

ENGINEERING
TOMORROW



Application Paper | VACON® 3000 Drive Kit

Transform your toughest applications – an introduction to modularity

**Get
access**

to unique modular
medium-voltage
drive resources

drives.danfoss.com | **VACON®**

Introduction

System Integrators are experts in their fields in some of the toughest applications imaginable: Specialists who are used to working in the major league of heavy duty engineering, facing some of the most complex challenges on the planet. They know how vital AC drives are to their business; where reliability, robustness, space and weight are crucial – and downtime is a disaster.

Danfoss Drives, on the other hand, is the expert in AC drives. Specifically dedicated to developing, producing and supporting AC drives and their applications, we offer you unparalleled competitive edge through quality, application-optimized products and a comprehensive range of product lifecycle services.

And Danfoss Drives provides unique support in designing modular medium-voltage drives.

Table of contents

The current playing field in medium-voltage AC drives	3
VACON® 3000 – The game-changer	4
New way of doing business	4
Modularity redefines the MV drive	4
Maximum design flexibility	5
Phase modules	6
Easy to integrate, for 5 good reasons	8
Rugged and reliable	9
Serviceability	10
Designing a definite-purpose MV drive	11
Motor side – Inverter, output filter and brake chopper	14
The control system	16
The liquid cooling system	18
Co-operation in system design – The Danfoss MVP Program®	19
Summary	19

The current playing field in **medium-voltage AC drives**

With infrastructures around the world developing and heavy industries becoming more important, the need for higher power output is growing. Motors are getting bigger in many industries and in a wide range of driven equipment. Medium-voltage (MV) AC drives are needed to satisfy the customers’ and users’ needs for variable speed AC drives in the medium and high power range. When the required power output increases, there comes a point when it makes sense to switch from LV drives to MV drives. It is not practical nor is it economical to use low-voltage (LV) AC drives in the upper power range. Above a certain power requirement there is no other choice than MV drives. The higher voltage enables lower current, fewer losses and reduced system costs (related to transformers and cable sizes).

Many applications operate on an MV power supply. The most common MV applications are the same applications that are commonly used with LV power supplies: fans and pumps. Marine and offshore, mining, metals, and oil and gas industries are some of the most common industries for MV applications. *Table 1 lists some examples.*

All these applications regularly push AC drives to their limits. Customers in these sectors are working in adverse environmental conditions, including dust, humidity and aggressive gases, but their equipment must remain reliable nevertheless.

Currently, the MV drives available to system integrators are fixed cabinet-built solutions. In many cases, integrating these “one size fits all” MV drive solutions to demanding applications is difficult and leads to many compromises in the system design. The lack of flexibility reduces the value the system integrator can add to the final product and prevents the system integrator from fulfilling the needs for each customer, application and segment.

Application examples

In applications where the AC drive is installed in a clean, standard electrical room, the standard solutions currently available on the market can be sufficient. In these applications, the MV drives are integrated into standard cabinets of fixed height.

However, applications often demand a specialized solution optimized for installation in an existing space, such as on ships, in oil and gas, or mining operations, where space is at a premium.

In marine applications, space on board a vessel is very restricted. This creates limitations for system integrators and OEMs who supply marine equipment. In order to incorporate a standard MV drive in a marine application, the designer is obliged to compromise by taking space from other components on board.

In the mining industry, space restrictions take many forms, from the limits placed on underground equipment to the high compactness of mobile machinery at the surface. For both underground and surface equipment, there is a need for flexible and compact MV drive configurations, which enable designers to flexibly integrate an MV drive into mobile equipment.

Table 1. Common applications utilizing a MV power supply

Application	Where the application is used
Fan	Large MV fans, such as ventilation fans for the mining industry
Pump	Centrifugal (variable torque) and positive displacement (constant torque) pumps are often large enough to warrant a MV power supply. Pumps are used in many industries.
Conveyor	Long downhill or horizontal conveyors
Compressor	Compressor stations for gas pipelines and plants, blowers for cement plants and the metals industry, pump stations for pumping oil, process and water industries.
Propulsion	High-power marine and offshore industries

VACON® 3000 – The game-changer

The VACON® 3000 Drive Kit is a simple, flexible and economical means of incorporating definite purpose-built motor drives into system integrator and OEM products and solutions. The phase modules are configurable in the full voltage range at 3.3 and 4.16 kV, enabling design engineers to target application-specific requirements for motor power, braking power and system control.

The VACON® 3000 Drive Kit makes it easy to differentiate between specific

market segments and deliver the best possible value for end users. The new modular solution allows for addressing unique industry requirements regarding installation, construction shapes and sizes – and even protection classes.

Danfoss Drives is working with selected qualified partners to push the boundaries of the MV drives market to deliver something never seen before – a unique modular approach, which gives you the ultimate solution for each

project with the flexibility and choice to take your business to the next level. We differentiate allowing customers to add both own value as well as own industry- and application-specific expertise.

Unique way of doing business

Not only is the VACON® 3000 Drive Kit exceptional, but the business model is also unique, offering you commercial advantages, no matter whether you are a system integrator, an OEM or the equipment owner. Due to close collaboration between Danfoss Drives and its authorized Medium Voltage

Partners (MVP) in the Danfoss MVP Program®, the engineers and the owners benefit from a high level of knowledge transfer and application engineering assistance from Danfoss Drives. This collaboration ensures strong system performance combined with a high system energy efficiency

– as well as the most power dense MV drives solutions available. Danfoss Drives can promise this based on its global and decades-long market leadership as a specialist in AC drives.

Modularity redefines the MV drive

The VACON® 3000 Drive Kit is a modular MV drive that offers a new dimension of application engineering for industrial applications with motor voltages of 3300 or 4160 V. It enables the complete customization of the enclosure to meet the unique needs, restrictions and characteristics of a variety of applications, including those with limited space and in harsh conditions.

The VACON® 3000 Drive Kit is designed in a power range starting from 2 MW. Basic configurations have a power of 2 or 3 MW. These configurations can be paralleled for systems of 4 MW and above.

With the modular MV drive you get a degree of flexibility not previously seen in MV drives.

The modular MV drive differs from other MV drives in several ways:

- It includes only the components you need and offers maximum design flexibility.
- It is delivered as a set of separate modules, like building blocks. You create the MV drive by building the modules into your own cabinet.
- It is compact and easy to integrate, and has high power density.

- It is rugged and especially designed for harsh environments.
- It is easily serviced, due to the easy replacement of phase modules.

Maximum design flexibility

The VACON® 3000 Drive Kit offers comprehensive functionality in a single package. The kit can be selected with either a diode front-end (DFE)-based 12-pulse configuration, or an active front end (AFE) for regenerative braking and low harmonics. Kits can be configured to include input filters, an output filter, a brake chopper and other options to achieve desired characteristics under various operating conditions.

