

## NC HVVF



### Product introduction

NC HVVF, integrating with the advanced power electronics technologies of the world, is a IGBT HVC independently developed by Nancal Energy-Saving Technology Co., Ltd.. PWM control technique is adopted to realize variable frequency control velocity of high-voltage motor. It is aimed to promote the performance of velocity variation startup of high-voltage motor, to improve control level, equipment power factor and operating efficiency of high voltage equipment, satisfy process control requirements, reduce energy consumption of the motor, as well as realize energy conservation and environmental protection.

NC HVVF belongs to voltage source, high-high structural inverter. It adopts unit series and can realize voltage output of 0 ~ 6/10kV directly relying on the perfect sine wave generated based on the principle of phase shift superposition. No output voltage-boosting device is required. It can directly drive the normal motor.

NC HVVF is as air-cooling model (10kV, 12500kVA). It water-cooling model (10kV, 25000kVA) has passed pattern test certification by a national authoritative organization.

The equipment can be extensively applied in the following industries:

**Thermal power:** induced draft fan, force draft fan, circulating water pump, condensate pump, feed pump, compressor etc.;

**Petroleum and petrochemical industry:** fan, compressor, pipeline pump, water pump, oil pump, electric submersible pump etc.;

**Metallurgy:** dust exhausting fan, induced draft fan, air blower, water pump, slurry machine, descaling pump etc.;

**Municipal water supply:** intake pump, water supply pump, booster pump etc.;

**Sewage treatment:** sewage pump, purification pumps, fresh water pump, etc.;

**Cement manufacturing:** kiln tail fan, kiln head fan, circulating fan, high temperature exhaust blower, raw material grinding machine;

**Mining:** drainage pump, exhaust fan, medium pump, scraper conveyor, main fan, belt conveyor etc.;

**Others:** paper making, pharmaceutical and wind tunnel test.

### Product Features

#### ● Remarkable performance features

- Output voltage 6kV, 10kV; the maximum power can be up to 20MW ;
- Vector control without speed sensor or close loop vector control with motor parameters self measuring function ;
- 32bit DSP all-digital control ;
- Power unit automatic bypass function [Option]. After exiting power unit fault and exit , the output voltage will reach auto balance, and the frequency converter will run continuously ;
- The harmonic content shall satisfy international standard requirements and shall be superior to national standard ;
- Support Profibus [Option], Modbus and other communication protocols ;
- Provide host computer monitoring software based on Windows. Support GPRS, CDMA and internal remote monitoring function as well ;
- State variable display monitor: Voltage, current, frequency, power, power factor, total power consumption, efficiency, total run time etc ;
- Auxiliary power switch duration: less than 5s. The frequency and speed conversion device will run continuously ;
- Allowable high input voltage fluctuation -40% ;
- Adaptive torque limitation function under the process of acceleration and deceleration as well as special working condition ;
- Fault self-recovery and forward and reverse rotation tracking restart function.

