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Advantages

How to selection?

Harmonics

EMC

2 -Level Inverter

3-Level Inverter

Comparison 2/3

24-Pluse DFE

AFE

EMC Filter

Effect

FAQs

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(+66) 0 2373-2734

Fax : (+66) 0 2728-1779

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Welcome Motor & Drives By **TiNAMiCS**





Power block VSDs principle



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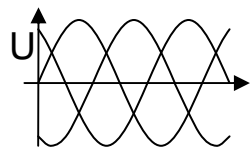
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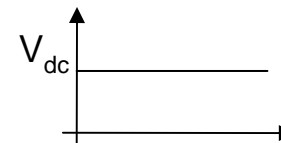
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$U, f = \text{constant}$



e.g. 3-ph., 400V AC

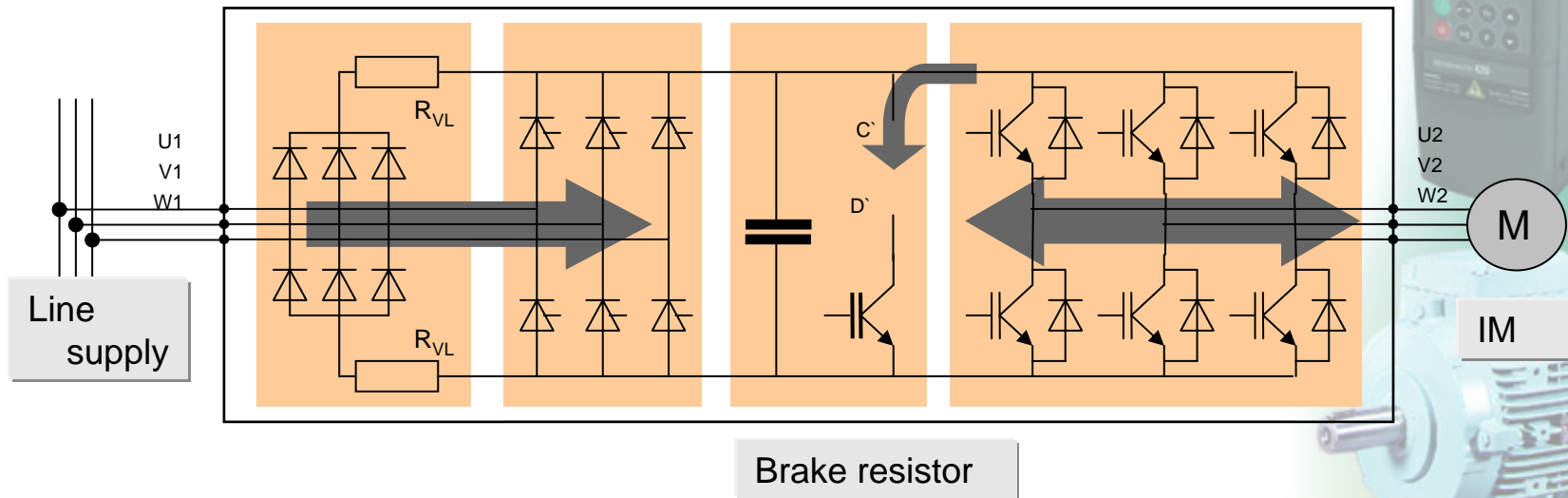
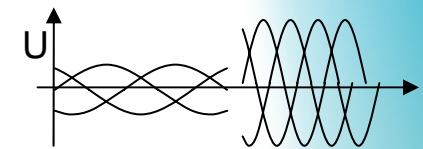
AC - DC



approx. $1.35 \cdot 400V = 540V$ DC

DC - AC

$V, f = \text{variable}$



Standard principle of all SIEMENS Drives power blocks!