A fixed-cabinet MV drive might include many components which are not needed in the application. By using a modular MV drive, the system integrator can leave out the modules that are not required, include only the necessary components and add components that are specifically relevant for the application. You scale up by adding more modules.

By default, a VACON® 3000 Drive Kit includes the main parts for the MV drive. Each kit includes the following functional units:

- Active Front End OR Diode Front End, including the relevant filter components.
- Inverter unit (INU) with either 3 or 6 liquid-cooled single-phase phase modules.
- Control unit with a fully-graphical user interface for fast set-up and use, with the latest technology built-in, to provide a wide choice of control options. The interface is familiar, since it is the similar interface as for the VACON® 100 family of low-voltage drives. This improves simplicity and efficiency for operators, when combining LV and MV applications in the same system. The control unit also includes built-

in PLC functionality for customer-specific application software.

- Pre-charge unit with a simplified design for the pre-charging of the DC link. The compact solution is perfect for space-sensitive applications, requires no pre-charging resistors and limits the inrush current for a fast and safe start-up.

Available options include, for example:

- Brake chopper unit for applications demanding dynamic braking
- Common mode input filter
- Output filter (dU/dt or sine filter)

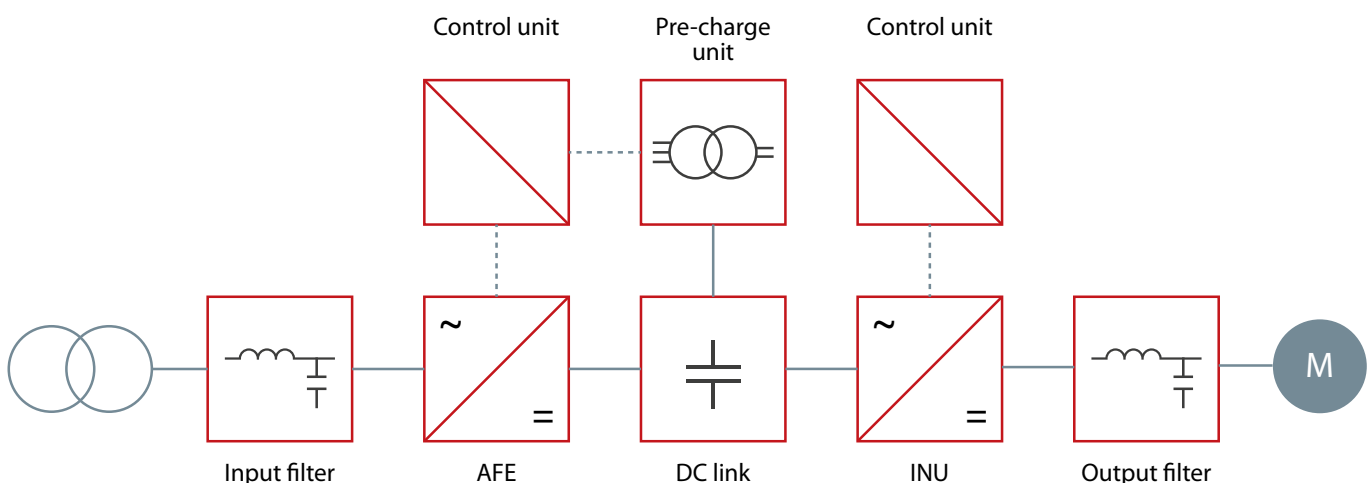


Figure 1. Basic block diagram of the VACON® 3000 Drive Kit with AFE

Phase modules

– Building blocks for the MV drive

A modular MV drive is made up of units designed to fit together like building blocks. You can arrange them as required, in different horizontal or vertical combinations. This modularity means that the system integrator or OEM wins the freedom to create the ideal configuration for each installation and purpose build a cabinet to meet any space limitation or comply with the ingress protection class demanded by the application.

The VACON® 3000 Drive Kit is a definite-purpose MV drive strong on modularity due to the multiple use of phase modules through the whole power range:

- Three 2 or 3 MW single-phase phase modules are installed to create an INU or AFE.
- The same phase modules are used for INU, AFE and brake chopper units (BCU), which reduces the size of the spare parts inventory and offers higher reliability and greater accessibility.
- Same physical size of the single-phase phase module and DC capacitor for DFE, enables installing the modules in stacks and side-by-side.

You are free to arrange the modules to use the form factor that best fits the application. This flexibility gives

equipment owners the opportunity to design and introduce AC drives to MV applications where it was previously impossible due to space restrictions. The modularity of the VACON® 3000 Drive Kit means that you can tailor the form factor to the specific application and create a definite-purpose MV drive.

Figure 3 shows examples of assemblies with different form factors:

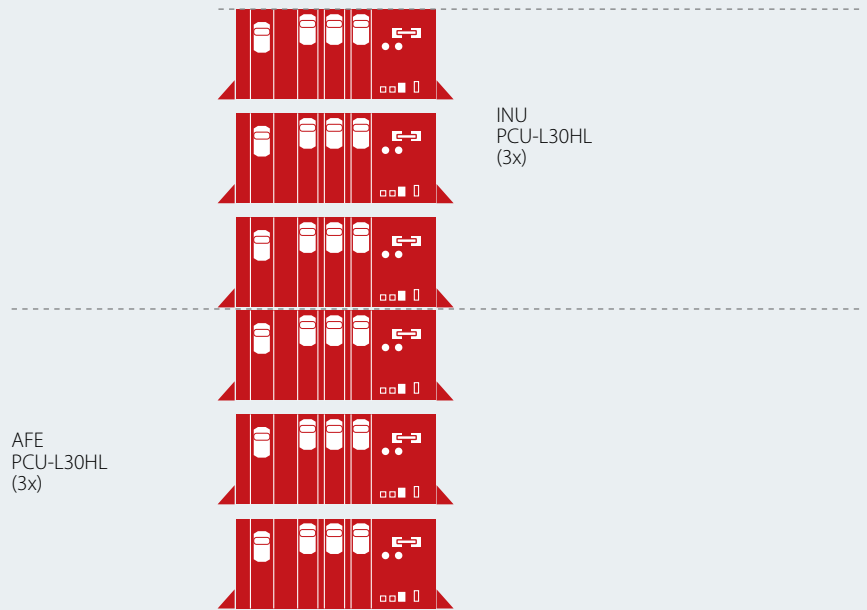
1. 3 MW AFE drive with the phase modules in a single stack
2. 3 MW AFE drive with the phase modules in a “six-pack” assembly
3. 3 MW 12-pulse drive with an additional DC capacitor (CDC), brake chopper unit (BCU) and D22 12-pulse DFE power module