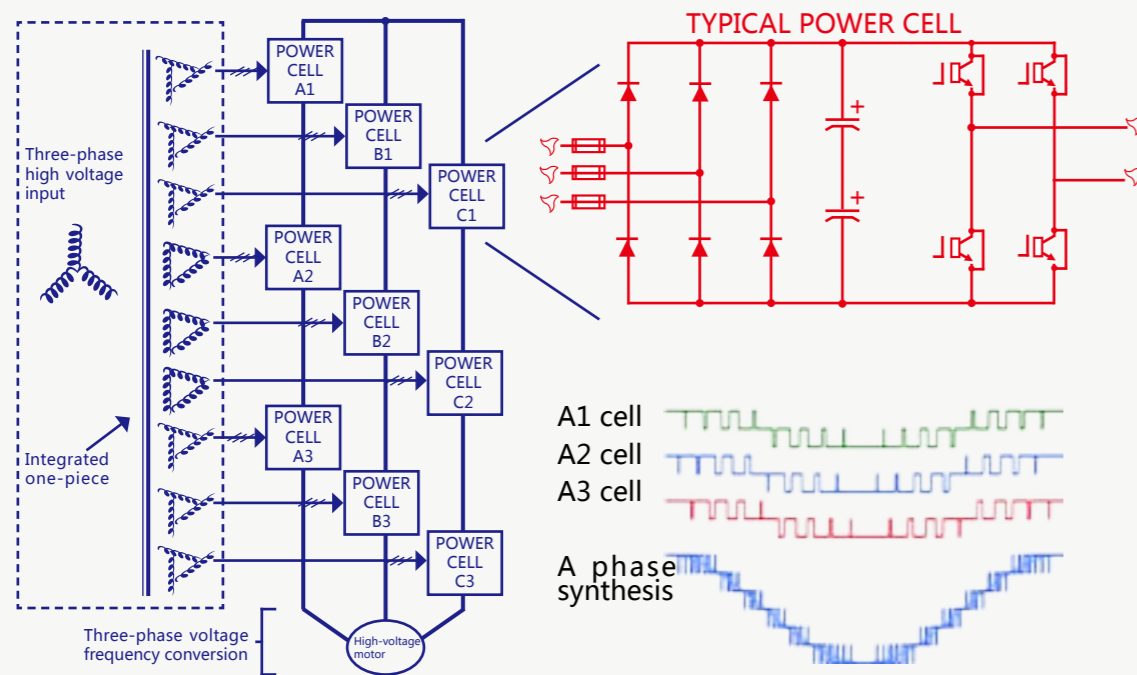
#### ● Humanized design philosophy

- Closed dustproof design of the controller. No cooling fan required and the reliability has been significantly improved ;
- Industrial-grade touch screen graphical monitoring operation interface in both Chinese and English ;
- One-piece input dry isolation transformer, H grade insulation and high reliable design ;
- Power unit modular design, interconvertible and convenient maintenance ;
- Redundancy design of the control source. No UPS required. The control power fluctuation or power outage will not affect frequency converter running ;
- Automatic derating due to environment temperature, altitude and other factors ;
- Internationally well-known EBM outer rotor cooling fan is adopted which is maintenance-free with long service life ;
- Humanized design at air inlet filter which can be replaced on line. It can be recycled after cleaning ;
- Synchronous switch function can support online switch of variable-frequency operation and power frequency operation ;
- Applicable to ordinary AC motors, including squirrel cage induction generator, winding motor and synchronous motor.

#### ● Reliable safety measures

- Perfect protection functions, including: transformer secondary short circuit, transformer overheating, input grounding, input overvoltage and output over-current, motor overload, overvoltage, output grounding, overload, power unit protection, cooling fan or water cooling system fault, high-pressure cupboard door interlock etc.. Certain faults can perform combination jump high voltage wire inlet switch ;
- Intelligent fault diagnosis function ;
- Historical records, fault and alarm records ;
- Automatic energy conservation function which can further reduce motor loss, and lower temperature rising.

## Operating principle



NC HVVF series HVC adopts cell-series multi-level technology. It belongs to direct high voltage source frequency control device to enable direct high voltage input and output, no output transformer required. The HVC is mainly composed of phase-shifting transformer, power unit and controller.

- 3kV
  - 3kV series product is composed of 9 power units. Every 3 of them will be connected in series and constitute a phase. Three phases will constitute a Y connection which directly supply power to 3kV motor.
- 6kV
  - 6kV series product is composed of 15 power units. Every 5 of them will be connected in series and constitute a phase. Three phases will constitute a Y connection which directly supply power to 6kV motor.
- 6.6kV
  - 6.6kV series product is composed of 18 power units. Every 6 of them will be connected in series and constitute a phase. Three phases will constitute a Y connection which directly supply power to 6.6kV motor.
- 10kV
  - 10kV series product is composed of 24 power units. Every 8 of them will be connected in series and constitute a phase. Three phases will constitute a Y connection which directly supply power to 10kV motor.

## Technical parameters

Input	Voltage	Three-phase, 3~10kV
	Frequency	50±5Hz
	Allowable voltage	±20%
Output	Instantaneous voltage reduction	40% voltage reduction allowable (No tripping at derated running)
	Output	3~10kV
	Overload capacity	120% 1min., 150% 5s, 200% Immediate
Complete machine	Frequency	0.5~120Hz
	Waveform	Multi-level PWM
Running operation	Efficiency	Overall efficiency >97% Inversion efficiency >98.5% (within the speed adjustable range)
	Setpoint frequency	Remote/local, automatic/manual operation
Running	Analog amount I/O	Given analog or panel settings
		0~10 v/4 ~20 mA, set arbitrary, extendable
Environment	Applicable location	Indoor, free of explosive or corrosive gas, free of conductive dust, free of oil mist
	Altitude	Derated running below 1000m and higher
	Ambient temperature	-15 ~ 40° C (Derated running Max.50° C)
	Ambient humidity	Below 95% relative humidity, no condensation
Control	Storage condition	-40° C ~70° C
	Acceleration and deceleration time	0.1 ~ 3200s (To be determined according to load condition)
	Control mode	Vector control or closed vector control of speed sensorless/VVVF control
	Main circuit structure	Cell-series multi-level
	PID Function	Built-in intelligent PID regulator
	Other functions	Prevent underspeed (Automatic downspeeding at overloading); instantaneous resurgence; critical speed avoidance(three groups optional); automatic energy conservation; fault self-recovery etc..
HMI	Frequency resolution	0.01HZ
	High-voltage isolation	Fiber-optic communication
	Control source	Single phase AC220V/5A, +20%, -30% (redundancy)
Others	Field bus	Profibus, Modbus optional
	Setting and monitoring	Start-up, stop, reset, frequency setting, running status, parameter setting, fault alarm, running log etc..
Protection function	Variable display	Voltage, current, frequency, power, power factor, total power consumption, device efficiency, total running time
	Protection grade and noise	Overvoltage, over current, motor overload, device overload, transformer overheating, grounding, fan fault, high-voltage cupboard door interlock, etc..
	Cooling method option	IP3X , <70dBA Air cooling or water cooling Automatic bypass of power unit, power frequency/power frequency inverter, speed measurement coded disc etc..

