SIEMENS

CATALOG DA64

Catalog DA 64
2002 / 2003

for variable-speed drives up to 90 kW

MICROMASTER
MICROMASTER Vector
MIDIMASTER Vector

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1. INTRODUCTION

The MICROMASTER, MICROMASTER Vector and MIDIMASTER Vector drive inverters use state-of-the-art IGBT power semiconductors and represent the result of years of experience in the area of drive inverter development.

A complete series extending from 120 W to 75 kW or up to 90 kW for applications with square-law load characteristics is available. They operate, as standard using the high-performance sensorless vector control. This offers the user the benefits of high torque and dynamic performance across a broad range of applications.

A parallel range of MICROMASTER drives from 120 W to 7.5 kW is especially suitable for driving basic machines.

COMBIMASTER (refer to Section 8) combines motor and inverter in one compact unit and is one of our top-of-the-line variable-speed drive products.

A high degree of user friendliness, an excellent price/performance ratio, compact dimensions are just some of the features of this product series. Furthermore, this series fulfills the highest quality and reliability standards worldwide.

1.1 Product overview

MICROMASTER, MICROMASTER Vector and MIDIMASTER Vector have been designed for use worldwide and are suitable for a wide range of supply voltages:

1/3 phase 208 - 240 V AC ±10%

3 phase 380 - 500 V AC ±10%

3 phase 525 - 575 V AC ±15% (only MIDIMASTER Vector)

Comment:

However, the following should be noted for this voltage data:

- The drive inverter operating range is between the two specified voltage values - from e.g. 208 - 240V
- The specified ±10% is not an operating range, it represents a range for brief voltage fluctuations.

Two operational characteristics are provided in these drive series:

- MICROMASTER Vector and MIDIMASTER Vector offer high performance, sensorless vector control for a high torque at low speeds as well as excellent dynamic characteristics in operation. This is the reason that these drives can even be used in sophisticated applications, for example, elevators, cranes and industrial washing machines.
- MICROMASTER has, as standard, a V/Hz control and is especially suitable for basic applications such as pumps and fans.
- Both of these drive types also profit from a PID controller which is integrated as standard (PI for MICROMASTER) for the closed-loop control.
- Furthermore, all of the products have the same user-friendly standard interface with seven keys and an LED display.
- User-friendly screwless terminals are used to connect the control wiring.
- Up to 31 drives can be connected to a PLC or PC system through a standard serial RS485 interface.
- A drive can be enabled via the keyboard, a digital input or the standard serial RS485 interface.
- The setpoint for the motor speed can either be selected via a digital setpoint, a motorized potentiometer, a fixed frequency, an analog input or the serial link.
- Mixed mode control is also available, allowing drive control and setpoint inputs to be from different sources.
- An integrated DC current brake allowing DC voltage to be output, even when the motor is stationary.
- The drives can be parameterized so that they automatically restarted after a power failure or a fault.
- The parameter sets of the various product types are completely compatible, so that the training time is reduced to a minimum.
- All of the drives are certified in accordance with VDE, UL and UL Canada and have been manufactured in compliance with the ISO9001 Standard.
- All of the drives conform to the requirements of the European Low-Voltage Directive 73/23/EC and have the CE Mark.
- The drive inverters do not process any date-related information and were therefore not influenced by the year 2000 issues.

1.2 Technical data

Drive inverter	MICROMASTER	MICROMASTER Vector	MIDIMASTER Vector
Line supply voltage	1-ph. 208 V – 240 V AC ±10% 3-ph. 208 V – 240 V AC ±10% 3-ph. 380 V - 500 V AC ±10%		3-ph. 208 V - 240 V AC ±10% 3-ph. 380 V - 500 V AC ±10% 3-ph. 525 V - 575 V AC ±15%
1-ph. 230 V AC 3-ph. 230 V AC 3-ph. 400 V AC 3-ph. 575 V AC	120 W – 3.0 kW 120 W – 4.0 kW 370 W – 7.5 kW		5.5 (VT 7,5) kW - 45 (VT 45) kW 11 (VT 15) kW - 75 (VT 90) kW 2.2 (VT 4) kW - 37 (VT 45) kW
Degree of protection	IP20/NEMA1		IP21/NEMA1 or IP56
In conformance with EN 55011, Class A for 1-ph. 230 V AC 3-ph. 230 V AC 3-ph. 400 V AC 3-ph. 575 V AC	Integrated filter External filter Integrated / external filter xxx		xxx Internal / external filter Internal / external filter xxx
In conformance with EN 55011, Class B for 1-ph. 230 V AC 3-ph. 230 V AC 3-ph. 400 V AC 3-ph. 575 V AC	External filter External filter External filter xxx		xxx External filter External filter xxx
Temperature range	0 – 50°C		0 – 40°C
Control technique	V/Hz	Sensorless vector control, FCC, V/Hz	
Overload capability [1])	150% rated output current for 60 s	150% rated output current for 60 s 200% rated output current for 3 s	
Protective functions	Undervoltage, overvoltage, overload, short-circuit, ground fault, motor failure, motor overtemperature, drive inverter overtemperature		
Max. motor cable length	Refer to Section 3		Refer to Section 3
Frequency range	0 - 400 Hz	0 - 650 Hz	0 - 650 Hz
Setpoint resolution	0.05 Hz		
Digital inputs	3, parameterizable (19 functions)	6, parameterizable (24 functions)	
Fixed frequencies	7	8	
Ramp-up/ramp-down times	2		
Relay outputs	1, parameterizable 110 V AC / 0.3 A 30 V DC / 1.0 A	2, parameterizable 240 V AC / 0.8 A 30 V DC / 2 A	
Analog inputs	1	2	
Analog outputs	-	1, parameterizable	2, parameterizable
Serial interfaces	RS485		
Dynamic braking	Compound braking	Braking chopper	External braking module
Internal technology controller	PI	PID	

[1]) The overload capability refers to the rated output currents of the MICROMASTER and MICROMASTER Vector drives as well as the rated output currents for constant torque operation (CT) of the MIDIMASTER Vector. It is valid for a 5 minute load duty cycle. This means that the drive units can have an overload condition of 50% for a total of 1 minute within a 5 minute period.

Table 1: Technical data

1.3 Conformity to International Standards

1.3.1 CE Mark:

The MICROMASTER, MICROMASTER Vector and MIDIMASTER Vector drive inverters fulfill the requirements of the Low-Voltage Directive 73/23/EC and therefore have the CE Mark. A certificate of conformance can be issued when required. The drive units are certified in compliance with the following Standards:

EN60204-1 Safety of Machinery, Electrical Equipment of Machines

EN60146-1-1 Semiconductor inverters; General requirements and line commutated inverters

1.3.2 Electromagnetic compatibility:

MICROMASTER, MICROMASTER Vector and MIDIMASTER Vector drive inverters, fulfill, when correctly installed and used in-line with the specifications, the requirements of Directive 89/336/EC regarding electromagnetic compatibility. When all of the Guidelines to reduce the effects of electromagnetic radiation are followed when installing the drive units, then all of the requirements for the CE certification of a machine will be fulfilled.

The following table lists the results (measured) with reference to emission and noise immunity of the MICROMASTER, MICROMASTER Vector and MIDIMASTER Vector drive inverters. The drive inverters were installed corresponding to the appropriate guidelines using shielded motor cables, shielded control cables and the line filters which are available as accessory (with the exception of single-phase units):

Test	Measurement	Test value	Limit value acc. to EN50081/EN50082
HF noise EN55011 (VDE0875 Part 11) and EN55022 (VDE 0878 Part 22)	Conducted through the line supply cable and radiated through air	1/3 phase 230/400/460V AC with integrated filter >= Class A 1/3 phase with external filter >= Class B (only cable-borne noise)	Class A Class B
ESD immunity EN61000-4-2 (VDE 0847 Part 4-2)	ESD through air discharge ESD through contact discharge	Level 4: 15 kV Level 4: 8 kV	8 kV 4 kV
Immunity to electric fields EN61000-4-3 (VDE 0847 Part 4-3)	Electric field is applied to the unit	10 V/m	26-1000 MHz 10 V/m
Noise immunity to noise pulses (burst) EN61000-4-4 (VDE 0847 Part 4-4)	Connected to all cable connections: Line supply cable Motor cable Control cables Braking resistor/module cable DC link cable	 Level 4: 4 kV Level 4: 4 kV 4 kV Level 4: 4 kV Level 4: 4 kV	 2 kV 2 kV 2 kV 2 kV 2 kV
Surge immunity EN61000-4-5 (VDE 0847 Part 4-5)	Connected to all line supply cables:	4 kV non-symmetrical 2 kV symmetrical	4 kV non-symmetrical 2 kV symmetrical

Table 2: EMC conformity

1.3.3 Limit values for harmonic currents in non-industrial² applications EN 61000-3-2

Since the 1st of January 2001, all electrical equipment, which fall under the EMC Directive must fulfill the regulations laid down in EN 61000-3-2 "Limit values for harmonic currents (drive units with input currents <= 16 A per phase)". All of the Siemens MICROMASTER, MIDIMASTER, MICROMASTER Eco and COMBIMASTER variable-speed drives, which are classified according to the Standard as devices for "Professional applications" fulfill the requirements laid down in the Standard.
For drives with 250 W to 550 W and 230 V 1-phase power supplies, which are used in non-industrial applications, then it is necessary to obtain authorization from the power supply company [power utility company] to connect the units to the public line supply.
More detailed information on this subject is provided in EN 61000- 3-12, Sections 5.3 and 6.4.
Drive units in this voltage and output range are supplied with the appropriate warning information and labels:
The harmonic currents generated by these products are specified in the table below:

Nominal value	Typical harmonic current (A)					Typical harmonic current (%)					Typical voltage distortion Nominal values, distribution transformer		
											10 kVA	100 kVA	1 MVA
	3.	5.	7.	9.	11.	3.	5.	7.	9.	11.	THD (%)	THD (%)	THD (%)
250W / 230V / 1AC	2.15	1.44	0.72	0.26	0.19	83	56	28	10	7	0.77	0.077	0.008
370W / 230V / 1AC	2.96	2.02	1.05	0.38	0.24	83	56	28	10	7	1.1	0.11	0.011
550W / 230V / 1AC	4.04	2.70	1.36	0.48	0.36	83	56	28	10	7	1.5	0.15	0.015

Table 3: EMC conformance in non-industrial applications

The permissible harmonic currents for “Drive units for professional applications” with an input power > of 1 kW have still not been defined. This means that all of the electrical equipment, which contain the drives listed above, and which have input powers >1 kW, do not require authorization before being connected to the line supply. Alternatively, by installing the input reactors, recommended in the "Options" Section, means that it is not necessary to apply for authorization to connect the unit to the line supply (drive units with 550 W 230V AC 1 phase are an exception to this rule).

² Industrial line supplies are those supplies which are not used to supply residential buildings.

1.4 Quotation text

6SE92 MICROMASTER IP20/NEMA1

0.12 to 3 kW, 1-ph. 208 - 240 V AC +/- 10%
0.12 to 4 kW, 3-ph. 208 - 240 V AC +/- 10%
0.37 to 7.5 kW, 3-ph. 380 to 500 V AC +/- 10%

6SE32 MICROMASTER Vector IP20/NEMA 1

0.12 to 3 kW, 1-ph. 208 - 240 V AC +/- 10%
0.12 to 4 kW, 3-ph. 208 - 240 V AC +/- 10%
0.37 to 7.5 kW, 3-ph. 380 to 500 V AC +/- 10%

6SE32 MIDIMASTER Vector IP21/NEMA1 or IP56/NEMA 4/12

5.5 to 45 kW (variable torque: 7.5 to 45 kW), 3-ph. 208 – 240 V AC +/- 10%
11 to 75 kW (variable torque: 11 to 90 kW), 3-ph. 380 to 500 V AC +/- 10%
2.2 to 37 kW (variable torque: 4 to 45 kW), 3-ph. 525 to 575 V AC +/- 15%

Technical data

Rated supply voltage	.....	V
Rated line frequency	.....	Hz
Rated output current at M = const.	.....	A
Overload capability (up to 50 % for 60 s)	.....	A
Overload capability (up to 100 % for 3 s)	.....	A
Rated output current at M~ n²	.....	A
Overload capability (up to 10 % for 60 s)		
Rated output at M = const.	.....	kW
Rated output at M ~ n²	.....	kW
Output frequency from..... to.....		Hz
Radio interference suppression (EN55011, Class A or B)		.....
Max. ambient temperature (40/50 ºC)	..... ºC	
Degree of protection (IP20/IP21/IP56)	.....	
Dimensions (HxWxD)	.....x.....x.....	mm
Weight	.....	kg
MICROMASTER, Order No.	.....	
MICROMASTER Vector, Order No.	.....	
MIDIMASTER Vector, Order No.	.....	

Voltage-source DC link inverters with constant DC link voltage and pulse-width modulation.
State-of-the-art power transistors in the inverter (IGBT technology) ensure optimum speed control of three-phase motors.
Fully-digital microprocessor-based open and closed-loop control.
All of the drive units are UL and cUL-certified and designed and constructed in compliance with VDE/EN.
They fulfill the requirements of the European Low-Voltage Directive 73/23/EEC (EN 60204-1 and EN 60146-1-1) and have the CE Mark.

Power sections

Incoming rectifier as uncontrolled diode bridge circuit.
High temperature-resistant DC link capacitors to smooth the DC link voltage. Six-pulse output inverter with IGBTs.

Pre-charging device

Pre-charging circuit with switching relay.

Motor control (open-loop)

V/Hz control with parameterizable voltage boost (6SE92).
Field-orientated closed-loop vector control where the output current is precisely monitored and with a self-adapting motor model (6SE32).

Standard operator panel

Keys/buttons to power-up and power-down, changes the direction of rotation, jogging, increase and reduce the output frequency and for parameterization.
Four-character 7-segment display for setpoints, actual values, parameter values and fault messages.

Optional intelligent plain text operator panel

Illuminated dot matrix LCD for multi-lingual menu-prompted operator control. Up to 10 parameter sets can be saved in a non-volatile fashion.
Master operation to network a max. of 31 drives. Integrated interface converter RS232 / RS485.
Direct PC connection to read and write parameter sets, also without a drive inverter.

Control terminal strip for external operator control

MICROMASTER 6SE92
3 parameterizable 24 V digital inputs with 18 selectable functions. 1 parameterizable relay output (floating 30V DC / 1A, 110V AC / 0.3A) with 13 selectable functions. 1 analog input for setpoint input or PI controller actual value feedback 0/2 -10 V.

15 V/50 mA power supply for PID encoder and digital inputs.

10 V/10 mA power supply for the setpoint potentiometer.
A PTC motor temperature sensor can be evaluated using a digital input.
All of the inputs and outputs are short-circuit proof.

MICROMASTER Vector 6SE32
MIDIMASTER Vector 6SE32
6 parameterizable 24 V digital inputs with 23 selectable functions. 2 parameterizable relay outputs (floating, 30V DC / 2A, 240V AC / 0.8A) with 13 selectable functions.
1 analog input for 0/2 -10 V, +/- 10V,
0/4 - 20 mA setpoint input. 1 additional analog input for setpoint input or PID controller actual value feedback 0/2 - 10 V, 0/4 – 20 mA. 1 parameterizable analog output with 6 selectable functions 0/4 - 20mA (MICROMASTER Vector).
2 parameterizable analog outputs, each with 6 selectable functions (MIDIMASTER Vector).
1 connection for a PTC motor temperature sensor.
15 V/50 mA power supply for PID encoder and digital inputs.
10 V/10 mA power supply for the setpoint potentiometer.
All of the connections are short-circuit proof.

Standard automation interface

Serial RS485 interface with USS protocol to connect a max. 31 drives; max. data transfer rate is 19.2 kbit/s.

Optional automation interface

PROFIBUS DP module to connect a max. of 125 drives, maximum data transfer rate is 12 Mbit/s.

CAN bus module, supports the CAN OPEN protocol

Standard functions for
MICROMASTER 6SE92
MICROMASTER Vector 6SE32
MIDIMASTER Vector 6SE32
V/Hz speed control for one or several asynchronous, synchronous or reluctance motors
Output frequency for 6SE32: 0 - 650Hz (only in V/Hz or FCC control in vector control only 325Hz is possible) and 0.01 Hz resolution of the output frequency
Output frequency for 6SE92: 0 - 400 Hz and 0.05Hz resolution of the output frequency
Overload capability is 50 % referred to the rated output current for a load duty cycle of 60 seconds within a 5 min period.
Integrated motor protection functions
PTC input (MICROMASTER via digital input)
I^2t monitoring

Output current limiting and monitoring

Integrated PID control (PI control for 6SE92) for e.g. closed-loop pressure or temperature control. Serial RS485 interface for the USS protocol. Integrated programmable sequence control to control an external brake. Restart-on-the-fly circuit to power-up the drive inverter to a motor which is already spinning. Automatic restart after line failure or fault. Flexible setpoint input using fixed frequencies, motorized potentiometer, jogging setpoint, via analog input or serial interface. Flexible control using keypad, digital inputs or serial interface.
Integrated, adjustable DC current brake.
Combined braking to quickly shutdown without external components. Additive setpoint input via an analog input and fixed frequencies/digital setpoint input as well as control via various sources.
Programmable ramp-function generator (0 - 650 s) with rounding-off capability.
8 fixed frequencies, parameterizable (7 for 6SE92).
4 frequency ranges can be suppressed to avoid resonance effects.
The drive units have an integrated EMC filter as standard corresponding to EN55011 Class A for drive units with single-phase line supply connection.

Additional standard functions

MICROMASTER Vector 6SE32
MIDIMASTER Vector 6SE32
Sensorless vector control for dynamic operating characteristics and high speed stability for three-phase asynchronous motors.
Overload capability 100 % referred to the rated output current for 3 seconds.
Integrated braking chopper with parameterizable load duty cycle (MICROMASTER Vector).

Accessories

Sub-chassis radio interference suppression filter
(with the voltage series 208 - 240V & 380 – 480V)
for MICROMASTER and MICROMASTER Vector corresponding to EN55011, Class A or Class B

External radio interference suppression filter
(with the voltage series 208 - 240V & 380 – 460V)
for MIDIMASTER Vector corresponding to EN55011 Class A or Class B

Line supply fuses (incl. semiconductor protection)
Line reactors

Braking resistors

(MICROMASTER Vector, MIDIMASTER Vector)
Braking modules (MIDIMASTER Vector)
Output dv/dt filters.
Output reactors.
Multi-lingual plain text operator panel OPM2.
Software tool for commissioning and diagnostics
PROFIBUS DP module CB 15.
CAN bus module, supports the CAN OPEN protocol

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2. TECHNICAL DESCRIPTION

MICROMASTER, MICROMASTER Vector and MIDIMASTER Vector are a series of drive inverters which are designed to be directly connected to the line supply. They are self-contained drive units which include all of the components required for their operation.
Depending on the line supply voltages, outputs and required functions, this series comprises three versions: MICROMASTER, MICROMASTER Vector and MIDIMASTER Vector. The MICROMASTER is the most favorably priced drive unit for basic applications.
MICROMASTER has three sizes with degree of protection IP20. The MICROMASTER Vector is, from the mechanical dimensions, identical to the MICROMASTER, however it has a higher degree of functionality and the sensorless vector control makes it ideally suited for applications requiring high dynamic response. It has additional I/O and larger, intelligent power end stages for additional overload requirements. The MIDIMASTER Vector has the same functionality as the MICROMASTER Vector, however it has an extended output range up to 75 kW (90 kW for variable torque). As standard, it has degree of protection IP21 but is also available with degree of protection IP56 (NEMA 4).

2.1 Power section

All of the drive inverters have fully integrated power end stages which are mounted on highly efficient heatsinks. The heatsinks are cooled using a fan controlled by software. De-rating is not required for ambient temperatures up to 50 °C (40 °C for MIDIMASTER Vector). This is due to the heat dissipation.
All of the drive units have an uncontrolled incoming rectifier, a capacitor-buffered DC link as well as a pulse width modulated inverter with IGBT transistors.
If a drive unit is connected to the line supply, the DC link is pre-charged through resistors and a pre-charging relay.
This limits the inrush current. The voltage in the DC link is converted into a pulsed voltage with a variable frequency amplitude using the latest generation of low-loss IGBTs in conjunction with optimized pulse patterns. This offers the following advantages:

- Lower inverter and motor losses
- Motor frequency range: 0 to 650 Hz
- Motor voltage range: 0 V to the line supply voltage
- Almost sinusoidal motor currents
- High motor utilization
- Quiet motor operation using pulse frequencies up to 16 kHz
- The drive inverter is protected against short-circuits and ground faults

An OFF command is not sufficient to electrically isolate the drive units from the line supply voltage. A suitable switching element must be used upstream from the drive inverters in order to ensure safe, reliable separation from the line supply.
Slow-acting line fuses can also be used for protection.
All of the MICROMASTER and MICROMASTER Vector drive units (this is not possible for MIDIMASTER) can also be directly connected to a pure DC supply with suitably dimensioned voltage using the DC link connections provided.

MICROMASTER (MM12/2 up to MM300/2), designed for operation with 3-phase 230 V line supplies can also be operated with 1-phase 230 V line supplies. All of the 1- and 3-phase 230 V MICROMASTER can also be operated on a 2-phase 208 V line supply. (*CAUTION: A 1- or 3-phase 230 V drive inverter will be destroyed if it is connected to a 3-phase 400 V line supply.)*

2.1.1 Thermal protection and automatic reduction of the pulse frequency

When the pulse frequency increases, the losses inside the power section also increase and result in higher heatsink temperatures. When the drive inverter is operated above the recommended ambient temperature, generally the drive inverter shuts down (trips) due to an overtemperature fault. In order to prevent such undesirable trips, MICRO/MIDIMASTER Vector automatically reduces its pulse frequency (e.g. from 16 kHz to 8 kHz). The heatsink temperature then decreases and operation can be continued without any interruption. If the load or the ambient temperature subsequently decreases, the drive inverter first checks whether the pulse frequency can be safely increased so that it can appropriately respond.

2.1.2 Fast current limiting

The fast current limiting (Fast Current Limit; FCL) is a cyclic hardware current limiting which is integrated in the drive inverter. Its threshold value is slightly below the threshold value for a software-related overcurrent trip (F002). Incorrect or undesirable trips are avoided thanks to a significantly faster response if suddenly loads are applied or fast acceleration is demanded.

2.1.3 Operation on non-grounded line supplies

A grounded (TN) line supply is always recommended for MICROMASTER & MIDIMASTER drive inverters.

The MICROMASTER series can be directly connected to a non-grounded line supply. If one of the input phases is directly connected to ground while the inverter is operational, it continues to run without any consequential damage.
MICROMASTER/MICROMASTER Vector is shutdown with an overcurrent alarm if one of the motor cables is short-circuited to ground.
MIDIMASTER Vector can only be operated on IT line supplies if the pulse frequency is reduced to 2kHz. The MIDIMASTER Vector (with a 2 kHz pulse frequency) continues to operate if one of the motor cables is short-circuited to ground. The drive inverter can be tripped due to an overcurrent when operated at more than 40 Hz or is close to being operated at full load. If two or more phases are short-circuited to ground, the drive inverter always trips due to overcurrent.

2.1.4 Using residual-current protective devices

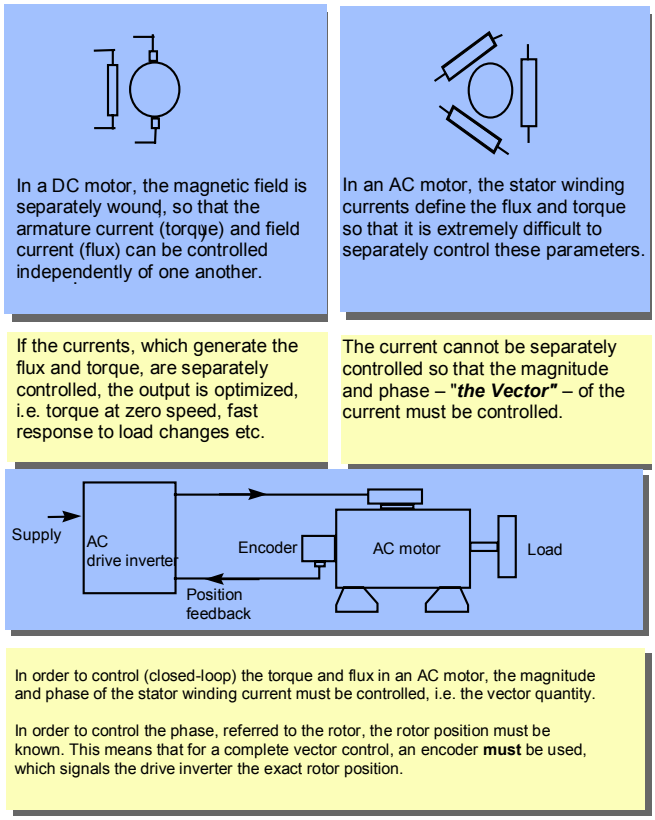
MICROMASTER and MICROMASTER Vector can be operated with residual-current protective devices under the following conditions:

- 1-phase: A residual-current protective device with 300mA (type A) is permissible
- 3-phase: A residual-current protective device with 300mA (type B) must be used
- The neutral conductor of the line supply is grounded.
- Only one drive inverter is operated on one residual-current protective device.
- The motor cables are no longer than 50m (shielded) or 100m (non-shielded) (otherwise an output reactor is recommended).
- We do not recommend using residual-current protective devices for supply voltages of 400-500V and pulse frequencies exceeding 4 kHz.

2.1.5 Vector control principles

What is vector control?

This is most easily explained by comparing with a DC motor.



2.1.6 Sensorless vector control

However, for many applications, it is neither necessary to use a pulse encoder nor is this justified for cost reasons.

If a drive inverter is to simulate the characteristics of a pulse encoder, the software algorithm must precisely calculate the rotor position and motor velocity. This is realized by mathematically modeling the fundamental properties of the motor.

To do this, the inverter must:

- Monitor the output voltage and output current extremely accurately.
- Calculate the motor parameters (rotor, stator resistance, leakage inductance, etc.)
- Precisely simulate the thermal motor properties.
- Adapt the motor parameters, taking into account the particular operating conditions.
- Carry-out mathematical calculations extremely quickly. This has been realized using an ASIC which Siemens developed:
- The so-called Flash Floating Point Processor (F^2P^2; Fast Floating Point Processor).

Siemens, who pioneered this technology, has, for the first time, integrated an almost closed-loop vector control without pulse encoder in a standard product. This has been achieved by using the Flash Floating Point Processor, explained above, which can execute the millions of computations per second in order to achieve the consistent high performance. Thanks to this technology, a torque rise to 150% or more for 0.5 Hz and to over 200% for 2.5 Hz is obtained. A consistently high performance is guaranteed over the complete temperature range by using a model to adapt the motor temperature.

The complete MICRO/MIDIMASTER Vector series has an overload capability of 200% for 3 seconds. This means that this drive inverter is especially suited for difficult applications, for example cranes and lifts.

It is not necessary to compute the motor constants, as this is realized automatically so that the user only has to set a gain factor to adjust the drive inverter to a specific system inertia; however, in many cases it isn't even necessary to change the standard values entered in the factory.

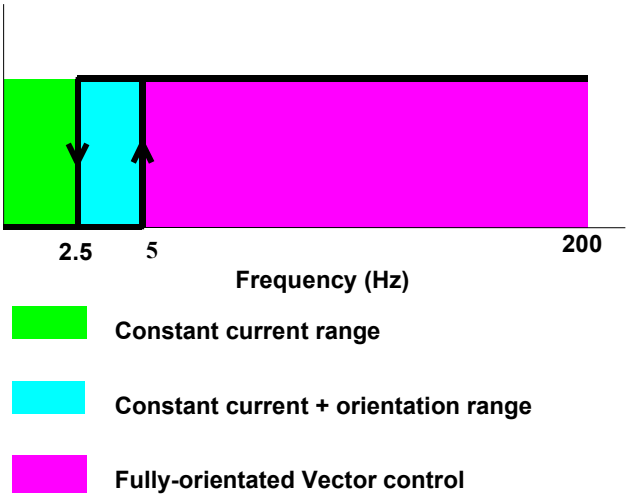
2.1.7 Flash Floating Point Processor

The sensorless vector control is an extremely sophisticated real-time control (closed-loop), which generally uses DSP or RISC processors or multiple processors. The Siemens solution relieves the microprocessor of time-consuming routine tasks and the floating-point functions are implemented in an customized ASIC. Control algorithms are precisely implemented thanks to the floating-point function without requiring ongoing re-scaling. Arithmetic overflows are thus avoided, guaranteeing a consistent high accuracy. The overall result is a reliable product with repeatable, dynamic performance. The floating-point processor is implemented using entirely combinatorial logic and achieves a performance equivalent to 3 Mflops. The algorithm, used in the MICRO/MIDIMASTER Vector is practically the same as the algorithm that is used in the widely accepted MASTERDRIVE series.

2.1.8 Benefits of sensorless vector control

- Excellent speed control with integrated slip compensation.
- High torque at low speeds without any excessive boost (breakaway torque).
- Lower losses, higher efficiency.
- Higher dynamic performance – improved response to loads of different magnitudes.
- Stable operation for large motors.
- Improved performance at the current limit with improved slip compensation.

2.1.9 Vector operating range



The above diagram illustrates the operating ranges of the MICRO/MIDIMASTER Vector sensorless vector control. Whereby the frequency range of the vector control lies between 5Hz and 200Hz; V/Hz control is automatically selected for values outside this range.

Constant current range

In this range, the drive inverter behaves just like a current source and outputs the current value, programmed in parameter P083, independent of the particular load.

For instance, for a 750 W motor, if P083 is set to 3.4 A then the motor current remains independent of the motor load (full or no load) at 3.4 A.

Constant torque (P078) and breakaway torque (P079) lie in this range and offer a torque capability of up to 250 %.

This range is below approx. 5 Hz (while the output frequency ramps-up from zero) and below 2.5 Hz (while the output frequency ramps-down from a frequency above 5 Hz). The 2.5 Hz hysteresis bandwidth prevents oscillation between the two operating modes. The specified 2.5 Hz and 5 Hz values approximately correspond to 5 % or 10 % of the value, programmed in P081 – the nominal rating plate frequency of the motor.

Constant current and orientation range

When operating in this range, and the output frequency is being ramped-up, the back EMF of the motor establishes itself. The system searches and locks onto the rotor speed using this information. Once locked, it will remain locked until the output frequency is reduced to below 2.5 Hz. The slip compensation is also active in this range.

Fully-orientated vector control

In this range, the drive inverter has determined the operating state of the motor and maintains the frequency setpoint within the operating range of the drive inverter. Deviations in the ambient temperature, the stator resistance, motor slip etc. are fully compensated over the complete load range and beyond.

The sensorless vector control is a real, closed-loop control which is highly dependent on the correctness of the data stamped on the motor rating plate as well as the accuracy of the inverter's current monitoring.

When using the sensorless vector control (SVC, Sensorless Vector Control), the data stamped on the rating plate of the squirrel-cage induction motor must be precisely entered (parameters P080 to P085). These parameters are set in the factory to the data of a four-pole Siemens 1LA5 motor. This data must be appropriately changed when using another motor. After the SVC mode has been activated (P077=3), when the drive inverter is powered-up the next time, the CAL message is displayed for several seconds. During this time, the drive inverter optimizes itself and computes the properties and characteristics of the motor model, for example, the stator resistance, leakage inductance, thermal time constant of the rotor and stator.

The calibration routine (CALibration) must be performed with the motor in a cold state. This is because the drive inverter automatically compensates for motor temperature changes.

SVC can only be used for induction motors and for single motor drives or multi-motor drives with a mechanically coupled load.

SVC cannot be used for:

- Synchronous or reluctance motors
- Multi-motor drives, group drives (where several motors are connected in parallel at the output of the drive inverter)
- Motors with rated outputs less than half the rated drive inverter output
- Motors with a higher current demand than the drive inverter can supply, i.e. I_{Motor} > P083 max.

  In cases such as these, a V/Hz characteristic must be parameterized;
  - P077 = 0 for applications with linear torque characteristics
  - P077 = 2 for applications with pump or fan characteristics (square-law torque characteristics, variable torque, VT).

The "Flying start" feature in both MICROMASTER Vector and MIDIMASTER Vector depend on the vector algorithm and therefore are subject to the same principles as for SVC operation.

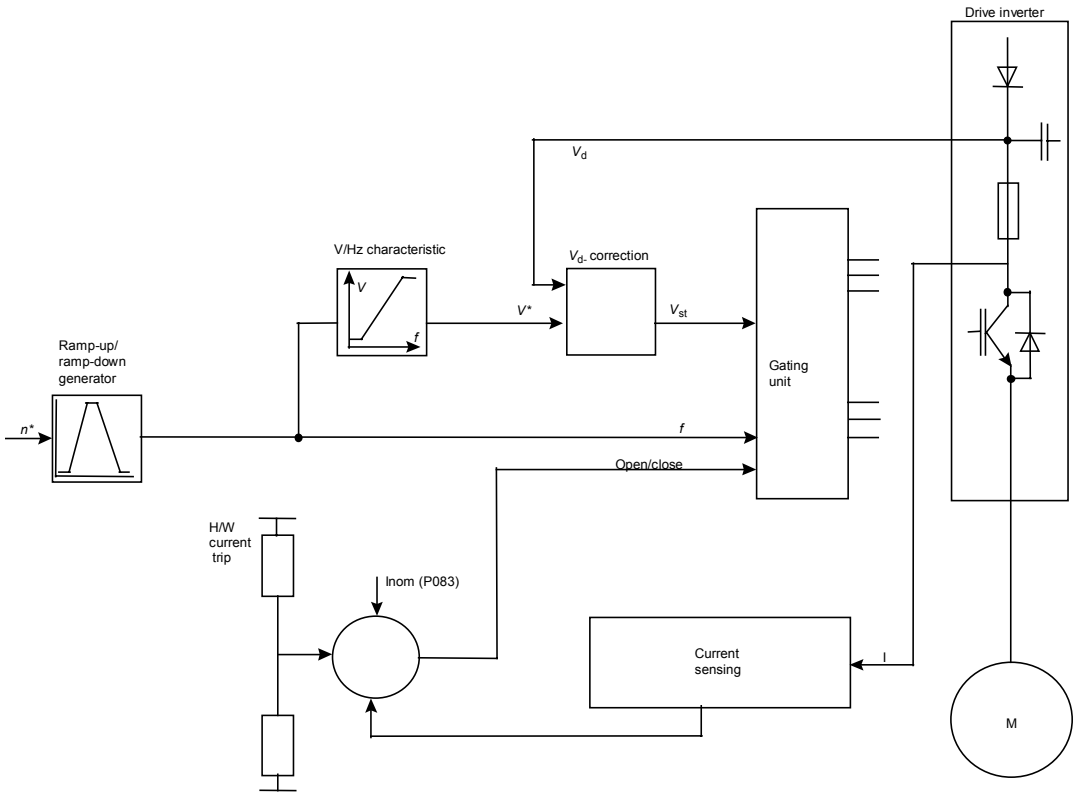
The restrictions, mentioned above, also apply to drive inverters, which are configured for operation in the FCC mode (Flux Current Control) (P077=1). This function was kept in the vector range in order to guarantee downwards compatibility with earlier MICRO and MIDIMASTER generations.

For MIDIMASTER, when a load with square-law torque characteristic is connected, a significantly higher motor current is permissible whereby, in almost all cases, the rated output is achieved using the next larger motor (the motor current can also be increased using parameter P083).

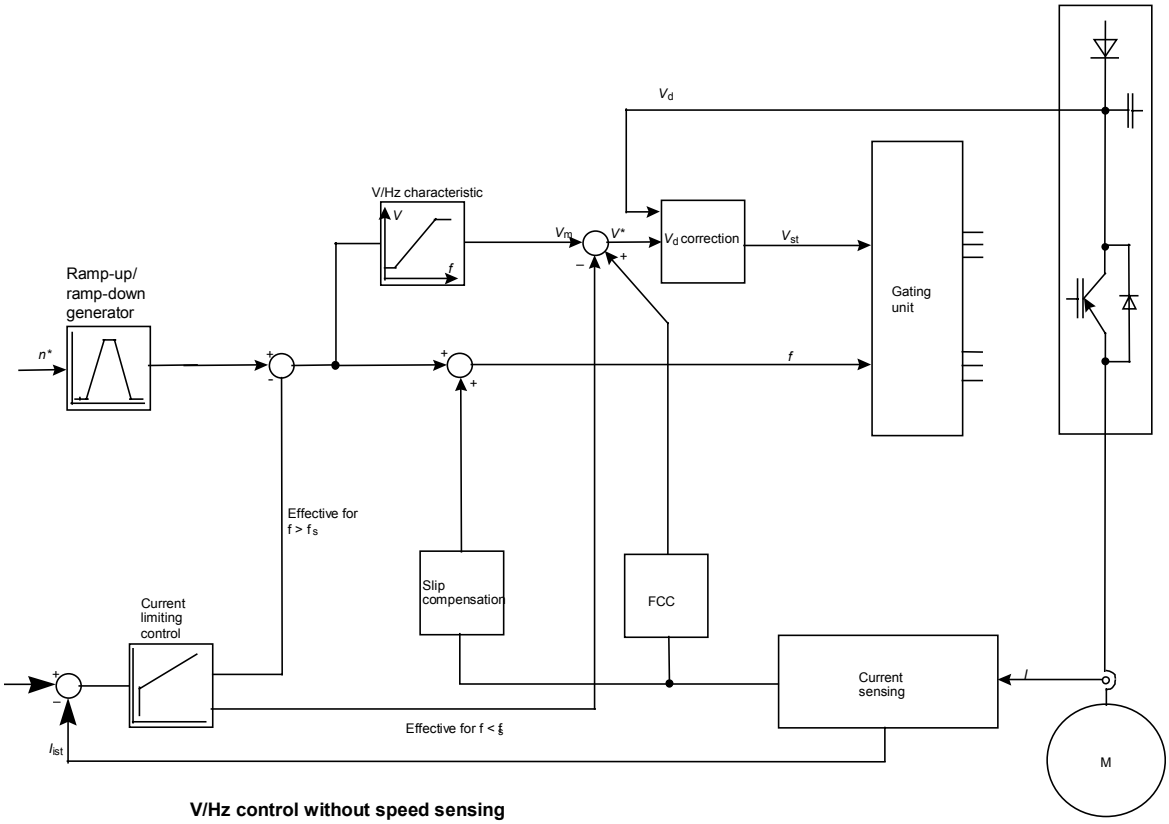
For a specific output, fan and pump drives can use a lower-rating drive inverter.

2.1.10 MICROMASTER and MICRO/MIDIMASTER Vector (in the V/Hz mode)

V/Hz control for single and multi-motor drives with asynchronous motors where there are no special requirements placed on dynamic response. This is the case, for example, for pumps and fans and basic drives for slides.



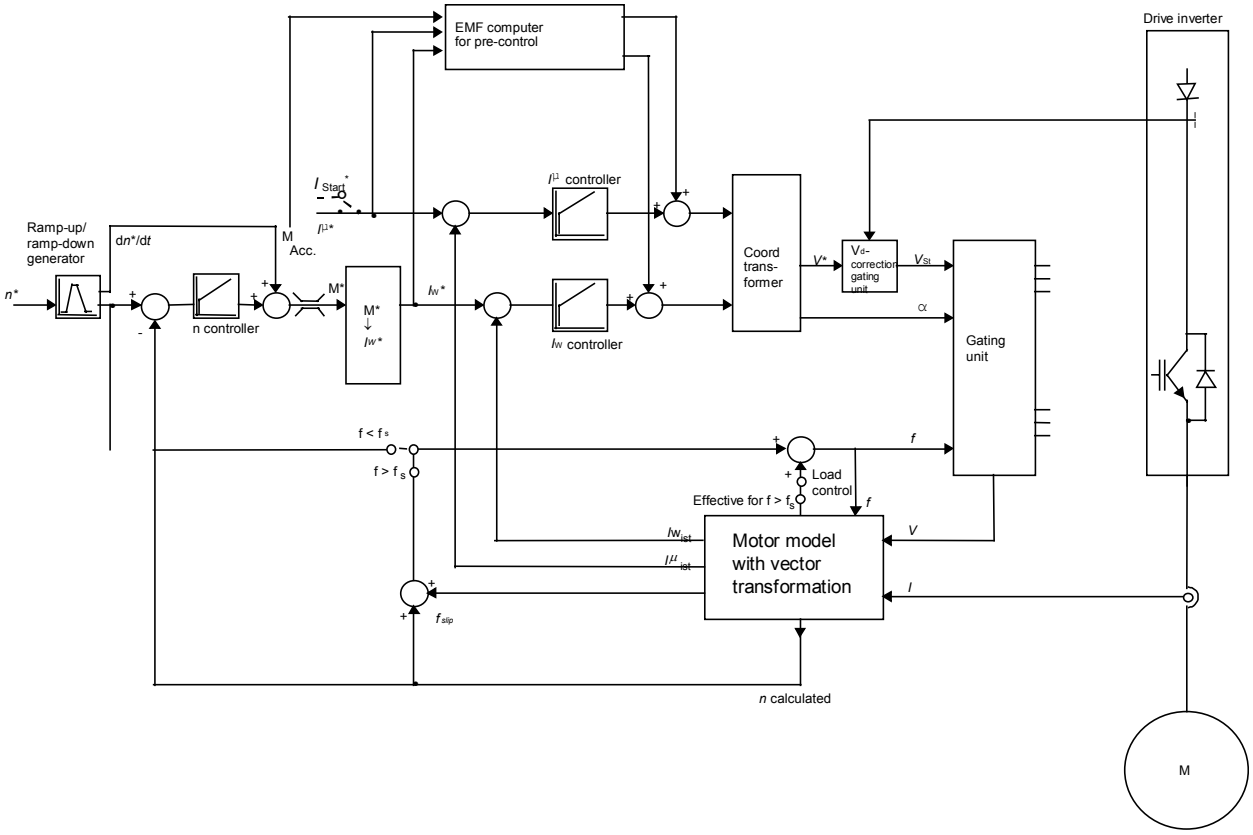
2.1.11 MICRO/MIDIMASTER Vector (in the FCC mode)



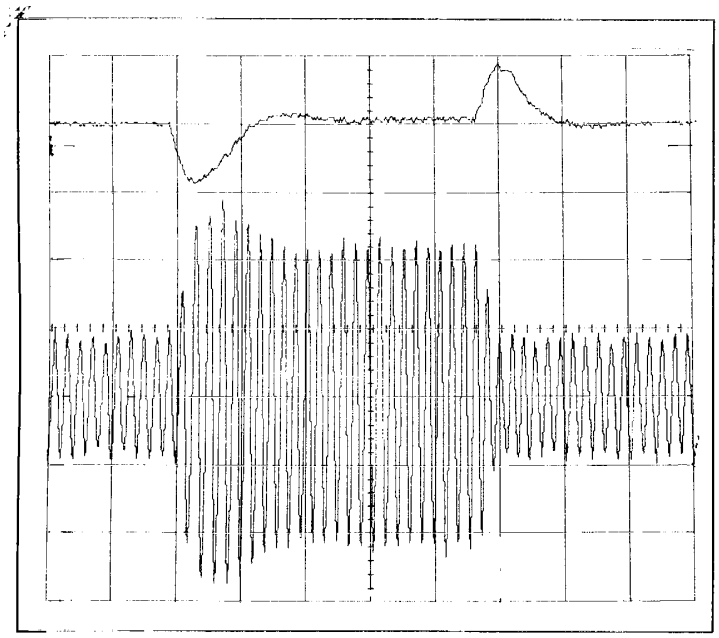
V/Hz control without speed sensing

2.1.12 MICRO/MIDIMASTER Vector (sensorless vector control)

This control type is preferably used for single drives with asynchronous motors where the requirements placed on the dynamic response range from low to high, and for speed control ranges up to 1:10. It is suitable for most industrial applications, for example, extruders, packaging machines, industrial washing machines, lifts and cranes.



