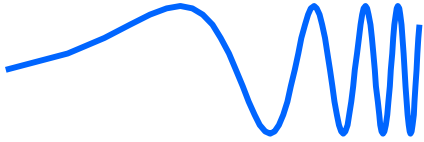


VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION



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- Full digital
- Regeneration back to mains
- Use of IGBT's power modules
- Design to drive high frequency spindles as well as any AC induction or synchronous motor with feedback
- Input voltage 3 x 200 ... 480 V
- Output frequency up to 1400 Hz
- Integrated Auto-Tuning
- The VHF1415 a 1430 are UL certified (USA and Canada)

VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

The mechanical design

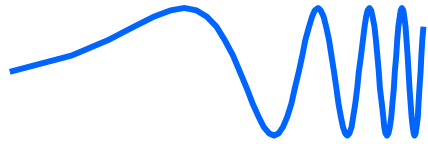
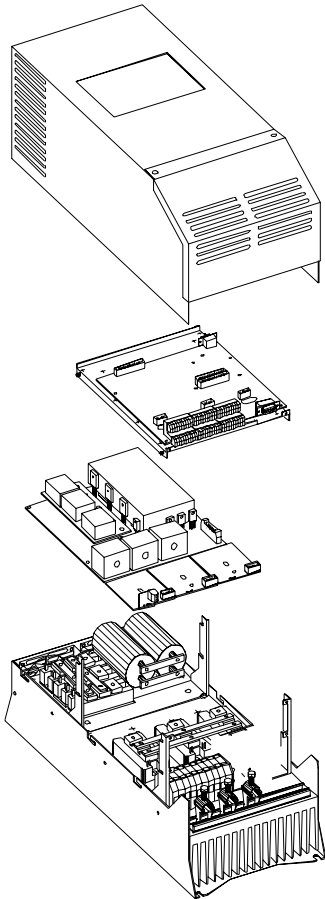
The user interface PC580

The control board with control terminal block

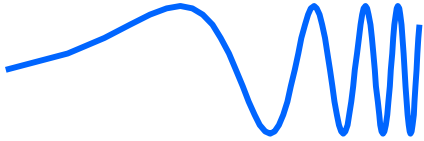
The switching power supply, current sensing
and input inverter control board

The input rectifier with inverter - the DC bus
capacitors, the output inverter bridge, the
power terminals and the input circuit breaker

The heatsink with brushless temperature
controlled fans



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VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

VHF1400 POWER RATINGS @ 400 V

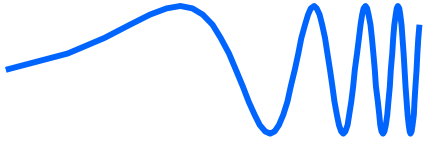
TYPE	I_{nom}	I_{peak}	Spindle
VHF1415	15 A	23 A	7.5 kW
VHF1430	30 A	45 A	15 kW
VHF1440	40 A	60 A	22 kW
VHF1455	55 A	83 A	30 kW
VHF1472	73 A	110 A	40 kW
VHF1490	90 A	136 A	50 kW

The spindles are typically rated with an overload capacity of 150 %

Drive overload without time limitation > 125 % I_{nom}

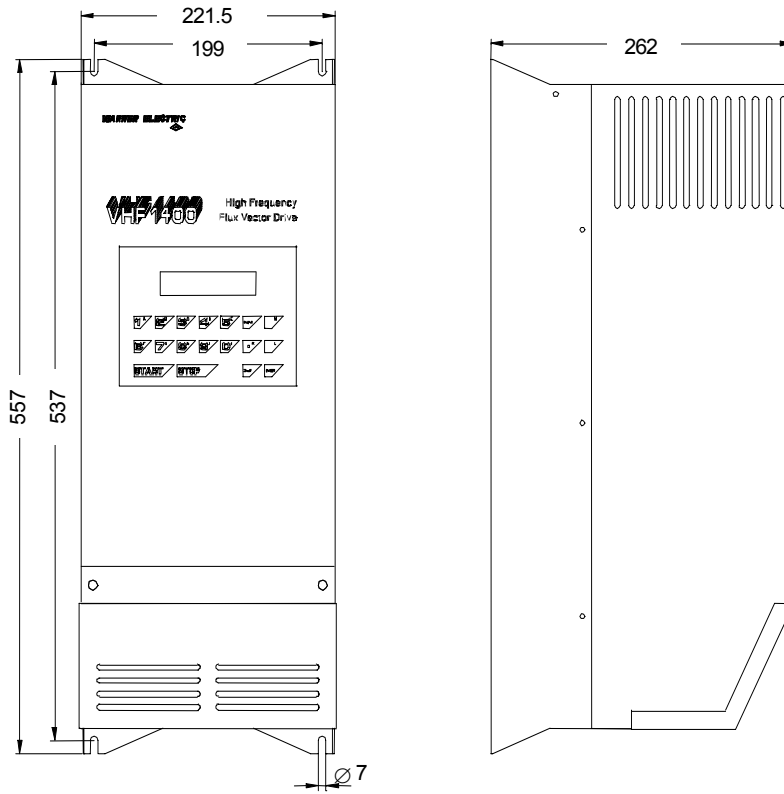
The correct sizing of an inverter has to be based on the current

