INNOMOTICS

Danfoss

B&P Elektromotoren

Uw specialist en partner voor beide merken

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Innomotics Low Voltage

Combination Guide Danfoss Drives

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Foreword

The purpose of this document is to provide guidance on selecting one of the Danfoss drives series iC7, Vacon® or VLT® in combination with Innomotics asynchronous and synchronous motors of cast iron and aluminum motor lines

- severe duty / general purpose (1LE...),
- explosion proof (1MB...),
- permanent magnet motors (1FZ...) or reluctance motors (1FP...).

Tables with technically evaluated combinations issue mandatory selection information in regard to motor insulation protection and bearing currents reduction.

Supporting tools are:
Innomotics Product Configurator: Configurators | Innomotics
Innomotics Engineering Manual: Engineering manual converter-fed motors | Innomotics

Danfoss MyDrive® Select: MyDrive® Select
Danfoss DriveFinder: Danfoss DriveFinder

Trademarks

VLT® is a registered trademark for Danfoss A/S.

VACON® and MyDrive® are registered trademarks of Danfoss Drives Oy.

iC7 is a word mark registered for Danfoss A/S.

1 How to select the right motor and drive

1. **APPLICATION**.
   Start with the application and the motor shaft.

2. **LOAD PROFILE.**
   The maximum torque can be determined based on the torque curve and the load profile.

3. **SELECT THE MOTOR.**
   Select the correct motor in relation to motor torque and speed and further application dependent parameters. Use the Innomotics Product Configurator and motor catalogues for support.
   NOTICE: When running the motor with higher speed in field weakening area, the maximum torque will be reduced.

4. **SELECT THE DRIVE.**
   Select the correct frequency converter based on the motor (supply voltage, motor current), load profile (rated and max. overload current) and application dependent parameters (see 5.-9.). Use the Danfoss MyDrive Select tool and iC7, Vacon and VLT product design guides for support.
   NOTICE: Torque profile needs to match with selected drive. (e.g. Danfoss VLT® HVAC Drive FC 102 cannot run a hoist application with 160% overload)

5. **MAINS VOLTAGE.**
   The selection guides include tables for different supply voltages. Choose the correct table based on the AC line voltage.

6. **SELECT BY CURRENT.**
   Based on the expected maximum motor current, select the appropriate drive from the table. It is important to select by current, not by power rating! NOTICE: Nominal current for star/delta configuration of motor winding is different.

7. **OVERSIZING.**
   In some cases, the inverter may need to be oversized. Typical factors are ambient temperature, switching frequency, and installation at altitudes above 1000 m.

8. **EMC-FILTER.**
   Configure the EMC filter corresponding to the specific environmental demands.

9. **OPTIONS.**
   Select additional options for fieldbus, I/O, functional safety and power options (i.e. harmonics mitigation, motor voltage,..).

2 Combination Guide Danfoss Drive / Innomotics Motor - CONVERTER CAPABLE, SINGLE DRIVE

The following overview presents technically evaluated combinations of Danfoss drives series iC7, Vacon and VLT operating with Innomotics **asynchronous** motors of cast iron and aluminum motor lines severe duty / general purpose (1LE...) and explosion proof (1MB...) motors mandatory to motor isolation protection and bearing currents reduction.

AC line voltage	Power	Insulation grade standard design	Filter option	Remarks
380 – 480 V	≤ 18,5 kW	Basic	- / -	1), 3)
	≤ 18,5 kW	Advanced	- / -	3)
	> 18,5 kW	Advanced	- / -	2)
	≥ 200 kW	Advanced	- / CM-filter	2)
500 V	< 200 kW	Advanced	- / -	2)
	≥ 200 kW	Advanced	- / CM-filter	2)
AC line voltage	**Power**	**Insulation grade special design**	**Filter option Motor Isolation / Bearing currents**	**Remarks**
525 – 690 V	< 200 kW	Premium	du/dt	2)
	≥ 200 kW	Premium	du/dt + CM-filter	2)

Remarks:

