NEW TECHNOLOGY
COMPACT SERIES

High Efficiency Industrial Motors

PERMANENT MAGNET SYNCHRONOUS MOTOR

Most efficient electric motor in the world! Low cost and high efficiency in one.

Voltpro

" Upgrade your energy "

High Efficiency Industrial Motors

Permanent Magnet Synchronous Motor

" Upgrade your energy "

/ Permanent Magnet Synchronous Motor

VoltPro is a new industrial motor range to meet high efficiency needs of industry by higher level of IE4 efficiency class. Main advantage of this product is cost effective solution ensured by using standard ferrite magnet in rotor design.

In motor design, main properties of two different motors are combined in one motor that can run with vector control driver at higher efficiency than IE4 energy efficiency level.

Reluctance and permanent magnet synchronous motor technologies are combined in one motor. Rotor magnetic circuit is designed in the way of that motor can produce both magnet and reluctance torque. Magnets are inserted lamination to get saliency between "d and "q" axis of rotor.

Low copper loss is achieved by using needle winding technology by decreasing end-turn dimensions. As known, needle winding causes high torque ripple. The magnetic circuit design is optimized to decrease torque ripple lower than %15.

Motor has sinusoidal EMF form for field oriented control (FOC) for high efficiency, torque & speed control in all application types, such as pumps, fans, compressors, traction, lifting etc. Most available application type is variable speed application where currently a driver is used. VoltPro PMSM motor can be replaced with current IE2 or IE3 motor without any cost difference.

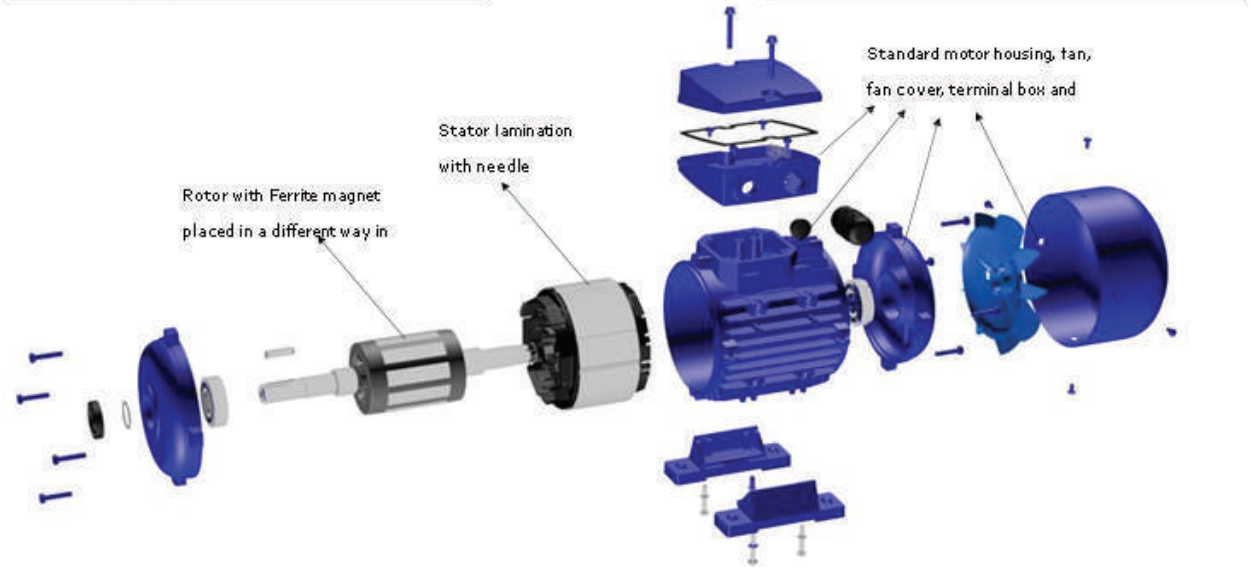
/ Product Range

RPM	1500											3000											
Power [kW]	0.25	0.37	0.55	0.75	1.1	1.5	2.20	3	4	5.5	7.5	0.37	0.55	0.75	1.1	1.5	2.2	3	4	5.5	7.5	11	15

/ Main Technical Properties

	1500 rpm	3000rpm
Motor Input Rated Voltage [V]	400	400
Rated Frequency [Hz]	125	250
Pole number	10	10
Thermal class	F	F
IP	55	55
Maximum speed [rpm]	3000	6000

	1500 rpm	3000rpm
Duty cycle	S1	S1
IP	55	55
Amb. Temp [°C]	40	40
Cooling	IC411	IC411
Frequency range	5-250	5-500
EMF form	Sinus	Sinus



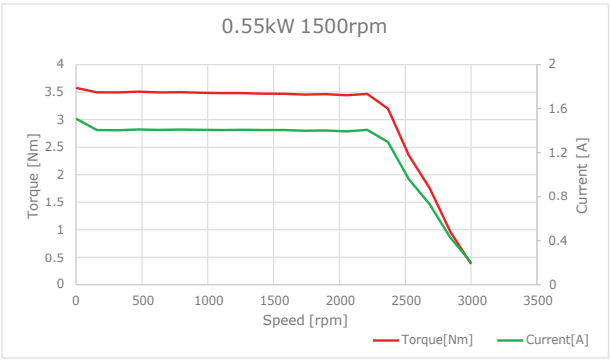
Permanent Magnet Synchronous Motor Range