Advantages of drive converter operation



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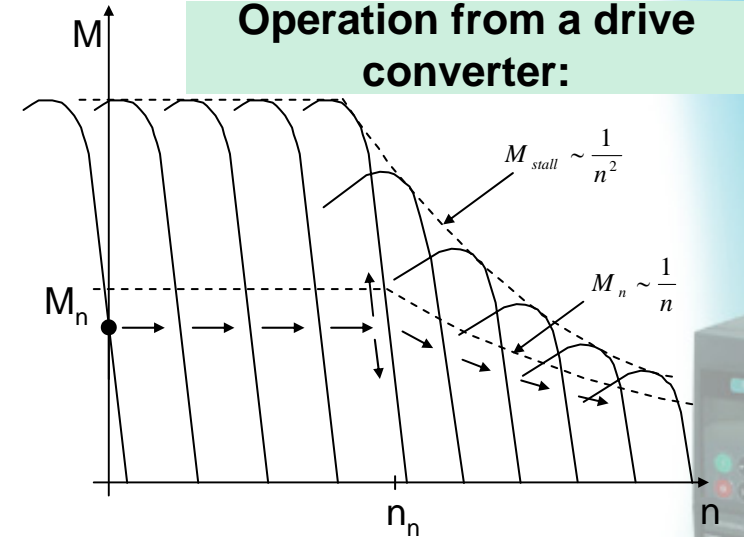
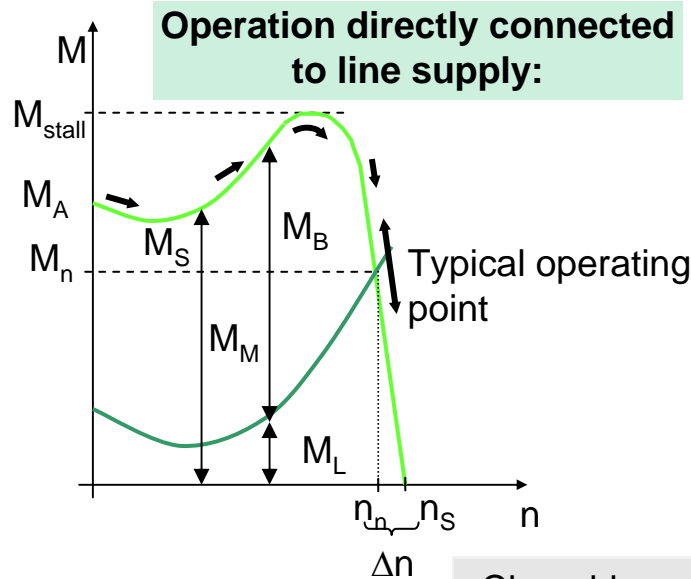
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- M_n Rated torque
- M_M Motor torque
- M_L Load torque
- M_B Accelerating torque
- M_A Locked rotor torque
- M_K Stall torque
- M_S Pull-up torque
- n_N Rated speed
- n_S Synchronous speed

- Closed-loop speed control results in energy saving and often in an improved process quality!
- No inrush current surge by controlling the frequency from 0Hz!
- Soft starting and braking using up and down ramps > reduces the stressing on the machine!
- High torque, also at low speeds, whereby a higher current than for rated speed is not required
- In the field-weakening mode, higher speeds than n_n (3000 RPM) can be reached



