

Medium Voltage Drive Technical Data

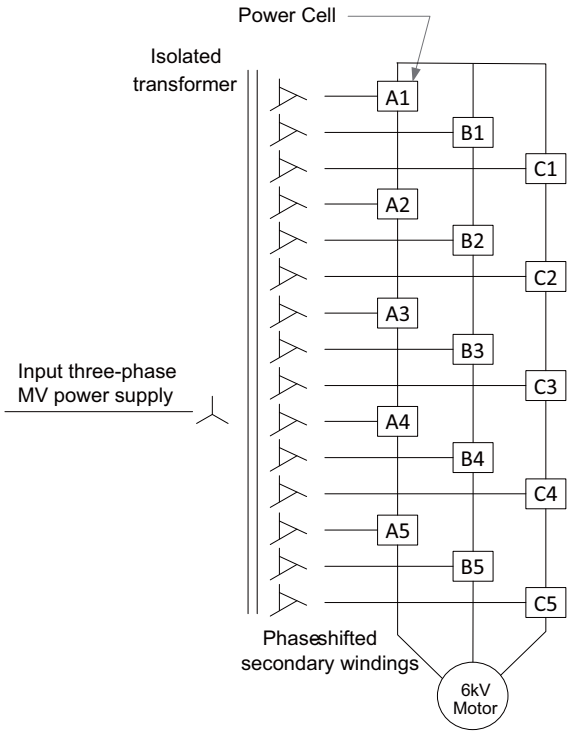
NANJING AUBO ELECTRIC CO., LTD

The **AUBO** series MV VFD adopts AC-DC-AC mode, the electronic switch component is IGBT. It is highly reliable by means of the power cells connected in series and voltage overlapping method.

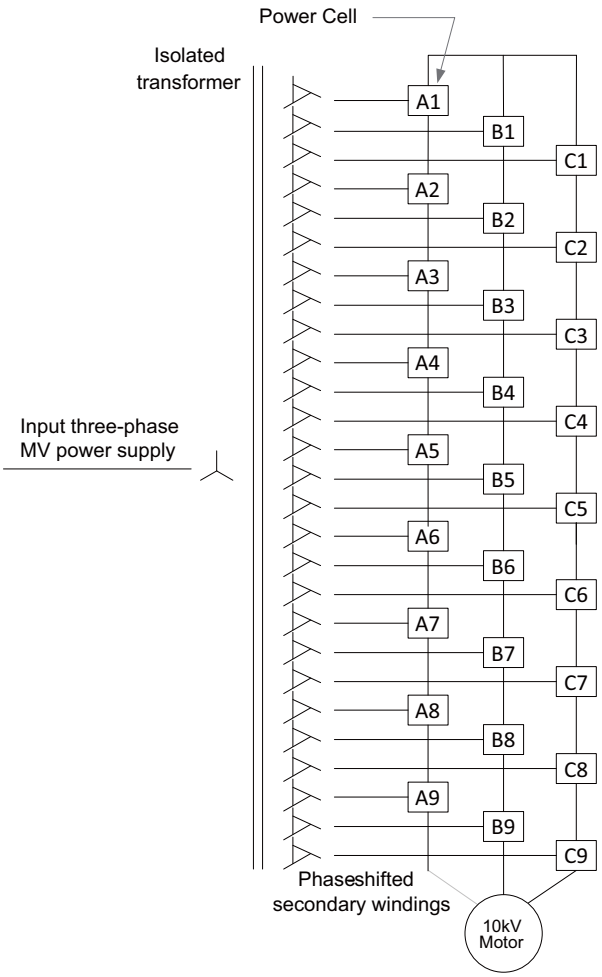
Topology of System

6kV series: Total 15 power cells, 5 cells per phase, three phases Y-connected.

10kV series : Total 27 power cells, 9 cells per phase, three phases Y-connected.