## Waveform test

Nancal frequency converter complies with the strictest voltage and current harmonic distortion requirements which can prevent other on-line equipment away from harmonic disturbance. Do not use expensive harmonic filter with low efficiency to avoid the occurrence of related resonance problems. Integration phase shifting transformer is adopted to eliminate the common-mode voltage of the motor. Isolated transformer is a section of Nancal frequency converter. No additional insulation is required for the motor. The frequency converter is applicable to induction motor or synchronous motor with a service factor of 1.0 or higher. Even at low rotational speed, there will be no obvious torque pulsation.

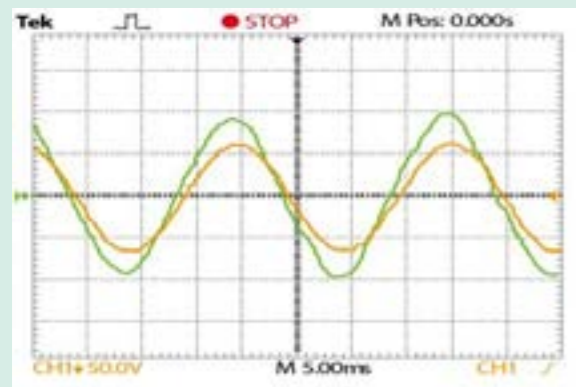


Figure 1 Waveform of input voltage and current

In addition, since diode rectifier is adopted for input, the input power factor of frequency and speed conversion device can be over 0.95. No power factor compensation device is required.

The input isolated transformer also ensures that the common-mode voltage undertaken by the motor is very slow, and will not affect electric motor insulation.

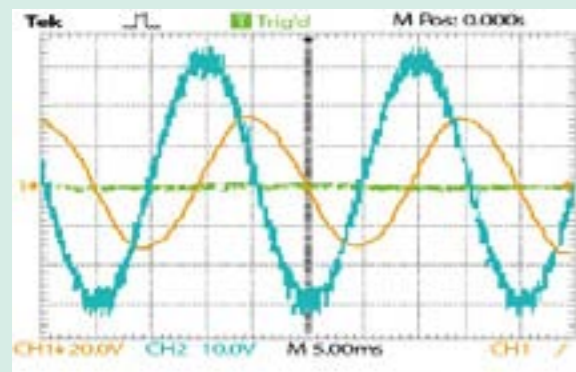


Figure 2 Waveform of output voltage and current

Phase-shifting transformer will supply power to each power unit at the input side. The vice-side winding of phase-shifting transformer adopts multiple configuration, which will be staggered to a certain electrical angle thus to realize the purpose of input harmonic offset. The 3kV, 6kV and 10kV output frequency and speed conversion device adopt 18-pulse, 30-pulse and 48-pulse rectifier respectively. The input harmonic current is very low can meet IEEE-519-1992 and GB/T14549-93 standard requirements. No harmonic filtering measures are required.

The leading-out terminals of each power unit at outlet side is in series and supply power to the motor after forming star connection. Multi-level phase shifting PWM technique is adopted at output of power unit which can be close to the output of sine wave. The Sine degree of the output waveform is good with small du/dt, without damage to the insulation of cable and motor, nor additional heat, torque pulsation on the motor. No filtering device is required for the frequency and speed conversion device. Normal motor can be applied, including the aged motor. The motor can be utilized without derating.

The output cable length of frequency and speed conversion device is not restricted. It is especially suitable for electric submersible pump and other special circumstances.



Figure 3 Power input without harmonic wave

Total distortion of voltage: lower than 2%;  
Total distortion of electric current: lower than 2%;  
The input of isolated transformer complies with IEEE519 and is superior to BT14549 standard.

