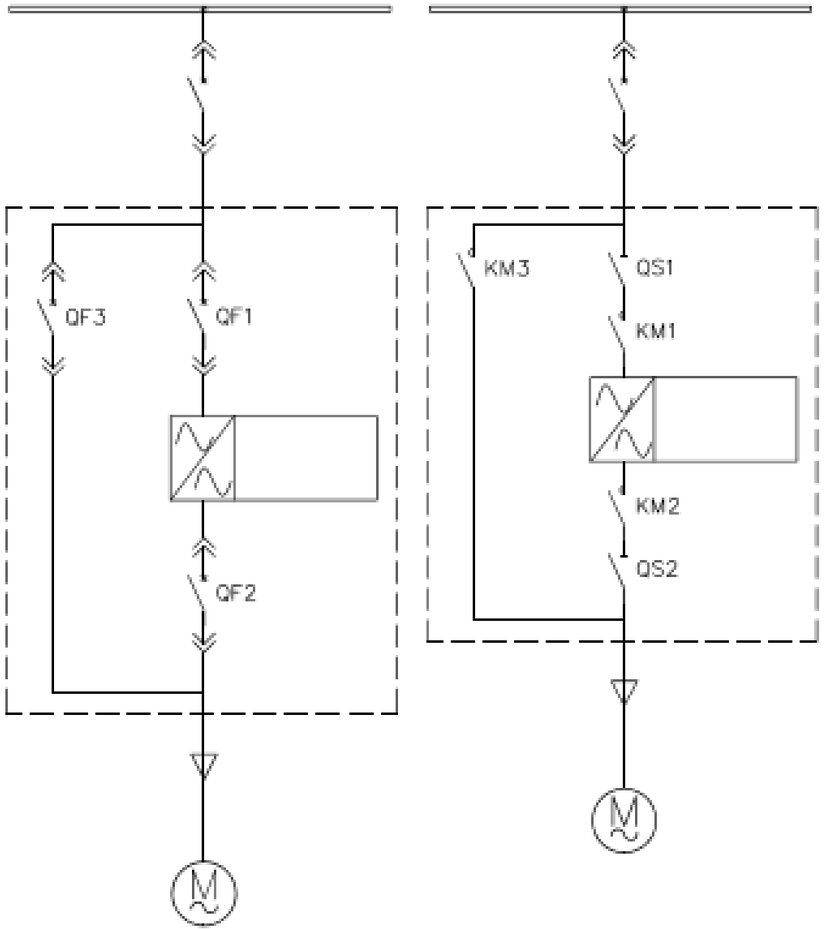
Honeywell

SolidDrive

Sensorless Vector Medium - Voltage VFD

Two common VSD Schemes



LEGEND FOR USING AEG VCBS AND VACUUM CONTACTOR;

SCHEME 1 USING VCB

QF1 = VCB TO VSD
QF2 = VCB FOR MOTOR CONTROL
QF3 = VCB FOR DIRECT STARTING OF OF MOTOR IF VSD IS FAULTY.

SCHEME 2 USING VACUUM CONTACTOR

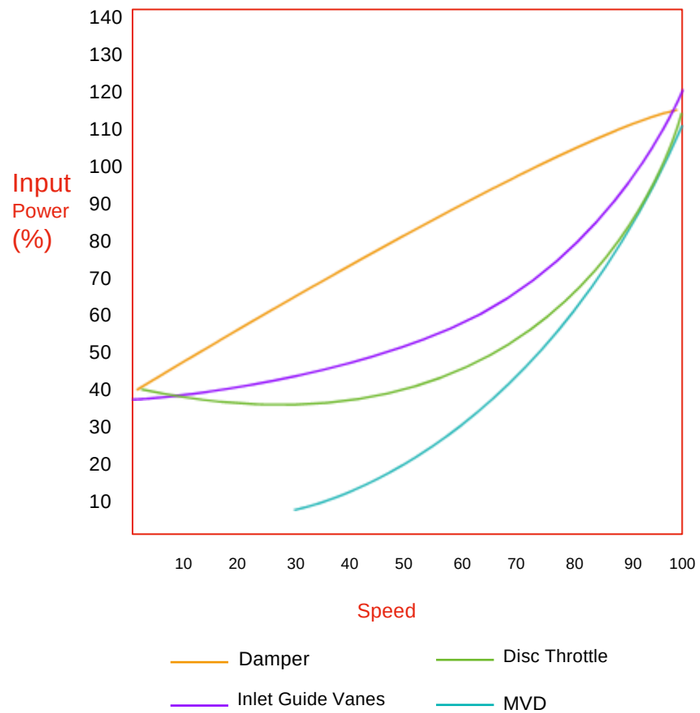
QS1 = DS FOR KM1 ISOLATION
QS2 = DS FOR KM2 ISOLATION
KM1 = VACUUM CONTACTOR FOR VSD SUPPLY
KM2 = VACUUM CONTACTOR FOR MOTOR SUPPLY
KM3 = VACUUM CONTACTOR FOR DIRECT STARTIN
(BY PASS VSD IF VSD IS FAULTY)

