Farwide

Medium and Low-Voltage drives Servo drives
New Energy Vehicle Drives solution provider

Power conversion series

PTI generator power on active rectifier module

PTO energy extraction inverter regulating power module

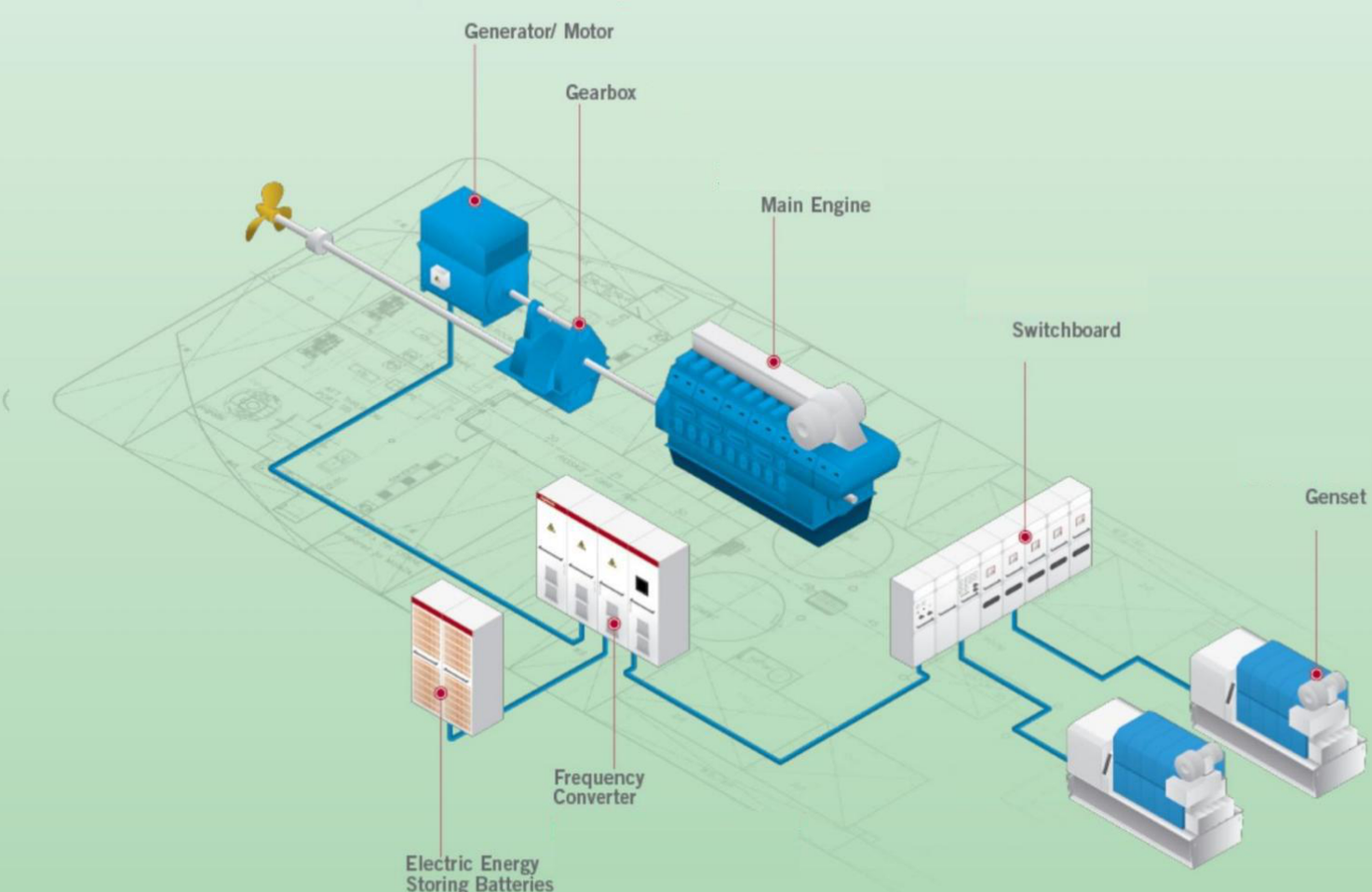
AFE active rectifier feedback front end

NFE low harmonic active rectifier module

PFE energy feedback inverter module unit

DCDC adjustable DC power module

User Manual V209



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Product information and drive system hardware description

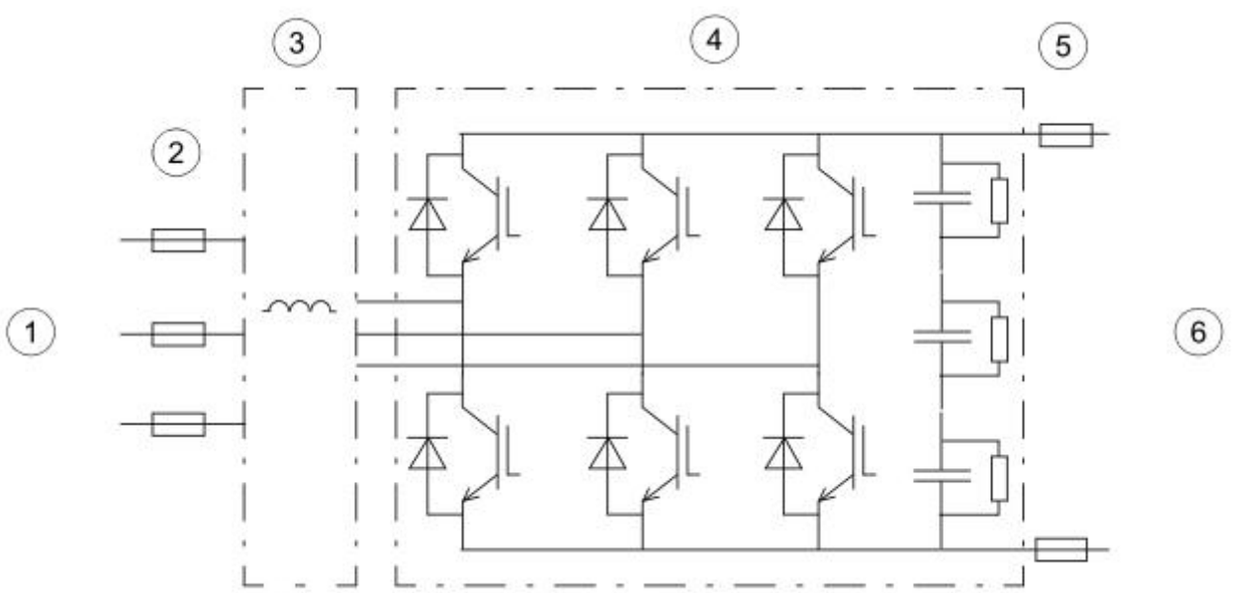
〉 〉 General introduction to the hardware characteristics of PTi, PTo, AFE, NFE, PFE, DCDC power conversion series drives

Principle of operation

This series of electric energy conversion series drivers is mainly used to transmit or convert the power between AC input and intermediate DC circuit. It usually contains one or more drive inverter modules and their matched L filters. Each inverter module consists of 6 IGBT components and 6 diodes connected in anti-parallel.

In the electric mode, the current starts from the AC power source and flows into the DC bus through the diode. In the regenerative feedback mode on demand, the current starts from the DC bus and flows into the power supply network through the IGBT. Regardless of whether it is in electric or power generation regeneration mode, real-time adjustment of the voltage of the DC circuit, real-time follow-up of the grid-side voltage, and real-time control and suppression of extremely low harmonics through IGBT are all critical and important. The general hardware circuit is shown below, among which,

1-grid side or generator,
2-AC side fast fuse,
3-L/LC/LCL filter,
4-inverter drive module (PTi/PTo/ALM /SMM/DCDC and other main modules),
5-DC side and its fast fuse