6kV Asynchronous Motor

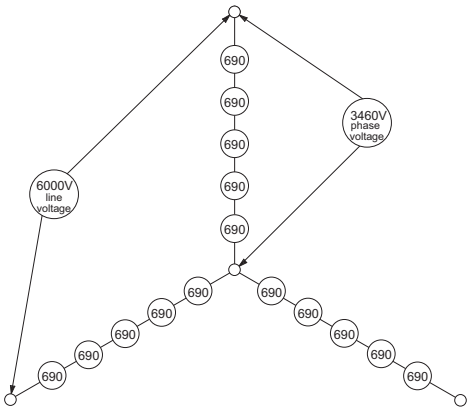


10kV Asynchronous or Synchronous Motor

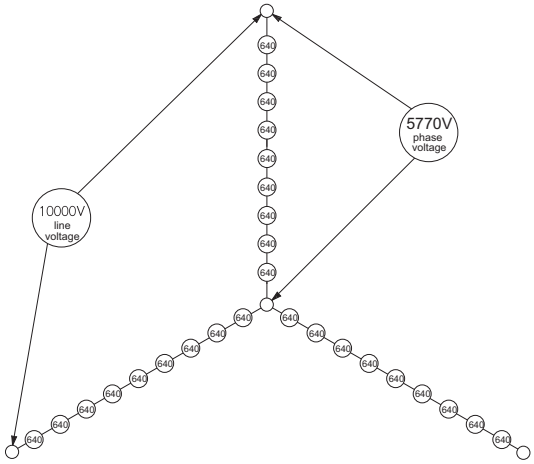
Voltage Overlapping Method

The **AUBO** MV VFD has a number of power cells connected in series, the independent phase-shift power is supplied to each power cell by the isolated transformer. Changing the power cells number in each phase you can get different output voltage conveniently without the limitation for the components' withstand voltage. For example, the 6kV VFD has 5 cells in each phase, the rated voltage of each power cell is 690V, the phase voltage is 3460V (the line voltage is 6kV); the 10kV VFD has 9 cells in each phase, the rated voltage of each cell is 690V, the working voltage is 640V.

Rated Voltage	Cells per Phase	Voltage per Cell(V)	Phase Voltage(V)	Line Voltage(kV)	Levels of Voltage
3.3kV	3	640	1900	3.3	7
4.16kV	4	600	2400	4.16	9
6kV	5	690	3460	6	11
6.6kV	6	640	3810	6.6	13
10kV	9	640	5770	10	19
11kV	9	690	6350	11	19