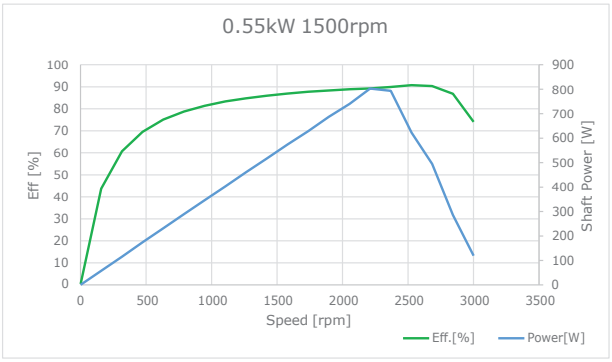
Induction Motor Range

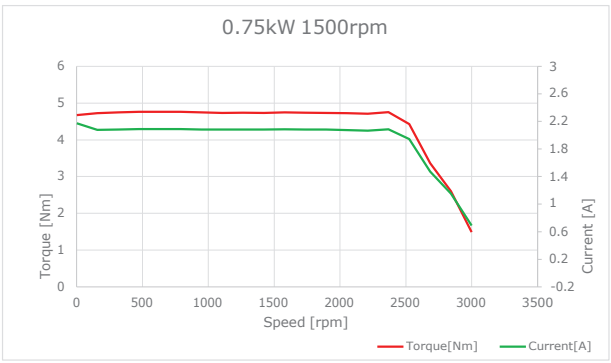
Torque[Nm]		1.2	1.6	1.8	2.4	3.5	4.8	7.0	9.6	12.7	14.0	17.5	19.1	23.9	25.5	35.0	47.8
[kW]	[rpm]																
0.37	3000	71															
0.25	1500		71														
0.55	3000			71													
0.37	1500				71												
0.75	3000				80												
0.55	1500					80											
1.1	3000					80											
0.75	1500						80										
1.5	3000						90										
1.1	1500							90									
2.2	3000							90									
1.5	1500								90								
3	3000								100								
2.2	1500										100						
4	3000									112							
3	1500												100				
5.5	3000											132					
4	1500														112		
7.5	3000													132			
5.5	1500															132	
11	3000															160	
7.5	1500																132
15	3000																160

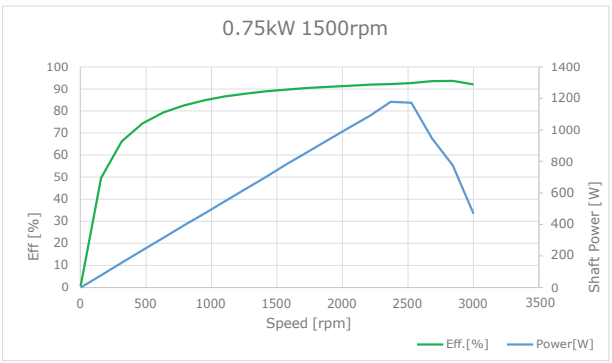
80 FRAME
100 FRAME
132 FRAME

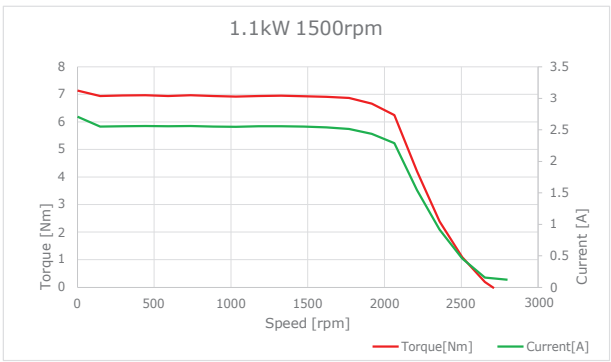
/ Performance Graphs for 80 Frame Motors