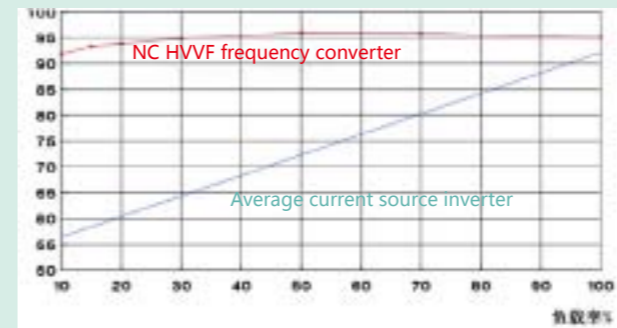


Figure 4 Power factor

The total power factor includes harmonic factor and displacement factor.

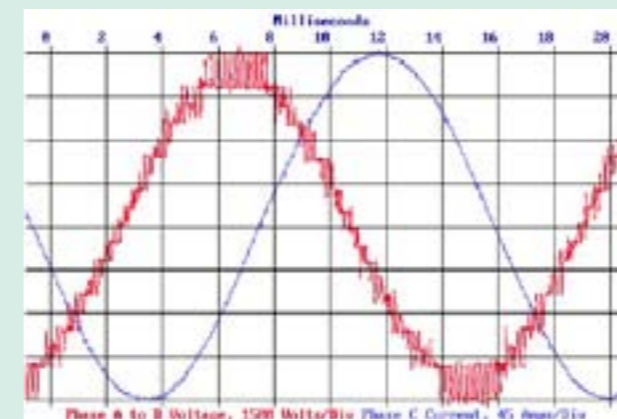


Figure 5 Multi-level, pulse width modulation of the output waveform

6kV frequency converter, 50Hz output waveform.

## Structural composition

### Phase-shifting transformer

The phase-shifting transformer provides isolation between power grid and rectifier unit, as well as voltage input of the rectifier unit. The internal resistance of phase-shifting transformer also imposes the impact on downstream equipment failure.

Different transformer connection methods are adopted by the phase-shifting transformer to realize different phase relations among power units, and form multiple connection. The multiple connection can improve the current waveform at transformer input side with low harmonic pollution and high input power factor.

The secondary side of transformer is to connected to power unit with silicone rubber cable. The transformer includes a cooling fan, corresponding contactor, thermal relay and fan control circuit. Temperature monitoring device of transformer provides interlock protection.



▲ Phase-shifting transformer

### Controller

The controller is composed of 32-bit high speed digital processor [DSP], dedicated large scale integrated circuit, touch screen and PLC. DSP can realize related algorithm associated with speed sensorless vector control. The dedicated large scale integrated circuit can realize multi-level PWM control. The touch screen can realize interaction between the high voltage variable frequency speed regulating device and user to provide friendly graphical interface in both Chinese and English which is convenient and rapid. The inbuilt PLC is to be used for logical processing of switch quantity. In addition, the input and output interface of on site switch quantity can satisfy user scene interface requirements.

High-speed optical fiber communication is adopted between the controller and power unit. The control section and high pressure electrical part are fully separated. The system has extremely high security and anti-interference ability.

Redundancy design is adopted on the control source. No UPS is required. The control power fluctuation or power outage will not affect frequency converter running;

### Power unit

The power unit is as three-phase input single-phase output AC-DC-AC inverter structure. The secondary side of transformer will input to the fuse protector through the power unit and then to the three-phase full bridge diode rectifier. Smooth DC will be formed after output rectifier capacitor filter. And then single phase variable voltage variable frequency ac output will be formed after the single-phase H bridge inverter circuit composed of 4 IGBT.

The functions of power unit control board are complete with perfect protection functions as well as optimized IGBT driving circuit. Each power unit machinery within frequency and speed conversion device is consistent with electrical equipment capability. They are interchangeable.