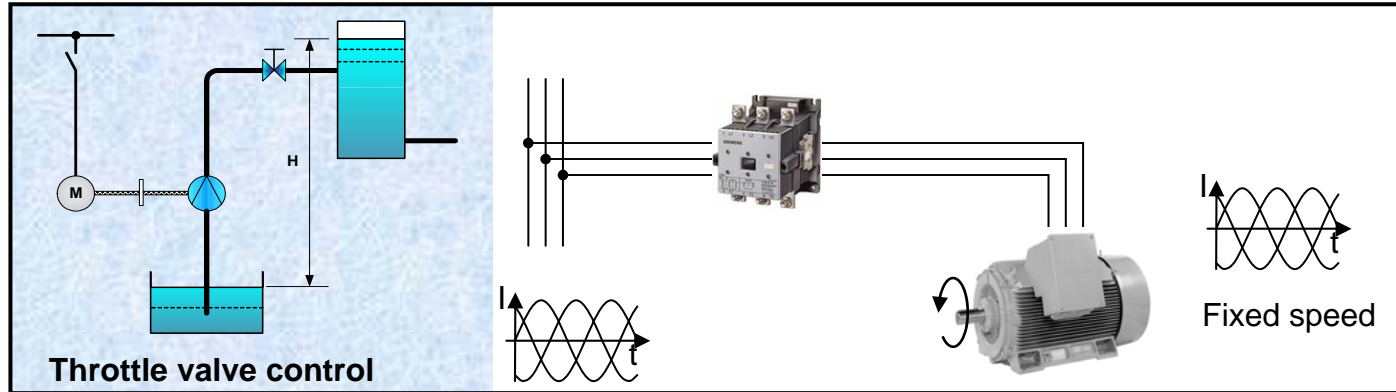
Energy saving

Flow control using a throttle

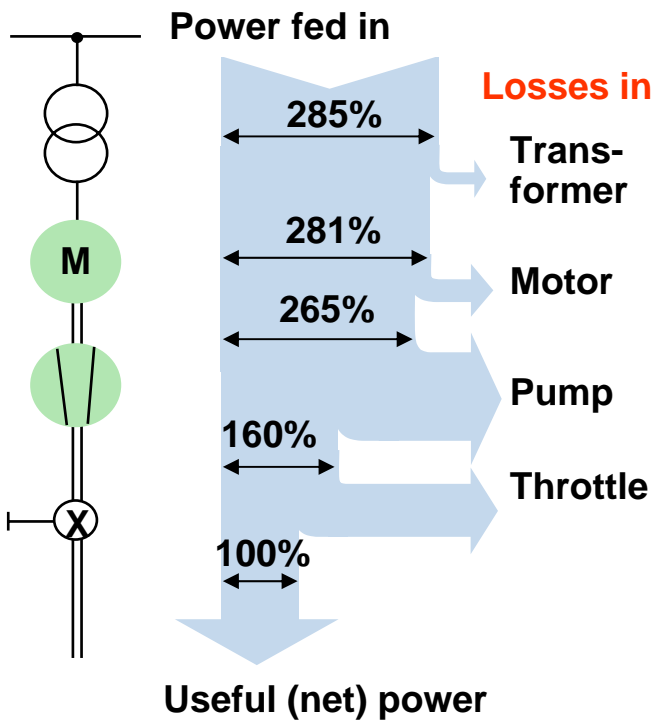


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Operation,
direct
online



Losses in the:

The drive process represents the main energy saving potential!
 Example:
 For a conventional fixed-speed drive with flow control using a throttle, 285 % of the power used is supplied in the form of electrical energy.

The energy balance of a pump, operated at constant speed, becomes increasingly more unfavourable, the lower the quantity of medium to be pumped.



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Energy saving Flow control using speed control

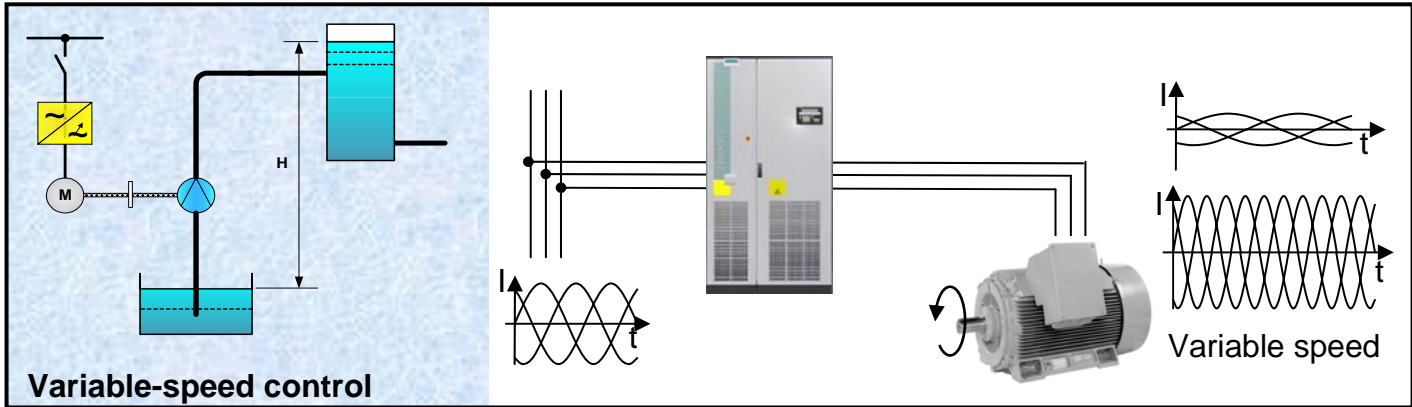
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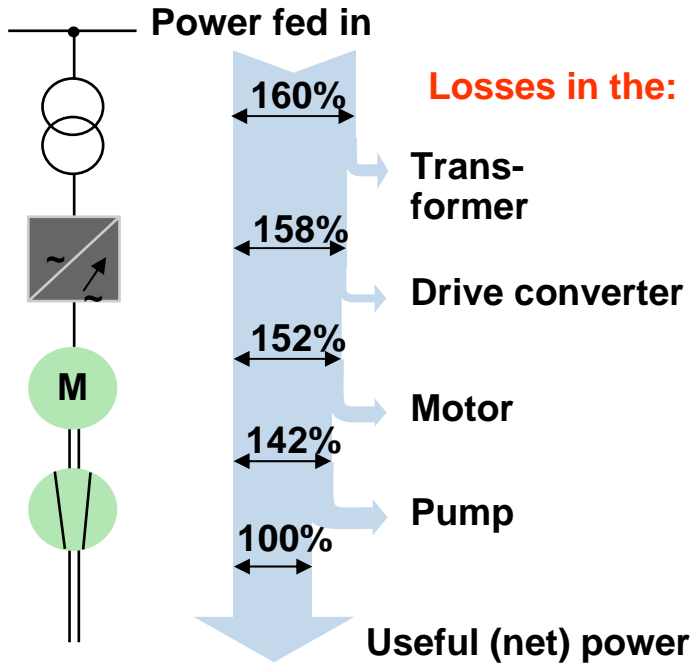
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Operation
from a
drive
converter



The drive process represents the main energy saving potential!
 Example:
 With electronic speed control, the power fed in is only 160% of the power required to pump the medium and the total losses are reduced to 1/3.
The process quality is also improved.