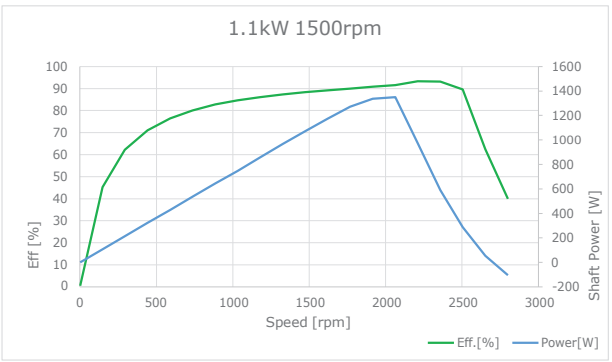




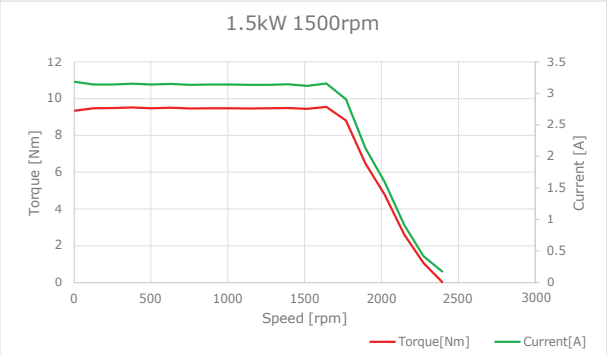


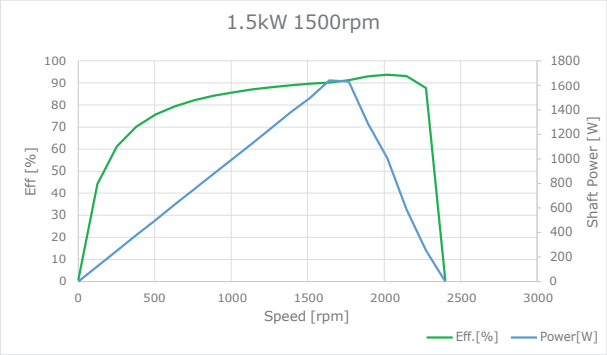


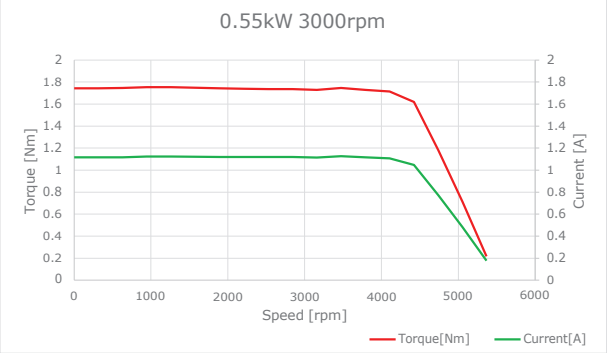


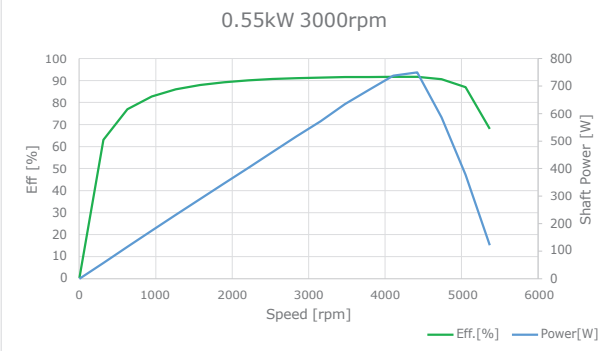


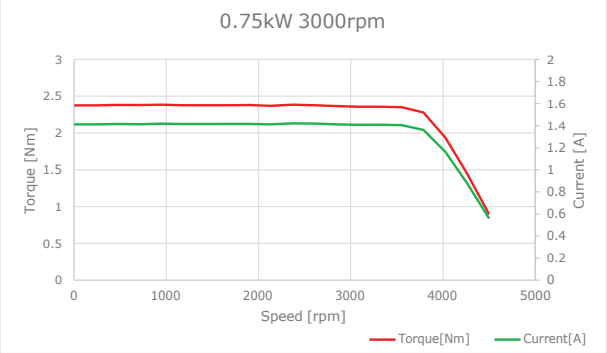
/ Performance Graphs for 80 Frame Motors