2.1.13 Torque and speed response



2.1.13.1 Features of different control techniques

Mode	V/Hz	FCC	SVC
Digital setpoint resolution	**0.01**		
Analog setpoint resolution	**10 bit**		
Internal frequency resolution	**0.01**		
Speed accuracy **- constant torque** **- field weakening range**	**>2 %**	**<2 % [1])** **<5 % [1])**	**≤1 %** **$f_{max}/f_n \times f_{slip}/10$ [2])**
Torque rise time	**≈ 50 ms**	**<25 ms**	**<10 ms**
Torque ripple	**<2 %**	**<2 %**	**<2 %**

[1]) With slip compensation

[2]) The slip values of standard motors are typically:
6 % at 1 kW, 3 % at 10 kW, 2 % at 30 kW, 1 % at 100 kW

2.2 Closed-loop PID control

All of the MICROMASTER Vector and MIDIMASTER Vector drive units have, as standard an integrated PID control, which uses the second analog input as actual value signal input (0 - 10 V or 0 - 20 mA). This therefore provides an accuracy of 10 bit.

MICROMASTER has a closed-loop PI control which uses the digital input for the setpoint and the analog input for the actual value signal. This function allows closed-loop control of quantities which only change slowly, for instance, temperature or pressure, without requiring any additional circuitry or software. This means that closed-loop speed control is also possible for slow processes.

The reference value or setpoint is entered directly as a percentage of the controlled variable (0 - 100 %). This means that the system is insensitive to measured quantities which are received from transducers. Examples of these transducers are, for example, pressure and flow velocity. The signal, received from the transducer, is transferred to one of the analog inputs where it is compared with the setpoint. The motor speed is then controlled so that the deviation between the setpoint and actual value is minimized.

Additional features of the PID control:

- Any display scaling can be selected (P010, P001)
- P, I and D factors can be separately defined
- Selectable sampling interval and filtering
- Can be flexibly adapted to the transducer signal
- The motor can be shutdown below a minimum frequency – this can be parameterized (P220)
- A message can be output at the minimum and maximum motor frequency – this can be selected using parameters (relay output, P061 and P062).

Parameters P201 to P220 are assigned to the PID function.

2.3 Shutting down (stopping) a motor

A drive can be shutdown in several ways:

- Selecting OFF 1
  (P051 to P055 or P356 = 1 or 2), this means that when the ON command is reset, the drive inverter is shutdown with the ramp-down time selected in P003.
- Selecting OFF 2
  (P051 to P055 or P356 = 4) means that the inverter is inhibited and the motor coasts down.
- Selecting OFF 3
  (P051 to P055 or P356 = 5) means that the motor is quickly braked. The motor is braked as quickly as possible along the drive inverter current limit.

In addition to the three OFF commands, there are four additional braking versions available.

- Selecting an external brake
  via the control relay outputs (P061 / P062 = 4)
- Selecting DC current braking
  means that the drive is quickly braked to standstill. The DC current braking is activated using P073 with a value greater than 0 and up to 200% (referred to P083). This corresponds to approx. 30 - 40 % of the regenerative braking. DC current braking is selected using OFF 1 or externally via DIN 1 - DIN 6 (P051 - P055 and P356 = 15). However, there is no defined motor stop, as the brake is effective for the time, parameterized in P003 and at a level, parameterized in P073. Correspondingly, if the DC current brake is activated using DIN1 - DIN6, it is activated as long as there is a (HIGH) signal. The energy generated while braking is discharged through the motor.

- Selecting COMPOUND BRAKING™
  is an effective method of stopping the motor in a controlled fashion without the need for an external braking resistor. The inverter controls this by impressing a controlled amount of DC current into the motor windings during ramp-down using a new software modulation technique. COMPOUND BRAKING™ is most effective at lower outputs where motor efficiencies are their lowest. The compound brake is activated by the magnitude of the braking current in P066 (greater 0 to 250%; referred to P083), and corresponds approximately to 50 - 60 % of the effect of regenerative braking. The energy generated is also discharged through the motor. Compound braking is always selected with the down ramp, i.e. as soon as a higher setpoint change is made with respect to f = 0 or with OFF 2 and OFF 3.

- The regenerative braking
  causes the motor to be quickly braked and in a controlled fashion. The energy fed back into the DC link is converted into thermal energy by the motor using the integrated braking chopper (P070 / P075) and an external braking resistor for MICROMASTER Vector or using the external brake module (EBU) and external braking resistor options for MIDIMASTER Vector.

  Comments:
  It is not possible to combine the various braking versions.
  If OFF 2 or OFF 3 is selected, the ON command (OFF 1) must be reset, as otherwise the drive inverter would go into the power-on inhibit condition if it was to be powered-up again.
  If compound braking is frequently used, this results in a high motor temperature.

2.4 Emergency Off

General information
The following stop function categories are defined in accordance with VDE 0113:

Category 0	Uncontrolled shutdown by immediately disconnecting the power feed (the motor coasts down).
Category 1	Controlled shutdown, whereby the power remains connected in order to shutdown the drive. The power feed is only disconnected when the drive has come to a standstill.
Category 2	Controlled shutdown, whereby the power remains connected even after the drive has come to a standstill.

For MICROMASTER, MICROMASTER Vector and MIDIMASTER Vector, only Category 0 can be achieved without using any external measures.

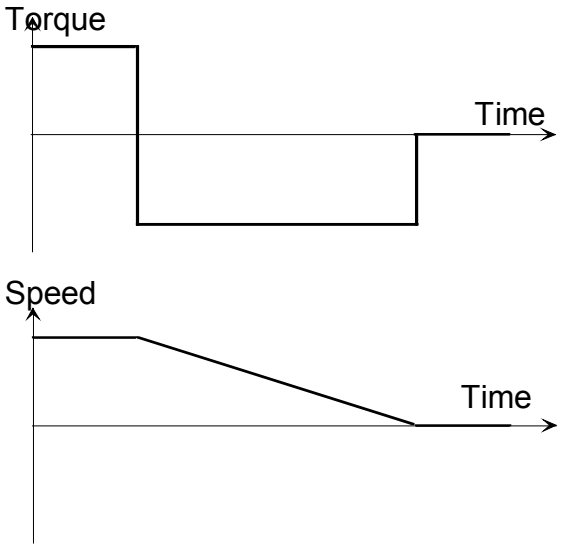
2.4.1 Safe standstill

This function has not been implemented in the MICROMASTER, MICROMASTER Vector and MIDIMASTER Vector.

2.5 Diagrams of COMPOUND BRAKING™, DC current and regenerative braking

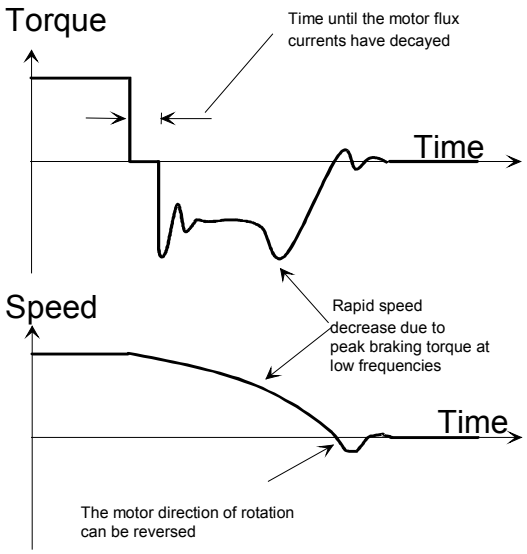
Regenerative braking

- Energy is dissipated in an external resistor
- Excellent braking torque
- Smooth
- Controlled
- Speed is reduced linearly and smoothly



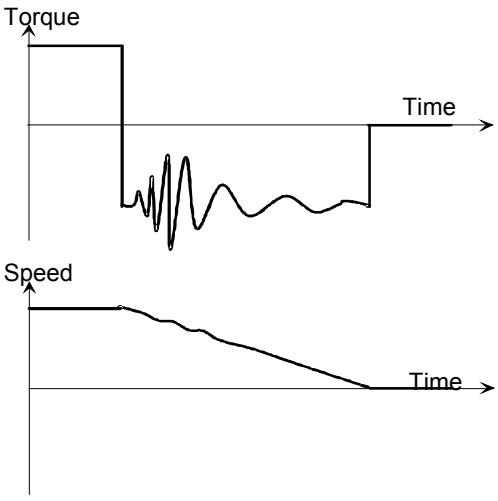
DC injection braking

- Energy is dissipated in the motor
- Poor braking torque
- Smooth
- Ramp-down is not controlled
- 30 - 40 % of the effectiveness of regenerative braking
- There is no defined motor stop



COMPOUND BRAKING™

- Energy is dissipated in the motor
- Good braking torque
- Controlled
- 50 - 60 % of the effectiveness of regenerative braking
- Speed is linearly reduced
- Low speed fluctuations due to the oscillating torque – depending on the load moment of inertia



3. Engineering information and instructions

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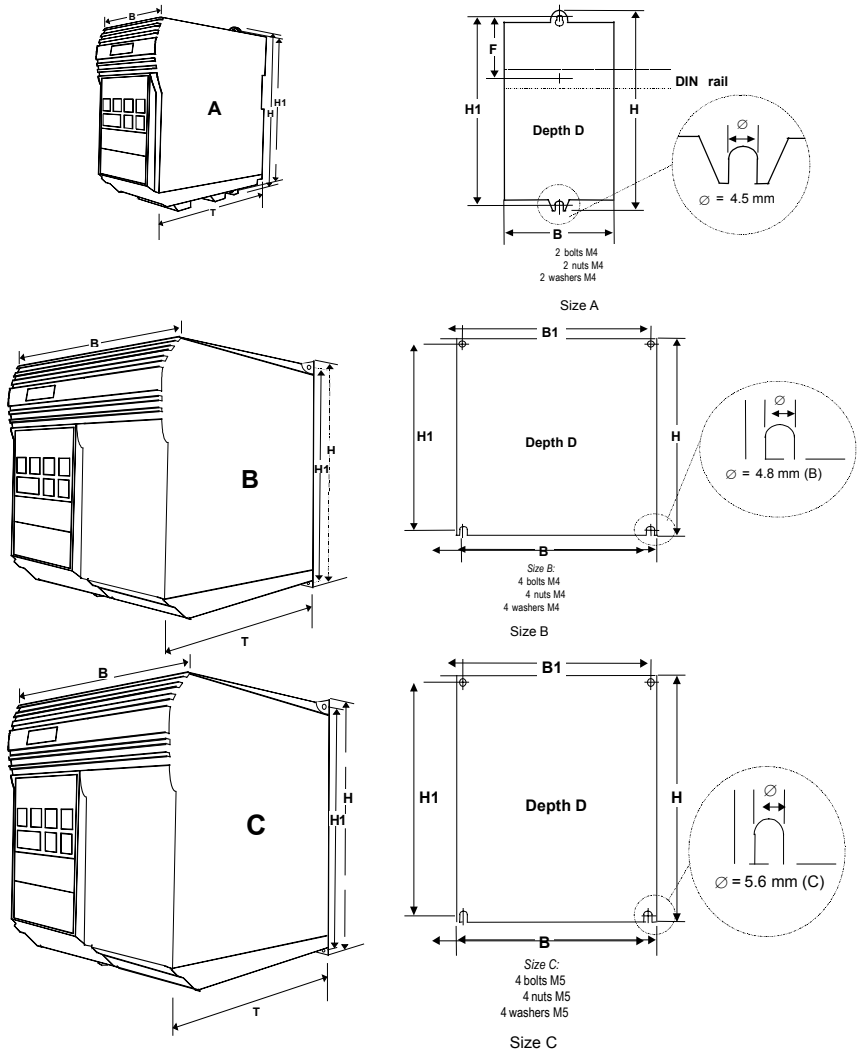
3.1 Technical comparison table

	MICROMASTER 6SE92	MICROMASTER Vector 6SE32	MIDIMASTER Vector 6SE32
Power range	120 W - 3 kW, 230 V, 1 AC 120 W - 4 kW, 230 V, 3 AC 370 W – 7.5 kW, 400 V, 3 AC	120 W - 3 kW, 230 V, 1 AC 120 W - 4 kW, 230 V, 3 AC 370 W – 7.5 kW, 400 V, 3 AC	5.5 kW - 45 kW, 230 V, 3 AC 11 kW - 75 kW, 400 V, 3 AC 2.2 kW - 37 kW, 575 V, 3 AC
Voltage range	208 - 240 V +/-10 % 380 - 500 V +/-10 %	208 - 240 V +/-10 % 380 - 500 V +/-10 %	208 - 240 V +/-10 % 380 - 500 V +/-10 % 525 - 575 V +/-15 %
Line supply frequency	47-63Hz	47-63Hz	47-63Hz
Power factor	cos $\Phi \geq 0.98$, total $\lambda \geq 0.7$	cos $\Phi \geq 0.98$, total $\lambda \geq 0.7$	cos $\Phi \geq 0.98$, total $\lambda \geq 0.7$
Power on/power off cycles	Max. 100.000 (guaranteed) (5-sec. interval)	Max. 100.000 (guaranteed) (5-sec. interval)	Max. 100.000 (guaranteed) (5-sec. interval)
Inrush current	No higher than the nominal input current	No higher than the nominal input current	No higher than the nominal input current
Inverter efficiency	97 %	97 %	97 %
Operating temperature	0 - 50 °C	0 - 50 °C	0 - 40 °C (50 °C without cover)
Storage temperature	-40 to +70 °C	-40 to +70 °C	-40 to +70 °C
Relative air humidity	95 %, moisture condensation is not permissible	95 %, moisture condensation is not permissible	95 %, moisture condensation is not permissible
Minimum lateral clearances	No clearance is required	No clearance is required	IP20 / IP21 housing sizes A - 6 Clearance is not required Housing size 7 = 100mm IP56 = 150 mm
Minimum clearances to the top	100mm	100mm	IP20 / IP21 = 100mm IP56 = 150mm
Minimum clearances to the bottom	100mm	100mm	IP20 / IP21 = 100mm IP56 = 150mm
Degree of protection	IP20/NEMA 1 (optional cable gland plate to meet NEMA1 for Size A drive units)	IP20/NEMA 1 (optional cable gland plate to meet NEMA1 for Size A drive units)	IP21/NEMA 1 (optional IP56/NEMA 4, also available)
Cooling	Software-controlled fan cooling	Software-controlled fan cooling	Fan cooling
Output frequency	0 - 400 Hz	0 - 650 Hz	0 - 650 Hz
Output frequency resolution	0.05 Hz	0.05 Hz	0.05 Hz
Overload capability	150% of the rated output current for max. 60 s within 5min	150% of the rated output current for max. 60 s within 5min 200% rated output current for 3 s	
Control technique	V/Hz	SVC, FCC, V/Hz	SVC,FCC,V/Hz
Digital inputs	3 (> 7.5 V = high, 33 V max.)	6 (> 7.5 V = high, 33 V max.)	6 (> 7.5 V = high, 33 V max.)
Analog input 1	0 - 10 V/PI input 10-bit resolution, differential input	0(2) - 10 V, 0/4 - 20 mA -10 V/+10 V bipolar 10-bit resolution, differential input	0(2) - 10 V, 0/4-20 mA -10 V/+10 V bipolar 10-bit resolution, differential input
Analog input 2	Not available	0(2) - 10 V, 0(4) - 20 mA PID input, 10-bit resolution	0(2) - 10 V, 0/4) - 20 mA PID input, 10-bit resolution
Analog output 1	Not available	0/4 - 20 mA with 500 Ω max. load 10-bit resolution	0/4 - 20 mA 500 Ω max. load 10-bit resolution
Analog output 2	Not available	Not available	0/4 - 20 mA 500Ω max. Last
Relay output 1	30 V DC, 1A; 110 V AC, 0.3 A, NO contact	30 V DC, 2 A; 240 V AC, 0.8 A changeover contact	30 V DC, 2 A; 240 V AC, 0.8 A changeover contact
Relay output 2	Not available	30 V DC, 2 A; 240 V AC, 0.8 A NO contact	30 V DC, 2 A; 240 V AC, 0.8 A NO contact
RS485 interface	Type D	Type D/terminal strip	Type D/terminal strip
Braking chopper	Not available	Integrated	Optional, external module
Compound braking	Yes	Yes	Yes
Fast current limiting	Yes	Yes	Yes
Closed-loop PID control	Integrated PI control	Integrated PID control	Integrated PID control
Motor protection - external	PTC input at the digital input	Special PTC input	Special PTC input
Motor protection - internal	I^2t	I^2t (UL certified)	I^2t (UL certified)
Drive inverter protection	Short-circuit protection, cable/ground Short-circuit protection, cable/cable Overtemperature protection Overvoltage protection Overcurrent protection	Short-circuit protection, cable/ground Short-circuit protection, cable/cable Overtemperature protection Overvoltage protection Overcurrent protection	Short-circuit protection, cable/ground Short-circuit protection, cable/cable Overtemperature protection Overvoltage protection Overcurrent protection

3.2 Dimensions and weights



MICROMASTER und MICROMASTER Vector inverters must be mounted to a suitable, flat surface using bolts, washers and nuts.

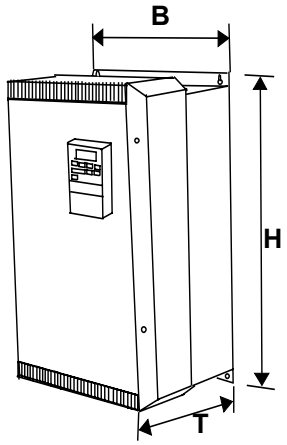
Two bolts are required for Size A drive units. (M4)

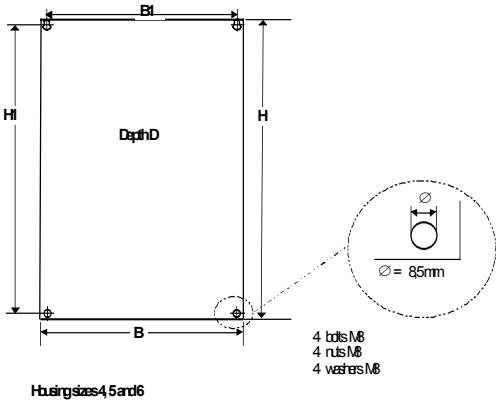
Four bolts are required for Size B drive units. (M4)

Four bolts are required for Size C drive units. (M5)

Type	MMxxx 1-ph. 230 V AC, with filter, Class A	MMxxx/2 1/3-ph. 230 V AC, without filter	MMxxx/3 3-ph. 400 - 500 V AC, without filter	Housing dimensions (mm)										
MM12	A	A	-	Size	H		W		D	H1	W1	F	Weight (kg/lb)
MM25	A	A	-										
MM37	A	A	A										
MM55	A	A	A										
MM75	A	A	A										
MM110	B	B	A	A	175	x	73	X	141	160	-	55	0.8 / 1.8
MM150	B	B	A										
MM220	C	C	B	B	184	x	149	X	172	174	138	-	2.6 / 5.7
MM300	C	C	B										
MM400	-	C	C	C	215	x	185	X	195	204	174	-	5 / 11
MM550	-	-	C										
MM750	-	-	C										

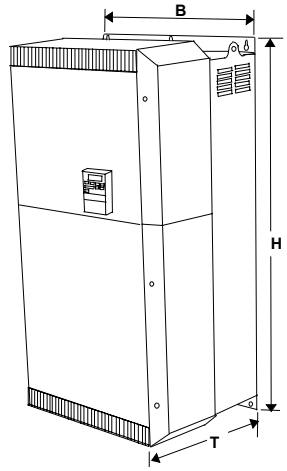
Table 1: MICROMASTER and MICROMASTER Vector sizes

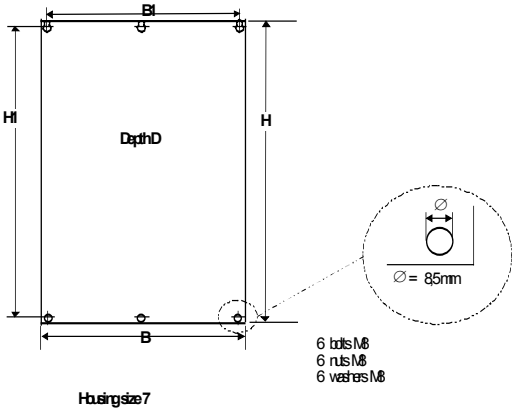




Housing sizes 4, 5 and 6

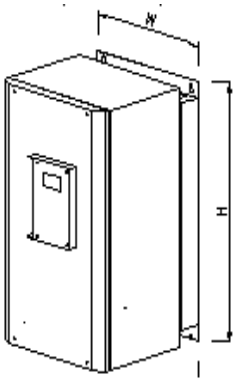
MIDIMASTER Vector – sizes 4, 5 and 6
Standard version: IP21
Version with integrated filter: IP20

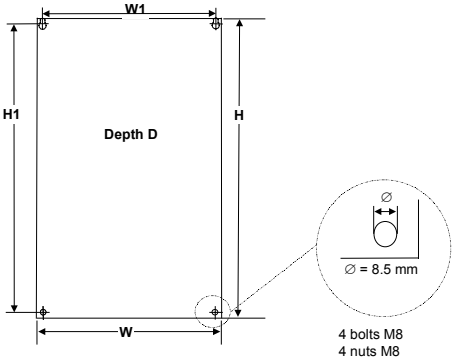




Housing size 7

MIDIMASTER Vector - size 7
Standard version: IP21
Version with integrated filter: IP20





Frame Sizes 4, 5 and 6

MIDIMASTER Vector - sizes 4, 5, 6 and 7 in degree of protection IP56

MIDIMASTER Vector Type	Size 3-ph. 208 – 240 V AC	3-ph. 400 – 500 V AC	3-ph. 525 – 575 V AC
MDV220/4	-	-	4
MDV400/4	-	-	4
MDV550/2	4	-	-
MDV550/4	-	-	4
MDV750/2	5	-	-
MDV750/3	-	4	-
MDV750/4	-	-	4
MDV1100/2	5	-	-
MDV1100/3	-	4	-
MDV1100/4	-	-	4
MDV1500/2	6	-	-
MDV1500/3	-	5	-
MDV1500/4	-	-	5
MDV1850/2	6	-	-
MDV1850/3	-	5	-
MDV1850/4	-	-	5
MDV2200/2	6	-	-
MDV2200/3	-	6	-
MDV2200/4	-	-	6
MDV3000/2	7	-	-
MDV3000/3	-	6	-
MDV3000/4	-	-	6
MDV3700/2	7	-	-
MDV3700/3	-	6	-
MDV3700/4	-	-	6
MDV4500/2	7	-	-
MDV4500/3	-	7	-
MDV5500/3	-	7	-
MDV7500/3	-	7	-

Table 2: MIDIMASTER Vector - sizes

Drive unit dimensions (mm)								
Standard version:					**IP21/NEMA 1**			
Size	H		W		D	H1	W1	Weight kg
4	450	x	275	X	210	430	255	11
5	550	x	275	x	210	530	255	15
6	650	x	275	x	285	630	255	27
7	850	x	420	x	310	830	400	56
Version with integrated EMC filter:					**IP20/NEMA 1**			
Size	H		W		D	H1	W1	Weight kg
4	700	x	275	X	210	680	255	19
5	800	x	275	x	210	780	255	24
6	920	x	275	x	285	900	255	39
7	1150	x	420	x	310	1130	400	90
Version with increased degree of protection:					**IP56/NEMA 4/12**			
Size	H		W		D	H1	W1	Weight kg
4	675	x	360	X	351	655	313	30
5	775	x	360	x	422	755	313	40
6	875	x	360	x	483	855	313	54
7	1150	x	500	x	570	1130	553	100

Note:
Dimension "D" for drive units with degree of protection IP21 and IP20 includes the operator panel. If an OPM2 operator panel with plain text display, is installed, then an additional 30 mm will be required.

Dimension "D" for drive units with degree of protection IP56 does not includes the front panel access door - add 25 mm to include this extra depth.

Table 3: MIDIMASTER Vector – dimensions and weights

3.3 Degrees of protection

The IP number defines the degree of protection against the ingress of dirt, foreign bodies, water etc. (Ingress Protection; IP) for the associated drive inverter.

MICROMASTER and MICROMASTER Vector have degree of protection IP20 (this corresponds to the US NEMA 1 Class).

MIDIMASTER Vector models with degree of protection IP21 (this corresponds to the US NEMA 1 Class) or IP56 (this corresponds to the US NEMA 4/12 Class).

The significance of the individual IP class numbers referred to the protection against the ingress of dirt etc. is explained in Table 4:

First number IP**X**xx	**Second number** Ipx**X**x	**Third number (not specified)** IPxx**X**
0 No specific protection	**0** No specific protection	**0** No specific protection
1 Protected against solid objects with a diameter of 50 mm	**1** Protected against water falling vertically	**1** Protected against impact up to 0.225 J
2 Protected against solid objects with a diameter larger or equal to 12 mm	**2** Protected against vertically falling spray water if the equipment is tipped up to 15 degrees to the vertical	**2** Protected against impact up to 0.375 J
3 Protected against solid objects with a diameter larger or equal to 2.5 mm	**3** Protected against vertically falling spray water if the equipment is tipped up to 60 degrees to the vertical	**3** Protected against impact up to 0.5 J
4 Protected against solid objects with a diameter larger or equal to 1 mm	**4** Protected against water sprayed from all directions	**5** Protected against impact up to 2.0 J
5 Protected against dust (limited ingress)	**5** Protected against low-pressure water jets from all directions	**7** Protected against impact up to 6.0 J
6 Protected against dust (totally)	**6** Protected against low-pressure water jets from all directions	**9** Protected against impact up to 20.0 J
	7 Protected against immersion between 15 cm and 1 m	
	8 Protected against immersion under pressure	

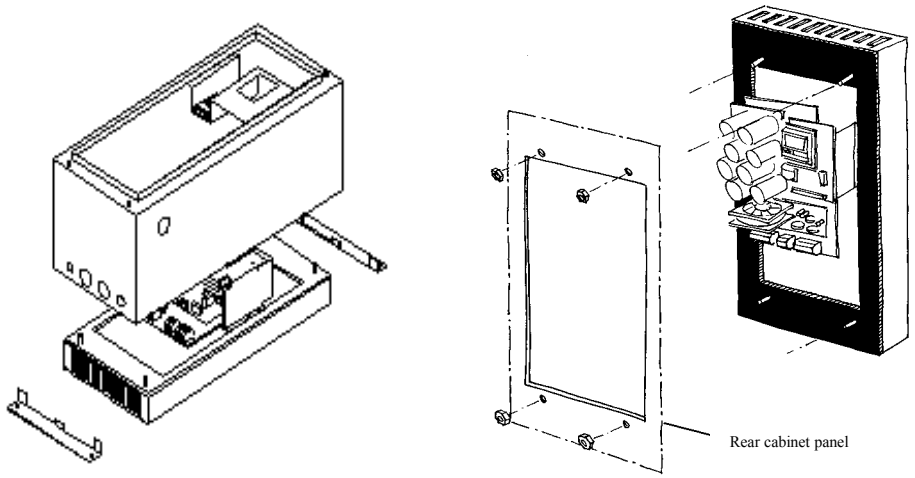
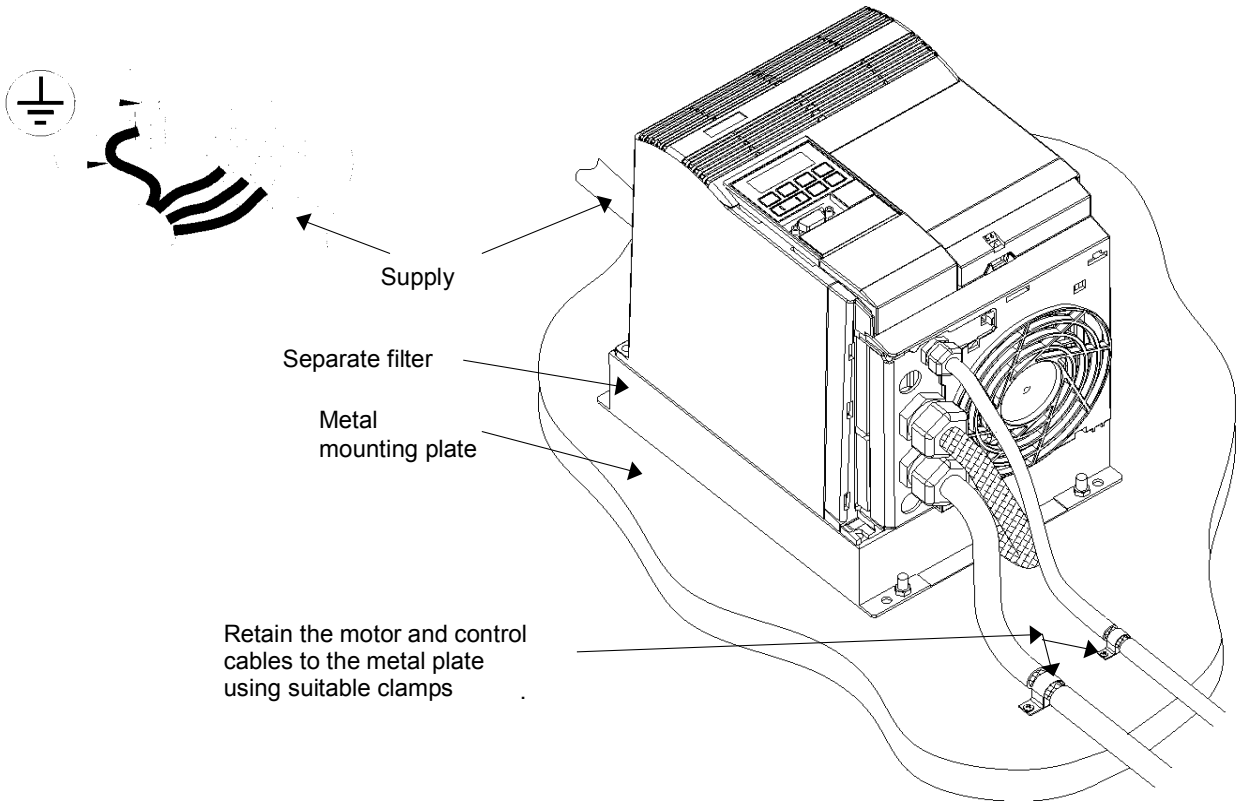


Fig. 2: MIDIMASTER Vector with degree of protection IP56 – installed in a housing

MIDIMASTER Vector, with degree of protection IP56/NEMA 4/12, can be accommodated in a larger housing, whereby the heatsink protrudes through the rear cover of the unit. This ensures that the heat from the drive inverter is dissipated to the ambient air without the need for additional cooling fans. This guarantees the IP56 degree of protection. Only the minimum mounting clearance of 150mm to the next drive unit must be observed.



3.4 Mounting and installation guidelines

Fig. 3.11.3 Wiring guidelines to optimize the noise immunity of MICROMASTER and MICROMASTER Vector, Size C

The drive inverters are designed for use in industrial environments with strong electromagnetic noise and disturbances. Generally, safe, reliable and fault-free operation is guaranteed if the drive units have been correctly installed. However, if problems do occur, then the following guidelines might possibly help. It can be especially effective to connect the drive inverter ground potential, as subsequently described, to 0 V of the system.

(1) Ensure that all of the drive units are correctly grounded using a short grounding cable with adequate cross-section, to a common neutral point or a busbar. It is especially important that all of the control devices, connected to the drive inverter (for example, a PLC) are connected to the same grounding or neutral point through a short grounding cable with adequate cross-section. Flat conductors are preferred (for example, finely-stranded or metal brackets), as they have a low impedance at high frequencies.
If motors are fed from the drive inverter, the potential bonding conductor should be directly connected to 0 V (PE) of the particular drive inverter.

(2) Remove the paint from the mounting plate in order to establish a good electrical connection between the heatsink and the housing. Please use serrated washers when mounting and installing MIDIMASTER Vector.

(3) When possible, use shielded cables to connect-up the control terminals. Assemble the cable ends correctly so that non-shielded wires and conductors are kept as short as possible. Where possible, use cable glands.

(4) Separately route the control cable, as far as possible, away from the supply cable. This can be realized, for example, by using separate cable ducts. If control cables and line supply cables (power cables) cross over, then arrange the cables so that they cross at an angle of 90°.

(5) Ensure that the contactors in the electrical cabinet are provided with noise suppression devices. For AC coils, use RC elements or for DC coils, use free-wheeling diodes. Varistors are also effective. This is especially important if the contactors are controlled using the drive inverter relay connection.

(6) Use shielded cables to connect-up the motors or route the cables in a protective pipe and ground the shield at both ends using cable glands.

(7) If the drive inverters are installed in an environment which is prone to electromagnetic disturbances, then a noise suppression filter should be used to dampen the cable-borne and radiated noise and disturbances. In order to guarantee optimum operating conditions, there should be a good electrical connection between the filter and the mounting plate.

(8) If a line-side EMC filter and line reactor are simultaneously used, the EMC filter must be located between the drive inverter and line reactor.

3.5 Line supply

The drive inverters are designed for limit values defined in the following standards. These standards describe the noise voltages permissible at the line supply input.

IEC/EN 61000-4-4: (VDE 0847 Part 4-4)	Brief voltage spikes/noise pulses:	4 kV
IEC/EN 61000-4-5: (VDE 0847 Part 4-5)	Surge voltages:	4 kV common mode 2 kV differential mode
IEC/EN 61000-4-11: (VDE 0847 Part 4-11)	Voltage dips:	30 % for 60 ms 10 % for 100 ms
	Voltage interruptions:	>95 % for 5 s
	Voltage fluctuations:	V_{rated} +/-10 %
IEC/EN 61000-2-4: (VDE 0839 Part 2-4)	Level of compatibility for low-frequency, cable-borne noise in industrial systems and plants, Class 3, 10 % distortion factor (THD)	
EN 61000-3-2	Limit values for harmonic currents (drive unit incoming current <= 16 A per phase) Since the 1st of January 2001, all electrical equipment, where the EMC Directive applies, must be in full compliance with EN 61000-3-2. (refer to Section 1.3.3)	

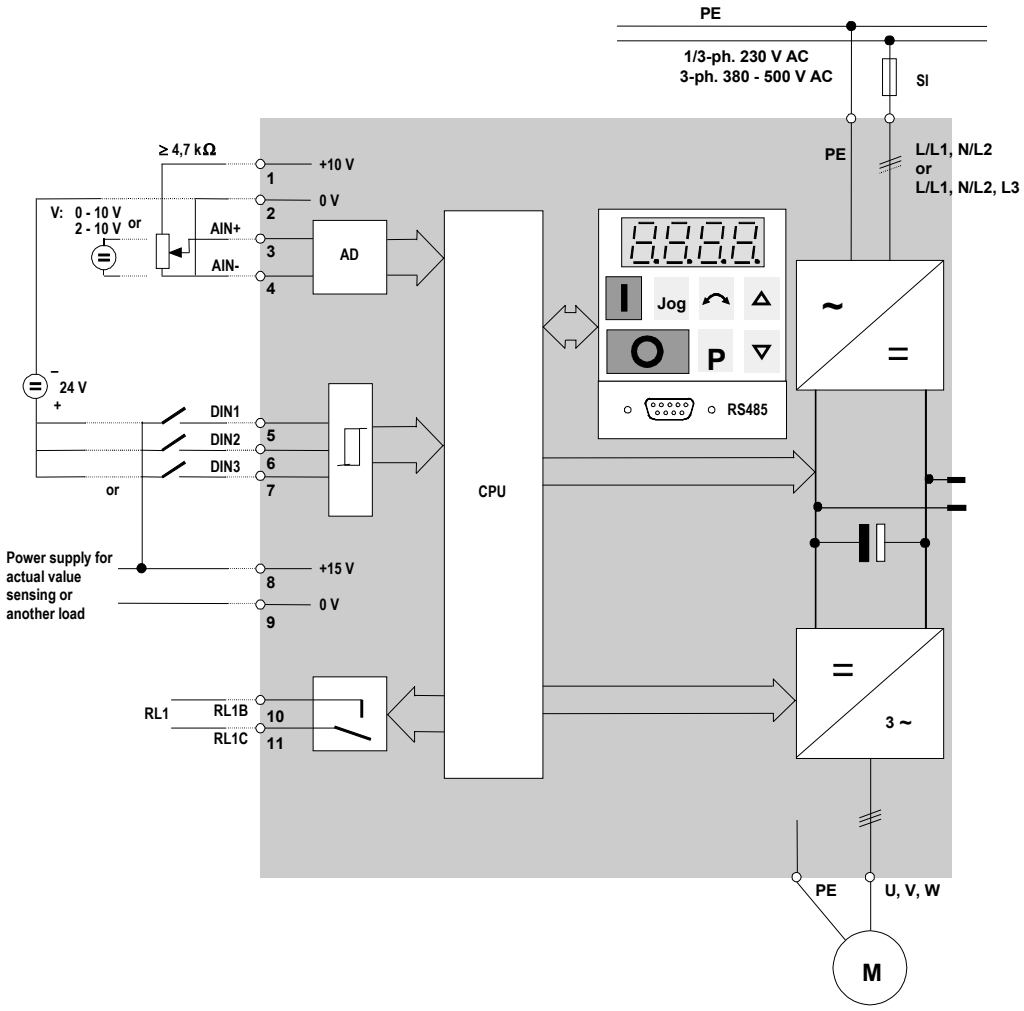
Line harmonics and line impedance

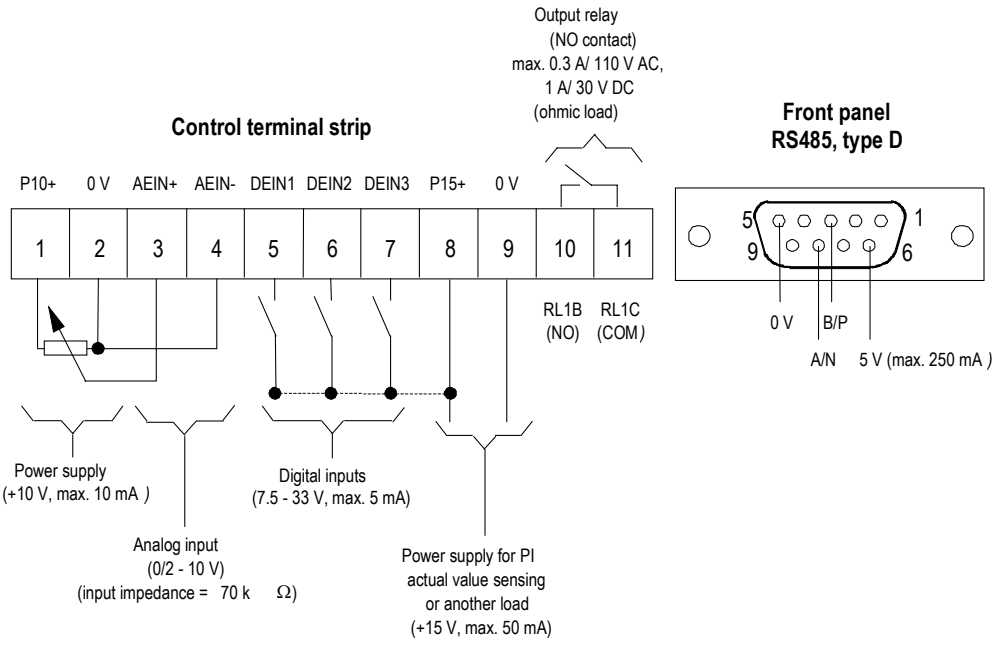
Line harmonics
When operational, drive inverters cause non-sinusoidal line currents with harmonics. The harmonic currents can be reduced by additionally using line reactors.
Line impedance
The ratio between the rated drive power / line supply fault level should not fall below 1 %. This means, that when the drive inverter is operating at full load, the voltage drop across the line impedance should be greater than or equal to 1% of the rated voltage. If the line impedance is below this value (rated drive inverter power / line supply fault level less than 1%), a line-commutating reactor must be used, as otherwise this could result in a shorter lifetime of the DC link capacitors.
The power supply company (power utility company) should be contacted regarding the line supply fault level. This may also be able to be taken from the rating plate of the upstream transformer.
Voltage and current spikes
Furthermore, line-commutating reactors reduce or smooth voltage and current spikes.