How to select VSD ?



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1. Type of Load or Load Characteristics

2. Environments of Installation





Load Characteristics



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$M \sim n^2$	$M \sim n$		$M = \text{const}$
<ul style="list-style-type: none"> • Pumps • Fans • Blowers • Compressors • Turbo compressors 	<ul style="list-style-type: none"> • Calendar drives (calendaring to smooth and emboss) • Paper machines • Plastic making and finishing machines 	<ul style="list-style-type: none"> • Feed drives • Positioning drive • Elevators, cranes • Extruders, mixers • Reciprocating and screw compressors 	<ul style="list-style-type: none"> • Winders • Main spindle for machine tools • Mixers, crushers, saws, coilers
VT	VT	CT	CT
Without encoder	Without encoder	With encoder	With encoder

The control (closed-loop) is optimized for the particular application!

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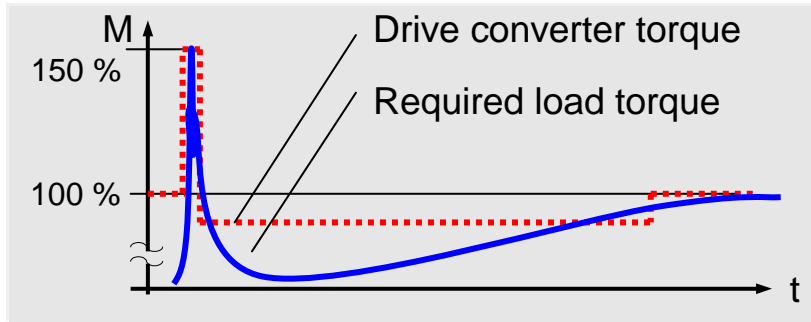
Load Square-law characteristic and starting behaviour



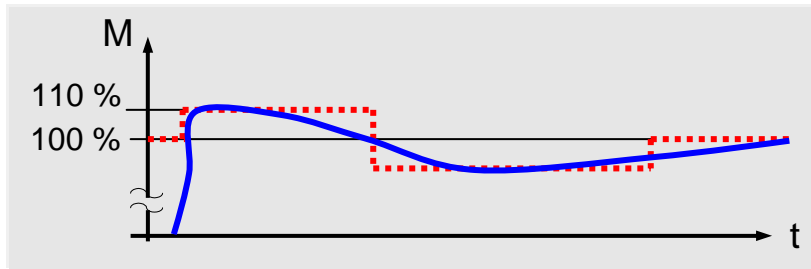
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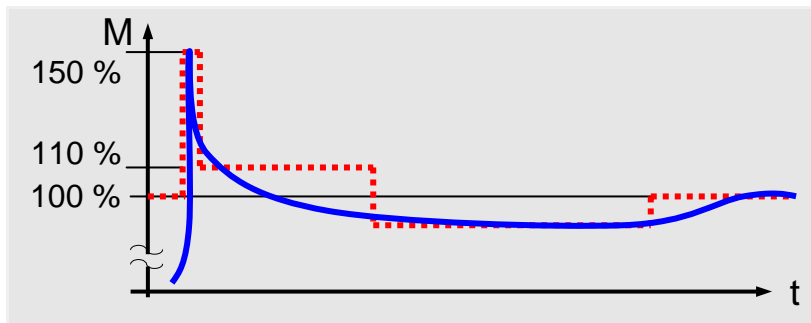
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Square-law characteristic and short high breakaway torque:
Compressors, fans



Square-law characteristic and longer external moment of inertia:
fans, centrifuges



Square-law characteristic and short high breakaway torque and long average torque:
oil pumps