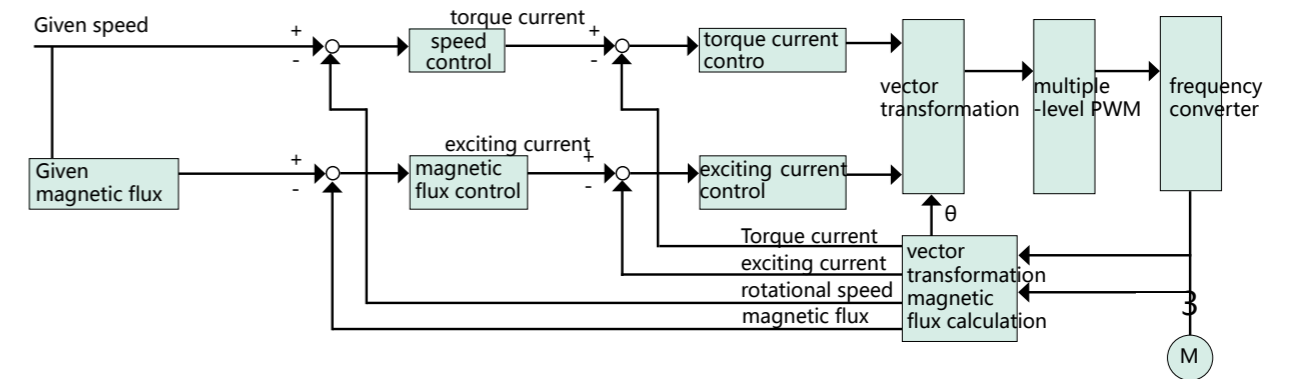


▲ Air-cooled power unit



▲ Water-cooled power unit

## Vector control without speed sensor



NC HVVF series high-voltage frequency and speed conversion device adopts speed sensorless vector control technology which can greatly increase the performance of frequency and speed conversion device under the circumstance not increasing hardware complexity, expand the high-end application area of frequency and speed conversion device to make the frequency and speed conversion device can be applied in fields with big starting torque, and high rotational speed precision as well as dynamic property. Even for fan and water pump with comparatively low loading steady state and dynamic requirements. The functions such as the inherent automatic torque limiter of speed sensorless vector control, fast speed tracking re-starting etc. can effectively prevent over current jumping at acceleration process, over voltage jumping at deceleration process, as well as shut down caused by power grid fluctuation and other abnormal factors to ensure the reliable operation of frequency and speed conversion device.

## HMI

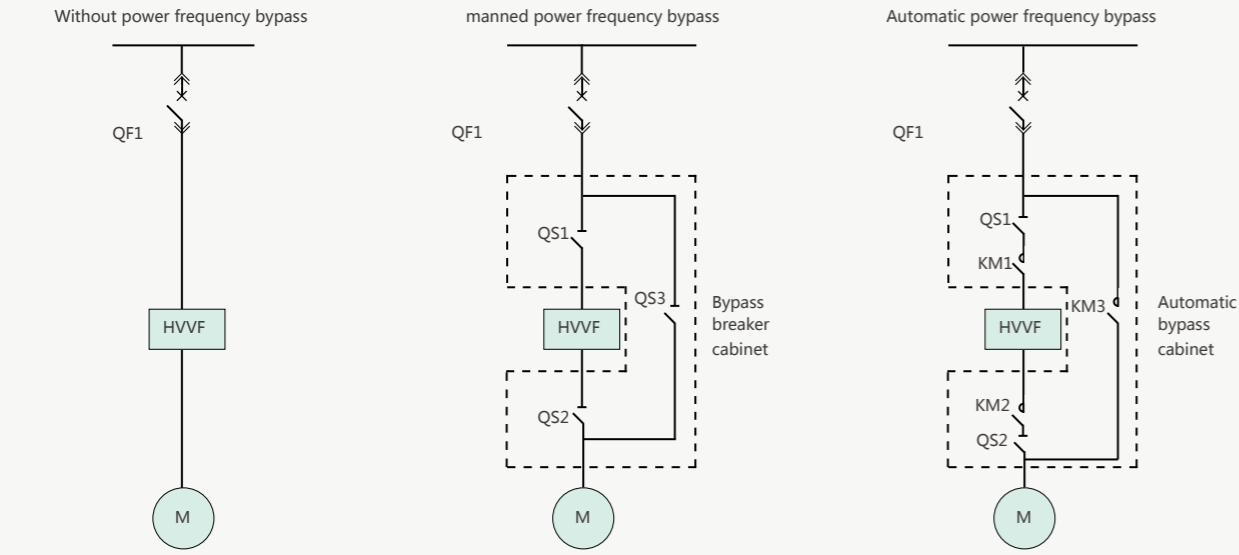
NC HVVF series high-voltage frequency and speed conversion device has friendly HMI.

The control cabinet of frequency and speed conversion device is equipped with local/remote selected switch, start-up, stop and emergency stop and other buttons, as well as indicator lights such as high voltage electricity, running, alarm, fault.

The Chinese and English display touch screen has completion status monitoring, parameter setting, fault alarm, running log display and other functions.



### Developing program-Power frequency bypass solution



According to user's special needs, also can configure "multiple in one" solution etc..