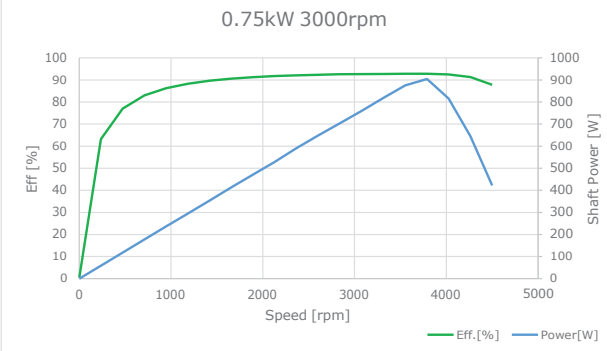


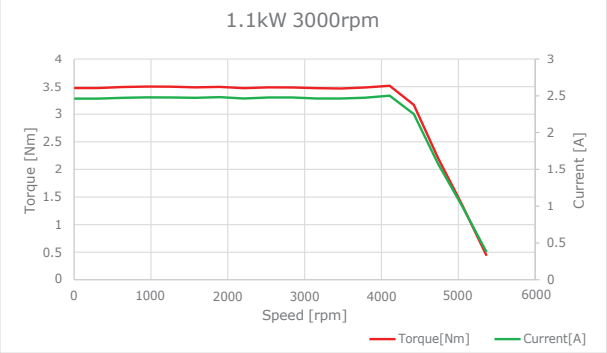


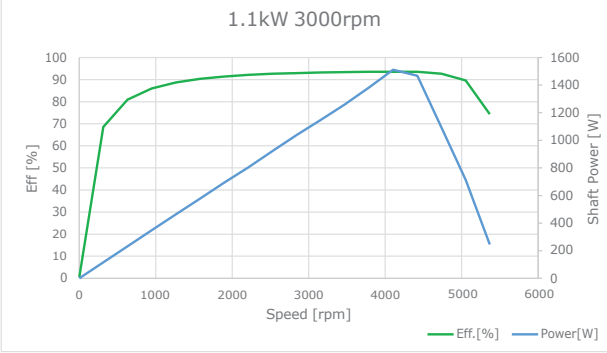




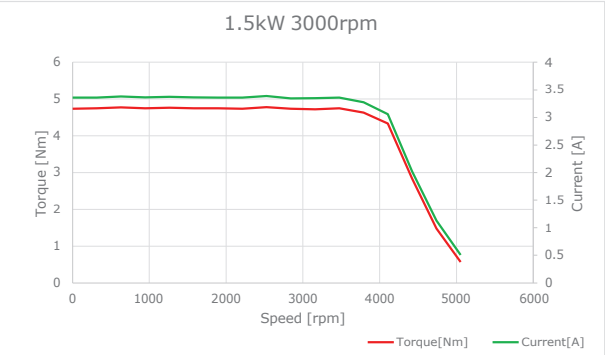


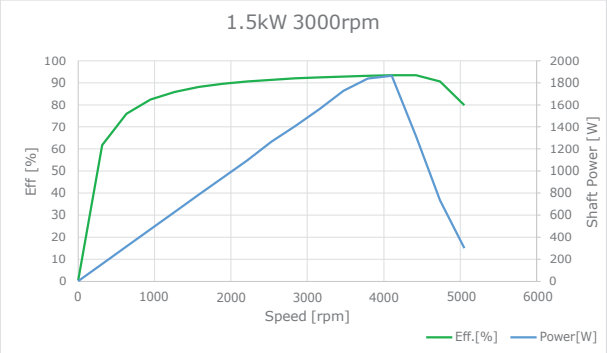


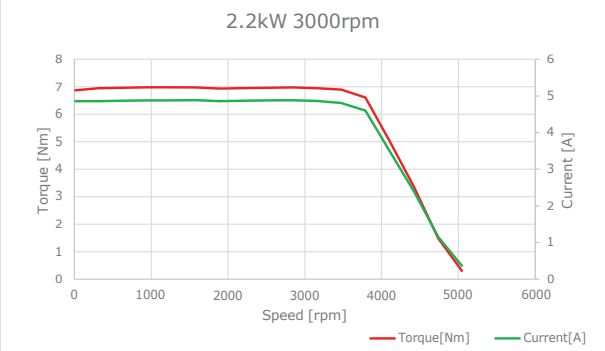


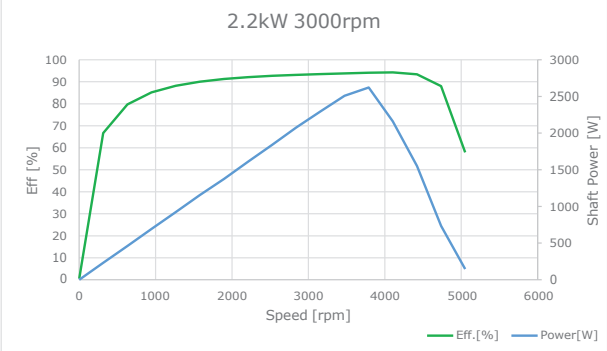


/ Performance Graphs for 80 Frame Motors









Base speed [rpm]	Frame	kW	Nm	Rated Current [A]	Rated Eff [%]	Max.Torque [Nm]	Max. Current [A]	Max. "d" axis Current [A]	Max. Speed [rpm]
1500	80	0.55	3.5	1.4	86.4	10.5	5.6	7	3000
	80	0.75	4.8	2.1	89.3	14.4	8.4	10.5	3000
	80	1.1	7.0	2.6	88.9	21.00	10.4	13	3000
	80	1.5	9.6	3.2	89.5	28.8	12.8	16	3000
3000	80	0.55	1.8	1.2	91.2	5.4	4.8	6	6000
	80	0.75	2.4	1.4	92.6	7.2	5.6	7	6000
	80	1.1	3.5	2.6	93.5	10.5	10.4	13	6000
	80	1.5	4.8	3.4	92.3	14.4	13.6	17	6000
	80	2.2	6.4	4.9	93.5	19.2	19.6	24.5	6000

/ Driver Selection Chart

VoltPro electronic is used to drive PMSM motor with sensor or sensorless. Drive type is FOC (Field Oriented Control).

RPM	1500				3000				
Power [kW]	0,55	0,75	1,1	1,5	0,55	0,75	1,1	1,5	2,2
Current [A]	1,40	2,10	2,6	3,2	1,20	1,40	2,6	3,4	4,9
	VoltPro 0.75kW Input: 3~ 400V Output: 3~ 400V 0-500Hz	VoltPro 0.75kW Input: 3~ 400V Output: 3~ 400V 0-500Hz	VoltPro 1.5kW Input: 3~ 400V Output: 3~ 400V 0-500Hz	VoltPro 1.5kW Input: 3~ 400V Output: 3~ 400V 0-500Hz	VoltPro 0.75kW Input: 3~ 400V Output: 3~ 400V 0-500Hz	VoltPro 0.75kW Input: 3~ 400V Output: 3~ 400V 0-500Hz	VoltPro 1.5kW Input: 3~ 400V Output: 3~ 400V 0-500Hz	VoltPro 1.5kW Input: 3~ 400V Output: 3~ 400V 0-500Hz	VoltPro 2.2kW Input: 3~ 400V Output: 3~ 400V 0-500Hz

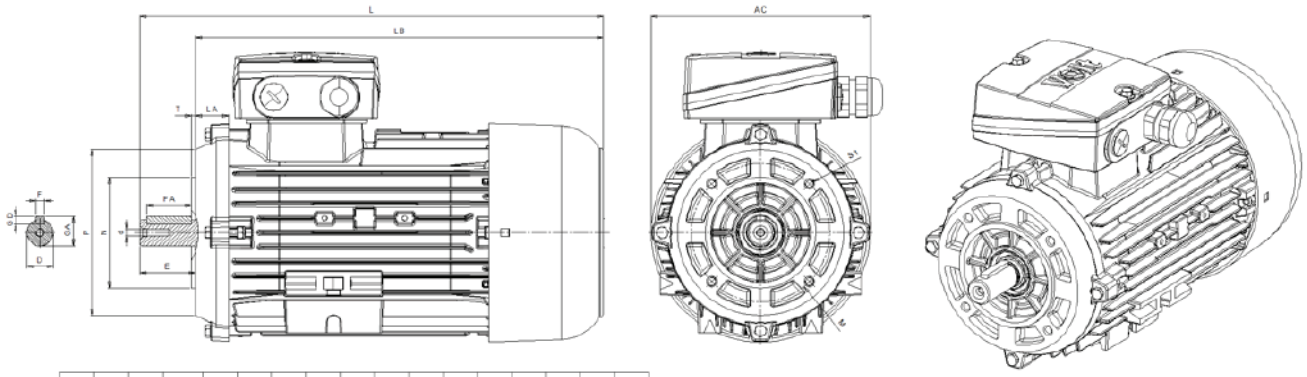
/ Driver setup

Driver should be adjusted for the motor. Firstly, all electrical connection must be done. And below steps should be followed one by one. Driver has "Auto Tuning" mode to drive PMSM motor. For ramp up and ramp down settings, detail information can be found in manual.