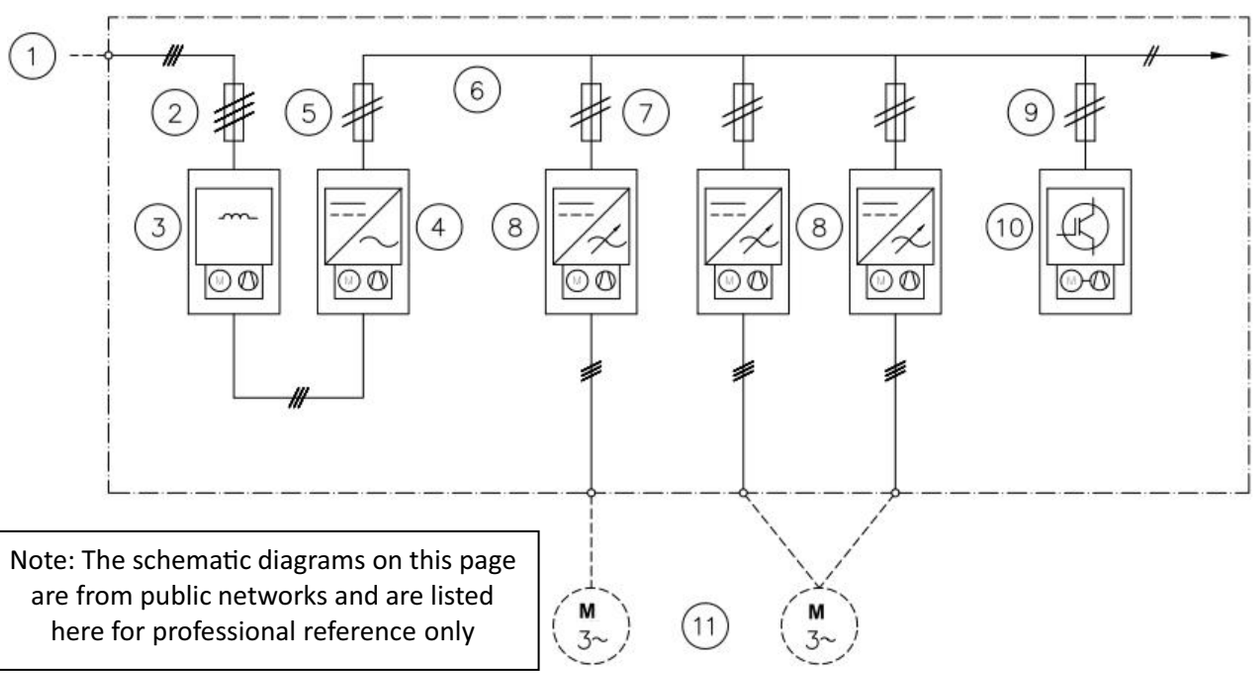
Power on and charge

This series of electric energy conversion series drivers is mainly used to transmit or convert the power between AC input and intermediate DC circuit. Usually need to match an L filter and soft-start charging circuit to realize the slow charging of the capacitor bank on the DC when the power is turned on. Almost all AIMs (LC/LCL) have a built-in soft-start charging circuit, so the inverter module with AIM and its charging circuit at the front end

can be directly powered on, but in some applications only the above picture is installed 4 For the inverter module such as PTi/DCDC, etc., it is necessary to realize the power-on charging of the DC through the external charging circuit or the slow switch of the generator from low-speed to high-speed power generation. At this time, it is forbidden to directly connect the grid or high-speed generator Cut directly to the inverter 4. Because there is no buffer limit the charging current will exceed the current limiting capacity of the diode connected in parallel on the IGBT, which will cause its damage.
in:
The AFE active front end has a bidirectional function, that is, when the power is transmitted from the AC input to the intermediate DC circuit, the AFE active front end rectifies the AC current and voltage; When the power is transferred from the intermediate DC circuit to the AC input, the AFE active front end inverts the DC current and voltage, and can keep the DC bus DC voltage constant at the set value through specific control techniques and settings to achieve energy efficiency The main user benefits and benefits are as follows:

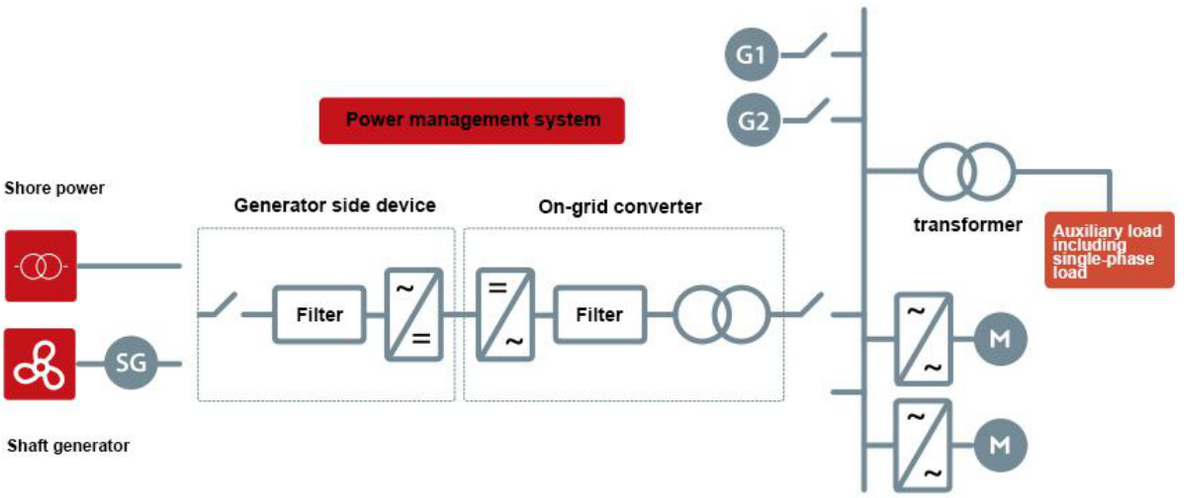
Very low grid-side harmonic pollution, THDi is much smaller than ordinary 6/12 or multi-pulse rectifiers.
Adjustable and optimized power factor, keep cosα=1
Even when the grid is extremely unstable, the voltage controller can still maintain a constant DC link voltage
Excellent dynamic performance, to ensure real-time fast two-way flow of energy.
Adjustable and controlled current and voltage can improve the energy efficiency of the system.

In a typical AFE active front end configuration, the expected number of motor inverters are connected to the intermediate DC circuit, as shown in the figure below.



Note: The schematic diagrams on this page are from public networks and are listed here for professional reference only

In a typical PTi/PTo power generation configuration, the expected number of generators, filters, active rectifiers, isolation transformers, and inverters are connected to the intermediate DC circuit, as shown in the figure below.



In a typical PTi/PTo power generation configuration of gas turbines and wind turbines, the expected number of generators, filters, active rectifiers, inverters are connected to the intermediate DC circuit, and the integrated drive configuration is inspired, as shown in the following figure.

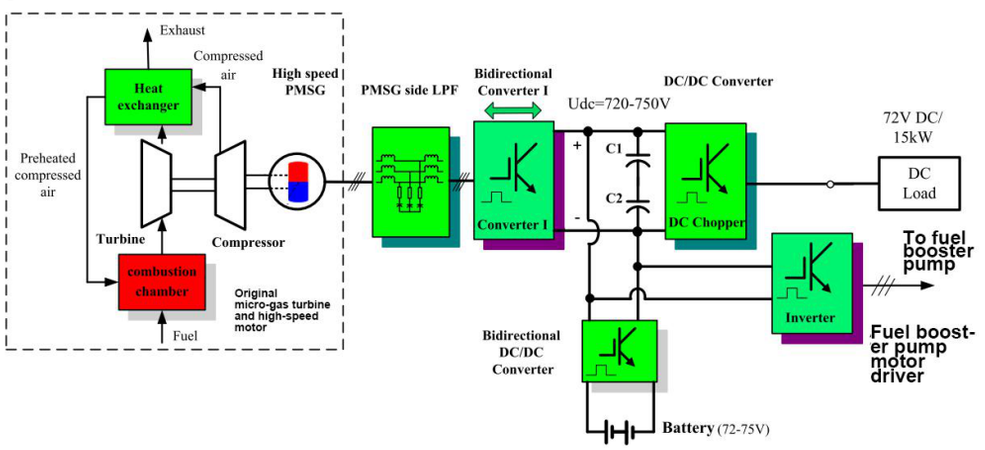


Figure 1 Electrical structure diagram of micro gas turbine power generation system

The I/O definition and wiring diagram of each control unit are described as follows:

〉Series control unit system standard wiring diagram (example)

〉B series control unit system standard wiring diagram (example) 4

********** Please refer to [Standard User Manual]**********

〉Control I/O and signal terminal hardware basic principles and connection methods in detail (example)

〉Driver selection

1. The main dimensions that need to be considered in the selection of this series of drives are the rated frequency, voltage, current and other electrical parameters of the generator where the power is taken. Installation structure, main cooling method, LCL supply method, soft start charging circuit supply method and other hardware structure forms.
2. In order to reduce the types and quantity of spare parts for users, the related IGBT inverter units of this series have almost all parts and general motor inverters (VFD or SMM) with the same structure and composition. The difference in power between them is only achieved through different software configurations and interlock settings.
3. The default modulation carrier configuration of the drives related to this series of power conversion is 8K for low power (<=7.5kW), 4K for medium power (<=110kW), and 2K for high power (>=132kW), for higher frequency power generation When the reference carrier needs to be upgraded when the inverter and lower input harmonic control are required, the driver needs to be derated and selected. If you have any questions, please contact our representative.

Rated current, maximum current, installation dimensions, heat dissipation requirements, cabinet ventilation requirements, and environmental requirements.

The design goals and characteristics of this series of corresponding dedicated drives are:
The XXX in XXXA-XB in the model column represents the design rated current of the product (specifically subject to the actual product, and the rated power is valid at the rated voltage). The rated values corresponding to different shapes are calibrated. Please select the hardware composition and shape Refer to the standard manual for the code.
Rated value: It is the rated current continuously available under IN 40 ℃, no overload, and rated modulation carrier.
The rated current In and calorific value are valid based on the factory rated carrier (8-6K for small power machines, 2-4K for medium and high power machines)
Imax Maximum output current. Ten seconds are allowed at startup. In other cases, the length of time depends on the temperature.
The overload current value of the drive allows 1 minute to reach about 150% of the rated value every 5 minutes. In other cases, the length of time depends on the temperature of the drive. In some extreme or special applications, if more current is required, it should pass Enlarge the drive model to get a larger output current value.
About current: Due to the difference in control mode of different series models, the output current required for different operating points will be slightly different (about 3-10%)
*** For specific ratings, installation dimensions, heat dissipation requirements, cabinet ventilation requirements, and environmental requirements for specific models, please refer to the relevant chapters in the standard manual.