(further details are provided in Section 3.14, Line reactors)

3.6 Control connections

MICROMASTER:





MICROMASTER Vector & MIDIMASTER Vector

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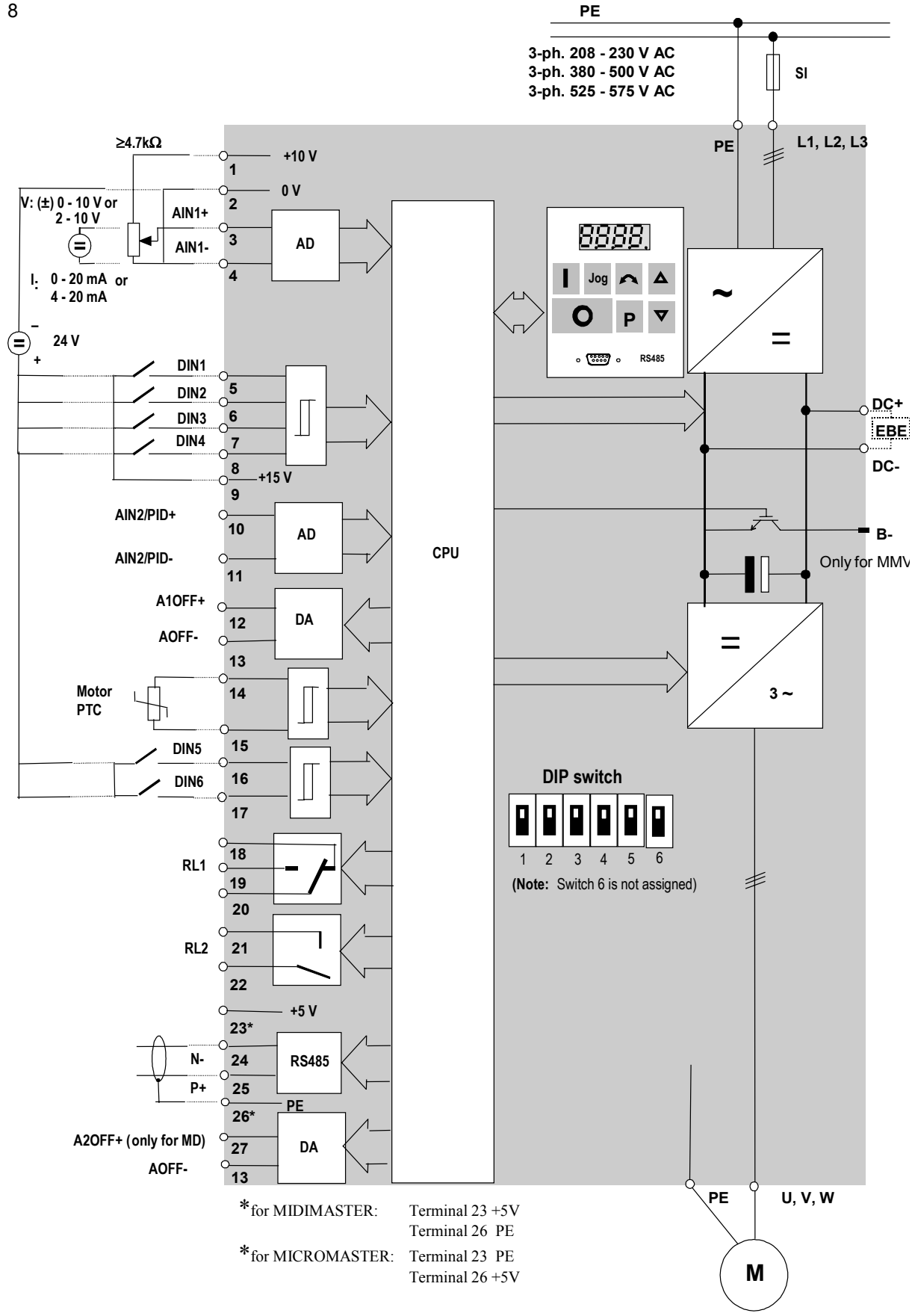
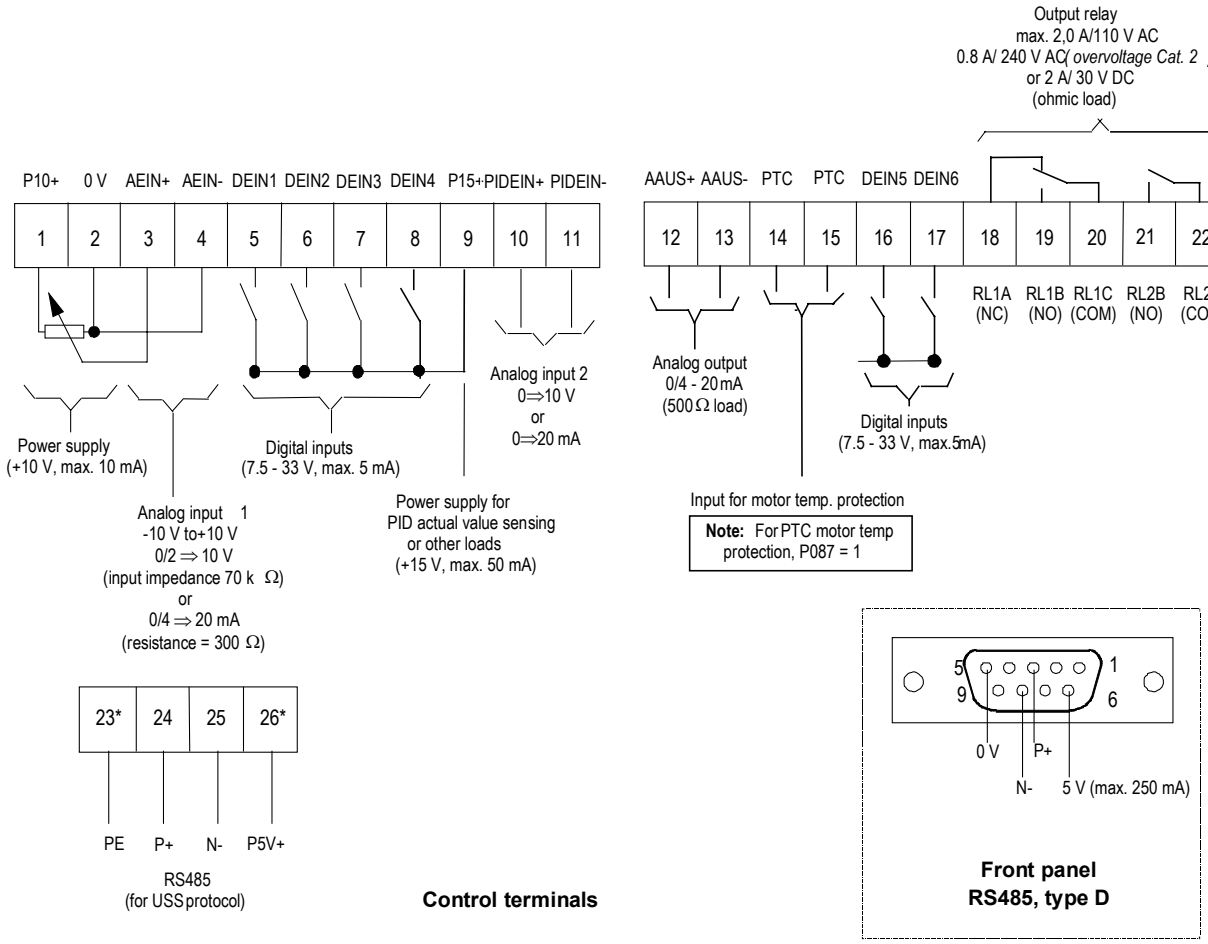


MICROMASTER Vector & MIDIMASTER Vector



Caution: Terminals 23 and 26 have different functions for MICROMASTER Vector and MIDIMASTER Vector.

*for MIDIMASTER Vector:	Terminal 23	+5V
	Terminal 26	PE
*for MICROMASTER Vector:	Terminal 23	PE
	Terminal 26	+5V

3.7 Recommended cable cross-sections

MICROMASTER Vector	MICROMASTER Basic	Recommend-ed cable cross-section, line side	Recommend-ed cable cross-section, motor side	Max. cable cross section
MMV12; MMV25; MMV37	MM12; MM25; MM37;	1.0 mm²	1.0 mm²	4.0 mm²
MMV55; MMV75	MM55; MM75	1.5 mm²	1.0 mm²	4.0 mm²
MMV110; MMV150; MMV220	MM110; MM150; MM220	2.5 mm²	1.5 mm²	4.0 mm²
MMV300	MM300	4.0 mm²	2.5 mm²	4.0 mm²
MMV12/2; MMV25/2;	MM12/2; MM25/2;	1.0 mm²	1.0 mm²	4.0 mm²
MMV37/2 MMV55/2; MMV75/2	MM37/2; MM55/2; MM75/2	1.0 mm²	1.0 mm²	4.0 mm²
MMV110/2	MM110/2;	1.5 mm²	1.5 mm²	4.0 mm²
MMV150/2	MM150/2	2.5 mm²	1.5 mm²	4.0 mm²
MMV220/2; MMV300/2	MM220/2; MM300/2	2.5 mm²	2.5 mm²	4.0 mm²
MMV400/2	MM400/2	4.0 mm²	2.5 mm²	4.0 mm²
MMV37/3; MMV55/3;	MM37/3; MM55/3;	1.0 mm²	1.0 mm²	4.0 mm²
MMV75/3; MMV110/3	MM75/3; MM110/3	1.0 mm²	1.0 mm²	4.0 mm²
MMV150/3	MM150/3	1.5 mm²	1.0 mm²	4.0 mm²
MMV220/3	MM220/3	1.5 mm²	1.5 mm²	4.0 mm²
MMV300/3; MMV400/3;	MM300/3; MM400/3	2.5 mm²	1.5 mm²	4.0 mm²
MMV550/3	MM550/3	2.5 mm²	2.5 mm²	4.0 mm²
MMV750/3	MM750/3	4.0 mm²	2.5 mm²	4.0 mm²
MMV220/3F	MM220/3F	1.5 mm²	1.0 mm²	4.0 mm²
MMV300/3F	MM300/3F	1.5 mm²	1.5 mm²	4.0 mm²
MMV400/3F	MM400/3F	2.5 mm²	1.5 mm²	4.0 mm²
MMV550/3F	MM550/3F	2.5 mm²	2.5 mm²	4.0 mm²
MMV750/3F	MM750/3F	4.0 mm²	2.5 mm²	4.0 mm²

MIDIMASTER Vector	Torque application	Recommend-ed cable cross-section, line side	Recommend-ed cable cross-section, motor side	Max. cable cross section
MDV550/2	Constant torque (CT)	6.0 mm²	4.0 mm²	16.0 mm²
MDV550/2	Variable torque (VT)	6.0 mm²	6.0 mm²	16.0 mm²
MDV750/2	Constant torque (CT)	10.0 mm²	6.0 mm²	35.0 mm²
MDV750/2	Variable torque (VT)	10.0 mm²	6.0 mm²	35.0 mm²
MDV1100/2	Constant torque (CT)	16.0 mm²	10.0 mm²	35.0 mm²
MDV1100/2	Variable torque (VT)	----------	----------	----------
MDV1500/2	Constant torque (CT)	25.0 mm²	16.0 mm²	35.0 mm²
MDV1500/2	Variable torque (VT)	25.0 mm²	16.0 mm²	35.0 mm²
MDV1850/2	Constant torque (CT)	35.0 mm²	16.0 mm²	35.0 mm²
MDV1850/2	Variable torque (VT)	35.0 mm²	16.0 mm²	35.0 mm²
MDV2200/2	Constant torque (CT)	35.0 mm²	25.0 mm²	35.0 mm²
MDV2200/2	Variable torque (VT)	35.0 mm²	35.0 mm²	35.0 mm²
MDV3000/2	Constant torque (CT)	70.0 mm²	50.0 mm²	95.0 mm²
MDV3000/2	Variable torque (VT)	70.0 mm²	70.0 mm²	95.0 mm²
MDV3700/2	Constant torque (CT)	95.0 mm²	70.0 mm²	95.0 mm²
MDV3700/2	Variable torque (VT)	95.0 mm²	95.0 mm²	95.0 mm²
MDV4500/2	Constant torque (CT)	95.0 mm²	95.0 mm²	95.0 mm²
MDV4500/2	Variable torque (VT)	----------	----------	----------
MDV750/3	Constant torque (CT)	6.0 mm²	4.0 mm²	16.0 mm²
MDV750/3	Variable torque (VT)	6.0 mm²	4.0 mm²	16.0 mm²
MDV1100/3	Constant torque (CT)	6.0 mm²	4.0 mm²	16.0 mm²
MDV1100/3	Variable torque (VT)	6.0 mm²	6.0 mm²	16.0 mm²
MDV1500/3	Constant torque (CT)	10.0 mm²	6.0 mm²	35.0 mm²
MDV1500/3	Variable torque (VT)	10.0 mm²	6.0 mm²	35.0 mm²
MDV1850/3	Constant torque (CT)	16.0 mm²	10.0 mm²	35.0 mm²
MDV1850/3	Variable torque (VT)	16.0 mm²	10.0 mm²	35.0 mm²
MDV2200/3	Constant torque (CT)	25.0 mm²	10.0 mm²	35.0 mm²
MDV2200/3	Variable torque (VT)	25.0 mm²	16.0 mm²	35.0 mm²
MDV3000/3	Constant torque (CT)	35.0 mm²	16.0 mm²	35.0 mm²
MDV3000/3	Variable torque (VT)	35.0 mm²	25.0 mm²	35.0 mm²
MDV3700/3	Constant torque (CT)	35.0 mm²	25.0 mm²	35.0 mm²
MDV3700/3	Variable torque (VT)	35.0 mm²	25.0 mm²	35.0 mm²
MDV4500/3	Constant torque (CT)	50.0 mm²	50.0 mm²	95.0 mm²
MDV4500/3	Variable torque (VT)	50.0 mm²	50.0 mm²	95.0 mm²
MDV5500/3	Constant torque (CT)	70.0 mm²	70.0 mm²	95.0 mm²
MDV5500/3	Variable torque (VT)	70.0 mm²	70.0 mm²	95.0 mm²
MDV7500/3	Constant torque (CT)	95.0 mm²	95.0 mm²	95.0 mm²
MDV7500/3	Variable torque (VT)	95.0 mm²	95.0 mm²	95.0 mm²

MIDIMASTER Vector	Torque application	Recommend-ed cable cross-section, line side	Recommend-ed cable cross-section, motor side	Max. cable cross section
MDV220/4	Constant torque (CT)	1.5 mm²	1.5 mm²	16.0 mm²
MDV220/4	Variable torque (VT)	1.5 mm²	1.5 mm²	16.0 mm²
MDV400/4	Constant torque (CT)	1.5 mm²	1.5 mm²	16.0 mm²
MDV400/4	Variable torque (VT)	1.5 mm²	1.5 mm²	16.0 mm²
MDV550/4	Constant torque (CT)	2.5 mm²	1.5 mm²	16.0 mm²
MDV550/4	Variable torque (VT)	2.5 mm²	1.5 mm²	16.0 mm²
MDV750/4	Constant torque (CT)	4.0 mm²	2.5 mm²	16.0 mm²
MDV750/4	Variable torque (VT)	4.0 mm²	2.5 mm²	16.0 mm²
MDV1100/4	Constant torque (CT)	4.0 mm²	4.0 mm²	16.0 mm²
MDV1100/4	Variable torque (VT)	4.0 mm²	4.0 mm²	16.0 mm²
MDV1500/4	Constant torque (CT)	6.0 mm²	4.0 mm²	35.0 mm²
MDV1500/4	Variable torque (VT)	6.0 mm²	4.0 mm²	35.0 mm²
MDV1850/4	Constant torque (CT)	10.0 mm²	6.0 mm²	35.0 mm²
MDV1850/4	Variable torque (VT)	10.0 mm²	6.0 mm²	35.0 mm²
MDV2200/4	Constant torque (CT)	10.0 mm²	10.0 mm²	35.0 mm²
MDV2200/4	Variable torque (VT)	10.0 mm²	10.0 mm²	35.0 mm²
MDV3000/4	Constant torque (CT)	16.0 mm²	10.0 mm²	35.0 mm²
MDV3000/4	Variable torque (VT)	16.0 mm²	10.0 mm²	35.0 mm²
MDV3700/4	Constant torque (CT)	25.0 mm²	16.0 mm²	35.0 mm²
MDV3700/4	Variable torque (VT)	25.0 mm²	16.0 mm²	35.0 mm²

3.8 Max. motor cable lengths

Drive inverter power KW	Rated voltage V	Housing size	Without output reactor		With output reactor	
			Non-shielded cable M	Shielded cable m	Non-shielded cable M	Shielded cable m
MICROMASTER / MICROMASTER Vector						
0.12 - 1.5	208-240 ±10%	A, B	200	200	250	225
2.2 – 4.0	208-240 ±10%	C	185	150	235	185
0.37 - 1.5	380-500 ± 10%	A	110	80	185	125
2.2 – 3.0	380-500 ± 10%	B	170	140	220	170
4.0 - 7.5	380-500 ± 10%	C	200	200	300	250
MIDIMASTER Vector						
5.5	208-240 ±10%	4	200	50	250	80
7.5 - 11	208-240 ±10%	4, 5	300	200	350	225
15 - 22	208-240±10%	6	300	300	350	325
30 - 45	208-240±10%	7	300	300	350	325
7.5 - 18.5	380-500± 10%	4, 5	150	75	200	100
22 - 37	380-500± 10%	6	200	150	250	175
45 - 75	380-500 ± 10%	7	300	300	350	325
2.2 - 18.5	525-575 ± 10%	4,5	100	100	150	125
22 - 37	525-575 ± 10%	6	150	150	200	175

Standard cable lengths are 50m for non-shielded cables and 25m for shielded cables. The above mentioned maximum cable lengths are for constant torque applications (CT) under the following conditions:

- Max. 460 V rated voltage for MICROMASTER, MICROMASTER Vector and MIDIMASTER Vector with a voltage range 3-ph. 380-500 V AC.

- The pulse frequency which is set corresponds to that set in the factory:
  Max. 16 kHz pulse frequency for 230V MICROMASTER and MICROMASTER Vector
  Max. 4 kHz pulse frequency for 400V MICROMASTER, MICROMASTER Vector and all MIDIMASTER Vector drive units

- The maximum overload is:
  150% rated output current for MICROMASTER and MICROMASTER Vector
  150% rated output current for MIDIMASTER Vector for constant torque (CT) applications

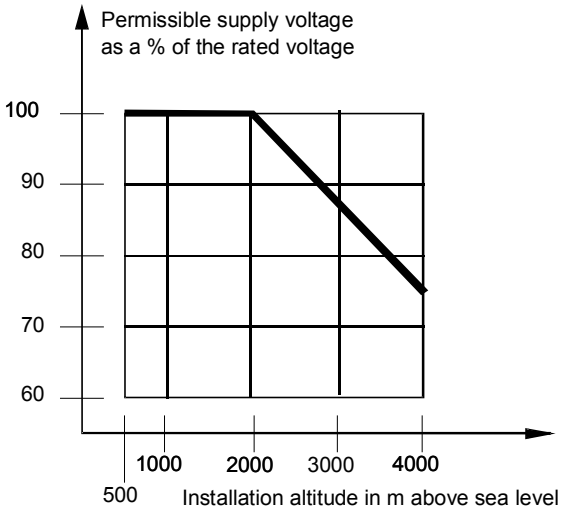
  (The overload capability refers to the rated output currents of the MICROMASTER and MICROMASTER Vector drive units, rated output currents for constant torque applications (CT) of the MIDIMASTER Vector and for a load duty cycle of 5 minutes. This means that the drive units can withstand a of 50% overload condition for a total of 1 minute over a period of 5 minutes.)

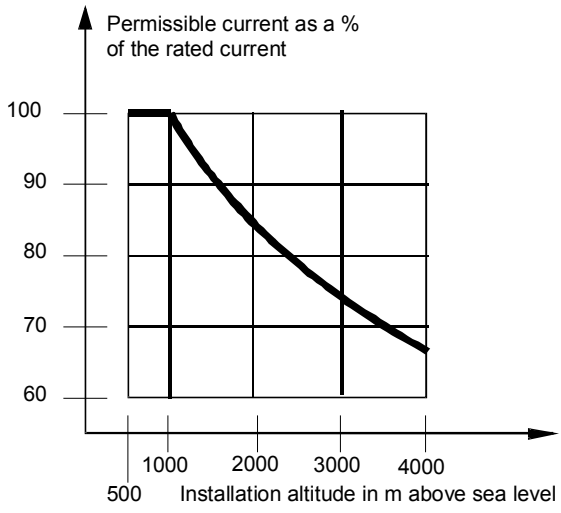
Another possibility of extending the cable lengths (with the exception of using an output reactor) is to use the next larger drive inverter.

Comment: For longer cable lengths (> standard cable lengths), problems can be incurred for vector control types (P77 = 3).

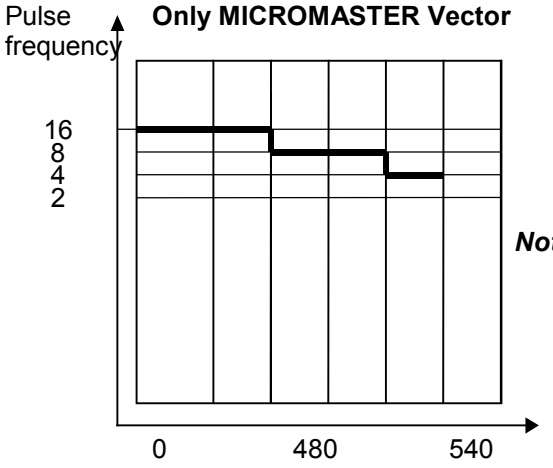
3.9 De-rating

Voltage and current de-rating for high installation altitudes





Max. pulse frequency referred to the line supply voltage



Note: *The pulse frequency is automatically reduced*

Maximum output current referred to the pulse frequency

As a result of higher switching losses at increased switching frequencies, the maximum continuous current (100 %) of some drive inverters can be reduced, if a pulse frequency other than the standard pulse frequency is selected.

Type	Perm. load as a % of the max. continuous current	
	at 16 kHz	at 8 kHz
MMV75/3	80	100
MMV110/3	50	80
MMV150/3	50	80
MMV220/3	80	100
MMV300/3	50	80
MMV400/3	50	80
MMV550/3	50	80
MMV750/3	50	80

Note: *If the pulse frequency is either 2 or 4 kHz, the above mentioned drive inverters are not de-rated.*

Type	Perm. load as a % of the max. continuous current	
	at 16 kHz	at 8 kHz
MDV550/2	39	75
MDV750/2	64	90
MDV1100/2	55	75
MDV1500/2	38	68
MDV1850/2	43	79
MDV2200/2	38	68
MDV750/3	55	100
MDV1100/3	39	75
MDV1500/3	64	90
MDV1850/3	55	75
MDV2200/3	40	75
MDV3000/3	47	88
MDV3700/3	40	75
MDV550/4	75	100
MDV750/4	55	100
MDV1100/4	39	75
MDV1500/4	64	90
MDV1850/4	55	75

Note: *For all other Size 6 drive inverters, 575 V and Size 7 MIDIMASTER Vector, the pulse frequency can either be 2 or 4 kHz.*

3.10 Selection aid for motors

A detailed description of the motors and selection tables is provided in the following Catalogs:

M 11: Three-phase low-voltage squirrel-cage induction motors

DA 47: Reluctance motors: Synchronous motors for variable-speed drives

DA 48: SIEMOSYN motors: Synchronous motors for variable-speed drives

The technical guidelines, specified here, refer to Siemens 1LA5, 1LA6 and 1LA7 low-voltage motors as well as the Siemens 1LA5 force-ventilated motors. If third-party motors are used, then their specific technical data must be carefully observed.

All types of load characteristics are conceivable; only the most important are discussed here:

- constant-torque drives

If M = const. ("Constant torque", CT)

- blower and pump drives

with M ~ n² ("Variable torque", VT).

Motor torque utilization:

Which motor is best suited for a specific application depends on its permissible torque characteristic over the speed range.

Typical characteristics for the continuous permissible torque of a non-ventilated motor with a rated frequency of 50 Hz are shown in **Fig. 1**. The torque which can be used at low speeds is significantly lower than that at 50 Hz due to the lower cooling effect. The torque reduction factor is not the same for all motors. The assignment tables below specify the torque reduction as a function of the speed in the frequency range f = 0 Hz to 50 Hz when utilized according to temperature rise Class F.

For frequencies, which lie above the rated frequency f_n, the voltage remains the same if the maximum drive inverter output voltage has been reached. The motor is operated with field weakening in this range. The torque, which can be thermally used, decreases with approx. f_n/f. The stall torque decreases as a function of $(f_n/f)^2$ which means that the safety margin to the stall torque decreases and the load capability of the drive decreases.

For MICROMASTER and MIDIMASTER drives with a field-weakening range of f = 50 Hz to 100 Hz, the load capability for 1LA5, 1LA6 and 1LA7 motors drops to approx. 10% at 100 Hz.

The assignment tables indicate that Siemens 1LA5/1LA6/1LA7 low-voltage motors can be generally operated with 100% rated torque if they are utilized according to temperature rise Class F in a 1:2 control range. If they are operated in accordance with temperature rise Class B, then, for 1LA5/1LA6/1LA7 motors, the permissible torque must be reduced by approx. 10%.

Force-ventilated motors:

In addition to non-ventilated 1LA5, 1LA6 and 1LA7 motors, force-ventilated 1LA5/1LA7 motors can be used. According to **Fig. 1**, the permissible S1 torque at the rated frequency can be used down to standstill.

It makes sense to use force-ventilated motors if a high torque utilization is required, even at the lowest speeds.

Standard motors with pole numbers > 4 should be operated with speeds > approx. 2200 RPM (e.g. in the field-weakening range). For non-ventilated motors, the fan noise can be reduced in this way.

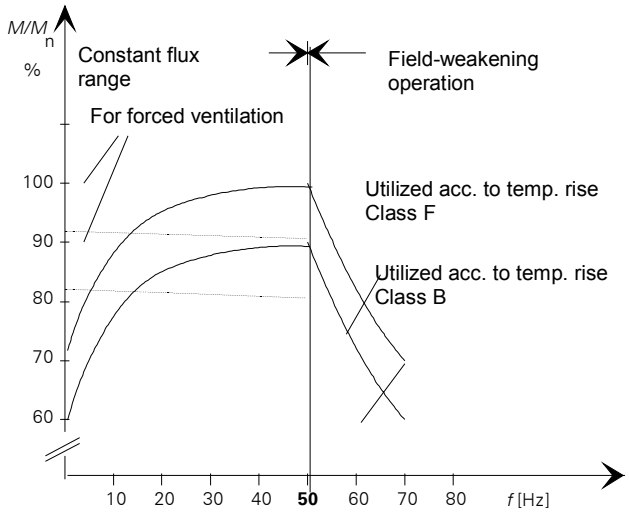


Fig. 1: Typical characteristics of the permissible torque for force-ventilated motors (e.g. 1LA5/1LA6/1LA7) with a rated frequency of 50 Hz. (precise data for 1LA5, 1LA6 and 1LA7 motors should be taken from the assignment tables further below).

Maximum speeds:

The maximum mechanical speeds of 1LA5, 1LA6 and 1LA7 motors are specified in Catalog M11.

Motor protection:

MICROMASTER Vector and MIDIMASTER Vector:
The motors are protected using a PTC thermistor. This is connected to the drive inverter control terminals. The motor protection function is activated using the parameter P087 = 1; for a motor fault ("Low signal" at the control input), error code F004 is displayed.

For **MICROMASTER**, this is realized using a digital input as external trip signal in conjunction with a PTC thermistor and an additional resistor. Please refer to the Operating Instructions for further details.

Another possibility of thermally monitoring the motor is the internal **I^2t calculation** (parameter P074) of the drive inverter. In this case, various de-rating characteristics can be parameterized corresponding to the motor output, whereby the motor current is limited as a function of the frequency and an alarm (W005) or a fault message (F074) is initiated. "Alarm" and "Fault signals" can be output via the digital outputs, the last fault can be read-out using parameter P930 = and the last alarm using parameter P931, or displayed on the OPM2 plain text operator panel.

Long cables between the drive inverter and motor:

25m shielded and 50m non-shielded cables are used as standard cable lengths between the drive inverter and motor, both for the MICROMASTER as well as for the MIDIMASTER series.
Long cables (shielded > 50m, non-shielded > 100m) between the motor and drive inverter or several cables routed in parallel (group drives) result in re-charging currents due to the cable capacitance and voltage spikes due to voltage reflections. This means, that depending on the drive inverter line voltage, the motor frame size and cable lengths between the motor and drive inverter, output reactors and / or DV/d*v* filters may be required.
The drive inverter must also cover these additional currents which can mean that the current limiting of the drive inverter is activated and / or the drive unit is tripped with an "Overcurrent fault signal" (F002). It can also cause the vector control (P077 = 3) to behave incorrectly. This can be resolved by using the next largest drive inverter and / or a higher cable cross-section. Generally, for MICROMASTER, it is more favorable to select a drive inverter with a higher rated output than using an output reactor or a DV/d*t* filter.
The ordering data for output reactors is specified in the **Section, Options**. When using output reactors, the maximum permissible output and pulse frequency must be observed.

Information and instructions on using motors with type of protection " EEx de or EEx d " when connected to drive inverters:

Siemens 1MJ6 squirrel-cage induction motors can be connected directly to the line supply voltage or can be fed from a drive inverter as explosion-protected motors with flameproof enclosure, type of protection "EEx de or EEx d". The flameproof enclosure guarantees explosion protection for drives, whereby the terminal boxes, with degree of protection EEx e, are normally designed for a 690 V rated voltage. When variable-speed drives are used in hazardous zones, we recommend that 1MJ6 and 1MJ8 squirrel-cage induction motors are used with flameproof enclosure. Siemens has a general certificate of conformity for these motors, also when they are fed from drive inverters. When using drive inverters with EEx d motors from other manufacturers, it is necessary to have this general certificate of conformity confirmed by the particular motor manufacturer. Up until now, the Physikalisch-Technische Bundesanstalt (PTB – a German regulatory body) specified, that the peak voltages, occurring when motors are fed from drive inverters, do not exceed 1078V in the Eex e terminal boxes (this is certified for line supply voltage up to 690V). Recent investigations carried-out by the PTB regarding the air and creepage distances, has resulted in the fact that also higher voltage spikes are permissible in the terminal box when the motors are fed from drive inverters. This means that now voltage spikes up to **1952 V** (690 x √2 x 2) are permissible for these terminal boxes. Voltage spikes can occur at the motor due to voltage reflections and because it is especially critical that the permissible voltage spikes in the motor terminal box are not exceeded in hazardous environments, the following measures are required.

- The pulse frequency must be limited to 4KHz (P076)
- Voltage reflections must be reduced (these voltage reflections can be reduced using output reactors and / or dv/dt filters.)

Supplementary measures for operating 1MJ6 and 1MJ8 motors in hazardous environments

Line supply voltages, 208 V to 240 V ± 10 %
No additional measures required

Line supply voltages, 380 V to 400 V ± 10 %
1MJ6 070 to 1MJ6 313
No additional measures required

1MJ6 070 to 1MJ6 166
No additional measures required

1MJ6 183 to 1MJ6 313
1MJ8 313 to 1MJ8 457
Insulated non-drive end bearings are required, option: L27 (Loher)

Line supply voltage
440 V to 460 V ± 10 % and 500 V ± 10 %

1MJ8 313 to 1MJ8 457
Insulated non-drive end bearings are required, option: L2

Notes:

When selecting the output reactors, the max. output frequency and the max. pulse frequency should be taken into account.
It is not possible to use sinusoidal or dv/dt filters from the MASTERDRIVE 6SE70... series for applications with MICROMASTER / MIDIMASTER. The reasons are technical ones (the filters are matched to the pulse frequency and modulation of the MASTERDRIVE series).

PTC thermistors and tripping units are specified for 1MJ motors. More detailed information is provided in Catalog NS 2 under the Info "Operating explosion-protective motors with AC drive inverters" ID: 4886577

Drive inverter & motor assignment

The selection parameters for 2, 4, 6 and 8-pole squirrel-cage motors are essentially the voltage and current. However, instead of the current, the rated motor power can be used. For safety reasons, when engineering the drive, it should be noted (especially for third-party motors), that the rated drive inverter output current is dimensioned to be approx. 10% higher than the rated motor current ($I_{inverter\ rated} \geq 1.1 * I_{motor\ rated}$). Furthermore, it is assumed that the motors are used in accordance with temperature rise Class F and continuous duty S1.

The (motor) output $P_{Catalog}$, specified in the Catalogs, refers to the rated speed n_n of the particular motor. The permissible S1 torque in the associated speed range (for constant torque applications) and at the associated speed operating point (for blower and pump applications) can be determined as follows:

$$M_{permissible} = \frac{P_{Catalog} \cdot 9550}{n_n} in Nm$$

$P_{Catalog}$: Shaft output in kW at n_n

n_n: Motor rated speed in RPM

The last position of the motor Order No. listed in Catalog M11 (shown as ".") signifies the type of construction.

The motor rated current is greater than the rated drive inverter current

A "larger" motor (current, voltage, power) should never be operated together with a smaller drive inverter. There may be some exceptions:

Motors in the partial load range

Motors for pump and fan applications (VT).

Motors in the partial load mode

Generally, we recommend that this operating mode is not used!

If the drive inverter is to be connected to a larger motor than that specified in the assignment table, e.g. the drive is only operated in the partial load range, then the following limits and restrictions should be carefully observed:

The maximum drive inverter current (short-time current P086 & P186) should be greater than or at least the same as the rated motor current or, if applicable, the same as the sum of the rated currents of the connected motors (for multi-motor drives). Otherwise, peak currents which could occur, would trip the drive (shutdown) due to an overcurrent condition. This is because the leakage inductance and therefore the current ripple are higher for larger motors. Under no circumstances may the Vector control type be selected (the V/Hz control type with the factory set motor parameters should be selected). The pulse frequency should be set as low as possible.

Blower and pump drives with 1LA5, 1LA6 and 1LA7 motors: ("Variable torque", VT)

Blower (fan) and pump drives with a load characteristic M ~ n^2 (VT) only require the full torque at the rated speed. Generally, increased starting torques are not expected due to load surges. This is the reason that the drive inverter does not require an overload capability.

For fan and pump drives, the motor and drive inverter should be matched so that the max. motor current at full torque and at the rated operating point corresponds to the drive inverter continuous current.

The favorable pulse pattern permits, in almost all cases, the same output at the rated operating point as for direct online operation (where the motor is directly connected to the line supply). Motors must be used so that they comply with temperature rise Class F.

"Variable torque", VT

For fan and pump drives, for each[1)] specified motor output, the next smaller MIDIMASTER Vector can be used. The prerequisite is that the square-law V/Hz characteristic (P077 = 2) is selected and the lowest possible pulse frequency (P076 = 6=2KHZ). With this setting, a significantly higher continuous output current at the MIDIMASTER Vector is possible, so that in most cases, the rated power for the next larger motor is reached. However, the overload capability of the drive inverter is max 110% as a result of this measure.

1) Except MDV4500/2; MDV110/2; MDV750/3

3.11 Maintaining the EMC Directives

Since January 1996, all manufacturers/companies assembling electrical equipment which have an autonomous function and which are offered to end users as a single unit, must fulfill the EMC Directive 89/336/EC. Manufacturers/companies assembling electrical equipment can prove this conformance in three different ways:

1. *Self-certification*
   In this case, the manufacturer makes a declaration that the European Standards, which are applicable for the intended use of the electrical equipment, are fulfilled. In this case, only the Standards, published in the official journal of the European Union, can be specified in the manufacturer's declaration.

2. *Technical construction file*
   A technical construction file can be prepared for the equipment, describing its EMC characteristics. This file must be approved by a 'Competent Body' appointed by the appropriate European government organization. This approach allows the use of Standards which are still being prepared.

3. *EC type-examination certificate*
   This approach is only applicable for equipment which operates with radio transmission.
   MICROMASTER, MICROMASTER Vector and MIDIMASTER Vector drive units do not have an autonomous function until they have been connected to other components and devices (e.g. a motor). This is the reason that the basic units are not permitted to have a CE Mark which would indicate compliance with the EMC Directive.
   All of the details regarding the EMC characteristics of the products, if these are installed corresponding to the design/ wiring guidelines in Section 3.11, are listed in the following tables.
   The EMC characteristic is classified into three separate classes which will be subsequently described. It is important to note that the individual stages are only achieved if the standard (or a lower) pulse frequency is used as well as a motor cable which is a maximum of 25 m long.

Class 1: General industrial environments

Compliance with the EMC Product Standard for motor drive systems EN 61800-3 for use in the **Second Environment (industrial environment)** and for **restricted marketing.**

EMC Phenomena	**Standard**	**Level**
Emission:		
Radiated emission	EN 55011 (VDE 0875 Part 11)	Level A1 *
Cable-borne emission	EN 61800-3 (VDE 0160 Part 100)	*
Noise immunity:		
Electrostatic discharge (ESD)	EN 61000-4-2 (VDE 0847 Part 4-2)	8 kV discharge into air
Burst interference	EN 61000-4-4 (VDE 0847 Part 4-4)	2 kV power cable, 1 kV control
Radio frequency electromagnetic field	EN 61000-4-3 (VDE 0847 Part 4-3)	26 - 1000 MHz, 10 V/m

- *Emission limits are not applicable within a plant or system where no other consumers/loads are connected to the same power supply transformer.*

Class 2: Filtered industrial environments

For this level, manufacturers/companies assembling electrical equipment can themselves certify that their equipment is in conformance with the EMC Directive for industrial environments referred to the EMC characteristics of the motor drive system. In this case, the limit values, specified in the Standards EN 50081-2 and EN 50082-2 apply (VDE 0839 Part 81-2 and VDE 0839 Part 82-2).

EMC Phenomena	**Standard**	**Level**
Emission:		
Radiated emission	EN 55011 (VDE 0875 Part 11)	Level A1
Cable-borne emission	EN 55011 (VDE 0875 Part 11)	Level A1
Noise immunity:		
Line supply voltage distortion	EN 61000-2-4 (VDE 0839 Part 2-4)	
Voltage fluctuations, dips, unbalance, frequency deviations	IEC 1000-2-1	
Magnetic fields	EN 61000-4-8 (VDE 0847 Part 4-8)	50 Hz, 30 A/m
Electrostatic discharge (ESD)	EN 61000-4-2 (VDE 0847 Part 4-2)	8 kV discharge into air
Burst interference	EN 61000-4-4 (VDE 0847 Part 4-4)	2 kV power cable, 2 kV control
Radio frequency electromagnetic field, amplitude-modulated	ENV 50 140 (VDE 0847 Part 3)	80 - 1000 MHz, 10 V/m, 80 % AM, line supply and signal cables
Radio frequency electromagnetic field, pulse modulated	ENV 50 204 (VDE V 0847 Part 204)	900 MHz, 10 V/m 50 % utilization, 200 Hz repetition rate

Class 3: Filtered – for residential, commercial and light industry

For this level, manufacturers/companies assembling electrical equipment can themselves certify that their equipment is in conformance with the EMC Directive for residential, commercial and light industrial operations referred to the EMC characteristics of the motor drive system. In this case, the limit values, specified in Standards EN 50081-1 and EN 50082-1 (VDE 0839 Part 81-1 and VDE 0839 Part 82-1) apply. Since the 1st of January 2001, all electrical equipment, which fall within the validity area of the EMC Directive, must fulfill the requirements laid-down in EN 61000-3-2 "Limit values for harmonic currents (equipment input current <= 16 A per phase)". For drives with 250 W to 550 W and 230 V AC 1-phase line supplies, which are not used in industrial applications, then authorization is required from the power supply company (public utility) to connect the equipment to the public supply. More detailed information is provided in EN 61000- 3-12, Section 5.3 and 6.4 or in Section 1.3.3 Limit values for harmonic currents in non-industrial applications EN 61000-3-2

EMC Phenomena	**Standard**	**Level**
Emission:		
Radiated emission	EN 55022 (VDE 0878 Part 22)	Level B1
Cable-borne emission	EN 55022 (VDE 0878 Part 22)	Level B1
Noise immunity:		
Electrostatic discharge (ESD)	EN 61000-4-2 (VDE 0847 Part 4-2)	8 kV discharge into air
Burst interference	EN 61000-4-4 (VDE 0847 Part 4-4)	1 kV power cable, 0.5 kV control

Note

MICROMASTER, MICROMASTER Vector and MIDIMASTER Vector have been ***exclusively designed for professional applications.*** *This means that they do not fall under the Standard EN 61000-3-2 (VDE 0838 Part 2, limit values for harmonic currents for drive inverter input current = 16 A per conductor).*

Compliance table (MM & MMV):

Type	**EMC Class**
MM12 - MM300, MMV12 - MMV300	Class 2
MM12/2 - MM400/2, MMV12/2 - MMV400/2	Class 1
MM12/2 - MM400/2, MMV12/2 - MMV400/2 with external filter (refer to Table) *only 1 phase input*	Class 2*
MM37/3 - MM750/3, MMV37/3 - MMV750/3	Class 1
MM37/3 - MM750/3, MMV37/3 - MMV750/3 with external filter (refer to the selection table)	Class 2*

Compliance table (MDV):

Type	**EMC Class**
MDV550/2 - MDV4500/2	Class 1
MDV750/3 - MDV7500/3 with external Class A filter (refer to Table)	Class 2*
MDV750/3 - MDV3700/3 with external Class B filter (refer to Table)	Class 3
MDV750/4 - MDV3700/4	Class 1

* When installed in a metal housing, the emitted radio frequency field is reduced and generally limit values, Class 3 are maintained.