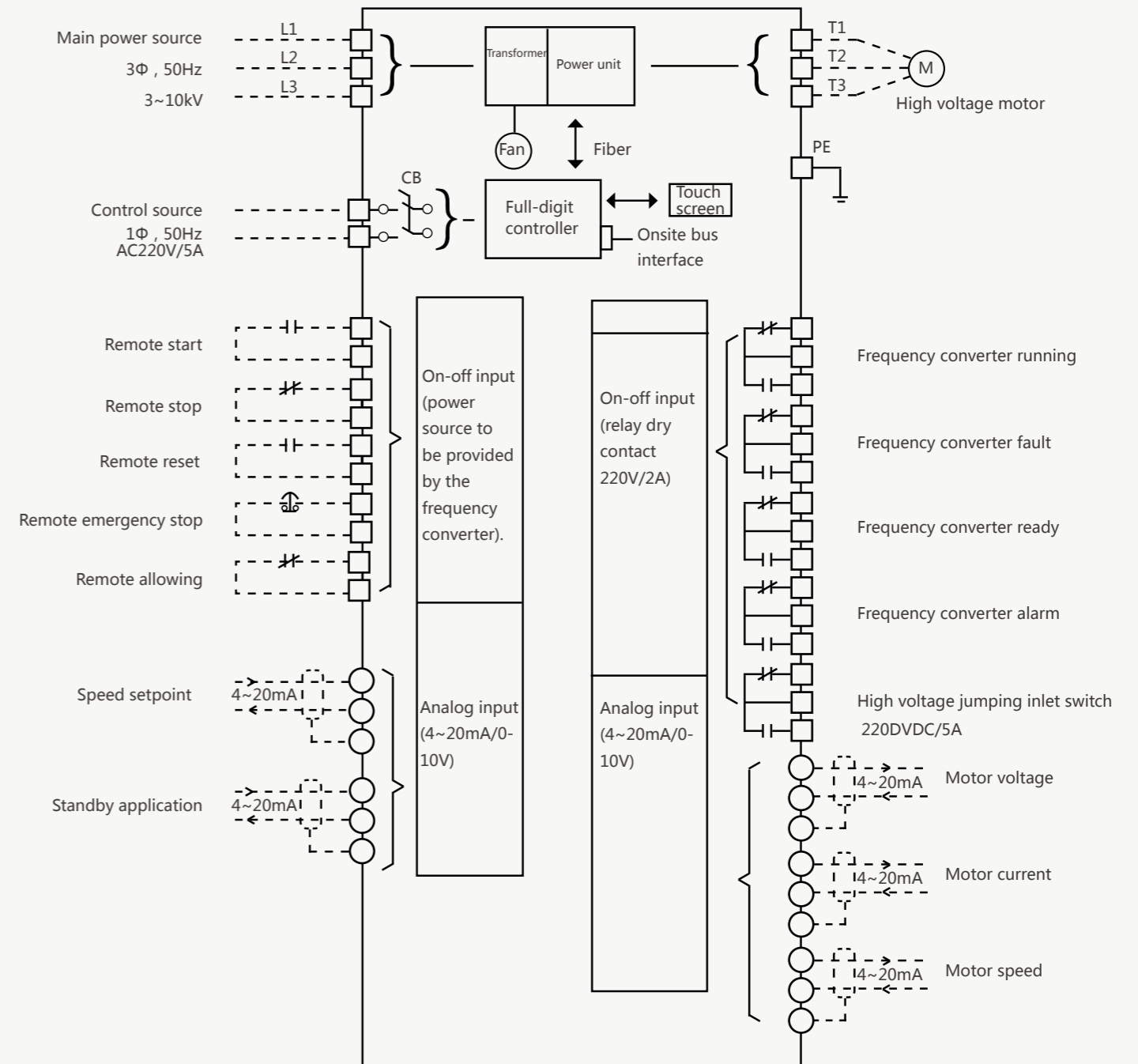
#### manned power frequency bypass

- The whole power frequency bypass is composed of three disconnected switches, namely QS1, QS2 and QS3 ;
- When QS1 and QS2 are connected and QS3 is disconnected, the motor will run in frequency conversion ;
- When QS1 and QS2 are disconnected and QS3 is connected, the motor will run in power frequency ;
- QS1, QS2 and QS3 are installed within a high-voltage board. QS2 and QS3 can realize mechanical interlocking ;
- The switch over course can not be completed automatically.