Energy-saving Efficiency Reliability

Medium-Voltage VFD:
The solution for your motor drive systems

About 50% of world's energy is used to drive motors. Today's environment calls for more efficient energy solutions, which provide exactly energy to match the actual load requirement. Medium Voltage VFD serves best to drive your pumps, fans, compressors and other devices.

- Saving energy by adjusting the speed of motors
- Soft-start, starting motor less than 1.5*rated current
- Minimize power line disturbance
- Enable close loop automatic control of the process (pressure, flow…)
- Increasing mechanical maintenance cycle (bearing and sealing) by decreasing rotating speed



Typical Applications
for Medium-Voltage VFD

Power Generation:

Induced and forced-draft boiler fans, Reactor recirculation pumps, Feedwater, Cooling, Circulation and Condensate pumps, Compressor

Petrochemical:

Fans, Pumps, Pipeline Pumps, Water Injection Pumps, Electric submersible pumps

Iron& Steel:

Dedusting Fans, Water Pumps, Slurry Pumps,

Descaling Pumps

Municipal Water Supply:

Intake Water Pumps, Booster Pumps

Sewage Treatment:

Sewage Pumps, Decontamination Pumps, Rinsing Pumps

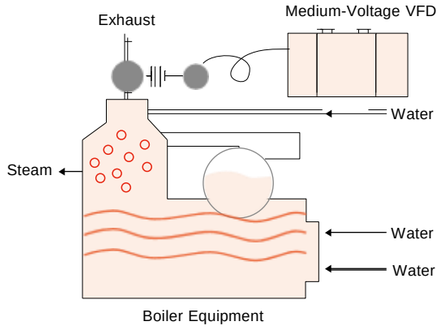
Cement:

Kilns Fans, Re-circulation Fans, Exhaust Fans, Raw mill Machines

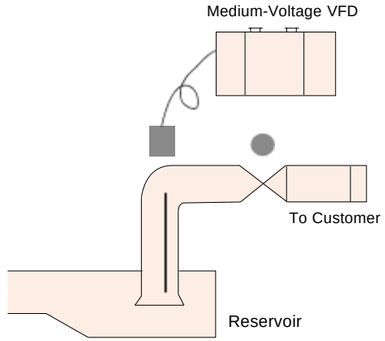
Paper Industry: Chip screw feeders

Pharmacy: Cleanout Pumps

Others: Wind tunnel, Lab and so on



Induced Draft Fan



Booster Pump in Water-Supply Line

Soliddrive series summary

Honeywell SolidDrive series Medium-voltage VFD (Variable Frequency Drive) with 32-bit DSP uses the sensorless vector control technology.

SolidDrive series Medium-voltage VFD chooses Cell Series Multi-level PWM IGBT drive technology. A robust H class multi-secondary winding transformer is used in the input side to eliminate harmonics. The input wave of the drive meets IEEE-519-1992 and related code for the voltage and current harmonic distortion ., The output section uses Multi-level PWM, with few harmonic, low common-mode voltage and dv/dt . SolidDrive is suitable for standard 3-phase induction motors and synchronous motors.

SolidDrive series Medium-voltage VFD is more efficient and reliable due to a number of patented technologies introduced. And we have the test capability (up to 20MW) to fully test each SolideDrive before shipping to prove performance and ensure problem free commissioning on site.

Eliminate input filter

Total Harmonic Distortion (THD) meets IEEE519-1992, no input harmonic filter required.

No power factor compensation equipment required

Input power factor >0.95.No reactive Power compensation required

No output filter required

Voltage: VTHD<2% (20 order below), dv/dt<1000V/us
Current: CTHD<2.5%, DC factor <1% is not required, be able to drive standard induction motor without derating.

Sensorless vector control

Speed range: 100:1, Static speed accuracy: 0.5%, Starting torque: 150% (Open-loop).

Closed-loop vector control

Speed range: 1000:1, Static speed accuracy: 0.1%, Starting torque: 150% (Closed-loop).