3.12 Technical data for line and output filter

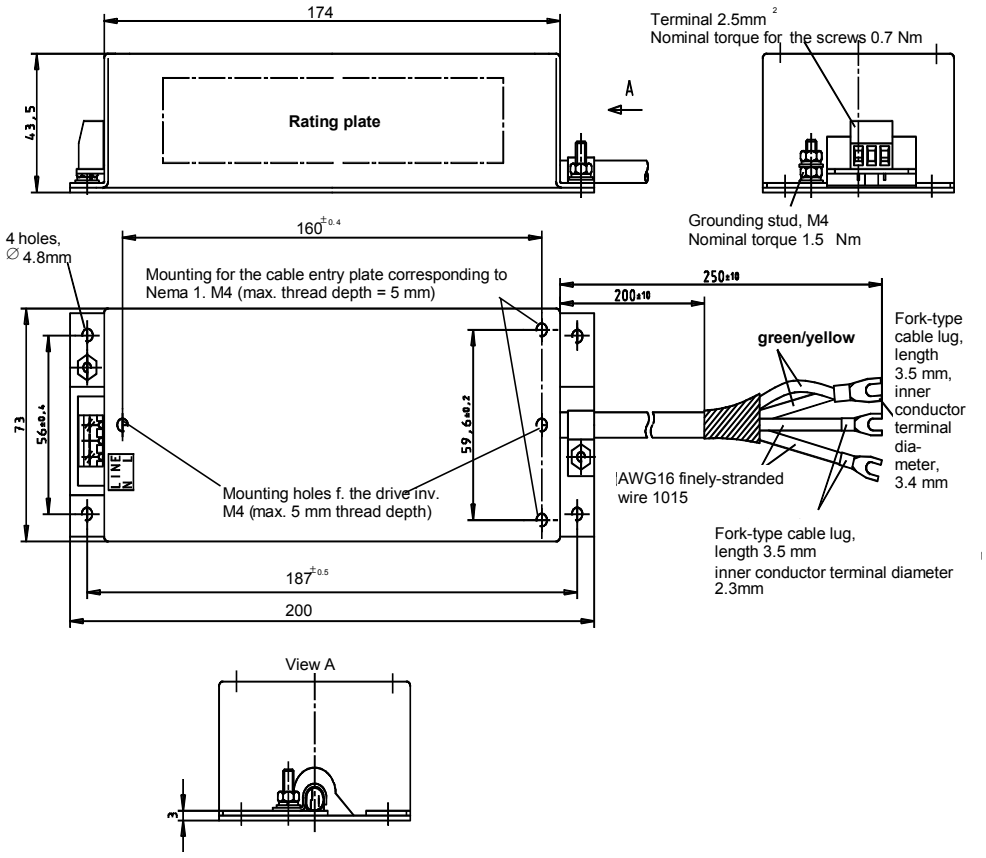
6SE3290-0BA87-0FB0

Radio interference suppression filter, Class B; 1-ph.; 208V – 240 V AC+/-10%; 3A; 50/60Hz

6SE3290-0BA87-0FB2

Radio interference suppression filter, Class B; 1-ph.; 208V – 240 V AC+/-10%; 10A; 50/60Hz

Housing dimensions are valid for both filters



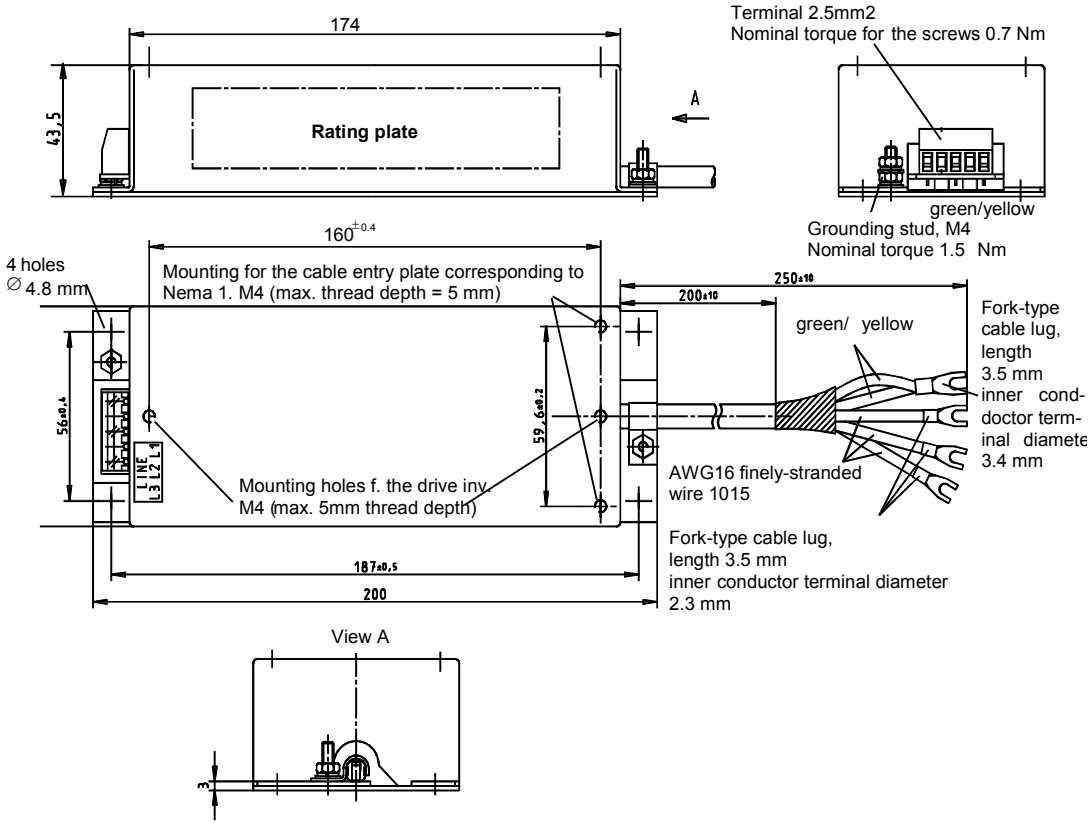
6SE3290-0DA87-0FA1

Radio interference suppression filter, Class A; 3-ph.; 208V – 460V AC+/-10%; 6A; 50/60Hz

6SE3290-0DA87-0FB1

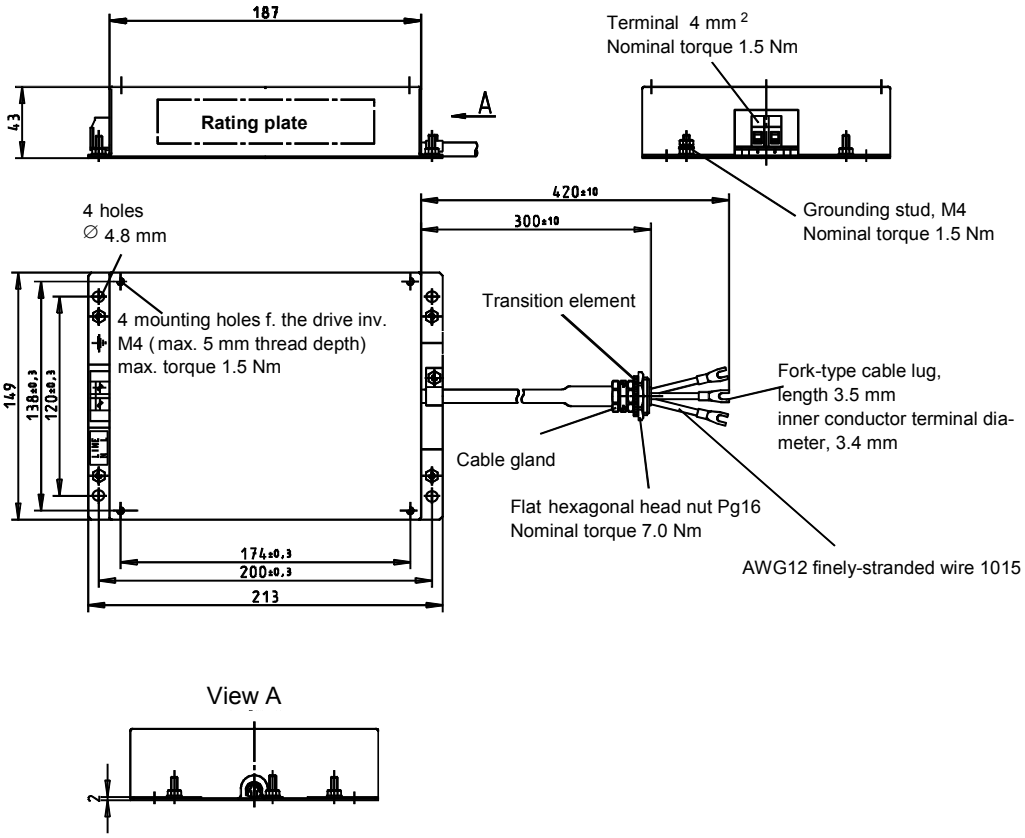
Radio interference suppression filter, Class B; 3-ph.; 208V – 460V AC+/-10%; 6A; 50/60Hz

Housing dimensions are valid for both filters



6SE3290-0BB87-0FB4

Radio interference suppression filter, Class B; 1-ph.; 208V – 240V AC+/-10% +/-10%; 22A; 50/60Hz

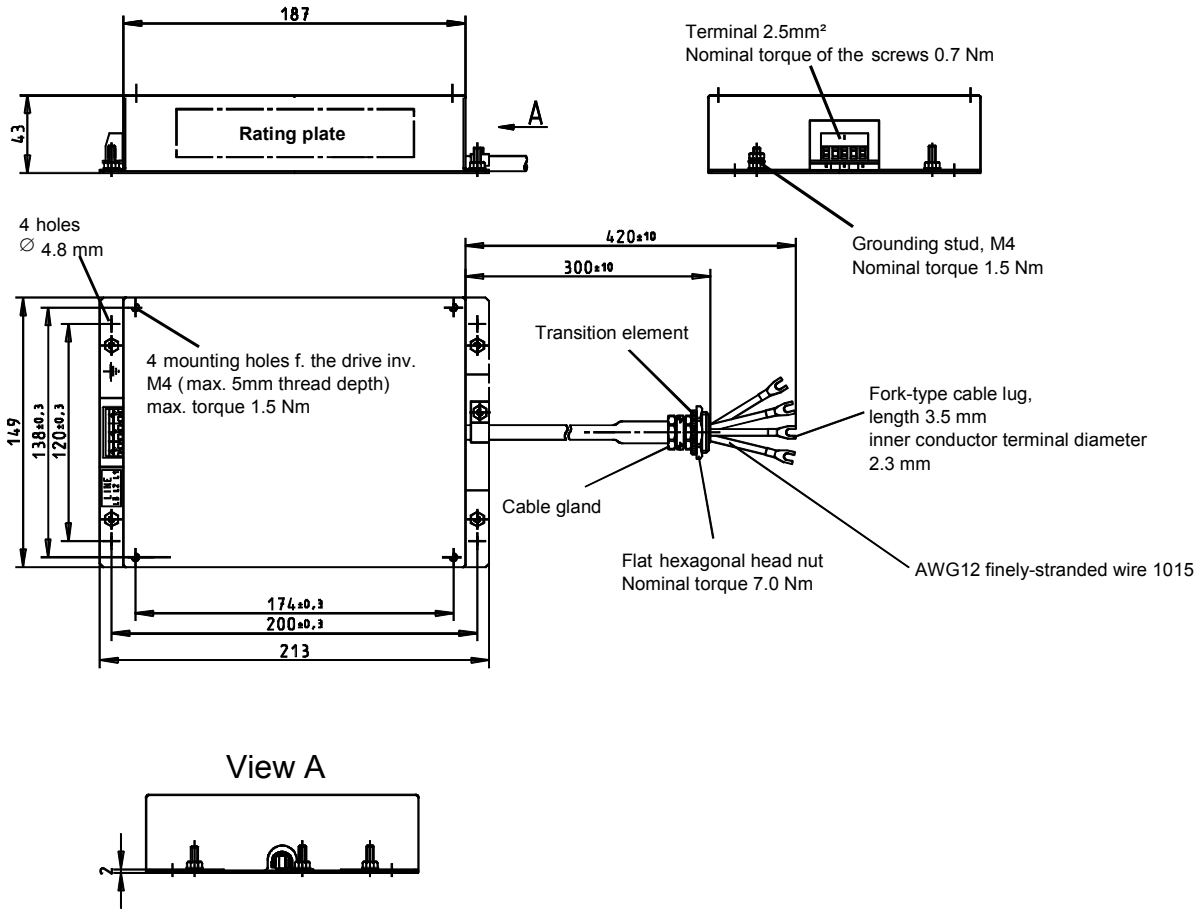


6SE3290-0DB87-0FA3

Radio interference suppression filter, Class A; 3-ph.; 208V – 480V AC+/-10%; 12A; 50/60Hz

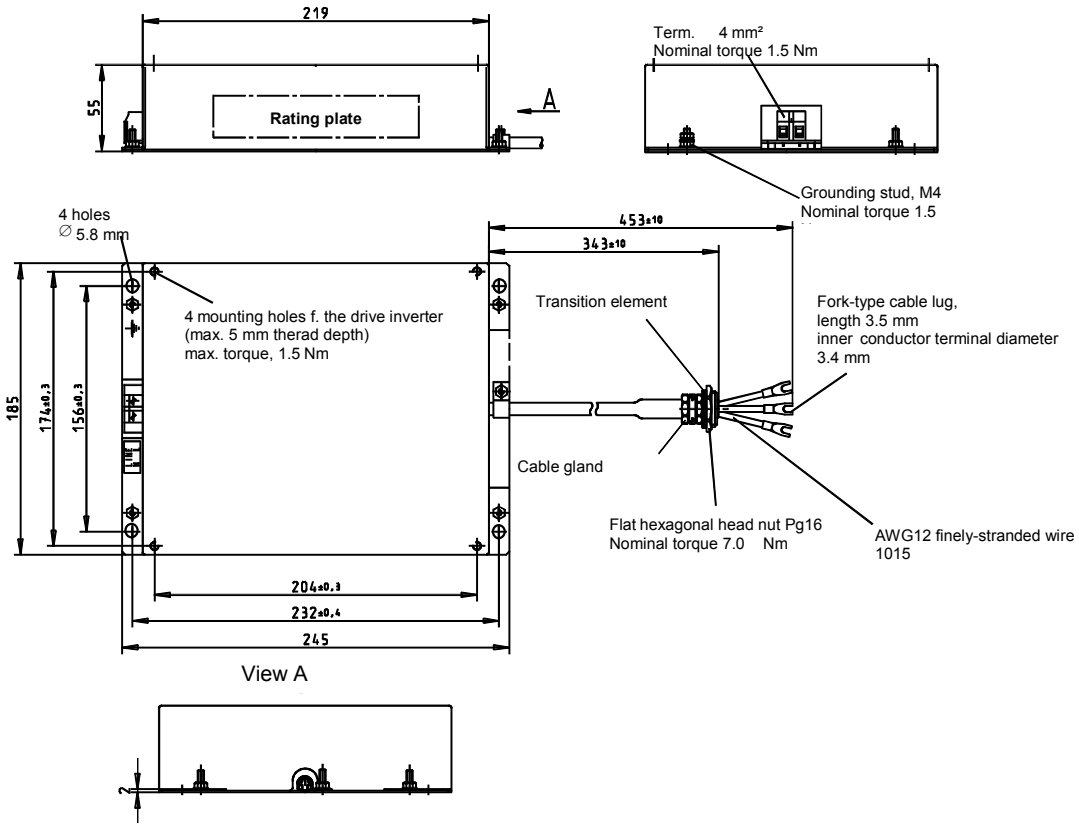
6SE3290-0DB87-0FB3

Radio interference suppression filter, Class B; 3-ph.; 208V – 480V AC+/-10%; 12A; 50/60Hz



6SE3290-0BC87-0FB4

Radio interference suppression filter, Class B; 1-ph.; 208V – 240V AC+/-10%; 32A; 50/60Hz

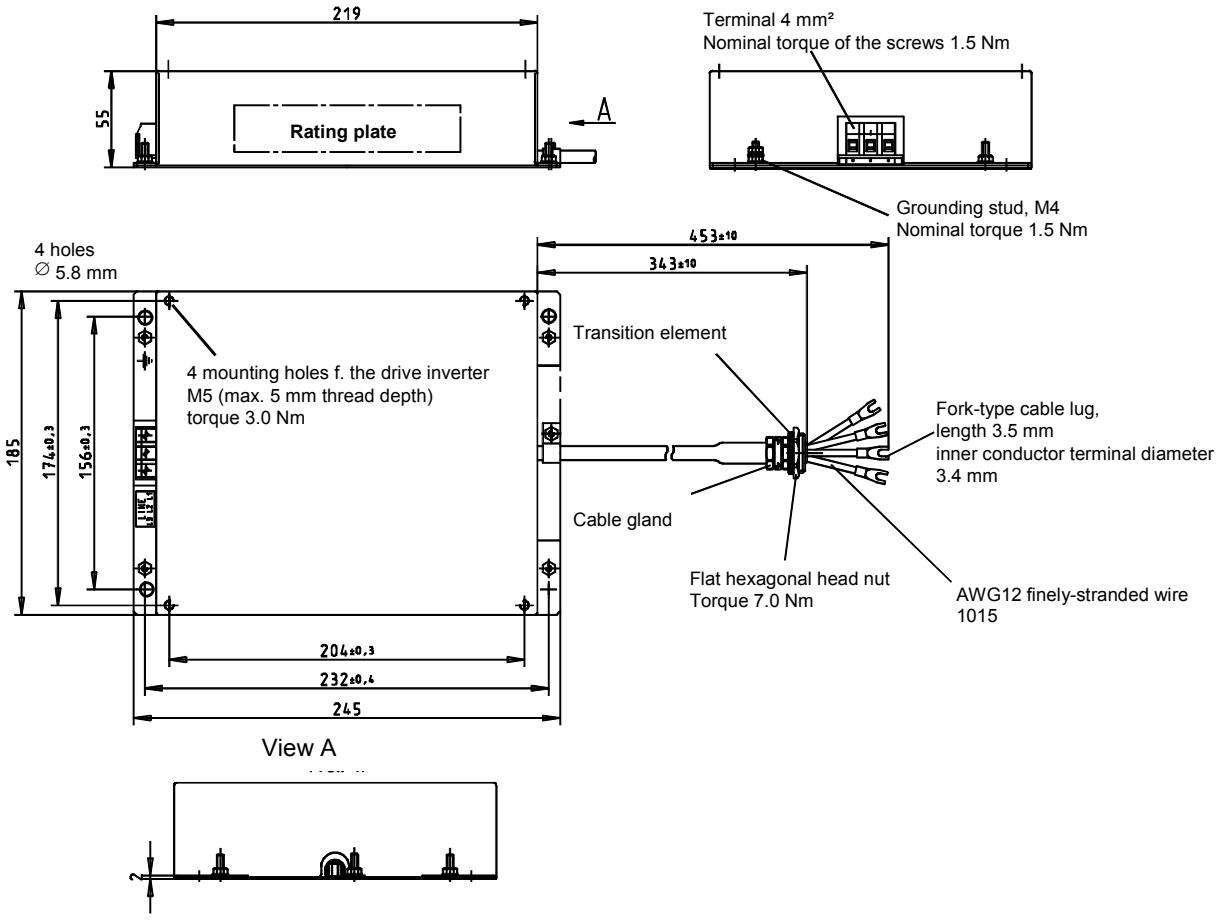


6SE3290-0DC87-0FA4

Radio interference suppression filter, Class A; 3-ph.; 208V – 480V AC+/-10%; 25A; 50/60Hz

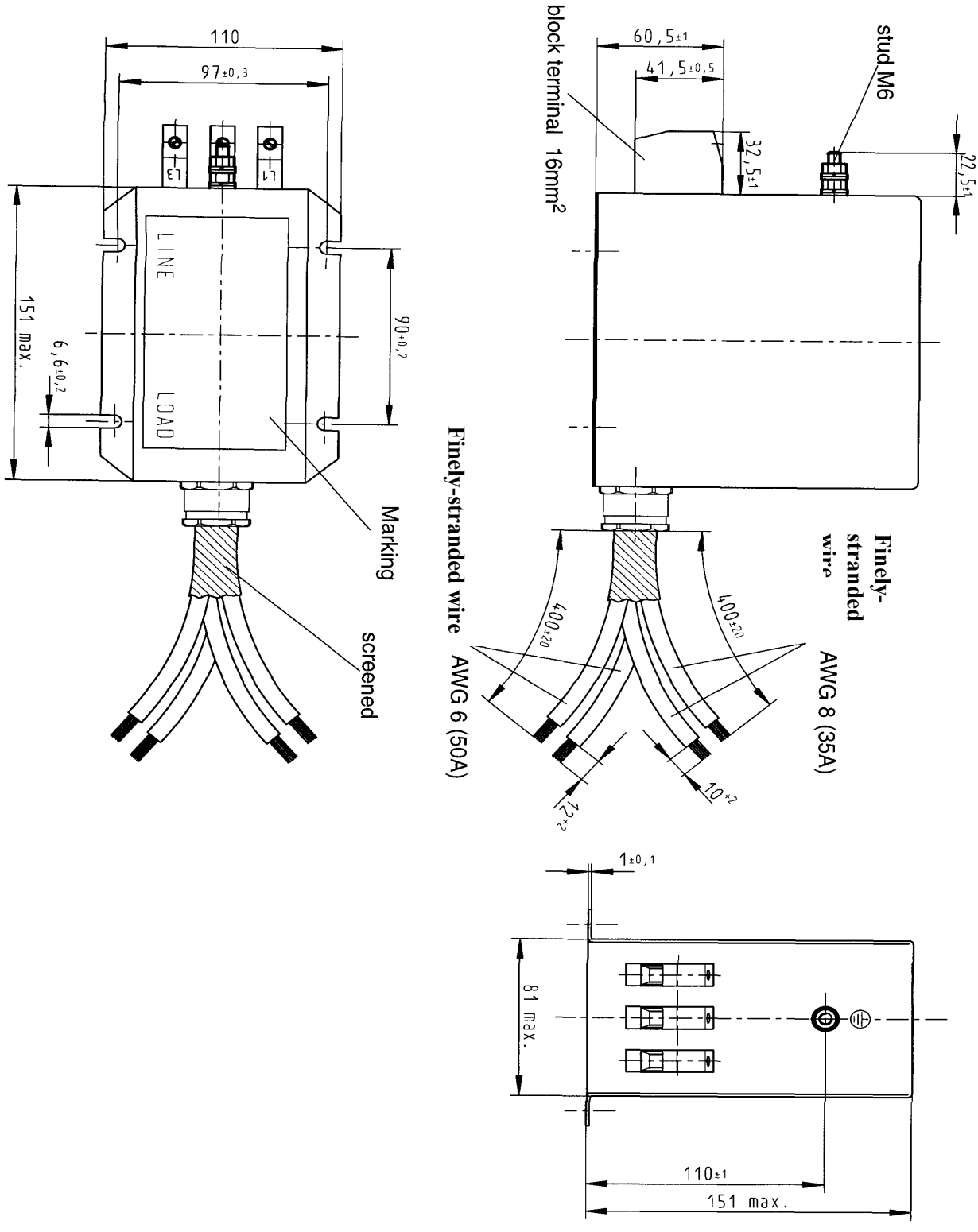
6SE3290-0DC87-0FB4

Radio interference suppression filter, Class B; 3-ph.; 208V – 480V AC+/-10%; 25A; 50/60Hz



6SE3290-0DG87-0FA5

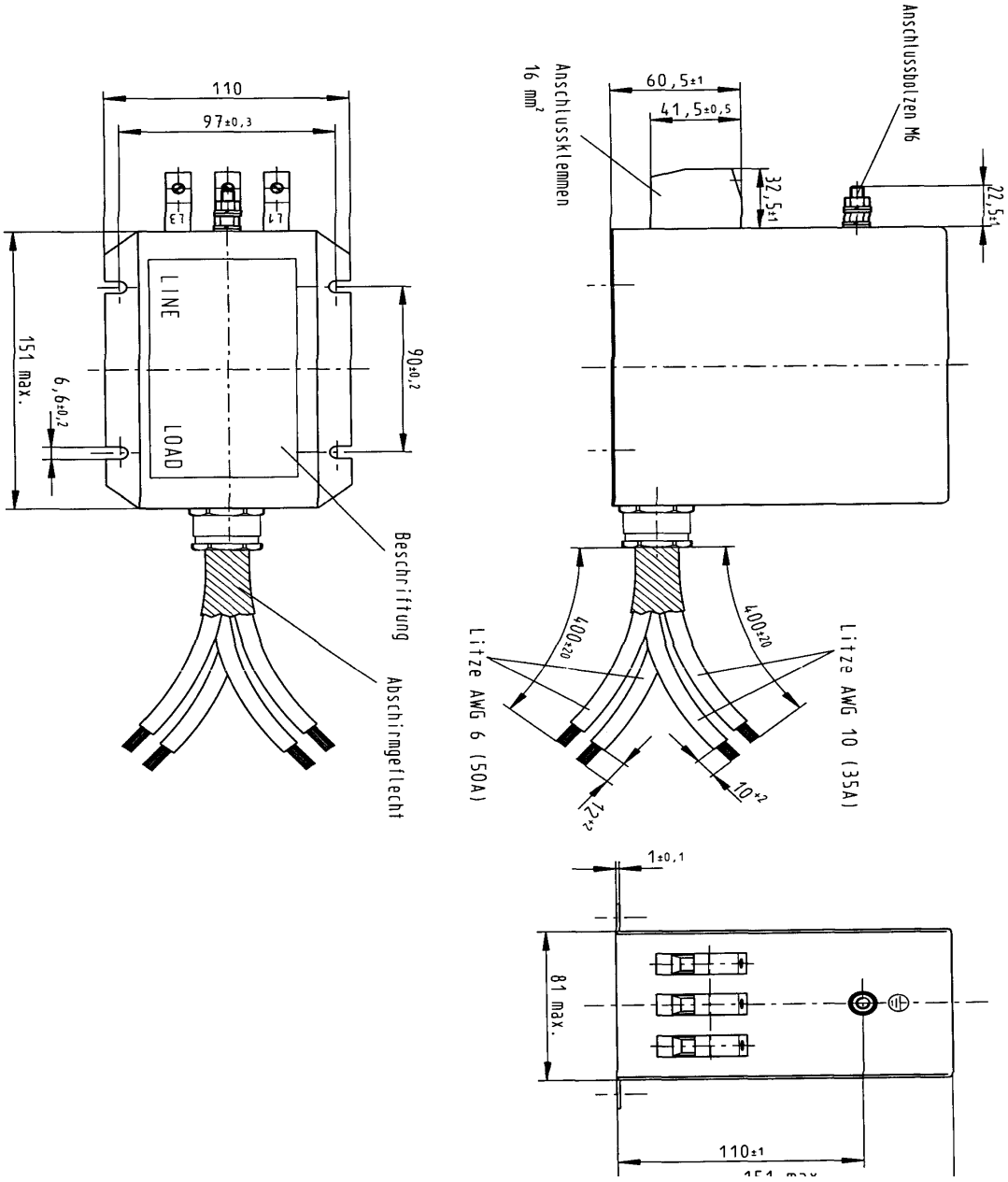
Radio interference suppression filter, Class A; 3-ph.; 208V – 460V AC+/-10%; 34A; 50/60Hz



6SE3290-0DH87-0FA5

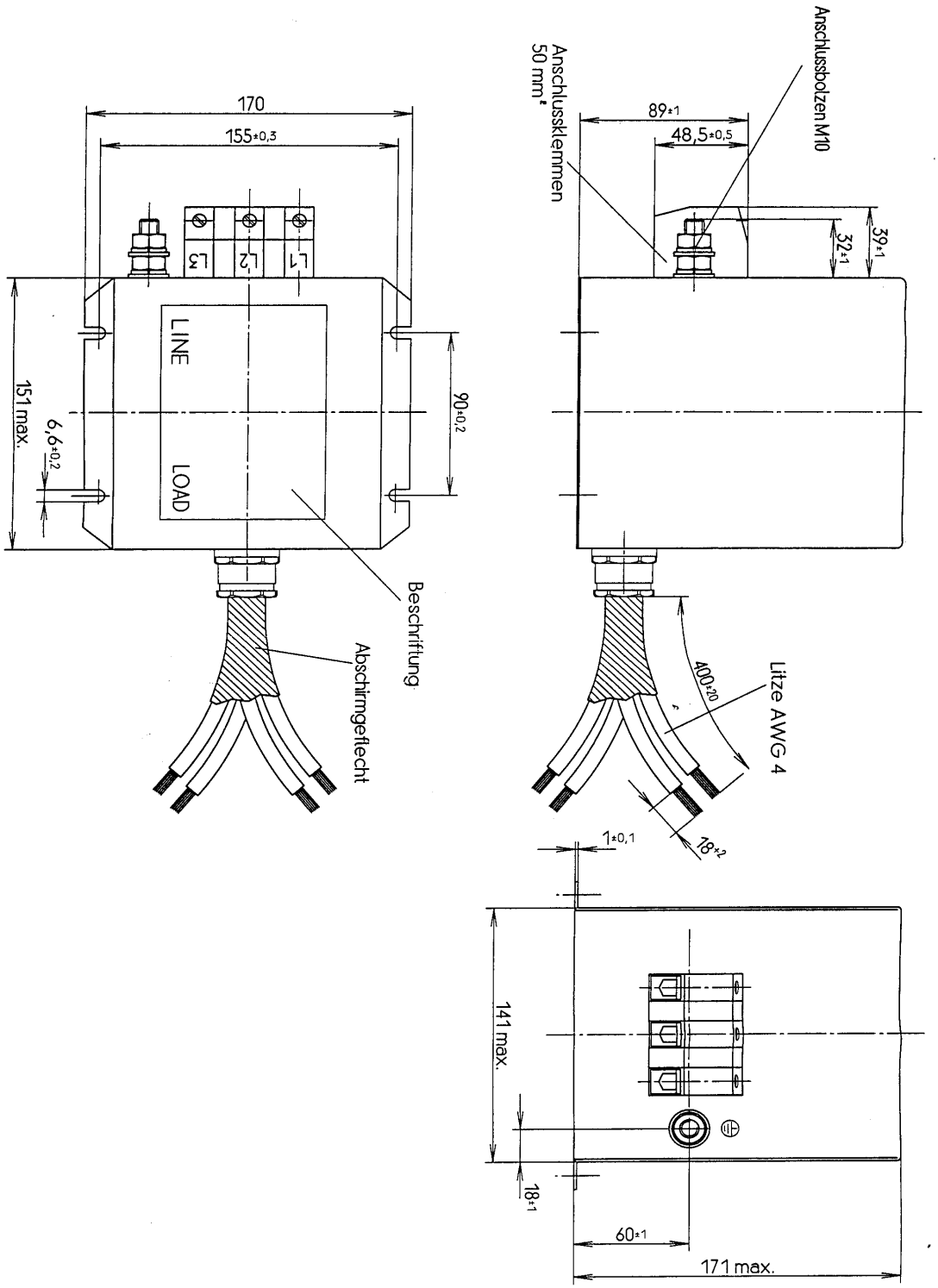
Radio interference suppression filter, Class A; 3-ph.; 208V – 460V AC+/-10%; 49A; 50/60Hz

Anschlussklemme	Terminals
Anschlussbolzen M6	M6 studs
Beschriftung	Labeling
Abschirmgeflecht	Shield braiding
Litze	Finely-stranded wire



6SE3290-0DJ87-0FA6

Radio interference suppression filter, Class A; 3-ph.; 208V – 460V AC+/-10%; 96A; 50/60Hz

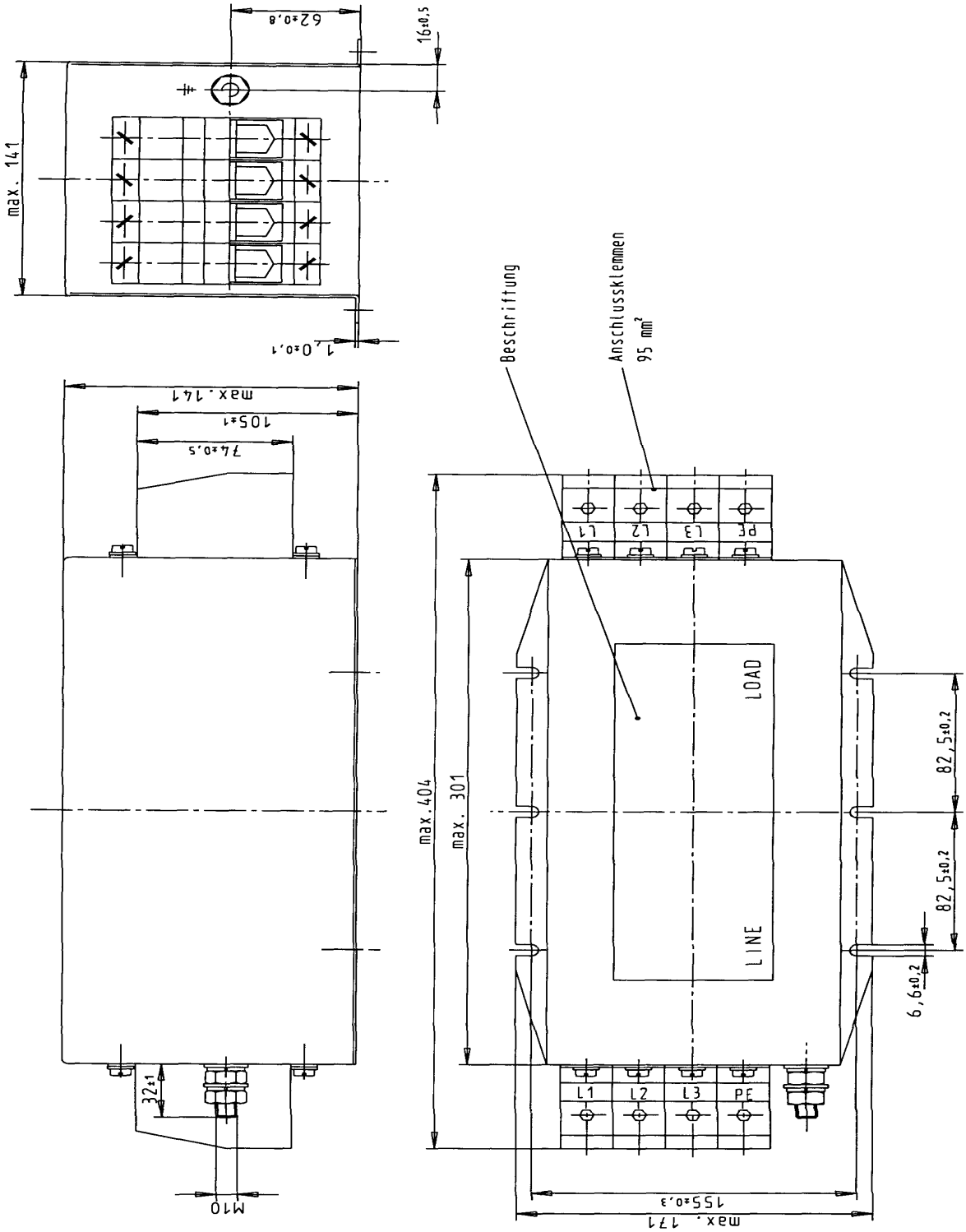


6SE3290-0DK87-0FA7

Radio interference suppression filter, Class A; 3-ph.; 208V – 460V AC+/-10%; 180A; 50/60Hz

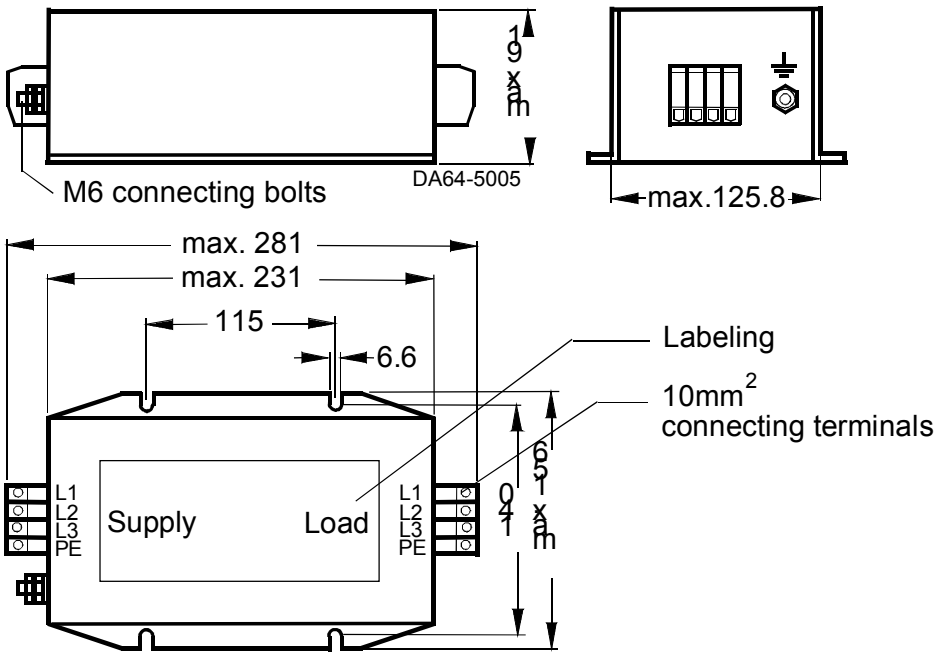
6SE3290-0DK87-0FB7

Radio interference suppression filter, Class B; 3-ph.; 208V – 460V AC+/-10%; 180A; 50/60Hz



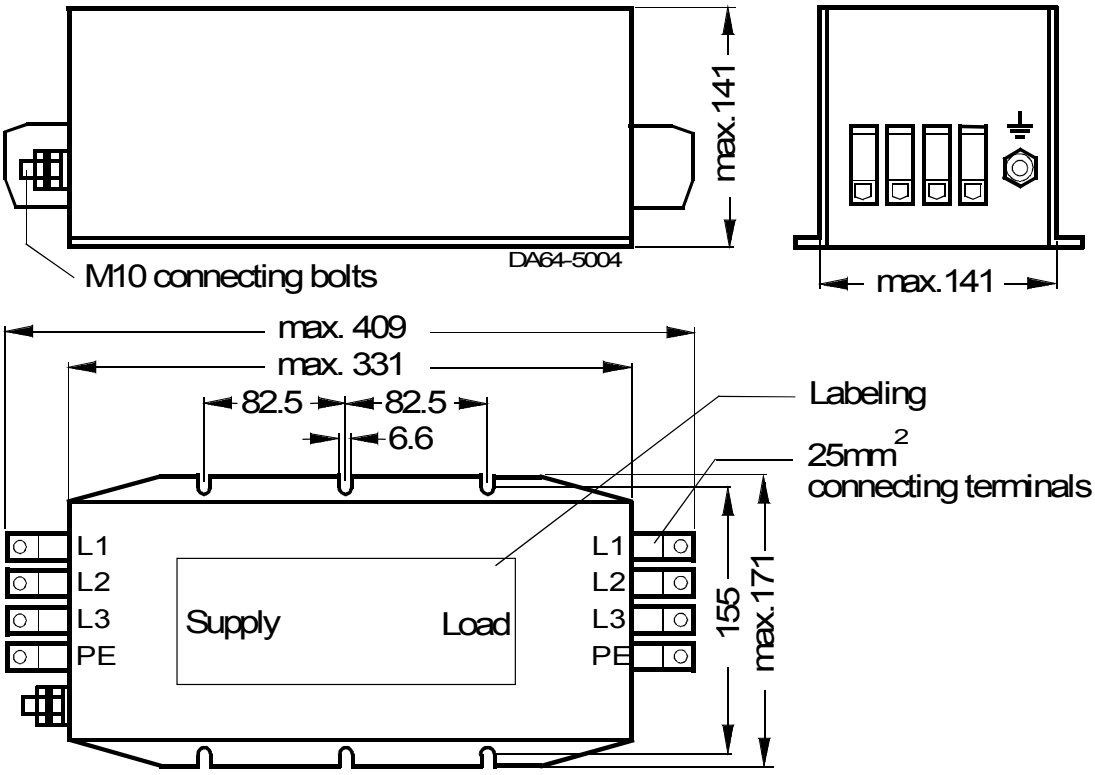
6SE2100-1FC20 EMC input filter, Class B

Radio interference suppression filter, Class B; 3-ph.; 208V – 460V AC+/-10%; 38A; 50/60Hz



6SE2100-1FC21 EMC input filter, Class B

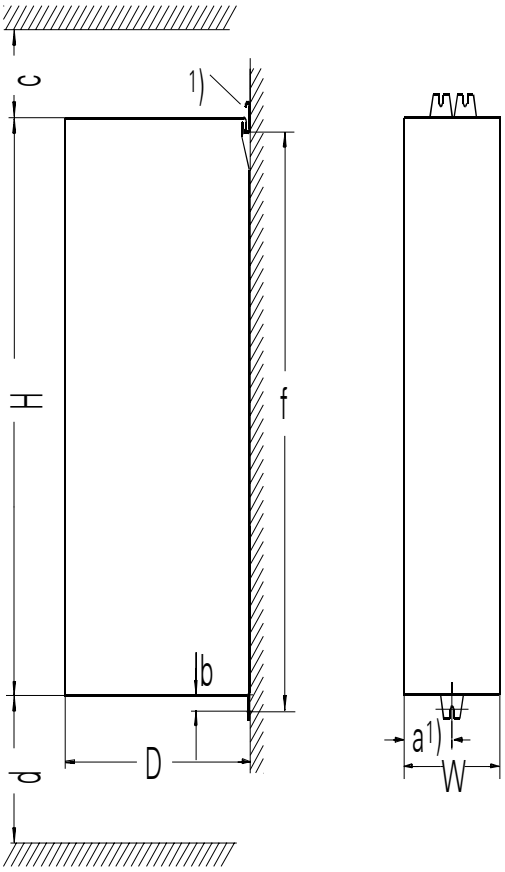
Radio interference suppression filter, Class B; 3-ph.; 208V – 460V AC+/-10%; 75A; 50/60Hz



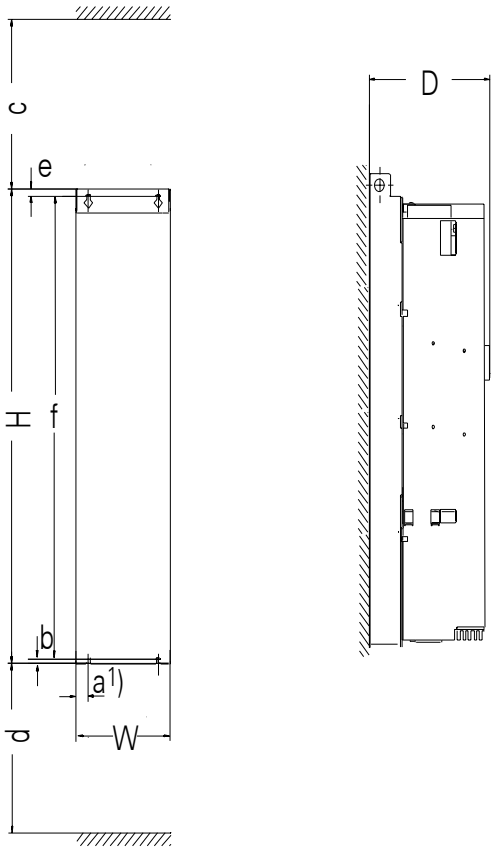
dV/dt output filter

(MASTER DRIVES series)

dV/dt output filter, Sizes B and C



Sizes E



dV/dt output filter

Size	B	C	E
H [mm]	425	600	1050
W [mm]	135	180	250
D [mm]	350	350	350
a [mm]	67.5	90	45 1)
b [mm]	16	16	10
c [mm]	100	100	350
d [mm]	250	250	400
f [mm]	425	600	1025
Weight, approx. [kg]	20	27	55

1) 2 lugs, left and right

f_{max} = 300 Hz

f_{puls} <= 4 kHz

Please refer to DA65.10 for additional details.

dV/dt output filter, Size:

B: 6SE7016-2FB87-1FD0
6SE7021-5FB87-1FD0

C: 6SE7022-2FC87-1FD0
6SE7023-4FC87-1FD0
6SE7024-7FC87-1FD0

E: 6SE7026-0HE87-1FD0
6SE7028-2HE87-1FD0

3.13 Line supply harmonics and line supply impedance

Line supply harmonics
In operation, the drive inverter causes non-sinusoidal line currents with harmonics. These harmonic currents can be reduced by using line reactors.
Line impedance
The ratio between the rated drive power / system fault level should not fall below 1 %. This means, that when the drive inverter is operating at full load, the voltage drop across the line impedance should be less than or equal to 1% of the rated voltage. If the line impedance is below this value (rated drive inverter power / system fault level less than 1%), a line-commutating reactor must be used, as otherwise this could result in a shorter lifetime of the DC link capacitors. The power supply company (power utility company) should be contacted regarding the system fault level or, this may be able to be taken from the rating plate of the upstream transformer.
Voltage and current spikes
Furthermore, line-commutating reactors reduce or smooth voltage and current spikes.

Table showing the non-sinusoidal harmonics caused by the drive inverter.
They are listed as an approximate percentage of 1 %, 2 % and 4 %.