1) Dynamic braking: > 10% duty cycle and >780 V DC needs verification, please contact Danfoss/Innomotics
2) Insulated NDE Bearing, see Innomotics engineering manual Engineering manual converter-fed motors | Innomotics
3) Insulation grade Basic/Advanced depending on shaft height (SH). Insulation grade details, please refer to the Innomotics engineering manual/catalog D81.1

General:

This table is valid for asynchronous motor technology and its intended use is for new drives/motor selection.
For retrofit cases please contact Danfoss/Innomotics
Liquid cooled Drives are not included, please contact Danfoss/Innomotics
Concerning max. screened / unscreened motor cable length or max. motor cable length with CE/EMC compliance, please check the Danfoss drive related design guide.
Various output filter technologies are optionally available from Danfoss which may be beneficial for the application in relation to retrofit- or special applications, reduction of common-mode currents, reduction of heat loss generation in the motor, etc. In case of question please contact Danfoss.

3 Combination Guide Danfoss Drive / Innomotics Motors - CONVERTER DUTY, SINGLE DRIVE

The following overview presents technically evaluated combinations of Danfoss drives series iC7, Vacon and VLT operating with Innomotics **synchronous** motors of cast iron and aluminum motor lines of permanent magnet motors (1FZ...) and reluctance motors (1FP...). mandatory to motor insulation protection and bearing currents reduction.

AC line voltage	Power	Insulation grade standard design	Filter option Motor Isolation / Bearing currents	Remarks
380 – 480 V	≤ 18,5 kW	Basic	- / -	1), 3)
		Advanced	- / -	3)
	> 18,5 kW	Advanced	- / -	2)
	≥ 200 kW	Advanced	- / CM-filter	2)
500 V	< 200 kW	Advanced	- / -	2)
	≥ 200 kW	Advanced		

AC line voltage	Power	Insulation grade special design	Filter option Motor Isolation / Bearing currents	Remarks
525 – 690 V	< 200 kW	Premium	du/dt	2)
	≥ 200 kW	Premium	du/dt + CM-filter	2)

AC line voltage	Power	Insulation grade standard design	Filter option Motor Isolation / Bearing currents	Remarks
380 – 500 V	< 200 kW	Advanced	- / -	2), 4)
	≥ 200 kW	Advanced	- / CM-filter	2), 4)

AC line voltage	Power	Insulation grade special design	Filter option Motor Isolation / Bearing currents	Remarks
525 – 690 V	< 200 kW	Premium	du/dt	2)
	≥ 200 kW	Premium	du/dt + CM-filter	2)

Remarks:

2) Insulated NDE Bearing, see Innomotics engineering manual Engineering manual converter-fed motors | Innomotics

4) PM-Syn motors (1FZ...): for rated AC line voltage 500 V and a rated motor voltage ≥480 V insulation grade premium must be selected,
please refer to the Innomotics engineering manual/catalog D81.1

General:

This table is valid for asynchronous, PM-Syn and Syn-RM motor technology and its

intended use is for new drives/motor selection.
For retrofit cases please contact Danfoss/Innomotics
Liquid cooled Drives are not included, please contact Danfoss/Innomotics
Concerning max. screened / unscreened motor cable length or max. motor cable length with CE/EMC compliance, please check the Danfoss drive related design guide.
Various output filter technologies are optionally available from Danfoss which may be beneficial for the application in relation to retrofit- or special applications,
reduction of common-mode currents, reduction of heat loss generation in the motor, etc. In case of question please contact Danfoss.

4 Definitions

Converter Capable Motor
Electric machine designed for direct online start and potentially capable to be operated by a power electronics frequency converter.
Please check for additional requirements.

Converter Duty Motor
Electrical machine designed specifically for operation with a power electronics frequency converter and optimized towards their temperature and insulation specification.

Dynamic braking
Special considerations must be taken, if standard frequency converters with 6-pulse or 12-pulse rectifier are in use and dynamical braking functions are activated via parameters. For all Danfoss frequency converters, two functionalities are possible: Braking with “Overvoltage Control” and braking with a brake-chopper with a brake resistor connected. Those standard drives can´t feed energy in the mains, because of their diode/thyristor rectifier.