Step	Parameter	Descirption	Value
1	P0.0.02	Control Mode	1
2	P0.0.11	Acceleration Time	100
3	P0.0.12	Deceleration Time	20
4	P0.0.13	Type of Motor	2
5	P0.0.14	Rated Power	xx
6	P0.0.15	Rated Frequency	xx
7	P0.0.16	Rated Voltage	xx

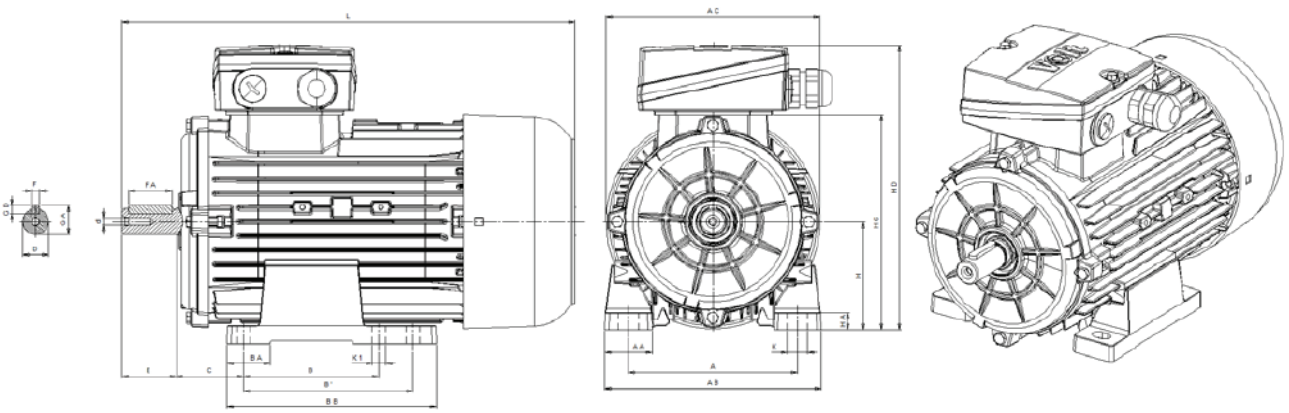
Step	Parameter	Descirption	Value
8	P0.0.17	Rated Current	xx
9	P0.0.18	Rated Speed	xx
10	P5.2.11	Back electromotive force current	30
11	P5.2.19	Start initial position to detect pulse current	80
12	P0.0.24	Auto Tunning	12

/ Construction Type of B3



TYPE	AC	D	d	E	FA	F	GD	GA	L	LA	LB	M	N	P	S1	T
80	158	19	M6	40	32	6	6	21.5	336	24	295	100	80	120	M6	3
90	158	19	M6	40	32	6	6	21.5	341	301	295	115	95	140	M8	3

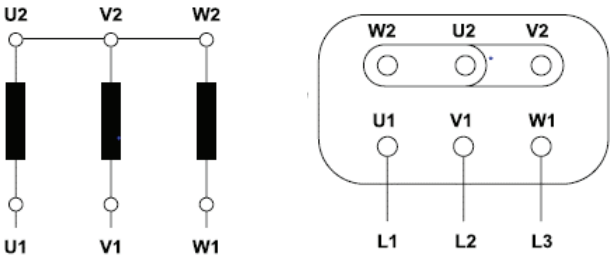
/ Construction Type of B14



TYPE	A	AA	AB	AC	B	B'	BB	BA	C	D	d	E	FA	F	GD	GA	H	HA	HC	HD	K	K1	L
80	125	35	166	158	100	--	125	32	50	19	M6	40	32	6	6	21.5	80	13	159	210	15	10	335
90	140	45	186	158	100	125	155	32	50	19	M6	40	32	6	6	21.5	90	13	169	220	15	10	335

/ Electrical Connection

VoltPro has 3 phase Y connected stator winding. Star point of Y connection is placed inside motor. There is not any wire connection from star point to terminal box. There is 3 wire connection inside terminal box for 3 phase supply output of driver.



/ Thermal protection

Thermal protection of motor can be provided in two ways. First is to use PTC (Positive Thermal Coefficient Resistance) and second is to define current limit in driver setup. 3 pcs of PTC connected electrically in series is placed inside the stator winding to detect winding temperature. PTC is connected to a relay or driver electronic board. When PTC is connected to driver, driver can measure winding temperature on-line and after a threshold temperature is reached, the motor load is decreased or stopped and driver display overheating signal. PTC placement in winding is optional and on request by customer.

/ Insulation System

Stator winding insulation system is made by using insulation paper inside the slot and plastic support for both side of stator lamination. Plastic material of support is special material for high voltage application and appropriate for EU norm.

Thanks to needle winding technology so this motor has fully electrical insulated winding that means there is not any physical contact between each phase winding, there is no need for insulation between phases. By the way for inverter duty running, it is more reliable than classical distributed winding technology.

/ VoltPro Advantages of PMSM For The Application

VoltPro PMSM motor is the best choice for the applications need variable speed and power where the motor can be used as a load sensor to detect the torque or power need of load. Especially for pump, fan and compressor applications, the load needs of system change continuously and drive system should be able to sense this change to save energy and to increase efficiency of system. For some application this can be done without using any sensor, in example pressure or flow rate control for a pump or fan systems. Thanks to linear torque vs current characteristic of motor so that torque or power needs of system can be measured by using motor as a sensor while the motor runs. Special control algorithms can be implemented in firmware for this purpose. VoltPro can support you on request.

/ Application Without Fan

VoltPro motor series have high efficiency level (>IE4) that means low loss so that it can be used without fan for special application where the noise is critical. In this case the motor can be used with decreased rated power without fan cooling system.