Drive inverter supply voltage	Harmonic No. (1 = basic fundamental)	Current harmonic referred to the basic fundamental, for a 1 % line supply impedance	Current harmonic refer to the basic fundamental, for a 2 % line supply impedance	Current harmonic refer to the basic fundamental, for a 4 % line supply impedance
1-ph. 230 V AC	1	100	100	100
	3	87.9	83.1	76.2
	5	68.2	56.9	41.3
	7	45.5	29.2	14.3
	9	24.2	10.8	6.3
	11	9.1	7.7	6.3
	13	6.1	6.2	3.2
3-ph. 230 V AC (drive inverter <= 22 kW)	1	100	100	100
	5	72.9	56.3	39.4
	7	48.4	31.3	14.7
	11	10.6	6.6	6.9
	13	5.5	6.6	3.4
3-ph. 230 V AC (drive inverter > 22 kW)	1	100	100	100
	5	32	29.2	26.0
	7	9.6	7.9	6.9
	11	7.8	7.0	5.9
	13	3.7	3.6	3.4
3-ph. 400/500 V AC (drive inverter <= 37 kW)	1	100	100	100
	5	72.5	62.0	41.0
	7	52.6	36.7	16.5
	11	17.0	7.4	7.3
	13	7.2	6.2	3.2
3-ph. 400/500 V AC (drive inverter > 37 kW)	1	100	100	100
	5	42.7	37.8	32.6
	7	17.7	13.2	9.2
	11	6.7	7.1	6.9
	13	4.0	3.5	3.3

Calculating a line reactor using an example.

u_K = short-circuit rating of the transformer as a %

S_n = rated apparent transformer rating

S_K = system fault level

u_i = ratio between the drive inverter rated power / system fault level (impedance)

P_U = drive inverter power

[The apparent power of the drive inverter ($S_{drive\ inverter} = \sqrt{3} * V * I_{drive\ inverter}$) can be neglected for this calculation, refer to the values in brackets]

Calculation example: $S_K = (100 / u_K) * P_n$ $u_i = (100\% / S_K) * P_U$

Transformer 1 V = 400V; S_n = 100KVA; u_K = 4%; drive inverter MDV 45000/3 =45KW (~ 58KVA)

$S_K = (100\% / u_K) * P_n = (100\% / 4\%) * 100KVA = 2500KVA$

$u_i = (100\% / S_K) * P_U = (100\% / 2500) * 45 = \underline{1.8\%}$ (~ 2.3%) In this case, a line reactor is not required

Transformer 2 V = 400V; S_n = 500KVA; u_K = 4%; drive inverter MDV 45000/3 =45KW (~ 58KVA)

$S_K = (100\% / u_K) * S_n = (100\% / 4\%) * 500KVA = 12500KVA$

$u_i = (100\% / S_K) * P_U = (100\% / 12500) * 45 = \underline{0.36\%}$ (~ 0.4%) In this case, a line reactor is required

3.14 Technical data & dimensions for line reactors & output reactors

Line reactors, MICROMASTER

Order No. [MRPD]	Enclos-ure size	Curr-ent	Voltage	Weight	
6SE6400-3CC00-4AB0	FSA	4A	1-ph. 200V - 240V AC+/-10%	0.5Kg	
6SE6400-3CC01-0AB0	FSA	10A	1-ph. 200V - 240V AC+/-10%	0.6Kg	
6SE6400-3CC00-3AC0	FSA	3A	3-ph. 200V - 240V AC+/-10%	0.6Kg	
6SE6400-3CC00-2AD0	FSA	2A	3-ph. 200V - 240V AC+/-10%	0.6Kg	
6SE6400-3CC00-5AC0	FSA	5A	3-ph. 200V - 240V AC+/-10%	0.6Kg	
6SE6400-3CC00-4AD0	FSA	4A	3-ph. 380V - 480V AC+/-10%	0.8Kg	
6SE6400-3CC00-6AD0	FSA	6A	3-ph. 380V - 480V AC+/-10%	0.6Kg	
6SE6400-3CC00-8BC0	FSB	8A	3-ph. 200V - 240V AC+/-10%	1.0Kg	
6SE6400-3CC01-4BD0	FSB	14A	3-ph. 200V - 240V AC+/-10%	1.3Kg	
6SE6400-3CC02-6BB0	FSB	26A	3-ph. 200V - 240V AC+/-10%	1.2Kg	
6SE6400-3CC01-0BD0	FSB	10A	3-ph. 380V - 480V AC+/-10%	1.2Kg	
4EM4704-3CB	FSC	18A	1-ph. 200V - 240V AC+/-10%	0.7Kg	For more details, please refer to Catalog PD30 2001
4EM4807-8CB	FSC	25A	1-ph. 200V - 240V AC+/-10%	1.0Kg	
4EM4912-2CB	FSC	18A	1-ph. 200V - 240V AC+/-10%	1.8Kg	
4EM4912-5CB	FSC	25A	1-ph. 200V - 240V AC+/-10%	2.0Kg	
4EP3400-1US	FSC	11.2A	3-ph. 200V - 240V AC+/-10%	0.7Kg	
4EP3500-0US	FSC	16A	3-ph. 200V - 240V AC+/-10%	1.0Kg	
4EP3600-4US	FSC	18A	3-ph. 200V - 240V AC+/-10%	1.8Kg	
4EP3400-1US	FSC	11.2A	3-ph. 380V - 460V AC+/-10%	1.4Kg	
4EP3500-0US	FSC	16A	3-ph. 380V - 460V AC+/-10%	1.9Kg	
4EP3600-4US	FSC	18A	3-ph. 380V - 460V AC+/-10%	2.5Kg	
4EM4807-6CB (3 x)	FSC	14A	3-ph. 380V - 460V AC+/-10%	1.1Kg	
4EP3700-7US	FSC	18A	3-ph. 380V - 460V AC+/-10%	3.3Kg	
4EP3801-0US	FSC	22.4A	3-ph. 380V - 460V AC+/-10%	3.8Kg	
4EP3600-8US	FSC	12.5A	3-ph. 460V - 500V AC+/-10%	2.3Kg	
4EP3600-2US	FSC	16A	3-ph. 460V - 500V AC+/-10%	2.5Kg	
4EP3800-8US	FSC	22.4A	3-ph. 460V - 500V AC+/-10%	5.0Kg	

Dimensions for 6SE... line reactors

Enclos-ure size	Enclosure dimensions (mm)						Dimensions, mounting holes (mm)						Thread size
	A	B	C	D	E	F	G	H	I	J	K	L	
FSA	200	75.5	50	200	73	-	-	160	187	56	-	-	M4 (2)
FSB	213	150	50	213	150	-	138	174	120	200	-	-	M4 (4)
FSC	-	-	-	-	-	-	-	-	-	-	-	-	-

MICROMASTER output reactors **

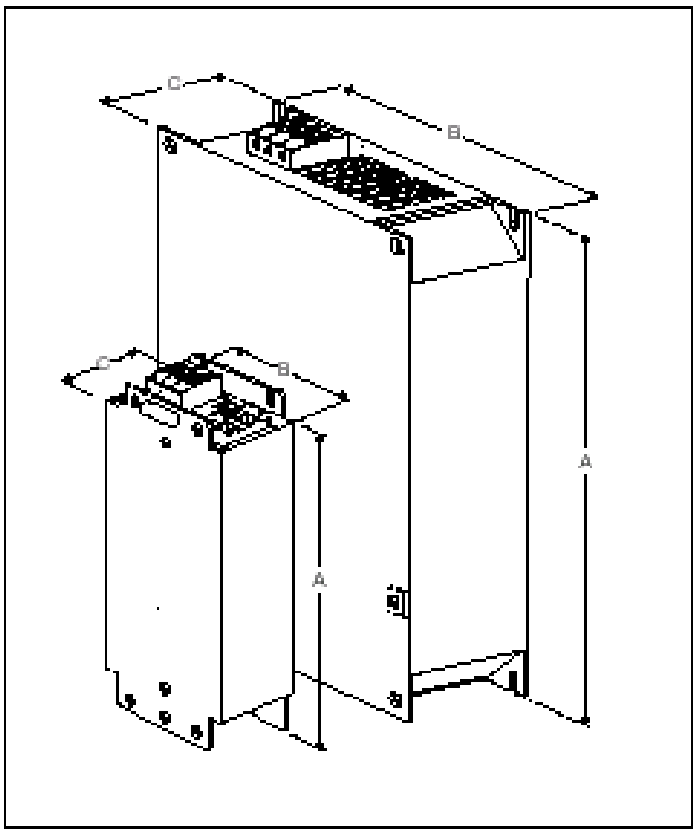
Order No. [MRPD]	Enclos-ure size	Curr-ent	Voltage	Weight	
6SE6400-3TC00-4AD0	FSA	4A	3-ph. 200V - 480V AC+/-10%	0.8Kg	
6SE6400-3TC01-0BD0	FSB	10A	3-ph. 200V - 480V AC+/-10%	3.4Kg	
6SE3200-3TC03-2CD0	FSC	32A	3-ph. 200V - 480V AC+/-10%	5.6Kg	

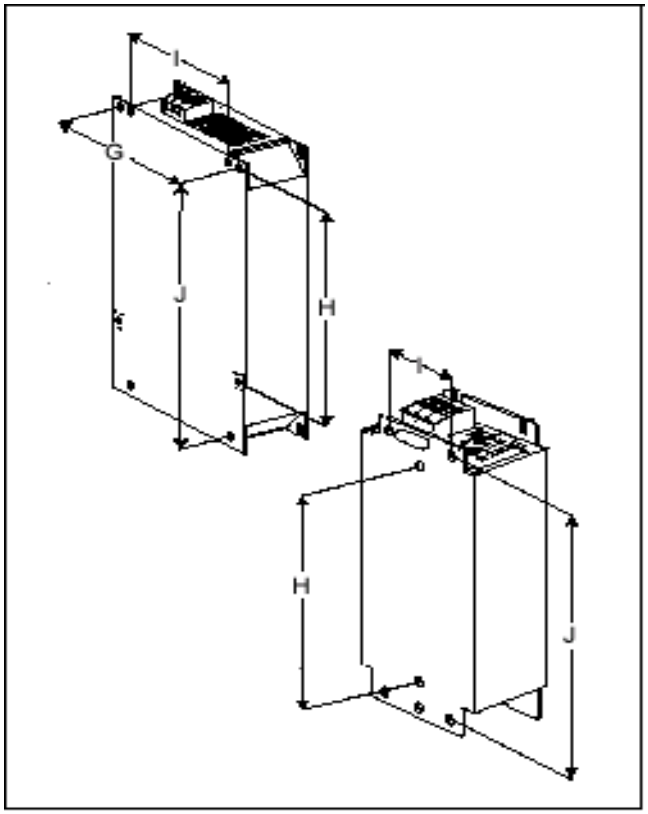
Dimensions for 6SE... output reactors

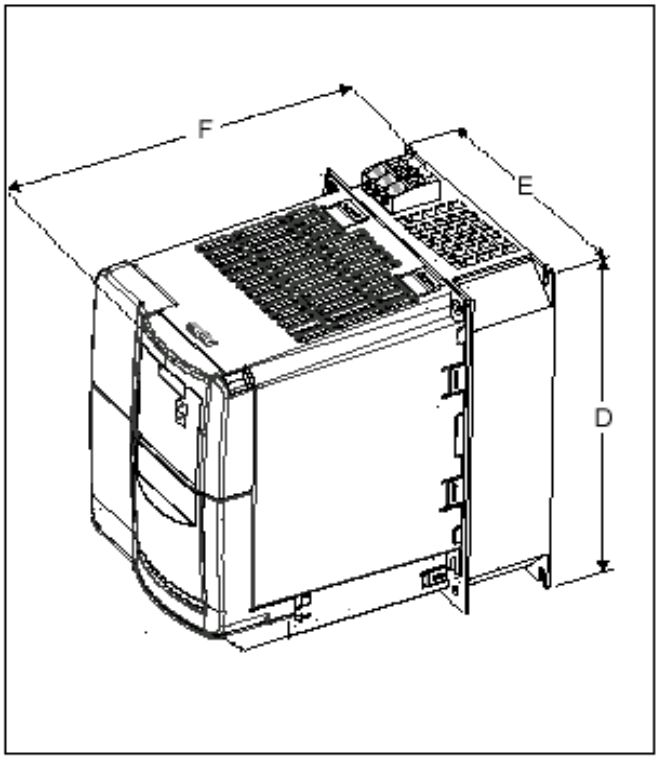
Enclos-ure size	Enclosure dimensions (mm)						Dimensions, mounting holes (mm)						Thread size
	A	B	C	D	E	F	G	H	I	J	K	L	
FSA	200	75.5	50	200	75.5	199	-	160	56	187	-	-	M4 (2)
FSB	213	150	70	213	150	219	138	174	120	200	-	-	M4 (4)
FSC	245	185	80	245	185	229	174	204	156	232	-	-	M5 (6)

** For 230V units, the pulse frequency must be reduced from 16KHz (factory setting) to 4kHz (P076)

Schematic diagram of the 6SE... reactor enclosure





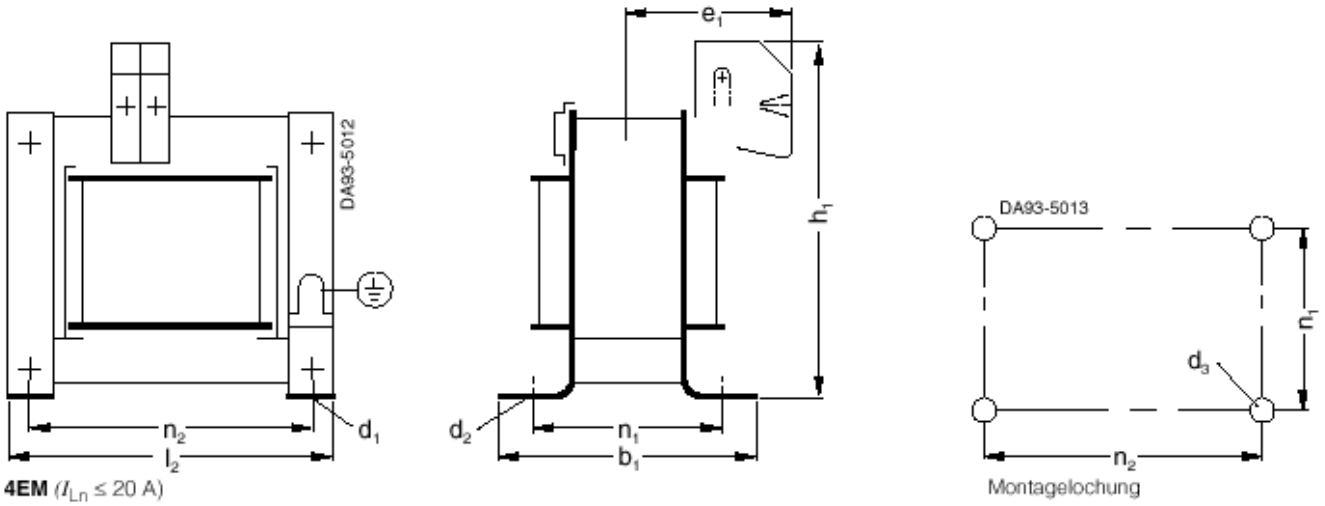


Technical data for line reactors 4E...

Please refer to Catalog PD30 2001 for more details

3-phase line supply reactors 4EM... dimensions with terminals for any reactor arrangement

I_{Ln} up to 40A



4EM ($I_{Ln} \leq 20$ A)

Mounting holes

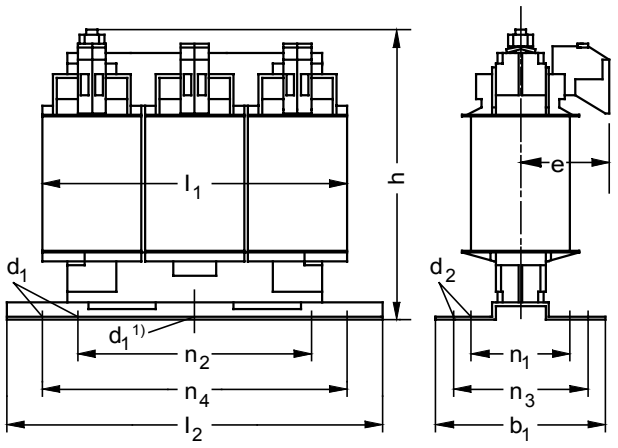
Type	Rated AC currents I_{Ln}	b1	d1	d2	d3	e1 max	h1 max	l2 max	n1	n2
All dimensions in mm										
4EM46	To 40 A	51	3.6	7	M3	53.0	85.0	61	39	50.0
4EM47	To 40 A	60	4.8	9	M4	54.0	89.0	67	45	55.0
4EM48	To 40 A	69	4.8	9	M4	56.5	98.0	79	53	65.0
4EM49	To 40 A	85	4.8	9	M4	65.0	103.0	85	69	70.0
4EM50	To 40 A	97	5.8	11	M5	66.0	111.5	97	77	80.0
4EM51	To 40 A	111	5.8	11	M5	73.0	111.5	97	91	80.0
4EM52	To 40 A	115	5.8	11	M5	70.5	131.0	121	92	100.0
4EM61	To 40 A	110	5.8	11	M5	73.5	118.0	106	92	87.5

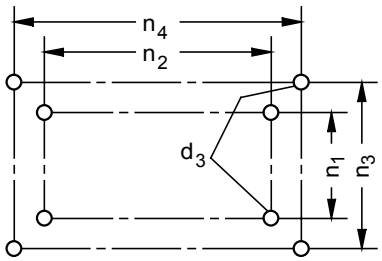
4EM (*I* Ln __20 A)
8WA9200 terminal
Cross-sect.: solid: 0.5 mm 2 to 6 mm 2
finely-stranded: 1.5 mm 2 to 4 mm 2

4EM (*I* Ln 22.4 A to 40 A)
RKW 110 or TRKSD 10 terminal
Cross-sect.: solid: 1 mm 2 to 16 mm 2
finely-stranded: 1 mm 2 to 10 mm 2

3-phase line supply reactors 4EP... dimensions with terminals for any reactor arrangement

I_{Ln} = 35.5 A





n_3 and n_4 mounting holes according to EN 60852-4

n_1 and n_2 mounting holes according to DIN 41308

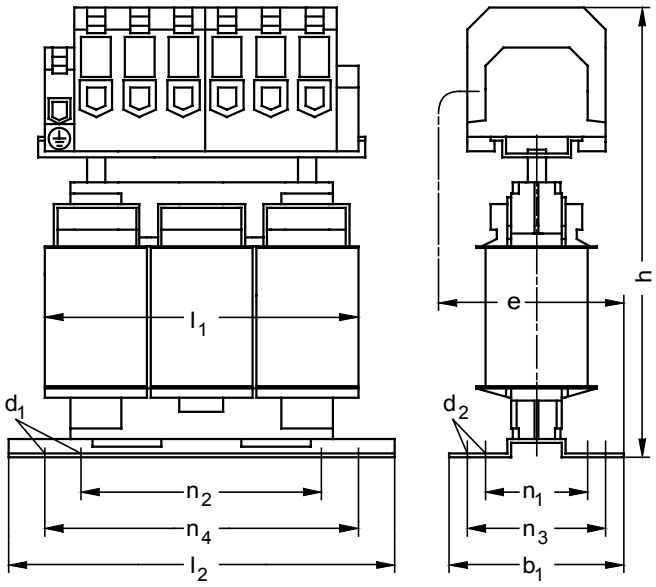
Three-phase line reactor Type	b_1 max. mm	d_1 mm	D_2 Mm	d_3 mm	e max. mm	h max. mm	l_1 max. mm	l_2 max. mm	n_1 ± IT12 mm	n_2 ± IT12 mm	n_3 ± IT12 mm	n_4 ± IT12 mm
4EP32	57.5	4.8	9	M4	56	108	78	88.5	34	1)	42.5	79.5
4EP33	64	4.8	9	M4	55	122	96	124	33	1)	44	112
4EP34	73	4.8	9	M4	59	122	96	124	42	1)	53	112
4EP35	68	4.8	9	M4	57	139	120	148	39	90	48	136
4EP36	78	4.8	9	M4	62	139	120	148	49	90	58	136
4EP37	73	5.8	11	M5	60	159	150	178	49	113	53	166
4EP38	88	5.8	11	M5	67	159	150	178	64	113	68	166
4EP39	99	7	13	M6	62	181	182	219	56	136	69	201
4EP40	119	7	13	M6	72	181	182	219	76	136	89	201

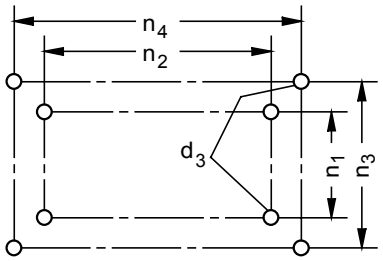
Retaining slot at the center of the foot

Terminal 8WA9200 (for $I_{Ln} \leq 15$ A)	Cross-sections:	solid	0.5 mm² to 6.0 mm²
		finely-stranded	1.5 mm² to 4.0 mm²
Terminal RKW 110 or TRKSD 10	Cross-sections:	solid	1.0 mm² to 16.0 mm²
(for I_{Ln} 16 A to 35.5 A)		finely-stranded	1.0 mm² to 10.0 mm²

3-phase line supply reactors 4EP... dimensions with terminals for any reactor arrangement

I_{Ln} 36 A to 50 A





n_3 and n_4 mounting holes according to EN 60852-4

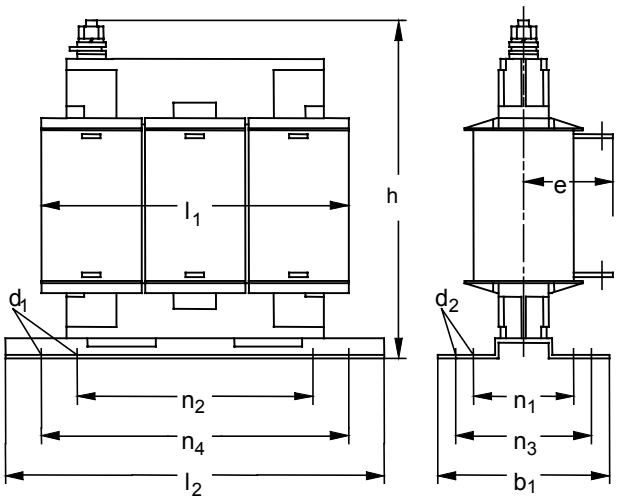
n_1 and n_2 mounting holes according to DIN 41308

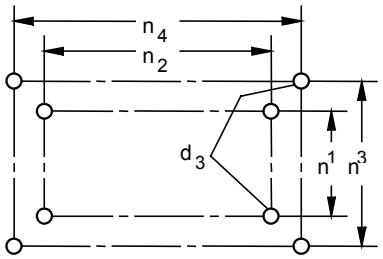
Three-phase line reactor Type	b_1 max. mm	d_1 mm	D_2 Mm	d_3 mm	e max. mm	h Max. mm	l_1 max. mm	l_2 max. mm	n_1 ± IT12 mm	n_2 ±IT12 mm	n_3 ±IT12 mm	n_4 ±IT12 mm
4EP38	88	5.8	11	M5	86	193	150	178	64	113	68	166
4EP39	99	7	13	M6	91.5	220	182	219	56	136	69	201
4EP40	119	7	13	M6	101.5	220	182	219	76	136	89	201

Terminal 8WA1304 (for I_{Ln} 40 A to 50 A)	Cross-sections:	solid	1.0 mm² to 16.0 mm²
		multi-stranded	10.0 mm² to 25.0 mm²
		finely-stranded	2.5 mm² to 16.0 mm²
Associated ground terminal, EK 16/35		solid	2.5 mm² to 16.0 mm²
		finely-stranded	4.0 mm² to 16.0 mm²

3-phase line supply reactors 4EP... dimensions with flat connector for any reactor arrangement

I_{Ln} = 51 A

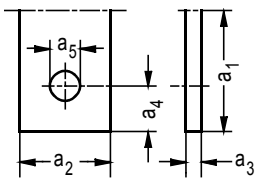




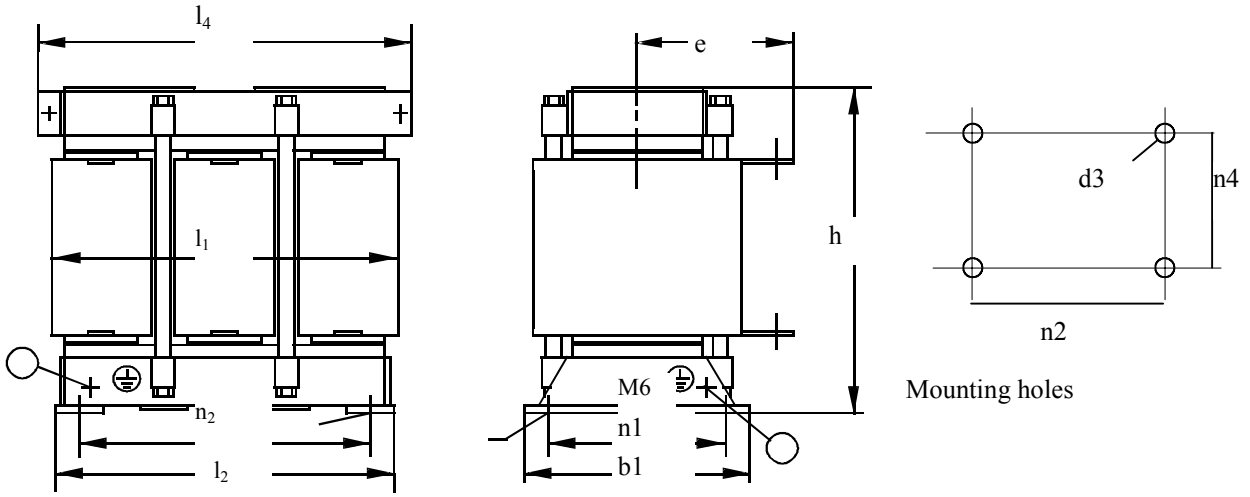
n_3 and n_4 mounting holes according to EN 60852-4

n_1 and n_2 mounting holes according to DIN 41308

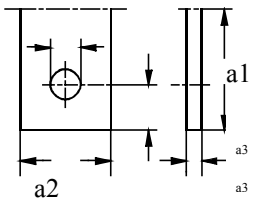
Three-phase line reactor Type	b_1 max. mm	d_1 mm	d_2 Mm	d_3 mm	e max. mm	H Max. Mm	l_1 max. mm	l_2 max. mm	N_1 ±IT12 Mm	n_2 ±IT12 mm	n_3 ±IT12 mm	n_4 ±IT12 mm
4EP38	88	5.8	11	M5	76	153	150	178	64	113	68	166
4EP39	99	7	13	M6	73	179	182	219	56	136	69	201
4EP40	119	7	13	M6	83	179	182	219	76	136	89	201

Flat connector	Rated current I_{Ln} A	a_1 mm	a_2 mm	a_3 mm	a_4 Mm	a_5 mm
	51 to 80	30	20	3	10	9
	81 to 200	35	25	5	12.5	11

Three-phase line reactors 4EU... dimensions with flat connectors, for mounting reactors onto horizontal surfaces



Three-phase line reactor Type	b_1 max. mm	d_1 mm	D_2 Mm	d_3 mm	e max. mm	H Max. Mm	l_1 max. mm	l_2 max. mm	l_4 max. mm	n_1 +/- IT12 mm	n_2 +/- IT12 mm	① ②
4EU24	104	7	13	M6	80	220	219	206	196	70	176	M6
4EU25	128	7	13	M6	97	220	219	206	196	94	176	M6
4EU27	146	10	18	M8	114	250	255	235	280	101	200	M6
4EU30	155	10	18	M8	116	280	285	264	310	118	224	M6
4EU36	169	10	18	M8	180	335	345	314	360	138	264	M6
4EU39	174	12	18	M10	197	385	405	366	410	141	316	M6
4EU43	194	15	22	M12	212	435	458	416	460	155	356	M6
4EU45	221	15	22	M12	211	435	458	416	460	182	356	M6
4EU47	251	15	22	M12	231	435	458	416	460	212	356	M6
4EU50	195	12.5	12.5	M10	220	565	533	470	518	158	410	M12
4EU52	220	12.5	12.5	M10	242	565	533	470	518	183	410	M12

Flat connector	Rated current I_{Ln} A	a_1 mm	a_2 mm	a_3 mm	a_4 mm	a_5 mm	a_6 mm	a_7 mm
	45 to 80	30	20	3	10	9	-	-
	81 to 200	35	25	5	12.5	11	-	-
	201 to 315	40	30	6	15	14	-	-
	316 to 800	50	40	6	20	14	-	-
	801 to 1000	50	40	8	20	14	-	-

MIDIMASTER output reactors**

Order No. [MRPD]	Enclos-ure size	Curr-ent	Voltage	Weight	
4EP3700-5DS	FS4	50A	3-ph. 200V - 480V AC +/- 10%	3.3Kg	MDV550/2
6SE6400-3TC02-8DC0	FS4	28A	3-ph. 200V - 480V AC +/- 10%	1.3Kg	MDV750/2
6SE6400-3TC05-4DD0	FS5	54A	3-ph. 200V - 480V AC +/- 10%	10.7Kg	
6SE6400-3TC08-0ED0	FS6	80A	3-ph. 200V - 480V AC +/- 10%	10.4Kg	
6SE6400-3TC15-4FD0	FS7	154A	3-ph. 200V - 480V AC +/- 10%	11.2Kg	
6SE7022-2FS87-1FE0* **	FS4	25.5A	3-ph. 500V - 575V AC +/- 10%	25.0Kg	
6SE6400-3TC02-2DE0	FS5	22A	3-ph. 500V - 600V AC +/- 10%	1.2Kg	
6SE6400-3TC02-7DE0	FS5	27A	3-ph. 500V - 600V AC +/- 10%	2.5Kg	
6SE6400-3TC03-2DE0	FS6	32A	3-ph. 500V - 600V AC +/- 10%	16.0Kg	
6SE6400-3TC05-2EE0	FS7	52A	3-ph. 500V - 600V AC +/- 10%	3.3Kg	

Dimensions

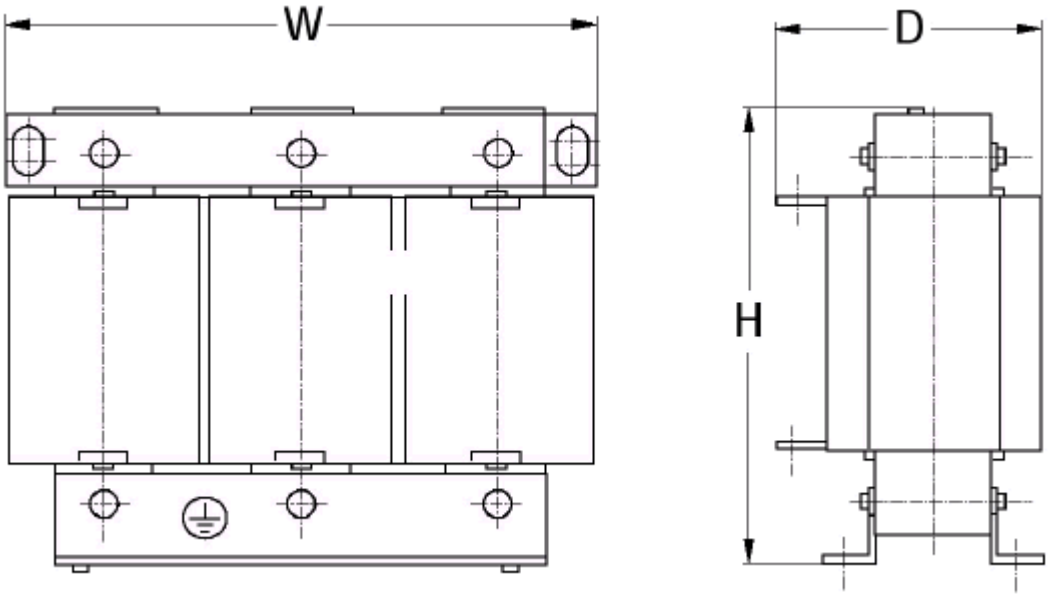
Order No. [MRPD]	Reactor dimensions (mm)			Dimensions mounting holes (mm)				Thread size
	H	B (W)	T (D)	N1	N2	N3	N4	
6SE6400-3TC02-8DC0	122	124	73	42	*	53	112	M4
6SE6400-3TC05-4DD0	210	225	150	76	176	-	-	M6
6SE6400-3TC08-0ED0	210	225	150	76	176	-	-	M6
6SE6400-3TC15-4FD0	210	225	150	76	176	-	-	M6
6SE7022-2FS87-1FE0* **	220	207	128	***				M6
6SE6400-3TC02-2DE0	122	124	73	42	*	53	112	M4
6SE6400-3TC02-7DE0	139	148	78	49	90	58	136	M4
6SE6400-3TC03-2DE0	210	225	179	76	176	-	-	M6
6SE6400-3TC05-2EE0	159	178	73	49	113	53	166	M5

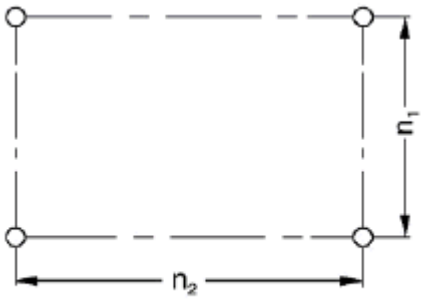
* Retaining slot at the center of the foot

** For 230V drive units, the pulse frequency must be reduced from 16KHz (factory setting) to 4kHz (P076)
For output reactors 4E... the maximum output frequency (f_{max}) is 120Hz

*** FMAX = 300HZ, FP = 3KHZ; for more detailed information, refer to DA65.10

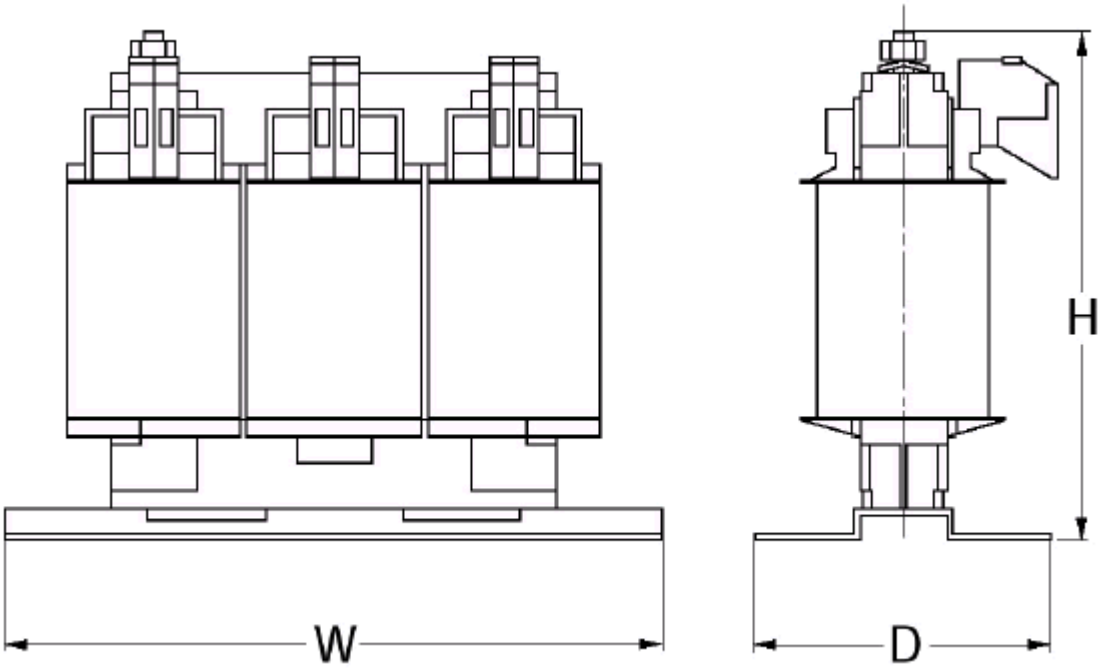
Schematic diagram, output reactor 6SE... type 1

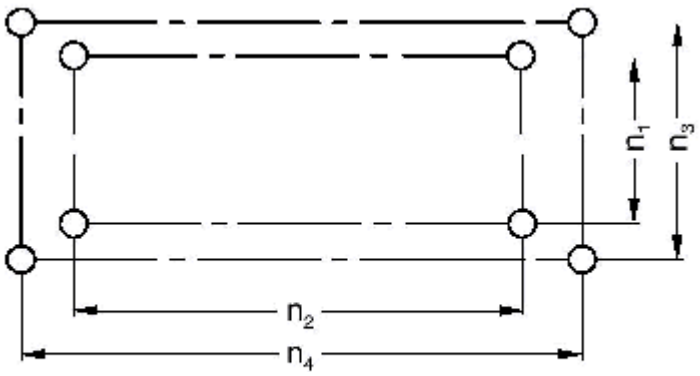




Mounting holes

Schematic diagram, output reactor 6SE... type 2



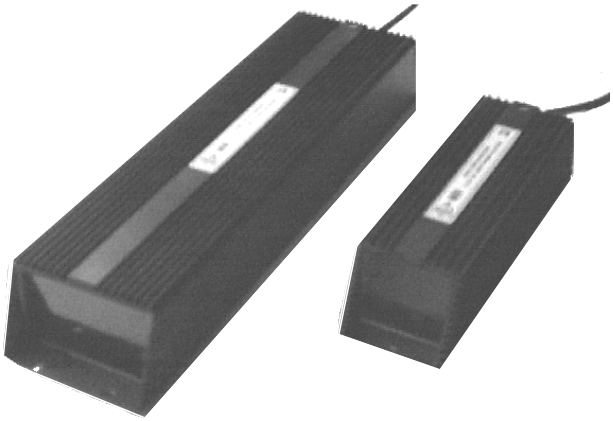


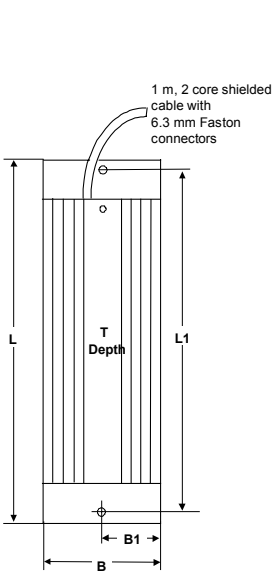
n1 and n2, mounting holes according to DIN 41308
n3 and n4, mounting holes according to EN60852-4

3.15 MICROMASTER Vector braking resistors

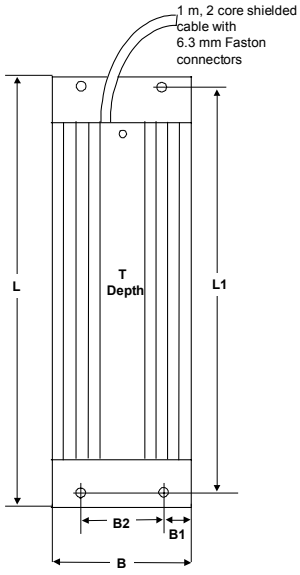
These braking resistors are used with the MICROMASTER Vector drive inverters. They enable high inertia loads to be quickly decelerated. When the motor and load decelerate, the excess energy is fed back to the drive inverter and is stored in the DC link capacitors. This causes the DC link voltage to increase. The drive inverter is shutdown (tripped) when this DC link voltage exceeds a specific value. The drive inverter dissipates the excess energy in the externally mounting braking resistor.

The resistor case is manufactured out of extruded aluminum to dissipate the heat generated when braking/decelerating.





Mounting holes: 2 x 5.5 mm



Mounting holes: 4 x 5.5 mm

The resistors must be installed in a vertical position and secured to a metal surface (> 0.5 m^2) using two/four M5 screws.
They are cooled by convection so that a minimum 100 mm clearance must be provided above and below the components to allow an unimpeded air flow. The resistor must be mounted at least 50 mm from the side of the inverter to prevent the units from being overheated.

The thermal cut-out switch, supplied with the braking resistor, should be mounted directly onto the resistor body.

Resistor Order No.	Continuous rating W	Peak power (5% duty cycle) W	Resistance (tol. ± 10%) Ω	Peak voltage DC V	Dimensions L mm	L1 mm	W mm	W1 mm	W2 mm	D mm	Weight kg	Inverter type
6SE3290-0CA87-2RA0	40	800	200	450	200	190	57	28	-	54	1.3	MMV12 - MMV75 MMV12/2 - MMV75/2
6SE3290-0CB87-2RA0	80	1600	100		280	271	57	28	-	54	1.7	MMV110 - MMV150 MMV110/2 - MMV150/2
6SE3290-0CC87-2RA0	200	4000	40		338	330	80	20	40	54	3.1	MMV220 - MMV300 MMV220/2 - MMV400/2
6SE3290-0DA87-2RA0	80	1600	400	900	280	270	57	28	-	54	1.7	MMV37/3 -MMV150/3
6SE3290-0DB87-2RA0	150	3000	200		280	271	83	23	40	54	2.5	MMV220/3 - MMV300/3
6SE3290-0DC87-2RA0	400	7500	85		400	390	103	28	40	52	3.8	MMV400/3 - MMV750/3

When braking, the inverter dissipates the braking energy of the motor and load to the externally mounted resistor. The lower the value of the external resistor, then the greater the braking power. The resistors are able to dissipate large amounts of energy for short periods, but when used continuously, the rating is considerably less. Standard braking resistors are designed for a 5% load duty cycle. To protect the resistor and the inverter from overload, the MICROMASTER Vector 'Braking chopper' (P070) limits the duty cycle (ratio of "Time ON" to "Time OFF") to 5% (12 seconds in 4 minutes!). This reduces the maximum dissipation level of the resistor.

The resistor must be adequately rated to withstand the resulting power dissipation. However, it may not have less than 40Ω for 230V and 80Ω for 400V drive units. It must also be ensured that the resistor has the required voltage strength. If an unsuitable resistor is used, this could be destroyed as a result of the pulsed voltage.

3.16 Electronic braking module (EBU) and braking resistors for MIDIMASTER Vector

The kinetic energy of the motor and load is fed back into the drive inverter when using the optional electronic braking module (EBU) and braking resistor. It is then converted into heat in the external braking resistors which significantly improves the braking effect. The DC link voltage increases during regenerative operation, whereby the electronic braking module and the braking resistor limit this increase.

A reference voltage is established from the line supply voltage. This is compared with the DC link voltage, derived in the inverter. If the DC link voltage is excessively high (which occurs during regenerative braking), the circuit-breaker (of the EBU) is tripped and the voltage is reduced by dissipating some of the energy in the external resistors (energy from the DC link). The continuous rated power of the braking resistors is 10 % of the peak power. The minimum permissible resistance value for a maximum power of the individual brake modules is listed in the following tables. The switch-on duration of the circuit-breaker (of the EBU) is limited to approx. 10 % (typically 5 s ON, 45 s OFF!), in order to protect the external resistors from excessive energy dissipation.

The electronic braking modules (EBU) should be mounted directly next to the MIDIMASTER Vector and connected to the DC link and the braking resistor using short, shielded connecting cables.