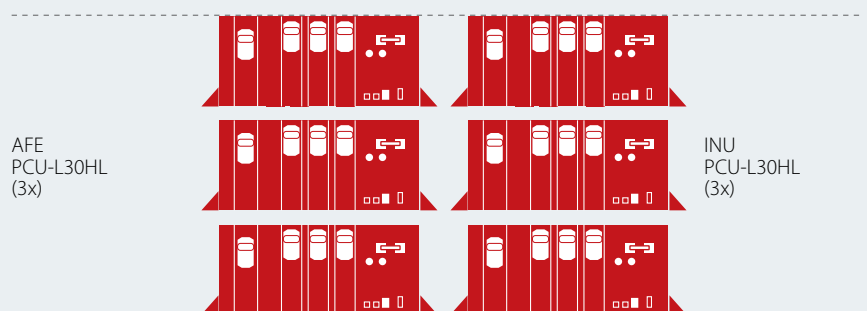
Figure 2. The 2 and 3 MW single-phase phase modules (L20 and L30)

Examples of assemblies with different form factors:

AFE single-stack assembly



AFE two-stack assembly



DFE single-stack assembly with brake chopper unit



Easy to integrate, for 5 good reasons

The modular MV drive consists of compact modules which are easy to integrate into your own definite-purpose packages. The individual modules have a high power density, which means that you can fit more power conversion capacity into a limited space. The power density of the VACON® 3000 phase modules is over 10 MVA/m³, which is twice as high as the MV drives currently available in the market. In other words, the VACON® 3000 fits the same output power in half the space.

The size of all the components in the VACON® 3000 Drive Kit has been optimized. The pre-charge unit for the AC drive is very simple and compact. The input and output filter chokes have hybrid forced-air core cooling through a compact air-to-liquid heat exchanger. This reduces the heat losses to the air during the cabinet integration and therefore reduces the number of fans needed for cooling the cabinet.

Five factors come together to make VACON® 3000 Drive Kit the ideal choice for system integrators and OEMs, who require ease of integration:

- **Modularity.** The modularity and standard module sizes allow freedom and flexibility in design and installation, saving time in both engineering and assembly.
- **Small size.** Small size due to encapsulated modules with a high power density gives designers more options for packaging the entire system and reduces installation costs and time.
- **Efficient heat management.** Individual modules are encapsulated with a liquid cooling system to most efficiently remove heat. A compact, liquid-cooled aluminum heat sink is used for safe, efficient and reliable temperature control. Good heat management gives the builder of the system greater packaging flexibility. Modules can be stacked immediately beside one another, since heat loss is taken care of via liquid cooling.
- **Easy to install.** The phase modules are designed for easy integration into new and existing layouts. All power, control and coolant connections are made at the front of each phase module for easy access and integration. Terminals can be

changed to work with different cable lugs by simply removing and replacing screws from the outside. Multi-hole mounting rails located along the top and bottom sides of each module allow for a variety of mounting arrangements. Equipment slides can be attached to the mounting rails to facilitate inspection and maintenance.

Figure 4 shows the features which make the phase modules easy to install.

- **Easy to use.** User-friendly PC tools, control interface and user interface are in common with VACON® Low Voltage AC Drives and make it easy to tune drive characteristics for specific applications. The drive control unit features a removable keypad that can be used to monitor and supervise drive functions from multiple locations, and to quickly transfer operating parameters among drives.

Table 2. Size and power density of the 2 and 3 MW phase modules L20 and L30

	L20		L30	
Height	0.238 m		0.238 m	
Depth	0.761 m		0.761 m	
Width	0.437 m		0.632 m	
Volume (one module)	0.08 m ³		0.11 m ³	
Quantity of modules in AFE/INU	3		3	
Volume (AFE/INU)	0.24 m ³		0.34 m ³	
Nominal current	340 A	425 A	510 A	640 A
Nominal voltage	4160 V	3300 V	4160 V	3300 V
Power (S)	2450 kVA	2429 kVA	3675 kVA	3658 kVA
Power/volume	>10000 kVA/m ³		>10000 kVA/m ³	

Figure 4. Easy-integration features of the phase module

- 1 Exchangeable cable lugs and connectors
- 2 Power, control and coolant connections in the front
- 3 Multi-hole mounting rails



Rugged and reliable

The VACON® 3000 is a rugged and reliable MV drive solution. It can manage high vibration and ambient operating temperatures between 0 to +45 °C, dependent on cabinet design. Factors that contribute to the ruggedness of VACON® 3000:

- **3-level NPC topology.** The single-phase phase modules have a 3-Level NPC topology, which reduces the number of components in the AFE and INU sections, increasing the robustness and reliability of the product.
- **Solid construction.** The IGBTs and other components inside the phase module are tightly packaged and are free of moving parts to ensure long life.
- **Rugged components.** The modules are designed to be as maintenance free as possible. The DC link has film capacitors and there are no snubber capacitors in the modules.
- **No added insulation.** Insulation material can cause problems and limit reliability. In VACON® 3000 the insulation is built into the structure of the phase module.
- **Liquid cooling.** Liquid-cooled modular units ensure proper cooling without needing maintenance-intensive fans inside the modules. Good heat management through liquid cooling also lowers the total number of fans in the cabinet, reducing the overall maintenance task. No air circulation inside the phase modules for cooling also limits the ingress of foreign bodies such as dust from the external environment and protects the electronics.
- **Protection.** The INU and AFE phase modules monitor the phase current and DC voltages, and in case of a fault, stop automatically and independently. The phase modules also have an earth fault detection circuit.

Serviceability

The modular MV drive configuration enables equipment operators to react fast in a downtime situation. The drive modules are designed to be easily replaceable, which leads to shorter mean time to repair (MTTR), and increased uptime.

To make access and installation of the phase modules easy, all the terminals for power and control cabling as well as the liquid cooling connections are located in the front of the phase module. Replacing a phase module takes only a few minutes and requires no special tools.

The same easy-to-handle phase modules are used for INU, AFE and BCU. The same units can be used as spare parts for several purposes, which significantly reduces the size of the spare parts inventory. Simply exchange the relevant module and the process is up and running again.

Danfoss Drives offers an excellent worldwide service network based on its global reach. The service personnel are focused on AC drives and can react fast and effectively to deliver AC drive support. The Danfoss DrivePro® services include troubleshooting, maintenance,

repairs and replacements, which aim to improve productivity, performance and uptime. Equipment operators get specialized training and access to expert knowledge, to benefit their business directly. The comprehensive portfolio of services spans the entire life cycle of the drives.