Regarding use: The product does not require complex parameter adjustments. PTI does not need to be adjusted and can be started after receiving power. When PTO is used as a grid-connected operation, it needs to work in direct torque control without adjusting the parameters to start, while PTO does not need to be grid-connected. Working in V/F mode, set 50HZ or 60HZ according to the working AC frequency of the equipment

〉 Wiring

1.1. Main power line

Port name	Instructions for use
+/-	DC voltage access
U、V、W	PTI motor access
U1、V1、W1	PTO power output
PE， 	Enclosure electrical safety, protective grounding
	General electrical grounding, such as shielding layer/signal equipotential grounding, etc.

Note: It is forbidden to connect the power line incorrectly, otherwise it will cause serious damage to the drive!

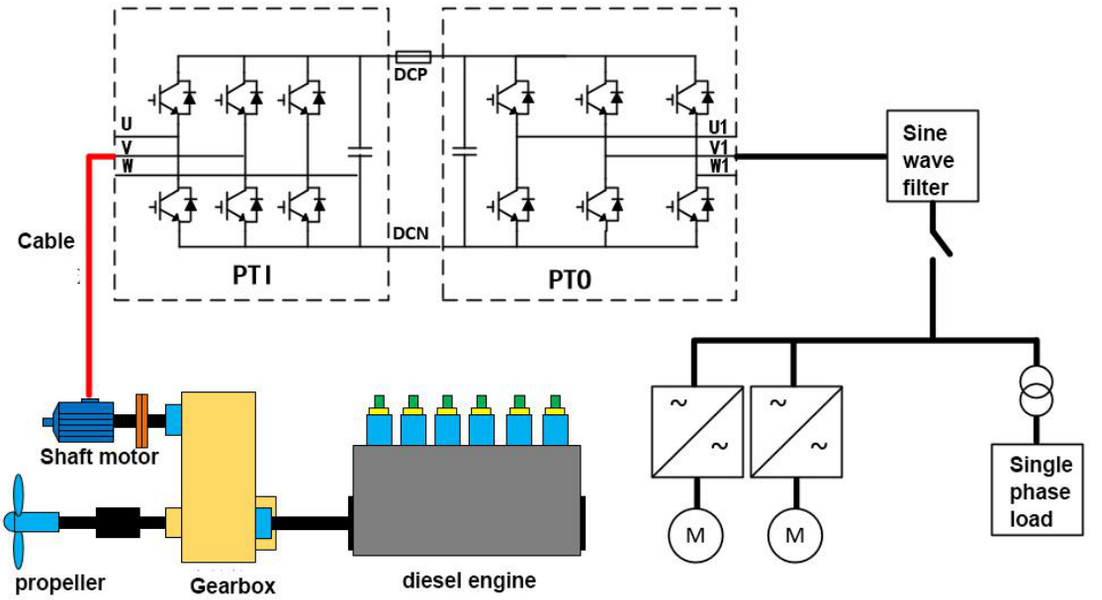
〉 PTi/PTo power generation and power acquisition and power conversion device/shore power supply conversion/shaft belt power generation application description

In order to improve and optimize energy and efficiency in small and medium island power generation industries such as ships and gas turbines, with the support of corresponding variable current technology, high-speed generator power generation, The combined technical form of shaft belt power generation and on-shore power supply reduces fuel consumption, improves efficiency, reduces the size of the generator set and increases its power density.

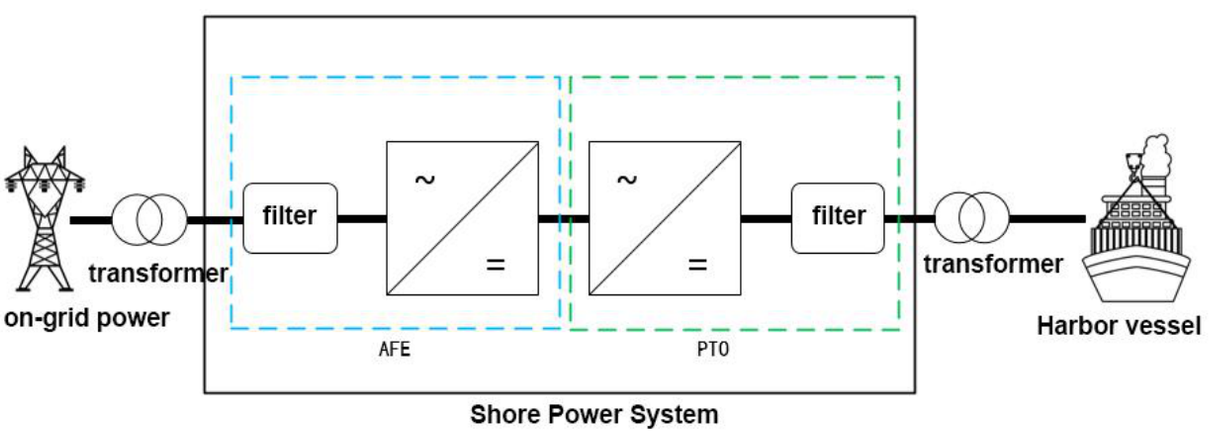
Its main application principles and related technical background are introduced as follows,
For these island power generation application scenarios, taking ships as an example, their offshore self-power generation or docking to the onshore public power grid needs to provide power for the on-board equipment at all times, and an intermediate device is required to allow the ship to connect to the local power grid (different regions). Electricity can be obtained from the power grids of different standards. At this time, the main engine power generation on the ship can be shut down to reduce port pollution. When offshore, the device needs to seamlessly switch from shore power to the power supply of the shaft generator on the main engine shaft. At this time, the corresponding grid-connected inverter needs to be based on the main engine corresponding to different ship forwarding. The speed of the shaft generator can be flexibly adjusted and output a constant and reliable power supply for the equipment on the marine island grid.

Since these isolated power grids for ships require constant voltage and frequency, this PTi/PTo can achieve stable and reliable power supply under different ship traveling speeds corresponding to the ship’ s shaft generator. The module is connected to induction, permanent magnet or synchronous generators, and controls these generators to work in power generation or electric state. Therefore, the shaft generator and the main engine are coupled together, so the electric energy can be transferred from the shaft motor to the main engine. Under the 2 working modes of increasing or taking the thrust. The main topology and principles are as follows:

The principle block diagram of a typical shaft belt power generation system



Schematic diagram of shore power supply conversion system



TTi (Power Take in) main technical index parameters

Function parameter name	Parameter characteristic index or requirement
Power rating	30KW-630KW, more power can be realized through parallel and power modules
Input voltage	Three-phase, specification 1: 380-500VAC Three-phase, specification two: 690-750VAC
Input frequency	1000HZ, please consult for higher frequency
DC voltage	380VAC power system: 500-750VDC 690VAC power system: 950-1100VDC
DC voltage accuracy	0.2%
way to control	Direct torque control
Failsafe	Overvoltage, undervoltage, overheating, overcurrent, overload, short circuit
Operating temperature	-40-+70 , derating should be used if it exceeds 40
cooling method	Air cooling, liquid cooling optional
High-speed bus control	MODBUS; CANopen, optional EtherCAT; ProfiNET

PTo (Power Take out) main technical index parameters

Function parameter name	Parameter characteristic index or requirement
Power rating	30KW - 630KW, More power is achieved through parallel and power modules
Input voltage	380VAC power system: 500-750VDC 690VAC power system: 950-1100VDC
The output voltage	Three-phase 380VAC Three-phase 690VAC
Output frequency	0-500HZ; grid connection of public grid (50/60HZ)
way to control	Direct torque control
Transient voltage regulation rate	+15% - -10%
Steady-state voltage adjustment rate	±1%
Voltage fluctuation rate	1%
Steady-state frequency adjustment rate	±1%
Transient frequency	About 5%

adjustment rate	
Frequency fluctuation rate	About 1%
Failsafe	Overvoltage, undervoltage, overheating, overcurrent, overload, short circuit
Operating temperature	-40-+70 , derating should be used if it exceeds 40
cooling method	Air cooling, liquid cooling optional
High-speed bus control	MODBUS; CANopen, optional EtherCAT; ProfiNET

This series of current conversion devices (drivers) use specific IGBT control strategies to achieve complex controlled operations such as constant speed, variable speed, speed change, load change (50-80%) cut in or out of normal speed or extremely high speed generators. To meet and adapt under the conditions, the main characteristics brought by the key technologies of the listed related products are shown in:

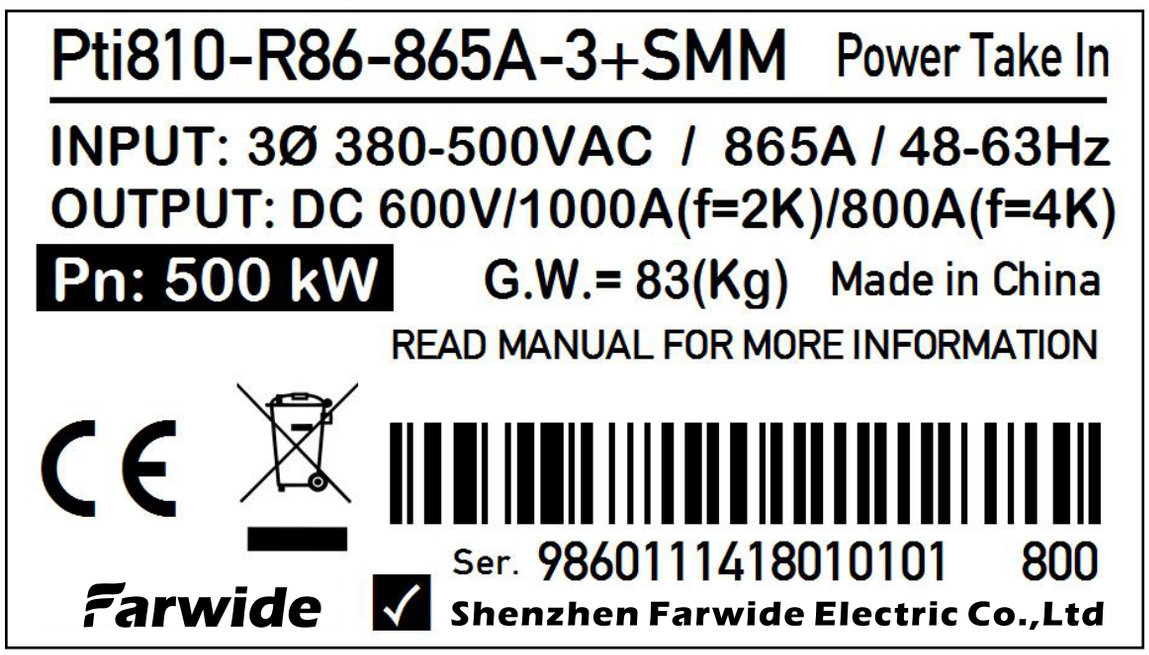
1. No specific grid (or motor side) voltage real-time detection and monitoring module is required, and the reliability is higher.

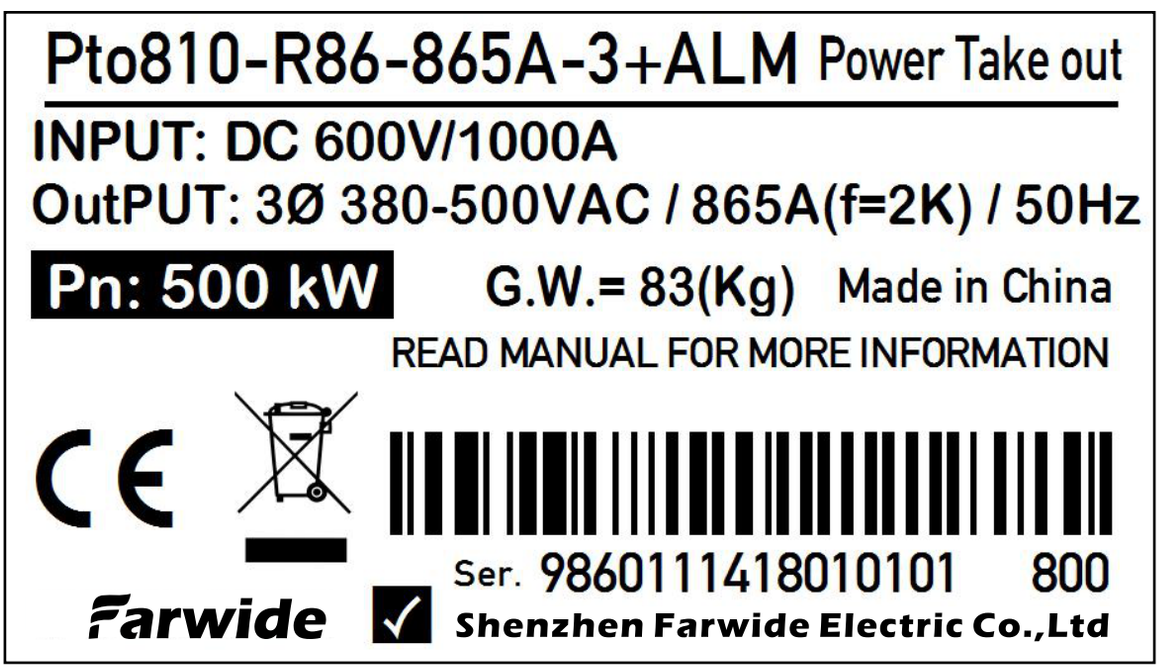
2. The specific drive control method improves the energy efficiency conversion rate of the system to a higher state.

3. PTi's ability to adapt to the generator, PTo to the load end and strong adaptation and extremely fast adjustment response.

Delivery check and drive module identification

Check the delivered product for damage. Before starting installation and operation, please carefully check the model label on the delivered drive module to confirm whether the delivered product model is consistent with the ordered product model. The label is located on the top, front and right side of the drive module. A typical example is as follows：





Typical model description：Model 1.XXX-2.XXX-3.XXXX-4.XX-5.XXXX, where tier 1 is the product series, 2 is the product structure and volume, 3 is the product rated current, and 4 is the product rated input voltage level (B It means built-in brake chopper, 1 means single-phase 220V, 3 means three-phase 380V, 6 means three-phase 690V, etc.), 5 means customized model code (for more information or application models, please consult our company)

〉 AFE/NFE/PFE active rectifier feedback front-end related application instructions

The function of AFE (Active Front End) active rectifier/feedback unit

Active Front End is translated from English Active Front End. The hardware structure of AFE/NFE/PFE described in this article is usually composed of two functional modules: AIM (LC/LCL) + ALM. From the structural point of view, due to the use of IGBT power components, it is equivalent to an inverter. The input is AC and the output is DC, because it is located on the power inlet side, so it is called the front end. Its active meaning is that, compared with the traditional diode or controllable silicon rectification technology, the active front end is no longer passively converting AC to DC, but has many active control functions. It can not only eliminate high-order harmonics and improve power factor, but also is not affected by power grid fluctuations and has excellent dynamic characteristics. For more details, please refer to the previous article or the introduction of external public resources.

NFE (Non-regenerative Front End) function of non-regenerative rectifier unit

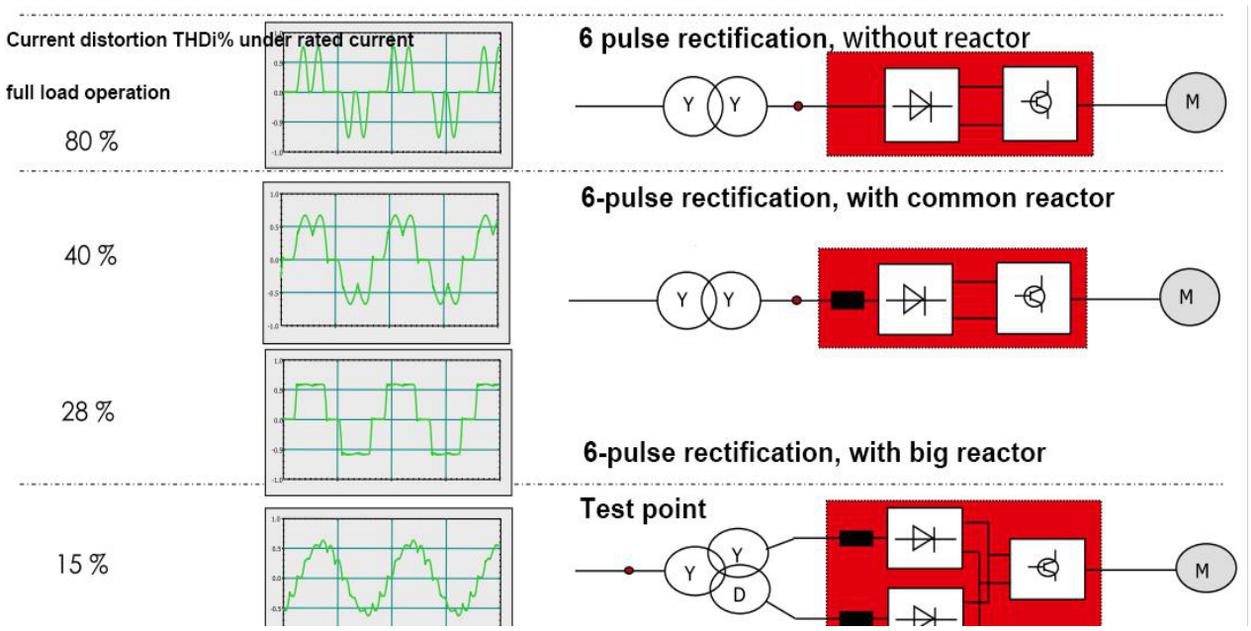
Its current design has the same hardware composition as the above-mentioned AFE, and it is also controlled by special AFE software. It realizes the NFE mode through specific torque direction limitation, that is, the front-end unit only works in the rectifier mode to achieve unidirectional energy flow, which is suitable for low harmonics. Wave rectification applications and applications where energy feedback is not required or impossible.