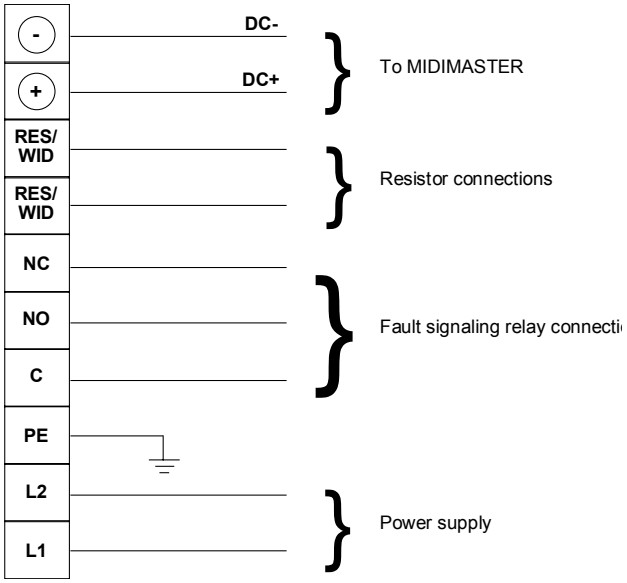
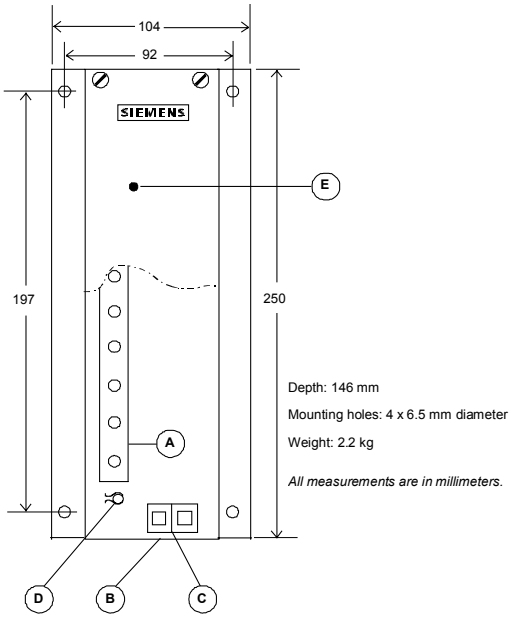


Fig. 2 - Terminal block diagram of the electronic braking module (EBU)



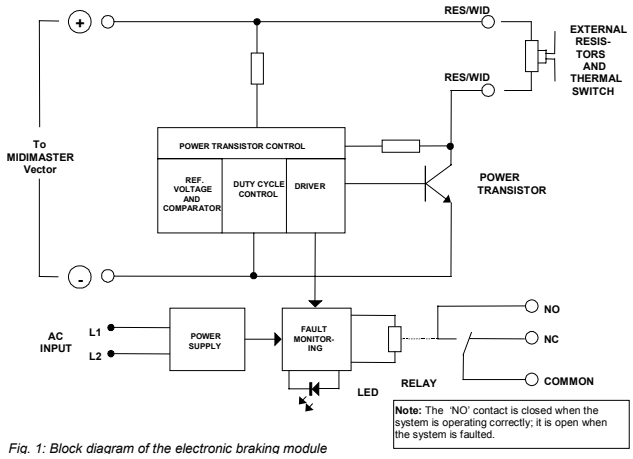


Fig. 1: Block diagram of the electronic braking module

Fig. 3 – Block diagram of the electronic braking module with external braking resistor

EBU technical data

Ambient temperature:	0 to 40 °C
Storage/transport temperature:	-30 to +85 °C
Degree of protection of the EBU:	IP20
Degree of protection of the ext. braking resistors:	IP20
Air humidity (moisture condensation is not permissible):	0 to 95 %

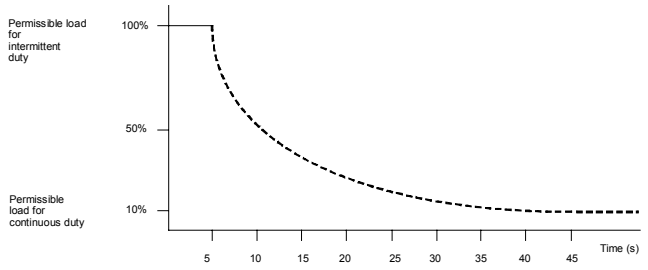


Fig. 4 - Cycle diagram for the electronic braking module

Resistor type	A	B	D	E
Dimensions L x W x D (mm)	560 x 185 x 150	560 x 365 x 150	560 x 365 x 150	495 x 425 x 300
MIDIMASTER Vector line supply voltage (V)	208 - 240	208 - 240	380 - 500	380 - 500
Resistance (Ω)	20	10	40	20
Surge power (kW)	7.5	15	15	30
Average power (kW)	1.25	2.5	2.5	5
Order No.	**6SE3213-6SP87-0RA0**	**6SE3221-4SP87-0RA0**	**6SE3214-0TP87-0RA0**	**6SE3222-4TP87-0RA0**

While braking, the electronic braking module discharges the energy of the motor and load into the external power resistors. The lower the value of the external resistor, than the higher the braking power. The resistors can discharge a significant amount of energy for a short period of time. However, if they are continually used, then the amount of energy which can be discharged is significantly lower. In order to protect the resistors against overload, the EBU limits its own operating cycle (the ratio between the ON time and the OFF time) to 10 %. This means that the maximum discharge power is reduced to the value shown in Fig. 3.

Drive inverter	EBU		Associated resistances					
Type	Order No.	Minimum total resistance for each EBU Ω	Order No.	Resistance Ω	Brief peak rated value (5 s) kW	Power for a switch-on duration =20 % kW	Continuous rated power kW	Peak voltage DC V
MD(V)550/2 to MDV4500/2	**6SE3190-0CX87-2DA0**	10	**6SE3213-6SP87-0RA0**	20	7.5	5	1.25	380
			6SE3221-4SP87-0RA0	10	15	10	2.5	380
MD(V)750/3 to MDV7500/3	**6SE3190-0DX87-2DA0**	20	**6SE3214-0TP87-0RA0**	40	15	10	2.5	950
			6SE3222-4TP87-0RA0	20	30	20	5	950
MDV220/4 to MD(V)3700/4	***Your local Siemens sales office can provide you with information about the range of electronic braking modules which are available for this drive inverter.***							

Braking resistors

Resistor type	Order No.	Cont. rated power kW	Brief rated peak power kW	Resistance Ω	Notes
A	**6SE3213-6SP87-0RA0**	1.25	7.5	20	Only for line supply voltages
B	**6SE3221-4SP87-0RA0**	2.5	15	10	208 V - 240 V
D	**6SE3214-0TP87-0RA0**	2.5	15	40	Only for line supply voltages
E	**6SE3222-4TP87-0RA0**	5	30	20	380 V - 500 V

If the electronic braking modules are used for high load moments of inertia (or extremely short ramp-down times), then it may be necessary to connect additional resistors in parallel or to connect several electronic braking modules in parallel.

Braking power for drive inverters with line supply voltages 3-ph. 208 V to 240 V AC

Drive inverter Type	Rated drive inverter power kW	Braking power (min.)	Peak braking power kW	Total number of external EBUs required	Total number of resistors required	Resistor type
MDV550/2	5.5	Medium	7.5	1	1	A
		High	15	1	1	B
MDV750/2	7.5	Medium	7.5	1	1	A
		High	15	1	1	B
MDV1100/2	11	Medium	7.5	1	1	A
		High	15	1	1	B
MDV1500/2	15	Low	7.5	1	1	A
		Medium	15	1	1	B
		High	30	2	2	B
MDV1850/2	18.5	Low	7.5	1	1	A
		Medium	15	1	1	B
		High	30	2	2	B
MDV2200/2	22	Low	7.5	1	1	A
		Medium	15	1	1	B
		High	30	2	2	B
MDV3000/2	30	Low	15	1	1	B
		Medium	15	1	1	B
		High	30	2	2	B
MDV3700/2	37	Low	15	1	1	B
		Medium	30	2	2	B
		High	45	3	3	B
MDV4500/2	45	Low	15	1	1	B
		Medium	30	2	2	B
		High	60	4	4	B

Braking power for drive inverters with line supply voltages 3-ph. 380 V to 500 V AC

Drive inverter Type	Rated drive inverter power kW	Braking power (min.)	Peak braking power kW	Total number of external EBUs required	Total number of resistors required	Resistor type
MDV750/3	11(VT)	Medium	15	1	1	D
		High	15	1	1	D
MDV1100/3	11	Medium	15	1	1	D
		High	15	1	1	D
MDV1500/3	15	Medium	15	1	1	D
		High	15	1	1	D
MDV1850/3	18.5	Low	15	1	1	D
		Medium	15	1	1	D
		High	30	1	1	E
MDV2200/3	22	Low	15	1	1	D
		Medium	15	1	1	D
		High	30	1	1	E
MDV3000/3	30	Low	15	1	1	D
		Medium	30	1	1	D
		High	60	2	2	E
MDV3700/3	37	Low	15	1	1	D
		Medium	30	1	1	E
		High	60	2	2	E
MDV4500/3	45	Low	15	1	1	D
		Medium	30	1	1	E
		High	60	2	2	E
MDV5500/3	55	Low	15	1	1	D
		Medium	60	2	2	E
		High	90	3	3	E
MDV7500/3	75	Low	30	1	1	E
		Medium	60	2	2	E
		High	120	4	4	E

Note:
*Do **not** connect RES/WID output of EBUs connected in parallel if several EBUs are used.*

MICROMASTER
MICROMASTER Vector
MIDIMASTER Vector

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4. COMMUNICATIONS & INTERFACES

4.1 Communications, operator control and display elements

MICROMASTER, MICROMASTER Vector and MIDIMASTER Vector have the identical operator control and display elements.

The AC drive inverters can either be controlled, data read-out and parameterized at the unit itself or also externally:

1. At the drive inverter, using:
   - Membrane keypad with 7 keys - this is provided as standard
   - Optional OPM2 operator panel with plain text display
   - Or control terminal strip
2. Externally, using:
   - Serial RS 485 interface
   - Optional OPM2 operator panel with plain text display
   - Optional PROFIBUS module
   - Or a PC with DRIVE-MONITOR

4.2 Standard operator panel

The standard operator panel has 7 keys as well as an LED display comprising 4 x 7 segments, and has the following functions:

- Starting the drive inverter
- Operator control functions:
- Motor ON/OFF, increasing/decreasing the motor frequency setpoint;
- "Clockwise/counter-clockwise rotation" selection and the jog frequency using the JOG key
- Starting and stopping with a pre-set frequency
- Displaying motor frequency setpoints and actual values
- Displaying and changing parameters
- Displaying the AC drive inverter status
- Displaying alarm messages
- Displaying and resetting fault messages

The function keys can be individually inhibited. The OFF key is always active for safety reasons.

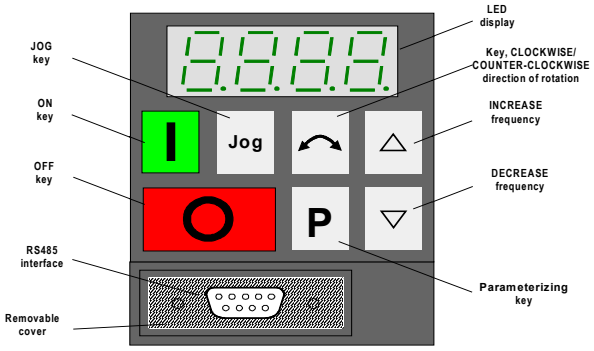


Fig. 1: Standard operator panel

There is a 9-pin SUB-D connector (X502) on the membrane keypad which forms the RS485 interface. The optional PROFIBUS module or the plain text operator panel can be connected to this interface. The drive can be connected directly to a PC via the RS232 interface on the plain text operator panel.

4.3 Serial RS485 interface

The RS485 interface of the MICROMASTER and the MIDIMASTER operates with the USS protocol, can be networked with 31 nodes (stations) via a bus and allows a max. data transfer rate of 19.2 kbit/s.

It is possible to access the RS485 interface via a SUB-D connector (refer to **Table 1** for the pin assignment) - for 6SE32 drives – via the control terminal strip.

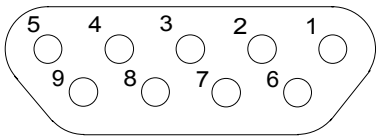


Fig. 2: Pin assignment of the SUB-D connector

Pin	Function, information
1	Not assigned
2	Not assigned
3	RS485 send and receive data line, two-wire, positive differential input/output B/P
4	Not assigned
5	Reference potential, 0V
6	5V/250mA power supply
7	Not assigned
8	RS485 send and receive data line, two-wire, negative differential input/output A/N
9	Not assigned

Table 1: Pin assignment of the SUB-D connector

Notes:

1. *Refer to the following documentation: "Universal Serial Interface Protocol Specifications":*
   Order No. E20125-D0001-S302-A1 (German)
   Order No. E20125-D0001-S302-A1-7600 (English)
2. *If the PROFIBUS module is connected to the SUB-D connector at the equipment cover, then the internal RS485 ports of the 6SE32 drive (terminals 23 and 24) do not have to be used.*
3. *If the plain text operator panel is connected at the SUB-D connector at the equipment cover, then it is not permissible to connect the internal RS485 ports of the 6SE32 drive (terminals 23 and 24) to a PC, a PLC or any other serial bus master.*
4. *It is not possible to simultaneously connect the PROFIBUS module and the plain text operator panel to the drive inverter.*

4.4 Control terminal strips

All of the functions required to control and monitor the MICROMASTER and the MIDIMASTER are accessible via control terminal strips.

- Control commands, e.g. on/off, clockwise/counter-clockwise, jogging
- Analog setpoint inputs
- Digital setpoint inputs, e.g. fixed frequency
- Digital outputs, e.g. operation, alarm
- Analog outputs, e.g. frequency setpoint, output current

The response times of the inputs are as follows:

Digital input:	25 ms, depending on the de-bounce time (P056)
Analog input:	15 ms for stepping signals (> 0.5 V)
RS485 interface:	25 ms

Refer to Section 3.4 for additional information on using the control terminals.

4.5 Plain text operator panel (optional)

4.5.1 Using the plain text operator panel

The optional plain text operator panel is intended to additionally enhance the user friendliness of the MICROMASTER, MICROMASTER Vector and MIDIMASTER Vector. Furthermore, it has been designed for use with COMBIMASTER. This provides the operator with a plain text basis for commissioning, parameterizing, configuring and operating the drive inverter. The following functions are provided:

- Back lit LCD display with a high resolution and contrast control.
- 7 languages
- Up to 31 drive inverters can be centrally controlled, which are networked via USS.
- Up to 10 parameter sets can be saved in the non-volatile memory for uploading and downloading data between the plain text operator panel and drive.
- Help texts for diagnostics (troubleshooting).
- Insulated RS232 interface to connect to a PC.

The plain text operator panel fits perfectly into the front panel of the drive (screws are not required) and can be easily removed by lifting a bracket below the unit.

The plain text operator panel can be connected to the drive using a cable which means that it can be used as mobile terminal. It can also be mounted on a cabinet door thus serving as a favorably priced "Man/machine" interface for one or several drives in a cabinet.

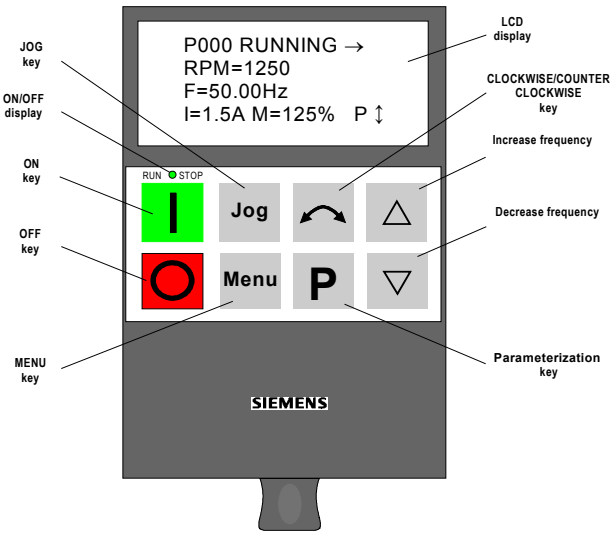
Caution:

When using the plain text operator panel as interface converter RS232/ RS485 or without drive inverter, then an additional 6V DC power supply is always required. The specifications are listed on Page 4/4.

The operator panel is automatically activated as soon as it is connected to a drive inverter or the voltage is switched-on.

Dimensions H x W x D	130 mm x 73 mm x 40 mm
Current drain at 5 V	200 mA
Degree of protection	IP 54
Max. cable length	5 m

Table 2: Technical data



The keys have the same functions as on the standard operator panel; the exception is the MENU key, with which the main menu screen can always be selected. Information on which key should be pressed is provided in the righthand screen column.

All of the main functions are accessible from the main menu screen.

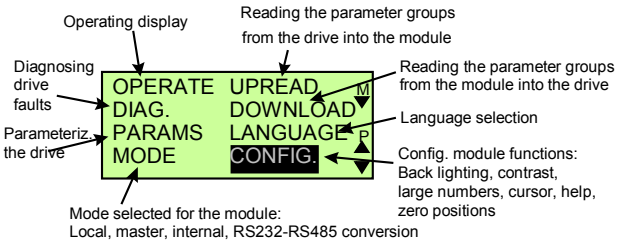
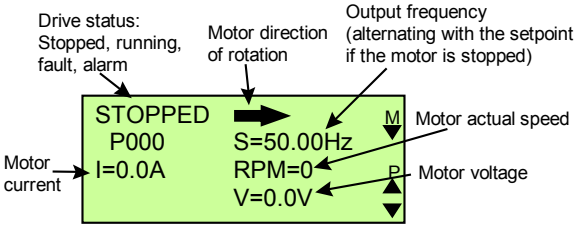


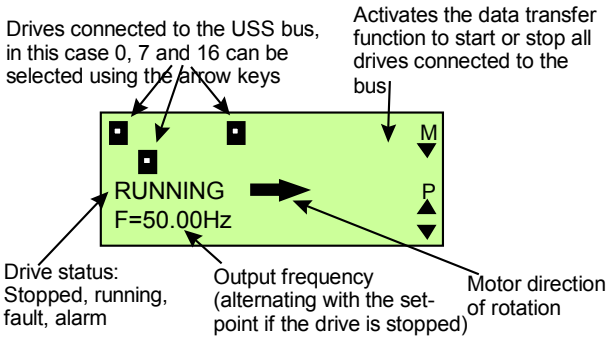
Fig. 5.3: Main menu screen

A help screen is displayed by simultaneously pressing the menu and the ↘ key. The help screen displays the main functions of the plain text display module.

When powered-up, unless otherwise configured, the operating display appears.



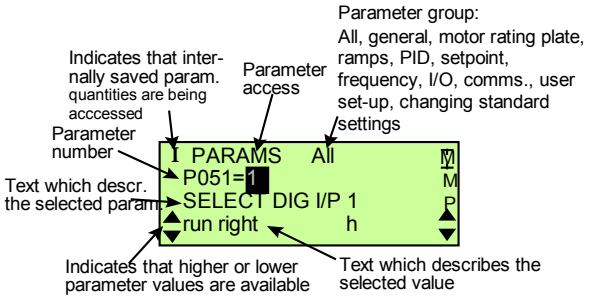
Operating display in the LOCAL mode



Operating display in the MASTER mode

The status LED indicates whether the drive is presently running. If the LED is green, the drive runs; if it is red, the drive was stopped.

If the drive parameters are accessed, the help texts are linked with the parameter and the parameter values.



4.5.2 RS232 interface

The plain text operator panel is equipped with an RS232 interface which allows the drive to be connected to a PC.

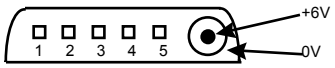


Fig. 4: Pin assignment of the RS232 connector

Pin	Function, information
1	Not assigned
2	External TxD
3	External RxD
4	External RTS
5	Insulated 0V

Power supply to operate an OPM2

The power supply specifications are as follows:

Voltage tolerance 6V ± 0.5V

Current drain for operation with a drive inverter: 50mA,

Current drain for operation without drive inverter: 250mA

Connector:

- outer diameter: 3.5 mm (=0V)

- inner diameter: 1.35 mm (=+6V

Designation	Order No.
Multi-lingual plain-text operator panel OPM2 with integrated interface converter RS232/RS485	6SE3290-0XX87-8BF0
CABLE SET TO MOUNT THE OPM 2 IN THE CABINET, 3M LONG	6SE3290-0XX87-8PK0
PC INTERFACE CABLE RS232 FOR OPM 2, 1M LONG	6SE3290-0XX87-8SK0

Table 3: Ordering data for the OPM2 plain text operator panel

4.6 PROFIBUS module CB15

Using this option, MICROMASTER, MICROMASTER Vector or MIDIMASTER Vector can be controlled via a serial PROFIBUS-DP bus (SINEC L2-DP).

PROFIBUS-DP is a serial high-speed communications system which has been optimized for the actuator/sensor range, where extremely short response times are important. It operates as a decentralized I/O system. It replaces conventional wiring to the sensors and actuators using a serial RS485 bus system which connects the various stations (nodes) with one another.

The suitability of this system for these types of applications has been recently improved by increasing the bus transfer rate up to 12Mbd. The protocol is defined in DIN19245 as well as EN50170 which guarantees communications between the PROFIBUS-DP stations, independent of the manufacturer.

Using this bus system, up to 125 stations can be networked with one another. An extremely flexibly data structure allows the system to be optimized so that it precisely corresponds to the requirements of each device.

PROFIBUS-DP is the core of the new generation of SIMATIC S7 automation systems from Siemens. All technical, display and PLC operator functions can be integrated using this bus system. In order to configure a SIMATIC-based automation system, it is only necessary to run the appropriate STEP7 configuration tool on a PC. The bus is configured using drag and drop in a PROFIBUS-DP network which is displayed graphically.

The advantages of the automation of a system using PROFIBUS-DP are listed in the following:

- Only one single network for operator panels, drives, sensors, actuators, PLCs.
- Cost saving when it comes to the installation time and wiring.
- Simple commissioning using the SIMATIC S7 PLC system and the STEP7 software.
- High degree of flexibility so that the automation system can be subsequently modified.
- Can be easily integrated into more complex process display systems, for example, PCS7.
- Remote diagnostics reduce the downtime when faults develop.

Features of the CB15 PROFIBUS option:

- Permits fast cyclic communications via a PROFIBUS link.
- Supports all PROFIBUS baud rates up to 12Mbd.
- Up to 125 drive inverters can be controlled using the PROFIBUS-DP protocol (with bus amplifier).
- Compliance with EN50170 guarantees open communications on the serial bus system. It can be used together with other PROFIBUS-DP/SINEC L2-DP peripheral devices connected to the serial bus. The data format corresponds to the VDI/VDE Directive 3689 “PROFIBUS profile for variable-speed drives”.
- Non-cyclic communications channel to connect DRIVE-MONITOR or other service tools.
- Supports PROFIBUS control commands SYNC and FREEZE.
- Can be easily configured using the "S7 Manager" software or any other original PROFIBUS commissioning tool.
- Can be easily integrated into a SIMATIC S5 or S7 PLC system using specifically developed function blocks (S5) or software modules (S7).
- It can be just as easily plugged into the operator panel as the plain text operator panel.
- No special power supply is required.
- Digital and analog inputs can be read via the serial bus and digital as well as analog outputs can be controlled via the serial bus.
- Response time when processing the data: 5 ms

The output frequency (and therefore the motor speed) can be locally controlled at the drive or via the serial bus.

Multi-mode operation is possible: Control data can be input via the terminal strip (digital inputs) and setpoints via the serial bus. Alternatively, the setpoint can be received from a local source (analog input), whereby the drive is controlled via the serial bus.

- All of the drive parameters are accessible via the serial connecting cable.

The PROFIBUS module fits perfectly onto the drive operator panel and can be easily removed by lifting a bracket below the unit.

Notes:

1. *The PROFIBUS module may only be plugged onto the drive inverter or withdrawn from it when the drive inverter is in a no-voltage condition (i.e. powered-down).*
2. *If the PROFIBUS module is inserted in the SUB-D connector of the operator panel, the internal RS 485 terminals of the 6SE32 drive inverter (terminals 23 and 24) may not be used.*
3. *The PROFIBUS module may not be connected to the drive inverter using a cable.*
4. *The PROFIBUS module cannot be simultaneously used with the plain text operator panel.*

Either a PPO, type 1 or PPO, type 3, according to the specifications in VDI/VDE 3689 may be used for communications via PROFIBUS-DP. In practice, this means that process data (control words, setpoints in the transfer telegram and status words, actual values in the receive telegram) are always sent. However, parameter data transfer can be inhibited it the bus bandwidth or the PLC memory space is restricted. Generally, the data structure and thus the PPO type are specified by the bus master. If a PPO type is not specified (e.g. if a combined PROFIBUS DP/ PROFIBUS FMS bus master is used), the standard PPO type = 1 (parameter data transfer).

Process data, from the serial link, always has a higher priority than the parameter data. This means that a setpoint or drive control change command is processed faster than a parameter change command.

The parameter write access via the serial link can, when required, be enabled or inhibited. The parameter read access is always enabled so that drive data, diagnostic and fault messages etc. can always be read-out. This permits a low-cost display system to be implemented.

The drive can be locally controlled using ON, OFF, JOG and direction of rotation reversal at any time as if the module was not installed.

The PROFIBUS cable is connected to the 9-pin SUB-D connector on the PROFIBUS module.

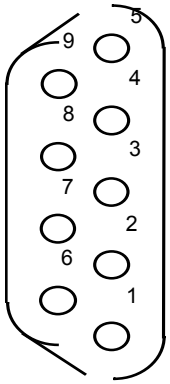


Fig. 5: Pin arrangement of the PROFIBUS SUB-D connector

Pin	Function, information
1	Not assigned
2	Not assigned
3	RS485 send and receive data line, two-wire, positive differential input/output B/P
4	Switch-on the send section ("request- to-send" RTS)
5	Reference potential, 0 V
6	Insulated power supply, 5V, for the terminating resistors
7	Not assigned
8	RS485 send and receive data line, two-wire, negative differential input/output A/N
9	Not assigned

Table 4: Pin assignment of the SUB-D connector

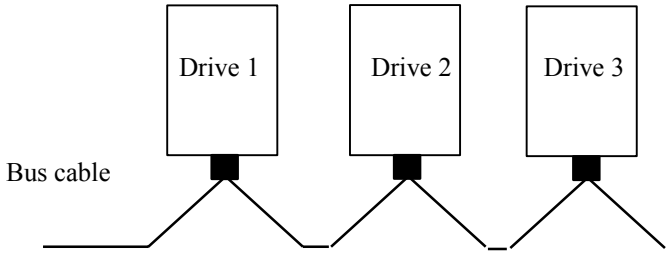
The cable shield should be connected to the housing of the SUB-D connector. The following cable lengths and data transfer rates are possible:

Data transfer s rate (kbit/s)	**Max. cable length of a segment (m)**
9.6	1200
19.2	1200
93.75	1200
187.5	1000
500	400
1500	200
12000	100

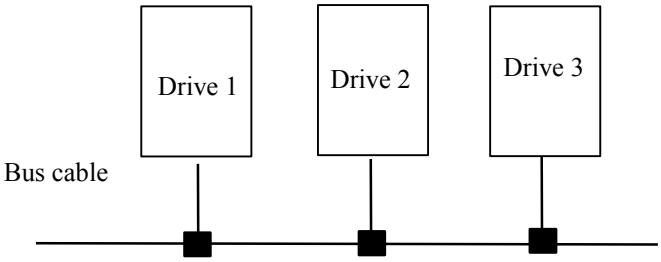
Table 5: Max. cable lengths and data transfer rates

A segment can be extended by using RS485 amplifiers. Recommended: SINEC L2 amplifier for RS 485 (Order No.: 6ES7972-0AA00-0XA0).

In order to guarantee reliable operation of the serial bus system, the cable must be terminated at both ends using terminating resistors. It is important to note that when the drive inverter is in a no-voltage condition, when (line supply OFF) it is not able to guarantee the power supply of the bus module / terminating resistor. This means, under certain circumstances, an active bus terminating device should be used. (Order No.: 6ES7972-0DA00-0AA0). For operation at 12Mbd, cables / connectors with integrated damping network should be used as terminating device. Furthermore, for 12Mbd operation, a drop cable (spur cable) from the main bus cable is not permitted.



Permissible configuration for 12Mbd



Permissible configuration at 12Mbd

Suitable SINEC-L2 DP connectors and cables for reliable operation up to 12Mbd are listed in Table 6:

The floppy disk, supplied together with the PROFIBUS module, includes the Manual and 2 data files to configure the associated PLC system.

Order No.	Description
6ES7972-0BB10-0XA0	Bus connector with PG interface
6ES7972-0BA10-0XA0	Bus connector without PG interface
6ES7901-4BD00-0XA0	Bus cable

Table 6: Order numbers of the connectors and cables

Brief instructions for setting-up PROFIBUS communications:

- The bus cable between the master system and drive must be correctly terminated. This includes the necessary terminating resistors and (at 12Mbd) the terminating network.
- The bus cable must be shielded and the shield must be connected to the housing of the cable connector.
- The PROFIBUS master must be correctly configured so that communications can be established with a DP slave using either PPO type 1 or PPO type 3 (only PPO type 1 if the PPO type has not been configured using remote operator control).
- When using the COM ET software together with a SIMATIC S5, the correct descriptive file must be used so that an IM 308B/C can be configured as bus master. If the SIMATIC Manager is used for an S7, the object manager must be loaded.
- The bus must be ready (when using a SIMATIC module, the operator panel switch must be set to ON).
- The max. bus baud rate is only 12 Mbd.
- The PROFIBUS module must be correctly inserted in the drive inverter and the drive inverter must be connected to a power source.
- The slave address for the drive (parameter P918) must be set so that it corresponds to the address configured in the PROFIBUS master and it must be uniquely defined in the bus.

PROFIBUS should be installed, carefully maintaining the EMC guidelines and regulations (*these are described in detail in the Operating Instructions for the drive and the PLC*).

Dimensions H x W x D	115 mm x 102 mm x 30 mm
Degree of protection	IP 21
Max. bus transfer rate	12 Mbd

Table 7: Technical data

Designation	Order No.
PROFIBUS module CB15	6SE3290-0XX87-8PB0

Table 8: PROFIBUS ordering data

Note: The mounting kit for IP56 drive inverters is provided with each drive inverter and cannot be separately ordered.

4.7 CAN bus module CB16

The CAN bus module was developed for operation with MICROMASTER Vector / MIDIMASTER Vector and supports the CAN Open protocol. It fulfills the requirements of the CAN specification DS402.
All of the drive inverter parameters are accessible via the bus. There are no restrictions regarding the parameters harmonized in the DS402 specification.

The drive inverter I/O signals can be controlled via this gateway. The "Device profile" for the I/O modules (DS401) has not been implemented.

Designation	Order No.
CAN bus module	6SE3290-0XX87-8CB0

Table 9: CAN bus ordering data

4.8 AS-Interface module

Designation	Order No.
AS-Interface module	On request

Table 10: AS-Interface ordering data

4.9 Software tools

DVA-S5 software package to integrate the drive inverter into a SIMATIC S5 control system via USS protocol or PROFIBUS DP

Designation	Order No.
Software package DVA-S5	6DD1800-0SW0

Table 11: DVA-S5 ordering data
supplied as: 3.5" floppy disk (1 x)

DriveMonitor and DriveES

DriveMonitor is the freely-available commissioning (start-up) tool for drives from the following drive families
- MICROMASTER Basic / Vector / ECO
- MIDIMASTER Vector / ECO

and is supplied on the documentation CD (this is included in the scope of supply).
Contrary to the DriveES basic software, DriveMonitor operates without a project structure and exclusively on the file system. Communications is only possible via USS, which is also contrary to Drive ES basic software.
The drive commissioning software DriveMonitor runs
- Under MS Windows NT/MS Windows 2000: PG / PC with a Pentium processor as well as a minimum of 32 MB RAM. We recommend 64 MB of RAM.
- DriveMonitor requires approx. 75 Mbytes.

Comment:
SIMOVIS has been replaced by DRIVE-MONITOR. Both can be installed together on a computer but cannot be simultaneously used.

Drive ES

The Drive ES (option) philosophy is to use an operator interface as basis which many of our customers already know, use and has been well proven as it operates with SIMATIC (this has a No. 1 position in PLC systems) and the associated software (STEP7 manager). By using our drives, it is not necessary to learn a new software environment. Drive ES is supplied in German, English, French, Italian and Spanish. Drive ES comprises four components, Drive ES Basic, Drive ES Graphic (not for MM3 drive inverters) and Drive ES SIMATIC and Drive ES PCS7 which are individually available:

Drive ES Basic
Allows drives to be parameterized both online and offline.

Designation	Order No.
Drive ES Basic	6SW1700-5JA00-1AA0

Table 12: DriveES Basic ordering data
supplied as: CD-ROM (1 x)

Drive ES SIMATIC
This requires that STEP 7 V5 SP 2 has been installed. It provides a SIMATIC block library. This means that PROFIBUS DP communications can be simply and reliably programmed between the SIMATIC-CPU and the drives.

Designation	Order No.
Drive ES SIMATIC	6SW1700-5JC00-1AA0

Table 13: DriveEs Simatic ordering data
supplied as: CD-ROM (1 x)

Drive ES PCS7 (option) means that a PCS7 must have been installed. It includes a PCS7 block library. The screen and control blocks for drives are available.

Designation	Order No.
Drive ES PCS7	6SW1700-5JD00-1AA0

Table 14: DriveEs PCS7 ordering data
supplied as: CD-ROM (1 x)

4.10 Diagnostic functions, fault codes and parameter list

The MICROMASTER, MICROMASTER Vector and MIDIMASTER Vector drive inverters have two alarm function stages: **Warnings** and **Faults.**

1. ***Warnings***
   The first stage implies a warning which is output if a drive inverter operating parameter reaches its limit value. These parameters can include, for example, current, voltage or temperature. When this warning is output, the display flashes (and a bit is set in the message which is returned via the serial interface); however, the drive inverter is not shutdown (tripped). The warning is automatically reset once the cause of the warning has been removed (e.g. by reducing the load which had caused the drive inverter to reach its current limit).

   The last warning number which was displayed is saved in parameter P931. However, an output relay can be parameterized using parameter P061 or P062 (not for 6SE92) so that it changes-over when a warning is output. Alternatively, the relay can either be switched using a warning before current limiting, voltage limiting, motor overtemperature or slip limiting (only for 6SE32).

   The warning messages can always be accessed via the serial interface, by reading parameter P931. The warning buffer memory can be deleted by writing 0 into it.

2. ***Faults***
   The second alarm stage is a "Fault". As soon as a fault condition is detected, the drive inverter output is shutdown and a flashing fault code is displayed (a bit is set in the message which is returned via the serial interface). The drive inverter can only be reset if the cause of the fault has been removed. The fault can be acknowledged by pressing the P key on the operator panel twice, switching a digital input (if such an input was parameterized) or via the serial interface.

   The fault code, which last occurred, is saved in parameter P930. It is possible to configure an output relay using parameters P061 or P062 (not for 6SE92) so that its state changes if a fault is output.

   After a fault code has been acknowledged, the drive inverter changes into a power-on inhibit status. The drive inverter must then be actively powered-down (using the keypad, digital input or serial interface, depending on which control technique was configured) before it can be powered-up again. This can be de-activated by setting parameter P081; in this case, the drive inverter attempts a restart as soon as the fault has been acknowledged.

   The fault buffer memory can be deleted by writing 0 into it. In the case of 6SE32, parameters P140, P141, P142 and P143 contain the last as well as the second from last, third from last and fourth from last faults.

4.11 Table of the fault and alarm codes

Fault message	Text	6SE32...	6SE92...	Alarm	Text	6SE32...	6SE92...
F001	Overvoltage	**X**	**X**				
F002	Overcurrent	**X**	**X**	**W002**	Current limit active	**X**	**X**
F003	Overload	**X**	**X**	**W003**	Voltage limit active	**X**	**X**
F004	Overtemperature, motor	**X**		**W004**	Slip limit exceeded	**X**	
F005	Overtemperature, drive inverter	**X**	**X**	**W005**	Inverter overtemperature (heatsink)	**X**	**X**
F008	USS protocol time out	**X**	**X**	**W006**	Motor overtemperature	**X**	**X**
F009	Undervoltage	**X**		**W010**	15V power supply – current limit	**X**	
F010	Initialization fault	**X**	**X**	**W018**	Auto re-start after fault (P018)	**X**	**X**
F011	Fault, internal interface	**X**	**X**	**W075**	Overload, braking resistor	**X**	
F012	External trip	**X**	**X**				
F013	Program fault	**X**	**X**				
F016	Vector control instable	**X**					
F030	Fault, Profibus	**X**	**X**				
F031	Fault, DP module	**X**	**X**				
F033	DP bus configuration fault	**X**	**X**				
F036	Profibus module Watchdog trip	**X**	**X**				
F057	Delayed trip (refer to P057)	**X**					
F074	Motor overtemperature by I^2t calculation	**X**	**X**				
F075	Overcurrent during ramping down	**X**	**X**				
F101	Internal interface fault	**X**	**X**				
F105	Inverter overtemperature (internal sensor)	**X**	**X**				
F106	Parameter fault P006	**X**	**X**				
F112	Parameter fault P012 / P013	**X**	**X**				
F151 -156	Digital input parameter fault	**X**	**X**				
F188	Automatic calibration failure	**X**					
F201	P006 = 1 while P201 = 2	**X**	**X**				
F212	Parameter fault P211 / P212	**X**	**X**				
F231	Output current measurement imbalance	**X**	**X**				
F255	Watchdog trip	**X**	**X**				

4.12 Parameter list

Legend:

• = These parameters can also be changed while the drive inverter is operational.

✧✧✧ = The setting value depends on the drive inverter type.

Parameter	Function	Range [factory setting]	
		MICROMASTER	MICRO/MIDIMASTER Vector
P000	Operating display	-	-
P001 •	Display mode	0 - 8 [0]	0 - 9 [0]
P002 •	Ramp-up time (seconds)	0 – 650.0 [10.0]	0 – 650.0 [10.0]
P003 •	Ramp-down time (seconds)	0 – 650.0 [10.0]	0 – 650.0 [10.0]
P004 •	Smoothing time (seconds)	0 – 40.0 [0.0]	0 – 40.0 [0.0]
P005 •	Digital frequency setpoint (Hz)	0.00 – 400.00 [5.00]	0.00 – 650.00 [5.00]
P006	Frequency setpoint source selection	0 - 2 [0]	0 - 3 [0]
P007	Keypad control	0 - 1 [1]	0 - 1 [1]
P009 •	Parameter protection setting	0 - 3 [0]	0 - 3 [0]
P010	Display scaling	-	0.00 – 500.00 [1.00]
P011	Frequency setpoint memory	0 - 1 [0]	0 - 1 [0]
P012 •	Minimum motor frequency (Hz)	0.00 - 400.00 [0.00]	0.00 - 650.00 [0.00]
P013 •	Maximum motor frequency (Hz)	0.00 - 400.00 [50.00]	0.00 - 650.00 [50.00]
P014 •	Skip frequency 1 (Hz)	0.00 - 400.00 [0.00]	0.00 - 650.00 [0.00]
P015 •	Automatic restart after line failure	0 - 1 [0]	0 - 1 [0]
P016 •	Start on the fly	0 - 2 [0]	0 - 4 [0]
P017 •	Smoothing type	1 - 2 [1]	1 - 2 [1]
P018 •	Automatic restart after fault	0 - 1 [0]	0 - 1 [0]
P019 •	Skip frequency bandwidth	0.00 - 10.00 [2.00]	0.00 - 10.00 [2.00]
P020 •	Ramp time for start on the fly (s)	0.5 - 25.0 [2.00]	-
P021 •	Minimum analog frequency (Hz)	0.00 - 400.00 [0.00]	0.00 - 650.00 [50.00]
P022 •	Maximum analog frequency (Hz)	0.00 - 400.00 [50.00]	0.00 - 650.00 [50.00]
P023 •	Analog input 1 type	0 - 2 [0]	0 - 3 [0]
P024 •	Analog setpoint addition	0 - 2 [0]	0 - 2 [0]
P025 •	Analog output 1	-	0 - 105 [0]
P026 •	Analog output 2	-	0 - 105 [0] MIDI
P027 •	Skip frequency 2 (Hz)	0.00 - 400.00 [0.00]	0.00 - 650.00 [0.00]
P028 •	Skip frequency 3 (Hz)	0.00 - 400.00 [0.00]	0.00 - 650.00 [0.00]
P029 •	Skip frequency 4 (Hz)	0.00 - 400.00 [0.00]	0.00 - 650.00 [0.00]
P031 •	Jog frequency right (Hz)	0.00 - 400.00 [5.00]	0.00 - 650.00 [5.00]
P032 •	Jog frequency left (Hz)	0.00 - 400.00 [5.00]	0.00 - 650.00 [5.00]
P033 •	Jog ramp-up time (seconds)	0 - 650.0 [10.0]	0 - 650.0 [10.0]
P034 •	Jog ramp-down time (seconds)	0 - 650.0 [10.0]	0 - 650.0 [10.0]
P040	Positioning function	-	0.1 [0]
P041 •	Fixed frequency 1 (Hz)	0.00 - 400.00 [5.00]	0.00 - 650.00 [5.00]
P042 •	Fixed frequency 2 (Hz)	0.00 - 400.00 [10.00]	0.00 - 650.00 [10.00]
P043 •	Fixed frequency 3 (Hz)	0.00 - 400.00 [15.00]	0.00 - 650.00 [15.00]
P044 •	Fixed frequency 4 (Hz)	0.00 - 400.00 [20.00]	0.00 - 650.00 [20.00]

Parameter	Function	Range [factory setting]	
		MICROMASTER	MICRO/MIDIMASTER Vector
P045	Inversion fixed setpoints for fixed frequencies 1 - 4	0 - 7 [0]	0 - 7 [0]
P046	Fixed frequency 5 (Hz)	0.00 - 400.00 [25.00]	0.00 - 650.00 [25.00]
P047	Fixed frequency 6 (Hz)	0.00 - 400.00 [30.00]	0.00 - 650.00 [35.00]
P048	Fixed frequency 7 (Hz)	0.00 - 400.00 [35.00]	0.00 - 650.00 [40.00]
P049	Fixed frequency 8 (Hz)	-	0.00 - 650.00 [0.00]
P050	Inversion fixed setpoint for fixed frequencies 5 - 8	0 - 7 [0]	0 - 7 [0]
P051	Selection control function, DIN1 (terminal 5), fixed frequency 5	0 - 19 [1]	0 - 24 [1]
P052	Selection control function, DIN2 (terminal 6)	0 - 19 [2]	0 - 24 [2]
P053	Selection control function, DIN3 (terminal 7)	0 - 19 [6]	0 - 24 [6]
P054	Selection control function, DIN4 (terminal 8)	-	0 - 24 [6]
P055	Selection control function, DIN5 (terminal 16)	-	0 - 24 [6]
P356	Selection control function, DIN5 (terminal 17) 1	-	0 - 24 [6]
P056	Digital input debounce time	0 - 2 [0]	0 - 2 [0]
P057	Digital input, Watchdog trip (seconds)	-	0 - 650.0 [1.0]
P061	Selection relay output 1	0 - 13 [6]	0 - 13 [6]
P062	Selection relay output 2	0 - 4 [8]	0 - 13 [8]
P063	External brake release delay (seconds)	0 - 20.0 [1.0]	0 - 20.0 [1.0]
P064	External brake stopping time (seconds)	0 - 20.0 [1.0]	0 - 20.0 [1.0]
P065	Current threshold for relay (A)	0 - 99.9 [1.0]	0 - 300.0 [1.0]
P066	Compound braking	0 - 1 [0]	0 - 250 [0]
P069	Ramp extension disabled	-	0 - 1 [1]
P070	Braking resistor duty cycle	-	0 - 4 [0] MMV
P071 •	Slip compensation (%)	-	0 - 200 [0]
P072 •	Slip limit (%)	-	0 - 500 [250]
P073 •	DC injection braking (%)	0 - 250 [0]	0 - 250 [0]
P074 •	I^2t motor protection	0 - 8 [0]	0 - 7 [0]
P075 •	Braking chopper enable	-	0 - 1 [0] (MMV)
P076 •	Pulse frequency	0 - 7 [0 or 4]	0 - 7 [0 or 4]
P077	Control mode	0 - 2 [1]	0 - 3 [1]
P078 •	Continuous boost (%)	0 - 250 [100]	0 - 250 [100]
P079 •	Starting boost (%)	0 - 250 [0]	0 - 250 [0]
P080	Nominal rating plate motor power factor (cosϕ)	-	0.00 - 1.00 [✧✧✧
P081	Nominal rating plate frequency for motor (Hz)	0.00 - 400.00 [50.00]	0.00 - 650.00 [50]
P082	Nominal rating plate speed for motor (RPM)	0 - 9999 [✧✧✧]	0 - 9999 [✧✧✧]
P083	Nominal rating plate current for motor (A)	0.1 - 99.9 [✧✧✧]	0.1 - 99.9 [✧✧✧]
P084	Nominal rating plate voltage for motor (V)	0 - 1000 [✧✧✧]	0 - 1000 [✧✧✧]
P085	Nominal rating plate power for motor (kW)	0 - 75.0 [✧✧✧]	0.12 - 75.0 [✧✧✧]
P086 •	Motor current limit (%)	0 - 250 [150]	0 - 250 [150]