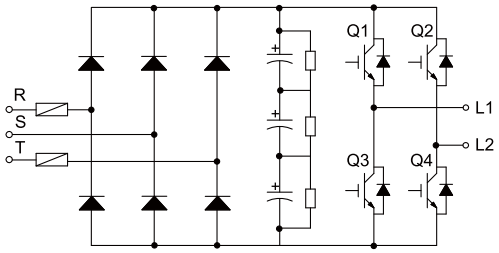
Take 5 cells for example



Take 9 cells for example

Power Cell Topologh

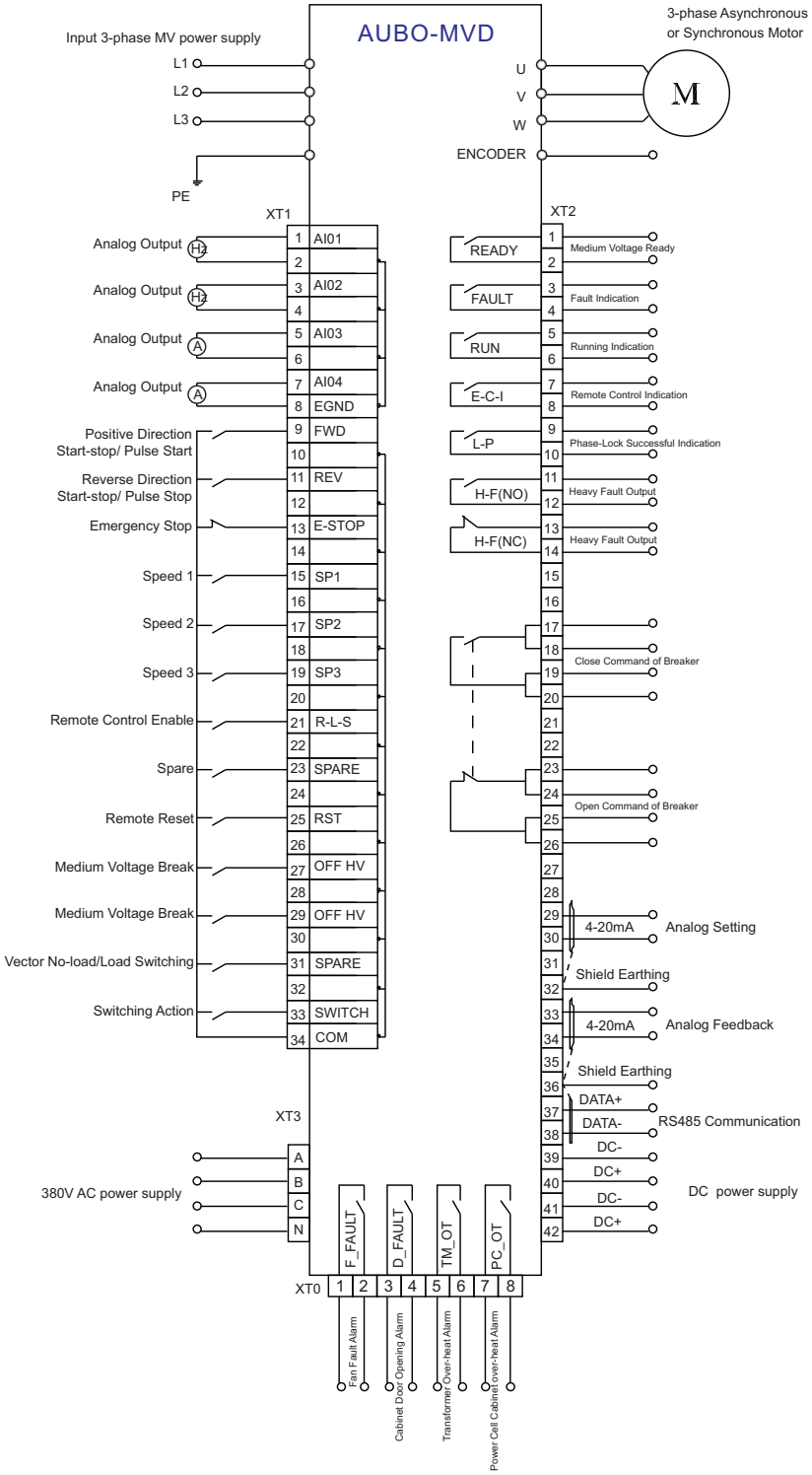
The power cell adopts AC-DC-AC mode, it is equal to a low voltage voltage-source inverter with three-phase input and single phase output. All power cells are same electrical and mechanical features, thus very easy to maintenance and replacement.



Fuse Diode rectifier DC link Inverter output

The power cell receives the signals by the optic fiber and adopts the voltage vector mode to control the IGBTs (Q1 ~ Q4) ON/OFF with the single phase PWM output waveform. Each cell only has three possible output voltage statuses. When Q1 and Q4 are conducted, the output voltage status between L1 and L2 is "1" ; when Q2 and Q3 are conducted, the output voltage status between L1 and L2 is ; when Q1 and Q2 are conducted or Q3 and Q4 are conducted, the status between L1 and L2 is "0" .

External Terminals



The **AUBO** general MV VFD is self-developed and manufactured by Nanjing Aubo Electric Co., Ltd. It is used for the medium voltage (synchronous or asynchronous) AC motor. The MV VFD adopts the power cells connected in series and voltage overlapping method with the mature technology and reliable components. It has self-developed voltage vector PWM control method with the high control accuracy and fast response, VFD efficiency in excess of 98%, multi-language LCD display, modular design and easy to maintain, the wider input voltage range meets the grid condition; AVR (automatic voltage regulator) prevents damage to the motor isolation from the over-voltage, the boosted torque at low frequency, flying start function and transient power loss permission, optional bypass system to meet the continuous production requirement, lower harmonic and higher power factor,…etc.