#### Automatic power frequency bypass

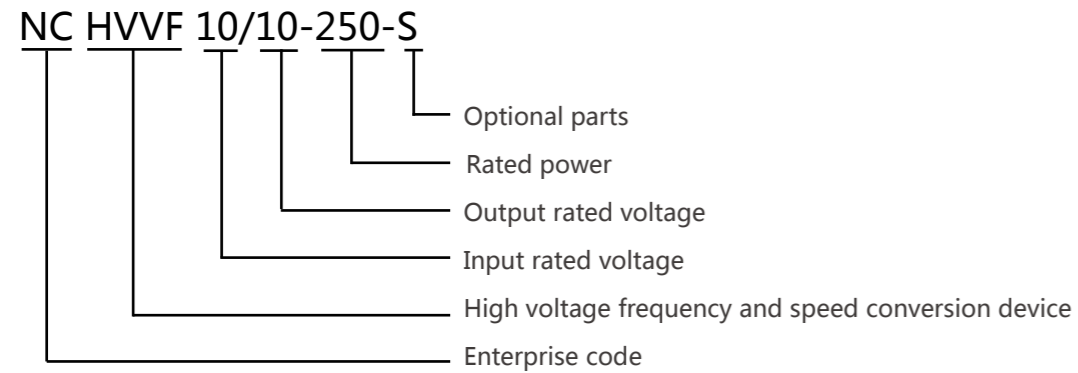
- The whole power frequency bypass is composed of three high voltage contactor, namely KM1, KM2 and KM3, well as two disconnected switches, namely QS1 and QS2 ;
- When QS1 and QS2 are disconnected, KM1 and KM2 connected, and KM3 disconnected, the motor will run in frequency conversion ;
- When QS1 and QS2 are disconnected, KM1 and KM2 disconnected, and KM3 is connected, the motor will run in power frequency ;
- KM2 and KM3 adopt electric interlock ;
- The switching process will complete automatically, no manual intervention required. The switching process can be completed during motor running process.

### Standard wiring diagram

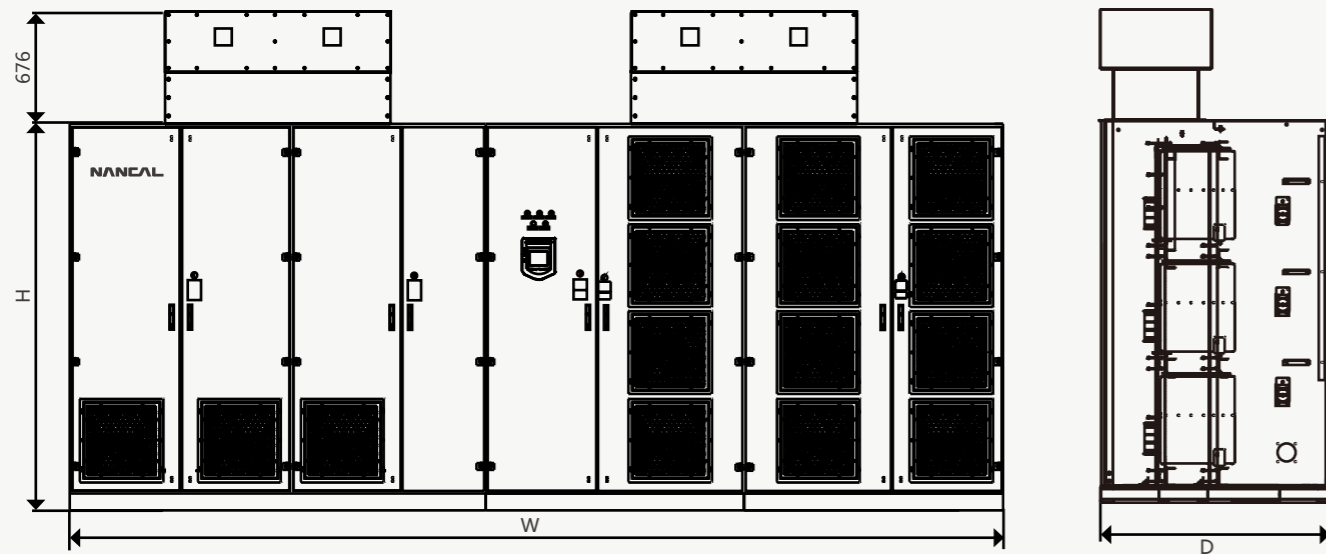


## Partial voltage frequency converter products

### Model description



### Overall dimensions



### Product spec.

#### Output voltage 6kV

Power ( kW )	Reference output current ( A )	Width ( W/mm )	Depth ( D/mm )	Height ( H/mm )	Weight ( Kg )	Ventilation quantity ( m <sup>3</sup> /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	4230	1400	2327	5450	375
1600	180	5100	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	1500	2327	8500	450
2800	309	5614	1500	2327	9500	450
3150	350	5614	1500	2327	10000	450
3550	388	7450	1800	2600	11800	540
4000	434	7450	1800	2600	12300	540
4500	486	7450	1800	2600	12800	540
5000	546	7450	2000	2600	13800	540
5600	611	7450	2000	2600	14800	540
6300	687	7450	2000	2600	15800	540
8000-16000	<1750	-	-	-	-	water cooling