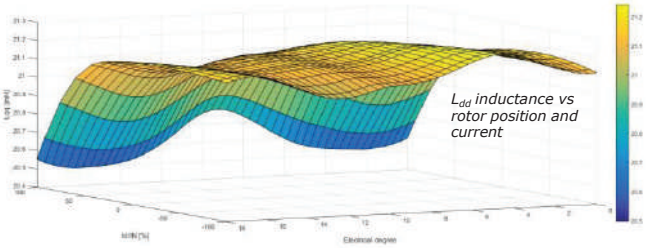
/ Controllability of Motor

VoltPro was designed for sensor less control with FOC drive. It has a saliency, difference between "d" and "q" axis inductance, in its rotor magnetic circuit. By the means of this, it can be driven with different sensorless drive algorithms. Such as, high frequency injection, estimators using monitored stator voltage or currents, flux based position estimators, position estimators based on back-EMF, observed-based estimators (Luenberg observer, sliding mode observer, Kalman filter). PMSM drives without mechanical sensors for motor position or speed have the attraction of lower cost and higher reliability.
Motor inductance change with current and rotor position is important to drive the motor with optimum load angle. Below parameter list should be considered to drive VoltPro PMSM motor in optimum running. Especially during overload running region, saturated inductance value should be considered in sensorless control algorithm.

Motors has low electrical time constant and low mechanical time constant due to low rotor inertia by the means of ferrite magnet usage.

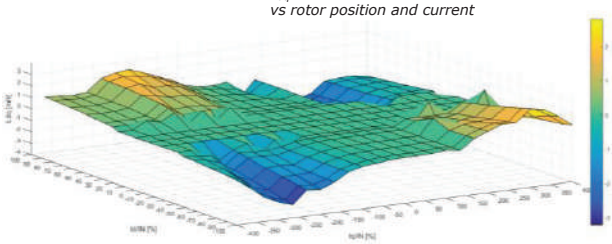
1. L_{dd} "d" axis inductance vs I_d and I_q currents $L_{dd} = \delta\Psi_d/\delta i_q = f(I_d, I_q)$
2. Flux linkage of "d" axis vs I_d and I_q currents
3. L_{qq} "q" axis inductance vs I_d and I_q currents $L_{qq} = \delta\Psi_q/\delta i_q = f(I_d, I_q)$
4. Flux linkage of "q" axis vs I_d and I_q currents
5. L_{dq} cross saturation inductance $L_{dq}(i_d, i_q) = \Delta\lambda_d/\Delta i_q$ I_d=constant
6. L_{qd} cross saturation inductance $L_{qd}(i_d, i_q) = \Delta\lambda_q/\Delta i_d$ I_q=constant
7. L_{dd} "d" axis inductance vs I_d, I_q and rotor position
8. L_{qq} "q" axis inductance vs I_d, I_q and rotor position

Inductance and flux parameters for sensorless drive.

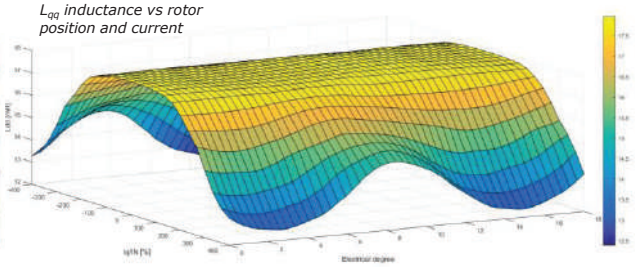


Sample inductance vs current & rotor position

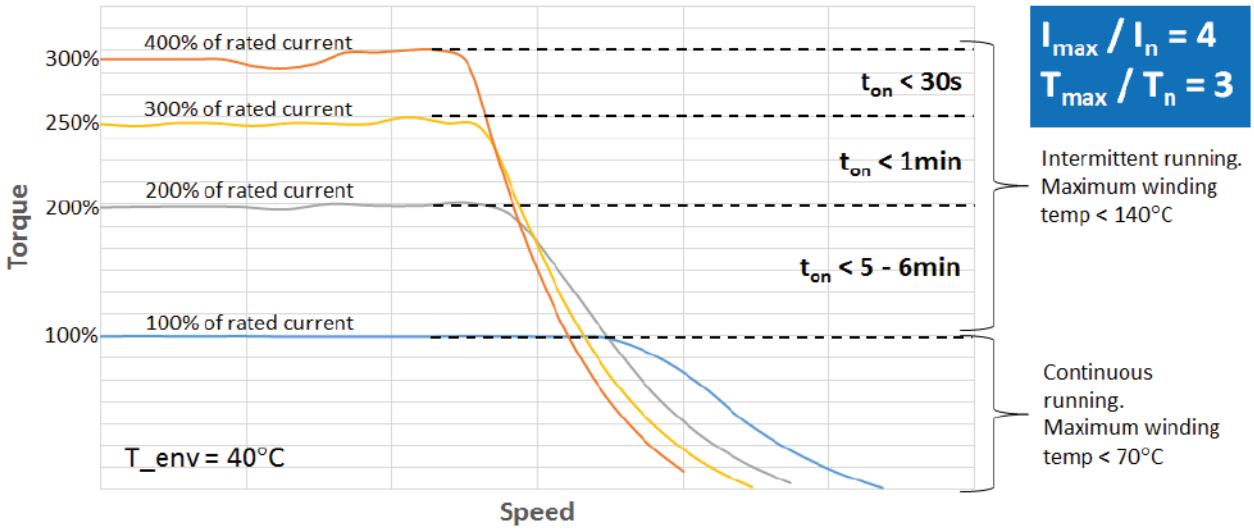
L_{dq} cross saturation inductance vs rotor position and current