The **AUBO** general MV VFD is complied with IEEE 519-1992 and GB/T14549-1993. They do not require the additional input filter, saving the cost for harmonic elimination. Because of the high power factor of the system, the compensation device for power factor is not needed, thus the reactive power are effectively reduced, saving the cost for the grid capacity enlargement.

High-Quality Power Input Section

The **AUBO** general MV VFD adopts the isolated transformer with the phase-shifted secondary windings, which can provide the isolated power supply for the power cells with multi-pulse diode rectifier (30 pulses for 6kV, 54 pulses for 10kV), the harmonic current of power cells can be effectively reduced. Please refer to the current/voltage waveform with the 30-pulse rectifier in Figure 1.



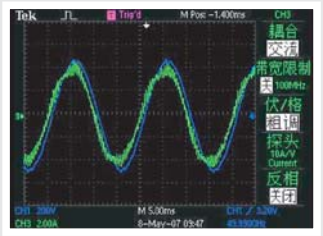


Figure 1:
30-pulse wave form of input voltage/current

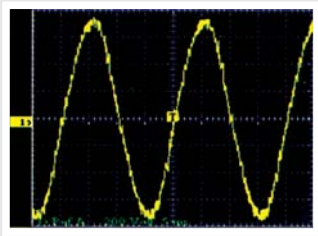


Figure 2:
wave form of output line-voltage

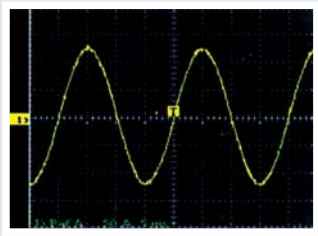


Figure 3:
wave form of output current

Perfect Power Output Section

The **AUBO** general MV VFD adopts the power cells connected in series and voltage overlapping method (i.e. Power cells multi-level cascade technology), it can output the perfect PWM sinusoidal waveform (see Figure 2 and Figure 3). It has the following advantages:

- No need for the additional output filter
- Directly driving general synchronous or asynchronous motor
- No de-rating operation on the motor
- No dV/dt stress on the insulation of motor and cables
- No torque ripple, extending service life of motors and mechanism
- No cable length restriction within the acceptable voltage drop.

Besides the above advantages, the **AUBO** general MV VFD has the following protection functions and features:

- Overload and over-current
- Phase loss and grounding
- Over voltage
- Overheat
- Current limit
- Redundant control power supply
- Cell Bypass (optional)
- Cabinet door alarm
- Phase-Lock function
- Synchronous Switching between VFD and Grid system
- Soft start of motor
- High efficiency >98% (VFD at full-load)
- Electrical Isolation by the optic fiber
- Built-in PID regulator
- RS485 communication with the protocol, Modbus as standard, optional Profibus-DP, Ethernet,etc
- Accurate fault records, easy to check fault history
- Compact structure and layout, customized design is available