Parameter	Function	Range [factory setting]	
		MICROMASTER	MICRO/MIDIMASTER Vector
P087 •	Motor PTC enable	-	0 - 1 [0]
P088	Automatic calibration	-	0 - 1 [1]
P089 •	Stator resistance (Ω)	0.01 - 100.00 [✧✧✧]	0.01 - 199.00 [✧✧✧]
P091 •	Serial link slave address	0 - 30 [0]	0 - 30 [0]
P092 •	Serial link baud rate	3 - 7 [6]	3 - 7 [6]
P093 •	Serial line time-out (seconds)	0 - 240 [0]	0 - 240 [0]
P094 •	Serial link nominal system setpoint (Hz)	0.00 - 400.00 [50.00]	0.00 - 650.00 [50.00]
P095 •	USS compatibility	0 - 2 [0]	0 - 2 [0]
P099 •	Option module type	0 - 2 [0]	0 - 2 [0]
P101 •	Operation for Europe or North America	0 - 1 [0]	0 - 1 [0]
P111	Inverter power rating (kW/hp)	0.0 - 75.0 [✧✧✧]	0.0 - 75.0 [✧✧✧]
P112 •	Inverter type	1 - 8 [✧✧✧]	1 - 8 [✧✧✧]
P113 •	Drive model	0 - 29 [✧✧✧]	0 - 29 [✧✧✧]
P121	Enable/disable RUN button	0 - 1 [1]	0 - 1 [1]
P122	Enable/disable FORWARD/REVERSE button	0 - 1 [1]	0 - 1 [1]
P123	Enable/disable JOG button	0 - 1 [1]	0 - 1 [1]
P124	Enable/disable ⇧ and ⇩ buttons	0 - 1 [1]	0 - 1 [1]
P125 •	Reverse direction inhibit	0 - 1 [1]	0 - 1 [1]
P128 •	Fan switch-off delay time (seconds)	0-600 [120]	0-600 [120] MMV
P131 •	Frequency setpoint (Hz)	0.00 - 400.00 [-]	0.00 - 650.00 [-]
P132 •	Motor current (A)	0.0 - 99.9 [-]	0.0 - 300.0 [-]
P133 •	Motor torque (% nominal torque)	0 - 250 [-]	0 - 250 [-]
P134 •	DC link voltage (V)	0 - 1000 [-]	0 - 1000 [-]
P135 •	Motor RPM	0 - 9999 [-]	0 - 9999 [-]
P137 •	Output voltage (V)	0 - 1000 [-]	0 - 1000 [-]
P138	Instantaneous rotor/shaft frequency (Vector mode only)	-	0.00 - 650.00 [-]
P139	Peak output current detect	0.0-99.9 [-]	-
P140	Most recent fault code	0 - 255 [-]	0 - 255 [-]
P141	Most recent fault code - 1	0 - 255 [-]	0 - 255 [-]
P142	Most recent fault code - 2	0 - 255 [-]	0 - 255 [-]
P143	Most recent fault code - 3	0 - 255 [-]	0 - 255 [-]
P186 •	Motor instantaneous current limit (%)	-	0 - 500 [200]
P201 •	PID closed-loop mode	0 - 2 [0]	0 - 1 [0]
P202 •	P gain	0.0 - 999.9 [1.0]	0.0 - 999.9 [1.0]
P203 •	I gain	0.00 - 99.9 [0.00]	0.00 - 99.9 [0.00]
P204 •	D gain	-	0.0 - 999.9 [0.0]
P205 •	Sample interval	1 - 2400 [1]	1 - 2400 [1]
P206 •	Transducer filtering	0 - 255 [0]	0 - 255 [0]
P207 •	Integral capture range (%)	0 - 100 [100]	0 - 100 [100]
P208	Transducer type	0 - 1 [0]	0 - 1 [0]
P210	Transducer reading (%)	0.00 - 100.00 [-]	0.00 - 100.00 [-]
P211 •	0 % setpoint	0.00 - 100.00 [0.00]	0.00 - 100.00 [0.00]

Parameter	Function	Range [factory setting]	
		MICROMASTER	**MICRO/MIDIMASTER Vector**
P212 •	100 % setpoint	0.00 - 100.00 [100.00]	0.00 - 100.00 [100.00]
P220	Frequency cut-off	0 - 1 [0]	0 - 1 [0]
P321	Minimum analog frequency for analog setpoint 2	-	0.00 - 650.00 [0.00]
P322 •	Maximum analog frequency for analog setpoint 2	-	0.00 - 650.00 [0.00]
P323	Analog input 2 type	-	0 - 2 [0]
P386 •	Sensorless Vector speed control loop gain – proportional term	-	0.0 - 20.0 [1.0]
P387	Sensorless Vector speed control loop gain – integral term	-	0.01 - 10.0 [1.0]
P720 •	Direct input/output functions	0 - 1 [0]	0 - 7 [0]
P721	Analog input 1 voltage (V)	0.0 - 10.0 [-]	0.0 - 10.0 [-]
P722 •	Analog output 1 current 1 (mA)	-	0.0 - 20.0 [-]
P723	State of digital inputs	0 - 7 [-]	0 - 31 [-]
P724 •	Relay output control	0 - 1 [0]	0 - 3 [0]
P725	Analog input 2 voltage (V)	-	0.0 - 10.0 [-]
P726 •	Analog output 2 current 2 (mA)	-	0.0 - 20.0 [0] MIDI
P910 •	LOCAL/USS mode	0 - 4 [0]	0 - 4 [0]
P922	Software version	0 - 9999 [-]	0 - 9999 [-]
P923 •	Equipment system number	0 - 255 [0]	0 - 255 [0]
P930	Most recent fault code	0 - 9999 [-]	0 - 255 [-]
P931	Most recent warning type	0 - 9999 [-]	0 - 99 [-]
P944	Reset to factory default settings	0 - 1 [0]	0 - 1 [0]
P971 •	EEPROM storage control	0 - 1 [1]	0 - 1 [1]

Table 15: Parameter list

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5 Drive inverter selection & ordering data

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5.1 MICROMASTER/MICROMASTER Vector

MICROMASTER / MICROMASTER Vector, 1-ph. 208V - 240V AC±10%, with integrated filter
IP20 (NEMA 1)

MICRO-MASTER Type	MICRO-MASTER Vector Type	Rated motor power kW	Rated output current A	Maximum continuous output current A	Input current A	Dimensions H x W x D mm	Weight (approx.) kg	MICROMASTER Order No.	MICROMASTER Vector Order No.
MM12	MMV12	0.12	0.75	0.9	1.8	147 x 73 x 141	0.95	**6SE9210-7BA40**	**6SE3210-7BA40**
MM25	MMV25	0.25	1.5	1.7	3.2	147 x 73 x 141	0.95	**6SE9211-5BA40**	**6SE3211-5BA40**
MM37	MMV37	0.37	2.1	2.3	4.6	147 x 73 x 141	0.95	**6SE9212-1BA40**	**6SE3212-1BA40**
MM55	MMV55	0.55	2.6	3.0	6.2	147 x 73 x 141	0.95	**6SE9212-8BA40**	**6SE3212-8BA40**
MM75	MMV75	0.75	3.5	3.9	8.2	147 x 73 x 141	0.95	**6SE9213-6BA40**	**6SE3213-6BA40**
MM110	MMV110	1.1	4.8	5.5	11	184 x 149 x 172	2.6	**6SE9215-2BB40**	**6SE3215-2BB40**
MM150	MMV150	1.5	6.6	7.4	14.4	184 x 149 x 172	2.6	**6SE9216-8BB40**	**6SE3216-8BB40**
MM220	MMV220	2.2	9.0	10.4	20.2	215 x 185 x 195	5.0	**6SE9221-0BC40**	**6SE3221-0BC40**
MM300 1)	MMV300 1)	3.0	11.8	13.6	28.3	215 x 185 x 195	5.0	**6SE9221-3BC40**	**6SE3221-3BC40**

MICROMASTER/MICROMASTER Vector, 1-ph. / 3-ph. 208V – 240V AC±10%, without filter
IP20 (NEMA 1)

MICRO-MASTER Type	MICRO-MASTER Vector Type	Rated motor power kW	Rated output current A	Maximum continuous output current A	Input current 1AC I 3AC A		Dimensions H x W x D mm	Weight (approx.) kg	MICROMASTER Order No.	MICROMASTER Vector Order No.
MM12/2	MMV12/2	0.12	0.75	0.9	1.8	1.1	147x73x141	0.9	**6SE9210-7CA40**	**6SE3210-7CA40**
MM25/2	MMV25/2	0.25	1.5	1.7	3.2	1.9	147x73x141	0.9	**6SE9211-5CA40**	**6SE3211-5CA40**
MM37/2	MMV37/2	0.37	2.1	2.3	4.6	2.7	147x73x141	0.9	**6SE9212-1CA40**	**6SE3212-1CA40**
MM55/2	MMV55/2	0.55	2.6	3.0	6.2	3.6	147x73x141	0.9	**6SE9212-8CA40**	**6SE3212-8CA40**
MM75/2	MMV75/2	0.75	3.5	3.9	8.2	4.7	147x73x141	0.9	**6SE9213-6CA40**	**6SE3213-6CA40**
MM110/2	MMV110/2	1.1	4.8	5.5	11	6.4	184x149x172	2.4	**6SE9215-2CB40**	**6SE3215-2CB40**
MM150/2	MMV150/2	1.5	6.6	7.4	14.4	8.3	184x149x172	2.4	**6SE9216-8CB40**	**6SE3216-8CB40**
MM220/2	MMV220/2	2.2	9.0	10.4	20.2	11.7	215x185x195	4.8	**6SE9221-0CC40**	**6SE3221-0CC40**
MM300/2 1)	MMV300/2 1)	3.0	11.8	13.6	28.3	16.3	215x185x195	4.8	**6SE9221-3CC40**	**6SE3221-3CC40**
MM400/2	MMV400/2	4.0	15.9	17.5	-	21.1	215x185x195	4.8	**6SE9221-8CC13**	**6SE3221-8CC40**

1) For single-phase voltages, MMV300 and MMV300/2 require an external reactor (e.g. 4EM4807-8CB) and a 32 A line fuse

MICROMASTER/MICROMASTER Vector, 3-ph. 380V - 500V AC±10%, without filter
IP20 (NEMA 1)

Drive inverter		Rated motor power	Rated output current		Maximum continuous output current		Input current	Dimensions H x W x D	Weight (approx.)	Drive inverter	
MICRO-MASTER Type	MICRO-MASTER Vector Type	kW	400 V A	500 V A	400 V A	500 V A	A	mm	kg	MICROMASTER Order No.	MICROMASTER Vector Order No.
MM37/3	MMV37/3	0.37	1.05	0.95	1.2	1.06	2.2	147x73x141	0.9	**6SE9211-1DA40**	**6SE3211-1DA40**
MM55/3	MMV55/3	0.55	1.5	1.3	1.6	1.45	2.8	147x73x141	0.9	**6SE9211-4DA40**	**6SE3211-4DA40**
MM75/3	MMV75/3	0.75	2.0	1.8	2.1	1.9	3.7	147x73x141	0.9	**6SE9212-0DA40**	**6SE3212-0DA40**
MM110/3	MMV110/3	1.1	2.8	2.5	3.0	2.7	4.9	147x73x141	0.9	**6SE9212-7DA40**	**6SE3212-7DA40**
MM150/3	MMV150/3	1.5	3.7	3.3	4.0	3.6	5.9	147x73x141	0.9	**6SE9214-0DA40**	**6SE3214-0DA40**
MM220/3	MMV220/3	2.2	5.2	4.6	5.9	5.3	8.8	184x149x172	2.4	**6SE9215-8DB40**	**6SE3215-8DB40**
MM300/3	MMV300/3	3.0	6.8	6.0	7.7	6.9	11.1	184x149x172	2.4	**6SE9217-3DB40**	**6SE3217-3DB40**
MM400/3	MMV400/3	4.0	9.2	8.1	10.2	9.1	13.6	215x185x195	4.8	**6SE9221-0DC40**	**6SE3221-0DC40**
MM550/3	MMV550/3	5.5	11.8	10.4	13.2	11.8	17.1	215x185x195	4.8	**6SE9221-3DC40**	**6SE3221-3DC40**
MM750/3	MMV750/3	7.5	15.80	13.9	17.0	15.2	22.1	215x185x195	4.8	**6SE9221-5DC40**	**6SE3221-5DC40**

MICROMASTER/MICROMASTER Vector, 3-ph. 380V - 480V AC±10%, with integrated filter, Class A,
IP20 (NEMA 1)

Drive inverter		Rated motor power	Rated output current		Maximum continuous output current		Input current	Dimensions H x W x D	Weight (approx.)	Drive inverter	
MICRO-MASTER Type	MICRO-MASTER Vector Type	kW	400 V A	480V A	400 V A	480V A	A	mm	kg	MICROMASTER Order No.	MICROMASTER Vector Order No.
MM220/3F	MMV220/3F	2.2	5.2	4.6	5.9	5.3	8.8	184x149x172	2.4	**6SE9215-8DB50**	**6SE3215-8DB50**
MM300/3F	MMV300/3F	3.0	6.8	6.0	7.7	6.9	11.1	184x149x172	2.4	**6SE9217-3DB50**	**6SE3217-3DB50**
MM400/3F	MMV400/3F	4.0	9.2	8.1	10.2	9.1	13.6	215x185x195	4.8	**6SE9221-0DC50**	**6SE3221-0DC50**
MM550/3F	MMV550/3F	5.5	11.8	10.4	13.2	11.8	17.1	215x185x195	4.8	**6SE9221-3DC50**	**6SE3221-3DC50**
MM750/3F	MMV750/3F	7.5	15.80	13.9	17.0	15.2	22.1	215x185x195	4.8	**6SE9221-5DC50**	**6SE3221-5DC50**

5.2 MIDIMASTER Vector

MIDIMASTER Vector, 3-ph. 208 V – 240 V AC±10%, without filter
IP21 (NEMA 1)

Drive inverter	Rated output current at 2) M = const.	Rated output current at 1) 2) M ~ n²	Input current (max. cont. current)	Rated motor output at M = const.		Rated motor output at M ~ n²		Dimensions H x W x D	Weight approx.	Drive inverter
Type	A	A	A	kW	hp	kW	hp	mm	kg	Order No.
MDV550/2	22	28	32	5.5	7.5	7.5	10	450x275x210	11	**6SE3222-3CG40**
MDV750/2	28	42	45	7.5	10	11	15	550x275x210	14.5	**6SE3223-1CG40**
MDV1100/2	42	-	61	11	15	-	-	550x275x210	15.5	**6SE3224-2CH40**
MDV1500/2	54	68	75	15	20	18.5	25	650x275x285	26.5	**6SE3225-4CH40**
MDV1850/2	68	80	87	18.5	25	22	30	650x275x285	27.0	**6SE3226-8CJ40**
MDV2200/2	80	95	100	22	30	30	40	650x275x285	27.5	**6SE3227-5CJ40**
MDV3000/2	104	130	143	30	40	37	50	850x420x310	55.0	**6SE3231-0CK40**
MDV3700/2	130	154	170	37	50	45	60	850x420x310	55.5	**6SE3231-3CK40**
MDV4500/2	154	-	170	45	60	-	-	850x420x310	56.5	**6SE3231-5CK40**

MIDIMASTER Vector, 3-ph. 380 – 500V AC±10%, without filter
IP21 (NEMA 1)

Drive inverter	Rated output current at 2) M = const.	Rated output current at 1) 2) M ~ n²	Input current at 400V (max. cont. current)	Rated motor output at M = const.		Rated motor output at M ~ n²		Dimensions H x W x D	Weight approx.	Drive inverter
Type	A	A	A	kW	hp	kW	hp	mm	kg	Order No.
MDV750/3	19	23.5	30	7.5	10	11	15	450x275x210	11.5	**6SE3221-7DG40**
MDV1100/3	26	30	32	11	15	15	20	450x275x210	12.0	**6SE3222-4DG40**
MDV1500/3	32	37	41	15	20	18.5	25	550x275x210	16.0	**6SE3223-0DH40**
MDV1850/3	38	43.5	49	18.5	25	22	30	550x275x210	17.0	**6SE3223-5DH40**
MDV2200/3	45	58	64	22	30	30	40	650x275x285	27.5	**6SE3224-2DJ40**
MDV3000/3	58	71	79	30	40	37	50	650x275x285	28.0	**6SE3225-5DJ40**
MDV3700/3	72	84	96	37	50	45	60	650x275x285	28.5	**6SE3226-8DJ40**
MDV4500/3	84	102	113	45	60	55	75	850x420x310	57.0	**6SE3228-4DK40**
MDV5500/3	102	138	152	55	75	75	100	850x420x310	58.5	**6SE3231-0DK40**
MDV7500/3	138	168	185	75	100	90	120	850x420x310	60.0	**6SE3231-4DK40**

MIDIMASTER Vector, 3-ph. 525 – 575V AC±15%, without filter
IP21 (NEMA 1)

Drive inverter	Rated output current at 2) M = const.	Rated output current at 1) 2) M ~ n²	Input current (max. cont. current)	Rated motor output at M = const.		Rated motor output at M ~ n²		Dimensions H x W x D	Weight approx.	Drive inverter
Type	A	A	A	kW	hp	kW	hp	mm	kg	Order No.
MDV220/4	3.9	6.1	7	2.2	3	4	5	450x275x210	11.0	**6SE3213-8FG40**
MDV400/4	6.1	9	10	4	5	5.5	7.5	450x275x210	11.5	**6SE3216-1FG40**
MDV550/4	9	11	12	5.5	7.5	7.5	10	450x275x210	11.5	**6SE3218-0FG40**
MDV750/4	11	17	18	7.5	10	11	15	450x275x210	11.5	**6SE3221-1FG40**
MDV1100/4	17	22	24	11	15	15	20	450x275x210	12.0	**6SE3221-7FG40**
MDV1500/4	22	27	29	15	20	18.5	25	550x275x210	16.0	**6SE3222-2FH40**
MDV1850/4	27	32	34	18.5	25	22	30	550x275x210	17.0	**6SE3222-7FH40**
MDV2200/4	32	41	45	22	30	30	40	650x275x285	27.5	**6SE3223-2FJ40**
MDV3000/4	41	52	55	30	40	37	50	650x275x285	28.5	**6SE3224-1FJ40**
MDV3700/4	52	62	65	37	50	45	60	650x275x285	28.5	**6SE3225-2FJ40**

1) Overload capability, 10% for 60s

2) Based on a 400V input voltage, for other voltages the current is inversely proportional.

MIDIMASTER Vector, 3-ph. 208 V - 240 V AC±10%, with integrated filter, Class A, IP20 (NEMA 1)

Drive inverter	Rated output current at 2) M = const.	Rated output current at 1) 2) M ~ n²	Input current (max. cont. current)	Rated motor output at M = const.		Rated motor output at M ~ n²		Dimensions H x W x D	Weight approx.	Drive inverter
Type	A	A	A	kW	hp	kW	hp	mm	kg	Order No.
MDV550/2	22	28	32	5.5	7.5	7.5	10	700x275x210	18	**6SE3222-3CG50**
MDV750/2	28	42	45	7.5	10	11	15	800x275x210	22	**6SE3223-1CG50**
MDV1100/2	42	-	61	11	15	-	-	800x275x210	23	**6SE3224-2CH50**
MDV1500/2	54	68	75	15	20	18.5	25	920x275x285	37	**6SE3225-4CH50**
MDV1850/2	68	80	87	18.5	25	22	30	920x275x285	38	**6SE3226-8CJ50**
MDV2200/2	80	95	100	22	30	30	40	920x275x285	38	**6SE3227-5CJ50**
MDV3000/2	104	130	143	30	40	37	50	1150x420x310	85	**6SE3231-0CK50**
MDV3700/2	130	154	170	37	50	45	60	1150x420x310	86	**6SE3231-3CK50**
MDV4500/2	154	-	170	45	60	-	-	1150x420x310	87	**6SE3231-5CK50**

MIDIMASTER Vector, 3-ph. 380 – 460V AC±10%, with integrated filter, Class A, IP20 (NEMA 1)

Drive inverter	Rated output current at 2) M = const.	Rated output current at 1) 2) M ~ n²	Input current at 400V (max. cont. current)	Rated motor output at M = const.		Rated motor output at M ~ n²		Dimensions H x W x D	Weight approx.	Drive inverter
Type	A	A	A	kW	hp	kW	hp	mm	kg	Order No.
MDV750/3	19	23.5	30	7.5	10	11	15	700x275x210	19	**6SE3221-7DG50**
MDV1100/3	26	30	32	11	15	15	20	700x275x210	19	**6SE3222-4DG50**
MDV1500/3	32	37	41	15	20	18.5	25	800x275x210	23	**6SE3223-0DH50**
MDV1850/3	38	43.5	49	18.5	25	22	30	800x275x210	24	**6SE3223-5DH50**
MDV2200/3	45	58	64	22	30	30	40	920x275x285	38	**6SE3224-2DJ50**
MDV3000/3	58	71	79	30	40	37	50	920x275x285	39	**6SE3225-5DJ50**
MDV3700/3	72	84	96	37	50	45	60	920x275x285	39	**6SE3226-8DJ50**
MDV4500/3	84	102	113	45	60	55	75	1150x420x310	87	**6SE3228-4DK50**
MDV5500/3	102	138	152	55	75	75	100	1150x420x310	88	**6SE3231-0DK50**
MDV7500/3	138	168	185	75	100	90	120	1150x420x310	90	**6SE3231-4DK50**

1) Overload capability, 10% for 60s

2) Based on a 400V input voltage, for other voltages the current is inversely proportional.

MIDIMASTER Vector, 3-ph. 208 – 240V AC±10%, without filter
IP56 (NEMA 4/12)

Drive inverter	Rated output current at 2) M = const.	Rated output current at 1) 2) M ~ n²	Input current (max. cont. current)	Rated motor output at M = const.		Rated motor output at M ~ n²		Dimensions 3) H x W x D	Weight approx.	Drive inverter
Type	A	A	A	kW	hp	kW	hp	mm	kg	Order No.
MDV550/2	22	28	32	5.5	7.5	7.5	10	675x360x351	30	**6SE3222-3CS45**
MDV750/2	28	42	45	7.5	10	11	15	775x360x422	39	**6SE3223-1CS45**
MDV1100/2	42	-	61	11	15	-	-	775x360x422	40	**6SE3224-2CS45**
MDV1500/2	54	68	75	15	20	18.5	25	875x360x483	50	**6SE3225-4CS45**
MDV1850/2	68	80	87	18.5	25	22	30	875x360x483	52	**6SE3226-8CS45**
MDV2200/2	80	95	100	22	30	30	40	875x360x483	54	**6SE3227-5CS45**
MDV3000/2	104	130	143	30	40	37	50	1150x500x570	95	**6SE3231-0CS45**
MDV3700/2	130	154	170	37	50	45	60	1150x500x570	96	**6SE3231-3CS45**
MDV4500/2	154	-	170	45	60	-	-	1150x500x570	97	**6SE3231-5CS45**

MIDIMASTER Vector, 3-ph. 380 – 500V AC±10%, without filter
IP56 (NEMA 4/12)

Drive inverter	Rated output current at 2) M = const.	Rated output current at 1) 2) M ~ n²	Input current at 400V (max. cont. current)	Rated motor output at M = const.		Rated motor output at M ~ n²		Dimensions 3) H x W x D	Weight approx.	Drive inverter
Type	A	A	A	kW	hp	kW	hp	mm	kg	Order No.
MDV750/3	19	23.5	30	-	-	11	15	675x360x351	29	**6SE3221-7DS45**
MDV1100/3	26	30	32	11	15	15	20	675x360x351	30	**6SE3222-4DS45**
MDV1500/3	32	37	41	15	20	18.5	25	775x360x422	39	**6SE3223-0DS45**
MDV1850/3	38	43.5	49	18.5	25	22	30	775x360x422	40	**6SE3223-5DS45**
MDV2200/3	45	58	64	22	30	30	40	875x360x483	50	**6SE3224-2DS45**
MDV3000/3	58	71	79	30	40	37	50	875x360x483	52	**6SE3225-5DS45**
MDV3700/3	72	84	96	37	50	45	60	875x360x483	54	**6SE3226-8DS45**
MDV4500/3	84	102	113	45	60	55	75	1150x500x570	97	**6SE3228-4DS45**
MDV5500/3	102	138	152	55	75	75	100	1150x500x570	99	**6SE3231-0DS45**
MDV7500/3	138	168	185	75	100	90	120	1150x500x570	100	**6SE3231-4DS45**

1) Overload capability, 10% for 60s

2) Based on a 400V input voltage, for other voltages the current is inversely proportional.

3) The dimension “D” for drive units with degree of protection IP56 does not include the operator panel cover – please add an extra 25 mm.

MIDIMASTER Vector, 3-ph. 525 – 575V AC±15%, without filter
IP56 (NEMA 4/12)

Drive inverter	Rated output current at 2) M = const.	Rated output current at 1) 2) M ~ n²	Input current (max. cont. current)	Rated motor output at M = const.		Rated motor output at M ~ n²		Dimensions 3) H x W x D	Weight approx.	Drive inverter
Type	A	A	A	kW	hp	kW	hp	mm	kg	Order No.
MDV220/4	3.9	6.1	7	2.2	3	4	5	675x360x351	28	**6SE3213-8FS45**
MDV400/4	6.1	9	10	4	5	5.5	7.5	675x360x351	29	**6SE3216-1FS45**
MDV550/4	9	11	12	5.5	7.5	7.5	10	675x360x351	29	**6SE3218-0FS45**
MDV750/4	11	17	18	7.5	10	11	15	675x360x351	29	**6SE3221-1FS45**
MDV1100/4	17	22	24	11	15	15	20	675x360x351	30	**6SE3221-7FS45**
MDV1500/4	22	27	29	15	20	18.5	25	775x360x422	39	**6SE3222-2FS45**
MDV1850/4	27	32	34	18.5	25	22	30	775x360x422	40	**6SE3222-7FS45**
MDV2200/4	32	41	45	22	30	30	40	875x360x483	50	**6SE3223-2FS45**
MDV3000/4	41	52	55	30	40	37	50	875x360x483	52	**6SE3224-1FS45**
MDV3700/4	52	62	65	37	50	45	60	875x360x483	54	**6SE3225-2FS45**

1) Overload capability, 10% for 60s
2) Based on a 400V input voltage, for other voltages the current is inversely proportional.
3) The dimension “D” for drive units with degree of protection IP56 does not include the operator panel cover – please add an extra 25 mm.

6 Options

OPTIONS
MICROMASTER
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6. Options

6.1 Overview of the options

Options	Order No.	MICROMASTER	MICROMASTER Vector	MIDIMASTER Vector
Grounding strap for MM/MMV, Size A	**6SE3290-0XX87-8FK0**	Available	Available	-
NEMA cable gland plate for Size A	**6SE3290-0XX 87-8NA0**	Available	Available	-
Multi-lingual plain text operator panel (OPM2)	**6SE3290-0XX 87-8BF0**	Available	Available	Included in the scope of supply
CABLE KIT TO MOUNT THE OPM2 IN THE ELECTRICAL CABINET, 3m LONG	**6SE3290-0XX87-8PK0**	Available	Available	Available
Connecting cable RS232, PC – OPM2, 1m	**6SE3290-0XX87-8SK0**	Available	Available	Available
PROFIBUS DP module CB 15 for baud rates up to 12 Mbit/s	**6SE3290-0XX 87-8PB0**	Available	Available	Available
CAN bus module, supports the CAN OPEN protocol	**6SE3290-0XX87-8CB0**	-	Available	Available
DriveMonitor	**Refer to Section 4.8**	Available	Available	Available
Drive ES Basic	**6SW1700-5JA00-1AA0**	Available	Available	Available
Drive ES SIMATIC	**6SW1700-5JC00-1AA0**	Available	Available	Available
Drive ES PCS7	**6SW1700-5JD00-1AA0**	Available	Available	Available
Filter	**Refer to 6.2**	Available	Available	Available
Reactors	**Refer to 6.3**	-	Available	Available
Braking resistor	**Refer to 6.4**	-	Available	Available
Braking module	**Refer to 6.5**	-	-	Available

Caution:

When using the filters and reactors, it is important to observe the voltages and frequencies!

It is not permissible to use radio interference suppression filters and filters to reduce cable-borne faults if the drive inverter is connected to an ungrounded (IT) line supply.

6.2. Ordering data, filters

6.2.1 MICROMASTER & MICROMASTER Vector (1-ph 230V AC)*

Rated power [KW]	Designation	Drive inverter IP20/21 Order No.	radio interference suppression filter Class A* Order No.	radio interference suppression filter Class B* Order No.	Output filter dV/dt Order No.
0.12	MM12	6SE9210-7BA40	Integrated	-	-
0.12	MM12/2	6SE9210-7CA40	-	**6SE3290-0BA87-0FB0**	-
0.12	MMV12	6SE3210-7BA40	Integrated	-	-
0.12	MMV12/2	6SE3210-7CA40	-	**6SE3290-0BA87-0FB0**	-
0.25	MM25	6SE9211-5BA40	Integrated	-	-
0.25	MM25/2	6SE9211-5CA40	-	**6SE3290-0BA87-0FB0**	-
0.25	MMV25	6SE3211-5BA40	Integrated	-	-
0.25	MMV25/2	6SE3211-5CA40	-	**6SE3290-0BA87-0FB0**	-
0.37	MM37	6SE9212-1BA40	Integrated	-	-
0.37	MM37/2	6SE9212-1CA40	-	**6SE3290-0BA87-0FB2**	-
0.37	MMV37	6SE3212-1BA40	Integrated	-	-
0.37	MMV37/2	6SE3212-1CA40	-	**6SE3290-0BA87-0FB2**	-
0.55	MM55	6SE9212-8BA40	Integrated	-	-
0.55	MM55/2	6SE9212-8CA40	-	**6SE3290-0BA87-0FB2**	-
0.55	MMV55	6SE3212-8BA40	Integrated	-	-
0.55	MMV55/2	6SE3212-8CA40	-	**6SE3290-0BA87-0FB2**	-
0.75	MM75	6SE9213-6BA40	Integrated	-	-
0.75	MM75/2	6SE9213-6CA40	-	**6SE3290-0BA87-0FB2**	-
0.75	MMV75	6SE3213-6BA40	Integrated	-	-
0.75	MMV75/2	6SE3213-6CA40	-	**6SE3290-0BA87-0FB2**	-
1.1	MM110	6SE9215-2BB40	Integrated	-	-
1.1	MM110/2	6SE9215-2CB40	-	**6SE3290-0BB87-0FB4**	-
1.1	MMV110	6SE3215-2BB40	Integrated	-	-
1.1	MMV110/2	6SE3215-2CB40	-	**6SE3290-0BB87-0FB4**	-
1.5	MM150	6SE9216-8BB40	Integrated	-	-
1.5	MM150/2	6SE9216-8CB40	-	**6SE3290-0BB87-0FB4**	-
1.5	MMV150	6SE3216-8BB40	Integrated	-	-
1.5	MMV150/2	6SE3216-8CB40	-	**6SE3290-0BB87-0FB4**	-
2.2	MM220	6SE9221-0BC40	Integrated	-	-
2.2	MM220/2	6SE9221-0CC40	-	**6SE3290-0BC87-0FB4**	-
2.2	MMV220	6SE3221-0BC40	Integrated	-	-
2.2	MMV220/2	6SE3221-0CC40	-	**6SE3290-0BC87-0FB4**	-
3.0	MM300	6SE9221-3BC40	Integrated	-	-
3.0	MM300/2	6SE9221-3CC40	-	**6SE3290-0BC87-0FB4**	-
3.0	MMV300	6SE3221-3BC40	Integrated	-	-
3.0	MMV300/2	6SE3221-3CC40	-	**6SE3290-0BC87-0FB4**	-

* Technical data refer to Chapter 3
The maximum line voltage when using the radio interference suppression filter is 1-ph 208V - 240V +/-10% AC

** The maximum output frequency when using the dv/dt filter is 300Hz
The maximum pulse frequency when using the dv/dt filter is 4 kHz

6.2.2 MICROMASTER & MICROMASTER Vector (3-ph 230V AC)*

Rated power [KW]	Designation	Drive inverter IP20/21 Order No.	radio interference suppression filter Class A* Order No.	radio interference suppression filter Class B* Order No.	Output filter dV/dt** f_{max} = 300 Hz f_{puls} <= 4 kHz Order No.
0.12	MM12/2	6SE9210-7CA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	-
0.12	MMV12/2	6SE3210-7CA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	-
0.25	MM25/2	6SE9211-5CA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	-
0.25	MMV25/2	6SE3211-5CA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	-
0.37	MM37/2	6SE9212-1CA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	-
0.37	MMV37/2	6SE3212-1CA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	-
0.55	MM55/2	6SE9212-8CA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	-
0.55	MMV55/2	6SE3212-8CA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	-
0.75	MM75/2	6SE9213-6CA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	-
0.75	MMV75/2	6SE3213-6CA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	-
1.1	MM110/2	6SE9215-2CB40	**6SE3290-0DB87-0FA3**	**6SE3290-0DB87-0FB3**	-
1.1	MMV110/2	6SE3215-2CB40	**6SE3290-0DB87-0FA3**	**6SE3290-0DB87-0FB3**	-
1.5	MM150/2	6SE9216-8CB40	**6SE3290-0DB87-0FA3**	**6SE3290-0DB87-0FB3**	-
1.5	MMV150/2	6SE3216-8CB40	**6SE3290-0DB87-0FA3**	**6SE3290-0DB87-0FB3**	-
2.2	MM220/2	6SE9221-0CC40	**6SE3290-0DC87-0FA4**	**6SE3290-0DC87-0FB4**	-
2.2	MMV220/2	6SE3221-0CC40	**6SE3290-0DC87-0FA4**	**6SE3290-0DC87-0FB4**	-
3.0	MM300/2	6SE9221-3CC40	**6SE3290-0DC87-0FA4**	**6SE3290-0DC87-0FB4**	-
3.0	MMV300/2	6SE3221-3CC40	**6SE3290-0DC87-0FA4**	**6SE3290-0DC87-0FB4**	-
4.0	MM400/2	6SE9221-8CC13	**6SE3290-0DC87-0FA4**	**6SE3290-0DC87-0FB4**	-
4.0	MMV400/2	6SE3221-8CC40	**6SE3290-0DC87-0FA4**	**6SE3290-0DC87-0FB4**	-

* Technical data refer to Chapter 3
The maximum line voltage when using the radio interference suppression filter is 1-ph 208V - 240V +/-10% AC

** The maximum output frequency when using the dv/dt filter is 300Hz
The maximum pulse frequency when using the dv/dt filter is 4 kHz

6.2.3 MICROMASTER & MICROMASTER Vector (3-ph 400V AC)*

Rated power [KW]	Designation	Drive inverter IP20/21 Order No.	radio interference suppression filter Class A* Order No.	radio interference suppression filter Class B* Order No.	Output filter dV/dt** Order No.
0.37	MM37/3	6SE9211-1DA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	**6SE7016-2FB87-1FD0**
0.37	MMV37/3	6SE3211-1DA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	**6SE7016-2FB87-1FD0**
0.55	MM55/3	6SE9211-4DA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	**6SE7016-2FB87-1FD0**
0.55	MMV55/3	6SE3211-4DA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	**6SE7016-2FB87-1FD0**
0.75	MM75/3	6SE9213-6DA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	**6SE7016-2FB87-1FD0**
0.75	MMV75/3	6SE3213-6DA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	**6SE7016-2FB87-1FD0**
1.1	MM110/3	6SE9212-7DA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	**6SE7016-2FB87-1FD0**
1.1	MMV110/3	6SE3212-2DA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	**6SE7016-2FB87-1FD0**
1.5	MM150/3	6SE9214-0DA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	**6SE7016-2FB87-1FD0**
1.5	MMV150/3	6SE3214-0DA40	**6SE3290-0DA87-0FA1**	**6SE3290-0DA87-0FB1**	**6SE7016-2FB87-1FD0**
2.2	MM220/3	6SE9215-8DB40	**6SE3290-0DB87-0FA3**	**6SE3290-0DB87-0FB3**	**6SE7016-2FB87-1FD0**
2.2	MM220/3F	6SE9215-8DB50	**Integrated**	-	**6SE7016-2FB87-1FD0**
2.2	MMV220/3	6SE3215-8DB40	**6SE3290-0DB87-0FA3**	**6SE3290-0DB87-0FB3**	**6SE7016-2FB87-1FD0**
2.2	MMV220/3F	6SE3215-8DB50	**Integrated**	-	**6SE7016-2FB87-1FD0**
3.0	MM300/3	6SE9217-3DB40	**6SE3290-0DB87-0FA3**	**6SE3290-0DB87-0FB3**	**6SE7021-5FB87-1FD0**
3.0	MM300/3F	6SE9217-3DB50	**Integrated**	-	**6SE7021-5FB87-1FD0**
3.0	MMV300/3	6SE3217-3DB40	**6SE3290-0DB87-0FA3**	**6SE3290-0DB87-0FB3**	**6SE7021-5FB87-1FD0**
3.0	MMV300/3F	6SE3217-3DB50	**Integrated**	-	**6SE7021-5FB87-1FD0**
4.0	MM400/3	6SE9221-0DC40	**6SE3290-0DC87-0FA4**	**6SE3290-0DC87-0FB4**	**6SE7021-5FB87-1FD0**
4.0	MM400/3F	6SE9221-0DC50	**Integrated**	-	**6SE7021-5FB87-1FD0**
4.0	MMV400/3	6SE3221-0DC40	**6SE3290-0DC87-0FA4**	**6SE3290-0DC87-0FB4**	**6SE7021-5FB87-1FD0**
4.0	MMV400/3F	6SE3221-0DC50	**Integrated**	-	**6SE7021-5FB87-1FD0**
5.5	MM550/3	6SE9221-3DC40	**6SE3290-0DC87-0FA4**	**6SE3290-0DC87-0FB4**	**6SE7021-5FB87-1FD0**
5.5	MM550/3F	6SE9221-3DC50	**Integrated**	-	**6SE7021-5FB87-1FD0**
5.5	MMV550/3	6SE3221-3DC40	**6SE3290-0DC87-0FA4**	**6SE3290-0DC87-0FB4**	**6SE7021-5FB87-1FD0**
5.5	MMV550/3F	6SE3221-3DC50	**Integrated**	-	**6SE7021-5FB87-1FD0**
7.5	MM750/3	6SE9221-5DC40	**6SE3290-0DC87-0FA4**	**6SE3290-0DC87-0FB4**	**6SE7021-5FB87-1FD0**
7.5	MM750/3F	6SE9221-5DC50	**Integrated**	-	**6SE7021-5FB87-1FD0**
7.5	MMV750/3	6SE3221-5DC40	**6SE3290-0DC87-0FA4**	**6SE3290-0DC87-0FB4**	**6SE7021-5FB87-1FD0**
7.5	MMV750/3F	6SE3221-5DC50	**Integrated**	-	**6SE7021-5FB87-1FD0**

* Technical data refer to Chapter 3
The maximum line voltage when using the radio interference suppression filter is 3-ph 380V - 460V +/-10% AC

** The maximum output frequency when using the dv/dt filter is 300Hz
The maximum pulse frequency when using the dv/dt filter is 4 kHz

6.2.4 MIDIMASTER Vector (3-ph 230V AC)*

Rated power [KW]	Designation	Drive inverter IP20/21 Order No.	radio interference suppression filter Class A* Order No.	radio interference suppression filter Class B* Order No.	Output filter dV/dt** Order No.
5.5 (CT)	MDV550/2	6SE3222-3CG40	**6SE3290-0DG87-0FA5**	**6SE2100-1FC20**	
5.5 (CT)	MDV550/2F	6SE3222-3CG50	**Integrated**	**-**	
7.5 (CT)	MDV750/2	6SE3223-1CG40	**6SE3290-0DH87-0FA5**	**6SE2100-1FC20**	
7.5 (CT)	MDV750/2F	6SE3223-1CG50	**Integrated**	**-**	
11 (CT)	MDV1100/2	6SE3224-2CH40	**6SE3290-0DJ87-0FA6**	**6SE2100-1FC21**	
11 (CT)	MDV1100/2F	6SE3224-2CH50	**Integrated**	**-**	
15 (CT) 18.5 (VT)	MDV1500/2	6SE3225-4CH40	**6SE3290-0DJ87-0FA6**	**6SE2100-1FC21**	
15 (CT) 18.5 (VT)	MDV1500/2F	6SE3225-4CH50	**Integrated**	**-**	
18.5 (CT) 22 (VT)	MDV1850/2	6SE3226-8CJ40	**6SE3290-0DJ87-0FA6**	**6SE2100-1FC21**	
18.5 (CT) 22 (VT)	MDV1850/2F	6SE3226-8CJ50	**Integrated**	**-**	
22 (CT) 30 (VT)	MDV2200/2	6SE3227-5CJ40	**6SE3290-0DJ87-0FA6**	**6SE3290-0DK87-0FB7**	
22 (CT) 30 (VT)	MDV2200/2F	6SE3227-5CJ50	**Integrated**	**-**	
30 (CT) 37 (VT)	MDV3000/2	6SE3231-0CK40	**6SE3290-0DK87-0FA7**	**6SE3290-0DK87-0FB7**	
30 (CT) 37 (VT)	MDV3000/2F	6SE3231-0CK50	**Integrated**	**-**	
37 (CT) 45 (VT)	MDV3700/2	6SE3231-3CK40	**6SE3290-0DK87-0FA7**	**6SE3290-0DK87-0FB7**	
37 (CT) 45 (VT)	MDV3700/2	6SE3231-3CK50	**Integrated**	**-**	
45 (CT)	MDV4500/2	6SE3231-5CK40	**6SE3290-0DK87-0FA7**	**6SE3290-0DK87-0FB7**	

* Technical data refer to Chapter 3
The maximum line voltage when using the radio interference suppression filter is 3-ph 208V - 240V +/-10% AC

** The maximum output frequency when using the dv/dt filter is 300Hz
The maximum pulse frequency when using the dv/dt filter is 4 kHz