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The mechanical dimensions

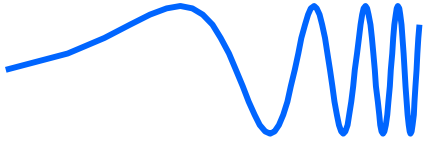


All dimensions in mm

VHF1415 VHF1440 VHF1472
 VHF1430 VHF1455 VHF1490

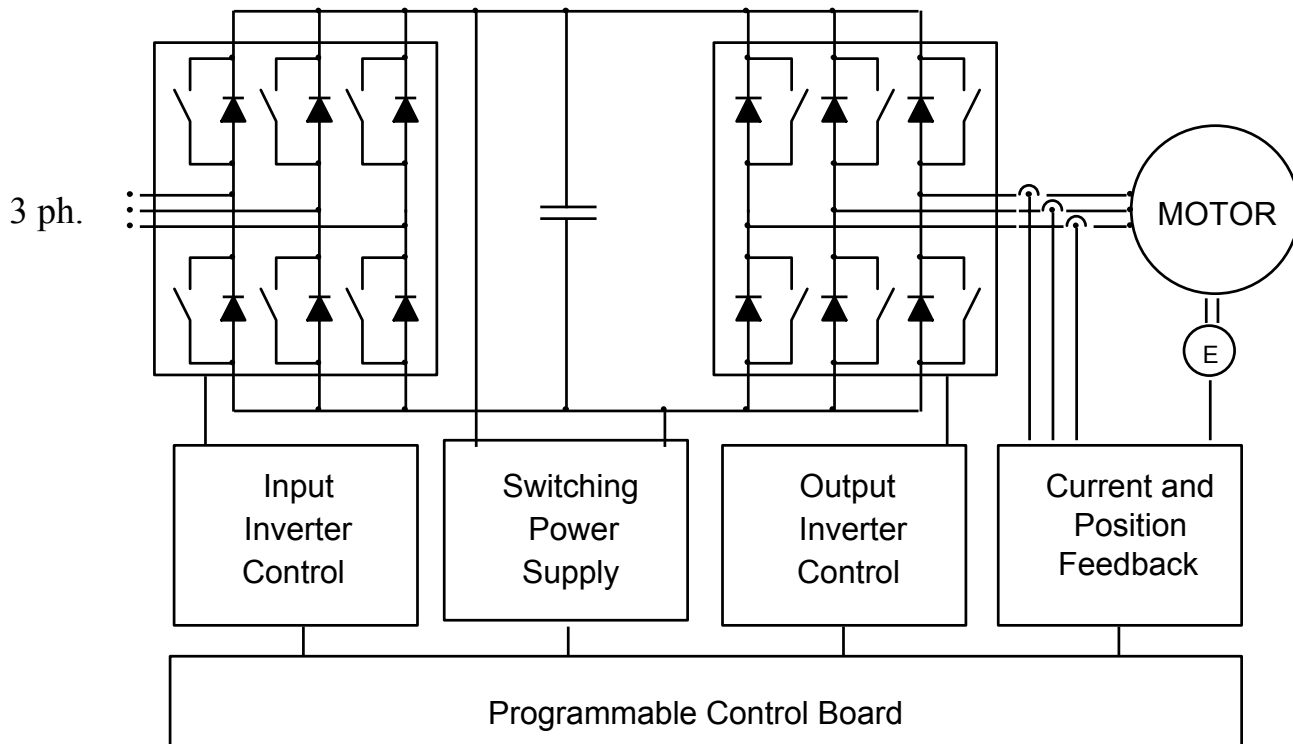
A	557	645
B	262	318
C	221.5	308
D	199	279
E	537	625
4x	M6	M8