L_{qq} inductance vs rotor position and current



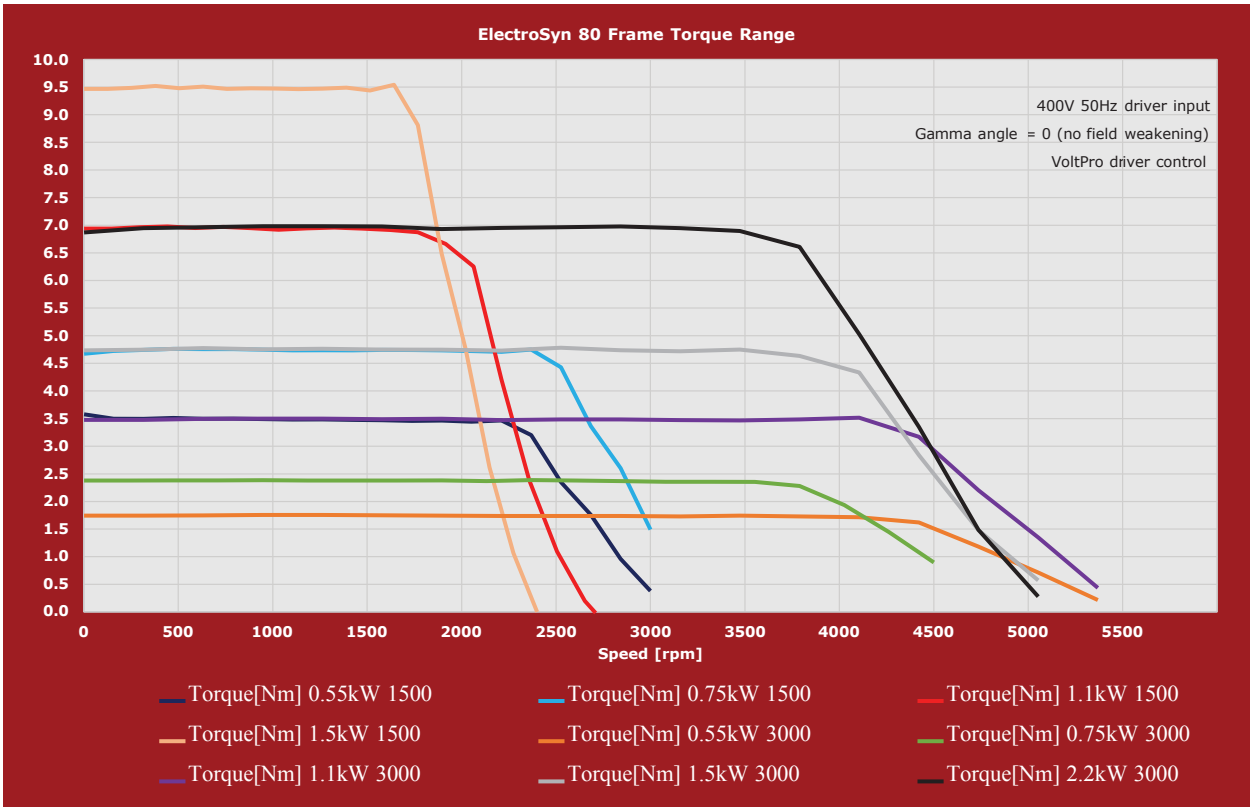
/ Overload Capacity (Saturated Inductances)



/ Torque vs Speed Graph for 80 Frame Motors

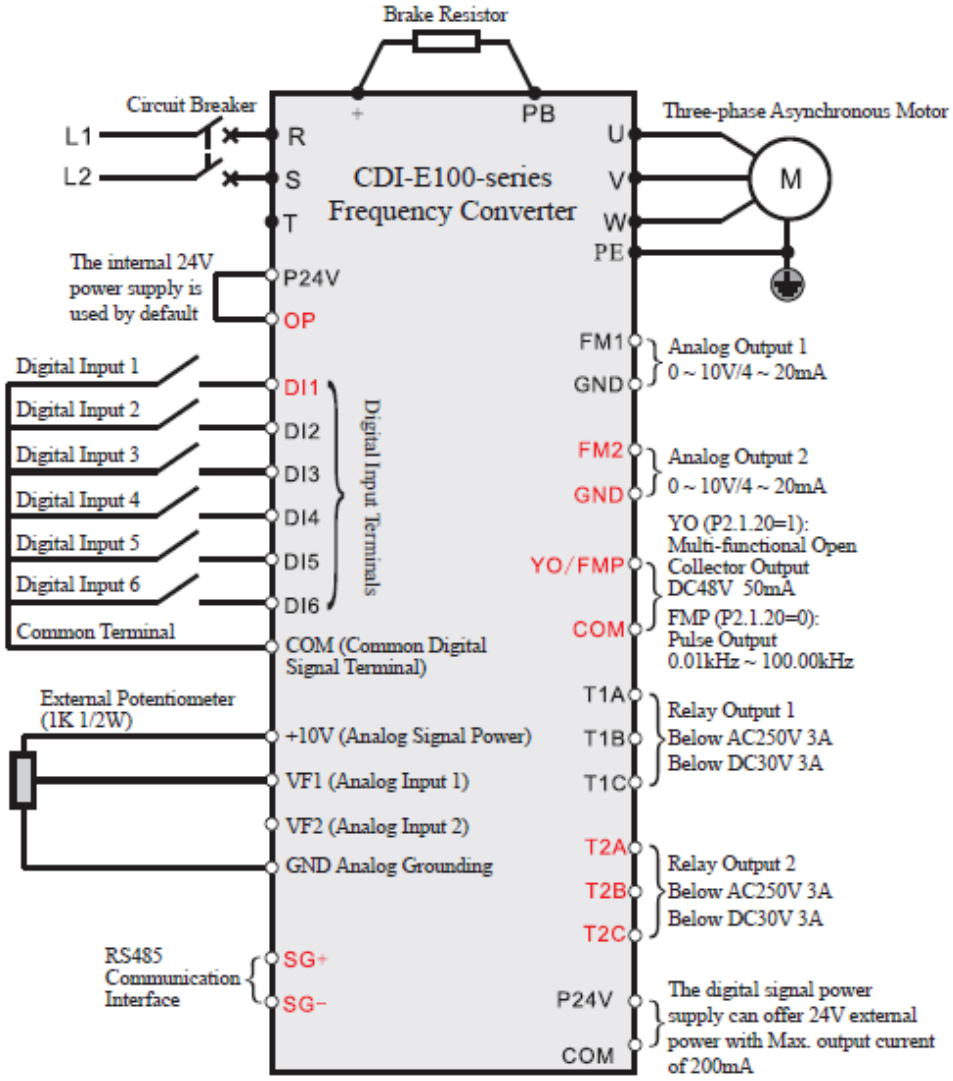
Torque vs speed graph for all types of 80 frame motor range is given below.