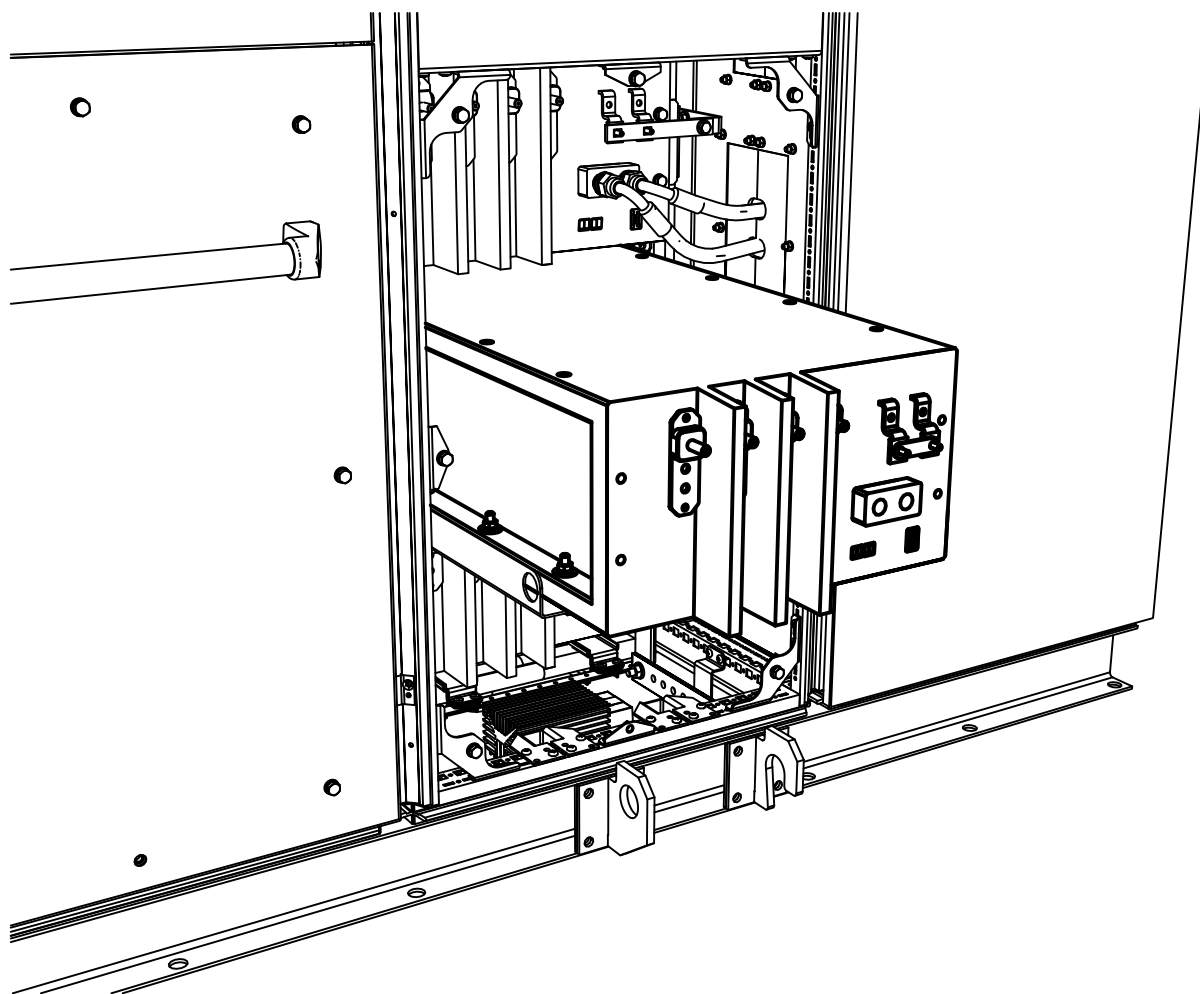


Figure 5. The phase modules are easy to remove and replace

Designing a definite-purpose MV drive with VACON® 3000 Drive Kit

Getting started

Before starting the design of a MV drive system, get this basic information:

- Supply voltage: VACON® 3000 Drive Kit supports motor voltages of 3300 and 4160 V.
- Required current: VACON® 3000 Drive Kit configurations are available for currents starting from 340 A.
- Motor type: Use VACON® 3000 Drive Kit only for the control of induction motors!
- Harmonic mitigation requirements: what level of harmonic distortion is acceptable?
- Is regeneration required?
- Is there a dedicated supply transformer for the drive system?

There are two ways to create a definite-purpose drive:

- Use a VACON® 3000 reference design from Danfoss Drives.
- Develop your own original design.

If you choose to use one of the existing VACON® 3000 reference designs, simply obtain the reference design from the Danfoss MVP® Portal and order the modules as a kit. Add commercially available standard parts and build the MV drive according to the instructions.

If you prefer to create an original design for the application, you can use one of the existing VACON® 3000 reference designs as a starting point, or start from scratch. You can order the required modules as a kit or separately.

In each case, the Danfoss MVP Program® provides you with the necessary tools, training and support needed to create definite purpose MV drives for specific projects. Project owners can discuss their needs in depth with Danfoss Medium Voltage Partners, to define a design encompassing the exact characteristics they expect of a MV drive.

Harmonic mitigation and regeneration: the choice between DFE and AFE

Choose a front-end type, either diode front end or active front end according to the harmonic mitigation requirements and the need for regeneration.

The 12-pulse DFE will lead to harmonic distortion levels typically less than 15%.

The AFE offers reduced harmonic distortion to less than 5% (meets the requirements of system standard IEEE-519) and continuous power regeneration.

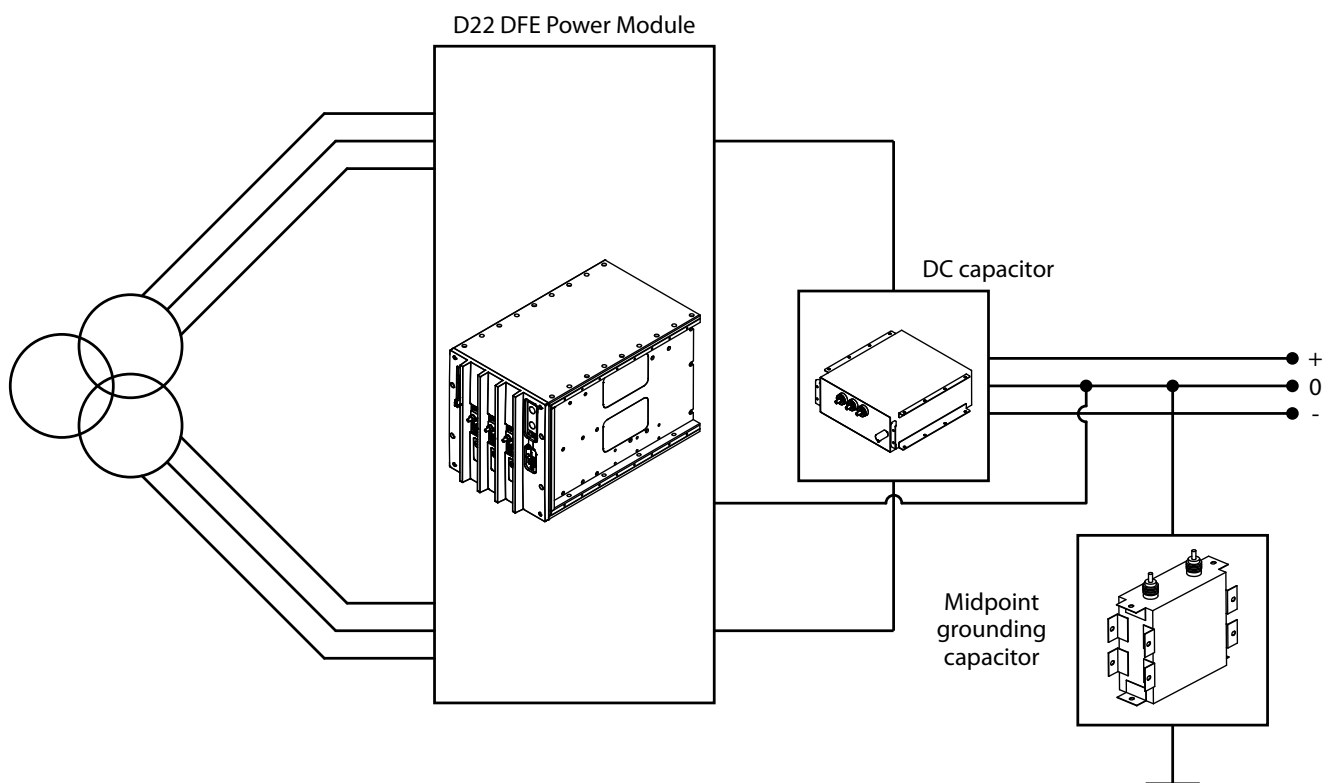
Table 3. Technical comparison of the 12-pulse DFE and AFE