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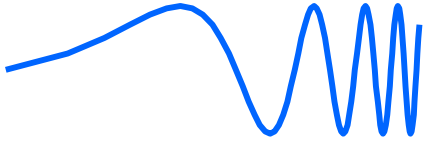


VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

VHF1400 block diagram

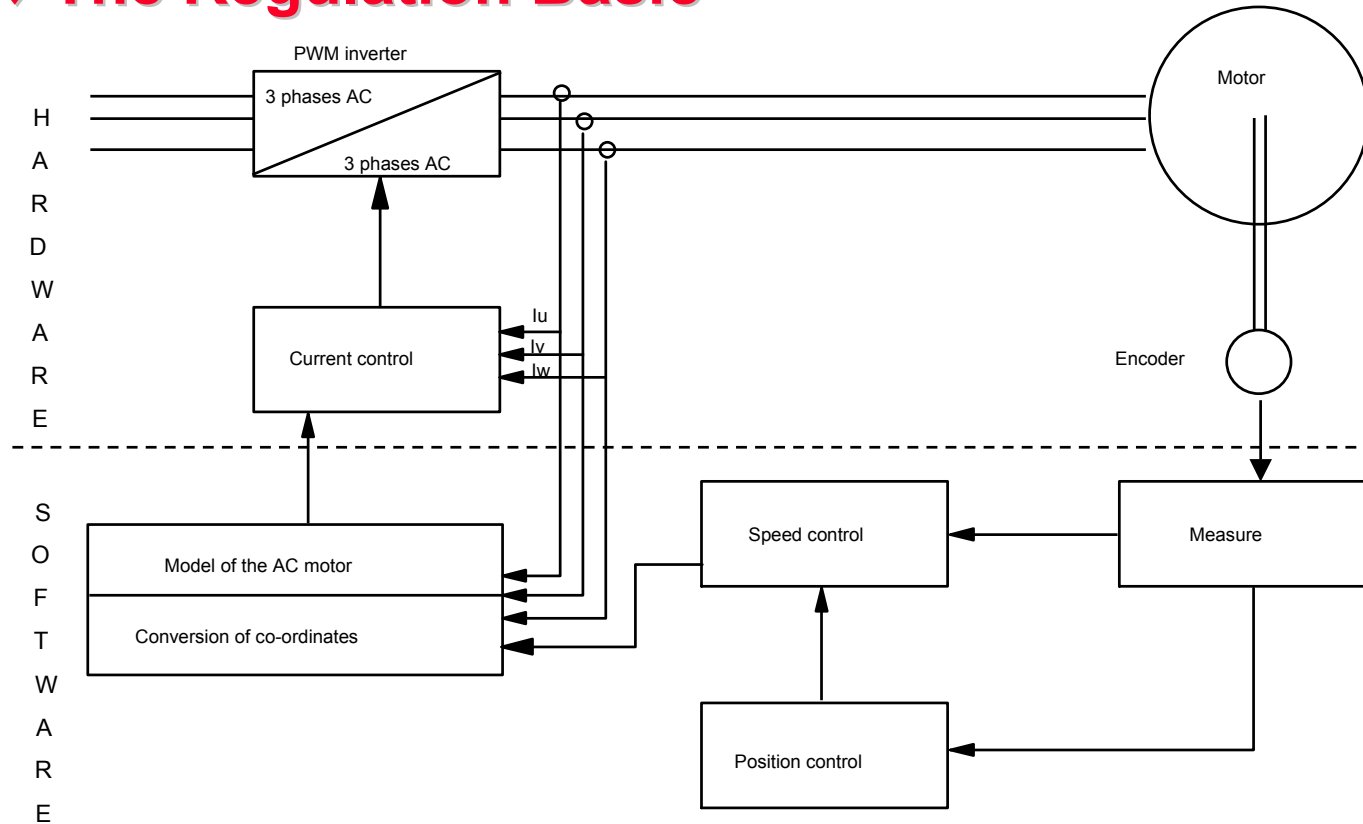


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◆ The Regulation Basic



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VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ Specific Features of the VHF Flux Vector Control