The function of PFE (Power-regenerative Front End) energy feedback unit

Its current design is similar to the hardware composition of the above-mentioned AFE. It has one more diode unidirectional circuit on the DC circuit than AFE. It is also controlled by a special AFE software, which is realized by real-time monitoring and feedback of the specific DC bus DC voltage. PFE mode, that is, the PFE front-end unit only works in the energy feedback mode to realize the unidirectional flow of energy from the DC side to the grid side. It is suitable for replacing the braking chopper energy consumption braking and other common DC bus voltage values that need to be controlled. And the application field that can provide energy feedback to the power grid.

A general introduction to the grid-side harmonic control capability between BLM (Basic Diode Rectification) and AFE

BLM (Basic Line Module) basic rectifier module, which mainly realizes AC to DC conversion through ordinary diodes or thyristors. Generally, AC or DC reactors are used to suppress the harmonics of the rectifier loop. If supplemented by reactances with different inductances The multi-channel power input of the phase-shifting transformer or the phase-shifted transformer can be rectified separately to achieve lower input harmonics.

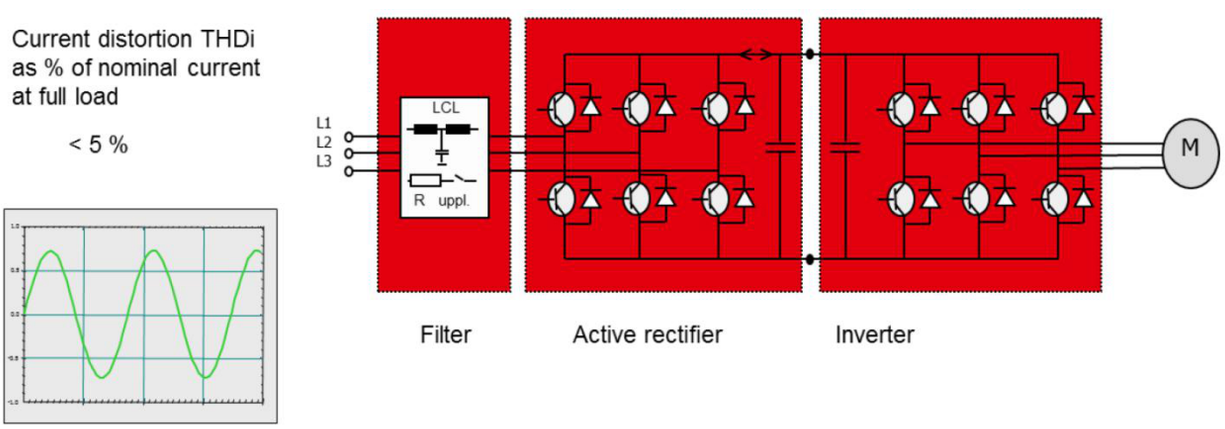


12 Pulse rectification

AFE (Active Front End) active rectification method, because of its dynamic IGBT adjustment, the THDi typical value of the grid-side total current harmonics can be controlled within 3-5%. When the input is at its rated load current, When the load is smaller and lighter, the THDi value of the harmonics of the total current on the grid side will slightly increase due to the smaller inductance of the LCL.

The typical hardware topology principle and harmonic control value introduction are shown in Figure 1 as follows:

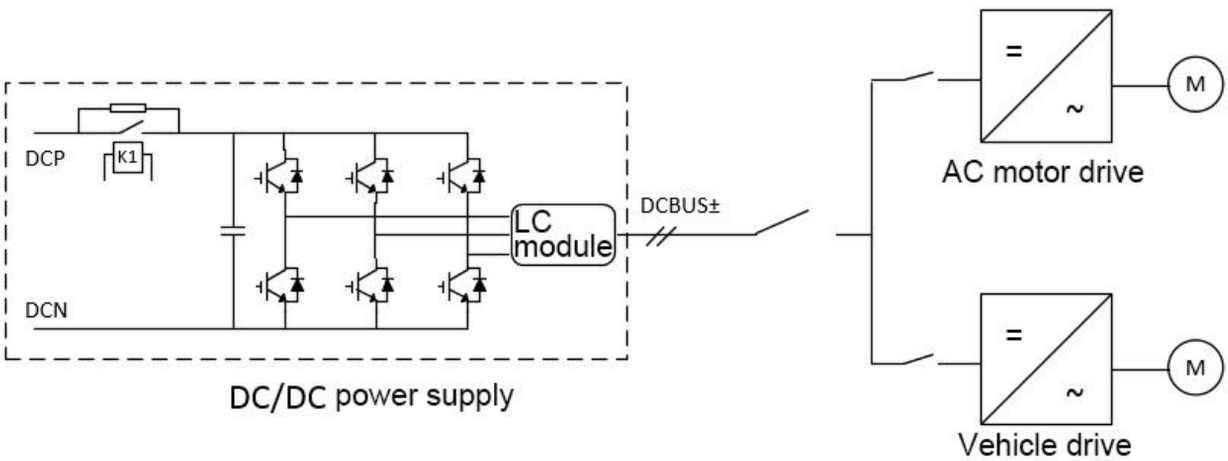
Frequency converter with active IGBT-rectifier



Typical application mode

As an active front end, AFE works both in smart rectification and power generation to the grid
1. AFE single machine can be equipped with a single drive or a common DC bus with multiple drives and DC/DC power supply
2. AFE scan also connect the common DC bus in parallel according to power requirements. At this time, load distribution and master-slave control are required between AFEs.
Regarding use: The product does not require complicated parameter adjustment, and it can be run after checking the wiring before power-on.

Schematic diagram of typical system principle 2



Main technical index parameters of AFE/NFE/PFE

Function parameter name	Parameters or requirements
Power rating	30KW-400KW, greater power can be achieved through parallel and power modules
Input voltage	Three-phase specification 1: 380-500VAC Three-phase specification 2: 690-750VAC
Input frequency	50/60HZHZ
DC voltage	380VAC power system: 500-750VDC 690VAC power system: 950-1100VDC
DC voltage accuracy	0.2%
way to control	Direct torque control
Failsafe	Overvoltage, undervoltage, overheating, overcurrent, overload, short circuit
Operating temperature	-40-+70 , derating should be used if it exceeds 40
cooling method	Air cooling, liquid cooling optional
High-speed bus control	MODBUS; CANopen, optional EtherCAT; ProfiNET

This series of current conversion devices (drivers) use specific IGBT control strategies to achieve the constant speed, variable speed, speed change, and load change (50-80%) To meet and adapt under complex controlled conditions such as cut in

or out, the main characteristics brought by the key technologies of the listed related products are shown in: 1. No specific grid (or motor side) voltage real-time detection and monitoring module is required, and the reliability is more high. 2. The specific drive control method improves the energy efficiency conversion rate of the system to a higher state. 3. To the load end and strong adaptability and extremely fast adjustment response ability.

About the harmonic distortion of AFE

According to industry standards, it is lower than the harmonic limit value given in IEEE519. Measure according to IEC 61000-4-7.

Rsc	THDu voltage[%]	THDi current [%]
20	3	3-5*#
100	0.8	3-5*#

$$\sqrt{\sum_{2}^{50}\left(\frac{I_n}{I_N}\right)^2}$$

I_n nth **Harmonic component**

I_N **Related current**

THD = Total harmonic distortion,THD voltage depends on short circuit ratio (R_{SC})。
Harmonic distortion spectrum also includes interharmonics

$R_{SC} = I_{SC}/I_N$

I_{SC} = The short-circuit current at the point of common coupling (PCC).

I_N = Rated current of IGBT power supply unit

* Other loads may affect the THD value

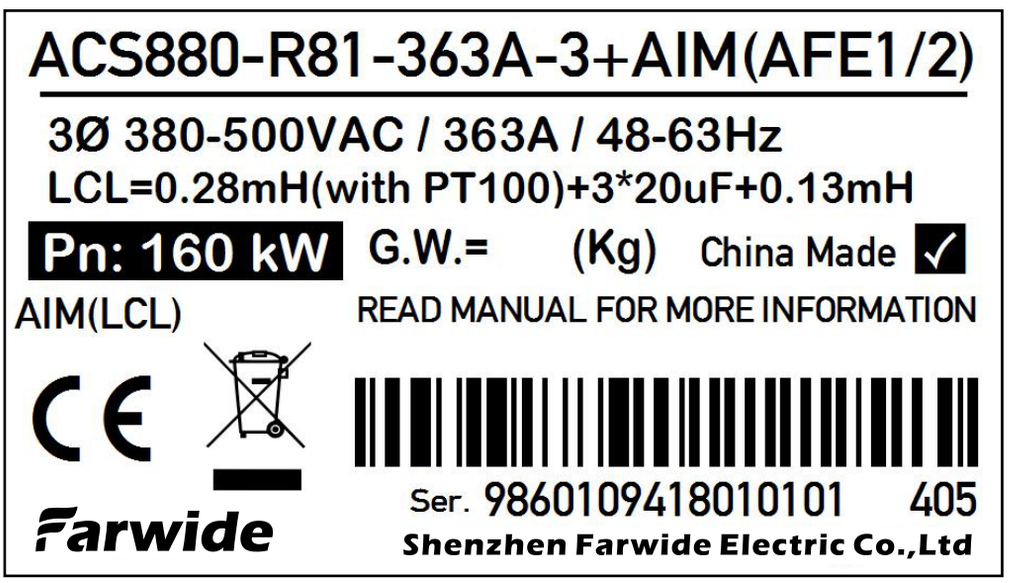
3-5% is the typical value of the total THDi under the system >=80% load rate. This value will be blocked by the line of the power grid, short-circuit ratio, instant load rate, and hardware differences of different models will fluctuate. Under the installed device system, the load rate of the back end of the AFE is different, and the total harmonic distortion will change significantly.