Feature	12-pulse DFE	AFE
Technology	Diode	IGBT
Type	Non-Regenerative	Regenerative
Switching frequency	Line frequency	1050 Hz (50 Hz input) 1260 Hz (60 Hz input)
Efficiency (whole AC drive at nominal load)	> 98.5%	> 98%
THDi	< 15%	< 5%
Line filter		LC filter (common mode filter optional)
DC link pre-charge	External pre-charge unit (included in kit)	External pre-charge unit (included in kit)
Phase modules	2 x 3-phase DFE module	3 x single-phase phase module

DFE features

- The DFE power module features two integrated series-connected liquid-cooled 6-pulse rectifiers
- The diode rectifiers are simple, reliable and well-proven.
- Supply through a dedicated transformer with 2 secondary windings.
- This unit is suitable as a rectifying device when a THDi-level of below 15% is accepted and no regeneration to the mains is required.
- The 12-pulse DFE includes a separate DC link capacitor and a midpoint grounding capacitor.

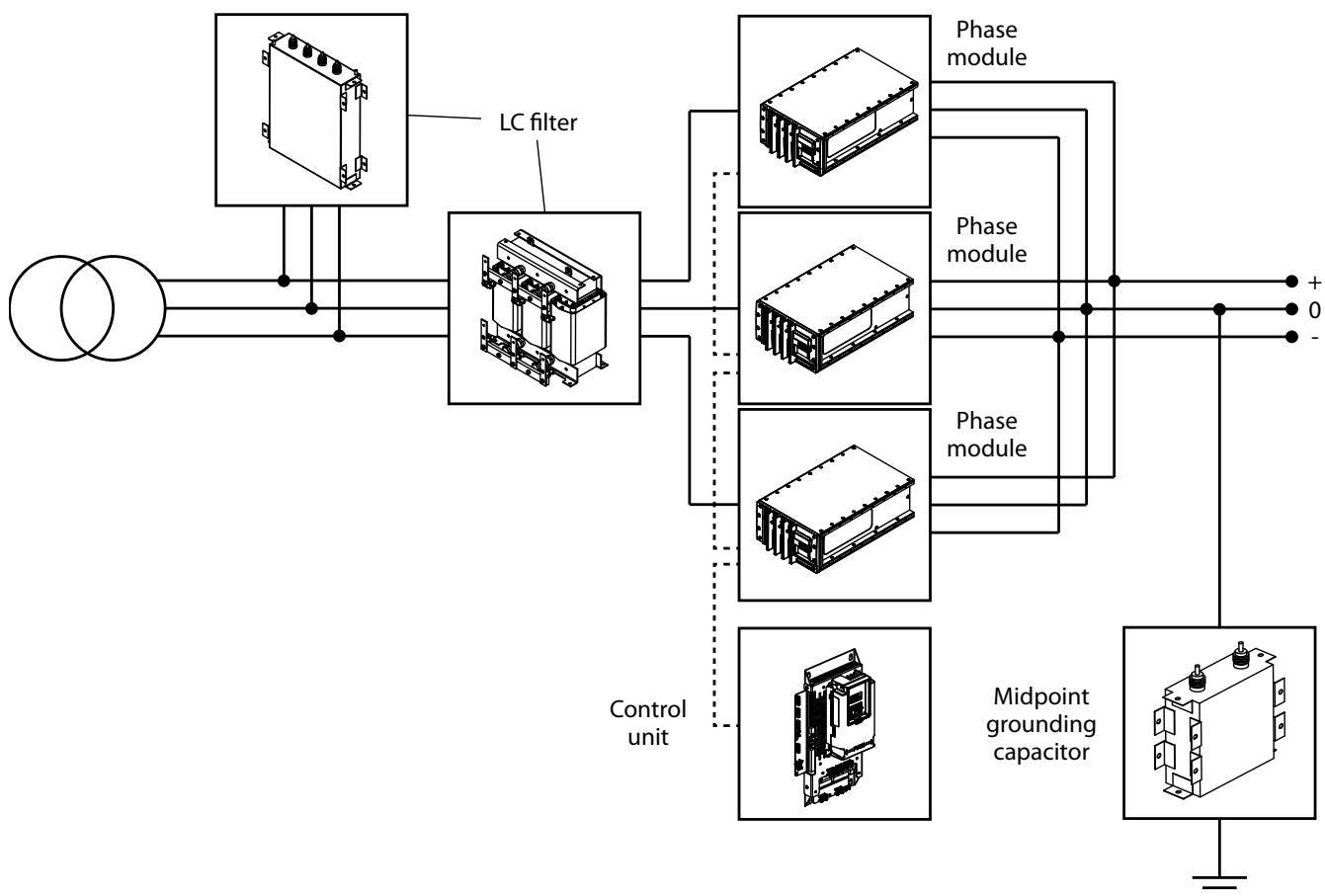
Figure 6. The default 12-pulse DFE configuration



AFE features

- The AFE phase modules are liquid-cooled single-phase power conversion units. In sets of three, the phase modules make a full 3-phase regenerative low harmonic rectifier.
- The phase modules are 3-level neutral point clamped (NPC).
- The AFE utilizes PWM controlled high-voltage IGBT technology to allow bi-directional power flow to the AC grid eliminating the need to install bulky resistor load banks.
- The same phase module type is used in AFE and INU units and as brake choppers (BCU).
- The AFE is regenerative and supplies power back to the supply side during motor braking.
- The AFE can be adjusted to run at unity power factor or used to provide 0.8 leading or 0.8 lagging power factor to the system.
- An LC filter on the input side is mandatory and included in the kit by default. The AFE also includes a midpoint grounding capacitor.
- If there is no dedicated supply transformer, a common mode filter must be installed on the input side (available as option).
- The AFE comes with its own control unit, which controls the phase modules and the pre-charge unit.
- Supply voltage feedback to the AFE control unit is needed for AFE voltage synchronization.
- The AFE makes it possible for the INU to achieve stable operation of the AC motor in the presence of weak power systems with fluctuating system voltage and frequency.
- AFE modules can be connected in parallel in order to increase the power.