- Speed mode control
- Speed regulation - max.. cumulated error < 0.2%
- Position regulation - precision +/- 1 encoder pulse
- Position teach-in
- Torque regulation - Programmable from 0 to 150%
- Variable switching Frequency
- Full torque at zero speed
- Auto-tuning
- Test of sin-cos / encoder channels connections
- Increased shaft Nm per Amps compared to V/Hz drives

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VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ The Benefits of the VHF1400 (1)

- Full digital
 - » No change of the performances due to temperature and / or aging of the components
 - » Higher reliability
 - » Easy to program
 - » Same control boards for all power ratings
- The Flux Vector Modulation
 - » Peak torque down to zero speed
 - » Can be used for positioning application
 - » Improved speed accuracy and stability
 - » Increased motor power

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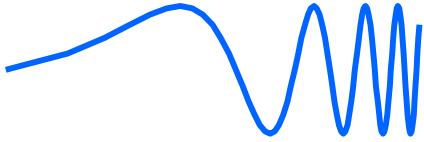


VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ The Benefits of the VHF1400 (2)

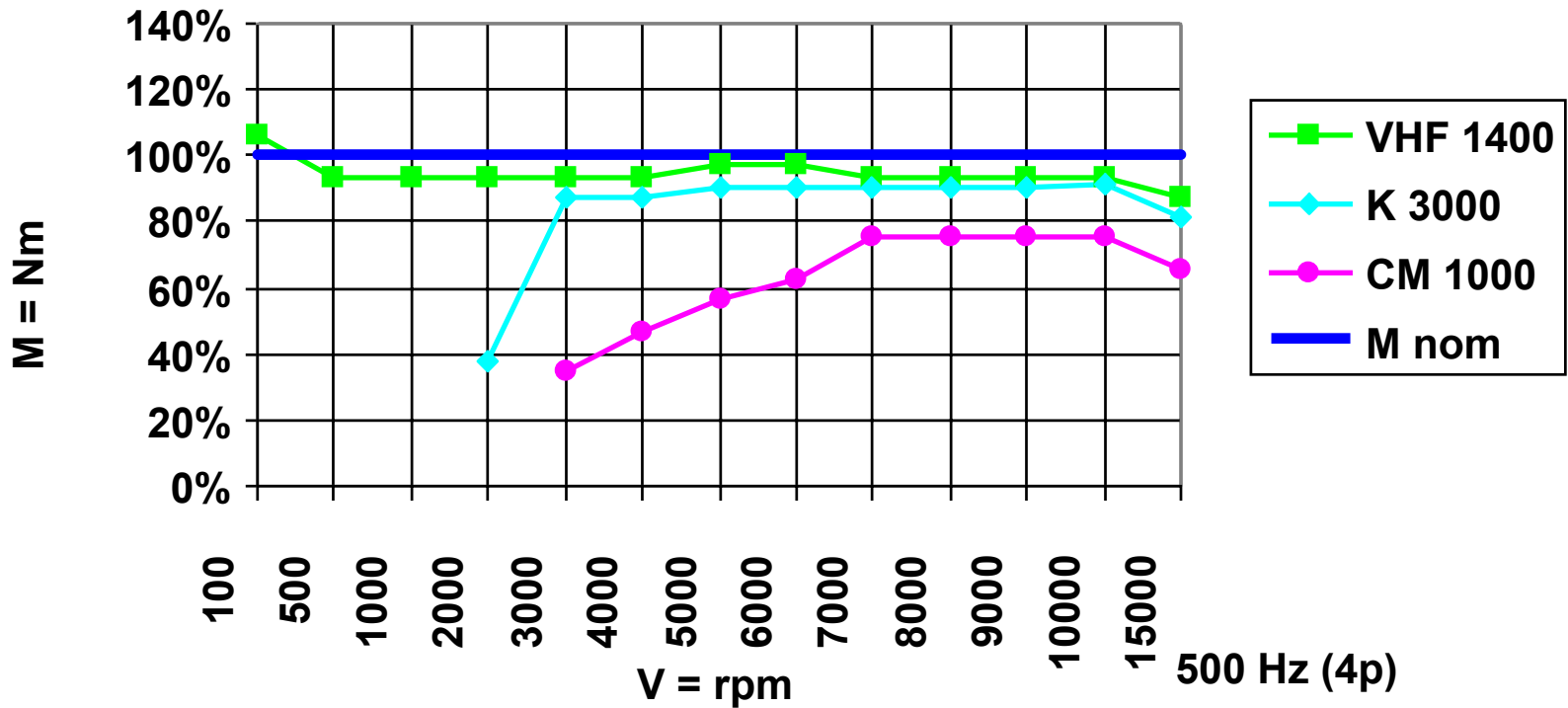
- Energy savings
 - » Regeneration back to mains
 - » Higher Nm / A at motor shaft
- User friendly
 - » Auto-tuning
 - » Position teach-in
 - » Easy to program
- Comply to the EEC regulations