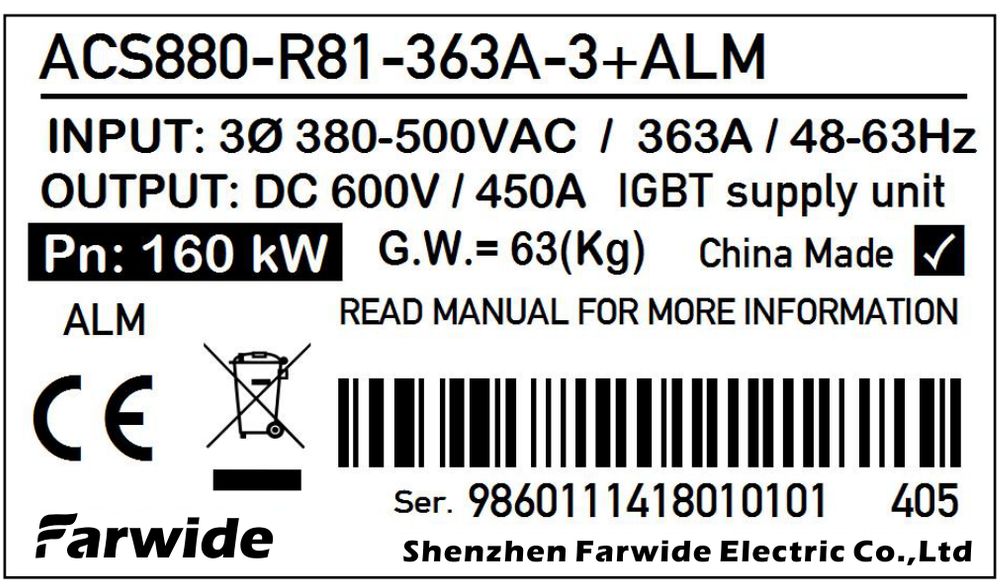
The following table uses 37kW as an example to illustrate the laboratory measured values of harmonic distortion under different load rates (For general reference only), the design principles of each model are the same, but due to hardware differences, there will be certain differences. The above table and actual applications shall prevail.

Operating mode	The measured value of THDi for 37kW AFE at different load rates (example)			
Load factor	30%	50%	75%	100%
Electric mode rectification	10%	5.5%	4%	3%
Power generation mode Feedback	8%	6%	5%	3%

Delivery inspection and module identification

Check the delivered product for damage. Before starting installation and operation, please carefully check the model label on the delivered drive module to confirm whether the delivered product model is consistent with the ordered product model. The label is located on the top, front and right side of the drive module. Typical examples are as follows:





Typical model description : Model 1.XXX-2.XXX-3.XXXX-4.XX-5.XXXX, where tier

1 is the product series, 2 is the product structure and volume,

3 is the product rated current,

4 is the product rated input voltage level (B It means built-in brake chopper, 1 means single-phase 220V, 3 means three-phase 380V, 6 means three-phase 690V, etc.),

5 means customized model code (for more information or application models, please consult our company)

AFE/NFE/PFE multi-transmission energy feedback type four-quadrant combined drive hardware topology diagram (example)

》》》The electrical connection and topology diagram of the multi-transmission energy feedback type four-quadrant drive unit are as follows, and the wiring description mainly includes:

1. The hardware interlocking control between LCL and ALM is realized through the network cable connection, and the logical linkage and control are realized through the following items or direct communication
2. The PT+/PT- on the ALM control module has been connected at the factory to detect the temperature of the LCL unit, and it will not be able to start ALM if it is disconnected or short-circuited.
3. DI5 and COM on the ALM control module have been connected at the factory to be used as the ALM operation enable signal, indicating that the LCL is ready to be powered on, and the ALM can be run, and it will not be able to run if it is disconnected.
4. COM1 and NO1 on the ALM control module need to be connected to DI5, COM of SMM1, SMM2..., there is no line sequence requirement, this signal line is used as the operation enable signal of SMM1, SMM2..., indicating that ALM has been
Run, SMM1, SMM2... can be run, disconnected will not be able to run SMM1, SMM2...
5. The R, S, T of LCL are connected to the power grid 380VAC, the chassis is grounded, and the 2Pin terminal block on the LCL (if any, only some models use 220V contactor) are connected to 220VAC for the control of the internal main contactor
6. The AC main power terminals U/L1, V/L2, W/L3 of ALM are respectively connected to L1/U, L2/V, L3/W of LCL. SMM's U, V, W output is connected to the motor
7. The DC bus terminals DC+ and DC- of ALM are respectively connected to DC+ and DC- of SMM1, SMM2...
8. ASM intelligent rectification feedback module with N (kW) ALM and LCL units, the total power of the connected SMM unit should not exceed N (kW), otherwise it will report overvoltage due to insufficient feedback energy or insufficient rectification capacity. Report over-current. All power lines of ASM (LCL+ALM) should be wired according to the requirements of N (kW).

》》》》》Four-quadrant combined mode work, start and stop operation

sequence》》》》》》

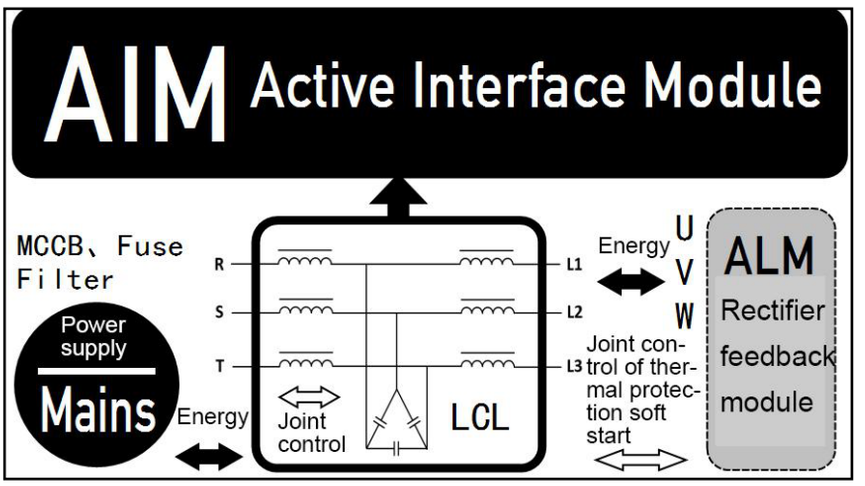
1.Power on after confirming that the wiring between each unit is ready

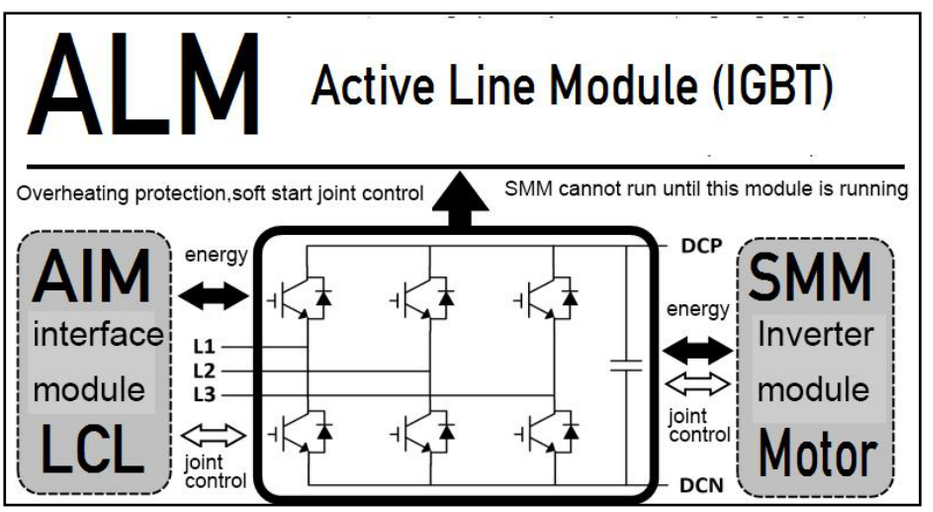
2. After power-on, ALM does not need to set parameters, SMM1, SMM2.. units should set 1012 groups of parameters one by one, the running enable is DI5