Figure 7. The default AFE configuration



Motor side – Inverter, output filter and brake chopper

The inverter unit is similar for all VACON® 3000 drives, independent of the front-end type. The inverter includes three phase modules, which make a full 3-phase inverter. The phase modules are the same ones that are used in the AFE.

The inverter unit also includes a control unit for the phase modules and a pre-charge unit for charging the DC link. By default, the kit includes no output filter, but dU/dt and sine filters are available as options.

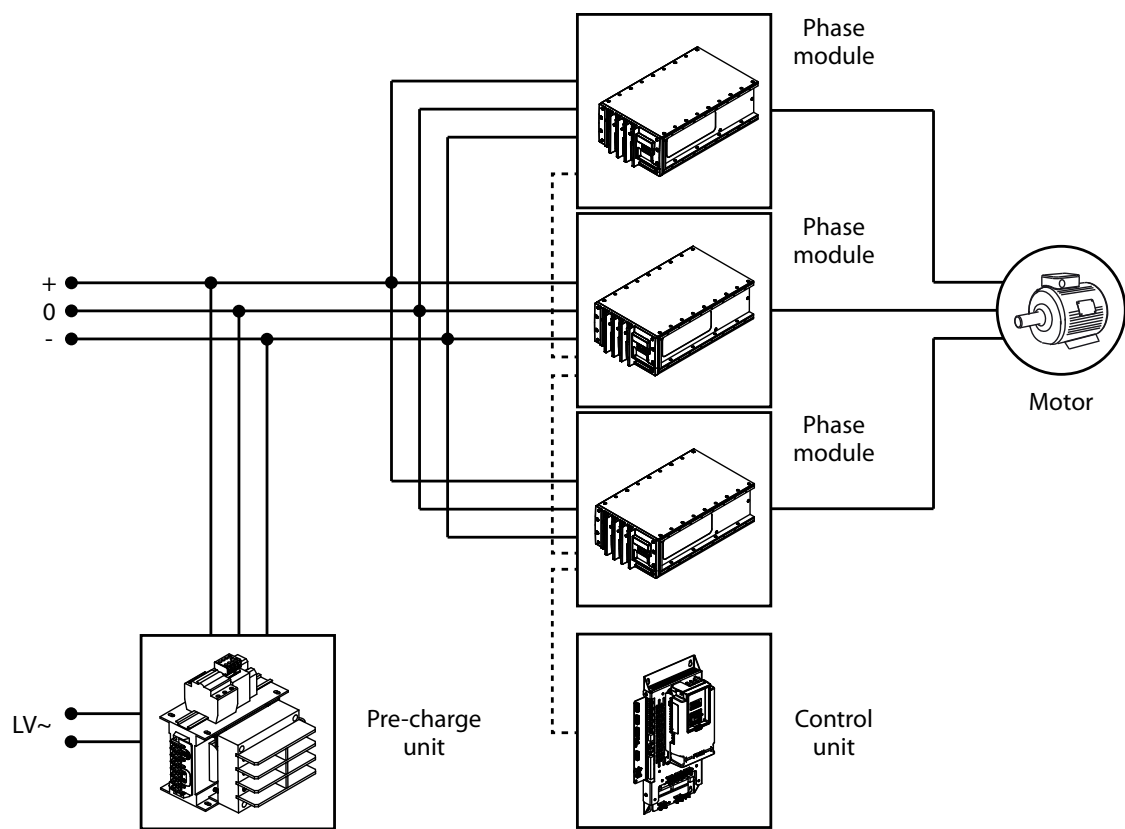
The output voltage can be selected between 0 and U_{IN} (3300 or 4160 V) and the output frequency between 0 and 120 Hz. The available output current ratings are listed in Table 4.

Table 4. Available output current ratings

3300 V	4160 V
425 A	340 A
640 A	510 A

To achieve greater output current ratings, mount two or more inverter units in parallel.

Figure 8. The default inverter unit configuration



dU/dt filter

A dU/dt filter is a low-pass filter, for which the cutoff frequency is above the nominal switching frequency of the AC drive. The dU/dt filter gives the motor protection against high dU/dt values and voltage pulses, and thus extends the life time of the motor.

The need for a dU/dt filter is defined by the motor characteristics. If the motor insulation can handle the peak phase-to-phase and phase-to-ground voltages and a high enough dU/dt, there is no need for an output filter.

We recommend a dU/dt filter in these circumstances:

- In installations with motors that are not intended for operation with an AC drive
- In installations with old motors or general-purpose motors
- In applications with the risk of partial discharge in the motor windings
- In applications with short motor cables

Sine filter

A sine filter is a low-pass filter, for which the cutoff frequency is set to remove all the high frequency components of the AC drive output voltage. It gives out a near perfect voltage sine wave. This decreases motor insulation strain and motor losses, and thus extends the life time of the motor.

Select a sine filter when there is no other way to handle maximum permitted dU/dt, than with a perfect sine wave connected to the motor.

We recommend a sine filter under these circumstances:

- In installations with old motors with weak insulation
- In applications with many parallel motors
- In applications where you need to reduce motor noise levels
- In applications with long motor cables

Brake chopper

Brake chopper units are available as an option for applications that require dynamic braking.

The brake chopper consists of one phase module for each set of three inverter phase modules. The phase module used for the brake chopper is of the same type which is used for INU and AFE. It also comes with its own control unit. Brake resistors are optional.

The **control** system

The VACON® 3000 Drive Kit includes one or two control units by default, depending on the front-end type. All kits include the INU control unit, which controls the inverter phase modules. In AFE drive kits, there is a separate control unit to control the AFE phase modules. The brake chopper option includes a separate control unit for the brake chopper module or modules.

In a VACON® 3000 Drive Kit with AFE, the AFE control unit also controls the pre-charging of the DC link and ensures that the AFE voltage is synchronized smoothly to the input voltage before the AFE start-up. This enables a smooth transition from the pre-charged state to the run state. Supply voltage feedback to the AFE control unit is required for the voltage synchronization. You can supply the voltage feedback with a potential transformer, which is available as an option. In 12-pulse drives, the INU control unit controls the pre-charging.