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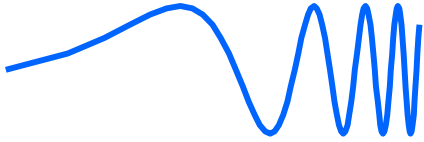


VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

Spindle current = I nom.

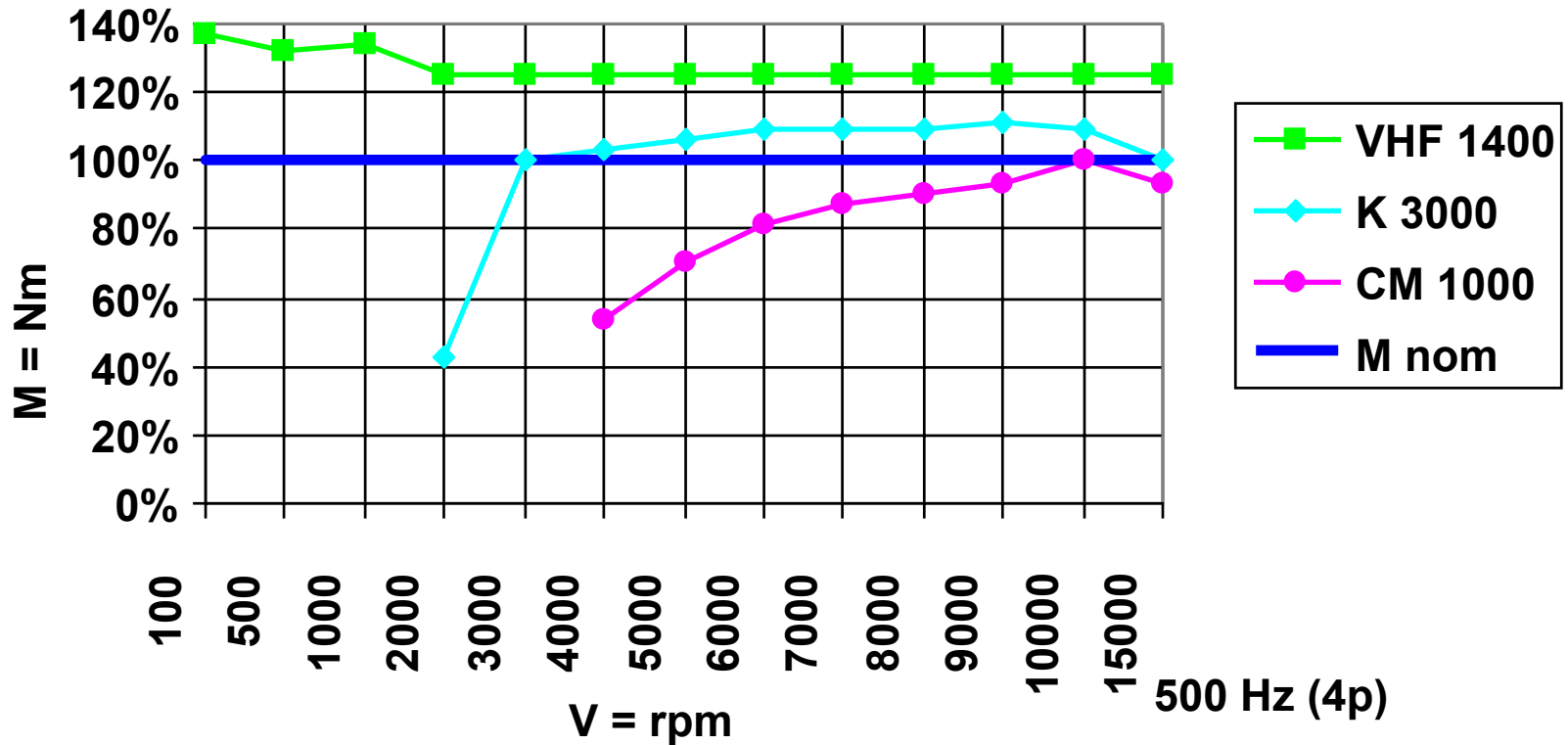


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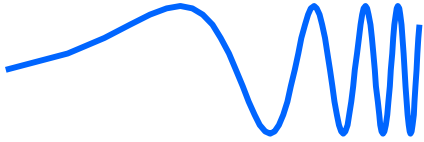


VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

Spindle current = I nom. + 20%



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VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ Brushless / AC-vector and AC-induction motors

	BL	AC vector	AC V/Hz
Max. speed	-	+	++
Peak Torque	3..4 x M_N	2 x M_N	1.5 x M_N
Inertia	LOW	HIGH	HIGH
Dynamic	HIGH	MEDIUM	LOW
Package price	Highest	Middle	Lowest

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VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ Acceleration time of a motor

- $P = M * n / 9549$ [kW = Nm * RPM / k]

- Acceleration time

$$t = 0.105 * J * n / M \quad [s = k * \text{kgm}^2 * \text{RPM} / \text{Nm}]$$

$$= J * n^2 / 9.12 * 10^4 * P$$

J = Inertia of the motor and attached load

- The acceleration time is defined by the driven inertia, the square of the speed to reach and the available motor power



VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ The Required Parameters

- Nominal Motor Voltage
- Nominal Motor Frequency
- Number of poles
- Nominal Motor Power
- Nominal Motor Current
- Nominal Speed at Nominal Load
- Encoder or resolver specifications

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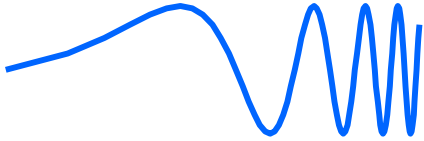


VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ The Speed / Position Feedback

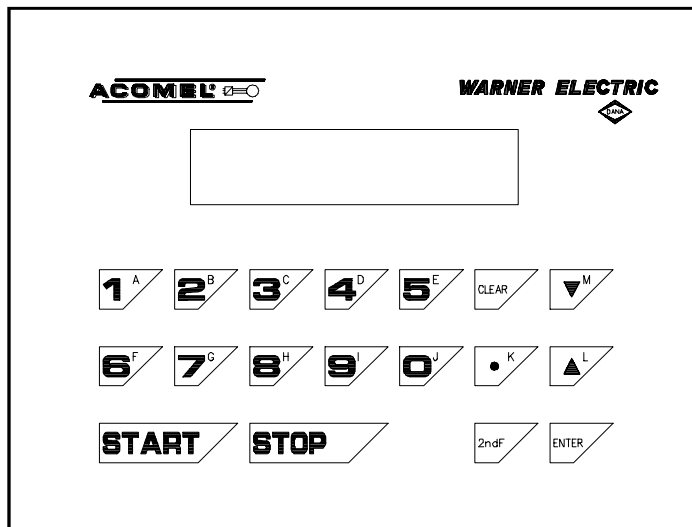
- Sin-Cos 1V peak-peak, with integrated signal tuning
- Encoder delivering 5 V TTL signals:
 - Channels A & B, 90° electrical shifted
 - Index channel C
 - Their complementary values, $A = \bar{B} = C$
 - Number of pulses per revolution: 500 to 2000
 - We strongly suggest to use a 1000 or 1024 pulses encoder
- A gear wheel with corresponding formatting electronic can be also used. We strongly suggest the use of 1000 or 1024 pulses resolution

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VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

The programming KEYPAD - PC580



- Numerical Keys 0 to 9
- Decimal point
- Alphabetical 2ndF Keys A to M
- Arrow up and Arrow down
- 2ndF - Second Function Key
- ENTER Key
- START Key
- STOP Key

