .....	1.1-45 kW
3 x 380-480 V .....	1.1-1000 kW
3 x 525-600 V .....	1.1-90 kW
3 x 525-690 V .....	1.1-1400 kW

#### Power range – Low harmonic drive

3 x 380-480 V .....	160-710 kW
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#### Power range – 12-pulse drive

3 x 380-500 V .....	315-1000 kW
3 x 525-690 V .....	450-1400 kW

#### Fieldbus

MOD		META	BAC	
DN	LON	BAC	TCP	EIP
PB	PN	BIP		

#### Protection rating

IP00	IP20	IP21/Type 1
■	■	■
IP54/Type 12	IP55/Type 12	IP66/Type 4X
■	■	■



# VACON® drives

The broad range of VACON® NXP drives provides solutions no matter what type of AC drive you need. Air cooled or liquid cooled, wall mounted or floor standing, bottom or top cable entry, 6-pulse, 12-pulse or Active Front End (AFE) are just some of the options possible.

As standard they are designed to operate reliably with up to 300m cable lengths (power size dependent), without the need for any additional output filters. They include an AC choke harmonic filter and can be configured with built in RFI filters providing different levels of EMC performance as required, including compliance with the most commonly specified international EMC standard for mining and mineral processing facilities, IEC 61800-3 Category C3.

Active Front End (AFE) versions of the VACON® NXC and AFE modules combined with separate Inverter Unit (INU) modules provide solutions for regenerative applications and when low harmonic current distortion is required.

The VACON® 100 INDUSTRIAL drives are designed to operate reliably with up to 200m cable lengths (power size dependent), include a built in DC link choke harmonic filter and include a built in RFI filter ensuring compliance with at least IEC 61800-3 Category C3.

The built in PLC functionality according to IEC61131-3 of both the VACON® NXP and VACON® 100 enables OEMs to integrate their own functionality in the drives.





## VACON® NXP and VACON® NXC Air Cooled

Used extensively for all mining and mineral processing equipment applications and on stockyards and bulk material handling facilities including conveyors, feeders, crushers, mills, screens, slurry pumps, flotation cells, paste thickeners, ship loaders, stackers, reclaimers, mine ventilation fans, dewatering pumps, and more.

## VACON® NXP IP00 drive modules

These compact drive modules with separate AC chokes and separate front end and inverter unit modules for higher powers are ideally suited for applications where drives need to be built into low height enclosures as is often common on underground coal mine motor starter skids.

Complemented by a comprehensive range of air cooled VACON® NXP common DC bus modules and VACON® NXP liquid cooled drives and modules, there really isn't a tight space or harsh environment where we can't provide you an AC drive that meets your needs.

## VACON® 100 INDUSTRIAL

The VACON® 100 INDUSTRIAL is a workhorse for a wide range of industrial applications. It is easy to integrate into all major control systems and is easily adaptable to different needs. All power sizes are available as drive modules. The free-standing enclosed drive version for higher power sizes contains a wide range of configurable options and an innovative control compartment for safe access, without opening the cabinet door.

All kW ratings below are based on high overload ratings.

### Power range

3 x 208-240 V .....0.37-75 kW  
 3 x 380-500 V .....0.75-1100 kW  
 3 x 525-690 V .....2.2-1800 kW

### Power range – Low harmonic drive

3 x 380-500 V .....110-1200 kW  
 3 x 525-690 V .....90-1800 kW

### Power range – 12-pulse drive

3 x 380-500 V .....160-1100 kW  
 3 x 525-690 V .....200-1800 kW

All kW ratings below are based on high overload ratings.

### Power range

3 x 380-500 V .....160-1100 kW  
 3 x 525-690 V .....200-1800 kW

All kW ratings below are based on high overload ratings.

### Power range

3 x 208-240 V .....0.37-75 kW  
 3 x 380-500 V .....0.75-500 kW  
 3 x 525-690 V .....4-630 kW

### Fieldbus

MOD		META		
DN	CAN	PB	TCP	EIP
BAC	PN	LON		

### Protection rating

IP00	IP20	IP21/Type 1
		■
IP54/Type 12	IP55/Type 12	IP66/Type 4X
■		

### Fieldbus

MOD		META		
DN	CAN	PB	TCP	EIP
BAC	PN	LON		

### Protection rating

IP00	IP20	IP21/Type 1
■		
IP54/Type 12	IP55/Type 12	IP66/Type 4X

### Fieldbus

MOD	META	BAC	TCP	BIP
PB	DN	CAN	BAC	LON
TCP	EIP	PN	ECAT	

### Protection rating \*Dependent upon enclosure size

IP00	IP20	IP21/Type 1
■		■*
IP54/Type 12	IP55/Type 12	IP66/Type 4X
■*		





## Adverse effects of harmonics

- Limitations on supply and network utilization
- Increased transformer, motor and cable heating
- Reduced equipment lifetime
- Costly equipment downtime
- Control system malfunctions
- Pulsating and reduced motor torque
- Audible noise

## Harmonics mitigation

While AC drives help optimize production, save energy and extend equipment lifetime, they also introduce harmonic currents to the mine-site grid.