High efficiency

VFD efficiency ≥98.5%, total drive system efficiency (VFD & transformer) ≥97%

High reliability and availability throughout life time

30 years design Life: MTBF (Mean Time between Failures) > 100,000 hours; MTTR (Mean Time to Repair) < 10mins

SolidDrive Features

- Integrated sensorless vector control, closed-loop vector control and V/F control. Self-detecting function for motor parameters.
- 32-bit DSP full-digital control.
- Dust-proof and self-cooling design for control unit, featuring high reliability.
- Automatic Power cell bypass control function【optional】can bypass the failed power cell and keep the system running without interruption.
- Industrial touch-screen HMI and operator interface supporting Chinese and English.
- Embedded PLC with analog and digital I/O expandable, PID function for process control
- Supported major industrial BUS including Modbus, Profibus
- Enable Windows based remote management and control, support GPRS, CDMA internet access.
- Comprehensive safety protection, including transformer short circuit, overheating, primary ground fault protection, over-voltage, over-current, motor over-load, motor over-voltage, output ground fault, VFD over-load , power cell protection, cooling fan protetction, interlock etc..
- Monitoring: input voltage, current ,frequency, power, power factor, kWh and efficiency; runtime; output voltage, current, speed, frequency, torque and power etc.
- Intelligent fault-diagnosing function.
- Fault log and event log.
- H-Class Line side Dry type transformer.
- Modular design of power cell, exchangeable structure, easy for service Power Interruption Ride-Through: SolidDrive can maintain the operation in the event of a power loss less than 5 seconds.
- Wide Range of Input Voltage. SolidDrive VFD allows 40% of voltage dip.
- Redundant design for control power and no UPS required.
- Automatic Torque adjustment and control during the speed change.
- Automatic fault reset function, speed tracking restart function for forward or reverse rotation.
- Automatic derating with the change of ambient temperatures and altitude.
- Washable, reusable and on line changeable air inlet filter.
- On line switch between VFD and Power Frequency drive.

SolidDrive Topology Structure

SolidDrive uses Cell Series Multi-level technology. It directly connects the high-voltage and does not need output transformer. SolidDrive consists of three sections: Isolation transformer section, power cell section and the control section.

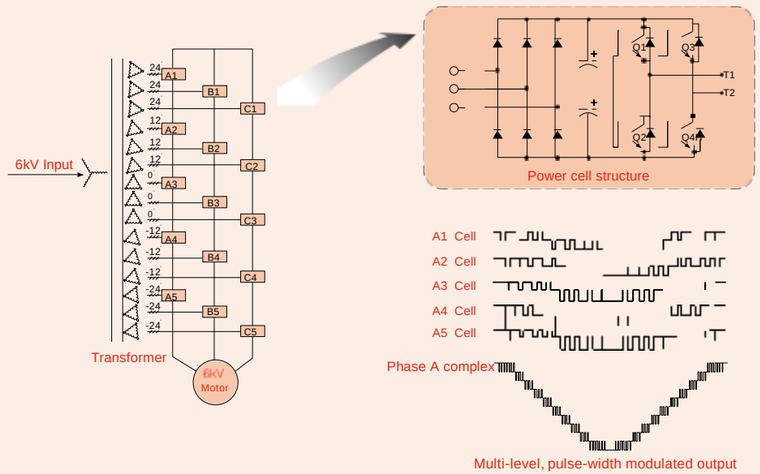
3kV 3kV series includes 9 power cells, each phase includes 3 power cells. And three Phases form Y, connect to 3kV motor directly.

6kV 6kV series includes 15 power cells, each phase includes 5 power cells. And three Phases form Y , connect 6kV motor directly.

6.6kV 6.6kV series includes 18 power cells, each phase includes 6 power cells. And three Phases form Y , connect 6.6kV motor directly.

10kV 10kV series includes 24 power cells, each phase includes 8 power cells. And three Phases form Y, connect to 10kV motor directly.

6kV SolidDrive series topology structure



Power Cell

The Power Cell is 3 phase input and 1 phase output, AC-DC-AC structure. AC voltage from the transformer secondary winding pass through the power cells input fuses to 3-phase diode rectifier, and with capacitance filter to become smoothly DC voltage, then the DC voltage feeds a single-phase H-bridge circuit with 4 IGBT and becomes single-phase AC output with variable voltage and variable frequency.

The power cell's control board is multi-functional, including complete protection and optimized IGBT drive circuit. Each power cell has the same mechanical and electrical structure, and can be exchanged with each other..