Starting **Operation**

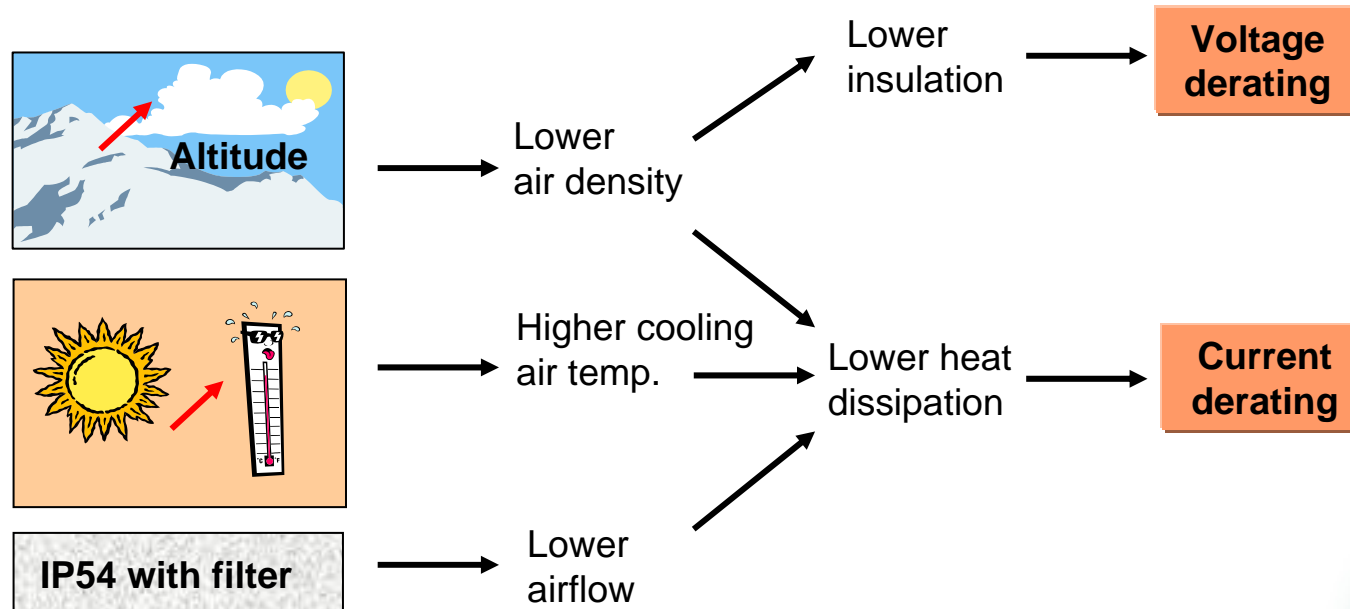


Technical data

Voltage de-rating for installation altitudes >2000 m



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Technical data

Current de-rating acc. to installation altitude and temperature

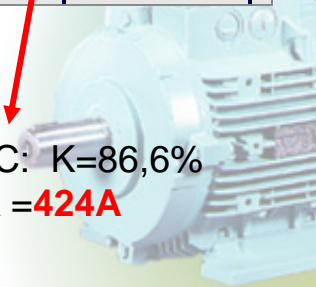


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Install. alt. above sea level in m	Ambient temperture in °C						
	20	25	30	35	40	45	50
0	100%					95.0%	90.0%
500						95.0%	90.0%
1000						95.0%	90.0%
1500						95.0%	90.0%
2000						95.0%	90.0%
2500				96.3%	91.4%	86.6%	
3000				96.2%	92.5%	87.9%	83.3%
3500			96.7%	92.3%	88.8%	84.3%	79.9%
4000			97.8%	92.7%	88.4%	85.0%	80.8%

With increasing altitude and/or increasing ambient temperature, the maximum rated output current must be reduced.
 For IP54 degree of protection, the de-rating is somewhat higher.

Example: $I_N = 490A$
 $H = 2500m, t = 50^\circ C: K = 86,6\%$
 $I_N^* = 0,866 * 490A = 424A$



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Basics of variable-speed drives

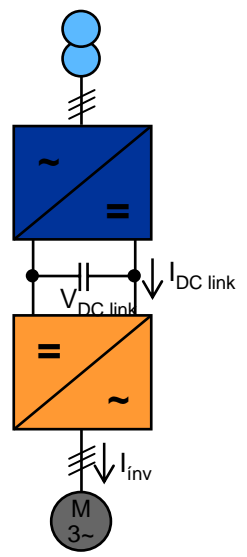
Drive engineering: Step-by-step procedure



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Required drive data

- Application: $M \sim n^2$, $M = \text{const.}$
- Electrical data:
Output, speed/ control range, overload, supply voltage, line frequency, motor utilization
- Version: Cooling type, degree of protection, type of construction
- Ambient conditions:
Installation altitude, cooling-medium temperature

Motor

- Mechanical limiting speed
- Thermally permissible torque for continuous operation
- Maximum torque

Inverter

- Rated output current
- Base load current
- Short-time current
- $I_{inv} = \frac{P}{\sqrt{3} * V_M * \cos\phi_M * \eta_M}$