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VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ Programming Features

- Plain text instructions
- Plain text messages
- English, German, French, Italian, Spanish
- 7 Pre-set Speeds
- 8 Pre-set Stop Positions
- 3 Prohibited Frequencies (F & Bandwidth)
- 8 Groups of complete Motor Parameters, including acceleration, deceleration auto-tuning parameters
- RS422 serial link

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VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ Inputs / Outputs

- 1 programmable dedicated Analog Input for Speed Control Mode - 12 bits resolution
- 1 dedicated Analog Input for Torque Control Mode
- START, STOP, RESET, Priority Stop
- 1 Programmable Analog Inputs for Customized Functions
- 13 Dedicated Digital Inputs
- 2 Programmable Analog Outputs (0 ... 10 V)
- 5 Programmable Digital Outputs
 - » relays with switching contact - 100 mA / 30 VDC

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VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ Input Voltage and Protections

- Voltage 3 x 200 V -15% to 480 V +10% (170 V to 530 V) auto-ranging (no manual settings)
- Power Modules IPM or IGBT's with integrated protections - current, voltage, temperature
- Short-circuit between phases
- Earth short-circuit
- Converter Temperature with 2 alarm levels
- Temperature Regulated Brushless Fans

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VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ Regeneration Back to Mains

- Energy Saving
- Braking Torque Programmable
- Increased Braking Dynamic
- No Braking Resistors (Heat, Fire risk)
- No Electrolytic Capacitors - Environment protection
- Smaller input capacitor - better power factor

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VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ The Auto - Tuning

- If one of the basic motor parameters is modified, the auto-tuning process will be required
- The VHF1400 will determine, without any additional information, the inertia of the motor and its attached load and set the proper regulation parameters for the speed and the position loop
- Those parameters are individually recorded for the 8 motor parameters groups
- Fine tuning process

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VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ The Position Teach-In

- The Stop Position or the Reference Position of the motor shaft can be recorded in Teach-In mode
- To do it:
 - » Select the corresponding program step
 - » Rotate manually the motor shaft to the desired position
 - » Press “ENTER” on the KeyPad
 - » The position is now recorded and the angle referred to the “zero” position of the encoder or resolver is displayed

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VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ Where to use the VHF Flux Vector Drive (1)

- For High Speed Application
 - » High Speed Machining - Grinding / Milling / Drilling
 - » High Speed Compressor - Air conditioning using high speed turbine
- Large speed ratio and / or increased speed Control
 - » Zero Speed to full Speed with full Torque availability
 - » Speed closed loop for high accuracy
- Torque Controlled Operation
 - » Use the VHF in Torque Mode Control
 - » Rewinding

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VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ Where to use the VHF Flux Vector Drive (2)

- Large Inertia ratio
 - » The AC induction motor is a large inertia motor and make the application less sensitive to the load inertia variations
- Sensitive Mechanical System with Critical Speeds
 - » Use the “Prohibited Frequency” features to avoid to work at these critical speeds
- Heavy Environmental Conditions
 - » The AC induction motor is a very robust unit and doesn't care less to the environmental conditions than a DC motor

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VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ Where to use the VHF Flux Vector Drive (3)

- Positioning Applications
 - » Middle and High Power applications, where the high dynamic and expensive solution of the Brushless motor is not required
 - » If the load inertia shows large variations during operation
- Cycling Applications
 - » The maximum programmed torque is available for acceleration and deceleration
 - » The regenerated energy is sent back to the lines

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VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ Where to use the VHF Flux Vector Drive (4)

- For Regenerative Applications
 - » Unwind processes at constant speed, tension or torque
 - » Dynamic braking processes for test benches
- For Cost Efficient Solution
 - » Considering material and maintenance costs, at middle or large power, an AC induction motor based concept is less expensive than any Brushless or DC-motor based solution

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VHF1400 - FLUX VECTOR CONTROL WITH SHAFT ORIENTATION

◆ Where to use the VHF Flux Vector Drive (5)

- The Industry Segments
 - » Machine Tools
 - » Textile
 - » Wire mill
 - » Rolling mill
 - » Air Conditioning
 - » Pumps and Fans
 - » Conveyor
 - » Special Equipment's

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