SolidDrive series need the fewest power cells in the same power VFDs because of higher-voltage degree IGBT used. And this reduces the quantity of components and enhances the reliability.

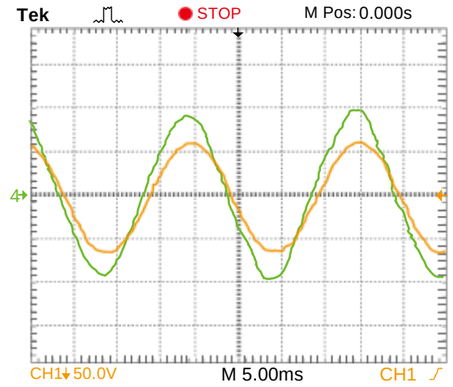
Be benefits from the power cell auto bypass technology, the failure of any power device (diode, IGBT, etc.) or control device will not result in a process trip and allow for continued operation of VFD system.

Soliddrive Series Waveform

Input

At the input side, the power cells are supplied power by phase-shifting transformer whose secondary winding is multiple structure and their electric angle is staggered, which can eliminate most of the harmonic currents drawn by the individual power cells. 3kV, 6kV, 6.6kV, 10kV output series choose 18, 30, 36 and 48 pulses rectifier respectively and the input harmonic current is very low, which meets the most stringent IEEE-519-1992 and GB/T14549-93 requirements for the voltage and current harmonic distortion without filter .

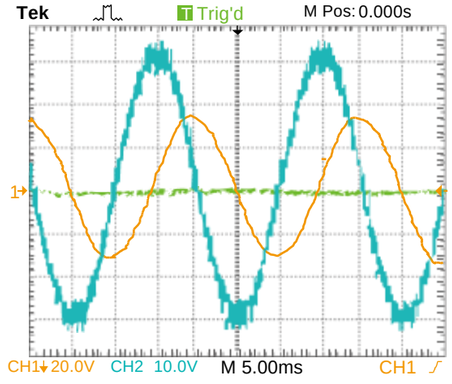
The isolation transformer ensure the lower common mode voltage and no damage to motor insulation.



Input Voltage and Current waveforms

Output

Each power cell's output terminals connected in series form to Y connected to supply the motor directly. Drives can provide a sinusoidal output wave form because each power cell chooses multilevel PWM technology. In addition, there is no need for derating. In fact, drives eliminate harmful VFD-induced harmonics which cause motor heating. Similarly VFD induced torque pulsations are eliminated (even at low speeds), thereby reducing the stress on mechanical equipments. Common mode voltage stress and dv/dt stress are also minimized.Drives need no filter and can be suitable for normal motor, include old motor without derating. The cable length can be up to 12km with no restriction, which is especially suitable for some special applications, such as electric submersible pumps and etc.



Output voltage and current waveforms

SolidDrive Controller

Controller

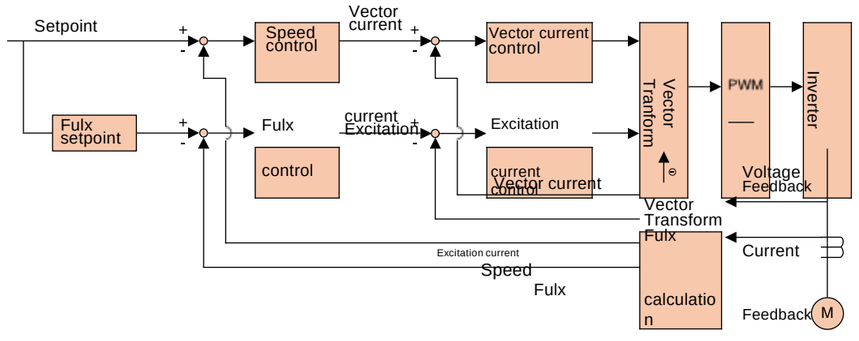
SolidDrive series VFD's controller includes 32-bit DSP, ASIC, HMI and PLC. DSP is in charge of the operation of sensorless vector control technology; ASIC is in charge of the control of multi-level PWM technology; Graphic HMI is in charge of the human and machine interface, supporting English and Chinese; PLC inside is in charge of the logic control.