Rectifier unit

- Rated output DC link current
- Base load DC link current
- Short-time DC link current
- $I_{DC \text{ link}} = \frac{P}{V_{ZK} * \eta_M * \eta_{WR}}$

Drive converter transformer

- Apparent power
- $S = \frac{P}{\lambda * \eta_M * \eta_U}$

Where

- I_{inv} ... Inverter current
- $I_{DC \text{ link}}$... DC link current
- P ... Required power at the load point
- V_M ... Motor voltage at the load point
- $V_{DC \text{ link}}$... DC link voltage
- $\cos\phi_M$... $\cos\phi$ of the motor
- λ ... Line power supply factor (typ. 0.95 for rectifier unit)
- η_M ... Motor efficiency
- η_{WR} ... Inverter efficiency (typ. 0.98)
- η_U ... Drive converter efficiency (typ. 0.97)



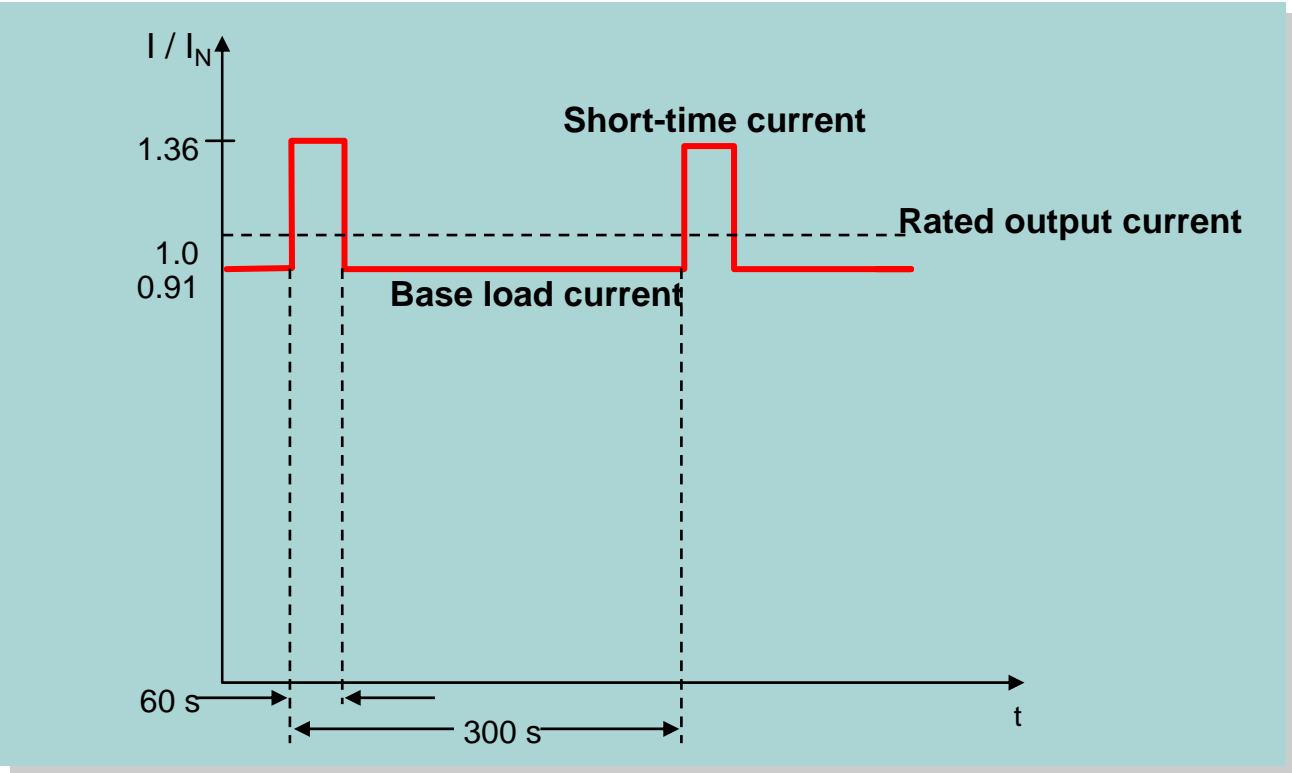


Basics of variable-speed drives

Overload capability of the drive converter using



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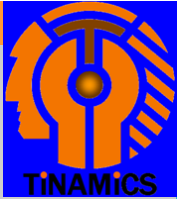
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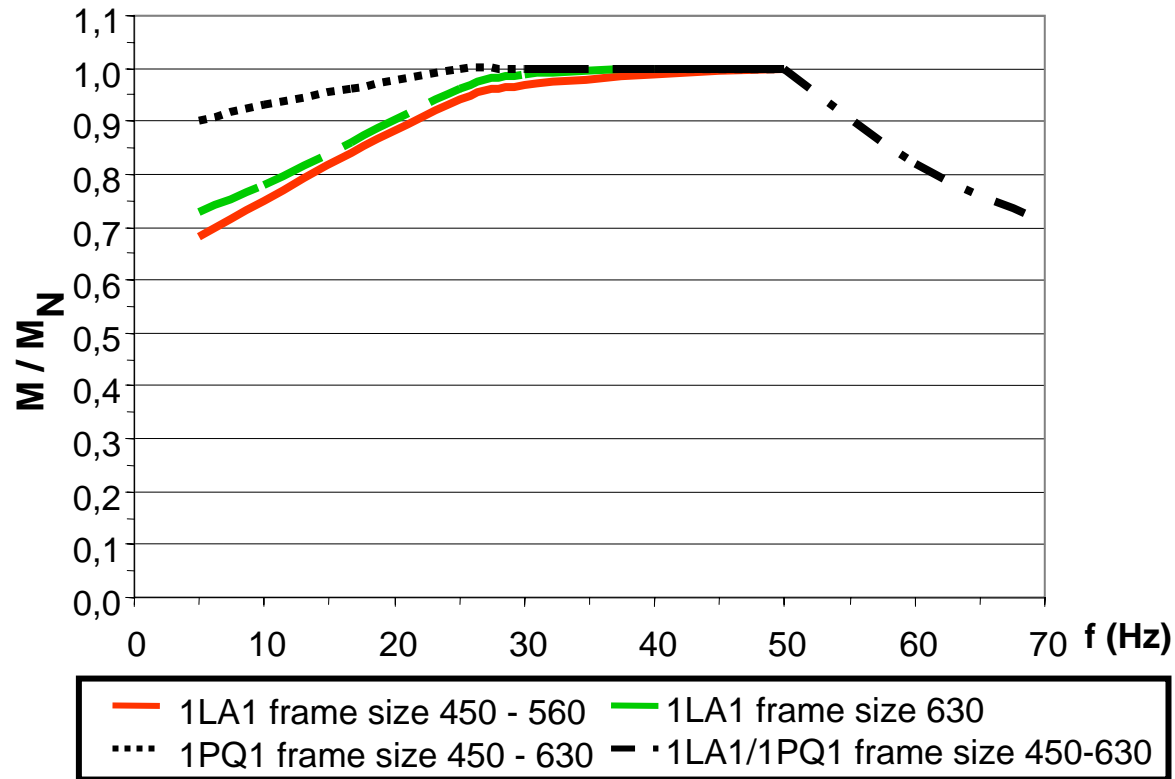


Basics of variable-speed drives

Thermally permissible torque for continuous operation