The control units are connected to the phase modules with optical fiber cables. The phase modules are connected to the control unit in a daisy-chain. In drives with parallel power circuits, the parallel INU and AFE phase modules are connected to the same control units (up to six phase modules to a control unit). The control system example figures 9 and 10 show the control connections in typical AFE and 12-pulse drives.

Motor control and the need for an encoder

VACON® 3000 Drive Kit supports four different motor control modes:

- U/f control
- Open loop control (sensorless vector control) – speed control
- Indirect closed loop control (augmented sensorless vector control) – speed and torque control
- Closed loop control (field oriented) – full control of torque and speed (requires an encoder)

The customer specifications define the control method, and therefore also the need for an encoder. VACON® 3000 control units include encoder connections as standard.

Fieldbus communication

VACON® 3000 Drive Kit supports several different fieldbus communication protocols. The control units support PROFINET and Ethernet/IP communication as standard. Other fieldbus protocols are available as options.

The VACON® 3000 control unit is based on the control unit for VACON® 100 low-voltage drives. Therefore, the same fieldbus options which are available for VACON® 100 are also available for VACON® 3000.

Figure 9. Control system example for a VACON® 3000 Drive Kit with AFE drive (input filters not shown)

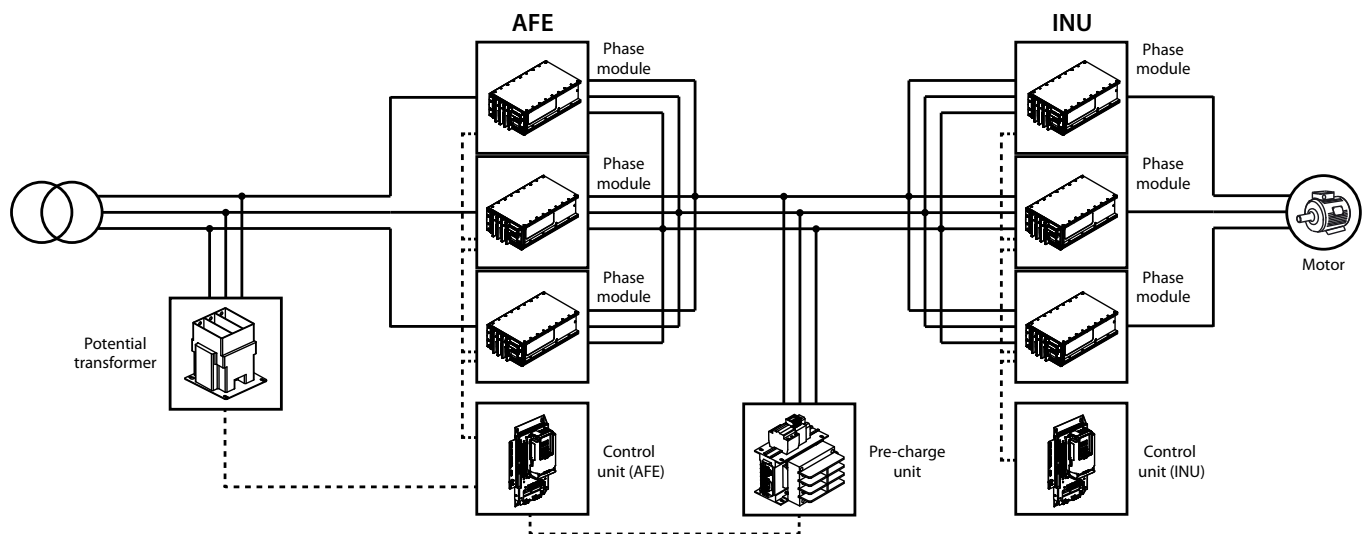
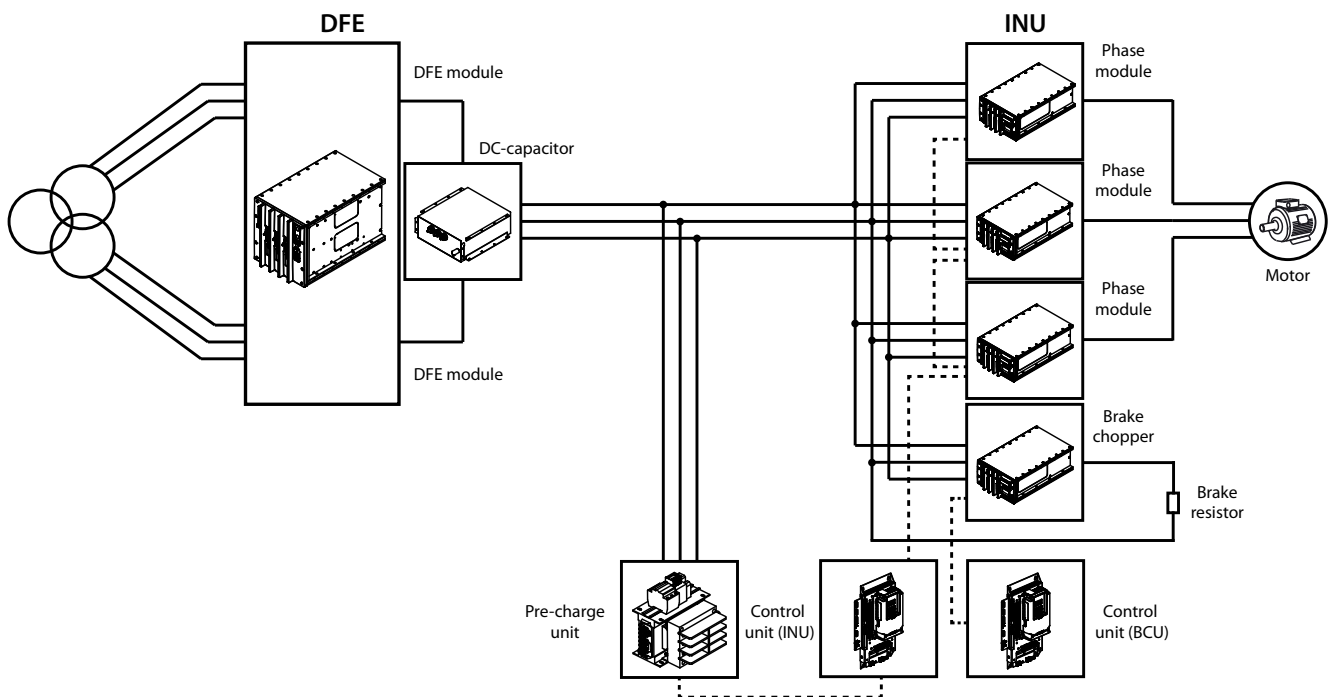


Figure 10. Control system example for a VACON® 3000 Drive Kit with 12-pulse DFE and the brake chopper option



The **liquid cooling** system

The VACON® 3000 Drive Kit is liquid-cooled with a glycol/water solution. The aluminum heat sink of the power modules is grounded, so no deionized cooling water is necessary.