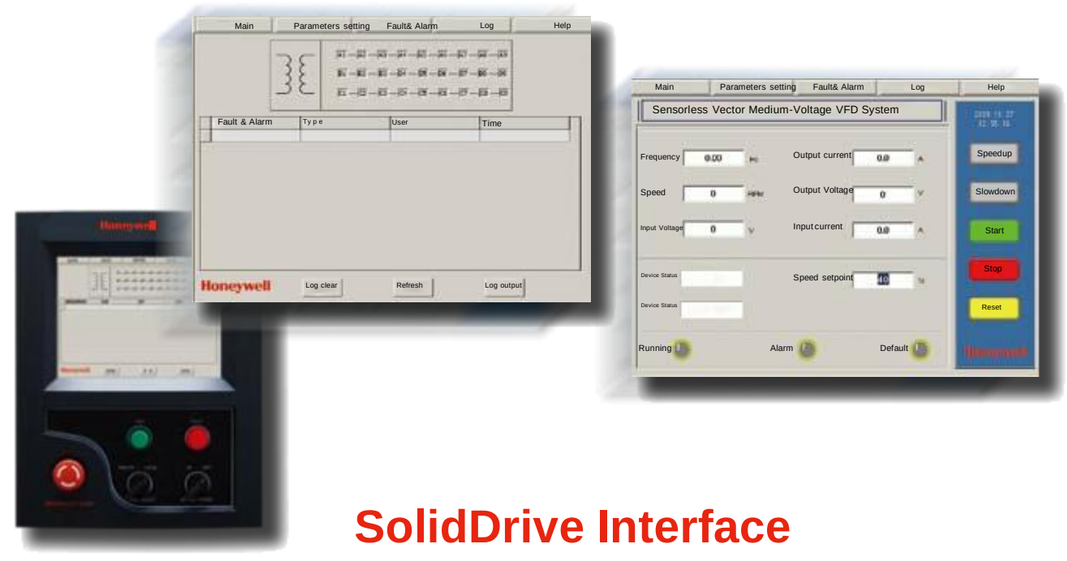
The fiber optic communication is used, which make completed isolation in electrics between the control section and the high-voltage section. The total system has the best performance of safety and reliability.

Single phase 220V control power is redundant design, and no UPS required, which make sure the driver keep running with control power's fluctuation or losing .

Sensorless vector control

SolidDrive series chooses sensorless vector control technology., which can consumedly enhance the drives ability, and exploit the applications such as great start-up torque request , high speed precision and high dynamic ability without adding hardware components. Drive has torque-limited function for trip free operation, auto-reset function for dedicated faults and "Spinning Load Restart" function. Even for the fan, pump, or lower dynamic load requirements, sensorless vector control could efficiently prevent the motor from over-current and over-voltage tripping during the acceleration and deceleration procedure with inherent functions.





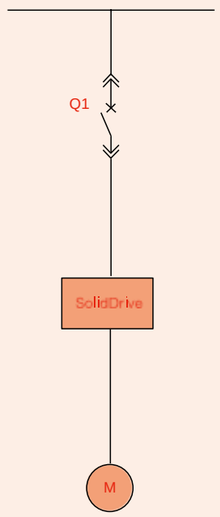
SolidDrive Interface

SolidDrive medium-voltage drive has a user-friendly interface. The control panel installed at the front-door has remote/local switch, start/stop switch, and emergency stop button. Besides, there are indicate lights for status running, alarm and fault.

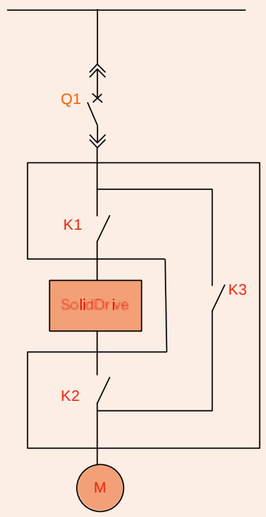
Touch screen HMI supports both Chinese and English language. Through the touch screen operators can operate the equipment, check system status and record events etc..