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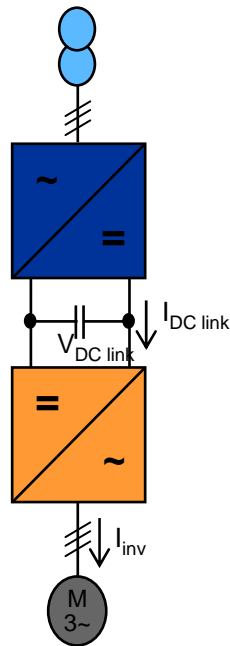


Basics of variable-speed drives

Drive engineering: Example of a pump/fan drive



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Required drive data

- Pump/fan drive
- Electrical data:
P = 500 kW, n = 1480 RPM, 690 V / 50 Hz,
Motor utilization acc. to insulating class F
- Version: Air cooling, IM B3 (motor)
- Ambient conditions:
Installation altitude < 1000 m, cooling-medium temperature < 40°C

Motor

- Motor required with $P_M \geq 500$ kW, 4-pole
- From Catalog M11:
1LA8 403-4PM80
($P_M = 545$ kW, $\cos\phi_M = 0.86$, $\eta_M = 0.966$)

Inverter

- $I_{inv} = \frac{500 \text{ kW}}{\sqrt{3} * 690V * 0,86 * 0,966} = 503 \text{ A}$
- Inverter required with rated output current ≥ 503 A
- From Catalog DA65.10:
6SE7035-7WK60 ($I_N = 570$ A)

Rectifier unit

- $I_{DC \text{ link}} = \frac{500 \text{ kW}}{1.35 * 690 \text{ V} * 0.966 * 0.98} = 567 \text{ A}$
- Rectifier unit required with rated output DC link current ≥ 567 A
- From Catalog DA 65.10:
6SE7037-7HH85-0AA0 ($I_N = 774$ A)