If not kept under control, these harmonics can affect the performance and reliability of generators and other equipment.

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## Harmonics mitigation solutions

Reliable estimation of the harmonic impact of AC drives on the mine site electrical system, combined with the use of the optimum mitigation equipment, helps plants avoid the hidden and often expensive consequences of harmonic distortion.

All VLT® and VACON® drives supplied for mine site installations incorporate a DC link choke or AC choke, first level, harmonic filter as standard. If required, additional harmonic filters and other harmonic mitigation solutions, as well as software tools for calculating harmonic mitigation requirements are also available.

Danfoss Drives has developed a wide range of mitigation solutions which can help restore weak networks, increase network capacity, and meet compact retrofit demands or secure sensitive environments:

- Advanced active filters
- Advanced harmonic filters
- Low harmonic drives
- AFE low harmonic drives
- 12-pulse drives



# Harmonics calculation software

Using reliable estimates of the harmonic impacts of AC drives, plants can avoid the hidden and often expensive consequences of harmonic interference: erratic performance or overloading of motors, circuit breakers and power factor correction devices.

## Easy to use at any phase of the mine project

The VLT® Motion Control Tool MCT 31 software tool is easy to use, requiring input of only a few points of readily available data to get an initial assessment of the harmonic impact on the mains supply. With more data entered, typically available from electrical load lists and cable schedules even at feasibility study stages of a mining project, the accuracy of the results can be improved.

The VLT® Motion Control Tool MCT 31 software enables a quick evaluation of whether additional harmonic mitigation is required. If so, the software can determine an optimal harmonic mitigation solution specific to the project to avoid unnecessary and costly over-engineering.

## No need for high processing power

The VLT® Motion Control Tool MCT 31 software tool provides useful data without the need for the high processing power requirements of more sophisticated harmonic calculation tools. Although not a substitute for these sophisticated alternatives, VLT® Motion Control Tool MCT 31 has proven many times to provide a useable and reliable estimate of the harmonic impact of AC drives at the different stages of mining projects, from feasibility study through to detailed engineering.

# Commissioning software

## Easy engineering and setup with VLT® Motion Control Tool MCT 10, VACON® NCDrive and VACON® Live

These Windows-based software tools provide easy configuration via a PC, and provide plant managers with a comprehensive overview of all the drives in a system of any size. They add a new level of flexibility in configuration, monitoring and troubleshooting.

▶ **VLT® Motion Control Tool MCT 10** is an engineering tool enabling data exchange over a traditional RS485 interface, fieldbus (PROFIBUS, Ethernet, and more) or via USB. Use it with all VLT® drives.

▶ **VACON® NCDrive** is a commissioning tool for the VACON® NXP drives, allowing for real time parameterization and monitoring via the standard RS-232 connection or optional CAN bus option card.

▶ The **VACON® Live** commissioning tool supports the VACON® 100 Family of AC drive products. Real-time parameterization and monitoring are available via the standard RS-485 connection using an RS-485 to USB converter or through the built-in Ethernet port (AutoDHCP or Static IP).

Use of these software tools reduces the risk of incorrect configuration, and facilitates rapid troubleshooting. They are especially useful tools for documenting and recording as-commissioned settings for each AC drive on your site.