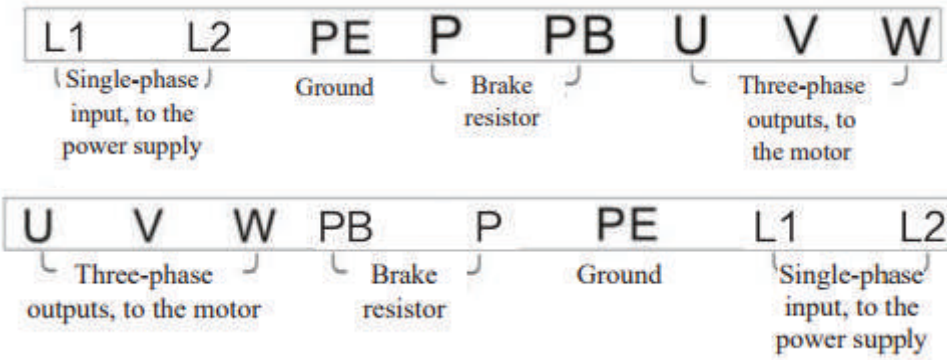
Test Condition: 400V 50Hz driver input / gamma angle = 0 (no field weakening)



/ Wiring Diagram of VoltPro Driver

VoltPro driver wiring diagram should be done according to below figure. For PID closed loop control with sensor (pressure, flow rate...) external analog inputs can be used. For detail information please examine on manual.

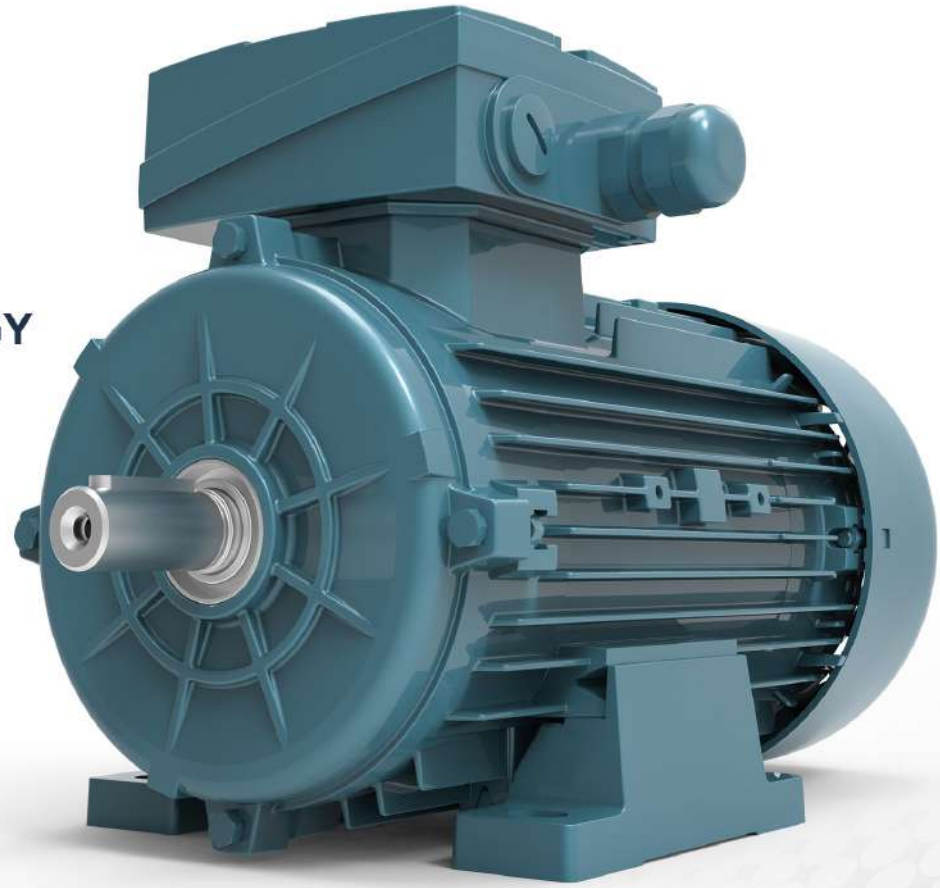




MEET THE MOST EFFICIENT ELECTRIC MOTOR OF THE WORLD

$\eta >$ IE4 $\$ <$ IE3

Low Cost and High Efficiency in One



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