Converter transformer

- $S = \frac{500 \text{ kW}}{0.95 * 0.966 * 0.97} = 562 \text{ kVA}$



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Simply exciting

The performance features of SIEMENS

- **Wide range of drive applications in the industrial environment**
- **Large range of functions**
- **Simple to commission**
- **Standard operator philosophy**
- **Versatile control versions**
- **High starting torque and smooth-running motor operation**
- **Saves energy and reduces costs**
- **Versatile communication modules**
- **Vector control with and without speed feedback**
- **Integrated into TIA**



Power range: 0.12 – 250 kW

Voltages: 110 / 230 / 400 / 575 / 600



Frequency inverters, set everything in motion



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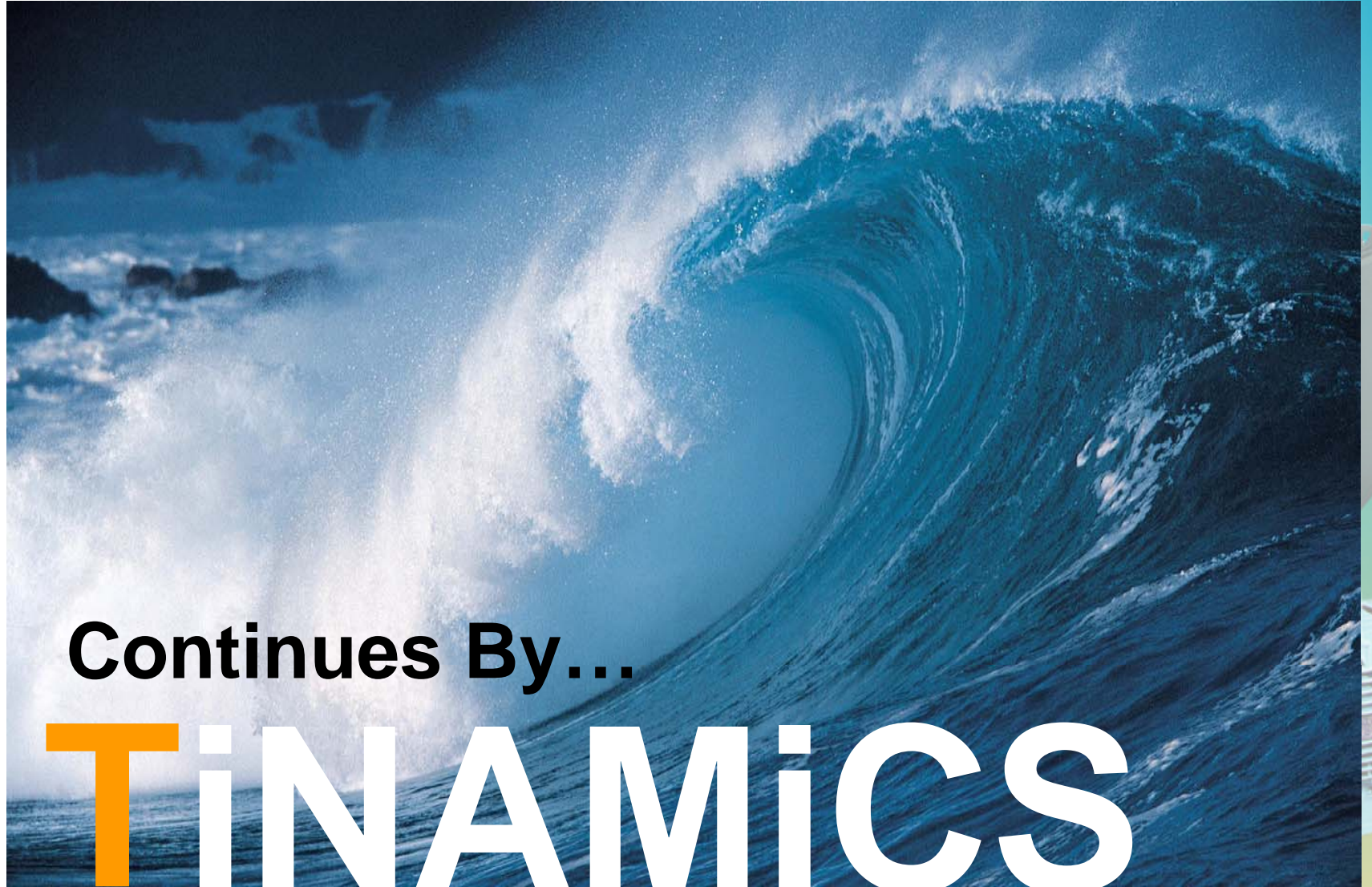
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