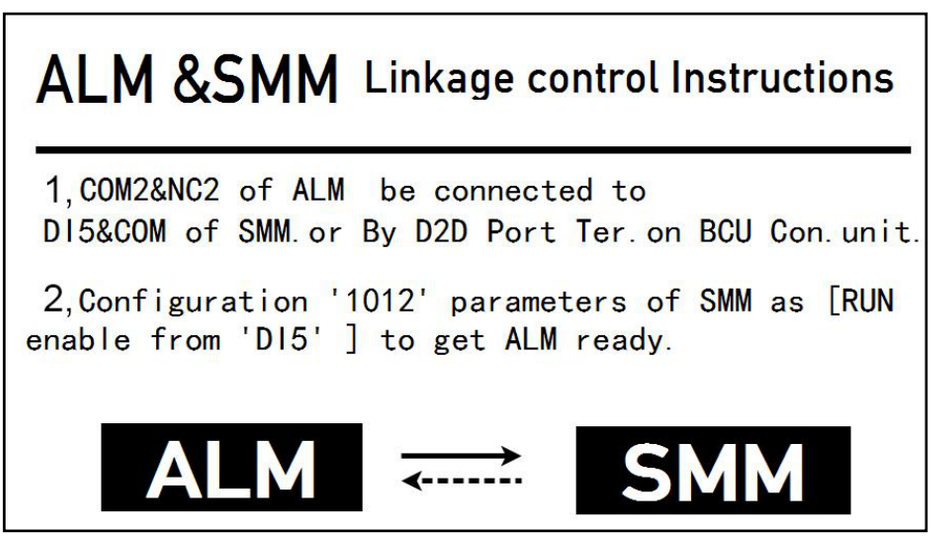
3. To start the ALM unit, press the green start button on the panel or start it remotely through an external terminal

4. Start each SMM unit

5. The stopping sequence is to stop each SMM unit first, and then stop the ALM unit







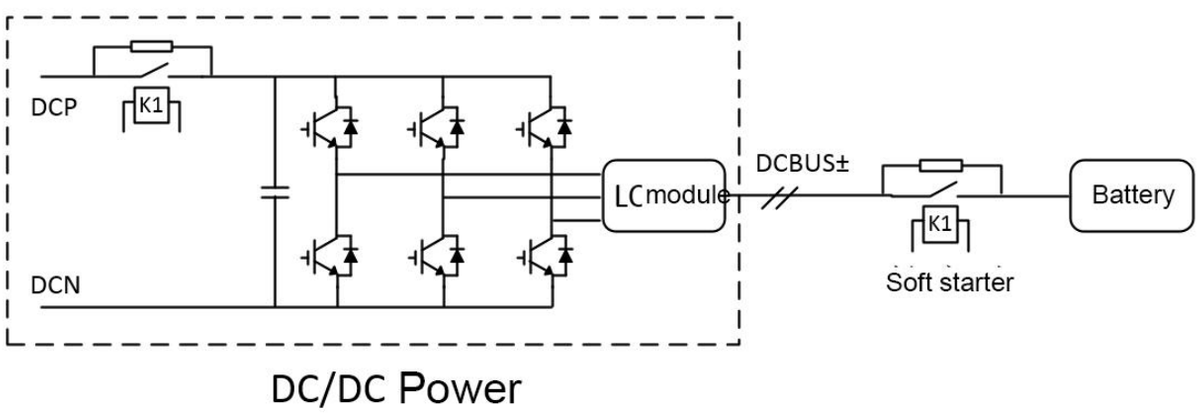
〉 DC/DC power supply application instructions

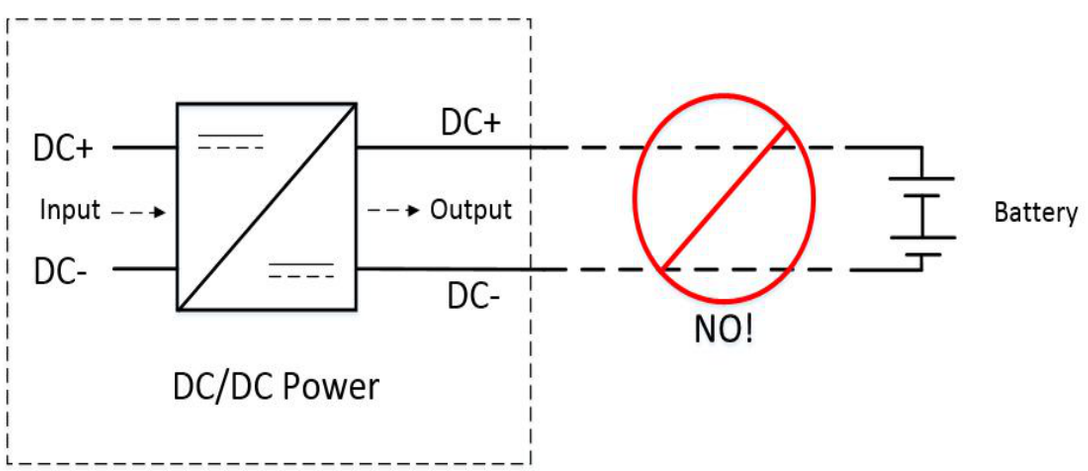
Application mode

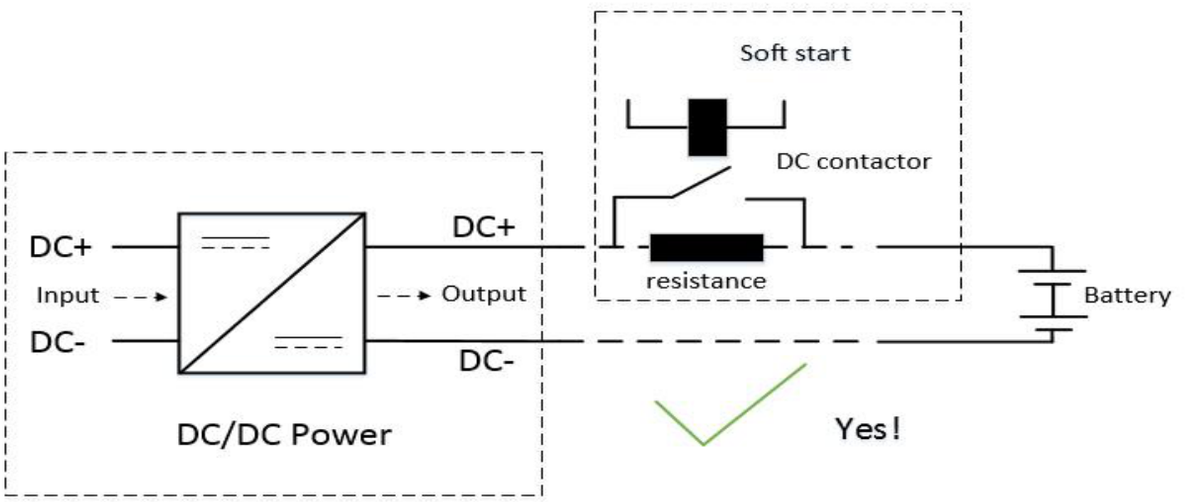
1. The DC/DC two-way power supply has a built-in input soft-start device, without output soft-start. When testing with battery load, an external soft-start is required to avoid damage to the battery due to excessive charging current caused by direct power-on
2. Differential-mode inductance equipment should not be added between the DC power supply and the DC load, and the output cable should not be wound. The wound cable is equivalent to the inductance, which may cause the DC voltage at the load end to be unstable.

The following left picture is an explanation: the DC/DC power module does not contain a soft-start power-on circuit, and the output terminal is strictly prohibited to directly connect to a battery-type DC power supply, otherwise it will cause excessive charging current to the DC power supply and damage the DC power supply or Battery equipment. The right picture below shows the correct connection method for battery-connected equipment. It is necessary to connect a Soft start device between the DC power supply and the battery. It consists of a soft start resistor and a DC contactor. If you need this usage, please contact our technical support. .