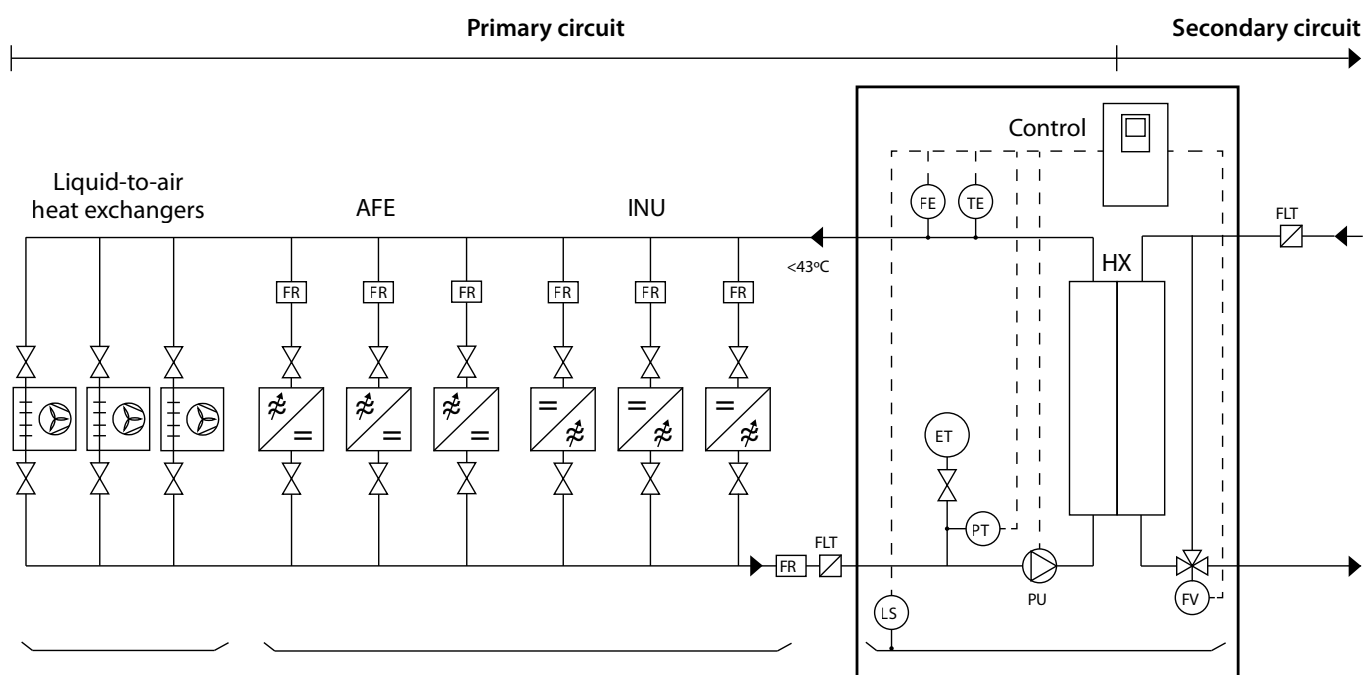
The power modules as well as the liquid-to-air heat exchangers of the magnetics have a simple inlet-outlet piping arrangement for connection to a heat exchanger.

Couplings can be easily exchanged from the front of each power module. Also, the heat exchanger equipment and the AC drive can be installed in different locations.

Heat exchangers are not part of the VACON® 3000 Drive Kit, but Danfoss offers a range of appropriate cooling units based on liquid-to-liquid heat exchangers.

Figure 11 below shows an example of the liquid cooling system for the VACON® 3000 Drive Kit with AFE, but the example is also applicable to 12-pulse drives.

Figure 11. Example of the cooling system



ET	= Expansion tank	HX	= Heat exchanger
FE	= Flow supervision	LS	= Leak sensor
FLT	= Filter	PT	= Pressure transmitter
FR	= Flow restrictor	PU	= Pump
FV	= Flow actuator	TE	= Temperature supervision

Co-operation in system design

– The Danfoss MVP Program®

In the Danfoss MVP Program®, Danfoss co-operates with its Medium Voltage Partners, a special network of partner companies with long-standing experience in the medium-voltage sector. They integrate individual drive modules, input and filter technology in one compact, fully assembled and tested unit and provide their support on-site during installation, start up and service. The Danfoss MVP Program® provides partners with the necessary tools, training and support needed to create definite purpose MV drives for

their projects. Danfoss supplies the core components for the MV drives, while the partners engineer and assemble the MV drive cabinets.

The value-add partners, including system integrators, OEMs and panel builders work together with Danfoss Drives to create synergies that deliver application optimized MV drives. Our partners continuously receive support via the Danfoss MVP Program®, adding value by being able to create their own system and cabinet offering – tailored

perfectly to the applications and segments where they are experts.

The Medium Voltage Partner will have access to exclusive content via our MVP Portal where knowledge transfer, engineering support and business collaboration are the main benefits. Danfoss engineers and support staff are well-equipped to assist customers with all aspects of the integration process including design, installation, commissioning, documentation, training and ongoing support.

Summary

Danfoss Drives presents a new way to design and deliver MV drives. The VACON® 3000 Drive Kit gives system integrators and OEMs a simple, flexible and economical means of incorporating purpose-built motor drives into their products and solutions.

The new modular solution enables the complete customization of enclosures to meet the unique needs, restrictions and characteristics of a variety of applications. The flexibility of the modular MV drive gives system integrators the opportunity to design and introduce AC drives to MV

applications where it was previously impossible due to space restrictions.

The power density of the liquid-cooled VACON® 3000 phase modules is twice as high as the MV drives currently available in the market. The modules are rugged and reliable, easy to install, use and service.

Not only is the VACON® 3000 Drive Kit exceptional, but the business model is also unique. The Danfoss MVP Program® is based on close collaboration between Danfoss Drives and its authorized Medium Voltage Partners.

The engineers and the owners benefit from a high level of knowledge transfer and application engineering assistance from Danfoss Drives.

For more information, visit danfoss.com/en/products/ac-drives/dds/vacon-3000/ and mvp.danfoss.com

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.

For more information visit our website



Any information, including, but not limited to information on selection of product, its application or use, product design, weight, dimensions, capacity or any other technical data in product manuals, catalogues descriptions, advertisements, etc. and whether made available in writing, orally, electronically, online or via download, shall be considered informative, and is only binding if and to the extent, explicit reference is made in a quotation or order confirmation. Danfoss cannot accept any responsibility for possible errors in catalogues, brochures, videos and other material. Danfoss reserves the right to alter its products without notice. This also applies to products ordered but not delivered provided that such alterations can be made without changes to form, fit or function of the product. All trademarks in this material are property of Danfoss A/S or Danfoss group companies. Danfoss and the Danfoss logo are trademarks of Danfoss A/S. All rights reserved.