Overvoltage Control will take the kinetic energy of the motor and application, and extend the ramp down time, until the motor is stopped. This is happening with a higher DC link voltage (740 ... 780 VDC for 380-500 V frequency converters and approx. 980...1040 VDC for 525-690 V converters) during the ramp down phase. The ramp down time could be extended minutes, depending on the application. This feature has to be enabled by parameters.

For Brake -chopper and -resistors the brake energy from the motor and the application will be transferred from the converter to the brake resistor and will be converted into heat losses. The ramp down time with brake chopper operation is typically short, a few seconds, depending on the sizing of the resistor and the application itself.

The levels for the brake chopper DC voltage are approx. 40...50 V higher, then the Overvoltage Control. Exact details and levels for each Danfoss frequency converter type can be found in the individual documentation. The brake chopper operation must be available by hardware (chopper and resistor) and by enabled by parameters.

The drives DC link voltage level has a direct influence on the entire peak voltage- and dv/dt performance and must be considered, especially when the application has the possibility to feed-back brake energy. Examples are hoists and lifts, centrifuges, fans or any other application with a high moment of inertia. For many standard applications typically no significant brake energy occurs, like on pumps, extruders or compressors. In this case the DC voltage depends on the AC line voltage and the load of the drive. A typical DC voltage of a drive on 400 V mains supply is 540 V DC, which is calculated by “actual AC line voltage” x 1,35.

For dynamical braking, at least the Advanced insulation grade has to be used, or the Premium insulation grade for 690 V applications.

If a drive with an Active Front End - AFE is used, then the DC link voltage gets boosted up to 110%, as a factory default value. Also, when the AFE has the possibility to feed regenerative energy into the mains, the DC link voltage remains constant.

For special applications/projects where customized engineering is required, like higher AFE boost voltage, common DC bus systems and multi-axis applications or very short, but parallel motor cables (large power systems) are used please contact Danfoss/Innomotics.

Single Drive
A Single Drive system means one frequency converter, that runs one motor. Independent, if a passive or an active infeed rectifier is used.

Multidrive/Systemdrive
Multidrive/Systemdrive or multi axis systems means a common DC Bus system with

several inverter units, connected to the same DC bus, and could operate several motors, with one common mains supply. Here the DC link voltage hast to be observed individually, and special considerations must be made, regarding insulation grade and/or filters.

5 Special considerations for applications with ATEX/Ex zone requirements

General:
For explosion proof motors the optional design for converter operation must be selected:
B43: converter operation with utilization according to temperature class 130 (B) or

B44: converter operation with utilization according to temperature class 155 (F).

Motor must be selected with 3 PTC or 6 PTC for winding to reach the safety requirements of the explosion proof certificates. Optional Pt100 thermal sensors can be selected for monitoring but not for safety functions.

Monitoring of PTC winding sensor with the VLT® PTC Thermistor Card MCB 112 (VLT) or the OPTAF STO and ATEX option board (VACON NXP) or the OC7T1 ATEX Temperature Monitor card (IC7).

All explosion proof motors designed as converter capable are equipped with two separate rating plates with data for direct-on-line (DOL) and variable speed drive (VSD) operations. The data and limits (min/max frequency, current, torque, ...) for VSD must be respected if operated by converter.

The order codes B43 and B44 include the second rating plate with VSD data and for motors SH280 or bigger insulated bearing on non-drive end (NDE).

Multidrive/Systemdrive is not allowed or with special conditions, please contact Danfoss/Innomotics.

Remarks:
With optional design for converter operation according to thermal class 155 (F), the full output power—equivalent to that of a direct-on-line (DOL) at rated frequency—can be achieved in the flameproof Ex db design, or in other protection types, within the IE4 version. The output power in thermal class 130 (B) is reduced by approximately 10% compared to class 155 (F).

Should the voltage at the motor terminal not reach the specified full grid voltage, safe operation is possible. However, the field weakening duty will start in those cases earlier and result in a reduction of the output power.

The descriptions of the valid “Declaration of Compliance with the order 2.1” for VSD operation must be considered.



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