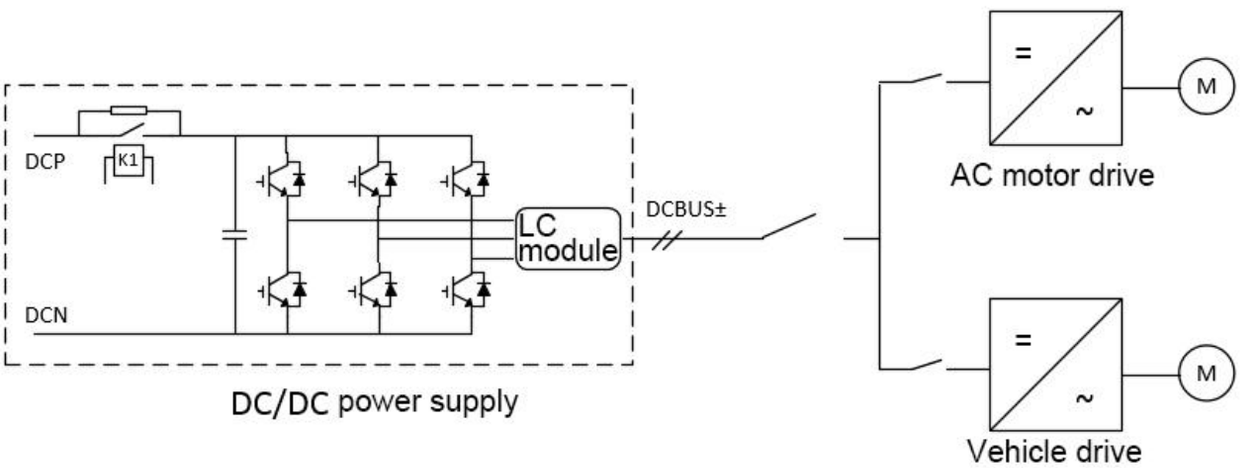
Schematic diagram of DC/DC power supply principle





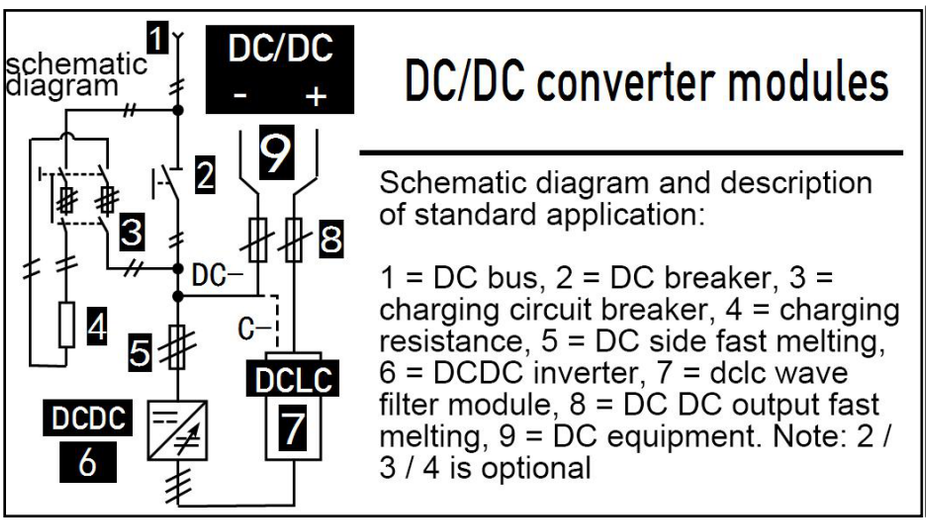


Schematic diagram of battery load



Schematic diagram of connecting drive

1. The basic hardware composition and schematic diagram of DCDC



Notice: This instruction is a special quick guide to use, basic electrical specifications and safety precautions, relevant personnel must refer to the random standard driver user manual

Main technical indicators of DC/DC

Function parameter name	Parameters or requirements
Power rating	30KW-630KW, more power can be realized through parallel and power modules
Input voltage	Specification 1: DC500-750V
The output voltage	Specification 2: DC950-1100V
DC voltage accuracy	input voltage
Source effect	0.2%FS
Load effect	0.2%FS
Ripple (Vrms)	0.2%FS
Response time	0.5%FS
way to control	3ms (10%-90% sudden load)
Failsafe	Direct torque control
Operating temperature	Overvoltage, undervoltage, overheating, overcurrent, overload, short circuit
cooling method	-40-+70 , derating should be used if it exceeds 40
High-speed bus control	Air cooling, liquid cooling optional

DC/DC main debugging parameters

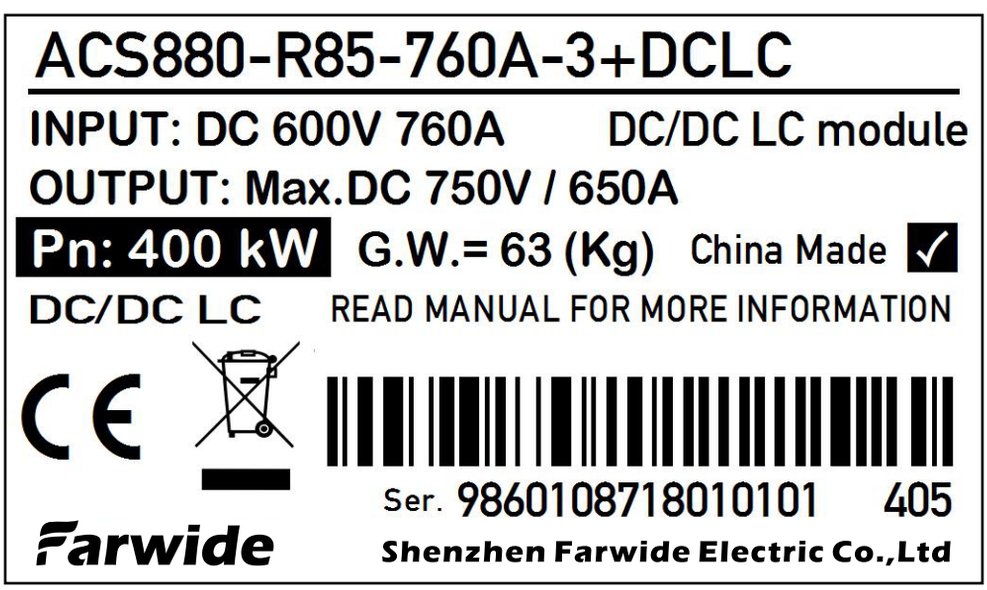
Parameter number	parameter name
P45.00	DC output voltage given
P45.01	DC output current setting (when set to negative current, it can be used as battery discharge test)
P45.02	Voltage loop gain (adjust the voltage response speed)
P45.07	The load equivalent capacitance (mF) defaults to 4mF. Please set the parameters according to the actual load, which affects the voltage response and is associated with

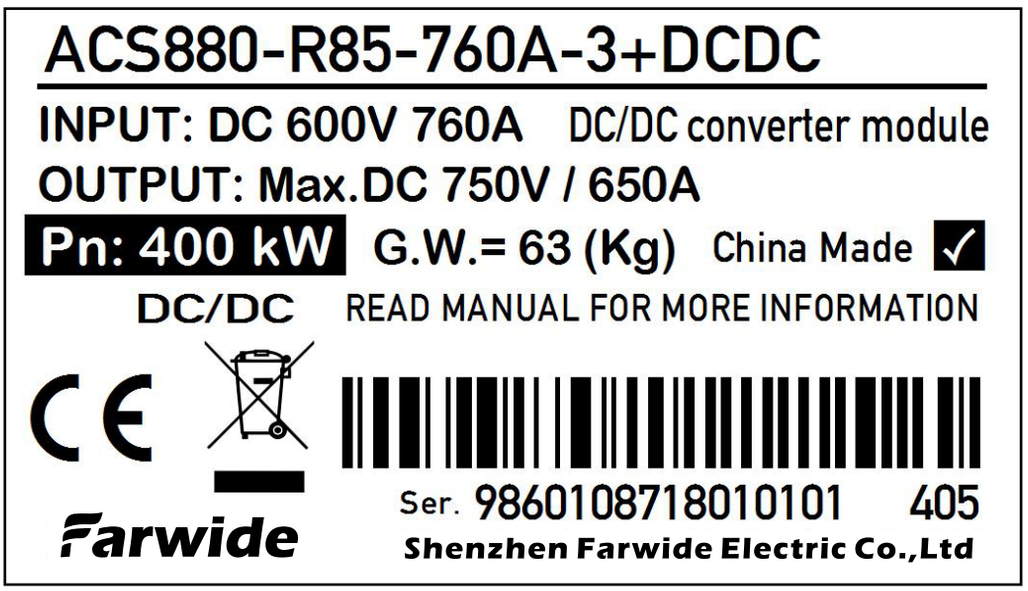
	the P45.02 parameter group
P45.14	Voltage feedback gain% (used to fine-tune the voltage feedback error)
P45.15	Voltage feedback offset (used to correct a fixed voltage error value)

This series of current conversion devices (drivers) use specific IGBT control strategies to achieve the constant speed, variable speed, speed change, and load change (50-80%) The main characteristics brought by the key technologies of the listed related products are shown in the following: 1. No specific grid (or motor side) voltage real-time detection and monitoring module is required, and the reliability is higher. 2. The specific drive control method improves the energy efficiency conversion rate of the system to a higher state. 3. To the load end and strong adaptability and extremely fast adjustment response ability.

1.2. Delivery inspection and module identification

Check whether the delivered product is damaged. Before starting installation and operation, please carefully check the model label on the delivered drive module to confirm whether the delivered product model is consistent with the ordered product model. The label is located on the top, front and right side of the drive module. A typical example is as follows :





Typical model description：

Model 1.XXX-2.XXX-3.XXXX-4.XX-5.XXXX, where tier

1 is the product series,
2 is the product structure and volume,
3 is the product rated current, and
4 is the product rated input voltage level (B It means built-in brake chopper, 1 means single-phase 220V, 3 means three-phase 380V, 6 means three-phase 690V, etc.),
5 means customized model code (for more information or application models, please consult our company)