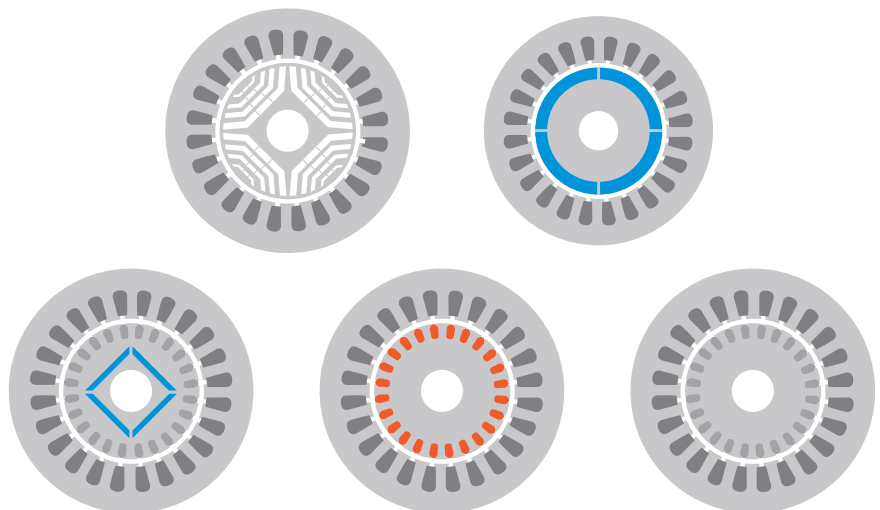
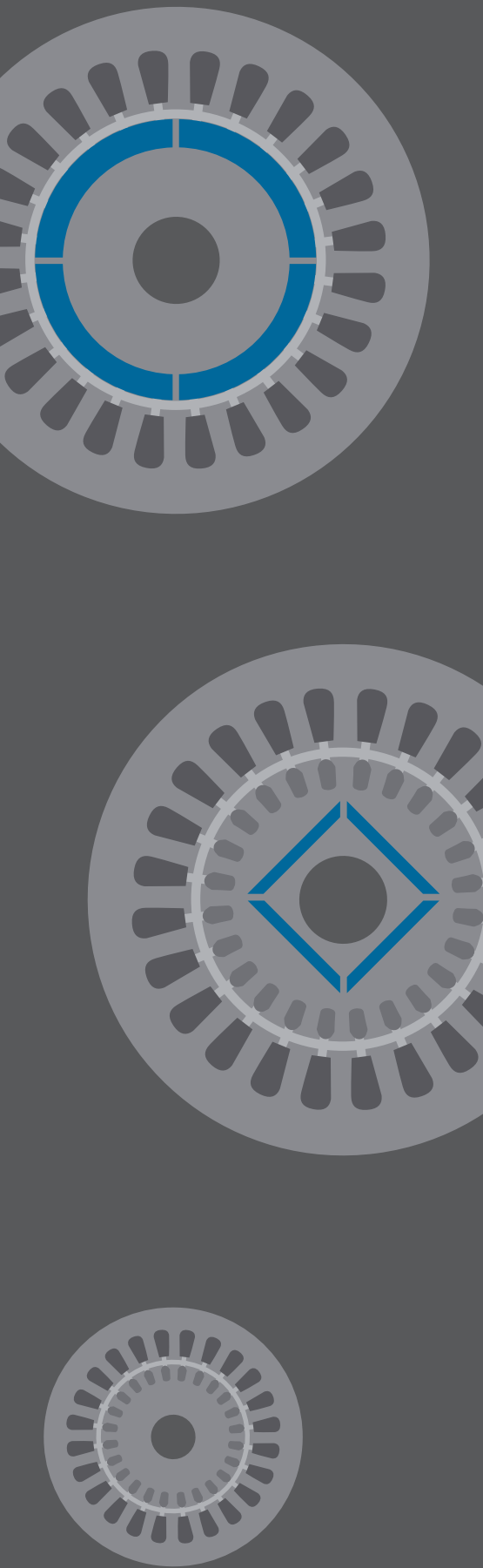


# Motor independence

To enjoy the benefits of a single drive platform, with cost savings in training, service, and storage of spare parts:

- Select a quality VLT® or VACON® drive meeting your specific requirements
- Choose the best value, reliable and efficient motor for your system, enabled by Danfoss 'one drive for all motors' concept

Each VLT® or VACON® drive is configurable, compatible and efficiency-optimized for all typical motors – liberating you from the performance and price restrictions of bundled motor-drive package deals.





# Global service network – **we react fast** wherever you are

VLT® and VACON® drives operate on mine sites, stockyards, bulk materials handling facilities, processing plants and related port facilities all over the world.

No matter where or what your project, you can be sure Danfoss Drives will be there to back you up. You can get immediate access to our expertise through your local Danfoss office, and you can call on service staff to minimize downtime and maximize productivity at your facility.

Our experts, located in more than 100 countries, are always ready to support you with engineering and application advice and service.

Our range of DrivePro® services provides you with the expert support, exactly where you need it, right on time. And we remain on the job until your drives challenges are solved.





# A better tomorrow is **driven by drives**

**Danfoss Drives is a world leader in variable speed control of electric motors.**

We offer you unparalleled competitive edge through quality, application-optimized products and a comprehensive range of product lifecycle services.

You can rely on us to share your goals. Striving for the best possible performance in your applications is our focus. We achieve this by providing the innovative products and application know-how required to optimize efficiency, enhance usability, and reduce complexity.

From supplying individual drive components to planning and delivering complete drive systems; our experts are ready to support you all the way.

You will find it easy to do business with us. Online, and locally in more than 50 countries, our experts are never far away, reacting fast when you need them.

You gain the benefit of decades of experience, since 1968. Our low voltage

and medium voltage AC drives are used with all major motor brands and technologies in power sizes from small to large.

**VACON® drives** combine innovation and high durability for the sustainable industries of tomorrow.

For long lifetime, top performance, and full-throttle process throughput, equip your demanding process industries and marine applications with VACON® single or system drives.

- Marine and Offshore
- Oil and Gas
- Metals
- Mining and Minerals
- Pulp and Paper
- Energy

- Elevators and Escalators
- Chemical
- Other heavy-duty industries

**VLT® drives** play a key role in rapid urbanization through an uninterrupted cold chain, fresh food supply, building comfort, clean water and environmental protection.

Outmaneuvering other precision drives, they excel, with remarkable fit, functionality and diverse connectivity.

- Food and Beverage
- Water and Wastewater
- HVAC
- Refrigeration
- Material Handling
- Textile

## **VLT® | VAGON®**

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