Standards Code	Standards Description
GB/T 156-2007	Standard voltages
GB/T 1980-2005	Standard frequencies
GB/T 2423.10-2008	Base environmental testing for electric and electronic products regulations -Guidelines for vibration (sinusoidal)
GB/T 4588.1-1996	standard of single-double sided PCBs without plated-through hole
GB/T 4588.2-1996	standard of single- double sided PCBs with plated-through holes
GB/T 15139-1994	General technical standard for electrical equipment structure
GB/ T 13422-1992	Power semiconductor converters-Electrical test methods
GB/T 14549-1993	Quality of electric energy supply harmonics in public supply network
IEEE 519-1992	Practices and requirements for harmonic control in electrical power systems
GB/T 12668.4-2006/ IEC 61800-4:2002	Adjustable speed electrical power drive systems. Part 4: General requirements. Rating specifications for A.C. power drive systems above 1000V A.C. and not exceeding 35kV
GB 3797-2005	Electrical control assemblies
GB/T 2900.18-2008	Electrotechnical terminology-Low voltage apparatus
GB/T 3859.1-1993	Semiconductor converters. Specification of basic requirements
GB/T 3859.2-1993	Semiconductor converters. Application guide
GB/T 3859.3-1993	Semiconductor converters. Transformers and reactors (eqv IEC 60146-1-3:1991)
GB 4208-2008	Degrees of protection provided by enclosures (IP Code) (eqv IEC 60529:1989)
GB/T 16935.1-2008	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests (idt IEC 60664-1:1992)
IEC 60076	Electric power transformer
IEC 60721-3-1:1997	Classification of environmental conditions Part 3: classification of groups of environmental arameters and their severities, storage.
IEC 60721-3-2:1997	Classification of environmental conditions Part 3: classification of groups of environmental parameters and their severities.
IEC 60721-3-3:2008	Classification of environmental conditions Part 3: classification of groups of environmental parameters and their severities. Stationary use at weather protected locations.
IEC 61800-3:2004	Adjustable speed electrical power dive systems Part 3: product standard including specific test methods.
IEC 106:1989	Environment condition guides for specifying performance rating of equipments.
GB/T 3859.4-2004	Semiconductor converter-Self-commutated semiconductor converters including direct d.c.converters
GB12668.3-2003/ IEC61800-3:1996	Adjustable speed electrical power dive systems Part 3: EMC product standard including specific test methods
IEC 61000-2-4:2002	Electromagnetic Compatibility (EMC) Part 2-4: Environment - Compatibility Levels in Industrial Plants for Low-Frequency Conducted Disturbances
IEC 61000-4-7:2002	Electromagnetic compatibility-(emc)-part 4-7: testing and measurement techniques- general guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto
GB/T 13534-2009/ IEC60757:1983	Code for designation of colors.
IEC 60204-11:2000	Safety of machinery. Electrical equipment of machines. Requirements for HV equipment for voltages above 1000 V a.c. or 1500 V d.c. and not exceeding 36 kV
IEC 60073	The color using of button and indicator
DL 994-2006	High voltage variable frequency drive used in draft fan and pump of power plant

Configuration Table:

AMV- I- V□□-□□□KW / □□□A

- □□□A: **Rated power and Rated output current**
- V□□: **Rated Output Voltage(KV):0-2.3,0-3.3,0-4.16,0-6,0-6.6,0-10,0-11**
- I: **INVERTER**
- AMV: **Aubo Medium Voltage**

Please verify the rated voltage and current of the motor nameplate to guarantee the compatibility with the selected **AUBO** general MV VFD.

For Exampl: AMV-IV66-1120KW/116A,6.6KV rated voltage ,1120kw rated power and 116A rated current

Technical Specifications

Rated Power	125-22000KW/155-27500kVA※
Rated Voltage	2.3kV,3.3kV,4.16kV,6kV,6.6kV,10kV,11kV (-20%~+15%)※
Rated Frequency	50Hz/60Hz (-10%~10%)※
Modulation Technique	SPWM/SVPWM
Control Power Supply	380, 5kVA (can be customized)
Input Power Factor	>0.96
Efficiency	≥0.97
Output Frequency Range	0~120HZ ※
Frequency Resolution	0.01Hz
Instantaneous Over-current Protection	200% protect immediately
Overload Capability	110% for 60s, 120% for 120s, 150% for 3s
Current-limit Protection	10%-150% setting
Analog Input	2 channels 4~20mA
Analog Output	4 channels 4~20mA
Communications	RS485 interface, ModBus RTU as standard, Optional Profibus DP, EtherNet, DeviceNet, etc.
Accelerating and Decelerating Time	5s ~ 1600s(depend on the load)
Digital Inputs/Outputs	12 inputs/13 outputs (extensible)
Temperature of Operation	-5 ~ +45℃※
Storage/ Transportation Temperature	-40 ~ +70℃※
Cooling Method	forced air-cooling
Environment Humidity	<95%, non-condensation※
Installing Altitude	<1000m, if > 1000m, de-rating 1% per 100m
Dust	non-conductive, non-corrosive , <6.5mg/dm^3※
Protection Level	IP41※
Cabinet Colors	Rittal 7036
Noise Level	<79DB
Transformer Temperature Monitoring	Temperature meter display A, B, C, coil winding temperature,90℃ alarm,110℃ trip, Alarm temperature can be arbitrarily set
Power Cells Temperature Monitoring	Temperature switch 75℃ alarm,85℃ trip
HMI	LCD,10',display all information ,fault diagnosis and set parameter
PLC	Logic control, DI/DO/AI/AO, Communication with HMI and DCS
Harmonics Generation	MVD using phase shifting transformer and unit series technology, harmonic mutual offset, the total voltage and currentdistortion of aluminum is less than 1.2% and 0.8%, said the perfect harmonic inverter

※ Consult Availability with Nanjing Aubo Electric Co., Ltd.