Bypass Diagram

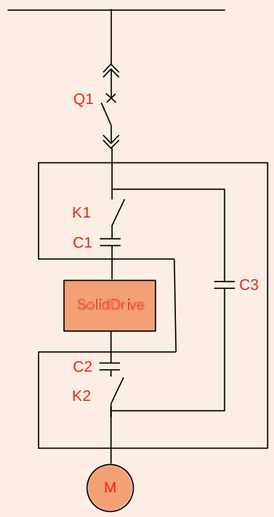
No Frequency Bypass



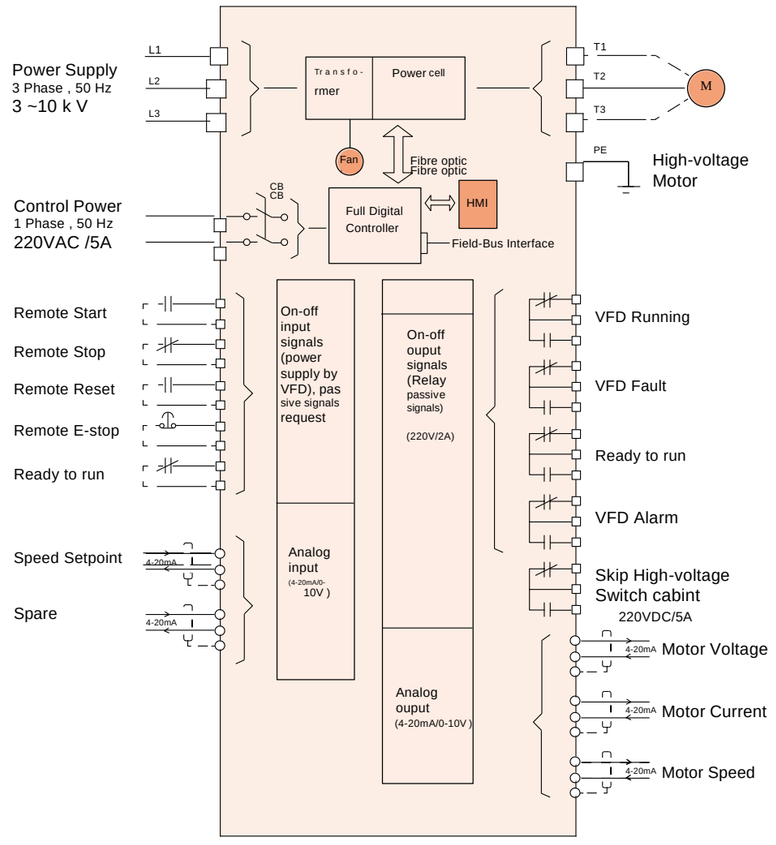
Manual Frequency Bypass



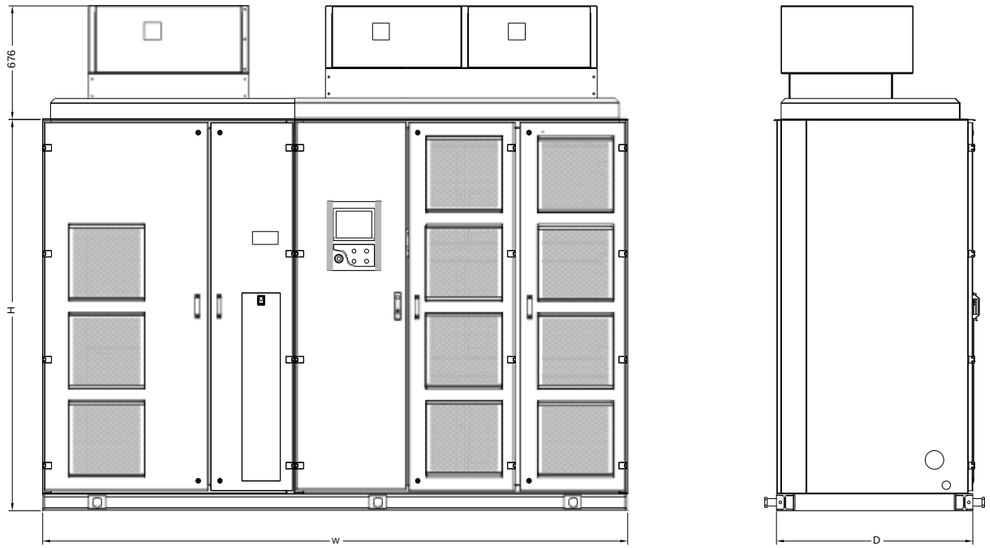
Auto Frequency Bypass



Standard Control Diagram



Demension



Product Type

Output Voltage: 10 kV

Power (kW)	Rated Current (A)	Width W (mm)	Depth D (mm)	Height H (mm)	Weight (kg)	Air flow (m^3/min)
220	16	4934	1219	2327	3000	280
250	18	4934	1219	2327	3150	280
280	20	4934	1219	2327	3250	280
315	22	4934	1219	2327	3350	280
355	25	4934	1219	2327	3450	280
400	28	4934	1219	2327	3500	280
450	31	4934	1219	2327	3600	280
500	34	4934	1219	2327	3650	280
560	38	4934	1219	2327	3750	280
630	43	4934	1219	2327	3950	280
710	48	4934	1219	2327	4200	280
800	54	5134	1400	2327	4400	280
900	60	5134	1400	2327	4500	280
1000	67	5134	1400	2327	4650	280
1120	75	5134	1400	2327	4800	280
1250	83	5134	1400	2327	5250	280
1400	94	5134	1400	2327	5450	375
1600	109	5614	1400	2327	6000	375
1800	122	5614	1400	2327	6300	375
2000	135	5614	1400	2327	6500	375
2240	150	6770	1400	2327	6650	540
2500	170	6770	1400	2327	7000	540
2800	190	6770	1400	2327	7500	540
3150	210	6970	1400	2327	8000	540
3550	235	6970	1400	2327	9000	540
4000	264	7794	1400	2500	9500	540
4500	298	7794	1400	2500	10000	540
5000	328	7794	1400	2500	11000	540
5600	365	7794	1400	2500	12000	540
6300	416	1079 0	18 0 0	2777	19000	720
710 0	466	1079 0	18 0 0	2777	20000	720
8000	523	1079 0	18 0 0	2777	21000	720
9000	583	1079 0	18 0 0	2777	22000	720
10000	643	1079 0	18 0 0	2777	23000	720
10000-20000	<145 0	174 0 0	2000	2800	48000	Water cooling

Product Type

Output Voltage: 6.6 kV

Power	Rated Current	Width W	Depth D	Height H	Weight	Air flow
(kW)	(A)	(mm)	(mm)	(mm)	(kg)	(m^3/min)
220	24	4105	1219	2327	3300	300
250	26	4105	1219	2327	3465	300
280	30	4105	1219	2327	3575	300
315	34	4105	1219	2327	3685	300
355	37	4105	1219	2327	3795	300
400	42	4105	1219	2327	3850	300
450	45	4105	1219	2327	3960	300
500	52	4105	1219	2327	4015	300
560	57	4105	1219	2327	4125	300
630	65	4305	1400	2327	4345	300
710	74	4305	1400	2327	4620	300
800	82	4305	1400	2327	4840	300