6.2.5 MIDIMASTER Vector (3-ph 400V AC)*

Rated power [KW]	Designation	Drive inverter IP20/21 Order No.	radio interference suppression filter Class A* Order No.	radio interference suppression filter Class B* Order No.	Output filter dV/dt** f_{max} = 300 Hz f_{puls} <= 4 kHz Order No.
7.5 (CT) 11 (VT)	MDV750/3	6SE3221-7DG40	**6SE3290-0DG87-0FA5**	**6SE2100-1FC20**	**6SE7021-5FB87-1FD0**
7.5 (CT) 11 (VT)	MDV750/3F	6SE3221-7DG50	**Integrated**	**-**	**6SE7021-5FB87-1FD0**
11 (CT) 15 (VT)	MDV1100/3	6SE3222-4DG40	**6SE3290-0DG87-0FA5**	**6SE2100-1FC20**	**6SE7022-2FC87-1FD0**
11 (CT) 15 (VT)	MDV1100/3F	6SE3222-4DG50	**Integrated**	**-**	**6SE7022-2FC87-1FD0**
15 (CT) 18.5 (VT)	MDV1500/3	6SE3223-0DH40	**6SE3290-0DH87-0FA5**	**6SE2100-1FC20**	**6SE7023-4FC87-1FD0**
15 (CT) 18.5 (VT)	MDV1500/3F	6SE3223-0DH40	**Integrated**	**-**	**6SE7023-4FC87-1FD0**
18.5 (CT) 22 (VT)	MDV1850/3	6SE3223-5DH40	**6SE3290-0DH87-0FA5**	**6SE2100-1FC20**	**6SE7024-7FC87-1FD0**
18.5 (CT) 22 (VT)	MDV1850/3F	6SE3223-5DH50	**Integrated**	**-**	**6SE7024-7FC87-1FD0**
22 (CT) 30 (VT)	MDV2200/3	6SE3224-2DJ40	**6SE3290-0DJ87-0FA6**	**6SE2100-1FC21**	**6SE7024-7FC87-1FD0**
22 (CT) 30 (VT)	MDV2200/3F	6SE3224-2DJ50	**Integrated**	**-**	**6SE7024-7FC87-1FD0**
30 (CT) 37 (VT)	MDV3000/3	6SE3225-5DJ40	**6SE3290-0DJ87-0FA6**	**6SE2100-1FC21**	**6SE7026-0HE87-1FD0**
30 (CT) 37 (VT)	MDV3000/3F	6SE3225-5DJ50	**Integrated**	**-**	**6SE7026-0HE87-1FD0**
37 (CT) 45 (VT)	MDV3700/3	6SE3226-8DJ40	**6SE3290-0DJ87-0FA6**	**6SE2100-1FC21 6SE3290-0DK87-0FB7**	**6SE7028-0HE87-1FD0**
37 (CT) 45 (VT)	MDV3700/3F	6SE3226-8DJ50	**Integrated**	**-**	**6SE7028-0HE87-1FD0**
45 (CT) 55 (VT)	MDV4500/3	6SE3228-4DK40	**6SE3290-0DK87-0FA7**	**6SE3290-0DK87-0FB7**	**6SE7031-7HS87-1FD0**
45 (CT) 55 (VT)	MDV4500/3F	6SE3228-4DK50	**Integrated**	**-**	**6SE7031-7HS87-1FD0**
55 (CT) 75 (VT)	MDV5500/3	6SE3231-0DK40	**6SE3290-0DK87-0FA7**	**6SE3290-0DK87-0FB7**	**6SE7031-7HS87-1FD0**
55 (CT) 75 (VT)	MDV5500/3F	6SE3231-0DK50	**Integrated**	**-**	**6SE7031-7HS87-1FD0**
75 (CT) 90 (VT)	MDV7500/3	6SE3231-4DK40	**6SE3290-0DK87-0FA7**	**6SE3290-0DK87-0FB7**	**6SE7032-3HS87-1FD0**
75 (CT) 90 (VT)	MDV7500/3F	6SE3231-4DK50	**Integrated**	**-**	**6SE7032-3HS87-1FD0**

* Technical data refer to Chapter 3
The maximum line voltage when using the radio interference suppression filter is 3-ph 380V - 460V +/-10% AC
External Class A filters can be integrated into IP56 (NEMA 4/12) / drive units.
For Class B filters, a separate enclosure is required in compliance with the required degree of protection

** The maximum output frequency when using the dv/dt filter is 300Hz
The maximum pulse frequency when using the dv/dt filter is 4 kHz

6.2.6 MIDIMASTER Vector (3-ph. 575V AC)

Rated power [KW]	Designation	Drive inverter IP21 Order No.	Radio interference suppression filter Class A* Order No.	Radio interference suppression filter Class B* Order No.	Output filter dV/dt** Order No.
2.2 (CT) 4 (VT)	MDV220/4	6SE3213-8FG40	-	-	**6SE7021-5FB87-1FD0**
4 (CT) 5.5 (VT)	MDV400/4	6SE3216-1FG40	-	-	**6SE7021-5FB87-1FD0**
5.5 (CT) 7.5 (VT)	MDV550/4	6SE3218-0FG40	-	-	**6SE7021-5FB87-1FD0**
7.5 (CT) 11 (VT)	MDV750/4	6SE3221-1FG40	-	-	**6SE7021-5FB87-1FD0**
11 (CT) 15 (VT)	MDV1100/4	6SE3221-7FG40	-	-	**6SE7022-2FC87-1FD0**
15 (CT) 18.5 (VT)	MDV1500/4	6SE3222-2FH40	-	-	**6SE7023-4FC87-1FD0**
18.5 (CT) 22 (VT)	MDV1850/4	6SE3222-7FH40	-	-	**6SE7023-4FC87-1FD0**
22 (CT) 30 (VT)	MDV2200/4	6SE3223-2FJ40	-	-	**6SE7023-4FC87-1FD0**
30 (CT) 37 (VT)	MDV3000/4	6SE3224-1FJ40	-	-	**6SE7024-7FC87-1FD0**
37 (CT) 45 (VT)	MDV3700/4	6SE3225-2FJ40	-	-	**6SE7024-7FC87-1FD0**

* Technical data refer to Chapter 3

** The maximum output frequency when using the dv/dt filter is 300Hz
The maximum pulse frequency when using the dv/dt filter is 4 kHz

6.3. Ordering data, reactors

6.3.1 MICROMASTER & MICROMASTER Vector (1-ph 230V AC)*

Rated power [KW]	Designation	Drive inverter IP20/21 Order No.	line reactor 2%* Order No.	line reactor 4% Order No.	Output reactor** Order No.
0.12	MM12	6SE9210-7BA40	**6SE6400-3CC00-4AB0**	-	**6SE6400-3TC00-4AD0**
0.12	MM12/2	6SE9210-7CA40	**6SE6400-3CC00-4AB0**	-	**6SE6400-3TC00-4AD0**
0.12	MMV12	6SE3210-7BA40	**6SE6400-3CC00-4AB0**	-	**6SE6400-3TC00-4AD0**
0.12	MMV12/2	6SE3210-7CA40	**6SE6400-3CC00-4AB0**	-	**6SE6400-3TC00-4AD0**
0.25	MM25	6SE9211-5BA40	**6SE6400-3CC00-4AB0**	-	**6SE6400-3TC00-4AD0**
0.25	MM25/2	6SE9211-5CA40	**6SE6400-3CC00-4AB0**	-	**6SE6400-3TC00-4AD0**
0.25	MMV25	6SE3211-5BA40	**6SE6400-3CC00-4AB0**	-	**6SE6400-3TC00-4AD0**
0.25	MMV25/2	6SE3211-5CA40	**6SE6400-3CC00-4AB0**	-	**6SE6400-3TC00-4AD0**
0.37	MM37	6SE9212-1BA40	**6SE6400-3CC01-0AB0**	-	**6SE6400-3TC00-4AD0**
0.37	MM37/2	6SE9212-1CA40	**6SE6400-3CC01-0AB0**	-	**6SE6400-3TC00-4AD0**
0.37	MMV37	6SE3212-1BA40	**6SE6400-3CC01-0AB0**	-	**6SE6400-3TC00-4AD0**
0.37	MMV37/2	6SE3212-1CA40	**6SE6400-3CC01-0AB0**	-	**6SE6400-3TC00-4AD0**
0.55	MM55	6SE9212-8BA40	**6SE6400-3CC01-0AB0**	-	**6SE6400-3TC00-4AD0**
0.55	MM55/2	6SE9212-8CA40	**6SE6400-3CC01-0AB0**	-	**6SE6400-3TC00-4AD0**
0.55	MMV55	6SE3212-8BA40	**6SE6400-3CC01-0AB0**	-	**6SE6400-3TC00-4AD0**
0.55	MMV55/2	6SE3212-8CA40	**6SE6400-3CC01-0AB0**	-	**6SE6400-3TC00-4AD0**
0.75	MM75	6SE9213-6BA40	**6SE6400-3CC01-0AB0**	-	**6SE6400-3TC00-4AD0**
0.75	MM75/2	6SE9213-6CA40	**6SE6400-3CC01-0AB0**	-	**6SE6400-3TC00-4AD0**
0.75	MMV75	6SE3213-6BA40	**6SE6400-3CC01-0AB0**	-	**6SE6400-3TC00-4AD0**
0.75	MMV75/2	6SE3213-6CA40	**6SE6400-3CC01-0AB0**	-	**6SE6400-3TC00-4AD0**
1.1	MM110	6SE9215-2BB40	**6SE6400-3CC02-6BB0**	-	**6SE6400-3TC01-0BD0**
1.1	MM110/2	6SE9215-2CB40	**6SE6400-3CC02-6BB0**	-	**6SE6400-3TC01-0BD0**
1.1	MMV110	6SE3215-2BB40	**6SE6400-3CC02-6BB0**	-	**6SE6400-3TC01-0BD0**
1.1	MMV110/2	6SE3215-2CB40	**6SE6400-3CC02-6BB0**	-	**6SE6400-3TC01-0BD0**
1.5	MM150	6SE9216-8BB40	**6SE6400-3CC02-6BB0**	-	**6SE6400-3TC01-0BD0**
1.5	MM150/2	6SE9216-8CB40	**6SE6400-3CC02-6BB0**	-	**6SE6400-3TC01-0BD0**
1.5	MMV150	6SE3216-8BB40	**6SE6400-3CC02-6BB0**	-	**6SE6400-3TC01-0BD0**
1.5	MMV150/2	6SE3216-8CB40	**6SE6400-3CC02-6BB0**	-	**6SE6400-3TC01-0BD0**
2.2	MM220	6SE9221-0BC40	**4EM4704-3CB**	**4EM4912-2CB**	**6SE3200-3TC03-2CD0**
2.2	MM220/2	6SE9221-0CC40	**4EM4704-3CB**	**4EM4912-2CB**	**6SE3200-3TC03-2CD0**
2.2	MMV220	6SE3221-0BC40	**4EM4807-3CB**	**4EM4912-2CB**	**6SE3200-3TC03-2CD0**
2.2	MMV220/2	6SE3221-0CC40	**4EM4807-3CB**	**4EM4912-2CB**	**6SE3200-3TC03-2CD0**
3.0	MM300	6SE9221-3BC40	**4EM4807-8CB**	**4EM4912-5CB**	**6SE3200-3TC03-2CD0**
3.0	MM300/2	6SE9221-3CC40	**4EM4807-8CB**	**4EM4912-5CB**	**6SE3200-3TC03-2CD0**
3.0	MMV300	6SE3221-3BC40	**4EM4807-8CB**	**4EM4912-5CB**	**6SE3200-3TC03-2CD0**
3.0	MMV300/2	6SE3221-3CC40	**4EM4807-8CB**	**4EM4912-5CB**	**6SE3200-3TC03-2CD0**

* Technical data refer to Chapter 3
6SE64... line reactors can be used for line impedances of ≥ 1% and above and are comparable with 2% reactors.
The maximum line voltage when using the line reactors is 3-ph 208V - 240V +/-10% AC

** Technical data refer to Chapter 3
f_{puls} <= 4 kHz When using output reactors, the pulse frequency should be reduced to 4kHz (P076).
f_{max} 120Hz The maximum output frequency (f_{max} ~ 120Hz) depends on the ratio between the drive inverter output voltage, the voltage drop across the output reactor (V_K) and the motor being used.
The drive inverter can be over-dimensioned as an alternative to using an output reactor (refer to Chapter 3)

6.3.2 MICROMASTER & MICROMASTER Vector (3-ph 230V AC)*

Rated power [KW]	Designation	Drive inverter IP20/21 Order No.	line reactor* Order No.	line reactor 4% Order No.	Output reactor** Order No.
0.12	MM12/2	6SE9210-7CA40	**6SE6400-3CC00-3AC0**	**-**	**6SE6400-3TC00-4AD0**
0.12	MMV12/2	6SE3210-7CA40	**6SE6400-3CC00-3AC0**	**-**	**6SE6400-3TC00-4AD0**
0.25	MM25/2	6SE9211-5CA40	**6SE6400-3CC00-3AC0**	**-**	**6SE6400-3TC00-4AD0**
0.25	MMV25/2	6SE3211-5CA40	**6SE6400-3CC00-3AC0**	**-**	**6SE6400-3TC00-4AD0**
0.37	MM37/2	6SE9212-1CA40	**6SE6400-3CC00-5AC0**	**-**	**6SE6400-3TC00-4AD0**
0.37	MMV37/2	6SE3212-1CA40	**6SE6400-3CC00-5AC0**	**-**	**6SE6400-3TC00-4AD0**
0.55	MM55/2	6SE9212-8CA40	**6SE6400-3CC00-5AC0**	**-**	**6SE6400-3TC00-4AD0**
0.55	MMV55/2	6SE3212-8CA40	**6SE6400-3CC00-5AC0**	**-**	**6SE6400-3TC00-4AD0**
0.75	MM75/2	6SE9213-6CA40	**6SE6400-3CC00-5AC0**	**-**	**6SE6400-3TC00-4AD0**
0.75	MMV75/2	6SE3213-6CA40	**6SE6400-3CC00-5AC0**	**-**	**6SE6400-3TC00-4AD0**
1.1	MM110/2	6SE9215-2CB40	**6SE6400-3CC00-8BC0**	**-**	**6SE6400-3TC01-0BD0**
1.1	MMV110/2	6SE3215-2CB40	**6SE6400-3CC00-8BC0**	**-**	**6SE6400-3TC01-0BD0**
1.5	MM150/2	6SE9216-8CB40	**6SE6400-3CC01-4BD0**	**-**	**6SE6400-3TC01-0BD0**
1.5	MMV150/2	6SE3216-8CB40	**6SE6400-3CC01-4BD0**	**-**	**6SE6400-3TC01-0BD0**
2.2	MM220/2	6SE9221-0CC40	**-**	**4EP3400-1US**	**6SE3200-3TC03-2CD0**
2.2	MMV220/2	6SE3221-0CC40	**-**	**4EP3400-1US**	**6SE3200-3TC03-2CD0**
3.0	MM300/2	6SE9221-3CC40	**-**	**4EP3500-0US**	**6SE3200-3TC03-2CD0**
3.0	MMV300/2	6SE3221-3CC40	**-**	**4EP3500-0US**	**6SE3200-3TC03-2CD0**
4.0	MM400/2	6SE9221-8CC13	**-**	**4EP3600-4US**	**6SE3200-3TC03-2CD0**
4.0	MMV400/2	6SE3221-8CC40		**4EP3600-4US**	**6SE3200-3TC03-2CD0**

* Technical data refer to Chapter 3
6SE64... line reactors can be used for line impedances of ≥ 1% and above and are comparable with 2% reactors.
The maximum line voltage when using the line reactors is 3-ph 208V - 240V +/-10% AC

** Technical data refer to Chapter 3
f_{puls} <= 4 kHz When using output reactors, the pulse frequency should be reduced to 4kHz (P076).
f_{max} 120Hz The maximum output frequency (f_{max} ~ 120Hz) depends on the ratio between the drive inverter output voltage, the voltage drop across the output reactor (V_K) and the motor being used.
The drive inverter can be over-dimensioned as an alternative to using an output reactor (refer to Chapter 3)

6.3.3 MICROMASTER & MICROMASTER Vector (3-ph. 400V AC)+

Rated power [KW]	Designation	Drive inverter IP20/21 Order No.	2% line reactor* Order No.	4% line reactor* Order No.	Output reactor** Order No.
0.37	MM37/3	6SE9211-1DA40	**6SE6400-3CC00-2AD0**	-	**6SE6400-3TC00-4AD0**
0.37	MMV37/3	6SE3211-1DA40	**6SE6400-3CC00-2AD0**	-	**6SE6400-3TC00-4AD0**
0.55	MM55/3	6SE9211-4DA40	**6SE6400-3CC00-2AD0**	-	**6SE6400-3TC00-4AD0**
0.55	MMV55/3	6SE3211-4DA40	**6SE6400-3CC00-2AD0**	-	**6SE6400-3TC00-4AD0**
0.75	MM75/3	6SE9213-6DA40	**6SE6400-3CC00-4AD0**	-	**6SE6400-3TC00-4AD0**
0.75	MMV75/3	6SE3213-6DA40	**6SE6400-3CC00-4AD0**	-	**6SE6400-3TC00-4AD0**
1.1	MM110/3	6SE9212-7DA40	**6SE6400-3CC00-4AD0**	-	**6SE6400-3TC00-4AD0**
1.1	MMV110/3	6SE3212-2DA40	**6SE6400-3CC00-4AD0**	-	**6SE6400-3TC00-4AD0**
1.5	MM150/3	6SE9214-0DA40	**6SE6400-3CC00-6AD0**	-	**6SE6400-3TC00-4AD0**
1.5	MMV150/3	6SE3214-0DA40	**6SE6400-3CC00-6AD0**	-	**6SE6400-3TC00-4AD0**
2.2	MM220/3	6SE9215-8DB40	**6SE6400-3CC01-0BD0**	-	**6SE6400-3TC01-0BD0**
2.2	MM220/3F	6SE9215-8DB50	**6SE6400-3CC01-0BD0**	-	**6SE6400-3TC01-0BD0**
2.2	MMV220/3	6SE3215-8DB40	**6SE6400-3CC01-0BD0**	-	**6SE6400-3TC01-0BD0**
2.2	MMV220/3F	6SE3215-8DB50	**6SE6400-3CC01-0BD0**	-	**6SE6400-3TC01-0BD0**
3.0	MM300/3	6SE9217-3DB40	**6SE6400-3CC01-0BD0**	-	**6SE6400-3TC01-0BD0**
3.0	MM300/3F	6SE9217-3DB50	**6SE6400-3CC01-0BD0**	-	**6SE6400-3TC01-0BD0**
3.0	MMV300/3	6SE3217-3DB40	**6SE6400-3CC01-0BD0**	-	**6SE6400-3TC01-0BD0**
3.0	MMV300/3F	6SE3217-3DB50	**6SE6400-3CC01-0BD0**	-	**6SE6400-3TC01-0BD0**
4.0	MM400/3	6SE9221-0DC40	**4EP3400-1US (4EP3400-3US)**	**3x4EM4807-6CB**	**6SE3200-3TC03-2CD0**
4.0	MM400/3F	6SE9221-0DC50	-- "--	-- "--	**6SE3200-3TC03-2CD0**
4.0	MMV400/3	6SE3221-0DC40	-- "--	-- "--	**6SE3200-3TC03-2CD0**
4.0	MMV400/3F	6SE3221-0DC50	-- "--	-- "--	**6SE3200-3TC03-2CD0**
5.5	MM550/3	6SE9221-3DC40	**4EP3500-0US (4EP3600-8US)**	**4EP3700-7US (4EP3800-8US)**	**6SE3200-3TC03-2CD0**
5.5	MM550/3F	6SE9221-3DC50	-- "--	-- "--	**6SE3200-3TC03-2CD0**
5.5	MMV550/3	6SE3221-3DC40	-- "--	-- "--	**6SE3200-3TC03-2CD0**
5.5	MMV550/3F	6SE3221-3DC50	-- "--	-- "--	**6SE3200-3TC03-2CD0**
7.5	MM750/3	6SE9221-5DC40	**4EP3600-4US (4EP3600-2US)**	**4EP3801-0US (4EP3800-8US)**	**6SE3200-3TC03-2CD0**
7.5	MM750/3F	6SE9221-5DC50	-- "--	-- "--	**6SE3200-3TC03-2CD0**
7.5	MMV750/3	6SE3221-5DC40	-- "--	-- "--	**6SE3200-3TC03-2CD0**
7.5	MMV750/3F	6SE3221-5DC50	-- "--	-- "--	**6SE3200-3TC03-2CD0**

* Technical data refer to Chapter 3
6SE64... line reactors can be used for line impedances of ≥ 1% and above and are comparable with 2% reactors.
The maximum line voltage when using the line reactors is 3-ph 380V - 480V +/-10% AC
For voltages above 480 V, the reactors in brackets should be used.

** Technical data refer to Chapter 3
f_{puls} <= 4 kHz When using output reactors, the pulse frequency should be reduced to 4kHz (P076).
f_{max} 120Hz The maximum output frequency (f_{max} ~ 120Hz) depends on the ratio between the drive inverter output voltage, the voltage drop across the output reactor (V_K) and the motor being used.
The drive inverter can be over-dimensioned as an alternative to using an output reactor (refer to Chapter 3)

6.3.4 MIDIMASTER Vector without integrated A filter (3-ph. 230V AC)

Rated power [KW]	Designation	IP20 IP21 Order No.	2% line reactor* Order No.	4% line reactor* Order No.	Output reactor** Order No.
5.5 (CT)	MDV550/2	6SE3222-3CG40	-	**4EP3600-5US**	**4EP3700-5DS**
7.5 (CT)	MDV750/2	6SE3223-1CG40	-	**4EP3700-2US**	**6SE6400-3TC02-8DC0**
11 (CT)	MDV1100/2	6SE3224-2CH40	-	**4EP3800-2US**	**6SE6400-3TC05-4DD0**
15 (CT) 18.5 (VT)	MDV1500/2	6SE3225-4CH40	-	**4EP3800-7US**	**6SE6400-3TC05-4DD0**
18.5 (CT) 22 (VT)	MDV1850/2	6SE3226-8CJ40	-	**4EP3900-2US**	**6SE6400-3TC08-0ED0**
22 (CT) 30 (VT)	MDV2200/2	6SE3227-5CJ40	-	**4EP3900-2US**	**6SE6400-3TC08-0ED0**
30 (CT) 37 (VT)	MDV3000/2	6SE3231-0CK40	-	**4EP4000-2US**	**6SE6400-3TC15-4FD0**
37 (CT) 45 (VT)	MDV3700/2	6SE3231-3CK40	-	**4EU2451-2UA00**	**6SE6400-3TC15-4FD0**
45 (CT)	MDV4500/2	6SE3231-5CK40	-	**4EU2551-4UA00**	**6SE6400-3TC15-4FD0**

6.3.5 MIDIMASTER Vector with integrated A filter (3-ph. 230V AC)

Rated power [KW]	Designation	IP20 IP21 Order No.	2% line reactor Order No.	4% line reactor Order No.	Output reactor* Order No.
5.5 (CT)	MDV550/2F	6SE3222-3CG50	-	**4EP3600-5US**	**4EP3700-5DS**
7.5 (CT)	MDV750/2F	6SE3223-1CG50	-	**4EP3700-2US**	**6SE6400-3TC02-8DC0**
11 (CT)	MDV1100/2F	6SE3224-2CH50	-	**4EP3800-2US**	**6SE6400-3TC05-4DD0**
15 (CT) 18.5 (VT)	MDV1500/2F	6SE3225-4CH50	-	**4EP3800-7US**	**6SE6400-3TC05-4DD0**
18.5 (CT) 22 (VT)	MDV1850/2F	6SE3226-8CJ50	-	**4EP3900-2US**	**6SE6400-3TC08-0ED0**
22 (CT) 30 (VT)	MDV2200/2F	6SE3227-5CJ50	-	**4EP3900-2US**	**6SE6400-3TC08-0ED0**
30 (CT) 37 (VT)	MDV3000/2F	6SE3231-0CK50	-	**4EP4000-2US**	**6SE6400-3TC15-4FD0**
37 (CT) 45 (VT)	MDV3700/2F	6SE3231-3CK50	-	**4EU2451-2UA00**	**6SE6400-3TC15-4FD0**
45 (CT)	MDV4500/2F	6SE3231-5CK50	-	**4EU2551-4UA00**	**6SE6400-3TC15-4FD0**

* Technical data refer to Chapter 3
For (VT / M~n²), the next largest line reactor should be used.
The maximum line voltage when using the line reactors is 3-ph 208V - 240V +/-10% AC

** Technical data refer to Chapter 3
f_{puls} <= 4 kHz When using output reactors, the pulse frequency should be reduced to 4kHz (P076).
f_{max} 120Hz The maximum output frequency (f_{max} ~ 120Hz) depends on the ratio between the drive inverter output voltage, the voltage drop across the output reactor (V_K) and the motor being used.
The drive inverter can be over-dimensioned as an alternative to using an output reactor (refer to Chapter 3)

6.3.6 MIDIMASTER Vector without integrated A filter (3-ph. 400V AC)

Rated power [kW]	Designation	IP21 Order No.	2% Line reactor* Order No.	4% Line reactor* Order No.	Output reactor** Order No.
7.5 (CT) 11 (VT)	MDV750/3	6SE3221-7DG40	**4EP3600-5US** **(4EP3600-3US)**	**4EP3900-5US** **(4EP4001-0US)**	**4EP3700-5DS**
11 (CT) 15 (VT)	MDV1100/3	6SE3222-4DG40	**4EP3700-2US** **(4EP3700-6US)**	**4EP3900-5US** **(4EP4001-0US)**	**4EP3700-5DS**
15 (CT) 18.5 (VT)	MDV1500/3	6SE3223-0DH40	**4EP3700-5US** **(4EP3700-1US)**	**4EP4001-1US** **(4EP4001-2US)**	**6SE6400-3TC05-4DD0**
18.5 (CT) 22 (VT)	MDV1850/3	6SE3223-5DH40	**4EP3800-2US** **(4EP3801-2US)**	**4EU2451-4UA00** **(4EU2451-5UA00)**	**6SE6400-3TC03-8DD0**
22 (CT) 30 (VT)	MDV2200/3	6SE3224-2DJ40	**4EP3800-7US** **(4EP3900-1US)**	**4EU2451-4UA00** **(4EU2551-1UB00)**	**6SE6400-3TC08-0ED0**
30 (CT) 37 (VT)	MDV3000/3	6SE3225-5DJ40	**4EP3900-2US** **(4EP4000-1US)**	**4EU2551-2UB00** **(4EU2551-3UB00)**	**6SE6400-3TC07-5ED0**
37 (CT) 45 (VT)	MDV3700/3	6SE3226-8DJ40	**4EP4000-2US** **(4EP4000-8US)**	**4EU2751-1UB00** **(4EU2551-3UB00)**	**6SE6400-3TC07-5ED0**
45 (CT) 55 (VT)	MDV4500/3	6SE3228-4DK40	**4EP4000-6US** **(4EP4000-8US)**	**4EU2751-1UB00** **(4EU2751-3UB00)**	**6SE6400-3TC15-4FD0**
55 (CT) 75 (VT)	MDV5500/3	6SE3231-0DK40	**4EU2451-2UA00** **(4EU2551-2UA00)**	**4EU2751-1UB00** **(4EU2751-6UB00)**	**6SE6400-3TC14-5FD0**
75 (CT) 90 (VT)	MDV7500/3	6SE3231-4DK40	**4EU2551-4UA00** **(4EU2551-6UA00)**	**4EU2751-2UB00** **(4EU3052-0UB000A)**	**6SE6400-3TC14-5FD0**

* Technical data refer to Chapter 3
For (VT / M~n²), the next largest line reactor should be used.
The maximum line voltage when using the line reactors is 3-ph 380V - 480V +/-10% AC
For voltages above 480 V, the reactors in brackets should be used.

** Technical data refer to Chapter 3
f_{puls} <= 4 kHz When using output reactors, the pulse frequency should be reduced to 4kHz (P076).
f_{max} 120Hz The maximum output frequency (f_{max} ~ 120Hz) depends on the ratio between the drive inverter output voltage, the voltage drop across the output reactor (V_K) and the motor being used.
The drive inverter can be over-dimensioned as an alternative to using an output reactor (refer to Chapter 3)

6.3.7 MIDIMASTER Vector with integrated A filter (3-ph. 400V AC)

Rated power [kW]	Designation	IP21 Order No.	2% Line reactor* Order No.	4% Line reactor* Order No.	Output reactor* Order No.
7.5 (CT) 11 (VT)	MDV750/3F	6SE3221-7DG50	**4EP3600-5US** **(4EP3600-3US)**	**4EP3900-5US** **(4EP4001-0US)**	**4EP3700-5DS**
11 (CT) 15 (VT)	MDV1100/3F	6SE3222-4DG50	**4EP3700-2US** **(4EP3700-6US)**	**4EP3900-5US** **(4EP4001-0US)**	**4EP3700-5DS**
15 (CT) 18.5 (VT)	MDV1500/3F	6SE3223-0DH50	**4EP3700-5US** **(4EP3700-1US)**	**4EP4001-1US** **(4EP4001-2US)**	**6SE6400-3TC05-4DD0**
18.5 (CT) 22 (VT)	MDV1850/3F	6SE3223-5DH50	**4EP3800-2US** **(4EP3801-2US)**	**4EU2451-4UA00** **(4EU2451-5UA00)**	**6SE6400-3TC03-8DD0**
22 (CT) 30 (VT)	MDV2200/3F	6SE3224-2DJ50	**4EP3800-7US** **(4EP3900-1US)**	**4EU2451-4UA00** **(4EU2551-1UB00)**	**6SE6400-3TC08-0ED0**
30 (CT) 37 (VT)	MDV3000/3F	6SE3225-5DJ50	**4EP3900-2US** **(4EP4000-1US)**	**4EU2551-2UB00** **(4EU2551-3UB00)**	**6SE6400-3TC07-5ED0**
37 (CT) 45 (VT)	MDV3700/3F	6SE3226-8DJ50	**4EP4000-2US** **(4EP4000-8US)**	**4EU2751-1UB00** **(4EU2551-3UB00)**	**6SE6400-3TC07-5ED0**
45 (CT) 55 (VT)	MDV4500/3F	6SE3228-4DK50	**4EP4000-6US** **(4EP4000-8US)**	**4EU2751-1UB00** **(4EU2751-3UB00)**	**6SE6400-3TC15-4FD0**
55 (CT) 75 (VT)	MDV5500/3F	6SE3231-0DK50	**4EU2451-2UA00** **(4EU2551-2UA00)**	**4EU2751-1UB00** **(4EU2751-6UB00)**	**6SE6400-3TC14-5FD0**
75 (CT) 90 (VT)	MDV7500/3F	6SE3231-4DK50	**4EU2551-4UA00** **(4EU2551-6UA00)**	**4EU2751-2UB00** **(4EU3051-0UB00)**	**6SE6400-3TC14-5FD0**

* Technical data refer to Chapter 3
For (VT / M~n²), the next largest line reactor should be used.
The maximum line voltage when using the inverter with line reactors is 3-ph 380V - 460V +/-10% AC!
For voltages above 460 V, the reactors in brackets should be used.

** Technical data refer to Chapter 3
f_{puls} <= 4 kHz When using output reactors, the pulse frequency should be reduced to 4kHz (P076).
f_{max} 120Hz The maximum output frequency (f_{max} ~ 120Hz) depends on the ratio between the drive inverter output voltage, the voltage drop across the output reactor (V_K) and the motor being used.
The drive inverter can be over-dimensioned as an alternative to using an output reactor (refer to Chapter 3)

6.3.8 MIDIMASTER Vector without integrated A filter (3-ph. 575V AC)

Rated power [kW]	Designation	Drive inverter IP21 Order No.	2% Line reactor* Order No.	4% Line reactor* Order No.	Output reactor** Order No.
2.2 (CT) 4 (VT)	MDV220/4	6SE3213-8FG40	**4EP3400-3US**	**3 x 4EM4807-1CB**	**6SE7022-2FS87-1FE0**
4 (CT) 5.5 (VT)	MDV400/4	6SE3216-1FG40	**4EP3600-8US**	**3 x 4EM4911-7CB**	**6SE7022-2FS87-1FE0**
5.5 (CT) 7.5 (VT)	MDV550/4	6SE3218-0FG40	**4EP3600-2US**	**4EP3800-8US**	**6SE7022-2FS87-1FE0**
7.5 (CT) 11 (VT)	MDV750/4	6SE3221-1FG40	**4EP3600-3US**	**4EU3800-8US**	**6SE7022-2FS87-1FE0**
11 (CT) 15 (VT)	MDV1100/4	6SE3221-7FG40	**4EP3700-6US**	**4EP4001-0US**	**6SE7023-4FS87-1FE0**
15 (CT) 18.5 (VT)	MDV1500/4	6SE3222-2FH40	**4EP3700-1US**	**4EP4001-0US**	**6SE6400-3TC02-2DE0**
18.5 (CT) 22 (VT)	MDV1850/4	6SE3222-7FH40	**4EP3801-2US**	**4EP4001-2US**	**6SE6400-3TC02-7DE0**
22 (CT) 30 (VT)	MDV2200/4	6SE3223-2FJ40	**4EP3800-1US**	**4EP4001-2US**	**6SE6400-3TC03-2DE0**
30 (CT) 37 (VT)	MDV3000/4	6SE3224-1FJ40	**4EP3900-1US**	**4EU2551-1UB00**	**6SE6400-3TC05-2EE0**
37 (CT) 45 (VT)	MDV3700/4	6SE3225-2FJ40	**4EP4000-7US**	**4EU2551-1UB00**	**6SE6400-3TC05-2EE0**

* Technical data refer to Chapter 3
For (VT / M~n²), the next largest line reactor should be used.
The maximum line voltage when using the line reactors is 3-ph 525V - 575V +/-10% AC

** Technical data refer to Chapter 3
f_{puls} <= 4 kHz When using output reactors, the pulse frequency should be reduced to 4kHz (P076).
f_{max} 120Hz The maximum output frequency (f_{max} ~ 120Hz) depends on the ratio between the drive inverter output voltage, the voltage drop across the output reactor (V_K) and the motor being used.
The drive inverter can be over-dimensioned as an alternative to using an output reactor (refer to Chapter 3)

6.5 Braking resistors for MICROMASTER Vector

Electronic braking module (EBU) and braking resistors for MIDIMASTER Vector

Braking resistors for MMV

Resistor Order No.	Continuous rated power W	Peak power (5% on time) W	Resistance (tol.±10%) Ω	Peak voltage DC V	Dimensions L mm	L1 mm	W mm	W1 mm	W2 mm	D mm	Weight kg	Drive inverter type
6SE3290-0CA87-2RA0	40	800	200	450	200	190	57	28	-	54	1.3	MMV12 - MMV75 MMV12/2 - MMV75/2
6SE3290-0CB87-2RA0	80	1600	100		280	271	57	28	-	54	1.7	MMV110 - MMV150 MMV110/2 - MMV150/2
6SE3290-0CC87-2RA0	200	4000	40		338	330	80	20	40	54	3.1	MMV220 - MMV300 MMV220/2 - MMV400/2
6SE3290-0DA87-2RA0	80	1600	400	900	280	270	57	28	-	54	1.7	MMV37/3 -MMV150/3
6SE3290-0DB87-2RA0	150	3000	200		280	271	83	23	40	54	2.5	MMV220/3 - MMV300/3
6SE3290-0DC87-2RA0	400	7500	85		400	390	103	28	40	52	3.8	MMV400/3 - MMV750/3

Electronic braking modules for MDV

Drive inverter	EBU		Associated resistors					
Type	Order No.	Minimum total resistance for each EBU Ω	Order No.	Resist-ance Ω	Brief peak rated value (5 s) kW	Power for on time =20 % kW	Contin-uous rated power kW	Peak voltage DC V
MD(V)550/2 to	**6SE3190-0CX87-2DA0**	10	**6SE3213-6SP87-0RA0**	20	7.5	5	1.25	380
MDV4500/2			**6SE3221-4SP87-0RA0**	10	15	10	2.5	380
MD(V)750/3 to	**6SE3190-0DX87-2DA0**	20	**6SE3214-0TP87-0RA0**	40	15	10	2.5	950
MDV7500/3			**6SE3222-4TP87-0RA0**	20	30	20	5	950
MDV220/4 to MD(V)3700/4	***Your local Siemens sales office can provide you with information about the range of electronic braking modules which can be supplied for these drive inverters.***							

Braking resistors for EBU

Resistance type	Order No.	Continuous rated power kW	Brief peak rated value kW	Resist-ance Ω	Notes
A	**6SE3213-6SP87-0RA0**	1.25	7.5	20	Only for line supply voltages
B	**6SE3221-4SP87-0RA0**	2.5	15	10	208 V - 240 V
D	**6SE3214-0TP87-0RA0**	2.5	15	40	Only for line supply voltages
E	**6SE3222-4TP87-0RA0**	5	30	20	380 V - 500 V

Notes:
When braking, the inverter (MMV) or the electronic braking module (option for MDV) dissipates the braking energy of the motor and load to the externally mounted resistor. The lower the value of the external resistor, then the greater the braking power. The resistors are able to dissipate large amounts of energy for short periods, but when used continuously, the rating is considerably less. In order to protect the resistors against overload, the drive inverter / 'braking chopper' (P070), or the EBU limits its own duty cycle (the ratio between the ON time and the OFF time) to 5% (= 12 seconds in 4 minutes! drive inverter) or 10 % (EBU). This reduces the maximum dissipation level to the values shown in Fig. 3.
If the electronic braking module is used for high load moments of inertia (or extremely short ramp-down times), it may be necessary to connect additional resistors in parallel or connect several electronic braking modules (EBUs) in parallel. In this case, the resistor must be adequately rated to withstand the resulting power dissipation. However, the resistance may not be less than 40Ω for 230V and 80Ω for 400V drive units. (more detailed information is provided in Chapter 3)

6.6 Recommended protection

We recommend slow-acting line fuses to protect the feeder cable. The rule of thumb "input current (max. continuous current) of the drive inverter + ~30%" can be used to determine the rated fuse current for fuses, circuit-breakers, motor protection circuit-breakers, bimetallic protective elements. When using motor protection circuit-breakers it must be ensured that the devices used are certified for drive inverter operation. We recommend 3RU.... or 3RV.... devices or 3NA... fuses.

MICROMASTER, MICROMASTER Vector

Line supply voltage	Version MM = MICROMASTER MMV = MICROMASTER Vector	Recommended rated fuse currents A	Recommended fuse utilization category gG/gL Order No.	Recommended circuit-breaker Order No. (b)
1-ph. 230 V AC	MM12, MMV12, MM25, MMV25, MM37, MMV37	10	**3NA3803**	**5SX2 110 -6**
	MM55, MMV55, MM75, MMV75	16	**3NA3805**	**5SX2 116 -6**
	MM110, MMV110, MM150, MMV150,	20	**3NA3807**	**5SX2 120 -6**
	MM220, MMV220	20	**3NA3810**	**5SX2 125 -6**
	MM300, MMV300 (a)	32	**3NA3812**	**5SX2 132 -6**
1-ph. 230 V AC, 3-ph. 230 V AC	MM12/2, MMV12/2, MM25/2, MMV25/2, MM37/2, MMV37/2, MM55/2, MMV55/2, MM75/2, MMV75/2	10	**3NA3803**	**5SX2 310 -6**
	MM110/2, MMV110/2, MM150/2, MMV150/2	16	**3NA3805**	**5SX2 316 -6**
	MM220/2, MMV220/2	20	**3NA3807**	**5SX2 320 -6**
	MM300/2, MMV300/2 (a)	25	**3NA3810**	**5SX2 325 -6**
Only 3-ph. 230V AC	MM400/2, MMV400/2	32	**3NA3812**	**5SX2 332 -6**
3-ph. 380 V - 500 V AC (c)	MM37/3, MMV37/3, MM55/3, MMV55/3, MM75/3, MMV75/3, MM110/3, MMV110/3, MM150/3, MMV150/3,	10	**3NA3803**	**5SX2 310 -6**
	MM220/3, MMV220/3, MM300/3, MMV300/3	16	**3NA3805**	**5SX2 316 -6**
	MM400/3, MMV400/3, MM550/3, MMV550/3	20	**3NA3807**	**5SX2 320 -6**
	MM750/3, MMV750/3	25	**3NA3810**	**5SX2 325 -6**

Information on the tables: "Recommended fusing for MICROMASTER & MIDIMASTER"

3NA... fuses are not UL certified,
5SX... circuit-breakers with characteristic type B from 6A to 50A & characteristic type C from 0.5A to 50A, are certified for UL 1077 and CSA 22.2 No. 235 - M 89 and can be used as "supplementary protectors"

- not available
- additional data on 3NA... und 5SX2... fuses are provided in the Catalog for Installation Technology I 2.1 or in the NS K Catalog

(a) MM(V)300 and MM(V)300/2 require an external reactor for 1-phase voltages (e.g. 4EM4807-8CB) and a 32A line fuse.

(b) Characteristic type A (fast acting) = 5SX2 ... -5 > cable protection for control systems, limited semiconductor protection

Characteristic type B (slow-acting) = 5SX2 ... -6 > cable protection for socket outlets

Characteristic type C (slow-acting) = 5SX2 ... -7 > general cable protection, suitable for motors

(c) Rated voltage for circuit-breakers = 230/400V (max. 440V +10%)

MIDIMASTER Vector

Line supply voltage	Version MDV = MIDIMASTER Vector	Recommended rated fuse currents A	Recommended fuse utilization category gG/gL Order No.	Recommended circuit-breaker Order No.
3 AC 230 V	MDV550/2	50	**3NA3820**	**5SX2 350 -6** (d)
	MDV750/2, MDV1110/2	63	**3NA3822**	**5SX7 363 -6** (d)
	MDV1500/2	80	**3NA3824**	**5SX7 380 -7** (d)
	MDV1850/2,	100	**3NA3830**	**5SX7 491 -7** (d)
	MDV2200/2	125	**3NA3132**	**5SX2 492 -7** (d)
	MDV3000/2	160	**3NA3036**	**-**
	MDV3700/2, MDV4500/2	200	**3NA3140**	**-**
3 AC 380 V - 500 V (e)	MDV750/3	35	**3NA3814**	**5SX2 340 -6**
	MDV1100/3	40	**3NA3017**	**5SX2 340 -6**
	MDV1500/3, MDV1850/3	50	**3NA3820**	**5SX2 350 -6**
	MDV2200/3, MDV3000/3	80	**3NA3824**	**5SX7 380 -7**
	MDV3700/3	100	**3NA3830**	**5SX7 491 -7**
	MDV4500/3	125	**3NA3032**	**5SX2 492 -7**
	MDV5500/3	160	**3NA3036**	**-**
	MDV7500/3	200	**3NA3140**	**-**
3 AC 525 V - 575 V	MDV220/4, MDV400/4	10	**3NA3803-6**	**-**
	MDV550/4	16	**3NA3805-6**	**-**
	MDV750/4	25	**3NA3810-6**	**-**
	MDV1100/4, MDV1500/4	35	**3NA3814-6**	**-**
	MDV1850/4, MDV2200/4	50	**3NA3820-6**	**-**
	MDV3000/4	63	**3NA3822-6**	**-**
	MDV3700/4	80	**3NA3824-6**	**-**

Information on the tables: "Recommended fusing for MICROMASTER & MIDIMASTER"

3NA... 3NA... fuses are not UL certified,
5SX... circuit-breakers with characteristic type B from 6A to 50A & characteristic type C from 0.5A to 50A, are certified for UL 1077 and CSA 22.2 No. 235 - M 89 and can be used as "supplementary protectors"
"-" = not available

(d) Only for operation with 3-ph. 230V AC.

(e) Characteristic type A (fast acting) = 5SX2 ... -5 > cable protection for control systems, limited semiconductor protection

Characteristic type B (slow-acting) = 5SX2 ... -6 > cable protection for socket outlets

Characteristic type C (slow-acting) = 5SX2 ... -7 > general cable protection, suitable for motors

(f) Rated voltage for circuit-breakers = 230/400V (max. 440V +10%)

Additional data on 3NA... und 5SX2... fuses are provided in the Catalog for Installation Technology I 2.1 or in the NS K Catalog

OPTIONS
MICROMASTER
MICROMASTER Vector
MIDIMASTER Vector

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**Information on COMBIMASTER,
please refer to Catalogs DA64.8 and M11.**

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