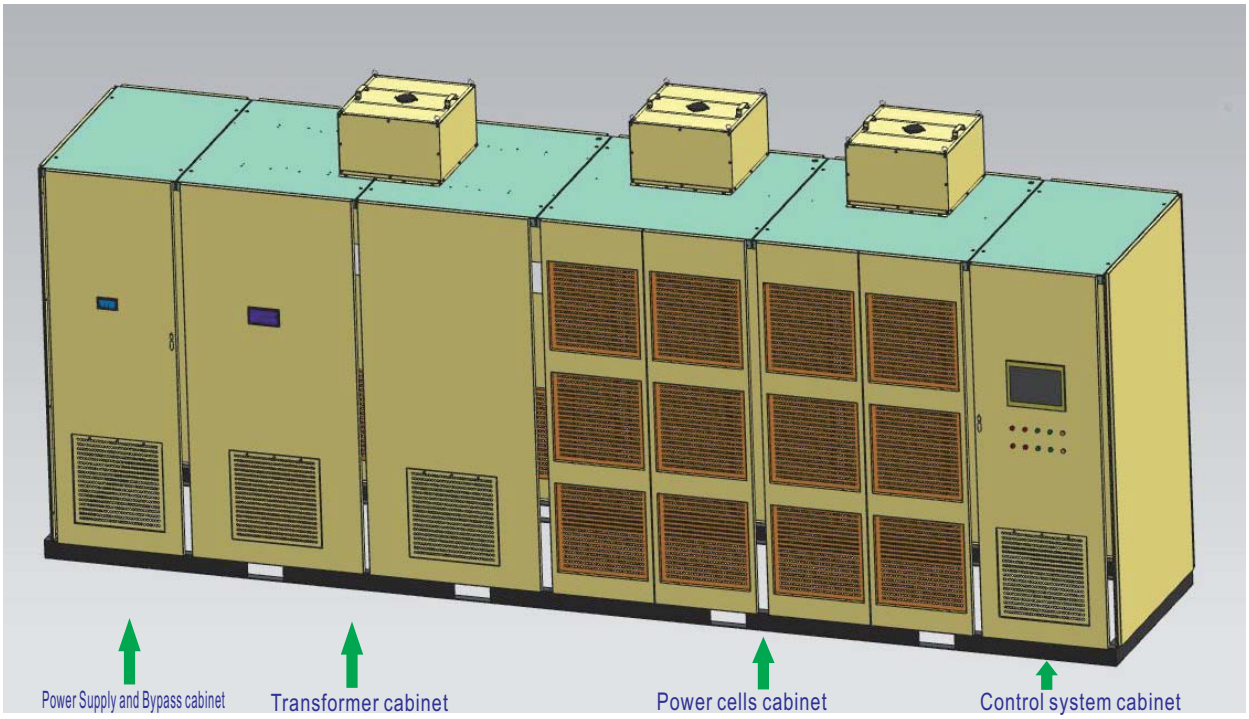
The **AUBO** general MV VFD has 2.3kV, 3.3kV 4.16kV, 6kV, 6.6kV 10kV, 11kV ratings, and Aubo can supply the customized VFD to meet special ratings.