900	92	4305	1400	2327	4950	300
1000	103	4305	1400	2327	5115	300
1120	115	4305	1400	2327	5280	300
1250	127	4305	1400	2327	5775	300
1400	143	5270	1400	2327	5995	450
1600	164	5270	1400	2327	6600	450
1800	182	5270	1400	2327	7150	450
2000	200	5270	1400	2327	7700	450
2240	225	5270	1400	2327	8250	450
2500	250	5270	1400	2327	9350	540
2800	281	6100	1400	2327	10450	540
3150	318	6100	1400	2327	11000	540
3550	353	6100	1400	2327	12980	540
4000	395	6600	1800	2777	13530	648
4500	442	6600	1800	2777	14080	648
5000	496	6600	1800	2777	15180	648
5600	555	6600	1800	2777	16280	648
6300	625	6600	1800	2777	17380	648
6300-13000	< 1450	12800	2000	2800	44000	水冷

Product Type

Output Voltage: 6 kV

Power	Rated Current	Width W	Depth D	Height H	Weight	Air flow
(kW)	(A)	(mm)	(mm)	(mm)	(kg)	(m^3/min)
220	26	3800	1219	2327	3000	250
250	29	3800	1219	2327	3150	250
280	33	3800	1219	2327	3250	250
315	37	3800	1219	2327	3350	250
355	41	3800	1219	2327	3450	250
400	46	3800	1219	2327	3500	250
450	50	3800	1219	2327	3600	250
500	57	3800	1219	2327	3650	250
560	63	3800	1219	2327	3750	250
630	71	4000	1400	2327	3950	250
710	81	4000	1400	2327	4200	250
800	90	4000	1400	2327	4400	250
900	101	4000	1400	2327	4500	250
1000	113	4000	1400	2327	4650	250
1120	126	4000	1400	2327	4800	250
1250	140	4000	1400	2327	5250	250
1400	157	4870	1400	2327	5450	375
1600	180	4870	1400	2327	6000	375
1800	200	5350	1400	2327	6500	375
2000	220	5350	1400	2327	7000	375
2240	248	5350	1400	2327	7500	375
2500	275	5614	1400	2327	8500	450
2800	309	5614	1400	2327	9500	450
3150	350	5614	1400	2327	10000	450
3550	388	6 11 4	18 0 0	2777	11 8 0 0	540
4000	434	6 11 4	18 0 0	2777	12 3 0 0	540
4500	486	6 11 4	18 0 0	2777	12 8 0 0	540
5000	546	6 11 4	18 0 0	2777	13 8 0 0	540
5600	6 11	6 11 4	18 0 0	2777	14 8 0 0	540
6300	687	6 11 4	18 0 0	2777	15 8 0 0	540
6300-13000	<145 0	12 8 0 0	2000	2800	40000	Water cooling

Note:

1. Rated current data is referred to the standard 4 pole motors with star connection.
2. Please contact our sales agent for other voltage class (2.3kV, 3kV, 3.3kV, 4.16kV, 7.2kV, 13.8kV, etc.)