## Partial voltage frequency converter products

### Product spec.

#### Output voltage 10kV

Power ( kW )	Reference output current ( A )	Width ( W/mm )	Depth ( D/mm )	Height ( H/mm )	Weight ( Kg )	Ventilation quantity ( m <sup>3</sup> /min )
220	16	5134	1219	2327	3000	280
250	18	5134	1219	2327	3150	280
280	20	5134	1219	2327	3250	280
315	22	5134	1219	2327	3350	280
355	25	5134	1219	2327	3450	280
400	28	5134	1219	2327	3500	280
450	31	5134	1219	2327	3600	280
500	34	5134	1219	2327	3650	280
560	38	5134	1219	2327	3750	280
630	43	5134	1219	2327	3950	280
710	48	5134	1219	2327	4200	280
800	54	5364	1400	2327	4400	280
900	60	5364	1400	2327	4500	280
1000	67	5364	1400	2327	4650	280
1120	75	5364	1400	2327	4800	280
1250	83	5364	1400	2327	5250	280
1400	94	5364	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	5614	1400	2327	6650	540
2500	170	6970	1400	2327	7000	540
2800	190	6970	1400	2327	7500	540
3150	210	6970	1400	2327	8000	540
3550	235	6970	1400	2327	9000	540
4000	264	7794	1500	2500	9500	540
4500	298	7794	1500	2500	10000	540
5000	328	7794	1500	2500	11000	540
5600	365	7794	1500	2500	12000	540
6300	416	9014	2000	2600	19000	720
7100	466	9014	2000	2600	20000	720
8000	523	9014	2200	2600	21000	720
9000	583	9014	2200	2600	22000	720
10000	643	9014	2200	2600	23000	720
12000-20000	< 1750	-	-	-	-	water cooling

## After-sale services

### Our services

- 24-hr onsite service
- Energy-saving and benefit evaluation
- Product reconstruction
- Before-sale technology support
- Training
- Spare parts after-sale service
- Product upgrading
- Preventative maintenance
- Maintenance and replacement

## Model selection instruction

<b>Load type</b>	<input type="checkbox"/> Fan <input type="checkbox"/> Water pump <input type="checkbox"/> Oil pump <input type="checkbox"/> Compressor <input type="checkbox"/> Belt conveyor <input type="checkbox"/> Grinding machine <input type="checkbox"/> Others _____
<b>Network voltage</b>	<input type="checkbox"/> 3kV <input type="checkbox"/> 3.3kV <input type="checkbox"/> 6kV <input type="checkbox"/> 6.6kV <input type="checkbox"/> 10kV <input type="checkbox"/> 其他: _____
<b>Motor parameter</b>	Type : _____ ; Power(kW) : _____ ; Voltage(kV): _____ ; Current(A): _____ ; Frequency(Hz): _____ ;
	Type : _____ ; Power(kW) : _____ ; Voltage(kV): _____ ; Current(A): _____ ; Frequency(Hz): _____ ;
	Type : _____ ; Power(kW) : _____ ; Voltage(kV): _____ ; Current(A): _____ ; Frequency(Hz): _____ ;
<b>Power frequency switch cabinet by-pass solution</b>	<input type="checkbox"/> No by-pass required <input type="checkbox"/> One-one manual by-pass <input type="checkbox"/> One-one automatic by-pass
<b>By-pass solution within power unit</b>	<input type="checkbox"/> Internal by-pass function required <input type="checkbox"/> No internal by-pass function required
<b>Communication protocol</b>	<input type="checkbox"/> Profibus standard configuration <input type="checkbox"/> Modbus standard configuration
<b>Other special requirements</b>	

# Modbus standard configuration



- frequency converter pattern test certificate (air cooling)
- Beijing enterprise technology center
- National quality trustworthy unit
- Computer information system integration enterprise
- Best cooperation award of SIEMENS
- Fastest Growth Integrator of SIEMENS LD BU
- Zhongguancun high-tech enterprise

- frequency converter pattern test certificate (water cooling)
- Qingke-The 6th The top 50 enterprise with the highest investment value in China
- The Top 10 new technology application award in 2011
- Grade AAA enterprise with credit rating
- 2012.08.22GBT19001-2008 ISO9001:2008QMS-M
- Certificate of software enterprise
- National high-tech enterprises