Attention In the case of the special load or special motor or special operation environment, in addition to consider the rated power and rated current of the motor, the selection of **AUBO** general MV VFD should also refer to the following:

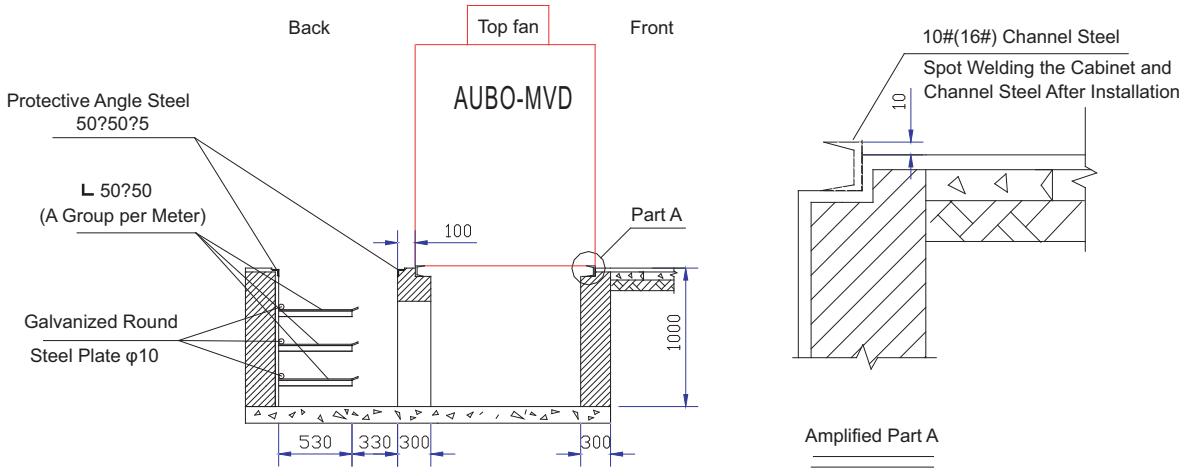
- For the load with the high torque ripple such as compressor, vibrating machine and kneader, the rated current of the selected VFD should be larger than the maximum current of motor at the industrial frequency based on the practical operation condition.
- For the submersible pump with higher than the rated current of the general motor, the rated current of the selected VFD should be larger than the rated current of the motor.
- For the asynchronous motor with multiple poles, the rated current of the selected MV VFD should be enlarged according to the rated current of the motor and the practical working condition.
- When the roots fan with large starting current, the rated current of the selected VFD should be enlarged accordingly.
- For the **AUBO** general MV VFD driving several motors in parallel, the rated current of the selected VFD should be larger than the total current value of these motors.
- For the oil pump with peak current, the rated current of the selected MV VFD should be enlarged properly.
- Under the extreme environments, such as high temperature or high altitude (>1000m), the **AUBO** general MV VFD should be de-rating and the VFD power should be enlarged accordingly.
- If the required working condition is explosion-proof, the **AUBO** general MV VFD should be placed at safety site because that it is not the explosion-proof design.

Notice The advice above does not include the cases of special loads and special motors. Please contact with Nanjing Aubo Electric Co. Ltd. to confirm the selection of the **AUBO** general MV VFD.

For example:1120KW/6.6KV MVD



Cabinets Layout(Front view)



Cross Section of Cable Trench

Installation Instruction:

1. The minimum length of the cable trench is the length of MVD cabinets and the bypass cabinet.
2. For the safety and convenience of the cable placement, it is recommended that the cabinets be installed upon the cable trench as the above figure show. The bottom of the MVD is made of 10# channel steel, (For the rated power is ≥1600kW, it is made of 16# channel steel. For the rated power is ≥ 4000kW, it is made of 18# I beam steel.) Please refer to MVD weight accordingly.
3. Keep a certain space around the cabinets. The distance between the back of cabinet and the wall must be ≥1000mm for 6kV MVD and ≥1200mm for 10kV MVD , the distance between the top of cabinet and the ceiling must be ≥800mm, the distance between the front of cabinet and the wall must be ≥1500mm.

The **AUBO** general MV VFD is consist of a transformer cabinet, a power cell cabinet/control cabinet. The start cabinet should be equipped for the high power VFD. Please refer to the dimension of **AUBO** general MV VFD, which includes the basic layout, installed location, as well as hoisted location, top fan of cabinets, input cable size and connected location.