Product Model Description

SolidDrive A / B - C

- C: Output Rate Power(kW)
- B: Output Voltage(kV)
- A: Input Voltage(kV)
- SolidDrive: Product Series

For example:
SolidDrive 6/6-1000, represents SolidDrive Series Medium-Voltage VFD, 6kV input voltage, 6kV output voltage, 1000kW output power.

Technical Specifications

Input Data	
Voltage, Frequency	3 Phase 3~10KV, 45~55Hz
Undulation Range	±20%
Permissible voltage dip	40%(with derating)

Output Data	
Output Voltage	3 ~10 K V
Overload capacity	120% for 1 min, 150% for 5 secs, 200% for direct protection
Output Frequency	0 . 5 ~12 0 H z
Waveform	Multi-level PWM

General	
Efficiency	Inverter efficiency>98.5%, Overall efficiency>97%
Power Factor	>0.95(in speed range)

Running	
Operation mode	Local/Remote, Auto/Manual
Frequency setting	Analog inputs/ Panel inputs
Analog I/O	0~10V/4~20mA,set freely, extend

Environment*	
Operation condition	Indoors,without explosive or corrosive gas, electrically conductive dust and oil mist.
Height above sea level	Under 1000m, derating above 1000m
Temperature	-15 ~ 4 0℃, (Up to 50℃ when derating)
Humidity	<95% Relative humidity, non-condensing
Storage temperature	- 4 0 ~7 0℃

Control	
Time of Speedup/ Slowdown	0.1~3200s(refer to the load)
Control Type	Sensorless Vector Control/Close loop Vector control/ VVVF control
Main Power Structure	Power Cell series multi level
PID Function	Intellectualized PID control inside
Other Functions	Auto-restart at once, Stall protection, critical speed obviation, energy saving, auto-reset
Frequency resolution	0 . 01H z
Power section	Fiber-optic cable
Control Power	1Phase 220VAC/5A, +20~-30%(redundancy)
Commuication	Profibus-DP, Modbus for choice

HMI	
Setting and monitoring	Start,Stop,Reset,Frequency setpoint,Running status, Parameters setting,Fault and alarm, Running Reports and so on
Display	Voltage,Current,Frequency,Power,Power Factor, Power consumption,Effiecency, runtime

Others	
Protections	Over-voltage,over-current,motor over-load,VFD over-load,transformer overheating,Grounding, Fan alarm, Cabinet's interlock
Protection Degree	IP3X
Noise level	<70 dBA
Cooling Type	Air-cooling or Water-cooling
Opinions	Power cells auto- bypass , Frequency/ VFD Switch, Encoder

Ordering information required

1. Primary schemes or ZENITH SWITCHGEAR AEG ZSG12/ZSG17.5 Scheme Number of each switchgear used;
2. Single line system diagram;
3. Rated voltage, rated current, rated short circuit breaking current;
4. Control voltage and nos. of auxiliary contacts.
5. Plan view of substation layout or switchgear layout diagram;
6. Specification and type of incoming and outgoing power and control cables;
7. Specification and requirement of control, measurement and protection schemes of each type of switchgear panel;
8. Requirement of interlocks and automatic features if any;
9. Model/part numbers, specification and quantity of key switchgear components.
10. If bus duct is required, please specified the rated current, length and height of crossing and other detail dimensions;
11. If switchgear is used in special operating environmental condition, please specify clearly;
12. Other special requirements if any.

How to contact us?

ZENITH SWITCHGEAR (M) SDN. BHD.
SALES OFFICE:
UNIT AM13-PJ INDUSTRIAL PARK, JALAN KEMAJUAN, 46200 PETALING JAYA, SELANGOR DARUL EHSAN, MALAYSIA.
Jimmy Wong, Managing Director, Mobile: +60173460728, Office/Fax: +60379317072, email: jimwkm@gmail.com, jimwkm@qq.com
FACTORY ADDRESS:
NO.5, JALAN RAJAWALI 1A, BANDAR PUCHONG, 47100, SELANGOR, MALAYSIA.