Transportation Conditions

- **AUBO** general MV VFD can be transported by the truck, train, ship, etc.
- During the transportation, please be handling carefully, keep dry and away from direct sunlight , strenuous vibration and impact, and do not be inverted.
- Please consider the limited height while selecting the conveyance and route.
- Please consider the bearing capacity of conveyance which must be larger than the weight of VFD cabinets.

Storage Conditions

The operation temperature range of **AUBO** MV VFD is -5°C~45°C and the storage circumstance temperature range is -40°C~70°C. The surrounding temperature can affect the life time and reliability of the VFD.

Please don't install the VFD in an area where temperatures are not appropriate. If the surrounding temperature exceeds the permissible value, it is strongly suggested that ventilation condition be improved or the area be air-conditioned. Following situations should be avoided for the VFD storage and operation:

- Exposed to sunlight
- Corrosive gas
- Inflammable and explosive gas
- Conductive dust
- Condensing
- Salt, oil fume and heavy dust

Handling Conditions

- Crane
- Chain hoist
- Roller

Construction Conditions

- The VFD has to be installed vertically.
- No obvious vibration on the ground.
- The ground must be fire-proof material, smooth and wear-resistant, level and be able to bear the weight of VFD (minimum 1000kg/m^2)

Attention

- The transformer cabinet and power cell cabinet are completely assembled, carefully tested and packed in the factory before the delivery. While lifting, please ensure to match the heavy center of the transformer cabinet and power cell cabinets accordingly.
- Mount the transformer cabinet according to the package marks and layout. Don't lift the transformer cabinet only by the hook of the cabinet.
- If the installation ground is not flat and horizontal, the metal cabinets of the VFD maybe distorted, causing cabinet doors to be dislocated and not to be opened and closed properly.
- The device inside the cabinet is not rainproof, so it should be protected. If it is necessary to temporarily be stored outdoor, heaters should be placed inside the equipment to prevent condensing, the drive should be covered by a plastic film or a tarp.
- Standing under the crane is forbidden while lifting the cabinets.
- It is forbidden to stand under the crane or manually correct the cabinet position when the cabinet is lifting.

Power Cables Selection

The selection of cables should meet the following requirements:

- Current capacity
- Manufacturer standard
- Placement method
- Voltage drop caused by cable length
- Electric indistries standard

Power Cables Installation

- Screened cables with shielding effect is recommended between the VFD and motor.
- If the whole section area of screen layer is less than 50% section area of single-phase cable, a grounding cable should be added.
- Section area of grounding cables should be > 16mm².
- After the cabinets are installed, the cabinets and channel steel base should be fixed by spot wielding, and the channel steel base should be reliable grounding. The resistance of grounding should be ≤ 4Ω.

Control and Communication Cables Selection

- The control cable should be the twisted cable or screened cable with high quality.
- Analog input and output cable: twisted cable with screen, section area 0.5~1.5mm².
- Digital input and output cable: twisted cable with screen, section area 0.5~1.5 mm².
- The encoder cable: twisted cable with screen, section area 0.5~1.5mm².
- Communication cable: professional communication wires or twisted cable with screen, section area 0.5~1.5 mm².

Control and Communication Cables Installation

- Control, communication, and power cables should be separately placed in cable channel and bridge duct. In case of mix wiring, the distance between the secondary wires and power cables should be kept away at > 30cm, and avoid placement in parallel.
- It is not forbidden for power cable or ground cable to share a same screen cable with the signal wires.
- If the length of control cable is longer than 50m, active isolated repeater and auxiliary relay should be used in the input and output circuit.
- Shielding layer of cables should be single-end grounding at the side of VFD.
- Once the electric interference between different components, a electric balance cable should be placed in parallel to control wires with earth-connection, and the section area of wires should be > 16mm².
- If there are relays or contactors in the circuit, or the load is inductive or capacitive, anti-interference components should be mounted in the circuit of relays or contactors.
- Control signal and communication cables should be placed at the corner and the earth-connection.
- Cables for different type of signals should be cross placed.
- The distance between shielding layer and terminal should be short as possible. Avoid wiring a cable to extent connection of the earth cable.

For more information, please contact with Nanjing Aubo Electric Co., Ltd.